



Agilent 1100 Series Refractive Index Detector



Reference Manual



Agilent Technologies

Notices

© Agilent Technologies, Inc. 2003

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies, Inc. as governed by United States and international copyright laws.

Microsoft[®] is a U.S. registered trademark of Microsoft Corporation.

Manual Part Number

G1362-90002

Edition

Edition 04/03

Printed in Germany

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

Software Revision

This guide is valid for A.01.xx revisions of the Agilent 1100 Series Refractive Index Detector software, where xx refers to minor revisions of the software that do not affect the technical accuracy of this guide.

Warranty

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

Technology Licenses

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

Restricted Rights Legend

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed as “Commercial computer software” as defined in DFAR 252.227-7014 (June 1995), or as a “commercial item” as defined in FAR 2.101(a) or as “Restricted computer software” as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Agilent Technologies’ standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as

defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

Safety Notices

CAUTION

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

WARNING

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

In This Guide...

1 Installing the Refractive Index Detector

How to install the refractive index detector

2 Optimizing the Refractive Index Detector

Optimizing the refractive index detector performance and running a check out

3 Troubleshooting and Test Functions

The detector's built-in troubleshooting and test functions

4 Repairing the Refractive Index Detector

Instructions on how to repair the detector

5 Identifying Parts and Materials

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

6 Introduction to the Refractive Index Detector

An introduction to the detector, including instrument overview, theory of operation, external communication and internal connectors

7 Control Module Screens for the Refractive Index Detector

This chapter is intended to introduce an operator to the screens available for operation of the Agilent 1100 refractive index detector (RID) with the Agilent 1100 control module.

8 Specifications

Performance specifications of the detector

A Appendix: Safety Information

Index

Contents

1	Installing the Refractive Index Detector	11
	Site Requirements	12
	Physical Specifications	14
	Unpacking the Detector	15
	Optimizing the Stack Configuration	18
	Installing the Detector	20
	Flow Connections to the Detector	22
2	Optimizing the Refractive Index Detector	25
	Refractive index detector optimization	26
	Running a check out sample	29
	Starting Your Detector	29
	Setting the Chromatographic Conditions	29
	Checking baseline noise and drift	33
	Starting Your Detector	33
	Setting the Test Conditions	34
	Evaluation	40
3	Troubleshooting and Test Functions	41
	Overview of the Detector's Indicators and Test Functions	42
	Status Indicators	43
	Power Supply Indicator	43
	Detector Status Indicator	43
	Error Messages	45

Contents

Time-out	46
Shutdown	47
Remote Time-out	48
Synchronization Lost	49
Leak	50
Leak Sensor Open	51
Leak Sensor Short	52
Compensation Sensor Open	53
Compensation Sensor Short	54
Fan Failed	55
Thermal Fuse Open	56
Heater Resistance Too High	57
Heater Fuse	58
Wrong Temperature Profile	59
Undecipherable Temperature Signal	60
Maximum Temperature Exceeded	61
Purge Valve Fuse Blown	62
Recycle Valve Fuse Blown	63
Purge Valve Not Connected	64
Recycle Valve Missing	65
Lamp Voltage too High	66
Lamp Current too High	67
Lamp Voltage too Low	68
Lamp Current too Low	69
Wait Function Timed Out	70
Not-Ready Messages	71
Purge Time Running	72
Wait for Purge	73
Unbalanced Diodes	74
Not Enough Light	75
Too Much Light	76
Refractive Index Calibration	77

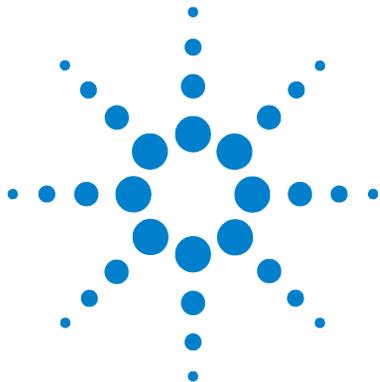
The Refractive Index Calibration Procedure	78
Optical Balance	82
The Optical Balance Procedure	83
Using the Built-in Test Chromatogram	85
Procedure using the Agilent ChemStation	86
Procedure using the Control Module	87
Using the Built-in DAC Test	88
4 Repairing the Refractive Index Detector	91
Introduction to the Repairing the Refractive Index Detector	92
Overview of the Repairing of the Refractive Index Detector	94
Simple Repairs	95
Flow Cell Flushing	96
Correcting Leaks	97
Replacing Leak Handling System Parts	98
Exchanging Internal Parts	99
Removing the Covers	100
Exchanging the Detector Main Board	103
Exchanging the Fan	107
Exchanging the Leak Sensor or Leak Plane	109
Removing the Optical Unit	112
Replacing the Valve Tubing	114
Replacing the Recycle Valve	116
Replacing the Leak Pan	118
Replacing the Purge Valve	119
Exchanging the Power Supply	121
Replacing Status Light Pipe	124
Installing the Optical Unit	125
Replacing the Foams and Covers	127
Assembling the Cabinet Kit	129
Replacing the Interface Board	130

	Replacing the Detector's Firmware	131
5	Identifying Parts and Materials	133
	Overview of Main Assemblies	134
	Optical Unit Assembly	136
	Control Module	138
	Sheet Metal Kit	139
	Plastic Parts	140
	Foam Parts	141
	Power and Status Light Pipes	142
	Leak Parts	143
	Accessory Kit	144
	Cable Overview	146
	Analog Cables	148
	Remote Cables	151
	BCD Cables	155
	Auxiliary Cable	157
	CAN Cable	158
	External Contact Cable	159
	RS-232 Cable Kit	160
6	Introduction to the Refractive Index Detector	161
	Introduction to the Refractive Index Detector	162
	How the Detector Operates	163
	Refractive Index Detection	163
	Detection Principle	166
	Flow Path	168
	Electrical Connections	173

Instrument Layout	175
Early Maintenance Feedback (EMF)	176
EMF Counters	176
Using the EMF Counters	176
Electronics	177
Detector Main Board (RIM)	178
Firmware Description	180
Data flow for chromatographic output	182
Optional Interface Boards	183
BCD Board	184
LAN Board	185
Interfaces	186
Analog Signal Output	187
GPIB Interface	187
CAN Interface	187
Remote Interface	187
RS-232C	189
Setting the 8-bit Configuration Switch	191
GPIB Default Addresses	192
Communication Settings for RS-232C Communication	193
Forced Cold Start Settings	194
Stay-Resident Settings	195
The Main Power Supply Assembly	196
7 Control Module Screens for the Agilent 1100 RI Detector	199
Major keys on the Agilent 1100 Control Module	200
Screens available from the Analysis screen	201
Screens available from the System screen	210
Screens available from the Records screen	213

Contents

	Diagnostics and Tests	218
8	Specifications	221
	Performance Specifications	222
A	Safety Information	225
	General Safety Information	226
	Lithium Batteries Information	229
	Radio Interference	230
	Sound Emission	231
	Solvent Information	232
	Agilent Technologies on Internet	234
	Index	235



1 Installing the Refractive Index Detector

Site Requirements	12
Physical Specifications	14
Unpacking the Detector	15
Optimizing the Stack Configuration	18
Installing the Detector	20
Flow Connections to the Detector	22



Site Requirements

Power Consideration

The detector power supply has wide ranging capabilities and accepts any line voltage in the range mentioned in [Table 1](#) on page 14. 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.

WARNING

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

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 14) allow 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 an 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 14.

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	17 kg (38 lbs)	
Dimensions (width × depth × height)	345 × 435 × 180 mm (13.5 × 17 × 7 inches)	
Line voltage	100 – 240 VAC, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz ± 5 %	
Power consumption	160 VA	Maximum
Ambient operating temperature	0 – 55 °C (32 – 131 °F)	
Ambient non-operating temperature	-40 – 70 °C (-4 – 158 °F)	
Rel. 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.

CAUTION

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

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
<i>Reference Manual</i>	1
Accessory kit (see Table 3)	1

1 Installing the Refractive Index Detector

Detector Accessory Kit Contents

Table 3 Accessory Kit Contents (Part Number G1362-68705)

Description	Part Number	Quantity
Interface tubing kit includes:	G1362-68706	1
Ferrule 1/8"	0100-1700	2
Nut 1/8" PPS	0100-1708	2
2 m Tubing flexible	0890-1760	2
Interfacing capillary, 400mm lg, 0.17mm i.d. includes:	G1362-87300	1
Hand tight fitting (reorder pack with 10 pcs.)	5062-8541	4
Restriction capillary, 3700mm lg, 0.17mm i.d. includes:	G1362-87301	1
CAN cable	5181-1516	1
PEEK adapter to pump's active inlet valve	0100-1847	1

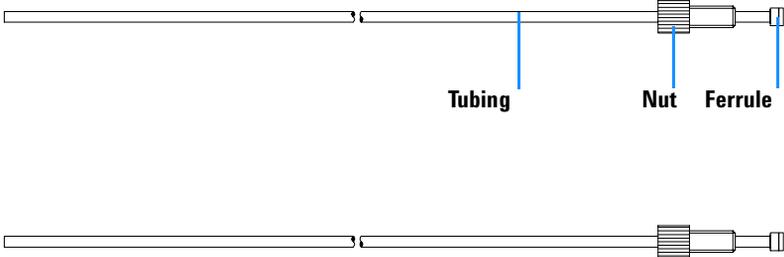


Figure 1 Interface tubing kit Parts

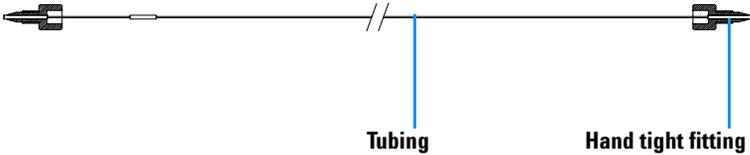


Figure 2 Interfacing Capillary Parts

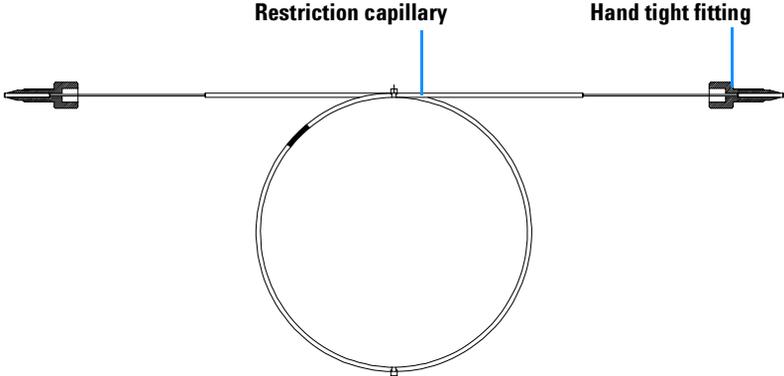


Figure 3 Restriction Capillary Parts

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.

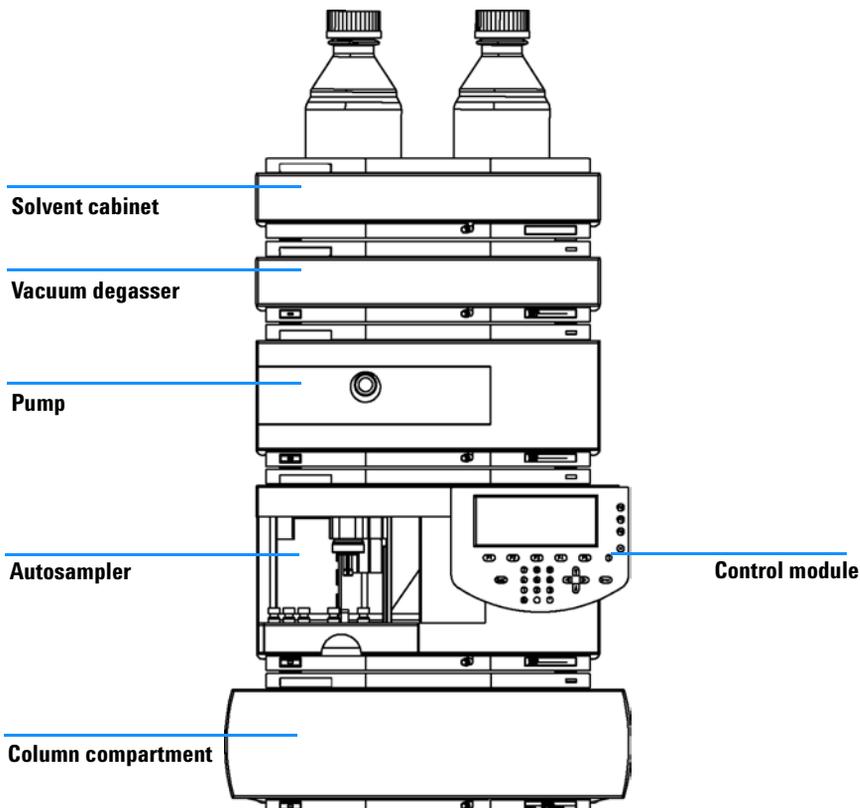


Figure 4 Recommended Stack Configuration (Front View)

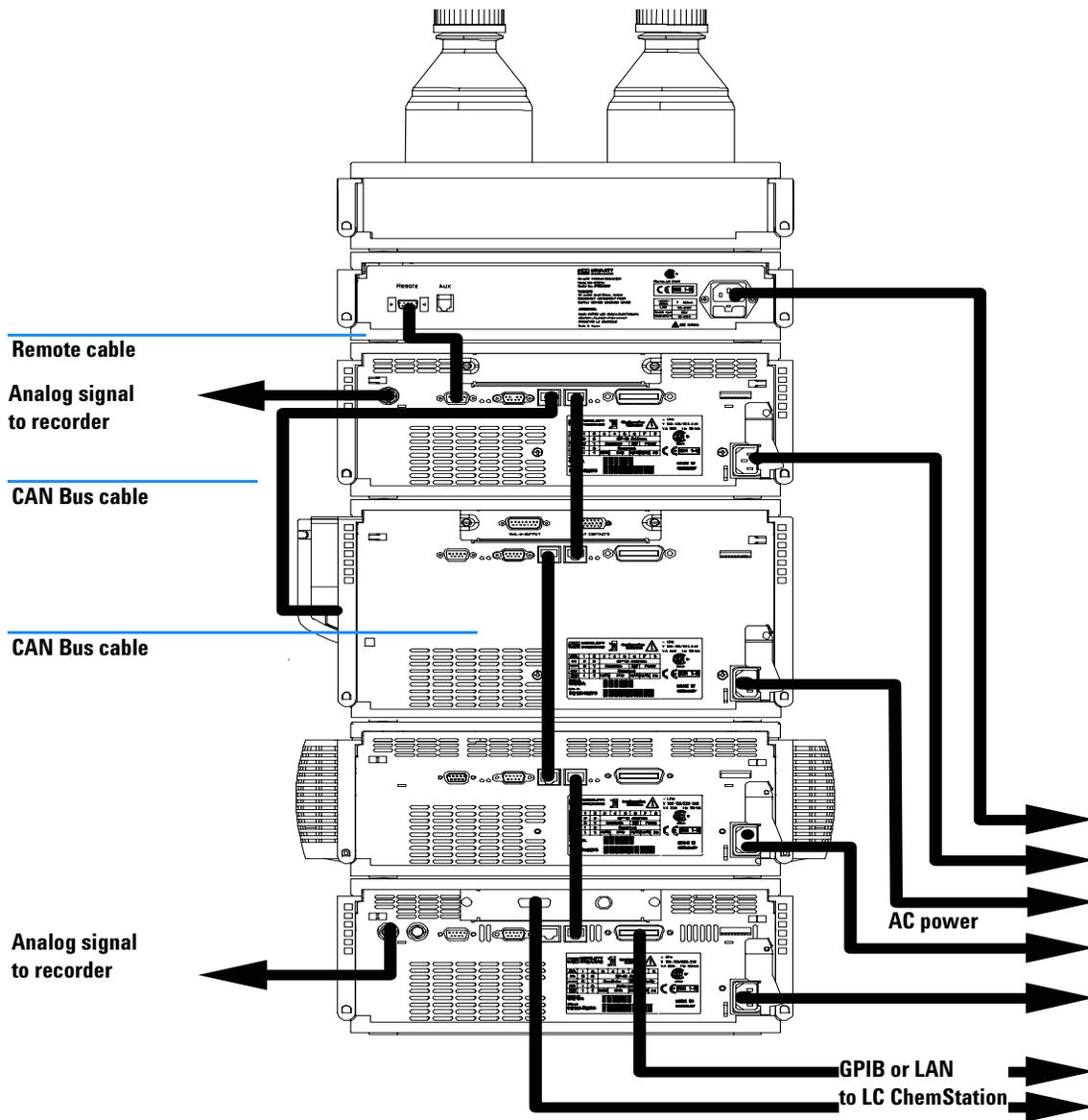


Figure 5 Recommended Stack Configuration (Rear View)

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 146.

- 1 Install the LAN interface board in the detector (if required), see “[Replacing the Interface Board](#)” on page 130.
- 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.

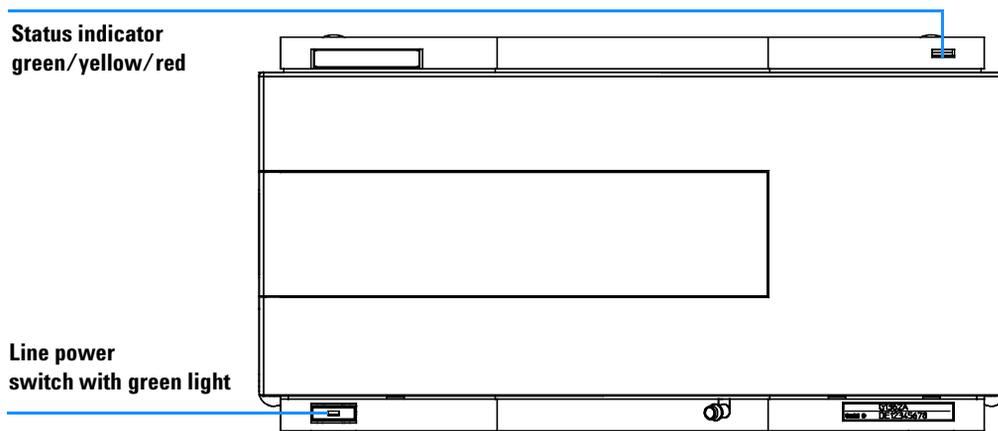


Figure 6 Front View of Detector

- 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.

- 7 Connect the analog cable (optional) for a chart recorder, integrator or other data collection device.
- 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.

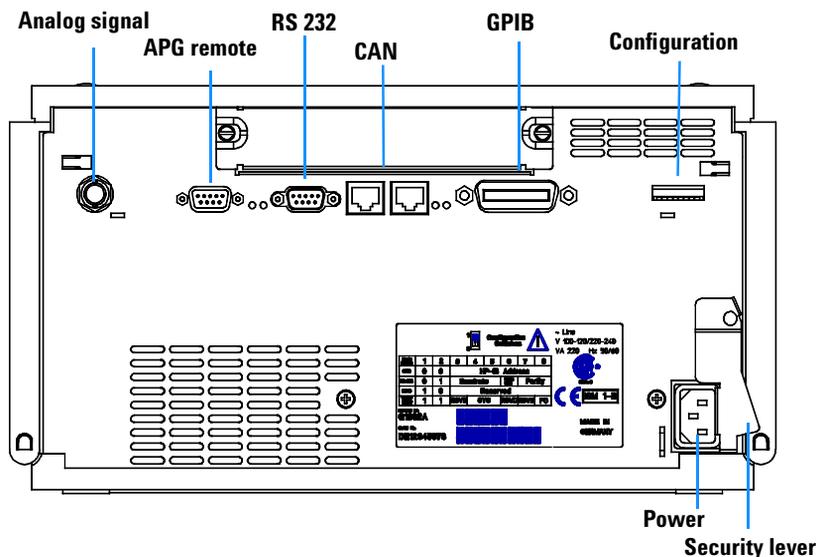


Figure 7 Rear View of Detector

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 191.

Flow Connections to the Detector

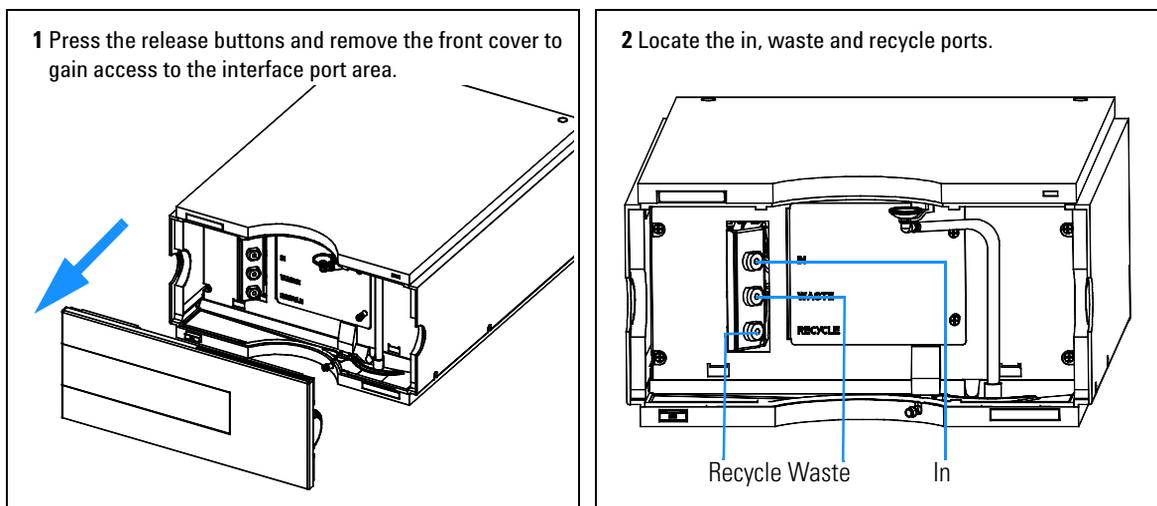
Preparations	Detector is installed in the LC system.
Parts required	Other modules Interface tubing kit G1362-68706 Interfacing capillary G1362-87300 see “ Detector Accessory Kit Contents ” on page 16.

WARNING

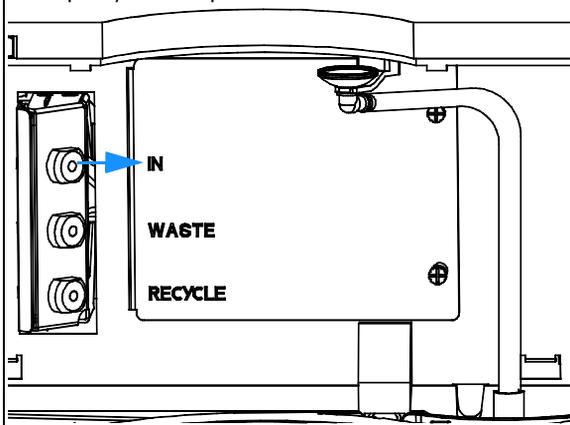
When working with solvents please observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.

NOTE

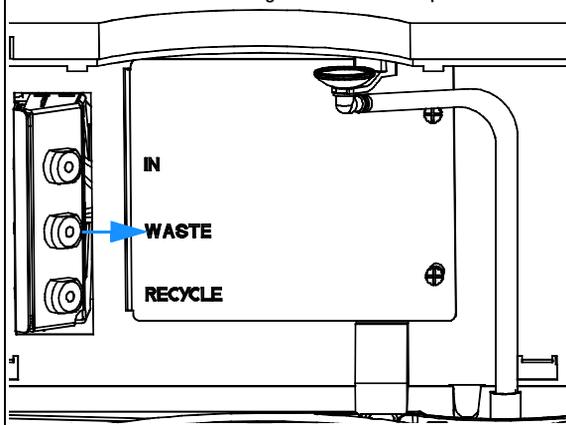
The flow cell is shipped with a filling of isopropanol (also recommended when the instrument and/or flow cell is shipped to another location). This is to avoid breakage due to subambient conditions.



3 Remove the blanking plug and connect the interfacing capillary to the in port.



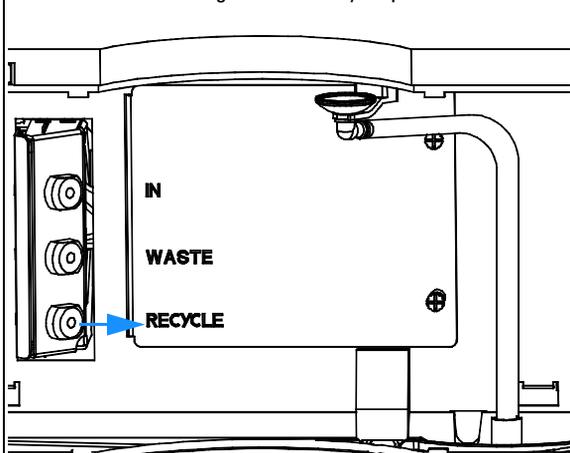
4 Remove the blanking plug and connect one of the tubes from the interface tubing kit to the waste port.



NOTE

The back pressure rating of the refractive index flow cell is 5 bar. Therefore the RI detector must be the last module in the flow system. If an additional detector is to be installed it must be connected before the refractive index detector in order to avoid damage to the RID flow cell due to overpressure.

5 Remove the blanking plug and connect the other tube from the interface tubing kit to the recycle port.



NOTE

Remove all blanking plugs from all outlet ports (waste & recycle) of the detector to avoid potential damage to the flow cell, if the recycle valve is accidentally switched to one of these ports, while flow is applied to the detector.

1 Installing the Refractive Index Detector

6 Direct the waste tube into a suitable waste container. Make sure that there is no restriction of this tube.

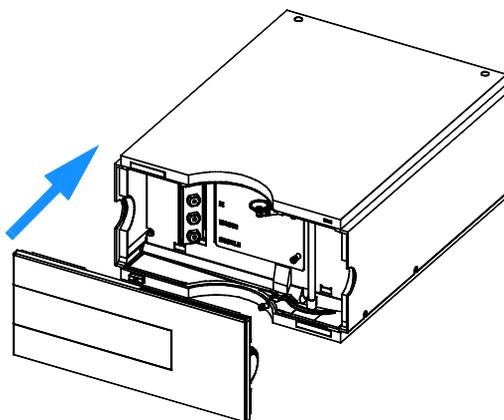
7 If solvent recycling is to be used direct the recycle tube into the solvent bottle. Make sure that there is no restriction of this tube.

NOTE

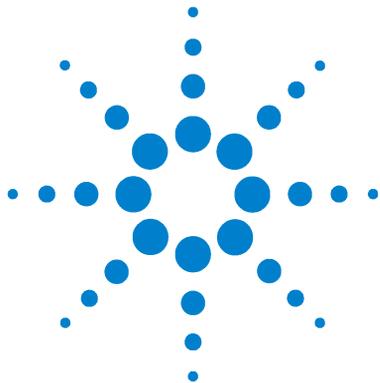
To optimize detector performance the waste container and solvent bottle should be positioned above the level of the refractive index detector and solvent pump. This will maintain a *slight* pressure in the sample cell. Route the tubing behind the front covers of the Agilent 1100 Series modules in the stack.

8 Establish flow and observe if leaks occur.

9 Replace the front cover.



The installation of the detector is now complete.



2 Optimizing the Refractive Index Detector

Refractive index detector optimization 26

Running a check out sample 29

Checking baseline noise and drift 33



Refractive index detector optimization

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

1 Position the solvent and waste reservoirs correctly

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

2 Do not overpressurize the flow cell

Be aware to not exceed a 5 bar pressure drop after the flow cell when hooking up additional devices like other detectors or a fraction collector. If an additional detector is installed place it before the G1362A refractive index detector.

3 Use the correct solvents

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

4 Check for leaks

Leaks within the LC instrument that the refractive index detector is connected to will cause problems with baseline long term noise or drift. Confirm that the instrument is free from leaks by performing the Agilent 1100 Series diagnostic pressure test. Ensure that the connections from the on-line vacuum degasser to the pump and the detector inlet, waste and recycle connections are air tight.

5 Verify frit, filter and fitting quality

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

6 Control the optical unit temperature

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

7 Use an appropriate response time

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

8 Recycle mobile phase

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

9 Consider using a degasser

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

10 Flush the degasser

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

11 Use pre-mixed solvents, only

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

12 Consider solvent changes with time

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

13 Eliminate mobile phase/column combination problems

2 Optimizing the Refractive Index Detector

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

Running a check out sample

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

When required	If you want to checkout the detector
Hardware required	LC system with G1362A RID
Parts required	Zorbax Eclipse XDB C8, 150mm x 4.6mm i.d. (Part number 993967-906 or 5063-6600) Agilent isocratic checkout sample (Part number 01080-68704)

Starting Your Detector

- 1 Turn on the detector.
- 2 You are now ready to change the settings of your detector.

Setting the Chromatographic Conditions

- 1 Set up the instrument with the following chromatographic conditions.

