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Agilent 1100 Series Fluorescence Detector



Reference Manual

A

Notices

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1 Installing the Fluorescence Detector

How to install the fluorescence detector

2 First Steps with the Fluorescence Detector

How to start with the detector

3 Optimizing the Fluorescence Detector

Detection with the Agilent 1100 series fluorescence detector, either fluorescence or phosphorescence, can give you very sensitive and selective results if you understand what you are doing and why. This chapter explains in detail how to optimize detection.

4 Troubleshooting and Test Functions

This chapter describes the detector's built in troubleshooting and test functions.

5 Repairing the Fluorescence Detector

Instructions on how to repair the detector

6 Identifying Parts and Materials

Detailed illustrations and listings for parts and materials identification for the detector

7 Introduction to the Fluorescence Detector

An introduction to the detector

8 Therory of Operation

Instrument overview, theory of operation, external communication and internal connectors

9 Introduction to the Control Module

This chapter is intended to introduce an operator to the screens available for operation of the Agilent 1100 diode array detector with the Agilent 1100 control module.

Please use the manual of Control module for further detailed reference.

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Site Requirements

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

Power Consideration

The detector power supply has wide ranging capabilities and accepts any line voltage in the range mentioned in Table 1 on page 16. Consequently, there is no voltage selector in the rear of the detector. There are also no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

WARNING **To disconnect the detector from line, unplug the power cord. The power supply still uses some power, even if the power switch on the front panel is turned off.**

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

WARNING

Make sure to have easy access to the power cable of the instrument, in order to disconnect the instrument from line.

CAUTION

Power Cords

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

WARNING **Never operate your instrumentation from a power outlet that has no ground connection. Never use a power cord other than the Agilent Technologies power cord designed for your region.**

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

Bench Space

The detector dimensions and weight (see Table 1 on page 16) allows you to place the detector 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 should carry a Agilent 1100 Series system, make sure that the bench is designed to bear the weight of all modules.

The detector should be operated in a horizontal position.

Environment

Your detector will work within the specifications at ambient temperatures and relative humidity described in Table 1 on page 16.

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 "Performance Specifications" on page 330) 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 Do not store, ship or use your detector under conditions where temperature fluctuations could cause condensation within the detector. Condensation will damage the system

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

Physical Specifications

Table 1 Physical Specifications

Type	Specification	Comments
Weight	11.5 kg (26 lbs)	
Dimensions (width × depth × height)	345 × 435 × 140 mm (13.5 × 17 × 5.5 inches)	
Line voltage	100 – 120 or 220 – 240 VAC, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz ± 5 %	
Power consumption	180 VA / 70 W / 239 BTU	Maximum
Ambient operating temperature	0 – 40 °C (32 – 104 °F)	
Ambient non-operating temperature	-40 – 70 °C (-4 – 158 °F)	
Humidity	< 95%, at 25 – 40 °C (77 – 104 °F)	Non-condensing
Operating altitude	Up to 2000 m (6500 ft)	
Non-operating altitude	Up to 4600 m (14950 ft)	For storing the detector
Safety standards: IEC, CSA, UL, EN	Installation category II, pollution degree 2	

Unpacking the Detector

Damaged Packaging

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

If there are signs of damage, please do not attempt to install the detector.

CAUTION

Delivery Checklist

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

Table 2 Detector Checklist

Description	Quantity
Detector	1
Power cable	1
CAN cable (Part number 5181-1519)	1
Flow cell	1 (built-in)
Optional flow cell/cuvette	as ordered
Reference Manual	1

Accessory kit (see Table 3 on page 18)	1

Detector Accessory Kit Contents

Table 3 Accessory Kit Contents (Part Number G1321-68705)

Description	Part Number	Quantity
Teflon Tubing flexible i.d. 0.8 mm (flow cell to waste), re-order 5 m	5062-2462	2 m
Corrugated tubing (to waste), re-order 5 m	5062-2463	1.2 m
Fitting male PEEK	0100-1516	2
Capillary column-detector, one side preinstalled 380 mm lg, 0.17 mm i.d. includes:	G1315-87311	1
Ferrule front SST	0100-0043	1
Ferrule back SST	0100-0044	1
Fitting SST	79814-22406	1
Hex key set 1 – 5 mm	8710-0641	1
Screwdriver hexagonal 4 mm, 100 mm long	5965-0027	1
Screwdriver hexagonal 2.5 mm, 100 mm long	5965-0028	1
Needle-Syringe	9301-0407	
Glass-Syringe	9301-1446	
Calibration Sample, Glycogen	5063-6597	
Sample filter, diameter=3 mm, pore size 0.45 µm	5061-3367 (pack of 100)	5
Wrench open end 1/4 – 5/16 inch	8710-0510	1

ESD wrist strap	9300-1408	1

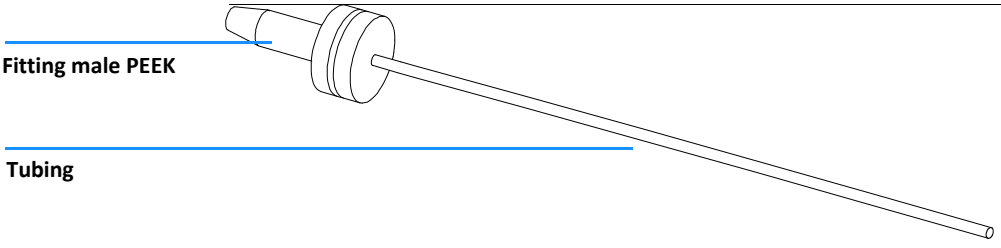


Figure 1 Waste Tubing Parts

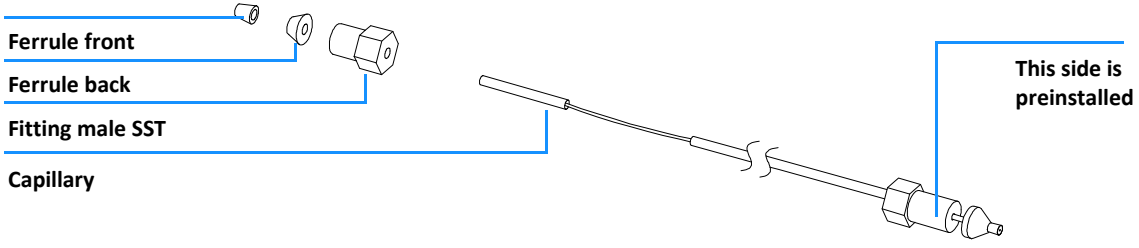


Figure 2 Inlet Capillary (Column-Detector) Parts

Optimizing the Stack Configuration

If your detector is part of a complete Agilent 1100 Series system, you can ensure optimum performance by installing the following configuration. This configuration optimizes the system flow path, ensuring minimum delay volume.

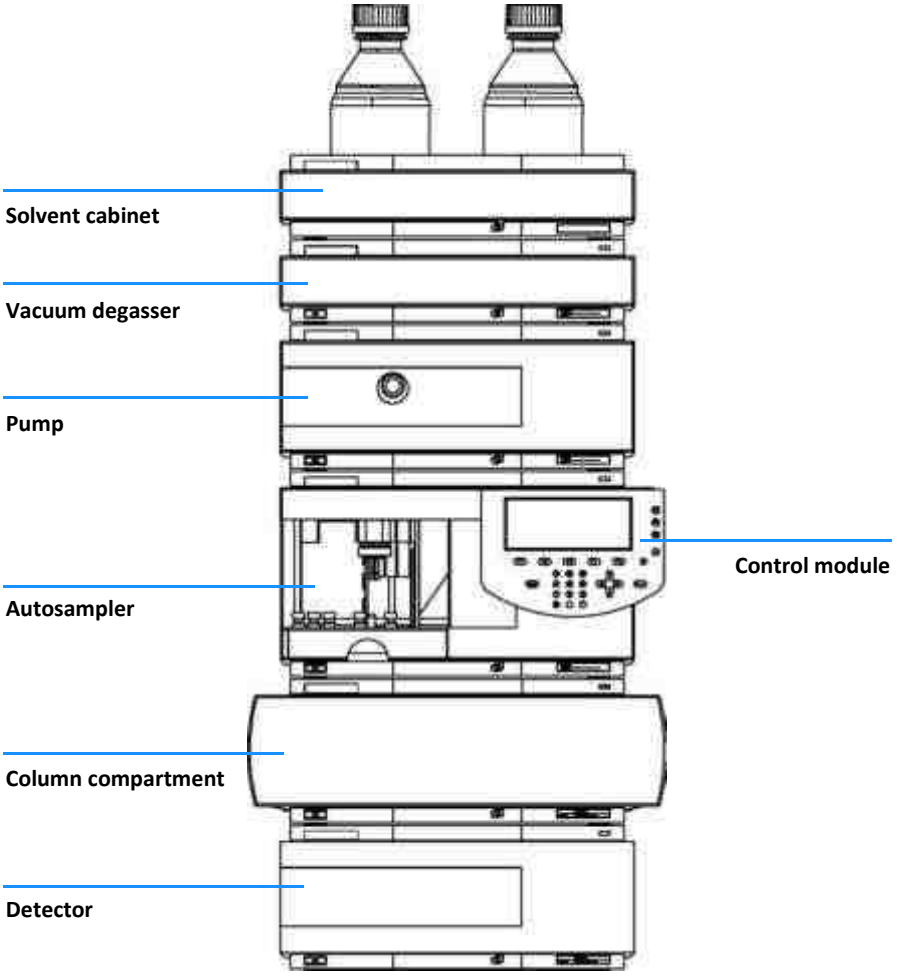


Figure 3 Recommended Stack Configuration (Front View)

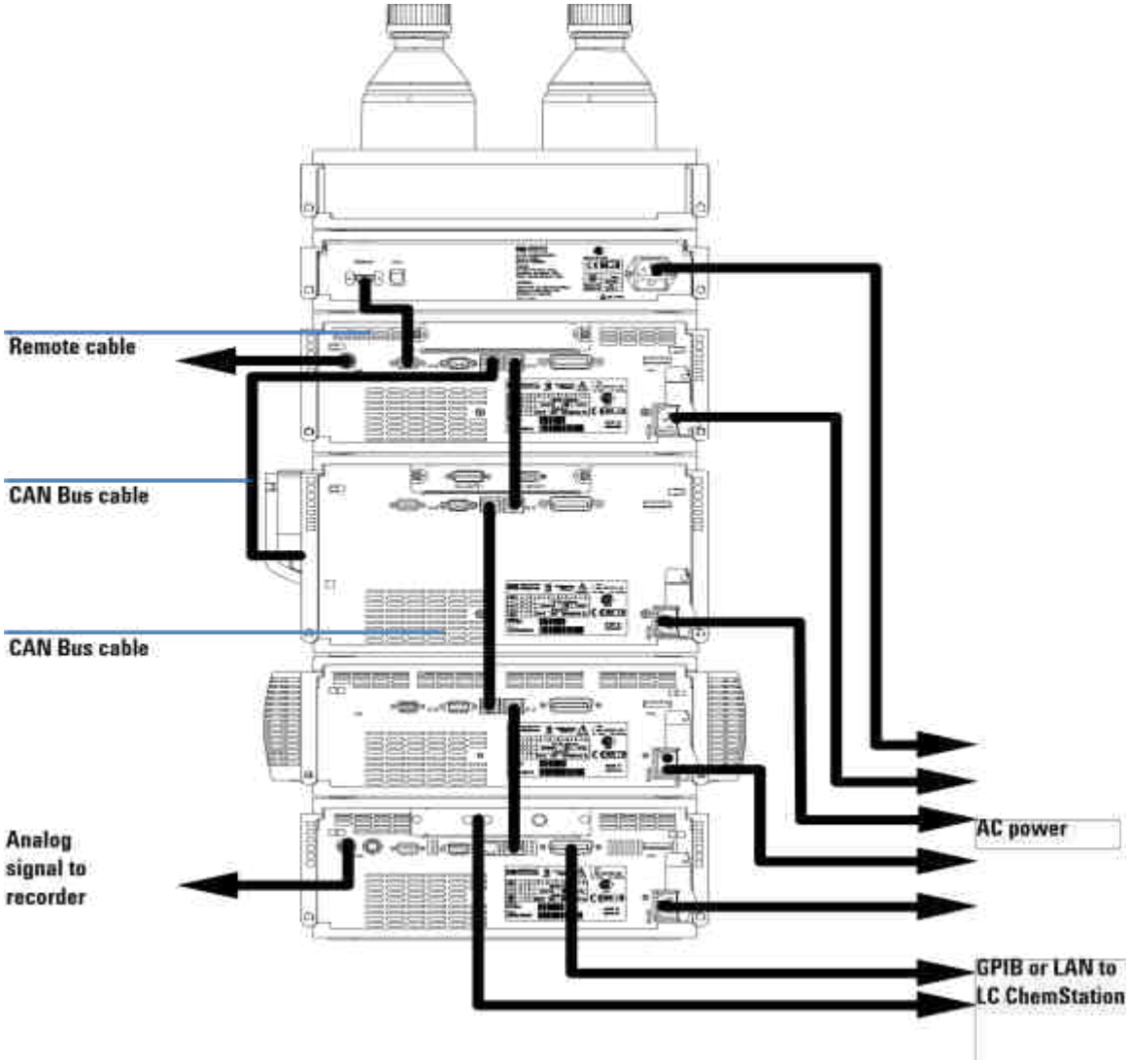


Figure 4 Recommended Stack Configuration (Rear View)

Installing the Detector

Preparations	Locate bench space
	Provide power connections
	Unpack the detector
Parts required	Detector
	Power cord, for other cables see below and "Cable Overview" on page 218, ChemStation and/or Control Module G1323A/B.

1 Install the LAN interface board in the detector (if required), see "Replacing the Interface Board" on page 199.

2 Place the detector in the stack or on the bench in a horizontal position.

3 Ensure the line power switch at the front of the detector is OFF.

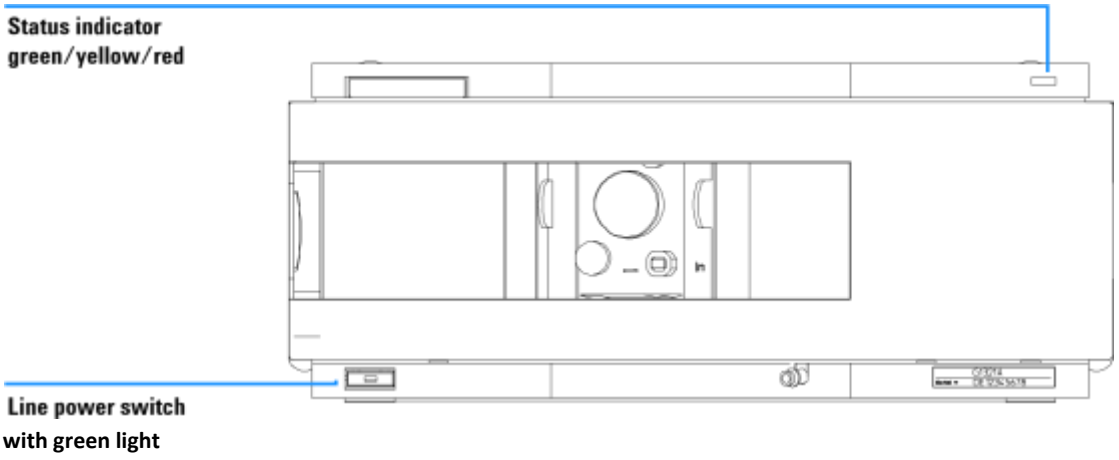


Figure 5 Front View of Detector

4 Connect the power cable to the power connector at the rear of the detector.

5 Connect the CAN cable to other Agilent 1100 Series modules.
6 If a Agilent ChemStation is the controller, connect either
   - the GPIB cable to the detector or
   - the LAN connection to the LAN interface board in the detector.

NOTE If a Agilent 1100 DAD/MWD/FLD is in the system, the LAN/GPIB should be connected to the DAD/MWD/FLD (due to higher data load).

7 Connect the analog cable(s) (optional).
8 Connect the APG remote cable (optional) for non-Agilent 1100 Series instruments.
9 Turn on power by pushing the button at the lower left hand side of the detector. The status LED should be green.

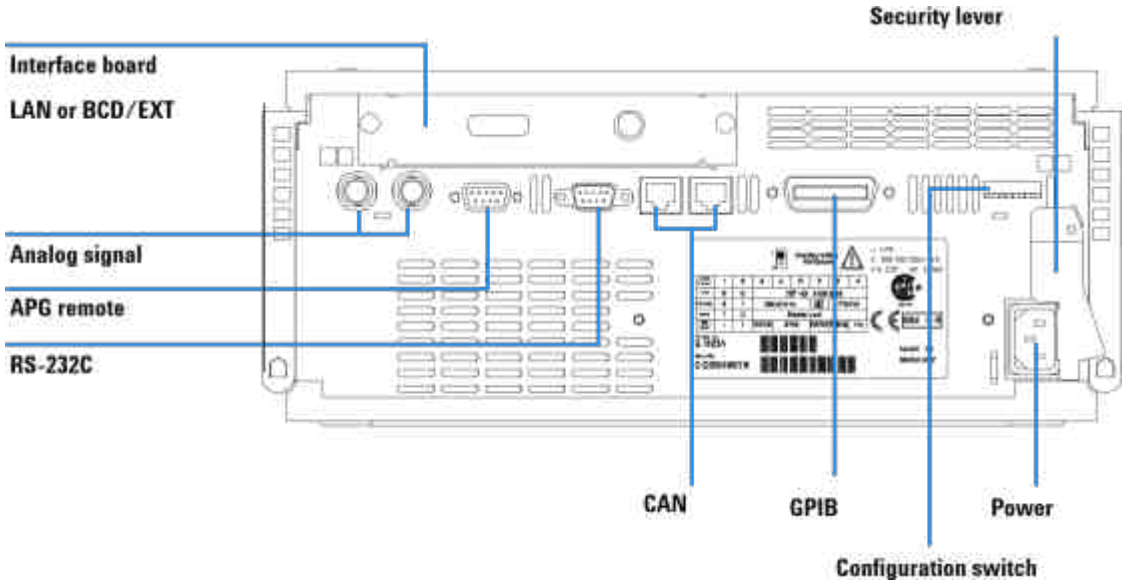


Figure 6 Rear View of Detector

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

WARNING **To disconnect the detector from line, unplug the power cord. The power supply still uses some power, even if the power switch at the front panel is turned off.**

NOTE The detector was shipped with default configuration settings. To change these settings see “Setting the 8-bit Configuration Switch” on page 292.

Flow Connections to the Detector

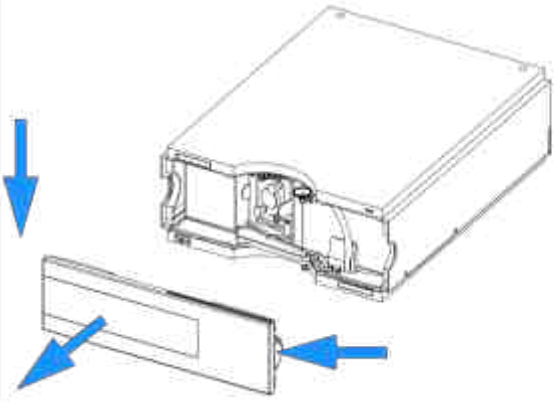
Preparations	Detector is installed in the LC system.
Parts required	Other modules Parts from accessory kit, see"Detector Accessory Kit Contents" on page 18. Two wrenches 1/4 – 5/16 inch for capillary connections

WARNING

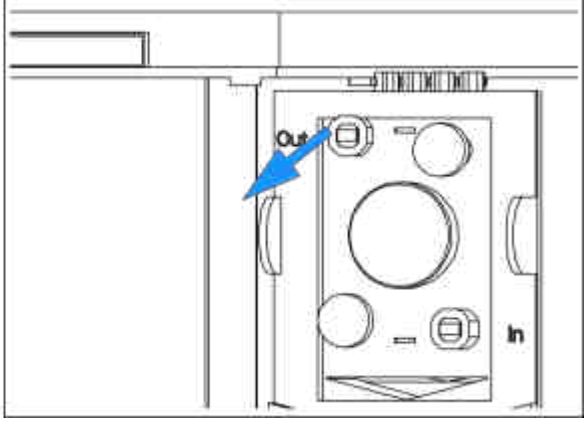
When working with solvents please observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.

NOTE The flow cell is shipped with a filling of isopropanol (also recommended when the instrument and/or flow cell is shipped to another location). This is to avoid breakage due to subambient conditions.

1 Press the release buttons and remove the front cover to gain access to the flow cell area.

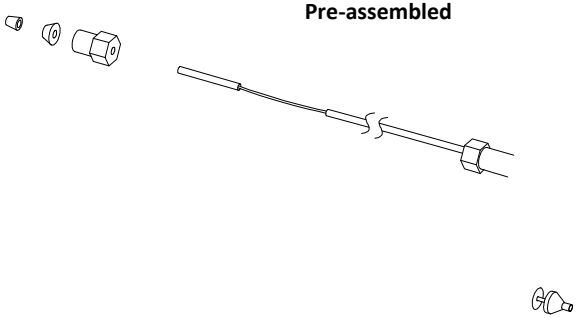


2 Locate the flow cell.

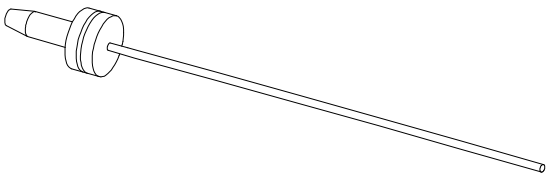


3 Assemble the column detector capillary from the accessory kit. One side is already factory-assembled.

Pre-assembled



4 Assemble the waste tubing from the accessory kit.



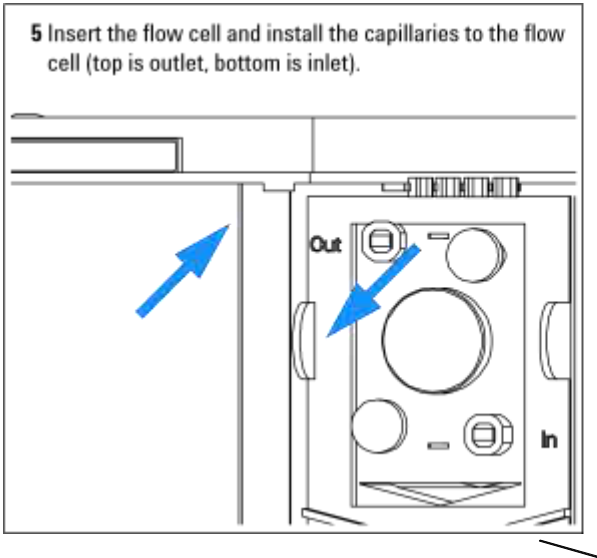
Note:

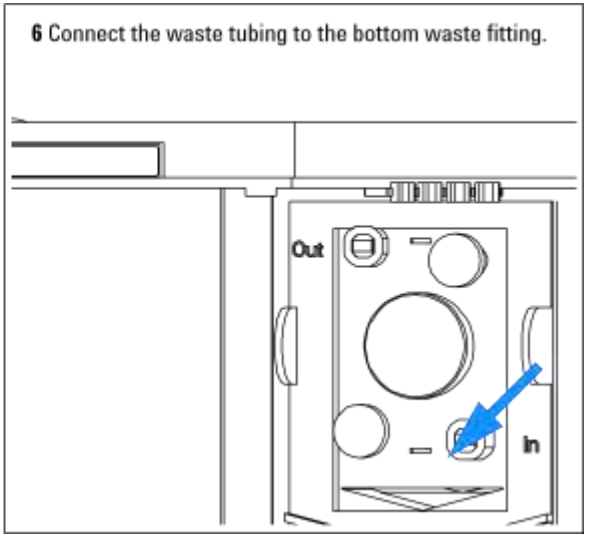
The fluorescence detector should be the last module in the flow system. An additional detector should be installed before the fluorescence detector to prevent any overpressure to the quartz cell (maximum 20 bar) . When working with detector behind the FLD (on own risk) determine the backpressure of this detector first by

- removing the column and the last detect and measuring system pressure at the application flow rate.

- connecting the last detector (without column and FLD) and measuring the system pressure with flow.

- the difference in measured pressure is due to the back pressure generated by the last detector and is the pressure seen by the FLD.





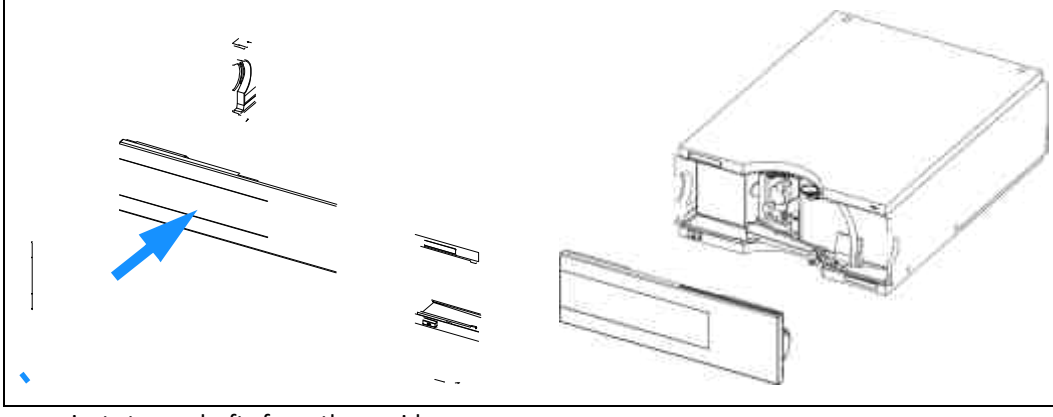
The installation of the detector is now complete.

NOTE

7 Establish flow and observe if leaks occur.

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

8 Replace the front cover.





2

First Steps with the Fluorescence Detector

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Before You Start

Your normal LC grade solvents usually give good results most of the time. But experience shows that baseline noise can be higher (lower signal-to-noise ratio) when impurities are in the solvents.

Flush your solvent delivery system for at least 15 minutes before checking sensitivity. If your pump has multiple channels, you should also flush the channels not in use.

Optimization Overview

1 Setting the right PMT value

For most applications a setting of 10 is adequate. The G1321A A/D converter exhibits a large linear range making PMT switching unnecessary for most applications. For example, if at high concentrations a peak is cut off; decrease the PMT setting. Remember that low PMT settings decrease the signal to noise ratio.

The built-in PMT gain test uses the parameters in the detector. When using the PMT gain test, the wavelength setting and lamp energy mode (depending on Multiwavelength-Mode and Lamp-Economy) will affect the pmt gain calculation.

NOTE If you have changed one or more parameter(s), you have to press 'OK' to write down the new settings into the FLD. Then re-enter 'FLD-Signals' and start the PMT gain test.

---

2 Using an appropriate response time

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

3 Finding the optimum wavelength

Most fluorescent active molecules absorb at 230 nm. Set the excitation wavelength to 230 nm and on-line scan the emission spectra

(multi-emission mode). Then set the determined emission wavelength and perform a multi-excitation scan (multi-excitation mode) to find the best excitation wavelength.

4 Evaluating fluorescence spectra

In contrast to diode array based UV detectors where UV spectra are evaluated by taking a spectrum at the peak maximum and selecting a reference spectrum at the baseline, correct fluorescence spectra are obtained by selecting a peak maximum spectrum and a reference around the inflection points. Selecting reference spectra at the baseline is not useful because the spectrum on the baseline is very noisy (no light!).

5 Switching lamp on only for analysis

Unless maximum sensitivity is needed, the lamp lifetime can significantly be increased by switching it on just for analysis. In contrast to other LC detectors the G1321A fluorescence detector equilibrates within seconds after the lamp is switched on.

For highest reproducibility and linearity change the lamp setting to always ON (default is on only during run).

NOTE One hour of initial warm-up of the instrument is recommended.

---

6 Do not overpressurize the detector quartz flow cell

Be aware to not exceed a 20 bar pressure drop after the flow cell when hooking up additional devices like other detectors or a fraction collector. It's better to place a UV detector before the G1321A fluorescence detector.

NOTE When comparing fluorescence excitation spectra directly with DAD spectra or literature based absorbance spectra, you should consider large differences in the used optical bandwidth (FLD=20 nm) which cause a systematic wavelength maximum shift depending on the absorbance spectrum of the compound under evaluation.

Getting Started and Checkout

This chapter describes the check out of the Agilent 1100 series fluorescence detector using the Agilent isocratic checkout sample.

When required	If you want to checkout the detector
Hardware required	LC system with G1321A FLD
Parts required	Start-up Kit 5063-6528, includes
	LC cartridge Hypersil ODS, 5um, 125x4mm with CIS cartridge holder
	Agilent isocratic checkout sample (Part number 01080-68704)
	Fittings, Qty=2 (Part number 0100-1516)
	Capillary, 150 mm long, 0.17 mm i.d. (Part number 5021-1817)

Starting Your Detector

1 Turn on the detector.

2 Turn on the lamp.

When the lamp is turned on the first time the instrument performs some internal checks and a calibration check which takes about 5 minutes.

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

Setting the Chromatographic Conditions

1 Set up the system with the following chromatographic conditions and wait until the baseline gets stable.

Table 4 Chromatographic Conditions

Mobile phases	A = water = 35% B = Acetonitrile = 65%
Column	OSD-Hypersil column, 125 mm x 4 mm i.d. with 5 µm particles
Sample	Isocratic standard sample, 1:10 diluted in methanol
Flow rate	1.5 ml/min
Compressibility A (water)	46
Compressibility B (Acetonitrile)	115
Stroke A and B	auto
Stop time	4 minutes
Injection volume	5 µl
Oven temperature (1100)	30 °C
FLD Excitations/Emission Wavelength	EX = 246 nm, EM = 317 nm
FLD PMT Gain	PMT = 10
FLD Response time	4 seconds

2 Set the FLD setpoints according to Figure 7 (on the local control module this information is split across separate screens).

In this example additional excitation wavelengths (B, C, D) are used. This will increase the scan time and may lower the performance.

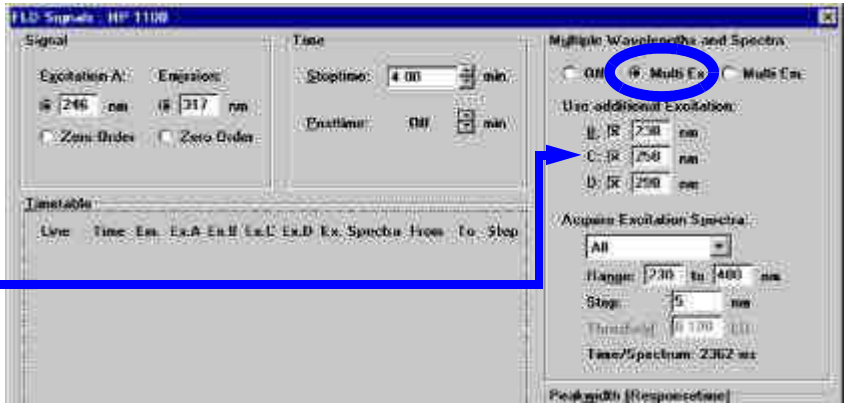


Figure 7 FLD Parameters

3 Start the run.

4 The resulting chromatograms are shown in Figure 8:

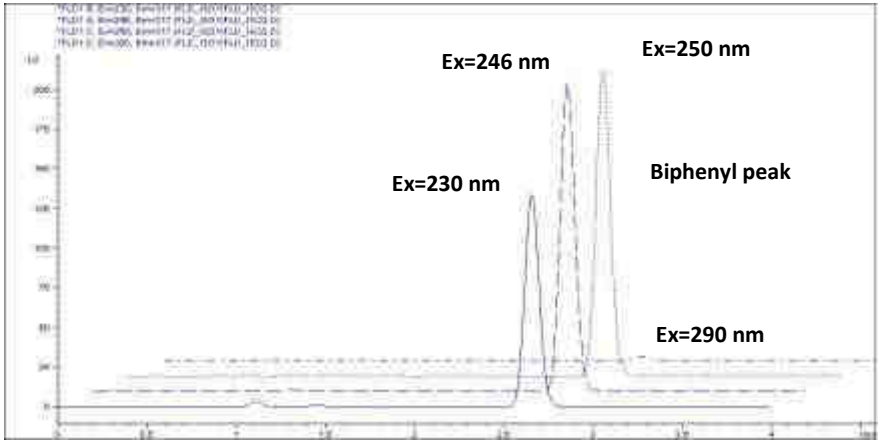


Figure 8 Biphenyl peak with different excitation wavelengths

5 The excitation maxima is around 250 nm.

Observe the maxima via the isoabsorbance plot

1 Load the data file (λ_{EX}=246 nm, λ_{EM}=317 nm) and open the isoabsorbance plot.

2 The maximum λ_{EX} will be found around 250 nm.

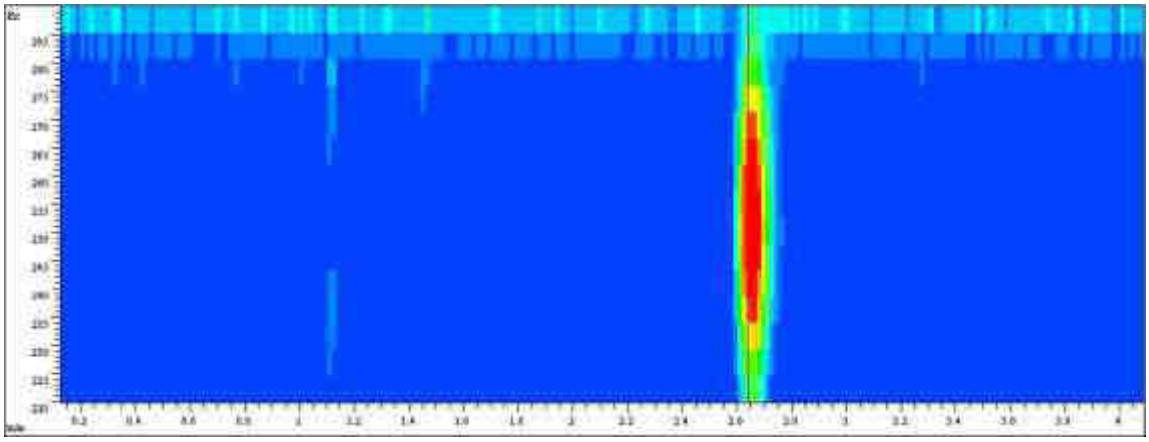


Figure 9 Isoabsorbance Plot

Method Development

Fluorescence detectors are used in liquid chromatography when superior limits of detection and selectivity are required. Thorough method development, including spectra acquisition, is fundamental to achieve good results. This chapter describes three different steps that can be taken with the Agilent 1100 Series fluorescence detector. Table 5 gives an overview of how to benefit from the operation modes during these steps.

Table 5 Steps for thorough method development

	Step 1: Check system	**Step 2: Optimize limits of detection and selectivity**	**Step 3: Set up routine methods**
Fluorescence scan	Find impurities (for example, in solvents and reagents)	Determine simultaneously the excitation and emission spectra of a pure compound	
Signal mode		Perform wavelength switching	Use for lowest limits of detection

Spectral mode/multi-wavelength detection	Determine Ex/Em spectra for all separated compounds in a single run	Collect online spectra, perform library search, determine peak purity
	Activate up to four wavelength simultaneously	Deactivate wavelength switching

Step 1: Check the LC system for impurities

A critical issue in trace level fluorescence detection is to have an LC system free of fluorescent contamination. Most contaminants derive from impure solvents. Taking a fluorescence scan is a convenient way to check the quality of the solvent in a few minutes. This can be done, for example, by filling the FLD cuvette directly with the solvent for an offline measurement even before the start of a chromatographic run. The result can be displayed as an isofluorescence plot or a three-dimensional plot. Different colors reflect different intensities.

Figure 10 shows a sample of slightly impure water which was planned for use as mobile phase. The area where fluorescence of the contaminated water sample can be seen is between the stray light areas: the first- and second-order Raleigh stray light and Raman stray light.

A pure water sample was put into the flow cell. Spectra were recorded at 5nm step sizes.

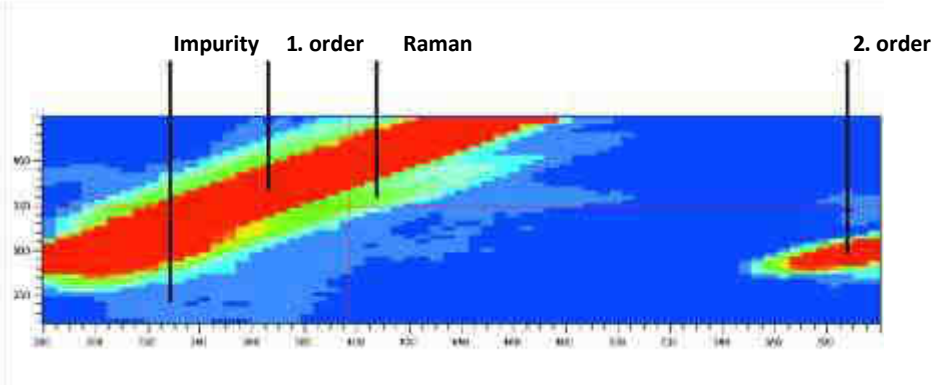


Figure 10 Isofluorescence plot of a mobile phase

Since "excitation" and "emission" wavelength are the same for Raleigh stray light, the area of first-order Raleigh stray light is visible in the left upper area of the diagram. The Raman bands of water are seen below the first-order Raleigh stray light. Since the cut-off filter cuts off light below 280 nm, the second-order Raleigh stray light starts above 560 nm.
Stray light acts in the same way as impurities in that it simulates background noise. In both cases, a higher noise level and therefore a higher limit of detection are obtained.

This indicates that high sensitivity measurements should be done away from wavelength settings that have a high stray light background.

Step 2: Optimize limits of detection and selectivity

Excitation spectrum with emission at 440 nm, emission spectrum with excitation at 250 nm of 1 ug/ml quinidine.

Detector settings: step size 5 nm, PMT 12, Response time 4 s.

To achieve optimum limits of detection and selectivity, analysts must find out about the fluorescent properties of the compounds of interest. Excitation and emission wavelengths can be selected for optimum limits of detection and best selectivity. In general, fluorescence spectra obtained with different instruments may show significant differences depending on the hardware and software used.

The traditional approach is to extract an appropriate excitation wavelength from the UV spectrum that is similar to the fluorescence excitation spectrum (see Figure 11) and to record the emission spectrum. Then with an optimum emission wavelength determined, the excitation spectrum is acquired.

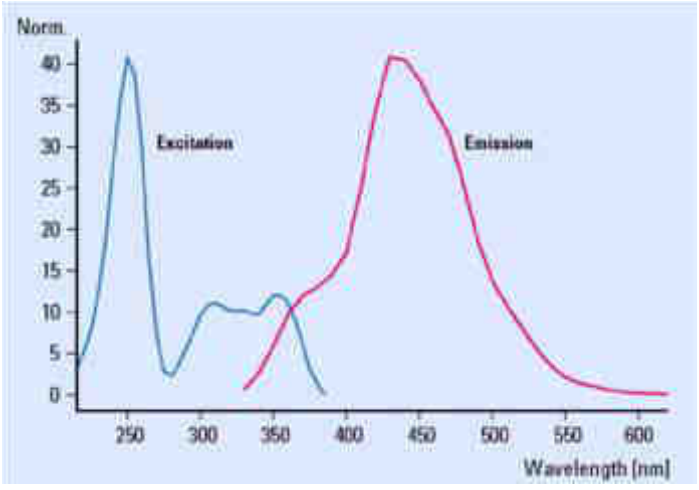


Figure 11 Excitation and emission spectra of quinidine

These tasks have to be repeated for each compound using either a fluorescence spectrophotometer or stop-flow conditions in LC. Usually each compound requires a separate run. As a result, a set of excitation and emission spectrum is obtained (Figure 10 on page 40) for each compound. Since this is a tedious procedure, it is applicable only when there is a limited number of compounds of interest.

The Agilent 1100 Series LC offers three different ways to obtain complete information on a compound's fluorescence:

Procedure I - Take a fluorescence scan offline for a single compound as described above for the mobile phase. This is done preferably with a manual FLD cuvette when pure compounds are available.

Procedure II - Use two LC runs with the Agilent 1100 Series FLD to separate the compound mix under known conditions and acquire emission and excitation spectra separately.

Procedure III - Use an Agilent 1100 Series FLD/DAD combination and acquire UV/Visible spectra (equivalent to excitation spectra) with the DAD and emission spectra with the FLD-both in a single run.

Procedure I - Take a fluorescence scan

Because fluorescence spectra traditionally have not been easily available with previous LC fluorescence detectors, standard fluorescence spectrophotometers have been used in the past to acquire spectral information for unknown compounds. Unfortunately this approach limits optimization, as there are differences expected in optical design between an LC detector and a dedicated fluorescence spectrophotometer, or even between detectors. These differences can lead to variations for the optimum excitation and emission wavelengths.

The Agilent 1100 Series fluorescence detector offers a fluorescence scan that delivers all spectral information previously obtained with a standard fluorescence spectrophotometer, independent of the LC fluorescence detector. Figure 12 on page 44 shows the complete information for quinidine as obtained with the Agilent 1100 Series FLD and a manual cuvette in a single offline measurement. The optima for excitation and emission wavelengths can be extracted as coordinates of the maxima in the three dimensional plot. One of the three maxima in the center of the plot can be chosen to define the excitation wavelength. The selection depends on the additional compounds that are going to be analyzed in the chromatographic run and the background noise that may be different upon excitation at 250 nm, 315 nm or 350 nm. The maximum of emission is observed at 440 nm.

Details for Figure 12 on page 44:

All excitation and emission spectra of Quinidine (1 µg/ml) are shown in graphic. Fluorescence intensity is plotted vs excitation and emission wavelengths.

Detector settings: step size 5 nm, PMT 12, Response time 4 s

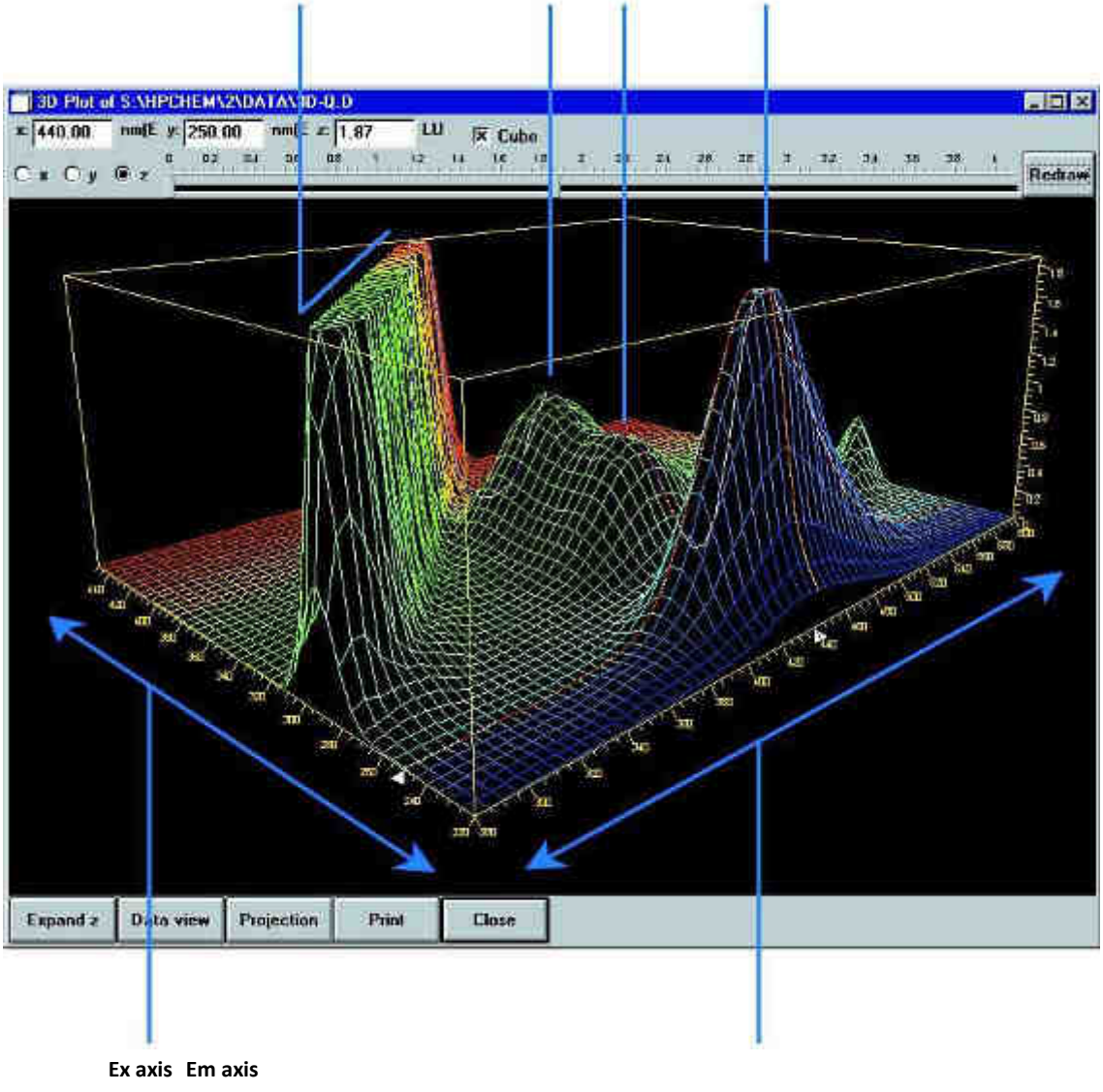


Figure 12 Characterization of a pure compound from a fluorescence scan

Procedure II - Take two LC runs with the FLD

The conditions for the separation of organic compounds such as polyaromatic nuclear hydrocarbons (PNAs) are well described in various standard methods, including commonly used EPA and DIN methods. Achieving the best detection levels requires checking for the optimum excitation and emission wavelengths for all compounds. Yet taking fluorescence scans individually makes this a tedious process. A better approach is to acquire spectra online for all compounds during a run. This speeds up method development tremendously. Two runs are sufficient for optimization.

During the *first run*, one wavelength is chosen in the low UV range for the excitation wavelength and one emission wavelength in the spectral range for the emission wavelength. Most fluorophores show strong absorption at these wavelengths and the quantum yield is high. Excitation is sufficient for collecting emission spectra.

Figure 13 on page 46 contains all emission spectra obtained in a single run from a mix of 15 PNAs. This set of spectra is used to set up a timetable for optimum emission wavelengths for all compounds.

The individual compound spectra in the isofluorescence plot show that at least three emission wavelengths are needed to detect all 15 PNAs properly:

Table 6 Timetable for PNA analysis

0 min:	350 nm	for naphthalene to phenanthrene
8.2 min:	420 nm	for anthracene to benzo(g,h,I)perylene
19.0 min:	500 nm	for indeno(1,2,3-cd)pyrene

In the second run, three setpoints for emission wavelengths are entered into the time-program and excitation spectra are recorded, as shown in figure 8. The area of high intensity (red) is caused by stray light when emission spectra overlap with the excitation wavelength. This can be avoided by fitting the spectral range automatically. Excitation at 260 nm is most appropriate for all PNAs.

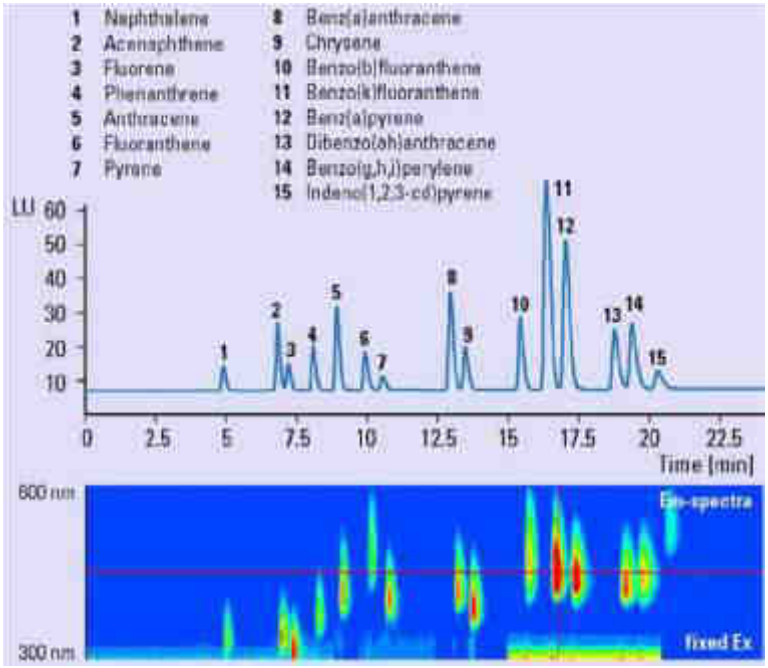
Table 7 Conditions for Figure 13 and Figure 14 on page 47

Column	Vydac, 2.1 x 200 mm, PNA, 5 µm
Mobile phase	A = water; B = acetonitrile (50:50)

Gradient	3 minutes, 60% 14 minutes, 90% 22 minutes, 100%
Flow rate	0.4 ml/min
Column temperature	18 °C
Injection volume	5 µl
FLD settings	PMT 12, response time 4 s, step size 5 nm

This shows the isofluorescence plot of emission spectra for 15 PNAs (5 µg/ml) with a fixed excitation wavelengths (260 nm).

Figure 13



Optimization of the time-program for the emission wavelength

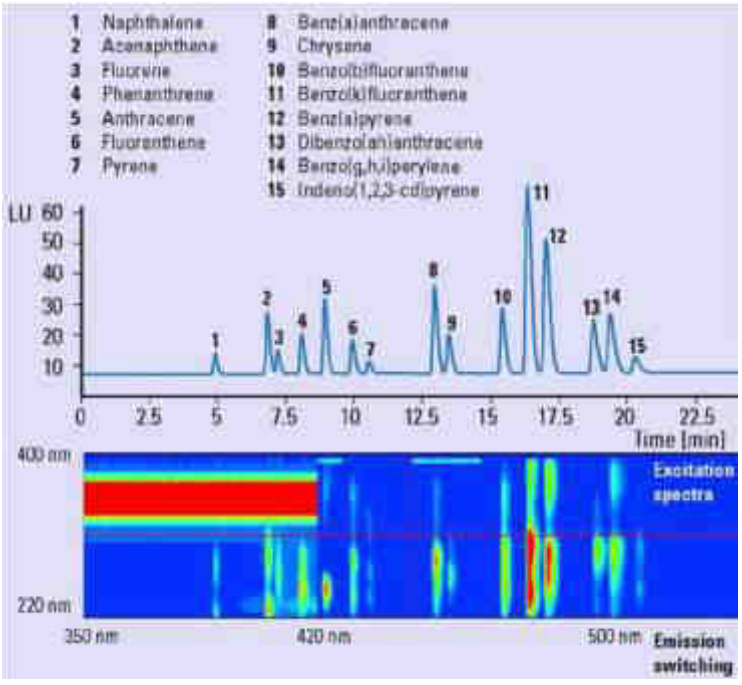


Figure 14 Optimization of the time-program for the excitation wavelength

The obtained data are combined to setup the time-table for the excitation wavelength for best limit of detection and selectivity. The optimized switching events for this example are summarized in Table 8.

Table 8 Timetable for the analysis of 15 polynuclear aromatic hydrocarbons

Time [min]	Exitation Wavelength [nm]	Emission Wavelength [nm]
0	260	350
8.2	260	420
19.0	260	500

This timetable gives the conditions for optimum detection based on the results of two chromatographic runs.

Procedure III - Make a single run with the Agilent 1100 Series DAD/FLD combination

For most organic compounds, UV-spectra from diode array detectors are nearly identical to fluorescence excitation spectra. Spectral differences are caused by specific detector characteristics such as spectral resolution or light sources.

In practice, combining a diode array detector with a fluorescence detector in series gives the full data set needed to achieve the optimum fluorescence excitation and emission wavelengths for a series of compounds in a single run. With the UV/Visible/excitation spectra available from the diode array detector, the fluorescence detector is set to acquire emission spectra with a fixed excitation wavelength in the low UV range.

The example is taken from the quality control of carbamates. Samples are analyzed for the impurities 2,3-diamino-phenazine (DAP) and

2-amino-3-hydroxyphenazine (AHP). Reference samples of DAP and AHP were analyzed with diode array and fluorescence detection. Figure 9 shows the spectra obtained from both detectors for DAP. The excitation spectrum of DAP is very similar to the UV absorption spectrum from the diode array detector. Figure 16 on page 50 shows the successful application of the method to a carbamate sample and a pure mixture of DAP and AHP for reference. The column was overloaded with the non-fluorescent carbamate (2-benzimidazole carbamic acid methylester/MBC) to see the known impurities, AHP and DAP.

This is an impurity of carbamates. The excitation spectrum in a second run shows the equivalence of UV-spectra and fluorescence excitation spectra. An excitation wavelength at 265 nm was used for taking the emission spectrum and an emission wavelength at 540 nm was used for taking the excitation spectrum.

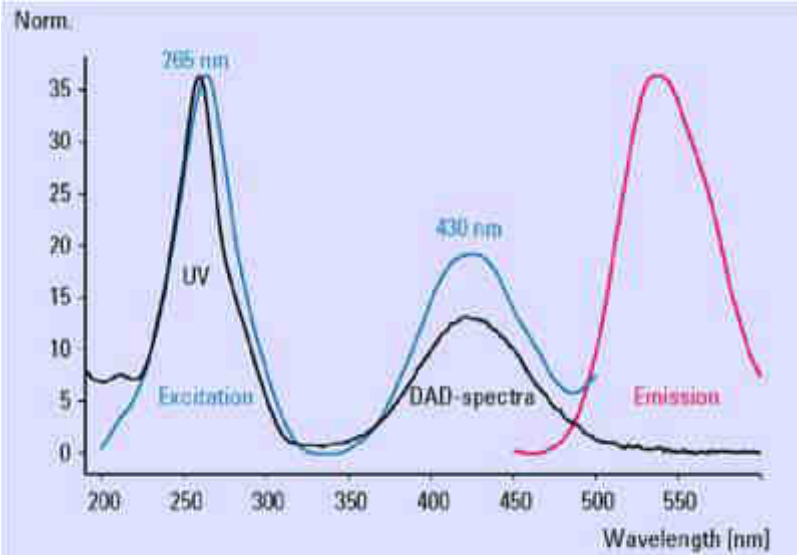


Figure 15 UV-spectrum and fluorescence spectra for 2,3-diaminophenazine (DAP)

The two upper traces are obtained using two different excitation wavelengths. The lower trace is a pure standard of the known impurities.

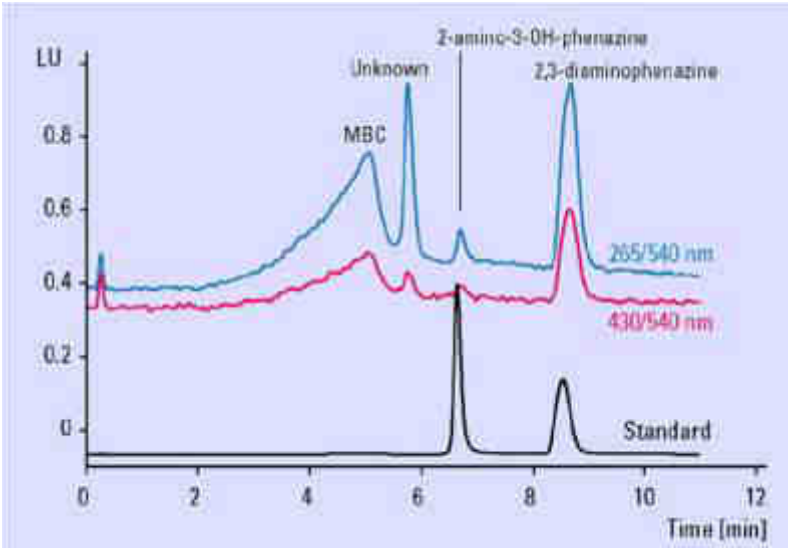


Figure 16 Qualitive analysis of MBC (2-benzimidazole carbamic acid methylester) and impurities

Table 9 Conditions for Figure 15 and Figure 16 on page 50

Column	Zorbax SB, 2 x 50 mm, PNA, 5 µm
Mobile phase	A = water; B = acetonitrile
Gradient	0 minutes, 5% 10 minutes, 15%
Flow rate	0.4 ml/min
Column temperature	35 °C
Injection volume	5 µl

FLD settings	PMT 12, response time 4 s, step size 5 nm Ex 265 nm and 430 nm Em 540 nm

Step 3: Set up routine methods

In routine analysis, sample matrices can have a significant influence on retention times. For reliable results, sample preparation must be thorough to avoid interferences or LC methods must be rugged enough. With difficult matrices, simultaneous multi-wavelength detection offers more reliability than timetable-controlled wavelength switching. The Agilent 1100 Series FLD can, in addition, acquire fluorescence spectra while it records the detector signals for quantitative analysis. Therefore qualitative data are available for peak confirmation and purity checks in routine analysis.

Multi wavelength detection

Time-programmed wavelength switching traditionally is used to achieve low limits of detection and high selectivity in routine quantitative analysis. Such switching is difficult

if compounds elute closely and require a change in excitation or emission wavelength. Peaks can be distorted and quantitation made impossible if wavelength switching occurs during the elution of a compound. Very often this happens with complex matrices, influencing the retention of compounds.

In spectral mode, the Agilent 1100 Series FLD can acquire up to four different signals simultaneously. All of them can be used for quantitative analysis. Apart from complex matrices, this is advantageous when watching for impurities at additional wavelengths. It is also advantageous for reaching low limits of detection or increasing selectivity through optimum wavelength settings at any time. The number of data points acquired per signal is reduced and thus limits of detection may be higher, depending on the detector settings compared to the signal mode.

PNA analysis, for example, can be performed with simultaneous multi wavelength detection instead of wavelength-switching. With four different wavelengths for emission, all 15 PNAs can be monitored (Figure 17 on page 53).

Table 10 Conditions for Figure 17 on page 53

Column	Vydac, 2.1 x 250 mm, PNA, 5 µm
Mobile phase	A = water; B = acetonitrile (50:50)
Gradient	3 minutes, 60% 14.5 minutes, 90% 22.5 minutes, 95%
Flow rate	0.4 ml/min
Column temperature	22 °C
Injection volume	2 µl
FLD settings	PMT 12, response time 4 s,

The upper trace was received with traditional wavelength switching.

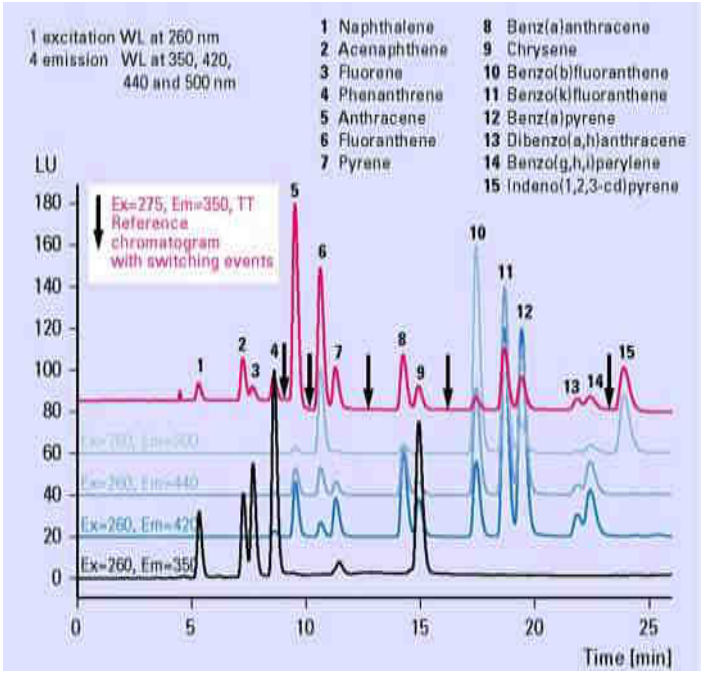


Figure 17 Simultaneous multi wavelength detection for PNA-analysis

Previously, only diode array detectors and mass spectrometric detectors could deliver spectral information on-line to confirm peak identity as assigned by retention time.

Now, fluorescence detectors provide an additional tool for automated peak confirmation and purity control. No additional run is necessary after the quantitative analysis.

During method development, fluorescence excitation and emission spectra are collected from reference standards and entered into a library-at the choice of the method developer. All spectral data from unknown samples can then be compared automatically with library data. Table 3 illustrates this principle using a PNA analysis. The match factor given in the report for each peak indicates the degree of similarity between the reference spectrum and the spectra from a peak. A match factor of 1,000 means identical spectra.
In addition, the purity of a peak can be investigated by comparing spectra obtained within a single peak. When a peak is calculated to be within the user-defined purity

limits, the purity factor is the mean purity value of all spectra that are within the purity limits.

The reliability of the purity and the match factor depends on the quality of spectra recorded. Because of the lower number of data points available with the fluorescence detector in general, the match factors and purity data obtained show stronger deviations compared to data from the diode array detector, even if the compounds are identical.

Table 11 shows an automated library search based on the emission spectra from a PNA reference sample.

