

# LC-4000

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# LC-4000 Series HPLC and UHPLC Systems

**The LC-4000 Series HPLC has key separation platforms at 50MPa for conventional HPLC (3, 5 and 10  $\mu\text{m}$  columns), at 70MPa for RHPLC (intermediate columns such as 2 to 3  $\mu\text{m}$  and 'Coreshell'), and at 130MP for UHPLC (sub 2 $\mu\text{m}$ ).**

## LC-4000 Series HPLC

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## Advances in HPLC Solvent Delivery

For more than three decades JASCO analytical HPLC pumps have employed an asymmetric twin-piston solvent delivery system SSQD (Slow Suction, Quick Delivery) which provides significantly better flow and pressure characteristics than conventional twin-piston reciprocating designs. SSQD Technology offers the highest stability 'compensated' solvent delivery used in the PU-4180/85 RHPLC and PU-4280/85 UHPLC pump models, this makes it an excellent choice for detectors that are affected by flow pulsation like ECD, RI and mass spec.

## Pioneering Optical Design

As a pioneer in optical spectroscopy, JASCO has optical designs that few can match. We have developed a range of HPLC detectors with unrivaled performance, including the class leading FP-4020 fluorescence detector with S/N greater than 2300:1 (Water Raman), RI-4035 UHPLC refractive index detector and the unique CD-4095 circular dichroism detector for chiral chromatography.



*LC-4000 Series HPLC*

## HPLC Method Development

With the range of separation columns becoming increasingly diverse – the traditional 5 $\mu\text{m}$  fully porous particle is finally losing ground to some of the newer technologies such as the new superficially porous solid core (coreshell) and the wide variety of sub-2 $\mu\text{m}$  particles. Requirements for method development are becoming more demanding and time consuming. For method development the CO-4065 prep columns oven can accommodate up to 10 analytical, preparative columns with automatic switching, and 6 or 10 solvent selection valves, controlled by the ChromNAV Method Development Module.



*Preparative HPLC System*

## Compact and Easy to Use



The footprint of the LC-4000 Series HPLC is only 30cm – requiring only a very small amount of bench space. For easy maintenance, all LC-4000

instruments feature front-panel access for replacing consumables such as pump seals and check valves and detector light sources. The autosampler consumables such as the syringe parts are easy to access.

HPLC modules are often used for non-HPLC applications, such as high accuracy feed pumps or stand-alone detectors for monitoring flow and reactors. For unattended operation RS-232 remains a convenient method for control and monitoring, using a simple communication protocol that can be included with each module.

# RHPLC Systems

## 'Conventional Analytical' HPLC and RHPLC Systems up to 70MPa

The LC-4000 Series RHPLC system with maximum operating pressure 700bar, 70MPa) has been designed to future-proof your HPLC requirements. The system can be used with conventional 3 – 5  $\mu\text{m}$  particle size analytical columns at typical lower pressures around 10 to 20 MPa (1500 to 3000 psi) and can also be used with smaller particles such as shorter length UHPLC columns and superficially porous (SPP) or Coreshell that require slightly higher pressure solvent delivery to provide optimum linear velocity through the column.



# UHPLC System Configurations

## Analytical UHPLC Systems

The LC-4000 UHPLC System is great for chromatographers who need to run a large number of samples or get results quickly. Pioneering column technology continues to push particle sizes ever smaller. The LC-4000-130 UHPLC (130MPa – 20,000 psi) is designed to take advantage of the separation efficiency of the very small particles coupled with longer and narrower columns. The LC-4000-130 system incorporates many of the same features as the 70 MPa system, but with materials designed to withstand even higher pressures.



# Single Quad LC-MS

The LC-4000-MS mass spectrometry system has been developed to harness the power of a single quadrupole MS with an easy to use HPLC system.

The CMS expression is a high resolution mass spectrometer with wide mass range and a choice of sources including ESI, APCI and ASAP – a direct injection method.

The separation system can be configured for a wide range of applications, including standard HPLC or UHPLC, to take full advantage of the speed and sensitivity of the mass spectrometer.

The LC-4000 Series includes various pump options for solvent delivery with accurate and pulseless flow, with flexible configuration for isocratic or binary and quaternary gradients.

The AS-4150 autosampler has capacity for up to 180 – 2 mL samples and includes full or variable loop injections. The sample pre-load feature eliminates sample loading time between injections for the fastest sample cycle time to get results faster.

Several optional column ovens offer the advantage of temperature control with single column or multi-columns for rapid method development.

The mass spectrometer can be a simple, cost effective CMS expression single quadrupole instrument, or a higher specification tandem MS with either a triple quadrupole (TQ) or time of flight (TOF) with fully integrated control of the LC for a powerful high throughput analytical or preparative system. Multiple source options include ESI and APCI.



# Preparative HPLC Systems

## Three Platform Options:

- Up to 20 mL/min for columns up to 21.2 mm ID
- Up to 50 mL/min for columns up to 30 mm ID
- Up to 120 mL/min for columns up to 50 mm ID

Large column oven CO-4065 for multiple preparative columns and optional automatic column switching

Open-bed fraction collector with sample trays for tubes, plates or large containers

ChromNAV-FC for fraction control using time, threshold or slope from up to four different detector signals



*LC-4000 Preparative HPLC*

# Compact HPLC System Configurations - LC-4500 Series

The LC-4500 compact HPLC for routine analytical & small scale preparative separations.

