Antec Scientific
Hoorn 131
2404 HH Alphen a/d Rijn
The Netherlands

LC 110 pump

User manual

193.0010S, Edition 6, 2022

CE Declaration of conformity

We Antec Scientific, Alphen a/d Rijn The Netherlands, declare that the product:

LC 110S pump	**type 193**

to which this declaration relates, is in conformity with the following CE directives:

Machinery Directive (2006/42/EC)

Low Voltage Directive (2014/35/EU) applied with the following standards:

Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General Requirements	**IEC 61010-1 (2010 + Corrigendum: 2011)**
Electrical accessories – Cord sets and interconnection cords	**IEC 60799 (1998)**

EMC Directive (2014/30/EU) applied with the following standards:

Electrical equipment for measurement, control and laboratory use - EMC requirements Part 1: General Requirements	**IEC 61326-1 (2006)** **EN 61326 Corrigendum 2 (2011)**
Electromagnetic compatibility (EMC) Part 3-2	**EN 61000-3-2 (2005 + A1:2008 + A2:2009)**

RoHS directive (2011/65/EU) Restriction of Hazardous Substances
WEEE directive (2012/19/EC) Waste Electrical and Electronic Equipment

Use manufacturer-supplied cable(s) only to connect all I/O's with other devices. Thoroughly connect the shielding to common. Manufacturer will not accept any liability for damage, direct or indirect, caused by connecting/integration this instrument to devices or systems, which do not meet the essential requirements or relevant safety standards.

April 20th, 2016
Dr. N.J. Reinhoud (managing Director)

WEEE directive

Antec Scientific is a Business-to-Business producer of analytical analysis equipment which fall under WEEE Annex IA categories 8 and 9 (includes medical devices and monitoring and control instruments). All equipment of Antec Scientific which are subjected to the WEEE directive (shipped after August 13, 2005) are labelled with the “crossed out wheelie-bin”.

The symbol on the product indicates that the product must not be disposed as unsorted municipality waste.

Collection & recycling information (business-to-business)
Antec Scientific offers the possibility for disposal and recycling of their instrument at an appropriate recycling facility if requested (there may be costs involved with this service). Please contact Antec (info@antecscientific.com) for more information about this service and to register the return and disposal of end-of-life instruments. To assure hygienic & personal safety all instrument should be returned with a signed decontamination form which is available on the web-site.

Shipping address for end-of-life products:

Antec Scientific
Hoorn 131
2404 HH Alphen a/d Rijn, The Netherlands

In case of questions, or if further information is required about the collection & recycling procedure, please contact Antec or your local distributor.

ROHS directive

The LC 110S is ROHS compliant and in conformity with Directive 2002/95/EC Restricted use of Hazardous Substances in electrical and electronic Equipment (ROHS).

Intended use

HPLC: High pressure liquid chromatography (HPLC) is a method for separating substance mixtures, determining substances and measuring their concentration. The device or system is suitable for high-pressure liquid chromatography. It is suitable for laboratory use, for analyzing substance mixtures that can be dissolved in a solvent or solvent mixture.

Pumps: The LC 110S pump is a conveying system for analytical and semi-preparative applications. Pump head inlays made of different materials cover all needs of the user. If biocompatibility is required, titanium or ceramic inlays can be used. The pump head can operate at liquid pressures up to a maximum of 650 bar. The pump heads can be exchanged by the user. Automatic piston back-flushing increases the service life of the seals and pistons, and removes salt and other substances from the area behind the seals.

Room ventilation, AC system, sunlight: Always use the device in rooms that are well-ventilated, and are preferably equipped with an air-conditioning system. When setting up the system at the installation location, make sure that it is protected against direct sunlight.

Check intended use: Only use the device for applications that fall within the scope of the specified intended use. Else the protective and safety equipment of the device could fail. Due to the new drive used in the pump, pump heads of older series cannot be used any more.

Laboratory use:

- Biochemistry analyses
- Chiral analyses
- Food analyses
- Pharmaceutical analyses
- Environmental analyses
- Clinical analyses (research purpose only)

With respect to clinical analyses the instrument is intended for *research purposes only*. While clinical applications may be shown, this instrument is not tested by the manufacturer to comply with the In Vitro Diagnostics Directive.

Where is it prohibited to use the device or system?

DANGER! Risk of explosion! Never use the device in potentially explosive atmospheres without appropriate protective equipment and approval by a notified body! Inform the technical service department of the manufacturer!

Symbols

Explanations of symbols & labels on the device or in user manual:

Symbol	Explanation
	Hazard symbol indicating microelectronic devices that can be damaged by electrostatic discharge when touched.
	Flow direction symbol for piston back flushing: inlet to flush pump.
	Flow direction symbol for piston back flushing: outlet from the flush pump.
	Quality mark of a Nationally Recognized Testing Laboratory (NRTL) in Canada and the United States. The certified device or system has successfully passed the quality and safety tests.
	CE (Conformité Européenne) mark for equipment that complies with the pertinent EU directives and comes with a declaration of conformity from the manufacturer.
	The caution/warning sign denotes a hazard. It calls attention to a procedure or practice which, if not adhered to, could result in severe/lethal injury or damage/destruction of parts or all of the equipment. Do not proceed beyond a warning sign until the indicated conditions are fully understood and met.
	The attention sign signals relevant information. Read this information, as it might be helpful.

Safety practices

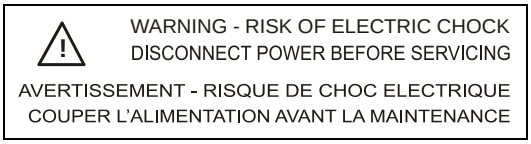
The following safety practices / protective measures are intended to ensure safe operation of the instrument.

- You are only permitted to perform the maintenance tasks described in this manual.
- All other maintenance tasks are to be performed exclusively by the manufacturer or a company authorized by the manufacturer.

Electrical hazards

Without exception, the following applies to all maintenance tasks that can be performed by the user:

- Switch off the device and pull the power plug!
- Never open a device! Removal of protective panels on the instrument can result in exposure to potentially dangerous voltages which may lead to **severe injury or loss of life**! The instrument may only be opened by authorized service engineers of the manufacturer or a company authorized by the manufacturer.



Place the LC 110S on a flat and smooth surface or inside a PR 110 pump rack. Connect the detector to a grounded AC power source, line voltage 100 – 240 VAC, frequency 50/60 Hz. The instrument should be connected to a protective earth via a grounded socket using the power cord supplied by the manufacturer.

The power source should exhibit minimal power transients and fluctuations. Replace faulty or frayed power cords.

Laboratory regulations

Observe national and international regulations pertaining to laboratory work!

- Good Laboratory Practice (GLP) of the American Food & Drug Administration
- For development of methods and validation of devices:
- Protocol for the Adoption of Analytical Methods in the
- Clinical Chemistry Laboratory, American Journal of Medical Technology, 44, 1, pages 30–37 (1978)
- Accident prevention regulations published by the accident insurance companies for laboratory work

Solvents

Organic solvents are highly flammable. Since capillaries can detach from their screw fittings and allow solvent to escape, it is prohibited to have any open flames near the analytical system!

Regularly check for leaks and clogged LC tubing and connections. Test back pressure without column. Do not close or block drains or outlets. Do not allow flammable and/or toxic solvents to accumulate. Follow a regulated, approved waste disposal program. Never dispose of such products through the municipal sewage system.

Solvents suitable for use in HPLC:

- Acetic acid (10–50%), at 25 °C
- Acetone
- Acetonitrile
- Ethanol
- Ethyl acetate
- Hexane/heptane
- Isopropanol
- Methanol
- Phosphoric acid
- Water

Even small quantities of other substances, such as additives, modifiers or salts can influence the durability of the materials. The list of selected solvents were compiled based on research in the pertinent literature and is only a recommendation by the manufacturer. In the event of doubt, contact the technical support department of the manufacturer.

Unsuitable solvents

The following solvents can attack the components of the pump and are therefore not suitable:

- Mineral and organic acids (except in buffer solutions)
- Bases (except in buffer solutions)
- Liquids containing particles

Only suitable to a limited extent

The following solvents are suitable to only a limited extent for use in the pump:

- Methylene chloride
- Tetrahydrofuran (THF)
- Dimethyl sulfoxide (DMSO)
- Slightly volatile solvents
- Fluorinated hydrocarbons

Self-ignition point

Only use solvents that have a self-ignition point higher than 150 °C under normal ambient conditions!

Solvent tray

To avoid damage from leaks, always place solvent bottles in a solvent tray on the device.

Toxicity: Organic solvents are toxic above a certain concentration. Ensure that work areas are always well-ventilated! Wear protective gloves, safety glasses and other relevant protective clothing when working on the device!

Operating the device or system

The device can be operated by means of the chromatography software at the workstation, the touch screen or the membrane keyboard at the device.

What expertise should users have to safely operate a HPLC device or system?

- Completed degree as chemical laboratory technician or comparable vocational training
- Fundamental knowledge of liquid chromatography

- Participation in an installation of the system performed by the manufacturer or a company authorized by the manufacturer and suitable training on the system and chromatography software.
- Basic knowledge of Microsoft Windows®
- Knowledge regarding substances that are suitable only to a limited extent for use in liquid chromatography.

To what should the user pay particular attention?

To make your HPLC separations as efficient as possible, pay close attention to the following:

- Avoiding additional dead volumes:
    - Once they have been used, never re-use capillaries in other areas of the HPLC system.
    - Only use a given PEEK fitting for one specific port and never re-use it for other ports. Al-ways install new PEEK fittings on each separate port.
- When using special columns, obey the manufacturer's instructions on caring for the columns.
- Regularly check for clogged capillaries – test back pressure without column.
- Using filtered solvents
    - Use ultra-pure, filtered solvents for HPLC.
    - Filtration of substances under analysis.
    - Use of inline filters.

Devices are to be opened by the technical service department only. Only allow the technical service department of the manufacturer or a company authorized by the manufacturer to open the devices for maintenance and repair work.

Mobile Phase Requirements LC-EC

Electrochemical detection is a sensitive detection technique characterised by extremely low detection limits. A typical detection limit of 100 pmol/L or lower for catecholamines is no exception. Improving detection limits will always be limited by the weakest link in an LC-EC system. Therefore, in the ALEXYS analyzer or ROXY EC/LC system all hardware is carefully selected to warrant optimum performance.
In daily practice a couple of 'rules' must be obeyed to fully exploit the incredible linear dynamic range and low detection limits of an EC detector. These are not only hardware related, but also refer to mobile phase composition, degassing, temperature and pH stability and several other issues.

Mobile phase requirements

- Electrochemically clean, HPLC grade or better
- Ion strength 20 - 200 mmol/L
- Buffer pH near pKa
- In-line 0.2 µm filter & degassing of mobile phase
- EDTA for trapping of metal ions

Mobile phase must be clean as it is in direct contact with the working electrode in EC detection. High purity chemicals including water is a pre requisite. In some applications EDTA is added to the mobile phase to traps electrochemically metals such as Fe^{2+} by forming an inactive complex. However at higher working potentials (typically > 1.2 V vs. salt bridge AgCl ref) also EDTA can become electrochemically active and is not recommended. In that case only a passivation step with 15% HNO_3 is recommended (see installation guide).
Electrolytes assure contact between 3 electrodes in an electrochemical flow cell. Low ion strength destabilises an EC system and noise will increase. Extremely high buffer concentrations cause problems of salt formation. Therefore concentrations between 20 and 200 mmol/L are recommended.

Also constant pH is important for baseline stability and reproducible results. Stability of pH is best when close to pK_a of a buffer ion. Often used buffers are phosphate, carbonate, acetate and citrate. Modifiers such as methanol, propanol and acetonitril can be used without problems in DC amperometry, but not in pulsed amperometric detection as peaks are strongly attenuated. In our experience the quality and expiration date of organic modifiers can be a problem resulting in increased noise levels. Metal inlet frits in mobile phase bottles are not advised as metal ions are introduced that increase baseline noise. Instead 0.2 µm nylon inlet filters are recommended.

Avoid precipitation of buffer salts in organic solvents. Always start with flushing system with water when switching solvents.

Never switch off the LC 110S with mobile phase in it as salts will precipitate an clog the system. First flush with water, subsequently with water/methanol.

Vacuum degassing

Considerable amounts of the gases N_2, O_2 and CO_2 may be dissolved in HPLC mobile phases. Whenever the temperature changes, solvents are mixed or a pressure reduction occurs, these gases may show up as very small air bubbles. To avoid noisy baselines an in-line vacuum degasser has been integrated in the ALEXYS analyzer/ ROXY EC/LC system. It has a low dead volume (less than 0.5 mL) and high degassing efficiency. The advantage over helium degassing is that the degasser does not change the mobile phase composition.

Helium degassing

Degassing using helium is an effective and universally applicable method but only recommended when working in reductive electrochemical detection. All gases except helium are removed completely. Helium is not EC active and does not change the mobile phase properties significantly.
To prevent mobile phase contamination, only high-purity helium must be used.

Warranty conditions & spare parts

The factory warranty for the device is valid for 12 months after the date of dispatch. All warranty claims expire in the event that any unauthorized changes are made to the device. During the warranty period, any components with material or design-related defects will be replaced or repaired by Antec Leyden free of charge.

This warranty excludes the following:

- Accidental or wilful damage.
- Damage or errors caused by third parties that are not contractually related to Antec Leyden at the time the damage occurred.
- Wear & tear parts, fuses, glass parts & columns.
- Damage caused by negligence or improper operation of the device and damage caused by clogged capillaries.
- Packaging and transport damage.

In the event of device malfunctions, contact your local Antec representative or if not available in your country, the Antec main office.

