C196-E061K

Access to your success
SHIMADZU

Prominence

Shimadzu
High-Performance Liquid Chromatograph

How HPLC Should Be

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How HPLC Should Be

High-performance liquid chromatography (HPLC) is widely used in diverse fields such as pharmaceuticals, and biochemistry to chemistry, the environment, and food products.
The Shimadzu Prominence high-performance liquid chromatograph achieves an exceptional level of performance in each of these fields.
Prominence HPLC offers exceptional reliability and great expandability to support diverse applications from ultra-fast liquid chromatography to preparative LC, gel permeation chromatography (GPC), ion chromatography, and LC/MS.

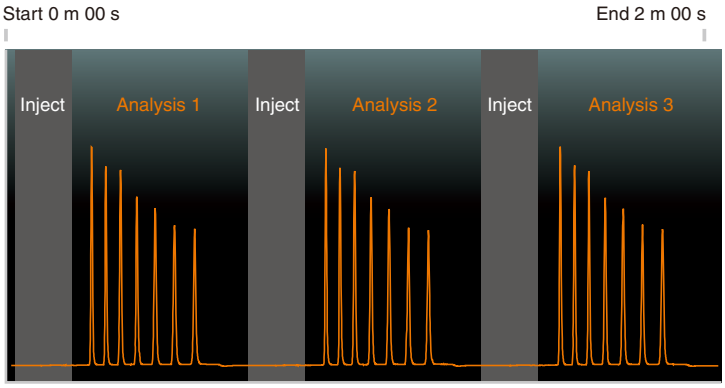
Contents

Superb Performance and Expanda

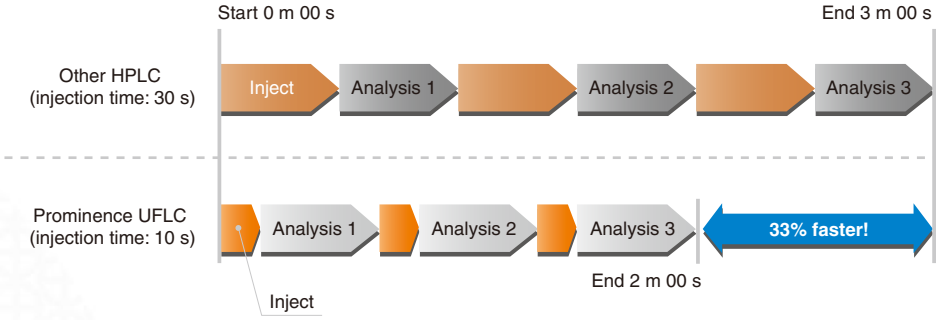
Genuine High Throughput

Reduced total analysis time

The SIL-20A Series autosamplers achieve unparalleled speed, with a sample injection movement of just 10 seconds. Prominence reduces the total analysis cycle time, not simply the time for the HPLC analysis itself.
The optional rack changer permits the serial analysis of up to 4,068 samples.
Prominence is an HPLC system that offers genuine high throughput.



Ultra-fast analysis of 7 components in 30-second cycles

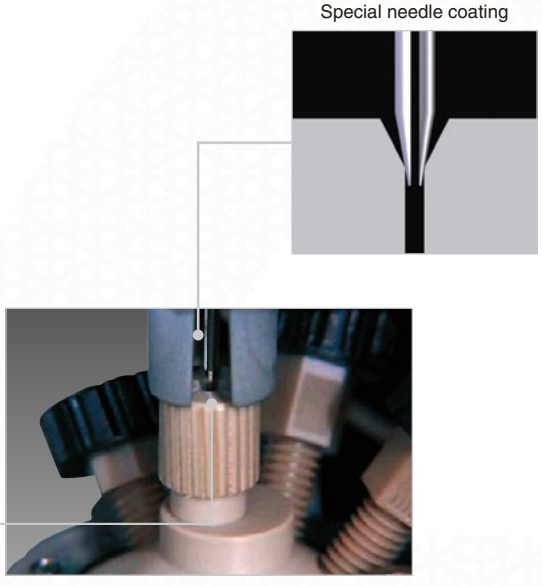


Comparison of total analysis times for 3 analyses by UFLC.
* Example using 30 sec analysis time for each analysis

Extremely Low Sample Carryover

Resolves a major problem with high-sensitivity analyses

Basic compounds and hydrophobic compounds readily adsorb to the sample path. Prominence restricts sample carryover to extremely low limits to avoid a variety of problems that such compounds can cause. In addition, the multi-rinse mode achieves optimal rinsing for proteins and other sample components that are difficult to wash away.
Prominence offers the optimal system for analyses demanding high sensitivity, such as impurity analysis and LC/MS.



bility

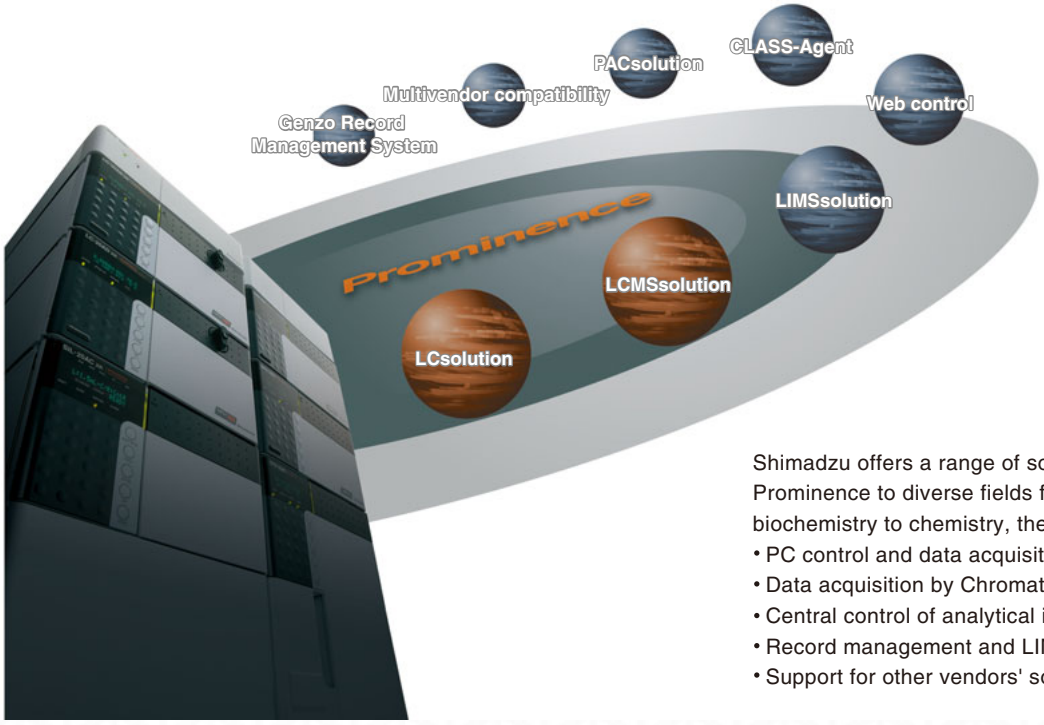
Hardware Expandability

Flexibly accommodates customer needs from ultra-fast analysis to dedicated analysis systems

Prominence allows configuration of the optimal analysis system for any application.
The conventional HPLC is the typical system, and features simple operation.
The UFLC system achieves a high level of separation at ultra-high speeds. The UFLCXR system and the LC/MS system maintain this ultra-high speed but offer higher separation performance.
This great expandability allows Prominence to meet the challenges of new applications.

Software Expandability

Apply the Prominence's excellent basic performance to a variety of fields



Shimadzu offers a range of software environments to apply Prominence to diverse fields from medicine, pharmaceuticals, and biochemistry to chemistry, the environment, and food products.

- PC control and data acquisition
- Data acquisition by Chromatopac and PC
- Central control of analytical instruments data
- Record management and LIMS
- Support for other vendors' software (multivendor compatibility)

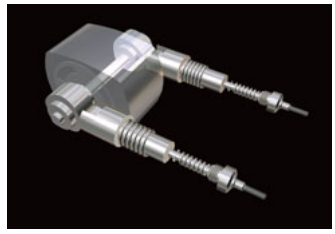
For Better Quality of Data

Solvent Delivery Units

Superb micro-volume pumping performance

The LC-20AD Series offers pumping flow rates from 100 nL/minute and achieves the highly stable flow-rate performance demanded by UFLC, LC/MS, and GPC.
The LC-20AD Series features pump heads with just 10 µL plunger volume equipped in parallel. The parallel double-plunger mechanism simultaneously compensates the pulsation for each pump head. It achieves high pumping accuracy across a broad flow-rate range from the micro to the semi-preparative scale.

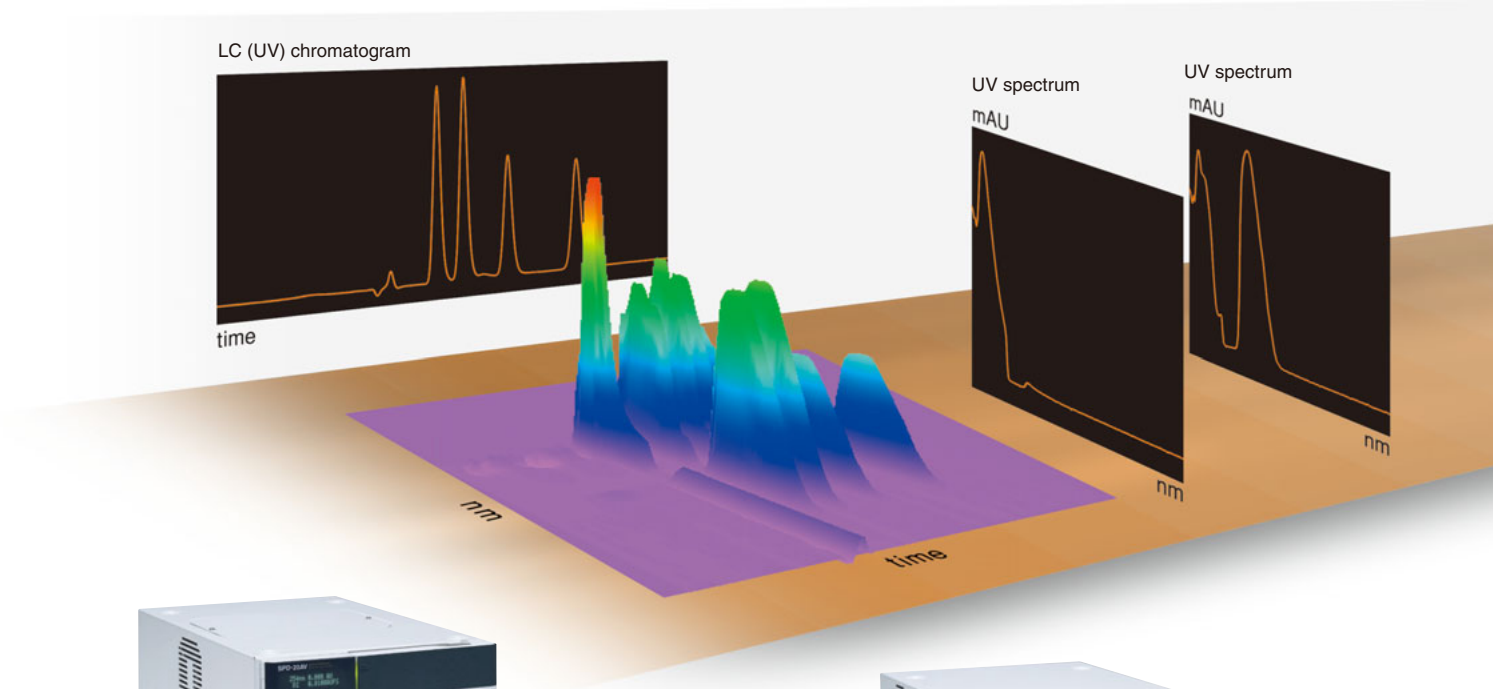
LC-20AD/20ADXR



LC-20AD parallel double-plunger drive mechanism

Detectors

Support risk reduction for analysis



SPD-20A/20AV

Selecting the appropriate detector is the key to the success of any application. For example, the dynamic range of the detector significantly affects the results of impurity analysis. The wide dynamic range and high sensitivity make SPD-20A/20AV UV-VIS detectors powerful tools for determining trace impurities.

SPD-M20A

The SPD-M20A photodiode array detector offers multi-wavelength detection across a designated wavelength range. It permits purity measurements using simultaneously acquired absorption spectra.

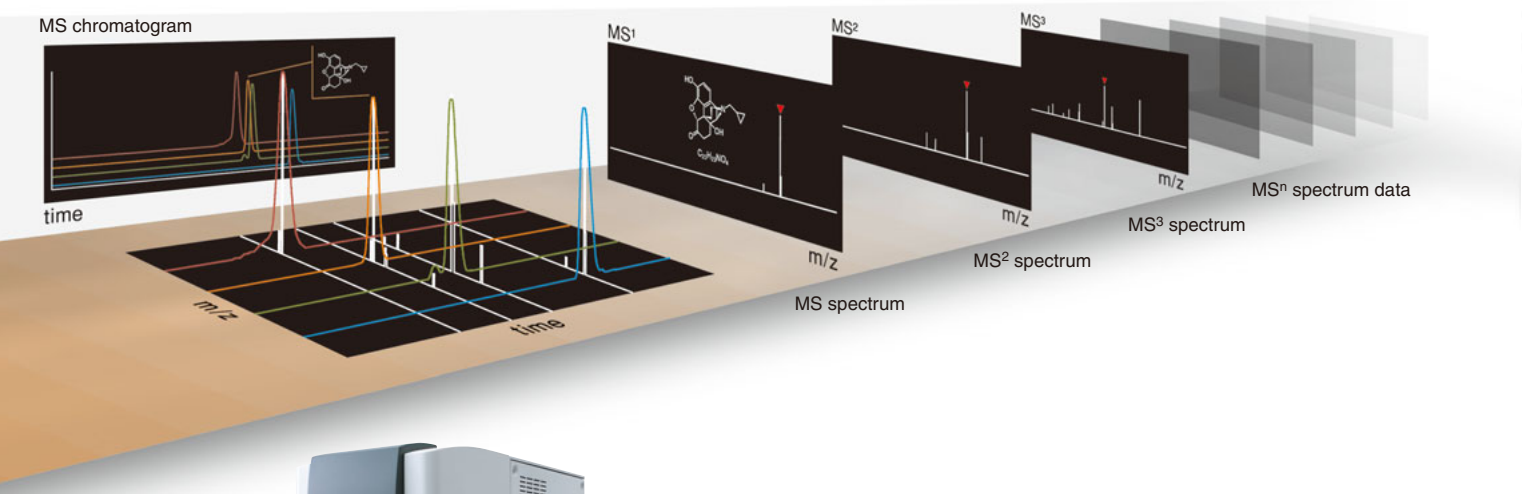
Autosamplers

World-Class Performance Unrivalled by Other Vendors

An autosampler must offer precise and accurate measurements on any type of sample to achieve the anticipated level of analysis results. The Prominence SIL-20A autosampler exceeds all expectations, resulting in a stellar reputation in such fields as medical, pharmaceuticals, and bio-chemistry. The extremely low sample carryover of the Prominence SIL-20A autosampler series is one reason for the superior analytical data.
Even under severe UFLC analysis conditions, the excellent basic performance of the Prominence SIL-20A autosampler series generates high-quality data.
The robot arm in the rack changer automatically loads both micro-plates and racks for standard 1.5 mL vials into the SIL-20A. It is a powerful tool for the analysis of a large number of samples.

SIL-20A series

Rack changer



LCMS-2020

LCMS-IT-TOF

In impurity analysis, some compounds may not absorb light. In such cases, an effective approach is to select a single quadrupole mass spectrometer (MS) as the LC detector. The greatest advantage in using an MS as the LC detector is that it easily provides mass information on each peak at the same time as the respective retention times.
The LCMS-2020 even allows customers with no experience with the MS method to utilize the mass spectrometer as an effective detector.

A mass spectrometer that offers accurate mass measurements is an effective tool for the structural analysis of impurities. The LCMS-IT-TOF is an ion-trap / time-of-flight hybrid mass spectrometer that permits structure predictions of impurities based on MS^n data. Combining the LCMS-IT-TOF with a Prominence system achieves analysis performance that exploits the excellent capabilities of each instrument to the full.

