C196-E056G

Access to your success
SHIMADZU

LC-2010HT

Shimadzu
High-performance Liquid Chromatograph

High Throughput HPLC

LC-2010HT

We HAVE it all !

LC-2010HT

Shimadzu High-performance Liquid Chromatograph

Advanced total solutions lead the way to the new generation.

HPLC is currently one of the primary tools used in a wide variety of fields including pharmaceuticals, food products, general chemistry, and environmental analysis. The increasing demand for even higher throughput analysis is emerging due to the strong influence of the pharmaceutical industry, which has been stimulated by new drug discovery strategies designed to promote more efficient product development and globalization. The environments that chromatographs are used in are changing greatly, as there is a constant demand for improved compliance to legal regulations represented in Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP) guidelines, and new compliance issues raised by the Food and Drug Administration [FDA]. Here, the conventional working procedures used by analysts to extract data require special knowledge and experience, making it a challenge to meet the needs of a finely delineated and speed-oriented information society.

- Blinding fast high-throughput analysis — **High Throughput**
- Effective automation of your analysis — **Automation**
- Assured data reliability and validation — **Validation**
- Operating system that anyone can easily use — **Ease of Use**

and

Superb performance realizing near-zero sample carryover

▼

A new look, new concept HPLC

Shimadzu presents you with the LC-2010HT and LCsolution.
The new look and total solution for your current and future HPLC needs.

LC-2010HT

TheLC-2010HT is a next-generation HPLC based on the concept of high-throughput analysis and automated validation. The LC-2010HT is comprised of a degassing unit, low-pressure gradient unit, pump unit, mixer, ultra fast autosampler, column oven, and a UV-VIS detector with a thermostatted flow cell. System reliability has been further improved by standardizing the flow line arrangement in order to integrate the units. New and improved features include flow rate accuracy, gradient concentration accuracy, and reduction of equipment flow path volume differences, and near zero sample carryover. The LC-2010HT is available in two models, the standard model (LC-2010HT) and the sample-cooled model (LC-2010HT), for use across a broad range of applications from conventional liquid chromatography to semi-micro liquid chromatography.

Contents

High throughput

**The latest technology for multiple samples, high-speed injection and automation is now condensed into a compact package!
This is optimum next-generation HPLC for high-throughput analysis.**

High throughput is in much demand in many facets of industry such as research, development, manufacturing, and product quality control. The Shimadzu LC-2010HT is a new generation high-throughput HPLC developed to meet this demand.

High Throughput Autosampler

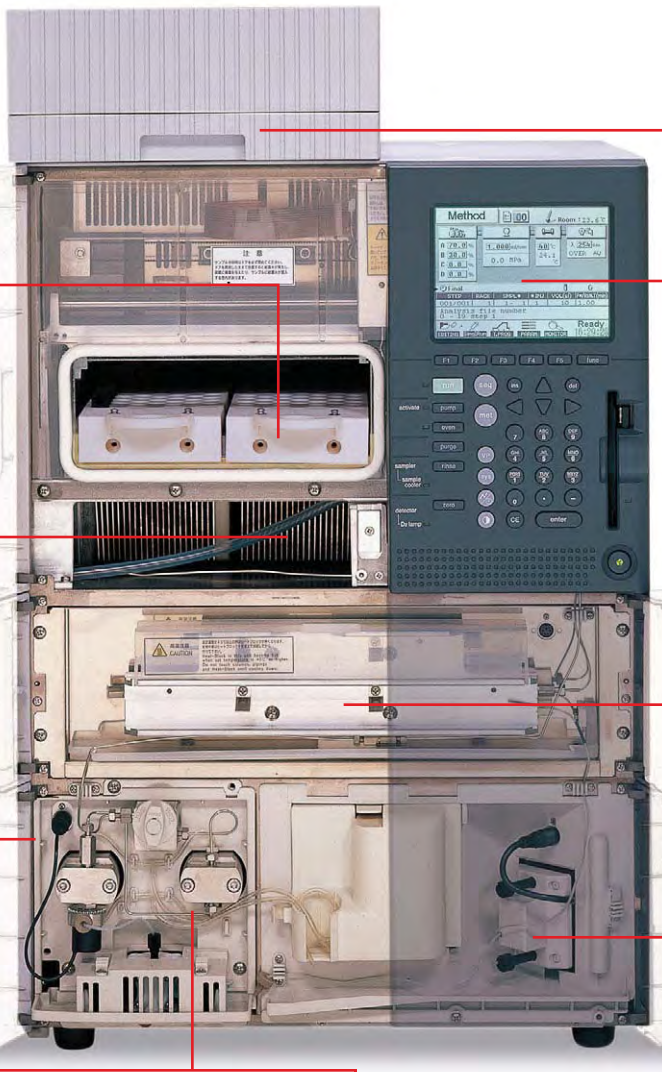
The high-performance metering pump can precisely measure sample volume with no sample loss.
In addition to superior repeatability (within 0.3%RSD*1) and low carryover (within 0.01%*1), the capacity and speed are greatly improved with this High Throughput Autosampler. Two sample racks for 1.5mL vials are equipped as standard.

Sample Cooler (LC-2010CHT)*2

A direct cooling mechanism with Peltier elements*2 provides for efficient and rapid cooling. The newly designed dehumidifier prevents condensation.

Degasser

A small-volume, high-efficiency 5-line degasser is incorporated to remove dissolved gases in mobile phases and in the rinsing solution of the autosampler.



Pump

Pulse-free solvent delivery is achieved by utilizing Shimadzu's proprietary micro volume serial double plunger design. A newly developed Dynamic Inlet Valve (Pat. Pending) greatly improves flow rate stability and gradient performance.

Reservoir Tray

The Reservoir Tray can accommodate six 1L bottles. Documents and small tools can be stored in the drawer, too.

System Controller

The Graphical User Interface (GUI) and Wizard function make it easy to operate the LC-2010HT.

Column Oven

The block heating-type column oven can heat and cool up to two columns. The temperature deviation is minimized by a double temperature control mechanism.
The advanced Column Management Device (CMD)*3 can be used to easily manage column information.

UV-VIS Detector

Thanks to the lowest baseline noise ($\pm 0.25 \times 10^{-5}$ AU or lower*1) ever, higher sensitivity analyses are achieved. The standard temperature-controlled cell reduces the influence of room temperature fluctuations on absorbance and gives a more stable baseline. A mercury lamp is built in to check wavelength accuracy.

*1 Under the analytical conditions determined by Shimadzu
*2 Standard for the LC-2010HT
*3 Optional item

Large sample capacity

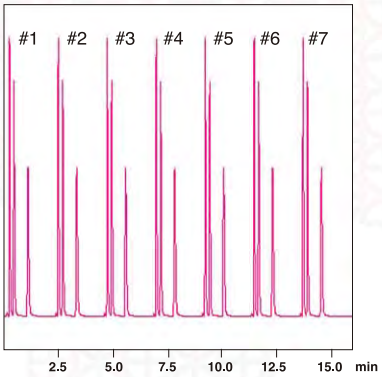
The LC-2010HT can handle up to 350 1mL vials or 210 1.5mL vials*1 .
When microtiter plate racks are used, up to 4 microtiter plates can be accommodated for continuous analysis of max. 1,536 samples.*2
Deep Well plates can also be used. Two separate sample racks are used so that you can load samples in a rack while analyses are performed on samples from the other rack.

