Agilent

Agilent InfinityLab LC Series

Evaporative Light Scattering Detectors

User Manual

Notices

Document Information

The information in this document also applies to 1260 Infinity II and 1290 Infinity II modules.

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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.

Contents

In This Book

This manual covers the following Agilent InfinityLab LC Series modules:

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

1 Introduction

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

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 carrield 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 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 ELSD must be the last in series if used with other detectors. If the Agilent 1260 Infinity III ELSD or Agilent 1290 Infinity III 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 III ELSD or Agilent 1290 Infinity III ELSD for standalone use and control using Agilent OpenLab CDS, OpenLab ChemStation, or OpenLab EZChrom.

Product Description of the 1290 Infinity III Evaporative Light Scattering Detector (G7102A)

The Agilent 1290 Infinity III Evaporative Light Scattering Detector (ELSD) is a high capability instrument that can detect analytes with no UV chromophore as it does not rely on optical absorption. The blue laser light source delivers sensitivity for every compound to be analyzed.

The G7102A ELSD is the only ELSD that delivers sub-ambient operation for detection of thermally labile analytes other ELSDs miss. The instrument delivers evaporation down to 10 °C providing high sensitivity for compounds with significant volatility below 30 °C.

The extended dynamic range PMT technology gives four orders of magnitude detection for trace impurity analysis. Real-time gas control, Peltier cooling components and a range of other high quality equipment and enhancements provide sensitivity, reproducibility and flexibility for many applications.

Features of the 1290 Infinity III Evaporative Light Scattering Detector (G7102A)

- *High sensitivity throughput* – each process is enabled by real-time control during injection, with programmable software. This sensitivity delivers superb responses for all compounds to low nanogram levels.
- *Peltier-cooled evaporation tube* – cools from 10 °C to 80 °C preventing degradation of thermally labile compounds.
- *Rapid heating and cooling of the evaporator tube* – minimizes equilibration time and increases sample throughput.
- *Extended dynamic range detection technology gives four orders of magnitude* – enabling analysis of samples with trace levels of impurities in a highly concentrated sample matrix, eliminating time-consuming reanalysis, recalibration or sample preparation.
- *Real-time gas control* – provides a uniform response across a solvent gradient that minimizes quantification errors.
- *Control and data collection system* – is compatible with many vendor platforms.
- *Solvent enhancement effects during gradient elution are eliminated* – through real-time evaporator gas programming for quantification.
- *Low dispersion and high-speed data output rates* – for fast LC applications.
- *Superb reproducibility below* 2 % – for reliable and accurate results.
- *Full DMSO transparency* – keeps early eluting compounds detectable.

Product Description of the 1260 Infinity III Evaporative Light Scattering Detector (G4260B)

The Agilent 1260 Infinity III Evaporative Light Scattering Detector (ELSD) is a high capability instrument ideal for detecting analytes with no UV chromophore as it does not rely on optical absorption.

The 1260 Infinity III ELSD is an industry-leading higher sensitivity alternative to RID and low wavelength UV. Patented gas flow technology and a heated nebulizer minimize quantification errors and help provide superb reproducibility for a wide range of applications.

Features of the 1260 Infinity III Evaporative Light Scattering Detector (G4260B)

- High sensitivity provides superb responses for all compounds down to low nanogram levels.
- Real-time gas control provides a uniform response across a solvent gradient that minimizes quantification errors.
- Control and data collection system is compatible with many vendor platforms
- Improved evaporation of difficult solvents and improved response to non-volatile compounds with operation up to 120 °C.
- Unrivaled response to semi-volatile compounds at ambient temperature with patented gas flow technology.
- Low dispersion and high-speed data output rates that are ideal for Fast LC applications.
- Superb reproducibility below 2 % for reliable and accurate results.
- Full DMSO transparency keeps early eluting compounds detectable.

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.

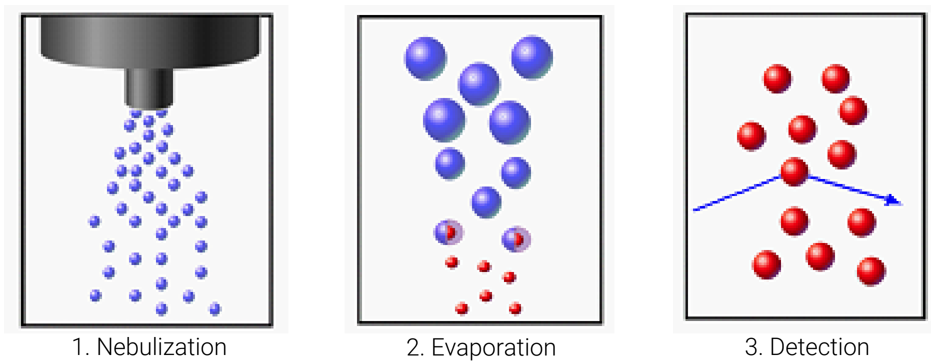


Figure 1: Principles of operation

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 15.

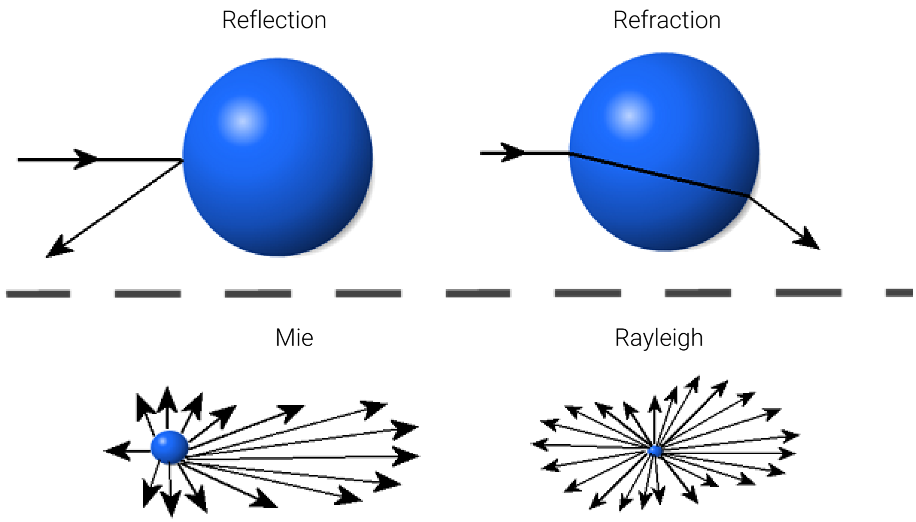


Figure 2: ELSD scattering mechanisms

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 G7102A ELSD, 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

