Agilent 1200 Infinity Series
Diode Array Detectors

User Manual

Agilent Technologies

Notices

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CAUTION

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WARNING

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

In This Book

This manual covers

- the Agilent 1290 Infinity Diode Array Detector (G4212A) and
- the Agilent 1260 Infinity Diode Array Detector (G4212B).

Find information on other Agilent Diode Array Detectors in separate manuals.

1 Introduction

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

2 Site Requirements and Specifications

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

3 Installing the Module

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

4 Using the Module

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

5 Optimizing the Detector

This chapter provides information on how to optimize the detector.

6 Troubleshooting and Diagnostics

Overview about the troubleshooting and diagnostic features.

7 Error Information

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

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This chapter describes the tests for the module.

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This chapter describes the maintenance of the module.

10 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

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Contents

1 Introduction

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

Overview of the Module

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

- Maximum of 160 Hz (G4212A) or 80 Hz (G4212B) data acquisition rate.
- Higher sensitivity for conventional LC as well as ultra fast applications by using next generation optical design.
- Increased sensitivity with 60 mm Max-Light cartridge flow cell.
- Optimized cell geometry for less peak dispersion for narrow bore applications.
- Max-Light cartridge flow cells for standard and bio-inert applications are available.
- More reliable and robust peak integration process (automated) due to less baseline noise/drift/refractive index and thermal effects especially under ultra fast gradient conditions.
- RFID tracking technology is used for the UV-lamp and the Max-Light cartridge flow cells.
- Multiple wavelength and full spectral detection at 160 Hz (G4212A)/80 Hz (G4212B) sampling rate, keeping up with the analysis speed of ultra-fast LC.
- Programmable 1 – 8 nm slit (G4212A) or fixed 4 nm slit (G4212B) for rapid optimization of sensitivity, linearity and spectral resolution provides optimum incident light conditions.
- Improved Electronic temperature control (ETC) provides maximum baseline stability and practical sensitivity under fluctuating ambient temperature and humidity conditions.
- Additional diagnostic signals for temperature and lamp voltage monitoring.
- Easy exchange of flow cell by cartridge design.

For specifications, see “Performance Specifications G4212A” on page 24 or “Performance Specifications G4212B” on page 26.

Optical System

The optical system of the detector is shown in Figure 1 on page 11.

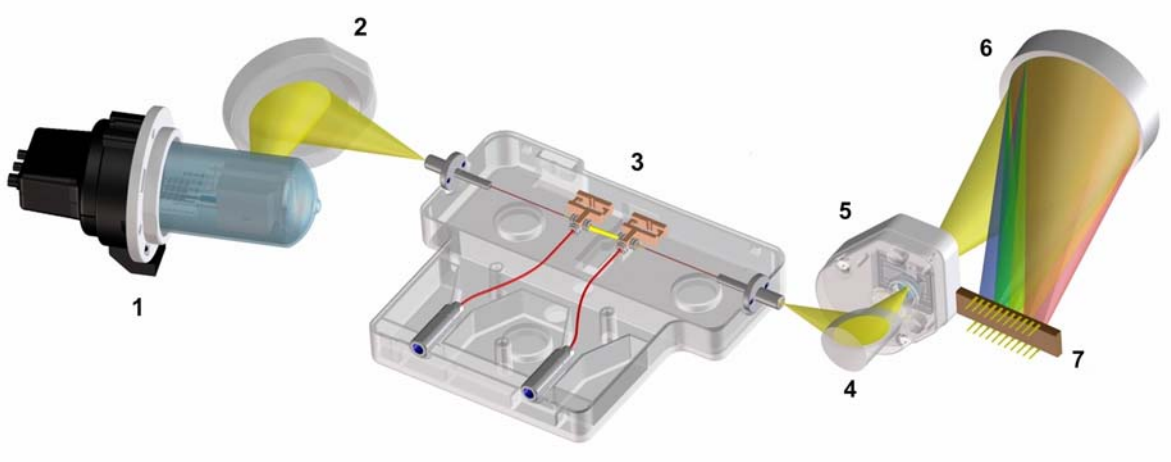


Figure 1 Optical System of the Detector

1	UV-lamp
2	Lamp mirror
3	Flow cell
4	Fold mirror
5	Programmable (G4212A) or Fixed (G4212B) slit
6	Grating
7	Array

The illumination source is a deuterium-arc-discharge lamp [1] for the ultraviolet (UV) wavelength range. Its light is focused by a lamp mirror [2] onto the entrance of the Max-light cartridge flow cell [3] with optofluidic waveguides. The light leaves the Max-light cartridge flow cell at the other side and is focused by the fold mirror [4] through the slit assembly [5] onto a holographic grating [6] light being dispersed onto the diode array [7]. This allows simultaneous access to all wavelength information.

Lamp

The light source for the UV-wavelength range is a long-life UV-lamp with RFID tag. As a result of plasma discharge in low-pressure deuterium gas, the lamp emits light over the 190 nm to approximately 800 nm wavelength range.

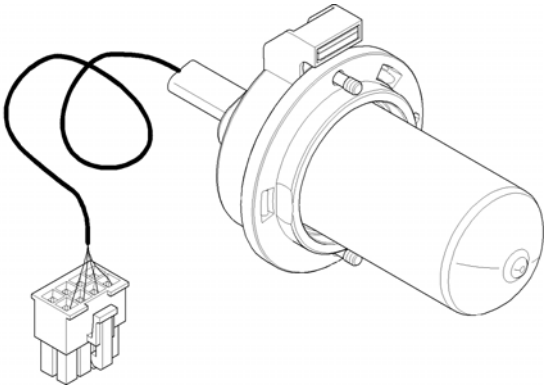


Figure 2 UV-Lamp

Max-Light Cartridge Flow Cell

The detector allows easy access to flow cells via a cartridge. A variety of optional flow cells can be inserted using the same quick, simple mounting system.

Max-Light Cartridge Flow Cells for standard and bio-inert applications are available. For testing of the detector, a Max-Light Cartridge Test Cell is available.

p/n	Description
G4212-60008	Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL)
G4212-60007	Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL)
G5615-60018	Max-Light Cartridge Cell Bio-inert (10 mm, V(σ) 1.0 µL) includes Peek Capillary 1.5 m i.d. 0.18 mm (0890-1763) and PEEK Fittings 10/PK (5063-6591)
G5615-60017	Max-Light Cartridge Cell Bio-inert (60 mm, V(σ) 4.0 µL) includes Peek Capillary 1.5 m i.d. 0.18 mm (0890-1763) and PEEK Fittings 10/PK (5063-6591)
G4212-60032	HDR Max-Light Cartridge Cell (3.7 mm, V(σ) 0.4 µL)
G4212-60038	ULD Max-Light Cartridge Cell (10 mm, V(σ) 0.6 µL)
G4212-60011	Max-Light Cartridge Test Cell

The optical principle of the Max-Light Cartridge cell is based on opto-fluidic waveguides. Nearly 100 % light transmission is achieved by utilizing total internal reflection in a non-coated silica fiber. Compromising refractive index and thermal effects are almost completely eliminated, resulting in significantly less baseline drift.

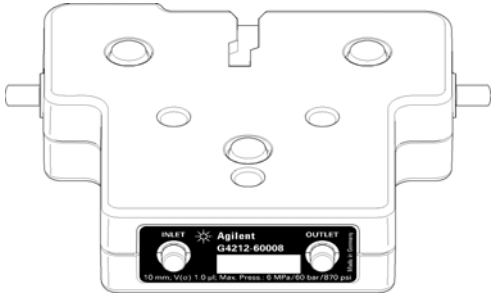


Figure 3 Max-Light Cartridge Flow Cell

NOTE For additional information on the Max-Light Cartridge flow cell refer to "Choosing a Flow Cell" on page 80 and "Inline Pressure Relief Valve Kit (G4212-68001)" on page 82.

Slit Assembly

Programmable Slit (G4212A)

The micro-slit system makes use of the mechanical properties of silicon combined with the precise structuring capabilities of bulk micro-machining. It combines the required optical functions – slit and shutter – in a simple and compact component. The slit width is directly controlled by the micro-processor of the instrument and can be set as method parameter.

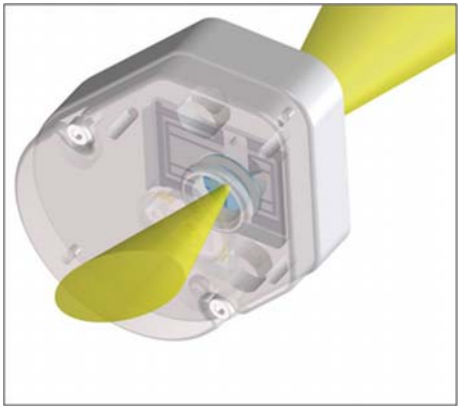


Figure 4 Slit Assembly

The slit width influences the spectral resolution and noise.

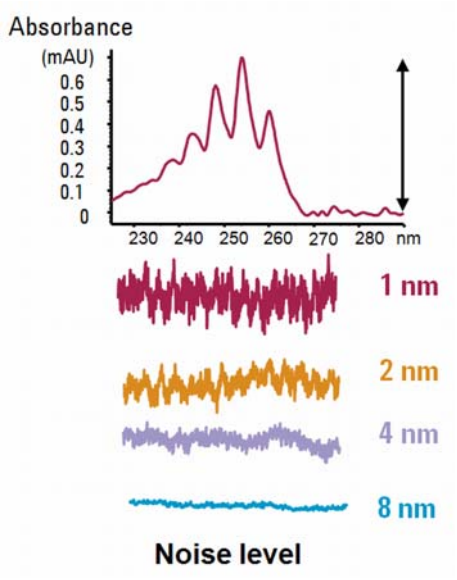


Figure 5 Influence of slitwidth on resolution and noise level

Fixed Slit (G4212B)

The fixed slit combines the required optical functions - slit and shutter - in a simple and compact component. The slit width is directly controlled by the micro-processor of the instrument and is fixed to 4 nm.

NOTE In March 2011 the optical unit type of the G4212B DAD changed from "Programmable Slit (like in the G4212A) fixed to 4 nm" to a real "Fixed Slit 4 nm". First serial number was DEAA301100.

Grating and Diode Array

The combination of dispersion and spectral imaging is accomplished by using a concave holographic grating. The grating separates the light beam into all its component wavelengths and reflects the light onto the photodiode array.

The diode array is a series of 1024 individual photodiodes and control circuits located on a ceramic carrier. It has a wavelength range from 190 – 640 nm and the sampling interval is ~0.5 nm.

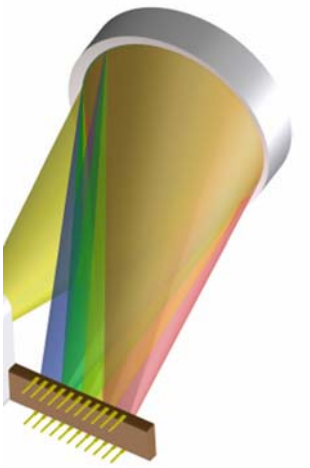


Figure 6 Grating and diode array

Bio-inert Materials

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

Max-Light Cartridge Cell Bio-inert (60 mm, V(σ) 4.0 µL) (G5615-60017) and Max-Light Cartridge Cell Bio-inert (10 mm, V(σ) 1.0 µL) (G5615-60018) offer highest sensitivity for bio-inert reverse phase applications. Please note that at low salt SEC or ion exchange chromatography potentially peak tailing might occur, and therefore for these applications the universal Bio-inert DAD (G1315C or D) or MWD (G1365C or D) is recommended.

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

Module	Materials
Agilent 1260 Infinity Bio-inert Quaternary Pump (G5611A)	Titanium, gold, platinum-iridium, ceramic, ruby, PTFE, PEEK
Agilent 1260 Infinity Bio-inert High-Performance Autosampler (G5667A)	Upstream of sample introduction: • Titanium, gold, PTFE, PEEK, ceramic Downstream of sample introduction: • PEEK, ceramic
Agilent 1260 Infinity Bio-inert Manual Injector (G5628A)	PEEK, ceramic
Agilent 1260 Infinity Bio-inert Analytical Fraction Collector (G5664A)	PEEK, ceramic, PTFE

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

Module	Materials
Bio-inert Flow Cells:	
Standard flow cell bio-inert, 10 mm, 13 µL, 120 bar (12 MPa) for MWD/DAD, includes Capillary Kit Flow Cells BIO (p/n G5615-68755) (G5615-60022) (*for Agilent 1260 Infinity Diode Array Detectors DAD G1315C/D*)	PEEK, ceramic, sapphire, PTFE
Max-Light Cartridge Cell Bio-inert (10 mm, V(σ) 1.0 µL) (G5615-60018) and Max-Light Cartridge Cell Bio-inert (60 mm, V(σ) 4.0 µL) (G5615-60017) (*for Agilent 1200 Infinity Series Diode Array Detectors DAD G4212A/B*)	PEEK, fused silica
Bio-inert flow cell, 8 µL, 20 bar (pH 1–12) includes Capillary Kit Flow Cells BIO (p/n G5615-68755) (G5615-60005) (*for Agilent 1260 Infinity Fluorescence Detector FLD G1321B*)	PEEK, fused silica, PTFE
Bio-inert heat-exchanger G5616-60050 (*for Agilent 1290 Infinity Thermostatted Column Compartment G1316C*)	PEEK (steel-cladded)
Bio-inert Valve heads	G4235A, G5631A, G5639A: PEEK, ceramic (Al_2O_3 based)
Bio-inert Connection capillaries	Upstream of sample introduction: • Titanium Downstream of sample introduction: • Agilent uses stainless-steel-cladded PEEK capillaries, which keep the flow path free of steel and provide pressure stability to more than 600 bar.

NOTE To ensure optimum bio-compatibility of your Agilent 1260 Infinity Bio-inert LC system, do not include non-inert standard modules or parts to the flow path. Do not use any parts that are not labeled as Agilent "Bio-inert". For solvent compatibility of these materials, see "Solvent information for parts of the 1260 Infinity Bio-inert LC system" on page 73.

2
Site Requirements and Specifications

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

Site Requirements

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

Power Consideration

The module power supply has wide ranging capabilities and accepts any line voltage in the range mentioned in Table 2 on page 23. Consequently, there is no voltage selector in the rear of the module. There are also no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

WARNING

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

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

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

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

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

WARNING

Incorrect line voltage at the module

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

➔ Connect your module to the specified line voltage.

CAUTION

Inaccessible power plug.

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

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

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

Power Cords

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

WARNING

Absence of ground connection or use of unspecified power cord

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

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

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

WARNING

Use of unsupplied cables

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

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

WARNING

Unintended use of supplied power cords

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

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

Bench Space

The module dimensions and weight (see Table 2 on page 23) allow you to place the module on almost any desk or laboratory bench. It needs an additional 2.5 cm (1.0 inches) of space on either side and approximately 8 cm (3.1 inches) in the rear for air circulation and electric connections.

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

The module should be operated in a horizontal position.

Environment

Your module will work within the specifications at ambient temperatures and relative humidity described in Table 2 on page 23.

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 "Specifications" on page 24) 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 will damage the system electronics.

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

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

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.

Physical Specifications

Table 2 Physical Specifications

Type	Specification	Comments
Weight	11.5 kg (26 lbs)	
Dimensions (height × width × depth)	140 x 345 x 435 mm (5.5 x 13.5 x 17 inches)	
Line voltage	100 – 240 VAC, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	160 VA / 130 W / 444 BTU	Maximum
Ambient operating temperature	4–40 °C (39–104 °F)	
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 80 % r.h. at 40 °C (104 °F)	Non-condensing
Operating altitude	Up to 2000 m (6562 ft)	
Non-operating altitude	Up to 4600 m (15091 ft)	For storing the module
Safety standards: IEC, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.

Performance Specifications

Specifications

Performance Specifications G4212A

Table 3 Performance Specifications G4212A

Type	Specification	Comments
Detection type	1024-element photodiode array	
Light source	Deuterium lamp	Equipped with RFID tag that holds lamp typical information.
Wavelength range	190 – 640 nm	
Short term noise (ASTM) Single and Multi-Wavelength	< ± 3 × 10^{-6} AU at 230 nm/4 nm, with 10 mm Max-Light cartridge cell Typically < ± 0.6 × 10^{-6} AU/cm at 230 nm/4 nm, with 60 mm Max-Light cartridge cell	see *"Specification Conditions"* below
Drift	< 0.5 × 10^{-3} AU/hr at 230 nm	see *"Specification Conditions"* below
Linear absorbance range	> 2.0 AU (5 %) at 265 nm	see *"Specification Conditions"* below
Wavelength accuracy	± 1 nm	After recalibration with deuterium lines
Wavelength bunching	2 – 400 nm	Programmable in steps of 1 nm
Slit width	1, 2, 4, 8 nm	Programmable slit
Diode width	~ 0.5 nm	
Signal data rate	up to 160 Hz	
Spectra Data rate	up to 160 Hz	

Table 3 Performance Specifications G4212A

Type	Specification	Comments
Flow cells	Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL) (G4212-60008), Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL) (G4212-60007), HDR Max-Light Cartridge Cell (3.7 mm, V(σ) 0.4 µL) (G4212-60032) ULD Max-Light Cartridge Cell (10 mm, V(σ) 0.6 µL) (G4212-60038) Max-Light Cartridge Cell Bio-inert (10 mm, V(σ) 1.0 µL) (G5615-60018) Max-Light Cartridge Cell Bio-inert (60 mm, V(σ) 4.0 µL) (G5615-60017) Max-Light Cartridge Test Cell (G4212-60011)	70 bar (1015 psi) Maximum Operating Pressure (MOP)[1] 150 bar (2175 psi) Maximum Incidential Pressure (MIP)[2] pH range 1.0 —12.5 (solvent dependent) available as standard and bio-inert versions. Cartridge type, equipped with RFID tags that holds cell typical information.
Local Control	Agilent Instant Pilot (G4208A)	B.02.11 or above
Test and troubleshooting software	Agilent LabAdvisor	B.01.03 SP4 or above
Analog outputs	Recorder/integrator: 100 mV or 1 V, output range 0.001 – 2 AU, one output	
Communications	Controller-area network (CAN), RS-232C, APG Remote: ready, start, stop and shut-down signals, LAN	
Safety and maintenance	Extensive support for troubleshooting and maintenance is provided by the Instant Pilot, Agilent Lab Advisor, and the Chromatography Data System. Safety-related features are leak detection, safe leak handling, leak output signal for shutdown of pumping system, and low voltages in major maintenance areas.	
GLP features	Early maintenance feedback (EMF) for continuous tracking of instrument usage in terms of lamp burn time with user-setable limits and feedback messages. Electronic records of maintenance and errors. Verification of wavelength accuracy with the emission lines of the deuterium lamp.	
Housing	All materials recyclable.	

[1] Maximum Operating Pressure (MOP): The maximum pressure at which the system can operate continuously under normal conditions.

[2] Maximum Incidential Pressure (MIP): The maximum pressure which the system can experience during a short time.

Performance Specifications G4212B

Table 4 Performance Specifications G4212B

Type	Specification	Comments
Detection type	1024-element photodiode array	
Light source	Deuterium lamp	Equipped with RFID tag that holds lamp typical information.
Wavelength range	190 – 640 nm	
Short term noise (ASTM) Single and Multi-Wavelength	< ± 3 × 10^{-6} AU at 230 nm/4 nm, with 10 mm Max-Light cartridge cell Typically < ± 0.6 × 10^{-6} AU/cm at 230 nm/4 nm, with 60 mm Max-Light cartridge cell	see *"Specification Conditions"* below
Drift	< 0.5 × 10^{-3} AU/hr at 230 nm	see *"Specification Conditions"* below
Linear absorbance range	> 2.0 AU (5 %) at 265 nm	see *"Specification Conditions"* below
Wavelength accuracy	± 1 nm	After recalibration with deuterium lines
Wavelength bunching	2 – 400 nm	Programmable in steps of 1 nm
Slit width	4 nm	Fixed slit
Diode width	~ 0.5 nm	
Signal data rate	80 Hz	
Spectra Data rate	80 Hz	

Table 4 Performance Specifications G4212B

Type	Specification	Comments
Flow cells	Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL) (G4212-60008), Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL) (G4212-60007), HDR Max-Light Cartridge Cell (3.7 mm, V(σ) 0.4 µL) (G4212-60032) ULD Max-Light Cartridge Cell (10 mm, V(σ) 0.6 µL) (G4212-60038) Max-Light Cartridge Cell Bio-inert (10 mm, V(σ) 1.0 µL) (G5615-60018) Max-Light Cartridge Cell Bio-inert (60 mm, V(σ) 4.0 µL) (G5615-60017) Max-Light Cartridge Test Cell (G4212-60011)	70 bar (1015 psi) Maximum Operating Pressure (MOP)[1] 150 bar (2175 psi) Maximum Incidential Pressure (MIP)[2] pH range 1.0 —12.5 (solvent dependent) available as standard and bio-inert versions. Cartridge type, equipped with RFID tags that holds cell typical information.
Local Control	Agilent Instant Pilot (G4208A)	B.02.11 or above
Test and troubleshooting software	Agilent LabAdvisor	B.01.03 SP4 or above
Analog outputs	Recorder/integrator: 100 mV or 1 V, output range 0.001 – 2 AU, one output	
Communications	Controller-area network (CAN), RS-232C, APG Remote: ready, start, stop and shut-down signals, LAN	
Safety and maintenance	Extensive support for troubleshooting and maintenance is provided by the Instant Pilot, Agilent Lab Advisor, and the Chromatography Data System. Safety-related features are leak detection, safe leak handling, leak output signal for shutdown of pumping system, and low voltages in major maintenance areas.	
GLP features	Early maintenance feedback (EMF) for continuous tracking of instrument usage in terms of lamp burn time with user-setable limits and feedback messages. Electronic records of maintenance and errors. Verification of wavelength accuracy with the emission lines of the deuterium lamp.	
Housing	All materials recyclable.	

[1] Maximum Operating Pressure (MOP): The maximum pressure at which the system can operate continuously under normal conditions.

[2] Maximum Incidential Pressure (MIP): The maximum pressure which the system can experience during a short time.

Specification Conditions

ASTM: “Standard Practice for Variable Wavelength Photometric Detectors Used in Liquid Chromatography”.

Reference conditions:

- Wavelength: 230 nm/4 nm with Reference Wavelength 360 nm/100 nm, Slitwidth 4 nm, TC 2 s, (or with RT = 2.2 * TC), ASTM
- Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL) (G4212-60008) with flow of 0.5 mL/min LC grade water or Max-Light Cartridge Test Cell (G4212-60011)

Linearity:

Linearity is measured with caffeine at 265 nm/4 nm with slit width 4 nm and TC 1 s (or with RT 2 s) with Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL) (G4212-60008) > 2.0 AU (5 %) [typical 2.5 AU (5 %)].

NOTE The specifications are based on the standard RFID tag lamp (5190-0917) and may be not achieved when other lamp types or aged lamps are used.

ASTM drift tests require a temperature change below 2 °C/hour (3.6 F/hour) over one hour period. Our published drift specification 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.

Performance tests should be done with a completely warmed up optical unit (> two hours). ASTM measurements require that the detector should be turned on at least 24 h before start of testing.

Time Constant versus Response Time

According to ASTM E1657-98 „Standard Practice of Testing Variable-Wavelength Photometric Detectors Used in Liquid Chromatography” the time constant is converted to response time by multiplying by the factor 2.2.

3
Installing the Module

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

Unpacking the Module

Damage to the module

Damaged Packaging

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

CAUTION

"Defective on arrival" problems

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

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

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

Condensation

CAUTION

Condensation within the module

Condensation will damage the system electronics.

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

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

Delivery Checklist

Ensure all parts and materials have been delivered with the module. The delivery checklist is shown below. Please report missing or damaged parts to your local Agilent Technologies sales and service office.

Table 5 Detector Checklist

Description	Quantity
Detector	1
Power cable	1
Cross-over network cable	1
Twisted pair network cable	1
Max-Light Cartridge Cell (as ordered)	1
User Manual	on Documentation CD (part of the shipment - not module specific)
Accessory kit	1

Detector Accessory Kit Contents

Detector Accessory Kit Contents (p/n G4212-68755)

p/n	Description
5062-2462	PTFE Tubing flexible i.d. 0.8 mm, o.d. 1.6 mm, 2 m, re-order 5 m (flow cell to waste)
5063-6527	Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste)
5042-9967	Tubing clip (set of 5 clips)
0100-1516	Fitting male PEEK, 2/pk
5067-4660	Inlet Capillary SST 0.12 mm I.D., 220 mm long
5181-1516	CAN cable, Agilent module to module, 0.5 m

Optimizing the Stack Configuration

If your module is part of a complete Agilent 1260 Infinity/1290 Infinity LC System, you can ensure optimum performance by installing the following configurations. These configurations optimize the system flow path, ensuring minimum delay volume.

For other possible configurations, please refer to the Agilent 1260 Infinity/1290 Infinity LC System Manual.

One Stack Configuration

One Stack Configuration for Agilent 1260 Infinity LC

Ensure optimum performance by installing the modules of the Agilent 1260 Infinity LC System in the following configuration (See Figure 7 on page 33 and Figure 8 on page 34). This configuration optimizes the flow path for minimum delay volume and minimizes the bench space required.

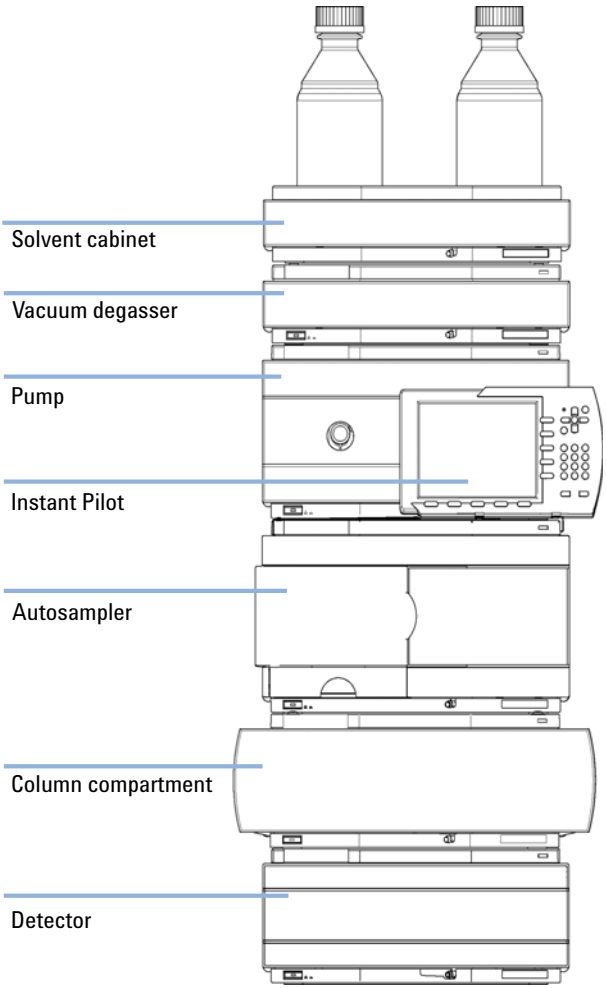


Figure 7 Recommended Stack Configuration for 1260 Infinity (Front View)

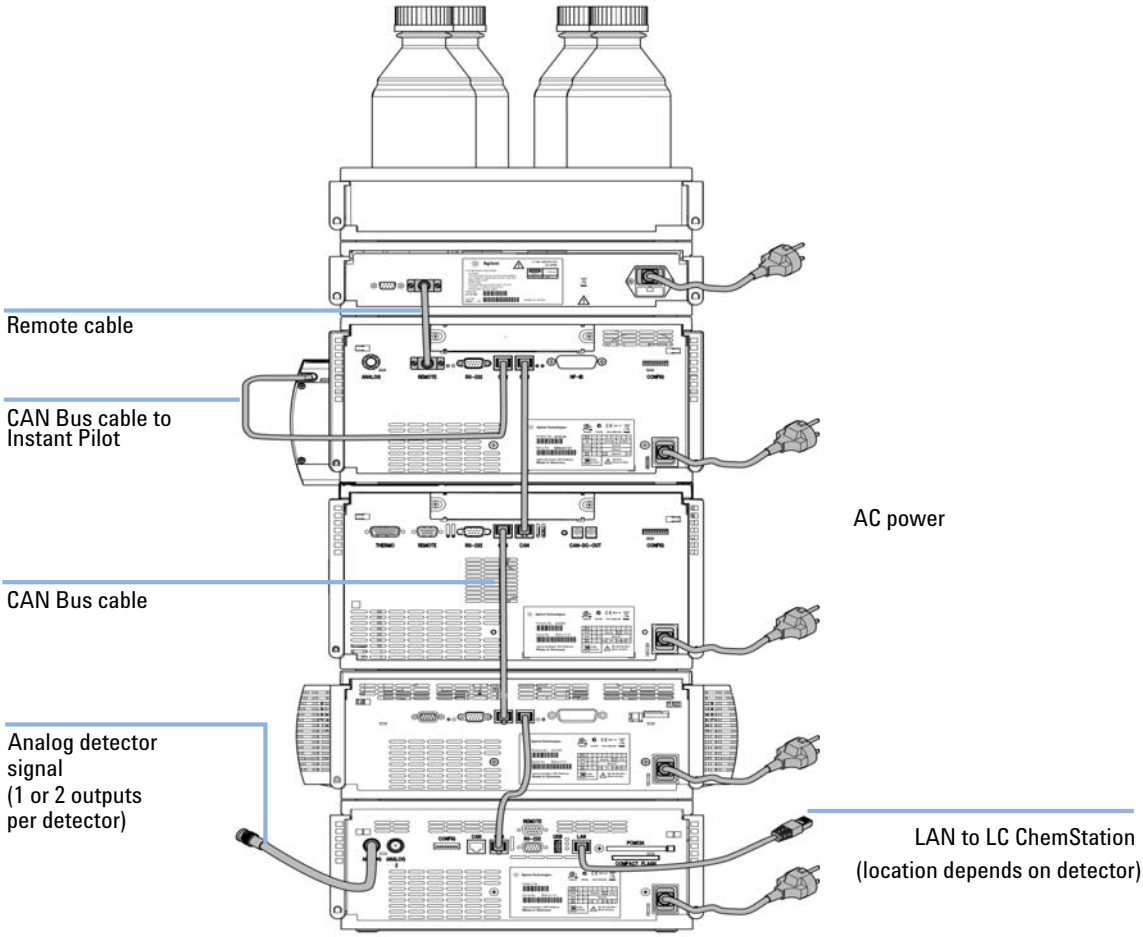


Figure 8 Recommended Stack Configuration for 1260 Infinity (Rear View)

One Stack Configuration for Agilent 1290 Infinity LC

Ensure optimum performance by installing the modules of the Agilent 1290 Infinity Binary LC System in the following configuration (See Figure 9 on page 35 and Figure 10 on page 36). This configuration optimizes the flow path for minimum delay volume and minimizes the bench space required.

The Agilent 1290 Infinity Binary Pump should always be installed at the bottom of the stack.

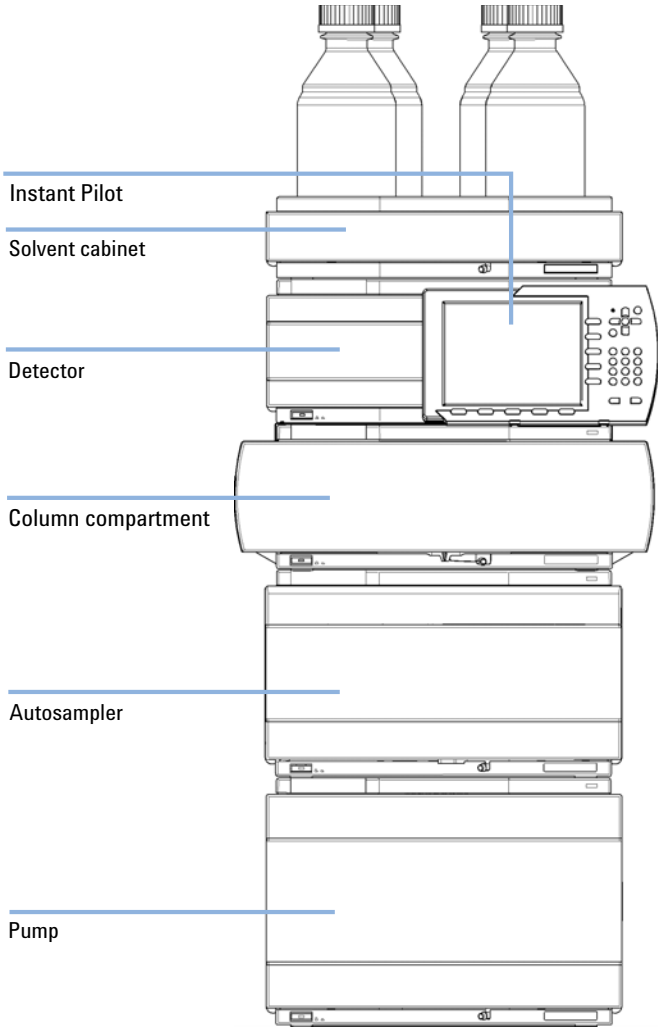


Figure 9 Recommended stack configuration for 1290 Infinity with binary pump (front view)

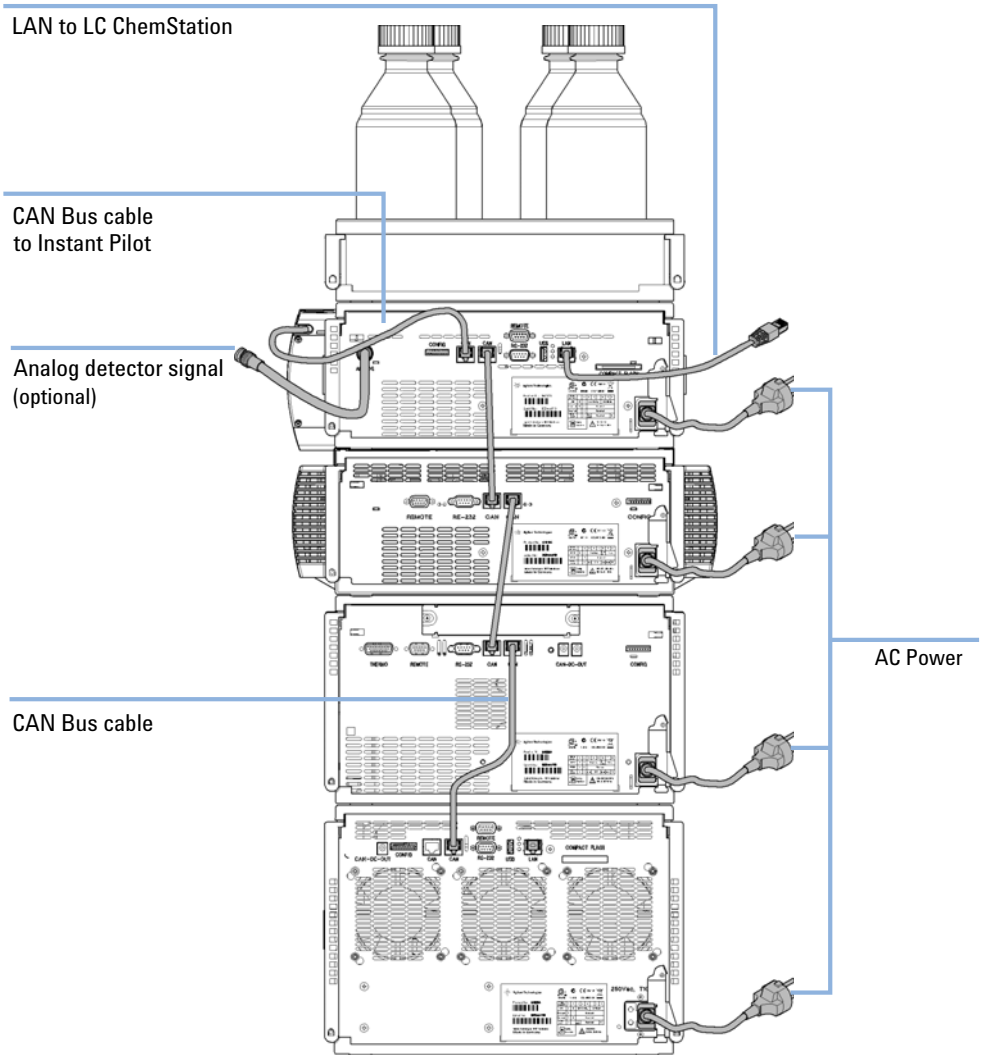


Figure 10 Recommended stack configuration 1290 Infinity with binary pump (rear view)

Two Stack Configuration

Two Stack Configuration for Agilent 1260 Infinity LC

To avoid excessive height of the stack when the autosampler thermostat is added to the system it is recommended to form two stacks. Some users prefer the lower height of this arrangement even without the autosampler thermostat. A slightly longer capillary is required between the pump and autosampler. (See Figure 11 on page 37 and Figure 12 on page 38).