*1 LC-2010AHT
*2 When 384-well plates are used.

High-speed injection

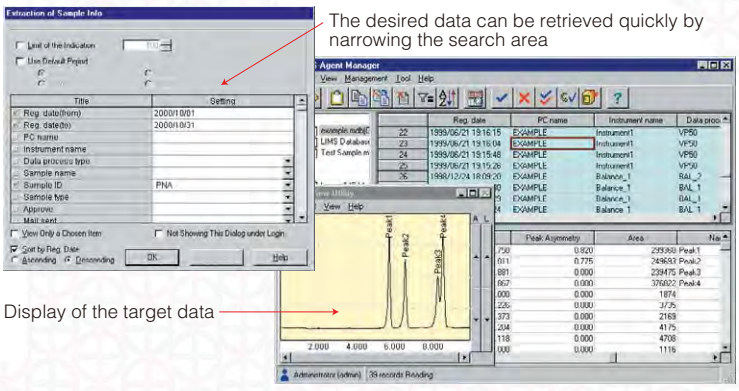
Injection time per sample has been greatly reduced. Just 15 seconds* are required from start to finish for unheard of high-speed sample injection.

*For a 10µL injection volume



High-speed analysis

Seven analyses are completed in 15 minutes thanks to high-speed injection and an ultra-fast column!
This enables major improvements in analysis throughput in the field of drug discovery.



Database

Multiple data are managed in one block with optional CLASS-Agent Manager*.
Required data can be easily retrieved from a mass of data as analysis data is automatically loaded into the database.

*Standard component of optional CLASS-Agent software.

Automation

Startup, analysis operation, and shutdown procedures are all automated! An intelligent HPLC that provides fully automated, repetitive operation.

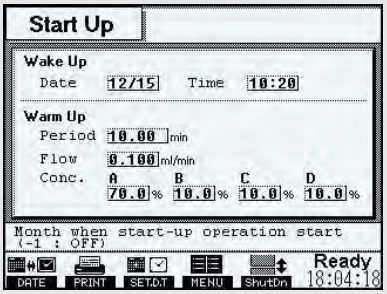
The format of HPLC analysis will change greatly as consecutive operation (device startup, operations for analysis preparation, analysis start, and shutdown after analysis) is automated. The Shimadzu LC-2010HT is an intelligent HPLC developed to meet labor saving requirements.

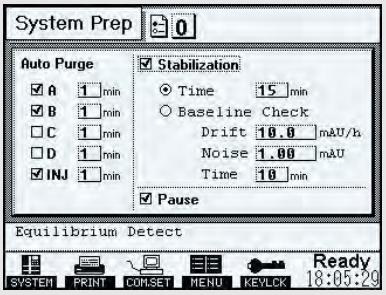
The flow of automated analysis*

Consecutive operations can be automated by advance setting of startup and shutdown parameters.

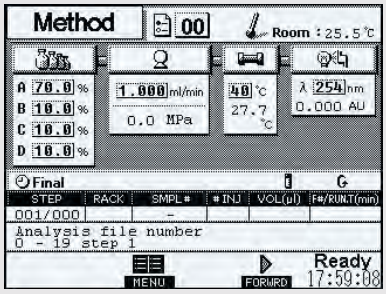
- Device startup
- Flow line purging with mobile phase
- Column / system equilibration
- Stabilizing baseline
- Analysis start
- Analysis
- Analysis finish
- Temp. control off for oven etc.
- Degasser and pump halted
- Shutdown

Setting startup parameters





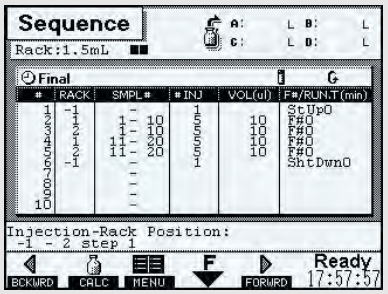
Filing normal analysis



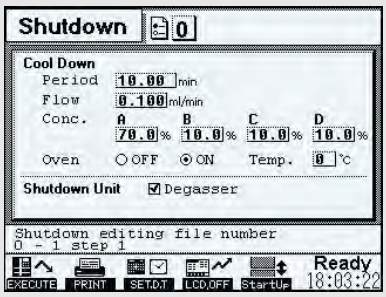
Setting startup parameters

Normal analysis using an LC-2010HT can be performed with a method file screen and sequence file screen.

Setting method parameters



Setting shutdown parameters



*These are examples of LC-2010HT screens. Screens and specifications of LCsolution are subject to change.

Automation functions

The LC-2010HT is replete with sensible automation functions to lighten your workload.

Automatic recognition

Automatically recognizes the sample rack type and detects vials, flow cell type, solvent leak, lamp house cover status and oven door status, etc.

Auto system check

Automatic check of baseline stability and system status.

Auto validation

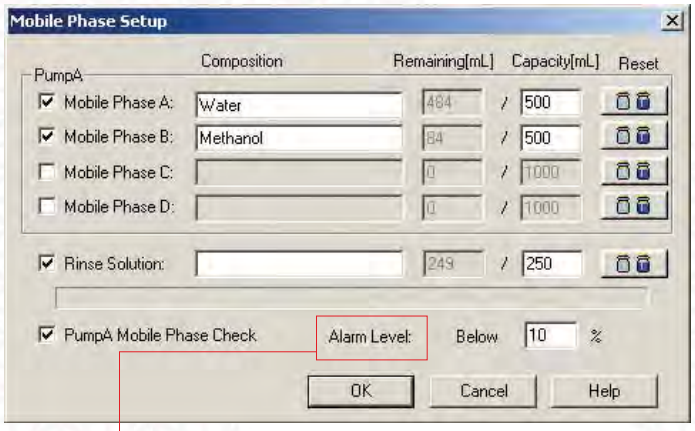
Automated high-level validation can be performed quickly, eliminating time-consuming periodic manual validations.

Auto log

Maintenance log, operation log, error log as well as column history can be automatically recorded.(*)

* CMD option required.

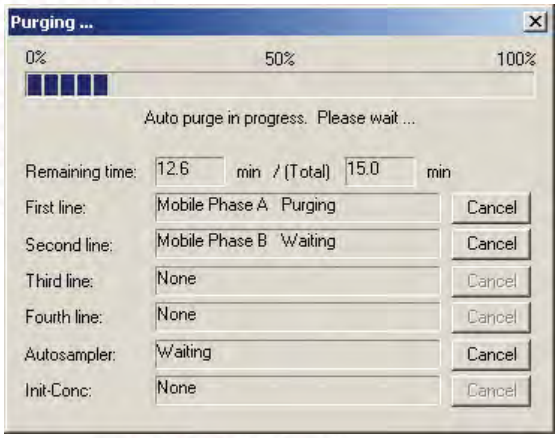
Parameter setting screen for mobile phase and rinse solution



You can even be warned that the remaining mobile phase is less than the set level.

Auto purge functions

The drain valve no longer has to be opened and closed manually as with conventional pumps. One touch automatically purges each flow line and rinse liquid line for the autosampler.