This simple modular HPLC system is so flexible that it can be used for a wide range of applications in academic research, teaching or QA/QC.

The extremely compact stackable design requires only 6 inches (15cm) of bench space, and can be easily fit into most fume cabinets where space is a premium.

The individual pump, detector and autosampler modules each have an option for keypad control, external control by RS232 or simple contact closure, so that they can be readily incorporated into other systems for both chromatography and non-chromatography applications.



## KEY FEATURES

### *LC-4500 Compact HPLC System*

- Compact module (only 15 cm wide) for efficient use of lab space
- PC control using ChromNAV 2.0
- User-friendly keypad for simple operation, or RS232 remote control
- Isocratic or gradient solvent pumps, with manual injector or autosampler
- Use with the compact UV-4570 UV-visible detector or choose a detector from the LC-4000 Series
- Modules can be used individually or combined into flexible systems



# Tandem LC-MS

## LC/SFC Drivers for SCIEX Analyst® Software



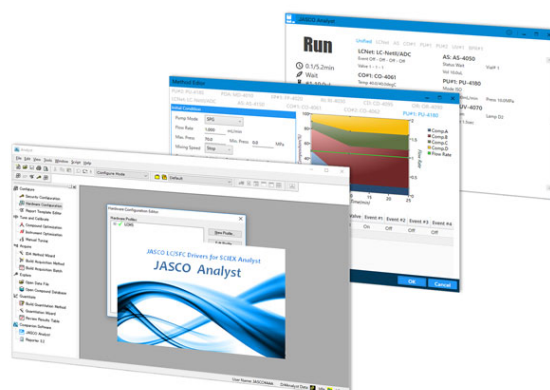
### Features

- Simultaneous control of SCIEX mass spectrometer and JASCO HPLC and SFC.
- Build versatile LC-MS/MS and SFC-MS/MS systems.
- High-sensitivity and high-throughput for a wide range of samples.
- Supports LC-4000, 4500 (and previous models), LC-3000, 2000, 1500 Series.

### SCIEX Mass Spectrometers

#### API 3200™, Triple Quad™ (3500, 4500, 5500, 6500+)

- Triple quad mass spectrometer with modern, robust, and straightforward design
- Known for accurate quantitation and Turbo VTM ion source, you can develop powerful methods for complex matrixes



#### QTRAP® (3200, 4500, 5500, 6500+)

- Unique tandem mass spectrometer with the hybrid capability of a triple quad for quantitation and linear ion trap for identification

JASCO LC and SFC systems are compatible with SCIEX Triple Quad™ and QTRAP® Mass Spectrometers. JASCO LC/SFC drivers offer integrated control with SCIEX Analyst® Software.

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# LC-4000 and LC-4500 Series HPLC Pumps

## LC-4000 and LC-4500 Series HPLC Pumps

The LC-4000 and LC-4500 Series of HPLC pumps can be used as part of any HPLC system or can be configured for stand-alone use with keyboard control.

Four operating pressures are available:

- Compact HPLC (500bar)
- RHPLC (700bar),
- UHPLC (1300 bar) and
- Conventional/preparative (500 bar).

## LC-4500 Series Compact HPLC Pumps



PU-4580 Compact HPLC Pump

### Compact HPLC Pumps

Only 6 inches wide (15cm)

**Options:** Isocratic, gradient, semi-micro and semi-preparative

**Flow Rate:**  $\pm 1\%$  or  $\pm 2 \mu\text{L}/\text{min}$ , whichever is larger. (0.5 – 10.0 mL/min)

**Operating Pressure:** 50 MPa (up to 6.0 mL/min), 35 MPa (up to 10.0 mL/min)

## LC-4000 Series Pumps

Each base unit has two expansion bays that allow an isocratic pump to be transformed into a binary or quaternary gradient solvent delivery system with internal degasser, mixer and optional solvent selection for method development.



HPLC, RHPLC  
PU-4180 Analytical Pump

### HPLC / RHPLC Pumps

**Options:** Isocratic, Binary (two pumps and high pressure mixer) and Quaternary (four solvent gradient mixer with vacuum degasser)