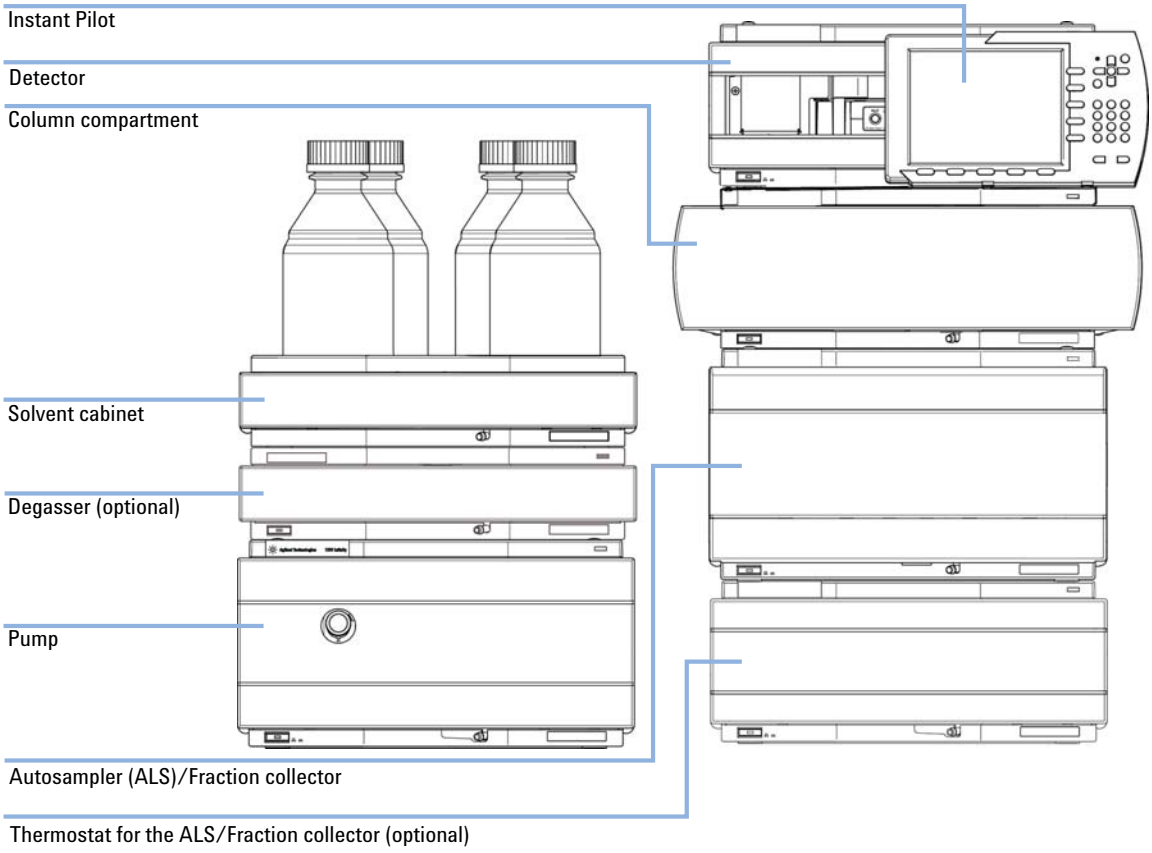


Figure 11 Recommended Two Stack Configuration for 1260 Infinity (Front View)

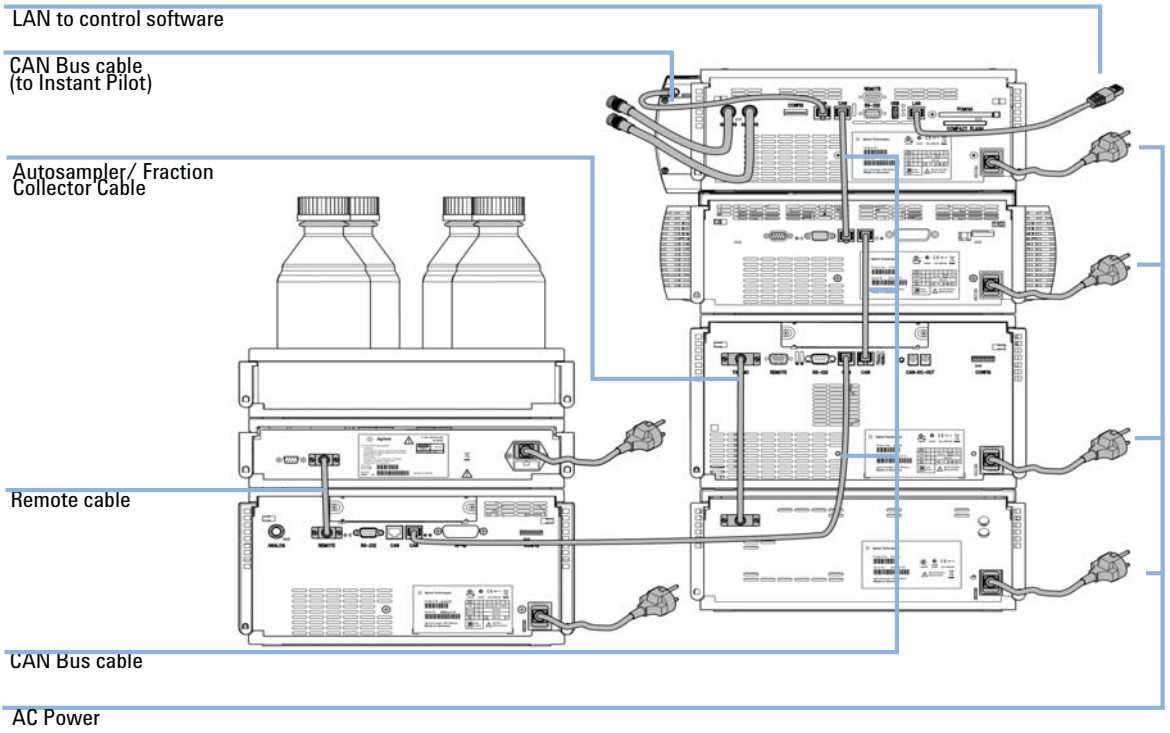


Figure 12 Recommended Two Stack Configuration for 1260 Infinity (Rear View)

Two Stack Configuration for Agilent 1290 Infinity LC

In case the autosampler thermostat is added to the system, a two-stack configuration is recommended, which places both heavy modules (1290 Infinity pump and thermostat) at the bottom of each stack and avoids high stacks. Some users prefer the lower height of this arrangement even without the autosampler thermostat. A slightly longer capillary is required between the pump and autosampler. (See Figure 13 on page 39 and Figure 14 on page 40).

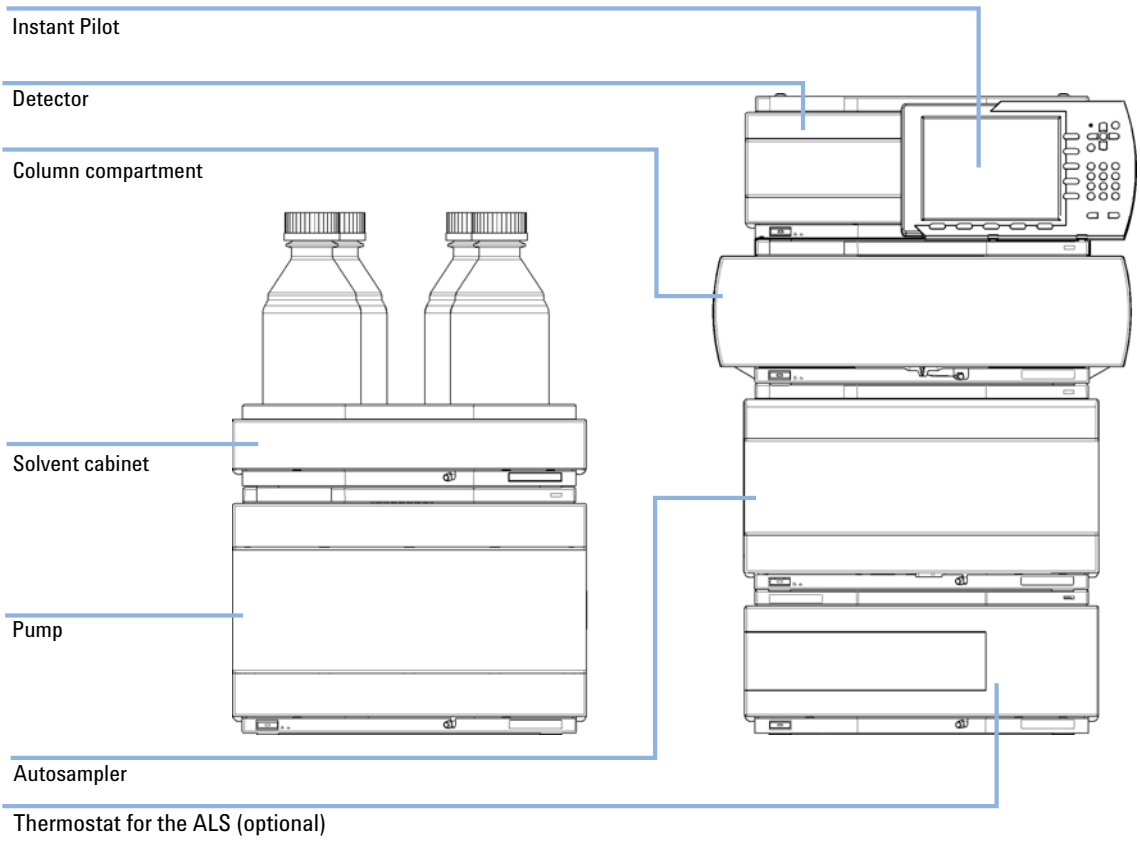


Figure 13 Recommended two stack configuration for 1290 Infinity with binary pump (front view)

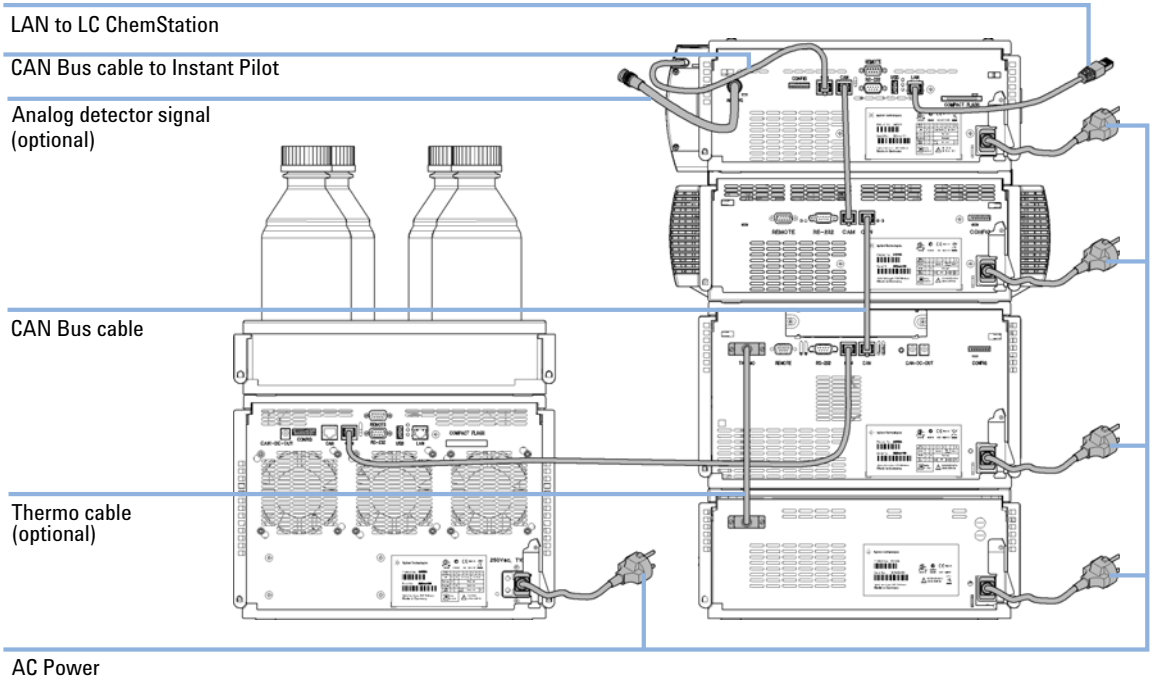


Figure 14 Recommended two stack configuration for 1290 Infinity with binary pump (rear view)

Installing the Detector

Parts required

#	Description
1	Detector
1	Power cord
1	LAN cable (cross-over or twisted pair network cable)

Other cables see below and section "Cable Overview" on page 192.

Software required

Instant Pilot and/or one of the following software solutions for control and data evaluation with the appropriate revisions:

1. Agilent ChemStation for LC (B.04.02 DSP3 or above)
2. EZChrome Elite (3.3.2 SP2 or above)
3. MassHunter (B.04.00 and B.03.01 SP2 or above)

Test and diagnostic software:

- Agilent LabAdvisor (B.01.03 SP4 or above)

Preparations

Locate bench space

Provide power connections

Unpack the module

WARNING

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

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

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

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

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

1 Note the MAC address of the LAN interface (rear of the module, under the configuration switch, see Figure 56 on page 224). It's required for LAN Configuration (see Chapter *"LAN Configuration"*).

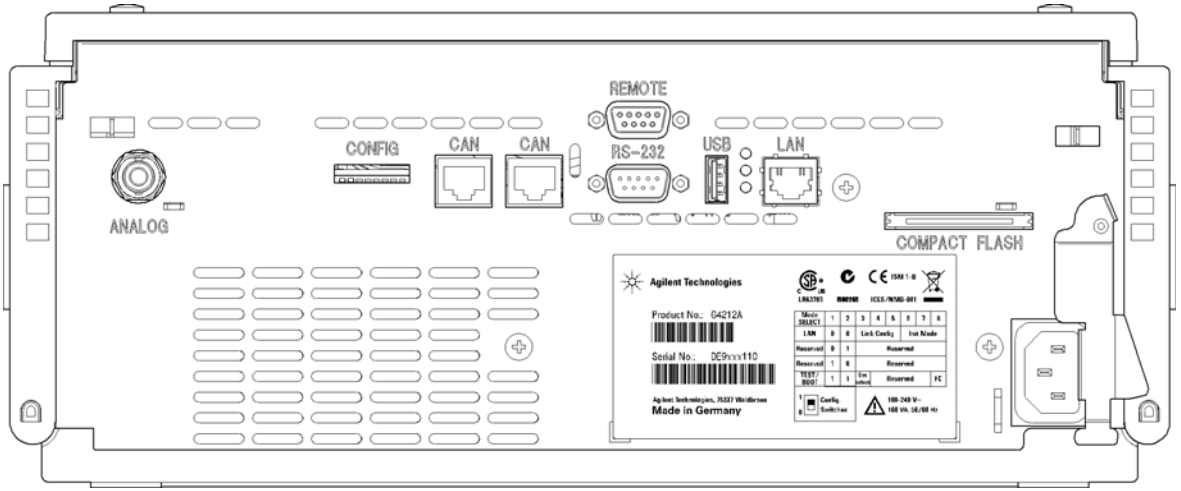


Figure 15 Rear View of Detector – Electrical Connections and Label

2 Set the Configuration Switch according the required initialization mode (default, fixed IP or Bootp), see Chapter *"LAN Configuration"*.

3 Place the module in the stack, see "Optimizing the Stack Configuration" on page 32.

4 Ensure the line power switch at the front of the module is OFF.

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

6 Connect the CAN cable to other Agilent modules.

7 Connect the LAN cable (e.g. from an Agilent ChemStation as controller) to the detector's LAN connector.

8 Connect the analog cable (optional).

9 Connect the APG remote cable (optional) for non-Agilent instruments.

10 Turn on power by pushing the button at the lower left hand side of the module. The status LED should be green.

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

NOTE The module was shipped with default configuration settings. To change these settings see chapter *"LAN Configuration"*.

NOTE After turn-on of the detector, it goes through a cycle of different states of heating up the optical unit and controlling the temperature. This is described in "Warm up of the Detector" on page 107.

Give the optical unit enough time to warm-up and stabilize (> 60 minutes).

Flow Connections to the Detector

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

Parts required	#	Description
	1	System
	1	Max-Light cartridge flow cell
	1	Capillaries and tubing from *Accessory Kit*.

CAUTION

Sample degradation and contamination of the instrument

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

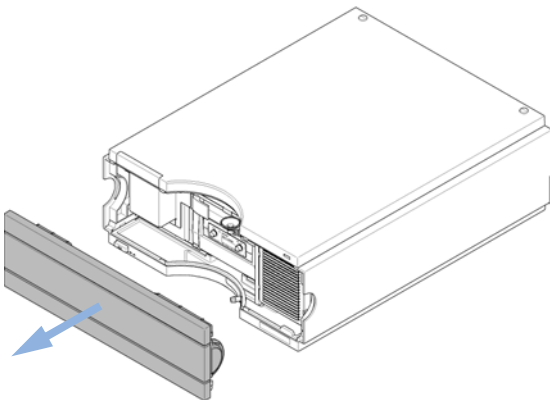
➔ For bio-inert applications, always use dedicated bio-inert parts, which can be identified by the bio-inert symbol or other markers described in this manual.

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

NOTE

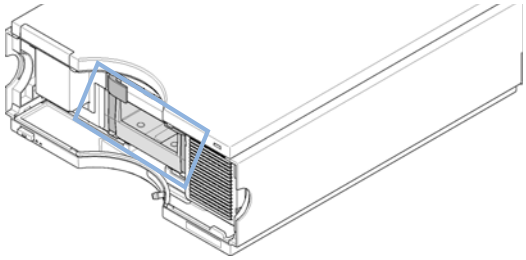
This procedure shows the detector outside of a system. In an Agilent 1260 Infinity Liquid Chromatograph, the detector is located below a G1316 TCC on the bench. In an Agilent 1290 Infinity Liquid Chromatograph, the detector is located between a G1316 TCC (below) and the Solvent Compartment (above). (See "Optimizing the Stack Configuration" on page 32.

1 Remove the front cover.

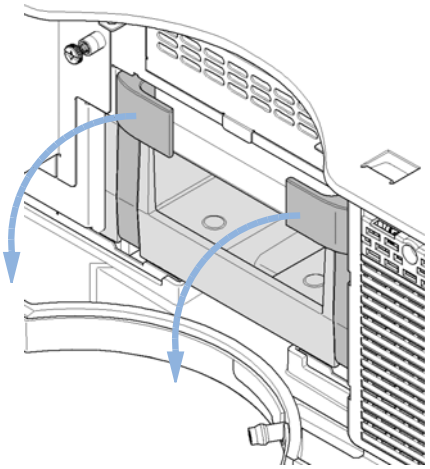


2 Remove the black hoods from the cell interfaces (in/out) and store them in the plastic case provided with the Max-Light Cartridge Flow Cell.

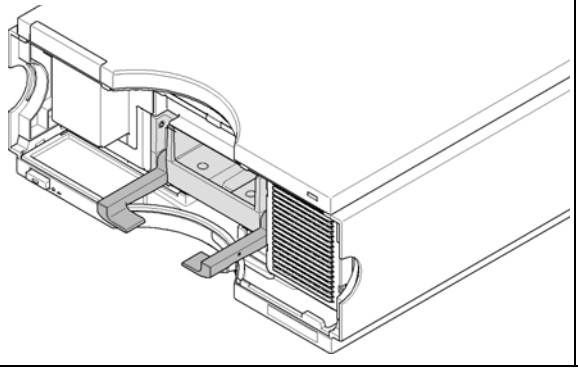
3 Locate the flow cell cartridge.



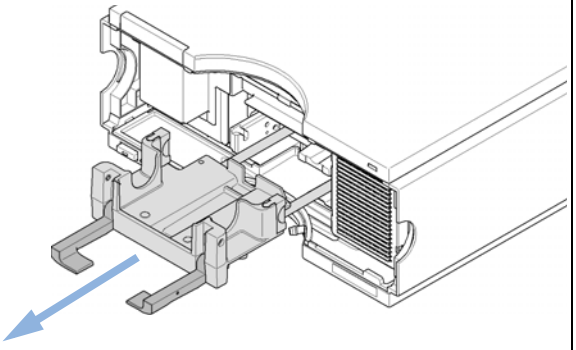
4 Unlock the flow cell cartridge by pulling the lever to the front.



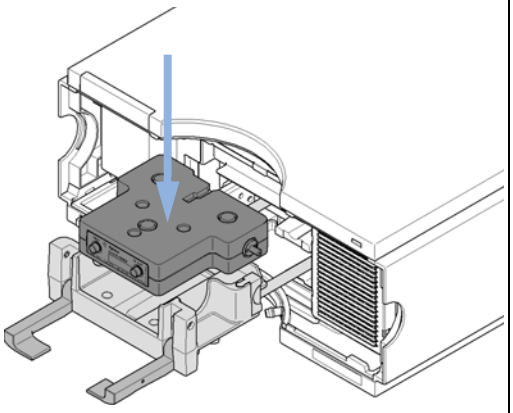
5 The lever should be in the final down position.



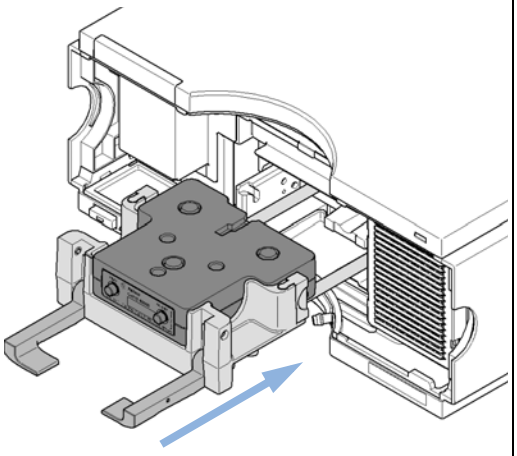
6 Pull the flow cell cartridge completely out towards the front.



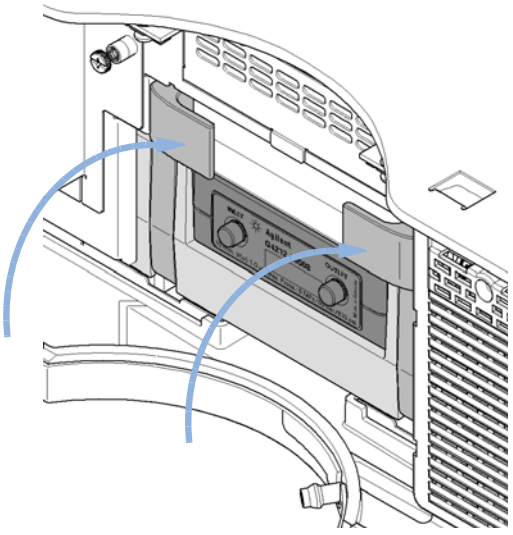
7 Remove the black hoods from the cell interfaces (in/out) and insert the cell into the cell cartridge holder.



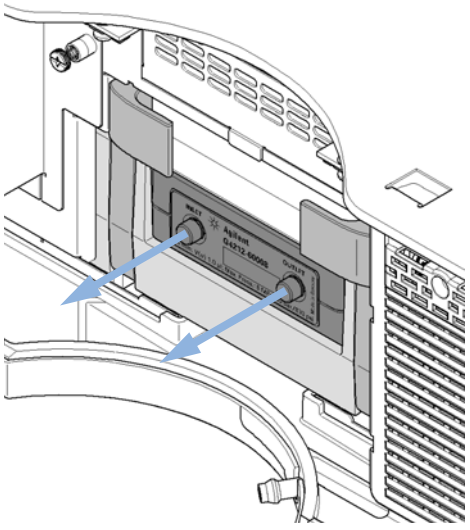
8 Slide the cell cartridge holder completely into the module.



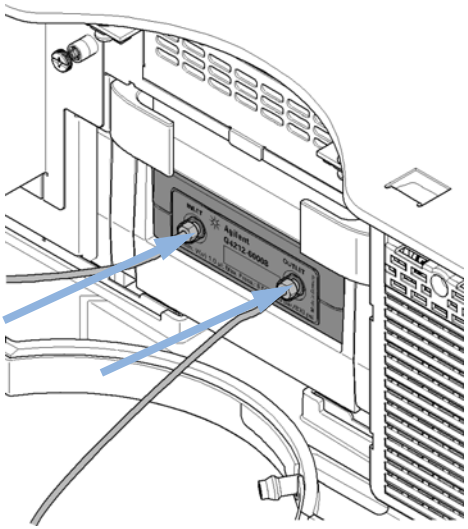
9 Lift the two levers into the upper final position to fix the cell.



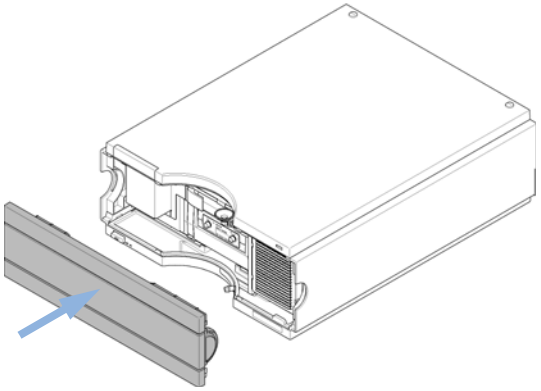
10 Remove the plugs from the CELL-IN and CELL-OUT (keep them safe).



11 Connect the inlet capillary to CELL-IN (left) and the waste tubing to CELL-OUT (right).



12 Close the front cover.



13 Route the inlet capillary and waste tubing towards their destinations.

NOTE The detector should be operated with the front cover in place to protect the flow cell area against strong drafts from the outside.

NOTE If the flow cell is replaced by a different flow cell, it should be flushed with isopropanol and the CELL-IN and CELL-OUT should be closed with the plugs.

NOTE To protect the flow cell against overpressure please refer to "Inline Pressure Relief Valve Kit (G4212-68001)" on page 82.

Initial Recalibration

The detector has been calibrated with a factory flow cell initially. After installation of the detector with the delivered or a new Max-Light Cartridge flow cell and an initial warm-up of at least 2 hours, a recalibration should be performed ("Wavelength Calibration" on page 156). This recalibration will correct slight changes due to

- significant environmental condition changes (temperature, humidity) during transport and storage,
- significant environmental condition changes (temperature, humidity) in final location and
- variances between factory test cell and the installed flow cell.

4
Using the Module

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

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); refer to "Specification Conditions" on page 28.
- For high sensitivity measurements, a stable environment is required; refer to "Environment" on page 22. Prevent drafts from air condition systems.
- Setting an appropriate reference wavelength could improve the baseline behavior. Alternatively use the 1.6 µL heat exchanger from the G1316C TCC.
- Do not work with removed front panels. When the front panel of the G1316C TCC (typically located below the detector) is removed while the TCC is set to high temperatures, the up-streaming air could influence the stability of the detector baseline.

Setting up the Detector with Agilent ChemStation

The setup of the detector is shown with the Agilent ChemStation B.04.02 based on the 1290 Infinity DAD (G4212A). Depending on the controller (e.g. Agilent Instant Pilot, EZChrom Elite, MassHunter) the screens look different. For the Instant Pilot refer to "Main Screens of the Detector with Agilent Instant Pilot (G4208A)" on page 69.

NOTE This section describes the detector settings only. For information of the Agilent ChemStation or other Agilent 1260 Infinity/1290 Infinity Series modules refer to the corresponding documentation or system manual.

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

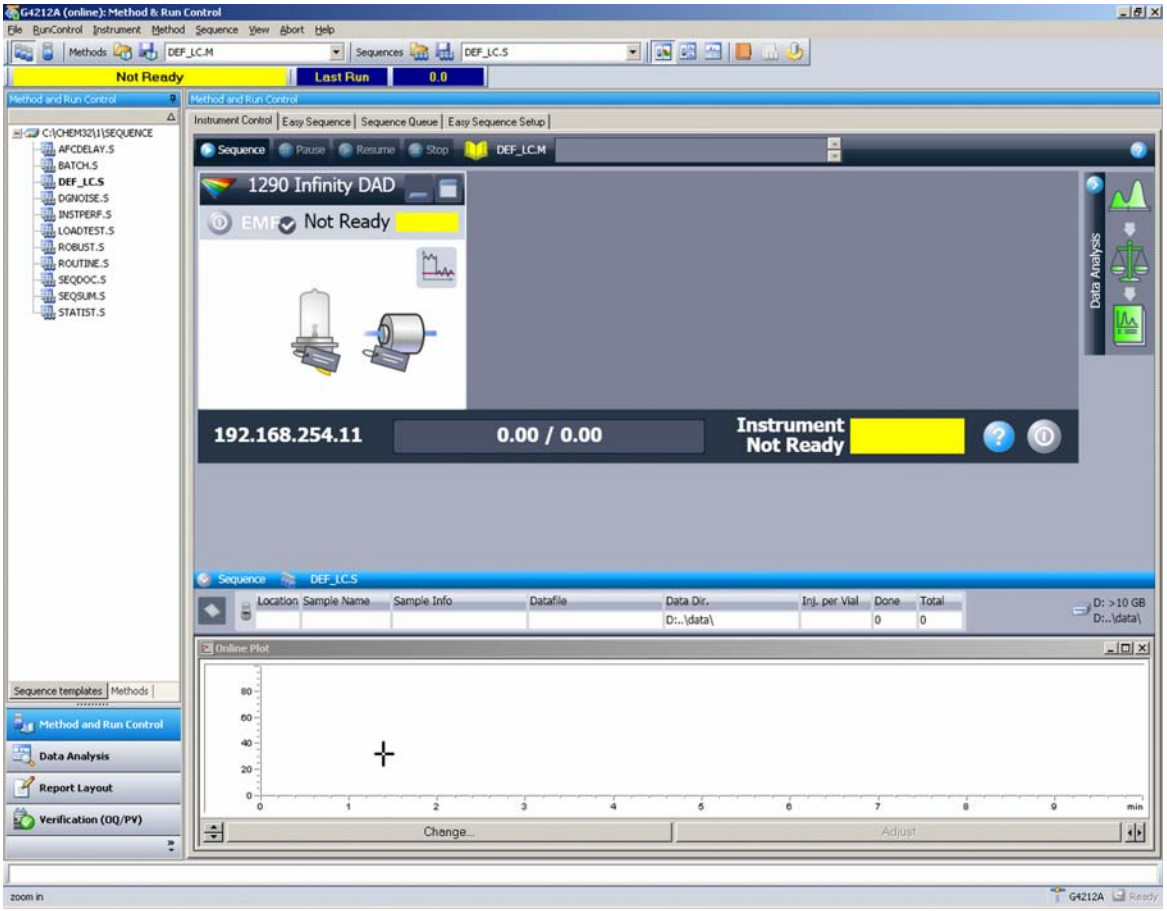
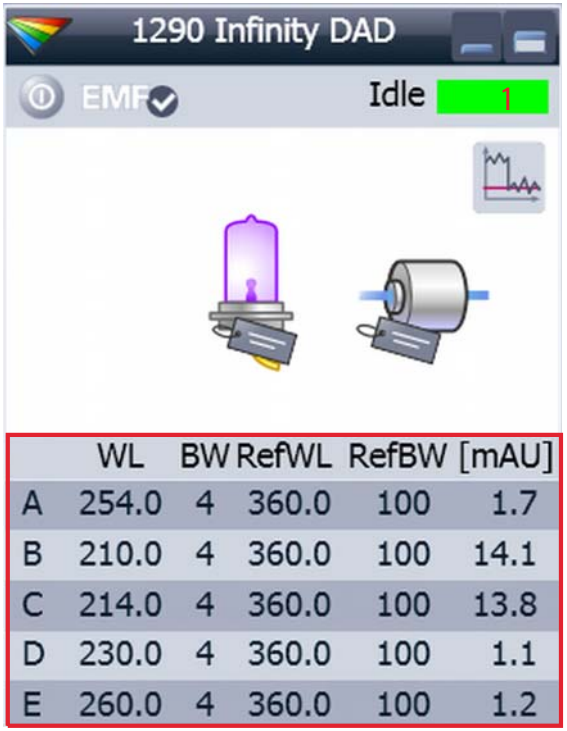


Figure 16 ChemStation Method & Run

The Detector GUI

Within the detector GUI, there are active areas. If you move the mouse cursor across the icons the cursor will change and you may click on the button (1) to

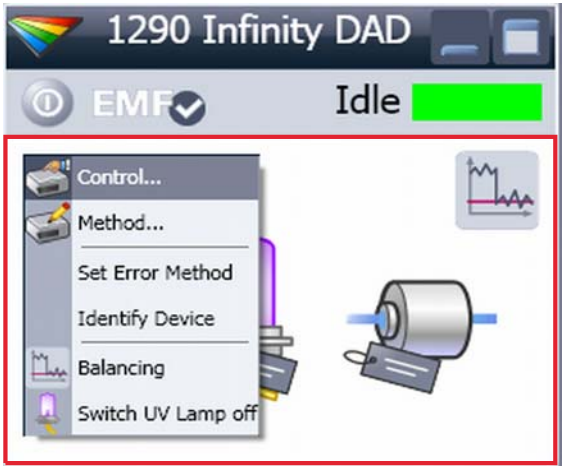
- *"Make Device Ready/Turn device off (standby)"*
- turn on/off the lamp



Signal Information, activated by button (1), shows actual values of all selected signals

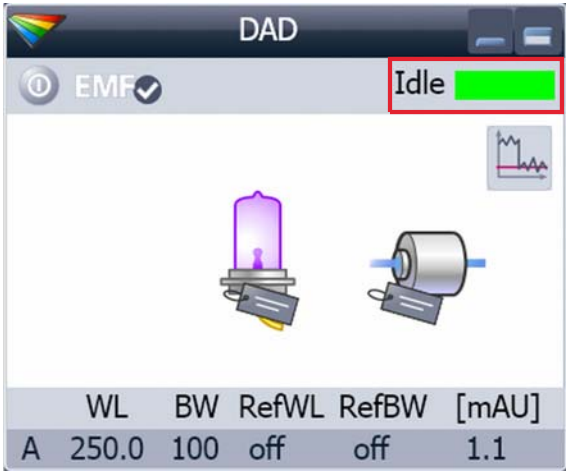
- Signal name (A, B, C, ...)
- Sample wavelength/bandwidth
- Reference wavelength/bandwidth
- Absorbance

If more signals are activated, the size of the detector GUI will change accordingly.



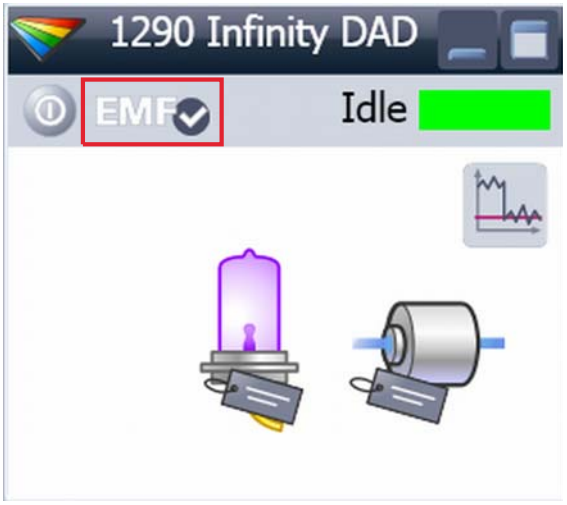
A right-click into the *Active Area* will open a menu to

- 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 UV-lamp on/off (same as click on button *"Make Device Ready/Turn device off (standby)"*)



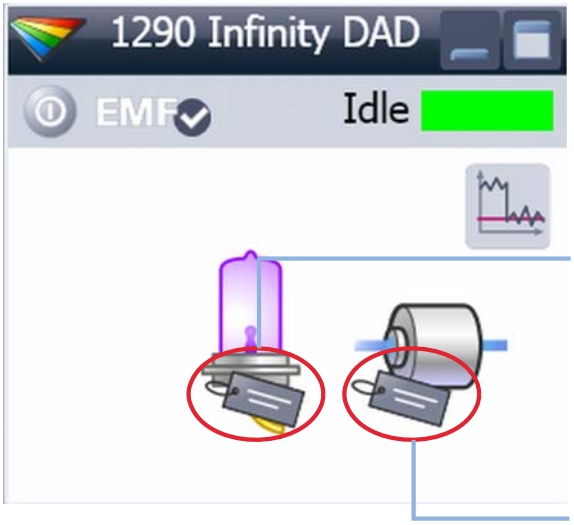
Module Status shows Run / Ready / Error state and "Not Ready text" or "Error text".

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



EMF Status shows
- Offline (gray)
- Ok. No Maintenance required
- EMF warning. Maintenance or check might be required (yellow)
- EMF warning. Maintenance required (red)

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



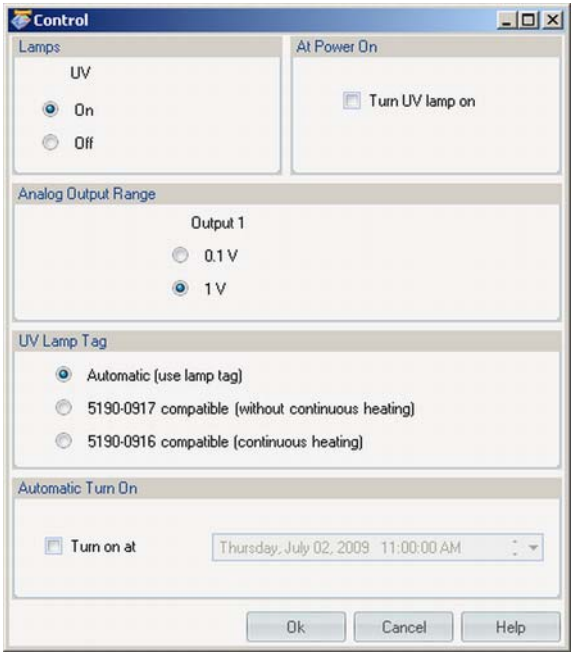
RFID tag information is displayed when moving with the mouse cursor on to the tag attached to the flow cell or lamp. The information provides flow cell and lamp related information like
- Part number
- Production date
- Serial number

and other details.

Lamp tag information	
Burn time	93.3 h
Minimum lifetime	2000.0 h
Number of ignitions	10
Product Number	5190-0917
Serial Number	824337
Production Date	4/9/2009 8:23:53 AM
Tested Date	7/16/2009 1:50:04 PM
Intensity at test	37275 counts

Cell tag information	
Cell Name	Max-Light Cell
Product Number	G4212-60008
Serial Number	10PP042325
Production Date	2/5/2009 12:49:06 PM
Optical path length	10.0 mm
Cell Volume (σ)	1.0 µL
Maximum pressure	60 bar
Tested Date	7/10/2009 1:44:52 PM
Cell Revision	0

Control Settings



Lamps: can be turned ON/OFF.
At Power On: automatic lamp-on at power on.

Analog Output Range: can be set to either 100 mV or 1 V full scale (1 V = default).

UV lamp Tag: Automatic detects a lamp with RFID tag. If no RFID tag lamp is used, *"UV lamp not ready"* is displayed and it cannot be ignited. A compatible mode has to be selected based on the used lamp; see Non-RFID-tag lamp information below.
Automatic Turn On: The module can be turned on at a specified date/time. If *"Turn UV lamp on"* at power on is set, the lamp is turned on as well.

Non-RFID-tag lamp
In case a non-RFID-tag lamp is used, the user interface will show this when selecting a compatible mode.
You may operate the detector outside of the guaranteed specification.

Method Parameter Settings

These settings are available via **Menu – Instrument – Setup Instrument Method** or via right click on the active area of the detector GUI.

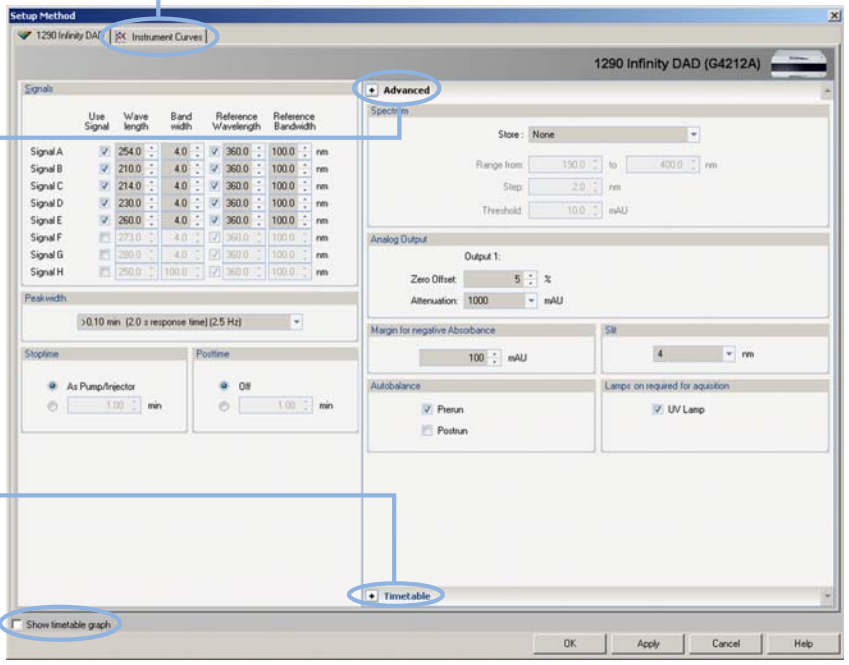
NOTE The Instrument Curves tab is not shown when opening the method parameter settings via right mouse click on the detector GUI.

