Agilent

Agilent InfinityLab
Evaporative Light Scattering Detectors

User Manual

Notices

Document Information

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WARNING

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

In This Book

This manual contains information on:

- Agilent 1260 Infinity II ELSD (G4260B)
- Agilent 1290 Infinity II ELSD (G7102A)

1 Introduction to the Detector

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

2 Site Requirements and Specifications

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

3 LAN Configuration

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

4 Using the Module

This chapter explains the operational parameters of the ELSD.

5 Optimizing Performance

This chapter gives hints on how to optimize the performance or use additional devices.

6 Troubleshooting and Diagnostics

This chapter gives an overview about the troubleshooting and diagnostic features.

7 Error Information

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

8 Maintenance

This chapter describes the maintenance of the ELSD.

9 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

10 Appendix

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

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1 Introduction to the Detector

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

Introduction to the ELSD

The Evaporative Light Scattering Detector is a unique and highly sensitive detector for semi-volatile and non-volatile solutes in a liquid stream. It is mainly used as a concentration detector for High Performance Liquid Chromatography (HPLC). The solvent stream containing the solute material is nebulized and carried by a gas flow through an evaporation chamber. The solvent is volatilized, leaving a mist of solute particles that scatter light to a photosensitive device. The signal is amplified and a voltage output provides the concentration of the solute particles passing through the light.

The Agilent 1260 Infinity II ELSD or Agilent 1290 Infinity II ELSD may be used alone, or as one of several detectors in a GPC or HPLC system. As the solvent or eluent is evaporated during the analysis, the Agilent 1260 Infinity II ELSD or Agilent 1290 Infinity II ELSD must be the last in series if used with other detectors. If the Agilent 1260 Infinity II ELSD or Agilent 1290 Infinity II ELSD is being used as the last detector in a series, care must be taken not to exceed the recommended backpressure in detector cells in other units.

This manual instructs the user in the installation and operation of the Agilent 1260 Infinity II ELSD or Agilent 1290 Infinity II ELSD for standalone use and control using Agilent OpenLab CDS, OpenLab ChemStation, or OpenLab EZChrom.

System Overview

Basic Principles of Operation

Nebulization

The eluent inlet is connected to the nebulizer via a short length of stainless steel capillary tube. The incoming eluent stream passes through the heated nebulizer and is mixed with the incoming nebulizer gas stream. The mixed gas and eluent stream form an aerosol plume containing a uniform dispersion of droplets that then passes as a continuous flow into the evaporator section. Any larger droplets or the inefficiently nebulized droplets collect in the nebulizer chamber waste trap and then drain off via the waste outlet into a collection bottle.

Evaporation

After nebulization, the atomized spray is propelled through the evaporation tube assisted by the carrier gas. In the evaporator section, the solvent is removed leaving a stream of dry particles of the analyte. A diffuser located in the evaporator assists in the drying of the particles, acting as an efficient heat exchanger, prevents ballistic particles reaching the scattering chamber and randomizes the particle plume. The ELS Detector uses patented gas flow technology in the evaporation zone to aid evaporation at low temperatures. By adding a stream of dry nitrogen (evaporation gas) at the entrance of the evaporator tube less volatile solvents (for example, water) are easily evaporated. This evaporation gas is controlled by the user and facilitates subambient operation.

Detection

Light in the optical chamber is passed through the instrument at right angles to the direction of particle flow. A light trap is located opposite the source of light to capture the transmitted incident beam eliminating internal reflections within the instrument body. When pure solvent is being evaporated, only its vapor passes through the light path and the amount of light scattered to the photomultiplier is small and gives a constant baseline response. When a nonvolatile solute is present a particle cloud passes through the light path, causing light to be scattered. This scattered light enters the optical aperture of the detection system and generates a signal response from the photodiode in real time. The quantity of light detected depends on the solute concentration and solute particle size distribution.

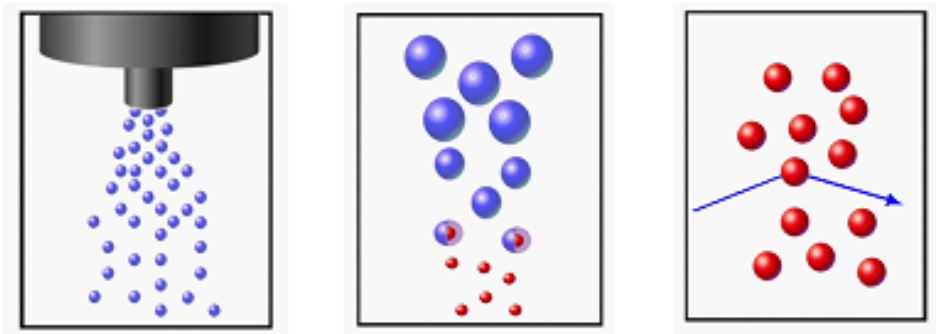

Figure 1 Principles of Operation

Theory

There are four main processes, by which the path of electromagnetic radiation or light can change direction, when passing through a medium containing a suspended particulate phase, see Figure 2 on page 11.

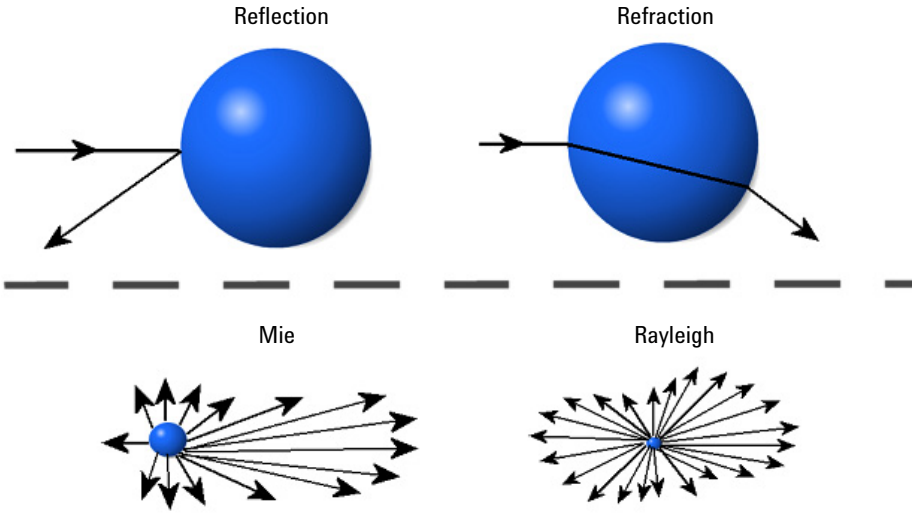

Figure 2 ELSD Scattering Mechanisms

The importance of each of these processes depends on the radius of the particle (r) compared to the wavelength (λ) of the incident light. Rayleigh scattering is predominant when r/λ is $< 5 \cdot 10^{-2}$. When particle dimensions are greater than λ/20 they no longer behave as point sources, and Mie scattering becomes predominant. Once particle size approaches the wavelength of incident light then reflection and refraction begin to prevail.

The relative importance of refraction and reflection can be understood by examining the effects of the incident light on a single spherical particle whose equilateral axis lies in the same plane as the photodetector and light source. With this configuration, refraction is of greater significance than reflection. Most organic compounds have refractive indices between 1.3 and 1.5. Changes in the refractive index within this range will not greatly affect the quantity of light reaching the detector. This accounts for similarities in the sensitivity of the instrument to various compounds.

Operational Parameters

The ELS Detector responds to all compounds that are less volatile than the mobile phase and is independent of a compound's optical properties. It therefore provides advantages over other spectroscopic detectors for detecting compounds that are deficient in a UV chromophore or fluorophore.

The removal of aqueous mobile phase within an ELSD is typically achieved by setting the evaporator temperature to the eluent's boiling point (for example 100 °C) to remove the solvent. For nonvolatile compounds, operating at these high temperatures maximizes the signal response.

However, at these temperatures volatile and semivolatile compounds are destroyed and are therefore not detected. This is problematic for small molecules, such as pharmaceuticals and drug candidates.

The ELS detector is designed to evaporate difficult solvents at ambient and subtemperatures to maximize detection of semivolatile compounds.

The ELSD has patented technology that reduces the evaporation time of highly aqueous solvents at low temperature, and also prevents the evaporation tube becoming saturated, which would otherwise prevent further evaporation occurring.

Using this patented evaporation gas technology, a 20 µm droplet of water at 30 °C can be dried ca. 3x faster than just temperature alone. Using the Agilent 1290 Infinity II ELSD (G7102A), water can be evaporated as low as 20 °C, providing maximum sensitivity to thermally sensitive compounds. For maximum sensitivity of nonvolatile compounds, the evaporation gas can be turned off at higher evaporation temperatures.

Therefore, unlike other ELS detectors, where the evaporator temperature is set according to the type of mobile phase, the ELS detector evaporator temperature is independent of the mobile phase. So, the ELS detector can be set at 30 °C for all types of mobile phase provided the evaporator gas flow is adjusted accordingly. This method of operation ensures that the ELSD sensitivity is maximized even for low molecular weight compounds.

To prevent against unnecessary gas usage, a controlled gas shutoff valve is integrated into the detector gas manifold. This shutoff valve will only allow gas to pass into the instrument when in RUN mode. Should the instrument default to STANDBY mode, the gas will reduce to a default value of 1.2 SLM for 15 min before closing.

Overview of ELS Detector

Figure 3 ELSD overview (front)

1	Front screen display
2	Keypad
3	Eluent inlet
4	Solvent waste outlet

Figure 4 ELSD overview (rear)

1	Vapor Sensor vent
2	Serial RS232 port
3	LAN connector (only active on G7102A)
4	Firmware button
5	I/O connector (Remote Start input)
6	Mains Switch
7	Mains Input
8	Gas Inlet port
9	Exhaust port

Table 1 ELS Detector I/O connections

	I/O description	Pin number
Inputs	Timetable Start	14 & ground
	Injection Sync	13 & ground
	Remote A/Z	7 & ground
Output	Pump stop contact closure – normally open	3 & 10
	Ground (to case)	1, 5, 6, 11

NOTE

To make appropriate remote start and A/Z connections from a third-party LC, a third-party remote start cable for Dimension software (Remote start cable (PL0890-0350)) can be purchased from Agilent Technologies.

2 Site Requirements and Specifications

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

Pre-installation Requirements

For a detailed description of the environmental and operating requirements of the ELSD, see the Site Preparation Checklist.

This manual will give you an overview of the ELS detector and describe its operation in more detail.

Site Requirements

A suitable environment is important to ensure optimal performance of the instrument, see the Site Preparation Checklist for more details.

Laser Safety

The Agilent 1290 Infinity II ELSD (G7102A) is classified as a "Laser Class 1" product (IEC825-1, CFR1040.10 & 1040.11). During normal operation of the ELSD no laser light is accessible to the user.

WARNING

Eye damage by laser light

Hazardous laser light can injure eyes.

- ✓ **Do not remove covers and interlocks.**
- ✓ **Observe and note the laser warning signs carefully.**

Power Considerations

Check the operating voltage of your instrument on the IEC inlet fuse holder on rear of unit.