**Flow Rate:** Up to 5 mL/min gradient (10mL/min isocratic)

**Operating Pressure:** Up to 700 Bar

**Degassing:** Vacuum (Option)

**Solvents:** 2, 6 or 10



RHPLC  
PU-4185 Semi-Micro Pump

### RHPLC Semi- Micro Pumps

**Options:** Isocratic, (two pumps and high pressure mixer)

**Flow Rate:** Up to 4 mL/min

**Operating Pressure:** Up to 700 Bar

**Degassing:** Vacuum (Option)

**Solvents:** 2, 6 or 10



UHPLC  
PU-4285 Semi-Micro Pump

#### UHPLC Pumps

**Options:** Isocratic, Binary (two pumps and high pressure mixer)

**Flow Rate:** Up to 2 mL/min

**Operating Pressure:** Up to 1,300 Bar

**Degassing:** Vacuum (Option)

**Solvents:** 2, 6 or 10



PREPARATIVE  
PU-4086/7 Preparative  
Pump

#### Preparative Pumps

**Options:** Isocratic and Binary (two pumps and high pressure mixer)

**Flow Rate:** Up to 20 mL/min (PU-4086)

**Flow Rate:** Up to 50 mL/min (PU-4087)

**Flow Rate:** Up to 150 mL/min (PU-4088)

**Operating Pressure:** Up to 500 Bar

**Degassing:** Vacuum (Option)

**Solvents:** 2, 6 or 10

### HPLC Pump Configuration

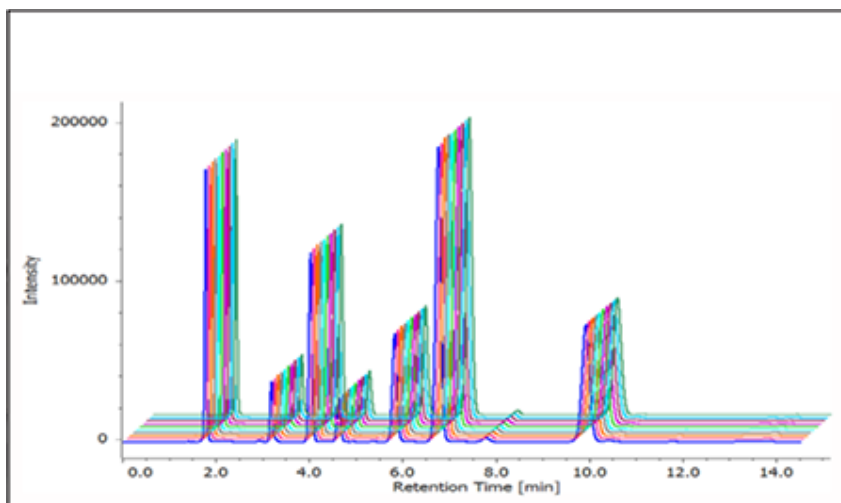
The unique expansion bays each pump base can be fitted with plug-in modules to quickly transform a simple isocratic pumping system into a multi-solvent delivery system. Install a second pump (with dynamic mixer) for binary gradients or a quaternary low pressure mixing gradient unit (four solvent), either can be configured with an optional low volume vacuum degasser. A 6 – or 10 solvent selection valve can be added for method development.

### Control

The PU-4000 Series pumps are normally used as part of a complete HPLC system, however for applications that require stand-alone operation, each instrument has its own keypad and can be controlled using an RS232 protocol and/or contact closures (TTL) to start/stop the pump.

## Retention Time Reproducibility

### Isocratic Retention time Reproducibility – PU-4180



PU-4180 Flow rate accuracy – (1.0mL/min)

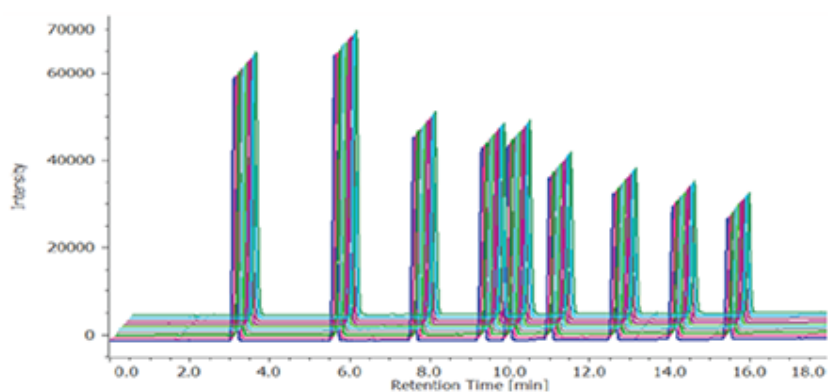
### Conditions

Mobile Phase	Acetonitrile/Water (80:20)
Flow Rate	1.0mL/min
Column	CrestPak C18S (4.6mmI.D. x 150mm, 5µm)
Column Temperature	40° C
Detection Wave Length	260nm, Response; 1sec
Sample	Polycyclic aromatic hydrocarbon (10µg/mL each) (Naphthalene, Fluorene, Anthracene, Pyrene, Chrysene, Benzon[a]pyrene)
Injection	10 µL

### Isocratic Peak Retention Time Reproducibility

#	Naphthalene	Fluorene	Anthracene	Pyrene	Chrysene	Benzon[a]pyrene
1	3.1400	3.9367	4.5000	5.6283	6.4934	9.4267
2	3.1417	3.9683	4.5017	5.6317	6.4950	9.4300
3	3.1417	3.9367	4.5000	5.6300	6.4933	9.4285
4	3.1400	3.9367	4.5002	5.6283	6.4950	9.4283
5	3.1400	3.9367	4.5000	5.6283	6.4950	9.4283
6	3.1400	3.9367	4.5000	5.6300	6.4933	9.4283
7	3.1416	3.9383	4.5016	5.6317	6.4967	9.4317
8	3.1400	3.9367	4.5000	5.6300	6.4950	9.4317
9	3.1400	3.9367	4.5000	5.6300	6.4949	9.4317
10	3.1400	3.9367	4.5017	5.6301	6.4950	9.4317
Average	3.1405	3.9370	4.5005	5.6299	6.4947	9.4297
Standard Deviation (n-1)	0.001	0.001	0.001	0.001	0.001	0.002
CV% (n-1)	0.025	0.018	0.017	0.022	0.016	0.020

