Agilent

Agilent InfinityLab LC Series

Refractive Index Detectors

User Manual

Notices

Document Information

The information in this document also applies to 1260 Infinity II and 1290 Infinity II modules.

Document No: SD-29000641 Rev. D
Edition: 10/2024

Copyright

Agilent Technologies
Hewlett-Packard-Strasse 8
76337 Waldbronn, Germany

Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

U.S. Government Restricted Rights. Software and technical data rights granted to the federal government include only those rights customarily provided to end user customers. Agilent provides this customary commercial license in Software and technical data pursuant to FAR 12.211 (Technical Data) and 12.212 (Computer Software) and, for the Department of Defense, DFARS 252.227-7015 (Technical Data - Commercial Items) and DFARS 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation).

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

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

Contents

In This Book

This manual covers the following Agilent InfinityLab LC Series modules:

- Agilent 1260 Infinity III Refractive Index Detector (G7162A)
- Agilent 1290 Infinity III Refractive Index Detector (G7162B)

1 Introduction

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

Overview of the Module

The Standard Optical (G7162A) and Micro Optical (G7162B) detectors described in this manual are designed for highest optical performance, GLP compliance, and easy maintenance. They include the following features:

- Advanced temperature controlled detector optics ready to use within two hours of installation
- Automatic zero and automatic purge combined with a recycle valve for automatic solvent recycling allow uninterrupted operation
- Durable tungsten lamp with a life expectancy of 40000 hours
- Automatic light intensity control circuit to ensure the optimum performance of the optics
- Integrated diagnostics for efficient troubleshooting
- Built-in refractive index calibration
- Front access to valves and capillaries for easy maintenance

G7162A Refractive Index Detector

This detector is equipped with the standard optical unit and is used for all standard applications.

It comprises the following features:

- Inlet port to sample cell 62 µL
- Inlet port to outlet port 590 µL
- Maximum data rate up to 74 Hz

G7162B Refractive Index Detector Micro

This detector is equipped with the micro optical unit and is used for all low volume applications.

It comprises the following features:

- Inlet port to sample cell 2.5 µL
- Inlet port to outlet port 265 µL

- Maximum data rate up to 148 Hz
- LED illumination.

Product Description of the 1260 Infinity III Refractive Index Detector (G7162A)

The Agilent 1260 Infinity III Refractive Index Detector (RID) is the ideal detector for fast and reliable LC results when routinely analyzing non-UV absorbing substances, such as carbohydrates, lipids, and polymers. The RID is also the detector of choice for gel permeation chromatography (GPC) or size exclusion chromatography (SEC).

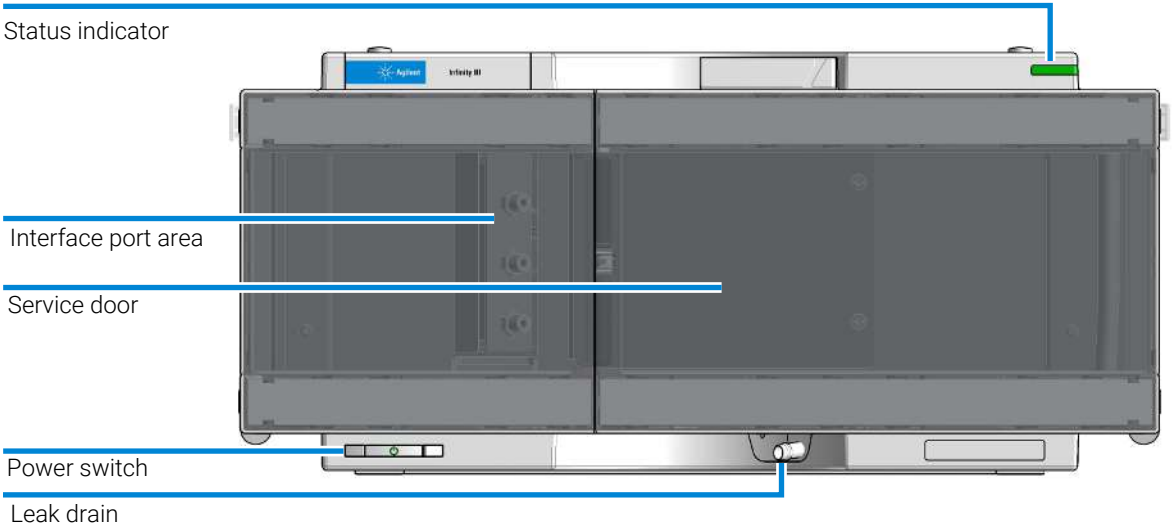


Figure 1: Overview of the G7162A Detector

Features of the 1260 Infinity III Refractive Index Detector (G7162A)

- High sensitivity and robust detection with an excellent reproducibility of only 0.1 % RSD
- Precise temperature control from ambient +5 °C to 55 °C to minimize baseline drift and optimize compound response
- Automatic light level adjustment compensates for lamp degradation and flow cell staining, ensuring optimum performance and lowest maintenance
- Integrated solvent recycle valve for solvent recycling between runs
- Programmable reference cell purging (autopurge) and auto-zeroing of the detector baseline before each run for unattended operation
- Convenient front access to the flow connections and valves next to the optical unit
- Early Maintenance Feedback (EMF) for prior notification of detector maintenance and continuous tracking of reference flow cell purging with user settable limits
- Fast and simple troubleshooting via diagnostic signal data collection
- Automatic offset adjustment for easy detection and quantification of negative peaks, and a time-programmable polarity switch for simple inversion of peaks for ease of integration
- Excellent linear response for compounds with little or no UV chromaphore in a wide concentration range

Product Description of the 1290 Infinity III Refractive Index Detector (G7162B)

The Agilent 1290 Infinity III Refractive Index Detector is equipped with an ultralow dispersion microflow cell, which significantly reduces run times for higher sample throughput and improved resolution. Lower solvent consumption means much lower cost of analysis. A high-performance detector of choice for accurate, reproducible, routine analysis of polymers and other compounds that aren't detectable by UV.

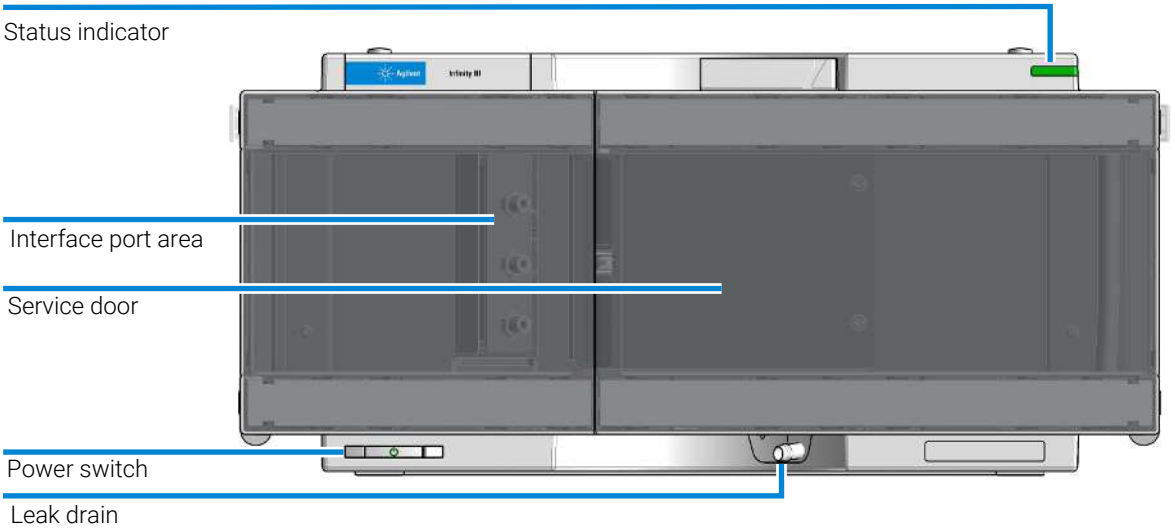


Figure 2: Overview of the G7162B Detector

Features of the 1290 Infinity III Refractive Index Detector (G7162B)

- Shorter run times – for considerably higher sample throughput.
- Ultralow dispersion – for improved sample definition and resolution.
- Reduced solvent consumption – for significant savings in analysis cost.
- Ideal tool for polymer analysis – consistent molecular weights, micro or analytical scale.
- Excellent sensitivity – achieve low limits of detection.
- 148 Hz data rate – even the narrowest distribution peaks can be detected and accurately quantified.
- Minimized band broadening – high-definition sample profiling.
- Fast startup – advanced low thermal mass design means that initial setup is typically less than two hours.
- Further time and solvent saving – a recycle valve enables sample to be recirculated when the sample is not passing through the flow cell.
- Automatic purging of reference flow cell – using programmable purge and wait times.
- Easy maintenance – convenient front access for maintaining instrument uptime.
- Early maintenance feedback (EMF) – indicates that preventative maintenance is due.
- Extensive diagnostics – includes error detection and display with Instant Pilot controller and Lab Advisor software.
- RoHS compliant – aligned with European Union directives regarding specific hazardous materials.

Operating Principle

How the Detector Operates

Refractive index

When a beam of light passes from one medium into another, the wave velocity and direction changes. The change in direction is called refraction. The relationship between the angle of incidence and the angle of refraction is expressed in Snell's Law of refraction.

$$n = \frac{n_2}{n_1} = \frac{\sin \alpha_1}{\sin \alpha_2}$$

Where:

- n = Refractive index of medium 1 relative to medium 2
- n_2 = Refractive index of medium 2
- n_1 = Refractive index of medium 1
- α_1 = angle of incident light in medium 1
- α_2 = angle of refraction in medium 2

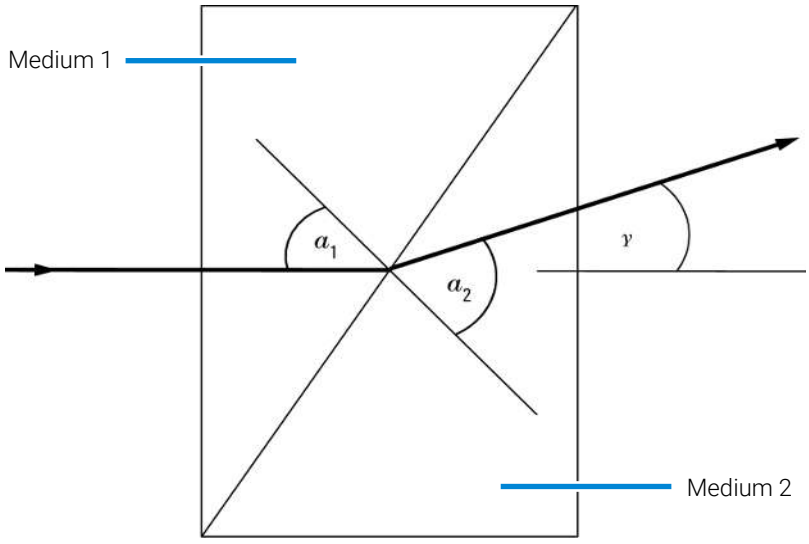


Figure 3: Light Refraction

According to the formula below small angles of external deflection are proportional to the difference between the refractive indices of medium 1 and medium 2.

$$\tan \gamma = \frac{n_1 - n_2}{n_1}$$

Where:

- γ = angle of external deflection
- n_2 = Refractive index of medium 2
- n_1 = Refractive index of medium 1

Factors that Affect Refractive Index

The refractive index of a medium is affected by a number of factors;

1. Wavelength

   The refractive index varies with changes in the wavelength of the incident light beam.

2. Density

   As the density of the medium changes the refractive index changes. At a fixed wavelength of incident light the changes in refractive index are generally linear in relation to the changes in medium density.

   The density of a medium will be affected by the following factors:

   - Composition (if not a pure substance)
   - Temperature
   - Pressure

Detection Principle

Detector Design

The Refractive Index Detector is a differential refractometer that measures the deflection of a light beam due to the difference in refractive index between the liquids in the sample and reference cells of a single flow cell.

A beam of light from the lamp passes through a flow cell which is separated diagonally into sample and reference cells. At the rear of the flow cell a mirror reflects the light back through the flow cell and via a zero glass, which affects the path of the light beam, to the light receiver. The light receiver has two diodes each of which produces an electrical current proportional to the amount of light that falls upon it (see Figure 4 on page 16).

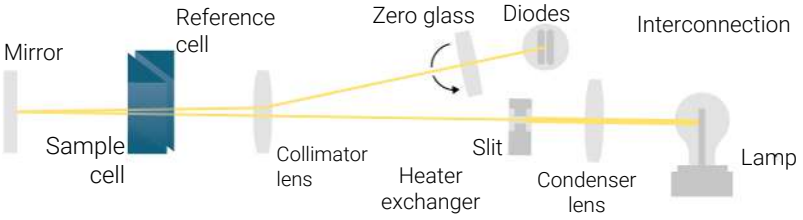


Figure 4: Light path

Measurements

Initially both sample and reference cell are flushed with mobile phase. The reference cell is then closed and solvent flows only through the sample cell. The refractive index of the mobile phase in both cells is the same and the position of the zero glass can be adjusted so that the detector is in optical balance with an equal amount of light falls on each diode.

When sample elutes from the column into the sample cell the refractive index of the cell contents changes. The change in refractive index deflects the light beam as it passes through the flow cell resulting in an unequal amount of light falling on each diode. The change in current from the diodes that this causes is amplified and used to produce the calibrated detector signal. This signal expressed, as nano Refractive Index Units (nRIU), corresponds to the difference between the refractive index of sample in the sample cell and the mobile phase in the reference cell.

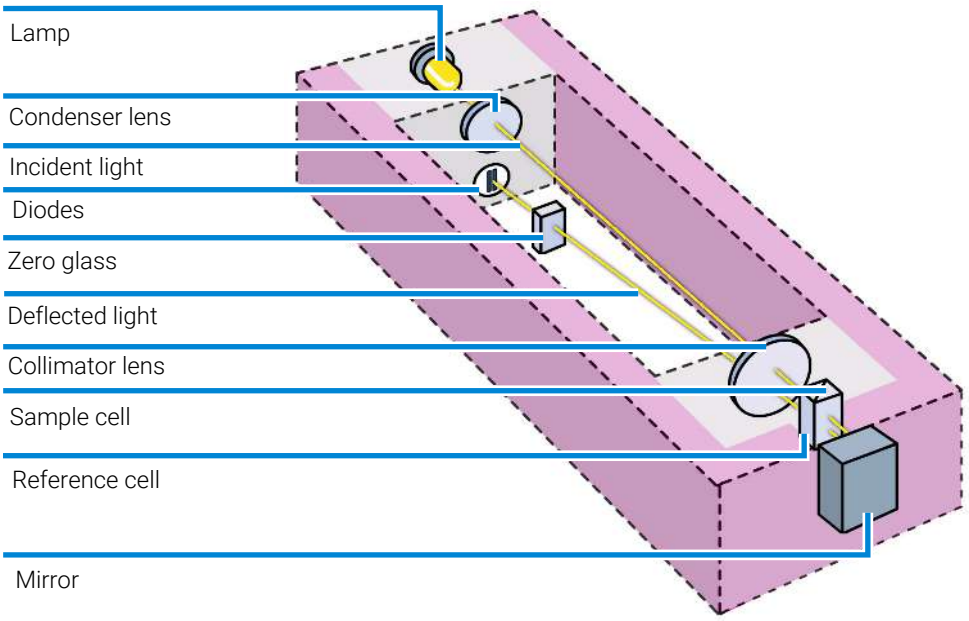


Figure 5: Optical Path

Flow Path

The column eluent enters the optical unit through the in port and passes through a heat exchanger. The combination of the heat exchanger and control of the optical unit temperature in the range of 5 °C above ambient to 55 °C minimizes changes in refractive index due to temperature variations. The eluent flows through the sample cell and via the same heat exchanger to the purge valve. With the purge valve in the OFF position the eluent passes to the recycle valve. If the recycle valve is also in the OFF/WASTE position the eluent will flow via the waste port into the waste container.

If the recycle valve is in the ON/BOTTLE position the eluent will flow via the recycle port back to the solvent bottle. The recycle valve can be manually set to the ON or OFF position or the **Automatic recycling after analysis** mode can be enabled. In this mode the recycle valve will automatically switch to the ON position after each analysis has been completed and return to the OFF position before the next analysis starts. Using this mode provides the benefits of

uninterrupted flow through the detector without the problems of excessive solvent usage or the contamination of mobile phase with recycled sample compounds.

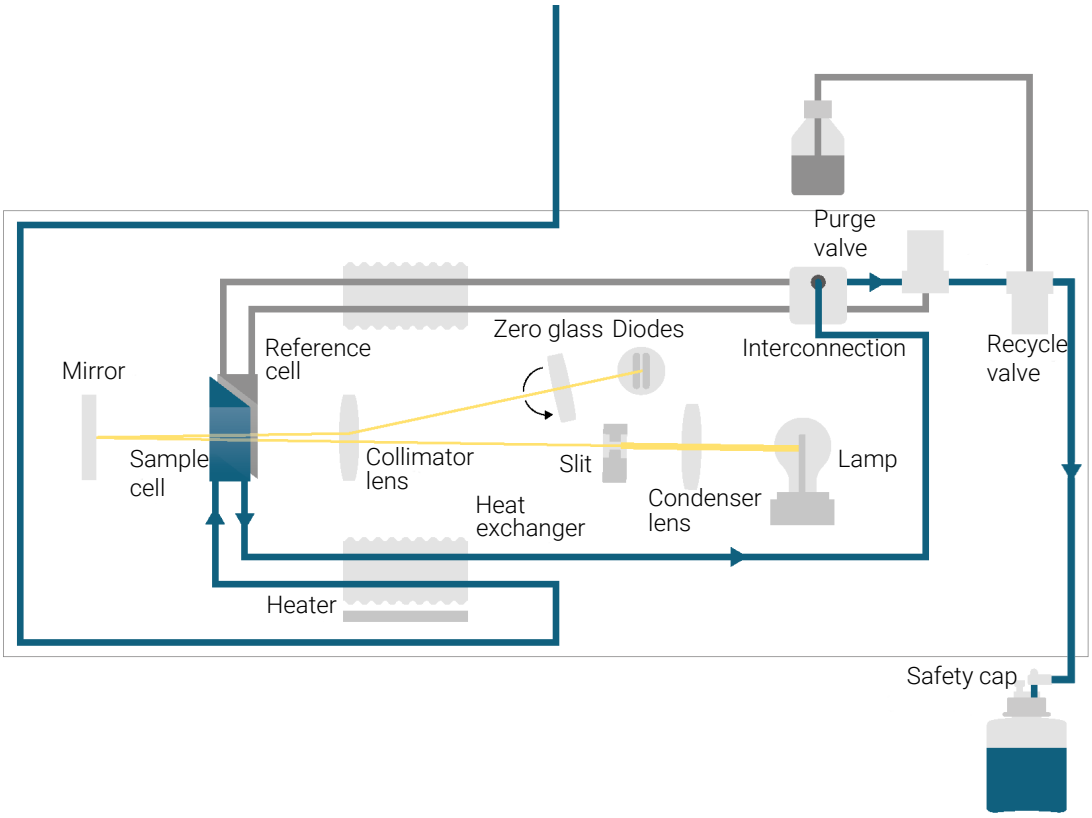
If the purge valve is in the *on* position the eluent cannot pass immediately to the recycle valve but will instead flow via a second heat exchanger through the reference cell and then into the recycle valve. Periodically switching the purge valve to the *on* position while only mobile phase is flowing will ensure that the liquid in the reference cell is as similar as possible to the flowing solvent. The purge valve can be manually set to the *on* position for a defined time or the Automatic purge mode can be enabled. In this mode the purge valve will automatically switch to the ON position for a defined purgetime prior to the start of each analysis. If a purgetime is set then a waittime must also be set to allow the detector baseline to stabilize after the switching of the purge valve position.

After both the purgetime and waittime have been completed the analysis will start. If the Automatic zero before analysis mode is enabled the detector output will be set to zero immediately before the analysis begins.

The different flow paths depend on the status of the Purge Valve and Recycle Valve.

Normal Flow Mode

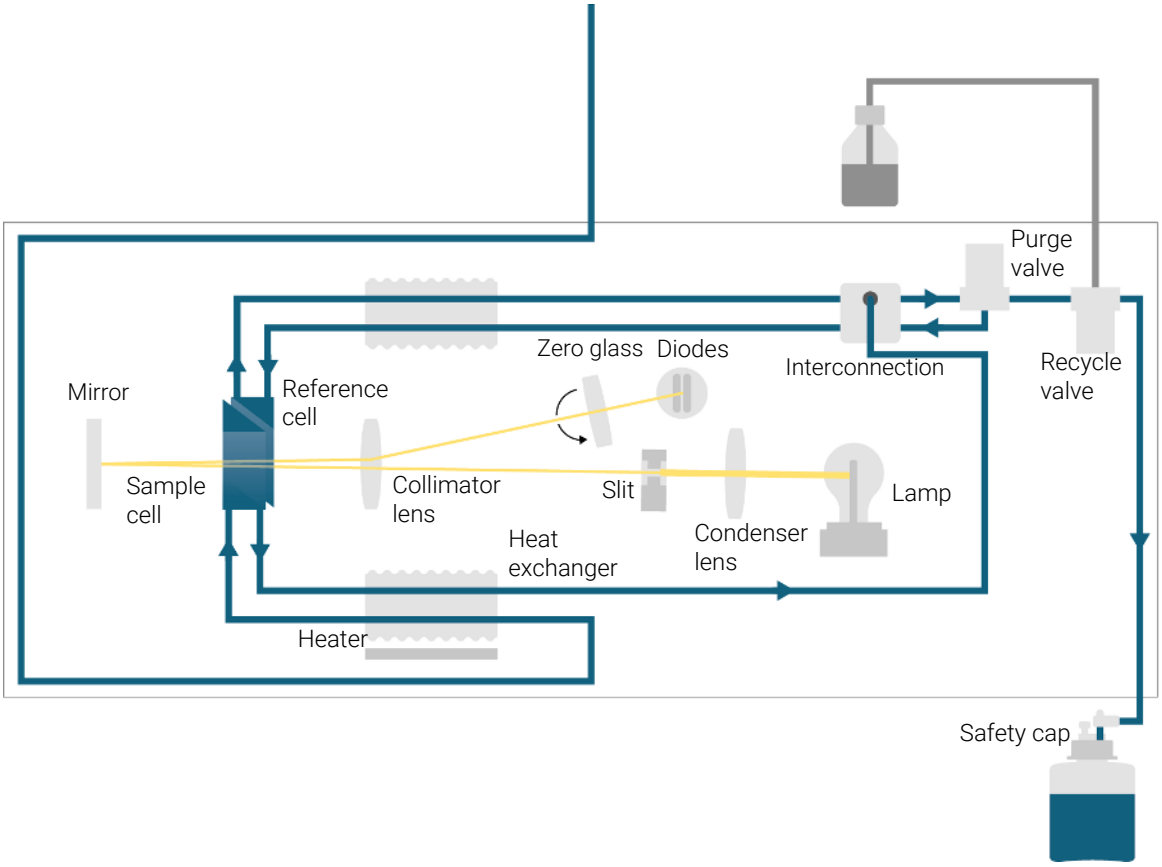
Purge Valve = OFF, Recycle Valve = OFF


Purge valve
Zero glass
Diodes
Interconnection
Recycle valve
Reference cell
Mirror
Sample cell
Collimator lens
Slit
Lamp
Heat exchanger
Condenser lens
Heater
Safety cap

Purge Mode

This mode is used for flushing the complete detector inclusive the reference side of the flow cell.

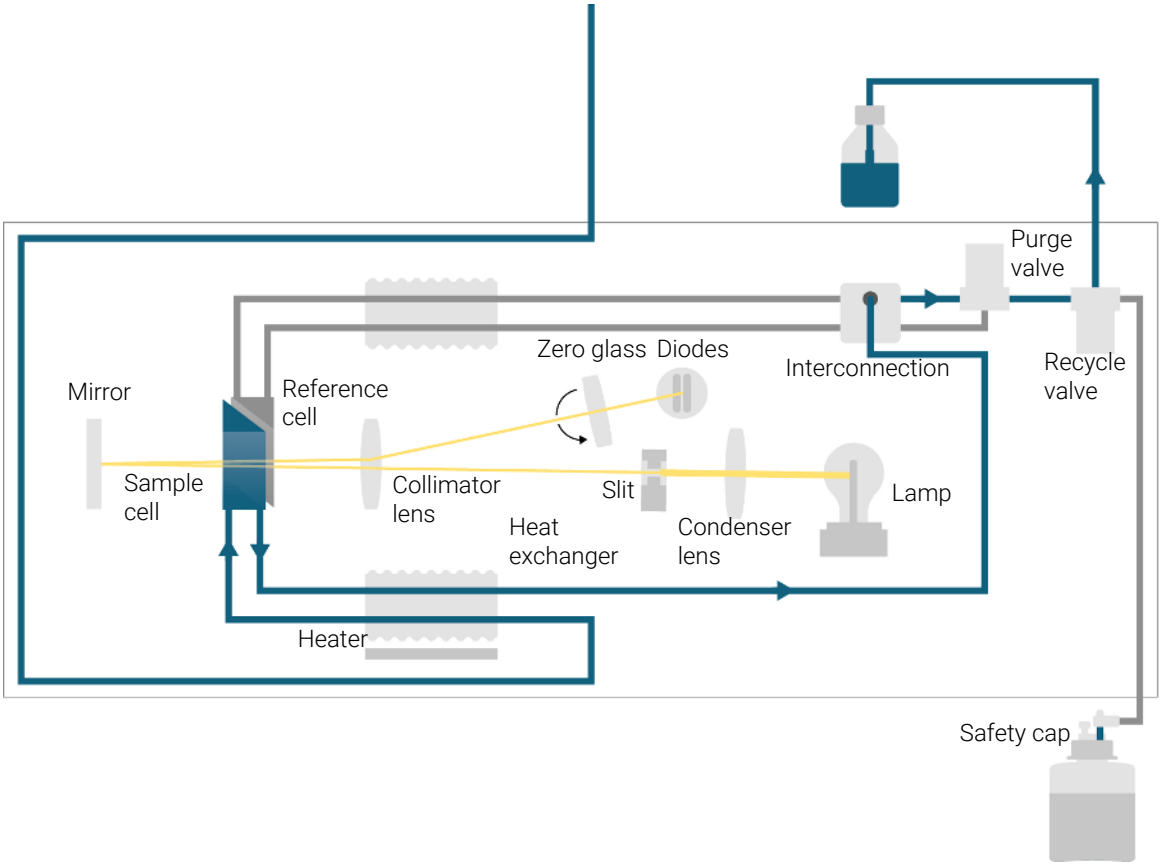
Purge Valve = ON, Recycle Valve = OFF



Recycle Mode

This mode is used for saving solvent during periods where no sample is running through.

Purge Valve = OFF, Recycle Valve = ON



Physical Plumbing

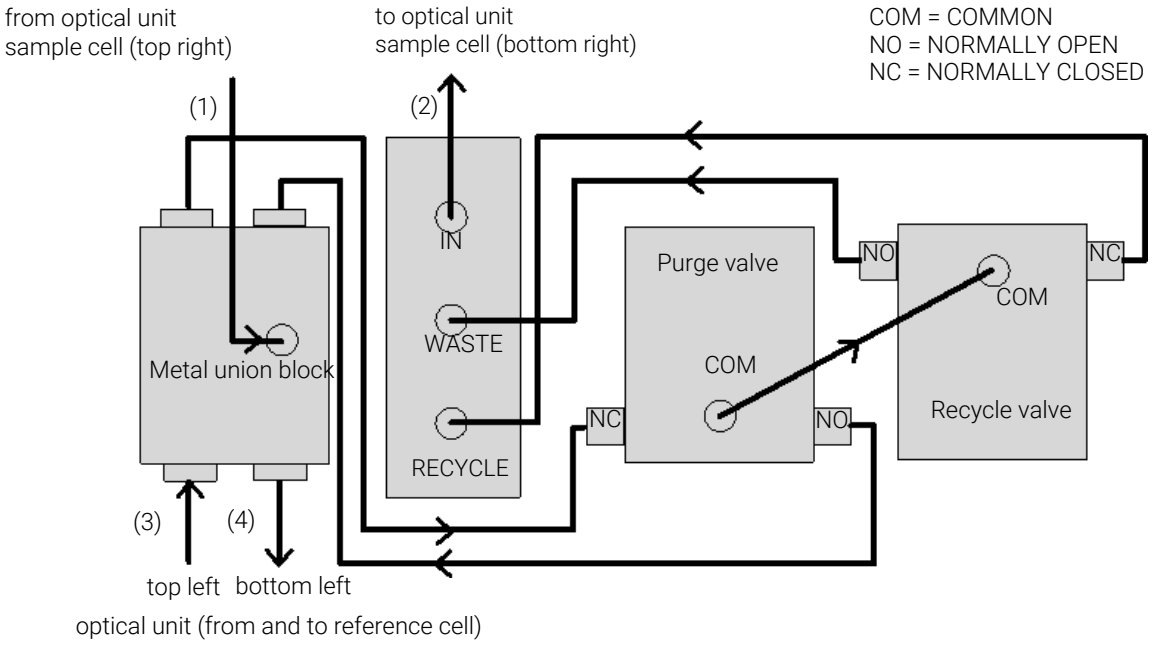


Figure 6: Physical Plumbing Connections

Capillaries (1) to (4) are part of the optical unit assembly. They are made of SST with an ID of 1.0 mm, except for (2), which has an ID of 0.2 mm. All other tubings (to and from the purge and the reference valve) are made of PTFE (available as).

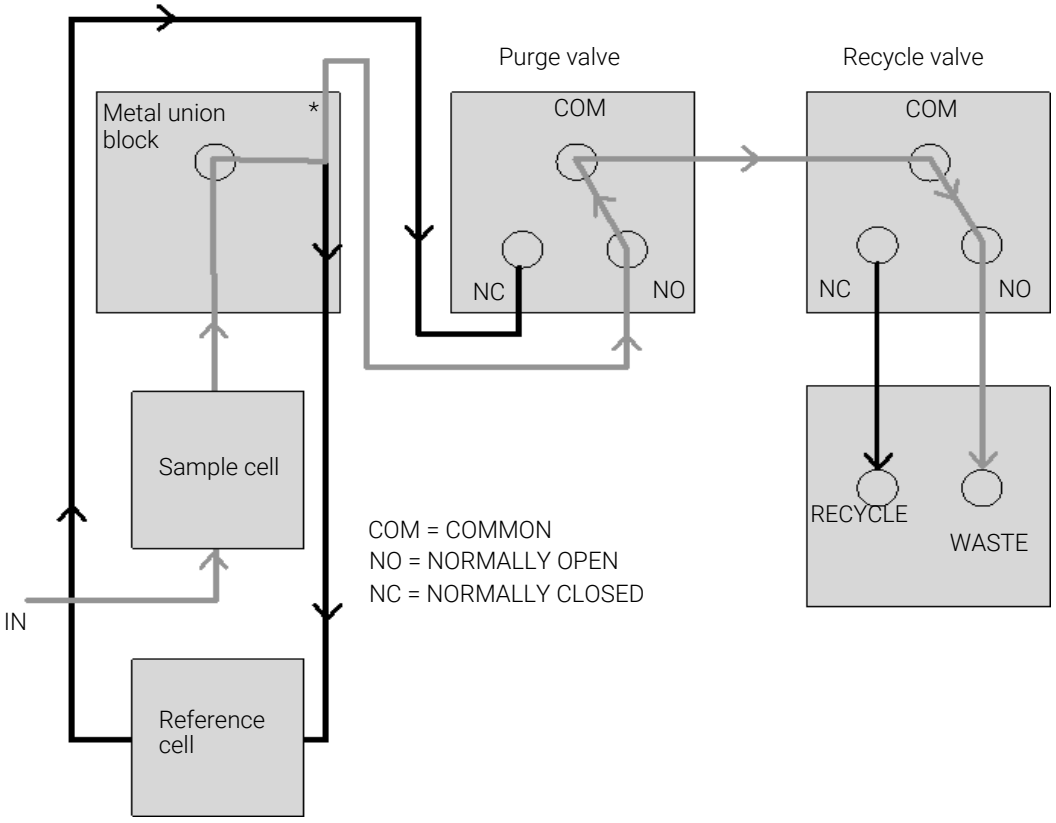


Figure 7: Flow path with the Purge- and Recycle-Valves = OFF

	Grey lines = flowing path Black lines = immobilized mobile phase
	*The T-connection in the metal union block results in both sides of the flow cell (sample and reference) always being exposed to the same pressure

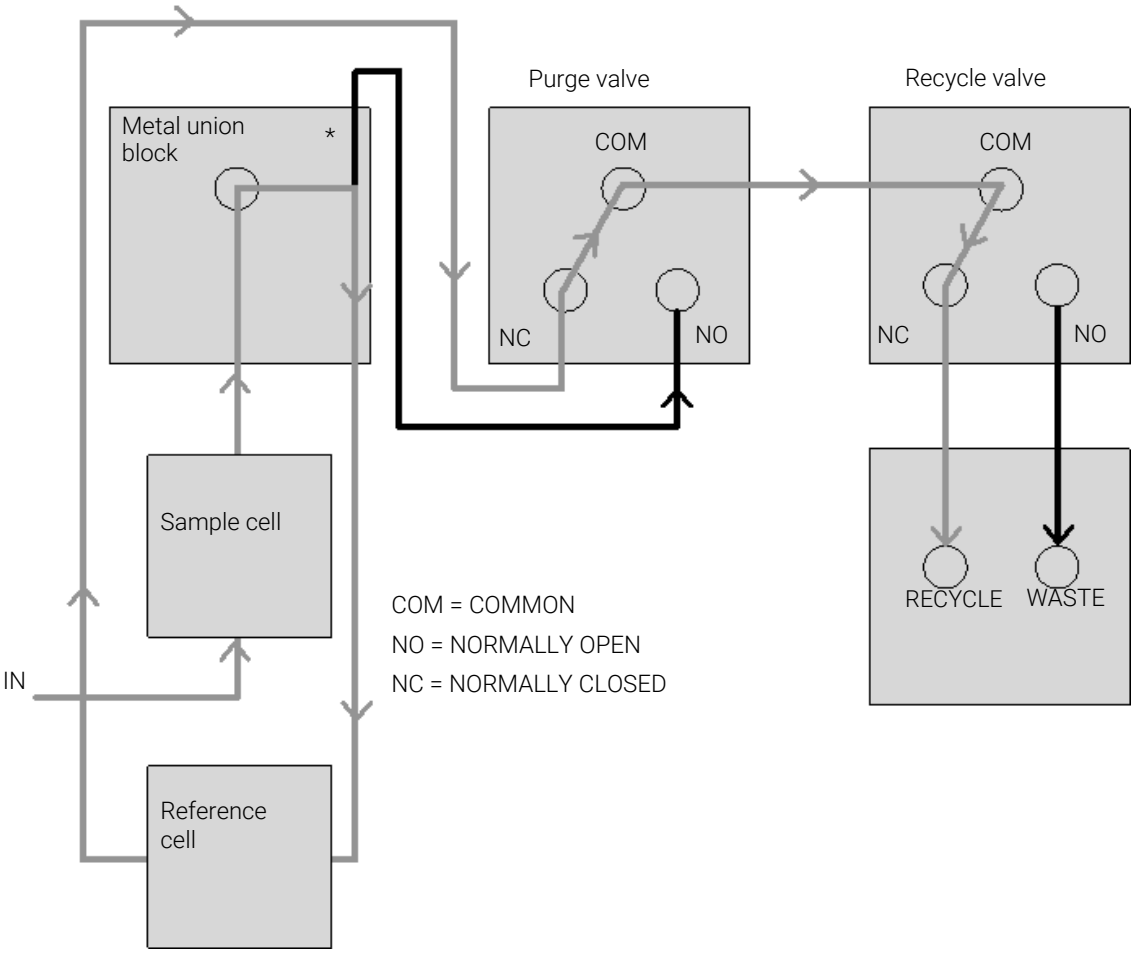


Figure 8: Flow path with the Purge- and Recycle-Valves = ON

	Grey lines = flowing path Black lines = immobilized mobile phase
	*The T-connection in the metal union block results in both sides of the flow cell (sample and reference) always being exposed to the same pressure

2 Site Requirements and Specifications

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

Site Requirements

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

Power Considerations

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

WARNING **Incorrect line voltage at the module**

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

- **Connect your module to the specified line voltage.**

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

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

- **Make sure that it is always possible to access the power plug.**
- **Remove the power cable from the instrument before opening the cover.**
- **Do not connect the power cable to the Instrument while the covers are removed.**

WARNING **Inaccessible power plug.**

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

- **Make sure the power connector of the instrument can be easily reached and unplugged.**
- **Provide sufficient space behind the power socket of the instrument to unplug the cable.**

Power Cords

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

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

WARNING **Unintended use of power cords**

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

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

WARNING **Absence of ground connection**

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

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

WARNING **Electrical shock hazard**

Solvents may damage electrical cables.