Validation

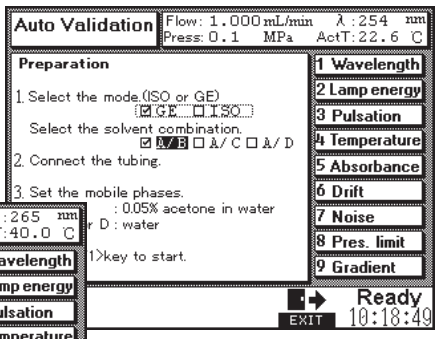
Anyone can promptly perform high-level validation at any time!
Supports GLP and GMP to an even greater degree.

High levels of validation in every field are required for analytical instruments that have to comply with regulations such as GLP, GMP, and ISO. The LC-2010HT is equipped with an auto-validation function to enable high-level validation of hardware.
Used with LCsolution and CLASS-Agent manager, results of validation are saved as electronic records.

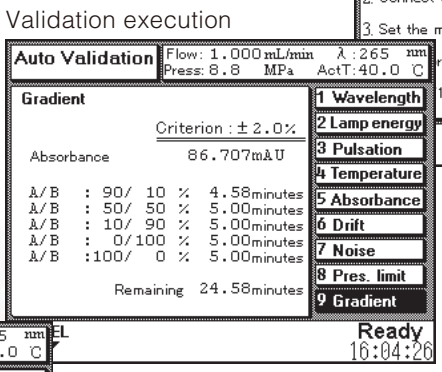
Auto validation

Previously, knowledge and experience were prerequisites for executing validation tests, but now anyone can perform validations using a uniform procedure.
The LC-2010HT auto-validation function automatically finishes in approximately 1.5 hours in isocratic mode and approximately 3 hours in gradient mode.

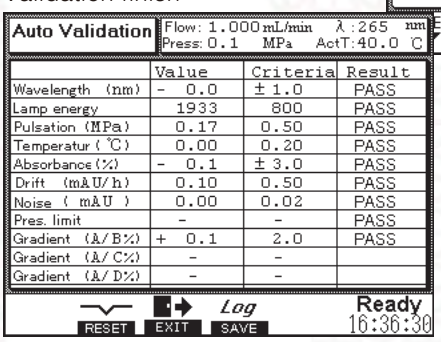
Validation start



Validation execution



Validation finish

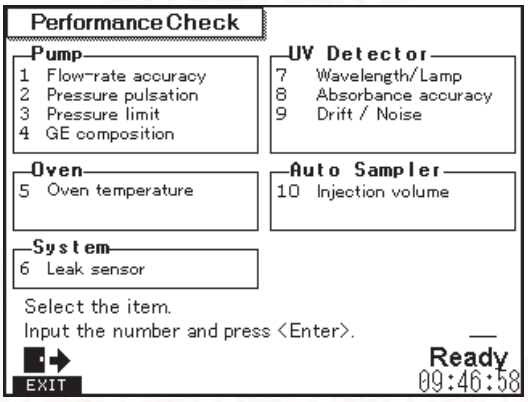


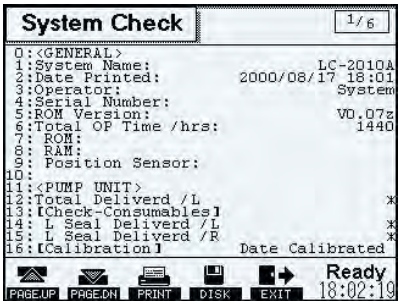
Auto validation tests important parameters such as solvent delivery stability, wavelength accuracy, absorbance level, and column temperature.

Performance check

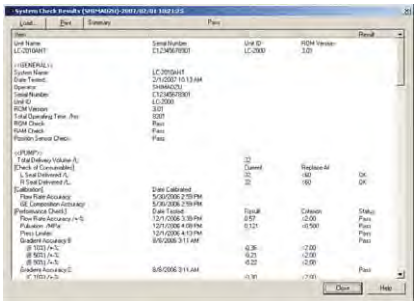
The performance-check function can be used if the validation of each unit is to be performed independently. This is a useful function when validations such as accuracy of the pump flow rate and injection volume accuracy need to be performed individually. This performance check can be executed even if the instruction manual is not available, since the validation procedure instructions are displayed on screen.

Performance check screen





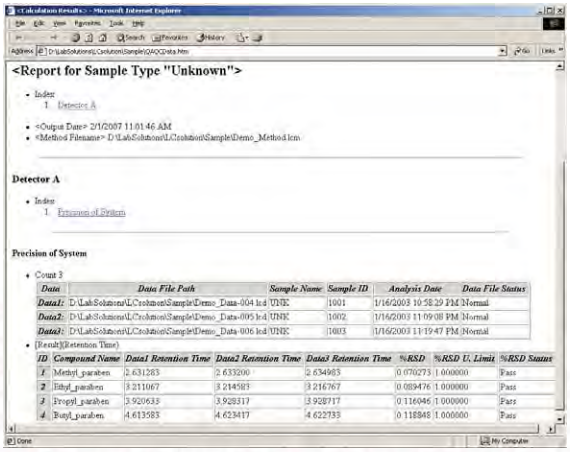
System check screen



System check report

System check

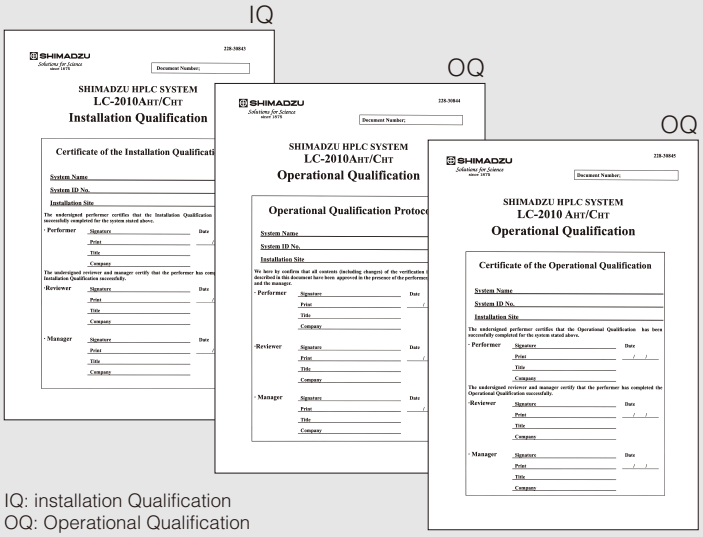
Daily checks can be performed automatically with the system check function. Device status can be easily checked as auto validation and performance check functions record the latest validation results together with device self-diagnosis results and the remaining service life status of consumables.



QA/QC report

System suitability test

LCsolution is equipped with a QA/QC function as standard so that system suitability tests can be easily performed on a daily basis. Also, it is possible to automate the operations that occur in a routine analysis, such as re-injections and analysis cancellations that depend on test results if the auto-validation function for results is used.