Manufacturer provides operational spare parts of the instrument and current accessories for a period of five years after shipment of the final production run of the instrument. Spare parts will be available after this five years period on an ‘as available’ basis. Manufacturer provides a variety of services to support her customers after warranty expiration. Repair service can be provided on a time and material basis. Contact your local representative for servicing. Qualified chemists on both contractual and as-needed basis can provide technical support and training.

The packaging of our devices provides the best possible protection against transport damage. However, immediately inspect each delivery for signs of transport damage. If the shipment is incomplete or damaged, inform the manufacturer within three workdays. Also inform the freight carrier about transport damage.

Table of contents

CHAPTER 1

Introduction

Congratulations on your purchase of the LC 110S HPLC pump. The LC 110S is a vital component of the ALEXYS analyzers and ROXY EC/LC systems. The pump has a double-piston design with an advanced pulsation dampening mechanism, assuring the delivery of solvents with very low residual pulsations and smooth baselines. With its improved motor drive and pump head design it is capable to operate at back pressures up 700 bar.

The LC 110S has a versatile 10 mL pump head which can deliver flow rates in the µL range up to 10 mL/min. High pressure gradient as well as flow rate programming is supported. Because the use of buffers and salts is indispensable in LC-EC the LC 110S is equipped with an automatic piston back flush module to maximize the piston and seal life span.

The LC 110S can also be used as a high quality stand-alone pump to be incorporated in any LC system.

Fig. 1. ALEXYS® Analyzer / ROXY EC/LC system equipped with two LC 110S pumps.

Before installation of the device (Chapter 4) read the safety instructions, intended use section, Chapter 2 “Description of the device’ and Chapter 3 ”Operation” carefully.

CHAPTER 2

Description of instrument

Front panel

The figure below shows the front view of the LC 110S. The keyboard and LCD display are located on the front side of the door. Display panel and foil key touchpad functions are listed in the table. The pump head, pressure transducer and capillaries are located behind the front door.

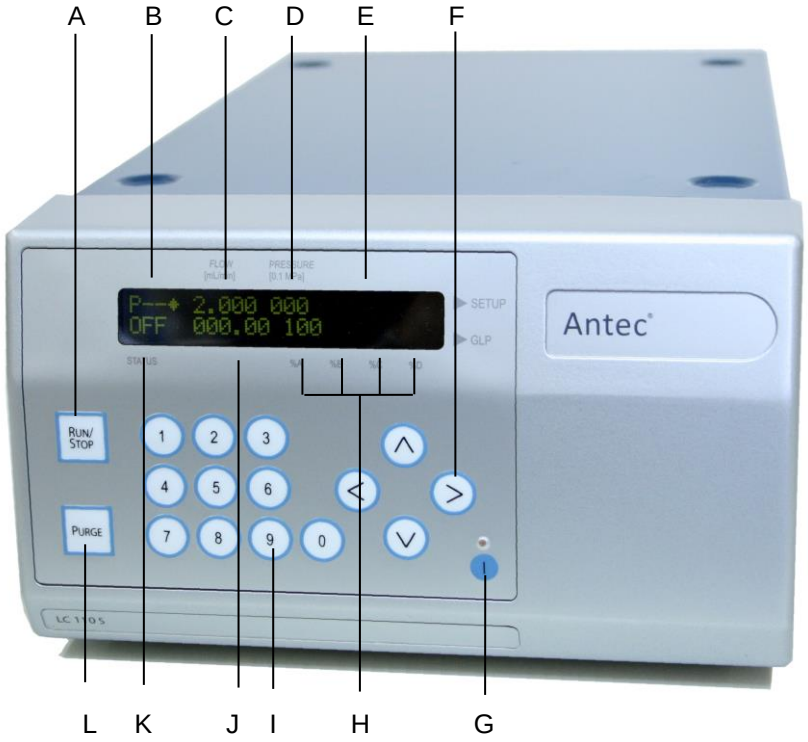


Fig. 2. Front view of the LC 110S. Display panel and foil key touchpad functions.

	LCD display		**Keyboard**
B	Program/Link	A	Pump START / STOP
C	Flow rate	L	Purge key
D	Pressure	I	Numeric key pad
E	Event status	H	Arrow keys
H	Gradients	G	Standbye key
J	Run time		
K	Status of pump, program or Link		

The display shows information about the current status of the pump, such as the flow rate, the measured pressure or the current status of the run-

ning program. It also serves to display input values while running parameters are being modified.

- START/STOP key [A]. Once the flow rate has been entered and set, the pumping process can be either started or stopped by pressing the START/STOP key.
- The PURGE key [L] allows immediate access to the purging function of the pump.
- The numeric keypad [I] allows for the entering of running parameters as well as for the control of program cycles
- The arrow keys [H] allow to navigate horizontally and vertically through the menus. Furthermore, the vertical arrow keys can be used to increase and decrease the displayed values.
- The standby key [G] allows for the pump to be easily shut off in an energy saving mode as well as restarted. By pressing down on the standby key for more than 2 seconds, the pump will be completely shut down. Once the pump has shutdown, the standby key will light up and remain lit. The pump can then be restarted by again pressing on the standby key for more than 2 seconds.

Note: To disconnect the pump from the mains power one need to toggle the mains on/off switch on the rear of the device.

Pump head

The pump head is the core element of a pump.

- Pump head 10 ml, for use in analytical applications, standard version made of stainless steel. Titanium or ceramic inlays for biocompatible applications
- Pump head 50 ml, for use in semi-preparative applications, standard version made of stainless steel. Titanium or ceramic inlays for biocompatible applications

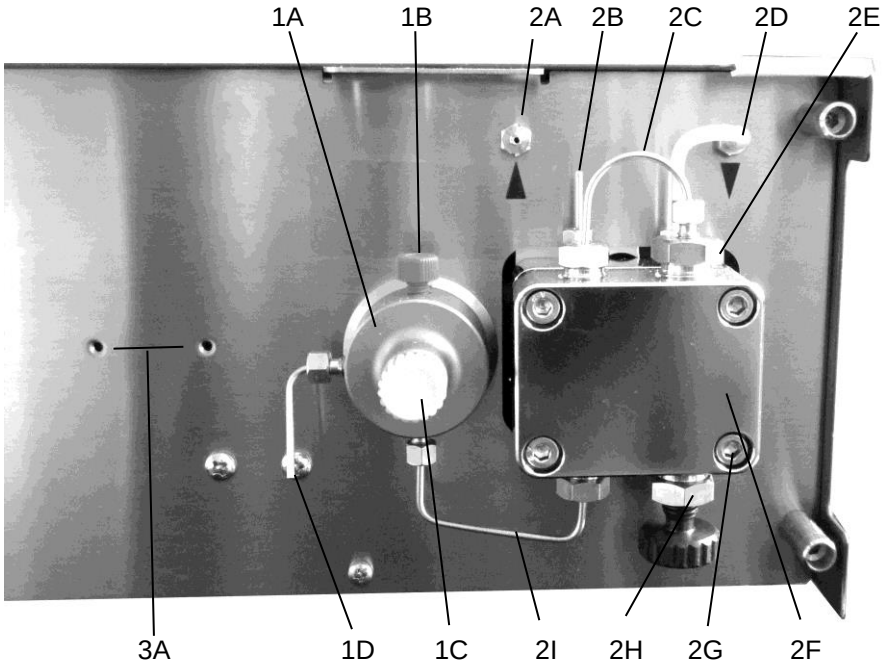


Fig. 3. Pump head and pressure transducer with purge valve.

2	**Pump Head**	**1**	**Pressure Transducer**
2A	Piston wash inlet	1A	Purge valve / pressure transducer
2B	Piston wash outlet	1B	High pressure eluent outlet (to injector)
2C	Capillary connection	1C	De-areation/purge screw
2D	Piston wash connection	1D	Purge outlet
2E	Outlet check valve		
2F	Pump head body		
2G	Pump head mounting screw	**3**	**Mixing chamber (optional)**
2H	Eluent inlet with check valve	3A	Mounting threads for static mixing chamber
2I	Capillary conn. to purge valve		

The LC 110S pump is standard delivered with a 10 mL stainless steel pump head with Sapphire pistons and PTFE seals (both high pressure and

wash seals). The pump head, all hydraulic connections including those of the optional integrated mixing chamber are located on the front side of the LC 110S behind the door (see the photo on the previous page). For information how to connect all eluent tubing to the pump head as well as on how to remove see the next chapters. The possibility exists for a static mixing chamber to be affixed to the metal plate behind the front door of the pump. The mounting threads (item 3A in Fig. 3) are used for this purpose. Antec recommends using an eluent mixer with all gradient systems.

Pump head identification

The front of the pump head is labelled with the max. pumping capacity (10 ml or 50 ml). Pump heads with inlays are additionally labelled with the respective material (Ti for titanium and C for ceramic). The pump automatically recognizes the pump head by means of an RFID chip (see next paragraph).

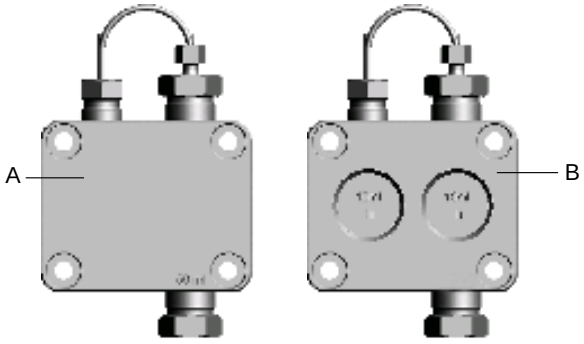


Fig. 4. A. Labelling on pump head without inlays (stainless steel). B. Labeling on pump head with titanium inlays.

RFID

The pump head is equipped with an RFID chip. It is used to monitor and save all important parameters and settings of the pump and pump head. In the display, a diamond icon designates the RFID function (A).

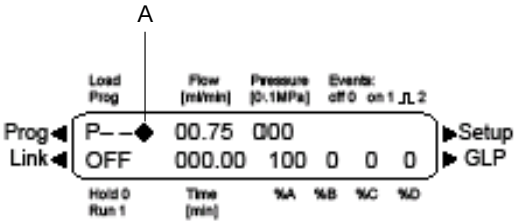


Fig 5. Pump RFID designation in the pump display.

The RFID technology offers the following advantages:

- Automatic detection of all important pump head parameters by means of radio signals (radio frequency identification), by the pump software or the chromatography software:
- Pump head type
- Serial number and year of manufacture
- Number of cycles and operating times
- Limit values of the pump head parameters
- Storage of all measuring data in accuracy with GLP (Good Laboratory Practice).
- Transfer of all data to the software and pump display.

Rear panel

The rear of the device contains the mains power connection, power switch, power ratings, connections for external devices, markings and warning signs.

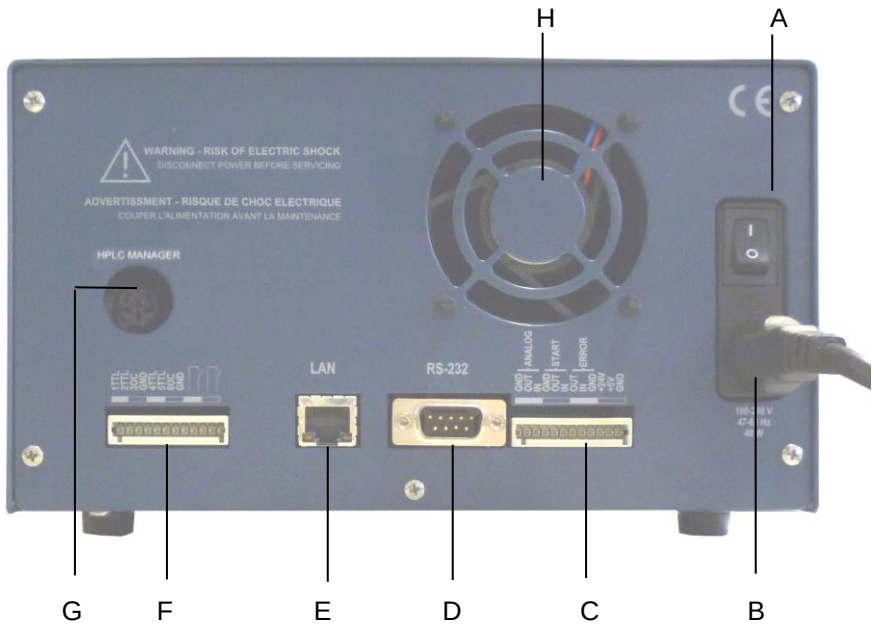


Fig. 6. Rear Panel of the LC 110S.

	Rear panel elements
A	ON/OFF switch
B	Power connector
C	REMOTE terminal strip connections
D	RS232 port
E	LAN ethernet port
F	EVENT terminal strip connections
G	Socket for optional connection with HPLC manager for low pressure gradient mixing
H	Fan opening

Electrical connections

- Use the Events and Remote terminal strips to connect the pump with external devices.
- Use the RSS232 port to connect the pump to a computer.
- Alternatively, use the LAN connection to connect the pump with external devices within a network.
- Use the HPLC manager connector to connect a Low Pressure Gradient mixer.

Caution! Electrostatic discharge can damage the electronics of the pump. Never touch the electronic contacts of the Events and Remote terminal strips!

Use manufacturer-supplied cable(s) only to connect all I/O's with other devices. Thoroughly connect the shielding to common. Manufacturer will not accept any liability for damage, direct or indirect, caused by connecting this instrument to devices, which do not meet relevant safety standards.

Remote terminal strip

- For receiving start, control and error signals from external devices
- For sending start, control and error signals to external devices

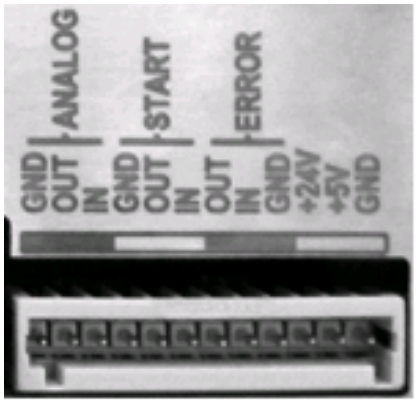


Fig. 7. Remote terminal strip.