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

Bench Space

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

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

The module should be operated in a horizontal position.

The module should be operated in a horizontal position, especially if a sample cooler is installed. Check position with a bulb.

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

Environment

Your module will work within the specifications at ambient temperatures and relative humidity described in Physical Specifications Master.

ASTM drift tests require a temperature change below 2 °C/hour (3.6 F/hour) over one hour period. Our published drift specification (refer also to Specification Conditions) is based on these conditions. Larger ambient temperature changes will result in larger drift.

Better drift performance depends on better control of the temperature fluctuations. To realize the highest performance, minimize the frequency and the amplitude of the temperature changes to below 1 °C/hour (1.8 F/hour). Turbulences around one minute or less can be ignored.

CAUTION Condensation within the module

Condensation can damage the system electronics.

- Do not store, ship or use your module under conditions where temperature fluctuations could cause condensation within the module.
- If your module was shipped in cold weather, leave it in its box and allow it to warm slowly to room temperature to avoid condensation.

NOTE This module is designed to operate in a typical electromagnetic environment, i.e. where RF transmitters such as mobile telephones may not be used in close proximity.

Specifications of the 1260 Infinity III Refractive Index Detector (G7162A)

Table 1: Physical Specifications of the 1260 Infinity III Refractive Index Detector (G7162A)

Parameter Name	External Value	Comment
Weight	14.7 kg (32.4 lbs)	
Dimensions (height × width × depth)	180 x 396 x 436 mm (7.1 x 15.6 x 17.2 inches)	
Line voltage	100–240 V~, ±10%	Wide-ranging capability
Line frequency	50 or 60 Hz, ±5%	
Power consumption	80 VA, 70 W	
Ambient operating temperature	4–55 °C (39–131 °F)	
Ambient non-operating temperature	-40–70 °C (-40–158 °F)	
Humidity	< 95% r.h. at 40 °C (104 °F)	Non-condensing
Operating altitude	Up to 3000 m (9842 ft)	
Safety standards: IEC, EN, CSA, UL	Overvoltage category II, Pollution degree 2	For indoor use only
ISM classification	ISM Group 1 Class B	According to CISPR 11

Table 2: Performance Specifications of the 1260 Infinity III Refractive Index Detector (G7162A)

Type	Specification
Detection type	Refractive Index
Designed for use with Agilent InfinityLab Assist	Intuitive User Interface, Automated Workflows, Predictive Maintenance & Assisted Troubleshooting
Refractive index range	1.00 – 1.75 RIU, calibrated
Measurement range	± $600 \cdot 10^{-6}$ RIU
Optical zeroing	Digitally via software, manually via set screw
Optics temperature control	5 °C above ambient to 55 °C

Type	Specification
Sample cell	Volume: 8 µL Maximum pressure: 5 bar (0.5 MPa) Maximum flow rate: 5 mL/min
Valves	Automatic purge and automatic solvent recycle
Volumes	Inlet port to sample cell 62 µL, inlet port to outlet port 590 µL
Liquid contact materials	316 stainless steel, PTFE and quartz glass
pH range	2.3 – 9.5
Performance specifications	Short term noise: $<\pm 1.25 \cdot 10^{-9}$ RIU Drift: $<200 \cdot 10^{-9}$ RIU/hr
Time programmable parameters	Polarity, peak width
Maximum data rate	74 Hz
Detector zero	Automatic zero before analysis
Instrument control	LC and CE Drivers A.02.12 or above Instrument Control Framework (ICF) A.02.03 or above InfinityLab Assist (G7180A) with firmware D.07.40 or above Agilent Instant Pilot (G4208A) with firmware B.02.19 or above Lab Advisor B.02.07 or above
Analog output	Recorder/integrator: 100 mV or 1 V, output range selectable, one output
Communication	LAN, Controller Area Network (CAN), Extended Remote Interface (ERI): ready, start, stop and shut-down signals
Safety and maintenance	Extensive diagnostics, error detection and display with Agilent InfinityLab Assist and with Agilent Lab Advisor software. Leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in major maintenance areas.
GLP	Early maintenance feedback (EMF) for continuous tracking of instrument usage with user-selectable limits and feedback messages. Electronic records of maintenance and errors. Automated operational qualification/performance verification (OQ/PV).
Housing	All materials recyclable

Specifications of the 1290 Infinity III Refractive Index Detector (G7162B)

Table 3: Physical Specifications of the 1290 Infinity III Refractive Index Detector (G7162B)

Parameter Name	External Value	Comment
Weight	14.7 kg (32.4 lbs)	
Dimensions (height × width × depth)	180 x 396 x 436 mm (7.1 x 15.6 x 17.2 inches)	
Line voltage	100–240 V~, ±10%	Wide-ranging capability
Line frequency	50 or 60 Hz, ±5%	
Power consumption	80 VA, 70 W	
Ambient operating temperature	4–55 °C (39–131 °F)	
Ambient non-operating temperature	-40–70 °C (-40–158 °F)	
Humidity	< 95% r.h. at 40 °C (104 °F)	Non-condensing
Operating altitude	Up to 3000 m (9842 ft)	
Safety standards: IEC, EN, CSA, UL	Overvoltage category II, Pollution degree 2	For indoor use only
ISM classification	ISM Group 1 Class B	According to CISPR 11

Table 4: Performance Specifications of the 1290 Infinity III Refractive Index Detector (G7162B)

Type	Specification
Detection type	Refractive Index
Designed for use with Agilent InfinityLab Assist	Intuitive User Interface, Automated Workflows, Predictive Maintenance & Assisted Troubleshooting
Refractive index range	1.00 – 1.75 RIU, calibrated
Measurement range	± $600 \cdot 10^{-6}$ RIU
Optical zeroing	Digitally via software, manually via set screw
Optics temperature control	5 °C above ambient to 55 °C

Type	Specification
Sample cell	Volume: 2.5 µL Maximum pressure: 5 bar (0.5 MPa) Maximum flow rate: 1 mL/min (100 % water)
Valves	Automatic purge and automatic solvent recycle
Volumes	Inlet port to sample cell 2.5 µL, inlet port to outlet port 265 µL
Liquid contact materials	316 stainless steel, PTFE and quartz glass
pH range	2.3 – 9.5
Performance specifications	Short term noise: $<\pm 1.75 \cdot 10^{-9}$ RIU Drift: $<200 \cdot 10^{-9}$ RIU/h
Time programmable parameters	Polarity, peak width
Maximum data rate	148 Hz
Detector zero	Automatic zero before analysis
Instrument control	LC and CE Drivers A.02.12 or above Instrument Control Framework (ICF) A.02.03 or above InfinityLab Assist (G7180A) with firmware D.07.40 or above Agilent Instant Pilot (G4208A) with firmware B.02.19 or above Lab Advisor B.02.07 or above
Analog output	Recorder/integrator: 100 mV or 1 V, output range selectable, one output
Communication	LAN, Controller Area Network (CAN) Extended Remote Interface (ERI): ready, start, stop and shut-down signals
Safety and maintenance	Extensive diagnostics, error detection and display with Agilent InfinityLab Assist and with Agilent Lab Advisor software. Leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in major maintenance areas.
GLP	Early maintenance feedback (EMF) for continuous tracking of instrument usage with user-selectable limits and feedback messages. Electronic records of maintenance and errors. Automated operational qualification/performance verification (OQ/PV).
Housing	All materials recyclable.

3 Installation

The installation of the module will be done by an Agilent service representative. In this chapter, only installation of user-installable options and accessories are described.

Installing Capillaries

This section provides information on how to install capillaries and fittings.

Install Capillaries

Capillaries and connections depend on which system is installed.

NOTE As you move to smaller-volume, high-efficiency columns, you will want to use narrow id tubing, as opposed to the wider id tubing used for conventional HPLC instruments.

NOTE Agilent capillaries are color-coded for quick identification, see At-a-Glance Details About Agilent Capillaries on page 247.

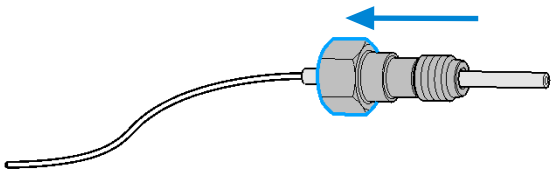
Table 5: Capillary connections for 1260 Infinity III systems

p/n	From	To
G7120-60007 (Bottle Head Assembly)	Solvent Bottle	Infinity III Pump
5500-1246 (Capillary ST 0.17 mm x 500 mm SI/SI)	Pump	Sampler
5500-1217 (Capillary, ST, 0.17 mm x 900 mm SI/SX)	Pump	Vialsampler with ICC
5500-1246 (Capillary ST 0.17 mm x 500 mm SI/SI)	Multisampler	MCT Valve/Heat Exchanger
5500-1252 (Capillary, ST, 0.17 mm x 400 mm SL/SL)	Vialsampler	MCT Valve/Heat Exchanger
5500-1240 (Capillary ST 0.17 mm x 105 mm SL/SL)	Vialsampler	ICC Heat Exchanger
5500-1250 (Capillary, ST, 0.17 mm x 120 mm SL/SL, long socket)	ICC Heat Exchanger	Column
5500-1193 (InfinityLab Quick Turn Capillary ST 0.17 mm x 105 mm, long socket)	MCT Heat Exchanger	Column
5500-1191 (InfinityLab Quick Turn Capillary ST 0.12 mm x 280 mm, long socket)	Column/MCT Valve	Detector
5062-8535 (Waste accessory kit (Flow Cell to waste))	VWD	Waste
5062-2462 (Tube PTFE 0.7 mm x 5 m, 1.6 mm od)	DAD/FLD	Waste
G5664-68712 (Analytical tubing kit 0.25 mm i.d. PTFE-ESD)	Detector	Fraction Collector

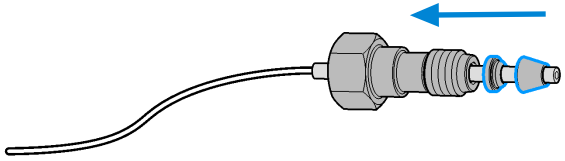
For correct installation of capillary connections it's important to choose the correct fittings, see Syntax for Capillary Description.

1 Select a nut that is long enough for the fitting you'll be using.

2 Slide the nut over the end of the tubing or capillary.



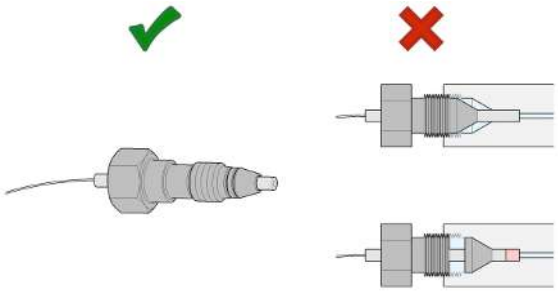
3 Carefully slide the ferrule components on after the nut and then finger-tighten the assembly while ensuring that the tubing is completely seated in the bottom of the end fitting.



4 Use a stable port installed to the module to gently tighten the fitting facing to the module. Or use the column to tighten the fitting facing to the column. This measure forces the ferrule to seat onto the tubing or capillary.

NOTE Do not overtighten. Over-tightening will shorten the lifetime of the fitting.

5 Loosen the nut and verify that the ferrule is correctly positioned on the tubing or capillary.



NOTE The first time that the Swagelok fitting is used on a column or an injection valve, the position of the ferrule is permanently set. If changing from a column or an injection valve to another, the fitting may leak or decrease the quality of the separation by contributing to band broadening.

For Bio and Bio-Inert Systems, the Swagelok instructions do not apply.

Handling Leak and Waste

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

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

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

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

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

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

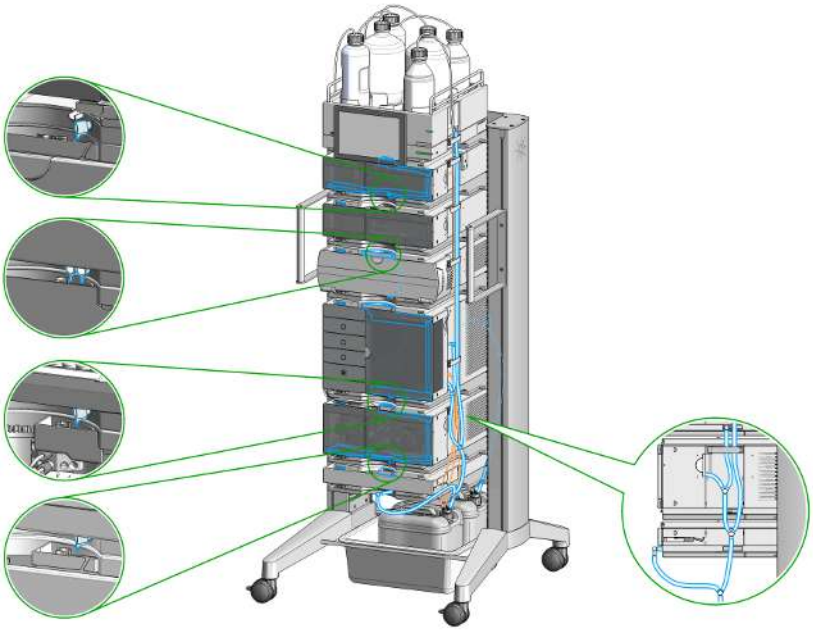


Figure 9: Infinity III Leak Waste Concept (Flex Bench installation)

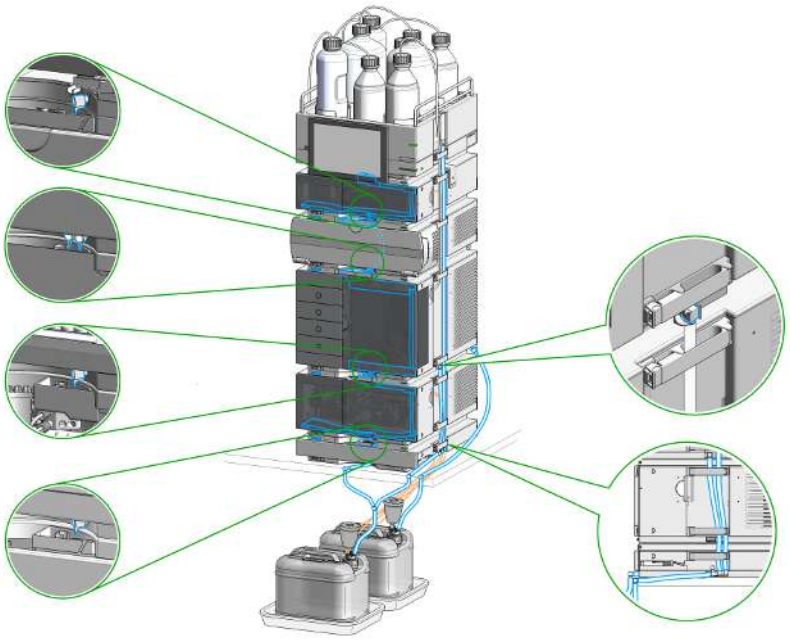


Figure 10: Infinity III Single Stack Leak Waste Concept (bench installation)

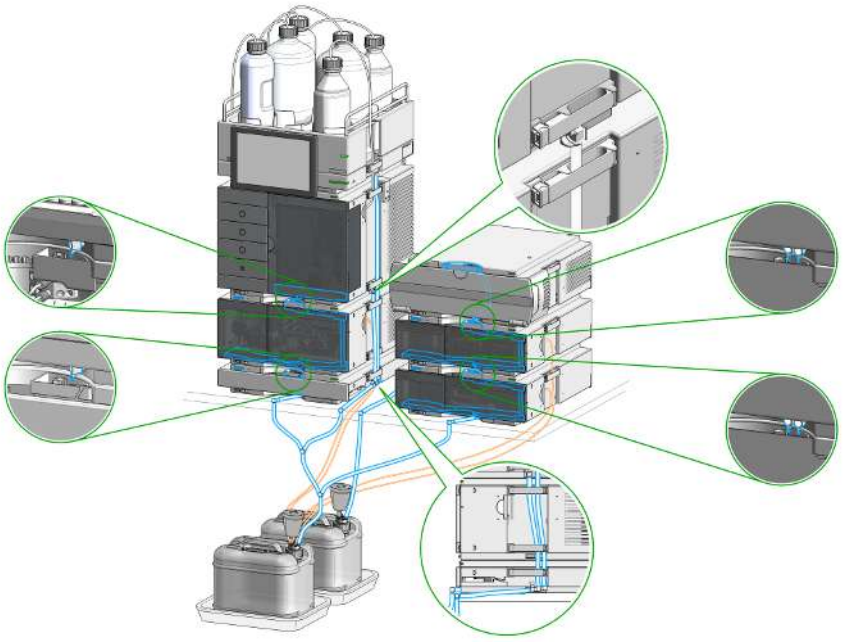


Figure 11: Infinity III Two Stack Leak Waste Concept (bench installation)

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

Drain Connectors Installation

Drain Connectors (available only as Drain Connectors Kit 5004-0000) have been developed to improve leak drainage for low flow leaks of high viscosity solvents (for example, isopropanol) in Agilent InfinityLab LC Series Systems. Install these parts to modules where they are missing (usually preinstalled).

- Make sure that dripping adapters are correctly installed on each module in the LC stack, excluding lowest module.
- Remove the dripping adapter if it is appeared to be installed on the lowest module in the LC stack and connect waste tube instead.
- Consider 5004-0000 (Drain Connectors Kit) if drain adaptor is missing on some module(s).

For illustration, see Handling Leak and Waste on page 39.

Parts required

Qty.	p/n	Description
	5004-0000	Drain Connectors Kit

Content of Drain Connectors Kit (p/n 5004-0000)

Parts can be ordered only as a complete kit.

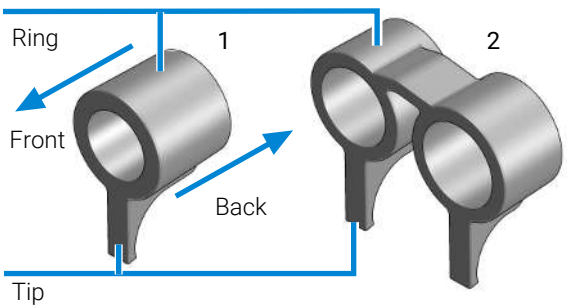


Figure 12: Overview of Drain Connectors: Single (left) and Double (right)

#	Qty.	p/n	Description
1	3		Single Drain Connector
2	1		Double Drain Connector

Table 6: Compatibility of drain connectors and modules

Drain Connector Type	Compatible Module	Compatible Module Type
Double	G7116A/B	Column Compartment
Single	G7114A/B	Detector
	G7115A	
	G7117A/B/C	
	G7121A/B	
	G7162A/B	
	G7165A	
	G7129A/B/C	Sampler
	G7167A/B/C	
	G5668A	
	G7137A	
	G7157A	
	G4767A	
	G7122A	Degasser
	G7104A/C	Pump
	G7110B	
	G7111A/B	
	G7112B	
	G7120A	
	G7131A/C	
	G7132A	
	G5654A	
	G4782A	

Preparations

- Leak drains of LC modules are clean and free of salt or solvent residuals.

NOTE

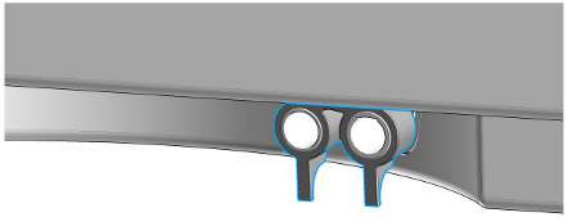
Do not install drain connectors on the bottom modules of the stack. Drain outlet of the bottom module has to be connected via waste tubing to a suitable waste container (see Leak and Waste Handling in the manual for a respective module).

NOTE In case of incorrect installation, drain connectors cannot fully perform the intended function.

NOTE It is not required to power off the HPLC stack to install Single and Double Drain Connectors. The installation of the connectors does not affect the analysis performed during the installation.

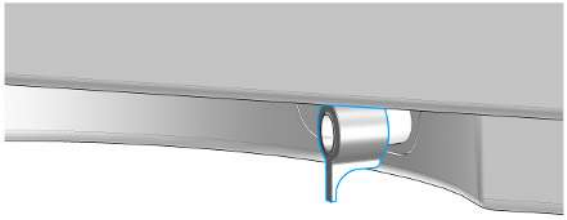
Install the Double Drain Connector on the leak drain of the 1260 Infinity III Multicolumn Thermostat (G7116A)/ 1290 Infinity III Multicolumn Thermostat (G7116B)

1 Align the rings with the leak drain outlets of the module, press slightly with the fingers, and slide the connector along the leak drain outlets until it is aligned with the front of the leak drain.



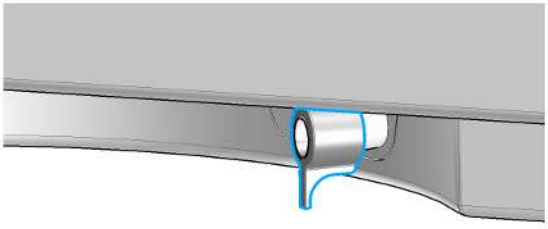
Install Single Drain Connectors on other modules in the LC stack

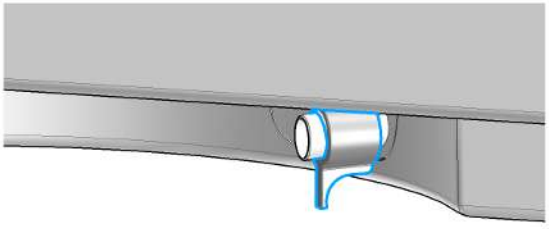
1 Align the ring with the leak drain outlet of the module, press slightly with the fingers, and slide the connector along the leak drain outlet until it is aligned with the front of the leak drain.



Make sure that the following requirements are covered:

- The tip of the drain connector points straight down.
- The leak drain outlets and the drain connectors are aligned properly.



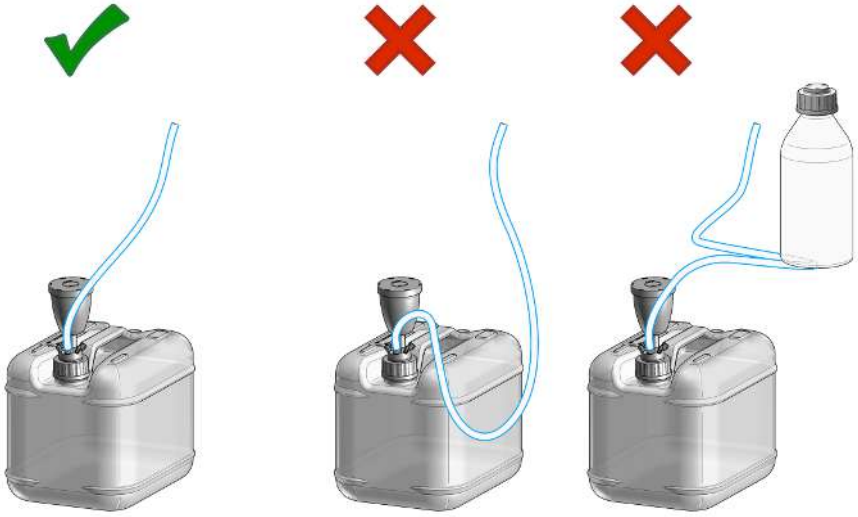


Waste Concept

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

NOTE To optimize detector performance the waste container and solvent bottle should be positioned above the level of the refractive index detector and solvent pump (e.g. in the solvent compartment). This will maintain a slight pressure in the sample cell.

Waste Guidance



NOTE

The waste drainage must go straight into the waste containers. The waste flow must not be restricted at bends or joints.

Leak Sensor

CAUTION

Solvent incompatibility

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

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

4 Using the Module

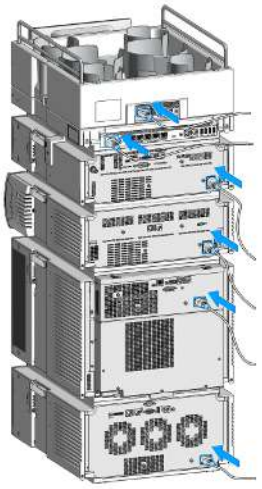
This chapter provides information on how to use the module.

General Information

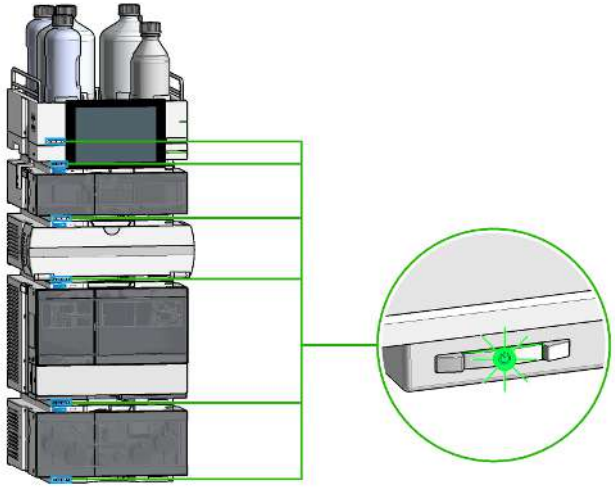
Turn On/Off

This procedure exemplarily shows an arbitrary LC stack configuration.

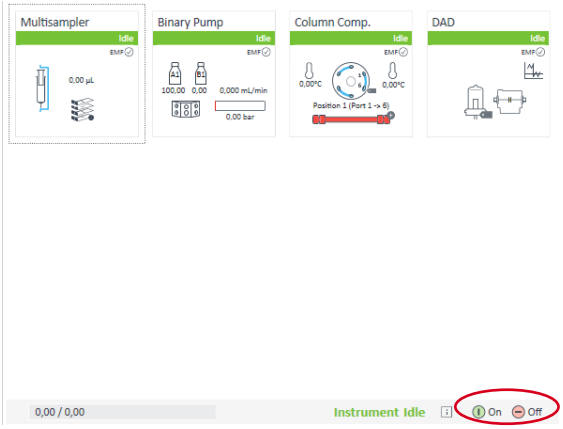
1



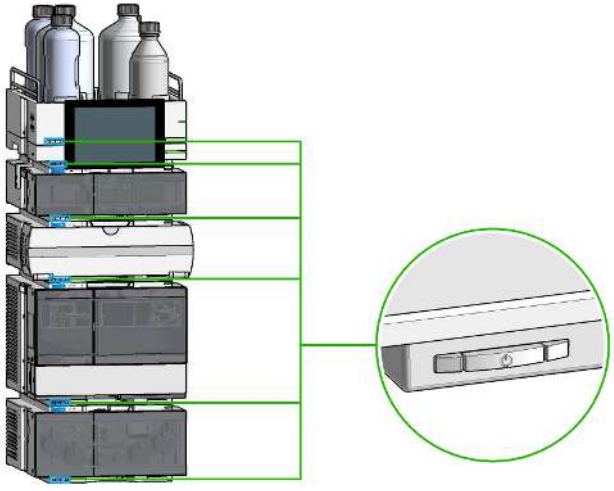
2 On/Off switch: On



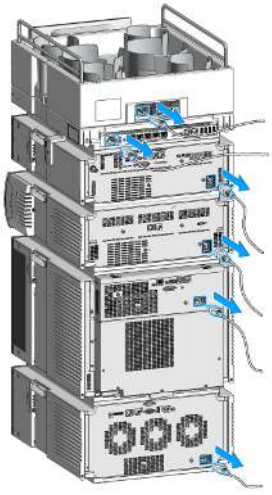
3 Turn instrument **On/Off** with the control software.



4 On/Off switch: Off



5



Status Indicators

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

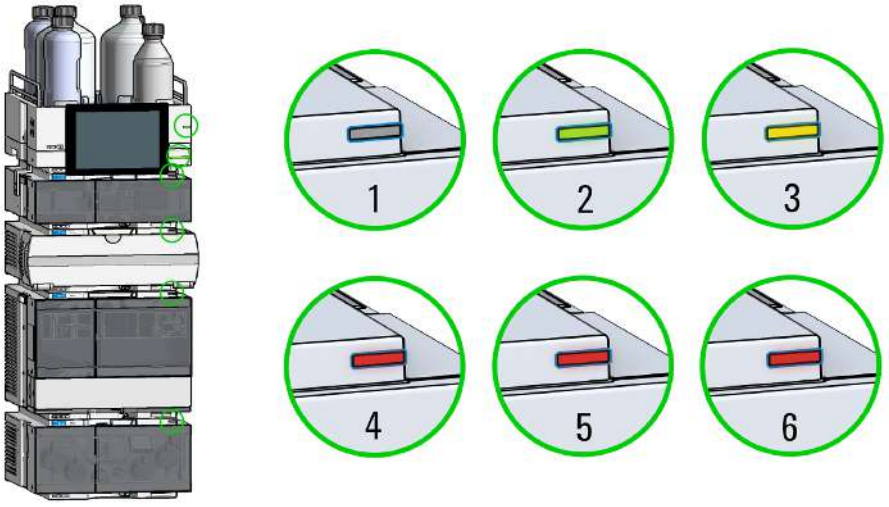


Figure 13: Arbitrary LC stack configuration (example)

1	Idle
2	Run mode
3	Not-ready. Waiting for a specific pre-run condition to be reached or completed.
4	Error mode - interrupts the analysis and requires attention (for example, a leak or defective internal components).
5	Resident mode (blinking) - for example, during update of main firmware.
6	Bootloader mode (fast blinking). Try to re-boot the module or try a cold-start. Then try a firmware update.

InfinityLab Assist Hub Status Indicator

The Assist Hub status indicator displays the status of the entire system. If a module in the system is not ready (yellow), the Assist Hub status indicator also shows not ready (yellow). The same applies for the module conditions Idle, Run mode, and Error mode.

Preparation of the System

Prepare a Run

This procedure exemplarily shows how to prepare a run. Parameters as shown in the screenshots may vary, depending on the system installed.

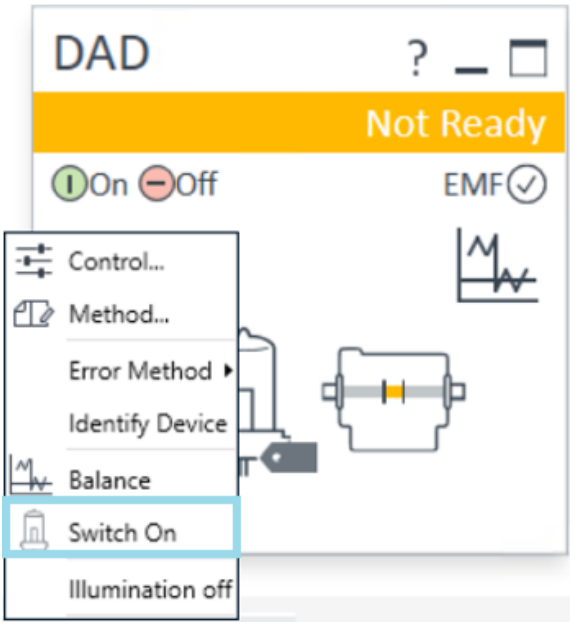
WARNING

Toxic, flammable and hazardous solvents, samples and reagents

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

- **When working with these substances observe appropriate safety procedures (for example by wearing goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the vendor, and follow good laboratory practice.**
- **Do not use solvents with an auto-ignition temperature below 200 °C (392 °F). Do not use solvents with a boiling point below 56 °C (133 °F).**
- **Avoid high vapor concentrations. Keep the solvent temperature at least 40 °C (72 °F) below the boiling point of the solvent used. This includes the solvent temperature in the sample compartment. For the solvents methanol and ethanol keep the solvent temperature at least 25 °C (45 °F) below the boiling point.**
- **Do not operate the instrument in an explosive atmosphere.**
- **Do not use solvents of ignition Class IIC according IEC 60079-20-1 (for example, carbon disulfide).**
- **Reduce the volume of substances to the minimum required for the analysis.**
- **Never exceed the maximum permissible volume of solvents (8 L) in the solvent cabinet. Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for solvent cabinet.**
- **Ground the waste container.**
- **Regularly check the filling level of the waste container. The residual free volume in the waste container must be large enough to collect the waste liquid.**
- **To achieve maximal safety, regularly check the tubing for correct installation.**

1 Switch on the detector.

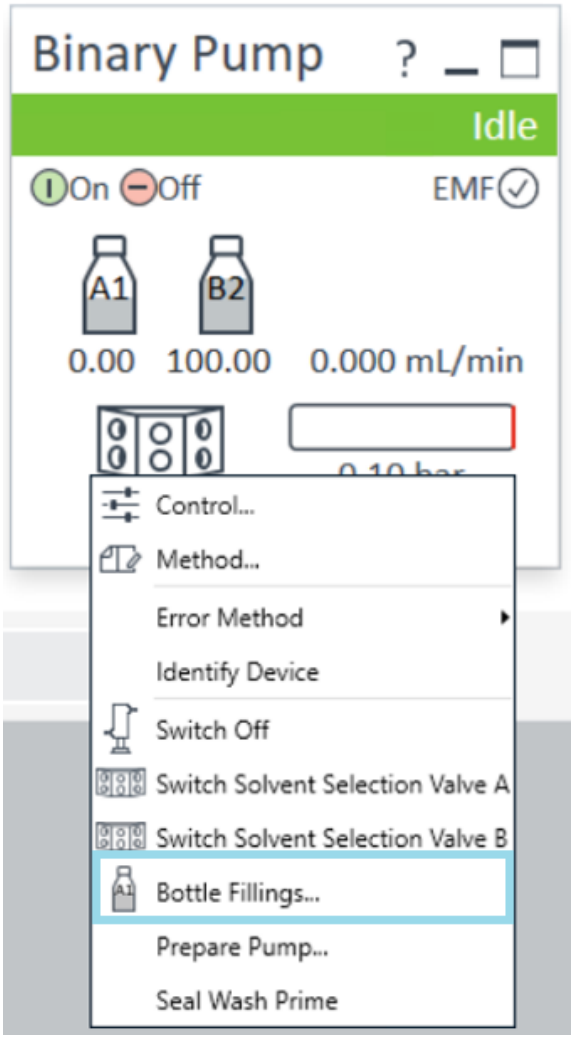


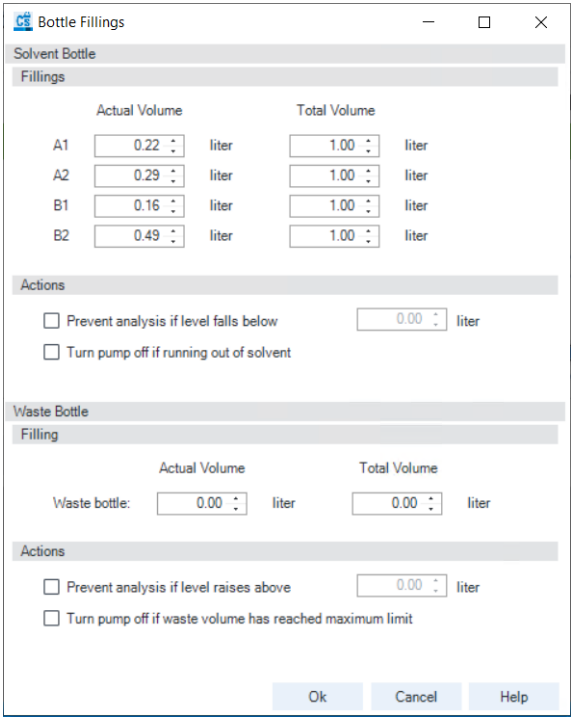
2 Fill the solvent bottles with adequate solvents for your application.

