PC Tech

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Instrument Brochure

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SPE-01 Cleanup Station

SPE-01 cleanup station is designed for sample preparation in trace analysis of food and environmental samples. By automating the tedious cleanup procedures, SPE-01 helps to increase the sample throughput and improves the quality of analytical results.

The instrument can handle up to 6 samples per batch without attendance. Up to 5 solvents can be used for column conditioning and multi step elution. Two fractions can be collected for each sample. These features make SPE-1 an ideal tool for sample preparation in multi residue analysis.

1. Features

1.1 Easy operation

SPE-01 uses built-in methods for automatic column cleanup. The method can be easily edited and can be saved for repeated use. The operation of instrument involves only 7 buttons. Typical routine operation procedures:

- Place sample inlet probe in samples,
- Place columns and receiving containers,
- Assign positions for column and fraction collection,
- Press the start/stop button.

The instrument will process the samples one by one till all the samples have been cleaned up.

1.2 Full automation

SPE-01 uses methods and sequence to automate all the procedures for the cleanup. A typical method will first condition the column, and then add sample from the loop to the column. Several steps of elution using different solvents are followed and target fractions are collected for instrumental determination. The instruments can store up to 4 methods for handling

different samples or for cleaning system to avoid cross contamination.

In case the previous step in sample preparation is slow, users can load one sample and start the cleanup first. When the second sample is ready for column cleanup, the instrument can be paused. After adding the second sample, the cleanup will resume.

1.3 Small footprint and computer-free operation

The instrument has a very small footprint and does not need computer. It helps to save precious laboratory space. When volatile or toxic solvents (such as hexane, acetone, and petroleum ether) are used in sample preparation, the instrument can be conveniently place in a fume hood.

1.4 Robust and flexible design

SPE-01 uses valves for liquid transfer and fraction collection. It does not involve complex XYZ motion control. Only moving parts are the pump plunger and the valve rotors. It helps to lower the cost of the device and make the device very reliable.

It is flexible in selection of columns and receiving containers. Both traditional chromatographic columns and SPE cartridges can be used. The receiving containers can have different shape and volume (such as flasks for rotary evaporator). It is convenient the following sample treatment. The volume for samples, elution solvents and fraction collection can be 0.1 to 1000 mL. This feature gives it a very wide application range.

The system has an over pressure warning function. In case the columns are blocked or the flow rate is too high, the process will pause. It can be resumed after the cause has been removed.

2. Applications

2.1 Column cleanup for analysis of pesticide residues and drugs in food samples

Traditional column chromatographic cleanup for food samples uses glass columns packed with silica gel, alumina, or Florisil. Now pre packed solid phase extraction cartridges are getting popular.

SPE-01 can accommodate both columns of traditional size and the small SPE cartridges. It provides elution using up to 5 solvents. A typical method of SPE-01 involves pre conditioning of column using a strong solvent (such as acetone) followed by a weak solvent (such as hexane). After adding the sample, columns are first eluted with a weak solvent to remove lipids and other low polarity components from sample matrix. The strength of elution solvents can be increased stepwise. In handling multi residue analysis, pesticides of different polarity may be collected into two fractions.

2.2 Solid phase extraction of water samples

Solid phase extraction is used for cleanup and enrichment of water samples for analysis of semi volatile organic pollutants. In most cases, water is drawn through the SPE cartridge by a vacuum pump. The flow is not stable. During the extraction process, the flow can decrease gradually or even stop due to accumulation of small particles and natural polymers (such as humic acids) in the sorbent bed. Frequent attendance is necessary. The unstable flow rate during sample addition and elution also affects the reproducibility of the analytical results.

SPE-01 uses a metering pump to deliver the sample through the SPE cartridge. It is faster and stable. A stable flow rate helps to improve reproducibility of the analysis.

The operation of SPE-01 is simple. The instrument will draw the sample to SPE cartridge according pre defined volume. All the necessary procedures (preconditioning, adding sample, air drying of sorbent bed prior to elution, elution, and collection) are carried out automatically for up to 6 water samples. There is no need of attendance during the sample preparation.

