GC-2010 Gas Chromatograph

INSTRUCTION MANUAL

Read this instruction manual thoroughly before using this instrument.
Save the manual for future reference.

SHIMADZU CORPORATION
ANALYTICAL & MEASURING INSTRUMENTS DIVISION
KYOTO, JAPAN

WARNING LABELS

Label conventions for this manual are provided below.

⚠	**WARNING**	Indicates a potentially hazardous situation which could result in death or serious injury.
⚠	**CAUTION**	Indicates a potentially hazardous situation which could result in minor or moderate injury and property damage.
NOTE		Emphasizes essential information.

Safety Precautions

The GC-2010 Gas Chromatograph is a qualitative and quantitative analysis system.
Review the following precautions for safe operation.

1. Use the system only for its intended purpose.

2. Follow the procedures described in this Instruction Manual.

3. Observe all warnings and precautions.

4. Never disassemble or modify the system without our permission.

5. Contact your Shimadzu representative for system repairs.

System WARNING labels

⚠ **WARNING**

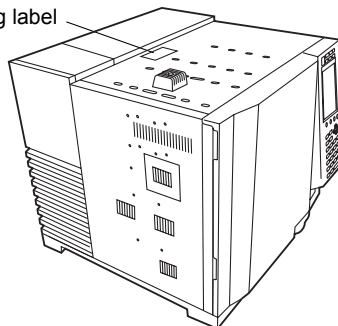## DO NOT TOUCH

High temperature injection ports, detectors and top cover.
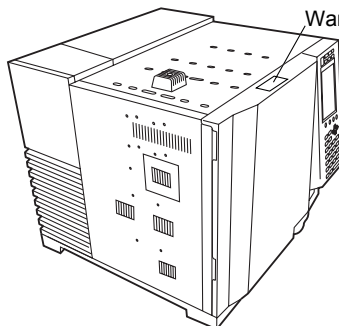
Warning label

⚠ **WARNING**

WARNING WHEN USING HYDROGEN

Shut off hydrogen and cap unused column fittings to prevent accumulation of hydrogen in oven and possible explosion.
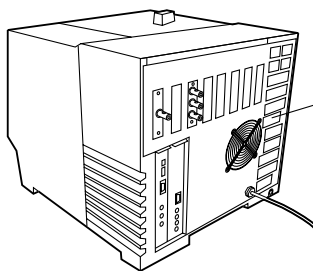
Warning label

⚠ **WARNING**

HOT AIR EXHAUST

Keep temperature sensitive materials away from opening.

Warning label

⚠ WARNING

HIGH VOLTAGE

Disconnect power cable before removing cover. Refer servicing to qualified service personnel.
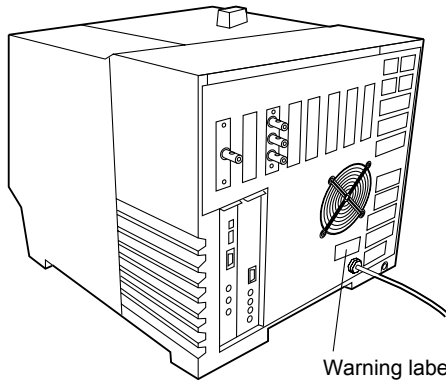
Warning label

⚠ WARNING

WARNINGS WHEN USING HYDROGEN

When hydrogen gas is in use, care should be exercised in order to prevent an accident.

1. Connect gas lines correctly. Do not connect the hydrogen line to the air inlet, or hydrogen will leak excessively.
2. When the device is not in use, the main valve of the hydrogen gas cylinder or generator must be closed. Also, make sure that there is no gas leakage from the main valve of the supply.
3. The flow line for hydrogen gas should be checked for leakage whenever it is used.
4. To prevent buildup of explosive concentrations in case the hydrogen gas leaks, the room in which the device is used should be well ventilated.
5. When analysis is complete, close the main valve of the hydrogen gas container immediately before performing other procedures.
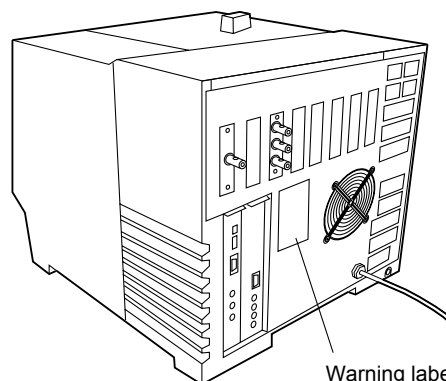
Warning label

Emergency Procedures

Follow these procedures in the event of an emergency (If an abnormality is detected in the GC-2010 gas chromatograph, for example).

Before using the system again after an emergency, inspect the system. Contact your Shimadzu representative if necessary.

1. Turn off the power switch of the GC-2010 gas chromatograph.
2. Turn off all power switches of peripheral units.
3. Close the main valve of the carrier gas, hydrogen, air and makeup gas supply.
4. Shut down the power supply.
   - If the power cable is tightened with screws to a power distribution board, turn off the switch provided on the power distribution board.
   - If the power cable is connected through a plug, unplug it.

Power cable

GC-2010
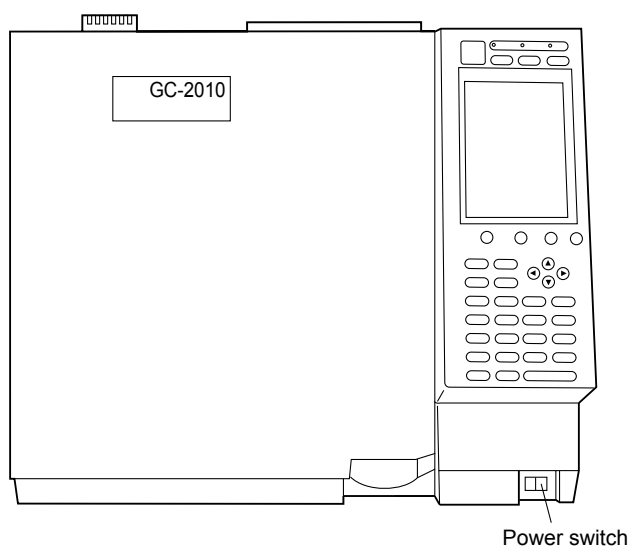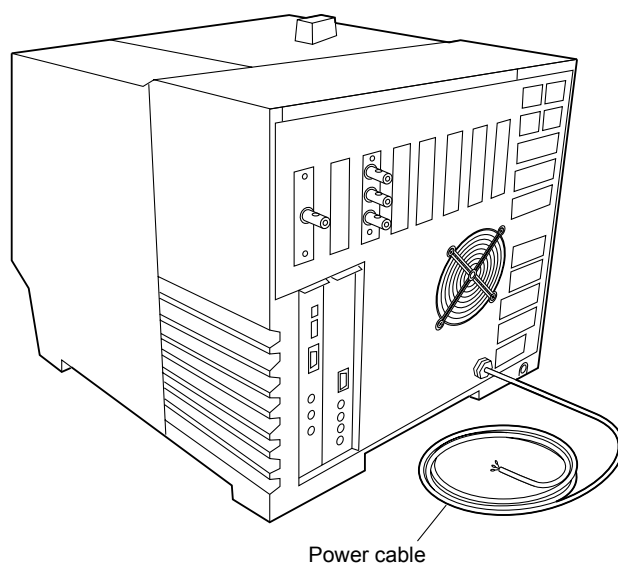
Power switch

Fig. Power switch and power cable

◆◆ Contents

Safety Precautions
WARNING LABELS
System WARNING labels
Emergency Procedures

◆◆ Contents

◆❖ Contents

◆◆ Contents

11   Creating an Oven Temperature Program

12   Injection Port

13   Detector

◆▶ Contents

14 Diagnosis

15 Optional Devices

◆ Contents

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16   Special Functions

◆▶ Contents

17 Printing

18 Maintenance and Inspection

◆◆ Contents

19   Troubleshooting

◆▶ Contents

1 Overview

1.1 System Features

The GC-2010 is a state-of-the-art, advanced gas chromatograph which embraces the concepts of flexibility, user-friendliness, and security. It meets and exceeds user demands for high performance, advanced (functionality), high reliability, and high productivity.

These concepts are illustrated by the following features, which include high processing speed and digitized signals.

1.1.1 Basic performance

(1) Improved reproducibility
Good reproducibility is obtained even for solvents like acetone, which have large expansion volumes.

(2) Reduced differences among units
Sensitivity differences between detectors have been reduced.

(3) Improved detector sensitivity
The sensitivity of the FPD (flame photometric detector) is now five times better than previous models.

(4) Increased oven cooling speed
The oven cooling speed is now 1.6 times faster than previous models.

1.1.2 Operation

(1) Intelligent diagnosis
The diagnosis function has improved considerably, with an advanced alarm system.

(2) Large LCD (liquid crystal display)
An improved, much larger 16-line LCD (240 × 320 dots), means that analysis parameters and programs can now be listed, improving operation. The display can switch between Japanese and English.

1.1.3 High speed analysis enabled

(1) Digitized detector signals
Detector signals are digitized to enable high speed analysis.

(2) High pressure injection mode
The high pressure injection mode (standard) enables high speed analysis.

1.2 **Specifications**

1.2.1 Column oven

Dimensions (mm)	: 280(W) $\times$ 280 (H) $\times$ 175 (D)
Volume (L)	: 13.7
Range of temperature	: Room temperature +4°C to 450°C
	-50°C to 450°C (When liquid carbon dioxide gas is used.)
Accuracy of temperature	: $\pm$1% (K) (Calibrated at 0.01°C)
Deviation of temperature	: Within 2°C (on a 200mm diameter column holder)
Stability of temperature	: Within $\pm$0.05°C
Temperature coefficient	: 0.01°C/°C
Range of linear temperature increase:	
	(in power voltage 100 VAC)
	40°C/min up to 200°C
	15°C/min up to 350°C
	7°C/min up to 450°C
	(in power voltage 230 VAC)
	70°C/min up to 200°C
	50°C/min up to 350°C
	35°C/min up to 450°C
Cooling speed	: Approximately 6 minutes cooling from 450°C to 50°C.
Overheat protection	: Programmable up to 470°C (A fixed circuit provides protection at 500°C)

1.2.2 Temperature program

Program ramps	: 20 ramps in total (Heating and cooling available)
Setting	: 0.1°C increments
Program setting	: -250 to 250°C/min, 0.01°C/min increments
Total time of total program	: Up to 9999.99 minutes

1.2.3 Injection port

Range of temperature	: Up to 450°C
Temperature setting	: 0.1°C increments
Overheat protection	: Programmable up to 470°C
Injection unit	: Split/Splitless injection, Direct injection

1.2.4 Detector

○ Hydrogen flame ionization detector (FID)

Range of temperature	: Up to 450°C, 0.1°C increments
Overheat protection	: Programmable up to 470°C
Minimum detection	: 3pg C/s
Dynamic range	: 10^7
Jet material	: Fused quartz
Time constant	: 4 ms to 2 s selectable

○ Thermal conductivity detector (TCD)

Amplifier	: With differential type filament protective circuit, tungsten rhenium filament, dual-element configuration
Power	: Constant current
Dynamic range	: 10^5
Sensitivity	: 20,000mV・ml/mg
Maximum temperature	: 400°C

1.2.5 Auxiliary heated zone

AUX3 to AUX5	: Available (optional)

1.2.6 Carrier gas flow control unit

○ Split/splitless mode

Range	: 0 to 970 kPa (The maximum pressure limit is the primary pressure minus 10 kPa.) 0.1 kPa increments
Program ramps	: 7 ramps possible
Program rate	: -400 to 400 kPa/min, 0.01 kPa/min increments
Split rate setting	: 0 to 9999.9, 0.1 increments

○ Direct injection mode
Pressure mode

Range	: 0 to 970 kPa (The maximum pressure limit is the primary pressure minus 10 kPa.) 0.1 kPa increments
Program ramps	: 7 ramps possible
Program rate	: -400 to 400 kPa/min

Flow rate mode

Range	: 0 to 1200 ml/min (When primary pressure is 980 kPa)
Program ramps	: 7 ramps possible
Program rate	: -400 to 400 ml/min/min 0.1 ml/min/min increments

1.2.7 Detector gas flow controller

Range	: 0 ~ 1200 ml/min (Air), 0.1 ml/min increments 0 ~ 200 ml/min (H_2) 0 ~ 100 ml/min (Makeup He)
Program ramps	: 7 ramps possible
Program rate	: -400 to 400 ml/min/min, 0.01 ml/min/min increments

1.2.8 Display

Back-light LCD 240 × 320 dot, 16 lines
The display can be switched between Japanese and English.

1.2.9 Dimensions, weight and power supply

Dimensions (mm)   : 515 (W) $\times$ 440 (H) $\times$ 530 (D) mm

Weight   : 30 kg

Power supply   : 100 VAC (standard model and FID detector), 1800 VA, 50/60 Hz

230 VAC (standard model with FID detector), 2600 VA, 50/60 Hz

2 Installation

2.1 Shipment Verification

This unit consists of the following parts. Verify that all items are present.

1. GC-2010 main body

2. Quick reference (Part Number 221-40450)

3. Instruction manual CD-ROM (Part Number 221-40442)

4. Standard accessories

Type	Description	Part No.	Qty'
Tools	Wrench 6 × 8	086-03003	2
	Wrench 10 × 12	086-03011	2
	Wrench for Glass insert nut	221-46977	1
Parts	Branch tube	221-09688-91	1
	Injection port Column nut	221-16325-01	1
	Column nut	221-32705	1
	Ferrule adjuster (for SPL) (SPL Column insertion jig)	221-41532-91	1
	Column hanger *	221-47159	1
	Injection port cover **	221-43597	1
	G-type blank nut (with 2pcs)	221-35566-92	1
Consumables	Silicon rubber septum (with 20pcs)	201-35584	1
	Silica wool stuffing (with 2g)	221-48600	1
	Graphite ferrule 0.5, for capillary (with 10pcs)	221-32126-05	1
	Aluminum gaskets (with 100pcs)	201-35183	1
	Glass insert, for split	221-41444-01	1
	Glass insert, for splitless	221-48335-01	1
	Fluoride rubber O-ring, for glass insert (with 5pcs)	036-11203-84	1

∗ The column hanger is inserted into the support slots in the oven interior.
∗∗ Attach the injection port cover to INJ/DET cover in case of manual injection. (Refer to "2.2 Component description".)

5. FID accessories (only for models with FID)

Description	Part No.	Qty'
Chromatopac signal cable	221-47251-91	1
Ferrule adjuster (for FID)	221-41532-92	1

6. TCD accessories (only for models with TCD)

Description	Part No.	Qty'
Ferrule adjuster (for TCD)	221-48610-01	1
CAUTION label TCD-2010	221-42741	1
Card case, A6	038-03055	1
Chromatopac signal cable	221-47251-91	1

Wrench 6X8
P/N086-03003

Wrench 10X12
P/N086-03011

Wrench for Glass insert nut
P/N221-46977

Graphite ferrule,0.5
for capillary(10pcs)
P/N221-32126-05

Silica wool
(2grams)
P/N221-48600

Injection port cover
P/N221-43597

Glass insert,for split
P/N221-41444-01

Glass insert,for splitless
P/N221-48335-01

Silicon rubber septum(20pcs)
P/N201-35584

Fluoride rubber O-ring(5pcs)
P/N036-11203-84

Aluminum gaskets(100pcs)
P/N201-35183

Branch tube
P/N221-09688-91

G-type blank nut
P/N221-35566-92

Column nut
P/N221-32705

Column nut of injection port
P/N221-16325-01

Ferule adjuster(For SPL)
P/N221-41532-91

Ferule adjuster(For Detector)

Fig. 2.1.1   Standard Accessories

■ AOC-20i Parts list for GC-2010

AOC-20i for GC-2010 consists of the following parts. Please check them when unpacking the unit.

	Description	Part No.	Qty'	Remarks
1	Auto injector	221-44527-30	1	
2	User's manual	221-40268	1	

Standard Auto injector accessories

	Description	Part No.	Qty'	Remarks
1	AOC cable	221-44819	1	
2	Rack (short)	221-45608-91	1	Short rack set 221-45610-91
3	Large Vial Holder (for solvent/waste)	221-34949-01	1	
4	Small Vial Holder	221-45609-92	1	
5	Syringe (10μl)	221-34618	1	
6	Cable clamp	072-60330-01	1	
7	Needle guide	221-44584	2	
8	Plunger holder	221-44790	5	
9	Barrel holder	221-44780	2	
10	Plunger Knob	037-02820	1	
11	Large Vial (4ml)	221-34267-91	1 set (5pcs)	
12	Large Cap (for 4ml)	221-34268-91	1 set (5pcs)	
13	Large Septum (for 4ml)	221-34266-91	1 set (15pcs)	
14	Small Vial (1.5ml)	221-34272-91	1 set (20pcs)	
15	Small Cap (for 1.5ml)	221-34273-91	1 set (20pcs)	
16	Large Septum (for 1.5ml)	221-41239-92	1 set (40pcs)	

AOC power supply
For 115V model (P/N 221-48401-91)

	Description	Part No.	Qty'	Remarks
1	AOC power supply	221-48402-91	1	
2	READY/START cord	221-48405-91	1	Accessories for power supply (P/N 221-48403-91)
3	RS-232C cable for AOC	221-48406-91	1	

For 230V model (P/N 221-48401-38)

	Description	Part No.	Qty'	Remarks
1	AOC power supply	221-48402-38	1	
2	READY/START cord	221-48405-91	1	Accessories for power supply (P/N 221-48403-31)
3	RS-232C cable for AOC	221-48406-91	1	
4	Ferrite core	075-08023-03	3	

Installation parts (P/N 221-44548-92)

	Description	Part No.	Qty'	Remarks
1	Spacer, back left	221-44585	1	
2	Spacer, front left	221-44892	1	
3	Spacer, for height adjustment	221-45215	1	
4	Spacer, back right	221-48270	1	
5	Spacer, front right	221-48271	1	
6	Spacer, SBB-320	037-38856-29	1	
7	Spring washer, for M4	023-77040	4	
8	Washer, for M4	023-66140-01	2	
9	Nut, for M4	023-04140	1	
10	Wrench, 7 x 8	086-03004	1	
11	Wrench, 5.5 x 7	086-03001	1	
12	Screw, M4 x 30	020-46554	4	

