228-90747
Aug. 2009

# SPECTROFLUOROMETRIC DETECTOR FOR SHIMADZU HIGH PERFORMANCE LIQUID CHROMATOGRAPH

# RF-20A/20Axs

## Prominence®

## INSTRUCTION MANUAL

Read the instruction manual thoroughly before you use the product.
Keep this instruction manual for future reference.

SHIMADZU CORPORATION
KYOTO JAPAN

ANALYTICAL & MEASURING INSTRUMENTS DIVISION

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# Introduction

## Read this manual thoroughly before using the instrument.

Thank you for purchasing this instrument.

This manual describes the installation, operation, hardware validation, usage cautions, and details on the accessories and options.

Read this manual thoroughly before using the instrument and operate the instrument in accordance with the instructions in this manual.

Also, keep this manual for future reference.

| | |
|---|---|
| **IMPORTANT** | • If the user or usage location changes, ensure that this Instruction Manual is always kept together with the product.<br>• If this manual or a product warning label is lost or damaged, immediately contact your Shimadzu representative to request a replacement.<br>• To ensure safe operation, read all **Safety Instructions** before using the instrument.<br>• To ensure safe operation, contact your Shimadzu representative if product installation, adjustment, or re-installation (after the product is moved) is required. |

**Notice**

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# Warranty and After-Sales Service

**Warranty**

1. Period:

Please consult your Shimadzu representative for information about the period of this warranty.

2. Description:

If a product/part failure occurs for reasons attributable to Shimadzu during the warranty period, Shimadzu will repair or replace the product/part free of charge. However, in the case of products which are usually available on the market only for a short time, such as personal computers and their peripherals/parts, Shimadzu may not be able to provide identical replacement products.

3. Exceptions:

Failures caused by the following are excluded from the warranty, even if they occur during the warranty period.

1) Improper product handling
2) Repairs or modifications performed by parties other than Shimadzu or Shimadzu designated companies
3) Product use in combination with hardware or software other than that designated by Shimadzu
4) Computer viruses leading to device failures and damage to data and software, including the product's basic software
5) Power failures, including power outages and sudden voltage drops, leading to device failures and damage to data and software, including the product's basic software
6) Turning OFF the product without following the proper shutdown procedure leading to device failures and damage to data and software, including the product's basic software
7) Reasons unrelated to the product itself
8) Product use in harsh environments, such as those subject to high temperatures or humidity levels, corrosive gases, or strong vibrations
9) Fires, earthquakes, or any other act of nature, contamination by radioactive or hazardous substances, or any other force majeure event, including wars, riots, and crimes
10) Product movement or transportation after installation

11) Consumable items

Note: Recording media such as floppy disks and CD-ROMs are considered consumable items.

* If there is a document such as a warranty provided with the product, or there is a separate contract agreed upon that includes warranty conditions, the provisions of those documents shall apply.

## After-Sales Service

If any problem occurs with this instrument, perform an inspection and take appropriate corrective action as described in the Section "6 Troubleshooting". If the problem persists, or the symptoms are not covered in the troubleshooting section, contact your Shimadzu representative.

## Replacement Parts Availability

Replacement parts for this instrument will be available for a period of seven (7) years after the product is discontinued. Thereafter, such parts may cease to be available.

Note, however, that the availability of parts not manufactured by Shimadzu shall be determined by the relevant manufacturers.

## Hardware Validation

Each LC component and the entire LC system should be checked periodically to ensure that they function normally, or the analysis data may not be reliable. To this end, it is necessary to carry out periodic hardware validation and keep records of the validation.

There are two types of hardware validation - component validation and system validation.

The purpose of component validation is to check that the individual components of the system function normally, while the system validation checks that the system as a whole (the several components in combination) functions normally.

Before shipment from the factory, this instrument was rigorously inspected. The results are summarized in the Inspection Certificate accompanying the instrument. To inspect the instrument performance after installation, repeat the Hardware Validation as described in "7 Hardware Validation".

☞ "7 Hardware Validation" P.7-1

## Hardware Validation Contract

This is a contract under which a qualified Shimadzu-approved engineer performs periodic component and system validation, and provides reports of the results.

Details of the contract can be obtained from your Shimadzu representative.

# Safety Instructions

- To ensure safe operation of the instrument, read these Safety Instructions carefully before use.
- Observe all of the WARNINGS and CAUTIONS described in this section. They are extremely important for safety.
- In this manual, warnings and cautions are indicated using the following conventions:

| | |
|---|---|
| ⚠WARNING | **Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or possibly death.** |
| ⚠CAUTION | **Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury or equipment damage.** |
| NOTE | **Emphasizes additional information that is provided to ensure the proper use of this product.** |

■ Application Precautions

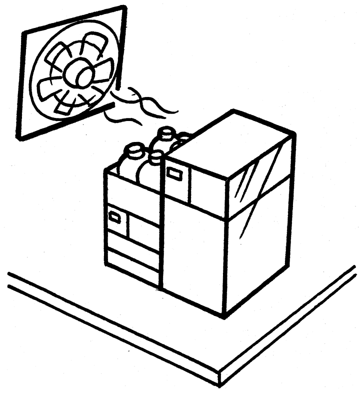
## ⚠WARNING

- **This instrument is a spectrofluorometric detector for high-performance liquid chromatograph.**
  **Use this instrument ONLY for the intended purpose.**

  Using this instrument for any other purpose could cause accidents.

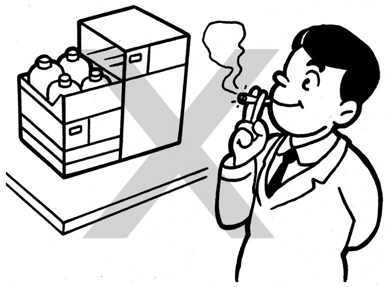
## ■ Installation Site Precautions

### ⚠WARNING



- **The solvents used in high performance liquid chromatograph are flammable and toxic. The room where the instrument is installed should be well ventilated;**

  otherwise, solvent vapors could cause poisoning or ignite and cause a fire.



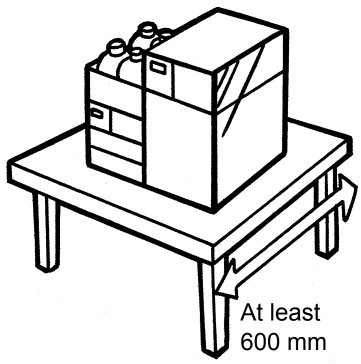
- **High performance liquid chromatograph uses large amounts of flammable organic solvents. Use of open flame in the vicinity of this instrument must be strictly prohibited. Do not install the instrument in the same room with any other equipment that emits or could potentially emit sparks, since sparks could cause a fire.**

  Provide fire extinguishers for use in case of fire.

- **Provide sink washing equipment as close to the instrument as possible.**

  If solvent gets into the eyes or onto the skin, it must be flushed away immediately. Provide sink washing equipment as close to the instrument as possible.

### ⚠CAUTION




- **The weight of this instrument is 16 kg (RF-20A) or 18 kg (RF-20Axs). During installation, consider the entire weight combined with other LC components.**

  The lab table on which this instrument is installed should be strong enough to support the total weight of the LC system. It should be level, stable and have depth of at least 600 mm.

  Otherwise, the instrument could tip over or fall off the table.

- **Avoid installation sites that are exposed to corrosive gases or excessive dust.**

  These adverse conditions may be detrimental to maintaining the instrument performance and may shorten its service life.

## Installation Precautions

To ensure safe operation, contact your Shimadzu representative if product installation, adjustment, or re-installation (after the product is moved) is required.

### ⚠WARNING

- **Take measures to prevent the instrument from falling in the event of an earthquake or other disaster.**

  Strong vibrations could cause the instrument to fall over, resulting in injury.

- **The power supply voltages and power consumptions of this instrument are listed below.**
  **The power supply voltage of the instrument is indicated on the label or the back of the instrument.**
  **Connect the instrument only to a power supply of the voltage indicated.**

  Failure to properly connect the instrument may result in fire or electric shock. Check that the power supply voltage is stable and that its current capacity is sufficient to operate all the components of the system. If not, the instrument will not operate at its rated performance.

  RF-20A

| Part No. | Power Supply Voltage | Power Consumption | Frequency |
|---|---|---|---|
| 228-45147-41 | AC100-120 V (100-120 V~) | 400 VA | 50/60 Hz |
| 228-45147-42 | AC100-120 V (100-120 V~) | | |
| 228-45147-48 | AC220-240 V (220-240 V~) | | |

  RF-20Axs

| Part No. | Power Supply Voltage | Power Consumption | Frequency |
|---|---|---|---|
| 228-45148-41 | AC100-120 V (100-120 V~) | 400 VA | 50/60 Hz |
| 228-45148-42 | AC100-120 V (100-120 V~) | | |
| 228-45148-48 | AC220-240 V (220-240 V~) | | |

- **Ground the instrument.**

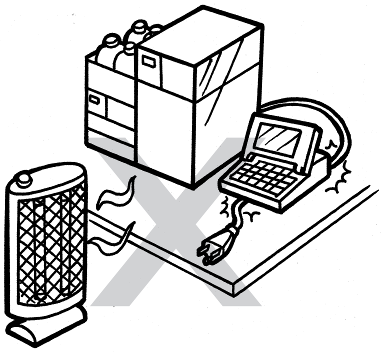
  Grounding is necessary to prevent electric shock in the event of an accident or electrical discharge, and important for ensuring stable operation.

## ⚠WARNING

- **Do not place heavy objects on the power cord, and keep any hot items away.**

  The cord could be damaged, resulting in fire, electrical shock or malfunction.

  If the cord becomes damaged, contact your Shimadzu representative immediately.



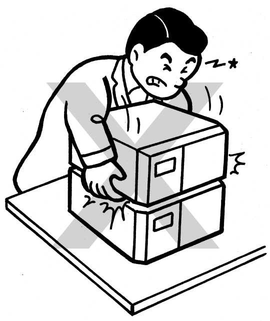
- **Do not modify the cord in any way. Do not bend it excessively or pull on it.**

  The cord could be damaged, resulting in fire, electrical shock or malfunction.

  If the cord becomes damaged, contact your Shimadzu representative immediately.

## ⚠CAUTION

- **When installing the instrument, be careful not to pinch your fingers between the system components, as this could result in injury.**



- **When opening the doors, be careful not to pinch your fingers as this could result in injury.**

- **Fit the Xenon lamp before turning the power switch ON.**

  The instrument is delivered with the Xenon lamp removed.

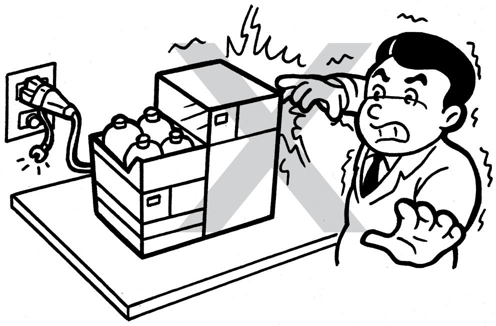
- **When turning the power switch ON, be sure to check that the Xenon lamp is fitted.**

  When the Xenon lamp is turned on, a high voltage of around 30 kV is applied to the terminal of the lamp. If the lamp is not fitted correctly at the time of ignition, the instrument may be damaged.

  ☞ "9.1.9 Fitting the Xenon Lamp" P.9-33

## Operation Precautions

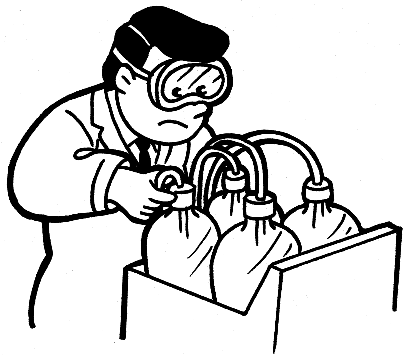
### ⚠WARNING



- **Take thorough measures to prevent buildup of static electricity.**

  ☞ "Static Electricity Precautions" P.X

  Static electricity could result in fire or explosion.



- **Always wear protective gloves and goggles when handling solvents and samples.**

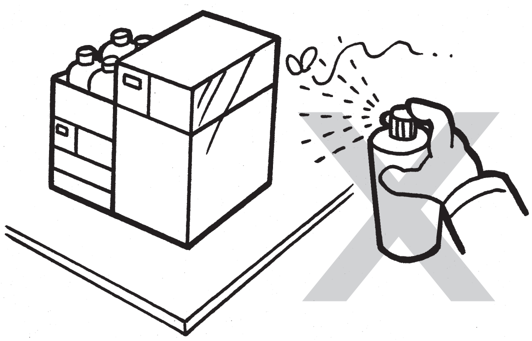
  If solvent gets into the eyes, blindness could result.

  Should solvent get into the eyes, flush immediately with large amounts of water and get medical attention.

- **Always wear protective gloves when handling any toxic or biologically infectious samples.**

- **Never use a cracked reservoir bottle.**

  If a helium degasser is used, pressure is exerted on the reservoir bottles and may cause cracks in the bottles. It could break the reservoir bottles and cause injury.



- **Do not use flammable sprays (hair sprays, insecticide sprays, etc.) near the instrument.**

  They could ignite and cause a fire.

## ■ Precautions for Instrument Inspection, Maintenance, Adjustment and Care

# ⚠WARNING

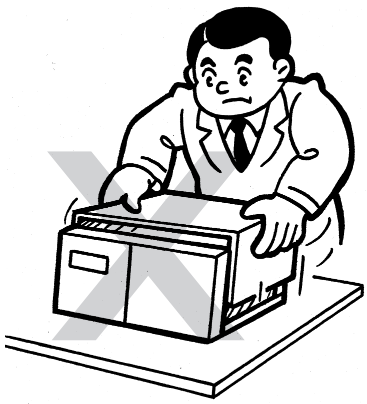
- **Unplug the instrument before inspection, maintenance, or parts replacement.**

  Failure to do so may cause electrical shock or short-circuit accidents to occur.

- **Never remove the main cover.**

  This may cause injury or malfunction of the instrument.

  The main cover does not need to be removed for routine maintenance, inspection and adjustment. Have your Shimadzu representative perform any repairs requiring removal of the main cover.



- **Replace fuses only with fuses of the proper type and capacity.**

  Any other fuses could cause a fire.

- **If the power cord plug gets dusty, remove the plug from the power outlet and wipe away the dust with a dry cloth.**

  If dust is allowed to accumulate, fire could result.

- **Replacement parts must be of the specifications given in "1.3 Component Parts" or "9.3 Maintenance Parts".**

  Use of any other parts may result in instrument damage and malfunction.

- **Do not allow spilled water to remain on the instrument surface, and do not use alcohol or thinner-type solvents to clean the surfaces.**

  These can cause rusting and discoloration.

- **Dispose of waste liquid properly and in accordance with the instruction by your administrative department.**

# Static Electricity Precautions

Liquid chromatograph (LC) uses flammable organic solvent(s) as the mobile phase. LC systems are also often used where large amount of flammable substances are present. Thus, an accident can produce large scale damage. Operators must be constantly on guard against accidents involving fire or explosion.

The major cause of these accidents is static electricity. Devising preventative measures for static electricity can be difficult, because the symptoms before an accident vary and can be hard to detect, since such accidents occur as a result of several simultaneous incidents. Recommended methods for preventing static electricity accidents are provided below. Take thorough safety measures based on this information.

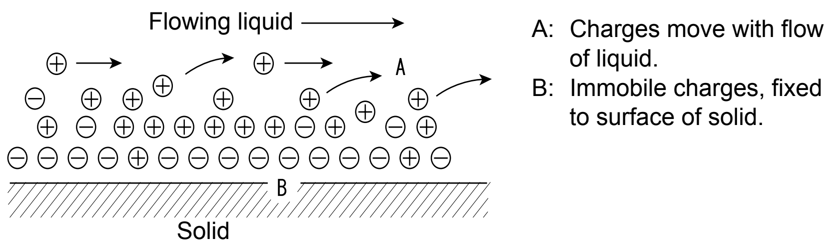
## ■ Typical Cause of Static Electricity Accidents

Static electricity accidents are generally caused by this sequence of events:

Generation of static electricity ↓

When liquid is passed through thin tubing at high flow rates, as in liquid chromatograph, the electrostatic charges of the flowing matter generate static electricity.

Generation of Static Electricity by a Liquid Flowing over a Solid



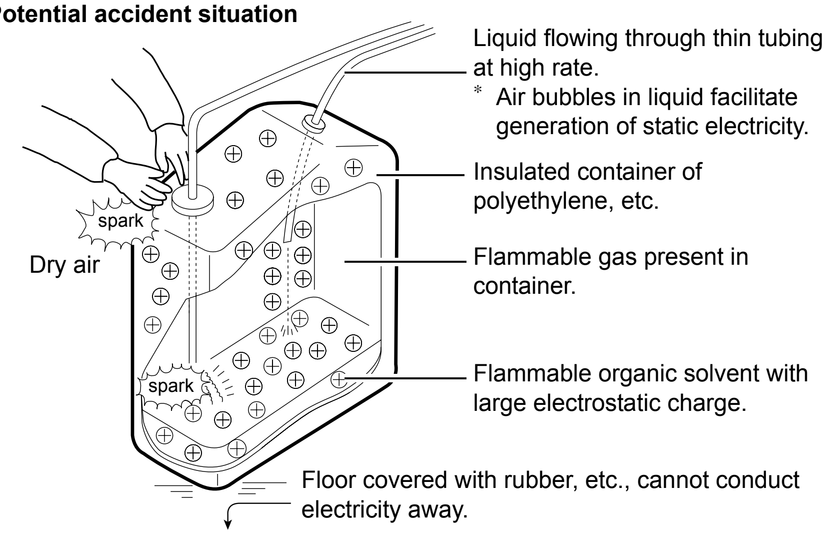

Accumulation of static electricity ↓

If electrostatically charged liquid is allowed to accumulate in an electrically insulated container, the charge will gradually increase, and can eventually reach several thousand volts.
If this happens and an electrical conductor is brought within a certain distance of the container, an electrical discharge will occur, releasing thermal energy which will ignite any flammable gas of sufficient density in the vicinity.

Release of energy through electrical discharge ↓

Ignition of flammable substances

**Potential accident situation**



## ■ Preventing Static Electricity Accidents

The best way to prevent static electricity accidents is simply to prevent the occurrence and accumulation of electrostatic charges.

### ⚠CAUTION

- **It is important to take multiple preventive measures without fail.**
- **If large amounts of flammable solvents are collected in a large container, implement preventative measures 1, 2, and 3 below.**

### Preventive Measure 1

Use a metal container for waste liquid, and ground the container.
This will ensure that the electrical charges of the container and liquid pass to the ground.

**Accessories for this measure**

| | | |
|---|---|---|
| (1) | Grounding wire with clip | Part No. 228-21353-91 |
| (2) | 18-L metal container | Part No. 038-00044 |
| (3) | 4-L metal container | Part No. 038-00043-01 |

### ⚠CAUTION

- **Be sure to ground the metal waste container properly.**

  If the grounding wire is not properly attached or connected to the ground, static electricity can build up in the container.

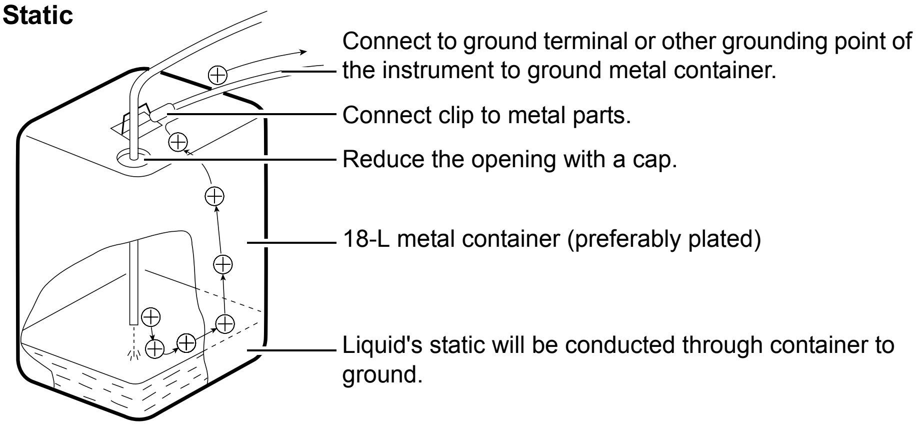
- **Be sure to verify, using a tester, that the waste container is properly grounded.**

  Some metal containers have surfaces that are oxidized or laminated. Such a container may not conduct electricity.

- **If the liquid to be drained into the waste container is virtually non-conductive ($10^{-10}$ S/m or less), it will be necessary to add properly conductive, and therefore safe, liquid to the tank.**

  This conductive liquid may be added beforehand.

**Preventive Measures for Static**



### Preventive Measure 2

Cover the spaces between the tubing and the sides of the inlet and outlet openings of the waste container with caps or other protective covering. This will prevent any sparks generated outside the container from getting inside.

**Accessories for this measure**

Caps for 18-L or 4-L container (with three 3-mm diameter openings)
Part No. 228-21354-91

### Preventive Measure 3

Keep electrostatically charged objects, including the human body, away from the waste liquid container.
To prevent electrostatic charging of the human body, take the following precautions:

- Wear anti-static clothing and shoes.
- Ground the human body with anti-static wrist straps. (For safety, the wrist strap should be connected to the ground using an intervening resistor of about 1 MΩ.)
- Spread anti-static matting or the like on the floor, to make the floor conductive.

## ⚠CAUTION

- **Persons who have not taken anti-static precautions should touch some grounded metal object before coming near the waste liquid container, in order to drain static charges.**

### Preventive Measure 4

Use tubing with an inner diameter of at least 2 mm for drain lines with high flow rates.

## ⚠CAUTION

- **Periodically check the tubing connections for leaks.**

  Air bubbles in liquid can multiply the electrostatic charge by a factor of 20, 30 or more.

**Preventive Measure 5**

If it is not possible to use a conductive waste liquid container, take the following precautions:

- Ensure that the end of the inflow tubing is always submerged inside the container. Also, place some type of grounded metal object, such as a ground wire connected to the instrument, into the liquid.

## ⚠CAUTION

The above precaution will be ineffective for low conductivity (less than $10^{-10}$ S/m) liquids.

- **Use as small a container as possible to minimize damage in the event of fire.**
- **Keep the room at a proper humidity.**

  Ambient humidity exceeding 65 % will prevent static.

### For Reference

Anti-static equipment (anti-static clothing, shoes and matting) and charge measurement equipment (potentiometer) are sold by specialty manufacturers.

## ■ In an Emergency

### ⚠WARNING

If any problem is detected, such as a burning smell, take the following action:

**Procedure**

1. Turn the power to the instrument OFF.

2. Disconnect the power cable at the rear of the instrument.

When the instrument is used again, inspect the instrument and, if necessary, contact your Shimadzu representative to request servicing.

## ■ During a Power Outage

### ⚠CAUTION

Take the following measures in the event of a power outage.

**Procedure**

1. Turn the power to the instrument OFF.

2. After confirming all related items in this section "Installation Precautions" and "Operation Precautions", use the standard startup procedure to start the instrument.

# Precautions for Mobile Phase Selection and Use

## ⚠CAUTION

- **If PEEK resin parts are used in the plumbing, do not use the following mobile phases. These mobile phases weaken the PEEK resin, which could result in cracked plumbing and mobile phase leaks:**

  Concentrated sulfuric acid, concentrated nitric acid, dichloroacetic acid, acetone, tetrahydrofuran (THF), dichloromethane, chloroform, dimethyl sulfoxide (DMSO), fluorine organic solvents such as hexafluoroisopropanol (HFIP)

Note: There is no problem with temporarily using a low-concentration aqueous solution with an acetone concentration of 0.5 % or less, e.g. for the purpose of checking the performance of the gradient.

NOTE

- Use only HPLC grade or comparable mobile phase, and filter it with a filter of 0.45 µm mesh or finer before use to remove particulates and foreign matter.

- Halogen ions can corrode the stainless steel material (SUS316L) used in the plumbing, so avoid, as much as possible, mobile phases that contain halogen ions - such as KCl, NaCl and $NH_4Cl$ - or mobile phases that generate halogen ions in certain reactions. If such mobile phases must be used, clean all flow lines thoroughly with water immediately after analysis.

- When SPD or a similar UV detector is used for high-sensitivity analysis, be sure to use HPLC grade mobile phases that have a low absorptivity of UV rays.

- Always degas the mobile phase, as air bubbles may tend to form during solvent mixing or during temperature or pressure changes. Air bubbles may cause pump malfunctions and detector signal noise.

- Understand the properties, including viscosities, of the mobile phase.

  ☞ "9.5 Mobile Phase Characteristics" P.9-48

# Precautions for the Xenon Lamp

## ⚠WARNING

- **When handling a Xenon lamp, always wear the following protective gear: a protective mask, a thick long-sleeved shirt, and safety gloves.**

  Gas at high pressure is enclosed in the Xenon lamp. If the lamp is subjected to a strong impact or the glass part is damaged, it may explode, scattering fragments.

  Use a protective mask that is able to cover the entire face with rigid plastic or similar material.

- **When handling a Xenon lamp, do not touch the glass part with bare hands.**

  If the Xenon lamp is lit while there are fingerprints on the glass part they will burn, and this may cause the lamp to explode.

  If you happen to touch the glass part with your bare hands, wipe the fingerprints off e.g. with a piece of gauze moistened with ethanol.

- **Always turn the power to the instrument OFF and unplug the power plug before replacing a Xenon lamp.**

  A high voltage of around 30 kV is applied to the positive (+) terminal of the Xenon lamp at the start of ignition, and this is extremely dangerous.

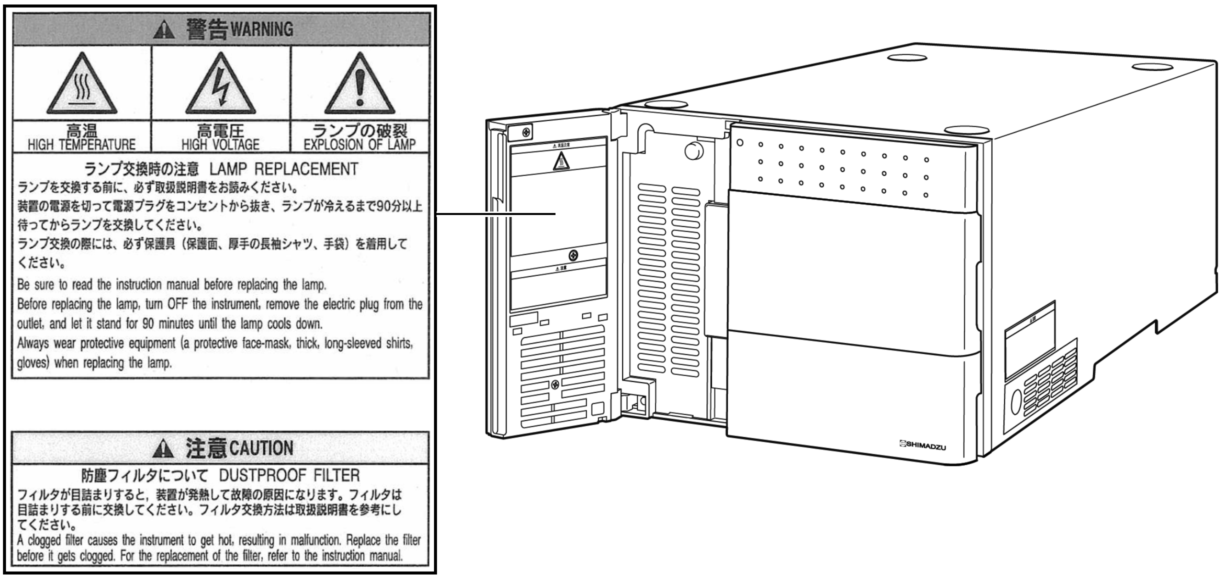
## ⚠WARNING

- **Make sure that the Xenon lamp has cooled sufficiently before attempting to replace it.**

  Immediately after being turned OFF the Xenon lamp is extremely hot and could burn you.

  The time required for the Xenon lamp to cool is at least 90 minutes after the power to the instrument has been turned OFF, or at least 30 minutes after the lamp has been turned OFF by setting [0] (OFF) for [LAMP] in the parameter settings group.

☞ "8.4 Inspecting/Replacing the Xenon Lamp" P.8-30



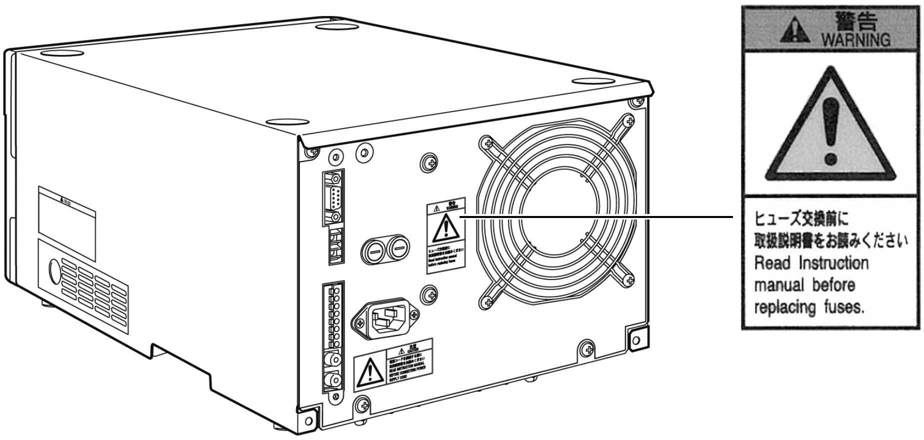
# Precautions on Replacing Fuses

## ⚠WARNING

- Before replacing fuses, turn the power to the instrument OFF and unplug the instrument.
- Only use fuses of the correct type and rating for replacement.

Failure to heed the above could result in fire, electric shock or short circuits.

☞ "8.5 Replacing the Fuse" P.8-35



# Disposal Precautions

When disposing of the instrument and Xenon lamps, contact your Shimadzu representative.
If you dispose of them yourself, do so in accordance with the processing standards determined by law, separately from general industrial waste and household garbage.

## ■ Materials of the Xenon Lamp

The raw materials used in the Xenon lamp are shown below.

| Lamp | Material in Use |
|---|---|
| Xenon lamp | • Metal (tungsten, brass, nickel-plated brass, stainless steel and nickel-plated zinc alloy)<br>• Quartz glass |

## ■ Disposal of Xenon Lamps

High-pressure Xenon gas is enclosed in the Xenon lamp. If it explodes, fragments of the lamp may scatter. Dispose of the lamp by following the procedure below:

### ⚠WARNING

- **Be sure to wear the following protective gear: a protective mask, thick long-sleeved shirt, and safety gloves.**

  High-pressure gas is enclosed in the Xenon lamp. When the lamp is broken, fragments of the glass may be scattered, and this could cause injury.

  Use a protective mask that is able to cover the entire face with rigid plastic or similar material.

- **Keep the spent lamp in the box in which it was packed at the time of delivery until you break it.**

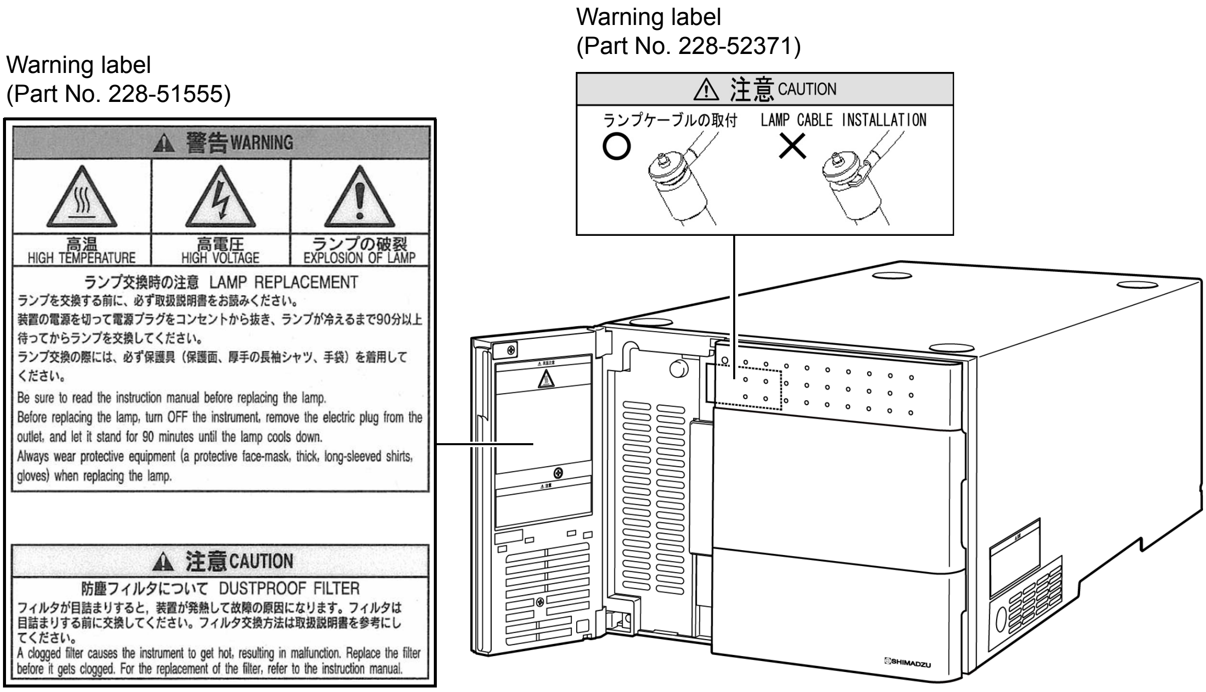
1. Carefully wrap up the Xenon lamp in a thick cloth to prevent fragments of glass scattering.
2. Strike the glass part of the Xenon lamp, wrapped in the cloth, with a hammer to break it.
3. Dispose of the broken Xenon lamp as industrial waste, to be handled separately from general household waste.

# Warning Labels

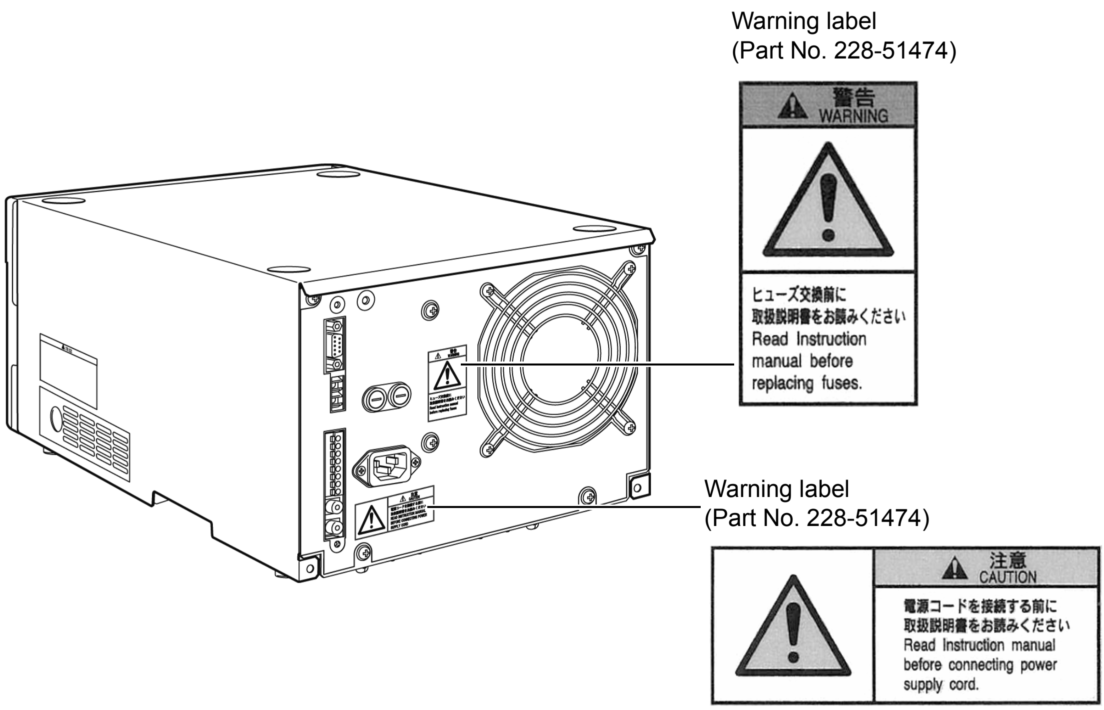
For safety operation, warning labels are affixed to where special attention is required.

Should any of these labels peel off or be damaged, obtain replacements from Shimadzu Corporation.

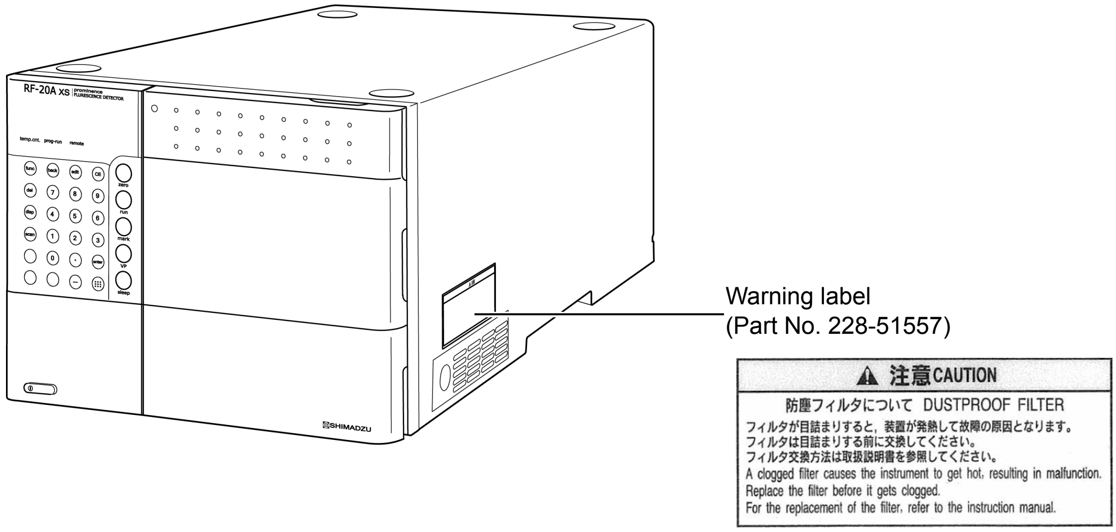
## ■ Front of the Instrument



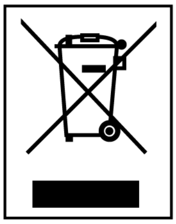

## ■ Back of the Instrument



## ■ Side of the Instrument



# Action for Environment (WEEE)
# To all users of Shimadzu equipment in the European Union:



WEEE Mark

Equipment marked with this symbol indicates that it was sold on or after 13th August 2005, which means it should not be disposed of with general household waste. Note that our equipment is for industrial/professional use only.

**Contact Shimadzu service representative when the equipment has reached the end of its life. They will advise you regarding the equipment take-back.**

With your co-operation we are aiming to reduce contamination from waste electronic and electrical equipment and preserve natural resource through re-use and recycling.
Do not hesitate to ask Shimadzu service representative, if you require further information.

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# Chapter 3 Preparation



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# 1

# Configuration

Contents

# 1.1 Overview

This instrument is a spectrofluorometric detector for high-performance liquid chromatograph developed for high performance and multi-function capabilities.

The RF-20A/20Axs is capable of the following measurements.

- Measurement in the single wavelength mode
- Measurement in the dual wavelength mode
- Measurement in the spectrum scanning mode
- Measurement using a time program

In the dual wavelength mode, dual wavelength chromatograms can be output using two wavelengths.

In the spectrum scanning mode, the excitation spectrum and emission spectrum are measured and the optimum conditions for chromatogram measurement are determined.

## ■ RF-10AXL Compatibility Mode

This instrument features a mode that enables it to be simulated as an RF-10AXL. In the RF-10AXL compatibility mode, it is possible to connect to the old type controllers (SCL-10Avp), which cannot be connected to RF-20A/Axs.

When the instrument is set to the RF-10AXL compatibility mode, some functions may no longer be usable, and the setting ranges may be restricted.

☞ "5.7.3 Notes on Operation" P.5-77

# 1.2 Features

- Excellent Signal-to-Noise Ratio Performance

Excellent S/N ratio performance has been achieved through improvement of the optical system and a high-order digital filter. In addition, the basic performance of the RF-20Axs has also been substantially improved by means such as expanding the range of measured wavelengths.

- Incorporation of Sophisticated Functions

Measurement of two wavelengths simultaneously enables the output of dual wavelength chromatograms. Spectrum scanning operation also enables excitation spectra and emission spectra to be obtained. In addition, the time program function has also been enhanced.

- No Need to Adjust the Optical Axis when Replacing the Xenon Lamp

When the Xenon lamp is replaced, it is not necessary to adjust the optical axis. A long-life Xenon lamp is used. It is also possible to monitor the total usage time of the Xenon lamp.

- Flow Cell with a Temperature Control Function Equipped (RF-20Axs Only)

Because the temperature of the flow cell section can be maintained at a constant level, it is possible to improve the analysis reproducibility of samples for which the fluorescent intensity is liable to fluctuate in accordance with temperature changes.

- Automatic Wavelength Accuracy Check Function Equipped (RF-20Axs Only)

The RF-20Axs is equipped with a function that automatically checks the wavelength accuracy using a built-in low-pressure Hg (mercury) lamp. You can easily check the wavelength accuracy in validation.

# 1.3 Component Parts

This instrument consists of the parts listed below. Check the parts and their quantities after unpacking.

| Part | Part No. | Q'ty | Remark |
|---|---|---|---|
| RF-20A/20Axs body | – | 1 | |
| Signal cable | 228-39306-91 | 2 | |
| AC Power Cord (for 100 V, 120 V) | 071-60816-12 | 1 | For 100 V, 120 V area |
| AC Power Cord (for 220-240 V) | 071-60825-51 | 1 | For 220-240 V area |
| Optical cable | 070-92025-51 | 1 | |
| Syringe, H4020-LL | 046-00017-01 | 1 | |
| Adapter for syringe | 228-15672-91 | 1 | |
| Male nut, PEEK | 228-18565 | 2 | |
| PEEK tubing | 670-10324-01 | 1 | ID 0.25 mm, OD 1.6 mm, L 50 cm |
| Tubing for plumbing | 228-18495-06 | 1 | ID 0.3 mm, OD 1.6 mm, L 2 m, made by ETFE |
| Cell gasket | 228-50422-01 | 1 | This is a consumable part (spare). |
| Instruction manual (English version) | 228-90747 | 1 | |
| Event cable | 228-28253-91 | 1 | |
| Drain OUT | 228-42205 | 1 | |
| Drain CTO | 228-42206 | 1 | |
| Straight tubing connector | 228-28163 | 1 | |
| Drain adapter | 228-42204 | 1 | |
| Silicone tubing | 228-25162-03 | 1 | ID 7 mm, OD 10 mm, L 1 m |
| Lock catch | 037-60177-05 | 1 | For securing the tubing |
| FEP tubing | 016-37722-06 | 1 | 50 cm, to protect the PEEK tubing |
| Xenon lamp | 228-51511-95 | 1 | |
| Spanner, 7 $\times$ 8 | 086-03047-04 | 1 | |

# 1.4 Optional Parts

1

## ■ Optional Cells

Changing the standard cell to the following optional cells enables use as a detector for a variety of applications including semi-micro LC, metal-free LC, FAST LC and so on.

| Part | Part No. | Remark |
|---|---|---|
| Flow cell<br>(RF-20A standard flow cell) | 228-45856-92 | This is the standard cell for the RF-20A.<br>Cell capacity: 12 µL<br>Wetting part materials: SUS316L, PTFE, quartz<br>Inlet tube ID: 0.25 mm<br>Volume from the end of the inlet tube to the center of the cell: 15 µL<br>Outlet tube ID: 0.25 mm<br>Volume from the center of the cell to the end of the outlet tube: 16 µL |
| Flow cell<br>(RF-20Axs standard flow cell) | 228-45856-91 | This is the standard cell for the RF-20Axs.<br>Cell capacity: 12 µL<br>Wetting part materials: SUS316L, PTFE, quartz<br>Compatible with the temperature control function (when installed on an RF-20Axs)<br>Inlet tube ID: 0.25 mm<br>Volume from the end of the inlet tube to the center of the cell: 45 µL<br>Outlet tube ID: 0.25 mm<br>Volume from the center of the cell to the end of the outlet tube: 21 µL |
| Temperature controlled flow cell for semi-micro LC | 228-51950-91 | Cell capacity: 3 µL<br>Wetting part materials: SUS316L, PTFE, quartz<br>Can be used with RF-20A/20Axs<br>Compatible with the temperature control function (when installed on an RF-20Axs)<br>Inlet tube ID: 0.13 mm<br>Volume from the end of the inlet tube to the center of the cell: 17 µL<br>Outlet tube ID: 0.13 mm<br>Volume from the center of the cell to the end of the outlet tube: 7 µL |
| Flow cell for inert LC | 228-51951-91 | This is a flow cell made of resin, making the material of the parts in contact with liquids non-metal.<br>Cell capacity: 12 µL<br>Wetting part materials: PEEK, PTFE, quartz<br>Can be used with RF-20A/20Axs<br>Temperature control function: Not compatible<br>Inlet tube ID: 0.25 mm<br>Volume from the end of the inlet tube to the center of the cell: 16 µL<br>Outlet tube ID: 0.25 mm<br>Volume from the center of the cell to the end of the outlet tube: 16 µL |

## ■ Photomultiplier for RF-20A

| Part Name | Part No. | Remark |
|---|---|---|
| Photomultiplier R928-08 | 200-75021 | On replacement with a photomultiplier, the measurement wavelength range is extended to 200 - 900 nm. |
| Photomultiplier R3788 | 200-75031 | On replacement with a photomultiplier, the measurement wavelength range is extended to 200 - 750 nm. |

## ■ Photomultiplier for RF-20Axs

| Part Name | Part No. | Remark |
|---|---|---|
| Photomultiplier R928-08 | 200-75021 | On replacement with a photomultiplier, the measurement wavelength range is extended to 200 - 900 nm. |

# 2

# Parts Identification and Functions

Contents

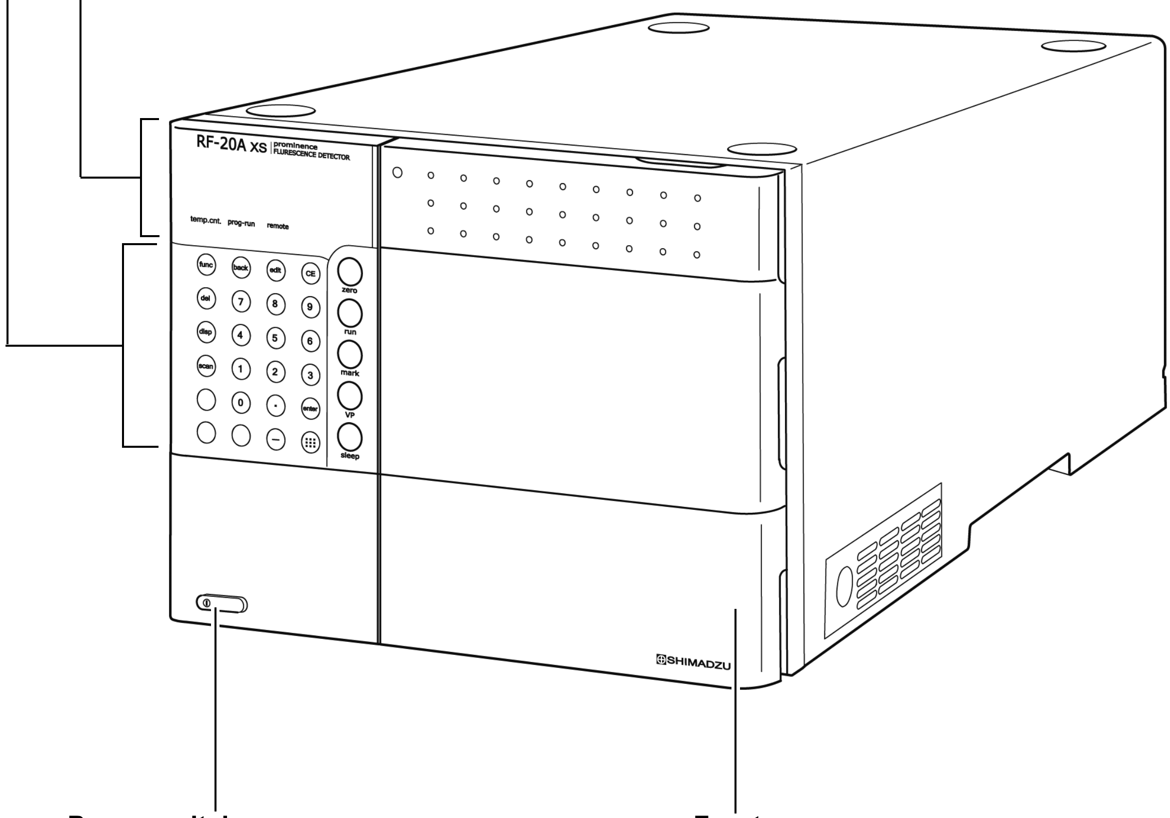
# 2.1 Front

**Keypad**

Used to configure settings and perform operations with the operation keys.
Press  to show the operation keys.

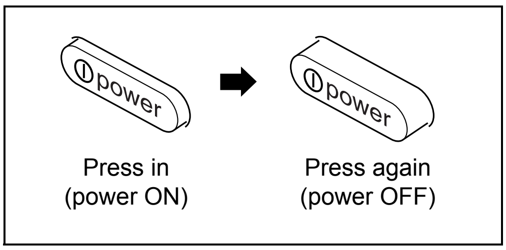
**Display panel**

Comprises the display screen and LED indicators and displays settings and operations.




**Power switch**

Used to switch the power ON/OFF.
Press the switch in to turn the power ON. Press it again (the switch will pop out) to turn the power OFF.




**Front cover**

Open this cover to remove or install the flow cell or to do the tubing work.
Always close this cover before starting measurement.

# 2.2 Behind Front Cover, Top Panel and Left Side

**Flow cell**

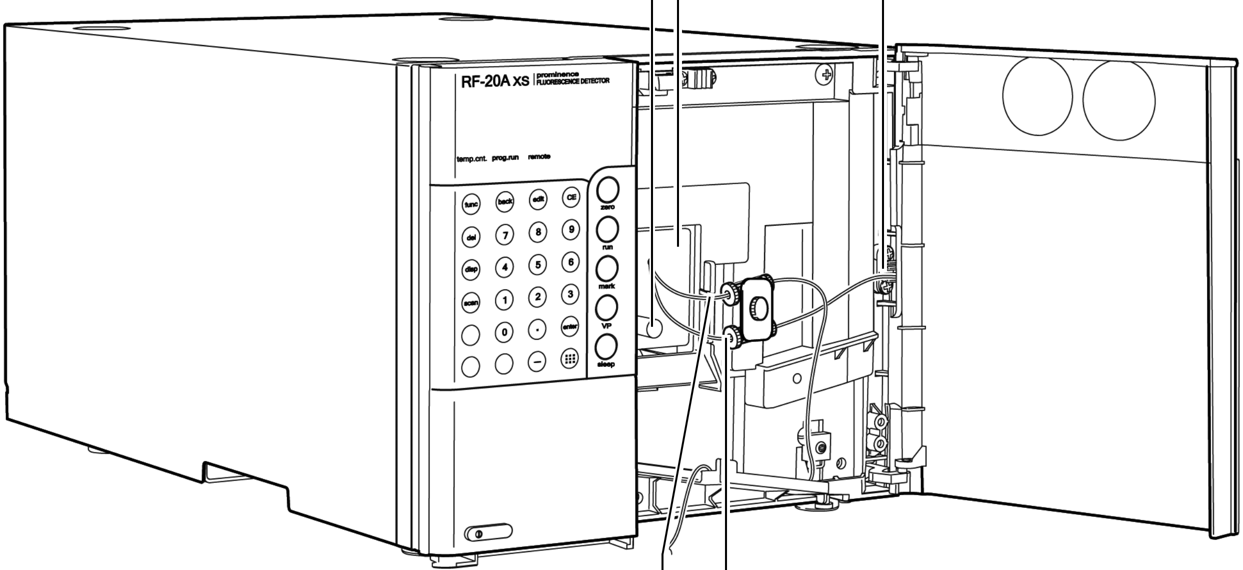
Monitor the mobile phase eluted from the column here.

**Cell housing screw**

Loosened to enable the flow cell to be pulled out.

**Tubing clamp**

Secures the tubing that is fitted to the flow cell.



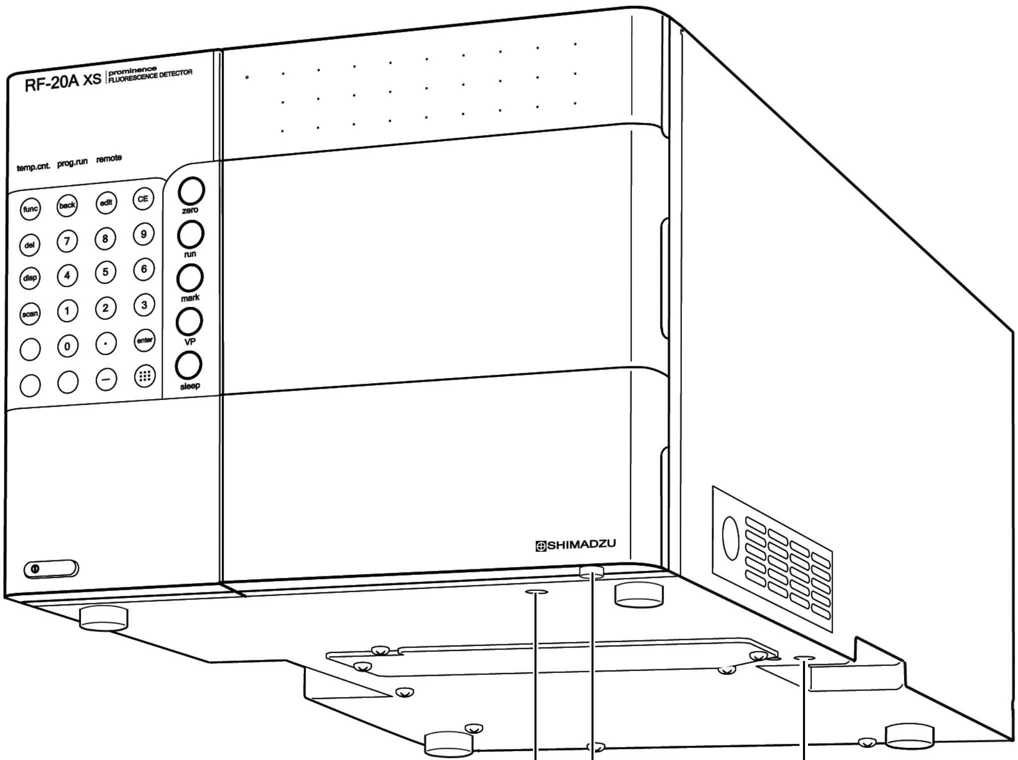

**Cell outlet tube**

Connected to the tubing that discharges the mobile phase after analysis.

**Cell inlet tube (with blue tubing)**

Connect the tubing from the column here.

# 2.3 Right Side and Base Panel




**Shipping screw (painted red)**

To prevent shock during transportation.
Remove before installation.

**Leakage drain outlet**

Liquid that leaks out of the instrument is led from this outlet to an LC-20A series module.

**Shipping screw (painted red)**

To prevent shock during transportation.
Remove before installation.

# 2.4 Back

**[REMOTE] connector**

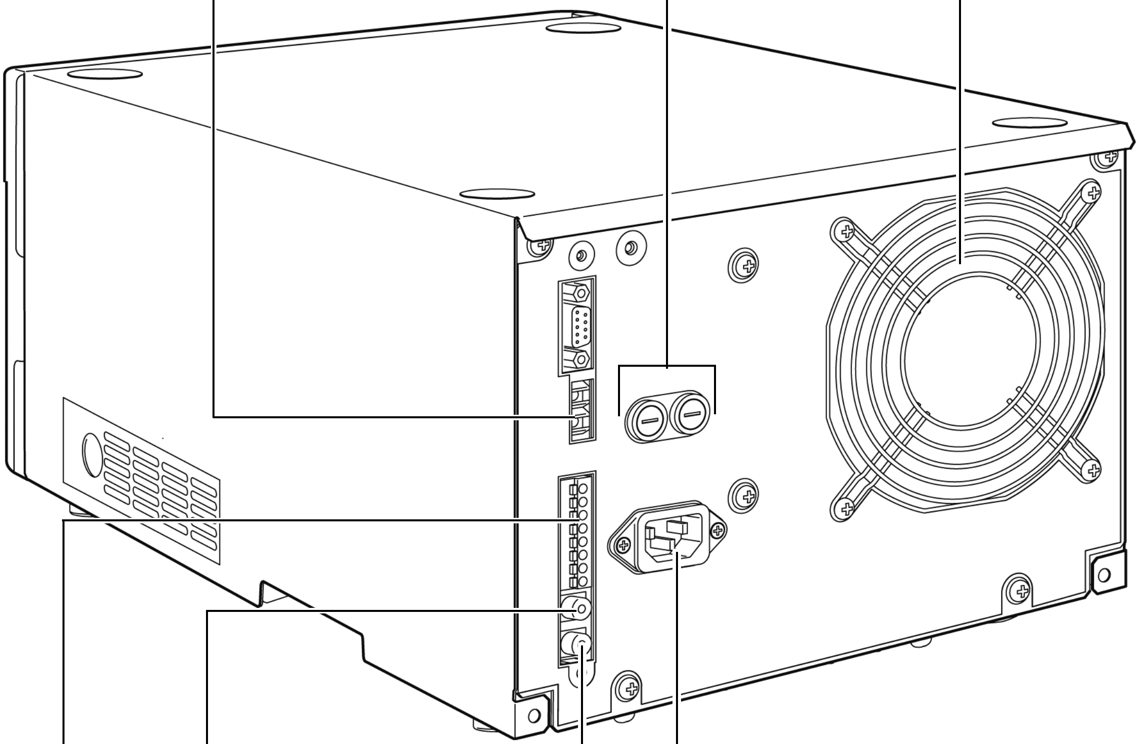
For connecting to the system controller.

**Fuse holders**

Fuses are set in these.

**Cooling fan**

Fan for internal cooling.



**Power cord connector**

For connecting the power cord.

**Analog output connector 2**

For connecting to external equipment such as a recorder, Chromatopac (integrator), etc.

**Analog output connector 1**

For connecting to external equipment such as a recorder, Chromatopac (integrator), etc.

**External input/output terminals**

For connecting to external equipment.

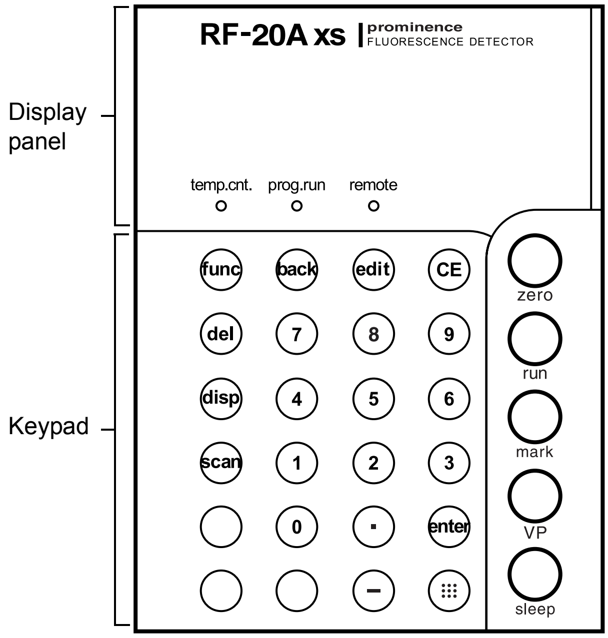
# 2.5 Names and Functions of Displays and Keypad

This instrument is controlled with the keys on the keypad.

The display allows you to check the instrument's status.

NOTE

- The illustration shows the RF-20Axs.
- The display panel may become hot when in use.



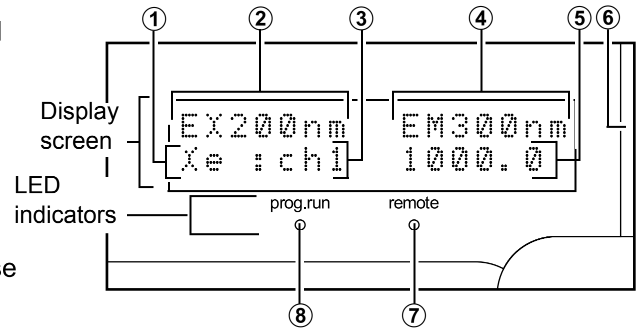

## 2.5.1 Display Panel

The display panel consists of a display screen and LED indicators. The names of elements of the display panel and their functions are given in the table below.

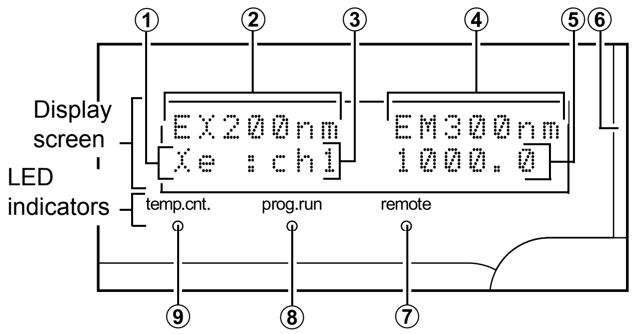
NOTE

In the absence of any indication to the contrary, the illustrations of LED indicators in this manual show those of the RF-20Axs.

RF-20A



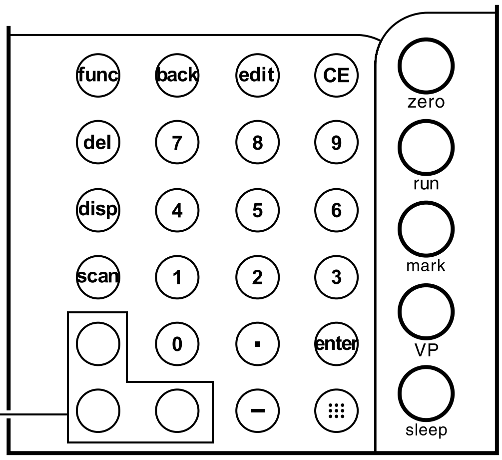

RF-20Axs



| No. | Display or Indicator | Function |
|---|---|---|
| ① | Indicator function | Shows the function of the Xenon lamp.<br>Xe: Xenon lamp lit<br>(No display): Xenon lamp not lit |
| ② | EX (excitation wavelength) | Shows the excitation wavelength of the currently indicated channel. |
| ③ | Indicated channel | Shows the currently indicated channel.<br>This is only displayed when measurement is being performed on multiple wavelengths. |
| ④ | EM (emission wavelength) | Shows the emission wavelength of the currently indicated channel. |
| ⑤ | Light intensity | Shows the fluorescent intensity. |
| ⑥ | Status indicator | Shows the status of the instrument with the color of an LED.<br>Green: When the power is ON.<br>Orange: During the sleep mode.<br>Red: When an error has occurred. |
| ⑦ | remote<br>(Remote control mode indicator) | Lit when the instrument is being controlled by the system controller. |
| ⑧ | prog.run<br>(Time program indicator) | Lit while a time program is being executed. |
| ⑨ | temp.cnt. (RF-20Axs only) | Shows the flow cell temperature control status.<br>Lit: The temperature of the flow cell is within ± 1 °C of the set temperature.<br>Flashing: The temperature of the flow cell is more than ± 1 °C outside the set temperature.<br>Off: Flow cell temperature control is not in effect. |

## 2.5.2 Keypad

This instrument is operated, and settings are made, by using the operation keys on its front face. There are the following two types of keys.




These are dummy keys.
They are not operational.

### ■ List of Keys That Can Always Be Operated

| Key | Name | Function |
|---|---|---|
| | Display key | Pressed to show the operation keys and enable their operation. |
| zero | Zero key | To adjust the zero position of analog output connectors 1 and 2.<br>To return the baseline to the zero position set with parameter settings group [BL OFS ANA1] (☞ P.5-24) or [BL OFS ANA2] (☞ P.5-24). |
| run | Run key | To start and stop the time program. |
| mark | Marker key | To mark data being recorded in the recorder.<br>The output connector for entering marks changes depending on the marker output setting. |
| VP | VP key | To move from the initial screen to VP mode. |
| sleep | Sleep key | To turn off the lighting in the display panel (display screen, LED indicators) and keypad (operation keys).<br>The status indicator turns orange (meaning "sleeping").<br>Input with the operation keys becomes impossible. However, operations are executed.<br>On pressing this key again, the lighting is turned back on.<br>Use this key when using the instrument through the nighttime. |

## ■ List of Keys That Can Be Operated on Pressing the Display Key

| Key | Name | Function |
|---|---|---|
| edit | Edit key | To activate the edit mode of the time program (from the initial screen). |
| disp | Disp key | To switch between channel displays when measuring multiple wavelengths. |
| scan | Scan key | To start a spectrum scan. |
| ▪ - 9 | Numeric keys | To enter numeric values. |
| enter | Enter key | To confirm the values entered for each item setting. |
| CE | Clear key | Used for the following purposes:<br>• To initialize the display screen.<br>• To clear the values entered up to that time while entering the values.<br>• To clear error messages and cancel alarms.<br>* Note that errors caused e.g. by faults with this instrument cannot be cleared with this key. |
| del | Delete key | To delete one line of the displayed program during time program editing. |
| func | Function key | To move to the next item to the right, or to the next item, on the display screen. |
| back | Back key | To scroll backward during time program editing.<br>To scroll backward through auxiliary function setting screens. |
| — | Minus key | To enter negative (–) numerical values. |

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# 3

# Preparation

Contents

# 3.1 Cautions on Operation

## ■ Cautions Prior to Operation

- When high-sensitivity analysis is required, light the Xenon lamp ahead of time, taking into account the time taken to achieve a stable baseline.

  The guide for the stabilization time is 1 hour after the Xenon lamp has lit.

- Check that there are no liquid leaks at the flow cell and tubing connections.

## ■ Cautions During Operation

- Make sure that the front cover is closed during measurement.

  If the front cover is opened during measurement the baseline will fluctuate and this may hinder high-sensitivity analysis. It may also increase noise.

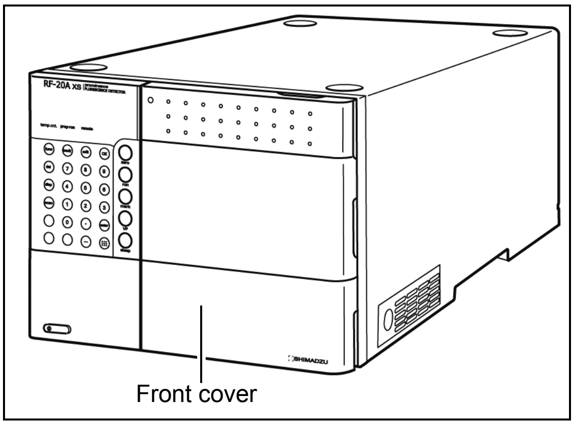



Fig. 3.1

## ■ Cautions After Operation

- Do not block the flow cell.

  The fault that is most likely to occur with this instrument is contamination of the cell or clogging of the flow cell.
  After analyzing a high-density sample, flush the flow cell thoroughly with mobile phase to ensure that none of the sample remains inside it. If a buffer solution is used as the mobile phase, flush with water after the completion of analysis.
  When the buffer solution dries, crystals will be generated, and these will cause clogging of the flow line in the flow cell.

# 3.2 Turning the Power ON/OFF

**1** Press the power switch to turn the power ON.
Press it again to turn the power OFF.

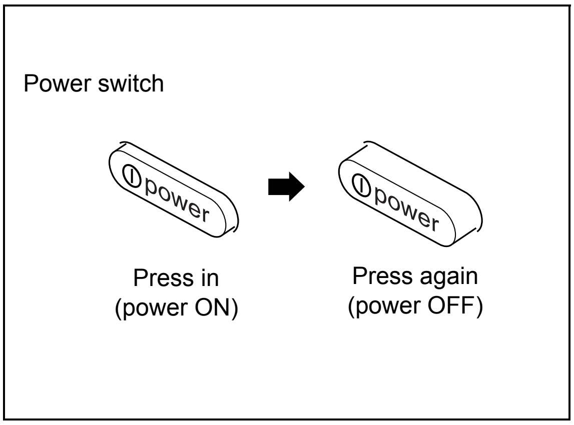
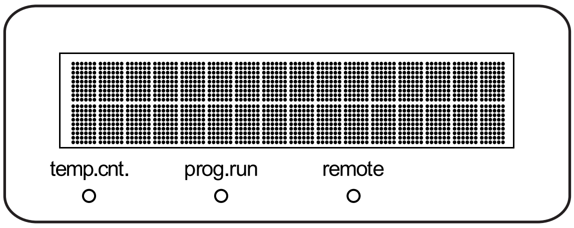
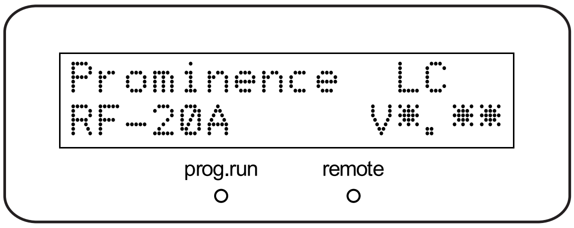



Fig. 3.2

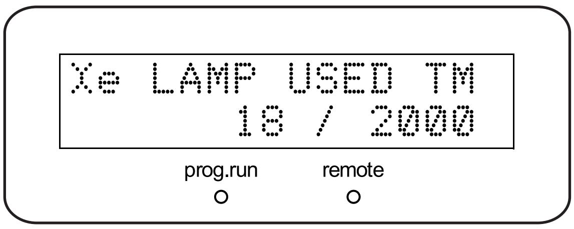
**2** When the power is turned ON, all the LED indicators and all the dots in the display matrix light up as shown on the right.
This instrument executes the following operations automatically.



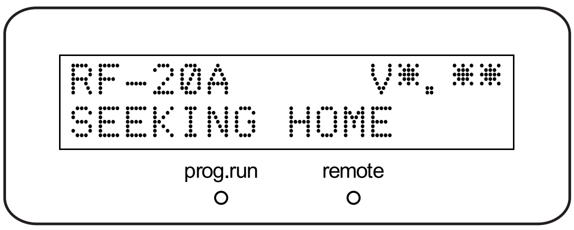

**3** The version number of the control program is displayed.
[V∗.∗∗] indicates the ROM version here.



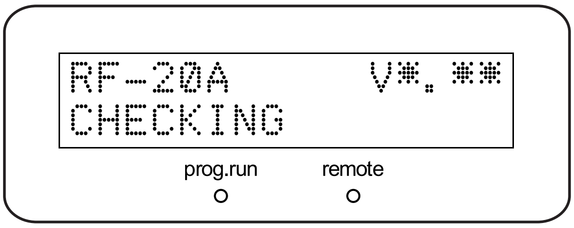

**4** The Xenon lamp cumulative operating time and replacement alert time are indicated.



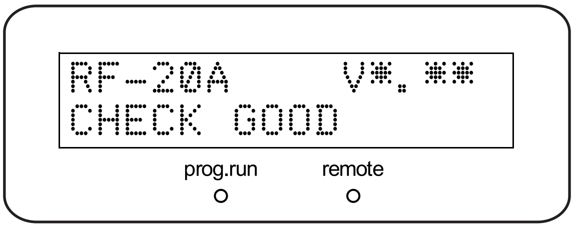

**5** The instrument is initialized and the home positions of the excitation side and emission side are detected.



**6** A memory check is executed.

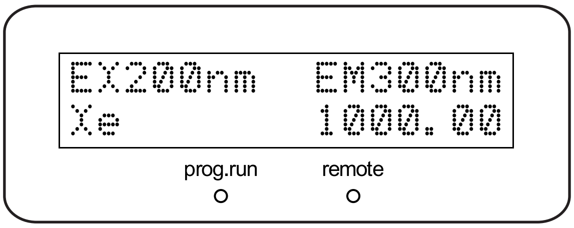



**7** If there is no abnormality, the screen shown to the right is displayed.

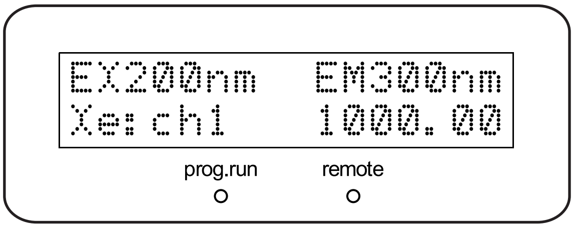



**8** The initial screen is displayed.
The operation keys will be displayed and become operable.

Initial screen in the single wavelength mode




Initial screen in the dual wavelength mode




NOTE

When connected to the system controller, press after the instrument has started up. This will display the operation keys and make them operable. Some operations, such as inputting settings, cannot be performed.

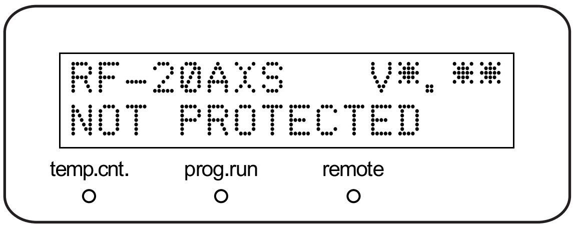
## ■ Example Error Message Display

### If an alarm sounds and [NOT PROTECTED] is displayed:

This error message is displayed if the parameters and time program that were set last time were erased on startup of the instrument.

**1** Press CE to cancel the alarm.
The content of the parameters and time program will be initialized.

**2** Set new parameters and a new time program.



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# 4

# Basic Operation

Contents

# 4.1 Measuring in the Single Wavelength Mode

This section explains the procedure for measurement in the single wavelength measurement mode, which is the basic measurement mode of this instrument.

For details on the "dual wavelength mode" and "spectrum scanning mode", see the following sections.

"4.2 Measuring in the Dual Wavelength Mode" P.4-21
"5.5 Measuring in the Spectrum Scanning Mode" P.5-61

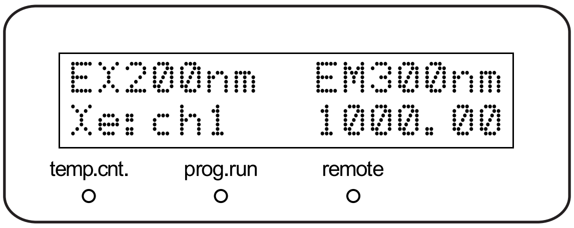
NOTE

- Before making settings, turn the power to the instrument ON to make the operation keys operable.
  "3.2 Turning the Power ON/OFF" P.3-3
- When this instrument is used in the RF-10AXL compatibility mode, some functions may no longer be usable, and the setting ranges may be restricted.
  "5.7.3 Notes on Operation" P.5-77

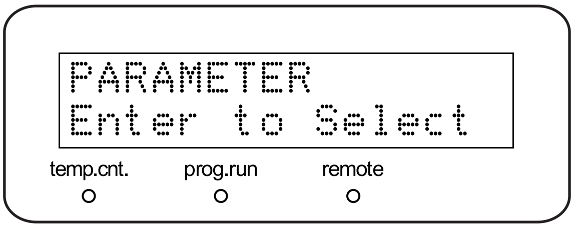
## 4.1.1 Setting the Measurement Mode

Set the measurement mode to single wavelength.

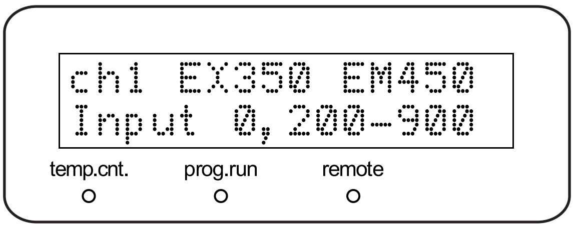
**1** Press **CE**.
The initial screen will be displayed.



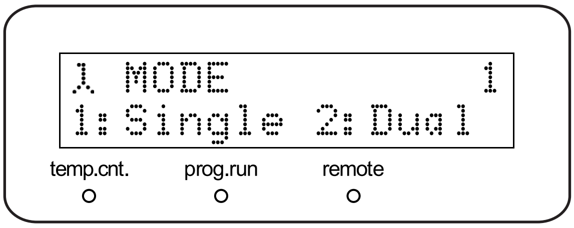

**2** Press **func**.
[PARAMETER] will be displayed.




**3** Press **enter**.
[ch1] will be displayed.



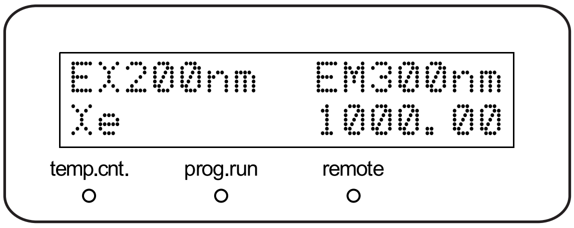
**4** Press **func** repeatedly until [λ MODE] is displayed.




**5** Enter **1** and press **enter**.
This sets the measurement mode to single wavelength.

**6** Press **CE** twice.
Setting of the measurement mode ends and you are returned to the initial screen.

Initial screen in the single wavelength mode

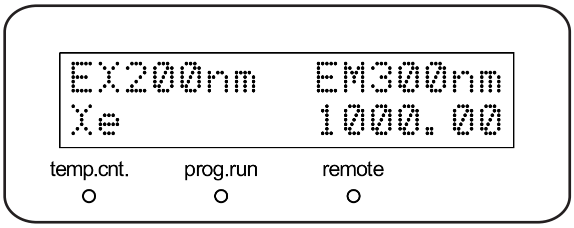



## 4.1.2 Setting the Measurement Wavelengths

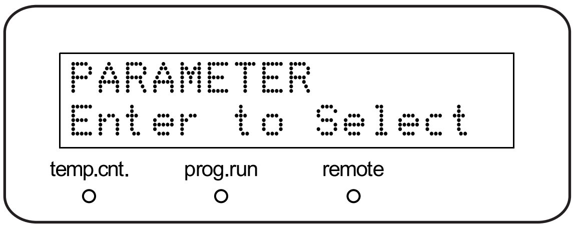
Set the excitation wavelength and emission wavelength.
The setting ranges for the wavelengths are as follows.

| Wavelength | Setting Range (Units: nm) |
|---|---|
| EX (excitation wavelength) | 0, 200 to 900 |
| EM (emission wavelength) | 0, 200 to 900 |

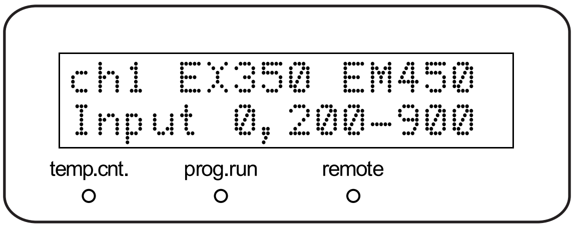
**1** Press **CE**.
The initial screen will be displayed.




**2** Press **func**.
[PARAMETER] will be displayed.

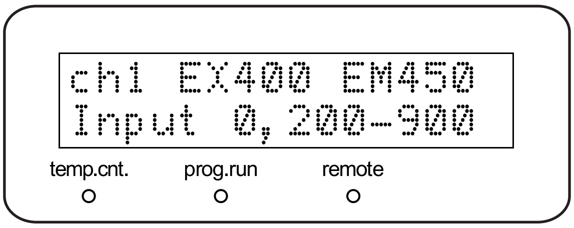


**3** Press (**enter**).
[ch1] will be displayed.
In the initial status, the excitation wavelength can be entered.




**4** Enter the excitation wavelength with the numeric keys, then press (**enter**).
This sets the excitation wavelength.

**5** Press (**func**).
The status in which the emission wavelength can be entered will be established.




**6** Enter the emission wavelength with the numeric keys, then press (**enter**).
This sets the emission wavelength.

**7** Press (**CE**) twice.
Setting of the excitation wavelength and emission wavelength ends and you are returned to the initial screen.

NOTE

This instrument has two analog output connectors: analog output connector 1 and analog output connector 2.
Set the analog output connector according to the equipment you are connecting to.

☞ "4.1.3 Setting the Analog Output Connectors" P.4-5

| Connected Equipment | Remark |
|---|---|
| When connecting a Chromatopac or a variable range recorder | Set the output mode for the analog output connectors to INTEGRATOR. |
| When connecting a fixed range recorder | Set the output mode for the analog output connectors to RECORDER, and set the output range at the instrument.<br>☞ "4.1.4 Setting the Output Ranges" P.4-7 |

## 4.1.3 Setting the Analog Output Connectors

Set whether to connect the Chromatopac (integrator) or recorder to the analog output connectors.

When connecting a Chromatopac to an analog output connector set [0], and when connecting a recorder set [1].

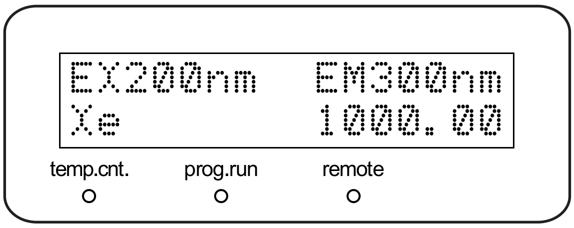
The settings for analog output connectors are shown below. They are common to analog output connectors 1 and 2.

| Set Value | Setting | |
|---|---|---|
| 0 | ch1: INTEGRATOR | Connect a Chromatopac or variable range recorder. |
| 1 | ch1: RECORDER | Connect a fixed range recorder. |
| 8* | The temperature of the flow cell is output.<br>Output range: 0 to 100 °C (0 to 10 mV) | |

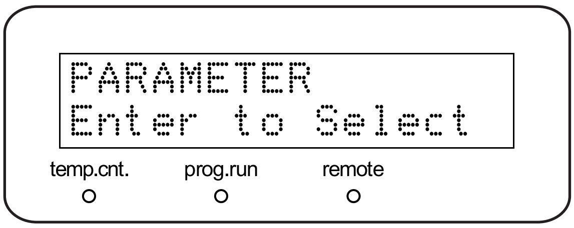
* : RF-20Axs only

### ■ Setting the Output Mode of an Analog Output Connector

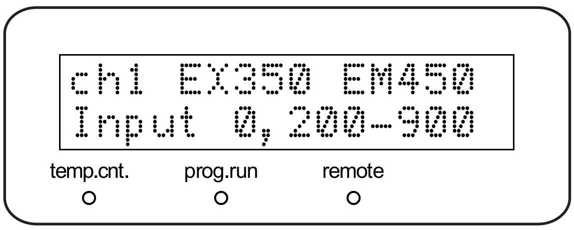
1 Press (CE).
The initial screen will be displayed.




2 Press (func).
[PARAMETER] will be displayed.



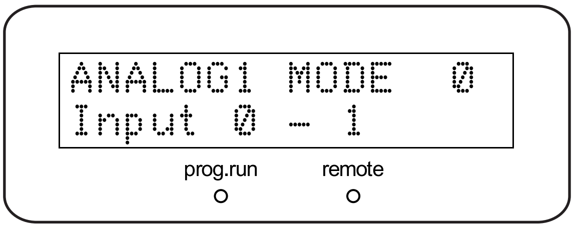

3 Press (enter).
[ch1] will be displayed.



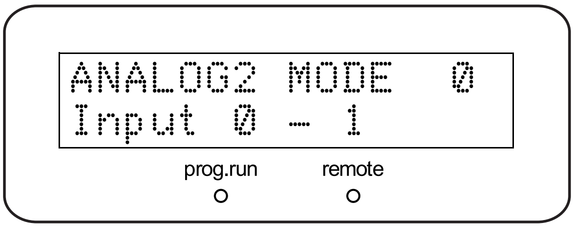
**4** Press **func** repeatedly until [ANALOG1 MODE] or [ANALOG2 MODE] is displayed.

＊ When setting analog output connector 1, display [ANALOG1 MODE] and when setting analog output connector 2, display [ANALOG2 MODE].

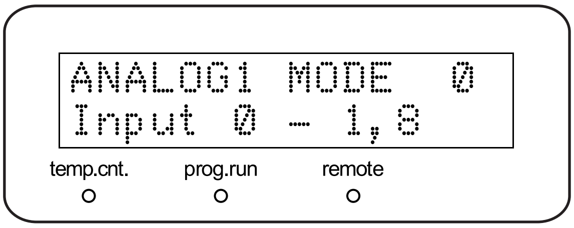
Analog output connector 1 (RF-20A)



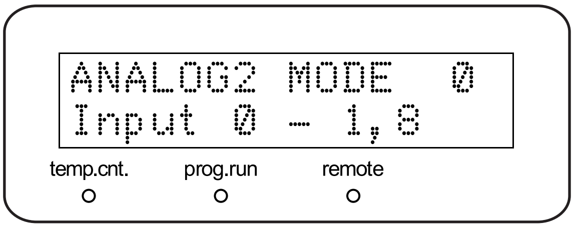

Analog output connector 2 (RF-20A)




Analog output connector 1 (RF-20Axs)




Analog output connector 2 (RF-20Axs)




**5** Enter **0**, **1** or **8** and press **enter**.

This sets the output mode of the analog output connectors.

＊ Note that [8] is only displayed on the display panel of the RF-20Axs.

**6** Press (**CE**) twice.
Analog output connector output mode setting ends and you are returned to the initial screen.

NOTE

To set the output mode of analog output connector 2 right after having set that of analog output connector 1, display the screen on which the output mode of analog output connector 2 can be set by pressing (**func**) after pressing (**enter**) in step 5.



## 4.1.4 Setting the Output Ranges

Before setting the output ranges, set analog output connectors 1 and 2 in accordance with the equipment they will be connected to.

☞ "4.1.3 Setting the Analog Output Connectors" P.4-5

NOTE

Note that the output range settings only take effect if the analog output connector has been set for RECORDER.