WARNING

Hazard of electrical shock or damage of your instrumentation

can result, if the devices are connected to a line voltage higher than specified.

- ✓ **Connect your instrument to the specified line voltage only.**

WARNING

Inaccessible power plug.

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

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

Power Cords

Your detector is delivered with a power cord which matches the wall socket of your particular country or region. The plug on the power cord which connects to the rear of the instrument is identical for all types of power cord.

WARNING

Absence of ground connection or use of unspecified power cord

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

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

WARNING

Use of unsupplied cables

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

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

WARNING

Unintended use of power cords

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

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

Bench Space

The module dimensions and weight (see Table 2 on page 21) allow you to place the module on almost any desk or laboratory bench. It needs an additional 2.5 cm (1.0 inches) of space on either side and approximately 15 cm (5.9 inches) in the rear for air circulation and electric connections.

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

The module should be operated in a horizontal position.

NOTE

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

Physical Specifications

Physical Specifications Agilent 1260 Infinity II ELSD (G4260B)

Table 2 Physical Specifications G4260B

Type	Specification	Comments
Weight	11.0 kg (24.3 lbs non-cooled)	
Dimensions (height × width × depth)	420 x 200 x 450 mm (16.5 x 7.9 x 17.7 inches)	
Line voltage	100 – 120 / 220 – 240 V~, ± 10 %	
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	150 W, 2A (max)	
Ambient operating temperature	10 – 35 °C (50 – 95 °F)	
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 10 – 80 % r.h	Non-condensing
Operating altitude	Up to 2000 m (6562 ft)	
Safety standards: IEC, EN, CSA, UL	Overvoltage category II, Pollution degree 2	For indoor use only
ISM Classification	ISM Group 1 Class B	According to CISPR 11

Physical Specifications Agilent 1290 Infinity II ELSD (G7102A)

Table 3 Physical Specifications G7102A

Type	Specification	Comments
Weight	11.0 kg (24.3 lbs, non-cooled), 13.3 kg (29.3 lbs, cooled)	
Dimensions (height × width × depth)	420 x 200 x 450 mm (16.5 x 7.9 x 17.7 inches)	
Line voltage	100 – 120 / 220 – 240 V~, ± 10 %	
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	150 W, 2A (max)	
Ambient operating temperature	10 – 35 °C (50 – 95 °F)	
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 10 – 80 % r.h at 35 °C (95 °F)	Non-condensing
Operating altitude	Up to 2000 m (6562 ft)	
Safety standards: IEC, EN, CSA, UL	Overvoltage category II, Pollution degree 2	For indoor use only
ISM Classification	ISM Group 1 Class B	According to CISPR 11

Performance Specifications

Performance Specifications (G4260B)

Table 4 Performance Specifications G4260B

Type	Specification	Comment
Light Source	LED 480 nm (Class 1 LED product)	
Detector	PMT with digital signal processing	
Nebulizer	OFF, 25 – 90 °C	
Evaporator		
Non-cooled	OFF, 25 – 120 °C	
Cooled	Not Applicable	
Gas Flow Range	0.9 – 3.25 SLM (controlled gas shut-off)	
Short Term Noise	<0.2 mV	See conditions in "Specification Conditions" on page 24.
Drift	<1 mV/h	See conditions in "Specification Conditions" on page 24.
Operating Pressure	4.1 – 6.9 bar (60 – 100 psi)	
Eluent Flow range	0.2 – 5.0 mL/min	
Digital Output	10, 40 or 80 Hz (24 bit)	
Analogue Output	0 – 1.25 V FSD	
Communication	Ethernet Serial (RS232) Remote Start Input Pump Stop: 1 Contact closure	
Remote operation	Remote Start Input	

Table 4 Performance Specifications G4260B

Type	Specification	Comment
PC control	ELSD driver for OpenLab ChemStation edition ELSD driver for OpenLab EZChrom edition LC and CE Drivers Rev. A.02.11 or above	
Safety and maintenance	Gas shut-off Valve, Leak Detection, Laser Interlock	

NOTE

In order to control OpenLab CDS edition, the ELSD driver is required.

Specification Conditions

ASTM: “Evaporative Light Scattering Detectors Used in Liquid Chromatography”.

Table 5 Reference conditions

Gas flow	1.6 SLM
Neb temperature	70 °C
Evaporator temperature	70 °C
PMT Gain	1
Data Rate	40 Hz
Smoothing	G4260B: (30)
Light Source intensity	100 %

ASTM drift tests require a temperature change below 2 °C/h (3.6 °F/h) over one hour period. Our published drift specification is based on these conditions. Larger ambient temperature changes will result in larger drift. Better drift performance depends on better control of the temperature fluctuations. To realize the highest performance, minimize the frequency and the amplitude of the temperature changes to below 1 °C/h (1.8 °F/h). Turbulences around one minute or less can be ignored. ASTM measurements require that the detector should be turned on enough time before start of testing.

Performance Specifications (G7102A)

Table 6 Performance Specifications G7102A

Type	Specification	Comment
Light Source	LASER 405 nm, 10 mW (Class 3B)	
Detector	Dual PMT with digital signal processing	
Nebulizer	OFF, 25 – 90 °C	
Evaporator		
Non-cooled	OFF, 25 – 120 °C	
Cooled	OFF, 10 – 80 °C	
Gas Flow Range	0.9 – 3.25 SLM (controlled gas shut-off)	
Dynamic Range	Up to 4 orders of magnitude	
Short Term Noise	<0.1 LSU/h	See conditions in Table 7 on page 26
Drift	<1 LSU/h	See conditions in Table 7 on page 26
Operating Pressure	4.1 – 6.9 bar (60 – 100 psi)	
Eluent Flow Range	0.2 – 5.0 mL/min	
Digital Output	10, 40 or 80 Hz (24 bit)	
Remote Operation	Remote Start Input	
Communication	Ethernet Serial (RS232) Remote Start Input Pump Stop: 1 Contact closure	
PC Control	ELSD driver for OpenLab ChemStation edition ELSD driver for OpenLab EZChrom edition LC and CE Drivers Rev. A.02.11 or above	
Safety and maintenance	Gas shut-off Valve, Leak Detection, Laser Interlock	

NOTE

In order to control OpenLab CDS edition, the ELSD driver is required.

Specification Conditions

ASTM: “Evaporative Light Scattering Detectors Used in Liquid Chromatography”.

Table 7 Reference conditions

Gas flow	1.6 SLM
Neb temperature	70 °C
Evaporator temperature	70 °C
Data Rate	40 Hz
Smoothing	1

ASTM drift tests require a temperature change below 2 °C/h (3.6 °F/h) over one hour period. Our published drift specification is based on these conditions. Larger ambient temperature changes will result in larger drift. Better drift performance depends on better control of the temperature fluctuations. To realize the highest performance, minimize the frequency and the amplitude of the temperature changes to below 1 °C/h (1.8 °F/h). Turbulences around one minute or less can be ignored. ASTM measurements require that the detector should be turned on enough time before start of testing.

3 LAN Configuration

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

What You Have to Do First

The ELSD has an on-board LAN communication interface.

1 Note the MAC (Media Access Control) address for further reference. The MAC or hardware address of the LAN interface is a worldwide unique identifier. No other network device will have the same hardware address. The MAC address can be found at detector start up (see "Configuration Using Instrument Front Panel" on page 30).

2 Connect the instrument's LAN interface to

- the PC network card using a crossover network cable (point-to-point)

  or

- a hub switch using a standard LAN cable.

TCP/IP Parameter Configuration

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

- IP address
- Subnet Mask
- Default Gateway

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

- by manually setting the parameters via the front panel of the detector,
- by manually setting the parameters through the G7102A ELSD web-interface,
- by manually setting the parameters through a Telnet session.

The module can be configured, via the front panel, to obtain an IP address automatically or to use a static IP address (see Table 8 on page 29). When configured to obtain its IP address automatically, the module will request an IP address from the DHCP server after every power cycle.

NOTE

If the detector is assigned a temporary IP address (e.g. DHCP server), then communication with the PC may be prevented following a power cycle of the instrument.

Table 8 Default STATIC/IP parameters

IP address	192.168.254.27
Subnet Mask	255.255.255.0
Default Gateway	192.168.254.1

Configuration Using Instrument Front Panel

Configuration of the TCP/IP parameters via the front panel is the recommended method for setting up the module's LAN interface. On-board configuration is only possible during the module's start-up procedure.

1 Power on the detector, and press any front key when the following message is displayed "**Press a key to enter communication setup**".

NOTE

If no key is pressed within 5 s, the ELSD will continue its start-up routine. The previously stored TCP/IP parameters will be used.

2 Select LAN using left/right arrow keys and press **AZ/Stop** to confirm.

3 Select either Static or DHCP (automatic) IP address assignment and press **AZ/Stop** to confirm.

4 If Dynamic IP address is selected, the instrument will try to obtain an IP address from the network.

When successful, the detector will continue to the main menu screen.

5 If Static IP address is selected, the instrument will display the stored static TCP/IP settings.

NOTE

The detector will use the default TCP/IP settings if no IP address has been programmed previously (see Table 8 on page 29).

6 To enter a new IP address, use the up/down arrow keys.

7 To enter a new Subnet Mask, use the up/down arrow keys.

8 To enter a new Gateway address, use the up/down arrow keys.

9 When all values are populated press **AZ/Stop** to accept.

NOTE

If the IP address and Gateway combination are incompatible, the instrument will return an INVALID network setting message.

The instrument will continue to the main menu screen to confirm that the settings have been implemented.

Once the LAN settings are configured, they are stored in memory even after a power cycle.

NOTE

The MAC address and Host Names of the instrument are displayed on the LAN configuration screens for reference.

Configuration Using Web Browser

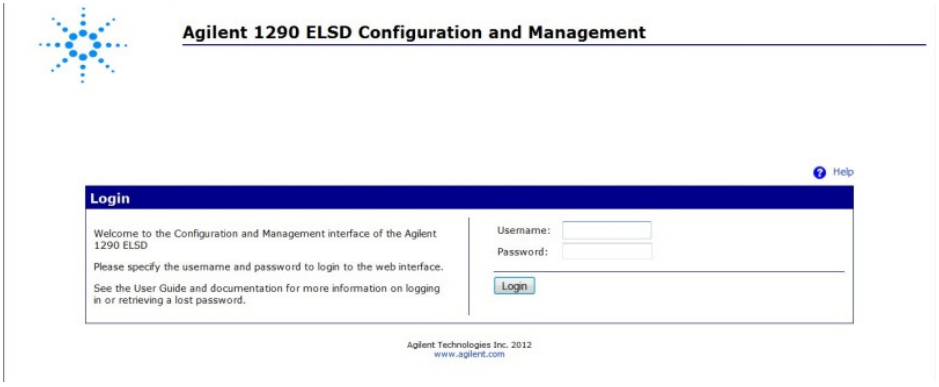
This procedure describes how to change the TCP/IP parameters and hostname using a PC, via a Web browser.

1 Using a Web browser such as Internet Explorer, type in the Host name or IP address of the ELSD into the address bar (for example http://192.168.254.27).

NOTE

The default host name is configured to the detector's serial number.