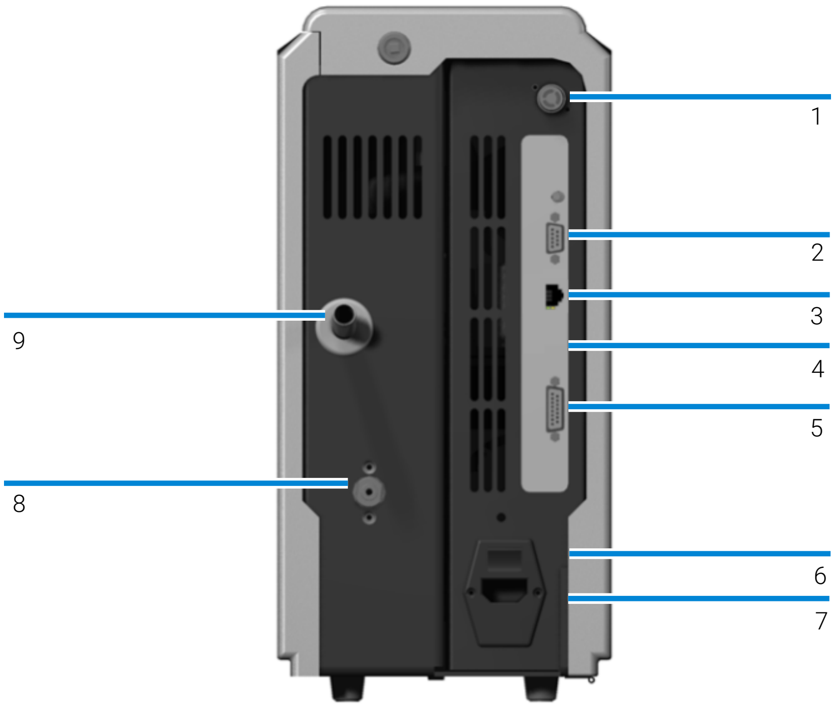


Figure 4: ELSD overview (rear)

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 (PL0890-0350 (Remote start cable)) can be purchased from Agilent Technologies.

2 Site Requirements and Specifications

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

Site Requirements

For a detailed description of the environmental and operating requirements of the ELSD, see the *Agilent CrossLab Start Up Services Agilent InfinityLab LC Series Site Preparation Checklist (InfinityLab-LC-site-prep-SiPCh-en-SD-29001837.pdf, SD-29001837)*.

Laser Safety

The Agilent 1290 Infinity III 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

Incorrect line voltage at the module

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

- **Connect your module to the specified line voltage.**

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

The absence of ground connection can lead to electric shock or short circuit.

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

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 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.

Specifications of the 1260 Infinity III Evaporative Light Scattering Detector (G4260B)

Table 2: Physical specifications of the 1260 Infinity III ELSD (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, 2 A (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 40° C (104° 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

Table 3: Performance specifications of the 1260 Infinity III ELSD (G4260B)

Type	Specification	Comment
Light Source	LED 480 nm (Class 1 LED product)	
Detector	PMT with digital signal processing	
Nebulizer	OFF, 25 – 90 °C	
Designed for use with Agilent InfinityLab Assist	Intuitive User Interface, Automated Workflows, Predictive Maintenance & Assisted Troubleshooting	
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 of the 1260 Infinity III Evaporative Light Scattering Detector (G4260B) on page 26.
Drift	< 1 mV/h	See conditions in Specification Conditions of the 1260 Infinity III Evaporative Light Scattering Detector (G4260B) 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)	
Analogue Output	0 – 1.25 V FSD	
Communication	Ethernet Serial (RS232) Remote Start Input Pump Stop: 1 Contact closure	
Remote operation	Remote Start Input	
Instrument control	ELSD driver for OpenLab CDS ELSD driver for OpenLAB ChemStation edition ELSD driver for OpenLAB EZChrom edition LC and CE Drivers Rev. A.02.11 or above for ICF	InfinityLab Assist (G7180A) with firmware D.07.40 or above not supported! For details about supported software versions refer to the compatibility matrix of the ELSD compatibility matrix and ICOCO
Safety and maintenance	Gas shut-off Valve, Leak Detection	No Laser fitted

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

Specification Conditions of the 1260 Infinity III Evaporative Light Scattering Detector (G4260B)

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

Table 4: 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.

Specifications of the 1290 Infinity III Evaporative Light Scattering Detector (G7102A)

Table 5: Physical specifications of the 1290 Infinity III ELSD (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

Table 6: Performance specifications of the 1290 Infinity III ELSD (G7102A)

Type	Specification	Comment
Designed for use with Agilent InfinityLab Assist	Intuitive User Interface, Automated Workflows, Predictive Maintenance & Assisted Troubleshooting	
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 Reference conditions on page 30
Drift	< 1 LSU/h	See conditions in Table 7 Reference conditions on page 30
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	
Instrument Control	ELSD driver for OpenLab CDS ELSD driver for OpenLab ChemStation edition ELSD driver for OpenLab EZChrom edition LC and CE Drivers Rev. A.02.11 or above for ICF	InfinityLab Assist (G7180A) with firmware D.07.40 or above not supported!
Safety and maintenance	Gas shut-off Valve, Leak Detection, Laser Interlock	

NOTE

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

Specification Conditions of the 1290 Infinity III Evaporative Light Scattering Detector (G7102A)

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 Installation

The installation of the module will be done by an Agilent service representative. In this chapter, only installation of user-installable options and accessories are described.

Delivery Checklist

Unpack the ELSD and accessories, and ensure that all parts and materials shown in the table below have been delivered with your module. Report any missing or damaged parts to your local Agilent Technologies sales and service office.

p/n	Description
G4260B	Agilent 1260 Infinity III Evaporative Light Scattering Detector **OR**
G7102A	Agilent 1290 Infinity III Evaporative Light Scattering Detector
PL0890-0325	RS232 communication cable
8121-0008	LAN Cable, shielded
G4260-60005	1260/1290 ELSD Infinity I Trigger Cable
G4260-63001	1260 ELSD Infinity II/III Trigger Cable
PL0890-0305	Gas inlet tube (5 m)
PL0890-0310	Rear exhaust hose (PVC-2 m)
G4261-63000	Solvent waste tube (1.9 m)
N/A	1 mm Allen key
G4260-60012	ELSD Software Drivers

4 Using the Module

This chapter explains the operational parameters of the ELSD.

Preparing the Module

Before Using the Detector

On start-up of both the Agilent 1260 Infinity III ELSD (G4260B) or the Agilent 1290 Infinity III 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 5 on page 35 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 5: 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 6: G4260B submenu screen

Figure 7: 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 41). 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 III 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 III 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 36), 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 36). 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 8: 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 (PL0890-0375 (ELSD Dimension Software)). A trigger cable has to be ordered separately. Use G4260-63002 (Infinity II/III Trigger Cable for Dimension Software) for an Infinity II/III system, and PL0890-0350 (Remote start cable) 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 17).

When the on-board timetable is triggered, the front panel of the ELSD will display TTRUN above the output, as shown in Figure 9 on page 44.

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.

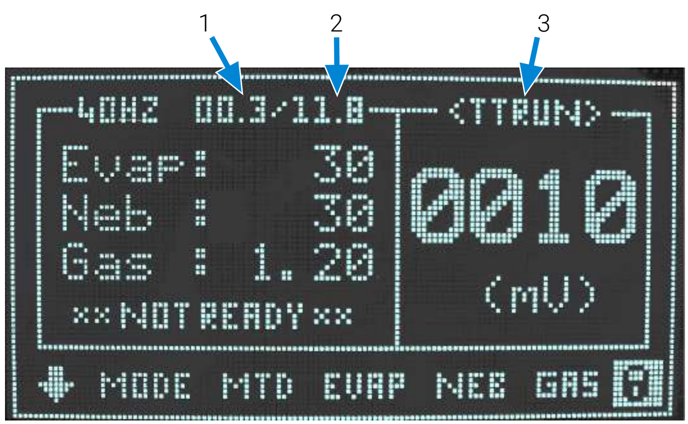


Figure 9: ELSD front panel display during timetable operation

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 8 Volatile mobile additives compatible with ELS detection on page 47 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 8: 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 13, 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 inOperational Parameters on page 16.