2.3 Analysis of drugs in biological samples

Solid phase extraction is used to remove proteins and lipids from biological samples (plasma and urine) prior to determination by HPLC or LC-MS. Many available automatic SPE systems are designed for such application. They use syringe to take an aliquot from each sample and add it to the SPE cartridge.

A problem with their design is the possibility of drying out of the sorbent bed during sample addition and elution. It may affect recovery and the efficiency of cleanup. Although cartridges that are tolerant to drying out are available, they are more expensive than normal silica based cartridges.

The design of SPE-01 can overcome the drying out problem as the liquid path is closed when there is no liquid flow. Another advantage of SPE-01 is its lower cost compared to other automatic SPE instruments. Several SPE-01 may be used together when higher sample throughput is required.

2.4 Regeneration of used SPE cartridges

Sometimes used SPE cartridges are regenerated for repeated use to reduce the cost. SPE-01 can use up to 4 elution solvents and the flow rate can go up to 16 mL/min. It is very convenient for fast regeneration of the cartridges. One method may be used specially for cartridge regeneration.

3. Specifications

Sample capacity	6 per batch
Volume of sample	0.1 to 1000 mL
Material of wetted parts	Stainless steel, Teflon, PEEK
System control	Micro controller with panel key pad and LCD as interface
Method	Permanent storage of four methods
Pump flow rate	up to 16 mL/min
Pressure limit of pump	6 bar
Power supply	24 VDC
Current	< 1 A
Weight	8 Kg
Dimension	30 x 36 x 45 cm (width x depth x height)

4. Ordering Information

Part Number	Description	
SPE-01-01	SPE cleanup station with a pump of 6-bar pressure limit	

LC-04SP Valve System

LC-04SP valve system provides a versatile platform for building valve based solutions. It can have up to 4 valves. Each valve can be a 2-position/6-port valve, a 2-position/8-port valve, a 2-position/10-port valve, a 6-position stream selection valve, or a 10-position stream selection valve.

The most outstanding feature of LC-04SP is its editable valve diagram. The software provides a drawing tool box. Users can design and edit the valve diagram according to their applications and the real valve connections. The software will memorize the diagram.

The other special feature of LC-04SP is its flexibility. Users can choose the number and type of valves according to their needs and can add more valves later.
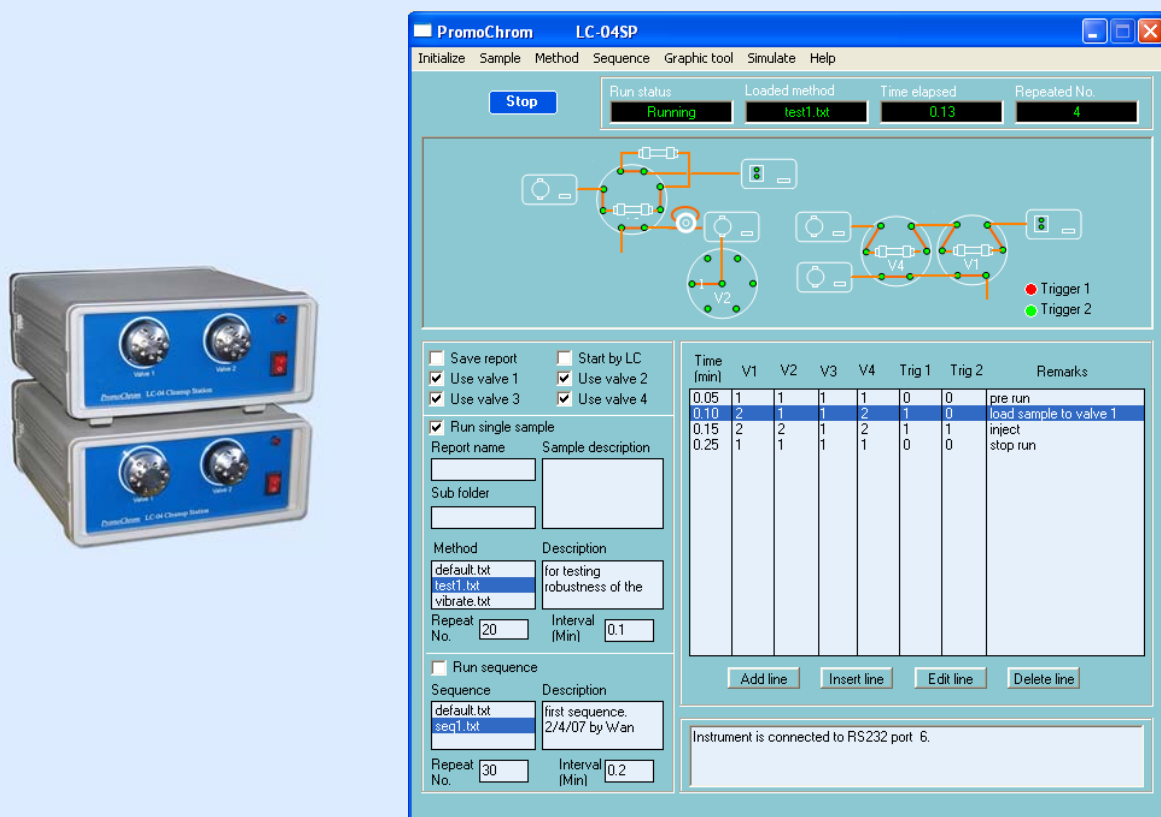