CBM-20A

The CBM-20A/CBM-20Alite is a system controller equipped with a data buffering function and acts as an interface for connecting LC workstations, network-client computers, and analytical instruments via Ethernet.

Supporting a Variety of Systems

CBM-20A

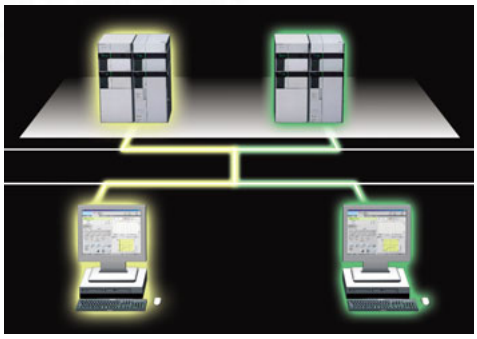
Up to eight units can be connected to the box-type CBM-20A. Also, adding an optional A/D conversion board makes it possible to accept chromatogram signals from other companies' detectors at LC workstations.

Space-Saving Type

CBM-20Alite

The card-type CBM-20Alite is used by incorporating it into an LC-20A-series solvent delivery pump or Autosampler. It can control up to five units, including the unit in which it is incorporated.

Providing a Flexible Installation Environment



CBM-20A/CBM-20Alite units and computers are connected via Ethernet. LAN cables can be used for connection; therefore, analytical instruments and computers can be installed in remote locations.
Also, the data buffering function protects important analytical data from unexpected communication errors.

*The data buffering function is available only when using LCsolution.

Achieving Auto-Purge with a Modular HPLC System

The Prominence system is equipped with auto-purge, a function that is normally available only with all-in-one HPLC systems. This makes it unnecessary to open or close the drain valve when, for example, replacing the mobile phase. Combining this function with the startup and baseline-check functions enables fully automatic analysis with a modular HPLC system.

Equipped with Web-Server Functions

The CBM-20A/CBM-20Alite not only enables connection to computers via Ethernet, but is also equipped with Web-server functions. These allow system control, monitoring, and maintenance management of devices to be performed from Internet Explorer without installing special software.

Checking Device Status at a Glance

It is possible to browse information about the operating status, including the status of devices and the existence of errors, as well as information about device maintenance, including the results of the latest system checks and whether or not consumable parts have been used beyond recommended limits. Also, messages such as "Use next week" or "Perform maintenance" can be communicated between users with the memo function.

The operating status of devices in the network can be checked at a glance.

Control Possible via Network

Devices can be controlled from Internet Explorer without using a special workstation. Execution and monitoring of device conditioning before analysis can be carried out from another room or some other remote location. This makes it unnecessary to keep visiting the laboratory to check on the devices.

Centralized Management of Maintenance Information

Maintenance information, such as the usage frequency of consumable parts in analytical instruments, can be obtained quickly via Internet Explorer. This function is very useful for ensuring the stability and effective use of analytical instruments.

- CBM-20A (228-45012-XX) Number of connectable units: 8 Data buffering: Approx. 24 hours (for a sampling rate of 500 ms) Event I/O: 4 inputs, 4 outputs Connectable units: 4 solvent delivery units, 1 Autosampler, 1 column oven, 2 detectors, 1 fraction collector, 2 sub-controllers
- CBM-20Alite (228-45011-38) Number of connectable units: 5 (including the unit in which it is incorporated) Data buffering: Approx. 24 hours (for a sampling rate of 500 ms) Event I/O: 2 inputs, 2 outputs Connectable units: 4 solvent delivery units, 1 Autosampler, 1 column oven, 2 detectors

LC-20A

Thanks to drive-system modifications, the LC-20AD/20ADXR/20AT/20AB offers a level of solvent delivery performance previously unseen. It provides the ideal system for a range of applications from conventional LC to micro LC. Also, incorporating a system controller (CBM-20Alite) in this unit makes it possible to control and monitor the operating status from PCs in the network, and perform device management for the whole system.

Superior Solvent Delivery Performance

LC-20AD

The LC-20AD offers the fastest solvent delivery performance in the world. With an automatic pulsation-correction mechanism and high-speed micro plunger driving, it achieves pulse-free solvent delivery. Thanks to improvements in solvent-delivery control firmware, solvent-delivery performance in the micro-flow-rate range below 50 µL/min has been significantly improved.

Supports Ultra-High-Separation/High-Speed Analysis

LC-20ADXR

The LC-20ADXR permits high-speed separation and ultra-high-separation analysis thanks to great pressure-resistance properties.

Superior Maintainability

LC-20AT

The LC-20AT possesses a high level of maintainability while delivering high performance. The ability to remove bubbles has been improved by modifying the pump-head structure and the flow line.

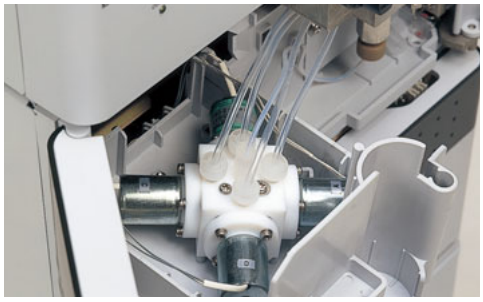
Binary Solvent Delivery Unit

LC-20AB

The LC-20AB is a binary, high-pressure gradient solvent delivery unit that incorporates two sets of LC-20AD systems. Its space-saving design can be used to create a two-solvent high-pressure gradient.

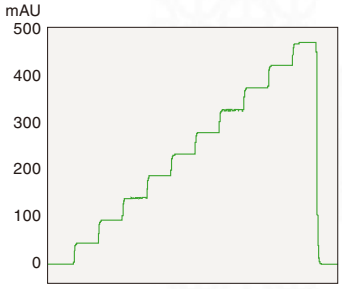
Low-Pressure Gradient Unit

The optional low-pressure gradient unit can be incorporated in the LC-20AD/20AT, enabling gradient elution in a compact space with a small void volume. Automatic matching adjustment of the solenoid valve and pump gives concentration accuracies of ±0.5% (LC-20AD) and ±1.0% (LC-20AT).



Accurate Gradient Solvent Delivery

By harmonizing two solvent delivery systems, the LC-20AB delivers solvent with an accurate concentration across a wide range from the micro-flow-rate region to the conventional flow-rate region.



Set value(%)	Measured value(%)	Error
10	9.98	-0.157%
20	20.05	0.262%
30	30.09	0.287%
40	40.03	0.069%
50	50.03	0.066%
60	60.02	0.032%
70	70.01	0.011%
80	80.00	0.001%
90	90.05	0.054%

Continued Improvements to Solvent Delivery Specifications

The flow-rate accuracy and precision in the micro-flow-rate region have been improved thanks to the adoption of a new type of check valve and modifications to the solvent-delivery control method. Nonpolar organic solvents, such as hexane, can be delivered stably.

Flow-Rate Accuracy

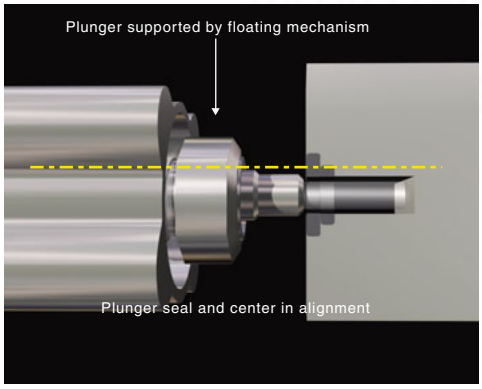
Set value (mL/min)	Measured value, n=6 (mL/min)	Error (%)
0.010	0.010	-1.20%
0.050	0.050	-0.06%
0.200	0.201	0.43%
1.000	1.000	-0.10%

Flow-Rate Precision

Set value (mL/min)	Flow-rate reproducibility, n=6 (RSD%)
0.010	0.49
0.050	0.08
0.200	0.08
1.000	0.01

Improved Durability

A new type of plunger made with a technique that reflects consideration of the material structure and a precise plunger-holding mechanism help to increase the service life of plunger seals and enable stable solvent delivery over long periods.



- LC-20AD Solvent delivery method: Parallel-type double plunger, Plunger capacity: 10 µL, Maximum discharge pressure: 40 MPa, Flow-rate setting range: 0.0001 to 10.0000 mL/min
- LC-20ADXR Solvent delivery method: Parallel-type double plunger, Plunger capacity: 10 µL, Maximum discharge pressure: 66 MPa, Flow-rate setting range: 0.0001 to 5.0000 mL/min
- LC-20AT Solvent delivery method: Series-type double plunger, Plunger capacity: 47µL on primary side, 23 µL on secondary side, Maximum discharge pressure: 40 MPa, Flow-rate setting range: 0.001 to 10.000 mL/min
- LC-20AB Solvent delivery method: Parallel-type double plunger (2 sets), Plunger capacity: 10 µL, Maximum discharge pressure: 40 MPa, Flow-rate setting range: 0.0001 to 10.0000 mL/min

Gradient
- LC-20AB Gradient type: High-pressure mixing, Number of mixed solvents: 2, LC-20AB high-pressure GE system
- LC-20AD/20ADXR/20AT Gradient type: High-pressure mixing, Number of mixed solvents: 2 or 3, LC-20AD/20AT high-pressure GE system
- LC-20AD/20AT Gradient type: Low-pressure mixing, Number of mixed solvents: 4 max, LC-20AD/20AT low-pressure GE system

DGU-20A3/20A5 Degasser

The DGU-20A3/20A5 is an on-line degasser that uses fluoroethylene membrane. The internal capacity is small at 0.4 mL, only 1/25th of that for existing Shimadzu models, and the waiting time at mobile-phase replacement or stabilization can be significantly reduced. The degassing efficiency has also been improved, ensuring thorough degassing even at high flow rates.

- Number of degassed solvents for DGU-20A3: 3
- Number of degassed solvents for DGU-20A5: 5

SIL-20A

The SIL-20A(C)/20A(C)HT/20A(C)XR offers greater analysis efficiency, achieved through improvements in sample injection speed and processing capacity. Also, comprehensive sample carryover countermeasures make it possible to perform analysis without carryover, even in high-sensitivity LC-MSMS.

Supporting High-Throughput Analysis

SIL-20A/20AHT/20AXR

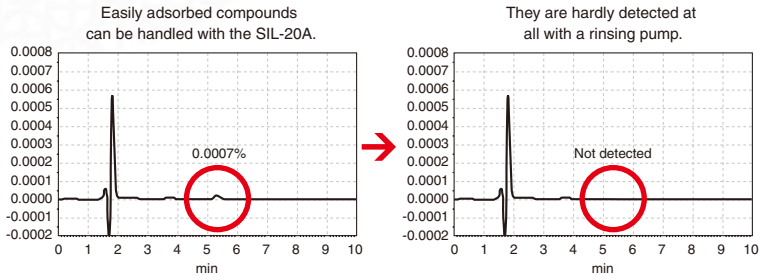
The SIL-20A is a total-volume injection-type Autosampler that enables high-speed injection and multi-sample processing. It was designed to ensure greater stability, with improved durability attained through modifications in valves and sample loops.

Equipped with Cooling Function

SIL-20AC/20ACHT/20ACXR

The SIL-20AC is equipped with a sample cooler that incorporates a dehumidifying function. Samples can be maintained at a fixed temperature in the range of 4°C to 40°C. The high cooling speed makes it possible to keep easily decomposed sample constituents in a stable condition.

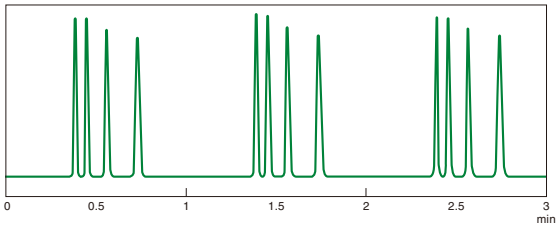
Sample Carryover Reduced to an Absolute Minimum



Sample Carryover Test for Chlorhexidine

Adsorption of sample constituents has been reduced to an absolute minimum by using a special processing technology for the sampling needle (patent pending) and rethinking the structure of the needle seal and the materials used in flow-line parts. As a result, there is hardly any sample carryover. Also, the adoption of a PEEK rotor seal allows use over a wide pH range, from strongly acidic conditions to strongly basic conditions. Using the optional rinse kit (228-43042-91) makes it possible to rinse the sampling needle with two different solvents, selected in accordance with the purpose.

High Throughput



Only 10 seconds* are required for sample injection. High-speed vertical motion of the needle enables ultra-high-speed sample processing, which was considered impossible with conventional auto-samplers. Using in combination with a high-speed separation column makes an analysis cycle of less than one minute a reality.

*10 µL injection

Precise Sample Injection

Injection-Volume Accuracy

Set value (µL)	Measured value (µL)	Error (%)
1	0.99	-0.90
2	1.99	-0.70
5	5.01	0.20
10	10.00	0.00
20	19.92	-0.40
50	49.90	-0.20
100	99.70	-0.30

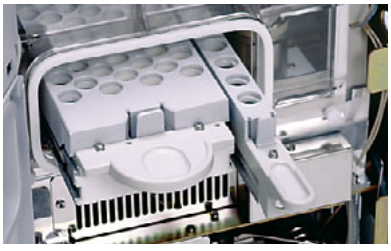
Injection-Volume Precision

Injection volume (µL)	Area reproducibility (%RSD)
1	0.43
2	0.25
5	0.06
10	0.04
20	0.03
50	0.10
100	0.11

Greater accuracy has been attained by incorporating a high-performance sampling device that can measure out the samples with high precision. The design reflects an emphasis on basic performance as well as functionality. Also, using direct injection means valuable samples are not wasted.

- SIL-20A Injection method: Total-volume sample injection, variable injection volume
- SIL-20AHT Injection-volume setting range: 0.1 to 100 µL (standard), 0.1 to 2,000 µL (option)
- SIL-20AXR Number of processed samples: 175 (1 mL vials), 105 (1.5 mL vials), 50 (4 mL vials), two 96-well MTPs, two 384-well MTPs, and ten 1.5 mL vials in addition to these.
- SIL-20AC Injection method: Total-volume sample injection, variable injection volume
- SIL-20ACHT Injection-volume setting range: 0.1 to 100 µL (standard), 0.1 to 2,000 µL (option)
- SIL-20ACXR Number of processed samples: 175 (1 mL vials), 70 (1.5 mL vials), 105 (1.5 mL vials), 50 (4 mL vials), two 96-well MTPs, two 384-well MTPs, and ten 1.5 mL vials in addition to these.

*A sample rack for 1.5mL vials and a control vial rack are included in the SIL-20A/20AC as standard accessories.



Rack Changer: Increasing the Number of Processed Samples

A rack changer is an optional product that can be used to change the microplates in the autosampler's racks and thereby facilitate serial analysis. Up to 12 plates can be mounted in the rack changer. This model incorporates a cooling function. When the samples have been prepared, simply set them in the rack changer to perform continuous sample processing.

- Rack changer C (228-45030-XX) Compatible plates: 96-well MTPs, 96-well DWPs
  384-well MTPs, 384-well DWPs
  1.5mL vial plate (54 vials)
  Number of processed plates: 12
  Sample cooler: Block cooling/heating,
  used together with dehumidifying function, 4°C to 40°C

CTO-20A

The CTO-20A/20AC precisely regulates the temperature around the column and supports stable analysis that is not influenced by the ambient temperature.
In addition to the column, various other parts and units can be accommodated, including a manual injector, gradient mixer, high-pressure flow-line selection valves (2-position/6-port valves or 6-position/7-port valves, two in total), a conductivity-detection cell block, and a reaction coil.

Accommodating Multiple Columns

CTO-20A

The CTO-20A is a forced-air circulation-type column oven. It can regulate the temperature in a range going from 10°C above room temperature to 85°C. It also allows the setting of complex temperature programs by incorporating, for example, linear or step-wise increases and decreases in temperature.

Cooling Also Supported

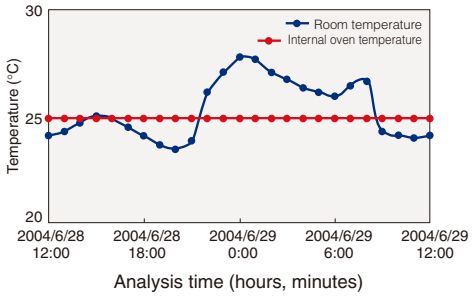
CTO-20AC

The CTO-20AC model is equipped with a cooling function. Using an electronic cooler, it can regulate the temperature in a large range from 10°C below room temperature to 85°C.