3 Place solvent tubings with bottle head assemblies into the solvent bottles.

4 Place solvent bottles into the solvent cabinet.

5 Solvent bottle filling dialog (in the software).





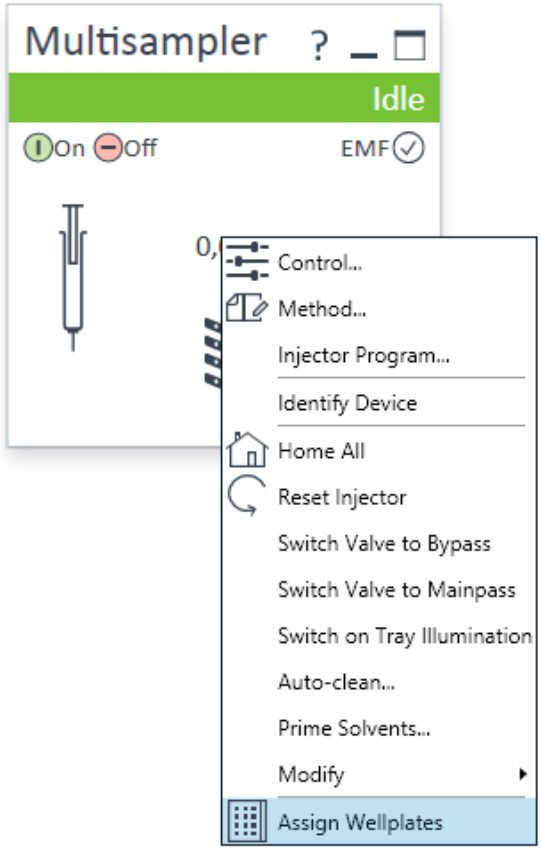
6 Purge the pump.

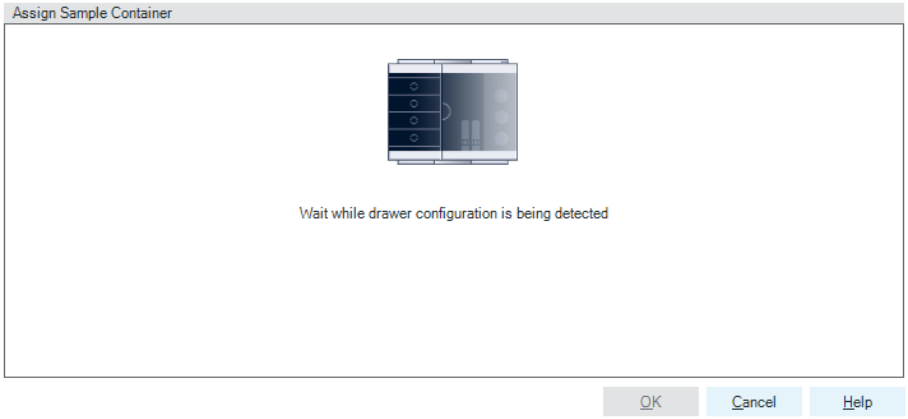
NOTE

For details on priming and purging, refer to the technical note *Best Practices for Using an Agilent LC System Technical Note (InfinityLab-BestPractice-en-SD-29000194.pdf, SD-29000194)*.

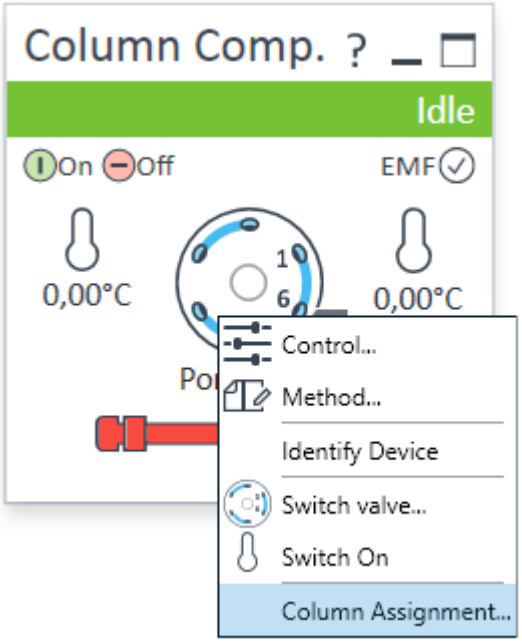
7 Change solvent type if necessary.

8 Choose the tray format of the sampler.

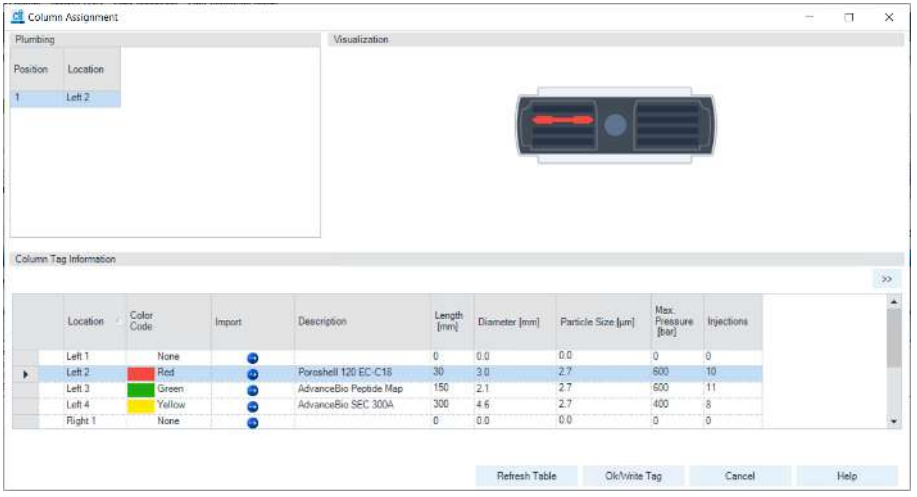




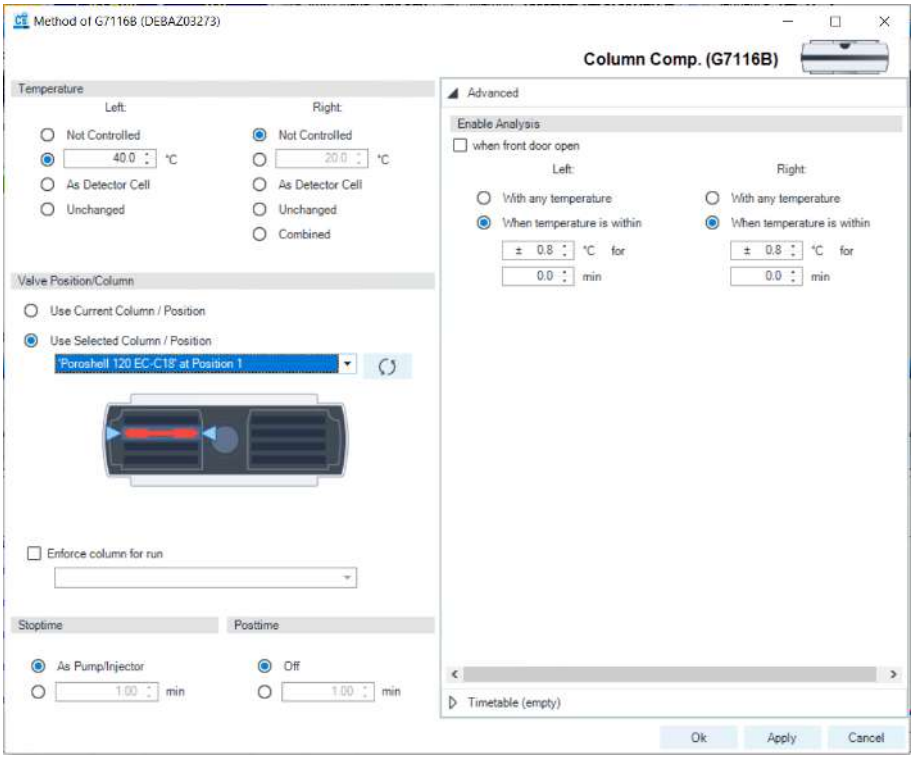
9 Add a new column.



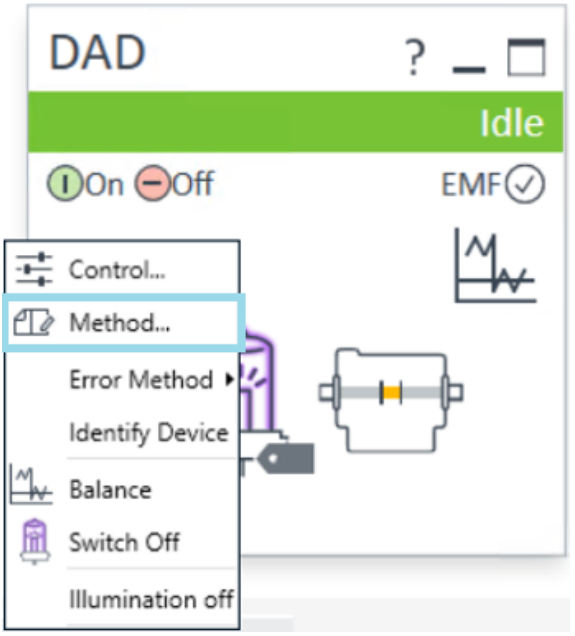
10 Enter the column information.



11 Select the column in the Method settings of the column compartment.



12 Set the detector parameters according to the needs of your method.


DAD
Idle
On
Off
EMF
Control...
Method...
Error Method
Identify Device
Balance
Switch Off
Illumination off

Prime and Purge the System

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

Table 7: Choice of priming solvents for different purposes

Activity	Solvent	Comments
After an installation	Isopropanol	Best solvent to flush air out of the system
When switching between reverse phase and normal phase (both times)	Isopropanol	Best solvent to flush air out of the system
After an installation	Ethanol or Methanol	Alternative to Isopropanol (second choice) if no Isopropanol is available
To clean the system when using buffers	Bidistilled water	Best solvent to re-dissolve buffer crystals
After a solvent change	Bidistilled water	Best solvent to re-dissolve buffer crystals
After the installation of normal phase seals (P/N 0905-1420)	Hexane + 5% Isopropanol	Good wetting properties

NOTE The pump should never be used for priming empty tubings (never let the pump run dry). Use a syringe to draw enough solvent for completely filling the tubings to the pump inlet before continuing to prime with the pump.

1 Open the purge valve of your pump (by turning it counterclockwise) and set flow rate to 3 – 5 mL/min.

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

3 Set flow to required value of your application and close the purge valve.

NOTE Pump for approximately 10 minutes before starting your application.

NOTE Do NOT exceed the flow rate of the 1290 Infinity III RID (Micro) whilst purging pump. Bypass detector when purging >1 mL/min.

Preparing the Detector

For best performance of the detector

- Let the lamp warm-up and stabilize for at least one hour (initial turn on of the module requires a longer time depending on the environment and the application needs).
- For high sensitivity measurements, a stable environment is required; refer to Environment. Prevent drafts from air condition systems.
- Do not work with removed/open front panels/doors. When the system includes a G1316 TCC (typically located below the detector) and its front panel is removed while the TCC is set to high temperatures, the up-streaming air could influence the stability of the detector baseline.

Running the Sample and Verifying the Results

1 To start a run select the menu item RunControl > Run Method.

2 This will start the modules and the online plot on the Agilent ChemStation will show the resulting chromatogram.

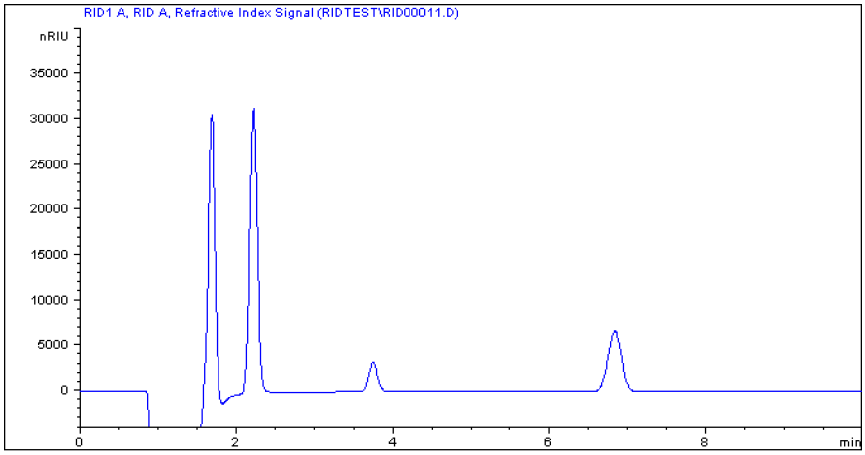


Figure 14: Isocratic standard sample chromatogram

Preparing the Module

Set Up the Detector with Agilent OpenLab ChemStation

The setup of the detector is shown with the Agilent OpenLab ChemStation C.01.07 and LC and CE Drivers A.02.13.

NOTE This section describes the detector settings only. For information on the Agilent OpenLab ChemStation or other 1200 Infinity modules refer to the corresponding documentation.

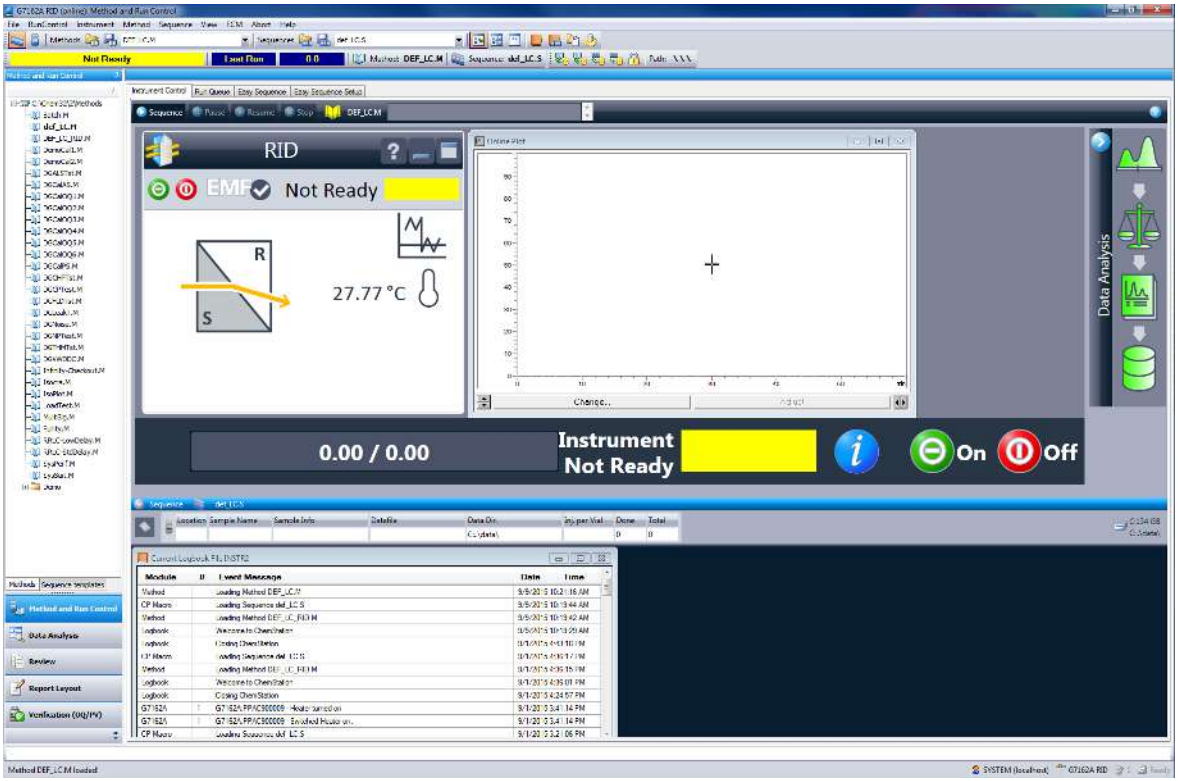
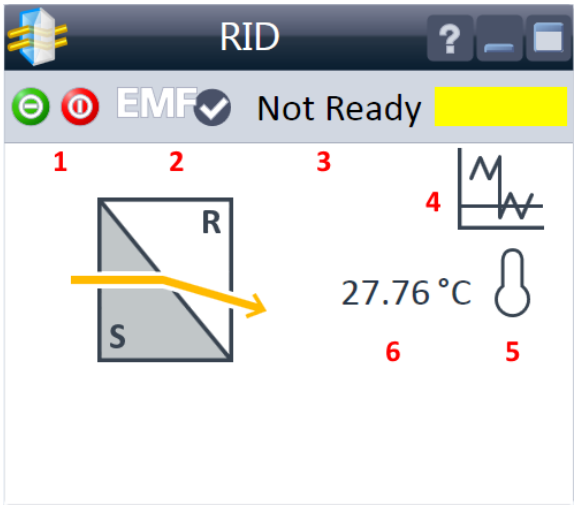


Figure 15: ChemStation Method and Run Control (just detector is shown)

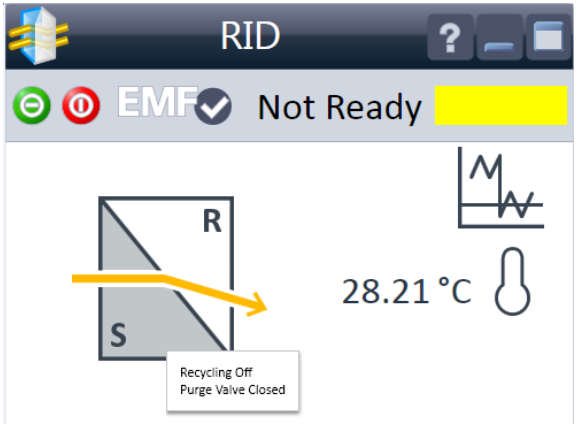
After successful load of the OpenLab ChemStation, you should see the module as an active item in the graphical user interface (GUI).

The Detector User Interface



Within the detector GUI, there are active areas. If you move the mouse cursor across the icons the cursor will change.

1. Make device ready or turn off
2. EMF status
3. Detector status
4. Balance
5. Heater status (on/off)
6. Heater temperature



The Purge Valve status (closed/open) and the Recycle Valve status (off/on) is shown when the cursor moves across the flow cell icon.

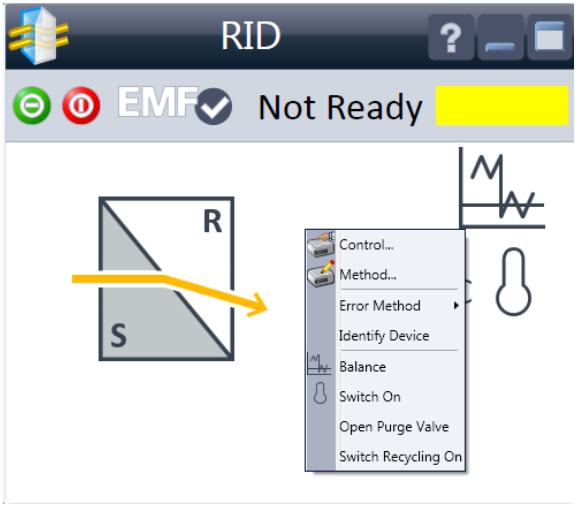
EMF Status shows Run / Ready / Error state and “Not Ready text” or “Error text”

- Offline (gray)
- Ok. No Maintenance required (green)
- EMF warning. Maintenance might be required (yellow)
- EMF warning. Maintenance required (red)

Important: The EMF settings can be accessed via Agilent Lab Advisor. The limit(s) can be changed. Based on the limit, the User Interface displays the above status.

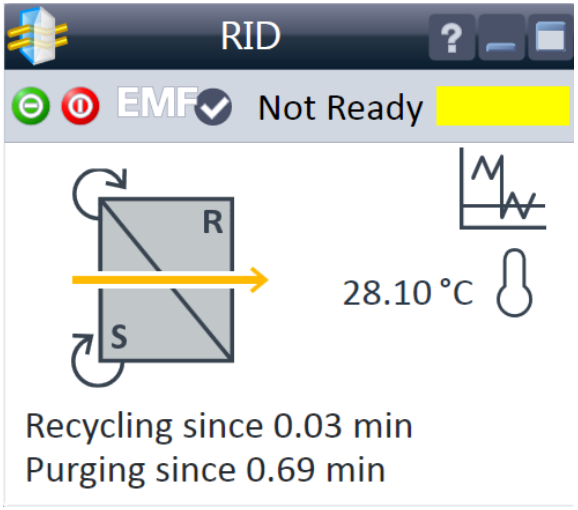
Module Status shows Run / Ready / Error state and “Not Ready text” or “Error text”

- Error (red)
- Not ready (yellow)
- Ready (green)
- Pre run, Post run (purple)
- Run (blue)
- Idle (green)
- Offline (dark gray)
- Standby (light gray)



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

- Show the **Control** Interface (special module settings)
- Show the **Method** interface (similar as via menu **Instrument** > **Setup Instrument Method**)
- Set **Error Method**
- Identify Module (Status LED will blink)
- Perform a **Balance**
- Switch the Heater on/off (same as click on button **Make Device Ready/Turn device off (standby)**)
- Open/close Purge Valve
- Recycle Valve on/off



If the Purge Valve or Recycle Valve has been turned on, the on-time is displayed below the flow cell icon.

Detector Control Settings

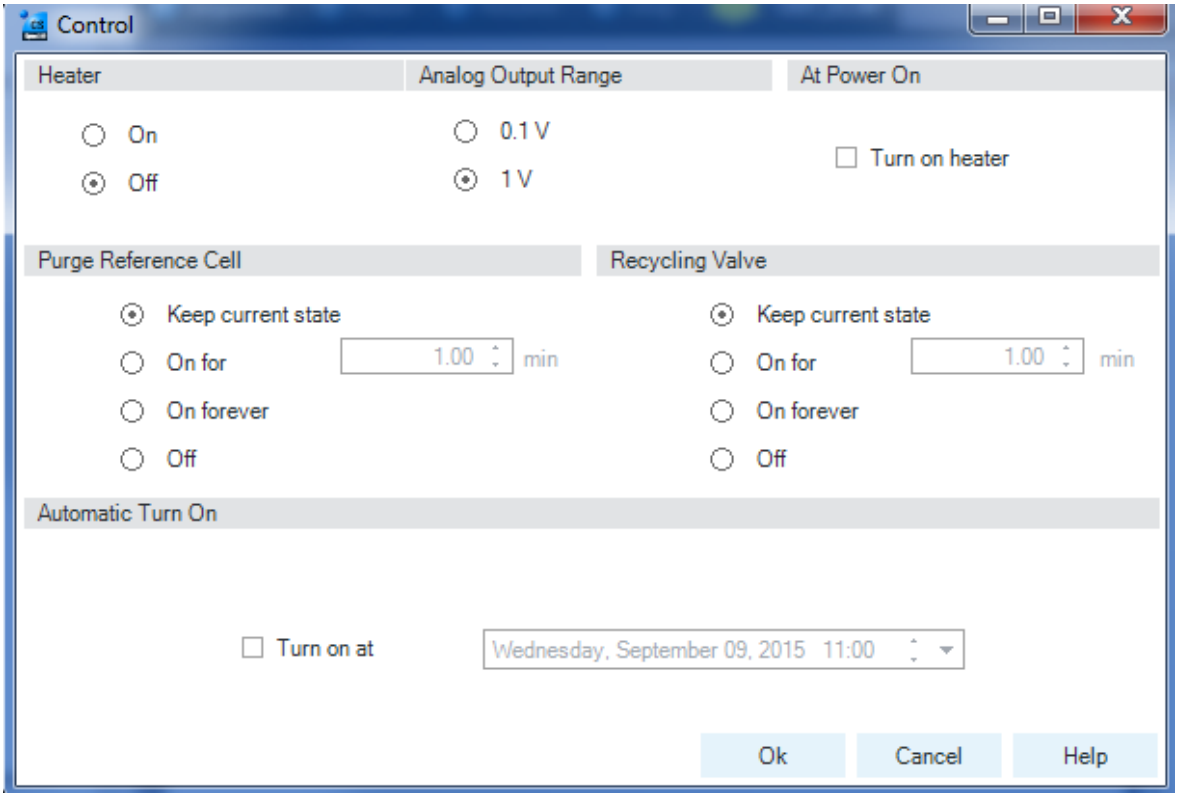


Figure 16: Control settings

The figure shows the default settings.

- Heater: Select the On option to switch the RID heater on. This parameter requires setting the Optical Unit Temperature. Select the Off option to switch the optical unit heater off.
- Analog Output Range: can be set to either 100 mV or 1 V full scale, for additional settings see Analog Output (under Method Parameter Settings on page 70).
- At Power On: When activated, the optical unit heater is turned on automatically when the RID is switched on. For shortest equilibration times, Agilent recommends to leave this function always on.

- Purge Reference Cell: This parameter is used to exchange the content of the reference cell in the case of solvent change or reference cell contamination. Enter a time interval (minutes) to purge the reference cell. This will be started immediately if you click OK on this window. Allow additional time for baseline stabilization after purging.
- Recycling Valve: Select the On option to switch the recycling of the eluent on. The Off option diverts the flow of the RID to the waste bottle.
- Automatic Turn On: This function allows you to turn on the optical unit heater at a specified date and time. It requires that the At Power On function is turned off. Select Turn Heater on at: to activate the date and time fields, and enter the date and time in the appropriate fields in the specified format.

Method Parameter Settings

These settings are available via Menu > Instrument > Set up Instrument Method or via right click into the module's active area (does not show the Instrument Curves tab).

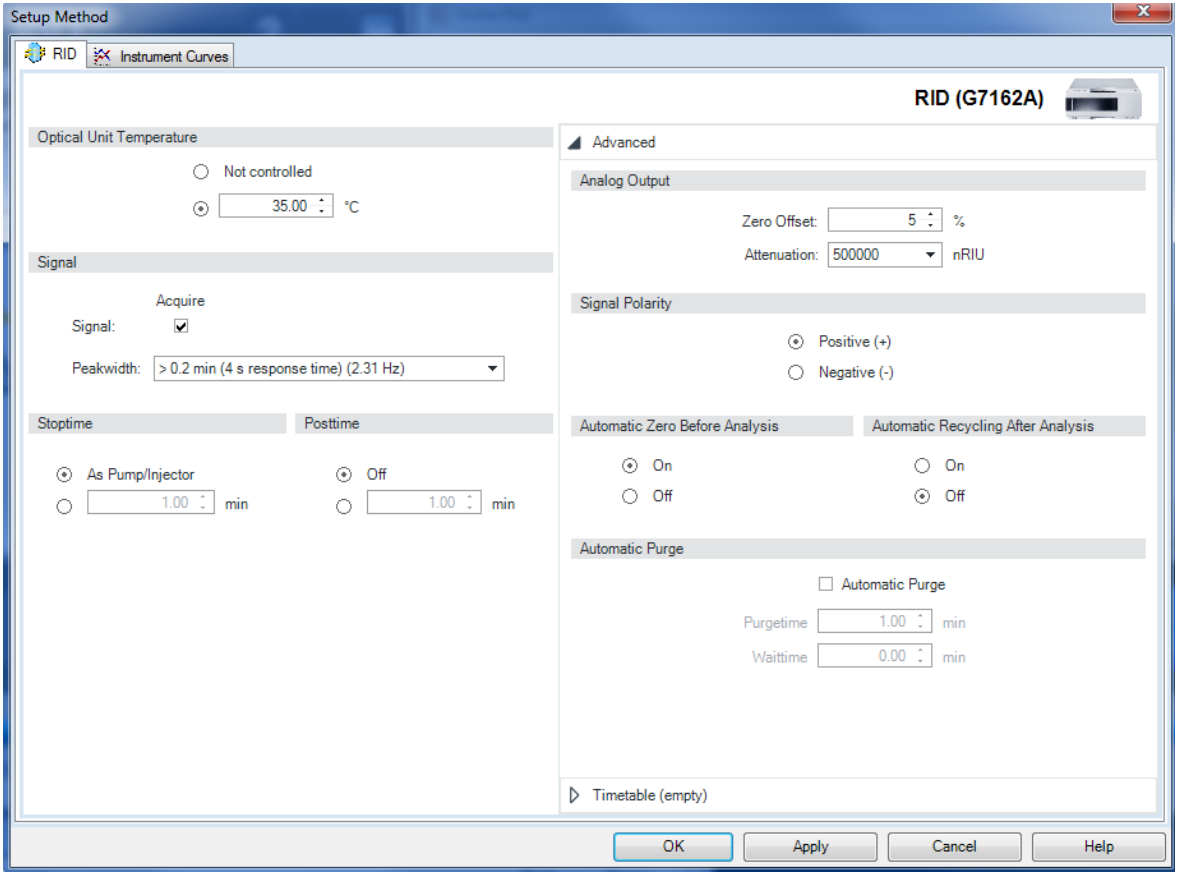
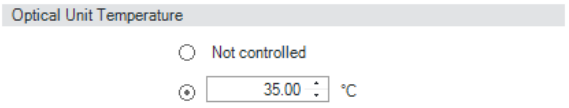
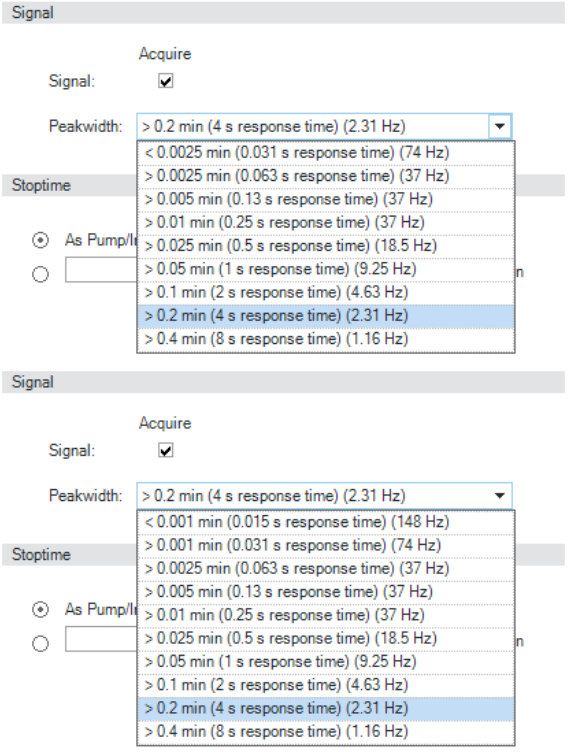
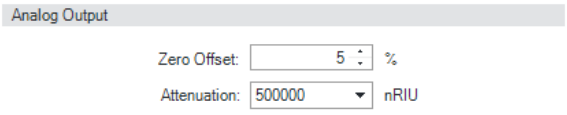


Figure 17: Method parameter settings

NOTE For additional help and support: Highlight the desired cell and press **F1**. A help screen will open with additional information and documentation about the topic.

Table 8: Method parameter settings

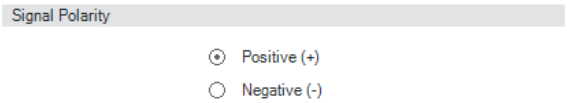
	Optical Unit Temperature: This item sets the temperature of the optical unit. The optical unit of the Agilent 1260 Infinity III RID can be operated between 5 °C above ambient and 55 °C. The recommended setting is 5 °C above ambient. This will improve baseline stability.
	Peakwidth (Response time, Data Rate): Peakwidth enables you to select the peak width (response time) for your analysis. The peak width is defined as the width of a peak, in minutes, at half the peak height. Set the peak width to the narrowest expected peak in your chromatogram. The peak width sets the optimum response time for your RID. Limits: When you set the peak width (in minutes), the corresponding response time is set automatically and the appropriate data rate for signal acquisition is selected. If **Acquire Signal** check box is not marked, signals are not stored. **NOTE:** The 1260 Infinity III RID (G7162A) has a data rate of up to 74 Hz. The 1290 Infinity III RID (G7162B) has a data rate of up to 148 Hz.
	Stoptime/Posttime The **Stoptime** is the time where either the complete system stops (**As Pump/Injector**) or the module (if different from system stop time). The data collection is stopped at this time. You can set the **Posttime** so that your module remains in the not ready state during the Posttime to delay the start of the next analysis. A Posttime period can be used to allow your column to equilibrate after changes in solvent composition or temperature change.



Analog Output

The range can be set to either 100 mV or 1 V full scale, see Detector Control Settings on page 69.

- **Zero Offset**: 1 – 99 % in steps of 1 % (5 % equal to 50 mV).
- **Attenuation**: 488 – 1000000 nRIU at discrete values for either 100 mV or 1 V full scale.



Signal Polarity

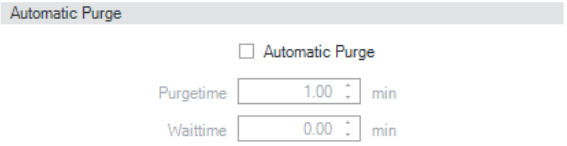
Use this item to set the polarity of the RID signal. Because of the nature of analytes and eluents, refractive index detectors can show negative and positive peaks, even within a run.

Automatic Zero Before Analysis

Use this setting to activate an automatic zeroing of the signal before the run is started. If automatic purge is selected, the purge will be performed before the automatic zero.