Table 4 Chromatographic Conditions

Mobile phases	35% Water, 65% Acetonitrile
Column	Zorbax Eclipse XDB C8, 150mm x 4.6mm i.d.
Sample	Isocratic standard sample
Flow rate	1.5 ml/min
Stroke A	20 μ l
Stop time	10 minutes
Injection volume	20 μ l

2 Optimizing the Refractive Index Detector

Table 4 Chromatographic Conditions (continued)

Column compartment temperature	25 ° C
Optical unit Temperature	35 ° C
Polarity	Positive
Peak Width (Response time)	0.2 minutes (4 seconds, standard)

2 Set the RID setpoints according to [Figure 8](#).

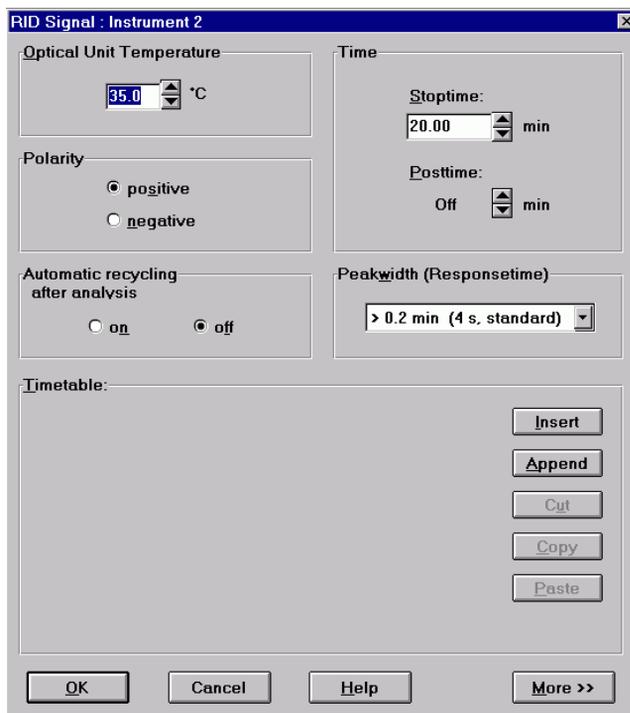


Figure 8 RID Check Out Sample Parameters

- 3 Turn the heater on and purge the detector reference cell for 20 minutes as shown in Figure 9:

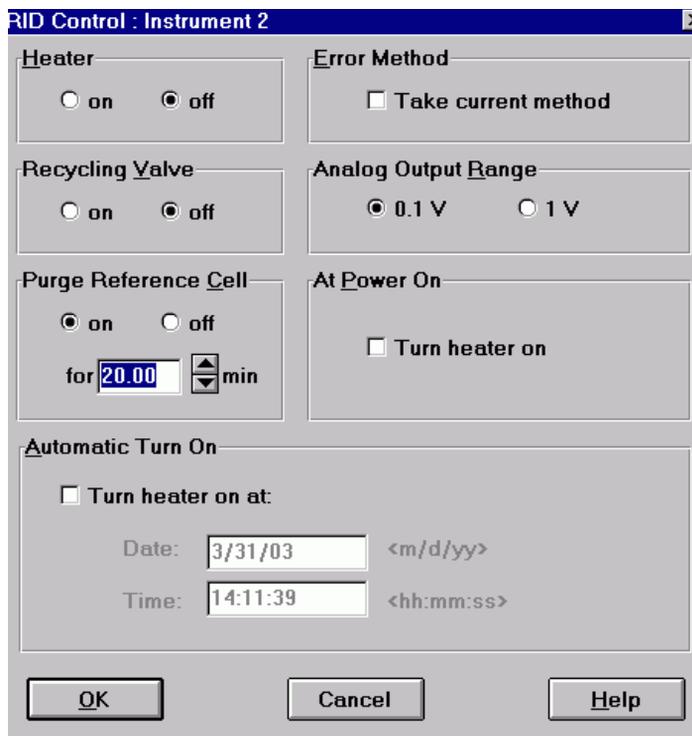


Figure 9 RID Check Out Sample Control

- 4 When purging has finished allow the baseline to stabilize and start the analysis.
- 5 If you are using the Control Module in place of the Agilent ChemStation enter the *Plot* function and select *Ref.Index*, set a *time range* of 10 minutes and the *RID signal* from -4000 to 40000 nRIU.

2 Optimizing the Refractive Index Detector

NOTE

The resulting chromatogram should only be seen as a qualitative example, the checkout procedure is not meant as a quantitative procedure. Its intent is only to verify the presence of the for peaks from the checkout sample - nothing more.

Please be aware of the large negative air / solvent peak from the injection (cut out from the bottom of the following figure) prior to the first peak of interest. This is to be expected in a regular chromatogram, especially if a non-degassed sample is injected into degassed solvent and the sample solvent properties don't perfectly match with the mobile phase properties. Only similar zooming factors in the display of a chromatogram will lead to similar looking results.

The resulting chromatogram is shown in [Figure 10](#):

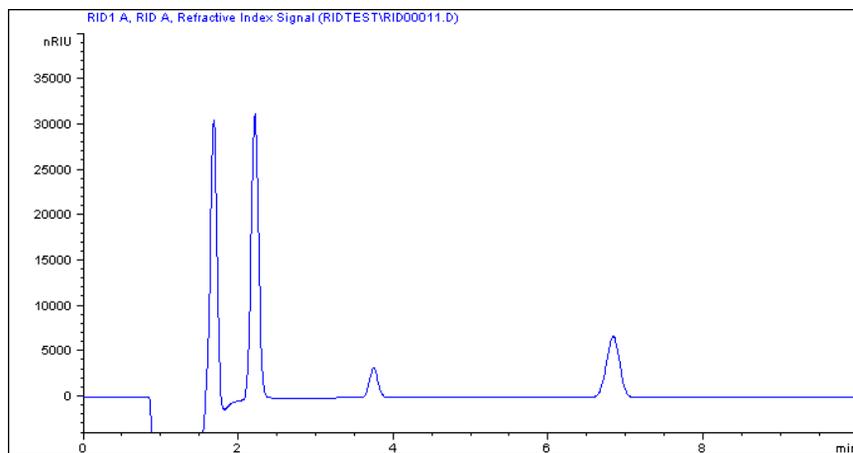


Figure 10 Isocratic Standard Sample Chromatogram

Checking baseline noise and drift

This chapter describes checking the baseline noise and drift for the Agilent 1100 series refractive index detector.

When required	If you want to checkout the detector
Hardware required	LC system with G1362A RID
Parts required	Restriction capillary (Part number G1362-87301)

Starting Your Detector

- 1 Turn on the detector.
- 2 You are now ready to change the settings of your detector.
Ideally, you should simply load the method oqnois2.m and sequence oqnois2.s from the HPCHEM\Methods\oqpv and HPCHEM\Sequence\oqpc directories.

Setting the Test Conditions

- 1 Connect the restriction capillary directly between the column compartment heat exchanger outlet and the in port of the detector.
- 2 .Set up the instrument with the following test conditions.

Table 5 Chromatographic Conditions (use method oqnois2.m and sequence oqnois2.s from the HPCHEM\Methods\oqpv and HPCHEM\Sequence\oqpc directories)

Mobile phases	LC grade water
Column	Restriction capillary 2.7m x 0.17mm i.d.
Flow rate	1.0 ml/min
Compressibility	46
Stroke	20 µl
Stop time	20 minutes
Column compartment temperature	40 ° C
Optical unit Temperature	40 ° C
Polarity	Positive
Peak Width (Response time)	0.2 minutes (4 seconds, standard)

- 3 Set the RID setpoints according to [Figure 11](#).

NOTE

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

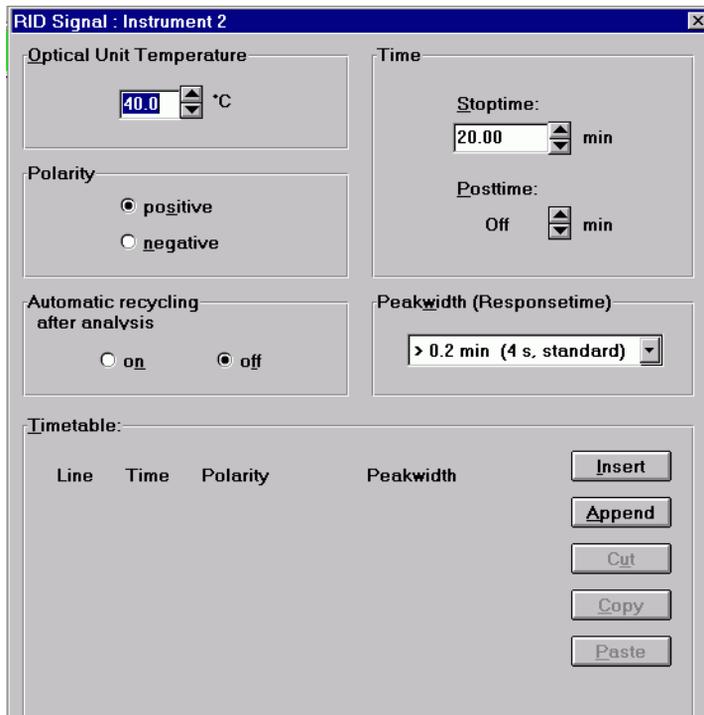


Figure 11 RID Baseline Check Parameters

NOTE

The Agilent ChemStation can automatically calculate the baseline short term noise, long term noise (wander) and drift. Follow steps 4 to 9.

NOTE

If you are not using the Agilent ChemStation go to step 10.

- 4 Edit the Agilent ChemStation method (*Method and Run Control- Method Edit Entire Method*).
- 5 Specify the report style Performance + Noise as shown in [Figure 12](#)

2 Optimizing the Refractive Index Detector

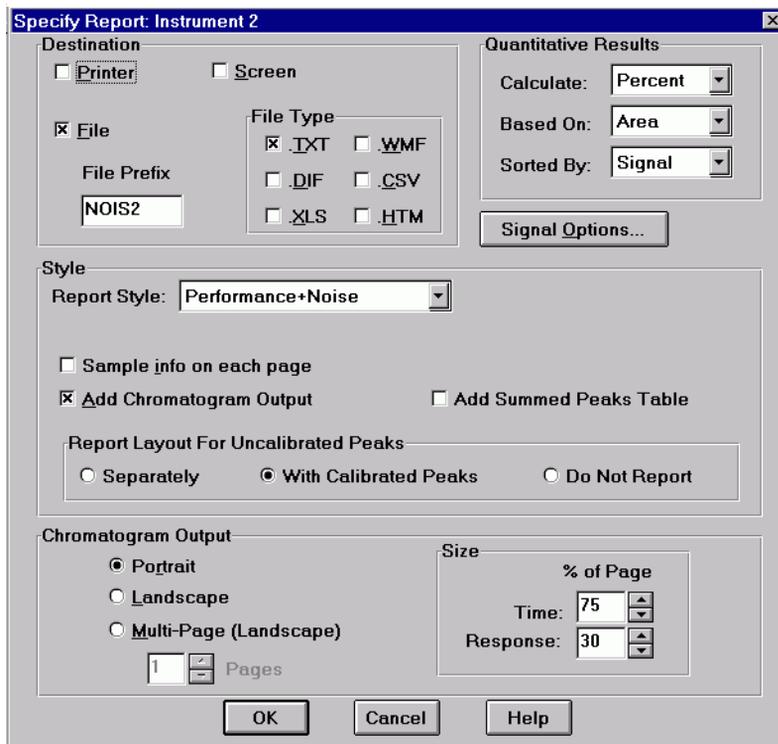


Figure 12 RID Baseline Check Out Report

- 6 Set the noise determination time range to 0 - 20 minutes as shown in [Figure 13](#):

Noise Determination: Instrument 2

Time ranges for noise determination:

from:	<input type="text" value="0"/>	to:	<input type="text" value="20"/>	min.
from:	<input type="text"/>	to:	<input type="text"/>	min.
from:	<input type="text"/>	to:	<input type="text"/>	min.
from:	<input type="text"/>	to:	<input type="text"/>	min.
from:	<input type="text"/>	to:	<input type="text"/>	min.
from:	<input type="text"/>	to:	<input type="text"/>	min.
from:	<input type="text"/>	to:	<input type="text"/>	min.

Ok Cancel

Figure 13 RID Baseline Check Out Noise Ranges

7 Save the Agilent ChemStation method.

2 Optimizing the Refractive Index Detector

- Turn the heater on and purge the detector reference cell for 20 minutes as shown in Figure 14:

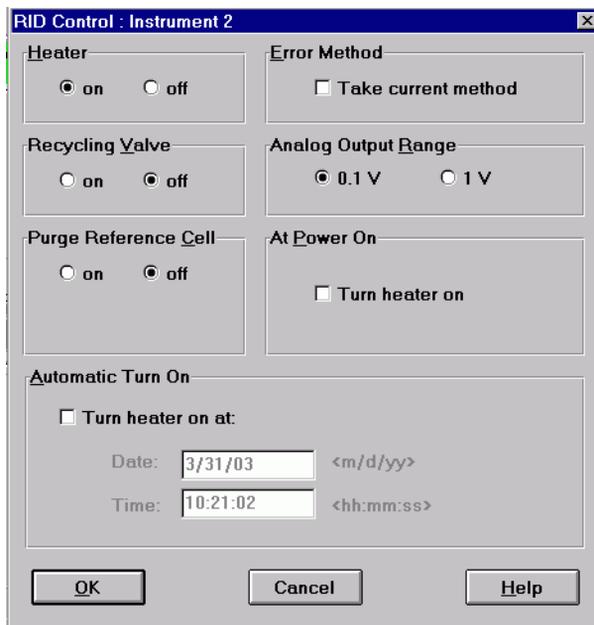


Figure 14 RID Baseline Check Control

- When purging has finished allow the baseline to stabilize and start the sequence (blank run - no injection).
- If you are using the Control Module in place of the Agilent ChemStation enter the *Plot* function and select *Ref.Index*, set a *time range* of 20 minutes and the *RID signal* from -200 to 200 nRIU.

11 The Agilent ChemStation report is shown in Figure 15:

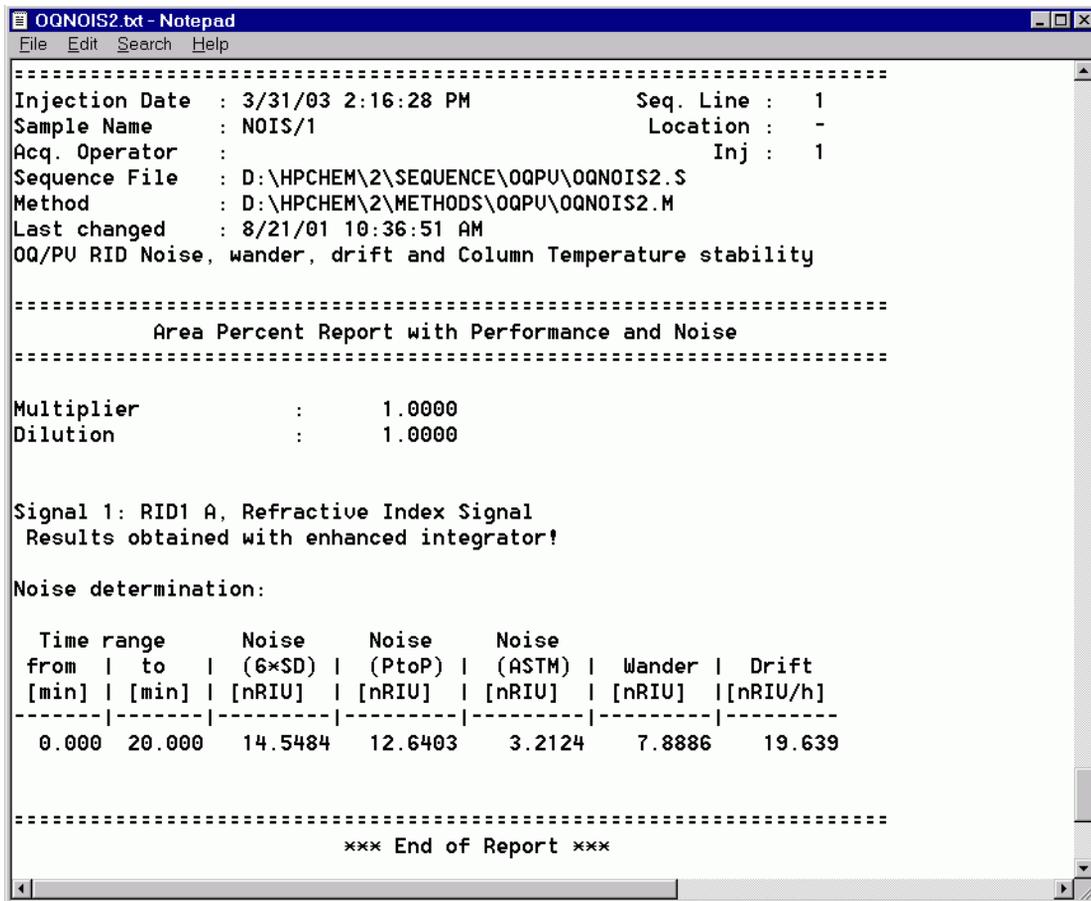


Figure 15 Baseline Check Out Results

Evaluation

For the Control Module *Rescale* the plot and measure the baseline noise and drift on the screen. If a printer is configured for the Agilent 1100 Series instrument the plot can be printed by pressing the m key and selecting *Print Plot*.

The following values are calculated automatically by the Agilent ChemStation.

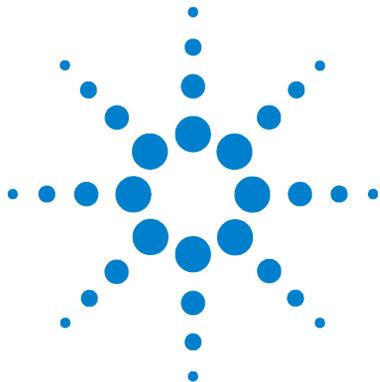
- **Noise (ASTM):** The short term noise in nRIU based on ASTM method E-1303-95 “Practice for Refractive Index Detectors used in Liquid Chromatography” using 0.5 minute segments.
- **Wander:** The long term noise in nRIU based on ASTM method E-1303-95 “Practice for Refractive Index Detectors used in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

NOTE

Factors that will affect the baseline stability include;

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

See “[Refractive index detector optimization](#)” on page 26.



3 Troubleshooting and Test Functions

Overview of the Detector's Indicators and Test Functions	42
Status Indicators	43
Error Messages	45
Not-Ready Messages	71
Refractive Index Calibration	77
Optical Balance	82
Using the Built-in Test Chromatogram	85
Using the Built-in DAC Test	88



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 ready, not-ready, run, and error states) of the detector. The status indicators provide a quick visual check of the operation of the detector (see [“Status Indicators”](#) on page 43).

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 45).

Not-Ready Messages

During the wait for a specific condition to be reached or completed the detector will generate a not-ready message. For each message a short description is provided (see [“Not-Ready Messages”](#) on page 71).

Refractive Index Calibration

Refractive index calibration is recommended after exchange of the optical unit to ensure correct operation of the detector. The procedure uses a solution of known refractive index compared to LC grade water (see [“Refractive Index Calibration”](#) on page 77).

Optical Balance

Optical balance allows the balance of light falling on the light receiving diodes to be restored. The sample and reference cells must both be fully purged before the procedure is started, see [“Optical Balance”](#) on page 82).

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.

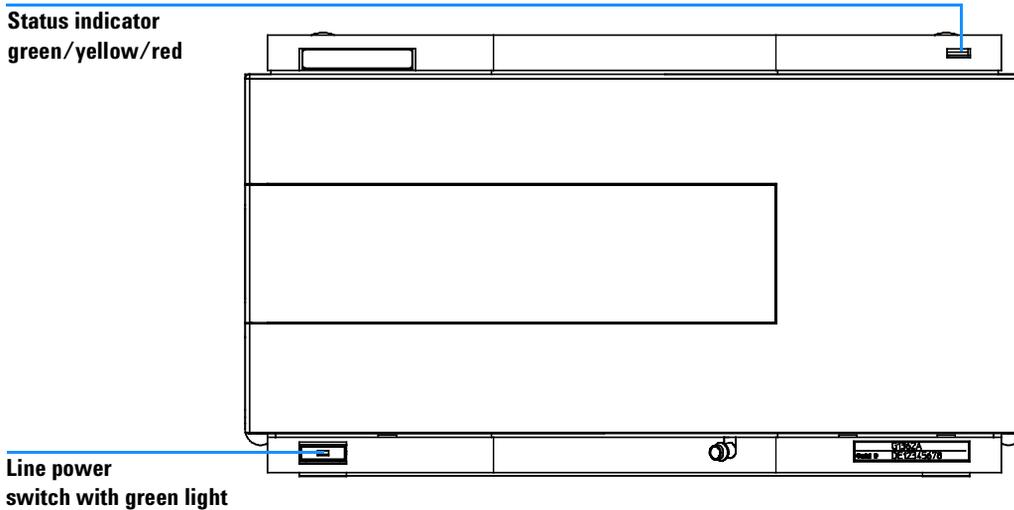


Figure 16 Location of Status Indicators

Power Supply Indicator

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

Detector Status Indicator

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

3 Troubleshooting and Test Functions

- 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 operating in a running analysis.
- 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 set point.
- 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 RIM board.

Probable Causes

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

Suggested Actions

- ✓ Ensure all fittings are tight.
- ✓ Exchange defective capillaries.
- ✓ Exchange valve.
- ✓ Exchange optical unit.

NOTE

Make sure the leak sensor area is dry before restarting the instrument.

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 RIM 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 RIM board in the detector has failed (open circuit).

The resistance across the temperature compensation sensor (NTC) on the RIM 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 RIM board.

Suggested Actions

- ✓ Exchange the RIM board.

Compensation Sensor Short

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

The resistance across the temperature compensation sensor (NTC) on the RIM 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 RIM board.

Suggested Actions

- ✓ Exchange the RIM board.

Fan Failed

The cooling fan in the detector has failed.

The hall sensor on the fan shaft is used by the RIM 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 RIM board.

Suggested Actions

- ✓ Ensure the fan is connected correctly.
- ✓ Exchange fan.
- ✓ Exchange the RIM board.

Thermal Fuse Open

The thermal fuse of the optical unit heater has failed.

Probable Causes

- Heater cable disconnected.
- Defective thermal fuse.
- Defective RIM board.

Suggested Actions

- ✓ Ensure the heater cable is connected correctly.
- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Heater Resistance Too High

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

Probable Causes

- Heater cable disconnected.
- Defective heater.
- Defective RIM board.

Suggested Actions

- ✓ Ensure the heater cable is connected correctly.
- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Heater Fuse

The electronic fuse of the heater has been activated.

Probable Causes

- Short in heater circuit.
- Defective heater.
- Defective RIM board.

Suggested Actions

- ✓ Powercycle the detector.
- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Wrong Temperature Profile

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

Probable Causes

- Defective heater.
- Defective RIM board.

Suggested Actions

- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Undecipherable Temperature Signal

Probable Causes

- Heater cable disconnected.
- Defective or disconnected sensor.
- Defective RIM board.

Suggested Actions

- ✓ Ensure the heater cable is connected correctly.
- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Maximum Temperature Exceeded

The maximum heater temperature has been exceeded.

Probable Causes

- Defective heater.
- Defective RIM board.

Suggested Actions

- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Purge Valve Fuse Blown

The electronic fuse on the purge valve has been activated.

Probable Causes

- Short in purge valve circuit.
- Defective purge valve.
- Defective RIM board.

Suggested Actions

- ✓ Power cycle the module.
- ✓ Replace purge valve.
- ✓ Exchange the RIM board.

Recycle Valve Fuse Blown

The electronic fuse on the recycle valve has been activated.

Probable Causes

- Short in recycle valve circuit.
- Defective recycle valve.
- Defective RIM board.

Suggested Actions

- ✓ Power cycle the module.
- ✓ Replace recycle valve.
- ✓ Exchange the RIM board.

Purge Valve Not Connected

When activated no response was received from the purge valve.

Probable Causes

- Purge valve disconnected.
- Defective purge valve.
- Defective RIM board.

Suggested Actions

- ✓ Connect purge valve.
- ✓ Replace purge valve.
- ✓ Exchange the RIM board.

Recycle Valve Missing

When activated no response was received from the recycle valve.

Probable Causes

- Recycle valve disconnected.
- Defective recycle valve.
- Defective RIM board.

Suggested Actions

- ✓ Connect recycle Valve.
- ✓ Replace recycle valve.
- ✓ Exchange the RIM board.

Lamp Voltage too High

Probable Causes

- Contaminated flow cell.
- Defective lamp or optics.
- Defective RIM board.

Suggested Actions

- ✓ Flush the flow cell.
- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Lamp Current too High

Probable Causes

- Defective lamp.
- Defective RIM board.

Suggested Actions

- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Lamp Voltage too Low

Probable Causes

- Defective lamp.
- Defective RIM board.

Suggested Actions

- ✓ Exchange optical unit.
- ✓ Exchange the RIM board.

Lamp Current too Low

Probable Causes

- Optical unit cable disconnected.
- Defective lamp.
- Defective RIM board.

Suggested Actions

- ✓ Connect optical unit cable.
- ✓ Exchange optical unit.
- ✓ Exchange RIM board.

Wait Function Timed Out

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

Not-Ready Messages

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

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

Purge Time Running

Meaning

- The purge valve is open, liquid is flowing through both sample and reference cell.

Suggested Actions

- ✓ Allow the reference purge time to elapse.

Wait for Purge

Meaning

- The detector is waiting after the automatic purge of the reference cell.

Suggested Actions

- ✓ Allow the wait time to elapse.

Unbalanced Diodes

Meaning

- The diode balance value is outside the pre-set range -0.5 to + 0.5, an unequal amount of light is falling on the two light receiving diodes.

Suggested Actions

- ✓ Flush the reference cell with the mobile phase being used.
- ✓ Perform the RID Optical Balance procedure (see “[Optical Balance](#)” on page 82).

Not Enough Light

Meaning

- There is insufficient light falling on the light receiving diodes to generate a refractive index signal.

Suggested Actions

- ✓ Flush the flow cell with the mobile phase being used to ensure that it is free of air bubbles or other contamination.

Too Much Light

Meaning

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

Refractive Index Calibration

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

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

NOTE

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

The Refractive Index Calibration Procedure

When required	Recommended after exchange of the optical unit or RIM board.
Tools required	Laboratory balance
Parts required	DAB/Ph Eur/BP/JP/NF/USP Grade Sucrose Syringe 9301-1446 Syringe needle 9301-0407 Sample filter 5061-3367 PEEK fitting 0100-1516

Steps

- 1 Preparation of the Sucrose calibration solution.
- 2 Preparing the pump.
- 3 Start Refractive Index Calibration.
- 4 Flushing the degasser and pump.
- 5 Purging the sample and reference cells.
- 6 Fill the sample cell with calibration solution.
- 7 Calibrate Refractive Index.

Preparation of the Sucrose sucrose Calibration Solution

- 1 To prepare 25 ml of the calibration solution 87.5 mg of the Sucrose sample is required.
- 2 Add the weighed amount of sample into a suitable volumetric flask.
- 3 Dispense 10 ml of LC grade water into the flask and shake to dissolve.
- 4 Dilute the contents of the flask to volume with LC grade water.
Wait five minutes and shake again. The solution is now ready for use.

Preparation of the Pump

- 1 Fill a suitable solvent bottle with LC grade water.
- 2 Connect this bottle to Channel A of the pump, A1 if a binary pump.

Start Refractive Index Calibration

- 1 From the user interface start the RID Calibration (see [Figure 17](#)).
 Agilent ChemStation: *Diagnosis - Maintenance - RID Calibration*
 Control Module: *System - Tests - RID - Calibrate*.
- 2 Follow the instructions with reference to the steps below.

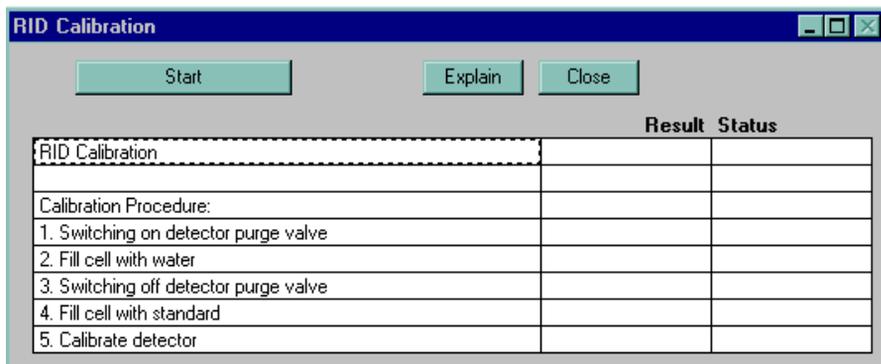


Figure 17 Start Refractive Index Calibration

Purging the Sample and Reference Cells

- 1 The purge valve will automatically switch to the On position.
- 2 Using a syringe or LC pump flush the sample and reference cell with about 20 ml of LC grade water.
- 3 Click continue and the purge valve will automatically switch to the Off position.

Fill the Sample Cell with Calibration Solution

- 1 Remove the inlet capillary or flushing syringe from the in port.
- 2 Take the syringe and fix the needle to the syringe adapter.
- 3 Suck about 1.5 ml of the calibration sample into the syringe.
- 4 Keep the syringe in a horizontal position.
- 5 Remove the needle.
- 6 Add the filter to the syringe and fit the needle to filter.

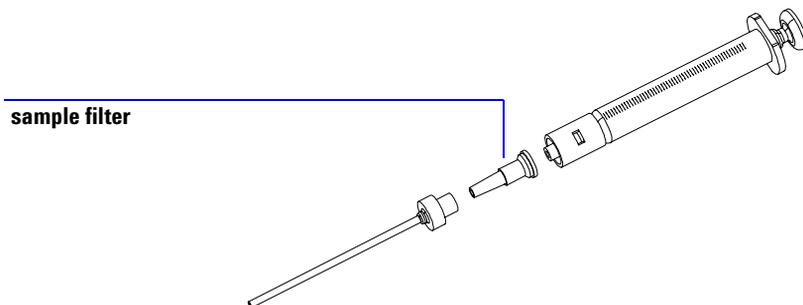


Figure 18 Syringe with Sample Filter

- 7 Lift the needle tip and carefully eject approximately 0.5 ml to remove air out of the syringe and to flush the needle.
- 8 Add the PEEK fitting to the needle tip and fix both at the flow cell inlet.

NOTE

Do not inject the calibration solution without the sample filter.

- 9 Slowly inject about 1.0 ml and wait for about 10 seconds to inject another 0.1 ml. This will assure that the cell is filled properly.

Calibrate Refractive Index

- 1 If the detector response differs from the theoretical response of 512,000 nRIU +/- 5,000 nRIU enter the theoretical value (512,000) in the dialog box. If the detector response is within the theoretical response click *OK* (see [Figure 19](#)).

NOTE

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

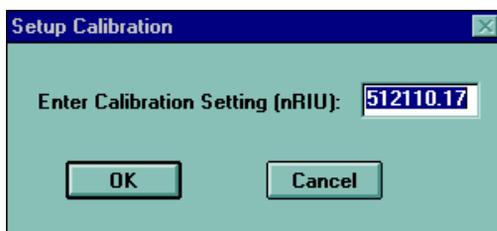


Figure 19 Calibrate Refractive Index

Optical Balance

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

Diode balance is calculated as follows;

Diode Balance

$$diodebalance = \frac{(diode1 - diode2)}{(diode1 + diode2)}$$

Where:

diode1 = signal proportional to the amount of light falling on diode 1

diode2 = signal proportional to the amount of light falling on diode 2

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

NOTE

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

NOTE

Both sample and reference cell must be purged with the same solvent before optical balance is performed.

The Optical Balance Procedure

When required	When light falling on light receiving diodes is out of balance.
Tools required	Flat-head screwdriver.
Parts required	None.

Steps

- 1 Purging the sample and reference cells.
- 2 Start optical balance.
- 3 Adjust optical balance.

