SHIMADZU
Excellence in Science

High Performance Liquid Chromatograph

# i-Series

## Specifications

# Maximum Reliability and Stability

## — Fundamental functions assure analysis results —

ANALYTICAL INTELLIGENCE

Advanced
**i-Series**
High Performance Liquid Chromatograph

### Use of Multiple Detectors Expands Application Range

In addition to the UV-visible (UV/VIS) absorbance detector or photodiode array (PDA) detector included as standard, a fluorescence detector or differential refractive index detector can be added.

### Excellent Baseline Stability Unaffected by Circumstances

The UV/VIS detector and the PDA detector employ dual-temperature control (TC-Optics and flow cell) and provide measurements with a stable baseline hardly affected by room temperature fluctuation.

### Supports High-Speed Multi-Analyte Processing

A 14-second injection cycle maximizes the number of samples that can be processed.

Moreover, a total of 1536 samples can be accommodated in right and left sample racks.

### Autosampler Enhances Data Reliability

Excellent reproducibility for injection volumes less than 1 µL, wide linearity range and ultra-low carryover (<0.0025%) improve the reliability of data, especially for analyses of precious biological samples and direct analyses of concentrated samples.

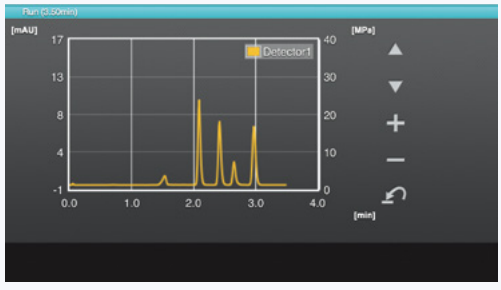
### Open Access Sample Placement

A direct access mechanism on sample racks allows the user to place the sample on racks that are not involved in sample injection even during analysis.

Furthermore, racks can be shared by multiple analysts, without interrupting the analysis of samples placed by others. Overall, this function enhances work efficiency.

### System Monitoring via Smart Devices

System status and chromatograms can be viewed remotely from smart devices and home computers. Situations can be checked without needing to visit the laboratory.




Window on a Smartphone


## Refined Usability

Control panel with a color LCD touch panel allows anyone to operate the instrument, regardless of experience level. Easily and reliably perform routine maintenance following on-screen instructions.

## Displays Chromatogram in Real Time

The chromatogram real-time monitor allows the user to immediately confirm the success or failure of data, even in a computer-less laboratory environment.

## Large-Capacity Column Oven Supports Up to 90°C

The Forced-air circulation method enhances column temperature stability. Maximum operating temperature of 90°C allows high-temperature analyses such as sugar analysis. Moreover, three 300 mm long columns or six 100 mm long columns can be accommodated.

## Quaternary Solvent Delivery Unit

A 10 µL micro plunger ensures accurate quaternary gradient delivery. Optional reservoir switching valve further extends the solvent selection to seven so that the solvent for the flow path rinsing can be set.

## Auto Shutdown Function Reduces Power Consumption

After analysis is complete, the auto shutdown function minimizes power consumption in standby mode and can reduce power consumption by at least 95% compared to normal standby mode.

## Compact Footprint

The i-Series brings together all the functions required for LC analysis in an integrated form. With its space-saving design, which is only 410 mm wide, three units can be installed on a laboratory bench compared to only two comparable instruments from other companies. The instrument footprint does not change even if another detector is installed.