IQ: installation Qualification
OQ: Operational Qualification

FDA compliance support

When devices are installed or reinstalled due to a move, checks must be carried out to ensure that the installation environment and device meet the specifications and the device performance meets the established criteria in order for the instrument to comply with FDA inspections. In the case of installation qualification (IQ) checks, analysis device specifications, software, attached documents, and suitability qualification at the time of device installation (including installation environment check as well as customer training certificate) are required. With the LC-2010HT, installation qualification and operational qualification (OQ) documents are attached as standard. Shimadzu qualified service personnel perform installation qualification and operational qualification (service cost is not included).

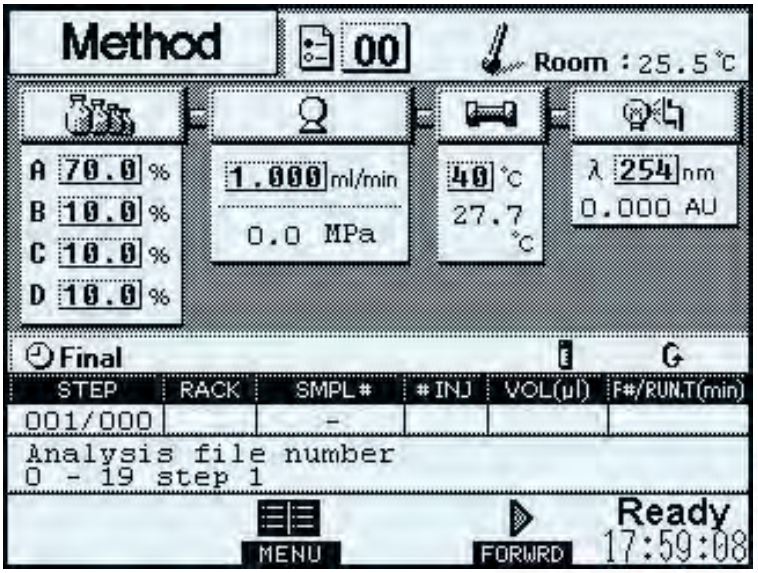
Ease of use

Automation functions and an analysis application CD-ROM provide powerful support during daily analysis!
All consumables can be replaced from the front of the instrument.

Mastery of equipment operating method….
Here, valuable time is saved - which minimizes the total cost - as the LC-2010HT is an intelligent HPLC fully equipped with the necessary functions and features for daily operation and maintenance.

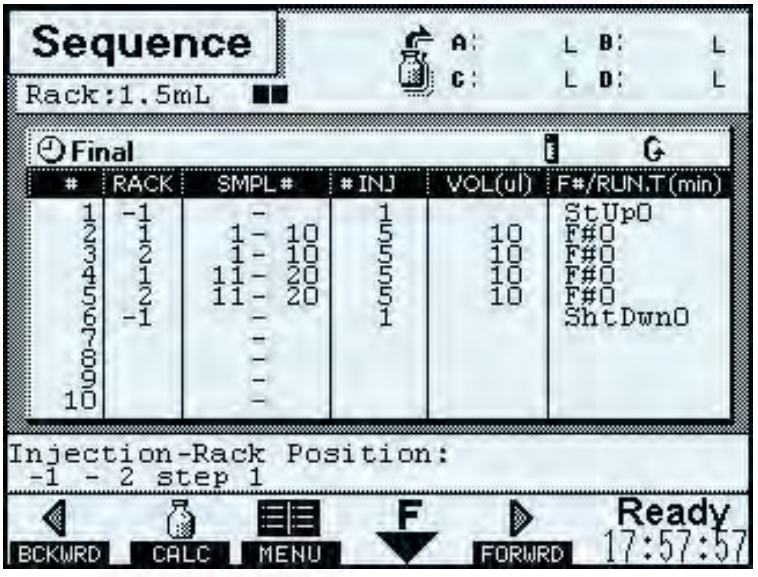
Graphical User Interface (GUI)

Analytical conditions can be set intuitively using GUI screens. Even beginners can operate it very easily.



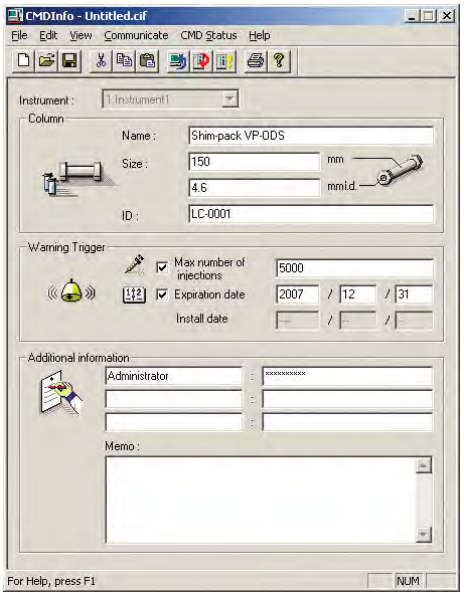
Easy Schedule Setting

An analysis schedule can be prepared easily from the injection sequence window.



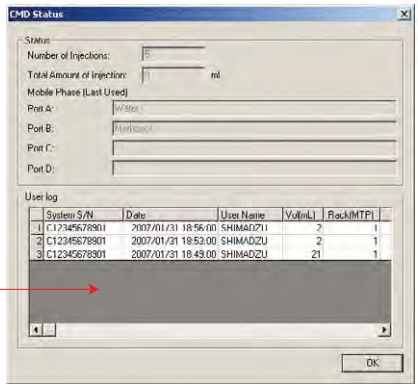
Automatic recording of column history

When the CMD is used, the injection number, eluent volume, and the previously used mobile phase, etc., are automatically recorded, so the column history can be easily checked.



Screen for setting column data

Analysis history can be checked.



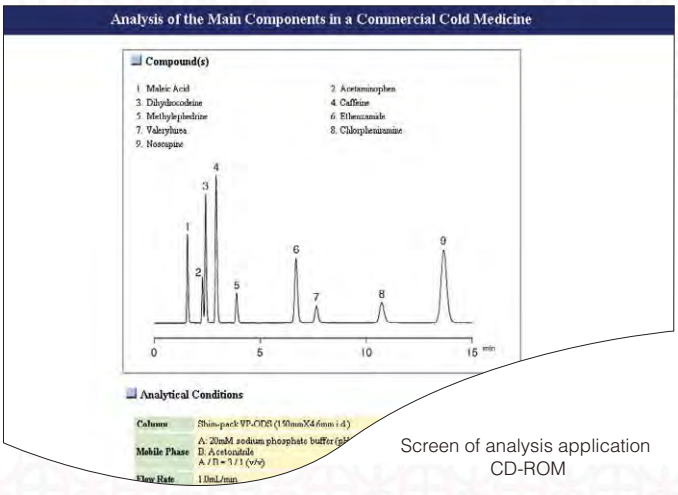
A column with CMD

Cell replacement

Lamp replacement

Front access for maintenance

Maintenance such as lamp or flow cell replacement is easy.



Screen of analysis application CD-ROM

Analysis application CD-ROM

Analysis is possible as soon as the sample is prepared. Installation only requires preparation of the mobile phase and column; therefore, complicated plumbing and wiring are not needed. Moreover, anyone can easily use the analysis application CD-ROM because it is complete with analytical know-how such as analysis parameters and the mobile phase preparation method.

High performance

This new instrument configuration redefines the benchmarks for performance and reliability.