5 Optimizing the Performance of the Module

This chapter provides information on how to optimize the module.

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 Maintenance and Troubleshooting Tools of the Module

This chapter gives an overview of the maintenance, troubleshooting, and diagnostic features available.

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 74 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	• Please contact your Agilent service representative.

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. • Optical section contaminated and requires cleaning. • Please contact your Agilent service representative.

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. • Please contact your Agilent service representative.

Display not On, but Power Connected

Probable cause		Suggested actions
1	Instrument Power Supply	• Please contact your Agilent service representative.
2	Faulty display	• Please contact your Agilent service representative.

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. • Please contact your Agilent service representative.

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	• Please contact your Agilent service representative.

High Back-Pressure 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

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

What Are Error Messages

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

This chapter provides general information on maintenance of the module.

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

Safety Information Related to Maintenance

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.

WARNING Personal injury or damage to the product

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

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

WARNING Electrical shock

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

- Do not remove the cover of the module.
- Only certified persons are authorized to carry out repairs inside the module.

WARNING Sharp metal edges

Sharp-edged parts of the equipment may cause injuries.

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

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.**

CAUTION

Safety standards for external equipment

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

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 III 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

Qty.	p/n	Description
1		Allen keys
1		TERA TERM software
1		Current firmware file

Parts required

Qty.	p/n	Description
1		Serial cable (supplied with instrument)

NOTE

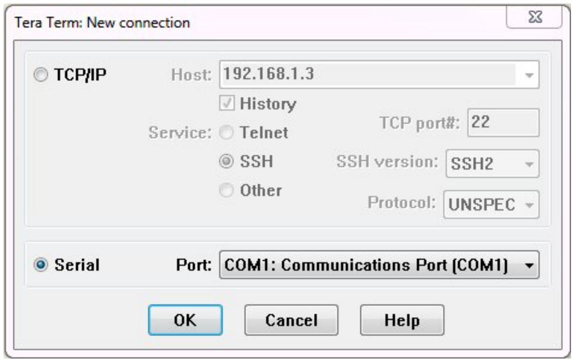
Only Firmware versions v30.42 or later are compatible with the 1290 Infinity II/III ELSD.

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.

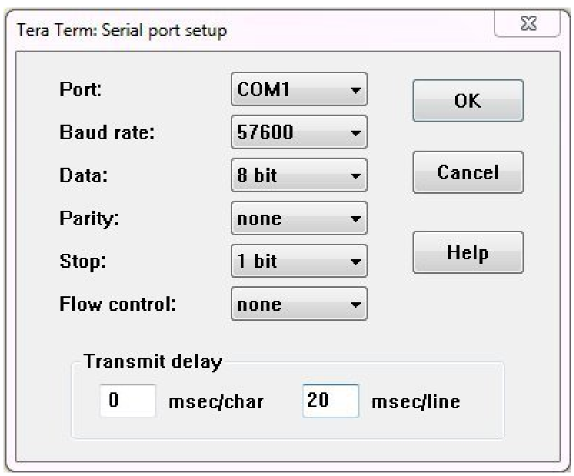
2 Open the Tera Term program, and select File > New Connection from the toolbar.

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 9: Transmit delay values

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

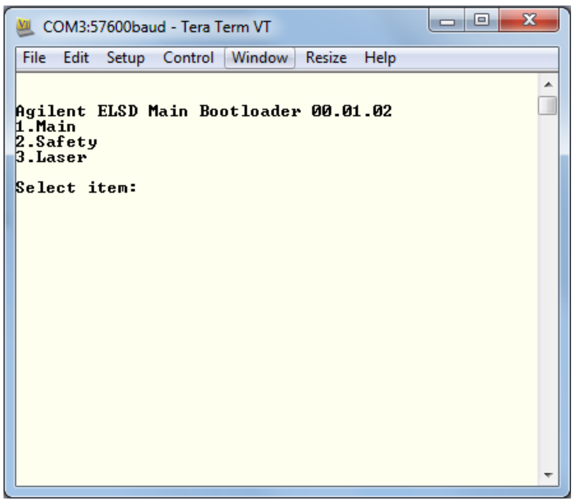
6 Put the detector into Service mode by holding down the rear Flash button whilst switching on the module.

The front panel will display:

SERVICE MODE

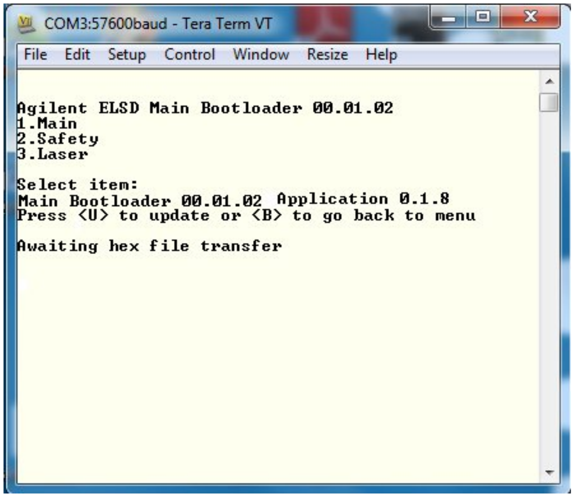
Reboot for normal operation

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

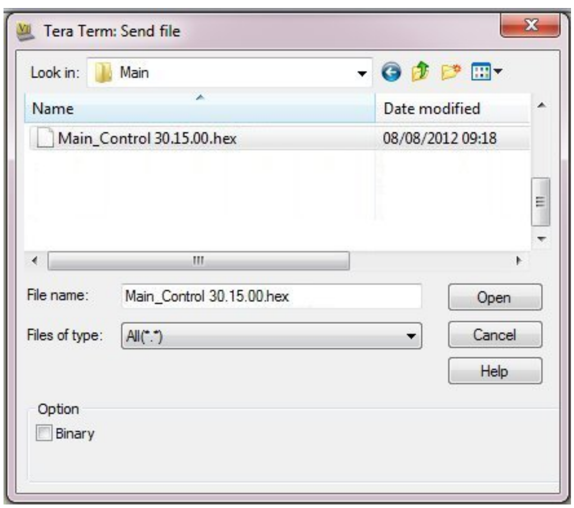


7 Select the firmware you wish to upgrade/downgrade by pressing the appropriate number (e.g. press **1** to upgrade the main control firmware).

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

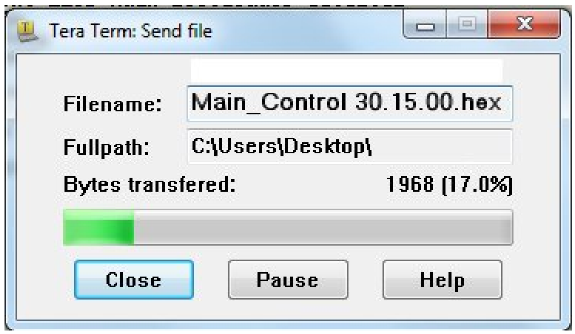


9 To choose the firmware file, select the **Send File** option from the **File** menu in the toolbar and navigate to the folder where the file is located.