Table 11 Peak confirmation using a fluorescence spectral library

Meas. RetTime [min]	Library RetTime [min]	CalTbl [min]	Signal	Amount [ng]	Purity Factor	#	Match	Libary Name
4.859	4.800	5.178	1	1.47986e-1	-	1	993	Naphthalene@em
6.764	7.000	7.162	1	2.16156e-1	-	1	998	Acenaphthene@em
7.137	7.100	7.544	1	1.14864e-1	-	1	995	Fluorene@em
8.005	8.000	8.453	1	2.56635e-1	-	1	969	Phenanthrene@em
8.841	8.800	9.328	1	1.76064e-1	-	1	993	Anthracene@em
9.838	10.000	10.353	1	2.15360e-1	-	1	997	Fluoranthene@em
10.439	10.400	10.988	1	8.00754e-2	-	1	1000	Pyrene@em
12.826	12.800	13.469	1	1.40764e-1	-	1	998	Benz(a)anthracene@em
13.340	13.300	14.022	1	1.14082e-1	-	1	999	Chrysene@em
15.274	15.200	16.052	1	6.90434e-1	-	1	999	Benzo(b)fluoranthene@em
16.187	16.200	17.052	1	5.61791e-1	-	1	998	Benzo(k)fluoranthene@em
16.865	16.900	17.804	1	5.58070e-1	-	1	999	Benz(a)pyrene@em

18.586	18.600	19.645	1	5.17430e-1	-	1	999	Dibenz(a,h)anthracene@em
19.200	19.100	20.329	1	6.03334e-1	-	1	995	Benzo(g,h,i)perylene@em
20.106	20.000	21.291	1	9.13648e-2	-	1	991	Indeno(1,2,3-cd)pyrene@em

Example: Optimization for Multiple Compounds

Using PNAs as a sample, this example uses the described scanning functions.

Setting the Chromatographic Conditions

1 This example uses the following chromatographic conditions (the detector settings are shown in Figure 18 on page 56).

Table 12 Chromatographic Conditions

Mobile phases	A = water = 50% B = Acetonitrile = 50%
Column	Vydac-C18-PNA, 250 mm x 2.1 mm i.d. with 5 µm particles
Sample	PAH 0.5 ng
Flow rate	0.4 ml/min
Compressibility A (water)	46
Compressibility B (Acetonitrile)	115
Stroke A and B	auto
Time Table	at 0 minutes %B=50
	at 3 minutes %B=60

	at 14.5 minutes %B=90
	at 22.5 minutes %B=95
Stop time	26 minutes
Post time	8 minutes
Injection volume	1 µl
Oven temperature (1100)	30 °C
FLD PMT Gain	PMT = 15
FLD Response time	4 seconds

Select a Excitation wavelength in the low UV (230...260nm). This will cover nearly all fluorescence in your sample.

DO NOT select additional emission wavelengths (B, C, D). Doing so will increase the scan time and will lower the performance.

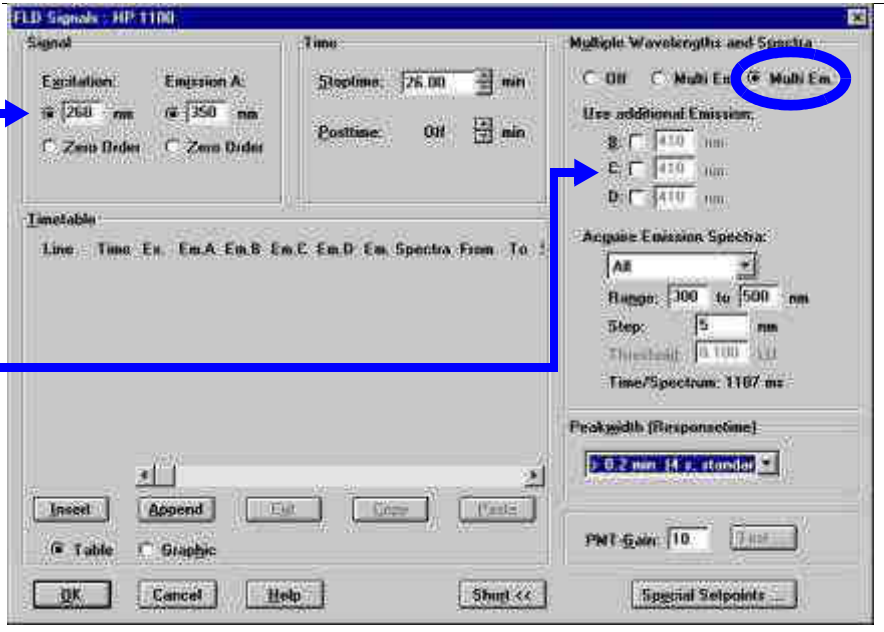


Figure 18 Detector Settings for Emission Scan

2 Wait until the baseline stabilizes. Complete the run.

3 Load the signal. (In this example just the time range of 13 minutes is

displayed).

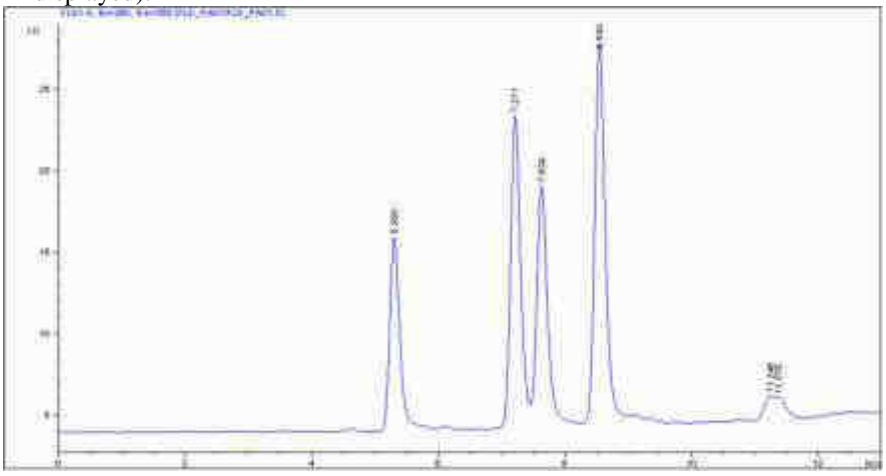


Figure 19 Chromatogram from Emissions Scan

4 Use the isoabsorbance plot and evaluate the optimal emission wavelengths, shown in the table below.

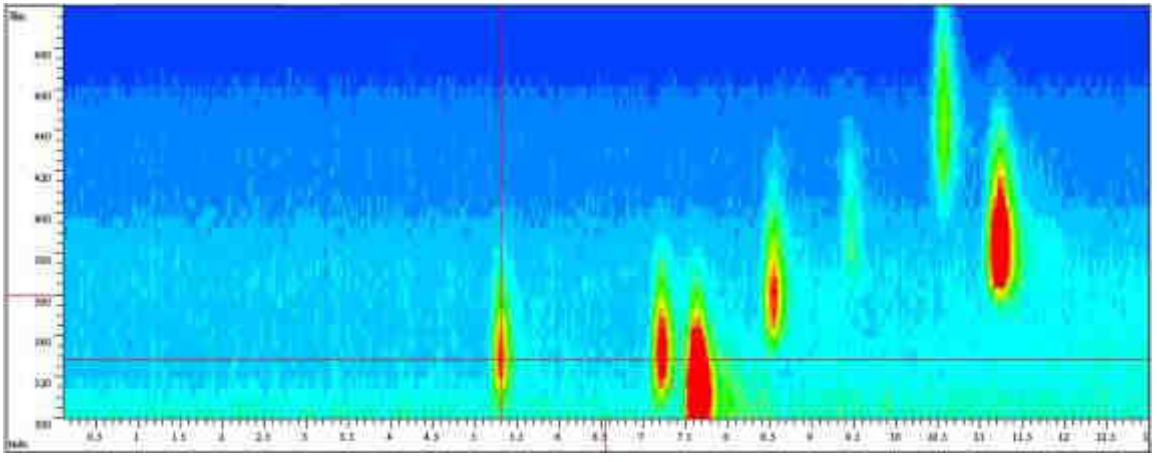


Figure 20 Isoabsorbance Plot from Emission Scan

Table 13

Peak #	Time	Emission Wavelength
1	5.3 min	330 nm
2	7.2 min	330 nm
3	7.6 min	310 nm
4	8.6 min	360 nm
5	10.6 min	445 nm
6	**11.23 min**	385 nm

5 Using the settings and the timetable (from previous page), do a second run for the evaluation of the optimal excitation wavelength. See Figure 21.

DO NOT select additional excitation wavelengths (B, C, D). Doing so will increase the scan time and will lower the performance

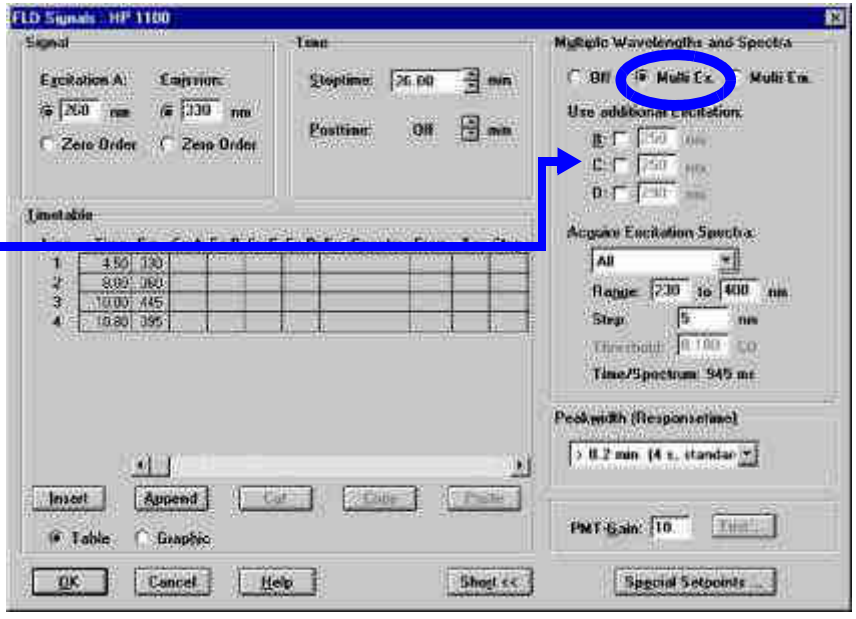


Figure 21 Detector Settings for Excitation Scan

6 Wait until the baseline stabilizes. Start the run.

7 Load the signal.

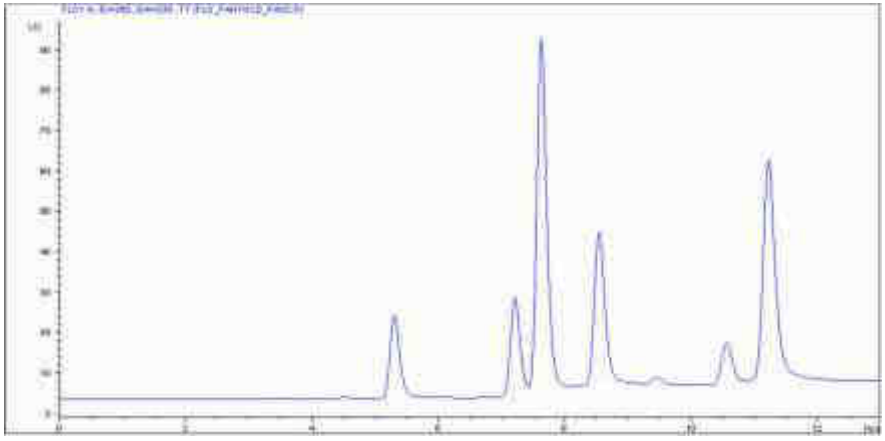


Figure 22 Chromatogram - excitation scan at reference wavelength 260/330 nm

8 Use the isoabsorbance plot and evaluate the optimal excitation wavelengths (in this example just in the time range of 13 minutes).

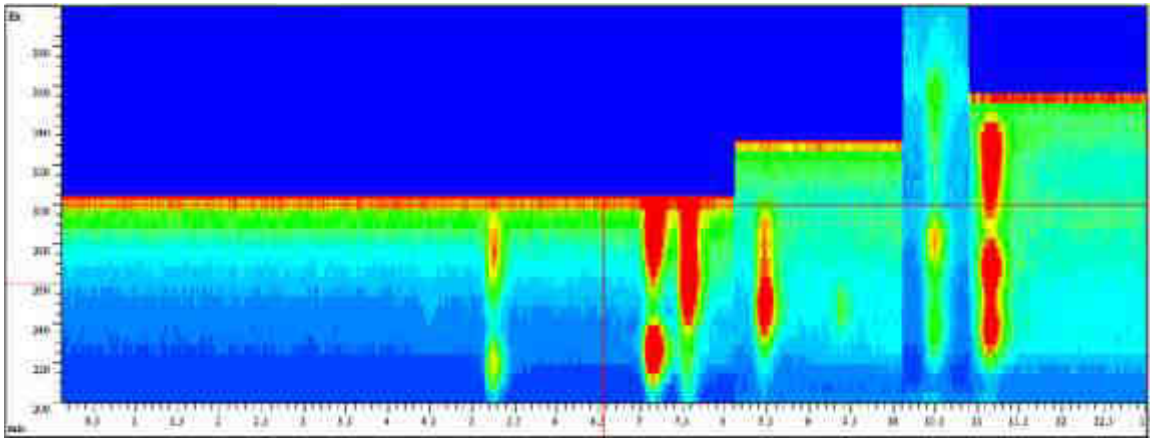


Figure 23 Isoabsorbance Plot - Excitation

The table below shows the complete information about emission (from Figure 20 on page 57) and excitation maxima.

Table 14

Peak #	Time	Emission Wavelength	Excitation Wavelength
1	5.3 min	330 nm	220 / 280 nm
2	7.3 min	330 nm	225 / 285 nm
3	7.7 min	310 nm	265 nm
4	8.5 min	360 nm	245 nm
5	10.7 min	445 nm	280 nm
6	**11.3 min**	385 nm	270 / 330 nm

Evaluating The System Background

The example below uses water.

1 Pump solvent through your system.

2 Set the fluorescence scan range under FLD special setpoints according to your needs.

The scan time will increase when the range is enlarged. With the default values, the scan takes about 2 minutes.

NOTE

3 Set PMT gain to 16.

The wavelength range and step number defines the duration. Using the maximum range, the scan would take approximately 10 minutes

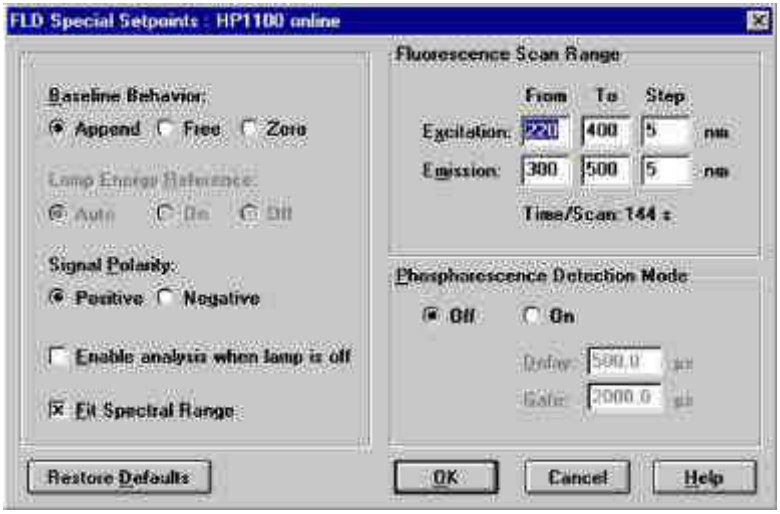


Figure 24 FLD special settings

completed, the isoabsorbance scan appear, see Figure

4 Define a data file name and take a fluorescence scan. After the scan is

results 25 on page 62.

NOTE A low background will improve the signal-to-noise, see also "Reducing Stray Light" on page 74.

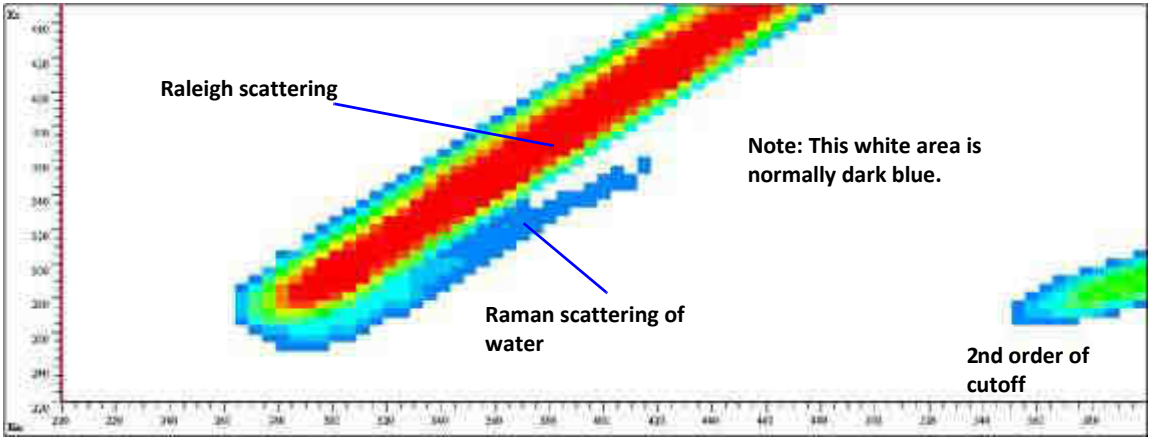


Figure 25 Fluorescence Scan of Water



3 Optimizing the Fluorescence Detector

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Design Features Help Optimization 65
Finding the Best Wavelengths 66
Finding the Best Signal Amplification 68
Changing the Xenon Flash Lamp Frequency 70
Selecting the Best Response Time 72
Reducing Stray Light 74



Agilent Technologies

Optimization Overview

Refer to “Optimization Overview” on page 33 for details.

Design Features Help Optimization

The Agilent 1100 fluorescence detector has several features you can use to optimize detection:

Table 15

PMTGAIN	Amplification factor
LAMP	Flash frequency
RESPONSETIME	Data reduction interval

Check Performance Before You Start

Before you start you should check that your detector is performing according to the specifications published by Agilent Technologies.

Your normal LC grade solvents may give good results most of the time but our experience shows that baseline noise can be higher with LC grade solvents than with fluorescence grade solvents.

Flush your solvent delivery system for at least 15 minutes before checking sensitivity. If your pump has multiple channels, you should also flush the channels not in use.

Finding the Best Wavelengths

The most important parameters to be optimized in fluorescence detection are the excitation and emission wavelengths. Generally, it is assumed that the best excitation wavelength can be taken from the excitation spectrum acquired on a spectrofluorimeter. It is also assumed that once the optimal excitation wavelength has been found for one particular instrument type this wavelength can also be applied to other instruments.

Both assumptions are wrong.

The optimum wavelength for the excitation depends on the absorption of the compounds but also on the instrument characteristics, for example the lamp type and the gratings. As most organic molecules absorb best in the ultra-violet range the Agilent 1100 fluorescence detector was designed to give an optimum signal-to-noise

ratio in the 210 nm to 360 nm range of the spectrum. To achieve greatest sensitivity, the absorbance wavelength of your sample molecule should match the wavelength range for your instrument. In other words, an excitation wavelength in the ultra-violet range. Your Agilent 1100 fluorescence detector has a broad excitation wavelength range, but for higher sensitivity you should choose a wavelength in the ultra-violet range (near 250 nm).

The design elements that contribute to lower efficiency in the lower ultra-violet range are the xenon flash lamp and the gratings. Flash-type lamps shift the optimum wavelength to lower wavelength ranges with the Agilent 1100 fluorescence detector to a maximum of 250 nm. The excitation grating is blazed for highest efficiency at 300 nm.

A Real Example

Although an excitation wavelength of 340 nm is quoted in the literature the Agilent 1100 fluorescence detector scan of orthophthalaldehyde, a derivative of the amino acid alanine, (Figure 26 on page 67) shows a maximum between 220 nm and 240 nm.

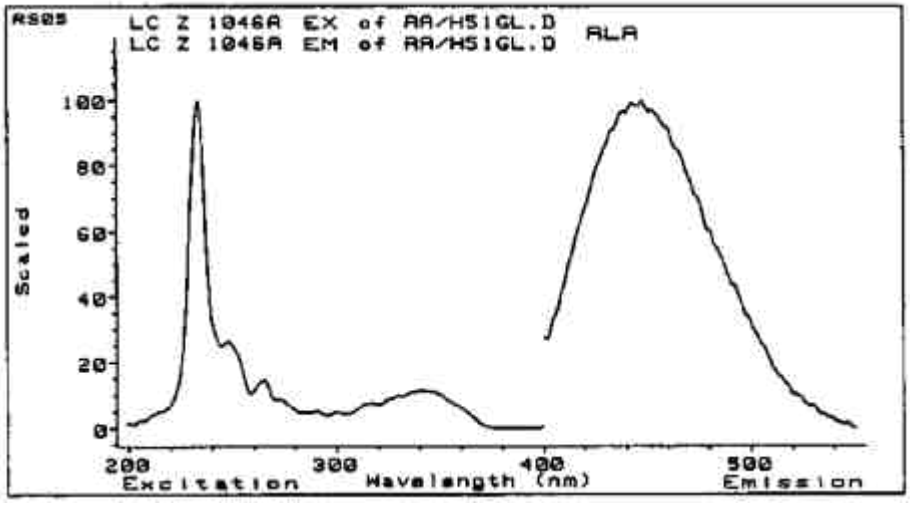


Figure 26 Scan Orthophthalaldehyde Derivative of Alanine

When you are looking for the wavelength by scanning, scan over the whole range. As this example shows a maximum may be found in a completely different wavelength range.

NOTE When comparing fluorescence excitation spectra directly with DAD spectra or literature based absorbance spectra, you should consider large differences in the used

optical bandwidth (FLD=20 nm) which cause a systematic wavelength maximum shift depending on the absorbance spectrum of the compound under evaluation.

Finding the Best Signal Amplification

Increasing the PMTGAIN increases the signal and the noise. Up to a certain factor the increase in signal is higher than the increase in noise.

The step from gain to gain is equal to a factor of 2 (which is the same as on the HP 1046 A FLD).

In Figure 27 the PMTGAIN was gradually raised from 4 up to 11 (the peak is from the Agilent Technologies isocratic sample which was diluted 1000 times). With increasing PMTGAIN there was an improvement in signal-to-noise up to 10. Above 10 the noise increased proportionately to the signal with no improvement in signal-to-noise.

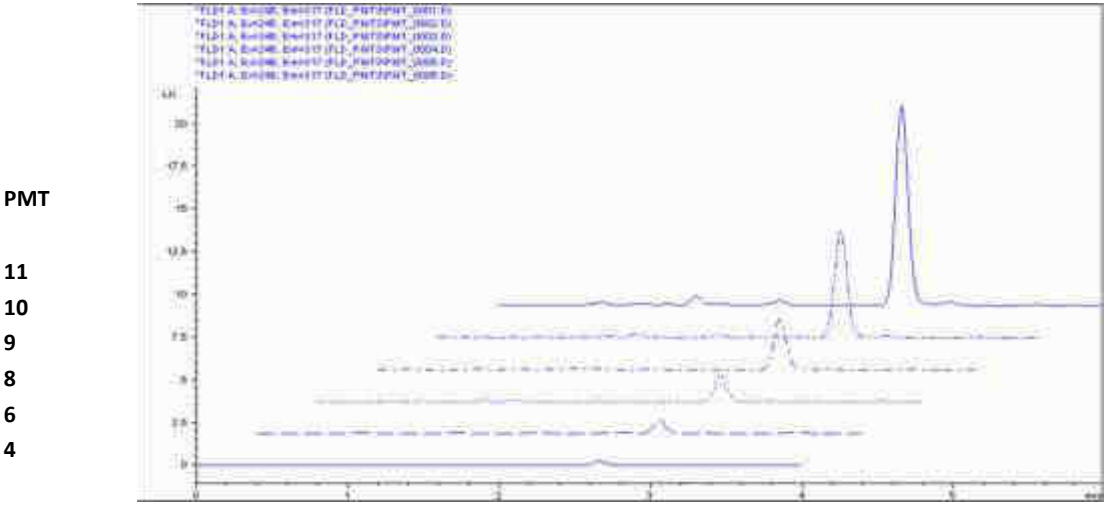


Figure 27 Finding Best PMTGAIN for Biphenyl

The reason for this is the fact, that quantification of baselines (especially at low background levels) is not sufficient for statistically working filter methods. For the best gain, check your solvent under flow conditions with the auto-gain function. Do not use higher values than proposed by the system, if not necessary, because of excessive high fluorescence signals.

Use the PMT test to automatically determine the setting.

Changing the Xenon Flash Lamp Frequency

Modes

The lamp flash frequency can be changed into the following modes:

Table 16 Flash Lamp Modes

Positioning	296 Hz (Standard), 560 V	63 mJoule (18.8 W)
	74 Hz (Economy), 560 V	63 mJoule (4.7 W)
Rotation (Multi Ex/Em)	74 Hz (Standard), 950 V	180 mJoule (13.3 W)
	74 Hz (Economy), 560 V	63 mJoule (4.7 W)

Best sensitivity can be expected with "**no economy**", see Figure 28.

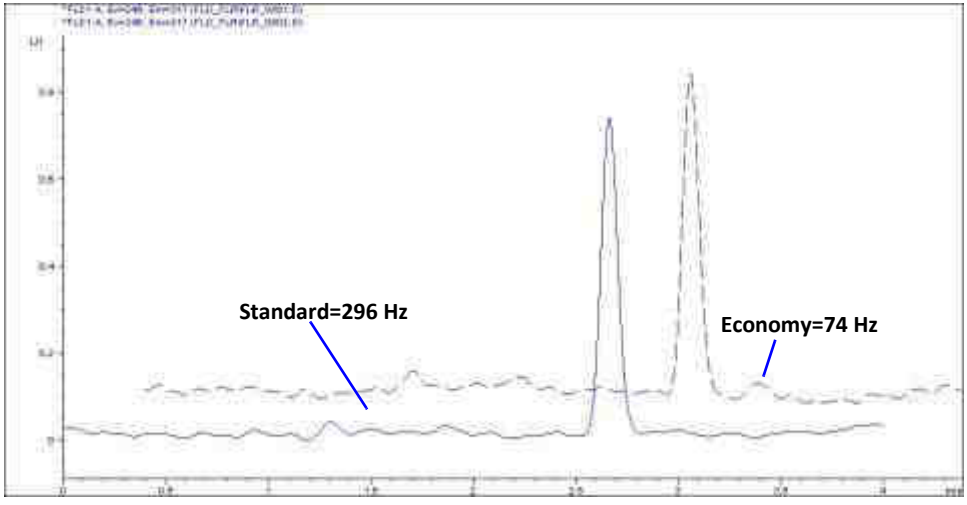


Figure 28 Xenon Flash Lamp Frequency

Lamp life savings

There are three ways to save lamp life:

- switch to "lamp on during run" without loss of sensitivity.

- switch to “economy” mode with a certain loss of sensitivity.
- a combination of the above.

Selecting the Best Response Time

Data reduction using the RESPONSETIME function will increase your signal-to-noise ratio.

For example, see Figure 29.

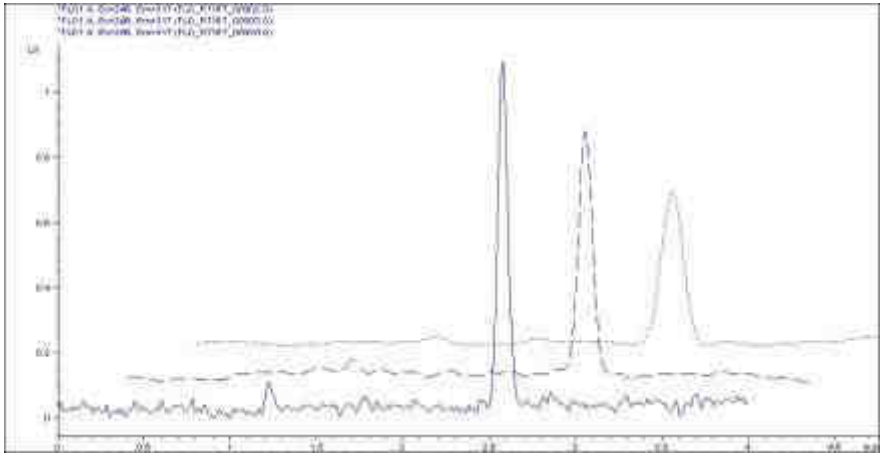
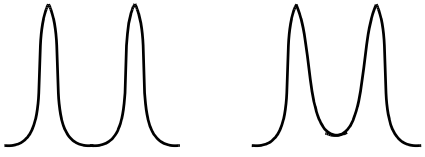


Figure 29 Finding Best Response Time

LC fluorescence detectors typically work with response times of 2 or 4 seconds. The default of the Agilent 1100 fluorescence detector is 4 seconds. It is important to know that comparing sensitivity requires using the same response time. A response time of 4 seconds (default) is equivalent to a time constant of 1.8 seconds and appropriate for standard chromatographic conditions.



Responsetime 2 sec **Responsetime 8 sec**

Figure 30 Separation of Peaks using Responsetime

Reducing Stray Light

Cut-off filters are used to remove stray light and 2nd order or higher stray light by allowing complete transmission above the cut-off and little or no transmission below the cut-off point. They are used between excitation and emission gratings, to prevent any stray excitation light from reaching the photomultiplier tube, when it is measuring emission.

When the emission and excitation wavelengths are close together, the distortion due to scattering severely limits the sensitivity. When the emission wavelength is twice the excitation wavelength the 2nd order light is the limiting factor. To explain the effect of such higher order light, assume the detector is on, but no sample is eluting through the flow cell.

The lamp sends 1 million photons into the flow cell at, for example 280 nm. Scattering on the surface of the flow cell and scattering from the molecules of solvent allow 0.1% of this light to leave the cell through the window at right angles to the incident light. Without a cut-off filter, these remaining 1000 photons will reach the emission grating. 90% will be reflected totally without dispersion onto the photomultiplier. The other 10% disperses at 280 nm (1st order) and at 560 nm (2nd order). To remove this stray light, you need a cut-off filter around 280 nm.
Because of a known set of applications a 295 nm cut-off filter is built-in for undisturbed application up to 560 nm without compromises (see Figure 31 on page 75).

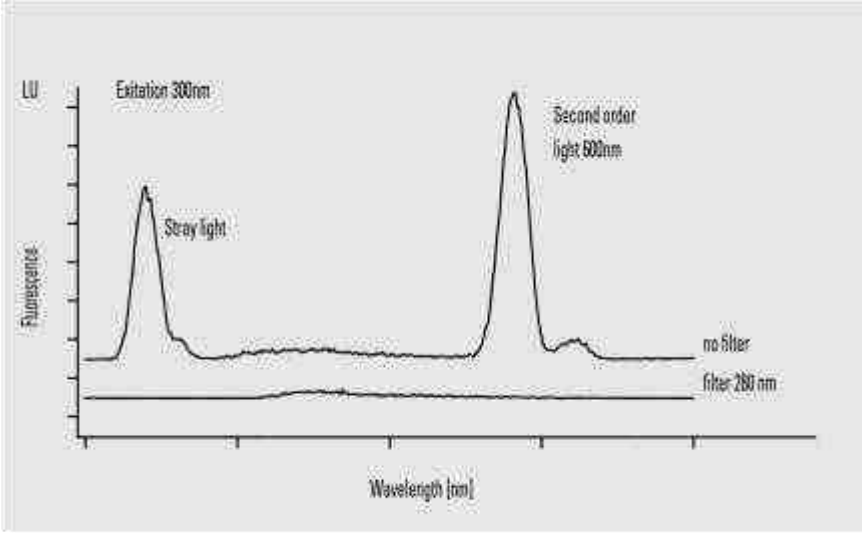


Figure 31 Reducing Stray Light



4
Troubleshooting and Test Functions

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Wavelength Verification and Calibration 105

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Test Functions 118



Agilent Technologies

Overview of the Detector's Indicators and Test Functions

Status Indicators

The detector is provided with two status indicators which indicate the operational state (prerun, run, and error states) of the detector. The status indicators provide a quick visual check of the operation of the detector (see page 79).

Error Messages

In the event of an electronic, mechanical or hydraulic failure, the detector generates an error message in the user interface. For each message, a short description of the failure, a list of probable causes of the problem, and a list of suggested actions to fix the problem are provided (see "Error Messages" on page 81).

Wavelength Recalibration

Wavelength recalibration is recommended after repair of internal components to ensure correct operation of the detector. The detector uses specific properties of the excitation and emission light characteristics, see "Wavelength Verification and Calibration" on page 105).

Test Functions

A series of test functions are available for troubleshooting and operational verification after exchanging internal components (see "Test Functions" on page 118).

Status Indicators

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

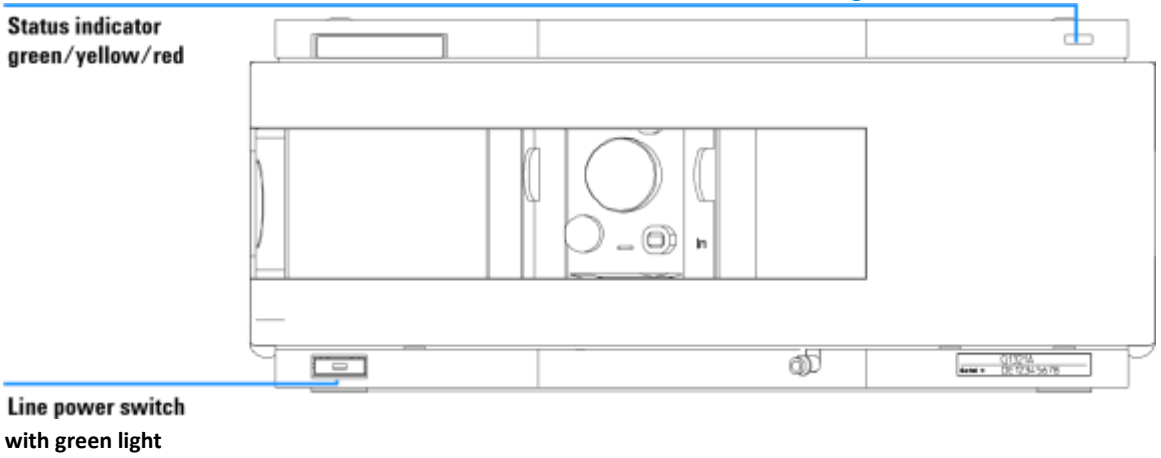


Figure 32 Location of Status Indicators

Power Supply Indicator

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

Detector Status Indicator

The detector status indicator indicates one of four possible detector conditions:

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

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 detector is switched on, and an entry is written into the detector logbook.

This section describes the meaning of detector error messages, and provides information on probable causes and suggested actions how to correct error conditions.

Time-out

The time-out threshold was exceeded (set in sequence parameter on the Agilent ChemStation or Configure-LC system).

Probable Causes

- The analysis was completed successfully, and the time-out function switched off the pump as requested.
- A not-ready state was present during a sequence or multiple-injection run for a period longer than the time-out threshold.

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

Shutdown

An external instrument has generated a shut-down signal (through CAN or REMOTE lines).

The detector 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 Causes

- Leak detected in an external instrument with a remote connection to the system.
- Shut-down in an external instrument with a remote connection to the system.
- The degasser failed to generate sufficient vacuum for solvent degassing.

Suggested Actions

✓ Fix the leak in the external instrument before restarting the pump.

✓ Check external instruments for a shut-down condition.

✓ Check the degasser for an error condition. Refer to the *Reference Manual* for the Agilent 1100 Series vacuum degasser.

Remote Time-out

A not-ready condition is still present on the remote input.

When an analysis is started, the system expects all not-ready conditions (e.g. 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 Causes

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

Suggested Actions

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

✓ Exchange the remote cable.

✓ Check the instrument for defects (refer to the instrument's reference documentation).

Synchronization Lost

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 Causes

- CAN cable disconnected.
- Defective CAN cable.
- Defective main board in another module.

Suggested Actions

✓ Ensure all the CAN cables are connected correctly.

✓ Switch off the system. Restart the system, and determine which module or modules are not recognized by the system.

✓ Ensure all CAN cables are installed correctly.

Leak

A leak was detected in the detector.

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 FLM board.

Probable Causes

- Loose fittings.
- Broken capillary.
- Leaking flow cell.

Suggested Actions

✓ Ensure all fittings are tight.

✓ Exchange defective capillaries.

✓ Exchange flow cell.

formation

Detector leak error may be caused by the Agilent 1100 sampler. In each sampler injection sequence, step# 2 ejects the mobile phase stored in the metering head during the previous injection. This mobile phase is ejected through the short plastic tube connected to port# 4 of the sampler switching valve. The output of port# 4 is integrated into the sampler's contingency leak drain system, which eventually terminates in the leak pan of the bottom module of the stack - the detector. With normal injection volumes and run times, the output of port# 4 is small, and evaporates right in the sampler leak pan. However, the output of port# 4 is significant, and a substantial volume of ejected mobile phase reaches the detector leak pan.
There are two possible fixes. Select the one which is most convenient.

1. The waste drain plumbing orientation, shown in step 6 on page 28, eliminates the possibility of any leak drainage from above reaching the detector leak pan. The leak drain for the detector can be connected to the detector's leak drain fitting, and taken to waste separately.
2. If it is desired that the system has only one leak drain tube, then it's possible in increase the length of the small plastic tube which is connected to port# 4 of the sampler switching valve. This tube can then be taken to waste separately. The tube which normally serves as the detector cell outlet tube can be used for this purpose.

Leak Sensor Open

The leak sensor in the detector 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 Causes

- Leak sensor not connected to the FLM board.
- Defective leak sensor.

Suggested Actions

✓ Ensure the leak sensor is connected correctly.

✓ Exchange the leak sensor.

Leak Sensor Short

The leak sensor in the detector 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 Causes

- Defective leak sensor.

Suggested Actions

✓ Exchange the leak sensor.

Compensation Sensor Open

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

The resistance across the temperature compensation sensor (NTC) on the FLM 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 Causes

- Defective FLM board.

Suggested Actions

✓ Exchange the FLM board.

Compensation Sensor Short

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

The resistance across the temperature compensation sensor (NTC) on the FLM 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 Causes

- Defective FLF board.

Suggested Actions

✓ Exchange the FLF board.

Fan Failed

The cooling fan in the detector has failed.

The hall sensor on the fan shaft is used by the FLM board to monitor the fan speed. If the fan speed falls below two revolutions/second for more than five seconds, the error message is generated.

Probable Causes

- Fan cable disconnected.
- Defective fan.
- Defective FLM board.

Suggested Actions

✓ Ensure the fan is connected correctly.

✓ Exchange fan.

✓ Exchange the FLM board.

Motor Errors

NOTE Monochromator motor errors may show up during the **initialization** or during **operation** of the detector.

There are individual messages for either the excitation or the emission side.

If an error occurs, do a lamp ignition. This will clear the error and a re-initialization of the motors is performed.

Table 17 Motor Errors

Message	Description	Probable Causes	Suggested Actions
Motor Or Encoder Not Found EX 6705 EM 6706	During initialization of the detector, the excitation and emission monochromator are activated.	encoder cables mixed on FLM board monochromator assembly not connected monochromator or encoder defective monochromator motor power driver defective	check encoder connections to FLM check motor connections to FLF (Ex) and FLM (Em) and encoders to FLM replace monochromator assembly defective FLF board (Ex) or FLM board (Em)
Encoder Index Not Found EX 6707 EM 6708	During initialization of the detector, the excitation- and emission monochromator are activated and the encoder should generate an index.	encoder defective encoder electric defective monochromator defective or missing one phase monochromator motor power driver defective	replace monochromator assembly replace FLM board check for connection to FLF (Ex) and FLM (Em) or replace monochromator assembly defective FLF board (Ex) or FLM board (Em)

Table 17 Motor Errors, continued

Message	Description	Probable Causes	Suggested Actions

Motor Friction Too High EX 6709 EM 6710	During initialization of the detector, the excitation and emission grating resistance test provides the resistance history of the excitation and the emission grating drives. The number of revolutions after switching off the drives is a measure of friction. The history may show an increasing friction of the drive(s) over a length of time.	friction too high defective monochromator assembly	replace monochromator assembly replace monochromator assembly
Motor Position Not Found EX 6711 EM 6712	When the wavelength is changed the monochromator should move to the new position. The position could not be found.	defective monochromator assembly	reset monochromator settings replace monochromator assembly
Motor Position Lost EX 6713 EM 6714	A mechanical shock to the instrument during operation may cause a movement of the monochromator. The position is lost and the lamp will turn off.	short mechanical shock message appears intermittently without mechanical shock	re-ignite the lamp replace monochromator assembly
Motor Speed Too Low EX 6715 EM 6716	For proper operation the monochromator gratings must run at a certain constant revolution.	revolution too low	replace monochromator assembly
Motor Speed Unstable EX 6717 EM 6718	For proper operation the monochromator gratings must run at a certain constant revolution.	defective monochromator assembly	re-ignite the lamp replace monochromator assembly.
Motor Encoder Index Wrong EX 6717 EM 6718	The actual encoder pattern is checked against a known pattern	encoder was replaced and has a different pattern or no reset of pattern was made encoder lost position completely	reset pattern via user interface and recalibrate replace monochromator assembly

Lamp Cover Open

The lamp cover in the optical compartment has been removed. The lamp cannot be turned on while this message is on.

Probable Causes

• lamp cover removed.

Suggested Actions

✓ close lamp cover and tighten the screws.

FLF Board not found

The FLF board could not be found by the main board (FLM). This message comes together with some other message generated on the FLF board (e.g. Leak, ...).

Probable Causes

- FLF board not connected to the FLM board.
- defective FLF board.
- defective FLM board.

Suggested Actions

✓ Check the connection between the FLF board and the FLM board.

✓ Exchange the FLF board.

✓ Exchange the FLM board.

ADC Not Calibrated

The analog-to-digital converter located on the FLF board cannot calibrate.

Probable Causes

• defective ADC or other FLF electronics.

Suggested Actions

✓ Exchange the FLF board.

A/D Overflow

This message is not implemented in firmware revision A.03.66 and below.

It indicates an overload situation of the A/D converter (sample signal). The user-interface will show a not-ready condition for the FLD and an info event is written into the logbook. If the message comes up during a run, it includes the time of occurrence and when it disappears.

```
1100  FLD 1 A/D overflow (RT is 0.32 min) 16:33:24 02/11/ 99
1100  FLD 1 A/D overflow finished (RT is 0.67 min)16:33:46 02/11/ 99
```

NOTE If this condition is present prior to a run, the not-ready will prevent the system to start the run/sequence.

Probable Causes

- PMT setting to high
- wavelength setting wrong.

Suggested Actions

✓ reduce PMT gain

✓ change wavelength setting.

Flash Lamp Current Overflow

The lamp current of the xenon flash lamp is monitored constantly. If the current gets too high, an error is generated and the lamp is turned off.

Probable Causes

- shortage of flash lamp assembly • shortage of trigger pack assembly.
- defective FLL board.

Suggested Actions

✓ Exchange the flash lamp assembly.

✓ Exchange the FLL board (includes the trigger pack).

Flash Trigger Lost

This message is displayed when the flash trigger is no longer generated.

Probable Causes

- firmware problem
- defective encoder

Suggested Actions

✓ Reboot the detector (power cycle).

✓ Multi Mode Off: exchange the firmware or replace the main board.

✓ Multi Mode Ex: replace EX monochromator assembly.

✓ Multi Mode Em: replace EM monochromator assembly.

Wavelength Calibration Failed

This message may show up during a wavelength calibration.

If the expected deviation is larger than the specified wavelength accuracy, the message "Wavelength *Calibration Failed*" is displayed and the instrument stays in a *Not Ready* condition.

Probable Causes

- Flash lamp not ignited or position not correct.
- Cell position not correct.
- Solvent in the cell not clean or air bubble in the cell.
- monochromator assembly position not correct (after replacement).

Suggested Actions

✓ Check the flash lamp image and position. See also "No Peaks" on page 104.

✓ Check the cell position.

✓ Flush the flow cell.

✓ Reset monochromator settings and re-run the wavelength calibration.

Wavelength Calibration Lost

After exchanging the monochromator assemblies, the calibration factors should be reset to defaults values (a new FLM board comes with default values). In this case "*Wavelength Calibration Lost"* is displayed and the instrument stays in a *Not Ready* condition.

Probable Causes

- Reset of monochromator settings after exchange.
- Replacement of FLM board.

Suggested Actions

✓ Perform a wavelength calibration.

Flow Cell Removed

The detector has an automatic cell recognition system. When the flow cell is removed, the lamp is turned off and a NOT READY condition exists. If the flow cell is removed during an analysis, a SHUT DOWN is generated.

Probable Causes

- Flow cell has been removed during analysis.

Suggested Actions

✓ Insert flow cell and turn on the lamp.

No Peaks

If no peaks are shown in the chromatogram, the user-interface shows the module still in "Ready". There is no feedback mechanism that checks whether the lamp is on.

Probable Causes

- defective FLL board / Trigger pack
- defective Xenon flash lamp
- wrong position of monochromator
- FLF board defective

Suggested Actions

✓ Perform a "Lamp Intensity Test" on page 119. If no profile available (very low counts),

✓ replace FLL board / Trigger pack

✓ replace Xenon flash lamp

✓ perform a "Check of Raman Band of Water" on page 108 to check the wavelength calibration.

✓ replace FLF board

Wavelength Verification and Calibration

The wavelength calibration is based on a Glycogen solution, which acts as a strong elastic light scatterer (refer to ASTM Test Method E388-72-1993 "*Spectral Bandwidth and Wavelength Accuracy of Fluorescence Spectrometers*"). The Glycogen solution is introduced into the flow cell and then the built-in wavelength calibration functionality is used.

The algorithm is based on evaluating different grating orders and calculating the wavelength scales of both, excitation and emission monochromator, by applying the fundamental grating equation.

A complete wavelength calibration is not always required. In most cases a quick wavelength accuracy verification is sufficient enough, see the table below.

NOTE

Table 18 Reasons for doing a Verification or Calibration

	Verification	WL calibration
interest	X	
GLP compliance	X	
cell change	X	(X)
lamp change	X	(X)
monochromator change		X
main board change		X
optical unit change		X

(X) only required, if deviation is too large.

NOTE

Prior to a wavelength calibration, a wavelength accuracy verification should be performed, see "Check of Raman Band of Water" on page 108. If the deviation is more than ±3 nm, the wavelength calibration should be done as described in "The Wavelength Calibration Procedure" on page 114.

NOTE

The duration of the wavelength calibration is about 15 minutes plus setup time for the calibration sample and system. Depending on the maximum intensity found during this scan, the PMT gain will be changed automatically and requires an additional 1 minute per scan.

Table 19 on page 107 shows the steps performed during the wavelength calibration.

The excitation grating and the emission grating are calibrated using Rayleigh stray light from the flow cell or cuvette measured with the photomultiplier tube.

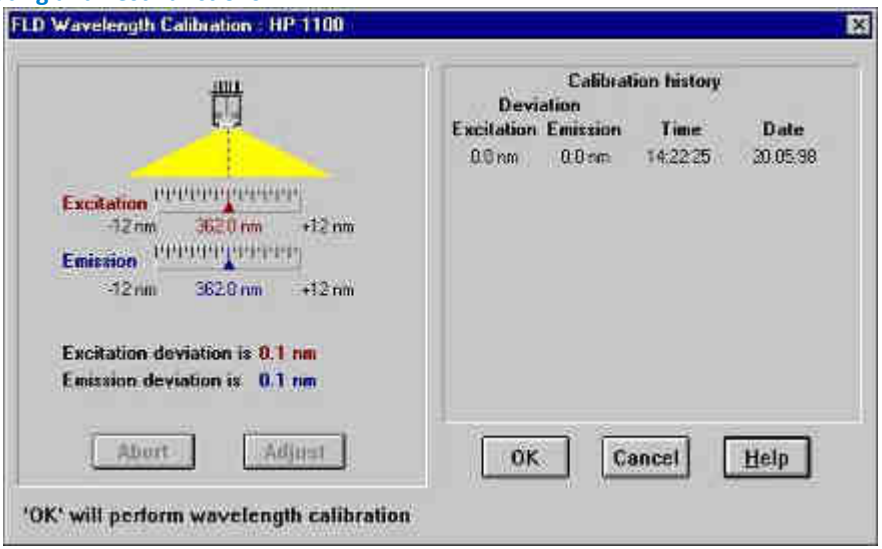


Figure 33 Wavelength Calibration - User Interface

Table 19 Wavelength Calibration Steps

Step	Description	Duration
1	Preparation	max 30 s
2	Excitation rotation scan, full circle	60 s
3	Excitation rotation scan, high resolution	44 s
4	Excitation position scan, low resolution	55 s variable
5	Excitation position scan, high resolution	260 s variable
6.n	Emission rotation scan, full circle (# of scans depends on the required PMT gain, 1 minute per scan)	61 s variable
6.n	Em rotation scan, full circle" (instrument profile)	9 s
6.n	Em rotation scan, full circle" (instrument profile)	9 s
6.n	Em rotation scan, full circle" (instrument profile)	9 s
6.n	Em rotation scan, full circle" (instrument profile)	9 s
7	Emission rotation scan, high resolution, part I	44 s

8	Emission rotation scan, high resolution, part II	44 s
9	Emission position scan, low resolution	50 s variable
10	Emission position scan, high resolution	250 s variable

Notes:

1 Variable times means that they could be a little bit longer.

2 Steps “6.n Em rotation scan, full circle" (instrument profile)” have been added with firmware revisions A.03.64 .

NOTE When the lamp is of, the calibration process will stop within the first two steps with “ Wavelength Calibration Failed” , see “Wavelength Calibration Failed” on page 101.

Check of Raman Band of Water

This test is a verification of the wavelength calibration, described in section “Wavelength Verification and Calibration” on page 105, using the Raman band of water.

NOTE This test requires the Agilent ChemStation Spectra module or the Control Module and a running HPLC system.

Using the Agilent ChemStation

1 Set up the HPLC system and the ChemStation.

1 Flush the flow cell with clean bi-distilled water.

2 Turn on the FLD lamp.

3 Select “**Verification (OQ/PV)**”.

4 Create a **New Instrument Verification**.

5 Select the “Excitation Wavelength Accuracy” and the “Emission Wavelength Accuracy” checks (Raman Band of Water).

6 Set the limits to 3 nm on both tests.

7 Run the verification.

8 The FLD will change into the multi-excitation mode with emission wavelength at 397 nm and scan in the range of the expected maximum of 350 nm ±20 nm.

As result, the maxima should be found at 350 nm ±3 nm, see Figure 34 on page 109.

The FLD will change into the multi-emission mode with excitation wavelength at 350 nm and scan in the range of the expected maximum of 397 nm ±20 nm.

As result, the maxima should be found at 397 nm ±3 nm, see Figure 35 on page 109.

If the limits are not met, check for "Interpretation of the Results" on page 125 or perform "The Wavelength Calibration Procedure" on page 114.

NOTE

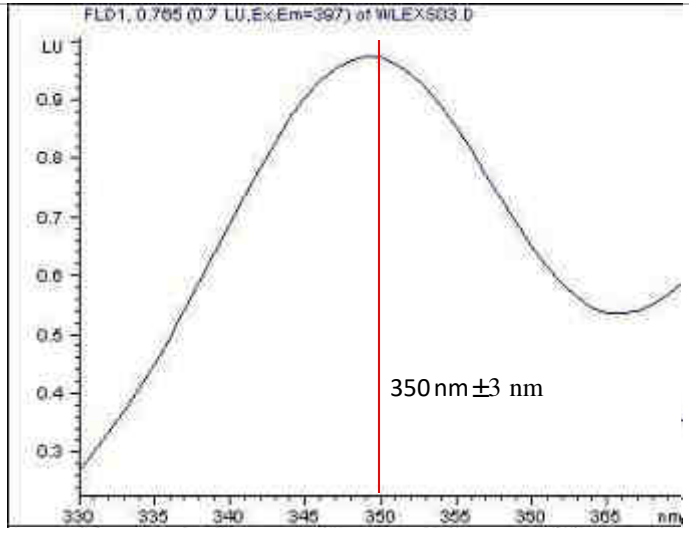


Figure 34 Excitation Spectrum

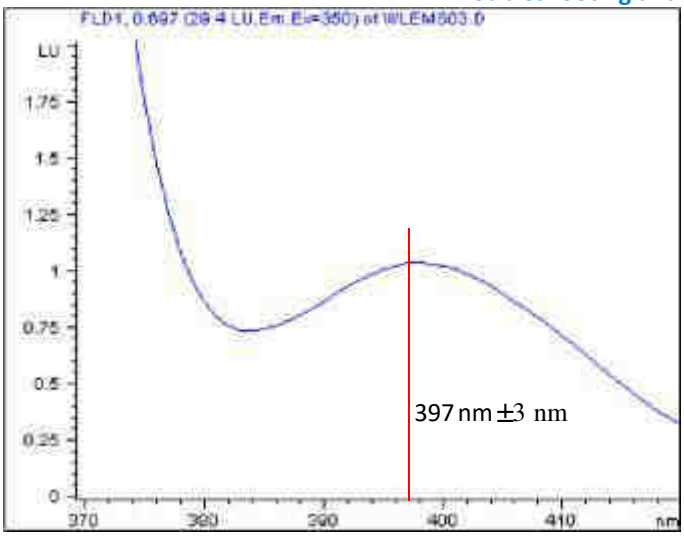


Figure 35 Emission Spectrum

Using the Control Module

1 Create the methods WLEMTEST and WLEXTEST as listed Table 20 on page 113.

2 Copy the methods to your PC card and re-boot the control module.

3 On the *Analysis* screen press the *Method* button and copy the methods into the module.

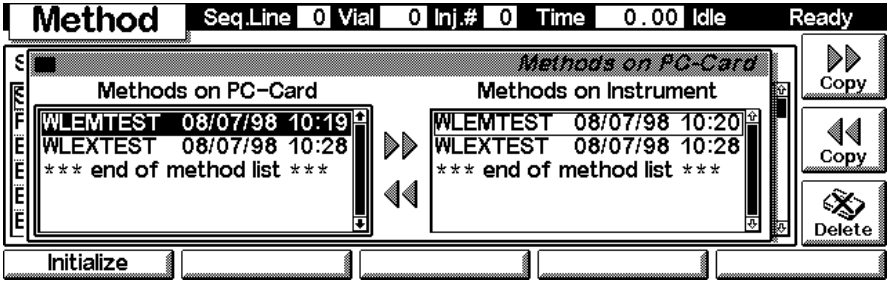


Figure 36 Copying Methods into the FLD

4 Load the method WLEXTEST. The FLD will change into the multi-emission mode and scan in the range of the expected maximum of 397 nm ±20 nm.

5 Turn the pump on and flush with water for a few minutes to assure a clean flow cell. Flow rate should be 0.5 to 1 ml/min and the baseline stable.

You may remove the flow cell and check for air bubbles. After re-inserting the cell, turn the lamp on.

NOTE

6 From the *Analysis* screen select *Settings - FL Detector*. Press then the *Spectrum* button will open the window below.

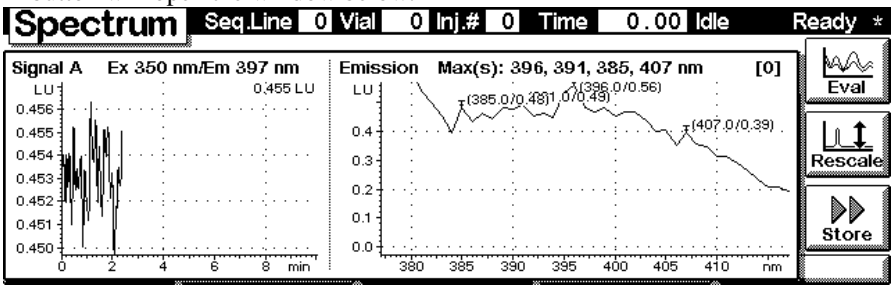


Figure 37 Online Emission Spectra

7 Press the *Store* button a few times to store a few spectra in a temporary buffer.

8 Press the *Eval* button to change to the following screen.

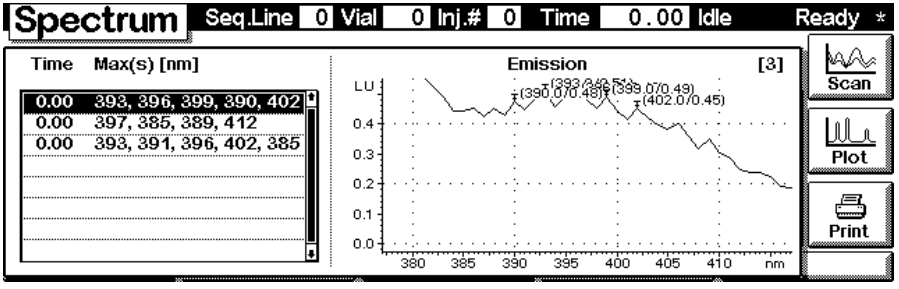


Figure 38 Evaluating Online Emission Spectra

9 You can now select a stored spectra and evaluate/print them. The maximum should be found at 397 nm ±3 nm.

10 Load the method WLEMTEST. The FLD will change into the multi-excitation mode and scan in the range of the expected maximum of 350 nm ±20 nm.

11 Repeat steps step 6 to step 8.

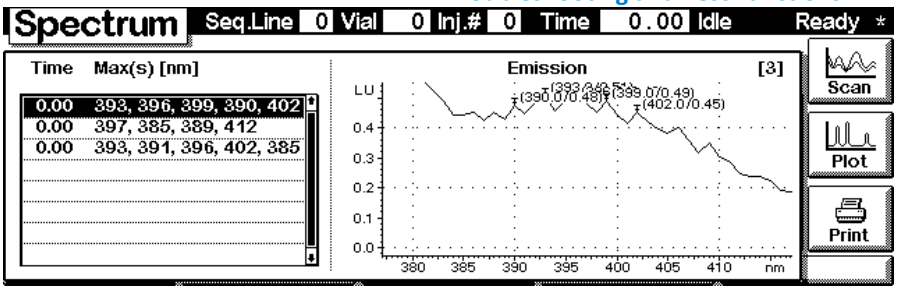


Figure 39 Evaluating Online Excitation Spectra

12 You can now select a stored spectra and evaluate/print them. The maximum should be found at 350 nm ±3 nm.

NOTE The spectra on the control module is a real raw data spectrum. Therefore it looks not that smooth as on the Agilent ChemStation (uses the spline algorithm).

NOTE If the limits are not met, check for "Interpretation of the Results" on page 125 or perform "The Wavelength Calibration Procedure" on page 114.

Method Settings

Table 20 Method Settings

Setting	Value in WLEXTEST	Value in WLEMTEST
Peak Width	>0.2 min (4 s, standard)	>0.2 min (4 s, standard)
Fit Spectral Range	OFF	OFF
PMT Gain	12	12
Flash Lamp	ON	ON
Spectrum Range	EX 377 - 417 nm step 1 nm	EM 330 - 370 nm step 1 nm
Store Spectra	All w/o signal	All w/o signal
EX Wavelength	350 nm, ON	350 nm, OFF

EM Wavelength	397 nm, OFF	397 nm, ON
Multi WL Settings	Multi EX	Multi EM

The Wavelength Calibration Procedure

When required	If application requires, or see Table 18 on page 105.
Tools required	Laboratory balance
Parts required	Glycogen Calibration Sample, Syringe, needle, sample filter and PEEK fitting from the Accessory Kit, see "Accessory Kit" on page 216

Steps

1 Preparation of the Glycogen Calibration Sample.

2 Preparation of the Flow Cell.

3 Wavelength Calibration.

4 Verification using "Check of Raman Band of Water" on page 108.

Preparation of the Glycogen Calibration Sample

1 To prepare 10 ml of the calibration solution you have to use 10 mg of the Glycogen sample (a tolerance of ±20 % is not critical).

2 Fill the prepared amount into a suitable bottle/vial.

3 Fill 10 ml of distilled water into the vial and shake.

4 Wait 5 minutes and shake again. After 10 minutes the solution is ready.

Preparation of the Flow Cell

1 Flush the flow cell with water.

2 Remove the inlet capillary from the flow cell.

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

4 Suck about 1.0 ml of the calibration sample into the syringe.

5 Keep the syringe in a horizontal position.

6 Remove t#he needle.

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

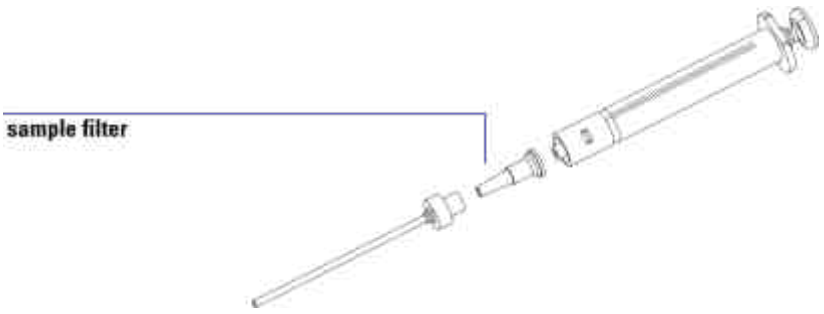


Figure 40 Syringe with Sample Filter

8 Lift the needle tip and carefully eject approximately 0.5 ml to remove air out of the syringe and to flush the needle.

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

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

---

10 Slowly inject about 0.2 ml and wait for about 10 seconds to inject another 0.1 ml. This will assure that the cell is filled properly.

Wavelength Calibration

1 From the user interface start the FLD Wavelength Calibration (see Figure 41).

Agilent ChemStation: *Diagnosis - Maintenance - FLD Calibration* Control Module: *System - Tests - FLD - Calibrate*.

NOTE If the wavelength calibration process fails, refer to "Wavelength Calibration Failed" on page 101.

---

2 If a deviation is displayed, press Adjust and OK. The history table will be updated.

NOTE

To look at the history table (ChemStation) start a wavelength calibration and abort immediately. No changes are made to the calibration at this time.

NOTE Rinse the flow cell with pure water at a minimum of 1.5 ml/min to get rid of the Glycogen from the cell and the capillaries. When organic solvent is sequentially applied (without rinsing), a blockage of capillaries may occur.