### Gradient Performance for PU-4180LPG Quaternary RHPLC Pump



PU-4180 Quaternary gradient mixing performance (1.0mL/min)

## Conditions

Mobile Phase	A; Water, B, Acetonitrile
Flow Rate	1.0mL/min
Gradient	(A/B) (65/35) → (5/95) Linear Gradient
Flow Rate	1.0mL/min
Column	CrestPak C18S (4.6mm I.D. x 150mm, 5µm)
Column Temperature	40° C
Detection Wave Length	254nm, Response; 1sec
Sample	Alkylphenone samples 10µg/mL (Benzophenone 5µg/mL) (Acetanilide, Acetophenone, Propiophenone, Butyrophenone, Benzophenone, Valerophenone, Hexanophenone, Heptanophenone, Octanophenone)
Injection	10 µL

## Gradient Peak Retention Time Reproducibility

#	Acetanilide	Acetophenone	Propiophenone	Butyrophenone	Benzophenone	Valerophenone
1	3.117	5.617	7.590	9.303	9.950	10.980
2	3.117	5.617	7.590	9.307	9.950	10.983
3	3.113	5.617	7.590	9.307	9.950	10.983
4	3.117	5.617	7.590	9.307	9.953	10.983
5	3.117	5.617	7.590	9.307	9.953	10.983
6	3.117	5.620	7.593	9.310	9.953	10.987
7	3.117	5.620	7.590	9.307	9.953	10.983
8	3.117	5.617	7.590	9.310	9.953	10.987
9	3.117	5.617	7.593	9.310	9.957	10.987
10	3.117	5.620	7.593	9.313	9.957	10.990
Average	3.116	5.618	7.591	9.308	9.953	10.985
Standard Deviation (n-1)	0.001	0.002	0.002	0.003	0.002	0.003
CV% (n-1)	0.034	0.029	0.021	0.030	0.025	0.026

## HPLC Pump Configurations

The PU-4180/85 and PU-4280/85 can be configured for single pump gradient and multiple pump gradient operation. The single pump quaternary gradient module offers excellent gradient formation for up to four solvents. A newly designed 4-way valve for switching the solvents is synchronized to the operation of the pump motor control – ‘variable cycle adaption’ optimizes delivery according to gradient resolution and flow rate. This highly efficient quaternary gradient can be applied across a wide flow-rate range. Binary and ternary gradient (using 2 or 3 pumps) with optional



built-in degasser can be used for fast cycle high-resolution gradient formation; the gradient response time is superior to the single pump quaternary gradient system.

*PU-4180 Compact Quaternary Gradient Pump  
with Degasser*

## Eliminating Pulsation

The problems caused by pressure variations in solvent delivery when switching between two pump heads in a double reciprocating pump are virtually eliminated with JASCO's unique asymmetric design that precisely controls the cross-over points of the plungers. The LC-4000 series analytical pumps offer flow rate precision with RSDs of better than 0.05% (difficult to achieve with commercially available pumps).

## Maximum Pressure

The PU-4180 and 4185 pumps operate at pressures up to 70 MPa (700bar), typically used with RPLC for core-shell columns or similar micro packing materials as well as for use with conventional HPLC. The PU-4280/85 UHPLC pumps operate at pressures up to 130 MPa (1300 bar) for columns with particle sizes of less than 2  $\mu\text{m}$ .



## Gradient Mixing

Multi-pump gradient mixing is done using a variable speed dynamic mixer with a range of a small volume mixing chambers to provide the smallest possible dead volume, offering higher mixing efficiencies for all HPLC solvents. The optional in-line TERA mixer is a turbulent-flow solvent mixer uniquely designed to offer high efficiency mixing with minimal dead volume.

*PU-4185-Binary Pump  
Two Pump Binary Gradient*

## Solvent Degasser

The in-line vacuum solvent degasser uses a Teflon AF membrane with a hold-up volume of only 400 $\mu\text{L}$  (per solvent line); for fast solvent priming with minimal waste. Despite its small size, the new degasser offers more effective and stable degassing than larger previous generation models. A degasser for preparative HPLC is also available.

## Preparative and Semi-Preparative Pumps

The LC-4000 Preparative HPLC includes pumps at three scales. PU-4086 – flow rates up to 20 mL/min, PU-4087 – up to 50 mL/min and PU-4088 up to 120mL/ min. Single and multi-pump gradient modes can be used with the each pump for isocratic and gradient. The new 'MK2 technology' used in the PU-4086 and PU-4087 motor driver control has been increased so that the maximum pressure can be used at much higher flow-rates for all models, for use with longer preparative HPLC columns that generate more back pressure, and for faster and more productive preparative separations.



*PU-4186 Semi-Prep Pump  
Recycling Inlet Switching Unit,  
Recycling Valve Unit (Option)*

# LC-4000/4500 Series HPLC, RHPLC and UHPLC Autosamplers

## HPLC Autosamplers

The LC-4000/4500 Series HPLC autosamplers provide a range of options to suit any sample injection requirements. Any of these products can be added to an existing system with keypad or optional RS232 control.