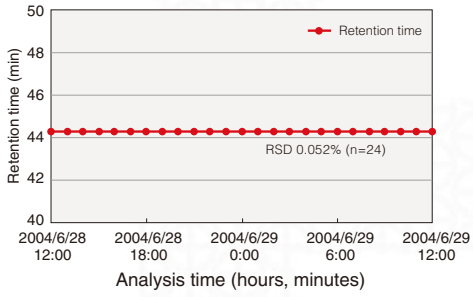
Precise Temperature Regulation

The interior of the oven is precisely regulated with a high-performance thermistor. Also, the temperature is calibrated at two different temperatures to ensure a high level of accuracy.

Changes in Room Temperature and Internal Oven Temperature in One Day

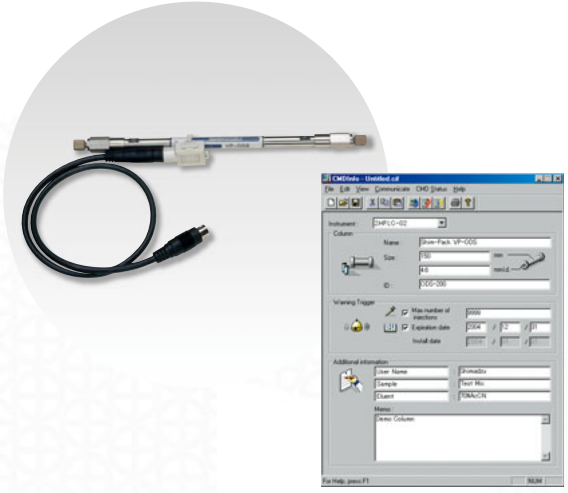


Changes in Room Temperature and Stability of Retention Time for Vitamin A Acetate in One Day



Installation of CMD (Option)

This product supports installation of the CMD (Column Management Device), which can be used to record information about the way the column is used, such as the number of injections, the amount of mobile phase that flows, and the composition of the last mobile phase used. This information can be managed at an LC workstation (LCsolution) or a PC in the network using the Web-control function.



Incorporation of Flow-Line Selection Valve

The FCV-12AH/14AH high-pressure flow-line selection valve can be incorporated and controlled. Position display is also possible.

- CTO-20A Temperature-control method: Forced air-circulation Cooling method: None Temperature setting range: 4°C to 85°C
  Temperature-control precision: 0.1°C max. (typically 0.04°C max.) Temperature-control range: 10°C above room temperature to 85°C
- CTO-20AC Temperature-control method: Forced air-circulation Cooling method: Electronic cooling Temperature setting range: 4°C to 85°C
  Temperature-control precision: 0.1°C max. (typically 0.04°C max.) Temperature-control range: 10°C below room temperature to 85°C

FCV-20AH2/20AH6 Flow-Line Selection Valves

The FCV-20AH2/20AH6 is a stand-alone, high-pressure, flow-line selection valve. The valve position is controlled by event signal input. Direct control is also possible from the unit itself.

- FCV-20AH2 Valve type: 2-position/6-port rotary valve Maximum operating pressure: 39.2 MPa (400 kg /cm^2)
  Operating pH range: pH1 to pH10 Operating temperature range: 4°C to 35°C
- FCV-20AH6 Valve type: 6-position/7-port rotary valve Maximum operating pressure: 39.2 MPa (400 kg /cm^2)
  Operating pH range: pH1 to pH10 Operating temperature range: 4°C to 35°C

SPD-20A / M20A

The SPD-20A/20AV/M20A is an absorbance detector that offers a high level of sensitivity and stability. The lineup consists of the SPD-20A/20AV dual-wavelength absorbance detector and the SPD-M20A photodiode array detector. They are equipped with temperature-controlled flow cells to increase the peak-response and baseline stability.

Highest Level of Sensitivity in the World

UV-VIS Detector

SPD-20A / 20AV

The SPD-20A/20AV is UV-VIS detector takes sensitivity to the limit. It has a noise level of 0.5 x 10^{-5} AU max., making it one of the most sensitive models of its kind in the world. The SPD-20AV has a mode that allows the deuterium lamp and tungsten lamp to be lit simultaneously, enabling high-sensitivity wavelength-programming detection for ultraviolet light and the entire visible-light range.

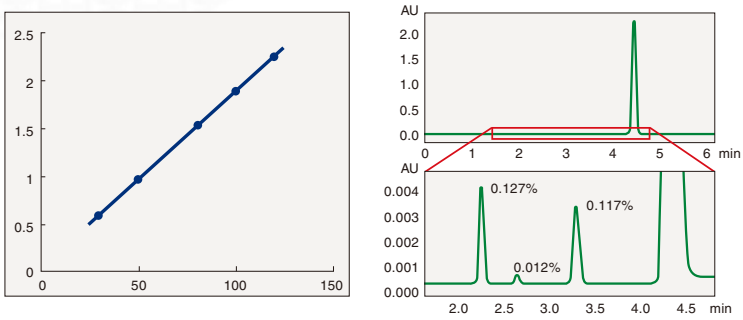
Sensitivity Levels Approaching Those of UV-VIS Detectors

PDA Detector

SPD-M20A

The SPD-M20A also has a high-sensitivity mode. Using light-source compensation, it offers a sensitivity level that, at 0.6 x 10^{-5} AU, is comparable to that of UV-VIS detectors.

Superior Linearity



Concentration Linearity for Drug Substance A and Purity Test

Using newly developed signal processing technology, the stray-light correction function has been enhanced, and the linearity has been improved to a point where it satisfies the following ASTM standards:

- SPD-20A/20AV : 2.5AU
- SPD-M20A : 2.0AU

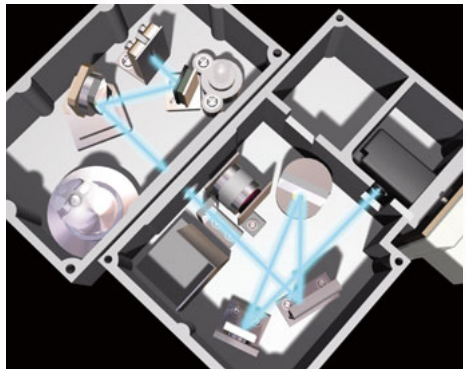
This product ensures greater analysis precision in, for example, purity tests.

Browser Control Supported

The SPD-M20A is equipped with an Ethernet interface and Web-server functions, allowing devices to be monitored and controlled from PCs in the network. Also, as a stand-alone, high-sensitivity, multi-wavelength detector, it can be incorporated into other companies' HPLC systems.

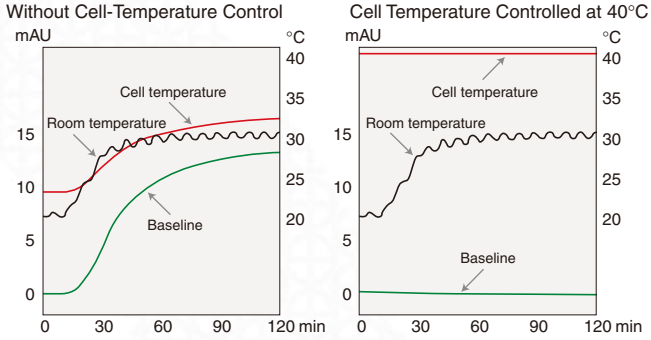
Consideration Given to Validation

The incorporation of a low-pressure mercury lamp for wavelength calibration ensures simple calibration in the ultraviolet region.



Greater Stability Achieved with a Temperature-Controlled Flow Cell

The SPD-20A/20AV and SPD-M20A are equipped with a temperature-controlled flow cell as a standard feature. This helps increase baseline stability and analysis reliability.



Effect of Temperature-Controlled Flow Cell: Behavior of Baseline When Room Temperature is Changed from 20°C to 30°C

- SPD-20A Light source: Deuterium (D2) lamp Wavelength range: 190 to 700 nm Bandwidth: 8 nm Wavelength accuracy: 1 nm max.
- SPD-20AV Light source: Deuterium (D2) lamp, tungsten (W) lamp Wavelength range: 190 to 900 nm Bandwidth: 8 nm Wavelength accuracy: 1 nm max.
- SPD-M20A Light source: Deuterium (D2) lamp, tungsten (W) lamp Number of diode elements: 512 Wavelength range: 190 to 800 nm Slit width: 1.2 nm (high-resolution mode), 8 nm (high-sensitivity mode) Wavelength accuracy: 1 nm max.

- Optional cells for SPD-20A/20AV: Semi-micro temperature-controlled flow cell (228-45605-93), micro-cell (228-25293-92), inert cell (228-33338-91), and other types of preparative cells.
- Optional cells for SPD-M20A: Semi-micro temperature-controlled flow cell (228-45605-94), micro-cell (228-25293-93), inert cell (228-34187-91), and other types of preparative cells.

RF-20A / 20Axs

The excellent basic performance of the Prominence series is further enhanced by the RF-20A/20Axs fluorescence detectors, which offer world-leading sensitivity, excellent ease of maintenance, and validation support functions. They support a wide range of applications from conventional analysis to ultra-fast analysis.

RF-20Axs

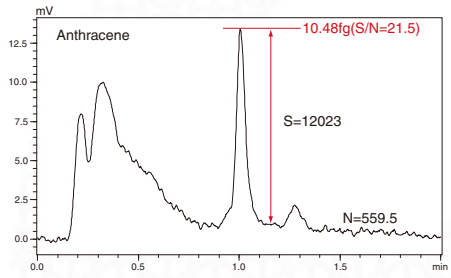
Offering world-class levels of sensitivity and easy maintenance, the RF-20Axs features a water Raman S/N ratio of at least 2000 and a temperature-controlled cell with a cooling function. This maintains a constant detector cell temperature, even if the room temperature fluctuates significantly, to ensure superb reproducibility with no drop in sensitivity. In addition, the RF-20Axs incorporates an automatic wavelength accuracy check function using an internal low-pressure mercury lamp to provide simple confirmation of the wavelength accuracy for validation.

RF-20A

The RF-20A, which offers best-in-class sensitivity, features a water Raman S/N ratio of at least 1200, as well as excellent ease-of-use with such features as maintenance from the front panel and adoption of a long-life lamp.

Achieves World-Leading Sensitivity

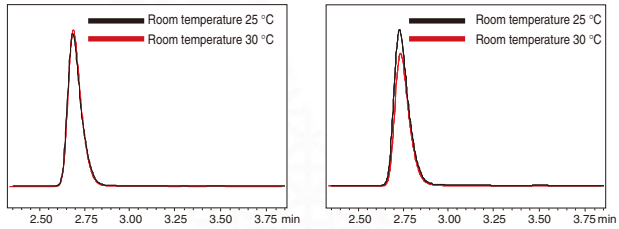
An S/N ratio of 21.5 was achieved for an injection of 10.48 fg anthracene (RF-20Axs).
This is equivalent to approx. 1.5 fg limit of detection (S/N ratio = 3), which is excellent.



High-Sensitivity Analysis of Anthracene

Cell Temperature Control Further Enhances Reproducibility (RF-20Axs)

The fluorescence intensity drops as the temperature rises. A fluctuation of about 1°C near room temperature may result in approximately 5% intensity fluctuations for some compounds. To prevent this, the RF-20Axs features a temperature-controlled cell with a cooling function. It maintains a constant detector cell temperature, even if the room temperature fluctuates significantly, to ensure superb reproducibility with no drop in sensitivity.



With cell temperature control — No cell temperature control

Effect of Temperature-Controlled Cell (Acridine)

	Rate of Change (%)	%RSD
RF-20Axs (With cell temperature control)	0.64	0.29
RF-20A (No cell temperature control)	-17.45	6.30

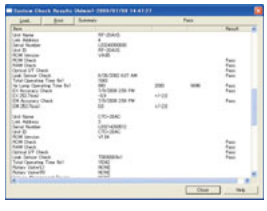
Rate of Change
Consecutive analyses are performed at 25°C and 30°C room temperature. The rate of change shows the change in the peak area, taking the average peak area value at 25°C as 1. It is used to confirm the effect of long-term fluctuations in room temperature due to the passage of the seasons.
%RSD
Consecutive analysis is performed while changing the room temperature from 25°C to 30°C, and the %RSD value is determined from the analysis data (n=6). It is used to confirm the effect of room-temperature fluctuations during the analysis.

Easy Maintenance

The Xenon lamp and flow cell can be replaced at the front panel. No positional adjustment is required when replacing the Xenon lamp, and no tools are required to replace the flow cell. The standard flow cell or semimicro flow cell can be rapidly switched. In addition, the Xenon lamp life has been extended to 2000 hours, four times longer than previous Shimadzu lamps.

Powerful Validation Functions

RF-20Axs incorporates an automatic wavelength accuracy check function using an internal low-pressure mercury lamp. It provides simple confirmation of the wavelength accuracy for validation. In addition, simple operations from the workstation permit all tasks from conducting the system check to printing the report.



Simple Wavelength Calibration (RF-20Axs)

If a wavelength displacement is discovered in the RF-20Axs during the system check, it can be easily corrected using the calibration menu. It is not necessary to provide a separate low-pressure mercury lamp each time the check is conducted.

- Option Cells: Temperature-Controlled Flow Cell for Semimicro LC (228-51950-91), Flow Cell for Inert LC (228-51951-91)
- Photomultiplier R928-08 (200-75021): Replacing the photomultiplier with this option extends the measurement wavelength range to 200 nm - 750 nm.
- Photomultiplier R3788 (200-75031): Replacing the photomultiplier with this option extends the measurement wavelength range to 200 nm - 900 nm. For RF-20A (supplied as standard with RF-20Axs)

LCMS-2020

A Mass Spectrometer is the ultimate detector for a chromatograph.
Using the LCMS-2020 as a detector for HPLC significantly enhances the application range.
The LCMS-2020 is compatible with ultra-fast LC (UFLC) analysis as well as conventional HPLC.

UFscanning 15,000 u/sec fast scanning speed

Controls the voltage applied to the Quadrupole according to the scan speed and m/z.
Adopting this new technology (patent pending) maintains resolution and achieves high ion transmittance even at high scanning speeds.

UFswitching Rapid 15-millisecond positive/negative ionization switching

To detect both positive and negative ions, analysis is performed while switching between the positive and negative ionization modes.
The LCMS-2020 adopts a high-voltage power supply featuring novel technology (patent pending) to achieve an ultra-fast polarity switching time of just 15 ms.

UFsensitivity Superior sensitivity for UFLC

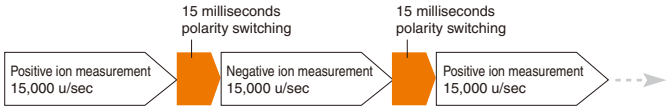
The newly developed Qarray® ion optical system achieves superior sensitivity, reproducibility, and linearity.

UFscanning & UFswitching

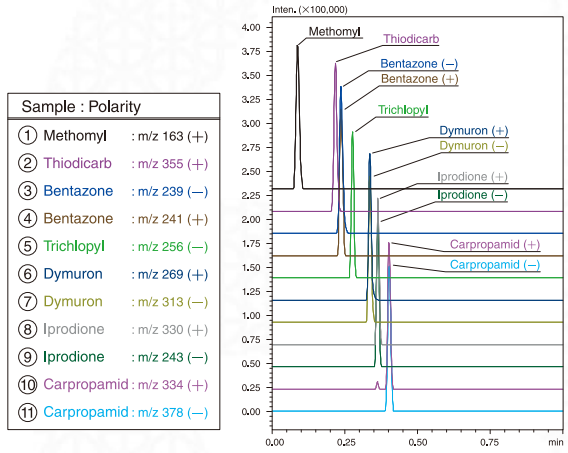
UFLC/MS Measurement

UFscanning and UFswitching are critical for ultra-fast analysis.

For example, in ultra-fast analysis where 6 compounds may elute within 1 minute, ultra-fast (MS measurement) detection is also required. The UFswitching and UFscanning functions make such ultra-fast MS measurement Possible.