Switches to additional instrument signals for troubleshooting

Toggles to Advanced Settings (actual window)

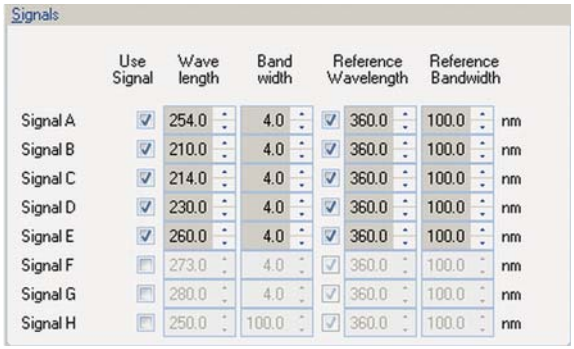
Toggles to Timetable Settings

Opens the Time table graph



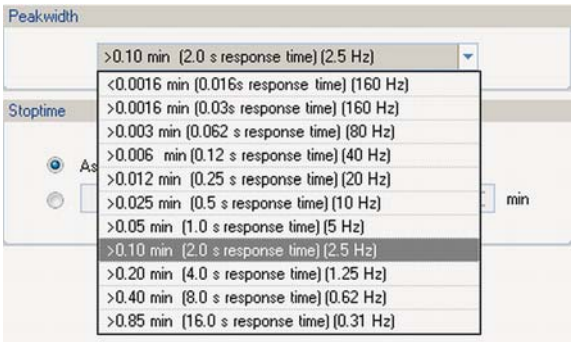
General Method Settings

Signals



Up to 8 individual signals can be set. For each of the signals, the wavelength and bandwidth can be set for sample and reference.
Limits:
Wavelength: 190.0 to 640.0 nm in steps of 0.1 nm
Bandwidth: 1.0 to 400.0 nm in steps of 0.1 nm
Setting an appropriate reference wavelength could improve the baseline behavior. Alternatively use the 1.6 µL heat exchanger from the G1316C TCC or an optional DAD heat exchanger (if available).

Peakwidth



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 detector. The peak detector ignores any peaks that are considerably narrower, or wider, than the peak width setting. The response time is the time between 10 % and 90 % of the output signal in response to an input step function. When the All spectrum storage option is selected, then spectra are acquired continuously depending on the setting of the peak width. The time specified by the peak width is used as a factor in the acquisition of spectra. The acquisition time for one spectrum is slightly less than the peak width divided by 8, which is the acquisition time.

Limits: When you set the peak width (in minutes), the corresponding response time is set automatically and the appropriate data rate for signal and spectra acquisition is selected.

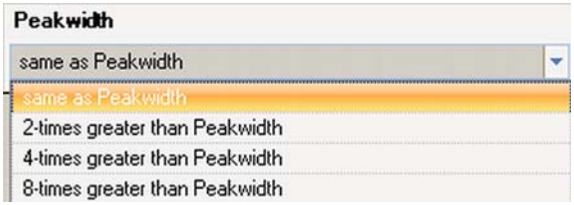
- Do not use peak width shorter than necessary.
- G4212B: Do not use 0.025 seconds response time (no filtering/high noise and no need (actually ultra-fast LC doesn't deliver peaks < 0.0025 min/ < 0.15 sec).

NOTE

The 1290 Infinity DAD (G4212A) has a data rate of up to 160 Hz.

The 1260 Infinity DAD (G4212B) has a data rate of up to 80 Hz.

Peakwidth (time programmed)



These selections can be made during time programmed operation.
When used in a timetable, Peakwidth changes the filters used for peak-controlled spectra acquisition, but not the data rate of a chromatographic signal.

NOTE

This setting makes sense only with peak-controlled spectra; it allows you to change the peakwidth setting to account for broadening peaks at the end of the run.

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.
A posttime period can be used to allow module's items to equilibrate (e.g. after gradient change or temperature change).

Advanced Method Parameter Settings

These settings are available via a click on the **Advanced** link of the Method Parameter Settings (in case the Time Table Settings are open).

This screen shows the default settings.

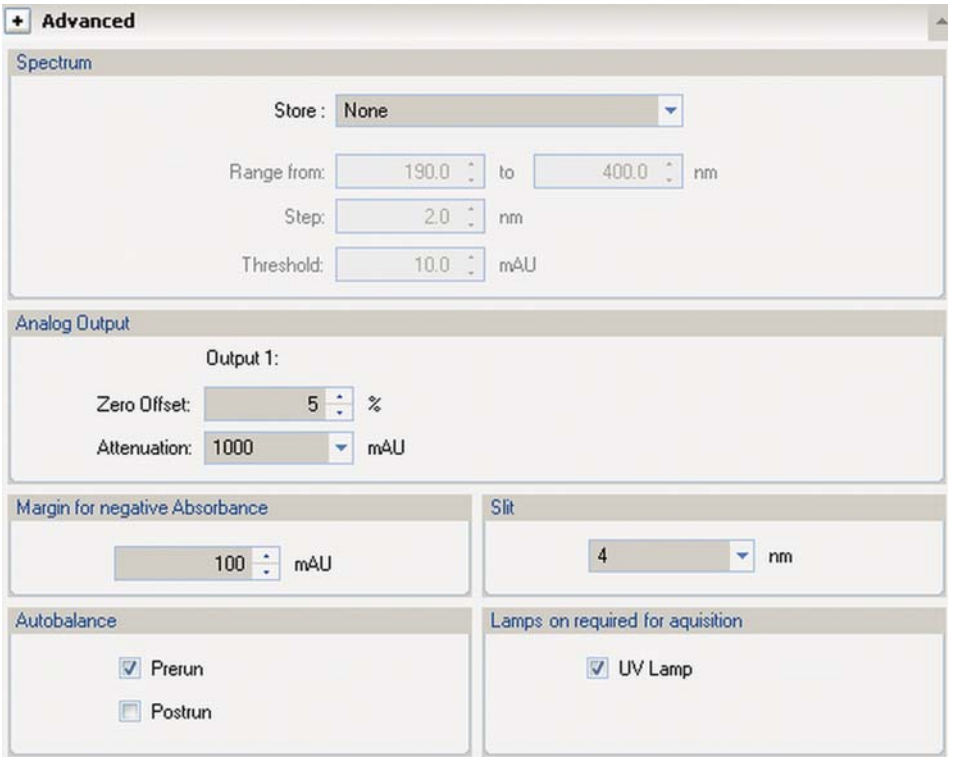
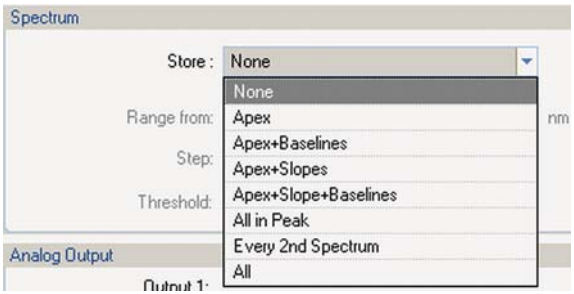


Figure 17 Method Parameter Settings

NOTE The 1260 Infinity DAD (G4212B) has a fixed slit width of 4 nm.

Spectrum Settings

Store



Defines at which points on *"signal A"* spectra will be taken and saved. Signal A is used to control the *"peak controlled spectra acquisition"*; the other signals have no influence on spectra acquisition.
Limits:
190.0 to 640.0 nm in steps of 0.1 nm for both low and high values. The high value must be greater than the low value by at least 0.1 nm.

None — No spectra are taken.

Apex — Spectra are taken at the apex of the peak.

Apex + Baselines — Spectra are taken at the apex and baselines of the peak.

Apex + Slopes — Spectra are taken at the apex, upslope, and down slope of the peak.

Apex + Slopes + Baselines — Spectra are taken at the apex, baselines, upslope, and down slope of the peak.

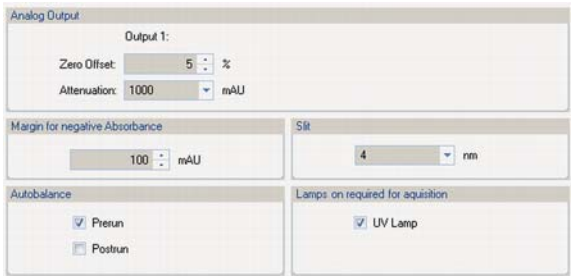
All in Peak — All spectra within the peak are taken.

Every 2nd spectrum — Spectra are taken continuously as for All, but only every second spectrum is stored; other spectra are discarded. This reduces the amount of data storage necessary.

Range — Range defines the wavelength range for spectral storage. Limits: 190 to 640 nm in steps of 1 nm for both low and high values. The high value must be greater than the low value by at least 2 nm.

Step	Step defines the wavelength resolution for spectral storage. Limits: 0.10 to 100.00 nm nm in steps of 0.1 nm.
Threshold	The threshold is the height in mAU of the smallest expected peak. The peak detector ignores any peaks which are lower than the threshold value and does not save spectra. Limits: 0.001 to 1000.00 mAU in steps of 0.001 mAU.

Other Advanced Method Parameter Settings



This screen (part of the Advanced Method Settings) shows the default settings.

Analog Output

The Range can be set to either 100 mV or 1 V full scale, see "Control Settings" on page 56.

Zero Offset

1 to 99 % in steps of 1 % (5 % equal to 50 mV).

Attenuation

0.98 to 2000 mAU at discrete values for either 100 mV or 1 V full scale.

Margin for Negative Absorbance

Use this field to modify the detector's signal handling to increase the margin for negative absorbance. Use this option if, for example, your solvent gradient produces a decreasing baseline absorbance, and for GPC analyses. Limits: 100 to 4000 mAU.
The higher the value the greater the baseline noise. Set this value only if you expect negative absorbance greater than -100 mAU.

Slit (G4212A)

You can select the optical bandwidth (1, 2, 4 or 8 nm) of the detector; the narrower the slit, the smaller the optical bandwidth of the instrument, but the lower its sensitivity. The smaller the optical bandwidth the higher the spectral resolution.

NOTE

The 1260 Infinity DAD (G4212B) has a fixed slit width of 4 nm.

Autobalance

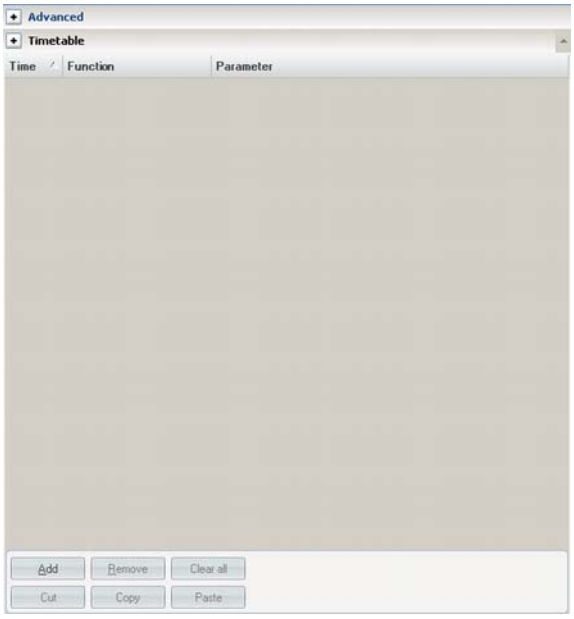
Defines, whether a balance is performed prior to a run and/or after a run has finished.

Lamp on required for analysis

If unchecked, the lamp will be turned off after the analysis has finished.

Time Table Settings

Timetable window

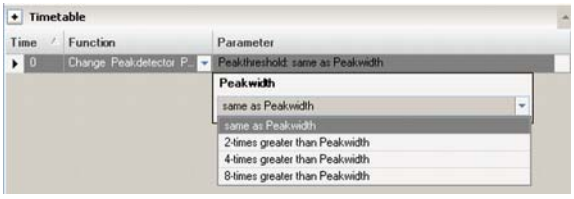


You may set up time events to change functions with their parameters over the run time. Add lines as required.
Time Limits:
0.00 to 99999.00 minutes in steps of 0.01 min.
Via the buttons in the bottom area, time table lines can be added, removed, cut copied, pasted or completely cleared.

Functions

You may set up time events to change functions with their parameters over the run time. Add lines as required.
Limits:
0.00 to 99999.00 minutes in steps of 0.01 min.

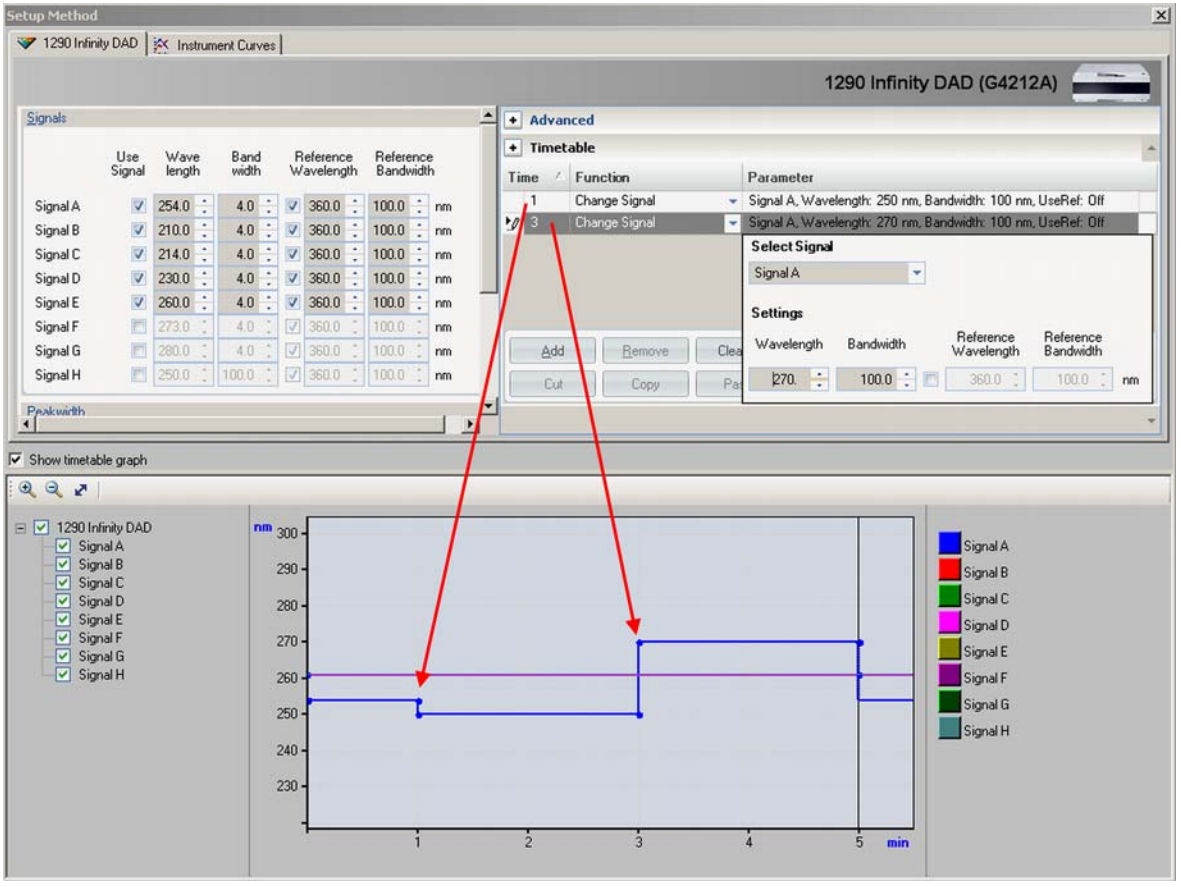
Parameter



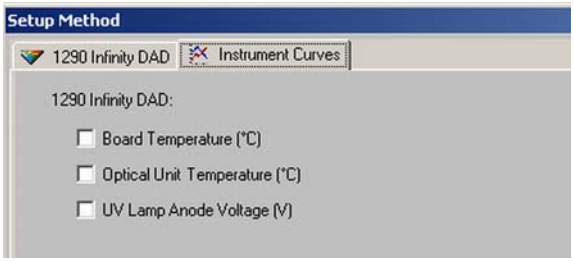
Based on the chosen function, a certain parameter can be selected.

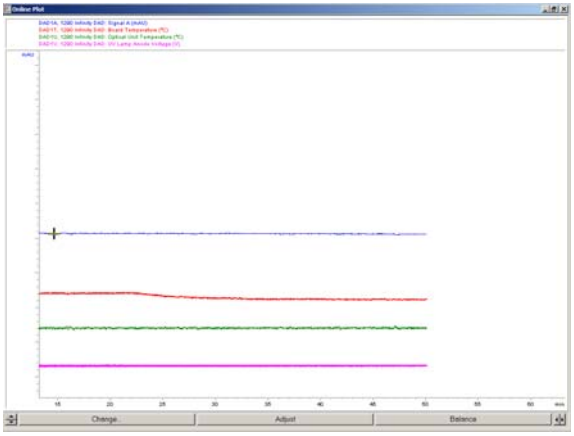
Time Table Graph

In this view the activated signals are shown how they change according the time table.



Instrument Curves





The detector has several signals (internal temperatures, voltages of lamps) that can be used for diagnosing problems. These can be baseline problems deriving from deuterium lamps wander / drift problems due to temperature changes.
These signals can be used in addition to the normal baseline signal to determine whether correlation to temperature or voltage/current of the lamp.
These signals are available via the Agilent ChemStation Online Plot/Data Signal and/or Agilent Lab Advisor Software.

Instrument Configuration

These settings are available via menu **Instrument – Instrument Configuration**.

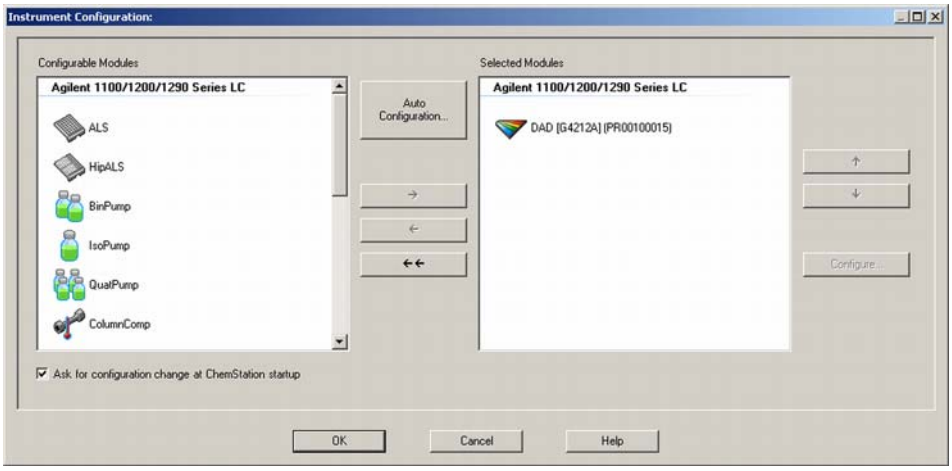
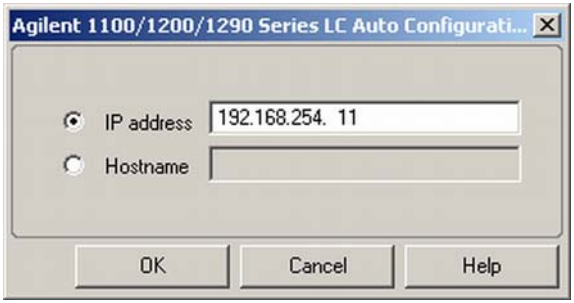
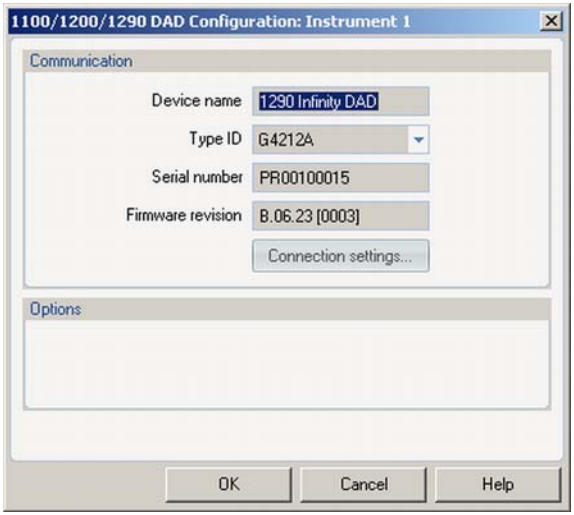


Figure 18 Menu **Instrument Configuration**

Via the **Instrument Configuration** screen additional modules can be added to a system.



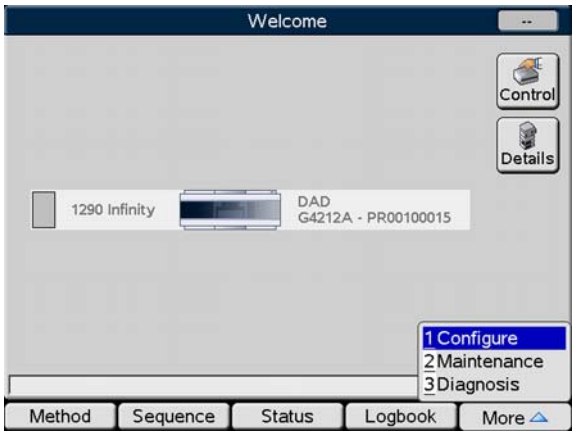
Use the **Auto Configuration** to define the LAN communication between the Agilent ChemStation and the host module (usually the Agilent detector).
Changing parameters become active after reboot of the ChemStation.



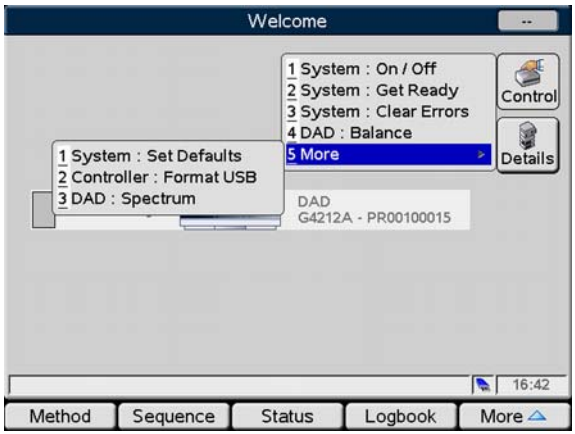
Device name: based on the module.
Type ID: based on the module (product number). Some modules may allow changing the type based on hardware/firmware. This results in a change of features and functions.
Serial number: based on the module.
Firmware revision: based on the module.
Options: lists installed options.

Main Screens of the Detector with Agilent Instant Pilot (G4208A)

Below the main screens for the use of the detector are shown.

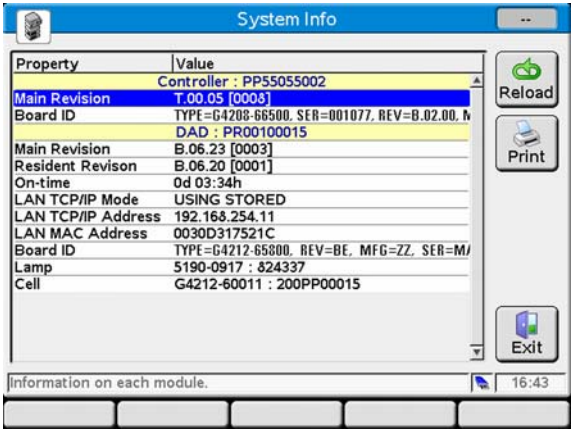


The Welcome screen shows all modules of the system.



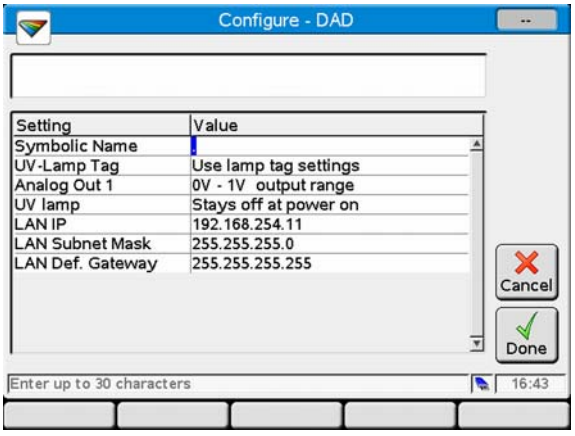
The **Control** screen allows

- Lamp On/Off
- Get Ready
- Reset of Errors
- Balance
- Take Spectrum



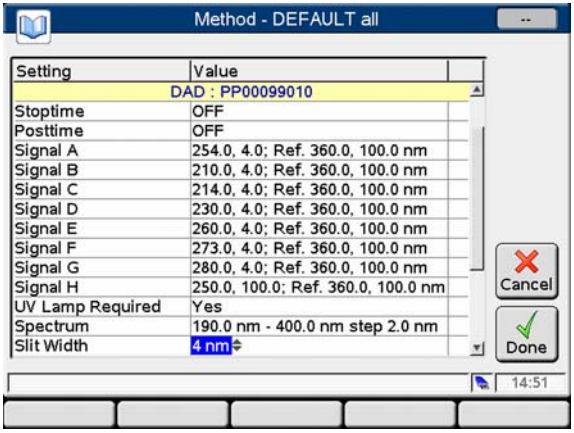
The **System Info** screen list details of the detector

- Firmware revision
- On-time
- LAN settings
- Main Board information
- Lamp RFID tag Information
- Flow cell RFID tag Information

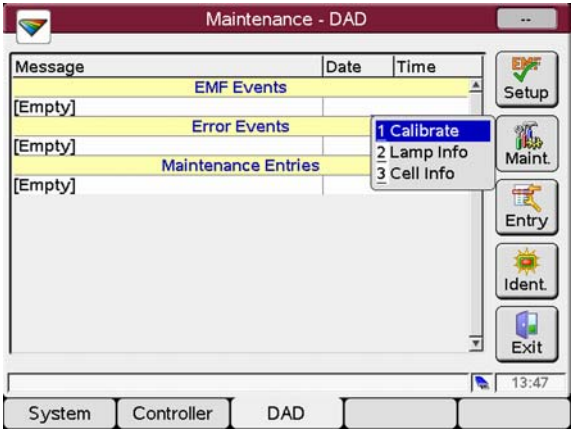


The **Configuration** screen allows to configure

- Symbolic name of module
- Temperature control
- Lamp and cell RFID tag use
- Analog Output range
- UV lamp at power on
- LAN settings



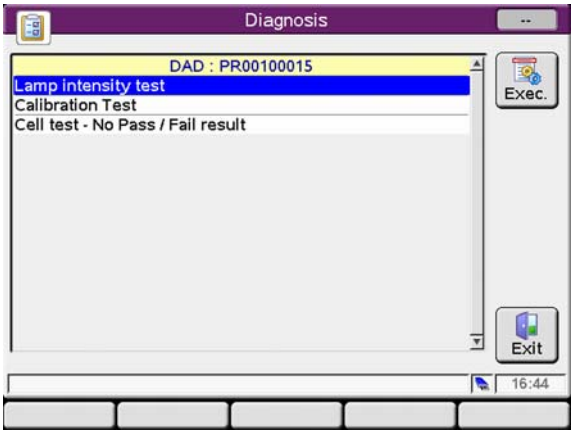
The **Method** screen lists all method parameters of the detector. These can be edited.



The **Maintenance** screen allows

- EMF setup
- Maintenance (calibrate, cell/lamp info)
- logging of maintenance activities
- module identification (blinking LED)

Firmware Updates can be done via the System Maintenance screen.



The **Diagnose** screen provides access to module specific tests

- Lamp Intensity
- Calibration
- Cell

Solvent Information

Observe the following recommendations on the use of solvents.

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

Solvent information for parts of the 1260 Infinity Bio-inert LC system

For the Agilent 1260 Infinity Bio-inert LC system, Agilent Technologies uses highest quality materials (see "Bio-inert Materials" on page 17) in the flow path (also referred to as wetted parts), which are widely accepted by life scientists, as they are known for optimum inertness to biological samples, and ensure best compatibility to common samples and solvents over a wide pH range. Explicitly, the complete flow path is free from stainless steel and free from other alloys containing metals such as iron, nickel, cobalt, chromium, molybdenum or copper, which can interfere with biological samples. The flow downstream of the sample introduction contains no metals whatsoever.

However, there are no materials that combine suitability for versatile HPLC instrumentation (valves, capillaries, springs, pump heads, flow cells etc.) with complete compatibility with all possible chemicals and application conditions. This section recommends the preferred solvents. Chemicals that are known to cause issues should be avoided, or exposure should be minimized, for example, for short-term cleaning procedures. After potentially aggressive chemicals have been used, the system should be flushed with compatible standard HPLC solvents.

PEEK

PEEK (Polyether-Ether Ketones) combines excellent properties with regard to biocompatibility, chemical resistance, mechanical and thermal stability and is therefore the material of choice for biochemical instrumentation. It is stable in the specified pH range, and inert to many common solvents. There is still a number of known incompatibilities with chemicals such as chloroform, methylene chloride, THF, DMSO, strong acids (nitric acid > 10 %, sulphuric acid > 10 %, sulfonic acids, trichloroacetic acid), halogenes or aequous halogene solutions, phenol and derivatives (cresols, salicylic acid etc.).

When used above room temperature, PEEK is sensitive to bases and various organic solvents, which can cause it to swell. As normal PEEK capillaries are very sensitive to high pressure, especially under such conditions, Agilent uses stainless-steel cladded PEEK capillaries to keep the flow path free of steel and to ensure pressure stability to at least 600 bar. If in doubt, consult the available literature about the chemical compatibility of PEEK.

Titanium

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. Reducing 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). The addition of nitric acid to hydrochloric or sulfuric acids significantly reduces corrosion rates. 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 %.

Fused silica

Fused silica is inert against all common solvents and acids except hydrofluoric acid. 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 (a mixture of concentrated hydrochloric and nitric acid).

Zirconium Oxide

Zirconium Oxide (ZrO_2) 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.

PTFE

PTFE (polytetrafluorethen) is inert to almost all common acids, bases and solvents. There are no documented incompatibilities for HPLC applications.

Sapphire, Ruby and Al_2O_3-based ceramics

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

Data above were collected from external resources and are meant as a reference. Agilent cannot guarantee the completeness and correctness of such information. Information can also not be generalized due to catalytic effects of impurities like metal ions, complexing agents, oxygen etc. Most data available refers to room temperature (typically 20 – 25 °C, 68 – 77 °F). If corrosion is possible, it usually increases at higher temperatures. If in doubt, consult additional resources.

5 Optimizing the Detector

This chapter provides information on how to optimize the detector.

Introduction

The detector has a variety of parameters that can be used to optimize performance. Depending on whether signal or spectral data need to be optimized, different settings are recommended. The following sections describe optimization for:

- signal sensitivity, selectivity and linearity,
- spectral sensitivity and resolution (DAD only), and
- disk space required for storing data.

NOTE The information in this chapter should be seen as a basic introduction to diode array detector techniques. Some of these techniques may not be available in the instrument software controlling the detector.

How to Get the Best Detector Performance

The information below will guide you on how to get the best detector performance. Follow these rules as a start for new applications. It gives rules-of-thumb for optimizing detector parameters.

Optimization Overview

Table 6 Optimization Overview

Parameter	Impact
1 Selection of flow cell	• peak resolution versus sensitivity
• Choose flow cell according to used column ("Choosing a Flow Cell" on page 80).	
2 Connection of flow cell	• chromatographic resolution
3 Setting the peak width (response time)	• peak resolution versus sensitivity versus disk space
• Use peak width according "Choosing a Flow Cell" on page 80 as starting point. • Set the peak-width close to the width of a narrow peak of interest in your chromatogram.	
4 Setting wavelength and bandwidth	
• Sample wavelength: ◦ Never miss a peak by the use of a browser wavelength like 250 nm with 100 nm bandwidth. ◦ Select specific wavelength with reduced optical bandwidth if you need selectivity, e.g. 254.0 nm / 4 nm and 360.0 nm / 100 nm as reference wavelength. ◦ Set the sample wavelength to a peak or valley to get best linearity in general; select a valley to get best linearity for high concentrations.	• sensitivity versus selectivity • sensitivity versus linearity
• Reference wavelength: ◦ Select the reference wavelength with broad bandwidth (30...100 nm) wavelength range where your analytes have little or no absorbance (e.g. sample at 254 nm, reference at 320 nm). ◦ Select the reference wavelength as near as possible to the UV range.	• baseline drift due to RI effects.
5 Setting the slit width (G4212A only)	
• Use 4 nm slit for normal applications. • Use narrow slit (e.g 1 nm) if your analytes have narrow absorbance bands and for high concentrations. • Use a wide slit (e.g. 8 nm) to detect very low concentrations. • Optimizing spectral acquisition (DAD only) • Select spectra acquisition mode according to your needs (see "Spectrum Settings" on page 61). • Set the spectral wavelength range (for colorless samples 190...400 nm is sufficient). • Set step to 4 nm for normal use; set small step (and slit width) if high resolution of spectra with fine structure is wanted.	• spectral resolution, sensitivity and linearity.

Choosing a Flow Cell

Several flavors of the Max-Light Cartridge Flow Cell are available, see (Table 7 on page 80).

Table 7 Specifications for Max-Light Cartridge Flow Cells

Cartridge Cells	• Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL) (G4212-60008) • Max-Light Cartridge Cell Bio-inert (10 mm, V(σ) 1.0 µL) (G5615-60018) • Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL) (G4212-60007) • Max-Light Cartridge Cell Bio-inert (60 mm, V(σ) 4.0 µL) (G5615-60017) • HDR Max-Light Cartridge Cell (3.7 mm, V(σ) 0.4 µL) (G4212-60032) • ULD Max-Light Cartridge Cell (10 mm, V(σ) 0.6 µL) (G4212-60038) • Max-Light Cartridge Test Cell (G4212-60011)
Maximum pressure	70 bar (1015 psi) Maximum Operating Pressure (MOP)[1] 150 bar (2175 psi) Maximum Incidential Pressure (MIP)[2]
pH range	1.0-12.5 (solvent dependent)

[1] Maximum Operating Pressure (MOP): The maximum pressure at which the system can operate continuously under normal conditions.

[2] Maximum Incidential Pressure (MIP): The maximum pressure which the system can experience during a short time.

Normal Applications

The Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL) (G4212-60008) covers a wide range of applications:

- all column diameter down to at least 2.1 mm ID or even less
- applications with peak dispersion (Peakwidth x flow) down to ~2 µL [example: pw = 0.04 min at flow = 0.1 mL/min gives peak dispersion of 0.04 min x 0.1 mL/min = 0.004 mL = 4 µL]

High Sensitiviy

If higher sensitivity is necessary, the Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL) (G4212-60007) can be used. This cell enhances the detector by lowering the limit of detection (LOD) by a factor of about 3 (depending on the application).

Ultra-Low Dispersion

The Max-Light Cartridge ULD cell can be used with the G4212A DAD and G4212B DAD. The cell is a requirement for the Ultra-Low Dispersion Kit solution which currently exists as 1290 Infinity Ultra-Low Dispersion Kit (5067-5189). The cell should be part of the ultra-low dispersion solution.

High Dynamic Range

The Max-Light Cartridge HDR cell can be used with the G4212A DAD and G4212B DAD. The cell is required as a part of the High Dynamic Range (HDR) solution which will be introduced March/April 2013.

NOTE

To protect the flow cell against overpressure (e.g. in systems with LC/MS) install Inline Pressure Relief Valve Kit (G4212-68001), see "Inline Pressure Relief Valve Kit (G4212-68001)" on page 82.

Recommendations

For G4212-60007 and G4212-60008

The use of Peek-FS capillaries is not recommended. In combination with the SST zero dead volume fitting (e.g. at the inlet) the capillary could break and the glass particles could block/damage the flow cell.

Inline Pressure Relief Valve Kit (G4212-68001)

When several detectors are installed in a system the connecting capillary and fittings between the detectors must be carefully chosen to keep chromatographic influence on peak shape small. On the other hand narrow bore connection capillaries generate a significant pressure drop dependent on flow rate and solvent properties.

The pressure relief valve is designed to protect the flow cell of a Agilent 1200 Series Infinity Diode Array Detector (G4212A DAD and G4212B DAD). Agilent strongly recommends installing the pressure relief valve at the outlet of the detector as soon as a second detector is installed like in LC/MS applications.

The pressure relief valve with a low internal volume check valve. The dead volume is smaller than 100 nL delay volume (inlet to outlet). The ball of the check valve is spring loaded and adjusted to open at typically 100 bar. On overpressure (typically around 100 bar) it releases the pressure to waste.

Application Information

For the analysis and characterization of proteins and large biomolecules for SEC, AEX and RP applications add 100 mM salt into mobile phase or 10 % organic to prevent secondary interaction.

For cation exchange chromatography the usage of an Agilent Diode Array Detector G1315C/D with the respective bio-inert flow cell is highly recommended to avoid unspecific interaction of the protein with the flow cell.

For applications with mobile phases of a pH above 12.5 use an Agilent Diode Array Detector G1315C/D and the respective bio-inert flow cell.

Special Information of 60 mm Cartridge Flow Cell

Application Information

The geometrical volume of the 60 mm cell is 6 times larger than the 10 mm cell. However, the chromatographic relevant dispersion volume, the square roots of variances, accounting for cell specific geometrical volume shape and fluidic flow pattern, have been determined as σV = 4 µL and σV = 1 µL in for the 10 mm cell.

Due to the larger dispersion volume, the 60 mm cell is primarily designed for 4.6 mm column applications to achieve highest sensitivity with no additional peak broadening. However, if sensitivity is important the 60 mm cell will also be advantageous in case of smaller columns (3 mm, 2.1 mm) but depending on the chromatographic system and method additional peak broadening might occur.

The upper limit of concentration

Care should be taken in methods where high background absorption of solvents or modifiers are present. When using the 60 mm cell the detector will measure 6 times the background absorption as in case of the 10 mm cell, which will reduce the remaining dynamic absorbance range for sample peaks. Furthermore those UV absorbing modifiers could compromise the sensitivity gain (signal/noise) of 60 mm cell.

The linearity limit of the detector is seen at about 2 AU for both, the 10 mm and the 60 mm Max-Light Cartridge Flow Cell. Using firmware revision B.06.25 and below, the 60 mm Max-Light Cartridge Cell linearity limit would be 333 mAU/cm.