Purging the Sample and Reference Cells

- 1 Switch the purge valve to the On position.
- 2 Purge the sample and reference cells for around 10 minutes with the solvents to be used.
- 3 Switch the purge valve to the Off position

Start Optical Balance

- 1 From the user interface start the RID optical balance (see [Figure 20](#)).
 Agilent ChemStation: *Diagnosis - Maintenance - RID Optical Balance*
 Control Module: *Analysis(RID) - m - Status*

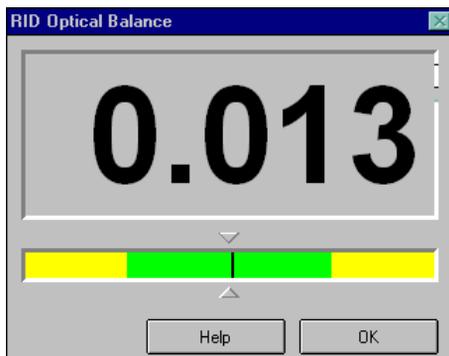


Figure 20 Optical Balance

Adjust Optical Balance

- 1 While monitoring the optical balance use the flat-headed screwdriver to turn the zero glass adjustment screw slowly (see [Figure 21](#)).
- 2 When the diode balance value reaches 0.00 optical balance is restored.

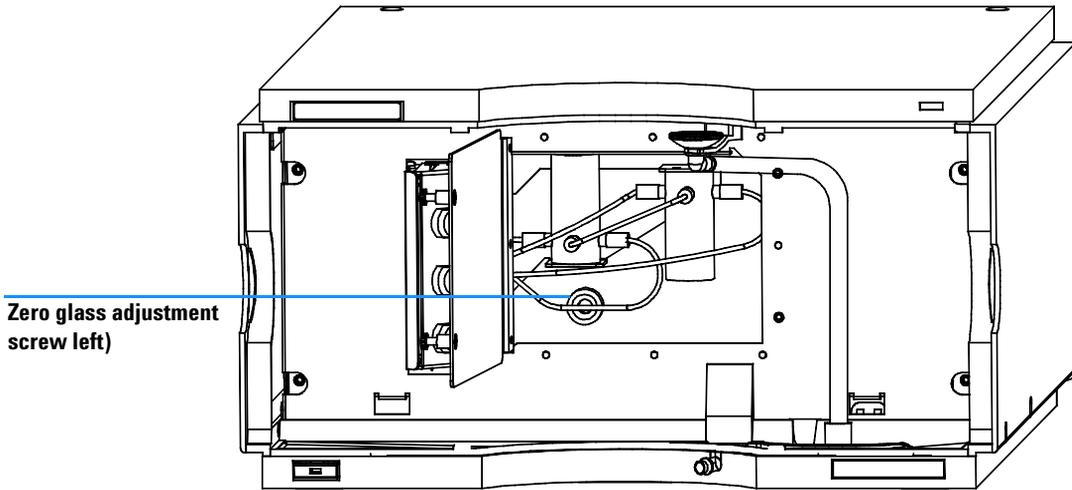


Figure 21 Turning the zero glass adjustment screw

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 22](#). The chromatogram is continuously repeated until a stop is executed either by means of a stop time or manually.

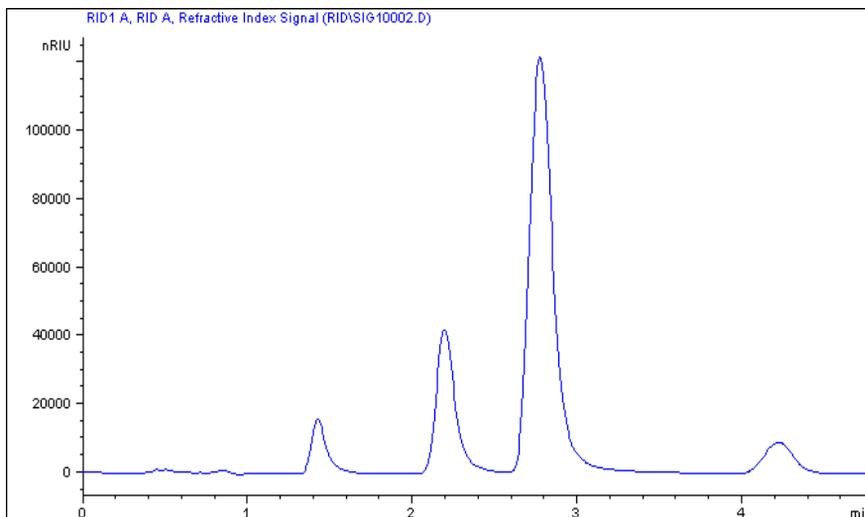


Figure 22 Built-in Test Chromatogram (default settings)

NOTE

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

Table 6

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 RID default parameter
 - peakwidth to >0.2 minutes (standard),
 - set stop time to 4.8 minutes.
- 2 Complete the Sample Information (blank run - no injection).
- 3 Type into the command line (or as pre-run command):
`PRINT SENDMODULE$(LRID,"SIMU:DFLT").`
- 4 The logbook shows "Preparing for a simulation".
- 5 Start the run.

The results are processed like a normal chromatogram.

NOTE

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

Procedure using the Control Module

- 1 Load the RID default parameter
 - peakwidth to >0.2 minutes (standard),
 - set stop time to 4.8 minutes.
- 2 Enter System - *Tests - RI Detector*.
- 3 Select the function *Default test chromatogram* and press *Execute*.
The logbook shows “Simulated chromatogram enabled”.
- 4 Enter the *Plot* function and select *Ref.Index*, set a *time range* of 4.80 minutes and the *RID signal* from -5000 to 125000 nRIU.

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 analysis (blank run - no injection).

After the run has finished, the plot can be output to a printer connected to the Agilent 1100 Series instrument by pressing the m-key and selecting *Print Plot*.

NOTE

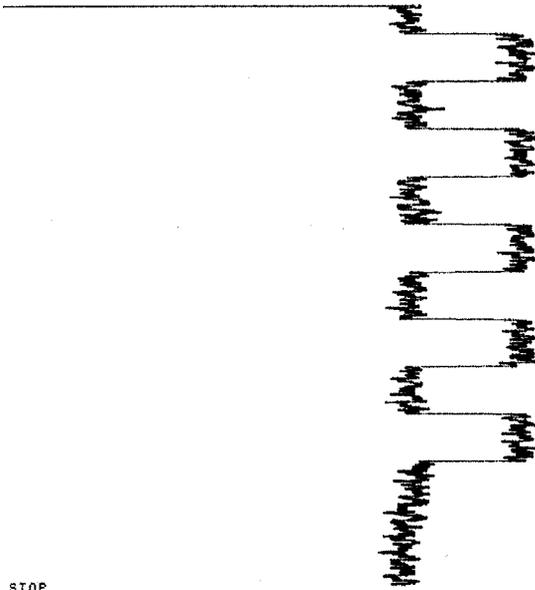
The test chromatogram is switched off automatically at the end of the run.

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 23](#).

```
* LIST: ZERO = 50, 51.614
* LIST: ATT 2^ = -4
* CHT SP 5 @
* PLOT
```

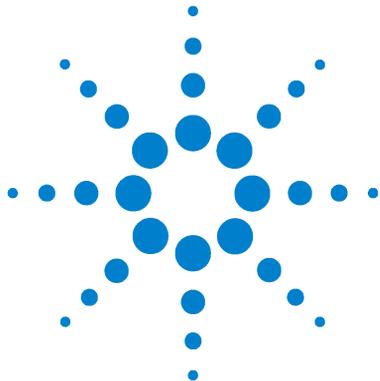


STOP

Figure 23 DAC Test (Example)

- 1 Enable the function (*System - Tests - RID - 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 - RID - Disable DAC Test Pattern*).
- 4 Evaluate the noise (should be < 5 μV).

3 Troubleshooting and Test Functions



4 Repairing the Refractive Index Detector

Introduction to the Repairing the Refractive Index Detector 92

Overview of the Repairing of the Refractive Index Detector 94

Simple Repairs 95

Exchanging Internal Parts 99



Introduction to the Repairing the Refractive Index Detector

Simple Repairs

The detector is designed for easy repair. The most frequent repairs such as flow cell flushing 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 95.

Exchanging Internal Parts

Some repairs may require exchange of defective internal parts. Exchange of these parts requires the removal of 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 99.

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.

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 of another Agilent 1100 Series module) when handling electronic boards and components (see “[Using the ESD Strap](#)” on page 93).

CAUTION

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

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 of other Agilent 1100 Series modules 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.

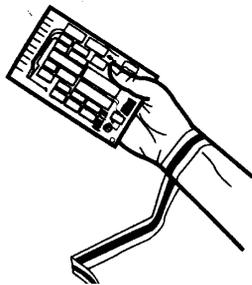


Figure 24 Using the ESD Strap

Overview of the Repairing of the Refractive Index Detector

Figure 25 shows the main assemblies and their locations.

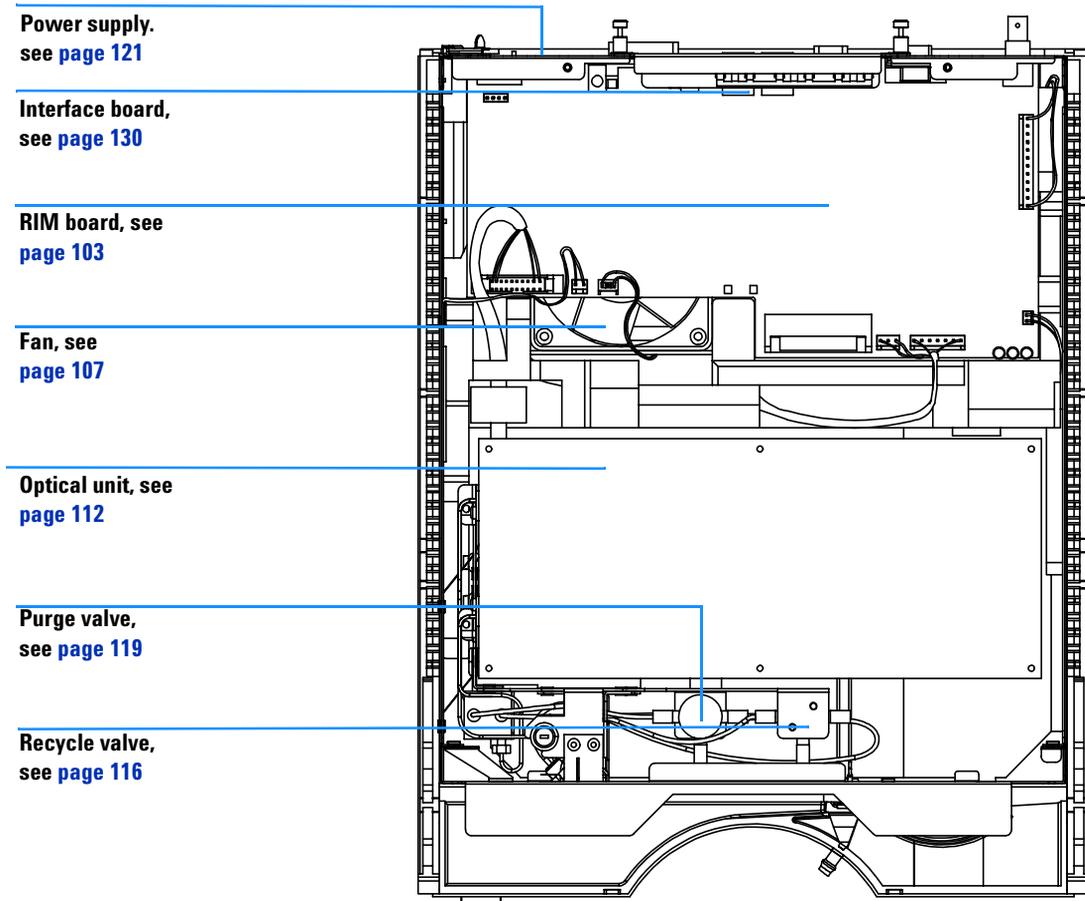


Figure 25 Main Assemblies

Simple Repairs

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

Table 7 Simple Repairs

Procedure	Typical Frequency	Notes
Flow cell flushing	If flow cell is contaminated.	
Leak sensor drying	If leak has occurred.	Check for leaks.
Leak handling System replacement	If broken or corroded.	Check for leaks.

Flow Cell Flushing

When required	If flow cell is contaminated
Tools required	Glass syringe, adapter
Parts required	Strong solvent, tubings to waste

NOTE

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

NOTE

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

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

Flushing Procedure

- 1 Flush with the strong solvent.
- 2 Leave this solution in the cell for about one hour.
- 3 Flush with mobile phase.

CAUTION

The strong solvent used may be dangerous and proper attention to safety should be given.

NOTE

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

Correcting Leaks

When required	If a leakage has occurred in the valve 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 Open the service door
- 3 Use tissue to dry the leak sensor area and the leak pan.
- 4 Observe the interface ports and the valve area for leaks and correct, if required.
- 5 Close the service door.
- 6 Replace the front cover.

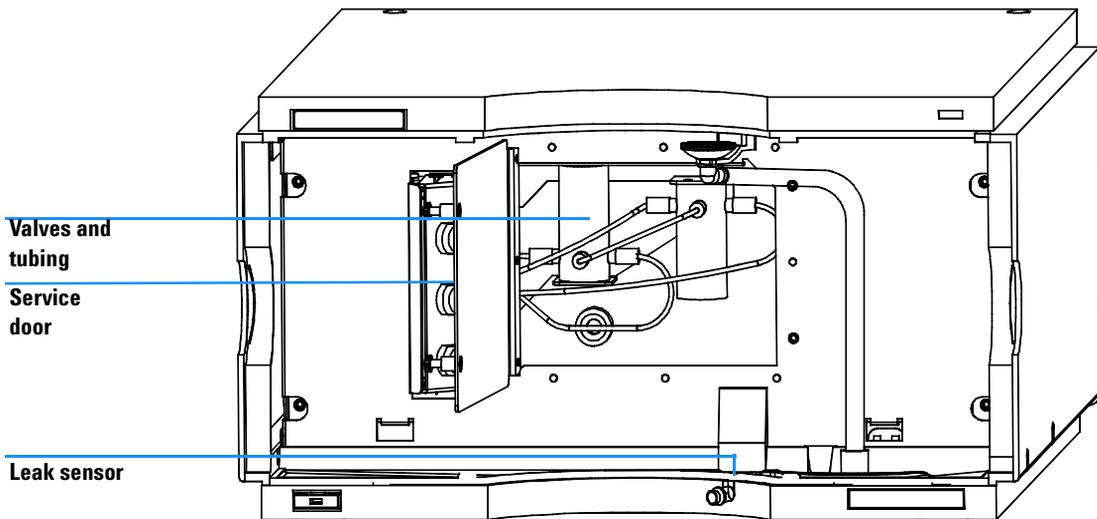


Figure 26 Observing for Leaks

Replacing Leak Handling System Parts

When required	If the parts are corroded or broken
Tools required	None
Parts required	Leak funnel 5061-8388 Leak funnel holder 5041-8389 Leak tubing (120mm) 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.

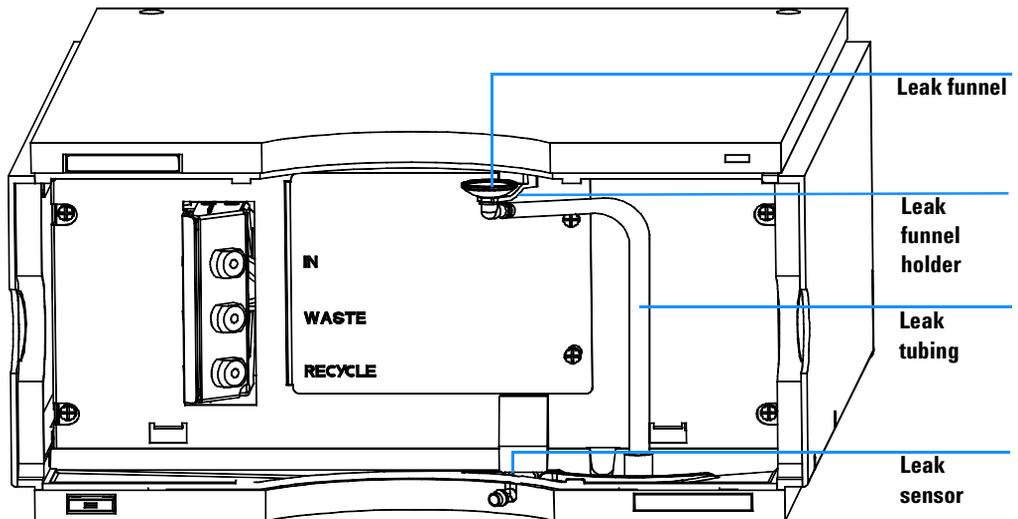


Figure 27 Replacing Leak Handling System Parts

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.

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”](#) on page 93.

Removing the Covers

When required	For all repairs inside the detector
Tools required	Screwdriver POZI 1 PT3
Parts required	Depends on the repairs to be done

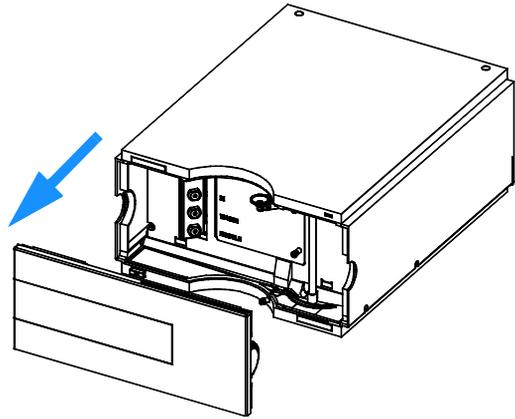
CAUTION

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

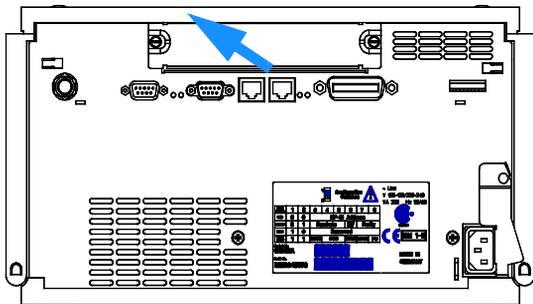
Preparations for this procedure:

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

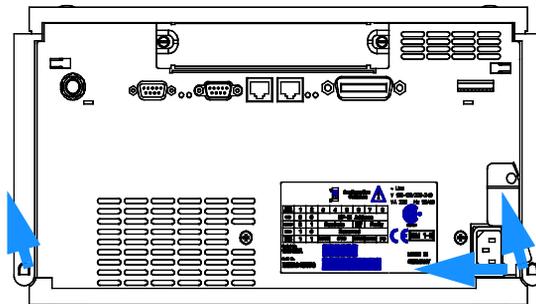
- 1 Press the release buttons and remove the front cover for access to the interface port area.



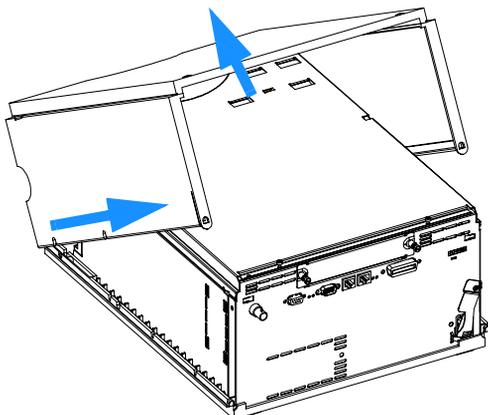
2 If installed, unscrew and remove the interface board. Place the board on the ESD kit.



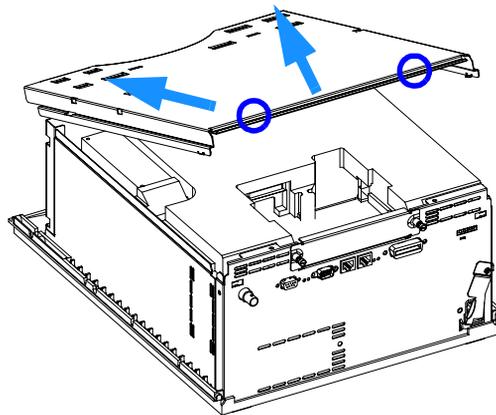
3 Move the power lock across the power inlet and lift the clips on the rear of the cover.



4 Lift the cover up and slide it towards the rear.

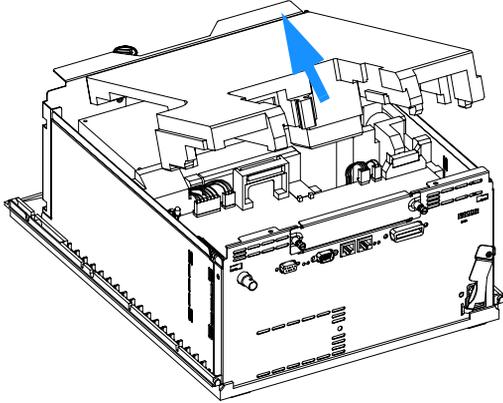


5 Unscrew the screws at the rear of the top plate, slide the plate towards the front and remove it.



4 Repairing the Refractive Index Detector

6 Lift out and remove the top foam.



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

Exchanging the Detector Main 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 (RIM) G1321-69500 (exchange assembly)

- 1 Switch off the module, and disconnect the cables.
- 2 Remove module from stack and place it on the workbench.

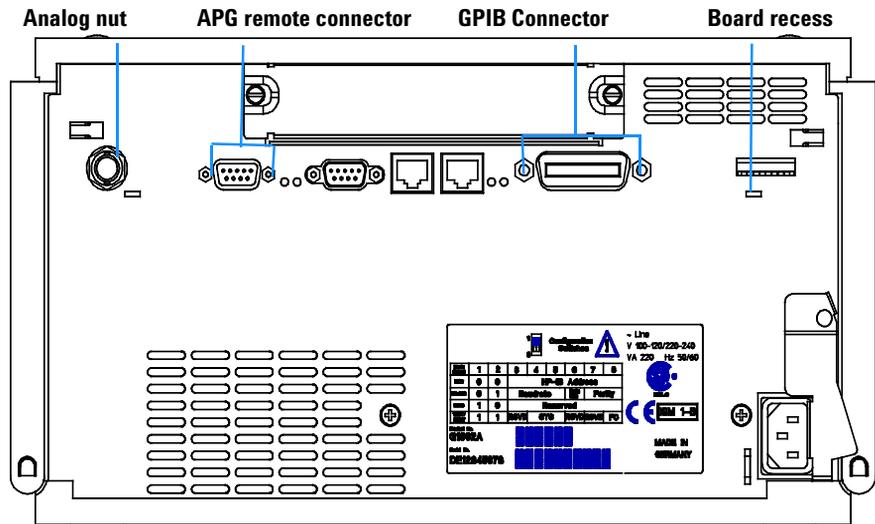


Figure 28 Unscrew Connectors from Board

- 3 Remove the front cover, top cover and top foam section, see “[Removing the Covers](#)” on page 100.
- 4 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.
- 5 Disconnect all connectors from the detector main board.

4 Repairing the Refractive Index Detector

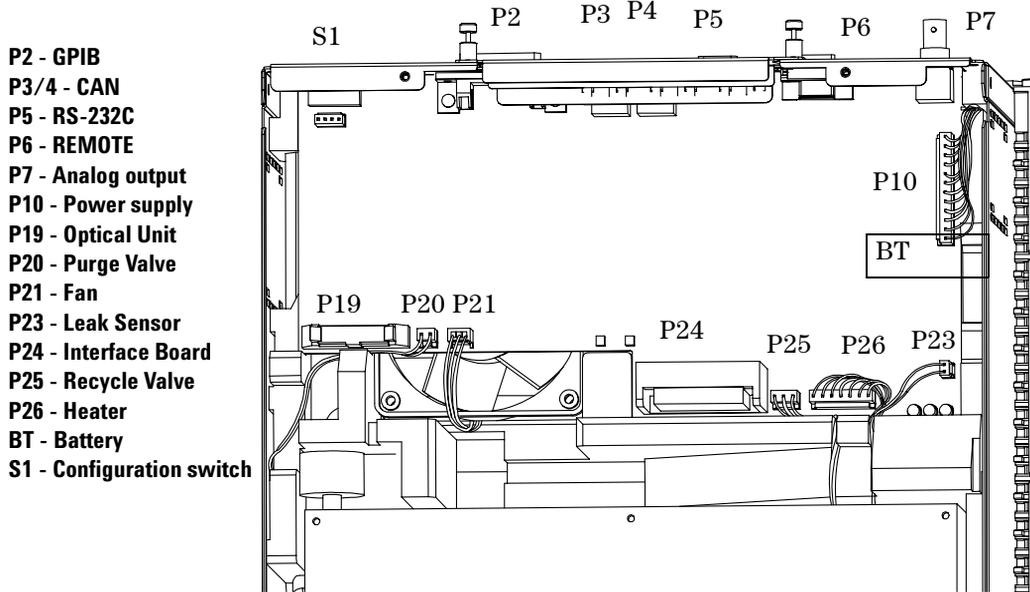


Figure 29 location on RIM board Location of Connectors on RIM Board

- 6 Remove the detector main board. Place the board on the ESD kit.
- 7 On the new board check the switch setting of address switch S1, see [“Setting the 8-bit Configuration Switch”](#) on page 191.

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.

- 8 Install the new detector main board and reconnect the connectors. Assure that the board is fitted correctly into the board recess in the rear panel.
- 9 Refit the screws at the REMOTE and GPIB connectors and the nuts of the ANALOG connectors.
- 10 Reinstall the top foam section, top cover and front cover, see [“Replacing the Foams and Covers”](#) on page 127.
- 11 Replace detector into the stack and reconnect the cables.

- 12** If a new RIM board is installed performance of the Refractive Index Calibration as described in [“The Refractive Index Calibration Procedure”](#) on page 78 is recommended to check the response of the detector.

NOTE

If a new RIM 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 131.