☞ "4.1.3 Setting the Analog Output Connectors" P.4-5

### ■ When a Chromatopac Is Used as the Recorder:

- Normally it is connected to the analog output connector set for INTEGRATOR.
  ☞ "4.1.3 Setting the Analog Output Connectors" P.4-5
- The range when a Chromatopac is used is normally set with the [ATTEN] setting at the Chromatopac, but since the dynamic range at the instrument side is extremely wide, set gain and sensitivity at the instrument.
  ☞ "4.1.7 Setting Gain" P.4-16
  "4.1.8 Setting Sensitivity" P.4-17
- Regardless of the range setting, the analog output connector set for INTEGRATOR outputs a voltage of 1 V at the maximum value (1000) for fluorescent intensity.

### ■ When a Recorder Is Used:

Connect the recorder to the analog output connector set for RECORDER.

☞ "4.1.3 Setting the Analog Output Connectors" P.4-5

## ■ Details of Output Range Settings

These details are common to analog output connectors 1 and 2.

| Set Value | Output Range |
|---|---|
| 0 | Short (output is 0 mV) * |
| 1 | × 1 |
| 2 | × 1/2 |
| 3 | × 1/4 |
| 4 | × 1/8 |
| 5 | × 1/16 |
| 6 | × 1/32 |
| 7 | × 1/64 |
| 8 | × 1/128 |
| 9 | × 1/256 |

* When a baseline offset value, [BL OFS ANA1] or [BL OFS ANA2], is set, the corresponding set voltage is output.

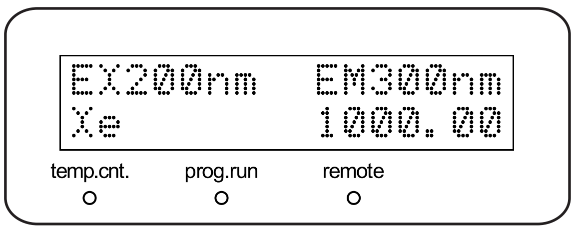
When the fluorescent intensity is the maximum value (1000) and the output range is × 1, a voltage of 500 mV (half of that when INTEGRATOR is set) is output at the terminal.
The output range determines the maximum value of the fluorescent intensity recorded by the recorder, and the maximum value is selected by applying the following formula.

Output range ≤ 20 / (maximum value of fluorescence)

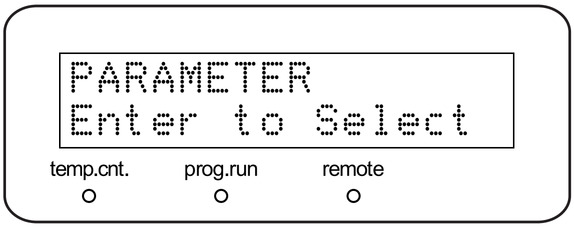
- When a range of fluorescent intensity of 0 to 150 is recorded by the recorder:
  Output range ≤ 20 / 150 = 1/7.5
  The output range is [× 1/8] and the set value is [4].

## ■ Setting the Output Range of the Analog Output Connectors

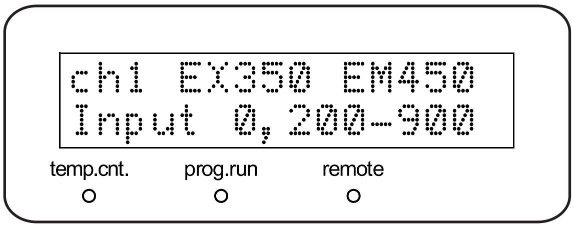
**1** Press CE.
The initial screen will be displayed.



**2** Press (**func**).
[PARAMETER] will be displayed.



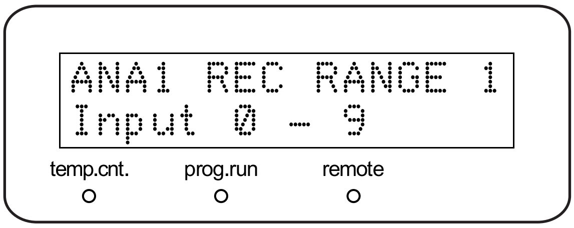

**3** Press (**enter**).
[ch1] will be displayed.



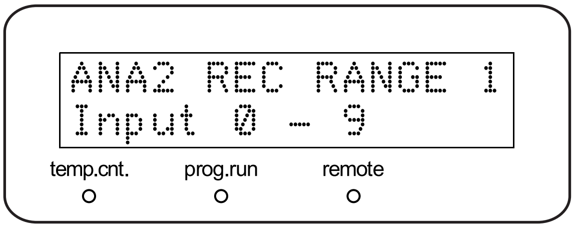

**4** Press (**func**) repeatedly until [ANA1 REC RANGE] or [ANA2 REC RANGE] is displayed.

∗ When setting analog output connector 1, display [ANA1 REC RANGE] and when setting analog output connector 2, display [ANA2 REC RANGE].

Analog output connector 1




Analog output connector 2




**5** Enter the set value from the numeric keys and press (**enter**).
This sets the output range for the analog output connector.

**6** Press **CE** twice.

Setting of the output range for the analog output connector ends and you are returned to the initial screen.

* To set the output range of analog output connector 2 right after having set that of analog output connector 1, display the screen on which the output range of analog output connector 2 can be set by pressing **func** after pressing **enter** in step 5.

## 4.1.5 Setting Baseline Offset Values

Set baseline offset values for analog output connectors 1 and 2. Connect the recorder or Chromatopac to the analog output connector and set the output range, gain, and sensitivity.

☞ "4.1.3 Setting the Analog Output Connectors" P.4-5
"4.1.4 Setting the Output Ranges" P.4-7
"4.1.7 Setting Gain" P.4-16
"4.1.8 Setting Sensitivity" P.4-17

The setting range for the baseline offset values of analog output connectors is indicated below.
This range is common to analog output connectors 1 and 2.

| Setting Range (Units: mV) |
|---|
| –2 to 250 (default value: 0) |



### ■ Setting the Recorder's Zero Position

When using a recorder, set the zero position of the recorder main unit by following the procedure below.

1. Connect the recorder to the analog output connector for which [RECORDER] was set.
   ☞ "4.1.3 Setting the Analog Output Connectors" P.4-5

2. Press (zero) to set the fluorescent intensity to [0].

3. Align the position of the recorder's pen with the [0] graduation on the chart by using the pen position adjusting knob.
   From this point on, pressing (zero) will return the recorder's pen to the [0] graduation on the chart.

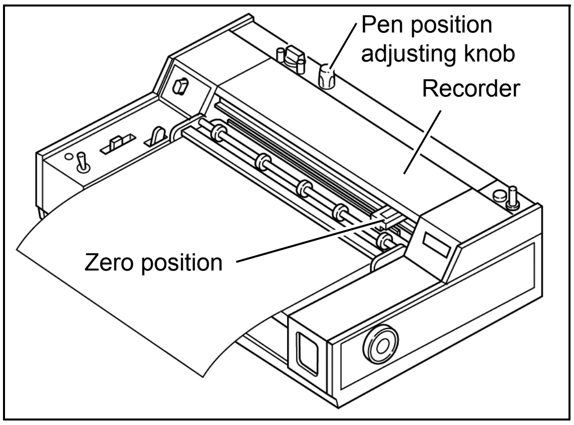
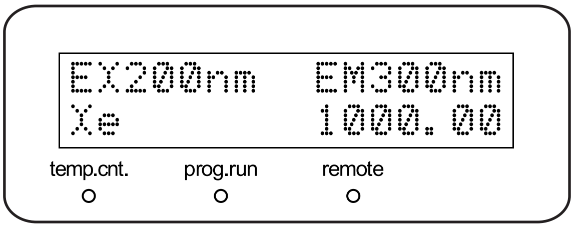


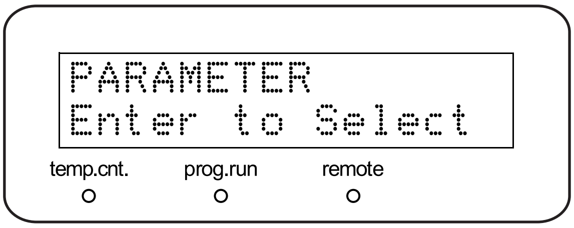

Fig. 4.1

## ■ Setting the Baseline Offset Values of Analog Output Connectors

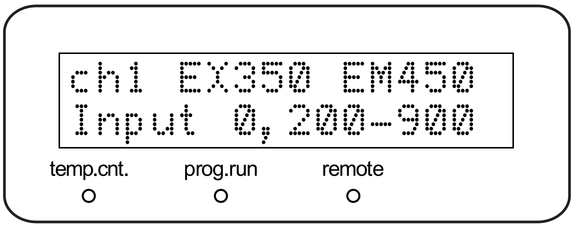
**1** Press **CE**.
The initial screen will be displayed.




**2** Press **func**.
[PARAMETER] will be displayed.



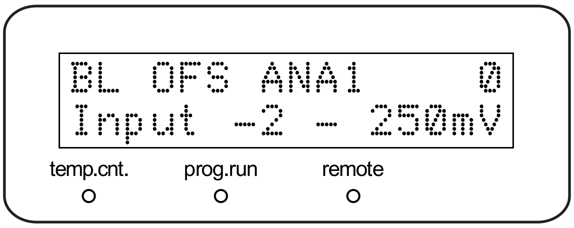

**3** Press **enter**.
[ch1] will be displayed.



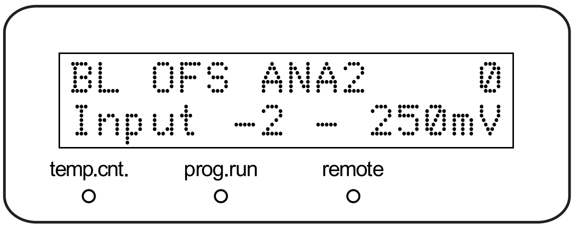

**4** Press **func** repeatedly until [BL OFS ANA1] or [BL OFS ANA2] is displayed.

∗ When setting analog output connector 1, display [BL OFS ANA1] and when setting analog output connector 2, display [BL OFS ANA2].

Analog output connector 1




Analog output connector 2



**5** Enter the offset value (units: mV) from the numeric keys and press **enter**.
This will change the baseline offset value.

**6** Press **CE** twice.
Setting of baseline offset values for analog output connectors ends and you are returned to the initial screen.
After completion of setting, each time you press **zero** the baseline returns to the position set here.
* To set the baseline offset of analog output connector 2 right after having set that of analog output connector 1, display the screen on which the baseline offset of analog output connector 2 can be set by pressing **func** after pressing **enter** in step 5.

## 4.1.6 Setting the Response (Response Speed)

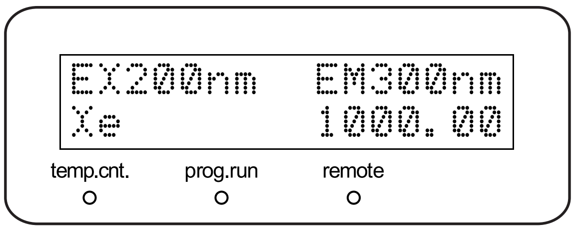
This instrument achieves an improved S/N ratio by using a digital filter. Decreasing the response value of this digital filter improves the responsiveness, but noise is increased. Increasing the response value causes deterioration in responsiveness, but noise is reduced.

The response for this instrument can be set at 11 levels, from [0] to [10].

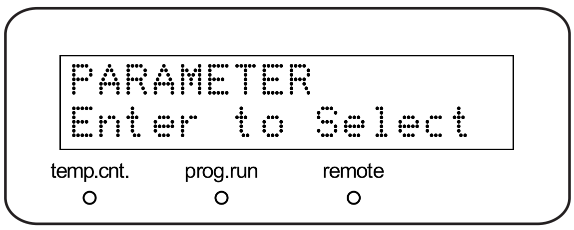
The changes in responsiveness according to the value set for response are shown in the table below by giving the correspondence with the time constants of conventional analog CR filters.

| Value Set for Response | Time Constant of Corresponding Analog CR Filter (Units: sec) | Usable Peak's Half-Height (Units: sec (minimum)) |
|---|---|---|
| 0 | No filter | 0.08 |
| 1 | 0.05 | 0.2 |
| 2 | 0.1 | 0.4 |
| 3 | 0.5 | 2.2 |
| 4 | 1.0 | 4.8 |
| 5 | 1.5 | 7.2 |
| 6 | 3.0 | 13 |
| 7 | 6.0 | 26 |
| 8 | 8.0 | 36 |
| 9 | 10.0 | 45 |
| 10 | 2.0 | 9 |

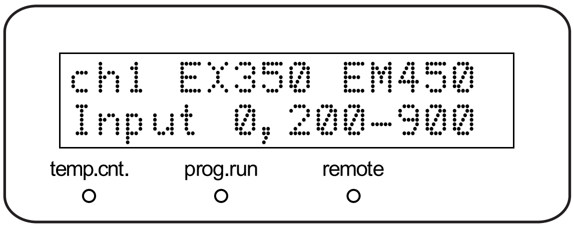
**1** Press **CE**.
The initial screen will be displayed.



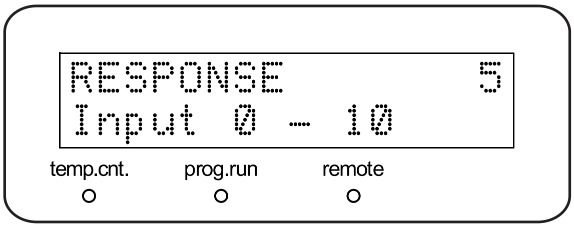

**2** Press **func**.
[PARAMETER] will be displayed.



**3** Press **enter**.
[ch1] will be displayed.




**4** Press **func** repeatedly until [RESPONSE] is displayed.




**5** Enter the set value from the numeric keys and press **enter**.
This sets the response.

**6** Press **CE** twice.
Response setting ends and you are returned to the initial screen.

NOTE

If a slow response value (time constant) is set, responsiveness is adversely affected and the peak height is decreased, but the smaller the width at half-height, the larger is the extent of the decrease in the peak height.
Here, as a guide, the situation where a width at half-height that decreases the peak height by 10 % can be used has been shown for each response. The relationship between peak's half-height and decrease in peak height is shown in the graph to the right.
Note that even if the responsiveness is adversely affected and the peak spreads, the peak area doesn't change.

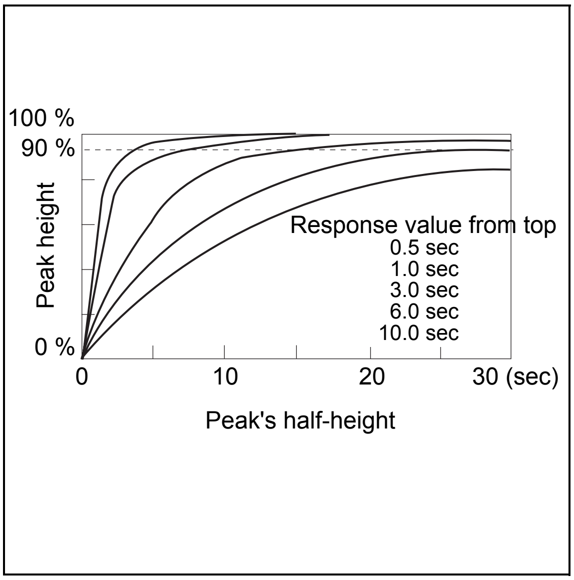



Fig. 4.2

## 4.1.7 Setting Gain

This is the procedure for setting gain. By combining the setting of sensitivity and gain, you can set the measuring range.

The settings for gain are shown below.

| Set Value | Gain |
|---|---|
| 1 | × 1 |
| 2 | × 4 |
| 3 | × 16 |

The combinations of sensitivity and gain are shown below.

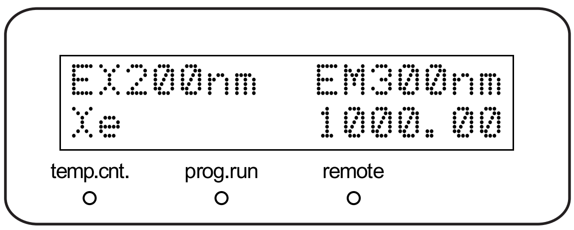
| Sensitivity | Gain | Sensitivity Magnifications |
|---|---|---|
| 3 (LOW) | 1 | Approx. × 1 |
| | 2 | Approx. × 4 |
| | 3 | Approx. × 16 |
| 2 (MED) | 1 | Approx. × 32 |
| | 2 | Approx. × 128 |
| | 3 | Approx. × 512 |
| 1 (HI) | 1 | Approx. × 1024 |
| | 2 | Approx. × 4096 |
| | 3 | Approx. × 16384 |

NOTE

When the sensitivity and/or gain have been changed, plot a revised calibration curve.

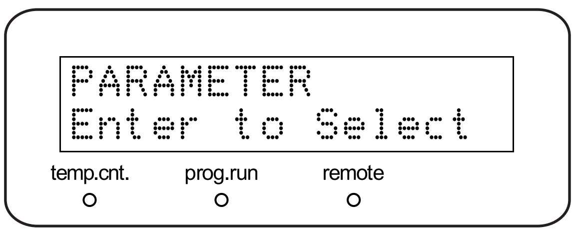
**1** Press **CE**.

The initial screen will be displayed.

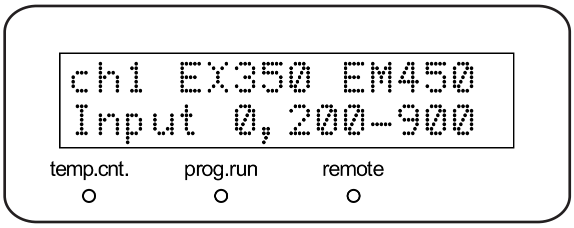



**2** Press **func**.

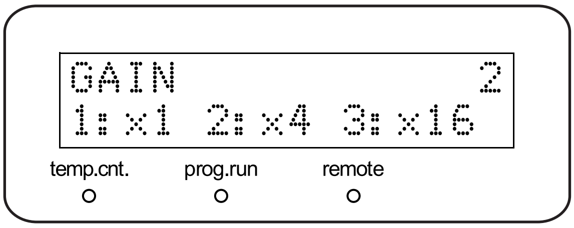
[PARAMETER] will be displayed.



**3** Press **enter**.
[ch1] will be displayed.




**4** Press **func** repeatedly until [GAIN] is displayed.






**5** Enter the set value from the numeric keys and press **enter**.
This sets the gain.

**6** Press **CE** twice.
Gain setting ends and you are returned to the initial screen.

## 4.1.8 Setting Sensitivity

This is the procedure for setting sensitivity. By combining the setting of sensitivity and gain, you can set the measuring range.

☞ "4.1.7 Setting Gain" P.4-16

NOTE

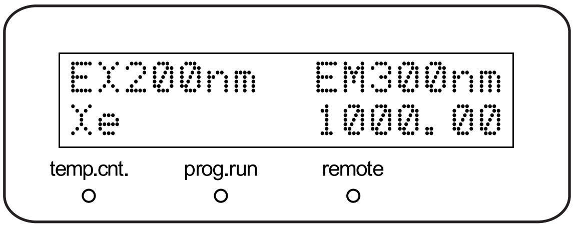
When using a Chromatopac, select the sensitivity of this instrument such that the noise becomes several percent of the plot range when the [ATTEN] setting of the Chromatopac is [0]. Next, select an [ATTEN] setting that ensures that the targeted peak is within the plot range. If the peak height is beyond the plot range even when [ATTEN] of the Chromatopac is set to the lowest sensitivity, change the sensitivity of this instrument to low sensitivity.

The settings for sensitivity are shown below.

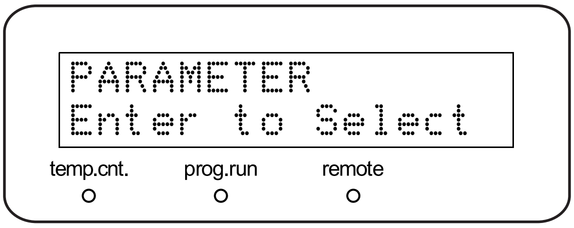
On shipping from the factory, the setting is [2] (MED).

| Set Value | Sensitivity | Sensitivity Magnifications |
|---|---|---|
| 1 | HIGH | Approx. × 1 |
| 2 | MED | Approx. × 32 |
| 3 | LOW | Approx. × 1024 |

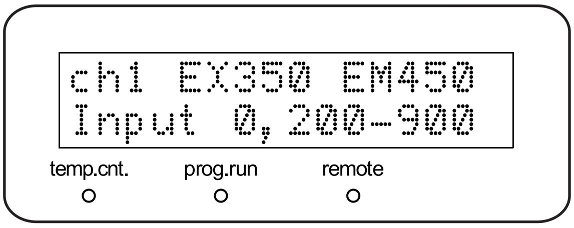
**1** Press **CE**.
The initial screen will be displayed.



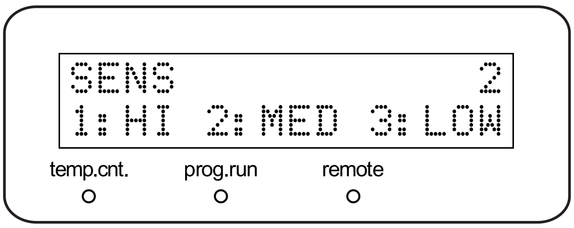

**2** Press **func**.
[PARAMETER] will be displayed.




**3** Press **enter**.
[ch1] will be displayed.




**4** Press **func** repeatedly until [SENS] is displayed.




**5** Enter the set value from the numeric keys and press **enter**.
This sets the sensitivity.

**6** Press **CE** twice.
Sensitivity setting ends and you are returned to the initial screen.

## 4.1.9 Setting the Flow Cell Temperature (RF-20Axs Only)

Set the temperature of the flow cell.
The fluorescent intensity of the sample varies depending on its temperature. In order to obtain stable analysis results unaffected by the ambient temperature, the temperature of the sample in the flow cell is fixed at all times.

NOTE

The guide for the set temperature of the flow cell is the same temperature as the instrument's ambient temperature.

Since condensation may occur in the vicinity of the flow cell depending on the ambient humidity if the temperature of the flow cell goes below the flow cell's ambient temperature, it is made impossible to cool the flow cell more than 10 °C below the ambient temperature. If the ambient temperature rises to more than 10 °C higher than the set temperature, [LOW SET TEMP] is displayed on the display screen every 60 minutes and it may not be possible to obtain normal analysis results.

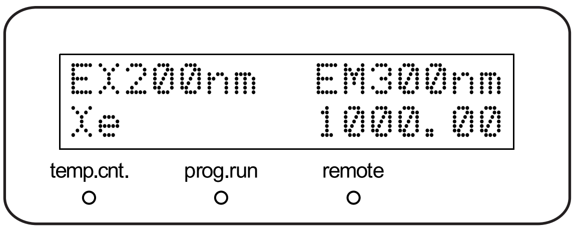
NOTE

The current ambient temperature can be checked at [ROOM TEMP].
☞ "Displaying the Ambient Temperature [ROOM TEMP] (RF-20Axs Only)" P.5-33

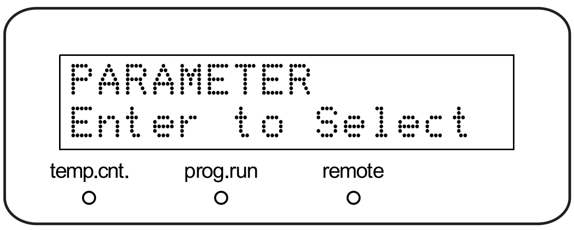
The setting range for flow cell temperature is shown below.

| Set Value | Setting |
|---|---|
| 0 | The temperature is not adjusted. |
| 4 to 40 °C | The temperature is adjusted to the set value. |

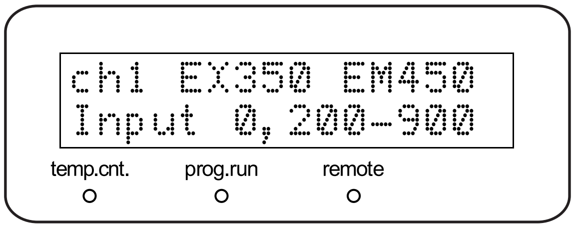
**1** Press **CE**.
The initial screen will be displayed.



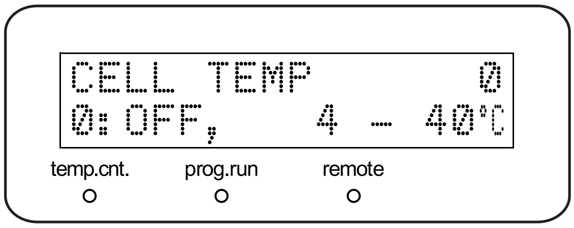

**2** Press **func**.
[PARAMETER] will be displayed.



**3** Press **enter**.
[ch1] will be displayed.




**4** Press **func** repeatedly until [CELL TEMP] is displayed.




**5** Enter the set value from the numeric keys and press **enter**.
This sets the temperature of the flow cell.

**6** Press **CE** twice.
Flow cell temperature setting ends and you are returned to the initial screen.

# 4.2 Measuring in the Dual Wavelength Mode

This section explains the procedure for measurement in the dual wavelength mode.
In the dual wavelength mode you can set the excitation wavelength and emission wavelength of channel 1 and channel 2, and record chromatograms for each channel at the same time.



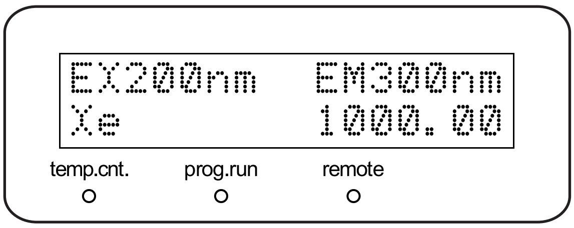
NOTE

- When quantifying in the dual wavelength mode, create the calibration curve in the dual wavelength mode. The wavelength accuracies in the single wavelength mode and dual wavelength mode are different, and there will be differences in the peak heights between them.
- Before making settings, turn the power to the instrument ON to make the operation keys operable.
  ☞ "3.2 Turning the Power ON/OFF" P.3-3
- When this instrument is used in the RF-10AXL compatibility mode, measurement in the dual wavelength mode is not possible.

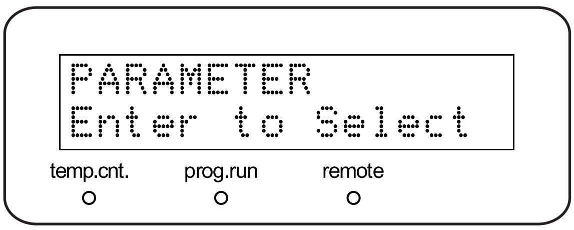
## 4.2.1 Setting the Measurement Mode

Set the measurement mode to dual wavelength.

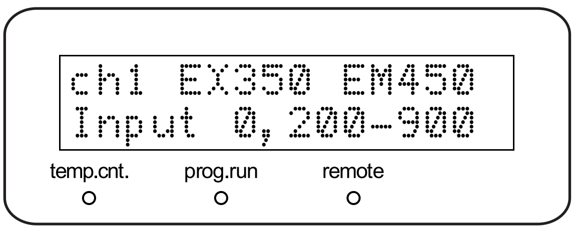
**1** Press (CE).
The initial screen will be displayed.



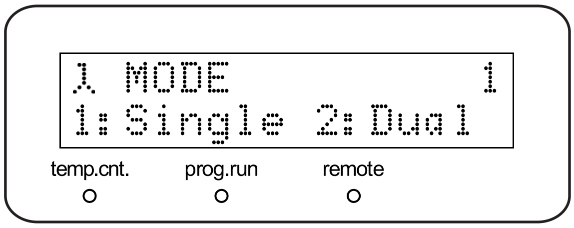

**2** Press (func).
[PARAMETER] will be displayed.




**3** Press (enter).
[ch1] will be displayed.



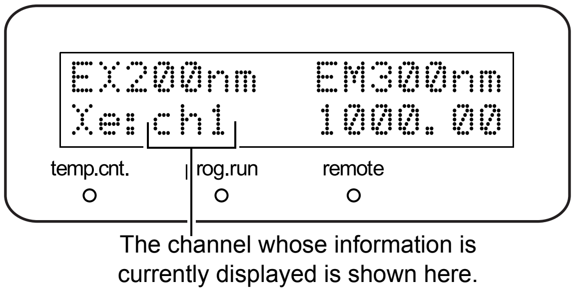
**4** Press (func) repeatedly until [λ MODE] is displayed.




**5** Enter (2) and press (enter).
This sets the measurement mode to dual wavelength.

**6** Press (CE) twice.
Setting of the measurement mode ends and you are returned to the initial screen.

Initial screen in the dual wavelength mode




NOTE

On pressing (disp) on the keypad, the indication changes between channel 1 and channel 2.

## 4.2.2 Setting the Measurement Wavelengths

Set the excitation wavelength and emission wavelength for each channel.

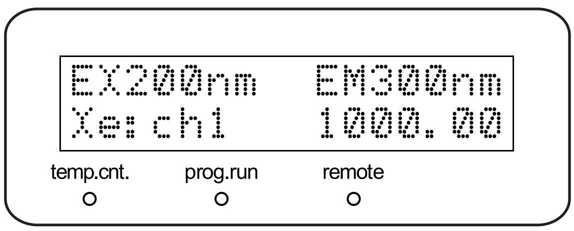
The setting ranges for the wavelengths are as follows. These ranges are common to channel 1 and channel 2.

| Wavelength | Setting Range (Units: nm) |
|---|---|
| EX (excitation wavelength) | 200 to 900 |
| EM (emission wavelength) | 200 to 900 |

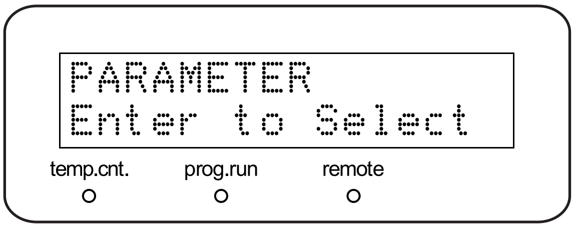
NOTE

In the dual wavelength mode, neither channel 1 nor channel 2 can be set to 0 nm.

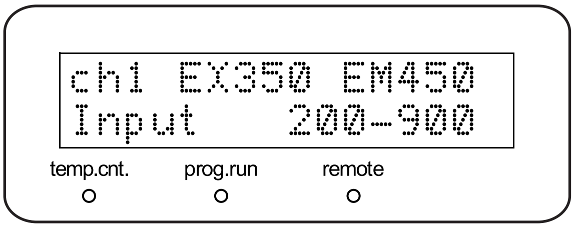
**1** Press (CE).
The initial screen will be displayed.



**2** Press **func**.
[PARAMETER] will be displayed.

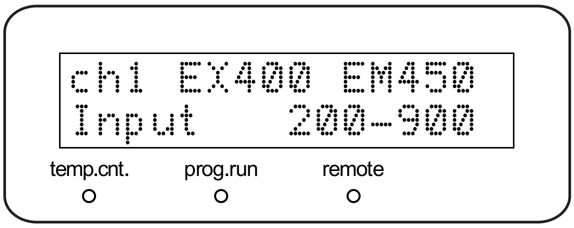



**3** Press **enter**.
[ch1] will be displayed.
In the initial status, the excitation wavelength can be entered.



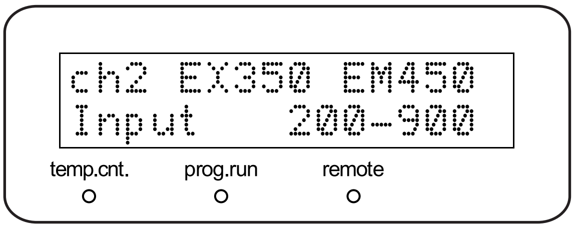

**4** Enter the excitation wavelength with the numeric keys, then press **enter**.
This sets the excitation wavelength for channel 1.

**5** Press **func**.
The status in which the emission wavelength of channel 1 can be entered will be established.



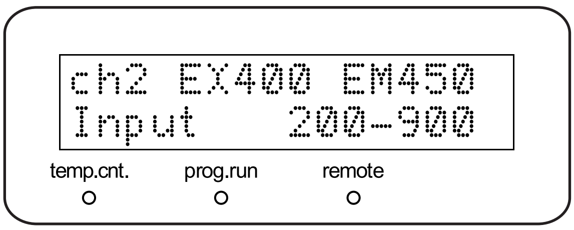

**6** Enter the emission wavelength with the numeric keys, then press **enter**.
This sets the emission wavelength of channel 1.

**7** Press **func** twice.
[ch2] will be displayed.
In the initial status, the excitation wavelength can be entered.




**8** Enter the excitation wavelength with the numeric keys, then press **enter**.
This sets the excitation wavelength for channel 2.

**9** Press **func**.
The status in which the emission wavelength of channel 2 can be entered will be established.



**10** Enter the emission wavelength with the numeric keys, then press **enter**.
This sets the emission wavelength.

**11** Press **CE** twice.
Setting of the excitation wavelength and emission wavelength ends and you are returned to the initial screen.

NOTE

This instrument has two analog output connectors: analog output connector 1 and analog output connector 2.
Set the analog output connector according to the equipment you are connecting to.

☞ "4.2.3 Setting the Analog Output Connectors" P.4-25

| Connected Equipment | Remark |
|---|---|
| When connecting a Chromatopac or a variable range recorder | Set the output mode for the analog output connectors to INTEGRATOR. |
| When connecting a fixed range recorder | Set the output mode for the analog output connectors to RECORDER, and set the output range at the instrument.<br>☞ "4.2.4 Setting the Output Ranges" P.4-28 |

## 4.2.3 Setting the Analog Output Connectors

Set whether to connect the Chromatopac (integrator) or recorder to the analog output connectors. In the dual wavelength mode, chromatograms can be recorded simultaneously for channel 1 and channel 2. Here we will set which of analog output connectors 1 and 2 the data of channels 1 and 2 is output to, and whether this data is recorded by a Chromatopac or a recorder.

### ■ Setting the Output Mode of an Analog Output Connector

- Settings for analog output connector 1

| Set Value | Setting | |
|---|---|---|
| 0 | ch1: INTEGRATOR | The data of channel 1 is output to analog output connector 1. This setting is made when a Chromatopac or variable range recorder is connected to analog output connector 1 and the channel 1 data is recorded by the Chromatopac. |
| 1 | ch1: RECORDER | The data of channel 1 is output to analog output connector 1. This setting is made when a fixed range recorder is connected to analog output connector 1 and the channel 1 data is recorded by the recorder. |
| 2 | ch2: INTEGRATOR | The data of channel 2 is output to analog output connector 1. This setting is made when a Chromatopac or variable range recorder is connected to analog output connector 1 and the channel 2 data is recorded by the Chromatopac. |
| 3 | ch2: RECORDER | The data of channel 2 is output to analog output connector 1. This setting is made when a fixed range recorder is connected to analog output connector 1 and the channel 2 data is recorded by the recorder. |
| 8* | The temperature of the flow cell is output.<br>Output range: 0 to 100 °C (0 to 10 mV) | |

* : RF-20Axs only

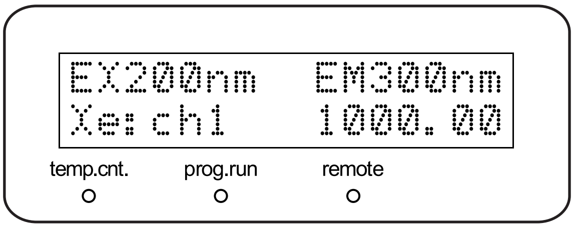
- Settings for analog output connector 2

| Set Value | Setting | |
|---|---|---|
| 0 | ch1: INTEGRATOR | The data of channel 1 is output to analog output connector 2. This setting is made when a Chromatopac or variable range recorder is connected to analog output connector 2 and the channel 1 data is recorded by the Chromatopac. |
| 1 | ch1: RECORDER | The data of channel 1 is output to analog output connector 2. This setting is made when a fixed range recorder is connected to analog output connector 2 and the channel 1 data is recorded by the recorder. |
| 2 | ch2: INTEGRATOR | The data of channel 2 is output to analog output connector 2. This setting is made when a Chromatopac or variable range recorder is connected to analog output connector 2 and the channel 2 data is recorded by the Chromatopac. |
| 3 | ch2: RECORDER | The data of channel 2 is output to analog output connector 2. This setting is made when a fixed range recorder is connected to analog output connector 2 and the channel 2 data is recorded by the recorder. |
| 8* | The temperature of the flow cell is output.<br>Output range: 0 to 100 °C (0 to 10 mV) | |

* : RF-20Axs only

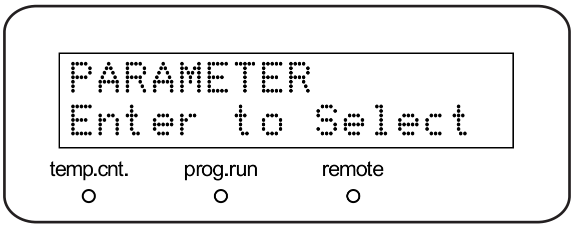
**1** Press (CE).

The initial screen will be displayed.



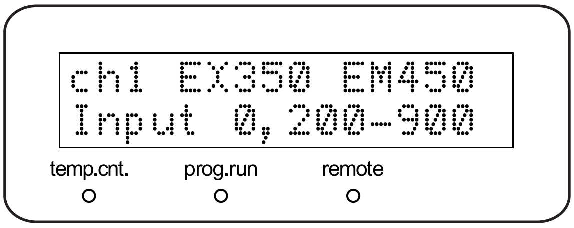

**2** Press (func).

[PARAMETER] will be displayed.




**3** Press (enter).

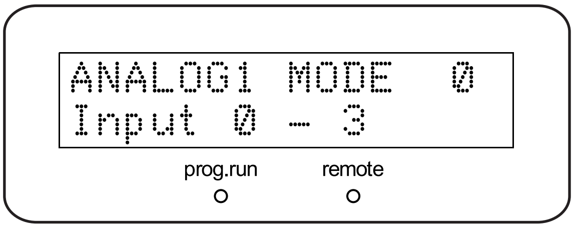
[ch1] will be displayed.



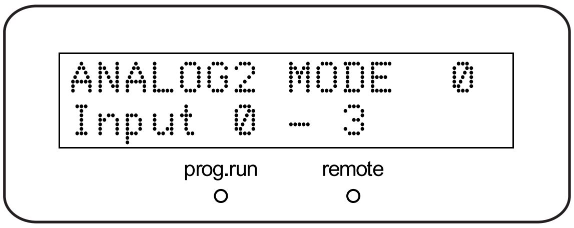

**4** Press (func) repeatedly until [ANALOG1 MODE] or [ANALOG2 MODE] is displayed.

* When setting analog output connector 1, display [ANALOG1 MODE] and when setting analog output connector 2, display [ANALOG2 MODE].

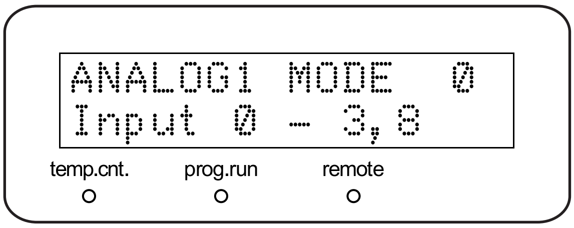
Analog output connector 1 (RF-20A)



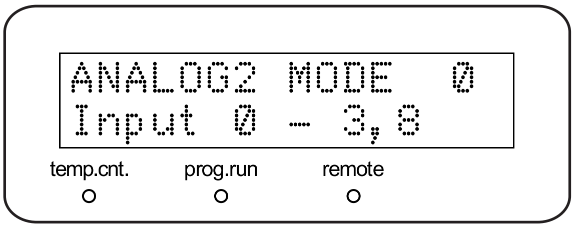

Analog output connector 2 (RF-20A)



Analog output connector 1 (RF-20Axs)




Analog output connector 2 (RF-20Axs)






**5** Enter the set value from the numeric keys and press **enter**.
This sets the output mode of the analog output connectors.
* Note that [8] is only displayed on the display panel of the RF-20Axs.

**6** Press **CE** twice.
Analog output connector output mode setting ends and you are returned to the initial screen.
* To set the output mode of analog output connector 2 right after having set that of analog output connector 1, display the screen on which the output mode of analog output connector 2 can be set by pressing **func** after pressing **enter** in step 5.

## 4.2.4 Setting the Output Ranges

Before setting the output ranges, set analog output connectors 1 and 2 in accordance with the equipment they will be connected to.

☞ "4.2.3 Setting the Analog Output Connectors" P.4-25

NOTE

Note that the output range settings only take effect if the analog output connector has been set for RECORDER.

☞ "4.2.3 Setting the Analog Output Connectors" P.4-25

### ■ When a Chromatopac Is Used as the Recorder:

- Normally it is connected to the analog output connector set for INTEGRATOR.
  ☞ "4.2.3 Setting the Analog Output Connectors" P.4-25
- The range when a Chromatopac is used is normally set with the [ATTEN] setting at the Chromatopac, but since the dynamic range at the instrument side is extremely wide, set gain and sensitivity at the instrument.
  ☞ "4.2.7 Setting Gain" P.4-36
  "4.2.8 Setting Sensitivity" P.4-38
- Regardless of the range setting, the analog output connector set for INTEGRATOR outputs a voltage of 1 V at the maximum value (1000) for fluorescent intensity.

### ■ When a Recorder Is Used:

Connect the recorder to the analog output connector set for RECORDER.

☞ "4.2.3 Setting the Analog Output Connectors" P.4-25

## ■ Details of Output Range Settings

These details are common to analog output connectors 1 and 2.

| Set Value | Output Range |
|---|---|
| 0 | Short (output is 0 mV) * |
| 1 | × 1 |
| 2 | × 1/2 |
| 3 | × 1/4 |
| 4 | × 1/8 |
| 5 | × 1/16 |
| 6 | × 1/32 |
| 7 | × 1/64 |
| 8 | × 1/128 |
| 9 | × 1/256 |

* When a baseline offset value, [BL OFS ANA1] or [BL OFS ANA2], is set, the corresponding set voltage is output.



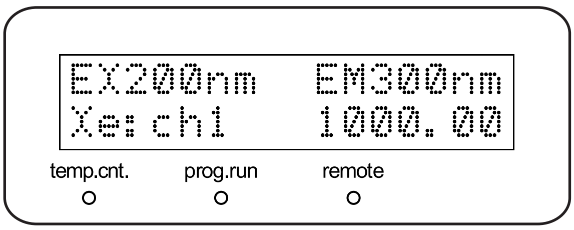
When the fluorescent intensity is the maximum value (1000) and the output range is × 1, a voltage of 500 mV (half of that when INTEGRATOR is set) is output at the terminal.
The output range determines the maximum value of the fluorescent intensity recorded by the recorder, and the maximum value is selected by applying the following formula.

Output range ≤ 20 / (maximum value of fluorescence)

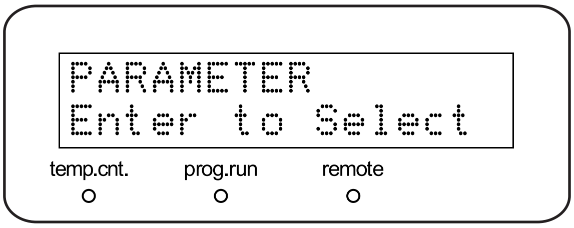
- When a range of fluorescent intensity of 0 to 150 is recorded by the recorder:
  Output range ≤ 20 / 150 = 1/7.5
  The output range is [× 1/8] and the set value is [4].

## ■ Setting the Output Range of the Analog Output Connectors

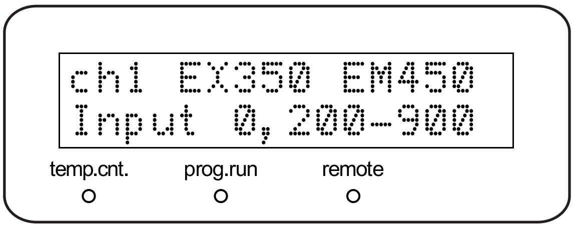
**1** Press CE.
The initial screen will be displayed.



**2** Press (**func**).
[PARAMETER] will be displayed.



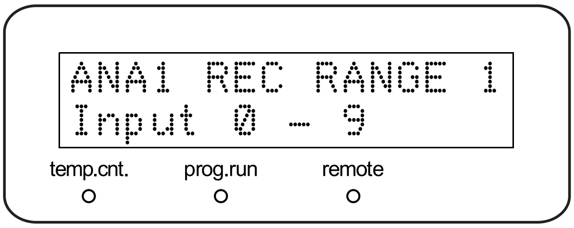

**3** Press (**enter**).
[ch1] will be displayed.



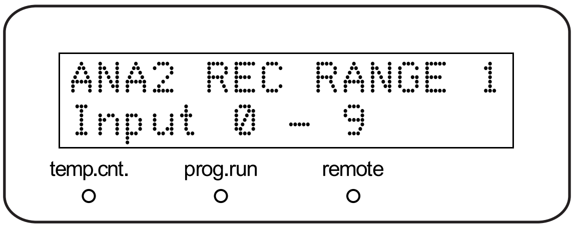

**4** Press (**func**) repeatedly until [ANA1 REC RANGE] or [ANA2 REC RANGE] is displayed.

* When setting analog output connector 1, display [ANA1 REC RANGE] and when setting analog output connector 2, display [ANA2 REC RANGE].

Analog output connector 1




Analog output connector 2




**5** Enter the set value from the numeric keys and press (**enter**).
This sets the output range for the analog output connector.

**6** Press (**CE**) twice.
Setting of the output range for the analog output connector ends and you are returned to the initial screen.

* To set the output range of analog output connector 2 right after having set that of analog output connector 1, display the screen on which the output range of analog output connector 2 can be set by pressing (**func**) after pressing (**enter**) in step 5.

## 4.2.5 Setting Baseline Offset Values

Set baseline offset values for analog output connectors 1 and 2. Connect the recorder or Chromatopac to the analog output connector and set the output range, gain, and sensitivity.

☞ "4.2.3 Setting the Analog Output Connectors" P.4-25
"4.2.4 Setting the Output Ranges" P.4-28
"4.2.7 Setting Gain" P.4-36
"4.2.8 Setting Sensitivity" P.4-38

The setting range for the baseline offset values of analog output connectors is indicated below. This range is common to analog output connectors 1 and 2.

| Setting Range (Units: mV) |
| --- |
| –2 to 250 (default value: 0) |

### ■ Setting the Recorder's Zero Position

When using a recorder, set the zero position of the recorder main unit by following the procedure below.

**1** Connect the recorder to the analog output connector for which [RECORDER] was set.

☞ "4.2.3 Setting the Analog Output Connectors" P.4-25

**2** Press **zero** to set the fluorescent intensity to [0].

**3** Align the position of the recorder's pen with the [0] graduation on the chart by using the pen position adjusting knob.
From this point on, pressing **zero** will return the recorder's pen to the [0] graduation on the chart.

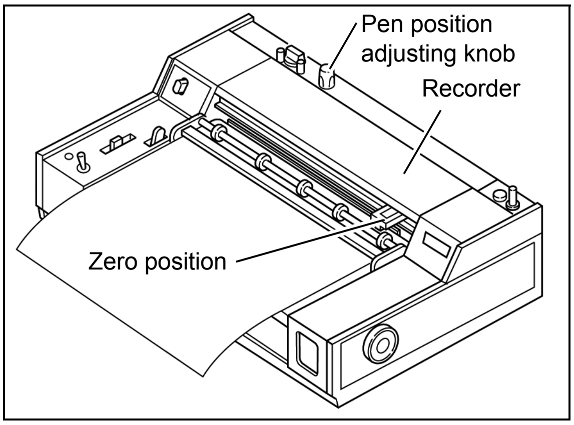
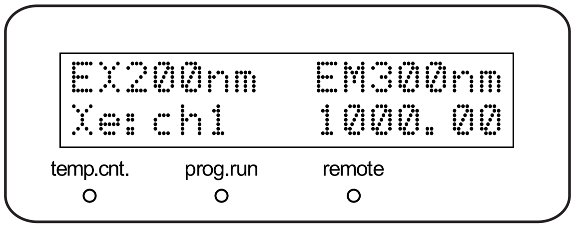


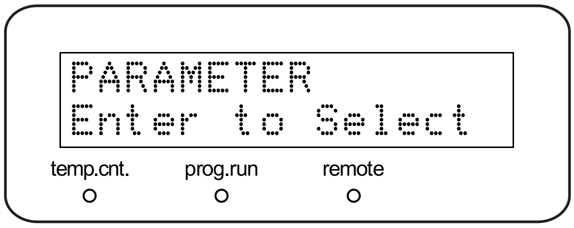

Fig. 4.3

## ■ Setting the Baseline Offset Values of Analog Output Connectors

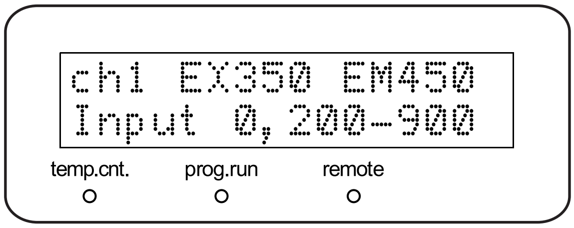
**1** Press **CE**.
The initial screen will be displayed.




**2** Press **func**.
[PARAMETER] will be displayed.

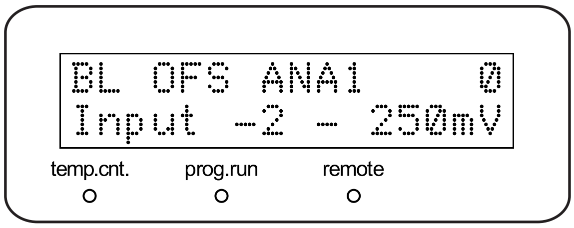



**3** Press **enter**.
[ch1] will be displayed.

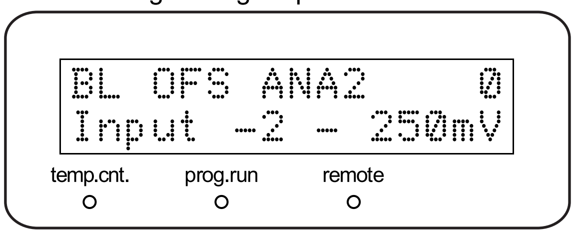



**4** Press **func** repeatedly until [BL OFS ANA1] or [BL OFS ANA2] is displayed.
* When setting analog output connector 1, display [BL OFS ANA1] and when setting analog output connector 2, display [BL OFS ANA2].

When setting analog output connector 1:




When setting analog output connector 2:




**5** Enter the offset value (units: mV) from the numeric keys and press **enter**.
This will change the baseline offset value.

**6** Press CE twice.

Setting of baseline offset values for analog output connectors ends and you are returned to the initial screen.

After completion of setting, each time you press zero the baseline returns to the position set here.

* To set the baseline offset of analog output connector 2 right after having set that of analog output connector 1, display the screen on which the baseline offset of analog output connector 2 can be set by pressing func after pressing enter in step 5.



## 4.2.6 Setting the Response (Response Speed)

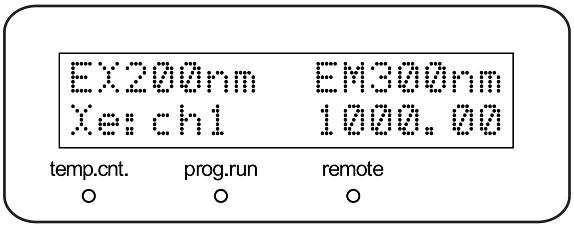
This instrument achieves an improved S/N ratio by using a digital filter. Decreasing the response value of this digital filter improves the responsiveness, but noise is increased. Increasing the response value causes deterioration in responsiveness, but noise is reduced.

The response for this instrument can be set at 11 levels, from [0] to [10].

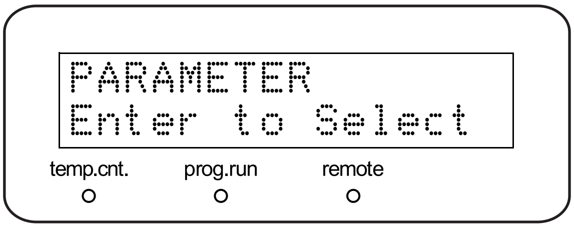
The changes in responsiveness according to the value set for response are shown in the table below by giving the correspondence with the time constants of conventional analog CR filters.

| Value Set for Response | Time Constant of Corresponding Analog CR Filter (Units: sec) | Usable Peak's Half-Height (Units: sec (minimum)) |
|---|---|---|
| 0 | No filter | If a value smaller than [3] is set in the dual wavelength mode, the response is not improved any more. |
| 1 | 0.05 | |
| 2 | 0.1 | |
| 3 | 0.5 | |
| 4 | 1.0 | 4.8 |
| 5 | 1.5 | 7.2 |
| 6 | 3.0 | 13 |
| 7 | 6.0 | 26 |
| 8 | 8.0 | 36 |
| 9 | 10.0 | 45 |
| 10 | 2.0 | 9 |

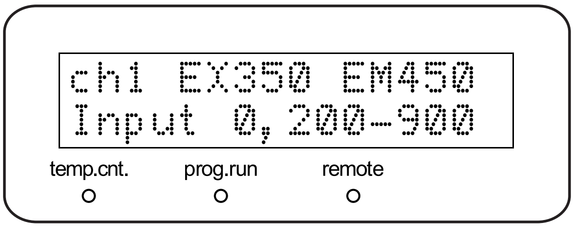
**1** Press **CE**.
The initial screen will be displayed.



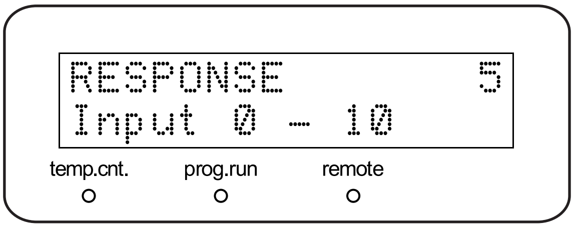

**2** Press **func**.
[PARAMETER] will be displayed.




**3** Press **enter**.
[ch1] will be displayed.




**4** Press **func** repeatedly until [RESPONSE] is displayed.




**5** Enter the set value from the numeric keys and press **enter**.
This sets the response.

**6** Press **CE** twice.
Response setting ends and you are returned to the initial screen.

NOTE

If a slow response value (time constant) is set, responsiveness is adversely affected and the peak height is decreased, but the smaller the width at half-height, the larger is the extent of the decrease in the peak height.
Here, as a guide, the situation where a width at half-height that decreases the peak height by 10 % can be used has been shown for each response. The relationship between peak's half-height and decrease in peak height is shown in the graph to the right.
Note that even if the responsiveness is adversely affected and the peak spreads, the peak area doesn't change.

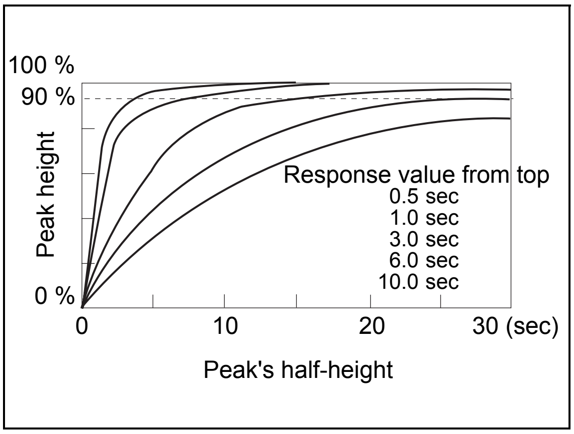



Fig. 4.4

## 4.2.7 Setting Gain

This is the procedure for setting gain. By combining the setting of sensitivity and gain, you can set the measuring range.

The settings for gain are shown below.

| Set Value | Gain |
|---|---|
| 1 | × 1 |
| 2 | × 4 |
| 3 | × 16 |

The combinations of sensitivity and gain are shown below.

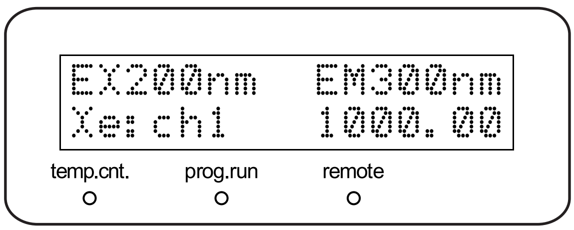
| Sensitivity | Gain | Sensitivity Magnifications |
|---|---|---|
| 3 (LOW) | 1 | Approx. × 1 |
| | 2 | Approx. × 4 |
| | 3 | Approx. × 16 |
| 2 (MED) | 1 | Approx. × 32 |
| | 2 | Approx. × 128 |
| | 3 | Approx. × 512 |
| 1 (HI) | 1 | Approx. × 1024 |
| | 2 | Approx. × 4096 |
| | 3 | Approx. × 16384 |

NOTE

When the sensitivity and/or gain have been changed, plot a revised calibration curve.

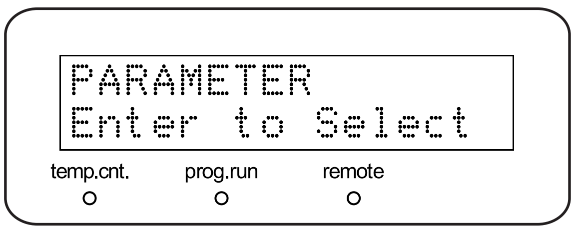
**1** Press **CE**.

The initial screen will be displayed.

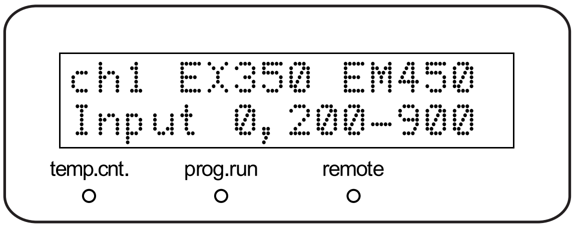



**2** Press **func**.

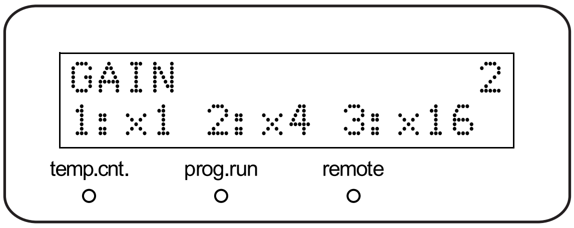
[PARAMETER] will be displayed.



**3** Press (**enter**).
[ch1] will be displayed.




**4** Press (**func**) repeatedly until [GAIN] is displayed.




**5** Enter the set value from the numeric keys and press (**enter**).
This sets the gain.

**6** Press (**CE**) twice.
Gain setting ends and you are returned to the initial screen.

## 4.2.8 Setting Sensitivity

This is the procedure for setting sensitivity. By combining the setting of sensitivity and gain, you can set the measuring range.

"4.2.7 Setting Gain" P.4-36

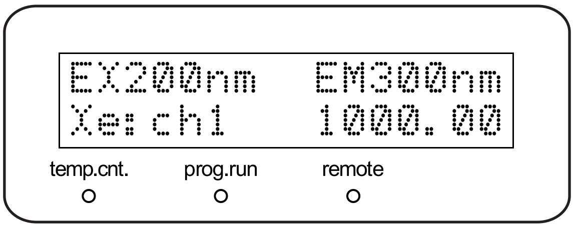
NOTE

When using a Chromatopac, select the sensitivity of this instrument such that the noise becomes several percent of the plot range when the [ATTEN] setting of the Chromatopac is [0]. Next, select an [ATTEN] setting that ensures that the targeted peak is within the plot range. If the peak height is beyond the plot range even when [ATTEN] of the Chromatopac is set to the lowest sensitivity, change the sensitivity of this instrument to low sensitivity.

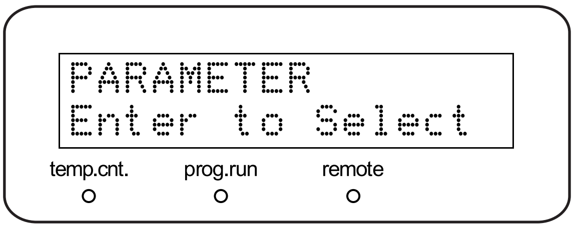
The settings for sensitivity are shown below.
On shipping from the factory, the setting is [2] (MED).

| Set Value | Sensitivity | Sensitivity Magnifications |
|---|---|---|
| 1 | HIGH | Approx. × 1 |
| 2 | MED | Approx. × 32 |
| 3 | LOW | Approx. × 1024 |

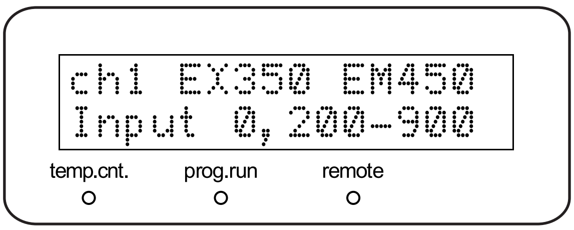
**1** Press **CE**.
The initial screen will be displayed.



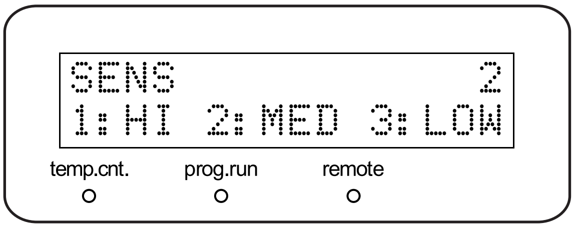

**2** Press **func**.
[PARAMETER] will be displayed.




**3** Press **enter**.
[ch1] will be displayed.



**4** Press **func** repeatedly until [SENS] is displayed.




**5** Enter the set value from the numeric keys and press **enter**.
This sets the sensitivity.

**6** Press **CE** twice.
Sensitivity setting ends and you are returned to the initial screen.

## 4.2.9 Setting the Flow Cell Temperature (RF-20Axs Only)

Set the temperature of the flow cell.

The fluorescent intensity of the sample varies depending on its temperature. In order to obtain stable analysis results unaffected by the ambient temperature, the temperature of the sample in the flow cell is fixed at all times.

NOTE

The guide for the set temperature of the flow cell is the same temperature as the instrument's ambient temperature.

Since condensation may occur in the vicinity of the flow cell depending on the ambient humidity if the temperature of the flow cell goes below the flow cell's ambient temperature, it is made impossible to cool the flow cell more than 10 °C below the ambient temperature. If the ambient temperature rises to more than 10 °C higher than the set temperature, [LOW SET TEMP] is displayed on the display screen every 60 minutes and it may not be possible to obtain normal analysis results.

NOTE

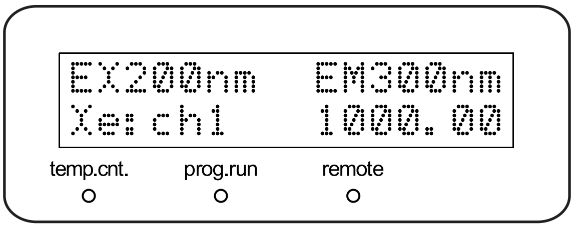
The current ambient temperature can be checked at [ROOM TEMP].

☞ "Displaying the Ambient Temperature [ROOM TEMP] (RF-20Axs Only)" P.5-33

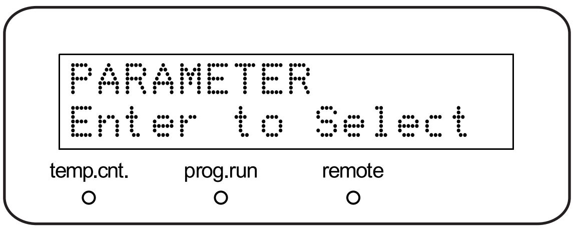
The setting range for flow cell temperature is shown below.

| Set Value | Setting |
|---|---|
| 0 | The temperature is not adjusted. |
| 4 to 40 °C | The temperature is adjusted to the set value. |

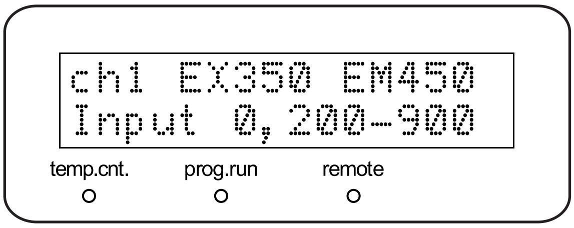
1 Press CE.
The initial screen will be displayed.



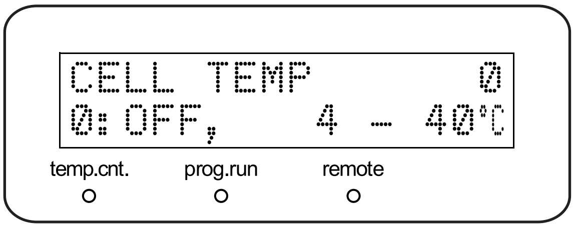

2 Press func.
[PARAMETER] will be displayed.



**3** Press **enter**.
[ch1] will be displayed.




**4** Press **func** repeatedly until [CELL TEMP] is displayed.




**5** Enter the set value from the numeric keys and press **enter**.
This sets the temperature of the flow cell.

**6** Press **CE** twice.
Flow cell temperature setting ends and you are returned to the initial screen.

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# 5

# Application Operation

Contents

# 5.1 Types of Screen and Their Explanations

## 5.1.1 Types of Screen

On turning the power ON, the initial screen appears.

Pressing **func**, **VP** and **edit** on the initial screen displays the following three screens.

- Auxiliary function screen
- VP function screen
- Time program edit screen

Initial screen

```
EX200nm   EM300nm
Xe        1000.00
```

Press **func** →

Auxiliary function screen

☞ P.5-3

```
PARAMETER
Enter to Select
```

Used to set the auxiliary functions.

- Parameter settings
- Control settings
- System settings
- Monitor display

Press **VP** →

VP function screen ☞ P.5-8

```
PRODUCT INFO
Press func or VP
```

Used to set the VP functions.

- Product information
- Maintenance information
- Validation support
- Calibration support

Press **edit** →

Time program edit screen

☞ P.5-54

```
TIME PROGRAM
 0 Used   32 Left
```

Used to edit time programs.

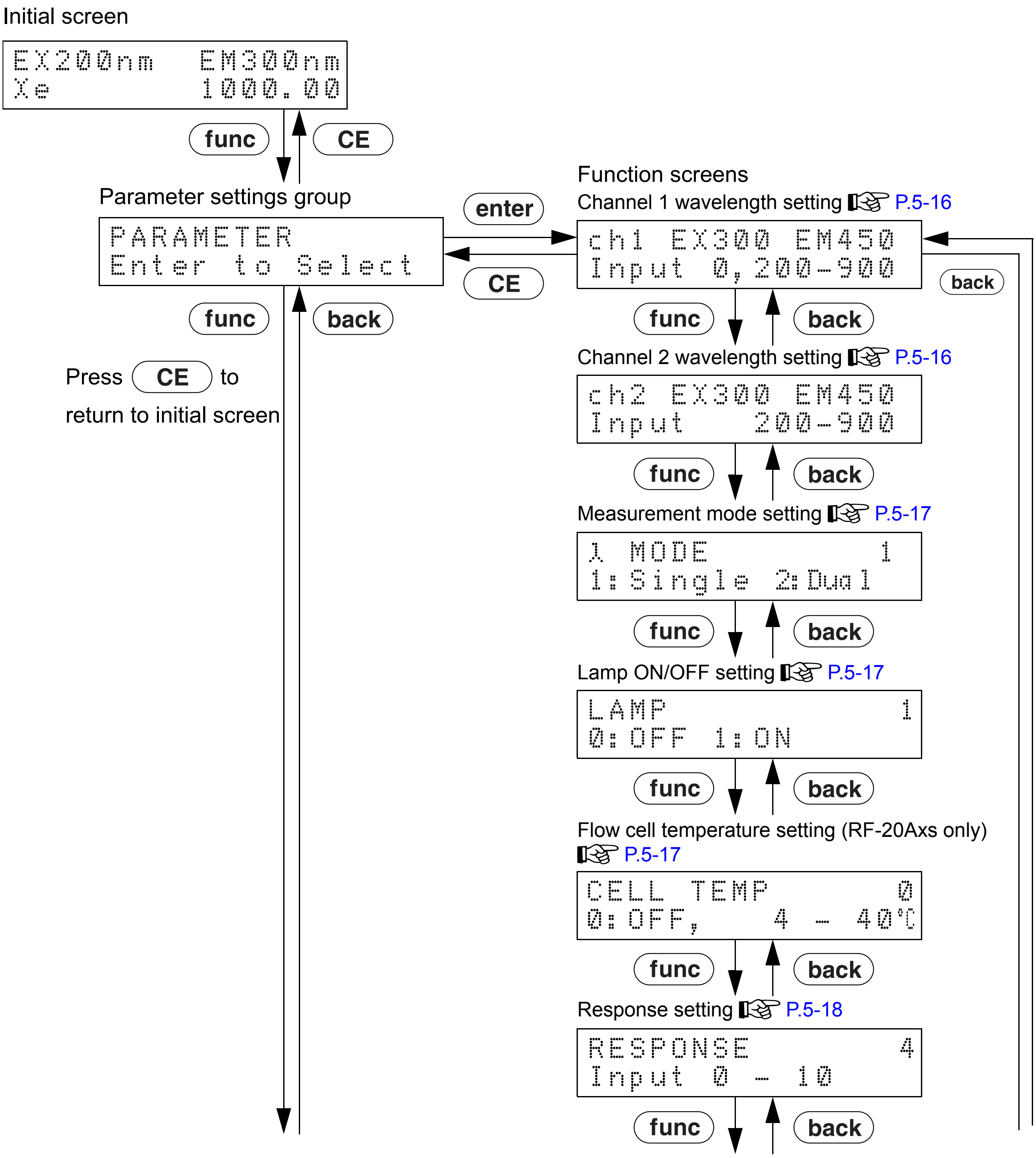
## 5.1.2 Auxiliary Function Screen

In this section the auxiliary function screens are shown in the following flow diagrams.

On each screen, press **func** to display the next screen, and **back** to return to the previous screen.

On auxiliary function group screens, press **enter** to enter each group.

Press **CE** to return to the initial screen.



Sensitivity setting ☞ P.5-19

```
SENS             2
1:Hi  2:MED  3:LOW
```

func ↓ ↑ back

Gain setting ☞ P.5-19

```
GAIN             1
1:x1  2:x4  3:x16
```

func ↓ ↑ back

Analog output connector 1 output mode setting
☞ P.5-20

```
ANALOG1 MODE     0
Input 0 - 1
```

func ↓ ↑ back

Analog output connector 2 output mode setting
☞ P.5-21

```
ANALOG2 MODE     0
Input 0 - 1
```

func ↓ ↑ back

Analog output connector 1 output range setting
☞ P.5-22

```
ANA1 REC RANGE 1
Input 0 - 9
```

func ↓ ↑ back

Analog output connector 2 output range setting
☞ P.5-23

```
ANA2 REC RANGE 1
Input 0 - 9
```

func ↓ ↑ back

Analog output connector 1 baseline offset setting
☞ P.5-24

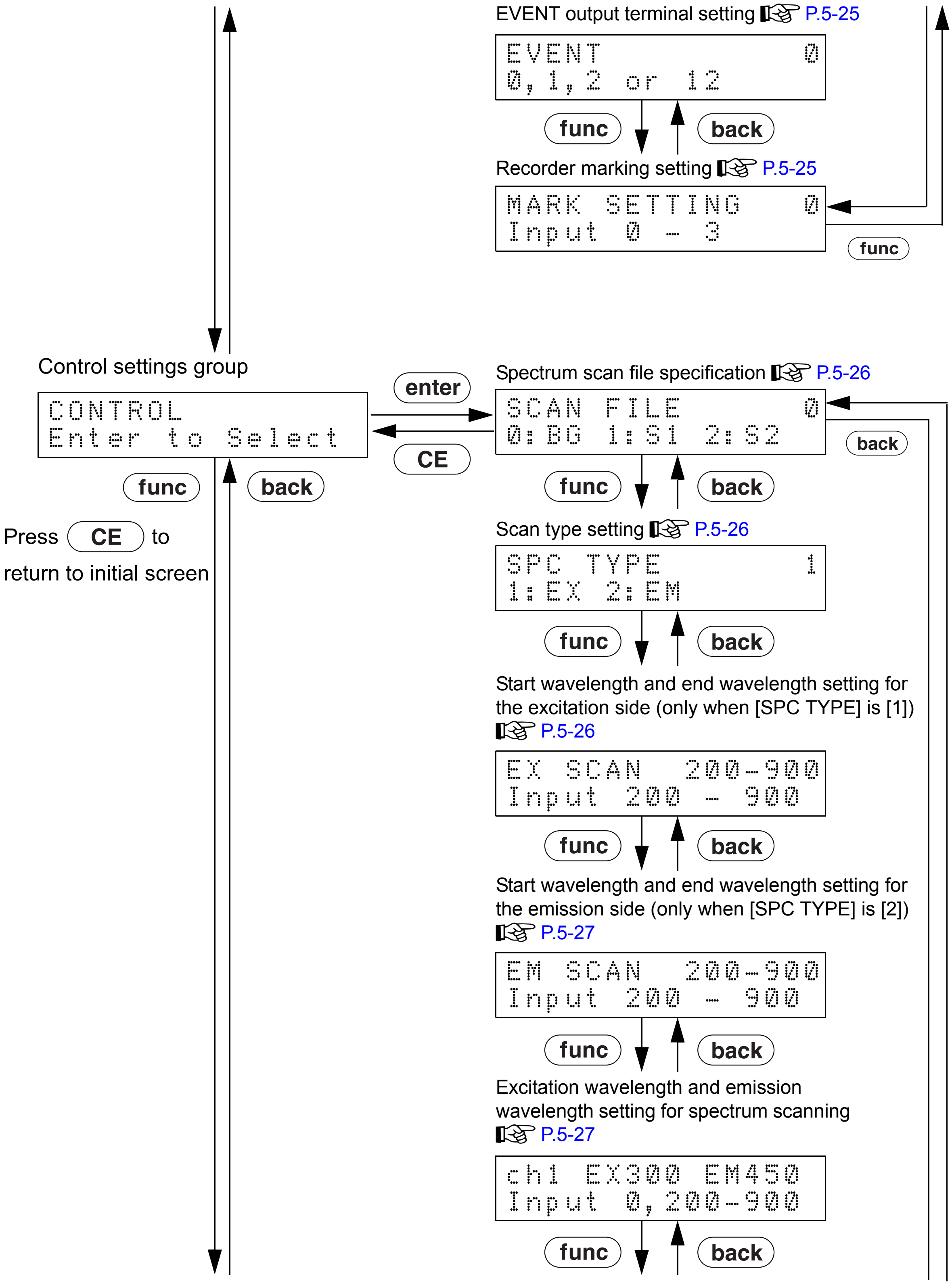
```
BL OFS ANA1      0
Input -2 - 250mV
```

func ↓ ↑ back

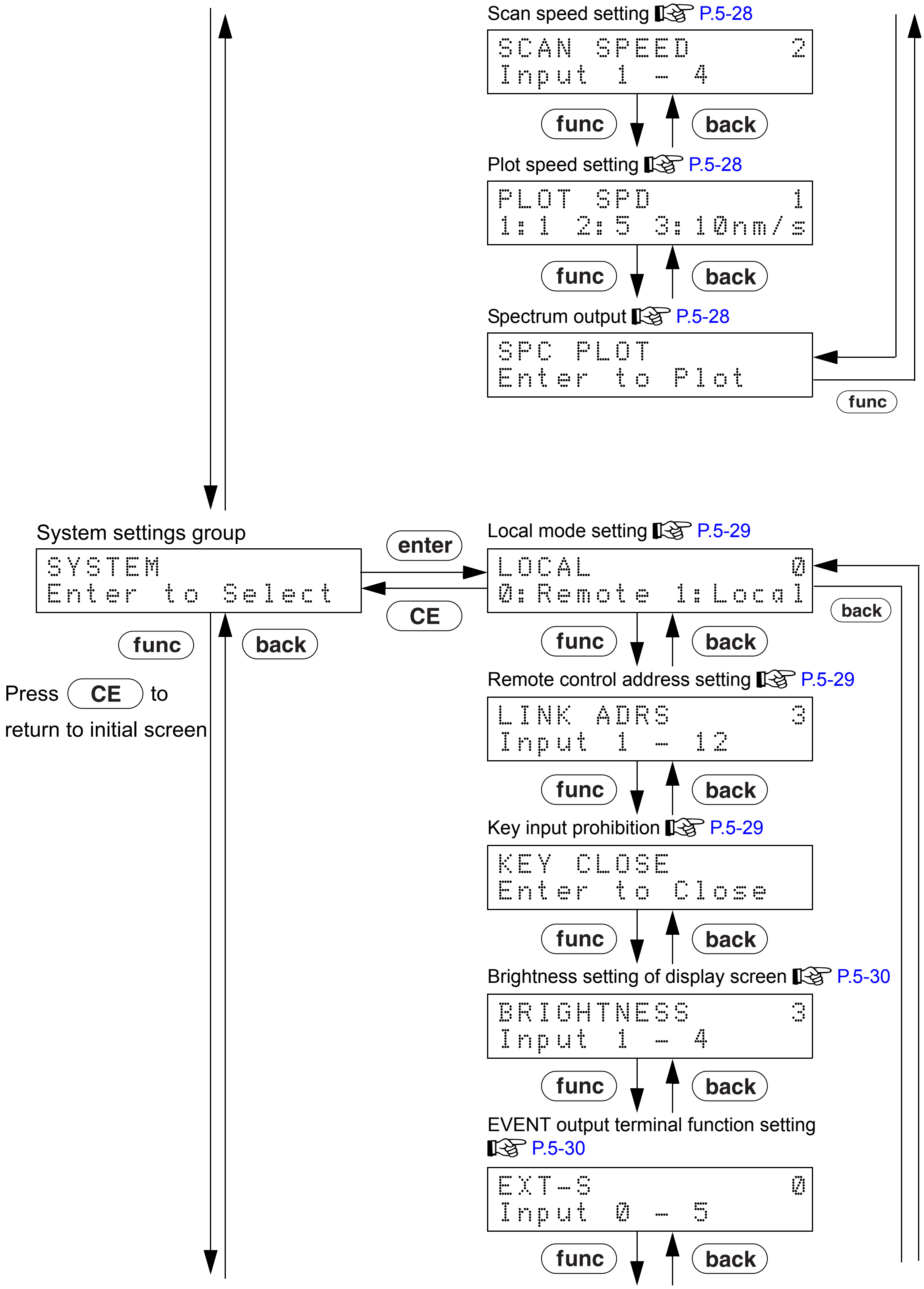
Analog output connector 2 baseline offset setting
☞ P.5-24

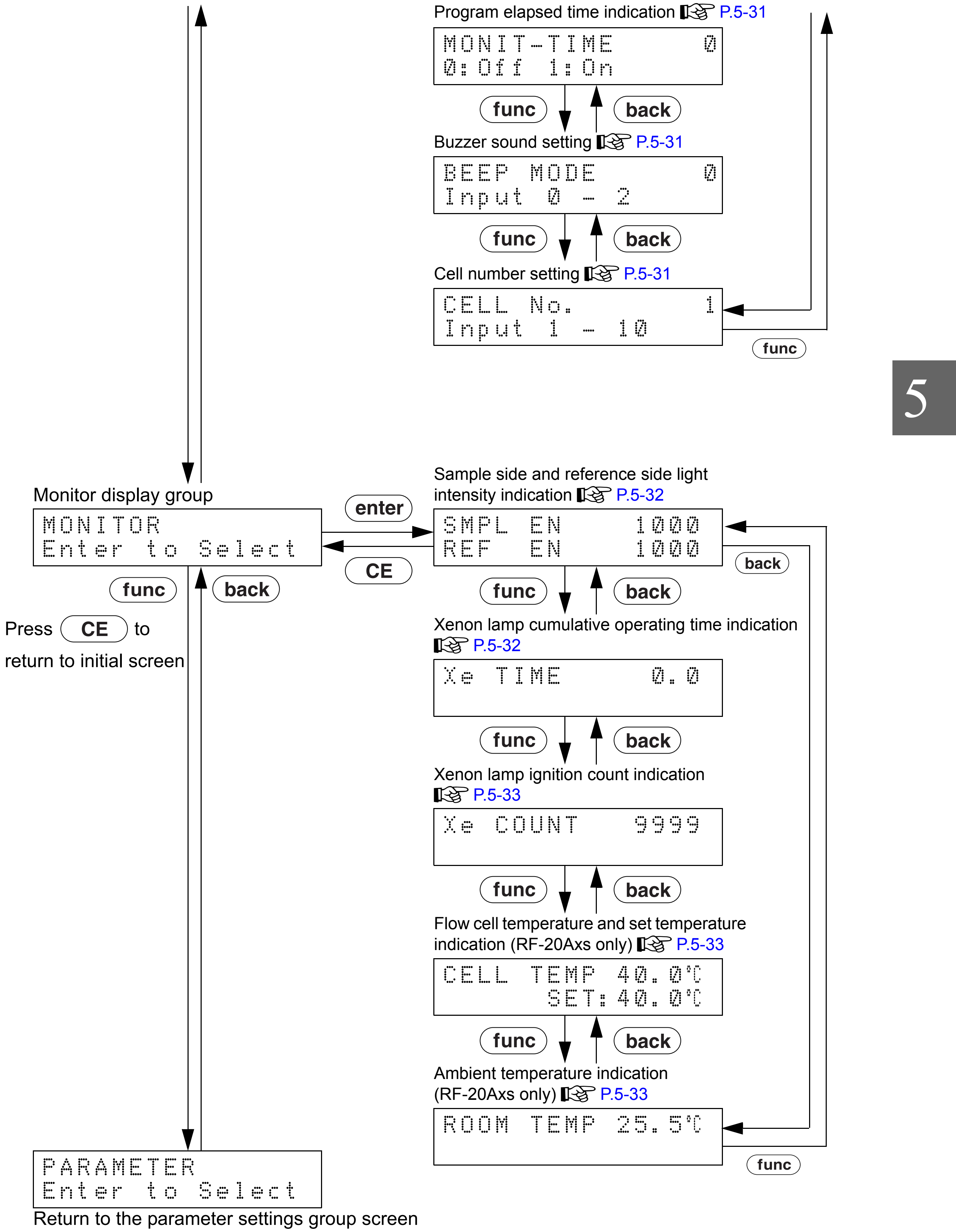
```
BL OFS ANA2      0
Input -2 - 250mV
```

func ↓ ↑ back


EVENT output terminal setting P.5-25
EVENT 0
0, 1, 2 or 12
func
back
Recorder marking setting P.5-25
MARK SETTING 0
Input 0 - 3
func
Control settings group
CONTROL
Enter to Select
enter
CE
func
back
Press CE to
return to initial screen
Spectrum scan file specification P.5-26
SCAN FILE 0
0: BG 1: S1 2: S2
back
func
back
Scan type setting P.5-26
SPC TYPE 1
1: EX 2: EM
func
back
Start wavelength and end wavelength setting for
the excitation side (only when [SPC TYPE] is [1])
P.5-26
EX SCAN 200-900
Input 200 - 900
func
back
Start wavelength and end wavelength setting for
the emission side (only when [SPC TYPE] is [2])
P.5-27
EM SCAN 200-900
Input 200 - 900
func
back
Excitation wavelength and emission
wavelength setting for spectrum scanning
P.5-27
ch1 EX300 EM450
Input 0,200-900
func
back

5


Scan speed setting P.5-28
SCAN SPEED 2
Input 1 – 4
func
back
Plot speed setting P.5-28
PLOT SPD 1
1:1 2:5 3:10nm/s
func
back
Spectrum output P.5-28
SPC PLOT
Enter to Plot
func
System settings group
SYSTEM
Enter to Select
enter
CE
func
back
Press CE to
return to initial screen
Local mode setting P.5-29
LOCAL 0
0:Remote 1:Local
back
func
back
Remote control address setting P.5-29
LINK ADRS 3
Input 1 – 12
func
back
Key input prohibition P.5-29
KEY CLOSE
Enter to Close
func
back
Brightness setting of display screen P.5-30
BRIGHTNESS 3
Input 1 – 4
func
back
EVENT output terminal function setting
P.5-30
EXT-S 0
Input 0 – 5
func
back


Program elapsed time indication P.5-31
MONIT-TIME 0
0:Off 1:On
func
back
Buzzer sound setting P.5-31
BEEP MODE 0
Input 0 - 2
func
back
Cell number setting P.5-31
CELL No. 1
Input 1 - 10
func
5
Monitor display group
MONITOR
Enter to Select
enter
CE
Sample side and reference side light intensity indication P.5-32
SMPL EN 1000
REF EN 1000
back
func
back
Press CE to return to initial screen
Xenon lamp cumulative operating time indication P.5-32
Xe TIME 0.0
func
back
Xenon lamp ignition count indication P.5-33
Xe COUNT 9999
func
back
Flow cell temperature and set temperature indication (RF-20Axs only) P.5-33
CELL TEMP 40.0℃
SET:40.0℃
func
back
Ambient temperature indication (RF-20Axs only) P.5-33
ROOM TEMP 25.5℃
func
PARAMETER
Enter to Select
Return to the parameter settings group screen

## 5.1.3 VP Function Screen

In this section the VP function screens are shown in the following flow diagrams.