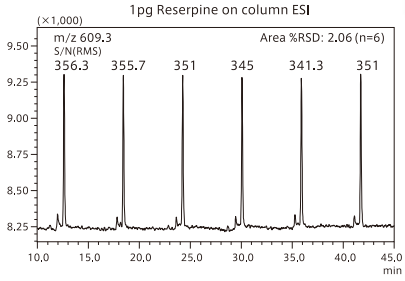
Sample : Polarity	
① Methomyl	: m/z 163 (+)
② Thiodicarb	: m/z 355 (+)
③ Bentazone	: m/z 239 (−)
④ Bentazone	: m/z 241 (+)
⑤ Trichlopyl	: m/z 256 (−)
⑥ Dymuron	: m/z 269 (+)
⑦ Dymuron	: m/z 313 (−)
⑧ Iprodione	: m/z 330 (+)
⑨ Iprodione	: m/z 243 (−)
⑩ Carpropamid	: m/z 334 (+)
⑪ Carpropamid	: m/z 378 (−)

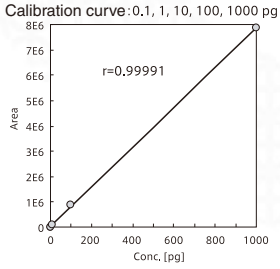


UFsensitivity

Ultra-fast analysis with excellent sensitivity

A newly developed ion optical system and new Qarray® optics provide excellent sensitivity, repeatability and linearity, even in ultra-fast analysis.



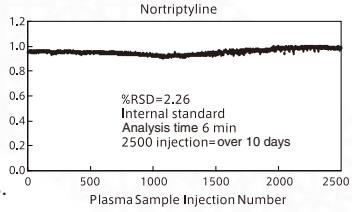


pg	Area
0.1	802.5
1	7743.5
10	84799.7
100	891423.7
1000	7864342.1

Hardware features that powerfully support 3 types of UF functionality

Toughness against dirty samples

In order to check the toughness of the LCMS-2020 against dirty samples, plasma samples simply precipitated with only acetonitrile were injected 2,500 times over 10 days (1µL volume per injection). Excellent reproducibility of peak area was demonstrated and its RSD was 2.26%.



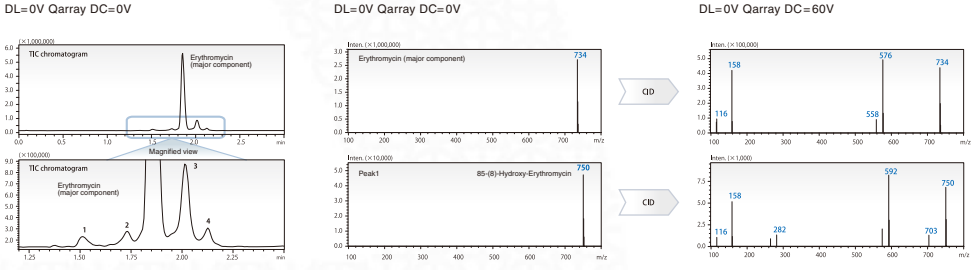
Easy Maintenance

The DL capillary (desolvation line), which transfers the sample into the vacuum chamber from the ion source, can be installed and removed without breaking the vacuum, greatly speeding maintenance operations.

Creating Fragment Ions by In-source CID

In-source CID is effective for confirming the molecular weight of synthetic compounds and for the quantification of impurities.

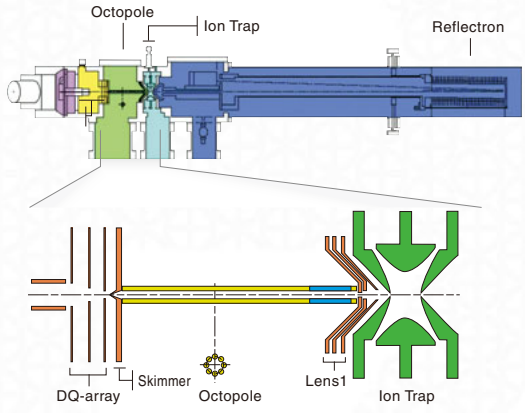
Using in-source CID (collision-induced dissociation) allows the generation of fragment ions. This example shows the composition of impurities in erythromycin estimated from fragment ions generated by in-source CID.
The multi-sequence mode permits several other methods, such as CID, positive/negative ion switching modes, and SCAN/SIM modes, with in a single analysis. Precisely setting the parameters reduces the risk of erroneous evaluations and enhances the reliability of analysis results.



LCMS-IT-TOF®

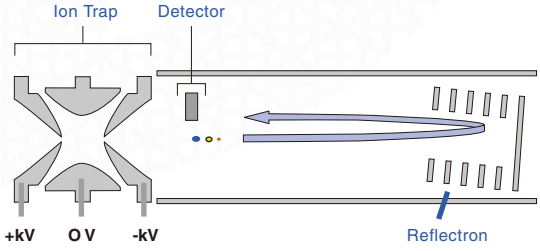
The LCMS-IT-TOF is a new type of hybrid mass spectrometer that combines IT (ion trap) and TOF (time-of-flight) technologies.
Shimadzu's unique IT-TOF configuration solves conventional problems of measurement speed and trap saturation associated with IT to automatically provide abundant information along the HPLC time axis, that is, within a restricted peak elution time.

Unique Ion Introduction Method



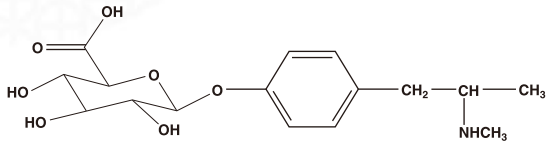
MALDI is a pulsed ionization method that is an extremely good match to TOF, which separates m/z by time of flight. However, linking an API (atmospheric-pressure ionization) method such as ESI or APCI to TOF requires the ions continuously generated by API to be converted to pulses.
The LCMS-IT-TOF uses the combination of a skimmer, octopole, and lens 1 to create ion pulses that are introduced into the ion trap. The advantage of this method, known as Compressed Ion Injection (CII) (US Patent US6700116, and others), is that the ions are compressed and introduced into the trap in one hit. This significantly improves the ion-trapping efficiency, which is a weak point of the QIT (Quadrupole Ion Trap), thereby enhancing sensitivity.

Handling Sharper Peaks

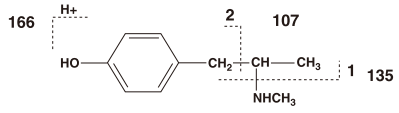


With the trend toward higher HPLC throughput, chromatographic peaks are becoming sharper and sharper. To accommodate this trend and achieve good quality data measurements, it is essential to increase the measurement speed of the MS detector.
In the LCMS-IT-TOF, faster spectrum measurement has been achieved by instantaneously extracting the ions from the ion trap and introducing them into the TOF using Ballistic Ion Extraction (BIE) (US Patent US6380666, and others).

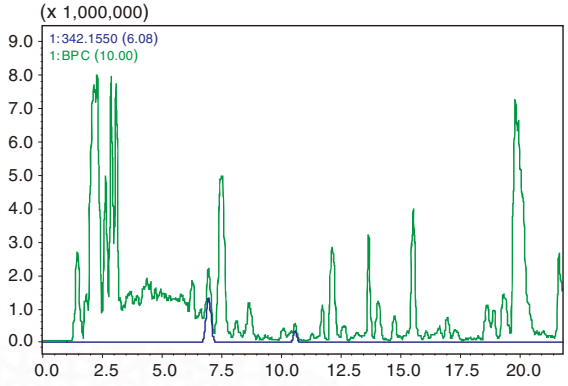
Diverse Automatic Analysis Modes



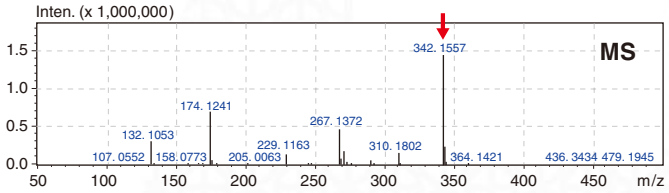
p-Hydroxy methamphetamine glucuronide: $C_{16}H_{23}NO_7$
Exact Mass: 341.1475



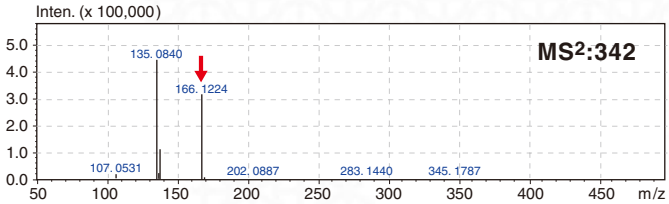
p-Hydroxy methamphetamine: $C_{10}H_{16}NO^+$
Exact Mass: 166.1232



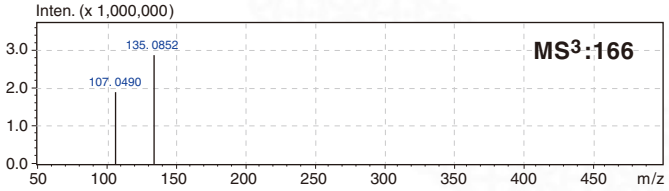
Analysis of p-hydroxy methamphetamine glucuronide



Found:342.156 Expected:342.155



Found:166.122 Expected:166.123

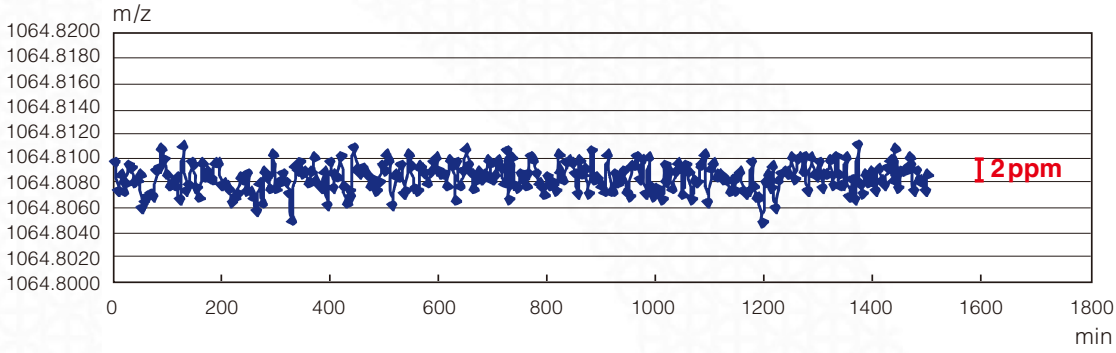


Found:135.085 Expected:135.081
Found:107.049 Expected:107.050

Samples supplied by Dr. Tsuchihashi, Forensic Science Laboratory, Osaka Prefectural Police

After a sample is injected for LC/MS analysis, it cannot be recovered. It is extremely important that the instrument itself can select the precursor ions suitable for MS^2 analysis. In addition to automatic precursor ion selection in order of intensity and mass, the LCMS-IT-TOF also offers monoisotopic mass selection and parent ion filtering by valence number. Automatic MS^3 can be conducted after automatic neutral-loss evaluation in the MS^2 spectrum. This provides powerful support for many types of structural analysis, such as the identification of Phase II metabolites in pharmacokinetic studies.

High Mass Accuracy and Stability Using External Standard Method



Highly accurate temperature control of the flight tube, Ballistic Ion Extraction (BIE) to restrict spatial spreading of the ion source position, and the 10-bit effective high-speed transient recorder permit extremely stable mass accuracy using an external standard method. Due to the difficulty of LC/MS analysis using an internal standard method, it is extremely important to achieve stable mass accuracy over a wide mass range using an external standard. The LCMS-IT-TOF offers automatic TOF mass calibration that can be completed for both polarities in approximately 20 minutes. After TOF mass calibration has been conducted, stability is maintained for an extended period of time.

SEC-AccuSpot-AXIMA System

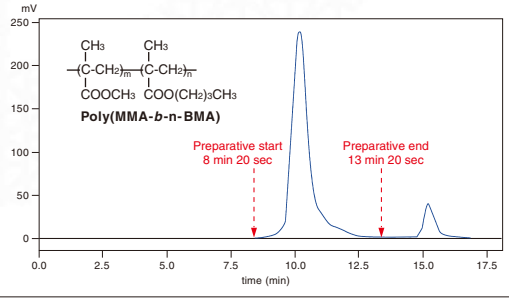
By permitting both molecular weight distribution calculations by SEC (Size Exclusion Chromatography) and the detection and identification of monomer units and additives by MS, the SEC-AccuSpot-AXIMA system opens up new possibilities for the characterization of synthetic polymers. The AccuSpot Plate Spotter significantly enhances throughput by automatically spotting the eluent from the SEC onto MALDI plates and conducting automatic online mixing of samples that require further ionization.

AccuSpot for GPC Analysis

The AccuSpot incorporates a kit that supports organic solvents such as THF and chloroform commonly used with GPC. The instrument incorporates exhaust functions to ensure both analytical performance and safety. The AccuSpot has been scaled down for micro-LC and the spot size is expected to enhance sensitivity for MALDI-TOF applications.

Micro-LC Separation and Efficient Spotting

It incorporates extensive functions for polymer analysis, from predictions of monomer unit and terminal structure to molecular weight distribution measurements. It also provides a powerful tool for the individual analysis of trace components, such as by-products and additives. The chromatogram of methyl methacrylate/n-butyl methacrylate copolymer (Poly (MMA-b-n-BMA)) is shown below as an example of the analysis of a copolymer with complex components. A micro-scale GPC column permits spotting onto a MALDI plate with no sample wastage.

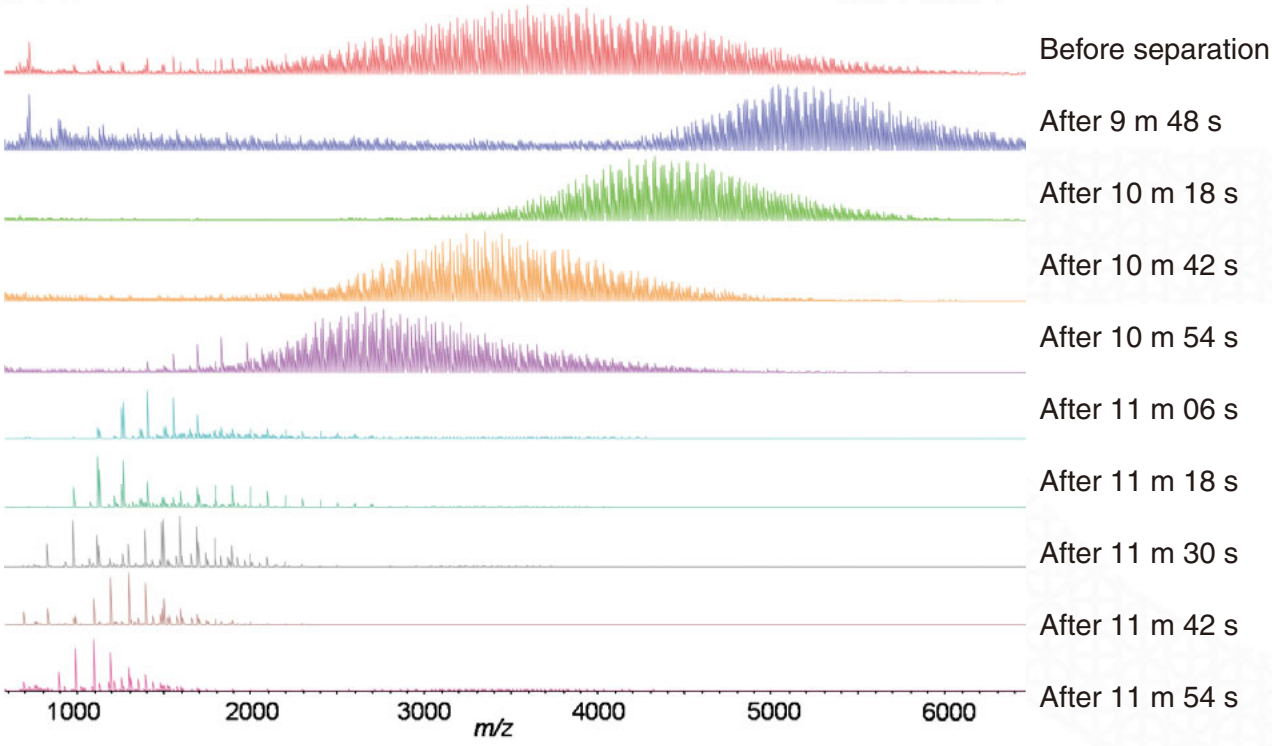


[Analytical conditions]