Signal	Explanations
ANALOG: OUT	Analog output signal. Either outputs the measured system pressure or a control voltage for *Pump B*. The output range can be set to values of max. 1, 2, 5 and 10 V.
ANALOG: IN	Analog input signal for controlling the flow rate, e.g.: 1 V for 1 ml/min in the case of the 10 ml pump head 1 V for 5 ml/min in the case of the 50 ml pump head.
START: OUT	Output is active for 500 ms when the pump starts.
START: IN	Activated by a voltage of 0 V against GND.
ERROR: OUT	Output is active until the *Error* condition has been eliminated.
ERROR: IN	A voltage of 0 V against GND stops the pump.

Events terminal strip

For test purposes or to trigger/control external devices:

- Sending control signals (Events) to external devices
- Opening and closing contacts
- Activating 500 ms pulses

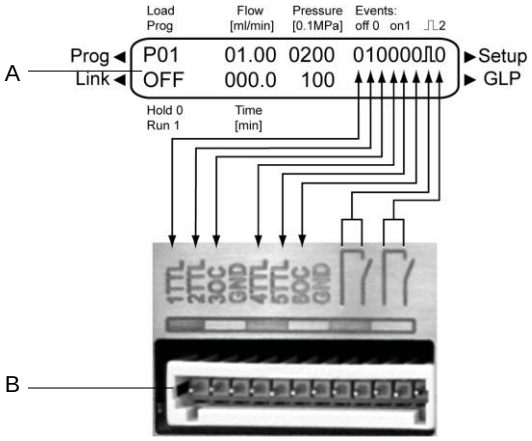


Fig. 8. Events terminal strip. Relation between Event terminal strip (B) and status of the individual Event contacts displayed in the LCD screen (A).

Entering control signals in the program

1. Select the program menu.
2. Select the program number.
3. Press horizontal arrow key to go to the editing mode of the sub-menu.
4. Enter values for events in the upper status bar, by using the vertical arrow keys.

Value	Explanations
0	Off
1	On
⎍	Pulse
-	No status change

Wiring of event & remote terminal strip

To enable signal transmission from external devices to the pump, the flat ribbon cable is connected with a connector strip and connected to the Remote terminal strip on the rear of the pump.

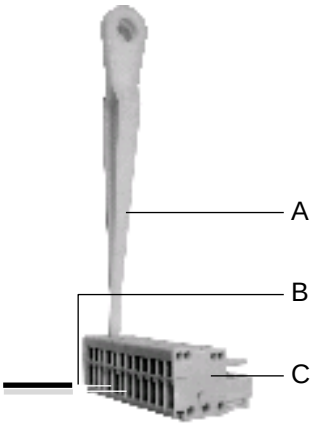
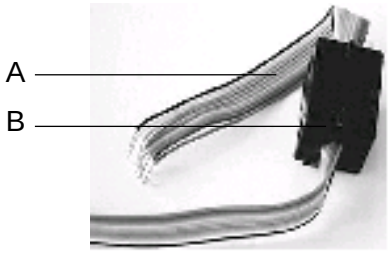


Fig. 9. Connection the flat ribbon cable with the connector strip.

1. Place the connector strip C (p/n 193.0400S) on a suitable surface.
2. Insert the stylus A into the opening on the top of the connector strip and press downward.
3. Keep the stylus pressed down and insert the lead B of the flat ribbon cable (p/n 193.0402) into the front of the connector strip.

4. Remove the stylus.
5. Check whether the cables are secured properly.

Flat ribbon cables that are connected to the Events and Remote terminal strips can some-times cause electromagnetic interference. This can be suppressed by means of a snap ferrite (p/n 193.0422) supplied in the accessory kit. To attach the ferrite, open the snap ferrite, place it around the flat ribbon cable and close it.



. Fig. 10. Flat ribbon cable (A) with snap ferrite (B) attached..

Pump control

The pump can be controlled individually, or as part of a high-pressure gradient system (HPG) or low-pressure gradient system (LPG), by means of a computer and chromatography software or standalone via the keyboard/display on the front of the device.

For digital control via PC with chromatography software two communication ports are available:

- A RS232 communication port for serial control.
- An Ethernet connector for control via a local Area Network (LAN).

For both types of connections a communication cable is supplied in the LC 110S accessory kit. The pump uses an open control protocol which is available on request.

Clarity chromatography software (DataApex, Czech Republic) is used for digital control of the LC 110S pump when the device is delivered as a part of an ALEXYS LC-EC system or ROXY LC/EC system.

LAN

At the factory the pump is set to DHCP (Dynamic Host Configuration Protocol). This means that the pump is automatically assigned an IP address within a local network. In the Setup menu, this setting can be modified manually.

C H A P T E R 3

Operation

Operating modes

Isocratic

- Analysis without gradients.
- The solvent composition is constant during the analysis.
- The solvent can be recycled.

Low Pressure Gradient (LPG)

The gradient is formed on the low-pressure side of the pump (low-pressure gradient).

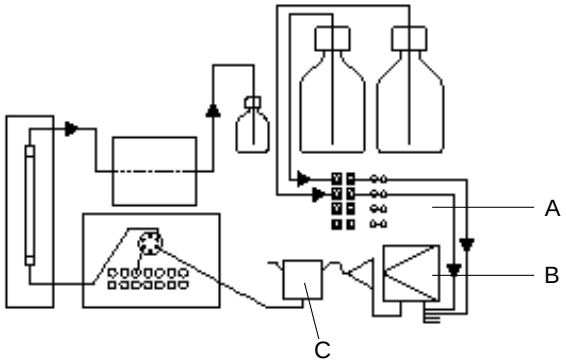


Fig. 11. Low Pressure Gradient operating mode: A. HPLC manager with degasser and gradient module, B. Pump with pressure sensor and mixing chamber, C. Mixing chamber.

For operation in the Low Pressure Gradient mode an optional HPLC manager with intake manifold is required.

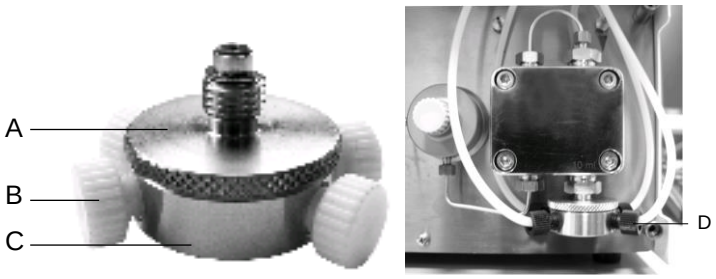


Fig. 12. Left side: Intake manifold with 4 inlets. A. Knurled-head screw, B. Filler cap, C. Mixing unit. Right-side: Intake manifold mounted on inlet of pump head with 4 eluent lines connected.

High Pressure Gradient (HPG)

The gradient is formed on the high-pressure side of the pump (high-pressure gradient).

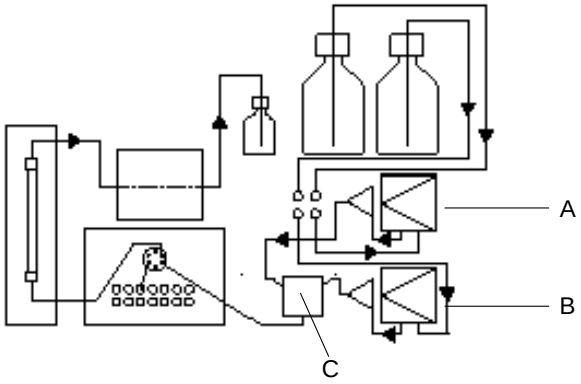


Fig. 13. High Pressure Gradient operating mode: A. Pump with degasser module and pres-sure sensor, B. Pump with pressure sensor and mixing chamber, C. Mixing chamber.

For operation in the High Pressure Gradient mode an optional static mixer is required.

Power On and Self test

Upon powering up the instrument the display will present the text " Antec LC 110S pump" and the software version, e.g. "V00.XX" or higher. The instrument performs a self test, including firmware validation and tests of the RAM memory, motor unit and will perform an initial piston wash. After completion the instrument will display the pump main menu and is ready for use.

Procedure:

1. Switch the on the pump
2. Wait until the pump has completed the self-test.

Operator errors and clogged capillaries can cause pressure spikes. To avoid damage to the pump head and pump head seals, never run the LC 110S without eluent in the pump head as well as in the rear seal washing compartment. To set up the piston back wash follow the instructions in chapter 2.

Avoid precipitation of buffer salts in organic solvents. Always start with flushing system with water when switching solvents. Never switch off the LC 110S with mobile phase in it as salts will precipitate an clog the system. First flush with water, subsequently with water/methanol.

Software control

The LC 110S can be controlled by Clarity Chromatography software from DataApex. For information about computer control with Clarity please refer to the Clarity user manual. When working stand-alone all operational parameters are set using the LC 110S keyboard. See the section below.

Main menu

For an explanation of all functions/parameters on the display and keyboard see chapter 2.

The main menu contains the current parameters of the pump. From here, the Setup, GLP, Program and Link menus can be accessed. During navigation through the display, the cursor is a flashing rectangle.

Navigation through the main menu

- Use the horizontal arrow keys to navigate through the two lines of the main menu's display.
- Use the number keys to enter a value. Alternatively: with the vertical arrow keys, you can increase and decrease the displayed values.

Fig. 14. Display LC 110S: main screen.

	Menu
A	SETUP menu
B	GLP menu
C	LINK menu
D	PROGRAM menu

Selecting the Setup menu:

- Use the horizontal arrow keys to put the cursor in the top line of the display.
- Press the right horizontal arrow key for approx. 1 second.
- Press START/STOP or hold horizontal arrow key for 1 second to return to the main menu.

Selecting the GLP menu:

- Use the horizontal arrow keys to put the cursor in the lower line of the display.
- Press the right horizontal arrow key for approx. 1 second.
- Press START/STOP or hold horizontal arrow key for 1 second to return to the main menu.

Selecting the Link menu:

- Use the horizontal arrow keys to put the cursor in the lower line of the display.
- Press the left horizontal arrow key for approx. 1 second.
- Press START/STOP or hold horizontal arrow key for 1 second to return to the main menu.

Selecting the Program menu:

- Use the horizontal arrow keys to put the cursor in the top line of the display.

- Press the left horizontal arrow key for approx. 1 second.
- Press START/STOP or hold horizontal arrow key for 1 second to return to the main menu.

SET-UP menu

In the Setup menu, fundamental parameters for controlling the pump are specified. Navigating through the Setup menu:

- Use the horizontal arrow keys to navigate through the two lines of the display.
- Use the vertical arrow keys to select the desired option.
- Move the cursor onto the diamond icon on the left in the lower line to navigate through the subitems of the Setup menu by means of the vertical arrow keys.
- Use the number keys to enter a value.
- Press START/STOP or hold horizontal arrow key for 1 second to return to the main menu.

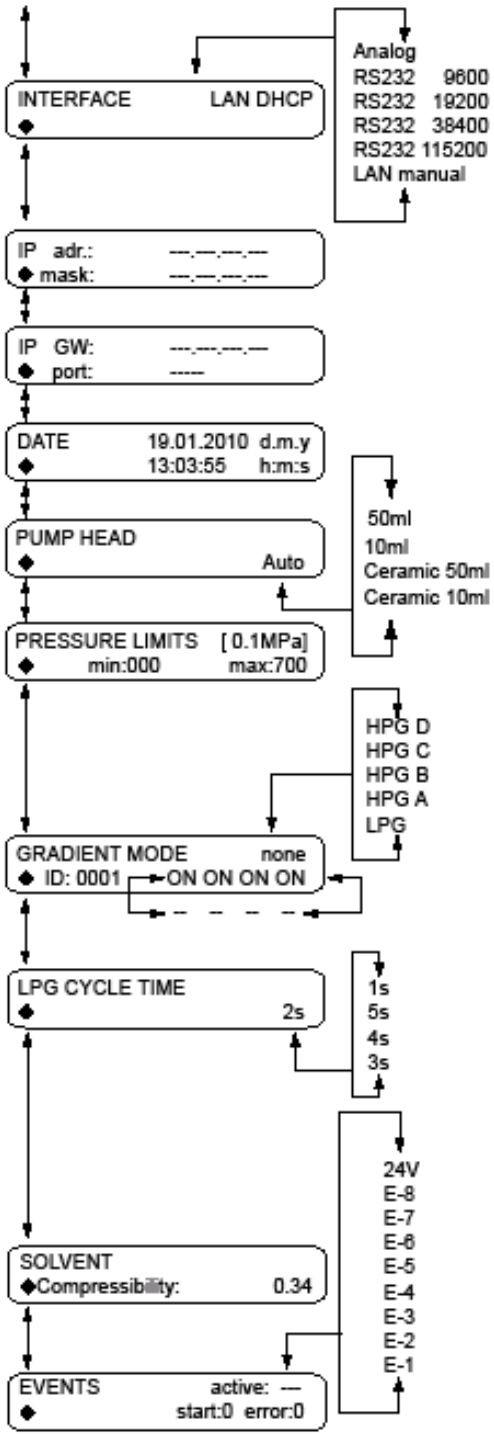


Fig. 15. Structure of the SETUP menu.