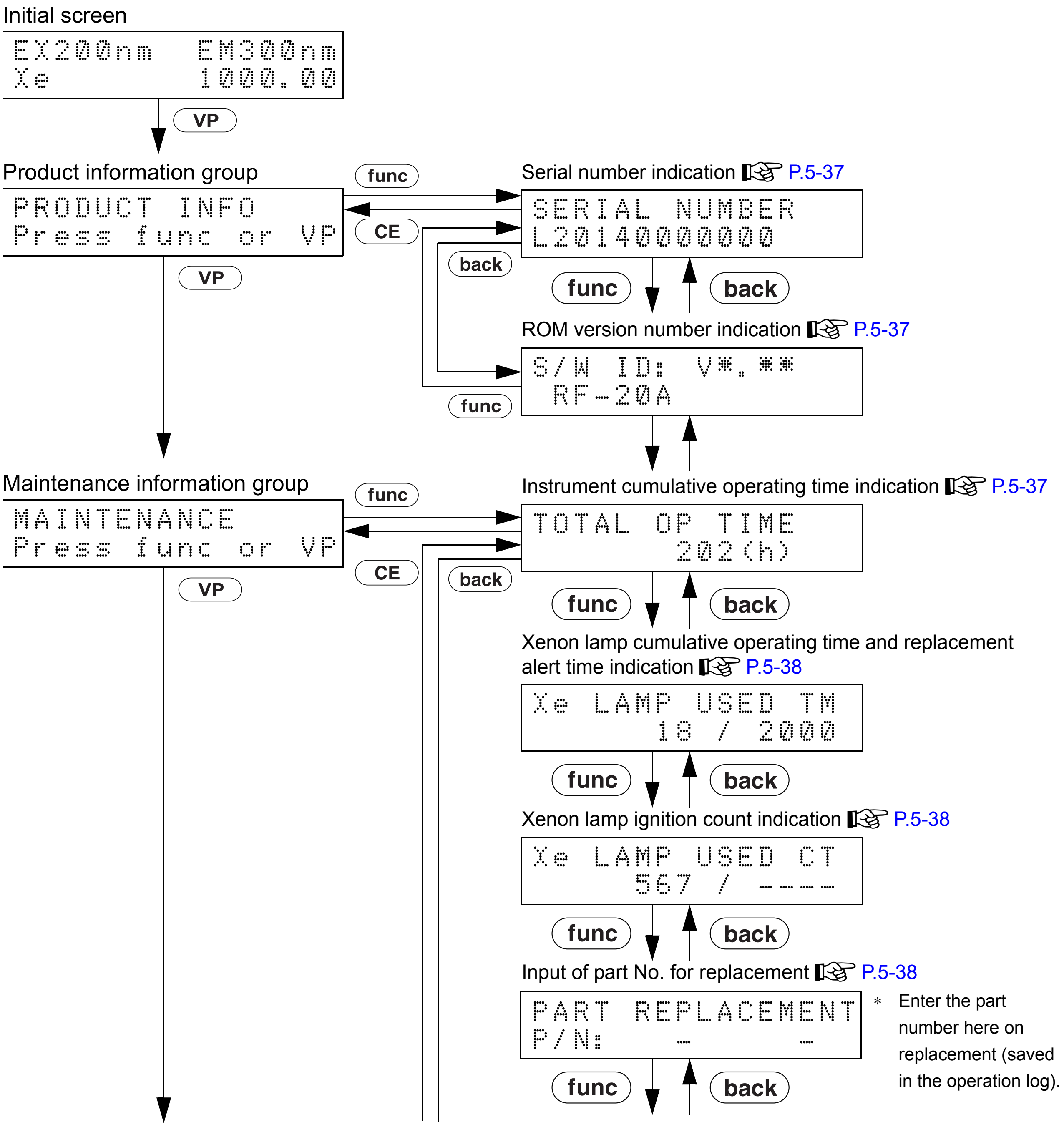
There are four types of VP function: the production information group, the maintenance information group, the validation support group and the calibration support group.

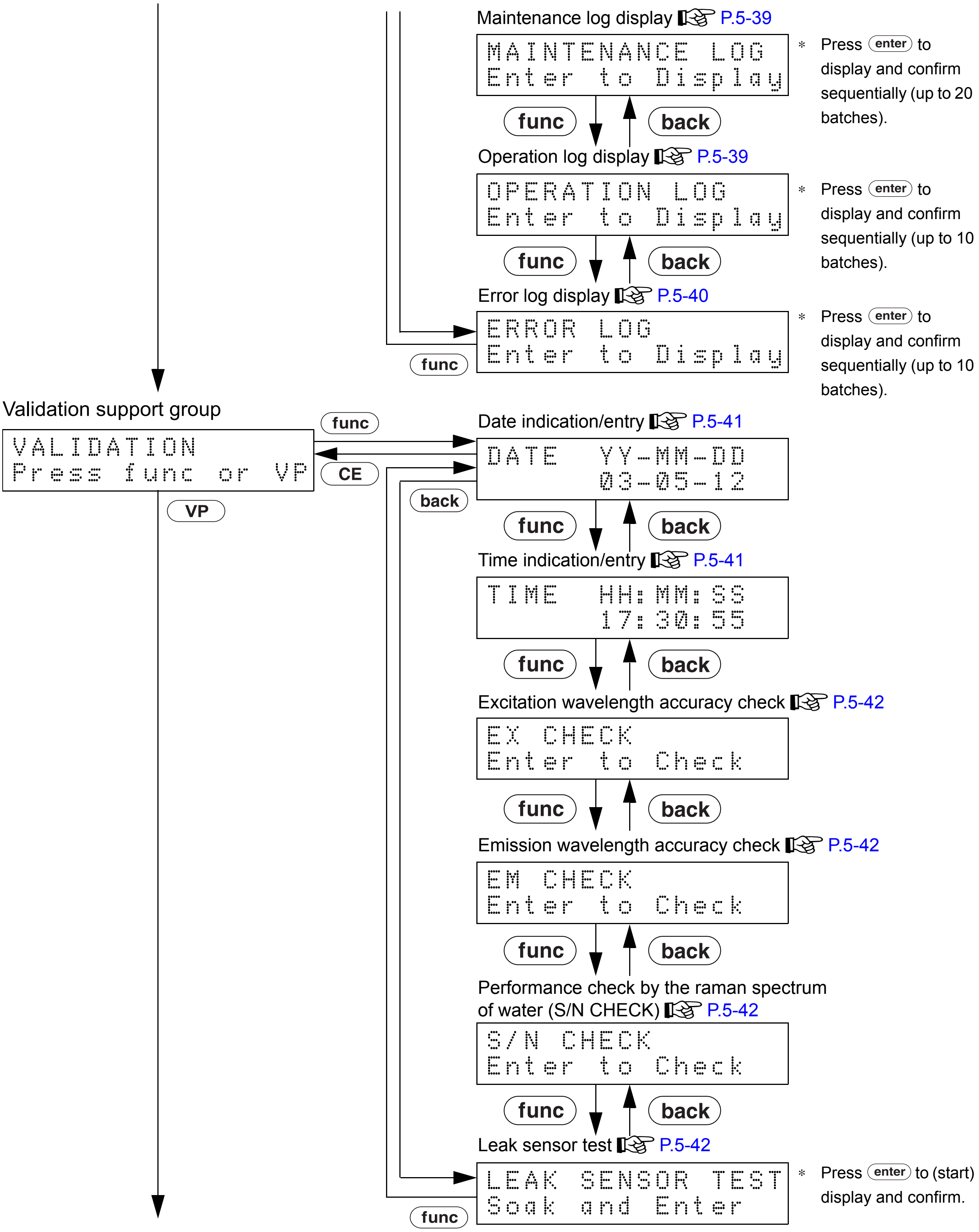
Press **VP** on the initial screen to show each group screen in succession.

Press **CE** to return from any group screen to the initial screen.

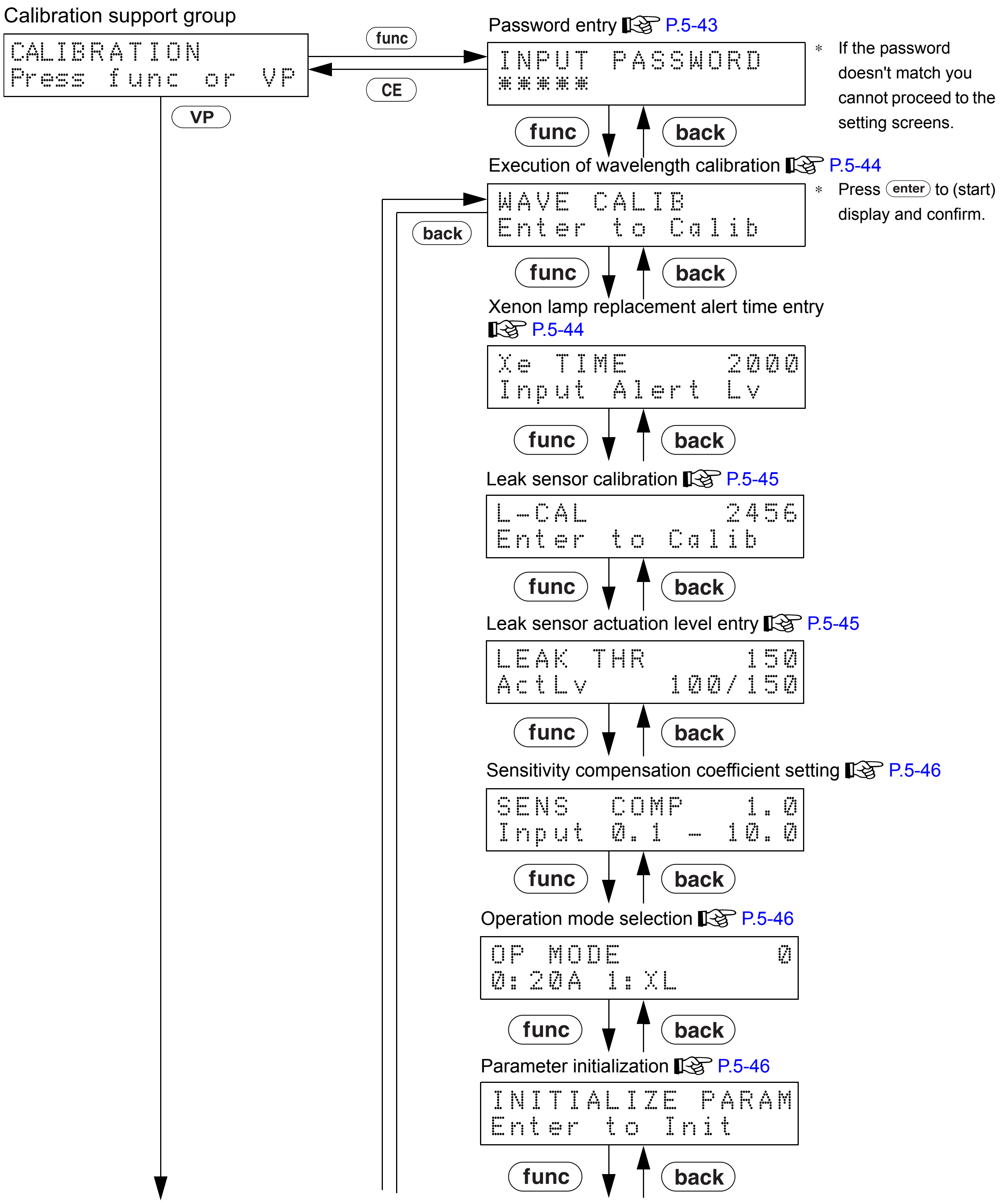
Press **func** or **back** on any setting screen in the group to display the next screen in the group or the previous screen in the group.

Press **CE** on any setting screen in the group to return to the group screen.





Maintenance log display P.5-39
MAINTENANCE LOG
Enter to Display
* Press enter to display and confirm sequentially (up to 20 batches).
func
back
Operation log display P.5-39
OPERATION LOG
Enter to Display
* Press enter to display and confirm sequentially (up to 10 batches).
func
back
Error log display P.5-40
ERROR LOG
Enter to Display
* Press enter to display and confirm sequentially (up to 10 batches).
func
Validation support group
VALIDATION
Press func or VP
func
CE
back
VP
Date indication/entry P.5-41
DATE YY-MM-DD
03-05-12
func
back
Time indication/entry P.5-41
TIME HH:MM:SS
17:30:55
func
back
Excitation wavelength accuracy check P.5-42
EX CHECK
Enter to Check
func
back
Emission wavelength accuracy check P.5-42
EM CHECK
Enter to Check
func
back
Performance check by the raman spectrum of water (S/N CHECK) P.5-42
S/N CHECK
Enter to Check
func
back
Leak sensor test P.5-42
LEAK SENSOR TEST
Soak and Enter
* Press enter to (start) display and confirm.
func


Calibration support group
CALIBRATION
Press func or VP
func
CE
VP
Password entry P.5-43
INPUT PASSWORD
*****
* If the password doesn't match you cannot proceed to the setting screens.
func
back
Execution of wavelength calibration P.5-44
WAVE CALIB
Enter to Calib
* Press enter to (start) display and confirm.
back
func
back
Xenon lamp replacement alert time entry P.5-44
Xe TIME 2000
Input Alert Lv
func
back
Leak sensor calibration P.5-45
L-CAL 2456
Enter to Calib
func
back
Leak sensor actuation level entry P.5-45
LEAK THR 150
ActLv 100/150
func
back
Sensitivity compensation coefficient setting P.5-46
SENS COMP 1.0
Input 0.1 - 10.0
func
back
Operation mode selection P.5-46
OP MODE 0
0:20A 1:XL
func
back
Parameter initialization P.5-46
INITIALIZE PARAM
Enter to Init
func
back

Password change ☞ P.5-47

```
CHANGE PASSWORD
Enter to Change
```

**func** **back**

CBM parameter setting ☞ P.5-48

To the product information group

**func**

```
CBM PARAMETER
Enter to Select
```

* Only when connected by link to CBM-20A/20Alite

5

# 5.2 Setting the Auxiliary Functions

The auxiliary functions are functions for setting the parameters for measurement and for displaying the settings made.

There are the following four types of auxiliary function.

| Group | Main Function |
|---|---|
| PARAMETER | To make settings relating to measurement, including wavelength, gain, sensitivity and so on. |
| CONTROL | To specify the files in which scan data is saved, set the scan speed, and so on. |
| SYSTEM | To make the settings when connected to a system controller, set the brightness of the display panel, and so on. |
| MONITOR | To show the statuses of the instrument, including wavelength output values and the cumulative operating time of the Xenon lamp. |

NOTE

When this instrument is used in the RF-10AXL compatibility mode, some functions may no longer be usable, and the setting ranges may be restricted.

☞ "5.7.3 Notes on Operation" P.5-77

When control is carried out from a system controller, the operations for some functions cannot be performed from the instrument. Either perform the operations for these functions from the system controller, or stop control by the system controller and perform the operations from the instrument.

## 5.2.1 List of Auxiliary Functions

The auxiliary functions are listed in the tables below.

"5.1.2 Auxiliary Function Screen" P.5-3

### ■ Parameter Settings Group

| Name | Operation | Function | Page |
|---|---|---|---|
| ch1 | Numeric keys | To set the excitation wavelength and emission wavelength for channel 1. | P.5-16 |
| ch2 | Numeric keys | To set the excitation wavelength and emission wavelength for channel 2. | P.5-16 |
| λ MODE | Numeric keys | To set the measurement mode. | P.5-17 |
| LAMP | Numeric keys | To set the lamp ON/OFF status. | P.5-17 |
| CELL TEMP (RF-20Axs only) | Numeric keys | To set the temperature of the flow cell. | P.5-17 |
| RESPONSE | Numeric keys | To set the response. | P.5-18 |
| SENS | Numeric keys | To set the sensitivity. | P.5-19 |
| GAIN | Numeric keys | To set the gain. | P.5-19 |
| ANALOG1 MODE | Numeric keys | To set the output mode for analog output connector 1. | P.5-20 |
| ANALOG2 MODE | Numeric keys | To set the output mode for analog output connector 2. | P.5-21 |
| ANA1 REC RANGE | Numeric keys | To set the output range for analog output connector 1. | P.5-22 |
| ANA2 REC RANGE | Numeric keys | To set the output range for analog output connector 2. | P.5-23 |
| BL OFS ANA1 | Numeric keys | To set the baseline offset value for analog output connector 1. | P.5-24 |
| BL OFS ANA2 | Numeric keys | To set the baseline offset value for analog output connector 2. | P.5-24 |
| EVENT | Numeric keys | To set the operation of the EVENT output terminal. | P.5-25 |
| MARK SETTING | Numeric keys | To set recorder marking. | P.5-25 |

### ■ Control Settings Group

| Name | Operation | Function | Page |
|---|---|---|---|
| SCAN FILE | Numeric keys | To specify the file number where scan data is to be saved. | P.5-26 |
| SPC TYPE | Numeric keys | To set whether the spectrum on the excitation side or that on the emission side is to be measured in spectrum scanning. | P.5-26 |
| EX SCAN | Numeric keys | To set the start wavelength and end wavelength of the excitation wavelengths in spectrum scanning (only when [SPC TYPE] is [1]). | P.5-26 |
| EM SCAN | Numeric keys | To set the start wavelength and end wavelength of the emission wavelengths in spectrum scanning (only when [SPC TYPE] is [2]). | P.5-27 |
| ch1 | Numeric keys | To set the excitation wavelength and emission wavelength for spectrum scanning. | P.5-27 |
| SCAN SPEED | Numeric keys | To set the scan speed for spectrum scanning. | P.5-28 |
| PLOT SPD | Numeric keys | To set the speed at which spectrum data is output to the recorder in spectrum scanning. | P.5-28 |
| SPC PLOT | enter key | To start or stop the output of spectrum data to the recorder. | P.5-28 |

## ■ System Settings Group

| Name | Operation | Function | Page |
|---|---|---|---|
| LOCAL | Numeric keys | To set whether this instrument is controlled from a system controller or controlled at the instrument itself. | P.5-29 |
| LINK ADRS | Numeric keys | To set the address if the instrument is controlled from the system controller. | P.5-29 |
| KEY CLOSE | enter key | To block receipt of inputs from the operation keys. | P.5-29 |
| BRIGHTNESS | Numeric keys | To set the brightness of the display panel. | P.5-30 |
| EXT-S | Numeric keys | To set the operation of the EVENT output terminal. | P.5-30 |
| MONIT-TIME | Numeric keys | To set whether the time program elapsed time is shown or hidden. | P.5-31 |
| BEEP MODE | Numeric keys | To set the buzzer sound. | P.5-31 |
| CELL No. | Numeric keys | To enter the cell number when a cell is replaced. | P.5-31 |

## ■ Monitor Display Group

| Name | Operation | Function | Page |
|---|---|---|---|
| SMPL EN, REF EN | Display | To show the light intensity levels of the sample side and reference side. | P.5-32 |
| Xe TIME | Display | To show the cumulative operating time of the Xenon lamp. | P.5-32 |
| Xe COUNT | Display | To show the ignition count of the Xenon lamp. | P.5-33 |
| CELL TEMP (RF-20Axs only) | Display | To show the current temperature of the flow cell and the set temperature. | P.5-33 |
| ROOM TEMP (RF-20Axs only) | Display | To show the ambient temperature of the instrument. | P.5-33 |

* The entry in the "Operation" column indicates the following types of operation.

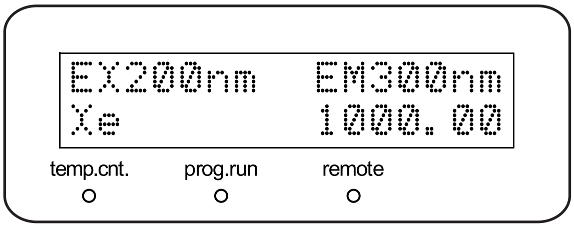
Display : Check the monitor.

enter key : Press enter to activate the function.

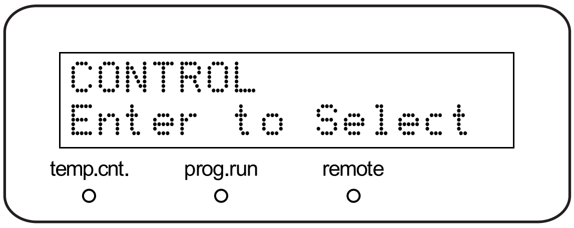
Numeric keys : Press • - 9 to enter a value, then press enter to confirm the value.

## 5.2.2 Showing the Auxiliary Function Screen

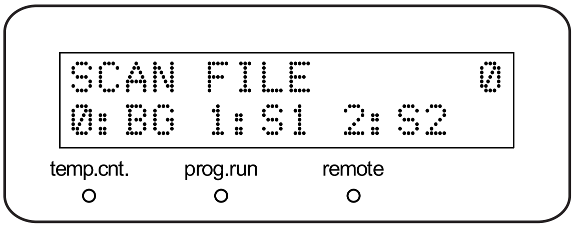
**1** Press **CE**.
The initial screen will be displayed.




**2** Press **func** repeatedly.
The auxiliary function groups will be displayed in the following sequence: [PARAMETER] → [CONTROL] → [SYSTEM] → [MONITOR].




**3** Select the auxiliary function group to be set and press **enter**.
This displays the first item within that auxiliary function group.

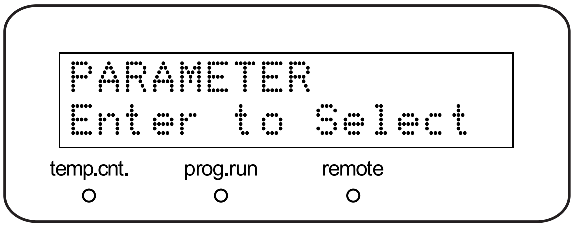



**4** Now press **func** or **back** repeatedly to select the item to be set.

**5** Press **CE** to return to the group screen.
Press **CE** a second time to return to the initial screen.

## 5.2.3 Parameter Settings Group

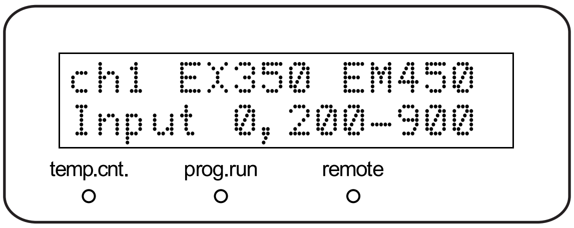
This is the group that relates to parameter settings.




### ■ Setting the Wavelength for Channel 1 [ch1]

Set the excitation wavelength and emission wavelength for channel 1.

☞ "4.1.2 Setting the Measurement Wavelengths" P.4-3
"4.2.2 Setting the Measurement Wavelengths" P.4-22




Enter each wavelength with the numeric keys, then press **enter**.

| Wavelength | Setting Range (Units: nm) |
|---|---|
| EX (excitation wavelength) | 0, 200 to 900 |
| EM (emission wavelength) | 0, 200 to 900 |

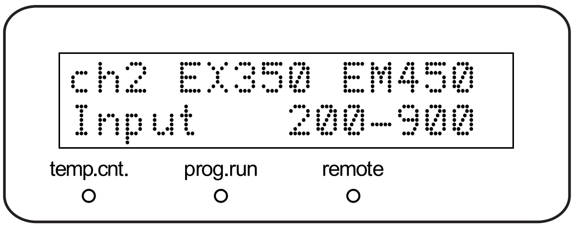
NOTE

When [2] (dual wavelength mode) has been set for [λ MODE], the setting cannot be made 0 nm.

### ■ Setting the Wavelength for Channel 2 [ch2] (Only in the Dual Wavelength Mode)

Set the excitation wavelength and emission wavelength for channel 2.

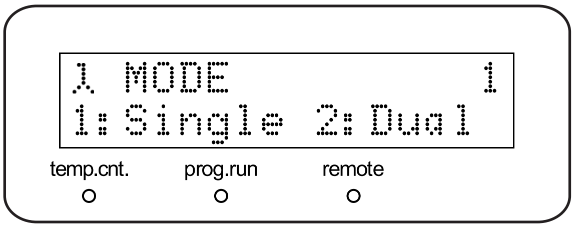
☞ "4.2.2 Setting the Measurement Wavelengths" P.4-22




Enter each wavelength with the numeric keys, then press **enter**.

| Wavelength | Setting Range (Units: nm) |
|---|---|
| EX (excitation wavelength) | 200 to 900 |
| EM (emission wavelength) | 200 to 900 |

## ■ Setting the Measurement Mode [λ MODE]




Set the measurement mode as single wavelength mode or dual wavelength mode

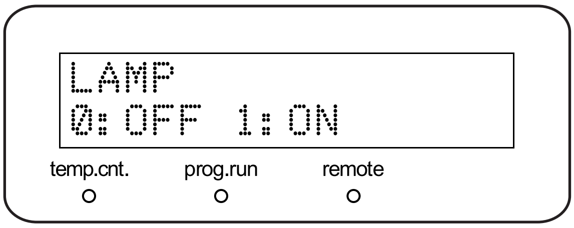
☞ "4.1 Measuring in the Single Wavelength Mode" P.4-2
"4.2 Measuring in the Dual Wavelength Mode" P.4-21

Enter the measurement mode with the numeric keys, then press **enter** .

| Set Value | Measurement Mode |
|---|---|
| 1 | Single wavelength mode |
| 2 | Dual wavelength mode |



## ■ Setting the Lamp ON/OFF Status [LAMP]




Set the ON/OFF status of the lamp.

Enter the set value from the numeric keys and press **enter** .

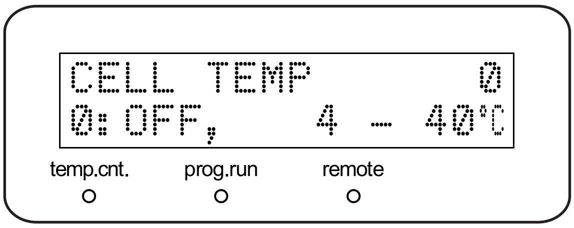
| Set Value | Setting |
|---|---|
| 0 | OFF |
| 1 | ON |

NOTE

When the Xenon lamp is turned ON this instrument is initialized.

On completion of initialization the set values are re-set to their status before the lamp was turned ON.

## ■ Setting the Flow Cell Temperature [CELL TEMP] (RF-20Axs Only)




Set the temperature of the flow cell.

☞ "4.1.9 Setting the Flow Cell Temperature (RF-20Axs Only)" P.4-19
☞ "4.2.9 Setting the Flow Cell Temperature (RF-20Axs Only)" P.4-40

Enter the set value from the numeric keys and press **enter** .

| Set Value | Setting |
|---|---|
| 0 | The temperature is not adjusted. |
| 4 to 40 °C | The temperature is adjusted to the set value. |

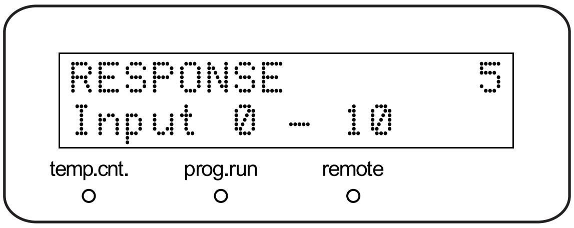
## ■ Setting the Response [RESPONSE]

Set the response.

☞ "4.1.6 Setting the Response (Response Speed)" P.4-14
"4.2.6 Setting the Response (Response Speed)" P.4-33

Enter the set value from the numeric keys and press **enter**.

The correspondence between the response values of this instrument and the time constants of an analog CR filter is indicated below.



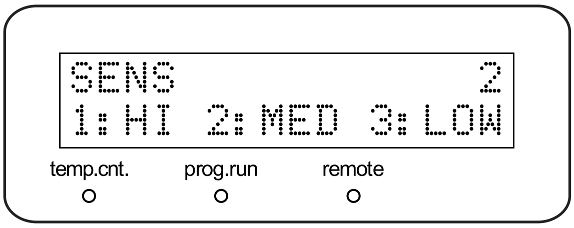

| Set Value | Time Constant (Units: sec) |
|---|---|
| 0 | No filter |
| 1 | 0.05 |
| 2 | 0.1 |
| 3 | 0.5 |
| 4 | 1.0 |
| 5 | 1.5 |
| 6 | 3.0 |
| 7 | 6.0 |
| 8 | 8.0 |
| 9 | 10.0 |
| 10 | 2.0 |

## ■ Setting the Sensitivity [SENS]

Set the sensitivity of the instrument.

☞ "4.1.8 Setting Sensitivity" P.4-17
"4.2.8 Setting Sensitivity" P.4-38

Enter the set value from the numeric keys and press **enter**.



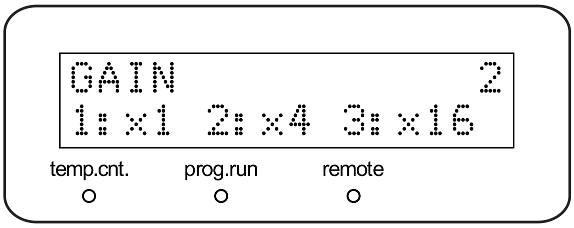

| Set Value | Sensitivity | Sensitivity Magnifications |
|---|---|---|
| 1 | HI | Approx. × 1 |
| 2 | MED | Approx. × 32 |
| 3 | LOW | Approx. × 1024 |

## ■ Setting the Gain [GAIN]

Set a magnification of the sensitivity (SENS). By combining the setting of sensitivity and gain, you can set the measuring range.

☞ "4.1.7 Setting Gain" P.4-16
"4.2.7 Setting Gain" P.4-36

Enter the set value from the numeric keys and press **enter**.




| Set Value | Gain |
|---|---|
| 1 | × 1 |
| 2 | × 4 |
| 3 | × 16 |

The combinations of sensitivity and gain are shown below.

| Sensitivity | Gain | Sensitivity Magnifications |
|---|---|---|
| 3 (LOW) | 1 | Approx. × 1 |
| | 2 | Approx. × 4 |
| | 3 | Approx. × 16 |
| 2 (MED) | 1 | Approx. × 32 |
| | 2 | Approx. × 128 |
| | 3 | Approx. × 512 |
| 1 (HI) | 1 | Approx. × 1024 |
| | 2 | Approx. × 4096 |
| | 3 | Approx. × 16384 |

NOTE

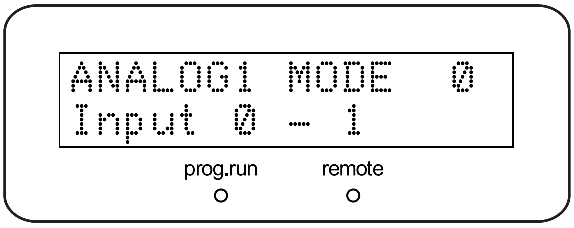
When the sensitivity and/or gain have been changed, plot a revised calibration curve.

## ■ Setting the Output Mode for Analog Output Connector 1 [ANALOG1 MODE]

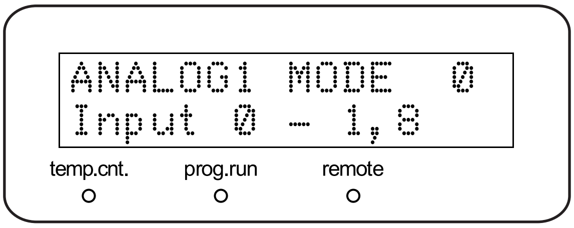
Set whether a Chromatopac or a recorder is connected to analog output connector 1.

☞ "4.1.3 Setting the Analog Output Connectors" P.4-5
"4.2.3 Setting the Analog Output Connectors" P.4-25

RF-20A




RF-20Axs



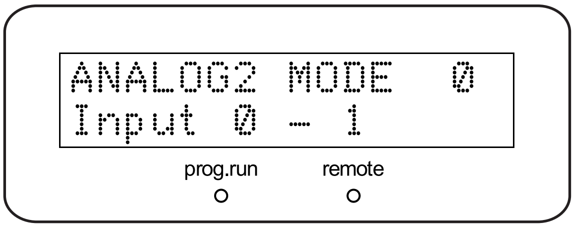

Enter the set value from the numeric keys and press **enter** .

| Measurement Mode | Set Value | Output Mode |
|---|---|---|
| Single wavelength mode | 0 | A Chromatopac or variable range recorder is connected to analog output connector 1. |
| | 1 | A fixed range recorder is connected to analog output connector 1. |
| | 8* | The temperature of the flow cell is output. Output range: 0 to 100 °C (0 to 10 mV) |
| Dual wavelength mode | 0 | Set when a Chromatopac or variable range recorder is connected to analog output connector 1 and the channel 1 data is recorded by the Chromatopac. |
| | 1 | Set when a fixed range recorder is connected to analog output connector 1 and the channel 1 data is recorded by the recorder. |
| | 2 | Set when a Chromatopac or variable range recorder is connected to analog output connector 1 and the channel 2 data is recorded by the Chromatopac. |
| | 3 | Set when a fixed range recorder is connected to analog output connector 1 and the channel 2 data is recorded by the recorder. |
| | 8* | The temperature of the flow cell is output. Output range: 0 to 100 °C (0 to 10 mV) |

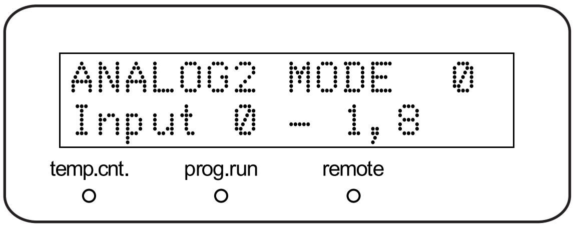
* : RF-20Axs only

## ■ Setting the Output Mode for Analog Output Connector 2 [ANALOG2 MODE]

RF-20A




RF-20Axs




Set whether a Chromatopac or a recorder is connected to analog output connector 2.

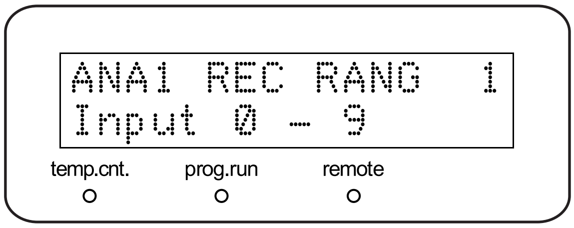
☞ "4.1.3 Setting the Analog Output Connectors" P.4-5
"4.2.3 Setting the Analog Output Connectors" P.4-25

Enter the set value from the numeric keys and press **enter**.

| Measurement Mode | Set Value | Output Mode |
|---|---|---|
| Single wavelength mode | 0 | A Chromatopac or variable range recorder is connected to analog output connector 2. |
| | 1 | A fixed range recorder is connected to analog output connector 2. |
| | 8* | The temperature of the flow cell is output. Output range: 0 to 100 °C (0 to 10 mV) |
| Dual wavelength mode | 0 | Set when a Chromatopac or variable range recorder is connected to analog output connector 2 and the channel 1 data is recorded by the Chromatopac. |
| | 1 | Set when a fixed range recorder is connected to analog output connector 2 and the channel 1 data is recorded by the recorder. |
| | 2 | Set when a Chromatopac or variable range recorder is connected to analog output connector 2 and the channel 2 data is recorded by the Chromatopac. |
| | 3 | Set when a fixed range recorder is connected to analog output connector 2 and the channel 2 data is recorded by the recorder. |
| | 8* | The temperature of the flow cell is output. Output range: 0 to 100 °C (0 to 10 mV) |

* : RF-20Axs only

## ■ Setting the Output Range for Analog Output Connector 1 [ANA1 REC RANGE]




Set the output range for analog output connector 1. Before making this setting, set the output mode of analog output connector 1 to RECORDER. If it is set to INTEGRATOR, this setting will not take effect.

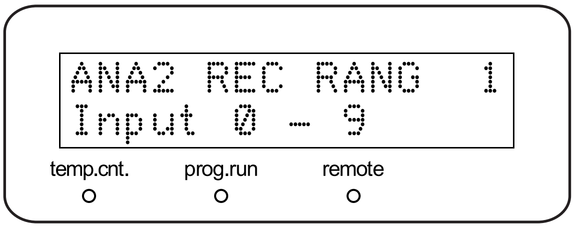
☞ "4.1.4 Setting the Output Ranges" P.4-7
"Setting the Output Mode for Analog Output Connector 1 [ANALOG1 MODE]" P.5-20

Enter the set value from the numeric keys and press **enter**.

| Set Value | Output Range |
|---|---|
| 0 | Short (output is 0 mV) * |
| 1 | × 1 |
| 2 | × 1/2 |
| 3 | × 1/4 |
| 4 | × 1/8 |
| 5 | × 1/16 |
| 6 | × 1/32 |
| 7 | × 1/64 |
| 8 | × 1/128 |
| 9 | × 1/256 |

* When a baseline offset value, [BL OFS ANA1] or [BL OFS ANA2], is set, the corresponding set voltage is output.

## ■ Setting the Output Range for Analog Output Connector 2 [ANA2 REC RANGE]




Set the output range for analog output connector 2. Before making this setting, set the output mode of analog output connector 2 to RECORDER. If it is set to INTEGRATOR, this setting will not take effect.

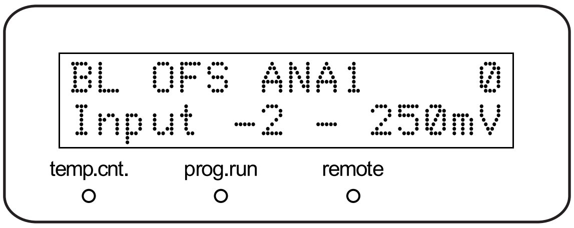
☞ "4.1.4 Setting the Output Ranges" P.4-7
"Setting the Output Mode for Analog Output Connector 2 [ANALOG2 MODE]" P.5-21

Enter the set value from the numeric keys and press **enter**.

| Set Value | Output Range |
|---|---|
| 0 | Short (output is 0 mV) * |
| 1 | × 1 |
| 2 | × 1/2 |
| 3 | × 1/4 |
| 4 | × 1/8 |
| 5 | × 1/16 |
| 6 | × 1/32 |
| 7 | × 1/64 |
| 8 | × 1/128 |
| 9 | × 1/256 |

* When a baseline offset value, [BL OFS ANA1] or [BL OFS ANA2], is set, the corresponding set voltage is output.

## ■ Setting the Baseline Offset Value for Analog Output Connector 1 [BL OFS ANA1]




Set the baseline offset value for analog output connector 1. Before making this setting, set the output mode and output range for analog output connector 1 and connect the recorder or Chromatopac to analog output connector 1.

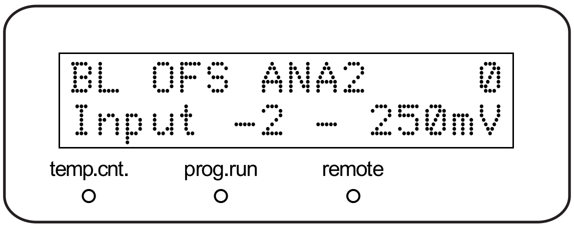
☞ "4.1.5 Setting Baseline Offset Values" P.4-11
"Setting the Output Mode for Analog Output Connector 1 [ANALOG1 MODE]" P.5-20
"Setting the Output Range for Analog Output Connector 1 [ANA1 REC RANGE]" P.5-22

Enter the set value from the numeric keys and press **enter**.

On pressing **zero** after making this setting, the baseline is set to the value set here.

| Setting Range (Units: mV) |
|---|
| –2 to 250 (default value: 0) |

## ■ Setting the Baseline Offset Value for Analog Output Connector 2 [BL OFS ANA2]




Set the baseline offset value for analog output connector 2. Before making this setting, set the output mode and output range for analog output connector 2 and connect the recorder or Chromatopac to analog output connector 2.

☞ "4.1.5 Setting Baseline Offset Values" P.4-11
"Setting the Output Mode for Analog Output Connector 2 [ANALOG2 MODE]" P.5-21
"Setting the Output Range for Analog Output Connector 2 [ANA2 REC RANGE]" P.5-23

Enter the set value from the numeric keys and press **enter**.

On pressing **zero** after making this setting, the baseline is set to the value set here.

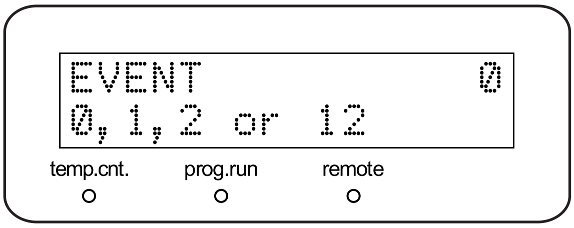
| Setting Range (Units: mV) |
|---|
| –2 to 250 (default value: 0) |

## ■ Setting the EVENT Output Terminal [EVENT]

Set the operation of the EVENT output terminal.

☞ "5.8 Connection to External Input/Output Terminals" P.5-81

Enter the set value from the numeric keys and press **enter**.

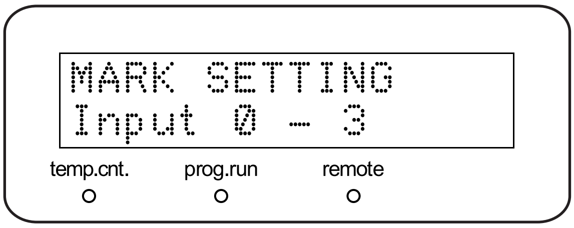



| Set Value | EVENT1 | EVENT2 |
|---|---|---|
| 0 | OFF | OFF |
| 1 | ON | OFF |
| 2 | OFF | ON |
| 12 | ON | ON |

## ■ Setting Recorder Marking [MARK SETTING]

Set marking to be output to a recorder.

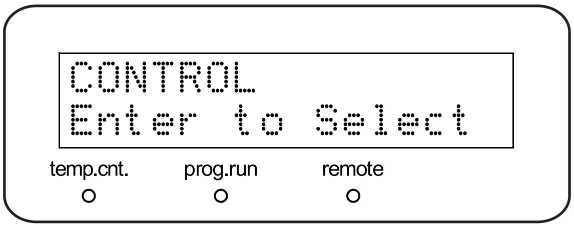
Enter the set value from the numeric keys and press **enter**.




| Set Value | Setting |
|---|---|
| 0 | OFF (no marking) |
| 1 | OUT1 (marking for output from analog output connector 1 only) |
| 2 | OUT2 (marking for output from analog output connector 2 only) |
| 3 | ALL (marking for output from analog output connectors 1 and 2) |

## 5.2.4 Control Settings Group

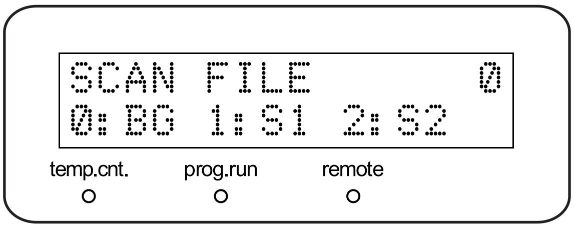
This is the group that relates to control of this instrument.




### ■ Setting the File Number of the File Where the Scan File Is to Be Saved [SCAN FILE]

Up to three sets of data generated by spectrum scannings can be saved.

Enter the file number with the numeric keys, then press **enter**.

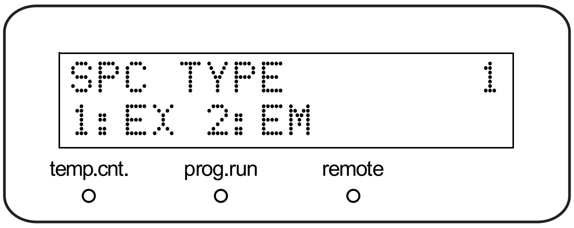



| Set Value | File Where Saved |
|---|---|
| 0 | Background |
| 1 | Sample 1 |
| 2 | Sample 2 |

### ■ Setting the Scan Type [SPC TYPE]

Set whether to use the excitation or emission scanning in spectrum scanning.

Enter the set value from the numeric keys and press **enter**.



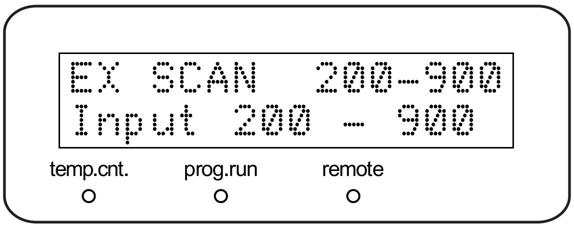

| Set Value | Scan Type |
|---|---|
| 1 | EX (excitation scanning) |
| 2 | EM (emission scanning) |

### ■ Setting the Start and End Excitation Wavelengths [EX SCAN]

Set the start and end excitation wavelengths in spectrum scanning.

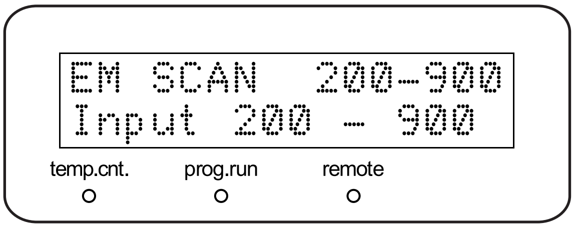
Make this setting when [1] (excitation scanning) is set for "Setting the Scan Type [SPC TYPE]" P.5-26.

Enter the set value from the numeric keys and press **enter**.




| Wavelength | Setting Range (Units: nm) |
|---|---|
| Start wavelength | 200 to 900 |
| End wavelength | 200 to 900 |

## ■ Setting the Start and End Emission Wavelengths [EM SCAN]




Set the start and end emission wavelengths in spectrum scanning.

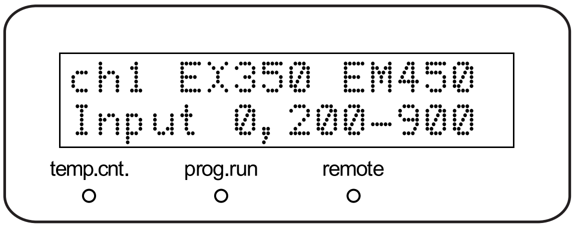
Make this setting when [2] (emission scanning) is set for "Setting the Scan Type [SPC TYPE]" P.5-26.

Enter the set value from the numeric keys and press **enter**.

| Wavelength | Setting Range (Units: nm) |
|---|---|
| Start wavelength | 200 to 900 |
| End wavelength | 200 to 900 |

## ■ Setting Excitation and Emission Wavelengths for Spectrum Scanning [ch1]






Set the excitation and emission wavelengths for spectrum scanning. When [1] is set for "Setting the Scan Type [SPC TYPE]" P.5-26, the emission wavelength is set, and when [2] is set the excitation wavelength is set.

Enter each wavelength with the numeric keys, then press **enter**.

| Wavelength | Setting Range (Units: nm) |
|---|---|
| EX (excitation wavelength) | 0, 200 to 900 |
| EM (emission wavelength) | 0, 200 to 900 |

NOTE

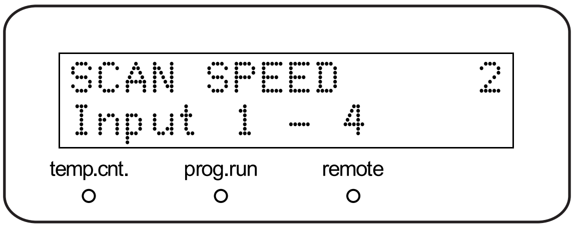
When this setting is changed, the wavelength for channel 1 in the parameter settings group is also changed.

☞ "Setting the Wavelength for Channel 1 [ch1]" P.5-16

## ■ Setting the Scan Speed [SCAN SPEED]

Set the scan speed for spectrum scanning.

Enter the set value from the numeric keys and press **enter**.

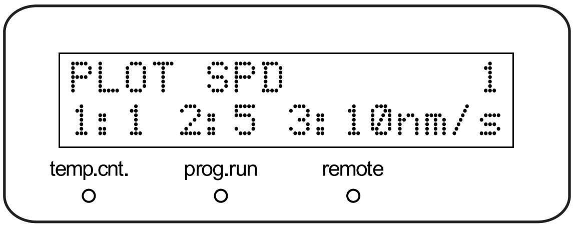



| Set Value | Scan Speed |
|---|---|
| 1 | SUPER (3000 nm/minute) |
| 2 | FAST (600 nm/minute) |
| 3 | MEDIUM (120 nm/minute) |
| 4 | SLOW (24 nm/minute) |

## ■ Setting the Speed at Which Spectrum Data Is Output [PLOT SPD]

Set the speed at which the spectrum data obtained in spectrum scanning is output.

Select the set value with the numeric keys, then press **enter**.

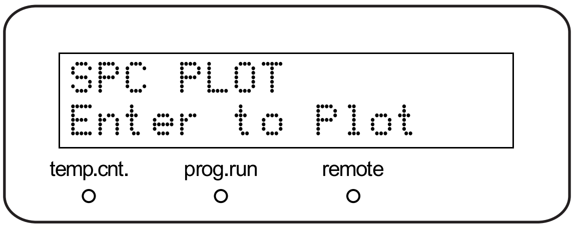



| Set Value | Output Speed (Units: nm/sec) |
|---|---|
| 1 | 1 |
| 2 | 5 |
| 3 | 10 |

## ■ Outputting Spectrum Data [SPC PLOT]

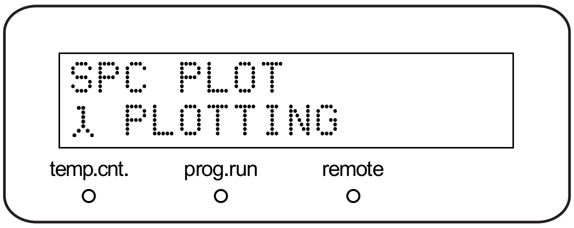
Output spectrum data.

**1** Press **enter** with the screen on the right displayed.



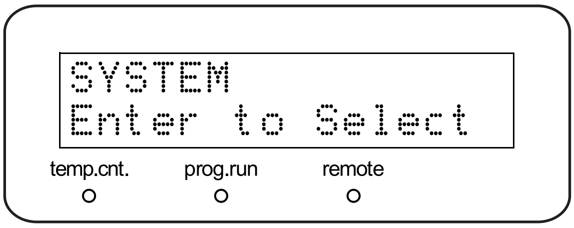

**2** During output, the screen to the right is displayed.

∗ To stop output, press **enter** again while the screen to the right is displayed.



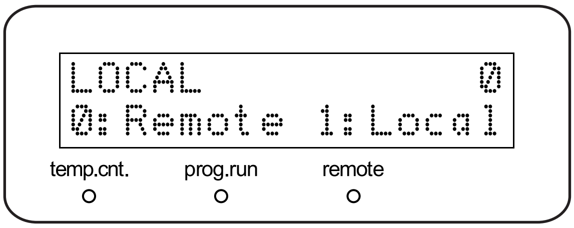
## 5.2.5 System Settings Group

This is the group that relates to system settings, such as connections with external devices.




### ■ Setting the Local Mode [LOCAL]

Set, when the instrument is connected to a system controller, whether it is controlled from that system controller or operated from the unit itself (local mode).
Enter the set value from the numeric keys and press **enter**.





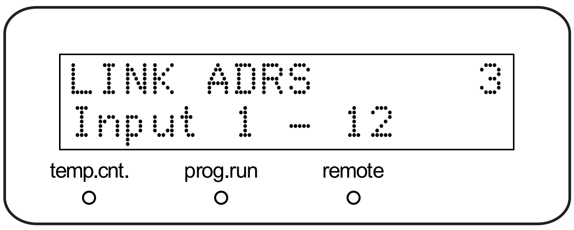

| Set Value | Mode | Function |
|---|---|---|
| 0 | Remote | The instrument is controlled from the system controller. |
| 1 | Local | The instrument is operated independently (local mode). |

NOTE

When the setting for the local mode has been changed from [1] to [0], exit LCsolution, turn the power to the system controller OFF and back ON, then start up LCsolution.

### ■ Setting a Remote Control Address [LINK ADRS]

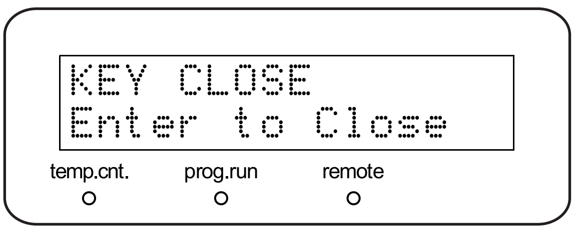
Set the address (channel number) used when using this instrument while it is connected to a system controller.
Enter the address with the numeric keys, then press **enter**.
For details on channel numbers, see:




☞ "Connecting to a System Controller" P.9-30

### ■ Prohibiting Key Input [KEY CLOSE]

Set whether to prohibit key input.
Pressing **enter** at the right of the screen establishes the input prohibited status.
To cancel this status, press **CE** while pressing **del**.

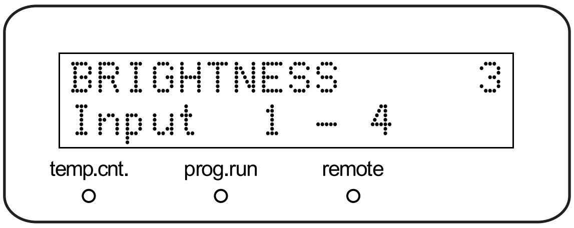


## ■ Adjusting the Brightness of the Display Screen [BRIGHTNESS]

Adjust the contrast of the display screen in four stages.

Enter the set value from the numeric keys and press **enter**.

| Set Value | Brightness Level (Units: %) |
|---|---|
| 1 | 25 |
| 2 | 50 |
| 3 | 75 |
| 4 | 100 |

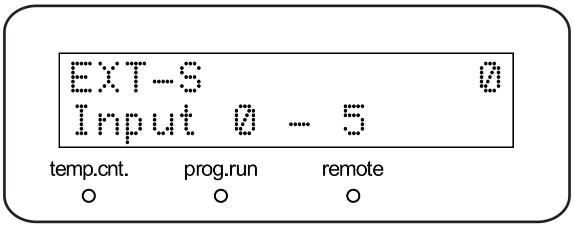



## ■ Setting the Function of the EVENT Output Terminal [EXT-S]

Set the control mode for external devices according to the EVENT output terminal (EVENT1, EVENT2).

Enter the set value from the numeric keys and press **enter**.

| Set Value | Setting |
|---|---|
| 0 | The setting for [EVENT] in the parameter settings group is followed. |
| 1 | EVENT1 is turned ON on execution of the time program. |
| 2 | EVENT2 is turned ON on the occurrence of an error. |
| 3 | The functions corresponding to the set values 1 and 2 are set. |
| 4 | EVENT1 is closed (set to ON) during spectrum scanning and it is used as a control terminal for external devices. |
| 5 | The functions corresponding to the set values 2 and 4 are set. |

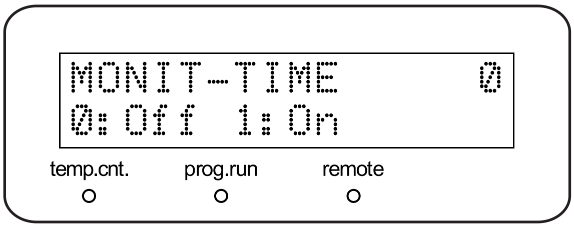



☞ "5.8 Connection to External Input/Output Terminals" P.5-81

## ■ Displaying the Program Elapsed Time [MONIT-TIME]

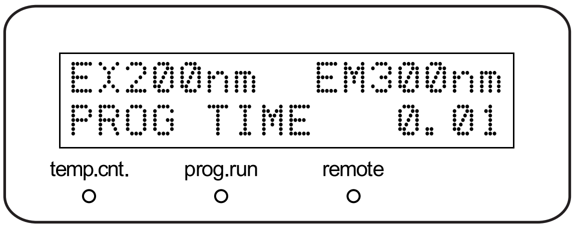
Set whether to display the time elapsed since the start during execution of the time program.

Enter the set value from the numeric keys and press **enter**.




| Set Value | Function |
|---|---|
| 0 | The time program elapsed time is not displayed. |
| 1 | The time program elapsed time is displayed. |

When [1] is set, the screen shown to the right is displayed during execution of the time program.

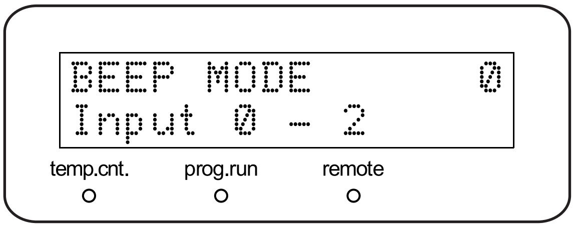





## ■ Setting the Buzzer Sound [BEEP MODE]

Set the buzzer sound.

Enter the set value from the numeric keys and press **enter**.



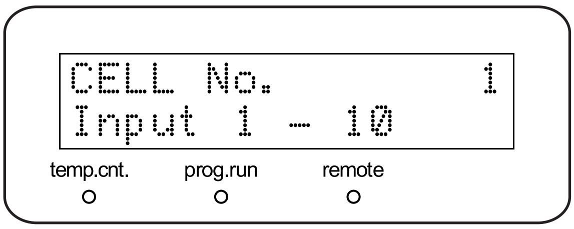

| Set Value | Control Mode |
|---|---|
| 0 | The buzzer sounds at key input and on occurrence of an error. |
| 1 | The buzzer only sounds on occurrence of an error.<br>It doesn't sound at key input. |
| 2 | No buzzer sounds. |

## ■ Setting the Cell Number [CELL No.]

Cell numbers are identification numbers used when multiple flow cell units are used.

If the instrument is being used having replaced the flow cell unit that it was provided with on shipping with a different type of flow cell unit, wavelength calibration must be performed.

On inputting the cell number of the flow cell unit when performing wavelength calibration, this instrument memorizes the wavelength calibration data for each cell number.



Upon entering the cell number set for this instrument, the instrument operates based on the wavelength calibration data that corresponds to the set cell.
Enter the set value from the numeric keys and press **enter**.

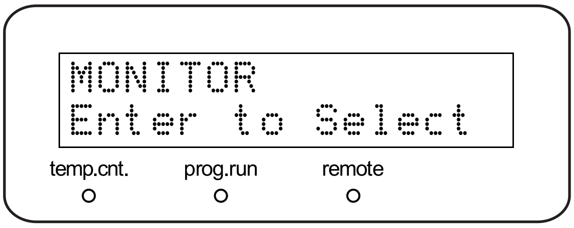
| Setting Range |
|---|
| 1 to 10 (default value: 1*) |

* The wavelength calibration data of the cell that was provided with the instrument on shipping is input.

☞ "5.9 Using the Spare Flow Cell Unit / Optional Cell" P.5-84
"8.7 Performing Wavelength Calibration" P.8-39

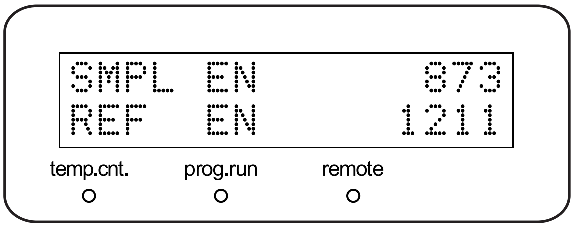
## 5.2.6 Monitor Display Group

This is the group that relates to settings for the display monitor.



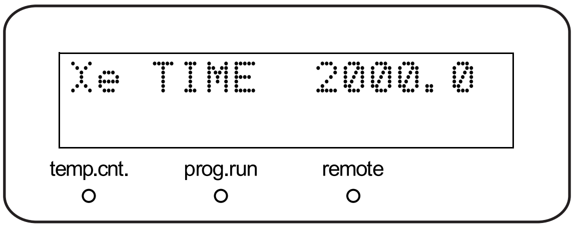

### ■ Displaying the Light Intensity [SMPL EN, REF EN]

Displays the light intensity of the sample (emission side) and reference side (excitation side) (units: mV).
The first line shows the light intensity for the sample.
The second line shows the light intensity for the reference.



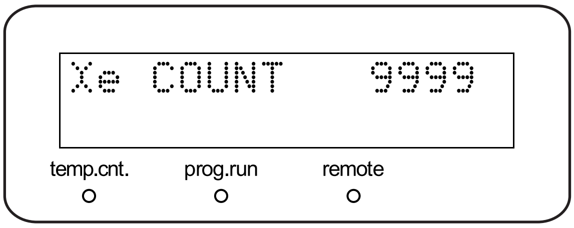

### ■ Displaying the Cumulative Operating Time of the Xenon Lamp [Xe TIME]

Displays the cumulative operating time of the Xenon lamp (units: hours).



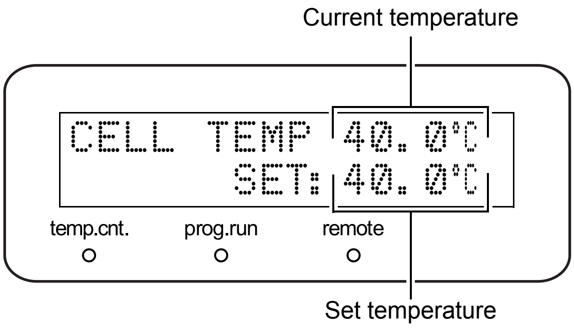
### ■ Displaying the Xenon Lamp Ignition Count [Xe COUNT]

Displays the ignition count of the Xenon lamp.



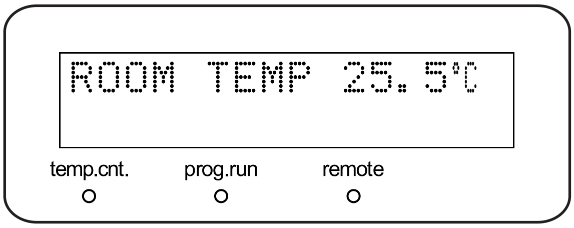

### ■ Displaying the Temperature of the Flow Cell [CELL TEMP] (RF-20Axs Only)

Displays the set temperature and current temperature of the flow cell.
The first line shows the current temperature of the flow cell and the second line shows the set temperature of the flow cell.




### ■ Displaying the Ambient Temperature [ROOM TEMP] (RF-20Axs Only)

Displays the ambient temperature of the instrument.



# 5.3 Setting the VP Functions

The VP functions support the validation of the instrument through the display of instrument information and check functions.

There are the following four types of VP function.

| Group | Main Function |
|---|---|
| PRODUCT | To display the instrument's serial number, unit name, ROM version and so on. |
| MAINTENANCE | To display the instrument's operating time, the Xenon lamp's cumulative operating time, and so on. |
| VALIDATION | To set the time and date, to check the memory and wavelength accuracy, to run performance checks by the raman spectrum of water, and so on. |
| CALIBRATION | To set the password, to set the Xenon lamp replacement alert time, and so on. |

NOTE

When this instrument is used in the RF-10AXL compatibility mode, some functions may no longer be usable, and the setting ranges may be restricted.

☞ "5.7.3 Notes on Operation" P.5-77

## 5.3.1 List of VP Functions

The VP functions are listed in the tables below.

☞ "5.1.3 VP Function Screen" P.5-8

### ■ Product Information Group

| Name | Operation | Function | Page |
|---|---|---|---|
| SERIAL NUMBER | Display | To show the serial number of the instrument. | P.5-37 |
| S/W ID: V | Display | To show the unit name of the instrument, and the ROM version. | P.5-37 |

### ■ Maintenance Information Group

| Name | Operation | Function | Page |
|---|---|---|---|
| TOTAL OP TIME | Display | To show the cumulative operating time of the instrument. | P.5-37 |
| Xe LAMP USED TM | Numeric keys | To show the Xenon lamp's replacement alert time, and its cumulative operating time. | P.5-38 |
| Xe LAMP USED CT | Display | To show the ignition count of the Xenon lamp. | P.5-38 |
| PART REPLACEMENT | Numeric keys | To enter the part numbers of parts replaced in maintenance. | P.5-38 |
| MAINTENANCE LOG | Display | To show the maintenance log. | P.5-39 |
| OPERATION LOG | Display | To show the operation log. | P.5-39 |
| ERROR LOG | Display | To show the error log. | P.5-40 |

* The entry in the "Operation" column indicates the following types of operation.

Display : Check the monitor.

enter key : Press enter to activate the function.

Numeric keys : Press · - 9 to enter a value, then press enter to confirm the value.

## Validation Support Group

| Name | Operation | Function | Page |
|---|---|---|---|
| DATE | Numeric keys | To set and show the date. | P.5-41 |
| TIME | Numeric keys | To set and show the time. | P.5-41 |
| EX CHECK | enter key | To check the wavelength at the excitation side. | P.5-42 |
| EM CHECK | enter key | To check the wavelength at the emission side. | P.5-42 |
| S/N CHECK | enter key | To run performance checks by the raman spectrum of water. | P.5-42 |
| LEAK SENSOR TEST | enter key | To check the leak sensor. | P.5-42 |

5

## Calibration Support Group

| Name | Operation | Function | Page |
|---|---|---|---|
| INPUT PASSWORD * | Numeric keys | To enter the password. | P.5-43 |
| WAVE CALIB | enter key | To calibrate the wavelength. | P.5-44 |
| Xe TIME | Numeric keys | To set the replacement alert time for the Xenon lamp. | P.5-44 |
| L-CAL | enter key | To calibrate the leak sensor. | P.5-45 |
| LEAK THR | Numeric keys | To set the actuation level of the leak sensor. | P.5-45 |
| SENS COMP | Numeric keys | To set the coefficients for eliminating differences in sensitivity among individual units when multiple units of this instrument are used. | P.5-45 |
| OP MODE | Numeric keys | To select the operation mode. | P.5-46 |
| INITIALIZE PARAM | enter key | To initialize the parameters. | P.5-46 |
| CHANGE PASSWORD | enter key | To set and change the password. | P.5-47 |
| CBM PARAMETER | Numeric keys, enter key | To set and show the CBM parameters.<br>This function is shown when the instrument is linked to a CBM-20A/20Alite. | P.5-48 |

* For the VP functions in the calibration support group, if the password doesn't match you cannot proceed to [WAVE CALIB] or any subsequent item by pressing func.

* The entry in the "Operation" column indicates the following types of operation.

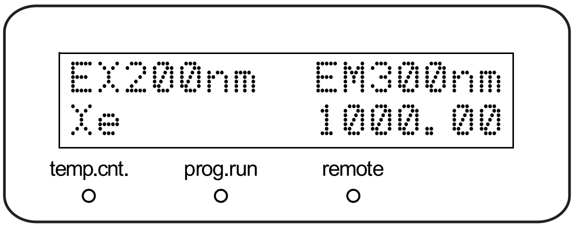
Display : Check the monitor.

enter key : Press enter to activate the function.

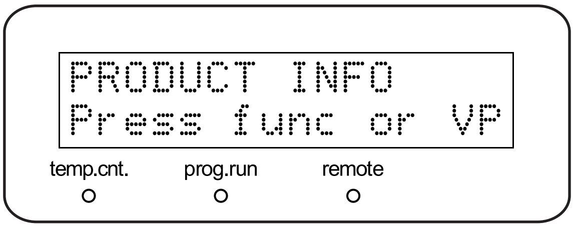
Numeric keys : Press · - 9 to enter a value, then press enter to confirm the value.

## 5.3.2 Showing the VP Function Screen

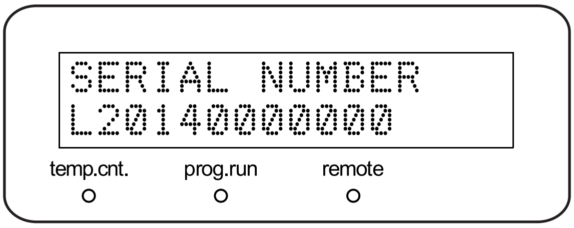
**1** Press (CE).
The initial screen will be displayed.




**2** Press (VP) to select the desired group.
The VP function groups will be displayed in the following sequence: [PRODUCT] → [MAINTENANCE] → [VALIDATION] → [CALIBRATION].




**3** Select the group to be set and press (func).
The first item in the group will be displayed.

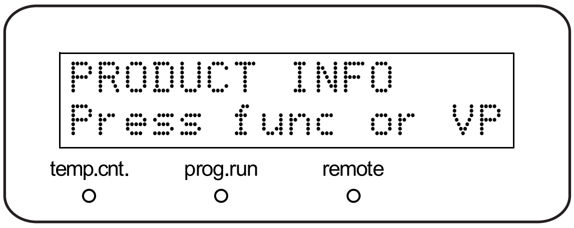



**4** Now press (func) or (back) repeatedly to select the item to be set.

**5** Press (CE) to return to the group screen.
Press (CE) a second time to return to the initial screen.

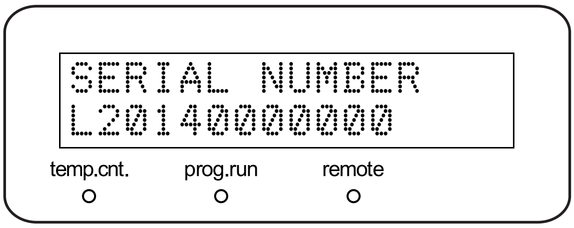
## 5.3.3 Product Information Group

This is the group that relates to information.



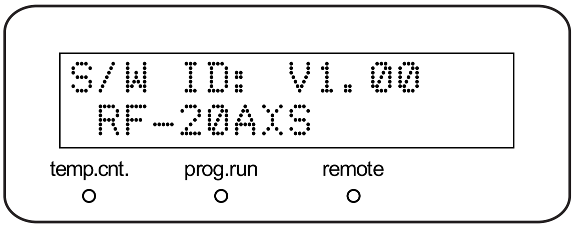

### ■ Showing the Serial Number [SERIAL NUMBER]

Shows the serial number of the instrument.



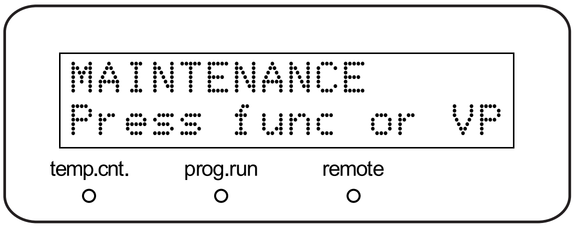

### ■ Showing the ROM Version Number [S/W ID]

Shows the unit name (same as the model name) of the instrument, and the version.



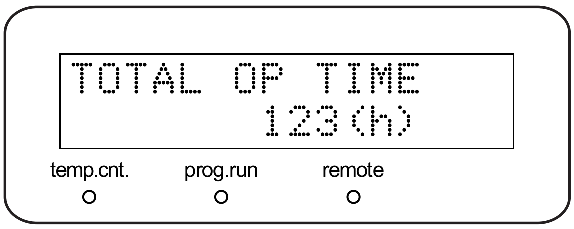

## 5.3.4 Maintenance Information Group

This is the group that relates to maintenance information.




### ■ Showing the Cumulative Operating Time [TOTAL OP TIME]

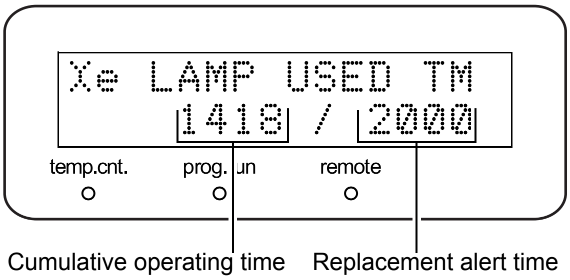
Shows the cumulative operating time of the instrument.



## ■ Showing the Replacement Alert Time for the Xenon Lamp, and Its Cumulative Operating Time [Xe LAMP USED TM]

Shows the cumulative operating time and replacement alert time of the Xenon lamp.
After replacing the Xenon lamp, enter (0) and press (**enter**) to reset the cumulative operating time.
When the cumulative operating time of the Xenon lamp has exceeded 2000 hours, replace it. If the Xenon lamp continues to be used beyond its service life (2000 hours), it may explode.

☞ "8.4 Inspecting/Replacing the Xenon Lamp" P.8-30

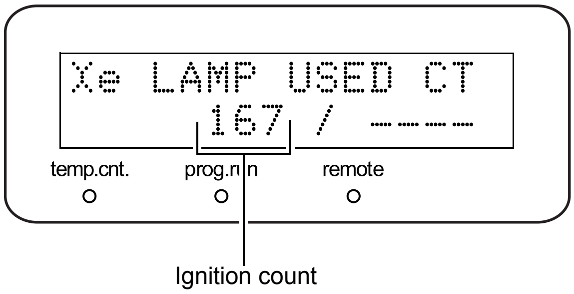



NOTE

When the cumulative operating time is reset, [Xe LAMP USED CT] is also reset. The reset information is saved in the maintenance log.

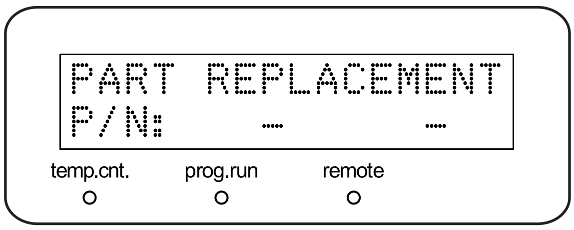
## ■ Showing the Ignition Count of the Xenon Lamp [Xe LAMP USED CT]

Shows the ignition count of the Xenon lamp.



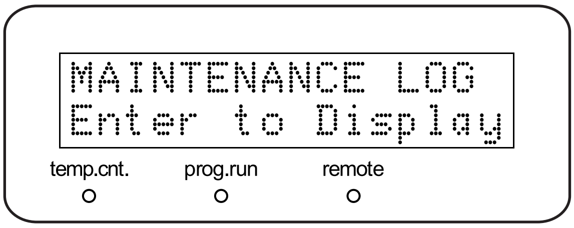

## ■ Entering the Part Number of a Replaced Part [PART REPLACEMENT]

Enter the part number here when a general part is replaced.
The entered part number is saved in the maintenance log.
∗ The entry is to be made by Shimadzu representative.

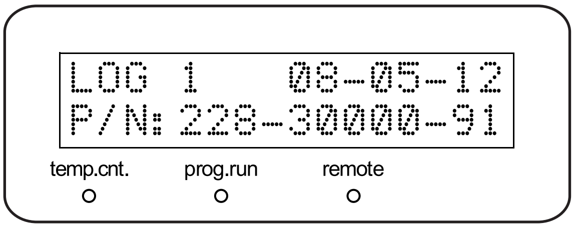


## ■ Showing the Maintenance Log [MAINTENANCE LOG]

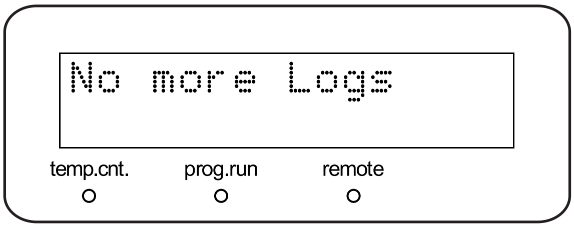
Shows the last 20 records, including the part numbers of parts that have been replaced and the date of replacement, and the Xenon lamp replacement record. Repeatedly pressing **enter** displays the replaced parts and dates in sequence.




The screen to the right indicates that a part with part number 228-30000-91 was replaced on May 12th, 2008.

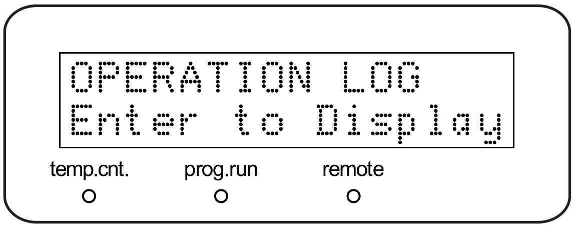



When the number of entries in the maintenance log is under 20, the screen shown to the right is displayed after the final log. Press **CE** to return to the relevant title screen.

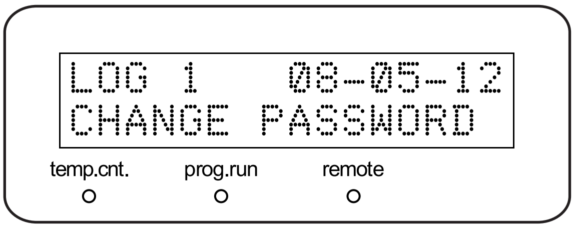



## ■ Showing the Operation Log [OPERATION LOG]

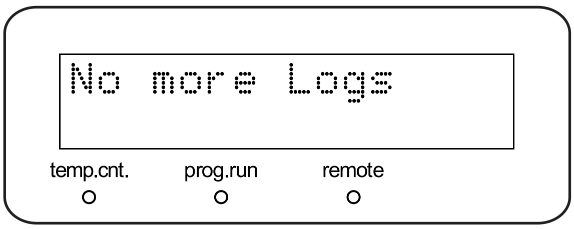
Shows the last 10 password changes and dates on which the parameters were initialized.
Press **enter** repeatedly to scroll through the operation log.




The screen to the right indicates that the password was changed on May 12th, 2008.

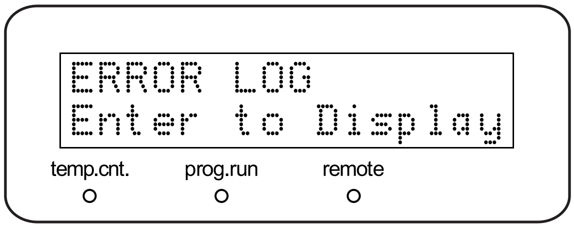



When the number of entries in the operation log is under 10, the screen shown to the right is displayed after the final log. Press **CE** to return to the relevant title screen.

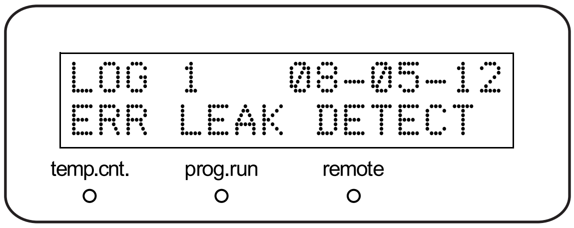


## ■ Showing the Error Log [ERROR LOG]

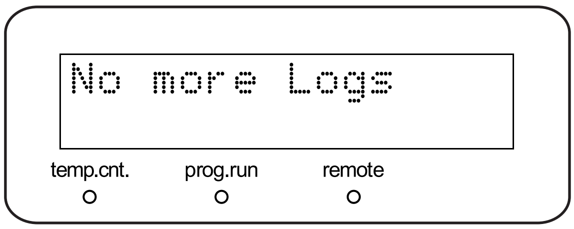
Shows the details of the last 10 errors and their dates of occurrence. Press **enter** repeatedly to scroll through the error log.




The screen to the right indicates that a leak check value error occurred on May 12th, 2008.

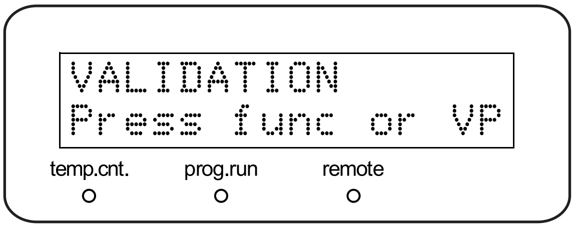



When the number of errors is under 10, the screen shown to the right is displayed after the final log. Press **CE** to return to the relevant title screen.



## 5.3.5 Validation Support Group

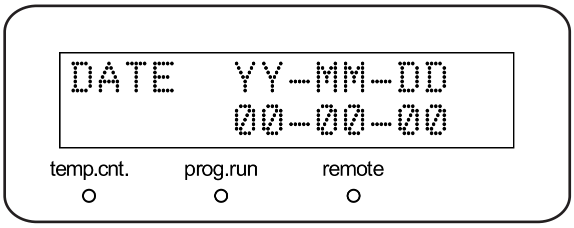
This is the group for checking whether this instrument is operating correctly or not.




### ■ Entering the Date [DATE]

Shows and enters the date. However, when the power is turned OFF the date is returned to the initial value of [00-00-00]. If the instrument is being controlled from a system controller, the date information is transferred from the system controller so the date cannot be changed.

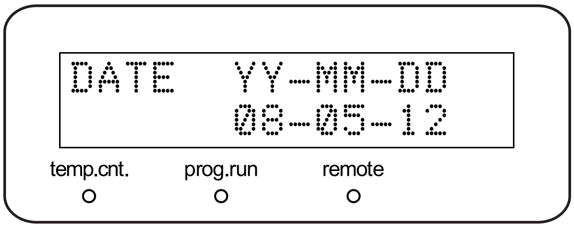
Date display






Example: Entering May 12th, 2008

**1** Make the entry in the order year, month, day of the month, from the numeric keys.
Enter the last two digits of the year, and enter the month and date in two-digit format.

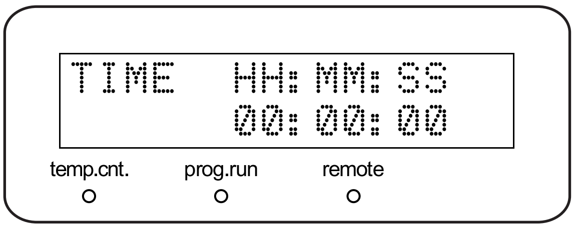



**2** Press **enter**.

### ■ Entering the Time [TIME]

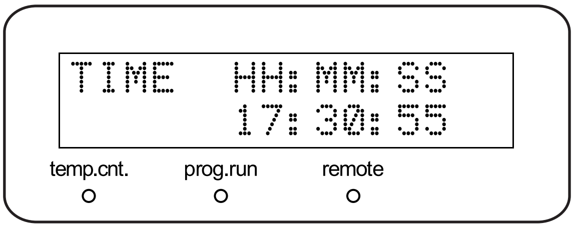
Shows and enters the time. However, when the power is turned OFF the time is returned to the initial value of [00:00:00]. If the instrument is being controlled from a system controller, the time information is transferred from the system controller so the time cannot be changed.

Time display



Example: Entering 5:30:55 pm

**1** Enter the time in the order hour, minute, second, from the numeric keys. The entry should be in the 24-hour system in the format "hour : minute : second".

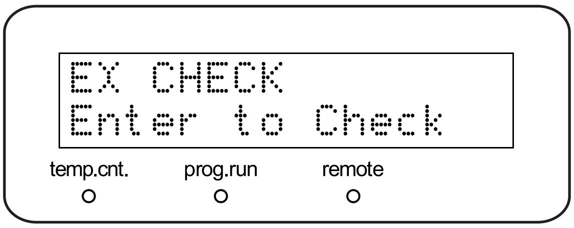



**2** Press **enter**.

## ■ Checking the Accuracy of the Excitation Wavelength [EX CHECK]

Check the accuracy of the excitation wavelength using the emission line from a low-pressure Hg (mercury) lamp.

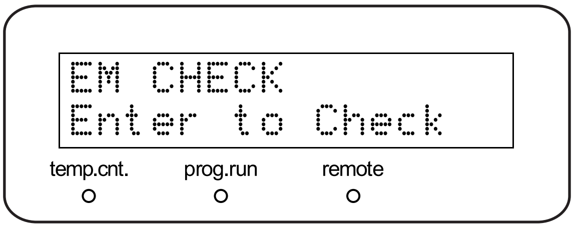
☞ "7.5.5 Checking Wavelength Accuracy" P.7-11




## ■ Checking the Accuracy of the Emission Wavelength [EM CHECK]

Check the accuracy of the emission wavelength using the emission line from a low-pressure Hg (mercury) lamp.

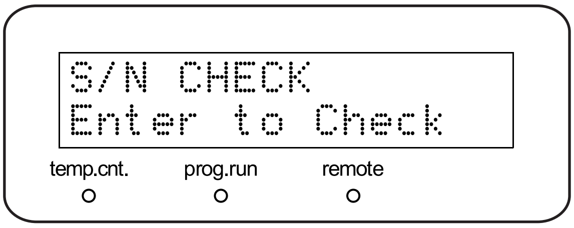
☞ "7.5.5 Checking Wavelength Accuracy" P.7-11




## ■ Performance Check by the Raman Spectrum of Water [S/N CHECK]

Check the sensitivity, S/N ratio and wavelength based on the raman spectrum of water.

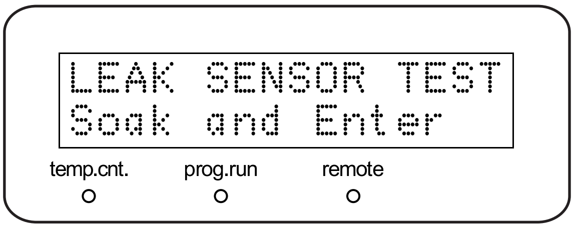
☞ "7.5.6 Inspecting a Performance Using the Raman Spectrum of Water" P.7-21




## ■ Checking the Leak Sensor [LEAK SENSOR TEST]

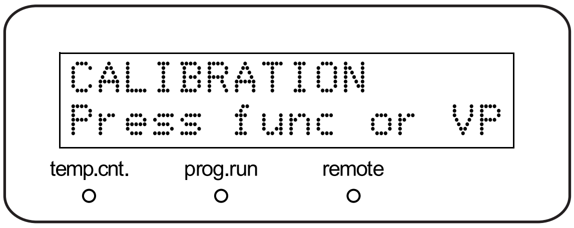
Check the operation of the leak sensor.

☞ "7.5.7 Checking the Leak Sensor" P.7-33



## 5.3.6 Calibration Support Group

This is the group for calibrating this instrument.

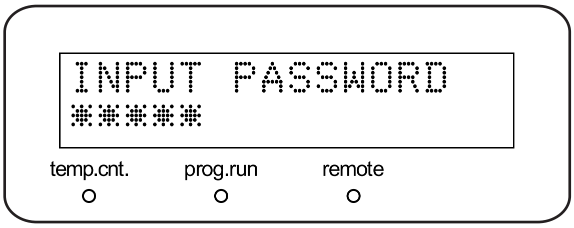



NOTE

The instrument is adjusted before leaving the factory. Do not change values unnecessarily.

### ■ Entering/Setting the Password [INPUT PASSWORD]

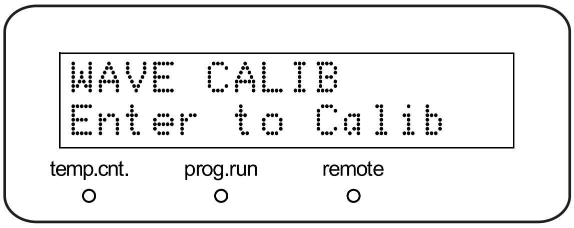
In order to prevent changes being made unnecessarily, a password has to be entered to change any of the items in the calibration group. If the password doesn't match, you cannot proceed to any setting screen. The password should be set and changed by the system administrator. Enter a 5-digit number with the numeric keys and press **enter**.




- Be sure to set a 5-digit number. The password on shipment is [00000].