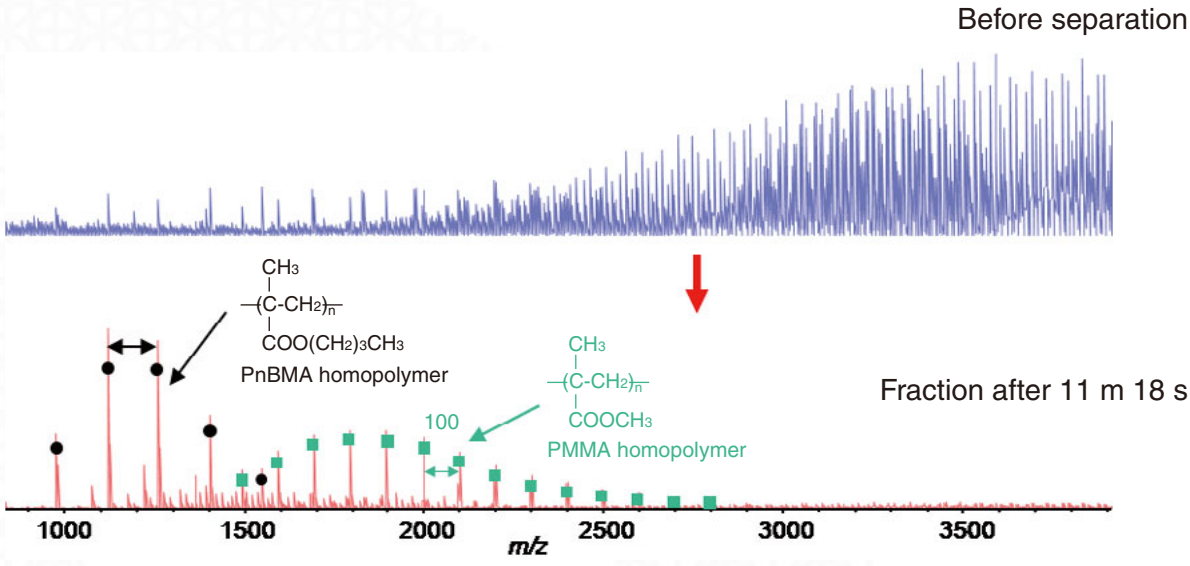
• **SEC**	Column : Shodex GF310A-1E (1.0 mmID x 250 mm) Flow rate : 10 µL/min, Eluent : THF Detector : UV (=220 nm), Injection volume : 1µL
• **AccuSpot**	Spot interval : 6 sec, Loadage : 1µL/well Loadage (mixture of matrix and cationizing reagent) : 0.2µL/well
• **MALDI-TOFMS**	Matrix : Dithranol-20 mg/mL- THF Cationizing reagent : Na-TFA-10 mg/mL-THF

THF : Tetrahydrofuran, TFA : Trifluoroacetic acid

Diverse Analytical Functions



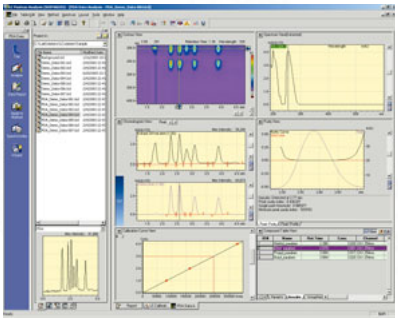
The AccuSpot conducted spotting at 6 sec intervals between the start and end of peak elution (five minutes from 8 m 20 s to 13 m 20 s) and the 50 spots obtained were each analyzed by MALDI-TOF-MS. Analysis of the mass spectrum for each spot with respect to the elution time confirmed the elution of components, each with a different molecular weight distribution with respect to the elution time.



Observing the spectrum from around 11 minutes 18 seconds confirmed two different molecular weight distributions that were not apparent before separation. On the spectrum above, the m/z 142 intervals between the peaks marked • indicate the existence of PnBMA homopolymer. In addition, the m/z 100 peak intervals between the peaks marked ▪ indicate the existence of PMMA homopolymer.
For a complex polymer compound such as a copolymer, the existence of trace by-products often affects the properties of the polymer. Therefore, the diverse analytical functions offered by the SEC-AccuSpot-AXIMA system provide a powerful tool for polymer analysis, as shown in this example.

LCsolution

[LC Workstation]



Advanced LC Workstation

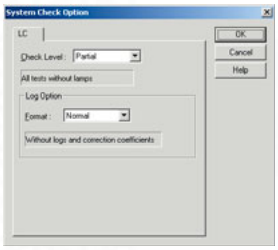
LCsolution

The LCsolution software package provides total support for analysis work, including hardware control of the Prominence series, the LC-VP series and the LC-8A/6AD pumps. Data acquisition, report generation, and data management are standard features.
The control software helps reduce the workload involved in analysis by automating all procedures from instrument conditioning to shutdown. These workstations also offer the functions required for ensuring the reliability of analysis data with respect to issues such as security and audit trails, which are demanded in analysis performed under regulations such as GLP/GMP or FDA 21 CFR Part 11.

Increasing the Efficiency of Analysis Work

Analysis workflow consists of a series of procedures starting from instrument conditioning and judgment of instrument stability to evaluation of sample results and shutdown after analysis. The automation functions offered by the combination of Prominence systems with LCsolution cover all of these procedures, thereby reducing the workload required to perform analyses. They also make it possible for anyone, even inexperienced operators, to perform analysis under stable conditions.

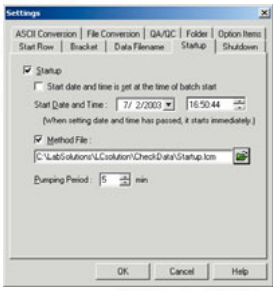
Instrument Condition Check



System Check

Ensures the hardware system is working properly prior to injecting the sample.

Starting Instruments



Startup

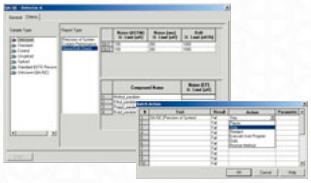
Instrument operation is started at a specified time.

Shutdown

Cooldown

After analysis is completed, appropriate cooldown is performed to protect the column.

Intelligent Instrument Control



Action

Generation of calibration curves, system suitability tests, and judgments of the sample's analysis results are automatically performed. The instrument is controlled intelligently with the action functions.

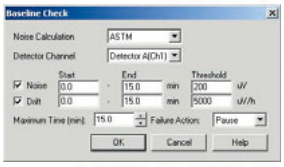
automation

Purge of Mobile Phase

Autopurge

The mobile phase and the autosampler's rinse solvent are purged automatically.

Instrument Stability Check



Baseline Check

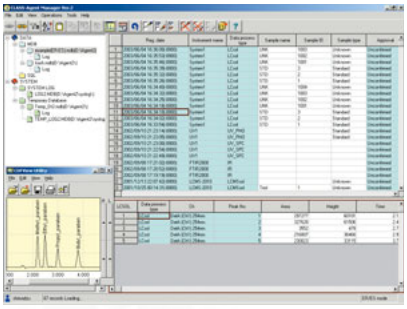
Judgments about column equilibrium and the stability of the instrument are made from noise and drift measurements after the start of solvent delivery.

LCsolution Licensing Information

LCsolution Single	Data acquisition and instrument control of a single Prominence/LC-VP system via CBM-20A, CBM-20Alite, SCL-10AVP or SIL-HT, or a single LC-2010/HT system.
LCsolution Multi	Data acquisition and instrument control of up to four Prominence/LC-VP systems via CBM-20A, CBM-20Alite, SCL-10AVP or SIL-HT, or up to four LC-2010/HT systems.
LCsolution Multi-PDA	Data acquisition and instrument control of up to four Prominence/LC-VP systems via CBM-20A, CBM-20Alite, SCL-10AVP or SIL-HT, or up to four LC-2010/HT systems. Capable of controling of up to two SPD-M20A detectors.

Optional Software

LCsolution Postrun Kit	Using the LCsolution Postrun Kit makes it possible to re-analyze the data accumulated by LCsolution at another PC.



Increasing the Efficiency of Data Management

CLASS-Agent

Database management provides an effective way of managing important analysis data safely over long periods of time and accessing it quickly when needed. CLASS-Agent makes this possible by allowing analysis data and information about the conditions at the time of analysis to be managed securely in a database. The CLASS-Agent Network System can be connected to various types of analytical instruments, including LCsolution, and helps achieve total data management for laboratories that effectively utilize network resources.

Chromatopac: Chromatography Data Processors

The Chromatopac, which was developed specifically as a device for processing chromatography data, is an integrator that also offers the basic functions of a data processor in an easy-to-use format.

C-R7A plus (223-04220-XX)

- Compact, high-speed parallel printer
- Chromatopac BASIC well-suited to system automation
- Highly reliable optical link control
- Supports GLP, GMP, and ISO-9000
- Sliding display screen saves space

C-R8A (223-04500-XX)

- Inherits data processing capability with established reputation and simple operability
- Equipped with automatic validation functions
- Handles high-speed RS-232C as a standard feature
- Simple operation optimized for factory use

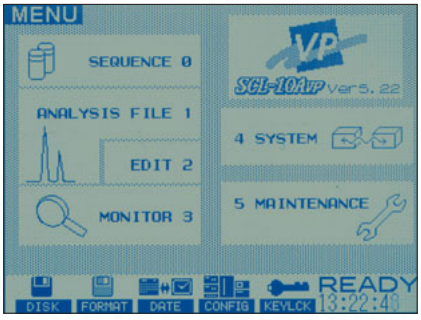
SCL-10AVP

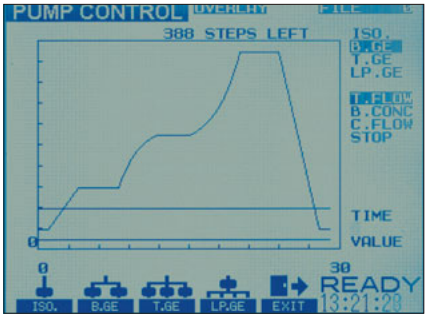
[System Controller]

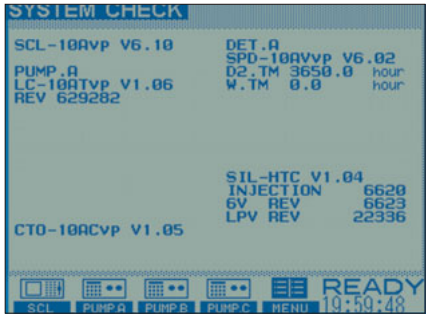
Supports a Wide Variety of System Configurations

The SCL-10AVP performs centralized control of all Prominence* and LC-VP series modules, and the LC-8A/6AD solvent delivery units. It also operates as an interface with LC workstations.

*Prominence modules are operated in VP compatible mode.







Customization Functions for Improving Operability

This controller is equipped with customization functions that allow parameters that are often used in time programs, for example, to be selected and displayed in a single screen. Clearly defined characters and a graphical function-key menu contribute to intuitive operation. With isocratic systems, it is possible to select "simple mode", in which only minimal operation parameters are displayed. For sample preparation such as dilution or reagent addition using autosampler pretreatment, it is possible to select either simple mode (Quick-pret) or a detailed setting mode (Pret-prog, Advanced).

Validation Support

From the maintenance screen, it is possible to load, display, and output operation logs and maintenance information for connected modules.

Specifications (SCL-10AVP)

	SCL-10AVP (228-45051-xx)
Display	Backlit LCD (320 x 240 dots)
Connectable units	Solvent delivery unit: 3 max.; Autosampler: 1; Column oven: 1; Detector: 2 max.; Fraction collector: 1; 2- or 6-position valve: 2 max. (via Option Box VP or Sub-controller VP); Solenoid valve unit: 1(via Sub-controller VP or solvent delivery unit); Helium degasser: 1 (via Sub-controller VP or solvent delivery unit)
Solvent delivery unit control	Solvent delivery control modes: Isocratic, High-pressure gradient, Low-pressure gradient, Constant-pressure delivery Programmable parameters: Flow rate, Pressure, Concentration, Max. pressure, Min. pressure, Linear, Step, Exponential function (all multi-level)
Autosampler control	Sample injection volume, Number of repetitions of injections, Analysis time or analysis file number, Pretreatment file number, Fraction collector file number
Column oven control	Oven temperature, Max. temperature
Detector control	Detection wavelength, Range, Time constant, Lamp switching, Wavelength scanning conditions, etc.
Fraction collector control	15 types of fractionation conditions, Time programs (peak-detection fractionation, high-purity fractionation based on 2-signal processing, etc.)
Input/Output terminals	External start input: 1; Error input: 3 General-purpose output: 4; External power switch control: 1; Optical link for Chromatopac: 1; Optical link for unit control: 8; RS-232C (for PC): 1
Analog boards	2 max. (Option)
Ambient temperature range	4°C to 35°C
Dimensions, weight	260(W) x 140(H) x 420(D)mm, 6kg
Power requirements	AC 110V, 230V, 320VA, 50/60Hz

LC-10Ai / 6AD / 8A

[Solvent Delivery Units]

Solvent Delivery Unit for Bio-inert HPLC System

LC-10Ai

This bio-inert solvent delivery unit incorporates a serial dual plunger and offers low-pulsation performance from an optimized cylinder volume. It can be used together with the SIL-10Ai and SPD-20A (with bio-inert cell) to construct a high-performance bio-inert LC system. The LC-10Ai uses PEEK resin in liquid contact parts and is ideal for the analysis of physiologically active substances and metal ions. Resistance to acids, bases, and high-concentration aqueous NaCl solutions is even higher than with stainless steel.

Solvent Delivery Unit for Analytical to Semi-Preparative Scale

LC-6AD

This multi-purpose pump delivers highly accurate solvent flow in a range from the low flow-rate region (< 1 mL/min) to semi-preparative flow rates (up to 20 mL/min). When used with the 6AD recycle kit, it achieves a very high level of recycling efficiency for semi-preparative columns. Depending on conditions, more than one million theoretical plates can be obtained.

Solvent Delivery Unit for Large-Scale Preparative Work

LC-8A

This solvent delivery unit is specifically designed for preparative separations and can perform solvent delivery at high flow rates (up to 150mL/min). With high flow-rate accuracy in the analytical region (1-2 mL/min), it is easy and convenient to use the same pump to perform large-scale separation with a preparative column (inner diameter: 20 to 50mm) after studying analytical conditions with a standard-size analytical column.

Specifications (LC-10Ai / 6AD / 8A)

	LC-10Ai (228-45089-xx)	LC-6AD (228-45068-xx)	LC-8A (228-45069-xx)
Solvent-delivery method	Serial dual plunger	Parallel dual plunger	Parallel dual plunger
Plunger capacity	Primary side: 47µL; Secondary side: 23µL	47µL	280µL
Maximum discharge pressure	27.4MPa	49.0MPa	29.4MPa
Flow-rate setting range	0.001 to 9.999mL/min	0.01 to 20.00mL/min 0.001 to 9.999mL/min (with switch selection)	0.1 to 150.0mL/min
Flow-rate accuracy	Within ±2% or ±2µL/min., whichever is larger (0.1 to 5.0mL/min.)	Within ±1% or ±10µL/min., whichever is larger (0.01 to 5.0mL/min.)	Within ±2% (0.5 to 150.0mL/min.)
Flow-rate precision	0.3% max.(RSD: 0.1% max.)	0.3% max.(RSD: 0.1% max.)	0.5% max.
Constant-pressure delivery	Possible	Possible	Possible
Plunger rinse mechanism	Syringe or rinsing pump (228-39625-91) used	Syringe or FCV-7AL (228-45077-91) used	Syringe or FCV-130AL (228-45078-91) used
Ambient temperature range	4°C to 35°C	10°C to 40°C	10°C to 35°C
Dimensions, weight	260(W) x 140 (H) x 420 (D)mm, 10kg	260(W) x 160(H) x 500(D)mm, 20kg	350(W) x 210(H) x 450(D)mm, 32kg
Power requirements	AC 110V, 230V, 100VA, 50/60Hz	AC 110V, 230V, 200VA, 50/60Hz	AC 110V, 230V, 750VA, 50/60Hz

* A PC-31L interface (228-31103-91) must be installed in the LC-6AD or the LC-8A to enable connection of the solvent delivery unit to the CBM-20A/Alite or SCL-10AVP system controller.
* System-check software cannot be used with the LC-6AD or the LC-8A.
* Use the 8A preparative mixer (228-20600-91) if the flow rate is greater than or equal to 10mL/min.