# Specifications

| | Model | LC-2050 (UV model without sample cooler) | LC-2050C (UV model) | LC-2050C 3D (PDA model) | LC-2050C LT (detector-less model) | LC-2060C (UV model) | LC-2060C 3D (PDA model) | LC-2060C 3D MT (PDA model) |
|---|---|---|---|---|---|---|---|---|
| | P/N | S228-65820-58 | S228-65821-58 | S228-65822-58 | S228-65823-58 | S228-65824-58 | S228-65825-58 | S228-65826-58 |
| Pump | Degassing unit | Five Lines: Mobile phase 4 + Rinse solution 1 (Volume 400 µL) | | | | | | |
| | Pumping method | Parallel-type double plunger | | | | | | |
| | Pulsation | ≤ 0.1 MPa (1.0 mL/min,10 MPa, Water) | | | | | | |
| | Flow rate setting range | 0.0001 to 10 mL/min | | | | | | |
| | Flow rate accuracy | ≤ ±1% or ≤ ±2 µL/min, below whichever is greater (0.01 to 2 mL/min, Specified condition)<br>≤ ±2% (2 to 5 mL/min, Specified condition) | | | | ≤ ±1% or ≤ ±2 µL/min, below whichever is greater (0.01 to 2 mL/min,1 to 40 MPa, Specified condition)<br>≤ ±2% or ≤ ±2 µL/min, below whichever is greater (0.01 to 3 mL/min, 40 to 60 MPa, Specified condition) | | |
| | Flow rate precision | < 0.06 %RSD or < 0.02 minSD, below whichever is greater | | | | | | |
| | Configuration | Four-solvent low-pressure gradient | | | | | | |
| | Gradient / range of set concentrations | 0 to 100%, in 0.1% steps | | | | | | |
| | Gradient / concentration accuracy | ±0.5% (0.1 to 2 mL/min, 1 to 20 MPa, Specified condition) | | | | | | |
| | Gradient / concentration precision | ±0.1% (1 mL/min,10 MPa, Specified condition) | | | | | | |
| | Maximum pressure | 50 MPa (0.0001 to 5 mL/min)<br>22 MPa (5.0001 to 10 mL/min) | | | | 70 MPa (0.0001 to 3 mL/min)<br>44 MPa (3.0001 to 5 mL/min)<br>22 MPa (5.0001 to 10 mL/min) | | |
| | System Delay Volume | 650 µL (Option: 460 µL, 1100 µL) | | | | 460 µL (Option: 650 µL, 1100 µL) | | 505 µL (Flow path 1)<br>765 µL (Flow path 2) |
| Autosampler | Injection method | Total-volume sample injection | | | | | | |
| | Injection volume accuracy | ±1% (50 µL, N = 10) | | | | | | |
| | Injection volume setting range | 0.1 to 100 µL (Option: 0.1 to 50 µL, 1 to 500 µL, 1 to 2,000 µL) | | | | 0.1 to 50 µL (Option: 0.1 to 100 µL, 1 to 500 µL, 1 to 2,000 µL) | | |
| | Injection volume reproducibility | RSD < 0.20% (5.0–2000 µL)<br>RSD < 0.25% (2.0–4.9 µL)<br>RSD < 0.5% (1.0–1.9 µL)<br>RSD < 1.0% (0.5–0.9 µL) | | | | | | |
| | Cross-contamination | 0.0025% (Caffeine, Specified condition) | | | | | | |
| | Injection cycle time | Min. 14 sec (Specified condition) | | | | | | |
| | Samples for processing | 336 (1 mL), 216 (1.5 mL), 112 (4 mL), 4 (MTP/DWP) | | | | | | |
| | Sample cooler | Not included | 4 to 45°C (Room temperature needs to be 30°C or lower and the humidity 70% or less to go down to 4°C. Room temperature needs to be 15°C or higher to go up to 45°C.) | | | | | |
| | Injection linearity | > 0.9999 (1 to 100 µL, Specified condition) | | | | > 0.9999 (1 to 50 µL, Standard Sample Loop, Specified condition),<br>> 0.9999 (1 to 100 µL, 100 µL Sample Loop (Option), Specified condition) | | |
| Column Oven | Heating and cooling method | Forced air circulation method | | | | | | |
| | Containable column size | 6 pieces at 10 cm max., 3 pieces at 10 to 30 cm | | | | | | 2 pieces at 10 to 30 cm |
| | Temperature control range | Room temperature – 12 to 90°C, Setting range 4 to 90°C | | | | | | |
| | Temperature control precision | ±0.1°C | | | | | | |
| | Temperature stability | ±0.8°C (Specified condition) | | | | | | |
| | Flow rate switching valve | Max. 1 pc | | | | | | Not allowed |

| | Model | LC-2050 (UV model without sample cooler) | LC-2050C (UV model) | LC-2060C (UV model) |
|---|---|---|---|---|
| | P/N | S228-65820-58 | S228-65821-58 | S228-65824-58 |
| UV Detector | Wavelength range | 190 to 700 nm | | |
| | Spectral bandwidth | 8 nm | | |
| | Wavelength accuracy | ≤ ±1 nm | | |
| | Wavelength reproducibility | ≤ ±0.1 nm | | |
| | Noise level | ≤ ±2.5 × $10^{-6}$ AU, (250 nm, Specified condition) | | |
| | Drift | ≤ 100 × $10^{-6}$ AU/h (250 nm, Specified condition) | | |
| | Simultaneous monitoring of 2 wavelengths | Enable (Any 2 wavelengths of 190 to 370 nm or 371 to 700 nm) | | |
| | Linearity | Up to 2.5 AU (5%) | | |
| | Sampling rate | Up to 100 Hz | | |
| | Light source | Deuterium ($D_2$) lamp | | |
| | Flow cell | 12 µL (10 mm, TC), 12 MPa | | 8 µL (10 mm, TC), 12 MPa |
| | Option cell | High-Speed: 8 µL (10 mm, TC), Semi-micro: 2.5 µL (5mm, TC) | | Conventional: 12 µL (10 mm, TC), Semi-micro: 2.5 µL (5 mm, TC) |