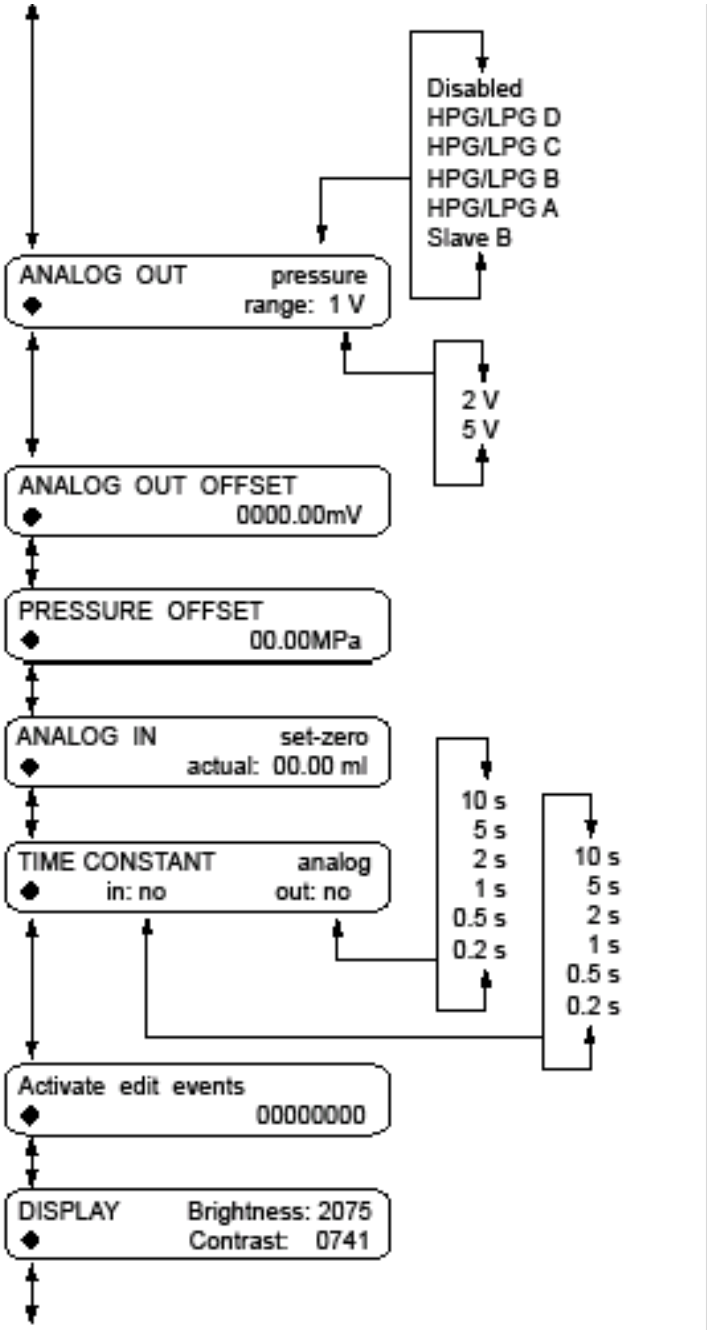


Fig. 16. Structure of the SETUP menu (cont.).

Parameter	Description
INTERFACE	Setting for external connection options of pump. The connections are on the rear of the device.
IP adr:/mask:	Network configuration: *IP address*, *Network Mask*
IP GW:/Port:	Network configuration: *Gateway*, *Port*
DATE	Setting for the date and time.
PUMP HEAD	Pump head selection. The selection is used as basis for calculating the flow rate and determines the max. system pressure. This value applies for all operating modes and cannot be exceeded.
PRESSURE LIMITS	Settings for the min. and max. pressure. The pump stops automatically if the pressure drops below the min. value or exceeds the max. value. The min. pressure value is used to ensure that the pump does not run dry. If the minimum is set *0*, the minimum system pressure is not monitored.
GRADIENT MODE	Here the modes of the high-pressure gradient (HPG), low-pressure gradient (LPG) and isocratic system can be set: LGP: activation of up to four channels. HPG: selection between pump name HPG A to HPG D. Isocratic system: *none*.
LPG CYCLE TIME	Time specification for the switching cycle of the valves of the Smartline Manager 5050. Factory preset is 2 seconds. When working with higher flow rates and lower mixing chamber volumes, reduce the time to achieve better mixing of the eluents. When working with lower flow rates and higher mixing chamber volumes, increase the time to obtain more precise mixtures.

SOLVENT	Data entry for the compressibility of the selected solvent: Water: 0.46 Benzene: 0.95 Chloroform: 0.97 Ethanol: 1.10 Acetone: 1.23 Methanol: 1.21 n-heptane: 1.40 n-hexane: 1.50 Diethyl ether: 1.84 Acetonitrile: 0.99 Tetrahydrofuran: 0.93 Water/methanol (10/90): 1.17 Water/methanol (20/80): 0.86 Water/methanol (40/60): 0.56 Water/methanol (50/50): 0.52 Water/methanol (60/40): 0.46 Water/methanol (80/20): 0.40 Water/methanol (90/10): 0.34
EVENTS	Used for testing the *Events* terminal strip. Connections E-1 to E-8 and 24 V can be selected. The lower line shows the statuses at the digital inputs.
ANALOG OUT	Used to output analog pump signals to external devices, by means of the *Remote* terminal strip on the rear of the device: *Pressure* preset for outputting the currently measured pressure for the purpose of external recordings or control. *Slave B* preset for outputting a signal for controlling a second pump. Presets: *HPG/LPG A* to *HPG/LPG D* Voltage range options: 1 V, 2 V, 5 V.
ANALOG OUT OFFSET	*OFFSET* data entry for the analog output.
PRESSURE OFFSET	Displays the automatic offset adjustment for the pressure display. Make sure that the bleed valve is open.

ANALOG IN	Calibration option of the analog input of the *Remote* terminal strip, for remote flow rate control. At *set-zero*, an input voltage that is present can be defined as zero point (i.e. defined as a flow of 0.00 ml/min), by means of the vertical arrow keys. If a deviating, positive control voltage is applied, a resulting flow rate is displayed at *actual*, based on the basic setting: 1 ml corresponds to 1 V for the 10 ml pump head, and 5 ml corresponds 1 V for the 50 ml pump head. This flow rate can then be changed by pressing the vertical arrow keys. Thus a second calibration point is generated, which modifies the scaling.
TIME CONSTANT	Selection of a time constant to be used for signal smoothing. The larger the value of the selected time constant, the stronger the applied signal smoothing. Both an external signal present at the analog input (in) and a signal generated at the analog output (out) can be smoothed.
ACTIVATE EDIT EVENTS	The E-1 to E-8 connections of the Events terminal strip can be activated (1) or deactivated (0) by means of the vertical arrow keys.
DISPLAY	Here the brightness and contrast of the display can be set.

Gradient mode

The LC 110S is capable of isocratic (none), high pressure gradient (HPG) and low pressure gradient (LPG) operation.

Setting up the gradient mode:

- Select “GRADIENT MODE“ from the SETUP Menu.
- Select the desired mode of operation (none/HPG/LPG).
- If you select either the high or low pressure gradient (i.e. HPG or LPG) you need to specify the channels used by each of the solvents:
  LPG: Choose up to 4 channels (valves), from A to D
  HPG: Choose names for each pump, from HPG A to HPG D
- Move to the second line by pressing the ► key and choose valves A to D (for LPG mode) or names for each pump actually present (for HPG mode) for each of the corresponding positions by pressing either the ▲ or ▼ key. It is important to turn ON channels indicating gradient composition (e.g. %A; %B; %C; %D) for all pumps which are set in HPG mode, e.g. if 2 pumps will be used and named as HPG A and HPG B, channels corresponding to both pumps (%A and %B) should be ON in both pumps (See Fig.17).This selection will apply for programs and define the number and names of solvents used in any gradient.

Fig. 17. Pump display when gradient mode for 2 pumps (HPG A and HPG B) is properly set. The first pump was configured as HPG A and both channels indicating %A and %B are ON.

GLP Menu

The GLP menu reports statistical data for essential parameters of the LC 110S. The figure below gives an overview of the GLP menu.

- Move the cursor onto the diamond icon to navigate through the subitems of the GLP menu by means of the vertical arrow keys.
- Press START/STOP or hold horizontal arrow key for 1 second to return to the main menu.

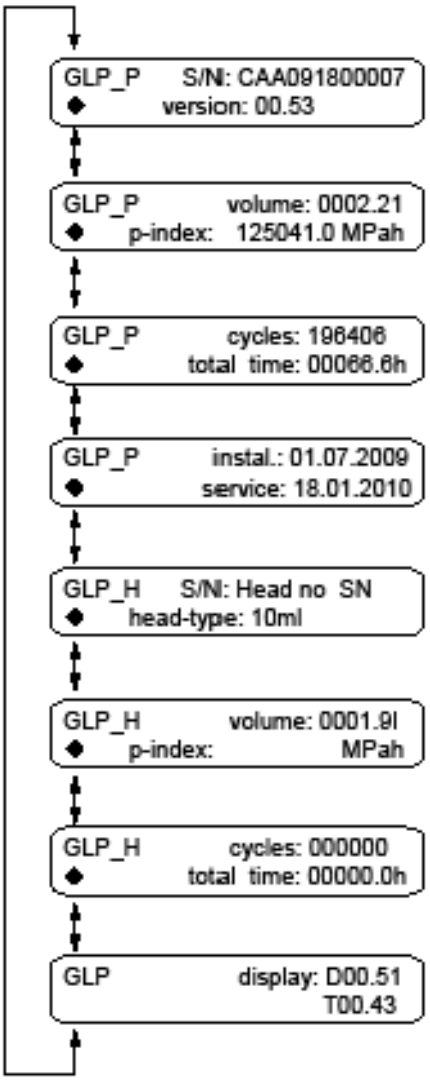


Fig. 18. Structure of the GLP menu.

Purging the pump

Purging the pump in the LPG system

The purging process of the pump is limited to a max. pressure of 5 MPa. If this value is exceeded during the purging process, the pump switches off automatically.

- In the Setup menu of the pump, select Gradient Mode LPG.
- In purging mode, select channel:MIX or gradients A, B, C and D.

Note: Before the purging process, open the purge valve to prevent pressure surge and damage to the column.

Procedure:

1. Open the bleed screw.
2. Press PURGE.
3. Select the purging mode.
4. Enter the value for the flow rate.
5. Press START/STOP to start the purging process.
6. Press START/STOP to stop the purging process.

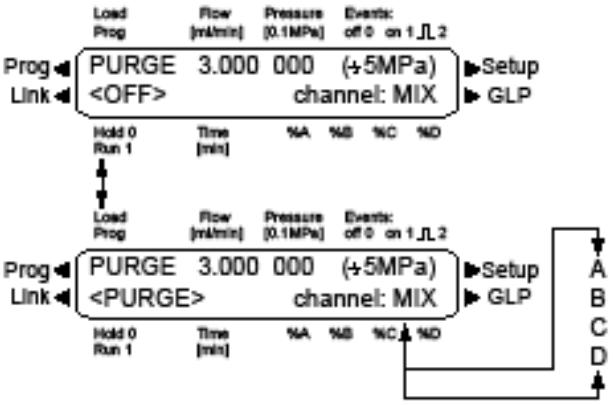


Fig. 19. Purging the pump in the LPG system.

Purging the pump in HPG or isocratic system

- In the Setup mode of the pump, select Gradient Mode HPG A, HPG B, HPG C or HPG D, or none.
- In purging mode, set the values for the flow rate.

Procedure:

1. Open the purge valve.
2. Press PURGE.
3. Enter the value for the flow rate.
4. Press START/STOP to start the purging process.
5. Press START/STOP to stop the purging process.

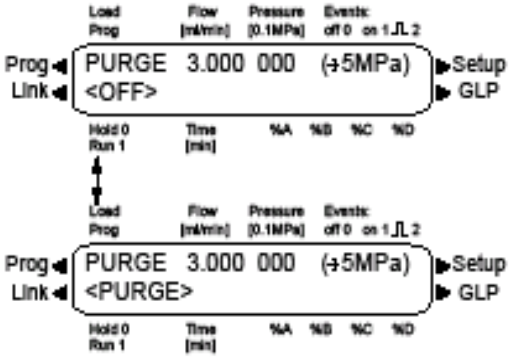


Fig. 20. Purging the pump in the HPG or isocratic system.

Piston backflushing

The pump is equipped with automatic piston backflushing. It increases the service life of the seals and pistons, and removes contaminants from the area behind the seals.

Functional principle
The piston backflushing function automatically flushes the rear piston area of the pump head upon switch-on and in continuous mode.

- Upon switch-on: The rear piston area of the pump head is automatically flushed for 8 seconds.
- In continuous mode: The rear piston area of the pump head is flushed automatically every 2 hours, for 15 seconds. The flushing interval can be changed in the chromatography software.

Recommended flushing solution
The recommended piston wash solution is 15% iso-propanol.

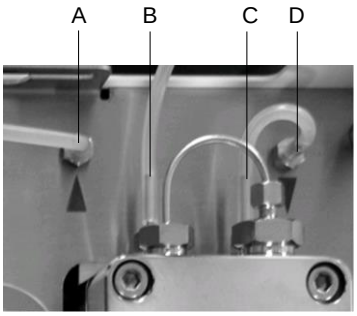


Fig. 21. tubing connections for piston backflushing.

	Legend
A	From the storage container of the flushing solution to the inlet of the flush pump
B	From the outlet of the flush pump to the inlet of the piston back-flushing
C	Outlet of piston backflushing
D	Outlet from the flush pump to the piston backflushing

Tubing connections

Low-pressure eluent line

Make sure that the tapered side of the cutting ring is pointed towards the fastening screw of the Teflon tube.

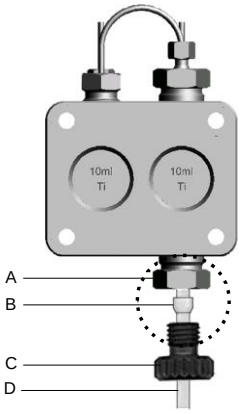


Fig. 22. Low-pressure tubing connection at the inlet of the pump head.