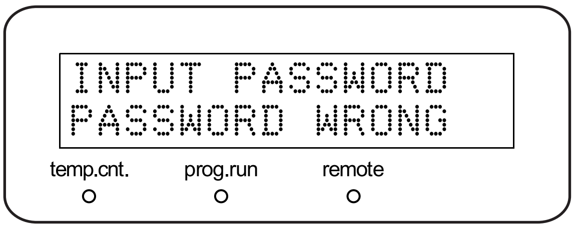
When the password matches, [WAVE CALIB] is displayed.

When the password matches:



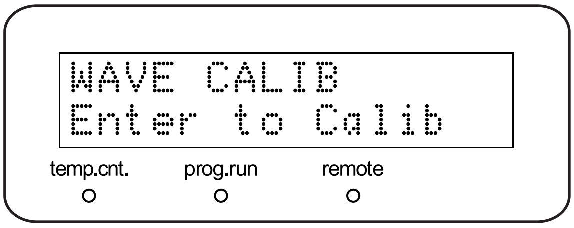

When the password doesn't match, the screen to the right is displayed and you cannot proceed to any setting screen.

When the password doesn't match:



## ■ Executing Wavelength Calibration [WAVE CALIB]

Performs wavelength calibration and a wavelength accuracy check automatically.



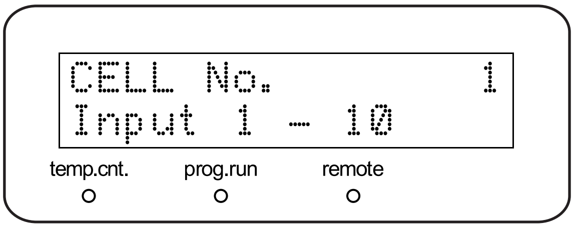

NOTE

When performing wavelength calibration on an RF-20A, fit the low-pressure Hg (mercury) lamp before starting wavelength calibration.

☞ "8.7 Performing Wavelength Calibration" P.8-39
"9.1.10 Fitting the Low-Pressure Hg (Mercury) Lamp (RF-20A Only)" P.9-37

1. Press **enter**.
   [CELL No.] will be displayed.

2. Enter the cell number set for the instrument with the numeric keys and press **enter**.
   The cell number of the flow cell unit provided with the instrument on shipping is set as [1].
   Wavelength calibration will start.
   ☞ "Setting the Cell Number [CELL No.]" P.5-31
   "5.9 Using the Spare Flow Cell Unit / Optional Cell" P.5-84
   "8.3 Disassembling the Flow Cell Unit and Cleaning/Replacing Each Part" P.8-11



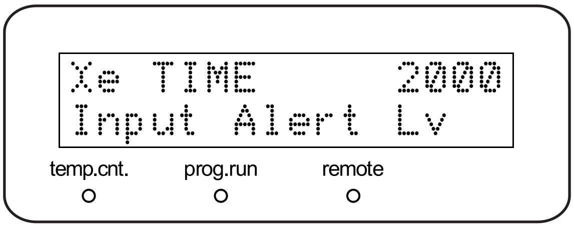

The time required for wavelength calibration is approximately 30 minutes. To discontinue the wavelength calibration, press **CE**.

☞ "8.7 Performing Wavelength Calibration" P.8-39

## ■ Setting the Replacement Alert Time for the Xenon Lamp [Xe TIME]

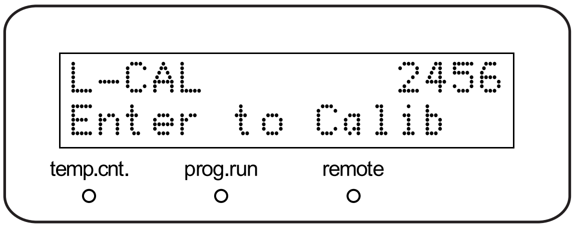
Set the replacement alert time for the Xenon lamp.
Enter the set value from the numeric keys and press **enter**.
The default value is [2000] hours.

| Setting Range (Units: hours) |
|---|
| 1 to 2000 |



## ■ Calibrating the Leak Sensor [L-CAL]

Calibrate the leak sensor.
While the leak sensor is dry, check that it is not in contact with the wall of the plastic panel, then turn the power to the instrument ON and, after at least 3 minutes have elapsed, press **enter**.

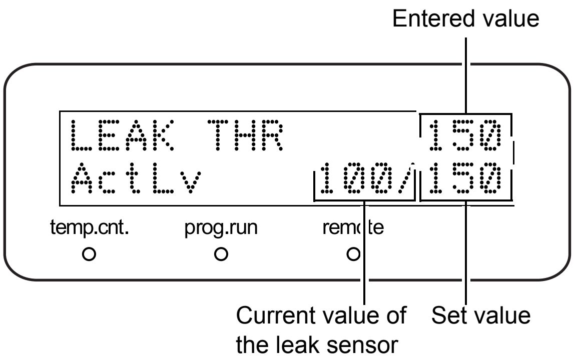



NOTE

Perform calibration when the leak sensor has been replaced.
When the leak sensor has been calibrated, re-set the leak sensor actuation level by following the procedure described next.

## ■ Setting the Leak Sensor Actuation Level [LEAK THR]

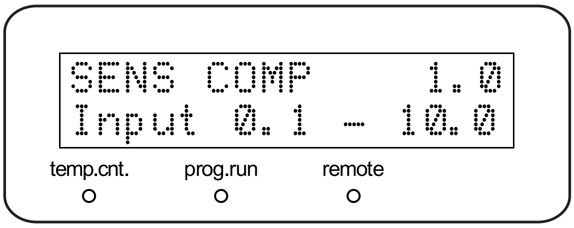
Set the actuation level (threshold value) of the leak sensor.
Enter the set value from the numeric keys and press **enter**. When the current value of the leak sensor exceeds the set value, a leak error occurs.
In the initial status, the value achieved by adjustment on shipment from the factory is set.




| Setting Range |
|---|
| 0 to 255 |

## ■ Setting the Sensitivity Compensation Coefficient [SENS COMP]

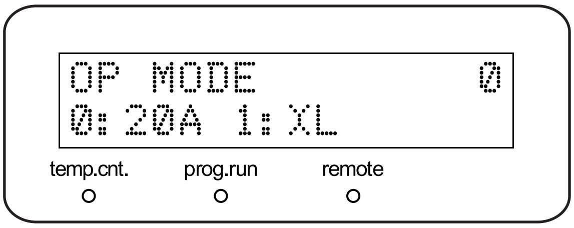
When multiple units of this instrument are used, set compensation coefficients to eliminate differences in the sensitivity of the individual units.
Enter the set value from the numeric keys and press **enter**.




| Setting Range |
|---|
| 0.1 to 10 (default value: 1) |

## ■ Selecting the Operation Mode [OP MODE]

Set the operation mode of the instrument according to the system controller that it is connected to.
Enter the set value from the numeric keys and press **enter**.
The default value is [0].

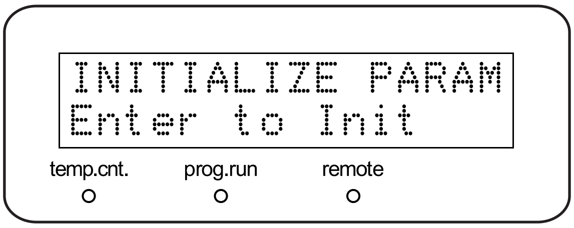



| Set Value | System Controller |
|---|---|
| 0 | Instrument controlled from a CBM-20A/ 20Alite. |
| 1 | Instrument controlled from an SCL-10Avp. (The instrument goes into the RF-10AXL compatibility mode and operates as an RF-10AXL.) |

"5.7.3 Notes on Operation" P.5-77

## ■ Initializing Parameters [INITIALIZE PARAM]

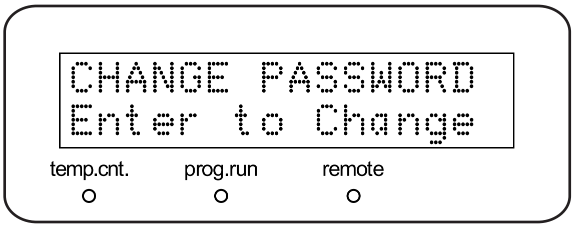
Initialize the set parameters, and the time programs.
Press **enter**.
The set parameters are returned to their default values and the time programs are deleted. A record is left in the operation log.



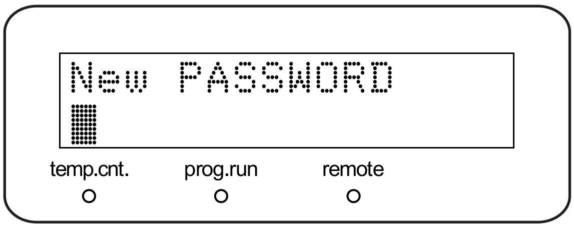
## ■ Changing the Password [CHANGE PASSWORD]

Change the password.

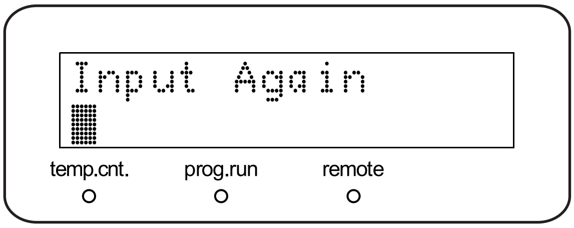
1. Press (**enter**).
   The password entry screen will be displayed.




2. Enter a 5-digit number with the numeric keys and press (**enter**).

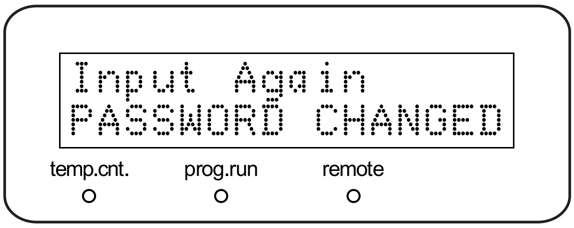



3. To confirm, enter the same password again.



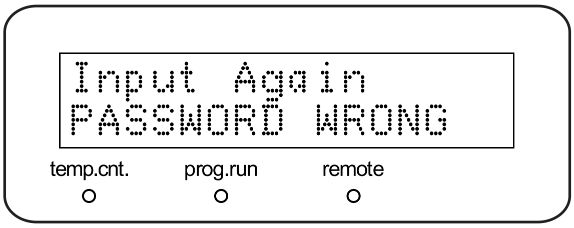

4. When the new password is registered, [PASSWORD CHANGED] appears.

When the password matches:




If you make a mistake when entering the password, [PASSWORD WRONG] appears. In this case the password doesn't change.

When the password doesn't match:




5. Press (**enter**) to return to the relevant title screen.

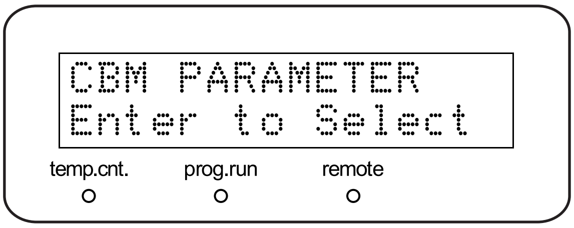
NOTE

Keep a record of the changed password so that you will not forget it.

## ■ Showing/Setting CBM Parameters [CBM PARAMETER]

This item is shown when the instrument is connected to a CBM-20A/20Alite.

On pressing **enter** the items described in "5.3.7 Showing and Setting CBM Parameters (Calibration Support Group)" P.5-49 are displayed and can be set.



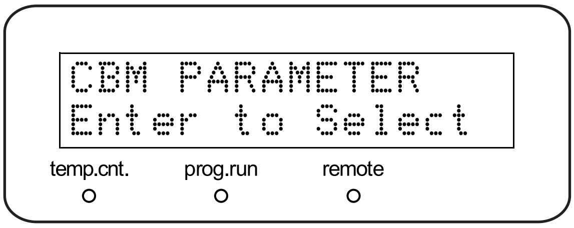
## 5.3.7 Showing and Setting CBM Parameters (Calibration Support Group)

This is the procedure for showing and setting the parameters of the CBM-20A/20Alite that controls the instrument.

Press **enter** to go to the CBM parameter setting screen.

Press **func** or **back** repeatedly to select the item to be set.

Pressing **CE** while any item is selected returns you to the screen on the right.






NOTE

If the instrument is not connected to a CBM-20A/20Alite or has been set to the local mode, the CBM parameter setting screen will not be displayed even on pressing **enter**.

### List of CBM Parameters

| | |
|---|---|
| SERIAL NUMBER | To show the serial number of the CBM. |
| S/W ID | To show the program version number of the CBM. |
| INTERFACE | To set the transmitting protocol for communications with the data processing unit. |
| ETHERNET SPEED | To set the Ethernet communications speed. *1 |
| USE GATEWAY | To set whether the default gateway is used or not. *1 |
| IP ADDRESS | To set the IP address of the CBM. *1 |
| SUBNET MASK | To set the subnet mask. *1 |
| DEFAULT GATEWAY | To set the default gateway. *1*2 |
| TRS MODE | To make the communication settings when serial transmissions are used. |

*1 If changes not allowed at the CBM-20A/20Alite, these parameters can only be shown, not changed.
*2 Cannot be set if [0] (the default gateway is not used) is set.

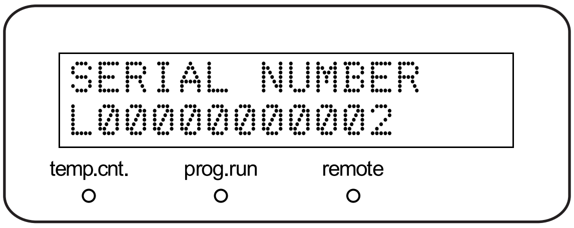
NOTE

The set parameters take effect when the CBM has been restarted.
Refer to the CBM-20A/20Alite instruction manual for details on each parameter.

## ■ Showing the Serial Number [SERIAL NUMBER]

Shows the serial number of the CBM that controls the instrument.

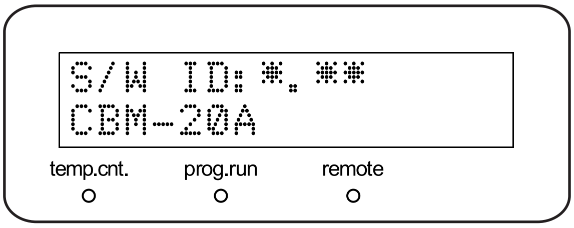
With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The serial number of the CBM-20A/20Alite is shown on the second line.




## ■ Showing the Software Version Number [S/W ID]

Shows the name (the same as the model name) and version of the software of the CBM that controls the instrument.

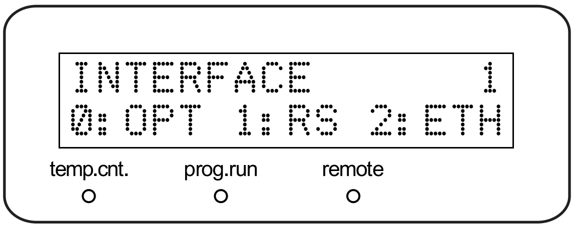
With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The first line shows the program version number and the second line shows the name of the system controller.




## ■ Setting the Transmitting Protocol for Communications with the Data Processing Unit [INTERFACE]

Set the transmitting protocol for communications between the CBM that controls this instrument and the data processing unit.

**1** With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The first line shows the current set value.



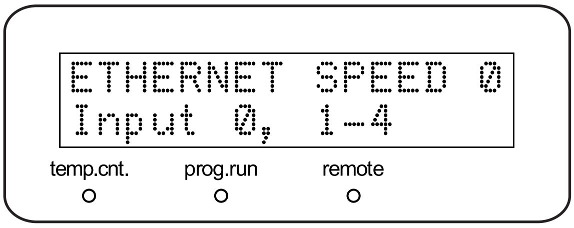

**2** Enter the set value from the numeric keys and press **enter**.

| Set Value | Transmitting Protocol |
|---|---|
| 0 | Connection by optical cable |
| 1 | Connection through serial transmission (RS-232C) |
| 2 | Connection by Ethernet |

## ■ Setting the Ethernet Communications Speed [ETHERNET SPEED]

Set the communications speed for the Ethernet network of the CBM that controls this instrument.

**1** With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The first line shows the current set value.




**2** Enter the set value from the numeric keys and press **enter**.

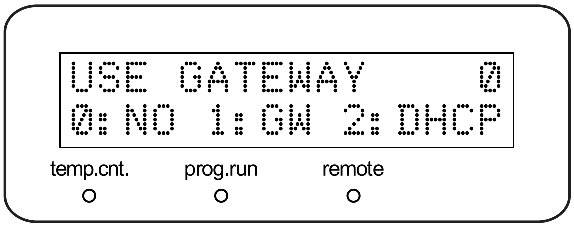
| Set Value | Communications Speed |
|---|---|
| 0 | Automatically recognized |
| 1 | 10 Mbps, Half Duplex |
| 2 | 10 Mbps, Full Duplex |
| 3 | 100 Mbps, Half Duplex |
| 4 | 100 Mbps, Full Duplex |



## ■ Setting Use/Non-Use of the Default Gateway [USE GATEWAY]

Set whether or not the default gateway of the CBM that controls this instrument is used.

**1** With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The first line shows the current set value.



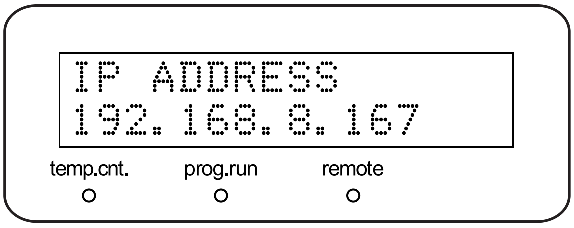

**2** Enter the set value from the numeric keys and press **enter**.

| Set Value | Default Gateway |
|---|---|
| 0 | The default gateway is not used. |
| 1 | The default gateway is used. |
| 2 | The DHCP server is used. |

## ■ Setting the IP Address [IP ADDRESS]

Set the IP address of the CBM that controls this instrument.

**1** With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The second line shows the current set value.




**2** Enter the set value from the numeric keys and press **enter**.

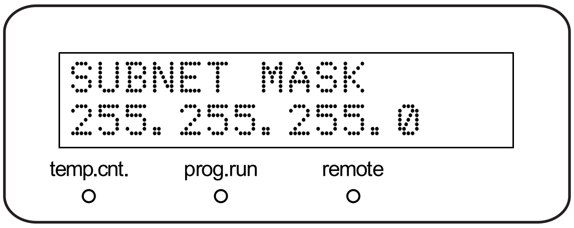
NOTE

Consult the network administrator about the set value.

## ■ Setting the Subnet Mask [SUBNET MASK]

Set the subnet mask of the CBM that controls this instrument.

**1** With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The second line shows the current set value.




**2** Enter the set value from the numeric keys and press **enter**.

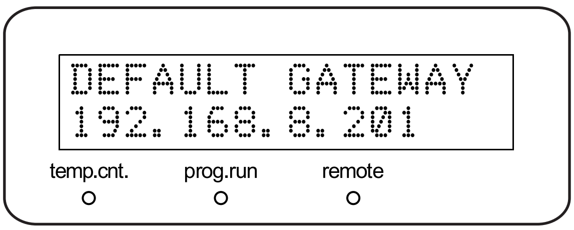
NOTE

Consult the network administrator about the set value.

## ■ Setting the Default Gateway [DEFAULT GATEWAY]

Set the default gateway of the CBM that controls this instrument.

**1** With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The second line shows the current set value.



**2** Enter the set value from the numeric keys and press **enter**.

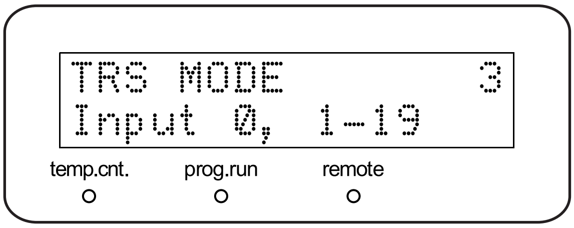
NOTE

Consult the network administrator about the set value.

## ■ Setting Serial Transmission [TRS MODE]

Make the settings to be used for serial transmission of the CBM that controls this instrument.

**1** With the [CBM PARAMETER] title screen displayed, repeatedly press **func** until the screen to the right appears.
The first line shows the current set value.






**2** Enter the set value from the numeric keys and press **enter**.

| Set Value | Meaning |
|---|---|
| 0 | Communications settings are not changed (default values). |
| 1 | Not usable (reserve) |
| 2 | Connected to CLASS-VP |
| 3 | Connected to LCsolution |
| 4 to 10 | Not usable (reserve) |
| 11 | Connected to C-R8A |
| 12 | Connected to C-R7A/C-R5A |
| 13 | Connected to C-R4A |
| 14 | Connected to C-R6A (without expansion ROM board) |
| 15 | Connected to C-R6A (with expansion ROM board) |
| 16 to 19 | Not usable (reserve) |

# 5.4 Creating Time Programs

This instrument sets parameters such as wavelength, response, output range and so on, and these are executed by a time program. The created time program is saved when the power is turned OFF.

## 5.4.1 List of Commands That Can Be Used in Time Programs

| Command | Operation | Function | Setting Range | | Page |
|---|---|---|---|---|---|
| | | | RF-20A/20Axs | In RF-10AXL Compatibility Mode | |
| XCH1 | Numeric keys | To set the excitation wavelength for channel 1. | 0, 200 to 900 nm | | P.5-16 |
| XCH2 | Numeric keys | To set the excitation wavelength for channel 2 (only in the dual wavelength mode). | 200 to 900 nm | Cannot be set | P.5-16 |
| MCH1 | Numeric keys | To set the emission wavelength for channel 1. | 0, 200 to 900 nm | | P.5-16 |
| MCH2 | Numeric keys | To set the emission wavelength for channel 2 (only in the dual wavelength mode). | 200 to 900 nm | Cannot be set | P.5-16 |
| ZERO | enter key | To zero-adjust the recorder. | – | | P.5-24 |
| MARK | enter key | To set marking at recorder output. | – | | P.5-25 |
| RNG1 | Numeric keys | To set the output range for analog output connector 1. | 0 to 9 | Cannot be set | P.5-22 |
| RNG2 | Numeric keys | To set the output range for analog output connector 2. | 0 to 9 | | P.5-23 |
| RESP | Numeric keys | Set the response. | 0: (without filter)<br>1: 0.05 sec<br>2: 0.1 sec<br>3: 0.5 sec<br>4: 1.0 sec<br>5: 1.5 sec<br>6: 3.0 sec<br>7: 6.0 sec<br>8: 8.0 sec<br>9: 10.0 sec<br>10: 2.0 sec | 1: 0.1 sec<br>2: 0.5 sec<br>3: 1.5 sec<br>4: 3.0 sec | P.5-18 |
| SENS | Numeric keys | To set the sensitivity. | 1: HIGH<br>2: MED<br>3: LOW | | P.5-19 |
| GAIN | Numeric keys | To set the gain. | 1: × 1<br>2: × 4<br>3: × 16 | | P.5-19 |

| Command | Operation | Function | Setting Range | | Page |
|---|---|---|---|---|---|
| | | | RF-20A/20Axs | In RF-10AXL Compatibility Mode | |
| SCAN | Numeric keys | To execute spectrum scanning and save the data in the specified file number. | 0 to 2 | | P.5-26 |
| EVNT | Numeric keys | To set the operation of the EVENT output terminal. | 0: OFF<br>1: Sets EVENT1 to ON<br>2: Sets EVENT2 to ON<br>12: Sets EVENT1 and EVENT2 to ON | 0: OFF<br>1: Sets EVENT1 to ON | P.5-25 |
| LOOP | Numeric keys | To set the number of repetitions of the time program (only when the instrument is used in isolation). | 0 to 255 times ([0] indicates 256 times) | | P.5-59 |
| STOP | enter key | To terminate the time program. | – | | P.5-60 |
| LAMP | Numeric keys | To turn the lamp off. | 0: OFF | | P.5-17 |
| CELT | Numeric keys | To set the flow cell temperature (RF-20Axs only). | 0: OFF<br>4 to 40 °C | Cannot be set | P.5-17 |

* The entry in the "Operation" column indicates the following types of operation.

enter key : Press enter to set the relevant function.

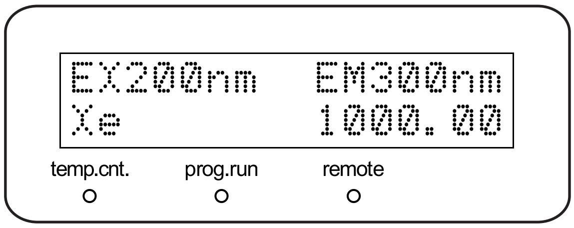
Numeric keys : Press • - 9 to enter a value, then press enter to confirm the value.

## 5.4.2 Time Program Edit Screen

When creating a time program, set the necessary parameters on the time program edit screen.

**1** Press (CE).

The initial screen will be displayed.

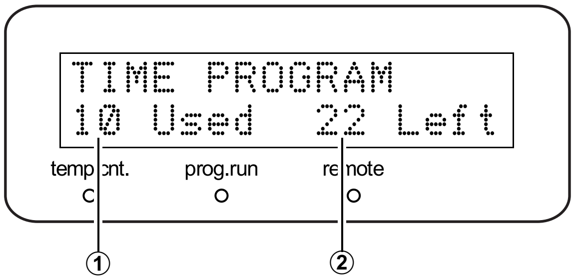



**2** Press (edit).

The number of steps in the time program will be displayed.

① Number of steps already set

② Number of remaining steps




This example shows that 10 steps have been set in the time program and there are 22 steps left.

**3** Press (enter).

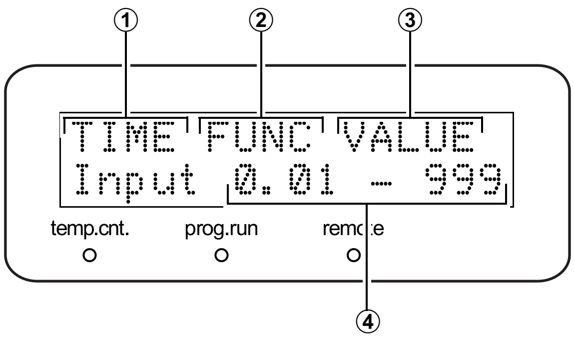
The time program edit screen appears.

① Time lapse (minutes) from time program start to execution of the command

② Name of command being executed

③ Set value

④ Setting range




"Example of Creation of a Time Program" P.5-57

## ■ Example of Creation of a Time Program

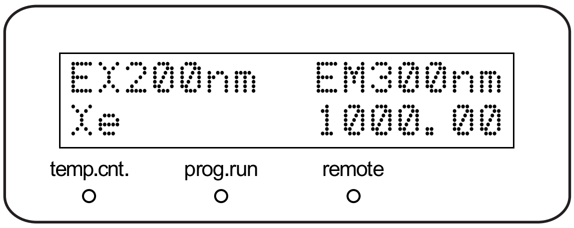
Shown here is an example where spectrum scanning is executed 5 minutes after the time program starts, the data is saved in file 2, and the time program is terminated after 10 minutes.

| Step | TIME (Minutes) | Command | Set Value |
|---|---|---|---|
| 1 | 5.0 | SCAN | 2 (specifies the file number in which the data is saved) |
| 2 | 10 | STOP | – |

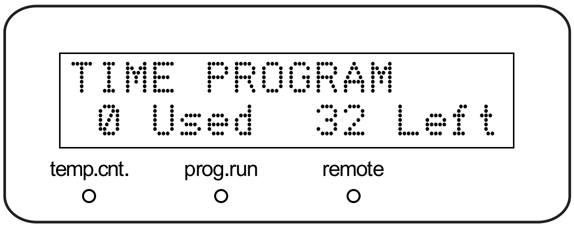
NOTE

- When multiple steps are set they are automatically re-ordered, so there is no need to set them in chronological sequence.
- Except when running the time program endlessly, set [STOP] at the end of the program.
- Pressing **back** at command selection displays the previous command.

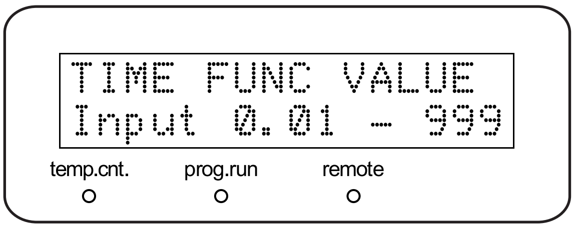
**1** Press **CE**.
The initial screen will be displayed.




**2** Press **edit**.
The screen showing the number of time program steps will be displayed.

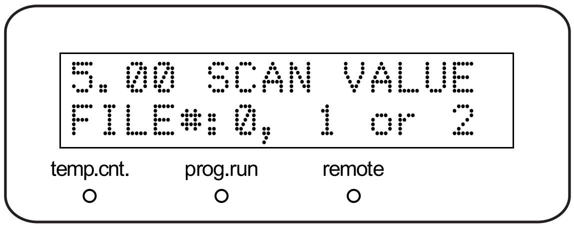



**3** Press **enter**.
The screen for setting [TIME] will be displayed.

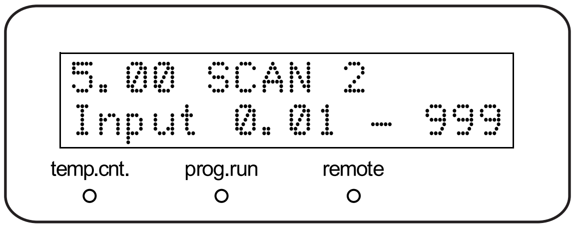



**4** Press **5** and **enter**.

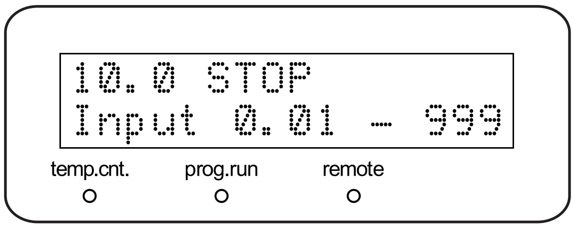
**5** Press (func) repeatedly until [SCAN] is displayed, then press (enter).




**6** Press (2) and (enter).
[SCAN] is executed 5 minutes after the time program starts and the data is saved in file number 2.




**7** Press (1), (0) and (enter).




**8** Press (func) repeatedly until [STOP] is displayed.

**9** Press (enter).
10 minutes after the time program started, the program stops.

**10** Press (CE).
This completes time program creation.

**11** Press (CE).
The time program is saved and you are returned to the initial screen.

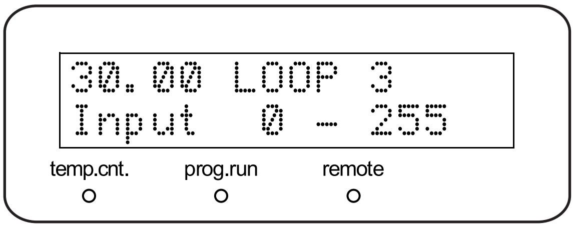
This procedure allows you to create a 2-step time program.

## Setting multiple steps:

Before setting [STOP], repeat steps 4 to 6 the number of times corresponding to the number of steps to set the time and command.

## 5.4.3 Setting the Loop Count of the Program [LOOP]

By setting [LOOP], the time program can be repeated the set number of times.




When the settings in the table to the right are made, steps 1 and 2 are repeated 3 times in a 30-minute cycle. Set [LOOP] at the very end of the program.

| Step | TIME | FUNC | VALUE |
|---|---|---|---|
| 1 | 15.00 | XCH1 | 210 |
| 2 | 20.00 | XCH1 | 220 |
| 3 | 30.00 | LOOP | 3 |

NOTE

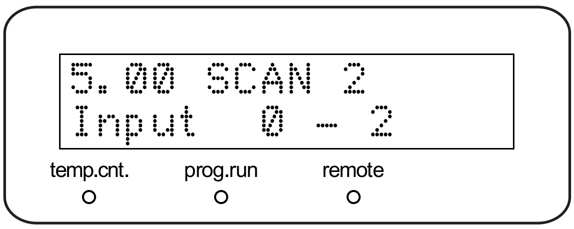
- Values of up to 255 can be set for the [LOOP] command. Note that when [0] is set, the program will be repeated 256 times.
- If any time program is set after the [LOOP] command, it will not be executed. The time program stops at the point where the [LOOP] command ends.

## 5.4.4 Deleting Steps

Delete unnecessary steps from a time program.

**1** Display the step that you want to delete.

∗ If deleting the second or a later step, repeatedly press **enter** until the step that you want to delete appears.




**2** Press **del**.

The displayed step is deleted.

If the next step is set, that step is displayed.

## 5.4.5 Starting a Time Program

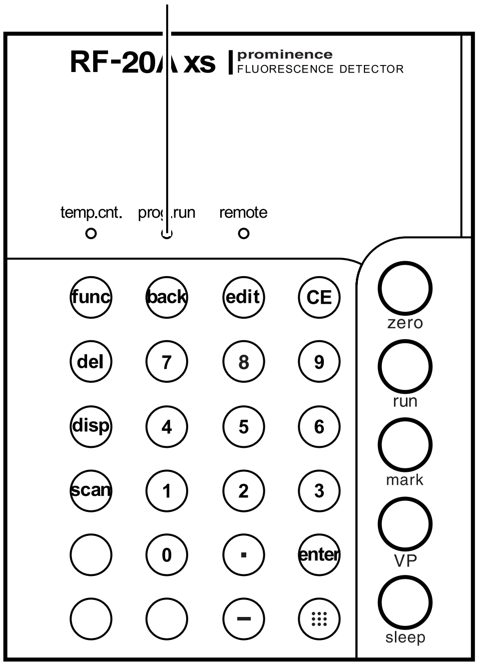
There are the following two methods for starting a time program.

- Press run.
- Input contact signals to the external input/output terminals.

  "5.8 Connection to External Input/Output Terminals" P.5-81

The time program indicator on the display panel will come on and the time program will start.

Time program indicator




NOTE

If set values are changed during the execution of a time program, the values after the changes will be applied only up until the time program ends. After the time program has ended, the settings made before the execution of the time program will be reinstated.

## 5.4.6 Stopping a Time Program [STOP]

There are the following three methods for stopping a time program.

- Press run during the execution of the time program to forcibly end it.
- Send contact signals to the external input/output terminals during the execution of the time program to forcibly end it.

  "5.8 Connection to External Input/Output Terminals" P.5-81
- Insert a [STOP] command in the time program.

  "Example of Creation of a Time Program" P.5-57

# 5.5 Measuring in the Spectrum Scanning Mode

This instrument features a spectrum scanning function to find the optimum excitation wavelength and emission wavelength. Two sample spectra and one background spectrum can be read. Executing spectrum scanning also makes it possible to ascertain the overall characteristics of a sample.

NOTE

In order to reduce the effects of fluctuations in excitation light intensity, this instrument outputs signals where the emission light intensity has been divided by the excitation light intensity (division correction), but this division correction is not applied on measurement of the excitation wavelength spectrum. This is because the excitation wavelength spectrum that has not been subjected to division correction shows excitation wavelengths with a higher detection limit.

5

## 5.5.1 Flow Line for Spectrum Scanning

In order to ensure that the liquid inside the cell doesn't move during spectrum scanning, a high-pressure 6-port valve is used as shown in the figure below.

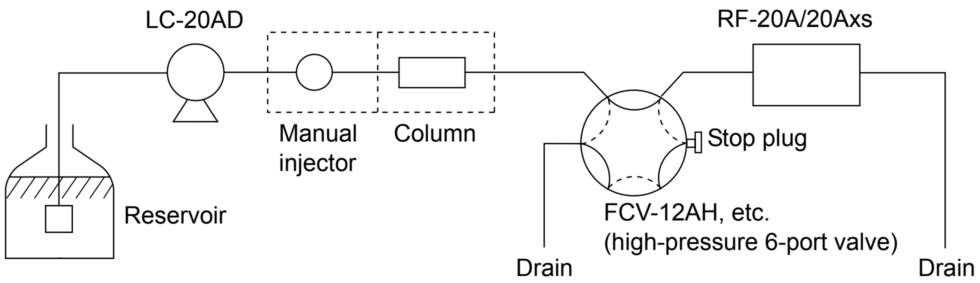



Fig. 5.1

The 6-port valve normally takes the positions indicated with solid lines as the flow line. Before starting spectrum scanning the flow line is switched to the positions shown with dotted lines, stopping flow (pumping). The method described in "Stopping the pump on reaching the peak" can also be used as a simple method for stopping the flow (pumping), but since the flow (pumping) doesn't stop immediately on stopping the pump, this time lapse has to be factored in.

NOTE

During pumping set the drain valve to the "open" position and don't stop the flow. This could shorten the life of the column as a result of pressure shock.

Follow the procedure from the next section onward to set the parameters required for spectrum scanning.

## 5.5.2 Overview of Spectrum Measurement

Spectrum measurement is carried out in accordance with the flow shown below. Details of each step are explained on the reference pages.

### ■ Setting the Spectrum Scanning Conditions

| Operation Details | Command | Page |
|---|---|---|
| Selecting whether the excitation side or the emission side is to be scanned | Control settings group<br>[SPC TYPE] | P.5-63 |
| Setting the scan start wavelength and scan end wavelength | Control settings group<br>[EX SCAN] or [EM SCAN] | P.5-64 |
| Wavelength setting<br>When scanning the excitation side, set a wavelength that emits fluorescent light for the emission side, and when scanning the emission side, set a wavelength that absorbs excitation light for the excitation side. | Control settings group<br>[ch1 EX*** EM***] | P.5-65 |
| Scan speed setting | Control settings group<br>[SCAN SPEED] | P.5-66 |

### ■ Setting Other Measurement Conditions

| Operation Details | Command | Page |
|---|---|---|
| Setting the measurement range (setting sensitivity and gain) | Parameter settings group<br>[SENS] or [GAIN] | P.5-67<br>P.5-68 |
| Setting the flow cell temperature (for RF-20Axs) | Parameter settings group<br>[CELL TEMP] | P.5-69 |

### ■ Measuring the Mobile Phase Spectrum

| Operation Details | Command | Page |
|---|---|---|
| Setting the scan file for background use<br>(SCAN FILE: 0) | Control settings group<br>[SCAN FILE] | P.5-70 |
| Measuring the spectrum of the mobile phase | scan key | P.5-72 |

### ■ Measuring the Spectrum of a Sample

| Operation Details | Command | Page |
|---|---|---|
| Setting the scan file for sample use<br>(SCAN FILE: 1 or 2) | Control settings group<br>[SCAN FILE] | P.5-72 |
| Measuring the spectrum of a sample | scan key | P.5-72 |

### ■ Outputting Spectrum Data

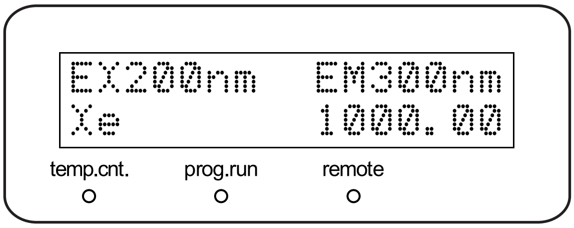
| Operation Details | Command | Page |
|---|---|---|
| Setting the plot speed | Control settings group<br>[PLOT SPD] | P.5-73 |
| Selecting the spectrum file to be output | Control settings group<br>[SCAN FILE] | P.5-73 |
| Executing plotting | Control settings group<br>[SPC PLOT] | P.5-73 |

## 5.5.3 Setting the Scan Type

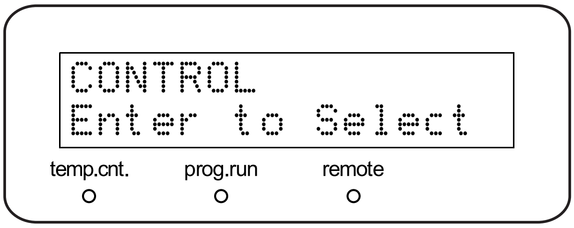
Set whether to use the excitation or emission scanning in spectrum scanning. The details of scan type settings are given in the table below.

| Set Value | Setting |
|---|---|
| 1 | EX (excitation scanning) |
| 2 | EM (emission scanning) |

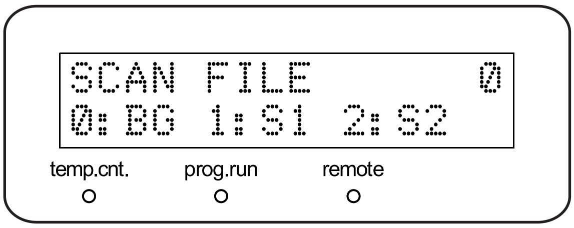
**1** Press **CE**.
The initial screen will be displayed.



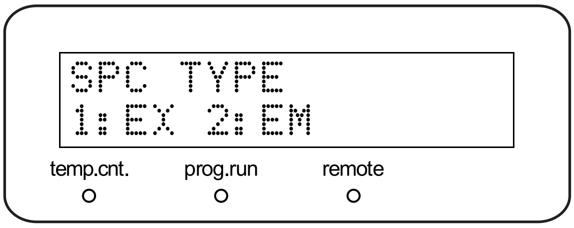

**2** Press **func** twice.
[CONTROL] will be displayed.




**3** Press **enter**.
[SCAN FILE] will be displayed.




**4** Press **func**.
[SPC TYPE] will be displayed.




**5** Enter the set value from the numeric keys and press **enter**.
This sets the scan type.

## 5.5.4 Setting the Start Wavelength and End Wavelength

Set the start wavelength and end wavelength for spectrum scanning.
If [1] (excitation scanning) was set in "5.5.3 Setting the Scan Type" P.5-63 the excitation wavelength is set, and if [2] (emission scanning) was set the emission wavelength is set. If [1] (excitation scanning) was set, [EX SCAN] is displayed. If [2] (emission scanning) was set, [EM SCAN] is displayed. The setting ranges for each wavelength are as follows.

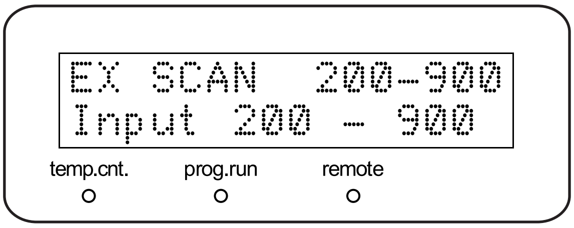
| Wavelength | Setting Range (Units: nm) | |
|---|---|---|
| | Start Wavelength | End Wavelength |
| EX (excitation wavelength) | 200 to 900 | 200 to 900 |
| EM (emission wavelength) | 200 to 900 | 200 to 900 |

**1** Press **func** repeatedly until [EX SCAN] or [EM SCAN] in the control settings group is displayed.

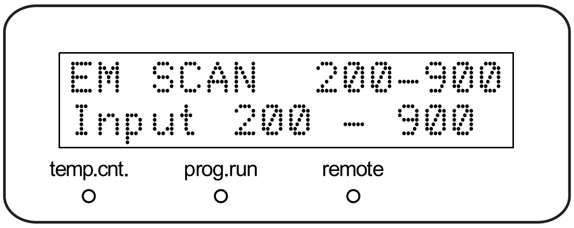
* If [1] was set for the scan type display [EX SCAN], and if [2] was set for the scan type display [EM SCAN].

☞ "5.5.3 Setting the Scan Type" P.5-63

Excitation wavelength setting screen




Emission wavelength setting screen




**2** In the initial status, the start wavelength can be entered.
Enter the start wavelength with the numeric keys and press **enter**.
It will now become possible to enter the end wavelength.

**3** Enter the end wavelength with the numeric keys and press **enter**.

## 5.5.5 Setting the Excitation Wavelength and Emission Wavelength

Set the excitation and emission wavelengths for spectrum scanning. If [1] (excitation scanning) was set in "5.5.3 Setting the Scan Type" P.5-63 the emission wavelength is set, and if [2] (emission scanning) was set the excitation wavelength is set.

The setting ranges for the wavelengths are as follows.

| Wavelength | Setting Range (Units: nm) |
|---|---|
| EX (excitation wavelength) | 0, 200 to 900 |
| EM (emission wavelength) | 0, 200 to 900 |

NOTE

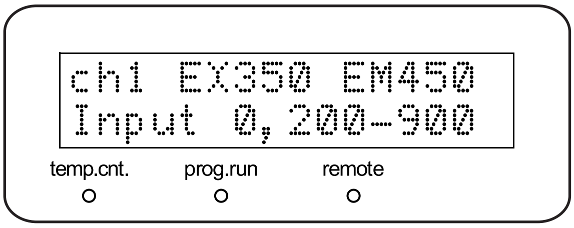
When this setting is changed, the wavelength for channel 1 in the parameter settings group is also changed.

"Setting the Wavelength for Channel 1 [ch1]" P.5-16



**1** Press **func** repeatedly until [ch1] in the control settings group is displayed.

∗ In the initial status, the screen shows the value set in "Setting the Wavelength for Channel 1 [ch1]" P.5-16.




**2** Enter the wavelength with the numeric keys and press **enter**.

The wavelengths will be set.

∗ If [1] was set for the scan type in [SPC TYPE] setting the emission wavelength is set, and if [2] was set the excitation wavelength is set.

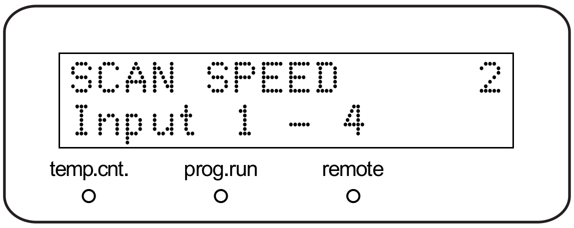
"5.5.3 Setting the Scan Type" P.5-63

### 5.5.6 Setting the Scan Speed

Set the scan speed for spectrum scanning. Details of the scan speed settings are given below.

| Set Value | Scan Speed |
|---|---|
| 1 | SUPER (3000 nm/minute) |
| 2 | FAST (600 nm/minute) |
| 3 | MEDIUM (120 nm/minute) |
| 4 | SLOW (24 nm/minute) |

**1** Press **func** repeatedly until [SCAN SPEED] in the control settings group is displayed.




**2** Enter the set value from the numeric keys and press **enter**.
This sets the scan speed.

## 5.5.7 Setting Sensitivity

This is the procedure for setting sensitivity. By combining the setting of sensitivity and gain, you can set the measuring range.

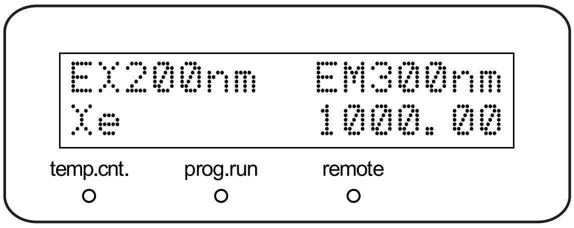
☞ "4.1.8 Setting Sensitivity" P.4-17

The settings for sensitivity are shown below. On shipping from the factory, the setting is [2] (MED).

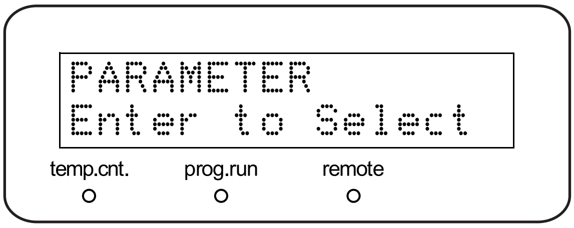
| Set Value | Sensitivity | Sensitivity Magnifications |
|---|---|---|
| 1 | HIGH | Approx. × 1 |
| 2 | MED | Approx. × 32 |
| 3 | LOW | Approx. × 1024 |



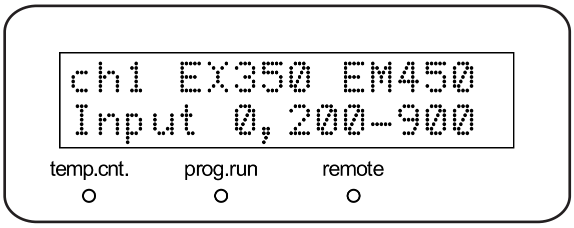
**1** Press **CE**.
The initial screen will be displayed.



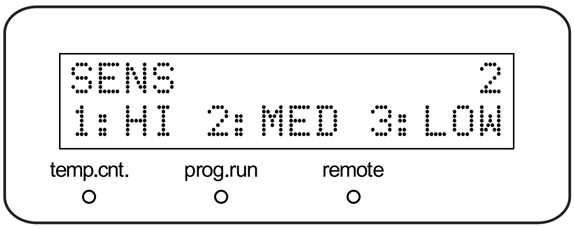

**2** Press **func**.
[PARAMETER] will be displayed.




**3** Press **enter**.
[ch1] will be displayed.




**4** Press **func** repeatedly until [SENS] is displayed.




**5** Enter the set value from the numeric keys and press **enter**.
This sets the sensitivity.

## 5.5.8 Setting Gain

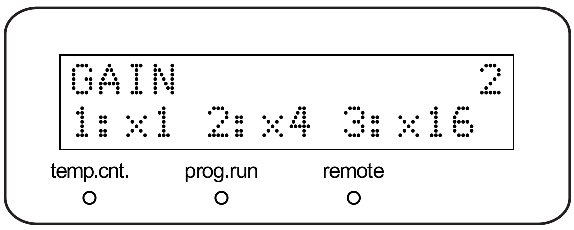
This is the procedure for setting gain. By combining the setting of sensitivity and gain, you can set the measuring range. The settings for gain are shown below.

| Set Value | Gain |
|---|---|
| 1 | $\times$ 1 |
| 2 | $\times$ 4 |
| 3 | $\times$ 16 |

The combinations of sensitivity and gain are shown below.

| Sensitivity | Gain | Sensitivity Magnifications |
|---|---|---|
| 3 (LOW) | 1 | Approx. $\times$ 1 |
| | 2 | Approx. $\times$ 4 |
| | 3 | Approx. $\times$ 16 |
| 2 (MED) | 1 | Approx. $\times$ 32 |
| | 2 | Approx. $\times$ 128 |
| | 3 | Approx. $\times$ 512 |
| 1 (HI) | 1 | Approx. $\times$ 1024 |
| | 2 | Approx. $\times$ 4096 |
| | 3 | Approx. $\times$ 16384 |

**1** Press **func** repeatedly until [GAIN] in the parameter settings group is displayed.




**2** Enter the set value from the numeric keys and press **enter**.
This sets the gain.

## 5.5.9 Setting the Flow Cell Temperature (RF-20Axs Only)

Set the temperature of the flow cell.

The fluorescent intensity of the sample varies depending on its temperature. In order to obtain stable analysis results unaffected by the ambient temperature, the temperature of the sample in the flow cell is fixed at all times.

Since condensation may occur in the vicinity of the flow cell depending on the ambient humidity if the temperature of the flow cell goes below the flow cell's ambient temperature, it is made impossible to cool the flow cell more than 10 °C below the ambient temperature. If the ambient temperature rises to more than 10 °C higher than the set temperature, [LOW SET TEMP] is displayed on the display screen every 60 minutes and it may not be possible to obtain normal analysis results.

NOTE

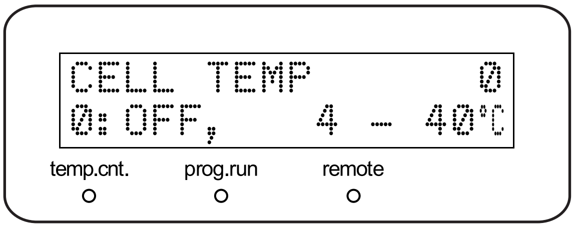
- The guide for the set temperature of the flow cell is the same temperature as the instrument's ambient temperature.
- The current ambient temperature can be checked at [ROOM TEMP].

☞ "Displaying the Ambient Temperature [ROOM TEMP] (RF-20Axs Only)" P.5-33

The setting range for flow cell temperature is shown below.

| Set Value | Setting |
|---|---|
| 0 | The temperature is not adjusted. |
| 4 to 40 °C | The temperature is adjusted to the set value. |

**1** Press **func** repeatedly until [CELL TEMP] in the parameter settings group is displayed.




**2** Enter the set value from the numeric keys and press **enter**.

This sets the temperature of the flow cell.

## 5.5.10 Setting the Scan File

This instrument can save two sample spectra and one background spectrum.
First of all, set the file number of the file in which the scan data is to be saved. Details of the file number settings are given below.

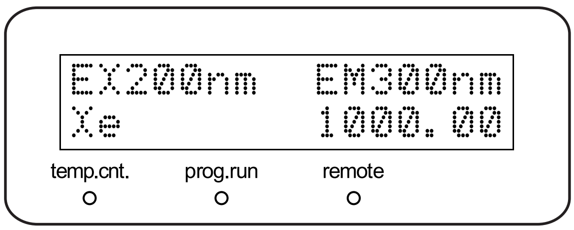
| File Number | Setting |
|---|---|
| 0 | For background spectra |
| 1 | For sample spectra |
| 2 | |

In spectrum scanning, first the mobile phase is scanned and the data acquired is saved in file number [0].
After that the sample is scanned and the data from this scan is saved in file number [1] or [2].
After measurement has ended, by outputting after subtracting the mobile phase scan data from the sample scan data, the spectrum of the sample can be ascertained (differential spectrum measurement).

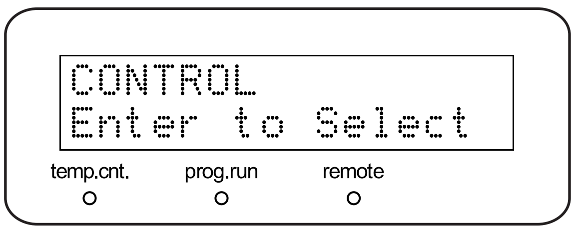
NOTE

- No subtraction is involved in display and output during measurement.
- When scan data is output after measurement, the background spectrum is subtracted from the sample spectrum and the result is output. First of all, in the state where the mobile phase has filled the flow cell, specify [0] as the file number and execute a scan.
- If differential spectrum measurement is not necessary, specify file number [0] at sample measurement.

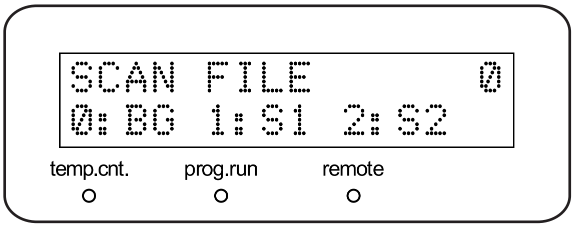
**1** Press **CE**.
The initial screen will be displayed.




**2** Press **func** twice.
[CONTROL] will be displayed.



**3** Press (enter).
[SCAN FILE] will be displayed.

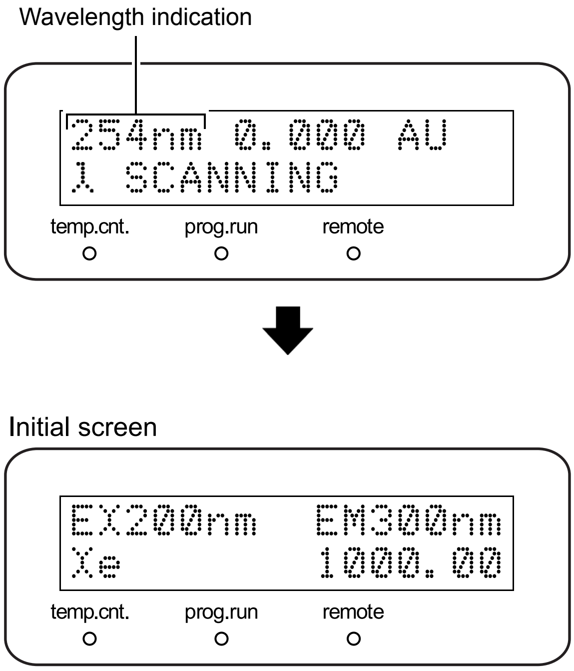



**4** Enter ( 0 ) and press (enter).
The file number of the file in which the scan data is to be saved is set as [0] (background).

**5** Press ( CE ) twice.
Scan file setting ends and you are returned to the initial screen.

## 5.5.11 Measuring Procedure

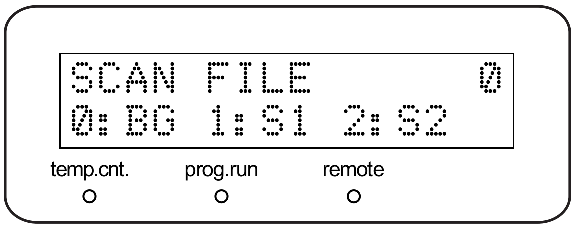
**1** Press scan while the flow cell is full of mobile phase.
Spectrum scanning will start.
During spectrum scanning the screen to the right is displayed and the wavelength in the first line is updated sequentially.
When spectrum scanning has proceeded from the start wavelength to the end wavelength, scanning stops and the initial screen is displayed.




**2** Pour in the sample.

**3** Stop flow into the cell at the point where the target peak has been eluted out.

**4** Once the baseline has stabilized, display [SCAN FILE] in the control settings group and press 1 or 2.




**5** Press scan.
Spectrum scanning will start.

NOTE

- Do not change the scanning conditions (start wavelength, end wavelength, scan speed, etc.) between the background ([SCAN FILE] = 0) and the sample ([SCAN FILE] = 1, 2). This will mean that correct spectrum data cannot be obtained.
- In gradient analysis, perform a gradient run without injecting the sample. Scan the background, stopping pumping when the peak is eluted out.

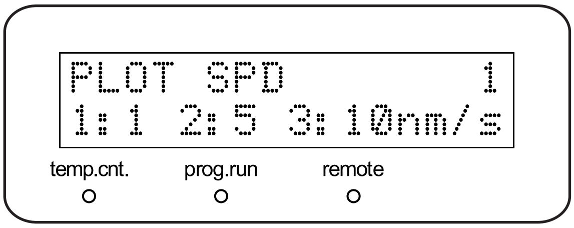
## 5.5.12 Outputting Spectrum Data

This is the procedure for outputting the read spectrum data. Before output, set the speed at which the spectrum data is to be output.

Details of the output speed settings are given below.

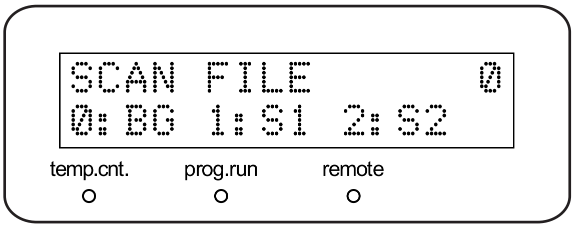
| Set Value | Plot Speed (Units: nm/sec) |
|---|---|
| 1 | 1 |
| 2 | 5 |
| 3 | 10 |

**1** Press **func** repeatedly until [PLOT SPD] in the control settings group is displayed.



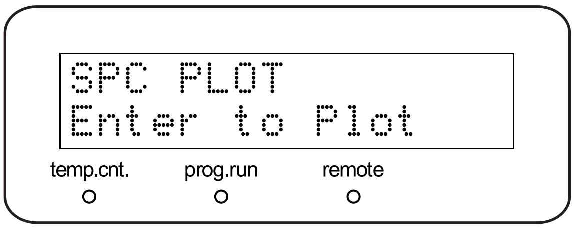

**2** Enter the plot speed setting value from the numeric keys and press **enter**.

**3** Press **func** or **back** until [SCAN FILE] is displayed.




**4** Enter the file number of the file to be output to with the numeric keys and press **enter**.

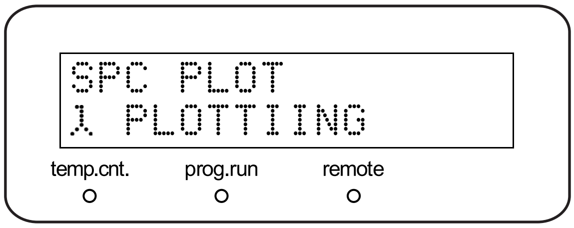
**5** Press **func** or **back** until [SPC PLOT] is displayed.




**6** Press **enter**.
Output will start.

## ■ To Stop Output Part Way Through

Press (enter) while the screen to the right is displayed.



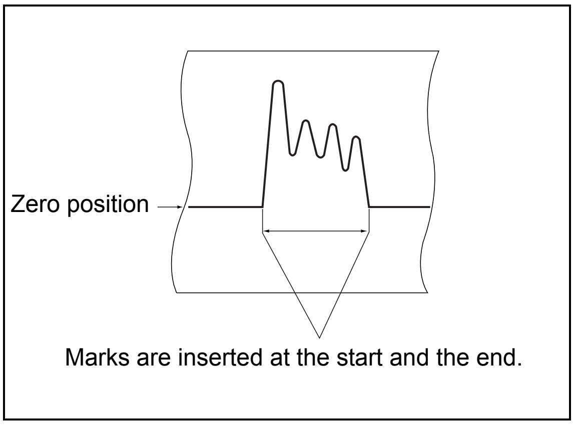




Fig. 5.2

### Example of output

The output time, T, is determined as follows.

$$T = \frac{\text{(SCAN END - SCAN BGN)}}{\text{Plot speed (1, 5, 10 nm/sec)}}$$

- When wavelengths from 200 nm to 350 nm are output at a plot speed of 5 nm/sec ([PLOT SPD] = [2]):

$$T = \frac{(350 - 200)}{5 \text{ nm/sec}} = 30 \text{ sec}$$

NOTE

- Only a file generated by spectrum scanning can output data. If there is no data in the file, the message [DATA NOT EXIST] will be displayed. Note that output will also not be possible if there is no data in the background file.
  "5.5.10 Setting the Scan File" P.5-70
- Spectrum data is erased when the power to the instrument is turned OFF.
- If the scan conditions (start wavelength, end wavelength, scan speed, etc.) are changed from those under which the scan was executed, correct output may not be possible.

# 5.6 Connecting to a CBM-20A or CBM-20Alite System Controller

## 5.6.1 Setting the Instrument

To operate this instrument with a CBM-20A or CBM-20Alite system controller, make the following settings.

| Setting Screen | Set Value | Page |
|---|---|---|
| LOCAL | 0: Remote | "Setting the Local Mode [LOCAL]" P.5-29 |
| ADRS | Remote control address | "Setting a Remote Control Address [LINK ADRS]" P.5-29 |
| OP MODE | 0: 20A | "Selecting the Operation Mode [OP MODE]" P.5-46 |

5

## 5.6.2 Basic Parameters

The following operations and settings are possible from a CBM-20A/20Alite. For details, refer to the CBM-20A/20Alite instruction manual.

- Wavelength setting
- Selection of single wavelength mode and dual wavelength mode
- Lamp ON/OFF status
- Gain setting
- Sensitivity setting
- Analog output connector setting
- Response setting
- ON/OFF status of flow cell temperature adjustment, temperature indication (RF-20Axs only)
- Time program creation

# 5.7 Connecting to an SCL-10Avp System Controller

## 5.7.1 Setting the Instrument

To operate this instrument with an SCL-10Avp system controller, make the following settings.

| Setting Screen | Set Value | Page |
|---|---|---|
| LOCAL | 0: Remote | "Setting the Local Mode [LOCAL]" P.5-29 |
| ADRS | Remote control address | "Setting a Remote Control Address [LINK ADRS]" P.5-29 |
| OP MODE | 1: XL * | "Selecting the Operation Mode [OP MODE]" P.5-46 |

* The instrument operates while recognized as an RF-10AXL.

## 5.7.2 Basic Parameters

The following settings and operations are possible from an SCL-10Avp. For details, refer to the SCL-10Avp instruction manual.

- Wavelength setting (single wavelength mode only)
- Lamp ON/OFF status
- Gain setting
- Sensitivity setting
- Setting the output range to the recorder
- Response setting
- Setting the spectrum measurement parameters and executing measurement
- Time program creation

## 5.7.3 Notes on Operation

### ■ Restrictions in the RF-10AXL Compatibility Mode

When this instrument is used while connected to an SCL-10Avp, it operates as an RF-10AXL and the functions are therefore restricted in the following way.

- The dual wavelength mode cannot be used.
- The EVENT2 terminal in the external input/output terminals cannot be used.
- The temperature of the flow cell cannot be set from the SCL-10Avp. Set the temperature at the instrument itself.

☞ "Setting the Flow Cell Temperature [CELL TEMP] (RF-20Axs Only)" P.5-17

- The settings of analog output connectors 1 and 2 ([ANALOG1 MODE], [ANALOG2 MODE]) are fixed as follows.

| Connector | Set Value | Output Mode |
|---|---|---|
| Analog output connector 1 | 0 | INTEGRATOR (Connect a Chromatopac or a variable range recorder.) |
| Analog output connector 2 | 1 | RECORDER (Connect a fixed range recorder.) |

☞ "Setting the Output Mode for Analog Output Connector 1 [ANALOG1 MODE]" P.5-20
"Setting the Output Mode for Analog Output Connector 2 [ANALOG2 MODE]" P.5-21

- The setting range for the response is as follows.

| Set Value | Time Constant (Units: sec) |
|---|---|
| 1 | 0.1 |
| 2 | 0.5 |
| 3 | 1.5 |
| 4 | 3.0 |

☞ "Setting the Response [RESPONSE]" P.5-18

- The setting ranges of the commands that can be used in time programs are restricted.

☞ "5.4.1 List of Commands That Can Be Used in Time Programs" P.5-54

5

## ■ Parameter Setting Ranges in the RF-10AXL Compatibility Mode

In the RF-10AXL compatibility mode some functions may not be usable and setting ranges may be restricted. The parameter setting ranges in the RF-10AXL compatibility mode are as follows.

### Auxiliary functions

| Group | Name | Operation | Setting Range | Page |
|---|---|---|---|---|
| Parameter settings | ch1 | Numeric keys | 0, 200 to 900 nm | P.5-16 |
| | ch2 | Numeric keys | Cannot be set | P.5-16 |
| | λ MODE | Numeric keys | Fixed as single wavelength mode | P.5-17 |
| | LAMP | Numeric keys | 0: OFF, 1: ON | P.5-17 |
| | CELL TEMP (RF-20Axs only) | Numeric keys | 0: OFF, 4 to 40 °C | P.5-17 |
| | RESPONSE | Numeric keys | 1: 0.1, 2: 0.5, 3: 1.5, 4: 3.0 | P.5-18 |
| | SENS | Numeric keys | 1: HI, 2: MED, 3: LOW | P.5-19 |
| | GAIN | Numeric keys | 1: ×1, 2: ×4, 3: ×16 | P.5-19 |
| | ANALOG1 MODE | Numeric keys | Fixed as 0 (connection to INTEGRATOR) | P.5-20 |
| | ANALOG2 MODE | Numeric keys | Fixed as 1 (connection to RECORDER) | P.5-21 |
| | ANA1 REC RANGE | Numeric keys | Cannot be set | P.5-22 |
| | ANA2 REC RANGE | Numeric keys | 0: short, 1: 1, 2 = 1/2, 3 = 1/4 4 = 1/8, 5 = 1/16, 6 = 1/32, 7 = 1/64, 8 = 1/128, 9 = 1/256 | P.5-23 |
| | BL OFS ANA1 | Numeric keys | –2 to 250 mV | P.5-24 |
| | BL OFS ANA2 | Numeric keys | –2 to 250 mV | P.5-24 |
| | EVENT | Numeric keys | 0: OFF, 1: ON | P.5-25 |
| | MARK SETTING | Numeric keys | 0: OFF, 1: OUT1, 2: OUT2, 3: ALL | P.5-25 |
| Control settings | SCAN FILE | Numeric keys | 0: BG, 1: S1, 2: S2 | P.5-26 |
| | SPC TYPE | Numeric keys | 1: EX, 2: EM | P.5-26 |
| | EX SCAN | Numeric keys | 200 to 900 nm | P.5-26 |
| | EM SCAN | Numeric keys | 200 to 900 nm | P.5-27 |
| | ch1 | Numeric keys | 0, 200 to 900 nm | P.5-27 |
| | SCAN SPEED | Numeric keys | 1: SUPER, 2: FAST, 3: MEDIUM, 4: SLOW | P.5-28 |
| | PLOT SPD | Numeric keys | 1: 1, 2: 5, 3: 10 | P.5-28 |
| | SPC PLOT | enter key | – | P.5-28 |

| Group | Name | Operation | Setting Range | Page |
|---|---|---|---|---|
| System settings | LOCAL | Numeric keys | 0: Remote, 1: Local | P.5-29 |
| | LINK ADRS | Numeric keys | 1 to 12 | P.5-29 |
| | KEY CLOSE | enter key | – | P.5-29 |
| | BRIGHTNESS | Numeric keys | 1 to 4 | P.5-30 |
| | EXT-S | Numeric keys | 0: EVENT<br>1: TIME PROGRAM<br>2: ERROR EVENT1<br>3: SCAN EVENT1 | P.5-30 |
| | MONIT-TIME | Numeric keys | 0: Off, 1: On | P.5-31 |
| | BEEP MODE | Numeric keys | 0: Activated on occurrence of errors and at key input<br>1: Activated on occurrence of errors<br>2: Buzzer sound OFF | P.5-31 |
| | CELL No. | Numeric keys | 1 to 10 | P.5-31 |
| Monitor display (display only) | SMPL EN<br>REF EN | Display | SMPL EN: 0 to 5000 mV<br>REF EN: 0 to 5000 mV | P.5-32 |
| | Xe TIME | Display | 0.0 to 9999.9 (h) | P.5-32 |
| | Xe COUNT | Display | 0 to 9999 | P.5-33 |
| | CELL TEMP<br>(RF-20Axs only) | Display | Current value: 0.0 to 9.9 °C<br>Set value: 4.0 to 40.0 °C | P.5-33 |
| | ROOM TEMP<br>(RF-20Axs only) | Display | 0.0 to 99.9 °C | P.5-33 |

5

## VP function

| Group | Name | Operation | Setting Range | Page |
|---|---|---|---|---|
| Product information (display only) | SERIAL NUMBER | Display | L*********** | P.5-37 |
| | S/W ID: V | Display | S/W ID: V*.** | P.5-37 |
| Maintenance information | TOTAL OP TIME | Display | 9999999 (h) | P.5-37 |
| | Xe LAMP USED TM | Numeric keys<br>Display | [Input] 0: Reset<br>[Display]<br>Cumulative operating time: 0 to 9999 (h)<br>Replacement alert time: 1 to 2000 (h) | P.5-38 |
| | Xe LAMP USED CT | Display | 9999/---- | P.5-38 |
| | PART REPLACEMENT | Numeric keys | PART REPLACEMENT<br>P/N: ***-*****-** | P.5-38 |
| | MAINTENANCE LOG | Display | LOG * YY-MM-DD<br>P/N: ***-*****-** | P.5-39 |
| | OPERATION LOG | Display | LOG * YY-MM-DD<br>*********** | P.5-39 |
| | ERROR LOG | Display | LOG * YY-MM-DD<br>*********** | P.5-40 |
| Validation support | DATE | Numeric keys | YY-MM-DD | P.5-41 |
| | TIME | Numeric keys | HH:MM:SS | P.5-41 |
| | EX CHECK | enter key | – | P.5-42 |
| | EM CHECK | enter key | – | P.5-42 |
| | S/N CHECK | enter key | – | P.5-42 |
| | LEAK SENSOR TEST | enter key | – | P.5-42 |
| Calibration support | WAVE CALIB | enter key | – | P.5-44 |
| | Xe TIME | Numeric keys | 1 to 2000 (h) | P.5-44 |
| | L-CAL | enter key | – | P.5-45 |
| | LEAK THR | Numeric keys | 0 to 255 | P.5-45 |
| | SENS COMP | Numeric keys | 0.1 to 10.0 | P.5-45 |
| | OP MODE | Numeric keys | 0: 20A, 1: XL | P.5-46 |
| | INITIALIZE PARAM | enter key | – | P.5-46 |
| | CHANGE PASSWORD | enter key | – | P.5-47 |
| | CBM PARAMETER | enter key | – | P.5-48 |

# 5.8 Connection to External Input/Output Terminals

The "external input/output terminals" are used for connection to external devices such as event outputs by using the event cable provided as an accessory.
The event cable signals and connection method are explained below.

**⚠WARNING**

- Before starting wiring work, turn the power to the instrument OFF and remove the plug from the power outlet.
- Do not use cables other than those specified for wiring.
- Do not do any wiring other than that specified.

Failure to observe these points will cause fire, electric shock or equipment failure.



## 5.8.1 External Input/Output Terminals

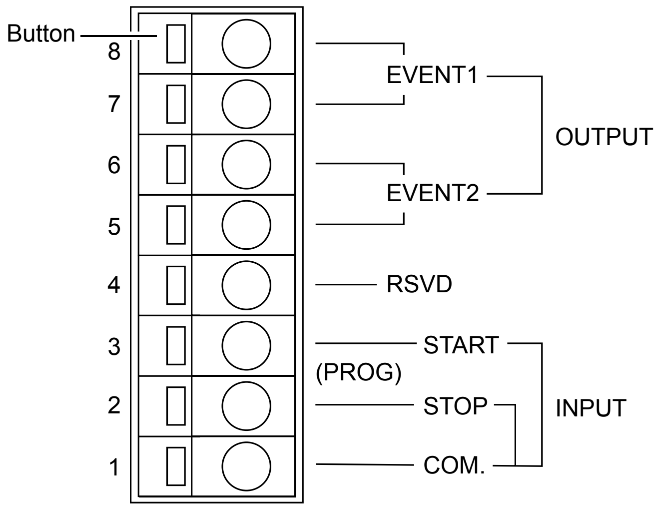



Fig. 5.3

| Signal | Explanation | Remark |
|---|---|---|
| EVENT1 (output) | This is a relay contact output. It is set ON and OFF by the time program or the EVENT setting in the auxiliary functions. | The rating for the relay contact is 30 V DC / 1 A |
| EVENT2 (output) | | |
| RSVD | Not used. Do not connect this terminal. | – |
| PROG. START (input) | Starts this instrument's time program in response to an external contact signal. If the start signal is input while the time program is running, it is restarted from time "0". | These signals are controlled by shorting between the input command terminal and the COMMON terminal in response to contacts at external devices.<br>The during of shorting (tc) should be as follows.<br>0.5 sec < tc < 10 sec |
| PROG. STOP (input) | Stops this instrument's time program in response to an external contact signal. | |
| COMMON | This is the COMMON terminal for inputs. | |

## 5.8.2 Wiring

**1** Strip off 10 mm of insulation from the end of the cable to be connected. Note that this is not necessary with the event cable provided.

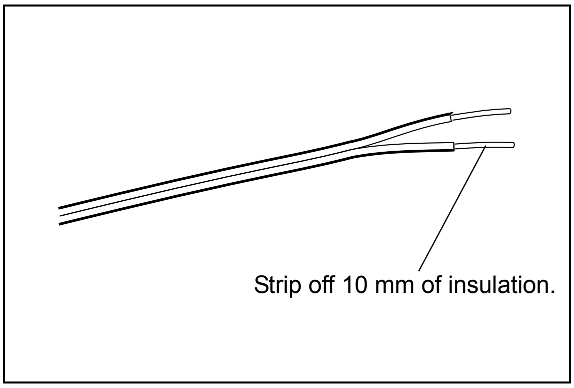



Fig. 5.4

**2** If the cable comprises single core wires, insert the wires into the holes in the terminals as they are.
If the cable comprises stranded wires, twist the strands at the end of the wire together well, then insert the wire with a tool such as a flat bladed screwdriver while holding down the button at the left of the terminal.
Also hold this button down when removing the cable.

NOTE

One event cable (part No.: 228-28253-91) is provided with this instrument. When connecting to terminals in two or more circuits, use the following cables.

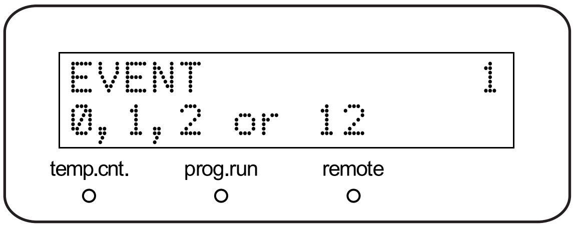
- Single core wire: ϕ 0.4 to ϕ 1.2 (AWG26 to 16)
- Stranded wire: 0.3 $mm^2$ to 1.25 $mm^2$ (AWG22 to 16), single wire diameter ϕ 0.18 or greater

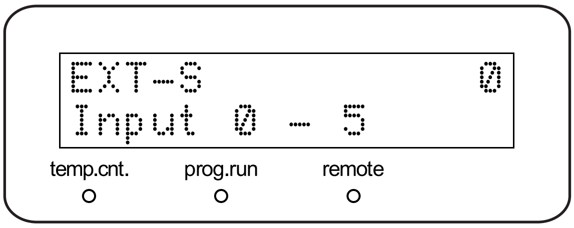
In order to avoid cable breakages, use stranded wires.

NOTE

When the EVENT1 or EVENT2 signal is used, set [EVENT] and [EXT-S] in the auxiliary functions.

☞ "Setting the EVENT Output Terminal [EVENT]" P.5-25
"Setting the Function of the EVENT Output Terminal [EXT-S]" P.5-30



# 5.9 Using the Spare Flow Cell Unit / Optional Cell

When this instrument is used with a flow cell unit other than the one that was provided with on shipping (i.e. a spare standard flow cell, and optional cell, etc.), wavelength calibration must be performed.
In order to avoid having to carry out wavelength calibration each time a spare standard flow cell or optional cell unit is used, this instrument features a function for recording the calibration data for multiple flow cell units, reading the wavelength calibration data of each flow cell unit on replacement and setting the wavelength.
The wavelength calibration data for up to 10 flow cell units can be recorded. The records are identified by numbers from 1 to 10 (cell numbers).
The cell number is input at wavelength calibration, and the wavelength calibration data is recorded in the instrument.
On inputting a cell number to [CELL No.] in the system settings group, the wavelength is set according to the wavelength calibration data of the input cell number.

## ■ Fitting the Flow Cell Unit

☞ "Fitting the Flow Cell Unit" P.8-7

## ■ Performing Wavelength Calibration

☞ "8.7 Performing Wavelength Calibration" P.8-39

The cell number [CELL No.] input in the wavelength calibration procedure becomes the identification number of the flow cell unit. Wavelength calibration data is recorded for each cell number.
The cell number [CELL No.] of the flow cell unit provided with the instrument on shipping is set as [1].

Example: Set the cell number [CELL No.] of the spare standard flow cell unit as [2], and set the cell number [CELL No.] of the optional temperature controlled flow cell for semi-micro LC as [3].

## ■ Reading Wavelength Calibration Data

When replacing a flow cell unit for which wavelength calibration has already been performed on the instrument, input the cell number for [CELL No.] in the system settings group. The wavelength will be set in accordance with the wavelength calibration data of the input cell number.

# 6

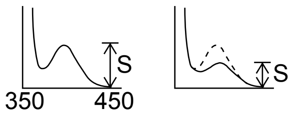
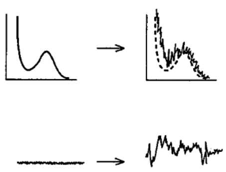
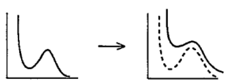
# Troubleshooting

Contents

# 6.1 Troubleshooting and Corrective Action

This section describes the probable causes of problems that can arise, and the corrective action to be taken to eliminate the causes. For more detailed procedures, see the indicated page.
If the problem cannot be resolved even after taking the indicated measures, or if there are problems not included in the following tables, contact your Shimadzu representative.

| Symptom | Probable Cause | Corrective Action | Page |
|---|---|---|---|
| Power does not turn ON even after switching ON the power. | Has the plug become detached from the power cord? | • Connect the plug on the power cord correctly. | P.9-7 |
| | Does the power cord have an internal disconnection? | • Replace it with a power cord of the same type. | P.1-4 |
| | Does the power supply match the power specifications of the instrument? | • Use a power supply that matches the power specifications of the instrument. | P.9-6 |
| | Has a fuse blown? | • Replace the fuse. | P.8-35 |
| The Xenon lamp won't light. | Has [0] (OFF) been set for [LAMP] in the parameter settings group? | • Set [1] (ON) for [LAMP] in the parameter settings group. | P.5-17 |
| | There is a connection fault in the wiring. | • Unplug the power plug from the power outlet and check the contact of the high-voltage cord connected to the positive (+) terminal of the Xenon lamp.<br>(It is essential to unplug the power plug before starting this check. If the power were turned ON accidentally it would be extremely dangerous.) | – |
| | Is the Xenon lamp very hot? | • Leave the lamp to cool for about 10 minutes. | – |
| The recorder's baseline doesn't vary. | Has the output range of analog output connectors 1 and 2 been set to [0]? | • Set the output ranges for analog output connectors 1 and 2 in the parameter settings group. | P.5-22<br>P.5-23 |
| | Is the Xenon lamp unlit? | • Set [1] (ON) for [LAMP] in the parameter settings group.<br>The Xenon lamp will light. | P.5-17 |
| | Has the recorder been off-scale in the (–) side (lower side)?<br>([OVER] appears on the display screen.) | • Press **zero** to adjust the recorder's zero position. | P.2-8 |
| | Has the circuit failed? | • Replace the faulty part. | – |

| Symptom | Probable Cause | Corrective Action | Page |
|---|---|---|---|
| S/N ratio fault (weak signal)<br> | This is a flow cell unit fitting fault. | • Check whether the flow cell unit is securely fitted in the sample compartment. | P.8-5<br>P.8-11 |
| | | • Check whether the rear plate is securely fitted to the flow cell unit. | P.8-5<br>P.8-11 |
| | Are there any air bubbles inside the cell? | • Purge the air bubbles. | P.8-5 |
| | | • Replace the cell gasket. | P.8-11 |
| | Is there variation in the wavelength? | • Perform a wavelength check. | P.7-11 |
| | | • If the wavelength is found not to be within the stipulations in the check, carry out wavelength calibration. | P.7-11<br>P.8-39 |
| | The sensitivity adjustment is faulty. | • Sensitivity adjustment is necessary. Contact your Shimadzu representative. | – |
| S/N ratio fault (too much noise)<br> | This is a flow cell unit fitting fault. | • Check whether the flow cell unit is securely fitted in the sample compartment. | P.8-5<br>P.8-11 |
| | | • Check whether the rear plate is correctly fitted to the flow cell unit. | P.8-5<br>P.8-11 |
| | Is the Xenon lamp flickering? | • Replace the Xenon lamp. | P.8-30 |
| | Are there any air bubbles inside the cell? | • Purge the air bubbles. | P.8-5 |
| | | • Replace the cell gasket. | P.8-11 |
| No raman peak of water is observed.<br> | Is the water used for analysis contaminated? | • Replace the water. | – |
| | Is the cell contaminated? | • Clean the cell. | P.8-5<br>P.8-11 |
| | | • Replace the cell. | P.8-11 |
| | Are there any air bubbles inside the cell? | • Purge the air bubbles. | P.8-5 |
| | | • Replace the cell gasket. | P.8-11 |
| | Is there substantial variance in the wavelength? | • Check the wavelength accuracy. | P.7-11 |
| | | • If the wavelength accuracy is found not to be within the stipulations in the check, carry out wavelength calibration. | P.7-11<br>P.8-39 |
| | Have the lens and/or mirror deteriorated? | • Clean the lens and mirror. | P.8-11 |
| [OVER] is displayed on the display screen. | Has the output to a Chromatopac been off-scale in the (+) side? | • Press **zero** to perform zero adjustment. | P.2-8 |
| | The setting for [SENS] in the parameter settings group is too high. | • Lower the setting for [SENS] in the parameter settings group. | P.5-19 |

6

| Symptom | | Probable Cause | Corrective Action | Page |
|---|---|---|---|---|
|  | Chromatogram peaks are trapezoidal. | The setting for [SENS] in the parameter settings group is too high. | • Lower the setting for [SENS] in the parameter settings group. | P.5-19 |
| | | The concentration of the sample is too high, or the volume poured in is too large. | • Dilute the sample or reduce the volume poured in. | – |
|  | Spiking | Are air bubbles entrained in the cell? (*1) | • Connect a back pressure device or ϕ 0.3 mm × 2 m tubing to the flow cell outlet tube and apply pressure. | – |
|  | Sawtooth baseline | | | |
|  | Continuous spiking | | • Degas the mobile phase. (Use the degasser.) | – |
|  | Continuous spiking | Have air bubbles built up inside the cell? (*1) | • Connect a back pressure device or ϕ 0.3 mm × 2 m tubing to the flow cell outlet tube and apply pressure. | – |
|  | Spiking that occurs with every pump stroke | | • Using the syringe provided as an accessory, clean the inside of the flow cell with 2-propanol. | P.8-5 |
|  | Drift | Is the cell contaminated? (*1) | • Disassemble the flow cell unit and clean the cell. If the contamination cannot be removed, replace the cell. | P.8-11 |
|  | Noise (large) | Is the lens soiled? | • Disassemble the flow cell unit and clean the lens. If the contamination cannot be removed, replace the lens. | – |
|  | Rise | If the drift stops when pumping is stopped, have impurities become entrained in the mobile phase? | • Inspect the mobile phase and the mobile phase flow line, and remove impurities. | – |
|  | Wander of the baseline | Is a strong airflow blowing directly onto the instrument? | • Prevent the airflow from blowing directly onto the instrument by using e.g. a screen.<br>• Change the installation position. | – |
|  | Noise corresponding to the pump stroke | Is the mobile phase pulsating? | • Eliminate the pulsation from the pump unit.<br>• Use a pulsation absorption device. | – |
|  | Noise (large) | Deterioration or life expiry of the lamp | • Replace the lamp. | P.8-30 |

*1 For details on the method for checking for air bubbles and contamination inside the cell, see:

☞ "8.2 Inspection and Simple Washing of the Cell" P.8-5

# 6.2 Dealing with Error Messages

The instrument has several diagnostic functions. Upon detection of a problem, an alarm sounds and an error message appears on the display panel.
The following list describes the error messages along with their causes and corrective actions.