Figure 1. LC-04SP and its control software

1. Instrument Hardware

LC-04SP can have one or two modules and each module has two valves. Figure 2 shows how the devices are connected. It communicates with computer through a RS-232 port or a USB port using a RS232 converter. The second module communicates with computer through the first module using a Y-cable. Each module has a remote port to obtain start/stop signals from other analytical instruments (such as LC-MS, HPLC, or GC). It also has a trigger port to trigger start and stop of other devices, such as pumps or samplers.

The two modules are identical. They can either work together as a 4-valve system or as two independent devices.
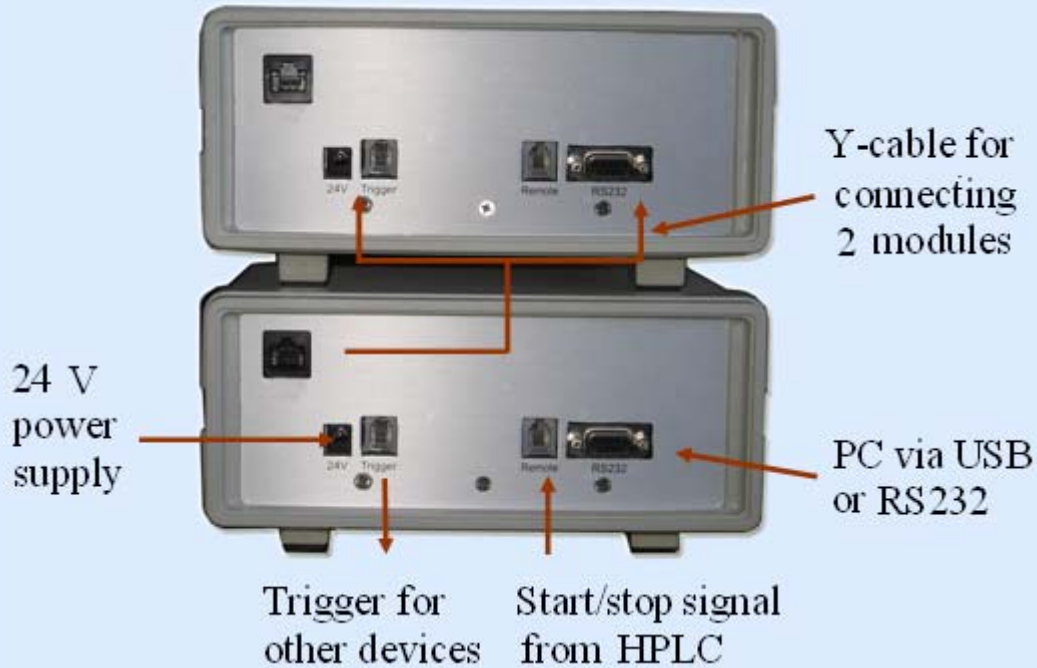

Figure 2. Cable connections for LC-04SP

2. Control Software

When the software is launched, it will search for the device and check the configurations. The software can detect the valve type and the current position of valves. The valve icons in the graphical user interface tell the valve type and the position of the valves.