Procedure:

1. Push the 1/8” Teflon or FEP tube (D) through the nut (C) and the ferrule (B).

2. Insert the tube end as far as possible into the inlet fitting (A) of the pump head.
3. Tighten the nut by hand.

High-pressure tubing connections

One-piece disposable polyetheretherketone fittings (PEEK) in combination with PEEK tubing can be used for easy installation of flexible thin capillaries for system pressures up to 300 bar. The tightening torque of the PEEK screw: tightened by hand (approx. 0.5 Nm).

The maximum pressure rating of PEEK tubing is 350 bar. Above 350 bar always use stainless steel tubing in combination with stainless steel nuts and ferrules.

CHAPTER 4

Installation guide

Unpacking

Inspect the *transport box* for possible damage as it arrives. Immediately inform the freight carrier in case of damage, otherwise they may not accept any responsibility. The device is fixated and protected by foam inserts at the top and bottom. Please keep the transport box and the foam inserts as it is designed for optimum protection during transport and it may be needed again. Carefully unpack the instrument and inspect it for completeness and possible damage. Contact your Antec supplier within three working days in case of damage or if not all marked items on the checklist are included. To unpack the device remove the foam insert on the top of the device. Grab the device firmly at its side near the front panel and lift it out of the transport box. A protective film is adhered to the LCD display to prevent scratching of the screen. Remove the protective film from the display before use. Prior to shipment, your pump has been inspected and tested to ensure the best possible performance. A certificate of performance is included in the ship kit. The shipment consist of the following parts:

Partnumber	Description
193.0035S	LC 110S pump with installed pump head
193.0010	LC 110S user manual
193.0012	LC 110S Certificate of Performance
193.0400S	LC 110S connector strips
193.0402	LC 110 / LC 110S open-ended IO cable
193.0404	LC 110 / LC 110S set for manual piston wash
193.0406	LC 110 / LC 110S tool set
193.0408	LC 110 / LC 110S power cable, EUR
193.0410	LC 110 / LC 110S power cable, US
193.0412	LC 110 / LC 110S RS232 cable
193.0414	LC 110 / LC 110S syringe 10 mL
193.0416	LC 110 / LC 110S 1/8" nut, inlet
193.0418	LC 110 / LC 110S 1/8" ferrule, inlet
193.0420	LC 110 / LC 110S PTFE eluent filter
193.0422	LC 110 / LC 110S ferrite
193.0426	LC 110 piston wash tubing, 2 meter
193.9428S	LC 110S LAN cable

Only use original parts and original accessories made by manufacturer or a company authorized by manufacturer. The Manufacturer

will not accept any liability for damage, direct or indirectly, caused by the use of non original parts and accessories.

Installation

The installation procedure consists of the following steps:

1. Electrical connections
2. Tubing and fittings
3. Priming system with water

Install the pump in an area, which meets the environmental conditions and space requirements listed in Table I. Place the LC 110S on a flat and smooth surface or inside the special PR 110 pump rack module (192.0042) which is part of the ALEXYS/ROXY LC-EC system. These are open metal stackable racks.

Table I. Environmental conditions & space requirements.

Parameter	Requirement
Operating temperature	4 – 40 °C; 39.2 – 104°F
Operating humidity	below 90%, non-condensing
Sunlight	Do not expose the device to direct sunlight
Side clearance	At least 5 cm, if there is another device on one side. At least 10 cm, if there are other devices on one both sides.
Clearance back side	At least 30 cm gap to the fan on the rear of the device Make sure that the power plug on the rear of the device is always accessible, so it can be disconnected from the power supply.

Operate the LC 110S and all accessories according to the instructions and operating procedures in this manual. This ensures proper operation and longevity of your equipment.

Use of this product outside the scope of this manual may present a hazard. The Manufacturer will not accept any liability for damage, direct or indirectly, caused by use of the device outside the scope of the manual.

Fig. 23. Top: PR 110 with stacker removed to insert pump. Bottom: PR 110 with stacker assembled (arrows marking the allen screws to fix stacker on frame).

To insert LC 110S pump in the PR 110 pump rack perform the following steps (see Fig. 23):

- Loosen Allen screws to remove the stacker.
- Insert the pump in the PR 110 frame. The instrument feet should be fixed in the black supports on the base plate of the frame.
- In case the pump is inserted properly the front of the door is aligned with the front side of the PR 110 frame.
- Fix the stacker back on the frame.

Connection of drain PR 110 rack

Make sure that the silicone waste tubing is connected to the drain on the back side of the PR 110 pump rack(Fig. 24, red circle), to collect and dispose any excess of mobile phase in case the pump head is leaking. The other tubing end should be placed into a waste bottle which is placed lower then the PR 110 rack to assure proper drainage.

Fig. 24. Rear view of LC 110S in the PR 110 pump rack. The drain is encircled in red.

Execute periodic leak checks on LC tubing and connections. Do not allow flammable and/or toxic solvents to accumulate. Do not close or block drains. Follow a regulated, approved waste disposal program. Never dispose of such products through the municipal sewage system.

Step 1 - Electrical connections

Mains:

- In case the pump is not used in combination with an OR 110 organizer rack, connect the mains outlet of the pump to a mains wall socket using the LC 110S power cable (EUR p/n 193.0408 or US 192.0410) supplied in the LC 110S accessory kit (see Fig. 24).
- In all other cases connect the mains outlet of the LC 110S pump and the OR 110 organizer rack using the OR110-LC 110S power cord (p/n 250.0144) supplied in the OR 110 accessory kit.

RS232 data connection:

- To make a serial data connection use the LC 110S RS232 cable (p/n 193.0412) supplied in the LC 110S accessory kit. Connect it to RS232 connector 1 (see Fig. 24) and a free PC COM port or USB-to-COM converter port.

For more detailed information about setting-up a serial connection for the LC 110S in a complete ALEXYS/ROXY system, please consult the installation checklists (p/n 180.0011A and 190.0011B) supplied with your system.

Step 2 - Tubing connections

The next section describes the connection of all tubing connections and priming procedure of the LC 110S. For specific instructions about the LC connections in an ALEXYS analyzer or ROXY EC/LC system, please refer to the relevant section in the LC connection kit installation guide supplied with you're system.

To access the LC 110S pump head and purge valve slide the drawer of the PR 110 module to the front as depicted in the figure below. Subsequently open the front door of the LC 110S by pulling it on the right side (the hinge is locate on the left side of the door):

Fig. 25. Accessing the LC 110S pump.

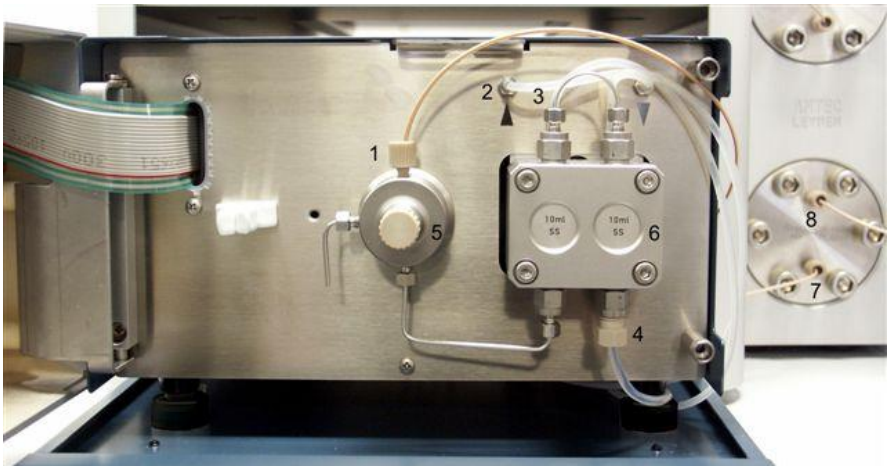


Fig. 26. Front side of LC 110S pump with open door: 1. High pressure outlet, 2. Piston wash inlet, 3. Piston wash outlet, 4. Low pressure inlet, 5. Purge valve, 6. Pump head assembly, 7. Pulse damper inlet, 8. Pulse damper outlet.

- The unit is equipped with an automatic piston wash unit. Connect the piston wash tubing (silicone tubing, O.D. 3 mm), part 193.0404, to the piston wash inlet and outlet (Fig. 26, number 2 and 3). For aqueous mobile phases the wash liquid is usually water. In case modifier is used in the mobile phase, the wash liquid may contain 10 – 25% modifier).

- Priming piston wash: Insert the tubing end connected to the inlet of the pump inside the bottle of wash liquid and connect a syringe to the other tubing end (connected to the outlet). Prime the piston wash flow path with the syringe till all tubing is filled with wash liquid. Subsequently insert the outlet in the bottle containing wash liquid.

Always connect the piston wash and make sure that the low pressure compartment of the LC 110S is filled with wash liquid. The piston wash seals need to be lubricated at all time. If not, damage may occur of the wear and tear parts inside the pump head.

- Switch on the pump by means of the power switch on the back side of the unit. The unit will initialize and the internal piston wash pump will start flushing automatically for a short time. The pump will flush with regular intervals during operation.

Refresh the wash solution every week. Check the piston wash fluid regularly, in case the solution gets turbid or contains particles please refresh the liquid immediately. The presence of black particles in the solution could indicate that the piston seals need to be replaced. In

case the volume of the wash liquid in the bottle increased over time this could indicate leakage at the high pressure piston seals.

- Set the pump flow rate Pmin and Pmax to the desired value using the keypad of the LC 110S.
- Connect the FEP tubing from the OR 100 degasser outlet assembly, between the outlet of the degasser and the inlet of the pump (Fig. 26, number 4) . Insert the tubing in the slits on the aluminum frame of the PR 110 module to fix them.
- The solvent filter should be placed between degasser and mobile phase reservoir (only water or MeOH:water 20:80 v/v% mixture for first use), part 180.0204. Never use a metal inlet filter in mobile phase bottle!

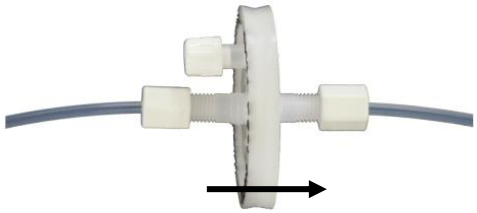


Fig. 27. In-line filter, arrow indicates flow direction. The white knob on top is an air vent which should be opened for filling the filter with mobile phase.

Read specifications on solvent filter. Aqueous type of filters are:

- NOT suitable for high percentages modifier and are
- NOT acid resistant.

Use another type of filter in these cases.

- Connect the pump outlet (Fig. 26, number 1) to the pulse dampener using a piece of 50 cm orange PEEK (ID 0.5 mm) or the corresponding tubing assembly (OR 100 pulse damper inlet assembly) from the LC connection kit.
- Depending on your configuration connect pulse dampener to a manual or electrically actuated injector or auto sampler. Consult the manual of auto sampler and detector for further installation instructions.
- Make sure all connections are leak free.

Step 3 - Priming system

To prime the system execute the following steps:

- Position the mobile phase bottle at a height well above the level of the pump. In case of an ALEXYS/ROXY system in the dedicated SR 110 solvent rack on top of the pump.
- Open purge valve (Fig. 26, number 5).
- The FEP inlet tubing should fill itself spontaneously with mobile phase due to gravity. If it doesn't please check if the inline filter is clogged or in case of a new filter, wet the filter with a small amount of MeOH:water solution (50:50 v/v%).
- At the moment the solvent supply lines are filled with solvent, press the purge key to enable rapid self-priming.
- When primed with sufficient liquid stop purging and shut the purge valve, **apply only gentle force**.
- Check if the correct flow rate is set and start pumping by pressing the Run/Stop key. The actual pump pressure is displayed in the top line of the LCD display.

Clarity HPLC software control

For control via the Clarity data system software stop the flow (Run/Stop) and open the control driver window in Clarity. The actual flow rate, when not running a method (single injection or sample sequence), can be altered by changing the stand bye flow (make sure the Standbye checkbox is active. By pressing the 'apply' button the entered flow rate will become active.

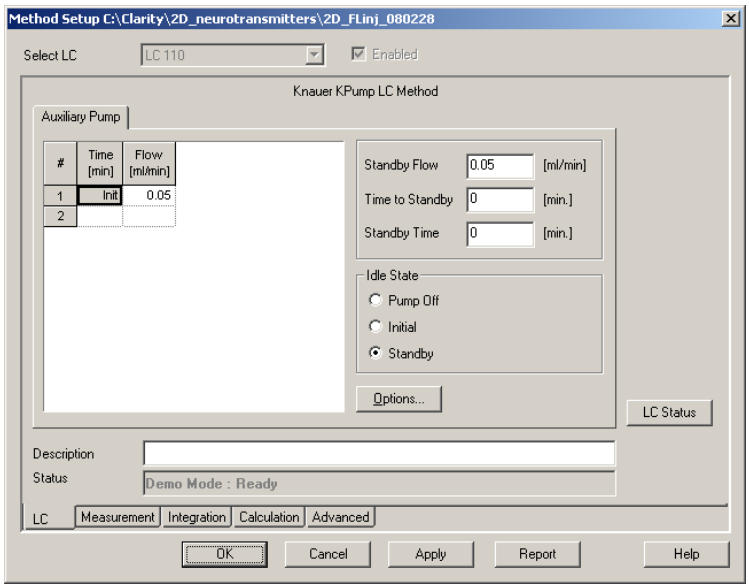


Fig. 28. Control of the LC 110S from the Clarity data system software.