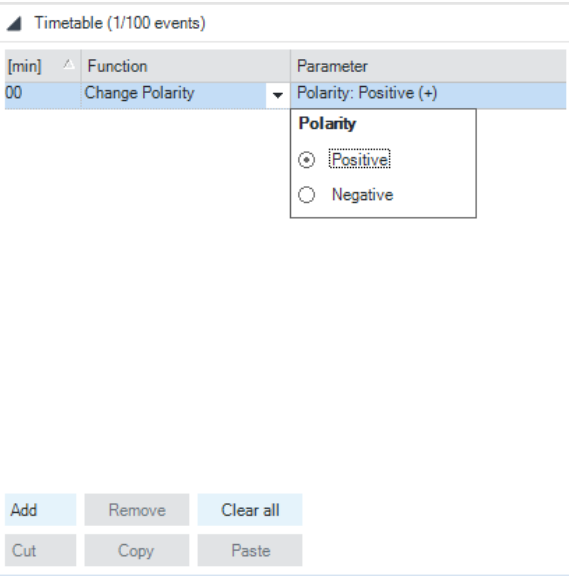
Automatic Recycling After Analysis:

This parameter can be used to select between automatic recycling of the effluent (**On**) or directing the effluent to the waste outlet of the RID (**Off**) after the run.



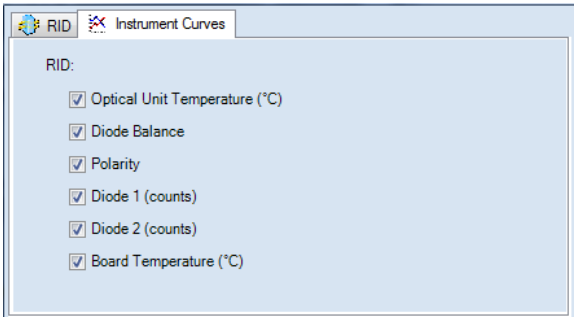
Automatic Purge

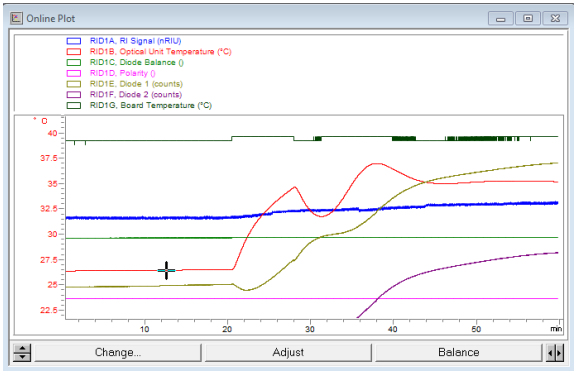
This parameter can be used to purge the reference cell and wait additional time for baseline stabilization. It is initiated each time the run is started. This should be used only if the content of the reference cell is expected to degrade during a run. The automatic purge is completed before the autozero is performed and before the injection is done.



Timetable

You may set up time events to change functions with their parameters over the run time. Add lines as required.
Time Limits: 0.00 to 99999.00 min in steps of 0.01 min.
Via the buttons in the bottom area time table lines can be added, removed, cut copied, pasted or completely cleared.
Based on the chosen function, a certain parameter can be selected.





Instrument Curves

The detector has several signals that can be used for diagnosing problems. These signals can be used in addition to the normal baseline signal to determine whether correlation to other signals exists. These signals are available via the Agilent ChemStation Online Plot/Data Signal and/or Agilent Lab Advisor Software.

- Optical unit temperature
- **Diode Balance** to diagnose peaks that exceed the dynamic range of the RID, for example in the case of extremely high concentrations/signals.
- **Polarity** monitors of polarity switching during the run.
- **Diode 1** and **Diode 2**: The RID signal is based on the ratio of the light level that is measured by two photodiodes. The RID signal is zero if the two diodes show the same light level. This parameter allows you to store individually the signal measured by the diode 1 and diode 2.
- Board Temperature
  The temperature around the Leak Sensor (at the power switch electronics) can be used for looking at ambient temperature changes.

5 Optimizing the Performance of the Module

This chapter provides information on how to optimize the module.

Refractive Index Detector Optimization

NOTE

Depending on the detector different inlet tubings are used (from the Accessory Kit):
G7162A:
G1362-87300 (Interfacing capillary)
G7162B:
5067-4784 (Capillary ST 0.075 mm x 220 mm) (Sampler to TCC/MCT)
5067-4783 (Capillary ST 0.075 mm x 340 mm) (Column to RID)

Follow these thirteen points to optimize the performance of your refractive index detector.

1. Position the solvent and waste reservoirs correctly

   Position the solvent and waste reservoirs above the level of the refractive index detector and solvent pump. This maintains a slight pressure in the sample cell and will improve the performance of the detector.

2. Do not overpressurize the flow cell

   Be aware to not exceed a 5 bar pressure drop after the flow cell when hooking up additional devices like other detectors or a fraction collector. If an additional detector is installed place upstream in the flow path it before the refractive index detector.

3. Use the correct solvents

   To minimize baseline noise and drift solvents must be LC grade and filtered prior to use.

4. Check for leaks

   Leaks within the LC instrument that the refractive index detector is connected to will cause problems with baseline long term noise or drift. Confirm that the instrument is free from leaks by performing the diagnostic pressure test (for the high pressure parts of the system between pump and column). Ensure that the connections from the on-line vacuum degasser to the pump and the detector inlet, waste and recycle connections are air tight.

5. Verify frit, filter and fitting quality

   Partially blocked frits, filters and fittings can cause baseline long term noise. Verify that the pressure drop across all such parts is within expected limits.

6. Control the optical unit temperature

Always control the optical unit temperature (heater = ON) for maximum detector sensitivity or with samples that could precipitate in the sample cell at room temperature and set an elevated optical unit temperature at least 5 °C above ambient conditions.

7. Use an appropriate response time

   For most applications a setting of 4 seconds is adequate. Only for high speed analyses (short columns at high flow rates) a lower setting is recommended. Bear in mind that even if the response time setting is too high fast peaks will appear a little smaller and broader but retention time and peak areas are still correct and reproducible.

8. Recycle mobile phase

   Use the recycle valve to allow automatic recycling of mobile phase delivered when no analysis is running. The pump flow can therefore continue uninterrupted until the next analysis without wasting mobile phase solvents. In addition the refractive index detector is always stabilized and ready for immediate use.

9. Consider using a degasser

   For many solvents you can achieve better baseline stability, when using a degasser. For some solvents a degasser might not lead to a better baseline quality.

10. Flush the degasser

    If flow is stopped and mobile phase remains inside the on-line vacuum degasser the solvent composition will change. When re-starting the flow or when using new mobile phase flush each degasser channel used for 10 minutes at the maximum flow rate of the pump (with the purge valve of the pump open to avoid a potential over-pressure in the RI detector's flow cell).

11. Use pre-mixed solvents, only

    Don't use a pump for mixing solvents. When operating the RI detector together with a quaternary pump, bypass the MCGV in the quaternary pump. You have to virtually convert the quaternary pump into an isocratic one, by directly connecting the solvent inlet tubing from degasser or solvent bottle to the active inlet valve of the pump (use 0100-1847 (PEEK adapter 1/4-28 to 10-32) , which is delivered with the accessory kit of the detector).

12. Consider solvent changes with time

Baseline drift can be caused by the tendency of certain solvents to change over time. For example the acetonitrile content of acetonitrile/water mixtures will decrease, tetrahydrofuran will form peroxides, the amount of water in hygroscopic organic solvents will increase and solvents such as tetrahydrofuran held in the reference cell may begin to regas.

13. Eliminate mobile phase/column combination problems

    Certain mobile phases in combination with specific columns can generate long term baseline noise. For example acetonitrile/water mobile phases with certain aminopropyl bonded phase columns. To eliminate the combination of mobile phase and column as a cause of long term noise replace the column with G1362-87301 (Restriction capillary) and re-evaluate the detector performance.

Potential Causes for Baseline Problems

Noise (short term)

Typically the sources for short term noise are either electronic (check the settings for the peak widths, check for ambient sources of electronic noise) or they are related to the solvents, their composition and flow (in order to verify this, turn off the pump, consider degassing your solvents, use only premixed solvents).

Wander (long term noise)

Excessive wander is an indication for a general system or environmental instability (system or laboratory might not be thermally stable, control instrument and laboratory temperature). Verify that the solvent properties are constant over time (flush out contamination, use only stabilized and premixed solvents). Clean the parts in the flow path and allow the system to be flushed out and equilibrated.

Drift

Excessive drift is an indication for a general system or environmental instability (system or laboratory might not be thermally stable, control instrument and laboratory temperature). Verify that the solvent properties are constant over time (flush out of contamination, use only stabilized solvents). Clean parts in the flow path and allow the system to be flushed out and equilibrated.

Detector Equilibration

The Refractive Index (RI) is a function of temperature, pressure and a property of the used solvent (it changes with solvent composition, degassing level and due to any trace of contamination). Therefore the Refractive Index Detector will detect any change in any of these parameters as a change in its signal and a variation of its baseline. Therefore the detector will trace down any instabilities in the system and the environment as well. It may sometimes appear, as if the detector itself was unstable or generating an unstable baseline, where in fact, the detector is simply displaying the instabilities of the environment and the rest of the system. By this the detector is often - without justification - blamed for instabilities, which it does not generate itself, but only detect. The fact that this detector is a universal detector makes it also sensitive to instabilities introduced to it from outside the detector.

This makes it very important to have a very stable environment and system for achieving best possible baseline stability. The baseline will get the better, the longer the system is used under identical and stable conditions. Keep the temperature in your laboratory and system constant and controlled. Ideally a system with an RID should be used always with the same type of analysis (stable solvent composition, temperature, flow rates, don't switch the pump off after analysis, instead just recycle solvents or at least reduce only the flow. Switch valves and settings only when needed. Don't expose the detector to draft of air or to vibrations). A change of any of these parameters may require a considerable amount of time for re-equilibration.

6 Diagnostics and Troubleshooting

This chapter gives an overview of the maintenance, troubleshooting, and diagnostic features available.

Diagnostic Features

This section gives an overview of the diagnostic features available.

User Interfaces

InfinityLab Assist

InfinityLab Assist provides you with assisted troubleshooting and maintenance at your instrument.

If the system in use supports the InfinityLab Assist, follow the instructions provided. Else, the preferred solution is to use Agilent Lab Advisor Software.

- Depending on the user interface, the available tests and the screens/reports may vary.
- The preferred tool for troubleshooting and diagnostics should be Agilent Lab Advisor Software, see Agilent Lab Advisor Software on page 114.
- Screenshots used within these procedures are based on the Agilent Lab Advisor Software.

Troubleshooting With HPLC Advisor

Baseline, Peak Shape, Pressure, Retention related issues, can be solved using the HPLC Advisor App. For more information, see Troubleshooting Reversed-Phase Chromatographic Techniques With HPLC Advisor.

If using an InfinityLab Assist, navigate to **Health** > **Troubleshooting** to help solve baseline, peak shape, pressure, and retention related issues.

Maintenance and Troubleshooting Tools of the Module

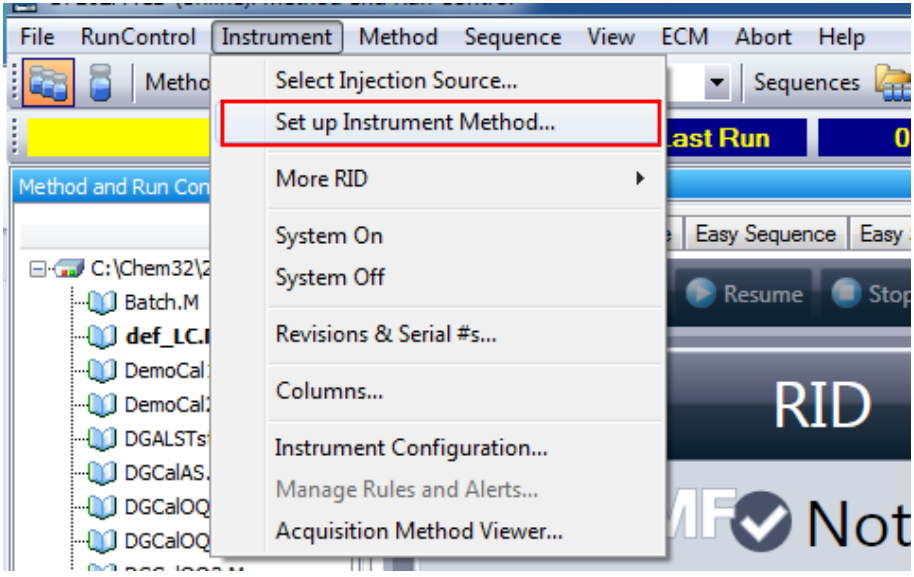
Available Signals

- Normal RIU signal
- Optical Temperature
- Board Temperature (measured at Leak Sensor)
- Polarity
- Diode Balance
- Diode 1
- Diode 2

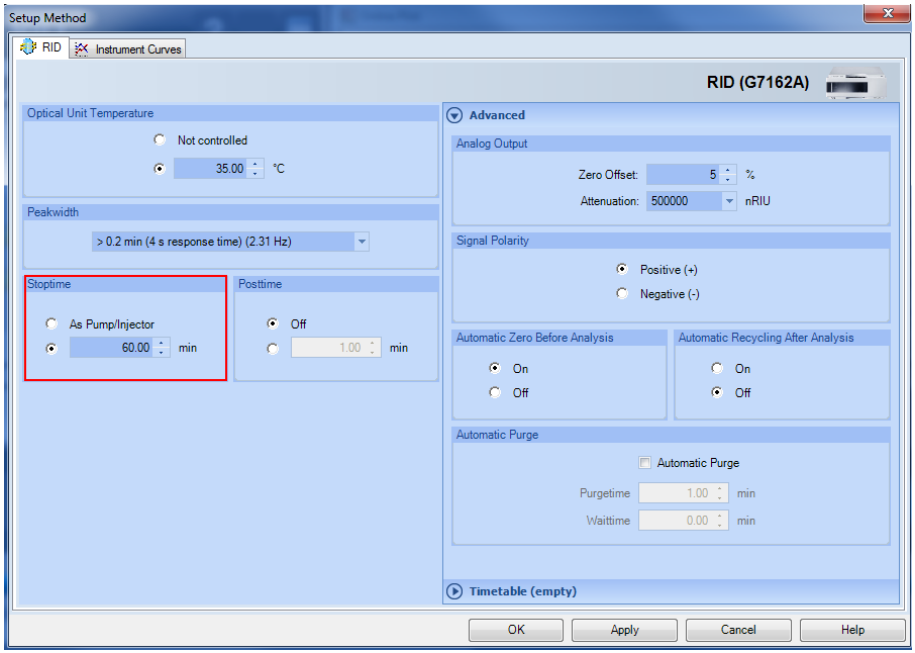
Using the Agilent OpenLab ChemStation

1 Load the Default LC Method (def_LC.M).

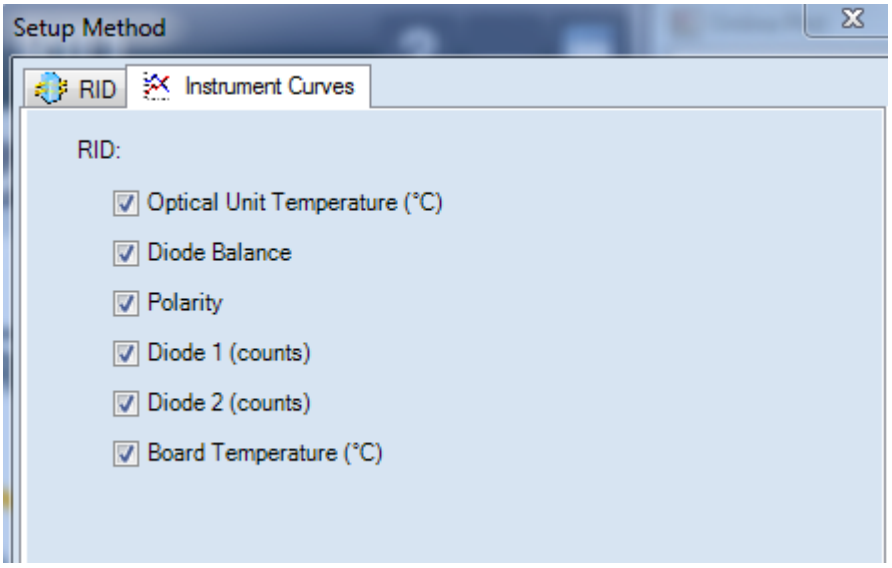
2 Select Instrument > Set up Instrument Method...



3 Under **RID** set a **Stoptime** of at least 60 min.

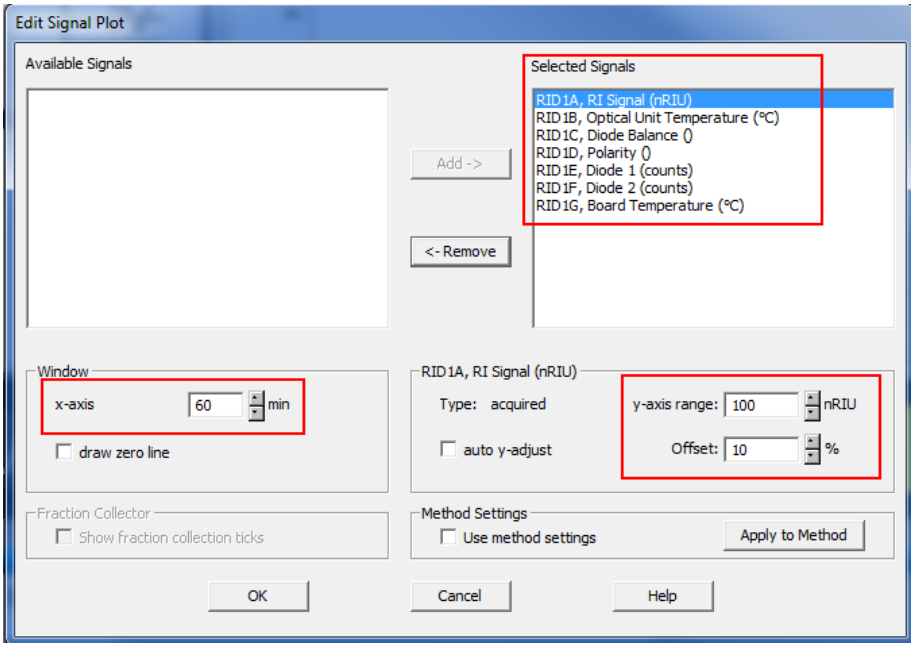


4 Under **Instrument Curves** you can select the available diagnostic signals. For baseline issue select the **Optical Unit Temperature**, **Diode Balance**, **Diode 1** and **Diode 2**.



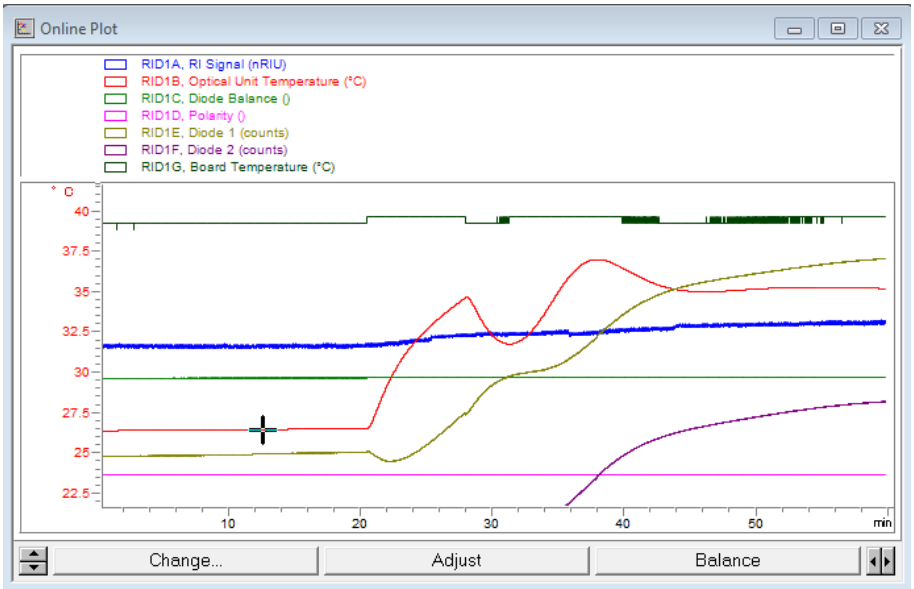
5 Click on **Apply** and **OK**.

6 In the **Edit Signal Plot** window add the signals shown below.



7 Set the initial y-range values according to your needs.

8 The Online Plot Window should look like this:



9 Save the method as “Test_baseline.M”.

10 Set up blank runs with 1 – 2 h duration. This will assure that long term effects become visible.

NOTE

Do not run shorter runs than 60 min. Typical effects from air condition systems run at cycles of 15 to 20 min.

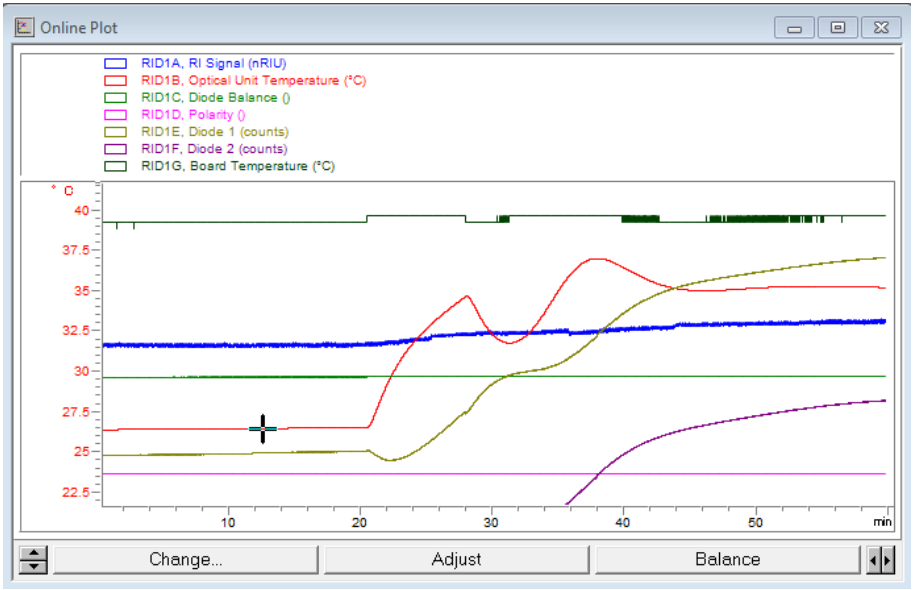
11 Start run when the baseline is stable.

Evaluation of the Diagnostic Signals

1 When the run has completed, open the Agilent OpenLab CDS Data Analysis.

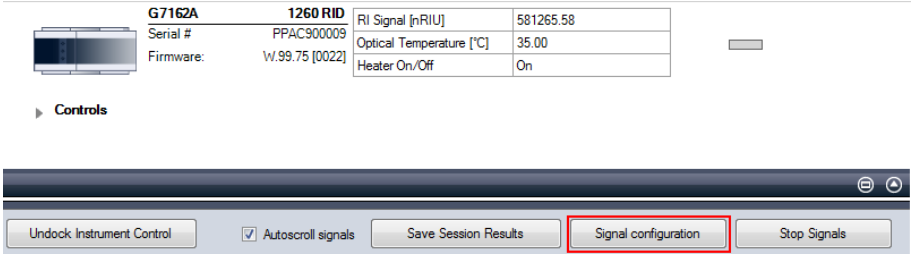
2 Load the data file.

3 Look for a correlation between the diagnostic signals and the normal RI signal.

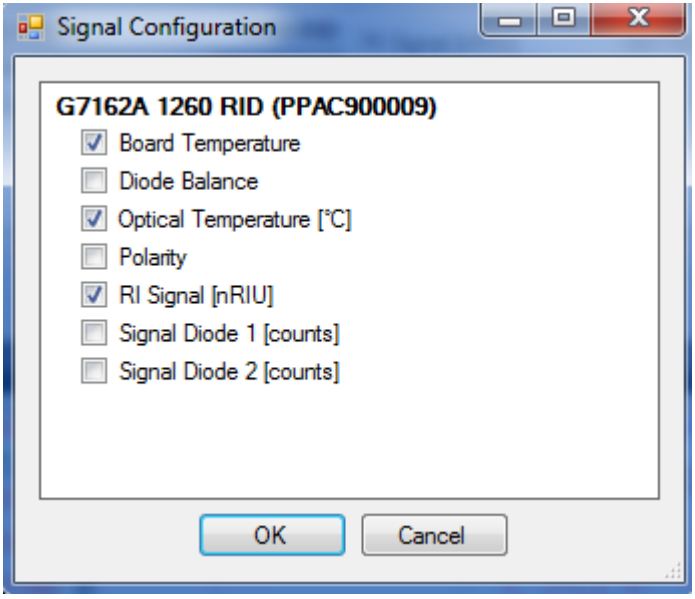


Using the Agilent Lab Advisor

1 Open the Instrument Control.



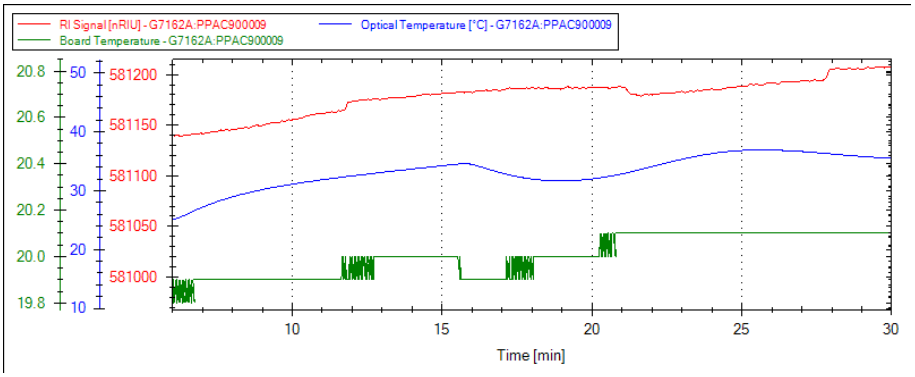
2 Open Signal Configuration and select the signals.



NOTE

If you select all signals from RID (or add signals from other modules), the maximal shown plot time may be limited to less than 60 minutes. This depends on the individual signal data rate. In the background the Lab Advisor splits the total run time into signal parts, see G7162_Using the Agilent Lab Advisor, step 5 on page 91. Select just the required signals (for example, RI signal, Optical, and Board Temperature) to have.

3 Open the signal window.



4 After appropriate run time (60 min) Save Session Results.

NOTE

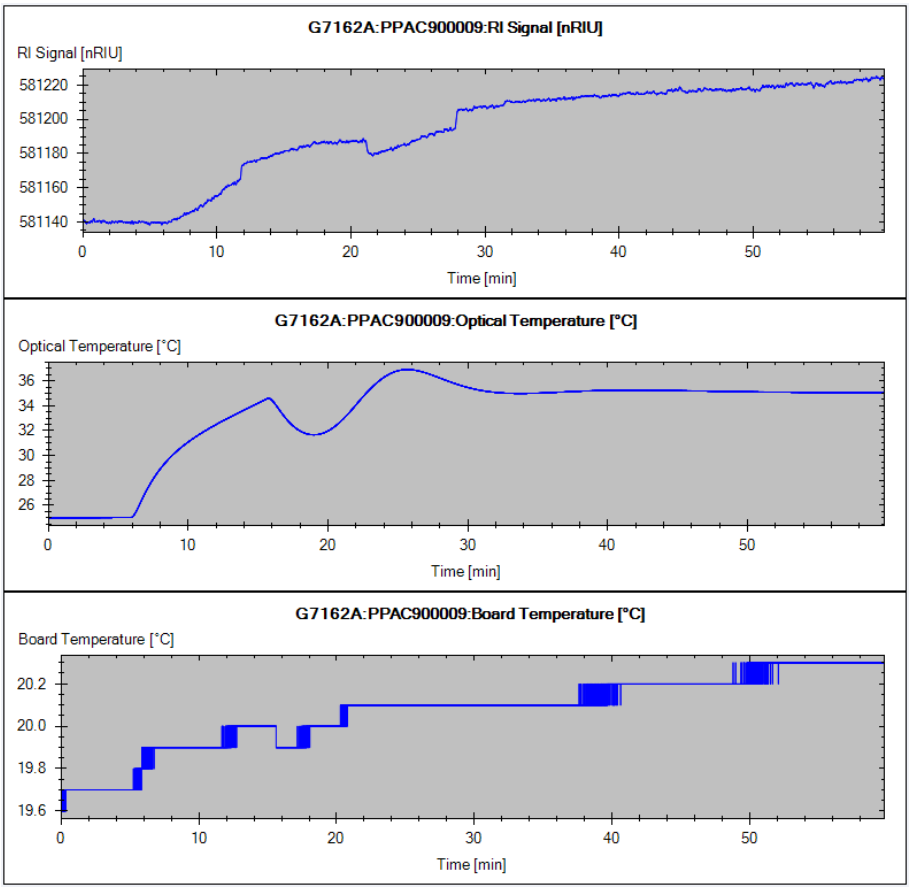
Do not stop the signals at this time, otherwise no signals are saved!

5 Open Logs and Results. The Session Results can be found under the module that hosts the communication to the Lab Advisor (in the example below it was the G7162A RID).

Result	Instrument Control - Done		9/8/2015 12:59:49 PM
Result	Instrument Control (Signal part) - Part 3		9/8/2015 12:47:47 PM
Result	Instrument Control (Signal part) - Part 2	splitted	9/8/2015 12:37:47 PM
Result	Instrument Control (Signal part) - Part 1	runs	9/8/2015 12:22:47 PM
Result	Instrument Control (Signal part) - Part 0		9/8/2015 12:07:47 PM
Result	Instrument Control - Done	single	9/8/2015 11:21:19 AM
Result	Instrument Control - Done	runs	9/3/2015 4:11:06 PM

The listed result window shows a split run (5 parts) and two single runs.

6 Open the Results and then select the Signals tab.



7 Evaluate the signals.

8 Use the Export Log function to save it into a ZIP file (for further evaluation).

Test Functions

This section describes the detector's built in test functions.

Introduction

All tests are described based on the Agilent Lab Advisor Software B.02.07 SP1 [147].

Table 9: Interfaces and available test functions

Interface	Comment	Available Function
Agilent Lab Advisor	For functions see Table 10 on page 93	Available functions depend on Product Level (Basic – Advanced – FSE)
Agilent ChemStation	No tests available Adding of temperature/lamp signals to chromatographic signals possible	Diagnostic Signals • Temperature optical unit • Diode 1 & 2 • Balance • Polarity
Agilent Instant Pilot G4208A	No tests available	• FW Update • EMF

Table 10: Function Overview Lab Advisor Basic/Advanced

Functions	Product Level	
Tests		
- ASTM Drift and Noise Test	Basic	Advanced
- D/A Converter Test	Basic	Advanced
Calibrations		
- RID Calibration	Basic	Advanced
Tools		
- Diagnostic Buffers	Basic	Advanced
- Module Info	Basic	Advanced
- Test Chromatogram	Basic	Advanced
- RID Tool Screen	Basic	Advanced
Controls		
- Advanced Method Parameters		
- Attenuation Analog Output		Advanced
- Analog Output 1 Offset [% Full Scale]		Advanced
- Polarity		Advanced

Functions	Product Level	
- Configuration		
- Remote Pulse Duration [s] *	Basic	Advanced
- Analog Output 1 Range		Advanced
- Control		
- Recycle	Basic	Advanced
- Heater On/Off	Basic	Advanced
- Method Parameters		
- Set Peakwidth		Advanced
- Set Optical temperature [°C]		Advanced
- Module Information		
- Identify Module	Basic	Advanced
- Purge + Prime		
- Start Purge		Advanced
- Set Purge Time [minutes]		Advanced
- Special Commands		
- Detector Reset	Basic	Advanced
- Clear Error	Basic	Advanced
Signals		
- RI Signal [nRIU]		Advanced
- Optical Temperature [°C]		Advanced
- Board Temperature [°C]		Advanced
- Signal Diode 1 [counts]		Advanced
- Signal Diode 2 [counts]		Advanced
- Diode Balance		Advanced
- Polarity		Advanced
EMF Counters		
- Time since last Purge	Basic	Advanced

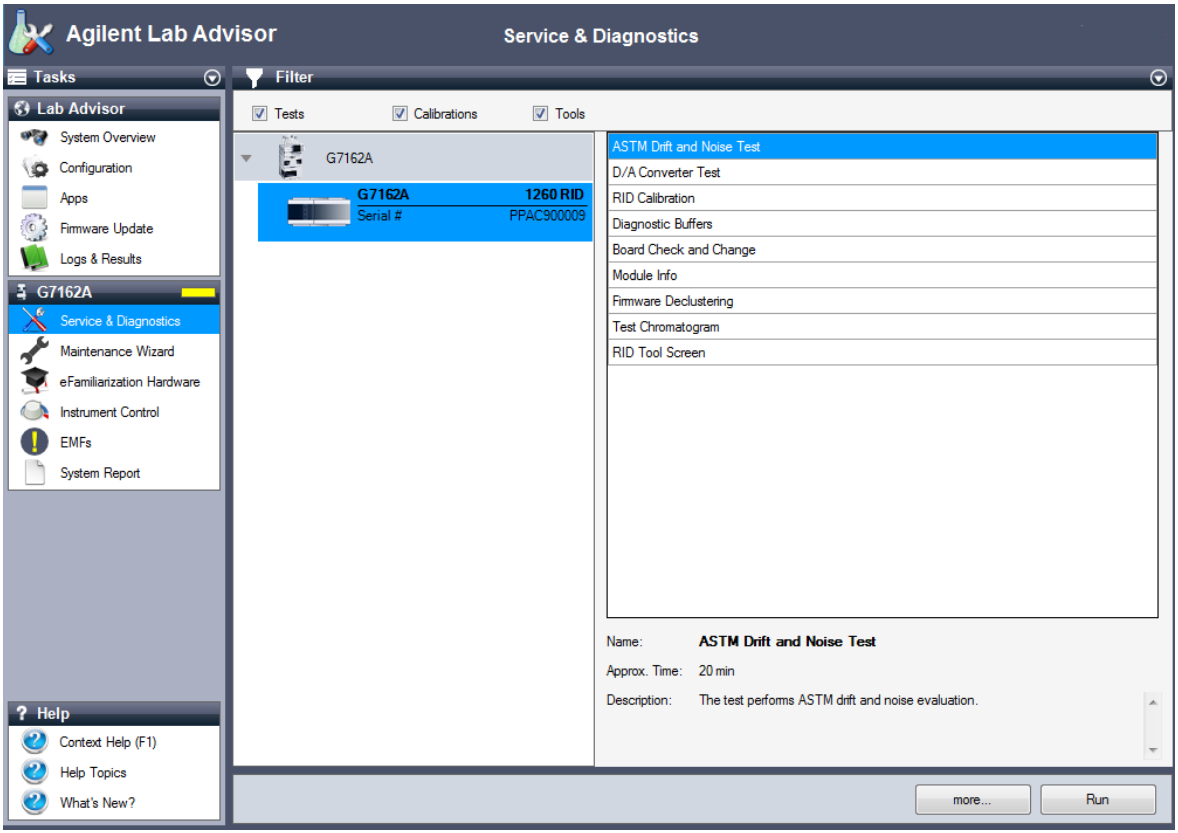


Figure 18: The Lab Advisor shows the available tests

Refractive Index Calibration

The refractive index calibration is based on a sucrose calibration solution, which has a known refractive index compared to LC grade water. After both the sample and reference cells have been purged with LC grade water the sucrose solution is introduced into the flow cell and then the built-in refractive index calibration functionality is used.