If communication is successful, the following login screen will appear:



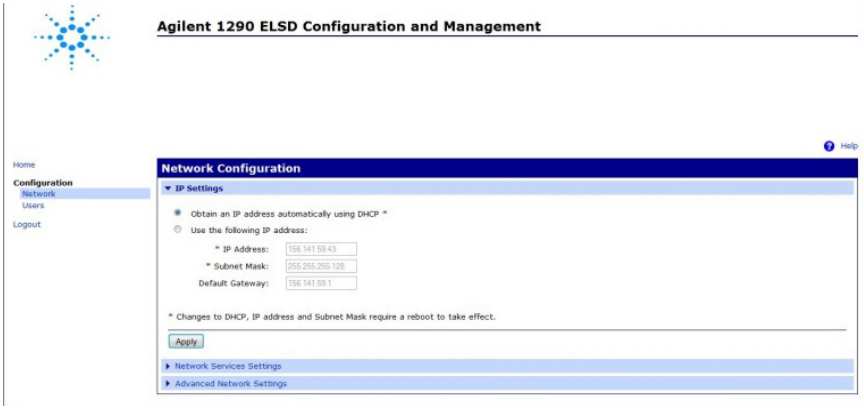
2 To log in, type the following information:

- **Username**:
  `user`
- **Password**:
  `Agilent`

NOTE

The login details are case-sensitive.

3 From the left menu, select **Network** to configure the TCP/IP settings.

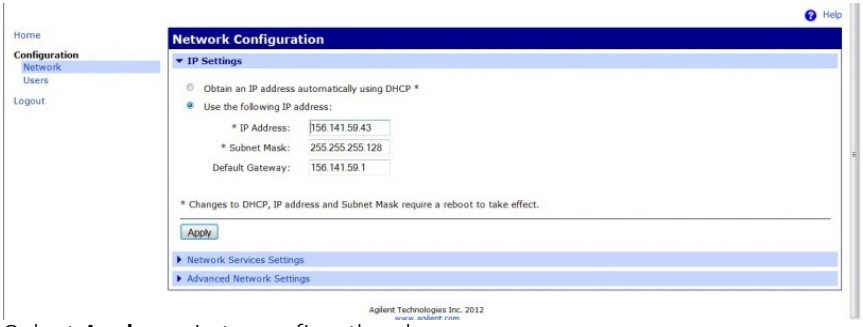


The detector can be configured to:

- obtain an IP address automatically (DHCP),
- use a static IP address,
- change Hostname (Advanced Network settings).

4 To use a static IP address, select **Use the following IP address**.

5 Enter the module's **IP Address**, **Subnet Mask**, and **Default Gateway** address and click **Apply**.



6 Select **Apply** again to confirm the changes.

7 Select **Logout** to close the session.

8 Restart the module for the new TCP/IP settings to be implemented.

NOTE Contact your system administrator for assistance on configuring the detector's network settings.

NOTE Changes to the TCP/IP parameters, other than those described, could render the ELSD inoperable.

With Telnet

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

1 Open the system (DOS) prompt window by clicking the Windows **Start** button and select **Run...**.

OR

Press the Windows button and **R** simultaneously, and click **OK**.

2 Type the following into the **RUN** dialog box:

- `Telnet <IP Address>`
- `Telnet <host name>` _ this can be set manually.

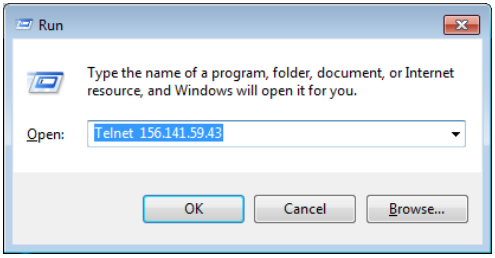


Figure 5 Starting a Telnet session

Where <IP address> may be the assigned address via the instrument, a configuration session using the Web interface of the default IP address (see Table 8 on page 29).

NOTE

If Telnet is not installed on your PC by default, you can turn on the feature via Windows Control Panel.

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

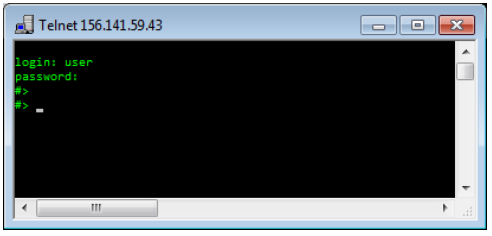


Figure 6 A connection to the module is made

3 Enter the following information when prompted:

- **login:**`user`
- **Password:**`Agilent`

NOTE

The login details are case-sensitive. The password will be not visible on screen.

4 At the #> prompt type
`set network ?` to view the available commands.

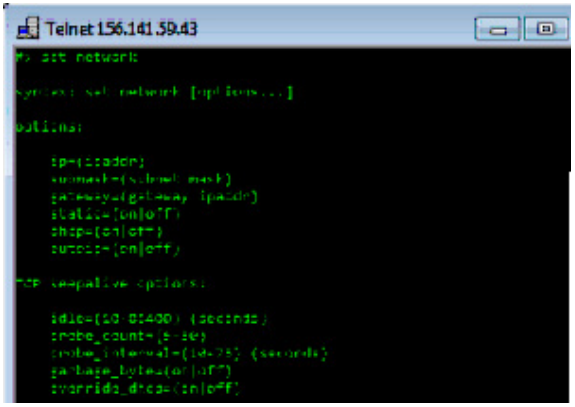


Table 9 Telnet commands

Value	Description
set network ?	displays syntax and descriptions of commands
set network	displays the current settings and list of commands
set network ip=<x.x.x.x>	sets new ip address
set network submask=<x.x.x.x>	sets new subnetmask
set network gateway=<x.x.x.x>	sets new default gateway
set network static=on/off	sets the ip to not change
set network dhcp=on/off	sets the device to or to not get its id from a dhcp server
set network autoip=on/off	sets the device to or to not try to automatically get an ip
quit	closes telnet and disconnects you

5 To change a parameter, follow the style:

Parameter value, for example:

```
set network static=on
set network ip=156.141.59.43
```

Then press **Enter**.

Parameter refers to the configuration parameters that you are defining, and value refers to the definitions you are assigning to the parameter. Each entry is followed by a carriage return.

6 When you have finished typing the configuration parameters, type `quit` and press **Enter** to exit.

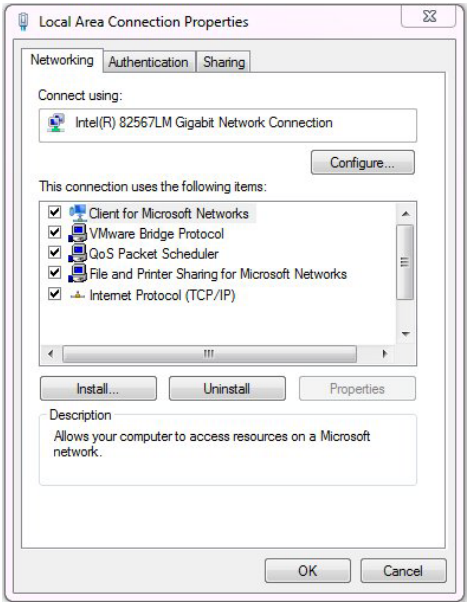
7 Restart the module for the new TCP/IP settings to be implemented.

PC and OpenLab CDS, OpenLab ChemStation or OpenLab EZChrom Software Setup

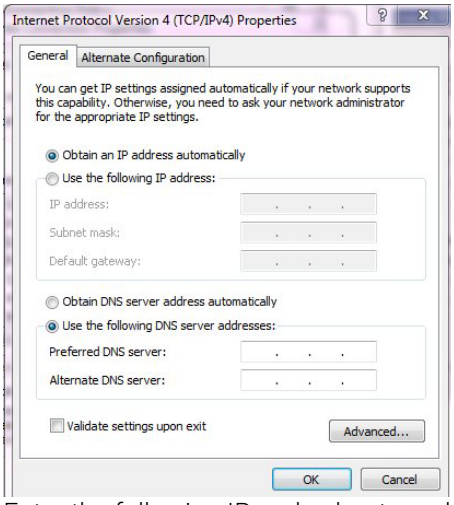
PC Setup for Local Configuration

This procedure describes how to the change the TCP/IP settings on your PC to match the modules default parameters in a local configuration using a cross-over LAN cable (see Table 8 on page 29).

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

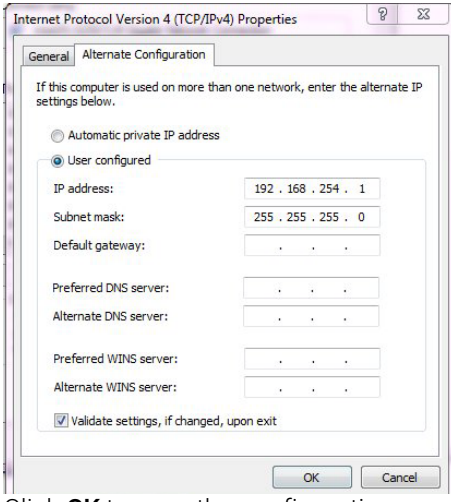


2 Select **Alternative Configuration**.



3 Enter the following IP and subnet mask address for the PC:

- **IP address**:
  `192.168.254.1`
- **Subnet mask**:
  `255.255.255.0`



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

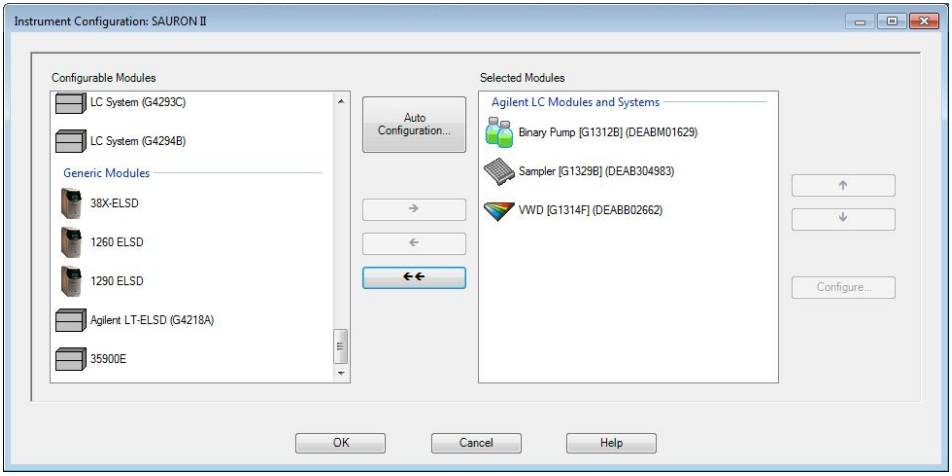
NOTE

It can take several seconds for the alternative network settings to take effect.