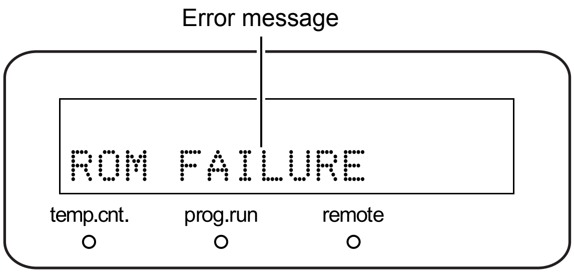
NOTE

Error messages are classified into the following three types. The type is indicated in the type column.

Fatal: The instrument stops operation. The error message cannot be cleared by pressing CE.

Alarm: The instrument stops operation. The error message can be cleared by pressing CE.

Warning: The instrument does not stop operation. The error message can be cleared by pressing CE.






| Error Message | Type | Cause and Action |
|---|---|---|
| ROM FAILURE<br>(ROM error) | Fatal | Cause: There is a fault with the ROM.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| RAM FAILURE<br>(RAM error) | Fatal | Cause: There is a fault with the RAM.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| ERR LM HOME<br>(Home position sensor error)<br>* RF-20Axs only | Fatal | Cause: Displayed when the home position sensor of the lamp mirror motor is not operating correctly.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |

| Error Message | Type | Cause and Action |
|---|---|---|
| ERR EX HOME POS<br>(Home position sensor error) | Fatal | Cause: Displayed when the home position sensor of the excitation grating motor is not operating correctly.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| ERR EM HOME POS<br>(Home position sensor error) | Fatal | Cause: Displayed when the home position sensor of the emission grating motor is not operating correctly.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| ERR EEPROM WRITE<br>(EEPROM writing error) | Fatal | Cause: An error in writing to the EEPROM has occurred.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| SYSTEM ERROR<br>(SYSTEM error) | Fatal | Cause: Displayed when an unanticipated error has occurred in the internal system.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| ERR COOLER<br>(Cooler error) | Fatal | Cause: Displayed when the temperature of the flow cell has failed to reach the set temperature within 30 minutes after the power was turned ON.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |

| Error Message | Type | Cause and Action |
|---|---|---|
| ERR HEATER<br>(Heater error) | Fatal | Cause: Displayed when the temperature of the flow cell has failed to reach the set temperature within 30 minutes after the power was turned ON.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| ERR OVER HEAT<br>(Overheating)<br>* In the RF-10AXL compatibility mode | Fatal | Cause: Displayed when the interior temperature has risen to an abnormal level.<br>Action: Check if the cooling fan is working. If the exhaust vents at the rear and side are obstructed, secure sufficient space for them to operate.<br>If the filters in the front cover and right side face are clogged, replace these filters. If the error is still displayed, turn the power OFF and contact your Shimadzu representative.<br>When this error occurs, the Xenon lamp is forcibly turned off. To relight the Xenon lamp, set [LAMP] in the parameter settings group to [0] (OFF) and then back to [1] (ON).<br>☞ "Setting the Lamp ON/OFF Status [LAMP]" P.5-17 |
| ERR LEAK SENS<br>(Leak sensor error) | Fatal | Cause: The leak sensor has malfunctioned, probably due to a broken/disconnected wire.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| ERR LEAK SENS2<br>(Leak sensor error 2) | Fatal | Cause: The leak sensor has malfunctioned, probably due to a short circuit.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |

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| Error Message | Type | Cause and Action |
|---|---|---|
| NOT PROTECTED<br>(Settings lost error) | Alarm | Cause: Displayed if the parameters and time program set for the previous measurement have been lost when the power is turned ON.<br>Action: Press (CE) to return to the initial screen, then set the parameters and time program again. |
| ERR LEAK DETECT<br>(Leak detection error) | Alarm | Cause: Displayed on detection of liquid leakage.<br>Action: Inspect for liquid leakage in the flow line, and wipe up liquid around the leak sensor. |
| ERR Xe LAMP<br>(Xenon lamp error) | Alarm | Cause: Displayed when the Xenon lamp cannot be turned on.<br>Action: Turn the power OFF and back ON, then turn the Xenon lamp on. The Xenon lamp cannot be turned on unless the power has been turned OFF once.<br>☞ "Setting the Lamp ON/OFF Status [LAMP]" P.5-17 |
| ERR OVER HEAT<br>(Overheating) | Alarm | Cause: Displayed when the interior temperature has risen to an abnormal level.<br>In the RF-10AXL compatibility mode this is a fatal error.<br>☞ "(Overheating)" P.6-7<br>Action: Check if the cooling fan is working. If the exhaust vents at the rear and side are obstructed, secure sufficient space for them to operate.<br>If the filters in the front cover and right side face are clogged, replace these filters. If the error is still displayed, turn the power OFF and contact your Shimadzu representative.<br>When this error occurs, the Xenon lamp is forcibly turned off. To relight the Xenon lamp, set [LAMP] in the parameter settings group to [0] (OFF) and then back to [1] (ON).<br>☞ "Setting the Lamp ON/OFF Status [LAMP]" P.5-17 |

| Error Message | Type | Cause and Action |
|---|---|---|
| ERR Hg LAMP<br>(Low-pressure Hg (mercury) lamp error)<br>* RF-20Axs only | Alarm | Cause: Displayed when the low-pressure Hg (mercury) lamp cannot be turned on.<br>Action: Turn the power OFF and then restart the instrument. If the same error is still displayed, contact your Shimadzu representative. |
| CHECK NG1<br>(Wavelength check error 1) | Alarm | Cause: Displayed when there is a wavelength discrepancy of greater than 2.0 nm in a wavelength check or on wavelength calibration. |
| CHECK NG2(EX***)<br>(Wavelength check error 2) | | Cause: No peak was found in the excitation wavelength peak detection shown inside the parentheses. |
| CHECK NG3(EM***)<br>(Wavelength check error 3) | | Cause: No peak was found in the emission wavelength peak detection shown inside the parentheses.<br>Action: For each cause, one of the following factors is likely. |

| Cause | Action |
|---|---|
| The flow cell unit has not been fitted accurately. | Fit the flow cell unit accurately. |
| There is error in the wavelength calibration. | Perform wavelength calibration with [WAVE CALIB] in the VP functions, then check the wavelength accuracy. |
| Large air bubbles are entrained, and fluorescent intensity is extremely large or small in the vicinity of the emission line wavelength of the low-pressure Hg (mercury) lamp. | Purge the air bubbles inside the cell. |
| There is a sample or mobile phase that strongly absorbs the emission line (254 nm) of the low-pressure Hg (mercury) lamp inside the flow cell. | Fill the cell with mobile phase that does not absorb the emission line in the vicinity of 254 nm. |

If the error is still displayed after taking the corrective action above, turn the power OFF and contact your Shimadzu representative.

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| Error Message | Type | Cause and Action |
|---|---|---|
| ERR CELL TEMP<br>(Flow cell temperature error)<br>* RF-20Axs only | Alarm | Cause: Displayed when the flow cell temperature has risen abnormally.<br>Action: If the exhaust vents at the rear and side are obstructed, secure sufficient space for them to operate. If the filters in the front cover and right side face are clogged, replace these filters. If the error is still displayed, turn the power OFF and contact your Shimadzu representative.<br>When this error occurs, the temperature adjustment function of the flow cell is forcibly turned off. To turn the function on again, set the temperature for [CELL TEMP] in the parameter settings group.<br>☞ "Setting the Flow Cell Temperature [CELL TEMP] (RF-20Axs Only)" P.5-17 |
| LAMP COVER OPEN<br>(Lamp cover error) | Alarm | Cause: Displayed when lamp cover 1 is not in place.<br>Action: Fit lamp cover 1.<br>When this error occurs, the Xenon lamp is forcibly turned off. To relight the Xenon lamp, set [LAMP] in the parameter settings group to [0] (OFF) and then back to [1] (ON).<br>☞ "Setting the Lamp ON/OFF Status [LAMP]" P.5-17 |
| ERR PELTIER FAN<br>(Peltier fan error)<br>* RF-20Axs only | Alarm | Cause: Displayed when the cooling fan for the Peltier cooling fan has stopped.<br>Action: Turn the power OFF and then restart the instrument. Set the temperature again for [CELL TEMP] in the parameter settings group.<br>If the same error is still displayed, contact your Shimadzu representative.<br>☞ "Setting the Flow Cell Temperature [CELL TEMP] (RF-20Axs Only)" P.5-17 |

| Error Message | Type | Cause and Action |
|---|---|---|
| ERR FAN STOP<br>(Rear fan stop error) | Alarm | Cause: Displayed when the cooling fan for the Xenon lamp's power supply stops.<br>Action: Check if the cooling fan is working. If the exhaust vents at the rear and side are obstructed, secure sufficient space for them to operate.<br>If the filters in the front cover and right side face are clogged, replace these filters. If the same error is still displayed, contact your Shimadzu representative.<br>When this error occurs, the temperature adjustment function of the flow cell is forcibly turned off. To turn the function on again, set the temperature for [CELL TEMP] in the parameter settings group.<br>☞ "Setting the Flow Cell Temperature [CELL TEMP] (RF-20Axs Only)" P.5-17<br>When this error occurs, the Xenon lamp is forcibly turned off. To relight the Xenon lamp, set [LAMP] in the parameter settings group to [0] (OFF) and then back to [1] (ON).<br>☞ "Setting the Lamp ON/OFF Status [LAMP]" P.5-17 |
| CBM-20A ERROR<br>(System controller error) | Alarm | Cause: Displayed when an error has occurred at the system controller.<br>(The error message is sent from the system controller.)<br>Action: Refer to the instruction manual for the system controller. |
| DATA NOT EXIST<br>(Warning at spectrum output) | Warning | Cause: Displayed if there is no data in file number [0], or if a file in which no scan data is saved has been specified, when [SPC PLOT] is executed and scan data is output.<br>Action: Check the settings for spectrum scanning.<br>☞ "5.5.10 Setting the Scan File" P.5-70 |

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| Error Message | Type | Cause and Action |
|---|---|---|
| NO PEAKS 1<br>(Peak detection error 1) | Warning | Cause: Displayed if, on executing [S/N CHECK], no raman spectrum peak was detected at an emission wavelength of 397 nm ± 10 nm.<br>Action: Execute the [S/N CHECK] again, and if the same indication is displayed, refer to "S/N ratio fault (weak signal)", "S/N ratio fault (too much noise)", and "No raman peak of water is observed." P.6-3 under "6.1 Troubleshooting and Corrective Action". |
| NO PEAKS 2<br>(Peak detection error 2) | Warning | Cause: Displayed if no raman spectrum peak can be detected on executing [S/N CHECK].<br>Action: Execute the [S/N CHECK] again, and if the same indication is displayed, refer to "S/N ratio fault (weak signal)", "S/N ratio fault (too much noise)", and "No raman peak of water is observed." P.6-3 under "6.1 Troubleshooting and Corrective Action". |
| NO PEAKS 3<br>(Peak detection error 3) | Warning | Cause: Displayed in the event of an error that doesn't correspond to [NO PEAKS 1] or [NO PEAKS 2] above.<br>Action: Execute the [S/N CHECK] again, and if the same indication is displayed, refer to "S/N ratio fault (weak signal)", "S/N ratio fault (too much noise)", and "No raman peak of water is observed." P.6-3 under "6.1 Troubleshooting and Corrective Action". |

| Error Message | Type | Cause and Action |
| --- | --- | --- |
| ERR FILE TYPE<br>(File type error) | Warning | Cause: Displayed when the spectrum types or wavelength ranges of the data in file number [0] and the data to be output are different when [SPC PLOT] is executed and the scan data is output.<br>Action: Rescan so that the spectrum type or wavelength range of the scan data to be output matches that of the data in file number [0], then execute [SPC PLOT] again.<br>"Outputting Spectrum Data [SPC PLOT]" P.5-28 |
| LAMP NOT LIT<br>(Warning when lamp not lit) | Warning | Cause: Displayed if zero or mark is pressed while the Xenon lamp is off.<br>Action: Set [1] (ON) for [LAMP] in the parameter settings group.<br>"Setting the Lamp ON/OFF Status [LAMP]" P.5-17 |
| SENSOR NO GOOD<br>(Warning on leak sensor test) | Warning | Cause: Displayed when a leak could not be detected on execution of [LEAK SENSOR TEST].<br>Action: Calibrate the leak sensor and change its actuation level (threshold value).<br>"Calibrating the Leak Sensor [L-CAL]" P.5-45<br>"Setting the Leak Sensor Actuation Level [LEAK THR]" P.5-45 |
| SELECT Xe SINGLE<br>(Wavelength mode warning) | Warning | Cause: Displayed when [EX CHECK] or [EM CHECK] is executed when the measurement mode is not the single wavelength mode while the Xenon lamp is on.<br>Action: Set [1] (single wavelength mode) for [λ MODE] in the parameter settings group.<br>"Setting the Measurement Mode [λ MODE]" P.5-17 |

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| Error Message | Type | Cause and Action |
|---|---|---|
| LOW SET TEMP<br>(Flow cell temperature control error)<br>* RF-20Axs only | Warning | Cause: Displayed if the room temperature exceeds the set temperature for the flow cell by 10 °C or more.<br>Action: Set a flow cell temperature that is within 10 °C of the room temperature. If the warning is still displayed, turn the power OFF and contact your Shimadzu representative.<br>☞ "Setting the Flow Cell Temperature [CELL TEMP] (RF-20Axs Only)" P.5-17 |
| CLOSED KEY<br>(Keys locked) | Warning | Cause: Displayed on pressing an operation key when the setting to prohibit key input has been made with [KEY CLOSE].<br>Action: Press CE while holding down del to cancel the prohibition on key input.<br>☞ "Prohibiting Key Input [KEY CLOSE]" P.5-29 |
| NO CAL DATA<br>("Wavelength not calibrated" alarm) | Warning | Cause: Displayed on input of a cell number for which wavelength calibration has not been performed ([CELL No.] in the system settings group)<br>Action: Input a cell number for which wavelength calibration has been performed. Or, carry out wavelength calibration for the cell number that you attempted to input.<br>☞ "Setting the Cell Number [CELL No.]" P.5-31<br>"8.2 Inspection and Simple Washing of the Cell" P.8-5 |
| NOT LOCAL MODE<br>("Not local mode" alarm) | Warning | Cause: Displayed on attempting to execute a function that can only be used when the local mode is [Local] while the local mode is set to [Remote].<br>Action: Set [1] (Local) for [LOCAL] in the system settings group.<br>☞ "Setting the Local Mode [LOCAL]" P.5-29 |

# 7

# Hardware Validation

This chapter explains the inspection procedures for periodically checking that individual components and the instrument as a whole are functioning normally, in order to assure the reliability of the analysis data.

Contents

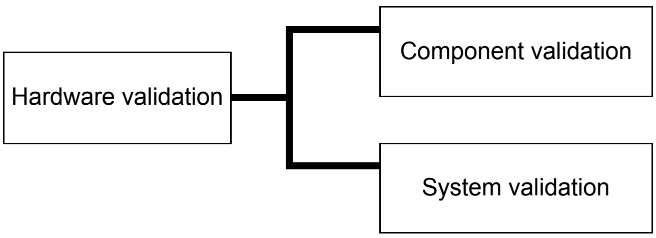
# 7.1 Overview of Hardware Validation

## 7.1.1 Hardware Validation

Hardware validation is the work of inspecting whether the LC system is running correctly and the instrument is suitable for the intended analysis, and of documenting this process. The performance of the LC system deteriorates with age, reflecting the wear of consumable parts. Hardware validation must therefore be performed periodically from the time of installation until the system is retired. Although aspects of validation related to analysis, such as method validation and system suitability tests should also be performed, hardware validation is a prerequisite for these aspects.

## 7.1.2 Types of Hardware Validation

A high performance liquid chromatograph consists of a number of LC components including pump(s), an autosampler, column oven, and detector(s). For this reason, hardware validation is divided into the inspection of individual components and system validation as a whole, and both these types of validation must be performed.




To inspect whether each LC component runs correctly.

To inspect items that cannot be inspected as a single component and also inspect the entire LC system for proper function.

The validation reports obtained during the production of each Shimadzu product are supplied with the product. This chapter describes the inspection procedures and guidelines for the inspection pass criteria for this component and, separately, for the HPLC system, to assist the user in validating the performance of this instrument. Refer to each instruction manual for each component for the method of hardware verification for that specific component.

# 7.2 Implementation of Hardware Validation

## 7.2.1 Periodic Inspection

Component and system validation must be performed at installation and every 6 to 12 months, as the performance of an LC system changes with age. It is also important to perform maintenance such as replacement of consumables in advance of hardware validation.

## 7.2.2 Daily Inspection

Check the condition of maintenance parts to ensure a high level of analysis data reliability. Also carry out system suitability and other tests and check points such as column deterioration and mobile phase adjustment.

## 7.2.3 Inspection After Maintenance

After any maintenance, component performance must be re-validated. The type of validation depends on the actual work done. If the validation cannot be achieved solely by the specific component validation, system validation is required.



NOTE

Maintenance information and results of hardware validation must be recorded and kept for future reference.

# 7.3 Precautions on Validation

## 7.3.1 Environment

Data reproducibility may be adversely affected by abrupt changes in ambient temperature and use of the instrument in locations where it is exposed to drafts.
The equipment should be installed in a room with minimal (< 2 °C) temperature fluctuation and away from sources of drafts, such as air conditioning systems.

## 7.3.2 Installation Site

The installation site is very important for ensuring correct validation. The site should satisfy the following conditions:

**⚠WARNING**

- Provide ample ventilation with no open flames in the vicinity.

  When flammable or toxic solvents are used as the mobile phase, the room must be properly ventilated. When flammable solvents are used, open flames must be strictly prohibited in the room.

**⚠CAUTION**

- Avoid dust or corrosive gas.

  Avoid installing the instrument in places subject to excessive dust or corrosive gas since service life and performance levels may be affected.

- Keep away from strong magnetic fields and noise.

  Do not install the instrument near equipment that generates strong magnetic fields. If the power supply line is subject to high electrical noise, use a commercially-available power surge protector.

- Provide adequate installation surface and space.

  The weight of this instrument is 16 kg (RF-20A) or 18 kg (RF-20Axs). During installation, consider the entire weight combined with other LC components. The lab table on which this instrument is installed should be strong enough to support the total weight of the LC system. It should be level, stable and have depth of at least 600 mm. If these precautions are not followed, the instrument could tip over or fall off the table. When components are installed side by side, maintain a gap of at least 30 mm between the components.

- Regulate room temperature and humidity.

  The room temperature should be between 4 and 35 °C, with minimal temperature variations throughout the course of a day. Humidity should be kept within 20 to 85 %.

- Position the instrument properly in the room.

  Install the instrument in a location that is free from vibration and away from sunlight, and heating/air conditioning drafts.

# 7.4 Equipment Required for Validation

The equipment and reagents listed below are required for hardware validation. Prepare necessary equipment and reagents depending on the system configuration of the instrument.

## ■ Testing Equipment

A list of testing equipment required for hardware validation is shown below. A certificate ensuring traceability of validation results and a validation report should accompany each item of testing equipment that is used.

| Equipment | Description |
|---|---|
| Thermo recorder | For inspection of the temperature setting accuracy for the column oven and the autosampler's sample cooler.<br>The thermo recorder must be certified as having an accuracy rating of ± 1.0 °C for the required temperature range (0 to 50 °C) at the time of inspection. |
| Resistance thermometer | For inspection of the temperature accuracy for the column oven.<br>The resistance thermometer must have a testing accuracy of ± 0.5 °C for the required temperature range (0 to 50 °C) at the time of inspection. |
| Thermocouple | For inspection of the temperature accuracy for the column oven and autosampler's sample cooler.<br>The thermocouple must have a testing accuracy of ± 0.6 °C for the required temperature range (0 to 50 °C) at the time of inspection. |
| DC voltage/current generator | For the hardware validation of the Chromatopac.<br>The DC voltage/current generator must be certified as having an accuracy rating of ± 0.15 % at the time of testing. |
| Stopwatch | For inspection of the flow rate accuracy for the pump.<br>The stopwatch must be certified at 5'30" ± 0.3 sec at the time of inspection. |
| Measuring flask | For inspection of the flow rate accuracy for the pump.<br>Obtain a 5-mL measuring flask. |
| Electronic balance | For inspection of the injection volume accuracy for the autosampler.<br>The balance must be calibrated and able to perform measurement with a precision of 0.001 g at the time of inspection. |

## ■ Standard Reagents for Validation

A list of standard reagents required for validation is shown below. The customer should prepare standard reagents to the stated specifications.

| Standard Reagent | Part No. | Description |
|---|---|---|
| Caffeine set<br>(5 concentrations) | 228-45725-91 | For inspection of the absorbance linearity for the UV-VIS spectrophotometric and photodiode array detectors. Also for inspection of system reproducibility for a system equipped with a UV-VIS spectrophotometric or photodiode array detector. |
| Caffeine (250 mg/L) | 228-45725-06 | For inspection of system reproducibility for a system equipped with a refractive index detector, inspection of autosampler carry-over, and inspection of the gradient concentration accuracy for gradient systems. |
| Anthracene (1 mg/L) | 228-32996-15 | For inspection of system reproducibility for a system equipped with a spectrofluorometric detector. |
| Glycerol (0.872 mg/L) | 228-32996-05 | For inspection of the span for the refractive index detector. |

## ■ Hardware Testing Equipment

A list of testing equipment required for hardware validation is shown below. Note that items such as autosampler vials or mobile phases may be required in addition to the items listed.

| Testing Equipment | Part No. | Description |
|---|---|---|
| Resistor tubing | 228-45726-91 | I.D. 0.13 mm × 2 m + I.D. 0.8 mm × 2 m<br>For inspection of the flow rate of the pump unit, the gradient concentration accuracy of the pump unit, etc. |
| Syringe | 046-00017-01<br>or<br>046-00038-01 | For inspection of the absorbance linearity for the UV-VIS spectrophotometric and photodiode array detectors. Also for inspection of the span for the refractive index detector.<br>This item is provided with detectors as a standard accessory. |
| Syringe adapter | 228-15672-91 | Same as above. |
| Coupling 1.6C | 228-16004-13 | For each kind of inspection and in plumbing the detector. |
| Male nut, PEEK | 228-18565 | Same as above. |
| Plug | 228-16006 | For inspection of the drift/noise for the refractive index detector. |
| Low-pressure Hg (mercury) lamp set | 200-38423 | For inspection of the wavelength accuracy for the photodiode array detector and the spectrofluorometric detector (RF-20A only).<br>The working voltage of the Hg lamp is 100 V AC.<br>Connect the Hg lamp and the power supply which is stepped down to 100 V AC using a transformer. |
| Low-pressure Hg (mercury) lamp holder | 228-34170-91 | For inspection of the wavelength accuracy for the photodiode array detector. |
| | 228-51952-91 | For inspection of the wavelength accuracy for the spectrofluorometric detector (RF-20A only). |
| Column<br>Shim-pack VP-ODS<br>or<br>LUNA C18 (2) | 228-34937-91<br>or<br>00F-4252-E0 | Particle size: 5 μm<br>Column dimension: I.D. 4.6 mm × length 150 mm<br>For system validation.<br>An equivalent ODS column may also be used. |

# 7.5 Detector Validation

## 7.5.1 Check Points

The check points for detector validation are listed below.

| Section | Check Points | Overview |
|---|---|---|
| 7.5.2 | Initialization check and ROM, RAM self diagnosis | • For the RF-20Axs:<br>Check the operation of the display, LEDs and drive section, check for correction operation of the wavelength accuracy check using the emission line of the low-pressure Hg (mercury) lamp, and check that the memory (ROM/RAM) is normal.<br>• For the RF-20A:<br>Check the operation of the display, LEDs and drive section, and check that the memory (ROM/RAM) is normal. |
| 7.5.3 | Firmware version check | Check the version of the firmware. |
| 7.5.4 | Check on cumulative operating time of Xenon lamp | Check the cumulative operating time of the Xenon lamp. |
| 7.5.5 | Wavelength accuracy check | Check the wavelength accuracy using the emission line of the low-pressure Hg (mercury) lamp. |
| 7.5.6 | Performance inspection | Inspect a performance using the raman spectrum of water. |
| 7.5.7 | Leak sensor test | Check the operation of the leak sensor. |

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## 7.5.2 Initialization Check and Self Diagnosis of the ROM and RAM

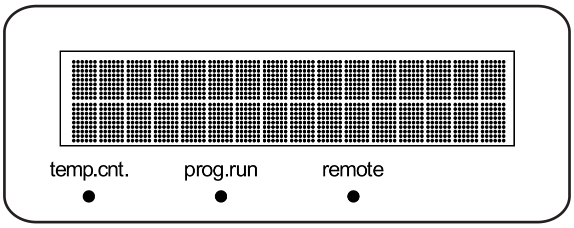
### ■ Objective

Check the operation of the display, LEDs and drive section, and check that the memory (ROM/RAM) is normal.

### ■ Check Procedure

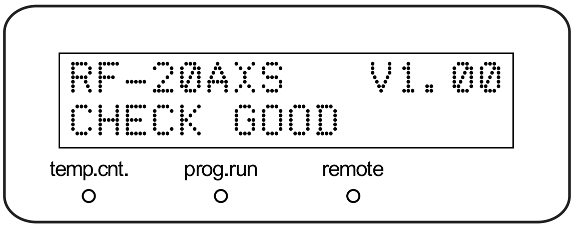
**1** Turn the power ON.

**2** Check that all of the dots in the display screen, and the LEDs in the key panel, are lit.




The initialization check ends and the system waits for the result to be displayed.

☞ "3.2 Turning the Power ON/OFF" P.3-3




| |
|---|
| **CHECK CRITERIA: [CHECK GOOD] is displayed on the screen.** |

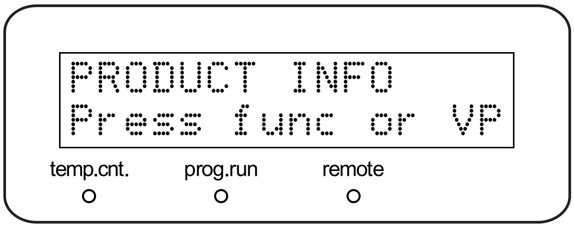
## 7.5.3 Checking the Firmware Version

### ■ Objective

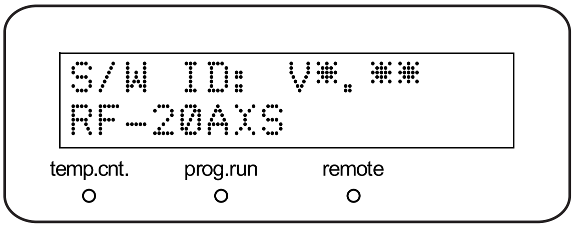
Check the version of the firmware.

### ■ Check Procedure

**1** Press **VP** on the initial screen.
[PRODUCT INFO] will be displayed.




**2** Press **func** twice.




**3** The version number appears.
"Showing the ROM Version Number [S/W ID]" P.5-37

| | |
|---|---|
| **CHECK CRITERIA:** | **The version number is displayed. The number is the same as the one used for administration purposes.** |

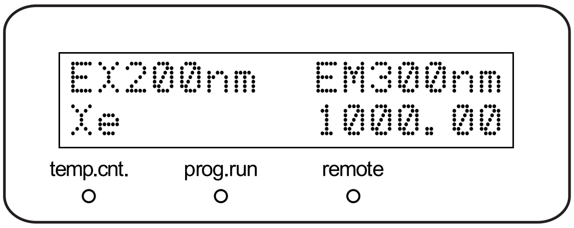
## 7.5.4 Checking the Cumulative Operating Time of the Xenon Lamp

### ■ Objective

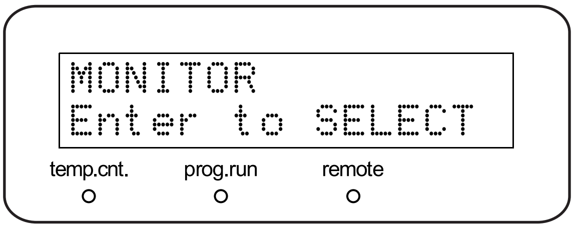
Check the cumulative operating time of the Xenon lamp.

### ■ Check Procedure

**1** Press **CE**.
The initial screen will be displayed.

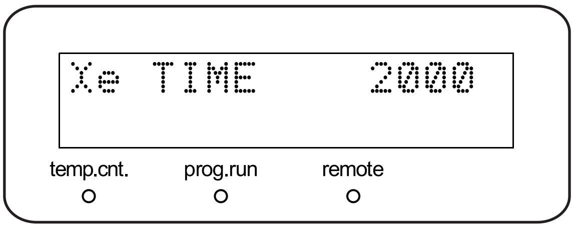



**2** Press **func** repeatedly until [MONITOR] appears.




**3** Press **enter**.
[SMPL EN, REF EN] will be displayed.

**4** Press **func**.
[Xe TIME] appears, and the cumulative operating time of the Xenon lamp is displayed.




**5** Press **CE** several times.
The initial screen is redisplayed.

| **CHECK CRITERIA: Cumulative operating time: Within 2000 hours** |
|---|

## 7.5.5 Checking Wavelength Accuracy

### ■ Objective

Check whether the difference between the set wavelength and the true wavelength satisfies the check criteria or not.

| Item | Details of Implementation |
|---|---|
| Emission wavelength check | Move the excitation grating to the 254 nm position, which is the emission line of the low-pressure Hg (mercury) lamp, perform scanning at the emission side from in front of the 254 nm line and in front of the 507 nm line (secondary line), and read the wavelength of the emission line. Calculate the difference between the wavelength of the read emission line and the wavelength of the true emission line and, if it is within ± 2.0 nm, judge the result to be normal. |
| Excitation wavelength check | Move the emission grating to the 254 nm position, perform scanning at the excitation side from in front of the 254 nm line and in front of the 507 nm line (secondary line), and read the wavelength of the emission line. Calculate the difference between the wavelength of the read emission line and the wavelength of the true emission line and, if it is within ± 2.0 nm, judge the result to be normal. |

### Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Water (for HPLC, or equivalent) | – | – |
| Low-pressure Hg (mercury) lamp (RF-20A only) | Option | 200-38423 |
| Low-pressure Hg (mercury) lamp holder (RF-20A only) | Option | 228-51952-91 |
| Step down transformer* (RF-20A only) | – | – |

* The working voltage of the low-pressure Hg lamp is 100 V AC.
Connect the low-pressure Hg lamp to a power supply that is stepped down to 100 V AC using a transformer.

NOTE

The wavelength accuracy check can only be executed in the single wavelength mode. Set the measurement mode to single wavelength mode.

☞ "4.1.1 Setting the Measurement Mode" P.4-2
"Setting the Measurement Mode [λ MODE]" P.5-17

7

## ■ Check Procedure (for RF-20Axs)

NOTE

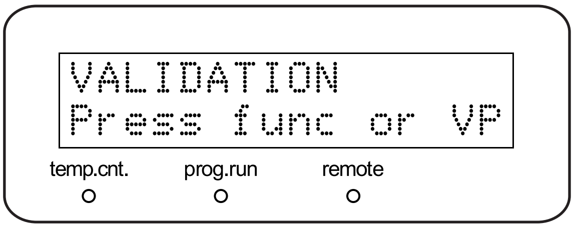
To discontinue the inspection, press **CE**.

**1** When a system controller is being used, set [1] for [LOCAL] in the system settings group.

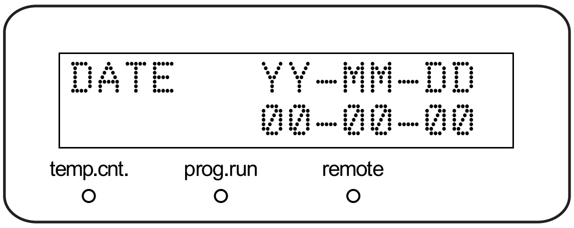
**2** Using the pump, pump water into the flow cell (flow rate: 1 mL/min).

**3** After checking that there are no air bubbles inside it, fit the flow cell.

**4** With the initial screen displayed, repeatedly press **VP** until [VALIDATION] appears.

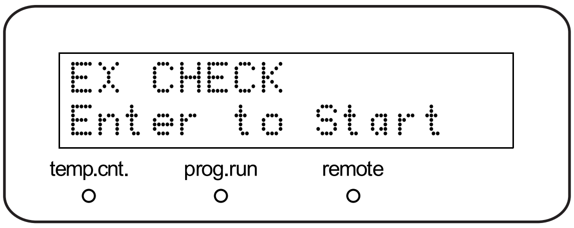



**5** Press **func**.
[DATE] will be displayed.

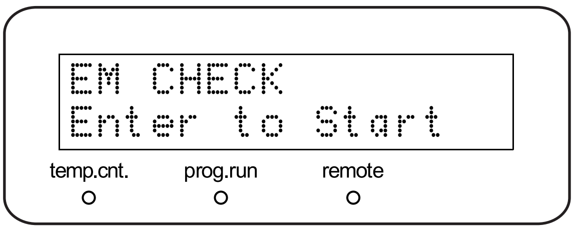



**6** Repeatedly press **func** until [EX CHECK] or [EM CHECK] appears.

[EX CHECK]




[EM CHECK]

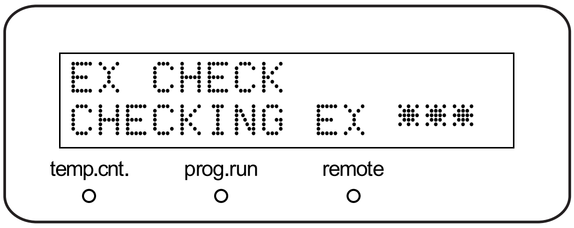



NOTE

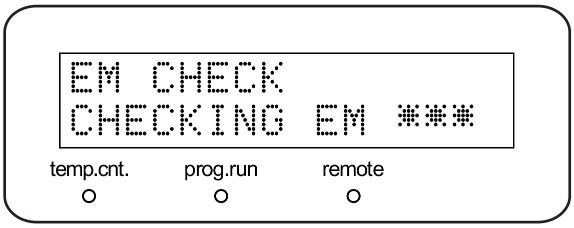
For a wavelength accuracy check at the excitation side, execute [EX CHECK], and for a wavelength accuracy check at the emission side, execute [EM CHECK].

**7** Press (**enter**).

After waiting about 2 minute for the low-pressure Hg (mercury) lamp to stabilize, [EX CHECK] or [EM CHECK] starts.



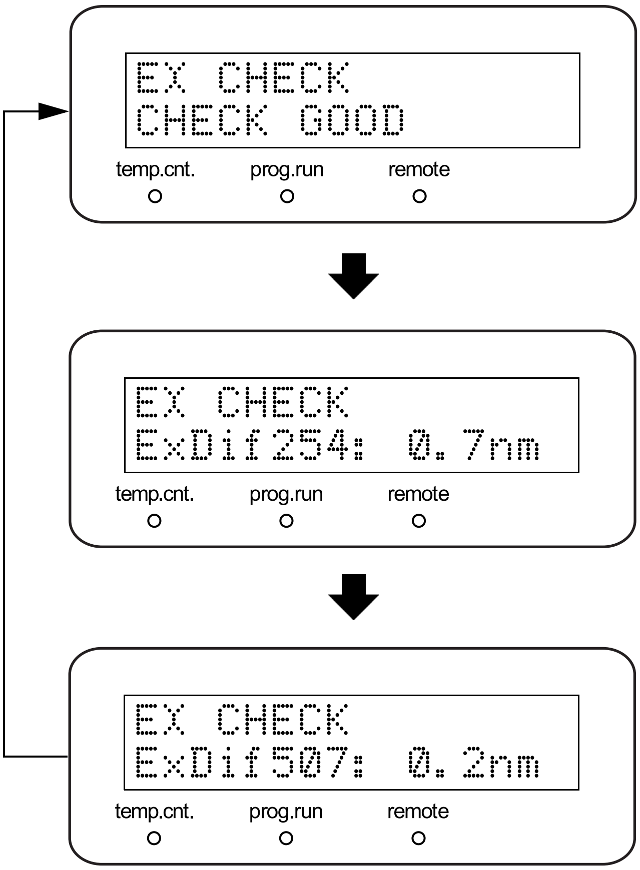

During wavelength accuracy check the screen to the right is displayed.
The wavelength that is being checked is indicated at [***]. When the wavelength accuracy check ends, the wavelength accuracy is displayed on the screen.




- If it is normal:

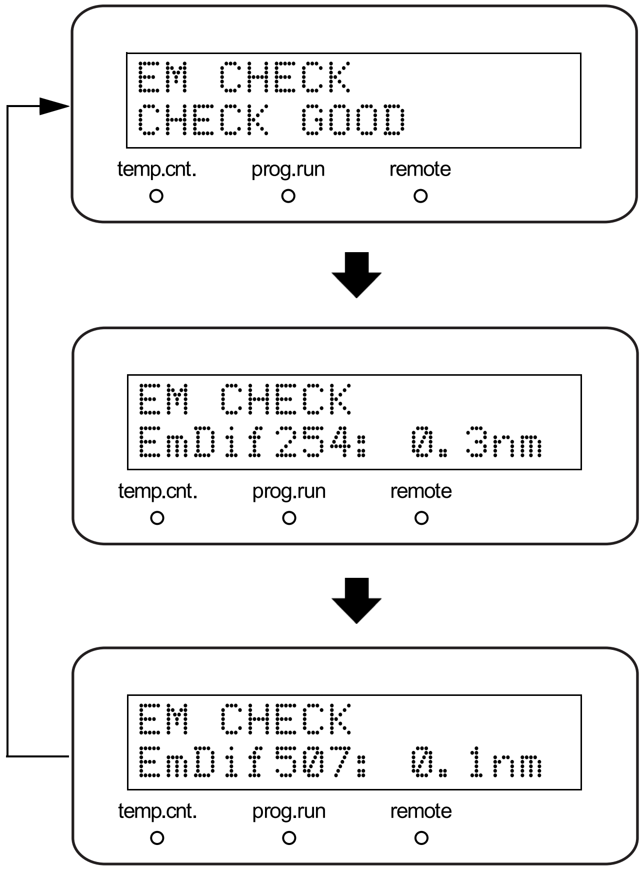
If the difference in wavelength is within the standard, [CHECK GOOD] and the actually measured values for each point are displayed alternating at two-second intervals.

[EX CHECK]




7

[EM CHECK]

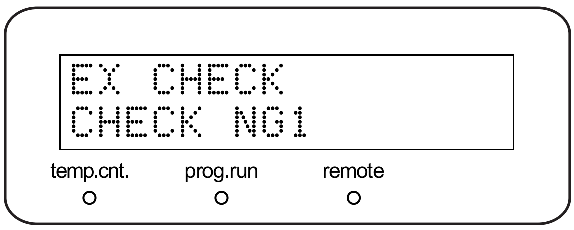



- If there is an abnormality:

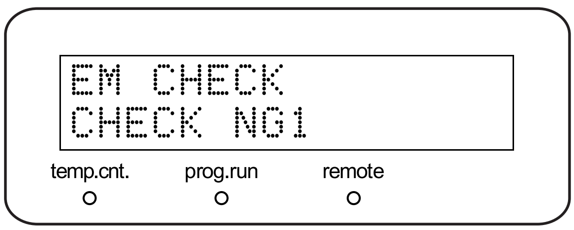
The screen to the right appears.

☞ "6.2 Dealing with Error Messages" P.6-5

[EX CHECK]




[EM CHECK]




**8** Press **CE** several times.

The initial screen is redisplayed.

| | |
|---|---|
| **CHECK CRITERIA:** | **For both excitation side and emission side** |
| | **Wavelength accuracy at 254 nm: Within ± 2.0 nm** |
| | **Wavelength accuracy at 507 nm: Within ± 2.0 nm** |

When a system controller or LCsolution is used, perform the following operation before analyzing the sample.

### When the system controller is connected:

1. Turn the power to the system controller OFF.
2. Set [0] for [LOCAL] in the system settings group.
3. Restart the system controller.

### When LCsolution is used:

1. Exit LCsolution.
2. Turn the power to the system controller OFF.
3. Set [0] for [LOCAL] in the system settings group.
4. After restarting the system controller, start LCsolution.



NOTE

Before starting analysis when using a system controller or LCsolution, be sure to set [0] for [LOCAL] in the system settings group, then restart the system controller and LCsolution.

## Check Procedure (for RF-20A)

NOTE

To discontinue the inspection, press CE.

1 When a system controller is being used, set [1] for [LOCAL] in the system settings group.

2 Set [0] for [LAMP] in the parameter settings group to extinguish the Xenon lamp.
Wait at least 30 minutes after that for the Xenon lamp to cool.

3 Turn the power to the instrument OFF.

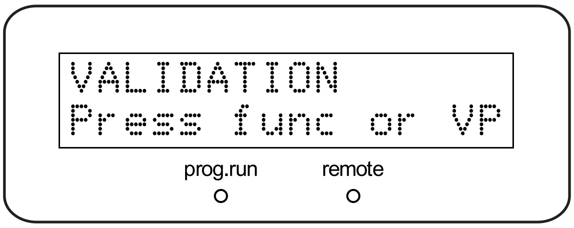
4 Fit the low-pressure Hg (mercury) lamp.
"9.1.10 Fitting the Low-Pressure Hg (Mercury) Lamp (RF-20A Only)" P.9-37

5 Using the pump, pump water into the flow cell (flow rate: 1 mL/min).

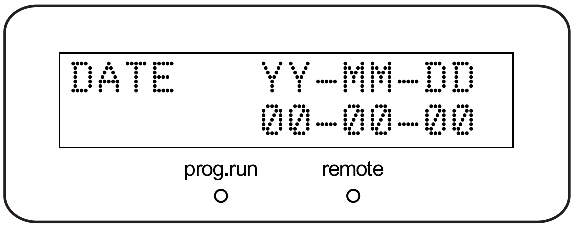
6 After checking that there are no air bubbles inside it, fit the flow cell.

7 Turn the power to the instrument ON.

8 With the initial screen displayed, repeatedly press VP until [VALIDATION] appears.

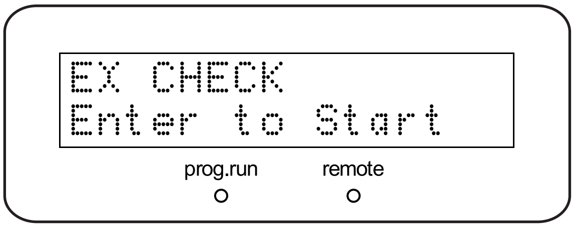



9 Press func.
[DATE] will be displayed.



**10** Repeatedly press **func** until [EX CHECK] or [EM CHECK] appears.

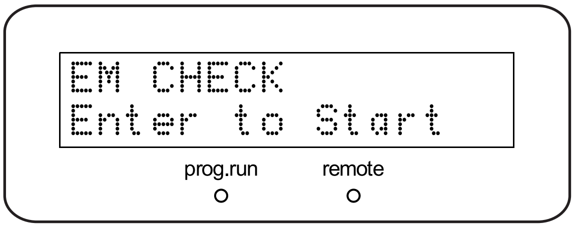
[EX CHECK]



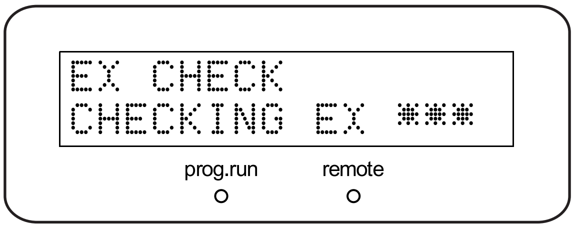

NOTE

For a wavelength accuracy check at the excitation side, execute [EX CHECK], and for a wavelength accuracy check at the emission side, execute [EM CHECK].

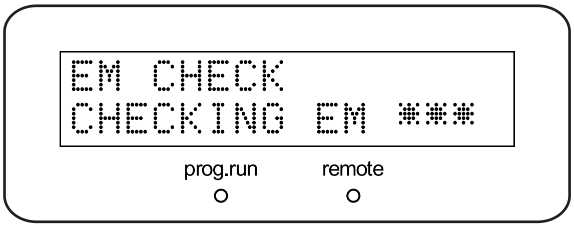
[EM CHECK]




**11** Press **enter**.
[EX CHECK] or [EM CHECK] starts.



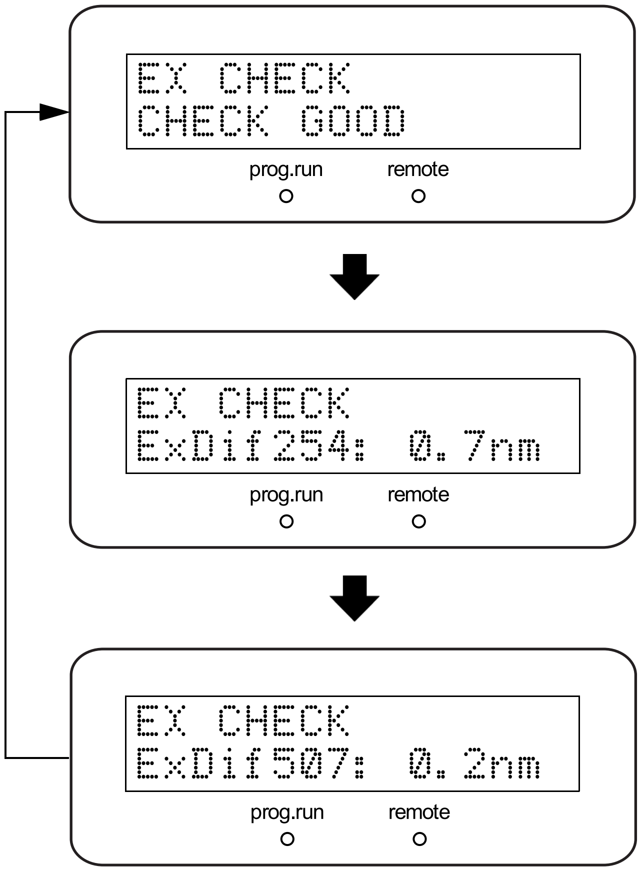

During wavelength accuracy check the screen to the right is displayed.
The wavelength that is being checked is indicated at [***]. When the wavelength accuracy check ends, the wavelength accuracy is displayed on the screen.



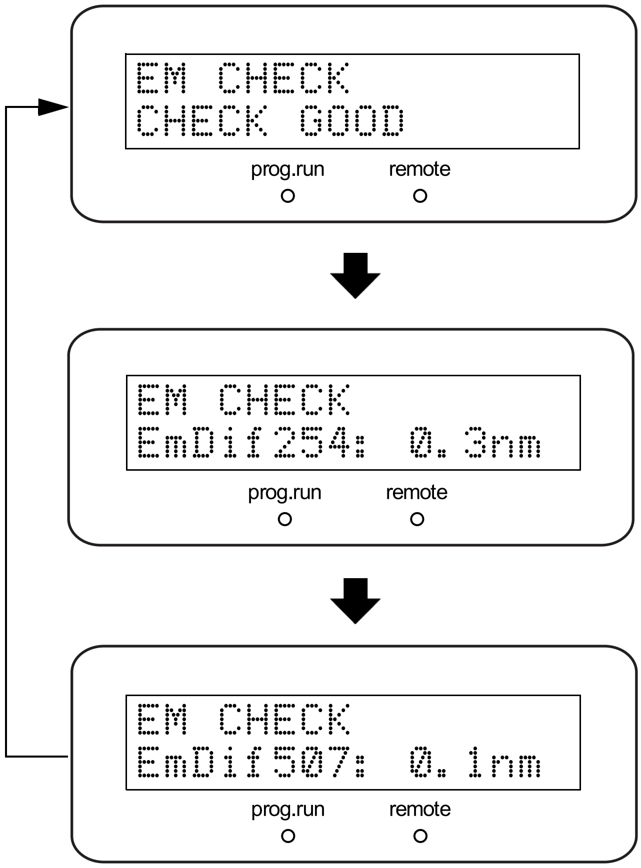
- If it is normal:

If the difference in wavelength is within the standard, [CHECK GOOD] and the actually measured values for each point are displayed alternating at two-second intervals.

[EX CHECK]



[EM CHECK]

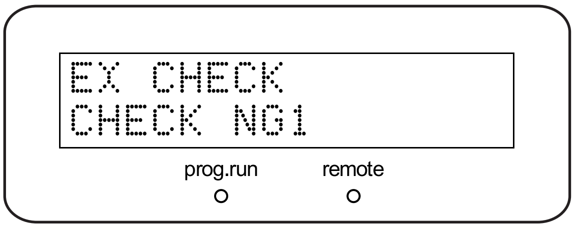



- If there is an abnormality:

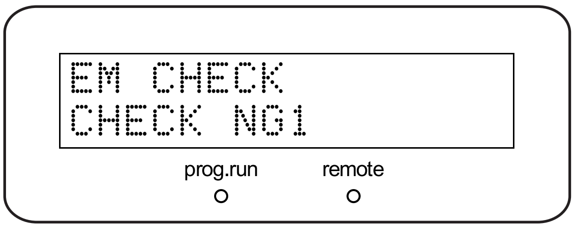
The screen to the right appears.

☞ "6.2 Dealing with Error Messages" P.6-5

[EX CHECK]




[EM CHECK]




**12** Press **CE** several times.

The initial screen is redisplayed.

NOTE

After the wavelength check has ended, be sure to remove the low-pressure Hg (mercury) lamp, and fit the Xenon lamp as it was fitted before.

**CHECK CRITERIA: For both excitation side and emission side**
**Wavelength accuracy at 254 nm: Within ± 2.0 nm**
**Wavelength accuracy at 507 nm: Within ± 2.0 nm**

After the wavelength accuracy inspection, perform the operation below.

### When neither a system controller nor LCsolution is used:

1. Turn the power to the instrument OFF.
2. Remove the low-pressure Hg (mercury) lamp, and fit the Xenon lamp as it was originally fitted.

### When the system controller is connected:

1. Turn the power to the instrument and the system controller OFF.
2. Remove the low-pressure Hg (mercury) lamp and fit the Xenon lamp as it was originally fitted.
3. Turn the power to the instrument ON and set [0] for [LOCAL] in the system settings group.
4. Restart the system controller.

### When LCsolution is used:

1. Exit LCsolution.
2. Turn the power to the instrument and the system controller OFF.
3. Remove the low-pressure Hg (mercury) lamp and fit the Xenon lamp as it was originally fitted.
4. Turn the power to the instrument ON and set [0] for [LOCAL] in the system settings group.
5. After restarting the system controller, start LCsolution.

NOTE

Before starting analysis when using a system controller or LCsolution, be sure to set [0] for [LOCAL] in the system settings group, then restart the system controller and LCsolution.

## 7.5.6 Inspecting a Performance Using the Raman Spectrum of Water

### ■ Objective

Sensitivity and S/N ratio checks, and a simple wavelength accuracy check, are performed by using the raman spectrum of water.

To carry out a detailed check on wavelength accuracy, see "7.5.5 Checking Wavelength Accuracy" P.7-11.

The explanation given here assumes the use of a Chromatopac or LCsolution.

For details of operation for Chromatopac and LCsolution, refer to the respective instruction manuals.

#### Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Methanol | For cleaning, product for HPLC or equivalent | – |
| Water | For cleaning, product for HPLC or equivalent | – |



### ■ Substituting Water in the Flow Line

Before starting the inspection, follow the procedure below to substitute water in the system flow line.

1. Open the front cover and the key panel.
2. Remove the column.
3. Connect the inlet and outlet tubes of the column with a 1.6C coupling, or connect the pump and the cell inlet tube with a tube.
4. Pour water into the reservoir bottle and feed it with the pump to substitute water in the flow line.

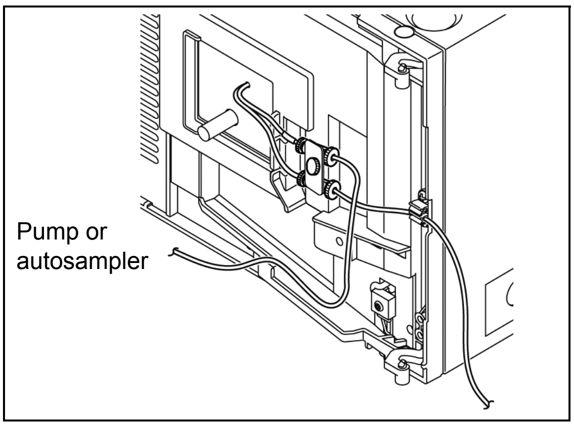



Fig. 7.1

NOTE

If the mobile phase is not miscible with water, first substitute it with a solvent that is miscible with both water and the mobile phase, then substitute this solvent with water.

**5** Remove the flow cell unit from the instrument. Check that there are no air bubbles in the cell.

**6** Fit the flow cell to the instrument, then close the front panel and the key panel.

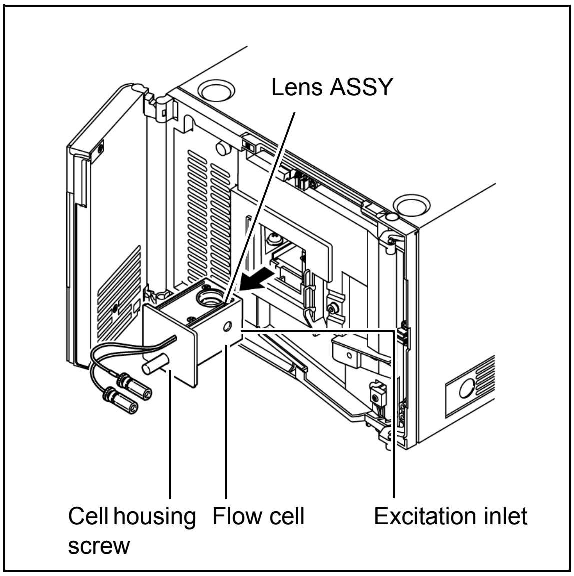



Fig. 7.2

**7** Carry out the inspection while pumping the water with the pump (flow rate: 1 mL/min).

## ■ Check Procedure (When Using a Chromatopac)

NOTE

To discontinue the performance inspection, press CE.

**1** Connect the instrument's analog output connector 1 and the Chromatopac, and turn the power to both units ON.

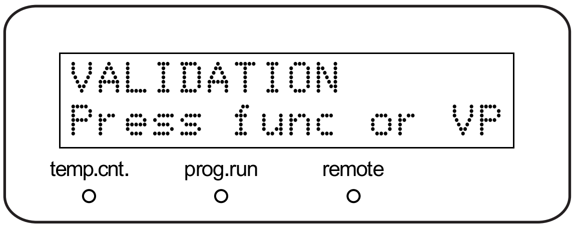
☞ "Connecting to a Chromatopac" P.9-31

**2** When a system controller is being used, set [1] for [LOCAL] in the system settings group.

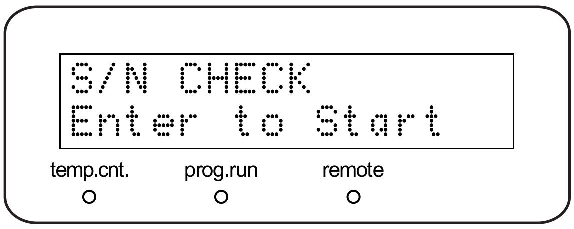
**3** Check that the Xenon lamp is lit.

* Wait at least 1 hour after lighting the Xenon lamp before starting the inspection.

**4** With the initial screen displayed, repeatedly press VP until [VALIDATION] appears.



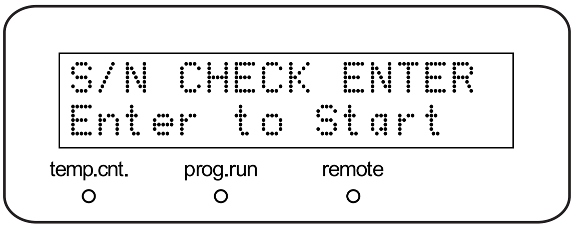

**5** Repeatedly press func until [S/N CHECK] appears.



**6** Press **enter**.
The instrument is automatically given the following settings.

| Item Set | Set Value |
|---|---|
| EX (excitation wavelength) | 350 nm |
| EM (emission wavelength) | 450 nm |
| GAIN | 2 (× 4) |
| SPC TYPE | 2 (emission scanning) |
| Start wavelength for EM SCAN | 350 nm |
| End wavelength for EM SCAN | 450 nm |
| SENS | 2 (MED) |
| RESPONSE | 5 (1.5 sec) |
| ANALOG1 MODE | 0 (Chromatopac) |

After setting has finished, automatic zeroing is executed and the screen to the right is displayed.




**7** Set a Chromatopac as follows.

| Item Set | Set Value |
|---|---|
| ATTEN | 7 (128 mV/full scale) |
| SPEED | 50 mm/min |

**8** Check the input signal level of the Chromatopac.

NOTE

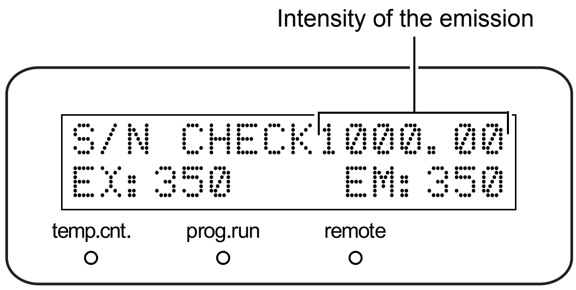
Check whether the input signal is within the range -1000 to +5000 uV. If it is outside this range, press **zero** to adjust the zero position, then check the input signal level again.

**9** Execute auto zeroing of the Chromatopac and start the Chromatopac record.

**10** Press (**enter**).

Spectrum scanning for the emission wavelength takes place automatically.

During spectrum scanning the screen to the right is displayed.




- When the raman spectrum peak is detected:

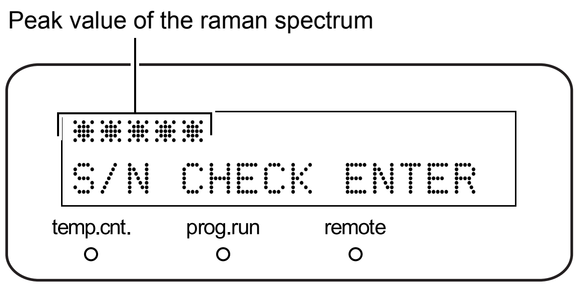
Spectrum scanning ends normally. The instrument is automatically given the following settings.

| Item Set | Set Value |
|---|---|
| EX (excitation wavelength) | 350 nm |
| EM (emission wavelength) | Peak wavelength of the measured raman spectrum |
| GAIN | 2 (× 4) |
| SENS | 2 (MED) |
| RESPONSE | 5 (1.5 sec) |
| ANALOG1 MODE | 0 (Chromatopac) |

After setting has finished, automatic zeroing is executed and the screen to the right is displayed.

Now continue by measuring the noise.

Proceed to step 11.



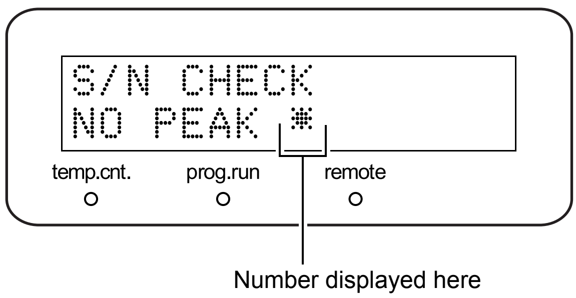

- If the peak of the raman spectrum was not detected, or the peak value is outside the established range:

Spectrum scanning ends abnormally.

The screen to the right appears.

Press (**CE**) to return to the screen at step 5.

Follow the procedure again from step 6.




NOTE

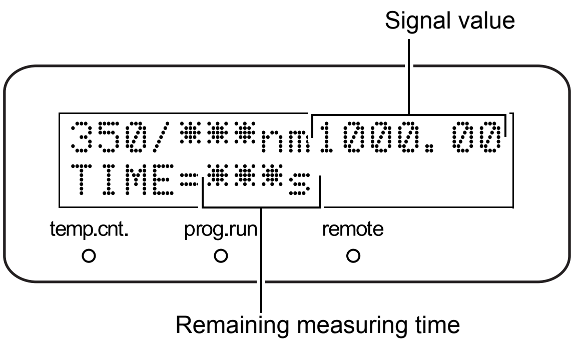
If the screen to the right is displayed repeatedly, see "No raman peak of water is observed." P.6-3 in "6.1 Troubleshooting and Corrective Action".

**11** Set a Chromatopac as follows.

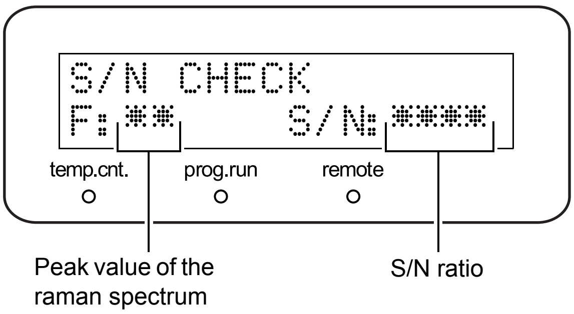
| Item Set | Set Value |
|---|---|
| ATTEN | 1 (2 mV/full scale) |
| SPEED | 10 mm/min |

**12** Move the Chromatopac's pen position to the zero on the recording paper, then start recording with the Chromatopac.

**13** Press (enter).
Measurement of noise starts automatically.
During measurement, the screen to the right is displayed.




After 15 minutes of measuring the noise, the peak value of the raman spectrum (the value at F on the screen to the right) and the S/N ratio are calculated and shown on the screen.




**14** This completes recording by the Chromatopac.

**15** On pressing (CE) several times, the performance inspection is ended and the initial screen is redisplayed.

## Detection of the raman spectrum's peak and calculation of noise

- The intensity value (F in the figure to the right) of the emission wavelength that corresponds to the peak of the raman spectrum is recorded in the instrument's memory, and is used for calculation of the S/N ratio.

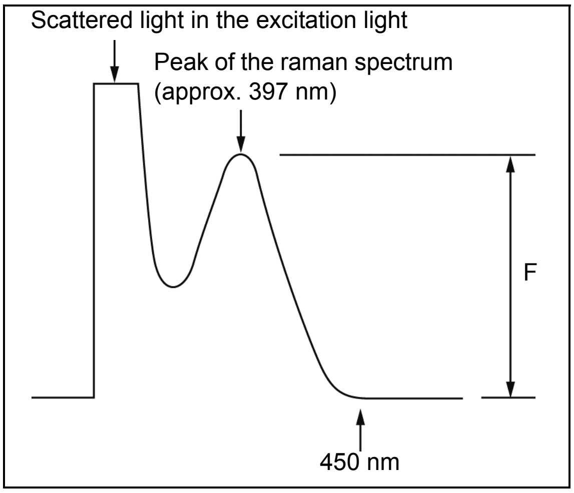



Fig. 7.3

- For noise, a section of baseline measured over 15 minutes is divided up at 30-second intervals, the difference between the minimum and maximum noise values in each interval is found, and the average value across all the intervals is taken as the noise width.

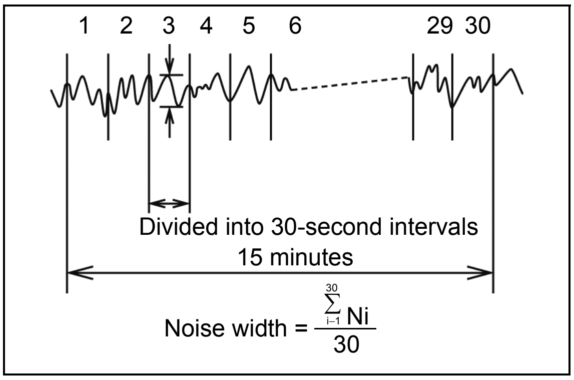



Fig. 7.4

| | |
|---|---|
| **CHECK CRITERIA:** | **30 ≤ F value ≤ 100** |
| | **S/N ≥ 600 (RF-20A)** |
| | **1000 (RF-20Axs)** |

If a system controller is connected, perform the following operation before starting sample analysis.

1. Turn the power to the system controller OFF.
2. Set [0] for [LOCAL] in the system settings group.
3. Restart the system controller.

NOTE

Before starting analysis when using a system controller or LCsolution, be sure to set [0] for [LOCAL] in the system settings group, then restart the system controller and LCsolution.

## ■ Check Procedure (When Using LCsolution)

NOTE

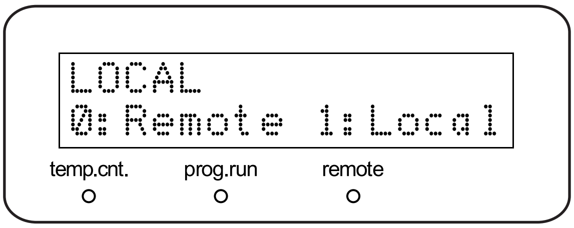
To discontinue the performance inspection, press CE.

**1** Turn the power to this instrument, the system controller, and LCsolution, ON.

NOTE

Set the settings for RF-20A/RF-20Axs in [System configuration] of LCsolution as follows.
Wavelength mode: Single
Base period: 20 msec or more
After finishing this inspection, set the settings to the former values.

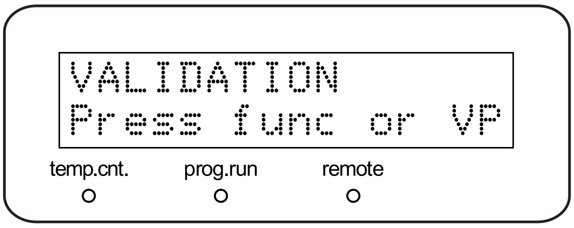
**2** Set [1] for [LOCAL] at this instrument.
☞ "Setting the Local Mode [LOCAL]" P.5-29



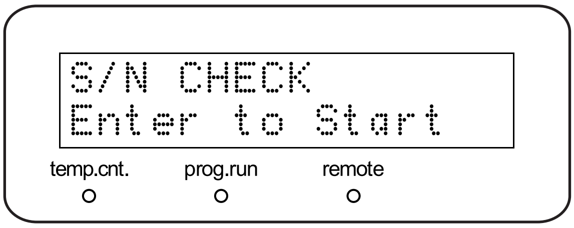

**3** Check that the Xenon lamp is lit.
Wait at least 1 hour after lighting the Xenon lamp before starting the inspection.

**4** Display the [Data Acquisition] window of LCsolution.

**5** With the initial screen displayed, repeatedly press VP until [VALIDATION] appears.



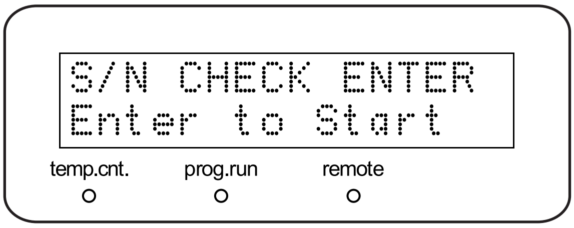
**6** Repeatedly press (**func**) until [S/N CHECK] appears.




**7** Press (**enter**).
The instrument is automatically given the following settings.

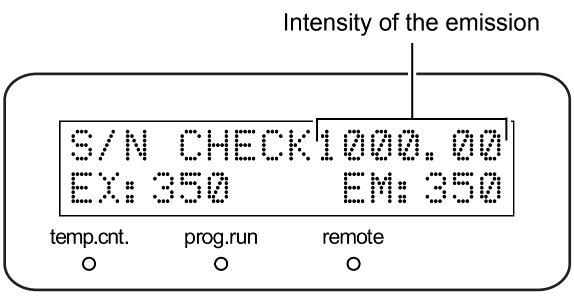
| Item Set | Set Value |
|---|---|
| EX (excitation wavelength) | 350 nm |
| EM (emission wavelength) | 450 nm |
| GAIN | 2 ($\times$ 4) |
| SPC TYPE | 2 (emission scanning) |
| Start wavelength for EM SCAN | 350 nm |
| End wavelength for EM SCAN | 450 nm |
| SENS | 2 (MED) |
| RESPONSE | 5 (1.5 sec) |
| ANALOG1 MODE | 0 (Chromatopac) |

After setting has finished, automatic zeroing is executed and the screen to the right is displayed.






**8** Press (**enter**).
Spectrum scanning for the emission wavelength takes place automatically.
During spectrum scanning the screen to the right is displayed.

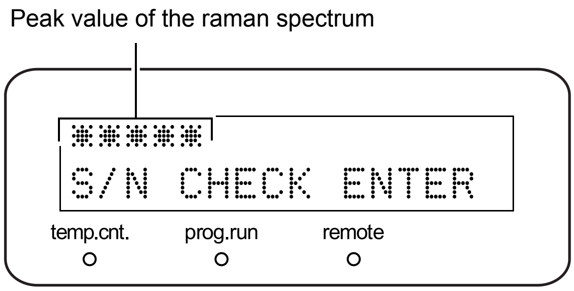


- When the raman spectrum peak is detected:

Spectrum scanning ends normally. The instrument is automatically given the following settings.

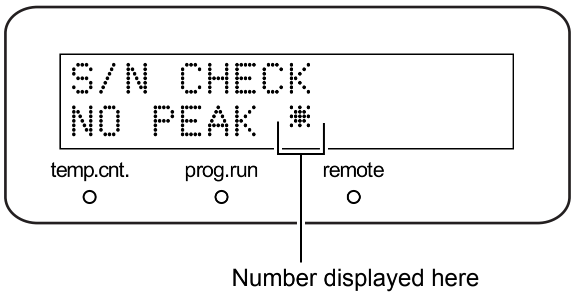
| Item Set | Set Value |
|---|---|
| EX (excitation wavelength) | 350 nm |
| EM (emission wavelength) | Peak wavelength of the measured raman spectrum |
| GAIN | 2 (× 4) |
| SENS | 2 (MED) |
| RESPONSE | 5 (1.5 sec) |
| ANALOG1 MODE | 0 (Chromatopac) |

After setting has finished, automatic zeroing is executed and the screen to the right is displayed. Now continue by measuring the noise.
Proceed to step 9.




- If the peak of the raman spectrum was not detected, or the peak value is outside the established range:

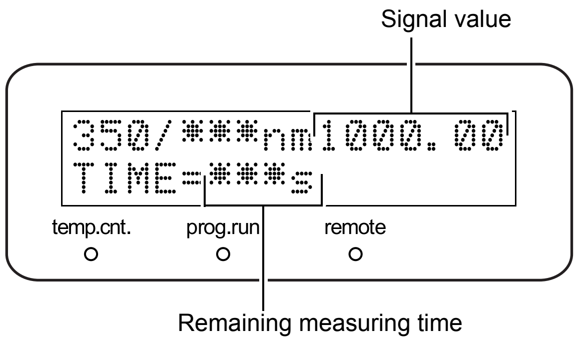
Spectrum scanning ends abnormally.
The screen to the right appears.
Press **CE** to return to the screen at step 6.
Follow the procedure again from step 7.



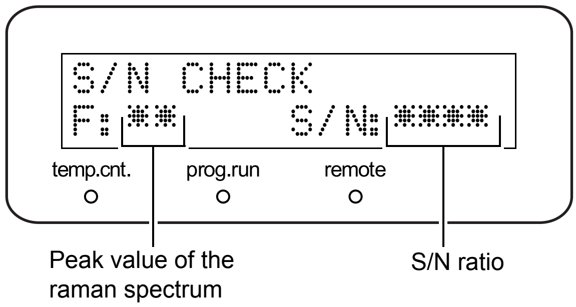

NOTE

- If the [No PEAK*] screen is displayed repeatedly, see "No raman peak of water is observed." in "6.1 Troubleshooting and Corrective Action" P.6-2.
- To check the shape of the spectrum, see the [Chromatogram View] in the [Data Acquisition] window of LCsolution.

**9** Press (enter).
Measurement of noise starts automatically.
During measurement, the screen to the right is displayed.




After 15 minutes of measuring the noise, the peak value of the raman spectrum (the value at F on the screen to the right) and the S/N ratio are calculated and shown on the screen.




NOTE

To check the noise, see the [Chromatogram View] in the [Data Acquisition] window of LCsolution.

7

**10** On pressing (CE) several times, the performance inspection is ended and the initial screen is redisplayed.

## Detection of the raman spectrum's peak and calculation of noise

- The intensity value (F in the figure to the right) of the emission wavelength that corresponds to the peak of the raman spectrum is recorded in the instrument's memory, and is used for calculation of the S/N ratio.

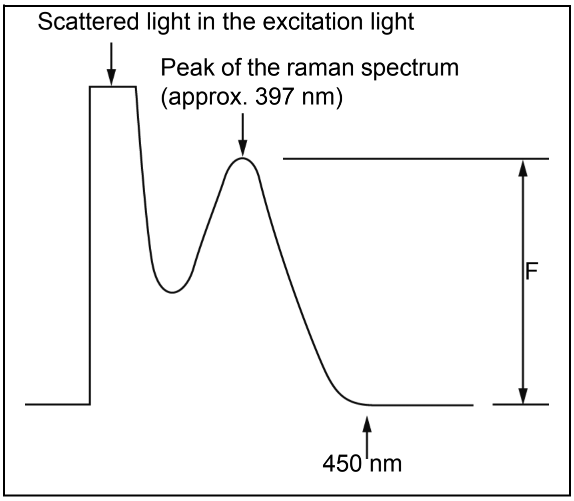
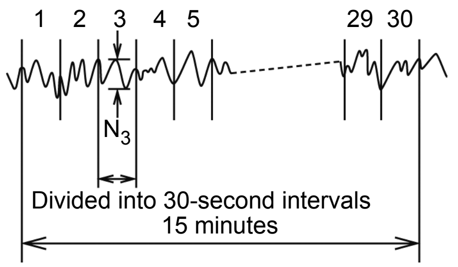



Fig. 7.5

- For noise, a section of baseline measured over 15 minutes is divided up at 30-second intervals, the difference between the minimum and maximum noise values in each interval is found, and the average value across all the intervals is taken as the noise width.




$$\text{Noise width} = \frac{\sum_{i=1}^{30} N_i}{30}$$

Fig. 7.6

| | |
|---|---|
| **CHECK CRITERIA:** | **30 ≤ F value ≤ 100** |
| | **S/N ≥ 600 (RF-20A)** |
| | **S/N ≥ 1000 (RF-20Axs)** |

Before starting sample analysis, perform the operation below.

**1** Turn the power to the system controller OFF.

**2** Set [0] for [LOCAL] in the system settings group.

**3** After restarting the system controller, start LCsolution.

NOTE

Before starting analysis when using a system controller or LCsolution, be sure to set [0] for [LOCAL] in the system settings group, then restart the system controller and LCsolution.

## 7.5.7 Checking the Leak Sensor

### ■ Objective

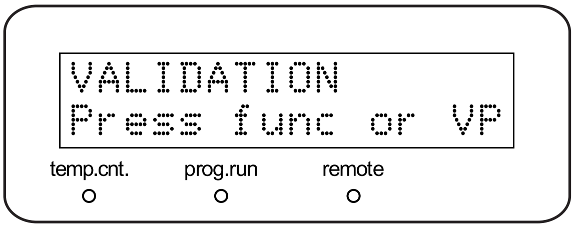
Check the operation of the leak sensor.

NOTE

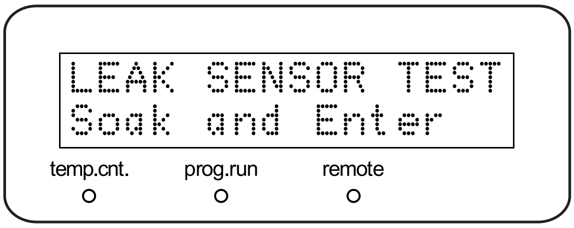
Take care that the leak sensor doesn't make contact with the plastic parts of the instrument.
After the test has ended, wipe up water in the vicinity of the leak sensor.

### ■ Check Procedure

**1** With the initial screen displayed, press **VP** three times.
[VALIDATION] will be is displayed.




**2** Repeatedly press **func** until [LEAK SENSOR TEST] appears.






**3** Dampen, with water, the thermosensor below the leak sensor by using the syringe or e.g. absorbent cotton.

NOTE

- In order to prevent the front cover falling off, remove it from the instrument before starting the work.
- During the test, take care not to bend the leak sensor.
- Take care that the thermosensor doesn't make contact with the instrument's leak tray.

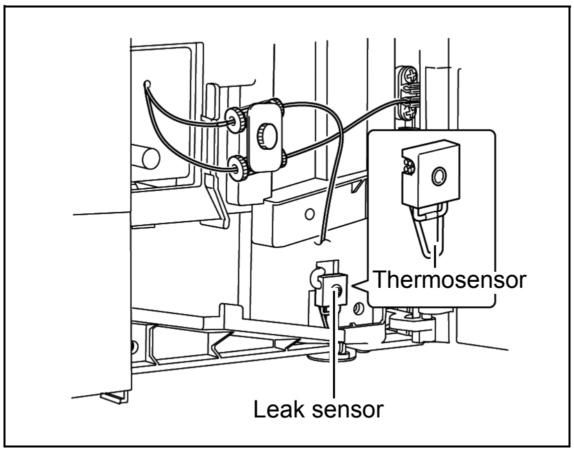
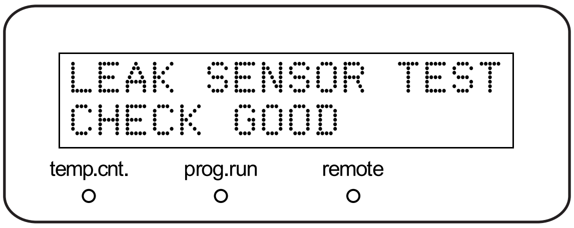



Fig. 7.7

**4** After about 10 seconds, press (**enter**).

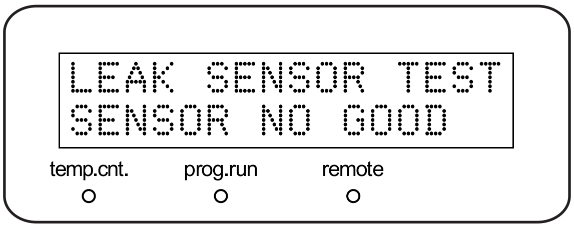
When a leak is detected, [CHECK GOOD] is displayed.

When a leak is detected:




When no leak is detected, [SENSOR NO GOOD] is displayed.

When no leak is detected:




**5** Press (**CE**).

The result display is cleared.

* If the result is [SENSOR NO GOOD], automatically calibrate the leak sensor and change its actuation level by following the sections on [L-CAL] and [LEAK THR].

"Calibrating the Leak Sensor [L-CAL]" P.5-45
"Setting the Leak Sensor Actuation Level [LEAK THR]" P.5-45

**CHECK CRITERIA: [CHECK GOOD] is displayed on the screen.**

# 7.6 System Validation

- The LC system comprises many individual components. It is a complete system that allows you to verify whether all of the individual components are in the appropriate status. It is subject to direct verification under conditions that conform to the intended use, and with system variations the performance of components on which measurement in isolation is impossible, and the performance of the system, are inspected.
- The standard system validation procedure described in this section is used to determine whether the LC system is functioning normally. This procedure constitutes the basis of the LC system performance inspection.
- System validation is performed at installation, and periodically thereafter. If a problem occurs during operation, system validation may be performed to determine whether the problem is in the LC system or in the analysis method.
- If the LC system passes the system validation, it can be assumed that the LC system is normal and that the problem lies in the particular analysis method or conditions being used.
- If the LC system does not pass the system validation, it may be assumed that there is an abnormality in the system, and component validation must be performed to identify the malfunctioning component(s).

## 7.6.1 Validation of an Isocratic LC System

### ■ Objective

An analysis is performed on the LC system being validated and the retention time and peak area are obtained for each peak. The data is then examined to check for reproducibility. Reproducible data validates the system. Generally, the system to be validated must consist of a minimum of the following components: a pump, column oven, autosampler, detector, system controller and data processor.

### ■ Equipment Required for Validation

| Part Name | Description |
|---|---|
| Mobile phase | Methanol/water = 9/1 (v/v)<br>* Use water and methanol that are for use with a liquid chromatograph. |
| Column | Shim-pack VP-ODS (part No.: 228-34937-91), LUNA C18 (2) (part No.: 00F-4252-E0) or equivalent ODS column Particle size: 5 µm, column dimension: I.D. 4.6 mm × length 150 mm |
| Sample | 1 mg/L solution of anthracene in acetonitrile (part No.: 228-32996-15)<br><Preparation Procedure><br>1. Weigh 20 mg of anthracene and place it in a 200-mL measuring flask.<br>2. Dissolve the anthracene in acetonitrile, and bring the total volume up to 200 mL.<br>3. Measure out 1 mL of the solution prepared in step 2 and place it in a 100-mL measuring flask.<br>4. Add acetonitrile to the solution in the measuring flask in step 3 to bring the total volume up to 100 mL. |
| Methanol | HPLC grade, or equivalent |
| 2-propanol | HPLC grade, or equivalent |

## ■ Checking and Preparing the LC System

**1** Check the connection status of each unit. Details on the connection of each unit are given in the units' instruction manuals. Connect the input cable of the Chromatopac through the relay terminal block provided with the Chromatopac to the integrator terminal of the detector with the signal cable (accessory with the detector).

* If the system normally uses a Chromatopac or LC workstation, the connections used for regular analysis will be satisfactory.

**2** Check the plumbing of the LC system. In particular, ensure that the plumbing from the autosampler outlet to the column inlet, and that from the column outlet to the detector inlet uses tubing with an internal diameter of no greater than 0.3 mm and no longer than 300 mm in order to keep the volume outside the column as small as possible.

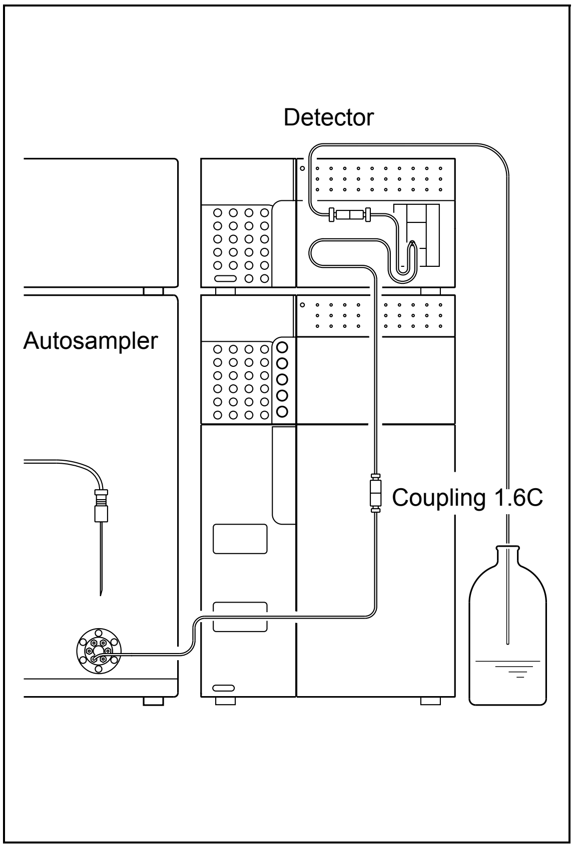



Fig. 7.8

**3** Clean the system flow lines using one of the procedures described below.
Before cleaning the flow lines, remove the column from the system, and connect the column inlet tubing to the column outlet tubing with a coupling 1.6C ("Fig. 7.8").

For a new system:
Clean the flow lines first with 2-propanol, then with water. In each case, pass the liquid through the flow lines for 10 minutes, at a rate of 2 mL/min.

For a system in use that uses a mobile phase with a low dielectric constant, such as hexane:
Clean the flow lines first with 2-propanol, then with water. In each case, pass the liquid through the flow lines for 10 minutes, at a rate of 2 mL/min.

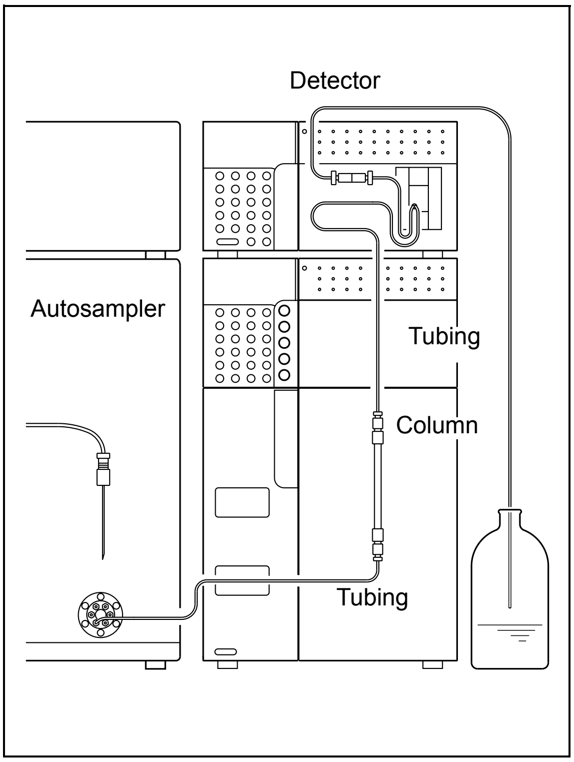



Fig. 7.9

7

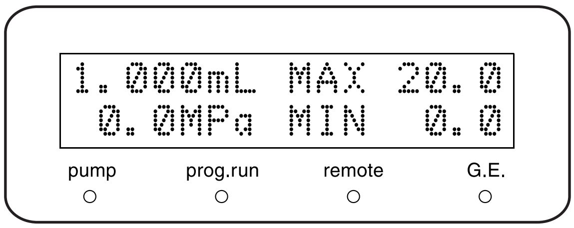
For a system that has been using a mixture of a water solution and an organic solvent as mobile phase, or water plus an organic solvent miscible with water (methanol, acetonitrile, etc.):
Clean the flow lines with water. Pass water through the flow lines for 10 minutes, at a rate of 2 mL/min.

**4** When cleaning is finished, pour mobile phase (mixture of methanol and water (9/1, (v/v)) into the reservoir bottle, and reconnect the column with the LC system ("Fig. 7.9"). Pour methanol into the reservoir bottle as a rinse liquid to purge the autosampler.