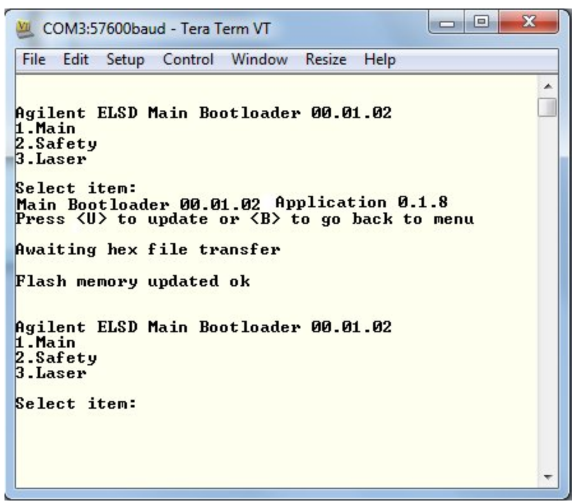
10 Select the firmware hex file and click **Open**.

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

This chapter provides information on parts and materials for maintenance.

Identifying Parts and Materials

p/n	Description
G4260B	Agilent 1260 Infinity III Evaporative Light Scattering Detector **OR**
G7102A	Agilent 1290 Infinity III 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	1260 ELSD Infinity II/III Trigger Cable
G4260-63002	Infinity II/III Trigger Cable for Dimension Software
PL0890-0640	ELSD Air Adapter Kit
8121-0008	LAN Cable, shielded
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/III Evaporative Light Scattering Detector User Manual

10 LAN Configuration

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

What You Have to Do First

The module has an on-board LAN communication interface.

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

1. Note the MAC (Media Access Control) address for further reference. The MAC or hardware address of the LAN interfaces is a world wide unique identifier. No other network device will have the same hardware address. The MAC address can be found on a label at the rear of the module (see Figure 11 on page 114, or Figure 12 on page 114).

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

Figure 10: MAC label (example)

2. Connect the instrument's LAN interface to

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

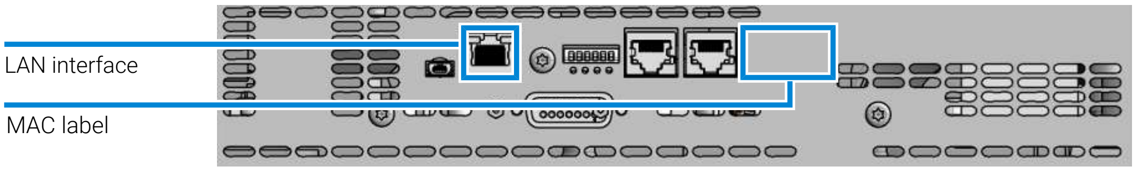


Figure 11: Location of LAN interfaces and MAC label (board with 6-bit configuration switch)

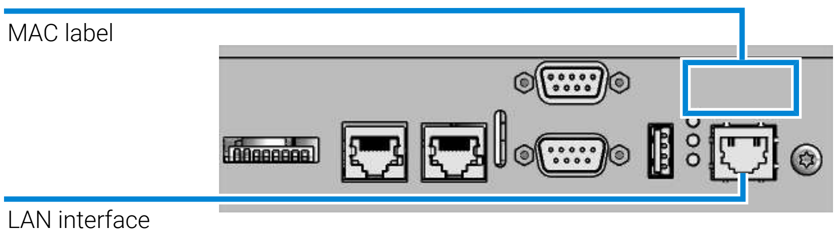


Figure 12: Location of LAN interfaces and MAC label (board with 8-bit configuration switch)

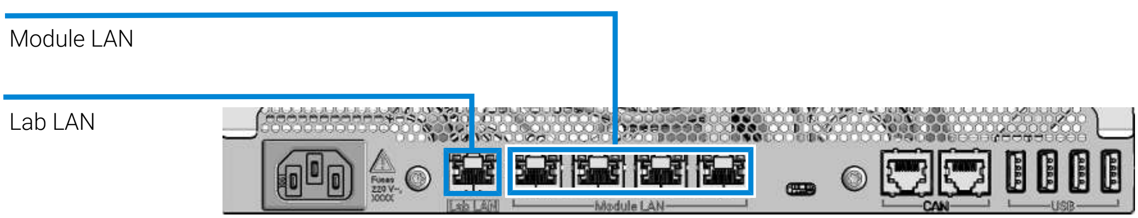


Figure 13: Location of LAN interfaces (InfinityLab Assist Hub)

TCP/IP Parameter Configuration

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

- IP address
- Subnet Mask
- Default Gateway

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

- by automatically requesting the parameters from a network-based DHCP Server (using the so-called Dynamic Host Configuration Protocol). This mode requires a LAN-onboard Module or a G1369C LAN Interface card, see Setup (DHCP) on page 124
- by manually setting the parameters using the Local Controller

Configuration Switch and Mode Selection

The module is shipped with all switches (SW) set to OFF.

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

Configuration Switch (8-Bit)

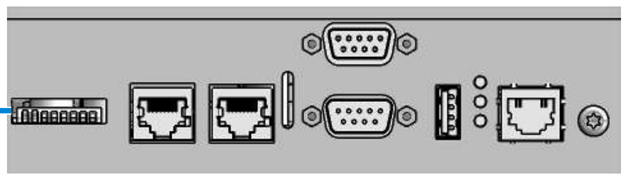


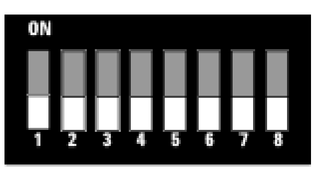
Figure 14: Location of configuration switch (8-bit) at the rear of the module

Table 10: Overview of 8-bit configuration switch settings

SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Mode	Init Mode
0	0	0	x	x	x	x	x	Link config	Speed and duplex mode determined by autonegotiation [1]
0	0	1	0	0	x	x	x	Link config	10 MBit, half-duplex [1]
0	0	1	0	1	x	x	x	Link config	10 MBit, full-duplex [1]
0	0	1	1	0	x	x	x	Link config	100 MBit, half-duplex [1]
0	0	1	1	1	x	x	x	Link config	100 MBit, full-duplex [1]
0	0	x	x	x	0	1	0	Init Mode Selection	Using stored
0	0	x	x	x	1	0	0	Init Mode Selection	USE DHCP to request IP Address (Host name will be the MAC address) [2]
0	0	x	x	x	0	1	1	Init Mode Selection	Use Default IP Address (192.168.254.11, Subnet mask: 255.255.255.0)
1	1	1	0	0	0	0	0	Test	Boot Resident System
1	1	0	0	0	0	0	1	Test	Revert to Default Data (Coldstart)

[1] The LAN interface supports 10 or 100 Mbps operation in full- or half-duplex modes. In most cases, full-duplex is supported when the connecting network device - such as a network switch or hub - supports IEEE 802.3u auto-negotiation specifications.
When connecting to network devices that do not support auto-negotiation, the LAN interface will configure itself for 10- or 100-Mbps half-duplex operation.
For example, when connected to a non-negotiating 10-Mbps hub, the LAN interface will be automatically set to operate at 10-Mbps half-duplex.
If the module is not able to connect to the network through auto-negotiation, you can manually set the link operating mode using link configuration switches on the module.