The valves can be switched directly by clicking at the valve icons or by using a method or sequence. A method includes time programs for each valve and gives explanation for each step. A sequence allows use of different methods in a batch of runs.

The software has a drawing tool box for users to build their own valve diagrams. It helps users to understand the working principle of the valve system. The software will memorize the drawing permanently..

The control software monitors the status of the hardware regularly. When there is an error such as a loosen cable or a valve fails to switch to the correct position, the software will detect it and give warning and help tips.
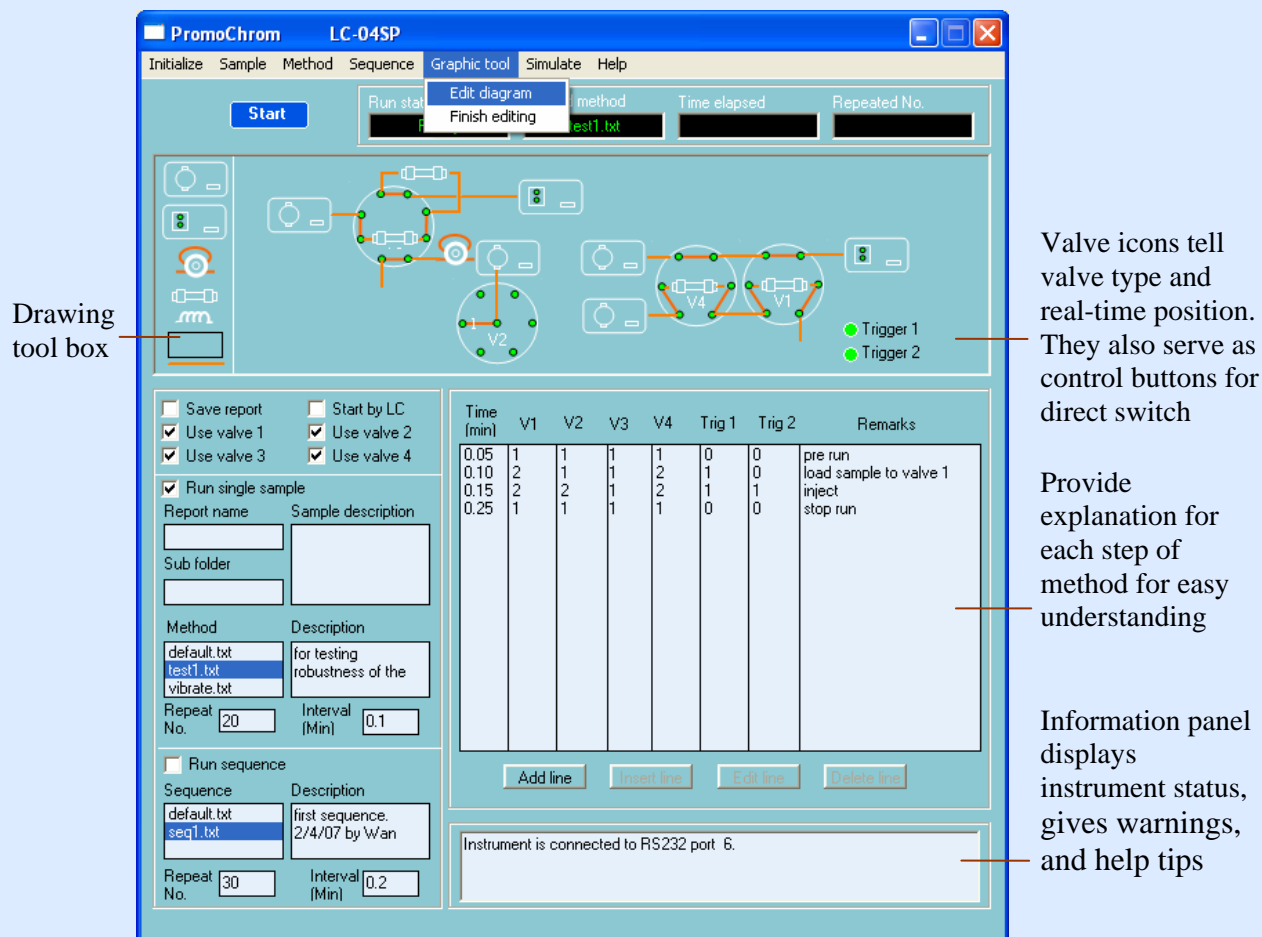
Figure 3. User interface of LC-04SP control software