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$(lrid,"ser YYYYYYYYYY")
```

4 Repairing the Refractive Index Detector

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$(lrid,"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

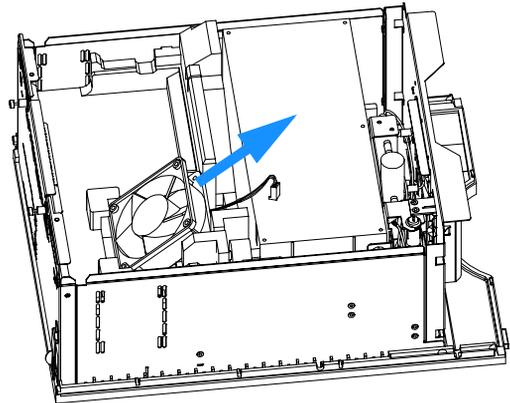
CAUTION

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

Preparations for this procedure:

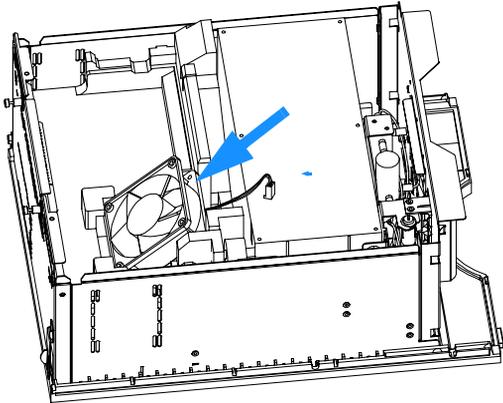
- Turn off the detector.
- Disconnect the power cable.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in [“Removing the Covers”](#) on page 100.
- Remove the detector main board as described in [“Exchanging the Detector Main Board”](#) on page 103.

1 Pull the fan up and out of the bottom foam.

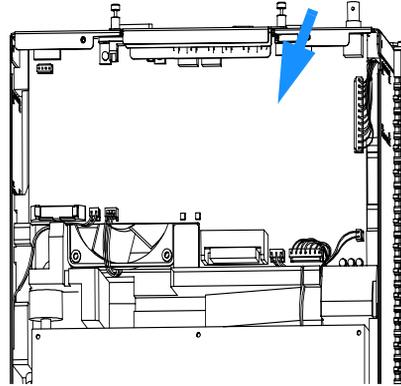


4 Repairing the Refractive Index Detector

2 Insert the fan into the bottom foam. (the air flow must be towards the bottom of the detector).



3 Replace the detector main board as described in “Exchanging the Detector Main Board” on page 103.



Next Steps:

- 4** Replace the covers as described in “Replacing the Foam and the Top Cover” on page 149.
- 5** Re-install the detector in the stack.

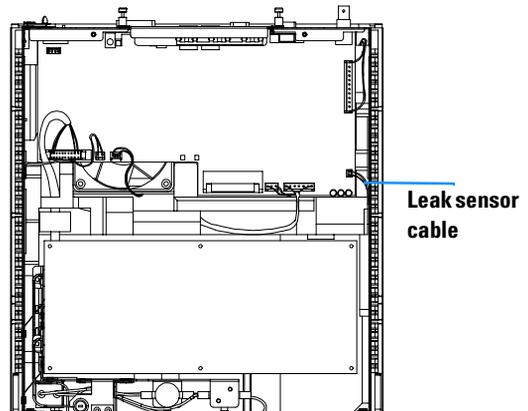
Exchanging the Leak Sensor or Leak Plane

When required	If defective
Tools required	Screwdriver POZI 1 PT3 Flat screwdriver
Parts required	Leak sensor assembly 5061-3356 Leak plane G1362-44101

Preparations for this procedure:

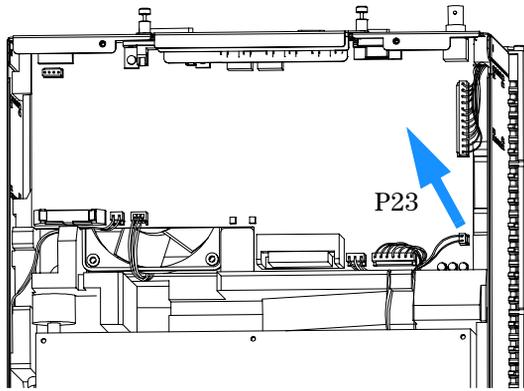
- Turn off the detector.
- Disconnect the power cable.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in “[Removing the Covers](#)” on page 100.

1 Locate the leak sensor cable.

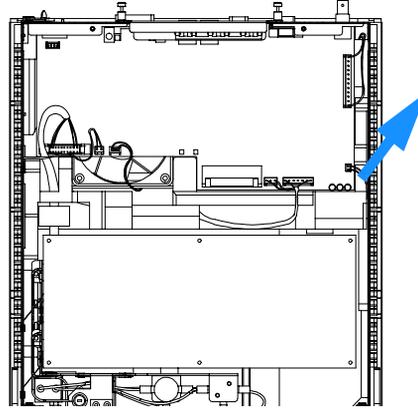


4 Repairing the Refractive Index Detector

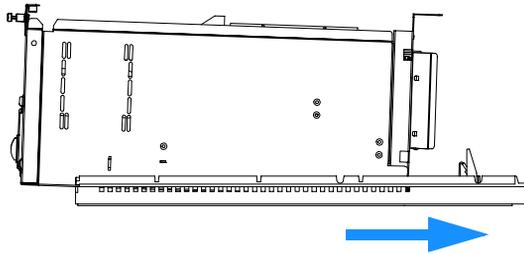
2 Disconnect the leak sensor cable from the detector main board.



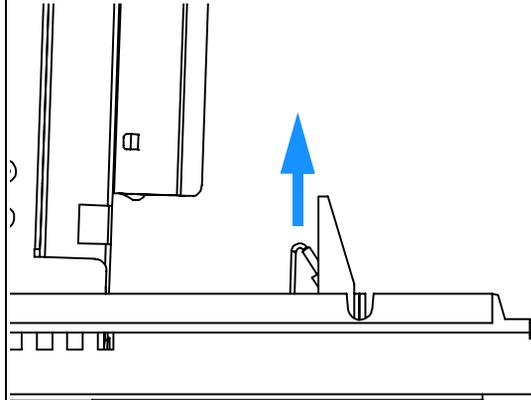
3 Remove the leak sensor cable from the side of the optical unit.



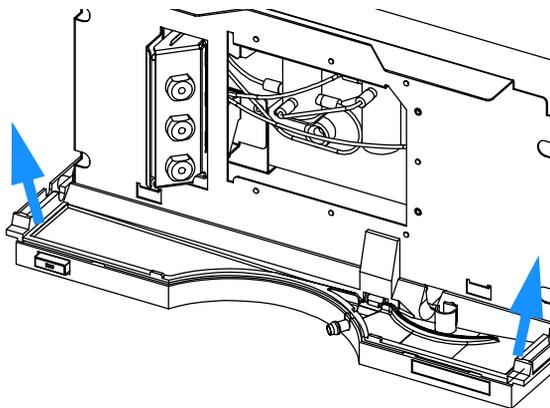
4 Slide the base forward and away from the detector.



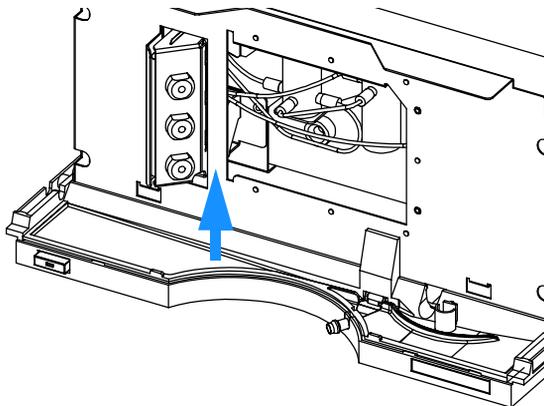
5 Locate the leak sensor and pull it out of the leak plane.



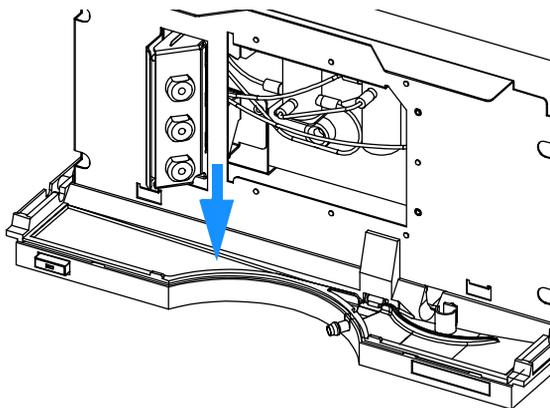
6 (If required) Use a flat screw driver to release the two clasps holding the leak plane in the base.



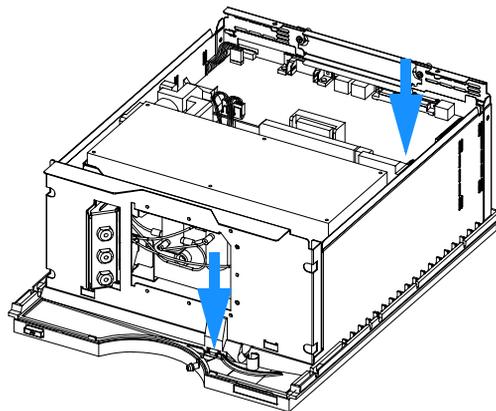
7 (If required) Pull the leak plane up and away from the base.



8 (If required) Press the replacement leak plane down firmly into the base.



9 Replace the leak sensor and reconnect the connector.



Next Steps:

10 Replace the covers as described in [“Replacing the Foams and Covers”](#) on page 127.

11 Re-install the detector in the stack.

Removing the Optical Unit

When required	For following repairs: flow cell, lamp, light receiving diodes, heater.
Tools required	Screwdriver POZI 1 PT3
Parts required	Optical unit G1362-69001 (exchange assembly)

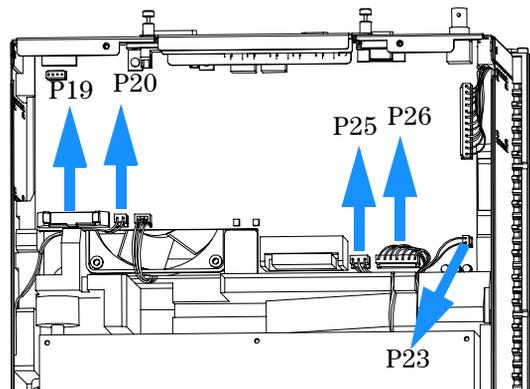
CAUTION

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

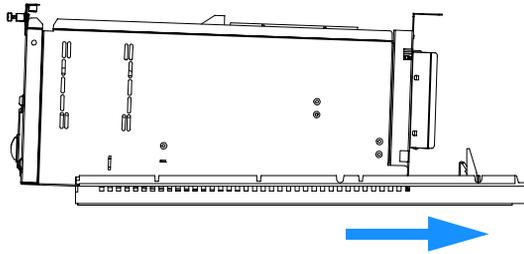
Preparations for this procedure:

- Turn off the detector.
- Disconnect the power cable.
- Disconnect capillaries.
- Remove detector from stack and place it on the workbench.
- Remove the covers as described in “Removing the Covers” on page 100.

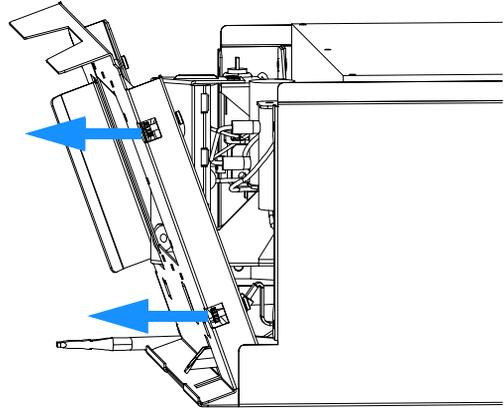
1 Disconnect the optical unit, heater, valve and leak sensor cables from the detector main board.



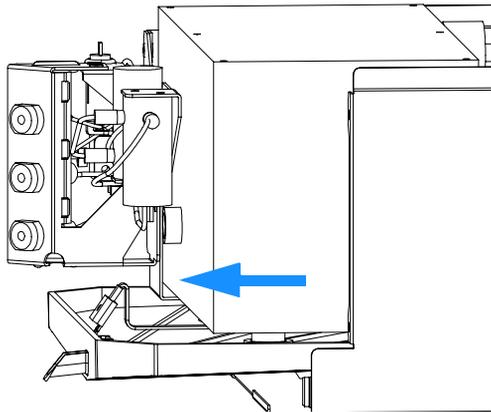
2 Slide the base forward and away from the detector.



3 Unscrew the four screws and remove the Z plane.



4 Slide the optical unit and leak plane forward and away from the detector.



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

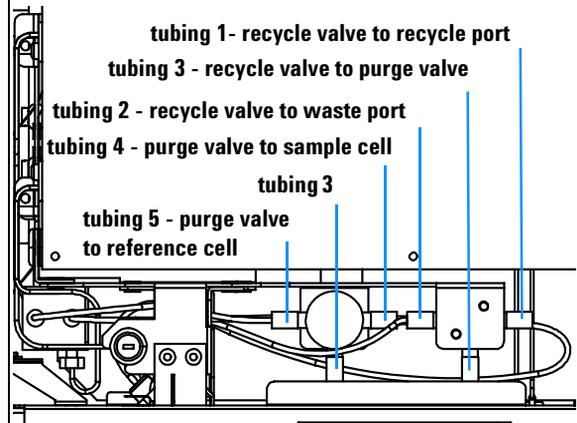
Replacing the Valve Tubing

When required	If defective
Tools required	Screwdriver POZI 1 PT3
Parts required	Tubing kit G1362-68709

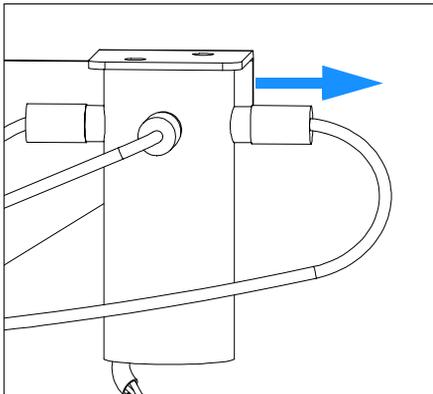
Preparations for this procedure:

- Optical unit has been removed as described in “Removing the Optical Unit” on page 112.

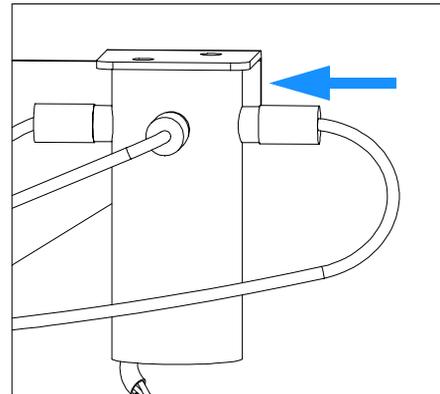
1 Identify the tubing to be changed.



2 Disconnect one of the valve tubes.



3 Carefully reconnect the valve tube.



4 Repeat steps 2 and 3 for the remaining tubes to be replaced.

5 Ensure that the fittings are tight and check for leaks.

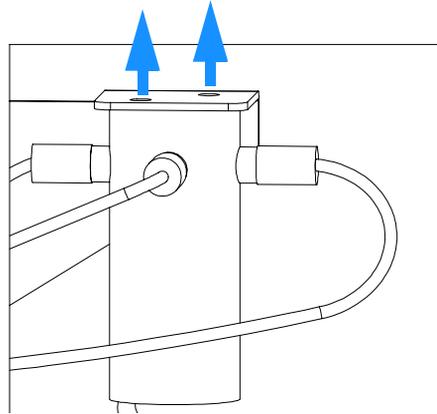
Replacing the Recycle Valve

When required	If defective
Tools required	Screwdriver POZI 1 PT3
Parts required	Recycle valve G1362-27701

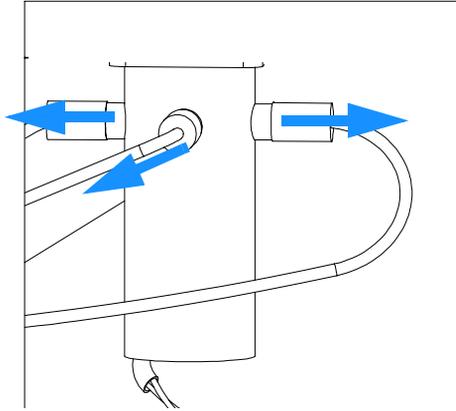
Preparations for this procedure:

- Optical unit has been removed as described in [“Removing the Optical Unit”](#) on page 112.

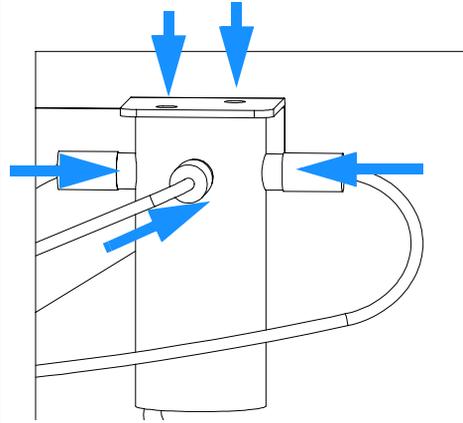
- 1 Unscrew the two screws and remove the recycle valve from the optical unit.



2 Disconnect the tubing connected to the recycle valve.
Note the position of the valve tubes.



3 Attach the new recycle valve and reconnect the tubes.
Check for leaks.



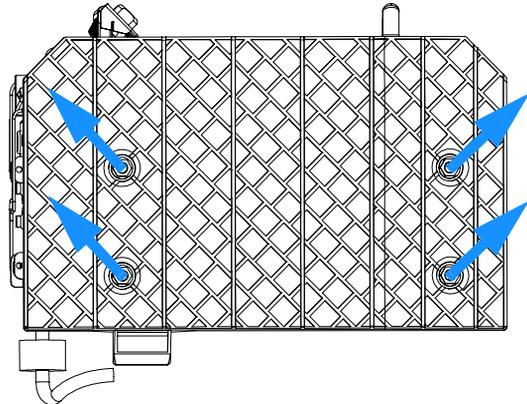
Replacing the Leak Pan

When required	If defective
Tools required	Wrench
Parts required	Leak Pan G1362-44100

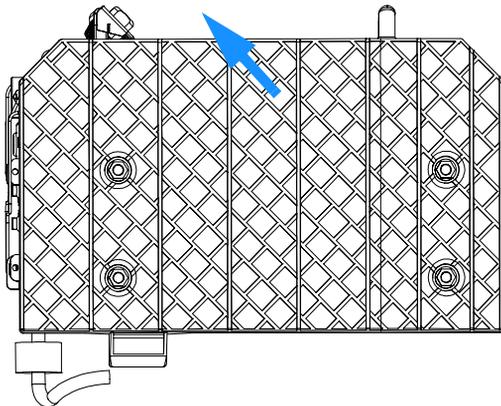
Preparations for this procedure:

- Optical unit has been removed as described in “[Removing the Optical Unit](#)” on page 112.

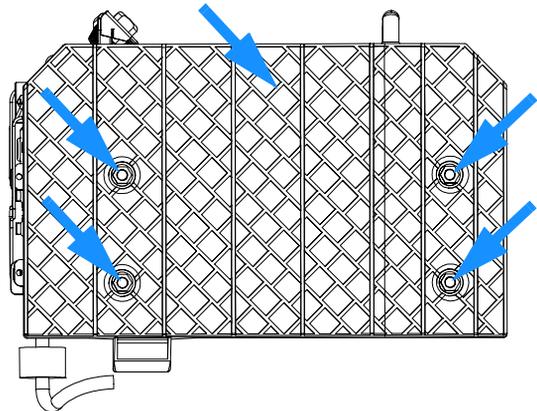
1 Unscrew the four nuts attaching the leak pan to the base of the optical unit.



2 Pull the leak pan away from the optical unit.



3 Attach the new leak pan to the base of the optical unit.



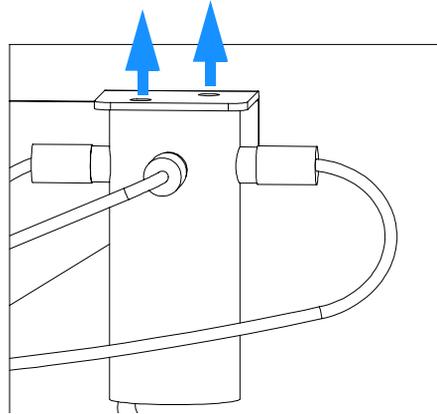
Replacing the Purge Valve

When required	If defective
Tools required	Screwdriver POZI 1 PT3
Parts required	Purge valve G1362-27700

Preparations for this procedure:

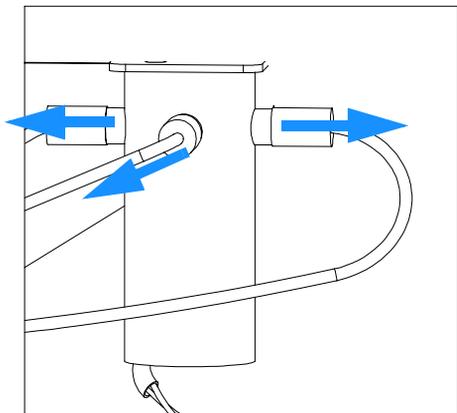
- Optical unit has been removed as described in [“Removing the Optical Unit”](#) on page 112.
- Leak plane has been removed as described in [“Replacing the Leak Pan”](#) on page 118

- 1 Turn the optical unit upside down unscrew the two screws and remove the recycle valve from the optical unit.

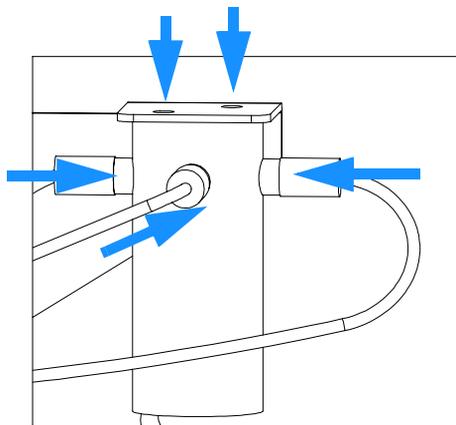


4 Repairing the Refractive Index Detector

2 Disconnect the tubing connected to the recycle valve. Note the position of the valve tubes.



3 Attach the new purge valve and reconnect the capillaries. Check for leaks.



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

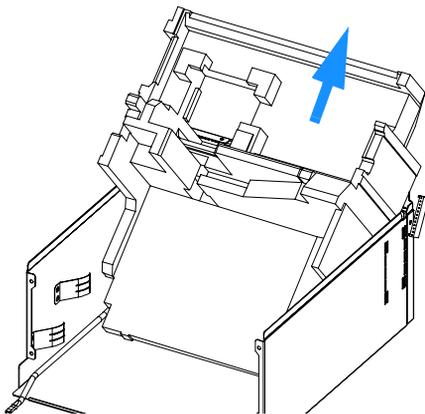
NOTE

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

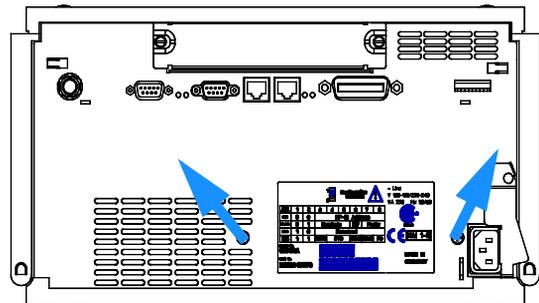
Preparations for this procedure:

- 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 100.
- Remove the detector main board, see “[Exchanging the Detector Main Board](#)” on page 103.
- Remove the fan assembly, see “[Exchanging the Fan](#)” on page 107.
- Remove the optical unit, see “[Removing the Optical Unit](#)” on page 112.

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

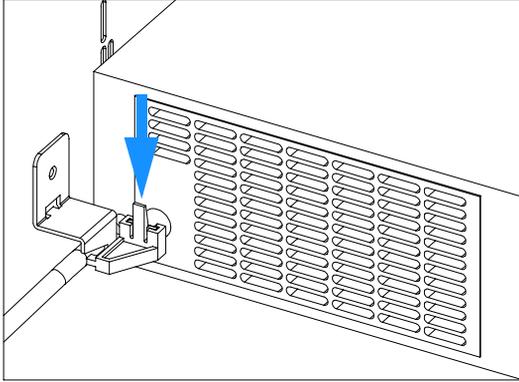


2 Unscrew the power supply at the rear of the module.

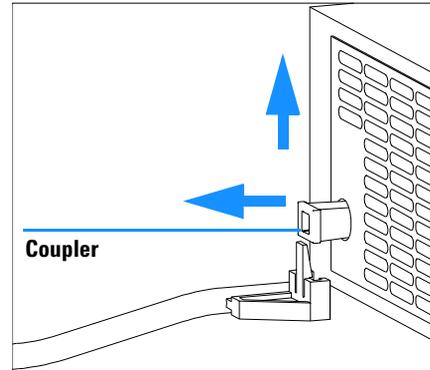


4 Repairing the Refractive Index Detector

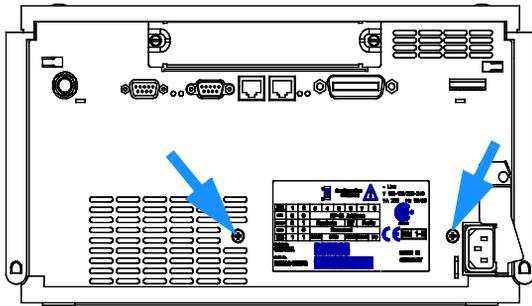
3 Press down the power switch light pipe to remove it from the coupler.



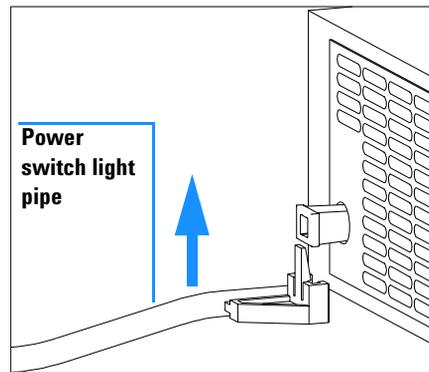
4 Remove the power supply completely. Re-use the coupler on the new power supply.



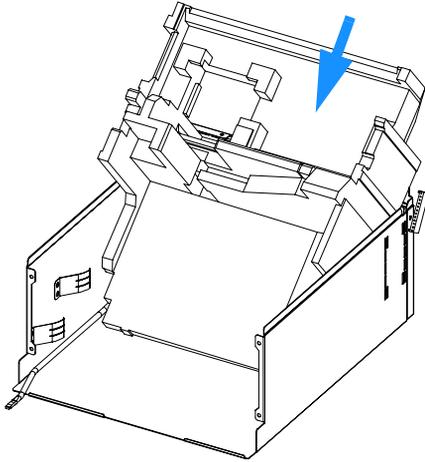
5 Insert the power supply into its location and fix it with the screws at the rear panel.



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



7 Reinstall bottom foam piece.



8 Reinstall the fan assembly, see “Exchanging the Fan” on page 107.

9 Reinstall the detector main board, see “Exchanging the Detector Main Board” on page 103.

10 Reinstall the optical unit, see “Installing the Optical Unit” on page 125.

11 Reinstall the front cover, top cover, see “Replacing the Foams and Covers” on page 127.

12 Replace detector into the stack.

13 Reconnect the power cable and turn on the detector.

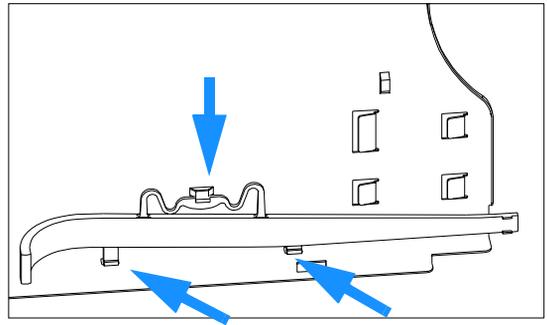
Replacing Status Light Pipe

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 100.

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



2 Replace the top cover, see “[Replacing the Foams and Covers](#)” on page 127.

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

4 Turn on the detector.

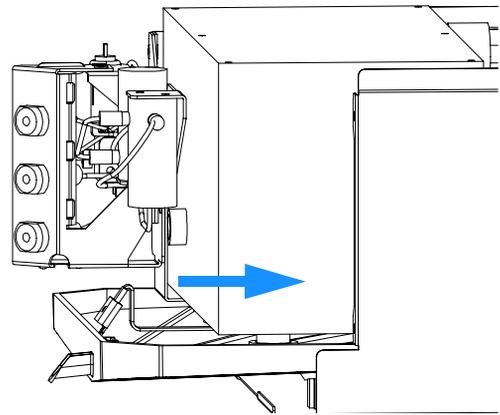
Installing the Optical Unit

When required	When all repairs on the optical unit have been completed or if optical unit replaced
Tools required	Screwdriver POZI 1 PT3 Hexagonal key, 4 mm
Parts Required	Optical Unit G1362-69001

Preparations for this procedure:

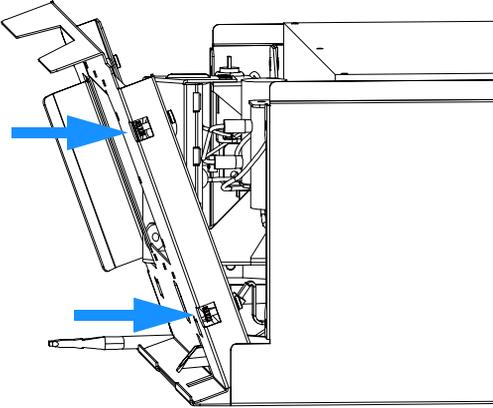
- All previous work has been completed.
- Power supply has been installed as described in [“Exchanging the Power Supply”](#) on page 121.
- Leak plane has been attached as described in [“Replacing the Leak Pan”](#) on page 118.

1 Slide the optical unit into the detector.

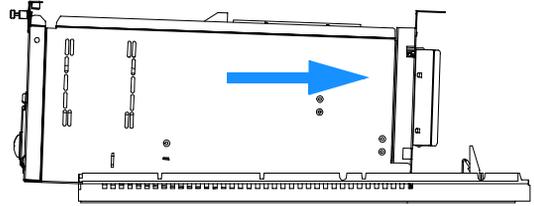


4 Repairing the Refractive Index Detector

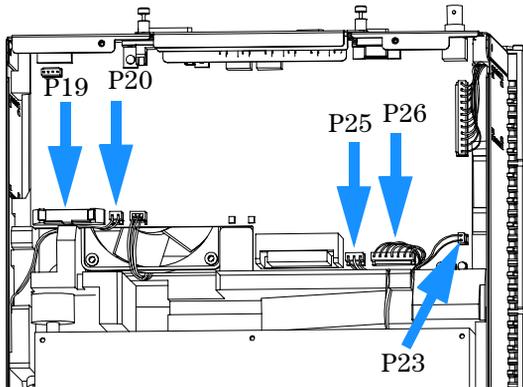
2 Replace the Z plane and tighten the four screws.



3 Slide the detector into the base. Ensure that the power switch light pipe is routed correctly to the power switch.



4 Reconnect the optical unit, heater, valve and leak sensor cables to the detector main board.



Next Steps:

- 5** Replace the covers as described in [“Replacing the Foams and Covers”](#) on page 127.
- 6** Re-install the detector in the stack.
- 7** If a new optical unit is installed performance of the Refractive Index Calibration as described in [“The Refractive Index Calibration Procedure”](#) on page 78 is recommended to check the response of the detector.

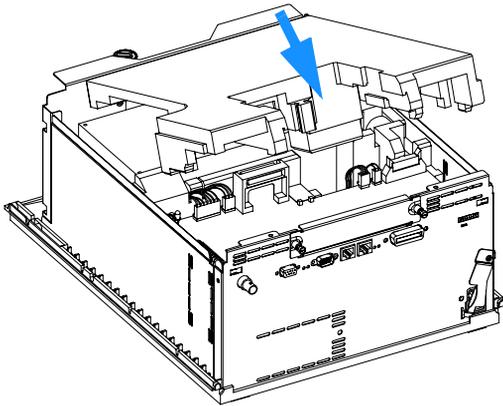
Replacing the Foams and Covers

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

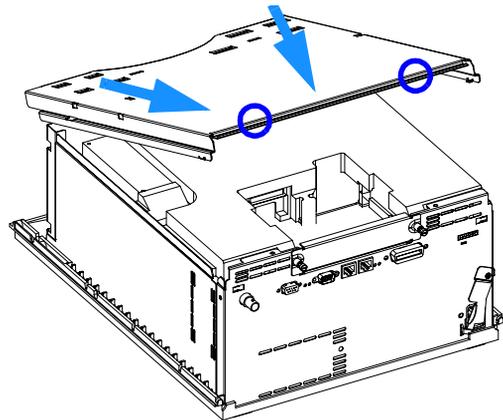
NOTE

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 top foam.

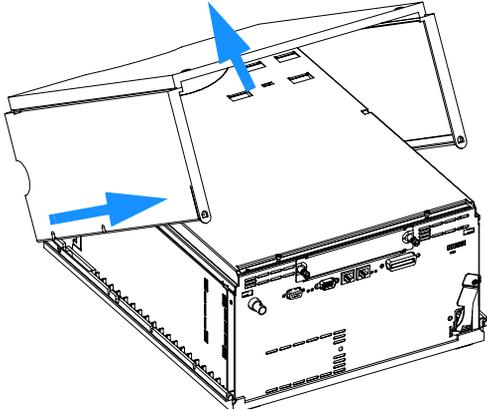


2 Place the top plate on the foam and slide it towards the rear and fix the screws at the rear of the top plate.

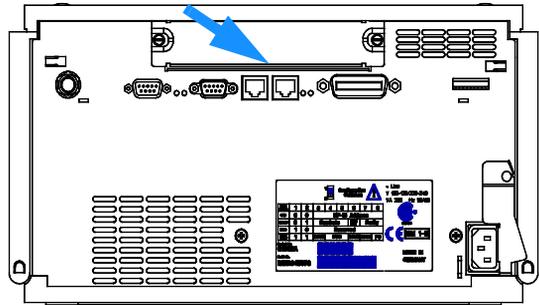


4 Repairing the Refractive Index Detector

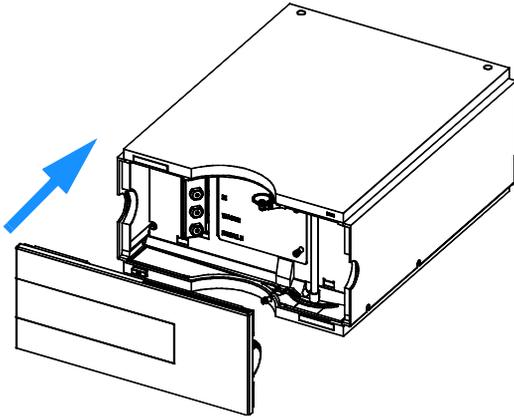
3 Replace the cover.



4 If installed, replace the interface board and fix it with its screws.



5 Replace the front panel.



Next Steps

6 Replace the detector into the stack.

7 Reconnect the power cable and turn on the detector.

Assembling the Cabinet Kit

When required	If cover is broken
Tools required	None
Parts required	Cabinet kit G1312-68703 (includes base, top, left and right)

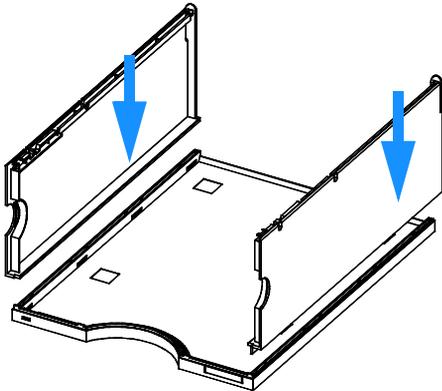
NOTE

The cabinet kit contains all parts, but it is not assembled.

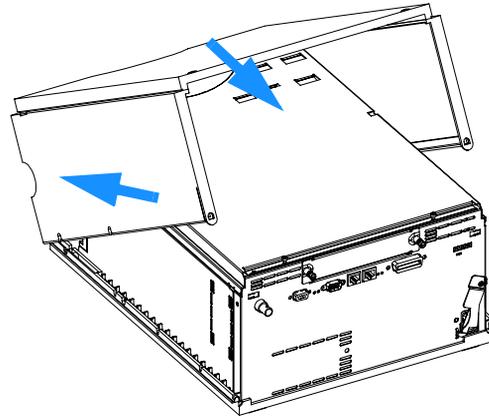
WARNING

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.



2 Replace the cover.



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

4 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 Board” on page 185
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.

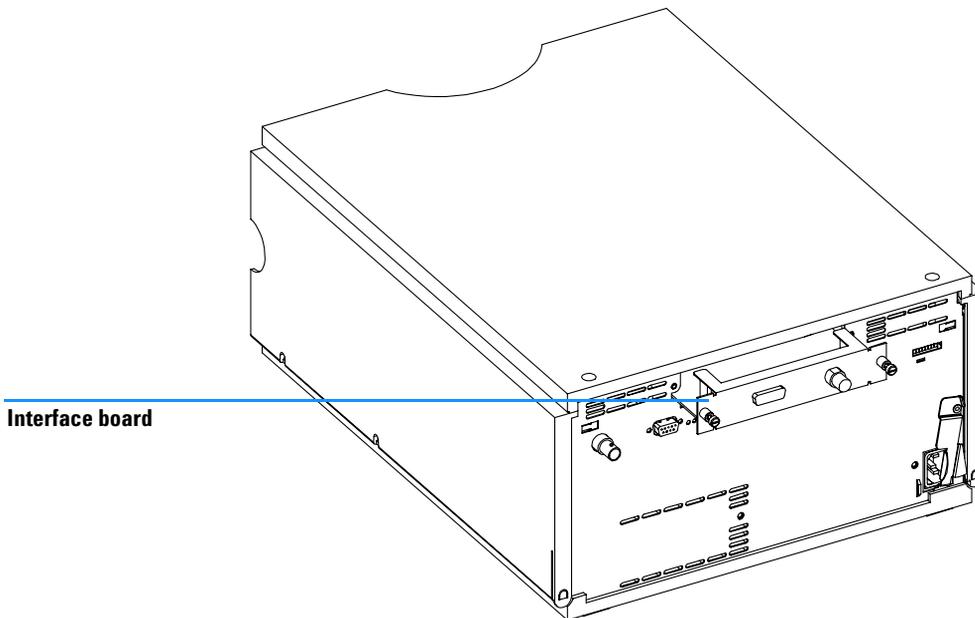


Figure 30 Location of the Interface Board

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 (RIM) the version on board is older than the previously installed one.

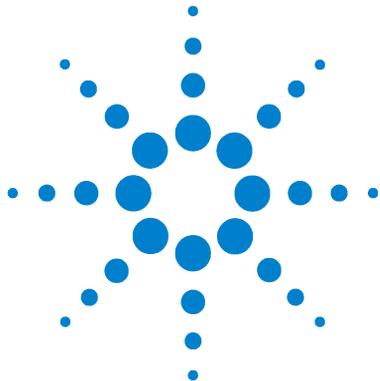
To upgrade the detector's firmware the following steps have to be taken:

- 1 Load the firmware into the detector, see help system of your user interface.
- 2 If RIM 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 105 or “[Entering the Serial Number using the Agilent ChemStation](#)” on page 105.

NOTE

For more detailed information about firmware-updates please refer to the technical support section on Agilent Technologies' world wide web page under <http://www.agilent.com> !.

4 Repairing the Refractive Index Detector



5 Identifying Parts and Materials

Overview of Main Assemblies	134
Optical Unit Assembly	136
Control Module	138
Sheet Metal Kit	139
Plastic Parts	140
Foam Parts	141
Power and Status Light Pipes	142
Leak Parts	143
Accessory Kit	144
Cable Overview	146
RS-232 Cable Kit	160



Overview of Main Assemblies

Figure 31 shows the main assemblies and their locations.

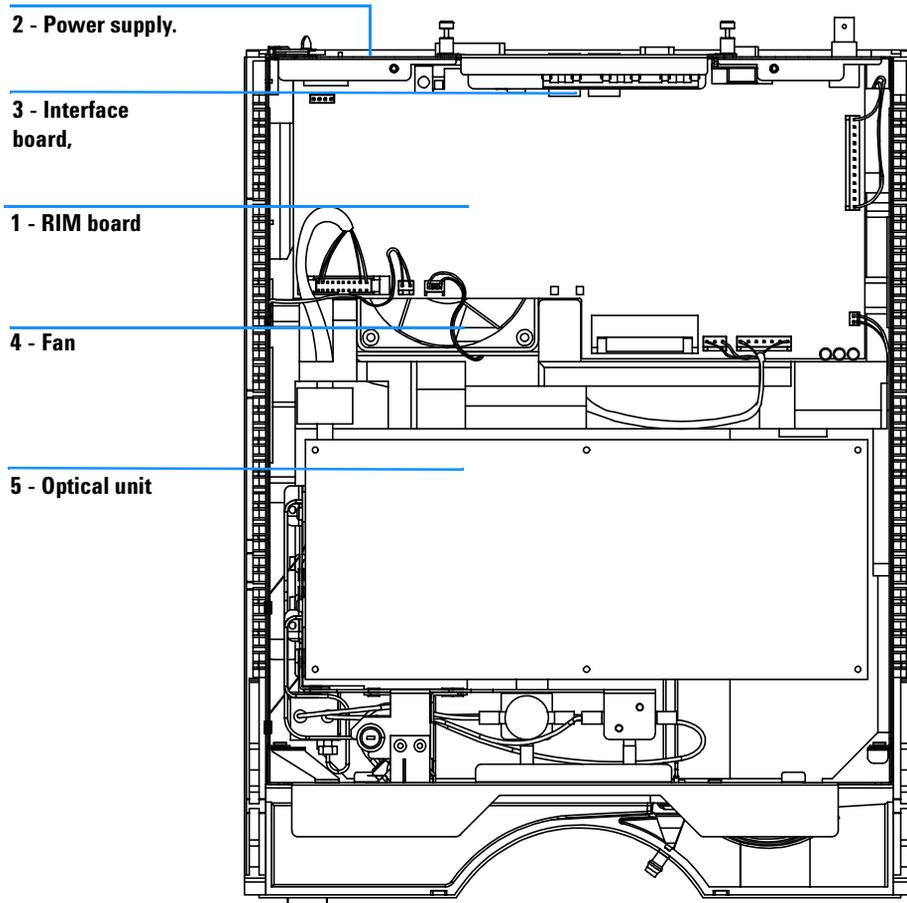


Figure 31 Main Assemblies

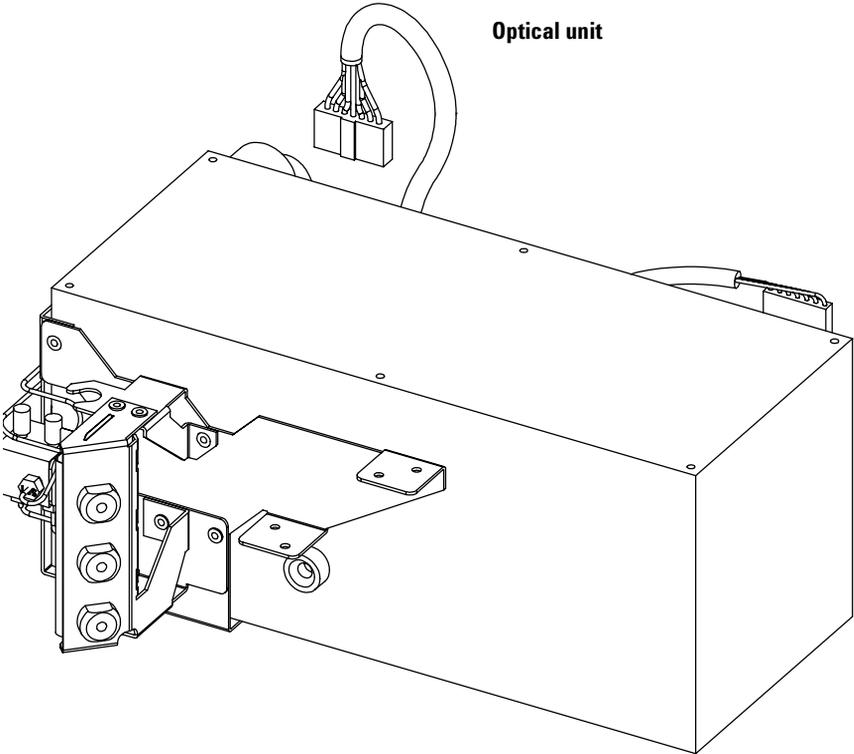
Table 8 Main Assemblies

Item	Description	Part Number
1	Detector main board RIM (exchange assembly, new part has PN G1362-66500)	G1362-69500