Required Detector Firmware

For use of the 60 mm Max-Light Cartridge Flow Cell a detector firmware B.06.26 (introduced December 2009) or later is required.

NOTE If the 60 mm Max-Light Cartridge Flow Cell is used with detector firmware B.06.25 and below, the detector output (digital and analog) is normalized to 1 cm. This means the peak height would be the same as on the 10 mm Cartridge Flow Cell, the noise is reduced by a factor of 6 and the linearity limit would be 333 mAU/cm.

Special Information for Bio-Inert Cartridge Flow Cells

Special Information for Bio-Inert Cartridge Flow Cells

For bio-inert applications use the specified BIO Max-Light Cartridge Flow Cell only.

Both bio-inert Max-Light Cartridge Flow Cells include

- PEEK tubing 1/16” (0890-1763) and
- Fingertight fitting long (5062-8541)

Recommendations

Assure the following:

- The capillary ends are right-angled when cutting capillaries.
- No pliers or wrenches are used to fix the PEEK fittings at the flow cell.
- No metal ferrules are used at the cell unions to prevent contaminations and damage.
- the flow cell is bypassed when flush procedures at pH > 12.5 are used.

Application Information

For the analysis and characterization of proteins and large biomolecules for SEC, AEX and RP applications add 100 mM salt into mobile phase or 10 % organic to prevent secondary interaction.

For cation exchange chromatography the usage of an Agilent 1260 Infinity Diode Array Detector G1315C/D with the respective bio-inert flow cell is highly recommended to avoid unspecific interaction of the protein with the flow cell.

For applications with mobile phases of a pH above 12.5 use an Agilent 1260 Infinity Diode Array Detector G1315C/D and the respective bio-inert flow cell.

Optimizing for Sensitivity, Selectivity, Linearity and Dispersion

Flow Cell Path Length

Lambert-Beer's law shows a linear relationship between the flow cell path length and absorbance.

$$\text{Absorbance} = -\log T = \log \frac{I_0}{I} = \varepsilon \times C \times d$$

where

T is the transmission, defined as the quotient of the intensity of the transmitted light I divided by the intensity of the incident light, I_0,

ε is the extinction coefficient, which is a characteristic of a given substance under a precisely-defined set of conditions of wavelength, solvent, temperature and other parameters,

C [mol/L] is the concentration of the absorbing species, and

d [cm] is the path length of the cell used for the measurement.

The detector can now output the signal in two forms:

1. In Absorbance divide by the path length AU/cm, that is then similar to [ε x C]. Advantage: samples with same concentration have same peak height also at cells with different path lengths.

   The upper limit of concentration: the linearity limit of the detector is then seen at about 2 AU/path length, so for the 6 cm Max-Light Cartridge Cell the linearity limit is 333 mAU/cm].

2. In AU that is equal to ε x C x d like normal done in the past: now for recalculation to your concentration C the path length must be considered.

Therefore, flow cells with longer path lengths yield higher signals. Although noise usually increases little with increasing path length, there is a gain in signal-to-noise ratio.

When increasing the path length, the cell volume could increase. Depending on the peak volume, this could cause more peak dispersion.

As a rule-of-thumb the flow cell volume should be about 1/3 of the peak volume at half height. To determine the volume of your peaks, take the peak width as reported in the integration results multiply it by the flow rate and divide it by 3).

NOTE This may result in problems when the used peak width is set to large and all peaks are filtered accordingly.

Traditionally LC analysis with UV detectors is based on comparing measurements with internal or external standards. To check photometric accuracy of the Agilent detector it is necessary to have more precise information on path lengths of the detector flow cells.

Part Number	Path Length	Cell Volume (σ)
G4212-60008/G5615-60018	1.0 cm	1.0 µL
G4212-60007/G5615-60017	6.0 cm	4.0 µL

Peak width (response time)

Response time describes how fast the detector signal follows a sudden change of absorbance in the flow cell. The detector uses digital filters to adapt response time to the width of the peaks in your chromatogram. These filters do not affect peak area nor peak symmetry. When set correctly, such filters reduce baseline noise significantly (Figure 19 on page 87), but reduce peak height only slightly. In addition, these filters reduce the data rate to allow optimum integration and display of your peaks and to minimize disk space required to store chromatograms and spectra.

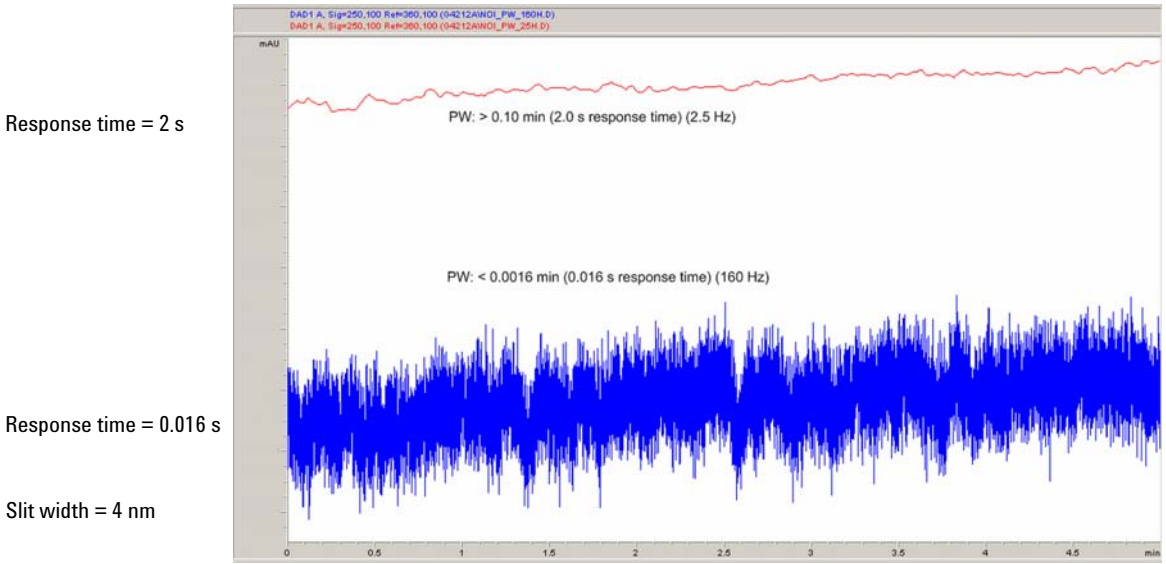


Figure 19 Influence of Response Time on Signal and Noise

Table 8 on page 88 lists the filter choices of the detector. To get optimum results, set peak width as close as possible to a narrow peak of interest in your chromatogram. Response time will the be approximately 1/3 of the peak width, resulting in less than 5 % peak-height reduction and less than 5 % additional peak dispersion. Decreasing the peak width setting in the detector will result in less than 5 % gain in peak height but baseline noise will increase by a factor of 1.4 for a factor of 2 response-time reduction. Increasing peak width (response time) by factor of two from the recommended setting (over-filtering) will reduce peak height by about 20 % and reduce baseline noise by a factor of 1.4. This gives you the best possible signal-to-noise ratio, but may affect peak resolution.

Table 8 Peak Width — Response Time — Data Rate

Peak width at half height [min][1]	Response [s]	Signal data rate [Hz]	Scan data rate [HZ] ≤126 pts/scan	Scan data rate [HZ] ≤251 pts/scan	Scan data rate [HZ] ≤501 pts/scan	Scan data rate [HZ] >501 pts/scan
< 0.0016	0.016	160[2]	160[2]	80	40	20
> 0.0016	0.03	160[2]	160[2]	80	40	20
> 0.003	0.062	80	80	80	80	40
> 0.006	0.12	40	40	40	40	40
> 0.012	0.25	20	20	20	20	20
> 0.025	0.5	10	10	10	10	10
> 0.05	1.0	5	5	5	5	5
> 0.10	2.0	2.5	2.5	2.5	2.5	2.5
> 0.20	4.0	1.25	1.25	1.25	1.25	1.25
> 0.40	8.0	0.625	0.62	0.625	0.625	0.625
> 0.85	16.0	0.3125	0.31	0.3125	0.3125	0.3125

1 Values in the User Interface may be rounded.

2 G4212A only

NOTE The maximum spectra scan rate depends on the data points per scan, see Table 8 on page 88. Running at 160 Hz, the spectra scan data rate is reduced automatically if the spectra scan data rate is more than 251 points/scan.

Sample and Reference Wavelength and Bandwidth

The detector measures absorbance simultaneously at wavelengths from 190 to 640 nm. A UV-lamp provides good sensitivity over the whole wavelength range.

If you know little about the analytes in your sample, store all spectra over the full wavelength range. This provides full information but fills up your disk space rather quickly. Spectra can be used to check a peak's purity and identity. Spectral information is also useful to optimize wavelength settings for your chromatographic signal.

The detector can compute and store at run time up to 8 signals with these properties:

- sample wavelength, the center of a wavelength band with the width of sample bandwidth (BW), and optionally
- reference wavelength, the center of a wavelength band with the width of reference bandwidth.

The signals comprises a series of data points over time, with the average absorbance in the sample wavelength band minus the average absorbance of the reference wavelength band.

Signal A in the detector default method is set to sample 254.0/4, reference 360.0/100, that is, the average absorbance from 252 – 256 nm minus the average absorbance from 310 – 410 nm. As all analytes show higher absorbance at 252 – 256 nm than at 310 – 410 nm, this signal will show you virtually every compound which can be detected by UV absorbance.

Many compounds show absorbance bands in the spectrum. Figure 20 on page 90 shows the spectrum of anisic acid as an example. To optimize for lowest possible detectable concentrations of anisic acid, set the sample wavelength to the peak of the absorbance band (that is, 252 nm) and the sample bandwidth to the width of the absorbance band (that is, 30 nm). A reference of 360,100 is adequate. Anisic acid does not absorb in this range.

If you work with high concentrations, you may get better linearity above 1.5 AU by setting the sample wavelength to a valley in the spectrum, like 225 nm for anisic acid.

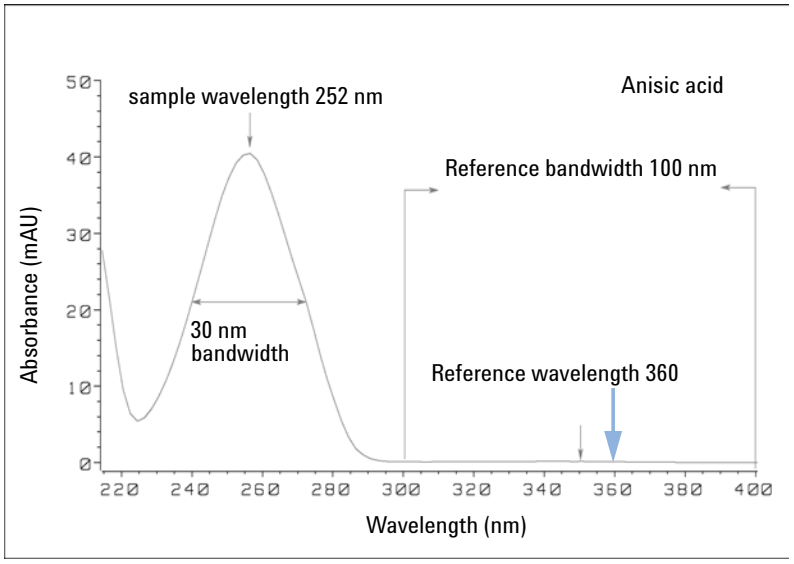


Figure 20 Optimization of Wavelength Setting

A wide bandwidth has the advantage of reducing noise by averaging over a wavelength range – compared to a 4 nm bandwidth, the baseline noise is reduced by a factor of approximately 2.5, whereas the signal is about 75 % of a 4 nm wide band. The signal-to-noise ratio for a 30 nm bandwidth is twice that for a 4 nm bandwidth in our example.

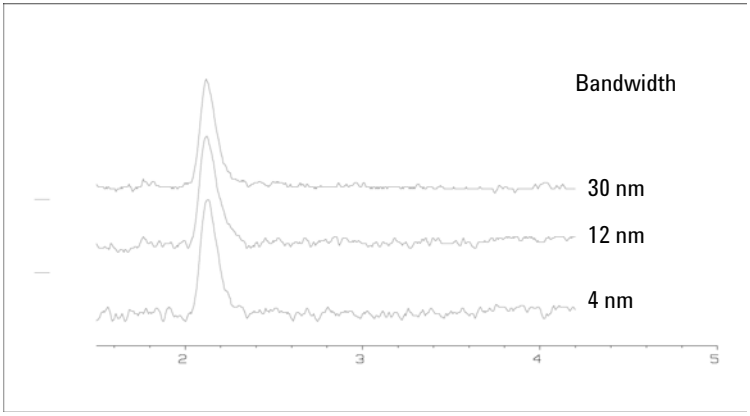


Figure 21 Influence of Bandwidth on Signal and Noise

Because the detector averages absorbance values that are calculated for each wavelength, using a wide bandwidth does not negatively impact linearity.

The use of a reference wavelength is highly recommended to further reduce baseline drift and wander induced by room temperature fluctuations or refractive index changes during a gradient.

An example of the reduction of baseline drifts is shown in Figure 22 on page 91 for PTH-amino acids. Without a reference wavelength, the chromatogram drifts downwards due to refractive index changes induced by the gradient. This is almost completely eliminated by using a reference wavelength. With this technique, PTH-amino acids can be quantified in the low picomole range even in a gradient analysis.

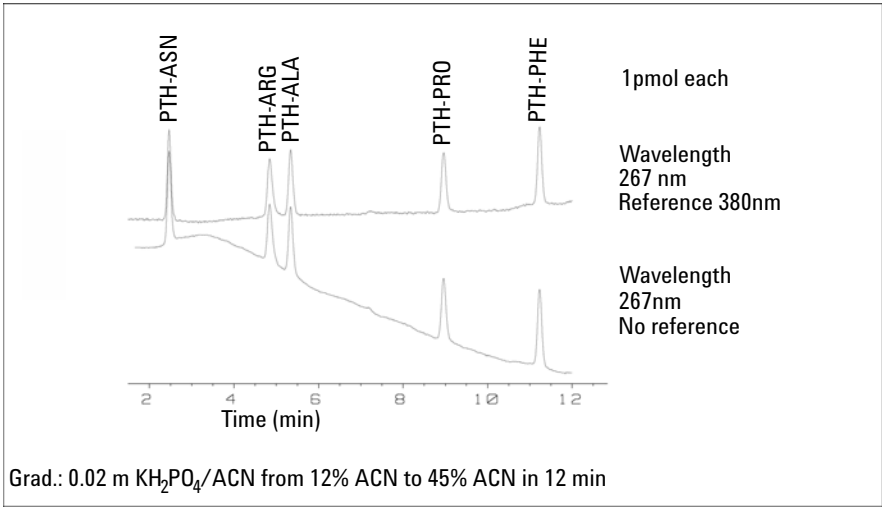


Figure 22 Gradient Analysis of PTH-Amino Acids (1 pmol each), with and without Reference

Slit Width (G4212A)

The 1290 Infinity DAD (G4212A) has a variable slit at the entrance of the spectrograph. This is an effective tool to adapt the detector to changing demand of different analytical problems.

A narrow slit provides spectral resolution for analytes with very fine structures in the absorbance spectrum. An example of such a spectrum is benzene. The five main absorbance bands (fingers) are only 2.5 nm wide and just 6 nm apart from each other.

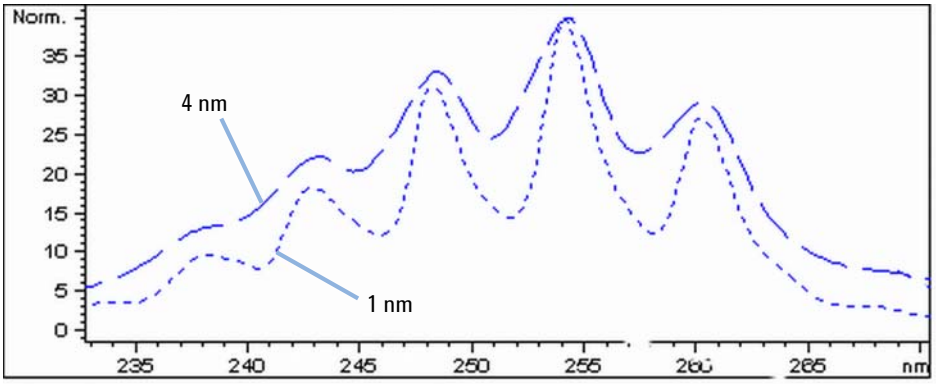


Figure 23 Benzene at 1 and 4 nm slit width (principle)

A wide slit uses more of the light shining through the flow cell. This gives lower baseline noise as shown in Figure 24 on page 93.

Slit width = 8 nm

Slit width = 1 nm

Data Rate = 160 Hz

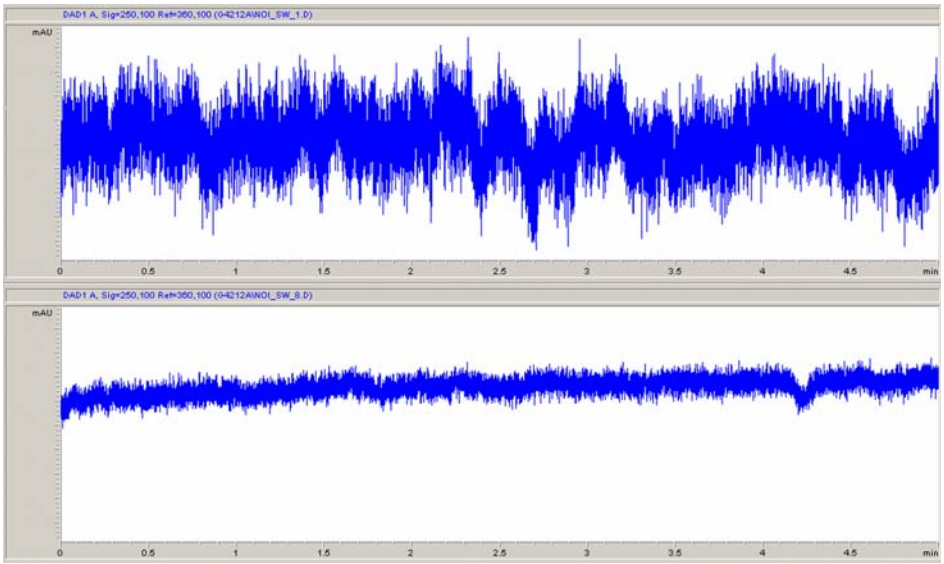


Figure 24 Influence of the Slit Width on Baseline Noise

However, with a wider slit, the spectrograph's optical resolution (its ability to distinguish between different wavelengths) diminishes. Any photodiode receives light within a range of wavelength determined by the slit width. This explains why the fine spectral structure of benzene disappears when using a 8 nm wide slit.

Furthermore, the absorbance is no longer strictly linear with concentration for wavelengths at a steep slope of a compound's spectrum.

Substances with fine structures and steep slopes like benzene are very rare.

In most cases the width of absorbance bands in the spectrum is more like 30 nm as with anisic acid (Figure 20 on page 90).

In most situations, a slit width of 4 nm will give the best results.

Use a narrow slit (1 or 2 nm) if you want to identify compounds with fine spectral structures or if you need to quantify at high concentrations (> 1000 mAU) with a wavelength at the slope of the spectrum. Signals with a wide bandwidth can be used to reduce baseline noise. Because (digital) bandwidth is computed as average of absorbance, there is no impact on linearity.

Use a wide (8 nm) slit when your sample contains very small concentrations. Always use signals with bandwidth at least as wide as the slit width.

Optimizing Spectral Acquisition

Storage of all spectra consumes a lot of disk space. It is very useful to have all spectra available during optimization of a method or when analyzing unique samples. However when running many samples of the same type, the large size of data files with all spectra may become a burden. The detector provides functions to reduce the amount of data, yet retaining the relevant spectral information.

For spectra options see "Spectrum Settings" on page 61.

Range

Only the wavelength range where the compounds in your sample absorb contains information that is useful for purity checks and library searches. Reducing the spectrum storage range saves disk space.

Step

Most substances have broad absorbance bands. Display of spectra, peak purity and library search works best if a spectrum contains 5 to 10 data points per width of the absorbance bands. For anisic acid (the example used before) a step of 4 nm would be sufficient. However a step of 2 nm gives a more optimal display of the spectrum.

Threshold

Sets the peak detector. Only spectra from peaks higher than threshold will be stored when a peak-controlled storage mode is selected.

Margin for Negative Absorbance

The detector adjusts its gain during *balance* such that the baseline may drift slightly negative (about -100 mAU). In some special case, for example, when gradient with absorbing solvents are used, the baseline may drift to more negative values.

Only for such cases, increase the margin for negative absorbance to avoid overflow of the analog-to-digital converter.

Optimizing Selectivity

Quantifying Coeluting Peaks by Peak Suppression

In chromatography, two compounds may often elute together. A conventional dual-signal detector can only detect and quantify both compounds independently from each other if their spectra do not overlap. However, in most cases this is highly unlikely.

With a dual-channel detector based on diode-array technology, quantifying two compounds is possible even when both compounds absorb over the whole wavelength range. The procedure is called peak suppression or signal subtraction. As an example, the analysis of hydrochlorothiazide in the presence of caffeine is described. If hydrochlorothiazide is analyzed in biological samples, there is always a risk that caffeine is present which might interfere chromatographically with hydrochlorothiazide. As the spectra in Figure 25 on page 96 shows, hydrochlorothiazide is best detected at 222 nm, where caffeine also shows significant absorbance. It would therefore be impossible, with a conventional variable wavelength detector, to detect hydrochlorothiazide quantitatively when caffeine is present.

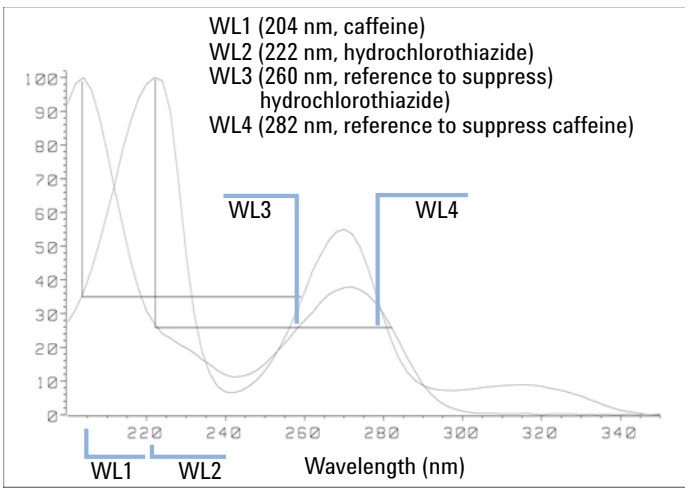


Figure 25 Wavelength Selection for Peak Suppression

With a UV-visible detector based on a diode array and the correct choice of a reference wavelength setting, quantitative detection is possible. To suppress caffeine, the reference wavelength must be set to 282 nm. At this wavelength, caffeine shows exactly the same absorbance as at 222 nm. When the absorbance values are subtracted from each another, any indication of the presence of caffeine is eliminated. In the same way, hydrochlorothiazide can be suppressed if caffeine is to be quantified. In this case the wavelength is set to 204 nm and the reference wavelength to 260 nm. Figure 26 on page 97 shows the chromatographic results of the peak suppression technique.

The trade-off for this procedure is a loss in sensitivity. The sample signal decreases by the absorbance at the reference wavelength relative to the signal wavelength. Sensitivity may be decreased by as much as 10–30 %.

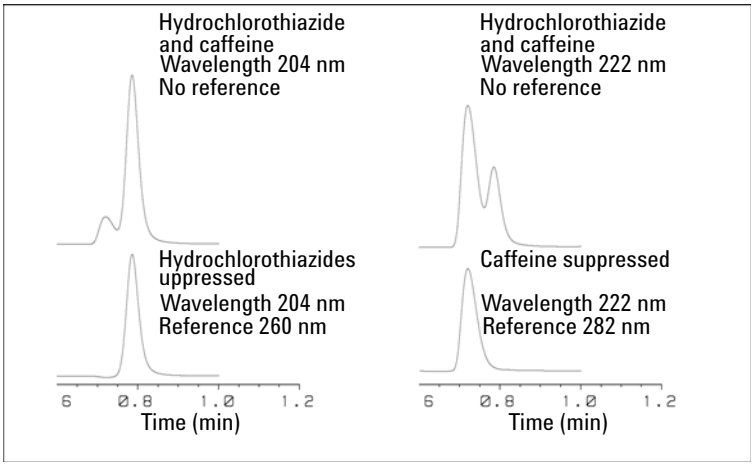


Figure 26 Peak Suppression Using Reference Wavelength

Ratio Qualifiers for Selective Detection of Compound Classes

Ratio qualifiers can be used where, in a complex sample, only one particular class needs to be analyzed – a parent drug and its metabolites in a biological sample, for example. Another example is the selective analysis of derivatives after pre- or post-column derivatization. Specifying a signal ratio that is typical for the sample class is one way of selectively plotting only those peaks that are of interest. The signal output remains at zero so long as the ratio is out of the user-specified ratio range. When the ratio falls within the range, the signal output corresponds to the normal absorbance, giving single, clear peaks on a flat baseline. An example is shown in Figure 27 on page 98 and Figure 28 on page 99.

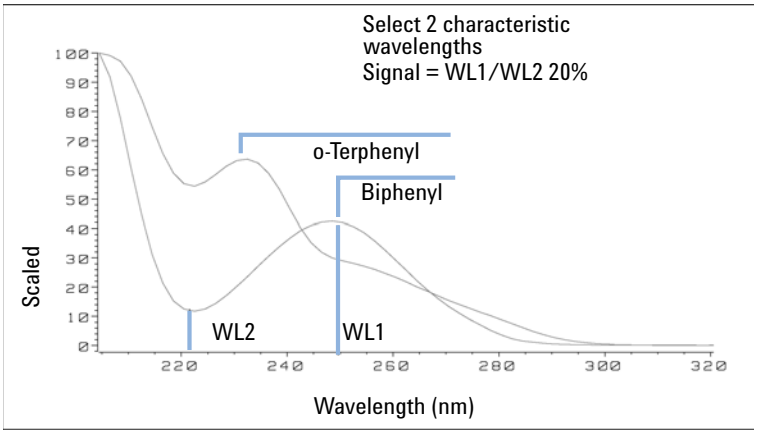


Figure 27 Wavelength Selection for Ratio Qualifiers

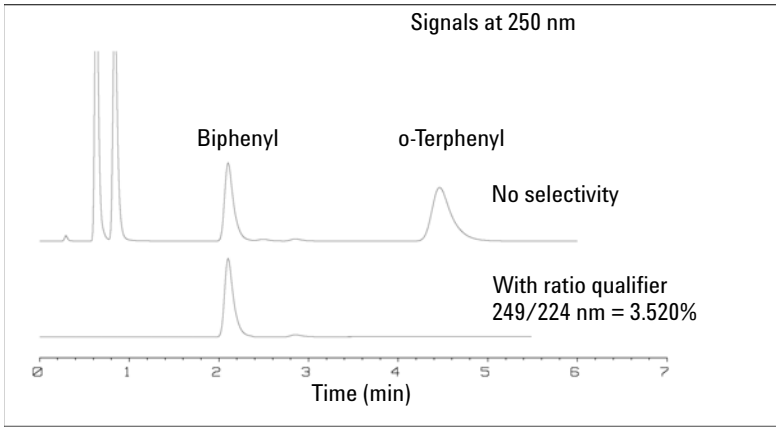


Figure 28 Selectivity by Ratio Qualifiers

In a four-component mixture, only biphenyl was recorded. The other three peaks were suppressed because they did not meet the ratio-qualifier criterion and therefore the output was set to zero. The characteristic wavelengths 249 nm (λ_1) and 224 nm (λ_2) were found from the spectra shown in Figure 27 on page 98. The ratio range was set at 2 – 2.4 (2.2 ±10%). Only when the ratio between 249 and 224 nm was within this range, is the signal plotted. Of all four peaks, only the third fulfilled the criterion (Figure 28 on page 99). The others were not plotted.

Optimizing the Detector Regarding to the System

Delay Volume and Extra-Column Volume

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

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

Extra-Column Volume

Extra-column volume is a source of peak dispersion that will reduce the resolution of the separation and so should be minimized. Smaller diameter columns require proportionally smaller extra-column volumes to keep peak dispersion at a minimum.

In a liquid chromatograph the extra-column volume will depend on the connection tubing between the autosampler, column and detector; and on the volume of the flow cell in the detector. The extra-column volume is minimized with the Agilent 1290 Infinity/Agilent 1260 Infinity LC system due to the narrow-bore (0.12 mm i.d.) tubing, the low-volume heat exchangers in the column compartment and the Max-Light cartridge cell in the detector.

How to Configure the Optimum Delay Volume

To maintain resolution in the Agilent 1290 Infinity/Agilent 1260 Infinity Diode-array Detector the 10 mm Max-Light cartridge cell has a low dispersion volume (σ volume 1.0 µL) and no further volume optimization is required. In situations where the alternative 60 mm Max-Light high sensitivity cell is used to get higher sensitivity the cell volume is optimized for the use with 3 mm and 4.6 mm inner diameter columns.

How to Achieve Higher Sensitivity

The detector has a number of parameters that are used to optimize performance. The following sections describe how the detector parameters affect performance characteristics:

- Flow cell affects sensitivity,
- Wavelength and bandwidth affect sensitivity, selectivity and linearity,
- Slit Width affects sensitivity, spectral resolution and linearity,
- Peak Width affects sensitivity and resolution.

Flow Cell

The Max-Light cartridge flow cell has a standard 10 mm path length and is optimized for minimal volume and dispersion (σ volume 1.0 µL). It has high light transmission minimizing noise to reduce noise due to the optofluidic waveguide. It is suitable for use with a wide range of analytical columns from short narrow-bore columns to long standard diameter (4.6 mm) columns. Generally the peak dispersion volume (calculated from peak width x flow rate) should be greater than about 2 µL for this cell (for example 0.02 min x 200 µL/min = 4 µL).

The Max-Light high sensitivity cell has a path length of 60 mm and this will give between three and five times increase in signal-to-noise values depending on the application conditions. The dispersion volume is fractionally increased compared to the standard cell.

Wavelength and Bandwidth

The detector measures absorbance simultaneously at wavelengths from 190 nm to 640 nm using diode-array detection. A UV-lamp provides good sensitivity over the whole wavelength range. The diode-array detector (DAD) can simultaneously compute and send to the data system up to eight chromatographic signals and the full-range spectra at every time point.

A UV chromatogram or signal is a plot of absorbance data versus time and is defined by its wavelength and bandwidth.

- The wavelength indicates the center of the detection band.
- The bandwidth defines the wavelength range over which the absorbance values are averaged to give the result at each time point.

For example, a signal at wavelength 250 nm with a bandwidth of 16 nm will be an average of the absorbance data from 242 nm to 258 nm. Additionally, a reference wavelength and reference bandwidth can be defined for each signal. The average absorbance from the reference bandwidth centered on the reference wavelength will be subtracted from its equivalent value at the signal wavelength to produce the output chromatogram.

The signal wavelength and bandwidth can be chosen so that they are optimized for:

- Broad band universal detection
- Narrow band selective detection
- Sensitivity for a specific analyte.

Broad band or universal detection works by having a wide bandwidth to detect any species with absorbance in that range. For example, to detect all absorbing molecules between 200 nm and 300 nm set a signal at 250 nm with a bandwidth of 100 nm. The disadvantage is that sensitivity will not be optimal for any one of those molecules. Narrow band or selective detection is used most often. The UV spectrum for a particular molecule is examined and an appropriate absorbance maximum is selected. If possible, the range where solvents absorb strongly should be avoided (below 220 nm for methanol, below 210 nm for acetonitrile). For example, in Figure 29 on page 104, anisic acid has a suitable absorbance maximum at 252 nm. A narrow bandwidth of 4 nm to 12 nm generally gives good sensitivity and is specific for absorbance in a narrow range.

The narrow band can be optimized for sensitivity for a specific molecule. As the bandwidth is increased the signal is reduced but so is the noise and there

will be an optimum for best S/N. As an approximate guide, this optimum is often close to the natural bandwidth at half-height of the absorption band in the UV spectrum. In the anisic acid example this is 30 nm.

The analytical wavelength is usually set at a wavelength maximum to increase sensitivity to that molecule. The detector is linear up to 2 AU and beyond for many applications. This offers a wide linear range for concentration. For high concentration analysis the concentration linear range can be extended by setting the wavelength to one with a lower absorbance such as a wavelength minimum or by taking a wider bandwidth which usually includes lower absorbance values. The use of wavelength maxima and minima for quantitation dates back to conventional UV detectors which because of mechanical tolerances in moving gratings needed to avoid steeply sloping parts of the spectrum. Diode-array based detectors do not have this limitation but for reasons of convention maxima and minima are chosen in preference to other parts of the spectrum.

The reference bandwidth is normally set on a region of the UV spectrum in which the analyte has no absorbance. This is shown in the spectrum for anisic acid in Figure 29 on page 104. This spectrum is typical of many small molecules containing a UV chromophore. For best results the reference has been set so that it is a wide band as close to the signal wavelength as possible but on a zero absorbance region. Reference bandwidths of 60 nm to 100 nm are commonly used. The default reference is 360 nm with a bandwidth of 100 nm. A wide bandwidth is used because this reduces the noise in the reference signal (from statistical theory, the error, i.e. noise in this case, is reduced by the square root of the number of determinations). It is important that the reference bandwidth does not extend to a part of the spectrum that has some absorbance as this would then reduce the resulting signal and sensitivity would be reduced. The use of a reference wavelength can help to reduce drift or wander in the chromatogram caused by refractive index changes due to room temperature fluctuation or gradient operation. The effect of a reference signal can be easily tested by setting two otherwise identical signals, one with and one without a reference signal. If there is no part of the spectrum with zero absorbance then it will be better to have the reference signal turned off.

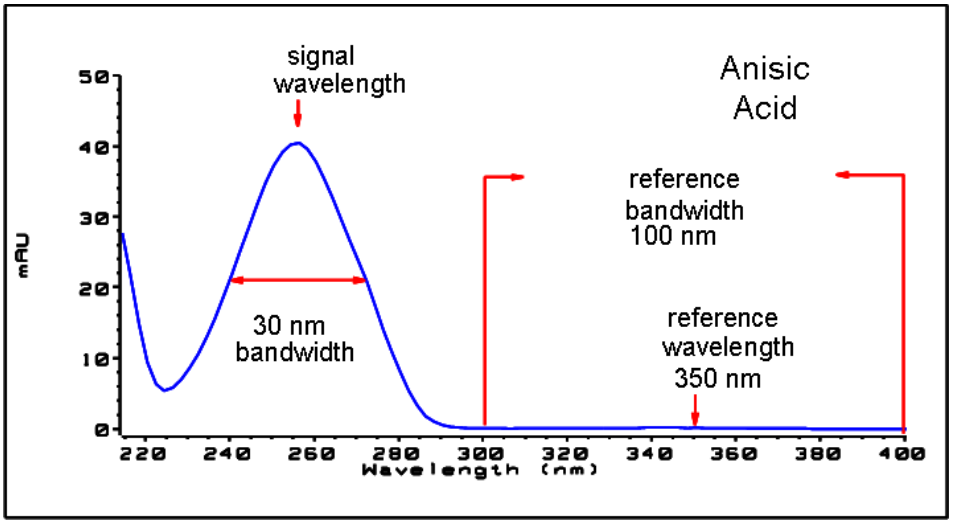


Figure 29 Spectrum of Anisic Acid

Peak Width, Response Time and Data Collection Rate

The peak width setting, response time and data rate in the detector are all linked. The available settings are shown in Table 9 on page 106. It is important to set this correctly for optimum sensitivity and to preserve the resolution achieved in the separation.

The detector internally acquires data points faster than is needed for a chromatogram and processes them to produce the signal seen by the data system. Part of the processing reduces the data to an appropriate data rate which allows the chromatographic peaks to be accurately drawn. As with most analytical determinations groups of readings are effectively averaged to reduce error in the result. The detector bunches raw data points and produces the output signal data at the required data collection rate by an electronic filtering process. If the resulting data rate is too slow (over filtering) the peak heights will be reduced and the resolution between them reduced; too fast and the data is noisier than it need be to accurately profile narrow peaks.

The *peak width* setting in the detector allows the user to correctly set these parameters without needing any knowledge other than sight of the chromatogram integration results to see how wide the peaks are. The peak width setting should be set for the narrowest peak width observed in the chromatogram. If it is set too wide it will make the peaks appear lower in height and wider (and potentially less resolved) and if it is set too narrow it will increase the baseline noise unnecessarily. Essentially the software uses this value to set the *data collection rate* such that it collects enough data points over the narrowest peaks and it is aiming for 15 to 25 points across a peak. The 1290 Infinity DAD can collect at a maximum 160 Hz if required which would allow enough data points to be collected over a peak that is only 0.1 s wide. The *response time* setting is another way of indicating how this filtering is set. It is measured in seconds and is about one-third of the peak width value (which is measured in minutes). It effectively shows how quickly the plotted signal responds to a step change in the input signal.

NOTE

The full spectra is not available under all conditions.

Based on the data points, the scan data rate is reduced, see Table 9 on page 106.

Table 9 Peak Width — Response Time — Data Rate

Peak width at half height [min][1]	Response [s]	Signal data rate [Hz]	Scan data rate [HZ] ≤126 pts/scan	Scan data rate [HZ] ≤251 pts/scan	Scan data rate [HZ] ≤501 pts/scan	Scan data rate [HZ] >501 pts/scan
< 0.0016	0.016	160[2]	160[2]	80	40	20
> 0.0016	0.03	160[2]	160[2]	80	40	20
> 0.003	0.062	80	80	80	80	40
> 0.006	0.12	40	40	40	40	40
> 0.012	0.25	20	20	20	20	20
> 0.025	0.5	10	10	10	10	10
> 0.05	1.0	5	5	5	5	5
> 0.10	2.0	2.5	2.5	2.5	2.5	2.5
> 0.20	4.0	1.25	1.25	1.25	1.25	1.25
> 0.40	8.0	0.625	0.62	0.625	0.625	0.625
> 0.85	16.0	0.3125	0.31	0.3125	0.3125	0.3125

1 Values in the User Interface may be rounded.

2 G4212A only

NOTE The maximum spectra scan rate depends on the data points per scan, see Table 9 on page 106. Running at 160 Hz, the spectra scan data rate is reduced automatically if the spectra scan data rate is more than 251 points/scan.