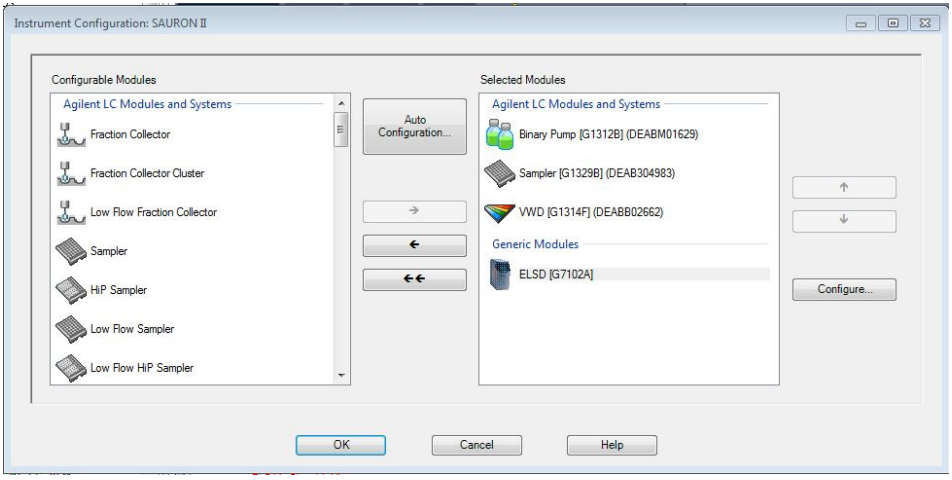
Agilent ChemStation Setup

This procedure describes the Agilent OpenLab ChemStation setup for the 1290 Infinity II ELSD detector (G7102A) and 1260 Infinity II ELSD (G4260B) using LAN as the communication method.

1 Open the **Instrument Configuration** window.

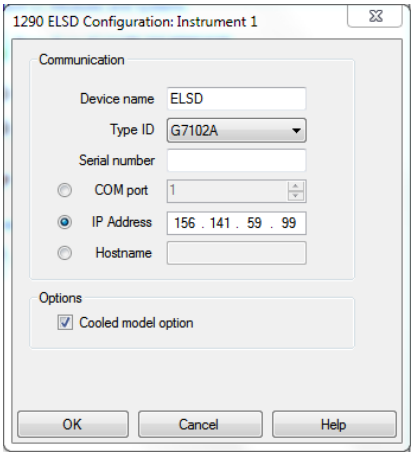


2 Select the required ELSD module and click **Configure...** to set the communication parameters.



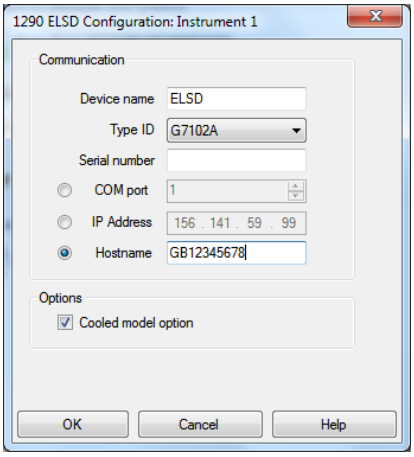
3 Select the instrument **Type ID**, according to the ELSD model connected.

4 Select **IP Address** and enter the module's IP address.

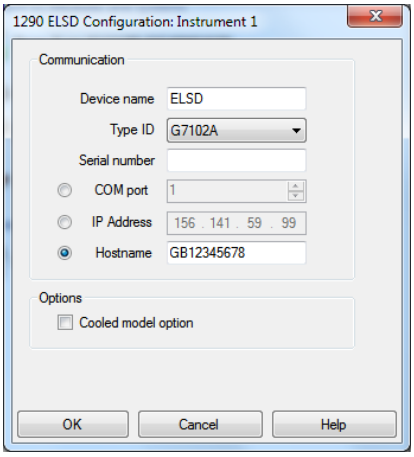


OR

Select **Hostname** and enter the instrument's serial number.



5 Cooled option is selected by default. Therefore, deselect **Cooled model option** if required.



6 Select **OK** to complete the configuration.

NOTE The detector's serial number is the default hostname.

NOTE If the detector is assigned a temporary IP address (e.g DHCP server), communication with the software might be prevented following a power cycle of the instrument.

Recommend using a static IP address to ensure communication with the software is preserved after power cycle.

4 Using the Module

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This chapter explains the operational parameters of the ELSD.

Before Using the Detector

On start-up of both the Agilent 1260 Infinity II ELSD (G4260B) or the Agilent 1290 Infinity II ELSD (G7102A), either Serial or LAN must be selected as the method of communication.

If Serial communication is selected, then no further configuration is required.

If LAN communication is selected, further configuration of the network settings is required (see chapter *LAN Configuration*).

Instrument Controls

The ELS Detector can be used as a standalone detector via the front keypad and screen, as shown in Figure 7 on page 43 or via PC control using software (e.g. OpenLab CDS ChemStation).

Display Screen

The graphical interface on the front of the instrument displays the current method, status, evaporator temperature, nebulizer temperature, gas flow, and output of the instrument. Operating parameters can be altered via the interactive menu bar at the bottom of the display.

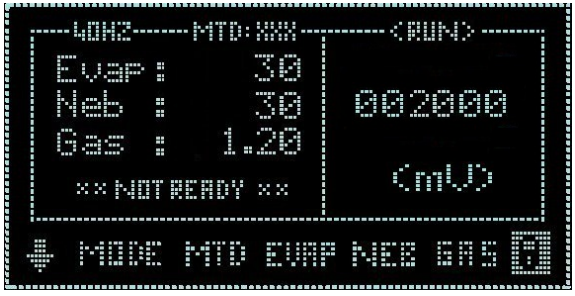

Figure 7 ELSD display screen

Keypad

The four arrows on the front of the instrument are used to navigate within the interactive menu bar. The **AZ/Stop** key has a dual function; it can be used to auto zero the ELSD at any time, unless a timetable is running. If the **AZ/Stop** key is pressed during an active timetable, the timetable will stop running and the ELSD will revert to **STANDBY** mode.

Main menu bar

To change the current settings, use the arrow keys to navigate across the interactive menu bar until the desired option is flashing. Using the up/down arrow keys to alter the parameter to the desired setting.

When the cursor is located in the “Home” position, the actual detector values are displayed in the main screen. If the instrument is controlled via PC software, then the home key will display a locked icon and the keypad will be disabled. To unlock the keypad, software control must be terminated.

Submenu Screen

The submenu screen is accessed from the front screen by selecting the ↓ key: This screen allows changes to the following electronic parameters:

Pmt	Set Signal Gain
Smth	Set Time Constant
LED	Set Light Source Intensity
PwrMd	Set Mode of ELSD when powered up
HZ	Set Data Output Rate
LAN	Displays the instruments TCP/IP settings With serial connection option displays “Instrument Configured for RS-232”

Figure 8 G4260B submenu screen

Figure 9 G7102A submenu screen

Status Mode

The ELS Detector can be operated in two modes; **STANDBY** or **RUN**, both of which are described over page:

To display the current mode and/or select a new mode, highlight the **MODE** function on the instrument display. The current mode will now be displayed on the screen. Using the arrow keys, scroll up or down until the desired option is displayed. The instrument acknowledges the command by displaying the mode of operation in the top-right corner of the screen.

Standby

The **STANDBY** mode is the "ground state" of the ELS detector, which is by default selected automatically after power-on (default can be changed using Power Mode, "Power Mode" on page 50). In **STANDBY** mode the heaters and light source are switched off, and the gas manifold valve is closed at power-on. The **STANDBY** mode gives the user a control platform in which to set up the operational parameters (gas flow, nebulizer, and evaporator temperatures) before switching the unit into **RUN** mode. The instrument will default to **STANDBY** mode should an error occur on the instrument.

Following a command or error, the instrument is switched from **RUN** to **STANDBY** mode. In this situation, the gas management system is invoked and the gas flow set to a minimum flow of 1.2 SLM for 15 min before the gas manifold valve is closed. This minimum "blanket" gas is **STANDBY** enough to nebulize and evacuate solvent should the instrument default to **STANDBY** mode with solvent still flowing.

CAUTION

Flooding the detector

If the instrument is left in STANDBY mode for longer than 15 min, gas flow to the unit is stopped to minimize gas usage.

✓ **The solvent pump must be turned off if the ELSD is going to be left in STANDBY mode longer than 15 min to prevent solvent flooding the detector.**

RUN

The **RUN** mode is the detector's operational mode. In this mode, the instrument is controlled at the set temperatures and gas flow, and the system is fully operational. During heating or cooling the instrument will display **NOT READY** to show that the system has not reached the set conditions. When the instrument has equilibrated, **READY** will be displayed and the instrument is ready for use.

Error conditions

The ELS Detector is equipped with several sensors and error checking facilities to ensure safe operation. If an error is detected, the instrument gives an audible warning and a visible description of the error condition. In event of any error condition, the unit defaults into the **STANDBY** mode in which the heaters, light source, and gas are turned off. A complete list of instrument errors and remedial actions is given in the troubleshooting section of this manual.

CAUTION

Solvent flooding the detector

✓ **It is strongly recommended that the pump stop from the I/O connector of the ELSD is connected to the HPLC pump to prevent solvent flooding the detector should an error occur.**

Clearing an Error

Once the source of the problem has been corrected, select **RUN** mode to put the ELSD back into its operational state. If the problem has not been rectified, the ELSD will repeatedly error when **RUN** mode is selected.

Operational Parameters

Method

The ELS Detector has 10 onboard preset methods. These methods comprise evaporator and nebulizer temperatures and gas flow, which can be optimized for specific applications.

These 10 onboard methods are selected using the front keypad and screen, via the **METHOD** option.

In addition to the 10 on-board preset methods, the ELS Detector has a method **XXX** that allows modification of the ELSD parameters to be made without the need for software control. Method **XXX** allows the detector to be used in standalone mode via the front screen and keypad.

Loading a Method

To load one of the 10 onboard methods, highlight **METHOD**. Using the arrow keys scroll up or down to the required method number. The instrument will acknowledge the change by displaying the method number in the top-left corner. These on-board methods cannot be edited.

Evaporator Temperature

The evaporator temperature is the most important setting on the ELS detector. It should be set according to the volatility of the compounds being analyzed.

If the compound is nonvolatile, e.g. sugars, then the evaporator temperature should be set to 80 – 90 °C.

If the compound is semivolatile, or has a low molecular weight, e.g. pharmaceutical drug, then the evaporator temperature should be set between 20 – 30 °C.

The evaporator temperature ranges for the ELS models are as follows:

G4260B/G7102A ELSD with non-cooled option	OFF, 25 – 120 °C (1 °C increments)
G7102A ELSD with cooled option	OFF, 10 – 80 °C (1 °C increments)

The default evaporator temperature for both models is 40 °C.

Nebulizer Temperature

The nebulizer temperature can be used to optimize signal response in addition to evaporator temperature. Higher nebulizer temperatures increase peak response, but the nebulizer temperature must not exceed the boiling point of the mobile phase.

The nebulizer temperature range for both models is: OFF, 25 – 90 °C (1 °C increments).

The default value is 40 °C.

Evaporator Gas Flow

The evaporator gas flow is used to control the ELS detector's evaporation process. The evaporator gas value is set according to the mobile phase composition, with higher gas flows (e.g. 1.6 SLM) being used for aqueous eluent compared to those containing organic solvents.