	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)	5181-1516
2	Power supply for power and status light parts, see page 142	0950-2528
3	Interface board BCD (BCD/external contacts), optional	G1351-68701
3	Interface board MIO (LAN), optional	see “ LAN Board ” on page 185
	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, new part has PN G1362-60001)	G1362-69001
6	Leak sensor assembly	5061-3356
	Leak handling parts, see page 143	
	Front cover and cabinet kit, see page 140	
	Sheet metal parts, see page 139	
	Foam parts, see page 141	

Optical Unit Assembly

Table 9 Optical Unit Assembly

Item	Description	Part Number
	Optical unit (exchange assembly, new part has PN G1362-60001)	G1362-69001
1	Purge valve	G1362-27700
2	Recycle valve	G1362-27701
3	Tubing kit, includes:	G1362-68709
4	Tubing 1 300mm recycle valve to recycle port	
5	Tubing 2 200mm recycle valve to waste port	
6	Tubing 3 120mm purge valve to recycle valve	
7	Tubing 4 270mm purge valve to sample cell	
8	Tubing 5 170mm purge valve to reference cell	



Optical unit

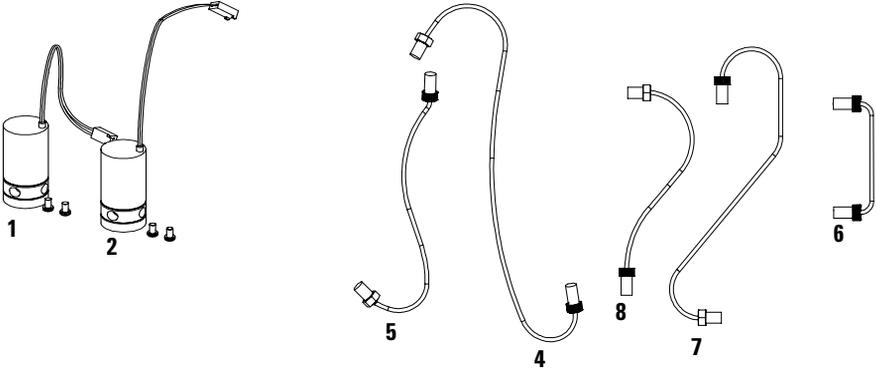


Figure 32 Optical Unit Parts

Control Module

Table 10 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

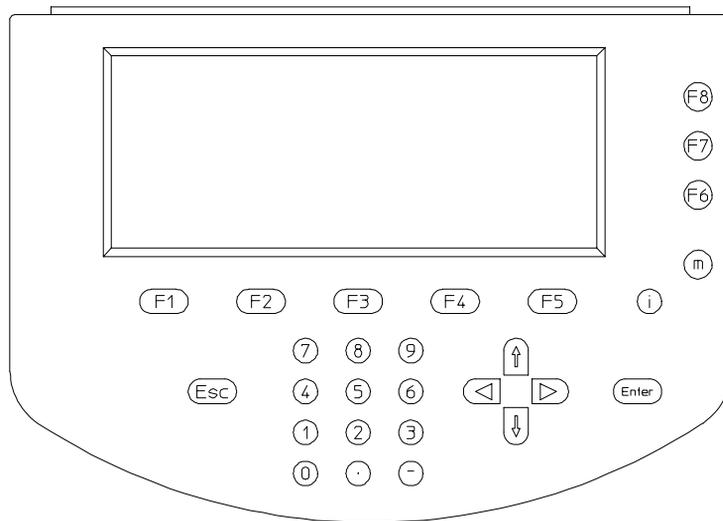


Figure 33 Control Module

Sheet Metal Kit

Table 11 Sheet Metal Kit Parts

Item	Description	Part Number
1	Sheet metal kit includes case and top cover	G1362-68701
2	Screws M3 for cover	5022-2112

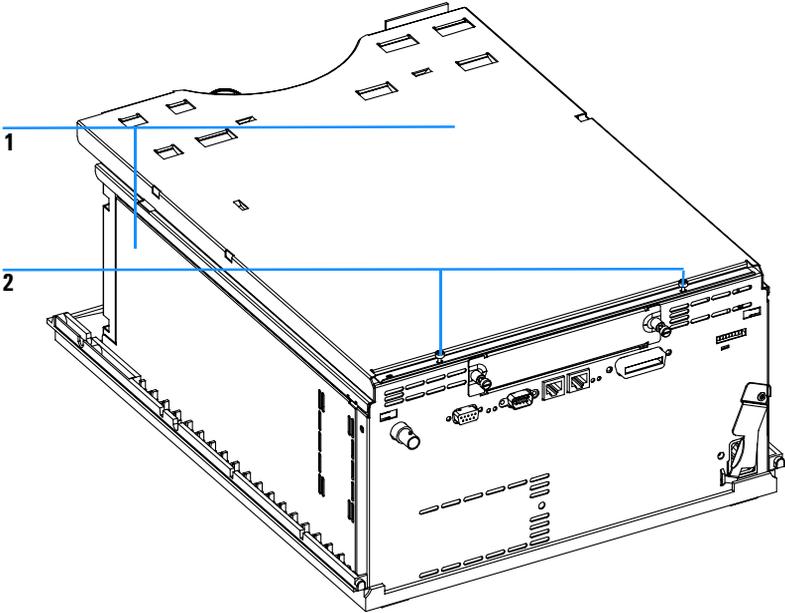


Figure 34 Sheet Metal Kit Parts

Plastic Parts

Table 12 Plastics Parts

Item	Description	Part Number
1	Front cover	G1362-68700
2	Plastics, includes base, sides and top	G1312-68703
3	Name plate Agilent 1100 Series	5042-1381
4	Name plate Serial Number (w/o serial number)	5042-1314

NOTE

For correct assembling of the top and sides, see [“Assembling the Cabinet Kit”](#) on page 129.

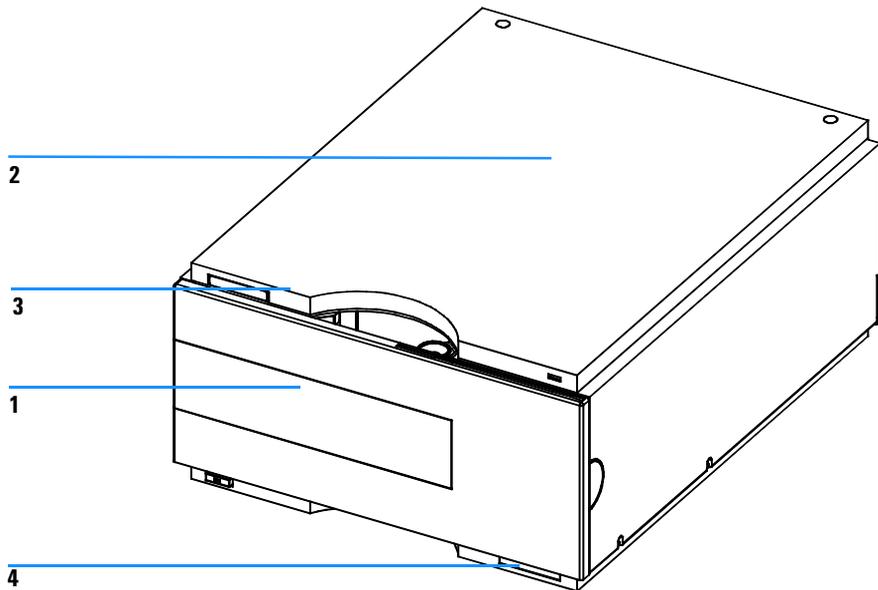


Figure 35 Plastic Parts

Foam Parts

Table 13 Foam Parts

Item	Description	Part Number
1, 2	EPP foam kit, includes top and bottom foam	G1362-68702
3	Guides for interface board	5041-8395

NOTE

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

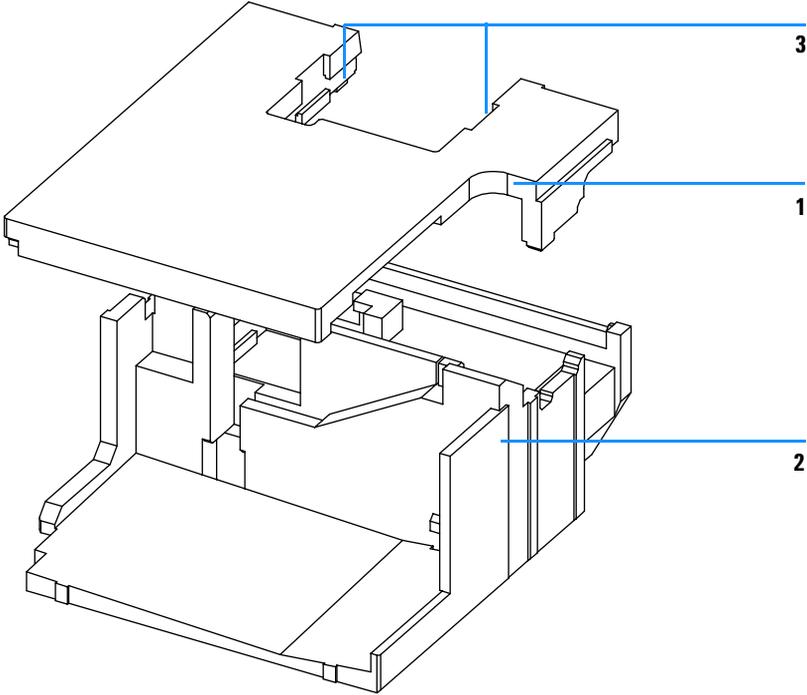


Figure 36 Foam Parts

Power and Status Light Pipes

Table 14 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

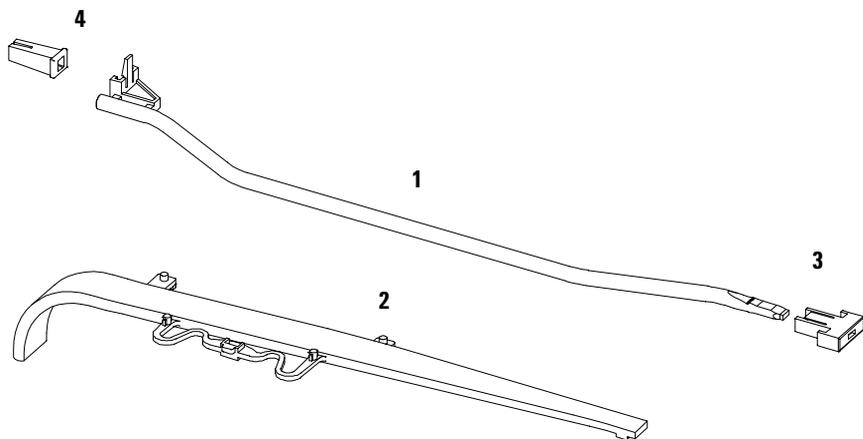


Figure 37 Power and Status Light Pipe

Leak Parts

Table 15 Leak Parts

Item	Description	Part Number
1	Leak sensor assembly	5061-3356
2	Leak plane	G1362-44101
3	Leak pan	G1362-44100
4	Leak funnel	5041-8388
5	Leak funnel holder	5041-8389
6	Clip	5041-8387
7	Leak Tubing 120 mm lg	0890-1711

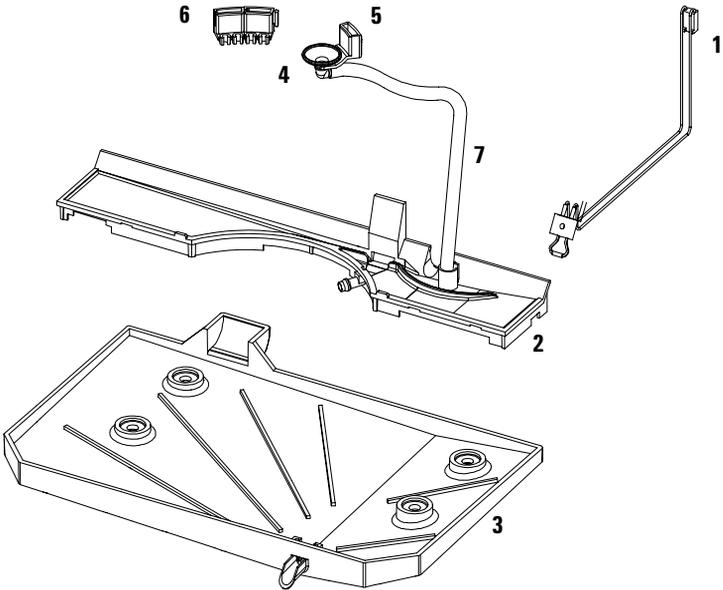


Figure 38 Leak Parts

Accessory Kit

This kit contains some accessories needed for the installation of the detector.

Table 16 Accessory Kit Parts G1362-68705

Item	Description	Part Number
	Interface tubing kit includes:	G1362-68706
1	Ferrule 1/8" (2x)	0100-1700
2	Nut 1/8" PPS (2x)	0100-1708
3	2 m Tubing flexible (2x)	0890-1760
4	Interfacing capillary, 400mm lg, 0.17mm i.d. includes:	G1362-87300
5	Hand tight fitting (2x)	5062-8541 (re-ord. 10 ocs.)
6	Restriction capillary, 3700mm lg, 0.17mm i.d. includes:	G1362-87301
7	Hand tight fitting (2x)	5062-8541 (re-ord. 10 ocs.)
8	CAN cable	5181-1516
9	PEEK adapter to pump's active inlet valve	0100-1847

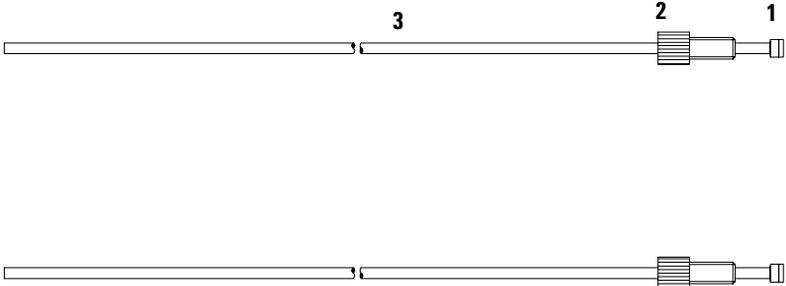


Figure 39 Interface Tubing Kit Parts

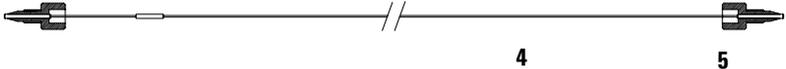


Figure 40 Interfacing Capillary Parts

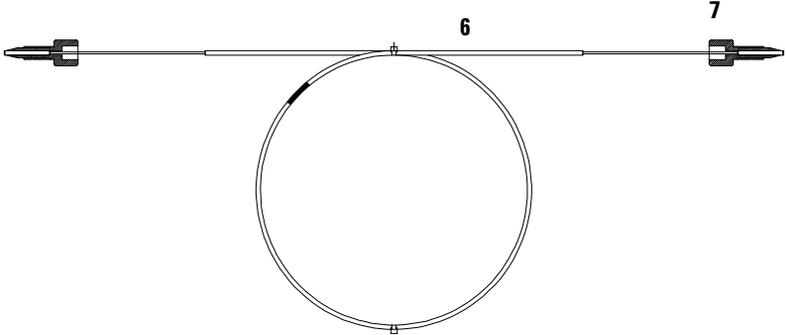


Figure 41 Restriction Capillary Parts

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.

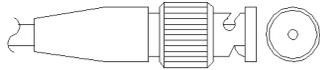
Table 17 Cables Overview

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
	3390/2/3 integrators	01040-60101
Remote cables	3394 integrator	01046-60210
	3396A (Series I) integrator	03394-60600
	3396 Series II / 3395A integrator, see page 152	
	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 1040 diode-array detector	01046-60202
	HP 1090 liquid chromatographs	01046-60202
	Signal distribution module	01046-60202
BCD cables	3396 integrator	03396-60560

Table 17 Cables Overview (continued)

Type	Description	Part Number
	General purpose (spade Lugs)	18594-60520
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	10833A
	Agilent 1100 module to Agilent ChemStation, 2 m	10833B
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.	34398A
Lan Cables	Twisted pair cross over LAN cable, 10 feet long (for point to point connection)	5183-4649
	Category 5 UTP cable, 8m long (for HUB connections)	G1530-61480

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.

Table 18 Agilent 1100 to 3390/2/3 Integrators

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

Table 19 Agilent 1100 to 3394/6 Integrators

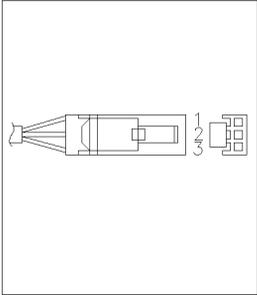
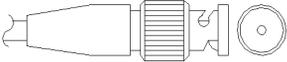
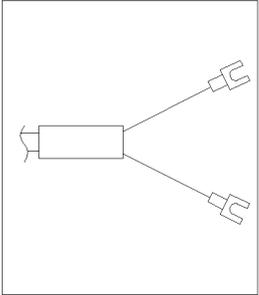
Connector 35900-60750	Pin 3394/6	Pin Agilent 1100	Signal Name
	1		Not connected
	2	Shield	Analog -
	3	Center	Analog +

Table 20 Agilent 1100 to BNC Connector

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

5 Identifying Parts and Materials

Table 21 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.

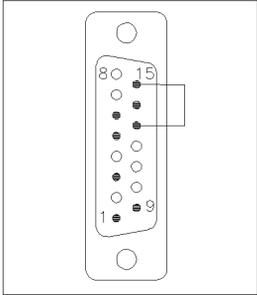
Table 22 Agilent 1100 to 3394 Integrators

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.

Table 23 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.

Table 24 Agilent 1100 to 3396 Series III / 3395B Integrators

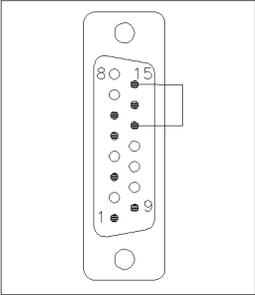
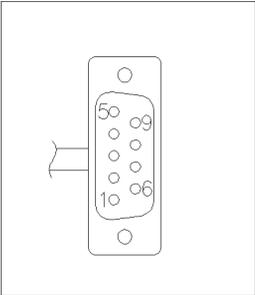
Connector 03396-61010	Pin 33XX	Pin Agilent 1100	Signal Name	Active (TTL)
	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	14	7 - Red	Ready	High
	4	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low
	13, 15		Not connected	

Table 25 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

5 Identifying Parts and Materials

Table 26 Agilent 1100 to HP 1090 LC, HP 1040 DAD or Signal Distribution Module

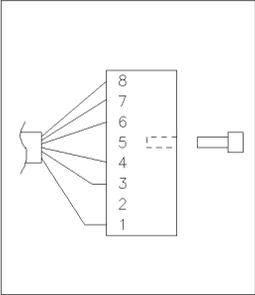
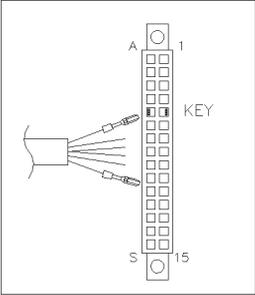
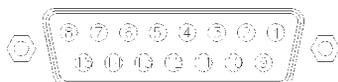
Connector 01046-60202	Pin HP 1090	Pin Agilent 1100	Signal Name	Active (TTL)
 <p>5 - Key</p>	1	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	4	3 - Gray	Start	Low
	7	4 - Blue	Shut down	Low
	8	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	3	7 - Red	Ready	High
	6	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low

Table 27 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



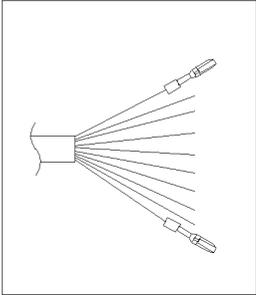
One end of these cables provides a 15-pin BCD connector to be connected to the Agilent 1100 Series modules. The other end depends on the instrument it is to be connected to.

Table 28 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

5 Identifying Parts and Materials

Table 29 Agilent 1100 to General Purpose

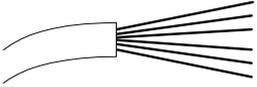
Connector 18594-60520	Wire Color	Pin Agilent 1100	Signal Name	BCD Digit
	Green	1	BCD 5	20
	Violet	2	BCD 7	80
	Blue	3	BCD 6	40
	Yellow	4	BCD 4	10
	Black	5	BCD0	1
	Orange	6	BCD 3	8
	Red	7	BCD 2	4
	Brown	8	BCD 1	2
	Gray	9	Digital ground	
	White	15	+5 Vt	Low

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.

Table 30 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

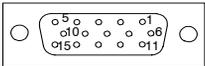


Both ends of this cable provide a modular plug to be connected to Agilent 1100 Series module's CAN-bus connectors.

Table 31

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

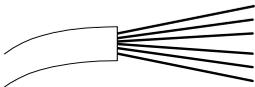
External Contact Cable



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.

Table 32 Agilent 1100 Series Interface Board to general purpose

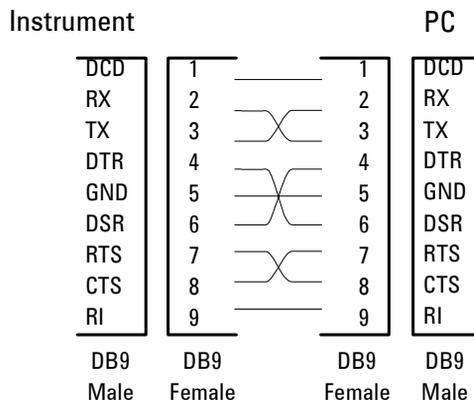
Connector G1103-61611	Color	Pin Agilent 1100	Signal Name
	White	1	EXT 1
	Brown	2	EXT 1
	Green	3	EXT 2
	Yellow	4	EXT 2
	Grey	5	EXT 3
	Pink	6	EXT 3
	Blue	7	EXT 4
	Red	8	EXT 4
	Black	9	Not connected
	Violet	10	Not connected
	Grey/pink	11	Not connected
	Red/blue	12	Not connected
	White/green	13	Not connected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

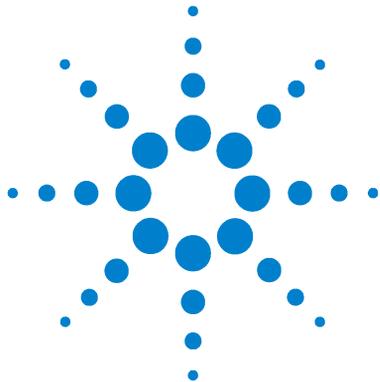


RS-232 Cable Kit

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.

Table 33 Agilent 1100 module to PC, RS-232 Cable Kit 34398As





6 Introduction to the Refractive Index Detector

Introduction to the Refractive Index Detector	162
How the Detector Operates	163
Detection Principle	166
Flow Path	168
Electrical Connections	173
Instrument Layout	175
Early Maintenance Feedback (EMF)	176
Electronics	177
Detector Main Board (RIM)	178
Firmware Description	180
Optional Interface Boards	183
Interfaces	186
Setting the 8-bit Configuration Switch	191
The Main Power Supply Assembly	196



Introduction to the Refractive Index Detector

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

- advanced temperature controlled detector optics ready to use within two hours of installation
- automatic zero and automatic purge combined with a recycle valve for automatic solvent recycling allow uninterrupted operation
- durable tungsten lamp with a life expectancy of 40,000 hours
- automatic light intensity control circuit to ensure the optimum performance of the optics
- integrated diagnostics for efficient troubleshooting
- built-in refractive index calibration
- front access to valves and capillaries for easy maintenance

For specifications, see [“Performance Specifications”](#) on page 222.

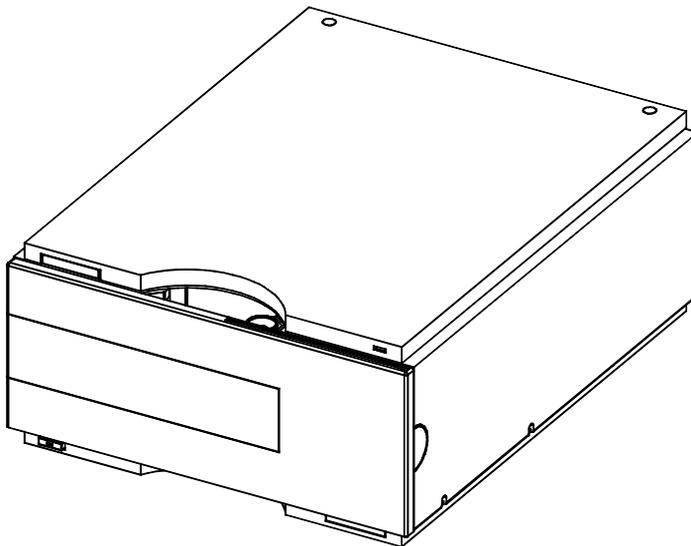


Figure 42 The Agilent 1100 Series Refractive Index Detector

How the Detector Operates

Refractive Index Detection

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

Snells's Law

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

Where:

n = Refractive index of medium 1 relative to medium 2

n_2 = Refractive index of medium 2

n_1 = Refractive index of medium 1

α_1 = angle of incident light in medium 1

α_2 = angle of refraction in medium 2

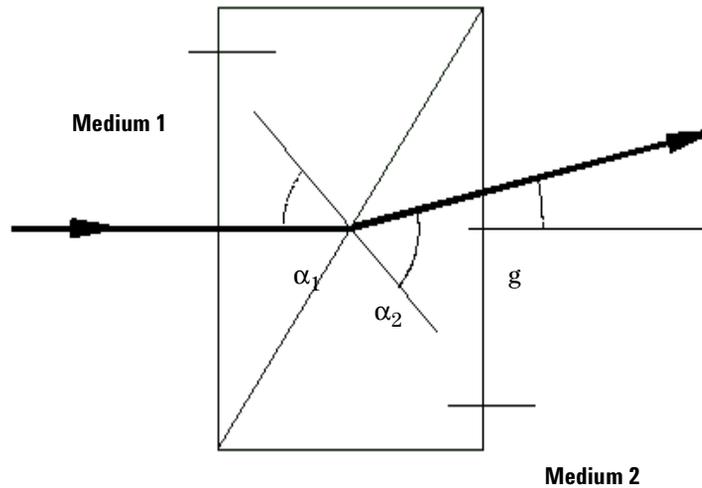


Figure 43 Light Refraction

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

$$\tan \gamma = \frac{n_1 \tilde{n} n_2}{n_1}$$

Where:

γ = angle of external deflection

Factors that Affect Refractive Index

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

1 Wavelength

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

2 Density

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

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

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

Detection Principle

Detector Design

The Agilent 1100 Series refractive index detector is a differential refractometer that measures the deflection of a light beam due to the difference in refractive index between the liquids in the sample and reference cells of a single flow cell.

A beam of light from the lamp passes through a flow cell which is separated diagonally into sample and reference cells. At the rear of the flow cell a mirror reflects the light back through the flow cell and via a zero glass, which affects the path of the light beam, to the light receiver. The light receiver has two diodes each of which produces an electrical current proportional to the amount of light that falls upon it (see [Figure 44](#)).

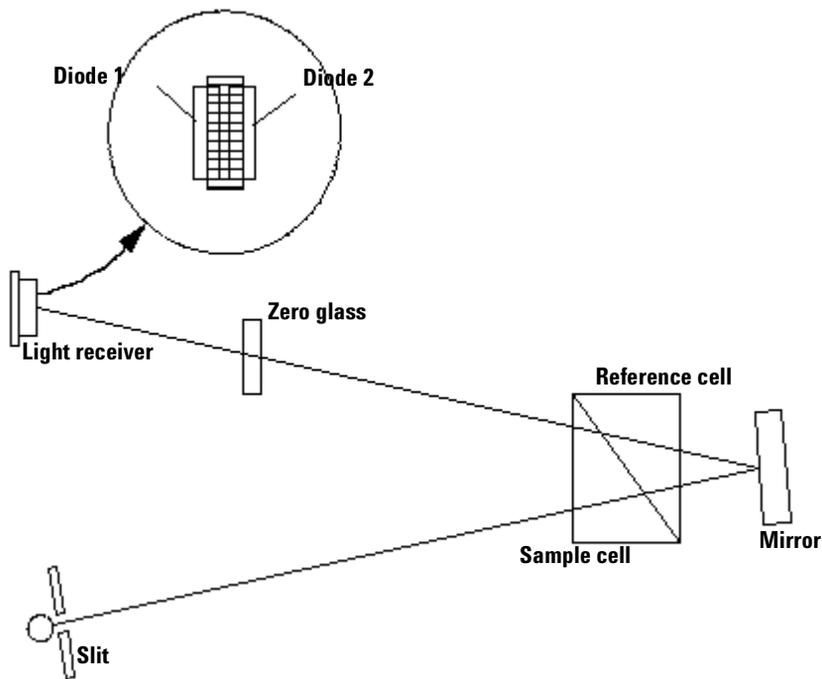


Figure 44 Detection Principle

Measurements

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

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

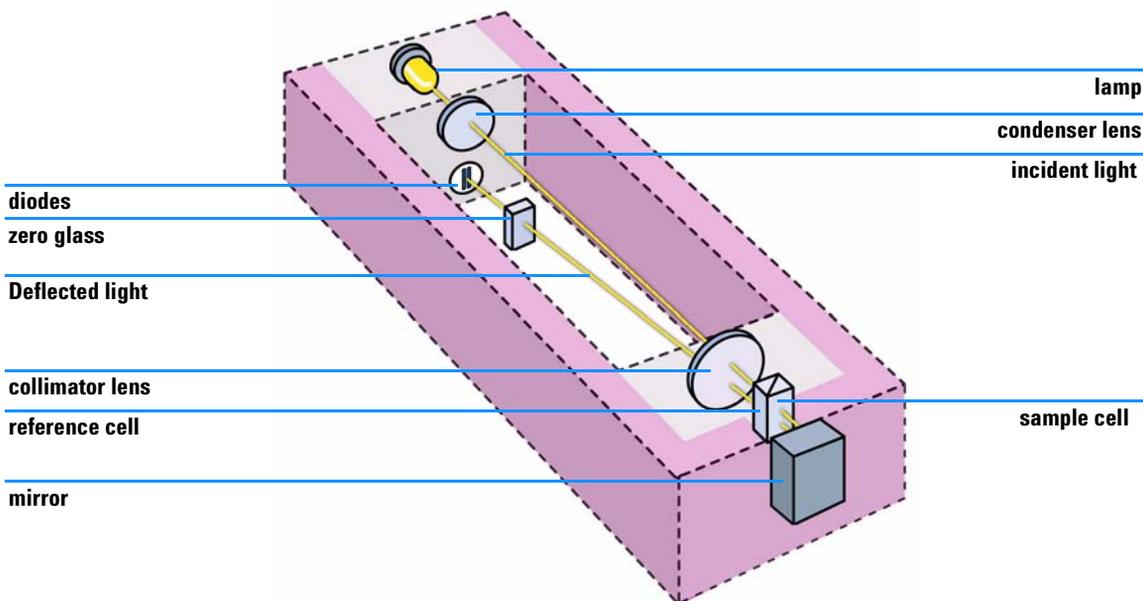


Figure 45 Optical Path

Flow Path

Flow Path

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

If the recycle valve is in the *on/bottle* position the eluent will flow via the recycle port back to the solvent bottle. The recycle valve can be manually set to the *on* or *off* position or the *Automatic recycling after analysis* mode can be enabled. In this mode the recycle valve will automatically switch to the *on* position after each analysis has been completed and return to the *off* position before the next analysis starts. Using this mode provides the benefits of uninterrupted flow through the detector without the problems of excessive solvent usage or the contamination of mobile phase with recycled sample compounds.