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



Legend:
- SW = switch
- 0 = off (SW down)
- 1 = on (SW up)
- x = optional setting

Configuration Switch (6-Bit)

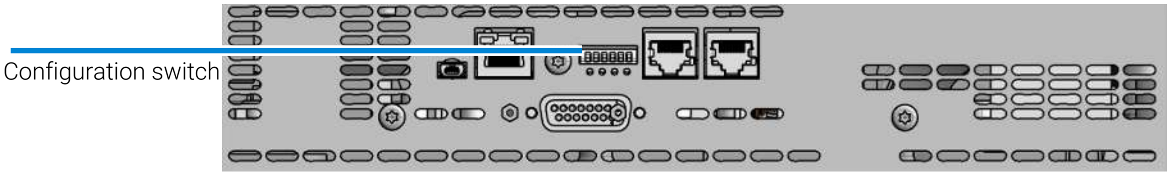
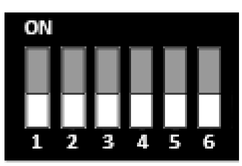


Figure 15: Location of configuration switch (6-bit) at the rear of the module

Table 11: Overview of 6-bit configuration switch settings

SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Mode	Init Mode
0	0	0	0	0	0	-	-	COM	Use Default IP Address (192.168.254.11, Subnet mask: 255.255.255.0)
0	0	0	0	1	0	-	-	COM	Use Stored IP Address
0	0	0	1	0	0	-	-	COM	USE DHCP to request IP Address (Host name will be the MAC address)
1	0	0	0	0	0	-	-	Test	Boot Main System/Keep Data
1	1	0	0	0	0	-	-	Test	Boot Resident System/Keep Data
1	0	0	0	0	1	-	-	Test	Boot Main System/Revert to Default Data
1	1	0	0	0	1	-	-	Test	Boot Resident System/Revert to Default Data



Legend:
- SW = switch
- - = not available
- 0 = off (SW down)
- 1 = on (SW up)

Configuration Switch (2-Bit)

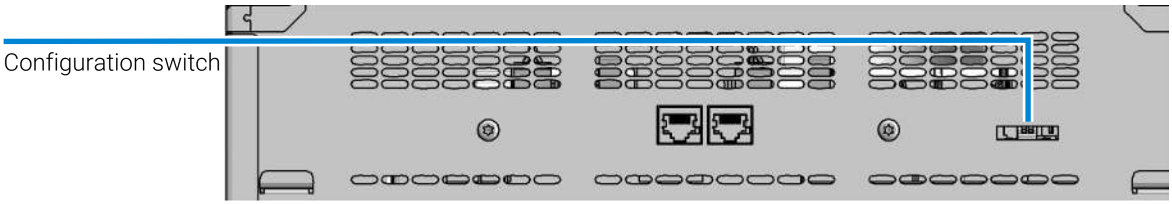


Figure 16: Location of configuration switch (2-bit) (G7116A/B) at the rear of the module

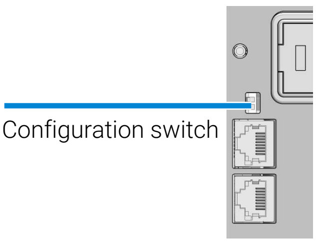


Figure 17: Location of configuration switch (2-bit) (G1170A, G7166A, G7170B) at the rear of the module

Table 12: Overview of 2-bit configuration switch settings (G1170A, G7116A/B, G7166A, G7170B)

SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Mode	Init Mode
0	0	-	-	-	-	-	-	COM	Default
0	1	-	-	-	-	-	-	Test	Coldstart
1	0	-	-	-	-	-	-	Test	Boot resident
1	1	-	-	-	-	-	-	Not supported	Not supported

Legend:
- SW = switch
- - = not available
- **G7116A/B:**
  - 0 = off (SW up)
  - 1 = on (SW down)
- **G1170A, G7166A, G7170B:**
  - 0 = off (SW right)
  - 1 = on (SW left)

Configuration Switch (1-Bit)

Configuration switch

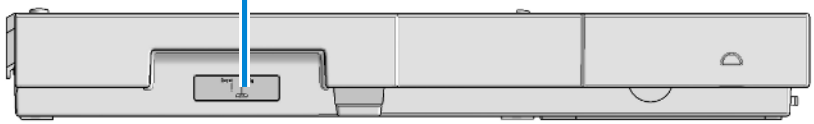


Figure 18: Location of configuration switch (InfinityLab Assist Hub) at the side of the module

Table 13: Overview of 1-bit configuration switch settings (G7180A)

SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Mode	Init Mode
0	-	-	-	-	-	-	-	Not supported	Configure the IP address (by using specific data or automatically with DHCP server)
1	-	-	-	-	-	-	-	Not supported	Configure default IP address (192.168.254.11

Legend:
- SW = switch
- - = not available
- 0 = off (SW front = right)
- 1 = on (SW back = left)

Using Stored

When initialization mode **Using Stored** is selected, the parameters are taken from the non-volatile memory of the module. The TCP/IP connection will be established using these parameters. The parameters were configured previously by one of the described methods.

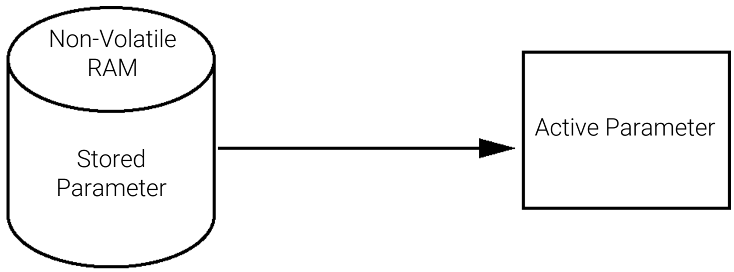


Figure 19: Using Stored (principle)

Using Default

When **Using Default** is selected, the factory default parameters are taken instead. These parameters enable a TCP/IP connection to the LAN interface without further configuration, see Table 14 Using default parameters on page 121.

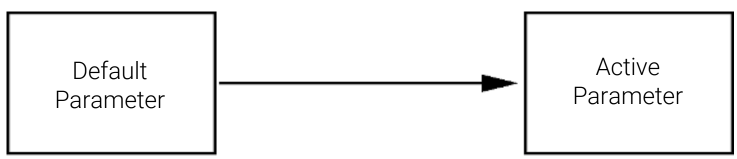


Figure 20: Using Default (principle)

NOTE Using the default address in your local area network may result in network problems. Take care and change it to a valid address immediately.

Table 14: Using default parameters

IP address:	192.168.254.11
Subnet Mask:	255.255.255.0
Default Gateway	not specified

Since the default IP address is a so-called local address, it will not be routed by any network device. Thus, the PC and the module must reside in the same subnet.

The user may open a Telnet session using the default IP address and change the parameters stored in the non-volatile memory of the module. He may then close the session, select the initialization mode Using Stored, power-on again and establish the TCP/IP connection using the new parameters.