Gradient performance

Gradient concentration accuracy is further improved through the use of a newly developed dynamic inlet valve (patent pending).
Excellent results are obtained with the LC-2010HT, even in the area of lab-to-lab reproducibility that is often an issue in validation tests.

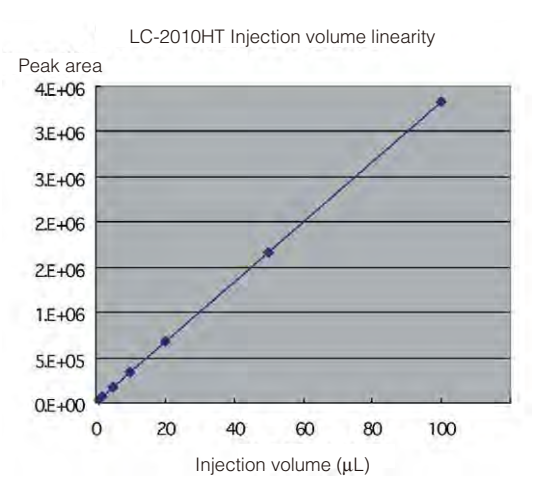
Set	Actual	Error (%)	Set	Actual	Error (%)
0	0.00	0.00	60	59.81	-0.19
3	3.03	0.03	70	69.87	-0.13
6	5.96	-0.04	80	79.87	-0.20
9	8.98	-0.02	85	84.86	-0.14
12	11.87	-0.13	88	87.88	-0.12
15	15.00	0.00	91	90.80	-0.20
20	19.93	-0.07	94	93.85	-0.15
30	29.86	-0.14	97	96.85	-0.15
40	39.87	-0.13	100	100.00	0.00
50	49.84	-0.16			

Example of actual measured concentration

Injection volume accuracy

Improvements to the drive units of the auto-sampler have simultaneously achieved greater speed, higher reproducibility, and superior reliability.
Even micro-volume sample injections can be performed accurately. All of the sample drawn is injected, so there is no sample loss, and injection volume linearity is excellent.

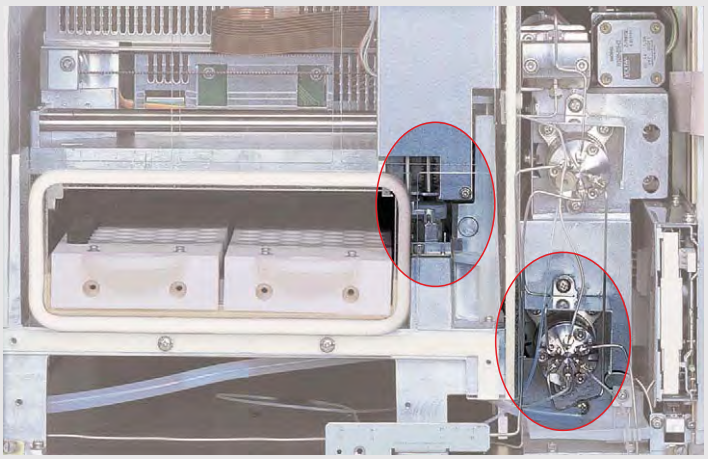
Injection volume linearity



Injection volume accuracy

Injection volume	
Set (µL)	Actual (µL)
50	50.08
10	10.07
5	5.08
1	1.05

Note:
Injection volume accuracy is measured using the gravimetric method.



Near-zero sample carryover

The surface of the sampling needle of the LC-2010HT's autosampler is coated using a special, innovative surface processing technology (patent pending). Furthermore, by employing newly developed rotor seals and needle seals made of PEEK, the LC-2010HT significantly reduces contamination, even with the most highly adsorbent sample compounds. As a result, the LC-2010HT demonstrates nearly zero sample carryover. The use of PEEK for the rotor seals means that the LC-2010HT has strong durability (5 times stronger compared to previous models).

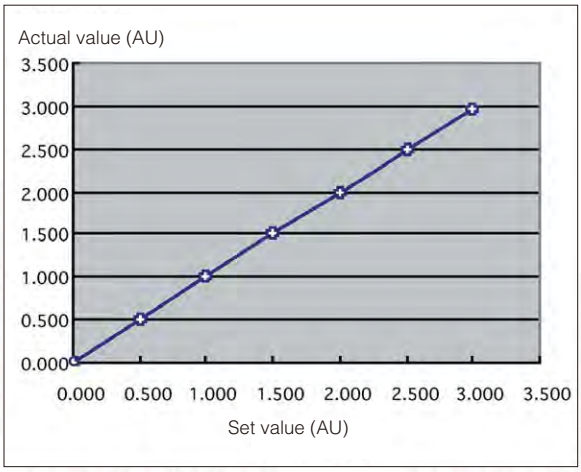
Set No.	50 µL	10 µL	5 µL	1 µL
1	0.06%	0.18%	0.06%	0.69%
2	0.07%	0.18%	0.25%	0.45%
3	0.05%	0.03%	0.03%	0.57%
4	0.06%	0.07%	0.09%	0.74%
5	0.07%	0.05%	0.15%	0.49%
6	0.03%	0.16%	0.14%	0.76%
7	0.05%	0.04%	0.20%	0.65%
8	0.05%	0.18%	0.17%	0.59%
9	0.03%	0.04%	0.16%	0.93%
10	0.05%	0.18%	0.08%	0.83%
AVG	0.05%	0.11%	0.13%	0.67%

Repeatability data injection volume

Injection volume repeatability and stability

Stability is another important factor that goes hand-in-hand with achieving high-speed injection to support high-throughput analysis.
Also, the main components such as the measuring pump, injection port, and valve are easily accessible from the instrument's front panel.
This example shows the reproducibility of data for injection volumes. Each injection volume was measured 50 times and the RSD (%) of the area value was determined.
The LC-2010HT provides extremely stable data.

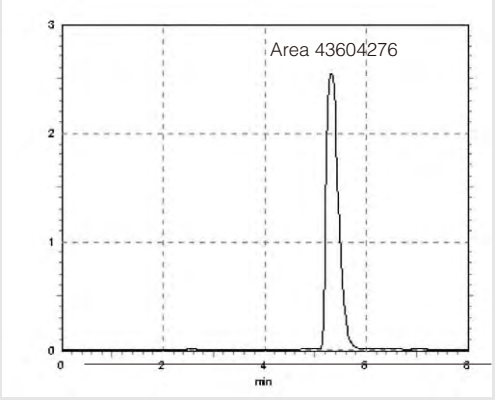
LC-2010HT Detector linearity



Temperature control flow cell

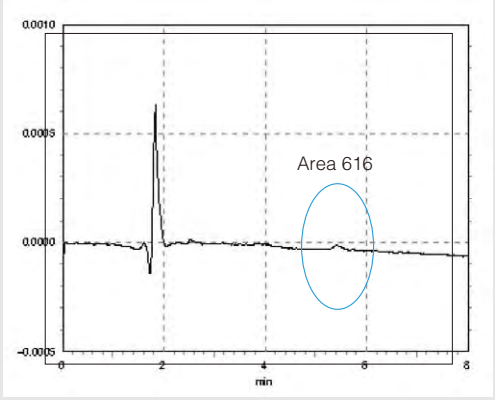
Detector linearity

Detector linearity has been further extended through the innovative development of a highly reliable optical system.
A temperature-controlled flow cell improves baseline stability in analyses using mobile phases that experience absorbance variation with temperature changes.