The higher the evaporator temperature, the lower the evaporation gas setting required (e.g. 1.0 – 0.9 SLM), regardless of mobile phase composition. Likewise, as the evaporator temperature is reduced to ambient and subambient temperatures, the gas flow needs to be increased to compensate (e.g. 1.6 – 1.8 SLM).

The evaporation gas range for both models is: 0.9 – 3.25 SLM (0.05 increments).

The default value is 1.6 SLM.

Detector Gain (PMT)

This parameter sets the factor by which the detector output signal is amplified. The gain setting does not change the sensitivity of the detector, but merely amplifies the captured signal by the inputted factor. The gain can be adjusted from 1 to 10 in increments of 0.1.

When setting the PMT (or Gain), both the signal and noise are simply amplified by the value set, so S/N values are unaffected. The raw signal output displayed on the parameter screen will reflect this increase or decrease in signal amplification.

Please note that the instrument output displayed on the main operating screen does not alter following a PMT change, thus the recorded baseline position will remain unchanged. Confirmation of a PMT change will be obvious by the change in baseline noise.

Response Time (Smoothing)

The data outputted from the detector can be averaged to produce a smoother response. The smoothing width is set to the number of data points over which the data is averaged and can be regarded as a digital time constant. The smoothing range is settable from 1 – 50, (in increments of 1) which translates to 0.1 – 5.0 s.

For most HPLC applications the default value of 1 (0.1 s) is satisfactory.

For GPC applications where peak widths can be >1 s, a value 50 (5 s) is recommended.

Light Source Intensity (LED)

The G4260B ELS detector's LED intensity can be adjusted to bring the peak response back on-scale. The intensity range can be set between 1 – 100 %, with the default factory setting being 100 %, for maximum sensitivity. The LED setting is stored in memory and is retained even after a power on/off cycle.

This feature is useful for preparative chromatography where samples of high concentration can be analyzed which would otherwise exceed the dynamic range of the detector.

NOTE The Agilent 1260 Infinity II ELSD (G4260B) performs an automatic autozero (i.e. 10 mV) following an LED change, to keep the signal on-scale.

NOTE The Agilent 1290 Infinity II ELSD (G7102A) Laser light source does not have power adjustment.

Power Mode

The instrument can be configured from the front panel submenu (see "Submenu Screen" on page 45), to start in either **RUN** or **STANDBY** mode when the unit is switched on via the rear power button.

To configure the Power Mode, select the required Status Mode (i.e. **STANDBY** or **RUN**) you wish the unit to start from the submenu screen (see "Submenu Screen" on page 45). The selected option will take effect the next time the module is power cycled. If **RUN** mode is selected as the desired Power mode, then the instrument will use the operating parameters stored in memory. In the unlikely event that the instrument encounters a fault during power-up, the unit will automatically switch to **STANDBY** mode.

Data Output Rate (Hz)

The rate at which the ELS Detector outputs data can be selected from the submenu screen. A 10 Hz output rate is selectable for standard LC applications, a 40 Hz output rate can be chosen for faster LC separations, and 80 Hz is used for UHPLC type applications with very narrow peaks. The data rate is stored in memory and is retained even after a power on/off cycle. The default value is 40 Hz.

NOTE

All ELSD conditions are retained on power cycling of the ELSD detector.

LAN (TCP/IP Settings)

This screen displays the ELSD's current configured TCP/IP settings. See chapter *LAN Configuration* for details on how to set these values.

With serial connection screen option displays “Instrument Configured for RS-232”.

Figure 10 TCP/IP settings

Controlling the ELSD During an Injection

The ELS Detector can change operational parameters in real time, during a sample injection, using an onboard timetable.

Real-Time Operation

The ELS Detector can store in memory a series of time-based events, within a single timetable. This timetable allows the operational settings of the ELSD to be changed in real time during a run.

The evaporator temperature (G7102A with cooled option), gas flow, PMT gain (G4260B), and smoothing parameters can all be configured within this timetable to change during a sample injection.

The timetable can be used to program the gas flow, to compensate for the change in ELSD response across a solvent gradient.

The single timetable, stored onboard the ELSD, is only customizable using the ELSD Dimension software, which can be purchased from Agilent (ELSD Dimension Software (includes trigger cable) (PL0890-0375)). A trigger cable has to be ordered separately. Use Infinity II Trigger Cable for Dimension Software (G4260-63002) for an Infinity II system, and Remote start cable (PL0890-0350) for a third-party system.

Creating a Real-Time Program

To create or modify the onboard timetable, the ELSD Dimension software must be installed on your PC.

The ELSD Dimension software package allows you to create a timetable on a PC, which can then be downloaded to the ELSD for later use.

The ELSD Dimension software also allows you to clear a time table from the ELSD detector memory.

The ELSD can only store a single timetable in memory, so the ELSD Dimension software can be used to create and save multiple timetables that can be downloaded individually later.

For further information on how to use ELSD Dimension software, please see the ELSD Dimension software online help.

NOTE

The Agilent ELSD Dimension software can only communicate with the ELSD using the serial port. LAN communication is not supported in ELSD Dimension.

Starting and Stopping Real-Time Control

The ELSD contains an internal timer to initiate the time-based events stored within the timetable. To start the internal timer and trigger the on-board timetable, a contact closure input via the I/O connector on the rear of the instrument is required (see "Overview of ELS Detector" on page 13).

When the on-board timetable is triggered, the front panel of the ELSD will display **TTRUN** above the output, as shown in Figure 11 on page 53.

When the timetable is running, the current and the total run time are displayed, in minutes, at the top-centre of the ELSD display. When the timetable reaches the end of its run time, the ELSD will revert to **RUN** mode and be primed ready to start the timetable again.

During an active timetable, where the evaporator temperature is being controlled, the status of the instrument will change from **READY** to **NOT READY**. This behavior is normal band will not affect the running of the timetable.

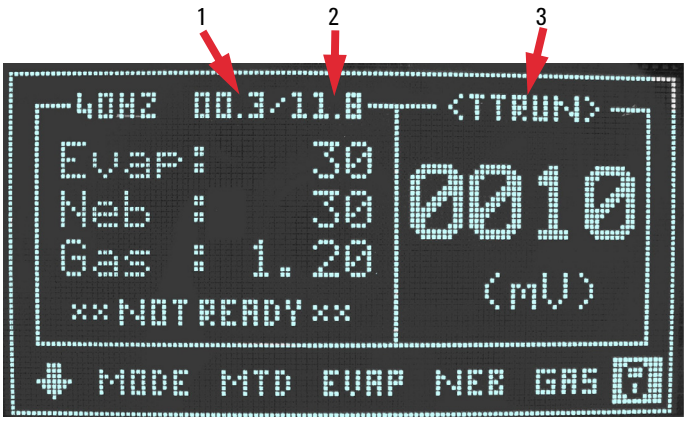

Figure 11 ELSD front panel display during timetable operation

1	Current run time
2	Total run time
3	Onboard Timetable is active

The **AZ/Stop** button on the instrument's front keypad can be used to interrupt the active timetable while it is running. When the **AZ/Stop** button is pressed, the timetable is stopped with the instrument put into **STANDBY** mode.

Controlling the ELSD within OpenLab CDS, OpenLab ChemStation or OpenLab EZChrom

The ELS Detector can be controlled directly using OpenLab CDS, OpenLab ChemStation (ChemStation Rev. B not supported), or OpenLab EZChrom. Digital data acquisition is performed without the need for an A/D interface. Controlling the ELSD using OpenLab provides full detector functionality with the added benefit of remote automation. The ELSD Driver is supplied on the CD supplied with the detector.

For further information on how to install and configure the ELSD driver, see the appropriate user guide supplied with the driver install.

General Considerations

The ELS Detector should be thought of as a detector like any other designed for liquid chromatography. The main distinguishing feature is the ability to evaporate the solvent from the column eluent. Therefore, normal system setup precautions should be remembered when starting to use the instrument. Any solvent that is intended for use with the ELSD should be fully miscible with any previously used in the liquid chromatograph. If there is any uncertainty, then a mutually miscible solvent should be run through the system as an intermediate liquid. Flush the sample loop also with miscible solvent where necessary. The intended eluent should be thoroughly degassed, should not contain nonvolatile salts or material, and should be fully compatible with the columns. All connections should be made with zero dead volume fittings and tubing with an I.D. ≤0.254 mm (≤0.010 in).

The ELSD requires nitrogen of purity >98 %, at an inlet pressure of 4.1 – 6.9 bar (60 – 100 psi). If in-house nitrogen is not available, we recommend the use of a nitrogen generator with a constant uninterrupted supply of high purity gas. Air can be used with nonflammable solvent systems. The eluent of choice should be fully volatile under the chosen detector parameters – any nonvolatilized eluent will increase baseline noise and reduce sensitivity.

The ELS Detector is a destructive technique and must be placed last when used in series with other detectors, or used with a flow splitter for semipreparative applications, where partial sample collection is required.

Solvent Recommendations

Any solvent that is intended for use with the ELS Detector should be thoroughly degassed, filtered (0.45 µm) and fully compatible with the columns. Solvents that are not properly degassed may cause problems at nebulization leading to a poor reproducibility.

Nonvolatile buffers are not compatible with the ELS Detector and should not be used. Only volatile mobile phase additives, such as those listed in Table 10 on page 57 should be used with the ELS detector.

Tetrahydrofuran (THF) stabilized with BHT, may increase the baseline noise level. Where possible unstabilized THF should be used with the ELS detector.

Solvents with high boiling points such as N-methylpyrrolidone (NMP), Dimethylsulphoxide (DMSO), m-Cresol, and 1,2,4-Trichlorobenzene (TCB) are not recommended.

Sample Preparation

Samples containing particulate matter should be filtered through a 0.45 µm filter prior to injection.

Column Considerations

The ELS detector will detect all nonvolatile components in the mobile phase, which includes column-packing material. Column-packing material will become chemically and mechanically broken down over the lifetime of the column, causing particles to enter the ELSD. This column “shedding” will lead to extremely high baseline.

Amino columns used with aqueous mobile phase are particularly prone to this type of shedding and should be checked regularly. To minimize column breakdown, always follow the manufacturer's instruction supplied with the column.

Table 10 Volatile mobile additives compatible with ELS detection

Mobile Phase Additive	pKa	pKb	pH Range	Bp (°C)	Mp (°C)
Acids					
Trifluoroacetic Acid (TFA)	0.3	13.70		72.4	-15.4
Formic Acid	3.75	10.25		100.7	8.3
Acetic Acid	4.75	9.25		116.0	16.6
Bases					
Ammonia	9.25	4.75		-33.4	-77.7
Methylamine	10.66	3.34		-6.6	-94.0
Ethylamine	10.81	3.19		16.6	-81.0
Triethylamine	11.01	2.99		89.3	-114.7
Buffers					
Ammonium Formate	3.8 9.2		3.0 – 5.0 8.2 – 10.2		120
Ammonium Acetate	4.8 9.2		3.8 – 5.8 8.2 – 10.2		111
Ammonium Bicarbonate	6.3 9.2 10.3		6.8 – 11.3		106
Ion-Pair Reagent					
Pentafluoropropionic acid (PFPA)	~0.6			97	
Heptafluorobutyric acid (HFBA)	~0.6			120	
Nonafluoropropionic acid (NFPA)	~0.6			140	
Tridecafluoroheptanoic acid	~0.6			175	

Transferring ELSD Temperature Methods

The direct transfer of ELSD operating conditions from other manufacturers' ELS detectors, or other designs of ELSD (e.g. Agilent G4218A ELSD) to the ELSD will not provide equivalent performance.