When the module is wired to the PC directly (e.g. using a cross-over cable or a local hub), separated from the local area network, the user may simply keep the default parameters to establish the TCP/IP connection.

NOTE

In the **Using Default** mode, the parameters stored in the memory of the module are not cleared automatically. If not changed by the user, they are still available, when switching back to the mode Using Stored.

Dynamic Host Configuration Protocol (DHCP)

General Information (DHCP)

The Dynamic Host Configuration Protocol (DHCP) is an auto configuration protocol used on IP networks. The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card G1369C, and "B"-firmware (B.06.40 or above) or modules with "D"-firmware. All modules should use latest firmware from the same set.

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

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

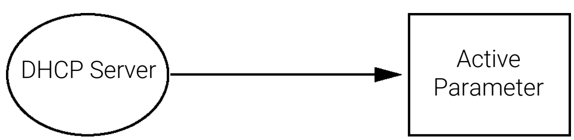


Figure 21: DHCP (principle)

NOTE

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

Setup (DHCP)

The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card G1369C, and “B”-firmware (B.06.40 or above) or modules with "D"-firmware. All modules should use latest firmware from the same set.

1 Note the MAC address of the LAN interface (provided with G1369C LAN Interface Card or mainboard). This MAC address is on a label on the card or at the rear of the mainboard, for example, *0030d3177321*.

   On the Local Controller the MAC address can be found under **Details** in the LAN section.

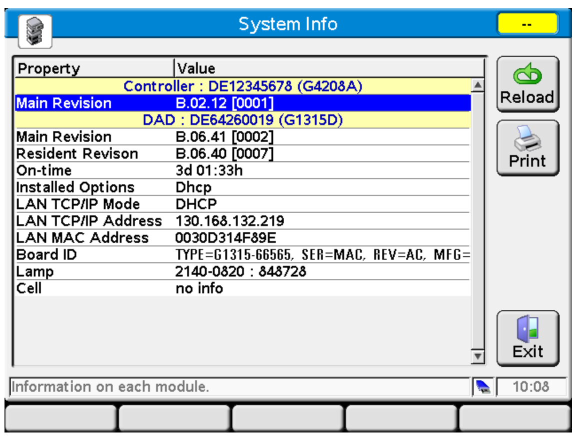


Figure 22: LAN setting on Instant Pilot

2 Set the configuration switch to DHCP either on the G1369C LAN Interface Card or the mainboard of above mentioned modules.

Table 15: G1369C LAN Interface Card (configuration switch on the card)

SW 4	SW 5	SW 6	SW 7	SW 8	Initialization Mode
ON	OFF	OFF	OFF	OFF	DHCP

3 Turn on the module that hosts the LAN interface.

4 Configure your Control Software (e.g. OpenLAB CDS ChemStation Edition, Lab Advisor) and use MAC address as host name, e.g. *0030d3177321*.

The LC system should become visible in the control software (see Note in section General Information (DHCP) on page 123).

Manual Configuration

Manual configuration only alters the set of parameters stored in the non-volatile memory of the module. It never affects the currently active parameters. Therefore, manual configuration can be done at any time. A power cycle is mandatory to make the stored parameters become the active parameters, given that the initialization mode selection switches are allowing it.

With the Instant Pilot (G4208A)

To configure the TCP/IP parameters before connecting the module to the network, the Instant Pilot (G4208A) can be used.

1 From the Welcome screen press the **More** button.

2 Select **Configure.**

3 Press the module button of the module that hosts the LAN interface (usually the detector).

4 Scroll down to the LAN settings.

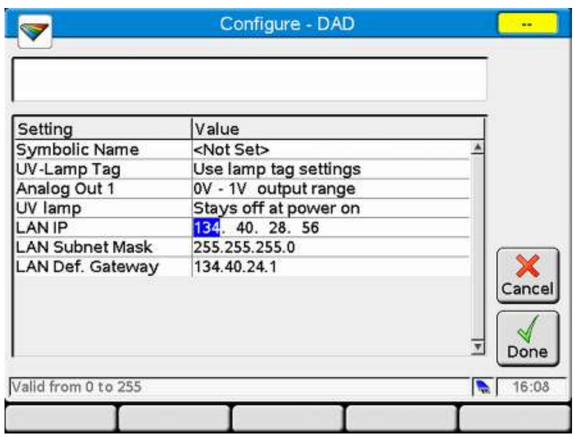


Figure 23: Instant Pilot - LAN configuration (edit mode)

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

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

PC and User Interface Software Setup

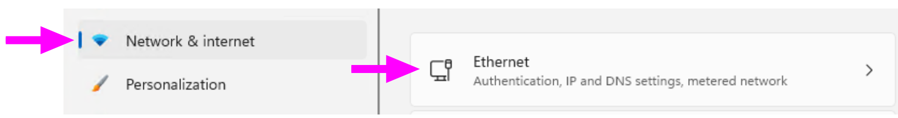
PC Setup for Local Configuration

This procedure describes the change of the TCP/IP settings on your PC to match the module's default parameters in a local configuration (see Table 14 Using default parameters on page 121).

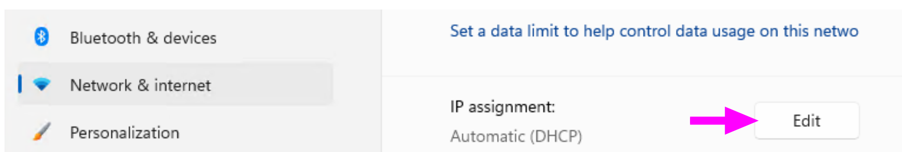
The individual steps may vary depending on the operating system. Below you can find the steps to set up a static IP address in Windows 11.

1 Navigate to the settings on your PC (Windows **Start** menu > **Settings**).

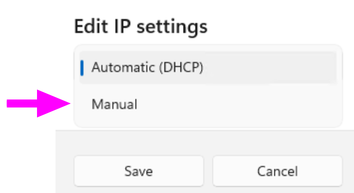
2 Under **Network and internet**, select **Ethernet**.



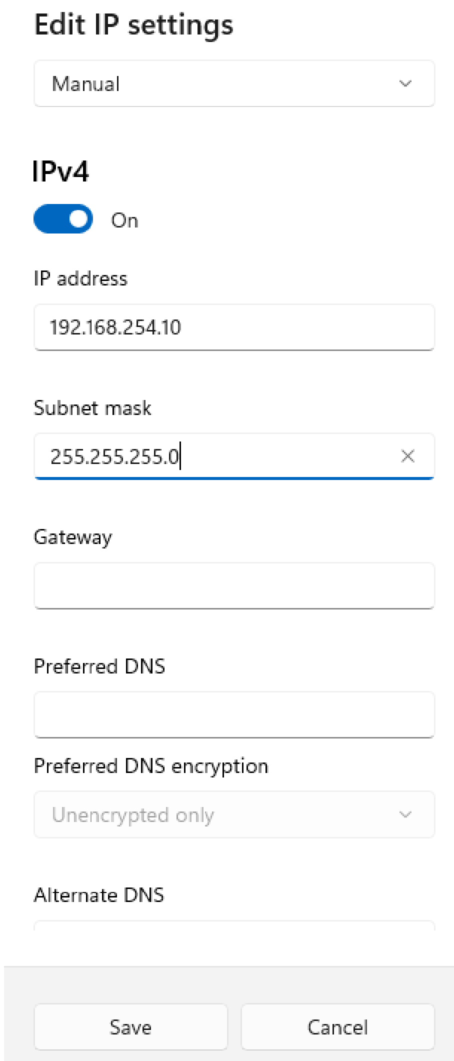
3 In section **IP assignment**, click **Edit**.