2.2 Component description

■ **Front**

```
┌─────────────────────────────────────────────┐
│                 ⚠ WARNING                    │
│            HIGH TEMPERATURE                    │
│                                               │
│  Danger of burns. Keep the column oven door   │
│  closed when the oven is at high temperature. │
│  Keep the injection port cover on when making │
│  manual injections.                           │
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GC-2010

Door latch
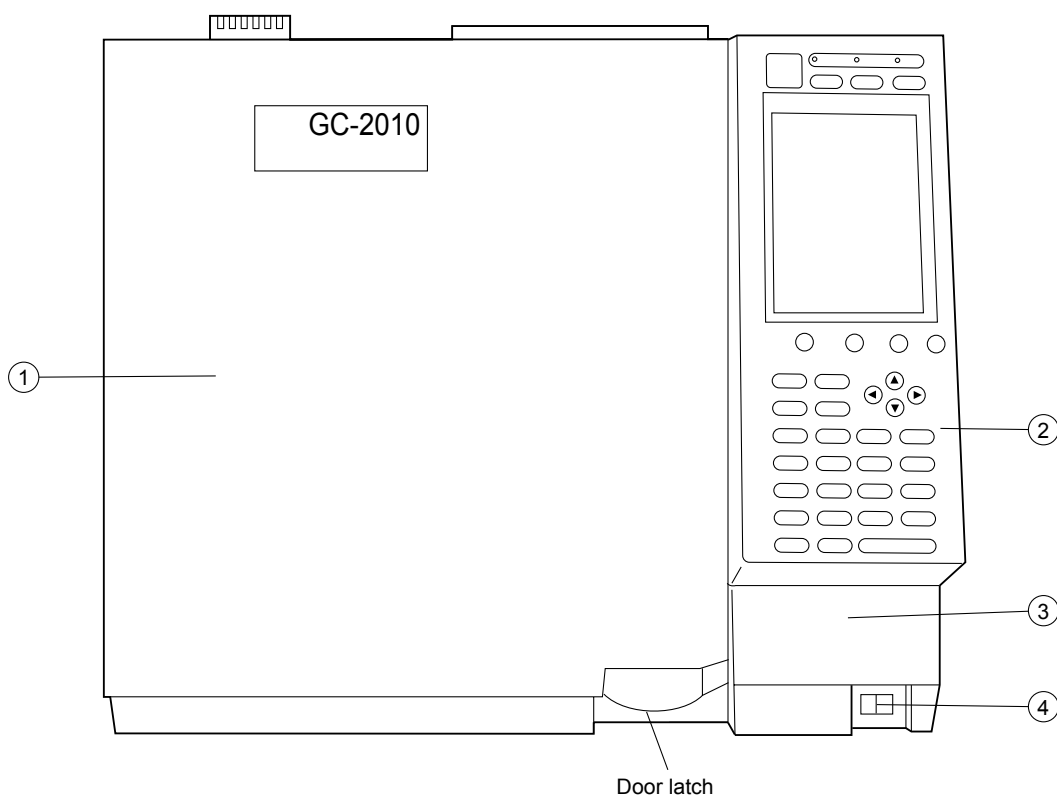
Fig. 2.2.1

No.	Name	Description
1	Column oven door	Pull the latch on the lower right to open the door. Press the center of the door to close it.
2	Key/Display	Used for various input and displaying component status.
3	Battery case for FPD fan	Houses the battery for FPD cooling fan (option).
4	Power switch	Turns the power of the unit on and off.

■ **Oven interior**

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⚠ WARNING

HIGH TEMPERATURE

Danger of burns. When the injection port or detector temperature is
high, never touch the connections or the internal surfaces of the oven.
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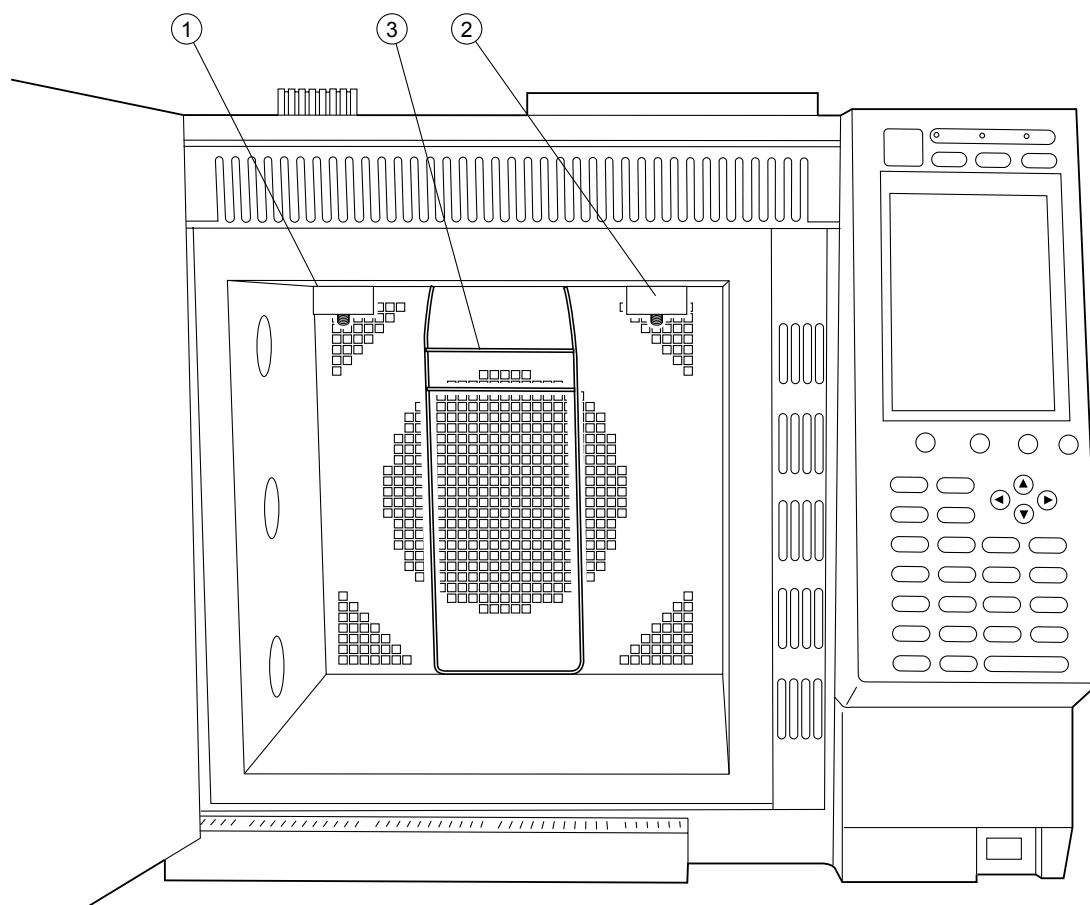

Fig. 2.2.2

No.	Name	Description
1	Column connection (injection port side)	Attaches the column to the injection port. (close-up ①).
2	Column connection (detector side)	Attaches the column to the detector (close-up ②).
3	Column hanger	Install the capillary column here. (Attaches to the top of the oven (close-up ③).

Close-up ① (injection port side)
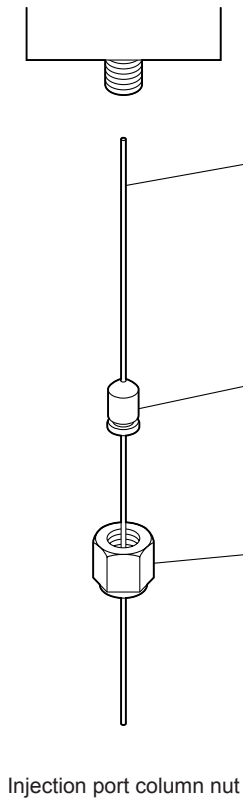
Close-up ② (detector side)
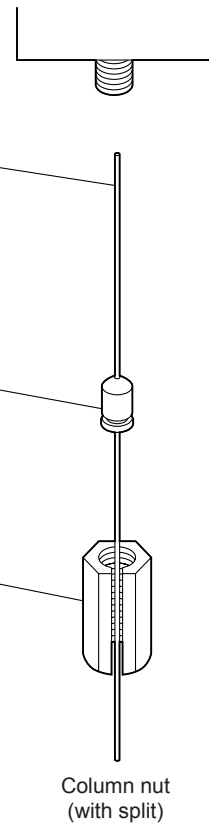
Capillary column

Graphite ferrule

Column nut

Injection port column nut

Column nut
(with split)
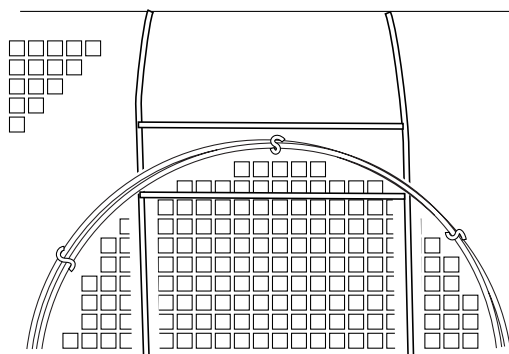
Close-up ③ (column hanger)

■ Rear

⚠ **WARNING**

HIGH VOLTAGE

Danger of electrical shock.
Only qualified service personnel may remove the rear cover.
Ensure that the power distribution board power is off before starting installation if the power cable will be connected directly to terminals on the power distribution board.
Ensure that the power supply is properly grounded.
Never put heavy objects on the power cable.

HIGH TEMPERATURE

Hot air is exhausted from the back of the unit. Do not place flammable items behind the unit. Do not touch the back of the GC near the exhaust.

HIGH PRESSURE GAS

Frequently check gas flow lines for leaks.
In particular, accumulations of hydrogen gas can cause an explosion.
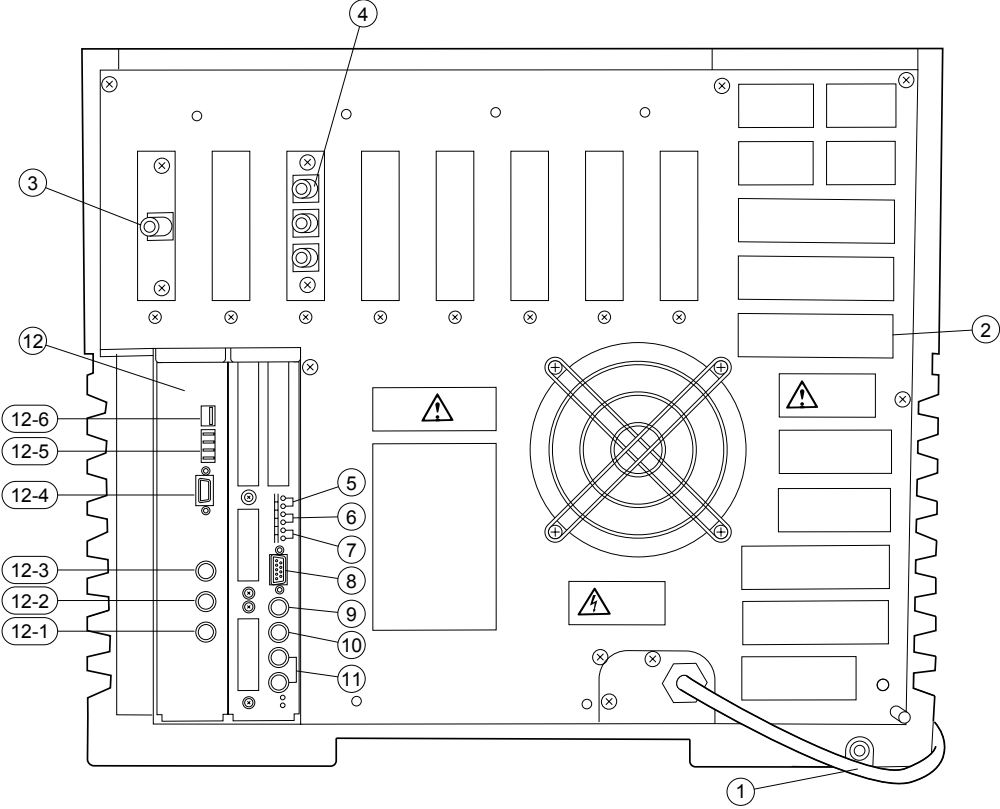
Fig. 2.2.3

⚠ **CAUTION**

Do not touch the connections or terminals when the power is on. This could damage the circuits.

No.	Name	Description
1	Power cable	Supplies power to the unit.
2	Exhaust vent	This vents the column oven during cooling.
3	Carrier gas inlet	Supplies carrier gas.
4	Detector gas inlet	Supplies detector gas.
5	START signal input terminal	Connect an external device if any to this terminal to receive a start signal.
6	READY signal terminal	Outputs the READY signal to any external device (Such as the auto injector).
7	START signal output terminal	Connect an external device if any to this terminal to output the start signal.
8	RS-232C connector	Connect the RS-232C cable (9 pin) to this connector. For I/O of digital signal.
9	Relay terminal	Relay terminal to switch at EVENT91 and 92.
10	AOC communication connector	Connect this connector to the RS-232C terminal in the power unit of AOC-20 i/s.
11	Detector signal output terminal (analog)	Outputs the detector signal to analog input of a Chromatopac or other type of data processing unit. (ch1, ch2)
12	AOC power supply *	Connects AOC-20i and AOC-20s (option).
12-1	INJECTOR1 connector	Connect the auto injector. (in single mode) Connect the main auto injector in dual mode.
12-2	INJECTOR2 connector	Connect the subordinate auto injector in dual mode.
12-3	SAMPLER connector	Connect the autosampler carousel.
12-4	RS-232C connector	Connector for external control
12-5	Fiber optic cable connector	Do not connect RS-232C and fiber optic cables simultaneously.
12-6	Start out/Ready in connector	Inputs the Ready signal to the gas chromatograph and outputs the start signal from the gas chromatograph.

∗ Only for units with AOC-20i.

NOTE   The symbol ⏚ indicates the functional ground terminal.

■ **Entire unit**

┌───┐
│   ⚠ **WARNING**   │
│   │
│   **HIGH VOLTAGE**   │
│   │
│ Danger of electrical shock.   │
│ Only qualified service personnel may remove the side covers. │
│   │
│   **HIGH TEMPERATURE**   │
│   │
│ Danger of burns. Never touch the top cover, the injection ports and detectors — while they are hot. │
└───┘

┌───┐
│   ⚠ **CAUTION**   │
│   │
│ All the GC unit covers (including the INJ/DET covers, carrier and detector gas controller covers) are essential to the optimal performance of the GC-2010. Ensure that these covers are in place when the GC is in use. │
└───┘
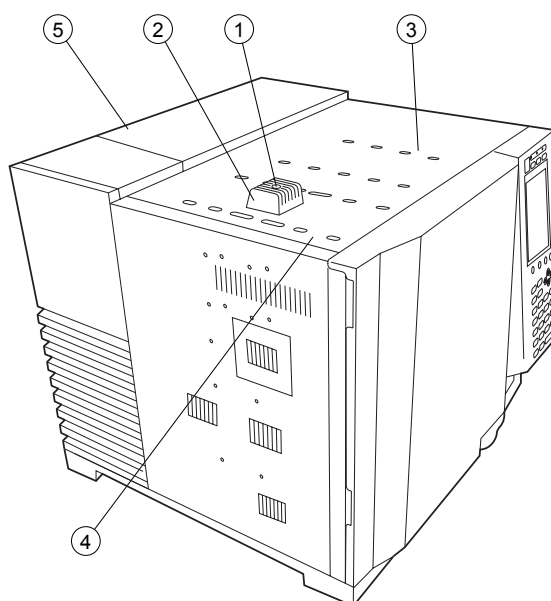
Fig. 2.2.4

No.	Name	Description
1	Injection port	Samples are injected into this port, which can become extremely hot.
2	Injection port cover	This cover becomes extremely hot. It protects you from the heat of the injection port.
3	Detector	The detector is located under the INJ/DET cover. The detector can become extremely hot.
4	INJ/DET cover	Lift up this cover to remove it. Keep the cover closed during operation.
5	Carrier and detector gas controller cover	Houses AFC, APC and manual flow controller. Open and lift up this cover to remove it.

2.3 **Installation site**

■ Installation location requirements

Consider the following points to ensure safe and appropriate unit operation when selecting the installation site.

2.3.1 Ambient temperature and humidity

For optimal performance, operate this unit within the following temperature and humidity specifications.

Temperature range:	18°C to 28°C
Relative humidity range:	50% to 60% (Avoid use under conditions where condensation forms)
Operating temperature range:	5°C to 40°C
Operating humidity range:	5% to 90% (Avoid use under conditions where condensation forms)

2.3.2 Installation location

Install the unit on a firm, stable and flat base.

2.3.3 Corrosive gas and dust

Avoid exposure to corrosive gas and excessive dust to prolong the service life and maintain optimal unit performance.

2.3.4 Electro-magnetic fields and power supply noise

This unit should not be used near strong electro-magnetic fields. The power supply must have little or no noise. These items can cause instrument problems.

2.3.5 Other precautions

For optimal performance, avoid the following conditions during installation:
(1) Fluctuating ambient temperature.
(2) Temperature changes from heating or air conditioning.
(3) Direct sunlight.
(4) Vibrations.

■ **Installation clearances**

> ⚠ **WARNING**
>
> Hot air is exhausted from the back vent. Do not place flammable matelials near the exhaust.

Minimum 300mm

Minimum 100mm

Depth 530mm

GC-2010

Hight 440mm

Width 515mm
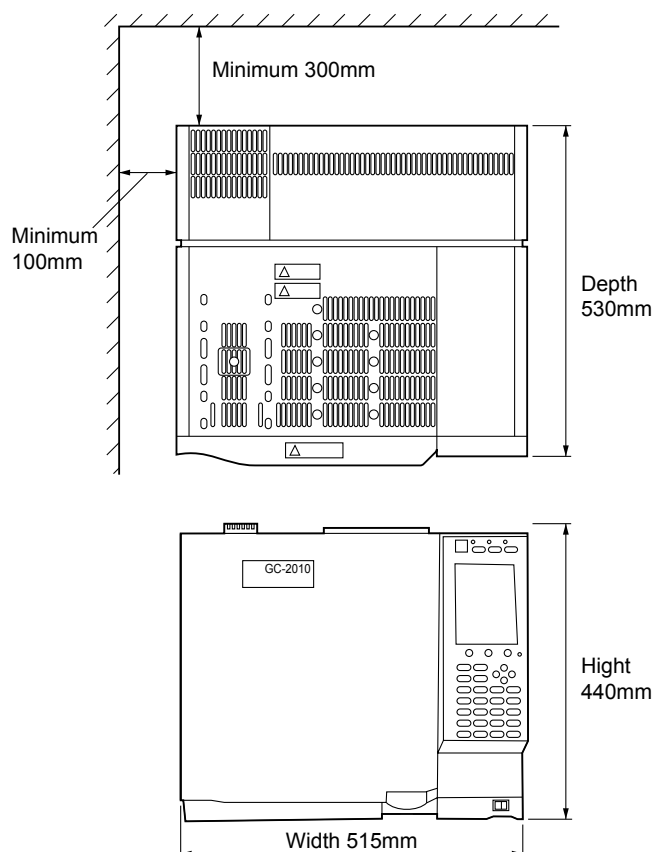
Fig. 2.3.1

2.3.6 Rear clearance

Hot air is vented at the back of the unit when the column oven cools. Consider the following during installation:
• Do not place any flammable materials behind the unit.
• Allow a clearance of 30cm or more between the back cover and the wall.
• Reserve extra space for maintenance and inspection behind the unit.

2.3.7 Left clearance

Allow a clearance of 10cm or more on the left side. The vent on the left side is important for properly cooling down the outer wall of the column oven and improving the cooling efficiency of the column oven.

2.4 **Moving the GC**

The GC-2010 weighs approximately 30kg (For a single FID model).
Two people must carry the GC; one on the left, and one on the right.

⚠ **CAUTION**
Move the GC carefully so it does not get bumped or jarred.

2.5 Power supply and wiring

⚠ **WARNING**

HIGH VOLTAGE

1. Before connecting the power cable to the distribution board, turn OFF the power to the distribution board.
2. The power supply must have a circuit breaker.
3. Do not place heavy items on the power cable.

Before connecting the power supply, verify the following items.

■ Power supply voltage

Use a power source with the following specifications to maintain optimal unit performance.

Commended power voltage: 115VAC ± 5%
230VAC ± 5%
Frequency 50/60Hz

Operating power voltage: 115VAC ± 10%
230VAC ± 10%
Frequency 50/60Hz

■ Power supply capacity

Calculate the power supply capacity by considering the total power consumption of the individual components as shown below.

Connect the power source to a terminal with sufficient capacity.

Standard model with FID: 1,800VA (115V model)/2,600VA (230V model)
Optional temperature control block (INJ, etc.): 150VA/pc
Maximum power is 2600VA (115V model), 3400VA (230V model)

| NOTE | Performance of the unit may be affected if the power supply voltage fluctuates or the capacity is insufficient.

■ Connecting the power cable

| NOTE | The power cable of the 230V model uses a plug.
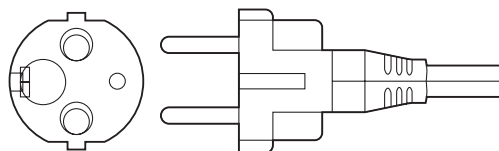
Fig. 2.5.1   Plug

⚠ **CAUTION**

Be careful to wire the plug correctly, as outlined on the next page to avoid damage to the unit or supply fuse.

The power cable for 115V model is color-coded as follows.
Black   ... Connected to HOT of AC line.
White   ... Connected to NEUTRAL of AC line.
Green ... Grounding (GROUND)
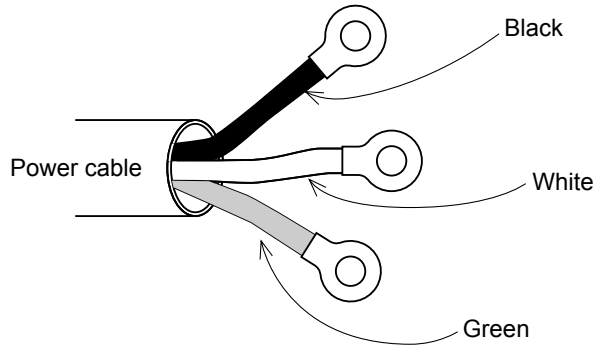
Fig. 2.5.2   Power cable

■ Symbol conventions

$\sim$: AC
O : Off, Open
| : On, Close
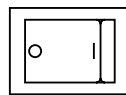
Power switch

OFF status
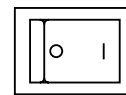
ON status

■ Heating energy generation

The following graph shows the heating values generated by the unit.
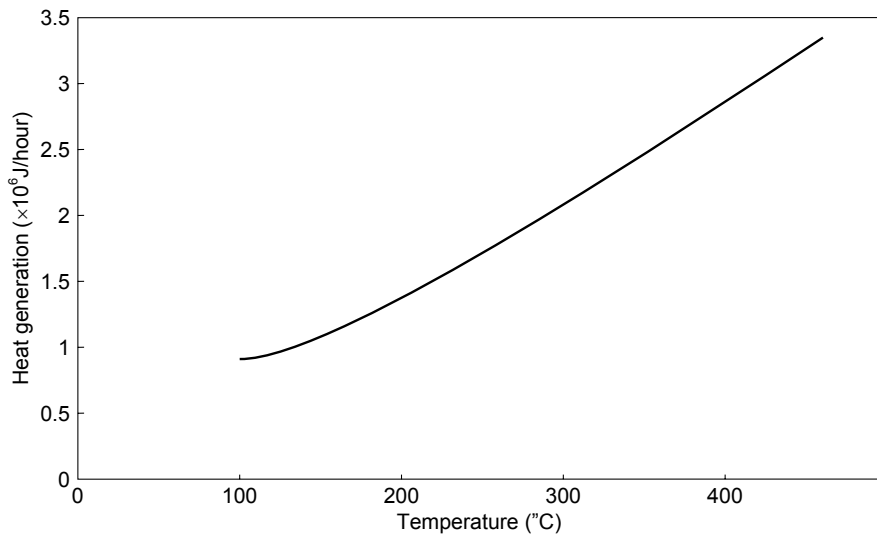
Fig. 2.5.3

■ Fuse

The following fuses are used in the GC-2010.

Fuse, No.	Rated current/voltage		Type *
	115V model	230V model	
F1, F2	15A/250V	10A/250V	T
F3, F4	5A/250V	3.15A/250V	T
F5, F6	5A/250V	5A/250V	T

∗Classification depending on "IEC127".

■ Allowing the GC to dry after transport.

⚠ **CAUTION**

GC-2010 may get wet from humidity in some transport conditions. In such case "drying-out" is necessary to avoid a short circuit at the heater in the injection port or the detector.

Under some transport conditions, condensation may form inside the GC components. To avoid injection port or detector heater unit short-circuits, allow the unit sufficient time to dry after transport, and follow the procedure below after installation.

(1) Seal the injection port and column connections.
(2) Remove the injection ports and detectors from all configured analytical lines. (See "8.3 Specifying the Analytical Flow Line Components ([Line Config])".)
(3) Set the column oven temperature to 300°C, and start the GC. (See "11 Creating an Oven Temperature Program" and "7 Starting and Stopping the GC [SYSTEM]".)
(4) Keep the column temperature at 300°C for 2 hours. (See "9 Monitoring the GC".)

Thermal insulation cup

Graphite ferrule with a wire

Column nut (or Column nut of injection port)
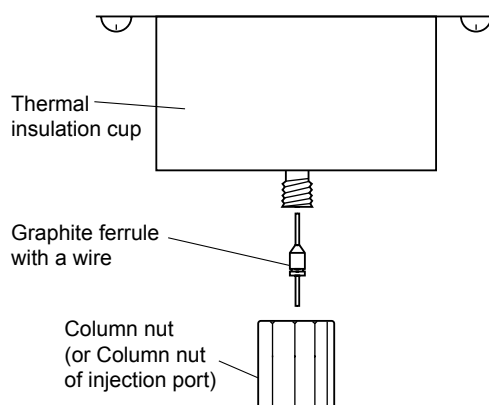
2.6 **Gas supply plumbing**

■ Gas type and supply purity

The following gases and associated purity valves are required to maintain optimal performance of the unit.

For detectors other than FID and TCD, refer to the instruction manual corresponding to each detector.

Carrier gas
- Helium (optimal) purity: 99.995% or more
- Nitrogen (acceptable) purity: 99.995% or more

Makeup gas
- FID
- Nitrogen (optimal) purity: 99.995% or more
- Helium (acceptable) purity: 99.995% or more
- TCD
- Nitrogen purity: 99.995% or more
- Helium puritiy: 99.995% or more
- Argon purity: 99.995 or more

Detector gas
- FID
- Hydrogen purity: 99.995% or more
- Air   Compressed air can be supplied by an oil-free compressor. (must be dehumidified)
-                   Dry air (Oil and organic components eliminated)

For high sensitivity analyses, use gases with a purity of 99.999% or more.

Gas supply pressures
- Carrier gas: 300 - 980kPa
- Make-up gas: 300 - 980kPa
- Hydrogen: 300 - 500kPa
- Air: 300 - 500kPa

The relationship of kPa and bar is as follows
- 100kPa = 1bar

Convert units between kPa and kgf/cm^2 as follows.
- $1kPa = 1.0^2 \times 10^{-2} kgf/cm^2$
- $1kgf/cm^2 = 98.1kPa$

Convert the units between kPa and psi as follows.
- $1kPa = 1.45 \times 10^{-1} psi$
- $1psi = 6.89kPa$

■ **High pressure gas cylinder precautions**

> ⚠ **WARNING**
>
> **HIGH PRESSURE**
>
> Gas cylinders are under high pressure. When handling gas cylinders, instruction and safety measures provided by the gas supplier must be strictly observed to prevent accidents.