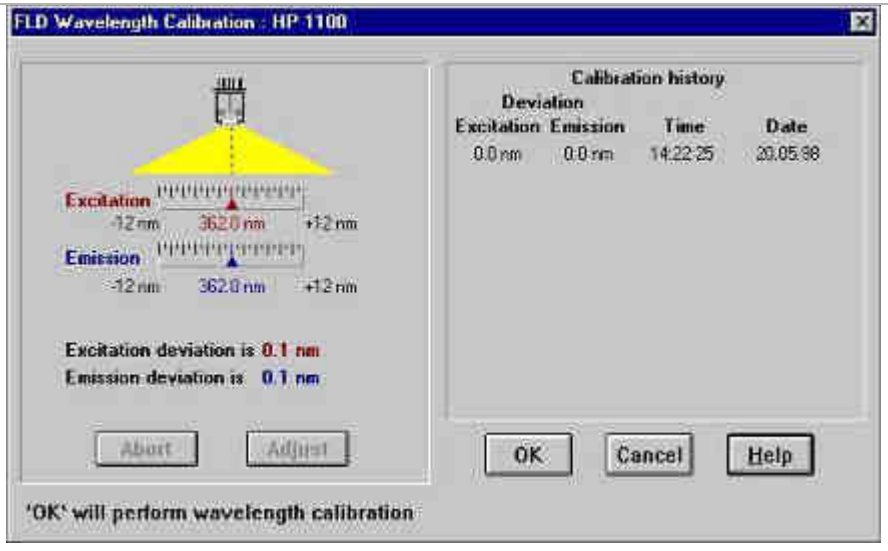


Figure 41 Wavelength Calibration - User Interface

Verification

1 Refit the capillary to the flow cell.

2 Follow the procedure "Check of Raman Band of Water" on page 108.

Test Functions

The light path is shown in Figure 42.

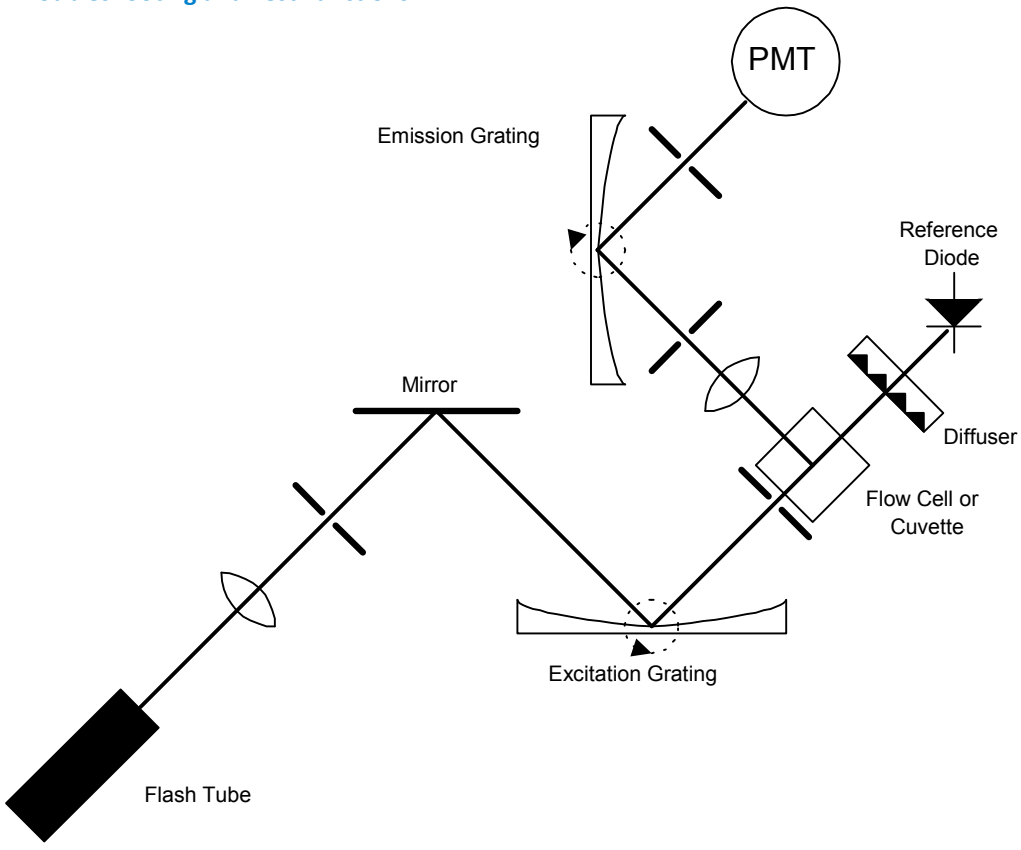


Figure 42 Schematic of the Light Path

Lamp Intensity Test

The intensity test scans an intensity spectrum via the reference diode (200 - 1200 nm in 1 nm steps) and stores it in a diagnosis buffer. The scan is displayed in a graphic window. There is no further evaluation of the test.

Results of this test are stored as lamp history (date code, intensity).

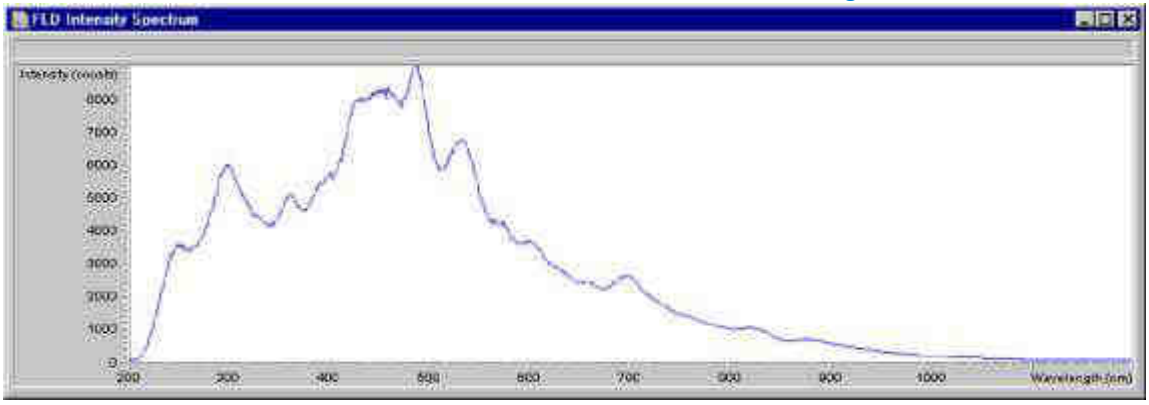


Figure 43 Lamp Intensity Test (typical)

NOTE The profile can vary from instrument to instrument. It is dependig on the age of the lamp and the content of the flow cell (use fresh water).

UV degradation, especially below 250 nm is significantly higher compared to visible wavelength range. Generally the "LAMP ON during run" setting or using "economy mode" will increase lamp life by a magnitude.

Lamp Intensity History

Results of the lamp intensity test (if the last one is older than one week) are stored as lamp history (date code, intensity of four different wavelengths, 250 nm, 350 nm, 450 and 600 nm) in a buffer. The data/plot can be retrieved via the diagnostics and provides intensity data over a length of time.

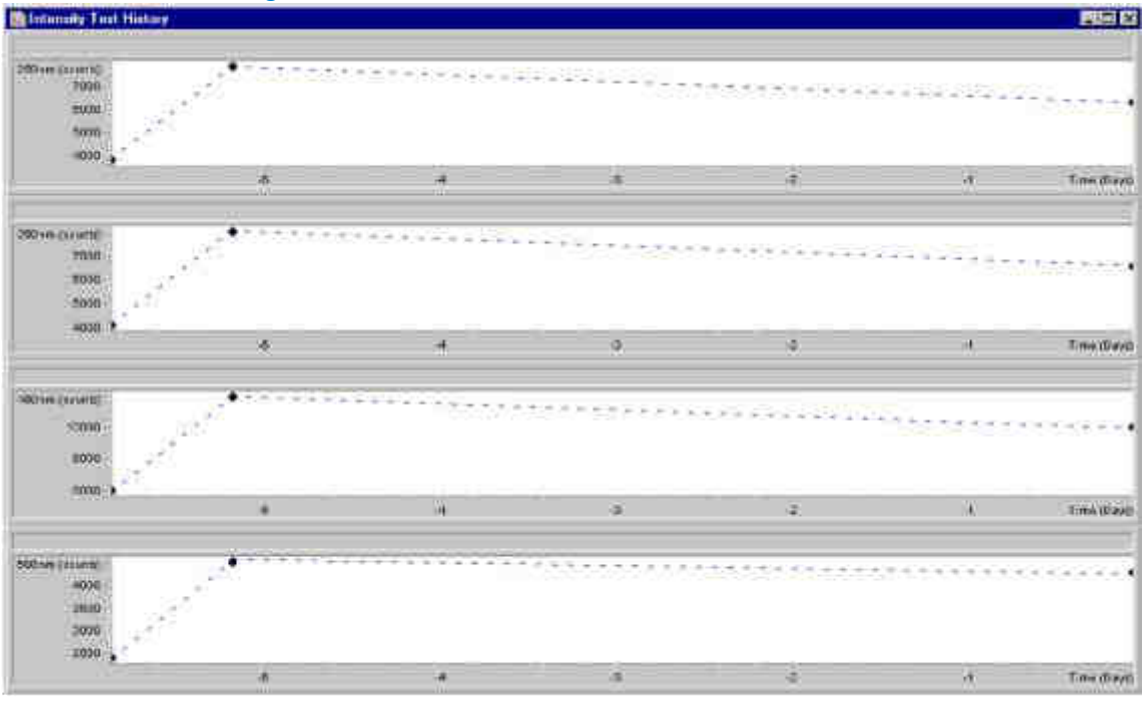


Figure 44 Lamp Intensity History

Dark-Current Test

The dark-current test measures the PMT signal with maximum and minimum gain while the lamp is off. It also reads the signal of the reference diode. The resulting values (two via reference diode and two from PMT) are shown in a table and checked against reasonable limits (see below).

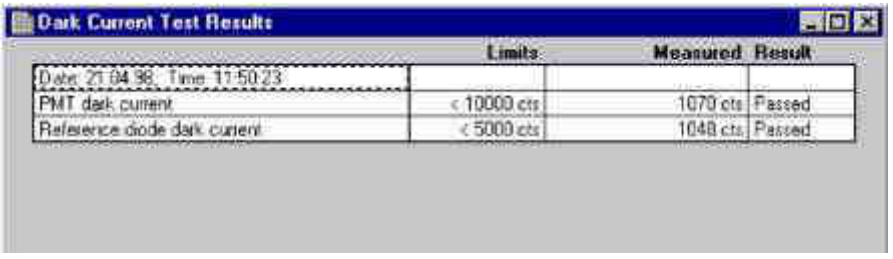


Figure 45 Dark-Current Test

Dark-Current Test Evaluation

Test Failed

Probable Causes

- Defective PMT.
- Defective reference diode or A/D converter

Suggested Actions

✓ Exchange the PMT.

✓ Exchange the FLF board

Excitation and Emission Grating Resistance History

This test runs automatically when the instrument is turned on (not accessible as an external test).

It provides the resistance history of the excitation and the emission grating drives. The number of revolutions after switching off the drives is a measure of friction. The history may show an increasing friction of the drive(s) over a length of time.

The history data contains the data/time information and the number of turns. The data/plot can be retrieved via the diagnostics.

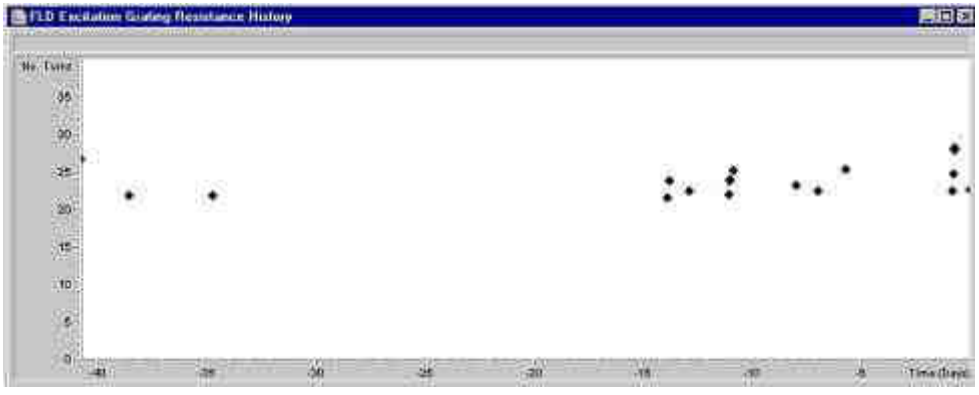


Figure 46 Resistance History

Friction Evaluation

Motor Error

Probable Causes

- Friction too high (< 12 turns)
- Defective monochromator assembly.

Suggested Actions

✓ Exchange the monochromator assembly.

Raman ASTM Signal-to-Noise Test

This test verifies the Raman ASTM signal-to-noise.

Table 21 Raman Signal-to-Noise Test Conditions

Duration	approximately 23 minutes
Report Style (Agilent ChemStation)	Performance+Noise
Noise Determination	5 to 20 minutes
Solvent	LC grade water, degassed
Flow rate	0.5 - 1 ml/min

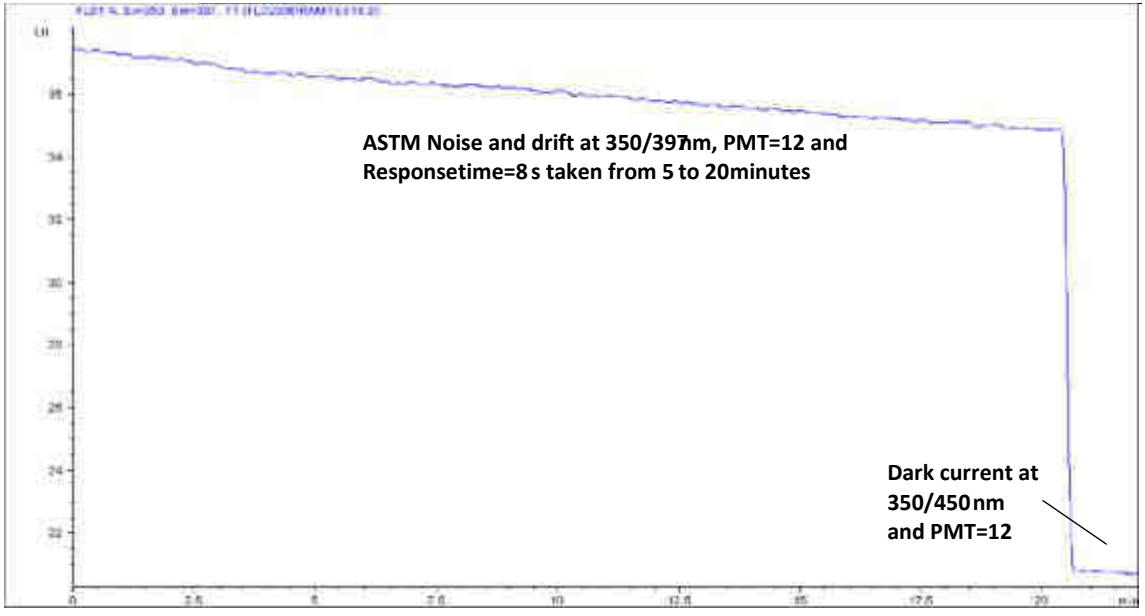


Figure 47 Raman ASTM Signal-to-Noise Test

Formula for the Raman ASTM S/N value (see Figure 48 for details):

$$RamanASTM = \frac{Height}{(RamanCurrent) - Height(DarkCurrent)}{ASTMNoise}$$

The result should be **> 200** with FLF board revision A.

The result should be **> 400** with FLF board revision B and above.

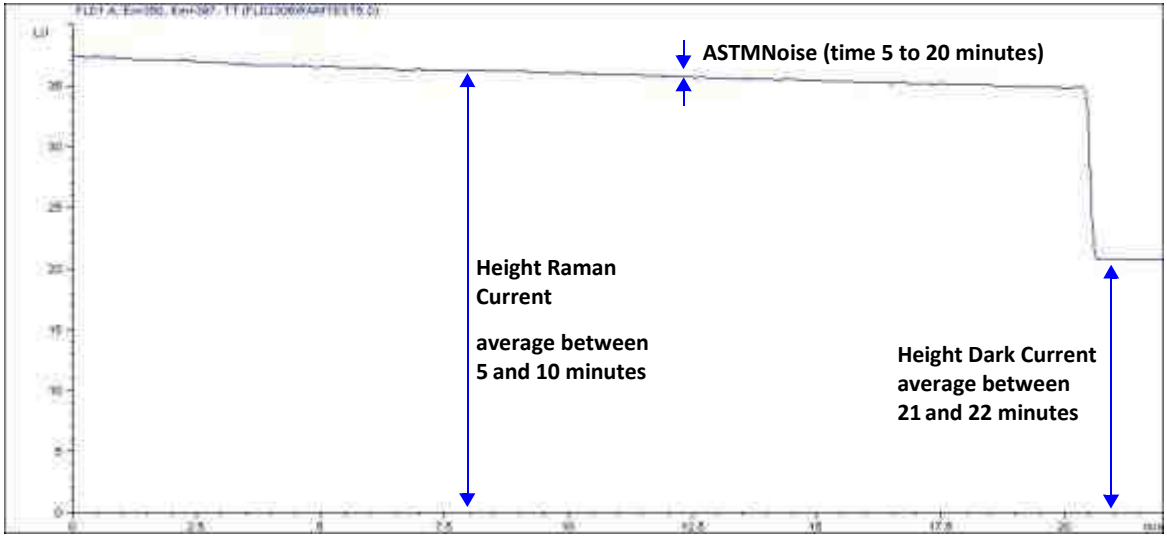


Figure 48 Raman ASTM signal/noise calculation

Procedure using an Agilent ChemStation

1 Set up the HPLC system and the ChemStation.

1 Flush the flow cell with clean bi-distilled water.

2 Turn on the FLD lamp.

3 Select "**Verification (OQ/PV)**".

NOTE Assure that the FLD signal is signal 1 (in case you use an additional detector in the system and your are using a ChemStation older than A.09.xx. Otherwise wrong calculations may be done due to wrong signals.

4 Create a **New Instrument Verification**.

5 Select the Signal to Noise/Temp. test.

6 Set the limits to 200 (revision A FLF board) or 400 (for revision B and above), see also "FLF Board revisions" on page 273.

NOTE To find out what board is installed you need at least firmware revision A.03.70 on the FLD. Refer to "How to retrieve the FLF board revision" on page 274.

7 Run the verification.

8 When the run is completed a report is displayed and the *status line* shows the *"Raman signal/noise ratio = "* value should be >200 (with FLF board revision A) or >400 (with FLF board revision B and above).

Interpretation of the Results

If the test shows low Raman values, check for:

- ✓ correctly positioned flow cell,
- ✓ clean flow cell (flush with clean bi-distilled water),
- ✓ no air bubble(s) (check via fluorescence scan or visual check of cell/cuvette),
- ✓ solvent inlet filter (may create air bubbles in flow cell).

Using the Built-in Test Chromatogram

This function is available from the Agilent ChemStation and the Control Module.

The built-in Test Chromatogram can be used to check the signal path from the detector to the ChemStation and the data analysis or via the analog output to the integrator or data system. An example is shown in Figure 49. The chromatogram is continuously repeated until a stop is executed either by means of a stop time or manually.

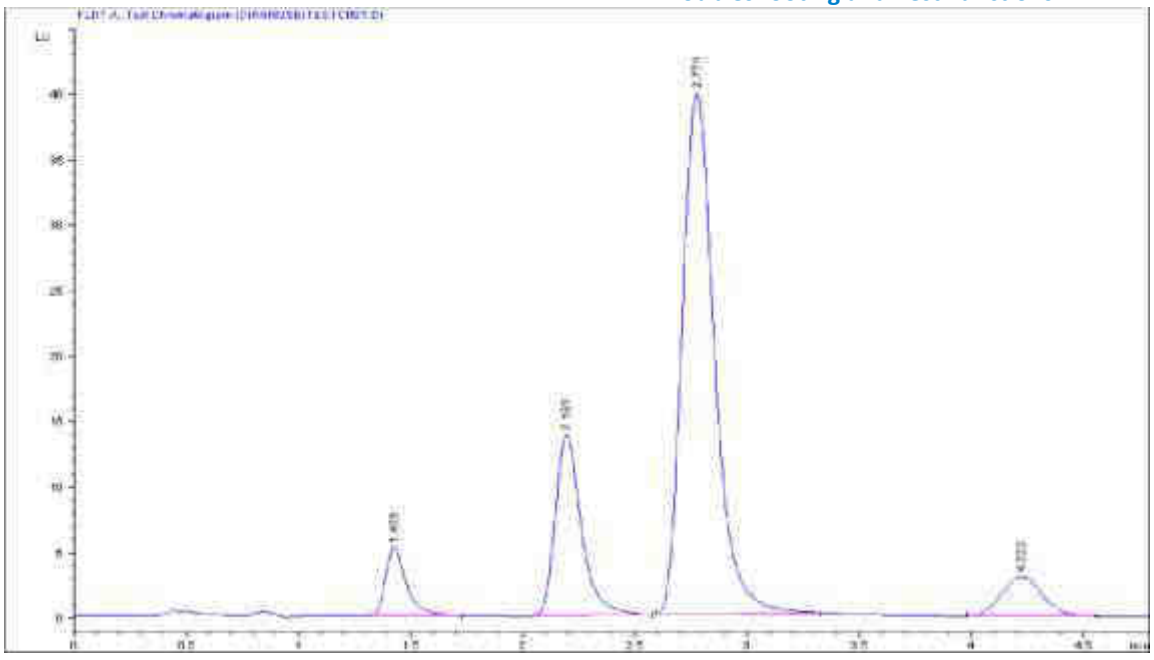


Figure 49 Built-in Test Chromatogram (default settings)

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

Table 22

Peakwidth = >0.05 min (response time = 1 s fast)	Stop time = 1.2 minutes
Peakwidth = >0.20 min (response time = 4 s STD)	Stop time = 4.8 minutes

Procedure using the Agilent ChemStation

1 Load the FLD default parameter
   - peakwidth to >0.2 minutes (standard),
   - set stop time to 4.8 minutes.

2 Complete the Sample Information (no injection).

3 Type into the command line (or as pre-run command):

   PRINT SENDMODULE$(LFLD,"SIMU:DFLT").

4 The logbook shows “Preparing for a simulation”.

5 Start the run.

The results are processed like a regular chromatogram.

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

Procedure using the Control Module

1 Load the FLD default parameter

- peakwidth to >0.2 minutes (standard),
- set stop time to 4.8 minutes.

2 Enter System - *Tests* - *FLD*.

3 Select the function *Enable test chromatogram* and press *Execute*.

The logbook shows “Simulated chromatogram enabled”.

4 Enter the *Plot* function and select *Signal A* and/or *Analog x*, set a *time range* of 10 minutes and the *FLD signal* from -1 to 50 LU.

NOTE If an Agilent ChemStation is connected, the next step will start the Agilent ChemStation simultaneously and will overwrite the previous used Data File!

5 Start the run.

After the run has finished, the plot can be printed to a connected printer by pressing the m-key and selecting *Print Plot*.

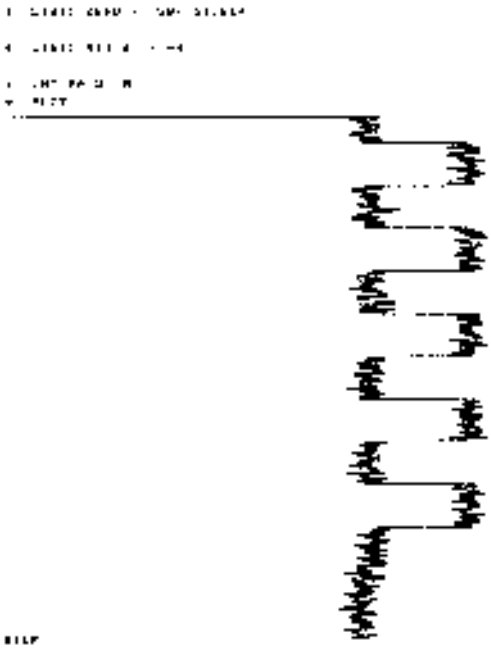
NOTE The test chromatogram is switched off automatically at the end of the run.

Using the Built-in DAC Test

This function is available from the Control Module ONLY.

The DAC test provides a test pattern as an analog output. The output voltages

(analog 1 and analog 2) should show a constant value corresponding to the ZERO OFFSET value. In addition to the constant voltage is a switched voltage with a duration of 12 seconds and a height of 10 µV, see Figure 50.



Limits:

Noise (pp) < 5 µV

Figure 50 DAC Test (Example)

1. Enable the function (*System - Tests - FLD - Enable DAC Test Pattern*).
2. Start the plot mode (e.g. Agilent 3396 with ATTN -4, ZERO=50, CS=5).
3. Stop the plot and disable the TAC Test (*System - Tests - FLD - Disable DAC Test Pattern*).
4. Evaluate the noise (should be< 5 µV).



5
Repairing the Fluorescence Detector

Introduction into Repairing the Fluorescence Detector 132
Overview of the Repairing of the Fluorescence Detector 135
Simple Repairs 136
Exchanging Internal Parts 144



Agilent Technologies

Introduction into Repairing the Fluorescence Detector

Simple Repairs

The detector is designed for easy repair. The most frequent repairs such as flow cell change can be done from the front of the detector with the detector in place in the system stack. These repairs are described in "Simple Repairs" on page 136.

Exchanging Internal Parts

Some repairs may require exchange of defective internal parts. Exchange of these parts (including flash lamp) requires removing the detector from the stack, removing the covers, and disassembling the detector. The security lever at the power input socket prevents the detector cover from being removed when line power is still connected. These repairs are described in "Exchanging Internal Parts" on page 144.

WARNING **To prevent personal injury, the power cable must be removed from the instrument before opening the detector cover. Do not connect the power cable to the detector while the covers are removed.**

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

WARNING **When working with solvents please observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.**

CAUTION Electronic boards and components are sensitive to electronic discharge (ESD). In order to prevent damage always use an ESD protection (for example, the ESD wrist

strap from the accessory kit) when handling electronic boards and components (see "Using the ESD Strap Electronic boards are sensitive to electronic discharge (ESD). In order to prevent damage, always use an ESD strap supplied in the standard accessory kit (see "Accessory Kit" on page 216) when handling electronic boards and components." on page 133).

There is a risk of damaging hardware due to overheating when operating the instrument without covers.

CAUTION

WARNING **Eye damage may result from directly viewing the light produced by the Xenon flash lamp used in this product. Always turn the xenon flash lamp off before removing it.**



Cleaning the Detector

The detector case should be kept clean. Cleaning should be done with a soft cloth slightly dampened with water or a solution of water and mild detergent. Do not use an excessively damp cloth allowing liquid to drip into the detector.

WARNING **Do not let liquid drip into the detector. It could cause shock hazard and it could damage the detector.**

Using the ESD Strap Electronic boards are sensitive to electronic discharge (ESD). In order to prevent damage, always use an ESD strap supplied in the standard accessory kit (see "Accessory Kit" on page 216) when handling electronic boards and components.

1. Unwrap the first two folds of the band and wrap the exposed adhesive side firmly around your wrist.
2. Unroll the rest of the band and peel the liner from the copper foil at the opposite end.
3. Attach the copper foil to a convenient and exposed electrical ground.

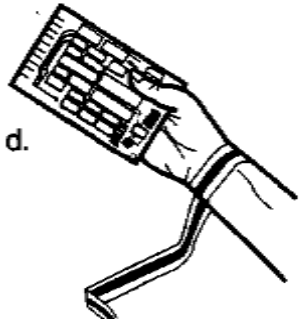


Figure 51 Using the ESD Strap

Overview of the Repairing of the Fluorescence Detector

Figure 52 shows the main assemblies and their locations.

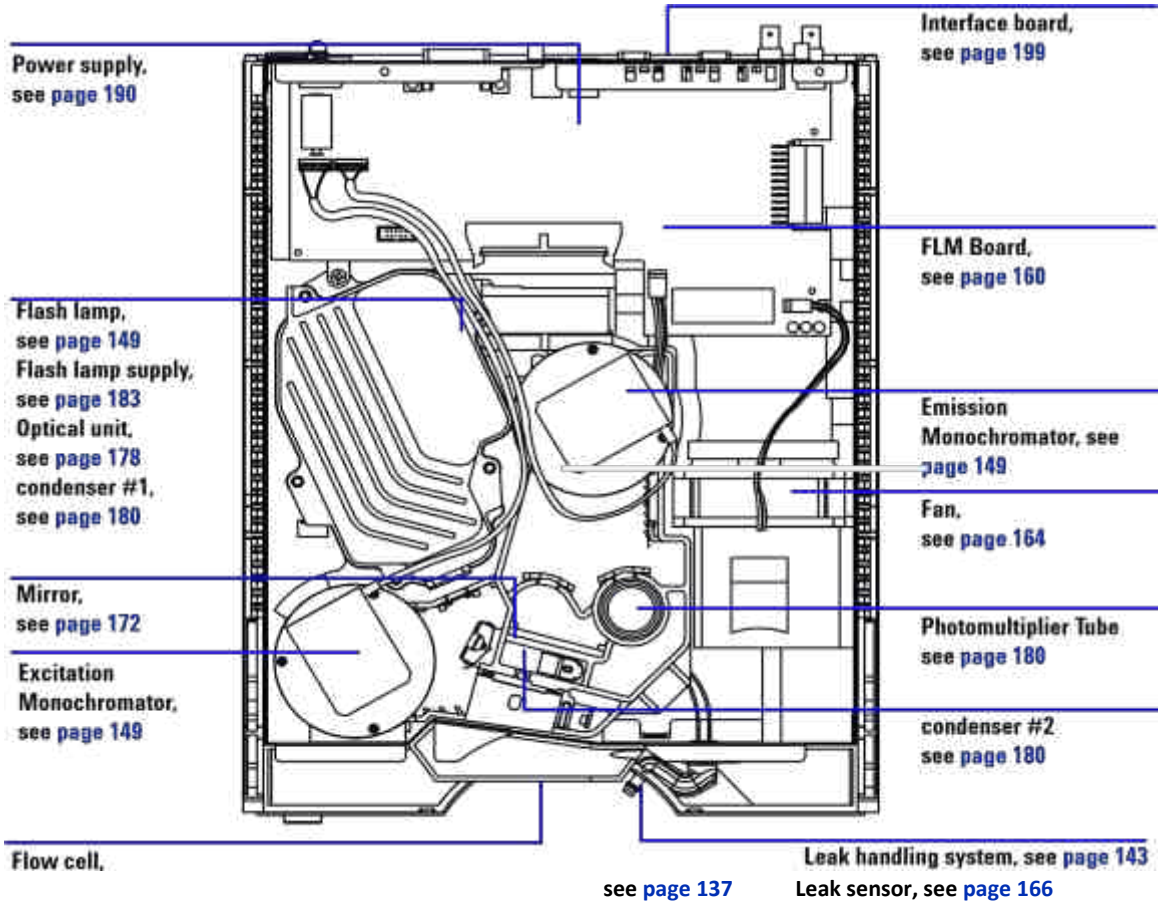


Figure 52 Main Assemblies

Simple Repairs

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

Table 23 Simple Repairs

Procedure	Typical Frequency	Notes
Flow cell exchange	If application requires a different flow cell type or if defective.	Complete Assembly A wavelength calibration check should be performed after replacement. If the flow cell is removed and inserted, then a quick calibration check is performed. If this fails, you must do a wavelength recalibration, see "Wavelength Verification and Calibration" on page 105.
Flow cell flushing	If flow cell is contaminated	
Leak sensor drying	If leak has occurred.	Check for leaks.
Leak handling System replacement	If broken or corroded.	Check for leaks.

Exchanging a Flow Cell

When required If an application needs a different type of flow cell or the flow cell is defective (leaky).

Tools required Two 1/4 inch wrenches for capillary connections

Parts required Standard flow cell, 8 µl, 20 bar, G1321-60005
Cuvette for off-line measurements, 8 µl, 20 bar, G1321-60007, refer to "How to use the Cuvette" on page 140 for more information on usage.

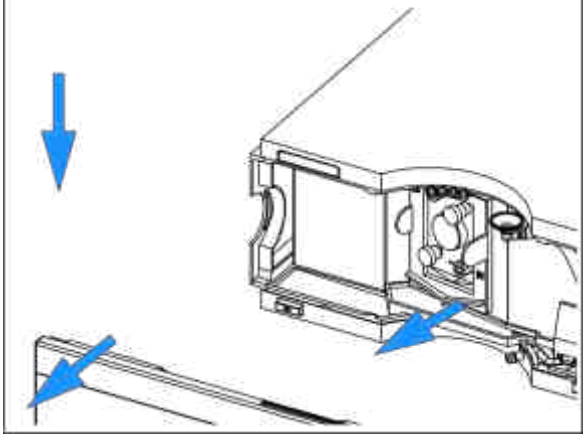
DO NOT install the inlet capillary to the outlet connection of the flow cell. This will result in poor performance.

ü

Preparations for this procedure:

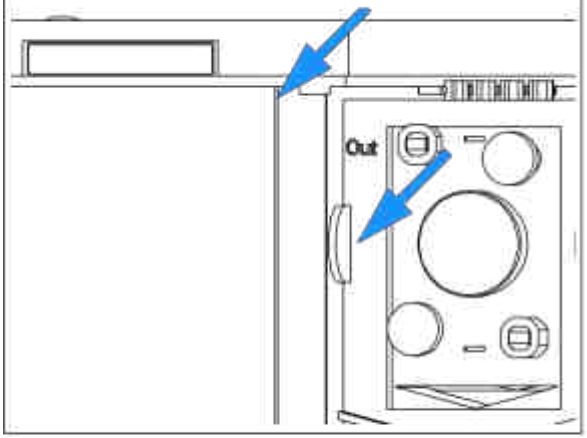
- Turn off the flow.

1 Press the release buttons and remove the front cover for access to the flow cell area.

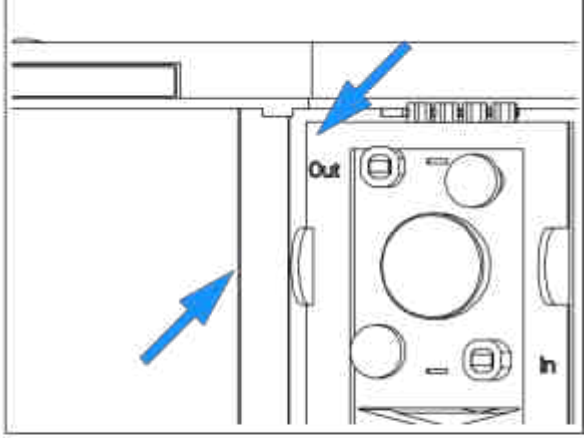


Note:

2 Disconnect the capillaries from the flow cell.



3 Unscrew the thumb screws and pull the flow cell out of the compartment.

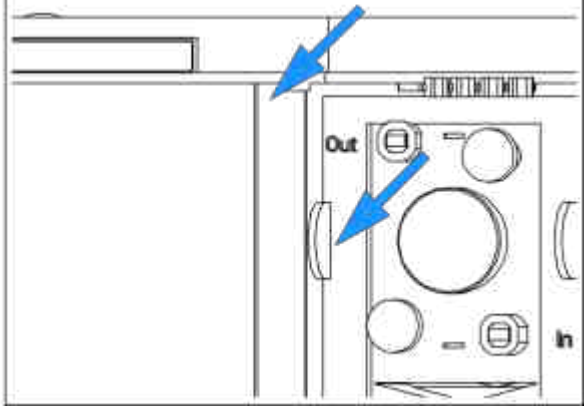


Note:

The label attached to the flow cell provides information on part number, cell volume and maximum pressure. The cell type will be automatically detected.

There are no parts that can be replaced on the flow cell. If defective (leaky) the flow cell has to be replaced completely.

4 Insert the flow cell and tighten the thumb screws. Reconnect the capillaries to the flow cell. DO NOT install the inlet capillary to the outlet connection of the flow cell. This will result in poor performance or damage.



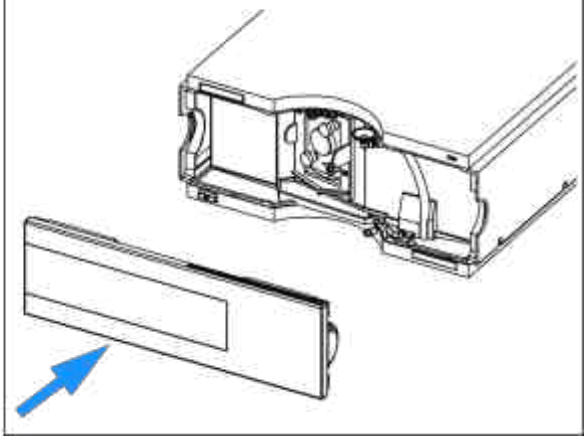
If an additional detector is added to the system, the fluorescence detector should be the last detector in the flow path except for evaporative detectors, like LC-MSD. Otherwise the back pressure generated by the other detector may overload the quartz flow cell and will lead to a defective cell (maximum pressure is 20 bar (2 MPa).

Always use the outlet capillary set supplied with the accessory kit.

Note:

To check for leaks, establish a flow and observe the flow cell (outside of the cell compartment) and all capillary connections.

5 Replace the front cover.



Note:

Perform a wavelength verification to check the correct positioning of the flow cell, as described in chapter "Wavelength Verification and Calibration" on page 105.

How to use the Cuvette

The cuvette is used for off-line measurements (no flow system required) and is basically a standard flow cell with a few changes:

- wide bore capillary connections for easier injections with a syringe
- identification lever for cell auto-recognition system.

1 Install the cuvette instead of the standard flow cell.

2 Connect the waste tubing to the outlet of the cuvette.

3 Use the syringe (see "Cuvette Kit" on page 214) to inject the compound.

4 Setup the parameters for the Fluorescence Scan (under Special Setpoints).

5 Select "Take Fluorescence Scan" on the user-interface to start the off-line measurement.

Flow Cell Flushing

When required	If flow cell is contaminated
Tools required	Glass syringe, adapter
Parts required	Bidistilled water, nitric acid (65%), tubings to waste

NOTE Aqueous solvents in the flow cell can built up algae. Algae do fluoresce. Therefore do not leave aqueous solvents in the flow cell for longer periods. Add a small percentage of organic solvents (e.g. Acetonitrile or Methanol ~5%).

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

Flushing Procedure

1. Flush with bidistilled water.
2. Flush with nitric acid (65%) using a glass syringe.
3. Leave this solution in the cell for about one hour.
4. Flush with bidistilled water.

CAUTION This concentration of nitric acid is dangerous and proper attention to safety should be given. Also the nitric acid flushing procedure is not an infallible remedy for a dirty cell. It is to be used as a last attempt to salvage the cell before cell replacement. Note that the cell is a consumable item.

NOTE Do not exceed the pressure limit of 20 bar (0.2 MPa).

Correcting Leaks

When required	If a leakage has occurred in the flow cell area or at the capillary connections
Tools required	Tissue Two 1/4 inch wrenches for capillary connections
Parts required	None

1 Remove the front cover.

2 Use tissue to dry the leak sensor area and the leak pan.

3 Observe the capillary connections and the flow cell area for leaks and correct, if required.

4 Replace the front cover.

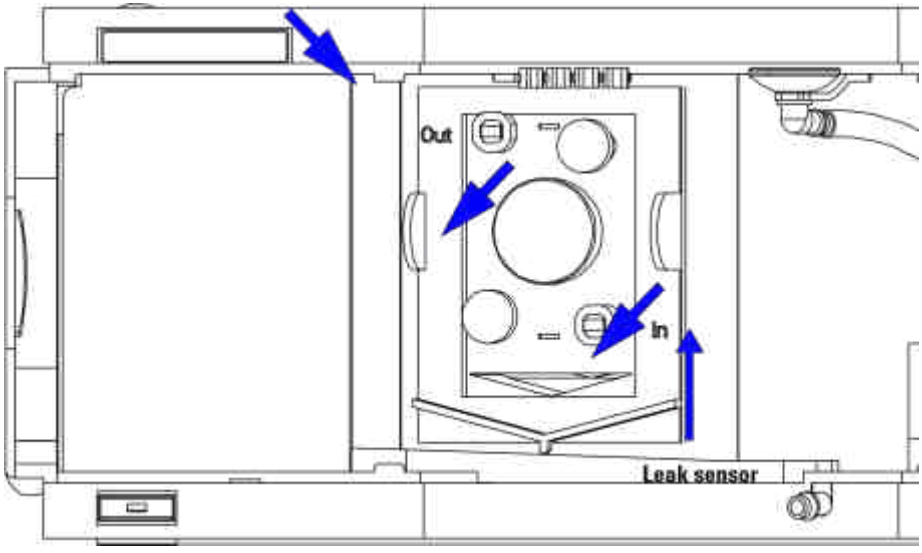


Figure 53 Observing for Leaks

Replacing Leak Handling System Parts

When required	If the parts are corroded or broken
Tools required	None
Parts required	Leak funnel 5061-3356 Leak funnel holder 5041-8389 Leak tubing (120 mm) 0890-1711

1 Remove the front cover.

2 Pull the leak funnel out of the leak funnel holder.

3 Pull out the leak funnel with the tubing.

4 Insert the leak funnel with the tubing in its position.

5 Insert the leak funnel into the leak funnel holder.

6 Replace the front cover.

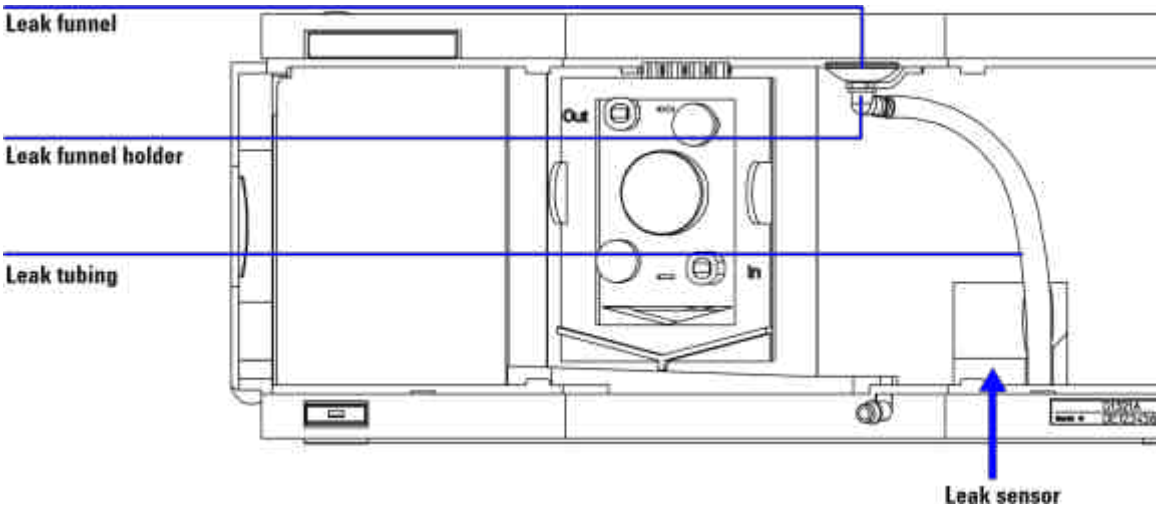


Figure 54 Replacing Leak Handling System Parts

Exchanging Internal Parts

WARNING **The following procedures require opening the main cover of the detector. Always ensure the detector is disconnected from the line power when the main cover is removed. The security lever at the power input socket prevents the detector cover from being removed when line power is still connected.**

WARNING

To disconnect the detector from line, unplug the power cord. The power supply still uses some power, even if the switch on the front panel is turned off.

WARNING **When working with solvents please observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.**

NOTE Always operate the detector with the top covers in place.

CAUTION There will be a risk of damaging hardware due to overheating when operating the instrument without covers.

CAUTION Electronic boards and components are sensitive to electronic discharge (ESD). In order to prevent damage always use an ESD protection (for example, the ESD wrist strap from the accessory kit) when handling electronic boards and components, see “Using the ESD Strap Electronic boards are sensitive to electronic discharge (ESD). In order to prevent damage, always use an ESD strap supplied in the standard accessory kit (see “Accessory Kit” on page 216) when handling electronic boards and components.” on page 133.

WARNING **Eye damage may result from directly viewing the light produced by the xenon flash lamp used in this product.**



Removing the Covers

When required For all repairs inside the detector **Tools required** Screwdriver POZI 1 PT3

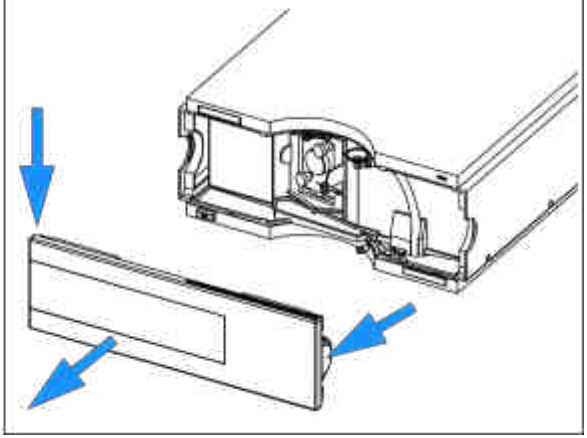
Parts required Depends on the work inside and the following procedures

CAUTION There will be a risk of damaging hardware due to overheating when operating the instrument without covers.

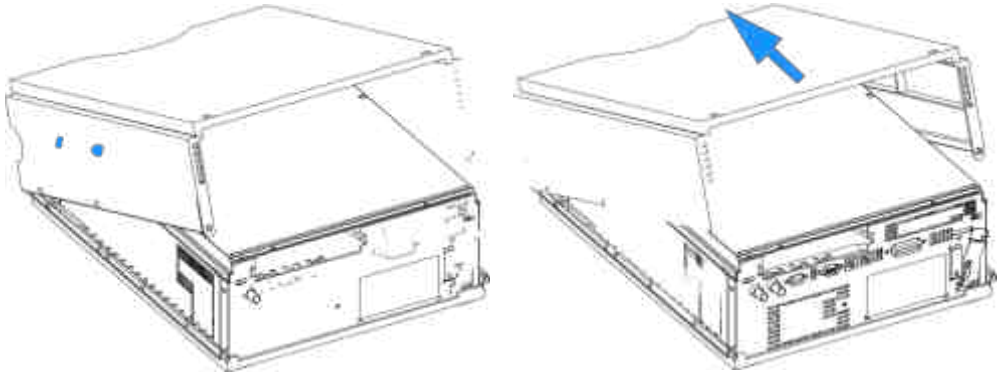
Preparations for this procedure:

- Turn off the detector.
- Disconnect the power cable.
- Remove the flow cell.
- Remove detector from stack and place it on the workbench.

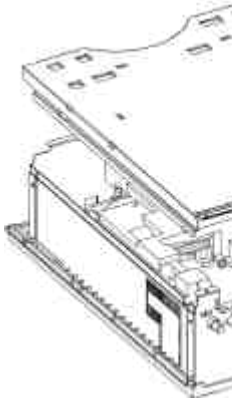
1 Press the release buttons and remove the front cover. Unclip and remove the waste funnel assemly.



4 Lift the cover up and sl ide it towards the rear.



5 plate towards the front



Warning:

Do not connect a power plug to the detector module after removing the top covers.

Removing the Rear Foam

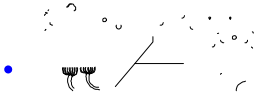
When required For all repairs inside the detector

Parts required Depends on the work inside and the following procedures

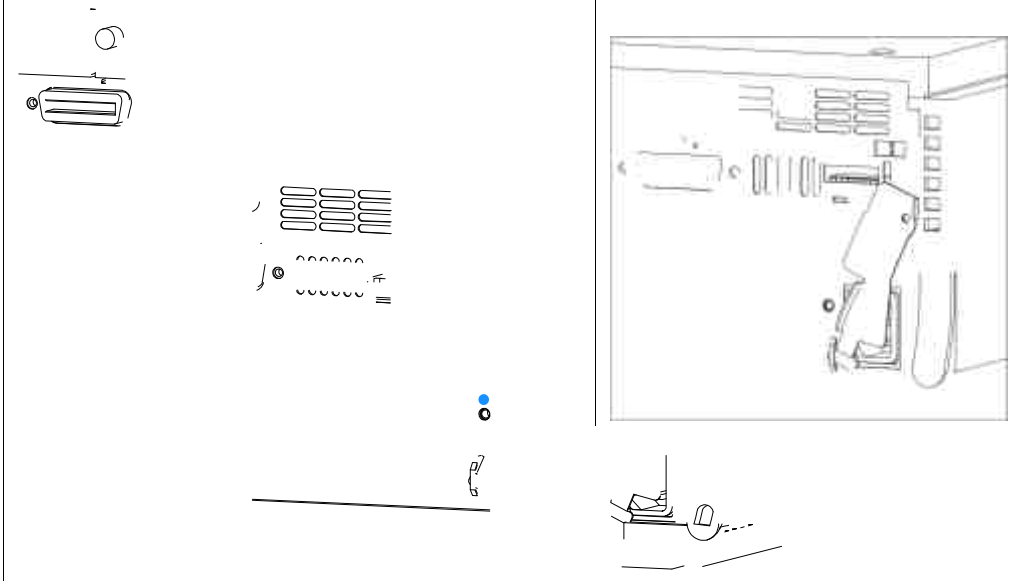
Preparations for this procedure:

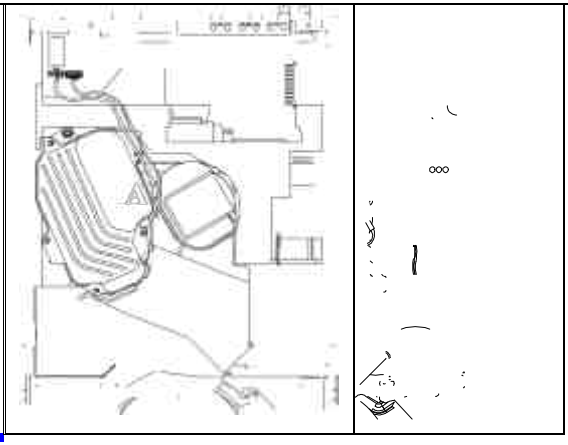
- Start with “Removing the Covers” on page 146.

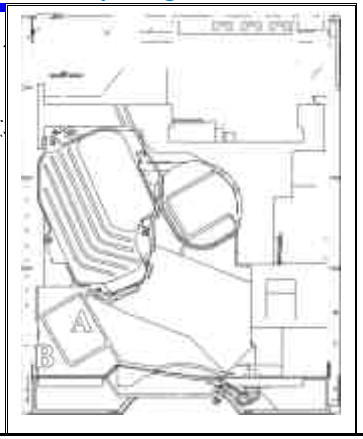
1 Using a pliers disconnect the cables from the main board.



2 Install the ESD strap. Move the power lock across the power inlet and lift the clips on the rear of the cover.







2	Carefully remove the rear foam.

Exchanging the Lamp

When required	Lamp: if noise or intensity exceeds limits or lamp does not ignite
Tools required	Screwdriver POZI 1 PT3 Hexagonal screwdriver 2.5 mm, 100 mm long Hexagonal screwdriver 4mm, 100 mm long
Parts required	Flash lamp 2140-0600

Wait until the lamp has cooled down before touching the lamp and/or triggerpack assembly.

WARNING

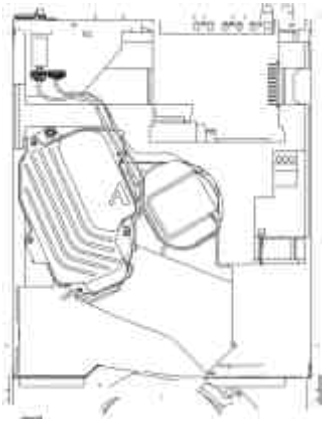
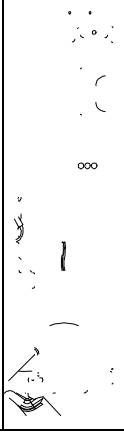
The instrument should not be operated without Xenon flash lamp. Otherwise the Triggerpack electronics will be damaged.

NOTE

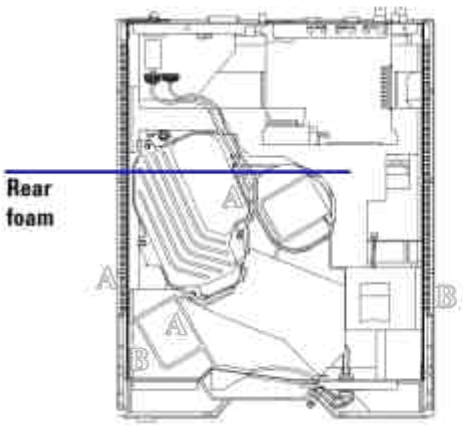
When loosening or removing screws take care that they do not fall into the instrument. This may result in a complete removal of other assemblies.

Preparations for this procedure:

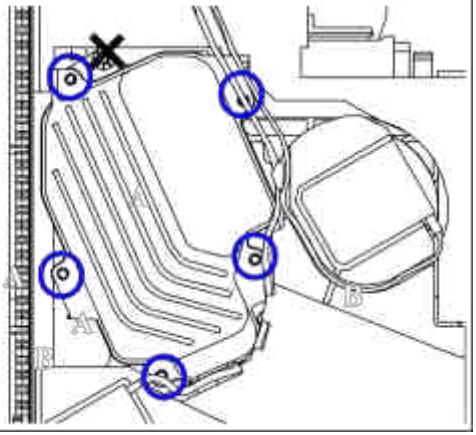
- Turn off the detector.
- Disconnect the power cable.
- Remove the flow cell or disconnect the tubings from the flow cell.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in "Removing the Covers" on page 146.

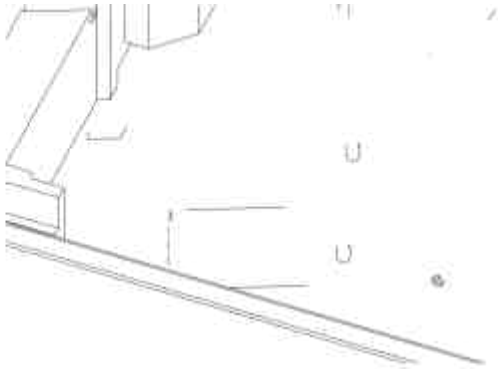
1	Disconnect the emission and the excitation cables and from the detector main board. 	
EM **EX**		

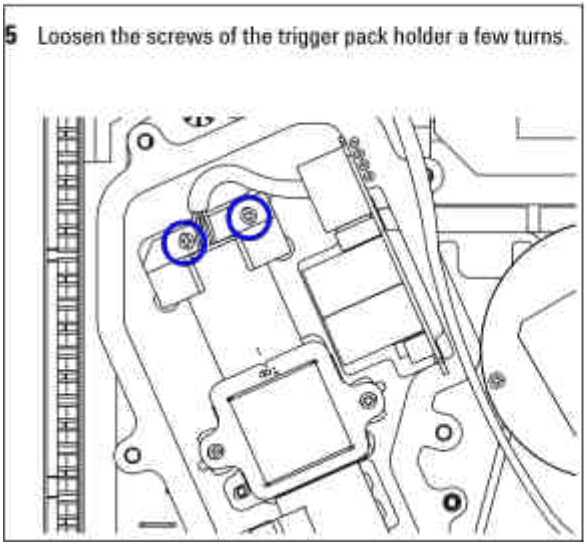
2 Carefully remove the rear foam.

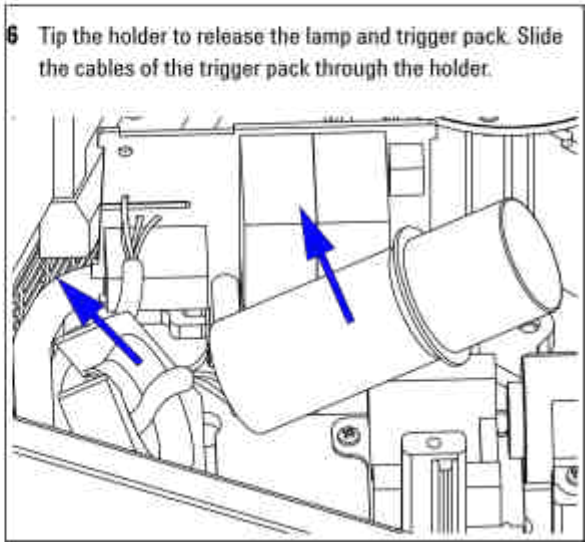


3 Using the 4 mm hexagonal key, unscrew the five screws, remove the cover and place it on the bench without turning it around.









WARNING:

While pulling off the lamp be careful that you do not scrape your skin on the metal plates.

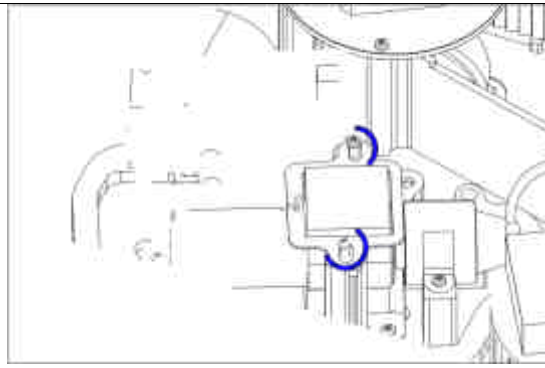
Do not remove the bottom pad. Otherwise the lamp will loose its correct position during reinstallation.

Note:

DO NOT unscrew the grounding screw (marked with X)

4 Using the 2.5 mm hexagonal key, unscrew the two screws and remove the brass pad together with its holder.

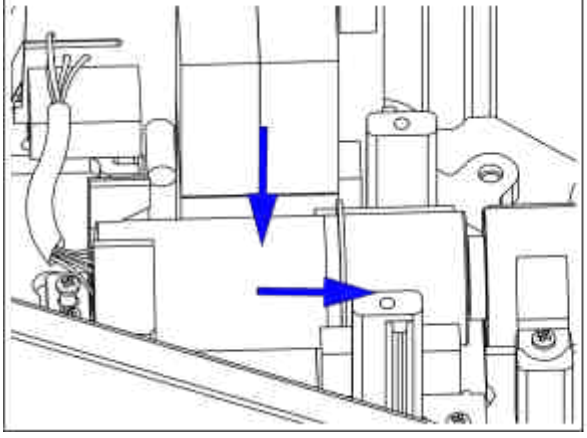




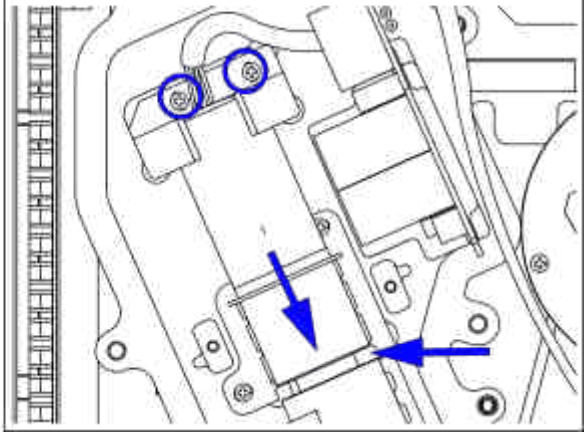
7 Remove the lamp carefully from the trigger pack.

8 Carfully insert the new lamp completely into the trigger pack and slide the cables through the holder.

9 Place the lamp on the bottom pad.



10 Refit the trigger pack holder by moving the lamp towards the condenser. Leave a distance of about 0.5 mm between each other. Refit the screws.

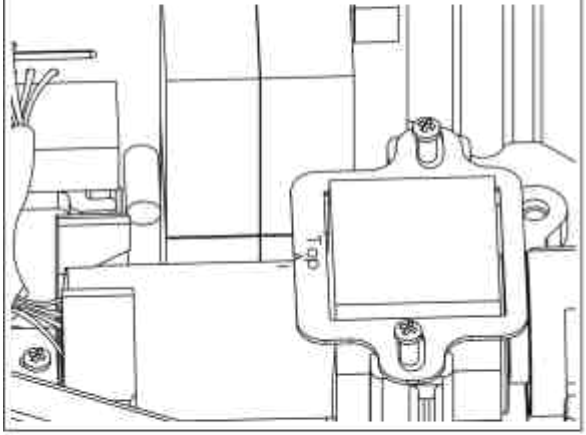


Exchanging the EX-condenser

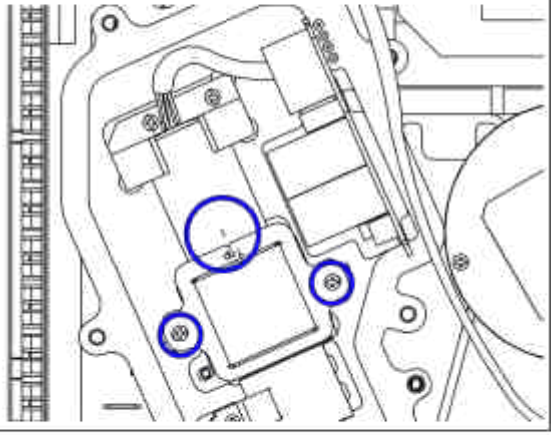
11 Place the pad with the holder on the stand-offs. The "TOP" sign should be directed towards the trigger pack. Refit the screws.

Note:

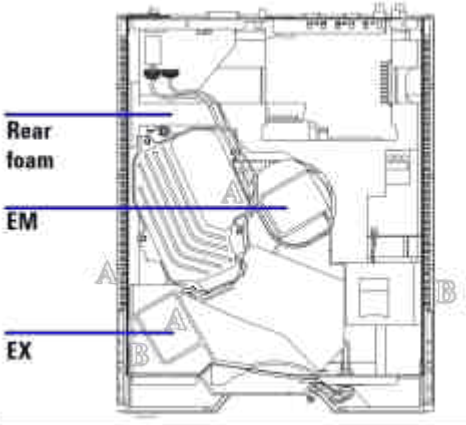
During the next step no horizontal movement should be made to the pad.



12 While pressing the top pad down onto the stand-offs, tighten the screws. Turn the trigger pack such as its marker stays in line with the "TOP" sign of the brass holder.