The following labels appear around the figure:

Drawing tool box

Valve icons tell valve type and real-time position. They also serve as control buttons for direct switch

Provide explanation for each step of method for easy understanding

Information panel displays instrument status, gives warnings, and help tips

3. Integration with other instruments

LC-04SP can work with any HPLC and LC-MS that can provide a contact closure or a TTL output. The remote port on LC-04SP can sense the start/stop signals from other instruments. It also has 2 output triggers to trigger start and stop of other devices. This function may be used to start a loading pump for on-line sample cleanup or to trigger the HPLC system for automatic run (it can be very useful when the HPLC does not have an auto sampler and otherwise has to be started manually).

4. Applications

LC-04SP provides a very powerful and versatile platform for building almost any valve based applications. Below are some examples.
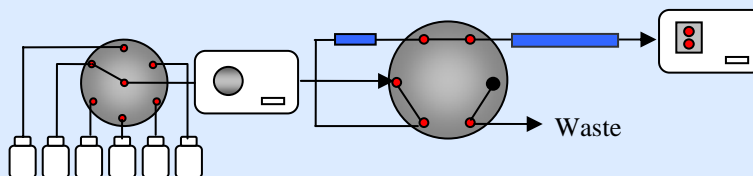
On-line sample cleanup. *One isocratic pump looks after both sample cleanup and HPLC elution. A 6-position stream selection valve provides stepwise gradient elution. This is the most economical solution for on-line sample preparation.*
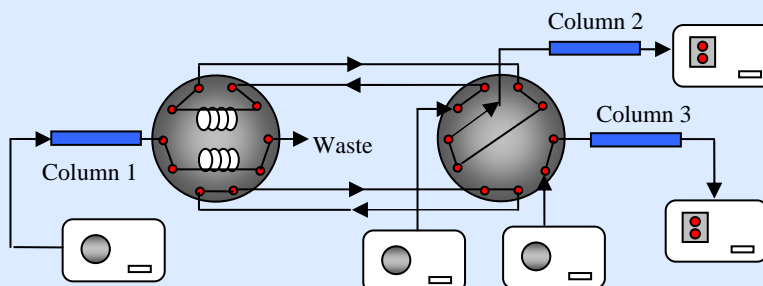
Comprehensive 2D HPLC. *All fractions from column 1 are separated and analyzed using column 2 and column 3. When column 2 is analyzing one of the fractions from column 1, the following fraction is stored in one of the 2 loops and column 3 is preparing for next analysis. Column 2 and column 3 look after analysis of fractions from column 1 alternately. Column 1 could be a normal phase column. Column 2 and column 3 could be 2 identical reverse phase column.*
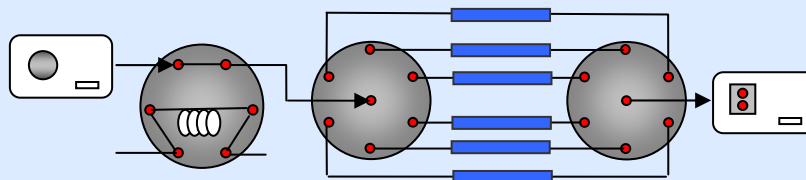
Automatic method development. *Six columns are connected with two 6-position stream selection valves for automatic column selection. One 2-posion/6-port valve is used for sample introduction. By controlling the switching time, each time only a portion of the sample in the loop is used for column testing. By using repeated injection, all columns may be tested with only once sample loading. This is very convenient for method development. It saves an auto sampler in this system.*
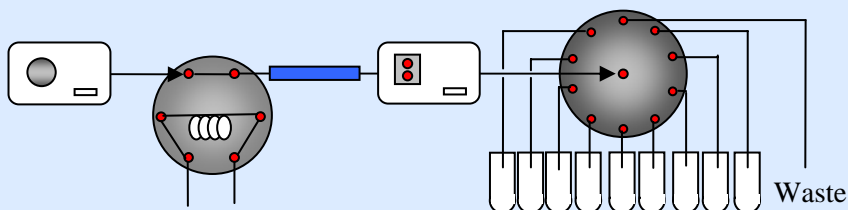
Large scale purification using an analytical scale HPLC. *Valve 1 is for sample injection and Valve 2 for fraction collection. A large volume of sample is loaded to the loop on valve 1. LC-04SP will inject a small portion of the sample to the column for each run and will start HPLC for the separation. When one run is completed, the LC-04SP will start the next run automatically until the whole sample in the loop has been processed. The purification can be done without attendance.*