General precautions are provided below.
Consult state and local regulations for specific precautions.

Keep gas cylinders away from the lab, preferably outdoors, but not exposed to direct sunlight. The area must be well-ventilated. Use tubing to bring the gases to the lab.
The temperature of gas cylinders must not exceed 40°C. Flammable items must be kept at least 2m from a gas cylinder.
When using high pressure gases, pay strict attention to ventilation, and perform daily leak checks. In particular, when using flammable gases (such as hydrogen), never smoke or allow open flame within 5m of the equipment. Fire extinguishers must be present.
Secure gas cylinders firmly with cylinder clamps so they cannot fall over. Use oil-free pressure valves only. Never use tubing which has contacted oil. When finished with the gas, tighten the main valve of the cylinder immediately.

■ Precautions on handling hydrogen gas

⚠ **WARNING**

HYDROGEN GAS PRECAUTIONS

Hydrogen can explode if it is allowed to accumulate in a poorly venti-
lated area.

1. Connect gas lines correctly. Hydrogen is released into the room if
   the tubing is accidentally connected to the air inlet.
2. When the unit is not in use, close the main valve of the hydrogen
   gas cylinder. Check for leaks at the main valve.
3. Every time the unit is used, check for leaks along the flow line from
   gas cylinder to the unit interior.
4. To prevent an explosion due to a hydrogen gas leak, the room in
   which the unit is used should be well ventilated. Prohibit the use of
   open flame in this room.
5. Close the main valve of the hydrogen cylinder immediately after
   completing the analyses. Then, turn OFF the unit and perform
   normal shut-down procedures.

⚠ **WARNING**

HYDROGEN GAS HANDLING PRECAUTIONS

The accumulation of hydrogen gas inside the column oven can cause
an explosion.
Close all hydrogen pressure regulator valves when not in use, and
seal the column connection.
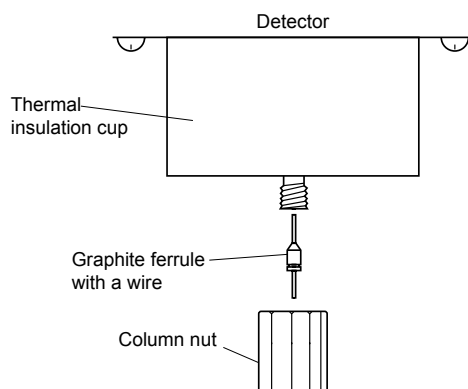
Capping the Detector Fitting.

⚠ **CAUTION**

GAS PLUMBING PRECAUTIONS

The pressure regulator valve will be damaged if pressure above its specifications is applied.
Set the gas inlet pressure within the allowable maximum pressure range.

⚠ **CAUTION**

Hydrogen gas supply precautions

Make sure that the supply pressure to the flow controller does not exceed 500kPa.
If the flow controller fails with a hydrogen gas supply pressure over 500 kPa, a dangerous situation exists. Lange amounts of leaking hydrogen could cause the FID flame to expand out of the detector.

Hydrogen gas is lighter than air. If it leaks, it can accumulate near the ceiling. Pay strict attention to ventilation so that leaking hydrogen is vented out of the room and cannot accumulate.

⚠ **CAUTION**

Supply pressure

When the GC shares gas supplies with other insturmentation, check all instrument specifications in order to provide adequate gas supply pressures for all the instruments.

⚠ **WARNING**

Hydrogen carrier gas precautions

If much hydrogen gas is released into the poorly ventilated room, it may cause the explosion.
1. In order to prevent hydrogen gas accumulate in the room, attach tubes to split vent, purge vent, TCD vent and ECD vent. Discharge the gas to open air or a ventilation equipment (such as the draft chamber).
2. Install the GC in the well ventilated area. (Ex. in the draft chamber)
3. In order to measure hydrogen gas concentration, equip a hydrogen gas sensor in the room. Keep the hydrogen concentration low.

■ **Supply gas tubing**

There are two types connections in the Gas Chromatograph: Type M and Type M connections are located at the main tubing connections in the instrument interior and exterior. The metal fittings contact directly.

Type G connectors, which are used in high temperature areas, are connected by tightening three to five aluminum gaskets between the fittings.
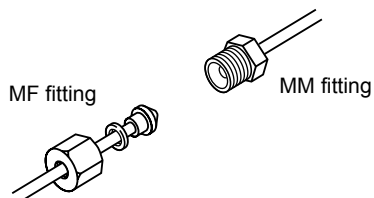
Fig. 2.6.1   Joining Type M fittings
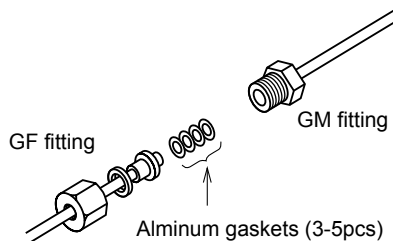
Fig. 2.6.2   Joining Type G fittings

Tightening the tubing connections
   Tools
   2 wrenches 10×12 (standard accessory)
   Use the 12mm wrench for Type M connections and the 10mm wrench for type G connections.
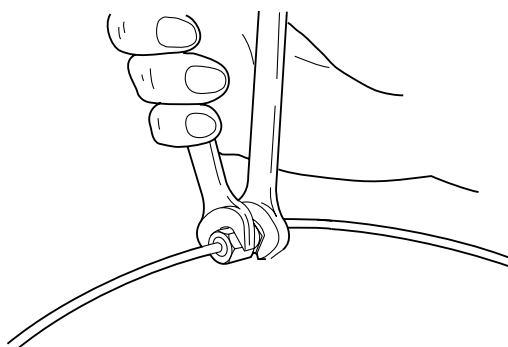
Fig. 2.6.3   Tightening the joints

■ Tubing between the gas cylinder and gas chromatograph
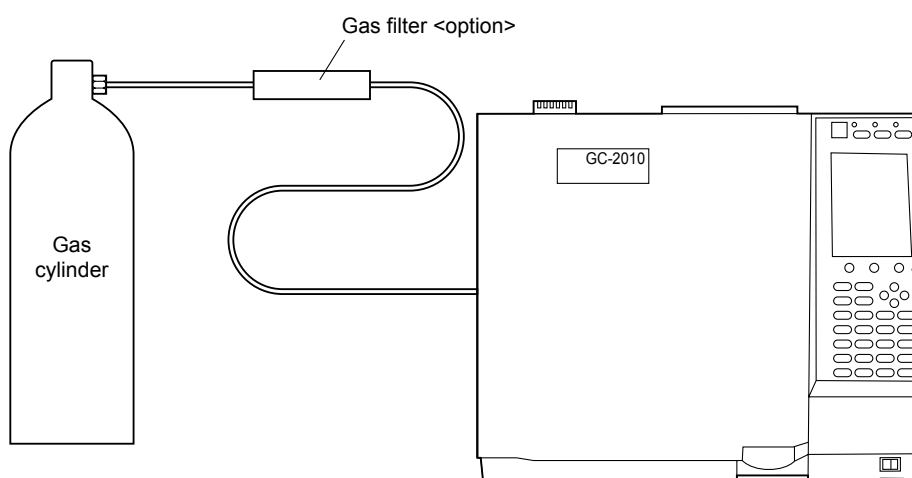
Fig. 2.6.4   Tubing between the gas cylinder and gas chromatograph

Use tubing with a 3mm O.D. and 2mm I.D. between the gas cylinder and gas chromatograph. The use of a gas filter is highly recommended. Contaminated tubing or poor quality gases can interfere with baseline stability.

<Option>   Gas filter (P/N 221-05619-01)
This absorbs organic compounds and moisture in the supply gas, improving its purity. The filter can be regenerated by baking in the GC oven at 250°C with 30mL/min carrier gas purging the filter.
Capacity: Approx. 200mL
Absorbent: Molecular sieve 5A
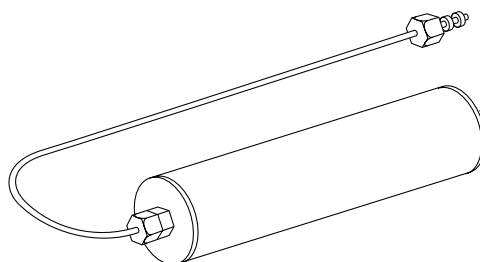
Fig. 2.6.5   Gas filter

■ Gas chromatograph tubing connections

Connections are provided on the rear panel of the unit for connecting external tubing.
They are labeled as follows.

Carrier gas .... CARRIER
Makeup gas .... MAKE UP
Hydrogen .... HYDROGEN
Air .... AIR

<Ex 1> When Carrier gas and Makeup gas are identical
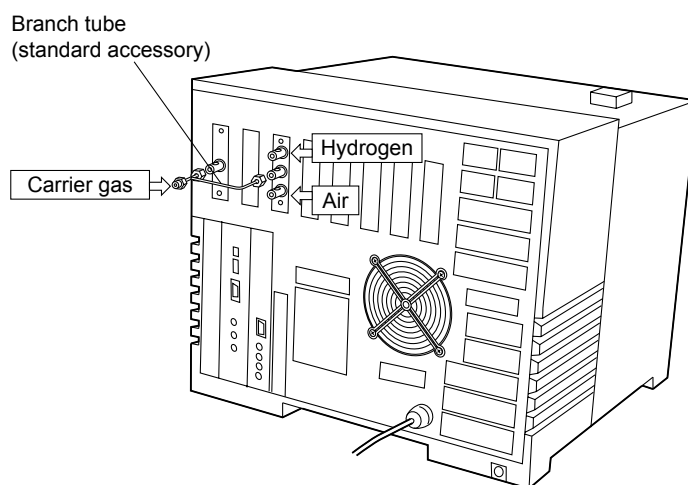
Fig. 2.6.6   When Carrier gas and Makeup gas are identical

<Ex 2> When Carrier gas and Makeup gas are different
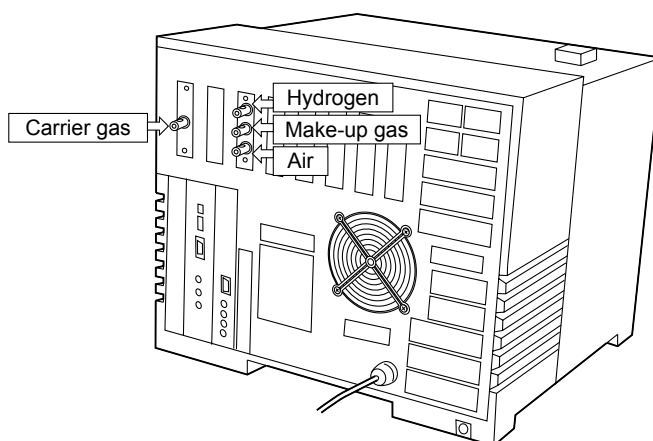
Fig. 2.6.7   When Carrier gas and Makeup gas are different

■ Checking for gas leaks

After plumbing the unit, check for gas leaks according to the following guidelines.

(1) Open the main valve of the gas cylinder.
(2) Adjust the gas supply to the specified pressures.
(3) Check for leaks with leak detecting fluid (option) or soapy water on all connections. Bubbles can be observed if a leak exists.
(4) If a leak is detected:
   • Further tighten the connection, or retighten it.
   • Replace the seal material.
(5) Wipe off the leak detecting fluid or soapy water using a wet cloth. Electronic leak detectors can also be used for hydrogen and helium leaks.

<Option>   "Snoop" Gas leak detecting fluid (P/N 670-11514)
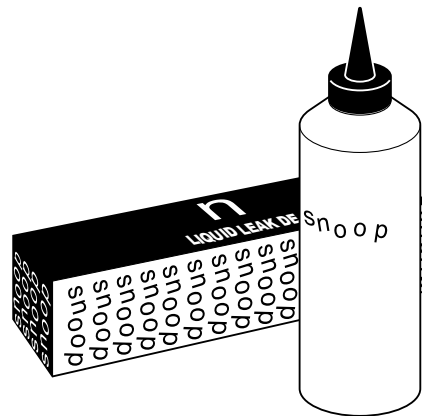
Fig. 2.6.8   Leak detecting fluid

⚠ **CAUTION**

Do not use the leak detecting fluid nor soapy water for gas leak check on the connections above the carrier and detector gas controllers (AFC/APC). The drips may damage the controller.

2.7 Connecting external device cables

■ Connecting the RS-232C cable

Connect the RS-232C cable to its terminal on the rear panel.
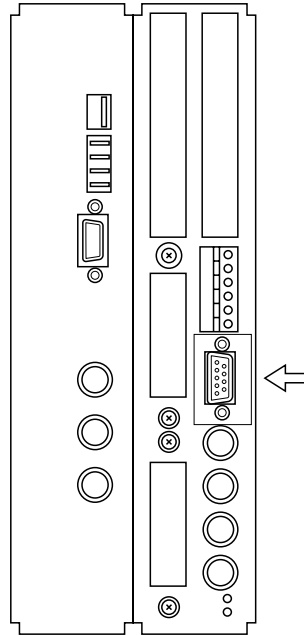
Fig. 2.7.1   Connecting the RS-232C cable

Detector control signal I/O and digital signal output occur through the RS-232C cable.
RS-232C cable connection parameters

- Connection to C-R8A
  Set data transmission parameters to equivalent values between the GC system and the C-R8A.
  Example of C-R8A settings: (For details, refer to the C-R8A instruction manual)
  Make the following settings on the transmission parameter setup screen for "LEVEL 2" and "9,600bps". (CONFIG T (T:TRS) ▽).

PORT	MODE	#No.	BPS
STD2	12917	8	9600

  Power cycle the C-R8A after changing transmission parameters.
  For GC-2010 data transmission parameters, refer to "16.6.5 Setting transmission parameters".
  Input "OPEN GCLC 8,1,1" on the C-R8A keyboard, and press the ENTER key to open the transmission port and start transmission of the detector signal.

  Channel No. of GC (Ch1 in this example)
  OPEN GCLC 8,1,1
  Channel No. of C-R8A (CH1 in this example)

- Connection to the personal computer
  To use GC solution, get GC-2010 transmission parameters to "LEVEL3", "115200bps".

■ Connecting the Chromatopac signal cable

Use the Chromatopac signal cable to send detector analog signals to the Chromatopac (C-R7A plus or earlier models). Connect the 4PIN signal cable to the connector (Ch1 or Ch2) on the rear panel. The START signal between the GC and Chromatopac is communicated through this signal cable. Therefore, there is no need to connect the START OUT terminals on the GC or the Chromatopac.
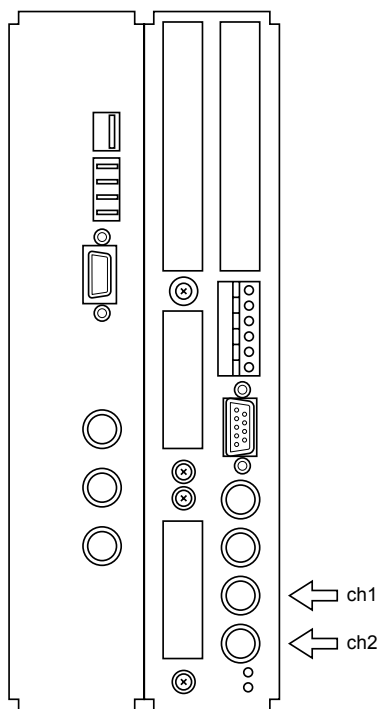
Fig. 2.7.2   Connecting the Chromatopac signal cable

■ Calibration of analog wide range signal

When the GC is connected to the Chromatopac C-R7A/C-R7A plus with a chromatopac signal cable (for analog signals), and the signal type is set to "Wide" on the [DET] key screen, perform a calibration for proper signal transmission. For details of the [DET] key, refer to "13 Detector".

(1) Set the detector controller on the [DET] key screen to "off". (Refer to 13.2.2.)
(2) On the Chromatopac, press the [Win 3] key and type the following:
    LOAD "ZCALIB"
(3) Press the [RUN] key of the Chromatopac.
(4) When "Channel No.(1:CH1, 2:CH2)" is displayed, enter the Chromatopac Channel number (1 for Ch.1, 2 for Ch. 2).
(5) When "Save to disk ? (Y: Yes, N: No)" is displayed, enter "Y".
(6) Set the detector controller to "on".

Check whether the calibration has done correctly as the following procedure, while the GC status is "System On" and the detector is set to "On". (Refer to "7 Starting and Stopping the GC [SYSTEM]" and "13 Detector".)

(1) Set "Signal Attenuation" to "x1".
(2) Press the [Win 1] key and press "F" to set Chromatopac zero level to FREE.
    (Refer to User's manual of Chromatopac.)
(3) Press [Zero adj.] (PF menu) on the screen of [MONIT] key. The detector signal level moves to 0µV. (Refer to "9 Monitoring the GC".)
(4) The signal level on the display of the Chromatopac is within ±50µVe, the calibration has done correctly.

If the calibration was failed, permorm the above-mentioned calibration procedure again.

The maximum difference between the signal level GC and Chromatopac is equal or less than ±5% (±50µV, in case signal level is form −1000 to 1000µV).
In case of SYSTEM Off and/or Detector controller Off, the detector signal level on screen of the [MONIT] key is 0µV but Chromatopac shows −1000µVe when the signal type is "Wide".

NOTE   For correct quantitation, perform this calibration when changing GC's or changing Chromatopac channels.

When the GC and the chromatopac C-R6A or previous models are connected with chromatopac signal cable (for analog signal), the signal type is set to "Linear" on the screen of the [DET] key. The calibration is not necessary.

■ Connecting the GC and Auto injector

NOTE This section describes the connection between the AOC-20i unit and GC-2010, the AOC power cable connection, and the method of turning the AOC on and off. For details of AOC-20 operation, refer to the AOC-20 User's manual.

■ Cable connections

Connect the cables as follows.
The AOC-20 power source is housed within the unit.

READY/START cable

Label 1
Label 2
Label 3
Label 4

Press these buttons when inserting or removing cables.
START OUT/READY IN terminal

RS-232C cable for AOC
Attach the D-sub connector to the RS-232C terminal of the AOC power source, and 6-PIN connector to the AOC terminal of the GC.

AOC cable
Connect the auto injector to INJECTOR 1 for single AOC

Wrap the cable around Ferrite core near the connector (power source side) as shown below.

230V model

Cable   Ferrite core

Fig. 2.7.3

NOTE If the AOC cable is connected to INJECTOR 2, follow the INJECTOR1 procedure. If the AOC-20s sample carousel cable is connected to SAMPLER, attach the ferrite cores on both side of the cable as for INJECTOR1.

■ Turning the AOC power on and off

When usin the AOC-20i with the GC-2010, the AOC power is turned on and off along with the GC power. However, for units with the AOC-20 power supply installed in the GC-2010, turn the AOC-20 on and off from the AOC parameter screen, accessed from the [OPTION] key. (Refer to "15.1 Auto Injector Parameters".)

■ Installing the AOC-20s

(1) Installation the autosampler carousel bracket.
Use four M4 screws to attach the carousel bracket to the top left of the GC-2010.

NOTE Eight holes are available. Use four holes which are marked as in Fig. 2.7.4.

NOTE Fasten the screws tightly to ensure electrical contact. Poor contact may lead to auto sampler carousel operational problems.
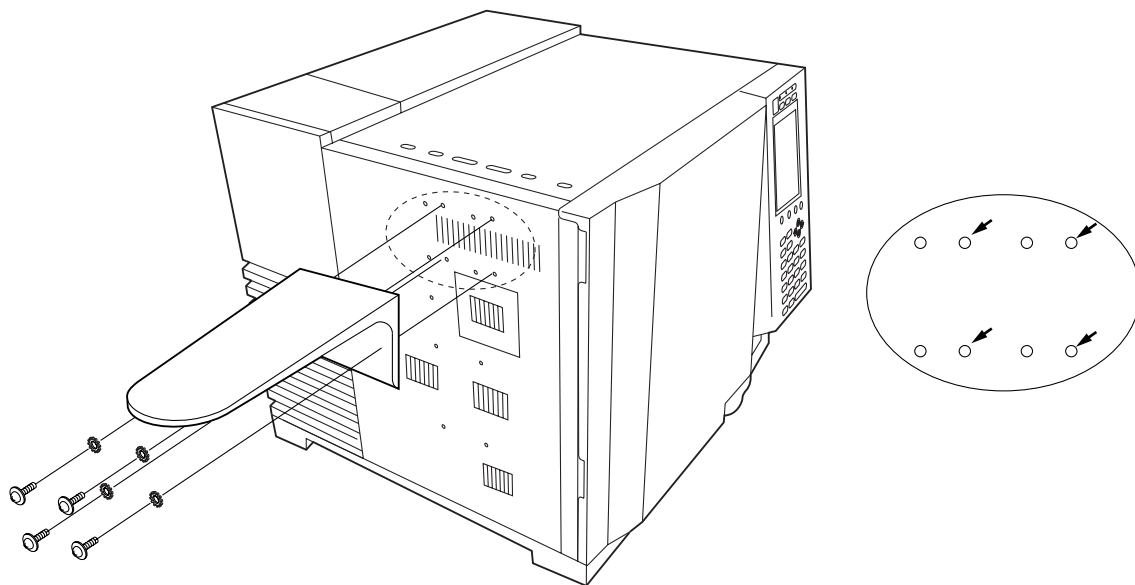
Fig. 2.7.4

(2) Installing the AOC-20s autosampler carousel.
Place the autosampler carousel on the bracket and fasten it with one M4 screw.
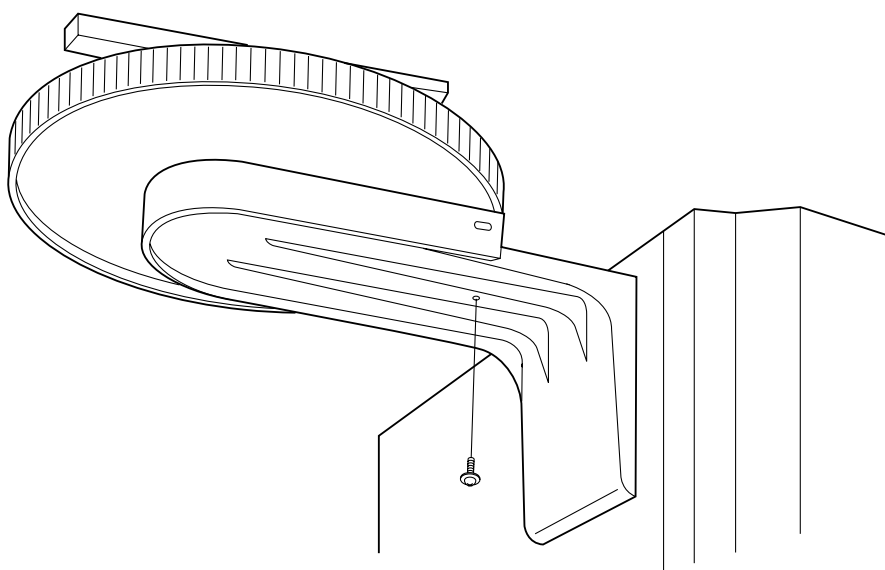
Fig. 2.7.5

■ Connecting the relay terminals

Connect the 8PIN relay cable (P/N 221-48568-91).