13 Replace the lamp housing cover and fix the screws. Carefully insert the rear foam. Reconnect the monochromator cables to the main board. Left is excitation, right is emission.



Next Steps:

- Replace the covers as described in "Replacing the Foam and the Top Cover" on page 149.
- Re-install the detector in the stack.
- Enter the replacement of the lamp in the maintenance logbook (this will reset the lamp counter).
- Turn the lamp on.
- Perform a wavelength verification to check the correct positioning of the replaced assemblies, as described in chapter "Wavelength Verification and Calibration" on page 105.

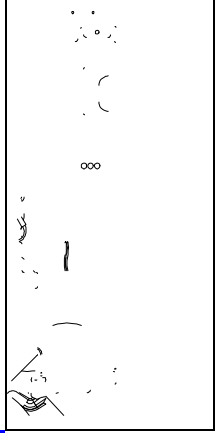
WARNING **When required** Condenser: if contaminated

Tools required	Screwdriver POZI 1 PT3 Hexagonal screwdriver 2.5 mm, 100 mm long Hexagonal screwdriver 4 mm, 100 mm long
Parts required	EX condenser Assembly 1000-1136

Wait until the lamp has cooled down before touching the lamp and/or triggerpack assembly.

The instrument should not be operated without Xenon flash lamp. Otherwise the Triggerpack electronics will be damaged.

NOTE When loosening or removing screws take care that they do not fall into the instrument. This may result in a complete removal of other assemblies.

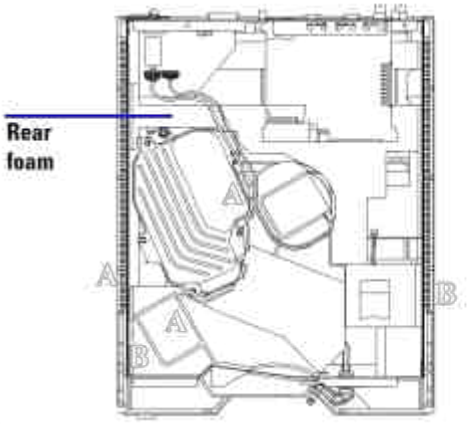
Preparations for this procedure: • Turn off the detector. • Disconnect the power cable. • Remove the flow cell or disconnect the tubings from the flow cell. • Remove detector from stack and place it on the workbench. • Remove the covers as described in "Removing the Covers" on page 146.	**1**	Disconnect the emission and the excitation cables and from the detector main board.	

EM

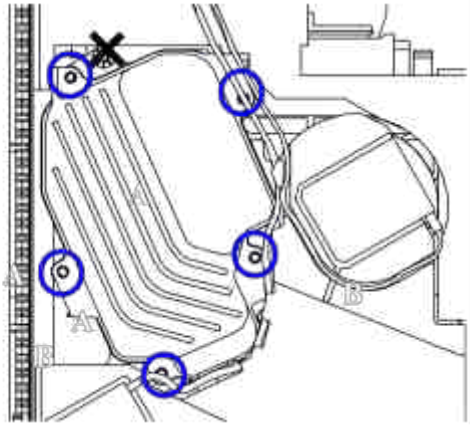
EX



2 Carefully remove the rear foam.

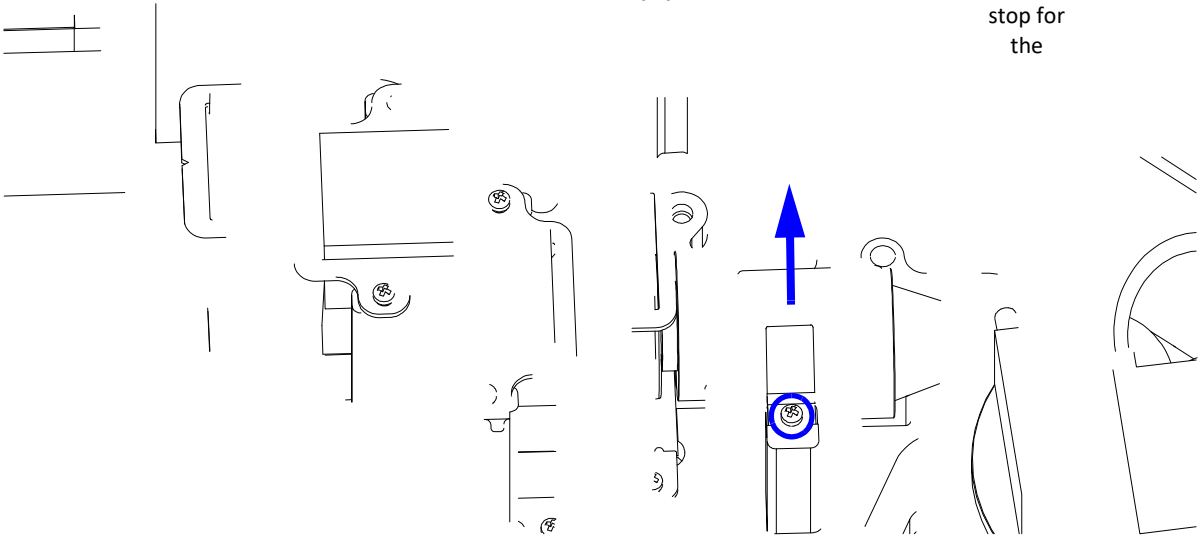


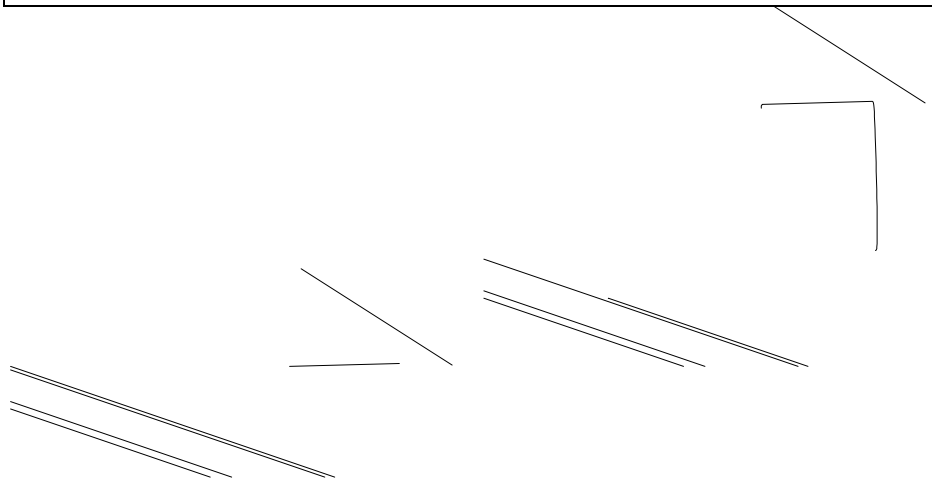
3 Using the 4 mm hexagonal key, unscrew the five screws, remove the cover and place it on the bench without turning it around. **DO NOT unscrew the grounding screw (marked with X).**



4

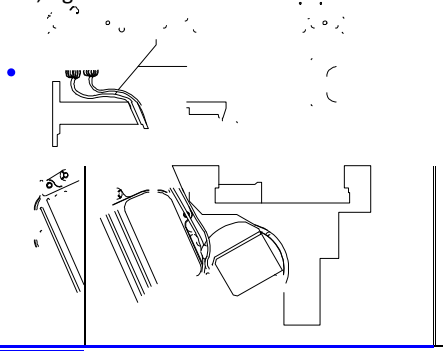
Using a 2.5 mm hexagonal key, loosen the screw and remove the condenser. There is a mechanical stop for the condenser.





6 Replace the lamp housing cover and fix the screws. Carefully insert the rear foam. Reconnect the monochromator cables to the main board. Left is

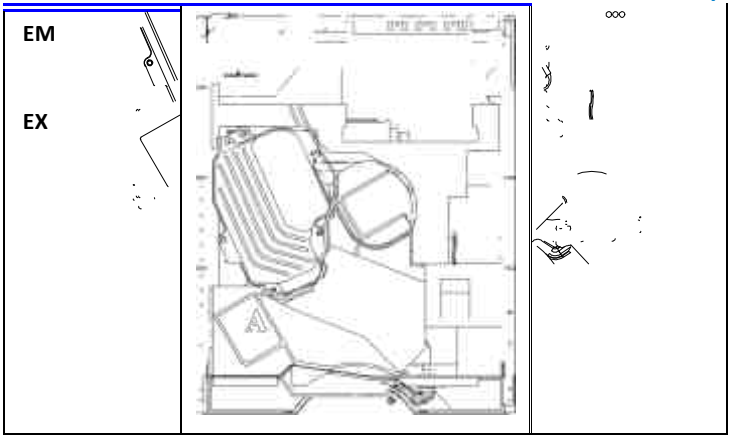
excitation, right is emission.



Next Steps:

- Replace the covers as described in “Replacing the Foam and the Top Cover” on page 149.
- Re-install the detector in the stack.
- Enter the replacement of the lamp in the maintenance logbook (this will reset the lamp counter).
- Turn the lamp on.
- Perform a wavelength verification to check the correct

  positioning of the replaced assemblies, as described in chapter “Wavelength Verification and Calibration” on page 105.



Replacing the Lamp Cover Window

When required	If window is blocking the light throughput due to contamination
Tools required	Screwdriver POZI 1 PT3 Hexagonal screwdriver 2.5 mm, 100 mm long Hexagonal screwdriver 4 mm, 100 mm long
Parts required	Quartz Window 1000-0999

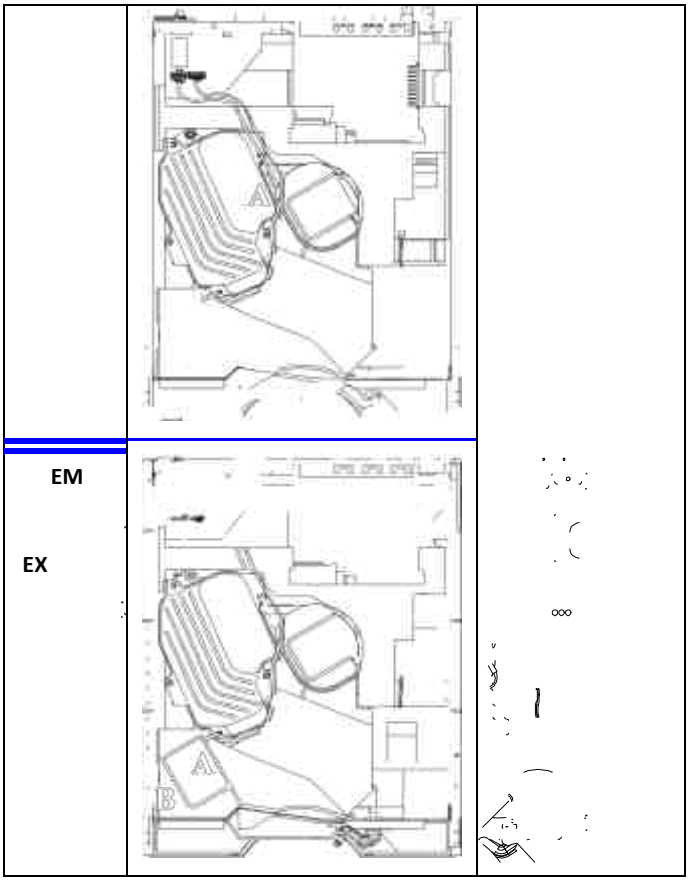
NOTE When loosening or removing screws take care that they do not fall into the instrument. This may result in a complete removal of other assemblies.

Preparations for this procedure:

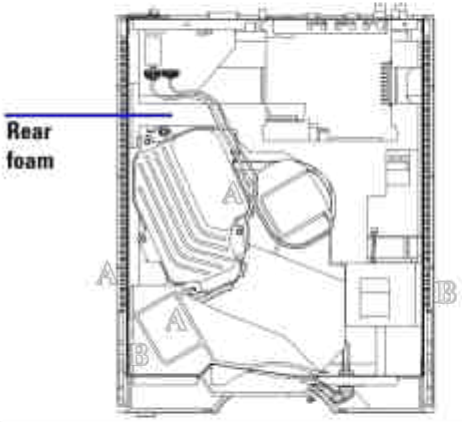
- Turn off the detector.
- Disconnect the power cable.
- Remove the flow cell or disconnect the tubings from the flow cell.
- Remove detector from stack and place it on the workbench.

1	Disconnect the emission and the excitation cables and from the detector main board.	

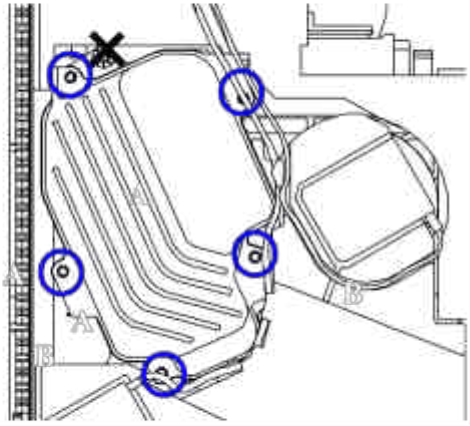
- Remove the covers as described in “Removing the Covers” on page 146.



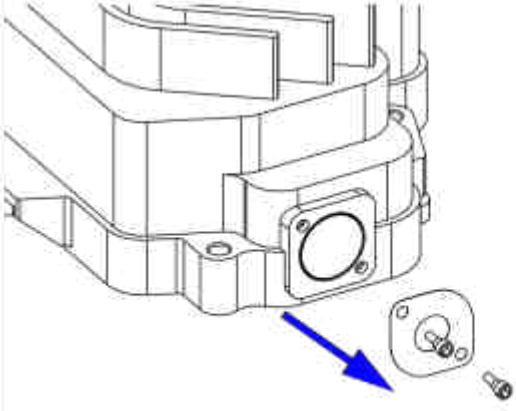
2 Carefully remove the rear foam.



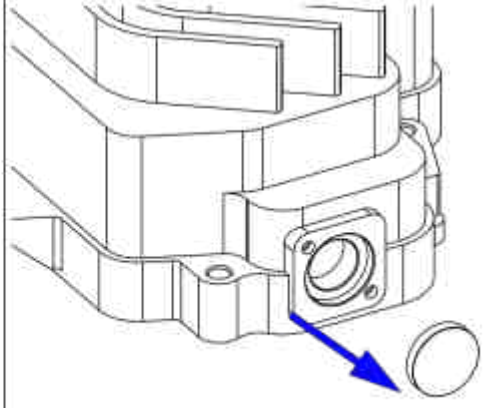
3 Using the 4 mm hexagonal key, unscrew the five screws, remove the cover and place it on the bench without turning it around. **DO NOT unscrew the grounding screw (marked with X).**



4 Using the 2.5 mm hexagonal key, unscrew one screws and loosen the other one. Slide the window holder out of the window area.



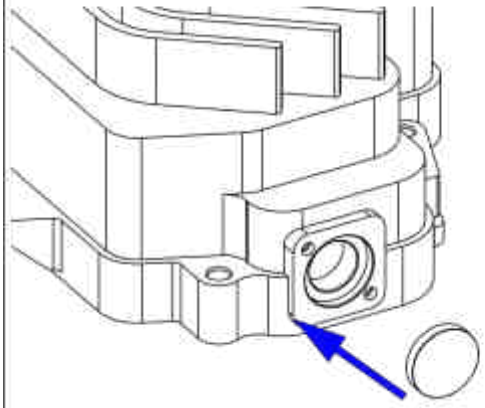
5 Use a toothpick to remove the window.



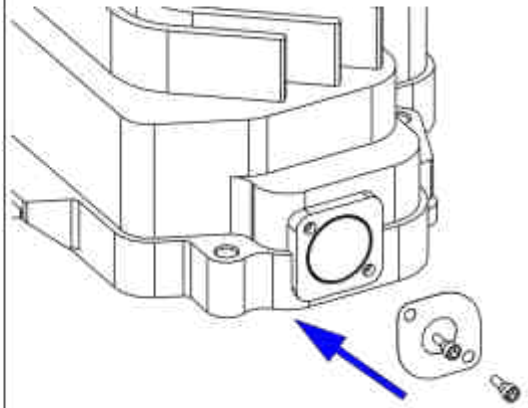
Note:

The quartz window may be cleaned with alcohol (e.g. ethanol).

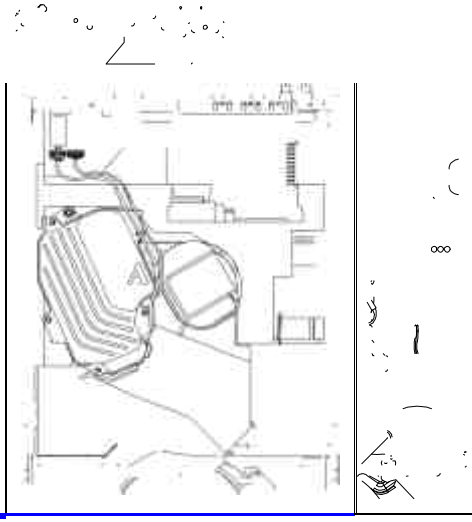
6 Insert the cleaned or new window.



7 Slide the window holder across the window and fix the screws.



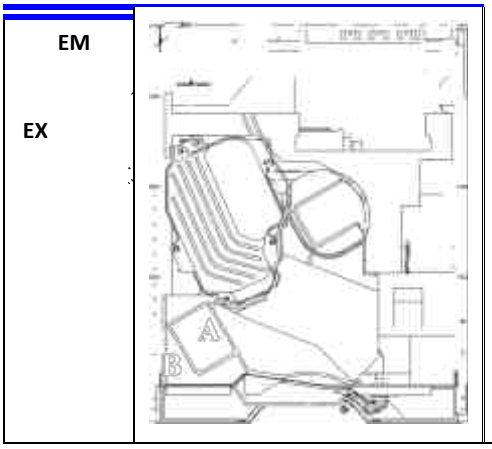
8 Replace the lamp housing cover and fix the screws. Carefully insert the rear foam. Reconnect the monochromator cables to the main board. Left is excitation, right is emission.



Rear foam

Next Steps:

- Replace the covers as described in “Replacing the Foam and the Top Cover” on page149.
- Re-install the detector in the stack.
- Turn the lamp on.



Exchanging the Processor Board

When required	If detector main board is defective or for repair on other assemblies
Tools required	Screwdriver POZI 1 PT3 Flat screw driver Hexagonal wrenches 5 mm, 7 mm and 15 mm
Parts required	Detector main board (FLM) G1321-69500 (exchange assembly)

1 Turn off the lamp.

2 Switch off the module, and disconnect the cables.

3 Remove module from stack and place it on the workbench.

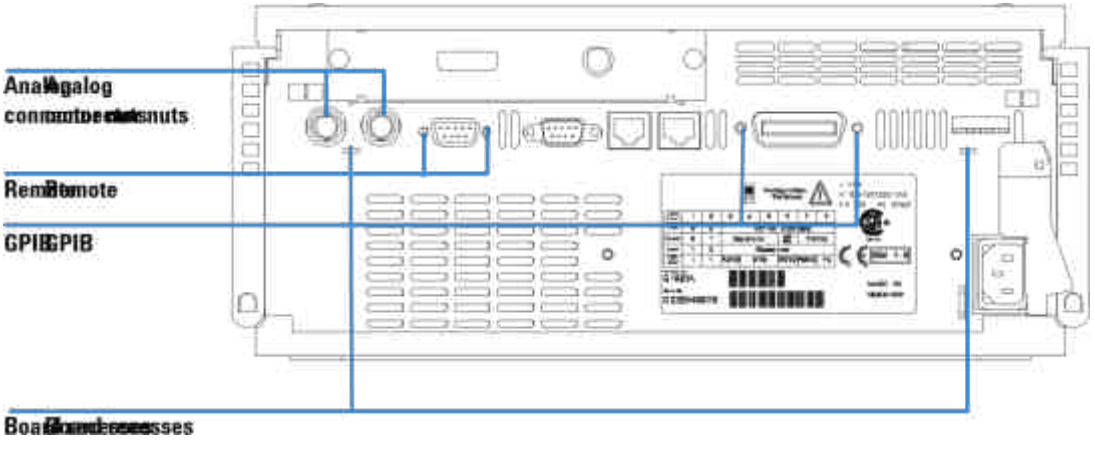


Figure 55 Unscrew Connectors from Board

4 Remove the front cover, top cover and top foam section, see "Removing the Covers" on page 146.

5 Use a 5-mm and 7-mm wrench to unscrew the REMOTE and the GPIB connector and a 15-mm wrench to unscrew the nuts of the ANALOG connectors.

6 Disconnect all connectors from the processor board.

NOTE When removing connectors, counter-hold with one hand on connector J12.

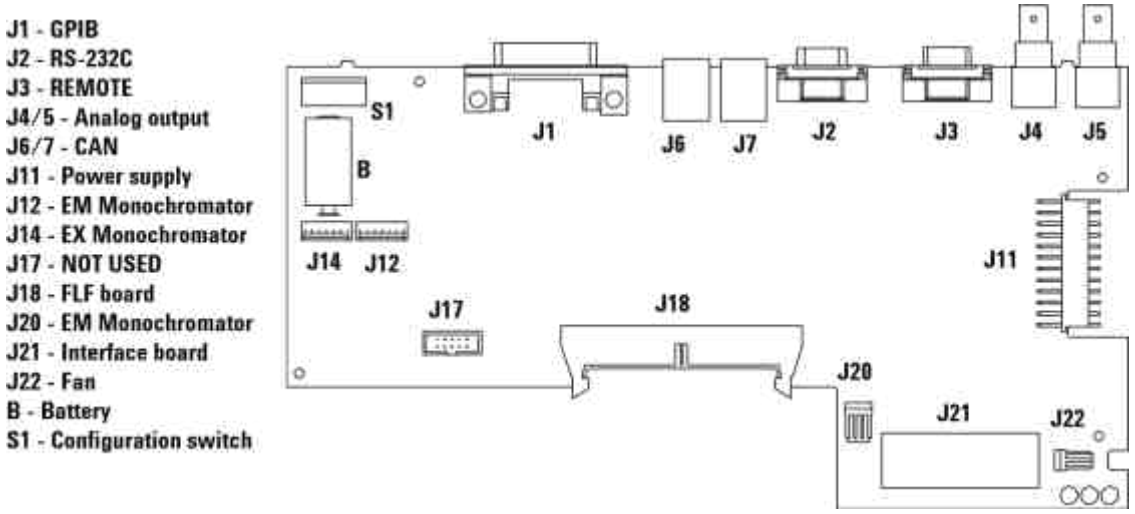


Figure 56 Location of Connectors on FLM Board

7 Remove the processor board. Place the board on the ESD kit.

8 On the new board check the switch setting of address switch S1, see "Setting the 8-bit Configuration Switch" on page 292.

NOTE An incorrect switch setting (for example, TEST/BOOT) may cause the module to revert to a basic mode (yellow or red flashing status light). In this case turn off the module, reset the address switches, and turn on the module again.

9 Install the new processor board and reconnect the connectors. Assure that the board is fitted correctly into the board recess in the rear panel.

10 Refit the screws at the REMOTE and GPIB connectors and the nuts of the ANALOG connectors.

11 Reinstall the top foam section, top cover and front cover, see "Replacing the Foams and Covers" on page 196.

12 Replace detector into the stack and reconnect the cables.

NOTE If a new FLM board is installed, update the serial number information of the detector in the user interface, see procedure below.

13 Check the firmware revision of the module. If it is older than the current firmware revision, update the firmware using the standard firmware update procedure, see "Replacing the Detector's Firmware" on page 200.

Entering the Serial Number using the Control Module

1 Connect the control module to the detector. Turn on the detector.

2 In the control module, press System (F5), then Records (F4). Using the up/down arrows, make sure that the detector is highlighted.

3 Press FW Update (F5). Now, press the m key. This will display a box which says Update Enter Serial#.

4 Press Enter. This will display the box labeled Serial#.

5 Alphabetic characters and numbers are created using the up and down arrows. In the box labeled Serial#, enter the 10-character serial number for the detector. When the 10-character serial number is entered, press Enter to highlight the complete serial number. Then, press Done (F6).

6 Turn the detector off, then on again. The Records screen should display the correct serial number for this module.

7 If a Agilent ChemStation is also connected, restart the Agilent ChemStation now as well.

Entering the Serial Number using the Agilent ChemStation

Module serial numbers are entered by typing specific commands in the command line at the bottom of the main user interface screen.

1 To enter a module serial number, type the following command in the command line:

```
print sendmodule$(lfld,"ser YYYYYYYYYY")
```

Where: YYYYYYYYYY is the 10-character serial number of the module in question.

NOTE The first two characters are letters, which should be capitalized.

The reply line will respond with RA 0000 SER followed by the module serial number you just entered.

2 Turn off the detector, then on again and restart the Agilent ChemStation. If the serial number you have just entered is different than the original module serial number, you will be given the opportunity to edit the configure 1100 access screen during the restart of the Agilent ChemStation.

3 After start up, the serial number you have just entered can be seen under the Instrument menu of the main user interface screen. The serial number of the detector can also be seen by typing the following command into the command line:

```
print sendmodule$ (lfld,"ser?")
```

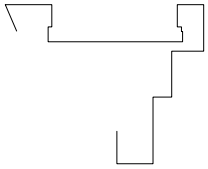
The reply line will give the module serial number.

Exchanging the Fan

When required If the fan is defective or noisy **Tools required** Screwdriver POZI 1 PT3

Parts required Fan assembly 3160-1017

CAUTION The fan must be installed in the correct orientation to ensure optimum cooling and operation of the detector.



Preparations for this procedure:

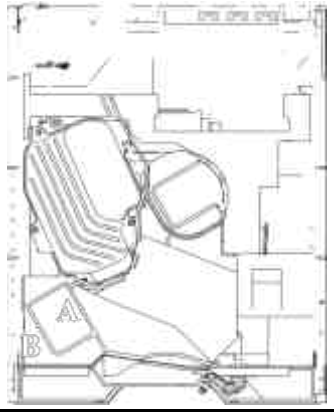
- Turn off the detector.
- Disconnect the power cable.
- Remove the flow cell.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in "Removing the Covers" on page 146.

1 Disconnect the emission and the excitation cables and from the detector main board.

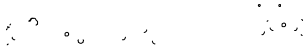


EM

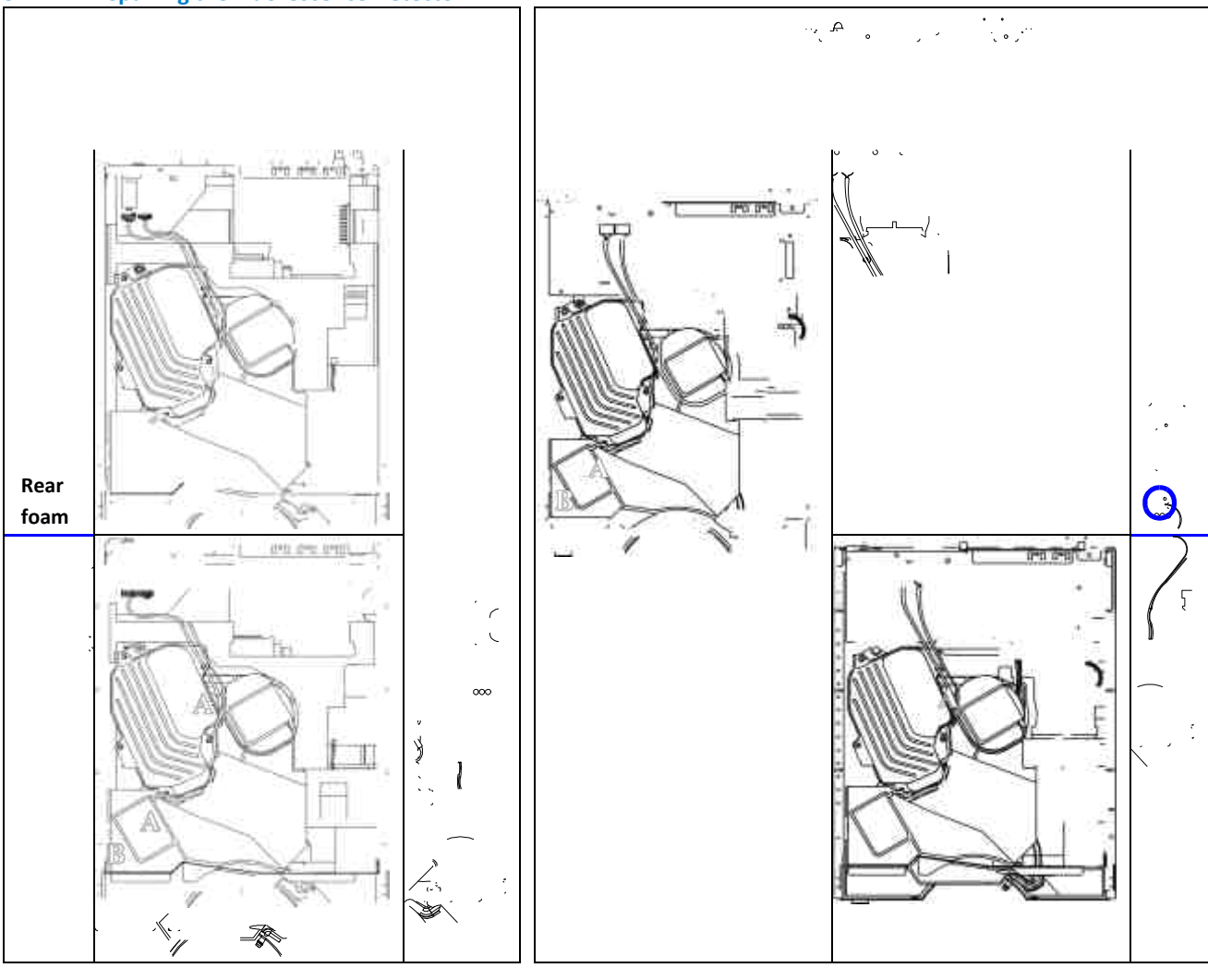
EX



2 Carefully remove the rear foam.



3 Lift the main board slightly. Bring the fan cable up and disconnect the fa
Pull out the fan.



Next Steps:

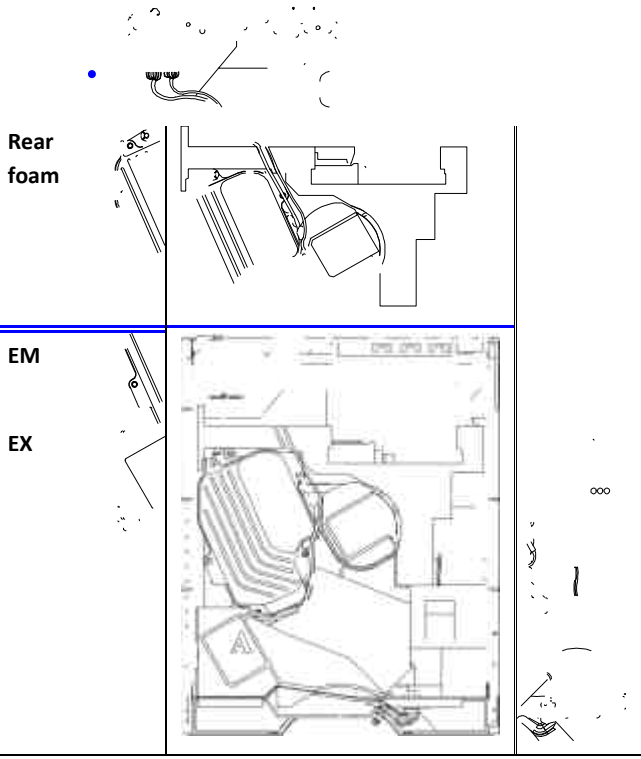
- Replace the covers as described in “Replacing the Foam and the Top Cover” on page149.
- Re-install the detector in the stack.

4 When the fan is inserted assure that the air flow is from the rear towards the front of the detector.

Insert the fan.

Lift the main board slightly. Reconnect the fan cable and route it underneath the board.

5 Carefully insert the rear foam. Reconnect the monochromator cables to the main board. Left is excitation, right is emission.



Exchanging the Leak Sensor or Leak Panel

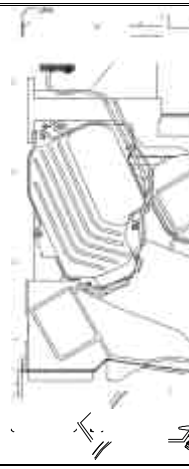
When required	If defective
Tools required	Screwdriver POZI 1 PT3 Flat screwdriver
Parts required	Leak sensor assembly 5061-3356 Leak Pan G1321-45501

Preparations for this procedure:

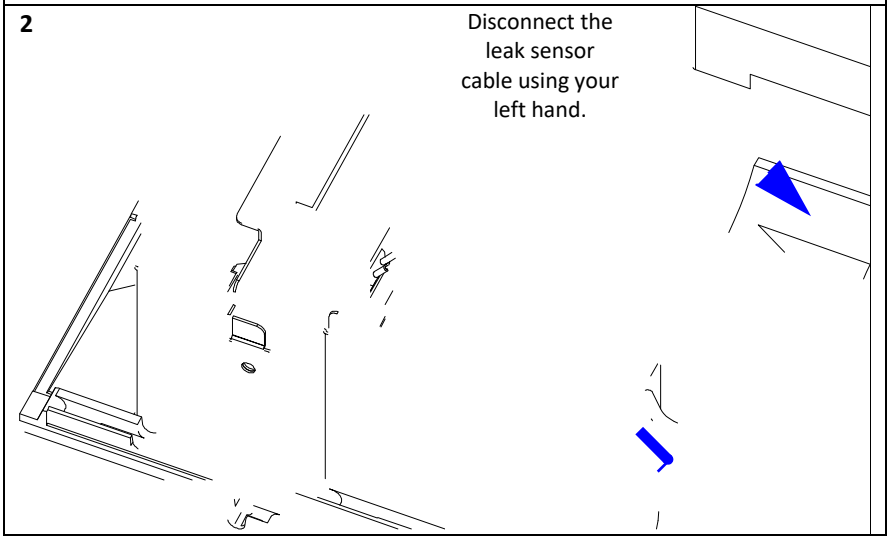
- Turn off the detector.
- Disconnect the power cable.
- Remove the flow cell.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in “Removing the Covers” on page 146.
- Remove the flow cell.

1 Locate the

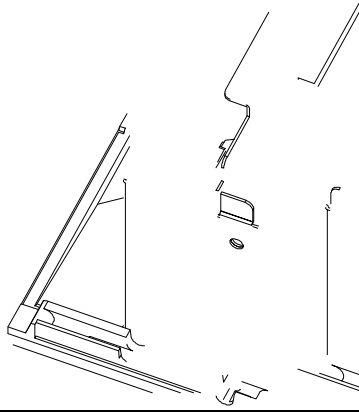


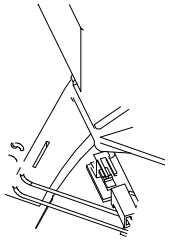


2 Disconnect the leak sensor cable using your left hand.



3 Pull out the leak sensor.

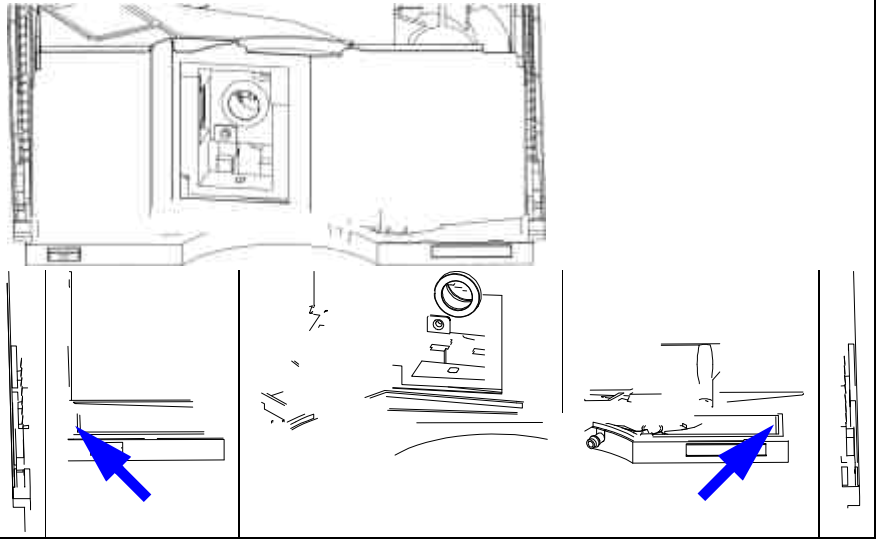




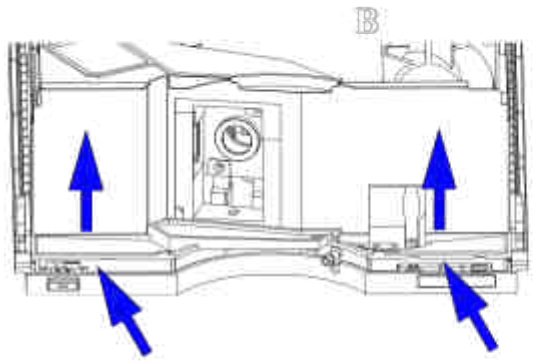
Note:

If you want to replace just the leak sensor, continue with step 8.

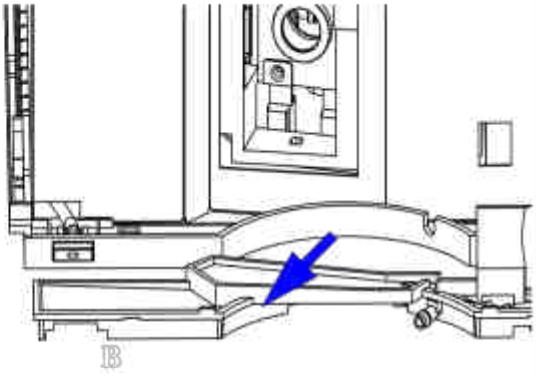
4 Using flat screw driver, release the leak base (two clasps).



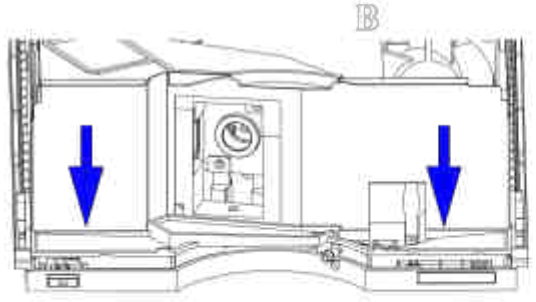
5 Use a flat screw driver to lift the leak base from the base.



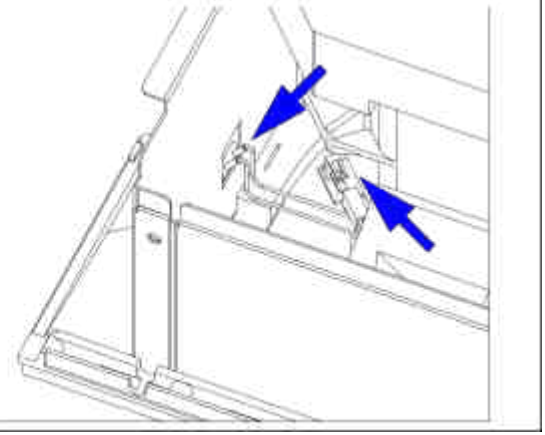
6 Remove the leak base completely.



7 Replace the leak pan into the cabinet bottom. Press the leak pan completely down into its recess.



8 Replace the leak sensor using your left hand and reconnect the connector.



Next Steps:

- Replace the covers as described in "Replacing the Foams and Covers" on page 196.
- Re-install the flow cell and the front panel
- Re-install the detector in the stack.

Replacing the EM-Condenser or Cutoff-Filter

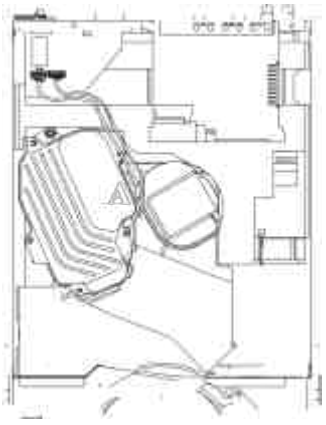
When required If light throughput is too low

Tools required Screwdriver POZI 1 PT3
Hexagonal key 2.5 mm

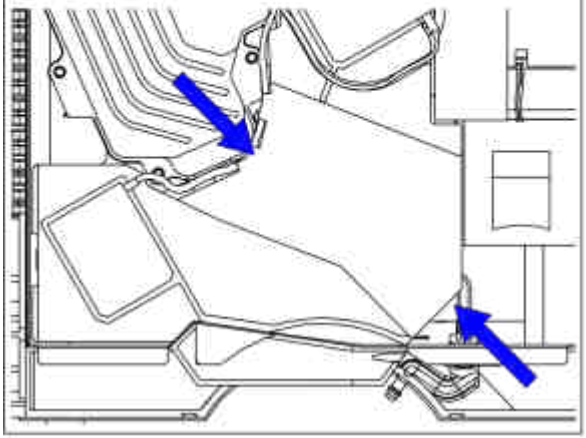
Parts required Condenser assembly EM 1000-1124
Cutoff filter 295 nm 5062-8530

Preparations for this procedure:

- Turn off the detector.
- Disconnect the power cable.
- Remove the flow cell.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in "Removing the Covers" on page 146.
- Remove the flow cell.

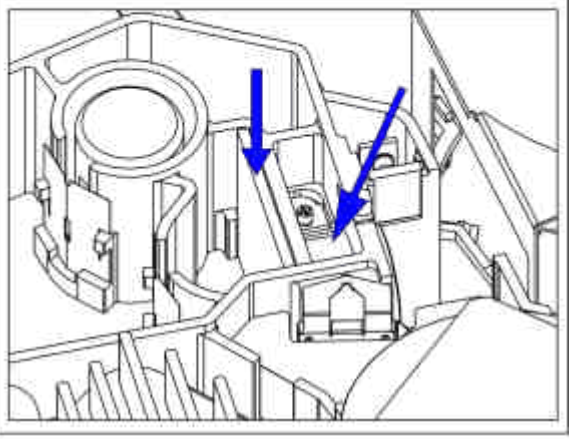
1	Disconnect the emission and the excitation cables and from the detector main board. 	
EM **EX**		

2 Carefully remove the front foam holding the foam as shown.



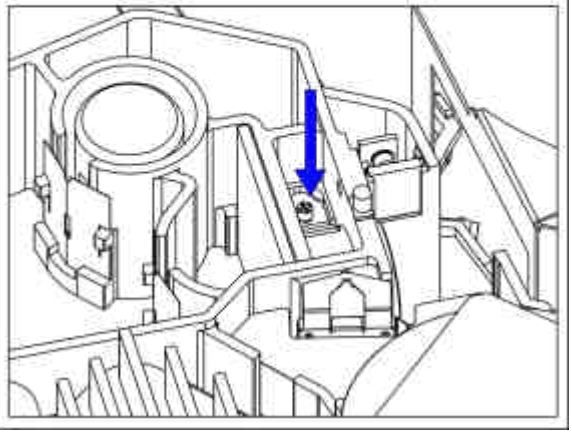
Note:

Locate the condenser assembly and the cutoff filter.

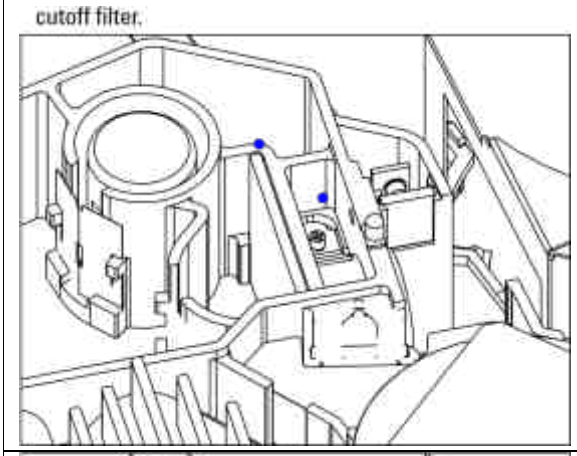
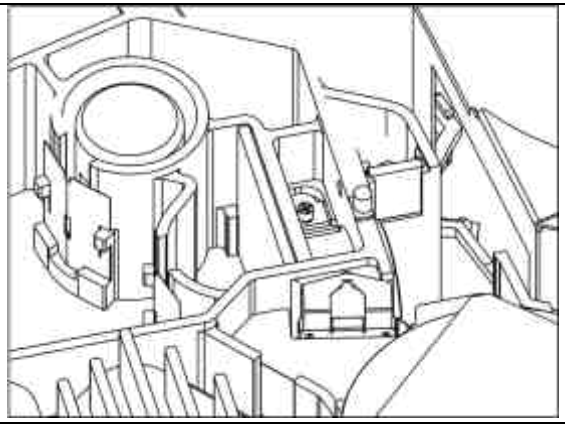
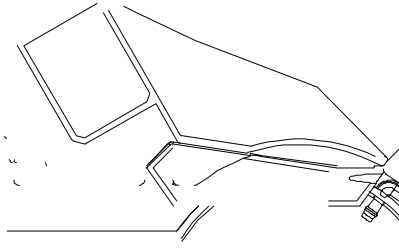


3 The cutoff filter can be replaced just by sliding it out and back in.

4 Use a 2.5 mm hexagonal key to loosen the screw.



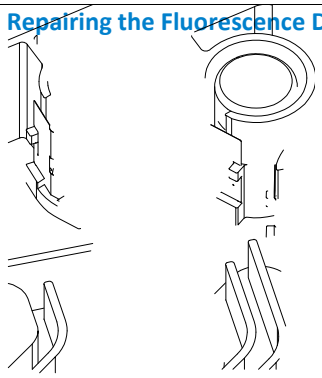


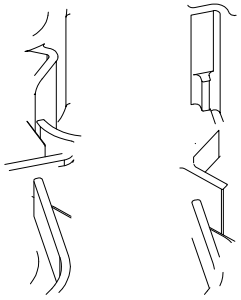
7	Use a 2.5 mm hexagonal key to fix the screw. Replace the cutoff filter.  	
8	Carefully replace the front foam.  	

Next Steps:

- Replace the covers as described in "Replacing the Foams and Covers" on page 196.
- Re-install the flow cell and the front panel.
- Re-install the detector in the stack.
- Turn the lamp on.
- Perform a wavelength verification to check the correct positioning of the replaced assemblies, as described in chapter "Wavelength Verification and Calibration" on page 105.

5 Slide out the condenser assembly and place it in a safe location.







Replacing the Mirror Assembly

NOTE

When required	If reflection is too low (contaminated)
Tools required	Screwdriver POZI 1 PT3 A pair of tweezers
Parts required	Mirror assembly 1000-1000

DO NOT touch the surface of any optical component during this procedure. This will reduce the reflection efficiency.

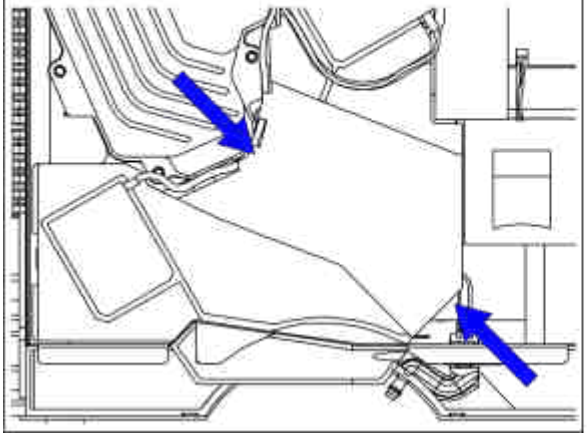
NOTE One side of the mirror is marked “R” representing the rear side.

Preparations for this procedure:

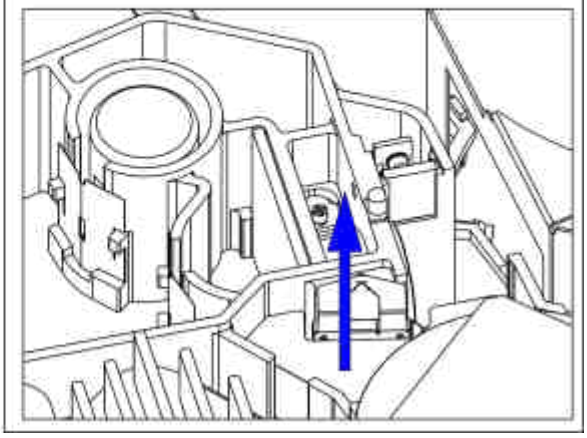
- Turn off the detector.
- Disconnect the power cable.
- Remove the flow cell.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in "Removing the Covers" on page 146.

1	Disconnect the emission and the excitation cables and from the detector main board. 	
EM **EX**		

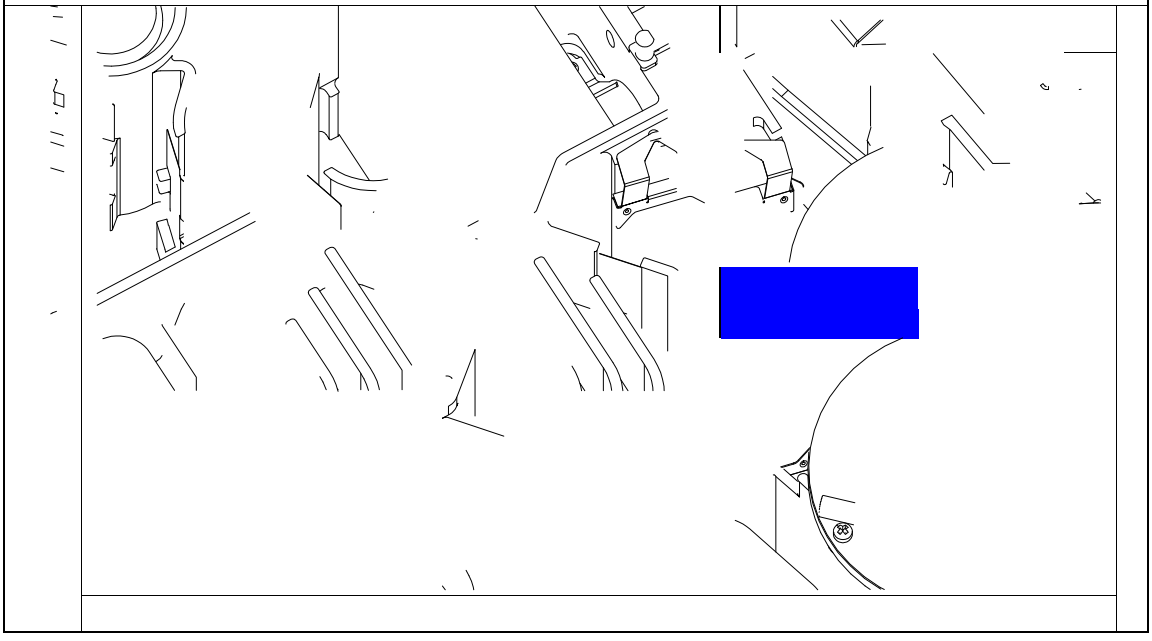
2 Carefully remove the front foam holding the foam as shown.



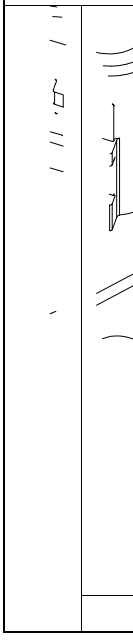
3 Remove the UV protector.

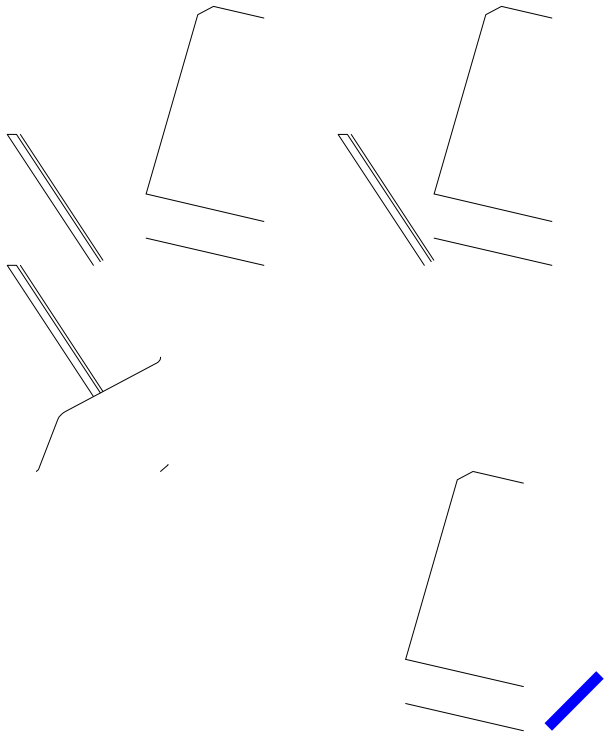


4 Locate the mirror assembly.



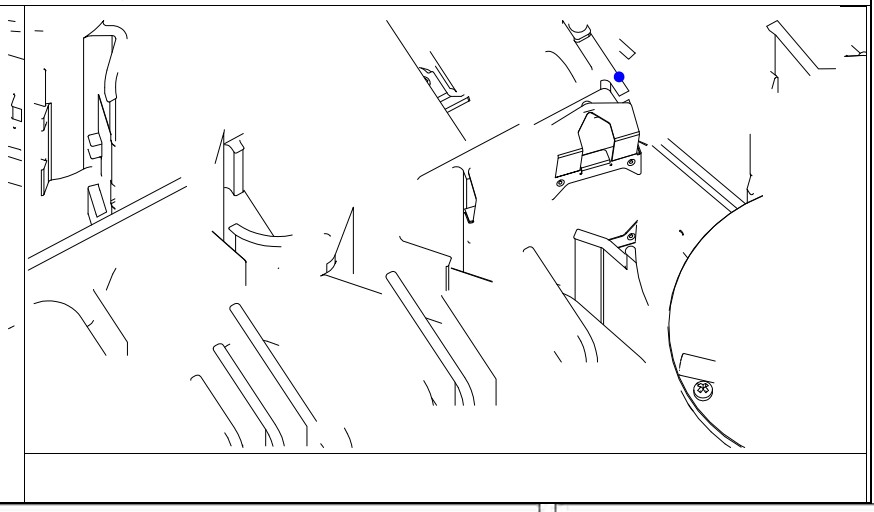
5 Use a pair



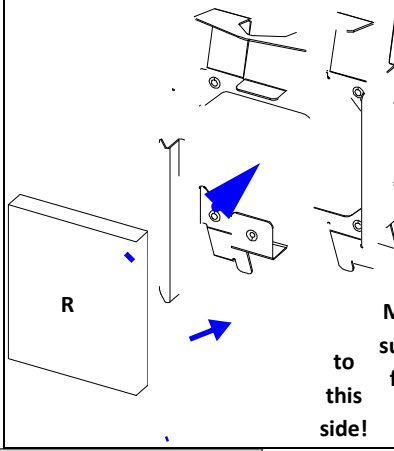


Note:

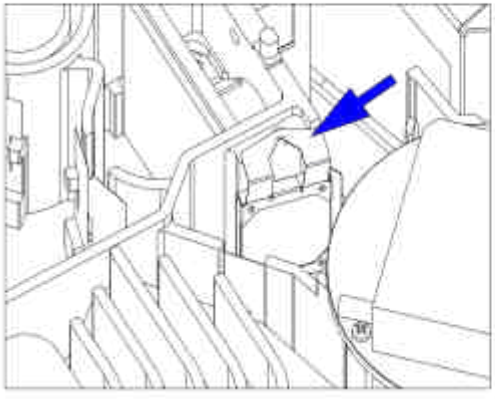
6 Remove the mirror assembly.



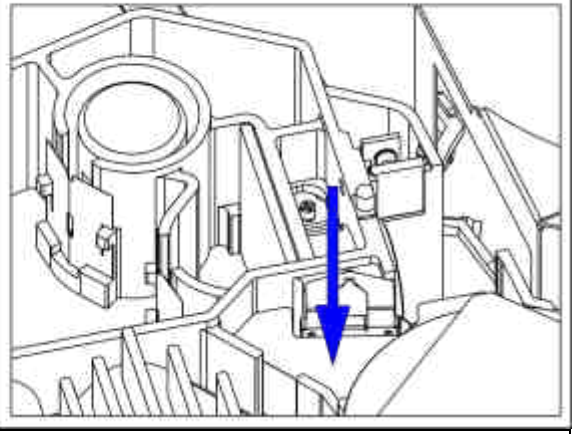
7 Insert the new mirror into the holder. The mirror surface faces towards the light. The back



8 Replace the mirror assembly and lock the top over the pin.

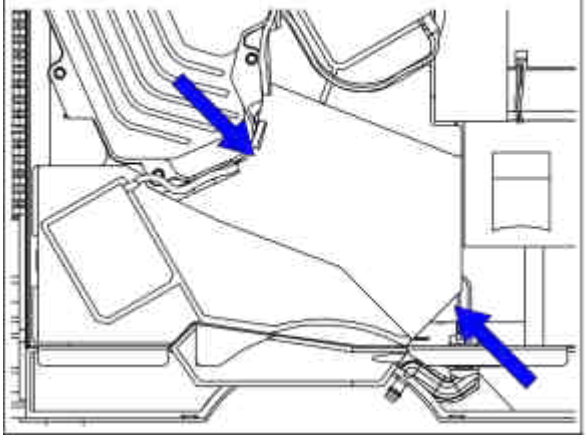


9 Replace the UV protector.



If the mirror is inserted in the opposite direction, the detector cannot be aligned correctly.

10 Replace the front foam.



Next Steps:

- Replace the covers as described in "Replacing the Foams and Covers" on page 196.
- Re-install the flow cell and the front panel
- Re-install the detector in the stack.
- Turn the lamp on.
- Perform a wavelength verification to check the correct positioning of the replaced assemblies, as described in chapter "Wavelength Verification and Calibration" on page 105.

Replacing the Slits

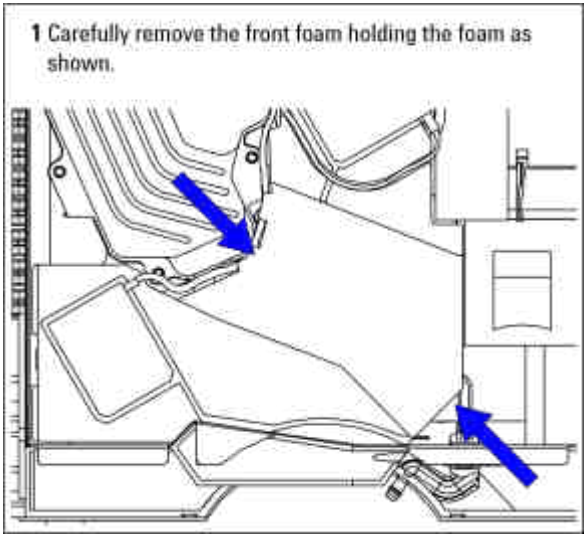
When required	If required.
Tools required	Screwdriver POZI 1 PT3
	A pair of tweezers
Parts required	Slit EX G1321-08103
	Slit EM G1321-08102 (also used for PMT)

NOTE

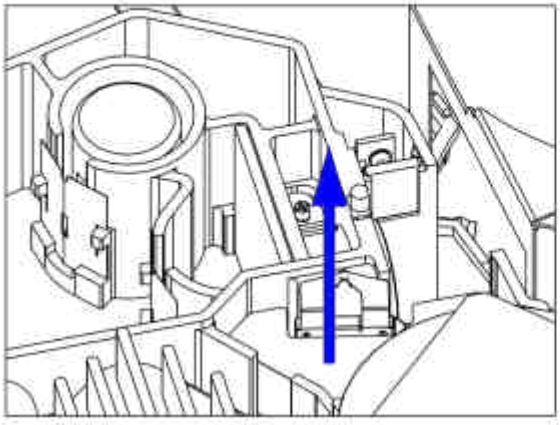
DO NOT touch the surface of any optical component during this procedure. This will deteriorate the reflection process.

Preparations for this procedure:

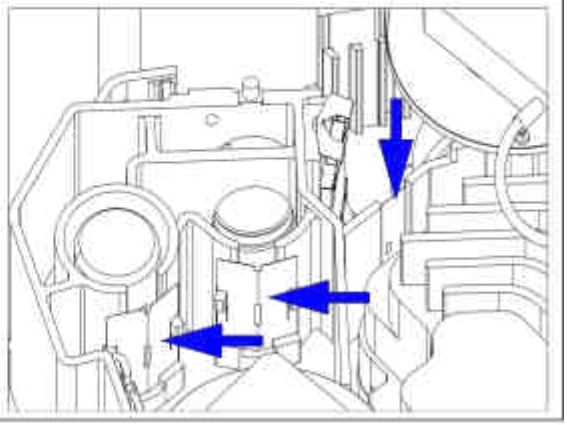
- Turn off the detector.
- Disconnect the power cable.
- Remove the flow cell.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in "Removing the Covers" on page 146.



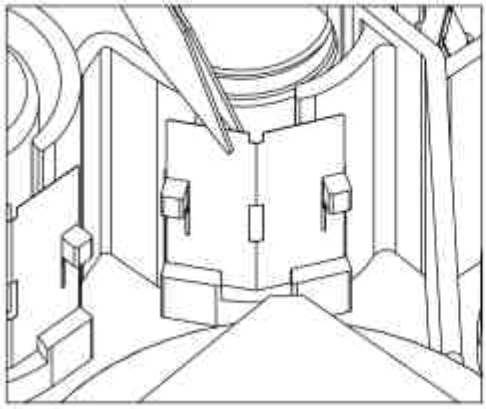
2 Remove the UV protector.



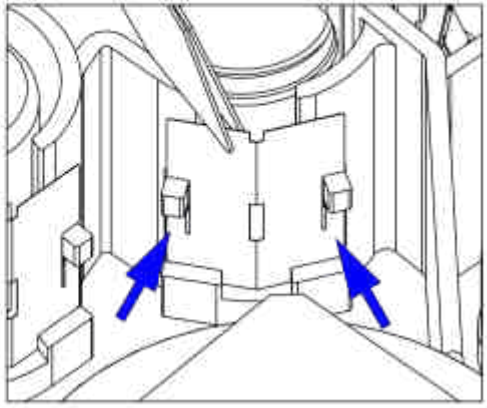
3 Locate the three slits (from left to right: PMT, EM, EX).