The pump is now ready for use. Continue with installation procedure of other parts of HPLC system, following instructions in corresponding manuals. In combination with electrochemical detection a passivation step with 15% HNO_3 is recommended (see installation guide of the detector and in case of a complete ALEXYS analyzer in the LC connection kit installation guide).

First remove all parts that are not acid-resistant such as nylon inlet filters, column and flow cell.

See installation guide of detector for passivation procedure with 15% HNO_3.

CHAPTER 5

LC 110S programs

The LC 110S can be programmed to perform the following actions:

- Control of flow rates
- Control of solvent compositions
- Output of control signals (Events)

The LC 110S can store up to twenty programs with a maximum of 100 program lines in total. Up to nine links can be created between existing programs.

Navigating through the Program menu

A diamond icon is displayed on the left of the lower line in the display. During data entry, the cursor turns into the underscore character.

- Use the horizontal arrow keys to navigate through the two lines of the display.
- Use the vertical arrow keys to select the desired option.
- Move the cursor onto the diamond icon on the left in the lower line to navigate through the sub-items of the Setup menu by means of the vertical arrow keys.
- Use the number keys to enter a value.
- Press START/STOP or hold horizontal arrow key for 1 second to return to the main menu.
- With the vertical arrow keys, you can increase and decrease the displayed values.

Creating a Program

The use of the display is demonstrated using the example of a program to be created: Program 01 is to be used to create a solvent gradient (channels A and B) with constant flow rate of 1 ml/min. The percentage of solvent A is to be continuously decreased from 100% to 0% within 0.50 minutes.

Procedure:

1. Select the Program menu.

2. Select the program number.
3. Press horizontal arrow key to go to the editing mode of the submenu.
4. Enter the value for the flow rate: 01.00.
5. Enter the value for channel A: 100.
6. Enter the value for channel B: 0.
7. To specify the time in the submenu, position the cursor on the diamond icon and press the vertical arrow keys.
8. Enter the time value: 000.5.
9. Enter the value for channel A: 0.
10. Enter the value for channel B: 100.
11. Position cursor on the diamond icon and press horizontal arrow key to exit the submenu.

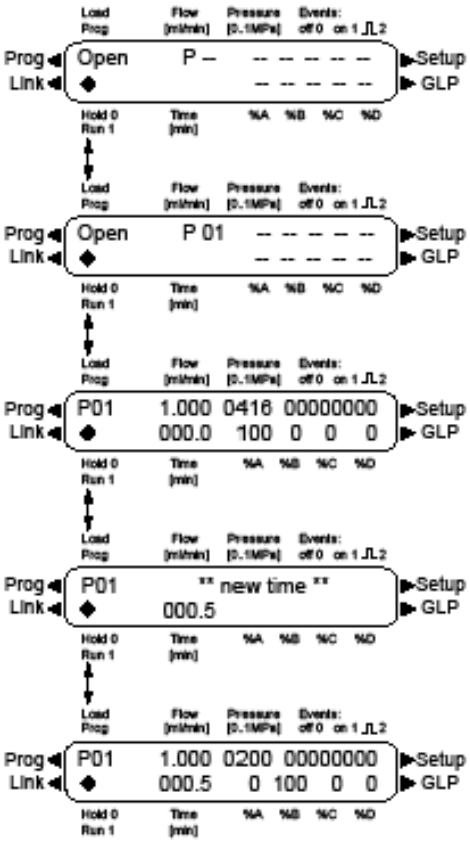


Fig. 29. Display of single steps, when creating a program.

Running a Program

During the program sequence, the changes in the solvent composition are displayed in the % A – % D fields. After the program sequence has been completed, the display switches to END mode.

Procedure:

1. Select the Program menu.
2. Select the program number.
3. Press horizontal arrow key to go to the editing mode of the sub-menu.
4. Press START/STOP; the display switches to OFF mode.
5. Enter program number, then press horizontal arrow key;
6. the display switches to HOLD mode.
7. Place the cursor onto HOLD and press 1; the display switches to RUN mode (program is running).
8. After the program has been completed, the display switches to END mode. Press START/STOP.

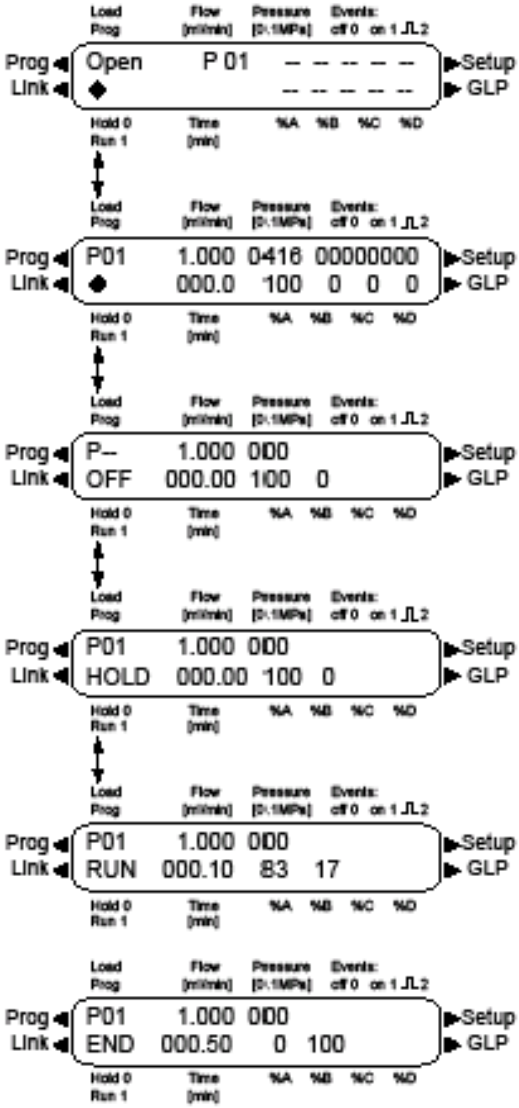


Fig. 30. Running a program.

Modifying & Deleting Programs

Modifying a program

To modify values in just enter new values and the old values are automatically overwritten.

Procedure:

1. Select the Program menu.
2. Select the program number.
3. Press horizontal arrow key to go to the editing mode of the submenu.
4. Enter the desired value.
5. Position cursor on the diamond icon and press horizontal arrow key for approx. 1 s. to exit the submenu.

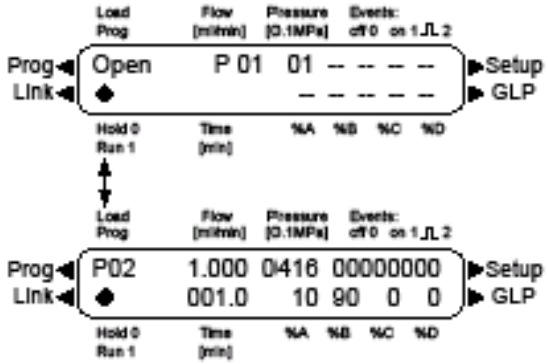


Fig. 31. Changing a program.

Deleting program lines

Procedure:

1. Select the Program menu.
2. Select the program number.
3. Press horizontal arrow key to go to the editing mode of
4. the submenu.
5. Enter the time value, for example: 000.7.
6. Press horizontal arrow key.
7. Confirm the query.
8. To cancel the deletion process, press any number

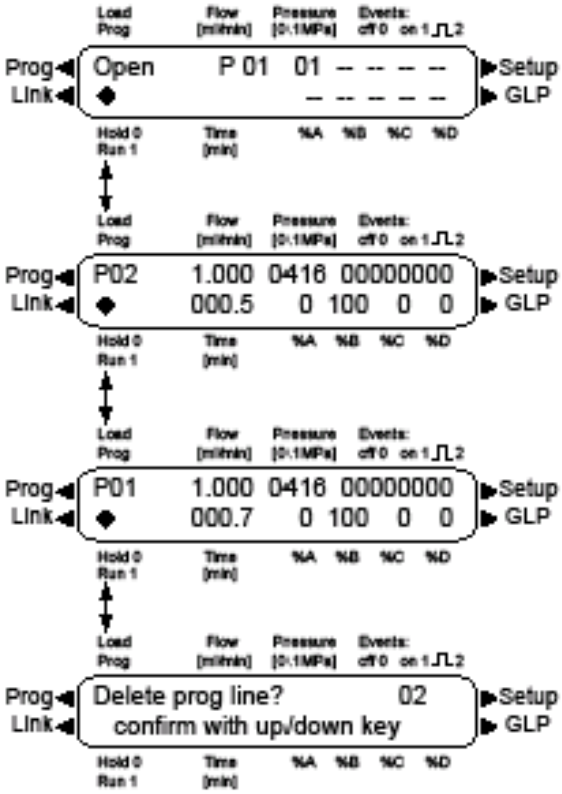


Fig. 32. Deleting program lines.

Deleting a program

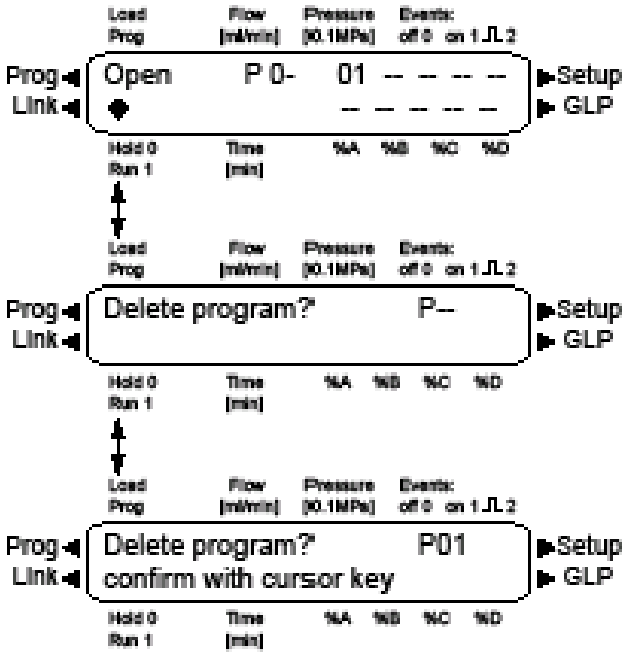


Fig. 33. Deleting a program.

Procedure:

1. Select the Program menu.
2. Enter program number 0.
3. Press horizontal arrow key to go to the editing mode of the sub-menu.
4. Enter number of the program to be deleted and press horizontal arrow key to confirm the entry.
5. Press vertical arrow key to confirm the query.

Wake-Up Program

The LC 110S can execute a program at a preset time (WAKE UP program). This program is preset as number 20. Make sure that the date and time of the LC 110S are set up properly in the SET-UP menu. The pump starts the selected program at the specified time and the display switches to RUN mode (program is running).

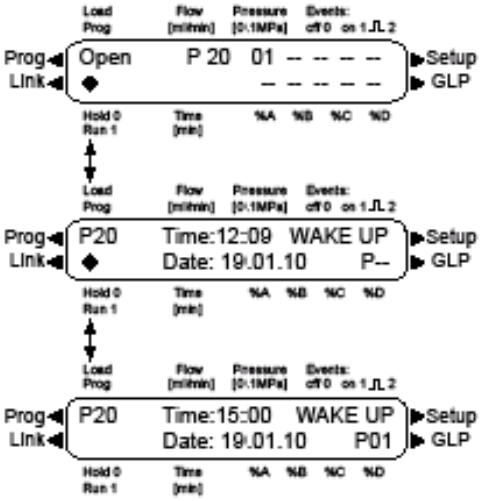


Fig. 34. Creating a Wake-Up program.

Procedure:

1. Select the Program menu.
2. Enter program number 20.
3. Press horizontal arrow key to go to the editing mode of the sub-menu.
4. Enter the date and time for the program start.
5. Enter the number of the program that should start at the
6. preset time.

7. To interrupt the current WAKE UP program, enter another
8. program number.

Link menu

Program links are combinations of existing programs and can be created and edited like any other program. The Link menu displays the status of active links. Max. nine program links between defined programs can be created and saved. A diamond icon is displayed on the left of the lower line in the display.

Navigating through the Link menu

- Use the horizontal arrow keys to navigate through the two lines of the display.
- Use the number keys to enter a value. (Alternatively: With the vertical arrow keys, you can increase and decrease the displayed values).
- Move the cursor onto the diamond icon to navigate through the sub-items of the Link menu by means of the vertical arrow keys.
- Press START/STOP or hold horizontal arrow key for approx. 1 second to return to the main menu.

Creating a link

Procedure:

- Select the Link menu.
- Enter the link number.
- Press horizontal arrow key to go to the editing mode of the sub-menu.
- Move the cursor to position P in the display and enter the
- program number.
- Move the cursor to position R (R = Repeat) and enter the value (number of repetitions for the specified program).
- Move the cursor to position W in the display and enter 1 or 0.

Note: If the W1 (W = Wait) setting is used, the pump waits for an external start signal or for the user to press number 1 before executing this line. If the W0 setting is used, the link sequence is run without interruption

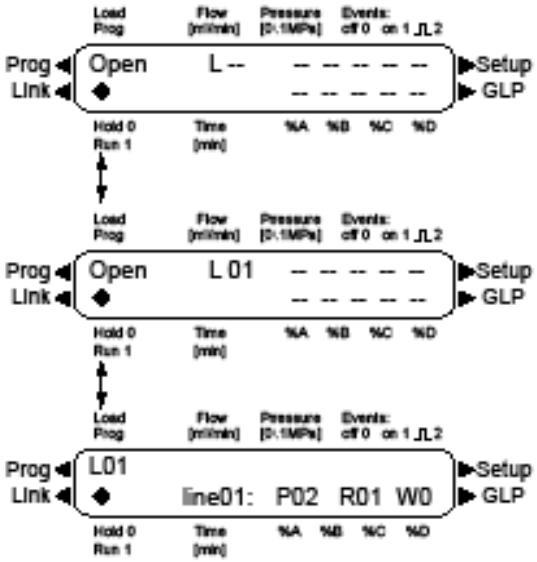


Fig. 35. Creating a link.