| | Model | LC-2050C 3D (PDA model) | LC-2060C 3D (PDA model) | LC-2060C 3D MT (PDA model) |
|---|---|---|---|---|
| | P/N | S228-65822-58 | S228-65825-58 | S228-65826-58 |
| PDA Detector | Wavelength range | 190 to 800 nm | | |
| | Spectral resolution | 1.4 nm (Specified condition) | | |
| | Slit width | 1.2 nm, 8 nm | | |
| | Device resolution | 0.6 nm/pixel | | |
| | Number of photodiode array elements | 1024 | | |
| | Wavelength accuracy | ≤ ±1 nm | | |
| | Noise level | ≤ ±3 × $10^{-6}$ AU (250 nm, reference: 350 nm, Specified condition) | | |
| | Drift | ≤ 500 × $10^{-6}$ AU/h (250 nm, reference: 350 nm, Specified condition) | | |
| | Linearity | Up to 2 AU (5%) | | |
| | Sampling rate | Up to 100 Hz | | |
| | Light source | Deuterium ($D_2$) lamp (Standard), tungsten (W) lamp (option) | | |
| | Flow cell | 10 µL (10mm, TC), 12 MPa | 8 µL (10 mm, TC), 12 MPa | |
| | Option cell | High-Speed: 8 µL (10 mm, TC), Semi-micro: 2.5 µL (5 mm, TC) | Conventional: 10 µL (10 mm, TC), Semi-micro: 2.5 µL (5 mm, TC) | |

| | Model | LC-2050 (UV model without sample cooler) | LC-2050C (UV model) | LC-2050C 3D (PDA model) | LC-2050C LT (detector-less model) | LC-2060C (UV model) | LC-2060C 3D (PDA model) | LC-2060C 3D MT (PDA model) |
|---|---|---|---|---|---|---|---|---|
| | P/N | S228-65820-58 | S228-65821-58 | S228-65822-58 | S228-65823-58 | S228-65824-58 | S228-65825-58 | S228-65826-58 |
| Miscellaneous | Dimensions | W410×H605×D500 mm (Not including reservoir tray height) | | | | | | |
| | Weight | 58 kg | 63 kg | | 53 kg | 63 kg | | 64 kg |
| | Available pH range | 1 to 13 | | | | | | |
| | Materials for parts in contact with liquids | Stainless steel (SUS316L, SUS316), FEP, PEEK, PTFE, perfluoroelastomer, ruby, sapphire, Hastelloy® C, GFP, ceramic, PFA, quartz, PPS | | | | Stainless steel (SUS316L, SUS316), FEP, PEEK, PTFE, perfluoroelastomer, ruby, sapphire, Hastelloy C, UHMWPE, ceramic, PFA, quartz, PPS | | |
| | Workstation | LabSolutions™ LC/GC Ver.5.103 or later, LabSolutions DB/CS Ver.6.103 or later (Incompatible with LCsolution™) | | | | | | |

# Optional Detector Specifications

## RID-20A

| | RID-20A (S228-65306-58) |
|---|---|
| Reflective index measurement range | 1 to 1.75 RIU |
| Noise level | ≤ 2.5 nRIU |
| Drift | ≤ 0.1 μRIU/h |
| Range | A mode: 0.01 to 500 μRIU<br>P and L modes: 1 to 5000 μRIU |
| Response | No filtering, 0.05 to 10 sec, 11 steps |
| Polarity switching | With a switch |
| Zero adjustment | Auto zero, auto optical zero, baseline shift functions |
| Maximum operating flow rate | 20 mL/min (150 mL/min with an option) |
| Temperature control of cell unit | 30 to 60°C (0.01°C steps) |
| Cell capacity | 9 μL |
| Material in contact with liquid | SUS316L, quartz, PTFE, $Al_2O_3$, ETFE |
| Maximum operating pressure | 0.4 MPa (4 kgf/cm²) |
| Operating temperature range | 4 to 35°C |
| Dimensions and weight | W260 × D420 × H140 mm, 12 kg |