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### AS-4550 Compact Autosampler

- Only 6 inches wide (15cm)
- Variable and fixed loop injection modes (includes: dilution and pre-column derivatization modes)
- Optional sample racks for a range of vial sizes and microplates
- Optional rack temperature control (4-40°C)



*AS-4550  
Autosampler*

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### AS-4050 General Purpose HPLC Autosamplers

The AS-4050 is a 60 sample autosampler for use with conventional HPLC with options for analytical and semi-preparative injection volumes.



*AS-4050 Routine  
HPLC Autosampler*

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### AS-4150/4250 RHPLC and UHPLC Autosamplers

The AS-4150 and AS-4250 are high-capacity, high performance autosamplers designed for RHPLC (up to 70MPa) and UHPLC (up to 130MPa), respectively, with a minimum injection cycle-time of only 30 seconds.



*RHPLC Autosampler  
AS-4150*

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### AS-4058 Preparative HPLC Autosamplers

The AS-4058 is a large volume injection autosampler, up to 5mL as standard (10mL, option). This autosampler is used in preparative systems with either PU-4087 (50mL/min) or PU-4088 (150mL/min) pumps.



*AS-4058 Preparative  
HPLC Autosampler*

## Sample Protection

Peltier control is available for maintaining sample temperature and light protection is available on the higher level models for photo-labile samples.

## Sample Derivatization and Dilution

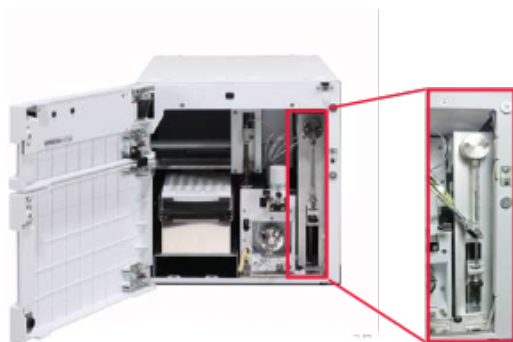
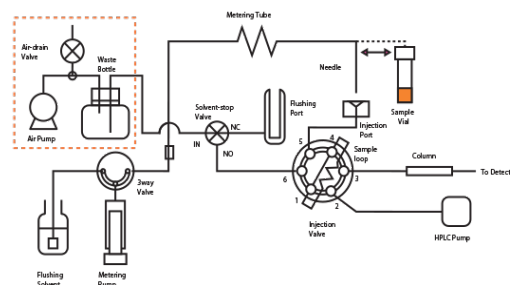
Sample preparation is available on the RHPLC and UHPLC autosamplers with programmable sample dilution and pre-column derivitization.

## Injection Modes

The injection mode can be switched between full loop and partial loop injections.

## Low Carry-Over

An external single solvent wash is included on all models. An optional 5 solvent flushing system can be added to virtually eliminate carry-over. An optional degasser can be installed for degassing up to 5 flushing solvents.



*Easy maintenance, access all consumable parts through the front panel*

## Maintenance

All LC-4000 Series HPLC autosamplers share the same simple maintenance features, with consumable parts such as injection ports, rotor seals, and loops accessible from the front panel for easy replacement.



# LC-4000 Series HPLC Column Ovens

## HPLC Column Ovens

The LC-4000 Series HPLC column ovens have been designed to provide excellent utility for a wide range of different user requirements.

All HPLC column ovens have built-in electronic cooling for controlling column temperature at sub-ambient temperatures. The CO-4062 and CO-4061 block-heater type ovens can be fitted with an optional micro-volume pre-heating unit for pre-heating the mobile phase before the column to improve resolution and peak shape.

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### CO-4061

For simple requirements the stackable CO-4061 can be used with column lengths up to 200mm (or up to 300mm with an optional extension).

### CO-4062

For RHPLC and UHPLC the CO-4062 has capacity for up to six 150 mm length columns, with optional one or two internally mounted automatic switching valves for 2 or 6 column selection.



*HPLC  
CO-4061/62  
Compact*

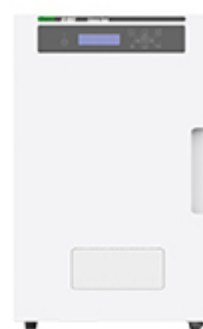
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### CO-4060/CO-4065

For GPC and larger preparative columns, select either of the two high-capacity CO-4060 or CO-4065 HPLC column ovens. The CO-4060 can accommodate columns with lengths up to 300mm or larger ID preparative columns. The CO-4065 can accommodate up to 10 columns with lengths up to 300mm and a pair of column selection valves is included as standard.



*CO-4060*



*CO-4065 Prep*



*CO-4060  
High  
Capacity*

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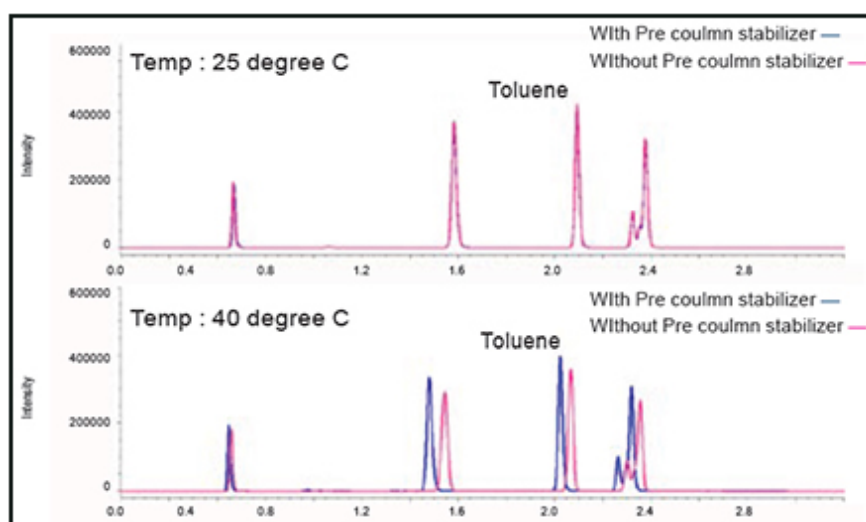
### RO-4068