If the purge valve is in the *on* position the eluent cannot pass immediately to the recycle valve but will instead flow via a second heat exchanger through the reference cell and then into the recycle valve (see [Figure 46](#)). Periodically switching the purge valve to the *on* position while only mobile phase is flowing will ensure that the liquid in the reference cell is as similar as possible to the flowing solvent. The purge valve can be manually set to the *on* position for a defined time or the *Automatic purge* mode can be enabled. In this mode the purge valve will automatically switch to the *on* position for a defined *purgetime* prior to the start of each analysis. If a *purgetime* is set then a *waittime* must also be set to allow the detector baseline to stabilize after the switching of the purge valve position.

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

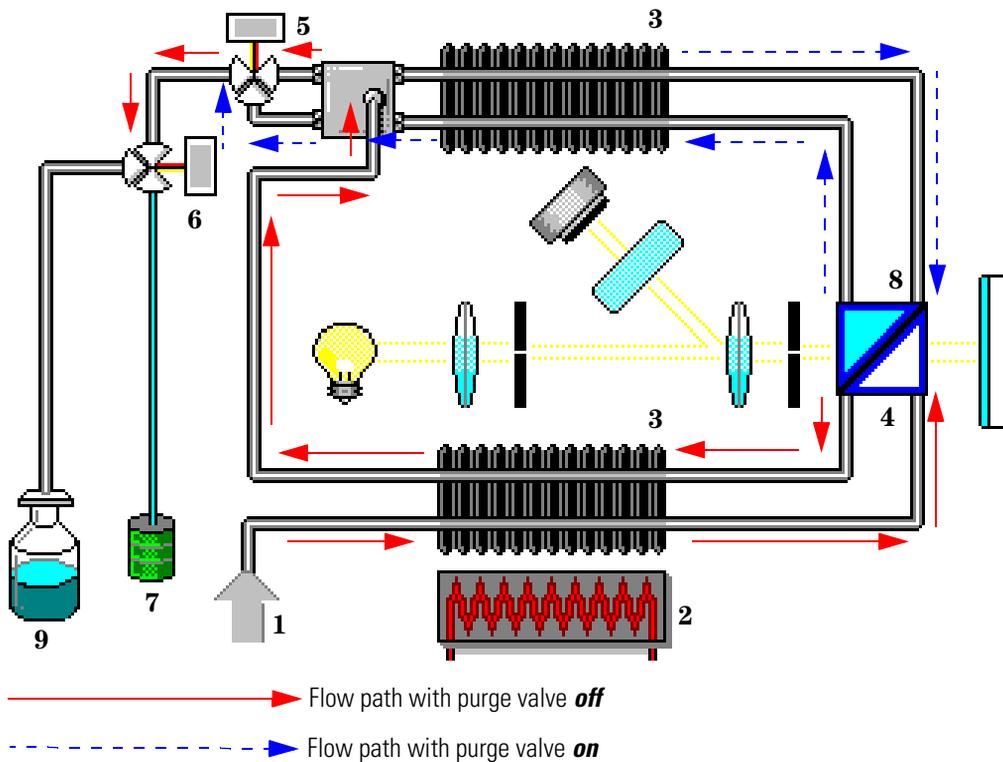
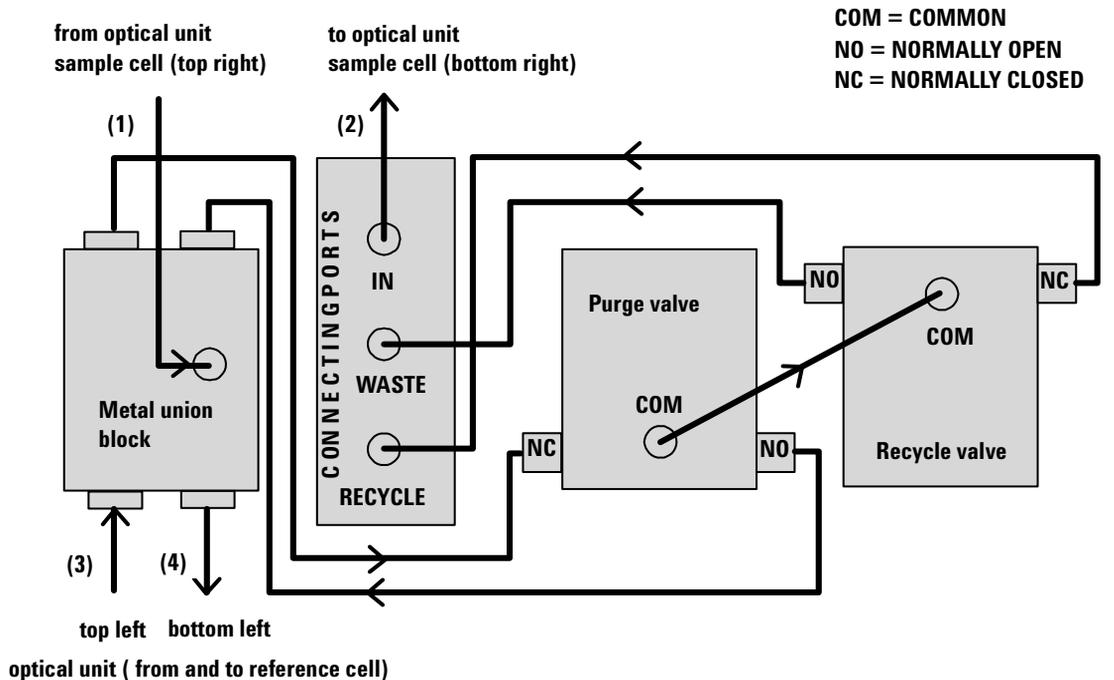


Figure 46 Flow Path

- 1 Flow in
- 2 Heater
- 3 Heat exchanger
- 4 Sample cell
- 5 Purge valve
- 6 Recycle valve
- 7 Waste container
- 8 Reference cell
- 9 Solvent bottle



Capillaries (1) to (4) are part of the optical unit assembly. They are made of SST with an ID of 1.0 mm, except for (2), which has an ID of 0.2 mm. All other tubings (to and from the purge and the reference valve) are made of Teflon and are available as a kit (PN G1362-68709)

Figure 47 G1362A Physical Plumbing Connections

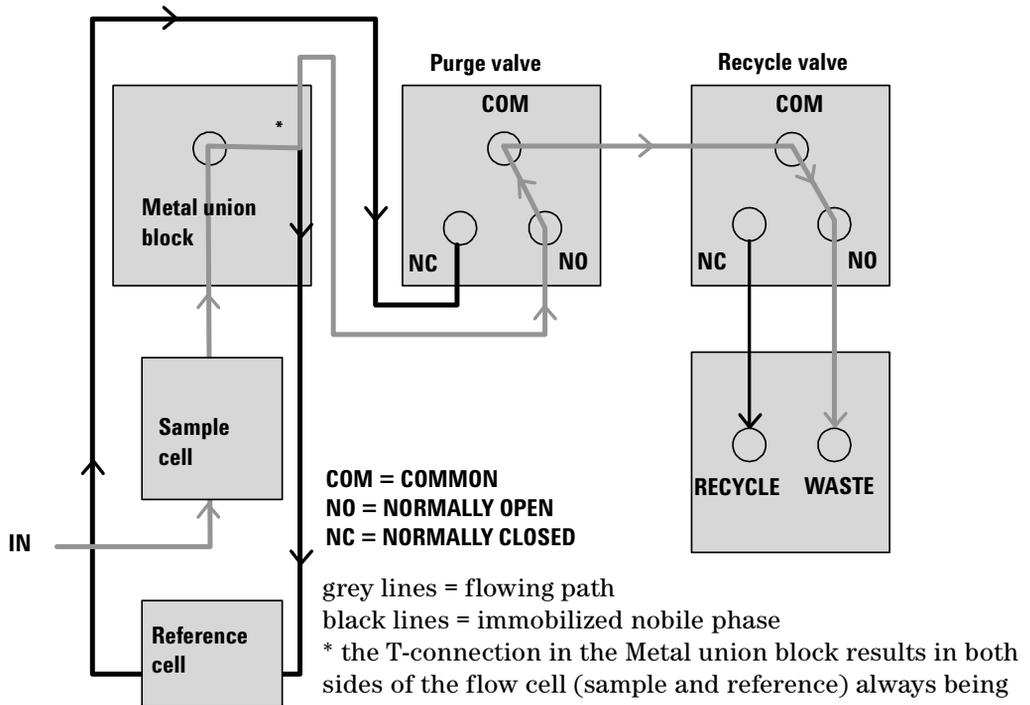


Figure 48 Flow path with the Purge- and Recycle-Valves = OFF

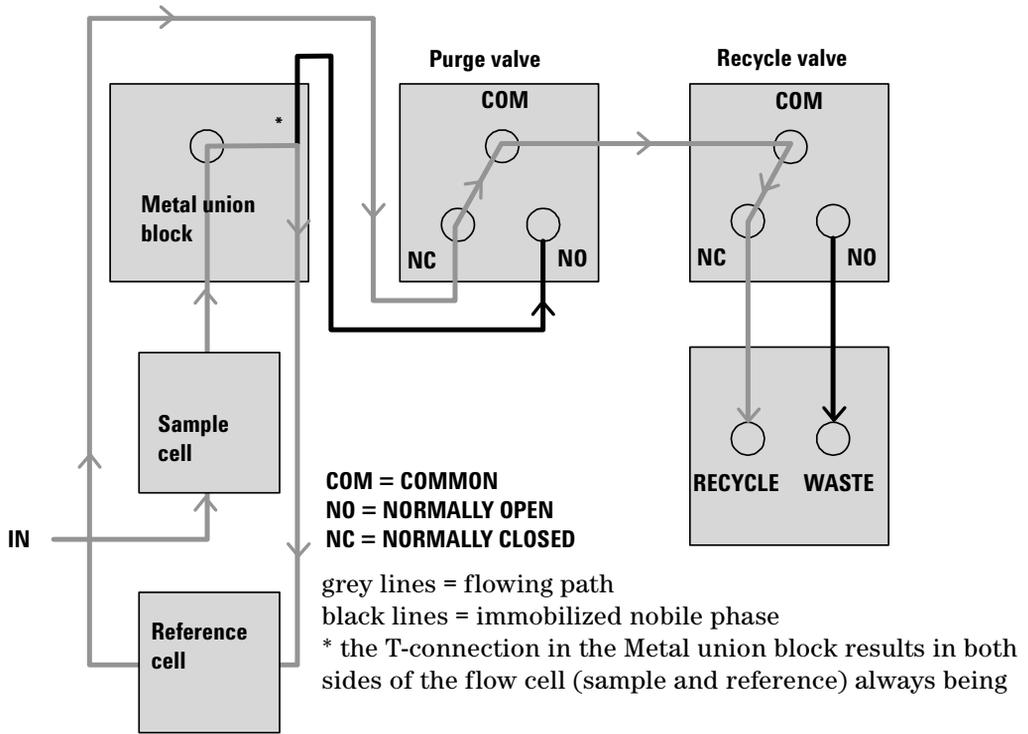


Figure 49 Flow path with the Purge- and Recycle-Valves = ON

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 192) 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.
- The independent analog output provides a signal 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 193). 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 V AC \pm 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.

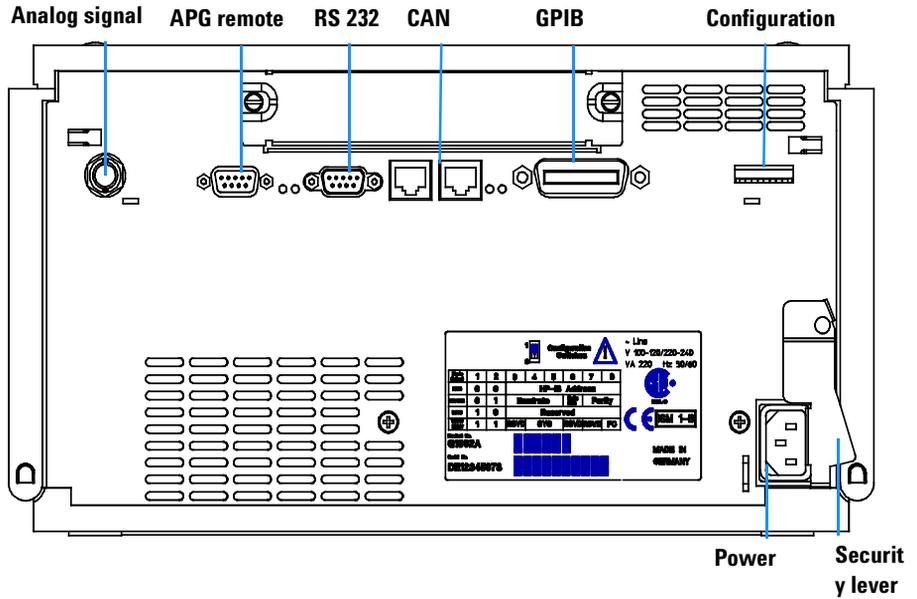


Figure 50 Electrical Connections

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 one EMF counters for the reference liquid age. The counters increment with the time that liquid remains in the reference cell, and can be assigned a maximum limit which provides visual feedback in the user interface when the limit is exceeded. The counters are reset to zero after the reference cell is purged.

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 counter time since last purge is dependent on the requirements for the analysis, 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 reference liquid age counters. Enter this values (or a value slightly less than the displayed values) as an EMF limit, and then reset the EMF counter to zero. The next time the EMF counter exceed the new EMF limit, the EMF flag will be displayed, providing a reminder that maintenance needs to be scheduled.

Electronics

The electronics are comprised of two main components:

- **detector main board** (RIM), see [page 178](#).
- **power supply**, see [page 196](#).

Optional:

- **interface board** (BCD/external contacts), see [page 184](#).
- **interface board** (LAN), see [page 185](#).

Detector Main Board (RIM)

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.

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 229.

Analog Outputs

There is a single independent analog output (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.

The Analog Output Range can be set to either 1.0V (default) or 0.1V full scale. The baseline Zero value has a default offset of 5% (settable to 0-99%). Attenuation can be set in 12 steps from 488-1000000 nRIU (default is 500000 nRIU).

Valve Drive

There are two identical valve drives for the purge and recycle valves. Each drive comprises an amplifier for the solenoids of the valve.

Heater Drive

This block comprises an amplifier and a filter for the current of the heater foil. This current is measured and routed to the ADC input multiplexer for data acquisition. In addition there are two comparators that, for diagnostics, detect shorts or openings in the thermal fuse and heater foil. The temperature sensor signal is amplified and routed to the ADC input multiplexer for data acquisition.

Lamp Drive

The electronic design of the tungsten lamp provides a regulated, filtered voltage between 2.2 V and 5.5 V. Two amplifiers measure the current and voltage of the lamp. These signals are routed to the ADC input multiplexer for data acquisition.

Diode Signal Measurement

Both diode signals are amplified and routed to the ADC input multiplexer for data acquisition. In addition the electronics analyses the difference and sum of the two diode signals and route these to the ADC input multiplexer.

Electronic Fuse

The valve and heater circuits are protected by electronic fuses. Any error on the board or shortage of the valves will activate the electronic fuses and switch off the supply voltage.

Safety Switches

If the EPP foam is removed while the instrument is still on, the safety light switches are activated and the deuterium lamp, the tungsten lamps and the fan are switched off.

Interfaces

For detailed information on interfaces, see [“Interfaces”](#) on page 186.

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 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 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
- 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 [“Data flow for chromatographic output”](#) on page 182.

Firmware Updates

Firmware updates can be done using your user interface:

- handheld control module with files from a PC-card or
- Agilent ChemStation-PC with files from CD-ROM

- For downloading the latest version of Firmware, please access Agilent Technologies' Technical Support Section under <http://www.agilent.com>

The file naming conventions are:

xxxx-vvv.DLB, where

xxxx is the product number, for example, 1362 for the G1362A RID, and vvv is the revision number, for example 360 is revision 3.60

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.

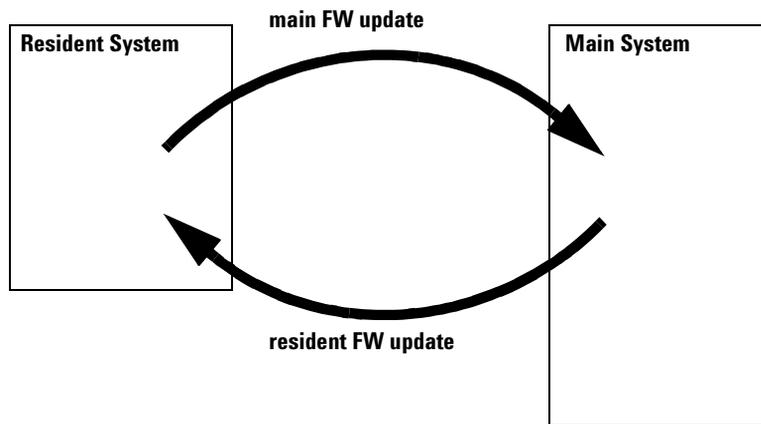


Figure 51 Firmware Update Mechanism

Data flow for chromatographic output

The data flow is shown below.

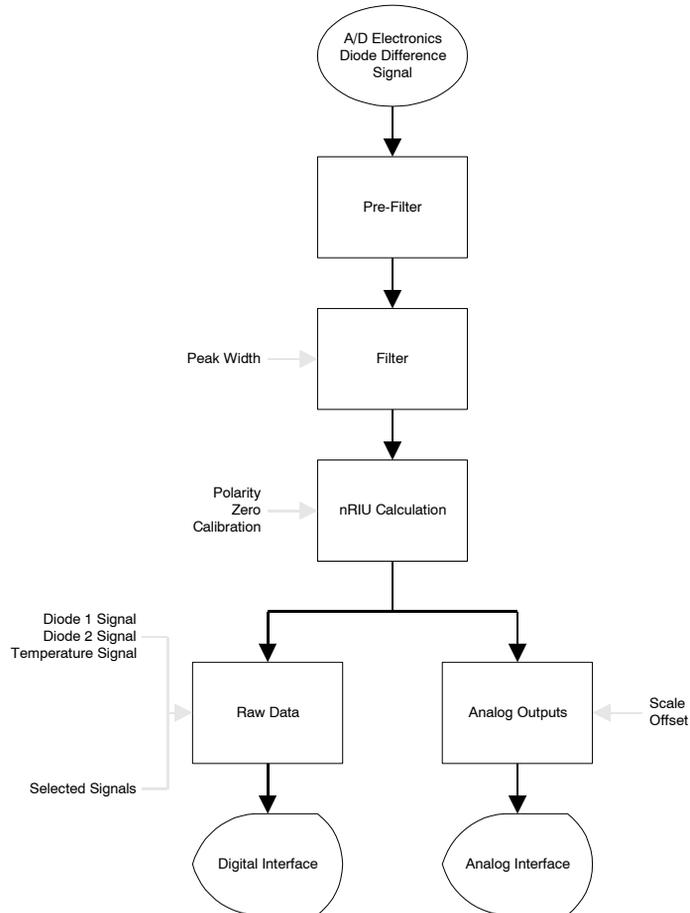


Figure 52 Data flow for chromatographic output

Optional Interface Boards

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

Table 34 Optional Interface Boards

Description	Part Number
BCD Board	G1351-68701
Fuse 250 mA (four are on the board)	2110-0004
LAN Board (see next page for details)	J2550B or J2552B

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). There are general purpose cables available to connect the BCD output, see “[BCD Cables](#)” on page 155 and the external outputs, see “[External Contact Cable](#)” on page 159 to external devices.

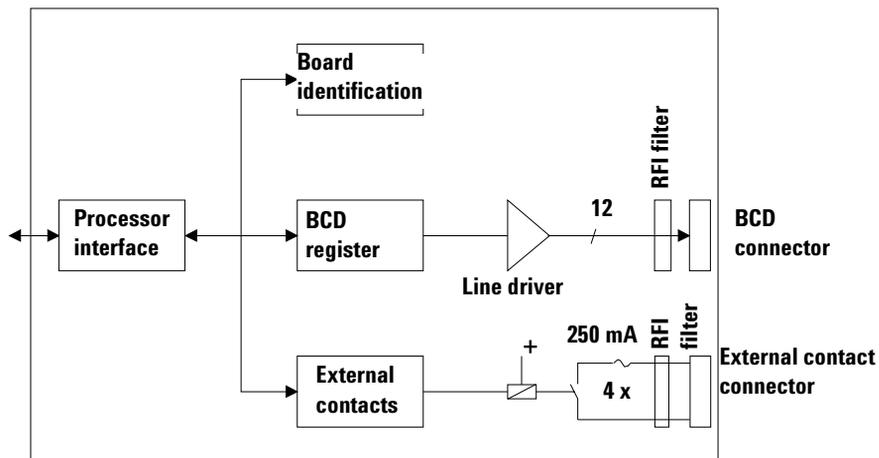


Figure 53 Block Diagram BCD Board

LAN Board

The HP JetDirect cards are network interface cards used in HP printers.

NOTE

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

NOTE

The LAN board can only be used together with:

a main board version G13XX-66520 (DAD/MWD/VWD/Pump/ALS/TCC) or G13XX-66500 (FLD/RID) and above.

a DOS-ChemStation software revision A.06.xx or above.

The following cards can be used with the Agilent1100 modules. The following cards can be used with the Agilent1100 modules

Table 35

Order Number	Supported networks
J4106A	Ethernet/802.3, RJ-45 (10Base-T)
J4105A	Token Ring/802.5, DB9, RJ-45 (10Base-T)
J4100A	Fast Ethernet, Ethernet/802.3, RJ-45 (10/100Base-TX) + BNC (10Base2)

NOTE

Minimum firmware of the JetDirect cards is A.05.05.

Recommended Cables

For point to point connection (not using a network hub) use a twisted pair cross over LAN cable (P/N 5183-4649, 10 feet long).

For standard network connections using a hub use category 5 UTP cables, (P/N G1530-61480, 8 m long).

The HP JetDirect cards are network interface cards used in HP printers.

Interfaces

The Agilent 1100 Series modules provide the following interfaces:

Table 36 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 7](#) on page 21.

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 146.

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 37 Default Addresses

Autosampler	28	Autosampler	28
Pump	22	RID	29
FLD	23		
VWD	24	Autosampler (HP 1050)	11
HP 8453A	25	Pump (HP 1050)	12
DAD/MWD	26	VWD (HP 1050)	10
Column Compartment	27	DAD (HP 1050)	17

CAN Interface

The CAN is an inter module 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 38 Remote Signal Distribution

Pin	Signal	Description
1	DGND	Digital ground
2	PREPARE	(L) Request to prepare for analysis (for example, calibration, detector lamp on). Receiver is any module performing pre-analysis activities.
3	START	(L) Request to start run / timetable. Receiver is any module performing run-time controlled activities.
4	SHUT DOWN	(L) System has serious problem (for example, leak: stops pump). Receiver is any module capable to reduce safety risk.
5		Not used
6	POWER ON	(H) All modules connected to system are switched on. Receiver is any module relying on operation of others.
7	READY	(H) System is ready for next analysis. Receiver is any sequence controller.

Table 38 Remote Signal Distribution (continued)

Pin	Signal	Description
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 39 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

6 Introduction to the Refractive Index Detector

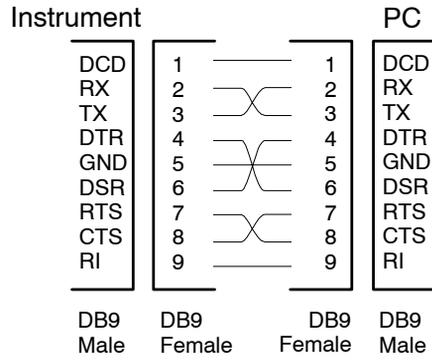


Figure 54 RS-232 Cable

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

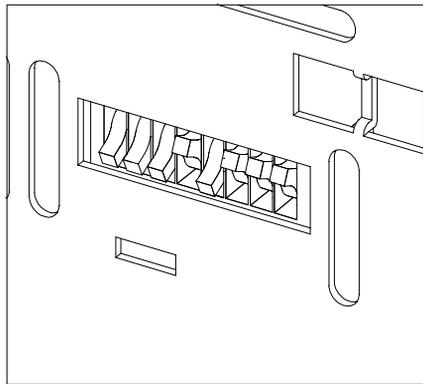


Figure 55 8-bit Configuration Switch

Table 40 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 41 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
HP 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 42 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 43 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 44 Data Bit Settings

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

Table 45 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 46 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 47 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 on site 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 – 240 Volts AC \pm 10 % and needs no manual setting.

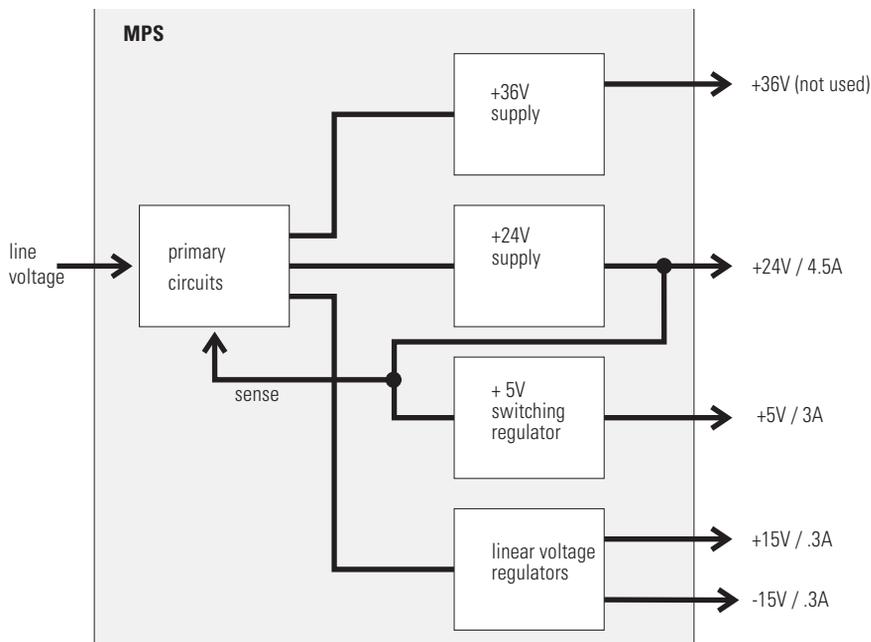


Figure 56 Main Power Supply (MPS) Block diagram

WARNING

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.

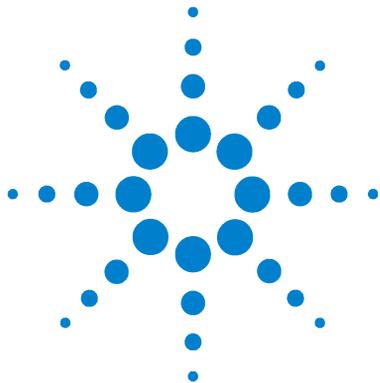
No accessible hardware fuse is needed because the main power supply is safe against any short circuits or overload conditions on the output lines. When overload conditions occur, the power supply turns off all output voltages. Turning the line power off and on again resets the power supply to normal 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 48 Main Power Supply Specifications

Maximum power	160 VA	Continuous output
Line Input	100 – 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	



7

Control Module Screens for the Agilent 1100 RI Detector

Major keys on the Agilent 1100 Control Module	200
Screens available from the Analysis screen	201
Screens available from the System screen	210
Screens available from the Records screen	213
Diagnostics and Tests	218



Major keys on the Agilent 1100 Control Module

Table 49

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 the following firmware revisions (earlier revisions do not support the RID):
Control Module firmware revision B.03.11.
LC Module main system firmware revision A.05.04

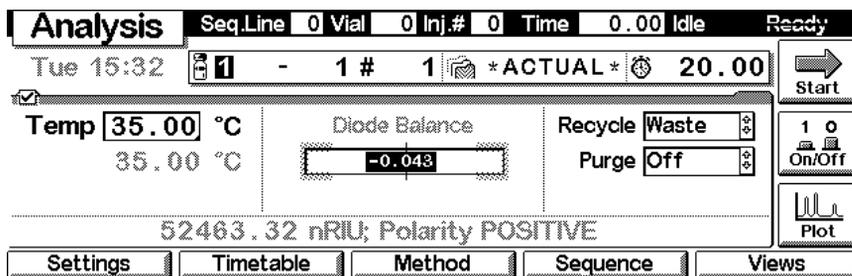
NOTE

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.

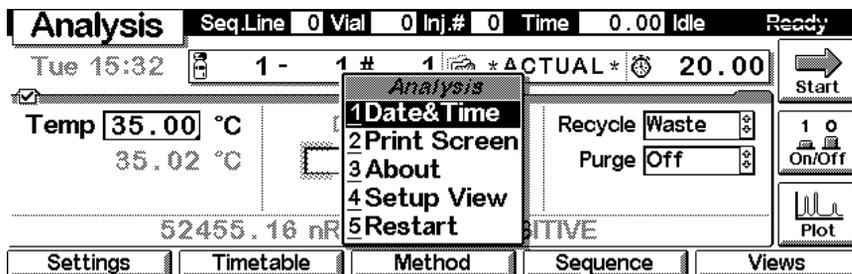
Screens available from the Analysis screen

The Analysis screen

This is the wake-up screen, if the Agilent 1100 refractive index detector is the only configured Agilent 1100 module. It is used to enter the most common RID method parameters.

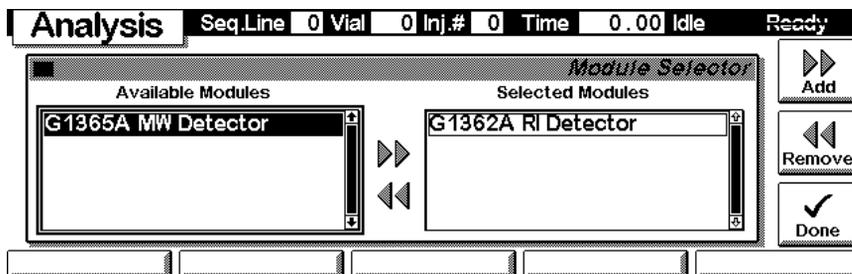


The **m**-key allows access to the context sensitive menu. **Setup view** leads you to add/remove sections for additional Agilent 1100 modules. **Restart** re-boots the control module.

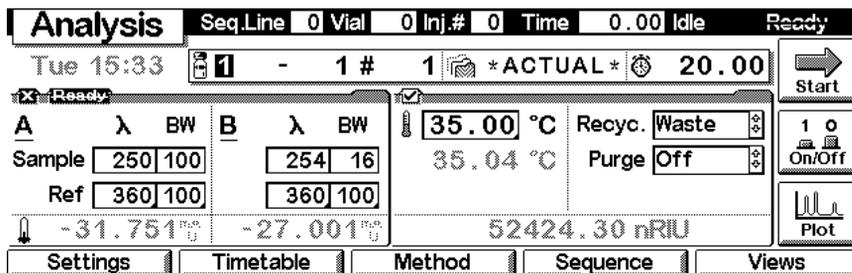


7 Control Module Screens for the Agilent 1100 RI Detector

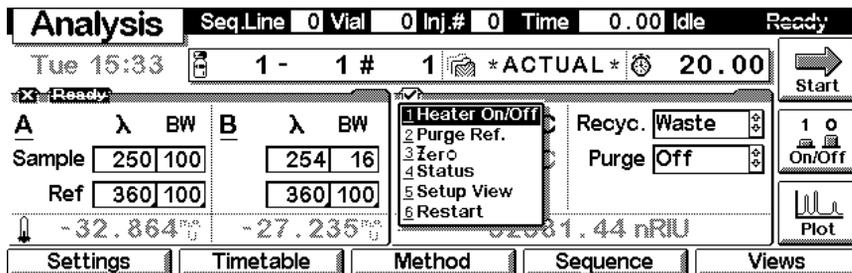
In the Setup view, e.g. the multiple wavelength detector can be added to the view.



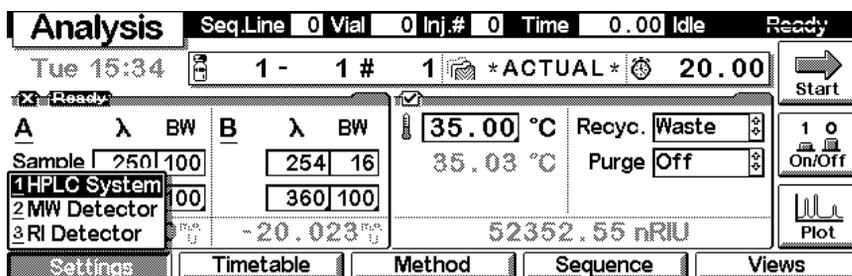
Here, e.g. the multiple wavelength detector parameters are shown on the display as well. The number of parameters on the display are restricted as additional modules are added. A maximum of 4 modules are shown automatically. If more modules are in the system, you have to select them in SetupView.