The relay terminal can be opened and closed by EVENT91 and 92. (Refer to "16.3 Time Program".)
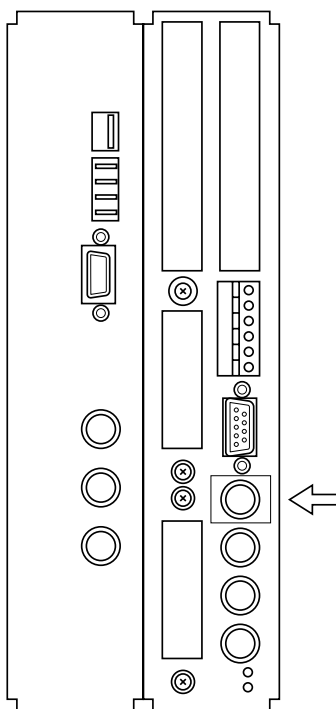
Fig. 2.7.6

EVENT91

Pin No.1 red COM	
Pin No.2 white NC	Conducted to Pin No. 1 COM at EVENT-91
Pin No.3 black NO	Conducted to Pin No. 1 COM at EVENT91

EVENT92

Pin No.4 yellow COM	
Pin No.5 blue NC	Conducted to Pin No. 4 COM at EVENT-92
Pin No.6 black NO	Conducted to Pin No. 4 COM at EVENT92

OPTION

Pin No.7 brown	(GROUND)
Pin No.8 gray	(GROUND)

3.1 AFC and APC Overview

The AFC (Advanced Flow Controller) is an electronic flow controller which sets and controls carrier gas pressures and flow rates based on entered parameters.
The APC (Advanced Pressure Controller) is an electronic flow controller for controlling detector gas pressures. The AUX APC can control the gas pressure of other optional devices.

3.2 **Definition of Terms**

■ Column inlet pressure

Column inlet pressure refers to the injection port pressure.
When set to "0 kPa", the injection port pressure is equal to atmospheric pressure.

■ Total flow rate

Total flow rate is the flow rate controlled by the TFC (Total Flow Controller) located upstream of the injection port.
(Refer to Fig. 3.3.1)

■ Column flow rate

The column flow rate in the GC-2010 gas chromatograph indicates the volume flow rate inside the column converted at the atmospheric pressure and the room temperature, which corresponds to the flow rate measured at room temperature by a flow meter connected to the column outlet.
The column flow rate can be calculated with the following equation:

$$Fc = \frac{60\pi d^4}{256\mu L} \times \frac{(P + P_0)^2 - P_0^2}{P_0} \times 10^3$$

where

Fc : Column flow rate (ml/min) P_0 : Column outlet pressure
d : Column inner diameter (mm)   (= atmospheric pressure) (kPa)
L : Column length (m)   μ : Viscosity coefficient *
P : Column inlet pressure (kPa)   (19.4μPa•sec, helium at 20°C)

   ∗ The viscosity coefficient depends the column oven temperature.

■ Linear velocity

Linear velocity indicates how many cm the carrier gas moves inside the column.
The terms "VELOCITY", "linear velocity" in this instruction manual indicate the average linear velocity inside the column.
The average linear velocity can be obtained with the following equation:

$$V = \frac{K}{\mu} \times \frac{(P + 2P_0)^2 \times P - 0.234}{\{(P + P_0) \times (P + 2P_0) + P_0^2\}}$$

where $K = \dfrac{D^4 \times 10^4}{L}$

V : Average linear velocity

■ Split ratio

For the GC-2010, split ratio refers to $\dfrac{\text{split frow}}{\text{column flow}}$.

3.3　Flow Line Diagram
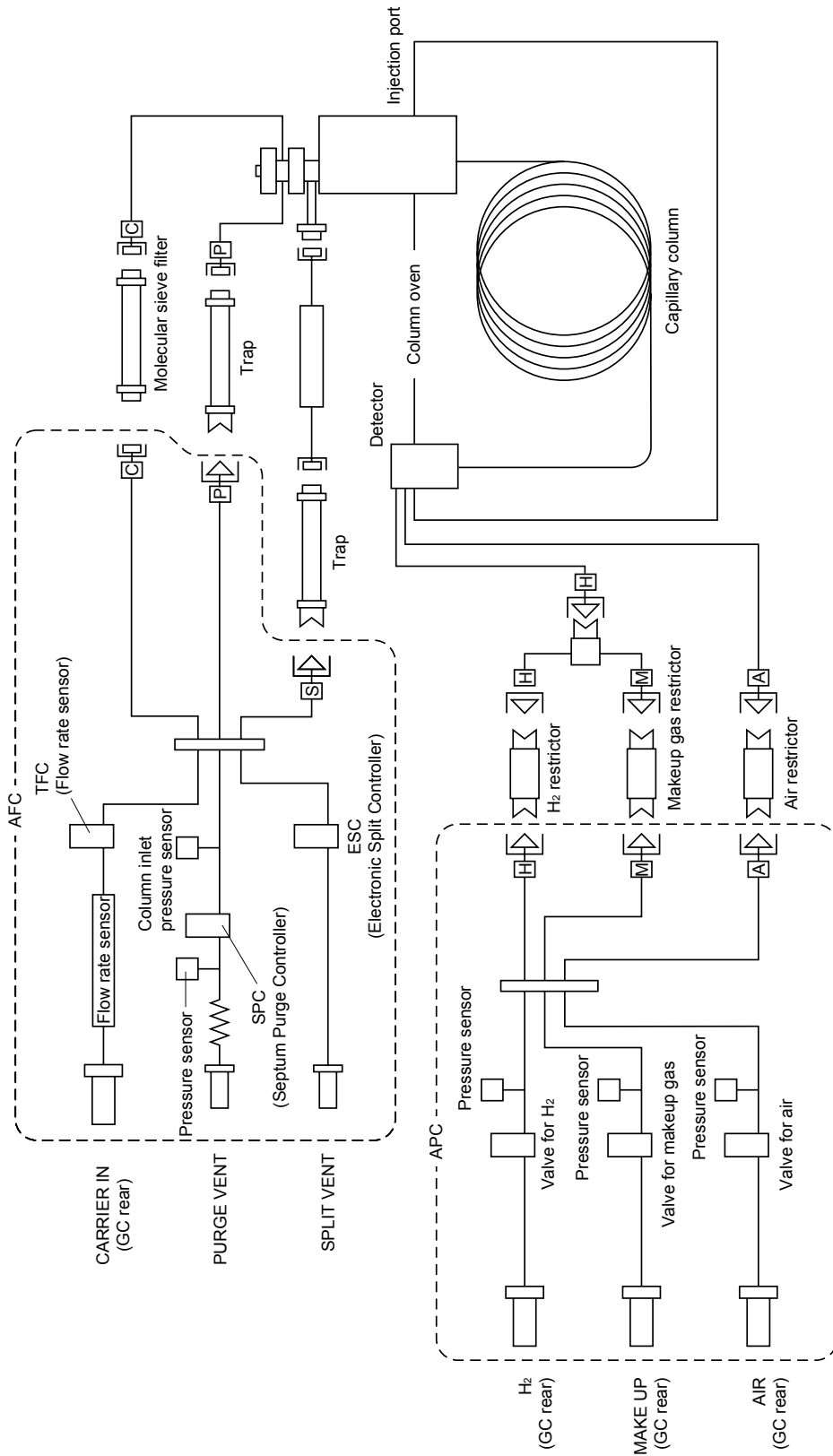
Fig. 3.3.1

3.4 AFC and APC control

3.4.1 AFC Control

AFC Control is illustrated in the following sections.

Split mode Control mode	Split	Splitless	DIRECT[*1]
Pressure	Section 3.4.2	Section 3.4.3	Section 3.4.4
Flow rate	———	———	Section 3.4.4
Linear velocity	Section 3.4.2	Section 3.4.3	Section 3.4.4

3.4.2 Split mode: "SPLIT" (AFC)

The AFC controls the total flow rate to keep it at a constant value. The TFC (Total Flow Controller) inside the AFC feeds back output from the column inlet pressure sensor, which controls the ESC (Electronic Split Controller), which, in turn, controls the column inlet pressure.

Fig.3.4.1 shows the control status with a split ratio of 1 : 40, a velocity of 30 cm/sec, a purge flow rate of 3 ml/min, and a column oven temperature of 50°C.

The column inlet pressure is calculated based on the linear velocity, the oven temperature, the column inner diameter, and the column length, and is automatically set to 49.6 kPa. In the same way, the column flow rate is automatically set to 1.67 ml/min, and the total flow rate is set to 69.8 ml/min (= 1.67 ml/min $\times$ 40 + 3 ml/min (= purge flow rate)).

When the Control mode is set to "PRESS", the column inlet pressure is controlled to remain at 49.6 kPa regardless of the column oven temperature.

When the Control mode is set to "VELOCITY", the column inlet pressure is set to a value which keeps the linear velocity constant despite changes in the column oven temperature. Even if the column oven temperature changes, as in programmed temperature analysis, the linear velocity is always kept constant. Generally, when the column oven temperature increases, the viscosity of the carrier gas also increases, and does not flow as easily.

Regardless of the Control mode, the ESC controls the column inlet pressure and the TFC controls the total flow rate as shown in Fig. 3.4.1.

*1. When WBI Injection is used, do not select Split mode or Splitless mode.

71.6ml/min

TFC
(Total Flow Controller)

CARRIER IN
(GC rear)

Flow rate
sensor

71.6ml/min

49.6kPa

Pressure sensor

Pressure sensor

3ml/min

3ml/min

PURGE VENT

66.9ml/min

SPC
(Septum Purge Controller)

Detector

Injection
port

SPLIT VENT

66.9ml/min

Column oven
(50℃)

1.67
ml/min

ESC
(Electronic Split Controller)

Valve   b   Sensor   a

Valve   b   is controlled so that the value of
sensor   a   remains constant.

Column inner diameter : 0.30 mm
Column length   : 25.0 m
Film thickness   : 0.50   m
Carrier gas   : He
Split ratio   : 40 = 66.9 ml/min / 1.67 ml/min
                         (split flow rate)(column flow rate)

Fig. 3.4.1   Split control

3.4.3 Split mode: "SPLITLESS" (AFC)

The control method changes only during the sampling time. During sampling time, the AFC controls the TFC (Total Flow Controller) so that the output from the column inlet pressure sensor becomes constant, and then controls the column inlet pressure.

After the sampling time, the AFC controls the total flow rate to keep it at a constant value using the TFC (Total Flow Controller) inside the AFC. As in split mode, the ESC (Electronic Split Controller) is controlled to maintain the column inlet pressure constant.

Figure 3.4.2 shows the control status during the sampling time with a split ratio of 1:40, a velocity of 30 cm/sec, a purge flow rate of 3 ml/min, and a column oven temperature of 50°C. The column inlet pressure is calculated based on the linear velocity, the oven temperature, the column inner diameter, and the column length, and is automatically set to 49.6 kPa. In the same way, the column flow rate is automatically set to 1.67 ml/min.

When the sampling time expires, control is identical to the split mode, shown in Fig. 3.4.1

When the Control mode is set to "PRESS", the column inlet pressure is controlled to remain at 49.6 kPa regardress of the column oven temperature.

When the Control mode is set to "VELOCITY", the column inlet pressure is set to a value which keeps the linear velocity constant despite changes in the column oven temperature. Even if the column oven temperature changes, as in programmed temperature analysis, the linear velocity is always kept constant. Generally, when the column oven temperature increases, the viscosity of the carrier gas also increases, and does not flow as easily.

Regardless of the Control mode, the ESC controls the column inlet pressure and the TFC controls the total flow rate as shown in Fig. 3.4.1. (after the sampling time).
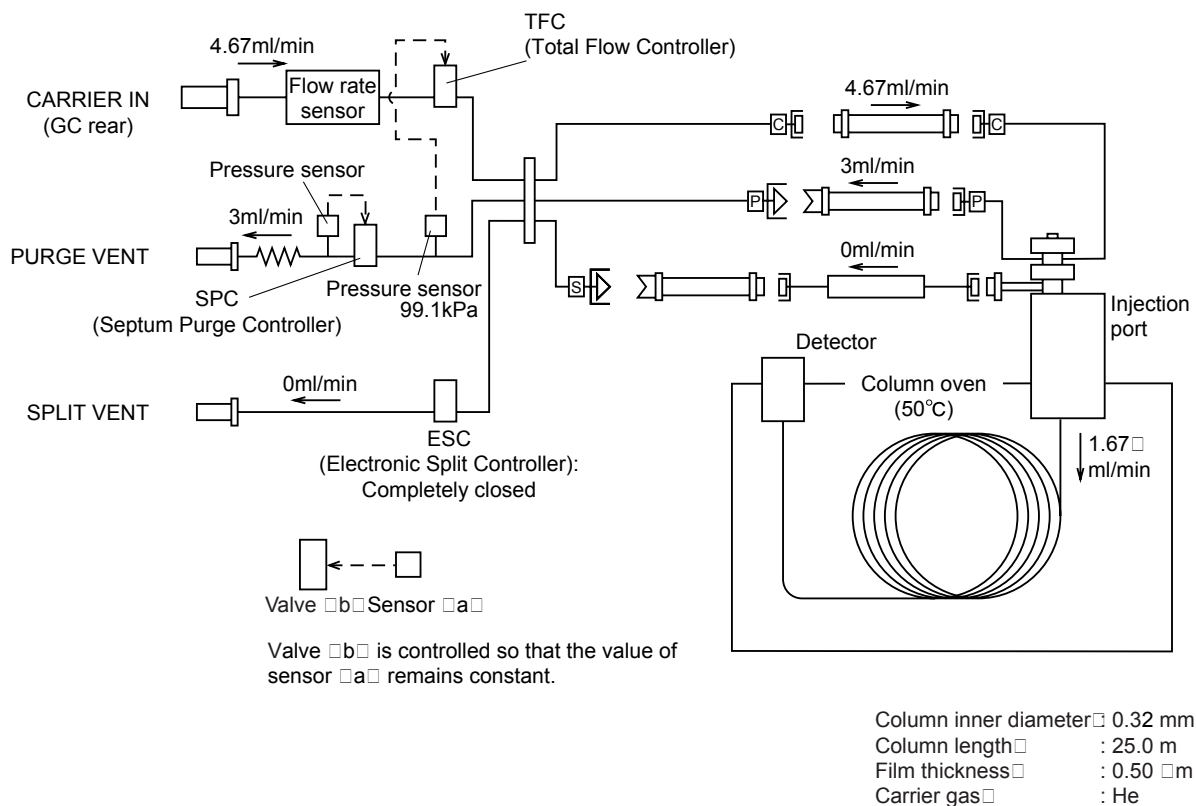
Fig. 3.4.2   Splitless control (during sampling time)

3.4.4 Split mode: "DIRECT"

The AFC offers three types of DIRECT mode, FLOW, PRESS and VELOCTY.

When the Control mode is set to "FLOW", the TFC controls the total flow rate as shown in Fig. 3.4.3. At that time, the column inlet pressure varies depending on the column type, the purge flow rate and the column oven temperature.

When the Control mode is set to "PRESS", the AFC controls the TFC (Total Flow Controller) to keep the column inlet pressure constant. The control method is equivalent to the sampling time in SPLITLESS mode. The control diagram is shown in Fig.3.4.2

When the Control mode is set to "VELOCITY", the column inlet pressure is set to a value which keeps the linear velocity constant despite changes in the column oven temperature. Even if the column oven temperature changes, as in programmed temperature analysis, the linear velocity is always kept constant. Generally, when the column oven temperature increases, the viscosity of the carrier gas also increases, and does not flow as easily.
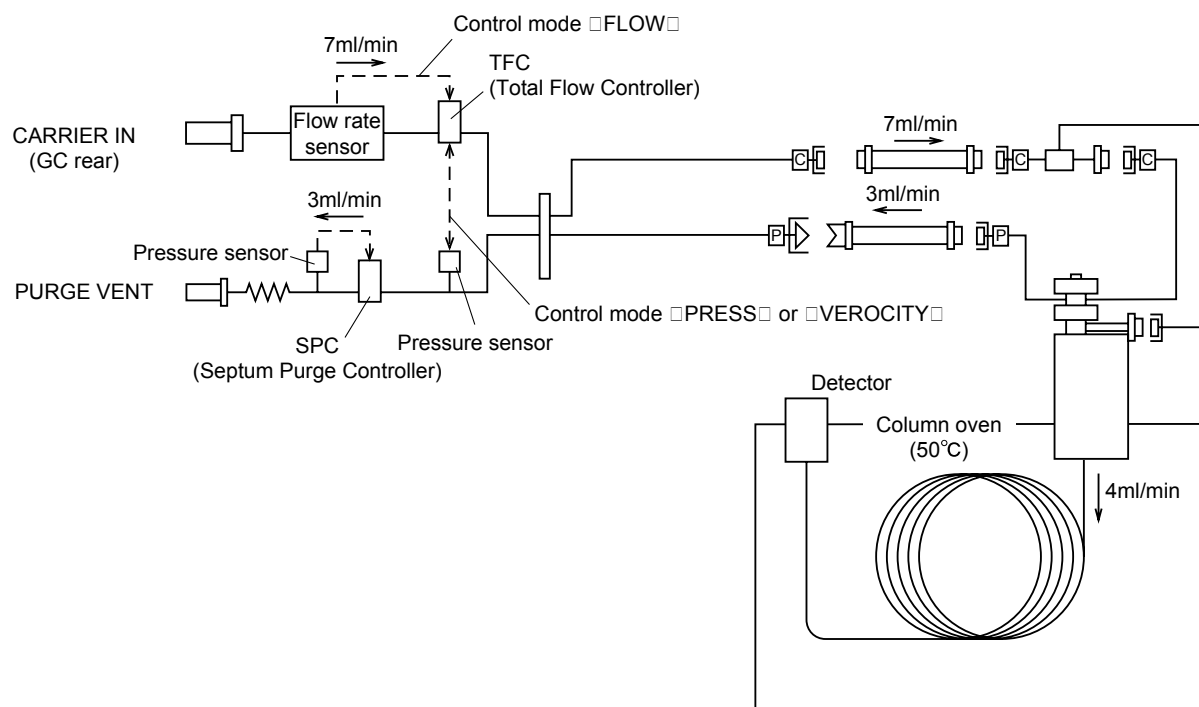
Fig. 3.4.3   Direct Control

3.4.5 Control by APC

The APC performs its control as illustrated in the figure below.
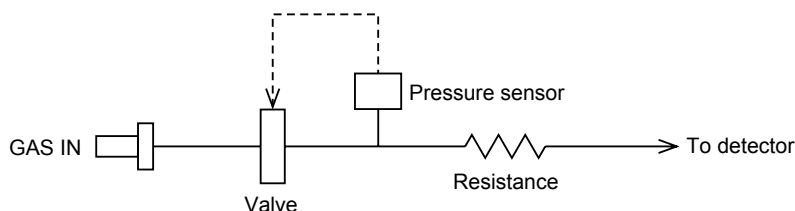
Fig. 3.4.4

As shown in Fig.3.4.4, the APC controls the pressure.
The flow rate is calculated based on resistance and pressure.
For example, for a flow rate of 400 ml/min of air, the pressure is controlled and set to approximately 61 kPa based on the pressure-flow rate characteristics of air stored in the memory of the GC-2010. (Refer to Fig. 3.4.5)
The resistance depends on the detector type and the gas type (air, hydrogen or makeup gas).
Fig.3.4.5-3.4.8 show the pressure-flow rate characteristic curves of the standard restrictor.
AUX APC offers "PRESS" and "FLOW" mode.
When the Control mode is "PRESS", AUX APC controls the pressure as shown in Fig.3.4.4.
When the Control mode is "FLOW", the pressure is calculated based on the set flow rate, calculated from the restrictor inner diameter, and length. (Refer to column flow rate in "3.2 Definition of Terms".) The equation in 3.2 is accurate when the flow in the restrictor is layer. Therefore, the flow rate accuracy depends on the restrictor used.

Fig. 3.4.5

H₂

Fig. 3.4.6

Makeup gas (FID)

Fig. 3.4.7

Makeup gas (TCD)
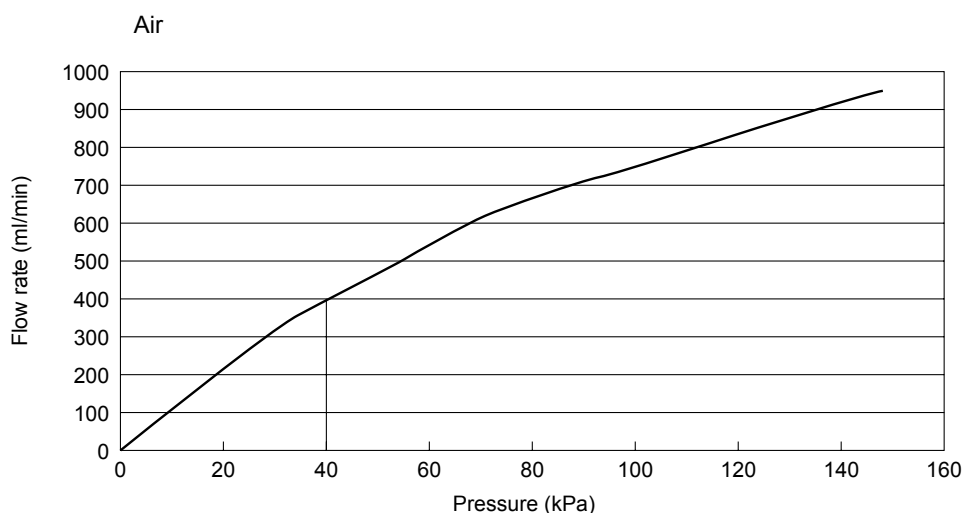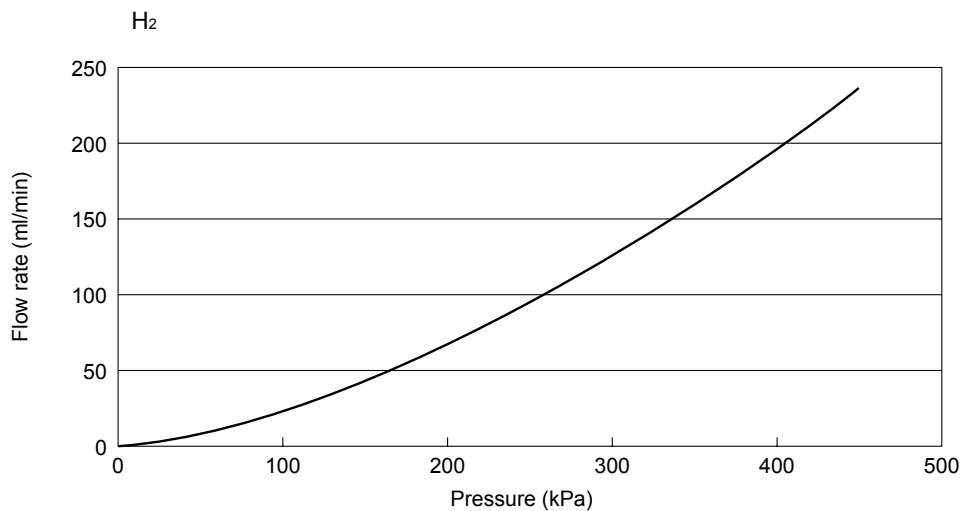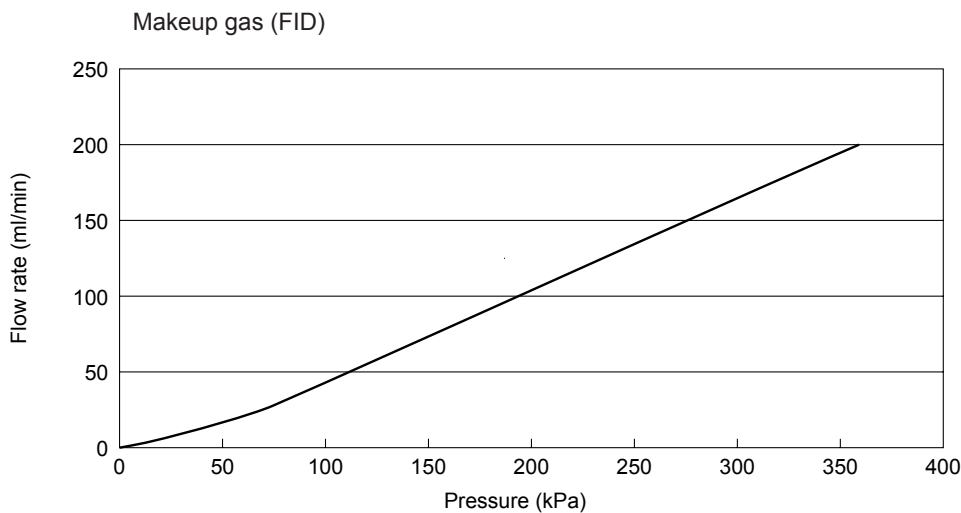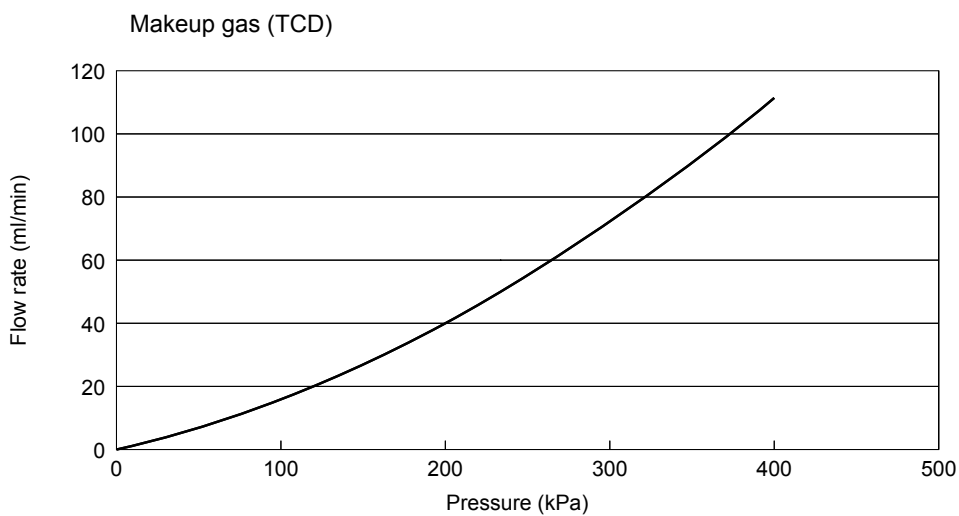
Fig. 3.4.8

3.5 AFC and APC Control Ranges

For the AFC, the column inlet pressure can be set from 0 to 970 kPa, and the total flow rate can be set to 0 to 1,200 ml. (Refer to Figs. 3.5.1 and 3.5.2.) However, these values are instrument specifications, valid when the primary pressure supplied to the GC-2010 is 980 kPa.

The allowable pressure and flow rate settings are limited by the primary pressure, as shown in Fig.3.5.1, Fig.3.5.2. In addition, the pressure settings are limited by the column type and the purge flow rate.
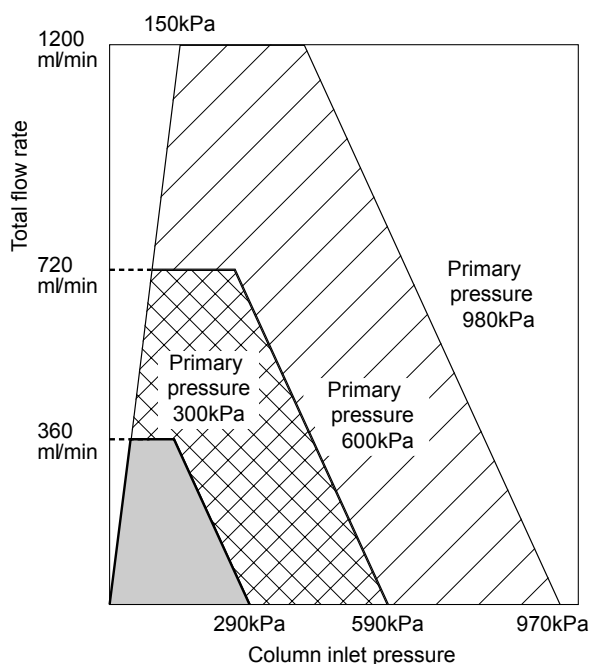
Fig. 3.5.1   Available setting ranges (He, H_2)
0-1ml/min, 0-1kPa is not a valid setting
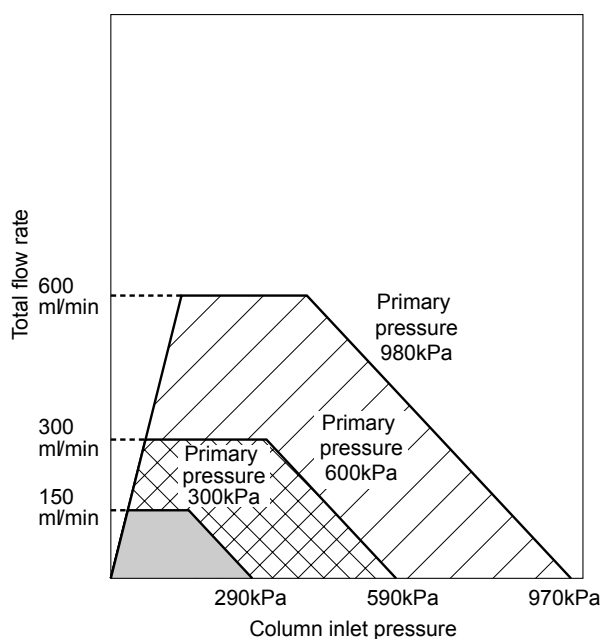
Fig. 3.5.2   Available setting ranges (N_2)
0-1ml/min, 0-1kPa is not a valid setting

NOTE   When options are added to the flow line, the range above becomes narrow.

The allowable pure flow rate setting depends on the column inlet pressure. Figure 3.5.3 shows the range of purge flow rates permitted.
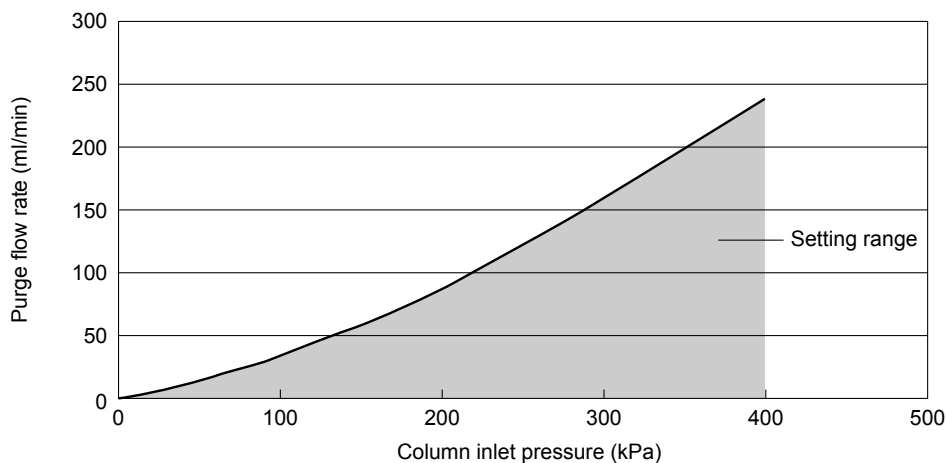
Fig. 3.5.3

Allowable APC settings are shown below, for a supply pressure of 500 kPa. (When the supply pressure is less than 500 kPa, the available maximum flow rate decreases proportionally.) When the set value is more than the set range, displayed values may not be accurate, or APC cannot control the flow.

Air (detector = FID) : 0 to 1,000 ml/min
H_2 (detector = FID) : 0 to 200ml/min
Makeup gas (detector = FID) : 0 to 100ml/min
Makeup gas (detector = TCD) : 0 to 20ml/min

3.6 AFC and APC Offset Calibration

The AFC and APC pressure and flow rate sensors can be calibrated (zeroed).
This calibration is required to correct minute deviations of the sensor values which may occur after long periods of use. If the sensor values deviate, "0.5 kPa" or "0.5 ml/min" could be displayed, for example, even through there is no actual pressure of flow. When data reproducibility is important, perform the offset calibration.
For the AFC, perform the offset calibration using the following procedure.
(In the case of WBI analysis, remove the WBI column from the injection port before the following procedure. After the proceduce attach the column to injection port as before.)

(1) Press[SYSTEM]key, toggle key, PF1 key, and change "Start GC" to "Manual Start"(refer to Fig.3.6.1 or 3.6.2).
If "Manual Start" was already set, proceed to the next step.

(2) Turn off the power. Wait until the column oven, the injection port and the detector have cooled down to 50°C or less.

(3) Turn on the power. Wait for approximately 1 minute.

(4) Press the [FLOW] key once and the toggle key twice, in that order. Then, the Fig. 3.6.2 opens.

(5) Press the PF2 key. The message "Zero Calibration Start" appears at the bottom of the monitor. Approximately 10 seconds later, the message "Zero calibration completed" appears. Calibration of the AFC is complete.

(6) Return the "Start GC" setting to its original status.

| NOTE | Refer to "5 Basic Key Operation". |

Fig. 3.6.1