4 Use a pair of tweezers to replace the slit.



5 Put slight pressure on to the spring part of the slit.



Next Steps:

- Replace the UV protector and the front foam.
- Replace the covers as described in "Replacing the Foams and Covers" on page 196. • Re-install the flow cell and the front panel

- Re-install the detector in the stack.
- Turn the lamp on.
- Perform a wavelength verification to check the correct positioning of the replaced assemblies, as described in chapter "Wavelength Verification and Calibration" on page 105.

Removing the Optical Unit

When required For following repairs: power supply, FLL board, Trigger Pack/FLF board and PMT.

Tools required Screwdriver POZI 1 PT3
Hexagonal key, 4 mm

Parts required Optical unit G1315-69002 (exchange assembly, comes with foam) or individual parts depending on the following procedures

CAUTION When working on the optical unit, a clean workbench with ESD protection mat must be available. Otherwise optical components or electronic boards may be damaged.

NOTE

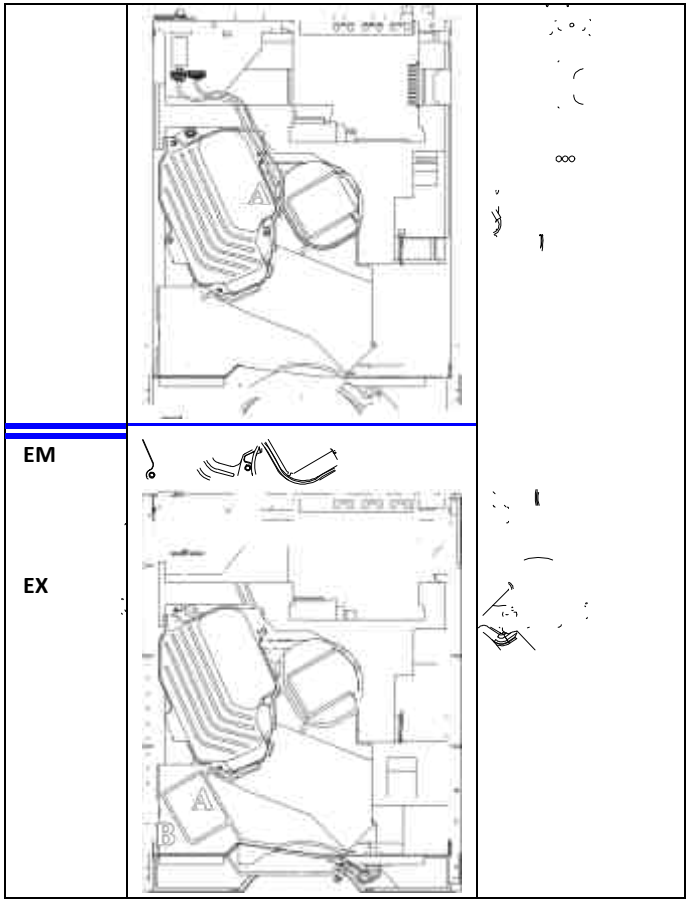
DO NOT remove the foam from the optical unit unless it is required during a procedure. Otherwise parts can fall out.

Preparations for this procedure:

- Turn off the detector.
- Disconnect the power cable.
- Disconnect capillaries.
- Remove detector from stack and place it on the workbench.

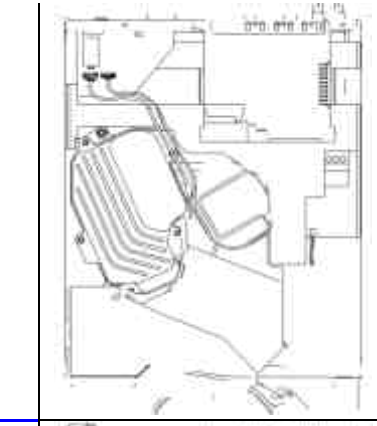
1	Disconnect cables (EM monochromator) and (EX monochromator) from the de	tector main board (FLM).

- Remove the covers as described in "Removing the Covers" on page 146.
- Remove the flow cell.

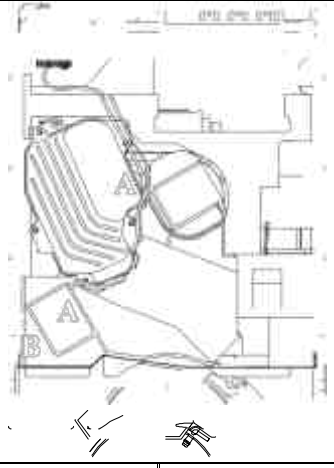




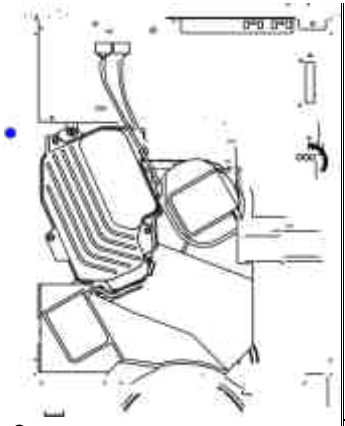
2 Carefully remove the rear foam (A). Leave the other foam on the assembly.



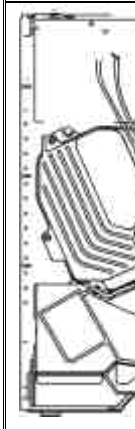
Rear foam



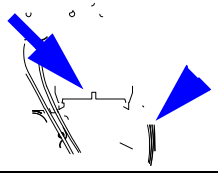
3 Disconnect the leak sensor cable (J3) and uns



Screw

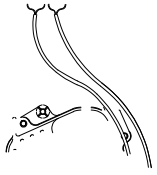


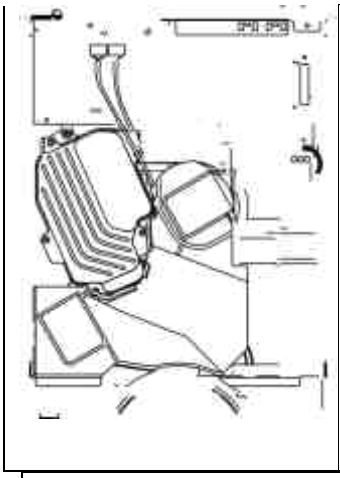
4 Disconnect the optical unit cable (J20).

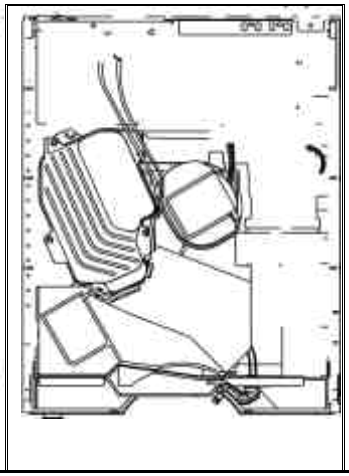


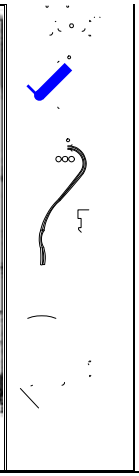
cable (J18) and the EM motor

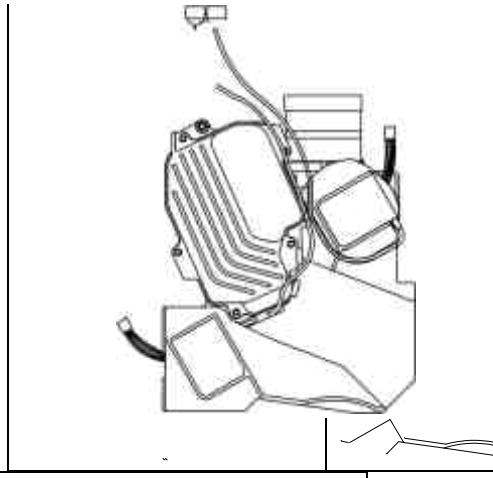
5 Remove the optical unit and place it on the be required).











Next Steps:

- Depending on the replacement you want to perform, proceed to the following procedures.

Replacing PMT and/or FLF board

When required	If defective or if application specific PMT is required.
Tools required	Screwdriver POZI 1 PT3 Hexagonal key, 4 mm and 2.5 mm Tweezers
Parts required	Photo-multiplier Tube (PMT) 1970-0201 Photo-multiplier Tube (PMT) for other application ranges, please contact Hamamatsu dealers. Alternative PMTs are either R928HA (185 to 900 nm) or R3788HA (185 to 750 nm). No other PMTs are recommended. FLF Board G1321-69531 (requires firmware revision A.04.06 or above), FLR Reference Diode board G1321-66533

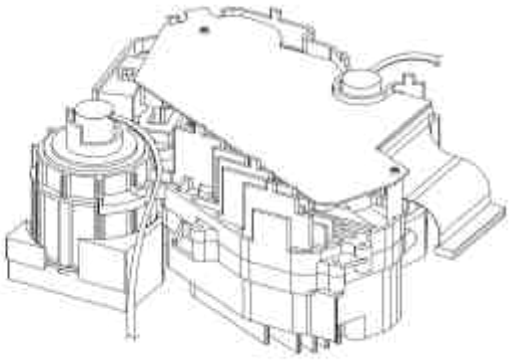
CAUTION

When working on the optical unit, a clean workbench with ESD protection mat must be available. Otherwise optical components or electronic boards may be damaged.

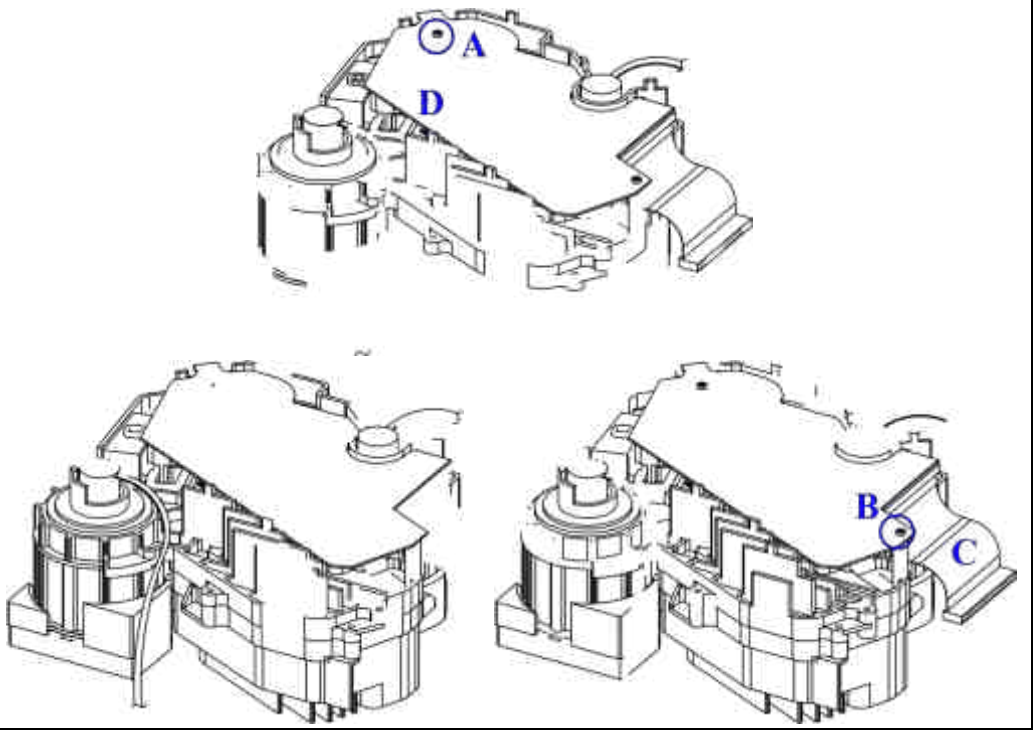
Preparations for this procedure:

- Optical unit has been removed as described in "Removing the Optical Unit" on page 178.
- The foam must be in place. Otherwise cutoff filter and diffuser will fall out.

1 Place the optical unit upside down on the ESD protection mat.

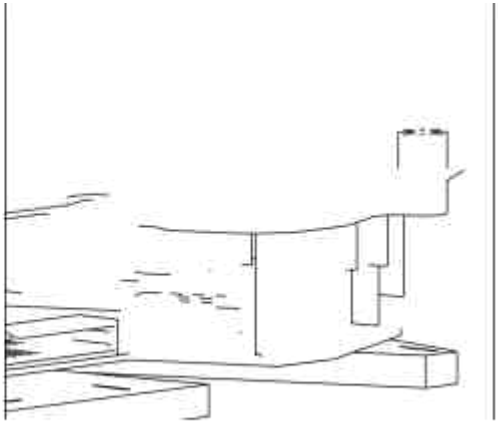


2 Unscrew screws A and B and disconnect connectors C and D.

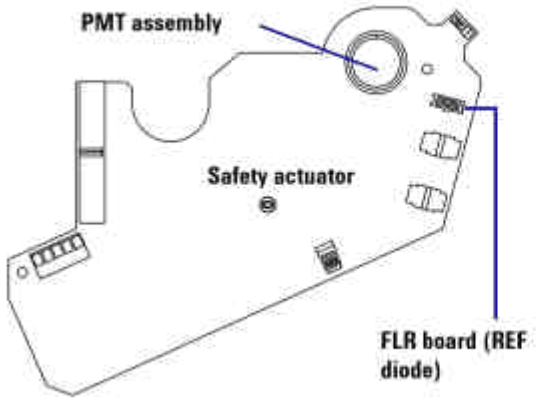


3

Disc
a fla



4 Remove the FLF board carefully in an upwards motion and place it on an ESD protected mat.

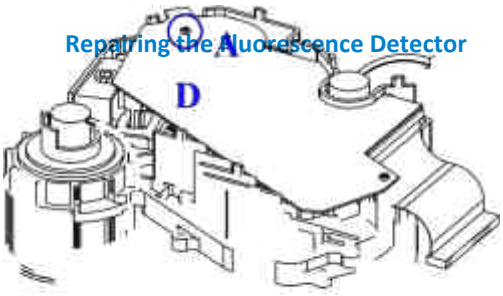


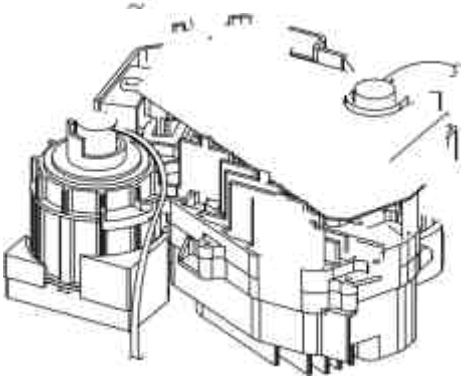
5 If you need to replace either the board or the PMT assembly, remove the PMT assembly from its socket.

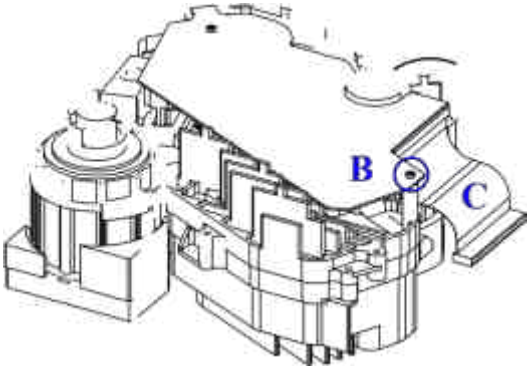
6 Replace the PMT assembly or the FLF board.

7 Re-install the PMT assembly in the socket.

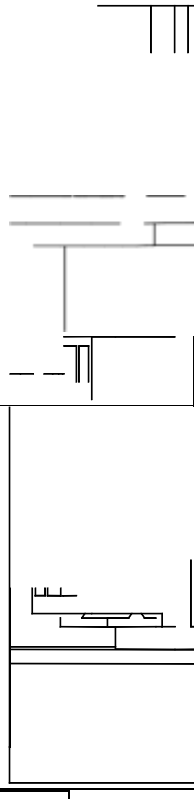
8 Replace the FLF board and fix the screws (A and B) and connectors (C and D).





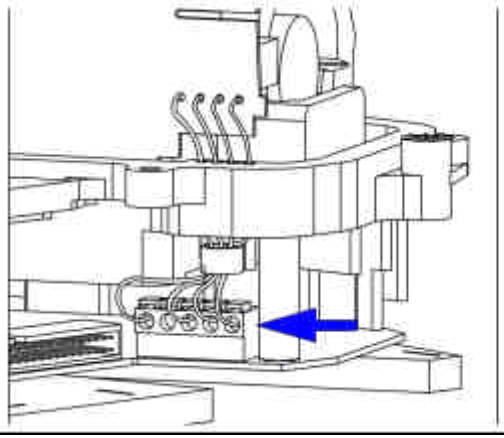


9 Check that the sa
board and castin



Next Steps:

10 Reconnect the wires to the connector. Use a flat screw driver to release the wire socket.



11 Put the wires into the released contacts using the tweezers.

Order of wires (left to right):

green
empty
brown
yellow
white

- Reinstall the optical unit as described in "Installing the Optical Unit" on page 194.
- If you replaced a G1321-66501 FLF board by a newer FLF board, update the FLD firmware to revision to latest version (to make it compatible).

Replacing FLL board and Trigger Pack

When required	If defective
Tools required	Screwdriver POZI 1 PT3
	Hexagonal key, 4 mm and 2.5 mm
Parts required	FLL Board G1321-66512 (**includes** trigger pack)

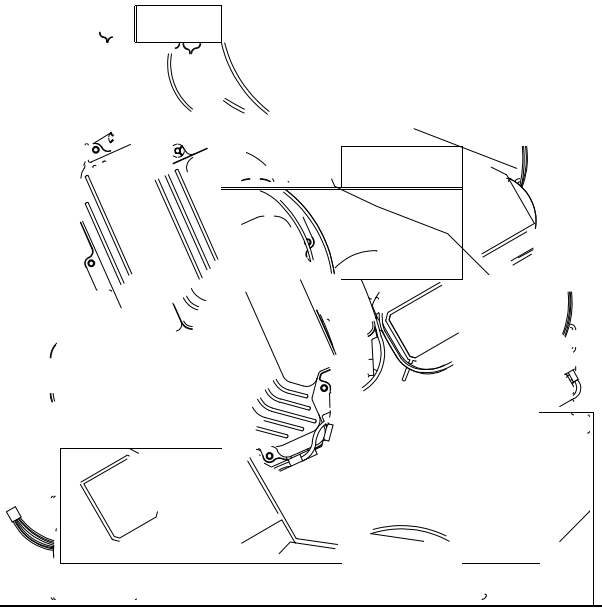
CAUTION When working on the optical unit, a clean workbench with ESD protection mat must be available. Otherwise optical components or electronic boards may be damaged.

WARNING **The instrument should not be operated without Xenon flash lamp. Otherwise the Triggerpack electronics will be damaged.**

Preparations for this procedure:

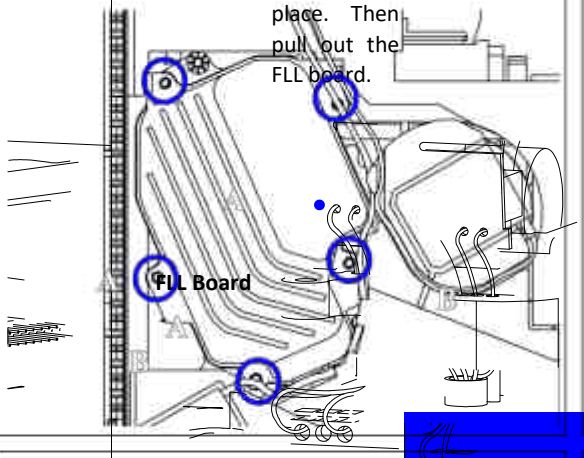
- Optical unit has been removed as described in "Removing the Optical Unit" on page 178.
- The foam must be in place. Otherwise cutoff filter and diffuser will fall out.

1 Place the optical unit on the ESD protection mat.



6

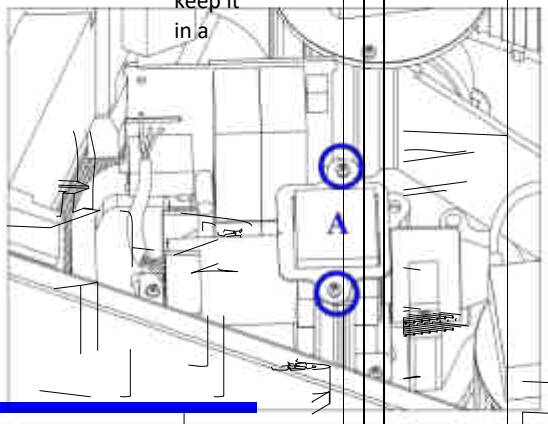
2 Using the 4 mm hexagonal key, unscrew the five screws and lift the cover.



Carefully pull off the ferret from safe place. Then pull out the FLL board.

7

3 Using the 2.5 mm hexagonal key, unscrew the two screws and remove the pad (A).

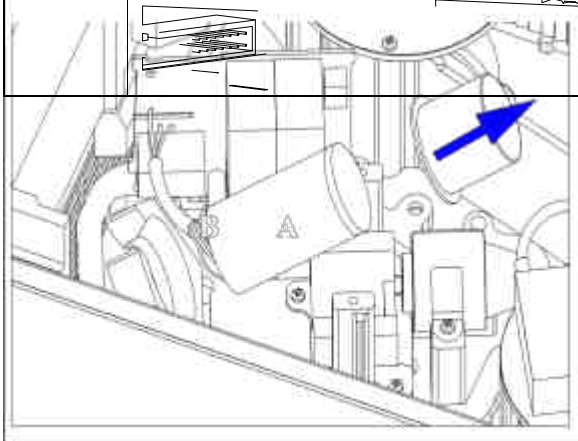


the wires and keep it in a

and the Ferret.

FLL Board

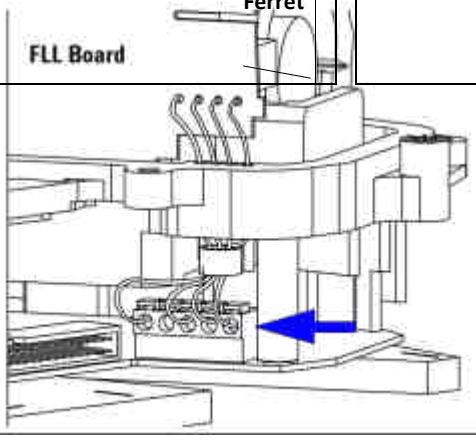
4 Remove the lamp as described in "Exchanging the Lamp" on page 149.

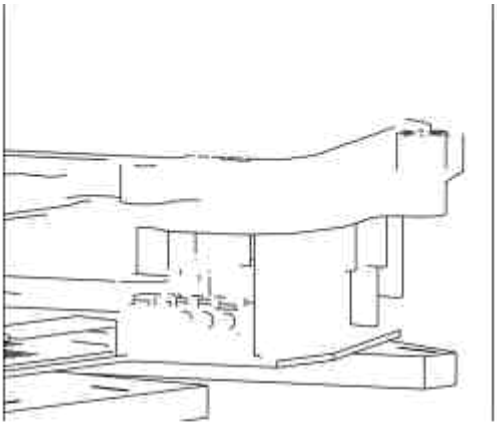


5 Disconnect the wires from the connector. Use a flat screw driver to release the wires.

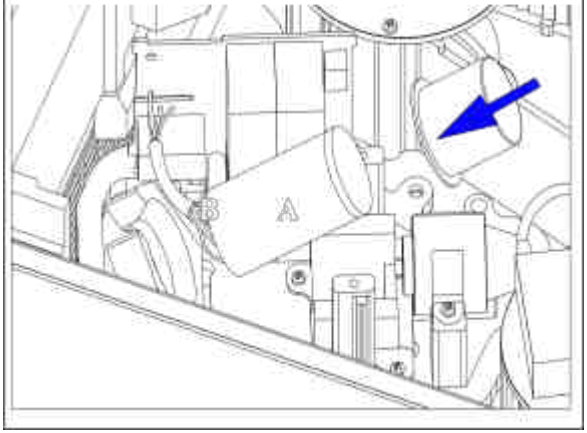
Ferret

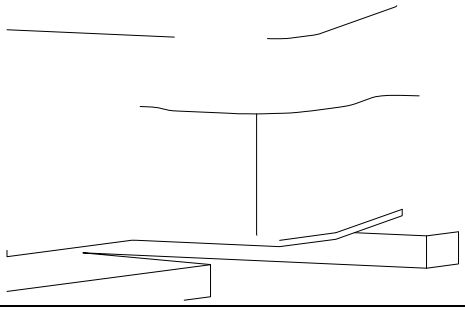
FLL Board





9 Reinstall the lamp as described in "Exchanging the Lamp" on page 149.



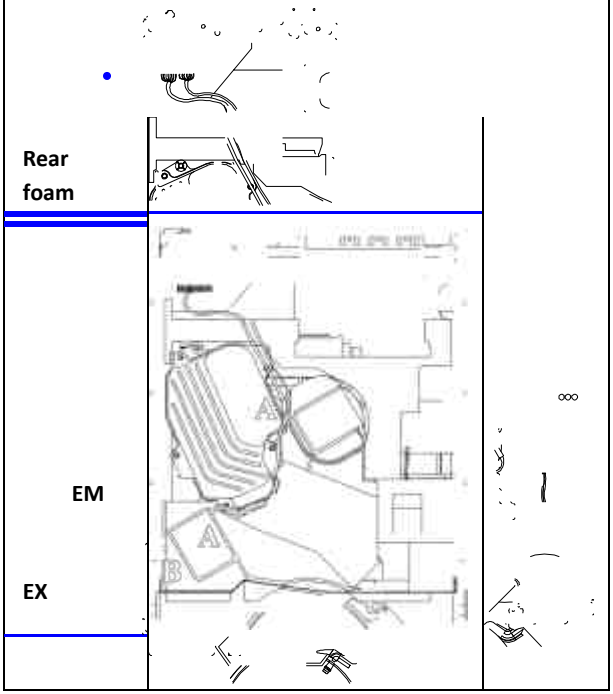


8 Put the wires into the released contacts using the tweezers.

Order of wires (left to right):

green empty
brown yellow
white

10 Replace the lamp housing cover. Insert the optical unit into its location and carefully insert the rear foam (A). Then reconnect the cables.



Next Steps:

- Replace the covers as described in "Replacing the Foam and the Top Cover" on page149.
- Re-install the detector in the stack.
- Reset the lamp counter as described in the user interface documentation.
- Turn the lamp on.
- Perform a wavelength verification to check the correct positioning of the replaced assemblies, as described in chapter "Wavelength Verification and Calibration" on page 105.

Replacing the EM and EX Grating

When required	If defective
Tools required	Screwdriver POZI 1 PT3
	Hexagonal key, 4 mm and 2.5 mm
Parts required	EM Grating assembly G1321-60004 (**includes** protection ring)
	EX Grating assembly G1321-60003 (**includes** protection ring)

CAUTION

When working on the optical unit, a clean workbench with ESD protection mat must be available. Otherwise optical components or electronic boards may be damaged.

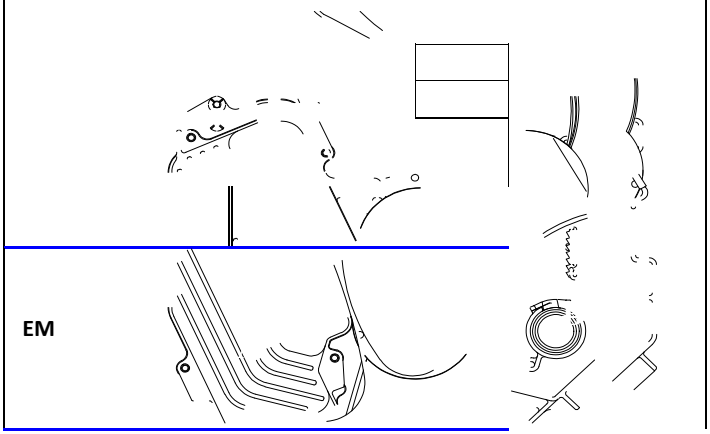
NOTE

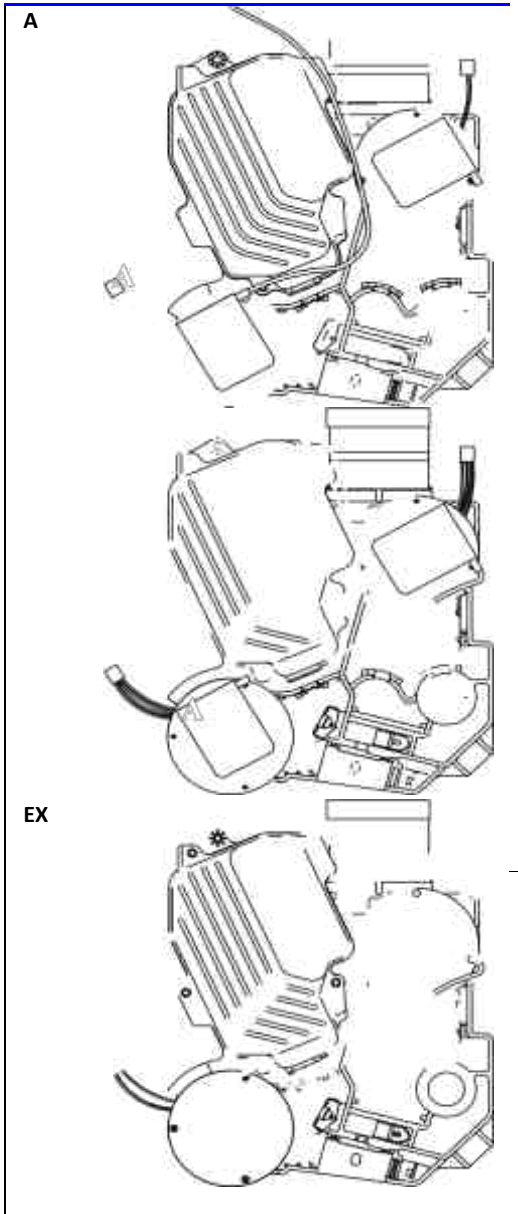
The grating assembly is shipped with a special transport packaging and includes a protection ring. DO NOT touch the grating surface and DO NOT bend the protection ring.

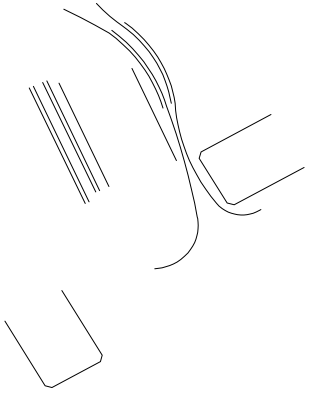
Preparations for this procedure:

- Optical unit has been removed as described in "Removing the Optical Unit" on page 178.
- The cables from the position encoders (at the rear of the EM or EX grating assembly) should be disconnected.
- Disconnect the encoder cable of the EX-monochromator from FLF board.

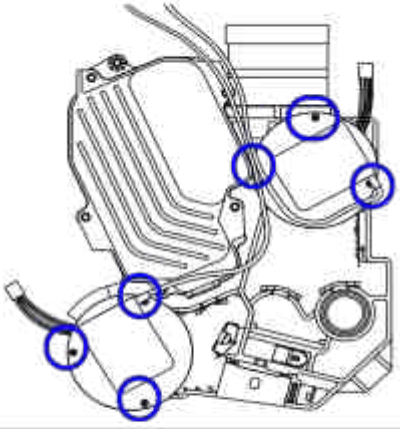
1 Place the optical on the ESD protection mat and remove the front foam (A). Locate the EM and EX grating assembly.



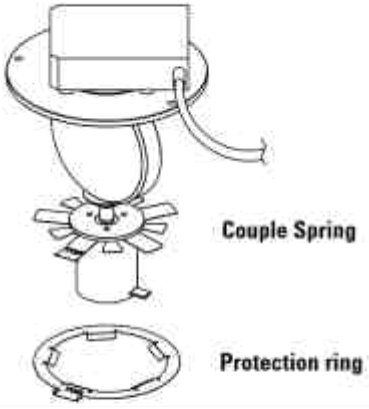

A
EX



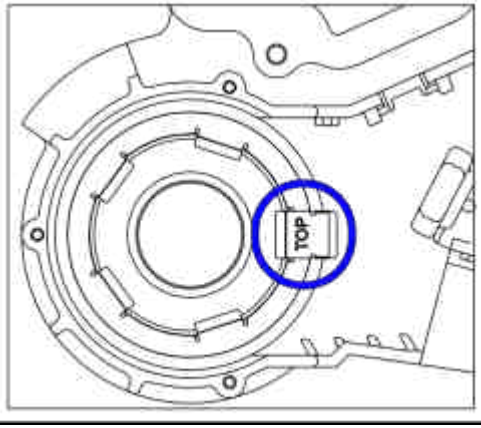
2 Use a 2.5 mm hex key to unscrew the 3 screws on the assembly you want to remove.



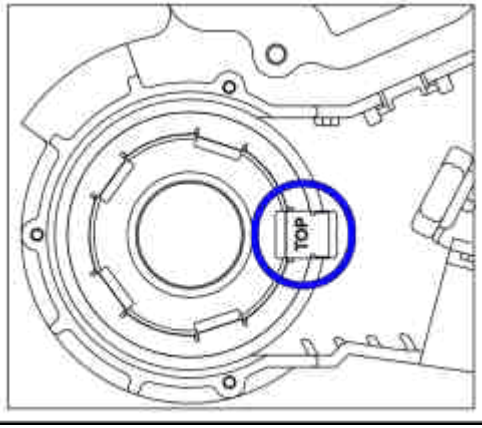
3 Carefully remove the grating assembly and the protection ring from its location.



4 Insert the new protection ring into its position. Do not bend the protection ring.

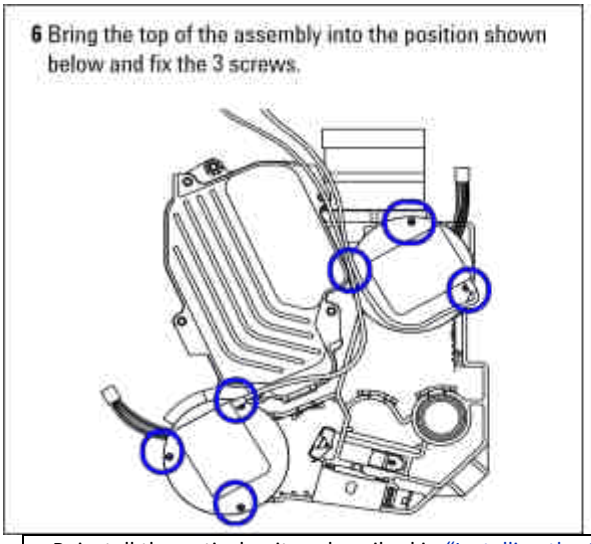


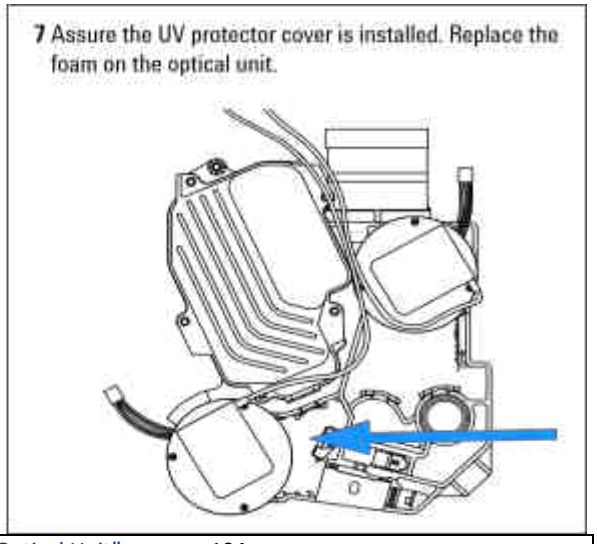
5 For reinstallation route the cable first through the hole. Carefully insert the grating into its position while pulling the cable slightly from below. The couple spring has to be clipped into the protection ring (TOP mark)!



Next Steps:

- Reconnect the encoder cable of the EX-monochromator to FLF board.





- Reinstall the optical unit as described in "Installing the Optical Unit" on page 194.
- Enter the replacement in the maintenance logbook.
- Reset the monochromator settings to default using the diagnose functions.
- In this case "*Wavelength Calibration Lost"* is displayed and the instrument stays in *Not Ready* condition until you perform a wavelength calibration.
- Perform a wavelength verification to check the correct positioning of the replaced assemblies, as described in chapter "Wavelength Verification and Calibration" on page 105.

Exchanging the Power Supply

When required	If defective
Tools required	Screwdriver POZI 1 PT3 Wrench 1/4 inch Wrench 5 mm Wrench 7 mm
Parts required	Power supply 0950-2528

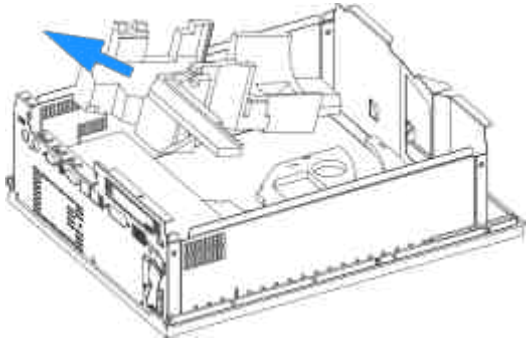
NOTE

The repair of the power supply assembly comprises exchanging the complete assembly. No serviceable parts are inside.

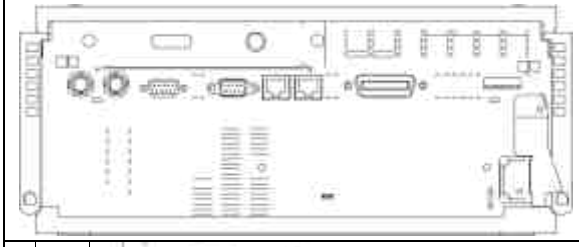
Preparations for this procedure:

- Turn off the lamp.
- Switch off the detector, and disconnect the cables.
- Remove the detector from the stack and place it on the workbench.
- Remove the front cover and top cover, see “Removing the Covers” on page 146.
- Remove the processor board, see “Exchanging the Processor Board” on page 160.
- Remove the fan assembly, see “Exchanging the Fan” on page 164.
- Remove the optical unit, see “Removing the Optical Unit” on page 178.

1 Carefully remove the bottom foam piece by sliding it out towards the rear.

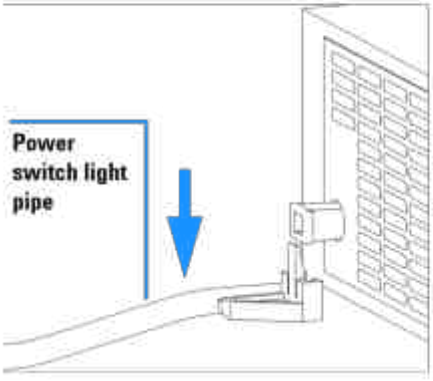


2 Unscrew the power supply at the rear of the module.

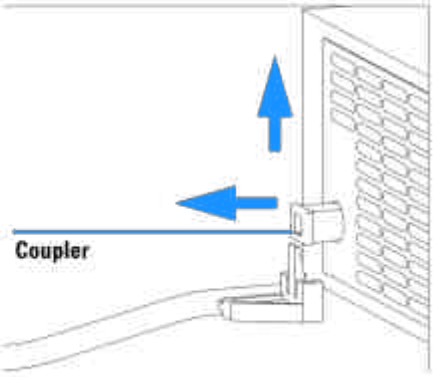




3 Press down the power switch light pipe to remove it from the coupler.

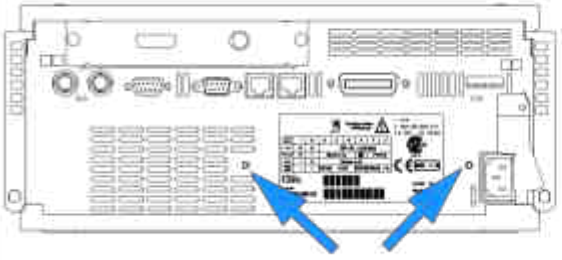


4 Remove the power supply completely.
Re-use the coupler on the new power supply.

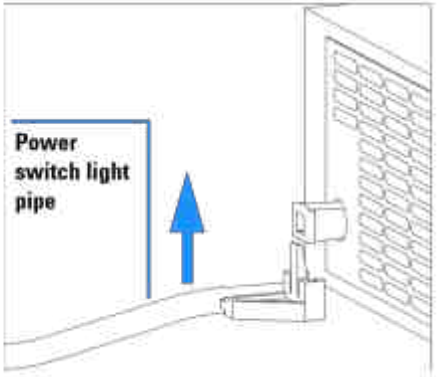


The repair of the power supply assembly is comprised of exchanging the complete assembly. No serviceable parts are inside.

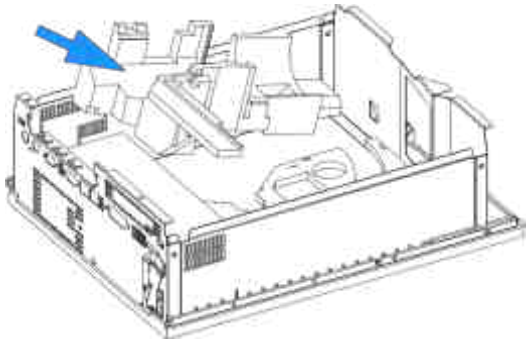
5 Insert the power supply into its location and fix it with the screws at the rear panel.



6 Press down and clip in the power switch light pipe into the power supply.



7 Reinstall bottom foam piece. Slide it in underneath the leak drain.



8 Reinstall the processor board, see "Exchanging the Processor Board" on page 160.

9 Reinstall the fan assembly, see "Exchanging the Fan" on page 164.

10 Reinstall the optical unit, see "Installing the Optical Unit" on page 194.

11 Reinstall the front cover, top cover, see "Replacing the Foams and Covers" on page 196.

12 Replace detector into the stack.

13 Reconnect the power cable and turn on the detector.

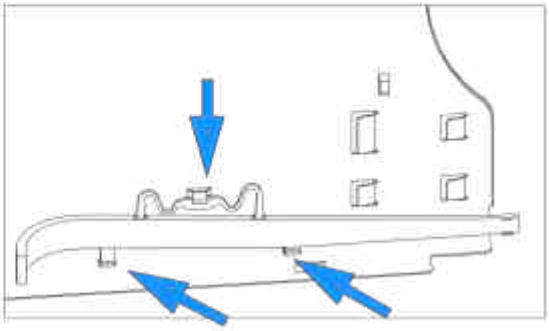
Replacing Status Light Pipe

When required	If part was broken or removed
Tools required	Screwdriver POZI 1 PT3
Parts required	Status light pipe 5041-8384

Preparations for this procedure:

- Remove the front cover and top cover, see "Removing the Covers" on page 146.

1 The status light pipe is clipped into the top cover.



2 Replace the top cover, see "Replacing the Foams and Covers" on page 196.

3 Replace the detector into the stack and reconnect the cables and capillaries.

4 Turn on the detector.

Installing the Optical Unit

When required When all repairs on the optical unit have been completed

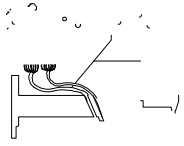
Tools required Screwdriver POZI 1 PT3
Hexagonal key, 4 mm

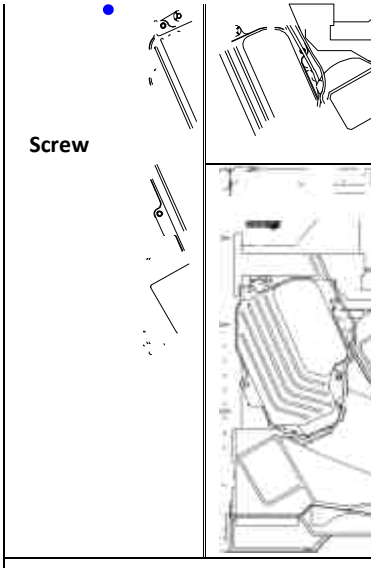
WARNING **For safe operation make sure that the ground cable is reconnected.**

Preparations for this procedure:

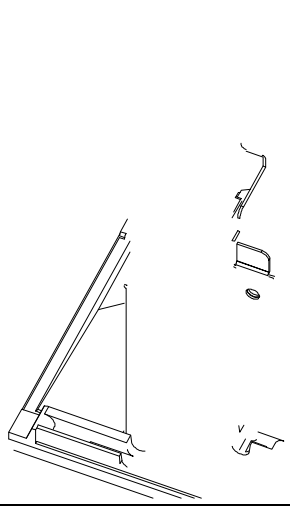
- All previous work has been completed.
- Power supply has been installed.
- Fan has been installed.
- The optical unit has its foam cover attached.

1 Place the optical unit in the instru
grounding screw.

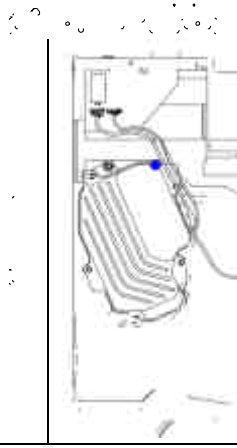


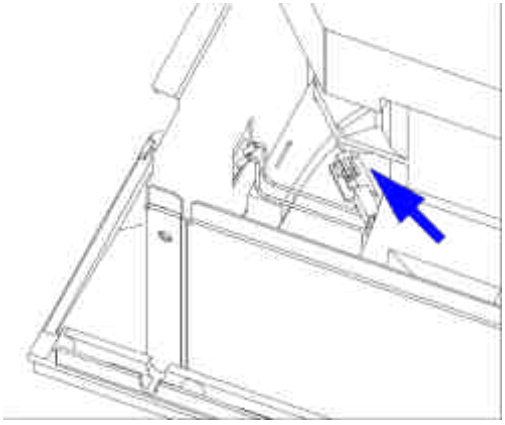


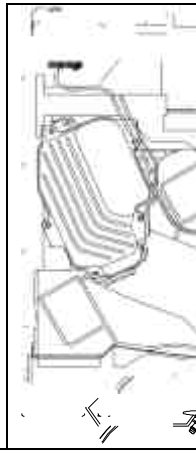
2 Reconnect the leak sensor cable (J3) using your left hand.



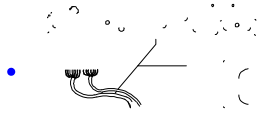
3 Reconnect the optical unit cable (J20).







4 Insert the rear foam and reconnect cables (EM monochromator) and (EX monochromator) to the detector main board (FLM).



Next Steps:

- Replace the covers as described in "Replacing the Foams and Covers" on page 196.
- Re-install the flow cell and the front panel
- Re-install the detector in the stack.
- Turn the lamp on.
- Perform a wavelength verification to check the correct

Rear foam			positioning of the replaced assemblies, as described in chapter "Wavelength Verification and Calibration" on page 105.
EM **EX**			

Replacing the Foams and Covers

Note:

If a new optical unit has been installed or assemblies within the optical unit have been replaced, then refer "Next Steps" on page 189.

When required When all repairs have been completed

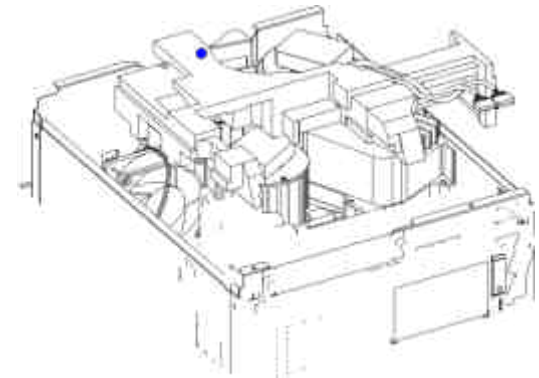
Tools required Screwdriver POZI 1 PT3

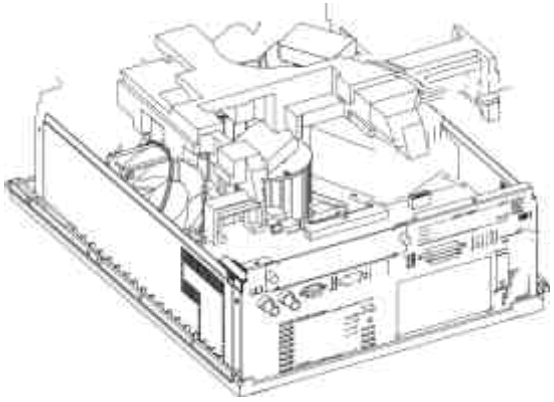
Prerequisites The detector is open and other procedures have been carried out

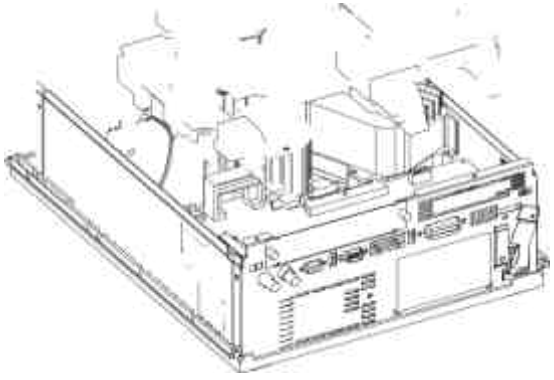
NOTE

The front cover (across the optical unit) should only be removed when required during a procedure. This will keep dust away from optical components.

1 Carefully insert the rear foam.





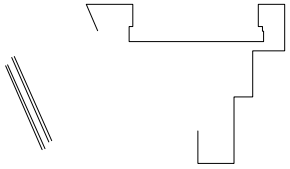


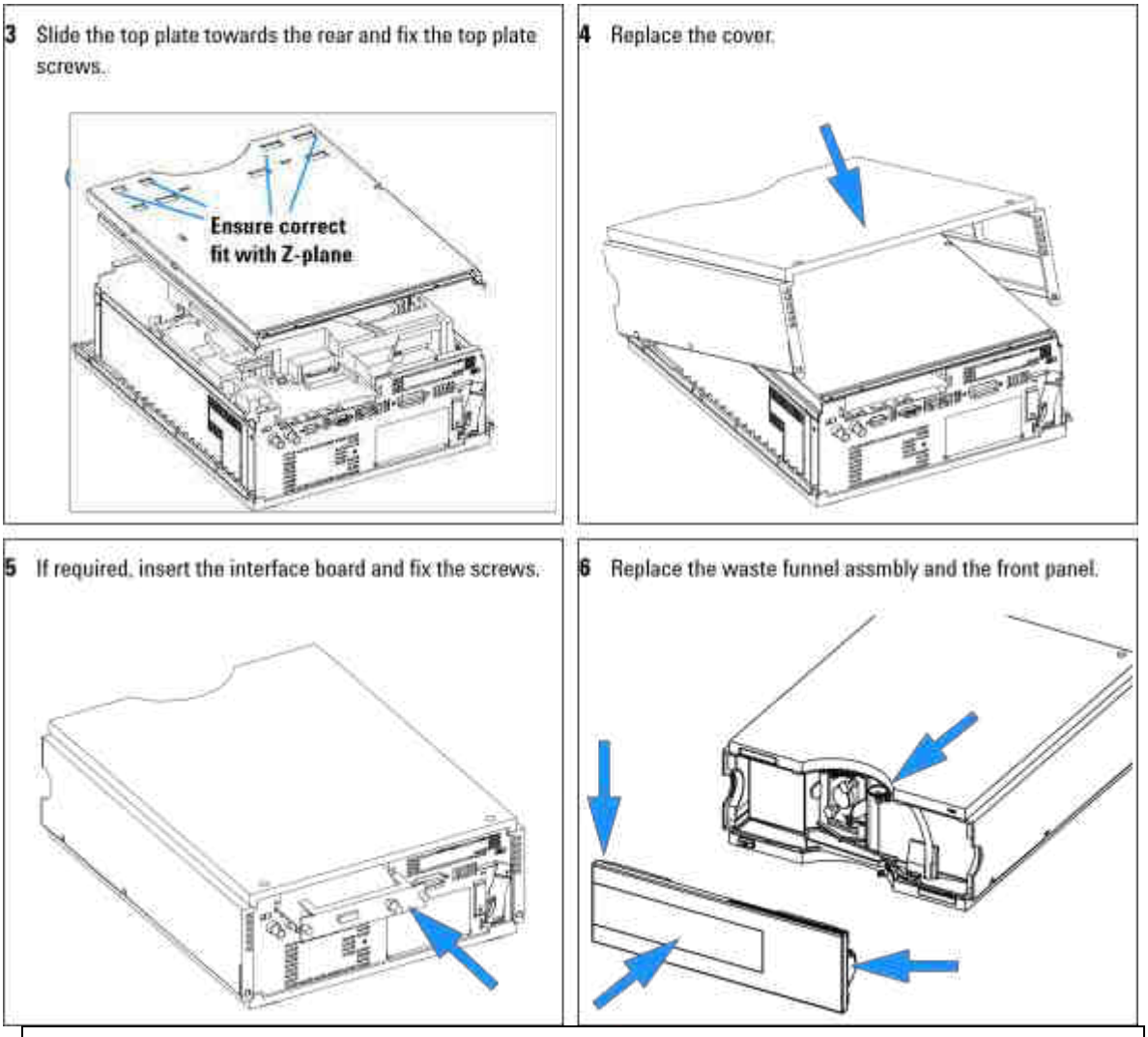
2

th
co

Rea

EX





Next Steps:
- Replace the detector into the stack and Reinstall the flow cell.
- Reconnect the power cable and turn on the detector.
- Turn the lamp on.

Assembling the Main Cover

When required If cover is broken

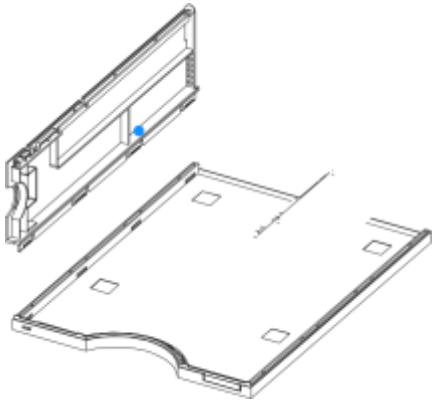
Tools required None

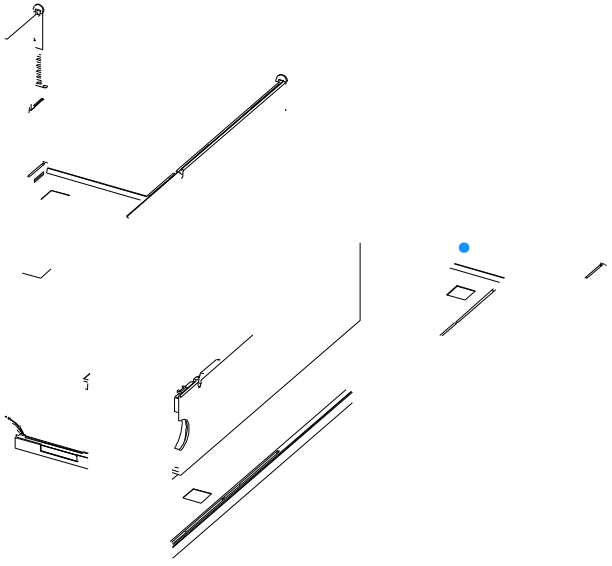
Parts required Plastics kit 5062-8582 (includes base, top, left and right) The

NOTE plastics kit contains all parts, but it is not assembled.

WARNING **If you mistakenly insert the left or right side in the opposite position, you may not be able to remove that side from the top part.**

1 Place the top part on the bench and insert the left and right sides into the top part.





Next steps:

- Replace the detector in the stack and reconnect the cables and capillaries.
- Turn on the detector.

Replacing the Interface Board

When required	For all repairs inside the detector or for installation of the board
Part required	Interface board (BCD) G1351-68701 with external contacts and BCD outputs Interface board (LAN) see "LAN Communication Interface Board" on page 286
Tools required	None

To replace the interface board unscrew the two screws, remove the board, slide in the new interface board and fix it with the board's screws.

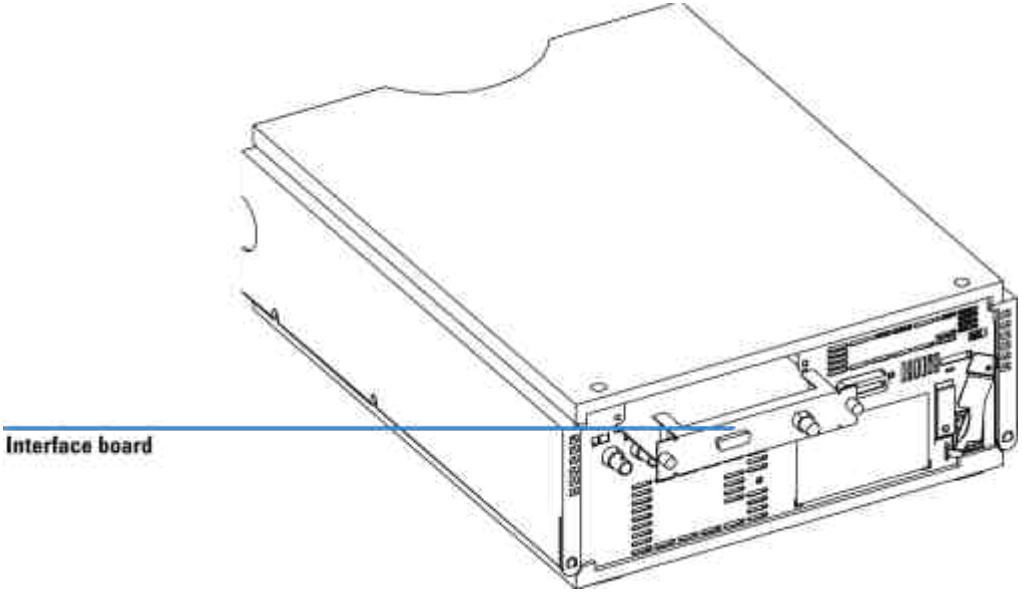


Figure 57 Location of the Interface Board

Replacing the Detector's Firmware

The installation of new firmware is required:

- if new version solves problems of currently installed version, or
- if after exchange of the main board (FLM) the version on board is older than the previously installed one.

To upgrade the detector's firmware the following steps have to be taken:

1 Load the firmware into the detector, see help system of your user interface.

2 If FLM board was replaced, reenter the serial number information of the module through the user interface, see “Entering the Serial Number using the Control Module” on page 162 or “Entering the Serial Number using the Agilent ChemStation” on page 163.



6
Identifying Parts and Materials

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Agilent Technologies

Overview of Main Assemblies

Figure 58 shows the main assemblies and their locations.

