# Agilent 1290 Infinity II Diode Array Detector

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 II Diode Array Detectors

- G7117B DAD (Variable Slit)
- G7117A DAD-FS (Fixed Slit)

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 Using the Module

This chapter explains the essential operational parameters of the module.

## 4 Preparing 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.

### 8 Test Functions and Calibration

This chapter describes the tests for the module.

### 9 Maintenance

This chapter describes the maintenance of the module.

### 10 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

### 11 Identifying Cables

This chapter provides information on cables used with the Agilent 1200 Infinity Series modules.

### 12 Hardware Information

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

### 13 LAN Configuration

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

### 14 Appendix

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

# 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 120 Hz (G7117A) or 240 Hz (G7117B) 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 applications are available, see "Max-Light Cartridge Flow Cell" on page 14.
- 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 120 Hz (G7117A)/240 Hz (G7117B) sampling rate, keeping up with the analysis speed of ultra-fast LC.
- Programmable 1 – 8 nm slit (G7117B) or fixed 4 nm slit (G7117B) 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.

# Product Description

## Product Description G7117A

The Agilent 1290 Infinity II Diode Array Detector FS (fixed slit) is based on the Agilent Max-Light cartridge cell with optofluidic waveguides that improve light transmission to near 100% efficiency without sacrificing resolution caused by cell dispersions effects.

With typical detector noise levels of < ±0.6 µAU/cm the 60 mm flow cell gives up to 10 times higher sensitivity than detectors with conventional flow cells.

Any compromising refractive index and thermal effects are almost completely eliminated, resulting in significantly less baseline drift for more reliable and precise peak integration.

For fast separations, this detector has multiple wavelength and full spectral detection at sampling rates up to 120 Hz.

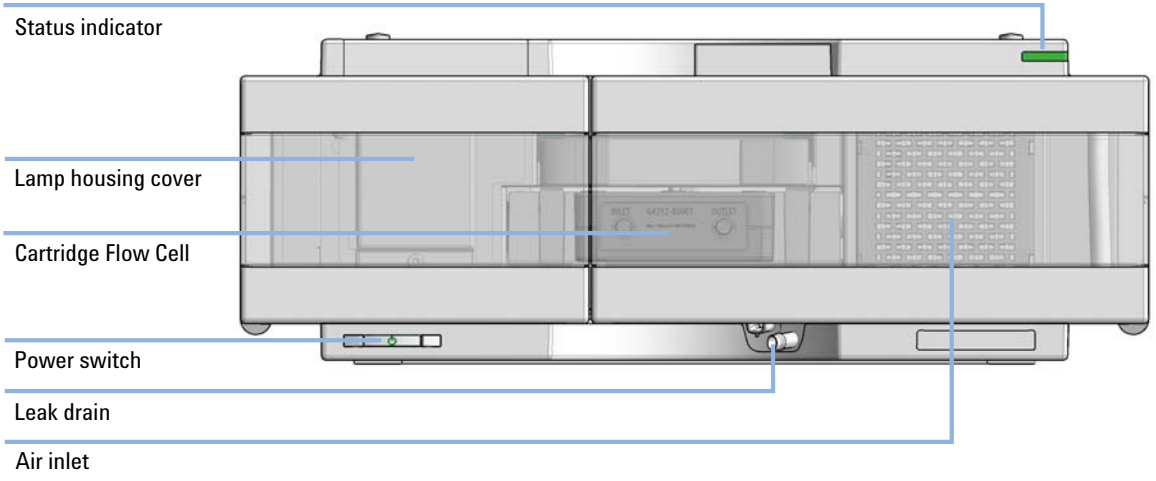


**Figure 1** Overview of the Diode Array Detector

# Product Description G7117B

The Agilent 1290 Infinity II Diode Array Detector (DAD) is based on the Agilent Max-Light cartridge cell with optofluidic waveguides that improve light transmission to near 100% efficiency without sacrificing resolution caused by cell dispersions effects.

With typical detector noise levels of < ±0.6 µAU/cm the 60 mm flow cell gives up to 10 times higher sensitivity than detectors with conventional flow cells.

Any compromising refractive index and thermal effects are almost completely eliminated, resulting in significantly less baseline drift for more reliable and precise peak integration.

For fast separations, this detector has multiple wavelength and full spectral detection at sampling rates up to 240 Hz.

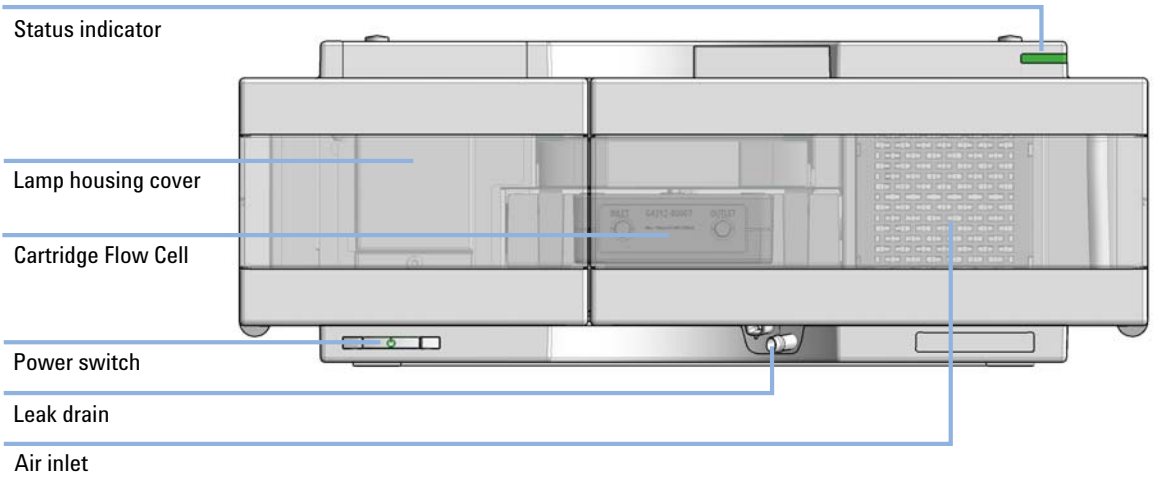


**Figure 2** Overview of the Diode Array Detector

# Optical System

The optical system of the detector is shown in Figure 3 on page 13.

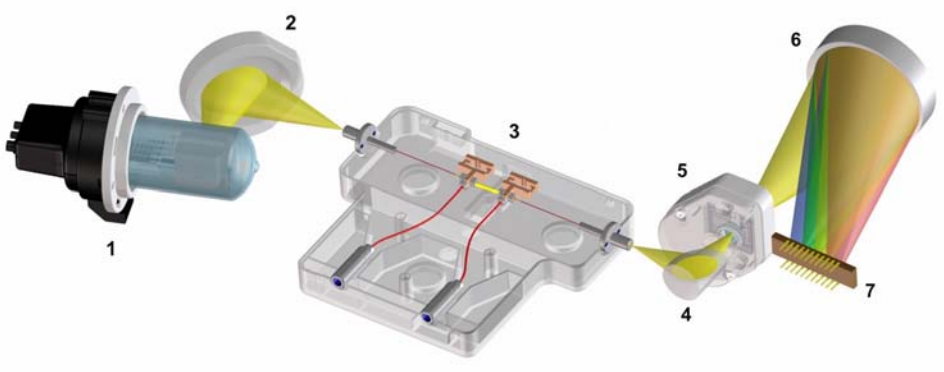


**Figure 3** Optical System of the Detector

| | |
|---|---|
| 1 | UV-lamp |
| 2 | Lamp mirror |
| 3 | Flow cell |
| 4 | Fold mirror |
| 5 | Programmable (G7117B) or Fixed (G7117A) 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.

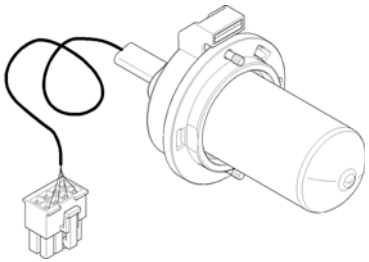

**Figure 4** UV-Lamp

## 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) |
| 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 5** Max-Light Cartridge Flow Cell

**NOTE** For additional information on the Max-Light Cartridge flow cell refer to "Choosing a Flow Cell" on page 68 and "Inline Pressure Relief Valve Kit (G4212-68001)" on page 70.

## Slit Assembly

### Programmable Slit (G7117B)

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.

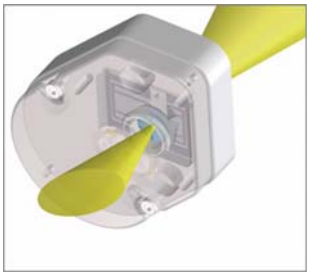

**Figure 6** Slit Assembly

The slit width influences the spectral resolution and noise.

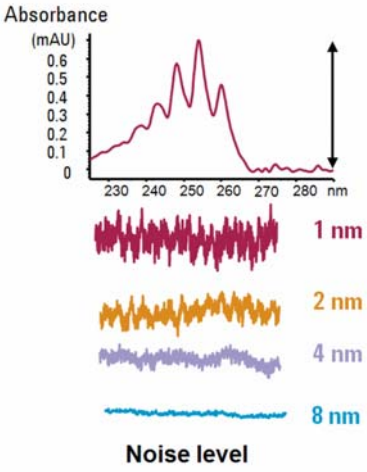


**Figure 7** Influence of slitwidth on resolution and noise level

## Fixed Slit (G7117A)

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

## 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.

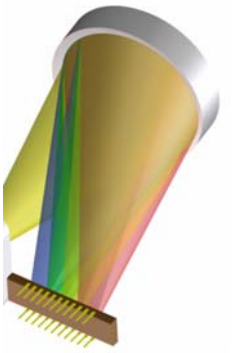

**Figure 8** Grating and diode array

# Leak and Waste Handling

The 1290 Infinity II Series has been designed for safe leak and waste handling. It is important that all security concepts are understood and instructions are carefully followed.

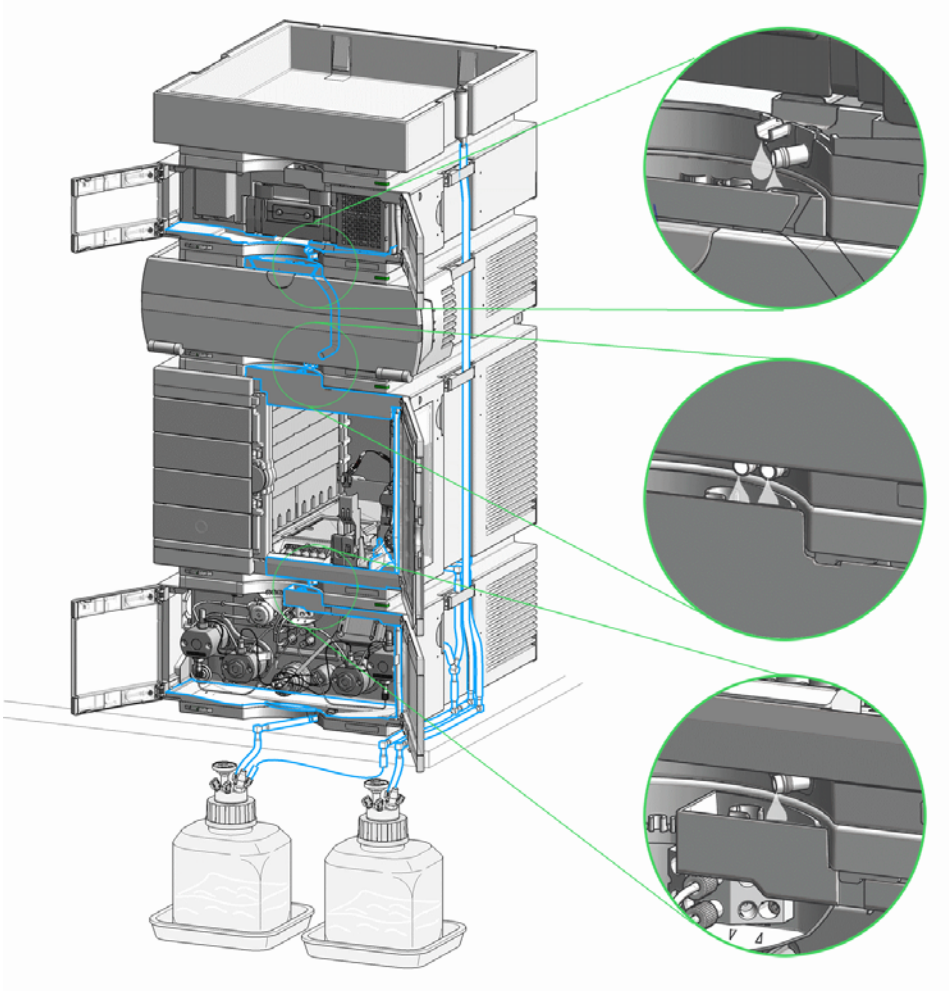

**Figure 9** Leak and waste handling concept (overview - typical stack configuration as an example)

The solvent cabinet is designed to store a maximum volume of 6 L solvent. The maximum volume for an individual bottle stored in the solvent cabinet should not exceed 4 L. For details, see the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets (a printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet).

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

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

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

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

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

# Waste Concept

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

# Operating Principle

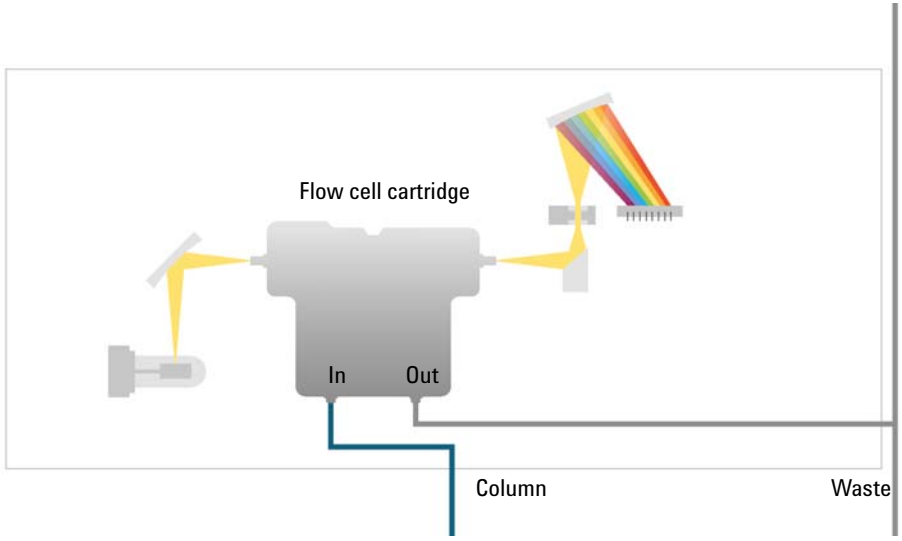


**Figure 10** Hydraulic path

# 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 1 on page 27. 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.

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**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 1 on page 27) 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 1 on page 27.

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 28) is based on these conditions. Larger ambient temperature changes will result in larger drift.

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

**CAUTION**

Condensation within the module

Condensation can damage the system electronics.

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

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

**NOTE**

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

# Physical Specifications

**Table 1** Physical Specifications

| Type | Specification | Comments |
|---|---|---|
| Weight | 11.5 kg (25.4 lbs) | |
| Dimensions (height × width × depth) | 140 x 396 x 436 mm (5.5 x 15.6 x 17.2 inches) | |
| Line voltage | 100 – 240 V~, ± 10 % | Wide-ranging capability |
| Line frequency | 50 or 60 Hz, ± 5 % | |
| Power consumption | 110 VA, 100 W | |
| Ambient operating temperature | 4 – 40 °C (39 – 104 °F) | |
| Ambient non-operating temperature | -40 – 70 °C (-40 – 158 °F) | |
| Humidity | < 95 % r.h. at 40 °C (104 °F) | Non-condensing |
| Operating altitude | Up to 2000 m (6562 ft) | |
| Non-operating altitude | Up to 4600 m (15092 ft) | For storing the module |
| Safety standards: IEC, EN, CSA, UL | Installation category II, Pollution degree 2 | For indoor use only. |

# Performance Specifications

## Specifications

### Performance Specifications G7117B

**Table 2** Agilent 1290 Infinity II Diode Array Detector (G7117B) Performance Specifications

| Feature | Specification |
|---|---|
| Detector type | 1024-element diode array |
| Light source | Deuterium |
| Number of signals | 8 |
| Maximum sampling rate | 240 Hz (both spectra and signals) |
| Short-term noise | with 10 mm Max-Light cartridge cell: $<\pm 3 \cdot 10^{-6}$ AU at 230/4 nm, slit width 4 nm, TC 2 s, ASTM<br>with 60 mm Max-Light cartridge cell: $<\pm 0.6 \cdot 10^{-6}$ AU/cm at 230/4 nm, slit width 4 nm, TC 2 s, ASTM |
| Drift | $<0.5 \cdot 10^{-3}$ AU/h at 230 nm |
| Linearity | >2.0 AU (5 %) at 265 nm<br>Typically 2.5 AU (5 %) |
| Wavelength range | 190 – 640 nm |
| Wavelength accuracy | ±1 nm, self-calibration with deuterium lines |
| Wavelength precision | <±0.1 nm |
| Slit width | Programmable: 1, 2, 4, 8 nm |
| Diode width | ~0.5 nm |
| Wavelength bunching | Programmable, 2 – 400 nm, in steps of 1 nm |

**Table 2** Agilent 1290 Infinity II Diode Array Detector (G7117B) Performance Specifications

| Feature | Specification |
|---|---|
| Spectral tools | Data analysis software for spectra evaluation, including spectral libraries and peak purity functions |
| Flow cells | User-exchangeable, self-aligning cartridge cells with RFID tags.<br>Max-Light Cartridge Cell (Standard): 10 mm, σV = 1.0 µL<br>Max-Light Cartridge Cell (High Sensitivity): 60 mm, σV = 4 µL<br>Max-Light Cartridge Ultra Low Dispersion (ULD) Cell: 10 mm, σV = 0.6 µL<br>Max-Light Cartridge High Dynamic Range (HDR) Cell: 3.7 mm, σV = 0.8 µL<br>Maximum Operating Pressure (MOP)[1]: 70 bar<br>Maximum Incidental Pressure (MIP)[2]: 150 bar |
| Analog output | Recorder/integrator: 100 mV or 1 V, output range 0.001 – 2 AU, one output |
| Communications | LAN, controller-area network (CAN), ERI: ready, start, stop and shut-down signals |
| GLP features | Data recovery card to prevent data losses. RFID for electronics records of flow cell and UV lamp conditions (path length, volume, product number, serial number, test passed, usage)<br>Early maintenance feedback (EMF) for continuous tracking of instrument usage in terms of lamp burn time with user settable limits and feedback messages. Electronic records of maintenance and errors. Verification of wavelength accuracy with deuterium lines. |
| Safety and maintenance | Extensive diagnostics, error detection and display through Agilent Instant Pilot and Agilent Lab Advisor software. Leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in major maintenance areas. |
| Others | Second generation of Electronic temperature control (ETC) for the complete optical unit |

1 Maximum operating pressure (MOP): Maximum pressure at which a system can operate continuously under normal conditions.

2 Maximum incidental pressure (MIP): The maximum pressure which the system can experience during a short time.

## Performance Specifications G7117A

**Table 3** Agilent 1290 Infinity II Diode Array Detector FS (G7117A) Performance Specifications

| Feature | Specification |
|---|---|
| Detector type | 1024-element diode array |
| Light source | Deuterium |
| Number of signals | 8 |
| Maximum sampling rate | 120 Hz (both spectra and signals) |
| Short-term noise | with 10 mm Max-Light cartridge cell: $<\pm 3 \cdot 10^{-6}$ AU at 230/4 nm, slit width 4 nm, TC 2 s, ASTM<br>with 60 mm Max-Light cartridge cell: $<\pm 0.6 \cdot 10^{-6}$ AU/cm at 230/4 nm, slit width 4 nm, TC 2 s, ASTM |
| Drift | $<0.5 \cdot 10^{-3}$ AU/h at 230 nm |
| Linearity | >2.0 AU (5 %) at 265 nm<br>Typically 2.5 AU (5 %) |
| Wavelength range | 190 – 640 nm |
| Wavelength accuracy | ±1 nm, self-calibration with deuterium lines |
| Wavelength precision | <±0.1 nm |
| Diode width | ~0.5 nm |
| Wavelength bunching | Programmable, 2 – 400 nm, in steps of 1 nm |
| Flow cells | User-exchangeable, self-aligning cartridge cells with RFID tags.<br>Max-Light Cartridge Cell (Standard): 10 mm, $\sigma V$ = 1.0 µL<br>Max-Light Cartridge Cell (High Sensitivity): 60 mm, $\sigma V$ = 4 µL<br>Max-Light Cartridge Ultra Low Dispersion (ULD) Cell: 10 mm, $\sigma V$ = 0.6 µL<br>Max-Light Cartridge High Dynamic Range (HDR) Cell: 3.7 mm, $\sigma V$ = 0.8 µL<br>Maximum Operating Pressure (MOP)[1]: 70 bar<br>Maximum Incidental Pressure (MIP)[2]: 150 bar |

**Table 3** Agilent 1290 Infinity II Diode Array Detector FS (G7117A) Performance Specifications

| Feature | Specification |
|---|---|
| Spectral tools | Data analysis software for spectra evaluation, including spectral libraries and peak purity functions |
| Analog output | Recorder/integrator: 100 mV or 1 V, output range 0.001 – 2 AU, one output |
| Communications | LAN, controller-area network (CAN),<br>ERI: ready, start, stop and shut-down signals |
| GLP features | Data recovery card to prevent data losses. RFID for electronics records of flow cell and UV lamp conditions (path length, volume, product number, serial number, test passed, usage)<br>Early maintenance feedback (EMF) for continuous tracking of instrument usage in terms of lamp burn time with user settable limits and feedback messages. Electronic records of maintenance and errors. Verification of wavelength accuracy with deuterium lines. |
| Safety and maintenance | Extensive diagnostics, error detection and display through Agilent Instant Pilot and Agilent Lab Advisor software. Leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in major maintenance areas. |
| Others | Second generation of Electronic temperature control (ETC) for the complete optical unit |

[1] Maximum operating pressure (MOP): Maximum pressure at which a system can operate continuously under normal conditions.

[2] Maximum incidental 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(s) 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(s) 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

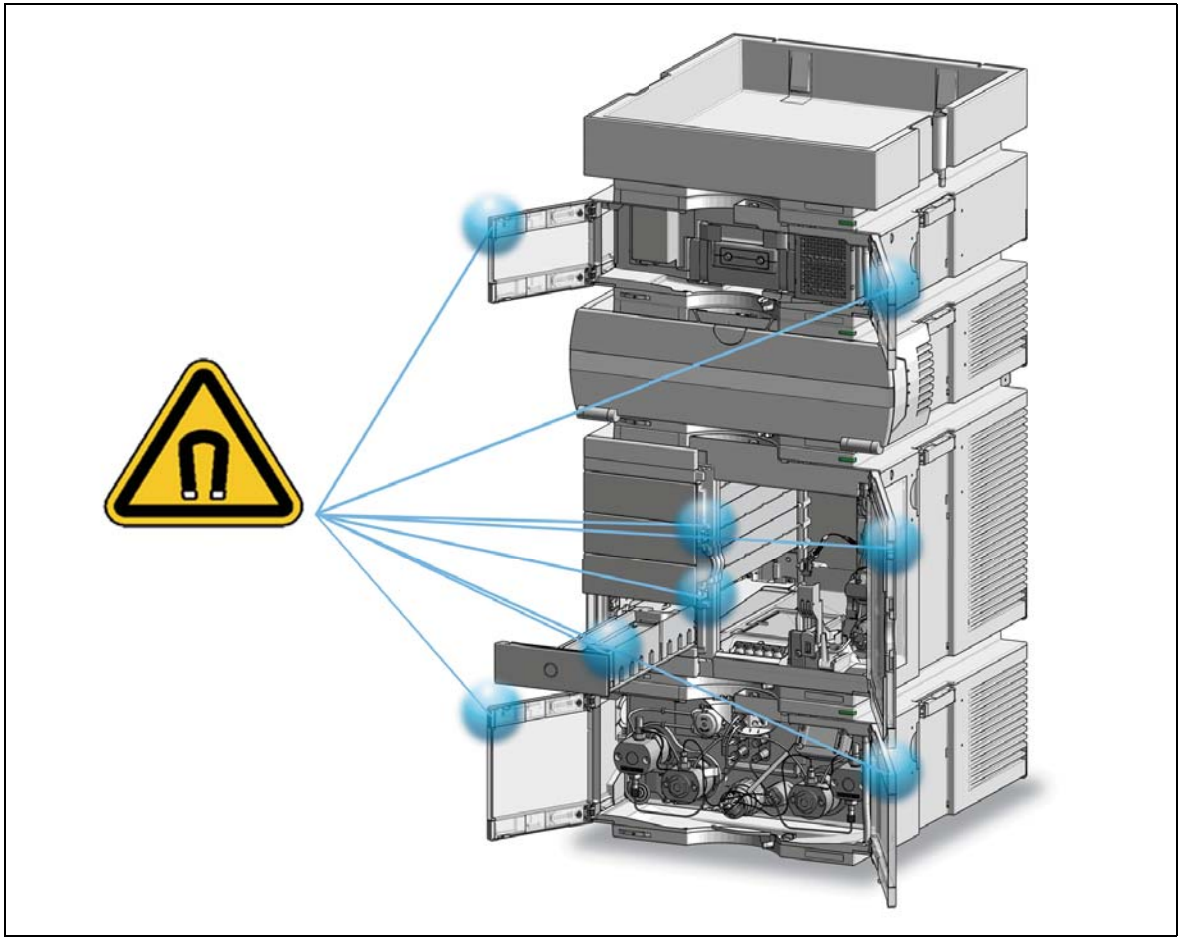
According to ASTM E1657-98 „Standard Practice of Testing Variable-Wavelength Photometric Detectors Used in Liquid Chromatography” the time constant is converted to response time by multiplying by the factor 2.2.