Warm up of the Detector

Give the optical unit enough time to warm-up and stabilize (> 60 minutes). The detector is temperature controlled. After turn-on of the detector, it goes through a cycle of different states:

- 0 to 0.5 minutes the heater control is OFF and the heater element runs at 0 % duty cycle.
- 0.5 to 1 minutes the heater control is OFF and the heater element runs at 66% duty cycle. This first minute is used as self-test of the heater functionality.
- 1 to 30 minutes the heater control is OFF and the heater element runs at 40% duty cycle.
- After 30 minutes the heater control is ON and is working with optimized parameters to get the optical unit into the optimal temperature window stabilized.

This cycle starts

- when the detector is turned off/on
- when the lamp is turned off/on

to ensure that the temperature control operates in a defined control range.

NOTE The times to stabilize the baseline may vary from instrument to instrument and depends on the environment. The example below was done under stable environmental conditions.

The figures below show the first two hours of a detector warm-up phase. The lamp was turned on immediately after turn on of the detector.

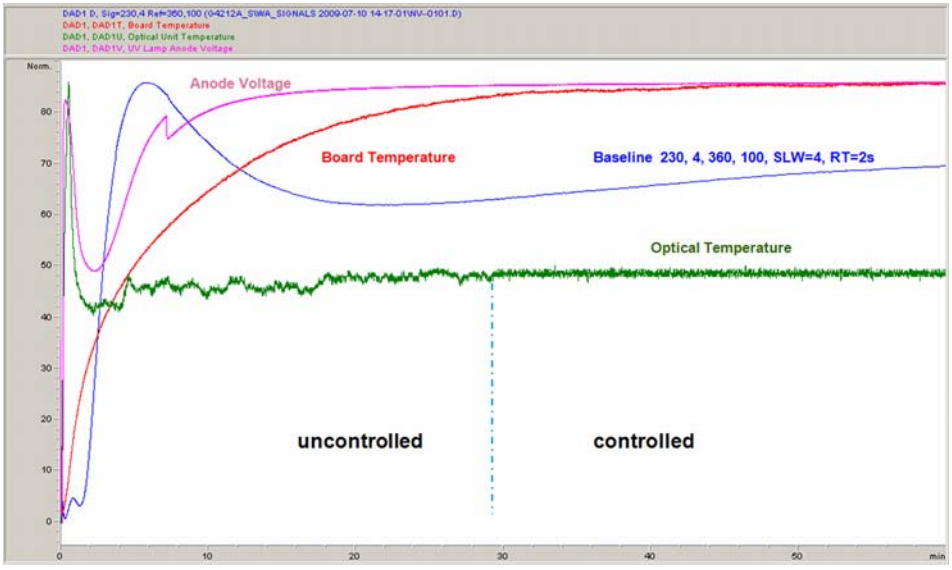


Figure 30 Detector Warm-up – 1st hour

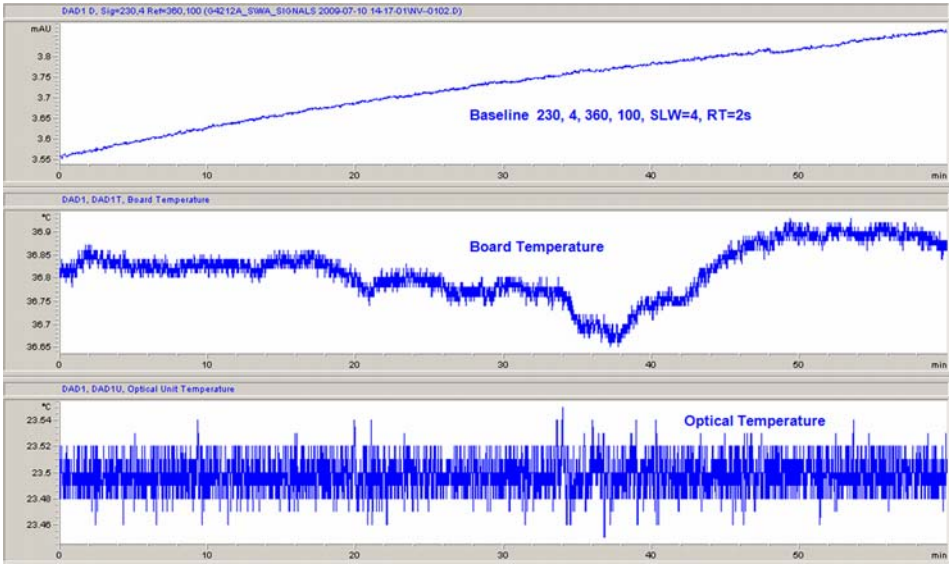


Figure 31 Detector Warm-up – 2nd hour

6
Troubleshooting and Diagnostics

Overview about the troubleshooting and diagnostic features.

Overview of the Module's Indicators and Test Functions

Status Indicators

The module is provided with two status indicators which indicate the operational state (prerun, run, and error states) of the module. The status indicators provide a quick visual check of the operation of the module.

Error Messages

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

Test Functions

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

Diagnostic Signals

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

For details see "Instrument Curves" on page 66.

Status Indicators

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

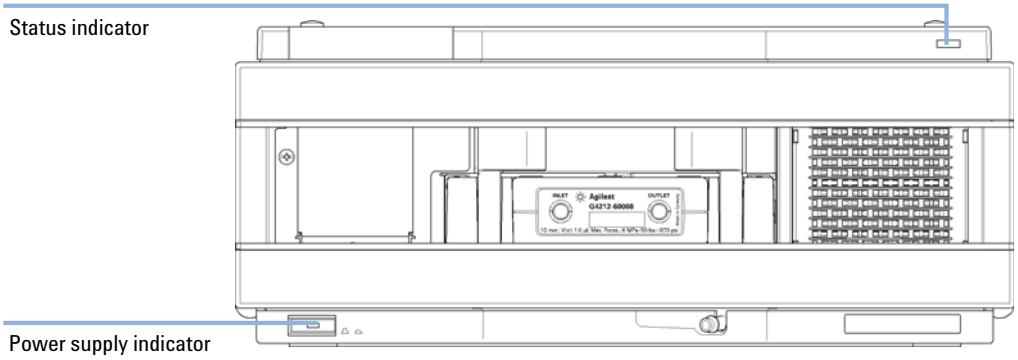


Figure 32 Location of Status Indicators

Power Supply Indicator

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

Module Status Indicator

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

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

  If the error occurs during analysis, it is propagated within the LC system, i.e. a red LED may indicate a problem of a different module. Use the status display of your user interface for finding the root cause/module of the error.
- A *blinking* indicator indicates that the module is in resident mode (e.g. during update of main firmware).
- A *fast blinking* indicator indicates that the module is in a low-level error mode. In such a case try to re-boot the module or try a cold-start (see "Special Settings" on page 219). Then try a firmware update (see "Replacing Module Firmware" on page 183). If this does not help, a main board replacement is required.

Available Tests vs User Interfaces

- Depending on the user interface, the available tests and the screens/reports may vary (see chapter *"Test Functions and Calibrations"*).
- Preferred tool should be the Agilent Lab Advisor software, see “Agilent Lab Advisor Software” on page 114.
- The Agilent ChemStation B.04.02 and above may not include any maintenance/test functions.
- Screenshots used within these procedures are based on the Agilent Lab Advisor software.

Agilent Lab Advisor Software

The Agilent Lab Advisor software is a standalone product that can be used with or without data system. Agilent Lab Advisor software helps to manage the lab for high quality chromatographic results and can monitor in real time a single Agilent LC or all the Agilent GCs and LCs configured on the lab intranet.

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

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

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

Intermittent Issues

Loose Optical Cable

Following intermittent problems may occur:

- Baseline (drift/noise)
- No peaks
- Lamp intensity test fails
- WL verification fails
- Other effects related to the optics

In such a case check the cable connection between optical unit (under the cover, see Figure 33 on page 115) and the main board. If this is loose, intermittent or constant effects can be seen.

NOTE Do not start replacements (optical or main board) before above check.

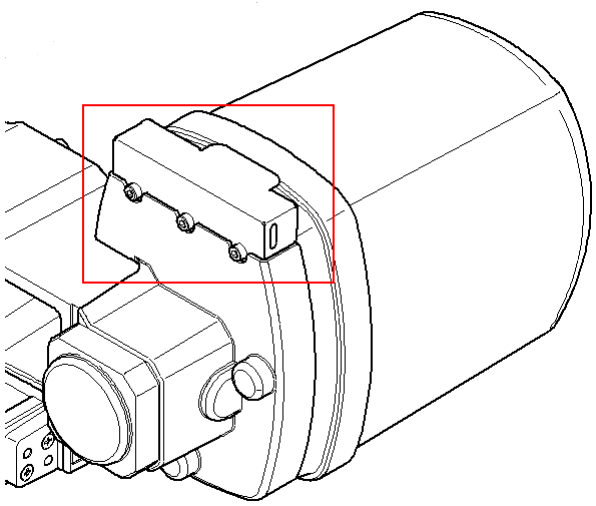


Figure 33 Location of Cover at Optical Unit

Board Type does not match when replacing the main board

When replacing a main board in the DAD, it may wake up with the wrong type. In this case it has been used by another person in another DAD before.

G4212B DAD boots as G4212A DAD

If the Main board was used previously in a G4212A DAD

- The module stays in resident mode (G4212A-R) and the RED error LED is on.
- Use the latest Agilent Lab Advisor.
- Connect to the DAD.
- Open **Service & Diagnostics**.
- Run **Board Check and Change**.
- Change the type to **G4212B**.
- Enter the correct serial number (as written on the module label).
- Apply the changes.
- Reboot the DAD (if not done automatically).

G4212A DAD boots as G4212B DAD

If the Main board was used previously in a G4212B/K4212B DAD

- The detector will boot as a G4212B DAD (no error).
- The DAD has the functionality of the G4212B/K4212B DAD.
- Enter the correct serial number (as written on the module label).
- The DAD can be reverted back to G4212A with Lab Advisor **Board Check and Change**.
- Reboot the DAD (if not done automatically).

Normal Routine

The normal routine is as follows:

- The main board has no type information.
- During boot of the DAD it retrieves the module type (G4212A or G4212B DAD) from the installed optical unit and keeps it.
- Via **Board Check and Change** add the serial number.
- Reboot the DAD (if not done automatically).

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 which requires attention before the analysis can be continued (for example, repair, or exchange of consumables is necessary). In the event of such a failure, the red status indicator at the front of the module is switched on, and an entry is written into the module logbook.

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

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

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

General Error Messages

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

Timeout

Error ID: 0062

The timeout threshold was exceeded.

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

Shutdown

Error ID: 0063

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

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

Probable cause	Suggested actions
1 Leak detected in another module with a CAN connection to the system.	Fix the leak in the external instrument before restarting the module.
2 Leak detected in an external instrument with a remote connection to the system.	Fix the leak in the external instrument before restarting the module.
3 Shut-down in an external instrument with a remote connection to the system.	Check external instruments for a shut-down condition.

Remote Timeout

Error ID: 0070

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

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

Lost CAN Partner

Error ID: 0071

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

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

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

Leak Sensor Short

Error ID: 0082

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

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

Probable cause	Suggested actions
1 Defective leak sensor.	Please contact your Agilent service representative.
2 Leak sensor incorrectly routed, being pinched by a metal component.	• Please contact your Agilent service representative. • Correct the routing of the cable. • If cable defective, exchange the leak sensor.

Leak Sensor Open

Error ID: 0083

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

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

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

Compensation Sensor Open

Error ID: 0081

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

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

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

Compensation Sensor Short

Error ID: 0080

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

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

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

Fan Failed

Error ID: 0068

The cooling fan in the module has failed.

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

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

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

Leak

Error ID: 0064

A leak was detected in the module.

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

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

Open Cover

Error ID: 0205

The top foam has been removed.

Probable cause	Suggested actions
1 Foam not activating the sensor.	Please contact your Agilent service representative.
2 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.

Detector Error Messages

These errors are detector specific.

Diode Current Leakage

Error ID: 1041

When the detector is switched on, the processor checks the leakage current of each of the optical diodes. If the leakage current exceeds the upper limit, the error message is generated.

Probable cause	Suggested actions
1 Defective PDA/optical unit.	Please contact your Agilent service representative.
2 Defective connector or cable.	Please contact your Agilent service representative.

UV Lamp Current

Error ID: 7450

The UV lamp current is missing.

The processor continually monitors the anode current drawn by the lamp during operation. If the anode current falls below the lower current limit, the error message is generated.

Probable cause	Suggested actions
1 Lamp disconnected.	Ensure the UV lamp connector is seated firmly.
2 Defective UV lamp or non-Agilent lamp.	Exchange the UV lamp.
3 Defective detector main board.	Please contact your Agilent service representative.
4 Defective power supply.	Please contact your Agilent service representative.

UV Lamp Voltage

Error ID: 7451

The UV lamp anode voltage is missing.

The processor continually monitors the anode voltage across the lamp during operation. If the anode voltage falls below the lower limit, the error message is generated.

Probable cause	Suggested actions
1 Defective UV lamp or non-Agilent lamp.	Exchange the UV lamp.
2 Defective detector main board.	Please contact your Agilent service representative.
3 Defective power supply.	Please contact your Agilent service representative.

UV Ignition Failed

Error ID: 7452

The UV lamp failed to ignite.

The processor monitors the UV lamp current during the ignition cycle. If the lamp current does not rise above the lower limit within 2 – 5 seconds, the error message is generated.

Probable cause	Suggested actions
1 Lamp too hot. Hot gas discharge lamps may not ignite as easily as cold lamps.	Switch off the lamp and allow it to cool down for at least 15 minutes.
2 Lamp disconnected.	Ensure the lamp is connected.
3 Defective UV lamp or non-Agilent lamp.	Exchange the UV lamp.
4 Defective detector main board.	Please contact your Agilent service representative.
5 Defective power supply.	Please contact your Agilent service representative.

UV Heater Current

Error ID: 7453

The UV lamp heater current is missing.

During UV lamp ignition, the processor monitors the heater current. If the current does not rise above the lower limit within one second, the error message is generated.

Probable cause	Suggested actions
1 Lamp disconnected.	Ensure the UV lamp is connected.
2 Ignition started without the top foam in place.	Please contact your Agilent service representative.
3 Defective UV lamp or non-Agilent lamp.	Exchange the UV lamp.
4 Defective detector main board.	Please contact your Agilent service representative.
5 Defective power supply.	Please contact your Agilent service representative.

Calibration Values Invalid

Error ID: 1036

The calibration values read from the spectrometer ROM are invalid.

After recalibration, the calibration values are stored in ROM. The processor periodically checks if the calibration data are valid. If the data are invalid or cannot be read from the spectrometer ROM, the error message is generated.

Probable cause	Suggested actions
1 Defective connector or cable.	Please contact your Agilent service representative.
2 Defective PDA/optical unit.	Please contact your Agilent service representative.

Wavelength Recalibration Lost

Error ID: 1037

The calibration information needed for your detector to operate correctly has been lost.

During calibration of the detector the calibration values are stored in ROM. If no data is available in the spectrometer ROM, the error message is generated.

Probable cause	Suggested actions
1 The detector is new.	Recalibrate the detector.
2 The detector has been repaired.	Please contact your Agilent service representative.

Illegal Temperature Value from Sensor on Main Board

Error ID: 1071

This temperature sensor (located on the detector main board) delivered a value outside the allowed range. The parameter of this event equals the measured temperature in 1/100 centigrade. As a result the temperature control is switched off.

Probable cause	Suggested actions
1 Defective sensor or main board.	Please contact your Agilent service representative.
2 Detector is exposed to illegal ambient conditions.	Verify that the ambient conditions are within the allowed range.

Illegal Temperature Value from Sensor at Fan Assembly

Error ID: 1072

This temperature sensor (located close to the fan) delivered a value outside the allowed range. The parameter of this event equals the measured temperature in 1/100 centigrade. As a result the temperature control is switched off.

Probable cause	Suggested actions
1 The temperature sensor is defect.	Please contact your Agilent service representative.
2 Defective main board.	Please contact your Agilent service representative.
3 Detector is exposed to illegal ambient conditions.	Verify that the ambient conditions are within the allowed range.

Heater at fan assembly failed

Error ID: 1073

Every time the deuterium lamp or the tungsten lamp (DAD only) is switched on or off a heater self-test is performed. If the test fails an error event is created. As a result the temperature control is switched off.

Probable cause	Suggested actions
1 Defective connector or cable.	Please contact your Agilent service representative.
2 Defective heater.	Please contact your Agilent service representative.

Heater Power At Limit

Error ID: 1074

The available power of the heater reached either the upper or lower limit. This event is sent only once per run. The parameter determines which limit has been hit:

0 means upper power limit hit (excessive ambient temperature drop).

1 means lower power limit hit (excessive ambient temperature increase).

Probable cause	Suggested actions
1 Excessive ambient temperature change.	Wait until temperature control equilibrates.

8
Test Functions and Calibration

This chapter describes the tests for the module.

Introduction

All tests are described based on the Agilent Lab Advisor Software B.01.03. Other user interfaces may not provide any test or just a few.

Table 10 Interfaces and available test functions

Interface	Comment	Available Function
Agilent Instrument Utilities	Maintenance tests are available	• Intensity • Cell • WL Calibration
Agilent Lab Advisor	All tests are available	• Self-Test • Intensity • Quick Noise • ASTM Drift and Noise • Cell • Dark Current • D/A Converter • Slit (G4212A only) • WL Verification • WL Calibration • Test Chromatogram (Tools) • Spectra Scan (Tools) • Module Infos (Tools) • Diagnostic (Tools)
Agilent ChemStation	No tests available Adding of temperature/lamp signals to chromatographic signals possible	• Temperature main board • Temperature optical unit • Lamp anode voltage
Agilent Instant Pilot	Some tests are available	• Intensity • WL Calibration • Cell

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

Use of Max-Light Cartridge Test Cell

The Max-Light Cartridge Test Cell is recommended to be used for several tests instead of the Max-Light Cartridge Cell (10 mm, V(σ) = 1 µL) or the Max-Light Cartridge Cell (60 mm, V(σ) = 4 µL) because it allows running the test(s) without any influence of the rest of the system (degasser, pump, sampler and others).

The results of the test cell are comparable with the Max-Light Cartridge Cell (10 mm, V(σ) = 1 µL) filled with water, e.g. Intensity Profile. Only the Absorbance value is higher on the Max-Light Cartridge Cell.

If the profile of the Max-Light Cartridge Cell differs in the low UV range, then absorbing solvents are in the cell and should be flushed out. See also "Cleaning of Max-Light Cartridge Cell" on page 178.

NOTE When using the Max-Light Cartridge Cell for tests/calibrations, it should be run at 0.5 mL/min constant flow with water. This assures that the light path is always flushed.

Below table gives an idea on the signal height variation of the Max-Light Cartridge Cells compared to Max-Light Cartridge Test Cell.

Table 11 Max-Light Cartridge Cells compared to Max-Light Cartridge Test Cell

Part Number	Description	Signal Height (typical)
G4212-60011	Max-Light Cartridge Test Cell	100 %
G4212-60008	Max-Light Cartridge Cell 10 mmV(σ) = 1 µL	~ 100 %
G4212-60007	Max-Light Cartridge Cell 60 mmV(σ) = 4 µL	~ 100 %
G5615-60018	Max-Light Cartridge Cell Bio-inert 10 mmV(σ) = 1 µL	~ 100 %
G5615-60017	Max-Light Cartridge Cell Bio-inert 60 mmV(σ) = 4 µL	~ 100 %
G4212-60032	Max-Light Cartridge Cell HDR (3.7 mm, V(σ) 0.4 µL)	100 %
G4212-60017	Max-Light Cartridge Cell ULD (10 mm, V(σ) 0.6 µL)	100 %

Conditions of Detector

The test usually should be performed with a detector turned on for at least one hour, so that the temperature regulation of the optical unit is working (not active during the first 30 minutes after turn on). If the detector is on, tests can be performed usually 10 minutes after the UV-lamp has been turned on.

Failing a Test

If a test fails with the Max-Light Cartridge Cell repeat the test with the Max-Light Cartridge Test Cell and compare. If the test fails also, then start with proposed actions mentioned in the details of the tests.

Self-Test

The self-test runs a series of individual tests (described on the next pages), and evaluates the results automatically. The following tests are run:

- Slit Test (G4212A only)
- Dark Current Test
- Intensity Test
- Wavelength Verification Test
- ASTM Noise Test, a simplified version of the ASTM Drift and Noise Test (without testing the Drift)

When

For complete detector check.

Parts required

#	Description
1	Max-Light Cartridge Cell (filled with water)
OR	
1	Max-Light Cartridge Test Cell

Preparations

- Lamp must be on for at least 10 minutes.
- For noise test a longer warm-up time may be required (> 2 hours).
- When using a Max-Light Cartridge Cell a flow rate of 0.5 mL/min with water is required.

1 Run the **Self-Test** with the recommended user interface (for further information see Online-Help of user interface).

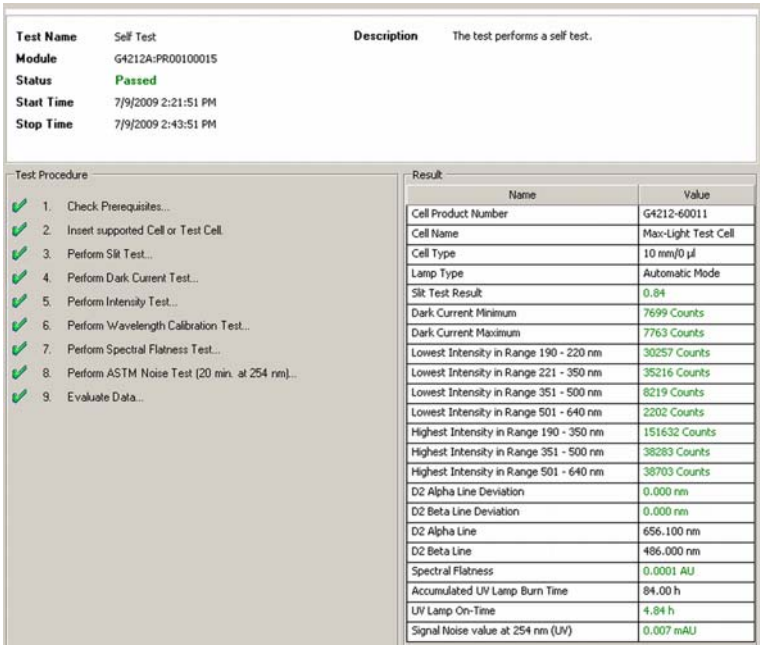


Figure 34 Self-Test – Results

Intensity Test

The intensity test measures the intensity of the UV-lamp over the full wavelength range (190 - 640 nm). Four spectral ranges are used to evaluate the intensity spectrum. The test is used to determine the performance of the lamp and optics (see also "Cell Test" on page 143). When the test is started, the 1-nm slit is moved into the light path automatically (G4212A only). On the G4212B, the 4 nm fixed slit is used. To eliminate effects due to absorbing solvents, the test should be done with water in the Max-Light Cartridge Cell or with the Max-Light Cartridge Test Cell. The shape of the intensity spectrum is primarily dependent on the lamp, grating, and diode array characteristics. Therefore, intensity spectra will differ slightly between instruments.

When In case of UV-lamp problem (drift, noise).

Parts required

	#	Description
	1	Max-Light Cartridge Cell (filled with water)
OR	1	Max-Light Cartridge Test Cell

Preparations Lamp must be on for at least 10 minutes.

1 Run the **Intensity-Test** with the recommended user interface (for further information see Online-Help of user interface).

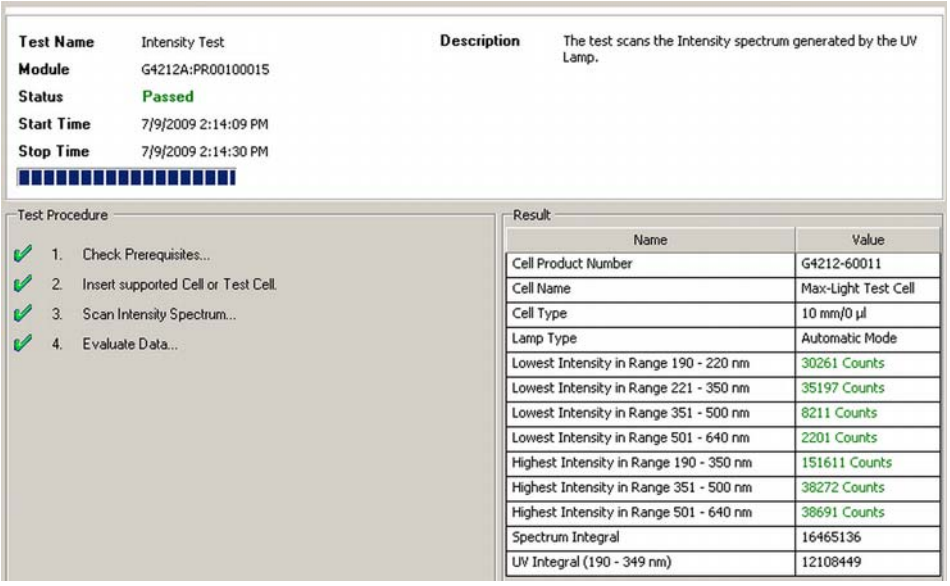


Figure 35 Intensity Test – Results

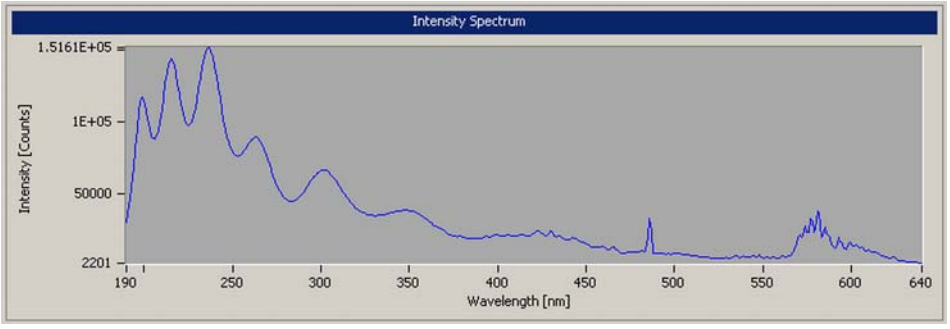


Figure 36 Intensity Test – Signals

Test Failed

Intensity Test Evaluation

Probable cause	Suggested actions
1 Absorbing solvent or air bubble in flow cell.	• Ensure the flow cell is filled with water, and free from air bubbles. • Repeat test with Max-Light Cartridge Test Cell and compare results.
2 Incorrect calibration	Recalibrate and repeat the test.
3 Dirty or contaminated flow cell.	Run the cell test. If the test fails, flush the flow cell. See also "Cleaning of Max-Light Cartridge Cell" on page 178.
4 Dirty or contaminated optical components.	Please contact your Agilent service representative.
5 Old UV-lamp.	Exchange the UV-lamp.
6 Defect optical unit.	If the test fails with Max-Light Cartridge Test Cell and new UV-lamp, please contact your Agilent service representative.

NOTE If only one range fails and the application does not require this range, the lamp may not be changed.

Cell Test

The cell test measures the intensity of the UV-lamp over the full wavelength range (190 - 690 nm), once with the Max-Light Cartridge Cell installed, and once with the Max-Light Cartridge Test Cell. The resulting intensity ratio is a measure of the amount of light absorbed by the Max-Light Cartridge flow cell. The test can be used to check for dirty or contaminated flow cell windows. When the test is started, the 1-nm slit is moved into the light path automatically (G4212A only). On the G4212B, the 4 nm fixed slit is used.

This test should be performed initially with a new detector/flow cell. The values should be kept for later reference/comparison.

When

In case of low intensity or noise and drift problem.

Parts required

#	Description
1	Max-Light Cartridge Cell (filled with water)
1	Max-Light Cartridge Test Cell

Preparations

- Lamp must be on for at least 10 minutes.
- When using a Max-Light Cartridge Cell a flow rate of 0.5 mL/min with water is required.

1 Run the **Cell-Test** with the recommended user interface (for further information see Online-Help of user interface).

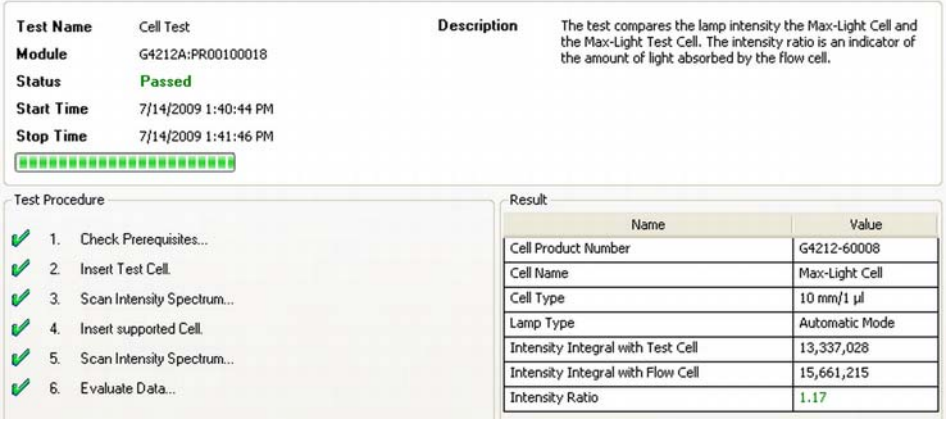


Figure 37 Cell Test – Results

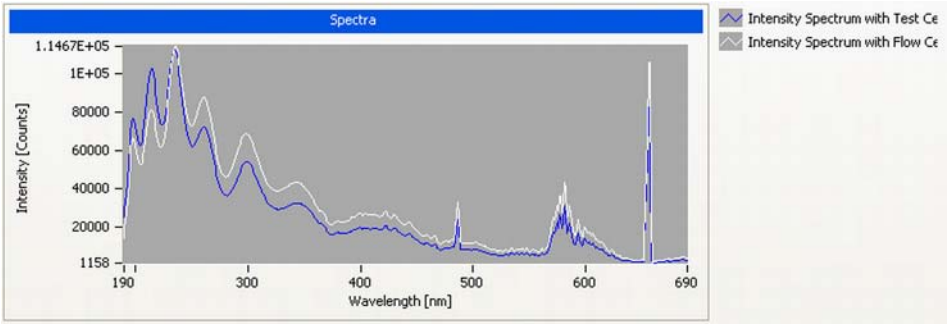


Figure 38 Cell Test – Signals

Test Failed (low ratio value)

Cell Test Evaluation

Probable cause	Suggested actions
1 Absorbing solvent or air bubble in flow cell.	Ensure the flow cell is filled with water, and free from air bubbles.
2 Dirty or contaminated flow cell.	Clean the flow cell as described in "Cleaning of Max-Light Cartridge Cell" on page 178.

Quick Noise Test

The quick noise test measures the noise of the detector, with Max-Light Cartridge Cell or with Max-Light Cartridge Test Cell installed, in one minute intervals over a total of 5 minutes.

The noise of the detector is calculated by using the maximum amplitude for all random variations of the detector signal of frequencies greater than one cycle per hour. The noise is determined for 5 one minute intervals and is based on the accumulated peak-to-peak noise for the intervals. At least seven data points per cycles are used in the calculation. The cycles in the noise determination are not overlapping.

If the test is performed with the Max-Light Cartridge Test Cell, the test results are not influenced by solvent or pump effects.

When

In case of noise and drift problem.

Parts required

	#	Description
	1	Max-Light Cartridge Cell (filled with water)
OR	1	Max-Light Cartridge Test Cell

Preparations

- Detector and UV-lamp must be on for at least 2 hours.
- ASTM measurements based on specifications may require longer stabilization times.
- When using a Max-Light Cartridge Cell a flow rate of 0.5 mL/min with water is required.

1 Run the **Quick Noise Test** with the recommended user interface (for further information see Online-Help of user interface).

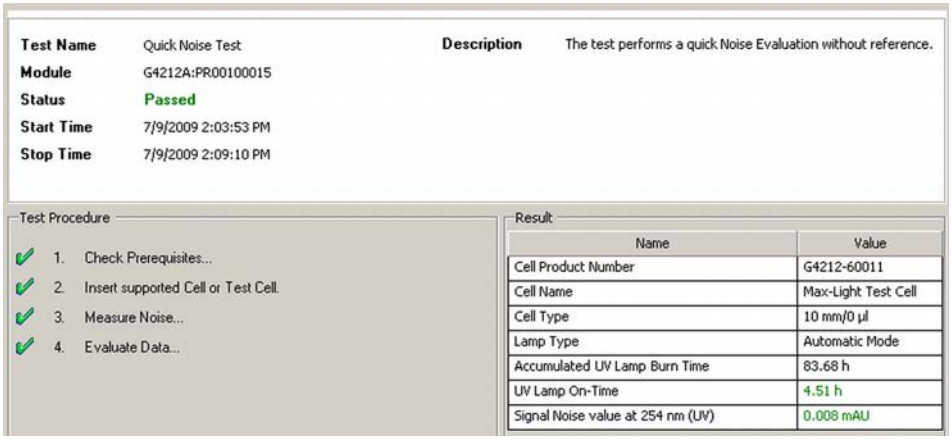


Figure 39 Quick Noise Test – Results

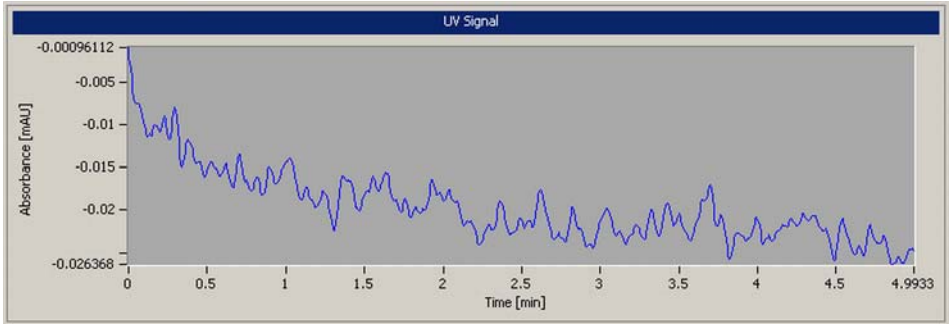


Figure 40 Quick Noise Test — Signals

Test Failed

Quick Noise Test Evaluation

Probable cause	Suggested actions
1 Insufficient lamp warm-up time.	Allow detector and UV-lamp turned on for at least 2 hours.
2 Absorbing solvent or air bubble in flow cell.	Ensure the flow cell is filled with water, and free from air bubbles.
3 Dirty or contaminated flow cell.	• Flush flow cell. • Clean the flow cell as described in "Cleaning of Max-Light Cartridge Cell" on page 178.
4 Old UV-lamp.	Exchange the UV-lamp.

ASTM Drift and Noise Test

The ASTM noise test determines the detector noise over a period of 20 minutes. The test is done with installed Max-Light Cartridge Cell or Max-Light Cartridge Test Cell.

This test does also check for the drift. It is also part of the “Self Test” (without checking for the drift).

If the test is performed with the Max-Light Cartridge Test Cell, the test results are not influenced by solvent or pump effects.

When

In case of noise and drift problem.

Parts required

	#	Description
	1	Max-Light Cartridge Cell (filled with water)
OR	1	Max-Light Cartridge Test Cell

Preparations

- Detector and UV-lamp must be on for at least 2 hours.
- ASTM measurements based on specifications may require longer stabilization times.
- When using a Max-Light Cartridge Cell a flow rate of 0.5 mL/min with water is required.

1 Run the **ASTM Drift and Noise Test** with the recommended user interface (for further information see Online-Help of user interface).

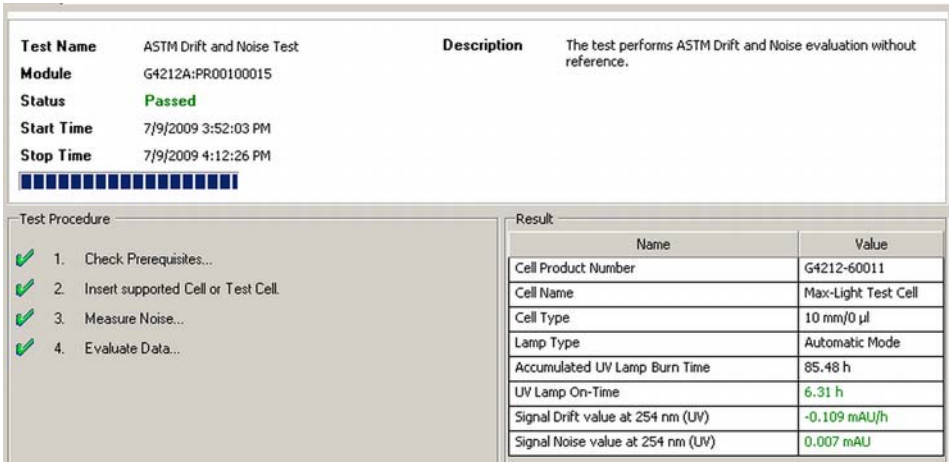


Figure 41 ASTM Drift and Noise Test – Results

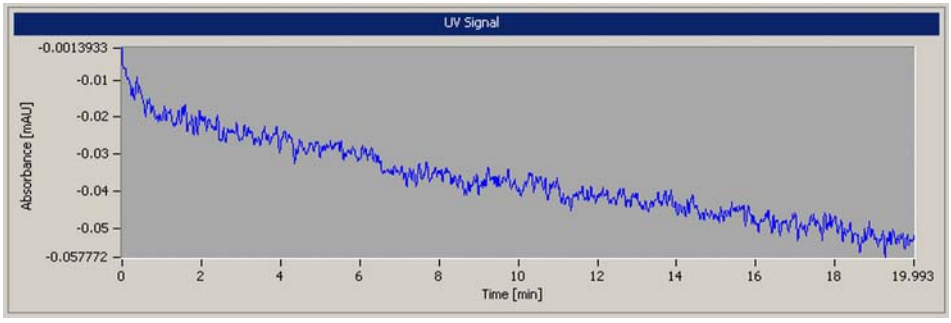


Figure 42 ASTM Drift and Noise Test – Signals

Test Failed

ASTM Noise Test Evaluation

Probable cause	Suggested actions
1 Insufficient lamp warm-up time.	Allow detector and UV-lamp turned on for at least 2 hours.
2 Absorbing solvent or air bubble in flow cell.	Ensure the flow cell is filled with water, and free from air bubbles.
3 Dirty or contaminated flow cell.	• Flush flow cell. • Clean the flow cell as described in "Cleaning of Max-Light Cartridge Cell" on page 178.
4 Old UV-lamp.	Exchange the UV-lamp.
5 Environment not according to specifications.	Improve environment.

Slit Test

Slit Test (G4212A)

The slit test verifies correct operation of the micromechanical slit.

During the test, the slit is moved through all slit positions while the detector monitors the lamp intensity change. When the slit position is changed, the intensity drop (move to smaller slit) or intensity increase (move to larger slit) must be within a defined range.

If the intensity changes are outside the expected range, the test fails.

When In case of problems.