5. Specifications

Power supply	24 VDC
Current	< 0.1A when no valve switching; < 0.8 A during valve switching
Number of valves	1 - 4
Type of valves	2-position/6-port, 2-position/8-port, 2-position/10-port 6-position stream selection, 10-position stream selection
Valve head	Cheminert valves from VICI (Valco Instruments)
Valve switching time	< 150 ms for 2-position valves < 200 ms per step for stream selection valves
Dimension	21 x 22.5 x 8.5 cm (width x depth x height)
Computer requirements	PC with Windows operation system

6. Ordering Information

Part Number	Description	
LC04-1-2P6P	First 2-position/6 port valve	
LC04-1-2P8P	First 2-position/8 port valve	
LC04-1-2P10P	First 2-position/10 port valve	
LC04-1-6P	First 6-position stream selection valve	
LC04-1-10P	First 10-position stream selection valve	
LC04-2-2P6P	Add one more 2/6 valve	
LC04-2-2P8P	Add one more 2/8 valve	
LC04-2-2P10P	Add one more 2/10 valve	
LC04-2-6P	Add one more 6 P stream selection valve	
LC04-2-10P	Add one more 10 P stream selection Valve	
LC-04TK	Tubing kit	

LC-04SP Standalone Valve

LC-04SP standalone valve can be controlled by both panel keys and computer. It provides an economical and convenient solution for valve applications.

The product can be controlled by LC-04SP software. The valve types can be 2-position/6-port; 2-position/8-port; 2-position/10- port; 6-position, or 10 position.

1. Features

Easy to use. Using only 6 buttons, users can program the valve switching according to their needs. The method and sequence are permanently stored.

Full automation. The built in method and sequence enable automatic valve switching within a run or between the runs. Computer is not necessary for many applications.

Easy integration with HPLC instruments. LC-04SP standalone valve can synchronize with an HPLC according to its start/stop signals. It can also work as a control master to control the start and stop of an HPLC. The later function is very useful when the HPLC do not have automatic start capability.

2. Applications

2.1 Automatic solvent selection for step gradient HPLC
2.2 Column switching for on-line sample enrichment and cleanup
2.3 Automatic sample injection for up to 10 samples.
2.4 Simple fraction collection.

3. Specifications

Power supply	24 VDC
Current	< 0.5 A
Valve switch time	< 150 ms per step
Pressure limit	5,000 PSI (345 bar)
Weight	1 Kg
Dimension	12.5 x 24.0 x 18.0 cm (width x depth x height)

4. Ordering Information

Part Number	Description	
LC04SD	LC-04SP standalone version Includes fittings for the valve ports, a remote cable, and power supply.	
LC04SD-01	LC-04SP standalone valve + PC control Includes fittings for the valve ports, a remote cable, power supply, RS232 cable, USB/RS232 converter, and control software	

LC-05 Auto Injector

LC-05 Auto Injector is for automatic introduction of samples from a fixed source for HPLC analysis. Typical applications are on-line monitoring. It enables a normal HPLC to fulfill tasks that cannot be done using a HPLC auto sampler.