# 3
# Using the Module



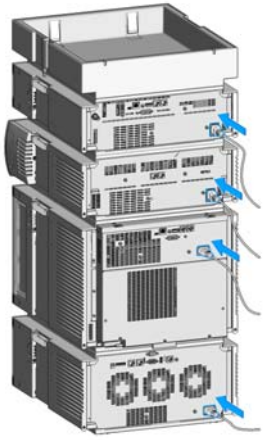
This chapter explains the essential operational parameters of the module.

# Magnets

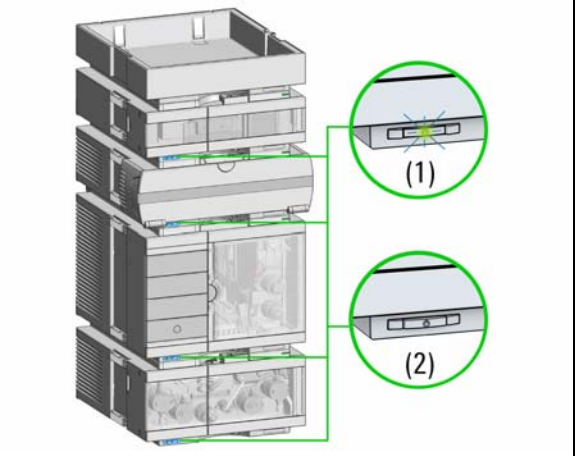


# Turn on/off

**1**



**2**

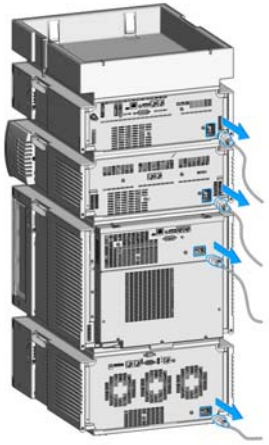



Power switch

(1) On

(2) Off

**3**



# Status Indicators

| | |
|---|---|
| **1** The module status indicator indicates one of six possible module conditions:<br>  <br><br>Status indicators<br>1. Idle<br>2. Run mode<br>3. Not-ready. Waiting for a specific pre-run condition to be reached or completed.<br>4. Error mode - interrupts the analysis and requires attention (for example a leak or defective internal components).<br>5. Resident mode (blinking) - for example during update of main firmware.<br>6. Bootloader mode (fast blinking). Try to re-boot the module or try a cold-start. Then try a firmware update. | |

# Instrument Configuration

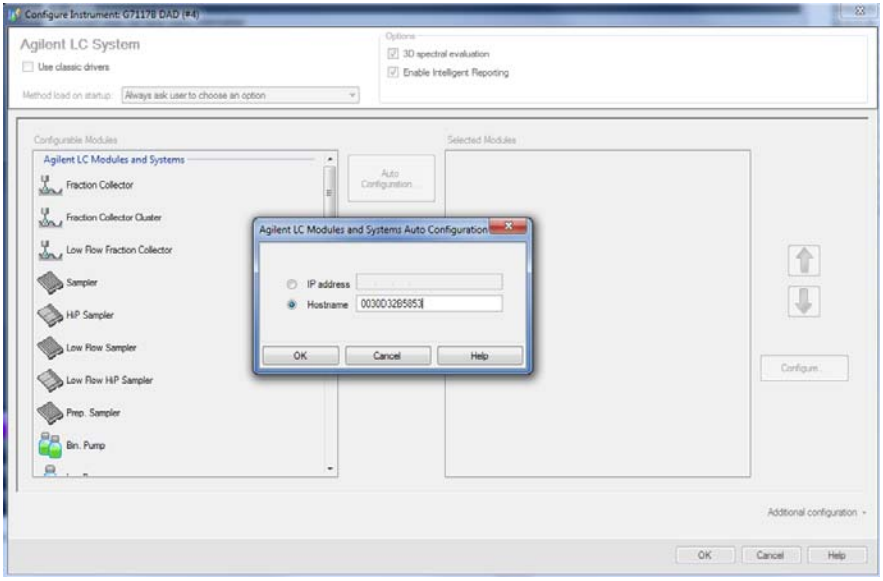
1 Set the switches of the Configuration switch at the rear of the module:

**a** All switches DOWN: module uses the default IP address 192.168.254.11.

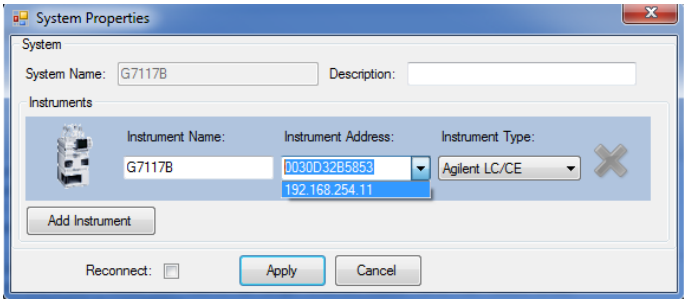
**b** Switch 4 UP and others DOWN: module uses DHCP.


2 Enter the setup information (MAC / IP address and/or Instrument Name).

**a** Agilent OpenLab ChemStation (Configure Instrument):



**b** Lab Advisor (Instrument Overview - Add Instrument):



# Set up the Detector with Agilent Open Lab ChemStation

The setup of the detector is shown with the Agilent OpenLab ChemStation C.01.06.

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

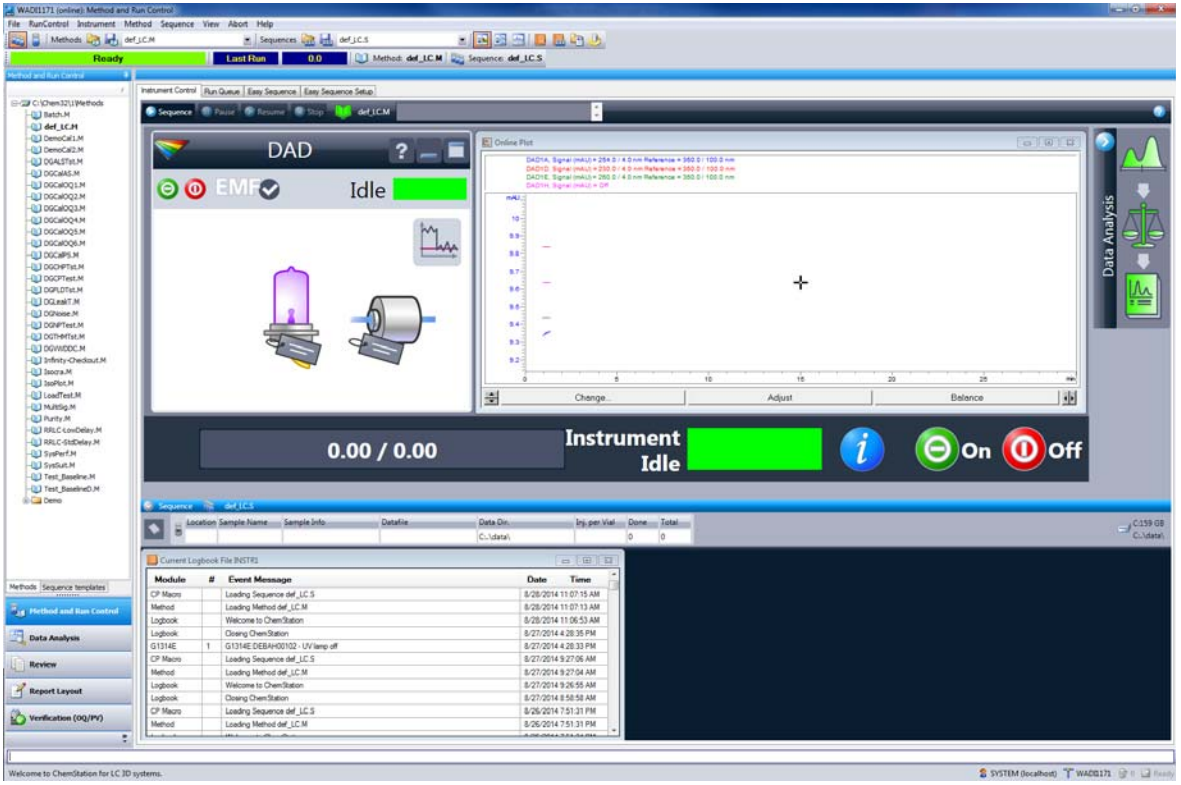
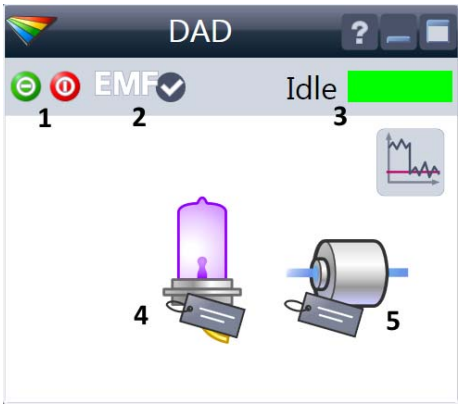



**Figure 11** ChemStation Method and Run Control (just detector is shown)

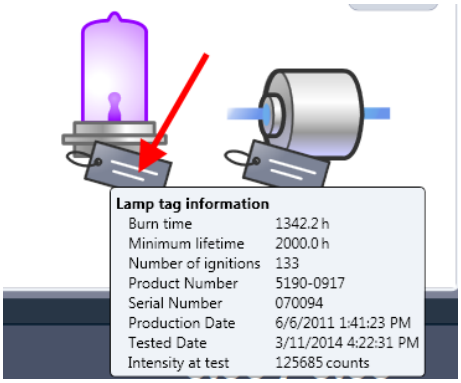
After successful load of the OpenLab ChemStation, you should see the module as an active item in the graphical user interface (GUI).

# The Detector User Interface




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

**1** Lamp: turn on and off of UV-lamp
**2** EMF status
**3** Detector status
**4** Lamp status (on/off) and information (RFID tag)
**5** Flow Cell information (RFID tag)




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.

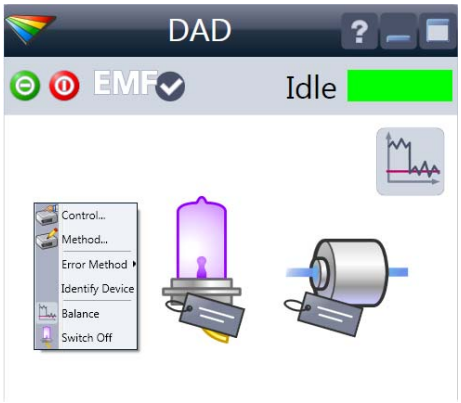

EMF Status shows Run / Ready / Error state and "Not Ready text" or "Error text"

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

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


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

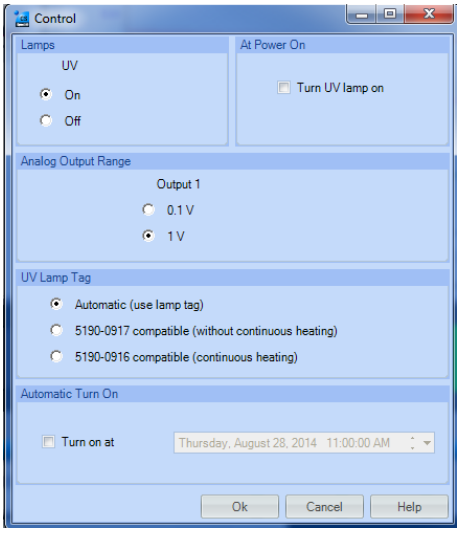
- Error (red)
- Not ready (yellow)
- Ready (green)
- Pre run, Post run (purple)
- Run (blue)
- Idle (green)
- Offline (dark gray)
- Standby (light gray)




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

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

# Detector Control Settings




The figure shows the default settings.

- **Lamps**: can be turned ON/OFF.
- **Analog Output Range**: can be set to either 100 mV or 1 Vfull scale, for additional settings see **Analog Output** (under "Method Parameter Settings" on page 43).
- **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.
  - Manual (by PN) uses the selected "heating" mode. This mode can also be used when the RFID tag of the standard lamp (Long-life Deuterium lamp (8-pin) with RFID tag (5190-0917)) is not recognized (defect RFID tag or reader).
  - **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. The correct selection is important for optimal performance and lifetime.
- **At Power On**: automatic lamp-on at power on.
- **Automatic Turn On**: automatic detector power on.

# Method Parameter Settings

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

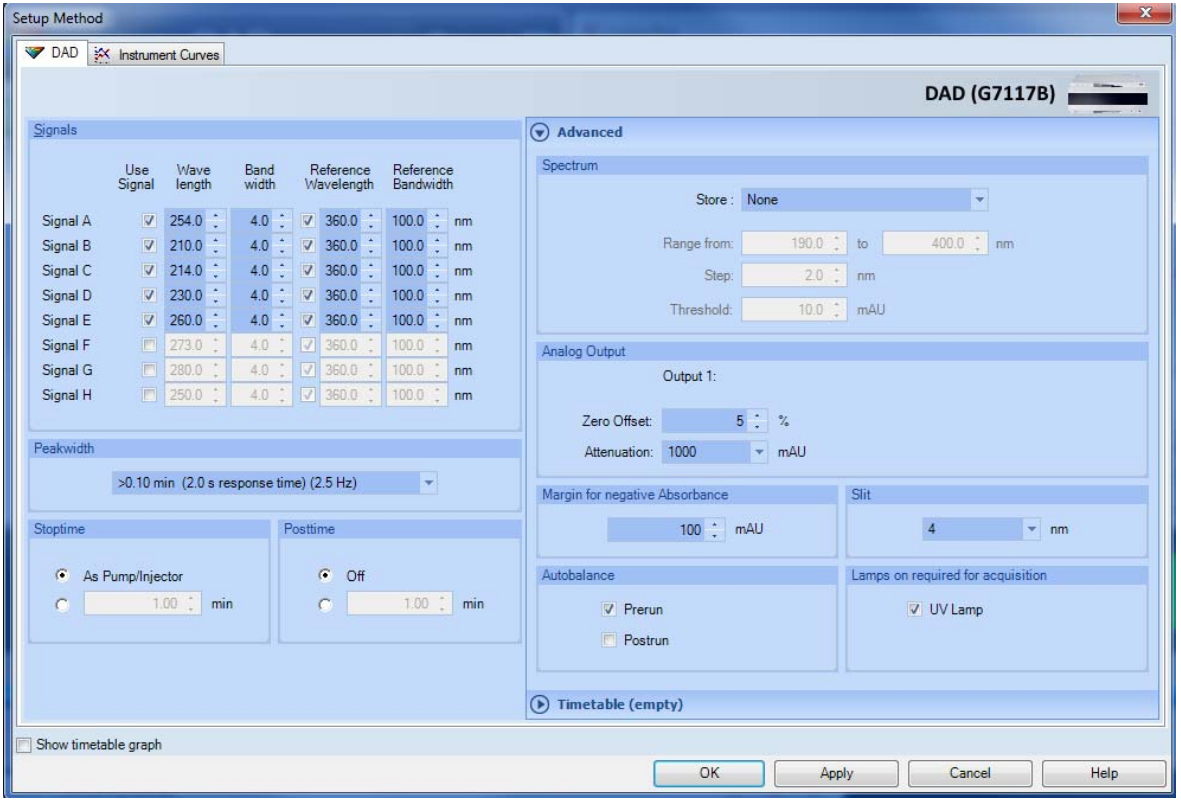
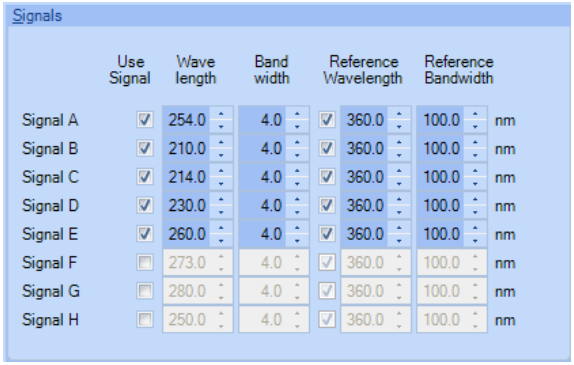



**Figure 12** Method parameter settings

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

**Table 4** Method Parameter 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.

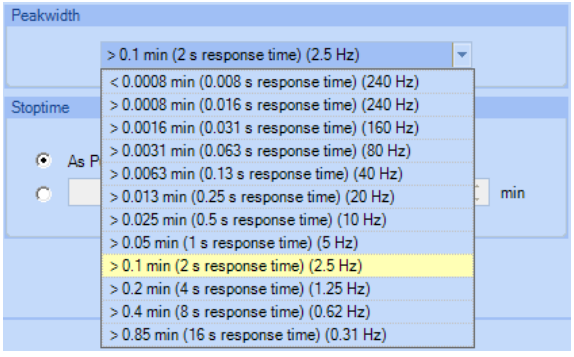



**Figure 13** G7117B Peakwidth Settings

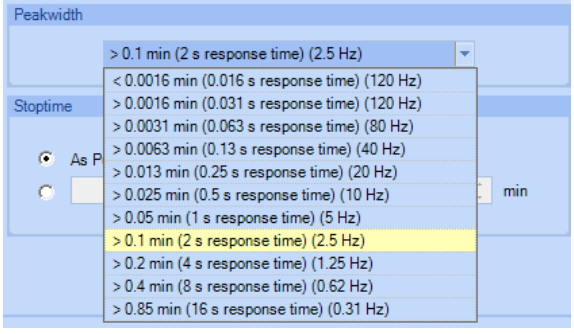



**Figure 14** G7117A Peakwidth Settings

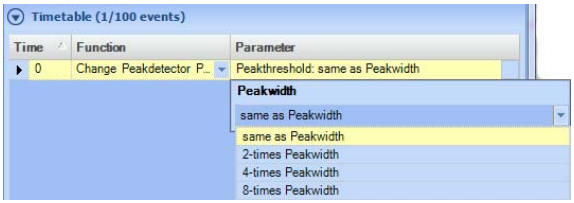
**Peakwidth** (Responsetime, Data Rate)
Peakwidth enables you to select the peak width (response time) for your analysis. The peak width is defined as the width of a peak, in minutes, at half the peak height. Set the peak width to the narrowest expected peak in your chromatogram. The peak width sets the optimum response time for your 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.
G7117A: Do not use 0.025 s response time (no filtering/high noise and no need (actually ultra-fast LC doesn't deliver peaks <0.0025 min/<0.15 s).

**NOTE**

The 1290 Infinity II DAD FS (G7117A) has a data rate of up to 120 Hz. The 1290 Infinity II DAD (G7117B) has a data rate of up to 240 Hz.

For details see "Peak width (response time)" on page 73.

**Table 4** Method Parameter Settings

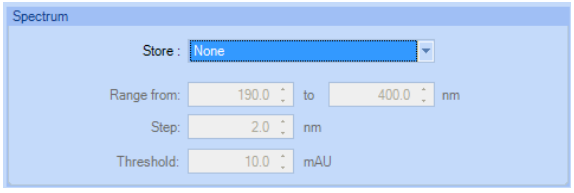



**Peakwidth** (time programmed)
These selections can be made during time programmed operation. When used in a timetable, Peakwidth changes the filters used for peak-controlled spectra acquisition, but not the data rate of a chromatographic signal.

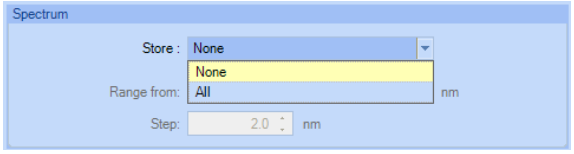
**NOTE**

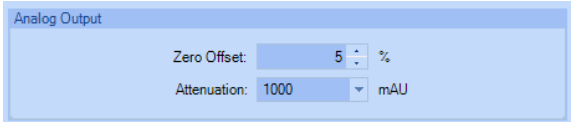
This setting makes sense only with peak-controlled spectra; it allows you to change the peakwidth setting to account for broadening peaks at the end of the run.


**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).




Spectrum Settings



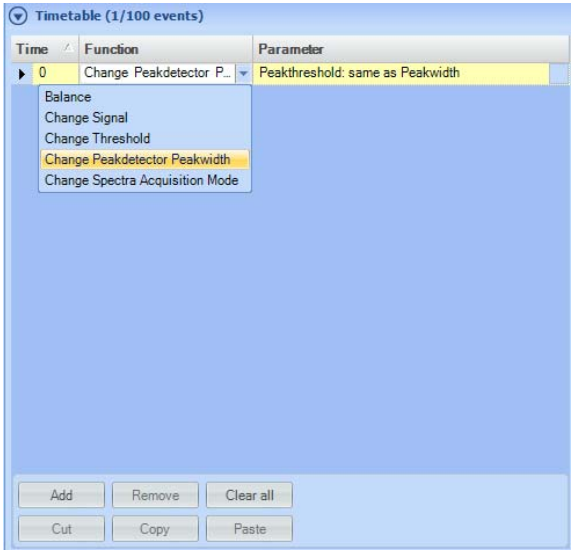

**Analog Output**
The range can be set to either 100 mV or 1 V full scale, see "Detector Control Settings" on page 42.

- **Zero Offset**: 1 – 99 % in steps of 1 % (5 % equal to 50 mV).
- **Attenuation**: 0.98 – 2000 mAU at discrete values for either 100 mV or 1 V full scale.

**Table 4** Method Parameter Settings

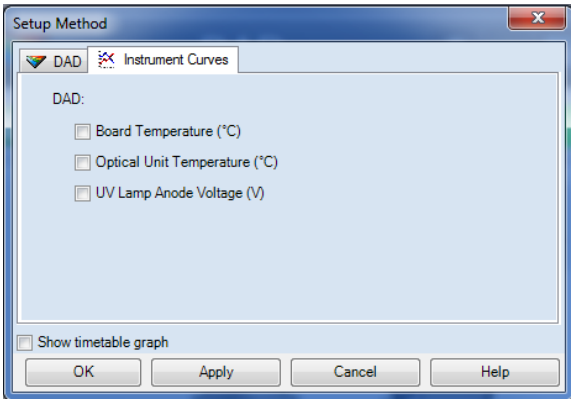

**Margin for negative Absorbance**
Use this field to modify the detector's signal handling to increase the margin for negative absorbance. Use this option if, for example, your solvent gradient produces a decreasing baseline absorbance, and for GPC analyses.
Limits: 100 to 4000 mAU.
The higher the value the greater the baseline noise. Set this value only if you expect negative absorbance greater than -100 mAU.
**Slitwidth** (G7117B): 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.
**Slitwidth** (G7117A): The 1290 Infinity DAD FS (G7117A) has a fixed slit width of 4 nm.

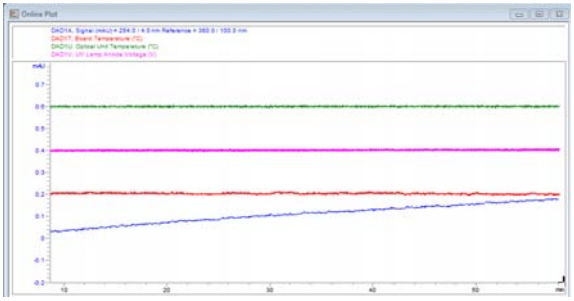

**Autobalance**
Defines, whether a balance is performed prior to a run and/or after a run has finished.
**Lamp on required for acquisition**:
If unchecked, the lamp will be turned off after the analysis has finished. Note that the lamp on requires at least one hour warm-up time, see "Warm up of the Detector" on page 94.




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

**Table 4** Method Parameter Settings



**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.

# 4
# Preparing the Module



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

# Leak and Waste Handling

**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.
- ➔ Never exceed the maximal permissible volume of solvents (6 L) in the solvent cabinet.
- ➔ Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.
- ➔ Arrange the bottles as specified in the usage guideline for the solvent cabinet.
- ➔ A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet.
- ➔ Ground the waste container.
- ➔ The residual free volume in the appropriate waste container must be large enough to collect the waste liquid.
- ➔ Check the filling level of the waste container regularly.
- ➔ To achieve maximal safety, check the correct installation regularly.
- ➔ Do not use solvents with an auto-ignition temperature below 200 °C (392 °F).

**NOTE**

**Recommendations for Solvent Cabinet**

For details, see the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.

For correct installation of your system contact your Agilent service representative.

# Waste Concept

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

# Setting up an Analysis

This chapter can be used for

- preparing the system,
- to learn the set up of an HPLC analysis and
- to use it as an instrument check to demonstrate that all modules of the system are correctly installed and connected. It is not a test of the instrument performance.
- Learn about special settings

## Before Using the System

### Solvent Information

Observe recommendations on the use of solvents in chapter “Solvents” in the pump’s reference manual.

### Priming and Purging the System

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

**Table 5** Choice of Priming Solvents for Different Purposes

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

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

1. Open the purge valve of your pump (by turning it counterclockwise) and set flow rate to 3 – 5 mL/min.
2. Flush all tubes with at least 30 mL of solvent.
3. Set flow to required value of your application and close the purge valve.