```
Flow  CAR1            NOT READY
INJ1  LINE1                   On
Inlet press(kPa)    0.0    100.0
Column flow(ml/min) 0.00    4.62
Liner vel(cm/s)     0.0     62.2
Split ratio         0.0     -1.0
Total flow(ml/min)  0.0     50.0
Split mode                 SPLIT
Control mode               PRESS
Carrier gas type              He



Advanced | Offset |Next Flow
```
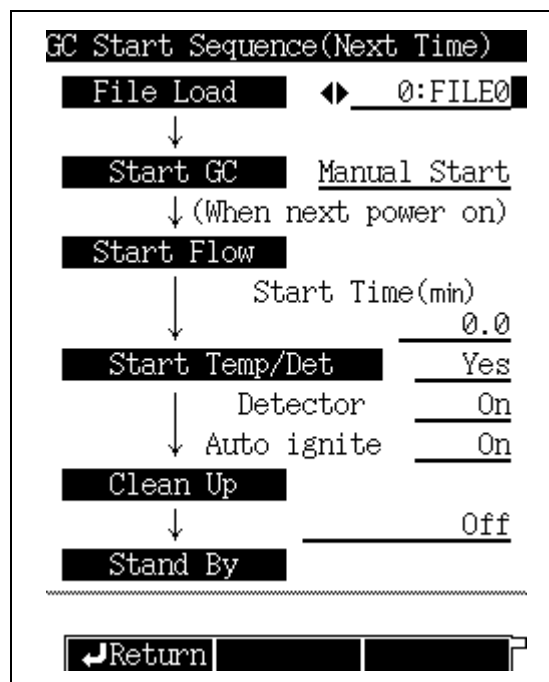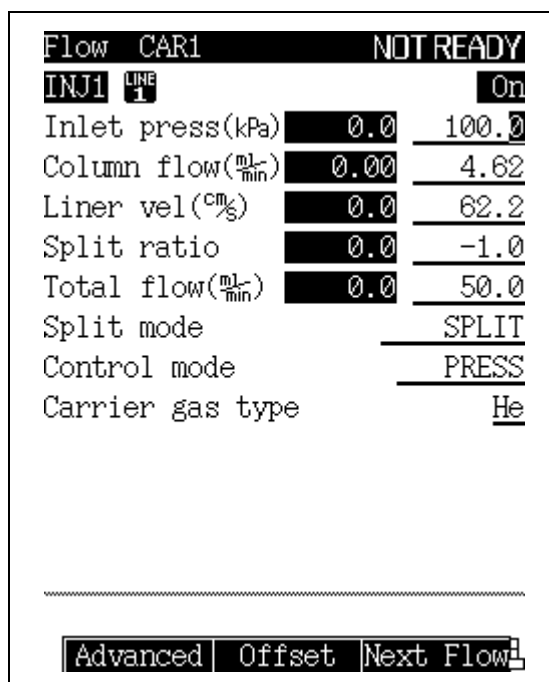
Fig. 3.6.2

Perform the offset calibration of the APC using the following procedure.

(1) Press[SYSTEM]key, toggle key, PF1 key, and change "Start GC" to "Manual Start" (refer to Fig.3.6.1 or 3.6.2).
    If "Manual Start" was already set, proceed to the next step.
(2) Turn off the power. Wait until the column oven has cooled down sufficiently.
(3) Turn on the power. Wait for approximately 1 minute.
(4) Press the [DET] key, the [PF2] key and the toggle key, in that order. The screen shown in Fig. 3.6.3 opens.
(5) Make sure that flow monitors of each gases do not change. When they change, wait for a while. Press the PF2 key. The message "Zero calibration Start" appears at the bottom of the monitor. Approximately 10 seconds later, the message "Zero calibration completeds" appears. Calibration of the APC is complete.
(6) Return the "Start GC" setting to its original status.

Fig. 3.6.3

4. *1* Capillary Column Overview

Two types of columns can be installed in a gas chromatograph.

The first type, the capillary column, chemically fuses the liquid phase to the interior of the column wall.
The other type, the packed column, fills the interior of the column with packing material, with the liquid phase coating the particles. This type of column is becoming obsolete.

Fused silica, chemically bonded, capillary columns are in wide use today, this chapter describes capillary column installation in a split/splitless injection system. Analytical conditions, as well as the analytes, determine the column selection.
Column vary in length, polarity, film thickness, and inner diameter.

4.2 **Location of Heated Zones**

The capillary column can be installed in the following heated zones.

Injection port   6−8 (Normally installed in 7)
               If 8 is selected, an auto injector cannot be installed.
Detector   1−4 (Normally installed in 4)

Top view
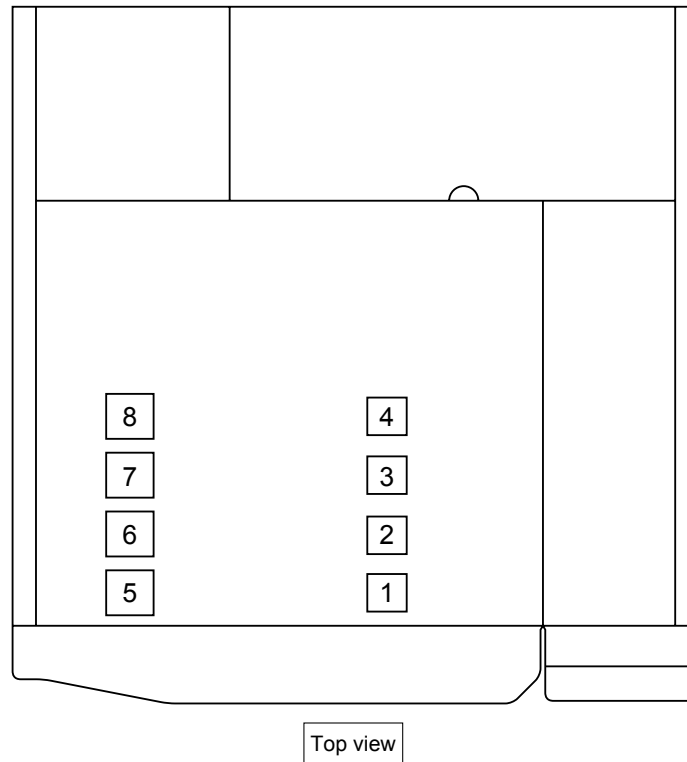
Fig. 4.2.1   Location of heated zones

4.3 Installing the column hanger

Insert the column hanger into hanger slots inside the column oven as shown.
The hanger is a standard accessory.
Squeeze the top of the hanger in order to insert in the slots.
When one hanger is installed, insert it in the back slots. Install two hangers in both the front and back slots.

Column hanger
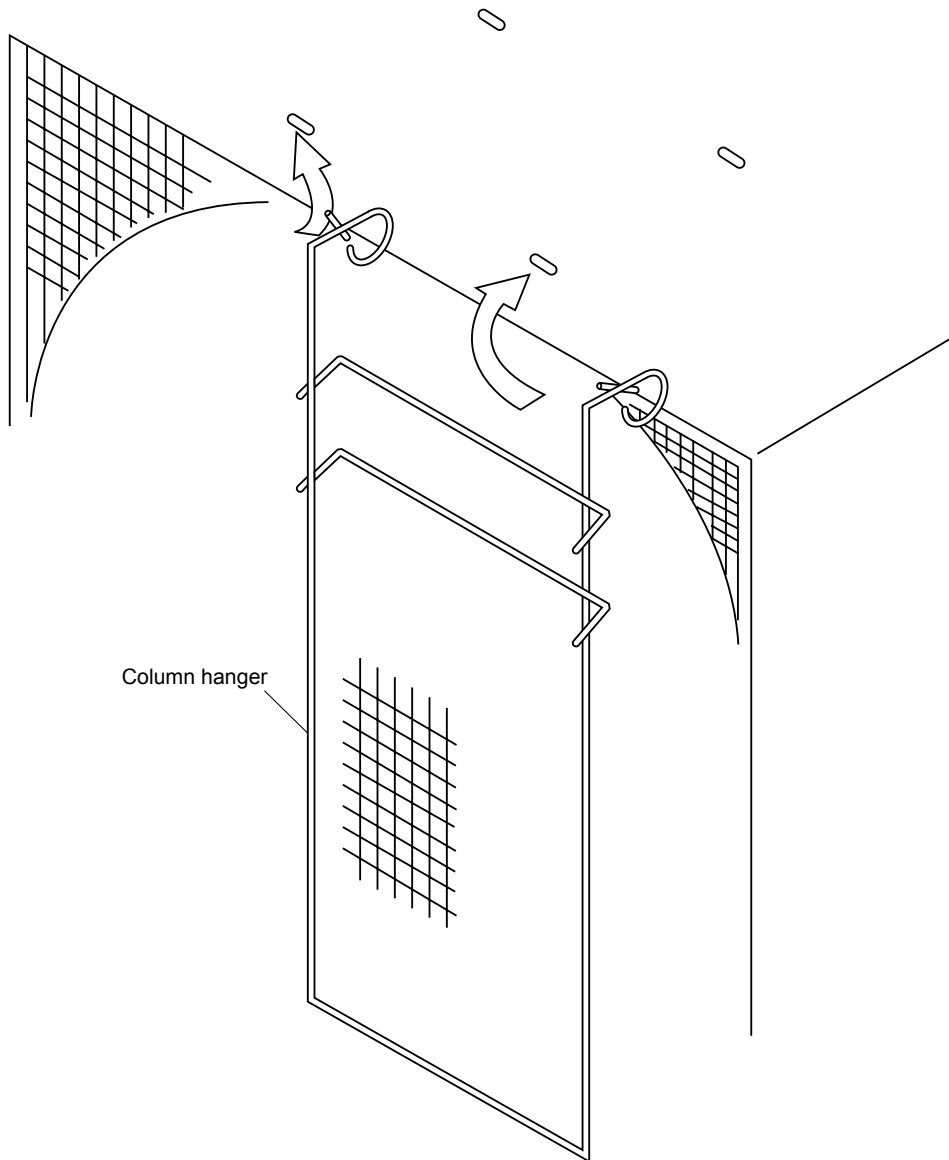
Fig. 4.3.1

4.4 Proper Placement of graphite Ferrules

⚠ **WARNING**

Wear safety glasses when handling the capillary column, to prevent eye injuries

---

4.4.1 Placing graphite ferrules on the column

Graphite ferrules are required for proper sealing. Follow these procedures to place one ferrule at each end of the capillary column.

The graphite adjuster marked with an "S" or "F" to indicate whether it is for the injection port or detector side.

{ S: For Split/spiltless injection port
{ F: For FID (detector)

(1) Remove the wire from a new graphite ferrule. Slide the graphite ferrule on the capillary column.

Graphite ferrule

Wire that comes with new ferrules

Slide ferrule on to capillary column
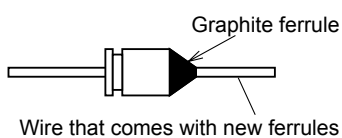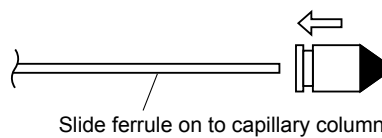
Fig. 4.4.1   Fig. 4.4.2

(2) Pull the capillary column through the column insertion jig so that 10 mm of column protrudes. Tighten the column nut to fasten the ferrule to the column at that position (tighten the column nut by hand, then 3/4 turn further with two wrenches in opposition).

10mm

Column injection jig
Fasten the ferrule at this position
Column nut
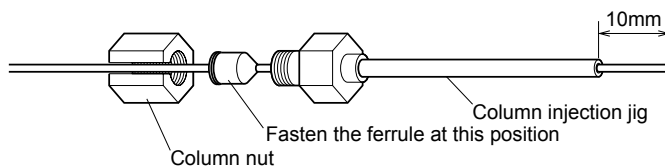
Fig. 4.4.3

(3) Because graphite may be present on the column end, the column must be clipped as shown below.

(a) Clip the column so it is flush with the and of the jig.

Clip the column here
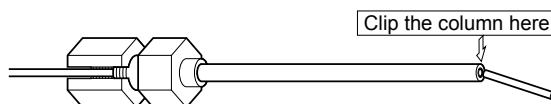
Fig. 4.4.4

(b) The edge of the cut must be completely straight.

○

×
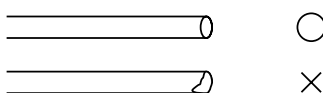
Fig. 4.4.5

NOTE Use only capillary column scoring tool to clip the column. (P/N 221-50595-91)

(4) Remove the slipped graphite with tweezers, etc. At that time, be careful not to damage the capillary column.
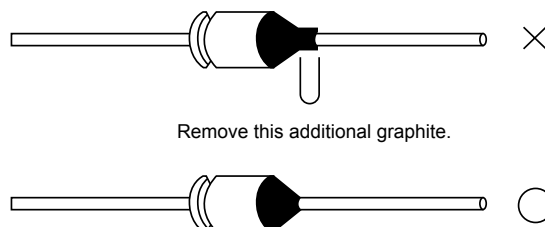
Remove this additional graphite.

Fig. 4.4.6

NOTE Graphite which becomes lodged under the adjuster must be removed from the column. If alolowed to remain, the graphite could clog the capillary adapter. If this occurs, unclog the adapter with compressed air or a thin wire.

4.4.2 Positioning the graphite ferrule

Position the ferrules as shown below (Fig. 4.4.7).
If the adjusters were used to fasten the ferrules to the column as described in the previous section, the ferrules should already be in the proper location.
In the split injection method using the wide bore column, fix the graphite ferrule at a place 15mm from the column end. The ferrule adjuster included in the accessories is not available for this case.
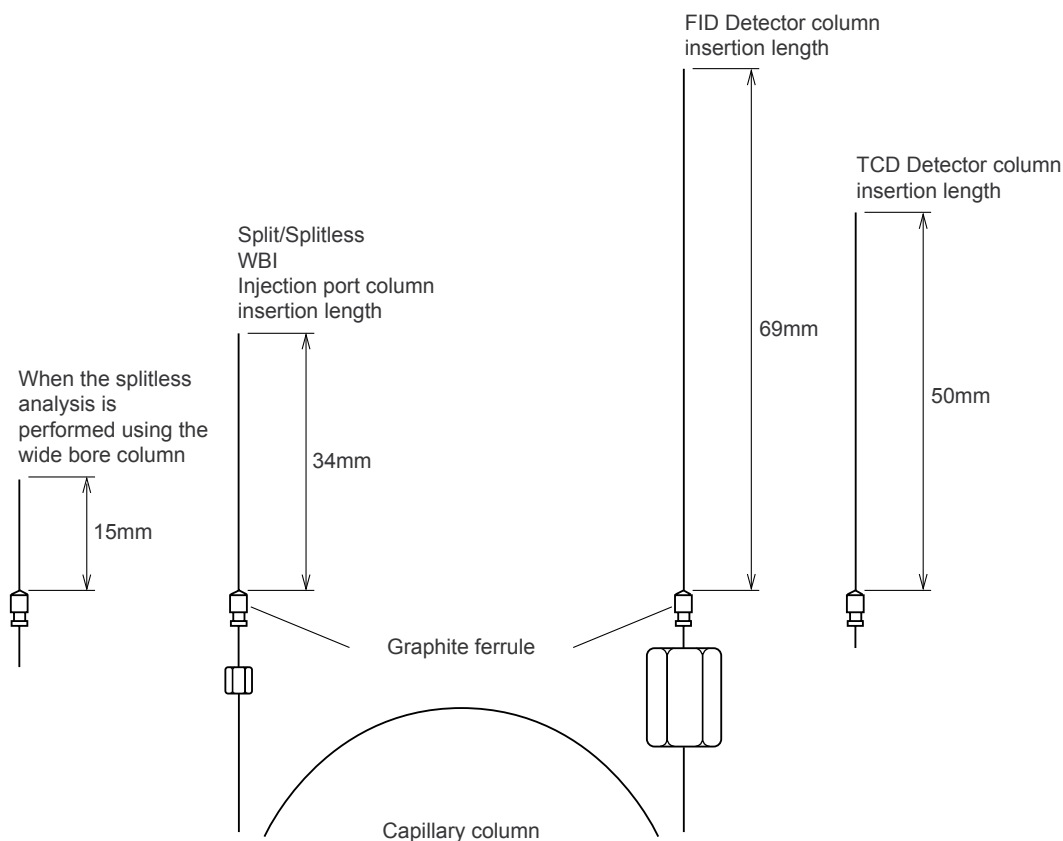
Fig. 4.4.7   Attaching position of graphite ferrule

4.*5* **Installing and removing the capillary column**

⚠ **WARNING**

Do not install or remove the capillary column until the temperature of the column oven, injection port and detector have dropped below 50°C. Danger of burns.

4.5.1 **Installing the capillary column**

(1) Attach the capillary column to the column hanger.
(2) Connect the capillary column to the injection port and the detector.
Note the following items during column installation:
(a) Do not force the column to bend too far.
(If the column does not reach the injection port or the detector, unwind a loop of the column.)
(b) Ensure that the capillary column does not touch the oven wall.

NOTE Tighten the column nuts first by hand, then an additional half turn by wrench.

4.5.2 **Removing the capillary column**

Remove the capillary column according to the following procedure.
If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The heated zones wil begin to cool down. Press the [MONIT] key, and ensure that the temperatures of the injection port, the detector and the column oven are 50°C or less. Press the [FLOW] key, and select [Off] (PF menu) to turn off carrier gas flow. It is now safe to remove the column.
Remove the capillary column by reversing the procedures described in "1. Installing the capillary column".

5.1 Keypad Description and Operation

The keypad functions control the unit, and displays the operational status.

STATUS/ TEMP/ FLOW lamp	Indicates the status of the entire GC, the heater and the flow controller, respectively.
START/ STOP key	Starts/stops analysis.
SYSTEM key	Starts/stops the GC.
DIAG key	Executes and allows diagnosis settings.
Screen	Displays 16 lines of information at a time on the large display area.
SET key	Displays the list of frequently accessed items.
PF key	Selects "PF (programmable functions)" displayed at the bottom of the screen.
MONIT key	Monitors the GC status and the chromatogram.
Toggle key	Toggles among PF items displayed.
FUNC key	Displays items which are not frequenty used.
Toggle key + Cursor keys	Sets On/Off of backlight and adjustment of contrast.
UNIT keys	Displays the setup screen for the zone indicated on the key.
Cursor keys	Moves the cursor up, down, left and right respectively.
Numeric keys	Inputs numeric values.
HELP key	Explains currently displayed items.
ENTER key	Validates input or selection.
CE key	Clears a numeric input or error.

5.1.1   Keypad operation

The keypad is used to operate the system and make parameter settings. The table below shows the function of each key.

Name	Function
START key	Starts the temperature program, pressure/flow rate program and time program. If a Pre-Run program is set, the Pre-Run program starts.
STOP key	Stops the program.
DIAG key	Performs unit self-diagnosis. Also, used for maintenance functions such as confirmation of various logs, part replacement status, and standard signal out put.
SYSTEM key	Starts/stops GC. Manages the analytical condition file.
PF key	Selects the PF menu displayed at bottom of the screen. (PF = programmable function)
Toggle key	Toggles through the PF menu displayed at bottom of the screen.
MONIT key	Monitors the GC status and analysis status. Displays the GC temperature, pressure and flow rate status for each heated zone, as well as chromatograms.
SET key	Accesses commonly-used items, such as temperature, pressure and flow rate for each component on one screen. Manages the analytical condition file like the [SYSTEM] key.
FUNC key	Accesses less frequently used items.
COL key	Sets the oven temperature program.
FLOW key	Sets the carrier gas flow rate parameters, such as pressure, flow rate and split ratio.
INJ key	Sets the temperature of injection port (or temperature program for an OCI/PTV).
DET key	Sets the detector temperature, range and current or other detector-related parameters.
OPTION key	Sets the parameters for optional units, such as an auto injector or CRG.
HELP key	Describes the procedure and sugggests valid parameter ranges. Jumps to a desired item using an index function.
Cursor key [△], [▽], [◁] and [▷]	Moves cursor up, down, left and right. A blinking cursor indicates the location of parameter value entry. [◁] and [▷] keys may be used to change the selection.
Numeric keys [0] ~ [9]	Enter numeric values.
Clear key [CE] key	・Clears the current numeric value. ・Clears display and alarm during an error.
ENTER key	Validates parameter input or item selection.

5.1.2   Screen

The areas of the 16-line screen display a variety of items. These items are divided by lines on the screen.

If all items cannot be displayed on one screen, " △ " and " ▽ " are displayed in the message line. Scroll through the screen by moving the cursors.

Displays the screen title and the GC status ("READY", "NOT READY" or "RUN" etc.).

Displays a message or error about the operating procedure.

Displays the menu selected by the [PF] key.
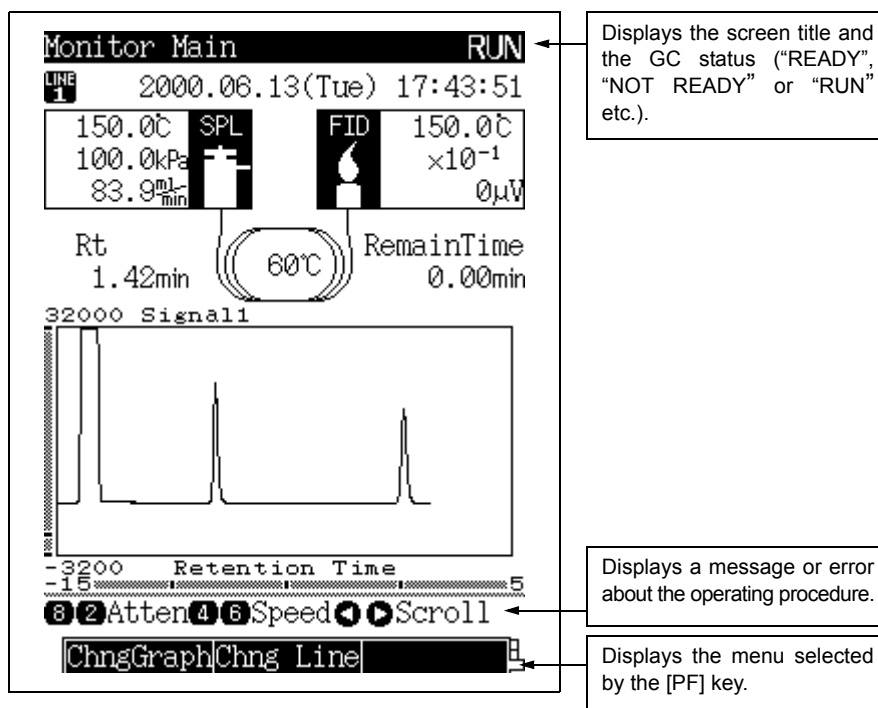
Fig. 5.1.1

■ [Return] (PF menu)

[Return] (PF menu) displayed in the PF menu line returns the display to the previous screen. [Return] (PF menu) is displayed in PF1.

■ Actual and set values

Actual (current) values are highlighted, while set values are underlined. The actual value blinks when it is NOT READY (the actual value has not reached the set value). When the values are equal (READY status), the actual value stops blinking.

Actual values   Set values
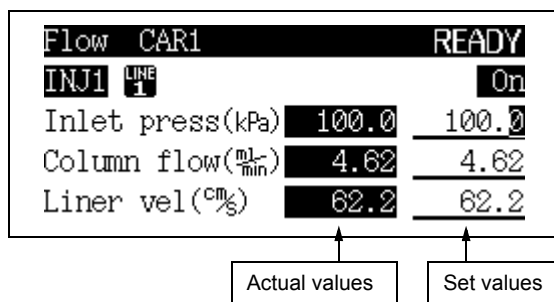
Fig. 5.1.2

5.1.3 Status indicators

Three status lights indicate the GC status regardless of the screen display. The STATUS, TEMP and FLOW lights indicate the GC status, the temperature control status and the gas control status, respectively. Light color and illumination are also used to indicate instrument parameter status.

■ STATUS indicator

Color	Status	Meaning
Off		Power is OFF.
Green	On	System is ready.
	Blinking	Program, like the temperature program, are executing.
Yellow	On	System is OFF. Alternatively, the system is ON, but is not ready.
	Blinking	Diagnosis, baking or flow controller calibration is being executed.
Red	On	An error has occurred in system.

■ TEMP indicator

Color	Status	Meaning
Off		Temperature control is not performed.
Green	On	All temperature controlled zones are ready.
	Blinking	Temperature program is running.
Yellow	On	One of the temperature controlled zones is not ready.
	Blinking	Temperature program is finished, and system is being cooled.
Red	On	An error related to temperature control has occurred.

■ FLOW indicator

Color	Status	Meaning
Off		Gas control is not performed.
Green	On	All gas control lines are ready.
	Blinking	Pressure/flow rate program is running, it is sampling time, or high pressure injection is occurring.
Yellow	On	One of the gas control lines is not ready.
	Blinking	Pressure/flow rate program is finished, and default values are being set.
Red	On	An error related to gas control has occurred.

5.2 Adjusting The Display

Turn the backlit LCD display on and off by pressing [Toggle] + [▽] to turn it off and [Toggle] + [△] to turn it on.

When the keypad is not in use, turning the backlit LCD display off is recommended, to prolong the life of the display.

The display turns off automatically with the backlit display saver (See "16.6.11 Other Settings"). When the display turns itself off, turn it back on by pressing any key.

To adjust the contrast the contrast, stand in front of the screen and press the [Toggle] + [◁] or [▷] keys.
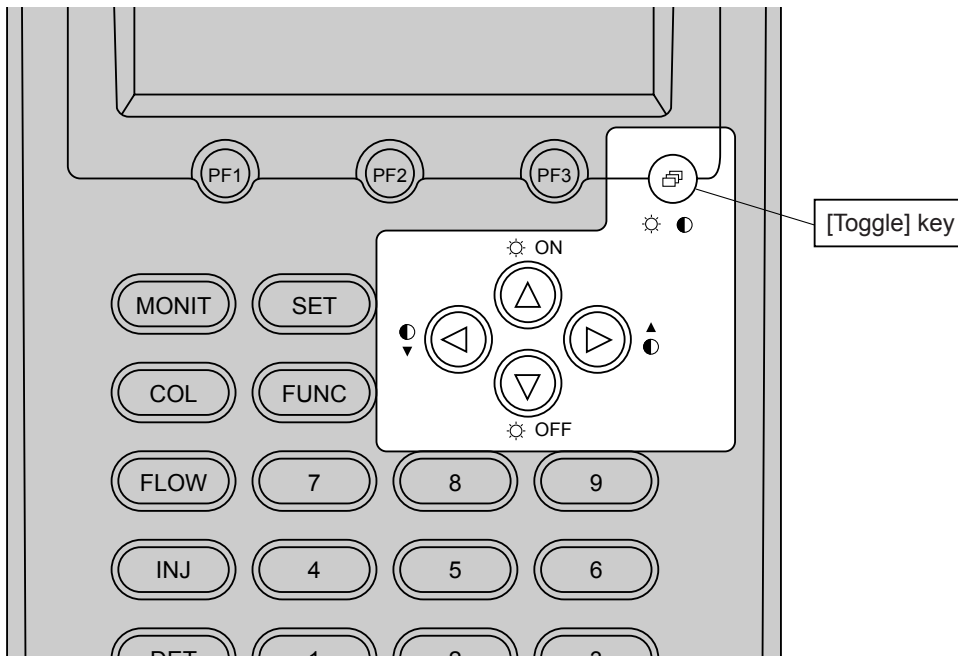
Fig. 5.2.1

5.3 Basic Key Operations

5.3.1 Screen display

Use the following 10 keys to display the parameter and status screens:
[DIAG], [SYSTEM], [MONIT], [SET], [FUNC], [COL], [FLOW], [INJ], [DET] and [OPTION].
Access the main function screens by pressing one of these keys, then the secondary
screens by selecting a PF menu item displayed at the bottom of the screen. (Because the
PF menu includes direct operations, some PF menu items do not have secondary screens.)

■ PF menu item selection

Select a desired PF menu item by pressing the PF keys ([PF1], [PF2] and [PF3]) underneath
the screen, which correspond to PF menu items.
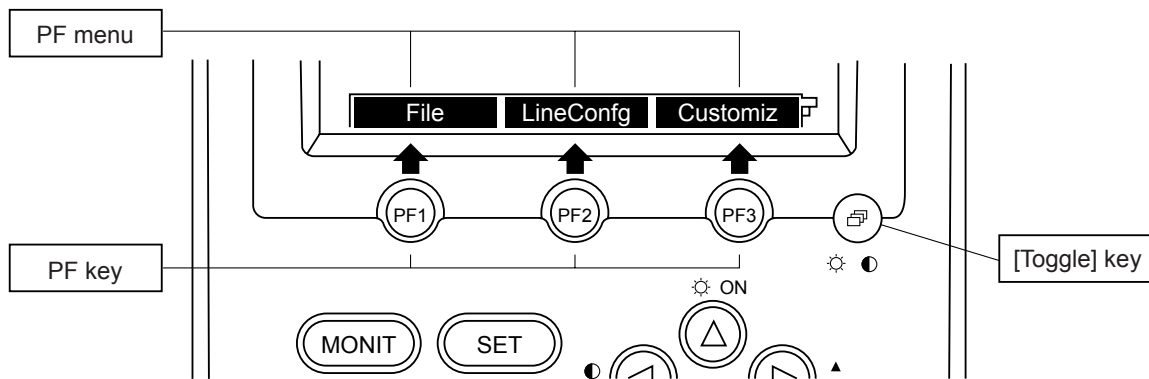
Fig. 5.3.1

If the PF menu continues over two or more pages, press the [Toggle] key to display the
desired PF menu, then press the [PF] key.

Example:

1st page of PF menu

Indicates page 1.
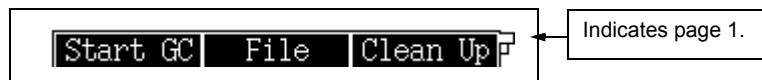
Press the [Toggle] key to display the 2nd page.

Indicates page 2.
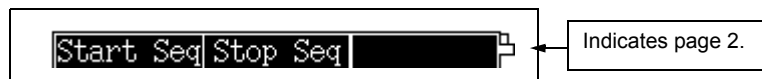
5.3.2   Moving the cursor

Use the four keys, [△], [▽], [◁] and [▷] to move the cursor to an item to be set.
However, for screens with listed items, only the [△] and [▽] keys may be available to move
the cursor. The [◁] and [▷] keys may perform a different function.

■ Moving the cursor using the [△], [▽], [◁] and [▷] keys
Example: Main screen of the [COL] key

```
Column                        RUN
Column             FILE 0:FILE0
Temp Monit(℃)                60.0
Temp program total(min)     20.00
        Rate(℃/min) Temp(℃) Time(min)
Init   --------     60.0       2.00
 1st    10.00      220.0       2.00
 2nd       END




Equilibration Time(min)      3.0

   Del Line Ins Line Fan Off
```

Move the cursor using the
[△], [▽], [◁] and [▷] keys.
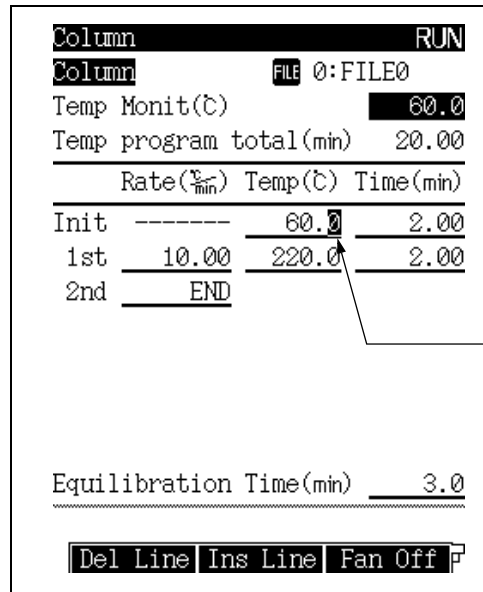
Fig. 5.3.2

■ Moving the cursor using only the [△] and [▽] keys
Example: Main screen of the [FLOW] key

```
Flow  CAR1                  READY
SPL1  LINE1                    On
Inlet press(kPa) 100.0      100.0
Column flow(mL/min)  4.62     4.62
Liner vel(cm/s)   62.2       62.2
Split ratio       20.0       20.0
Total flow(mL/min) 100.0    100.0
Split mode         ◀▶       SPLIT
Control mode                PRESS
Carrier gas type              He




   Column GasSaver On/Off
```
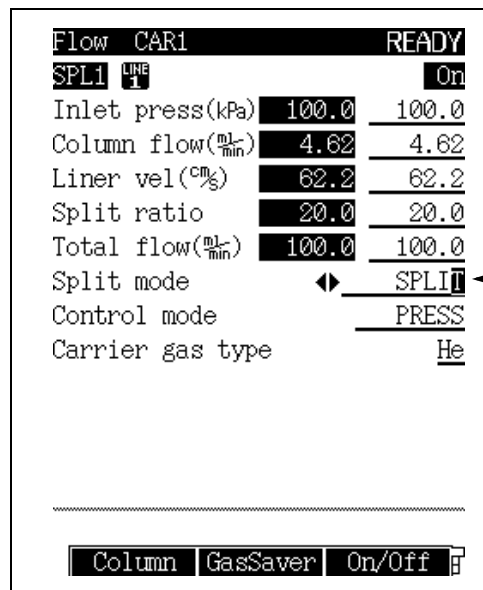
Move the cursor to each
parameter using the [△]
and [▽] keys.

Items marked with "◁" and
"▷" use the [◁] and [▷]
keys to change the selection.
For example, these keys
change the Split mode setting
in the following order:
SPLIT → SPLITLESS →
DIRECT → SPLIT.

Fig. 5.3.3

5.3.3 Entering numeric values

Enter a numeric value using the following procedure:

(1) Move the cursor to an item to be set.

(2) Use the numeric keys to enter a number.

(3) Press the [ENTER] key to validate the input.

NOTE   The value becomes valid when the [ENTER] key is pressed.

If you move the cursor or display another screen before pressing the [ENTER] key, the value is deleted.

To clear a value before pressing the [ENTER] key, press the [CE] key.

5.3.4 Changing a selection

Parameters marked with "◁" and "▷" are changed by making another selection. Change the selection using the following procedure.

(1) Move the cursor to the item.

(2) Select a desired choice by pressing the [◁] and [▷] key.

(3) Press the [ENTER] key to validate the selection.

NOTE   The selection change becomes valid when the [ENTER] key is pressed.

If you move the cursor or display another screen before pressing the [ENTER] key, the change is not made.

To clean the selection before pressing the [ENTER] key, press the [CE] key.

```
Display Customization

Inlet Pressure      ◀▶ On
Column Flow Rate       On
Linear Velocity       Off
```

Change the selection by pressing the [◁] and [▷] key. In this example, the selection changes in this order:
On → Off → On ...
Press the [ENTER] key to validate the selection.
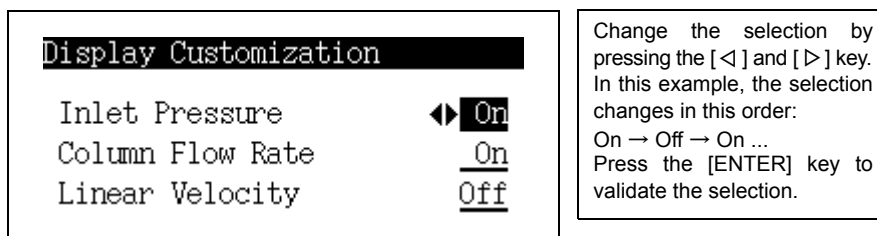
Fig. 5.3.4

5.3.5   Changing item names

Customize file names and other names with alphanumeric characters and symbols. Change the name using the following procedure:

(1) Move the cursor to an item to be changed using the [△] and [▽] keys.

(2) Move the cursor to a character to be changed using the [◁] and [▷] keys.

(3) Input a character as described in the following section on entering characters. The character input procedure described below.

(4) Press the [ENTER] key to validate the input.

(5) Repeat steps (2) to (4) to enter a name.

(6) Press the [CE] key to delete one character at the cursor's current position.