SIL-10AF / 10AP / 10Ai / HT

[Autosamplers]

Versatile Autosamplers

SIL-10AF / 10AP

The SIL-10AF and SIL-10AP injectors use the fixed-loop injection method. They can also perform sample pretreatment, including dilution and mixing, at a high speed. The SIL-10AP is a preparative autosampler that can inject up to 5mL while offering the same level of performance and functionality as the SIL-10AF.

Bio-inert Autosampler

SIL-10Ai

This bio-inert autosampler uses PEEK resin in parts that contact liquids. It can be used for the analysis of physiologically active substances and metal ions.

Sample Racks for SIL-10AF / 10AP / 10Ai

- Sample rack S (228-21046-91) for 1.5mL vials
- Sample rack MTP2* (228-40460-91) for 96-well standard/deep-well microtiter plates
- Reagent rack (228-20905) for 15mL reagent vials
- Sample rack L (228-21046-92) for 4.0mL vials
- Sample rack LL* (228-39384-91) for 13mL vials

* Cannot be used with SIL-10Ai.

High-Throughput Autosamplers

SIL-HTA / HTc

The SIL-HT autosampler enables ultra high-speed sample injection and multi-sample processing. It achieves excellent repeatability and near-zero sample carryover, and is ideal for the front-end of an LC-MS system. A Peltier sample cooler and built-in dehumidifier maintain sample temperatures from 4-40°C in the SIL-HTc.

Specifications (SIL-10AF/10Ai/10AP/SIL-HTA/HTc)

	SIL-10AF (228-45056-xx)	SIL-10Ai (228-45075-xx)	SIL-10AP (228-45057-xx)	SIL-HTA (228-45061-xx)	SIL-HTc (228-45062-xx)
Injection method	Loop injection, variable injection volume			Total-volume injection, variable injection volume	
Injection-volume setting range	1µL to 50µL (standard) 1µL to 400µL (option) 1µL to 2,000µL (option) 1µL to 5,000µL (option)	1µL to 50µL (standard) 1µL to 250µL (option)	1µL to 5,000µL (standard) 1µL to 400µL (option) 1µL to 2,000µL (option)	0.1µL to 100µL (standard) 1µL to 2,000µL (option)	
Number of samples processed	100 with 1.5mL vials (60 with optional cooler) 80 with 4mL vials (50 with optional cooler) 25 with 13mL vials (not applicable to SIL-10Ai) 192 with two 96-well microtiter plates			350 with 1mL vials 210 with 1.5mL vials (140 with SIL-HTc) 100 with 4mL vials 384 with four 96-well microtiter plates 1,536 with four 384-well microtiter plates	
Injection-volume accuracy	Not specified			1% max. (for 50µL injection)	
Injection-volume precision	RSD: 0.5% max. (10µL injection, standard mode)		RSD: 1% max. (10µL injection)	RSD: 0.3% max. (10µL injection, under specified conditions)	
Sample carryover	Not specified			0.01% max. (caffeine)	
Number of repeated injections	30 max. per sample			99 max. per sample	
Needle rinsing	Set freely before and after sample injection				
Sample cooler	Optional Sample Cooler S (228-45063-xx) or L (228-45064-xx) Block-heating /cooling method 4°C to 70°C			None	Block-heating /cooling method Used together with dehumidifying function 4°C to 40°C
Operating pH range	pH 1 to pH10			pH 1 to pH 14	
Operating temperature range	4°C to 35°C				
Dimensions, weight	Main unit : 260(W) x 280(H) x 420(D)mm, 19kg Syringe unit : 100(W) x 280(H) x 150(D)mm, 4kg			540(W) x 415(H) x 500(D)mm, 40kg(SIL-HTA), 45kg(SIL-HTc)	
Power requirements	AC 110V, 230V, 100VA, 50/60Hz			AC 110V, 230V, 150VA, 50/60Hz	AC 110V, 230V, 300VA, 50/60Hz

FRC-10A

[Fraction Collector]

A Fraction Collector for a Wide Variety of Fractionation Modes

The FRC-10A can be used over a wide range of flow rates, covering small and large-scale preparative work. It flexibly adapts to various applications, such as simple, manual collection performed while viewing chromatograms, and advanced, continuous and automated preparative separation and collection performed in combination with an autosampler and detector.

Convenient Fraction Simulation

Fraction simulation can be performed using LCsolution, so the optimization of fractionation conditions is very simple.

Minimal Influence of Variations in Elution Time

Even if the elution time changes due to the influence of fluctuations in room temperature or the composition of the mobile phase, it is still possible to accurately perform fractionation by catching the target component with special parameters. This function is indispensable for continuous automatic preparative separation.

Options

Fraction collector heads, racks, and collection tubes and vials are available as options. Select according to fraction size required.

	Collector heads	Racks	Collection containers		
Large-scale fractions	Fraction-collector head with valve (228-24105-91)	Large-volume kit (228-25324-91)	Commercial reagent bottles (500 to 1,000mL) can be used.		
Semi-large fractions		Rack No. 3: 16 fractions (228-25313-91)	50mL vials (glass, 20 pcs / set) (228-25318-91)	50mL vials (PP (polypropylene), 20 pcs / set) (228-25321-91)	
		Rack No. 2A: 64 fractions (228-25311-91)	20mL test tube (glass, 100 pcs / set) (228-25316-91)	32mL test tube (glass, 100 pcs / set) (228-25317-91)	25mL test tube (PP, 100 pcs / set) (228-25320-91)
Small fractions		Sample cooler L: 50 fractions (228-24975-93)	5L vials (glass, 100 pcs / set) (228-21287-91)	5mL vials (PP, 100 pcs / set) (228-21322-91)	
		Rack No. 1: 144 fractions (228-25310-91)	3.5mL test tube (glass, 250 pcs / set) (228-25315-91)	4.5mL test tube (PP, 250 pcs / set) (228-25319-91)	
	Fraction-collector head (228-25169-91)	Rack No. 5: 120 fractions (228-25314-91)	3.5mL test tube (glass, 250 pcs / set) (228-25315-91)	4.5mL test tube (PP, 250 pcs / set) (228-25319-91)	

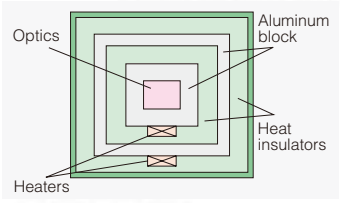
* A "fraction-collector head with valve" allows the eluate to be switched between the fraction side and the drain side using a 3-way solenoid valve. Use this model with standard fractionation in order to fully attain the FRC-10A's functionality.
* A "fraction-collector head" (i.e. without a valve) continuously directs the eluate to the fraction side without using a solenoid valve. It is used for micro-volume fractionation.

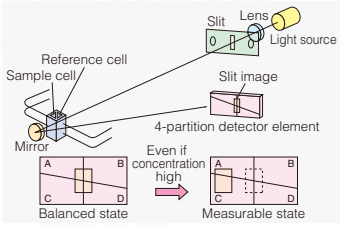
Specifications (FRC-10A)

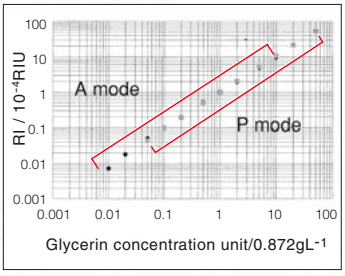
	FRC-10A (228-45070-xx)
Drive system	Arm-movement X-Y system
Maximum number of fractions	16 to 144 (depending on the type of rack used)
Collection method	Solenoid valve (fraction-collector head with valve) or direct through nozzle (fraction-collector head)
Maximum flow rate	150 mL/min
Fraction modes	Basic mode (using initial parameters), and Time-Program mode (14 different functions available)
Cooling function	Possible with sample cooler L (228-45064-xx)
Ambient temperature range	4°C to 35°C
Dimensions, weight	260(W) x 280(H) x 420(D)mm, 15kg
Power requirements	AC110V, 230V, 100VA, 50/60Hz

RID-10A

[Refractive Index Detector]







Improving Analysis Productivity in Refractive Index Detection

The RID-10A features dramatic improvements in the productivity of refractive index detection. Dual-temperature control of the optical system helps reduce the stabilization time and baseline drift after power-ON, and the adoption of three measurement modes allows all applications from high-sensitivity analysis to preparative work to be handled with a single unit.

Short Warm-up Time and Improved Baseline Stability

The optical system is housed inside a dual-temperature-controlled block. The temperature of the incoming mobile phase is controlled in two stages; consequently, the stabilization time is significantly shorter than with conventional systems. This dual-temperature control also helps significantly reduce baseline drift, thus increasing the reliability of analysis data.

Broad Application Range - from Analytical to Preparative-Scale HPLC

The adoption of an original 4-partition detector element (U.S. Patent No. 5398110; Japanese Patent No. 2504356) makes it possible to handle all applications from high-sensitivity to preparative analyses with a single unit using the following three measurement modes.

A (Analytical) mode	High-sensitivity to general-purpose analyses
P (Preparative) mode	High-concentration analysis, semi-preparative analysis (up to 20mL/min)
L (Large-scale prep.) mode	Large-volume preparative analysis with optional flow selection block (228-34102-91) for flow rates (up to 150mL/min)

4-Partitioned Detector Element

The detector element of the RID-10A is partitioned into four parts, and the parts used can be changed electrically. In A mode (for high-sensitivity analysis), the partitions are grouped left-right (combinations of A+C and B+D), and in P and L modes (for preparative analysis), the partitions are grouped top-bottom (combinations of A+B and C+D). In P and L modes, because measurement is possible regardless of the position of the element's center line, large refractive indexes for high-concentration samples can be handled.

Specifications (RID-10A)

	RID-10A (228-45095-xx)		
Refractive index range	1 to 1.75RIU	Maximum operating flow rate	20mL/min (150mL/min with option)
Noise level	2.5 x 10^{-9} RIU max	Temperature control of cell unit	30°C to 60°C (1°C steps)
Drift	1 x 10^{-7} RIU/hour max.	Cell volume	9µL
Range	A mode: 0.01 x 10^{-6} to 500 x 10^{-6} RIU P and L modes: 1 x 10^{-6} to 5,000 x 10^{-6} RIU	Cell pressure	2MPa (approx. 20kgf/cm^2; cell unit)
		Operating temperature range	4°C to 35°C
Response	0.05 to 10 sec, 10 steps	Dimensions, weight	260 (W) x 140 (H) x 420 (D)mm, 12kg
Polarity switching	With a switch	Power requirements	AC110V, 230V, 150VA, 50/60Hz
Zero adjustment	Auto zero, auto-optical zero, fine zero		

* Hexafluoroisopropanol (HFIP) cannot be used as the mobile phase.

Option: Pressure Relief Valve (228-33615-91)

The RID-10A incorporates various safety features. Its maximum pressure is five times that of former Shimadzu products and, as a standard feature, it incorporates a sensor that detects leakage from the cell unit. For extra safety, a pressure relief valve that prevents problems related to back-pressure irregularities is also available as an option.

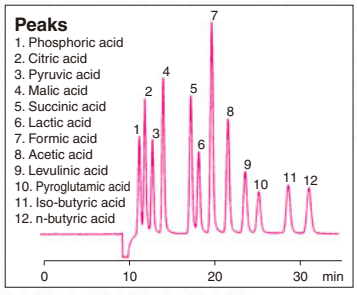
CDD-10AVP

[Conductivity Detector]

Ions	Concentration (µg/L)	RSD (%)
F	50	0.46
Cl	200	0.23
NO_2	15	5.41
Br	100	0.71
NO_3	80	0.54
PO_4	500	0.63
SO_3	200	2.30

Reproducibility in Anion Analysis

(Lower concentration limits of quantitative analysis range for 2001 edition of Water Supply Testing Methods, Japan)



Handles a Wide Variety of Analysis Options

The CDD-10AVP conductivity detector achieves an even higher level of sensitivity and makes it possible to perform a wide variety of analysis scenarios with a single unit. An option card enables the simultaneous 2-channel measurement of anions and cations, and a suppressor option allows expansion to a suppressor system for ultra-high sensitivity work. Organic acids can be analyzed using Shimadzu's unique post-column pH-buffered electroconductivity method.

Perform Analysis with Highest Sensitivity

The sensitivity of detectors that monitor weak electrical signals from analytes is affected by the inherent electrical noise of the detector itself. With the CDD-10AVP, electronic parts with low electrical noise are used, and the layout of the electronic components has been optimized in order to reduce noise levels, thereby attaining an extremely high level of sensitivity. Combining the CDD-10AVP with a suppressor unit makes it possible to perform ultra-high sensitivity ion analysis on the order of 0.25µg/L (detection limit: S/N=3) for Cl^-.

Applicable to Both Suppressor and Non-Suppressor Systems (available in limited regions)

When used with a CTO-20AC, expansion to a full suppressor system can be realized by adding the suppressor option. Suppressor functions can be disabled when necessary, making it possible to switch between anion analysis using a suppressor system and cation analysis using a non-suppressed system. In addition to a single flow-line system, expansion to a dual flow-line system is also possible, allowing the creation of a variety of system configurations. For example, simultaneous analysis of anions and cations using a combination of suppressed and non-suppressed detection is possible.

High-Sensitivity Analysis of Organic Acids

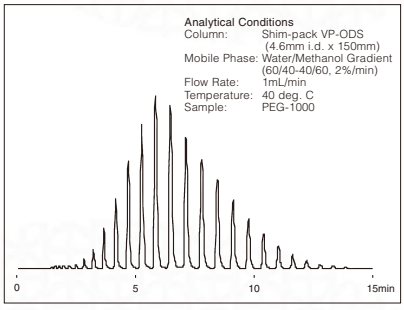
Shimadzu's post-column pH-buffered electroconductivity method (Patent No. 2017498) enables selective, high-sensitivity analysis of organic acids. Even samples that traditionally require time-consuming pretreatment to handle unwanted constituents can be analyzed after simple pretreatment procedures such as dilution and filtration. The level of reliability attained in quantitative analysis is much higher than that attained conventionally with a low-wavelength UV method or a simple conductivity method. Superior linearity enables batch analysis in cases where constituent concentrations differ greatly and, consequently, helps reduce analysis time.

Specifications (CDD-10AVP)

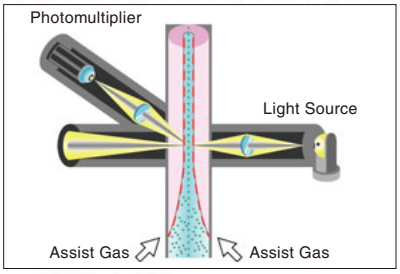
	CDD-10AVP (228-45054-xx)
Temperature coefficient	25nS·cm^{-1}/°C (background: 285µS·cm^{-1}; cell temperature: 43°C)
Cell volume	0.25µL
Cell constant	25µS·cm^{-1}
Material used in parts making contact with liquid	PEEK, SUS316
Maximum operating pressure	2.9MPa (30kgf/cm^2)
Response	0.05 to 10 sec., 10 steps
Zero adjustment	Autozero, baseline shift
Operating temperature range	4°C to 35°C
Dimensions, weight	260 (W) x 140 (H) x 420 (D)mm, 6.0kg
Power requirements	AC110VA, 230V, 250VA, 50/60Hz

ELSD-LT Ⅱ

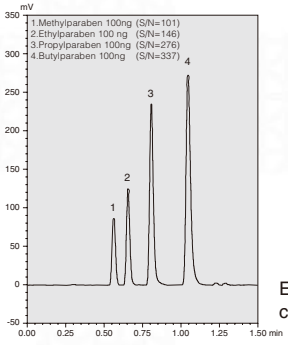
[Evaporative Light-Scattering Detector]



Chromatogram of Non-Chromophoric Compound



Assist Gas Functions



Example of analyzing 4 semi-volatile alkyl parabens, considered difficult to analyze with conventional ELSD detectors.