**NOTE** Pump for approximately 10minutes before starting your application.

# Requirements and Conditions

## What You Will Need

The table below lists the items you need to have for the set up of the analysis. Some of these are optional (not required for the basic system).

**Table 6** What you will need

| | |
|---|---|
| Agilent 1200 Infinity Series system | Pump (plus degassing) |
| | Autosampler |
| | Detector, standard flow cell installed |
| | Degasser (optional) |
| | Column Compartment (optional) |
| | Agilent CDS |
| | System should be correctly set up for LAN communication with the Agilent ChemStation |
| Column: | Zorbax Eclipse XDB-C18, 4.6 x 150 mm, 5 µm (993967-902) or an equivalent column |
| Standard: | Agilent isocratic checkout sample (01080-68704) |

## Conditions

A single injection of the isocratic test standard is made under the conditions given in Table 7 on page 54:

**Table 7** Conditions

| | |
|---|---|
| Flow | 1.5 mL/min |
| Stoptime | 8 min |
| Solvent | 100% (30% water/70% Acetonitrile) |
| Temperature | Ambient |
| Wavelength | sample 254 nm |
| Injection Volume | 1 µL |
| Column Temperature (optional): | 25 °C or ambient |

## Typical Chromatogram

A typical chromatogram for this analysis is shown in Figure 15 on page 55. The exact profile of the chromatogram will depend on the chromatographic conditions. Variations in solvent quality, column packing, standard concentration and column temperature will all have a potential effect on peak retention and response.

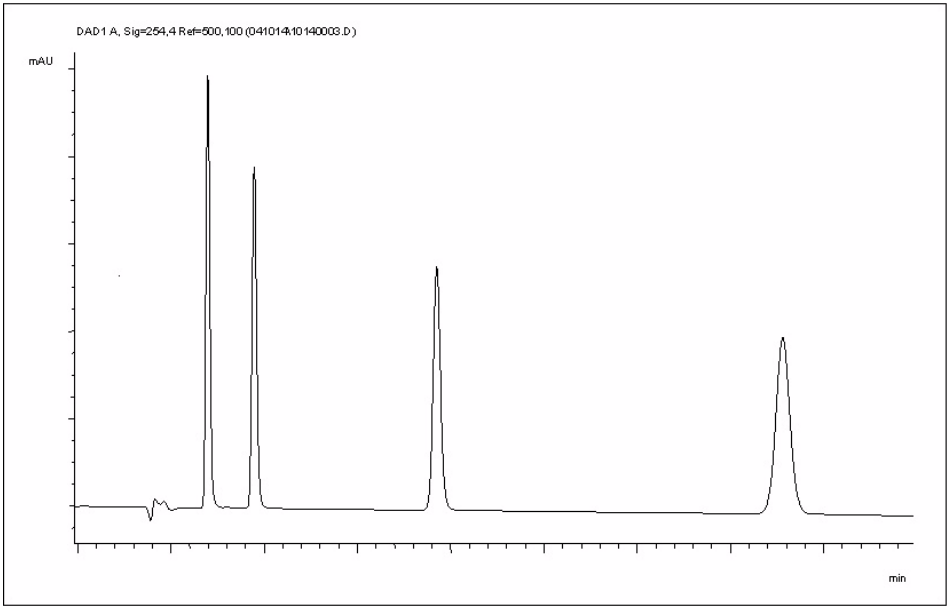



**Figure 15** Typical Chromatogram with UV-detector

## 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 32.
- For high sensitivity measurements, a stable environment is required; refer to "Environment" on page 26. Prevent drafts from air condition systems.
- Setting an appropriate reference wavelength could improve the baseline behavior.
- Do not work with removed/open front panels/doors. When the system includes a G1316 TCC (typically located below the detector) and its front panel is removed while the TCC is set to high temperatures, the up-streaming air could influence the stability of the detector baseline.

## Preparing the HPLC System

1. Turn on the control software and the monitor.
2. Turn on the modules.
3. Start the control software. The screen should show all modules and the system status is Not Ready.
4. Turn on the modules that require conditioning:
   a. Detector lamp (warm-up for at least 60 min to get a stable baseline).
   b. Column compartment (set temperature as required).
   c. Pump (purge).
   d. Sampler (prepare the standard isocratic sample into a vial).
   e. Solvents (fill water and Acetontrile into the solvent bottles).
5. Load the default method.
6. Pump the water/acetonitrile (30/70 %) mobile phase through the column for 10 min for equilibration.
7. Select the menu item **Run Control > Sample Info** and enter information about this application. Click **OK** to leave this screen.

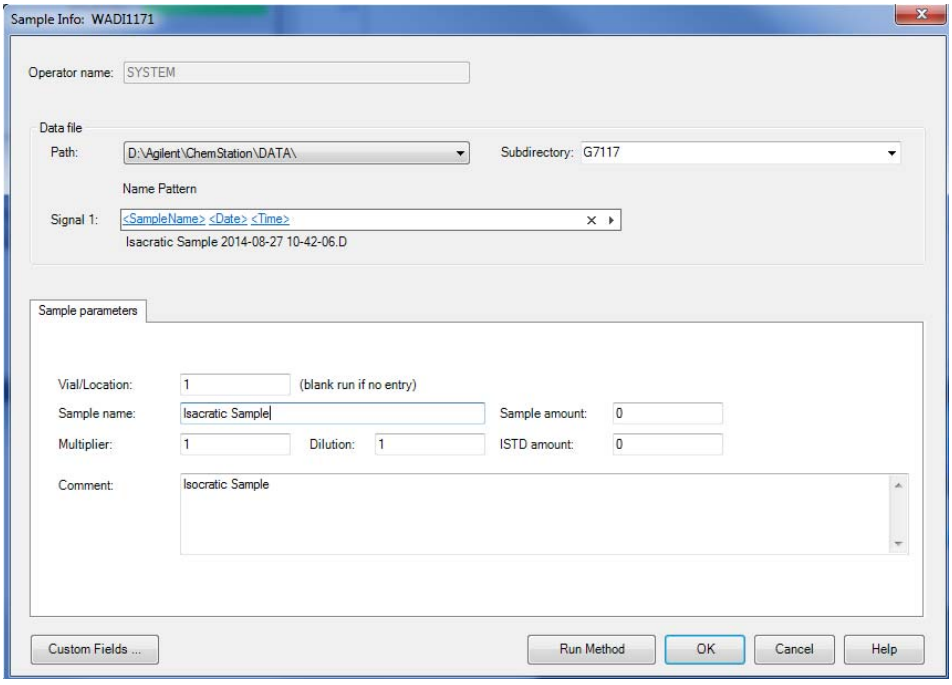



**Figure 16** Sample Info

## Running the Sample and Verifying the Results

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

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

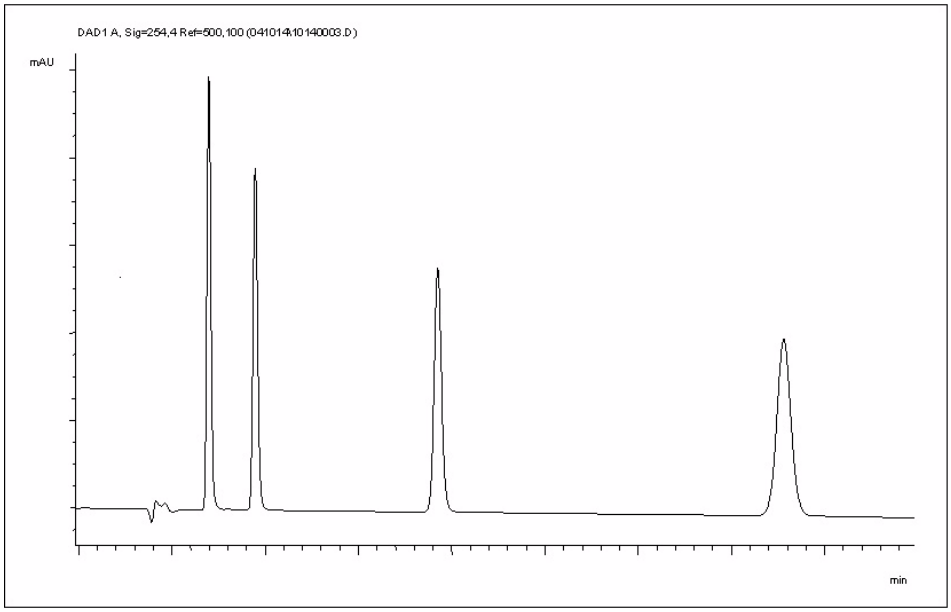



**Figure 17** Chromatogram with Isocratic Test Sample

**NOTE** Information about using the Data Analysis functions can be obtained from the Using your ChemStation manual supplied with your system.

# 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.

## Material Information

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

### Disclaimer

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

## PEEK

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

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.).

## Polyimide

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

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

## Polyethylene (PE)

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

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

## Tantalum (Ta)

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

## Stainless Steel (ST)

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

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

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

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

### Diamond-Like Carbon (DLC)

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

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

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

### Gold

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

### Zirconium Oxide ($ZrO_2$)

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

### Platinum/Iridium

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

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

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

TFE/PDD copolymer tubings, which are used in all Agilent degassers except G1322A, are not compatible with fluorinated solvents like Freon, Fluorinert, or Vertrel. They have limited life time in the presence of

Hexafluoroisopropanol (HFIP). To ensure the longest possible life with HFIP, it is best to dedicate a particular chamber to this solvent, not to switch solvents, and not to let dry out the chamber. For optimizing the life of the pressure sensor, do not leave HFIP in the chamber when the unit is off.

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

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

# 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 8** 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 68). | |
| **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 68 as starting point.<br>• Set the peak-width close to the width of a narrow peak of interest in your chromatogram. | |
| **4** Setting wavelength and bandwidth | |
| • Sample wavelength:<br>◦ Never miss a peak by the use of a browser wavelength like 250 nm with 100 nm bandwidth.<br>◦ 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.<br>◦ 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<br>• sensitivity versus linearity |
| • Reference wavelength:<br>◦ 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).<br>◦ Select the reference wavelength as near as possible to the UV range. | • baseline drift due to RI effects. |

**Table 8** Optimization Overview

| Parameter | Impact |
|---|---|
| **5** Setting the slit width (G7117B only) | |
| • Use 4 nm slit for normal applications.<br>• Use narrow slit (e.g 1 nm) if your analytes have narrow absorbance bands and for high concentrations.<br>• Use a wide slit (e.g. 8 nm) to detect very low concentrations.<br>• Optimizing spectral acquisition (DAD only)<br>• Set the spectral wavelength range (for colorless samples 190...400 nm is sufficient).<br>• 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 9 on page 68.

**Table 9** Specifications for Max-Light Cartridge Flow Cells

| | |
|---|---|
| Cartridge Cells | • Max-Light Cartridge Cell ( 10 mm, V(s) 1.0 µL) (G4212-60008)<br>• Max-Light Cartridge Cell ( 60 mm, V(s) 4.0 µL) (G4212-60007)<br>• HDR Max-Light Cartridge Cell ( 3.7 mm, V(s) 0.4 µL) (G4212-60032)<br>• ULD Max-Light Cartridge Cell ( 10 mm, V(s) 0.6 µL) (G4212-60038)<br>• Max-Light Cartridge Test Cell (G4212-60011) |
| Maximum pressure | 70 bar (1015 psi) Maximum Operating Pressure (MOP)[1]<br>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.

### High Sensitivity

If higher sensitivity is necessary, the Max-Light Cartridge Cell ( 60 mm, V(s) 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).

### Normal Applications

The Max-Light Cartridge Cell ( 10 mm, V(s) 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]

### Ultra-Low Dispersion

The Max-Light Cartridge ULD cell can be used with the G7117A DAD FS and G7117B 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 G7117A DAD FS and G7117B DAD. The cell is required as a part of the High Dynamic Range (HDR) solution.

**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 70.

### 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 (G7117A DAD FS and G7117B 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.

# 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 [m] 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 18 on page 74), 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.

Response time = 2 s

Response time = 0.016 s

Slit width = 4 nm

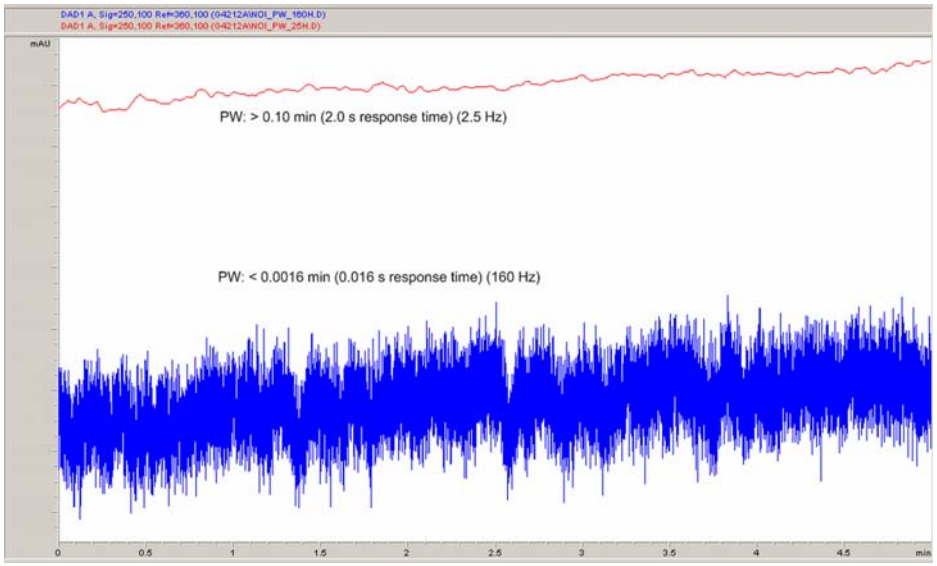



**Figure 18** Influence of Response Time on Signal and Noise

Table 10 on page 75 and Table 11 on page 76 list 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 then 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 the peak width (response time) by a 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 10** Peak Width — Response Time — Data Rate (G7117B)

| 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 |
|---|---|---|---|---|---|---|
| < 0.00078125 | 0.0078125 | 240 | 240 | 80 | 40 | 20 |
| > 0.00078125 | 0.015625 | 240 | 240 | 80 | 40 | 20 |
| > 0.0015625 | 0.03125 | 160 | 160 | 80 | 40 | 20 |
| > 0.003125 | 0.0625 | 80 | 80 | 80 | 40 | 20 |
| > 0.00625 | 0.125 | 40 | 40 | 40 | 40 | 20 |
| > 0.0125 | 0.25 | 20 | 20 | 20 | 20 | 20 |
| > 0.025 | 0.5 | 10 | 10 | 10 | 10 | 10 |
| > 0.05 | 1 | 5 | 5 | 5 | 5 | 5 |
| > 0.1 | 2 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| > 0.2 | 4 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| > 0.4 | 8 | 0.625 | 0.625 | 0.625 | 0.625 | 0.625 |
| > 0.85 | 16 | 0.3125 | 0.3125 | 0.3125 | 0.3125 | 0.3125 |

[1] Values in the User Interface may be rounded.

**Table 11** Peak Width — Response Time — Data Rate (G7117A)

| | Peak width at half height [min][1] | Response [s] | Scan data rate[Hz] ≤251 pts/scan | Scan data rate[Hz] ≤501 pts/scan | Scan data rate[Hz] > 501 pts/scan |
|---|---|---|---|---|---|
| < 0.0015625 | 0.015625 | 120 | 120 | 40 | 20 |
| > 0.0015625 | 0.03125 | 120 | 120 | 40 | 20 |
| > 0.003125 | 0.0625 | 80 | 80 | 40 | 20 |
| > 0.00625 | 0.125 | 40 | 40 | 40 | 20 |
| > 0.0125 | 0.25 | 20 | 20 | 20 | 20 |
| > 0.025 | 0.5 | 10 | 10 | 10 | 10 |
| > 0.05 | 1 | 5 | 5 | 5 | 5 |
| > 0.1 | 2 | 2.5 | 2.5 | 2.5 | 2.5 |
| > 0.2 | 4 | 1.25 | 1.25 | 1.25 | 1.25 |
| > 0.4 | 8 | 0.625 | 0.625 | 0.625 | 0.625 |
| > 0.85 | 16 | 0.3125 | 0.3125 | 0.3125 | 0.3125 |

1 Values in the User Interface may be rounded.

**NOTE** The maximum spectra scan rate depends on the data points per scan, see Table 10 on page 75 and Table 11 on page 76. 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 19 on page 78 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.

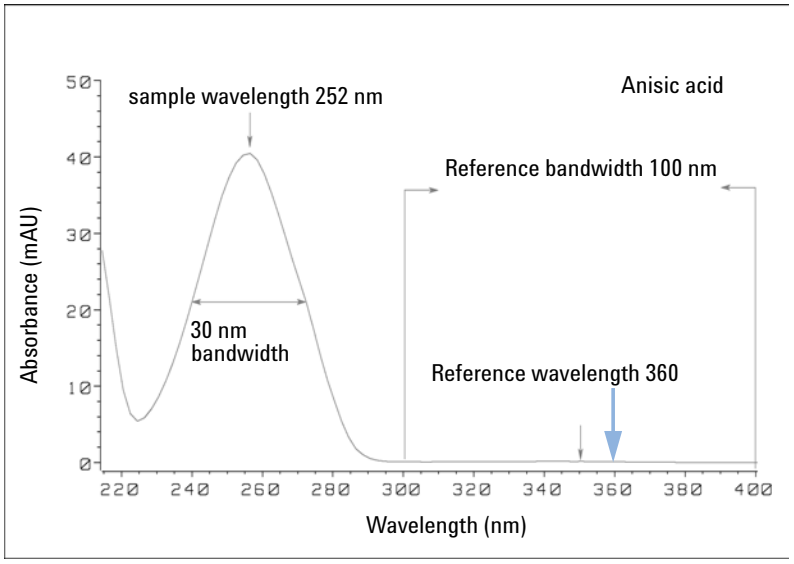



**Figure 19** Optimization of Wavelength Setting

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.

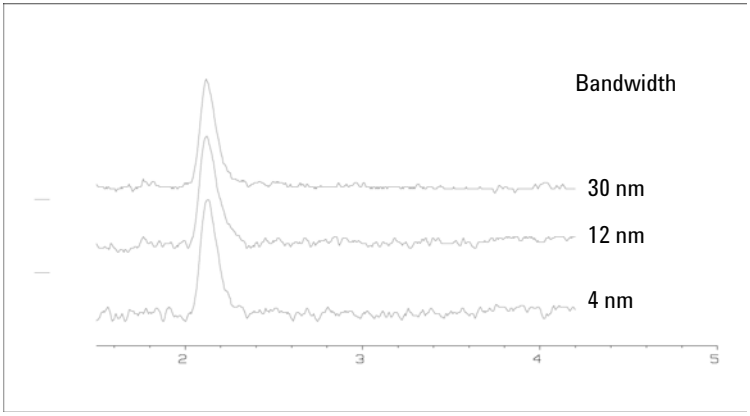



**Figure 20** Influence of Bandwidth on Signal and Noise

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 21 on page 79 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.

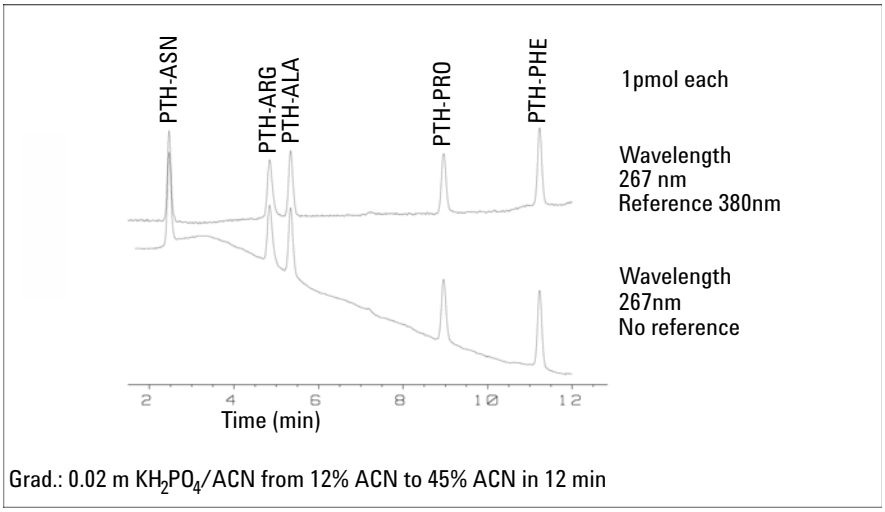



**Figure 21** Gradient Analysis of PTH-Amino Acids (1 pmol each), with and without Reference

## Slit Width (G7117B)

The 1290 Infinity DAD (G7117B) 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.

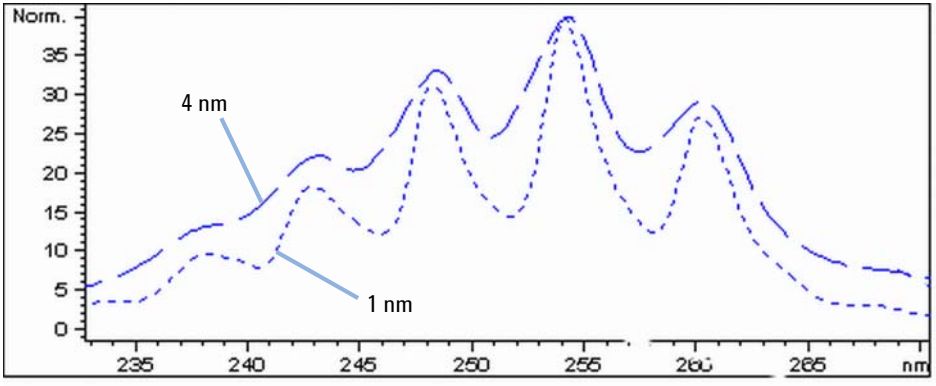



**Figure 22** Benzene at 1 and 4 nm slit width (principle)

A wide slit uses more of the light shining through the flow cell. This gives lower baseline noise as shown in Figure 23 on page 80.

Slit width = 1 nm

Slit width = 8 nm

Data Rate = 160 Hz

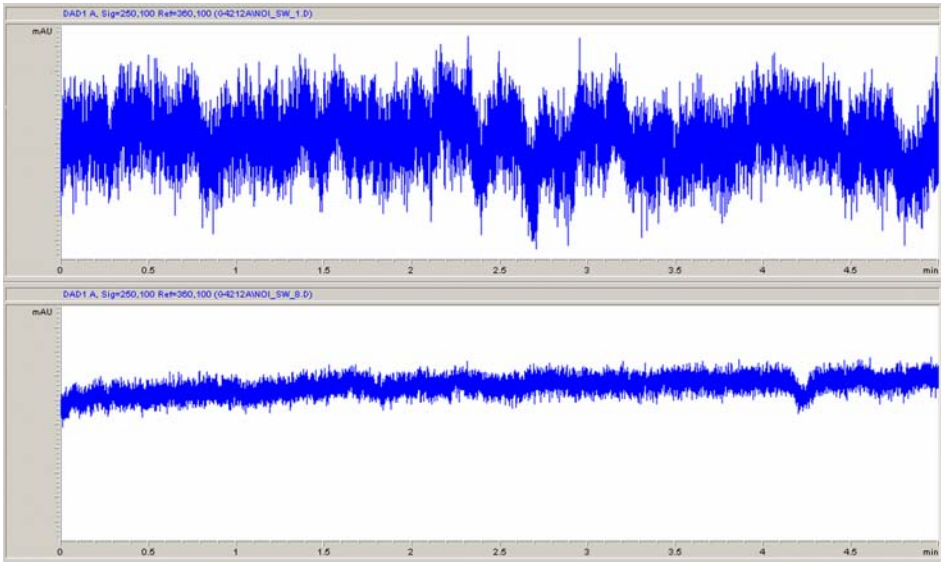



**Figure 23** Influence of the Slit Width on Baseline Noise

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 19 on page 78).

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.

### 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 24 on page 83 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.

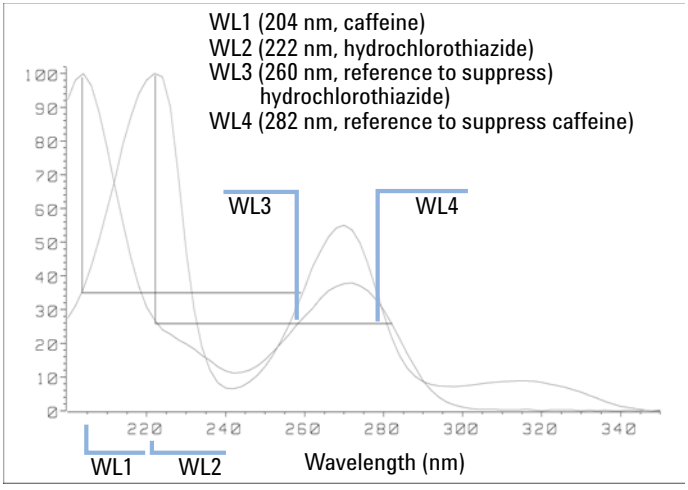



**Figure 24** Wavelength Selection for Peak Suppression

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 25 on page 84 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 %.