Sample carryover for chlorhexidine, which strongly absorbs to a sampling needle with conventional material, is only

0.0014%



Sample carryover (2 µL injection)

Automation for high productivity

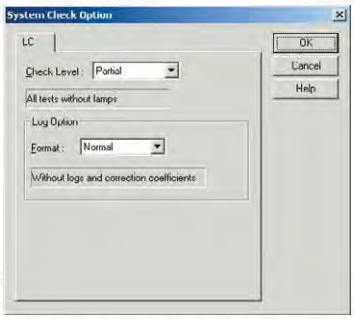
Automation of analysis reduces the time spent on a variety of operations –from bringing the instrument to the optimal conditions before the run to the device's shutdown. With LCsolution, these actions can be programmed into the method and batch files and automatically controlled by the software.

Startup

Operational navigation with assistant bar

Specifies whether to perform startup. Startup denotes the function of solvent delivery for the time specified at the beginning of the batch processing for purposes such as stabilizing the baseline.

System check



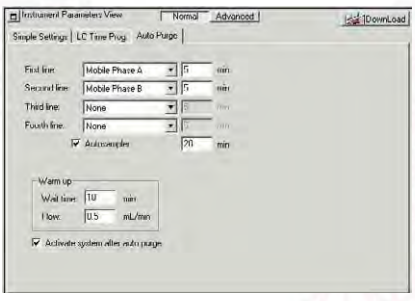
Hardware system check

Ensures the hardware system is working properly prior to injection of the sample. The results of a system check are displayed and recorded with the analysis data.

LCso

LabSolutions for High Perform

Auto purge



Auto purge

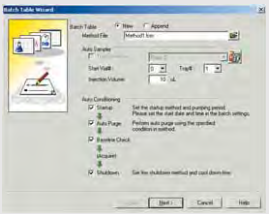
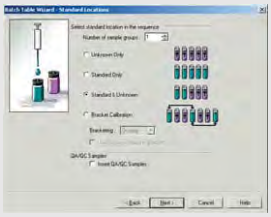
Auto purge is available for Prominence and the LC-2010HT.

It can be specified under the conditions set in the method file. Auto purge can also be set for a batch table row.

Batch table wizard Shutdown

Analysis schedule setting with wizard

Batch tables for the consecutive analysis of multiple samples can be easily created using a wizard. Many batch functions have been simplified. Just follow the wizard and enter the prompted items to create a batch table for multi-point calibration curves and repeat analysis.

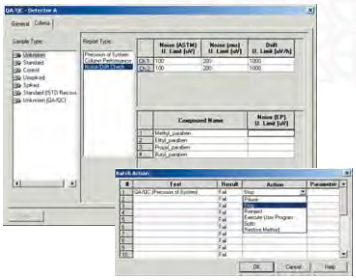




Shutdown

Cool down

After analysis is completed, you can protect the important column from damage by performing an appropriate cool down under a shutdown method's conditions.

Action



Intelligent instrument control

Up to 20 actions for batch processing can be specified based on the result for QA/QC and system check. The automatic action is based on a parameter value and is available for every sample type.

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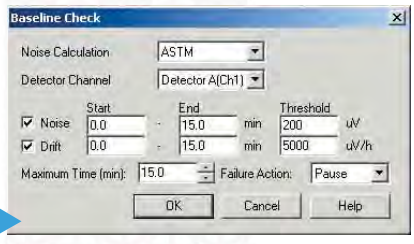
Baseline check



Checking instrument stability of before analysis

If the baseline check is selected, the noise and drift will be evaluated relative to the baseline on the specified channel in accordance with the settings for the method. The system will automatically decide whether or not to run the sample based on the result of the check.

Specifications

Specifications of LC-2010HT

Item			LC-2010CHT (228-45103-3X)	LC-2010AHT (228-45102-3X)
Pump	Pump type		Serial dual pluger, micro volume (10 µL on primary side, 5 µL on secondary)	
	Flow rate setting range		0.001–5 mL/min [1.0–35 MPa / 145–5076 psi]	
	Flow rate accuracy		±1% or ±2 µL/min, whichever is larger (1 mL/min, 3–10.0 MPa / 435–1450 psi, water, ambient temperature at 20°C, except in gradient solvent delivery), ±2% or ± 2 µL/min, whichever is larger (except above condition and in gradient solvent delivery)	
	Flow rate precision		±0.075% RSD or 0.02 min SD, whichever is larger (0.05–2 mL/min, 1.0–35 MPa / 145–5076 psi, methanol, ambient temperature at 20°C)	
	Pressure display accuracy		±2% or ±0.5 MPa, whichever is larger	
	Plunger cleaning		Automatic rinsing mechanism as standard equipment	
	LPGE	Number of solvents and setting range	Up to 4 solvents 0–100%, 0.1% step	
		Concentration accuracy	±0.5% (0.1–2 mL/min, 1.0–20.0 MPa / 145–2900 psi, aqueous acetone / water)	
		Concentration precision	±0.1% (0.1–2 mL/min, 1.0–20.0 MPa / 145–2900 psi, aqueous acetone / water)	
Degasser	Type		Membrane on-line degasser, 5 lines (4 × mobile phase, 1 × autosampler rinsing liquid)	
	Volume		4 mL/line for mobile phase, 2 mL/line for autosampler rinsing liquid	
Autosampler	Injection method		Full volume injection, variable injection possible (no sample loss)	
	Injection volume setting range		0.1–100 µL (standard), 1–2000 µL (optional) (0.1–0.9 µL in 0.1 µL step, 1–2000 µL in 1 µL step)	
	Sample capacity	1 mL vials	350	
		1.5 mL vials	140	210
		4 mL vials	100	
		Microtiter plates	Max. 4 plates (up to 384 samples with 96 well or 1536 samples with 384 well plates)	
		Deep well plates	Max. 4 plates (up to 384 samples with 96 plates)	
	Injection volume repeatability		RSD < 0.3% (10 µL injection)	
	Carryover		0.01% (under conditions determined by Shimadzu)	
	Injection volume accuracy		±1% (50 µL, n = 6)	
	Repetition injection frequency		1–99 / sample	
	Analytical run time setting		0.01–9999.9 min (0.01 min step)	
	Injection condition steps		Max. 202 steps	
	Operating pressure		35.0 MPa maximum	
	Rinsing liquid degassing		Standard	
	Sample cooler (LC-2010CHT only)	Type	Direct cooling type. (For setting temperature at 4°C, ambient temperature shall be 30°C or lower and humidity 70% or lower.) Dehumidifier incorporated.	———
		Temperature setting range	4–40°C (For setting temperature at 4°C, ambient temperature shall be 30°C or lower and humidity 70% or lower.)	———
Column Oven	Type		Block heating with preheating of the mobile phase	
	Temperature setting range		4–60°C, 1°C step	
	Temperature control precision		±0.1°C	
	Temperature control range		(Ambient temperature-15°C) –60°C	
	Columns accommodated		2 × 250 mm columns	
	Preheater volume		4 µL (for Semi-micro), and 9 µL, 2 channels	