Highly Versatile Detection Method

Not all compounds have a chromophore or other such structural property that allows the use of an absorbance detector. Refractive Index Detection (RID) is one option but it suffers from the inability to run gradient analysis. Evaporative Light Scattering Detection (ELSD) is a perfect alternative to RID as it is more rugged, quicker to stabilize, and gradient compatible. ELSD is ideal for applications like testing the purity of compounds, measuring the molecular weight distribution of synthetic polymers, and analyzing natural substances.

Detects Most Compounds

With the exception of some highly volatile compounds, the ELSD-LT Ⅱ is able to detect almost any compound. Unlike traditional absorbance detectors (UV-Vis, PDA, etc.), sensitivity is not dependent on the physical or structural properties of the compound, but rather the absolute quantity of the solute passing through the detector cell. Therefore, it is especially useful for detecting unknown or breakdown compounds and/or validating purity of a target compound. By this mechanism of detection the ELSD-LT Ⅱ is truly a universal detector.

Note: Due to the evaporative nature of this detector, it must only be used in an area with proper exhaust ventilation.

High Sensitivity by Low Temperature Evaporation

The ELSD-LT Ⅱ detector uses a unique nebulizer and drift tube design to achieve stable and low-temperature evaporation of mobile phases, making it possible to analyze semi-volatile and / or thermally unstable compounds.

High-sensitivity detection is achieved by focusing the sample at the detection point with assist gas flow. The ELSD-LT Ⅱ offers high sensitivity with this low-temperature evaporation technology and superb detection technology.

A smaller volume nebulizer and drift tube further improve sensitivity.

Automated Functions

Auto-Powerdown functions for the LED light source and nebulizer gas reduce operating costs. The self-cleaning design makes maintenance of the drift tube easier.

Specifications (ELSD-LT Ⅱ)

	ELSD-LT Ⅱ (228-45115-xx)		
Nebulizing Method	Siphon Splitting	Mobile phase flow rate	0.2mL/min - 2.5mL/min (see Note 2)
Light source	LED	Analog output	0V - 1V
Detection	Photomultiplier Tube	Operating temperature range	5°C - 40°C
Temperature setting range	Ambient to 80°C	Operating humidity range	<80% (5°C - 31°C), <50% (31°C - 40°C)
Nebulizer gas	Nitrogen (N_2) or Air (see Note 1)	Power supply	AC 115V, 230V, 150VA, 50/60Hz
Gas flow rate	Max. 3.0 L/min	Size	W250 x D550 x H450mm
Gas pressure	Max. 450 kPa	Weight	20kg

Note 1: Requires gas supply source, such as a gas line, nitrogen generator, or air compressor.
Note 2: 0.04 mL/min to 1.2 mL/min range when using a low-flow nebulizer.

Prominence nano System

Proteome analysis system combined with a Shimadzu mass spectrometer
– Providing maximum performance and a total solution –

When connected to a Shimadzu mass spectrometer, the Prominence nano system demonstrates its maximum performance.
A total system configuration, comprising the Prominence nano and either the LCMS-IT-TOF MS with a nano-ESI interface or a MALDI-TOF MS with the AccuSpot MALDI spotter, provides authentic results and a total solution for proteomic analyses.
* Prominence nano can operate stand-alone or with a mass spectrometer, including those manufactured by other vendors.

LC-20ADnano Solvent Delivery Unit

	LC-20ADnano (228-45121-3x)
Solvent delivery method	Reflux flow control system
Flow-rate setting range	1 nL/min – 5 µL/min (stand-alone operation) 10 nL/min – 5 µL/min (controlled by the Nano-Assist) 100 nL/min – 5 µL/min (controlled by CBM-20A, Solution software)
Safety measures	Liquid-leakage sensor, High-pressure/low-pressure limits
Operating temperature range	16°C - 28 °C
Dimensions, Weight	260 (W) x 140 (H) x 420 (D) mm, 11 kg
Power requirements	AC 110 V, 230V, 150 VA, 50/60 Hz

FCV nano Switching Valve

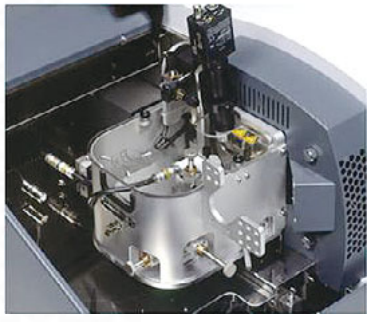
	FCV nano (228-45123-91)
Valve type	6-ports 2-position high-pressure switching valve
Port-to-port volume	approximately 25 nL
Inner diameter of flow pass	approximately 0.1 mm
Operating pH range	1 - 14
Maximum operating pressure	20 MPa
Dimensions, Weight	110 (W) x 110 (H) x 250 (D) mm, 4 kg

Combination of the Prominence nano System and a Shimadzu Mass Spectrometer

The AccuSpot MALDI spotting device, coupled to the Prominence nano, is a powerful tool when combined with Shimadzu MALDI-TOF MS Series instruments.

(Typical system configuration including the AccuSpot)
Prominence nano 1-dimensional system with the
AccuSpot MALDI spotting device

The high-grade LCMS-IT-TOF mass spectrometer, coupled to the Prominence nano through the nano-ESI interface, provides outstanding performance for proteomic / metabolomic analyses.
(Typical system configuration including the LCMS-IT-TOF)
Prominence nano 2-dimensional system with the LCMS-IT-TOF mass spectrometer (including LCMSsolution software) and the nano-ESI interface, NES-100



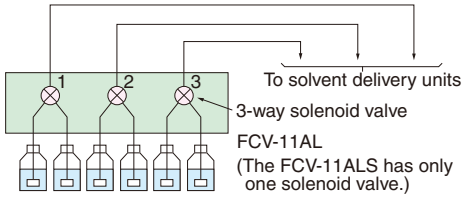
Optional Accessories

FCV Series Flow-Line Selection Valves

Reservoir Selection Valves

FCV-11AL (228-45048-91)
FCV-11ALS (228-45049-91)

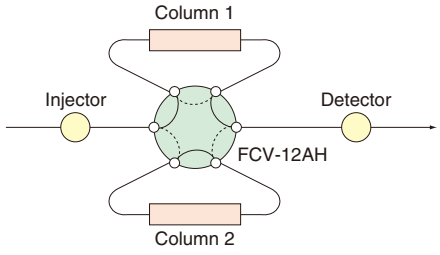
These solenoid valve units can automatically switch between two solenoids (e.g., mobile phase and column rinse solvent) plumbed to one solvent delivery unit. The FCV-11AL can handle the automatic selection of solvents for up to three solvent delivery units whereas the FCV-11ALS is used for one unit.



High-Pressure Flow-Line Selection Valves

FCV-12AH (228-45013-91)
FCV-12AHi (228-45013-94)

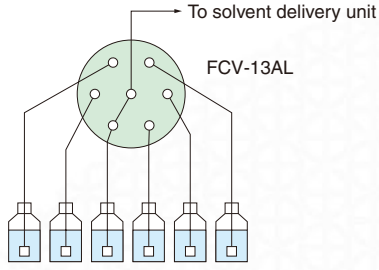
These flow-line selection valves incorporate 6-port, 2-position, high-pressure valves. They can be used for automatic column selection and automatic pretreatment.
* The liquid contact parts of the FCV-12AHi have bio-inert specifications.



Reservoir Selection Valve

FCV-13AL (228-45016-91)

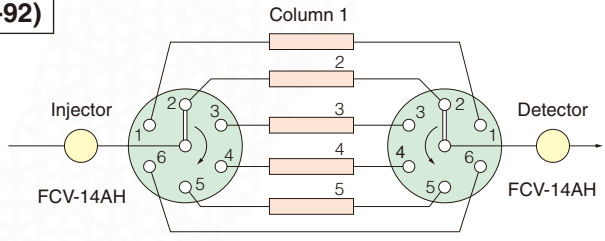
This unit performs automatic solvent selection and incorporates a 7-port, 6-position valve. It can perform the switching of up to six solvents for a stepwise gradient.



Column Switching Valves

FCV-14AH (228-45014-91)
FCV-14AHi (228-45014-92)

This unit performs automatic column selection and incorporates a 7-port, 6-position, high-pressure valve. It can be used for automatic multi-column switching. (Two units used.)
* The liquid contact parts of the FCV-14AHi have bio-inert specifications.



Reservoir Selection Valve

FCV-7AL (228-45077-91)

This device can switch between two solvents using a solenoid valve. It incorporates a pump that can automatically rinse the rear side of the solvent delivery unit's plunger seals.
It can be controlled from the LC-6AD or from a system controller or workstation connected via the LC-6AD.

Reservoir Selection Valve

FCV-130AL (228-45078-91)

This device can switch between two solvents using a solenoid valve. It incorporates a pump that can automatically rinse the rear side of the solvent delivery unit's plunger seals.
It can be controlled from the LC-8A or from a system controller or workstation connected via the LC-8A.

FCV Series Specifications (FCV-11AL/11ALS/12AH/13AL/14AH)

	FCV-11AL	FCV-11ALS	FCV-12AH	FCV-13AL	FCV-14AH
Valve type	Three 3-way solenoid valves	One 3-way solenoid valve	One 6-port, 2-position valve	One 7-port, 6-position valve	
Solvent pH usage range	1 to 14		1 to 10	1 to 14	1 to 10
Maximum pressure (kgf/cm^2)	0.5		350	5	350
Valve switching time	0.02 sec		0.2 sec		0.3 sec.
Control	LC-VP solvent delivery unit or SCL-10AVP *2		SCL-10AVP *1		
Dimensions	110(W) x 250(D) x 110(H)mm				
Weight	2.0kg		4.0kg		

* 1 An Option Box VP or a Sub-controller VP is required for control of the FCV-12AH /13AL /14AH. This does not apply to the FCV-12AH /14AH when it is connected to the CTO-20A/20AC. Two FCV-12AH units and a total of two FCV-13AL or FCV-14AH units can be controlled from the SCL-10AVP.
* 2 When using FCV-11AL /11ALS/15AL units for solvent selection, only one of these units can be controlled from the SCL-10AVP or a solvent delivery unit. The SCL-10AVP and Option Box VP or Sub-controller VP is required to use two of these units simultaneously.

Column Oven

Compact and affordable

CTO-10AS *VP* (228-45059-xx)

The CTO-10AS*VP* is a space-saving, compact and affordable oven with a block heating mechanism.
The CTO-10AS*VP* controls temperature from ambient -15°C, and accommodates two manual injectors.

Specifications (CTO-10AS*VP*)

	CTO-10AS*VP*
Type	Block heating
Temperature setting range	4 to 80°C
Temperature control precision	±0.1°C
Temperature control range	(Ambient temp,-15)°C to Room Ambient temp +60°C
Temperature control mechanism	Pre-heating, 10µLx2 channel
Applicable columns	25cm (2 columns max.)
Safety features	a) Temperature limit device using maximum temperature setting b) Thermal fuse c) Solvent leak sensor
Time program	Temperature setting changes Oven ON/OFF 320 steps, 0.1 - 999.9 min
Dimensions	130(W) x 420(D) x 415(H) mm
Weight	12kg
Ambient temperature range	4 to 35°C
Power requirements	AC 110V, 230V, 120VA,50/60Hz

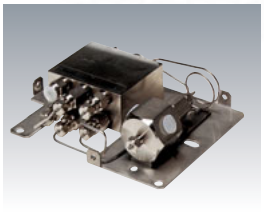
Options for Solvent Delivery Units

Automatic Rinsing Kit

- 20AD Automatic Rinsing Kit (228-45567-91)
- 20AT Automatic Rinsing Kit (228-45568-91)
- 20AB Automatic Rinsing Kit (228-18803-92)

These optional kits are used to continuously, automatically rinse the backs of the plunger seals and plunger units. They wash away the salt that is deposited on the surfaces of the seals and plungers when buffer solution is used as the mobile phase, thereby helping to prolong the service life of these parts.
There are kits for use with the LC-20AD, the LC-20AT, and the LC-20AB.

* The automatic rinse kit for the LC-20AB is shown in the photograph.



Mixer

- Mixer 0.5-2.6mL HP (228-45093-93)
- Mixer 100µL HP (228-35830-93)
- 20A Bio-inert Mixer (228-45093-92)
- 8A Preparative Mixer (228-20600-91)
- 6AD Preparative Mixer (228-20738-92)

These gradient mixers offer superior mixing performance. Mixing volumes of 0.5mL, 1.7mL, and 2.6mL can be selected for the Mixer 0.5-2.6mL HP. The mixing volume for the Mixer 100µL HP is 100µL. The 20A bio-inert mixer incorporates PEEK resin and ceramic for use with bio-inert systems, and two mixing volumes can be selected. There are also mixers for preparative applications. * The Mixer 0.5-2.6mL HP is shown in the photograph.

Helium Degasser

DGU-10B (228-45067-93)

This degasser purges dissolved air from the mobile phase and prevents phenomena such as bubble formation, baseline noise, and drift. The DGU-10B can degas up to four mobile phase solutions with helium gas. It is turned ON/OFF from the solvent delivery unit or system controller.

Options for Chemical Reaction Units

Chemical Reaction Chamber

CRB-6A (228-45065-XX)

This air circulation-type reaction chamber is used for post-column derivatization.
Temperature-control range: Between 15°C above room temperature and 150°C
Temperature-control precision: ±0.1°C (100V operation only)

Reagent Delivery Pump

PRR-2A (228-45145)

This peristaltic pump delivers reagent and is used for post-column derivatization.
It can deliver up to five liquids (100V operation only).

Options for Sample Injection Units

Sample Injectors

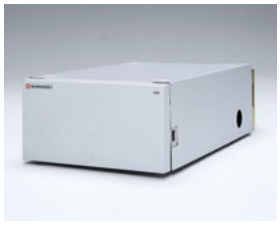
- Rheodyne 7725 (228-32210-91) For general analysis
- Rheodyne 7725i (228-32210-93) For general analysis
- Rheodyne 8125 (228-23200-91) For semi-micro systems
- Rheodyne 9725 (228-32650-91) For bio-inert LC systems
- Rheodyne 9725i (228-32650-93) For bio-inert LC systems

* The Rheodyne 7725i/9725i incorporates a position-sensing switch.

Optional Loops

Volume	Material	Part Number
100 µL	SUS	228-32211-16
	PEEK	228-32651-16
200 µL	SUS	228-32211-17
	PEEK	228-32651-17
500 µL	SUS	228-32211-18
	PEEK	228-32651-18
1 mL	SUS	228-32211-19
	PEEK	228-32651-18

Valve Options



Option Box VP (228-45060-xx) Sub-controller VP (228-35308-xx)

Option Box VP can house up to two FCV-11AL (S)/12AH/13AL/14AH units. One FCV-11AL or FCV-11ALS unit, up to two FCV-12AH units, up to two FCV-13AL/14AH units, and one DGU-10B unit can be controlled from the CBM-20A or SCL-10AVP via Option Box VP. Sub-controller VP has the same control functions as Option Box VP but has no housing capability.

* Option Box VP is shown in the photograph.

Solvent Recycle Valve Kit (228-45080-91)

Using a solvent recycle valve kit during isocratic analysis allows column eluent to return to the reservoir bottle when no peaks are detected according to the set threshold level. This helps reduce consumption of the mobile phase, especially at higher flow rates.

Manual Recycle Valve (228-20401-92)

This manual switching valve is used to perform recycling operations with preparative systems.

Manual Column Switching Valve (228-13000-95)

This manual switching valve is used to switch between preparative columns, or between a preparative column and an analytical column, in an analytical-to-preparative scaleup system.

Other Options

Reservoir Tray (228-45041-91)

The sturdy plastic tray will hold up to seven 1-liter reservoir bottles. Access behind the front panel allows for neat routing of reservoir tubing.

8A Column Holder (228-45079-91)

This holder supports the mounting of two columns with inner diameters in the range of 20 to 50mm, one analytical column, four manual selection valves of various types, and an 8A preparative mixer or an 8A analytical mixer.