Running a link

Procedure:

1. Select the Link menu.
2. Enter the link number.
3. Press horizontal arrow key to go to the editing mode of the sub-menu.
4. Press START/STOP to go to OFF mode.
5. Enter program number, then press horizontal arrow key;
6. the display switches to HOLD mode.
7. Press number 1. The display switches to HOLD mode.
8. Press number 1 again. The display switches to RUN mode (linked program is running).
9. After the linked program has been completed, press START/STOP. The display switches to the OFF mode.

After the link has been completed, the pump stops. The display switches to the END mode.

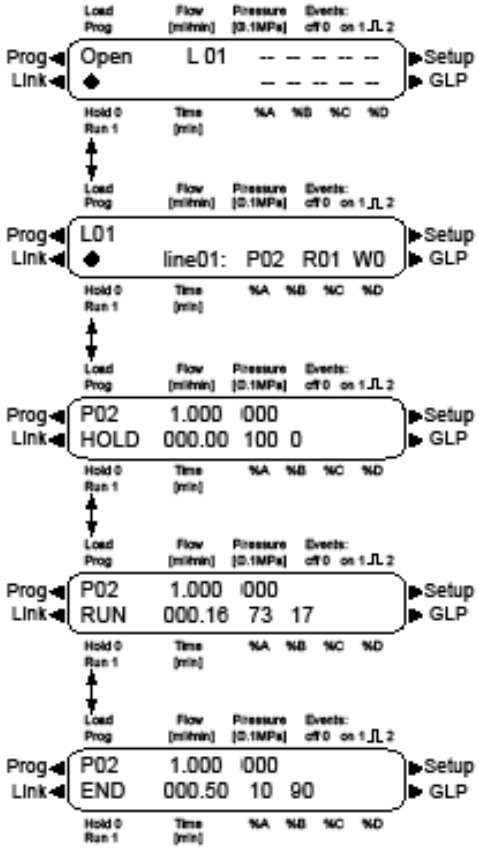


Fig. 36. Running a link.

Deleting a link

Procedure:

1. Select the Link menu.
2. Enter link number 0.
3. Press horizontal arrow key to go to the editing mode of
4. the submenu.
5. Enter number of the link to be deleted and press horizontal arrow key to confirm the entry.
6. Press vertical arrow key to confirm the query.

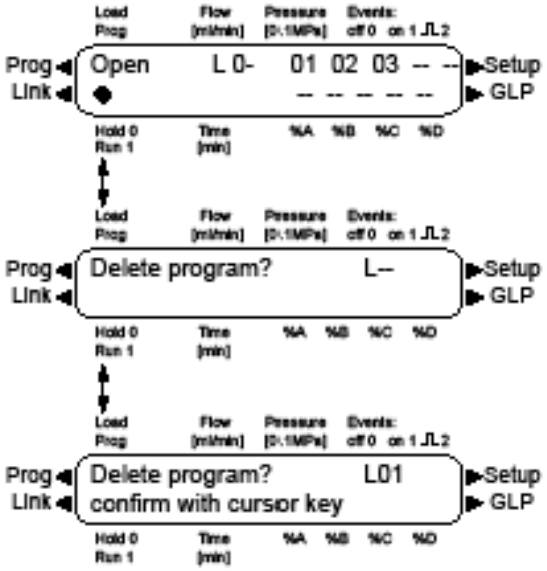


Fig. 37. Deleting a link.

CHAPTER 6

Maintenance

All moving parts are subject to normal wear and tear. It is therefore unavoidable that certain parts have to be replaced once in a while. The LC 110S is constructed in a way that worn out parts can easily be reached and replaced with a minimum of downtime. Proper maintenance of your HPLC device will ensure successful analyses and reproducible results.

How to contact Antec Technical Support

For technical support or questions please consult your local Antec distributor in your country. When no distributor is available in your country contact the Antec main office or Antec US office for American end-users. The contact address of your local distributor can be found on the Antec website in the 'contacts' section. Furthermore, the website contains a detailed knowledge base containing a large troubleshooting and maintenance section. This section of the site is accessible for registered end-users. Registration can be performed online on the website.

Antec Main Office in the Netherlands:

Languages:	English & Dutch
Available by telephone:	8:30 a.m. till 17:00 p.m. (CET)
Phone:	+31-(0)71-5813333
E-mail:	support@antecscientific.com

Antec LLC in the USA:

Languages:	English
Available by telephone:	8:30 a.m. till 17:00 p.m. (CDT)
Phone:	(888) 572-0012 (toll free)
E-mail:	sales.usa@antecscientific.com

Maintenance

The following maintenance work on the device should only be performed by Antec service engineers or a company/distributor authorized by Antec:

- Opening the device and service on the mechanics and electronics
- Opening the pump head and servicing/replacing pistons, seals, O-rings or mechanical parts of the pump head.

To be able to replace seals in the LC 110S pump head the following tool is required:

Partnumber	Description
193.0364S	LC 110S seal insertion tool

Service of parts inside of the pump head (seals, pistons and O-rings) should only be performed by trained service personnel. Replacement of seals and pistons by untrained end-users can lead to loss of pump performance or damage to the pump head and is at the end-users own risk and not covered by warranty.

What maintenance tasks may the user perform on the device?

Users may perform the following maintenance tasks themselves:

- Replacing the pump head
- Exchanging the check valves
- Cleaning the exterior

Removing the pump head

Perform the following procedure to remove the pump head:

1. Purge the pump head with distilled water.

Danger of skin irritation may exist if aggressive/toxic solvents remain in the pump head. Wear protective gloves!

2. Remove the tubes from the piston backflushing (B).
3. To remove the capillary, loosen the screws at the pump head outlet (B) and pressure sensor inlet (A).
4. Disconnect the eluent connection at the inlet of the pump head (D).
5. Using an Allen wrench, loosen the opposite pairs of fastening screws (C) at the pump head alternately and evenly, to prevent the pump pistons on the inside from jamming.
6. Hold the pump head by hand, and consecutively pull out all fastening screws.
7. Remove the pump head carefully.

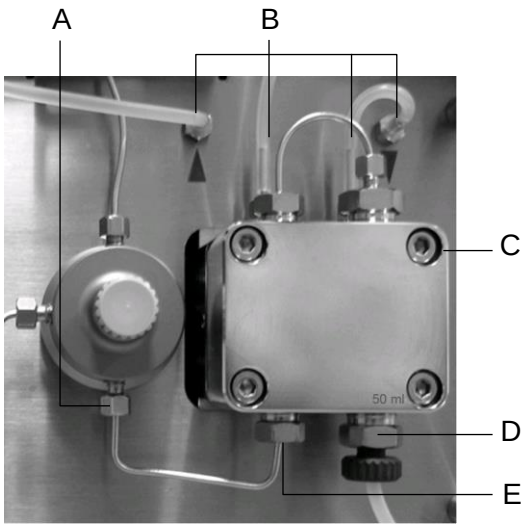


Fig. 38. Removal of pump head: [A] inlet fitting of the pressure sensor, [B] Connections for piston backflush, [C] Fixing screws of the pump head, [D] Inlet fitting the pump head and [E] Outlet fitting of the pump head.

Installing the pump head

Procedure:

1. Check whether the pump head has been assembled correctly.
2. Using an Allen wrench, tighten the opposite pairs of fastening screws evenly and alternately to prevent the pump pistons on the inside from jamming.
3. Tighten all fastening screws evenly.
4. Connect the capillary between the pump head and pressure sensor, and tighten the screws at the pump head inlet and at the pressure sensor inlet.

Exchanging the check valves

A check valve is a mechanical device, a valve, which normally allows fluid to flow through it in only one direction. The device is equipped with two check valves, one at the low-pressure inlet of the pump head and one at the outlet of the primary pump head chamber. When a check valve is dirty it may cause incorrect opening of closure leading to pressure fluctuations and an irregular flow.

Removing the check valve

Note: Alternately loosen the screw fittings of the capillary connections to prevent the capillary from bending.

Procedure:

1. With a wrench, unscrew the inlet fitting.
2. Remove the ball valve.
3. With a wrench, unscrew the capillary connection.
4. Remove the outlet fitting.
5. Remove the ball valve.

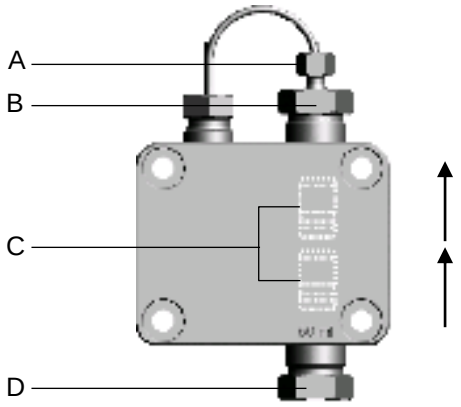


Fig. 39. Removing the check valves. A. Capillary connection, B. Outlet fitting, C. Check valve and D. Inlet fitting. The arrows indicate the flow direction of the check valve, make sure to install the valves back with the correct flow direction.

Cleaning the check valve

Procedure:

1. Put the valve in a beaker with a suitable cleaning solvent (isopropanol or ethanol).
2. Put the beaker in an ultrasonic bath and clean it for at least 10 minutes.

Installation of the check valve

Note: the inlet and outlet check valve are identical. Make sure to install the check valves with the correct flow direction. If installed incorrectly it may lead to malfunction of the pump or damage to the wear and tear parts in the pump head.

Fig. 40. Functional principle and flow direction of the check valve. A. Check valve, B. Ruby closing ball C. Flow direction. Note the ribbon on the side of the check valve cartridge, this indicates the direction of flow.

Procedure:

1. Insert the check valves in the bushing holes on the pump head.
2. Screw in the inlet fitting and tighten with a wrench (torque 8 Nm).
3. Screw in the outlet fitting and tighten with a wrench (torque 8 Nm).
4. Screw in the capillary connection and tighten with a wrench.

Periodic cleaning of the device

- All smooth surfaces of the device can be cleaned with a lightly moistened cleaning clot with water.
- The display or touchscreen of the devices can be cleaned with isopropanol and wiped dry with a soft, lint-free cloth.

DANGER of electric shock or short circuit if liquid cleaning solution enters the inside of the device! Cleaning cloth only lightly moisten!

Decontamination

Contamination of devices with toxic, infectious or radio-active substances poses a hazard for all persons during operation, repair, sale and disposal of a device.

Danger caused by toxic, infectious or radio-active substances! A contaminated device must never be submitted for repairs, sold or disposed of! Contract a specialist company to decontaminate the device or perform the decontamination yourself if you have the required expertise!

All contaminated devices must be properly decontaminated by

a specialist company or the operating company before they can be re-commissioned, repaired, sold or disposed of. All materials or fluids used for decontamination must be collected separately and disposed of properly.

Procedure for return of devices or parts thereof for repair or maintenance at Antec main office:

1. Call Antec front office for a Return Manufacturer Authorization (RMA) and quotation. Without RMA the returned device will not be processed.
2. Download a Decontamination form in PDF from the support section of the Antec web site. Non-decontaminated devices or devices not shipped with a filled in decontamination form will not be processed and shipped back to the sender.

Exploded view pump head

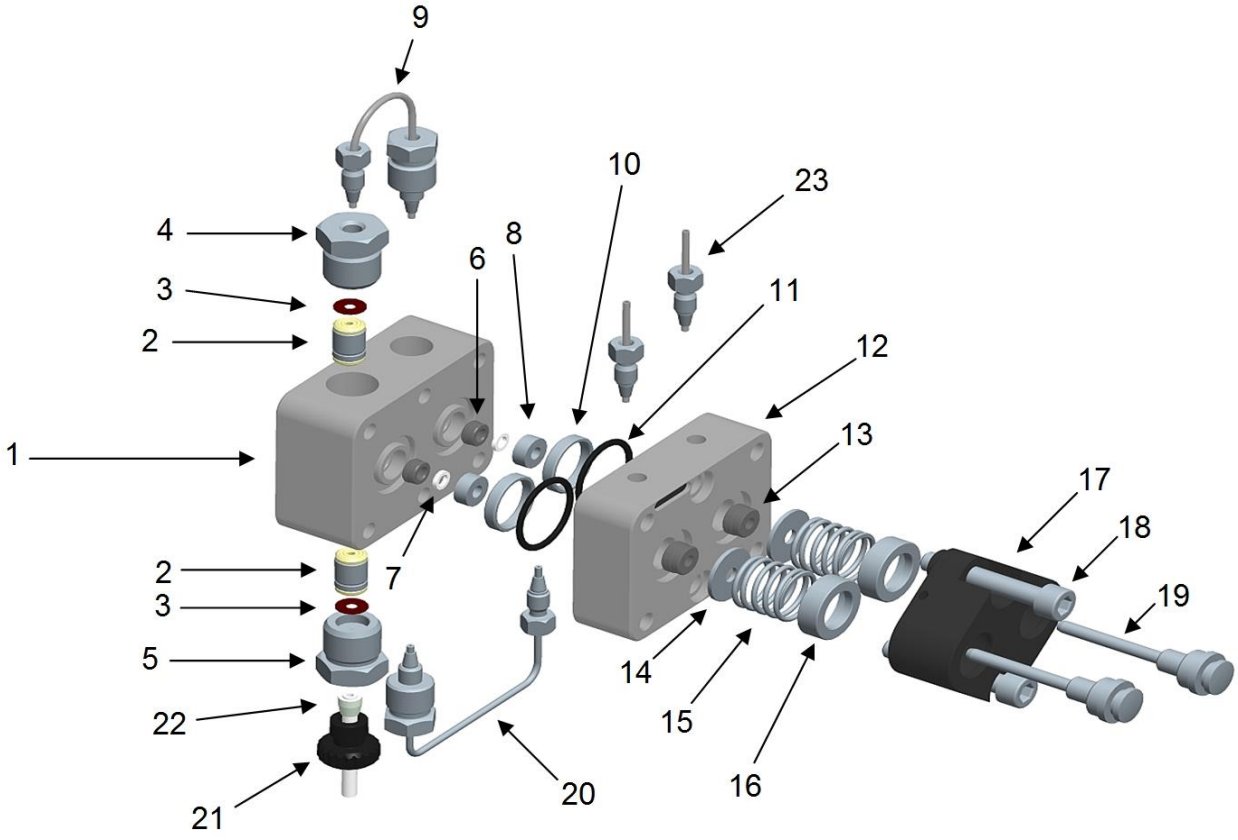


Fig. 41. Exploded view of the pump head.