Item		LC-2010CHT (228-45103-3X)	LC-2010AHT (228-45102-3X)
UV Detector	Light source	Deuterium lamp, Low pressure mercury lamp (for wavelength accuracy check)	
	Wavelength range	190–600 nm	
	Bandwidth	8 nm	
	Wavelength accuracy	±1 nm	
	Wavelength reproducibility	±0.1 nm	
	Cell	10 mm, 8 μL	
	Cell temperature control	Standard (Setting temperature: High, Low, and OFF, 3 steps)	
	Drift	1×10^{-4} AU/h (250 nm, air in cell, constant, room temperature)*	
	Noise level	$\pm 0.25 \times 10^{-5}$ AU (2 sec. time, constant, 250 nm, air in cell)*	
	Linearity	Absorbance deviation ±5% max. at 2.5 AU (Caffeine, 272 nm)	
	Simultaneous dual wavelength measurement	Selectable, two wavelengths in 190–370 nm or 371–600 nm	
	Signal output	Integrator signal output: 2 channels, 0.5, 1, 2, 4, 1.25, 2.5 AU/V, 6 steps	
Controller	Display	Backlit LCD display (320 × 240 dots)	
	Memory media	3.5 inch floppy disk drive (disk format, 2HD, MS-DOS)	
	Input / output terminals	2 × external inputs, 2 × external outputs (+3 option), 1 × optical link (for Chromatopac), 1 × RS-232C (for connection to PC), 2 × detector signal output (for integrator), BCD output of sample number (option)	
	File number	Method: 20 files System preparation: 10 files Shut-down: 2 files Sequence: 1 file	
	Solvent delivery unit control	Flow rate, Concentration, Max. pressure, Min. pressure, Linear, Step, Exponential function	
	Autosampler control	Sample injection volume, Number of injections, Analysis time, Analysis file number	
	Column oven control	Oven temperature, Max. temperature	
	Detector control	Wavelength, Time constant, Lamp ON / OFF, Integrator output range	
	Self diagnostics, Safety feature	Memory check, Max / Min pressure, Oven max. temperature, Lamp current, motor error check, Leak sensor, Lamp cover sensor, Lamp housing max. temperature	
Automation function		Auto start-up, Auto shut-down, Baseline stability autojudgment, Auto validation (Wavelength, Lamp energy, Solvent delivery pulsation, Column temperature, Absorbance, Baseline drift, Baseline noise, Pressure limit, Gradient accuracy) Auto purge, Cell auto recognition, Column management (option) Memory check, Max / Min pressure, Oven max. temperature, Lamp current, Motor revolution monitor, Leak sensor, Lamp cover sensor, Lamp housing max. temperature	
Applicable solvent		Organic solvents (except fluorine solvent, e.g. HFIPA), Aqueous solution and mixture of diluted acid or base (except halo-acids, e.g. hydrochloric acid)	
pH range		1–13 standard	
Liquid contact surface materials		SUS316, Ruby, Sapphire, PTFE, Hasteloy C, PEEK, Trifluoroethylene, PFA Perfluoroelastomer, Quartz, Ceramic	
Operating Ambient temperature range, humidity		4–35°C Max. 80% humidity	
Power requirements		AC 100 V-240 V, 700 VA, 50 / 60 Hz	
Size		W430 × D500 × H705 mm	
Weight		52 kg	47 kg

*Condition according to ASTM E1657-96

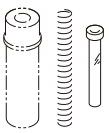
Options

Options for LC-2010HT

Description	Part Number	Set No
Sample rack for 1 mL vials (2 racks / set)	228-37532-91	For LC-2010AHT / 2010CHT (up to 350 vials)
Sample rack for 1.5 mL vials (2 racks / set)*	228-45409-91	For LC-2010AHT (up to 210 vials)
	228-44628-91	For LC-2010CHT (up to 140 vials)
Sample rack for 4 mL vials (2 racks / set)	228-37544-91	For LC-2010AHT / 2010CHT (up to 100 vials)
Sample rack for Microtiter plate (2 racks / set)	228-37545-91	For LC-2010AHT / 2010CHT (up to 4 vials)
Sample rack for Deep-well plate (2 racks / set)	228-37546-91	For LC-2010AHT / 2010CHT (up to 4 vials)
Column Management Device (CMD)	228-37281-91	For column management (1 device for 1 column)
CMD cable	228-39991	1 cable is required for 1 LC-2010AHT / 2010CHT
Optional board	228-40050-91	To add functions of: 1) BCD output of sample number 2) addition of event output terminal 3) analog output of pump pressure, column oven temperature, ambient temperature sensor, sample cooler temperature
Recycle valve	228-37383-91	For solvent recycle
Temperature-controlled flow cell for semi-micro HPLC	228-37384-91	Pass length: 5 mm, cell volume: 24 µL
500 µL sample loop kit	228-37548-98	
2 mL sample loop kit	228-37548-97	For large-volume injection
Maintenance kit without tools	228-39872-96	
Maintenance kit with tools	228-39872-97	

* Sample rack for 1.5 mL vials (2 racks / set) is included as standard accessory.

Vials for Autosampler

Racks	Applicable Sample Vials		
Sample Rack for 1 mL Vials	①  1 mL Glass (with PE cap) 250 pcs / set (228-39699-91)		
Sample Rack for 1.5 mL Vials	②  1.5 mL Glass (with cap, silicone rubber septum) 100 pcs / set (228-15652-92)	③  1 mL PP* (with PE cap) 200 pcs /set (228-31600-91)	④  0.2 mL PP* (with PE cap) 100 pcs / set (228-35217-91)
	⑤  1.1 mL Glass* (with cap, silicone rubber septum) 100 pcs / set (228-21283-91)	⑥  0.3 mL Glass* (with metal spacer, cap, silicone rubber septum) 100 pcs / set (228-16847-92) Vials without spacer as spare 100 pcs / set (228-16850-91)	
Sample Rack for 4 mL Vials	⑦  4 mL Glass (with cap, silicone rubber septum) 100 pcs / set (228-21287-91)	⑧  4 mL PP* (with PE cap, silicone rubber septum) 100 pcs / set (228-31537-91)	⑨  0.3 mL Glass* (with spring to be inserted in 4 mL vial) 100 pcs / set (228-21284-91) Vials without spring as spare 100 pcs / set (228-21285-91)

- All vials commonly used with the SIL-20A / 10AF / 10AP / 10Ai / HT can be used with the LC-2010HT.
- Regarding vials, microtiter plates, and deep-well plates marked*, the set temperature and actual temperature might differ due to differences in shape or in the thermal conductivity of the materials.
- Silicon rubber septa (with PTFE cover) (221-26718-93, 100 pcs) or PTFE septa (228-15655-91, 100 pcs) can be chosen for vials No. 2, 5, and 6.
- Silicon rubber septa (with PTFE cover) (228-21290-91, 100 pcs) or PTFE septa (228-23469-91, 100 pcs) can be chosen for vials No. 7, 8.
- Please use commercially available microtiter plates and deep-well plates.
- PP: polypropylene, PE: polyethylene

Technical Bulletin
Enhancing the Accurancy of Low-pressure GE systems

HPLC gradient (GE) systems are classified as high-pressure GE systems or low-pressure GE systems, according to the unit configuration. This bulletin describes how to make stable concentration settings with a low-pressure GE system, based on the LC-2010HT.