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

## RF-20A/RF-20Axs

| | RF-20A (S228-65304-58) | RF-20Axs (S228-65305-58) |
|---|---|---|
| Light source | Xenon lamp | Xenon lamp, low-pressure mercury lamp (To check wavelength accuracy) |
| Wavelength range | 0, 200 to 650 nm | 0, 200 to 750 nm |
| Spectral bandwidth | 20 nm | |
| Wavelength accuracy | ±2 nm | |
| Wavelength precision | ±0.2 nm | |
| S/N | Water Raman peak S/N 1200 min.<br>Low background S/N > 9000 | Water Raman peak S/N 2000 min.<br>Low background S/N > 12000 |
| Cell capacity | 12 μL, 2 MPa (approx. 20 kgf/cm²), SUS316L, PTFE (fluororesin), quartz | |
| Cell temperature control range | — | 4 to 40°C, 1°C steps |
| Cell temperature setting range | — | (Room temperature – 10°C) to 40°C |
| Functions | Four-wavelength detection, wavelength scanning | |
| Safety measures | Liquid-leakage sensor | |
| Operating temperature range | 4 to 35°C | |
| Dimensions and weight | W260 × D420 × H210 mm, 16 kg | W260 × D420 × H210 mm, 18 kg |

## ELSD-LT III

| | ELSD-LT III (S228-65900-58) |
|---|---|
| Nebulizing Method | Siphon splitting |
| Light Source | Semiconductor laser |
| Detector | Photodiode |
| Temperature Setting Range | Room temperature to 100 °C |
| Nebulizer Gas | Air or nitrogen* |
| Mobile Phase Flow Rate (Standard Nebulizer) | 0.2 to 2 mL/min |
| Operating Temperature Range | 4 to 35 °C |
| Operating Humidity Range | 20 to 85 % |
| Dimensions and weight | W 250 × D 530 × H 330 mm, 15.5 kg |

* Supply gas at a pressure of about 350 kPa. An air compressor may also be used.
A filter (P/N: S228-45528-92) is also available for filtering out moisture and other matter from the compressor.

# Main Optional Accessories

## Solvent Delivery Units

| Part Name | P/N | Description |
|---|---|---|
| FCV-11AL | S228-65611-58 | This is the mobile phase selection valve (3 flow lines).<br>An FCV-11AL connection kit is required to connect to an FCV-11AL unit. |
| FCV-11ALS | S228-65610-58 | This is the mobile phase selection valve (1 flow line).<br>An FCV-11AL connection kit is required to connect to an FCV-11AL unit. |
| FCV-11AL Connection Kit | S228-56249-41 | This kit includes connector cables and other items necessary for connecting FCV-11AL and FCV-11ALS units. |
| 780 µL Mixer Kit | S228-57313-41 | This parts set includes a mixer and tubing for using TFA or other UV-absorbing substance as a mobile phase. |
| 2 mL Mixer Kit | S228-57313-42 | This parts set includes a mixer and tubing for using TFA or other UV-absorbing substance as a mobile phase. |
| Compatible Volume System Kit | S228-57796-42 | This kit decreases the system volume to 650 µL. |
| Low Volume System Kit | S228-57796-43 | This kit decreases the system volume to 460 µL. |

## Autosamplers

| Part Name | P/N | Description |
|---|---|---|
| 50 µL Sample Loop | S228-56074-44 | This sample loop is used for injecting 50 µL volumes. (Standard configuration parts of LC-2060) |
| 100 µL Sample Loop | S228-56074-42 | This sample loop is used for injecting 100 µL volumes. (Standard configuration parts of LC-2050) |
| Optional 500 µL Sample Loop | S228-45405-41 | This increases the injection volume to 500 µL. |
| Optional 2 mL Sample Loop | S228-45405-42 | This increases the injection volume to 2 mL. |
| UHPLC Fitting (set of 1) | S228-56867-41 | Fitting for inlet to high-pressure capacity column |
| UHPLC Fitting (set of 10) | S228-56867-43 | Fitting for inlet to high-pressure capacity column |
| Sample Rack | S228-55735-41 | Additional sample rack |
| Plate for 1 mL Sample Vials (set of 2) | S228-56197-41 | Plate used to place 84 1 mL sample vials |
| Plate for 1.5 mL Sample Vials (set of 2) | S228-50830-92 | Plate used to place 54 1.5 mL sample vials |
| Plate for 4 mL Sample Vials (set of 2) | S228-56197-42 | Plate used to place 28 4 mL sample vials |
| Metal plate for 1.5ml Sample Vials (set of 1) | S228-61615-42 | Plate used to place 54 1.5 mL sample vials |