By adding a valve based fraction collector, large scale purification can be achieved using an analytical scale HPLC.

LC-05 Auto Injector is designed to work with any type of HPLC instruments. Its versatile interface makes the integration easy and fast. The user friendly and powerful software provides highly automatic and reliable control.

1. Working Principle

The injector consists of a divert valve, a load pump, a high-pressure switch valve, and the control software. The divert valve makes selection between two sources for injection. For on-line analysis, one source can be the sample and the other source can be the calibration solution. In case of repeated injection for large scale purification, the two sources can be two samples. The load pump is used to deliver sample to the sample loop. The pump can deliver very accurate volume, since the volume per cycle is fixed and the number of cycles is controlled by the software. The switch valve is used to connect the HPLC pump to the sample loop for injection.

Here is a typical working cycle. First the divert valve is connected to the sample and the switch valve is set to "load" position so that the loop is connected to the load pump. Then the load pump delivers certain amount of sample to the loop, while the HPLC pump is flushing the HPLC column. After the loop is filled with the sample, the switch valve connects the HPLC pump to the sample loop. The sample is carried to the HPLC column. At meantime, the injector sends start signal to the HPLC instrument to start the HPLC analysis. The injection can be repeated automatically at any pre set interval. For example, the injector may do analysis once a day. For each day, sample may be injected 3 times and calibration standards 2 times. Such setting can be easily achieved using the sequence table of the software.

The diagram of the software not only demonstrates the working principle but also serves as a graphical user interface. The software provides two types of control for the injector. The components of the injector can be directly switched by clicking on the relevant icons in the diagram. For example, clicking on the icon for the load pump starts pumping. A second click stops the pump. For a more automatic control, methods or sequence can be used.

The software monitors the status of the injector and the HPLC regularly. The status is reflected in the diagram for easy observation. For example, when the switch valve changes from inject position to load position, its connection diagram is updated for the new position. If the switch valve goes out of control, a warning message and help tips will be given in the notice panel. The analysis will be paused. The injector will also monitor the status of HPLC through a remote cable. It will start a run only when the HPLC is ready for analysis.

The user interface of the control software

2. Applications

2.1 Online analysis

Sometimes it is necessary to trace the progress of a chemical reaction in a reaction vessel. Samples need to be taken at a set interval and analyzed for the concentration of the reactants and the products. The manual sampling part can be tedious and labor intensive. It can also be challenging when the sampling interval is very short. In the above situation, a HPLC auto sampler cannot help with the sampling part. It can only let you collect enough samples and do the instrumental analysis as one batch.

The LC-05 Auto Injector is perfect for handling such situation. It can take sample from the reaction vessel automatically and inject into a HPLC for immediate analysis. It can also inject standard solution for calibration purpose. The HPLC will look after the chromatographic separation and quantitation for each sample. The diagram in the above software interface shows exactly how the instrument can be set up for such application.

In this application, a HPLC sampler is not necessary. The cost of the system is actually reduced since the cost of the LC-05 Auto Injector is lower than an HPLC auto sampler.

2.2 Purification of large volume samples

In large scale purification, the sample volume is large (from hundreds milliliters to several liters for some plant extracts). For most HPLC based purification system, each run can only handle not more than several milliliters of sample. It is limited by the column capacity and the maximum flow rate of the pump. To process such large amount of liquid, hundreds of repeated HPLC runs have to be carried out. Using a manual injector will occupy a full person and can only make use of the instrument for 8 hours per day. On the other hand, using an HPLC auto sampler is also not convenient. The sample needs to be divided into many sample vials as each vial can only hold several milliliters of sample. For many type of auto samplers, it is difficult to inject all the liquid in a vial to the HPLC. There is always some liquid to be left over in the sample vials.

The LC-05 Auto Injector provides a convenient and low cost solution for the purification. The whole sample container can be connected to one source of the LC-05 Auto Injector (the other source may be connected to a solution for washing the system). The injector can make hundreds or thousands of injections automatically. As long as the fraction collector can provide sufficient capacity and the mobile phase can be supplied without interruption, the instrument can work around the clock.