## ■ Check Procedure

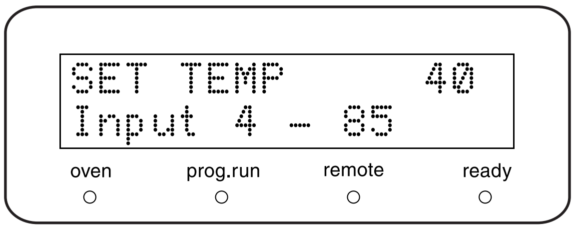
**1** Set the pumping flow rate to 1 mL/min.
Refer to the pump's instruction manual for the setting procedure.

Pump's display screen




**2** Set the column oven temperature to 40 °C.
Refer to the column oven's instruction manual for the setting procedure.

Column oven's display screen



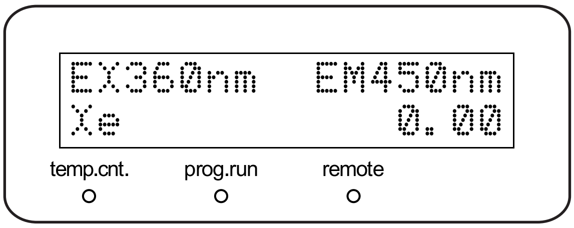

**3** Press **pump** on the pump panel, and **oven** on the column oven panel. Pumping and temperature regulation will start. Verify that liquid flows through the detector outlet tubing, and that there are no leaks from any of the connections.

**4** Set the detector parameters.

"Parameter Settings for Isocratic System Validation" P.7-40

Refer to the detector's instruction manual for the setting procedure.

Detector's display screen




**5** Set the autosampler parameters.

"Parameter Settings for Isocratic System Validation" P.7-40

Refer to the autosampler's instruction manual for the setting procedure.

**6** Set the data processor parameters.

"Parameter Settings for Isocratic System Validation" P.7-40

Refer to the data processor's instruction manual for the setting procedure.

**7** Monitor the baseline.

When the baseline has stabilized, press **zero** on the detector, then inject 10 µL of mobile phase, and verify that no peaks are observed.

**8** Inject 10 µL of the test sample six times, and analyze the data obtained.

**9** From the peak data obtained from the six analyses, derive the relative standard deviation (coefficient of variation (C.V.)) for: retention time and peak area ("Fig. 7.10").

$RSD\ (C.V.)$ value $= (SD/\overline{X}) \times 100$

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (Xi - \overline{X})^2}{n-1}}$$

$\overline{X} = (X1 + X2\ ...\ Xn - 1 + Xn)\ /\ n$

| | |
|---|---|
| *n*: | Number of analyses |
| *X1 ... Xn*: | Retention time (or areas) of each peak |
| $\overline{X}$: | Average |
| *SD*: | Standard deviation |
| *RSD*: | Relative standard deviation |
| *C.V.*: | Coefficient of variation |

Fig. 7.10

## ■ Parameter Settings for Isocratic System Validation

The parameters to be set for the various components when validation analysis of an isocratic system is performed are given below.

| | | |
|---|---|---|
| • Pump .................................... | Flow rate | 1 mL/min |
| | P. Max | 20.0 MPa |
| • Column oven .......................... | Oven temperature | 40 °C |
| • Time program ......................... | 7.00 STOP | |
| • Autosampler ........................... | RINSE VOLUME | 200 μL |
| | RINSE SPEED | 35 μL/s |
| | SAMPLING SPEED | 5 μL/s |
| | RINSE MODE | 0 (No needle rinsing) |
| • Detector................................. | EX (excitation wavelength) | 360 nm |
| | EM (emission wavelength) | 450 nm |
| | RESPONSE | 3 (0.5 sec) |
| | SENS | 2 (MED) |
| | GAIN | 1 (×1) |
| | CELL TEMP | 30 °C (RF-20Axs only) |
| | If the peak height exceeds the measuring range, change the SENS and GAIN settings to achieve a lower sensitivity. | |
| • Data processor ....................... | WIDTH | 5 |
| | DRIFT | 0 |
| | T. DBL | 0 |
| | ATTEN | 10 |
| | SLOPE | 500 |
| | MIN. AREA | 100000 |
| | STOP. TM | 7 |
| | SPEED | 5 |

**CHECK CRITERIA: When temperature fluctuations in a room are within ± 1 °C, the check criterion values for the relative standard deviation (coefficient of variation) of each item are as follows.**
**Retention time: 0.5 % max.**
**Peak area: 2.0 % max. for anthracene**

## 7.6.2 Validation of a Gradient LC System

### ■ Objective

An analysis is performed on the LC system being validated and the retention time and peak area are obtained for each peak. The data is then examined to check for reproducibility. Reproducible data validates the system. Generally, the system being validated consists of a minimum of the following components: a pump, column oven, autosampler, detector, system controller and data processor.

### ■ Equipment Required for Validation

| Part Name | Description |
|---|---|
| Mobile phase | A: Water<br>B: Methanol<br>A / B = 10 % / 90 %<br>* Both the water and the methanol should be HPLC grade. |
| Column | Shim-pack VP-ODS (Part No. 228-34937-91), LUNA C18 (2) (Part No. 00F-4252-E0) or equivalent ODS column<br>Particle size: 5 µm<br>Column dimension: I.D. 4.6 mm × length 150 mm |
| Sample | 1 mg/L solution of anthracene in acetonitrile (part No.: 228-32996-15)<br><Preparation Procedure><br>1. Weigh 20 mg of anthracene and place it in a 200-mL measuring flask.<br>2. Dissolve the anthracene in acetonitrile, and bring the total volume up to 200 mL.<br>3. Measure out 1 mL of the solution prepared in step 2 and place it in a 100-mL measuring flask.<br>4. Add acetonitrile to the solution in the measuring flask in step 3 to bring the total volume up to 100 mL. |
| Methanol | HPLC grade, or equivalent |
| 2-propanol | HPLC grade, or equivalent |

## ■ Checking and Preparing the LC System

1. Check the connection status of each unit. Details on the connection of each unit are given in the units' instruction manuals. Connect the input cable of the Chromatopac through the relay terminal block provided with the Chromatopac to the integrator terminal of the detector with the signal cable (accessory with the detector).
   * If the system normally uses a Chromatopac or LC workstation, the connections used for regular analysis will be satisfactory.

2. Check the plumbing of the LC system. In particular, ensure that the plumbing from the autosampler outlet to the column inlet, and that from the column outlet to the detector inlet uses tubing with an internal diameter of no greater than 0.3 mm and no longer than 300 mm in order to keep the volume outside the column as small as possible.

3. Clean the system flow lines using one of the procedures described below.
   Before cleaning the flow lines, remove the column from the system, and connect the column inlet tubing to the column outlet tubing with a coupling 1.6C ("Fig. 7.11").

   For a new system:
   Clean the flow lines first with 2-propanol, then with water. In each case, pass the liquid through the flow lines for 10 minutes, at a rate of 2 mL/min.

   For a system in use that uses a mobile phase with a low dielectric constant, such as hexane:
   Clean the flow lines first with 2-propanol, then with water. In each case, pass the liquid through the flow lines for 10 minutes, at a rate of 2 mL/min.

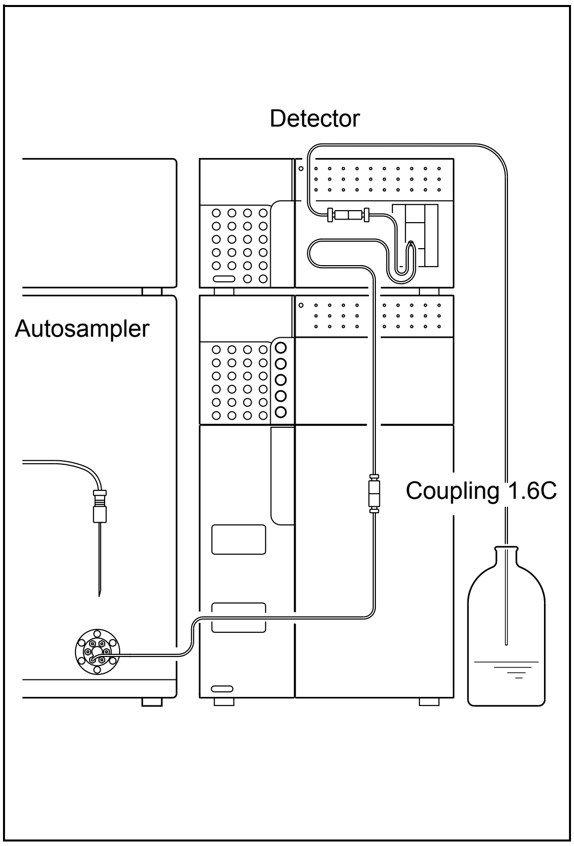



Fig. 7.11

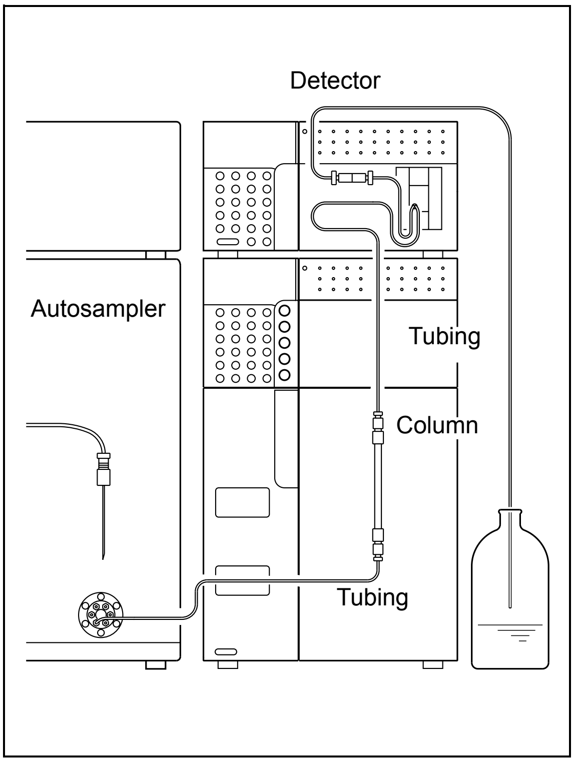



Fig. 7.12

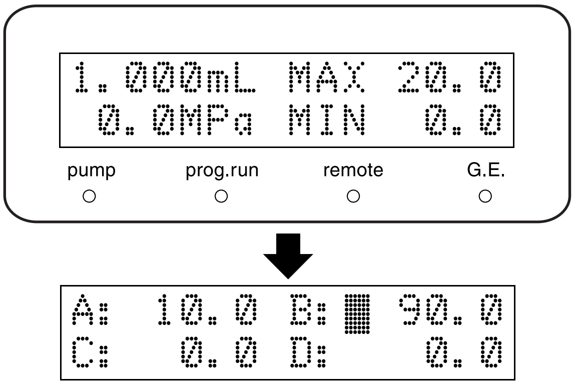
For a system that has been using a mixture of a water solution and an organic solvent as mobile phase, or water plus an organic solvent miscible with water (methanol, acetonitrile, etc.):
Clean the flow lines with water. Pass water through the flow lines for 10 minutes, at a rate of 2 mL/min.

4 When cleaning is finished, pour mobile phase (A: water, B: methanol) into the reservoir bottle, and reconnect the column with the LC system ("Fig. 7.11"). Pour methanol into the reservoir bottle as a rinse liquid to purge the autosampler.

## ■ Check Procedure

1 Set the pumping flow rate to 1 mL/min.
And, set the concentration of mobile phase B parameter to 90 %.
Refer to the pump's instruction manual for the setting procedure.

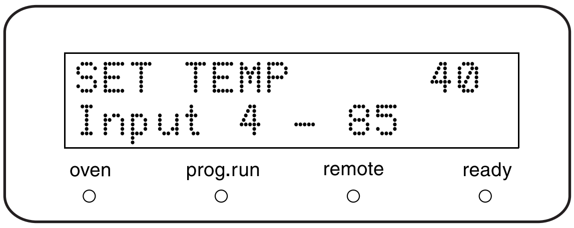
Pump's display screen




2 Set the column oven temperature to 40 °C.
Refer to the column oven's instruction manual for the setting procedure.

3 Press **pump** on the pump panel, and **oven** on the column oven panel. Pumping and temperature regulation will start.
Verify that liquid flows through the detector outlet tubing, and that there are no leaks from any of the connections.

Column oven's display screen

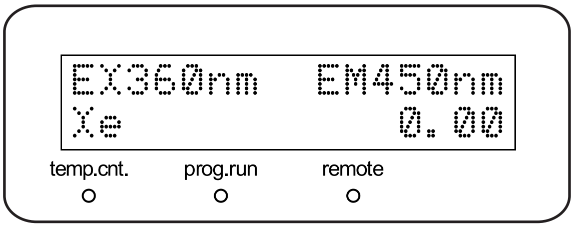


**4** Set the detector parameters.

☞ "Parameter Settings for Isocratic System Validation" P.7-45

Refer to the detector's instruction manual for the setting procedure.

Detector's display screen




**5** Set the autosampler parameters.

☞ "Parameter Settings for Isocratic System Validation" P.7-45

Refer to the autosampler's instruction manual for the setting procedure.

**6** Set the data processor parameters.

☞ "Parameter Settings for Isocratic System Validation" P.7-45

Refer to the data processor's instruction manual for the setting procedure.

**7** Monitor the baseline.

When the baseline has stabilized, press **zero** on the detector, then inject 10 µL of mobile phase, and verify that no peaks are observed.

**8** Inject 10 µL of the test sample five times, and analyze the data obtained.

**9** From the peak data obtained from the five analyses, derive the relative standard deviation (coefficient of variation (C.V.)) for: retention time and peak area ("Fig. 7.13").

*RSD (C.V.)* value = $(SD/\overline{X}) \times 100$

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(Xi-\overline{X})^2}{n-1}}$$

$\overline{X} = (X1 + X2 \ldots Xn - 1 + Xn) / n$

| | |
|---|---|
| *n:* | Number of analyses |
| *X1 ... Xn:* | Retention time (or areas) of each peak |
| $\overline{X}$: | Average |
| *SD:* | Standard deviation |
| *RSD:* | Relative standard deviation |
| *C.V.:* | Coefficient of variation |

Fig. 7.13

## ■ Parameter Settings for Isocratic System Validation

The parameters to be set for the various components when validation analysis of an isocratic system is performed are given below.

| | | |
|---|---|---|
| • Pump...................................... | Flow rate | 1 mL/min |
| | B. CONC | 90 % |
| | P. Max | 20.0 MPa |
| • Column oven........................... | Oven temperature | 40 °C |
| • Time program.......................... | 7.00 STOP | |
| • Autosampler............................ | RINSE VOLUME | 200 μL |
| | RINSE SPEED | 35 μL/s |
| | SAMPLING SPEED | 5 μL/s |
| | RINSE MODE | 0 (No needle rinsing) |
| • Detector .................................. | EX (excitation wavelength) | 360 nm |
| | EM (emission wavelength) | 450 nm |
| | RESPONSE | 3 (0.5 sec) |
| | SENS | 2 (MED) |
| | GAIN | 1 (×1) |
| | CELL TEMP | 30 °C (RF-20Axs only) |
| | If the peak height exceeds the measuring range, change the SENS and GAIN settings to achieve a lower sensitivity. | |
| • Data processor........................ | WIDTH | 5 |
| | DRIFT | 0 |
| | T. DBL | 0 |
| | ATTEN | 10 |
| | SLOPE | 500 |
| | MIN. AREA | 100000 |
| | STOP. TM | 7 |
| | SPEED | 5 |

**CHECK CRITERIA: When temperature fluctuations in a room are within ± 1 °C, the check criterion values for the relative standard deviation (coefficient of variation) of each item are as follows.**
**Retention time: 0.5 % max.**
**Peak area: 2.0 % max. for anthracene**

7

# 7.7 If Validation Fails

Should the system fail to satisfy any of the system validation check criteria, or should a component fail to satisfy any of the component validation check criteria, proceed as follows.

| |
|---|
| Check whether any consumable parts have reached the end of their service life:<br>The cause of failure to satisfy check criteria could be a consumable part that is no longer usable. Check consumable parts and replace them if necessary. |
| Perform troubleshooting:<br>It is possible that some minor problem (such as air bubbles) has caused the system to fail the criteria. Perform troubleshooting to check for such problems, and take action to eliminate any problems found. For troubleshooting procedures for individual system components, refer to the applicable instruction manuals. |
| If a cause cannot be determined, contact your Shimadzu representative:<br>If you are unable to determine the cause of the failure, or if you are unclear about troubleshooting or corrective action procedures, contact your Shimadzu representative. |

# 7.8 Reference Information

Generally, the variations of this instrument conform to "7.5 Detector Validation" P.7-7.
This section explains the following points by providing reference information on these variations.

- Wavelength calibration and the wavelength accuracy automatic checking function
- The operating procedure for wavelength calibration

☞ "8.7 Performing Wavelength Calibration" P.8-39

## 7.8.1 Automatic Wavelength Calibration Function

In order to lighten the burden on the analyst, this instrument performs wavelength calibration automatically when [WAVE CALIB] in the VP functions is executed.

### ■ Wavelength Calibration

The excitation wavelength and emission wavelength are calibrated using the zero line of the low-pressure Hg (mercury) lamp, its emission line at 254 nm, its secondary line at 507 nm and its tertiary line at 761 nm. On executing [WAVE CALIB] in the VP functions, wavelength calibration is performed according to the flow shown below.
Wavelength calibration is executed after [CALIBRATING SPAN] has been displayed.
After wavelength calibration has finished, the wavelength accuracy is checked automatically.

**1. Detection of grating home position**

The spectrophotometer decides the wavelength by taking the home position of the grating as the reference. At the outset the home positions of the excitation grating and emission grating are automatically detected.

↓

**2. Movement of the excitation grating to the region of the 254 nm position**

Scan the excitation side grating in the vicinity of the low-pressure Hg (mercury) lamp's emission line wavelength of 254 nm, and record the peak of light intensity with the photosensor at the excitation side.

↓

**3. Movement of the emission grating to the 0 nm position**

The excitation grating is moved to the 254 nm position found in step 2.
Next, scan the emission side grating in the vicinity of 0 nm, and record the peak of light intensity with the photosensor at the emission side.

↓

| | |
|---|---|
| **4. Calculation of the angle of turn required to move the emission grating to the 0 nm position** | The angle of turn required to move the emission grating from the home position to the 0 nm position is calculated. |
| **5. Movement of the emission grating to the region of the 254 nm position** | Scan the emission side grating in the vicinity of the low-pressure Hg (mercury) lamp's emission line wavelength of 254 nm, and record the peak of light intensity with the photosensor at the emission side. |
| **6. Calculation of the angle of turn required to move the emission grating to the 254 nm position** | The angle of turn required to move the emission grating from the home position to the 254 nm position is calculated. |
| **7. Movement of the excitation grating to the 0 nm position** | The emission grating is moved to the 254 nm position found in step 5.<br>Next, scan the excitation side grating in the vicinity of 0 nm, and record the peak of light intensity with the photosensor at the emission side. |
| **8. Calculation of the angle of turn required to move the excitation grating to the 0 nm position** | The angle of turn required to move the excitation grating from the home position to the 0 nm position is calculated. |
| **9. Movement of the excitation grating to the 254 nm position** | The emission grating is moved to the 254 nm position found in step 5.<br>Next, scan the excitation side grating in the vicinity of the low-pressure Hg (mercury) lamp's emission line wavelength of 254 nm, and record the peak of light intensity with the photosensor at the emission side. |
| **10. Calculation of the angle of turn required to move the excitation grating to the 254 nm position** | The angle of turn required to move the excitation grating from the home position to the 254 nm position is calculated. |

| | |
|---|---|
| **11. Movement of the excitation grating to the 507 nm position** | Scan the excitation side grating in the vicinity of 507 nm, and record the peak of light intensity with the photosensor at the emission side. |
| ↓ | |
| **12. Calculation of the angle of turn required to move the excitation grating to the 507 nm position** | The angle of turn required to move the excitation grating from the home position to the 507 nm position is calculated. |
| ↓ | |
| **13. Movement of the excitation grating to the 761 nm position** | Scan the excitation side grating in the vicinity of 761 nm, and record the peak of light intensity with the photosensor at the emission side. |
| ↓ | |
| **14. Calculation of the angle of turn required to move the excitation grating to the 761 nm position** | The angle of turn required to move the excitation grating from the home position to the 761 nm position is calculated. |
| ↓ | |
| **15. Movement of the emission grating to the 507 nm position** | The excitation grating is moved to the 254 nm position found in step 9.<br>Next, scan the emission side grating in the vicinity of 507 nm, and record the peak of light intensity with the photosensor at the emission side. |
| ↓ | |
| **16. Calculation of the angle of turn required to move the emission grating to the 507 nm position** | The angle of turn required to move the emission grating from the home position to the 507 nm position is calculated. |
| ↓ | |
| **17. Movement of the emission grating to the 761 nm position** | The excitation grating is moved to the 254 nm position found in step 9.<br>Next, scan the emission side grating in the vicinity of 761 nm, and record the peak of light intensity with the photosensor at the emission side. |
| ↓ | |

7

| | |
|---|---|
| **18. Calculation of the angle of turn required to move the emission grating to the 761 nm position** | The angle of turn required to move the emission grating from the home position to the 761 nm position is calculated. |
| **19. Determination of the span correction coefficients (S values)** | Using the ratio between the angles of turn of the gratings calculated for the excitation and emission sides at each of the wavelengths and the angle of turn from 0 to 761 nm determined by the instrument's design, the span correction coefficients (S values) for the excitation and emission sides are calculated.<br>The values determined by the design are corrected based on the span correction coefficients (S values) recorded here, and the angles of turn of the gratings for each wavelength, set when measurement is performed, are fixed. |
| **20. Reading the 254 nm emission line spectrum at the excitation side** | Adjust the emission side grating to the 254 nm position. Next, scan the excitation side grating in the vicinity of the low-pressure Hg (mercury) lamp's emission line wavelength of 254 nm, and record the peak of light intensity with the photosensor at the emission side. |
| **21. Reading the 507 nm emission line spectrum at the excitation side** | Scan the excitation side grating in the vicinity of 507 nm, and record the peak of light intensity with the photosensor at the emission side. |
| **22. Reading the 761 nm emission line spectrum at the excitation side** | Scan the excitation side grating in the vicinity of 761 nm, and record the peak of light intensity with the photosensor at the emission side. |
| **23. Reading the 254 nm emission line spectrum at the emission side** | Adjust the excitation side grating to the 254 nm position.<br>Next, scan the emission side grating in the vicinity of the low-pressure Hg (mercury) lamp's emission line wavelength of 254 nm, and record the peak of light intensity with the photosensor at the emission side. |

| | |
|---|---|
| **24. Reading the 507 nm emission line spectrum at the emission side** | Scan the emission side grating in the vicinity of 507 nm, and record the peak of light intensity with the photosensor at the emission side. |
| ↓ | |
| **25. Reading the 761 nm emission line spectrum at the emission side** | Scan the emission side grating in the vicinity of 761 nm, and record the peak of light intensity with the photosensor at the emission side. |
| ↓ | |
| **26. Resetting of the grating positions** | The excitation and emission gratings are returned to their positions before wavelength calibration started. |
| ↓ | |
| **27. Judgment of wavelength accuracy** | It is checked whether the wavelength accuracy is within ±2.0 nm at 254 nm, 507 nm and 761 nm on the excitation side, and at 254 nm, 507 nm and 761 nm on the emission side.<br>If all the values satisfy the check criteria, [CHECK GOOD] is displayed.<br>If even one of the values doesn't satisfy the check criteria, [CHECK NG*] is displayed. |

## 7.8.2 Automatic Checking Function of Wavelength Accuracy

[EX CHECK] automatically checks the wavelength accuracy of the spectroscope at the excitation side, while [EM CHECK] automatically checks the wavelength accuracy of the spectroscope at the emission side.
Both [EX CHECK] and [EM CHECK] use the 254 nm and 507 nm emission lines of the low-pressure Hg (mercury) lamp (secondary light), and the wavelength accuracy is automatically checked at each point in the following flow.
While wavelength accuracy is being checked, [CHECKING EX] or [CHECKING EM] is displayed.

| | |
| --- | --- |
| **1. Reading the 254 nm emission line spectrum** | The spectroscope on the side that is not being checked is adjusted to 254 nm.<br>Next, scan the wavelength of the spectroscope side to be checked in the vicinity of the low-pressure Hg (mercury) lamp's emission line wavelength of 254 nm, and record the peak of light intensity with the photosensor at the emission side. |
| ↓ | |
| **2. Reading the 507 nm emission line spectrum** | Scan the wavelength of the spectroscope side to be checked in the vicinity of 507 nm, and record the peak of light intensity with the photosensor at the emission side. |
| ↓ | |
| **3. Resetting of the wavelength** | The wavelength is returned to its value before execution of the automatic check on wavelength accuracy. |
| ↓ | |
| **4. Judgment of wavelength accuracy** | It is checked whether the wavelength accuracy is within ±2.0 nm at 254 nm and 507 nm.<br>If all the values satisfy the check criteria, [CHECK GOOD] is displayed.<br>If even one of the values doesn't satisfy the check criteria, [CHECK NG*] is displayed. |

# 8

# Maintenance

Contents

# 8.1 Periodic Inspection and Maintenance

It is necessary to perform periodic inspections of this instrument to ensure its safe use.
It is possible to have these periodic inspections performed by Shimadzu representatives on a contractual basis.
For information regarding the maintenance inspection contract, contact your Shimadzu representative.

> ⚠ **WARNING**
>
> - In the absence of any instructions to the contrary, always turn the power to the instrument OFF and unplug the instrument prior to performing inspections and maintenance.
>
>   Otherwise, fire, electric shock or malfunction may occur.

> ⚠ **CAUTION**
>
> - When replacing parts, use only the parts listed in "1.3 Component Parts" and "9.3 Maintenance Parts".
>
>   If any other parts are used, injury or malfunction may occur.
> - Never remove the main cover.
>
>   Otherwise, injury or malfunction may occur.
>   Contact your Shimadzu representative to remove the main cover.

## 8.1.1 Prior to Inspection and Maintenance

- Replace the mobile phase in the flow lines with water.
- Wipe away any dirt from the front panel and the main cover.
- Wipe away any dirt from the key panel with tissue paper or a soft cloth moistened with water.

## 8.1.2 List of Periodic Inspection and Maintenance

> ⚠ **CAUTION**
>
> - The replacement and maintenance periods listed in this table are presented only as guidelines. They are not guarantee periods.
>
>   These will vary depending on the conditions of use.

| Inspection/Maintenance Item | 1 Year | 2 Years | 3 Years | 6 Years | Remark | Page |
|---|---|---|---|---|---|---|
| Inspection and simple washing of the cell | ○ | | | | – | P.8-5 |
| Disassembly, cleaning and inspection of the flow cell unit (Replacement) | | ○ | | | On disassembling the flow cell unit, be sure to replace the cell gasket. | P.8-14 |
| Inspection/replacement of the Xenon lamp | | ○ | | | At a cumulative operating time of 2000 hours (Indicated at [Xe LAMP USED TM] under the VP function) | P.8-30 |
| Replacement of the fuse | | | ○ | | – | P.8-35 |
| Replacement of the filter | ○ | | | | Replace the filter when it becomes discolored from the original white. | P.8-37 |

**⚠CAUTION**

- When the cumulative operating time of the Xenon lamp has exceeded 2000 hours, replace it.

  If the Xenon lamp continues to be used beyond its service life (2000 hours), it may explode. If the Xenon lamp explodes, it could damage the instrument.

NOTE

The guaranteed service life of the Xenon lamp is a cumulative operating time of 2000 hours or 1 year starting from the date of delivery of the lamp, whichever is the shorter. If the Xenon lamp becomes unable to ignite within the guaranteed service life, it will be replaced free of charge.
Note that ignition becomes harder as the ignition count of the Xenon lamp increases. Since the guaranteed service life is premised on an ignition count of one ignition per day, if the ignition count is too high the lamp will not be covered by the guarantee.

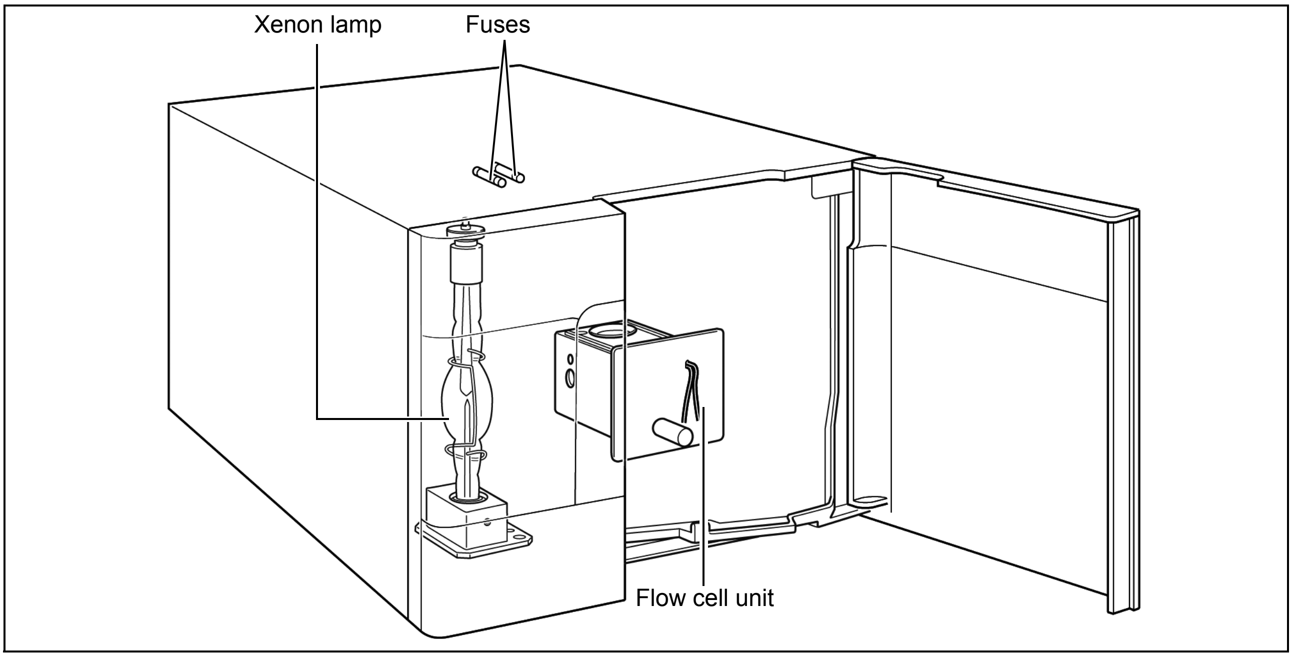



Fig. 8.1

### 8.1.3 Check After Inspection and Maintenance

After inspection and maintenance, check any leakage during pumping.

☞ "6.1 Troubleshooting and Corrective Action" P.6-2

# 8.2 Inspection and Simple Washing of the Cell

## 8.2.1 Inspecting the Cell

■ Nomenclature of Flow Cell Unit Parts

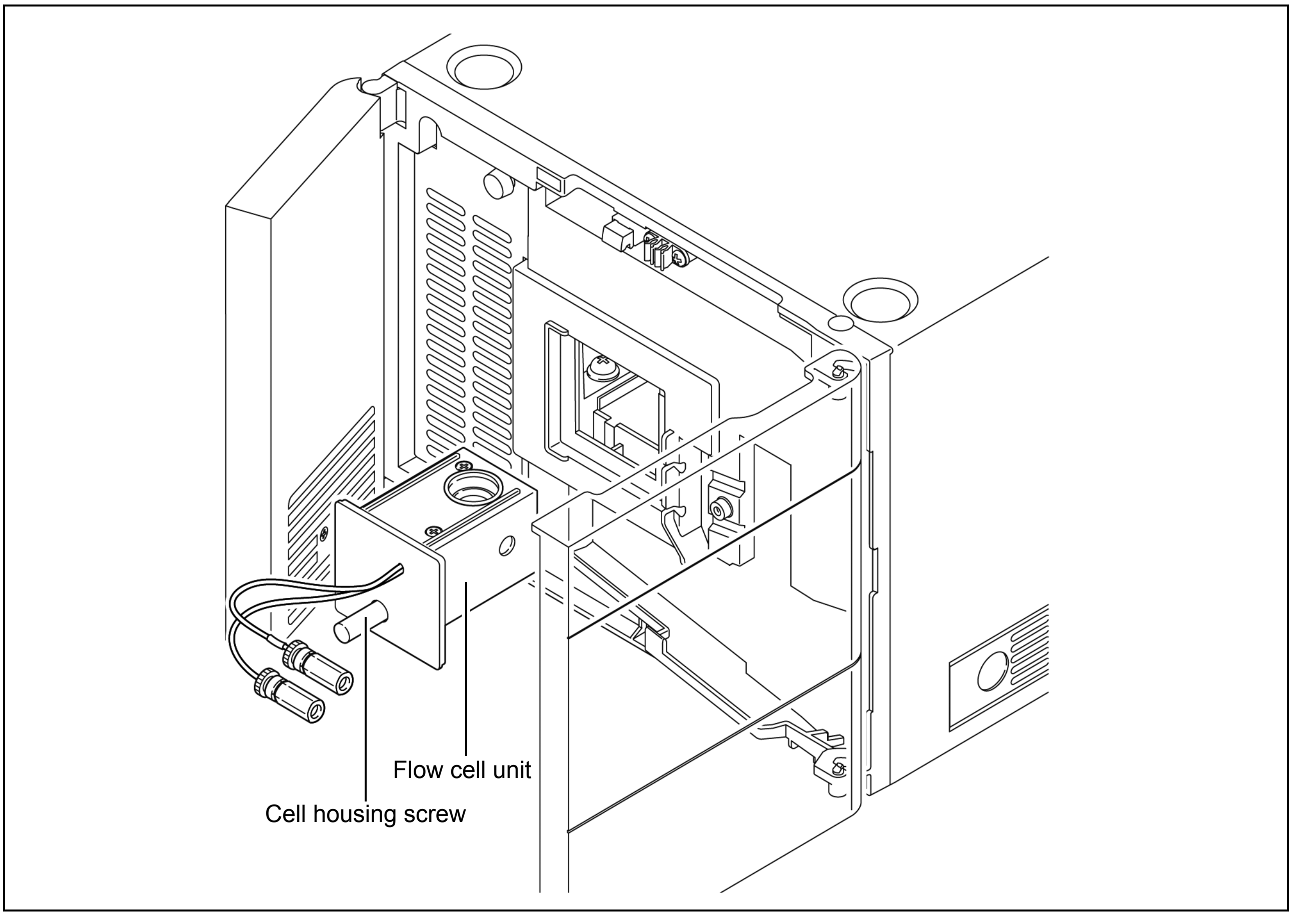



Fig. 8.2

## ■ Inspecting the Cell

**1** Turn the power to the instrument OFF and unplug the power plug.

**2** Open the front cover and the key panel.

NOTE

In order to prevent the front cover falling off, remove it from the instrument before starting the work.

**3** Unscrew the coupling fixing screw and remove the inlet and outlet couplings 1.6-0.8C.

**4** Unscrew the cell housing screw and remove the flow cell unit.

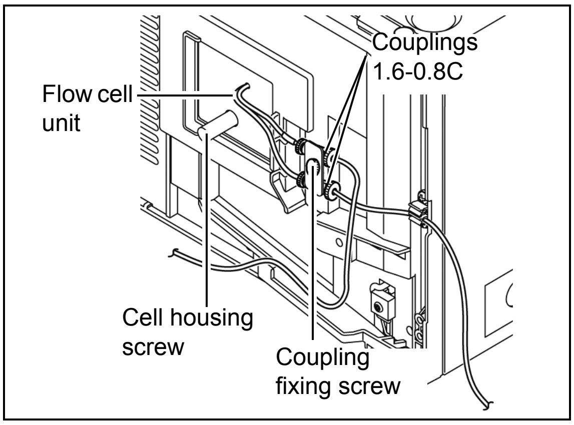



Fig. 8.3

**5** Pump with the flow line tubing still connected.

**6** With the mobile phase flowing, look inside the flow cell unit through the lens, and check for air bubbles and dirt.

∗ If there are any air bubbles or is any dirt, clean the cell.

☞ "8.2.2 Simple Cleaning of the Cell" P.8-8

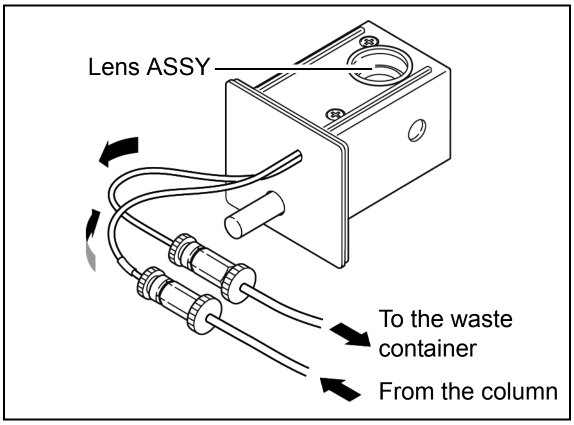



Fig. 8.4

## ■ Fitting the Flow Cell Unit

Fit the flow cell unit to the instrument by following the procedure below.

NOTE

Ensure that no air bubbles get into the flow line during fitting.

**1** Fit the flow cell unit with the lens ASSY facing upward.

**2** Screw in the cell housing screw.

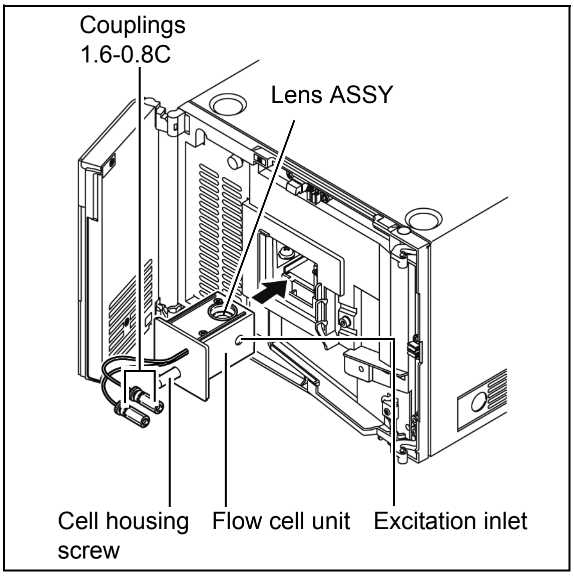



Fig. 8.5

**3** Secure the inlet and outlet couplings 1.6-0.8C with the coupling fixing screw.

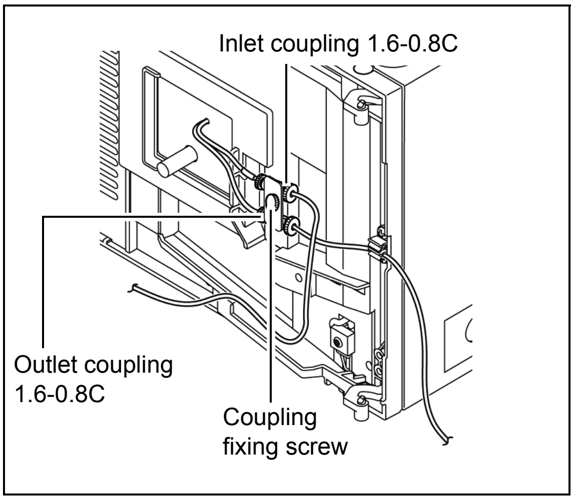



Fig. 8.6

**4** Close the front cover and key panel.

## 8.2.2 Simple Cleaning of the Cell

If any air bubble or dirt is found on inspecting the cell, perform simple cleaning of the cell by following the procedure below.

### Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Syringe | Standard accessory | 046-00017-01 |
| Syringe adapter | Standard accessory | 228-15672-91 |

The arrows indicate the direction of flow of the liquid.

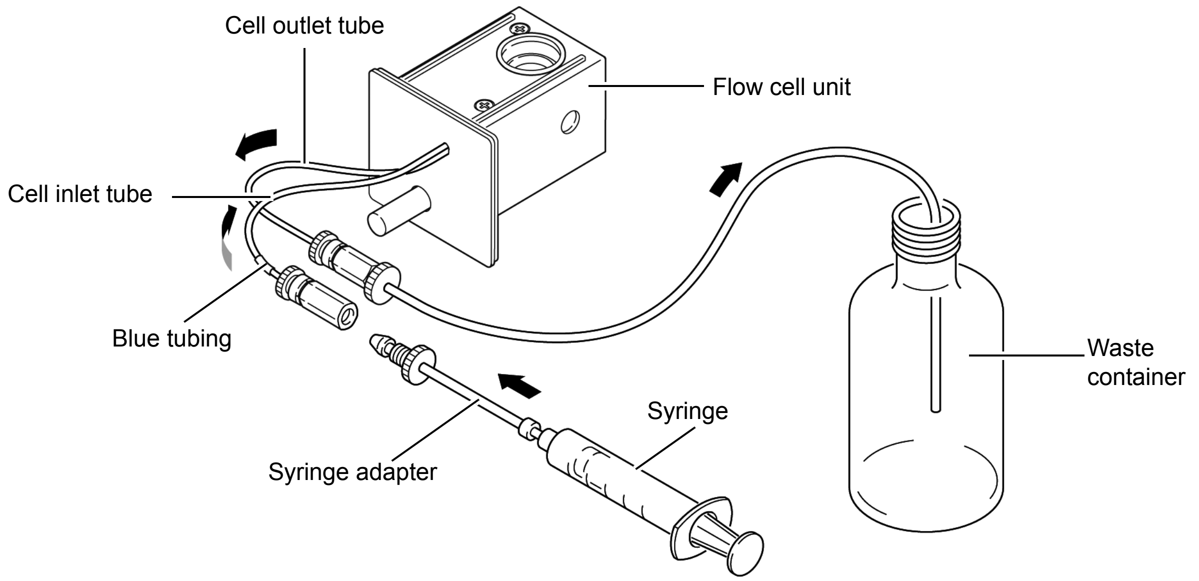



Fig. 8.7

## ■ Simple Cleaning of the Cell

**1** Fit the syringe adapter to the tip of the syringe.

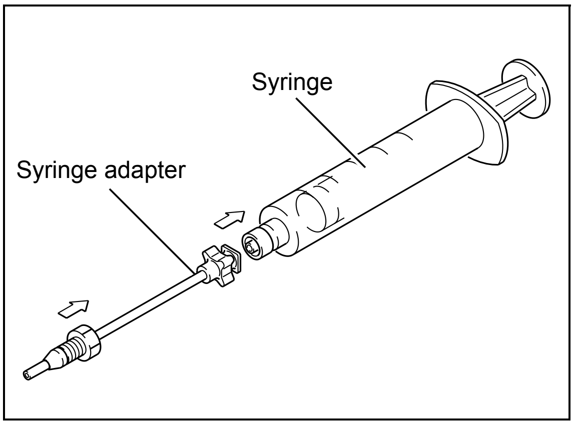



Fig. 8.8

**2** Remove the male nut PEEK at the column side of the inlet coupling 1.6-0.8C, and remove the tubing from the column side.

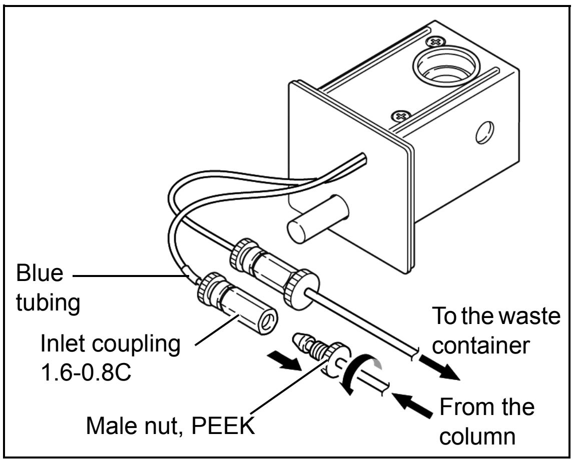



Fig. 8.9

**3** Fit the male nut 1.6MN of the syringe adapter to the inlet coupling 1.6-0.8C.

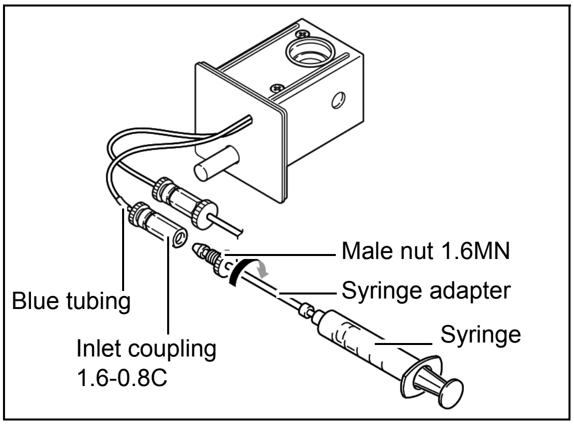



Fig. 8.10

8

**4** Fill the syringe with 2-propanol, then slowly push the syringe's plunger in.
The methanol in the syringe flows into the flow cell unit and removes soiling.

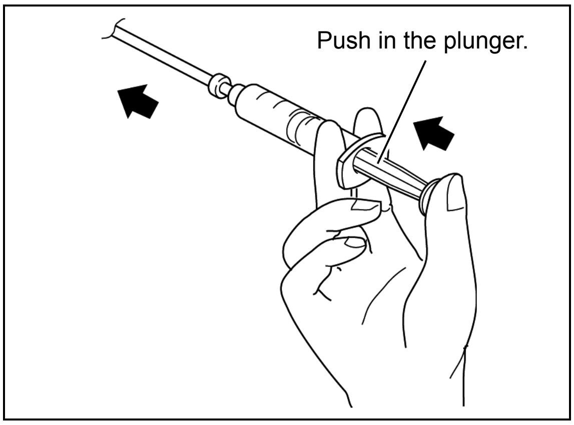



Fig. 8.11

**5** Replace the liquid in the syringe with the mobile phase to be used, then slowly push the syringe's plunger in.
The mobile phase in the syringe flows into the flow cell unit and cleans the cell.

**6** Remove the male nut 1.6MN of the syringe adapter from the inlet coupling 1.6-0.8C.

**7** Fit the tubing from the column onto the inlet coupling 1.6-0.8C and tighten the male nut PEEK.

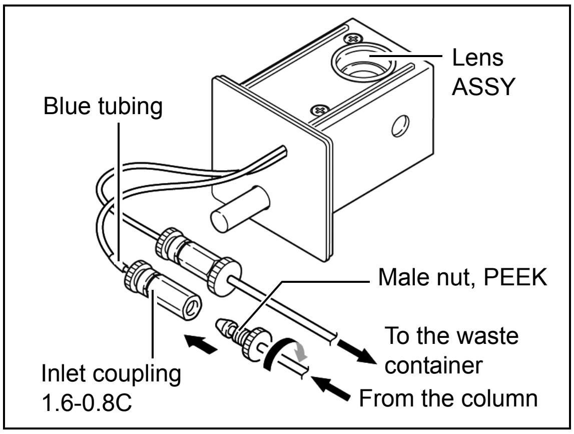



Fig. 8.12

## ■ Fitting the Flow Cell Unit

☞ "Fitting the Flow Cell Unit" P.8-7

# 8.3 Disassembling the Flow Cell Unit and Cleaning/Replacing Each Part

NOTE

Disassembly of the flow cell unit and replacing or cleaning its parts involves some precision work. If you need it to be done, Shimadzu service engineers can proceed with it.
Contact your Shimadzu representative as necessary.

Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Cell gasket | Consumable part | 228-50422-01 |
| Cell | Consumable part | 228-48626 |
| Syringe | Standard accessory | 046-00017-01 |
| Syringe adapter | Standard accessory | 228-15672-91 |

Tools used

| Part Name |
|---|
| Philips screwdriver |
| Hexagonal wrench (1.5 mm across flats) |
| Flathead screwdrivers (widths: 4.5 mm, 5.5 mm) |
| Forceps (with narrow ends) |
| Plastic forceps |
| Toothpicks |

## Component parts of the flow cell unit (RF-20A)

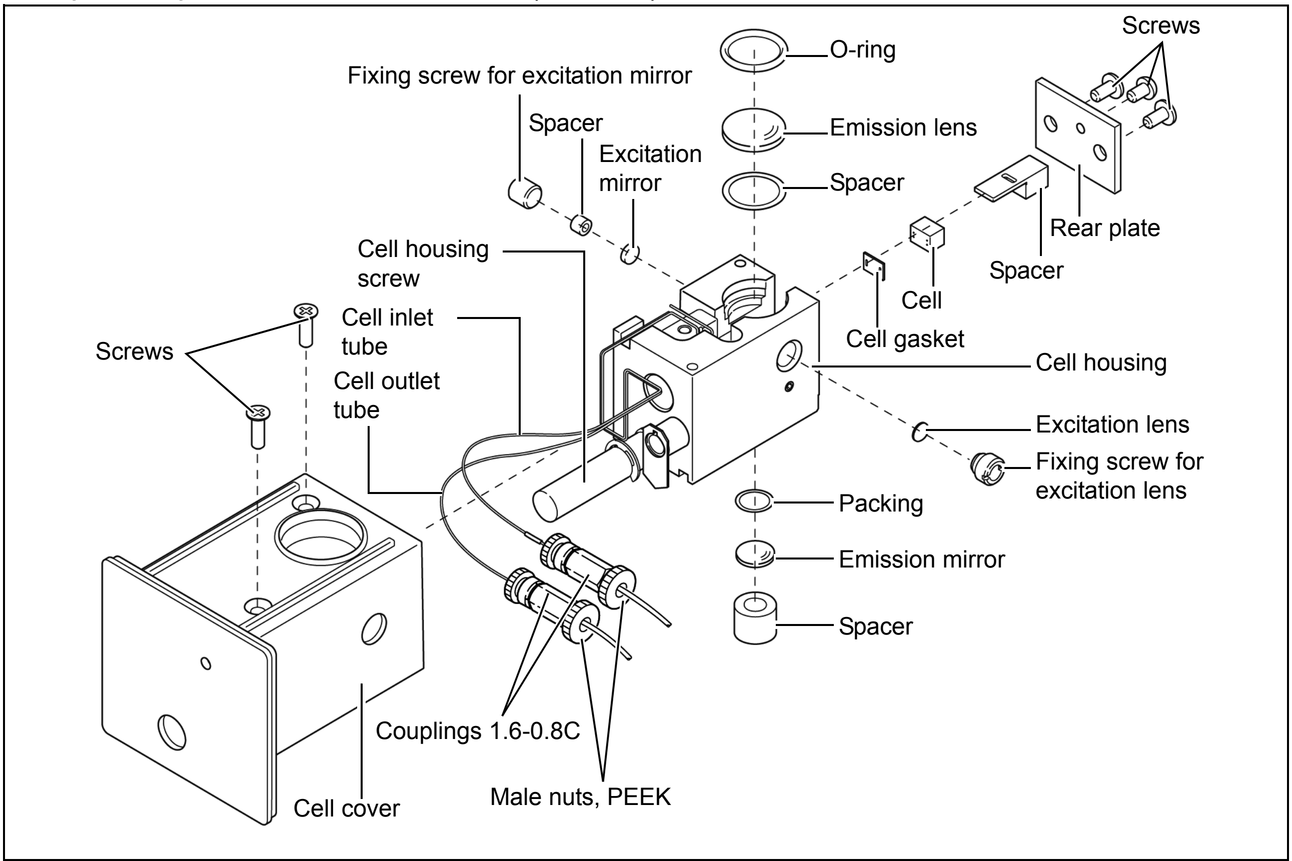



Fig. 8.13

Component parts of the flow cell unit (RF-20Axs)

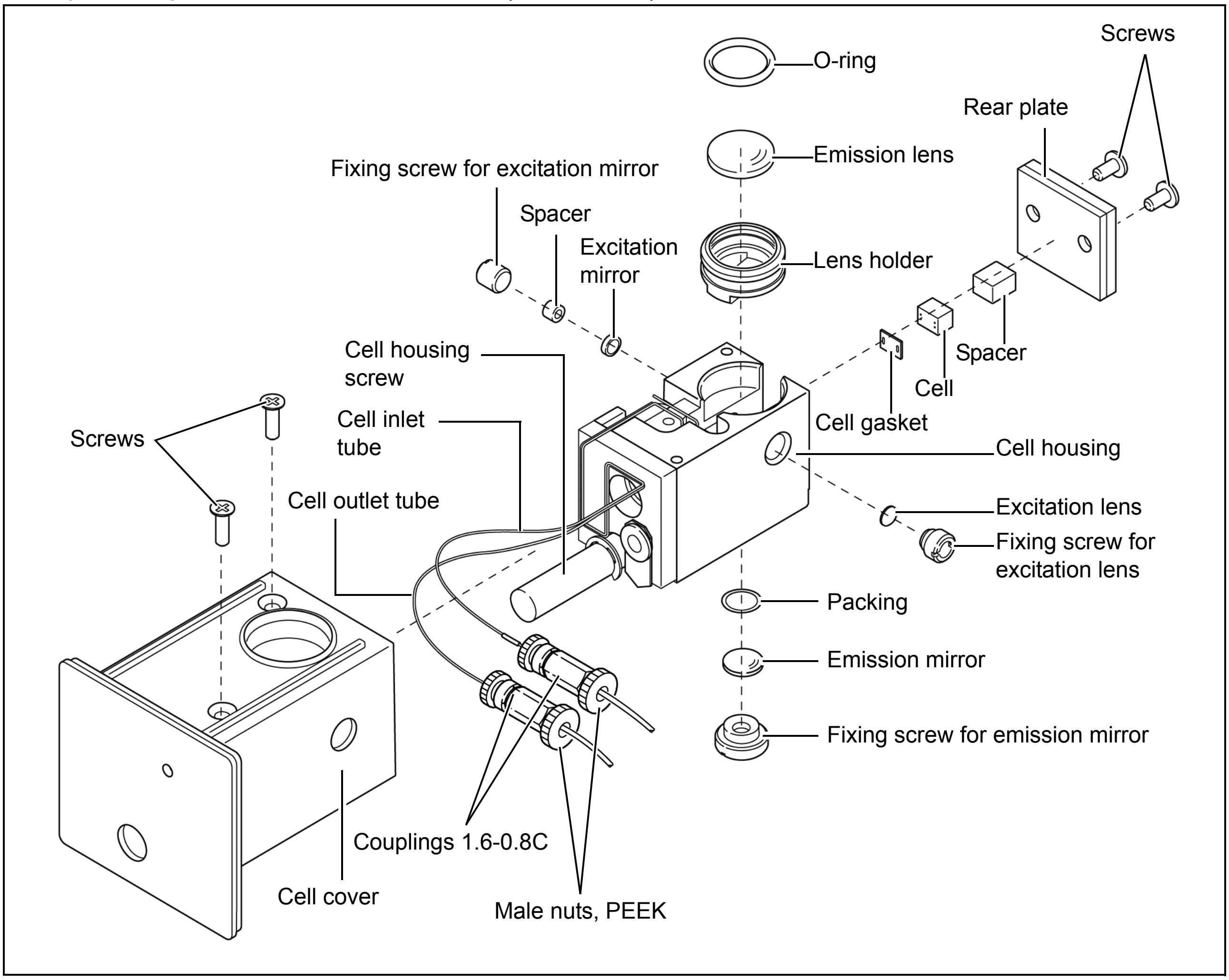



Fig. 8.14

8

## 8.3.1 Disassembling the Flow Cell Unit

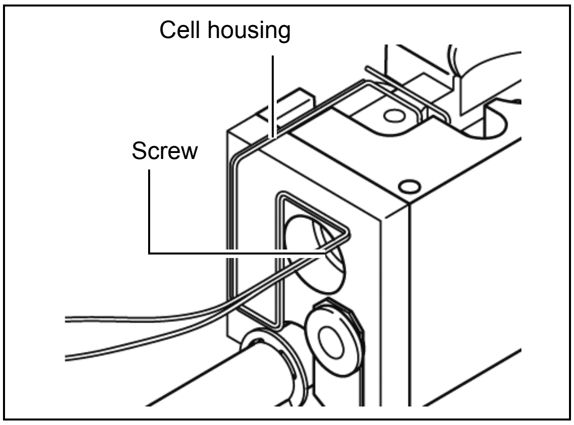



Fig. 8.15

**⚠CAUTION**

- Do not touch the screw inside the cell housing.

  The screw has been adjusted. Loosening or tightening it could cause cell breakage or liquid leakage.

### ■ Disassembling the Flow Cell Unit

**1** Turn the power to the instrument OFF and unplug the power plug.

**2** Open the front cover and the key panel.

NOTE

In order to prevent the front cover falling off, remove it from the instrument before starting the work.

**3** Unscrew the coupling fixing screw and remove the inlet and outlet couplings 1.6-0.8C.

**4** Unscrew the red screws of the inlet and outlet couplings 1.6-0.8C and remove the couplings 1.6-0.8C from the inlet tube and outlet tube.

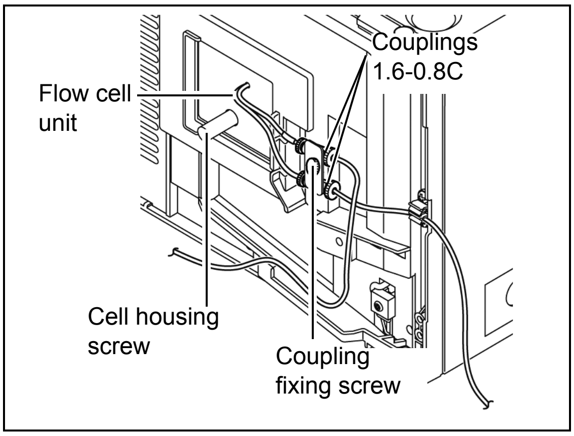



Fig. 8.16

**5** Stretch the tubes out straight.

**6** Unscrew the cell housing screw and remove the flow cell unit.

**7** Remove the two screws on the top face of the flow cell unit, press in the cell housing screw, and push the cell housing toward the rear.

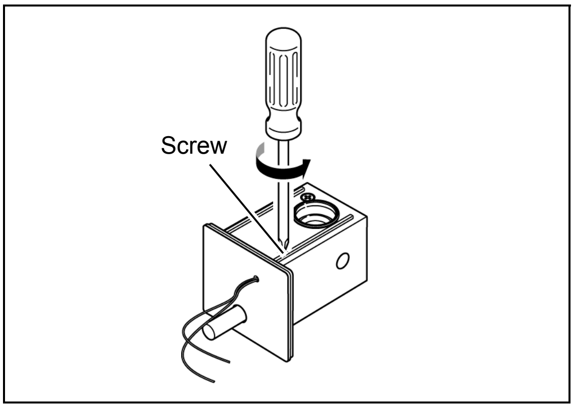



Fig. 8.17

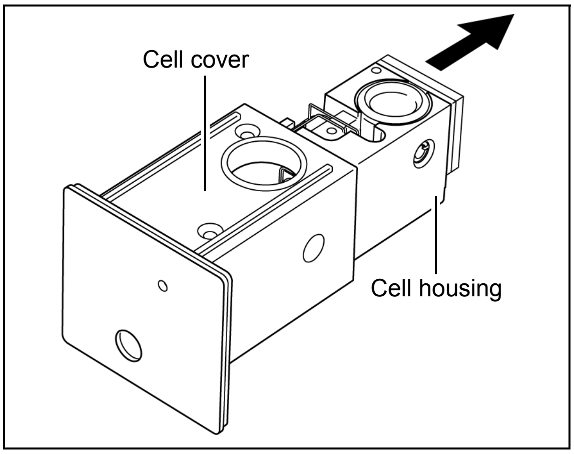



Fig. 8.18

**8** Remove the emission lens.

- For the RF-20AXS:

Loosen the fixing screw for the emission lens at the left side of the cell housing by about two turns with a hexagon wrench (1.5 mm across flats), then remove the lens holder. (The fixing screw for the emission lens should only be loosened and need not be removed.)

For details on how to remove the lens, see:

☞ "8.3.3 Cleaning the Emission Lens" P.8-19

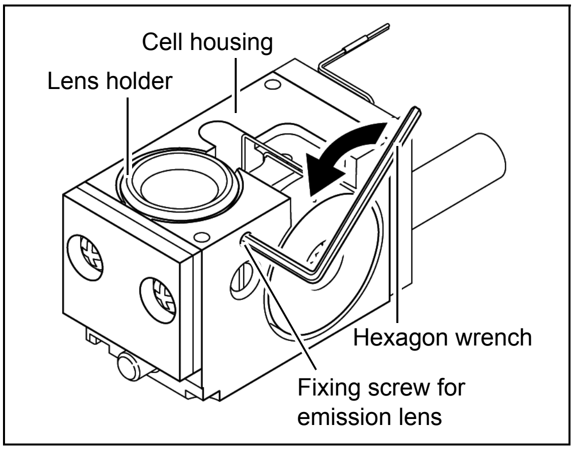



Fig. 8.19

8

- For the RF-20A:

Using an implement with a fine point, such as a toothpick, remove the O-ring from the cell housing while taking care not to damage the emission lens, then remove the emission lens and spacer.

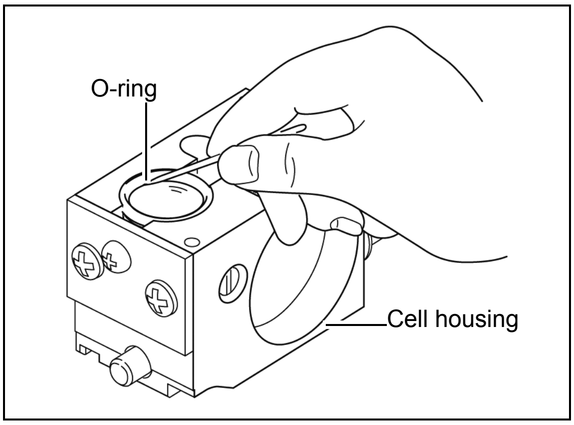



Fig. 8.20

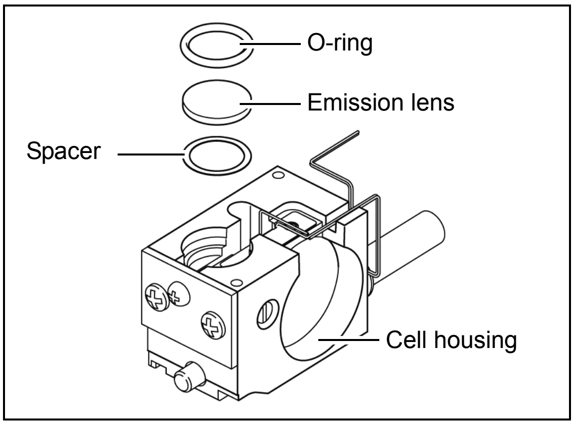



Fig. 8.21

**9** Loosen the two screws on the rear face of the cell housing alternately by equal amounts, and remove the rear plate.

**10** Remove the spacer, cell and cell gasket from the cell housing.

RF-20A

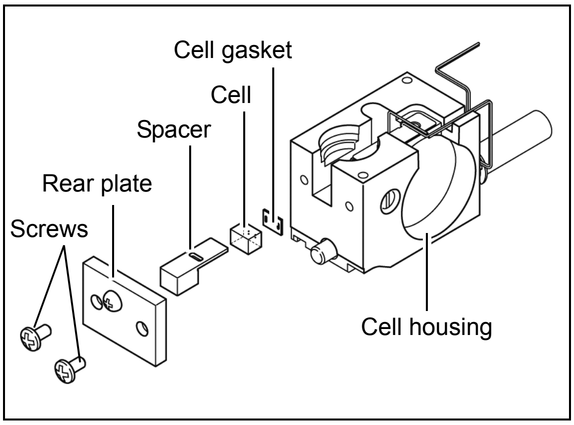



Fig. 8.22

NOTE

- Take care not to soil or damage the cell or cell gasket. This could cause reduced sensitivity or liquid leakage.
- Remove the components with plastic forceps or a similar tool.

RF-20Axs

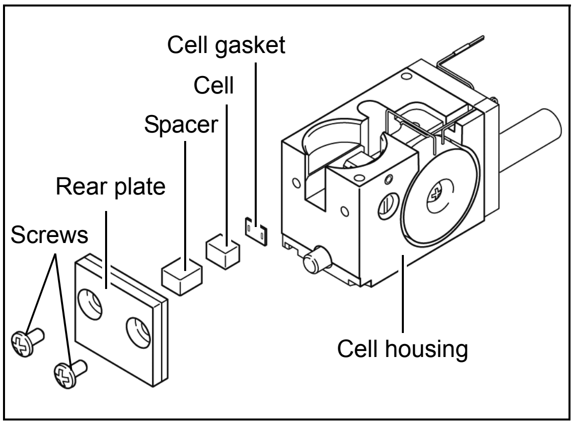



Fig. 8.23

## 8.3.2 Cleaning the Cell

Clean the cell removed in "8.3.1 Disassembling the Flow Cell Unit" P.8-14.

### ■ Cleaning the Cell

1. Clean the cell by immersing it in 2-propanol and wiping its surfaces with clean guaze or wiper cloth.
   * If the dirt cannot be removed, replace the cell with a new one.

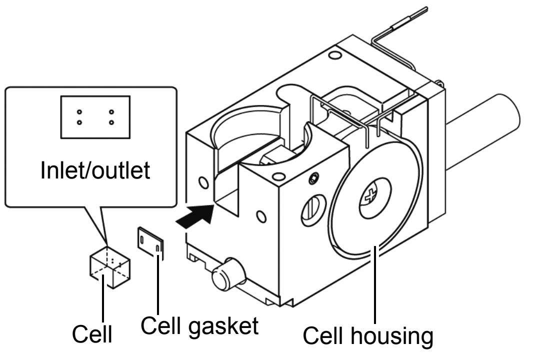
2. Moisten a piece of clean gauze or wiper cloth with 2-propanol and use it to wipe off the dirt inside the flow housing.

8

## ■ Fitting the Cell

NOTE

- Fit the cell so that the inlet side and outlet side face toward the front face of the flow cell unit.
  Fitting the cell the wrong way round will cause liquid leakage.
- When the flow cell unit has been disassembled and cleaned, be sure to replace the cell gasket.
- Remove dust and so on from the new cell gasket before using it.




Fit the cell with the inlet/outlet facing the front face of the cell housing.
* The illustration shows the RF-20Axs.

Fig. 8.24

**1** Fit the cell in the cell housing by following the procedure for removal in reverse.
Secure the cell gasket, cell and spacer while they are pressed against the lower part of the cell housing.
Tighten the two screws of the rear plate, alternately by equal amounts, half a turn at a time.

RF-20A

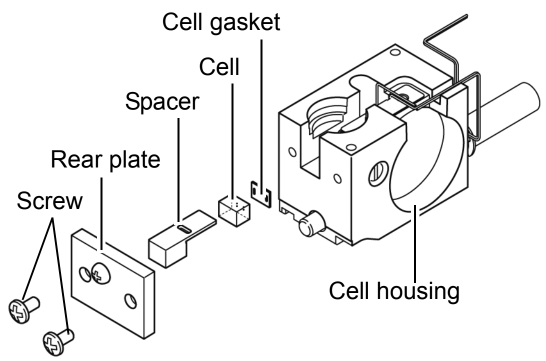



Fig. 8.25

RF-20Axs

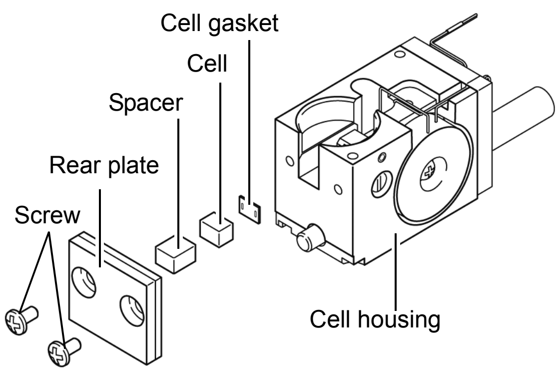



Fig. 8.26

## 8.3.3 Cleaning the Emission Lens

**⚠CAUTION**

- Do not subject the emission lens to ultrasonic cleaning.

  This could damage the emission lens.

### Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Emission lens | Replacement part | 228-48700 |

### ■ For the RF-20Axs:

Remove the emission lens from the lens holder removed in "8.3.1 Disassembling the Flow Cell Unit" P.8-14, then clean the lens.

**1** Using an implement with a fine point, such as a toothpick, remove the O-ring from the lens holder.

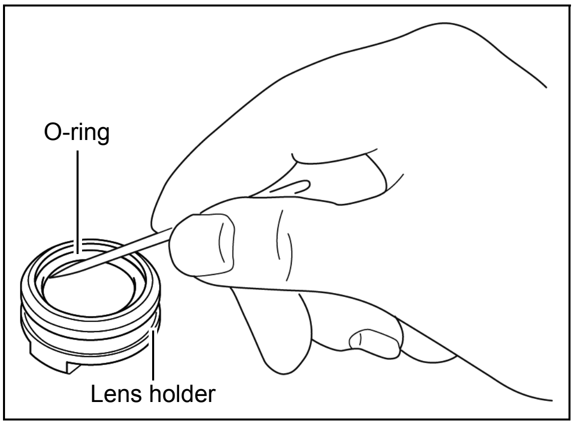



Fig. 8.27

**2** Remove the emission lens from the lens holder.

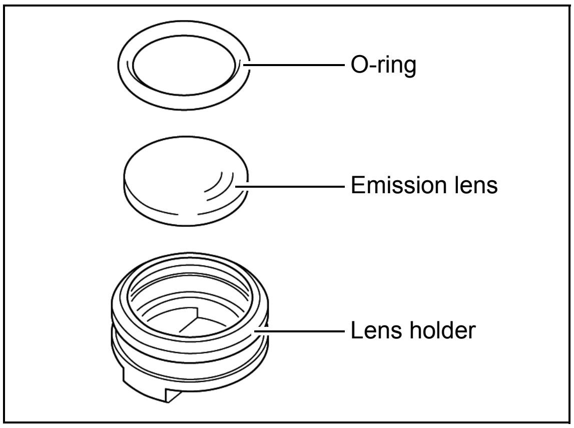



Fig. 8.28

8

3 Moisten a piece of clean gauze or wiper cloth with 2-propanol and use it to wipe off the dirt on the emission lens.

* If the dirt cannot be removed, replace the emission lens with a new one.

## ■ For the RF-20A:

Clean the emission lens removed in "8.3.1 Disassembling the Flow Cell Unit" P.8-14.

1 Moisten a piece of clean gauze or wiper cloth with 2-propanol and use it to wipe off the dirt on the emission lens.

* If the dirt cannot be removed, replace the emission lens with a new one.

## ■ Fitting the Emission Lens

1 Fit the emission lens by following the procedure for removal in reverse.

### 8.3.4 Cleaning the Emission Mirror

**⚠CAUTION**

- Do not subject the emission mirror to ultrasonic cleaning.

  This could damage the emission mirror.
- When wiping off the dirt, take care not to rub the coating face too hard.

  This could scratch the coating face.

Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Emission mirror | Replacement part | 228-52286-91 |

■ For the RF-20Axs:

**1** Remove the cell housing screw and the fixing screw for the emission mirror from the bottom face of the cell housing.

**2** Remove the emission mirror and packing from the cell housing.

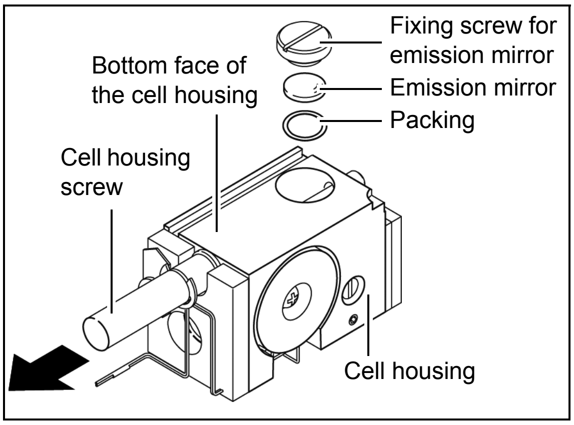



Fig. 8.29

**3** Moisten a piece of clean gauze or wiper cloth with 2-propanol and use it to wipe off the dirt on the emission mirror.

∗ If the dirt cannot be removed, replace the emission mirror with a new one.

## ■ For the RF-20A:

**1** Unscrew the fixing screw for the emission mirror with a hexagon wrench (1.5 mm across flats). (The screw need not be removed.)

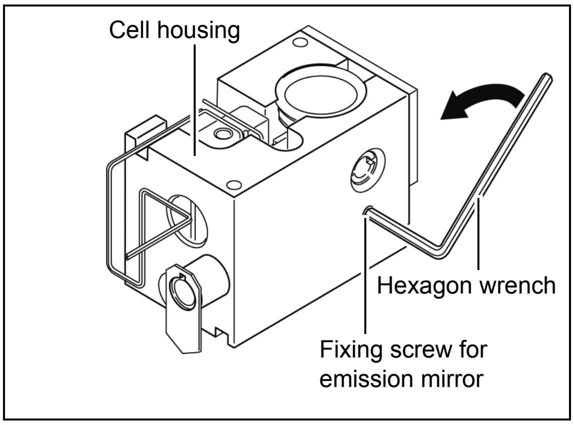



Fig. 8.30

**2** Remove the spacer, emission mirror and packing from the cell housing.
If the packing is difficult to remove, use forceps.

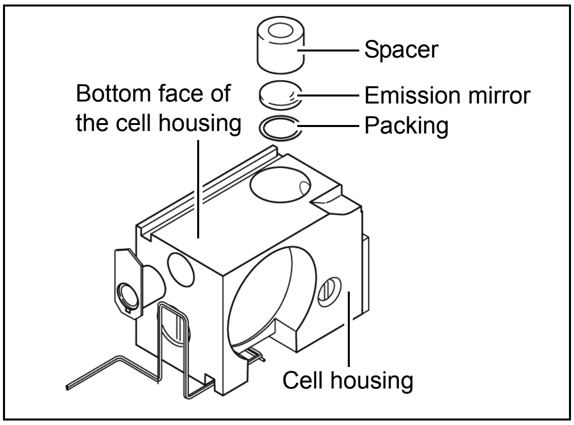



Fig. 8.31

**3** Moisten a piece of clean gauze or wiper cloth with 2-propanol and use it to wipe off the dirt on the emission mirror.

∗ If the dirt cannot be removed, replace the emission mirror with a new one.

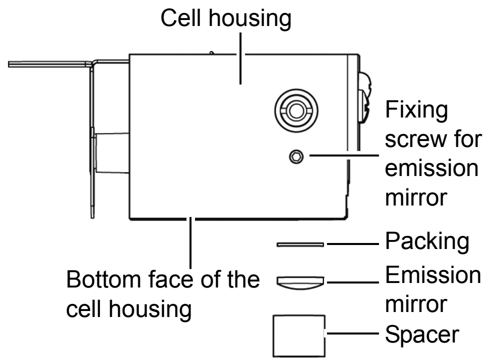
## ■ Fitting the Emission Mirror

NOTE

- Fit the emission mirror so that its convex side faces toward the bottom face of the cell housing.
- Tighten the emission mirror fixing screw lightly so as not to damage the emission mirror.

**1** Fit the emission mirror to the cell housing by following the procedure for removal in reverse.

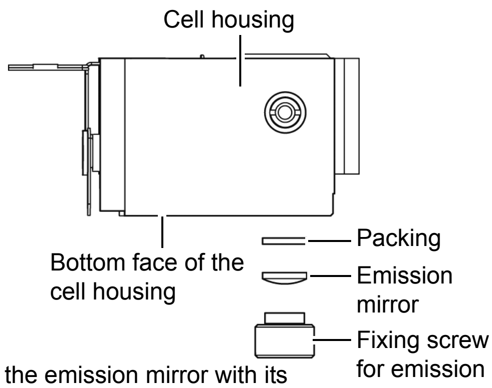
RF-20A




Fit the emission mirror with its convex side down.
Tighten the emission mirror fixing screw while the spacer is pressed against the emission mirror.

Fig. 8.32

RF-20Axs




Fit the emission mirror with its convex side down.

Fig. 8.33

8

## 8.3.5 Cleaning the Excitation Lens

> **⚠CAUTION**
>
> • Do not subject the excitation lens to ultrasonic cleaning.
>
> This could damage the excitation lens.

Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Excitation lens | Replacement part | 228-48699-01 |

### ■ Cleaning the Excitation Lens

**1** Remove the fixing screw for the excitation lens from the right side of the cell housing.

**2** Remove the excitation lens from the cell housing.

**3** Moisten a piece of clean gauze or wiper cloth with 2-propanol and use it to wipe off the dirt on the excitation lens.

∗ If the dirt cannot be removed, replace the excitation lens with a new one.

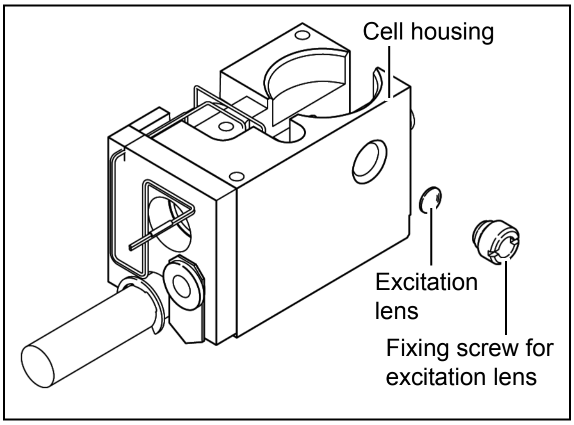


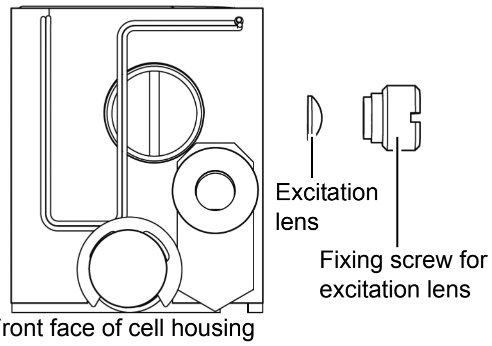

Fig. 8.34

### ■ Fitting the Excitation Lens

NOTE

- Be sure to fit the cell in the cell housing before fitting the excitation lens.
- Fit the excitation lens with its convex side faces toward the outside of the cell housing.
- When fitting the fixing screw for the excitation lens, do not tighten it any more strongly after it has made contact with the fixing screw.

**1** Fit the excitation lens in the cell housing by following the procedure for removal in reverse.




Fit the excitation lens with its convex side facing outward.

Fig. 8.35

## 8.3.6 Cleaning the Excitation Mirror

**⚠CAUTION**

- Do not subject the excitation mirror to ultrasonic cleaning.

  This could damage the excitation mirror.
- When wiping off the dirt, take care not to rub the coating face too hard.

  This could scratch the coating face.

Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Excitation mirror | Replacement part | 228-52285-91 |

### ■ Cleaning the Excitation Mirror

1. Remove the fixing screw for the excitation mirror from the left side of the cell housing.

2. Remove the spacer and excitation mirror from the cell housing.

3. Moisten a piece of clean gauze or wiper cloth with 2-propanol and use it to wipe off the dirt on the excitation mirror.

   * If the dirt cannot be removed, replace the excitation mirror with a new one.

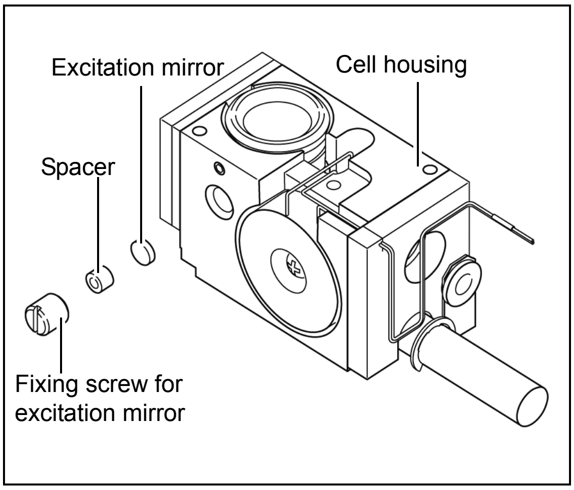


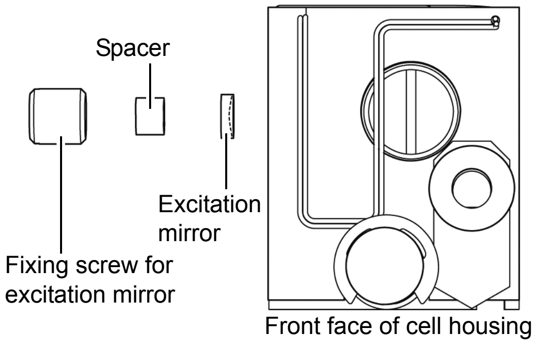

Fig. 8.36

## ■ Fitting the Excitation Mirror

NOTE

- Fit the excitation mirror with its concave side facing toward the inside of the cell housing.
- When fitting the fixing screw for the excitation mirror, do not tighten it any more strongly after it has made contact with the spacer.

**1** Fit the excitation mirror in the cell housing by following the procedure for removal in reverse.




Fit the excitation mirror with its concave side facing inward.

Fig. 8.37

## 8.3.7 Assembling and Fitting the Flow Cell Unit



### ■ Check After Assembly

After finishing cleaning or replacing each of the parts, reassemble the flow cell unit.
Before fitting the flow cell unit in the instrument, feed mobile phase into the flow cell with the syringe and check that there are no liquid leaks. Lead the outlet side tube into the waste container.

**1** Reassemble the flow cell unit by following the procedure for disassembly in reverse.

☞ "8.3.1 Disassembling the Flow Cell Unit" P.8-14

**2** Fit the syringe adapter to the tip of the syringe.

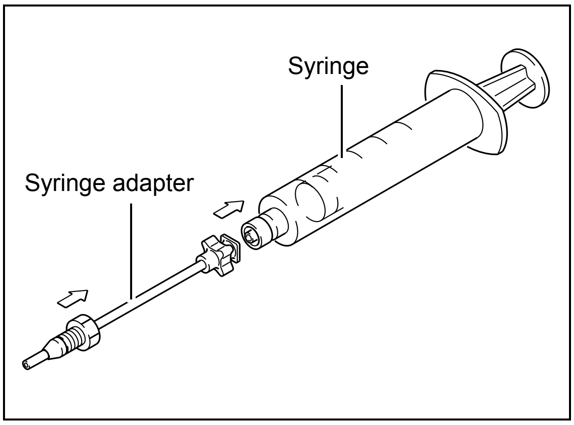



Fig. 8.38

**3** Fit the outlet tube to the outlet coupling 1.6-0.8C. Lead the outlet tube into the waste container.

**4** Fit the male nut 1.6MN of the syringe adapter to the inlet coupling 1.6-0.8C.

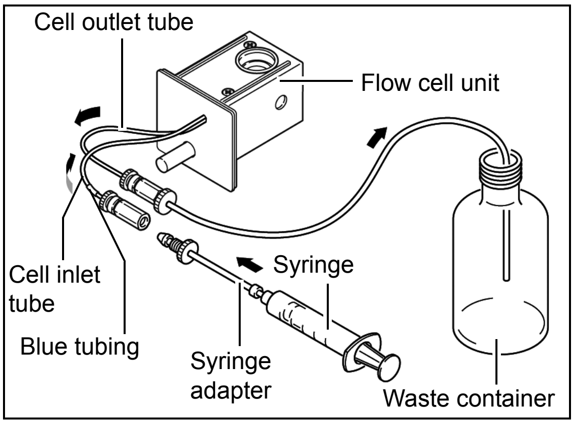



Fig. 8.39

**5** Fill the syringe with mobile phase, then slowly push the syringe's plunger in.

**6** Check that there is no liquid leakage from the flow line.

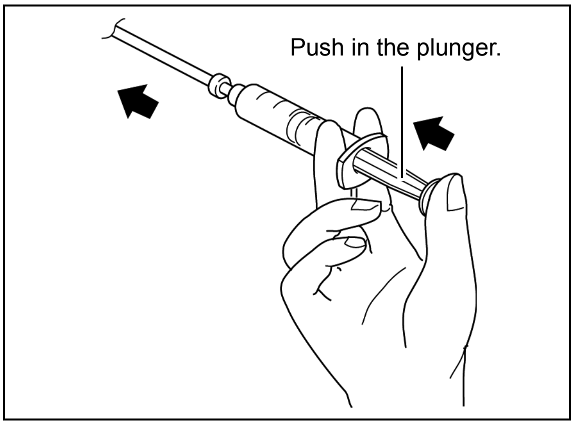



Fig. 8.40

**7** Remove the male nut 1.6MN of the syringe adapter from the inlet coupling 1.6-0.8C.

**8** Fit the tubing from the column onto the inlet coupling 1.6-0.8C and tighten the male nut PEEK.

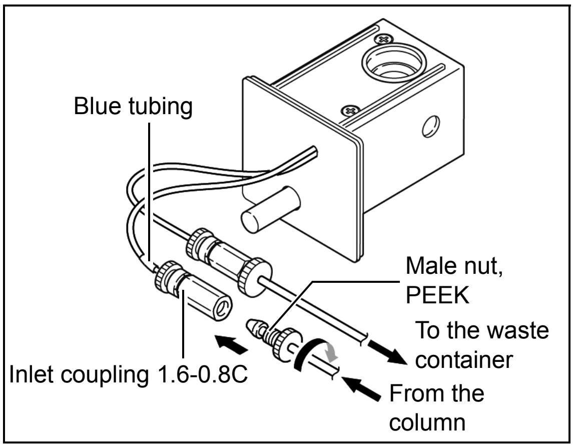



Fig. 8.41

## ■ Fitting the Flow Cell Unit

☞ "Fitting the Flow Cell Unit" P.8-7

8

# 8.4 Inspecting/Replacing the Xenon Lamp

**⚠WARNING**

- When handling a Xenon lamp, always wear the following protective gear: a protective mask, a thick long-sleeved shirt, and safety gloves.