Specifications for Prominence Syste

CBM-20A / 20Alite

System Controllers

→P8

	CBM-20A (228-45012-XX)	CBM-20Alite (228-45011-38)
Connectable units	Solvent delivery units: 4 max.; Autosamplers: 1, Column ovens: 1; Detectors: 2 max.; Fraction collectors: 1; Sub-controllers: 2 max.	Solvent delivery units: 4 max.; Autosamplers (SIL-10AF/10AP/10Ai): 1; Column ovens: 1; Detectors: 2 max.
Number of connectable units	8 (expansion possible up to 12)	5 (including the unit incorporating the system controller)
Data buffering	Approx. 24 hours for one analysis (at 500-ms sampling rate; available only with LCsolution)	
Event I/O	4 inputs, 4 outputs	2 inputs, 2 outputs
Analog boards	Up to 2 boards can be mounted.	Mounting not supported.
Operating temperature range	4°C to 35°C	
Dimensions, weight	260 (W) x 140 (H) x 420 (D) mm, 5.5 kg	120 (W) x 20 (H) x 100 (D) mm, 0.5 kg
Power requirements	AC 110V, 230V, 100VA, 50/60 Hz	Supplied from unit

LC-20AD / 20ADXR / 20AT / 20AB

Sovent Delivery Units

→P10

	LC-20AD (228-45000-XX)	LC-20ADXR (228-45137-XX)
Solvent delivery method	Parallel-type double plunger	
Plunger capacity	10 µL	
Maximum discharge pressure	40 MPa	66 MPa
Flow-rate setting range	0.0001 mL/min to 10.0000 mL/min	0.0001 mL/min to 3.0000 mL/min (to 66 MPa) 3.0001 mL/min to 5.0000 mL/min (to 44 MPa)
Flow-rate accuracy	No more than ±1% or ±2 µL/min, whichever is greater (0.01 mL/min to 2 mL/min)	No more than ±1% or ±2 µL/min, whichever is greater (0.01 mL/min to 3 mL/min: 1.0 to 40MPa) No more than ±2% or ±2µL/min, whichever is greater (0.01 mL/min to 3 mL/min: 40 to 60MPa)
Flow-rate precision	No more than 0.06% RSD or 0.02 min SD, whichever is greater	
Typical pulsation	0.03 MPa (for water at 1.0 mL/min, and 7 MPa)	0.05 MPa (for water at 1.0 mL/min, and 7 MPa)
Gradient type	High-pressure mixing/low-pressure mixing	High-pressure mixing
Mixing-concentration precision	0.1% RSD max.	
Constant-pressure solvent delivery	Supported	
Plunger rinsing mechanism	Manual rinsing or automatic rinsing using optional product	Equipped with an automatic rinsing kit
Safety measures	Liquid-leakage sensor, high-pressure/low-pressure limits	
Operating temperature range	4°C to 35°C	
Dimensions, weight	W 260 x H 140 x D 420 mm, 10 kg	
Power requirements	AC 110V, 230V, 150VA, 50/60 Hz	

	LC-20AT (228-45001-XX)	LC-20AB (228-45002-XX)
Solvent delivery method	Serial-type double plunger	Parallel-type double plunger (2 sets)
Plunger capacity	Primary side: 47 µL, Secondary side: 23 µL	10 µL
Maximum discharge pressure	40MPa	
Flow-rate setting range	0.001 mL/min to 10.000 mL/min	0.0001 mL/min to 10.0000 mL/min
Flow-rate accuracy	No more than ±2% or ±2 µL/min, whichever is greater (0.01 mL/min to 5 mL/min)	±2% (2 mL/min to 5 mL/min)
Flow-rate precision	No more than 0.06% RSD or 0.02 min SD, whichever is greater	
Typical pulsation	0.08 MPa (for water at 1.0 mL/min, and 7 MPa)	0.03 MPa (for water at 1.0 mL/min, and 7 MPa)
Gradient type	High-pressure mixing/low-pressure mixing	High-pressure mixing
Mixing-concentration precision	0.1% RSD max.	
Constant-pressure solvent delivery	Supported	Not supported
Plunger rinsing mechanism	Manual rinsing or automatic rinsing using optional product	
Safety measures	Liquid-leakage sensor, high-pressure/low-pressure limits	
Operating temperature range	4°C to 35 °C	
Dimensions, weight	W 260 x H 140 x D 420 mm, 11 kg	W 260 x H 140 x D 420 mm, 13 kg
Power requirements	AC 110V, 230V, 150VA, 50/60 Hz	AC 110V, 230V, 180VA, 50/60 Hz

DGU-20A3 / 20A5

Online Degassers

→P11

	DGU-20A3 (228-45018-32)	DGU-20A5 (228-45019-32)
Number of degassed solvents	3	5
Degassed flow-line capacity	380µL	
Operating temperature range	4°C to 35°C	
Dimensions, weight	260 (W) x 70 (H) x 420 (D) mm, 5 kg	260 (W) x 70 (H) x 420 (D) mm, 5.2 kg
Power requirements	Supplied from LC-20AD/20ADXR/20AT/20AB	

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SIL-20A / 20AC / 20AHT / 20ACHT / 20AXR / 20ACXR

Autosamplers

→P12

	SIL-20A (228-45006-XX)	SIL-20AHT (228-45119-XX)	SIL-20AXR (228-45135-XX)
Injection method	Total-volume sample injection, variable injection volume		
Maximum operating pressure	20 MPa	35 MPa	66 MPa
Injection-volume setting range	0.1 µL to 100 µL (standard), 0.1 µL to 2,000 µL (option)		0.1 µL to 50 µL (standard), 0.1 µL to 100 µL (option)
Number of processed samples	175 (1 mL vials) 105 (1.5 mL vials) 50 (4 mL vials) 192 (two 96-well MTP/DWP) 768 (two 384-well MTP/DWP) Also, ten 1.5 mL vials in addition to each of the above.		
Injection-volume accuracy	1% max (specified conditions)		
Injection-volume precision	RSD: 0.3% max. (specified conditions), (typically 0.2% RSD max)		
Sample Carryover	0.005% max. (specified conditions), (typically 0.0025% max)		0.005% max. (specified conditions), (typically 0.0035% max)
Number of repeated injections	30 max. per sample		
Needle rinsing	Set freely before and after sample injection.		
Sample cooler	None		
Operating pH range	pH1 to pH14		
Operating temperature range	4°C to 35°C		
Dimensions, weight	W 260 x H 415 x D 500 mm, 27kg		
Power requirements	AC 110V, 230V, 100VA, 50/60 Hz		

	SIL-20AC (228-45007-XX)	SIL-20ACHT (228-45120-XX)	SIL-20ACXR (228-45136-XX)
Injection method	Total-volume sample injection, variable injection volume		
Maximum operating pressure	20 MPa	35 MPa	66 MPa
Injection-volume setting range	0.1 µL to 100 µL (standard), 0.1 µL to 2,000 µL (option)		0.1 µL to 50 µL (standard), 0.1 µL to 100 µL (option)
Number of processed samples	175 (1 mL vials) 70 (1.5 mL vials) 50 (4 mL vials) 192 (two 96-well MTP/DWP) 768 (two 384-well MTP/DWP) Also, ten 1.5 mL vials in addition to each of the above.		
Injection-volume accuracy	1% max (specified conditions)		
Injection-volume precision	RSD: 0.3% max. (specified conditions), (typically 0.2% RSD max)		
Sample Carryover	0.005% max. (specified conditions), (typically 0.0025% max)		0.005% max. (specified conditions), (typically 0.0035% max)
Number of repeated injections	30 max. per sample		
Needle rinsing	Set freely before and after sample injection.		
Sample cooler	Block cooling/heating, used together with defumidifying function, 4°C to 40°C		
Operating pH range	pH1 to pH14		
Operating temperature range	4°C to 35°C		
Dimensions, weight	W 260 x H 415 x D 500 mm, 30kg		
Power requirements	AC 110V, 230V, 300VA, 50/60Hz		

Rack Changer

Rack Changer

→P13

	Rack changer C (228-45030-XX)
Compatible plates	96-well MTP, 96-well DWP, 384-well MTP, 384-well DWP, 1.5mL vial plate (54 vials)
Number of processed plates	12
Sample cooler	Block cooling/heating, used together with dehumidifying function, 4°C to 40°C
Operating temperature range	4°C to 35°C
Dimensions, weight	425 (W) x 415 (H) x 500 (D) mm, 32 kg
Power requirements	AC 110V, 230V, 350VA, 50/60 Hz

FCV-20AH2 /20AH6

High-Pressure Flow-Line Selection Valves

→P15

	FCV-20AH2 (228-45015-XX)	FCV-20AH6 (228-45017-XX)
Valve type	2-position/6-port rotary valve	6-position/7-port rotary valve
Maximum operating pressure	39.2 MPa (400 kg/cm2)	
Operating pH range	pH1 to pH10	
Operating temperature range	4°C to 35°C	
Dimensions, weight	110 (W) x 140 (H) x 250 (D) mm, 4 kg	110 (W) x 140 (H) x 250 (D) mm, 4 kg
Power requirements	AC 110V, 230V, 100VA, 50/60 Hz	

Specifications for Prominence Syste

CTO-20A / 20AC

Column Ovens

→P14

	CTO-20A (228-45009-XX)	CTO-20AC (228-45010-XX)
Temperature-control method	Forced-air circulation	
Cooling method	None	Electronic cooling
Temperature-setting range	4°C to 85°C	
Temperature-control precision	0.1°C max. (typically 0.04°C max.)	
Temperature-control range	10°C above room temperature to 85°C	10°C below room temperature to 85°C
Storage capacity	220 (W) x 365 (H) x 95 (D) mm	
Storable devices	2 manual injectors, gradient mixer, 2 high-pressure flow-line selection valves, etc.	
Time program	Linear temperature programs supported.	
Safety measures	Solvent sensor, temperature fuse, temperature upper limit	
Operating temperature range	4°C to 35°C	
Dimensions, weight	260 (W) x 415 (H) x 420 (D) mm, 20 kg	260 (W) x 415 (H) x 420 (D) mm, 23 kg
Power requirements	AC 110V, 230V, 600VA, 50/60 Hz	

SPD-20A / 20AV SPD-M20A

UV-VIS Detectors PDA Detector

Absorbance Detectors

→P16

	SPD-20A (228-45003-XX)	SPD-20AV (228-45004-XX)	SPD-M20A (228-45005-XX)
Light source	Deuterium (D2) lamp	Deuterium (D2) lamp, tungsten (W) lamp	
Number of diode elements	None		512
Wavelength range	190 nm to 700 nm	190 nm to 900 nm	190 nm to 800 nm
Bandwidth, slit width	8 nm		1.2 nm (high-resolution mode), 8 nm (high-sensitivity mode)
Wavelength accuracy	± 1 nm max.		
Wavelength precision	± 0.1 nm max.		
Noise	0.5 x 10^{-5} AU (under specified conditions)		0.6 x 10^{-5} AU (under specified conditions)
Drift	1 x 10^{-4} AU/h (under specified conditions)		5 x 10^{-4} AU/h (under specified conditions)
Linearity	2.5 AU (ASTM standard)		2.0 AU (ASTM standard)
Functions	Dual-wavelength detection in the range 190 to 370 nm and upwards of 371nm, ratio-chromatogram output, wavelength scanning		Contour output, spectrum library, MAX plotting
Cell	Optical wavelength: 10 mm, Capacity: 12µL, Pressure: 12 MPa		Optical wavelength: 10 mm, Capacity: 10µL, Pressure: 12 MPa
Cell temperature-control range	5°C above room temperature to 50°C		
Web control	——		Parameter setting, log management, management of consumable parts,etc.
Buffer memory	Refer to the information on the CBM-20A/20Alite		Approx. 20 minutes of data in the entire wavelength region (only when using LCsolution)
Operating temperature range	4°C to 35°C		
Dimensions, weight	260 (W) x 140 (H) x 420 (D) mm, 13 kg		260 (W) x 140 (H) x 420 (D) mm,12 kg
Power requirements	AC 110V, 230V, 160VA, 50/60 Hz		AC 110V, 230V, 150VA, 50/60 Hz

Prominence UFLC and Prominence UFLCXR system use SPD-20A UFLC version (228-45130-xx) which has a semi-micro temperature-controlled flow cell installed for optimization of fast analysis.
(Standard type temperature-controlled flow cell is optional for SPD-20A UFLC version.)

RF-20A / 20Axs

Fluorescence Detectors

→P18

		RF-20A (228-45147-XX)	RF-20Axs (228-45148-XX)
Light Source		Xenon lamp	Xenon lamp, low-pressure mercury lamp (to check wavelength accuracy)
Wavelength Range		0, 200 nm to 650 nm	0, 200 nm to 750 nm
Spectral Bandwidth		20 nm	
Wavelength Accuracy		± 2 nm	
Wavelength Reproducibility		± 0.2 nm	
S/N		Water Raman peak S/N 1200 min.	Water Raman peak S/N 2000 min.
Cell (capacity, pressure resistance, material)		12 µL; 2 MPa (approx. 20 kgf/cm2); SUS316L, PTFE (fluororesin), quartz	
Cell Temperature Input Range		—	4°C to 40°C, 1 °C step
Cell Temperature Control Range		—	(Room temperature - 10 °C) to 40 °C (2 mL/minute max. flow rate, 85 °C max. oven temperature)
Simultaneous Monitoring Of 2 Wavelengths	Measured wavelength	Any two wavelengths between 200 and 650 nm	Any two wavelengths between 200 and 750 nm
	Sampling period	0.5 s per wavelength	
Operational Ambient Temperature Range		4°C to 35°C	
Dimensions/Weight		W260 x H210 x D420 mm, 16 kg	W260 x H210 x D420 mm, 18 kg

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LCMS-2020

MS Detector

→P20

		LCMS-2020 (225-13300-XX)
Unit	Mass range	m/z 10 to 2000
	Sensitivity	ESI positive ion reserpine 1pg S/N: more than 150 (RMS measurement)
	Resolution	R=2M
	LC-compatible flowrates	ESI 0.001 to 2 mL/min
	Scan speed	15,000 u/sec max.
	Positive-negative ion switching time	15 msec
Software	Workstation	LCMSsolution Ver. 5 for LCMS-2020
	OS	Windows XP Professional, Windows Vista Business
	Controllable instruments	HPLC (Shimadzu Prominence series), LCMS-2020 main body and interfaces
	Multi Sequence mode function	Scan/SIM/Profile/Positive ion/Negative ion/CID switching in Max. 64 methods and Simultaneous data acquisition are possible.
	Autotuning	Optimization for sensitivity and resolution in both positive and negative ionization modes
Installation Conditions	Temperature	18°C to 28°C
	Humidity	40% to 70% (no condensation)
	Dimensions	W 350 x H 553 x D 726 mm
	Weight	77.5 kg (MS)
	Power requirements	MS unit: AC 200V, 10A, 50/60Hz
	Gas	Nitrogen gas: consumption rate 21.5 L/minute max.

LCMS-IT-TOF

MS Detector

→P22

		LCMS-IT-TOF (225-07100-XX)
Unit	Mass range MS	m/z 50 to m/z 5000
	Sensitivity MS^n	m/z 50 - 3000
	Resolution	R > 10,000 at m/z 1,000 (FWHM)
	Precursor resolution	R > 1,000 at m/z 1,000
	Positive ion sensitivity	5 pg reserpine MS/MS m/z 609→471 S/N≧50 (N:0 - peak)
	Negative ion sensitivity	20pg p -nitrophenol MS m/z S/N≧20 (N:0 - peak)
	Mass accuracy	ESI 0.001 to 1 mL/min 5 ppm at m/z 1,000 internal reference method
Software	LC-compatible flowrates	LCMSsolution for LCMS-IT-TOF
	Workstation	LCMSsolution Ver. 5 for LCMS-2020
	OS	Windows XP Professional
	Controllable instruments	HPLC (Shimadzu Prominence series), LCMS-IT-TOF main body and interfaces
	Measurement mode	MS and MS^n, n: Max. 10, Manual/Auto MS^n measurement
	Tuning	Automated or manual tuning
Installation Conditions	Temperature	18°C to 28°C
	Humidity	40% to 70% (no condensation)
	Dimensions	W 1685 x H 570 x D 685 mm
	Weight	280 kg (MS)
	Power requirements	MS unit: AC 200V, 10A, 50/60Hz
	Gas	Nitrogen gas: consumption rate 21.5 L/minute max. Argon gas: consumption rate 5 mL/minute max.

JQA-0376

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