Parts required

	#	Description
	1	Max-Light Cartridge Cell (filled with water)
OR	1	Max-Light Cartridge Test Cell

Preparations

- Lamp must be on for at least 10 minutes.
- When using a Max-Light Cartridge Cell a flow rate of 0.5 mL/min with water is required.

1 Run the **Slit Test** with the recommended user interface (for further information see Online-Help of user interface).

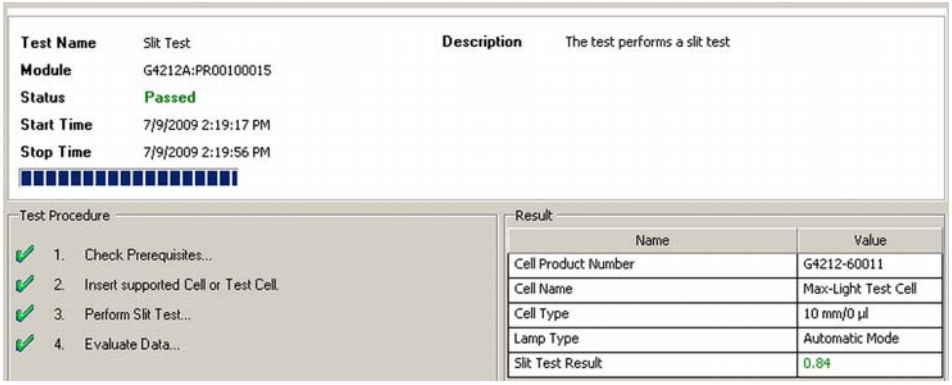


Figure 43 Slit Test – Results

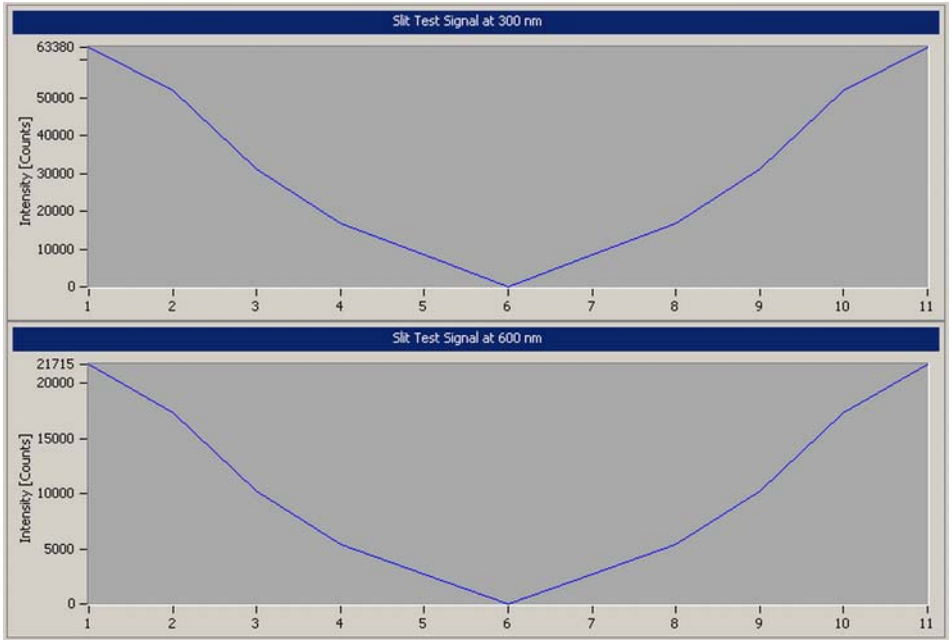


Figure 44 Slit Test – Signals

Test Failed

Slit Test Evaluation

Probable cause	Suggested actions
1 Air bubble in Max-Light Cartridge Cell.	Flush the flow cell or use the Max-Light Cartridge Test Cell.
2 Old lamp.	Run the “Intensity Test”. Exchange the lamp if old or defective.
3 Defective slit assembly.	Please contact your Agilent service representative.
4 Defective detector main board.	Please contact your Agilent service representative.
5 Defective optical unit.	Please contact your Agilent service representative.

Slit Test (G4212B)

There is no dedicated slit test for the G4212B DAD. To verify the proper function perform the following tests:

- Intensity Test (tests the normal position)
- Dark Current Test (tests the dark position)

Wavelength Verification Test

The detector uses the alpha (656.1 nm) and beta (486 nm) emission lines of the UV-lamp for wavelength calibration. The sharp emission lines enable accurate calibration. When verification is started, the 1-nm slit is moved into the light path automatically. The test is run with the Max-Light Cartridge Cell or with Max-Light Cartridge Test Cell installed.

If the test is performed with the Max-Light Cartridge Test Cell, the test results are not influenced by solvent or pump effects.

When

The detector is calibrated at the factory, and under normal operating conditions should not require recalibration. However, it is advisable to recalibrate:

- after repair of components in the optical unit,
- after exchange of the optical unit or main board,
- after replacing the Max-Light Cartridge Cell or UV-lamp,
- after significant environmental condition changes (temperature, humidity),
- at a regular interval, at least once per year (for example, prior to an Operational Qualification/Performance Verification procedure), and
- when chromatographic results indicate the detector may require recalibration.

Parts required

#	Description
1	Max-Light Cartridge Test Cell or
1	Max-Light Cartridge Cell

Preparations

- Lamp must be on for at least 10 minutes.
- When using a Max-Light Cartridge Cell a flow rate of 0.5 mL/min with water is required.

1 Run the Wavelength Verification Test with the recommended user interface (for further information see Online-Help of user interface).

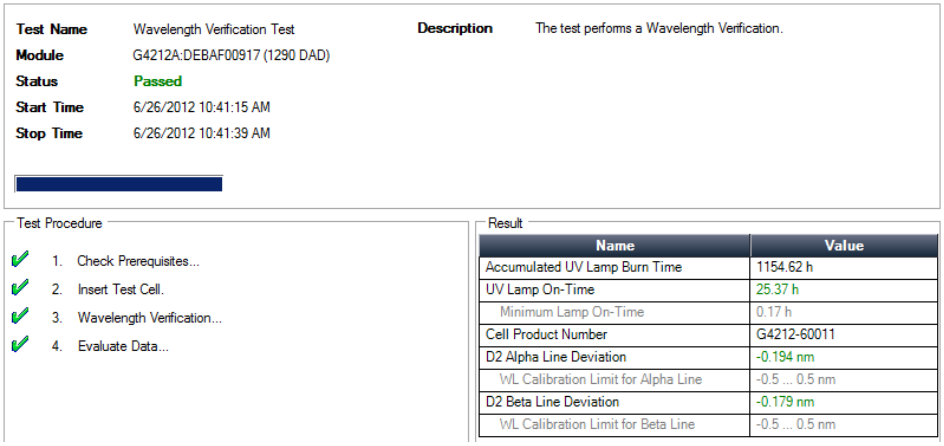


Figure 45 Wavelength Verification - Results

Wavelength Calibration

The detector uses the alpha (656.1 nm) and beta (486 nm) emission lines of the deuterium lamp for wavelength calibration. The sharp emission lines enable more accurate calibration than is possible with holmium oxide. When recalibration is started, the 1 nm slit is moved into the light path automatically (G4212A). The gain is set to zero.

On completion of the scan, the alpha- and beta-line deviations (in nm) are displayed. These values indicate how far the detector calibration deviates from the actual positions of the alpha and beta emission lines. After calibration, the deviation is zero.

To eliminate effects due to absorbing solvents, install the Max-Light Cartridge Test Cell before starting the test.

Improved wavelength calibration algorithm

The wavelength calibration algorithm has been changed to higher accuracy in UV wavelength range for G4212A/B DAD and K4212B DAD Clincal ed. with firmware B.06.33.

It has been found, that after a wavelength re-calibration (using the Agilent LabAdvisor or Instant Pilot), the measured wavelength in the lower UV might be out of the specified range of +1/-1 nm.

Example: Using Caffeine and measuring at 205 nm.

The higher wavelength range is not effected.

When

The detector is calibrated at the factory, and under normal operating conditions should not require recalibration. However, it is advisable to recalibrate:

- after maintenance (flow cell or UV-lamp),
- after repair of components in the optical unit,
- after exchange of the optical unit or main board,
- after significant environmental condition changes (temperature, humidity),
- at a regular interval, at least once per year (for example, prior to an Operational Qualification/Performance Verification procedure), and
- when chromatographic results indicate the detector may require recalibration.

Parts required

#	Description
1	Max-Light Cartridge Test Cell or
1	Max-Light Cartridge Cell

Preparations

- Detector/lamp must be on for more than 1 hour.
- When using a Max-Light Cartridge Cell a flow rate of 0.5 mL/min with water is required.

NOTE If the detector is operated in a lab environment that differs at average from the final test environment (25 °C) then the detector should be recalibrated for this temperature.

NOTE If the detector was repaired (opened covers), the wavelength calibration can be done 10 minutes after lamp on. A final wavelength calibration should be repeated after complete warm-up of the detector.

1 Run the **Wavelength Calibration** with the recommended user interface (for further information see Online-Help of user interface).

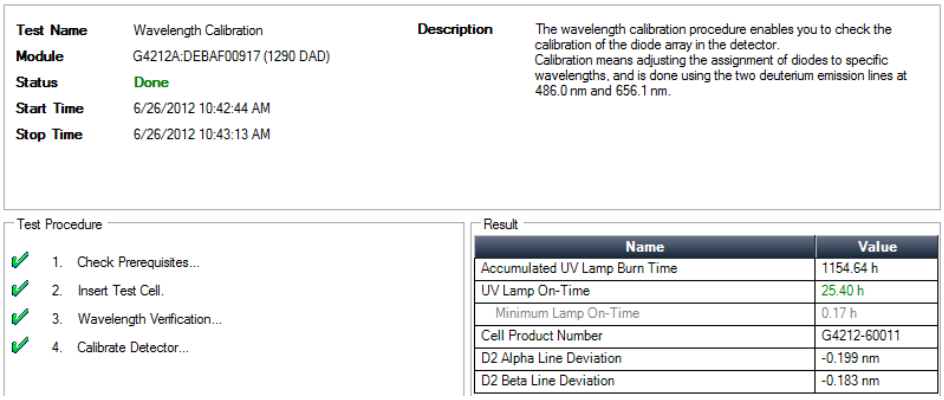


Figure 46 Wavelength Calibration – Results

Wavelength Recalibration Fails

Probable cause	Suggested actions
1 Absorbing solvent or air bubble in Max-Light Cartridge Cell.	Repeat calibration with Max-Light Cartridge Test Cell and compare results.
2 Dirty or contaminated Max-Light Cartridge Cell.	• Ensure the Max-Light Cartridge Cell is filled with water. • Recalibrate.
3 Old UV-lamp.	Exchange the UV-lamp.
4 Dirty or contaminated optical components.	Run the Cell Test. If the test fails, flush the flow cell. See also "Cleaning of Max-Light Cartridge Cell" on page 178.

NOTE If the test fails with Max-Light Cartridge Test Cell and new UV-lamp, the optical unit must be replaced.

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.

Running the test with Agilent LabAdvisor

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

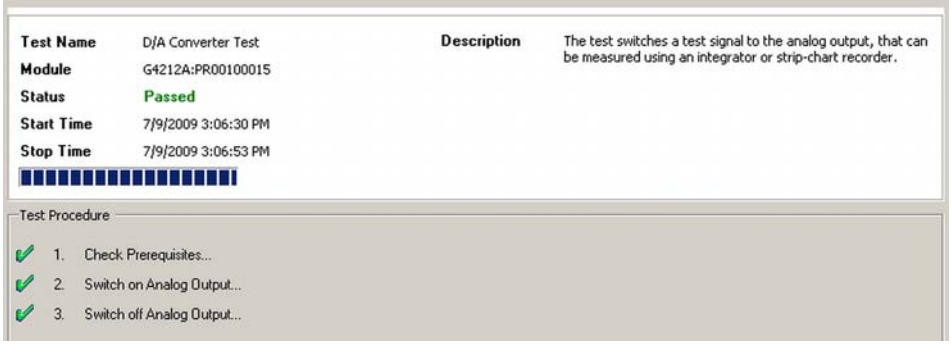


Figure 47 D/A Converter (DAC) Test – Results

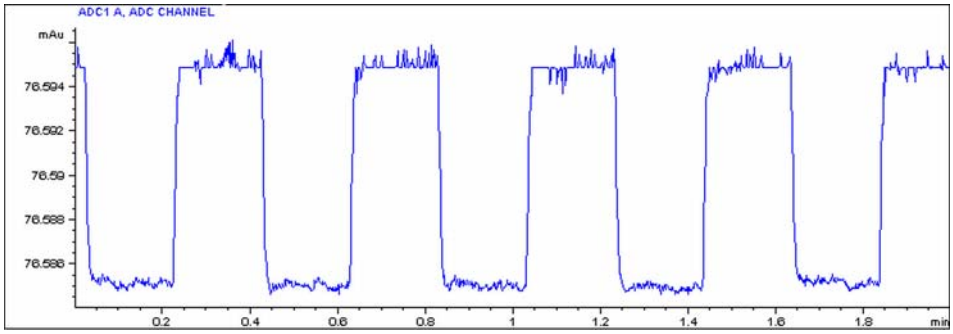


Figure 48 D/A Converter (DAC) Test – Example of Integrator Plot

Running the Test with Instant Pilot

The test can be started via the command line.

1 To start the test
`TEST: DAC 1`
Reply: **RA 00000 TEST:DAC 1**

2 To stop the test
`TEST:DAC 0`
Reply: **RA 00000 TEST:DAC 0**

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.

Dark Current Test

The dark-current test measures the leakage current from each diode. The test is used to check for leaking diodes which may cause non-linearity at specific wavelengths. During the test, the slit assembly moves to the dark position, cutting off all light falling onto the diode array. Next, the leakage current from each diode is measured, and displayed graphically. The leakage current (represented in counts) for each diode should fall within the limits.

When In case of problem.

1 Run the **Dark Current Test** with the recommended user interface (for further information see Online-Help of user interface).

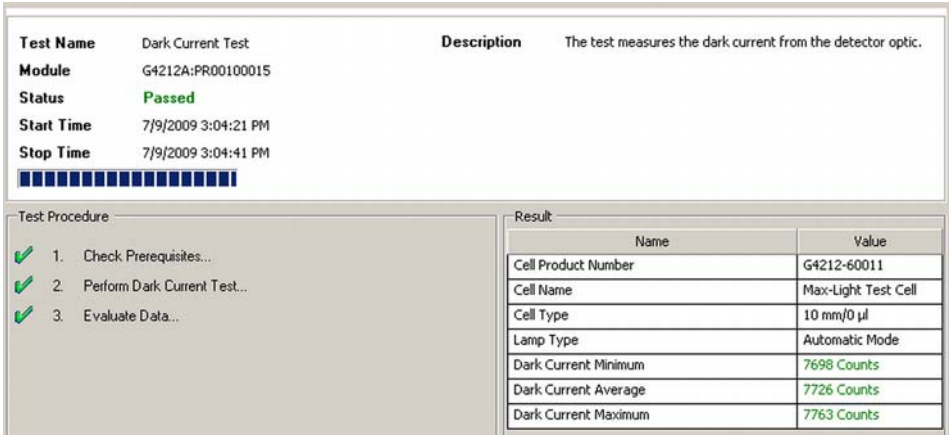


Figure 49 Dark Current Test – Results

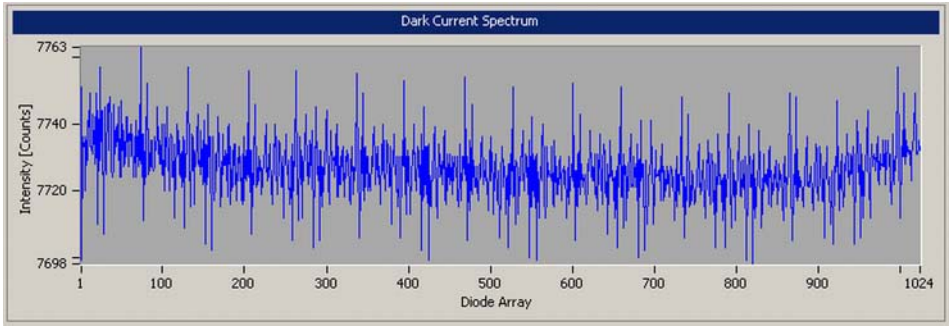


Figure 50 Dark Current Test – Signals

Test Failed

Probable cause	Suggested actions
1 Defective slit assembly (stray light).	Run the "Slit Test (G4212A)" on page 151 (part of the "Self-Test" on page 138).
2 Defective detector main board.	Please contact your Agilent service representative.
3 Defective PDA/optical unit.	Please contact your Agilent service representative.

9 Maintenance

This chapter describes the maintenance of the module.

Warnings and Cautions

WARNING

Toxic, flammable and hazardous solvents, samples and reagents

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

➔ When working with these substances observe appropriate safety procedures (for example by wearing goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the vendor, and follow good laboratory practice.

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

➔ Do not operate the instrument in an explosive atmosphere.

WARNING

Eye damage by detector light

Eye damage may result from directly viewing the UV-light produced by the lamp of the optical system used in this product.

➔ Always turn the lamp of the optical system off before removing it.

WARNING

Electrical shock

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

➔ Do not remove the cover of the module.

➔ Only certified persons are authorized to carry out repairs inside the module.

WARNING

Personal injury or damage to the product

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

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

CAUTION

Safety standards for external equipment

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

Introduction to Maintenance

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

NOTE

There are no serviceable parts inside.

Do not open the module.

Overview of Maintenance

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

Table 12 Overview of Maintenance

Procedure	Typical Frequency	Notes
Cleaning of module	If required	
Deuterium lamp exchange	If noise and/or drift exceeds your application limits or lamp does not ignite.	A wavelength calibration test and an intensity test should be performed after replacement.
Flow cell exchange	If leaking or if intensity drops due to contaminated flow cell.	A wavelength calibration test should be performed after replacement.
Leak sensor drying	If leak has occurred.	Check for leaks.
Leak handling System replacement	If broken or corroded.	Check for leaks.

Cleaning the Module

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

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

➔ Do not use an excessively damp cloth during cleaning.

➔ Drain all solvent lines before opening any connections in the flow path.

Replacing the Deuterium Lamp

When If noise or drift exceeds application limits or lamp does not ignite.

Tools required

Description
Screwdriver POZI 1 PT3

Parts required

#	p/n	Description
1	5190-0917	Long-life Deuterium lamp (8-pin) with RFID tag

Preparations Turn the lamp off.

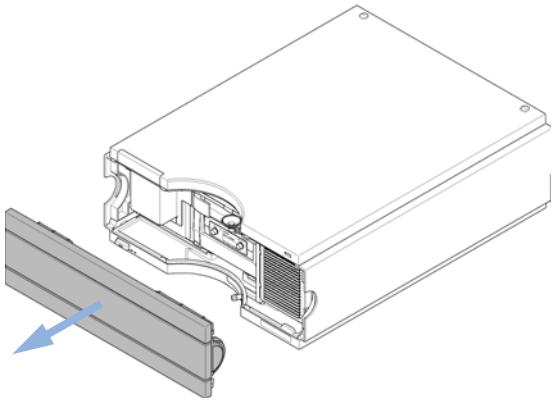
WARNING

Injury by touching hot lamp

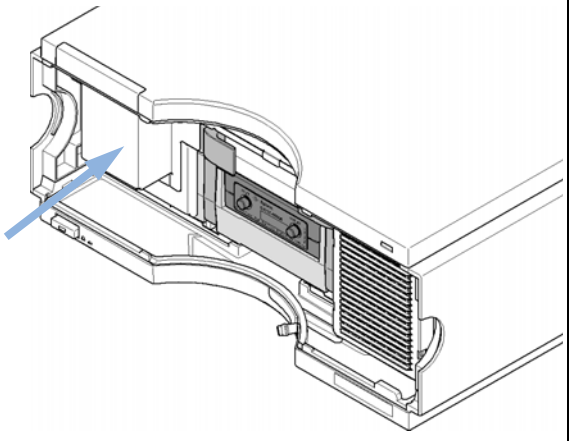
If the detector has been in use, the lamp may be hot.

➔ If so, wait for lamp to cool down.

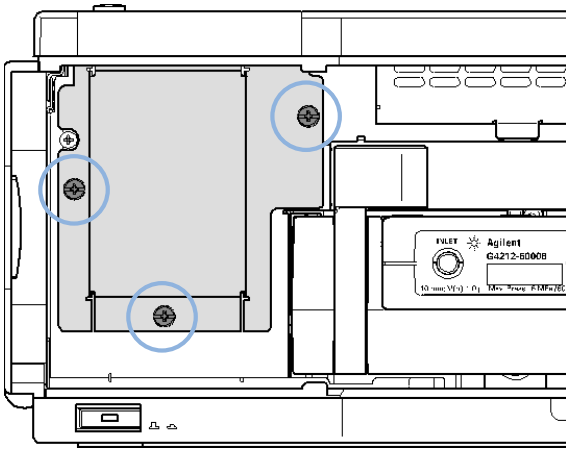
1 Remove the front cover.



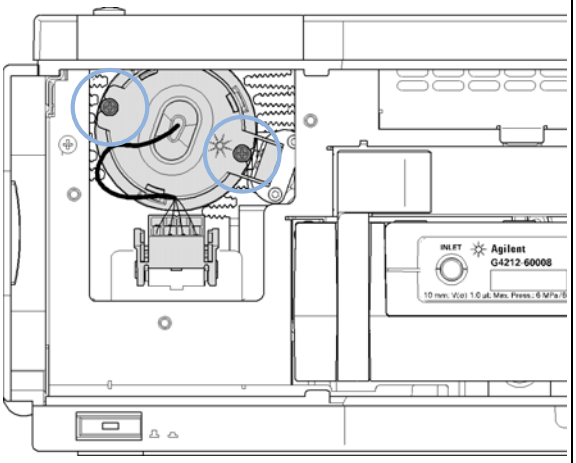
2 Locate the lamp area.



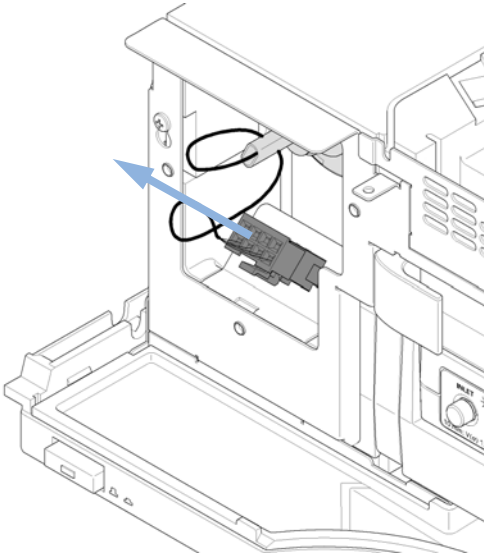
3 Unscrew the 3 screws of the lamp housing cover and remove the cover.



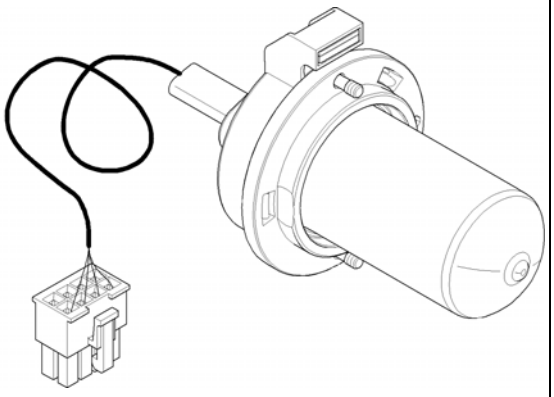
4 Locate the two screws that fix the lamp and unscrew.



5 Disconnect the lamp connector and remove the lamp.



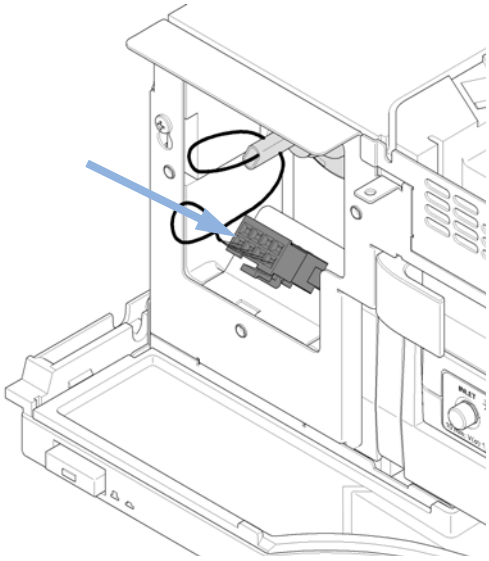
6 Place the lamp on a clean place.



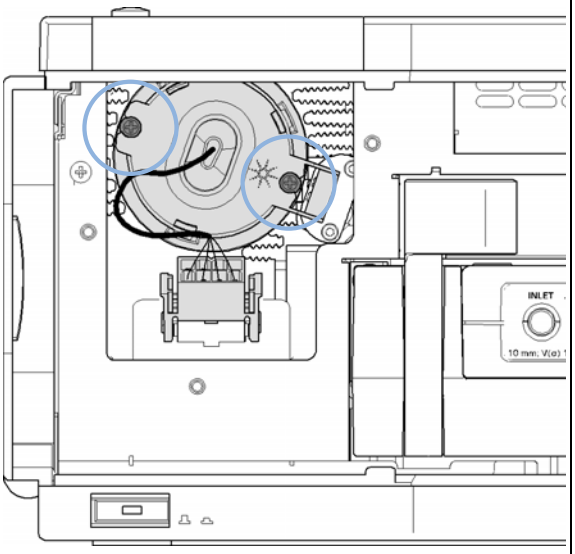
NOTE

Do not touch the glass bulb with your fingers. It may reduce the light output.

7 Insert the lamp and reconnect the lamp connector.

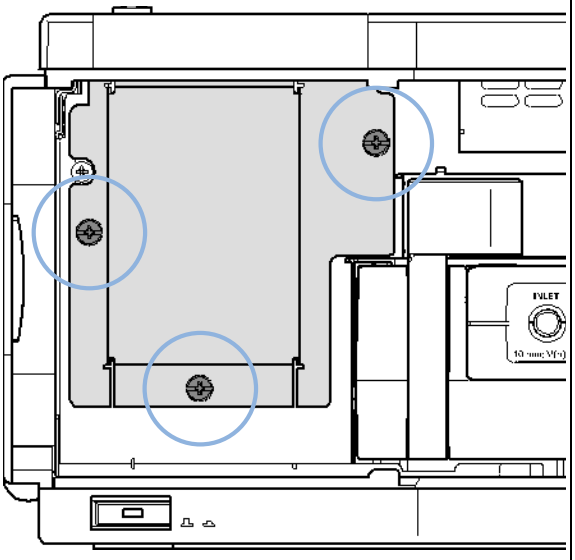


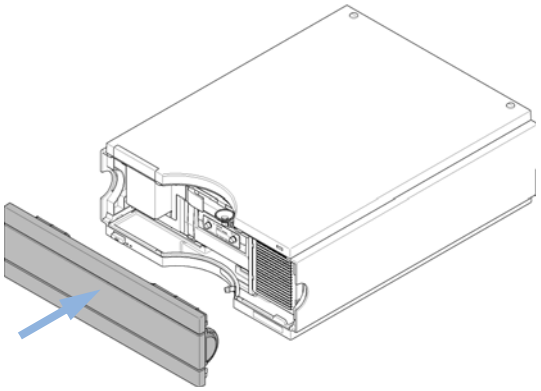
8 Locate the two screws and fix the lamp.



9 Fit the lamp wires in the lamp house cover so that they are not scratched by the cover.

10 Replace the lamp housing cover and fix the 3 screws.



11 Close the front cover. 	**12** Perform a Wavelength Re-calibration after lamp warm-up.

Replacing the Max-Light Cartridge Cell

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

When

If leaking or if intensity drops due to contaminated flow cell.

Tools required

Description
Wrench. hexagonal

Parts required

#	p/n	Description
1	G4212-60008	Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL)
1	G4212-60007	Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL)
1	G4212-60011	Max-Light Cartridge Test Cell
1	G5615-60018	Max-Light Cartridge Cell Bio-inert (10 mm, V(σ) 1.0 µL) includes Peek Capillary 1.5 m i.d. 0.18 mm (0890-1763) and PEEK Fittings 10/PK (5063-6591)
1	G5615-60017	Max-Light Cartridge Cell Bio-inert (60 mm, V(σ) 4.0 µL) includes Peek Capillary 1.5 m i.d. 0.18 mm (0890-1763) and PEEK Fittings 10/PK (5063-6591)
1	G4212-60032	HDR Max-Light Cartridge Cell (3.7 mm, V(σ) 0.4 µL)
1	G4212-60038	ULD Max-Light Cartridge Cell (10 mm, V(σ) 0.6 µL)

Preparations

Turn the pump off.

CAUTION

Sample degradation and contamination of the instrument

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

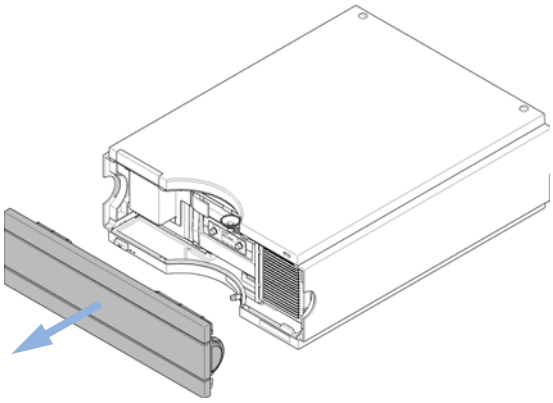
➔ For bio-inert applications, always use dedicated bio-inert parts, which can be identified by the bio-inert symbol or other markers described in this manual.

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

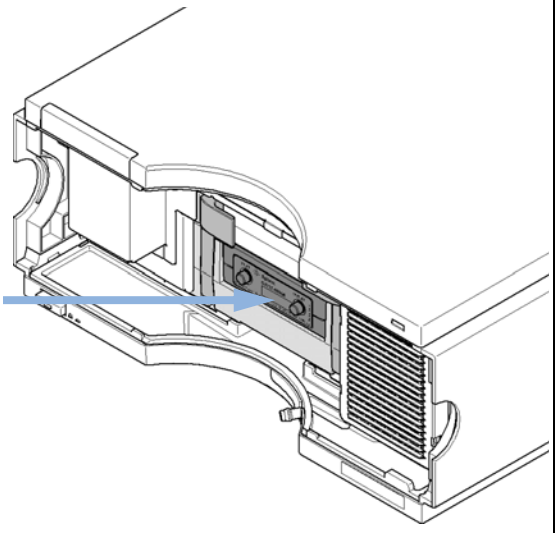
NOTE

The flow cell is shipped with a filling of isopropanol. This is to avoid breakage due to subambient conditions. In case the flow cell is not used for some time (stored), then flush the flow cell with iso-propanol.

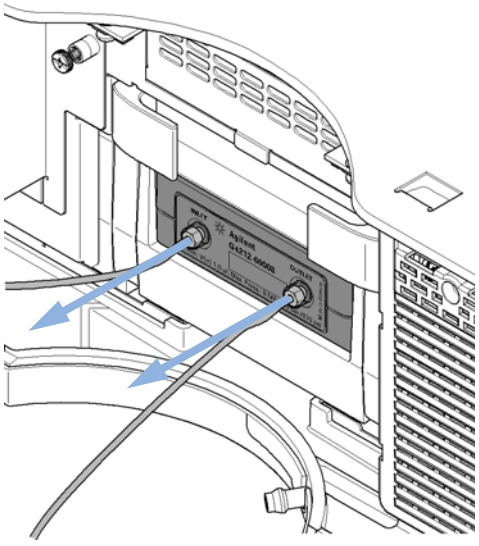
1 Remove the front cover.



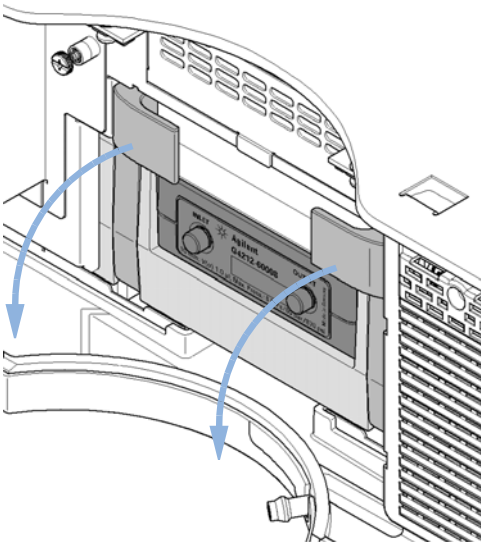
2 Locate the cell area.



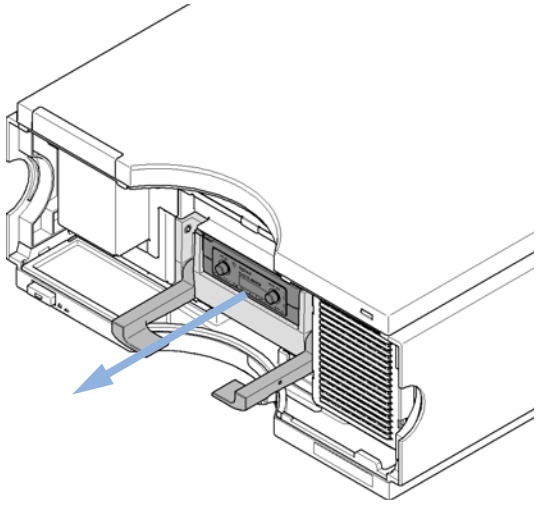
3 Disconnect the inlet capillary to CELL-IN (left) and the waste tubing to CELL-OUT (right).



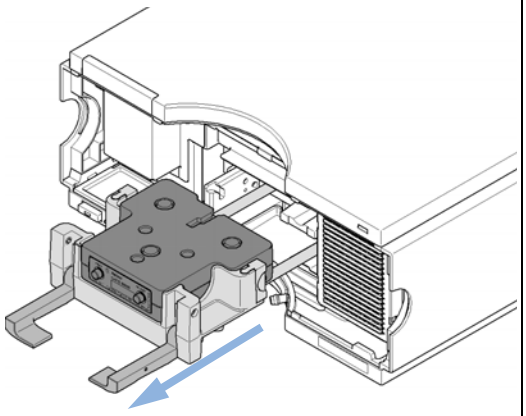
4 Unlock the cell cartridge holder by pulling the lever to the front.



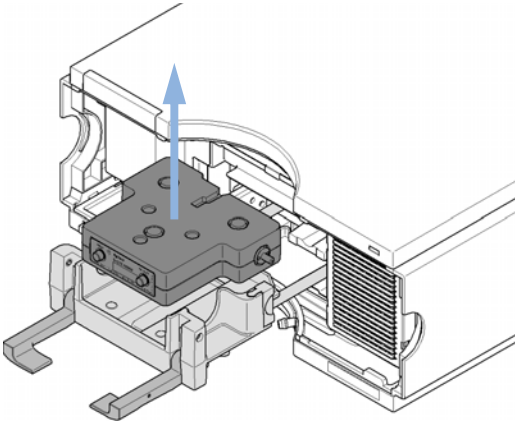
5 The lever should be in the final down position.



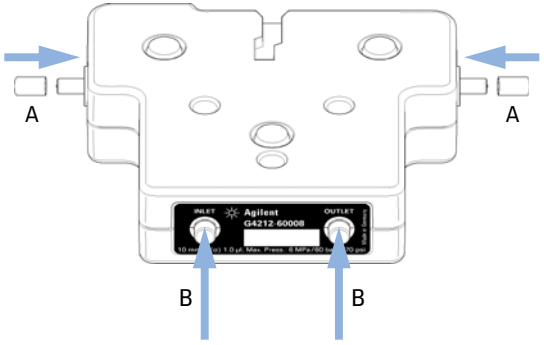
6 Pull the cell cartridge holder completely out towards the front.



7 Remove the cell from the cartridge holder.



8 Replace the black hoods [A] to the cell interfaces (in/out) and insert plugs [B] for save storage.



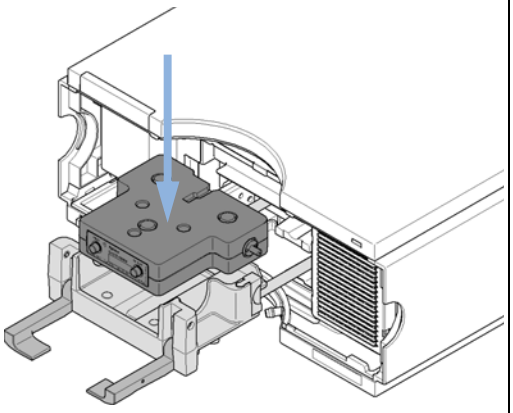
NOTE

The hoods and the plugs should be always in place to protect the flow cell.

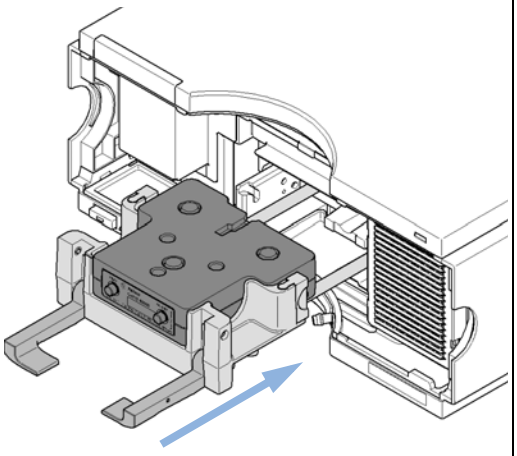
For longer storage, the flow cell should be flushed and filled with isopropanol to prevent the grow of algae.

Store it in the plastic case provided with the Max-Light Cartridge Flow Cell.

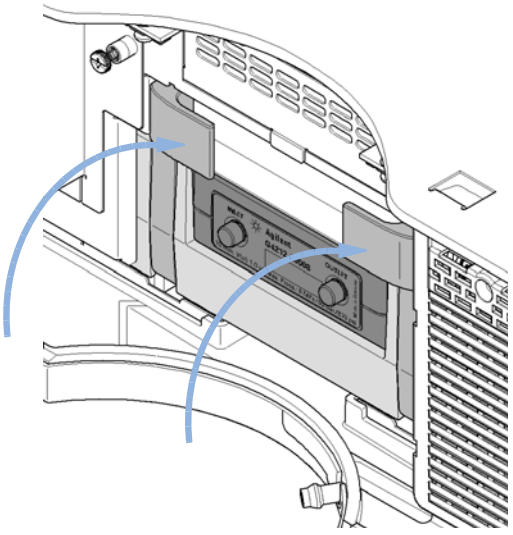
9 Remove the black hoods from the cell interfaces (in/out) and insert the cell into the cell cartridge holder.