The RO-2068 reaction oven is used for high temperature post-column sample processing with capacity for columns and reaction coils.



RO-4068  
Reaction Oven

## Pre-Column Temperature Stabilizer



Efficiency comparison of stabilizer

## Analysis Conditions

Column	X-Presspak VC18-W (3 mmI.D. x 50 mmL, 2 µm)	
Eluent	Water / Acetonitrile (Gradient)	
Flow Rate	1.0mL/min	
Sample	Gasoline Oxidization Products	

## Comparison of Toluene Peaks

Room Temp.	Oven Temp.	Pre-Column Stabilizer	Theoretical	Peak Width	tR(min)
21°C	25°C	With	56095	0.019	1.893
		Without	54747	0.019	1.897
	40°C	With	46021	0.020	1.799
		Without	36402	0.023	1.851

# HPLC and SFC Detectors

## Comprehensive Range of HPLC and SFC Detectors

The LC-4000 Series next generation HPLC detectors with the latest optical and electronic technologies for high sensitivity, excellent stability and easy maintenance.



**UV-Visible HPLC Detectors**



**PDA HPLC detectors**



**HPLC Fluorescence Detectors**



**Refractive Index**



**Circular Dichroism HPLC Detector**



**Mass Spectrometry**

# UV-Visible HPLC Detectors

## UV-Visible HPLC Detectors

### LC-4500 Series Compact detectors

The UV-4570 is only 6 inches wide (15cm) and can be used stand-alone or as part of a system for single wavelength measurement from the UV to Visible region (190-900 nm). With cassette-type tapered flow-cells and user replaceable lamps.

Programmable wavelength switching and spectral scanning

### Optional flow cells

Micro, preparative and high-pressure



*UV-4570 Compact UV-Visible Detector*

### LC-4000 Series Single/Dual Wavelength Scanning UV-Visible HPLC detectors.

The UV-4070 (190 – 900nm) and UV-4075 (190 – 700nm) UV-visible HPLC detectors both use an advanced Czerny-Turner monochromator with dual wavelength and scanning functions. Baseline change due to refractive index is minimized by the flow cell design, and fluctuation from changes in environmental and lamp temperature are reduced with a regulated lamp housing and temperature controlled cell.

### Optional flow cells

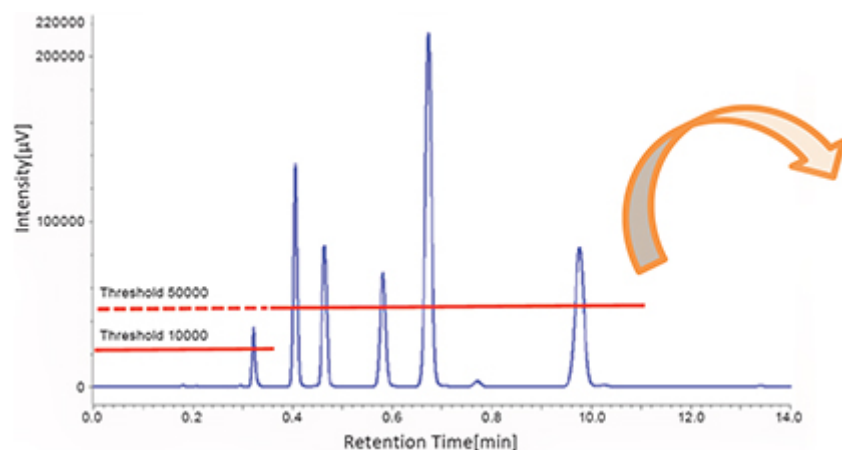
Semi-micro, semi-micro SP (UHPLC), preparative and high pressure for SFC

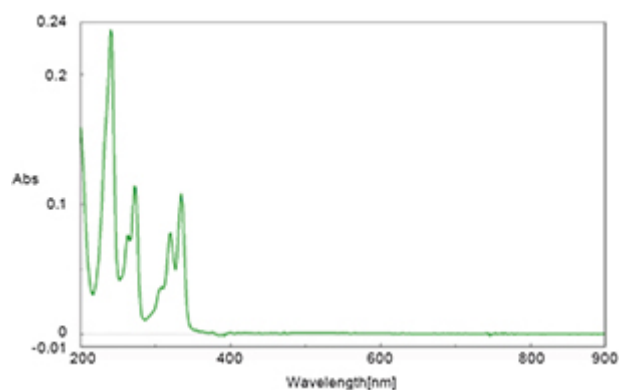


*UV-4070 UV-Visible Detector*

## Spectral Scanning and Dual Wavelength Detection

Both detectors include dual-wavelength data acquisition (up to 100Hz for UHPLC) and spectral scanning. Spectral scanning can be executed automatically in ChromNAV CDS, by time or by height when a peak exceeds a set threshold.