```
┌──────────────────────────────────┐
│ Rename File                      │
│                    FILE 0:GC-2010 │
│▓▓▓▓▓▓▓▓▓▓[File List]▓▓▓▓▓▓▓▓▓▓▓▓▓ │
│     0: GC-2010                    │
│     1: FILE1                      │
│     2: FILE2                      │
│     3: FILE3                      │
│     4: FILE4                      │
│     5: FILE5                      │
│     6: FILE6                      │
│     7: FILE7                      │
│   ❶ABC  ❷DEF  ❸GHI  ❹JKL          │
│   ❺MNO  ❻PQR  ❼STU  ❽VWX          │
│   ❾YZ   ❿0-9  ■▬Symbol            │
│                              ▽    │
│  ⏎Return│Alphabet│LowerChr        │
└──────────────────────────────────┘
```
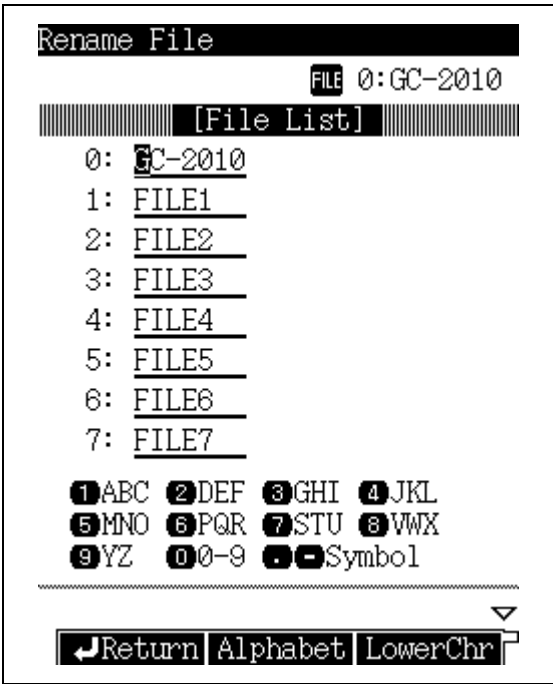
Fig. 5.3.5

■ Entering characters

Initially, the character input screen is in upper case mode.

Press [LowerChr] (PF menu) to select lower case mode. Press [NumerChr] (PF menu) to select numeric mode.

Alphabetic mode (upper case/lower case)

Key	Toggled characters
1	A/a → B/b → C/c → A/a → · · ·
2	D/d → E/e → F/f → F/f → · · ·
3	G/g → H/h → I/i → G/g → · · ·
4	J/j → K/k → L/l → J/j → · · ·
5	M/m → N/n → O/o → M/m → · · ·
6	P/p → Q/q → R/r → P/p → · · ·
7	S/s → T/t → U/u → S/s → · · ·
8	V/v → W/w → X/x → V/v → · · ·
9	Y/y → Z/z → Y/y → · · ·
0	0 → 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 0 → · · ·
.	(blank) → . → , → + → − → ＊ → ／ → # → $ → % → & → (blank) → · · ·
−	& → % → $ → # → ／ → ＊ → − → + → , → . → (blank) → & → · · ·

Numeric mode

Press the [0] to [9] keys to input numbers "0" to "9".

Press the [-] and [·] keys to toggle the symbols.

5.4 Getting Help

The Help function describes items on the setup screens.
Understanding the items helps to quickly and efficienty set up analytical parameters and proceed to the analyses.

5.4.1 Screen Help

If you do not know the meaning of an item on the screen, press the [HELP] key on the screen to display the item and its description. For example, Fig.5.4.1 displays the Diagnosis Help text.
Items which may be difficult to understand are linked to further descriptions, Access these underlined item descriptions by pressing [Display] (PF Menu) with the cursor on the item.
Fig. 5.4.2 shows the pop-up screen linked to the word "Log".
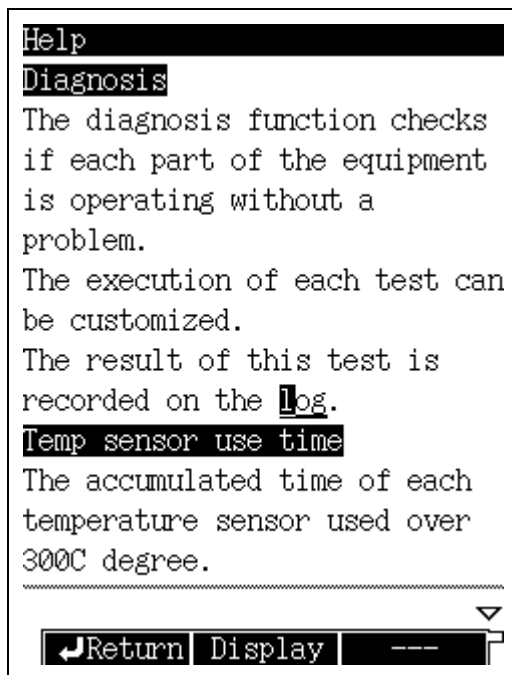
Fig. 5.4.1   Help screen

[Display]

[Back]
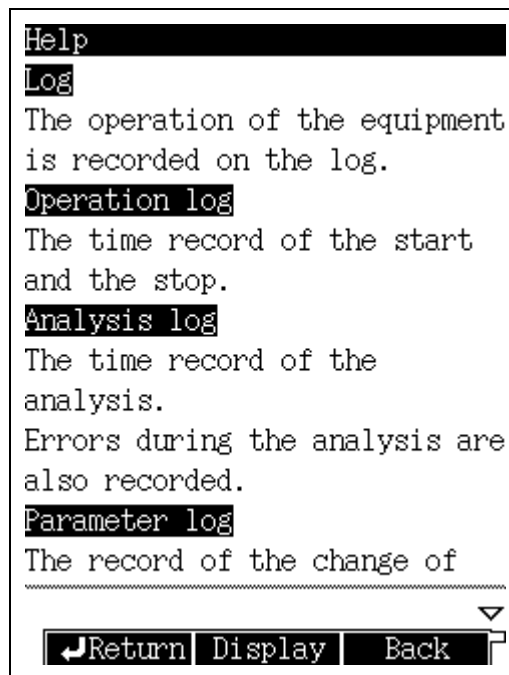
Fig. 5.4.2   Linked screen

5.4.2 PF menu

PF menu	Description
Return	Returns to the screen displayed before [HELP] key was pressed.
Display	Displays the explanation on item at the cursor position.
Back	Returns to the previous screen.

6.1 Analysis Flow Chart

6.1.1 Preparation

Glass insert preparation

Confirm that the insert is appropriate for the injection mode, that the silica wool has not moved, and that the glass insert O-ring has not deteriorated.

Septum preparation

After approximately 100 injections, replace the septum.

Column preparation

Attach the column to the hanger, install the hanger, and verify the proper position of the graphite ferrules. Tighten the injection port and detector collumn nuts.

When the above preparations are complete, turn on the GC.

6.1.2 Setting Parameters

Set the column information and the flow rates

From the [FLOW] key screen, set the column inlet pressure, the injection mode, the split ratio, the sampling time, etc.
From the [Column] (PF menu), set the column inner diameter, the column length and the film thickness. From the [Purge] (PF menu), set the purge flow rate.
Changing the column temperature after the flow rate has been set may change the flow rate.

Set the temperature of the detector and the injection port

From the screens of the [INJ] and [DET] keys, set the temperatures. If the detector is set to "Off", turn it "On". From [DET Gas] (PF menu), set hydrogen, air, makeup gas, etc.

Set the COL temperature and the temperature program

From the screen of the [COL] key, set the column initial temperature and the temperature program. Temperature settings must be within the allowable column and detector ranges.

Start GC control

Press the [SYSTEM] key to display the main screen.
Press [Start GC] (PF menu) to start GC control.
Press the [MONIT] key, and ensure that the temperature of each zone, the gas flow rate, the gas pressure, etc. are correct.

Set the detector

From the screen of the [DET] key, set the range and the time filter constant.
Ensure that the temperature of the detector is rising, then ignite the FID or set the TCD current value.

When all parameters reach their respective setup values, the STATUS indicator light becomes green and the system is ready for analysis.

The default zero parameter, "Zero at Ready" zeroes the detector signal when the GC is ready.

6.1.3   Analysis

Set the data processing unit

Perform the required settings for the data processing unit, such as specifying the processing parameters.

Check the baseline

Press the [MONIT] key, and ensure that the baseline is stable.
Press [Zero Adj] (PF menu) to zero the detector output. When the baseline is stable, you can start analysis.

Inject the sample

Aspirate the sample in the syringe, inject it into the GC injection port, and press [START] to analyze it.
For capillary column analysis, normally inject 1-2 μL.

⚠ **WARNING**

Wear protective goggles when using a syringe to inject samples.
The syringe plunger could be expelled due to injection port back pressure. Sample could get into the eyes.
By holding and supporting the plunger from the side with your middle finger, you can smoothly inject the sample and keep the plunger in the syringe.
Do not bend the plunger when holding the syringe in this position.

Hold here
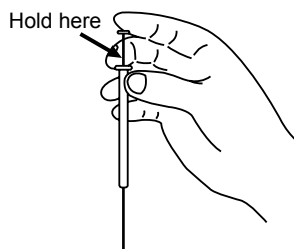
(Example)
How to hold a syringe when injection

■ Glass insert (liner)

- There are two types of glass inserts, one for split analysis and the other for splitless/WBI analysis. Select the correct type based on the sample injection method.
  A glass insert for split analysis can be used for splitless analysis. However, when injecting thermolabile samples, or samples that are highly absorptive or of low concentration, use the splitless insert.

- The position of the glass wool in the insert directly affects the reproducibility of results. For the AOC-20i auto injector, the glass wool is normally positioned 25 mm from the upper end of the glass insert.

- Samples come into direct contact with the inner surface of the glass insert and the silica wool. On these hot surfaces, unstable compounds may be decomposed or adsorbed. If this occurs, use deactivated lineas and glass wool.

For split analysis   For splitless/ WBI analysis
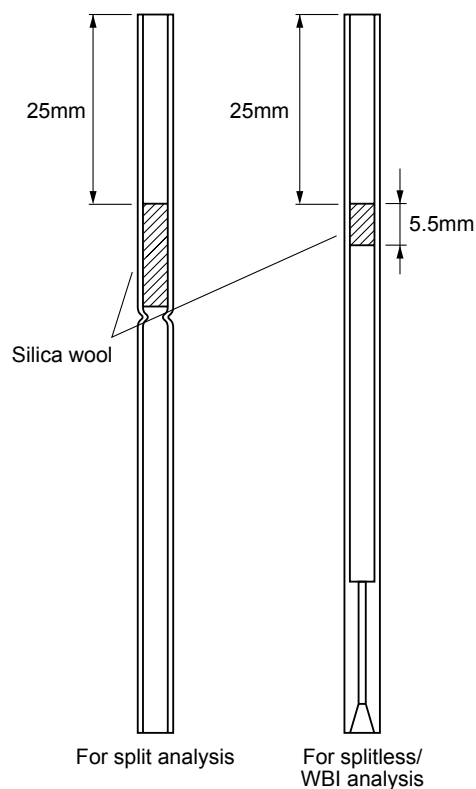
Fig. Correct placement of silica wool

■ Analytical column

- Verify that carrier gas is flowing through the column before increasing the column oven temperature. Otherwise, the column liquid phase becomes oxidized, and cannot separate compounds properly. This is especially important for polar columns.
  Press the [SYSTEM] key, and set a start time. This ensures that carrier gas flows for the set time prior to temperature control of the heated zones.

- Selection of the analysis column is very important in GC analysis. In general, select a liquid phase whose polarity and chemical characteristics are similar to those of the analysis target compound to obtain good peak shape. However, highly polar columns require low temperatures and do not last long.
  Therfore, when analyzing an unknown sample, begin by analyzing it on a neutral column at higher temperatures. Switch to a more polar column if necessary.

■ Installing the analysis column

Install the column as described in sections 4.3, 4.4, and 4.5.
Use a box nut on the injection port side. Use a column nut on the detector side.
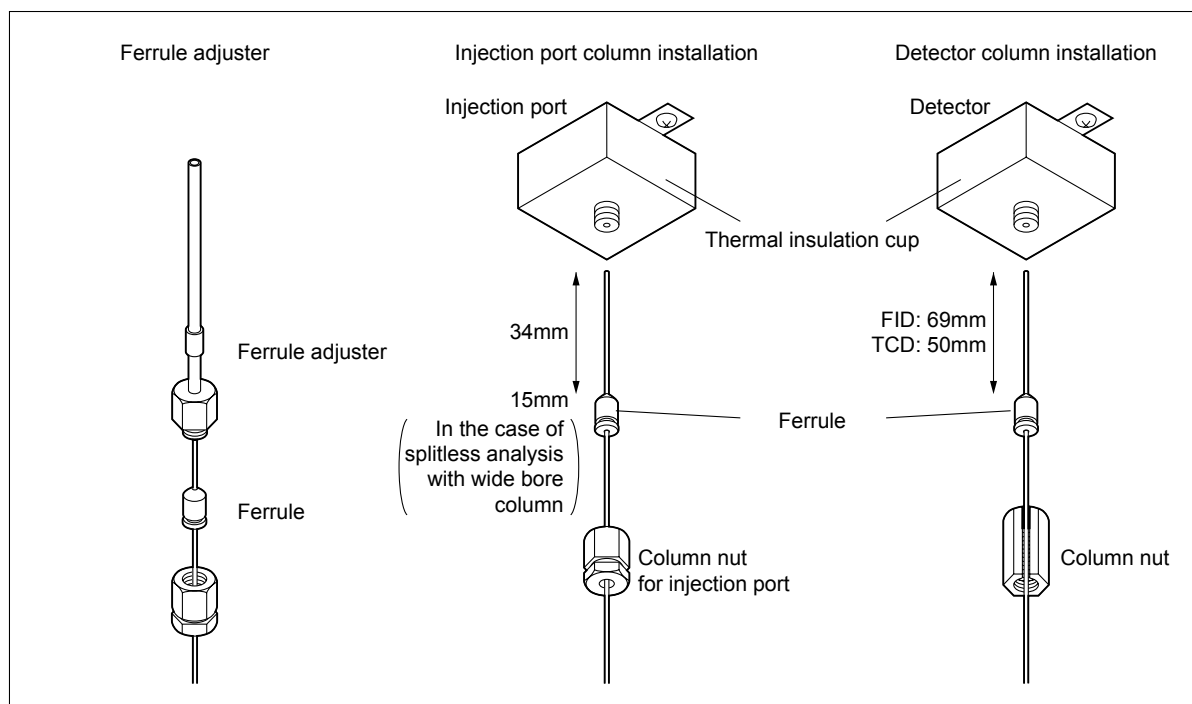
■ Sample injection modes

[Split injection]

In capillary columns, the inner diameter is small and the sample load capacity is low. Unlike packed columns, only a small (1-2 µL) amount of sample can be injected at onetime. The split injection mode only allows part of the injected sample to enter the column. This method is useful for samples of high consentration or about which nothing is known.

Try to perform a split injection method first. Set the split ratio to approximately 1:50. If the target peak is too large, increase the split ratio. If the target peak is too small or cannot be detected, decrease the split ratio. Select a proper split ratio in this way.

If the peak is still small with a split ratio set to "1:10" or less, try the splitless injection method.

[Splitless injection]

In the splitless injection method, almost all of the sample amount injected is introduced in the column by temporarily suspending the split flow.

This method is effective for analyzing a low concentration sample which cannot be easily analyzed by the split injection method.

To reduce band broadening and sharpen peaks, create a temperature ramp program. The column initial temperature is set to a temperature lower than the boiling point of the sample solvent.

[Direct injection]

In the direct injection method, almost the entire amount of injected sample is introduced into a wide bore column. Because the inner diameter of the wide bore column is 0.53 mm or more, separation is not as good as that of a column with smaller inner diameter. Because the peak shape is broad, sensitivity may not be good enough.

For the direct injection method, the WBI (Wide Bore Injection) injection port is required.

■ Setting the heated zone temperatures

The temperature of the injection port, the column oven and the detector are set individually. Usually, the injection port and the detector are set to a temperature 20°C higher than the column.

Never set the column temperature higher than the detector because the detector could become contaminated.

When creating a temperature program, be careful not to set the final oven temperature higher than that of the detector.

■ Column temperature program

Use a temperature program mainly to analyze samples with a wide boiling point range.

When developing analytical conditions for an unknown sample or a sample which will generate an unpredictable elution attend, use an initial program with a temperature increase rate of approximately 10°C/min. Based on the results, check the temperature range in which the peaks appear, then examine the analytical conditions. This procedure facilitates time program development.

■ Injection counter

The injection port septum and the glass insert are required to be inspected and replaced periodically. The GC-2010 probides a function which counts the number of injections. When the number of injections exceeds the limit, you are prompted to perform maintenance. (What is actually counted is the number of START times.)

Select the analysis counter on the [DIAG] key screen to set and reset the counter limit. Set the limit to perform maintenance on a regular basis.

The septum/glass insert replacement cycle varies, depending on the analytical conditions and samples. If the glass insert is easily contaminated (when analyzing non-volatile compunds for example), set a low counter limit. On the other hand, when analyzing cleaner samples, the limit can be increased.

■ Starting up the GC

Turn on the power and/or press the [SYSTEM] key to display the GC starup screen. On this screen, specify the files used for instrument startup and instrument cleaning (column bake - out).

Press [Start GC] (PF menu) to start temperature control of each heated zone accoding to the parameters set in the file.

A start up method should be used to initialize the system once it has been turned on. Set the start up method to "auto" to start the file as soon as the power is on; this helps with instrument recovery after a power failure.

The initial step in the startup method should be turning on the carrier gas flow. After a set time, increase the injection port and detector temperatures. The column oven temperature can then be set to increase. The oven temperature increases last to protect the column from damate and the detctor from contamination. The GC-2010 controls the temperatrues so that the column tempertrure never increases above the detector temperature, even if all temperatures are set to increase at the same time.

A clean up method uses higher oven temperatures than those used for the analysis. After set bake-out time, return the temperatures to their normal analytical parameter.

■ Shutting down the GC

To shut down the system, select [Stop GC] (PF menu) on the [SYSTEM] key screen. Then, the system stops temperature control after the period of time set as the stop time, flows the carrier gas for the period of time set as the flow-off time, then stops.

When shutting down the GC, the temperature of each part should be decreased at first, then the carrier gas should be stopped so that the column can be protected. It is convenient to use the stop time and the flow-off time.

Do not turn off the power, before select [Stop GC] (PF menu).

When shutting down the GC, the heated zones are cooled, and then the carrier gas flow is turned off. To accomplish these in the correct sequence automatically, use a stop time (this stops temperature control at the set time) and flow off time (turns off carrier gas flow at the set time). Do not turn off the GC without first selecting [Stop GC] (PF menu).

■ Obtaining reproducible analysis results

Follow these suggestions to obtain reproducible results:

- Use an AOC-20i auto injector.
- If more than one heated zone is dedicated as an injection port, but only one injection port is in use, do not increase the temperatures of the unused zones.
- If dual injections are normally perfomed, but single injections are being done, set temperatures for both injection ports.
- The GC is designed to perform optimally at room temperatures of 18-28°C. Room temperatures above 28°C will negatively inpact reproducibility.

7.1 [SYSTEM] Key Main Screen

7.1.1 Screen Description

The [SYSTEM] key main screen contains parameters related to starting and stopping the GC. When you press the [SYSTEM] key while the GC is in the system Off status, the screen shown in Fig. 7.1.1 appears. (However, if automatic start was set, the GC starts as soon as the power is turned on, and the screen shown in Fig. 7.1.1 does not appear.) To set up parameters related to the GC start, such as start time and clean up method on or off, press [Start GC] (PF menu). The GC starts, then enters standby mode according to the main screen setting.

However, if the GC is in system ON mode, pressing the [SYSTEM] key will access the screen shown in Fig. 7.1.2. Here, set up parameters relating to turning off the GC (such as stop time, flow off time, sleep time, etc.). Once the parameters have been specified, press [Stop GC] (PF menu) to begin the GC stop operations. If no program is running, the stop time countdown begins immediately. If a program is running, the countdown begins once the program is finished. When the countdown elapses, the GC stops and shuts down according to the GC stop parameters.
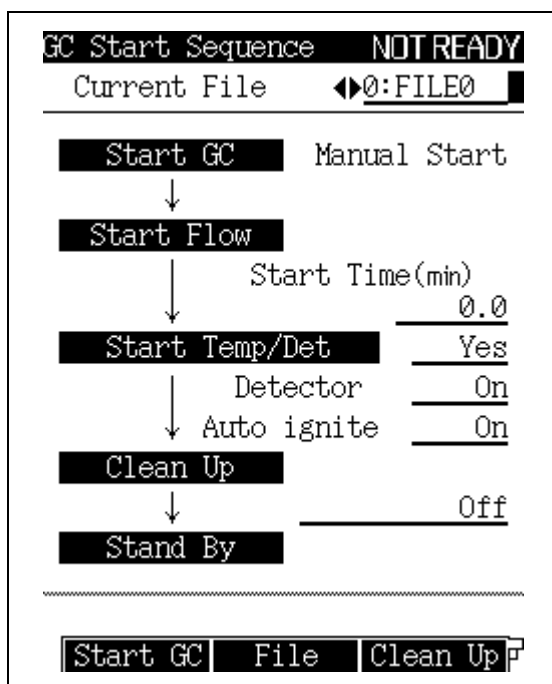
Fig. 7.1.1   Main screen accessed in system Off status
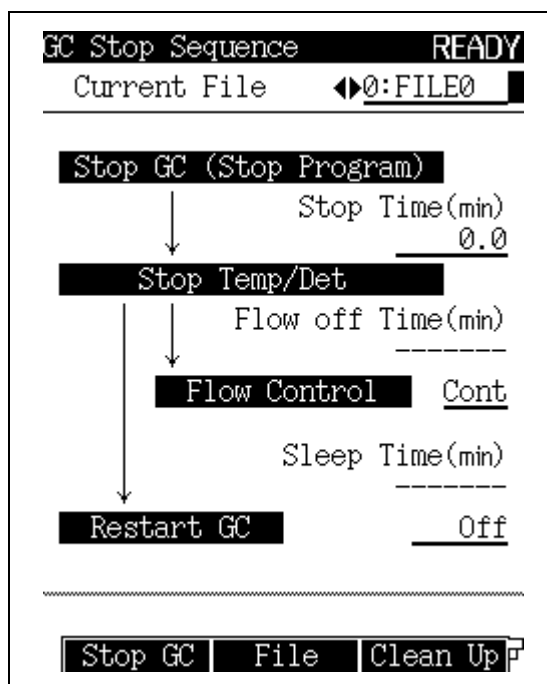
Fig. 7.1.2   Main screen accessed in system On status

7.1.2   Parameter

CURRENT FILE

Selection: File No. 0–9, Default: File No. 0

Changes the currently loaded file.

The GC will be controlled based on the parameters in the specified file.

START TIME

Range: 0.0–6000.0 min, Default: 0.0 min

Sets the period of time after flow control starts until temperature/detector control starts.

START TEMP/DET

Selection: Yes/No, Default: Yes

Select "Yes" to start temperature/detector control after the start time is finished.

Select "No" to continuously flow the carrier gas and not to start temperature/detector control.

DETECTOR

Selection: On/Off, Default: On

Prepaies the configured detector for analysis, but does not ignite the FID or FPD.

AUTO IGNIT

Selection: On/Off, Default: On

Ignites the FID/FPD detector automatically.

Select "On" for the FID/FPD detector to stand by in the ignited status. Select "Off" for it to standby without igniting.

CLEAN UP

Selection: Off/ Analysis Para/Clean Up Para, Default: Off

"Clean up" indicates running a GC program without injecting sample. Select whether to run the clean up program after the GC enters Ready status.

If the maximum temperature of the clean up oven temperature program is too close to maximum temperature of the column, select "Analysis Para" to perform clean up using a regular analysis program.

STOP TIME

Range: 0.0–6000.0 min, Default: 0.0 min

Sets the period of time after [Stop GC] (PF menu) is pressed (or after a program finishes if the program was running) to stop temperature control and cool the heated zones.

FLOW OFF TIME

Range: 0.0–6000.0 min, Default: --- (because the gas control is set to "Cont".)

Sets the period of time after temperature/detector control ends until gas control ends.

This item cannot be set if "Flow Control" is "Cont" (that is, if carrier gas is kept flowing).

FLOW CONTROL

Selection: End/Cont, Default: Cont

Select [End] to stop gas control after the flow OFF time finishes. This stops the flow of carrier gas.

Select [Cont] to continue the carrier gas flow.

SLEEP TIME

Range: 0.0–6000.0 min, Default: --- (because the RESTART GC is set to "Off".)

Sets the period of time after temperature/detector control ends until the GC restarts.

This item cannot be set if the GC is set to not restart.

RESTART GC

Selection: On/Off, Default: Off

Select [On] to restart the GC after the sleep time elapses.

Select [Off] to disable automatic GC restart.

7.1.3   PF menu

PF menu item	Description	Reference section
Start GC	Starts GC according to the parameters on the [SYSTEM] key main screen.	——
Stop GC	Starts GC according to the parameters on the [SYSTEM] key main screen. If no program is running,the stop time countdown begins immediately when [Stop GC] (PF menu) is selected. If [Stop GC] is selected while a program is running, the stop time countdown begins after the program finishes.	——
File	Displays the file list to change to another method file. On this sub screen, select files to load, edit, copy, initialize and rename.	8.2
Clean Up	Sets clean up parameters. In system ON status, select direct operation (PF menu) to run the clean up.	7.2
Start Seq	Sets the parameters for the next GC start up. Start time, detector and clean up parameters on this sub screen are immediately reflected on the [SYSTEM] key main screen.	7.3
Stop Seq	Sets the stop procedures. This item is not displayed in system ON status.	7.4
Maint INJ	Prepares the GC for maintenance of the injection port (replacement of septum, glass insert, etc.) . When GC is ready for maintenance, the message "GC is ready for maintenance" appears.	18.3, 18.4, 18.5
Anal.	Restores the GC for analysis after performing injection port maintenance. When pressed after maintenance of injection port is completed.	——

7.2 Specifying Clean Up Parameters

7.2.1 Screen Description

Select [Clean Up] (PF menu) from the [SYSTEM] key main screen to display the clean up parameter setup screen shown in Fig. 7.2.1. The parameters set for the clean up program are set by including "Clean Up Para" as part of the GC start procedure.

Clean up should be performed to eliminate contamination before analysis.

Reform the clean up when the gas chromatograph has not been used for a while or if a new column has been installed.

Fig. 7.2.1　Setting the clean up parameters

7.2.2　Parameter list

■ Main screen of clean up

COLUMN OVEN TEMP

Range: 0.0–450.0°C, Default: 25.0°C

Sets the default value of the column oven temperature for the clean up method.

The clean up oven temperature should be 20 to 30°C higher than the temperature program used for actual analysis. (Neither temperature should exceed the maximum temperature indicated on the column).

If the clean up oven temperature exceeds the maximum column temperature, indicate that the regular analysis parameters should be used for clean up by setting "Analysis Para" for the start procedure.

INLET PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100.0 kPa

Sets the default value of the column inlet pressure for the clean up method.

PURGE FLOW RATE

Range: Refer to Fig. 3.5.3, Default: 3.0 ml/min

Sets the septum purge flow rate for the clean up method. The septum purge removes contamination in the injection port near the septum. If the split ratio is set to "-1.0", the total flow rate remains fixed regardless of to the oven temperature.

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0

Sets the split ratio for the clean up method.

Set the split ratio to "-1.0" for the total flow rate to remain fixed regardless of the oven temperature.

INJECTION PORT TEMP

Range: 0.0–450.0°C, Default: 250.0°C

Sets the injection port temperature for the clean up method.

DETECTOR TEMP

Range: 0.0–450.0°C (in FID), Default: 250.0°C

Sets the detector temperature for the clean up method.

For any detector other than an FID, its set temperature must be within the valid range of the detector.

MAKE UP FLOW RATE

The range and default value depends upon the kind of detector. Refer to the values given for each detector.

Make up gas is inert gas which maximizes detector sensitivity. This sets its flow rate for the clean up method. Each type of detector requires different flow rates of make up gas.

AUX APC PRESS

Range: 0.0–970.0 kPa, Default: 100.0 kPa

Sets the AUX APC pressure for the clean up method.

This item is only valid when an AUX APC has been installed.

■ Clean up column oven temperature program

(The clean up temperature program consists of a single program ramp.)

CLEAN UP RATE
Range: END/-250.00–250.00°C/min, Default: END
Sets the rate of column temperature increase for the clean up program.

CLEAN UP TEMP
Range: 0.0–450.0°C, Default: 25.0°C
Sets the final temperature for the column oven temperature clean up program.
Do not exceed the maximum column temperature.

CLEAN UP TIME
Range: 0.00–9999.99 min, Default: 0.00 min
Sets the final temperature hold time for the clean up program.

■ Clean up column Inlet pressure program

(The clean up pressure program consits of a single program ramp.)

CLEAN UP RATE
Range: END/-400.00–400.00 kPa, Default: END
Sets the rate of column inlet pressure for the clean up program.

CLEAN UP PRESS
Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.) , Default: 0.0 kPa
Sets the final pressure for the column inlet pressure clean up program.

CLEAN UP TIME
Range: 0.00–9999.99 min, Default: 0.00 min
Sets the final pressure hold time for the clean up program.

■ Clean up total flow rate program

(The clean up total flow rate program consists of a single program ramp.)

CLEAN UP RATE
Range: END/-400.00–400.00 ml/min^2, Default: END
Sets the rate of total flow increase for the clean up program.

CLEAN UP FLOW RATE
Range: 0.0–1200.0 ml/min (Refer to Fig. 3.5.1.), Default: 50.0 ml/min
Set the final flow rate for the total flow rate clean up program.

CLEAN UP TIME
Range: 0.00–9999.99 min, Default: 0.00 min
Sets the final flow rate hold time for the clean up program.

7.2.3   PF menu

PF menu	Description	Reference section
Temp Prog	Sets the column oven temperature for the clean up program.	11.2
Press Prog	Sets the column inlet pressure for the clean up program.	12.5.5
Flow Prog	Sets the total flow rate for the clean up program.	12.5.6
Run	Displayed only while GC is in system ON status. Immediately runs the clean up program.	────
Stop	Stops clean up. This item is displayed only when the clean up program is in progress.	────
Next Line	Displays the clean up program set up screen for another analytical flow line.	────

7.3 Specifying Start Procedures

7.3.1 Screen description

Select [Start Seq] (PF menu) from the [SYSTEM] key main screen to display the start procedure setup screen shown in Fig. 7.3.1.

On this screen, set whether the system automatically starts (Auto Start) when the power is next turned on, or whether the system does not start until [Start GC] (PF menu) is pressed (Manual Start). Alternatively, only carrier gas flow is turned on the next time the power is turned on. To start the system, select [Start GC] (PF menu) as for a manual start. This is known as a semi-auto start. Finally, an analysis file can be set to begin the next time the power is turned on or the GC is restarted. Any settings changed on this screen are reflected in the [SYSTEM] key main screen.