Filling the sample cell with the sucrose calibration solution will give a theoretical detector response of 512,000 nRIU +/- 5,000 nRIU. The calibration algorithm will allow the actual detector response, if different, to be changed to the theoretical value.

NOTE Refractive index calibration is only required after exchange of the optical unit or the main (RIM) - board.

Preparing the Calibration

When

- Recommended after exchange of the optical unit or RIM board.

Tools required

Qty.	p/n	Description
1		Laboratory balance

Parts required

Qty.	p/n	Description
1		DAB/Ph Eur/BP/JP/NF/USP Grade Sucrose
1	5190-1539	Syringe 5mL with Luer-Lock
1	9301-0407	Syringe, External Valve adapter, SST
1	5190-5111	Syringe filter, 0.45 µm, 100/pk
1	0100-1516	Finger-tight fitting PEEK, 2/pk

1 Preparation of the sucrose calibration solution (final concentration: 3.5 g/L).

   a To prepare 25 ml of the calibration solution 87.5 mg of the Sucrose sample is required.

   b Add the weighed amount of sample into a suitable volumetric flask.

   c Dispense 10 ml of LC grade water into the flask and shake or stir to dissolve.

   d Dilute the contents of the flask to volume with LC grade water.

   Wait five minutes and shake again. The solution is now ready for use.

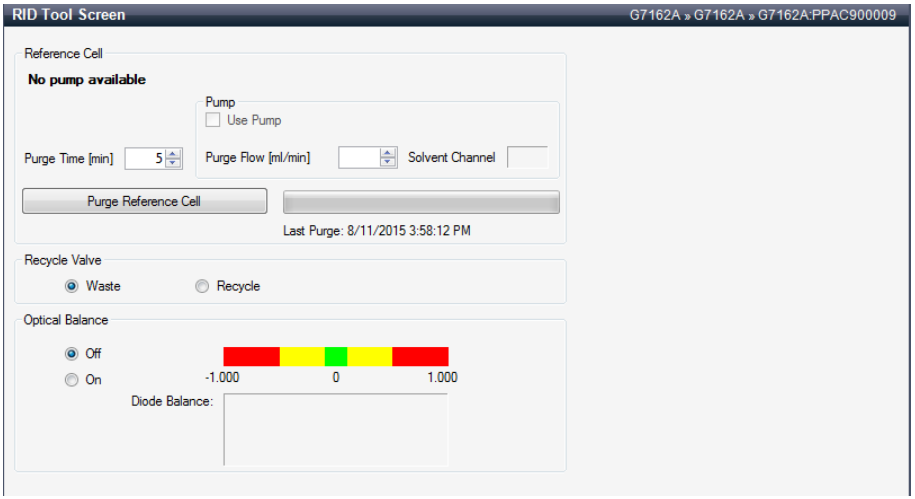
2 Preparing the pump.

   a Fill a suitable solvent bottle with LC grade water.

   b Connect this bottle to Channel A of the pump, A1 if a binary pump.

3 Flush the degasser and pump.

4 Run the RID Tools Screen with the Agilent Lab Advisor (for further information see Online-Help of user interface). (If an Agilent pump is part of the system, the pump section is active.)



5 Purging the sample and reference cells.

a The purge valve will automatically switch to the ON position.

b Using a syringe or LC pump flush the sample and reference cell with about 20 mL of LC grade water. (If an Agilent pump is part of the system, the pump section is active).

c The purge valve will automatically switch to the OFF position when you click continue.

6 Fill the sample cell with calibration solution.

a Take the syringe and fix the needle to the syringe adapter.

b Suck about 2 mL of the calibration sample into the syringe.

c Keep the syringe in a horizontal position.

d Remove the needle.

e Add the filter to the syringe and eject the calibration sample to waste (through the filter). This will ensure removing any particles from the filter.

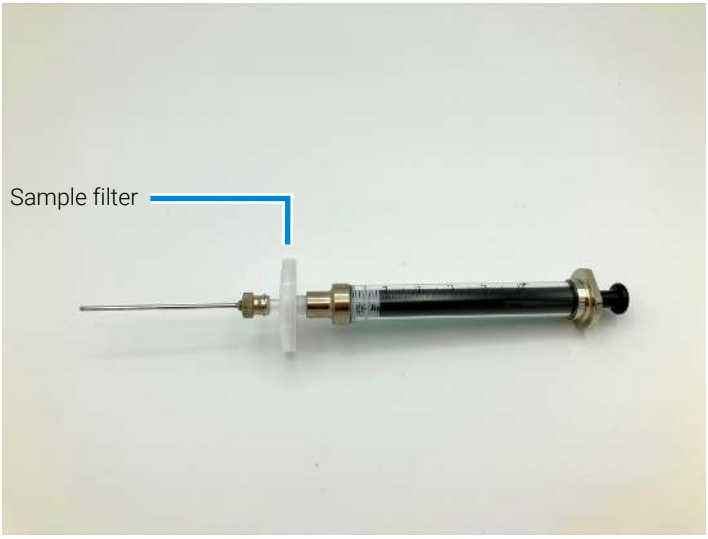


Figure 19: Syringe with Sample Filter

f Remove the filter.

g Take the syringe and fix the needle to the syringe.

h Suck about 4 mL of the calibration sample into the syringe.

i Keep the syringe in a horizontal position.

j Remove the needle.

k Add the filter to the syringe and fit the needle to the filter.

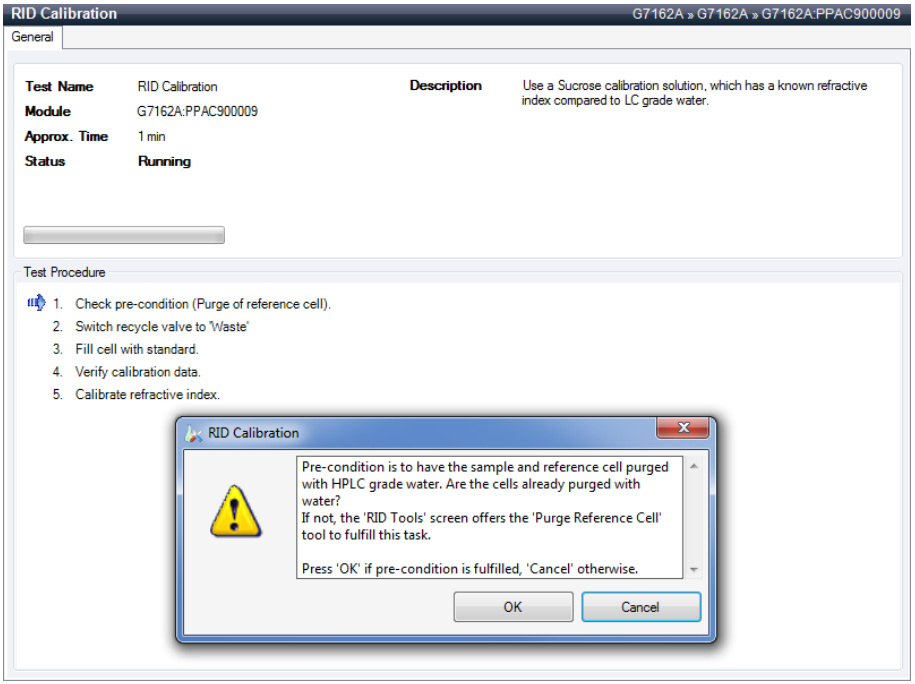
l Lift the needle tip and carefully eject approximately 0.5 mL to remove air out of the syringe.

NOTE Do not inject the calibration solution without the sample filter.

7 Leave the RID Tools Screen.

Performing the Calibration

1 Run the RID Calibration Screen with the Agilent Lab Advisor (for further information see Online-Help of user interface).



2 If the purge of the sample and reference side has been done, click **OK**.

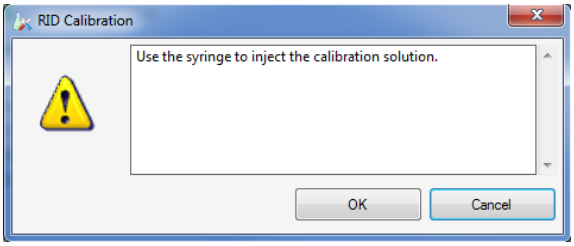
3 Remove the inlet capillary or flushing syringe from the in port.

4 Add the PEEK fitting to the needle tip and fix both at the flow cell inlet.

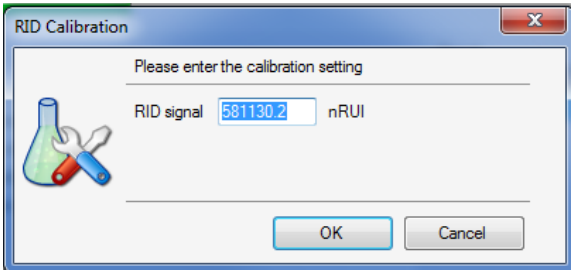
5 Inject the calibration sample: Slowly inject about 2.0 - 3.0 mL and wait for about 10 s to inject another 0.1 mL. This will assure that the cell is filled properly.

NOTE Do not inject the calibration solution without the sample filter.

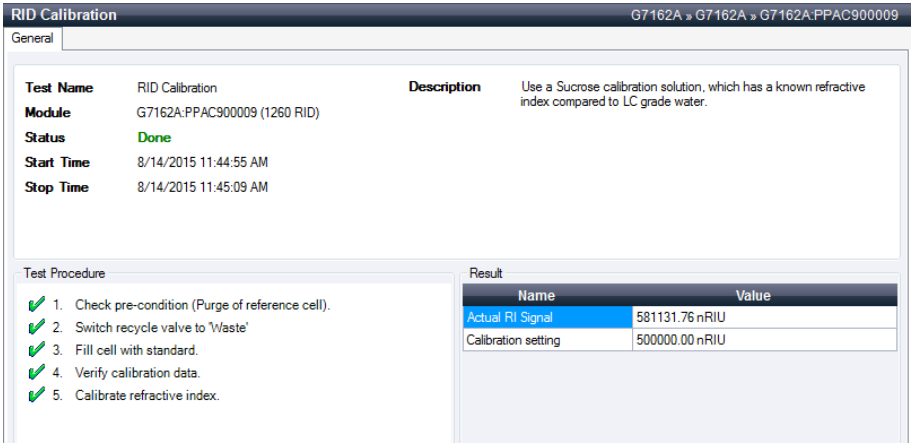
6 Click **OK**



7 If the detector response differs from the theoretical response of 512000 nRIU ± 5000 nRIU enter the theoretical value (512000) in the dialog box. If the detector response is within the theoretical response click **OK**.



8 The calibration was successful.



NOTE Rinse the sample cell with pure water at a minimum of 1.5 mL/min (the G7162B has a maximum flow limit of 1 ml/min of water!) to flush the sucrose from the cell and the capillaries. When organic solvent is sequentially applied (without rinsing), a blockage of capillaries may occur.

Optical Balance

When the sample and reference cells both contain the same liquids an equal amount of light should fall on each light receiving diode, the diode balance will equal 0. If this balance of light needs to be corrected the optical balance procedure can be used.

Diode balance is calculated as follows:

$$\text{diode balance} = \frac{(\text{diode}_1 - \text{diode}_2)}{(\text{diode}_1 + \text{diode}_2)}$$

Where:

- diode_1 = signal proportional to the amount of light falling on diode_1
- diode_2 = signal proportional to the amount of light falling on diode_2

Optical balance adjustment is a manual procedure where the position of the light beam falling on the light receiving diode is adjusted using the zero glass adjustment screw.

NOTE The detector will become not-ready when the diode balance value falls outside the range - 0.5 to + 0.5.

NOTE Both sample and reference cell must be purged with the same solvent before optical balance is performed. Prior to performing this procedure, the system must be well equilibrated.

The Optical Balance Procedure

When

- When light falling on light receiving diodes is out of balance.

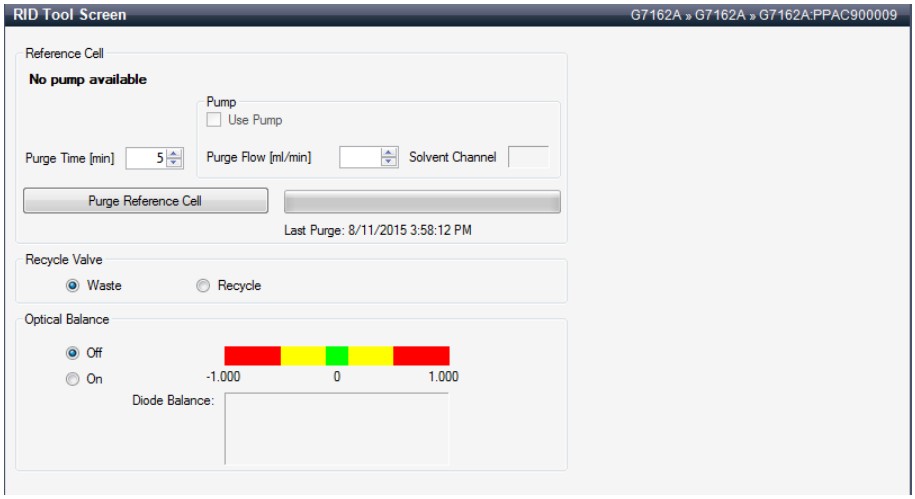
Tools required

Qty.	p/n	Description
1		Flat head screwdriver

NOTE

This procedure should only be performed to correct a permanent misalignment of the light beam that cannot be eliminated by flushing the sample and the reference cell with the same solvent and by equilibrating the system.

1 Run the RID Tools Screen with the Agilent Lab Advisor (for further information see Online-Help of user interface). (If an Agilent pump is part of the system, the pump section is active.)



2 Purging the sample and reference cells.

a Switch the purge valve to the **ON** position.

b Purge the sample and reference cells for around 10 min with the solvents to be used.

c Switch the purge valve to the **OFF** position

3 Select **Optical Balance**.

4 Adjust **Optical Balance**.

a While monitoring the optical balance use the flat-headed screwdriver to turn the zero glass adjustment screw slowly.

b When the diode balance value reaches 0.00 (green area), optical balance is restored.

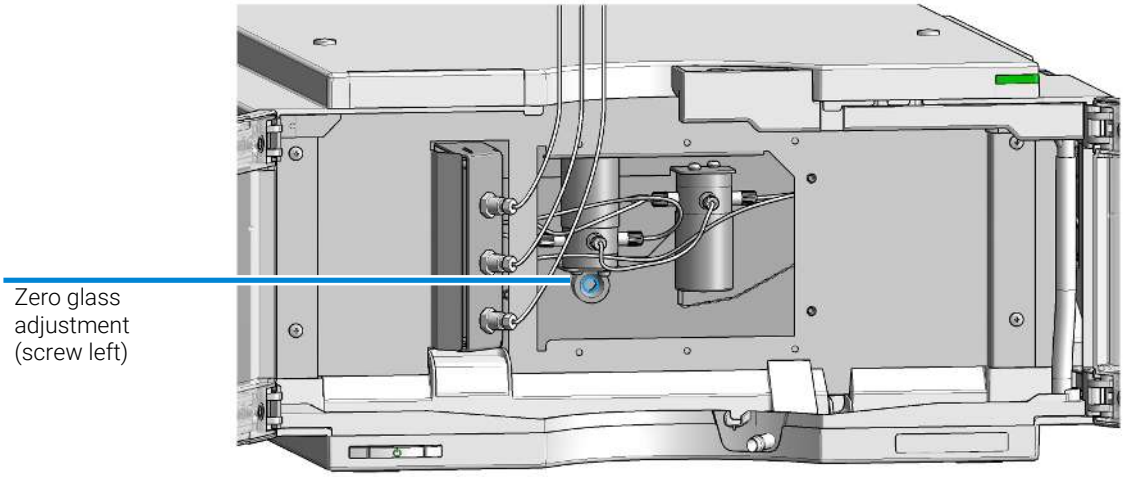


Figure 20: Turning the zero glass adjustment screw

Using the Built-In Test Chromatogram

This function is available from the Agilent ChemStation, Lab Advisor and Instant Pilot.

The built-in Test Chromatogram can be used to check the signal path from the detector to the data system and the data analysis or via the analog output to the integrator or data system. The chromatogram is continuously repeated until a stop is executed either by means of a stop time or manually.

NOTE

The peak height is always the same but the area and the retention time depend on the set peakwidth, see example below.

This procedure works for all Agilent 1200 Infinity detectors (DAD, MWD, VWD, FLD and RID). The example figure is from the RID detector.

Procedure using the Agilent Lab Advisor

1 Assure that the default LC method is loaded via the control software.

2 Start the Agilent Lab Advisor software (B.01.03 SP4 or later) and open the detector's **Tools** selection.

3 Open the test chromatogram screen

4 Turn the **Test Chromatogram** on.

5 Change to the detector's **Module Service Center** and add the detector signal to the Signal Plot window.

6 To start a test chromatogram enter in the command line: STRT

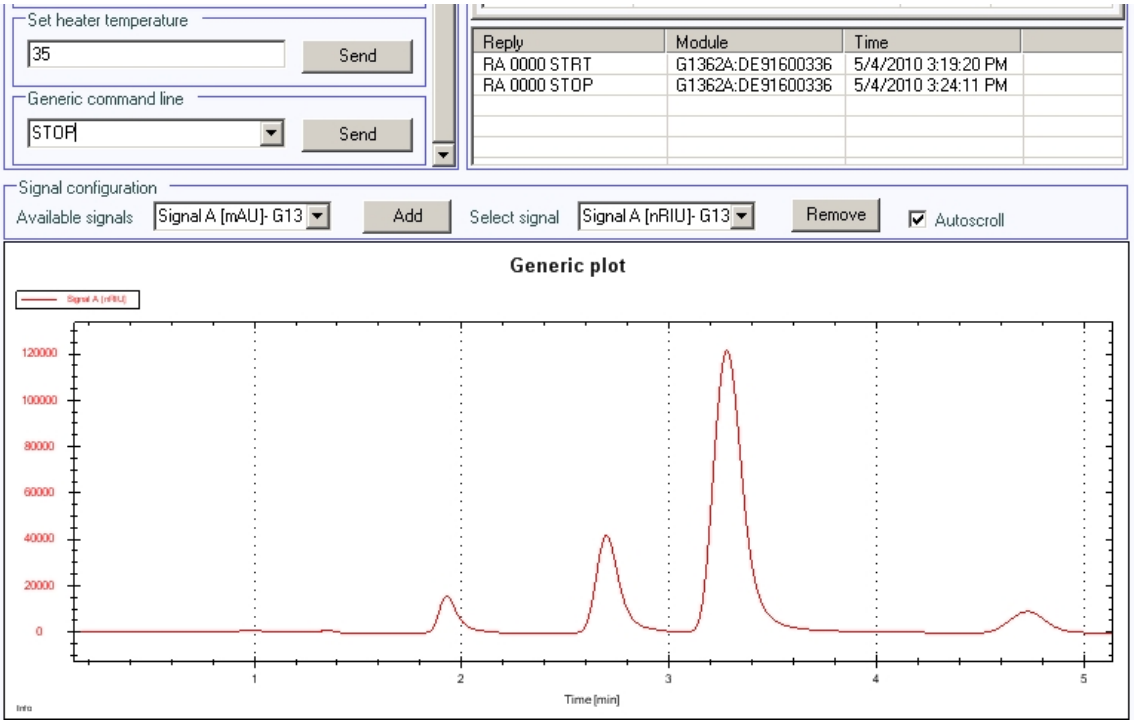


Figure 21: Test Chromatogram with Agilent Lab Advisor

7 To stop the test chromatogram enter in the command line: STOP

NOTE The test chromatogram is switched off automatically at the end of a run.

ASTM Drift and Noise Test

Setting the Test Conditions

When

- If you want to checkout the detector

Tools required

Qty.	p/n	Description
1		LC system with G7162A RID

Parts required

Qty.	p/n	Description
1	G1362-87301	Restriction capillary

1 Turn ON the detector.

You are now ready to change the settings of your detector.

2 Connect the restriction capillary directly between the column compartment heat exchanger outlet and the in port of the detector.

3 Set up the instrument with the following test conditions.

Table 11: Chromatographic Conditions

Mobile phases	LC grade water
Column	Restriction capillary 2.7 m x 1.7 mm i.d.
Flow rate	1.0 mL/min
Compressibility	46
Stroke	20 µL
Stop time	20 min
Column compartment temperature	35 °C
Optical unit temperature	35 °C
Polarity	Positive
Peak width (response time)	0.2 min (4 s, standard)

4 Set the RID setpoints.

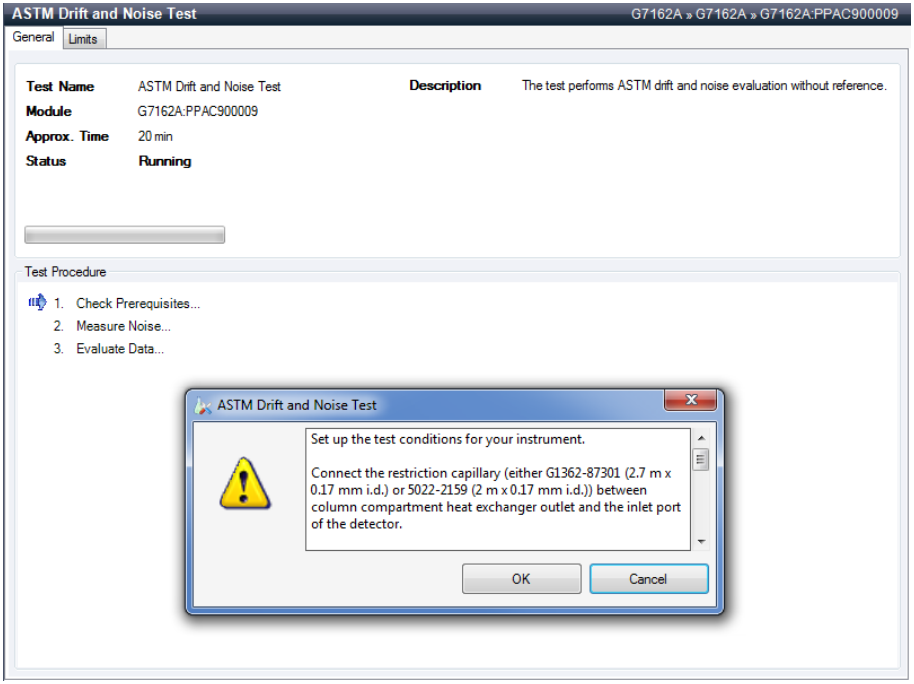
NOTE The optical unit temperature must be set at least 5 °C above ambient conditions. Therefore if ambient temperature is above 30 °C higher values for optical unit temperature and column compartment temperature must be set.

5 Turn the heater ON and purge the detector reference cell for 20 min.

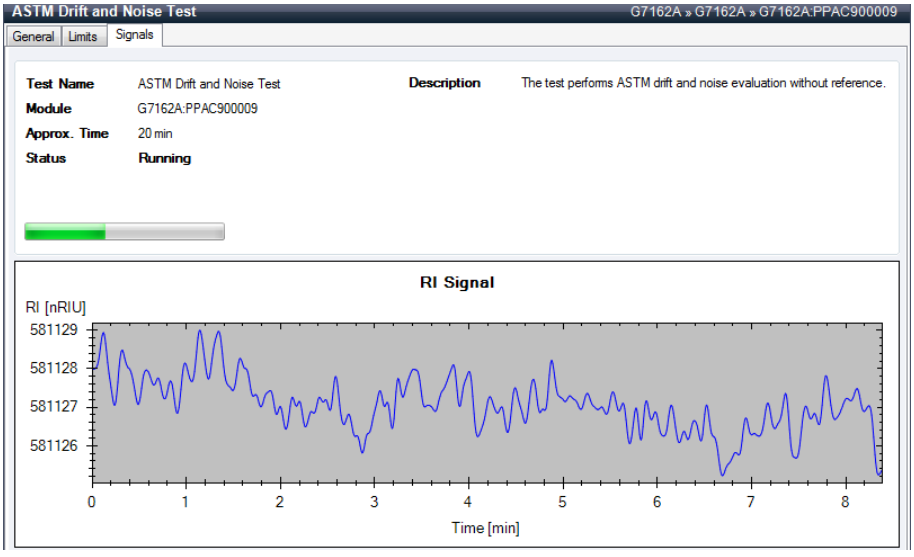
6 When purging has finished allow the baseline to stabilize.

NOTE For optimum performance a stabilization time of 2 hours minimum is recommend.

7 Run the ASTM Drift and Noise Test Screen with the Agilent Lab Advisor (for further information see Online-Help of user interface).

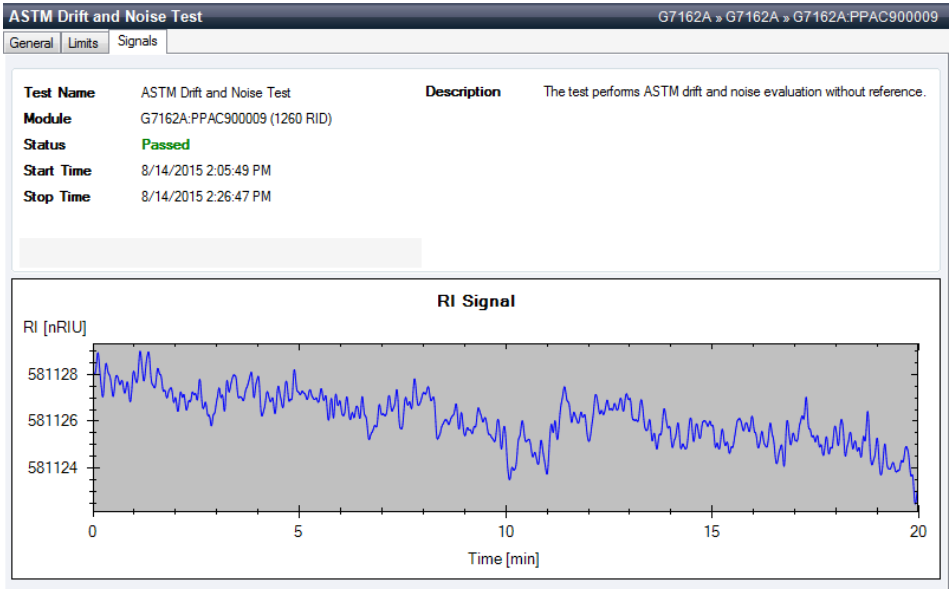


8 Click **OK**.



The measurement starts.

The test has completed and shows either PASSED of FAILED.



Evaluation

For the Instant Pilot *Rescale* the plot and measure the baseline noise and drift on the screen. If a printer is configured for the instrument the plot can be printed by pressing the **m** key and selecting **Print Plot**.

The following values are calculated automatically by the Agilent ChemStation.

- *Noise (ASTM):* The short term noise in nRIU based on ASTM method *E-1303-95 Practice for Refractive Index Detectors used in Liquid Chromatography* using 0.5 minute segments.
- *Wander:* The long term noise in nRIU based on ASTM method E-1303-95 *ractice for Refractive Index Detectors used in Liquid Chromatography* using 0.5 minute segments.
- *Drift:* The drift in nRIU/hour based on ASTM method E-1303-95 *Practice for Refractive Index Detectors used in Liquid Chromatography* measured over 20 minutes.

Factors that will affect the baseline stability include:

- Variations in the optics or eluent temperature
- Pressure fluctuations in the sample cell
- The quality of the water used
- Air bubbles in the flow cell

For diagnosing signal problems refer to chapter *Troubleshooting and Diagnostics* .

D/A Converter (DAC) Test

The detector provides analog output of chromatographic signals for use with integrators, chart recorders or data systems. The analog signal is converted from the digital format by the digital-analog-converter (DAC).

The DAC test is used to verify correct operation of the digital-analog-converter by applying a digital test signal to the DAC.

The DAC outputs an analog signal of approximately 50 mV (if the zero offset of the analog output is set to the default value of 5 %) which can be plotted on an integrator. A continuous square wave with an amplitude of 10 µV and a frequency of approximately 1 cycle/24 seconds is applied to the signal.

The amplitude of the square wave and the peak-to-peak noise are used to evaluate the DAC test.

When

- If the analog detector signal is noisy or missing.

Preparations

- Lamp must be on for at least 10 minutes. Connect integrator, chart recorder or data system to the detector analog output.

1 Run the D/A Converter (DAC) Test with the Agilent Lab Advisor (for further information see Online-Help of user interface).

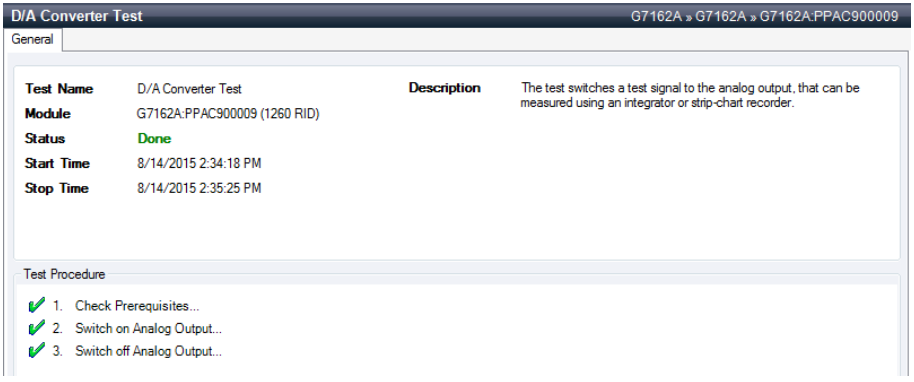


Figure 22: D/A Converter (DAC) Test- Results

D/A Converter Test failed

D/A Converter Test evaluation

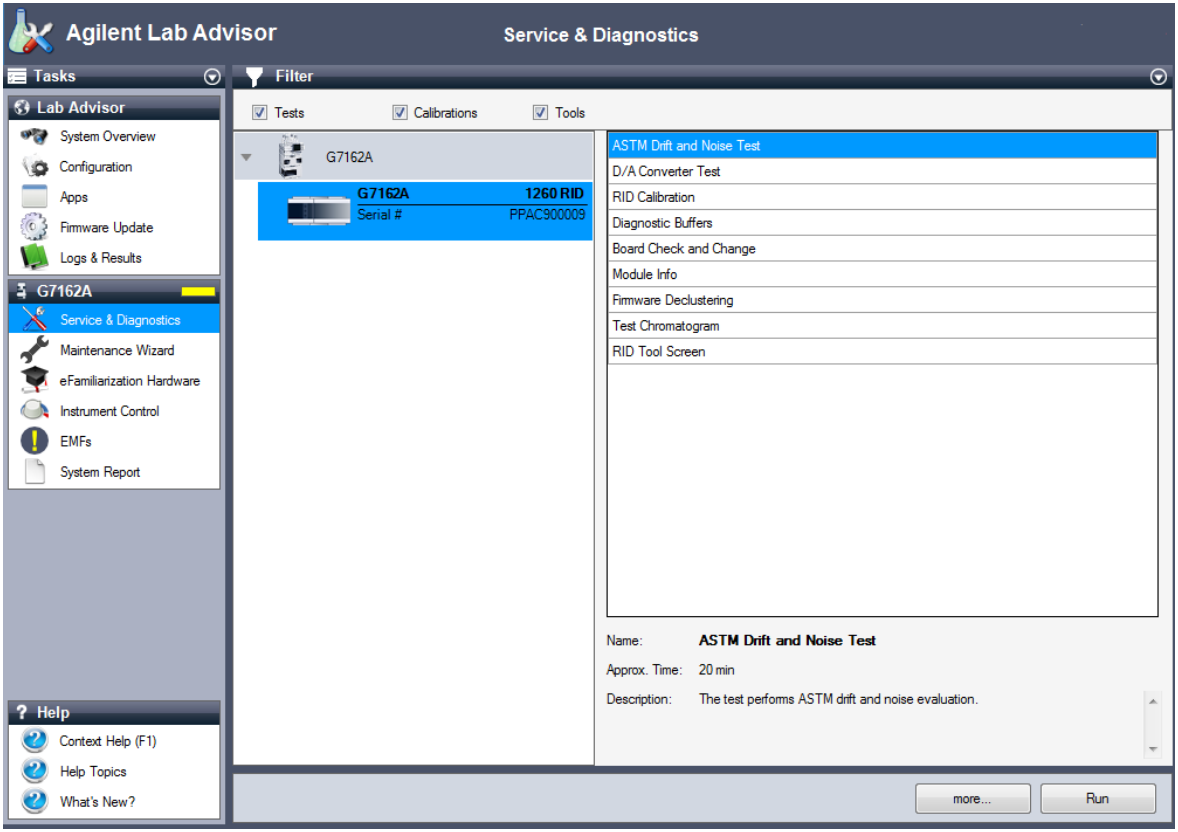
The noise on the step should be less than 3 µV.

Probable cause		Suggested actions
1	Bad cable or grounding problem between detector and external device.	• Check or replace the cable.
2	Defective detector main board.	• Please contact your Agilent service representative.

Available Tests vs User Interfaces

NOTE

Depending on the used interface, the available tests and the screens/reports may vary.
Preferred tool should be the Agilent Lab Advisor, see Agilent Lab Advisor Software on page 114.
Agilent Lab Advisor B.02.07 SP1 or later is required.
The Instant Pilot supports the G7162A/B with B.02.19 or later. It does not provide any test functions!



Agilent Lab Advisor Software

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

The Agilent Lab Advisor software is available in two versions:

- Lab Advisor Basic
- Lab Advisor Advanced

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

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

The optional Agilent Maintenance Wizard Add-on provides an easy-to-use, step-by-step multimedia guide for performing preventive maintenance on Agilent 1200 Infinity LC Series instrument.

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

Other Lab Advisor Functions

EMFs - Early Maintenance Feature

The EMFs screen allows you to view and manage the EMF counters for all modules in all systems.