Initial Condition		Time Program	
#	Time	Function	Value#1
1	0.50	Baseline Spectrum	
2	3.00	Start Auto scan	10000
3	3.50	Stop Auto scan	
4	3.60	Start Auto scan	50000
5	12.00	Stop Auto scan	
6			

## Easy User Maintenance

User maintenance can be done without removing the module from the system. Light source replacement is made through the front panel and automatic wavelength calibration can be carried out using a mercury lamp.

## Operation as a Stand-Alone Instrument

The UV-4000 series detectors have a keypad for direct control, parameters can be easily changed and operated in a time program for control throughout a separation (this can be triggered using a TTL pulse or contact closure). A simple RS232 protocol can be used for control through third part programs.



*Front panel access for lamp replacement*

# Photometric Diode Array (PDA) HPLC Detectors

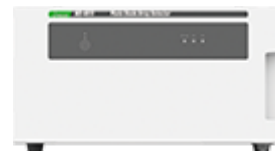
## PDA HPLC Detectors

The LC-4000 Series includes three PDA detectors. The MD-4017 is a simple replacement for a single wavelength detector, the MD-4015 is the workhorse for UV-Visible detection in the range 200 to 650nm and the MD-4010 has a wide wavelength range.



*Front-panel access for easy lamp replacement*

The MD-4010 PDA detector has high sensitivity, comparable to a single wavelength detector. It uses a 1024 element photometric diode array, with measurement wavelength range from 190nm to 900nm and resolution of 1nm. Fast spectral acquisition rate of up to 100 spectra/sec. The temperature controlled SP type semi-micro flow cell is used narrow peaks typically found with fast UHPLC or RPLC separations. An integrated mercury lamp is used for automatic wavelength calibration and validation.



*PDA Detector  
MD-4010/15/17*

The MD-4015 PDA detector is similar to the MD-4010 with equivalent sensitivity, covering the wavelength range from 200nm to 650nm using a 512 element PDA for 1nm resolution, and with high speed 100Hz spectral acquisition.

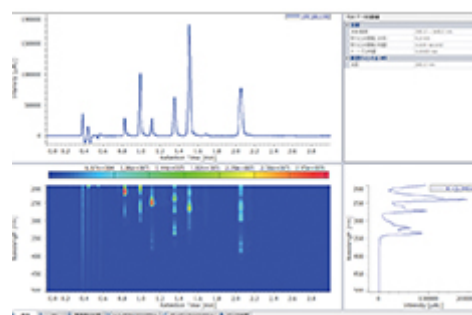
The MD-4017 uses a CMOS detector covering the UV region from 200-400nm; with 1nm resolution and up to 20Hz spectrum acquisition; useful for peak widths as small as 1 – 2 seconds.

## Optional Flow Cells

Semi-micro, semi-micro SP (UHPLC), preparative and high pressure for SFC.

## ChromNAV 2.0 PDA Data System

Includes: multi-functional analysis with spectral analysis, contour map, 3D, library search for peak identification, peak-purity and multi-wavelength quantitation.



*ChromNAV PDA data processing  
included as standard*

# HPLC Fluorescence Detectors

## HPLC Fluorescence Detectors

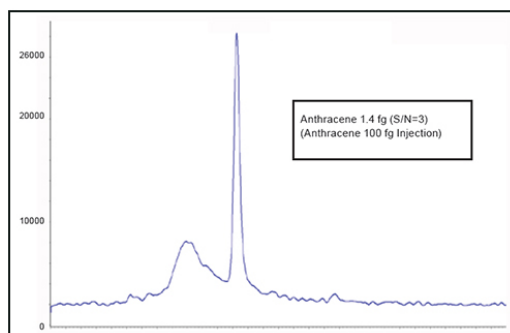
The FP-4020 and FP-4025 fluorescence detectors have been designed for the pursuit of extreme sensitivity. A complete redesign of the optics and electronics, as well as removing the effects of temperature fluctuation with a new temperature-regulated cell body has led to the highest sensitivity with stable detection.



FP-4020 HPLC Fluorescence Detector

## Unparalleled Sensitivity

The new axially irradiated cell design enables the very highest sensitivity detection. These changes have resulted in a leap in sensitivity with signal noise ratio of 2300:1 or higher (water Raman peak).

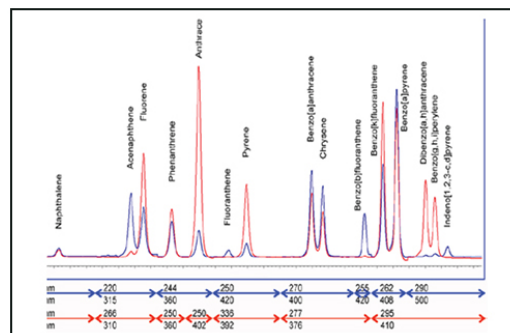


High sensitivity measurement of Anthracene

The FP-4025 is an excellent routine fluorescence detector that has a water Raman S/N of 1400:1.