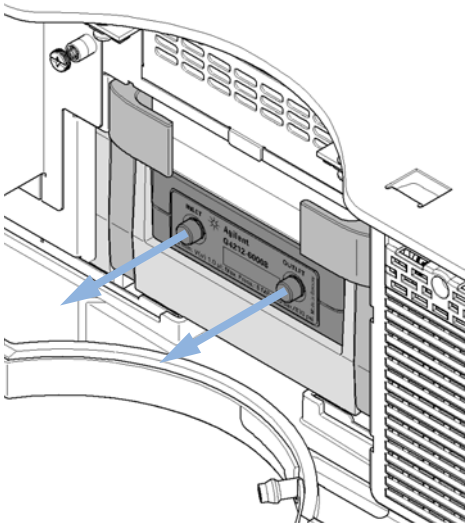
10 Slide the cell cartridge holder completely into the module.



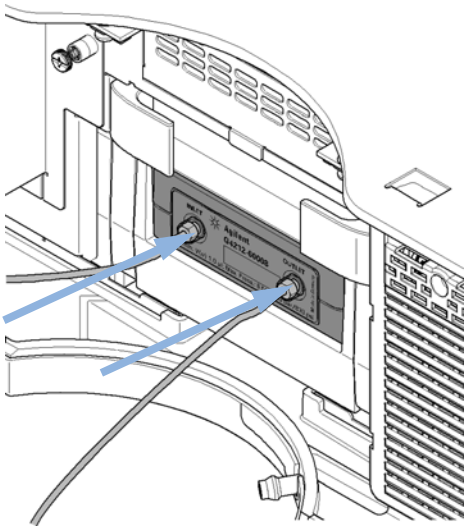
11 Lift the two levers into the upper final position to fix the cell.



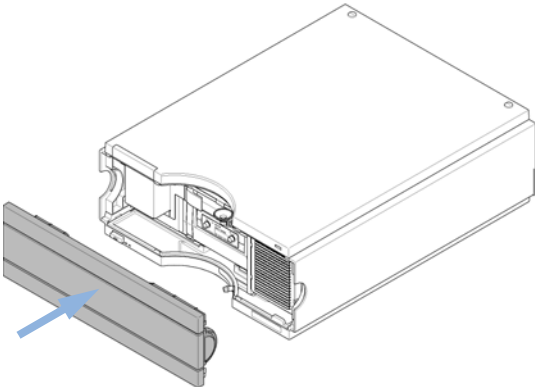
12 Remove the plugs from the CELL-IN and CELL-OUT (keep them safe).



13 Connect the inlet capillary to CELL-IN (left) and the waste tubing to CELL-OUT (right).



14 Close the front cover.



Cleaning of Max-Light Cartridge Cell

When	Low counts on Intensity Test or Cell Test (failed tests)	
Tools required	**p/n**	**Description**
		Alcohol (Iso-propanol or Ethanol)
		Lens tissue or Q-tips ®
	5062-8529	Cell cleaning fluid, 1 L

1 Flush the flow cell with the alcohol for some time.

2 Remove the cell from the cartridge holder (see "Replacing the Max-Light Cartridge Cell" on page 173).

3 Carefully clean the light inlet and outlet of the cell using lens tissue or Q-tips® with alcohol.

NOTE If Q-tips® are used, ensure that no cotton fluff remains at the inlet or outlet.

NOTE Do not touch the light inlet and outlet of the cell with your fingers. This will add a layer of contamination on the window and reduce the light throughput.

4 Flush the flow cell with water and repeat the Intensity Test and or Cell Test.

5 If tests fail again, the flow cell might be replaced if the chromatographic performace cannot be accepted.

NOTE If the cleaning with the alcohol did not improve, you may use Cell cleaning fluid, 1 L (5062-8529).

Storage of Max-Light Cartridge Cell

1 Flush the Max-Light Cartridge Flow Cell with iso-propanol or methanol and insert the plugs into the cell inlet and outlet (see "Replacing the Max-Light Cartridge Cell" on page 173).

2 Remove the Max-Light Cartridge Cell from the cartridge holder of the detector.

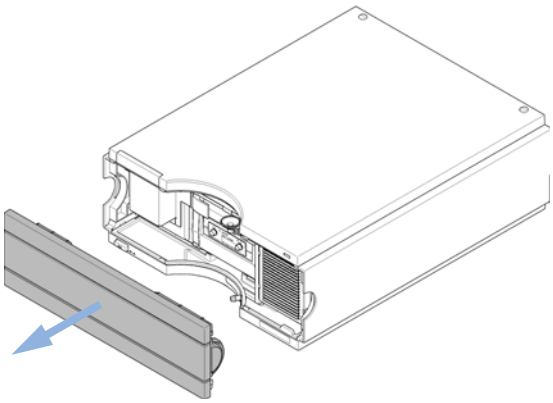
3 Replace the black hoods, that secure the cell light inlet and outlet.

4 Store the Max-Light Cartridge Cell in plastic case provided with the Max-Light Cartridge Flow Cell.

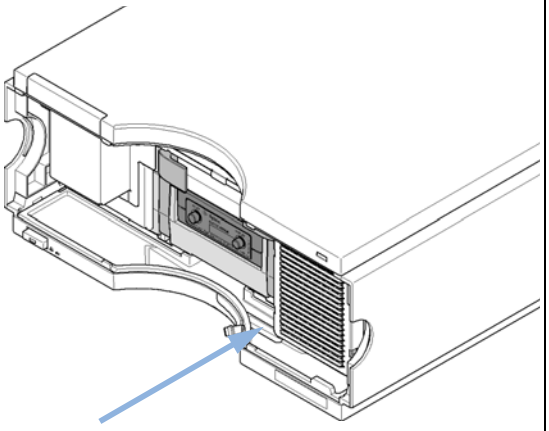
Drying the Leak Sensor

When	If leak has occurred.
Tools required	**Description** Tissue
Preparations	Turn the pump off.

1 Remove the front cover.

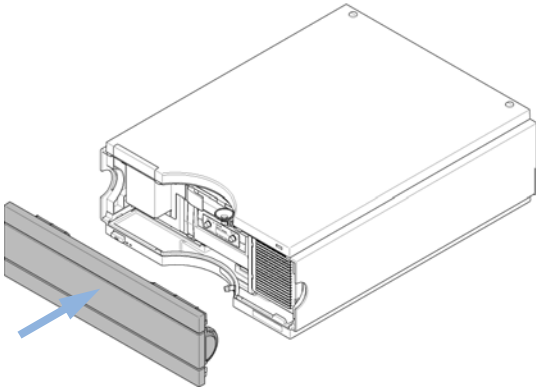


2 Locate the leak sensor area.



3 Dry the leak sensor and the area around. Check loose fittings at the flow cell. Note that the leak sensor does not touch the panel (clearance of about 1 mm).

4 Close the front cover.



Replacing Leak Handling System Parts

When If the parts are corroded or broken.

Tools required

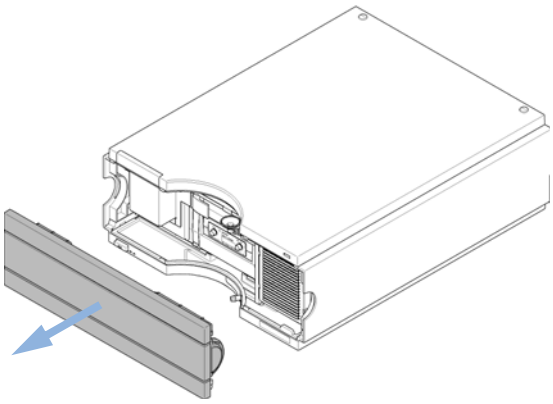
Description
Tissue

Parts required

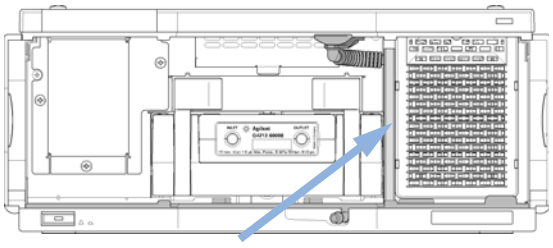
#	p/n	Description
1	5061-3388	Leak funnel
1	5041-8389	Leak funnel holder
1	5062-2463	Corrugated tubing, PP, 6.5 mm id, 5 m
1	G4212-40027	Leak downpipe

Preparations Turn the pump off.

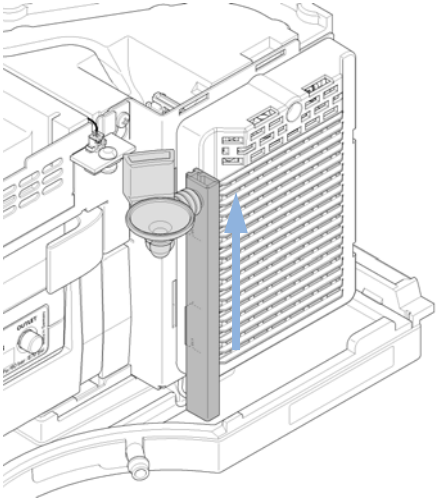
1 Remove the front cover.



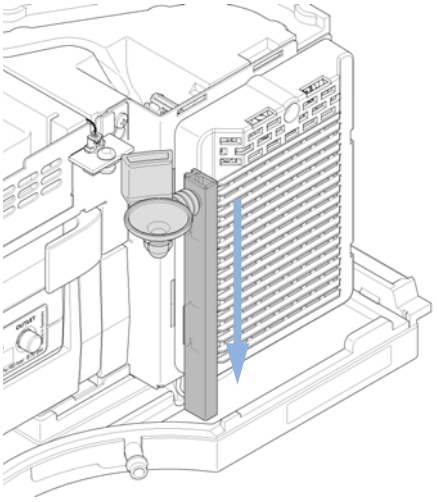
2 Locate the leak interface area.



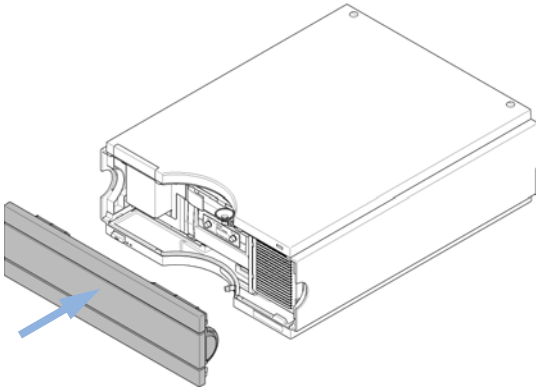
3 Pull the leak funnel out of the leak funnel holder and slide the Leak downpipe up for removal.



4 Insert the leak interface system parts. Ensure the tubing is fitted correctly in the bottom.



5 Close the front cover.



Replacing Module Firmware

When

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

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

Tools required

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

Parts required

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

Preparations

Read update documentation provided with the Firmware Update Tool.

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

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

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

Table 13 Module Specific Information (G4212A/G4212B)

	G4212A - 1290 DAD	G4212B - 1260 DAD
Initial firmware (main and resident)	B.06.23	B.06.30
Compatibility with 1100/1200/1260/1290 series modules	When using the G4212A in a system, all other modules must have firmware revision A.06.1x or B.06.1x and above (main and resident). Otherwise the communication will not work.	When using the G4212B in a system, all other modules must have firmware revision A.06.3x or B.06.3x and above (main and resident). Otherwise the communication will not work.
Compatibility with VSA Optical	Introduced 07/2012. Firmware B.06.51, B.06.43 or B.06.26 or later (depends on the used firmware set). Earlier revisions are not compatible with the VSA Optical. These revisions are the required versions for the new VSA Optical Unit and Main Boards.	
Conversion to / emulation	N/A	N/A

Information from Module's Assemblies

Lamp and Flow Cell RFID Tag

The detector is equipped with a UV lamp and flow cell identification system using RFID (radio frequency identification) tags attached to the assemblies and RFID tag readers at the optical unit. The table below lists all parameters stored in the RFID tag.

Table 14 RFID Tag Data

Lamp information	Flow cell information
• product number	• product number
• serial number	• serial number
• production date	• production date
• accumulated UV on time (in hours)	• nominal path length of the cell (in mm)
• actual UV lamp on time (in hours)	• cell volume (σ) in µL
• number of ignitions	• maximum pressure (in bar)
• date of last intensity test	• date of last cell test

NOTE The pressure value is always displayed in bar, even if the user interface uses other units, e.g. PSI.

Serial Number and Firmware Revision

The user interface provides module specific information that is stored in the main board. These are for example the serial number, firmware revision.

10
Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

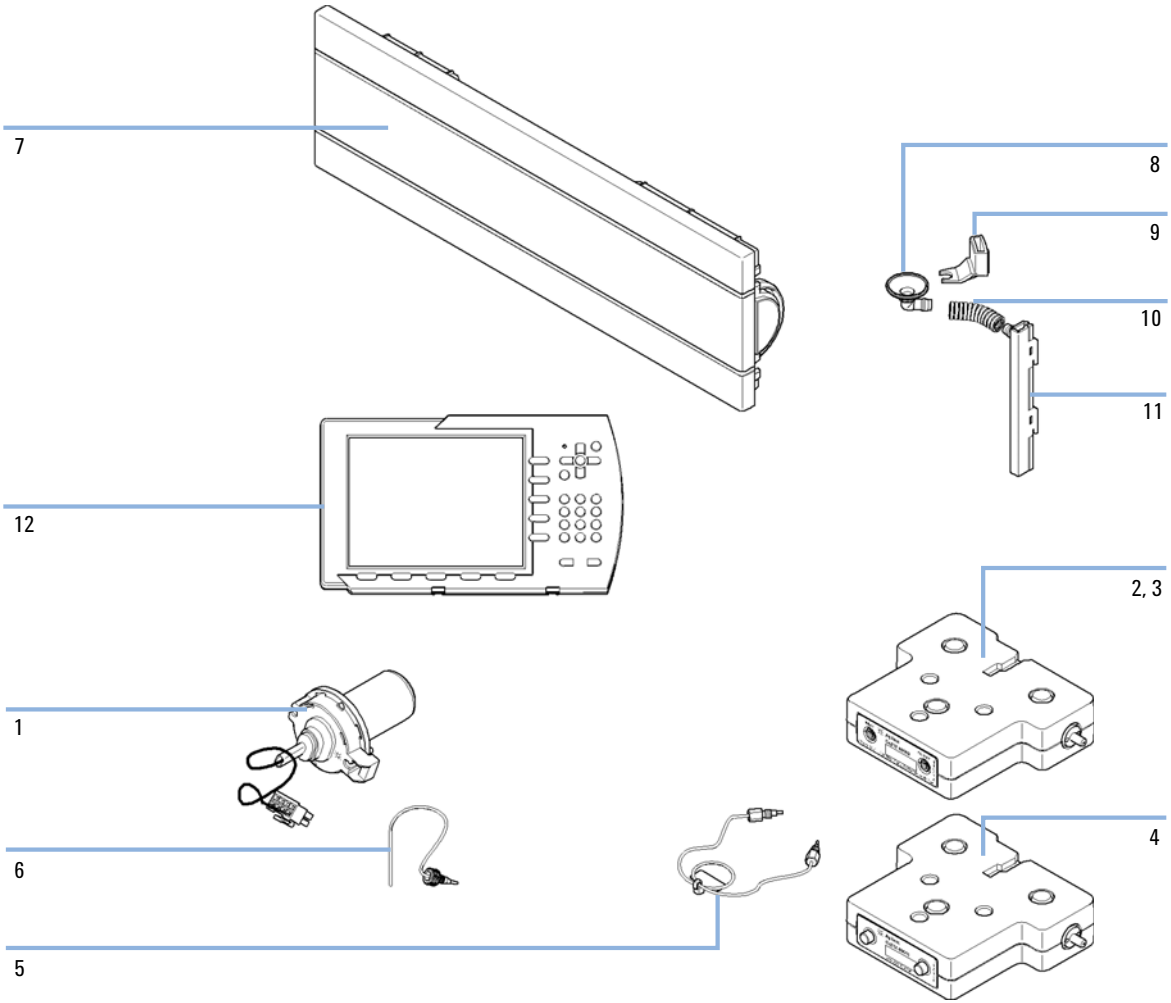
Overview of Maintenance Parts

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

Item	p/n	Description
1	5190-0917	Long-life Deuterium lamp (8-pin) with RFID tag
2	G4212-60008	Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL)
2	G5615-60018	Max-Light Cartridge Cell Bio-inert (10 mm, V(σ) 1.0 µL) includes Peek Capillary 1.5 m i.d. 0.18 mm (0890-1763) and PEEK Fittings 10/PK (5063-6591)
3	G4212-60007	Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL)
3	G5615-60017	Max-Light Cartridge Cell Bio-inert (60 mm, V(σ) 4.0 µL) includes Peek Capillary 1.5 m i.d. 0.18 mm (0890-1763) and PEEK Fittings 10/PK (5063-6591)
3	G4212-60032	HDR Max-Light Cartridge Cell (3.7 mm, V(σ) 0.4 µL)
3	G4212-60038	ULD Max-Light Cartridge Cell (10 mm, V(σ) 0.6 µL)
4	G4212-60011	Max-Light Cartridge Test Cell
5	5067-4660	Inlet Capillary SST 0.12 mm I.D., 220 mm long
6	5062-2462	PTFE Tubing flexible i.d. 0.8 mm, o.d. 1.6 mm, 2 m, re-order 5 m (flow cell to waste)
7	5067-4691	Front Panel DAD/VWD/FLD (1260/1290)
8	5041-8388	Leak funnel
9	5041-8389	Leak funnel holder
10	5063-6527	Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste)
11	G4212-40027	Leak downpipe
12	G4208A	Instant Pilot

NOTE Instant Pilot G4208A (requires firmware B.02.11 or above).

For cables refer to "Cable Overview" on page 192.


7
8
9
10
11
12
2, 3
1
4
6
5

Kits

Accessory Kit

Accessory kit (G4212-68755) contains some specific accessories and materials needed for the installation of the detector.

p/n	Description
5062-2462	PTFE Tubing flexible i.d. 0.8 mm, o.d. 1.6 mm, 2 m, re-order 5 m (flow cell to waste)
5063-6527	Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste)
5042-9967	Tubing clip (set of 5 clips)
0100-1516	Fitting male PEEK, 2/pk
5067-4660	Inlet Capillary SST 0.12 mm I.D., 220 mm long
5181-1516	CAN cable, Agilent module to module, 0.5 m

Inline Pressure Relief Valve Kit (G4212-68001)

NOTE To protect the flow cell against overpressure please refer to "Inline Pressure Relief Valve Kit (G4212-68001)" on page 82.

11
Identifying Cables

This chapter provides information on cables used with the Agilent 1260 Infinity/1290 Infinity LC modules.

Cable Overview

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

Analog cables

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

Remote cables

p/n	Description
03394-60600	Agilent module to 3396A Series I integrators
	3396 Series II / 3395A integrator, see details in section "Remote Cables" on page 196
03396-61010	Agilent module to 3396 Series III / 3395B integrators
5061-3378	Remote Cable
01046-60201	Agilent module to general purpose

BCD cables

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

CAN cables

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

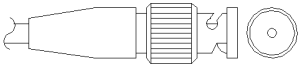
LAN cables

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

RS-232 cables

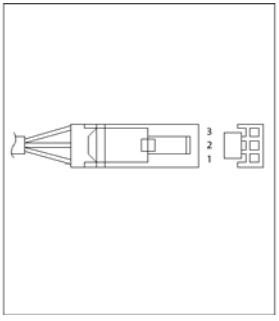
p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61601	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between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

Analog Cables

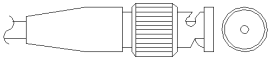


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

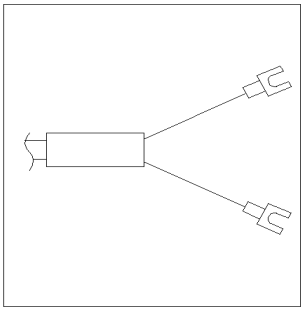
Agilent Module to 3394/6 Integrators

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

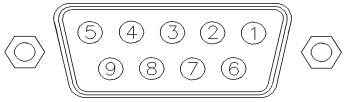
Agilent Module to BNC Connector

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

Agilent Module to General Purpose

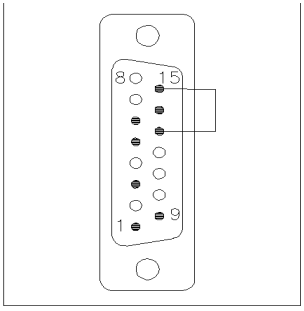
p/n 01046-60105	Pin	Pin Agilent module	Signal Name
	1		Not connected
	2	Black	Analog -
	3	Red	Analog +

Remote Cables



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

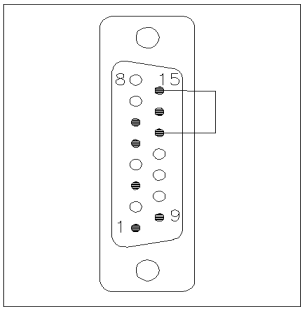
Agilent Module to 3396A Integrators

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

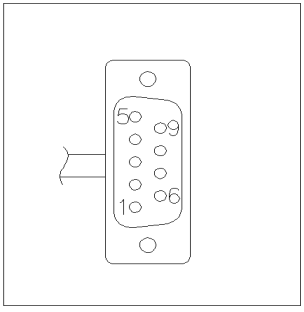
Agilent Module to 3396 Series II / 3395A Integrators

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

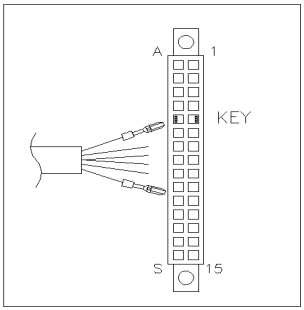
Agilent Module to 3396 Series III / 3395B Integrators

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

Agilent Module to Agilent 35900 A/D Converters

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

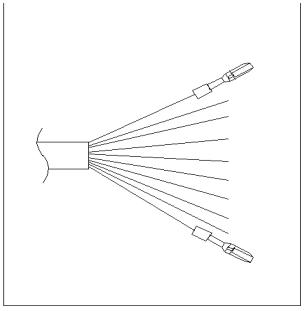
Agilent Module to General Purpose

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

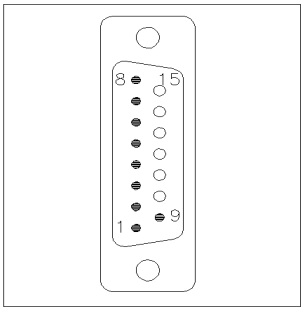
BCD Cables

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

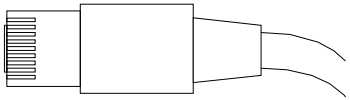
Agilent Module to General Purpose

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

Agilent Module to 3396 Integrators

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

CAN/LAN Cables



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

CAN Cables

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

LAN Cables

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

RS-232 Cables

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

12
Hardware Information

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

Firmware Description

The firmware of the instrument consists of two independent sections:

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

Resident System

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

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

Main System

Its properties are:

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

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

- run synchronization through APG remote,
- error handling,
- diagnostic functions,
- or module specific functions like
  - internal events such as lamp control, filter movements,
  - raw data collection and conversion to absorbance.

Firmware Updates

Firmware updates can be done using your user interface:

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

The file naming conventions are:

PPPP_RVVV_XXX.dlb, where

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

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

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

XXX is the build number of the firmware.

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

NOTE

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

Main and resident firmware must be from the same set.

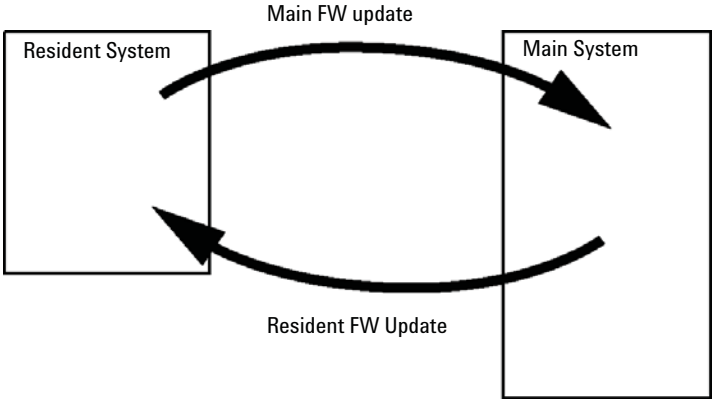


Figure 51 Firmware Update Mechanism

NOTE

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

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

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

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

- http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?whid=69761

Electrical Connections

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

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

Rear view of the module

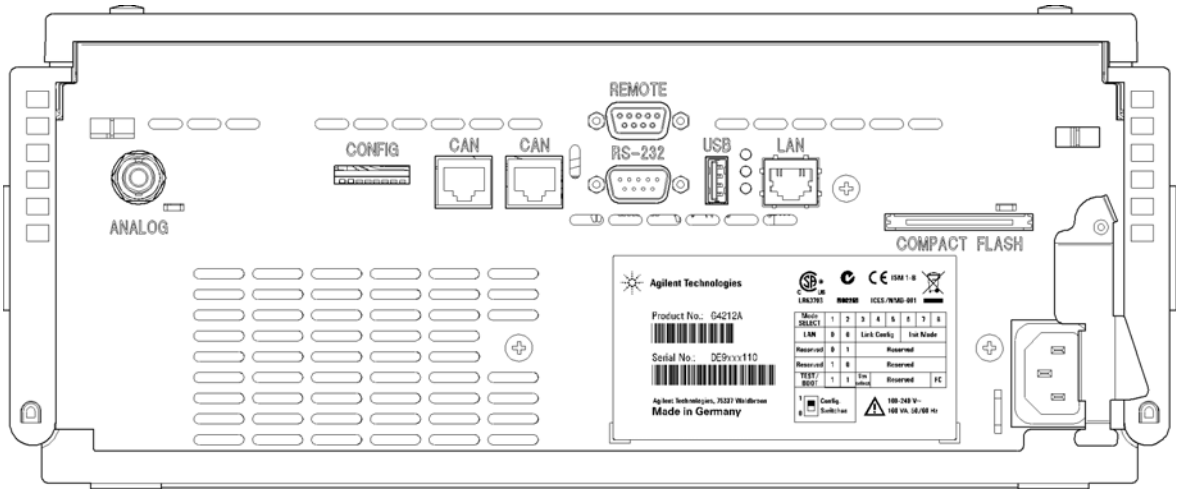


Figure 52 Rear View of Detector – Electrical Connections and Label

NOTE The CompactFlash Card Slot is not active yet. It may be used for future enhancements.

Information on Instrument Serial Number

Serial Number Information 1200 Series and 1290 Infinity

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

CCYWWSSSSS	Format
CC	country of manufacturing • DE = Germany • JP = Japan • CN = China
YWW	year and week of last major manufacturing change, e.g. 820 could be week 20 of 1998 or 2008
SSSSS	real serial number

Serial Number Information 1260 Infinity

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 1200 Infinity Series modules provide the following interfaces:

Table 15 Agilent 1200 Infinity Series Interfaces

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

Table 15 Agilent 1200 Infinity Series Interfaces

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

Table 15 Agilent 1200 Infinity Series Interfaces

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

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

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

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

Overview Interfaces

CAN

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

LAN

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

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

RS-232C (Serial)

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

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

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

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

Table 16 RS-232C Connection Table

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

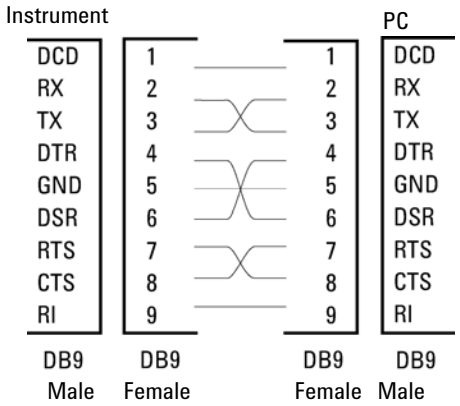


Figure 53 RS-232 Cable

Analog Signal Output

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

APG Remote

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

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

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

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

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

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

Table 17 Remote Signal Distribution

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

Special Interfaces

There is no special interface for this module.

Setting the 8-bit Configuration Switch

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

All modules with on-board LAN:

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

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

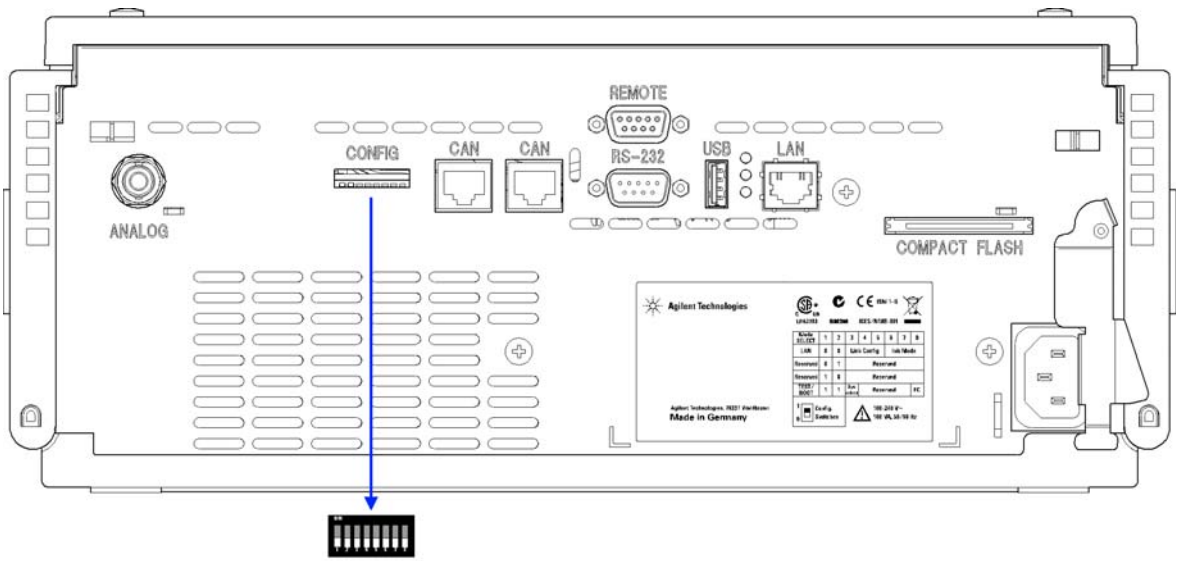


Figure 54 Location of Configuration Switch (example shows a G4212A DAD)

NOTE To perform any LAN configuration, SW1 and SW2 must be set to OFF. For details on the LAN settings/configuration refer to chapter LAN Configuration.

Table 18 8-bit Configuration Switch (with on-board LAN)

	Mode		Function					
	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8
LAN	*0*	*0*	Link Configuration			Init Mode Selection		
Auto-negotiation			*0*	x	x	x	x	x
10 MBit, half-duplex			1	*0*	*0*	x	x	x
10 MBit, full-duplex			1	*0*	1	x	x	x
100 MBit, half-duplex			1	1	*0*	x	x	x
100 MBit, full-duplex			1	1	1	x	x	x
Bootp			x	x	x	*0*	*0*	*0*
Bootp & Store			x	x	x	*0*	*0*	1
Using Stored			x	x	x	*0*	1	*0*
DHCP			x	x	x	1	*0*	*0*
Using Default			x	x	x	*0*	1	1
TEST	1	1	System					NVRAM
Boot Resident System			1					x
Revert to Default Data (Coldstart)			x	x	x			1

Legend:

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

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

NOTE For explanation of "Boot Resident System" and "Revert to Default Data (Coldstart)" refer to "Special Settings" on page 219.

Special Settings

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

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

Boot-Resident

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

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

Table 19 Boot Resident Settings (On-board LAN)

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

Forced Cold Start

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

CAUTION Loss of data

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

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

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

Table 20 Forced Cold Start Settings (On-board LAN)

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

Instrument Layout

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

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

Early Maintenance Feedback

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

EMF Counters

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

Using the EMF Counters

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

Setting the EMF Limits

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

13
LAN Configuration

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

What You Have to Do First

The module has an on-board LAN communication interface.

1 Note the MAC (Media Access Control) address for further reference. The MAC or hardware address of the LAN interfaces is a world wide unique identifier. No other network device will have the same hardware address. The MAC address can be found on a label at the rear of the module underneath the configuration switch (see Figure 56 on page 224).

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

Figure 55 MAC-Label

2 Connect the instrument's LAN interface (see Figure 56 on page 224) to
- the PC network card using a crossover network cable (point-to-point) or
- a hub or switch using a standard LAN cable.

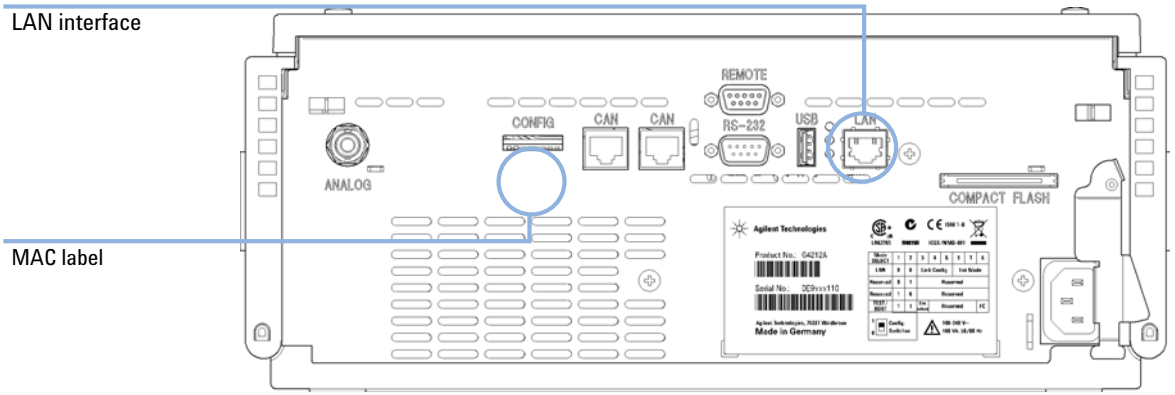


Figure 56 Location of LAN interfaces and MAC label

TCP/IP parameter configuration

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

- IP address
- Subnet Mask
- Default Gateway

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

- by automatically requesting the parameters from a network-based BOOTP Server (using the so-called Bootstrap Protocol)
- by automatically requesting the parameters from a network-based DHCP Server (using the so-called Dynamic Host Configuration Protocol). This mode requires a LAN-onboard Module or a G1369C LAN Interface card, see "Setup (DHCP)" on page 232
- by manually setting the parameters using Telnet
- by manually setting the parameters using the Instant Pilot (G4208A)

The LAN interface differentiates between several initialization modes. The initialization mode (short form 'init mode') defines how to determine the active TCP/IP parameters after power-on. The parameters may be derived from a Bootp cycle, non-volatile memory or initialized with known default values. The initialization mode is selected by the configuration switch, see Table 22 on page 227.

Configuration Switch

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

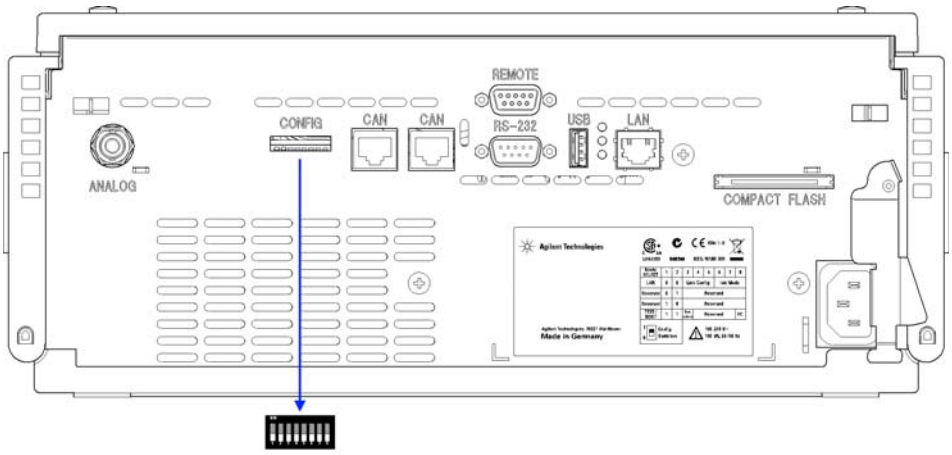


Figure 57 Location of Configuration Switch

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

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

Table 21 Factory Default Settings

Initialization ('Init') Mode	Bootp, all switches down. For details see "Initialization mode selection" on page 227
Link Configuration	speed and duplex mode determined by auto-negotiation, for details see "Link configuration selection" on page 234

Initialization mode selection

The following initialization (init) modes are selectable:

Table 22 Initialization Mode Switches

	SW 6	SW 7	SW 8	Init Mode
	OFF	OFF	OFF	Bootp
	OFF	OFF	ON	Bootp & Store
	OFF	ON	OFF	Using Stored
	OFF	ON	ON	Using Default
	ON	OFF	OFF	DHCP [1]

[1] Requires firmware B.06.40 or above. Modules without LAN on board, see G1369C LAN Interface Card

Bootp

When the initialization mode **Bootp** is selected, the module tries to download the parameters from a **Bootp** Server. The parameters obtained become the active parameters immediately. They are not stored to the non-volatile memory of the module. Therefore, the parameters are lost with the next power cycle of the module.

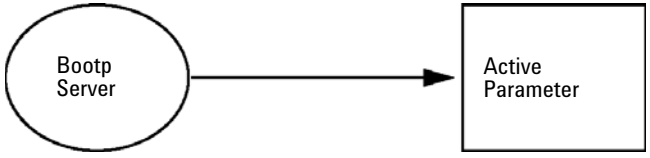


Figure 58 **Bootp** (Principle)

Bootp & Store

When **Bootp & Store** is selected, the parameters obtained from a **Bootp** Server become the active parameters immediately. In addition, they are stored to the non-volatile memory of the module. Thus, after a power cycle they are still available. This enables a kind of bootp once configuration of the module.

Example: The user may not want to have a **Bootp** Server be active in his network all the time. But on the other side, he may not have any other configuration method than **Bootp**. In this case he starts the **Bootp** Server temporarily, powers on the module using the initialization mode **Bootp & Store**, waits for the **Bootp** cycle to be completed, closes the **Bootp** Server and powers off the module. Then he selects the initialization mode Using Stored and powers on the module again. From now on, he is able to establish the TCP/IP connection to the module with the parameters obtained in that single **Bootp** cycle.