```
GC Start Sequence(Next Time)
   File Load      ◀▶   0:FILE0
        ↓
     Start GC        Manual Start
        ↓(When next power on)
   Start Flow
                  Start Time(min)
        ↓                      0.0
   Start Temp/Det             Yes
        ↓   Detector           On
        ↓ Auto ignite          On
   Clean Up
        ↓                      Off
    Stand By

   ↵Return
```

Fig. 7.3.1   Setting the start procedures for the next GC restart

7.3.2 Parameter list

FILE LOAD

Selection: File No. 0–9, Default: Current file

Selects a file to be loaded the next time the power is turned on or the GC restarted.

START GC

Selection: Auto Start/ Manual Start/Semi-Auto, Default: Manual Start

Sets the start method for the next time the power is turned on:

Select "Auto Start" to automatically start the GC.

Select "Manual Start" to start the GC by presssing [Start GC] (PF menu) from the [SYSTEM] key main screen.

Select "Semi-Auto" to start carrier gas flow only. The GC must still be started by pressing [Start GC] (PF menu) from the the [SYSTEM] key main screen.

START TIME

Range: 0.0–6000.0 min, Default: 0.0 min

Sets the period of time after gas control starts until temperature/detector control starts.

The "Start Time" value on the [SYSTEM] key main screen is set here.

NOTE   The start time set here can be overridden by entering another start time in the [Start GC] (PF menu) screen.

This function is useful if the preset start time is too long.

START TEMP/DET

Selection: Yes/No, Default: Yes

Select "Yes" to start temperature/detector control after the start time is elapses.

Select "No" to continue carrier gas flow only without starting temperature/detector control.

DETECTOR

Selection: On/Off, Default: On

Prepares the configured detector for analysis, but does not ignite the FID or FPD.

The "DETECTOR" setting on the [SYSTEM] key main screen is set here.

AUTO IGNITE

Selection: On/Off, Default: On

Establishes FID/FPD ignition conditions.

Select "On" for the FID/FPD detector to stand by in the ignited status. Select "Off" for it stand by without igniting.

The "AUTO IGNIT" setting on the [SYSTEM] key main screen is set here.

CLEAN UP

Selection: Off/Analysis Para/Clean Up Para, Default: Off

When performing clean up, select whether to use an analysis method or the program set in [Clean Up] (PF menu).

The "CLEAN UP" setting on the [SYSTEM] key main screen is set here.

7.3.3 Example: starting the system with carrier gas flow

In this example, carrier gas flows for a certain period of time before temperature control begins. The length of time the carrier gas should flow depends on how long the carrier gas flow was shut off.

- If the same column is used in the same analytical flow line as the day before:
  set a START TIME of approx. 10 minutes.
- If a different column is installed on the same flow line that has been in use:
  set a START TIME of approx.10 minutes.
- If the system has been out of use for a time with no column connected:
  set a START TIME of 1 to several hours.

7.4.1   Screen

Select [Stop Seq] (PF menu) from the [SYSTEM] key main screen to display the stop procedure setup screen shown in Fig. 7.4.1. "Stop Seq" is displayed only when the system is in OFF status.

The stop procedure setup screen consists of parameters equivalent to those on the [SYSTEM] key main screen when the GC is in system ON status, except that the current file cannot be changed.

Parameter changes on the stop procedure setup screen are reflected on the [SYSTEM] key main screen.

```
GC Stop Sequence

  Stop GC (Stop Program)
                Stop Time(min)
    │                    0.0
    │
  Stop Temp/Det
    │         Flow off Time(min)
    │               -------
    │    Flow Control    Cont
    │
    │          Sleep Time(min)
    │               -------
    │
  Restart GC            Off


 ⏎Return
```
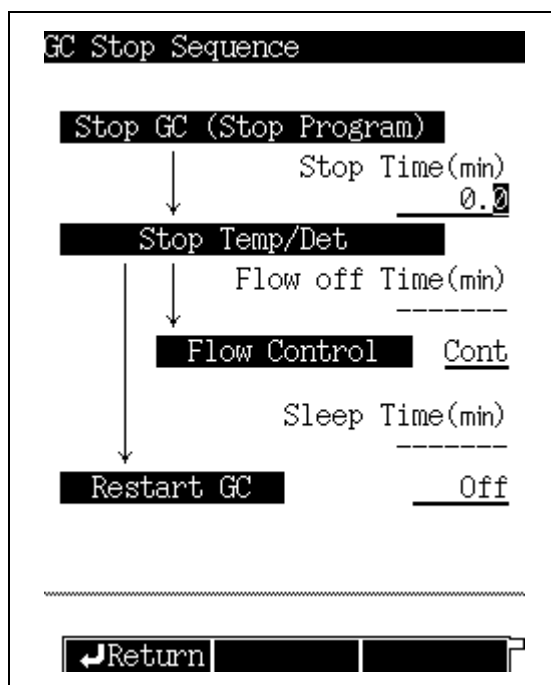
Fig. 7.4.1   Setting the stop procedures

7.4.2   Parameter list

STOP TIME

Range: 0.0–6000.0 min, Default: 0.0 min

Sets the period of time after [Stop GC] (PF menu) is pressed (or after a program finishes if the program was running) to stop temperature/detector control.

The "STOP TIME" value on the [SYSTEM] key main screen is set here.

FLOW OFF TIME

Range: 0.0–6000.0 min, Default: --- (because the gas control is set to "Cont".)

Sets the period of time between the end of temperature/detector control and the end of gas control.

This item cannot be set if "Flow Control" is "Cont" (that is, if carrier gas is kept flowing).

The [FLOW OFF TIME] setting on the [SYSTEM] key main screen is set here.

FLOW CONTROL

Selection: End/Cont, Default: Cont

Select "End" to end gas control after the flow off time elapses.

Select "Cont" to continue the carrier gas flow.

The "GAS CONTROL" setting on the [SYSTEM] key main screen is set here.

SLEEP TIME

Range: 0.1–6000.0 min, Default: --- (because the RESTART GC could be set to "Off".)

Sets the period of time after temperature/detector control ends until the GC restarts.

This item cannot be set if the GC is not set to restart automatically.

The "SLEEP TIME" setting on the [SYSTEM] key main screen is set here.

RESTART GC

Selection: On/Off, Default: Off

Select "On" to restart the GC once the sleep time has elapsed.

Select "Off" to not restart the GC automatically.

The "Restart GC" setting on the [SYSTEM] key main screen is set here.

7.4.3   System shut down examples

The following examples show various situations where STOP TIME and FLOW OFF TIME can be used effectively.

- After the end of an analysis, each heated zone is cooled. Once the column over is cool, carrier gas flow is shut off.

STOP TIME	=	0 minutes
FLOW CONTROL	=	End
FLOW OFF TIME	=	Approx. 20 minutes

- A column is conditioned, then the column over is cooled. Carrier gas flow is then shut down.

STOP TIME	=	Column conditioning time
FLOW CONTROL	=	End
FLOW OFF TIME	=	Approx. 20 minutes

- At the end of an analysis, each heated zone is cooled, but carrier gas is kept flowing for rapid equilibration for the next day's analysis. The next day, the system is automatically restarted (15 hours = 900 minutes later), and temperature control resumes.

START TIME	=	0 minutes (because the carrier gas continued to flow)
STOP TIME	=	0 minutes
FLOW CONTROL	=	Cont (to keep carrier gas flow on)
RESTART GC	=	On
SLEEP TIME	=	900 minutes (at the end of the SLEEP TIME, the GC restarts)

- At the end of an analysis, each heated zone is cooled, and the carrier gas flow is stopped once the column oven is cool. The following day (15 hours = 900 minutes later), carrierr gas flow is turned back on and temperature control begins.

START TIME	=	10 minutes (because carrier gas flow was off)
STOP TIME	=	0 minute
FLOW CONTROL	=	End
FLOW OFF TIME	=	Approx. 20 minutes
RESTART GC	=	On
SLEEP TIME	=	900 minutes (at the end of the SLEEP TIME, the GC restarts)

8.1 [SET] Key Main Screen

8.1.1 Main screen

Press the [SET] key to display the main screen shown in Fig. 8.1.1 and to make frequently used parameter settings.

To make changes to the [COL], [FLOW], [INJ], and [DET] parameters, the [customiz] (PF menu) key is pressed. Changes to these parameters are reflected in the [SET] key main screen.

The screen shows parameters for the components which make up one analytical flow line (injection port, detectors, and options). Use the [Line Config] (PF menu) to change the components in the flow line.

When the system is turned on, the temperatures are controlled for the components in the flow line. If the AFC is present, carrier gas is supplied to the injection port specified. If APC is present, detector gases are supplied to the detector specified. One injection port and up to two detectors can be included in an analytical flow line. Temperatures are not controlled, and gases are not supplied, to components which are not part of the analytical flow line.
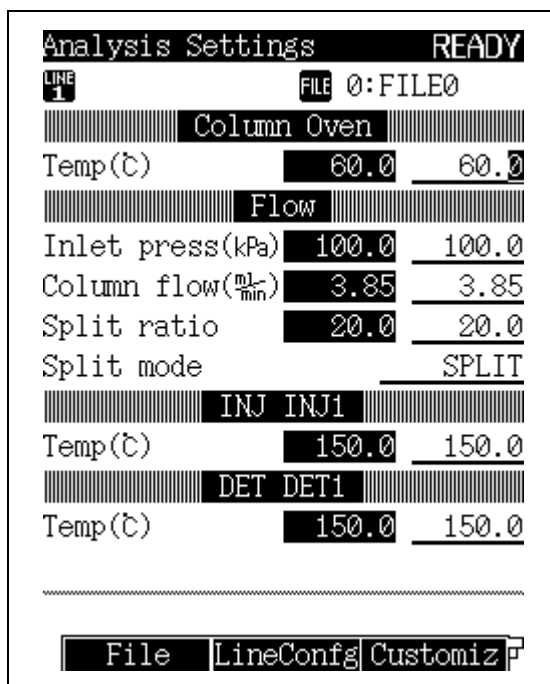
Fig. 8.1.1   [SET] key main screen

8.1.2   Parameter list

COLUMN OVEN

Range: 0.0–450.0°C, Default: 25.0°C

Sets the default temperature in the oven temperature program.

INLET PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100.0 kPa

Sets the column inlet pressure.

The initial pressure must be set in order to create a pressure program.

When the control mode is set to "pressure", the system keeps the column inlet pressure at a constant value while the oven temperature program is running.

COLUMN FLOW RATE

Default:[1] 1.00 ml/min

Sets the carrier gas flow rate at the capillary column exit (atmospheric pressure at 25°C).

When you set the carrier gas flow rate, the system calculates the column inlet pressure based on the inner diameter and the length of the column. The column flow rate is set separately so that the carrier gas flow rate desired occures at the initial temperature in the oven temperature program.

LINEAR VELOCITY

Default:[2] 30.0 cm/s

Sets the average linear velocity of the carrier gas flowing in the capillary column.

When you set the linear velocity, the system calculates the column inlet pressure based on the inner diameter and the length of the column. The linear velocity is set separately so that the linear velocity desired occures at the initial temperature in the oven temperature program.

When the control mode is set to "linear velocity", the column inlet pressure automatically changes so that the linear velocity remains constant even while the oven temperature program is running.

TOTAL FLOW RATE

Range: 0.0–1200.0 ml/min (Refer to Fig. 3.5.1.), Default: 500.0 ml/min

The total flow rate varies depending on the injection mode as follows:

In split or splitless mode, the total flow rate is equivalent to "column flow rate + split flow rate + septum purge flow rate".

In direct mode, the total flow rate is equivalent to "column flow rate + septum purge flow rate".

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0

The split ratio is "split flow rate / column flow rate."

When you set a split ratio, the system sets the total flow rate based on the calculated carrier gas flow rate and split flow rate, so that the desired split ratio occurs at the oven temperature.

Set the split ratio to "-1.0" to fix the total flow rate regardless of the oven temperature.

PURGE FLOW RATE

Default:[3] 3.0 ml/min

Set the septum purge flow rate.

SAMPLING TIME

Range: 0.00–9999.99 min, Default: 1.00 min

Sets the sampling time for splitless analysis.

The sampling time indicates the period of time after analysis starts until the split flow line is opened.

SPLIT MODE

Selection: SPLIT/SPLITLESS/DIRECT, Default: SPLIT

SPLIT: Controls the column inlet pressure and the total flow rate so that the column inlet pressure and split ratio occur as specified.

SPLITLESS: Closes the split flow line during the sampling time so that the set column inlet pressure is controlled by the Total Flow Controller.

Opens the split flow line and controls the Electronid Split Controller so that the preset column inlet pressure occurs (Refer to Fig. 12.5.2.) after the sampling time elapses.

DIRECT: Closes the split flow line and the set column inlet pressure (in pressure mode) or the set total flow rate (in flow mode) occurs. When making direct injection analyses, select WBI in the setup screen so that SPLIT mode is not available.

CONTROL MODE

Selection: PRESS/VELOCITY/FLOW (for direct injection mode), Default: PRESS

When the injection mode is set to "SPLIT" or "SPLITLESS"

PRESS: Controls the system so that the column inlet pressure remains constant.

VELOCITY: Controls the system so that the linear velocity remains constant.

When the injection mode is set to "DIRECT"

PRESS: Controls the system so that the column inlet pressure remains constant.

VELOCITY: Controls the system so that the linear velocity remains constant.

FLOW: Controls the system so that the flow rate remains constant.

INJECTION PORT TEMP

Range: 0.0–450.0°C, Default: 25.0°C

Set the injection port temperature (the default temperature for a programmable injection port).

DETECTOR TEMP

Range: 0.0–450.0°C (in FID), Default: 25.0°C

Set the detector temperature.

Allowable temperature ranges vary for each detector. Refer to range specified for the detector(s) in use.

1 The column flow rate ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less and the calculated total flow rate is 1,200 ml/min.

2 The linear velocity ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less.

3 The purge flow rate ranges from 0 to the total flow rate subtracted by the column flow rate and the split flow rate.

8.1.3　PF menu

PF menu	Description	Reference section
File	Displays file list to change the current file. On this sub screen, you can select files to load, copy, initialize and rename.	8.2
Line Confg	Specifies the injection port, detectors and options which make up the analytical flow line. Units set on this sub screen are displayed on the [SET] key main screen.	8.3
Customiz	Set the parameters displayed on the [SET] key main screen.	8.4
Print	Prints temperature, pressure and total flow rate on a Chromatopac.	——
Next Line	Switches through each of the parameter screens in turn. Press the [SET] key from the [SET] key main screen to switch to the next screen.	——

8.2 File Management

8.2.1 Screen description

Select [File] (PF menu) from the [SYSTEM] key main screen to display the file list shown in Fig. 8.2.1.

To change the current file, enter a file No. or move the cursor using the [△] and [▽] key; then press the [Load] (PF menu) key.

```
File Management
                    FILE 0:FILE0
▓▓▓▓▓▓▓▓▓▓▓ [File List] ▓▓▓▓▓▓▓▓▓▓▓
   ↕  ⓪  FILE0
      ①  FILE1
      ②  FILE2
      ③  FILE3
      ④  FILE4
      ⑤  FILE5
      ⑥  FILE6
      ⑦  FILE7
      ⑧  FILE8
      ⑨  FILE9