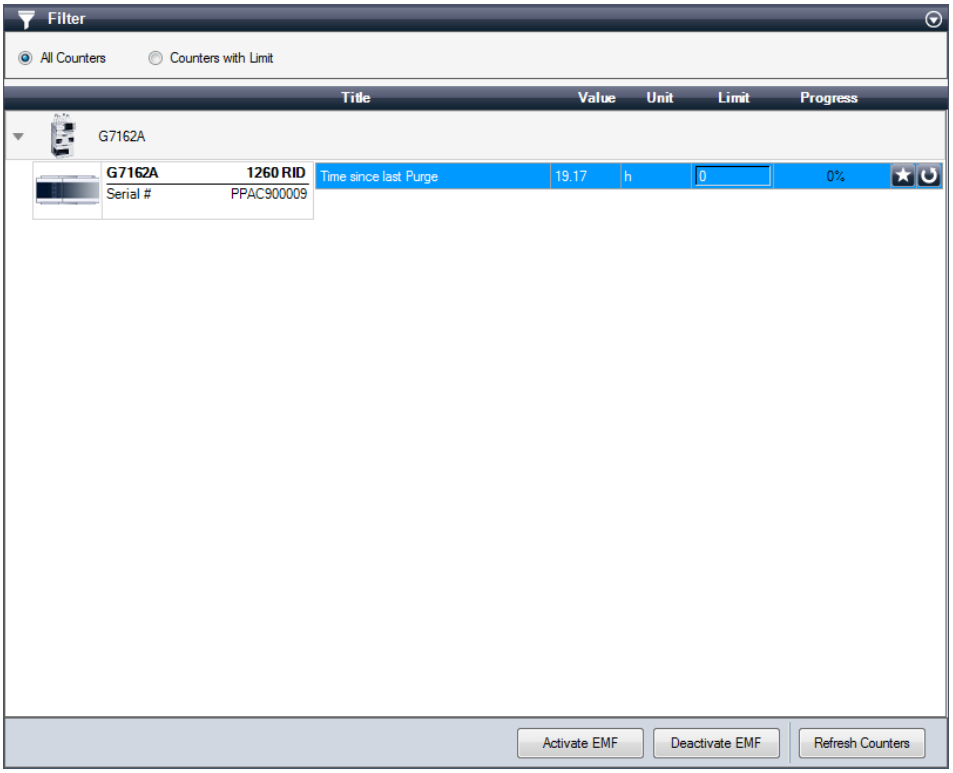


Figure 23: EMFs - Early Maintenance Feature

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.

What Are Error Messages

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

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

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

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

If using the InfinityLab Assist, instrument errors will generate a notification. To view the probable causes and recommended actions for this error, click on Help button displayed on the notification.

General Error Messages

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

Timeout

Error ID: 62

The timeout threshold was exceeded.

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

Shutdown

Error ID: 63

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

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

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

Remote Timeout

Error ID: 70

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

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

Lost CAN Partner

Error ID: 71

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

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

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

Leak

Error ID: 64

A leak was detected in the module.

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

Probable cause		Suggested actions
1	Loose fittings.	• Ensure all fittings are tight.
2	Broken capillary.	• Exchange defective capillaries.
3	Leaking valve.	• Exchange valve.
4	Leaking flow cell.	• Exchange flow cell components.

Leak Sensor Open

Error ID: 83

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

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

Probable cause		Suggested actions
1	Leak sensor not connected to the on/off switch board.	• Please contact your Agilent service representative.
2	Defective leak sensor.	• Please contact your Agilent service representative.
3	Leak sensor incorrectly routed, being pinched by a metal component.	• Please contact your Agilent service representative.
4	On/Off switch assembly defective.	• Please contact your Agilent service representative.

Leak Sensor Short

Error ID: 82

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

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

Probable cause		Suggested actions
1	Defective leak sensor.	• Please contact your Agilent service representative.
2	Leak sensor incorrectly routed, being pinched by a metal component.	• Please contact your Agilent service representative.
3	On/Off switch assembly defective.	• Please contact your Agilent service representative.
4	Cable or contact problem.	• Please contact your Agilent service representative.

Compensation Sensor Open

Error ID: 81

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

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

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

Compensation Sensor Short

Error ID: 80

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

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

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

Fan Failed

Error ID: 68

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

Probable cause		Suggested actions
1	Fan cable disconnected.	• Please contact your Agilent service representative.
2	Defective fan.	• Please contact your Agilent service representative.
3	Defective mainboard.	• Please contact your Agilent service representative.

Open Cover

Error ID: 205

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		Suggested actions
1	The top foam was removed during operation.	• Please contact your Agilent service representative.
2	Foam not activating the sensor.	• Please contact your Agilent service representative.
3	Defective sensor or main board.	• Please contact your Agilent service representative.

Cover Violation

Error ID: 7461

The top foam has been removed.

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

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

ERI Messages

Error ID: 11120, 11121

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

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

Refractive Index Detector Error Messages

These errors are detector-specific.

Thermal Fuse Open

Error ID: 2680

The thermal fuse of the optical unit heater has failed.

Probable cause		Suggested actions
1	Heater cable disconnected.	• Ensure the heater cable is connected correctly. • Please contact your Agilent service representative.
2	Defective mainboard.	• Please contact your Agilent service representative.
3	Defective thermal fuse.	• Please contact your Agilent service representative.

Heater Resistance Too High

Error ID: 2681

The resistance of the heater foil is above the set limit.

Probable cause		Suggested actions
1	Heater cable disconnected.	• Ensure the heater cable is connected correctly. • Please contact your Agilent service representative.
2	Defective mainboard.	• Please contact your Agilent service representative.
3	Defective heater.	• Please contact your Agilent service representative.

Heater Fuse

Error ID: 2682

The electronic fuse of the heater has been activated.

Probable cause		Suggested actions
1	Short in heater circuit.	• Power cycle the module.
2	Defective mainboard.	• Please contact your Agilent service representative.
3	Defective heater.	• Please contact your Agilent service representative.

Wrong Temperature Profile

Error ID: 2683

After turning ON the optical unit heat control, the temperature does not increase at a sufficiently fast rate to reach the set point.

Probable cause		Suggested actions
1	Defective mainboard.	• Please contact your Agilent service representative.
2	Defective heater.	• Please contact your Agilent service representative.

Undecipherable Temperature Signal

Error ID: 2684

Probable cause		Suggested actions
1	Heater cable disconnected.	• Ensure the heater cable is connected correctly. • Please contact your Agilent service representative.
2	Defective mainboard.	• Please contact your Agilent service representative.
3	Defective heater.	• Please contact your Agilent service representative.

Maximum Temperature Exceeded

Error ID: 2685

The maximum heater temperature has been exceeded.

Probable cause		Suggested actions
1	Defective mainboard.	• Please contact your Agilent service representative.
2	Defective heater.	• Please contact your Agilent service representative.

Purge Valve Fuse Blown

Error ID: 2686

The electronic fuse on the purge valve has been activated.

Probable cause		Suggested actions
1	Short in purge valve circuit.	• Power cycle the module.
2	Defective purge valve.	• Please contact your Agilent service representative.
3	Defective mainboard.	• Please contact your Agilent service representative.

Recycle Valve Fuse Blown

Error ID: 2687

The electronic fuse on the recycle valve has been activated.

Probable cause		Suggested actions
1	Short in recycle valve circuit.	• Power cycle the module.
2	Defective recycle valve.	• Replace recycle valve. • Please contact your Agilent service representative.
3	Defective mainboard.	• Please contact your Agilent service representative.

Purge Valve Not Connected

Error ID: 2688

When activated no response was received from the purge valve.

Probable cause		Suggested actions
1	Purge valve disconnected.	• Connect purge valve. • Please contact your Agilent service representative.
2	Defective purge valve.	• Please contact your Agilent service representative.
3	Defective mainboard.	• Please contact your Agilent service representative.

Recycle Valve Not Connected

Error ID: 2689

When activated no response was received from the recycle valve.

Probable cause		Suggested actions
1	Recycle valve disconnected.	• Connect recycle Valve. • Please contact your Agilent service representative.
2	Defective recycle valve.	• Replace recycle valve. • Please contact your Agilent service representative.
3	Defective mainboard.	• Please contact your Agilent service representative.

Lamp Voltage Too Low

Error ID: 2693

Probable cause		Suggested actions
1	Defective mainboard.	• Please contact your Agilent service representative.
2	Defective lamp or optics.	• Exchange the lamp.

Lamp Voltage Too High

Error ID: 2690

Probable cause		Suggested actions
1	Contaminated flow cell.	• Flush flow cell
2	Defective mainboard.	• Please contact your Agilent service representative.
3	Defective lamp or optics.	• Exchange the lamp.

Lamp Current too High

Error ID: 2691

Probable cause		Suggested actions
1	Defective mainboard.	• Please contact your Agilent service representative.
2	Defective lamp or optics.	• Exchange the lamp.

Lamp Current too Low

Error ID: 2694

Probable cause		Suggested actions
1	Optical unit cable disconnected.	• Connect optical unit cable. • Please contact your Agilent service representative.
2	Defective mainboard.	• Please contact your Agilent service representative.
3	Defective lamp or optics.	• Exchange the lamp.

Not-Ready Messages

Not-ready messages are displayed during the wait for a specific condition to be reached or completed or while a self-test procedure is running. In the event of such a failure, the yellow status indicator at the front of the detector is switched ON.

This section describes the meaning of detector not-ready messages.

Purge Time Running

Error ID: 2600

Event ID 2600

Probable cause		Suggested actions
1	The purge valve is open, liquid is flowing through both sample and reference cell.	• Allow the reference purge time to elapse.

Wait Function Timed Out

Error ID: 2692

Wait for temperature or wait for defined signal has not been fulfilled within the specified time frame.

Probable cause		Suggested actions
1	Time too short.	• Increase time.
2	The detector is waiting after the automatic purge of the reference cell.	• Allow the wait time to elapse.

Unbalanced Diodes

Probable cause		Suggested actions
1	The diode balance value is outside the pre-set range -0.5 to +0.5 , an unequal amount of light is falling on the two light receiving diodes.	• Flush the reference cell with the mobile phase being used. • Perform the RID Optical Balance procedure (see The Optical Balance Procedure on page 103).

Not Enough Light

Probable cause		Suggested actions
1	There is insufficient light falling on the light receiving diodes to generate a refractive index signal.	• Flush the flow cell with the mobile phase being used to ensure that it is free of air bubbles or other contamination.

Too Much Light

The amount of light falling on the light receiving diodes is too high to generate a refractive index signal.

Probable cause		Suggested actions
1	The sample cell content is varying too much from the reference cell.	• Purge reference and sample cell.

8 Maintenance

It is necessary to perform periodic inspection of the instrument to ensure its safe use. It is possible to have these periodic inspections performed by Agilent service representatives on a contractual basis. For information regarding the maintenance inspection contract, contact your Agilent representative.

Safety Information Related to Maintenance

WARNING Fire and damage to the module

Wrong fuses

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

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 Electrical shock

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

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

WARNING 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.

Introduction to Maintenance

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

NOTE There are no serviceable parts inside.
Do not open the module.

Overview of Maintenance

On the following pages maintenance procedures are described that can be carried out without opening the main cover.

Table 12: Maintenance Procedures

Procedure	Typical Frequency	Notes
Flow cell flushing	If flow cell is contaminated.	
Leak sensor drying	If leak has occurred.	Check for leaks.
Leak handling System replacement	If broken or corroded.	Check for leaks.
Replacing the detector's Firmware	If not up to date or corrupted.	

Cleaning the Module

To keep the module case clean, use a soft cloth slightly dampened with water, or a solution of water and mild detergent. Avoid using organic solvents for cleaning purposes. They can cause damage to plastic parts.

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

- **Do not use an excessively damp cloth during cleaning.**
- **Drain all solvent lines before opening any connections in the flow path.**

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

Storage of the Detector

NOTE

In case the detector is not used for some time (stored), then fill the flow cell (sample and reference side) with isopropanol.

Remove and Install Doors

When

- The instrument doors or the hinges are broken.

Tools required

Qty.	p/n	Description
1	5023-3138	Reversible Screwdriver + Blade 1,0 x 5,5

Parts required (Infinity III)

Qty.	p/n	Description
	5004-3180	Door Kit Infinity III 180mm Latched

Parts required (Infinity II)

Qty.	p/n	Description
	5004-0180	Door Kit Infinity II 180mm Latched

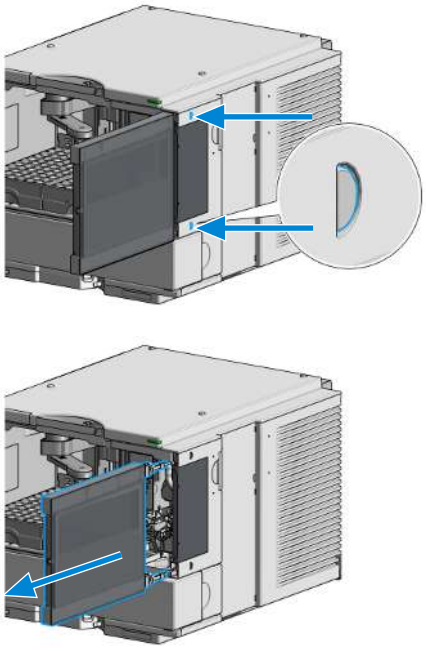
Preparations

- Finish any pending acquisition job.

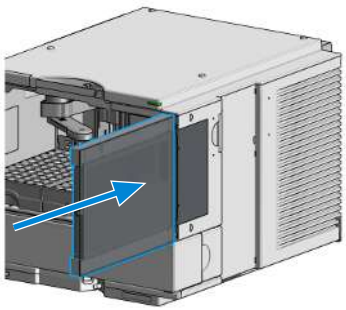
NOTE

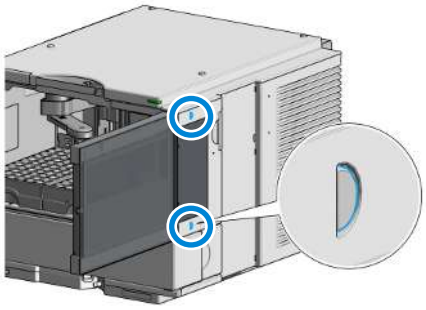
The figures shown in this procedure exemplarily show the Infinity III Vialsampler module. The principle of how to remove and/or install doors works in the same way for all Infinity III modules.

1 Press the release buttons and pull the front door out.



2 For the Installation of the front door, insert the hinges into their guides and push the door in until the release buttons click into their final position.





Flush the Flow Cell

When

- If flow cell is contaminated

Tools required

Qty.	p/n	Description
1		Glass syringe
1		Adapter

Parts required

Qty.	p/n	Description
1		Strong solvent
1		Tubings to waste

WARNING **Dangerous solvents**

The strong solvents used in this procedure are toxic and flammable and proper precautions are necessary.

- **Wear protective gloves and goggles.**
- **Don't expose yourself to the vapors.**

NOTE Aqueous solvents can build up algae and therefore should do not be left in the flow cell for long periods. Add a small percentage of organic solvents (e.g. acetonitrile or methanol ~ 5 %).

NOTE The strong solvent should dissolve any potential contaminants in the flow cell. For example water for aqueous mobile phase buffers, chloroform or tetrahydrofuran for not water soluble contaminants.

NOTE Do not exceed the flow cell pressure limit of 5 bar (0.5 MPa).

In case the cell is contaminated, follow the procedure below.

1. Use the purge mode and flush with the strong solvent.
2. Leave this solution in the cell for about one hour.
3. Flush with mobile phase.

Correct Leaks

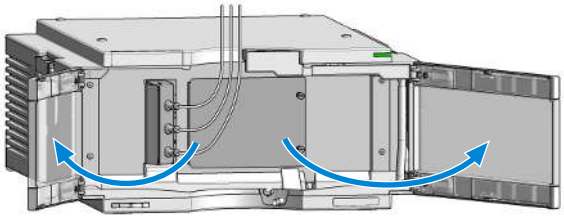
When

- If a leakage has occurred in the valve area or at the capillary connections

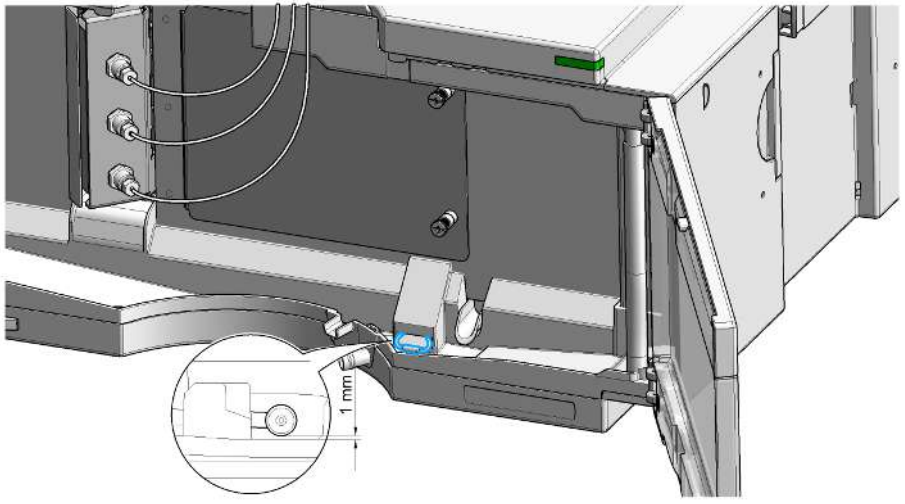
Tools required

Qty.	p/n	Description
1		Tissue
2		Wrench, 1/4 inch

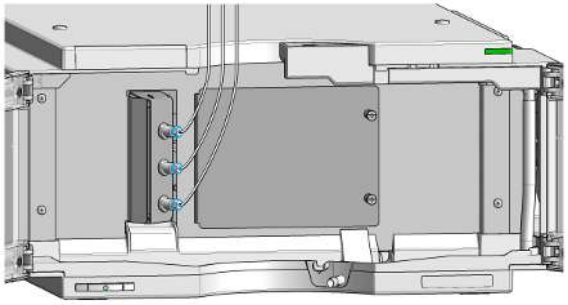
1 Open the doors.



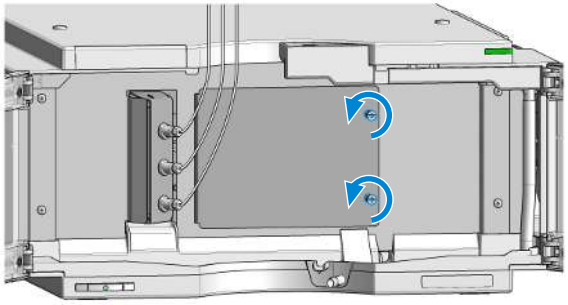
2 Observe the leak sensor area for leaks and correct, if required.



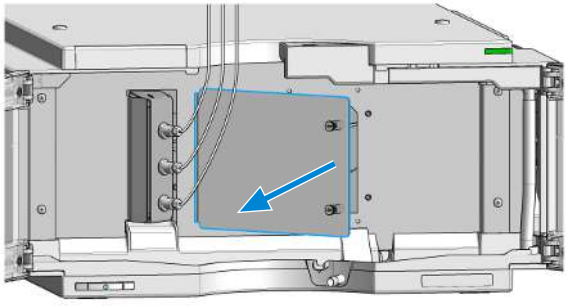
3 Observe the interface ports for leaks and correct, if required.



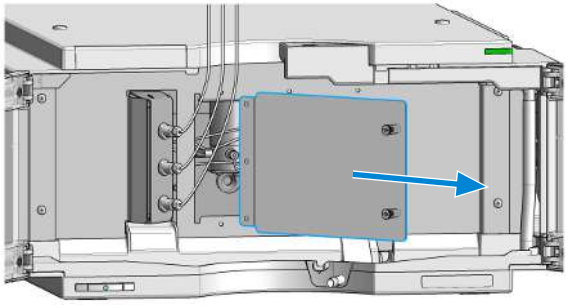
4 Unscrew the screws of the Service Door.



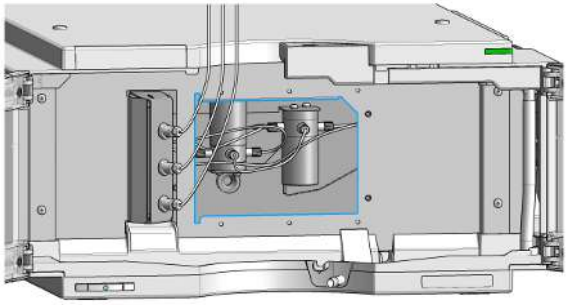
5 Open the Service Door.



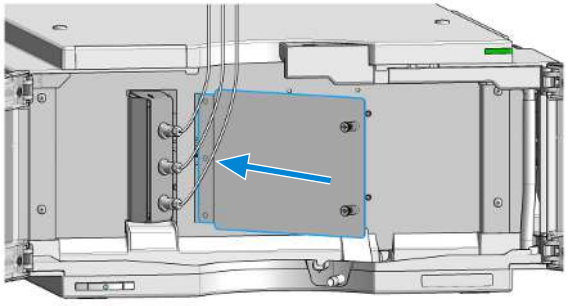
6 Remove the Service Door.



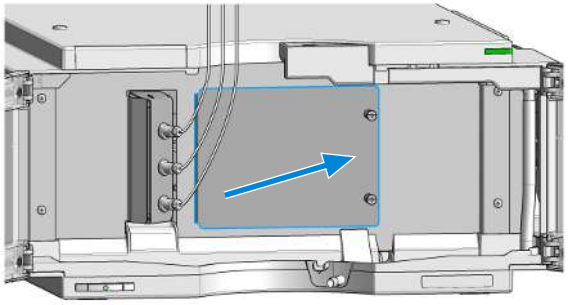
7 Observe the valve area for leaks and correct, if required.



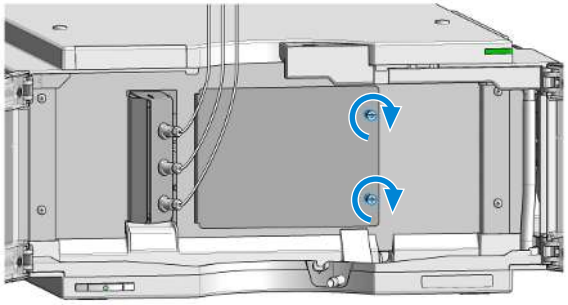
8 Install the Service Door.



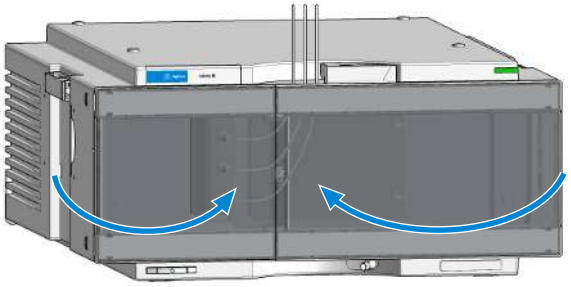
9 Close the Service Door.



10 Fasten the screws of the Service Door.



11 Close the doors.

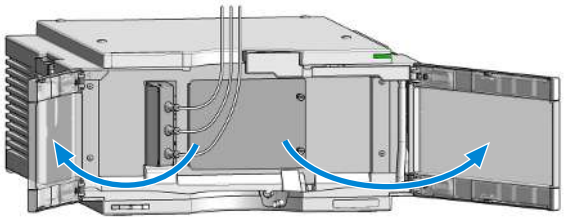


Replace Leak Handling System Parts

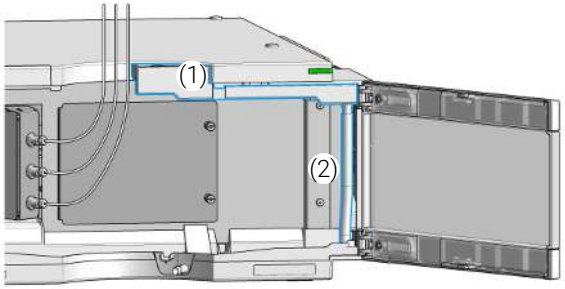
Parts required

Qty.	p/n	Description
1	5043-0856	Leak Adapter
1	5063-6527	Tubing, Silicon Rubber, 1.2 m, ID/OD 6 mm/ 9 mm approximately 85 mm required

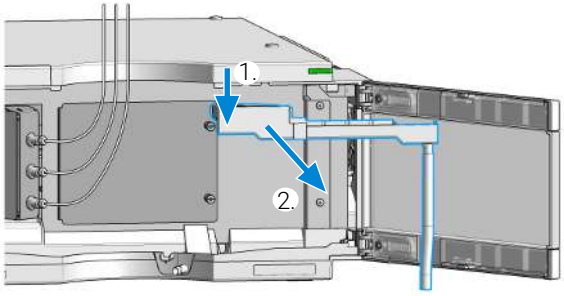
1 Open the doors.



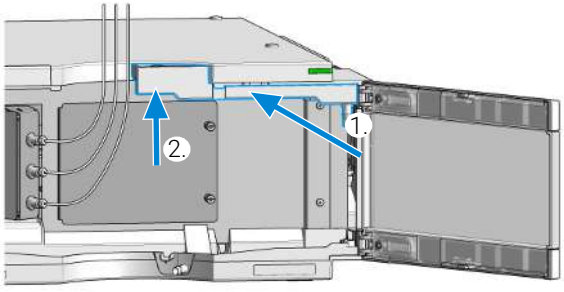
2 Locate the Leak Adapter (1) and Tubing (2).



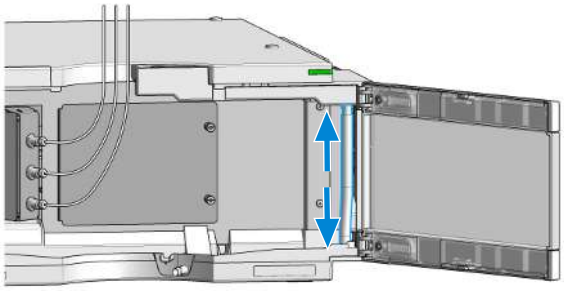
3 Press the Leak Adapter down and remove it together with the tubing.



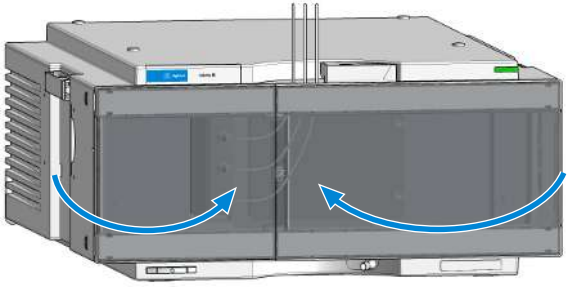
4 Install the Leak Adapter by pressing it into the Main Cover.



5 Insert the Tubing (approximately 115 mm required for replacement) between Leak Adapter outlet and Leak Panel.



6 Close the doors.



Replace the Module Firmware

When

Install a newer firmware

- It fixes known problems of older versions, or
- It introduces new features, or
- It ensures keeping all systems at the same (validated) revision

When

Install an older firmware

- It ensures keeping all systems at the same (validated) revision, or
- It ensures compatibility after adding a new module to the system, or
- A third-party control software requires a special version

Software required

- Agilent Lab Advisor software

Parts required

Qty.	p/n	Description
1		Firmware, tools and documentation from Agilent web site

Preparations

- Read update documentation provided with the Firmware Update Tool.

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

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

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

Module Specific Information

Table 13: Module specific information (G7162A/G7162B)

	G7162A/B
Initial firmware	D.06.76
Compatibility with 1100 / 1200 series modules	When using the G7162A/B in a system, all other modules must have firmware from set 6.50 or above (main and resident). Otherwise the communication will not work.
Conversion to / emulation	Not available

9 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

Overview of Maintenance Parts

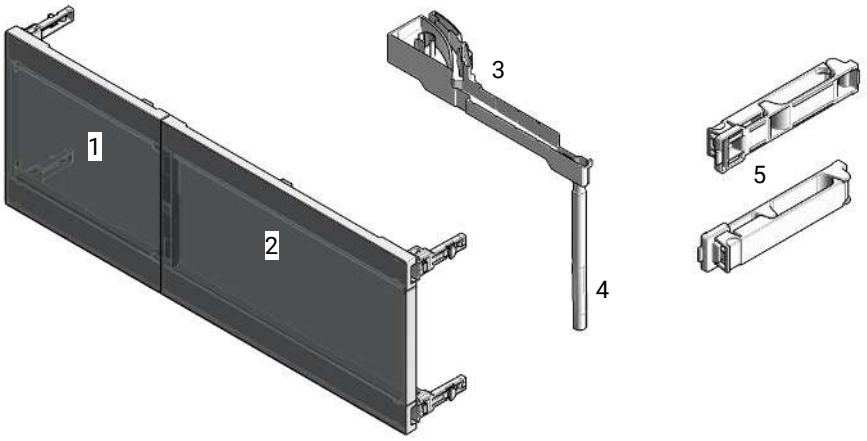


Figure 24: Maintenance Parts

#	Qty.	p/n	Description
1	1	5360-0017	Door 180mm left
2	1	5360-0018	Door 180mm right
3	1	5043-0856	Leak Adapter
4	1	5063-6527	Tubing, Silicon Rubber, 1.2 m, ID/OD 6 mm/9 mm for Waste and Leak Adapter (ca. 85 mm required)
5	1	5043-1013	Tubing Clip IF-II
	1	G1362-68706	Interface tubing kit
	1	G1362-87300	Interfacing capillary
	1	G1362-87301	Restriction capillary
	1	G7162-87300	Waste Tube Kit (recycle/waste)

For cables, see Cable Overview on page 179.

Accessory Kit

Accessory Kit for the 1260 Infinity III Refractive Index Detector

G7162-68755 (Accessory kit) contains some accessories needed for the installation of the G7162A RID.

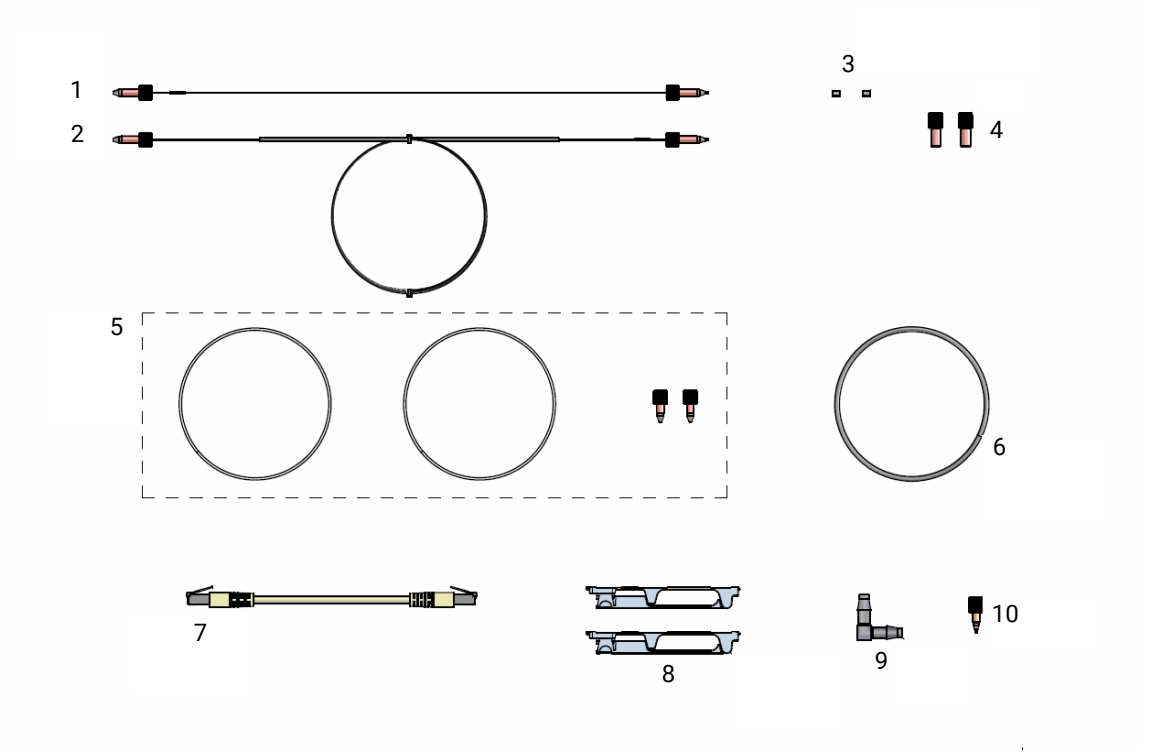


Figure 25: Accessory Kit

#	Qty.	p/n	Description
1	1	G1362-87300	Interfacing capillary
2	1	G1362-87301	Restriction capillary

Accessory Kit

#	Qty.	p/n	Description
3	2	0100-1700	FERRULE-AY-18IN
4	2	0100-1708	Nut 1/8 PPS
5	1	G7162-87300	Waste Tube Kit (recycle/waste) includes: Fitting, PK (2x), Tubing 2 m (2x)
	1	5042-6449	Flex-Tube OD 1.6 mm
	1	0100-1516	Finger-tight fitting PEEK, 2/pk
6	1	0890-1760	Tubing Flexible, 2 m
7	1	5181-1519	CAN cable, Agilent module to module, 1 m
8	2	5043-1013	Tubing Clip IF-II
9	1	5500-1155	Tube Connector, 90 degree, ID 6.4
10	1	0100-1847	PEEK adapter 1/4-28 to 10-32

Accessory Kit for the 1290 Infinity III Refractive Index Detector

G7162-68765 (Accessory kit) contains some accessories needed for the installation of the G7162B RID.