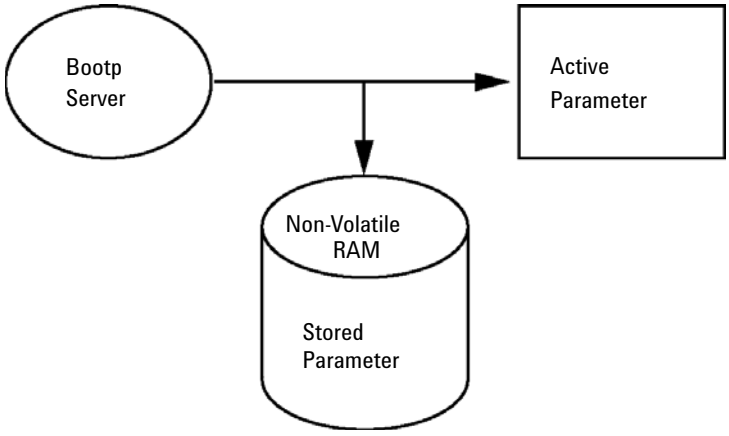


Figure 59 Bootp & Store (Principle)

NOTE Use the initialization mode **Bootp & Store** carefully, because writing to the non-volatile memory takes time. Therefore, when the module shall obtain its parameters from a **Bootp** Server every time it is powered on, the recommended initialization mode is **Bootp**!

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.

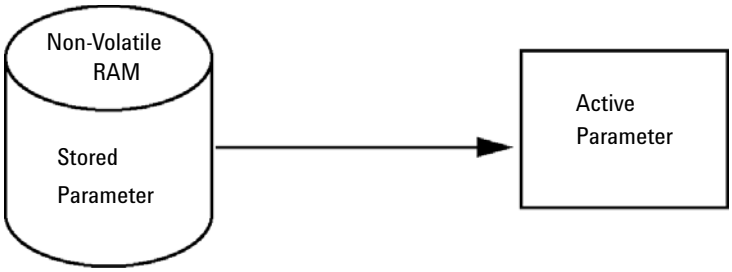


Figure 60 Using Stored (Principle)

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 23 on page 229.

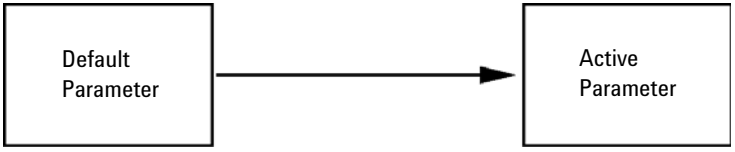


Figure 61 Using Default (Principle)

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

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

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

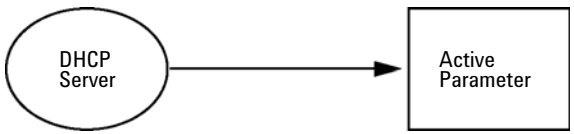


Figure 62 DHCP (Principle)

NOTE

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

Setup (DHCP)

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

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

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

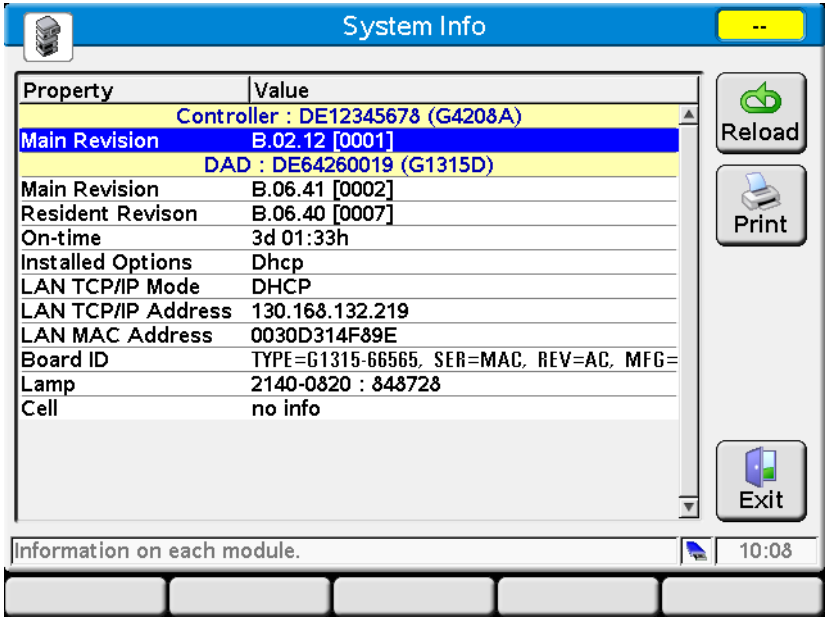


Figure 63 LAN Setting on Instant Pilot

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

Table 24 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 25 LC Modules inclusive 1120/1220 (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. Agilent ChemStation, LabAdvisor, 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 231).

Link configuration selection

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

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

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

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

Table 26 Link Configuration Switches

	SW 3	SW 4	SW 5	Link Configuration
	OFF	-	-	speed and duplex mode determined by auto-negotiation
	ON	OFF	OFF	manually set to 10 Mbps, half-duplex
	ON	OFF	ON	manually set to 10 Mbps, full-duplex
	ON	ON	OFF	manually set to 100 Mbps, half-duplex
	ON	ON	ON	manually set to 100 Mbps, full-duplex

Automatic Configuration with BootP

NOTE All examples shown in this chapter will not work in your environment. You need your own IP-, Subnet-Mask- and Gateway addresses.

NOTE Assure that the detector configuration switch is set properly. The setting should be either **BootP** or **BootP & Store**, see Table 22 on page 227.

NOTE Assure that the detector connected to the network is powered off.

NOTE If the Agilent BootP Service program is not already installed on your PC, then install it from your Agilent ChemStation DVD, located in folder **BootP**.

About Agilent BootP Service

The Agilent BootP Service is used to assign the LAN Interface with an IP address.

The Agilent BootP Service is provided on the ChemStation DVD. The Agilent BootP Service is installed on a server or PC on the LAN to provide central administration of IP addresses for Agilent instruments on a LAN. The BootP service must be running TCP/IP network protocol and cannot run a DHCP server.

How BootP Service Works

When an instrument is powered on, an LAN Interface in the instrument broadcasts a request for an IP address or host name and provides its hardware MAC address as an identifier. The Agilent BootP Service answers this request and passes a previously defined IP address and host name associated with the hardware MAC address to the requesting instrument.

The instrument receives its IP address and host name and maintains the IP address as long as it is powered on. Powering down the instrument causes it to lose its IP address, so the Agilent BootP Service must be running every time the instrument powers up. If the Agilent BootP Service runs in the background, the instrument will receive its IP address on power-up.

The Agilent LAN Interface can be set to store the IP address and will not lose the IP address if power cycled.

Situation: Cannot Establish LAN Communication

If a LAN communication with BootP service cannot be established, check the following on the PC:

- Is the BootP service started? During installation of BootP, the service is not started automatically.
- Does the Firewall block the BootP service? Add the BootP service as an exception.
- Is the LAN Interface using the BootP-mode instead of "Using Stored" or "Using Default" modes?

Installation of BootP Service

Before installing and configuring the Agilent BootP Service, be sure to have the IP addresses of the computer and instruments on hand.

1 Log on as Administrator or other user with Administrator privileges.

2 Close all Windows programs.

3 Insert the Agilent ChemStation software DVD into the drive. If the setup program starts automatically, click **Cancel** to stop it.

4 Open Windows Explorer.

5 Go to the BootP directory on the Agilent ChemStation DVD and double-click **BootPPackage.msi**.

6 If necessary, click the **Agilent BootP Service...** icon in the task bar.

7 The **Welcome** screen of the **Agilent BootP Service Setup Wizard** appears. Click **Next**.

8 The **End-User License Agreement** screen appears. Read the terms, indicate acceptance, then click **Next**.

9 The **Destination Folder** selection screen appears. Install BootP to the default folder or click **Browse** to choose another location. Click **Next**.

The default location for installation is:

C:\Program Files\Agilent\BootPService\

10 Click **Install** to begin installation.

11 Files load; when finished, the **BootP Settings** screen appears.

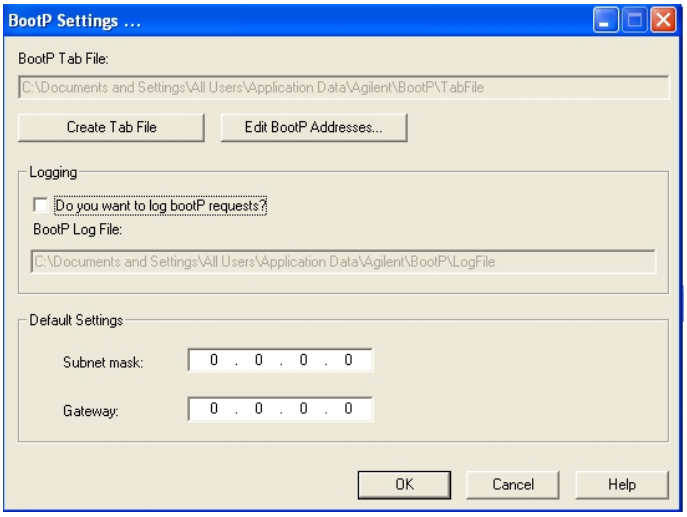


Figure 64 BootP Settings screen

12 In the **Default Settings** part of the screen, if known, you can enter the subnet mask and gateway.

Defaults can be used:

- The default subnet mask is 255.255.255.0
- The default gateway is 192.168.254.11

13 On the **BootP Settings** screen, click **OK**. The **Agilent BootP Service Setup** screen indicates completion.

14 Click **Finish** to exit the **Agilent BootP Service Setup** screen.

15 Remove the DVD from the drive.

This completes installation.

16 Start BootP Service in the Windows® services: On the Windows® desktop click right on **Computer** icon, select **Manage > Services and Applications > Services**. Select the **Agilent BootP Service** and click **Start**.

Two Methods to Determine the MAC Address

Enabling logging to discover the MAC address using BootP

If you want to see the MAC address, select the **Do you want to log BootP requests?** check box.

1 Open BootP Settings from **Start > All Programs > Agilent BootP Service > EditBootPSettings**.

2 In **BootP Settings...** check **Do you want to log BootP requests?** to enable logging.

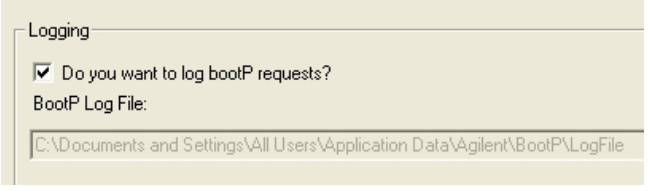


Figure 65 Enable BootP logging

The log file is located in

C:\Documents and Settings\All Users\Application Data\Agilent\BootP\LogFile

It contains a MAC address entry for each device that requests configuration information from BootP.

3 Click **OK** to save the values or **Cancel** to discard them. The editing ends.

4 After each modification of the BootP settings (i.e. **EditBootPSettings**) a stop or start of the BootP service is required for the BootP service to accept changes. See "Stopping the Agilent BootP Service" on page 243 or "Restarting the Agilent BootP Service" on page 244.

5 Uncheck the **Do you want to log BootP requests?** box after configuring instruments; otherwise, the log file will quickly fill up disk space.

Determining the MAC address directly from the LAN Interface card label

1 Turn off the instrument.

2 Read the MAC address from the label and record it.

The MAC address is printed on a label on the rear of the module.

See Figure 55 on page 224 and Figure 56 on page 224.

3 Turn on the instrument.

Assigning IP Addresses Using the Agilent BootP Service

The Agilent BootP Service assigns the Hardware MAC address of the instrument to an IP address.

Determining the MAC address of the instrument using BootP Service

1 Power cycle the Instrument.

2 After the instrument completes self-test, open the log file of the BootP Service using Notepad.

- The default location for the logfile is C:\Documents and Settings\All Users\Application Data\Agilent\BootP\LogFile.
- The logfile will not be updated if it is open.

The contents will be similar to the following:

```
02/25/10 15:30:49 PM

Status: BootP Request received at outermost layer

Status: BootP Request received from hardware address: 0010835675AC

Error: Hardware address not found in BootPTAB: 0010835675AC

Status: BootP Request finished processing at outermost layer
```

3 Record the hardware (MAC) address (for example, 0010835675AC).

4 The Error means the MAC address has not been assigned an IP address and the Tab File does not have this entry. The MAC address is saved to the Tab File when an IP address is assigned.

5 Close the log file before turning on another instrument.

6 Uncheck the **Do you want to log BootP requests?** box after configuring instruments to avoid having the logfile use up excessive disk space.

Adding each instrument to the network using BootP

1 Follow **Start > All Programs > Agilent BootP Service** and select **Edit BootP Settings**. The BootP Settings screen appears.

2 Uncheck the **Do you want to log BootP requests?** once all instruments have been added.

The **Do you want to log BootP requests?** box must be unchecked when you have finished configuring instruments; otherwise, the log file will quickly fill up disk space.

3 Click **Edit BootP Addresses...** The **Edit BootP Addresses** screen appears.

4 Click **Add...** The **Add BootP Entry** screen appears.

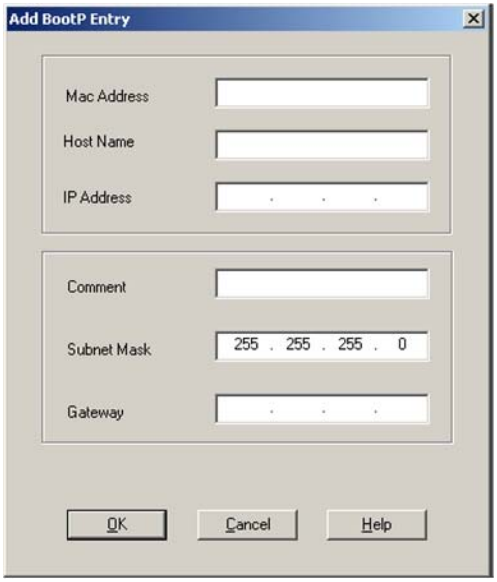


Figure 66 Enable BootP logging

5 Make these entries for the instrument:

- MAC address
- Host name, Enter a Hostname of your choice.

  The Host Name must begin with "alpha" characters (i.e. LC1260)
- IP address
- Comment (optional)
- Subnet mask
- Gateway address (optional)

The configuration information entered is saved in the Tab File.

6 Click **OK**.

7 Leave **Edit BootP Addresses** by pressing **Close**.

8 Exit **BootP Settings** by pressing **OK**.

9 After each modification of the BootP settings (i.e. EditBootPSettings) a stop or start of the BootP service is required for the BootP service to accept changes. See "Stopping the Agilent BootP Service" on page 243 or "Restarting the Agilent BootP Service" on page 244.

10 Power cycle the Instrument.

OR

If you changed the IP address, power cycle the instrument for the changes to take effect.

11 Use the PING utility to verify connectivity by opening a command window and typing:

Ping 192.168.254.11 for example.

The Tab File is located at

C:\Documents and Settings\All Users\Application Data\Agilent\BootP\TabFile

Changing the IP Address of an Instrument Using the Agilent BootP Service

Agilent BootP Service starts automatically when your PC reboots. To change Agilent BootP Service settings, you must stop the service, make the changes, and then restart the service.

Stopping the Agilent BootP Service

1 From the Windows control panel, select **Administrative Tools > Services**. The **Services** screen appears.

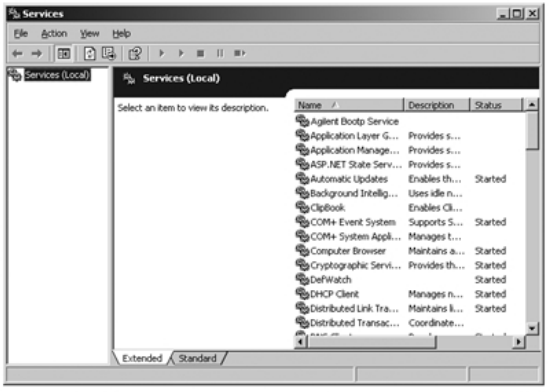


Figure 67 Windows Services screen

2 Right-click **Agilent BootP Service**.

3 Select **Stop**.

4 Close the **Services and Administrative Tools** screen.

Editing the IP address and other parameters in EditBootPSettings

1 Select **Start > All Programs > Agilent BootP Service** and select **Edit BootP Settings**. The **BootP Settings** screen appears.

2 When the **BootP Settings** screen is first opened, it shows the default settings from installation.

3 Press **Edit BootP Addresses...** to edit the Tab File.

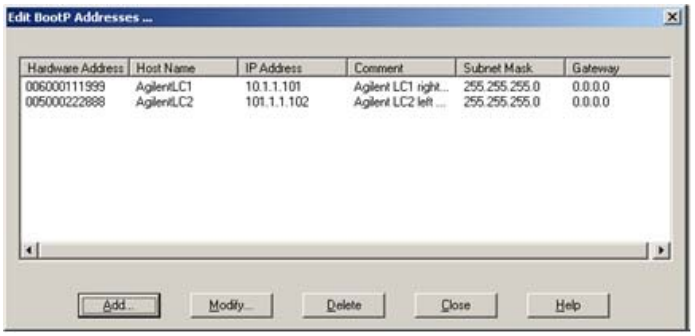


Figure 68 Edit BootP Adresses screen

4 In the **Edit BootP Addresses...** screen press **Add...** to create a new entry or select an existing line from the table and press **Modify...** or **Delete** to change the IP address, comment, subnet mask, for example, in the Tab File.

If you change the IP address, it will be necessary to power cycle the instrument for the changes to take effect.

5 Leave **Edit BootP Addresses...** by pressing **Close**.

6 Exit BootP Settings by pressing OK.

Restarting the Agilent BootP Service

1 In the Windows control panel, select **Administrative Tools > Services**. The **Services** screen appears, see Figure 67 on page 243.

2 Right-click **Agilent BootP Service** and select **Start**.

3 Close the **Services and Administrative Tools** screens.

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.

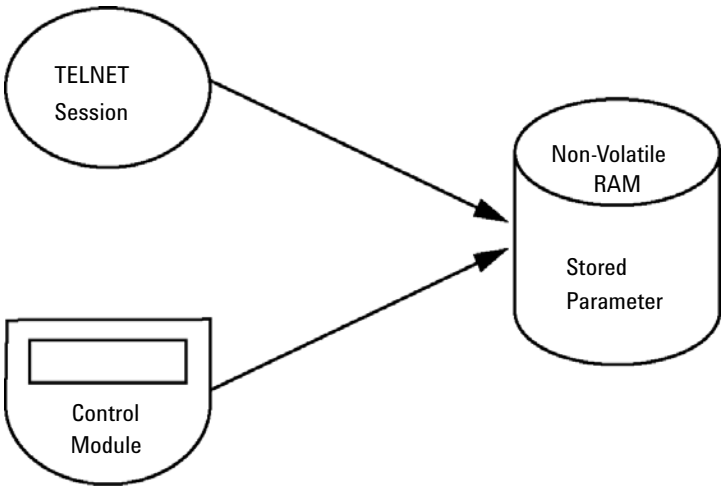


Figure 69 Manual Configuration (Principle)

With Telnet

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

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

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

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

Figure 70 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 226).

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

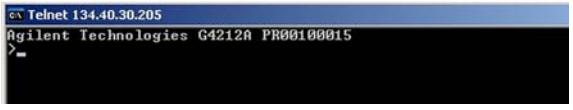


Figure 71 A connection to the module is made

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

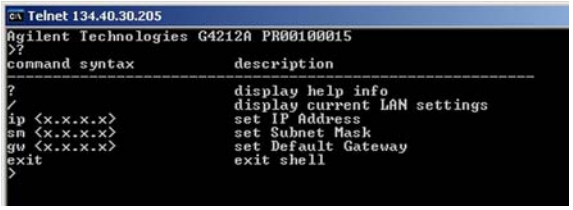


Figure 72 Telnet Commands

Table 27 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.

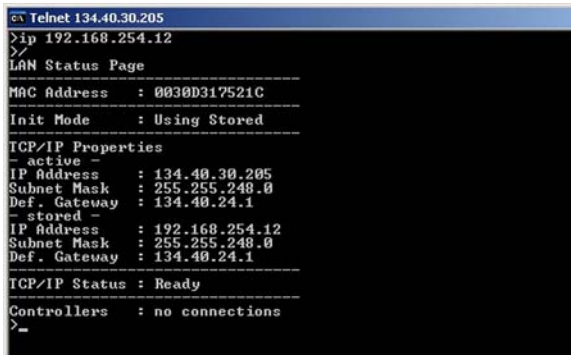
5 Use the “/” and press Enter to list the current settings.

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

Figure 73 Telnet - Current settings in "Using Stored" mode

6 Change the IP address (in this example 192.168.254.12) and type “/” to list current 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

Figure 74 Telnet - Change IP settings

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

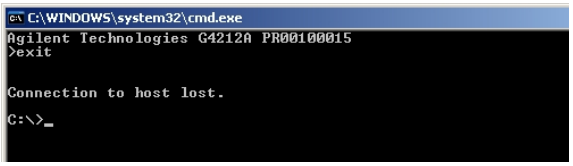


Figure 75 Closing the Telnet Session

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 **DAD** button.

4 Scroll down to the LAN settings.

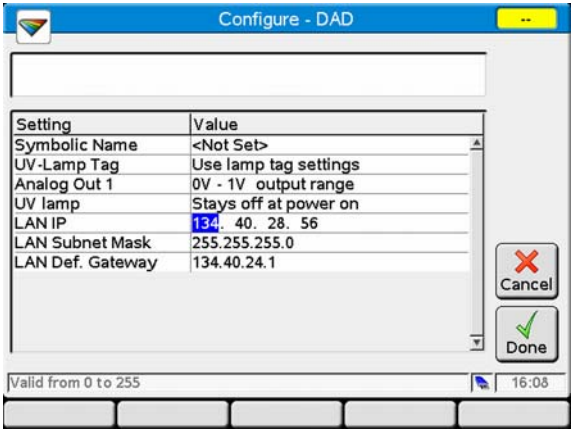


Figure 76 Instant Pilot - LAN Configuration (Edit mode)

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

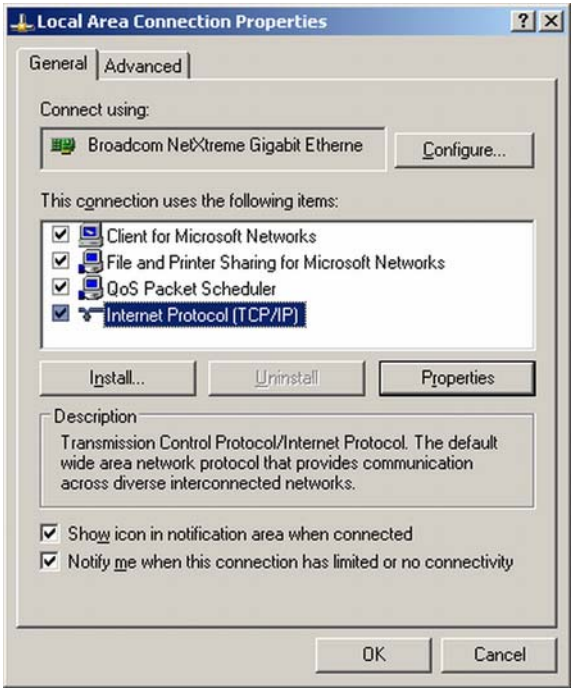
6 Leave the screen by clicking **Exit**.

PC and Agilent ChemStation Setup

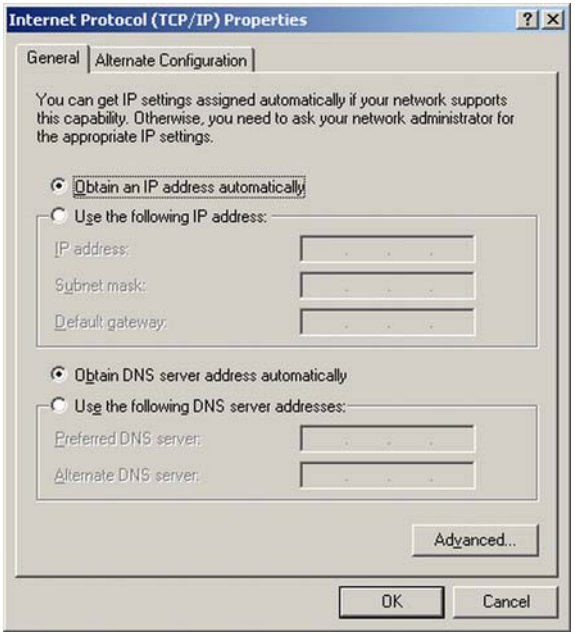
PC Setup for Local Configuration

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 23 on page 229).

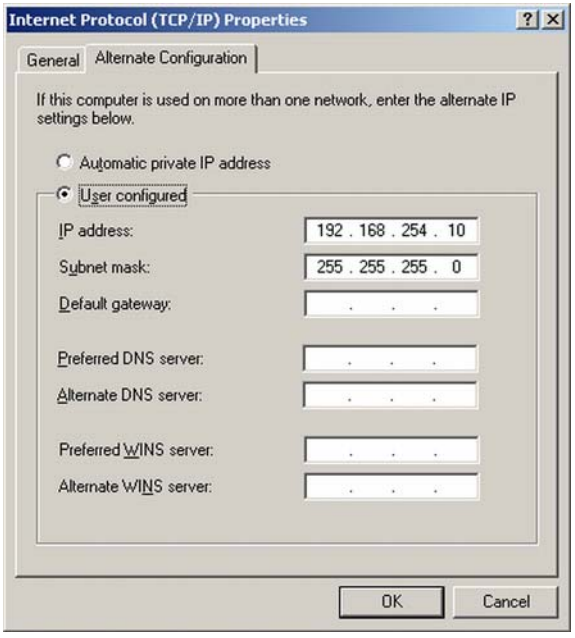
1 Open the Local Area Connection Properties and select **Internet Protocol (TCP/IP)**. Then click on **Properties**.



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.



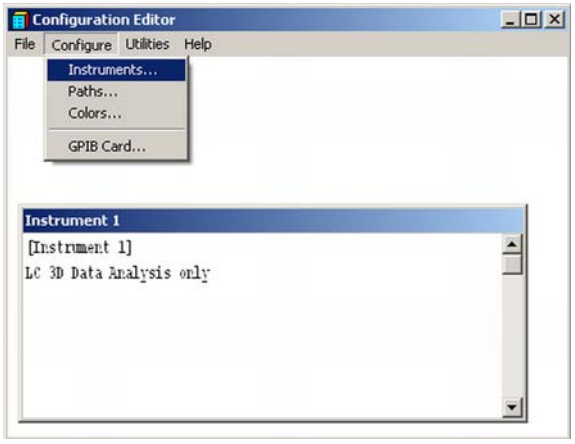
4 Click on **OK** to save the configuration.

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.

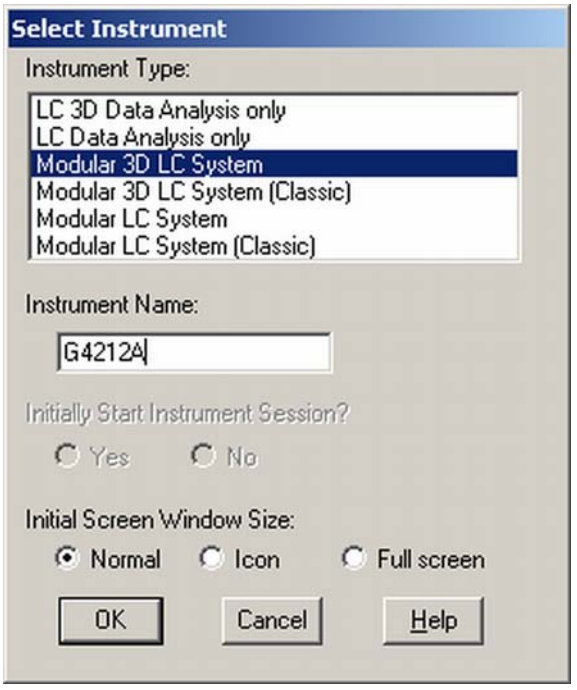


2 Select from the menu **Configure - Instruments**.

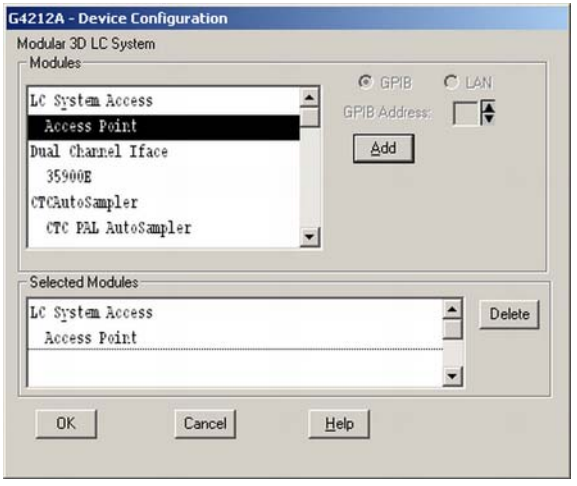
3 Select **Modular 3D LC System**.

4 Give the Instrument a name.

5 Click on **OK**.



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

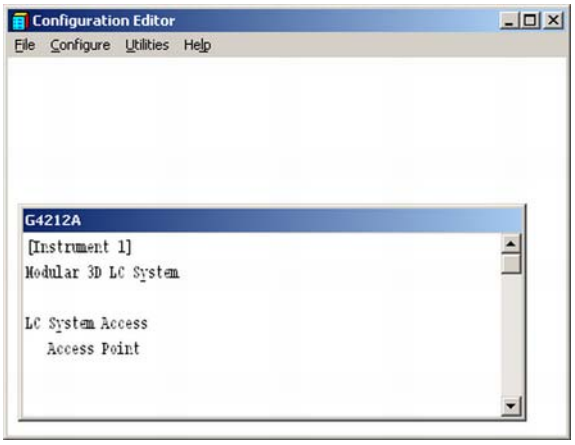


7 Click on **OK**.

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**.

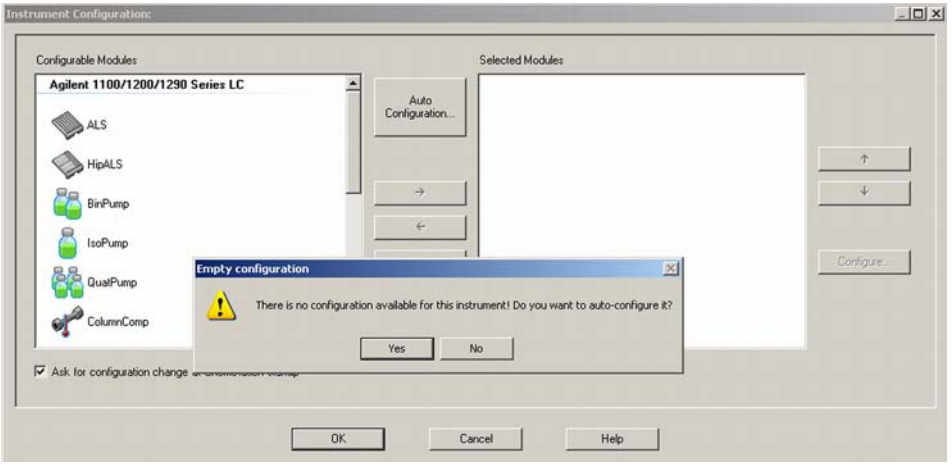


10 Exit the Configuration Editor.

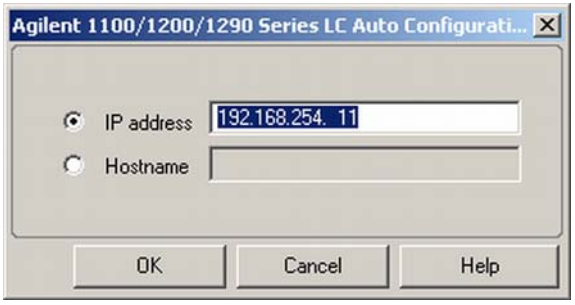
11 Start the Agilent ChemStation.

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**.



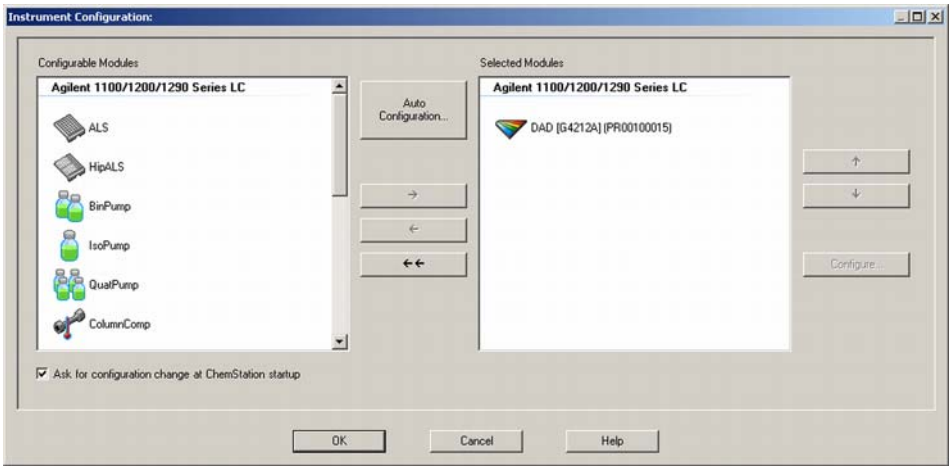
13 Enter the IP address or the Hostname of the module with the LAN-access.



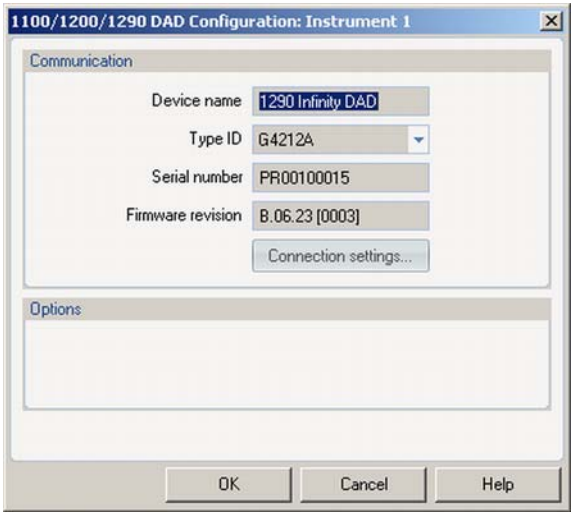
14 Click on **OK**.

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).

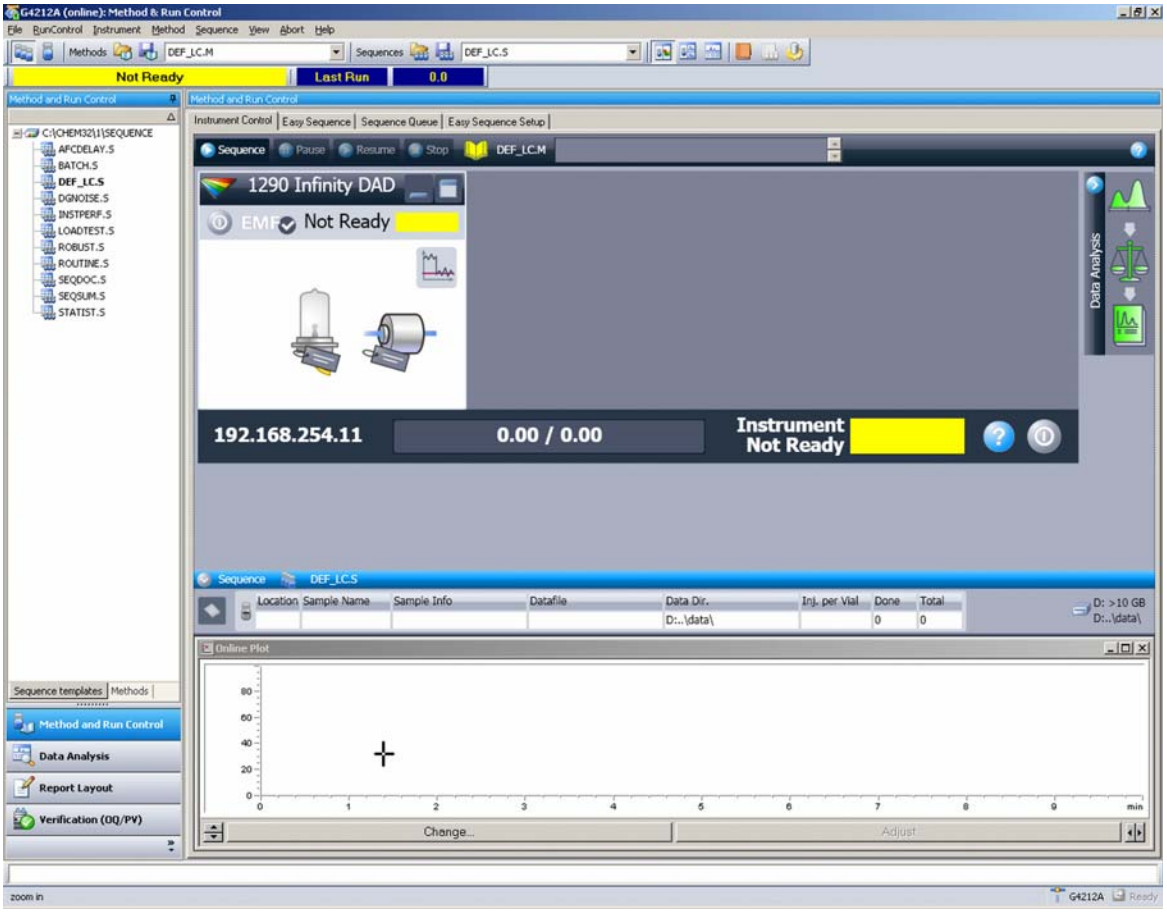


Figure 77 Screen After Successful Load of ChemStation

14
Appendix

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

Safety

Safety Symbols

Table 28 Safety Symbols

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

WARNING

A WARNING

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

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

CAUTION

A CAUTION

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

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

General Safety Information

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

WARNING

Ensure the proper usage of the equipment.

The protection provided by the equipment may be impaired.

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

Safety Standards

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

Operation

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

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

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

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

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

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

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

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

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

The Waste Electrical and Electronic Equipment Directive

Abstract

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

NOTE

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

Product Category:

With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a Monitoring and Control Instrumentation product.

NOTE

Do not dispose off in domestic household waste

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

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

Manufacturer's Declaration

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

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

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

Solvent Information

Flow Cell

To protect optimal functionality of your flow-cell:

- The recommended pH range of the cell is 1.0 - 12.5 (solvent dependent).
- If the flow cell is transported while temperatures are below 5 degree C, it must be assured that the cell is filled with alcohol.
- 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%).

Use of Solvents

Observe the following recommendations on the use of solvents.

- Brown glass ware can avoid growth of algae.
- 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, di-isopropylether) such ethers 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.

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http://www.agilent.com

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In This Book

This manual contains technical reference information about the Agilent 1290 Infinity Diode Array Detector (G4212A) and the Agilent 1260 Infinity Diode Array Detector (G4212B).

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

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