4 To edit the IP settings, select **Manual** from the drop-down list.



5 Enable (toggle) the **IPv4** connection and enter the following IP address settings:



6 Save your configuration settings.

11 Appendix

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

General Safety Information

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

WARNING

Ensure the proper usage of the equipment.

The protection provided by the equipment may be impaired.

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

Safety Standards

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

General

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

Before Applying Power

WARNING

Wrong voltage range, frequency or cabling

Personal injury or damage to the instrument

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

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.**

NOTE

Note the instrument's external markings described under Safety Symbols on page 136.

Ground the Instrument

WARNING

Missing electrical ground

Electrical shock

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

Do Not Operate in an Explosive Atmosphere

WARNING

Presence of flammable gases or fumes

Explosion hazard

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

Do Not Remove the Instrument Cover

WARNING

Instrument covers removed

Electrical shock

- **Do not remove the instrument cover**
- **Only Agilent authorized personnel are allowed to remove instrument covers. Always disconnect the power cables and any external circuits before removing the instrument cover.**

Do Not Modify the Instrument

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

In Case of Damage

WARNING

Damage to the module

Personal injury (for example electrical shock, intoxication)

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

Solvent Information

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.**
- **Do not use solvents with an auto-ignition temperature below 200 °C (392 °F). Do not use solvents with a boiling point below 56 °C (133 °F).**
- **Avoid high vapor concentrations. Keep the solvent temperature at least 40 °C (72 °F) below the boiling point of the solvent used. This includes the solvent temperature in the sample compartment. For the solvents methanol and ethanol keep the solvent temperature at least 25 °C (45 °F) below the boiling point.**
- **Do not operate the instrument in an explosive atmosphere.**
- **Do not use solvents of ignition Class IIC according IEC 60079-20-1 (for example, carbon disulfide).**
- **Reduce the volume of substances to the minimum required for the analysis.**
- **Do not use bottles that exceed the maximum permissible volume (2.5 L) as specified in the usage guidelines.**
- **Ground the waste container.**
- **Regularly check the filling level of the waste container. The residual free volume in the waste container must be large enough to collect the waste liquid.**
- **To achieve maximal safety, regularly check the tubing for correct installation.**

NOTE

For details, see the usage guideline for the solvent cabinet. A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available in the Agilent Information Center or via the Internet.

Recommendations on the Use of Solvents

Observe the following recommendations on the use of solvents.

- Brown glass ware can avoid growth of algae.
- Follow the recommendations for avoiding the growth of algae, see the pump manuals.
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.22 µm filters.
- Avoid or minimize the use of solvents that may corrode parts in the flow path. Consider specifications for the pH range given for different materials such as flow cells, valve materials etc. and recommendations in subsequent sections.
- Avoid the use of the following steel-corrosive solvents:
  - solutions of alkali halides and their respective acids (for example, lithium iodide, potassium chloride, and so on),
  - high concentrations of inorganic acids like sulfuric acid and nitric acid, especially at higher temperatures (if your chromatography method allows, replace by phosphoric acid or phosphate buffer which are less corrosive against stainless steel),
  - halogenated solvents or mixtures which form radicals and/or acids, for example:

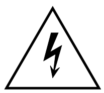
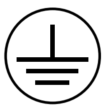
  $2CHCl_3 + O_2 \rightarrow 2COCl_2 + 2HCl$

  This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol,

  - chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, diisopropyl ether) should be filtered through dry aluminium oxide which adsorbs the peroxides,
  - solvents containing strong complexing agents (e.g. EDTA),
  - mixtures of carbon tetrachloride with 2-propanol or THF.
- Avoid the use of dimethyl formamide (DMF). Polyvinylidene fluoride (PVDF), which is used in leak sensors, is not resistant to DMF.

Safety Symbols

Table 16: Symbols

	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.
	Indicates flammable material used. Consult the Agilent Information Center / User Manual before attempting to install or service this equipment. Follow all safety precautions.
CE	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.
REF	Product Number
SN	Serial Number
	Power symbol indicates On/Off. The apparatus is not completely disconnected from the mains supply when the on/off switch is in the Off position
	Pacemaker Magnets could affect the functioning of pacemakers and implanted heart defibrillators. 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.

WARNING

A WARNING

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

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

CAUTION

A CAUTION

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

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

Material Information

This section provides detailed information about materials used in the HPLC system and general information about solvent/material compatibility.

General Information About Solvent/Material Compatibility

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

Disclaimer

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

MP35N

MP35N is a nonmagnetic, nickel-cobalt-chromium-molybdenum alloy demonstrating excellent corrosion resistance (for example, against nitric and sulfuric acids, sodium hydroxide, and seawater) over a wide range of concentrations and temperatures. In addition, this alloy shows exceptional resistance to high-temperature oxidation. Due to excellent chemical resistance and toughness, the alloy is used in diverse applications: dental products, medical devices, nonmagnetic electrical components, chemical and food processing equipment, marine equipment. Treatment of MP35N alloy samples with 10 % NaCl in HCl (pH 2.0) does not reveal any detectable corrosion. MP35N also demonstrates excellent corrosion resistance in a humid environment. Although the influence of a broad variety of solvents and conditions has been tested, users should keep in mind that multiple factors can affect corrosion rates, such as temperature, concentration, pH, impurities, stress, surface finish, and dissimilar metal contacts.

Polyphenylene Sulfide (PPS)

Polyphenylene sulfide has outstanding stability even at elevated temperatures. It is resistant to dilute solutions of most inorganic acids, but it can be attacked by some organic compounds and oxidizing reagents. Nonoxidizing inorganic acids, such as sulfuric acid and phosphoric acid, have little effect on polyphenylene sulfide, but at high concentrations and temperatures, they can still cause material damage. Nonoxidizing organic chemicals generally have little effect on polyphenylene sulfide stability, but amines, aromatic compounds, and halogenated compounds may cause some swelling and softening over extended periods of time at elevated temperatures. Strong oxidizing acids, such as nitric acid (> 0.1 %), hydrogen halides (> 0.1 %), peroxy acids (> 1 %), or chlorosulfuric acid degrade polyphenylene sulfide. It is not recommended to use polyphenylene sulfide with oxidizing material, such as sodium hypochlorite and hydrogen peroxide. However, under mild environmental conditions, at low concentrations and for short exposure times, polyphenylene sulfide can withstand these chemicals, for example, as ingredients of common disinfectant solutions.

PEEK

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

It is stable in the specified pH range (for the Bio-Inert LC system: pH 1 – 13 , see bio-inert module manuals for details), and inert to many common solvents.

There are still some known incompatibilities with chemicals such as chloroform, methylene chloride, THF, DMSO, strong acids (nitric acid > 10 %, sulfuric acid > 10 %, sulfonic acids, trichloroacetic acid), halogens or aqueous halogen solutions, phenol and derivatives (cresols, salicylic acid, and so on).