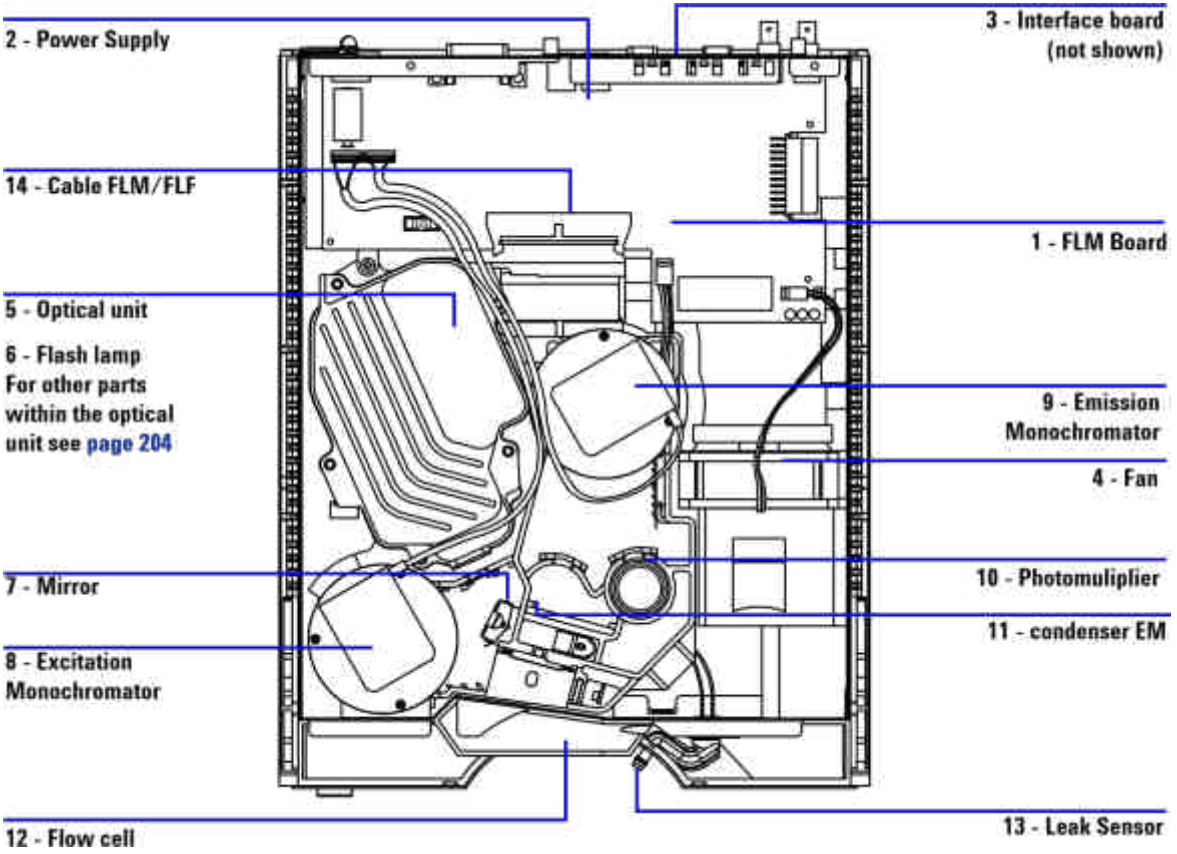


Figure 58 Main Assemblies

Table 24 Main Assemblies

Item	Description	Part Number

1	Detector main board FLM (**exchange assembly**)	G1321-69500
	Hexagonal nut for GPIB connector	0380-0643
	Hexagonal nut for RS-232C connector	1251-7788
	Nut for analog connector	2940-0256
	Washer for analog connector	2190-0699
	Cable CAN to Agilent 1100 Series modules (0.5 m), see page 233	5181-1516
2	Power supply for power and status light parts, see page 212	0950-2528
3	Interface board BCD (BCD/external contacts), optional, optional, see page 284	G1351-68701
3	LAN Communication Interface Board G1369A (LAN), optional, see page 286	G1369-60001
	Fuse for BCD board, 250 mA (total of 4 are on the board)	2110-0004
4	Fan assembly	3160-1017
5	Optical unit (**exchange assembly**), for additional optical unit parts, see page 204	G1321-69002
6	Xenon flash lamp	2140-0600
7	Mirror	1000-1000
8	Excitation Monochromator assembly (complete)	G1321-60003
9	Emission Monochromator assembly (complete)	G1321-60004
10	Photomuliplier tube assembly (PMT), see also page 180 for other types	1970-0201
11	Condenser EM, same as EX	1000-1124
12	Standard flow cell, 8 µl, 20 bar, see also page 204 for cell screws	G1321-60005
13	Leak sensor assembly and Leak handling parts, see page 213	5061-3356
14	Cable FLM - FLF board (comes with optical unit)	G1321-61600
	Front cover and plastic parts (housing), see page 210	
	Sheet metal parts, see page 209	

Foam parts, see page 211

Optical Unit Assembly

Table 25 Optical Unit Assembly

Item	Description	Part Number
	Optical unit (**exchange assembly**), comes with foam part and CableFLM/FLF	G1321-69002
1	Flash Lamp Board (FLL), **includes** trigger pack	G1321-66512
2	Xenon flash lamp	2140-0600
3	Condenser Excitation	1000-1136
4	Slit (EX) 2x4	G1321-08103
5	Mirror	1000-1000
6	Excitation Monochromator assembly (complete)	G1321-60003
7	Emission Monochromator assembly (complete)	G1321-60004
8	Standard Flow Cell, 8 µl, 20 bar, inlet i.d./length 0.17 mm/80 mm, outlet i.d./length 0.25 mm/80 mm	G1321-60005
	Cuvette, 8 µl, 20 bar inlet i.d./length 0.5 mm/80 mm, outlet i.d./length 0.5 mm/80 mm	G1321-60007
	Screw for flow cell / cuvette	G1321-22400
9	Slit (EM) 2x8	G1321-08102
10	Photomuliplier tube assembly (PMT), see also page 180 for additional information	1970-0201
11	Condenser Emission	1000-1124
12	Front-end Board (FLF), underneath the optical (**exchange assembly**) (requires firmware revision A.04.06 or above)	G1321-69531

12a	Reference Diode Board (FLR)	G1321-66533
12b	Diffuser plate (in front of the reference diode board FLR)	1000-1121
13	Cutoff Filter 295 nm, for other type see page 215	5062-8530
14	Carbon filter mat	01046-42701
15	Cable FLM - FLF board (comes with optical unit)	G1321-61600

Table 25 Optical Unit Assembly, continued

Item	Description	Part Number
	Foam Optics	G1321-40103
16	Cable chassis	G1321-61602
17	Screw M5 x 25 mm, for chassis cable	0515-2574
	Screw 2.5 mm hex, for monochromator, lamp pad, condenser #1, slits, etc.	0515-1052
	Screw M4 x 25 mm hex, for lamp housing	0515-2548
	Screw M4 x 8 mm, for FLF board	0515-2549

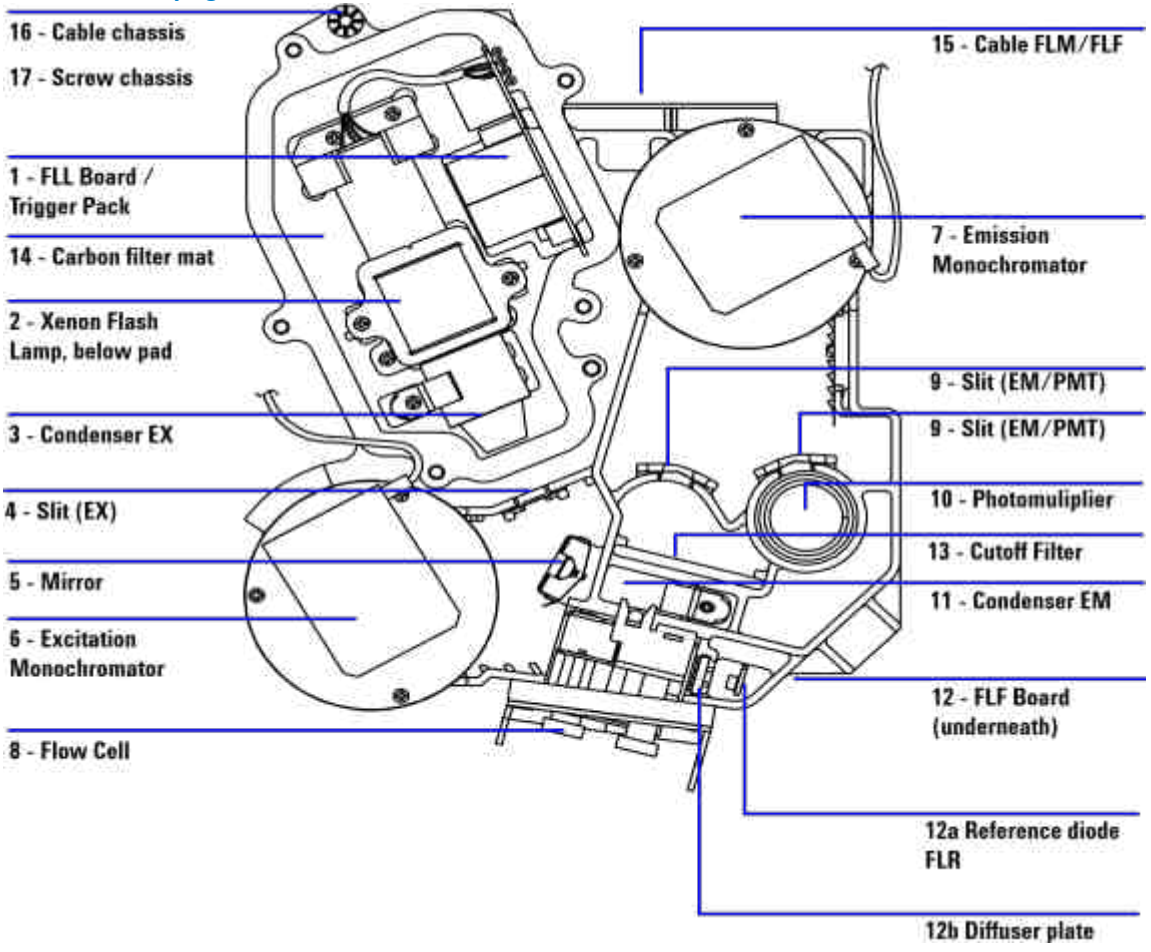


Figure 59 Optical Unit Parts

Lamp Cover Parts

Table 26 Lamp Cover Parts

Item	Description	Part Number
1	Plate	G1321-08100

2	Screw 2.5 mm hex	0515-1052
3	Quartz Window	1000-0999

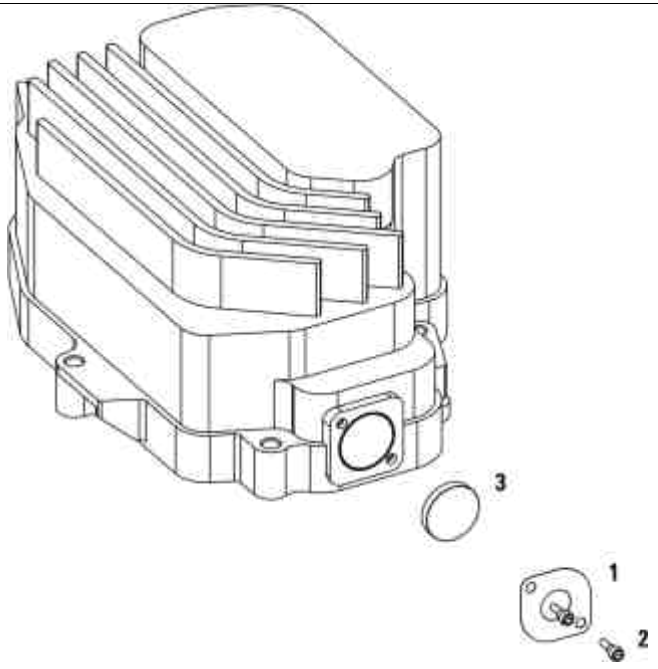


Figure 60 Lamp Cover Parts

Control Module

Table 27 Control Module Parts

Item	Description	Part Number
	Control Module, replacement part including cable	G1323-67001
	Plastic Housing Kit, includes front, back and a clamp	5062-8583
	CAN cable Agilent 1100 module to control module	G1323-81600

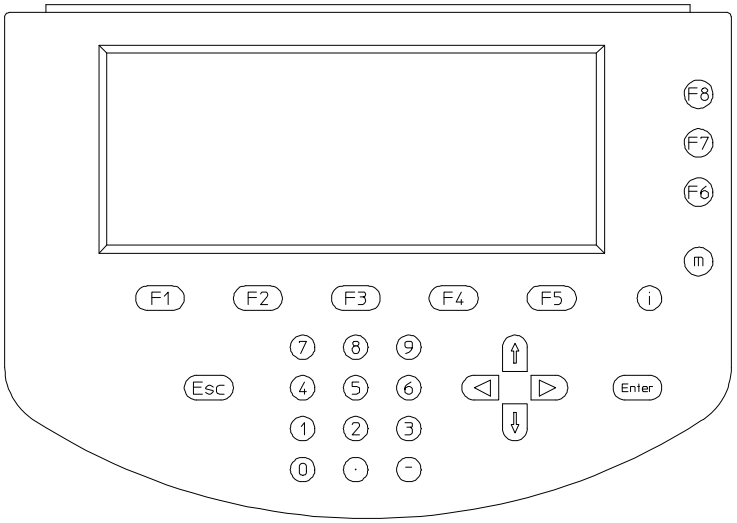


Figure 61 Control Module

Sheet Metal Kit

Table 28 Sheet Metal Kit Parts

Item	Description	Part Number
1	Sheet metal kit includes case and top cover	G1321-68701
2	Screws M3 for cover and flow cell door	5022-2112

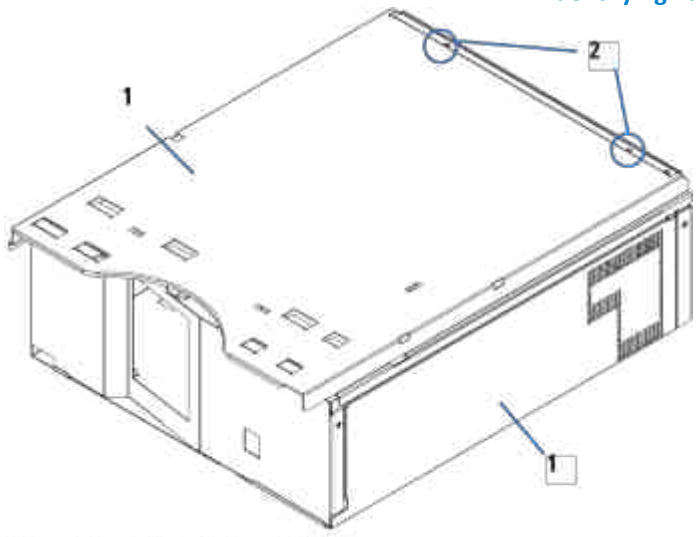


Figure 62 Sheet Metal Kit Parts

Plastic Parts

Table 29 Plastics Parts

NOTE

Item	Description	Part Number
1	Front cover	5062-8582
2	Plastics, includes base, sides and top	5062-8565
3	Name plate Agilent 1100 Series	5042-1381

4	Name plate Serial Number (w/o serial number)	5042-1314

For correct assembling of the top and sides, see “Assembling the Main Cover” on page 198.

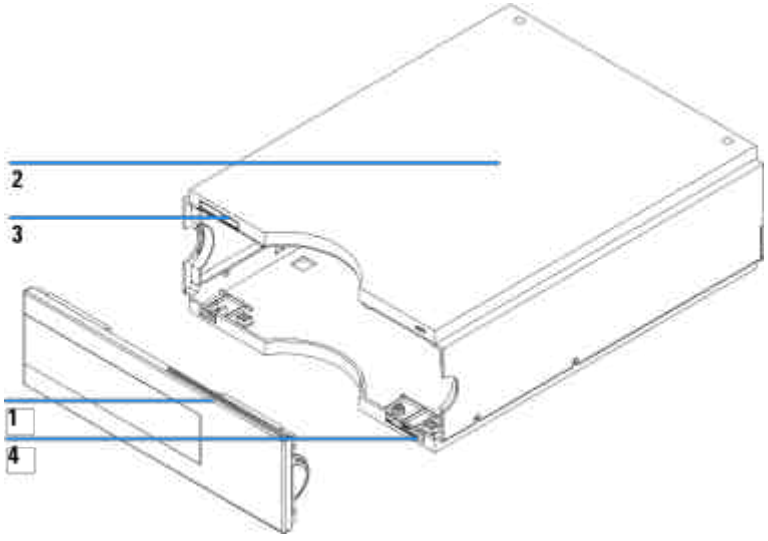


Figure 63 Plastic Parts

Foam Parts

Table 30 Foam Parts

Item	Description	Part Number
1, 2	EPP foam kit, includes bottom and top rear	G1321-68702
3	Foam Pads (located underneath the optical), set of two	G1321-68700
4	Guides for interface board	5041-8395

NOTE Do not order the individual part numbers imprinted on the foam.

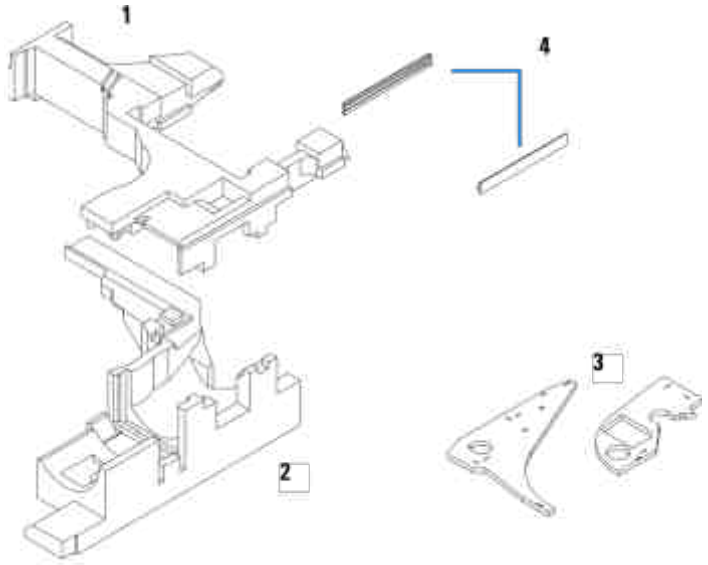


Figure 64 Foam Parts

Power and Status Light Pipes

Table 31 Power and Status Light Pipes

Item	Description	Part Number
	Power supply assembly	0950-2528
	Screw M4 x 0.7, 8 mm lg, to fix power supply at rear panel	0515-0910
	Washer	2190-0409
1	Power light pipe	5041-8382
2	Status light pipe	5041-8384
3	Power switch button	5041-8381

4	Coupler for power supply actuator	5041-8383

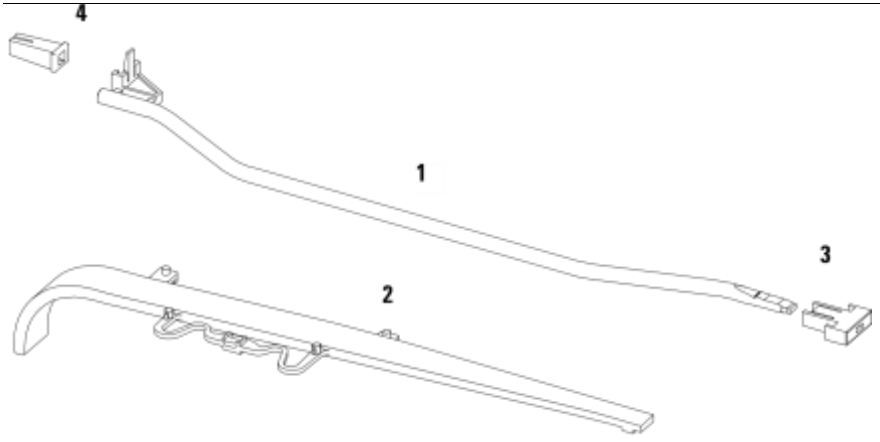


Figure 65 Power and Status Light Pipe

Leak Parts

Table 32 Leak Parts

Item	Description	Part Number
1	Leak sensor assembly	5061-3356
2	Leak pan	G1321-45501
3	Leak funnel	5041-8388
4	Leak funnel holder	5041-8389
5	Corrugated tubing, 120 mm lg, re-order 5 m	5062-2463
6	Corrugated tubing, 1200 mm lg, re-order 5 m	5062-2463

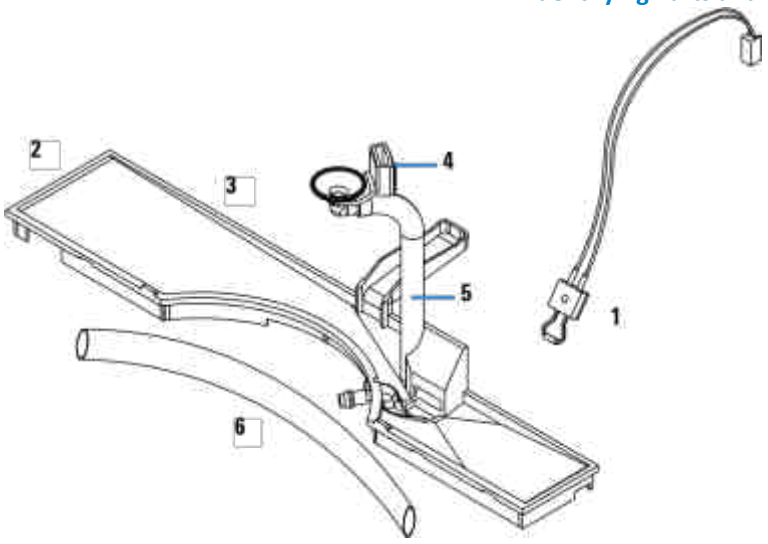


Figure 66 Leak Parts

Cuvette Kit

Table 33 Cuvette Kit

Item	Description	Part Number
	FLD Cuvette Kit, 8 µl, 20 bar	G1321-60007
	includes	
	Tubing, flexible, 1 meter	
	SST Fitting, QTY=1	79814-22406
	SST front ferrule, QTY=1	0100-0043
	SST back ferrule, QTY=1	0100-0044
	PEEK fitting, QTY=1	0100-1516
	Needle-Syringe	9301-0407

Glass-Syringe	9301-1446

Spare Parts

The spare parts listed below allow changes to the standard hardware configuration to adapt to specific application needs (as it was possible on the HP 1046 A Fluorescence detector).

NOTE

The installation of these parts may affect the performance of the detector and may not fulfill the instruments specifications.

Table 34 Spare Parts

Description	Part Number
Cutoff filter kit: 389 nm, 408 nm, 450 nm, 500 nm, 550 nm	5061-3327
Cutoff filter kit: 380 nm, 399 nm, 418 nm, 470 nm, 520 nm	5061-3328
Cutoff filter kit: 280 nm, 295 nm, 305 nm, 335 nm, 345 nm	5061-3329
Cutoff filter 370 nm	1000-0822
Photo-multiplier Tube (PMT) R928HA (185 to 900 nm)	contact Hamamatsu dealers
Photo-multiplier Tube (PMT) R3788HA (185 to 750 nm)	

Accessory Kit

This kit contains some accessories and tools needed for the installation and repair/calibration of the detector.

Table 35 Accessory Kit Parts

Item	Description	Part Number

	Accessory kit	G1321-68705
	includes	
	Corrugated tubing, 120 mm lg, re-order 5 m	5062-2463
1	Teflon Tubing flexible i.d. 0.8 mm (flow cell to waste), re-order 5 m	5062-2462
2	Fitting male PEEK, Qty=2	0100-1516
3	Capillary column – detector 380 mm lg, 0.17 i.d. includes items 4, 5 and 6 (not assembled)	G1315-87311
4	Ferrule front SST, qty=1	0100-0043
5	Ferrule back SST, qty=1	0100-0044
6	Fitting SST, qty=1	79814-22406
	Screwdriver hexagonal 4 mm, 100 mm long	5965-0027
	Screwdriver hexagonal 2.5 mm, 100 mm long	5965-0028
	Needle-Syringe	9301-0407
	Glass-Syringe	9301-1446
	Calibration Sample, Glycogen	5063-6597
	Sample filter, diameter=3 mm, pore size 0.45 µm, QYT=5	5061-3367 (pack of 100)
	Hex key set 1 – 5 mm	8710-0641
	Wrench open end 1/4 – 5/16 inch	8710-0510
	ESD wrist strap	9300-1408

2

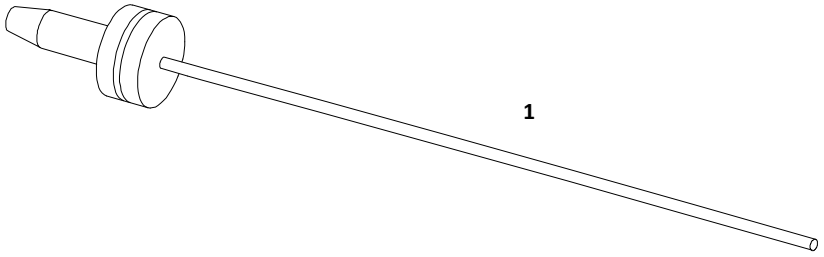


Figure 67 Waste Tubing Parts

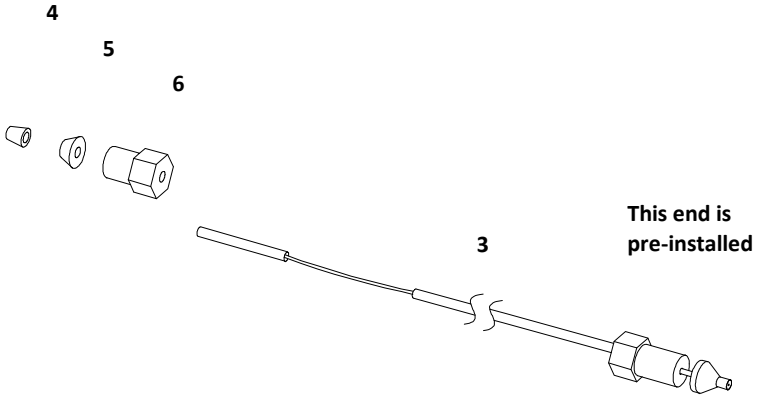


Figure 68 Inlet Capillary (Column-Detector) Parts

Cable Overview

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

Table 36 Cables Overview

Type	Description	Part Number

Analog cables	3390/2/3 integrators	01040-60101
	3394/6 integrators	35900-60750
	Agilent 35900A A/D converter	35900-60750
	General purpose (spade lugs)	01046-60105
Remote cables	3390 integrator	01046-60203
	3392/3 integrators	01046-60206
	3394 integrator	01046-60210
	3396A (Series I) integrator	03394-60600
	3396 Series II / 3395A integrator, see page 226	
	3396 Series III / 3395B integrator	03396-61010
	Agilent 1100 / 1050 modules / HP 1046A FLD	5061-3378
	HP 1046A FLD	5061-3378
	Agilent 35900A A/D converter	5061-3378
	HP 1090 liquid chromatographs	01046-60202
	Signal distribution module	01046-60202

Table 36 Cables Overview, continued

Type	Description	Part Number
BCD cables	3396 integrator	03396-60560
	General purpose (spade Lugs)	G1351-81600
Auxiliary	Agilent 1100 Series vacuum degasser	G1322-61600

CAN cables	Agilent 1100 module to module, 0.5 m	5181-1516
	Agilent 1100 module to module, 1 m	5181-1519
	Agilent 1100 module to control module	G1323-81600
External contacts	Agilent 1100 Series interface board to general purpose	G1103-61611
GPIB cable	Agilent 1100 module to Agilent ChemStation, 1 m	10833 A
	Agilent 1100 module to Agilent ChemStation, 2 m	10833 B
RS-232 cable	Agilent 1100 module to a computer This kit contains a 9-pin female to 9-pin female Null Modem (printer) cable and one adapter.	34398 A
LAN cable	Cross-over network cable (shielded, 3 m long), (for point to point connection)	5023-0203
	Twisted pair network cable (shielded, 7 m long) (for hub connections)	5023-0202

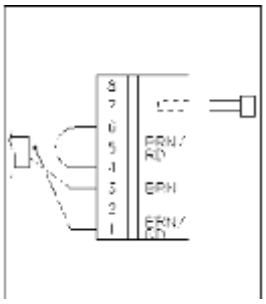
Analog Cables



One end of these cables provides a BNC connector to be connected to Agilent 1100 Series modules. The other end depends on the instrument to which connection is being made.

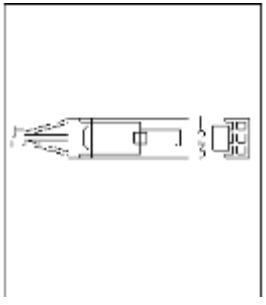
Agilent 1100 to 3390/2/3 Integrators

Connector	Pin	Pin	Signal Name
01040-60101	3390/2/3	Agilent 1100	

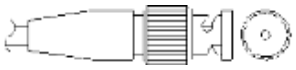


1	Shield	Ground
2		Not connected
3	Center	Signal +
4		Connected to pin 6
5	Shield	Analog -
6		Connected to pin 4
7		Key
8		Not connected

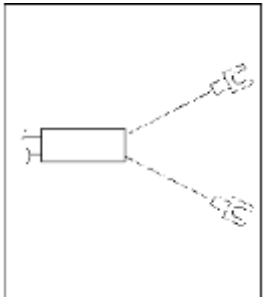
Agilent 1100 to 3394/6 Integrators

Connector 35900-60750	Pin 3394/6	Pin Agilent 1100	Signal Name
	1		Not connected
	2	Shield	Analog -
	3	Center	Analog +

Agilent 1100 to BNCctor Conne

Connector 8120-1840	Pin BNC	Pin Agilent 1100	Signal Name
	Shield	Shield	Analog -
	Center	Center	Analog +

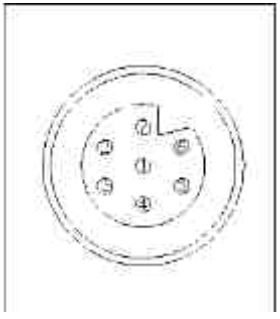
Agilent 1100 to General Purpose

Connector 01046-60105	Pin 3394/6	Pin Agilent 1100	Signal Name
	1		Not connected
	2	Black	Analog -
	3	Red	Analog +

Remote Cables

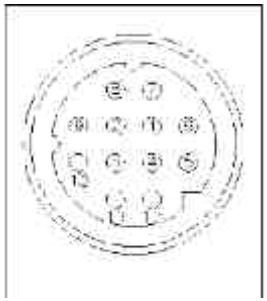
One end of these cables provides a Agilent Technologies APG (Analytical Products Group) remote connector to be connected to Agilent 1100 Series modules. The other end depends on the instrument it is to be connected to.

Agilent 1100 to 3390 Integrators

Connector 01046-60203	Pin 3390	Pin Agilent 1100	Signal Name	Active (TTL)
	2	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	7	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	NC	7 - Red	Ready	High
	NC	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low

Agilent 1100 to 3392/3 Integrators

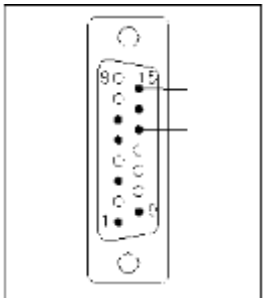
Connector 01046-60206	Pin 3392/3	Pin Agilent 1100	Signal Name	Active (TTL)
	3	1 - White	Digital ground	



4 - Key

NC	2 - Brown	Prepare run	Low
11	3 - Gray	Start	Low
NC	4 - Blue	Shut down	Low
NC	5 - Pink	Not connected	
NC	6 - Yellow	Power on	High
9	7 - Red	Ready	High
1	8 - Green	Stop	Low
NC	9 - Black	Start request	Low

Agilent 1100 to 3394 Integrators

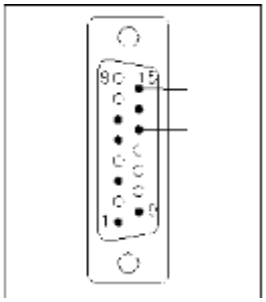
Connector 01046-60210	Pin 3394	Pin Agilent 1100	Signal Name	Active (TTL)
	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	5,14	7 - Red	Ready	High
	6	8 - Green	Stop	Low
	1	9 - Black	Start request	Low
	13, 15		Not connected	

NOTE

START and STOP are connected via diodes to pin 3 of the 3394 connector.

Agilent 1100 to 3396A Integrators

Connector 03394-60600	Pin 3394	Pin Agilent 1100	Signal Name	Active (TTL)
	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low

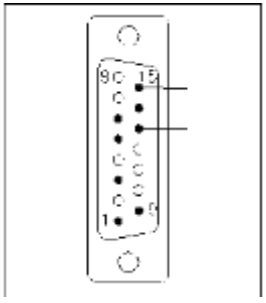


NC	4 - Blue	Shut down	Low
NC	5 - Pink	Not connected	
NC	6 - Yellow	Power on	High
5,14	7 - Red	Ready	High
1	8 - Green	Stop	Low
NC	9 - Black	Start request	Low
13, 15		Not connected	

Agilent 1100 to 3396 Series II / 3395A Integrators

Use the cable 03394-60600 and cut pin #5 on the integrator side. Otherwise the integrator prints START; not ready.

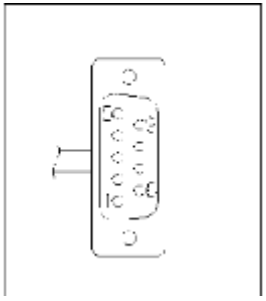
Agilent 1100 to 3396 Series III / 3395B Integrators



Connector 03396-61010	Pin 33XX	Pin Agilent 1100	Signal Name	Active (TTL)
	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	14	7 - Red	Ready	High
	4	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low

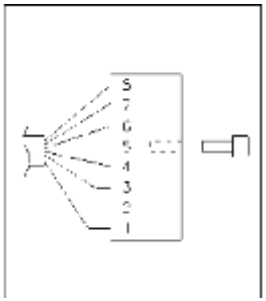
13, 15		Not connected

Agilent 1100 to HP 1050, HP 1046A or Agilent 35900 A/D Converters

Connector 5061-3378	Pin HP 1050 / ...	Pin Agilent 1100	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 1100 to HP 1090 LC or Signal Distr ibution Modul e

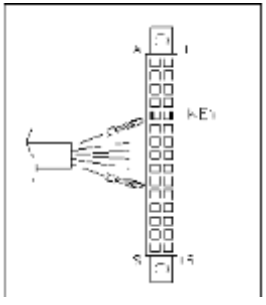
Connector 01046-60202	Pin HP 1090	Pin Agilent 1100	Signal Name	Active (TTL)
	1	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	4	3 - Gray	Start	Low
	7	4 - Blue	Shut down	Low



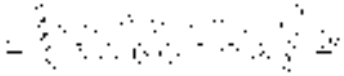
5 - Key

8	5 - Pink	Not connected	
NC	6 - Yellow	Power on	High
3	7 - Red	Ready	High
6	8 - Green	Stop	Low
NC	9 - Black	Start request	Low

Agilent 1100 to General Purpose

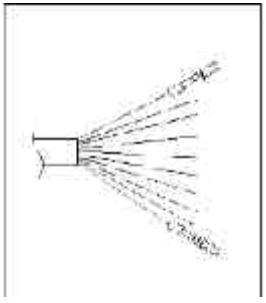
Connector 01046-60201	Pin Universal	Pin Agilent 1100	Signal Name	Active (TTL)
		1 - White	Digital ground	
		2 - Brown	Prepare run	Low
		3 - Gray	Start	Low
		4 - Blue	Shut down	Low
		5 - Pink	Not connected	
		6 - Yellow	Power on	High
		7 - Red	Ready	High
		8 - Green	Stop	Low
		9 - Black	Start request	Low

BCD Cables



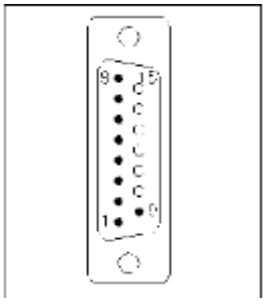
One end of these cables provides a 15-pin BCD connector to be connected to the Agilent 1100 Series modules. The other end depends on the instrument it is to be connected to

Agilent 1100 to General Purpose

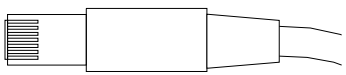
Connector G1351-81600	Wire Color	Pin Agilent 1100	Signal Name	BCD Digit
	Green	1	BCD 5	20
	Violet	2	BCD 7	80
	Blue	3	BCD 6	40
	Yellow	4	BCD 4	10
	Black	5	BCD 0	1
	Orange	6	BCD 3	8
	Red	7	BCD 2	4
	Brown	8	BCD 1	2
	Gray	9	Digital ground	Gray
	Gray/pink	10	BCD 11	800
	Red/blue	11	BCD 10	400
	White/green	12	BCD 9	200
	Brown/green	13	BCD 8	100
	not connected	14		

not connected	15	+5 V	Low

Agilent 1100 to 3396 Integrators

Connector 03396-60560	Pin 3392/3	Pin Agilent 1100	Signal Name	BCD Digit
	1	1	BCD 5	20
	2	2	BCD 7	80
	3	3	BCD 6	40
	4	4	BCD 4	10
	5	5	BCD0	1
	6	6	BCD 3	8
	7	7	BCD 2	4
	8	8	BCD 1	2
	9	9	Digital ground	
	NC	15	+ 5 V	Low

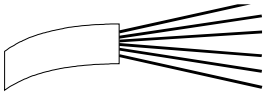
Auxiliary Cable



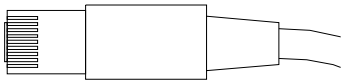
One end of this cable provides a modular plug to be connected to the Agilent 1100 Series vacuum degasser. The other end is for general purpose.

Agilent 1100 Series Degasser to general purpose

Connector G1322-61600	Color	Pin Agilent 1100	Signal Name
	White	1	Ground
	Brown	2	Pressure signal
	Green	3	
	Yellow	4	
	Grey	5	DC + 5 V IN
	Pink	6	Vent



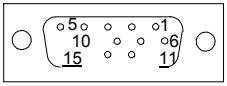
CAN Cable



Both ends of this cable provide a modular plug to be connected to Agilent 1100 Series module's CAN-bus connectors.

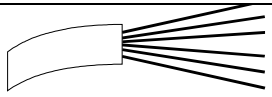
Agilent 1100 module to module, 0.5 m	5181-1516
Agilent 1100 module to module, 1 m	5181-1519
Agilent 1100 module to control module	G1323-81600

External Contact Cable



One end of this cable provides a 15-pin plug to be connected to Agilent 1100 Series module's interface board. The other end is for general purpose.

Agilent 1100 Series Interface Board to general purpose

Connector G1103-61611	Color	Pin Agilent 1100	Signal Name
	White	1	EXT 1
	Brown	2	EXT 1
	Green	3	EXT 2
	Yellow	4	EXT 2
	Grey	5	EXT 3
	Pink	6	EXT 3
	Blue	7	EXT 4
	Red	8	EXT 4
	Black	9	Not connected
	Violet	10	Not connected
	Grey/pink	11	Not connected
	Red/blue	12	Not connected
	White/green	13	Not connected
	Brown/green	14	Not connected
	White/yellow	15	Not connected

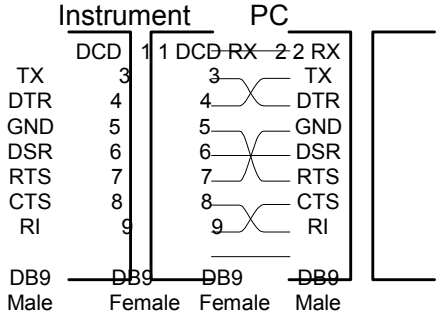
RS-232 Cable Kit

This kit contains a 9-pin female to 9-pin female Null Modem (printer) cable and one adapter. Use the cable and adapter to connect Agilent Technologies instruments with 9-pin male RS-232 connectors to most PCs or printers.

Agilent 1100 module to PC

RS-232 Cable Kit 34398As

Table 37



LAN Cables

Recommended Cables

Table 38

Description	Part number

Cross-over network cable (shielded, 3 m long), (for point to point connection)	5023-0203
Twisted pair network cable (shielded, 7 m long) (for hub connections)	5023-0202



7 Introduction to the Fluorescence Detector

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How the Detector Operates 239
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Analytical Information From Primary Data 251
Electrical Connections 256
Instrument Layout 258
Early Maintenance Feedback (EMF) 259

Agilent Technologies

Introduction to the Detector

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

- flash lamp for highest intensity and lowest detection limit
- multi-wavelength mode for on-line spectra
- spectra acquisition and simultaneous multi-signal detection
- optional cuvette is available and can be used for off-line measurements
- easy front access to flow cell for fast replacement and
- built-in wavelength accuracy verification.

For specifications, see “Performance Specifications” on page 330

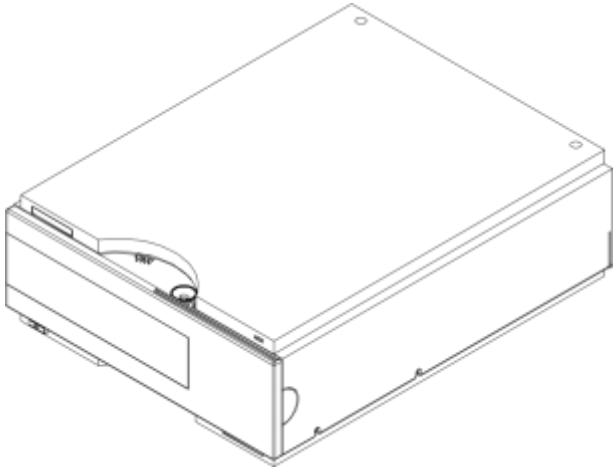


Figure 69 The Agilent 1100 Series Fluorescence Detector.

How the Detector Operates

Luminescence Detection

Luminescence, the emission of light, occurs when molecules change from an excited state to their ground state. Molecules can be excited by different forms of energy, each with its own excitation process. For example, when the excitation energy is light, the process is called *photoluminescence*.

In basic cases, the emission of light is the reverse of absorption, see Figure 70. With sodium vapor, for example, the absorption and emission spectra are a single line at the same wavelength. The absorption and emission spectra of organic molecules in solution produce bands instead of lines.

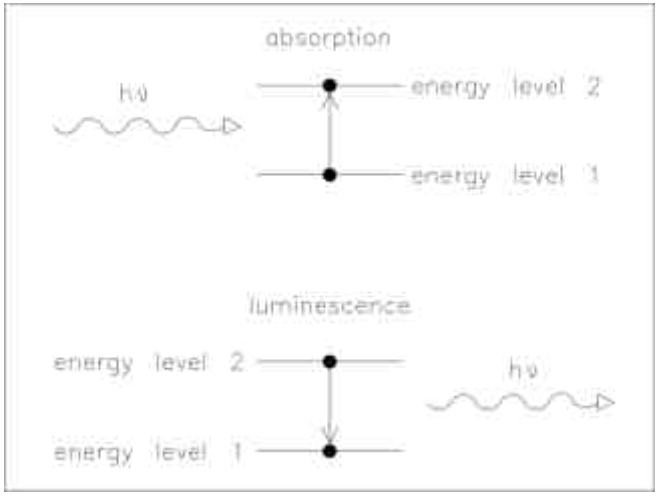


Figure 70 Absorption of Light Versus Emission of Light

When a more complex molecule transforms from its ground energy state into an excited state, the absorbed energy is distributed into various vibrational and rotational sub-levels. When this, same molecule returns to the ground state, this vibrational and rotational energy is first lost by relaxation without any radiation. Then the molecule transforms from this energy level to one of the vibrational and rotational sub-levels of its ground state, emitting light, see Figure 71. The characteristic maxima of absorption for a substance is its λ_{EX}, and for emission its λ_{EM}.

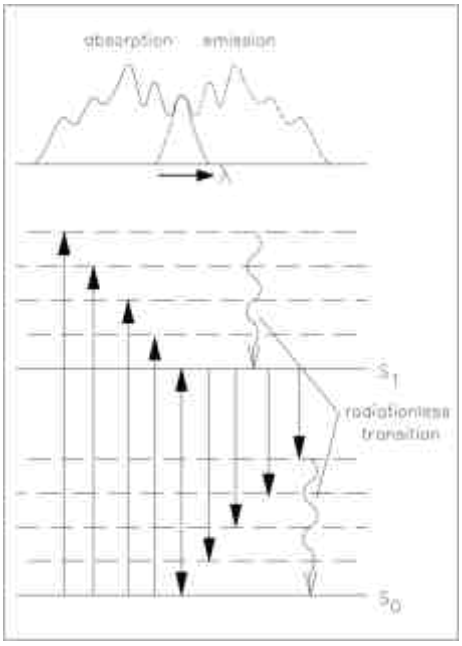


Figure 71 Relationship of Excitation and Emission Wavelengths

Photoluminescence is the collective name for two phenomena, *fluorescenc*e and *phosphorescence*, which differ from each other in one characteristic way--the delay of emission after excitation. If a molecule emits light 10^{-9} to 10^{-5} seconds after it was illuminated then the process was fluorescence. If a molecule emits light longer than 10^{-3} seconds after illumination then the process was phosphorescence.
Phosphorescence is a longer process because one of the electrons involved in the excitation changes its spin, during a collision with a molecule of solvent, for example. The excited molecule is now in a so-called triplet state, T, see Figure 72.

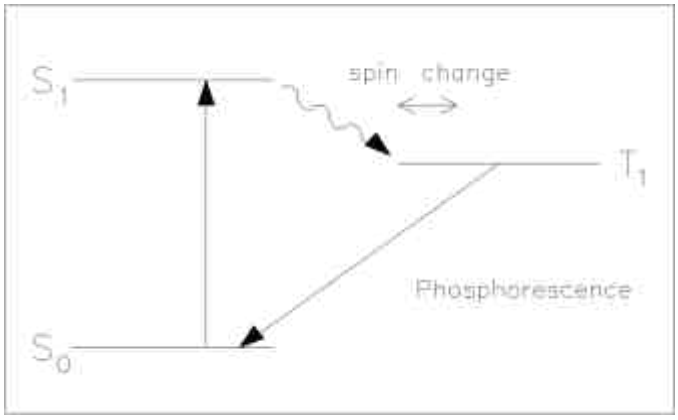


Figure 72 Phosphorescence Energy Transitions

The molecule must change its spin back again before it can return to its ground state. Since the chance of colliding with another molecule with the necessary spin for change is slight, the molecule remains in its triplet state for some time. During the second spin change the molecule loses more energy by relaxing without radiation. The light which is emitted during phosphorescence therefore has less energy and is at a longer wavelength than fluorescence.

Formula: $E = h \times l^{-1}$

In this equation:

E is energy h is Planck's constant l is the wavelength

Raman Effect

The Raman effect arises when the incident light excites molecules in the sample which subsequently scatter the light. While most of this scattered light is at the same wavelength as the incident light, some is scattered at a different wavelength. This inelastically scattered light is called Raman scatter. It results from the molecule changing it's molecular motions.

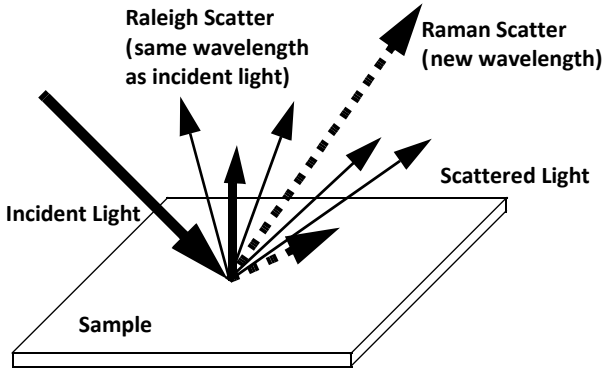


Figure 73 Raman

The energy difference between the incident light (E_i) and the Raman scattered light (E_s) is equal to the energy involved in changing the molecule's vibrational state (i.e. getting the molecule to vibrate, E_v). This energy difference is called the Raman shift.

$$E_v = E_i - E_s$$

Several different Raman shifted signals will often be observed; each being associated with different vibrational or rotational motions of molecules in the sample. The particular molecule and its environment will determine what Raman signals will be observed (if any).

A plot of Raman intensity versus Raman shift is a Raman spectrum.

Optical Unit

All the elements of the optical system, shown in Figure 74 on page 244, including Xenon flash lamp, excitation condenser, excitation slit, mirror, excitation grating, flow cell, emission condenser, cut-off filter, emission slit, emission grating and photo-multiplier tube are housed in the metal casting inside the detector compartment. The fluorescence detector has grating/grating optics, enabling the selection of both excitation and emission wavelengths. The flow cell can be accessed from the front of the fluorescence detector.

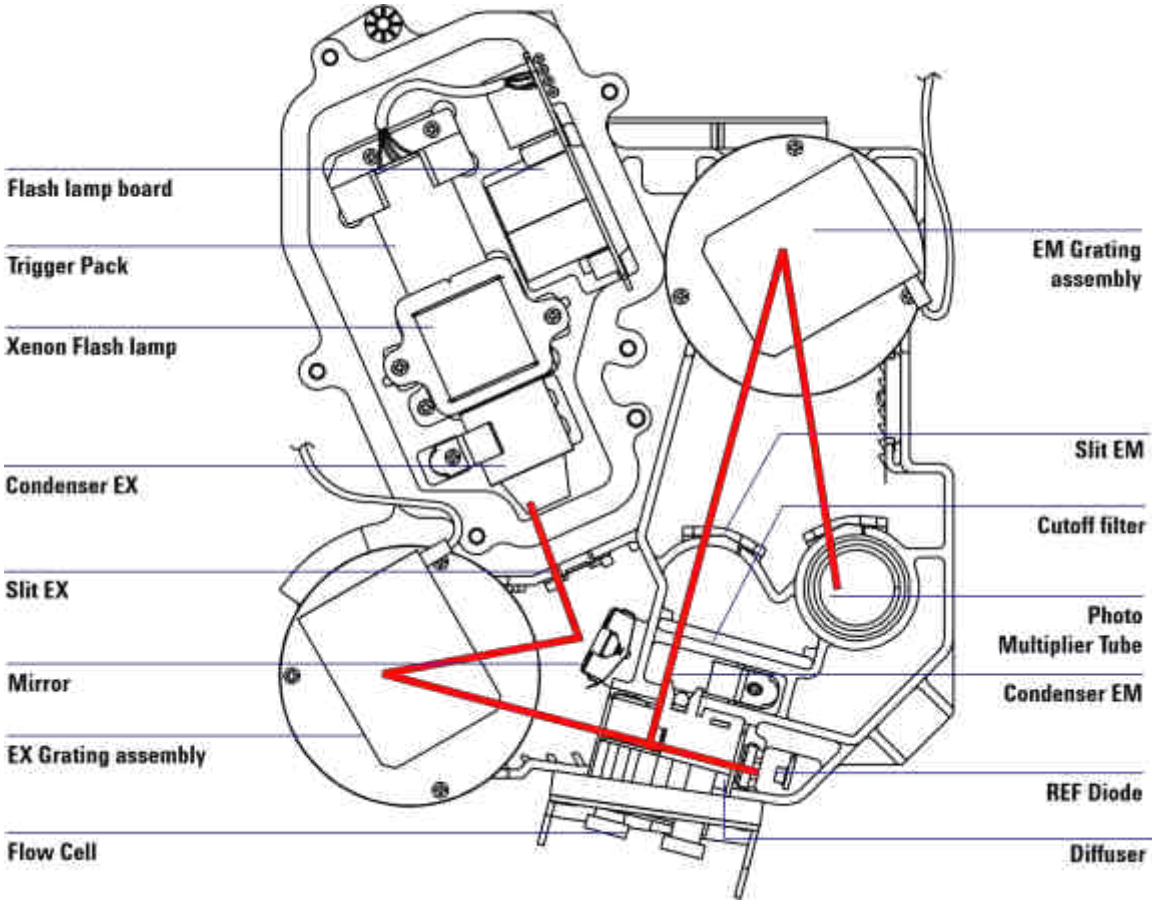


Figure 74 Optical Unit The radiation source is a xenon flash-lamp. The 3 µs flash produces a continuous spectrum of light from 200 nm to 900 nm. The light output distribution can be expressed as a percentage in 100 nm intervals, see Figure 75. The lamp can be used for some 1000 hours depending on the sensitivity requirements. You can economize during automatic operation using keyboard setpoints, so the lamp flashes during your analysis only. The lamp can be used until it no longer ignites, but the noise level may increase with usage.

UV degradation, especially below 250 nm is significantly higher compared to Visible wavelength range. Generally the "LAMP ON during run" - setting or using "economy mode" will increase lamp life by a magnitude.

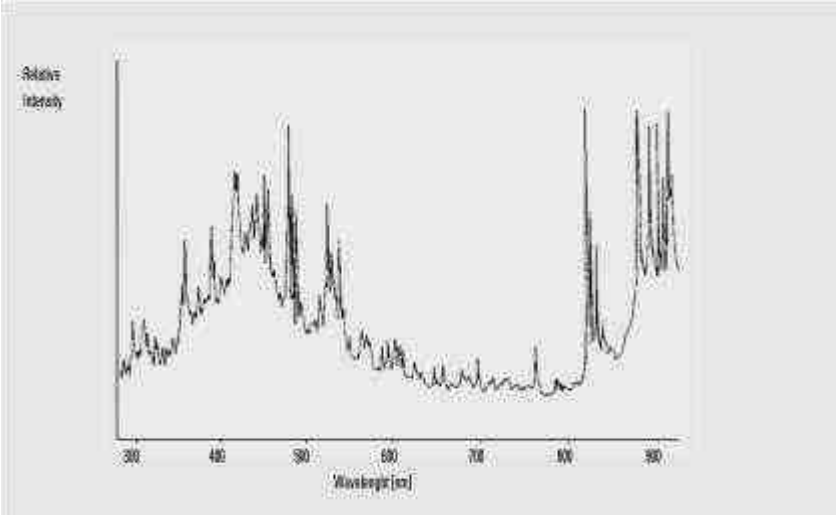


Figure 75 Lamp Energy Distribution (vendor data)

The radiation emitted by the lamp is dispersed and reflected by the excitation monochromator grating onto the cell entrance slit.

The holographic concave grating is the main part of the monochromator, dispersing and reflecting the incident light. The surface contains many minute grooves, 1200 of them per millimeter. The grating carries a blaze to show improved performance in the visible range.

Y

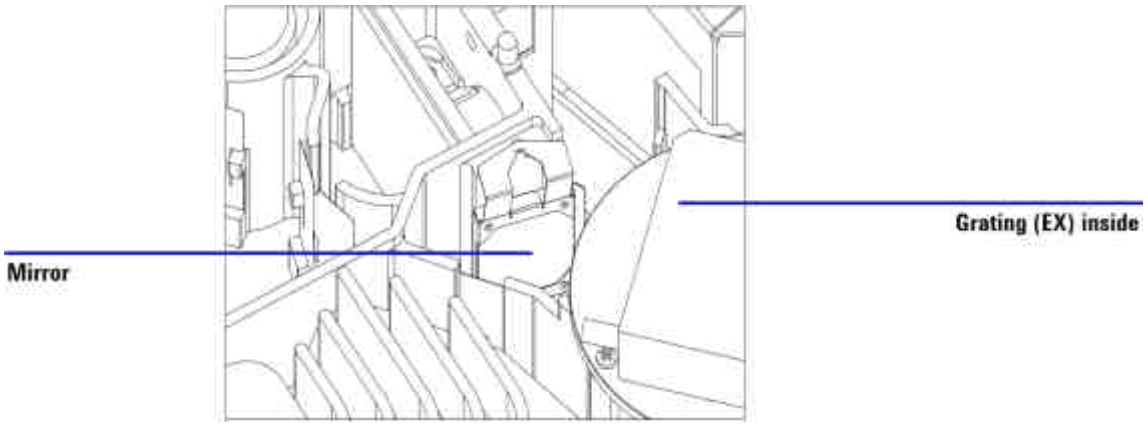


Figure 76 Mirror Assembly

The geometry of the grooves is optimized to reflect almost all of the incident light, in the 1st order and disperse it with about 70% efficiency in the ultra-violet range. Most

of the remaining 30% of the light is reflected at zero order, with no dispersion. Figure 77 illustrates the light path at the surface of the grating.

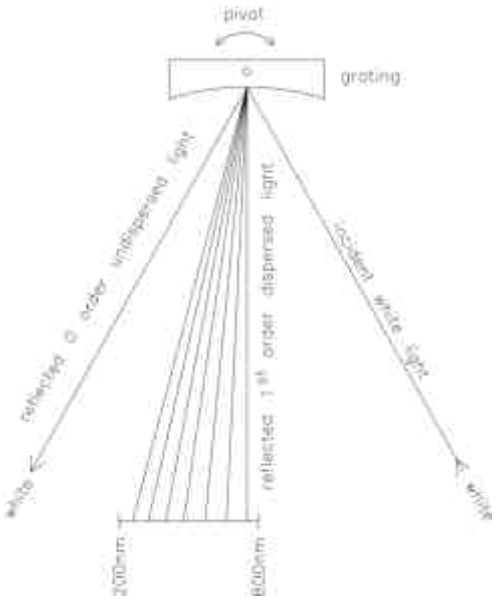


Figure 77 Dispersion of Light by a Grating

The grating is turned using a 3-phase brushless DC motor, the position of the grating determining the wavelength or wavelength range of the light falling onto the flow cell. The grating can be programmed to change its position and therefore the wavelength during a run.

For spectra acquisition and multi-wavelength detection, the grating rotates at 4000 rpm.

The excitation and emission gratings are similar in design, but have different blaze wavelengths. The excitation grating reflects most 1st order light in the ultra-violet range around 250 nm, whereas the emission grating reflects better in the visible range around 400 nm.
The flow cell is a solid quartz body with a maximum back pressure of 20 bar. Excessive back pressure will result in destruction of the cell. Operating the detector close to waste with low back pressure is recommended. A slit is integrated to the quartz body.

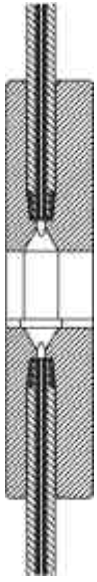


Figure 78 Cross-Section of Flow Cell

The luminescence from the sample in the flow cell is collected at right angles to the incident light by a second lens, and passes through a second slit. Before the luminescence reaches the emission monochromator, a cut-off filter removes light below a certain wavelength, to reduce noise from 1st order scatter and 2nd order stray light, see Figure 77 on page 247.

The selected wavelength of light is reflected onto the slit in the wall of the photo-multiplier compartment of the optical unit. The bandwidth of the emitted light is 20 nm.
On the photocathode, Figure 79, incident photons generate electrons. These electrons are accelerated by an electrical field between several arc-shaped dynodes. Depending on the voltage difference between any pair of dynodes, an incident electron may spark-off further electrons which accelerate onto the next dynode. An avalanche effect results: finally so many electrons are generated that a current can be measured. The amplification is a function of the voltage at the dynodes and is microprocessor controlled. You can set the amplification using the PMTGAIN function.

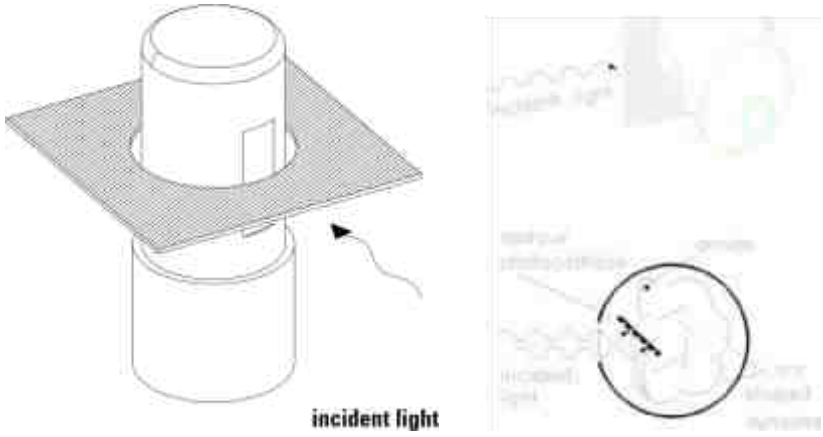


Figure 79 Photo-multiplier Tube

This type of so-called side-on photo-multiplier is compact ensuring fast response, conserving the advantages of the short optical path shown in Figure 74 on page 244.

PMTs are designed for specific wavelength ranges. The standard PMT offers optimum sensitivity from 200 to 600 nm. In the higher wavelength range a red-sensitive PMT can improve performance. For additional PMT types refer to"Replacing PMT and/or FLF board" on page 180.

Reference System

A reference diode, located behind the flow cell, measures the excitation (EX) light transmitted by the flow cell and corrects flash lamp fluctuations and long-term intensity drift. Because of a non-linear output of the diode (depending on the EX-wavelength), the measured data are normalized.

A diffuser is located in front of the reference diode (see Figure 74 on page 244). This diffuser is made of quartz, reduces light and allows integral measurement of the light.

Analytical Information From Primary Data

We now know how the primary data from your sample is acquired in the optical unit. But how can the data be used as information in analytical chemistry? Depending on the chemistry of your application, the luminescence measured by the fluorescence detector will have different characteristics. You must decide, using your knowledge of the sample, what mode of detection you will use.

Fluorescence Detection

When the lamp flashes, the fluorescing compounds in your sample will luminesce almost simultaneously, see Figure 80. The luminescence is short-lived, therefore the fluorescence detector need only measure over a short period of time after the lamp has flashed.

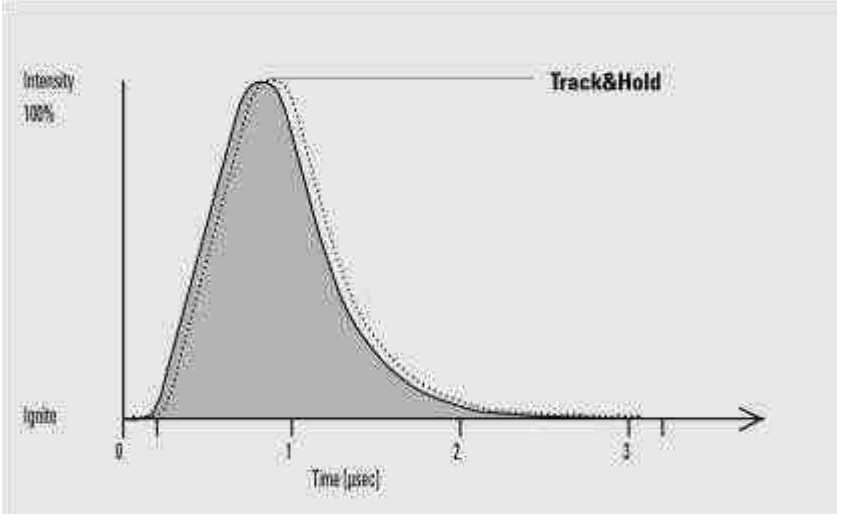


Figure 80 Measurement of Fluorescence

Phosphorescence Detection

An appropriate parameter set will be specified as soon as you chose the phosphorescence detection mode (special setpoints under FLD parameter settings).

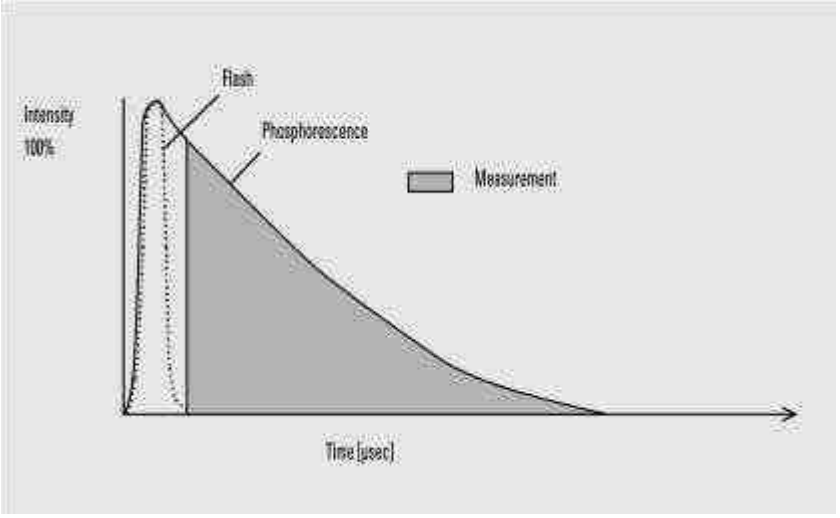


Figure 81 Measurement of Phosphorescence

Processing of Raw Data

If the lamp flashes at single wavelength and high-power, then the fluorescence data rate is 296 Hz. That means that your sample is illuminated 296 times per second, and any luminescence generated by the components eluted from the column is measured 296 times per second.

If the “economy” or multi-wavelength mode is set, then the flash frequency is 74 Hz.