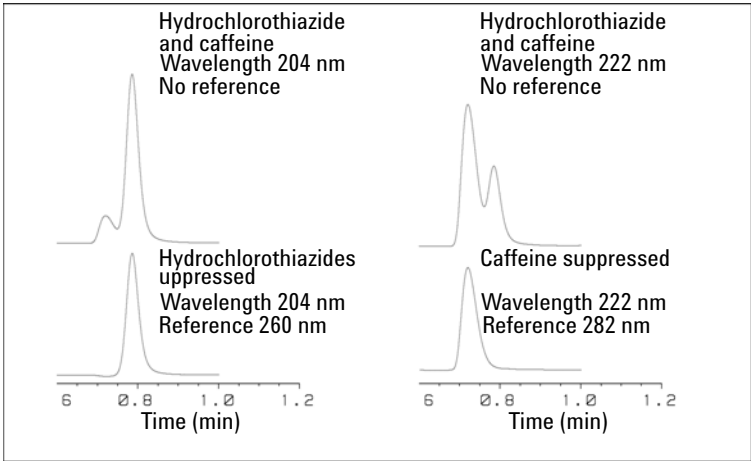



**Figure 25** Peak Suppression Using Reference Wavelength

# 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 26 on page 85 and Figure 27 on page 86.

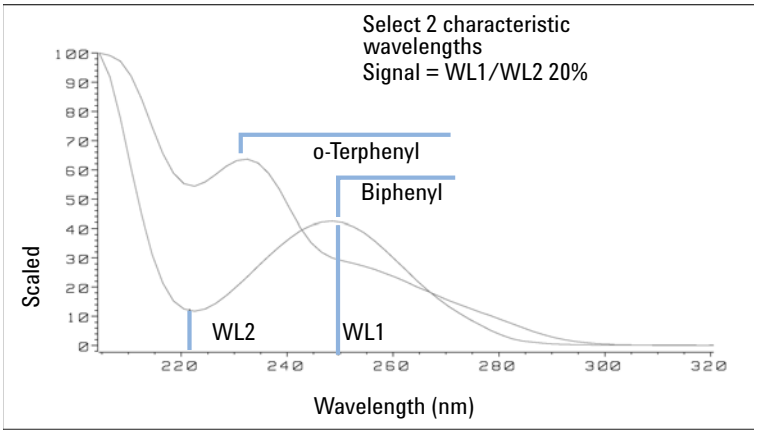



**Figure 26** Wavelength Selection for Ratio Qualifiers

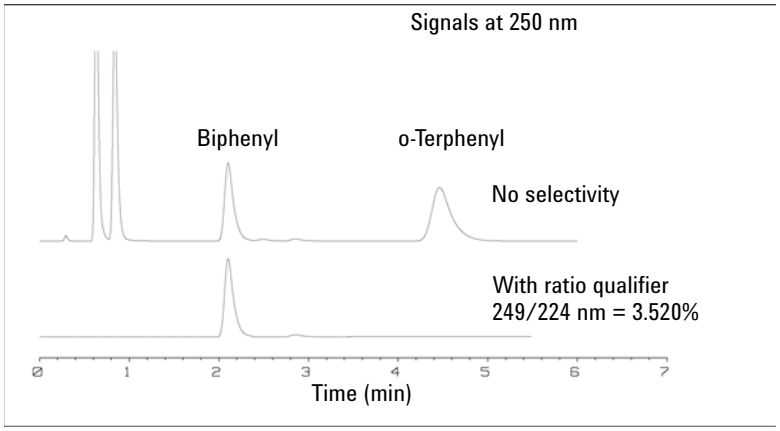



**Figure 27** Selectivity by Ratio Qualifiers

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 ($\lambda_1$) and 224 nm ($\lambda_2$) were found from the spectra shown in Figure 26 on page 85. 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 27 on page 86). 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 II DAD/Agilent 1290 Infinity DAD FS 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 28 on page 91, 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 28 on page 91. 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.

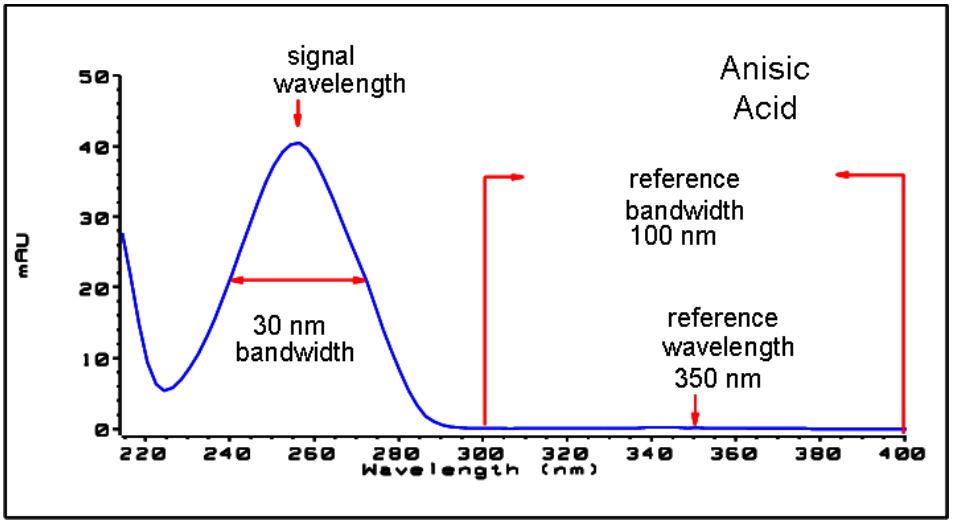



**Figure 28** Spectrum of Anisic Acid

## 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 12 on page 92 and in Table 13 on page 93. 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 up to 240 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 12 on page 92 and Table 13 on page 93.

**Table 12** Peak Width — Response Time — Data Rate (G7117B)

| 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 |
|---|---|---|---|---|---|---|
| < 0.00078125 | 0.0078125 | 240 | 240 | 80 | 40 | 20 |
| > 0.00078125 | 0.015625 | 240 | 240 | 80 | 40 | 20 |
| > 0.0015625 | 0.03125 | 160 | 160 | 80 | 40 | 20 |
| > 0.003125 | 0.0625 | 80 | 80 | 80 | 40 | 20 |
| > 0.00625 | 0.125 | 40 | 40 | 40 | 40 | 20 |
| > 0.0125 | 0.25 | 20 | 20 | 20 | 20 | 20 |
| > 0.025 | 0.5 | 10 | 10 | 10 | 10 | 10 |
| > 0.05 | 1 | 5 | 5 | 5 | 5 | 5 |
| > 0.1 | 2 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| > 0.2 | 4 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| > 0.4 | 8 | 0.625 | 0.625 | 0.625 | 0.625 | 0.625 |
| > 0.85 | 16 | 0.3125 | 0.3125 | 0.3125 | 0.3125 | 0.3125 |

[1] Values in the User Interface may be rounded.

**Table 13** Peak Width — Response Time — Data Rate (G7117A)

| | Peak width at half height [min][1] | Response [s] | Scan data rate[Hz] ≤251 pts/scan | Scan data rate[Hz] ≤501 pts/scan | Scan data rate[Hz] > 501 pts/scan |
|---|---|---|---|---|---|
| < 0.0015625 | 0.015625 | 120 | 120 | 40 | 20 |
| > 0.0015625 | 0.03125 | 120 | 120 | 40 | 20 |
| > 0.003125 | 0.0625 | 80 | 80 | 40 | 20 |
| > 0.00625 | 0.125 | 40 | 40 | 40 | 20 |
| > 0.0125 | 0.25 | 20 | 20 | 20 | 20 |
| > 0.025 | 0.5 | 10 | 10 | 10 | 10 |
| > 0.05 | 1 | 5 | 5 | 5 | 5 |
| > 0.1 | 2 | 2.5 | 2.5 | 2.5 | 2.5 |
| > 0.2 | 4 | 1.25 | 1.25 | 1.25 | 1.25 |
| > 0.4 | 8 | 0.625 | 0.625 | 0.625 | 0.625 |
| > 0.85 | 16 | 0.3125 | 0.3125 | 0.3125 | 0.3125 |

1 Values in the User Interface may be rounded.

**NOTE** The maximum spectra scan rate depends on the data points per scan, see Table 12 on page 92 and Table 13 on page 93. Running at 240, 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.

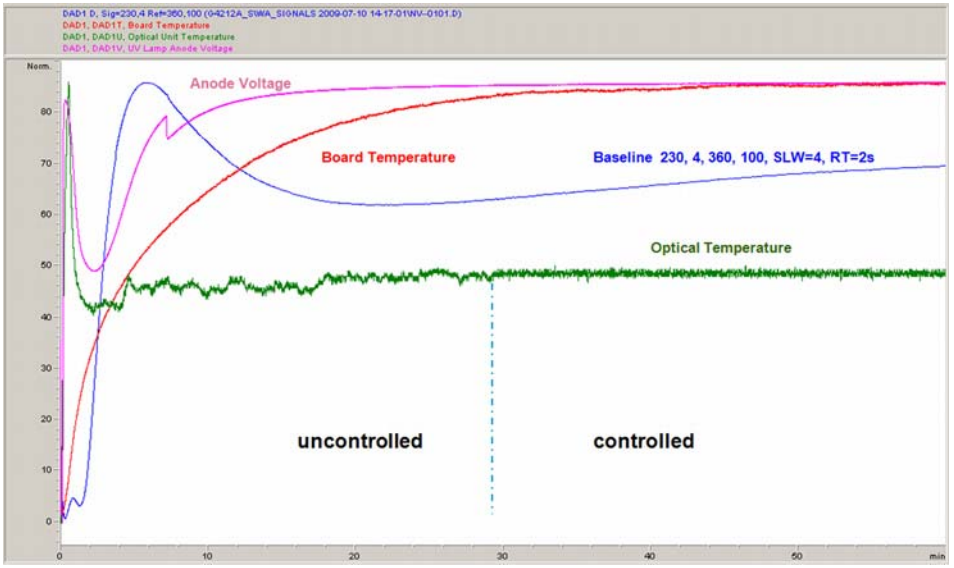



**Figure 29** Detector Warm-up – 1st hour

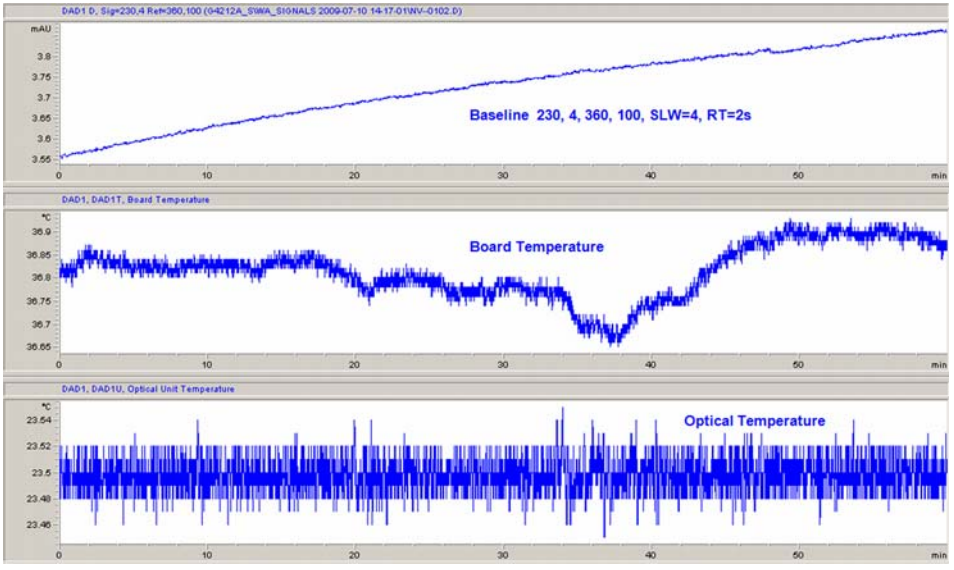



**Figure 30** Detector Warm-up – 2nd hour

# 6
# Troubleshooting and Diagnostics



Overview about the troubleshooting and diagnostic features.

# Available Tests vs User Interfaces

**NOTE**

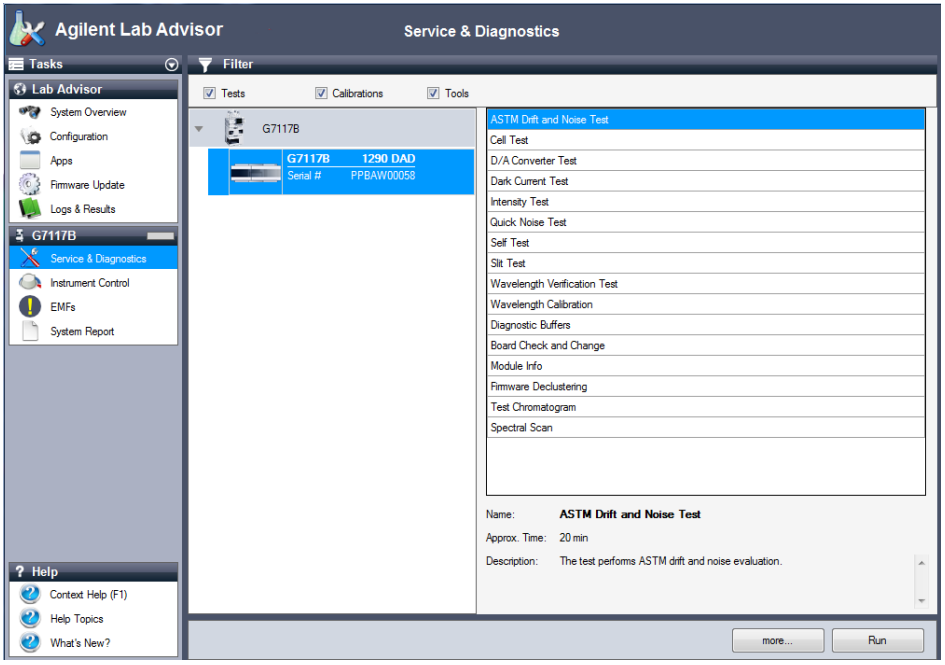
Depending on the used interface, the available tests and the screens/reports may vary.

Preferred tool should be the Agilent Lab Advisor, see "Agilent Lab Advisor Software" on page 99.

Agilent Lab Advisor B.02.06 or later is required.

The Instant Pilot does not support the G7117A/B at introduction. If running as G4212A/B DAD (emulation mode) the Instant Pilot firmware must be B.02.16.

- Preferred tool should be the Agilent Lab Advisor software, see "Agilent Lab Advisor Software" on page 99.
- 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 chromatographic data system. Agilent Lab Advisor helps to manage the lab for high-quality chromatographic results by providing a detailed system overview of all connected analytical instruments with instrument status, Early Maintenance Feedback counters (EMF), instrument configuration information, and diagnostic tests. By the push of a button, a detailed diagnostic report can be generated. Upon request, the user can send this report to Agilent for a significantly improved troubleshooting and repair process.

The Agilent Lab Advisor software is available in two versions:

- Lab Advisor Basic
- Lab Advisor Advanced

Lab Advisor Basic is included with every Agilent 1200 Infinity Series and Infinity II Series pump.

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

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

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

# 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. |
| 4 The degasser failed to generate sufficient vacuum for solvent degassing. | Check the vacuum degasser for an error condition. Refer to the *Service Manual* for the degasser or the 1260 pump that has the degasser built-in. |

## Remote Timeout

**Error ID: 0070**

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

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

## Lost CAN Partner

**Error ID: 0071**

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

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

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

## Leak Sensor Short

**Error ID: 0082**

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

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

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

## Leak Sensor Open

**Error ID: 0083**

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

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

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

## Compensation Sensor Open

**Error ID: 0081**

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

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

| Probable cause | Suggested actions |
|---|---|
| **1** Loose connection between the power switch board and the main board | Please contact your Agilent service representative. |
| **2** Defective power switch board | Please contact your Agilent service representative. |

## Compensation Sensor Short

**Error ID: 0080**

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

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

| Probable cause | Suggested actions |
|---|---|
| 1 Defective power switch board | Please contact your Agilent service representative. |
| 2 Loose connection between the power switch board and the 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. |

## ERI Messages

**Error ID: 11120 (+5 V) , 11121 (+25 V)**

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

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

# 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 Air Inlet

**Error ID: 1072**

This temperature sensor 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. | • Replace the cable to the main board.<br>• Please contact your Agilent service representative. |
| 2 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.02.06. Other user interfaces may not provide any test or just a few.

**Table 14** Interfaces and available test functions

| Interface | Comment | Available Function |
|---|---|---|
| Agilent Instrument Utilities | Maintenance tests are available | • Intensity<br>• Cell<br>• WL Calibration |
| Agilent Lab Advisor | All tests are available | • Self-Test<br>• Intensity<br>• Quick Noise<br>• ASTM Drift and Noise<br>• Cell<br>• Dark Current<br>• D/A Converter<br>• Slit (G7117B only)<br>• WL Verification<br>• WL Calibration<br>• Test Chromatogram (Tools)<br>• Spectra Scan (Tools)<br>• Module Infos (Tools)<br>• Diagnostic (Tools) |
| Agilent ChemStation | No tests available<br>Adding of temperature/lamp signals to chromatographic signals possible | • Temperature main board<br>• Temperature optical unit<br>• Lamp anode voltage |

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

The Lab Advisor shows the available test under Service & Diagnostics.

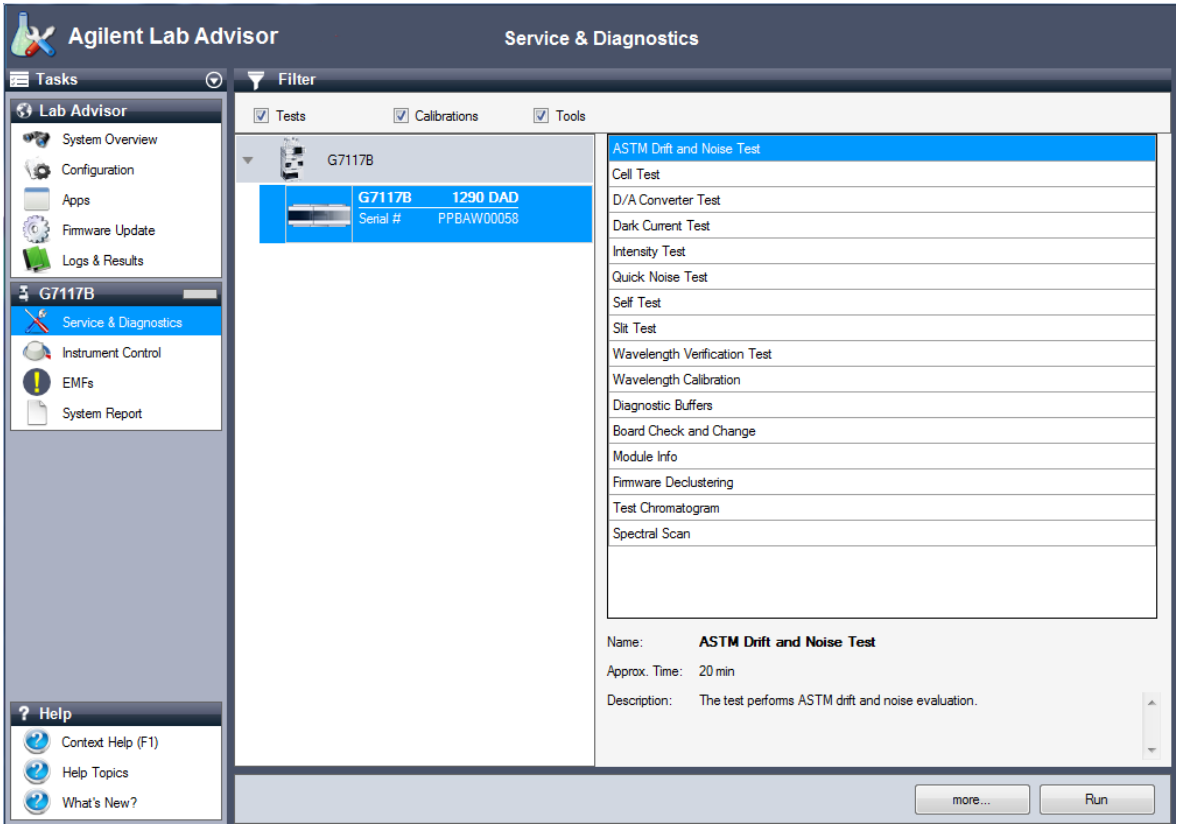



**Figure 31** The Lab Advisor shows the available test

# 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 "Clean the Max-Light Cartridge Cell" on page 163.

**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 15** 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 % |
| **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 (G7117B 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 Agilent Lab Advisor (for further information see Online-Help of user interface).

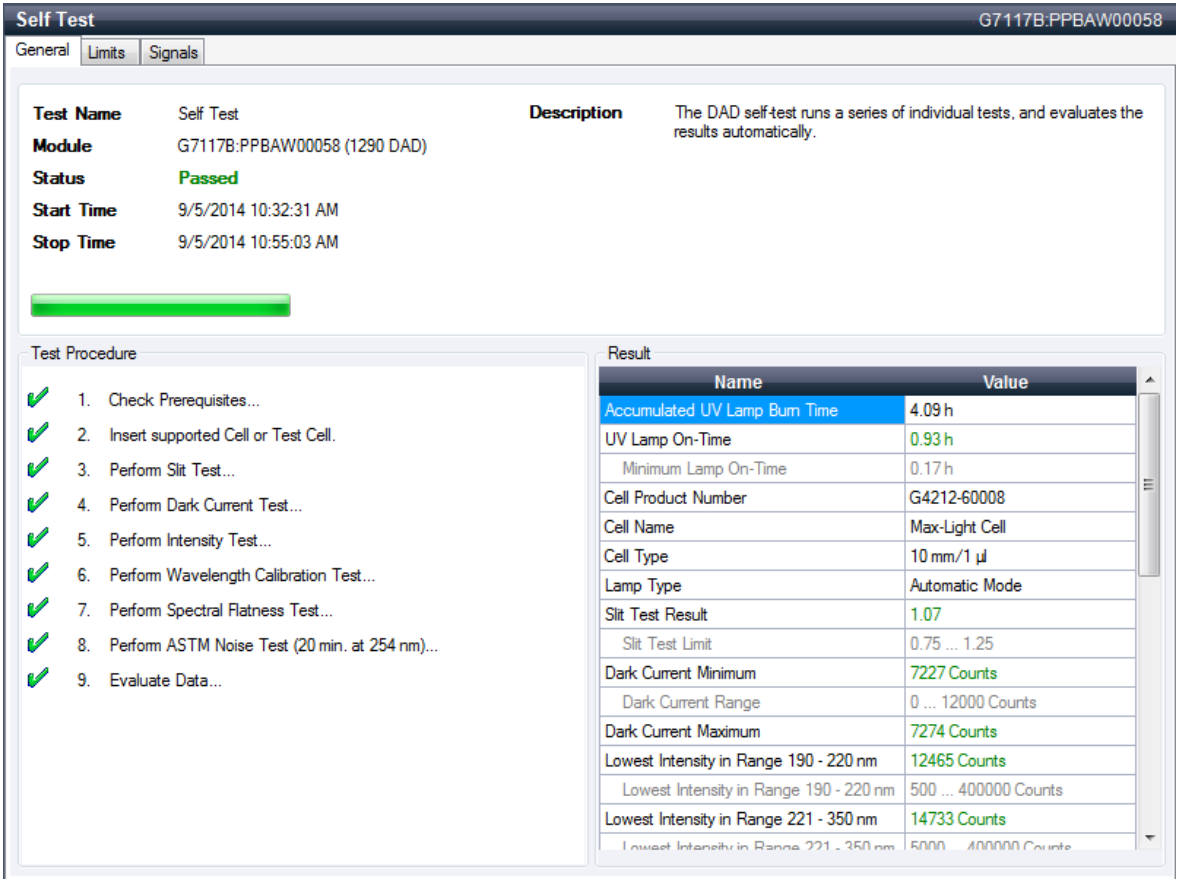



**Figure 32** Self-Test – Results

Under the tab **Signals** you can find the detailed signals from the tests.

# 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 127). When the test is started, the 1-nm slit is moved into the light path automatically (G7117B only). On the G7117A, 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 Agilent Lab Advisor (for further information see Online-Help of user interface).