## Column Ovens

| Part Name | P/N | Description |
|---|---|---|
| Column Clamp ASSY B5 | S228-15617-91 | This set of clamps is for adding a column with an outside diameter between 6.4 and 9.5 mm. |
| Column Clamp ASSY B8 | S228-15617-92 | This set of clamps is for adding a column with an outside diameter between 9.5 and 12.7 mm. |
| FCV-14AH | S228-65614-58 | Automatic column switching valve with 6 positions and 7 ports which is usable at a pressure of 34.3 MPa max. |
| FCV-34AH | S228-45185-41 | Automatic column switching valve with 6 positions and 7 ports which is usable at a pressure of 100 MPa max. |
| FCV Mounting Kit | S228-55765-42 | This parts kit is used to secure an FCV-14AH/ 34AH unit inside the column oven. |
| CMD | S228-37281-41 | This column management device is used to record information about columns. |
| CMD Cable | S228-39991 | This cable is used to connect between the CMD and main units. |

## UV Detectors

| Part Name | P/N | Description |
|---|---|---|
| Recycle Valve | S228-56808-41 | This low-pressure flow-line selection valve is used to recycle mobile phase. |
| Flow Cell for UV Detectors | S228-56167-41 | This cell is compatible with conventional analysis. (Standard configuration parts of LC-2050) |
| UHPLC Cell for UV Detectors | S228-45621-41 | This cell is compatible with UHPLC analysis. (Standard configuration parts of LC-2060) |
| Semi-Micro Cell for UV Detectors | S228-45605-46 | This cell is compatible with semi-micro analysis. |

## PDA Detectors

| Part Name | P/N | Description |
|---|---|---|
| W Lamp ASSY for PDA Detectors | S228-57110-41 | This assembly includes a tungsten lamp and its socket used for high-sensitivity analysis in the long-wavelength region. |
| Flow Cell for PDA Detectors | S228-42593-43 | This cell is compatible with conventional analysis. (Standard configuration parts of LC-2050) |
| High-Speed Cell for PDA Detectors | S228-45618-54 | This cell is compatible with fast analysis. (Standard configuration parts of LC-2060) |
| Semi-Micro Cell for PDA Detectors | S228-45605-47 | This cell is compatible with semi-micro analysis. |

## Other Options

| Part Name | P/N | Description |
|---|---|---|
| Earthquake Reinforcement Kit | S228-56298-41 | This kit is used to reinforce how the reservoir tray is attached. |
| 1 L Mobile Phase Bottles (set of 5) | S228-38583-42 | This is a set of five one-liter reservoir bottles for holding mobile phases. |
| Optional Detector Attachment Kit | S228-56245-41 | This kit contains a top plate and reservoir tray for installing an additional detector. |
| Optional Optical Board | S228-55518-41 | This board is used to install additional connectors for optical link cables.<br>It is used to install fluorescence detector RF-20A series and other detectors. |
| Camera ASSY for Autosampler | S228-55517-41 | This camera is installed inside autosamplers.<br>It allows you to monitor the needle action via the computer screen. |
| Optional AD Board | S228-55519-41 | This is an analog-digital converter board. It is used to input the detector signal as an analog signal, such as when a non-Shimadzu detector is connected. |
| Touch Panel Protecting Sheet | S228-59212-41 | Protecting sheet for touch panel. |
| Upgrade Kit UV | S228-58993-41 | Kit for upgrade from LC-2050 (UV model with sample cooler) to LC-2060. |
| Upgrade Kit PDA | S228-58993-42 | Kit for upgrade from LC-2050 (PDA model) to LC-2060. |
| Smart Automation Kit (4-mobile phase) | S228-26004-44 | This kit includes FCV-14AH for up to six columns switching and other parts. |
| Smart Automation Kit (7-mobile phase) | S228-26004-43 | This kit includes FCV-14AH for up to six columns switching, FCV-11AL for solvent delivery of seven mobile phases and other parts. |

ANALYTICAL INTELLIGENCE

- Automated support functions utilizing digital technologies, such as M2M, IoT, and Artificial Intelligence (AI), that enable higher productivity and maximum reliability.
- Allows a system to monitor and diagnose itself, handle any issues during data acquisition without user input, and automatically behave as if it were operated by an expert.
- Supports the acquisition of high quality, reproducible data regardless of an operator's skill level for both routine and demanding applications.



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