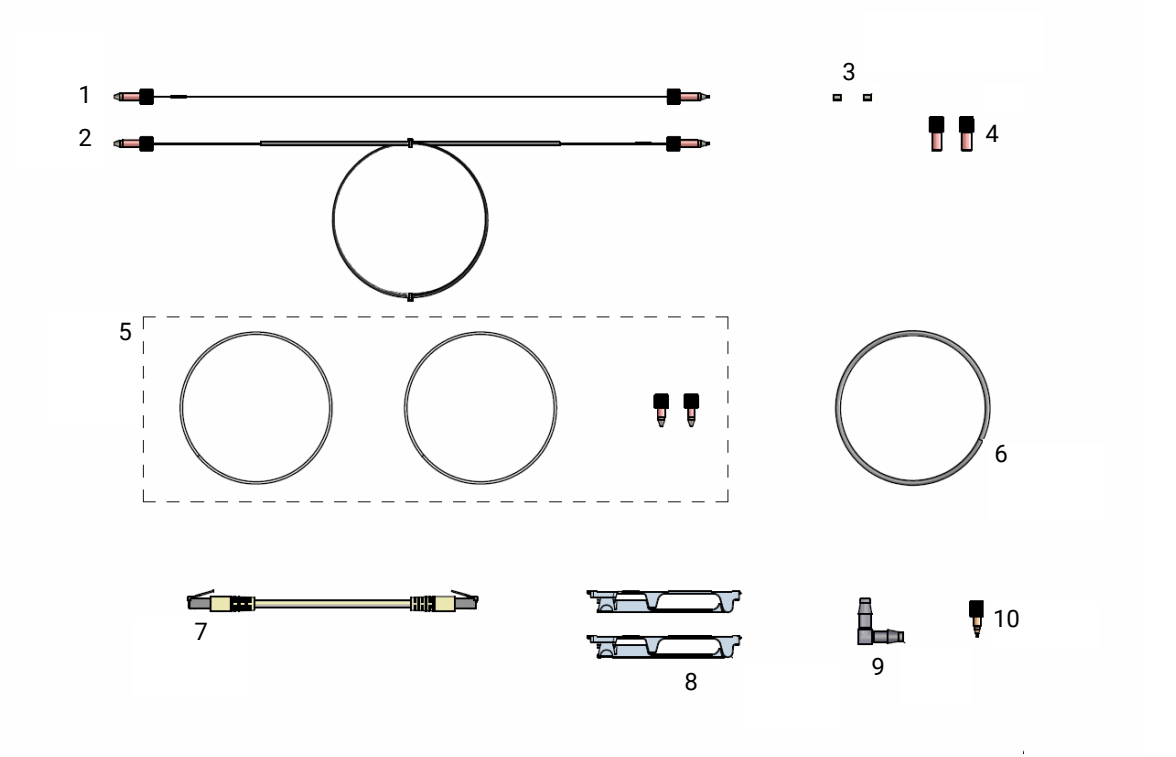
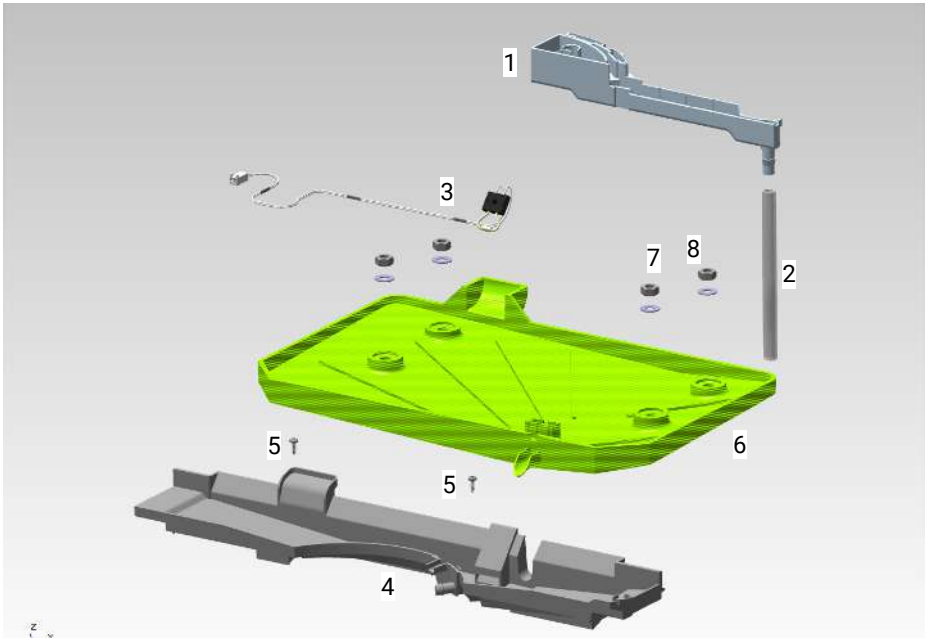


Figure 26: Accessory Kit

#	Qty.	p/n	Description
1	1	5067-4784	Capillary ST 0.075 mm x 220 mm (Sampler to TCC/MCT)
1	1	5067-4783	Capillary ST 0.075 mm x 340 mm (Column to RID)
2	1	G1362-87301	Restriction capillary
3	2	0100-1700	FERRULE-AY-18IN
4	2	0100-1708	Nut 1/8 PPS

#	Qty.	p/n	Description
5	1	G7162-87300	Waste Tube Kit (recycle/waste) includes: Fitting, PK (2x), Tubing 2 m (2x)
	1	5042-6449	Flex-Tube OD 1.6 mm
	1	0100-1516	Finger-tight fitting PEEK, 2/pk
6	1	0890-1760	Tubing Flexible, 2 m
7	1	5181-1519	CAN cable, Agilent module to module, 1 m
8	2	5043-1013	Tubing Clip IF-II
9	1	5500-1155	Tube Connector, 90 degree, ID 6.4
10	1	0100-1847	PEEK adapter 1/4-28 to 10-32

Leak Handling Parts



#	Qty.	p/n	Description
1	1	5043-0856	Leak Adapter
2	1	5063-6527	Tubing, Silicon Rubber, 1.2 m, ID/OD 6 mm/9 mm
3	1	5061-3356	Leak Sensor Assembly
4	1	G7162-44111	Leak Plane
5	1	0515-2529	Screw Tapping PAN-HD-TORX T10 3x8 ST-ZN
	1	5043-1013	Tubing Clip IF-II (not shown)
6	1	G1362-44110	Leak Pan
7	1	0535-0030	Nut M 14
8	1	3050-0900	Washer

10 Identifying Cables

This chapter provides information on cables used with the modules.

Cable Overview

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

Analog cables

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

Remote cables

p/n	Description
5188-8029	ERI to general purpose
5188-8044	Remote Cable ERI – ERI
5188-8045	Remote Cable APG – ERI
5188-8059	ERI-Extension-Cable 1.2 m
5061-3378	Remote Cable to 35900 A/D converter
01046-60201	Agilent module to general purpose
5188-8057	Fraction Collection ERI remote Y-cable

CAN cables

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

LAN cables

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

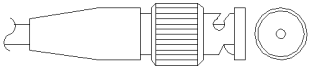
RS-232 cables

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

USB cables

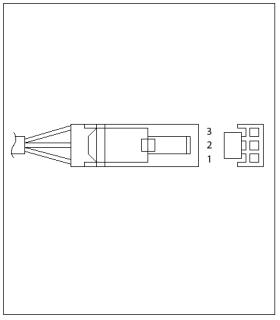
p/n	Description
5188-8050	USB A M-USB Mini B 3 m (PC-Module)
5188-8049	USB A F-USB Mini B M OTG (Module to Flash Drive)

Analog Cables

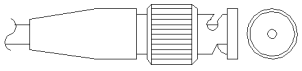


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

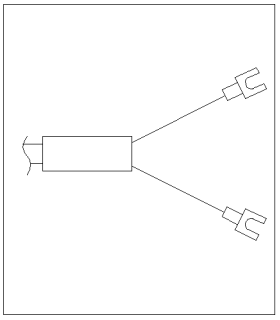
Agilent Module to 35900 A/D converters

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

Agilent Module to BNC Connector

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

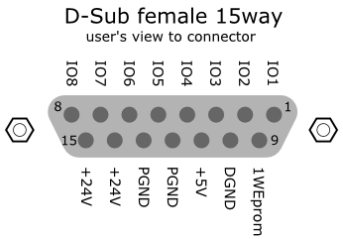
Agilent Module to General Purpose

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

Remote Cables

ERI (Enhanced Remote Interface)

- 5188-8029 ERI to general purpose (D-Sub 15 pin male - open end)
- 5188-8044 ERI to ERI (D_Sub 15 pin male - male)
- 5188-8059 ERI-Extension-Cable 1.2 m (D-Sub15 pin male / female)



p/n 5188-8029	pin	Color code	Enhanced Remote	Classic Remote	Active (TTL)
	1	white	IO1	START REQUEST	Low
	2	brown	IO2	STOP	Low
	3	green	IO3	READY	High
	4	yellow	IO4	PEAK DETECT	Low
	5	grey	IO5	POWER ON	High
	6	pink	IO6	SHUT DOWN	Low
	7	blue	IO7	START	Low
	8	red	IO8	PREPARE	Low
	9	black	1wire DATA		
	10	violet	DGND		
	11	grey-pink	+5V ERI out		
	12	red-blue	PGND		
	13	white-green	PGND		
	14	brown-green	+24V ERI out		
	15	white-yellow	+24V ERI out		
	NC	yellow-brown			

NOTE Configuration is different with old firmware revisions.
The configuration for IO4 and IO5 is swapped for modules with firmware lower than D.07.10.

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

- 5188-8045 ERI to APG (Connector D_Subminiature 15 pin (ERI), Connector D_Subminiature 9 pin (APG))

p/n 5188-8045	Pin (ERI)	Signal	Pin (APG)	Active (TTL)
	10	GND	1	
	1	Start Request	9	Low
	2	Stop	8	Low
	3	Ready	7	High
	5	Power on	6	High
	4	Future	5	
	6	Shut Down	4	Low
	7	Start	3	Low
	8	Prepare	2	Low
	Ground	Cable Shielding	NC	

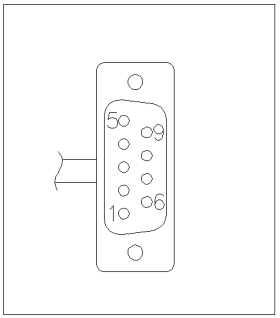
- 5188-8057 ERI to APG and RJ45 (Connector D_Subminiature 15 pin (ERI), Connector D_Subminiature 9 pin (APG), Connector plug Cat5e (RJ45))

Table 14: 5188-8057 ERI to APG and RJ45

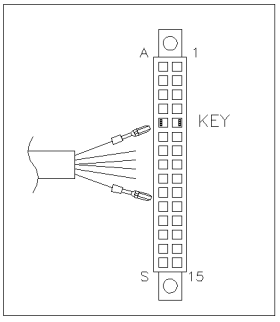
p/n 5188-8057	Pin (ERI)	Signal	Pin (APG)	Active (TTL)	Pin (RJ45)
					
	10	GND	1		5
	1	Start Request	9	High	
	2	Stop	8	High	
	3	Ready	7	High	
	4	Fraction Trigger	5	High	4
	5	Power on	6	High	
	6	Shut Down	4	High	
	7	Start	3	High	
	8	Prepare	2	High	
	Ground	Cable Shielding	NC		

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

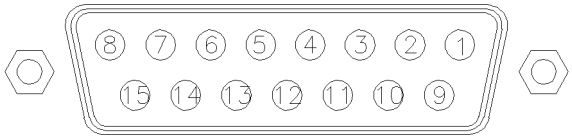
Agilent Module to Agilent 35900 A/D Converters

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

Agilent Module to General Purpose

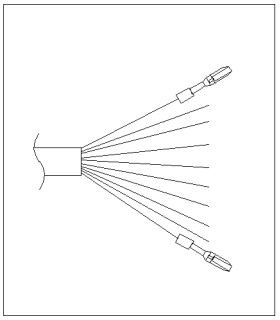
p/n 01046-60201	Wire Color	Pin Agilent module	Signal Name	Active (TTL)
	White	1	Digital ground	
	Brown	2	Prepare run	Low
	Gray	3	Start	Low
	Blue	4	Shut down	Low
	Pink	5	Not connected	
	Yellow	6	Power on	High
	Red	7	Ready	High
	Green	8	Stop	Low
	Black	9	Start request	Low

BCD Cables

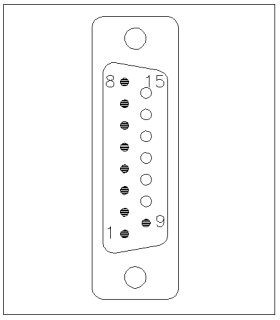


One end of these cables provides a 15-pin BCD connector to be connected to the Agilent modules. The other end depends on the instrument to be connected to

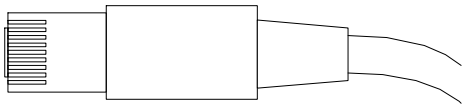
Agilent Module to General Purpose

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

Agilent Module to 3396 Integrators

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

CAN/LAN Cables



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

Can Cables

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

LAN Cables

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

RS-232 Cables

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

USB

To connect a USB Flash Drive use a USB OTG cable with Mini-B plug and A socket.

p/n	Description
5188-8050	USB A M-USB Mini B 3 m (PC-Module)
5188-8049	USB A F-USB Mini B M OTG (Module to Flash Drive)

11 Hardware Information

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

General Hardware Information

This section provides detailed hardware information on firmware that is valid for this module.

Firmware Description

The firmware of the instrument consists of two independent sections:

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

Resident System

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

- the complete communication capabilities (CAN, LAN, USB and RS- 232)
- memory management
- ability to update the firmware of the 'main system'

Main System

Its properties are:

- the complete communication capabilities (CAN, LAN, USB and RS- 232)
- memory management
- ability to update the firmware of the 'resident system'

In addition the main system comprises the instrument functions that are divided into common functions like

- run synchronization through APG/ERI remote,
- error handling,
- diagnostic functions,

- or module specific functions like
  - internal events such as lamp control, filter movements,
  - raw data collection and conversion to absorbance.

Firmware Updates

Firmware updates can be done with the Agilent Lab Advisor software with files on the hard disk (latest version should be used).

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

The file naming conventions are:

PPPP_RVVV_XXX.dlb, where

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

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

NOTE Update of main system can be done in the resident system only. Update of the resident system can be done in the main system only.
Main and resident firmware must be from the same set.

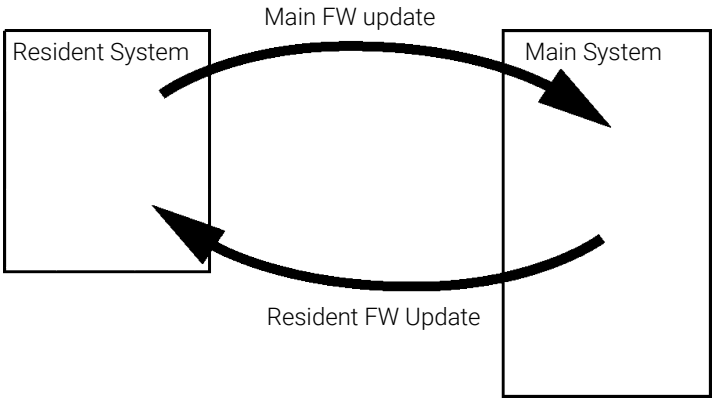


Figure 27: Firmware update mechanism

NOTE

Some modules are limited in downgrading due to their mainboard version or their initial firmware revision. For example, a G1315C DAD SL cannot be downgraded below firmware revision B.01.02 or to a A.xx.xx.
Some modules can be re-branded (e.g. G1314C to G1314B) to allow operation in specific control software environments. In this case, the feature set of the target type is used and the feature set of the original one is lost. After re-branding (e.g. from G1314B to G1314C), the original feature set is available again.
All this specific information is described in the documentation provided with the firmware update tools.

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

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

Electrical Connections

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

WARNING **Electric shock due to insufficient insulation of connected instruments**

Personal injury or damage to the instrument

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

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

Rear View of the Module

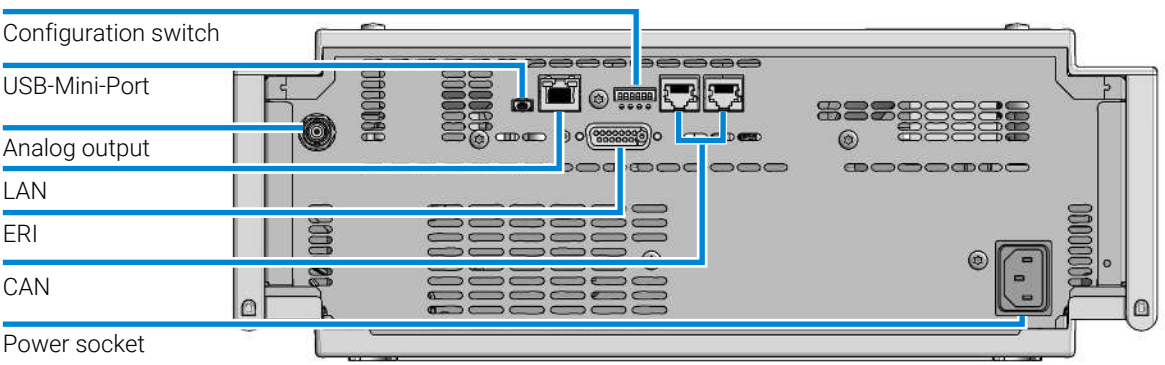


Figure 28: Rear view of detector (example shows a G7114A/B VWD) – electrical connections and label

Serial Number Information

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

CCXZZ00000	Format
CC	Country of manufacturing • DE = Germany • JP = Japan • CN = China
X	Alphabetic character A-Z (used by manufacturing)
ZZ	Alpha-numeric code 0-9, A-Z, where each combination unambiguously denotes a module (there can be more than one code for the same module)
00000	Serial number

Interfaces

The Agilent InfinityLab LC Series modules provide the following interfaces:

Table 15: Agilent InfinityLab LC Series interfaces

Module	CAN	USB	LAN (on-board)	RS-232	Analog	APG (A) / ERI (E)	Special
Pumps							
G7104A/C	2	No	Yes	Yes	1	A	
G7110B	2	Yes	Yes	No	No	E	
G7111A/B, G5654A	2	Yes	Yes	No	No	E	
G7112B	2	Yes	Yes	No	No	E	
G7120A, G7132A	2	No	Yes	Yes	1	A	
G7161A/B	2	Yes	Yes	No	No	E	
Samplers							
G7129A/B/C	2	Yes	Yes	No	No	E	
G7167A/B/C, G7137A, G5668A, G3167A	2	Yes	Yes	No	No	E	

Module	CAN	USB	LAN (on-board)	RS-232	Analog	APG (A) / ERI (E)	Special
G7157A	2	Yes	Yes	No	No	E	
Detectors							
G7114A/B	2	Yes	Yes	No	1	E	
G7115A	2	Yes	Yes	No	1	E	
G7117A/B/C	2	Yes	Yes	No	1	E	
G7121A/B	2	Yes	Yes	No	1	E	
G7162A/B	2	Yes	Yes	No	1	E	
G7165A	2	Yes	Yes	No	1	E	
Fraction Collectors							
G7158B	2	Yes	Yes	No	No	E	
G7159B	2	Yes	Yes	No	No	E	
G7166A	2	No	No	No	No	No	Requires a host module with on-board LAN with minimum FW B.06.40 or C.06.40, or with additional G1369C LAN Card
G1364E/F, G5664B	2	Yes	Yes	No	No	E	THERMOSTAT for G1330B
Others							
G1170A	2	No	No	No	No	No	Requires a host module with on-board LAN or with additional G1369C LAN Card.
G7116A/B	2	No	No	No	No	No	Requires a host module with on-board LAN or with additional G1369C LAN Card.
G7122A	No	No	No	Yes	No	A	
G7170B	2	No	No	No	No	No	Requires a host module with on-board LAN with minimum FW B.06.40 or C.06.40, or with additional G1369C LAN Card

NOTE

LAN connection is made between at least one of the Agilent modules and the Control PC.

- If an Assist Hub is installed, connect the LAN to the Lab LAN port of this module.
- If an Assist Hub is NOT installed and a detector (DAD/MWD/FLD/VWD/RID) is installed, connect the LAN to this module.
- If an Assist Hub is NOT installed and there are multiple detectors with spectral capabilities, consider using additional LAN connections for each detector.
- If an Assist Hub is installed, connect additional LAN connections from the detectors and pumps to the Assist Hub.

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

Overview Interfaces

CAN

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

LAN

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

NOTE

LAN connection is made between at least one of the Agilent modules and the Control PC.

- If an Assist Hub is installed, connect the LAN to the Lab LAN port of this module.
- If an Assist Hub is NOT installed and a detector (DAD/MWD/FLD/VWD/RID) is installed, connect the LAN to this module.
- If an Assist Hub is NOT installed and there are multiple detectors with spectral capabilities, consider using additional LAN connections for each detector.
- If an Assist Hub is installed, connect additional LAN connections from the detectors and pumps to the Assist Hub.

USB

The USB interface replaces the RS-232 Serial interface in new generation modules. For details on USB refer to USB (Universal Serial Bus) on page 204.

Analog Signal Output

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

Remote (ERI)

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

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

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

To provide maximum safety within a distributed analysis system, one line is dedicated to SHUT DOWN the system's critical parts in case any module detects a serious problem. To detect whether all participating modules are switched on or properly powered, one line is defined to summarize the POWER ON state of all connected modules. Control of analysis is maintained by signal readiness READY

for next analysis, followed by START of run and optional STOP of run triggered on the respective lines. In addition PREPARE and START REQUEST may be issued. The signal levels are defined as:

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

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

Table 16: ERI signal distribution

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

Special Interfaces

There is no special interface for this module.

ERI (Enhanced Remote Interface)

ERI replaces the AGP Remote Interface that is used in the HP 1090/1040/1050/1100 HPLC systems and Agilent 1100/1200/1200 Infinity HPLC modules. All new InfinityLab LC Series products using the communication board core electronics use ERI. This interface is already used in the Agilent Universal Interface Box 2 (UIB2)

ERI Description

The ERI interface contains eight individual programmable input/output pins. In addition, it provides 24 V power and 5 V power and a serial data line to detect and recognize further add-ons that could be connected to this interface. This way the interface can support various additional devices like sensors, triggers (in and out) and small controllers, etc.

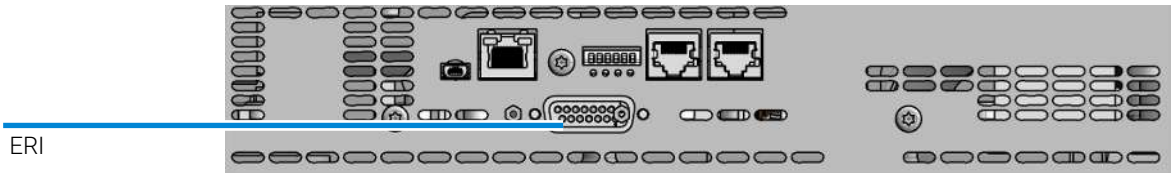
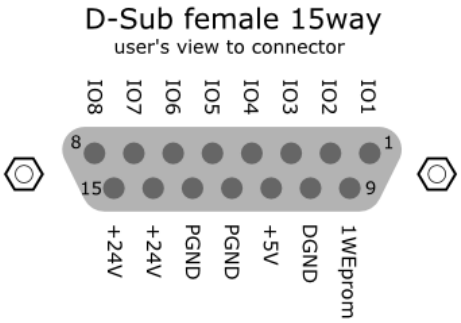


Figure 29: Location of the ERI interface



Pin	Enhanced Remote
1	IO 1 (START REQUEST)
2	IO 2 (STOP)
3	IO 3 (READY)
4	IO 4 (POWER ON)
5	IO 5 (NOT USED)
6	IO 6 (SHUT DOWN)
7	IO 7 (START)
8	IO 8 (PREPARE)
9	1 wire DATA
10	DGND
11	+5 V ERI out
12	PGND

	Pin	Enhanced Remote
	13	PGND
	14	+24 V ERI out
	15	+24 V ERI out

IO (Input/Output) Lines

- Eight generic bi-directional channels (input or output).
- Same as the APG Remote.
- Devices like valves, relays, ADCs, DACs, controllers can be supported/ controlled.

1-Wire Data (Future Use)

This serial line can be used to read out an EPROM or write into an EPROM of a connected ERI-device. The firmware can detect the connected type of device automatically and update information in the device (if required).

5V Distribution (Future Use)

- Available directly after turning on the hosting module (assures that the firmware can detect certain basic functionality of the device).
- For digital circuits or similar.
- Provides 500 mA maximum.
- Short-circuit proof with automatic switch off (by firmware).

24V Distribution (Future Use)

- Available by firmware command (defined turn on/off).
- For devices that need higher power
  - Class 0: 0.5 A maximum (12 W)
  - Class 1: 1.0 A maximum (24 W)
  - Class 2: 2.0 A maximum (48 W)
- Class depends on hosting module's internal power overhead.

- If a connected device requires more power the firmware detects this (overcurrent detection) and provides the information to the user interface.
- Fuse used for safety protection (on board).
- Short circuit will be detected through hardware.

USB (Universal Serial Bus)

USB (Universal Serial Bus) - replaces RS232, supports:

- a PC with control software (for example Agilent Lab Advisor)
- USB Flash Disk

Instrument Layout

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

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

Early Maintenance Feedback (EMF)

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

EMF Counters

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

Using the EMF Counters

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

Module-Specific Hardware Information

Setting the 6-bit Configuration Switch

The 6-bit configuration switch is located at the rear of the module with communication board electronics. Switch settings provide configuration parameters for LAN and instrument specific initialization procedures.

All modules with communication board electronics:

- Default is ALL switches DOWN (best settings).
  - Default IP address for LAN 192.168.254.11
- For specific LAN modes switches 4-5 must be set as required.
- For boot resident/cold start modes switches 1+2 or 6 must be UP.

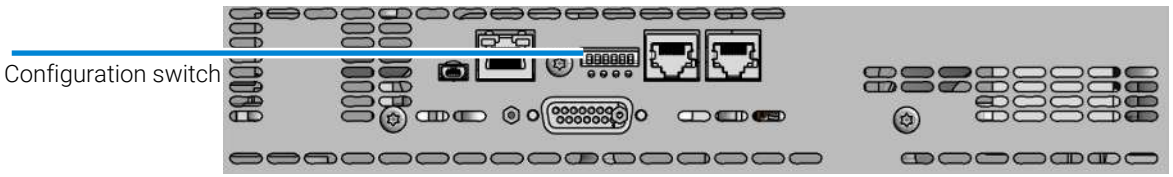


Figure 30: Location of configuration switch

Legend:

0 (switch down), 1 (switch up), SW (switch)

Special Settings

Boot-Resident/Main

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

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

Forced Cold Start

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

- Boot Main System / Revert to Default Data

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

  The instrument will boot to resident mode and changes to the module's default parameter. May be also required to load main firmware into the module.

CAUTION Loss of data

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

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

Data Flow for Chromatographic Output

The data flow is shown below.

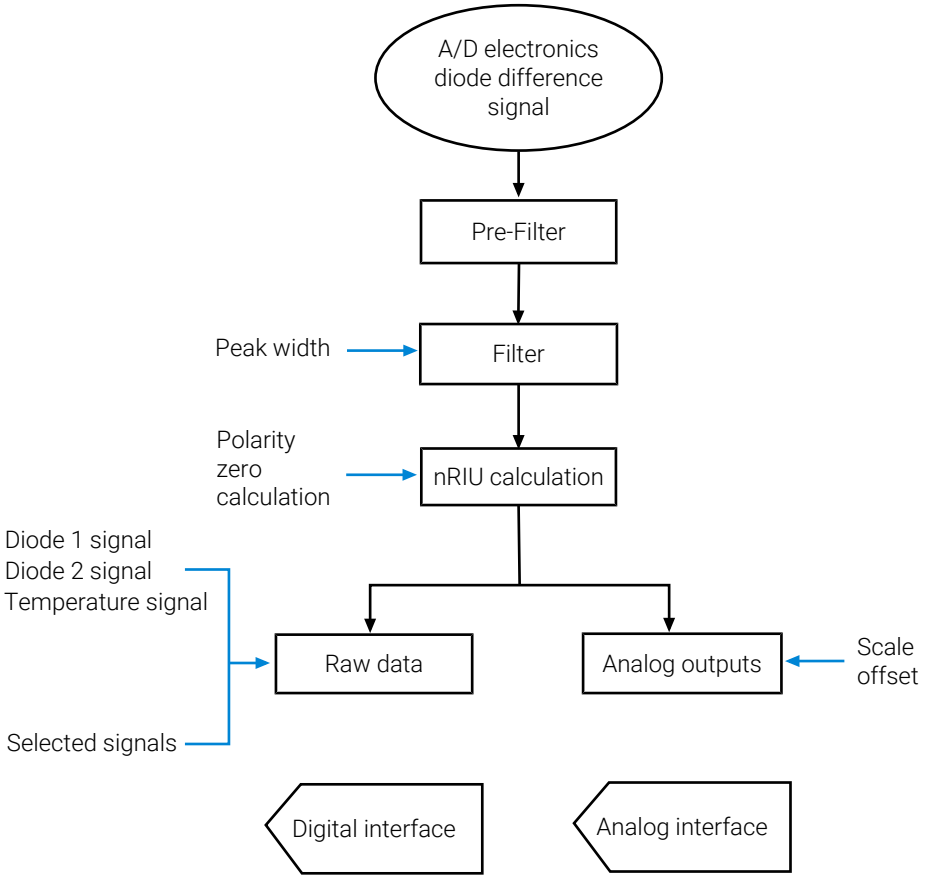


Figure 31: Data flow for chromatographic output

12 LAN Configuration

This chapter provides information on connecting the module to the control software.

What You Have to Do First

The module has an on-board LAN communication interface.

NOTE This chapter is generic and may show figures that differ from your module. The functionality is the same.

1 Note the MAC (Media Access Control) address for further reference. The MAC or hardware address of the LAN interfaces is a world wide unique identifier. No other network device will have the same hardware address. The MAC address can be found on a label at the rear of the module underneath the configuration switch (see Figure 33 on page 210).

Part number of the detector mainboard
Revision Code, Vendor, Year and Week of assembly
MAC address
Country of Origin

Figure 32: MAC label

2 Connect the instrument's LAN interface to

- the PC network card using a crossover network cable (point-to-point) or
- a hub or switch using a standard LAN cable.

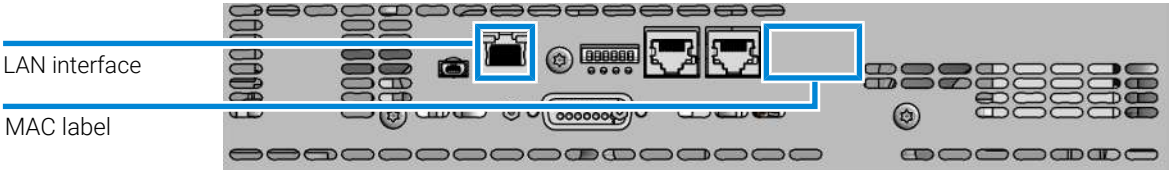


Figure 33: Location of LAN interfaces and MAC label

TCP/IP Parameter Configuration

To operate properly in a network environment, the LAN interface must be configured with valid TCP/IP network parameters. These parameters are:

- IP address
- Subnet Mask
- Default Gateway

The TCP/IP parameters can be configured by the following methods:

- by automatically requesting the parameters from a network-based DHCP Server (using the so-called Dynamic Host Configuration Protocol). This mode requires a LAN-onboard Module or a G1369C LAN Interface card, see Setup (DHCP) on page 215
- by manually setting the parameters using Telnet
- by manually setting the parameters using the Local Controller

The LAN interface differentiates between several initialization modes. The initialization mode (short form 'init mode') defines how to determine the active TCP/IP parameters after power-on. The parameters may be derived non-volatile memory or initialized with known default values. The initialization mode is selected by the configuration switch, see Table 17 on page 213.

Configuration Switch

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

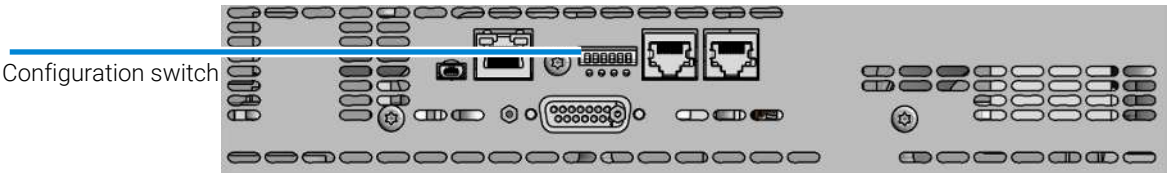


Figure 34: Location of configuration switch

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

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

Initialization Mode Selection

The following initialization (init) modes are selectable:

Table 17: Initialization mode switches

	SW1	SW2	SW3	SW4	SW5	SW6	Init Mode
	0	0	0	0	0	0	Use Default IP Address
	0	0	0	0	1	0	Use Stored IP Address
	0	0	0	1	0	0	Use DHCP
	Note: The setting '0' (down) is essential.						

Legend:

0 (switch down), 1 (switch up), SW (switch)

Default IP address for LAN is 192.168.254.11.

DHCP address is the module's LAN MAC address.

Using Stored

When initialization mode **Using Stored** is selected, the parameters are taken from the non-volatile memory of the module. The TCP/IP connection will be established using these parameters. The parameters were configured previously by one of the described methods.

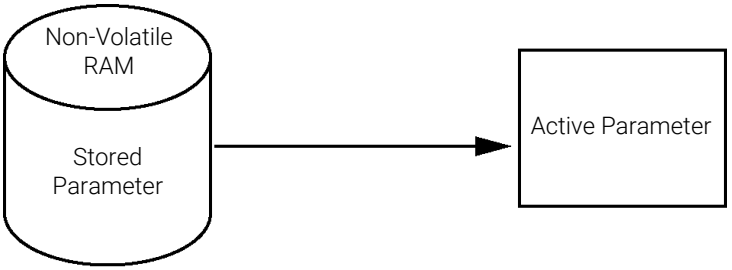


Figure 35: Using Stored (principle)

Using Default

When **Using Default** is selected, the factory default parameters are taken instead. These parameters enable a TCP/IP connection to the LAN interface without further configuration, see Table 18 on page 214.

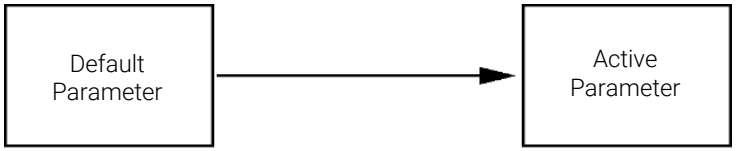


Figure 36: Using Default (principle)

NOTE Using the default address in your local area network may result in network problems. Take care and change it to a valid address immediately.

Table 18: Using default parameters

IP address:	192.168.254.11
Subnet Mask:	255.255.255.0
Default Gateway	not specified

Since the default IP address is a so-called local address, it will not be routed by any network device. Thus, the PC and the module must reside in the same subnet.

The user may open a Telnet session using the default IP address and change the parameters stored in the non-volatile memory of the module. He may then close the session, select the initialization mode Using Stored, power-on again and establish the TCP/IP connection using the new parameters.

When the module is wired to the PC directly (e.g. using a cross-over cable or a local hub), separated from the local area network, the user may simply keep the default parameters to establish the TCP/IP connection.

NOTE In the **Using Default** mode, the parameters stored in the memory of the module are not cleared automatically. If not changed by the user, they are still available, when switching back to the mode Using Stored.

Dynamic Host Configuration Protocol (DHCP)

General Information (DHCP)

The Dynamic Host Configuration Protocol (DHCP) is an auto configuration protocol used on IP networks. The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card G1369C, and “B”-firmware (B.06.40 or above) or modules with "D"-firmware. All modules should use latest firmware from the same set.

When the initialization mode “DHCP” is selected, the card tries to download the parameters from a DHCP Server. The parameters obtained become the active parameters immediately. They are not stored to the non-volatile memory of the card.

Besides requesting the network parameters, the card also submits its hostname to the DHCP Server. The hostname equals the MAC address of the card, e.g. *0030d3177321*. It is the DHCP server's responsibility to forward the hostname/address information to the Domain Name Server. The card does not offer any services for hostname resolution (e.g. NetBIOS).

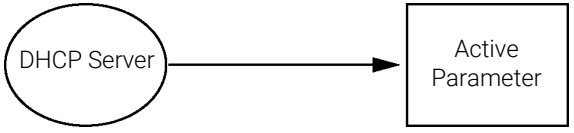


Figure 37: DHCP (principle)

NOTE

- It may take some time until the DHCP server has updated the DNS server with the hostname information.
- It may be necessary to fully qualify the hostname with the DNS suffix, e.g. *0030d3177321.country.company.com*.
- The DHCP server may reject the hostname proposed by the card and assign a name following local naming conventions.

Setup (DHCP)

The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card G1369C, and “B”-firmware (B.06.40 or above) or modules with "D"-firmware. All modules should use latest firmware from the same set.