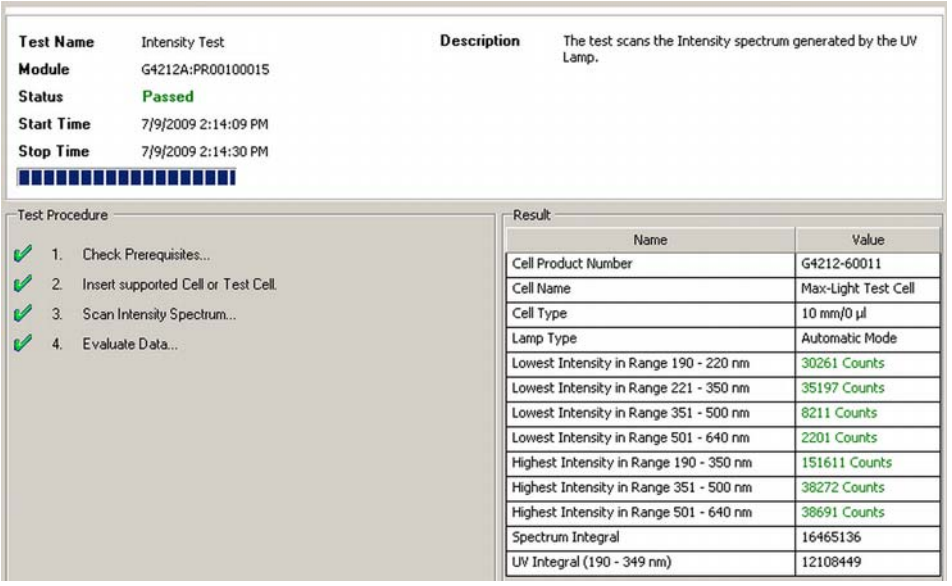



**Figure 33** Intensity Test – Results

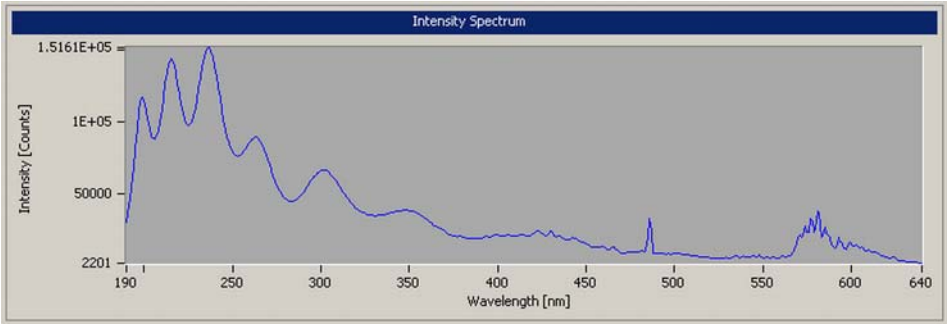



**Figure 34** Intensity Test – Signals

# 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.<br>• 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 "Clean the Max-Light Cartridge Cell" on page 163. |
| **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 (G7117B only). On the G7117A, 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 Agilent Lab Advisor (for further information see Online-Help of user interface).

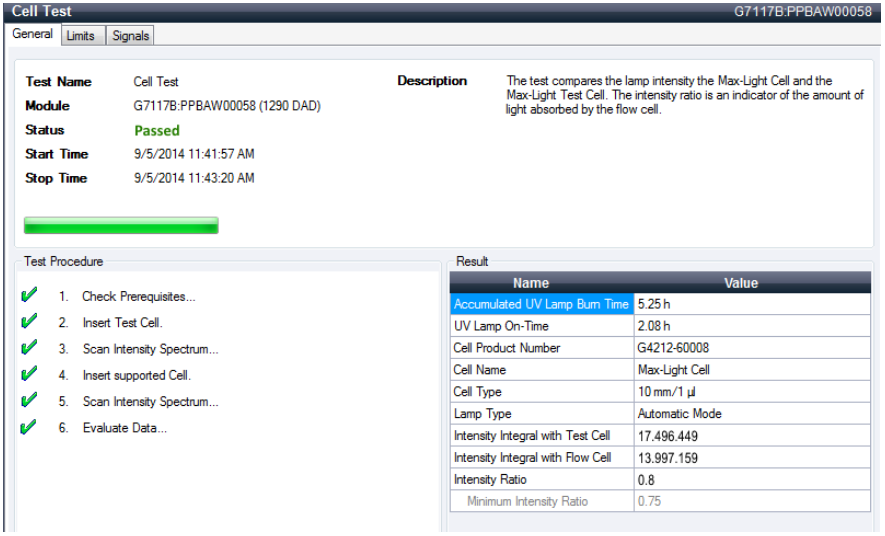



**Figure 35** Cell Test – Results

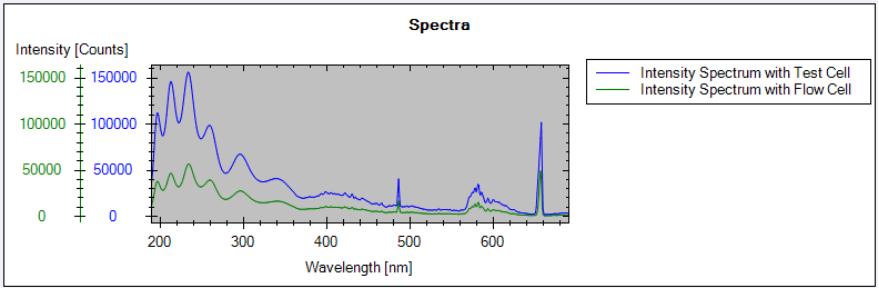



**Figure 36** Cell Test – Signals (example shows low intensity for flow cell)

# 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 "Clean the Max-Light Cartridge Cell" on page 163. |

# 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 Agilent Lab Advisor (for further information see Online-Help of user interface).

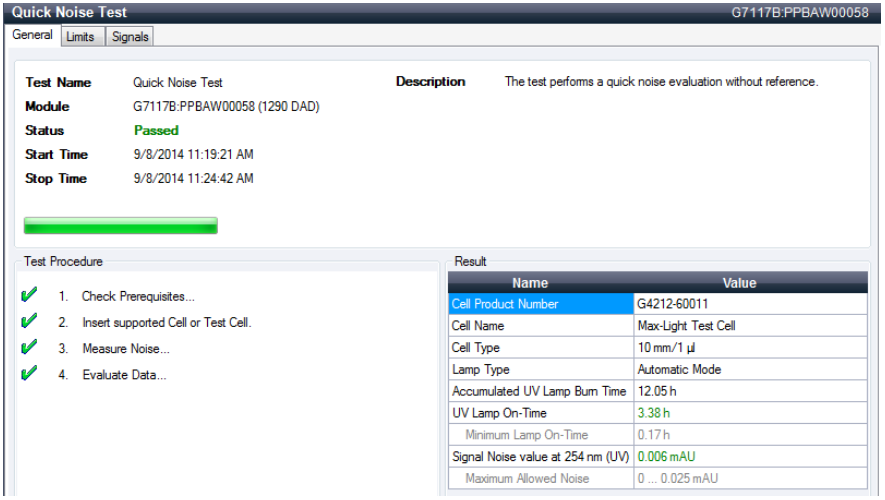



**Figure 37** Quick Noise Test – Results

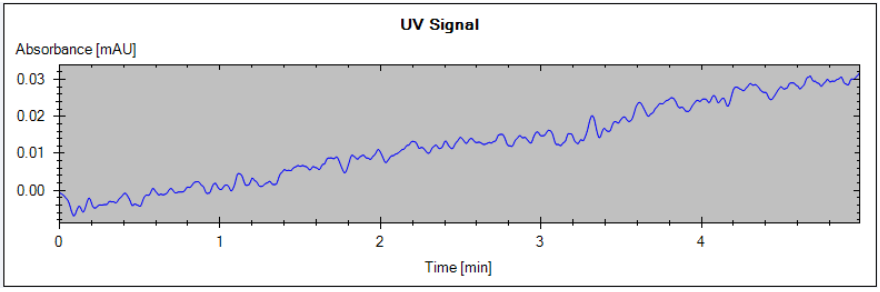



**Figure 38** Quick Noise Test – Signal

# 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.<br>• Clean the flow cell as described in "Clean the Max-Light Cartridge Cell" on page 163. |
| **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 Agilent Lab Advisor (for further information see Online-Help of user interface).

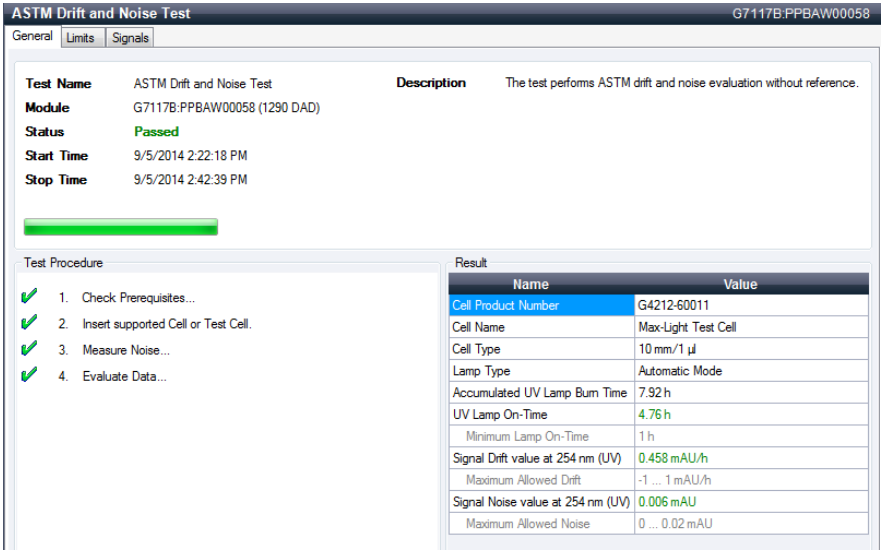



**Figure 39** ASTM Drift and Noise Test – Results

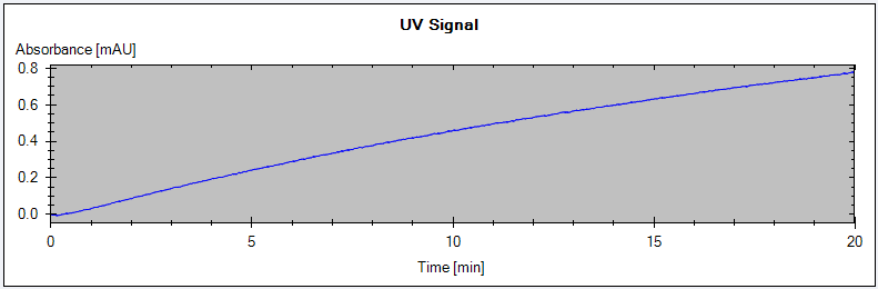



**Figure 40** ASTM Drift and Noise Test – Signal

# 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.<br>• Clean the flow cell as described in "Clean the Max-Light Cartridge Cell" on page 163. |
| **4** Old UV-lamp. | Exchange the UV-lamp. |
| **5** Environment not according to specifications. | Improve environment. |

# Slit Test

## Slit Test (G7117B)

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 Agilent Lab Advisor (for further information see Online-Help of user interface).

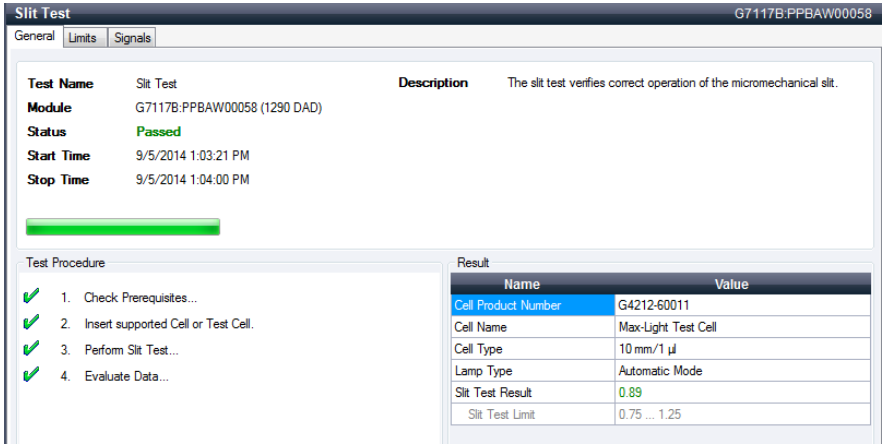



**Figure 41** Slit Test – Results

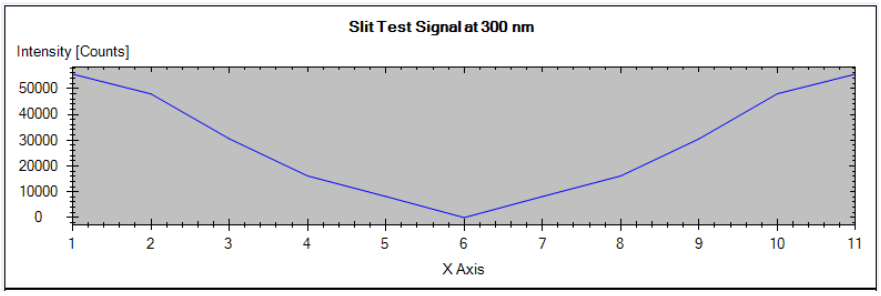



**Figure 42** Slit Test – Signal

## 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 (G7117A)

There is no dedicated slit test for the G7117A DAD FS. 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 Agilent Lab Advisor (for further information see Online-Help of user interface).

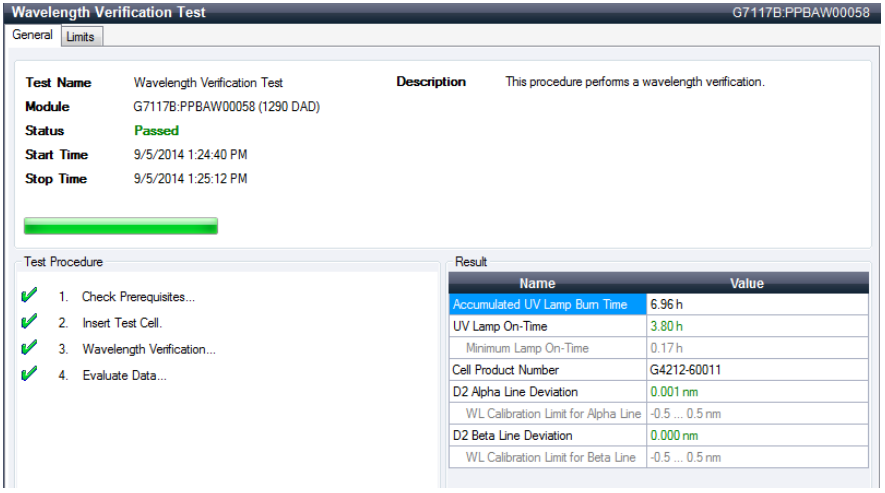



**Figure 43** Wavelength Verification – Results

# 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 (G7117B). 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.

**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 Agilent Lab Advisor (for further information see Online-Help of user interface).

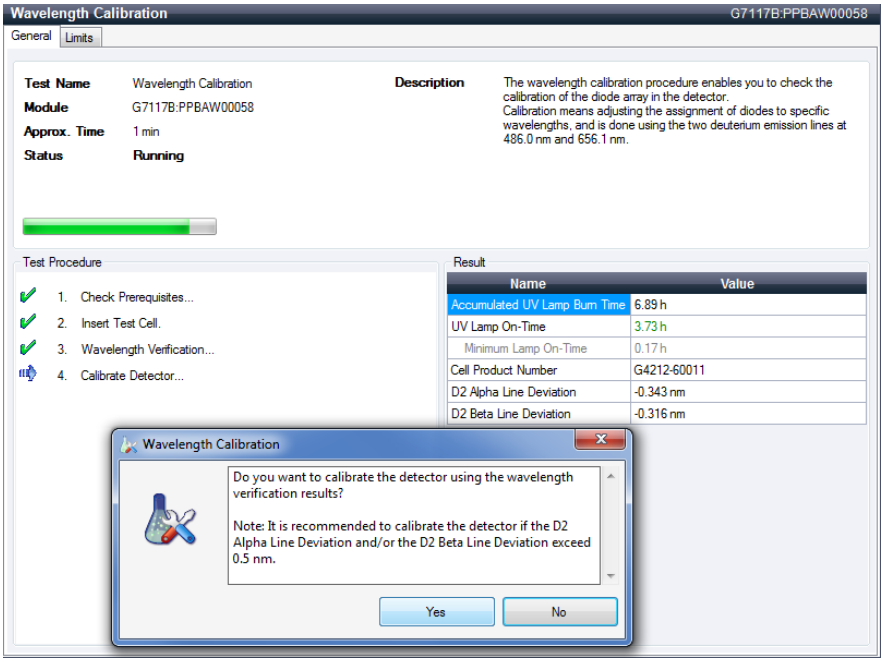



**Figure 44** Wavelength Calibration - Results

If you select **No**, the test is aborted.

If you select **Yes**, the re-calibration is performed (the offset is corrected).

# 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.<br>• 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 "Clean the Max-Light Cartridge Cell" on page 163. |

**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.

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

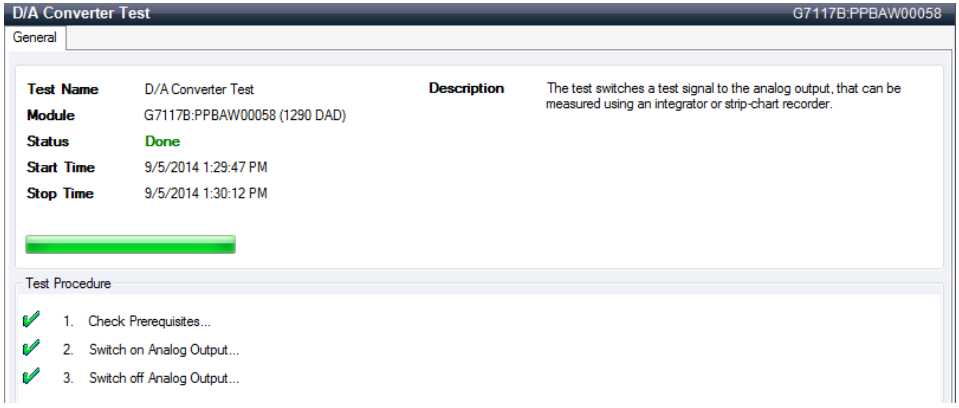



**Figure 45** D/A Converter (DAC) Test – Results

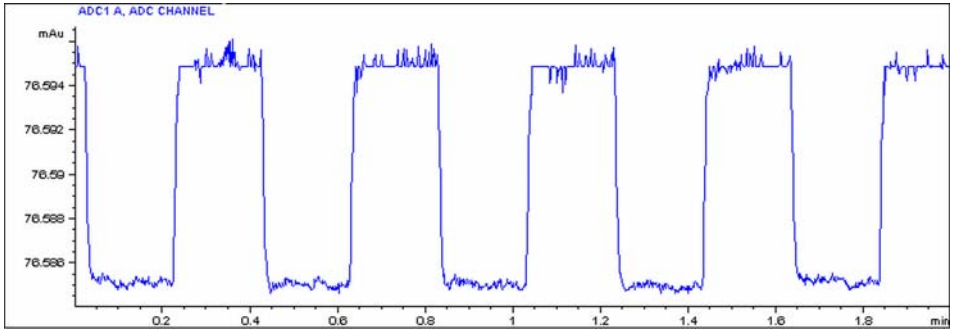



**Figure 46** D/A Converter (DAC) Test – Example of Integrator Plot

## 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).

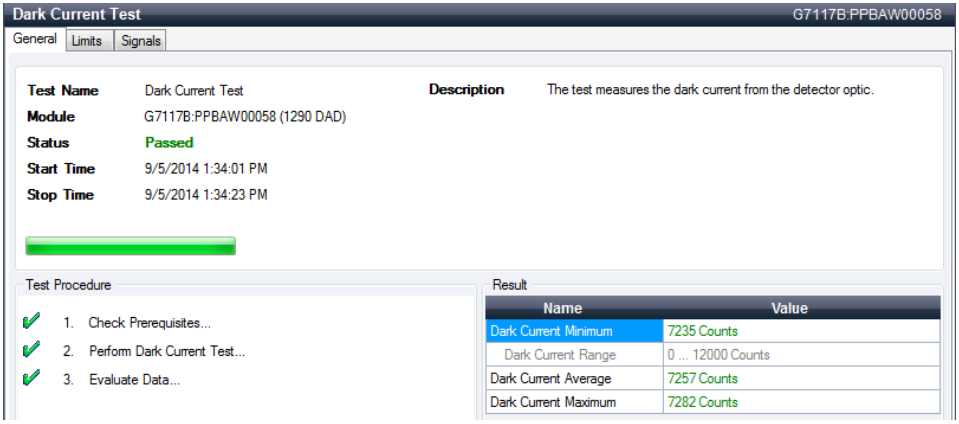



**Figure 47** Dark Current Test – Results

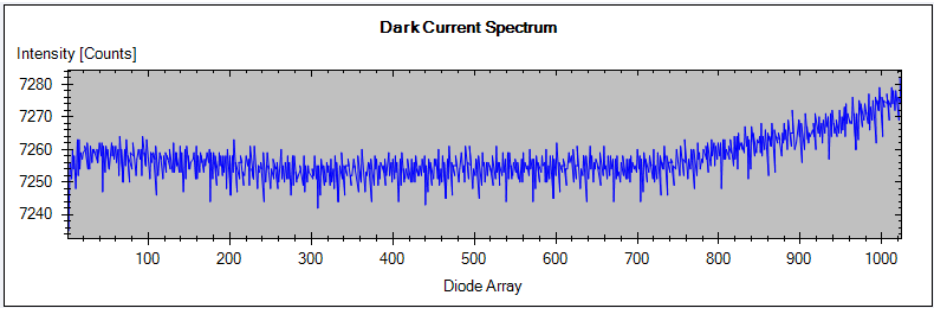



**Figure 48** Dark Current Test – Signals

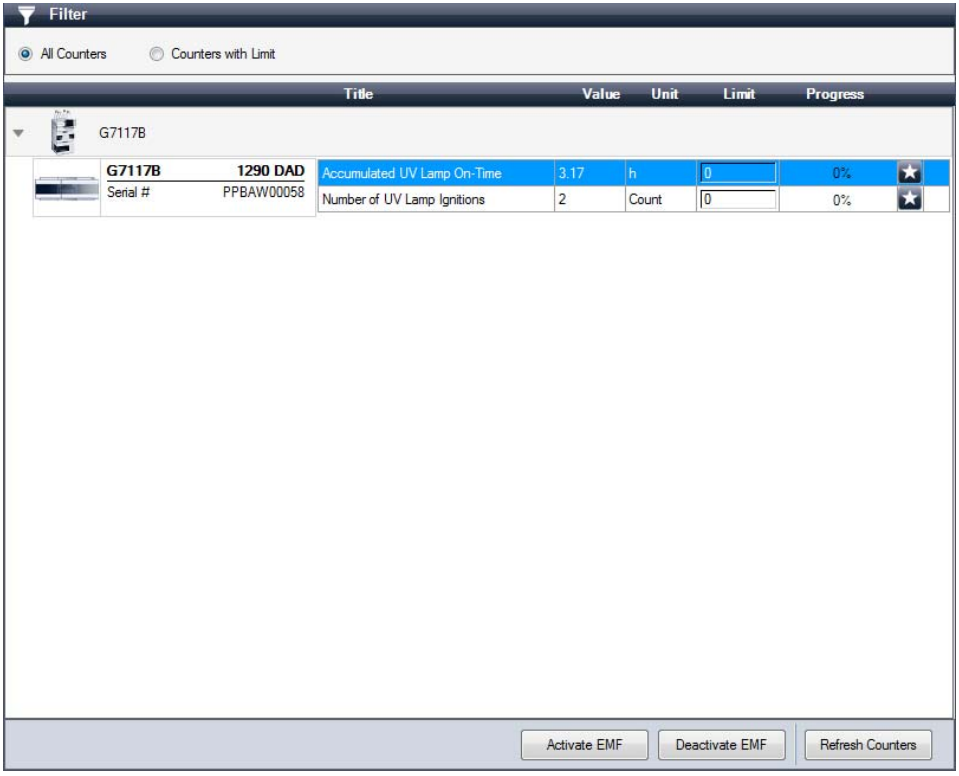
## Test Failed

| Probable cause | Suggested actions |
|---|---|
| **1** Defective slit assembly (stray light). | • Run the "Self-Test" on page 122.<br>• Run the "Slit Test (G7117B)" on page 136 (part of the "Self-Test" on page 122). |
| **2** Defective detector main board. | Please contact your Agilent service representative. |
| **3** Defective PDA/optical unit. | Please contact your Agilent service representative. |

# Other Lab Advisor Functions

## EMFs - Early Maintenance Feature

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



# 9 Maintenance



This chapter describes the maintenance of the module.

# Introduction to Maintenance

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

**NOTE**

There are no serviceable parts inside.

Do not open the module.

# 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.

---

# Overview of Maintenance

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

**Table 16** 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.

# Remove and Install Doors

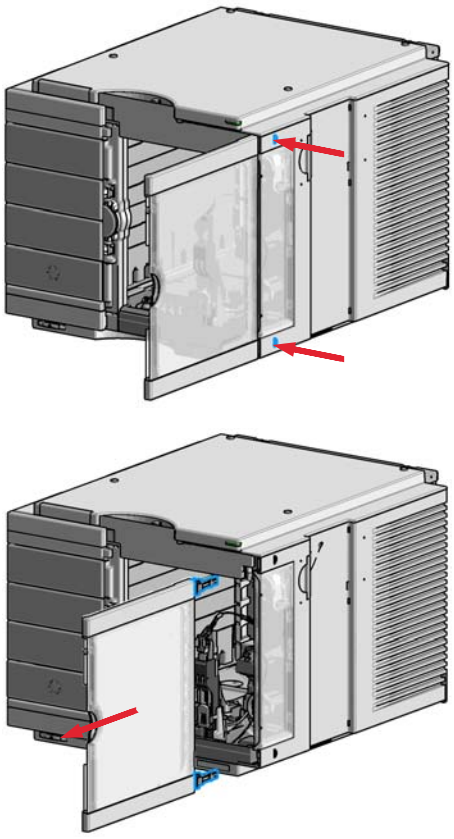
| Parts required | p/n | Description |
|---|---|---|
| | 5067-5737 | Door left |
| | 5067-5736 | Door right |

**NOTE**

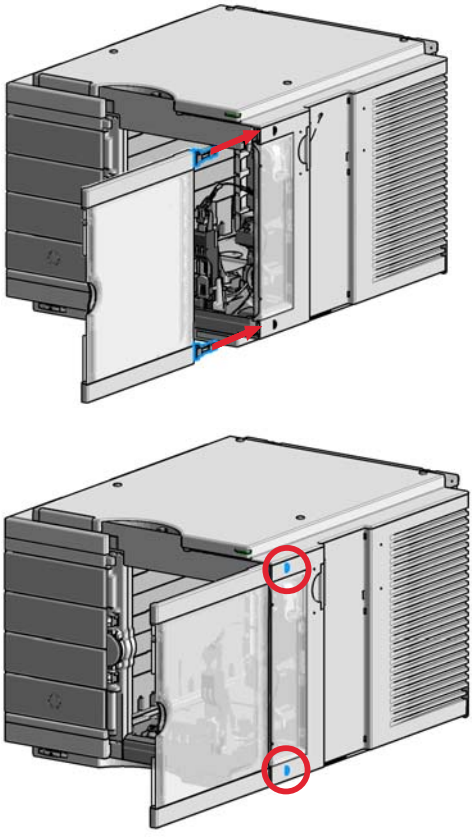
The figures shown in this procedure exemplarily show the Infinity II Multisampler module.