As stated in "Basic Principles of Operation" on page 9, the operating temperatures of the ELS detector are set according to the type of analyte and not the mobile phase composition as with other ELS detectors. For example, when HPLC grade water is used as the mobile phase the Agilent G4218A ELSD requires an evaporation temperature between 35 – 40 °C, whereas the Agilent G7102A can be operated as low as 20 – 30 °C for the equivalent solvent.

Therefore the transfer of operating conditions from other models of ELSD to the G7102A ELSD is not valid. The only way to ensure that the detector will provide the optimum analyte signal-to-noise is to follow the guidelines outlined in"Operational Parameters" on page 12.

5 Optimizing Performance

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Mobile Phase Priming 63

This chapter gives hints on how to optimize the performance or use additional devices.

Do’s and Don’ts of ELS Detection

CAUTION

Decreased performance

High pressures on the internal chamber will lead to increased baseline noise and low sensitivity.

- ✓ **NEVER block the exhaust outlet.**
- ✓ **NEVER allow the solvent waste outlet tube to become immersed in the waste solvent.**
- ✓ **When placing more than one HPLC detector in series, always place the ELS detector last.**
- ✓ **Only use volatile mobile phase additives.**

Location of the Detector Module

Place the detector conveniently near your HPLC system. The modular design of the ELSD enables you to locate it anywhere within the limitations imposed by the length of the power cord, fluid lines, and signal cables.

To keep liquid dead volume as low as possible and to minimize peak broadening in the lines, the distance between the column outlet and the flow cell inlet should be kept to a minimum.

Provide approximately 10 cm (4 inches) of space behind the unit so that the cooling fan intake is not impeded, and to allow easy access to the rear panel.

The ELS detector can be placed within 2 m of an extraction unit, using the exhaust tube provided.

Pumping Systems

It is recommended to use a high-performance pumping system with no flow pulses to minimize nebulization problems. Inconsistent solvent flow will result in poor reproducibility.

A backpressure regulator maybe necessary on certain pumps to minimize pulsation. This can also be achieved by the column itself or a coil of 0.127 mm (0.005 in) ID tubing placed between the pump and the injector/injection valve.

Mobile Phase Priming

The ELS detector does not require any mobile phase priming. It is recommended that priming of the LC system is performed without the ELS detector attached to prevent nonvolatile impurities contaminating the ELS detector.

The mobile phase should be degassed and filtered, either by sparging with Helium or using an online degasser.

6 Troubleshooting and Diagnostics

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This chapter gives an overview about the troubleshooting and diagnostic features.

Troubleshooting

If a problem is encountered, Agilent Technologies advises you to first follow the troubleshooting section to resolve the problem. If there is an error or fault and you follow the recommended course of action but the result is not satisfactory, then direct the matter to Agilent Technologies or your local distributor.

Malfunctions within the ELS Detector can arise from three general sources:

- The ELS Detector itself can be dirty or operating outside specification.
- The HPLC system has a broken, dirty, or nonoptimally operating component, but the problem is manifesting itself in the ELS Detector.
- A mobile phase and/or column problem, which by its very nature is spread throughout the HPLC system but appears as a malfunction of the ELS Detector.

To troubleshoot the ELS Detector, you must be able to separate the performance of the ELS Detector within the HPLC system from its performance outside the HPLC system. This section begins with guidelines for testing the ELS Detector as a standalone.

See "Module Specific Error Messages" on page 76 for possible causes and suggested solutions.

Troubleshooting an HPLC System

Standard practice is to add one component at a time back into the HPLC system so that the component causing the problem is easily identified if/when the condition re-occurs.

Begin troubleshooting by adding the pump to the ELS Detector first and finish by adding the column last. If another type of detector is available, use it before the ELS Detector to aid in troubleshooting.

General Problems

Baseline noise

Probable cause	Suggested actions
1 Poor nebulization	Increase the temperature of the nebulizer by 10 °C until the baseline noise decreases.
2 Insufficient evaporation	• Increase the temperature of the evaporator by 10 °C until the baseline noise decreases. • Increase the evaporation gas flow rate. • Decrease the nebulization temperature.
3 Nonvolatile additive in mobile phase	Use a volatile mobile phase.
4 Pressure difference created inside nebulizer chamber	• Ensure that the end of the liquid waste tube is not immersed in liquid. • Ensure that the exhaust tube at rear of unit is not blocked, or extraction is too strong.
5 Pump pulsations, especially in MicroBore applications where low flow rates are used	• Use a pulse free pump. • Increase the backpressure on the pump by fitting a backpressure column between the pump and the injection valve. • Use a pulse dampener directly after the pump in the system.

Baseline spikes

Probable cause		Suggested actions
1	Particulate matter in the gas supply	Filter the incoming gas, or change the supply.
2	Column shedding	Replace column or fit an inline filter with a 0.2 µm membrane filter directly after the column.
3	Poor nebulization	• Check solvent flow rate into ELSD is constant. • Check inlet gas flow is >60 psi and stable.
4	Insufficient evaporation	Increase the temperature of the evaporator by 10 °C until the baseline noise decreases.
5	Nonvolatile additive in mobile phase	Use a volatile mobile phase.

Low sensitivity

Probable cause		Suggested actions
1	Partial blockage in nebulizer or nebulizer inlet tube	Pump a 50/50 water/acetone mixture into ELSD at highest flow rate possible (do not exceed 5 mL/min) for 16 h.
2	Internal solvent trap is empty	Fill the front solvent trap with liquid until any excess flows out through front drain tube.
3	Gas pressure too low	Ensure inlet gas pressure **>**60 psi.
4	Laser power	Verify by switching the unit from **STANDBY** to **RUN** and check offset.
5	Optical chamber is contaminated	Clean contamination from widows in optical chamber.
6	Diffuser saturated with solvent	Stop the eluent flow and increase the evaporator temperature to maximum. Increase the flow rate to 2.8 SLM and wait 1 h.

Spiky peak tops but flat baseline

Probable cause	Suggested actions
1 Inconsistent nebulization	Nitrogen is the recommended gas - others can be used but may not nebulize as efficiently.
2 Incorrect gas being used	Change gas to nitrogen or evaluate different nitrogen sources.
3 Poor regulation of inlet gases	• If using bottled gas, check that gas regulator is functioning correctly and giving consistent flow. • Alternatively, use a pulse dampener.
4 Insufficient smoothing	The broader the peaks, the higher the smoothing value is required. Increase smoothing to 50 for Flash separations.
5 Sample precipitation during nebulization	• Reduce sample concentration or inject same loading in larger volume. • Check sample solubility in mobile phase eluents.
6 Inconsistent pump flow rates	See remedy for pump pulsation in the baseline noise section.

Large Baseline offset

Probable cause	Suggested actions
1 Inefficient evaporation	Increase the evaporator temperature and/or gas flow.
2 High concentration of nonvolatile buffer or stabilizer	Use a lower concentration of stabilizer, unstabilized solvent or, a more volatile buffer (ammonium acetate or ammonium formate).
3 Contaminated diffuser	Perform cleaning procedure.
4 Optics Heater failed	Refer to local distributor or Agilent Technologies.

Peak tailing

Probable cause	Suggested actions
1 Eluent particles lingering in the optical chamber	Increase evaporator gas flow rate.
2 Poor chromatography	Optimize HPLC separation.

Instrument Fails to zero

Probable cause	Suggested actions
1 Offset too high or output unstable due to impurity in mobile phase	• Stop pump flow and switch off unit. Restart unit and A/Z without liquid flowing. • Refer to local distributor or Agilent Technologies. • Optical section contaminated and requires cleaning.

No power

Probable cause	Suggested actions
1 Mains lead not connected	Attach mains lead to socket and inlet on rear of instrument.
2 Fuse failure	Replace fuse.
3 Power supply failure	Call Agilent Service representative.

No response (completely flat baseline)

Probable cause	Suggested actions
1 Data acquisition leads not connected	Ensure connectors to computer or integrator are securely connected.
2 Light source inactive	• Check LED or LASER intensity is 100 %. • Check LED or LASER is functioning correctly, by stopping solvent flow, cycling the power. Then reading the offset value in RUN mode should be below 130 mV.
3 Output below 0 mV	Stop pump flow and A/Z without liquid flowing.
4 Instrument in **STANDBY** mode	Select **RUN** mode.
5 Nebulizer or nebulizer inlet tube blocked	Manually syringe water into ELSD front Inlet port to remove obstruction.

Temperature error as soon as instrument powered on

Probable cause	Suggested actions
1 Temperature probe fault or disconnected	• Check RTD connections. • Consult Agilent Technologies or your local agent for further advice.

Display not on, but power connected

Probable cause	Suggested actions
1 Instrument Power Supply	Refer to local distributor or Agilent Technologies.
2 Faulty display	Refer to local distributor or Agilent Technologies.

Cooled Evaporator Temperature reads zero at start-up and cannot be changed

Probable cause	Suggested actions
1 Peltier cooler has not initiated correctly	• Switch detector off then on at the power socket. • Consult Agilent Technologies or your local agent if problem persists.

Vapor sensor error occurs, but there is no solvent or vapor leak inside unit

Probable cause	Suggested actions
1 Solvent vapor near the front of unit is being drawn into the unit	Remove any solvent bottle or solvent leak that is directly in front of the detector.
2 Faulty Vapor sensor	Check the rear vapor sensor is not damaged/bent.

Cooled Evaporator will not reach low temperature e.g. 10 °C

Probable cause	Suggested actions
1 Ambient lab temperature too high	Move detector to laboratory where ambient temperature is <25 °C.
2 Faulty Peltier cooler unit	Consult Agilent Technologies or your local agent if problem persists.

High backpressure from detector

Probable cause	Suggested actions
1 Nebulizer or nebulizer inlet tube blocked	Manually syringe water into ELSD front Inlet port to remove obstruction.

7 Error Information

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

What Are Error Messages

Error messages are displayed in the user interface when an electronic, mechanical, or hydraulic (flow path) failure occurs which requires attention before the analysis can be continued (for example, repair, or exchange of consumables is necessary). In the event of such a failure, the ELSD alarms with an error message displayed.

Module Specific Error Messages

These errors are detector-specific.

Internal temperature exceeded lower limit

Error ID: 10

Air temperature inside the instrument is ≤10 °C

Probable cause	Suggested actions
1 The environmental temperature is outside the specified operating limits of the instrument.	• Increase ambient temperature where detector is located. • Move the detector to a warmer location.

Internal temperature exceeded upper limit

Error ID: 11

Air temperature inside the instrument is >40 °C

Probable cause	Suggested actions
1 The environmental temperature is outside the specified operating limits of the instrument.	• Decrease ambient temperature where detector is located. • Move the detector to a cooler location.