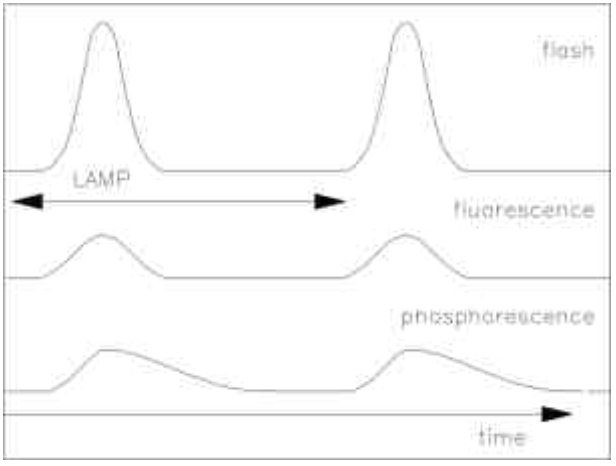


Figure 82 LAMP: Frequency of Flash, Fluorescence, and Phosphorescence

You can improve the signal-to-noise characteristics by disabling the “economy” mode.

Disabling the “economy” mode will shorten the lifetime of the lamp significantly. Consider lifetime saving by switching off the lamp after the run is completed.

NOTE

The data resolution is 20 bit at a response time of 4 seconds (default, which is equivalent to a time constant of 1.8 seconds and appropriate for standard chromatographical conditions). Weak signals may cause errors in quantification because of insufficient resolution. Check your proposed PMTGAIN. If it is significantly distant from your setting, change your method or check the purity of your solvent.

You can amplify the signal using PMTGAIN. Depending on the PMTGAIN you have set, a multiple of electrons is generated for every photon falling on the photomultiplier. You can quantify large and small peaks in the same chromatogram by adding PMTGAIN changes during the run into a timetable.

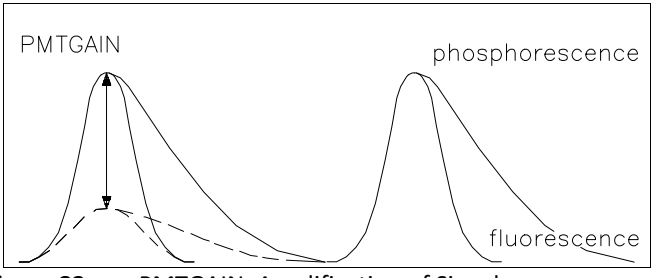


Figure 83 PMTGAIN: Amplification of Signal

Check proposed PMTGAIN. Deviations of more than 2 PMT gains should be corrected in the method.

Each PMTGAIN step is increased approximately by a factor of 2 (range 0 - 18). To optimize your amplification for the peak with the highest emission, raise the PMTGAIN setting until the best signal-to-noise is achieved.

After the photons are converted and multiplied into an electronic signal, the signal (at present analog) is tracked and held beyond the photo-multiplier. After being held, the signal is converted by an A-to-D converter to give one raw data point (digital). Eleven

of these data points are bunched together as the first step of data processing. Bunching improves your signal-to-noise ratio.

The bunched data, shown as larger black dots in Figure 84, is then filtered using a boxcar filter. The data is smoothed, without being reduced, by taking the mean of a number of points. The mean of the same points minus the first plus the next, and so on, is calculated so that there are the same number of bunched and filtered points as the original bunched points. You can define the length of the boxcar element using the RESPONSETIME function: the longer the RESPONSETIME, the greater the number of data points averaged. A four-fold increase in RESPONSETIME (for example, 1 sec to 4 sec) doubles the signal-to-noise ratio.

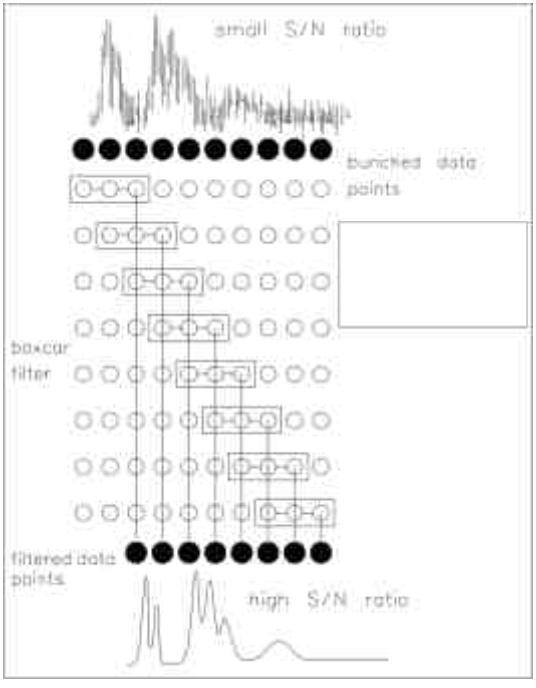


Figure 84 RESPONSETIME: Signal-to-Noise Ratio

Electrical Connections

- The GPIB connector is used to connect the detector with a computer. The address and control switch module next to the GPIB connector determines the GPIB address of your detector. The switches are preset to a default address (see “GPIB Default Addresses” on page 293) which is recognized once the power is switched on.

- The CAN bus is a serial bus with high speed data transfer. The two connectors for the CAN bus are used for internal Agilent 1100 Series module data transfer and synchronization.
- Two independent analog outputs provide signals for integrators or data handling systems.
- The interface board slot is used for external contacts and BCD bottle number output or LAN connections.
- The REMOTE connector may be used in combination with other analytical instruments from Agilent Technologies if you want to use features such as start, stop, common shut down, prepare, and so forth.
- With the appropriate software, the RS-232C connector may be used to control the detector from a computer through a RS-232C connection. This connector is activated and can be configured with the configuration switch next to the GPIB connector (see "Communication Settings for RS-232C Communication" on page 294). See your software documentation for further information.

  Together with a control module the RS-232C may be used to print screens to a connected printer.
- The power input socket accepts a line voltage of 100 – 120 V or 220 – 240 VAC ± 10 % with a line frequency of 50 or 60 Hz. Maximum power consumption is 220 VA. There is no voltage selector on your detector because the power supply has a wide-ranging capability. There are no externally accessible fuses, because automatic electronic fuses are implemented in the power supply. The security lever at the power input socket prevents removal of the detector cover when line power is still connected.

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

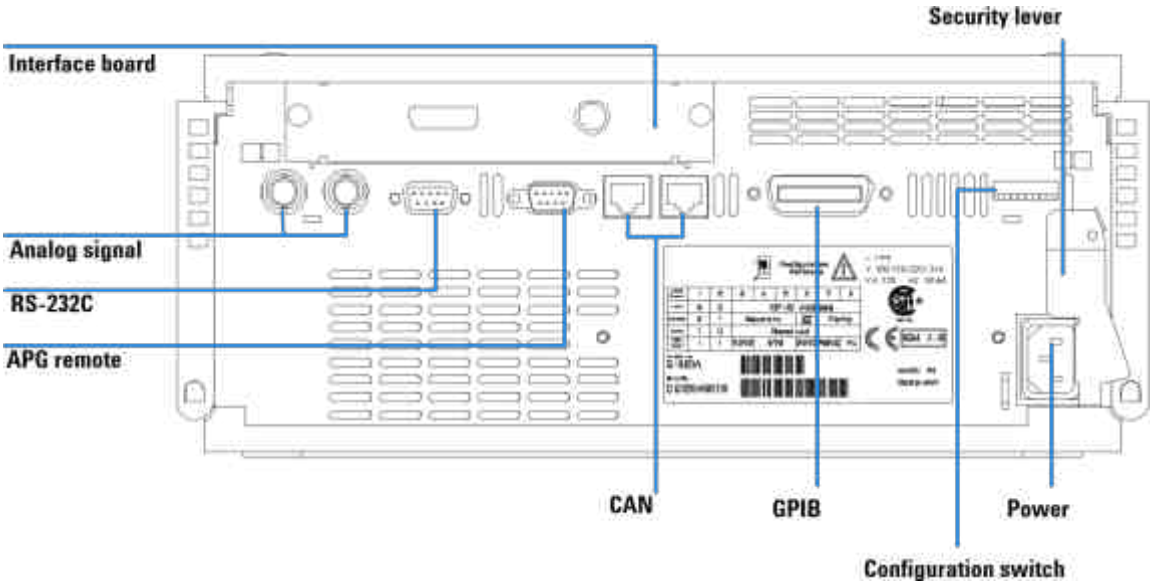


Figure 85 Electrical Connections

Instrument Layout

The industrial design of the detector 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 detector are placed. This pack is then housed in a metal inner cabinet which is enclosed by a plastic external cabinet. The advantages of this packaging technology are:

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

Early Maintenance Feedback (EMF)

Maintenance requires the exchange of components 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 detector 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

The detector provides three EMF counters for the lamp. The counters increment with lamp use, and can be assigned a maximum limit which provides visual feedback in the user interface when the limit is exceeded. The counters can be reset to zero after the lamp is exchanged. The detector provides the following EMF counters:

- number of flashes (low power mode, multiples of 1000 flashes)
- number of flashes (high power mode, multiples of 1000 flashes)
- Flash Lamp Life-Time (value of 0 – 100% as expected lifetime factor calculated from combined expected lifetime low power and high power flashes).

Figure 86 on page 260 shows the lamp life based on number of flashes vs. the input energy. The lamp flash frequency/energy can be changed into the following modes:

Table 39 Flash Lamp Modes

Position	296 Hz (Standard), 560 V	63 mJoule (18.8 W)
	74 Hz (Economy), 560 V	63 mJoule (4.7 W)
Rotation (Multi Ex/Em)	74 Hz (Standard), 950 V	180 mJoule (13.3 W)
	74 Hz (Economy), 560 V	63 mJoule (4.7 W)

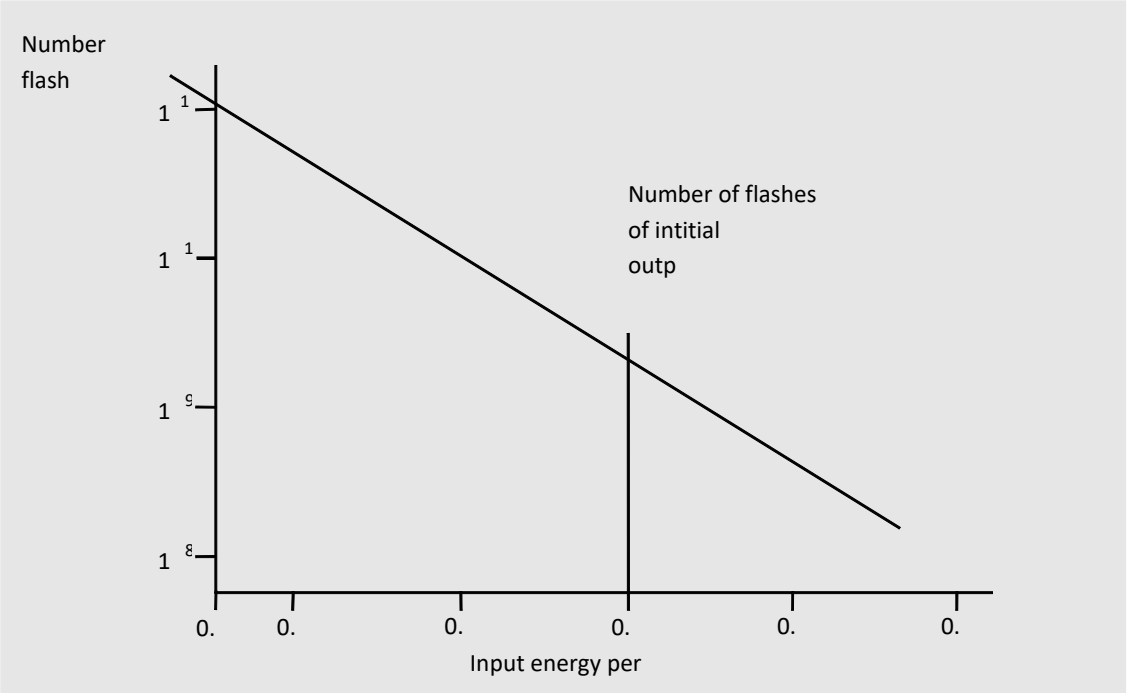


Figure 86 Lamp life

Using the EMF Counters

The user-selectable EMF limits for the EMF counters enable the early maintenance feedback to be adapted to specific user requirements. The useful lamp burn time is dependent on the requirements for the analysis (high or low sensitivity analysis, wavelength etc.), 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, no EMF limit should be set. When instrument performance indicates maintenance is necessary, take note of the values displayed by lamp 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.



8 Theory of Operation

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Agilent Technologies

Electronics

The electronics are comprised of four main components:

- **detector main board** (FLM), see page 265.
- **detector frontend board** (FLF), see page 269.
- **detector lamp board** (FLL), see page 275.
- **power supply**, see page 297.

Optional:

- **interface board** (BCD/external contacts), see page 284.
- **interface board** (LAN), see page 286.

Detector Main Board (FLM)

This board controls all information and activities of all assemblies within the detector. Through interfaces (CAN, GPIB, RS-232C or LAN) connected to the user interface, the operator enters parameters, changes modes and controls the detector.

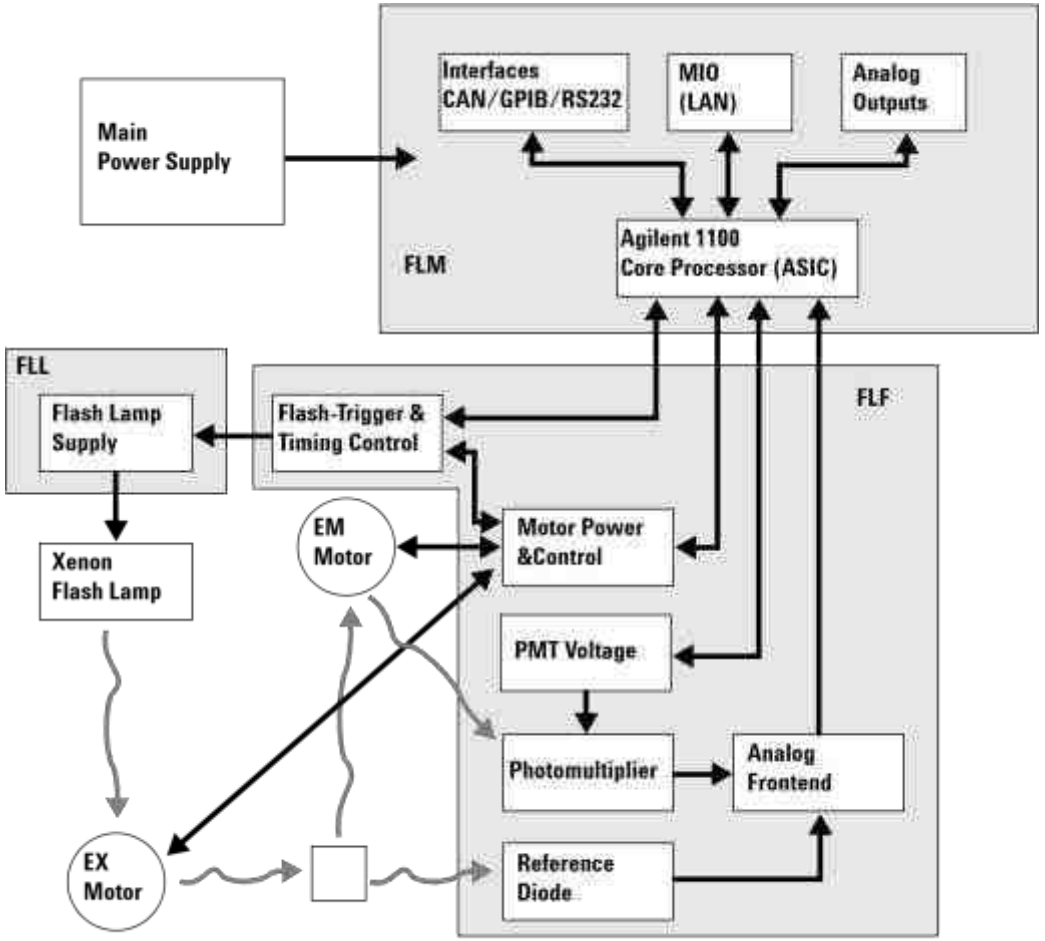


Figure 87 Detector Electronic Overview

ASIC — Application Specific Integrated Circuit

The 304-pin application specific integrated circuit (ASIC) provides interfacing to external devices through drivers, including LAN, GPIB, CAN, APG remote, and RS-232C. It is connected directly to the four control LEDs located near the connectors on

the board and the 8-bit configuration switch which is used to configure the address for the GPIB communication, the Baud rate for RS-232C transfer, and so on. For switch settings, refer to the *Installing Your Agilent 1100 Win System* handbook.

In addition, it controls the cooling fan via the PWM (pulse width modulation) driver. Movement of the cooling fan is sensed by the microprocessor.

Main processor

The Motorola MC 68332 microprocessor acts as the main processor with a clock frequency of 16 MHz. It exchanges data with the ASIC through the core bus as well as with the SRAM (static random access memory) of 4 × 512 kilobyte, the flash EEPROM (electrically erasable programmable read-only memory) of 1 MB and the 1 × 128 KB battery-backed

NV-RAM (non-volatile). Battery life is designed to last for more than 25 years under normal operating conditions.

Control lines provide communication to the frontend board, which provides high voltage power supplies for the flash lamp and the photomultiplier tube (PMT) and contains the data acquisition section.

FPGA—Field Programmable Gate Array

The FPGA is loaded with code to control the timing of the flash ignition and the data acquisition. Thus a realtime control of these critical functions is achieved without processor control.

Excitation/Emission Monochromator Motor Control

A chopped motor driver IC provides the signal to run the excitation/emission monochromator motor in positioning or rotation mode.

Encoder Signal Acquisition

Each monochromator includes an optical encoder to get the actual position of the device. The two encoder signals are amplified and prepared for A/D-conversion.

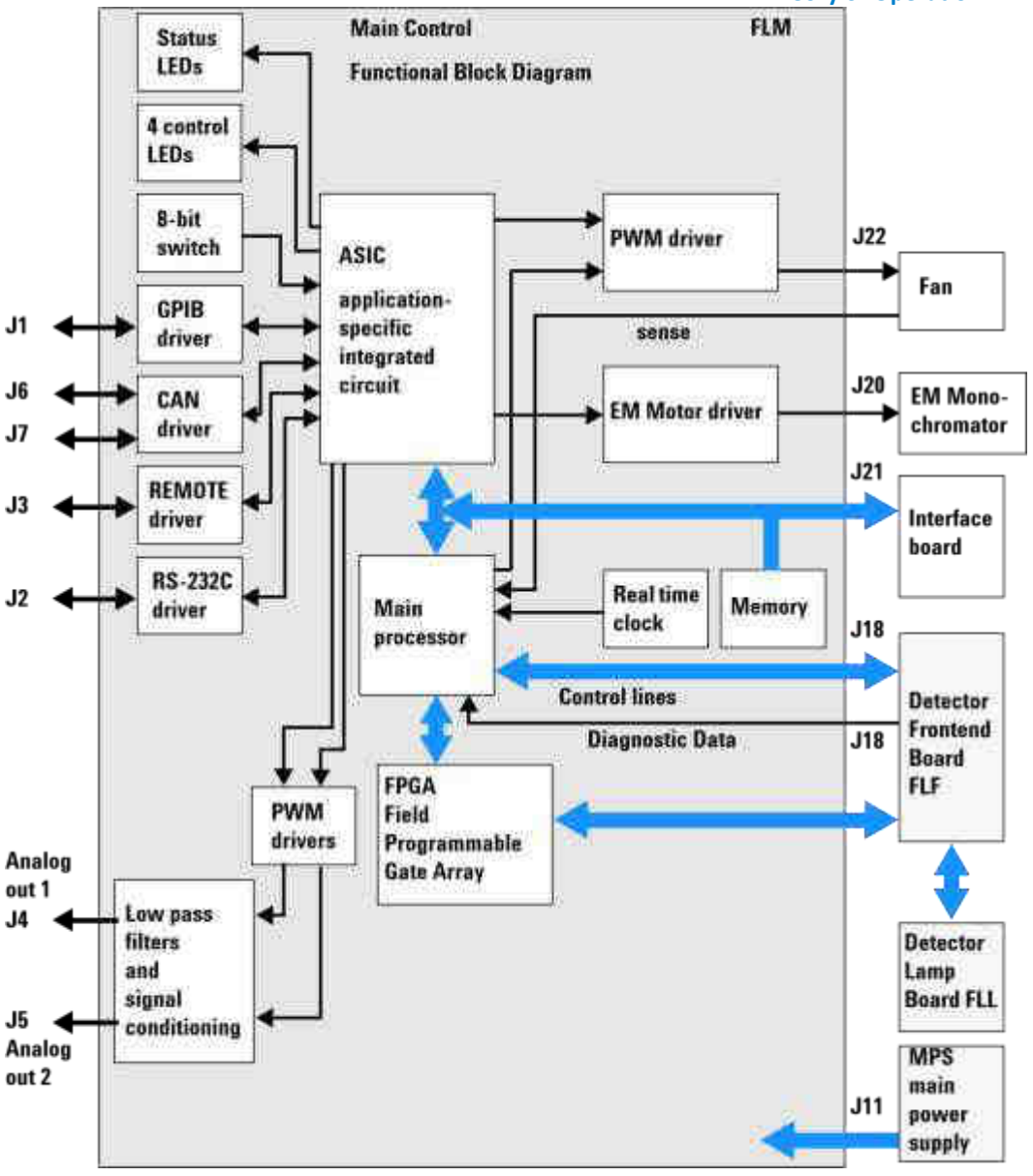


Figure 88 Block Diagram FLD Main Controller Functionality

Fan Drive

The operation of the fan is controlled by the main processor and runs with constant revolution. The fan produces a sense signal which is derived from the revolution. This sense signal is used for diagnostics.

On-board Battery

An on-board lithium battery buffers the electronic memory when the module is turned off.

For safety information on lithium batteries see “Lithium Batteries Information” on page 337.

Analog Outputs

There are two independent analog outputs (0…1 V full scale). Digital data from the ASIC is converted into a pulse-width modulated signal (PWM). The PWM signal is then fed to an amplitude modulator, which precisely turns the reference signal on and off. This signal then passes to a low-pass filter section.

Interfaces

For detailed information on interfaces, see “Interfaces” on page 287.

Detector Frontend Board (FLF)

Data Acquisition

The FLF board provides circuitry to measure three different physical effects:

- Fluorescence mode: peak value after flash
- Phosphorescence mode: integrated value after flash
- Chemoluminescence mode: amplified signal without flash operation

In parallel to the fluorescence signal the reference signal is acquired to get a compensation of lamp drift and noise effects. Both signals are amplified and buffered and routed to the ADC input multiplexer.

The 16-bit A/D-converter performs a conversion of the selected signal and additionally of the corresponding reference signal and several other signals:

- monochromator positions
- board temperature
- leak sensor status

Then the digital data are polled by the FPGA on the FLM main board to be available for calculations.

Flash Lamp Power Supply

The flash lamp is operated with discharge voltages of 500 V or 1250 V. The electronics design provides the voltages using a regulating pulse width modulator to switch a 24 V rail with a chopping frequency of 40 kHz to a transformer. The resulting high voltage is rectified and fed back to the error amplifiers which generate a control feedback signal for the regulator to increase or decrease the duty cycle of the output signal. An additional softstart-circuitry and a limitation of the maximum voltage ramp-up reduces the resulting noise emission of the power supply. The complete flash voltage supply is isolated by optocouplers to avoid crosstalk to other circuits by the large switching currents.

Flash Trigger Voltage Supply

The flash lamp trigger assembly includes an ignition transformer which needs a 160 V pulse to generate a short high voltage pulse (~ 10 kV) for a reliable lamp ignition. A second lamp power supply transformer output is used to generate this trigger voltage at both operating conditions.

Igniting the Flash Lamp

The flash lamp is a plasma discharge lamp with an energy-controlled intensity operated at 74 Hz or 296 Hz. The applied voltage charges a capacitor array and forms a controlled discharge voltage difference between lamp anode and cathode. Then an additional ignition electrode is driven with a high ignition voltage pulse to build up a small ionized channel from the ignition electrode to the cathode. If this ionization is existent, the voltage difference between anode and cathode leads to a flash discharge within a very short time (1 µs). After the flash the system pauses the regulator to force the ionized path to break down rapidly before charging the capacitors for the next cycle.

Flash Lamp Overcurrent Protection

A special firmware-controlled diagnostic circuitry shuts down the regulator when the charge current exceeds a critical value. This may happen when the output voltage lines are shorted. When an overcurrent condition is found, the circuit stops the voltage regulator within the time between two flashes, and the firmware reports an error signal when a restart of the regulator fails again.

Flash Voltage Safety Switch

A safety switch stops the voltage regulator when the lamp cover is removed to avoid high voltages on board when electronic parts are accessible.

Photomultiplier Tube Voltage Supply

The photomultiplier tube needs an adjustable working voltage between -240 V and -820 V for correct operation. The PMT gains are realized by variable operating voltage of the device. A regulated pulse width modulator is used to generate the high voltage by switching the 24 V rail to a transformer. The feedback loop has a D/A-converter-controlled base voltage to set the desired output voltage. The PMT output delivers a current signal which is proportional to the detected light and to the actual working voltage.

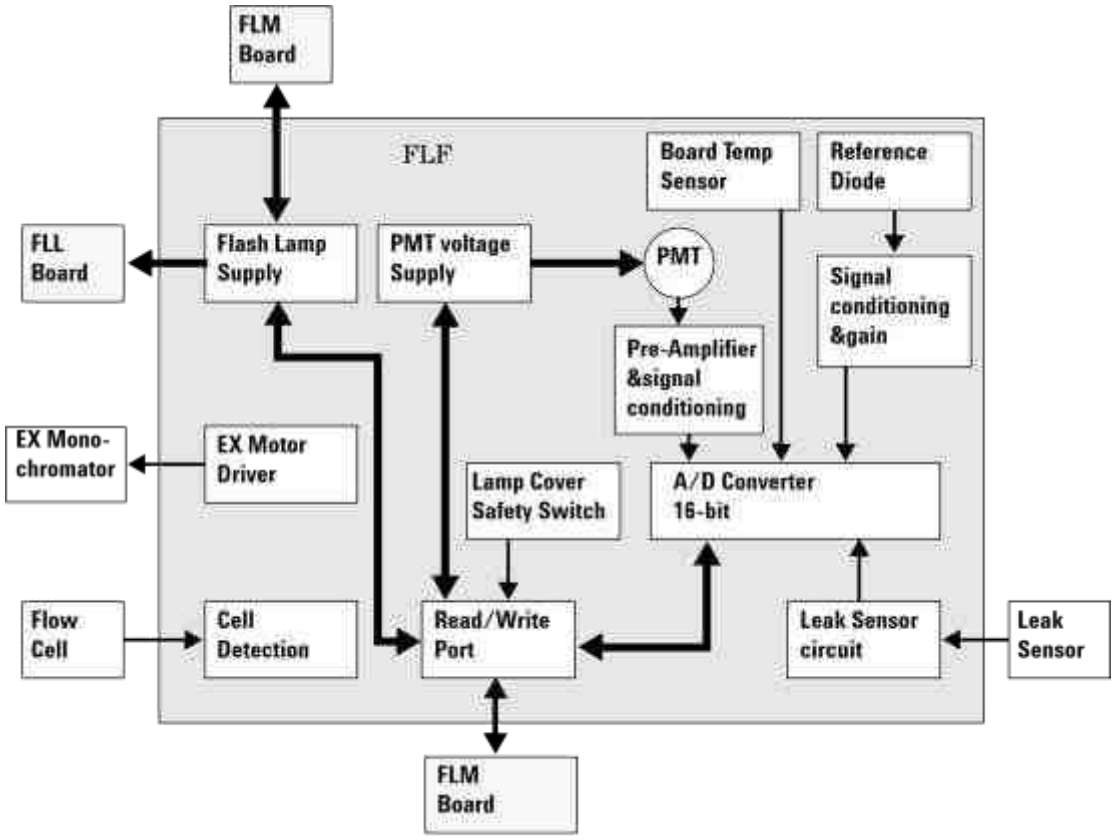


Figure 89 Block diagram FLF

Reference System

A reference photodiode is located behind the cell and monitors the incoming radiation through a diffusor window. The data are used to compensate the fluorescence data for drift effects. The reference path provides multiple gain stages which are set automatically according to the actual intensity.

Cell Detection

The system detects if a cell is inserted and switches off lamp operation, PMT high voltage and monochromator rotation if no cell is present to prevent injury (by UV radiation, high voltage or rotating parts) to the user.

Emission Monochromator Motor Control

A chopped motor driver IC provides the signal to run the excitation monochromator motor in positioning or rotation mode.

Leak Sensor

A leak sensor is mounted in the instrument's front chassis to detect leakage of the cell assy. In case of a leakage, the complete Agilent 1100 System is shut down to prevent system damage.

This block consists of a PTC for the leak detection and a NTC for the ambient temperature compensation. A leak would cool down the PTC and this change in resistance would generate a leak signal.

Digital Interface

The control and data lines from and to the Fluorescence Detector Main Board (FLM) are buffered by Read- and Write ports. The signals from the main board allow setting of the signal multiplexers, reference gain stages, lamp current and to start the initial self-calibration of the A/D-converter. The port to the main board drives the A/D-converter data and several control lines like cell detection, overcurrent detection and lamp cover safety switch position.

The signals driving the lamp are derived from the FPGA on the Main Board and have separate connections. This allows the lamp timing control without processor interaction and guarantees a realtime control of the lamp operation.

FLF Board revisions

There have been several board versions introduced since the introduction of the detector.

Table 40 FLF Board revisions

Part number	Revision	Changes
G1321-66501	A	original version. Raman ASTM signal to noise spec is >200

G1321-66511	B	This version (March 1999) received some hardware modifications in the PMT resistor chain require some adjustments in the PMT gain table. Needs minimum firmware A.03.70. Raman ASTM signal to noise spec is >400
G1321-66521	C	This version (April 1999) received some hardware modifications to improve the linearity. Needs minimum firmware A.03.70. Raman ASTM signal to noise spec is >400
G1321-66531	D	This version (December 2000) received some hardware changes to • implement a feedback whether the lamp is on or off • implement all previous back-loaded revision changes. With all FLF board revisions below, the user interface did not switch from Ready (green) to Error (red) when the lamp turned off or did not ignite. So, the user had the impression the lamp is on but it was not. Now the voltage on the FLF board that is supplied to the FLL board and trigger pack is monitored. If the lamp is flashing, the voltage shows regular voltage drops. If these are missing (and the lamp should be on), then an error (RE 6721 "NO LIGHT DETECTED") is generated. Needs minimum firmware A.04.06. Raman ASTM signal to noise spec is >400

Refer to "How to retrieve the FLF board revision" on page 274 for additional information.

How to retrieve the FLF board revision

Agilent ChemStation

The FLF board revision can be retrieved with the following ChemStation command:

```
PRINT SENDMODULE$(LFLD,"FLFR?")
```

The reply will be: RA 0000 FLFR "AAAA" for revsion A boards.

Control Module (G1323A/B)

1 Select FLD TESTS

2 Press m.m (m-dot-m)

3 Select Command **4** Type: FLFR?

5 Press Execute.

NOTE Firmware revisions below A.03.70 do not know this command (RE 0503).

Detector Lamp Supply Board (FLL)

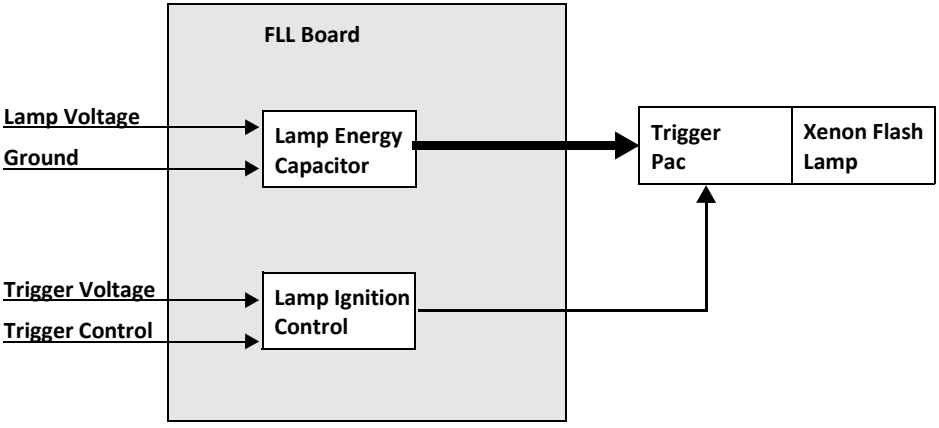


Figure 90 Block Diagram FLL Board

Lamp Energy Capacitors

The lamp high voltage circuit of the FLF board is used to charge the 4 energy capacitors of the FLL board. The energy per flash depends on the applied charging voltage ($1/2*C*U^2$). A power diode freewheeling circuit prevents the backflowing current from generating negative lamp discharge currents which may damage the flash lamp.

Lamp Ignition Control

An ignition voltage is switched by a thyristor to the TriggerPac ignition transformer to built a small ionized channel (refer "Igniting the Flash Lamp" on page 270). A freewheeling diode forces the thyristor to switch off again to prevent lamp damage.

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 series modules. Its properties are:

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

Main System

Its properties are:

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

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

- run synchronization through APG remote
- error handling,
- diagnostic functions,
- or module specific functions like:
- internal events such as lamp control, filter movements,
- raw data collection and conversion to absorbance (see “Raw Data Conversion to Fluorescence (LU) Units” on page 278.

Firmware Updates

Firmware updates can be done using your user interface:

- handheld control module with files from a PC-card or
- Agilent ChemStation with files from floppy disk

The file naming conventions are:

xxxx-vvv.DLB, where

xxxxis the product number, for example, 1315 for the G13151A DAD, and vvvis the revision number, for example 104 is revision 1.04 For instructions refer to your user interface.

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.

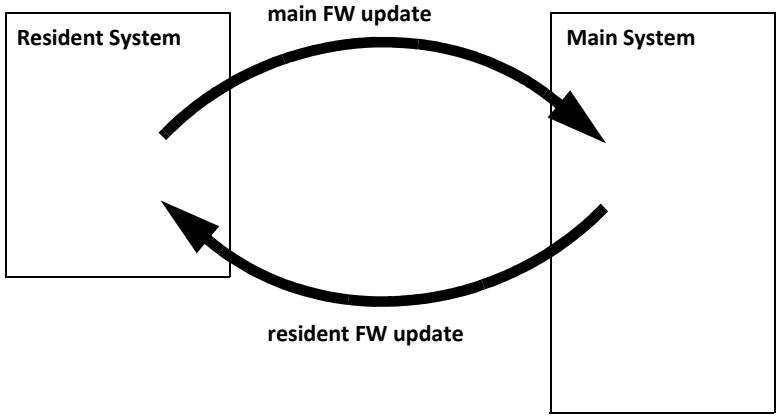


Figure 91 Firmware Update Mechanism

Raw Data Conversion to Fluorescence (LU) Units

LU (light or luminescence units) is used as new unit and will indicate the light intensity (not comparable with the physical unit Lumen!).

These units are calculated from the PMT (photomuliplier tube) in the emission path and a reference diode located behind the flow cell, see figure below.

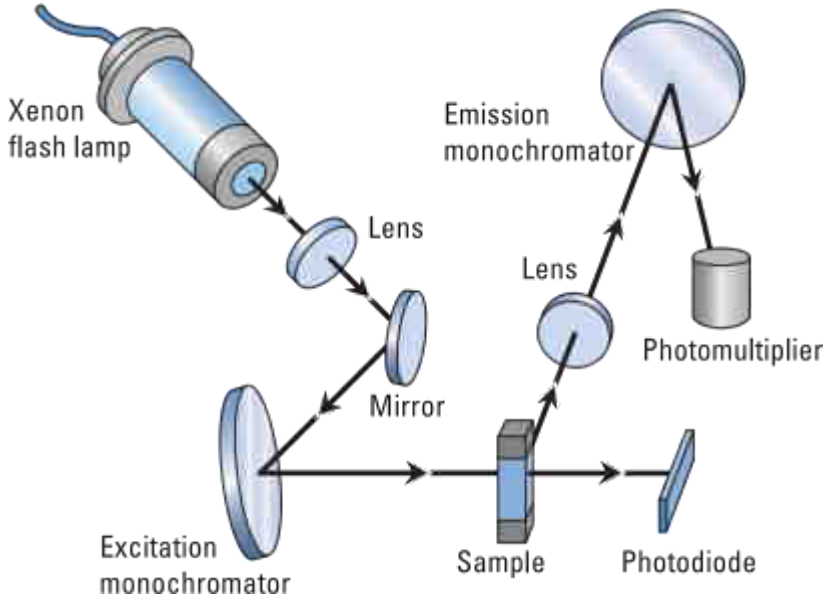


Figure 92 Optical Diagram of the FLD

Data flow for chromatographic output

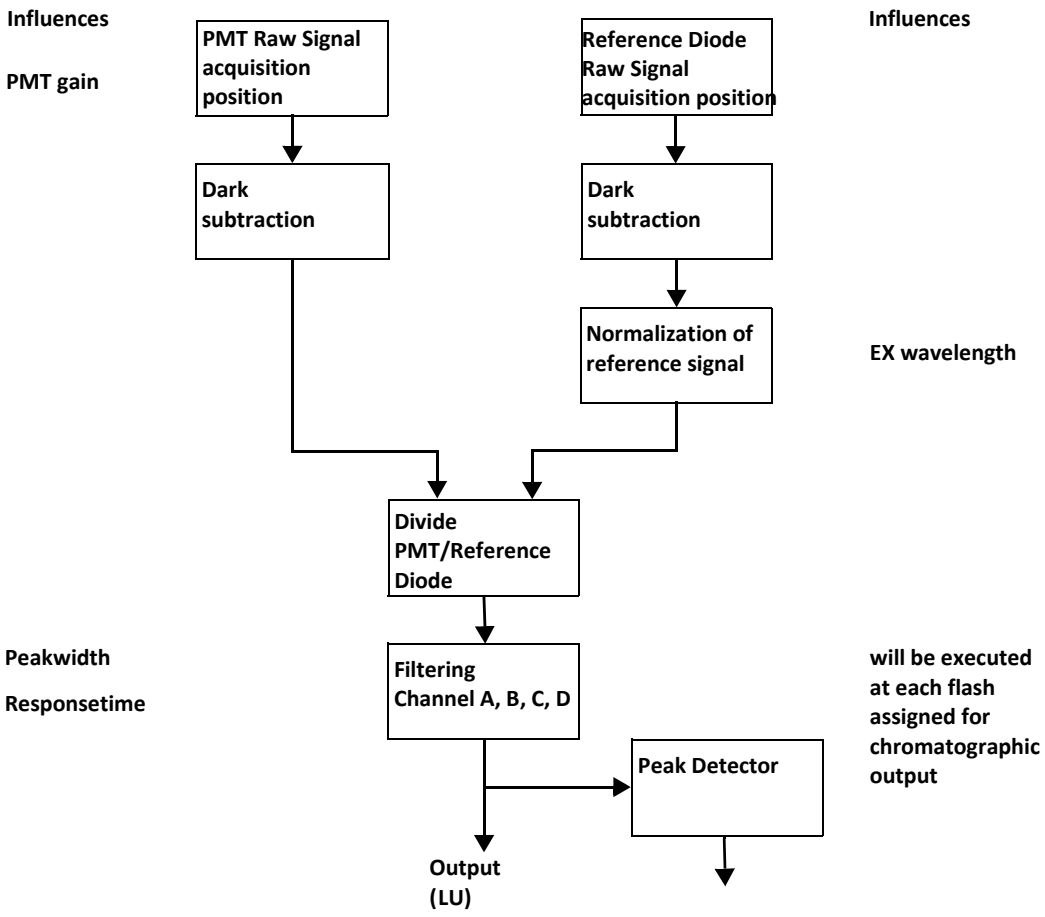


Figure 93 Data flow for chromatographic output

For multi-channel output, any single flash data point will be processed in a separate independent filter.

Data flow for spectral output

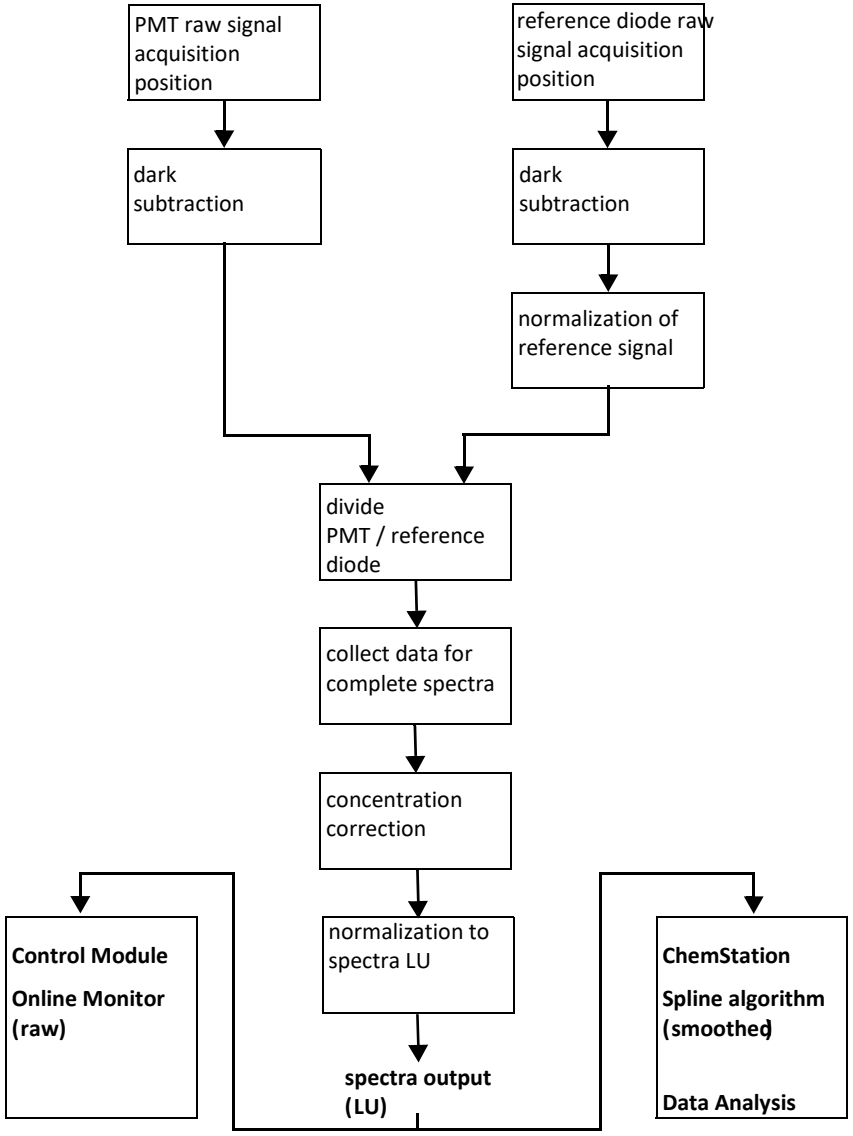


Figure 94 Data flow for spectral output

Raw Signal Acquisition (PMT and Reference Diode)

Each raw data value of the PMT and the reference diode signal is measured synchronized to the flashes of the xenon flash lamp with a 16-bit analog-to-digital converter.

Dark Subtraction

The dark value of the PMT and the reference signal are measured during any power cycle of the detector without flash lamp on. These values are stored and subtracted from any PMT and reference diode value

Normalize Reference Diode Signal

The reference diode, located behind the flow cell, measures the excitation (EX) light within the flow cell and corrects flash lamp fluctuations. Because of a non-linear output of the diode (depending on the EX-wavelength), the measured data are now normalized to get better real light level values within the flow cell.

Divide PMT/Reference Diode

With this calculation the output of the detector will suppress lamp effects like lamp flash fluctuations or lamp lifetime.

Filtering

FIR-filters (finite-impulse-response) are used to filter the given raw data and output it to a the digital data bus and the analog outputs.

Spectra: Collect data to complete spectra

All flashes that are measured to get spectral information are collected to get one spectra.

Concentration Correction

For every measured spectrum, a certain time is required. During this time the concentration within the flow cell may be changed. This can effect the spectra. To avoid this distortion every spectra point is corrected with the quasi-simultaneous measured concentration of the chromatographic channel A. As point of reference the mid-point of each spectra is used.

Concentration correction is not done

- If the cuvette is used, e.g. fluorescence scan.
- If ‘all spectra without signal’ is used as spectra acquisition mode.

Peak Detector

The peak detector (PD) always uses signal A as the *pilot* signal. The PD is adjusted by means of two setpoints: peakwidth and threshold. Both setpoints are time-programmable. While the PD-threshold is a method parameter of its own, the PD-peakwidth parameter is derived from the general peakwidth (PKWD) parameter. At the start of the run, the value for the PD-peakwidth is set equal to the PKWD setpoint. The peak detector recognizes changes in the slope of this signal (upslope, apex, downslope and baseline) and stores spectra according to the operator's instructions. During the run the PD-peakwidth parameter can be changed by time-programming.

Spectra Acquisition Modes

The spectra acquisition mode allows automatic storage of spectra during a run. The mode can be changed during the run by time-programming.

The modes in detail are:

Table 41 Spectra Acquisition Modes

Mode	Description
none	no spectra is stored
apex	if apex of a peak is detected, one spectra is measured and stored. In addition the next baseline spectra is stored.
all in peak	The peak detectors will start and stop spectrum acquisition at begin and end of a detected peak. In addition the next baseline spectra is stored.
all	periodically all spectra are stored. The period depends on the spectra range and step and the number of selected chromatographical outputs (signals).
all without signals	- for screening all flashes are used for spectra acquisition. - no concentration connection is done. - as chromatographical signal the mean of each spectra is output/stored.

Optional Interface Boards

The Agilent 1100 Series modules have one optional board slot that allows addition of an interface board to the modules.

Table 42 Optional Interface Boards

Description	Part Number
BCD Board	G1351-68701
Fuse 250 mA (four are on the board)	2110-0004
LAN Communication Interface Board	G1369A or G1369-60001

BCD Board

The BCD board provides a BCD output for the bottle number of the Agilent 1100 Series autosampler and four external contacts. The external contact closure contacts are relay contacts. The maximum settings are: 30 V (AC/DC); 250 mA (fused).

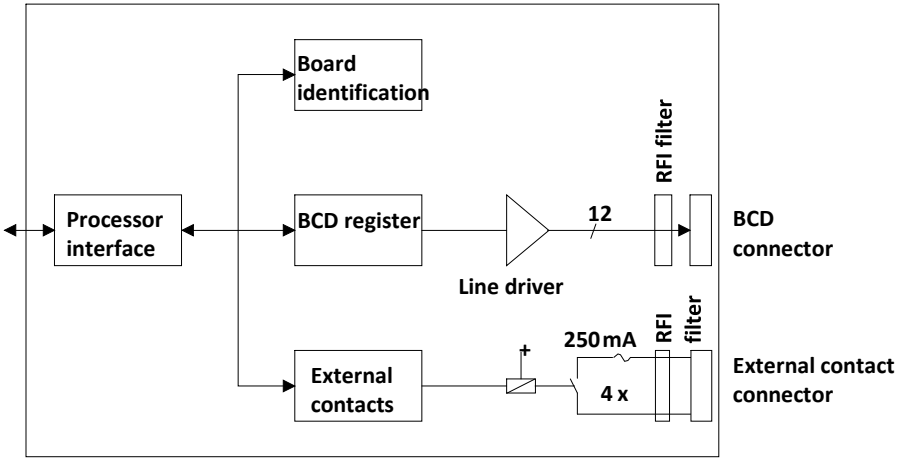


Figure 95 Block Diagram BCD Board

There are general purpose cables available to connect the BCD output, see "BCD Cables" on page 230 and the external outputs, see "External Contact Cable" on page 234 to external devices.

Table 43 Detailed connector layout (1100)

Pin	Signal name	BCD digit
1	BCD 5	20
2	BCD 7	80
3	BCD 6	40

4	BCD 4	10
5	BCD 0	1
6	BCD 3	8
7	BCD 2	4
8	BCD 1	2
9	Digital ground	
10	BCD 11	800
11	BCD 10	400
12	BCD 9	200
13	BCD 8	100
14	not connected	
15	+5 V	

LAN Communication Interface Board

NOTE One board is required per Agilent 1100 stack. It is recommended to add the LAN board to the detector with highest data rate.

The LAN board can only be used together with:

a main board version G13XX-66520 (for G1315A, G1365A, G1314A, G1310A, G1311A, G1312A and G1313A) or newer and on all other 1100 modules. a DOS-ChemStation software revision A.06.01 or above.

The following cards can be used with the Agilent 1100 modules.

NOTE

Table 44 LAN Boards

Type	Vendor	Supported networks
G1369A G1369-60001	Agilent Technologies	Fast Ethernet, Ethernet/802.3, RJ-45 (10/100Base-TX) **recommended for re-ordering**
J4106A (*)	Hewlett Packard	Ethernet/802.3, RJ-45 (10Base-T(
J4105A (*)	Hewlett Packard	Token Ring/802.5, DB9, RJ-45 (10Base-T)
J4100A (*)	Hewlett Packard	Fast Ethernet, Ethernet/802.3, RJ-45 (10/100 Base-TX) + BNC (10Base 2)

NOTE

These cards (*) may be longer orderable. Minimum firmware of the JetDirect cards is A.05.05.

Recommended Cables

Cross-over network cable (shielded, 3 m long), point to point connection)	5023-0203 (for
Twisted pair network cable (shielded, 7 m long) (for hub connections)	5023-0202

Interfaces

The Agilent 1100 Series modules provide the following interfaces :

Table 45 Agilent 1100 Series Interfaces

Interface Type	Pumps	Autosampler	DA Detector MW Detector FL Detector	VW Detector RI Detector	Thermostatted Column Compartment	Vacuum Degasser

CAN	Yes	Yes	Yes	Yes	Yes	No
GPIB	Yes	Yes	Yes	Yes	Yes	No
RS-232C	Yes	Yes	Yes	Yes	Yes	No
Remote	Yes	Yes	Yes	Yes	Yes	Yes
Analog	Yes	No	2 ×	1 ×	No	Yes*
Interface board	Yes	Yes	Yes	Yes	No	No

* The vacuum degasser will have a special connector for specific use. For details see description of main board.

- CAN connectors as interface to other Agilent 1100 Series modules,
- GPIB connector as interface to the Agilent ChemStation,
- RS-232C as interface to a computer,
- REMOTE connector as interface to other Agilent products,
- Analog Output connector(s) for signal output, and
- Interface slot for specific interfacing (external contacts, BCD, LAN and so on).

For identification and location of the connectors Figure 6 on page 24.

WARNING **Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations, see "Cable Overview" on page 218.**

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.

GPIB Interface

The GPIB connector is used to connect the module with a computer. The address and control switches next to the GPIB connector determine the GPIB address of your module. The switches are preset to a default address and recognized by the operating software from Agilent Technologies.

Table 46 Default Addresses

Autosampler	28	Autosampler	28
Pump	22	RID	29
FLD	23		
VWD	24	Autosampler (HP 1050)	18
Agilent 8453A	25	Pump (HP 1050)	16
DAD / MWD	26	VWD (HP 1050)	10
Column Compartment	27	DAD (HP 1050)	17

CAN Interface

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

Remote Interface

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

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

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

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

- standard TTL levels (0 V is logic true, + 5 V is false),
- fan-out is 10,
- input load is 2.2 kOhm against + 5 V, and

- outputs are open collector type, inputs/outputs (wired-or technique).

Table 47 Remote Signal Distribution

Pin	Signal	Description
1	DGND	Digital ground
2	PREPARE	(L) Request to prepare for analysis (for example, calibration, detector lamp on). Receiver is any module performing pre-analysis activities.
3	START	(L) Request to start run / timetable. Receiver is any module performing run-time controlled activities.
4	SHUT DOWN	(L) System has serious problem (for example, leak: stops pump). Receiver is any module capable to reduce safety risk.
5		Not used

Table 47 Remote Signal Distribution, continued

Pin	Signal	Description
6	POWER ON	(H) All modules connected to system are switched on. Receiver is any module relying on operation of others.
7	READY	(H) System is ready for next analysis. Receiver is any sequence controller.
8	STOP	(L) Request to reach system ready state as soon as possible (for example, stop run, abort or finish and stop injection). Receiver is any module performing run-time controlled activities.
9	START REQUEST	(L) Request to start injection cycle (for example, by start key on any module). Receiver is the autosampler.

RS-232C

The RS-232C connector is used to control the instrument from a computer through RS-232C connection, using the appropriate software. This connector can be activated by the configuration switch module next to the GPIB connector.

The RS-232C is designed as DCE (Data Communication Equipment) with a 9- pin male SUB-D type connector. The pins are defined as follows :

Table 48 RS-232C Connection Table

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

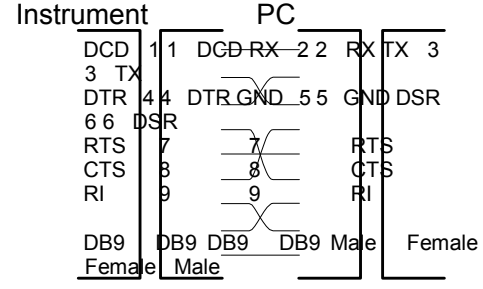


Figure 96 RS-232 Cable

Setting the 8-bit Configuration Switch

The 8-bit configuration switch is located next to the GPIB connector. Switch settings provide configuration parameters for GPIB address, serial communication protocol and instrument specific initialization procedures.

Factory setting is shown for the fluorescence detector

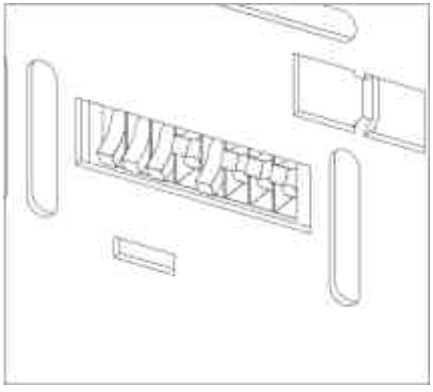


Figure 97 8- bit Configuration Switch

Table 49 8- bit Configuration Switch

Mode Select	1	2	3	4	5	6	7	8
GPIB	0	0		GPIB Address				
RS-232C	0	1	Baud rate			Data Bits	Parity	
Reserved	1	0	Reserved					
TEST/BOOT	1	1	RSVD	SYS		RSVD	RSVD	FC

Switches 1 and 2 define which set of parameters (for example, for GPIB, RS-232C, and so on) will be changed. Once the change has been completed, the instrument must be powered up again in order to store the values in the non-volatile memory.

In the non-volatile memory, the parameters are kept, regardless of whether you turn the instrument off and on again. They will be kept until the same set of parameters is changed and the power is reset. All other previously stored configuration settings will still remain in the non-volatile memory.

In this way, you can store more than one set of parameters using the same 8-bit configuration switch twice, for example, for both GPIB and RS-232C.

GPIB Default Addresses

If you just want to change the GPIB address and need a detailed procedure, refer to the *Installing Your Agilent ChemStation System* handbook.

Default GPIB address is set to the following addresses: **Table 50**
Default Addresses for Agilent Series 1100 Modules

Module	Address	Binary Address
Pump	22	0 0 0 1 0 1 1 0
FLD	23	0 0 0 1 0 1 1 1
VWD	24	0 0 0 1 1 0 0 0
Agilent 8453A	25	0 0 0 1 1 1 0 1
DAD / MWD	26	0 0 0 1 1 0 1 0
Column compartment	27	0 0 0 1 1 0 1 1
Autosampler	28	0 0 0 1 1 1 0 0
RID	29	0 0 0 1 1 1 0 1

where 0 means that the switch is down and 1 means that the switch is up.

Communication Settings for RS-232C Communication

The communication protocol used in this instrument supports only hardware handshake (CTS/RTS).

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

Table 51 Communication Settings for RS-232C Communication

Mode Select	1	2	3	4	5	6	7	8
RS-232C	0	1	Baud rate			Data Bits	Parity	

Use the following tables for selecting the setting which you want to use for RS-232C communication. The number 0 means that the switch is down and 1 means that the switch is up.

Table 52 Baud Rate Settings

Switches			Baud Rate	Switches			Baud Rate
3	4	5		3	4	5	
0	0	0	9600	1	0	0	9600
0	0	1	1200	1	0	1	14400
0	1	0	2400	1	1	0	19200
0	1	1	4800	1	1	1	38400

Table 53 Data Bit Settings

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

Table 54 Parity Settings

Switches		Parity
7	**8**	
0	0	No Parity
1	0	Odd Parity
1	1	Even Parity

One start bit and one stop bit are always used (not selectable).

Per default, the module will turn into 19200 baud, 8 data bit with no parity.

Forced Cold Start Settings

Switches 1 and 2 do not force storage of this set of parameters in non-volatile memory. Returning switches 1 and 2 to other positions (other than being both up) will allow for normal operation.

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

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

Table 55 Forced Cold Start Settings

Mode Select	1	2	3	4	5	6	7	8
TEST/BOOT	1	1	0	0	0	0	0	1

To return to normal operation, set switches back to your GPIB or RS 232 configuration settings.

Stay-Resident Settings

Firmware update procedures may require this mode in case of firmware loading errors.

Switches 1 and 2 do not force storage of this set of parameters in non-volatile memory. Returning switches 1 and 2 to other positions (other than being both up) will allow for normal operation.

If you use the following switch settings and power the instrument up again, the instrument firmware stays in the resident part, that is, it is not operable as a detector. It only uses basic functions of the operating system for example, for communication.

Table 56 Stay Resident Settings

Mode Select	1	2	3	4	5	6	7	8
TEST/BOOT	1	1	0	0	1	0	0	0

To return to normal operation, set switches back to your GPIB or RS-232C configuration settings.

The Main Power Supply Assembly

The main power supply comprises a closed assembly (no onsite repair possibility).

The power supply provides all DC voltages used in the module except for the voltages supplied by the lamp power supply to the deuterium and tungsten lamps in the detectors. The line voltage can vary in a range from 100 – 120 or 220 – 240 volts AC ± 10 % and needs no manual setting.

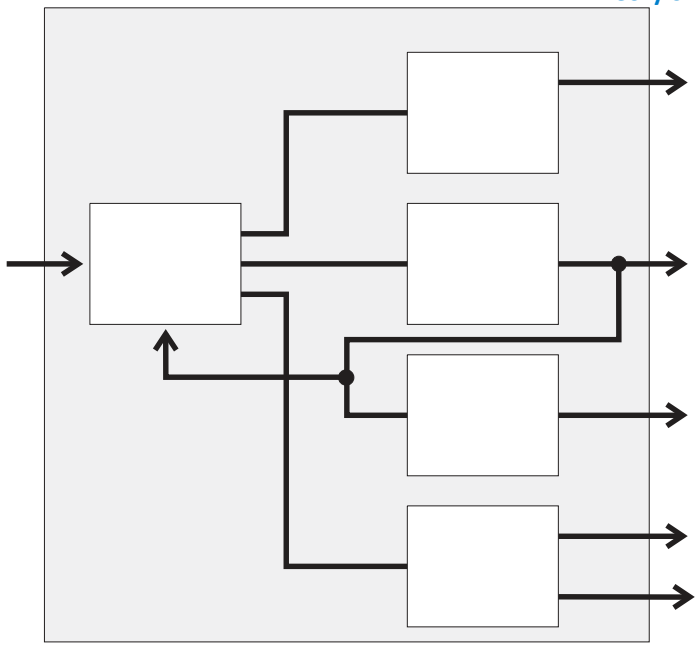


Figure 98 Main Power Supply (MPS) Blockdiagram

To disconnect the instrument from line, unplug the power cord. The power supply still uses some power, even if the power switch on the front panel is turned off.
No accessible hardware fuse is needed because the main power supply is safe against any short circuits or overload conditions on the output lines. When overload conditions occur, the power supply turns off all output voltages. Turning the line power off and on again resets the power supply to normal operation if the cause of the overload condition has been removed.

An over-temperature sensor in the main power supply is used to turn off output voltages if the temperature exceeds the acceptable limit (for example, if the cooling fan of the instrument fails). To reset the main power supply to normal operating conditions, turn the instrument off, wait until it is approximately at ambient temperature and turn the instrument on again.

The following table gives the specifications of the main power supply.

Table 57 Main Power Supply Specifications

Maximum power	130 W	Continuous output
Line Input	100 – 120 or 220 – 240 volts AC ± 10 %, line frequency of 50/60 Hz	Wide ranging
Output 1	+ 24 V / 4.5 A (maximum)	total power consumption of + 24 V and + 36 V must not exceed 107 W.
Output 2	+ 36 V / 2.5 A (maximum)	
Output 3	+ 5 V / 3 A	
Output 4	+ 15 V / 0.3 A	
Output 5	- 15 V / 0.3 A	



9
Introduction to the Control Module

Major keys on the Agilent 1100 Control Module 300
Screens available from the Analysis screen 301
Screens available from the System screen 317
Screens available from the Records screen 320
Diagnostics and Tests 325

Agilent Technologies

Major keys on the Agilent 1100 Control Module

Table 58

ESC	Return to previous screen and scroll through top layer views (Analysis, Settings)
m	Open context sensitive menus
i	Information/help
Enter	Store changed parameters or execute the choice from a pull-down menu
On/Off	Switch on lamp(s)
Start	Start a run
Plot	View the chromatogram
Views	Change between view of analysis - status - system screens

NOTE

The screens shown on the next pages are based on:

Control Module firmware revision B.01.01

LC Module firmware revision 3.8x

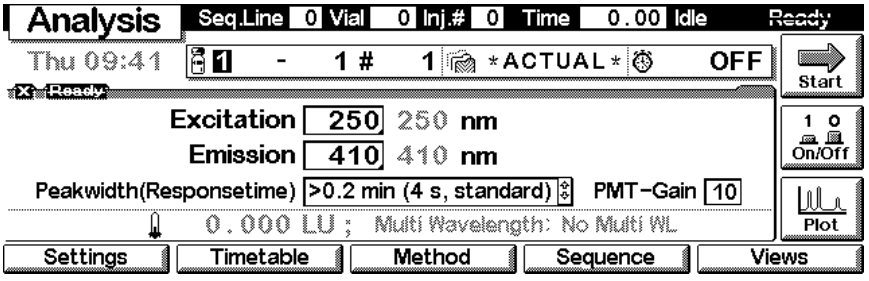
NOTE

In case the control module's display seems to be frozen (hang-up due to a communication problem on the CAN bus, unplug the control module from the LC module and reconnect.