The principle of how to remove and/or install doors works in the same way for all Infinity II modules.

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



**2** For the Installation of the front door. Insert the hinges into their guides and move the door in until the release buttons click into their final position.



# Replace 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**

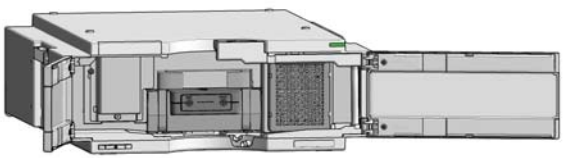
**If the detector has been in use, the lamp may be hot.**

➔ If so, wait for lamp to cool down.

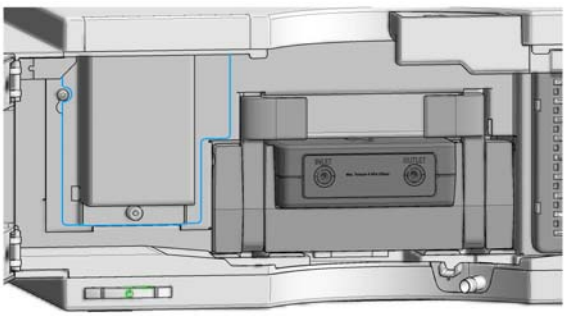
**NOTE**

The lamp house cover includes a magnet.

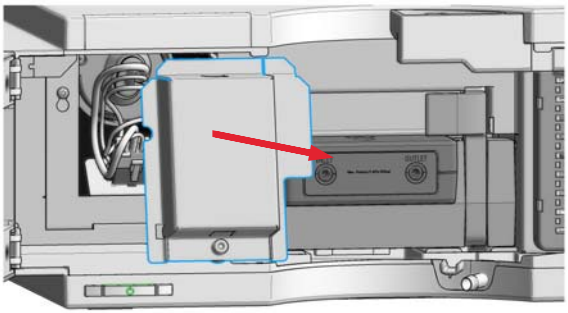
**1** Open the doors.



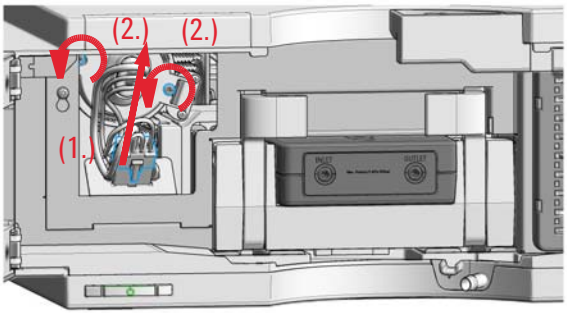
**2** Locate the lamp cover.



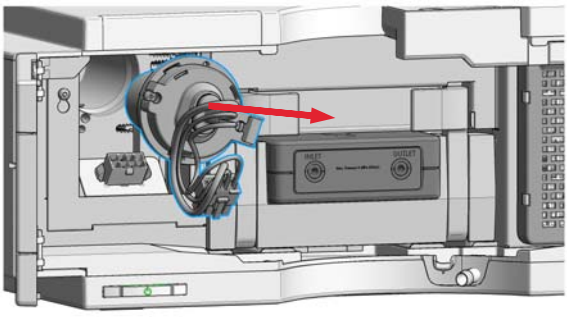
**3** Grab the lamp cover and pull it off (it is fixed by a magnet in the bottom of the cover).



**4** Unplug the lamp connector (1.) and unscrew the two lamp screws (2.) (Pozidriv).



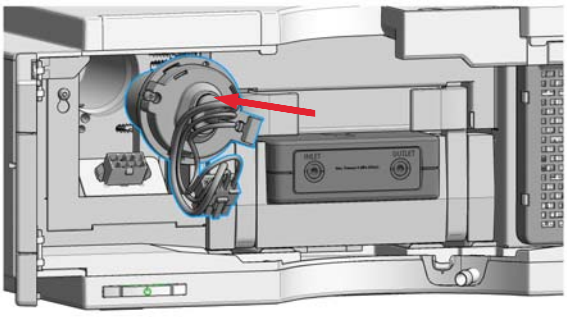

**5** Remove the lamp and place it on a clean place.



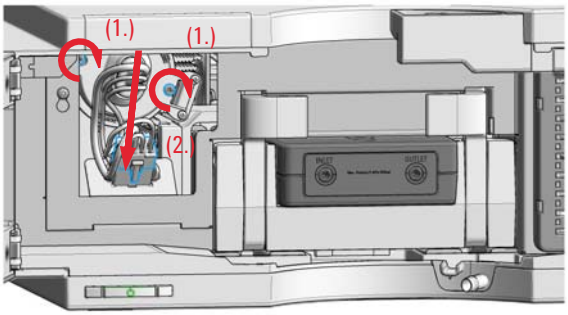
**NOTE**

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

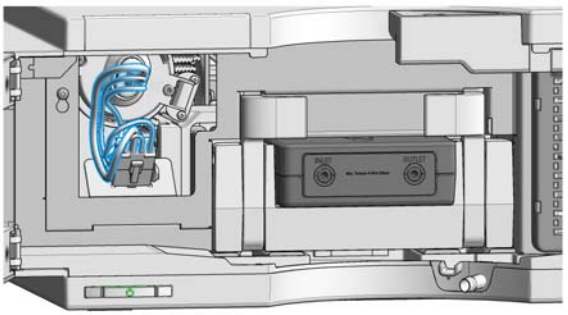
**6** Insert the lamp (RFID tag on the right side).



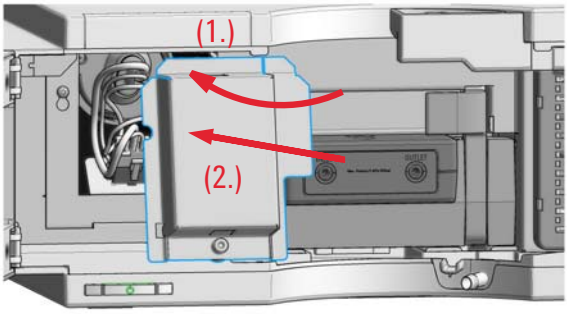
**7** Fix the lamp screws (1.) and reconnect the lamp connector (2.).



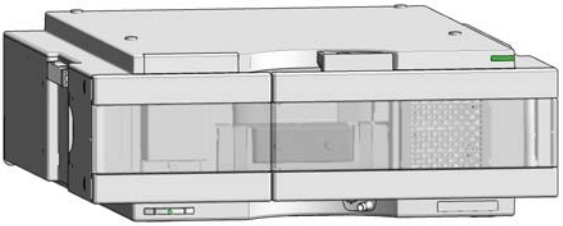

**8** Place the lamp cable in the lamp cover.



**9** Slide the lamp cover into the top position of the metal front (1.) and press the lamp cover completely in until it clicks (2.).




**10** Close the doors.



**11** Perform a Wavelength Re-calibration after lamp warm-up.

# Replace the Max-Light Cartridge Cell

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

**Tools required**

| Description |
|---|
| Wrench, 1/4 inch<br>for capillary connections |

**Parts required**

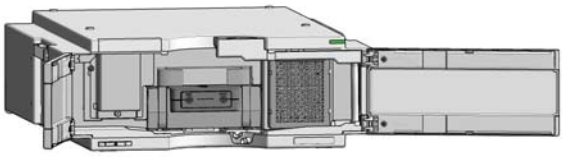
| p/n | Description |
|---|---|
| G4212-60008 | Max-Light Cartridge Cell (10 mm, V(σ) 1.0 µL) |
| G4212-60007 | Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL) |
| G4212-60011 | Max-Light Cartridge Test Cell |
| G4212-60032 | HDR Max-Light Cartridge Cell (3.7 mm, V(σ) 0.4 µL) |
| G4212-60038 | ULD Max-Light Cartridge Cell (10 mm, V(σ) 0.6 µL) |

**Preparations** Turn the pump off.

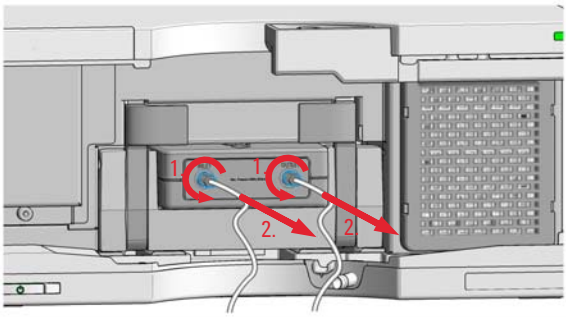
**NOTE** The flow cell is shipped with a filling of isopropanol. This is to avoid breakage due to subambient conditions. In case the flow cell is not used for some time (stored), then flush the flow cell with iso-propanol.

## Remove the Max-Light Cartridge Cell

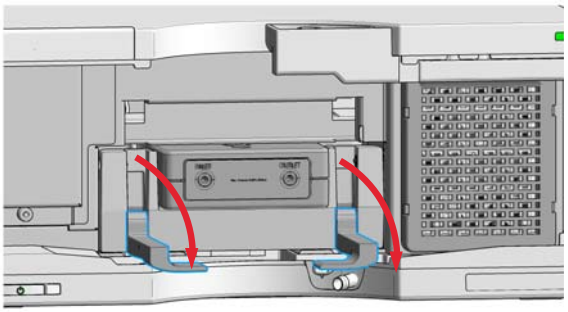
**1** Open the doors.



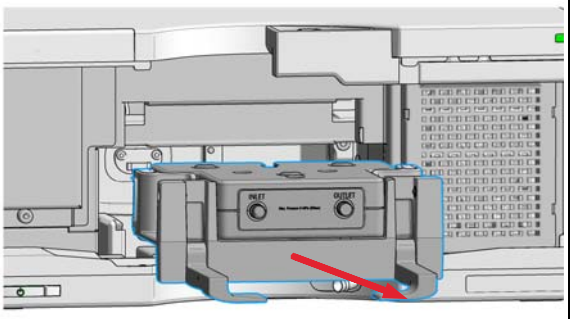
**2** Disconnect the capillaries from the flow cell cartridge.



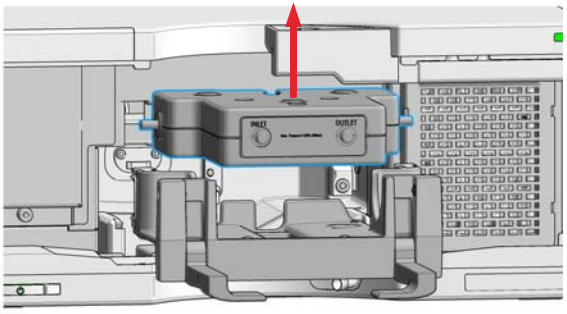

**3** Flip the cartridge lever towards the front (down).



**4** Pull the cartridge holder completely out.

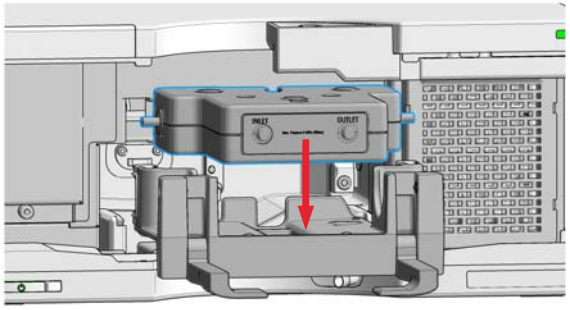


**5** Remove the flow cell cartridge.

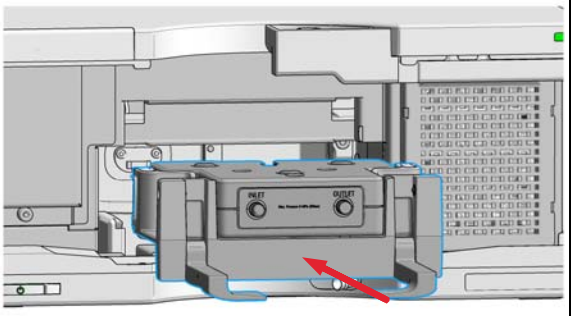


## Install the Max-Light Cartridge Cell

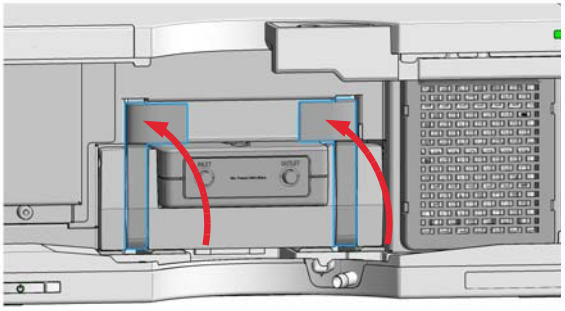
**1** Insert the flow cell cartridge.



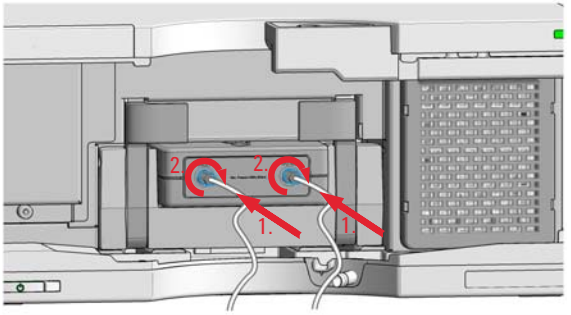
**2** Slide the cartridge holder completely into the detector.



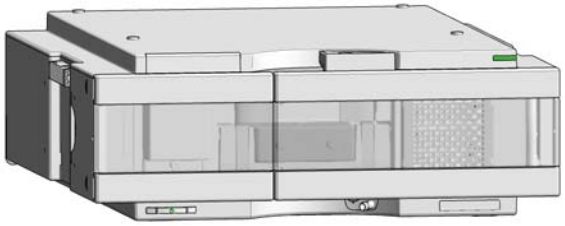
**3** Lift the cartridge lever up into the final position.



**4** Reconnect the capillaries.




**5** Close the doors.



# Clean the 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 ® |
| 5190-0530 | Cell cleaning solvent |

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

2 Remove the cell from the cartridge holder (see "Replace the Max-Light Cartridge Cell" on page 160).

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 the cleaning with the alcohol did not improve the results, the flow cell might be cleaned with cleaning fluid (PN 5190-0530). Use a concentration of 0.5 – 2 v/v % (cleaning fluid/water). Use a syringe to fill the flow cell with cleaning fluid.

The following cleaning protocols are recommended:

- Maximum 3 hours at 25 – 30 °C or
- 30 – 40 min at 30 – 35 °C.

**NOTE** The optimal concentration depends on the water quality, the contamination, the temperature, and other factors. The use of demineralized water may improve the cleaning characteristics.

6 Repeat step 4 on page 163.

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

# 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 "Replace the Max-Light Cartridge Cell" on page 160).

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

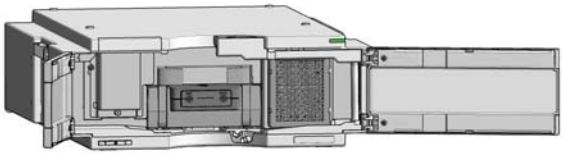
3 Replace the black hoods, that secure the cell light inlet and outlet.

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

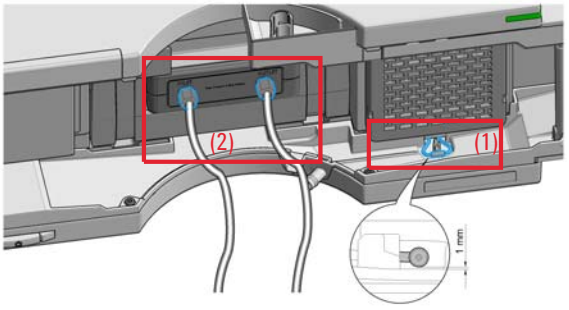
# Correcting Leaks

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

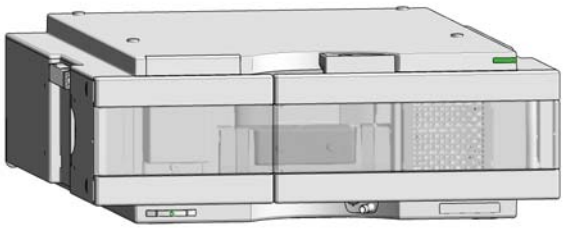
**1** Open the doors.



**2** Use tissue to dry the leak sensor area (1). Observe the capillary connections and the flow cell area (2) for leaks and correct, if required.



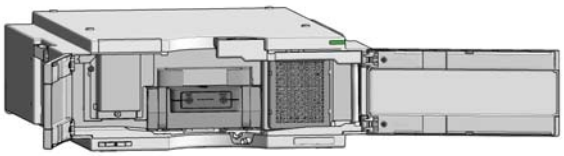

**3** Close the doors.



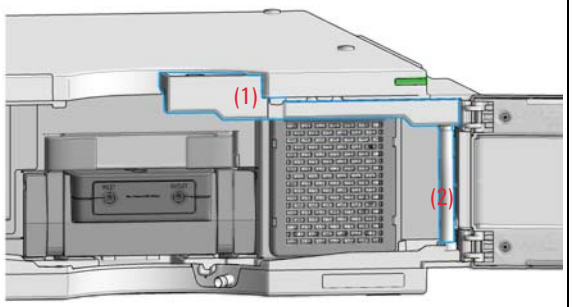
# Replace Leak Handling System Parts

| Parts required | p/n | Description |
|---|---|---|
| | 5043-0856 | Leak Adapter |
| | 5063-6527 | Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste) approximately 85 mm required |

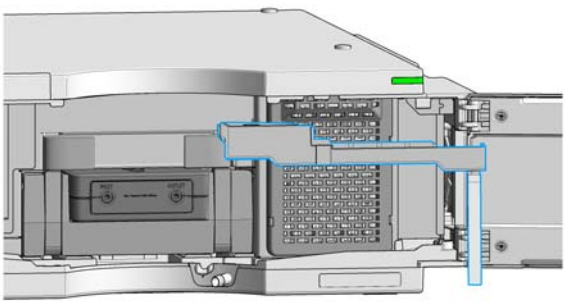
**1** Open the doors.



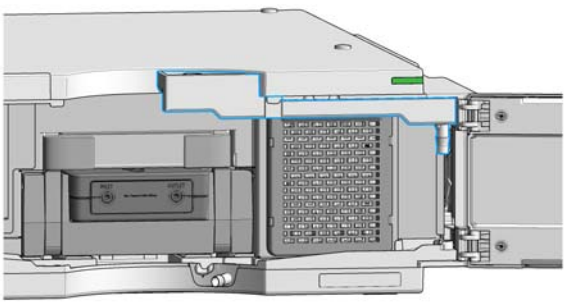
**2** Locate the Leak Adapter (1) and Tubing (2).



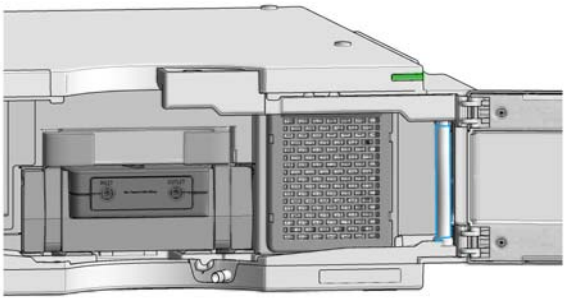

**3** Press the Leak Adapter down and remove it together with the tubing.



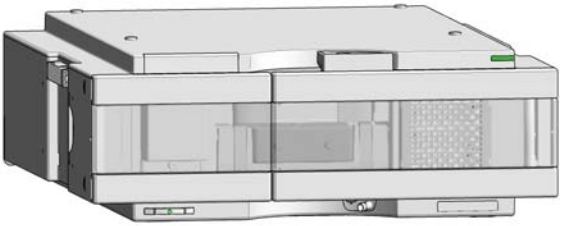
**4** Install the Leak Adapter by pressing it into the Main Cover.



**5** Insert the Tubing (approximately 85 mm required for replacement) between Leak Adapter outlet and Leak Panel.



**6** Close the doors.



# Replace the 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 |
|---|---|
| | Agilent Lab Advisor software |
| OR | Instant Pilot G4208A<br>(only if supported by module) |

**Parts required**

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

**Preparations**

Read update documentation provided with the Firmware Update Tool.

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

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

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

*Module Specific Information*

**Table 17** Module Specific Information (G7117A/G7117B)

| | G7117B 1290 DAD | G7117A 1290 DAD FS |
|---|---|---|
| Initial firmware (main and resident) | B.06.70 | |
| Compatibility with 1100/1200/1260/ 1290 series modules | When using the detector in a system, all other modules must have firmware from set 6.50 (latest version) or later (main and resident). Otherwise the communication will not work. | |
| Conversion to / emulation | G4212A | G4212B |

# 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 18** 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

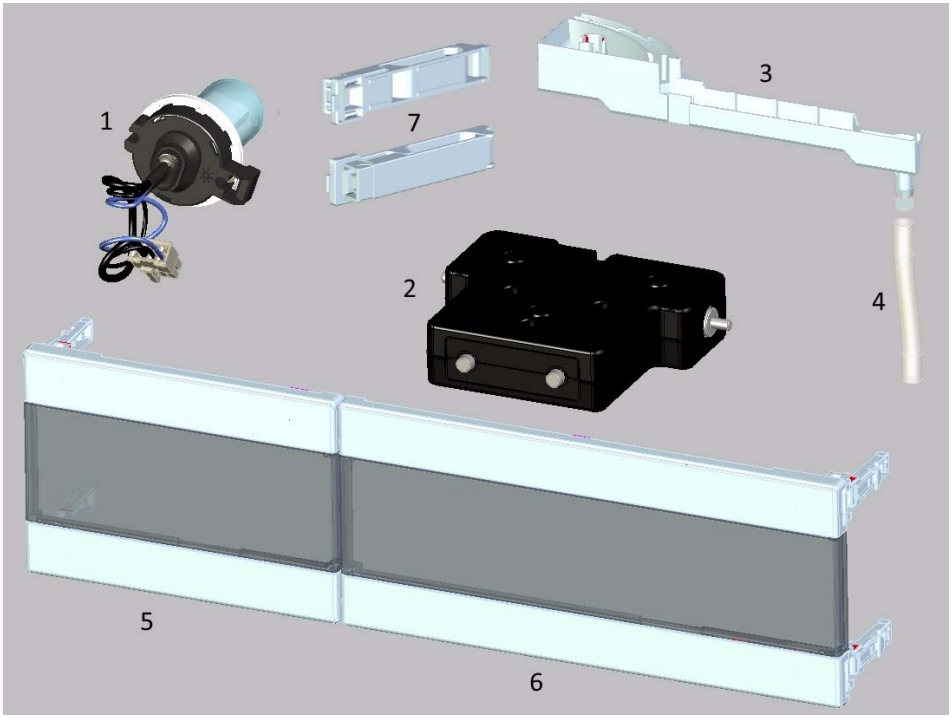



**Figure 49** Overview of maintenance parts

| 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) |
| OR | 2 | G4212-60007 | Max-Light Cartridge Cell (60 mm, V(σ) 4.0 µL) |
| OR | 2 | G4212-60011 | Max-Light Cartridge Test Cell |
| OR | 2 | G4212-60032 | HDR Max-Light Cartridge Cell (3.7 mm, V(σ) 0.4 µL) |
| OR | 2 | G4212-60038 | ULD Max-Light Cartridge Cell (10 mm, V(σ) 0.6 µL) |
| | 3 | 5043-0856 | Leak Adapter |
| | 4 | 5063-6527 | Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste) for Waste and Leak Adapter (ca. 85 mm required) |
| | | 5062-8535 | Waste accessory kit (Flow Cell to waste) |
| | 5 | 5067-5737 | Door left |
| | 6 | 5067-5736 | Door right |
| | 7 | 5043-1013 | Tubing Clip |

For cables, see "Cable Overview" on page 178.

# Accessory Kit

| G7117-68755 Accessory Kit | p/n | Description |
|---|---|---|
| | 5062-8535 | Waste accessory kit |
| | 5063-6527 | Tubing assembly, i.d. 6 mm, o.d. 9 mm, 1.2 m (to waste)<br>see item 4 in Figure 49 on page 174 |
| | 5181-1516 | CAN cable, Agilent module to module, 0.5 m |
| | 5500-1155 | Tube Connector, 90 degree, ID 6.4 |
| | 5043-1013 | Tubing Clip<br>see item 7 in Figure 49 on page 174 |

# 11
# Identifying Cables



This chapter provides information on cables used with the Agilent 1200 Infinity Series modules.