On-board Vapor sensor failed

Error ID: 12

The vapor sensor located on the main control board has failed.

Probable cause	Suggested actions
1 Vapor sensor not connected to the mainboard.	Please contact your Agilent service representative.
2 Defective vapor sensor.	Please contact your Agilent service representative.

Rear Vapor sensor failed

Error ID: 13

The vapor sensor located on the rear panel of the module has failed.

Probable cause	Suggested actions
1 Vapor sensor not connected to the mainboard.	Please contact your Agilent service representative.
2 Defective vapor sensor.	Please contact your Agilent service representative.

Vapor detected

Error ID: 14

Probable cause	Suggested actions
1 External vapor being drawn into unit.	Remove any source of solvent vapors close to the module.
2 Solvent leak inside unit.	Please contact your Agilent service representative.
3 Exhaust tube not fitted.	Fit black exhaust tube.

Leak detected

Error ID: 15

A leak was detected inside the module.

Probable cause	Suggested actions
1 Loose nebulizer fittings.	Please contact your Agilent service representative.
2 Blocked nebulizer causing leak at capillary fittings.	Please contact your Agilent service representative.

Fan Failed

Error ID: 16

Thermal shut-down of the main cooling fan.

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

Fan Stopped

Error ID: 17

A main cooling fan in the module has stopped.

Probable cause	Suggested actions
1 Obstruction of fan blades.	Please contact your Agilent service representative.
2 Defective fan.	Please contact your Agilent service representative.
3 Defective mainboard.	Please contact your Agilent service representative.

Nebulizer temperature limit exceeded

Error ID: 18

Nebulizer temperature exceeded threshold after stabilizing.

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

Evaporator temperature limit exceeded

Error ID: 19

Evaporator temperature exceeded threshold after stabilizing.

Probable cause	Suggested actions
1 Defective thermocouple.	Please contact your Agilent service representative.
2 Defective evaporator heater assembly.	Please contact your Agilent service representative.
3 Defective mainboard.	Please contact your Agilent service representative.

LED or Laser light source error

Error ID: 20

The LED or Laser light source has failed.

Probable cause	Suggested actions
1 LED or Laser Light source not connected to the mainboard.	Please contact your Agilent service representative.
2 Defective LED or Laser Light source.	Please contact your Agilent service representative.

Evaporator gas flow rate limit exceeded

Error ID: 21

Evaporator gas flow rate exceeded threshold after stabilizing.

Probable cause	Suggested actions
1 Insufficient gas inlet pressure.	Ensure that the gas inlet pressure is above 60 psi.
2 Defective mass flow controller.	Please contact your Agilent service representative.
3 Gas line not connected or Mass disconnected.	Check flow controller cable.

Invalid Nebulizer temperature

Error ID: 22

Invalid nebulizer temperature reading.

Probable cause	Suggested actions
1 Nebulizer heater not connected to the mainboard.	Please contact your Agilent service representative.
2 Defective nebulizer heater.	Please contact your Agilent service representative.

Invalid Evaporator temperature

Error ID: 23

Invalid evaporator temperature reading.

Probable cause	Suggested actions
1 Evaporator heater not connected to the mainboard.	Please contact your Agilent service representative.
2 Defective evaporator heater.	Please contact your Agilent service representative.
3 RTD Block to TEC board for cooled ELSD not connected to the mainboard.	Ensure that the evaporator heater is connected correctly.

Fan failed on cooled evaporator

Error ID: 24

Fans on cooled evaporator module have failed.

Probable cause	Suggested actions
1 Fan not connected to Peltier assembly.	Please contact your Agilent service representative.
2 Defective Peltier fan.	Please contact your Agilent service representative.

Cooled evaporator current out of range or communication failed

Error ID: 25

Peltier module current outside of normal range or communication to Peltier module has failed.

Probable cause	Suggested actions
1 Defective Peltier assembly.	Please contact your Agilent service representative.
2 Peltier assembly not connected to mainboard.	Please contact your Agilent service representative.
3 Defective mainboard.	Please contact your Agilent service representative.

Laser temperature out of range

Error ID: 26

Temperature control on Laser assembly outside of normal operating range.

Probable cause	Suggested actions
1 Defective Laser assembly.	Please contact your Agilent service representative.

Laser current out of range

Error ID: 27

Laser current outside of normal operating range.

Probable cause	Suggested actions
1 Defective Laser assembly.	Please contact your Agilent service representative.

Laser interlock open or failed

Error ID: 28

The laser interlock on the detector enclosure is open or failed.

Probable cause	Suggested actions
1 Module enclosure is open.	Please contact your Agilent service representative.
2 Interlock not connected to mainboard.	Please contact your Agilent service representative.
3 Interlock wiring is faulty.	Please contact your Agilent service representative.
4 Defective mainboard.	Please contact your Agilent service representative.

Communication to Laser failed

Error ID: 29

Communication between mainboard and laser assembly has failed.

Probable cause	Suggested actions
1 Laser assembly not connected to mainboard.	Please contact your Agilent service representative.
2 Defective Laser assembly.	Please contact your Agilent service representative.
3 Defective mainboard.	Please contact your Agilent service representative.

Leak Sensor failed

Error ID: 30

The leak sensor in the module has failed.

Probable cause	Suggested actions
1 Leak sensor not connected to the mainboard.	Please contact your Agilent service representative.
2 Defective leak sensor.	Please contact your Agilent service representative.
3 Defective mainboard.	Please contact your Agilent service representative.

8 Maintenance

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This chapter describes the maintenance of the ELSD.

Introduction to Maintenance

Trained personnel only should carry out maintenance inside the unit. There are no user serviceable parts inside the instrument. Unauthorized access to the instrument will invalidate the instrument warranty.

Information for Service Personnel

Please note that this instrument is double fused.

The following fuses are fitted:

- 2x T2A H 250 V

Cautions and Warnings

WARNING

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

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

- ✓ **Always unplug the power cable before opening the cover.**
- ✓ **Do not connect the power cable to the instrument while the covers are removed.**

WARNING

Toxic, flammable and hazardous solvents, samples and reagents

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

- ✓ **When working with these substances observe appropriate safety procedures (for example by wearing goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the vendor, and follow good laboratory practice.**
- ✓ **The volume of substances should be reduced to the minimum required for the analysis.**
- ✓ **Do not operate the instrument in an explosive atmosphere.**

WARNING

Eye discomfort

The light source in the G4260B ELSD is a Class 1 LED product. Temporary discomfort may result from directly viewing the light produced by this source.

- ✓ **Do not look into the beam.**

WARNING

Fire and damage to the module

Wrong fuses

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

CAUTION

Electronic boards and components are sensitive to electrostatic discharge (ESD).

ESD can damage electronic boards and components.

- ✓ **Be sure to hold the board by the edges, and do not touch the electrical components. Always use ESD protection (for example, an ESD wrist strap) when handling electronic boards and components.**

Cleaning the Module

The exterior of the instrument should be cleaned by wiping down with a soft cloth moistened with dilute detergent solution, followed by wiping down with a cloth moistened with de-ionized water. Ensure that no moisture enters the instrument.

WARNING

Electrical shock and burns

Liquid in the module electronics can cause shock hazard and damage the module.

- ✓ **Switch off and disconnect power cord from instrument before cleaning.**
- ✓ **Do not use an excessively damp cloth during cleaning.**
- ✓ **Drain all solvent lines before opening any fittings.**
- ✓ **Allow the instrument to dry off completely before reconnecting power.**

Inspection of Cables

Periodically inspect the connecting cables for signs of physical damage caused by abrasion, solvent spillage, impact etc.

Replace damaged cables, particularly the power cord, if any damage is observed.

Drying the Diffuser

If the instrument has been operated incorrectly, the diffuser may become blocked with liquid. This is manifested by loss of signal, increased baseline noise and in the extreme case gas bubbling out of the nebulizer drain tube. If this happens, proceed as follows:

1 Increase the gas flow to 2.8 SLM and increase the evaporator to maximum temperature.

   The diffuser will be dried out and the instrument ready to use after approximately 1 h under these conditions.

2 Reset the instrument to the correct operating conditions and allow to stabilize before continuing.

Cleaning the Nebulizer

A loss of sensitivity is a common indicator that the nebulizer requires cleaning. Flushing can remove blockages. Therefore it is recommended to initially flush the instrument with a suitable solvent (for example water).

The most common cause of nebulizer blockage is precipitation of mobile phase buffer. This blockage occurs either at the nebulizer tip or within the inlet tube leading to the nebulizer.

To clean the nebulizer, the following procedure is recommended.

1. Put the ELSD into **RUN** mode.
2. Set the evaporator and nebulizer temperature to 40 °C and the gas flow to 1.6 SLM.
3. Set pump flow rate to 5 mL/min.
4. Remove the column, select a suitable solvent (for example water if using aqueous buffers) and pump for 3 h or set pump flow rate to 1 mL/min and run overnight.

NOTE Pump the highest flow-rate possible if backpressure of ELSD is too high at 5 mL/min.

NOTE If the nebulizer becomes completely blocked, it is not possible to pump solvent into the ELSD.

It is recommended to regularly flush the ELSD with water to keep the nebulizer clear of obstruction.

Cleaning Evaporator Tube

If the evaporator tube becomes contaminated with nonvolatile material resulting in poor chromatography, it is recommended that the instrument is initially washed with a solvent suitable for the contamination, or a 1:1 mixture of acetone/water.

Depending on use, it is recommended to clean the evaporator tube once a week or every 40 h of use as a preventive routine. It is also recommended to clean the unit following the use of buffers. If cleaning the unit does not solve the problems, consult Agilent Technologies for further assistance.

NOTE Do not use solvents that contain additives when performing the cleaning procedure.

NOTE Ensure that the instrument is at equilibrium under the below conditions before leaving the instrument unattended.

1. Set the evaporator temperature to 40 °C, the nebulizer temperatures to 40 °C, and the gas flow to 2.8 SLM.
2. Pump the “cleaning” solvent into the instrument at 1 – 2 mL/min (while in the **RUN** mode) overnight, or for a minimum of 4 h.

Putting the Instrument into Storage

If the instrument is to be stored or not used for an extended period, it is recommended to follow this procedure:

1. Flush the detector with a mixture of Acetone/Water (50/50) at 1 mL/min for 15 min.
2. Allow the instrument to cool to ambient temperature in STANDBY mode with the gas supply still connected.
3. Tip the instrument forwards to try and empty the solvent within the nebulization chamber through the front waste tube (i.e. into the bottle).
4. Pour 10 – 20 mL of acetone into the rear exhaust tube to flush out the internal solvent trap, collecting any overflow of acetone at the front solvent pipe.
5. Repeat step 3 to drain the acetone.
6. Disconnect the waste bottle.
7. Using the gas supply, blow nitrogen gas through the exhaust to evaporate any remaining acetone in the solvent trap. Cover the waste tube with tissue paper to collect any acetone residue.
8. Plug the exhaust, waste tubes and solvent inlet with the plastic caps provided.

Updating Detector Firmware

The ELSD Firmware can be upgraded using Lab Advisor. Where Lab Advisor is not available, the following process may be used.