Pressing the **m**-key, while an RID-setting is selected (highlighted) gives access to a context sensitive menu for the RID (Heater ON/OFF, Purge Ref., Zero, Restart, etc.).

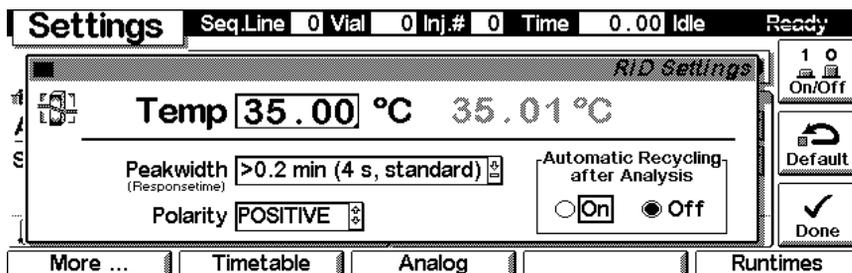


With the **Settings** key you open a pull-down menu where you can select the RID module.

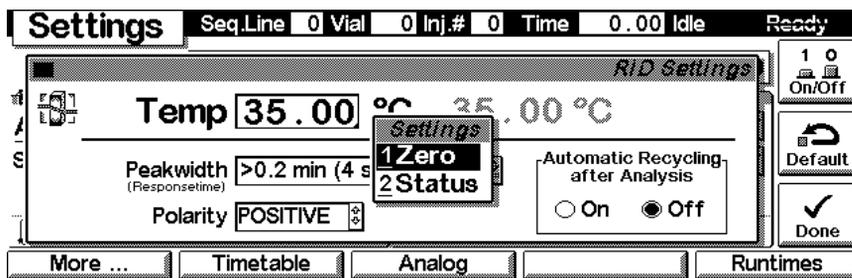


Settings

Within the **Settings** you can change the RID parameters and with a different set of parameters available through the F1-5 keys. F7 key resets the RID to default values. F8 opens a window to turn the heater on or off.

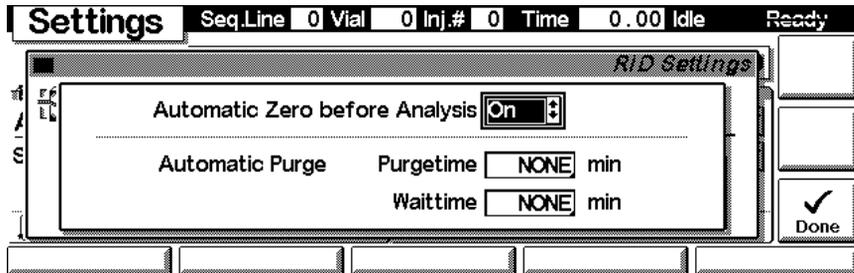


Use the **m**-key for the context sensitive menu. The **Status** command pulls up a monitor screen displaying signals as programmed. **Zero** will zero the refractive index signal.



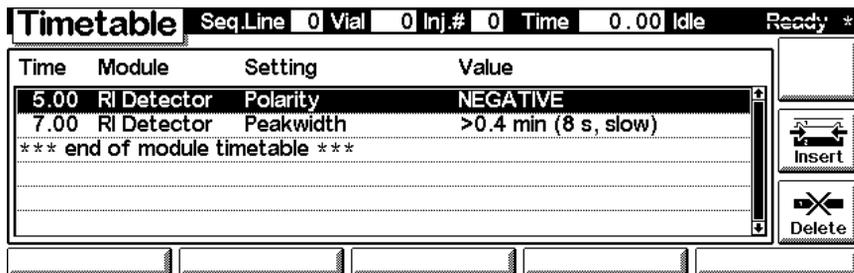
Settings - More

Use F1-key (**More**) opens a further screen where the automatic zero and automatic purge modes can be enabled.

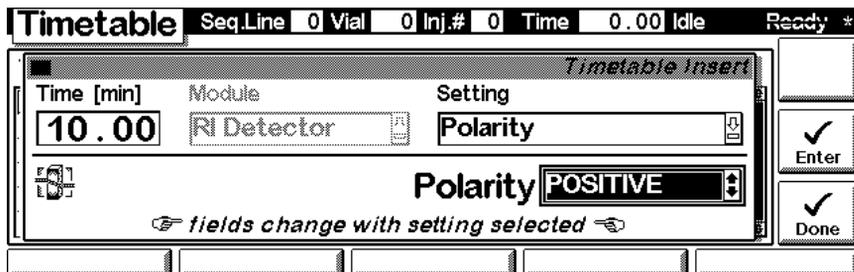


Settings - Timetable

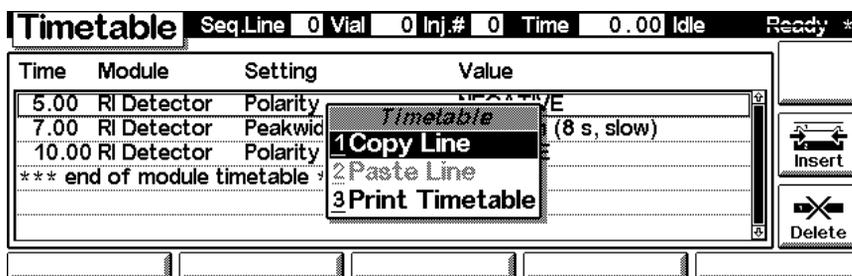
With the F2 key (**Timetable**) you can list the timetable for the RID. Press the F6 key (**Delete**) to remove entries.



Press the F7 key (**Insert**) to add timetable events. Use the F6 key (**Done**) to view the entered lines of the timetable.

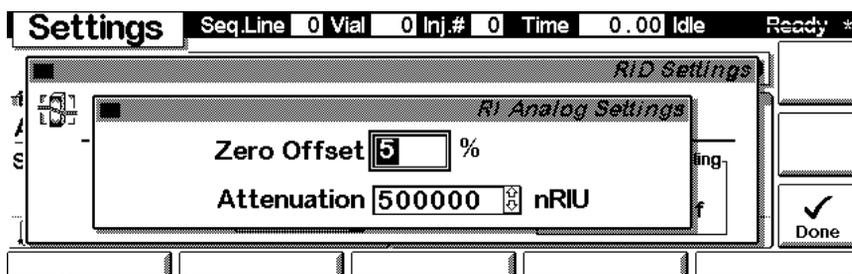


Use the **m**-key for the context sensitive menu. It gives you additional tools for the timetable.



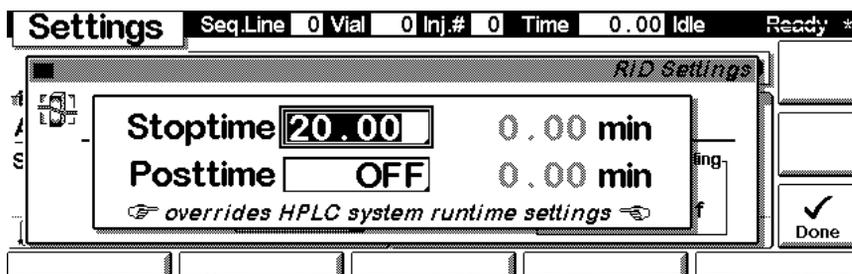
Settings - Analog

With the F3 key (**Analog**) you can change the settings for the analog output.



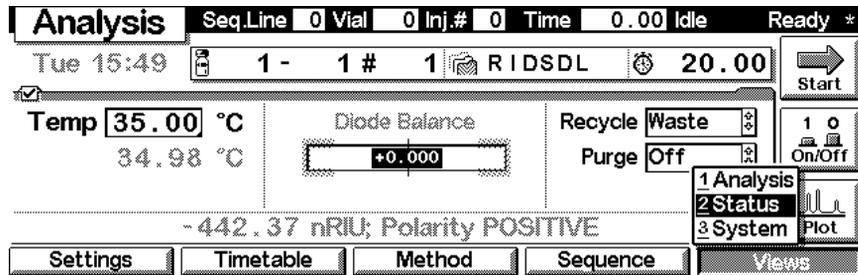
Settings - Run times

With the F5 key (**Runtimes**) you can change the stop time and the post-run time.



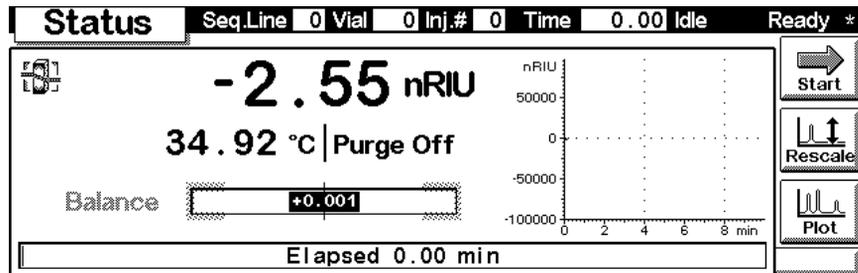
7 Control Module Screens for the Agilent 1100 RI Detector

Press Esc to return to the analysis screen followed by F5 key (**Views**) and select **Status**.

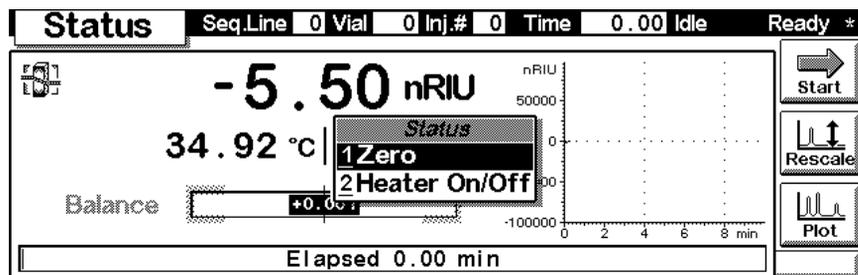


Status

This is an example if an Agilent 1100 RID is configured stand-alone.

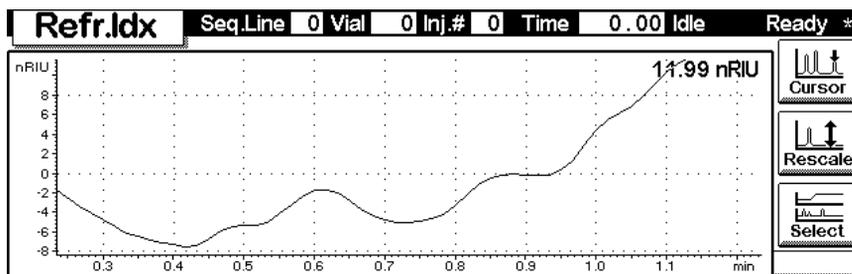


Press the **m**-key to open the context sensitive menu.

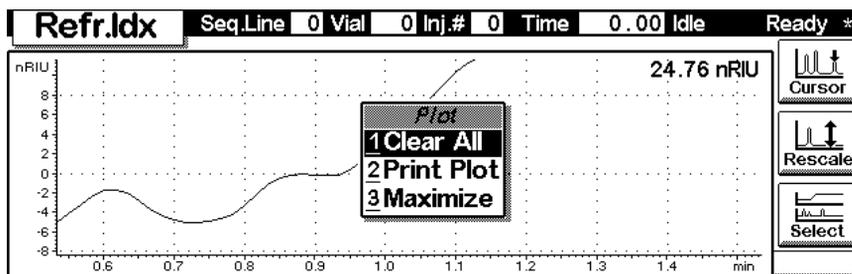


Signal plot

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.

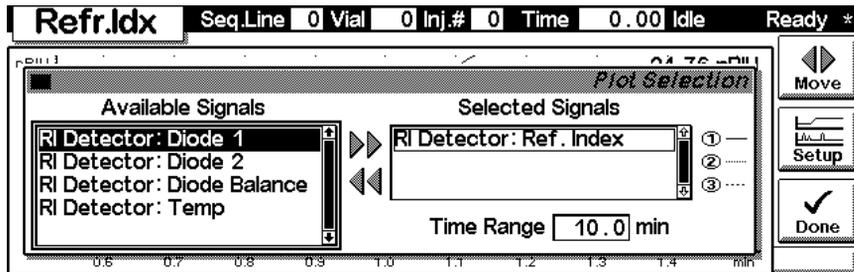


Press the **m**-key to open the context sensitive menu.



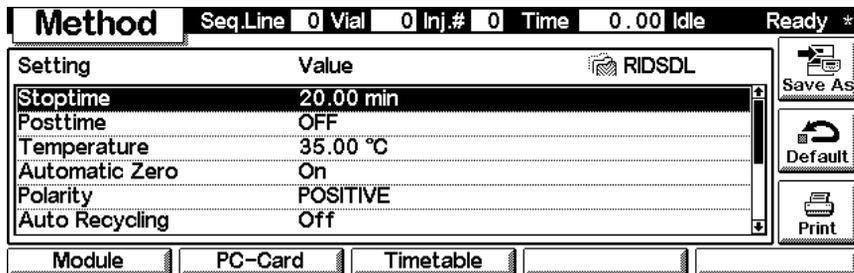
7 Control Module Screens for the Agilent 1100 RI Detector

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. Note that if other Agilent 1100 Series modules are configured only the Ref. Index and Temp. signals will be available.

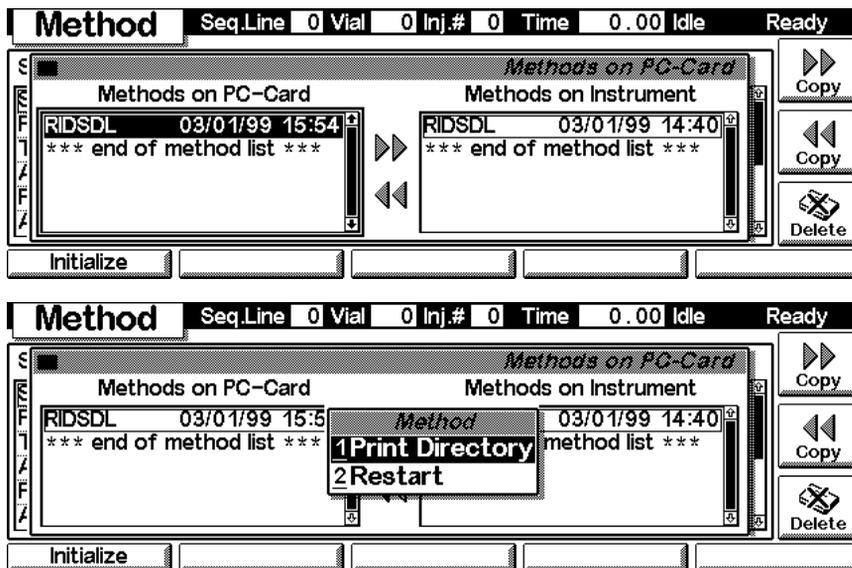


Method screens

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 module(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 EMF state and last system activities.

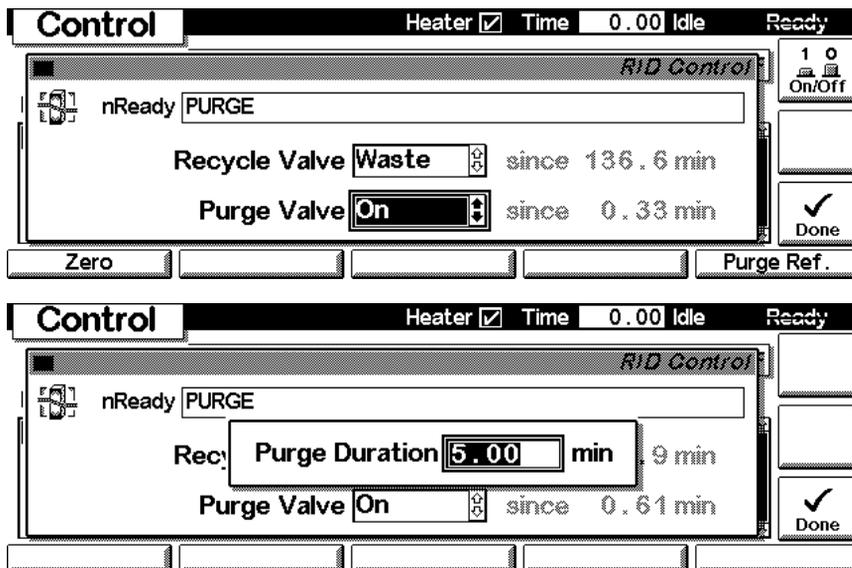
The screenshot displays the 'System' screen with the following elements:

- Title Bar:** System Heater Time 0.00 Idle Ready
- Status:** Mon 15:55 EMF Start
- Message Log:**

Module	Message	Id	Date	Time
RI Detector	Module method loaded	INFO	03/01	15:54:36
RI Detector	Setpoint changed	INFO	03/01	15:54:35
RI Detector	Heater on	STATE	03/01	15:47:16
Controller	No analysis	STATE	03/01	15:47:16
Controller	*** Control module ready ***	INFO	01/01	00:00:19
- Navigation Buttons:** Control, Configure, Tests, Records, Views
- Icons:** On/Off (1 0), Plot

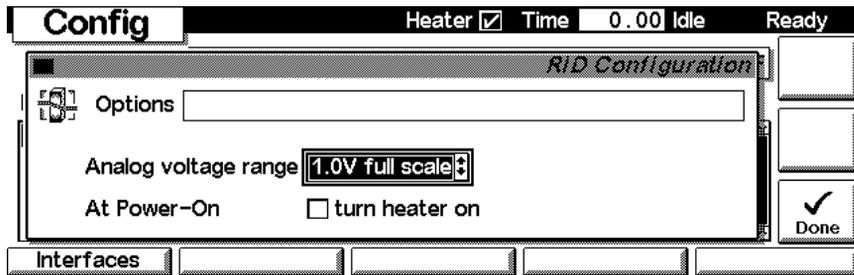
System - Control

Use the F1 key (**Control**) to select the RI-Detector. Here you receive information about the not-ready conditions if needed. Use the F5 key (**Purge Ref.**) to switch the purge valve to the on position for a defined time. Use the F8 key (**On/Off**) to turn the heater on or off.

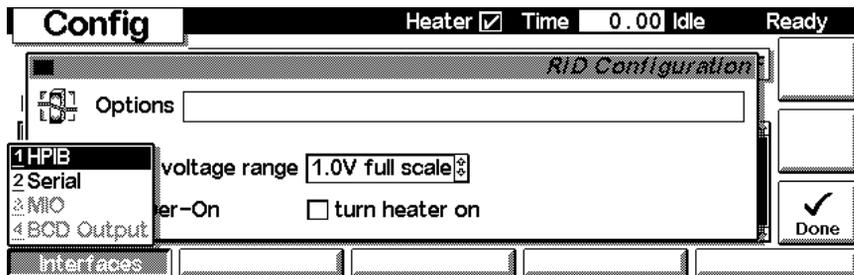


System - Configuration

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 RID. Here you define further special setpoints for the RID operation.



Use the F1 key (**Interfaces**) to access the interface settings (if required).



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 RID. Errors are reported either into the **System Log** (F2) or **Error Log** (F3).

Records						Heater <input checked="" type="checkbox"/>	Time	0.00	Idle	Ready
Module	Product#	Serial#	Version	On-Time	EMF					
Controller	G1323B	CN22514247	B.03.11		0d 00:00h					
RI Detector	G1362A*	DE91600336	A.05.04	[008]	0d 00:25h					

Buttons: EMF, System Log, Error Log, Maint Log, FW Update

Icons: Identify, Print

System / Error Log

Use the F2 key (**System Log**) or F3 key (**Error Log**) to look for errors.

Records						Heater <input checked="" type="checkbox"/>	Time	0.00	Idle	Ready
RI Detector System Logbook										
Message	Date	Time								
No analysis	03/31/03	08:37:14								
Heater on	03/31/03	08:37:14								
Setpoint changed	03/31/03	08:37:14								
Module method loaded	03/31/03	08:37:14								
*** end of logbook ***										

Buttons: (Empty)

Icon: Print

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.

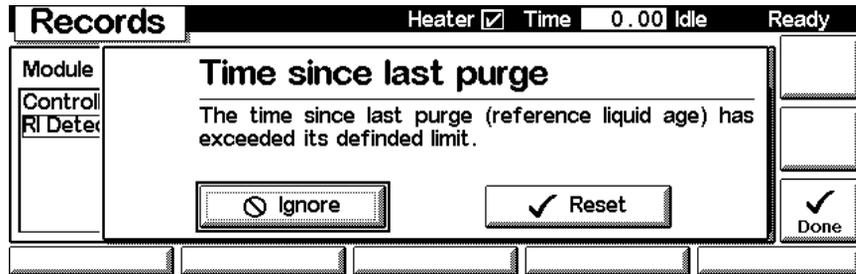
Records			Heater <input checked="" type="checkbox"/>	Time 0.00	Idle	Ready
<i>RI Detector Info Logbook</i>						
Message	Date	Time				
Run buffer overflow	03/31/03	08:37:14				
Module method loaded	03/31/03	08:37:14				
Method modified	03/31/03	08:37:14				
Info (0x00d6,10)	03/31/03	08:37:14				
Module method saved	03/01/03	14:40:57				
						Print

EMF (Early Maintenance Feedback)

Use the F1 key (**EMF**) to set EMF parameters. Choose menu item 1 (**Setup limits**) to select the time since last purge at which you want to receive a warning.

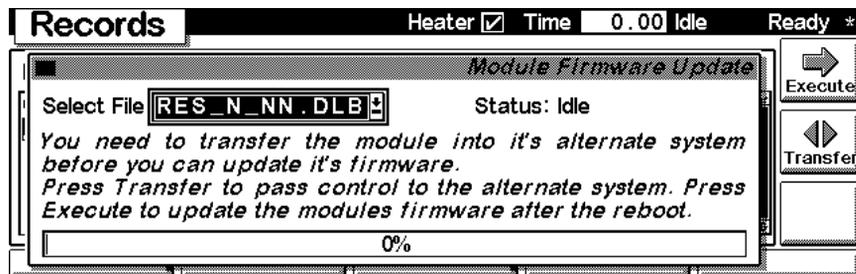
Records			Heater <input checked="" type="checkbox"/>	Time 0.00	Idle	Ready
<i>RI Detector EMF Limits</i>						
 G1362A RI Detector	Serial# DE91600336					
Time Since Last Purge	0.1	Limit	OFF h			
						Reset
						Done

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.



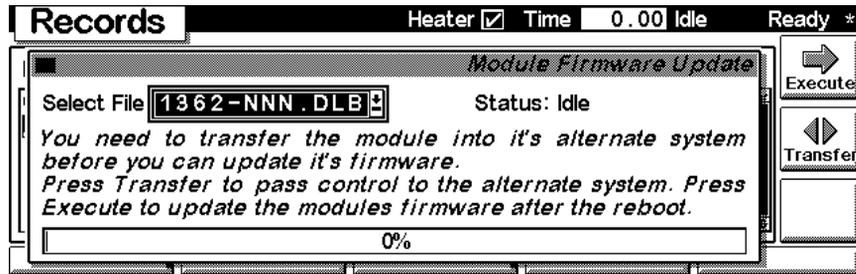
Firmware Update

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 RID. 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 (RES_n_nn.DLB, where n_nn is the revision) and press execute. If you want to update the main system firmware, press the F7 key (**Transfer**) to turn the module into the resident mode (the LED on module will blink yellow).



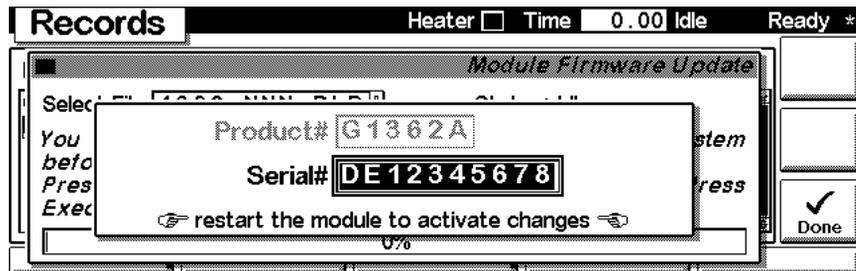
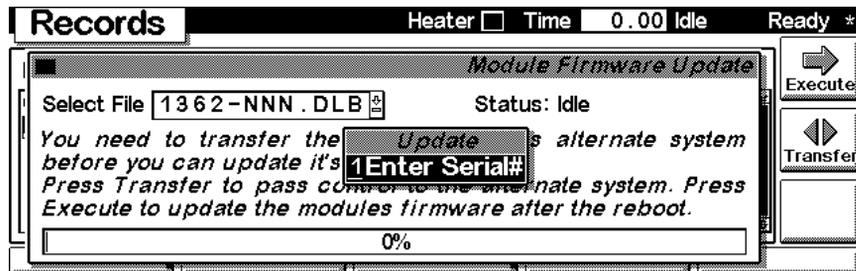
7 Control Module Screens for the Agilent 1100 RI Detector

To update the main system firmware select the a file from the PCMCIA card (1362-nnn.DLB, where nnn is the revision) 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).



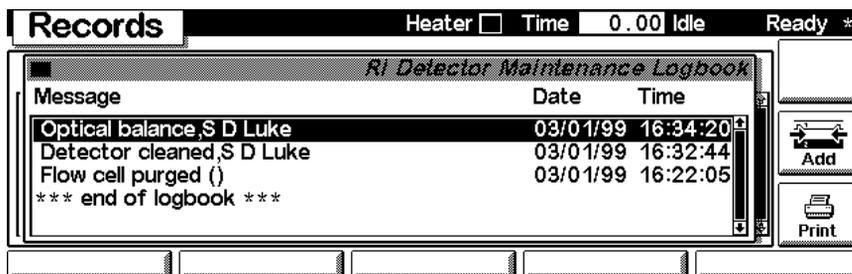
Changing the serial number

In case the serial number of the module has to be added, use the **m**-key to open the menu **Enter Serial#**. Choose **System** from the pull-down menu. Use the F3 key (**Records**) to select the RID. Use the F4 key (**Maint log**) to view and edit the maintenance logbook.

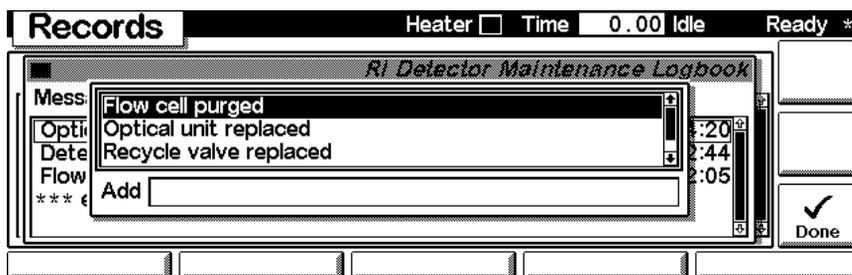


Maintenance activities

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 RID. Use the F4 key (**Maint log**) to view and edit the maintenance logbook.



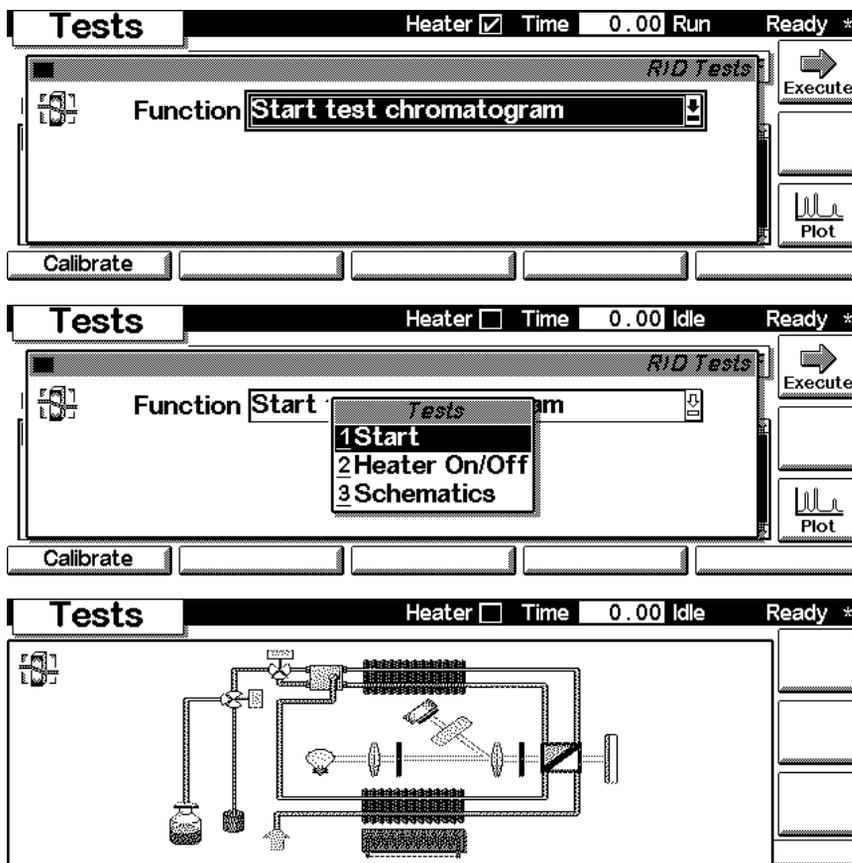
Use the F7 key (**Add**) to add new maintenance activities.



Diagnostics and Tests

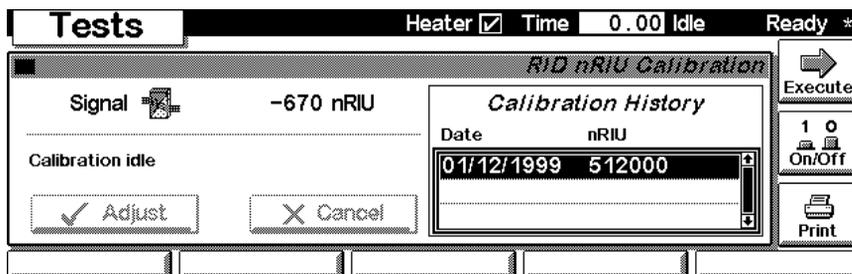
Tests screen

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 RID. Several tests available to test the Agilent 1100 RID are shown on the screen and in the function box. Press the **m**-key to open the context sensitive menu. Menu item 3 (**Schematics**) will show the RID diagram.



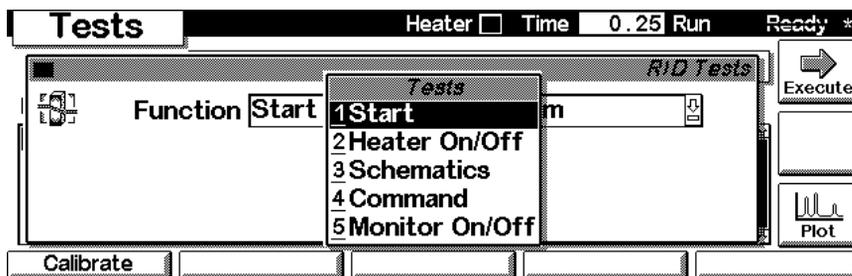
Refractive Index Calibration

Use the F1 key (**Calibrate**) and then F8 key (**Execute**) to start the refractive index calibration (using a sucrose calibration sample). If a deviation is found, press **Adjust**.



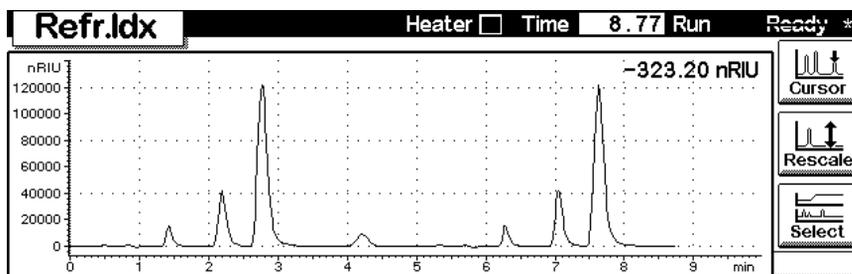
Built-in Test Chromatogram (Simulation)

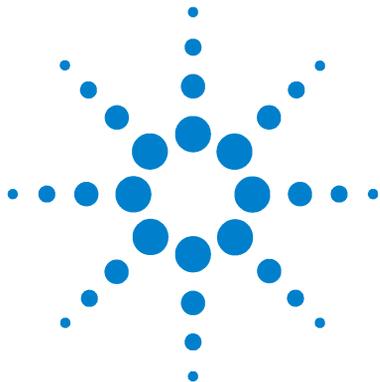
To start the built-in test chromatogram, use the F8 key (**Execute**) to enable the simulation. Then press the m-key to open the pop-up menu. Select **Start** to start a run (all modules in the Agilent 1100 system must be in ready state).



7 Control Module Screens for the Agilent 1100 RI Detector

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.





8 Specifications

Performance Specifications [222](#)



Performance Specifications

Table 50 Performance Specifications Agilent 1100 Series Refractive Index Detector

Type	Specification	Comments
Detection type	Refractive Index	
Refractive index range	1.00 - 1.75 RIU, calibrated	
Measurement range	+/- 600 x 10 ⁻⁶ RIU	
Optical zeroing		via set screw
Optics temperature control	5 ° C above ambient to 55 ° C	
Sample cell	volume 8uL maximum pressure 5 bar (0.5Mpa) maximum flow rate 5mL/minute	
Valves	Automatic purge and automatic solvent recycle	
Volumes	Inlet port to sample cell 62uL, inlet port to outlet port 590uL	
Liquid contact materials	316 stainless steel, teflon and quartz glass	
pH range	2.3 - 9.5	
Performance specifications	Short term noise < +/- 2.5 x 10 ⁻⁹ RIU Drift < 200 x 10 ⁻⁹ RIU/hour	see note below this table
Time programmable parameters	polarity, peakwidth	
Detector zero	automatic zero before analysis	

Table 50 Performance Specifications Agilent 1100 Series Refractive Index Detector (continued)

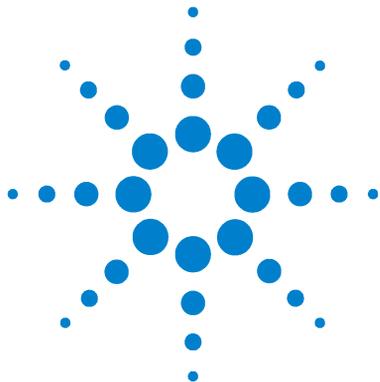
Type	Specification	Comments
Control and data evaluation	Parameter entry, signal display, on-line help and diagnostics with the Agilent 1100 Series Control Module. Optional PCMCIA card for method, sequence and logbook storage and transfer. Agilent ChemStation for LC PC based software for control and data evaluation.	
Analog outputs	Recorder/integrator: 100 mV or 1 V, output range selectable, one output	
Communications	Controller-area network (CAN), GPIB, RS-232C, LAN, APG Remote: ready, start, stop and shut-down signals	
Safety and maintenance	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.	
GLP features	Early maintenance feedback (EMF) for continuous tracking of instrument usage with user-selectable limits and feedback messages. Electronic records of maintenance and errors. Automated operational qualification/performance verification (OQ/PV).	
Housing	All materials recyclable.	

Table 50 Performance Specifications Agilent 1100 Series Refractive Index Detector (continued)

Type	Specification	Comments
Environment:	0 to 55 ° C constant temperature at <95% humidity (non-condensing)	
Dimensions:	180 mm x 345 mm x 435 mm (7 x 13.5 x 17 inches) (height x width x depth)	
Weight	17 kg (38 lbs)	

NOTE

Based on ASTM method E-1303-95 "Practice for Refractive Index Detectors used in Liquid Chromatography". Reference conditions; optics temperature 35 ° C, response time 4 s, flow 1.0 mL/min LC-grade Water, restriction capillary, column compartment temperature 35 ° C, Agilent 1100 Series on-line vacuum degasser, pump and thermostatted column compartment. Instrument equilibrated for 2 hours.



A Safety Information

General Safety Information	226
Lithium Batteries Information	229
Radio Interference	230
Sound Emission	231
Solvent Information	232
Agilent Technologies on Internet	234



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.

Operation

Before applying power, comply with the installation section. Additionally the following must be observed.

Do not remove instrument covers when operating. Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers, and devices connected to it must be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any intended operation.

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

Some adjustments described in the manual, are made with power supplied to the instrument, and protective covers removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided 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 51 shows safety symbols used on the instrument and in the manuals.

Table 51 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.
	Indicates a protected ground terminal.
	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.

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.

WARNING