When used above room temperature, PEEK is sensitive to bases and various organic solvents, which can cause it to swell. Under such conditions, normal PEEK capillaries are sensitive to high pressure. Therefore, Agilent uses stainless steel clad PEEK capillaries in bio-inert systems. The use of stainless steel clad PEEK capillaries keeps the flow path free of steel and ensures pressure stability up to 600 bar. If in doubt, consult the available literature about the chemical compatibility of PEEK.

Polyimide

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

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

Polyethylene (PE)

Agilent uses UHMW (ultra-high molecular weight)-PE/PTFE blends for yellow piston and wash seals, which are used in 1290 pumps, the G7104C and for normal phase applications in 1260 pumps.

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

Tantalum (Ta)

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

Stainless Steel (SST)

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

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

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

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

Titanium (Ti)

Titanium is highly resistant to oxidizing acids (for example, nitric, perchloric and hypochlorous acid) over a wide range of concentrations and temperatures. This is due to a thin oxide layer on the surface, which is stabilized by oxidizing compounds. Non-oxidizing acids (for example, hydrochloric, sulfuric and phosphoric acid) can cause slight corrosion, which increases with acid concentration and temperature. For example, the corrosion rate with 3 % HCl (about pH 0.1) at room temperature is about 13 µm/year. At room temperature, titanium is resistant to concentrations of about 5 % sulfuric acid (about pH 0.3). Addition of nitric acid to hydrochloric or sulfuric acids significantly reduces corrosion rates. Titanium is sensitive to acidic metal chlorides like $FeCl_3$ or $CuCl_2$.

Titanium is subject to corrosion in anhydrous methanol, which can be avoided by adding a small amount of water (about 3 %). Slight corrosion is possible with ammonia > 10 %.

Diamond-Like Carbon (DLC)

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

Fused Silica and Quartz (SiO_2)

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

Gold

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

Zirconium Oxide (ZrO_2)

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

Platinum/Iridium

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

Fluorinated Polymers (PTFE, PFA, FEP, FFKM, PVDF)

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

TFE/PDD copolymer tubings, which are used in all Agilent degassers except G1322A/G7122A, are not compatible with fluorinated solvents like Freon, Fluorinert, or Vertrel. They have limited life time in the presence of hexafluoroisopropanol (HFIP). To ensure the longest possible life with HFIP, it is best to dedicate a particular chamber to this solvent, not to switch solvents, and not to let dry out the chamber. For optimizing the life of the pressure sensor, do not leave HFIP in the chamber when the unit is off.

The tubing of the leak sensor is made of PVDF (polyvinylidene fluoride), which is incompatible with the solvent DMF (dimethylformamide).

Sapphire, Ruby, and Al_2O_3-Based Ceramics

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

At-a-Glance Details About Agilent Capillaries

The following section provides useful information about Agilent capillaries and its characteristics.

Syntax for capillary description

Type - Material - Capillary dimensions - Fitting Left/Fitting right

Table 17: Example for a capillary description

Code provided with the part	Meaing of the code
Color code: 	Material of the product is MP35N, the inner diameter is 0.20 or 0.25 mm
Capillary	The part is a connection capillary
MP35N	Material of the part is MP35N
0.25 x 80 mm	The part has an inner diameter of 0.25 mm and a length of 80 mm
SI/SI	Left fitting: Swagelok + 1.6 mm Port id, Intermediate Right fitting: Swagelok + 1.6 mm Port id, Intermediate

To get an overview of the code in use, see

- Color: Table 18 Color-coding key for Agilent capillary tubing on page 145
- Type: Table 19 Type (gives some indication on the primary function, like a loop or a connection capillary) on page 145
- Material: Table 20 Material (indicates which raw material is used for the capillary) on page 146
- Dimension: Table 21 Capillary dimensions (indicates inner diameter (id), length, and volume of the capillary) on page 146
- Fittings: Table 22 Fitting left/fitting right (indicates which fitting is used on both ends of the capillary) on page 147

Color Coding Guide

Table 18: Color-coding key for Agilent capillary tubing

Internal diameter in mm		Color code
0.015		Orange
0.025		Yellow
0.05		Beige
0.075		Black
0.075	MP35N	Black with orange stripe
0.1		Purple
0.12		Red
0.12	MP35N	Red with orange stripe
0.17		Green
0.17	MP35N	Green with orange stripe
0.20 /0.25		Blue
0.20 /0.25	MP35N	Blue with orange stripe
0.3		Grey
0.50		Bone White

NOTE

As you move to smaller-volume, high efficiency columns, you'll want to use narrow id tubing, as opposed to the wider id tubing used for conventional HPLC instruments.

Abbreviation Guide for Type

Table 19: Type (gives some indication on the primary function, like a loop or a connection capillary)

Key	Description
Capillary	Connection capillaries
Loop	Loop capillaries
Seat	Autosampler needle seats

Key	Description
Tube	Tubing
Heat exchanger	Heat exchanger

Abbreviation Guide for Material

Table 20: Material (indicates which raw material is used for the capillary)

Key	Description
ST	Stainless steel
Ti	Titanium
PK	PEEK
FS/PK	PEEK-coated fused silica [1]
PK/ST	Stainless steel-coated PEEK [2]
PFFE	PTFE
FS	Fused silica
MP35N	Nickel-cobalt-chromium-molybdenium alloy

[1] Fused silica in contact with solvent

[2] Stainless steel-coated PEEK

Abbreviation Guide for Capillary Dimensions

Table 21: Capillary dimensions (indicates inner diameter (id), length, and volume of the capillary)

Description
id (mm) x Length (mm)
Volume (µL)

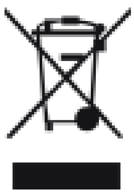
Abbreviation Guide for Fitting Left/Fitting Right

Table 22: Fitting left/fitting right (indicates which fitting is used on both ends of the capillary)

Key	Description
W	Swagelok + 0.8 mm Port id
S	Swagelok + 1.6 mm Port id
M	Metric M4 + 0.8 mm Port id
E	Metric M3 + 1.6 mm Port id
U	Swagelok union
L	Long
X	Extra long
H	Long head
G	Small head SW 4
N	Small head SW 5
F	Finger-tight
V	1200 bar
B	Bio
P	PEEK
I	Intermediate

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

Cables supplied by Agilent Technologies are screened to provide optimized protection against radio interference. All cables are in compliance with safety or EMC regulations.

Test and Measurement

If test and measurement equipment is operated with unscreened cables, or used for measurements on open set-ups, the user has to assure that under operating conditions the radio interference limits are still met within the premises.

Sound Emission

Sound Pressure

Sound pressure Lp < 70 db(A) according to DIN EN ISO 7779

Schalldruckpegel

Schalldruckpegel Lp < 70 db(A) nach DIN EN ISO 7779

Agilent Technologies on Internet

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

https://www.agilent.com

In This Book

This manual contains technical reference information about the Agilent 1260 Infinity III Evaporative Light Scattering Detector (G4260B) and Agilent 1290 Infinity III Evaporative Light Scattering Detector (G7102A).

The manual describes the following:

- introduction,
- site requirements and specifications,
- installation,
- using the module,
- optimizing performance,
- troubleshooting and diagnostics,
- error information,
- maintenance,
- parts and materials,
- LAN configuration,
- safety and related information.

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