## Dual Wavelength Measurement

Both detectors can be used for simultaneous detection at two wavelength pairs; excitation and emission wavelengths can be changed during the acquisition using a time program and automatic spectra scanning can be triggered manually, by time or automatically by threshold. A built-in mercury lamp enables automatic wavelength correction and the front-access design allows easy replacement of the flow cell assembly and light source.



Dual wavelength simultaneous measurement

## Spectral Scanning

Excitation and emission spectra can be scanned using ChromNAV chromatography data system and can be set to operate, manually, at a specified time or using a threshold trigger.

Initial Condition		Time Program	
#	Time	Function	Value #1
1	0.50	Baseline Spectrum	
2	3.00	Start Auto scan	10000
3	3.50	Stop Auto scan	
4	3.60	Start Auto scan	50000
5	12.00	Stop Auto scan	
6			



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## Control

Individual LC-4000 Series instruments are normally used as part of a complete HPLC system, however for applications (such as adding to a third party system or for a non-LC application) that require stand-alone operation, each instrument has its own keypad and can also be controlled using an RS232 command set, and/or contact closures (TTL) to start and stop the pump.

# Refractive Index HPLC Detectors

## Refractive Index HPLC Detector

The RI-4030/35 refractive index detectors include an optical system mounted in a precise temperature-regulated housing to eliminate the influence of changes in ambient temperature. Both detectors are fully stable just one hour after powering on.

The RI-4030 can be used for analytical and preparative scales. For preparative separations, the maximum flow rate is 120 ml/min.

The RI-4035 is a dedicated semi-micro RI detector with a micro-volume flow cell designed for use with fast semi-micro GPC analysis using columns with a fine pore size.

The 100Hz data acquisition rate makes the RI-4035 suitable for RHPLC and UHPLC separations. The LED light source in both detectors has a long lifetime (over 10,000 hours) for low maintenance. An optional pressure release safety-valve can be fitted to prevent damage to the flow cell in the event blockage.



*RI-4030 Refractive Index HPLC Detector*

# Chiral HPLC Detectors - Optical Rotation (ORD) and Circular Dichroism (CD)

## Circular Dichroism Detector

The CD-4095 is a unique HPLC CD detector for measuring circular dichroism developed from the market leading J-Series circular dichroism spectropolarimeters. Optically active compounds with a chromophore close to a chiral center may absorb circularly polarized light, which can be detected with excellent sensitivity and selectivity. When chiral compounds are measured using a UV-Visible detector, the d- and l- enantiomers cannot be distinguished even when separated by a chiral column, however the CD-4095 CD detector makes it possible to positively distinguish between the d- and l- enantiomers by measuring their positive and negative peaks. It is also possible to quantify the d- and l-forms even when they are not separated; a calibration curve based on the g-factor can be used to determine the enantiomeric ratio. ChromNAV CDS can be used to simultaneously measure the CD, g-factor data and UV-visible signals. The CD spectra of eluted compounds can be measured by triggering scanning manually, by timed program or automatically by threshold.

*The CD-4095 can be used with SFC and HPLC.*



**CD-4095** Circular Dichroism HPLC Detector

## Optical Rotation Detector

The OR-4090 chiral detector measures the angle of rotation of plane polarized light caused by optical active isomers and is useful for chiral compounds with no absorption. The OR-4090 uses a high intensity Hg-Xe arc lamp (150W) providing a strong output in the UV-Visible region where the largest optical rotations offer the highest sensitivity. The wide wavelength range from 350-900nm also allows measurement of a wide variety of samples.

*The OR-4090 can only be used with HPLC.*



**OR-4090** Optical Rotation

# Single Quadrupole Mass Spectrometer Detector

For HPLC and SFC

## expression CMS Single Quadrupole Mass Spectrometer Detector

The expression CMS range of compact single quadrupole mass spectrometers for small molecule analysis. The CMS can be interfaced with HPLC or SFC for analytical to preparative scale separations. ChromNAV chromatography Data system, includes integrated control for selecting measurement parameters and executing measurement with timed event control for switching polarity and mass range. TIC, EIC and SIM can all be used to monitor chromatograms and to trigger fraction collection for selective fractionation.



*expression CMS single quadrupole mass spectrometer*

Specification	cms-E	cms-S	cms-L
Ion Source		ESI, APCI, or APCI/ASAP (direct analysis probe)	
API interface		orthogonal ion sampling from heated capillary – allows for small single turbo pump (Patents pending)	
Flow rate range		10 $\mu$ L/min to 1 mL/min ESI; 10 $\mu$ L/min to 2 mL/min APCI	
Polarity		Positive & Negative ion switching in single analysis	
Polarity Switching Speed		50 ms	
m/z Range	80 to 800 m/z	10 to 1,200 m/z	10 to 2,000 m/z
Acquisition speed		10,000 m/z units sec <sup>-1</sup> (compatible with UHPLC)	
Resolution		0.5-0.7 m/z units (FWHM) at 1000 m/z units sec <sup>-1</sup> over entire acquisition range	

Specification	cms-E	cms-S	cms-L
SIM sensitivity		10 pg Reserpine (FIA – 5µL sample injection volume at 100 µL/min) 100:1 S/N (RMS) with SIM of m/z 609.28	
Accuracy		± 0.1 m/z units over entire acquisition range	
Dynamic Range		4.5 orders of magnitude	

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