Lithiumbatteri - Eksplosionsfare ved fejlagtig håndtering. Udskiftning må kun ske med batteri af samme fabrikat og type. Lever det brugte batteri tilbage til leverandøren.

WARNING

Lithiumbatteri - Eksplosionsfare. Ved udskiftning benyttes kun batteri som anbefalt av apparatfabrikanten. Brukt batteri returneres til apparatleverandøren.

NOTE

Bij dit apparaat zijn batterijen geleverd. Wanneer deze leeg zijn, moet u ze niet weggoien 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 unscrewed 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 $L_p < 70$ dB (A)
- At Operator Position
- Normal Operation
- According to ISO 7779:1988/EN 27779/1991 (Type Test)

Solvent Information

Observe the following recommendations on the use of solvents.

Flow Cell

Alkaline solutions (pH > 9.5) dissolve the quartz of a flow cell and should not be left in the system for several days.

Prevent any crystallization of buffer solutions. This will lead into a blockage/damage of the flow cell (maximum allowed pressure on the RID flow-cell is 5.0 bar or 0.5 MPa).

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

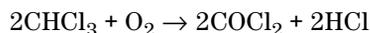
Aqueous solvents in the flow cell can build up algae. Therefore do not leave aqueous solvents sitting in the flow cell. Add small % of organic solvents (e.g. Acetonitrile or Methanol ~5%). Refer to “[Flow Cell Flushing](#)” on page 96.

Solvents

Brown glass ware can avoid growth of algae.

Always filter solvents, small particles can permanently block the capillaries. try to 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). Otherwise the system has to be flushed carefully after the use of these solvents (when not operated).
- Some inorganic acids like hydrochloric acid dissolve steel and must not be used (replace, if your chromatography method allows, by phosphoric acid or phosphate buffer which are less corrosive against stainless steel).
- Halogenated solvents or mixtures which form radicals and/or acids, for example:



This reaction, in which stainless steel probably acts as a catalyst, occurs quickly when not stabilized. Flush the system with pure water, when not in use.

- 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.
- Mixtures of carbon tetrachloride with 2-propanol or THF dissolve steel.

Agilent Technologies on Internet

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

<http://www.agilent.com>

Select “Products” - “Chemical Analysis”

It will provide also the latest firmware of the Agilent 1100 series modules for download.

Index

A

- accessory kit, 16
- accessory kit parts, 144
- Agilent on internet, 234
- algae information, 232
- algae, 96
- analog output, 178
- analog signal output, 187
- APG remote interface, 187
- automatic purge, 168
- automatic recycling after analysis, 168
- automatic zero before analysis, 168

B

- baseline noise, 27, 33
- baseline noise and drift, 34
- battery
 - description, 178
 - safety information, 229
- BCD board, 184
- BCD/LAN board, 183
- bench space, 13
- boards
 - interface board (BCD/LAN), 183

C

- cabinet kit
 - assembling, 129

- cable
 - connecting APG remote, 19
 - connecting CAN, 19
 - connecting GPIB, 19
 - connecting LAN, 19
 - connecting the ChemStation, 19
 - connecting the power, 19
 - overview and identification, 146
- CAN interface, 187
- check out sample, 29
 - setting the chromatographic conditions, 29
- checking baseline noise and drift
 - evaluation, 40
 - setting the test conditions, 34
- configuration switch
 - default settings, 191
 - description and factory settings, 191
- control module
 - Analysis screens, 201
 - Control screens, 211
 - Error Log screen, 213
 - Firmware Update screens, 215
 - Info Log and EMF screen, 214
 - introduction to FLD screens, 3
 - Maintenance screens, 217
 - Method screens, 208
 - Records screen, 213
 - Run Times screen, 205
 - serial number change of MWD, 216
 - Settings screens, 203
 - Signal Pilot screens, 207
 - Status screens, 206
 - System screen, 210
 - Tests and Diagnostic screens, 218
 - Timetable screens, 204
- covers
 - replacing, 127

D

- DAC test, 88
- DAM board
 - safety switches, 179
- damaged packaging, 15
- degasser, 27
- delivery checklist, 15
- Detection, 166
- detection principle, 166
- detector main board (RIM)
 - exchanging, 103
- dimensions and weight, 14
- diode signal measurement, 179

E

- early maintenance feedback (EMF), 176
- electrical connections
 - description of, 173
- electronic fuse, 179
- EMF (early maintenance feedback), 176
 - time since last purge, 176
- environment, 13
- Error, 45
- Error Messages, 45

Index

- error messages
 - compensation sensor open, 53
 - compensation sensor short, 54
 - fan failed, 55
 - heater fuse, 58
 - heater resistance too high, 57
 - lamp current too high, 67
 - lamp current too low, 69
 - lamp voltage too high, 66
 - lamp voltage too low, 68
 - leak, 50
 - leak sensor open, 51
 - leak sensor short, 52
 - maximum temperature exceeded, 61
 - purge valve fuse blown, 62
 - purge valve not connected, 64
 - recycle valve fuse blown, 63
 - recycle valve missing, 65
 - remote time-out, 48
 - remote timeout, 48
 - shutdown, 47
 - synchronization lost, 49
 - thermal fuse open, 56
 - time-out, 46
 - undecipherable temperature signal, 60
 - wait function timed out, 70
 - wrong temperature profile, 59
- ESD (electrostatic discharge) strap, 93
- exchanging. *see* repairs
- F**
- fan
 - exchanging, 107
- features
 - safety and maintenance, 223
- firmware
 - description, 180
 - main system, 180
 - raw data conversion, 182
 - resident system, 180
 - updates, 180
- firmware updates, 180
- Flow, 169
- flow cell
 - flushing, 96
- flow cell pressure, 26
- flow path, 168
- Flushing, 96
- foams
 - replacing, 127
- frits and filters, 26
- front view of module, 20
- fuses
 - BCD board, 183
 - power supply, 197
- G**
- GLP features, 223
- GPIO
 - default addresses, 187, 192
 - interface, 187
- H**
- heater drive, 179
- how the detector operates, 163
 - automatic purge, 168
 - automatic recycling after analysis, 168
 - automatic zero before analysis, 168
 - detection principle, 166, 167
 - detector design, 166
 - factors that affect refractive index, 164
 - flow path, 168
 - light refraction, 164
 - measurements, 167
 - optical path, 167
 - purge valve, 168
 - purgetime, 168
 - recycle valve, 168
 - Snell's Law, 163
 - waittime, 168
- humidity, 14
- I**
- Identifying, 133
- installation
 - accessory kit, 16
 - bench space, 13
 - damaged packaging, 15
 - delivery checklist, 15
 - environment, 13
 - flow connections, 22
 - of in, waste and recycle capillaries, 22
 - of the detector, 20
 - physical specifications, 14
 - power considerations, 12
 - power cords, 12
 - site requirements, 12
 - unpacking, 15
- instrument layout, 175
- interface board (BCD/LAN), 183
 - replacing, 130
- interfaces
 - analog signal output, 187
 - APG remote, 187
 - CAN, 187
 - GPIO, 187
 - overview, 186
 - RS-232C, 189
- internet, 234
- introduction
 - introduction to the detector, 162
 - operation of the detector, 163
- L**
- lamp drive, 179
- LAN interface board, 185
- leak handling system
 - replacing, 98
- leak plane
 - exchanging, 109
- leak sensor
 - exchanging, 109
- leak pan
 - replacing, 118
- leaks
 - correcting, 97
- line voltage and frequency, 14

M

message

- compensation sensor open, 53
- compensation sensor short, 54
- fan failed, 55
- heater fuse, 58
- heater resistance too high, 57
- lamp current too high, 67
- lamp current too low, 69
- lamp voltage too high, 66
- lamp voltage too low, 68
- leak, 50
- leak sensor open, 51
- leak sensor short, 52
- maximum temperature exceeded, 61
- not enough light, 75
- purge time running, 72, 73
- purge valve fuse blown, 62
- purge valve not connected, 64
- recycle valve fuse blown, 63
- recycle valve missing, 65
- remote time-out, 48
- remote timeout, 48
- shutdown, 47
- synchronization lost, 49
- thermal fuse open, 56
- time-out, 46
- too much light, 76
- unbalanced diodes, 74
- undecipherable temperature signal, 60
- wait for purge, 73
- wait function timed out, 70
- wrong temperature profile, 59

mobile phase recycling, 27

N

not-ready messages

- not enough light, 75
- purge time running, 72, 73
- too much light, 76
- unbalanced diodes, 74
- wait for purge, 73

O

operation temperature, 14

optical balance, 82

optical balance procedure, 83

optical unit

- installing, 125
- removing, 112

optical unit temperature, 26

optimization

- check for leaks, 26
- consider solvent changes with time, 27
- control the optical unit temperature, 26
- do not overpressurize the flow cell, 26
- eliminate mobile phase/column combination problems, 27
- flush the degasser, 27
- position the solvent and waste reservoirs correctly, 26
- recycle mobile phase, 27
- use an appropriate response time, 27
- use the correct solvents, 26
- verify frit, filter and fitting quality, 26

optional interface boards, 183

P

parts identification, 133

- accessory kit, 144
- cable overview, 146
- cables - analog, 148
- cables - APG remote, 151
- cables - auxiliary, 157
- cables - BCD, 155
- cables - CAN, 158
- cables - external contact, 159
- control module, 138
- foams parts, 141
- leak parts, 143
- main assemblies, 135
- optical unit, 136
- overview, 134
- plastic parts, 140
- power and status parts, 142
- sheet metal kit, 139

performance specifications, 222

physical specifications, 14

- humidity, 14
- line voltage and frequency, 14
- operation temperature, 14
- power consumption, 14
- safety standards, 14
- weight and dimensions, 14

power considerations, 12

power consumption, 14

power cords, 12

power supply

- description, 196
- specifications, 197

purge valve

- replacing, 119

purgetime, 168

R

rear view of module, 21, 174

recycle valve

- replacing, 116

refractive index

- calibration, 77
- optical balance, 82

refractive index calibration, 77

refractive index calibration procedure, 78

refractive index detector optimization, 26

Repairing, 91

Index

repairs

- assembling the cabinet kit, 129
- cleaning the instrument, 93
- correction leaks, 97
- definition of, 92
- exchanging internal parts, 99
- exchanging power supply, 119
- exchanging the detector main board (RIM), 103
- exchanging the fan, 107
- exchanging the leak sensor or leak plane, 109
- exchanging the power supply, 121
- flow cell flushing, 96
- installing the optical unit, 125
- introduction, 92
- of the detector, 3, 91
- removing the optical unit, 112
- replacing foams and covers, 127
- replacing interface board (BCD/LAN), 130
- replacing leak handling system, 98
- replacing the leak pan, 118
- replacing the purge valve, 119
- replacing the recycle valve, 116
- replacing the status light pipe, 124
- replacing the valve tubing, 114
- simple repairs overview, 94
- using the ESD strap, 93
- warnings and cautions, 92

response time, 27

restriction capillary, 27

RIM board

- analog output, 178
- battery, 178
- diode signal measurement, 179
- electronic fuse, 179
- heater drive, 179
- interfaces, 179
- lamp drive, 179
- valve drive, 178

RS-232C

- cable kit to PC, 160
- communication settings, 193
- interface, 189
- settings, 193

S

safety information

- on lithium batteries, 229
- standards, 14

serial number

- entered on Agilent ChemStation, 105
- entered on control module, 105

serial number change with control module, 216

Shutdown, 47

site requirements, 12

Snell's Law, 163

solvent and waste reservoirs, 26

solvents, 26, 27

specifications

- analog outputs, 223
- communications, 223
- GLP features, 223
- performance, 222
- safety and maintenance, 223

stack configuration, 18, 19

front view, 18

rear view, 19

status indicators, 43

status light pipe

replacing, 124

T

test chromatogram, 85

tests

DAC, 88

test chromatogram, 85

troubleshooting

error messages, 42

status indicators, 42, 43

U

unpacking, 15

using EMF, 176

using the detector

checking baseline noise and drift, 33

optimization, 26

running a check out sample, 29

V

valve drive, 178

valve tubing

replacing, 114

W

waittime, 168

weight and dimensions, 14

In This Book

This manual contains technical reference information about the Agilent 1100 Series refractive index detector. The manual describes the following:

- installing the RI detector,
- optimizing the RI detector ,
- troubleshooting and test functions,
- repairing the RI detector,
- identifying parts and materials,
- introduction to the RI detector and theory of operation,
- Control module screens for the RI detector,
- Specifications.



G1362-90002



Agilent Technologies