Solenoid Valve (Mobile Phase Mixing Valve) Drive

To reduce the dead volume and flow pulsations, the LC-2010HT uses a serial double-plunger pump, incorporating a primary pump head with a 10 µL plunger capacity. A low-pressure GE system mixes multiple mobile phases by switching the pump solenoid valve in synchronization with the pump intake stroke. A low-capacity plunger pump that requires frequent solenoid valve switching is unfavorable for accurate concentration settings.
However, the LC-2010HT eliminates this problem by allocating 100% concentration over four pump intake cycles, as shown in Fig.1.
Fig.1 shows the flow rate changes in the pump head and the solenoid valve operation timing for a concentration setting of B: 37.5%, A:62.5%.

Correction for Effects due to Mobile Phase Compressibility

Fig. 2 is an enlarged view of the transition from discharge to intake for the pump shown in Fig. 1. The point (1) in the diagram is where the pump plunger starts to retract from its fully advanced position. At this point, the pump head interior still retains high pressure from the discharge stroke. The mobile phase starts to flow into the pump head after the plunger retracts and allows the compressed mobile phase to expand back to atmospheric pressure inside the pump head ((2) in Fig. 2).

The hatched area in Fig. 2 represents the area where no mobile phase intake occurs. As this area increases in size and concentration errors increase at higher pressures, the solenoid valve operation timing is adjusted according to the monitored pressure values to reduce the concentration errors. Solenoid valve operation can be matched to the mobile phase compressibility by entering the compressibility value.

Correction for Errors due to Dalay in Solenoid Valve Response

A millisecond-order delay occurs before the solenoid valve operates after the signal is input. Consequently, the solenoid valve is operated early by a time corresponding to this delay.

Correction of Mechanical Errors

Mechanical errors in cams and other parts of the plunger drive train affect the concentration accuracy. The LC-2010HT is accurately calibrated before dispatch from the factory for the difference between the set concentration and measured values.

Using the techniques above, the LC-2010HT achieves a concentration accuracy of ±0.5% (water/acetone mixture at 0.1 to 2.0 mL/min. and 1 to 20 MPa).

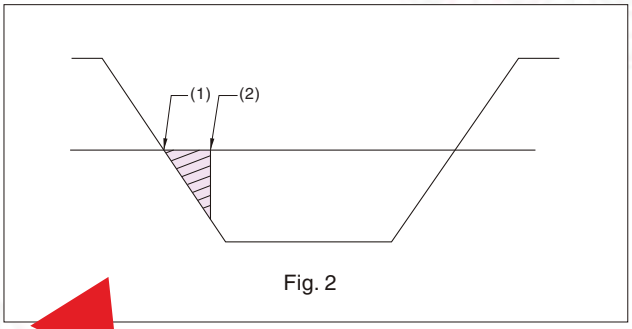


Fig. 2

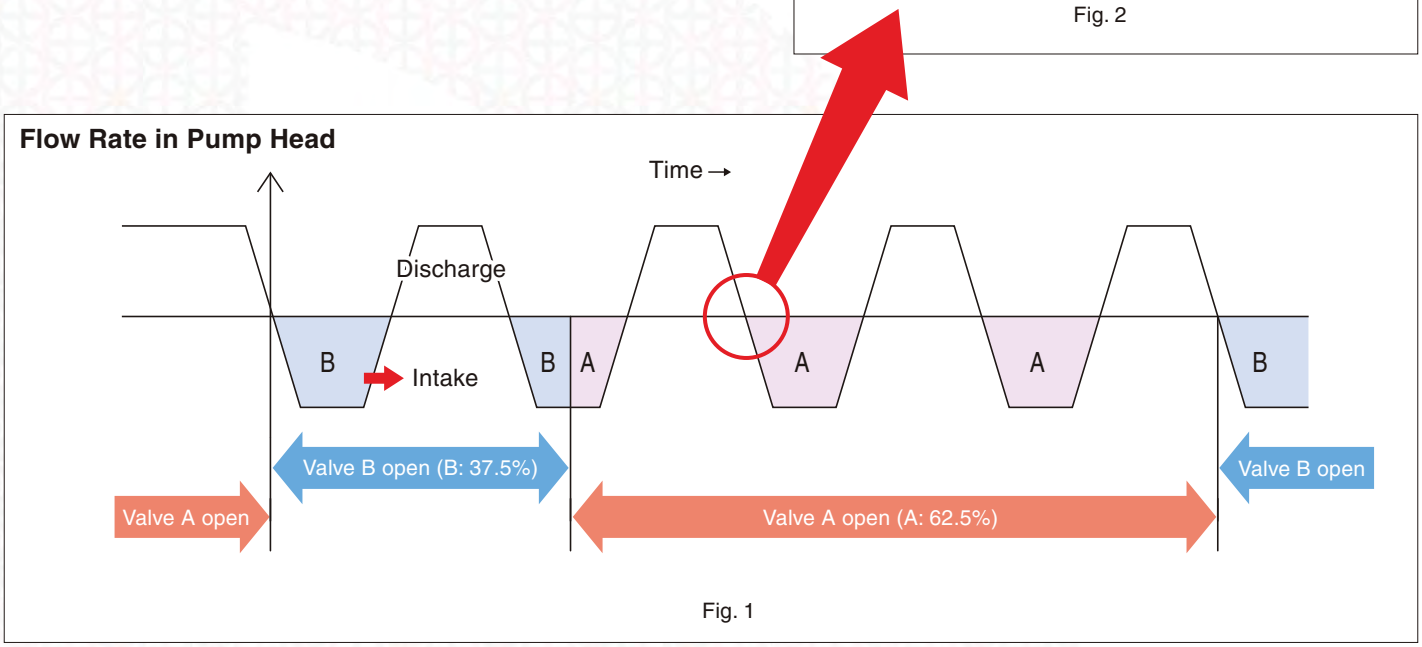
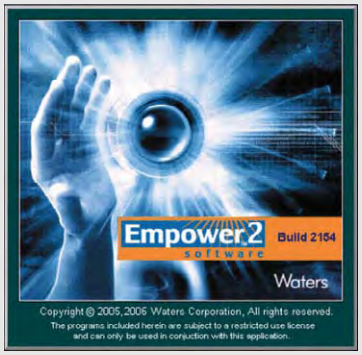


Fig. 1

Control of the LC-2010HT by Waters' Empower™2 chromatography data system is also available.

LC-2010 Series



Shimadzu LC Driver Version2.0 For Waters Empower™ Software

Control of Shimadzu's LC-2010 series by Waters' Empower2 chromatography data system is available through a collaboration between Waters and Shimadzu utilizing the "Open Interface Portal (OIP)" for multi-vendor hardware control. Shimadzu's LC-2010 series seamlessly operate within the Empower software environment. The full system, including autosampler control, uses Empower sample set methods, and data processing is integrated with Empower software so that the audit trail functions are fully utilized. This gives you full confidence in the compliance of the system to regulations such as GMP and 21 CFR Part 11.

*Empower™2 is registered trademarks of Waters in the USA and other countries.

ISO 9001

JQA-0376

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