ID	partnumber	Description	Qty
1	193.0304S	LC 110S HP pump head plate, SS	1
2	193.0302	LC 110 / LC 110S check valve	2
3	193.0303S	LC 110S check valve seal	2
4	193.0326S	LC 110S check valve nut 1/16", outlet	1
5	193.0324S	LC 110S check valve nut 1/8", inlet	1
6	193.0308	LC 110 / LC 110S piston seal, high pressure, PTFE	2
7	193.0358S	LC 110S centering ring, sapphire	2
8	193.0360S	LC 110S adaptor ring, SS	2
9	193.0342S	LC 110S capillary connection, SS	1
10	193.0362S	LC 110S support ring	2
11	193.0316	LC 110 / LC 110S O-ring	2
12	193.0330S	LC 110S LP pump head plate, SS	1
13	193.0310	LC 110 / LC 110S piston seal, piston wash, PTFE	2
14	193.0346	LC 110 / LC 110S cover disc, wash seals	2
15	193.0322	LC 110 / LC 110S spring	2
16	193.0340S	LC 110S spring retaining ring	2
17	193.0336S	LC 110S spring retaining plate	1
18	193.0334S	LC 110S retaining plate screw	2
19	193.0318	LC 110 / LC 110S piston, Sapphire	2
20	193.0350S	LC 110S capillary pumphead - transducer	1
21	250.1568	LC 110 / LC 110S 1/8" nut, inlet	1
22	250.1566	LC 110 / LC 110S 1/8" ferrule, inlet	1
23	193.0348	LC 110 / LC 110S capillary piston wash	2

CHAPTER 7

Trouble shooting

Error messages

The following error messages can appear in the LC 110S LCD display.
The messages are sorted alphabetically:

Table 2 Error messages.

Error message	Remedy
Auto pump head type: head data uninitialized!	Switch the device off and on. Check whether a pump head with RFID recognition has been installed. Repeat the automatic configuration in the chromatography software. Remove the pump head, clean it and install it again.
Auto pump head type: no head detected!	Switch the device off and on. Repeat the automatic configuration in the chromatography software. Remove pump head, clean it and install it again. Check whether a pump head with RFID recognition has been installed.
Cannot delete active program/link	Pause active program or link. Afterwards, delete the link.
Cannot edit program from the running link	First pause the link, then edit the data on the device display or in the chromatography software.
Cannot initialize LAN	Check the cables and connections in the local area network.
Cannot operate with an empty link	The link is empty. First create a link.
Cannot read data from FRAM	Switch the device off and on. If the system message appears again, notify Antec support.
Cannot read RTC	Switch the device off and on. If the system message appears again, notify Antec support.
Cannot start time table	Edit the data at the device display or in the chromatography software.
Cannot use non-existing component!	Change the setup settings or change the gradient in the program or in setup.
Cannot write data on FRAM	Switch the device off and on. If the system message appears again, notify Antec support.
Error input activated	Device error, change device settings.
Insufficient access	Change the entry.
Invalid command	Change the entry. Check the cable connections.
Invalid parameter(s)	Check the validity of the parameter(s).

Error message	Remedy
Invalid time in time table	Correct the time entry.
Invalid time table index	Change the entry in the program line.
Link is loaded	First unload the link then change the link or delete it
Link is running	Wait until the link has been executed, then change the link or delete it.
Maximum pressure! System stopped	Reduce the pressure or adjust the upper pressure limit. Restart the system.
Minimum pressure! System stopped	Increase the pressure or adjust the lower pressure limit. Restart the system.
No components are available in isocratic mode	Since the pump can only be operated using a specific valve, the entered data has to be adapted to isocratic mode.
No link available	Create a link and edit it.
No link available Pls edit link first	Create a link and edit it.
No time table to start	Edit the data by means of the chromatography software.
Non-existing component is set to non-0 value	Switch on the channel or edit the data using the chromatography software.
Not enough space to store link	Check the pump. Check the number of program lines. A maximum of 100 program lines are possible.
Not enough space to store program	Check the pump. Check the number of program lines. A maximum of 100 program lines are possible.
Not supported	Change the entry.
Prg not compatible with pump head!	Modify the program or replace the pump head.
Program does not exist	Create and edit a program.
Program is running.	Quit program or wait until program has been completed.
The gradient component is used!	The setup data can only be edited when no program has been loaded or started. First unload the program.
this link is used in WAKEUP	First quit or delete wakeup program (wu=wakeup), then edit or delete link.
this program is used in a link	First pause or delete the link, then edit or delete data by means of the chromatography software.
this program is used in WAKEUP	First quit or delete wakeup program (wu = wake up), then edit or delete data by means of the chromatography software.
Time already exists	Correct the time entry.
Time table line is empty	Edit the program line.
Too much lines in program	Check the number of program lines. A maximum of 100 program lines are possible.

Error message	Remedy
Unknown pump head type!	Check the pump head. Check whether a pump head with RFID recognition has been installed.
used!*/, CRC failed	Switch the device off and on.If the system message appears again, notify Antec support.
Wrong Line number	Change the line index in the link.
Wrong link	Check the link number. Values from 1–10 are possible. Correct the entry.

Other troubleshooting information:

Power status LED off

Possible cause	Remedy
No power	Plug in power cord, if OR 110 is used check power on this device
Power off	Switch on device using the on/off button at the front panel

No RS232 communication

Possible cause	Remedy
No RS232 connection	Plug in RS232 cable(s) or replace faulty RS232 cable.
Wrong COM port assigned	Reconfigure LC 110S in the Clarity configuration. See Clarity software manual.
RS232 driver not installed correctly of the PCI COM cards	(Re-) install the necessary RS232 driver from the installation CD supplied with the Serial port (PCI) connection kit (p/n 190.0202B and 190.0204B)

Excessive pump pulsations

Possible cause	Remedy
Detector related problem	See detector trouble shooting guide
Back pressure too low for pulse damper	For optimal dampening of flow pulsations a backpressure of at least (7 MPa = 70 bar =1000 psi) is needed. Use backpressure regulator or restriction capillary *between pulse damper and injector* to increase pressure
Check valve	Clean or replace check valves.
Seal	Replace seal
Piston	Remove pump head, clean or replace pistons

Leakage

Possible cause	Remedy
Connectors	Check connectors, replace if necessary
Leakage of seal	Replace seal and/or damaged piston

When trouble shooting is not successful and problems persist please contact your local Antec distributor or the Antec main office for service. Furthermore, on the Antec website more troubleshooting information can be accessed via our Knowledge base. To get access to the knowledge base please register yourself on the website.

A P P E N D I X 1

Specifications LC 110S Pump

General specifications	Delivery system	Double-piston pump with 10 mL pump head, primary and auxiliary piston in a serial configuration, automatic piston back flush.
	Wetted materials	PTFE, Sapphire, PEEK, Stainless Steel, Ruby and Ceramic (with standard 10 mL pump head)
	Power	Auto-sensing power supply, 100 – 240V, 47 – 63 Hz, 40 W
	Operating conditions	4 – 40°C (39.2 – 104°F) , < 90 % RH, non-condensing
	Flow rate	0.001 – 9.999 mL/min
	Max. pressure	70 MPa (up to 5 mL/min, pump head with metal inlays) 40 MPa (up to 10 mL/min)
	Flow rate accuracy	< 1.5 % (0.2 – 2 mL/min)
	Flow rate precision	< 0.1 % (1 mL/min)
	Pressure ripple	Residual pressure pulsation < 3% (H_20 as eluent and P = 12 MPa)
	Displacement volume	Primary piston 21.4 µL Secondary piston 9.7 µL
	Pressure protection shut down	Minimum pressure stop: $P_{min,}$:0 (off) - 75 MPa (FS), switch-off time 30 seconds. Maximum pressure stop: P_{mzx} :0.1 - 75 MPa, switch-off time < 1 s
	Operating modes	Isocratic, High Pressure gradient (up to quaternary gradient: 4 eluents), Low Pressure gradient (up to quaternary gradient: 4 eluents) with optional Knauer 5000 HPLC manager.
	Instrument control	Stand alone: via Numerical keypad & LCD (2 x 24 ch) display. Digital control: via RS232C or LAN. Analog control: via REMOTE connector (stop, flow, pressure, error)
	GLP features	Report of number of pump cycles, working time, delivered volume and service information
	IP protection class	IP 20
Physical specifications	Dimensions	390 (D) x 226 (W) x 135 (H) mm 15.4 “ (D) x 8.9” (W) x 5.3” (H)
	Weight	5.3 kg (11.7 lbs)

A P P E N D I X 2

Accessories and Spare parts

The following set of accessories is supplied with each LC 110S:

Partnumber	Description
193.0400S	LC 110S connector strips
193.0402	LC 110 / LC 110S open-ended IO cable
193.0404	LC 110 / LC 110S set for manual piston wash
193.0406	LC 110 / LC 110S tool set
193.0408	LC 110 / LC 110S power cable, EUR
193.0410	LC 110 / LC 110S power cable, US
193.0412	LC 110 / LC 110S RS232 cable
193.0414	LC 110 / LC 110S syringe 10 mL
193.0416	LC 110 / LC 110S 1/8" nut, inlet
193.0418	LC 110 / LC 110S 1/8" ferrule, inlet
193.0420	LC 110 / LC 110S PTFE eluent filter
193.0422	LC 110 / LC 110S ferrite
193.0426	LC 110 piston wash tubing, 2 meter
193.9428S	LC 110S LAN cable

The following pump head parts are available for the LC 110S:

Partnumber	Description
193.0300S	LC 110S pump head 10mL, SS, PTFE/Sapphire
193.0301S	LC 110S pump head 10mL, SS, PE/Zirconium
193.0304S	LC 110S HP pump head plate, SS
193.0302	LC 110 / LC 110S check valve
193.0303S	LC 110S check valve seal
193.0326S	LC 110S check valve nut 1/16", outlet
193.0324S	LC 110S check valve nut 1/8", inlet
193.0308	LC 110 / LC 110S piston seal, HP, PTFE
193.0312	LC 110 / LC 110S piston seal, HP, PE
193.0358S	LC 110S centering ring, sapphire
193.0360S	LC 110S adaptor ring, SS
193.0342S	LC 110S capillary connection, SS
193.0362S	LC 110S support ring
193.0316	LC 110 / LC 110S O-ring
193.0330S	LC 110S LP pump head plate, SS
193.0310	LC 110 / LC 110S piston seal, LP, PTFE
193.0346	LC 110 / LC 110S cover disc, wash seals
193.0322	LC 110 / LC 110S spring
193.0340S	LC 110S spring retaining ring
193.0336S	LC 110S spring retaining plate
193.0334S	LC 110S retaining plate screw

Partnumber	Description
193.0318	LC 110 / LC 110S piston, Sapphire
193.0320	LC 110 / LC 110S piston, Zirconium
193.0350S	LC 110S capillary pump head - transducer
250.1568	LC 110 / LC 110S 1/8" nut, inlet
250.1566	LC 110 / LC 110S 1/8" ferrule, inlet
193.0348	LC 110 / LC 110S capillary piston wash
193.0352	LC 110 / LC 110S pressure transducer
193.0354	LC 110 / LC 110S purge valve screw, PEEK
193.0356	LC 110 / LC 110S purge tubing assembly

The following power cables are available for the LC 110S. The European and US power cable are parts of the LC 110S accessory kit, the UK cable has to be ordered separately:

Partnumber	Description
193.0408	LC 110 / LC 110S power cable, EUR
193.0409	LC 110 / LC 110S power cable, UK
193.0410	LC 110 / LC 110S power cable, US

To be able to replace seals in the LC 110S pump head the following tool is required:

Partnumber	Description
193.0364S	LC 110S seal insertion tool

Service of parts inside of the pump head (seals, pistons and O-rings) should only be performed by trained service personnel. Replacement of seals and pistons by untrained end-users can lead to loss of pump performance or damage to the pump head and is at his own risk and is not covered by warranty.

A P P E N D I X 3

Abbreviations and terminology

Here you can find information on the abbreviations and terminology used in this device manual.

Terminology	Description
GLP	Good Laboratory Practice – quality assurance for laboratories
Gradient	Time-dependent composition of solvent (mobile phase) on low-pressure or high-pressure side of system
HPG	High Pressure Gradient (HPG). Operating mode of an HPLC or UHPLC system.The solvent is mixed on the high-pressure side of the pump.
HPLC	High-pressure liquid chromatography (HPLC).
IP address	Unique address of transmitter or receiver in local network or Internet (Internet protocol)
LINK	Combination of multiple chromatography programs in a single UHPLC system
Solvent	Mobile phase (eluent), carrier for liquid chromatography
LPG	Low-pressure gradient, LPG.Operating mode of an HPLC or UHPLC system. The solvent is mixed on the low-pressure side of the pump.
Manager	Combined device consisting of degassing module, gradient module and analog-to-digital converter
Remote	The chromatography software controls the pump.

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