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

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

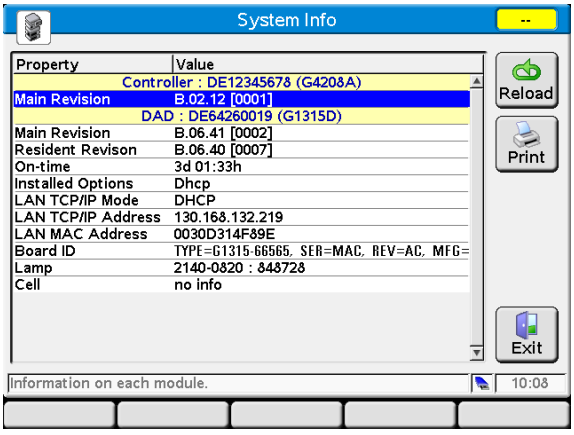


Figure 38: LAN setting on Instant Pilot

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

Table 19: G1369C LAN Interface Card (configuration switch on the card)

SW 4	SW 5	SW 6	SW 7	SW 8	Initialization Mode
ON	OFF	OFF	OFF	OFF	DHCP

Table 20: LC Modules with 8-bit configuration switch (B-firmware) (configuration switch at rear of the instrument)

SW 6	SW 7	SW 8	Initialization Mode
ON	OFF	OFF	DHCP

3 Turn on the module that hosts the LAN interface.

4 Configure your Control Software (e.g. OpenLAB CDS ChemStation Edition, Lab Advisor, Firmware Update Tool) and use MAC address as host name, e.g. *0030d3177321*.

The LC system should become visible in the control software (see Note in section General Information (DHCP) on page 215).

Manual Configuration

Manual configuration only alters the set of parameters stored in the non-volatile memory of the module. It never affects the currently active parameters. Therefore, manual configuration can be done at any time. A power cycle is mandatory to make the stored parameters become the active parameters, given that the initialization mode selection switches are allowing it.

With Telnet

Whenever a TCP/IP connection to the module is possible (TCP/IP parameters set by any method), the parameters may be altered by opening a Telnet session.

1 Open the system (DOS) prompt window by clicking on Windows START button and select "Run...". Type "cmd" and press OK.

2 Type the following at the system (DOS) prompt:

- `c:\>telnet <IP address>` or
- `c:\>telnet <host name>`

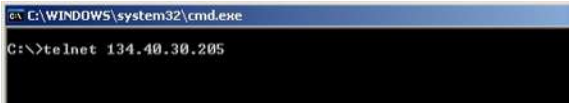


Figure 39: Telnet - Starting a session

where <IP address> may be the assigned address from a Bootp cycle, a configuration session with the Handheld Controller, or the default IP address (see Configuration Switch on page 212).

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

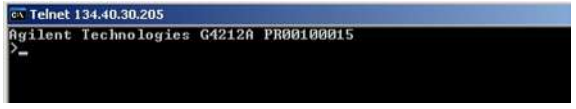


Figure 40: A connection to the module is made

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

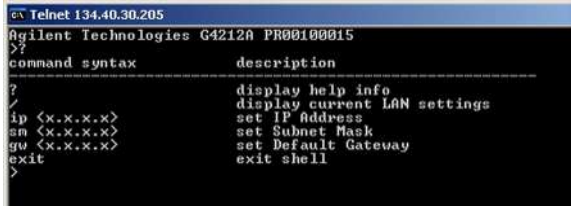


Figure 41: Telnet commands

Table 21: Telnet commands

Value	Description
?	displays syntax and descriptions of commands
/	displays current LAN settings
ip <x.x.x.x>	sets new ip address
sm <x.x.x.x>	sets new subnet mask
gw <x.x.x.x>	sets new default gateway
exit	exits shell and saves all changes

4 To change a parameter follows the style:

- parameter value, for example: `ip 134.40.28.56`

Then press [Enter], where parameter refers to the configuration parameter you are defining, and value refers to the definitions you are assigning to that parameter. Each parameter entry is followed by a carriage return.

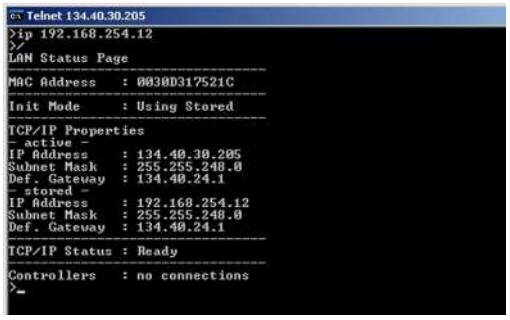
5 Use the "/" and press Enter to list the current settings.

Telnet - Current settings in "Using Stored" mode

information about the LAN interface
MAC address, initialization mode
Initialization mode is Using Stored
active TCP/IP settings

TCP/IP status - here ready
connected to PC with controller software (e.g. Agilent ChemStation), here not connected

6 Change the IP address (in this example 192.168.254.12) and type "/" to list current settings.



Telnet - Change IP settings

change of IP setting to Initialization mode is Using Stored

active TCP/IP settings

stored TCP/IP settings in non-volatile memory

connected to PC with controller software (e.g. Agilent ChemStation), here not connected

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

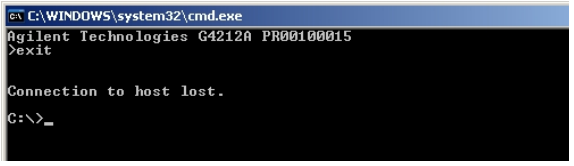


Figure 42: Closing the Telnet session

NOTE If the Initialization Mode Switch is changed now to “Using Stored” mode, the instrument will take the stored settings when the module is re-booted. In the example above it would be 192.168.254.12.

With the Instant Pilot (G4208A)

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

1 From the Welcome screen press the **More** button.

2 Select **Configure.**

3 Press the module button of the module that hosts the LAN interface (usually the detector).

4 Scroll down to the LAN settings.

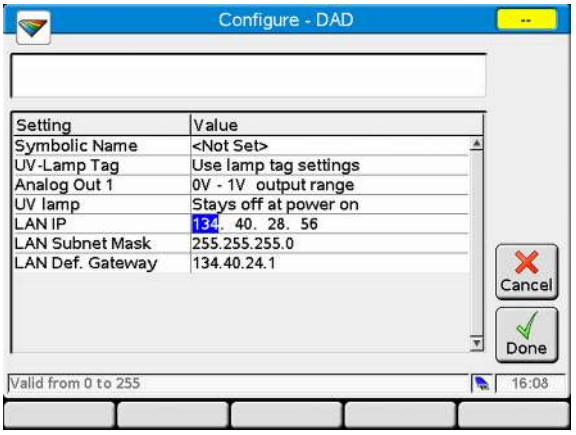


Figure 43: Instant Pilot - LAN configuration (edit mode)

5 Press the **Edit** button (only visible if not in Edit mode), perform the required changes and press the **Done** button.

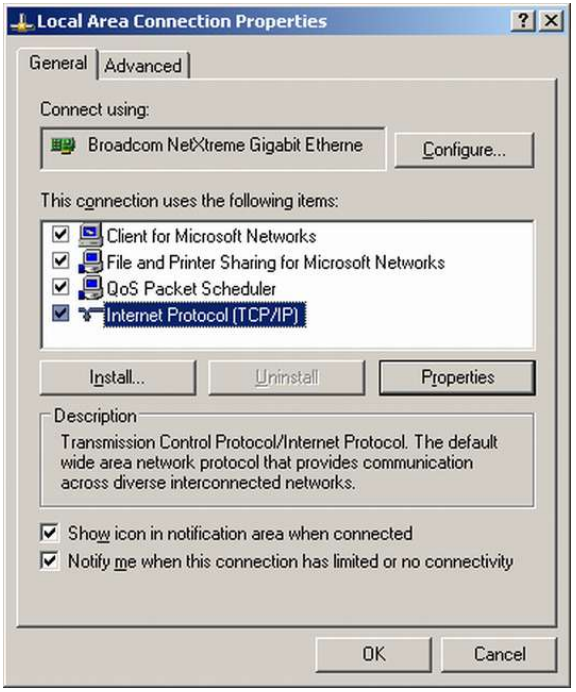
6 Leave the screen by clicking **Exit**.

PC and User Interface Software Setup

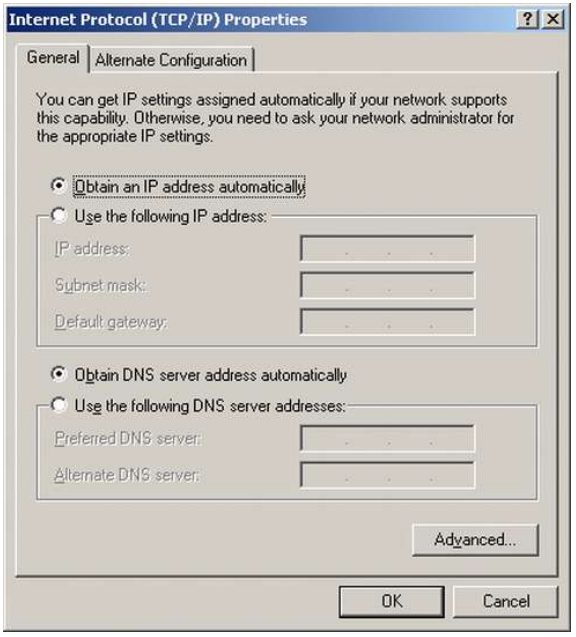
PC Setup for Local Configuration

This procedure describes the change of the TCP/IP settings on your PC to match the module's default parameters in a local configuration (see Table 18 on page 214).

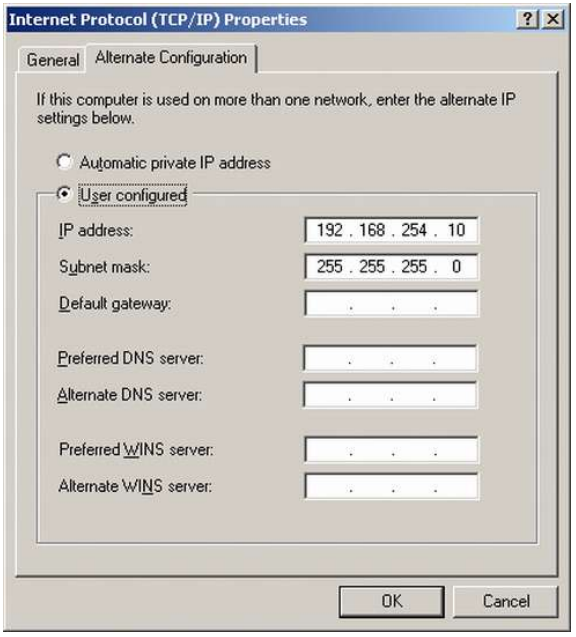
1 Open the Local Area Connection Properties and select Internet Protocol (TCP/IP). Then click on Properties.



2 You may enter here the fixed IP address of the module or use the Alternative Configuration.



3 We will use the direct LAN access via Cross-over LAN cable with the module's IP address.



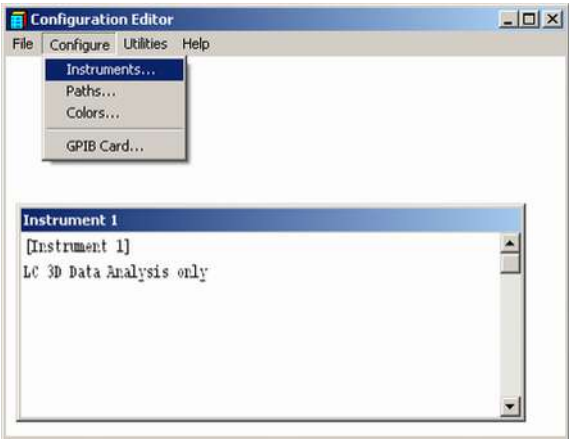
4 Click on **OK** to save the configuration.

Agilent ChemStation Setup

This procedure describes the Agilent ChemStation B.04.02 setup for the 1290 Infinity system using the 1290 Infinity DAD (G4212A) as the interfacing module. The setup works in the same way for all other systems.

NOTE The LAN must be connected to detector due to high data load on communication to Control Software.

1 Open the ChemStation Configuration Editor.

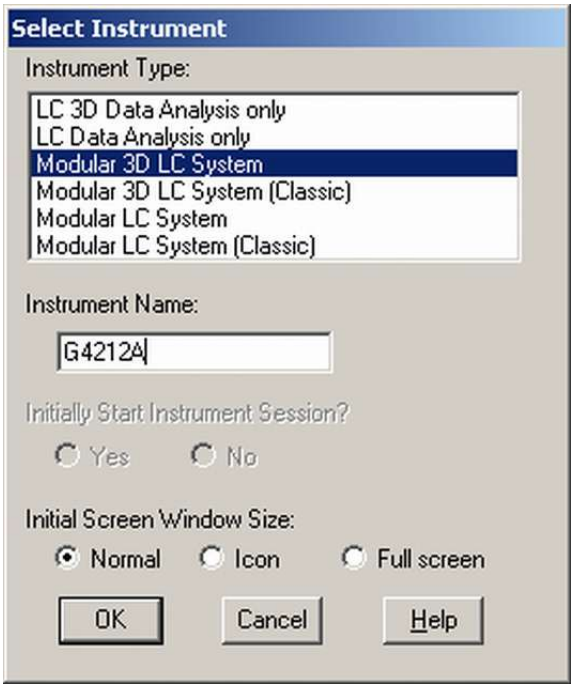


2 Select from the menu Configure - Instruments.

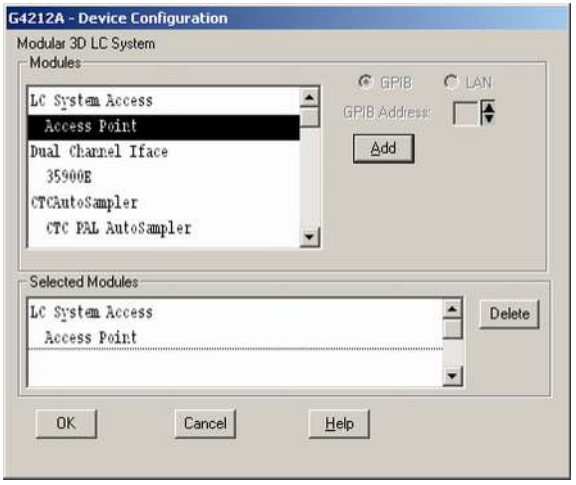
3 Select Modular 3D LC System.

4 Give the Instrument a name.

5 Click on **OK**.



6 Select **LC System Access — Access Point** and click on **Add**.

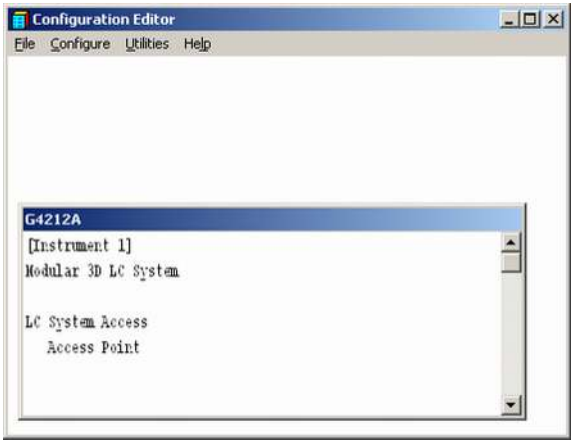


7 Click on **OK**.

The Configuration Editor shows now the new instrument.

8 If required, change under **Configure – Path** the folder locations.

9 Save the current configuration via **File – Save**.

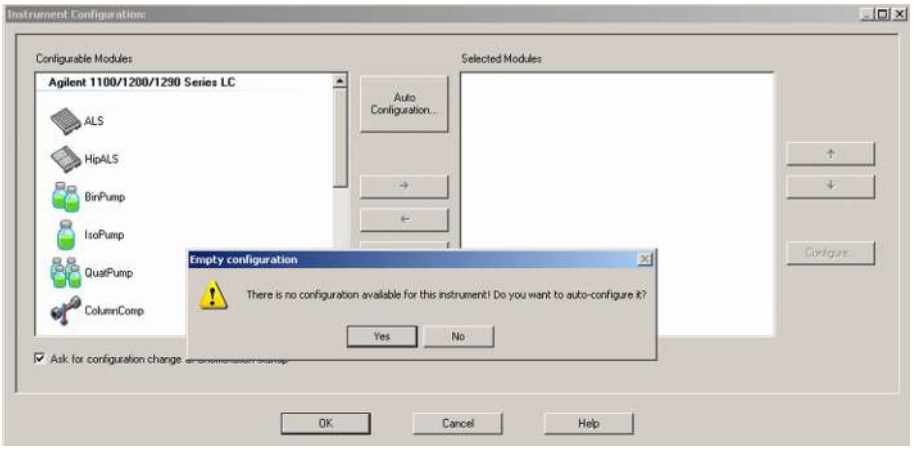


10 Exit the Configuration Editor.

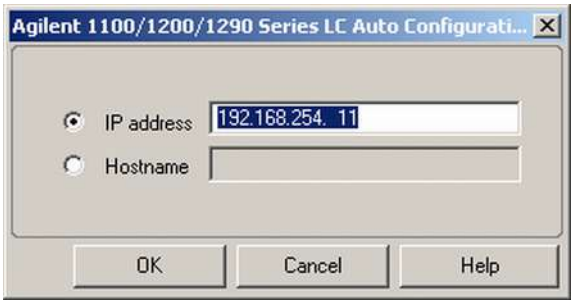
11 Start the Agilent ChemStation.

During first startup or when the system configuration has changed, a notification shows up.

12 The left column shows the modules that could be configured. You may select the module manually from the list. We use the Auto Configuration mode. Click on Yes.



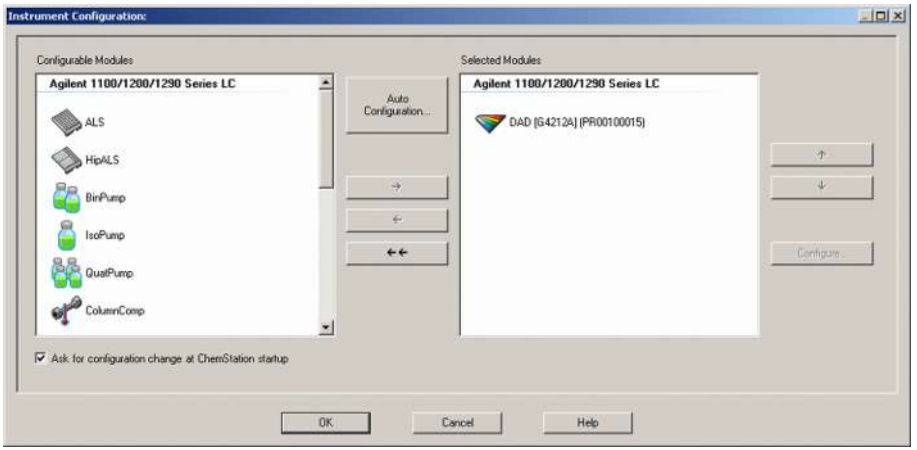
13 Enter the IP address or the Hostname of the module with the LAN-access.



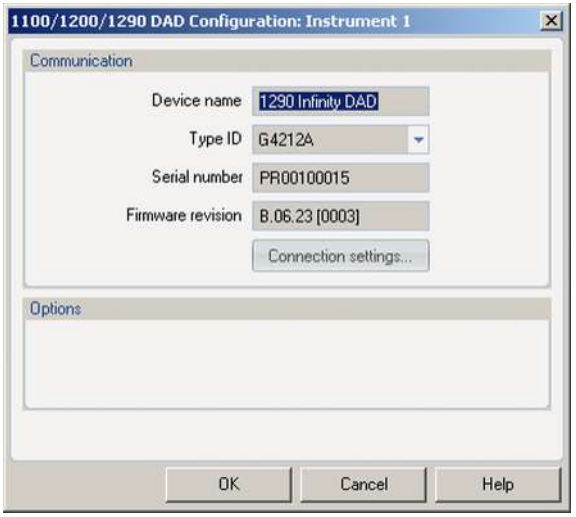
14 Click on OK.

The selected module is shown now in the right window (with serial number). In addition all other modules connected via CAN to the detector are shown as well.

15 Click on **OK** to continue the ChemStation loading.



16 You may see the details of the module by **selecting the module** and clicking on **Configure**.



Under **Connection Settings** you may change the IP/Hostname of the module (may require a re-start of the ChemStation).

After successful load of the ChemStation, you should see the module(s) as active item in the graphical user interface (GUI).

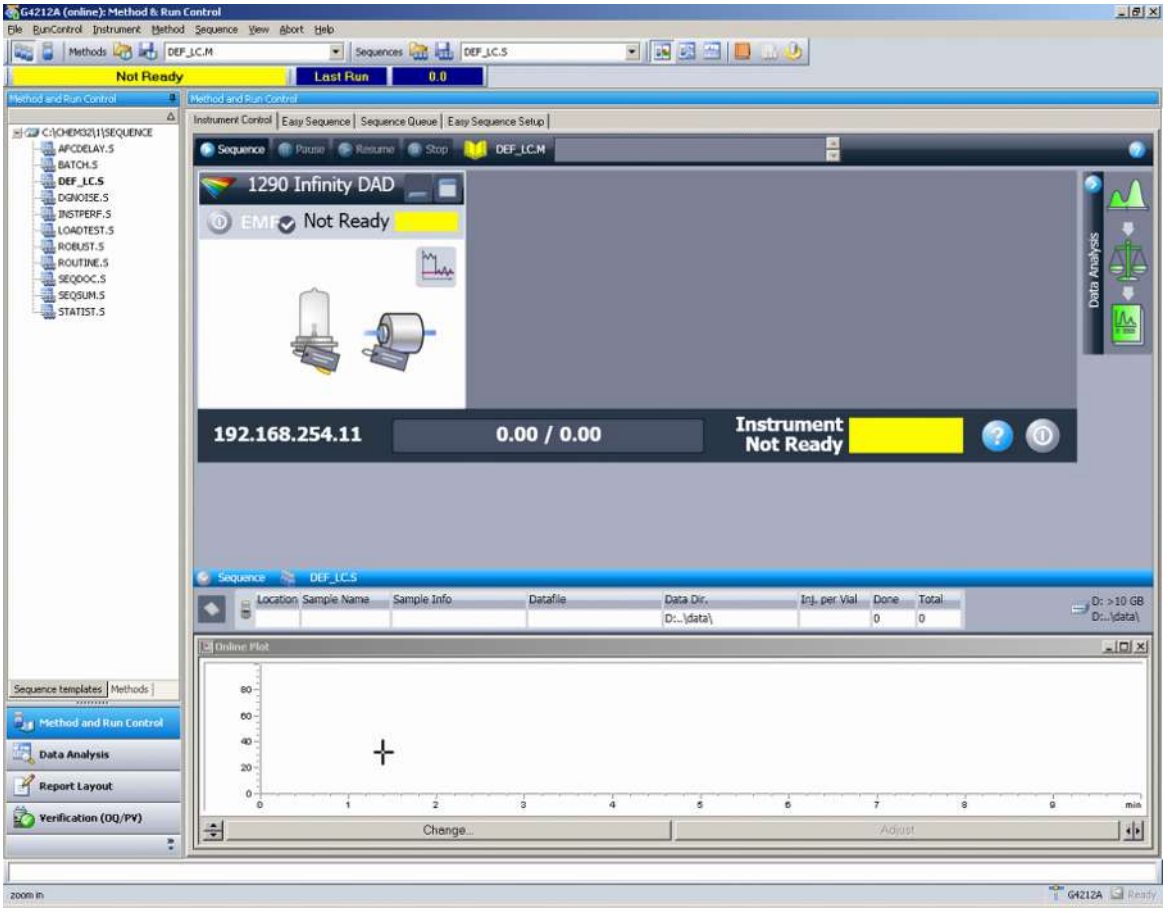


Figure 44: Screen after successful load of ChemStation

13 Appendix

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

General Safety Information

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

WARNING

Ensure the proper usage of the equipment.

The protection provided by the equipment may be impaired.

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

Safety Standards

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

General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

Before Applying Power

WARNING Wrong voltage range, frequency or cabling

Personal injury or damage to the instrument

- Verify that the voltage range and frequency of your power distribution matches to the power specification of the individual instrument.
- Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.
- Make all connections to the unit before applying power.

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.

NOTE Note the instrument's external markings described under Safety Symbols on page 238.

Ground the Instrument

WARNING Missing electrical ground

Electrical shock

- If your product is provided with a grounding type power plug, the instrument chassis and cover must be connected to an electrical ground to minimize shock hazard.
- The ground pin must be firmly connected to an electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in an Explosive Atmosphere

WARNING

Presence of flammable gases or fumes

Explosion hazard

- **Do not operate the instrument in the presence of flammable gases or fumes.**

Do Not Remove the Instrument Cover

WARNING

Instrument covers removed

Electrical shock

- **Do Not Remove the Instrument Cover**
- **Only Agilent authorized personnel are allowed to remove instrument covers. Always disconnect the power cables and any external circuits before removing the instrument cover.**

Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Agilent Sales and Service Office for service and repair to ensure that safety features are maintained.

In Case of Damage

WARNING

Damage to the module

Personal injury (for example electrical shock, intoxication)

- **Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.**

Solvent Information

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

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

- **When working with these substances observe appropriate safety procedures (for example by wearing goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the vendor, and follow good laboratory practice.**
- **Do not use solvents with an auto-ignition temperature below 200 °C (392 °F). Do not use solvents with a boiling point below 56 °C (133 °F).**
- **Avoid high vapor concentrations. Keep the solvent temperature at least 40 °C (72 °F) below the boiling point of the solvent used. This includes the solvent temperature in the sample compartment. For the solvents methanol and ethanol keep the solvent temperature at least 25 °C (45 °F) below the boiling point.**
- **Do not operate the instrument in an explosive atmosphere.**
- **Do not use solvents of ignition Class IIC according IEC 60079-20-1 (for example, carbon disulfide).**
- **Reduce the volume of substances to the minimum required for the analysis.**
- **Never exceed the maximum permissible volume of solvents (8 L) in the solvent cabinet. Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for solvent cabinet.**
- **Ground the waste container.**
- **Regularly check the filling level of the waste container. The residual free volume in the waste container must be large enough to collect the waste liquid.**
- **To achieve maximal safety, regularly check the tubing for correct installation.**

NOTE For details, see the usage guideline for the solvent cabinet. A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available in the Agilent Information Center or via the Internet.

Recommendations on the Use of Solvents

Observe the following recommendations on the use of solvents.

- Brown glass ware can avoid growth of algae.
- Follow the recommendations for avoiding the growth of algae, see the pump manuals.
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.22 µm filters.
- Avoid or minimize the use of solvents that may corrode parts in the flow path. Consider specifications for the pH range given for different materials such as flow cells, valve materials etc. and recommendations in subsequent sections.
- 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 sulfuric acid and nitric acid, especially at higher temperatures (if your chromatography method allows, replace 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:

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

    This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol,
  - chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, diisopropyl ether) should be filtered through dry aluminium oxide which adsorbs the peroxides,
  - solvents containing strong complexing agents (e.g. EDTA),
  - mixtures of carbon tetrachloride with 2-propanol or THF.
- Avoid the use of dimethyl formamide (DMF). Polyvinylidene fluoride (PVDF), which is used in leak sensors, is not resistant to DMF.

Flow cell

To protect optimal functionality of your 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.
- Aqueous solvents in the flow cell can built up algae. Therefore do not leave aqueous solvents sitting in the flow cell. Add a small % of organic solvents (e.g. acetonitrile or methanol ~5%).

Magnets

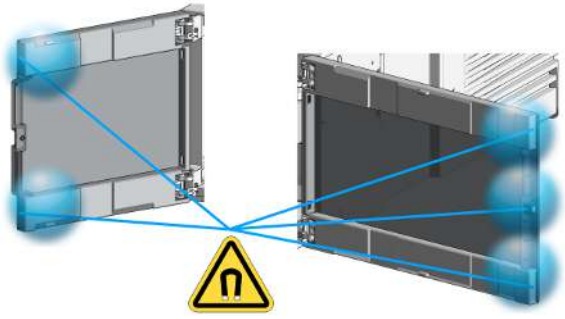
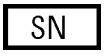


Figure 45: Magnets in doors of pumps, autosamplers, detectors, and fraction collectors

Safety Symbols

Table 22: Symbols

	The apparatus is marked with this symbol when the user shall refer to the instruction manual in order to protect risk of harm to the operator and to protect the apparatus against damage.
	Indicates dangerous voltages.

	Indicates a protected ground terminal.
	The apparatus is marked with this symbol when hot surfaces are available and the user should not touch it when heated up.
	Indicates flammable material used. Consult the Agilent Information Center / User Manual before attempting to install or service this equipment. Follow all safety precautions.
	Confirms that a manufactured product complies with all applicable European Community directives. The European Declaration of Conformity is available at: http://regulations.corporate.agilent.com/DoC/search.htm
	Manufacturing date.
	Product Number
	Serial Number
	Power symbol indicates On/Off. The apparatus is not completely disconnected from the mains supply when the on/off switch is in the Off position
	Pacemaker Magnets could affect the functioning of pacemakers and implanted heart defibrillators. A pacemaker could switch into test mode and cause illness. A heart defibrillator may stop working. If you wear these devices keep at least 55 mm distance to magnets. Warn others who wear these devices from getting too close to magnets.
	Magnetic field Magnets produce a far-reaching, strong magnetic field. They could damage TVs and laptops, computer hard drives, credit and ATM cards, data storage media, mechanical watches, hearing aids and speakers. Keep magnets at least 25 mm away from devices and objects that could be damaged by strong magnetic fields.
	Indicates a pinching or crushing hazard
	Indicates a piercing or cutting hazard.

WARNING

A WARNING

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

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

CAUTION

A CAUTION

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

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

Material Information

This section provides detailed information about materials used in the HPLC system and general information about solvent/material compatibility.

General Information About Solvent/Material Compatibility

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

Disclaimer

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

MP35N

MP35N is a nonmagnetic, nickel-cobalt-chromium-molybdenum alloy demonstrating excellent corrosion resistance (for example, against nitric and sulfuric acids, sodium hydroxide, and seawater) over a wide range of concentrations and temperatures. In addition, this alloy shows exceptional

resistance to high-temperature oxidation. Due to excellent chemical resistance and toughness, the alloy is used in diverse applications: dental products, medical devices, nonmagnetic electrical components, chemical and food processing equipment, marine equipment. Treatment of MP35N alloy samples with 10 % NaCl in HCl (pH 2.0) does not reveal any detectable corrosion. MP35N also demonstrates excellent corrosion resistance in a humid environment. Although the influence of a broad variety of solvents and conditions has been tested, users should keep in mind that multiple factors can affect corrosion rates, such as temperature, concentration, pH, impurities, stress, surface finish, and dissimilar metal contacts.

Polyphenylene Sulfide (PPS)

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

PEEK

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

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

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

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

Polyimide

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

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

Polyethylene (PE)

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

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

Tantalum (Ta)

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

Stainless Steel (SST)

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

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

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

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

Titanium (Ti)

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

Titanium is subject to corrosion in anhydrous methanol, which can be avoided by adding a small amount of water (about 3 %). Slight corrosion is possible with ammonia > 10 %.

Diamond-Like Carbon (DLC)

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

Fused Silica and Quartz (SiO_2)

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

Gold

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

Zirconium Oxide (ZrO_2)

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

Platinum/Iridium

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

Fluorinated Polymers (PTFE, PFA, FEP, FFKM, PVDF)

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

TFE/PDD copolymer tubings, which are used in all Agilent degassers except G1322A/G7122A, are not compatible with fluorinated solvents like Freon, Fluorinert, or Vertrel. They have limited life time in the presence of hexafluoroisopropanol (HFIP). To ensure the longest possible life with HFIP, it is best to dedicate a particular chamber to this solvent, not to switch solvents, and not to let dry out the chamber. For optimizing the life of the pressure sensor, do not leave HFIP in the chamber when the unit is off.

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

Sapphire, Ruby, and Al_2O_3-Based Ceramics

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

At-a-Glance Details About Agilent Capillaries

The following section provides useful information about Agilent capillaries and its characteristics.

Syntax for capillary description

Type - Material - Capillary dimensions - Fitting Left/Fitting right

Table 23: Example for a capillary description

Code provided with the part	Meaing of the code
Color code: 	Material of the product is MP35N, the inner diameter is 0.20 or 0.25 mm
Capillary	The part is a connection capillary
MP35N	Material of the part is MP35N
0.25 x 80 mm	The part has an inner diameter of 0.25 mm and a length of 80 mm
SI/SI	Left fitting: Swagelok + 1.6 mm Port id, Intermediate Right fitting: Swagelok + 1.6 mm Port id, Intermediate

To get an overview of the code in use, see

- Color: Table 24 on page 248
- Type: Table 25 on page 248
- Material: Table 26 on page 249
- Dimension: Table 27 on page 249
- Fittings: Table 28 on page 250

Color Coding Guide

Table 24: Color-coding key for Agilent capillary tubing

Internal diameter in mm		Color code
0.015		Orange
0.025		Yellow
0.05		Beige
0.075		Black
0.075	MP35N	Black with orange stripe
0.1		Purple
0.12		Red
0.12	MP35N	Red with orange stripe
0.17		Green
0.17	MP35N	Green with orange stripe
0.20 /0.25		Blue
0.20 /0.25	MP35N	Blue with orange stripe
0.3		Grey
0.50		Bone White

NOTE As you move to smaller-volume, high efficiency columns, you'll want to use narrow id tubing, as opposed to the wider id tubing used for conventional HPLC instruments.

Abbreviation Guide for Type

Table 25: Type (gives some indication on the primary function, like a loop or a connection capillary)

Key	Description
Capillary	Connection capillaries
Loop	Loop capillaries
Seat	Autosampler needle seats

Key	Description
Tube	Tubing
Heat exchanger	Heat exchanger

Abbreviation Guide for Material

Table 26: Material (indicates which raw material is used for the capillary)

Key	Description
ST	Stainless steel
Ti	Titanium
PK	PEEK
FS/PK	PEEK-coated fused silica [1]
PK/ST	Stainless steel-coated PEEK [2]
PFFE	PTFE
FS	Fused silica
MP35N	Nickel-cobalt-chromium-molybdenium alloy

Abbreviation Guide for Capillary Dimensions

Table 27: Capillary dimensions (indicates inner diameter (id), length, and volume of the capillary)

Description
id (mm) x Length (mm)
Volume (µL)

1 Fused silica in contact with solvent

2 Stainless steel-coated PEEK

Abbreviation Guide for Fitting Left/Fitting Right

Table 28: Fitting left/fitting right (indicates which fitting is used on both ends of the capillary)

Key	Description
W	Swagelok + 0.8 mm Port id
S	Swagelok + 1.6 mm Port id
M	Metric M4 + 0.8 mm Port id
E	Metric M3 + 1.6 mm Port id
U	Swagelok union
L	Long
X	Extra long
H	Long head
G	Small head SW 4
N	Small head SW 5
F	Finger-tight
V	1200 bar
B	Bio
P	PEEK
I	Intermediate

Waste Electrical and Electronic Equipment (WEEE) Directive

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

NOTE

Do not dispose of in domestic household waste
To return unwanted products, contact your local Agilent office, or see https://www.agilent.com for more information.

Radio Interference

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

Test and Measurement

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

Sound Emission

Sound Pressure

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

Schalldruckpegel

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

Agilent Technologies on Internet

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

https://www.agilent.com

In This Book

This manual contains technical reference information about the Agilent 1260 Infinity III Refractive Index Detector (G7162A) and Agilent 1290 Infinity III Refractive Index Detector (G7162B).

The manual describes the following:

- introduction,
- specifications,
- configuration,
- optimizing,
- troubleshooting and diagnostics,
- maintenance,
- parts identification,
- hardware information,
- safety and related information.

www.agilent.com

Edition: 10/2024

Document No: SD-29000641 Rev. D

Agilent