  Gas at high pressure is enclosed in the Xenon lamp. If the lamp is subjected to a strong impact or the glass part is damaged, it may explode, scattering fragments.
  Use a protective mask that is able to cover the entire face with rigid plastic or similar material.
- When handling a Xenon lamp, do not touch the glass part with bare hands.

  If the Xenon lamp is lit while there are fingerprints on the glass part they will burn, and this may cause the lamp to explode.

  If you happen to touch the glass part with your bare hands, wipe the fingerprints off e.g. with a piece of gauze moistened with ethanol.
- Always turn the power to the instrument OFF and unplug the power plug before replacing a Xenon lamp.

  A high voltage of around 30 kV is applied to the positive (+) terminal of the Xenon lamp at the start of ignition, and this is extremely dangerous.
- Make sure that the Xenon lamp has cooled sufficiently before attempting to replace it.

  Immediately after being turned OFF the Xenon lamp is extremely hot and could burn you.

  The time required for the Xenon lamp to cool is at least 90 minutes after the power to the instrument has been turned OFF, or at least 30 minutes after the lamp has been turned OFF by setting [0] (OFF) for [LAMP] in the parameter settings group.

**⚠CAUTION**

- When the cumulative operating time of the Xenon lamp has exceeded 2000 hours, replace it.

  If the Xenon lamp continues to be used beyond its service life (2000 hours), it may explode. If the Xenon lamp explodes, it could damage the instrument.

## 8.4.1 Replacing the Xenon Lamp

### Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Xenon lamp | Consumable part | 228-51511-95 |

**1** Turn the power to the instrument OFF, unplug the power plug, and wait until the Xenon lamp cools.

**2** Open the front cover and the key panel.

NOTE

In order to prevent the front cover falling off, remove it from the instrument before starting the work.

**3** Unscrew the knurled screw (white) securing lamp cover 1, then remove lamp cover 1 and the filter.

* The knurled screw (white) is not detachable from lamp cover 1.

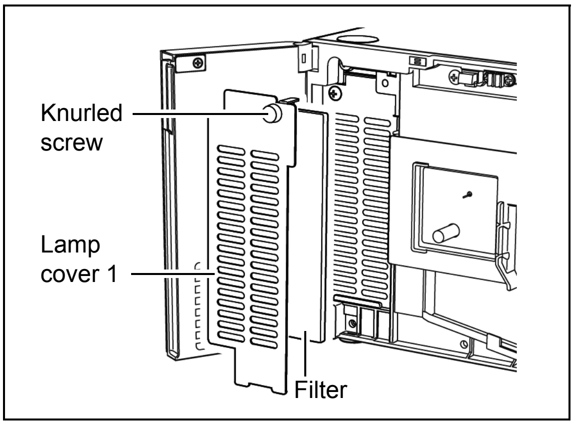



Fig. 8.42

**4** Remove the screw securing lamp cover 2, then remove lamp cover 2.

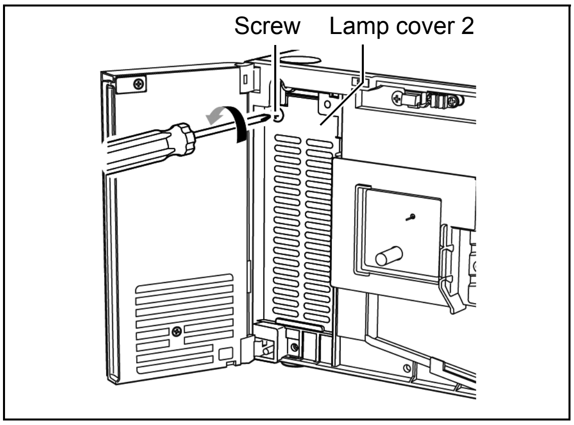



Fig. 8.43

8

**5** Unscrew the two screws on the front face of the lamp unit.

∗ The two screws need not be removed.

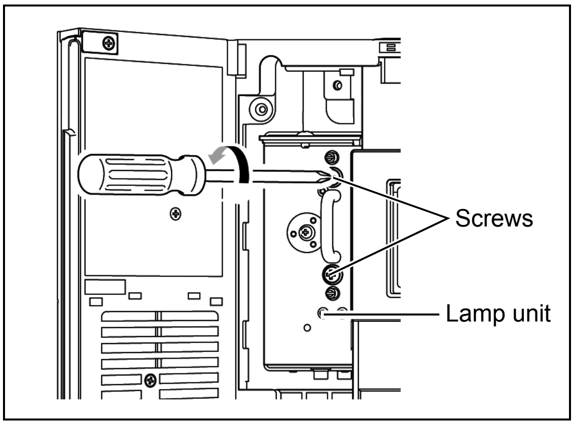



Fig. 8.44

**6** Hold the lamp unit's handle and pull the unit out of the instrument as shown in the figure to the right.

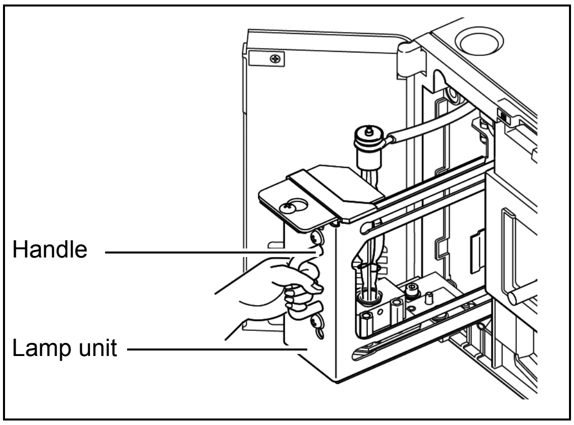



Fig. 8.45

**7** Unscrew the screw on the top of the lamp unit and pull the PTFE cover toward the front.

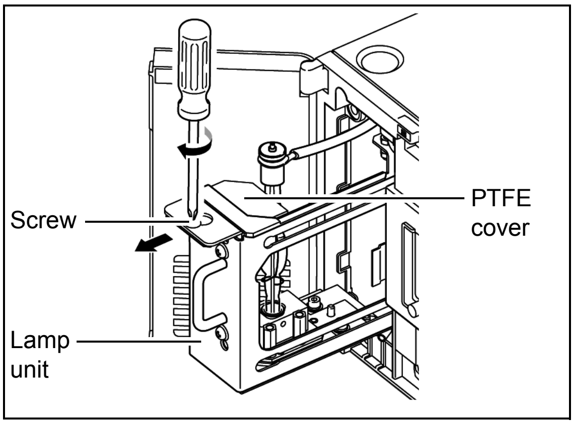



Fig. 8.46

**8** Unscrew the knurled nut at the top of the Xenon lamp and remove the cord terminal from the positive (+) terminal of the Xenon lamp.

> ⚠**CAUTION**
>
> - Be sure to unscrew the knurled nut by hand.
>
>   If a tool like a wrench is used, there is a risk of breaking the Xenon lamp, causing leakage of the gas inside it.

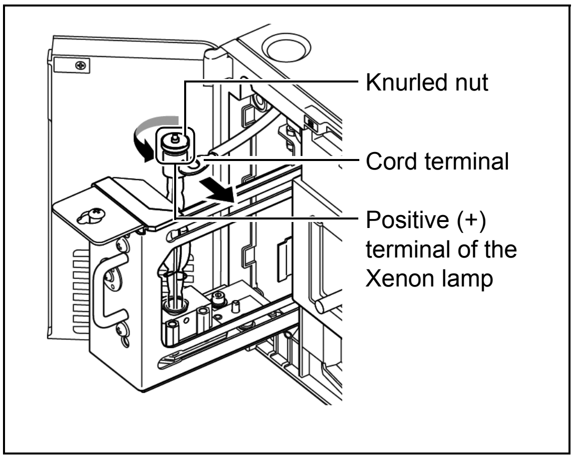



Fig. 8.47

**9** Remove the two hexagon spacers that secure the Xenon lamp to the instrument with the wrench provided as an accessory.

**10** Remove the Xenon lamp from the lamp unit together with its holder.

* The Xenon lamp doesn't come apart from the holder.

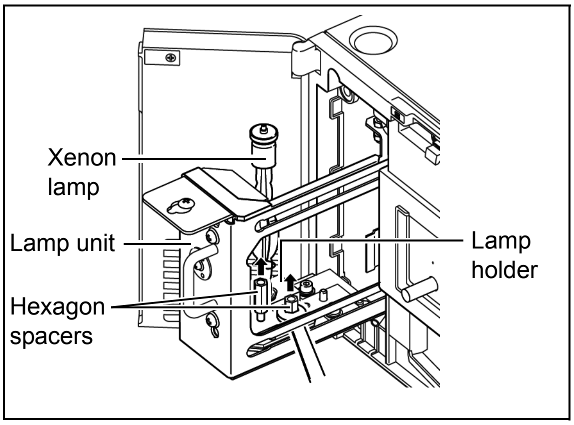



Fig. 8.48

**11** Fit the Xenon lamp in the lamp unit.

* The Xenon lamp comes with a lamp holder. Fit the lamp by aligning the two holes in the lamp holder with the positioning pins in the lamp unit.

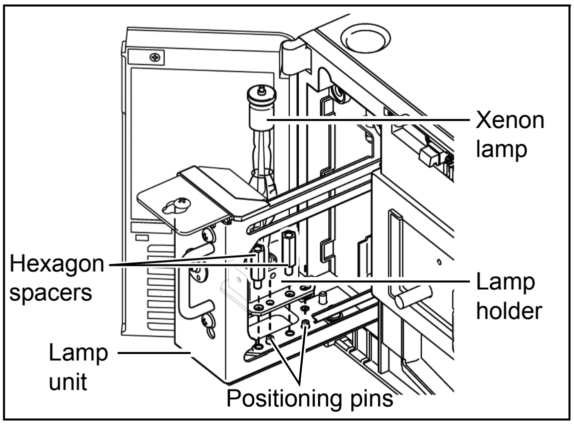



Fig. 8.49

**12** Once the Xenon lamp has been fitted in the lamp unit, fit the parts that were removed by following the procedure for their removal in reverse.

**⚠CAUTION**

- When fitting the cord terminal to the positive (+) terminal of the Xenon lamp, make sure that there is some slack in the cord.

  If there is no slack in the cord and the positive (+) terminal of the Xenon lamp is pulled by the cord while the lamp is on, the lamp may break.
- Be sure to tighten the knurled nut at the top of the Xenon lamp by hand.

  If a tool like a wrench is used, there is a risk of breaking the Xenon lamp, causing leakage of the gas inside it.
- Connect the lamp and cord correctly as shown in the figure to the right.

  If the connection is not made correctly, the cord could be damaged by heat generation.

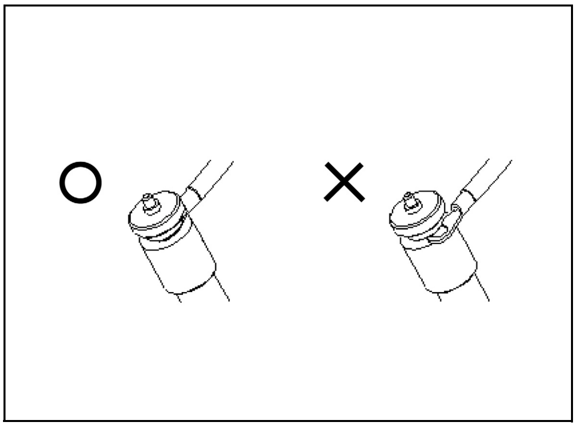


Fig. 8.50

## 8.4.2 Resetting the Cumulative Operating Time of the Xenon Lamp

After the Xenon lamp has been changed, reset its cumulative operating time to [0].

☞ "Showing the Replacement Alert Time for the Xenon Lamp, and Its Cumulative Operating Time [Xe LAMP USED TM]" P.5-38

# 8.5 Replacing the Fuse

**⚠WARNING**

- Before replacing fuses, turn the power to the instrument OFF and unplug the instrument.
- Only use fuses of the correct type and rating for replacement.

  Failure to heed the above could result in fire, electric shock or short circuits.

Be sure to use fuses of the following type and capacity for replacement.

Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| 250 V 5 AT (5 × 20) | Replacement part | 072-02004-23 |

## 8.5.1 Replacing the Fuse

1 Using a screwdriver, turn the fuse holder counterclockwise while applying a little pressure to remove it.

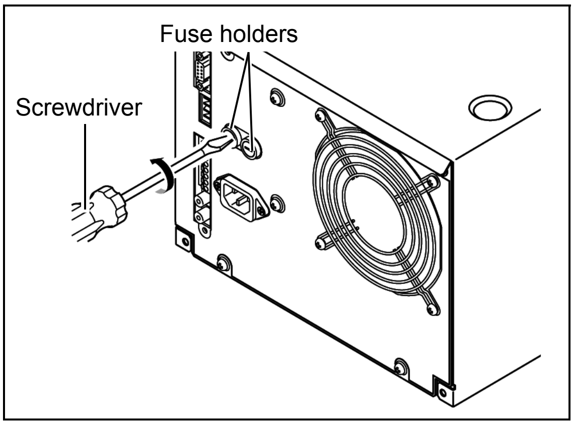



Fig. 8.51

2 Take the fuse out of the fuse holder.

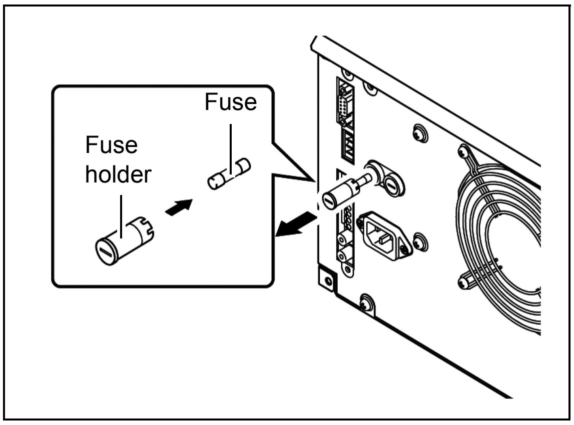



Fig. 8.52

**3** Fit a new fuse in the fuse holder and fit the fuse holder in the instrument.

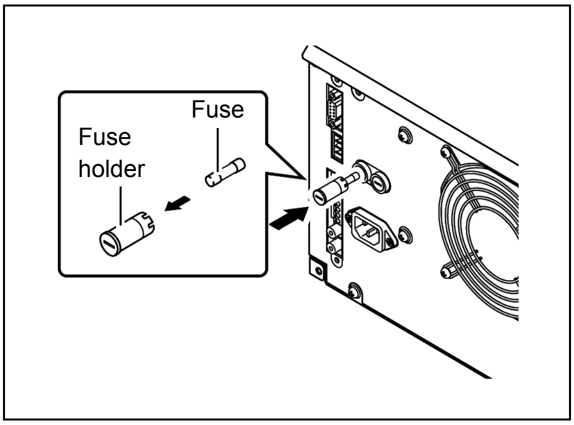



Fig. 8.53

**4** Using a screwdriver, turn the fuse holder clockwise while applying a little pressure to secure it.

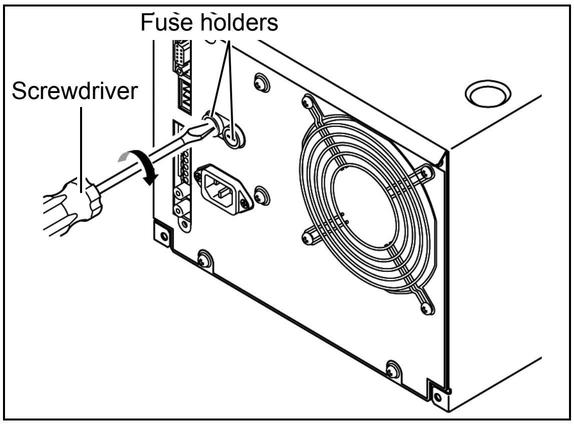



Fig. 8.54

# 8.6 Replacing the Filter

This instrument has filters fitted inside the right side face and the front cover. If the filter becomes clogged the performance of the instrument will deteriorate, and it may cause failure. If the filter becomes discolored from its original white, replace it with a new one.

NOTE

Be sure to turn the power to the instrument OFF before replacing the filters.

Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Air filter, side | Consumable part | 228-51147 |
| Air filter, front | Consumable part | 228-51146 |

## 8.6.1 Replacing the Filter in the Right Side Face

1. Hook your finger into the hole in the filter cover on the right side face, remove the filter cover, then remove the filter.

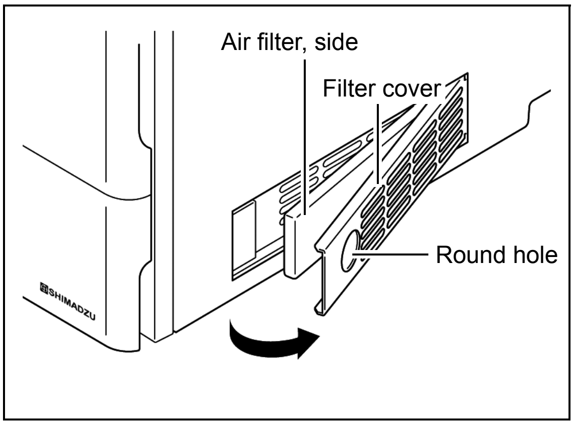


Fig. 8.55

2. Replace the filter and fit the filter cover as it was.
   * Align the catch on the filter cover with the instrument's chassis when fitting the cover.

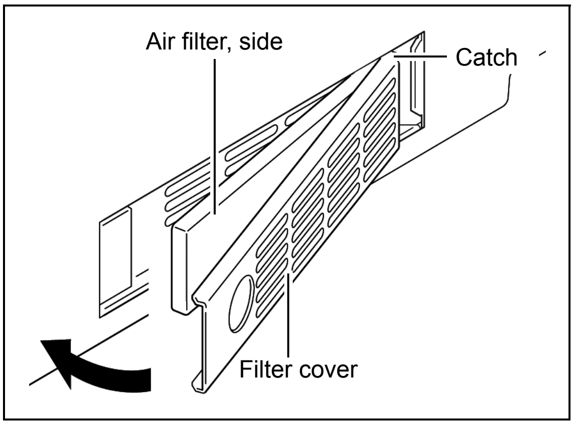


Fig. 8.56

## 8.6.2 Replacing the Filter in the Front Cover

**1** Turn the power to the instrument OFF and unplug the power plug.

**2** Open the front cover and the key panel.

NOTE

In order to prevent the front cover falling off, remove it from the instrument before starting the work.

**3** Unscrew the knurled screw (white) securing lamp cover 1 and remove lamp cover 1 and the filter.
∗ The knurled screw (white) is not detachable from lamp cover 1.

**4** Replace the filter and fit lamp cover 1 as it was.

**5** Close the front cover and key panel.

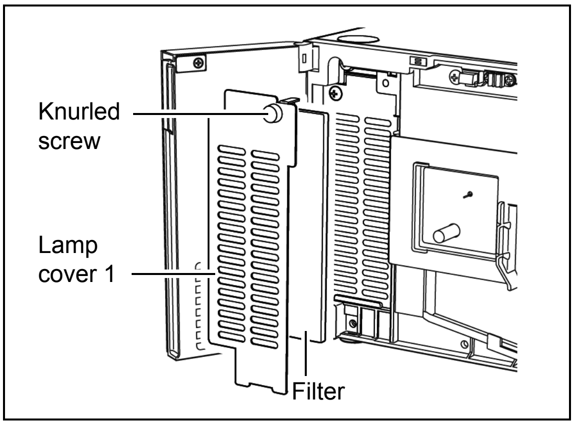



Fig. 8.57

# 8.7 Performing Wavelength Calibration

Wavelength calibration and a wavelength accuracy check are automatically performed using a low-pressure Hg (mercury) lamp.

## Wavelength calibration

| Item | Details of Implementation |
|---|---|
| Emission wavelength calibration | The excitation grating is moved to the 254 nm position which is the low-pressure Hg (mercury) lamp emission line, and scanning is performed at the emission side from in front of the 254 nm line, in front of the secondary line at 507 nm and in front of the tertiary line at 761 nm, the emission line spectrum is read, and the discrepancy between the true wavelength and the set wavelength is offset. |
| Excitation wavelength calibration | The emission grating is moved to the 254 nm position, and scanning is performed at the excitation side from in front of the low-pressure Hg (mercury) lamp's 254 nm line, in front of its secondary line at 507 nm and in front of its tertiary line at 761 nm, the emission line spectrum is read, and the discrepancy between the true wavelength and the set wavelength is offset. |

## Wavelength accuracy check

| Item | Details of Implementation |
|---|---|
| Emission wavelength check | Move the excitation grating to the 254 nm position, which is the emission line of the low-pressure Hg (mercury) lamp, perform scanning at the emission side from in front of the 254 nm line and in front of the 507 nm line (secondary line), and read the wavelength of the emission line. Calculate the difference between the wavelength of the read emission line and the wavelength of the true emission line and, if it is within ± 2.0 nm, judge the result to be normal. |
| Excitation wavelength check | Move the emission grating to the 254 nm position, perform scanning at the excitation side from in front of the 254 nm line and in front of the 507 nm line (secondary line), and read the wavelength of the emission line. Calculate the difference between the wavelength of the read emission line and the wavelength of the true emission line and, if it is within ± 2.0 nm, judge the result to be normal. |

## Parts used

| Part Name | Part Type | Part No. |
|---|---|---|
| Water (for HPLC, or equivalent) | - | - |
| Low-pressure Hg (mercury) lamp (RF-20A only) | Option | 200-38423 |
| Low-pressure Hg (mercury) lamp holder (RF-20A only) | Option | 228-51952-91 |
| Step down transformer* (RF-20A only) | – | – |

* The working voltage of the low-pressure Hg lamp is 100 V AC.
Connect the low-pressure Hg lamp to a power supply that is stepped down to 100 V AC using a transformer.

NOTE

Wavelength calibration can only be executed in the single wavelength mode. Set the measurement mode to the single wavelength mode.

☞ "4.1.1 Setting the Measurement Mode" P.4-2
"Setting the Measurement Mode [λ MODE]" P.5-17

## ■ For the RF-20Axs:

NOTE

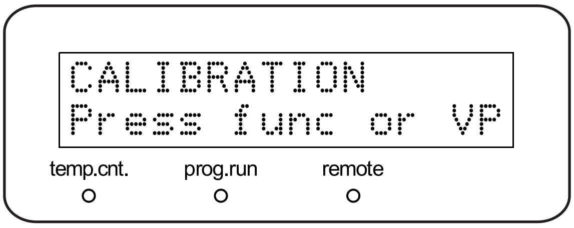
The time required for wavelength calibration is approximately 30 minutes.
To discontinue the wavelength calculation, press **CE**.

**1** When a system controller is being used, set [1] for [LOCAL] in the system settings group.

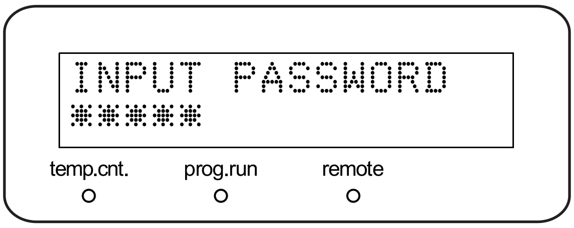
**2** Using the pump, pump water into the flow cell (flow rate: 1 mL/min).

**3** Check that there are no air bubbles inside the flow cell, then fit the flow cell to the instrument.

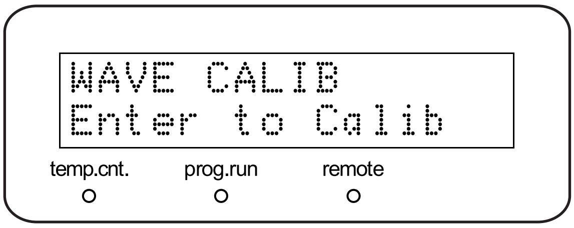
**4** With the initial screen displayed, repeatedly press **VP** until [CALIBRATION] appears.



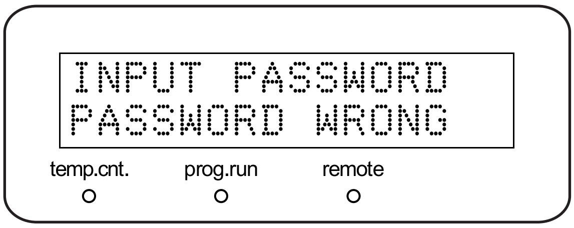

**5** Press **func**.
[INPUT PASSWORD] will be displayed.



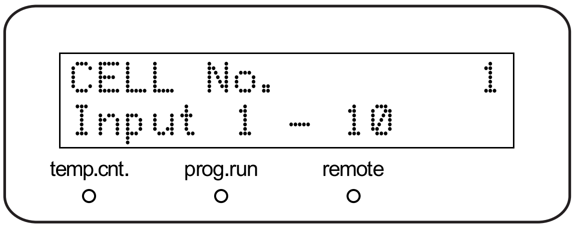
**6** Enter the password.
When the password matches, [WAVE CALIB] is displayed.




* If the password entered is incorrect, the screen to the right is displayed.
In this case, check the password and enter it again.




**7** Press **enter**.
[CELL No.] will be displayed.

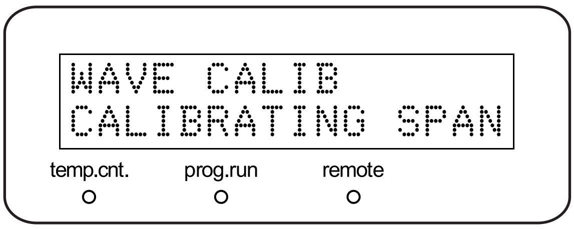



**8** Enter the cell number set for the instrument with the numeric keys and press **enter**.
Cell numbers are identification numbers used when multiple flow cell units are used.
The cell number of the flow cell unit provided with the instrument on shipping is set as [1].

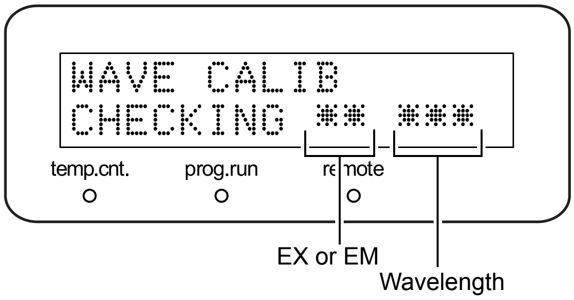
"Setting the Cell Number [CELL No.]" P.5-31
"5.9 Using the Spare Flow Cell Unit / Optional Cell" P.5-84

After waiting about one minute for the low-pressure Hg (mercury) lamp to stabilize, the wavelength calibration will start.

After the screen to the right has been displayed, wavelength calibration is executed.

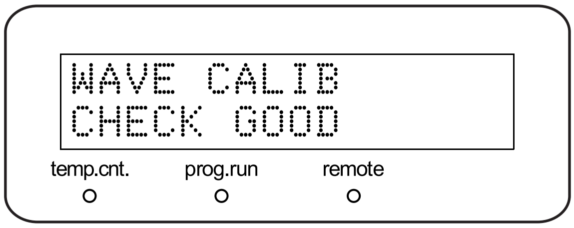


On completion of wavelength calibration the wavelength accuracy check starts automatically and the screen to the right is displayed.
On completion of wavelength calibration and the wavelength accuracy check, the result is displayed on the screen.




- If it is normal:

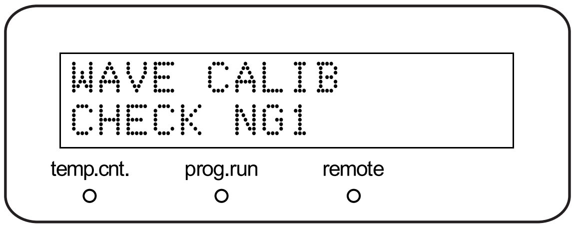
If the difference in wavelengths is within 2.0 nm, [CHECK GOOD] is displayed.




- If there is an abnormality:

The screen to the right appears.

"6.2 Dealing with Error Messages" P.6-5




**9** Press CE twice.
The initial screen is redisplayed.

When a system controller or LCsolution is used, perform the following operation before analyzing the sample.

## When the system controller is connected:

**1** Turn the power to the system controller OFF.

**2** Set [0] for [LOCAL] in the system settings group.

**3** Restart the system controller.

When LCsolution is used:

1 Exit LCsolution.

2 Turn the power to the system controller OFF.

3 Set [0] for [LOCAL] in the system settings group.

4 After restarting the system controller, start LCsolution.

NOTE

Before starting analysis when using a system controller or LCsolution, be sure to set [0] for [LOCAL] in the system settings group, then restart the system controller and LCsolution.

## ■ For the RF-20A:

NOTE

The time required for wavelength calibration is approximately 30 minutes.
To discontinue the wavelength calculation, press CE.

1 When a system controller is being used, set [1] for [LOCAL] in the system settings group.

2 Set [0] for [LAMP] in the parameter settings group to extinguish the Xenon lamp.
  * Wait at least 30 minutes after that for the Xenon lamp to cool.

3 Turn the power to the instrument OFF.

4 Fit the low-pressure Hg (mercury) lamp.
  ☞ "9.1.10 Fitting the Low-Pressure Hg (Mercury) Lamp (RF-20A Only)" P.9-37

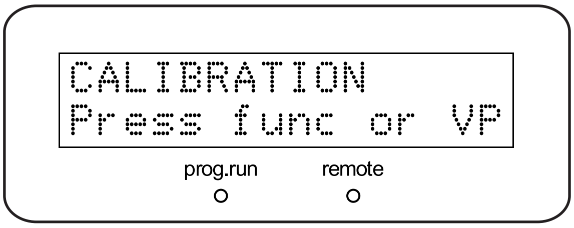
**5** Using the pump, pump water into the flow cell (flow rate: 1 mL/min).

"8.2 Inspection and Simple Washing of the Cell" P.8-5

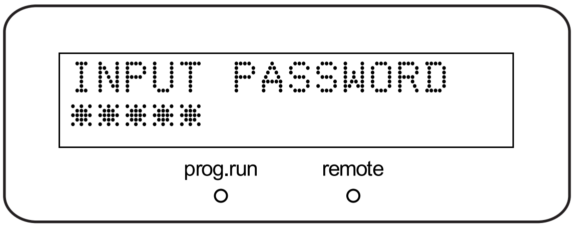
**6** Check that there are no air bubbles inside the flow cell, then fit the flow cell to the instrument.

**7** Turn the power to the instrument ON.

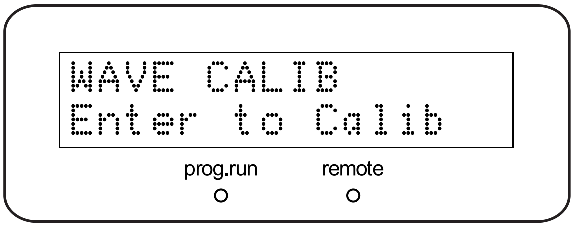
**8** With the initial screen displayed, repeatedly press **VP** until [CALIBRATION] appears.



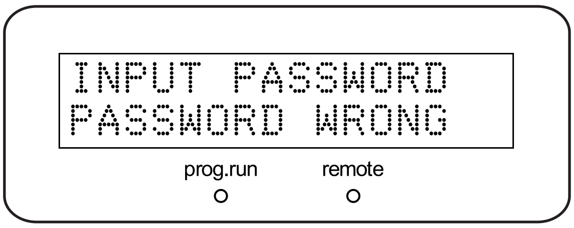

**9** Press **func**.
[INPUT PASSWORD] will be displayed.



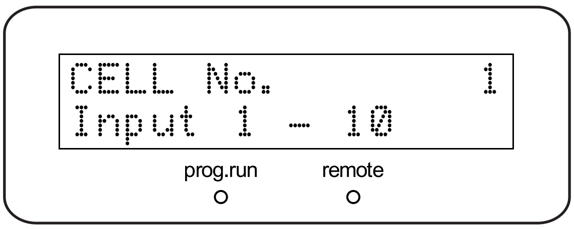

**10** Enter the password.
When the password matches, [WAVE CALIB] is displayed.
The default value is [00000].




* If the password entered is incorrect, the screen to the right is displayed.
In this case, check the password and enter it again.




**11** Press **enter**.
[CELL No.] will be displayed.



**12** Enter the cell number set for the instrument with the numeric keys and press **enter**.

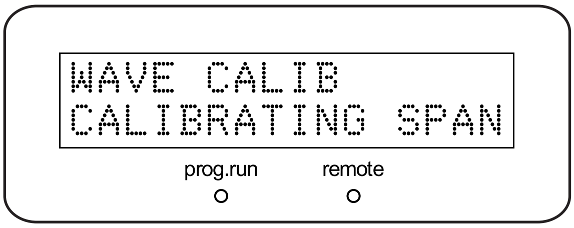
Cell numbers are identification numbers used when multiple flow cell units are used.

The cell number of the flow cell unit provided with the instrument on shipping is set as [1].

☞ "Setting the Cell Number [CELL No.]" P.5-31
"5.9 Using the Spare Flow Cell Unit / Optional Cell" P.5-84

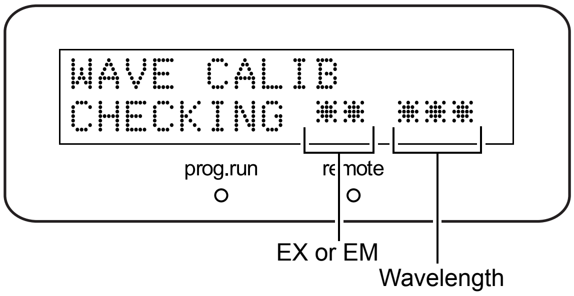
After waiting about one minute for the low-pressure Hg (mercury) lamp to stabilize, the wavelength calibration and wavelength accuracy check will start.

After the screen to the right has been displayed, wavelength calibration is executed.



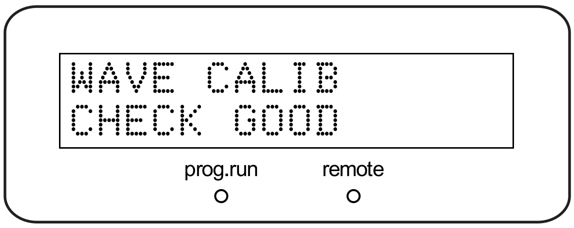

On completion of wavelength calibration the wavelength accuracy check starts automatically and the screen to the right is displayed.

On completion of wavelength calibration and the wavelength accuracy check, the result is displayed on the screen.




- If it is normal:

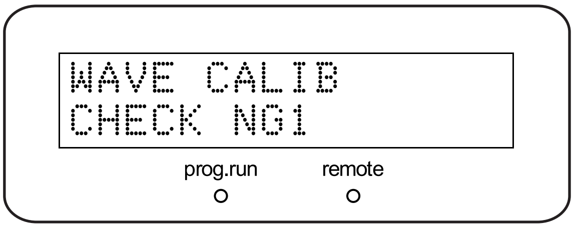
If the difference in wavelengths is within 2.0 nm, [CHECK GOOD] is displayed.



- If there is an abnormality:

The screen to the right appears.

☞ "6.2 Dealing with Error Messages" P.6-5




**13** Press CE twice.

The initial screen is redisplayed.

NOTE

After wavelength calibration has finished, be sure to remove the low-pressure Hg (mercury) lamp and fit the Xenon lamp.

After the wavelength accuracy inspection, perform the operation below.

## When neither a system controller nor LCsolution is used:

**1** Turn the power to the instrument OFF.

**2** Remove the low-pressure Hg (mercury) lamp, and fit the Xenon lamp as it was originally fitted.

## When the system controller is connected:

**1** Turn the power to the instrument and the system controller OFF.

**2** Remove the low-pressure Hg (mercury) lamp and fit the Xenon lamp as it was originally fitted.

**3** Turn the power to the instrument ON and set [0] for [LOCAL] in the system settings group.

**4** Restart the system controller.

When LCsolution is used:

1. Exit LCsolution.
2. Turn the power to the instrument and the system controller OFF.
3. Remove the low-pressure Hg (mercury) lamp and fit the Xenon lamp as it was originally fitted.
4. Turn the power to the instrument ON and set [0] for [LOCAL] in the system settings group.
5. After restarting the system controller, start LCsolution.

NOTE

Before starting analysis when using a system controller or LCsolution, be sure to set [0] for [LOCAL] in the system settings group, then restart the system controller and LCsolution.

# 8.8 Cleaning the Exterior

If the main cover or front panel becomes dirty, wipe it clean with a soft dry cloth or tissue paper.
For persistent stains, clean the exterior using the following procedure.

1. Dip a piece of cloth in a dilute neutral detergent and wring it out firmly to remove excess liquid.

2. Dip a piece of cloth into water and wring it out firmly; after wiping with this cloth until no detergent remains, wipe away moisture with a dry cloth.

NOTE

Do not allow spilled water to remain on the instrument surface, and do not use alcohol or thinner-type solvents to clean the surfaces.
These can cause rusting and discoloration.

# 9

# Technical Information

Contents

# 9.1 Installation

## 9.1.1 Installation Site

### ■ Suitable Sites and Preparation

To ensure safe operation, install the instrument in a suitable location that satisfies the following conditions.

**⚠WARNING**

- Provide sufficient ventilation in the room.

  The solvents used with the HPLC system are often flammable and toxic. The solvent vapors could cause poisoning or ignite and cause a fire.
- Use no fire sources near the instrument.

  The solvents used with the HPLC are often flammable. Therefore, the use of open flame where the instrument is installed must be strictly prohibited. Also, do not install in the same room with equipment that emits or could potentially emit sparks.
- Fire extinguishers are permanently available.

  Have fire extinguishers permanently available in case of fire.
- Provide sink washing equipment near the instrument.

  If solvent gets into the eyes or onto the skin, it must be flushed away immediately.

  Provide sink washing equipment as close to the instrument as possible.

**⚠CAUTION**

- Avoid dust and corrosive gas.

  To ensure that the instrument has a long service life and to preserve its performance levels, avoid installing it in places subject to large amounts of dust or corrosive gas.
- Do not install the instrument near equipment that generates strong magnetic fields.

  To ensure proper operation, do not install the instrument in places subject to strong magnetic fields.

  If the power supply line is subject to high electrical noise, install a surge protector.
- Install the instrument in a location that satisfies the following conditions to preserve its performance:
  - The room temperature is between 4 and 35 °C, with minimal temperature variation during a day.
  - Air currents from heating or air conditioning equipment are not directed onto the instrument.
  - Sunlight does not shine directly on the instrument.
  - There is no vibration.
  - The humidity stays within 20 to 85 %.
  - There is no condensation.

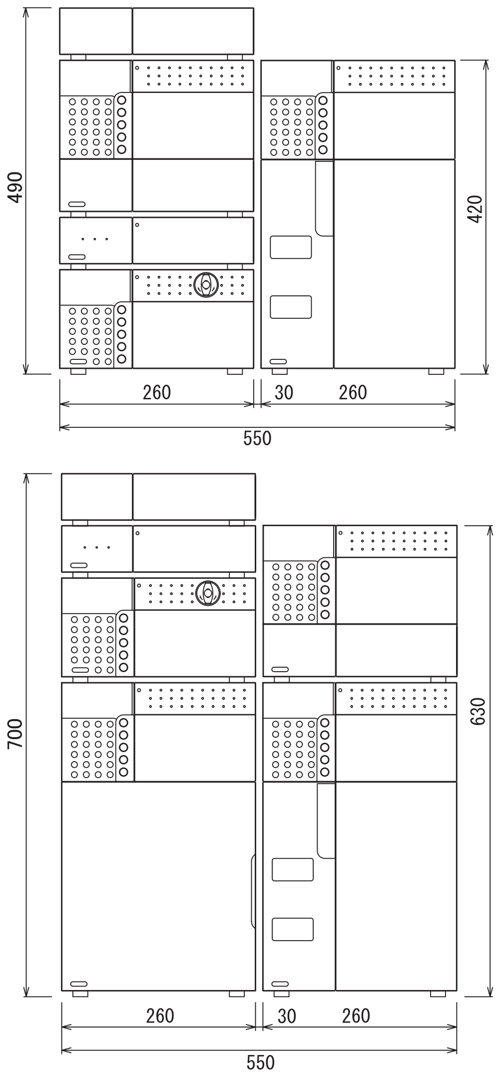
## ■ Required Installation Space

> **⚠CAUTION**
>
> - The weight of this instrument is 16 kg (RF-20A) or 18 kg (RF-20Axs). During installation, consider the entire weight combined with other LC components.
>
>   The lab table on which this instrument is installed should be strong enough to support the total weight of the LC system. It should be level, stable and have depth of at least 600 mm.
>
>   Otherwise, the instrument could tip over or fall off the table.
>
> - Keep at least 100 mm between the rear of the instrument and the wall.
>
>   This allows for sufficient air circulation to provide cooling and prevent the instrument from overheating and impairing the performance.

Typical system configurations and required installation spaces are shown in the figures below.

● System 1 (with manual injector)

● System 2 (with autosampler)




(Units: mm)

Fig. 9.1

## 9.1.2 Installation

### ■ Removing the Shipping Screws

In order to prevent shock during transportation, the instrument is fixed with the shipping screws. Remove these screws prior to installation.

NOTE

When the instrument is used without removing shipping screws, noise due to vibration may be heard during operation.

1 Loosen and remove the shipping screws (with washers, painted red).

☞ "2.3 Right Side and Base Panel" P.2-4

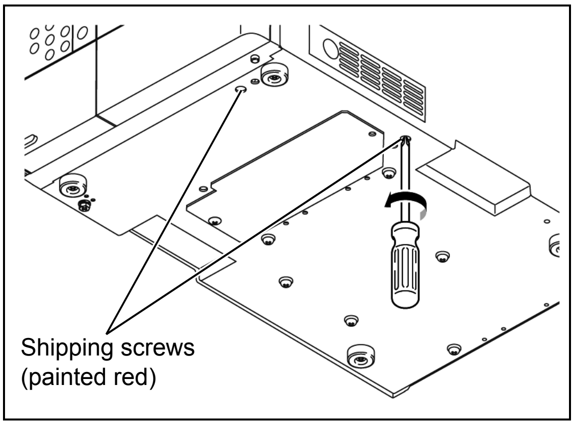



Fig. 9.2

### ■ Installation

The instrument is designed for stacking with other Shimadzu HPLC components.

☞ "9.4 Introduction to the HPLC System" P.9-45

NOTE

In order to ensure detection with the highest sensitivity and accuracy, install the instrument close to the column.
It is the general practice to install it above the column oven.

⚠CAUTION

- Take care to avoid pinching your fingers between the components.

  When the LC-20A series components are stacked on each other, the clearance between the components is only 5 mm.

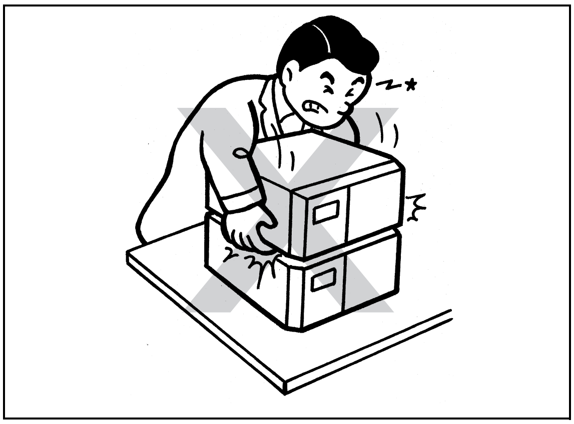


Fig. 9.3

## ■ Stacking Brackets

The use of commercially available stacking brackets is recommended. These brackets limit the possibility of the units falling off the lab table during an earthquake or the like. Various grades of stacking brackets are available.

Fasten the units firmly in place by attaching stacking brackets to both the right and left sides.
For more details, contact your Shimadzu representative.
An example of stacking bracket placement is shown in "Fig. 9.4".

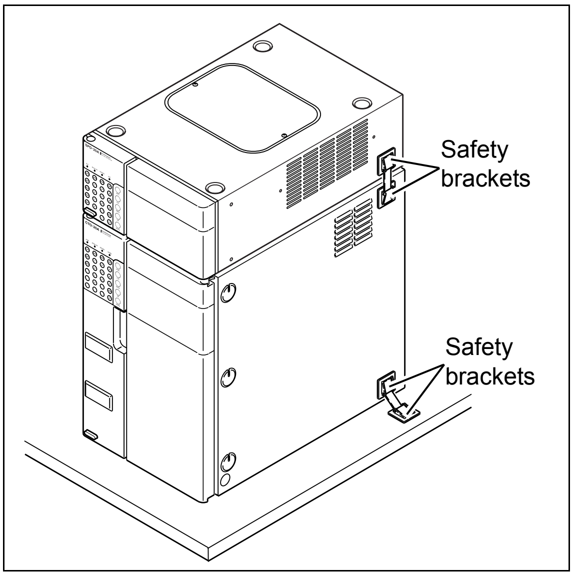



Fig. 9.4

## 9.1.3 Power Supply Connection

The following table shows the power supply voltage, power consumption, and frequency.

RF-20A

| Part No. | Power Supply Voltage | Power Consumption | Frequency |
|---|---|---|---|
| 228-45147-41 | AC100-120 V (100-120 V~) | | |
| 228-45147-42 | AC100-120 V (100-120 V~) | 400 VA | 50/60 Hz |
| 228-45147-48 | AC220-240 V (220-240 V~) | | |

RF-20Axs

| Part No. | Power Supply Voltage | Power Consumption | Frequency |
|---|---|---|---|
| 228-45148-41 | AC100-120 V (100-120 V~) | | |
| 228-45148-42 | AC100-120 V (100-120 V~) | 400 VA | 50/60 Hz |
| 228-45148-48 | AC220-240 V (220-240 V~) | | |

Verify that the power outlet to be used for connection has sufficient capacity. If the capacity is insufficient, a power outage or voltage drop can occur, affecting not only this instrument, but other equipment connected to the same power supply.

**⚠WARNING**

- The power supply voltage is indicated on the rear face of the instrument. Be sure to connect a suitable power supply.

  If a power supply voltage other than the one indicated is used, it will cause fire, electric shock or instrument failure.

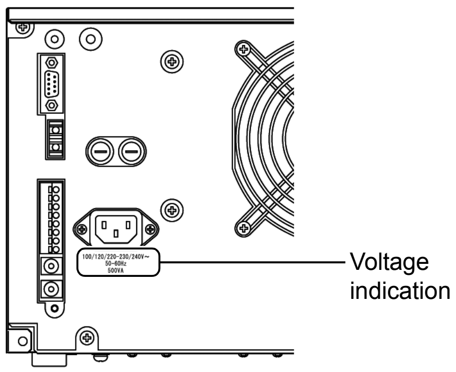



Fig. 9.5

**⚠CAUTION**

- Fit the Xenon lamp before turning the power switch ON.

  The instrument is delivered with the Xenon lamp removed.
- When turning the power switch ON, be sure to check that the Xenon lamp is fitted.

  When the Xenon lamp is turned on, a high voltage of around 30 kV is applied to the terminal of the lamp. If the lamp is not fitted correctly at the time of ignition, the instrument may be damaged.

  ☞"9.1.9 Fitting the Xenon Lamp" P.9-33

## ■ Connection to Power Outlet

**⚠WARNING**

- Handle the power cord with care.

  Observe the following precautions to avoid cord damage, fire, electric shock or instrument failure.

  - Do not place heavy objects on the cord.
  - Keep hot items away from the cord.
  - Do not modify the cord.
  - Do not bend the cord excessively or pull on it.
  - To unplug the instrument, pull the plug itself, NOT the cord.

  If the cord is damaged, contact your Shimadzu representative.

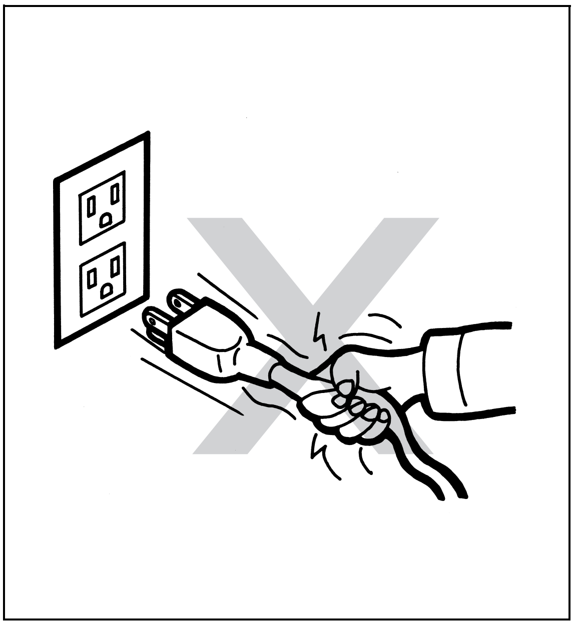


Fig. 9.6

**⚠CAUTION**

- Before plugging in the instrument, make sure that the power switch is OFF.

**1** Insert the connector end of the power cord into the power cord connector at the back of the instrument.

**2** Insert the plug end of the power cord into the power supply outlet.

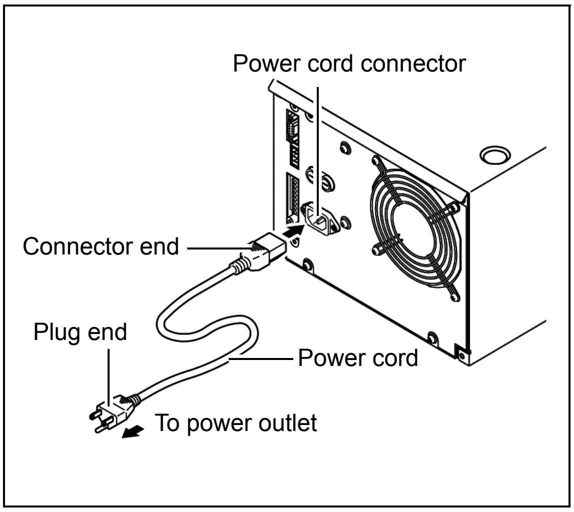



Fig. 9.7

## ■ Grounding

**⚠WARNING**

The three-line type power cable provided as an accessory includes the grounding wire.

Be sure to ground through this cable in order to prevent electrical shock and to ensure stable operation of the instrument.

## 9.1.4 Prior to Plumbing

Many different types of tubing and connector are used to plumb the instrument at installation. It is necessary to cut tubings and fit connectors prior to the plumbing. This section presents the instructions and precautions for these preparations.

### ■ Types of Tubing and Connector

The tubing and connectors used for the plumbing are made of stainless steel (SUS) or resin as follows.

**Stainless steel (SUS)**

- SUS tubing $\phi$ 1.6 O.D. $\times$ $\phi$ 0.3 I.D.
- SUS tubing $\phi$ 1.6 O.D. $\times$ $\phi$ 0.17 I.D.
- Male nut, 1.6MN
- Male nut, 1.6MN, W6
- Ferrule, 1.6F

**Resin**

- FEP tubing, PTFE tubing, ETFE tubing, PEEK tubing, PE tubing, etc.
- Male nut, PEEK
- Ferrule, PEEK
- PTFE ferrule

**⚠CAUTION**

- When resin tubing is used, be sure to use this instrument with a pressure of 20 MPa or less.

  Pumping with a pressure of 20 MPa or higher may cause tubing to come off at the connection.

### ■ Cutting Tubings

Cut the provided tubings to the proper lengths for installation.

**⚠CAUTION**

- Make the cut surface at right angles.

  Otherwise, dead volume will be created and may cause chromatographic peak broadening.
- Make sure that the inner diameter of the tubing is not deformed.

  Otherwise, the tubing may become clogged.

## Cutting SUS tubing:

**1** Position the provided file (for cutting SUS tubing, Part No.: 670-18928-02) diagonally against the tubing, and make an even incision around the whole circumference of the tubing.

∗ Make the incision in the tubing so that it is at right angles to the tubing's axis.

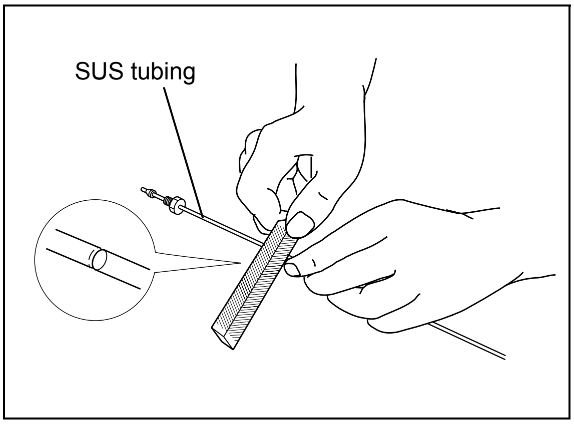



Fig. 9.8

**2** Holding the tubing at equal distances from the line of the incision, bend it up and down and from side to side to cut it off.

**3** File the cut surface to make it smooth and straight.

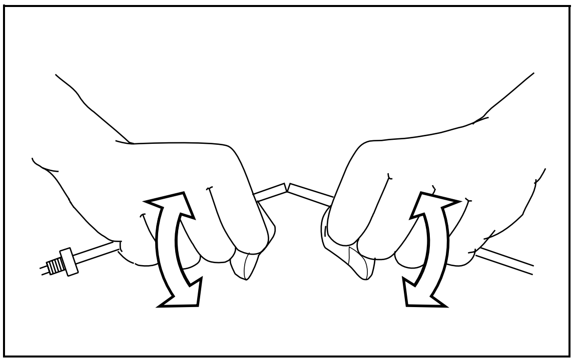


Fig. 9.9

## Cutting resin tubing:

Cut off the resin tubing at right angles using a cutter.

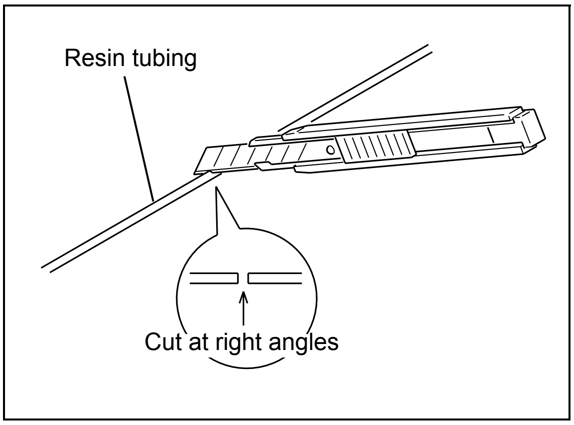



Fig. 9.10

## ■ Connecting Tubings

**1** Mount a male nut and a ferrule to the tubing.

> **⚠CAUTION**
>
> - Install stainless steel male nuts and ferrules on SUS tubing, and resin male nuts and ferrules on resin tubing.
>
>   If resin male nuts and ferrules are mounted on SUS tubing, the connection can be loosened easily and leakage may occur.

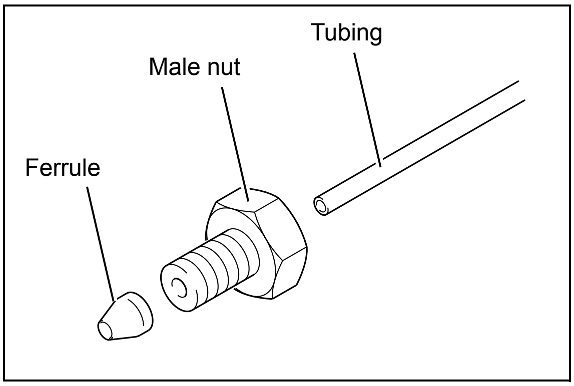



Fig. 9.11

**2** Insert the end of the tubing, with the ferrule on it, into the appropriate opening. Then tighten the male nut.

The ferrule will be secured on the tubing.

> **⚠CAUTION**
>
> - Insert the tubing completely into the opening, until it butts against the end of the opening.
>
>   Otherwise, dead volume will be created and may cause chromatographic peak broadening.
> - Do not overtighten the male nut.
>
>   Otherwise, the threads will be damaged.

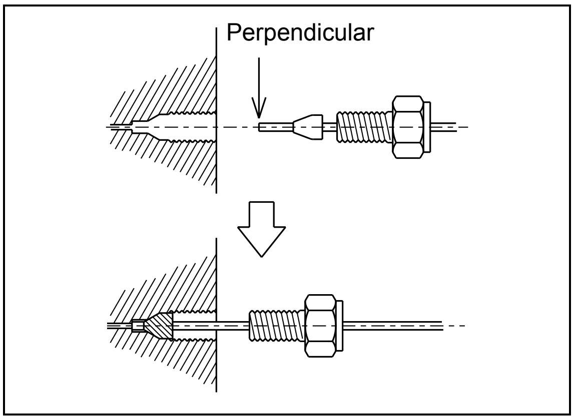



Fig. 9.12

NOTE

Use the following as rough guide for the degree of tightening to tighten a male nut with a wrench when connecting the PEEK tubing with an SUS ferrule and a male nut.

- 6-mm male nut:
  Tighten securely by hand and tighten another 120° (approx.) with a wrench.
- 8-mm male nut:
  Tighten securely by hand and tighten another 90° (approx.) with a wrench.

After connecting the PEEK tubing, pull the tubing to check that it does not come out.

- For an SUS male nut:
  Use the open-end wrench (provided) to tighten and loosen the nut.
  If the nut is to be connected to a coupling or other part that is not secured, use two wrenches to secure the coupling.
- For a resin male nut:
  Tighten and loosen the nut by hand.

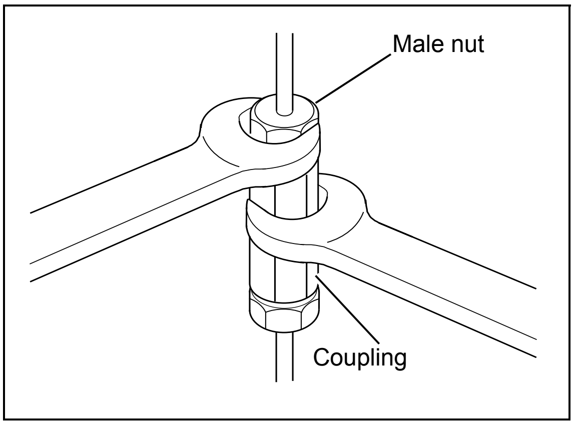



Fig. 9.13

**3** Loosen and move the male nut slightly to verify that the ferrule is secured on the tubing.

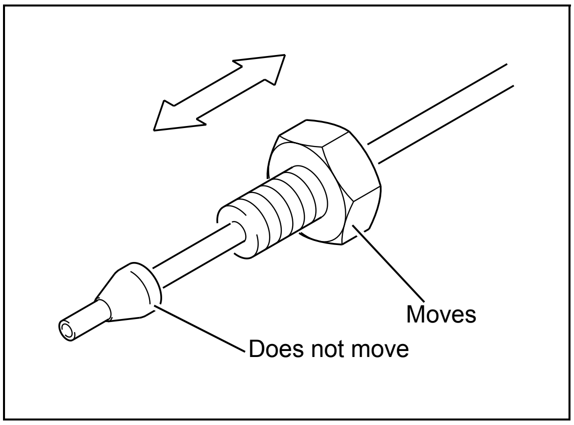



Fig. 9.14

9

## ■ Protective Plugs

The inlets and outlets of the units are fitted with protective plugs (bushings, stop plugs, caps and similar items) to keep out dirt and dust during shipment.
When the unit is not connected to other LC system components, keep the protective plugs in place.
Otherwise, dirt and dust may cause clogging of the instrument.
Remove the protective plugs of parts that are connected, and keep them so they will not get lost.

NOTE

- For stop plugs:
  Use the open-end wrench (provided) to tighten and loosen the nut.
- For resin plugs:
  Remove and replace the plugs by hand.

## ■ Bending Tubing for Plumbing

- For SUS tubing:

Making a bending radius (curvature radius) too small will deform the inner diameter of the tubing, and this will cause clogging or pressure increases in the tubing. Do not bend the tubing to excessive angles using pliers or similar tools. Also, do not bend and straighten out the same portion repeatedly. This will weaken the tubing, with the risk that it will break.

- For PEEK tubing:

Making a bending radius (curvature radius) too small will weaken the tubing and may cause liquid leakage. Make bends as naturally as possible, with a radius of at least 10 mm.

## 9.1.5 Plumbing

**⚠CAUTION**

- Before plumbing, turn OFF the power supply to all the components and unplug them.
- For plumbing, use the appropriate parts listed in "1.3 Component Parts".
- Connect only the tubing described in the instructions.

  Otherwise, injury or equipment failure may result.

The necessary plumbing is as follows:

- Plumbing of the cell inlet tube: Plumbing to be the flow line for the mobile phase from the column outlet to the instrument
- Plumbing of the cell outlet tube: Plumbing for draining solution on which detection has been completed
- Plumbing of tubing for leakages: If leaks occur in any of the units in a stack, this tubing directs it down to the lowest unit in the stack, and from there to a waste container.

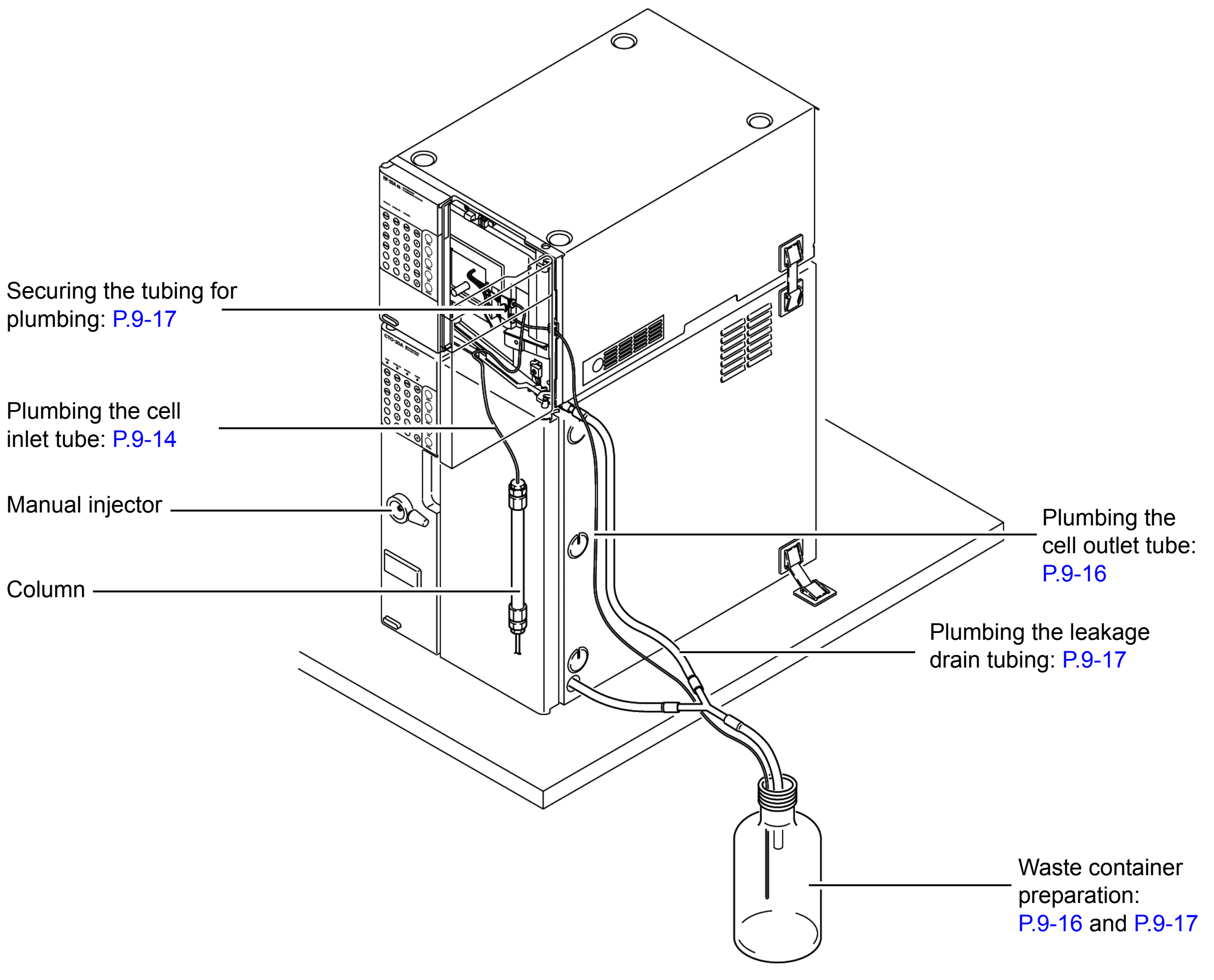



Fig. 9.15

## ■ Waste Container Preparation

Before plumbing, prepare a waste container, or a waste container made of metal, for the waste liquid on which detection has been completed.

> ⚠**WARNING**
>
> - Do not use cracked or damaged containers.
>
>   They may break.

> ⚠**CAUTION**
>
> - When using a mobile phase with high insulating characteristics, like hexane, use a waste container made of metal, and ground it.
>
>   Otherwise a static electric charge could accumulate in the waste container.
> - The waste container must be positioned lower than the instrument (for example, on the floor).
>
>   If it is positioned higher than the instrument, liquid will not drain, and will leak from the connections.

## ■ Plumbing the Cell Inlet Tube

**1** Before starting plumbing, open the front cover.

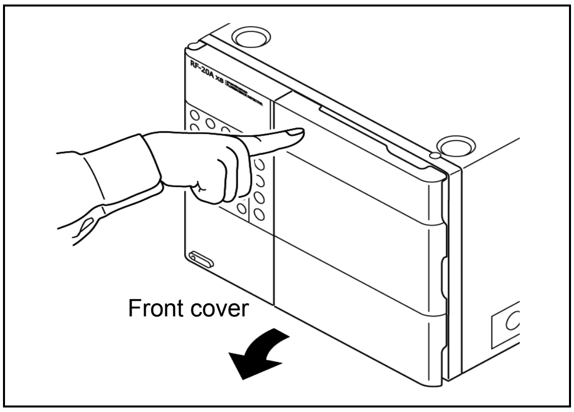



Fig. 9.16

**2** Cut the PEEK tubing provided (50 cm) to the length required to plumb from the column outlet to the cell inlet tube.

∗ To be prepared for accidents such as breakage of the PEEK tubing, use the PEEK tubing ensheathed by the FEP tubing provided.
Cut the FEP tubing about 35 to 40 mm shorter than the PEEK tubing, then ensheath the PEEK tubing with it. Leave equal lengths of PEEK tubing exposed at each end so that male nuts can be fitted.

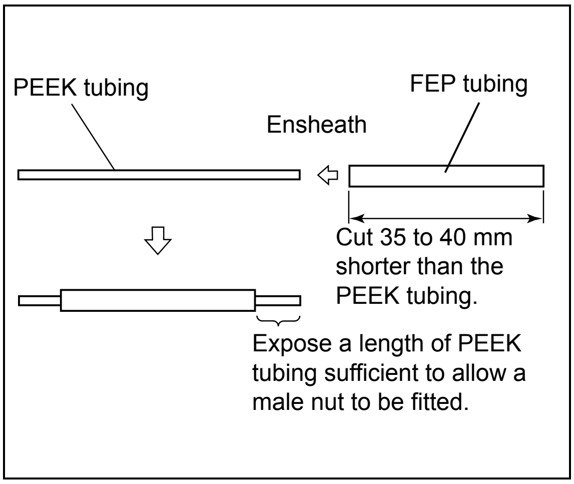



Fig. 9.17

**3** Fit male nuts PEEK to both ends of the PEEK tubing.

**4** Loosen and remove the stop plug that is fitted to the column outlet.

**5** Screw the male nuts PEEK on the PEEK tubing onto the couplings 1.6-0.8C on the column outlet and the cell inlet tube (the tube marked with a blue cover).

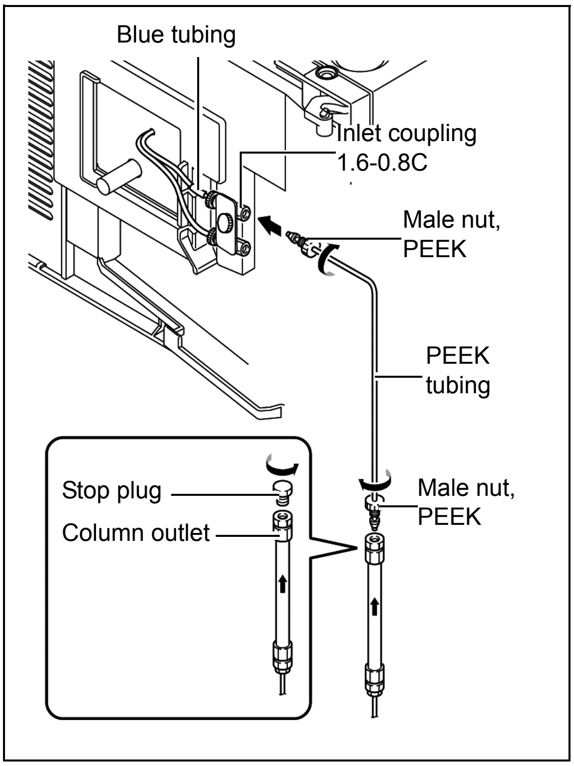



Fig. 9.18

## ■ Cautions on Handling Tubing

**⚠CAUTION**

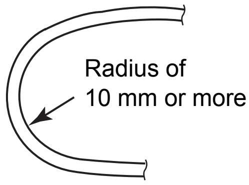
- Unusable solvents:
  Use of the following solvents will cause serious deterioration in the strength of the PEEK resin due to stress cracking. Never use these solvents.

  Concentrated sulfuric acid, concentrated nitric acid, dichloroacetic acid, acetone*, tetrahydrofuran (THF), dichloromethane, chloroform, dimethyl sulfoxide (DMSO), fluorine organic solvents such as hexafluoroisopropanol (HFIP)

  * There is no problem with temporarily using a low-concentration aqueous solution with an acetone concentration of 0.5 % or less, e.g. for the purpose of checking the performance of the gradient.

- When bending PEEK tubing, ensure the bending radius is at least 10 mm.

  Bending the tubing with a smaller bending radius will diminish its strength at that point. Note also that plumbing must not be bent unreasonably and left unsecured, but should be bent as naturally as possible.




- When cutting tubing, take care not to leave any damage on its surface.

  Damage on the surface of PEEK tubing will also diminish its strength.

## ■ Plumbing the Cell Outlet Tube

**1** Fit a male nut PEEK onto one of the ends of the tubing for plumbing provided (2 m).

**2** Screw the male nut PEEK on the tubing for plumbing onto the coupling 1.6-0.8C.

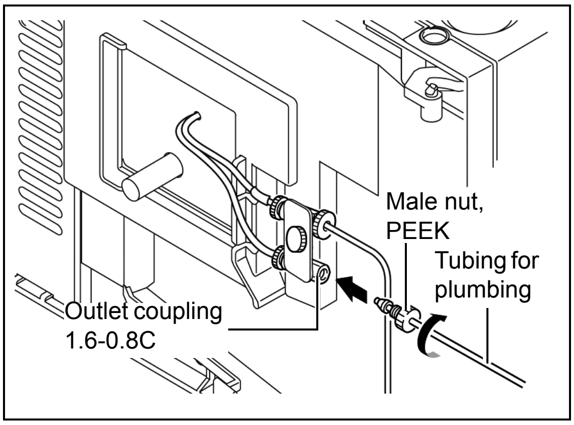



Fig. 9.19

**3** Place the other end of the tubing for plumbing inside the waste container.

NOTE

- To ensure a smooth flow of liquid, put the tubing into the bottle with its end pointing downward.
- The tubing for plumbing at the cell outlet side functions to apply a back pressure to the flow cell to prevent the generation of air bubble and should therefore be used with its uncut length of 2 m.
  (A guide for flow rate: max. 1.5 mL/min)
- The resisting pressure of the flow cell is 2 MPa. If the flow rate is large, shorten the length of the tubing for plumbing to bring the pressure below 2 MPa.

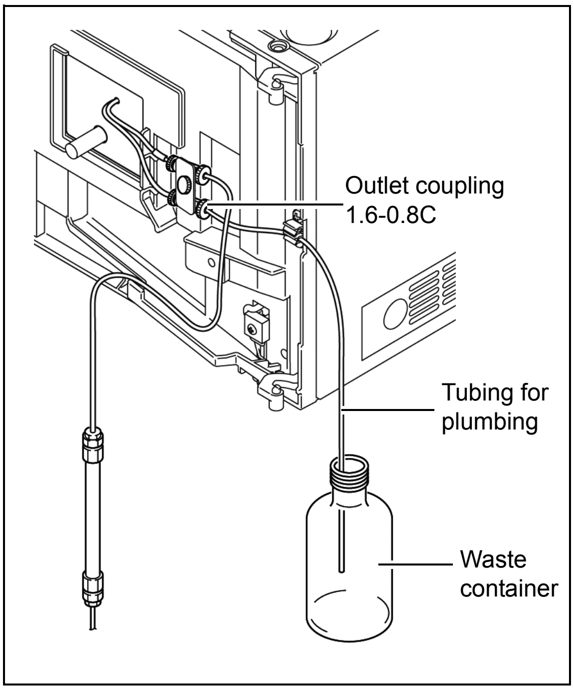



Fig. 9.20

## ■ Securing the Tubing for Plumbing

**1** Fit the two tubings for plumbing into the grooves of the tubing clamp.

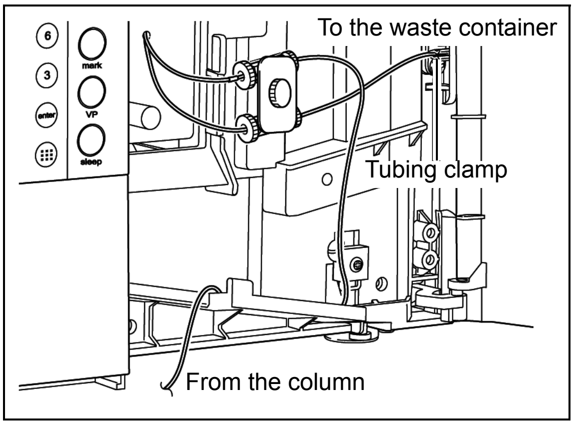



Fig. 9.21

**2** Close the front cover.

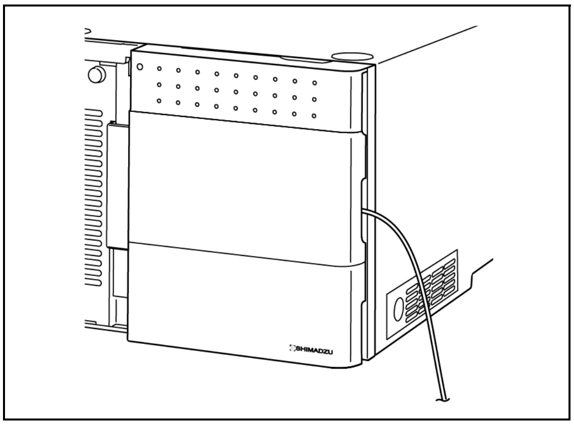


Fig. 9.22

## ■ Plumbing the Leakage Drain Tubing

This instrument is designed so that if leaks occur internally (except the column oven), the leaked liquid flows down to the lowest unit and is drained into the waste container.
The procedure for connecting the leakage drain tubing is given below. Except for the L-joint and the waste container, all parts shown in the figure on the right are standard accessories. (The L-joint is an accessory for the pump unit.)

NOTE

- For connecting, cut silicone tubing into lengths such that neither of the cut parts will sag.
- Set the silicone tubing so that its end does not touch the surface of the liquid in the waste container. If it does touch the surface, the liquid will not flow out.

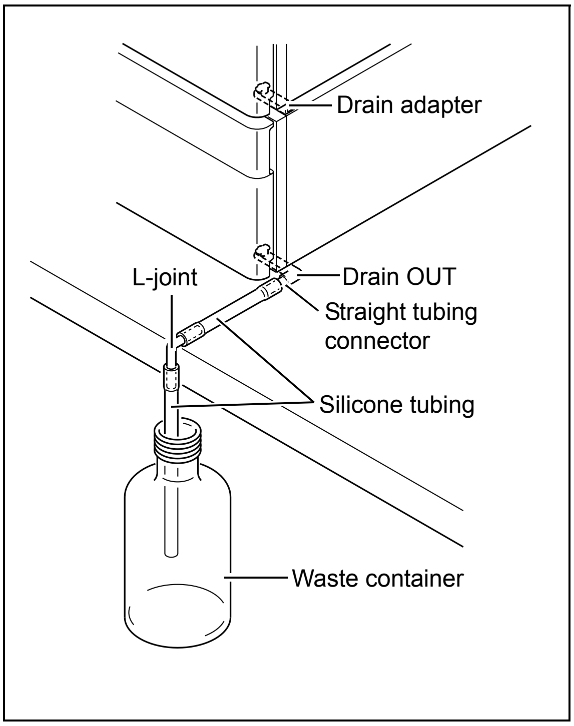



Fig. 9.23

9

## Lowest unit:

**1** Insert the drain OUT, STD into leakage drain outlet from the front of the instrument.

**2** Turn the drain OUT, STD counterclockwise 45° to secure.

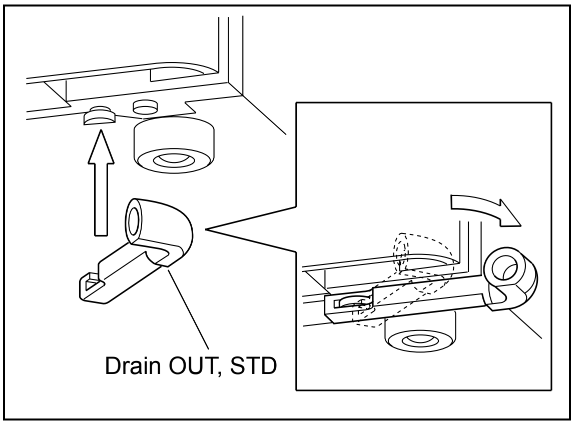



Fig. 9.24

**3** Connect one end of the silicone tubing to the drain OUT, STD with a straight tubing connector.

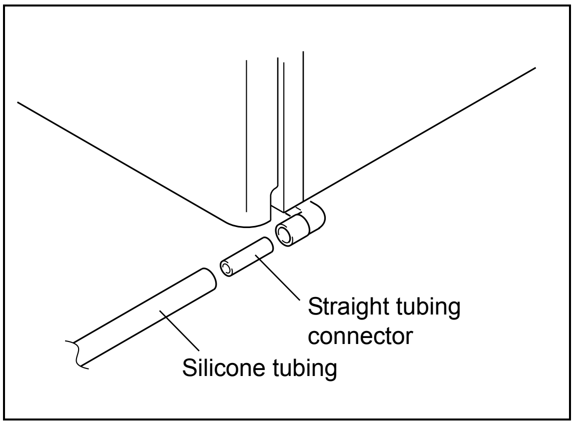



Fig. 9.25

**4** Cut the silicone tubing at the edge of the table, and connect an L-joint. Direct the L-joint head downward as in the figure to the right, and connect the other cut part of the silicone tubing.

**5** Insert the other end of the silicone tubing into the waste container.

∗ To ensure a smooth flow of liquid, insert the silicone tubing into the container with its tip pointing downward.

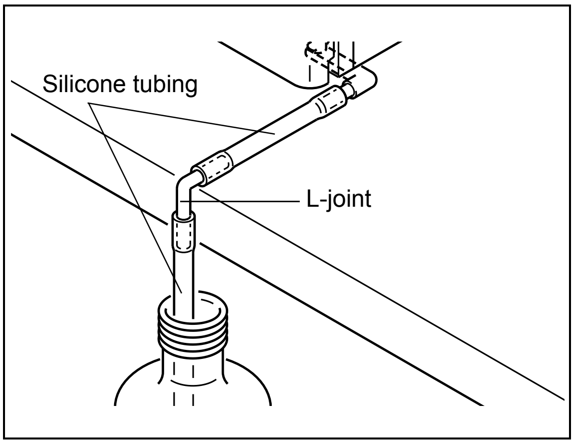



Fig. 9.26

## Second unit from bottom:

NOTE

Leaks from the column oven are drained separately (refer to the column oven instruction manual). If any units are installed on top of the column oven, carry out the same procedure as described in "Installation on top of the column oven:" P.9-20.

**1** Fit the drain adapter at the position shown in the illustration, and place it on the lower unit.

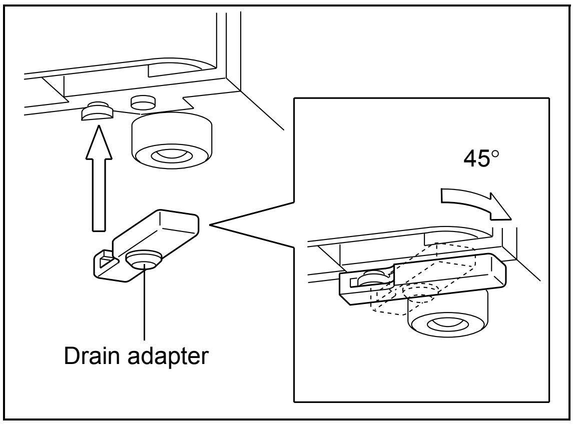



Fig. 9.27

**2** The drain adapter connects the drain outlet to the leakage hole of the lower unit.

**3** Pour some water onto a spot near the drain outlet of the top unit, and verify that the water flows to the waste container.

Cross-section of connection parts

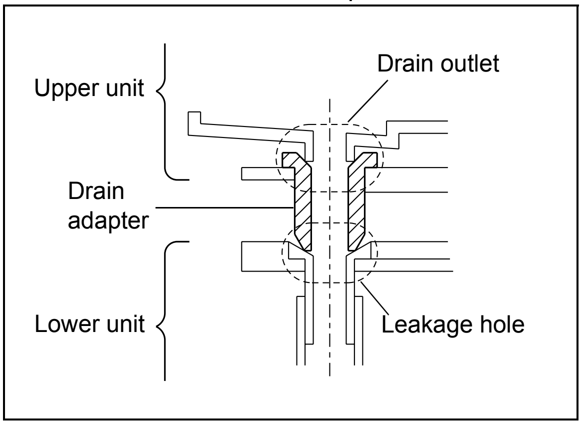



Fig. 9.28

## Installation on top of the column oven:

NOTE

When the lower unit has no leakage hole ("Fig. 9.28"), carry out the same procedure as described bellow.

1 Insert the drain OUT, CTO into the leakage drain outlet from the front of the instrument.

2 Turn the drain OUT, CTO counterclockwise 45° to secure.

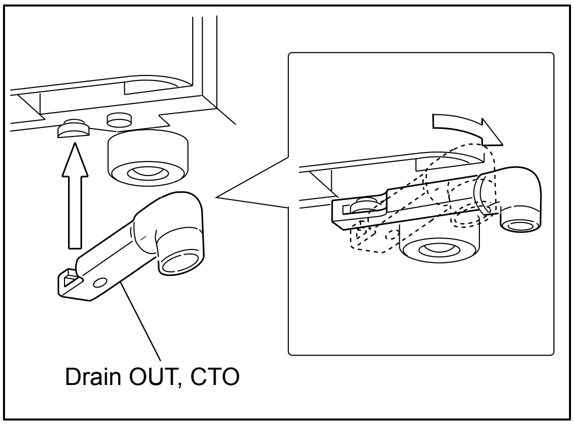



Fig. 9.29

3 Connect one end of the silicone tubing to the drain OUT, CTO with a straight tubing connector.

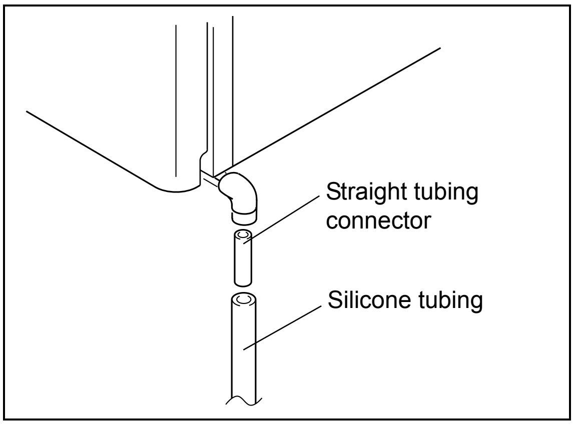



Fig. 9.30

4 Insert the other end of the silicone tubing into the waste container.

☞ "9.1.5 Plumbing" P.9-13

NOTE

- To ensure a smooth flow of liquid, insert the silicone tubing into the container with its tip pointing downward.
- Set the silicone tubing so that its end does not touch the surface of the liquid in the waste container. If it does touch the surface, the liquid will not flow out.

## ■ Front Cover Installation

1. After performing the plumbing, install the front cover by following the removal procedure in reverse.

2. Close the front cover.

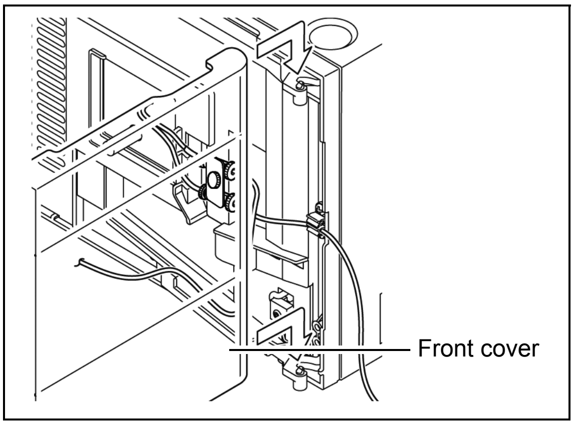



Fig. 9.31

## 9.1.6 Installation of Manual Injector and Column

Use the manual injectors listed below.

| Option Name | Part No. | Features |
|---|---|---|
| Manual injector<br>Type 7725 | 228-32210-91 | Manual injector for general purpose analysis.<br>Standard sample loop: 20 $\mu$L |
| Manual injector<br>Type 7725i | 228-32210-93 | Same as type 7725, but with a position sensing switch.<br>Can send signals synchronized with injection of samples to a system controller or Chromatopac. |
| Semi-micro manual injector<br>Type 8125 | 228-23200-91 | Manual injector for semi micro volume range.<br>Standard sample loop: 5 $\mu$L<br>Incorporates a position sensing switch. Can send signals synchronized with injection of samples to a system controller or Chromatopac. |
| Non-metallic manual injector<br>Type 9725 | 228-32650-91 | Has liquid-contacting parts made of non-metallic materials.<br>Maximum operating temperature: 60 °C |
| Non-metallic manual injector<br>Type 9725i | 228-32650-93 | Same as type 9725, but with a position sensing switch.<br>Can send signals synchronized with injection of samples to a system controller or Chromatopac. |

Fit the manual injector and the column in the manner shown in the figure below.