# Cable Overview

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

### Analog cables

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

### Remote cables

| p/n | Description |
|---|---|
| 5188-8029 | ERI<br>to general purpose |
| 5188-8044 | Remote Cable ERI – ERI |
| 5188-8045 | Remote Cable APG – ERI |
| 5061-3378 | Remote Cable<br>to 35900 A/D converter |
| 01046-60201 | 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) |

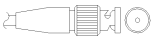
### RS-232 cables (not for FUSION board)

| p/n | Description |
|---|---|
| G1530-60600 | RS-232 cable, 2 m |
| RS232-61601 | RS-232 cable, 2.5 m<br>Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It'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 |

### USB cables

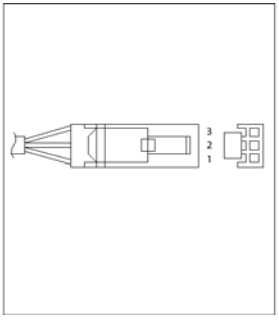
| p/n | Description |
|---|---|
| 5188-8050 | USB A M-USB Mini B 3 m (PC-Module) |
| 5188-8049 | USB A F-USB Mini B M OTG (Module to Flash Drive) |

# Analog Cables

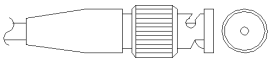


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

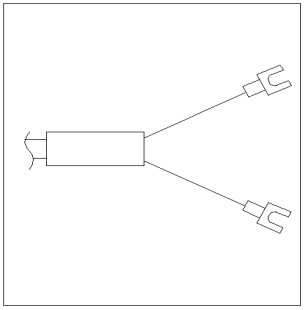
## Agilent Module to 35900 A/D converters

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

## Agilent Module to BNC Connector

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

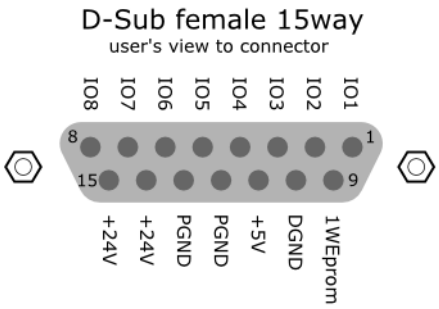
## Agilent Module to General Purpose

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

# Remote Cables

## ERI (Enhanced Remote Interface)

5188-8029 ERI to general purpose

| p/n 5188-8029 | pin | Enhanced Remote | Classic Remote |
|---|---|---|---|
|  | 1 | IO1 | START REQUEST |
| | 2 | IO2 | STOP |
| | 3 | IO3 | READY |
| | 4 | IO4 | POWER ON |
| | 5 | IO5 | NOT USED |
| | 6 | IO6 | SHUT DOWN |
| | 7 | IO7 | START |
| | 8 | IO8 | PREPARE |
| | 9 | 1wire DATA | |
| | 10 | DGND | |
| | 11 | +5V ERI out | |
| | 12 | PGND | |
| | 13 | PGND | |
| | 14 | +24V ERI out | |
| | 15 | +24V ERI out | |

5188-8044 ERI to ERI (Connector D_Subminiature 15 pin)

**Table 19** 5188-8044 ERI to ERI

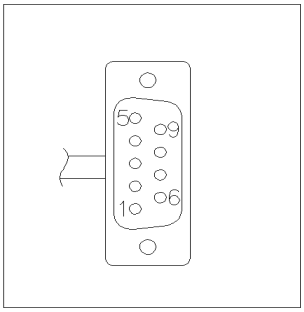
| p/n 5188-8044 | Pin (ERI) | Signal | Pin (ERI) |
|---|---|---|---|
|  | 10 | GND | 10 |
| | 1 | Start Request | 1 |
| | 2 | Stop | 2 |
| | 3 | Ready | 3 |
| | 5 | Power on | 5 |
| | 4 | Future | 4 |
| | 6 | Shut Down | 6 |
| | 7 | Start | 7 |
| | 8 | Prepare | 8 |
| | Ground Connection | Cable Shielding | NC |

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

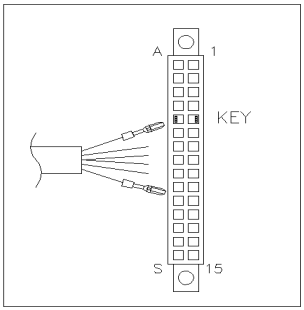
| p/n 5188-8045 | Pin (ERI) | Signal | Pin (APG) |
|---|---|---|---|
|  | 10 | GND | 1 |
| | 1 | Start Request | 9 |
| | 2 | Stop | 8 |
| | 3 | Ready | 7 |
| | 5 | Power on | 6 |
| | 4 | Future | 5 |
| | 6 | Shut Down | 4 |
| | 7 | Start | 3 |
| | 8 | Prepare | 2 |
| | Ground Connection | Cable Shielding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


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.

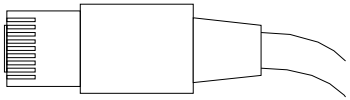
## Agilent Module to Agilent 35900 A/D Converters

| 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 |

# 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<br>Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It'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 |

# USB Cables

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

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

# 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, USB 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, USB 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 the following tools (latest version should be used):

- Agilent Lab Advisor software with files on the hard disk (*)
- Firmware Update Tool with local files on the hard disk (*)
- Instant Pilot (G4208A) with files on a USB Flash Disk

(*) Required tools, firmware and documentation are available from the Agilent web:
http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?whid=69761

The file naming conventions are:

PPPP_RVVV_XXX.dlb, where

PPPP is the product number, for example, 1315B for the G1315B DAD,

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

VVV is the revision number, for example 650 is revision 6.50,

XXX is the build number of the firmware.

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

**NOTE**

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

Main and resident firmware must be from the same set.

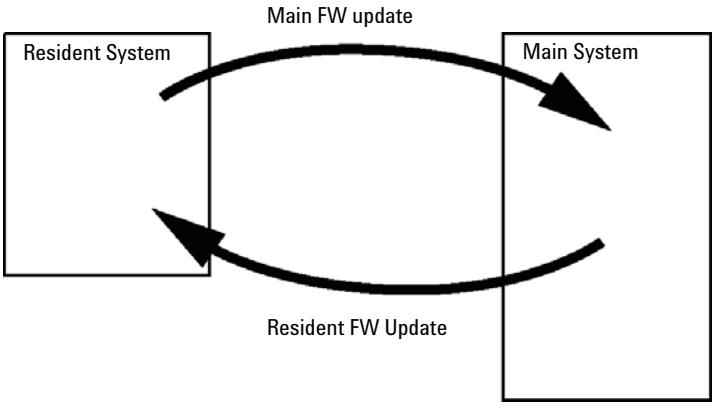



**Figure 50** Firmware Update Mechanism

**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 ERI/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 shutdown, prepare, and so on.
- With the appropriate software, the LAN connector may be used to control the module from a computer through a LAN connection. This connector is activated and can be configured with the configuration switch.
- With the appropriate software, the USB connector may be used to control the module from a computer through a USB connection.
- The power input socket accepts a line voltage of 100 – 240 VAC ± 10 % with a line frequency of 50 or 60 Hz. Maximum power consumption varies by module. There is no voltage selector on your module because the power supply has wide-ranging capability. There are no externally accessible fuses because automatic electronic fuses are implemented in the power supply.

**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

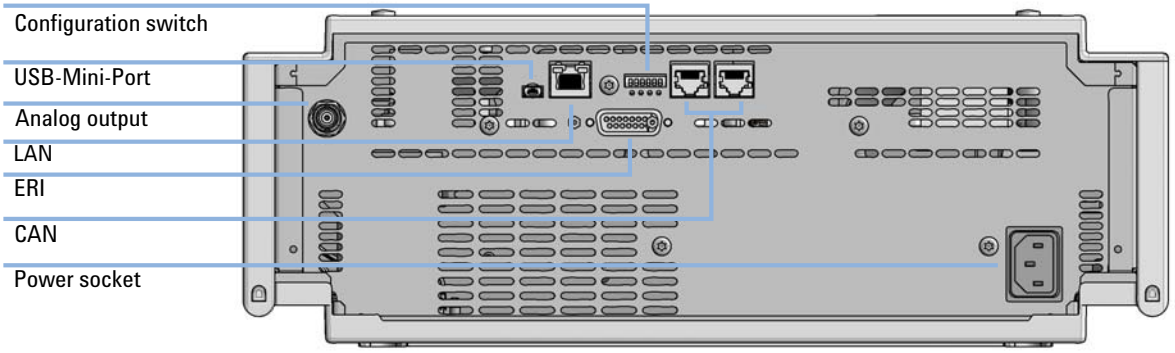



**Figure 51** Rear view of detector (example shows a G7114A/B VWD) – electrical connections and label

## 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<br>• DE = Germany<br>• JP = Japan<br>• 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<br>• DE = Germany<br>• JP = Japan<br>• 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 II modules provide the following interfaces:

**Table 20** Agilent 1200 Infinity II Series Interfaces

| Module | CAN | USB | LAN (on-board) | RS-232 | Analog | APG (A) / ERI (E) | Special |
|---|---|---|---|---|---|---|---|
| **Pumps** | | | | | | | |
| G7104A Flexible Pump | 2 | No | Yes | Yes | 1 | A | |
| G7120A High Speed Pump | 2 | No | Yes | Yes | 1 | A | |
| **Samplers** | | | | | | | |
| G7129A/B ALS | 2 | Yes | Yes | No | No | E | |
| G7167A/B Multisampler | 2 | Yes | Yes | No | No | E | |
| **Detectors** | | | | | | | |
| G7114A/B VWD | 2 | Yes | Yes | No | 1 | E | |
| G7117A/B DAD | 2 | Yes | Yes | No | 1 | E | |
| G7115A/B DAD | 2 | Yes | Yes | No | 1 | E | |
| **Others** | | | | | | | |
| G7116B MCT | 2 | No | No | No | No | No | Requires a HOST module via CAN |

**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
- USB (Universal Series Bus) 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.

### USB

The USB interface replaces the RS-232 Serial interface in new FUSION generation modules. For details on USB refer to "USB (Universal Serial Bus)" on page 202.

### 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.

### Remote (ERI)

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

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

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

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

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

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

**Table 21** ERI signal distribution

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

### Special Interfaces

There is no special interface for this module.

## ERI (Enhanced Remote Interface)

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

## ERI Description

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

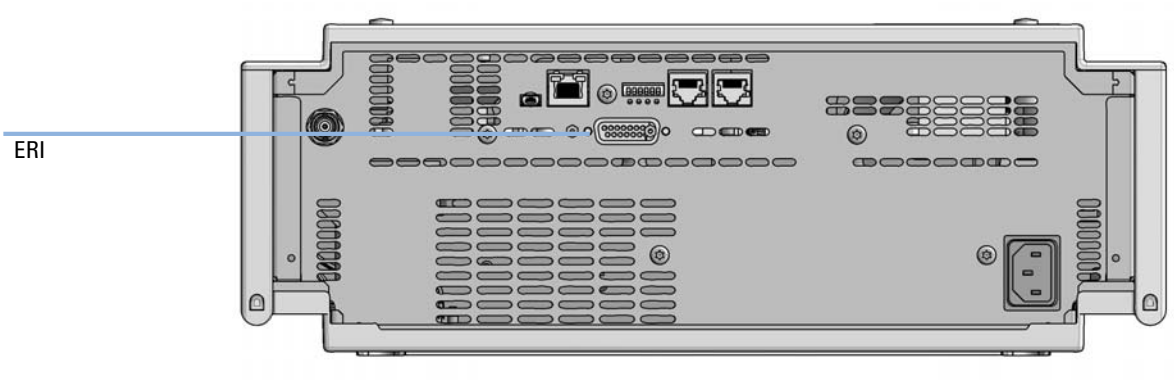
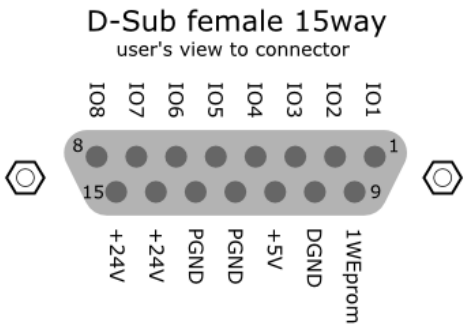



**Figure 52** Location of the ERI interface (example shows a G7114A/B VWD)




| Pin | Enhanced Remote |
|---|---|
| 1 | IO 1 (START REQUEST) |
| 2 | IO 2 (STOP) |
| 3 | IO 3 (READY) |
| 4 | IO 4 (POWER ON) |
| 5 | IO 5 (NOT USED) |
| 6 | IO 6 (SHUT DOWN) |
| 7 | IO 7 (START) |
| 8 | IO 8 (PREPARE) |
| 9 | 1 wire DATA |
| 10 | DGND |
| 11 | +5 V ERI out |
| 12 | PGND |
| 13 | PGND |
| 14 | +24 V ERI out |
| 15 | +24 V ERI out |

## IO (Input/Output) Lines

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

## 1-Wire Data (Future Use)

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

### 5V Distribution (Future Use)

- Available directly after turn on oft the hosting module (assures that certain base functionality of the device can be detected by firmware).
- For digital circuits or similar.
- Provided 500 mA maximum.
- Short-circuit proof with automatic switch off (by firmware).

### 24V Distribution (Future Use)

- Available by firmware command (defined turn on/off).
- For devices that need higher power
  - Class 0: 0.5 A maximum (12 W)
  - Class 1: 1.0 A maximum (24 W)
  - Class 2: 2.0 A maximum (48 W)
- Class depends on hosting module's internal power overhead.
- If a connected device requires more power the firmware detects this (overcurrent detection) and provides the information to the user interface.
- Fuse used for safety protection (on board).
- Short circuit will be detected through hardware.

## USB (Universal Serial Bus)

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

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

# Setting the 6-bit Configuration Switch

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

All modules with FUSION electronics:

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

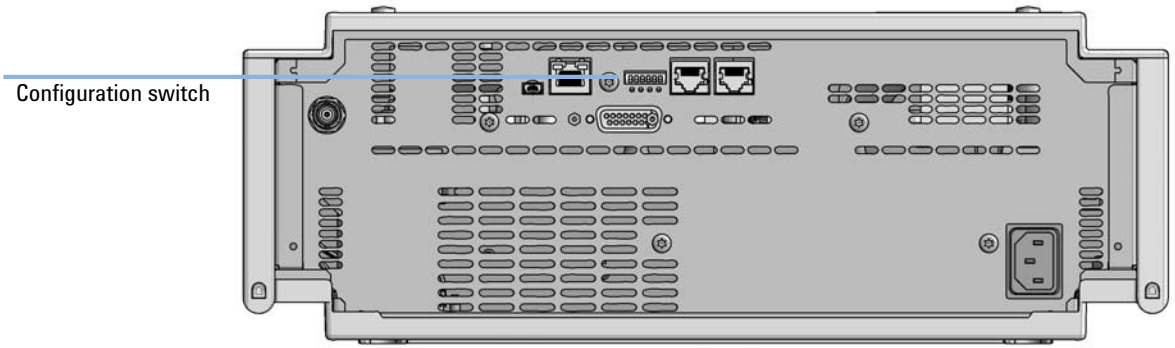



**Figure 53** Location of Configuration switch (example shows a G7114A/B VWD)

**Table 22** 6-bit Configuration Switch

| | Mode | Function/Setting | | | | |
|---|---|---|---|---|---|---|
| | **Switch 1** | **Switch 2** | **Switch 3** | **Switch 4** | **Switch 5** | **Switch 6** |
| **COM**[1] | **0** | n.a.[2] | n.a. | LAN Init Mode | | n.a. |
| Use Default IP Address[3] | | 0 | 0 | 0 | 0 | 0 |
| Use Stored IP Address | | 0 | 0 | 0 | 1 | 0 |
| Use DHCP to request IP Address[4] | | 0 | 0 | 1 | 0 | 0 |
| **Test** | **1** | **System** | **n.a.** | **n.a.** | **n.a.** | **ColdStart** |
| Boot Main System / Keep Data | | 0 | 0 | 0 | 0 | 0 |
| Boot Resident System / Keep Data | | 1 | 0 | 0 | 0 | 0 |
| Boot Main System / Revert to Default Data | | 0 | 0 | 0 | 0 | 1 |
| Boot Resident System / Revert to Default Data | | 1 | 0 | 0 | 0 | 1 |

1 When selecting mode COM, settings are stored to non-volatile memory. When selecting mode TEST, COM settings are taken from non-volatile memory.

2 not assigned - Always keep these switches on position '0' (off)

3 Default IP Address is 192.168.254.11

4 Host Name will be the MAC address.

# Special Settings

## Boot-Resident/Main

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

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

## Forced Cold Start

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

- Boot Main System / Revert to Default Data

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

- Boot Resident System / Revert to Default Data

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

**CAUTION**

Loss of data

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

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

If you use the following switch settings and power the instrument up again, it will start as described above.

**Table 23** Boot Resident / Forced Coldstart

| | SW1 | SW2 | SW3 | SW4 | SW5 | SW6 | Init Mode |
|---|---|---|---|---|---|---|---|
|  | 1 | 0 | 0 | 0 | 0 | 0 | Boot Main System / Keep Data |
| | 1 | 1 | 0 | 0 | 0 | 0 | Boot Resident System / Keep Data |
| | 1 | 0 | 0 | 0 | 0 | 1 | Boot Main System / Revert to Default Data |
| | 1 | 1 | 0 | 0 | 0 | 1 | Boot Resident System / Revert to Default Data |
| | Note: The setting '0' (down) is essential. | | | | | | |

# 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.

| Lamp Type | Counter Reset | Comment |
|---|---|---|
| lamp with RFID tag | NO | |
| lamp without RFID tag | YES | via Lab Advisor or Instant Pilot |

The detector provides the following EMF counters:

- Deuterium Lamp On-Time
- Number of UV lamp ignitions

## 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.

**NOTE** This function is only available via Agilent Lab Advisor or Instant Pilot.

# 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.

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

1 Note the MAC (Media Access Control) address for further reference. The MAC or hardware address of the LAN interfaces is a world wide unique identifier. No other network device will have the same hardware address. The MAC address can be found on a label at the rear of the module underneath the configuration switch (see Figure 55 on page 212).


**Figure 54** MAC-Label

2 Connect the instrument's LAN interface (see Figure 55 on page 212) to

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

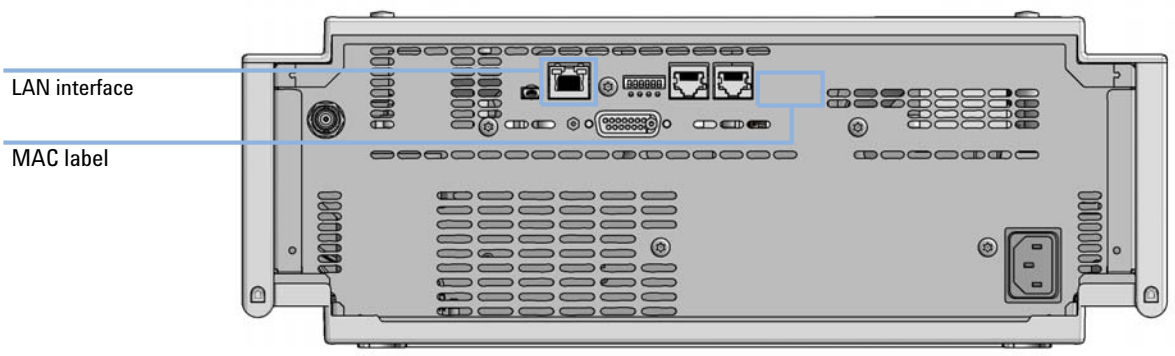



**Figure 55** Location of LAN interfaces and MAC label

# 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 220
- by manually setting the parameters using Telnet

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 25 on page 215.

# Configuration Switches

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

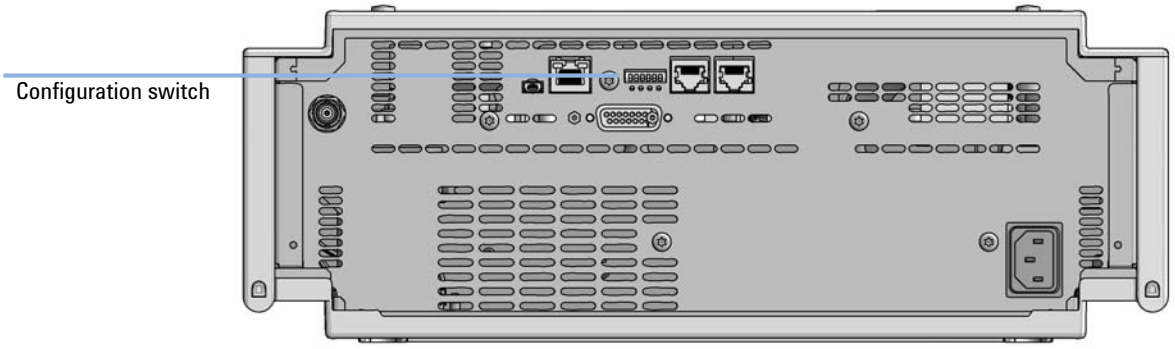



**Figure 56** Location of Configuration switch (example shows a G7114A/B VWD)

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 24** Factory Default Settings

| | |
|---|---|
| Initialization ('Init') Mode | Bootp, all switches down. For details see "Initialization Mode Selection" on page 215 |

# Initialization Mode Selection

The following initialization (init) modes are selectable:

**Table 25** Initialization Mode Switches

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

Default IP address for LAN is 192.168.254.11.

DHCP address is the module's LAN MAC address.

## 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.

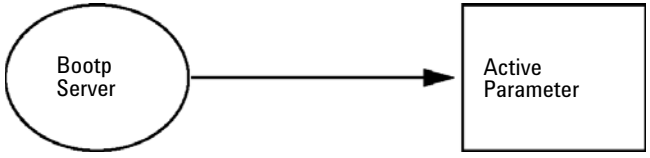



**Figure 57** **Bootp** (Principle)

## 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.

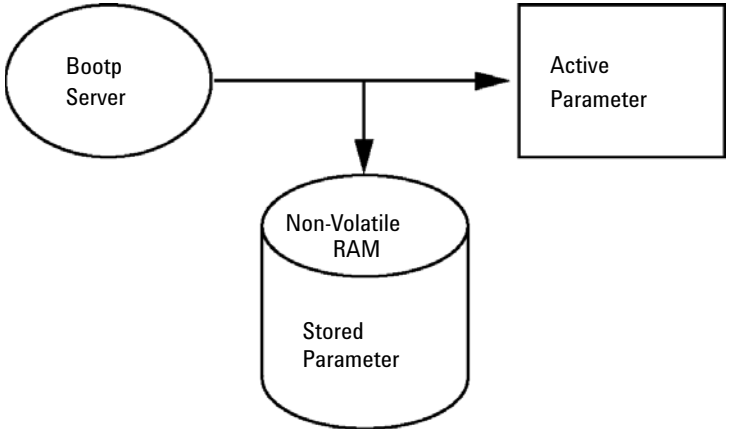



**Figure 58** Bootp & Store (Principle)

**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.

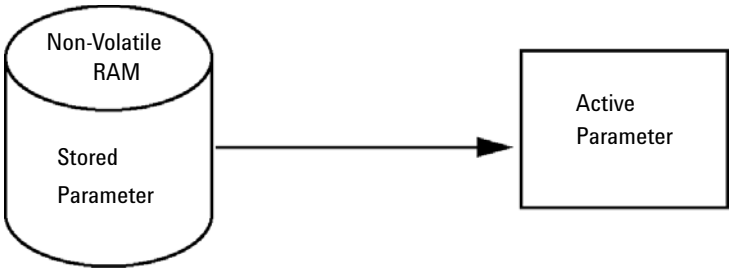



**Figure 59** Using Stored (Principle)

## 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 26 on page 218.

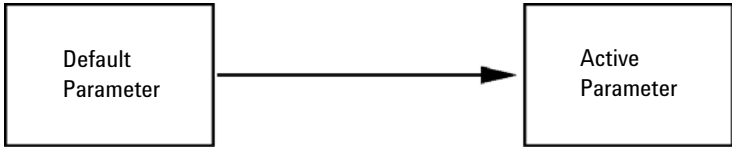



**Figure 60** Using Default (Principle)

**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 26** 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).

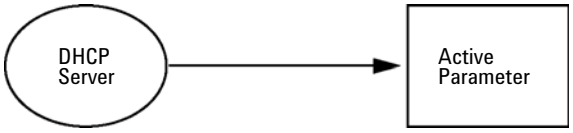



**Figure 61** DHCP (Principle)

**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.

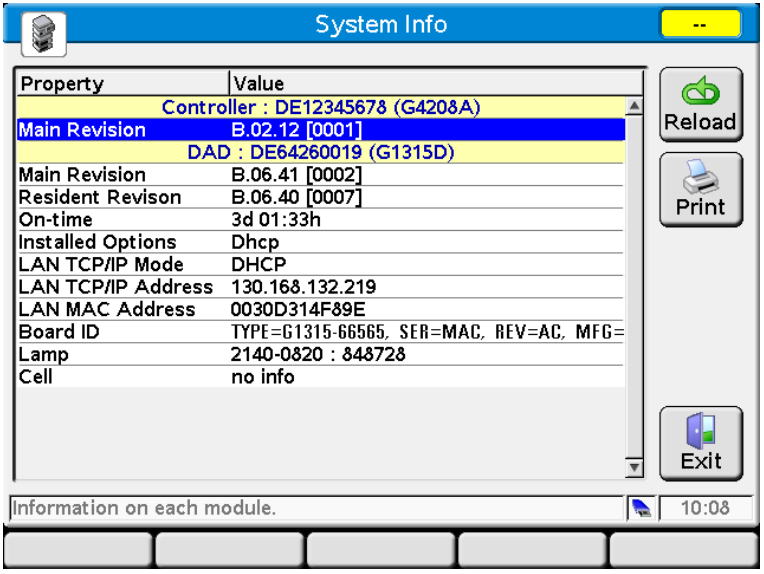



**Figure 62** LAN Setting on Instant Pilot

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

**Table 27** 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 28** 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, Lab Advisor, Firmware Update Tool) and use MAC address as host name, e.g. *0030d3177321*.