The Agilent 1290 Infinity II ELSD (G7102A) also contains additional firmware on the Peltier unit and the Laser assembly.

Firmware on all three assemblies can be upgraded using the same process.

Firmware upgrade is only possible via the serial port.

When

For majority of internal repairs

Tools required

Description
Allen keys
TERA TERM software
Current firmware file

Parts required

Description
Serial cable (supplied with instrument)

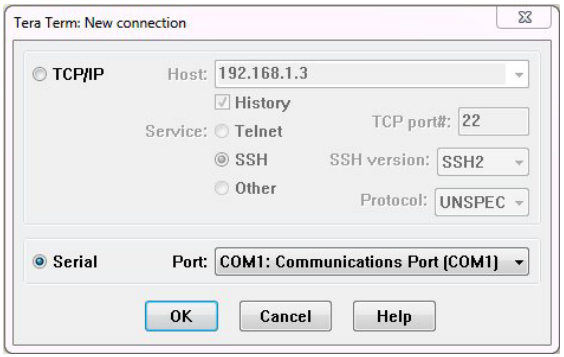
NOTE

Only Firmware versions v30.42 or later are compatible with the 1290 Infinity II ELSD.

To upgrade/downgrade the modules firmware carry out the following steps:

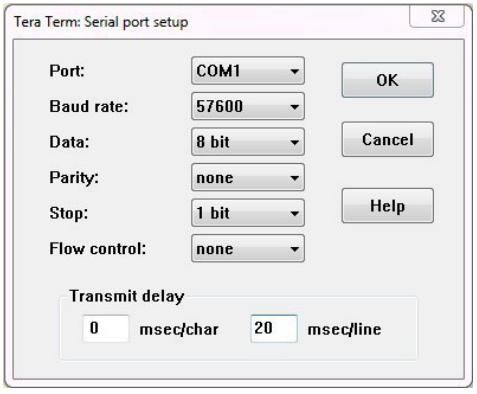
1. Connect the detector to a PC, via the serial port on the rear of the module, using a RS-232 cable.
2. Open the Tera Term program, and select **File >New Connection** from the toolbar.

3 Select **Serial** and choose the appropriate COM port, followed by **OK**.



4 From the toolbar menu, select **Setup >Serial Port** to configure the serial port connection.

5 Set the **Serial port** to the parameters shown below and click **OK**.



The **Transmit delay** values should be set according to the table below:

Table 11 Transmit delay values

Firmware type	msec/char	msec/line
Main	0	20
Safety	0	35
Laser	0	35

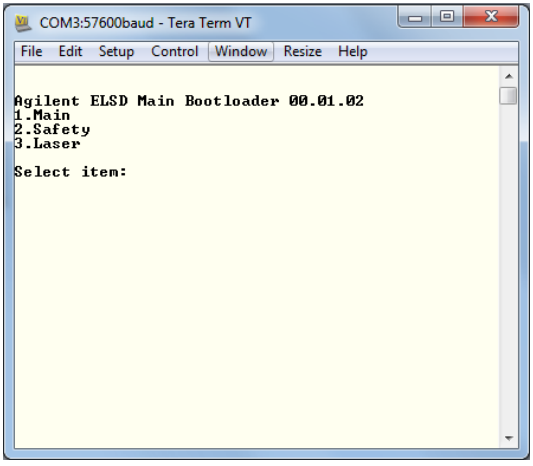
6 Put the detector into Service mode by holding down the rear Flash button whilst switching on the module.

The front panel will display:

SERVICE MODE

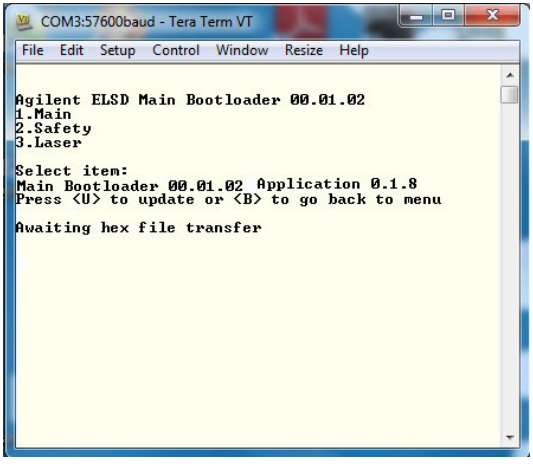
Reboot for normal operation

When in Service mode, the Tera Term displays the bootloader version and firmware menu.

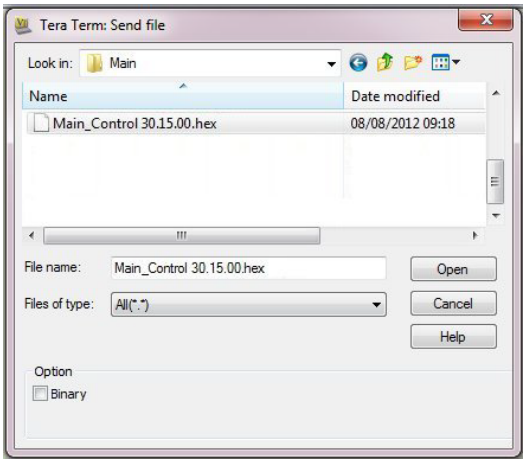


7 Select the firmware you wish to upgrade/downgrade by pressing the appropriate number (e.g. press **1** to upgrade the main control firmware).

8 Press **U** to begin the update process.

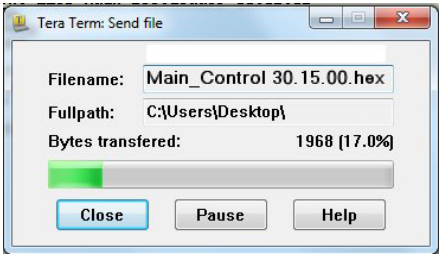


9 To choose the firmware file, select the **Send File** option from the **File** menu in the toolbar and navigate to the folder where the file is located.



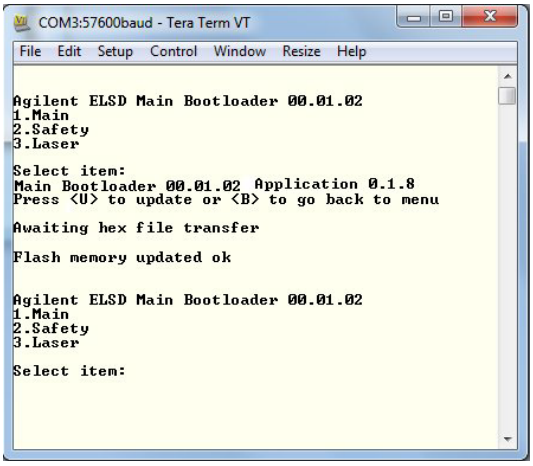
10 Select the firmware hex file and click **Open**.

The download will begin straightaway and progress will be displayed, as shown.



NOTE Do not disconnect or turn off the detector during the transfer process.

11 On successful completion of the file transfer, the software will display a **Flash memory updated ok** message.



12 Power cycle the module and check that the firmware version displayed on the ELSD front panel at boot-up is correct.

9 Parts and Materials for Maintenance

Identifying Parts and Materials 99

This chapter provides information on parts for maintenance.

Identifying Parts and Materials

	p/n	Description
	G4260B	Agilent 1260 Infinity II Evaporative Light Scattering Detector
OR	G7102A	Agilent 1290 Infinity II Evaporative Light Scattering Detector
	PL0890-0305	Gas inlet tube (5 m)
	PL0890-0310	Rear exhaust hose (PVC-2 m)
	PL0890-0315	Solvent waste tube (2 m)
	PL0890-0325	RS232 communication cable
	G4260-63001	Infinity II Modules to ELSD Trigger Cable
	G4260-63002	Infinity II Trigger Cable for Dimension Software
	PL0890-0640	ELSD Air Adapter Kit
	8121-0008	LAN shielded cable
	G4260-60005	1260/1290 ELSD Infinity I Trigger Cable
	PL0890-0350	Remote start cable (3rd party cable for Dimension software)
	G7102-90000	Agilent 1290 Infinity II Evaporative Light Scattering Detector User Manual

10 Appendix

General Safety Information 101
Waste Electrical and Electronic Equipment (WEEE) Directive 105
Radio Interference 106
Agilent Technologies on Internet 107

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

General Safety Information

Safety Symbols

Table 12 Safety Symbols

Symbol	Description
	The apparatus is marked with this symbol when the user shall refer to the instruction manual in order to protect risk of harm to the operator and to protect the apparatus against damage.
	Indicates dangerous voltages.
	Indicates a protected ground terminal.
	The apparatus is marked with this symbol when hot surfaces are available and the user should not touch it when heated up.
	Sample Cooler unit is designed as vapor-compression refrigeration system. Contains fluorinated greenhouse gas (refrigerant) according to the Kyoto protocol. For specifications of refrigerant, charge capacity, carbon dioxide equivalent (CDE), and global warming potential (GWP) see instrument label.
	Flammable Material For Sample Thermostat which uses flammable refrigerant consult Agilent Information Center / User Manual before attempting to install or service this equipment. All safety precautions must be followed.
	Confirms that a manufactured product complies with all applicable European Community directives. The European Declaration of Conformity is available at: **http://regulations.corporate.agilent.com/DoC/search.htm**
	Manufacturing date.

Table 12 Safety Symbols

Symbol	Description
	Power symbol indicates On/Off. The apparatus is not completely disconnected from the mains supply when the power switch is in the Off position.
	Pacemaker A pacemaker could switch into test mode and cause illness. A heart defibrillator may stop working. If you wear these devices keep at least 55 mm distance to magnets. Warn others who wear these devices from getting too close to magnets.
	Magnetic field Magnets produce a far-reaching, strong magnetic field. They could damage TVs and laptops, computer hard drives, credit and ATM cards, data storage media, mechanical watches, hearing aids and speakers. Keep magnets at least 25 mm away from devices and objects that could be damaged by strong magnetic fields.
	Indicates a pinching or crushing hazard.
	Indicates a piercing or cutting hazard.
	External Laser warning label located on rear of detector.
	Internal Laser warning label located on light source.
	Internal Laser beam label located on light source.

General Safety Information

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

WARNING

Ensure the proper usage of the equipment.

The protection provided by the equipment may be impaired.

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

Safety Standards

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

Operation

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

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

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

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

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided whenever possible. When inevitable, this has to be carried out by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or make any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged, even though the instrument has been disconnected from its source of supply. Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing and adjusting.

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

Waste Electrical and Electronic Equipment (WEEE) Directive

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

NOTE

Do not dispose of in domestic household waste

To return unwanted products, contact your local Agilent office, or see **https://www.agilent.com** for more information.

Radio Interference

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

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https://www.agilent.com

In This Book

This manual contains information on the Agilent 1260 Infinity II Evaporative Light Scattering Detector (G4260B) and Agilent 1290 Infinity II Evaporative Light Scattering Detector (G7102A).

The manual describes the following:

- Introduction
- Site Requirements and Specifications
- Using
- Optimizing
- Troubleshooting and Diagnostics
- Error Information
- Maintenance
- Parts
- Safety

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