For details on the fitting method, refer to the instruction manual for the pump unit or the column oven.

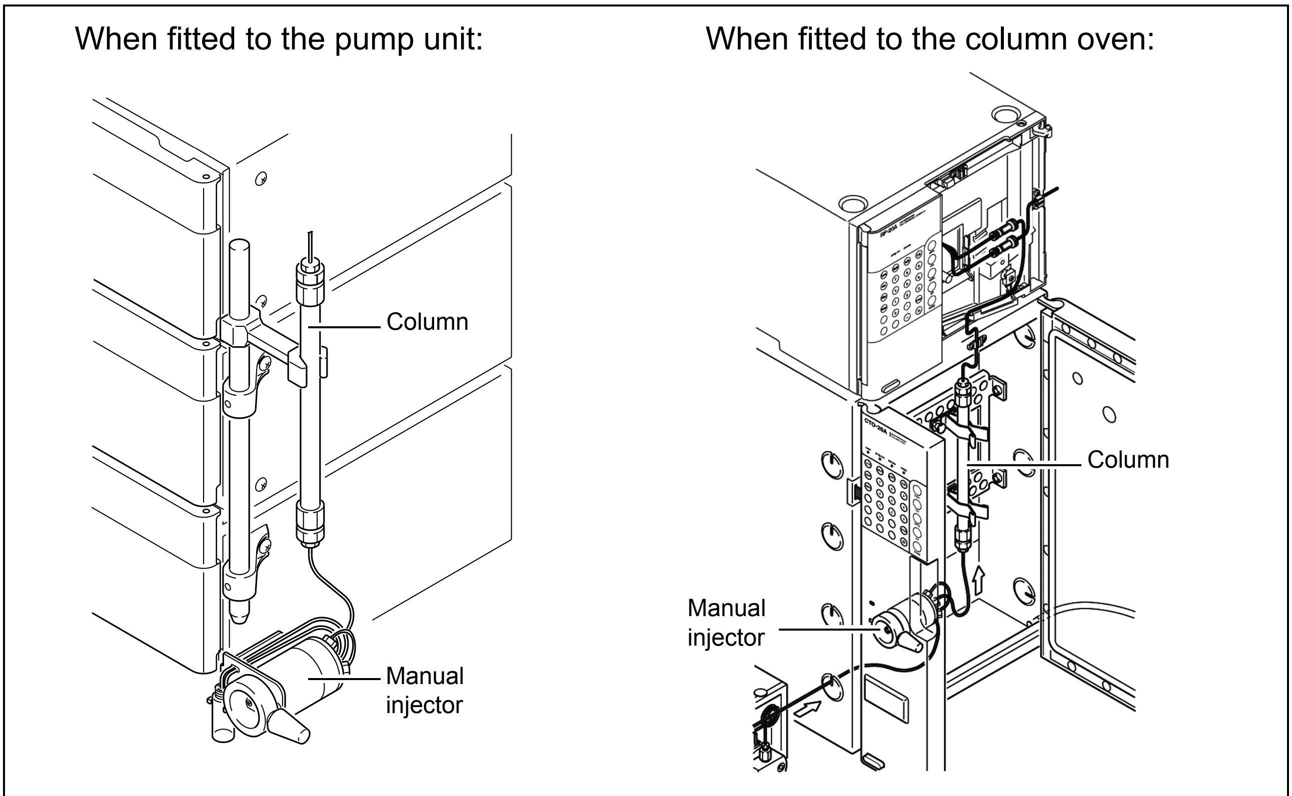



Fig. 9.32

## 9.1.7 Flow Line Plumbing

The figure below shows and example of the basic system plumbing when this instrument is used.
Carry out the plumbing in accordance with each individual system by referring to the figure below.

### When a manual injector and column are fitted to the column oven:

Carry out the plumbing of the reservoir bottle and pump unit by referring to the instruction manual for the pump unit.

☞ "9.1.5 Plumbing" P.9-13

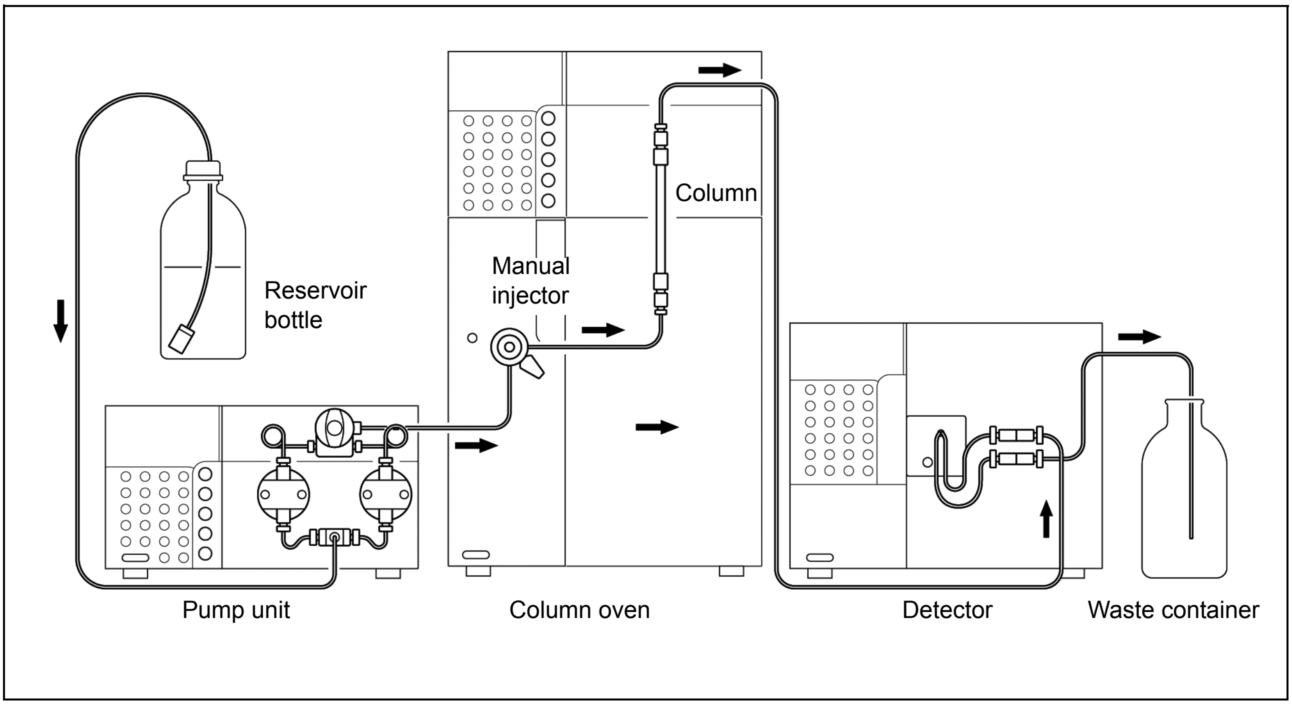



Fig. 9.33



### ■ Plumbing the Manual Injector

NOTE

For connecting ports 1 to 6 of the manual injector, use the male nuts (with long bushing) and ferrules, provided as manual injector standard accessories.

**1** Screw the sample loop male nuts (with long bushing) into ports 1 and 4 of the manual injector.

Back of manual injector

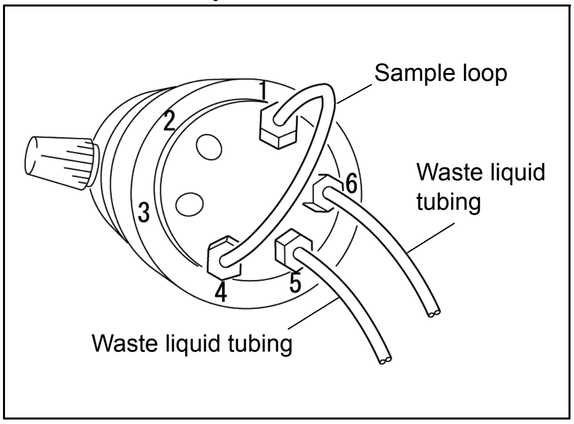



Fig. 9.34

**2** Install a male nut (with long bushing) and ferrule on one end of each of the two waste liquid tubing sections. Then attach the tubing and ferrules at ports 5 and 6 of the manual injector. Tighten the nuts.

**3** Unscrew and remove the vial cap.

**4** Route the other ends of the waste liquid tubing through the tubing opening and into the vial.

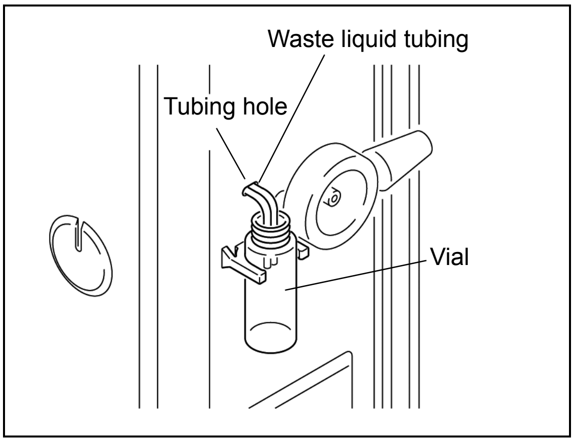



Fig. 9.35

NOTE

To prevent liquid from flowing out due to the siphon effect, position the ends of the waste liquid tubing level with the needle port.

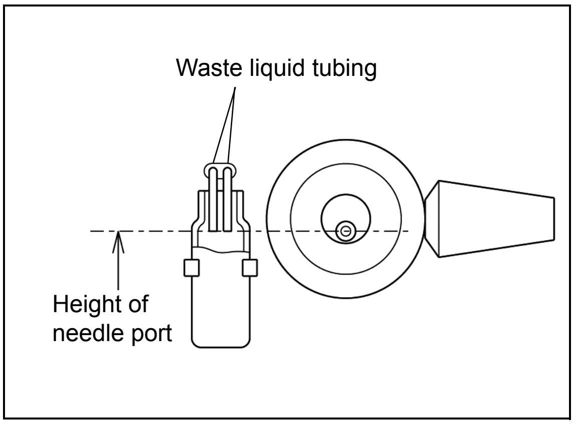



Fig. 9.36

NOTE

When a manual indicator is fitted to the column oven, pass the waste liquid tubing through the left door so that it is perpendicular to the door. If the tubing bends, it may contact the side face, with the result that the left door will not close.

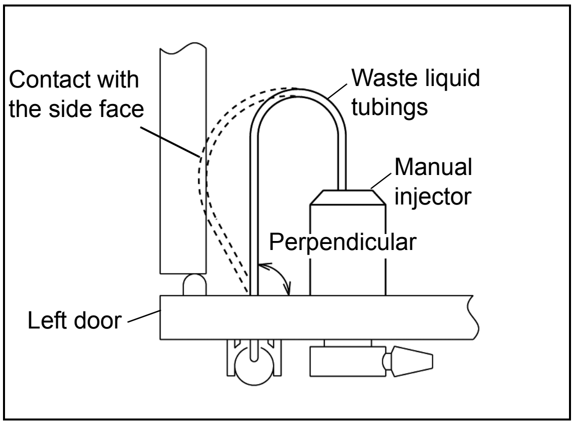



Fig. 9.37

## ■ Plumbing Between Pump Unit and Manual Injector

NOTE

Provide the SUS tubing with some extra length.
If there is no extra length, the pipe will be difficult to bend and the door will not close.

**1** Cut the ϕ 1.6 O.D. × ϕ 0.3 I.D. SUS tubing (standard accessory of the pump) long enough to connect the pump outlet and port 2 of the manual injector.

**2** Attach a male nut and ferrule to both ends of the SUS tubing.

- Pump outlet end:
  Male nut 1.6MN and ferrule 1.6F provided as standard accessories of the pump unit.
- Manual injector end:
  Male nut (long bushing) and ferrule (provided as manual injector standard accessories).

**3** Insert the ends of the SUS tubing into the pump outlet and port 2 of the manual injector, and tighten the male nuts.

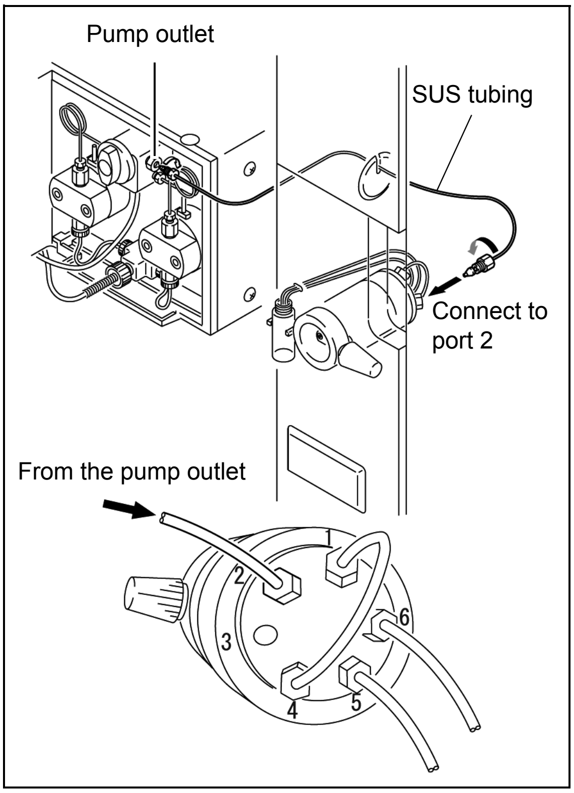



Fig. 9.38

9

## ■ Plumbing Between Manual Injector and Column

NOTE

Provide the SUS tubing with some extra length.
If the left door is opened when no extra length has been provided, the SUS tubing will pull the column.
If there is insufficient room for the length of the SUS tubing, loosen and remove the male nut from the column inlet before opening the left door.

**1** Cut the $\phi$ 1.6 O.D. $\times$ $\phi$ 0.3 I.D. SUS tubing (standard accessory of the pump unit) to a length appropriate for connecting port 3 of the manual injector and the column inlet.

**2** Attach a male nut and ferrule to both ends of the SUS tubing.

- Manual injector end:
  Male nut (long bushing) and ferrule (provided as manual injector standard accessories).
- Column end:
  Male nut and ferrule (provided as standard accessories of the column)

**3** Unscrew and remove the stop plug from the column inlet.

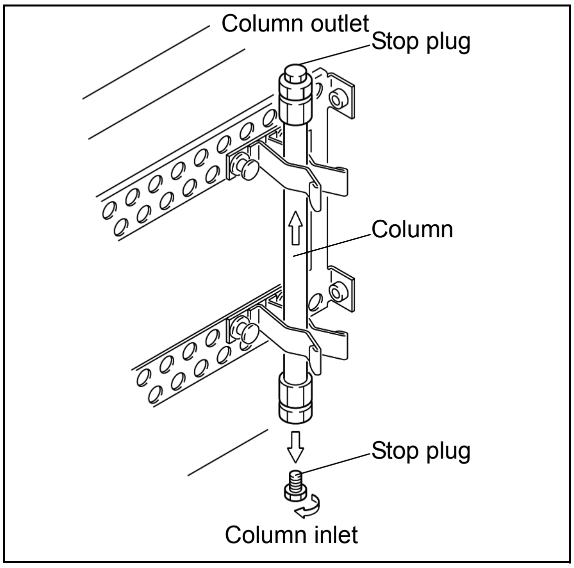



Fig. 9.39

**4** Insert the ends of the SUS tubing into port 3 of the manual injector and the column inlet, and tighten the male nuts.

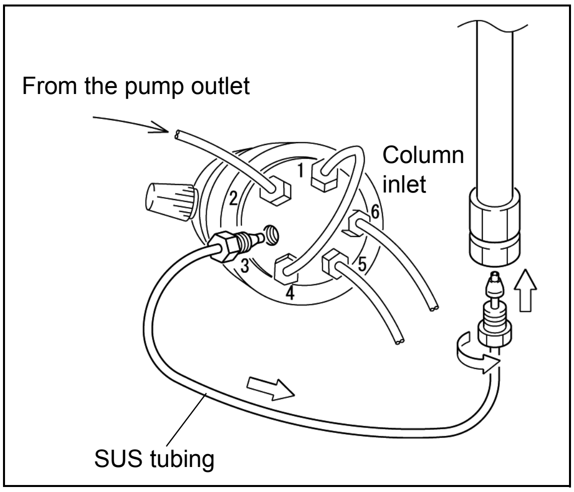



Fig. 9.40

## 9.1.8 Wiring

**⚠WARNING**

- Before performing wiring, turn OFF all the components and unplug the power cords.
- Do not use cables other than those specified for wiring.
- Do not perform any wiring operations other than those indicated.

Failure to observe these points will cause fire, electric shock or equipment failure.

### ■ Connectors

- [REMOTE] connector: For connection to the system controller.
- Analog output connectors 1 and 2: For connection to Chromatopac (or other integrator) or recorder (switched by the setting).
- External input/output terminals: For connection to the external equipment.
  "Connection to External Input/Output Terminals" P.5-81

Use those connectors among the above that are needed for the system. Connection instructions are provided on the following pages.

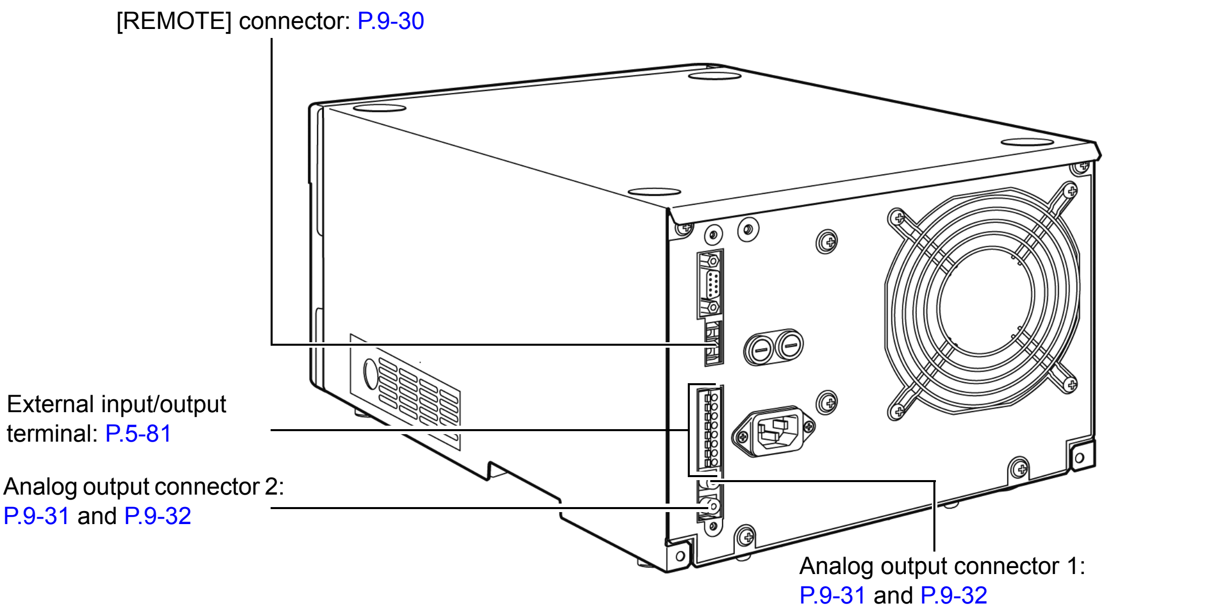



Fig. 9.41

## ■ Connecting the Optical Cable

The optical cable provided with this instrument is a two-way assembly for both transmission and reception of signals, and is connected to the [REMOTE] connector.
Instructions and precautions on connecting the optical cable are provided below.

**1** Before connection, remove the cap from the connection channel to be used.

> **⚠CAUTION**
>
> - The caps on the [REMOTE] connectors prevent dirt or dust from getting into the connector. If a [REMOTE] connector is not used, leave the cap on it to prevent dirt or dust from interfering with communication.
>
>   When a cap is removed, keep it in a safe place for future use.

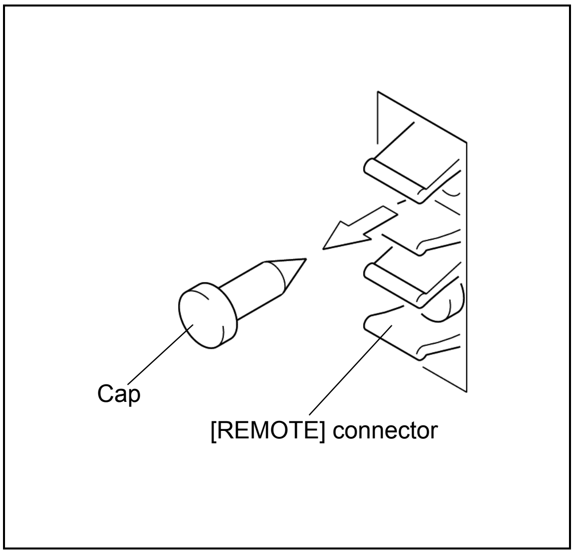



Fig. 9.42

**2** Insert the optical cable plug into the [REMOTE] connector until it clicks into place.

> **⚠CAUTION**
>
> - Make sure there is no dirt or dust on the plug.
>
>   Dirt or dust on the plug will get inside the [REMOTE] connector.
> - Be careful not to insert the plug across two different channels.
>
>   Failure to follow the precautions above could result in malfunction or communication problems.

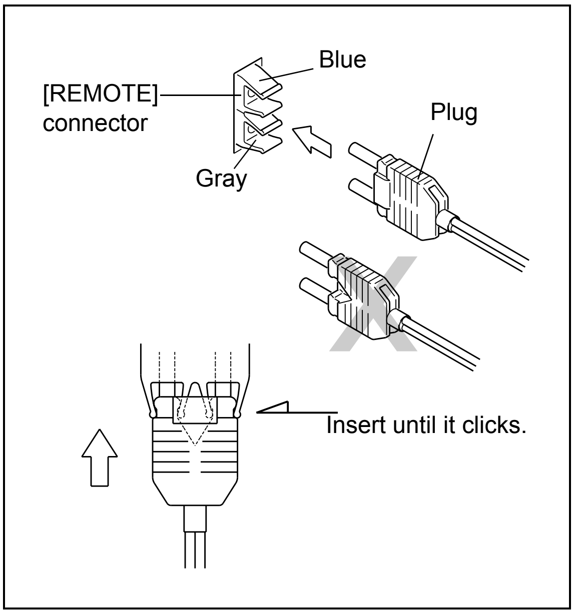



Fig. 9.43

**⚠CAUTION**

- Do not bend the optical cable with a radius of less than 35 mm.
- When inserting and removing the plug, grip the plug itself, not the cable.
- Do not bend the cable where it joins the plug.

  Failure to follow the precautions above could result in damage to the plug or a broken wire in the cable.

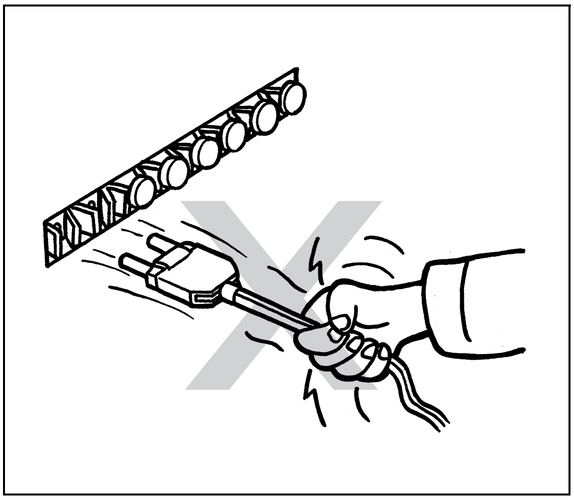


Fig. 9.44

9

## ■ Connecting to a System Controller

**1** Referring to "Connecting the Optical Cable" P.9-28, connect the instrument and system controller [REMOTE] connector with the optical cable.

* Channels between 3 and 8 of the system controller [REMOTE] connector are typically used for this purpose.

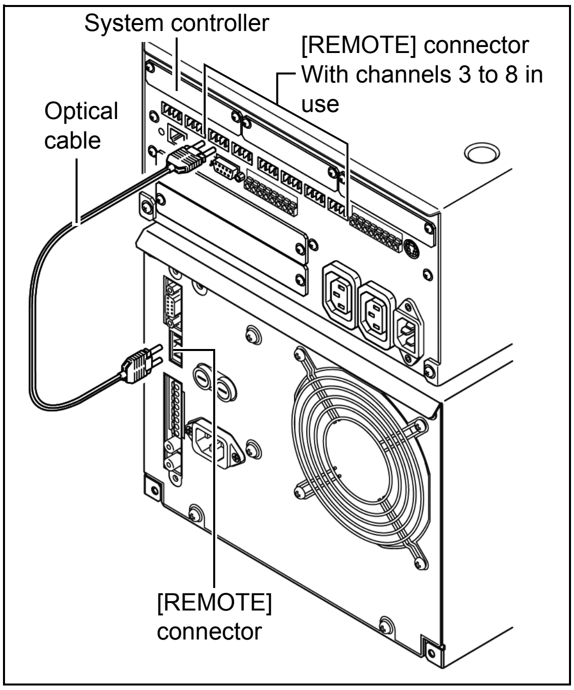


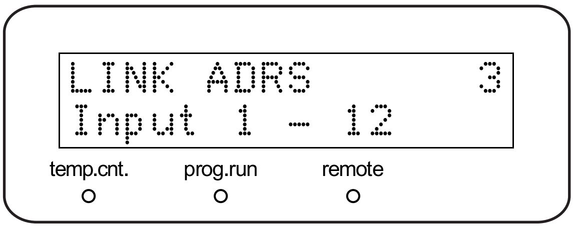

Fig. 9.45

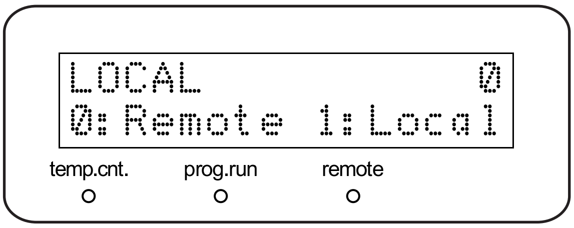
**2** Plug in the instrument, and turn the power switch ON.

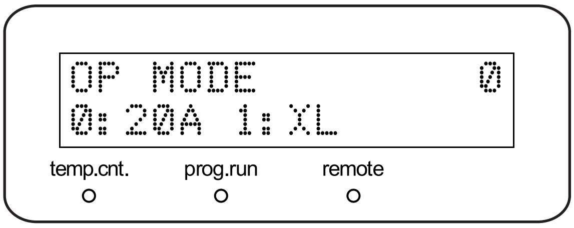
**3** Set the auxiliary functions [LINK ADRS], [LOCAL] and [OP MODE].

☞ "Setting a Remote Control Address [LINK ADRS]" P.5-29
"Setting the Local Mode [LOCAL]" P.5-29
"Selecting the Operation Mode [OP MODE]" P.5-46

- [LINK ADRS]
  Enter the system controller's connector channel number.
- [LOCAL]
  Enter [0] (remote mode).
- [OP MODE]
  Set in accordance with the system controller to be connected to.



## ■ Connecting to a Chromatopac

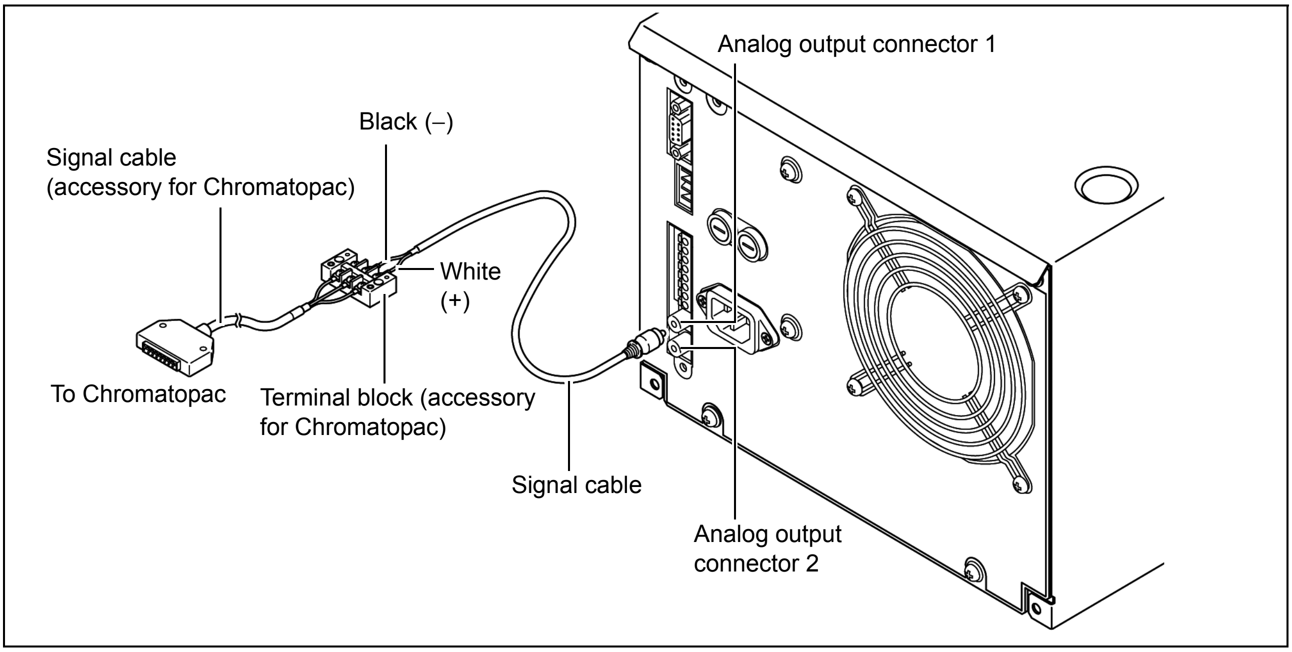



Fig. 9.46

**1** Connect the provided signal cable to analog output connector 1 or 2. Then connect the instrument to the Chromatopac as shown in the figure above.

* In the dual wavelength mode, when recording chromatograms for second wavelength, connect a signal cable to the other analog output connector too.

**2** Plug in the instrument, and turn the power switch ON.

**3** Using the auxiliary functions, set the sensitivity and gain, and the output mode for the analog output connectors.

☞ "Setting the Sensitivity [SENS]" P.5-19
"Setting the Gain [GAIN]" P.5-19
"Setting the Output Mode for Analog Output Connector 1 [ANALOG1 MODE]" P.5-20
"Setting the Output Mode for Analog Output Connector 2 [ANALOG2 MODE]" P.5-21

9

## ■ Connecting to a Recorder

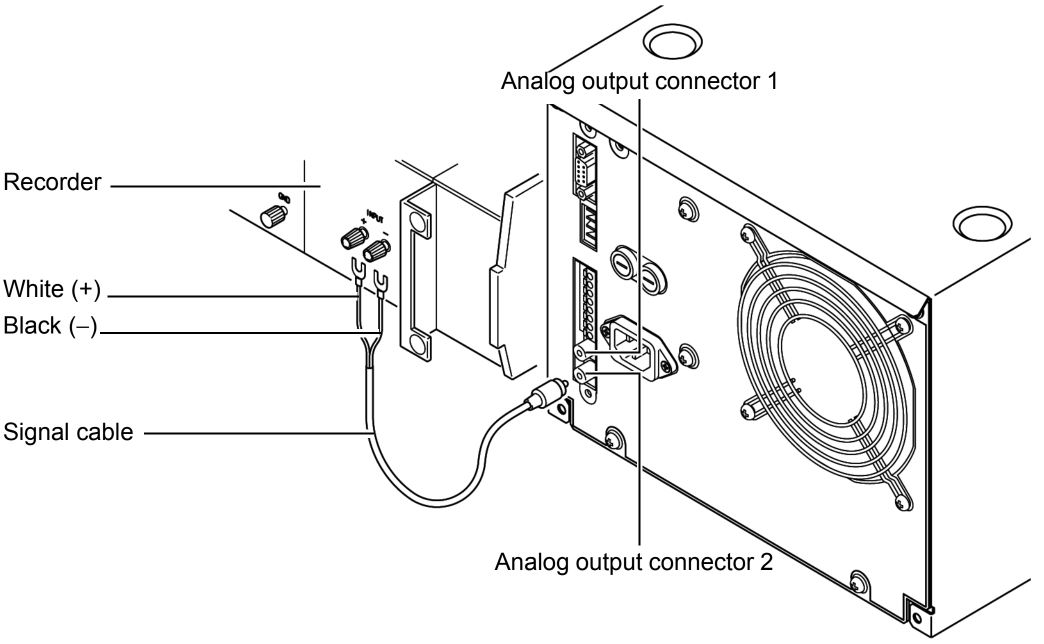



Fig. 9.47

1. Connect the signal cable provided as an accessory to analog output connector 1 or 2.
2. Connect the other end of the signal cable to the terminals at the recorder.
3. Plug in the instrument, and turn the power switch ON.
4. Set, at the recorder, the output mode of the analog output connector to which the connection has been made.

   ☞ "Setting the Output Mode for Analog Output Connector 1 [ANALOG1 MODE]" P.5-20
   "Setting the Output Mode for Analog Output Connector 2 [ANALOG2 MODE]" P.5-21

5. Set the output range of the analog output connector to which the connection has been made.

   ☞ "Setting the Output Range for Analog Output Connector 1 [ANA1 REC RANGE]" P.5-22
   "Setting the Output Range for Analog Output Connector 2 [ANA2 REC RANGE]" P.5-23

### 9.1.9 Fitting the Xenon Lamp

**⚠WARNING**

- When handling a Xenon lamp, always wear the following protective gear: a protective mask, a thick long-sleeved shirt, and safety gloves.

  Gas at high pressure is enclosed in the Xenon lamp. If the lamp is subjected to a strong impact or the glass part is damaged, it may explode, scattering fragments.
  Use a protective mask that is able to cover the entire face with rigid plastic or similar material.
- When handling a Xenon lamp, do not touch the glass part with bare hands.

  If the Xenon lamp is lit while there are fingerprints on the glass part they will burn, and this may cause the lamp to explode.

  If you happen to touch the glass part with your bare hands, wipe the fingerprints off e.g. with a piece of gauze moistened with ethanol.
- Always turn the power to the instrument OFF and unplug the power plug before replacing a Xenon lamp.

  A high voltage of around 30 kV is applied to the positive (+) terminal of the Xenon lamp at the start of ignition, and this is extremely dangerous.
- Make sure that the Xenon lamp has cooled sufficiently before attempting to replace it.

  Immediately after being turned OFF the Xenon lamp is extremely hot and could burn you.

  The time required for the Xenon lamp to cool is at least 90 minutes after the power to the instrument has been turned OFF, or at least 30 minutes after the lamp has been turned OFF by setting [0] (OFF) for [LAMP] in the parameter settings group.

9

**1** Turn the power to the instrument OFF and unplug the power plug.

**2** Open the front cover and the key panel.

NOTE

In order to prevent the front cover falling off, remove it from the instrument before starting the work.

**3** Unscrew the knurled screw (white) securing lamp cover 1, then remove lamp cover 1 and the filter.

∗ The knurled screw (white) is not detachable from lamp cover 1.

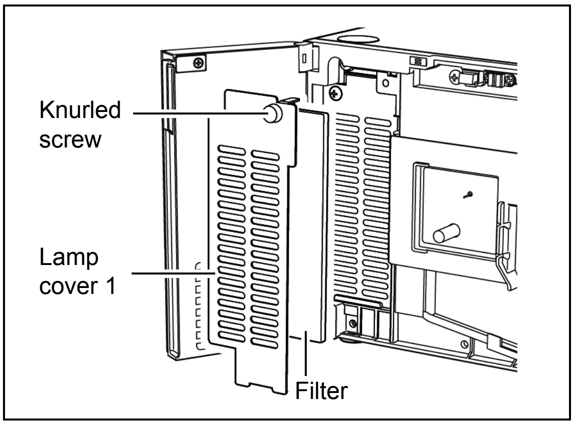



Fig. 9.48

**4** Remove the screw securing lamp cover 2 and remove lamp cover 2.

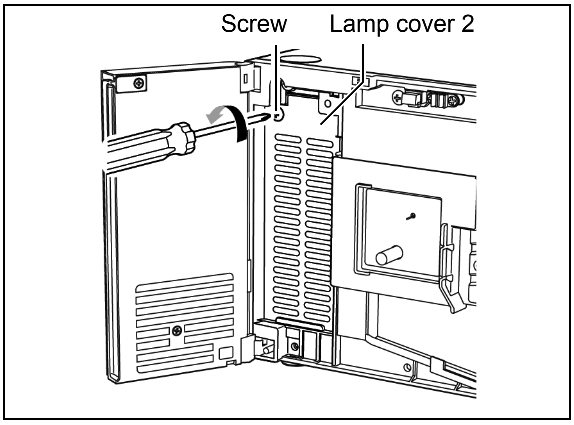



Fig. 9.49

**5** Unscrew the two screws on the front face of the lamp unit.

∗ The two screws need not be removed.

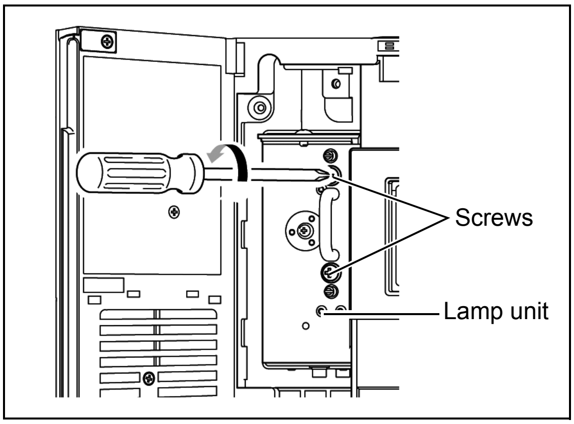



Fig. 9.50

**6** Hold the lamp unit's handle and pull the unit out of the instrument as shown in the figure to the right.

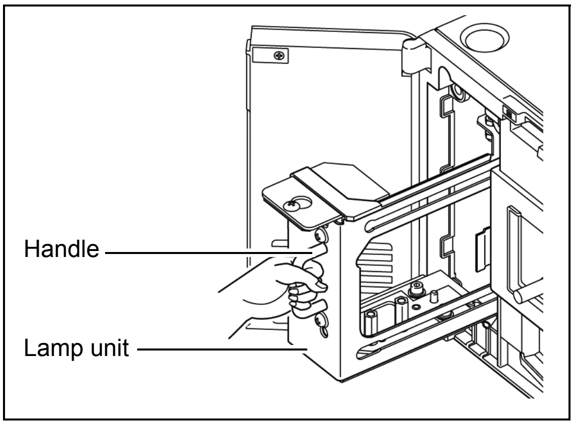



Fig. 9.51

**7** Unscrew the screw on the top of the lamp unit and pull the PTFE cover toward the front.

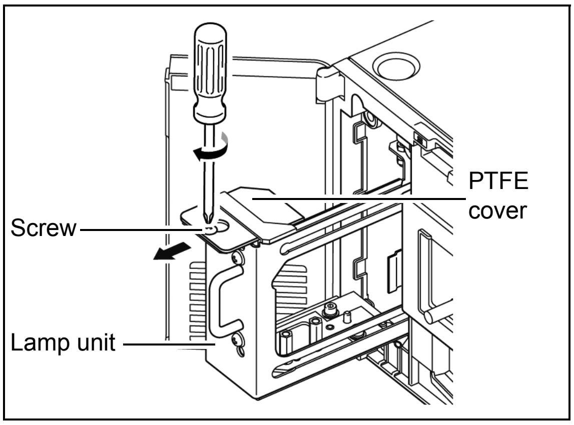



Fig. 9.52

**8** Remove the lamp unit's two hexagon spacers with the wrench provided as an accessory.

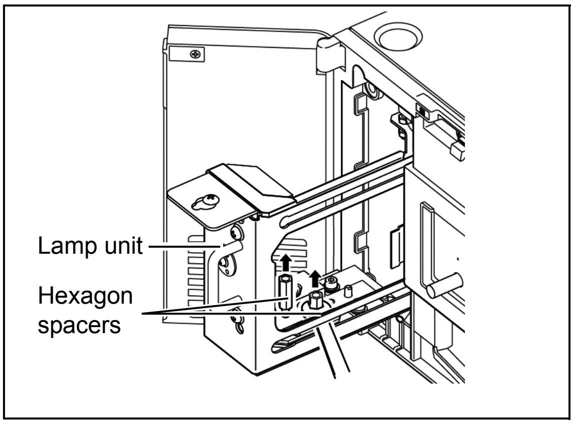



Fig. 9.53

**9** Fit the Xenon lamp in the lamp unit.
∗ The Xenon lamp comes with a lamp holder. Fit the lamp by aligning the two holes in the lamp holder with the positioning pins in the lamp unit.

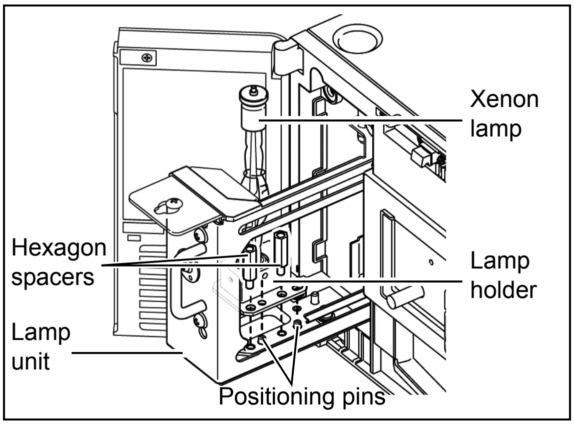



Fig. 9.54

**10** Secure the Xenon lamp to the instrument with the two hexagon spacers removed in step 8.

**11** Once the Xenon lamp has been fitted in the lamp unit, fit the parts that were removed by following the procedure for their removal in reverse.

**⚠CAUTION**

- When fitting the cord terminal to the positive (+) terminal of the Xenon lamp, make sure that there is some slack in the cord.

  If there is no slack in the cord and the positive (+) terminal of the Xenon lamp is pulled by the cord while the lamp is on, the lamp may break.
- Be sure to tighten the knurled nut at the top of the Xenon lamp by hand.

  If a tool like a wrench is used, there is a risk of breaking the Xenon lamp, causing leakage of the gas inside it.
- Connect the lamp and cord correctly as shown in the figure to the right.

  If the connection is not made correctly, the cord could be damaged by heat generation.

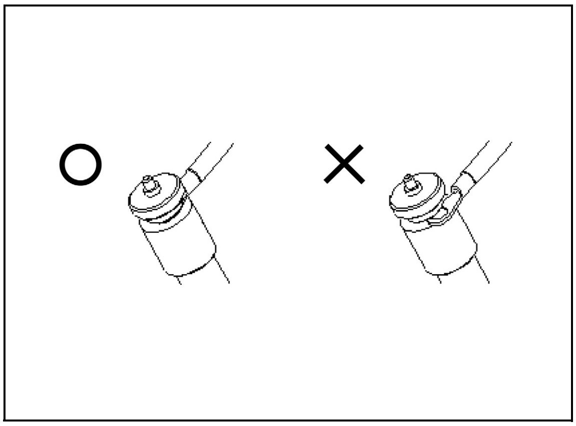



Fig. 9.55

## 9.1.10 Fitting the Low-Pressure Hg (Mercury) Lamp (RF-20A Only)

When performing wavelength calibration or checking the wavelength accuracy on an RF-20A, a low-pressure Hg (mercury) lamp is used.

Remove the Xenon lamp from the instrument and fit the low-pressure Hg (mercury) lamp in it.

Purchase the following parts as options.

### Parts used

| Part Name | Part No. |
|---|---|
| Low-pressure Hg (mercury) lamp (including power supply unit) | 200-38423 |
| Low-pressure Hg (mercury) lamp holder (for RF-20A)<br>* Supplied with one low-pressure Hg (mercury) lamp fixing screw | 228-51952-91 |

**1** Remove the silver cover from the low-pressure Hg (mercury) lamp and fit the lamp into the low-pressure Hg (mercury) lamp holder.

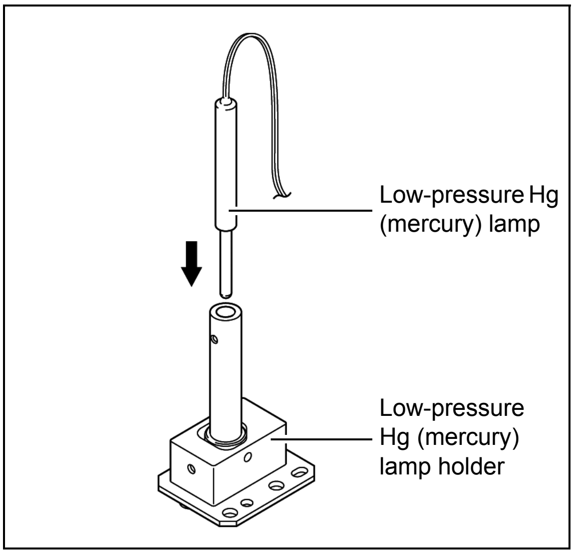



Fig. 9.56

**2** Secure the low-pressure Hg (mercury) lamp to the low-pressure Hg (mercury) lamp holder with the screw provided as an accessory with the holder.

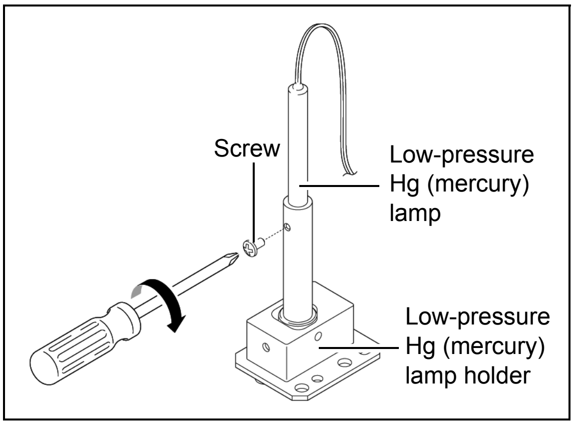



Fig. 9.57

**3** Remove the Xenon lamp.

☞ "8.4 Inspecting/Replacing the Xenon Lamp" P.8-30

**4** Fit the low-pressure Hg (mercury) lamp into the lamp unit so that the slit in the low-pressure Hg (mercury) lamp holder faces toward the back of the instrument.

* Fit so that the two holes in the low-pressure Hg (mercury) lamp holder mate with the positioning pins on the lamp unit.

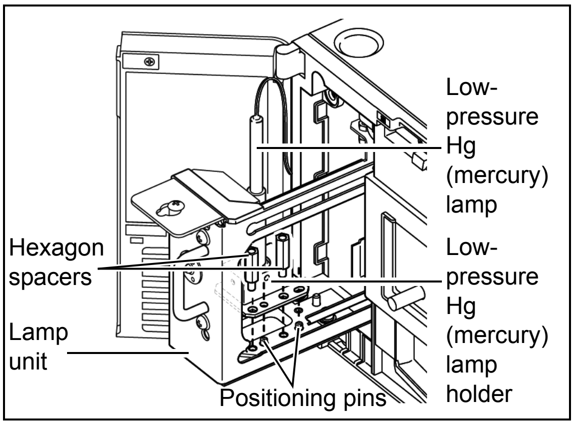



Fig. 9.58

**5** Using the two hexagon spacers that secured the Xenon lamp to the instrument, secure the low-pressure Hg (mercury) lamp holder to the lamp unit.

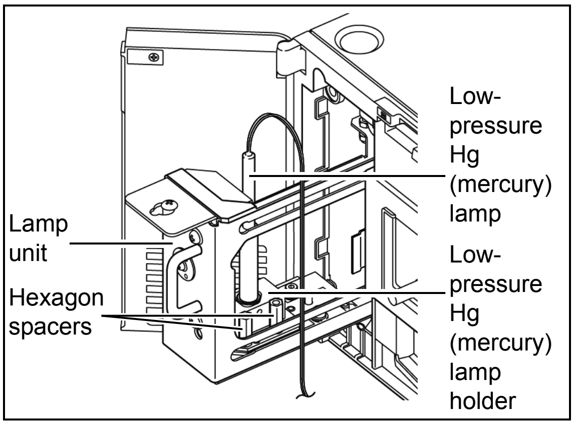



Fig. 9.59

**6** Place the lamp unit in the instrument as it was before.

NOTE

- The PTFE cover on the top face of the lamp unit need not be returned to its original position.
- When a low-pressure Hg (mercury) lamp has been fitted, it is no longer possible to fit the filters, lamp cover 1 or lamp cover 2.

**7** Tighten the two screws on the front face of the lamp unit to secure the lamp unit to the instrument.

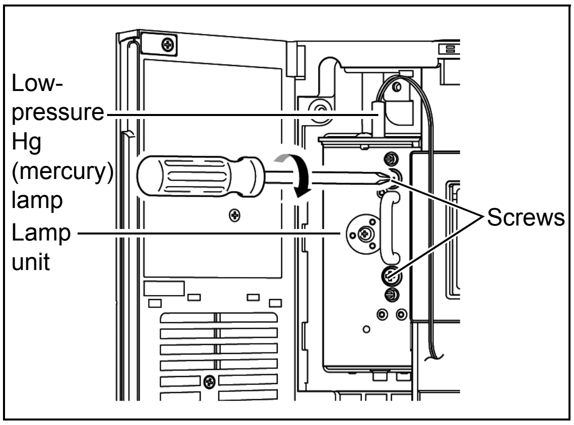



Fig. 9.60

**8** Close the front cover and key panel.

**9** Connect the low-pressure Hg (mercury) lamp's cord to the power supply unit, and turn the power ON at the power supply unit.

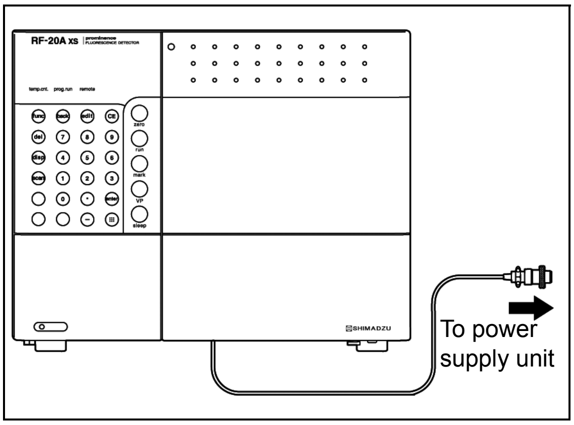



Fig. 9.61

NOTE

After completing wavelength calibration or a wavelength accuracy check, always remove the low-pressure Hg (mercury) lamp from the instrument and re-fit the Xenon lamp as it was originally.

# 9.2 Specifications

| Item | | RF-20A | RF-20Axs |
|---|---|---|---|
| Light Source | | Xenon lamp | Xenon lamp<br>Low-pressure Hg (mercury) lamp (for wavelength accuracy check) |
| Wavelength Range | | 0, 200 to 650 nm | 0, 200 to 750 nm |
| Spectral Bandwidth | | 20 nm | |
| Wavelength Accuracy | | ± 2 nm | |
| Wavelength Reproducibility | | ± 0.2 nm *1 | |
| S/N | | Water raman peak S/N of 1200 or greater *2 | Water raman peak S/N of 2000 or greater *2 |
| Cell Capacity | | 12 μL | |
| Cell Maximum Withstand Pressure | | 2 MPa {20 kgf/cm$^2$} | |
| Wetted Materials of Cell | | SUS316L, PTFE (fluorocarbon polymers), quartz | |
| Cell Inlet, Outlet Tube Diameter | | SUS316L tubing 0.8 mm O.D. × 0.25 mm I.D. | |
| Volume from the End of the Inlet Tube to the Cell Center | | 15 μL | 45 μL |
| Volume from the Cell Center to the End of the Outlet Tube | | 16 μL | 21 μL |
| Input Range for Cell Temperature | | – | 4 to 40 °C, in steps of 1 °C |
| Temperature Control Range | | – | (Room temperature *3 –10 °C) to 40 °C (Flow rate: less than 2 mL/min, Column oven: less than 85 °C) |
| Simultaneous Monitoring of 2 Wavelengths | Measured Wavelengths | Any two wavelengths within the range of 200 to 650 nm | Any two wavelengths within the range of 200 to 750 nm |
| | Sampling Frequency | 0.5 sec for one wavelength | |
| Sensitivity | | Can be set at three levels: HIGH, MED, and LOW (× 1, × 32, × 1024) | |
| Gain | | Can be set at three levels: × 1, × 4, × 16 | |
| Response | | Time constant: 11 levels can be selected, equivalent to "no filter", 0.05, 0.1, 0.5, 1.0, 1.5, 2.0, 3.0, 6.0, 8.0, and 10.0 seconds. | |
| Range | | Can be set to 10 levels: Short, × 1, × 1/2, × 1/4, × 1/8, × 1/16, × 1/32, × 1/64, × 1/128, and × 1/256 | |

*1: Indicates the reproducibility performance when the power is turned ON in the single wavelength mode and the wavelength is changed.
*2: Water raman peak measurement conditions: Ex 350 nm, RESPONSE = 1.5 sec
*3: Room temperature means the ambient temperature at the RF-20Axs.

<table>
<tr><th colspan="2">Item</th><th>RF-20A</th><th>RF-20Axs</th></tr>
<tr><td colspan="2">Zero Adjustment</td><td colspan="2">Auto zero function, baseline shift function</td></tr>
<tr><td colspan="2">Spectrum Scanning Function</td><td colspan="2">Of the three files generated by spectrum scanning with the flow stopped, one is for the background, and the data with the background deducted is output.<br>The file data is not backed up when the power is turned OFF.</td></tr>
<tr><td rowspan="2"></td><td>Scan Speed</td><td colspan="2">Can be set to the four levels of 24, 120, 600 and 3000 nm/minute (wavelength step 1 nm)</td></tr>
<tr><td>Speed of Output to Recorder</td><td colspan="2">1, 5, 10 nm/sec</td></tr>
<tr><td colspan="2">Time Program</td><td colspan="2">Can use either a detector in isolation or a system controller.</td></tr>
<tr><td rowspan="2"></td><td>Item Set</td><td colspan="2">Wavelength (including dual wavelength mode), auto zero, range, marker, response, spectrum scanning, event, lamp ON/OFF, loop, flow cell temperature, stop</td></tr>
<tr><td>Number of Steps with a detector in Isolation</td><td colspan="2">A maximum of 32 steps can be set.</td></tr>
<tr><td>Output</td><td>Analog Output Connector 1<br>Analog Output Connector 2</td><td colspan="2">INTEGRATOR output or RECORDER output (10 mV recorder terminals) can be selected.<br>Ch1 or ch2 can be selected (only in the dual wavelength mode).<br>The temperature of the flow cell can be output (RF-20Axs only).<br>The output can be switched between gain and sensitivity.<br>The output range can be set (only with RECORDER output).</td></tr>
<tr><td colspan="2">Light Source Operating Time Monitoring Function</td><td colspan="2">Can record up to 9999.9 hours.</td></tr>
<tr><td colspan="2">Dimensions</td><td colspan="2">W 26 cm × H 21 cm × D 42 cm</td></tr>
<tr><td colspan="2">Weight</td><td>16 kg</td><td>18 kg</td></tr>
<tr><td colspan="2">Operating Temperature Range</td><td colspan="2">4 to 35 °C</td></tr>
<tr><td colspan="2">Operating Humidity Range</td><td colspan="2">20 to 85 % (No condensation)</td></tr>
<tr><td colspan="2">Power Supply</td><td colspan="2">RF-20A
<table>
<tr><th>Part No.</th><th>Power Supply Voltage</th><th>Power Consumption / Frequency</th></tr>
<tr><td>228-45147-41</td><td>AC100-120 V (100-120 V~)</td><td rowspan="3">400 VA<br>50/60 Hz</td></tr>
<tr><td>228-45147-42</td><td>AC100-120 V (100-120 V~)</td></tr>
<tr><td>228-45147-48</td><td>AC220-240 V (220-240 V~)</td></tr>
</table>
RF-20Axs
<table>
<tr><th>Part No.</th><th>Power Supply Voltage</th><th>Power Consumption / Frequency</th></tr>
<tr><td>228-45148-41</td><td>AC100-120 V (100-120 V~)</td><td rowspan="3">400 VA<br>50/60 Hz</td></tr>
<tr><td>228-45148-42</td><td>AC100-120 V (100-120 V~)</td></tr>
<tr><td>228-45148-48</td><td>AC220-240 V (220-240 V~)</td></tr>
</table>
The "~" in the voltage indication shown on the back of the instrument (e.g. 240 V ~) means alternating current (AC).<br><br>Transient voltage: Installation category II (IEC)</td></tr>
</table>

# 9.3 Maintenance Parts

## 9.3.1 Consumable Parts

| Part Name | Part No. | Remark |
|---|---|---|
| Xenon lamp | 228-51511-95 | Light source |
| Cell gasket | 228-50422-01 | Flow cell part |
| Cell | 228-48626 | Cell made of quartz glass |
| Air filter, side | 228-51147 | This is a filter to prevent dust being sucked inside the instrument. It is fitted in the air inlet on the right side face of the instrument. |
| Air filter, front | 228-51146 | This is a filter to prevent dust being sucked inside the instrument. It is fitted in the air inlet on the front face of the instrument. |

## 9.3.2 Replacement Parts

### ■ Optical System

| Part Name | Part No. | Remark |
|---|---|---|
| Low-pressure Hg (mercury) lamp | 228-50946-91 | For wavelength checks and wavelength calibration (RF-20Axs only) |
| Ellipsoidal mirror ASSY | 228-51509-95 | For condensing light from the Xenon lamp |
| Back mirror ASSY | 228-51510-95 | Mirror in lamp housing (RF-20Axs only) |
| Hg lamp mirror ASSY | 228-45991-95 | For reflecting light from the Hg lamp |
| EX grating ASSY | 228-45997-95 | For excitation monochromator |
| EM grating ASSY | 228-45965-95 | For emission monochromator |
| EM mirror1 ASSY | 228-45968-95 | Spherical mirror in the EM monochromator |
| EM mirror2 ASSY | 228-45971-95 | Plane mirror in the EM monochromator |
| Splitter ASSY | 228-45748-95 | – |
| Photo-diode ASSY | 228-51073-95 | For monitoring the EX beam |
| Photomultiplier (R3788) | 200-75031 | For RF-20Axs |
| Photomultiplier (R212-14) | 200-75033 | For RF-20A |
| PMT base ASSY, 20Axs | 228-51703-91 | For RF-20Axs |
| PMT base ASSY, 20A | 228-51703-92 | For RF-20A |
| Window | 228-45749-01 | For the lamp housing |
| EX motor | 228-45743-91 | For EX grating rotation |
| EM motor | 228-45948-91 | For EM grating rotation |
| Hg mirror motor | 228-45744-95 | For Hg lamp mirror rotation (RF-20Axs only) |
| EX photo-sensor ASSY | 228-51007-42 | EX HP sensor with wire harness |

| Part Name | Part No. | Remark |
|---|---|---|
| EM photo-sensor ASSY | 228-51007-41 | EM HP sensor with wire harness |
| Hg mirror photo-sensor ASSY | 228-51007-43 | HP sensor for Hg lamp mirror, with wire harness |
| Belt, EX | 228-45937 | For EX grating rotation |
| Belt, EM | 670-11222 | For EM grating rotation |
| Activated carbon pack | 228-50569-12 | – |

## ■ Flow Cell/Plumbing Parts

| Part Name | Part No. | Remark |
|---|---|---|
| Flow cell unit ASSY 20Axs | 228-45856-91 | For RF-20Axs |
| Flow cell unit ASSY 20A | 228-45856-92 | For RF-20A |
| Emission lens, cell | 228-48700 | – |
| Excitation lens, cell | 228-48699-01 | – |
| Excitation mirror, cell | 228-52285-91 | – |
| Emission mirror, cell | 228-52286-91 | – |
| Joint tube ASSY, 20Axs | 228-50843-91 | For RF-20Axs |
| Joint tube ASSY, 20A | 228-50843-92 | For RF-20A |
| Spacer block, cell 20Axs | 228-45868-01 | For RF-20Axs |
| Spacer block, cell 20A | 228-51177 | For RF-20A |
| Fixing screw, EX cell lens | 228-51949-01 | – |
| EX slit, cell | 228-45878 | – |
| Fixing screw, cell joint | 228-50389 | – |
| Spacer gasket, EM lens | 228-51176 | For RF-20A |
| Male nut, 0.8MN PEEK | 228-46363 | For OD 0.8 mm tube, PEEK |
| Coupling 1.6-0.8C | 228-40998-10 | Coupling for connecting a cell inlet/outlet tube and a tube with a 1.6 mm O.D. |
| Tubing clamp | 228-39621 | Part for securing tubing for plumbing |
| Tubing for plumbing | 228-18495-06 | For tubings for waste drainage, purchasing units: m |
| Male nut, PEEK | 228-18565 | – |

## ■ Electrical Parts

| Part Name | Part No. | Remark |
|---|---|---|
| Fuse 5AT, 250 V | 072-02004-23 | – |
| Printed circuit board, RF20-CPU | 228-45784-45 | – |
| Printed circuit board, RF20-TEMP | 228-50355-45 | For RF-20Axs |
| Printed circuit board, LC20-KEY-S | 228-45600-42 | Printed circuit board incorporated in the control panel |
| Display VFD | 228-51558-01 | Display incorporated in the control panel |
| Control panel, RF20Axs | 228-51468-91 | For RF-20Axs |
| Control panel, RF20A | 228-51468-92 | For RF-20A |
| HP sensor, COVER OPEN | 228-50995-41 | – |
| Xe lamp power supply, 150 W | 228-51469 | – |
| Power supply, ZWS150AF-24 | 074-80429-75 | For RF-20Axs |
| Power supply, ZWS75AF-24 | 074-80429-35 | For RF-20A |
| Fan ASSY, XE | 228-50658-41 | Back panel fan |
| Fan ASSY, Peltier | 228-50661-41 | Front panel fan (for RF-20Axs) |
| Leak sensor | 228-50666-41 | – |

## ■ Others

| Part Name | Part No. | Remark |
|---|---|---|
| Base ASSY, XS | 228-45892-91 | Temperature control unit (RF-20Axs only) |
| Right door ASSY | 228-51460-91 | Front cover |

# 9.4 Introduction to the HPLC System

The Prominence LC (LC-20A) series components are for use with Shimadzu high performance liquid chromatography (HPLC) systems, which are designed to provide high accuracy and high sensitivity analyses. Example system configurations are provided below, along with descriptions of the functions of the various components.

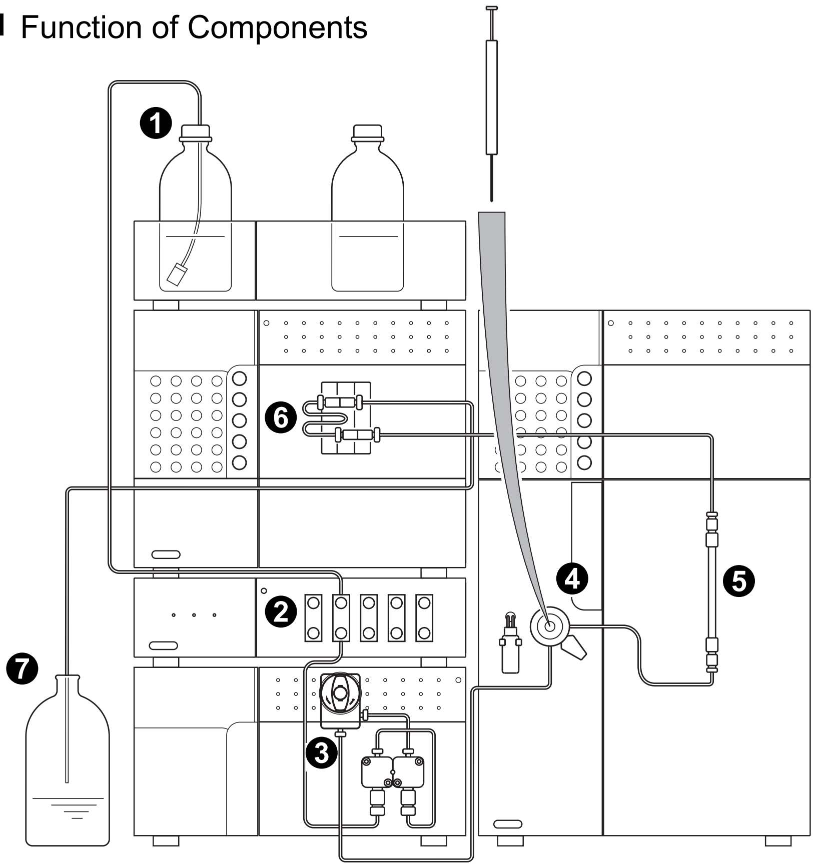
## 9.4.1 Example of a Relatively Simple (Isocratic) System

Each component of the system is controlled locally. This is a simple system composed of the minimum number of components for stable analysis.

■ Solvent Flow

❶ Reservoir bottle
↓
❷ Degasser
↓
❸ Pump unit
↓
❹ Manual injector
↓
❺ Column
↓
❻ Detector
↓
❼ Waste container

■ Function of Components




❶ Mobile phase is drawn out of the reservoir bottle and pumped through the tubing by the pump.
❷ The degasser removes dissolved air from the mobile phase, preventing air bubbles and consequent rise, drift or other baseline irregularities caused by dissolved air.
❸ The pump unit sends the mobile phase through the manual injector, column and detector, in that order, and finally into the waste container.
❹ Samples are injected into the system by the manual injector, with a syringe.
❺ In the column, the components are separated by means of the mutual interactions of the mobile phase and the column packing (stationary phase).
❻ The detector detects the components eluted from the column, and sends the signal data to a Chromatopac or PC.
❼ Mobile phase from the detector drains into the waste container.

## 9.4.2 Example of Autosampler System (1)

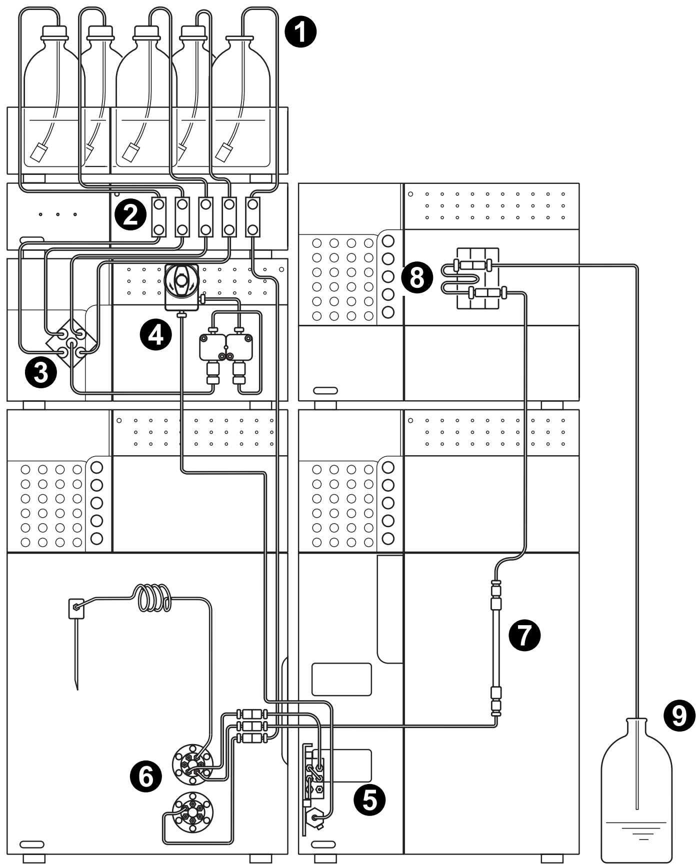
Centralized control of all the components by a CBM-20Alite system controller enhances ease of operation and is well suited for automated analyses.

The CBM-20Alite can control a maximum of five LC components. Since it is installed in the pump unit or autosampler, a space-saving system can be configured.

### ■ Solvent Flow

❶ Reservoir bottle
↓
❷ Degasser
↓
❸ Low-pressure gradient unit
↓
❹ Pump unit
↓
❺ Mixer
↓
❻ Autosampler
↓
❼ Column
↓
❽ Detector
↓
❾ Waste container

### ■ Function of Components




❶ Mobile phase is drawn out of the reservoir bottle and pumped through the tubing by the pump.

❷ The degasser removes dissolved air from the mobile phase, preventing air bubbles and consequent rise, drift or other baseline irregularities caused by dissolved air.

❸ The low-pressure gradient unit mixes up to four mobile phases that have been degassed by the degasser. This item is necessary for a low-pressure gradient system.

❹ The pump unit sends the mobile phase through the autosampler, column and detector, in that order, and finally into the waste container.

❺ The mixer enhances the mixing efficiency of the mobile phases. This item is required for a low or high pressure gradient system.

❻ The autosampler automatically injects the sample into the flow lines. By adding a rack changer, it is possible to automatically change the autosampler racks.

❼ In the column, the components are separated by means of the mutual interactions of the mobile phase and the column packing (stationary phase).

❽ The detector detects the components eluted from the column, and sends the signal data to a Chromatopac or PC.

❾ Mobile phase from the detector drains into the waste container.

## 9.4.3 Example of Autosampler System (2)

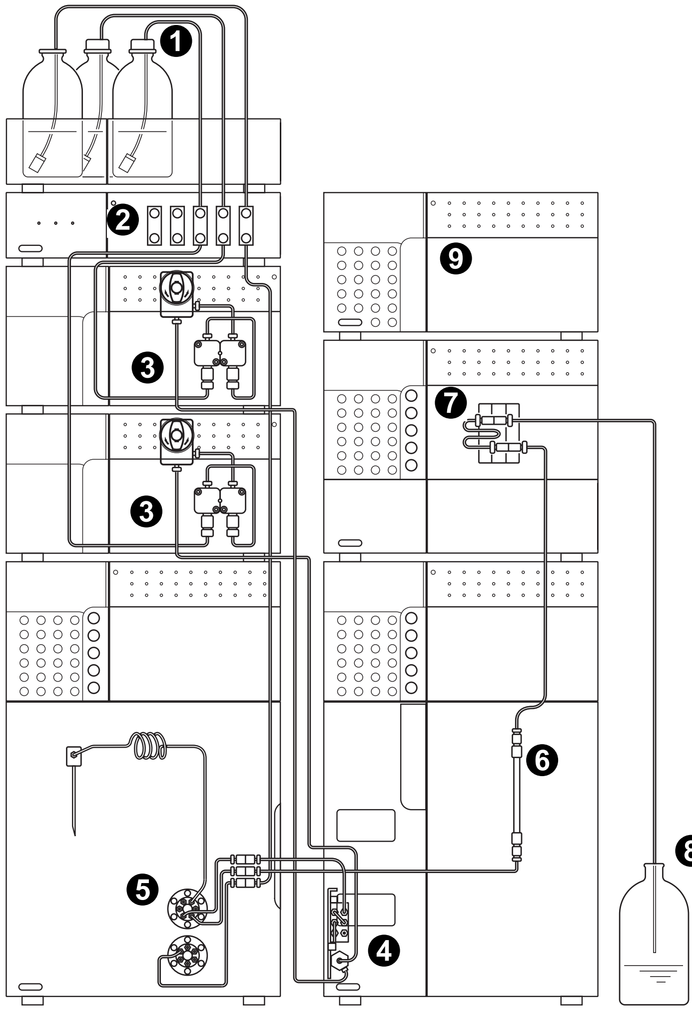
The CBM-20A system controller can control a maximum of eight LC components (twelve LC components as an option).

Use the same type of pumps for a high-pressure gradient system.

### ■ Solvent Flow

❶ Reservoir bottle
↓
❷ Degasser
↓
❸ Pump unit
↓
❹ Mixer
↓
❺ Autosampler
↓
❻ Column
↓
❼ Detector
↓
❽ Waste container

### ■ Function of Components




❶ Mobile phase is drawn out of the reservoir bottle and pumped through the tubing by the pump.
❷ The degasser removes dissolved air from the mobile phase, preventing air bubbles and consequent rise, drift or other baseline irregularities caused by dissolved air.
❸ The pump unit sends the mobile phase through the autosampler, column and detector, in that order, and finally into the waste container.
❹ The mixer enhances the mixing efficiency of the mobile phases.
❺ The autosampler automatically injects the sample into the flow lines. By adding a rack changer, it is possible to automatically change the autosampler racks.
❻ In the column, the components are separated by means of the mutual interactions of the mobile phase and the column packing (stationary phase).
❼ The detector detects the components eluted from the column, and sends the signal data to a Chromatopac or PC.
❽ Mobile phase from the detector drains into the waste container.
❾ The CBM-20A system controller can control a maximum of eight LC components (twelve LC components as an option) including a maximum of four pump units.

# 9.5 Mobile Phase Characteristics

| | (1) Solvent<br>(*)η ≤ 0.5 cp, B.P. > 45 °C<br>(**)η ≤ 0.5 cp, B.P. < 45 °C | (2) Source | (3) UV Cutoff | (4) R.I.$_{25°}$ | Boiling Point (°C) | Viscosity (cP, 25 °C) | (5) p' | (6) $e°_a$ | (7) Water Solubility $\%^{W}$in$^{20\ °C}$ Solvent | (8) Dielectric Constant $e^{20}$ | (9) p'+ 0.25e |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | FC-78(*)<br>FC-75(Fluorescent solvent)<br>FC-43 | (LC specific) | 210 nm<br>210<br>(opaque under 210) | 1.267<br>1.276<br>1.291 | 50<br>102<br>174 | 0.4<br>0.8<br>2.6 | < -2<br>< -2<br>< -2 | -.25<br>-.25<br>-.25 | | 1.88<br>1.86<br>1.9 | p' and Dielect. const (Function proportional to strength) |
| 2 | Isooctane(*)<br>(2,2,4-tri methylpentane) | LC | 197 | 1.389 | 99 | 0.47 | 0.1 | 0.01 | 0.011 | 1.94 | 0.1 |
| 3 | n-Heptane(*) | LC | 195 | 1.385 | 98 | 0.40 | 0.2 | 0.01 | 0.010 | 1.92 | 0.5 |
| 4 | n-Hexane(*) | LC | 190 | 1.372 | 69 | 0.30 | 0.1 | 0.01 | 0.010 | 1.88 | 0.5 |
| 5 | n-Pentane(**) | LC | 195 | 1.355 | 36 | 0.22 | 0.0 | 0.00 | 0.010 | 1.84 | 0.5 |
| 6 | Cyclohexane | LC | 200 | 1.423 | 81 | 0.90 | -0.2 | 0.04 | 0.012 | 2.02 | 0.5 |
| 7 | Cyclopentane(*) | LC | 200 | 1.404 | 49 | 0.42 | -0.2 | 0.05 | 0.014 | 1.97 | 0.6 |
| 8 | l-Chlorobutane(*) | LC | 220 | 1.400 | 78 | 0.42 | 1.0 | 0.26 | | 7.4 | 2.8 |
| 9 | Carbon disulfide | LC | 380 | 1.624 | 46 | 0.34 | 0.3 | 0.15 | 0.005 | 2.64 | 1.7 |
| 10 | 2-Chloropropane(**) | LC | 230 | 1.375 | 36 | 0.30 | 1.2 | 0.29 | | 9.82 | 3.7 |
| 11 | Carbon tetrachloride | LC | 265 | 1.457 | 77 | 0.90 | 1.6 | 0.18 | 0.008 | 2.24 | 2.3 |
| 12 | n-Butyl ether | | 220 | 1.397 | 142 | 0.64 | 2.1 | 0.25 | 0.19 | 2.8 | 2.4 |
| 13 | Triethylamine | | | 1.398 | 89 | 0.36 | 1.9 | 0.54 | | 2.4 | 2.4 |
| 14 | Bromoethane(*) | | | 1.421 | 38 | 0.38 | 2.0 | 0.35 | | 9.4 | 4.3 |
| 15 | i-Propyl ether(*) | | 220 | 1.365 | 68 | 0.38 | 2.4 | 0.28 | 0.62 | 3.9 | 3.2 |
| 16 | Toluene | LC | 285 | 1.494 | 110 | 0.55 | 2.4 | 0.29 | 0.046 | 2.4 | 2.9 |
| 17 | p-Xylene | | 290 | 1.493 | 138 | 0.60 | 2.5 | 0.26 | | 2.3 | 3.0 |
| 18 | Chlorobenzene | | | 1.521 | 132 | 0.75 | 2.7 | 0.30 | | 5.6 | 4.1 |
| 19 | Bromobenzene | | | 1.557 | 156 | 1.04 | 2.7 | 0.32 | | 5.4 | 4.1 |
| 20 | Iodobenzene | | | | | | 2.8 | 0.35 | | | |
| 21 | Phenyl ether | | | 1.580 | 258 | 3.3 | 3.4 | | | 3.7 | 3.7 |
| 22 | Phenetole | | | 1.505 | 170 | 1.14 | 3.3 | | | 4.2 | 4.9 |
| 23 | Ethyl ether(**) | LC | 218 | 1.350 | 35 | 0.24 | 2.8 | 0.38 | 1.3 | 4.3 | 4.0 |
| 24 | Benzene | LC | 280 | 1.498 | 80 | 0.60 | 2.7 | 0.32 | 0.058 | 2.3 | 3.6 |
| 25 | Tricresy phosphate | | | | | | | | | | |
| 26 | Ethyl iodide | | | 1.510 | 72 | 0.57 | 2.2 | | | 7.8 | 4.2 |
| 27 | n-Octanol | | 205 | 1.427 | 195 | 7.3 | 3.4 | 0.5 | 3.9 | 10.3 | 5.8 |
| 28 | Fluorobenzene | | | 1.46 | 85 | 0.55 | 3.1 | | | 5.4 | 4.6 |
| 29 | Benzylether | | | 1.538 | 288 | 4.5 | 4.1 | | | | |
| 30 | Methylene chloride(**) | LC | 233 | 1.421 | 40 | 0.41 | 3.1 | 0.42 | 0.17 | 8.9 | 5.6 |
| 31 | Anisole | | | 1.514 | 154 | 0.9 | 3.8 | | | 4.3 | 4.6 |
| 32 | i-Pentanol | | | 1.405 | 130 | 3.5 | 3.7 | 0.61 | 9.2 | 14.7 | 7.3 |
| 33 | 1,2-Dichloroethane | LC | 228 | 1.442 | 83 | 0.78 | 3.5 | 0.44 | 0.16 | 10.4 | 6.3 |
| 34 | t-Butanol | | | 1.385 | 82 | 3.6 | 4.1 | 0.7 | miscible | 12.5 | |

| | (1) Solvent (*)η ≤ 0.5 cp, B.P. > 45 °C (**)η ≤ 0.5 cp, B.P. < 45 °C | (2) Source | (3) UV Cutoff | (4) R.I.25° | Boiling Point (°C) | Viscosity (cP, 25 °C) | (5) p' | (6) e°a | (7) Water Solubility %W in 20 °C Solvent | (8) Dielectric Constant $e^{20}$ | (9) p'+ 0.25e |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | n-Butanol | LC | 210 | 1.397 | 118 | 2.6 | 3.9 | 0.7 | 20.1 | 17.5 | 8.3 |
| 36 | n-Propanol | LC | 240 | 1.385 | 97 | 1.9 | 4.0 | 0.82 | miscible | 20.3 | |
| 37 | Tetrahydrofuran(*) | LC | 212 | 1.405 | 66 | 0.46 | 4.0 | 0.57 | miscible | 7.6 | |
| 38 | Propylamine(*) | | | 1.385 | 48 | 0.35 | 4.2 | | miscible | 5.3 | |
| 39 | Ethylacetate(*) | LC | 256 | 1.370 | 77 | 0.43 | 4.4 | 0.58 | 8.8 | 6.0 | 5.8 |
| 40 | i-Propanol | LC | 205 | 1.384 | 82 | 1.9 | 3.9 | 0.82 | miscible | 20.3 | |
| 41 | Chloroform(*) | LC | 245 | 1.443 | 61 | 0.53 | 4.1 | 0.40 | 0.072 | 4.8 | 5.6 |
| 42 | Acetophenone | | | 1.532 | 202 | 1.64 | 4.8 | | | 17.4 | 8.7 |
| 43 | Methylethyl | LC | 329 | 1.376 | 80 | 0.38 | 4.7 | 0.51 | 23.4 | 18.3 | 9.1 |
| 44 | Cyclohexanone | | | 1.450 | 156 | 2.0 | 4.7 | | | 18.3 | 9.1 |
| 45 | Nitrobenzene | | | 1.550 | 211 | 1.8 | 4.4 | | | 34.8 | 13.2 |
| 46 | Benzonitrile | | | 1.536 | 191 | 1.2 | 4.8 | | | 25.2 | 10.9 |
| 47 | Dioxane | LC | 215 | 1.420 | 101 | 1.2 | 4.8 | | miscible | 2.2 | |
| 48 | Tetramethyl urea | LC | 265 | 1.449 | 175 | | 6.0 | 0.56 | | 23.0 | 10.7 |
| 49 | Quinoline | | | 1.625 | 237 | 3.4 | 5.0 | | | 9.0 | 7.4 |
| 50 | Pyridine | | | 1.507 | 115 | 0.88 | 5.3 | | miscible | 12.4 | |
| 51 | Nitroethane | | 380 | 1.390 | 114 | 0.64 | 5.2 | | 0.9 | | |
| 52 | Acetone(*)<br>Benzyl alcohol | LC | 330 | 1.356<br>1.538 | 56<br>205 | 0.30<br>5.5 | 5.1<br>5.7 | 0.71 | miscible | 13.1 | 8.8 |
| 53 | Tetramethyl guanidine | | | | | | 6.1 | 0.6 | | | |
| 54 | Methoxyethanol | LC | 210 | 1.400 | 125 | 1.60 | 5.5 | | miscible | 19.9 | |
| 55 | Tris (cyanoethoxy) propane | GC | | | | | 6.6 | 0.56 | | | |
| 56 | Propylene carbonate | LC | | | | | 6.1 | | | | |
| 57 | Ethanol | LC | 210 | 1.359 | 78 | 10.8 | 4.3 | | miscible | 24.6 | |
| 58 | Oxydipropionitrile | GC | | | | | 6.8 | | | | |
| 59 | Aniline | | | 1.584 | 184 | 3.77 | 6.3 | | | 6.9 | 8.1 |
| 60 | Acetic acid | | | 1.370 | 118 | 1.1 | 6.0 | | miscible | 6.2 | |
| 61 | Acetonitrile(*) | LC | 190 | 1.341 | 82 | 0.34 | 5.8 | | miscible | 37.5 | |
| 62 | N, N-dimethylaceta-mide | LC | 268 | 1.436 | 166 | 0.78 | 6.5 | 0.88 | | 37.8 | |
| 63 | Dimethylformamide | LC | 268 | 1.428 | 153 | 0.80 | 6.4 | | | 36.7 | |
| 64 | Dimethylsulfoxide | LC | 268 | 1.477 | 189 | 2.00 | 7.2 | 0.62 | miscible | 4.7 | |
| 65 | N-methyl-2-pyrolidone | LC | 285 | 1.468 | 202 | 1.67 | 6.7 | | | 32 | |
| 66 | Hexamethyl phosphoric acid triamide | | | 1.457 | 233 | 3 | 7.4 | 0.65 | | 30 | |
| 67 | Methanol(*) | LC | 205 | 1.326 | 65 | 0.54 | 5.1 | | miscible | 32.7 | |
| 68 | Nitromethane | | 380 | 1.380 | 101 | 0.61 | 6.0 | | 2.1 | | |
| 69 | m-Cresol | | | 1.540 | 202 | 14 | 7.4 | | | 11.8 | 10.0 |
| 70 | N-methylformamide | | | 1.447 | 182 | 1.65 | 6.0 | | miscible | 182 | |
| 71 | Ethylene glycol | | | 1.431 | 182 | 16.5 | 6.9 | | miscible | 37.7 | |
| 72 | Formamide | | | 1.447 | 210 | 3.3 | 9.6 | | miscible | 111 | |
| 73 | Water | LC | | 1.333 | 100 | 0.89 | 10.2 | | | 80 | |

9

(1) An asterisk (*) indicates solvents most suitable for LC, with low boiling points (> 45 °C) and low viscosity (≤ 0.5 cp). Double asterisks (**) indicate solvents with a very low viscosity and boiling point.

(2) "LC" in the "Source" column indicates that a grade of solvent specifically for LC is commercially available from companies like the following:
Burdick & Jackson, Baker Chemical, Mallinckrodt Chemical, Fischer Scientific, Waters Associate, Manufacturing Chemists, Inc.
"GC" in the "Source" column indicates that a solvent is used as a stationary phase for gas chromatography, and can be purchased from companies selling GC columns and stationary phases. (These solvents are used as a stationary phase in liquid-to-liquid LC.)

(3) The wavelength (nm) below which the mobile phase becomes opaque.

(4) Refractive index at 25 °C.

(5) Polarity parameter of mobile phase.

(6) Mobile phase's strength parameter in relation to liquid-to-solid adsorption in alumina.

(7) Water solubility ($\%^{W}$) at 20 °C of mobile phase used in liquid-to-solid adsorption.

(8) Value at 20 °C.

(9) Function consisting of p' (proportional to mobile phase strength) plus the dielectric constant, in ion chromatography.

Sources: A.M.Krstulovic, P.R.Brown: *Reversed-Phase High-Performance Liquid Chromatography,* Wiley Interscience (1982)

# Index

## G



## I



## K



## L



## M



## N



## O



## P



## R



## S

## T



## V



## W



## X



## Z

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