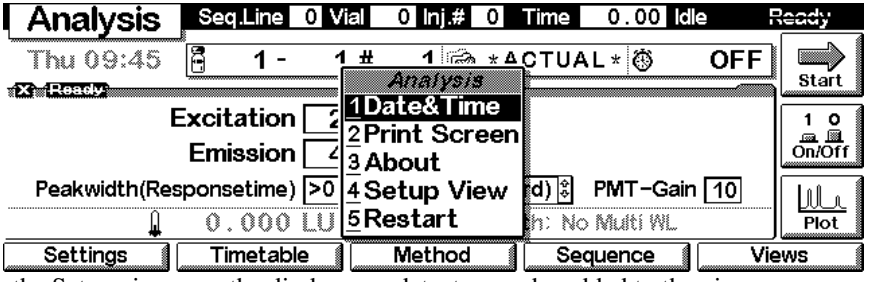
Screens available from the Analysis screen

The Analysis screen

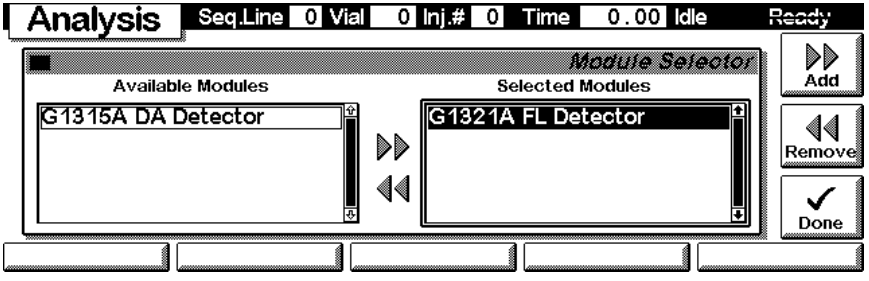
This is the wake-up screen, if the Agilent 1100 fluorescence detector is the only configured Agilent 1100 module. It is used to enter the most common FLD method parameters.



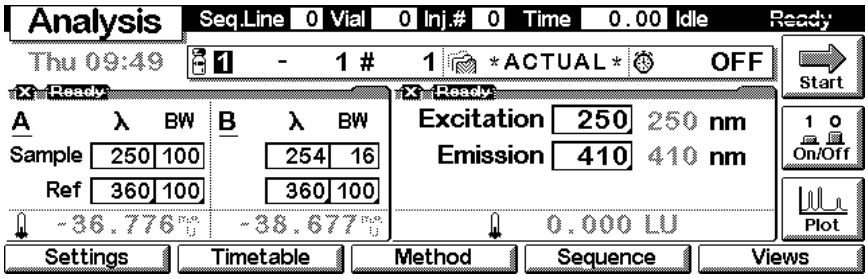
The **m**-key allows access to the context sensitive menu. **Setup view** leads you to add sections for additional Agilent 1100 modules. **Restart** re-boots the control module.



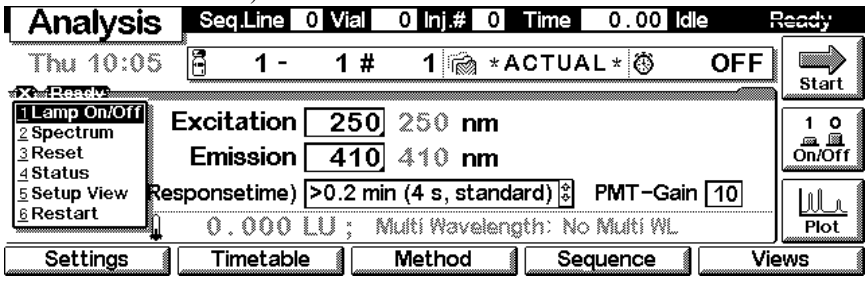
In the Setup view, e.g. the diode array detector can be added to the view.



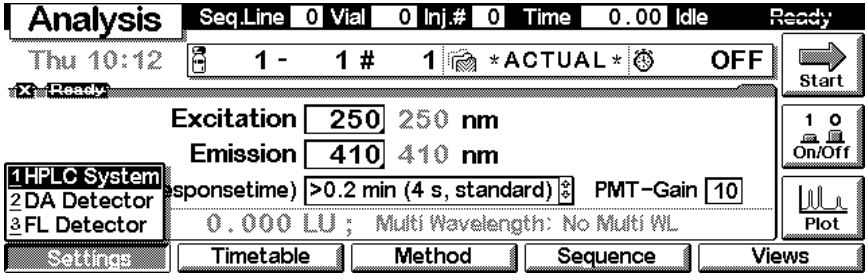
Here, e.g. the diode array detector parameters are shown on the display as well. The number of parameters on the display are restricted as additional modules are added. Maximum 4 modules are shown automatically. If more modules are in the system, you have to chose in Setup view. The number of parameters on the display are restricted as additional modules are added.



The **m**-key gives access to a context sensitive menu (e.g. when the cursor is positioned in the excitation window).

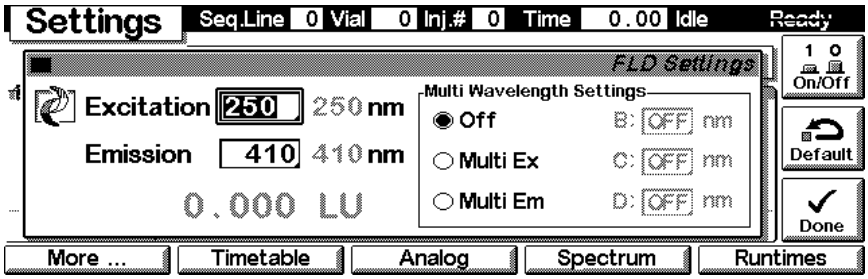


With the **Settings** key you open a pull-down menu where you can select the FLD module.

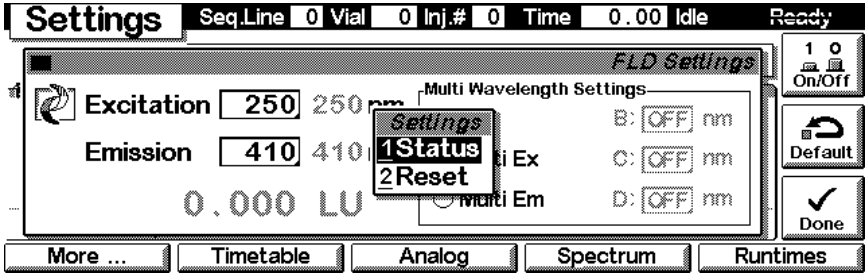


Settings

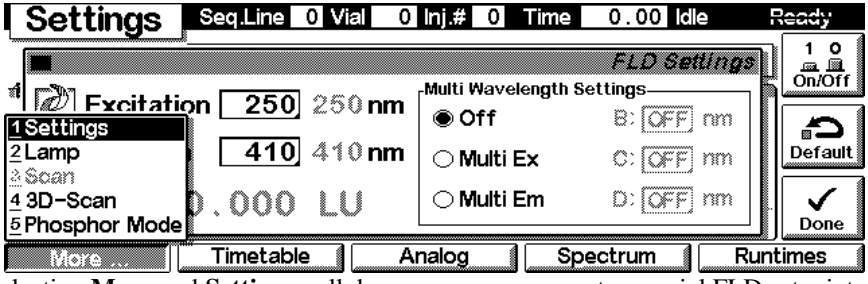
Within the **Settings** you can change the FLD parameters and with a different set of parameters available through the F1-5 keys. F7 key resets the FLD to default values. F8 opens a window to turn on the lamp.



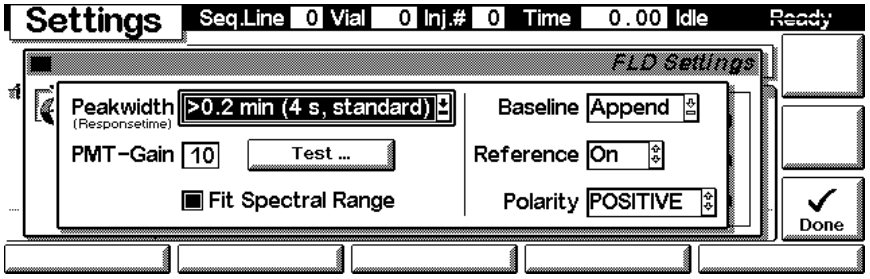
Use the **m**-key for the context sensitive menu. The **Status** command pulls up a monitor screen displaying signals and spectra as programmed. **Reset** will load the FLD default parameters.



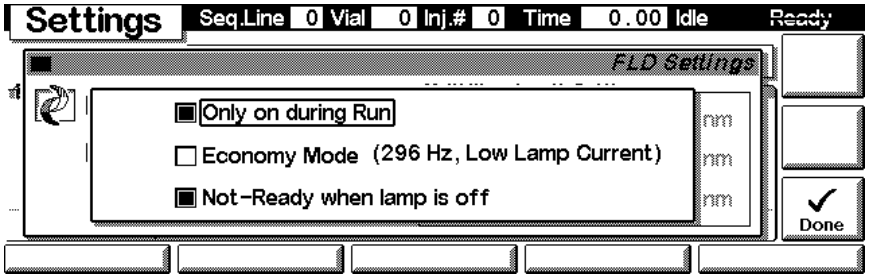
Use F1-key (**More**) opens a pull-down menu. The item **Scan** is available when Multi-Ex or Multi-Em mode has been selected. The **Phosphor** mode is not available with FLD firmware revisions A.03.6X and below.



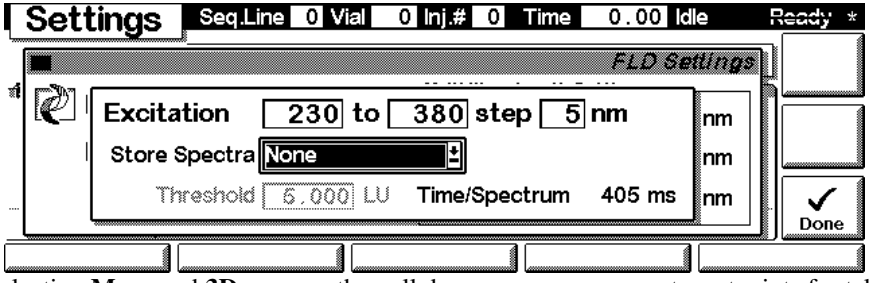
Selecting **More** and **Settings** pull down menu you can enter special FLD setpoints. The **PMT-Test** allows the automatic check for optimum signal/noise and dynamic range under current conditions in the flow cell.



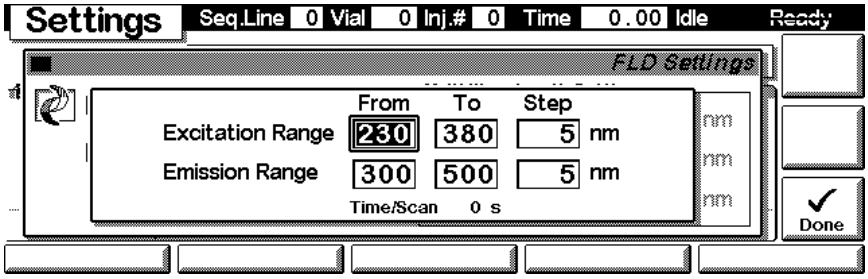
Selecting **More** and **Lamp** on the pull down menu you can enter different lamp operating modes. Deselect '**Not-Ready when lamp is off**' when you keep the FLD on during analysis with another detector.



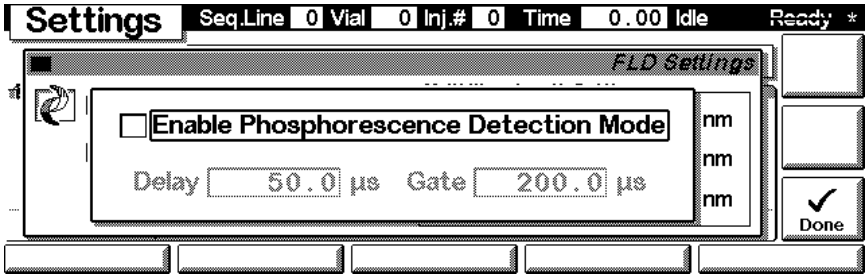
Selecting **More** and **Scan** on the pull down menu you can enter setpoints for spectrum acquisition (Multi-Ex or Multi-Em).



Selecting **More** and **3D-scan** on the pull down menu you can enter setpoints for taking for the 3D-fluorescence scans. Data can only be displayed using the 3 D-Agilent ChemStation software.

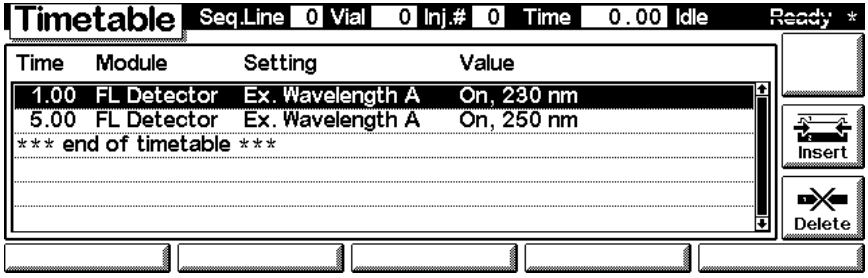


Selecting **More** and **Phosphor** on the pull down menu you can enter setpoints for measuring phosphorescence. This mode is not available with FLD firmware revisions A.03.6X and below.

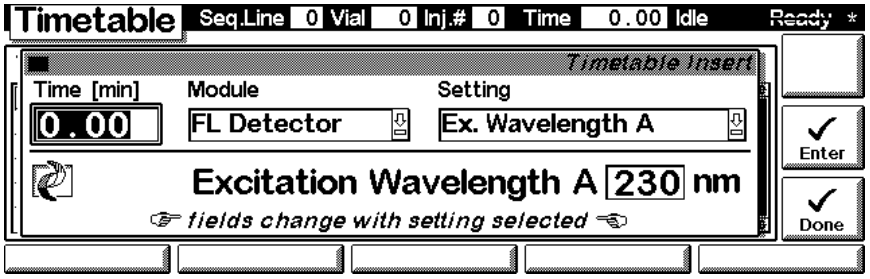


Settings - Timetable

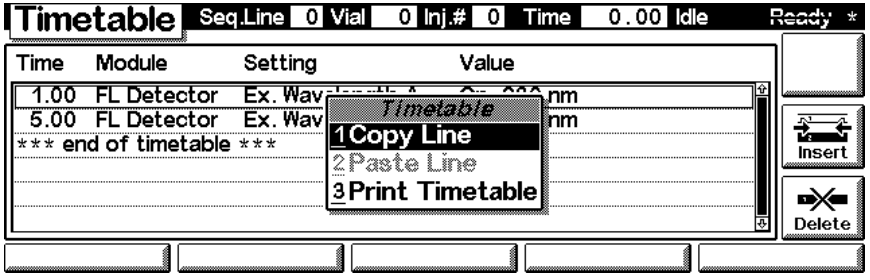
With the F2 key (**Timetable**) you can list the timetable for the FLD. Press F7 key (**Insert**) to add entries or F6 key (**Delete**) to remove entries.



Press the F7 key (**Insert**) to add timetable events. Use the F6 key (**Done**) to view the entered lines of the timetable.

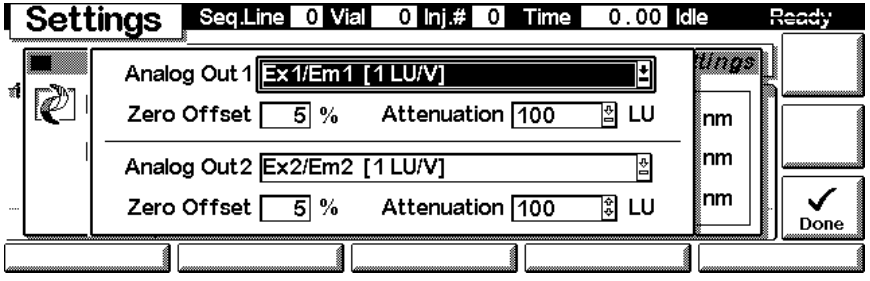


Use the **m**-key for the context sensitive menu. It gives you additional tools for the timetable.



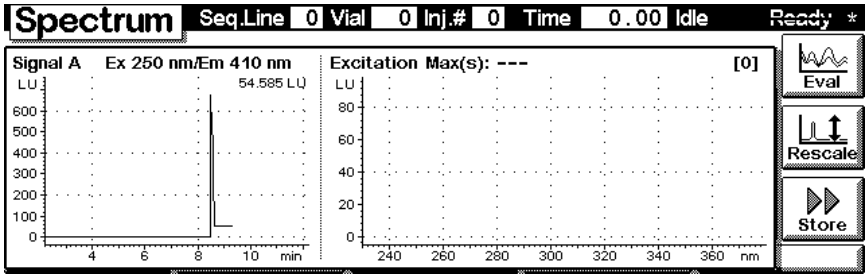
Settings - Analog

With the F3 key (**Analog**) you can change the settings for the analog outputs.

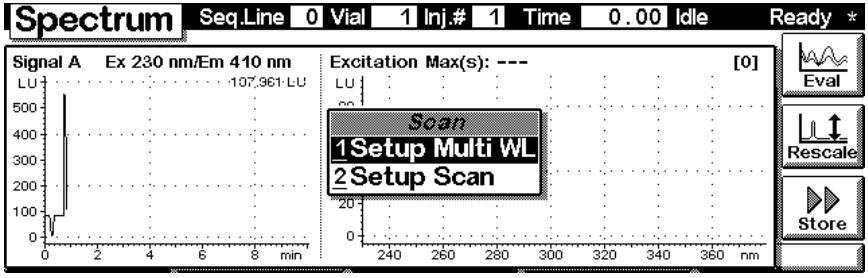


Settings - Spectrum Monitor

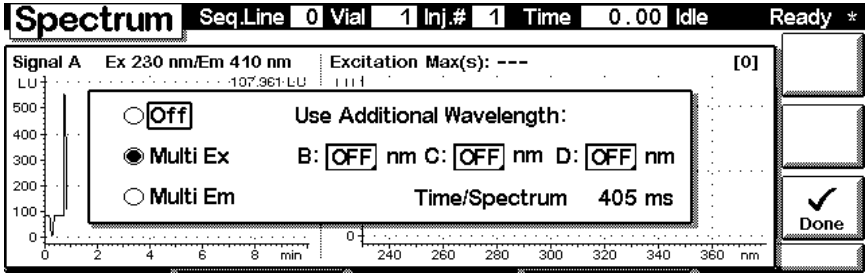
With the F4 key (**Spectrum**) you can watch the signals and spectra on-line as programmed. The F6 key (**Store**) will restart acquisition of spectra and loads the spectrum into memory in the control module. Spectra are lost when a new analysis is started or when the Control Module is switched off. The F8 key (**Eval**) leads to the next screen below.



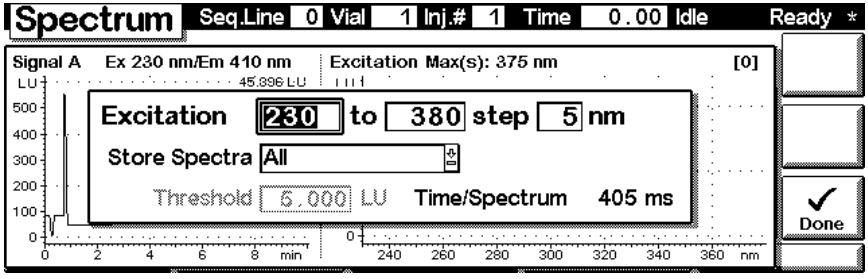
The m key starts the context sensitive menu to change setpoints for spectra acquisition.



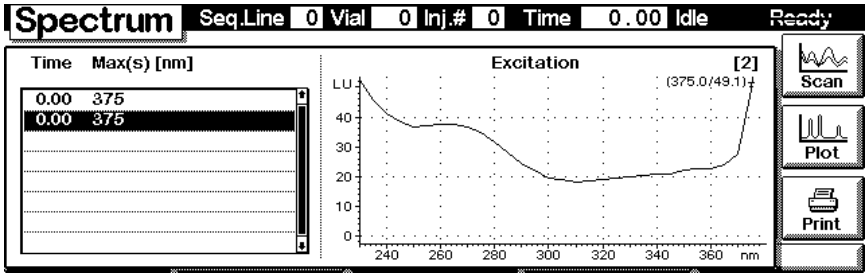
From Menu item 1 (**Setup Multi WL**) you can switch between Excitation and Emission spectra and choose simultaneous multi-wavelengths detection.



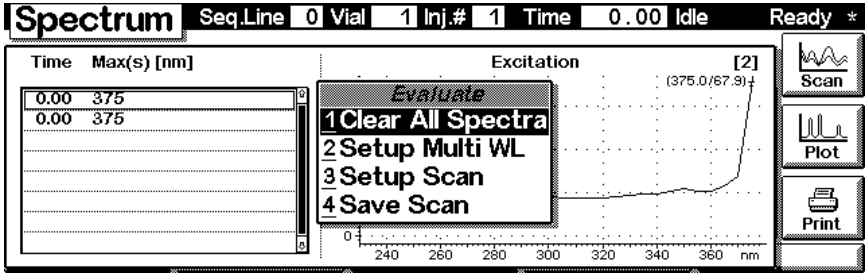
From Menu item 2 (**Setup Scan**) you can set spectra acquisition parameter. Store spectra is only valid if an Agilent Chemstation is connected.



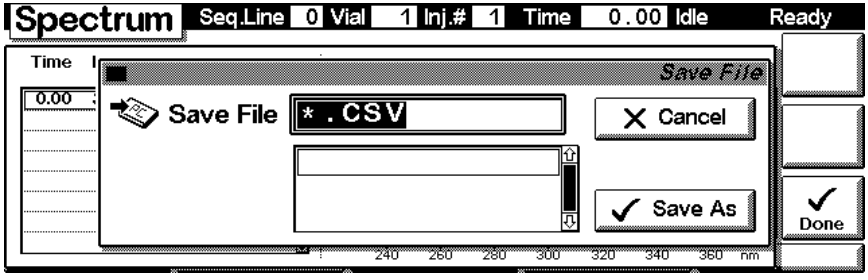
With the F8 key (**Eval**) to call up the stored spectra. Use F7 key (**Plot**) to enlarge the spectrum plot. Use F6 key (**Print**) to print the plot to a printer. The F8 key (**Scan**) will return to the acquisition screen.



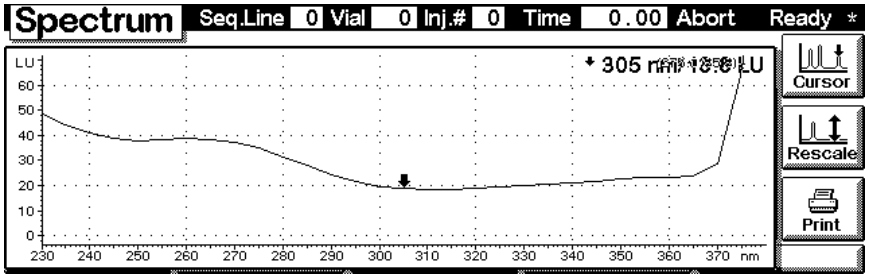
During spectra review press the **m**-key to open the context sensitive menu. The menu item 1 (Clear All Spectra) empties the memory in the Control Module. The menu item 4 (Save Spectrum) leads to the next screen.



With a PC card inserted into the Control Module spectra can be stored as *.csv files and viewed with Microsoft Excel “ software. Letters of the filename can be entered by pressing several times the numerical keys (see *Reference Manual of the Control Module*).

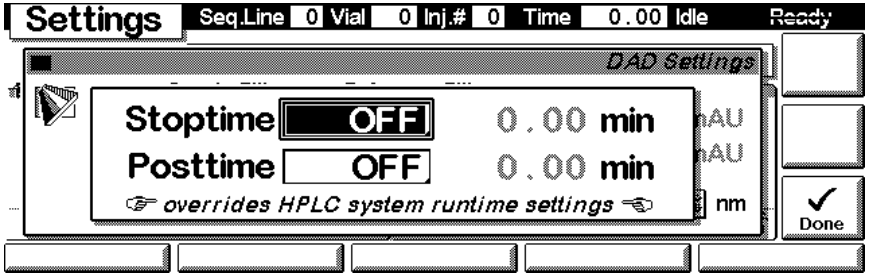


With the F8 key (**Cursor**) you can cruise with the cursor through the spectrum. The F6 key (**Print**) starts printing of the spectrum. Press **Esc** key to return to previous screen.

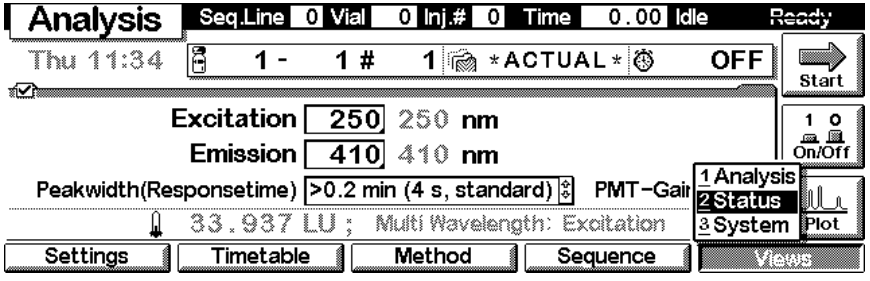


Settings - Run times

With the F5 key (**Runtimes**) you can change the stop time and the post-run time.

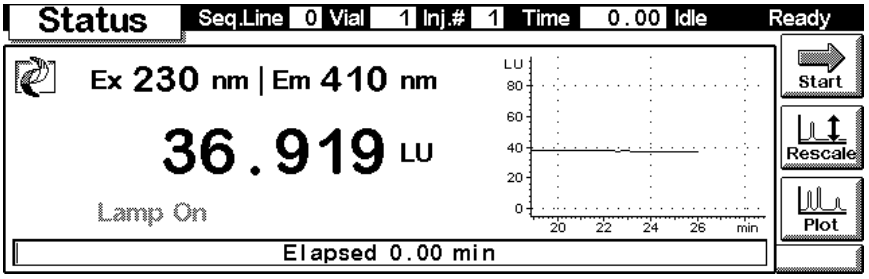


Press F5 key (**Views**) and select **Status**.

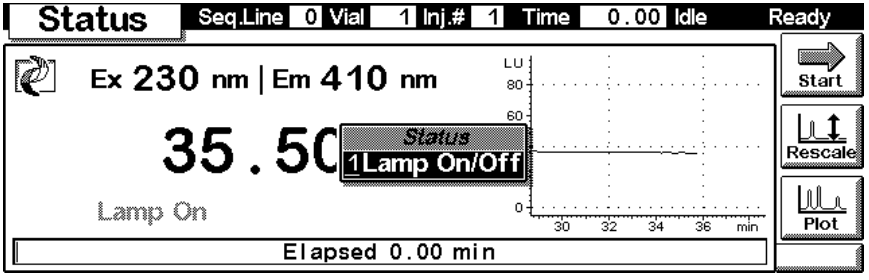


Status

This is an example if an Agilent 1100 FLD is configured stand-alone.

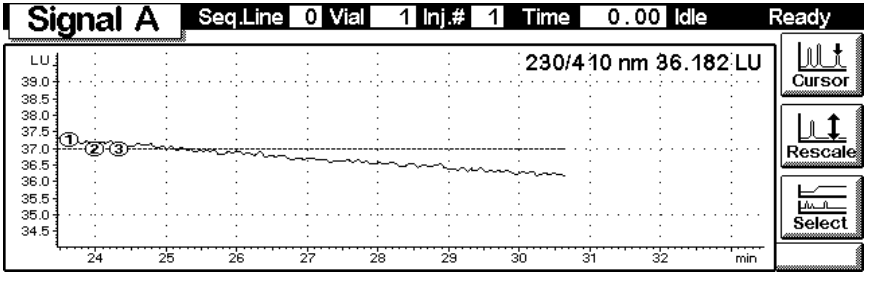


Press the **m**- key to open the context sensitive menu.

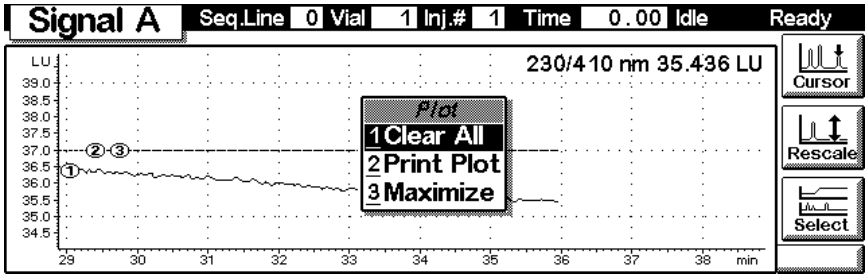


Signal plot

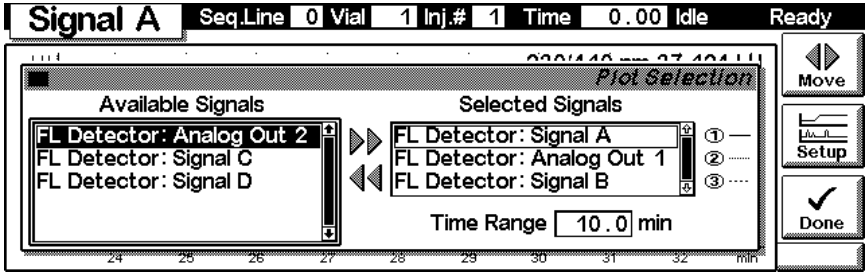
Press F6 key (**Plot**) to enter the plot screen (available also from the **Analysis** and **System** screen). Here you can observe the on-line signal(s). To add additional on-line signals (maximum 3), press F6 key (**Select**). If more than one signal is configured (see next), use the 1-2-3 number key to switch between the signals.



Press the **m**- key to open the context sensitive menu.

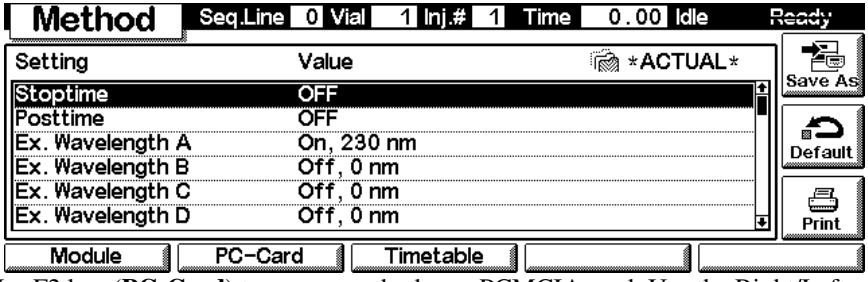


Press F6 key (**Select**). Here you can add additional on-line signals (maximum are 3). Additional signals could be also pressure or temperature signals from other modules. Use the Right/Left arrows to switch between Available and Selected Signals. Use the F8 key (**Move**) to enter available signals into the box for selected signals or vice versa.

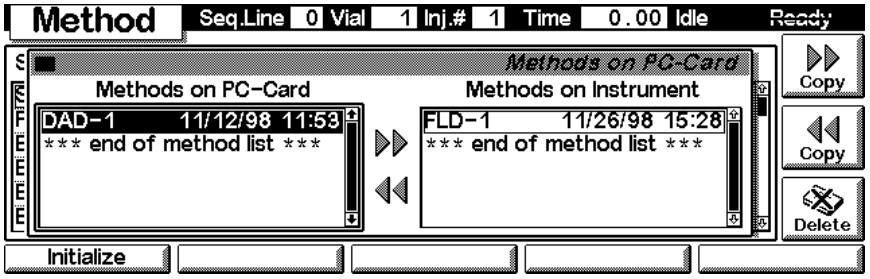


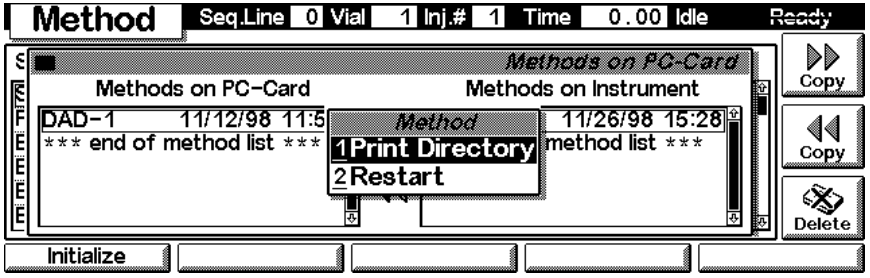
Method screens

Use ESC to return to the **Analysis** screen. Use the F3 key (**Method**) to view the parameters in a method and F8 key (**Save As**) to save the method in the mdodule(s). The PC-Card key is only active when a PCMCIA card is inserted in the control module.



Use F2 key (**PC-Card**) to save a method on a PCMCIA card. Use the Right/Left arrows to switch between PC-Card and Instrument window. Use the UP/Down arrows to select the method. Use the F7/F8 keys (**Copy**) to enter available signals into the box for selected signals or vice versa. Press the **m**-key to open the context sensitive menu.

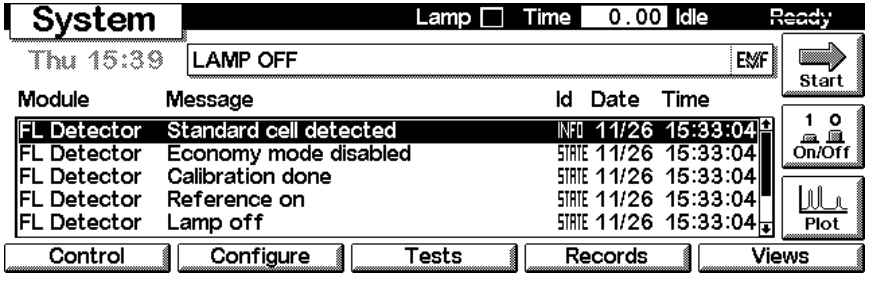




Screens available from the System screen

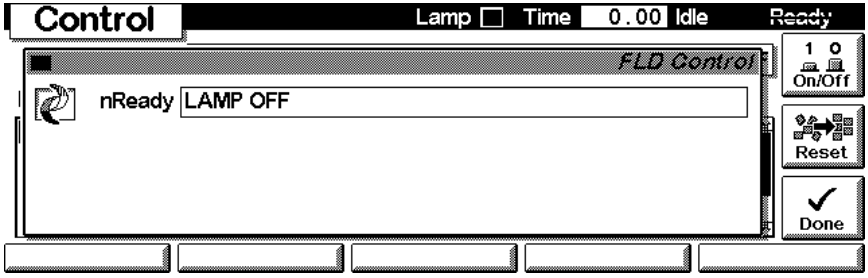
System screen

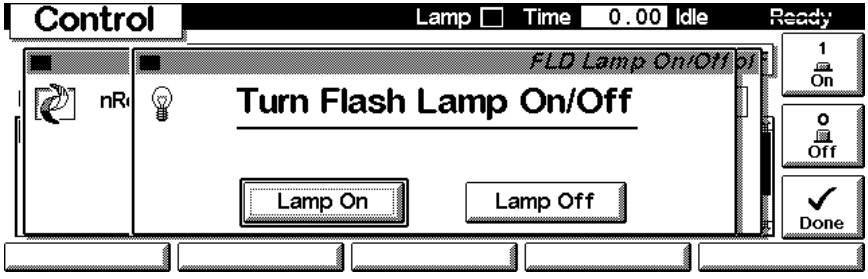
Use the Esc key to receive **Views** on the F5 key. Choose **System** from the pull-down menu. This screen shows the last activities in the system.



System - Control

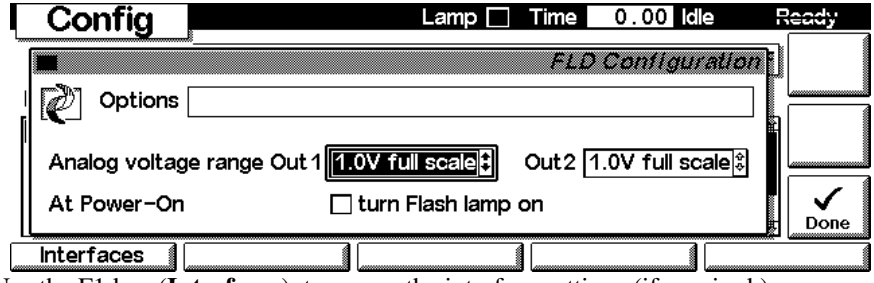
Use the F1 key (**Control**) to select the FL-Detector. Here you receive information about the not-ready conditions if needed. F2 key (**Reset**) does a re-initialization of the FLD. Use the F8 key (**On/Off**) to turn on the lamp(s).



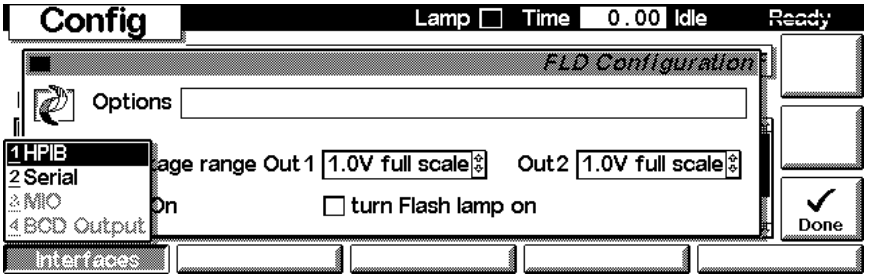


System - Configuration

Use the **Esc** key to receive **Views** on the F5 key. Choose **System** from the pull-down menu. Use the F2 key (**Configure**) to select the FLD. Here you define further special setpoints for the FLD operation.



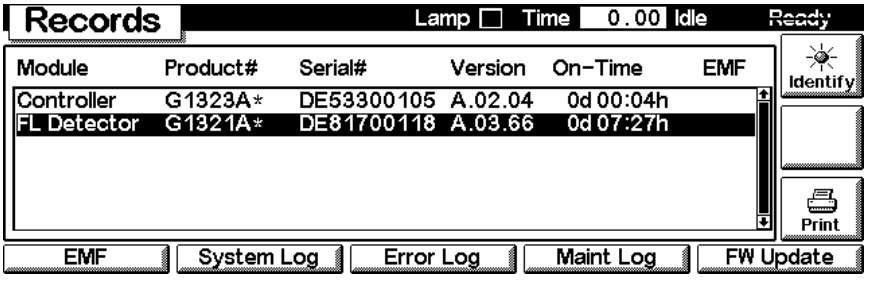
Use the F1 key (**Interfaces**) to access the interface settings (if required).


Config
Lamp
Time
0.00
Idle
Ready
FLD Configuration
Options
1 HPIB
2 Serial
3 MIO
4 BCD Output
age range Out 1
1.0V full scale
Out 2
1.0V full scale
On
turn Flash lamp on
Done
Interfaces

Screens available from the Records screen

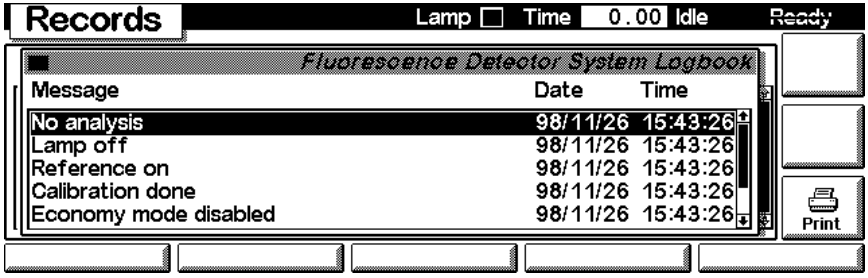
Records screen

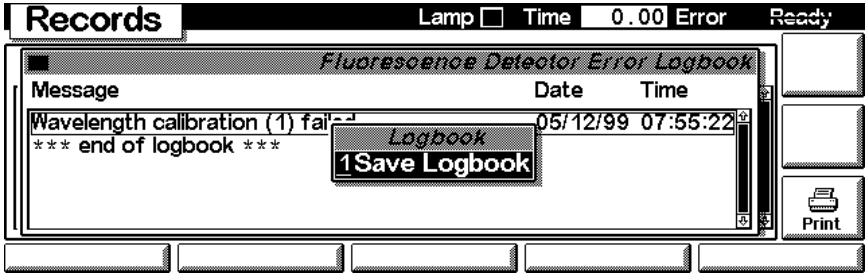
Use the Esc key to receive **Views** on the F5 key. Choose **System** from the pull-down menu. Use the F4 key (**Records**) to select the FLD. Errors are reported either into the **System Log** (F2) or **Error Log** (F3).



System / Error Log

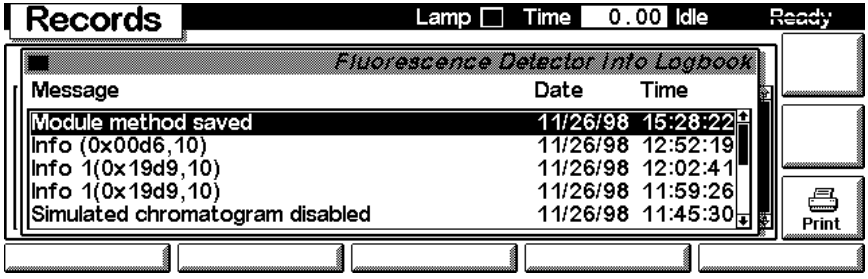
Use the F2 key (**System Log**) or F3 key (**Error Log**) to look for errors. For troubleshooting reasons they can be printed or saved to a file on the PCMCIA card (pressing the **m**- key).





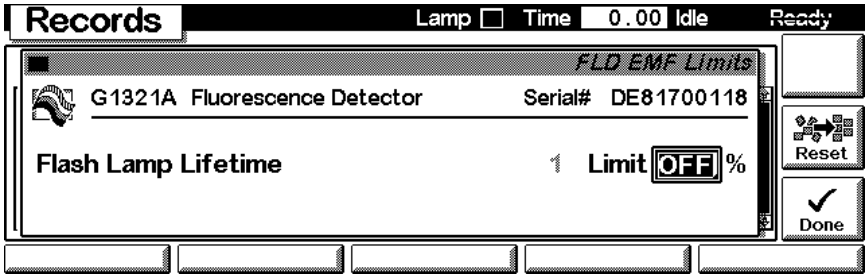
Info Log

Use the **m**-key to receive a pop-up menu, Select **Info Log**. A list of the last events are listed. For troubleshooting reasons they can be printed or saved to a file on the PCMCIA card (pressing the **m**- key).

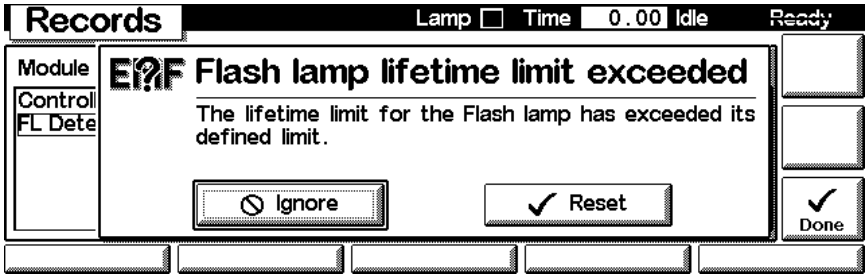


EMF (Early Maintenance Feedback)

Use the F1 key (**EMF**) to set EMF parameters. Choose menu item 1 (**Setup limits**) to select lamp-on level for the Xenon lamp at which you want to receive a warning.

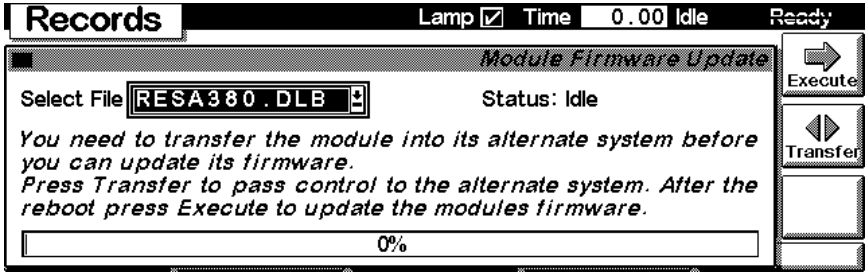


If a set limit has been exceeded, a message box will pop up. This will not stop a sequence or run (information only to plan maintenance activities). If you press **Reset**, the limits will be removed. **Ignore** will continue to keep the EMF flag set.



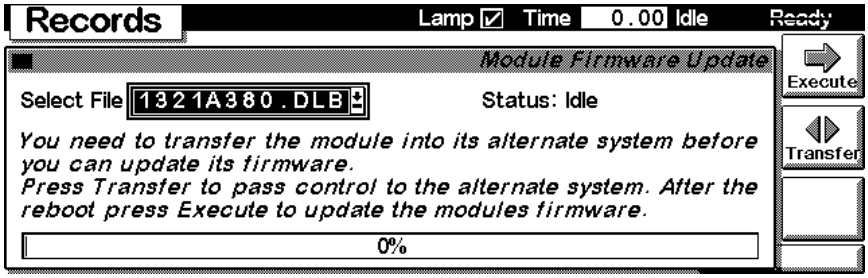
Firmware Update

Use the Esc key to receive **Views** on the F5 key. Choose **System** from the pull-down menu. Use the F3 key (**Records**) to select the FLD. Use the F5 key (**FW Update**) to enter the Update section. If you want to update the resident firmware (together with specific main firmware revisions), select the a file from the PCMCIA card (RESnnnn.DLB) and press execute. If you want to update the main firmware, press F7 key (**Transfer**) to turn the module into the resident mode (LED on module should blink yellow).



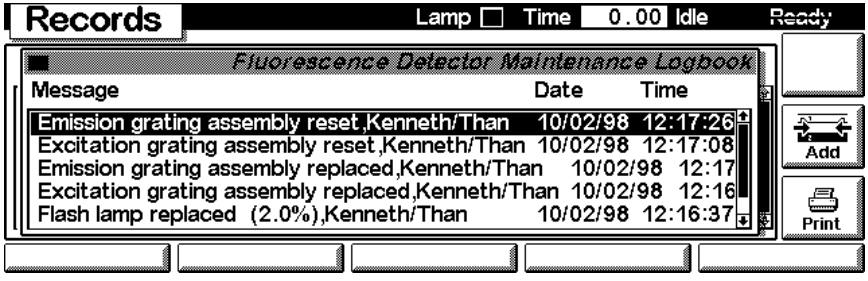
Use the Esc key to receive **Views** on the F5 key. Choose **System** from the pull-down menu. Use the F3 key (**Records**) to select the FLD. Use the F5 key (**FW Update**) to enter the Update section. Select the a file from the PCMCIA card (1321nnnn.DLB) and

press execute. When the update has finished the update, press F7 key (**Transfer**) to return the module into the normal mode (LED on module should stays yellow).

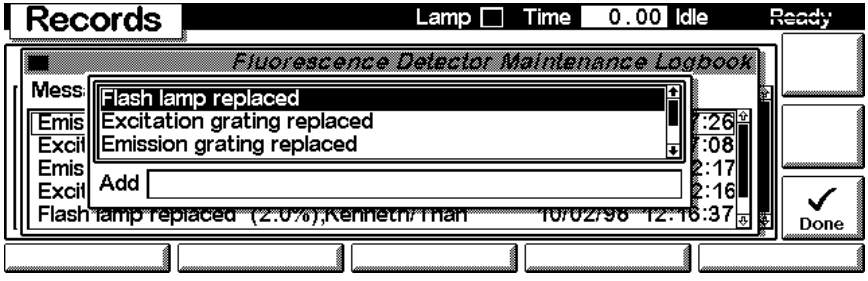


Maintenance activities

Use the Esc key to receive **Views** on the F5 key. Choose **System** from the pull-down menu. Use the F3 key (**Records**) to select the FLD. Use the F4 key (**Maint log**) to view and edit the maintenance logbook.



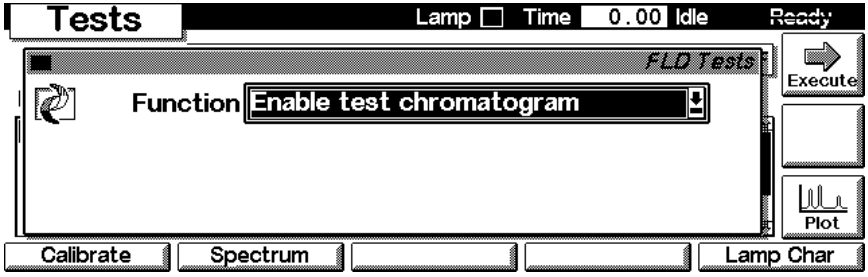
Use the F7 key (**Add**) to add new maintenance activities.

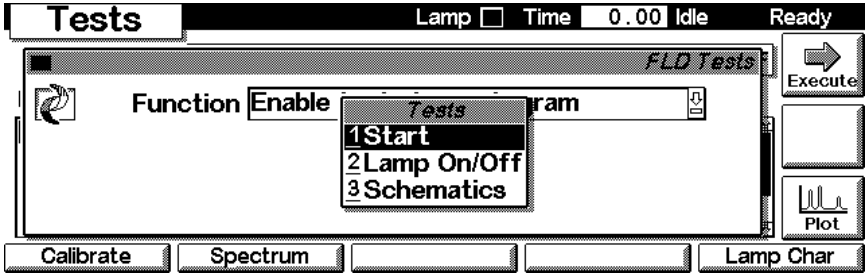


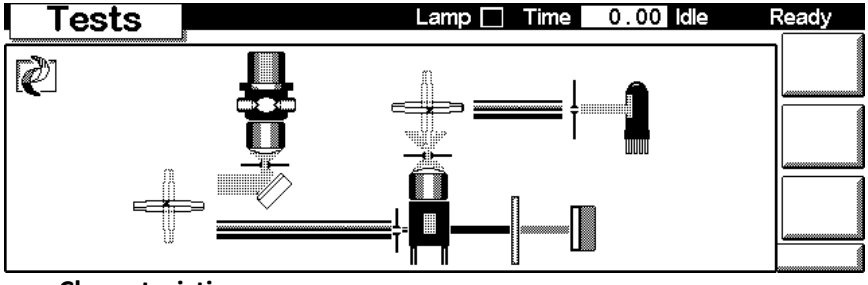
Diagnostics and Tests

Tests screen

Use the Esc key to receive **Views** on the F5 key. Choose **System** from the pull-down menu. Use the F3 key (**Tests**) to select the FLD. Several tests are available to test the Agilent 1100 FLD. Additional test are listed in the function box. Press the **m**-key to open the context sensitive menu. Menu item 3 (**Schematics**) will popup the FLD diagram.

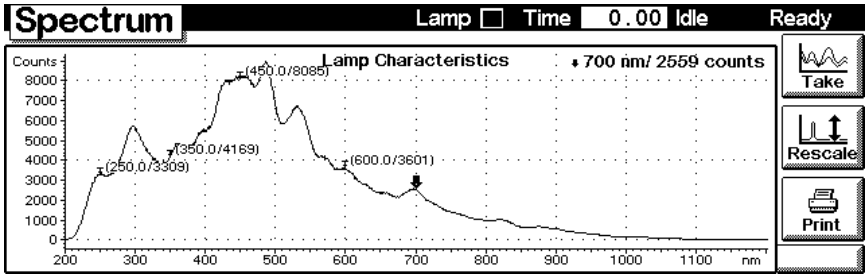






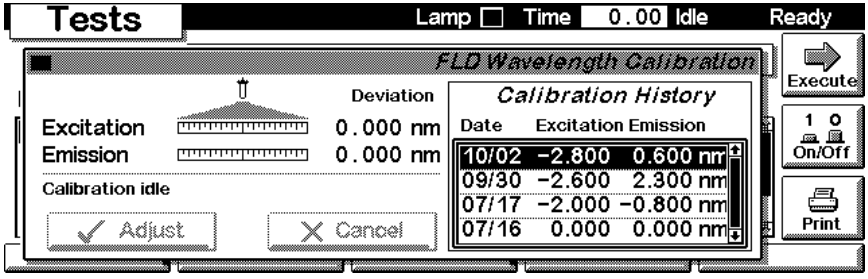
Lamp Characteristic

Use the F5 key (**Lamp Char**) to get the instrument profile. Use F8 key (**Take**) to generate a new profile.



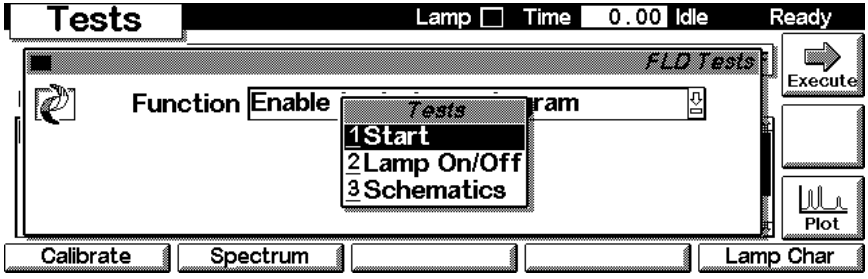
Wavelength Calibration

Use the F1 key (**Calibrate**) and then F8 key (**Execute**) to start the FLD wavelength calibration (with Glycogen in the flow cell). If a deviation is found, press **Adjust**.

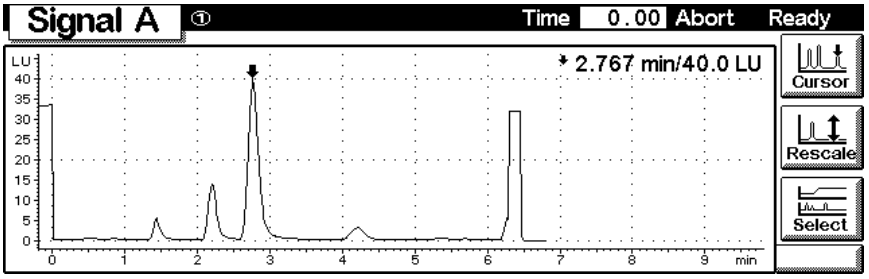


Built-in Test Chromatogram (Simulation)

To start the built-in test chromatogram, use the F8 key (**Execute**) to enable the simulation. Then press the m-key to open the pop-up menu. Select **Start** to start a run (all modules in the Agilent 1100 system must be in ready state).



Use the F6 key (**Plot**) to view the signal. A simulated chromatogram (4 peaks) will repeat until the run is stopped. The signal is also available on the analog output. A change of the peakwidth will change the retention times.


Signal A
Time 0.00 Abort Ready
2.767 min/40.0 LU
LU
40
35
30
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 min
Cursor
Rescale
Select

10
Specifications

Performance Specifications 330

Performance Specifications

Table 59 Performance Specifications Agilent 1100 Series Fluorescence Detector

Type	Specification	Comments
Detection type	Multi-signal fluorescence detector with rapid on-line scanning capabilities and spectral data analysis	
Performance Specifications	10 fg Anthracene, Ex=250 nm, Em=400 nm* RAMAN (H_2O) > 200 (FLF rev A) RAMAN (H_2O) > 400 (FLF rev >A) Ex=350 nm, Em=397 nm, dark value 450 nm, standard flow cell time constant=4 seconds (8 seconds responsetime)	see note below this table see "Raman ASTM Signal-to-Noise Test" on page 123
Light source	Xenon Flash Lamp, normal mode 20 W, economy mode 5 W	
Pulse frequency	296 Hz for single signal mode 74 Hz for spectral mode	
Excitation Monochromator	Range: 200 nm - 700 nm and zero-order Bandwidth: 20 nm (fixed) Monochromator:concave holographic grating, F/1.6, blaze: 300 nm	
Emission Monochromator	Range: 280 nm - 900 nm and zero-order Bandwidth: 20 nm (fixed) Monochromator:concave holographic grating, F/1.6, blaze: 400 nm	

Reference System:	in-line excitation measurement
Timetable programing:	up to 4 signal wavelengths, response time, PMT Gain, baseline behavior (append, free, zero), spectral parameters

Table 59 Performance Specifications Agilent 1100 Series Fluorescence Detector,

Type	Specification	Comments
Spectrum acquisition:	Excitation or Emission spectra Scan speed: 28 ms per datapoint (e.g. 0.6 s/spectrum 200-400 nm, 10 nm step) Step size: 1-20 nm Spectra storage: All	
Wavelength characteristic	Repeatability+/- 0.2 nm Accuracy+/- 3 nm setting	
Flow cells	Standard: 8 µl volume and 20 bar (2 MPa) pressure maximum, quartz Optional: Fluorescence cuvette for offline spectroscopic measurements with 1 ml syringe, 8 µl volume, quartz	
Control and data evaluation	Agilent ChemStation for LC, Agilent 1100 Control Module with limited spectral data analysis and printing of spectra	
Analog outputs	Recorder/integrator: 100 mV or 1 V, output range >10^2 luminescence units, two outputs	

Communications	Safety and

maintenance	Controller-area network (CAN), GPIB, RS-232C, LAN, APG Remote: ready, start, stop and shut-down signals	
	Extensive diagnostics, error detection and display (through control module and ChemStation), leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in major maintenance areas.	

Table 59 Performance Specifications Agilent 1100 Series Fluorescence Detector,

Type	Specification	Comments
GLP features	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, using the Raman band of water.	
Housing	All materials recyclable.	
Environment:	0 to 40 °C constant temperature at <95% humidity (non-condensing)	
Dimensions:	140 mm x 345 mm x 435 mm (5.5 x 13.5 x 17 inches) (height x width x depth)	
Weight:	11.5 kg (25.5 lbs)	

NOTE Reference conditions: standard cell 8 µl, response time 4 s, flow 0.4 ml/min LC-grade Methanol, 2.1 x 100 mm ODS column.



A
Safety Information

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Solvent Information 341
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Agilent Technologies

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.

General

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

This instrument is designed and certified as a general purpose laboratory instrument for research and routine application only. It is not certified for in-vitro or medical applications.

Operation

Before applying power, comply with the installation section. Additionally the following must be observed.

Do not remove instrument covers when operating. Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers, and devices connected to it must be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any intended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, and so on) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

CAUTION The operator of this instrument is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

Some adjustments described in the manual, are made with power supplied to the instrument, and protective covers removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible. When inevitable, this should be carried out by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or make any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged, even though the instrument has been disconnected from its source of supply. Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing and adjusting.

Safety Symbols

Table 60 shows safety symbols used on the instrument and in the manuals.

Table 60 Safety Symbols

Symbol	Description
	The apparatus is marked with this symbol when the user should refer to the instruction manual in order to protect the apparatus against damage.
	Indicates dangerous voltages.

Table 60 Safety Symbols, continued

Symbol	Description
	Indicates a protected ground terminal.
	Eye damage may result from directly viewing the light produced by the deuterium lamp used in this product. Always turn off the deuterium lamp before opening the metal lamp door on the side of the instrument.

WARNING **A warning alerts you to situations that could cause physical injury or damage to the equipment. 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 a possible loss of data. Do not proceed beyond a caution until you have fully understood and met the indicated conditions.

Lithium Batteries Information

WARNING **Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the equipment manufacturer. Lithium batteries may not be disposed-off into the domestic waste.**

Transportation of discharged Lithium batteries through carriers regulated by IATA/ICAO, ADR, RID, IMDG is not allowed. Discharged Lithium batteries shall be disposed off locally according to national waste disposal regulations for batteries.

Lithiumbatteri - Eksplosionsfare ved fejlagtig håndtering. Udskiftning må kun ske med batteri af samme fabrikat og type. Lever det brugte batteri tilbage til leverandøren.

Lithiumbatteri -

WARNING

WARNING Eksplosionsfare. Ved udskiftning benyttes kun batteri som anbefalt av apparatfabrikanten. Brukt batteri returneres appararleverandoren.

NOTE

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



Radio Interference

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

Test and Measurement

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

Sound Emission

Manufacturer's Declaration

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

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

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

UV-Radiation (UV-lamps only)

Emissions of ultraviolet radiation (200-315 nm) from this product is limited such that radiant exposure incident upon the unprotected skin or eye of operator or service personnel is limited to the following TLVs (Threshold Limit Values) according to the American Conference of Governmental Industrial Hygienists:

Table 61 UV-Radiation Limits

Exposure/day	Effective Irradiance
8 hours	0.1 µW/cm^2
10 minutes	5.0 µW/cm^2

Typically the radiation values are much smaller than these limits:

Table 62 UV-Radiation Typical Values

Position	Effective Irradiance
Lamp installed, 50-cm distance	average 0.016 µW/cm^2
Lamp installed, 50-cm distance	maximum 0.14 µW/cm^2

Solvent Information

Observe the following recommendations on the use of solvents.

Flow Cell

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

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

If the flow cell is transported while temperatures are below 5 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 small % of organic solvents (e.g. Acetonitrile or Methanol ~5%).

Solvents

Brown glass ware can avoid growth of algae.

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

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

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

  This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol.
- Chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, di-isopropylether) such ethers should be filtered through dry aluminium oxide which adsorbs the peroxides.
- 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.

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Select “Products” - “Chemical Analysis”

It will provide also the latest firmware of the Agilent 1100 series modules for download.

A Safety Information

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In This Book

This manual contains technical reference information about the Agilent 1100 Series fluorescence detector. The manual describes the following:

- installing the detector,
- optimization of the detector,
- diagnostics and troubleshooting,
- repairing the detector,
- parts and materials, and
- introduction to the detector and theory of operation.

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