For the fraction collection, there are two options. When the fractions to be collected are simple (e.g. less than 6 fractions and well separated), a valve based collector can be used. This is a very reliable and economical approach. The valve based collector is an optional add on for the injector and can be directly controlled by the software. When the components to be collected are complicated, a collector with more features may be used.

3. Specifications

Injection Valve	
Material of wetted parts	Stainless steel and Valcon H (reinforced carbon fiber composite PTFE lubricated inert engineering polymer)
Pressure limit	5,000 psi (liquid)
Switch time	< 120 ms
Sample loop	Specify when order (5 uL to 10 mL)
Divert Valve	
Material of wetted parts	Teflon and PEEK
Switch time	< 3 ms
Loading Pump	
Material of wetted parts	Teflon and PEEK
Flow rate	4 mL/min
Accuracy	2%
Repeatability	1%
Maximum output pressure	5 psi (0.35 bar)
System	
Communication with PC	RS232
Power supply	24 VDC
Current	< 1A
Remote interface	TTL signal or contact closure for input; TTL output
Weight	2 Kg
Dimension	25 x 23 x 11.5 cm (width x depth x height)

4. Ordering Information

Part Number	Description	
LC05	LC-05 Auto injector	
LC05-01	LC-05 Auto injector with fraction collector	

LC-06 Dosing Pump

   LC-06 dosing pump can be used for accurate delivery of reagents or solvents in a laboratory environment. The built-in program and clear display make the automation of the operation fast and easy. Users can use the six panel keys to set the delivery speed, amount, solvent source, and the timing. Its remote interface makes it easy to integrate with other devices. The built-in divert valve can be used to select between two inlets or outlets.

Specifications

Material of wetted parts	Teflon and PEEK
Speed	1 - 120 stroke/min
Stroke volume	20, 40 & 60 μL
Maximum outlet pressure	5 psi (0.35 bar)
Accuracy	2%
Repeatability	1%
Power supply	24 VDC
Current	< 0.5 A
Communication with PC	RS232
Remote interface	TTL signal or contact closure for input; TTL output
Weight	1 Kg
Dimension	12.5 x 20.5 x 22.5 cm (width x depth x height)

Ordering Information

Part Number	Description)	
LC06	LC-06 dosing pump without PC control	
LC06-01	LC-06 dosing pump with PC control Include control software, RS232 cable, and USB/RS232 converter	

LC-08 Column Selector

LC-08 column selector can make column change with a button press or using built-in method. It eliminates troubles in manually changing HPLC columns and improves efficiency and reliability in analysis.

Features

Easy to use. Using only 6 buttons, users can program the column selector according to their needs. The method and sequence are permanently stored.

Full automation. The built in method and sequence enable automatic column switching within a run or between the runs. Computer is not necessary for many applications.

Easy integration with HPLC instruments. LC-08 column selector can synchronize with an HPLC according to its start/stop signals. It can also work as a control master to control the start and stop of an HPLC. The later function is very useful when the HPLC do not have automatic start capability.

Applications

1. Direct column switch by pressing the up and down buttons. It eliminates all the troubles in manual column change.
2. Use different columns in a batch of analysis.
3. Screen for right columns in method development. Several columns can be tested one by one without attendance.
4. Automatic column regeneration. By adding an HPLC pump only, columns can be regenerated automatically. As the column selector can control the pump, computer and autosampler are not necessary.
5. Simple fraction collection.

Specifications

Power supply	24 VDC
Current	< 0.5 A
Valve switch time	< 150 ms per step
Pressure limit	5,000 psi (345 bar)
Number of column	6
Weight	2 Kg
Dimension	22 x 20.5 x 20.5 cm (width x depth x height)

Ordering Information

Part Number	Description	
LC08	LC-08 stand alone version Includes fittings for the 12 ports, a remote cable, and power supply	
LC08-01	LC-08 stand alone + PC control Includes fittings for the 12 ports, a remote cable, power supply, RS232 cable, USB/RS232 converter, and control software	
LC08TK	Column connection kit	