The LC system should become visible in the control software (see Note in section "General Information (DHCP)" on page 219).

# 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.

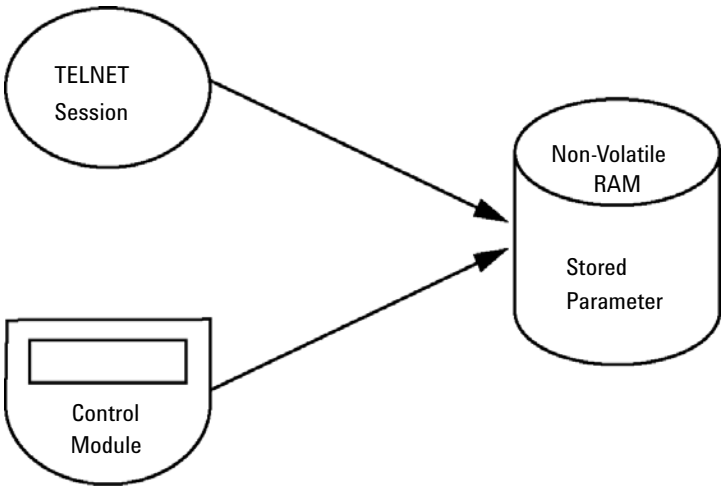



**Figure 63** Manual Configuration (Principle)

## 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 64** 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 Switches" on page 214).

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

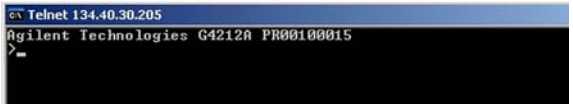



**Figure 65** A connection to the module is made

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

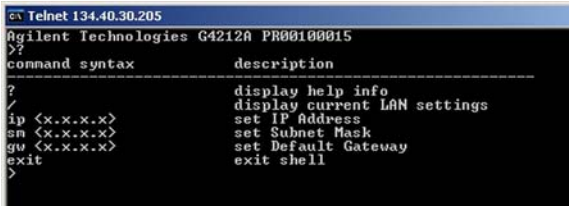



**Figure 66** Telnet Commands

**Table 29** 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.

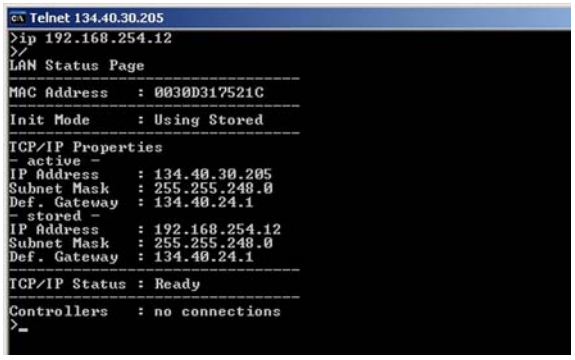
5 Use the "/" and press Enter to list the current settings.


**Figure 67** Telnet - Current settings in "Using Stored" mode

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

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

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




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 68** Telnet - Change IP settings

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

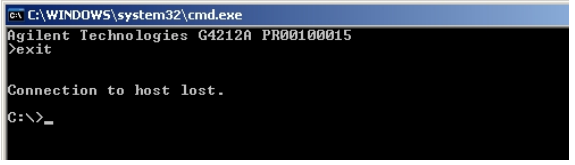



**Figure 69** Closing the Telnet Session

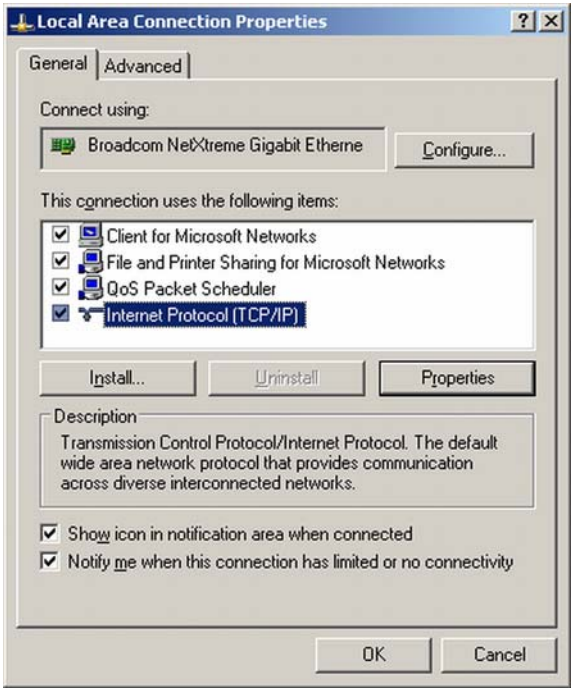
**NOTE** If the Initialization Mode Switch is changed now to "Using Stored" mode, the instrument will take the stored settings when the module is re-booted. In the example above it would be 192.168.254.12.

# PC and Agilent ChemStation Setup

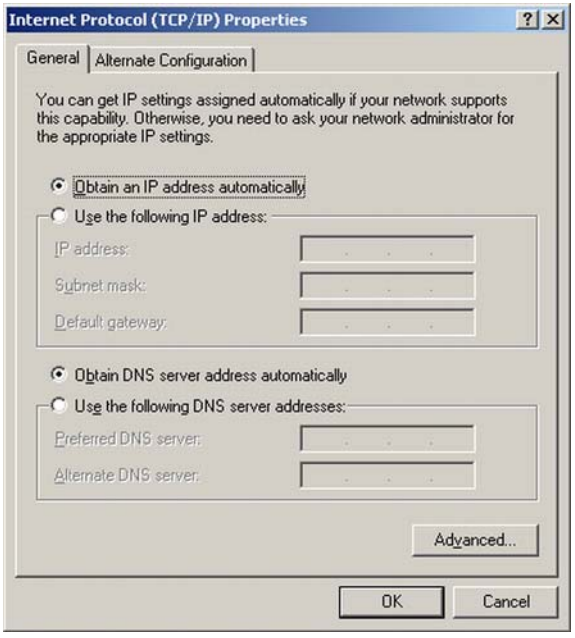
## PC Setup for Local Configuration

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 26 on page 218).

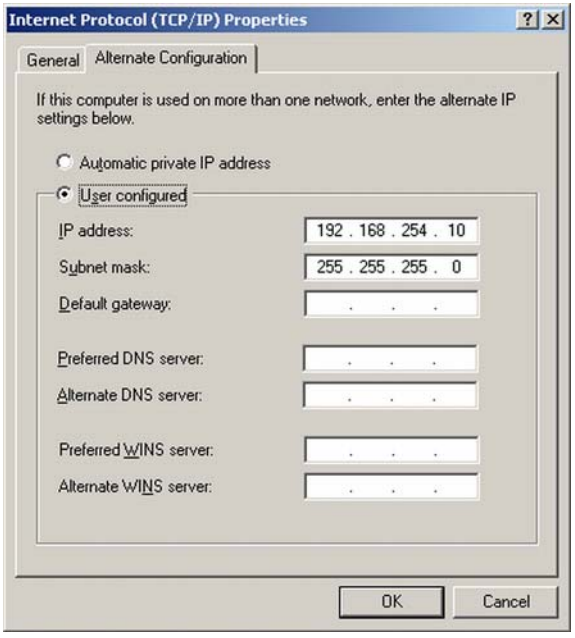
1 Open the Local Area Connection Properties and select **Internet Protocol (TCP/IP)**. Then click on **Properties**.



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.



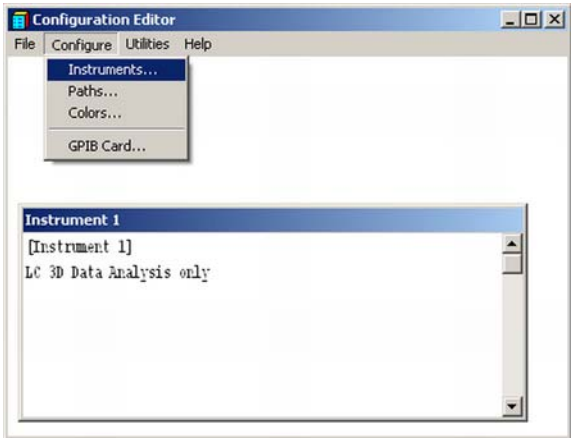

4 Click on **OK** to save the configuration.

## 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.

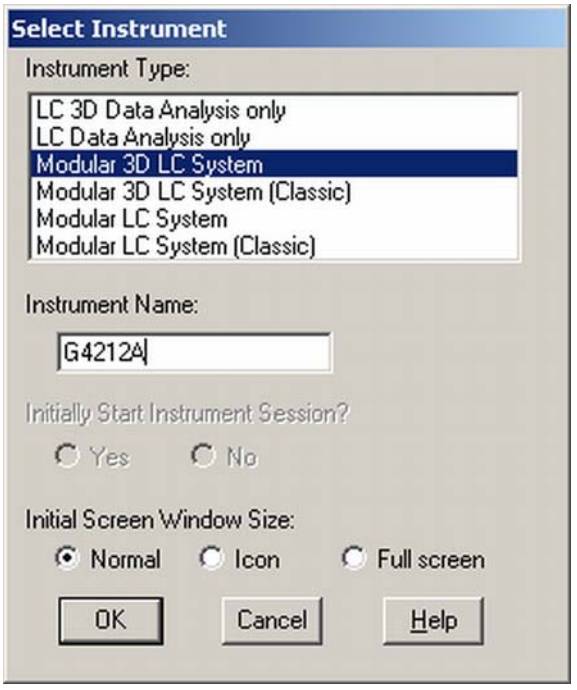



2 Select from the menu **Configure - Instruments**.

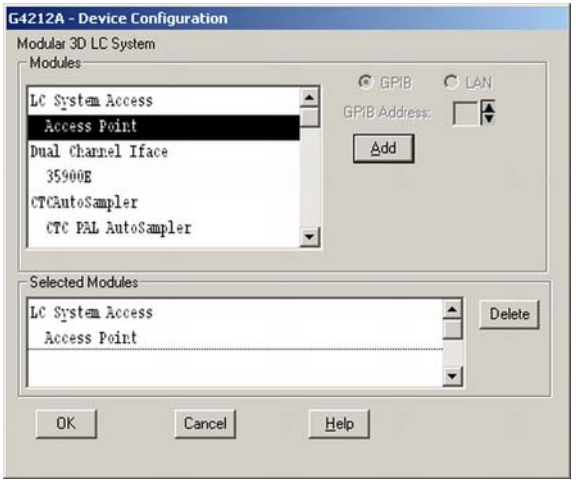
3 Select **Modular 3D LC System**.

4 Give the Instrument a name.

5 Click on **OK**.




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

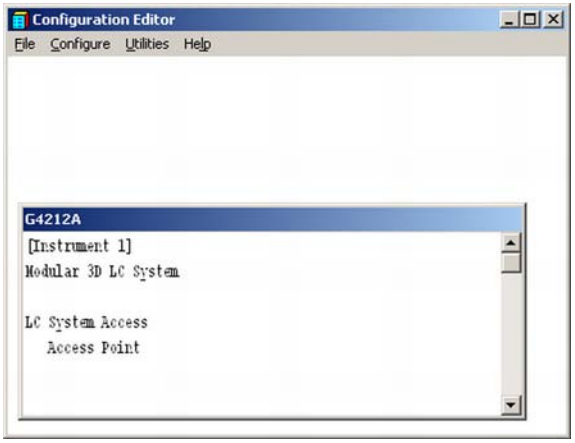



7 Click on **OK**.

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**.

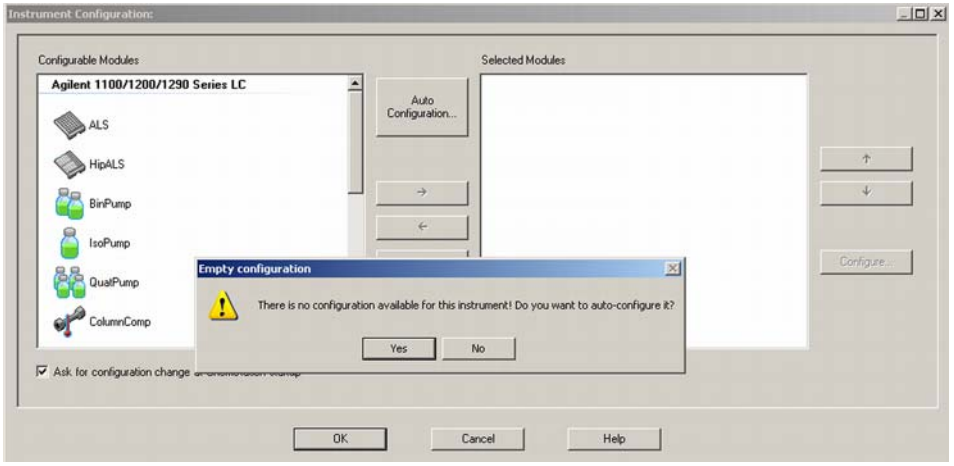



10 Exit the Configuration Editor.

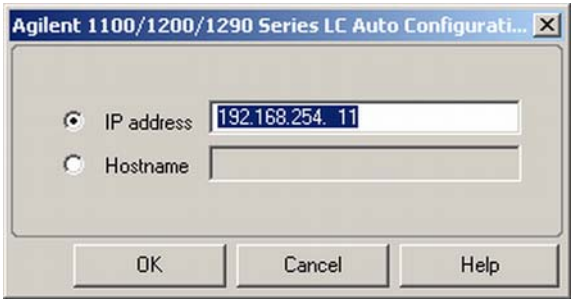
11 Start the Agilent ChemStation.

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**.



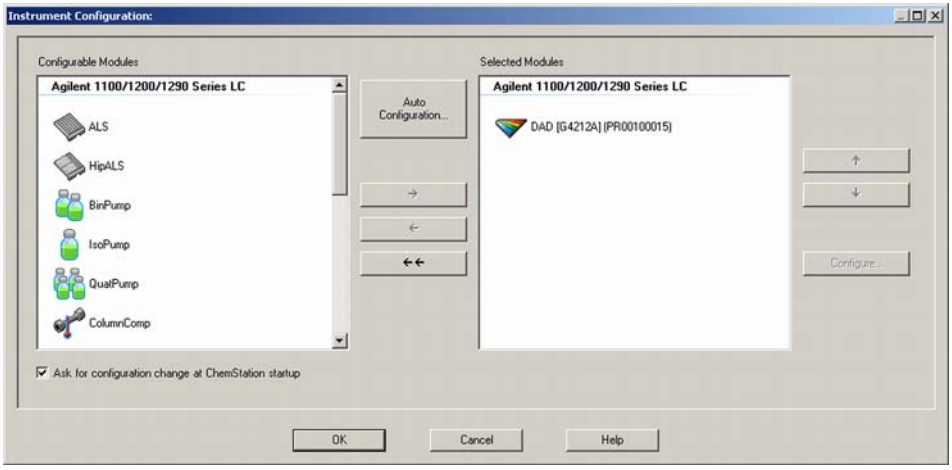
13 Enter the IP address or the Hostname of the module with the LAN-access.



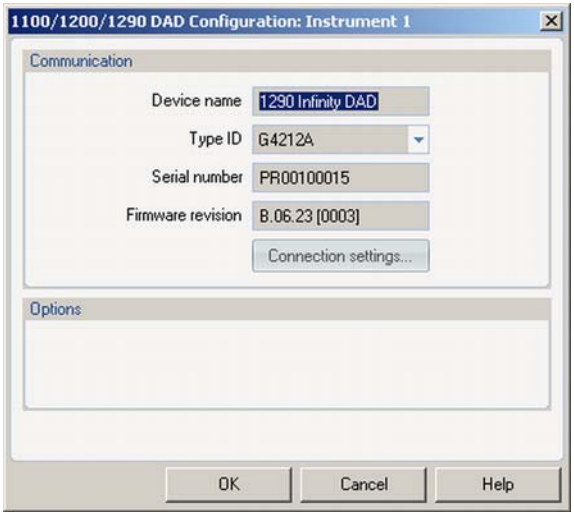

14 Click on **OK**.

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).

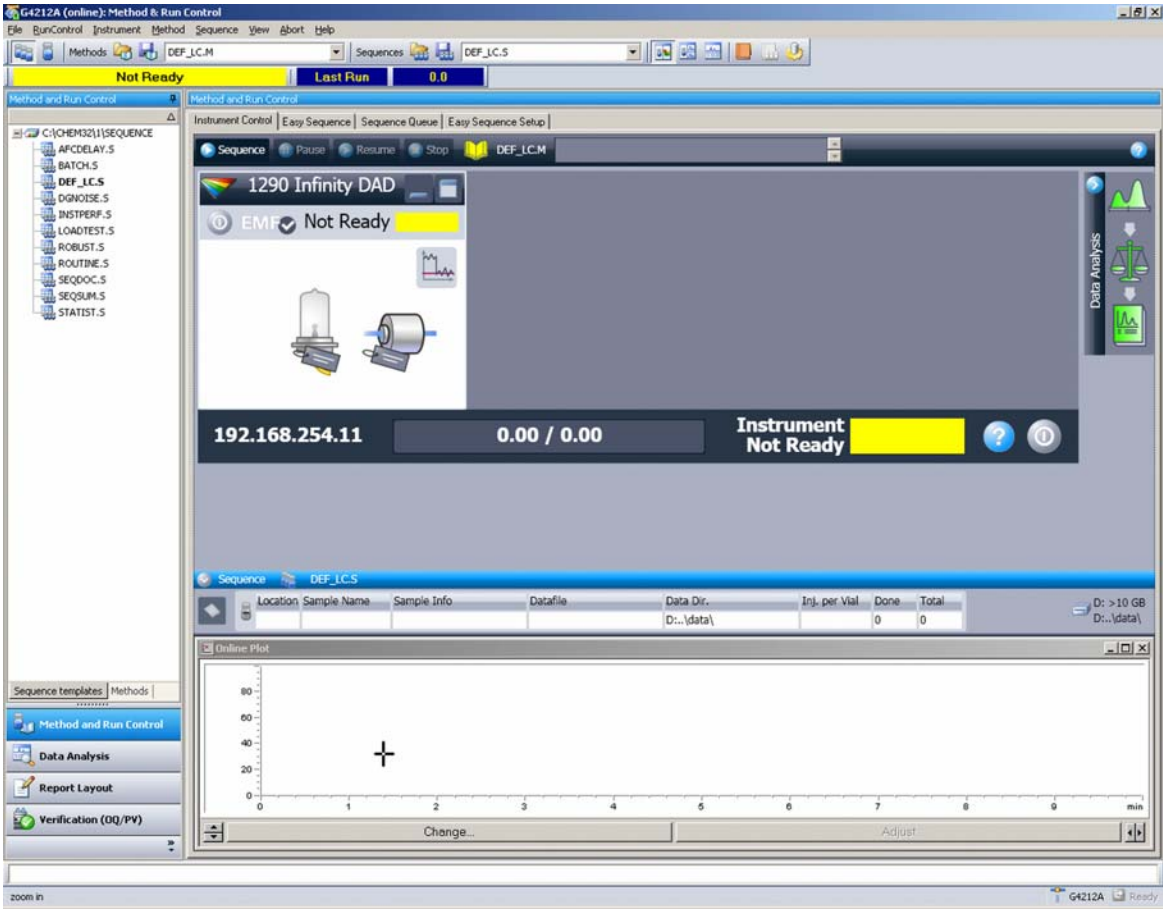



**Figure 70** Screen After Successful Load of ChemStation

# 14
# Appendix



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

# General Safety Information

## General Safety Information

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

**WARNING**

**Ensure the proper usage of the equipment.**

**The protection provided by the equipment may be impaired.**

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

## Safety Standards

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

## General

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

## Before Applying Power

**WARNING**

**Wrong voltage range, frequency or cabling**

**Personal injury or damage to the instrument**

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

**NOTE**

Note the instrument's external markings described under "Safety Symbols" on page 240.

## Ground the Instrument

**WARNING**

**Missing electrical ground**

**Electrical shock**

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

## Do Not Operate in an Explosive Atmosphere

**WARNING**

**Presence of flammable gases or fumes**

**Explosion hazard**

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

## Do Not Remove the Instrument Cover

**WARNING**

**Instrument covers removed**

**Electrical shock**

➔ Do Not Remove the Instrument Cover

➔ Only Agilent authorized personnel are allowed to remove instrument covers. Always disconnect the power cables and any external circuits before removing the instrument cover.

## Do Not Modify the Instrument

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

## In Case of Damage

**WARNING**

**Damage to the module**

**Personal injury (for example electrical shock, intoxication)**

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

## Solvents

**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.
- ➔ Never exceed the maximal permissible volume of solvents (6 L) in the solvent cabinet.
- ➔ Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.
- ➔ Arrange the bottles as specified in the usage guideline for the solvent cabinet.
- ➔ A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet.
- ➔ Ground the waste container.
- ➔ The residual free volume in the appropriate waste container must be large enough to collect the waste liquid.
- ➔ Check the filling level of the waste container regularly.
- ➔ To achieve maximal safety, check the correct installation regularly.
- ➔ Do not use solvents with an auto-ignition temperature below 200 °C (392 °F).

# Safety Symbols

**Table 30** Symbols

| | |
|---|---|
|  | 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. |
|  | The apparatus is marked with this symbol when hot surfaces are available and the user should not touch it when heated up. |
|  | Cooling unit is designed as vapor-compression refrigeration system.<br>Contains fluorinated greenhouse gas (refrigerant) according to the Kyoto protocol.<br>For specifications of refrigerant, charge capacity, carbon dioxide equivalent (CDE), and global warming potential (GWP) see instrument label. |
|  | Confirms that a manufactured product complies with all applicable European Community directives. The European Declaration of Conformity is available at:<br>http://regulations.corporate.agilent.com/DoC/search.htm |
|  | Manufacturing date. |
|  | Power symbol indicates On/Off.<br>The apparatus is not completely disconnected from the mains supply when the power switch is in the Off position |

**Table 30** Symbols

| | |
|---|---|
|  | Pacemaker<br>Magnets could affect the functioning of pacemakers and implanted heart defibrillators.<br>A pacemaker could switch into test mode and cause illness. A heart defibrillator may stop working. If you wear these devices keep at least 55 mm distance to magnets. Warn others who wear these devices from getting too close to magnets. |
|  | Magnetic field<br>Magnets produce a far-reaching, strong magnetic field. They could damage TVs and laptops, computer hard drives, credit and ATM cards, data storage media, mechanical watches, hearing aids and speakers. Keep magnets at least 25 mm away from devices and objects that could be damaged by strong magnetic fields. |
|  | Indicates a pinching or crushing hazard |
|  | Indicates a piercing or cutting hazard. |

**WARNING**

**A WARNING**

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

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

**CAUTION**

A CAUTION

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

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

## Refrigerant

The refrigerant HFKW-134a is used only in the Agilent Infinity II Sample Cooler.

**Table 31** Physical properties of refrigerant HFKW-134a

| | |
|---|---|
| Molecular weight | 102 |
| Critical temperature | 101.1 °C |
| Critical pressure | 40.6 bar |
| Boiling point | -26.5 °C |

**WARNING**

**Refrigerant**

**Refrigerant HFKW-134a is known as a safe refrigerant, however accidents can occur if it is handled incorrectly. For this reason, the following instructions must be observed:**

- ➔ Avoid contact with liquid refrigerant HFKW-134a.At atmospheric pressure HFKW-134a evaporates at approximately -26 °C and causes frost bite.
- ➔ After skin contact, rinse the affected area with water.
- ➔ After eye contact, rinse the eye(s) with plenty of water for at least 15 minutes and consult a doctor.
- ➔ HFKW-134a must not be allowed to escape in enclosed areas. Although HFKW-134a is not toxic, there is a danger of suffocation as gaseous refrigerant is heavier than air.
- ➔ Please observe the following first aid instructions. After inhalation, move the affected person to fresh air, keep him warm and allow him to rest. If necessary, he should be supplied with oxygen. If he has stopped breathing or is breathing erratically, he should be given artificial respiration. In the case of cardiac arrest, carry out heart massage. Send for a doctor immediately.
- ➔ Moreover, it must be noted that HFKW-134a must always be extracted from the system and collected. It must never be discharged into the atmosphere on environmental grounds (greenhouse effect).

**CAUTION**

General hazards and improper disposal

Improper disposal of the media and components used pollutes the environment.

- ➔ The breakdown of the sample cooler unit must be carried out by specialist refrigeration company.
- ➔ All media must be disposed of in accordance with national and local regulations.
- ➔ Please contact your local Agilent Service Center in regard to safe environmental disposal of the appliance.

# 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 of 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-isopropyl ether) 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

# Index

## T



## U



## V



## W

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# In This Book

This manual contains technical reference information about the Agilent 1290 Infinity II Diode Array Detector FS (G7117A) and the Agilent 1290 Infinity II Diode Array Detector (G7117B).

The manual describes the following:

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



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