    ↵Return   Load      ---
```
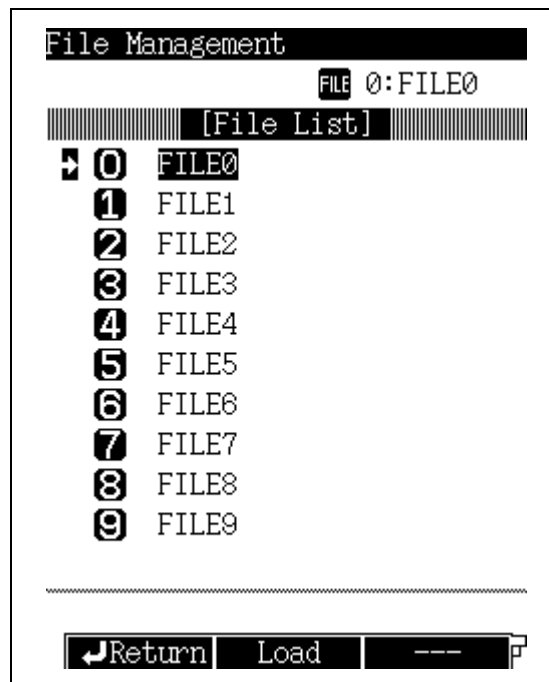
Fig. 8.2.1   File list screen

8.2.2 PF menu

PF menu	Description	Reference section
Load	Selects the current file.	――
Copy	Copies file name and file contents from the source file to a destination file.	8.2.3
File Init	Initializes file name and file contents. The current file cannot be initialized.	8.2.5
Rename	Changes the file name.	8.2.4

8.2.3 Copying a file

Select [Copy] (PF menu) on the file list screen to display the file copy screen shown in Fig. 8.2.2. Enter the source file number (Src. File) and the destination File number (Dst. File), then press [Copy] (PF menu). The name and contents of the source file are copied to the destination file.
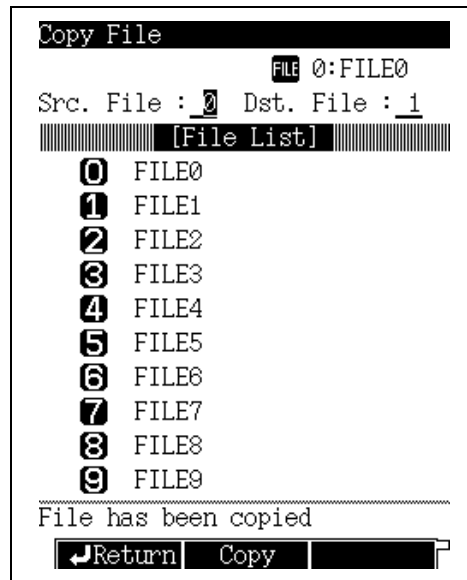
Fig. 8.2.2   Copying File

8.2.4 Renaming a file

Select [Rename] (PF menu) on the file list screen to display the file rename screen shown in Fig. 8.2.3. Move the cursor using the [△] and [▽] keys to select the file to be renamed. Enter the new file name using the numeric keys and the [◁] and [▷] keys. Refer to "5.3.5 Changing item names" for more information..
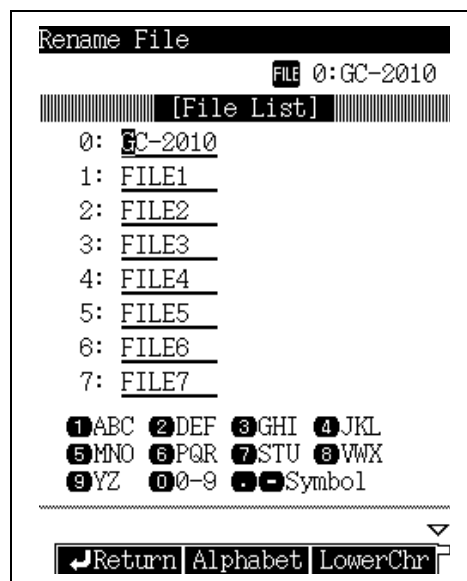
Fig. 8.2.3   Renaming a file

8.2.5   Initializing a file

Select [File Init] (PF menu) on the file list screen to display the file initialization screen shown in Fig. 8.2.4. Enter the file number or move the cursor to select the file. Then press [File Init] (PF menu).

During File initialization, the file name and contents are deleted. The parameters return to their default settings. Once a file is initializen, the action cannot be undone. The current file cannot be initialized.
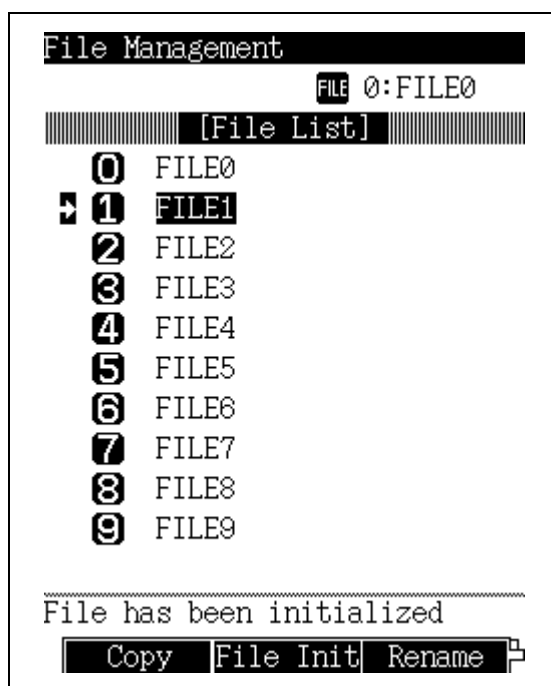
Fig. 8.2.4   Initializing a file

8. 3 Specifying the Analytical Flow Line Components ([Line Config])

8.3.1   Screen description

Select [Line Confg] (PF menu) from the [SET] key main screen to display the Line Configuration screen shown in Fig. 8.3.1.

The [SET] key main screen displays the parameters for one analytical flow line. The line configuration screen determines the components (injection port, detector (s), and options) of the analytical flow line.

When the system is turned on, the temperatures are controlled for the components in the flow line. If the AFC is present, carrier gas is supplied to the specified injection port, If APC is present, detector gases are supplied to the detector (s) specified, One injection port and up to two detecotrs can be included in an analytical flow line, Temperatures are not controlled, and gases are not supplied, to conponents which are not part of the analytical flow line.

The line configuration screen displays all the components installed. Move the cursor to the desired component using the [$\triangle$] and [∇] keys. Use the [$\triangleleft$] and [$\triangleright$] to specify the analytical flow line (1-4) to which the component belongs. Press [Enter] to validate the selection. If more than one injection port is specified for an analytical flow line, the most recent selection applies.
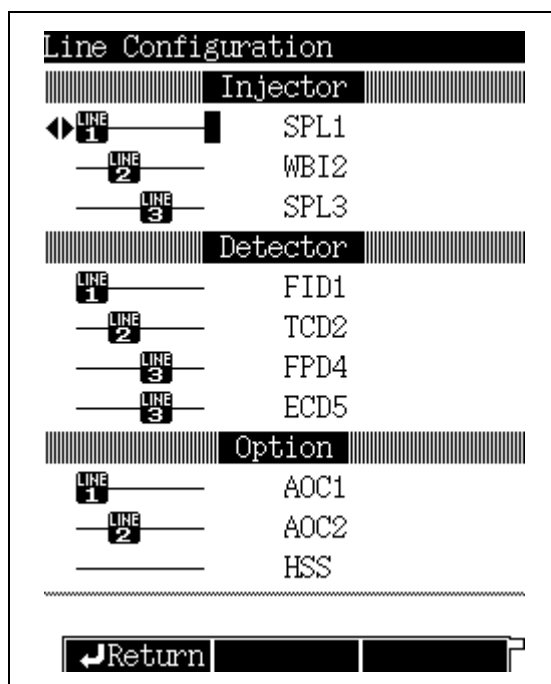
Fig. 8.3.1   Line configuration setup screen

■ Line configuration examples

Suppose that a SPL (split/splitless injection port), a WBI (direct injection port), a FID (hydrogen flame ionization detector) and a TCD (thermal conductivity detector) are installed.

(1) When using only the SPL and the FID
Select the SPL and the FID for line 1.
In this case, only the temperature of the SPL and the FID will be controlled. Carrier gas and detector gas will be supplied.
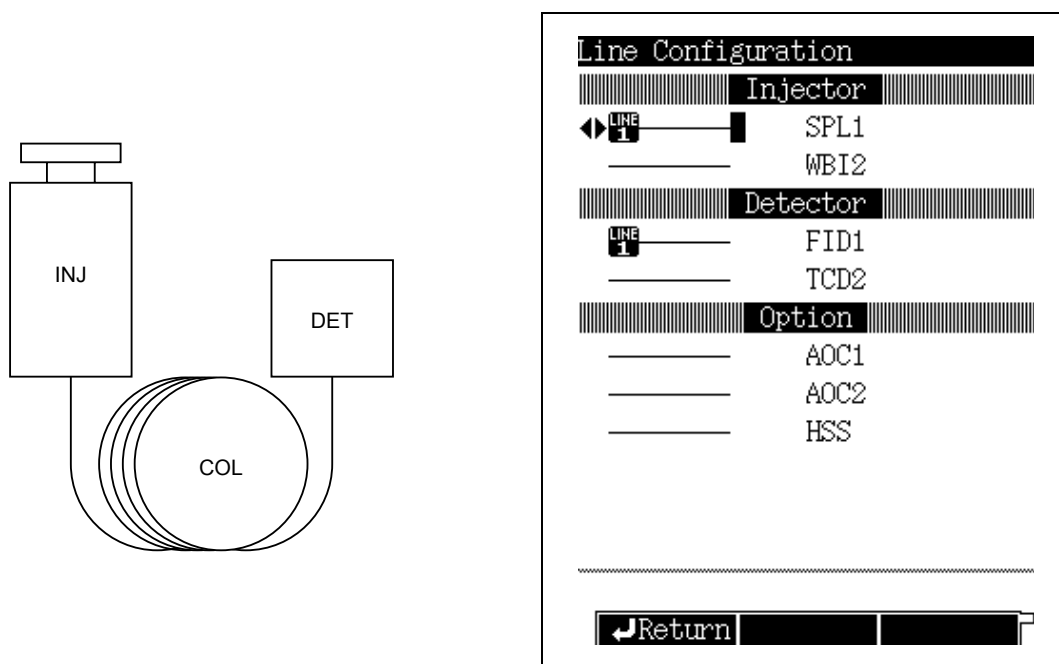
Fig. 8.3.2   Line configuration (Example 1)

(2) When using a SPL and FID for one line, and a WBI and TCD on an other line, select the SPL and the FID for line 1, and the WBI and TCD for line 2.
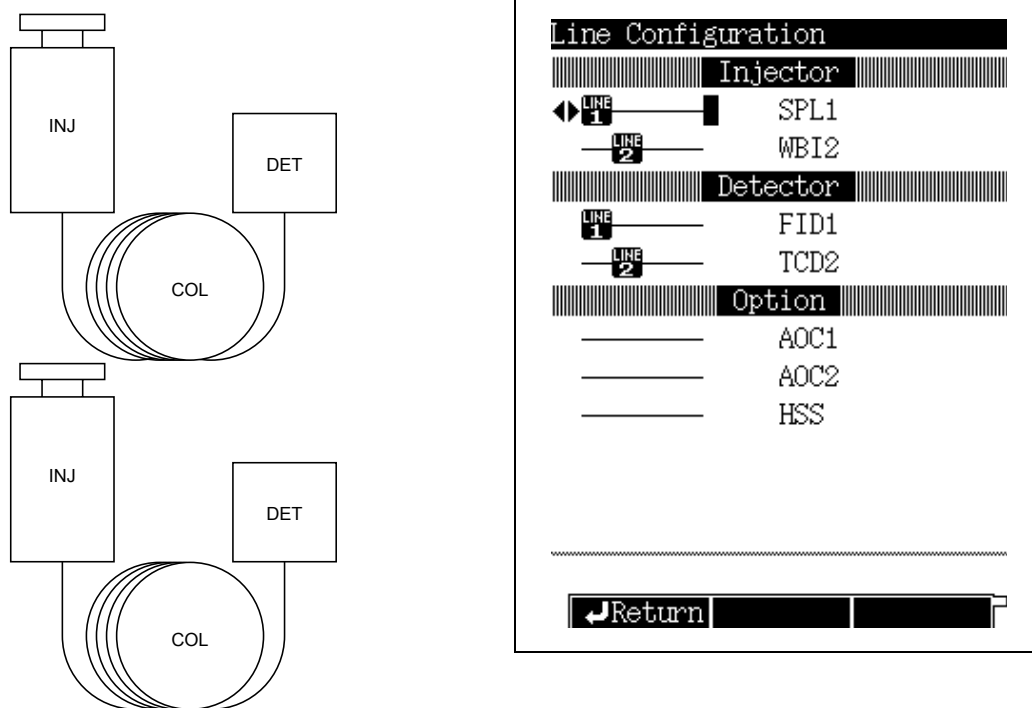
Fig. 8.3.3   Line configuration (Example 2)

(3) When using a single column connected to two detectors:
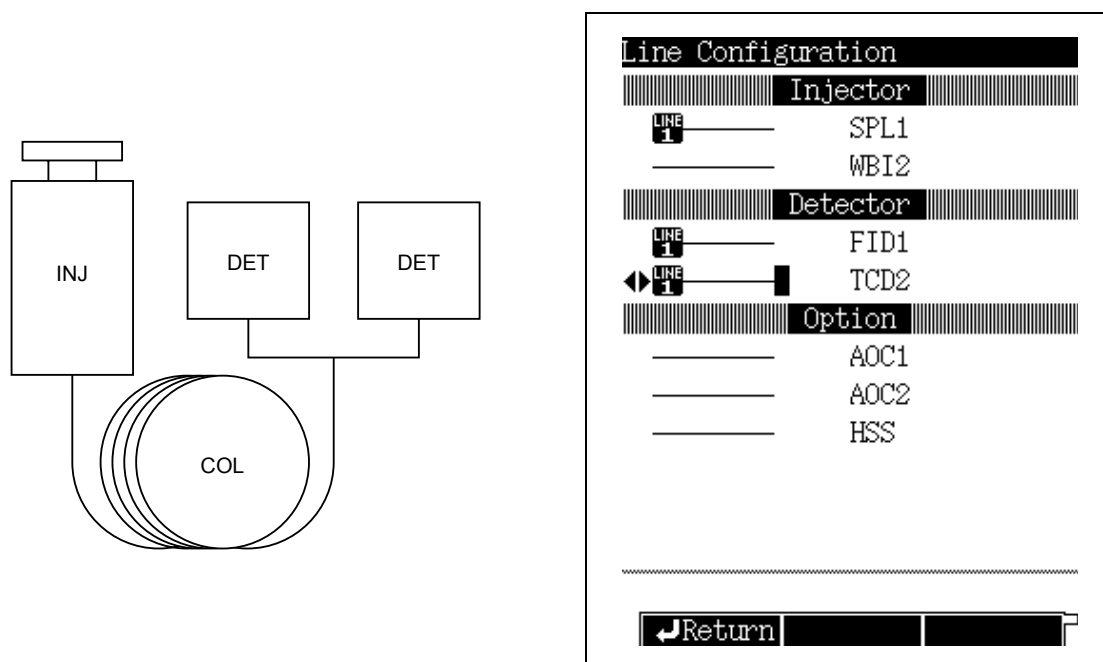
Fig. 8.3.4   Line configuration (Example 3)

8.4 Changing Items Displayed with [Customiz]

8.4.1 Screen description

Select [Customiz] (PF menu) from the [SET] key main screen to display the Display Customization screen shown in Fig. 8.4.1.

On this screen, set the items which will be displayed on the [SET] key main screen. Set an item to "On" to display it on the main screen. Set the item to "Off" to wide its display.

Even if the sampling time display is "On" the sampling time is only displayed in SPLITLESS mode.

Move the cursor using the [△] and [▽] keys to select an item to be changed; select "On" or "Off" using the [◁] and [▷] keys, then press the [ENTER] key to validate the selection.

The default it setting displays the column inlet pressures, column flow rate, split ratio, sampling time and the split mode.
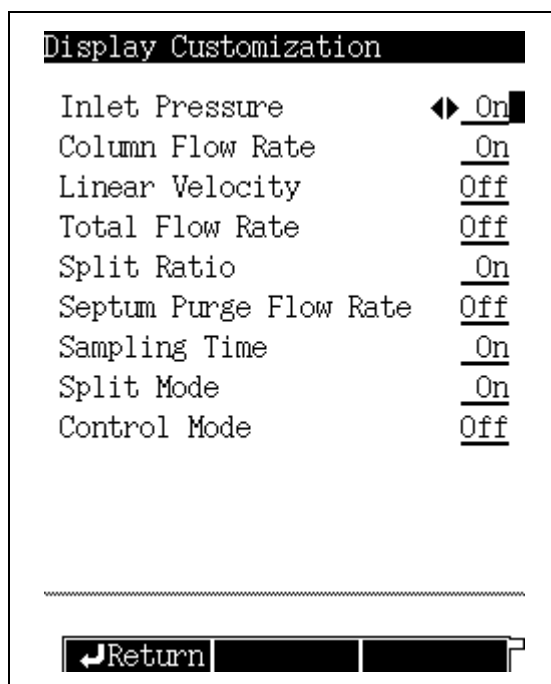
Fig. 8.4.1   Customizing the [Set] key main screen

9.1 [MONIT] key Main Screen

9.1.1 Screen description

Press the [MONIT] key to display the main monitor screen shown in Fig. 9.1.1. In the upper portion of the main screen, monitor the status of the injection port, the column and the detectors configured in each line. In the lower portion of the screen, monitor the chromatogram, the temperature program, etc.

Select [Temp Mon] and [Flow Mon] (PF menu) to monitor the temperature, the pressure and the flow rate of all injection ports, columns and detectors configured in all configured lines.

The injection port temperature, inlet pressure and purge flow rate are displayed.

The column oven temperature is displayed.

The chromatogram is displayed.

The detector range (setup value), temperature and the voltage are displayed.
This value, multiplied by the range (attenuation) coefficient, is output as the analog signal.
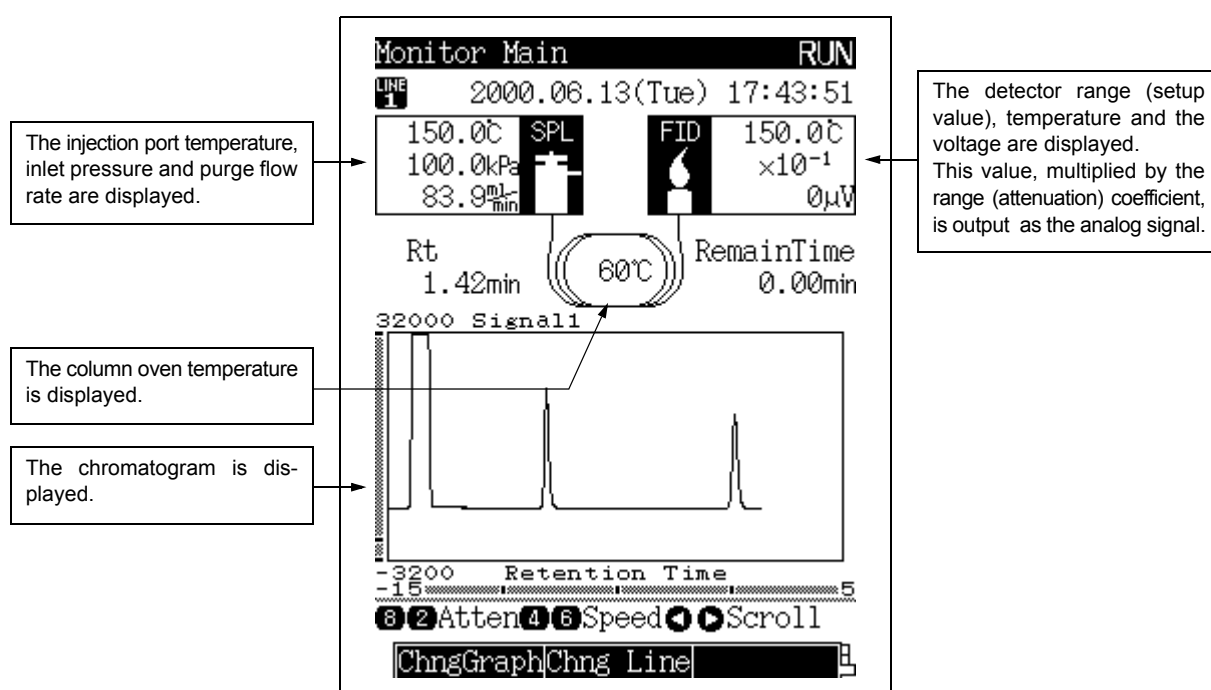
Fig. 9.1.1   [MONIT] key main screen

■ Detector status

The ignition status of an FID or FPD detector can be confirmed on the Monitor Screen.

For a FID:
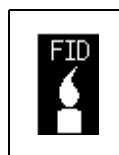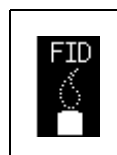
Flame = On   Flame = Off

■ Changing the monitor magnification (zoom)

The chromatogram and the temperature (or pressure, flow rate) program is displayed on the lower portion of the Monitor Screen.

The signal axis and the time axis are displayed. If there is a temperature (or pressure, flow) program, the temperature axis (or pressure axis, flow axis) is also displayed. Use the [Chng Graph] (PF menu) key to switch the graph displayed.

Use the numeric keys and cursor keys to change the magnification and the position of each axis on the screen.

NOTE If the temperature (or pressure, flow) program is displayed, the time axis (x-axis) cannot be changed.
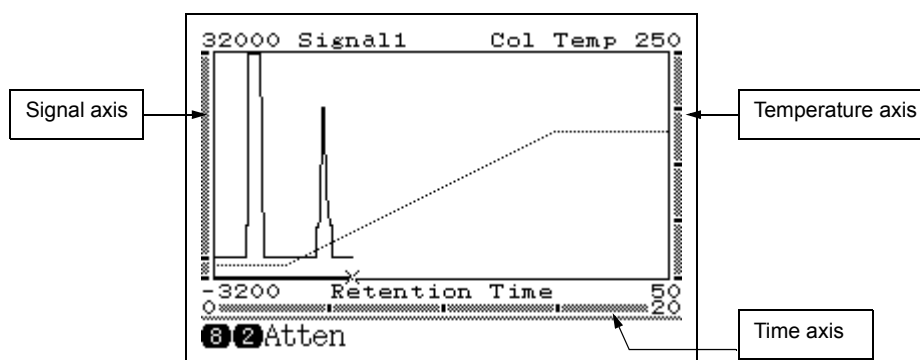
Fig. 9.1.2   Monitor screen (chromatogram and temperature program)
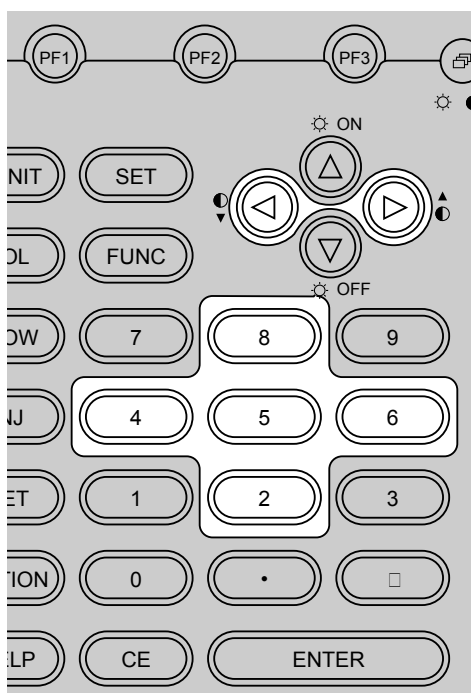
To magnify the time axis:

4 : Zooms the time axis scale.

6 : Unzooms the time axis scale.

To magnify the signal axis:

2 : Zooms the signal axis scale.

8 : Unzooms the signal axis scale.

To maximize the display:

5 : Automatically adjusts the signal axis so that the maximum value of the chromatogram signal is displayed on the screen.

Keys to move along the time axis

▷ : Moves the chromatogram in the + direction.

◁ : Moves the chromatogram in the - direction.

9.1.2   Parameter list

RETENTION TIME (Rt)

Retention time is the length of time from compound injectio to detection.

The retention time is specific to each compound. Compounds are identified based on matching the retention time to a standard compound retention time.

REMAIN TIME

The longest program time subtracted by the current retention time is displayed.

LONGEST PROGRAM TIME

The longest program time indicates the total time of the longest program when comparing the temperature program, the pressure program, the flow rate program and the time program.

9.1.3   PF menu

PF menu	Description	Reference section
Temp Mon	Displays the current and set temperatures of column, injection port and detector.	9.2
Flow Mon	Displays inlet pressure, total flow rate and purge flow rate for injection port, and hydrogen flow rate, air flow rate and makeup gas flow rate for detector. The display format depends on the typeof flow controller installed.	9.3
Zero Adj	Automatically moves the baseline to zero point.	9.4
Zero Free	Returns to the baseline level before zero point adjustment.	9.4
Up	Moves the baseline up by 100 µV from current level.	9.4
Down	Moves the baseline down by 100 µV from current level.	9.4
Chng Graph	Switches the graph display from chromatogram and column oven temperature program to chromatogram and pressure program. For direct injection mode with flow control, the flow rate program is displayed instead of the pressure program.	——
Chng Line	Displays the monitor screen for another configured analytical line. Switch between monitored lines by pressing [MONIT] key from the monitor screen.	——

9.2 Monitoring the Temperature with [Temp Mon]

9.2.1 Screen description

Press [Temp Mon] (PF menu) from the [MONIT] key main screen to display the Temp Monitor screen shown in Fig. 9.2.1.
Monitor the temperature of all installed column ovens, injection ports and detectors from this screen.

```
┌─────────────────────────────────────┐
│ Temp Monitor              RUN        │
│                    ACTUAL  SETTING    │
│    Column    Temp(℃)▊ 60.0    60.0   │
│    SPL1      Temp(℃)▊150.0   150.0   │
│    WBI2      Temp(℃)▊  0.0    25.0   │
│    FID1      Temp(℃)▊150.0   150.0   │
│    TCD2      Temp(℃)▊  0.0    25.0   │
│                                       │
│                                       │
│                                       │
│                                       │
│ ┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈ │
│   ⏎Return│ Flow Mon │          ▶      │
└─────────────────────────────────────┘
```

The components that are included in the current analytical line are underlined.
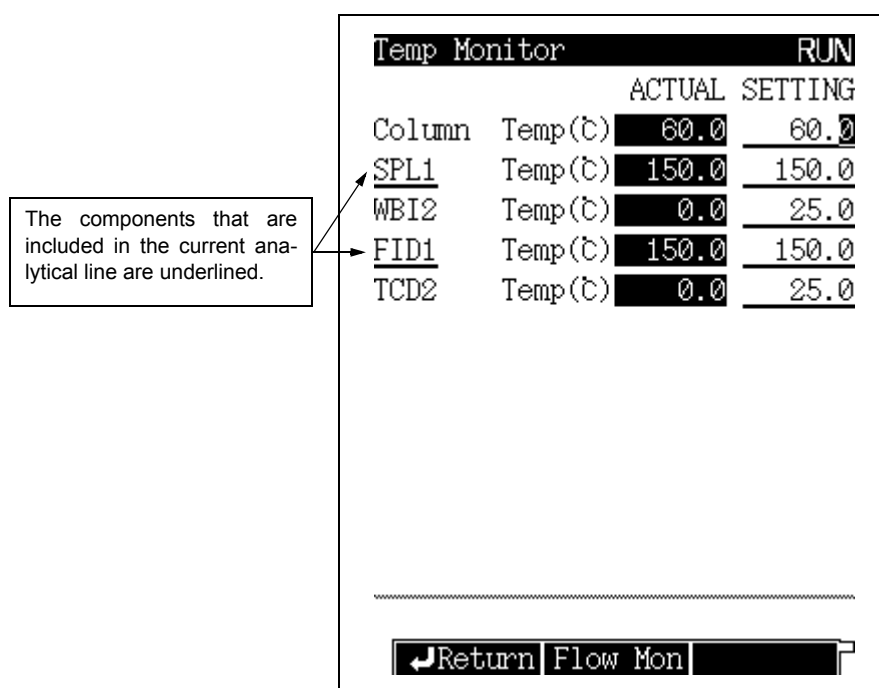
Fig. 9.2.1   Temperature monitor

NOTE Heated zones without installed components are not displayed on the screen.

9.2.2 PF menu

PF menu	Description	Reference section
Flow Mon	Monitor pressure and flow rate for the injection ports and detectors.	9.3

9.3 Monitoring the Flow Rate with [Flow Mon]

9.3.1 Screen description

Press [Flow Mon] (PF menu) from the [MONIT] key main screen to display the Flow Monitor screen shown in Fig. 9.3.1.
Monitor the flow rate and the pressure of the injection ports, and the detector gas flow rates of the detectors.

Displayed items depend on the type of injection ports, detectors and flow controllers.

The name of injection port and detectors constructing the current line are under lined.

```
Flow Monitor              RUN
                  ACTUAL  SETTING
SPL1 Inlet Prs.  100.0    100.0
      Total flow  83.9     83.9
      Purge flow   3.0      3.0
WBI2 Inlet Prs.  -----    100.0
      Total flow  -----
      Purge flow  -----      3.0
FID1    H2 flow   47.0     47.0
      MakeUpFlow   30.0     30.0
       Air flow  400.0    400.0
TCD2 MakeUpFlow    0.0     30.0



     ↵Return  Temp Mon
```

Fig. 9.3.1   Flow rate monitor

NOTE   Flow controllers that have hot been installed are not displayed on the screen.

9.3.2 PF menu

PF menu	Description	Reference section
Temp Mon	Monitor temperature of the column oven, injection ports and detectors.	9.2

9.4 Zero Point Adjustment

Zero point adjustment should be executed when the baseline is off-scale. If the baseline cannot be seen on the screen, execute zero point adjustment so that the baseline returns to the zero point. The baseline level can also be manually adjusted.

9.4.1　Screen description

Press [Zero Adj] or [Zero Free] (PF menu) from the [Monit] key main screen, the chromatogram displayed on the monitor screen changes as shown in Fig. 9.4.1 or Fig. 9.4.2.
Press [Up] or [Down] (PF menu) to adjust the baseline level manually.
Zero point adjustments are effective not only for the GC monitor screen, but also a connected pc or Chromatopac. However, zero point adjustments made on the Chromatopac do not adjust the monitor screen baseline level.
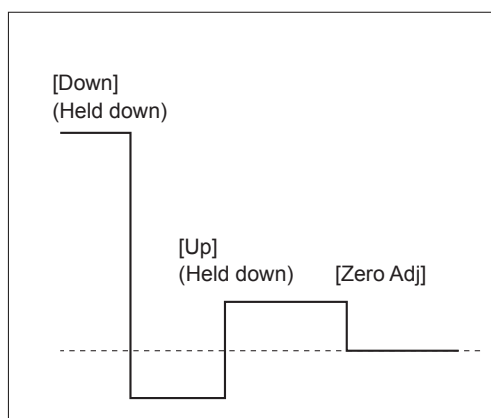
Since the [Down] has been held down too long, the zero point has deviated into the negative zone.

Fig. 9.4.1　Zero point adjustment
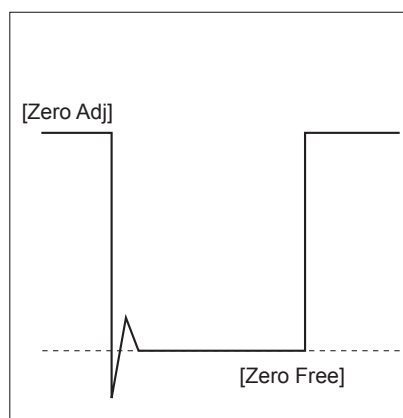
Fig. 9.4.2　Zero free adjustment

NOTE　Zero point adjustments are only valid for the currently displayed detector. To adjusts the zero point for another detector, first switch to its display by pressing [Chng Line] (PF menu), then execute the adjustment.

10.1 **Making an Injecting and Starting an Analysis**

10.1.1 Verifying the gas chromatograph status

---

(1) Ensure that the STATUS indicator light is green.

(2) When the STATUS light is green, perform a zero point adjustment (See "9.4 Zero Point Adjustment").

(For a description of the items which determine the Ready Status, refer to "16.6.6 Setting the Ready Check Parameters".)

10.1.2 Making manual injection

■ Aspiration

1. Preparation
- ・10 µL Syringe
- ・Sample
- ・Rinse solvent
- ・Liquid waste container

2. Syringe handling precautions

Needle   Barrel   Plunger   Plunger button
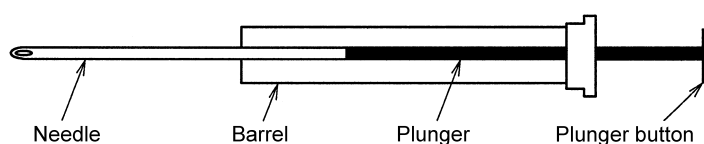
Fig. 10.1.1   Typical syringe

- ・The plunger keeps the sample from becoming contaminated. Do not bend it or touch it. Keep it clean.
- ・Never bend the needle.

3. Solvent pre-wash

Clean the syringe with solvent 3 to 5 times using the following procedure.

(1) Place the syringe into the rinse solvent. Pull the plunger to aspirate approximately 10 µl of Solvent.

(2) Expel the solvent into the liquid waste container.

4. Sample pre-wash

Flush the syringe with sample 3 to 5 times using the following procedure.

(1) Place the syringe into the sample. Pull the plunger to aspirate approsimately 10 µl of sample.

(2) Expel the sample into the liquid waste container.

5. Preparing to inject

(1) With the needle in the sample vial, pump the plunger to eliminate air bubbles inside the syringe.

(2) When air bubbles are eliminated, aspirate exactly 1 µl of sample.

(3) Gently wipe the syringe needle with a lint-free wipe.

(4) Aspirate an additional 0.5 µl of air.
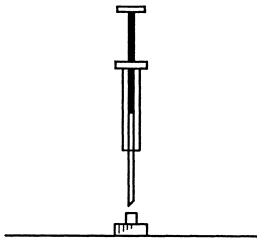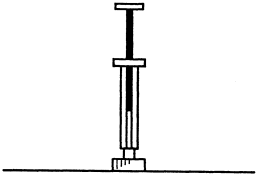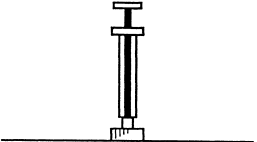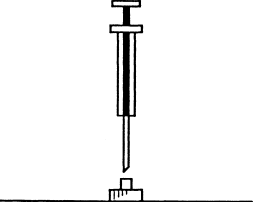
Fig. 10.1.2

■ Injection

Aspirate sample.	Insert syringe until it touches needle guide.	Push plunger to inject sample. At same time, press [START] key of gas chromatograph.	Promptly pull out syringe.

⚠ **WARNING**

Wear protective goggles when handling samples.

10.1.3 Starting the analysis

A green STATUS light indicates that the GC is ready for analysis.

Press the [START] key to start the temperature program, the time program, the pressure program and the flow rate program.

Any pre-set programs execute prior to the start of the analysis programs.

10.2 Terminating the Analysis

10.2.1 Terminating the analysis

When the various programs (temperature, time, pressure, and flow rate) are finished, the gas chromatograph automatically returns to the initial status and becomes ready.
To stop the programs before their completion, press the [STOP] key. The chromatograph automatically returns to the ready status.

10.2.2 External devices

■ When the gas chromatograph is connected to a Chromatopac

・ Key operation of the gas chromatograph
Press the [START] key of the gas chromatograph to start the Chromatopac automatically.
Pressing the GC [STOP] key, however, does not stop the Chromatopac.

NOTE   To stop the Chromatopac from starting automatically, refer to "16.6.9 Setting the link device code".

・ Key operation from the chromatopac
The gas chromatograph is not controlled by the Chromatopac. Pressing the Chromatopac [START] or [STOP] key does not start or stop a GC analysis.

■ When the gas chromatograph is linked to a personal computer (pc).

Press the GC [START] key or the PC [STOP] key to start both units.
However, each unit must be stopped individually. Stopping one unit does not affect the other.
However, the end of a batch sequence signals both units to stop.

11.1 [COL] Key Main Screen

11.1.1 Screen description

Press the [COL] key to display the column screen shown in Fig. 11.1.1. The oven temperature program is set from this screen.

Enter a value other than 0 in the rate field displayed with "END". Once a valid rate has been entered, set the temperature (final temp) and time (hold time) for the line.

In addition to the oven temperature program, the equilibration time is set from this screen. Equilibration time is the length of time allowed for the oven temperature to properly equilibrate before the system is Ready.

Up to 20 temperatue increase/ decrease ramps can be set.

```
Column                        RUN
Column              FILE 0:FILE0
Temp Monit(℃)              60.0
Temp program total(min)     2.00
       Rate(℃/min) Temp(℃) Time(min)
Init   -------      60.0      2.00
 1st      END



Equilibration Time(min)     3.0

Del Line Ins Line Fan Off
```

Fig. 11.1.1   [COL] key main screen

NOTE   Press the [COL] key, to move the cursor directly to the temperature portion of the ramp. This facilitates program edits when only the temperature needs to be changed.

11.1.2 Parameter list

TEMP

Range: 0.0−450.0°C, Default: 25.0°C

Set the initial and the final temperature for each ramp of in the oven temperature program.
The column oven temperature should never exceed the maximum operating temperature of the column. Keep the column temperature as low as possible to prolong the column life and reduce detector noise. To set the maximum over temperature, refer to "16.6.4 Setting the maximum temperature limits"

┌───┐
│   ⚠ **CAUTION**   │
│   │
│ Never increase the column oven temperature while air (oxygen) is │
│ mixed with the carrier gas. This can damage the column (especially │
│ for polar columns).   │
└───┘

TIME

Range: 0.00−9999.99 min, Default: 0.00 min

Set the hold time for the initial temperature and the final temperature for each stage of the oven temperature program.

RATE

Range: END/-250.0−250.0°C/min, Default: END

Set the program rate for the oven temperature program.

Set the rate to "0"; "END" appears and the program finishes at the previous ramp.

Move the cursor to "END" and set any numeric value other than "0" to complete the temperature and the time for that ramp.

EQUILIBRATION TIME

Range: 0.00−9999.99 min, Default: 3.00 min

After the programs finish and the oven temperature returns to the initial value, the equilibration time must elapse befor the system is considered Ready. This allows for even temperature distribution.

11.1.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes the current line.	―
Ins Line	Inserts a line in line at the current cursor position.	―
Fan Off	Stops the fan operation.	―
Fan On	Restarts the fan operation.	―
Print	Prints the column oven program from a Chromatopac.	―

NOTE "Fan Off" can not be operated in the following case.
- Oven temperature setting value ≥ 50 deg
- Program running

11.*2* Temperature Programs

11.2.1 Isothermal analysis

The isothermal analysis technique keeps the column oven temperature at a constant value. This method is useful for separating compounds within a narrow boiling point range.

11.2.2 Programmed analysis

When the sample contains compounds over a wide boiling point range, isothermal analysis is irsufficient for separating all the compounds. At lower temperatures, the high boiling point compounds will co-elute with wide peaks. Low concentrations of high boiling point compounds may never be detected. On the other hand, at a higher temperatures, the compounds with a low boiling point will co-elute too rapidly.

There is an optimal temperature for separating various compounds. Using an oven temperature that increases gradually controls the elution, and improves the separation, of all the compounds.

11.2.3 Creating a temperature program

■ Screen terminology

1-ramp temperature program

Initial setting	(TEMP)....	T1
Initial setting hold time	(TIME).....	a
Program rate	(RATE)....	$\frac{T2-T1}{b}$
Final temperature	(TMP)......	T2
Final temperature hold time	(TIM).......	c
Equilibration time	(ETIM).....	d
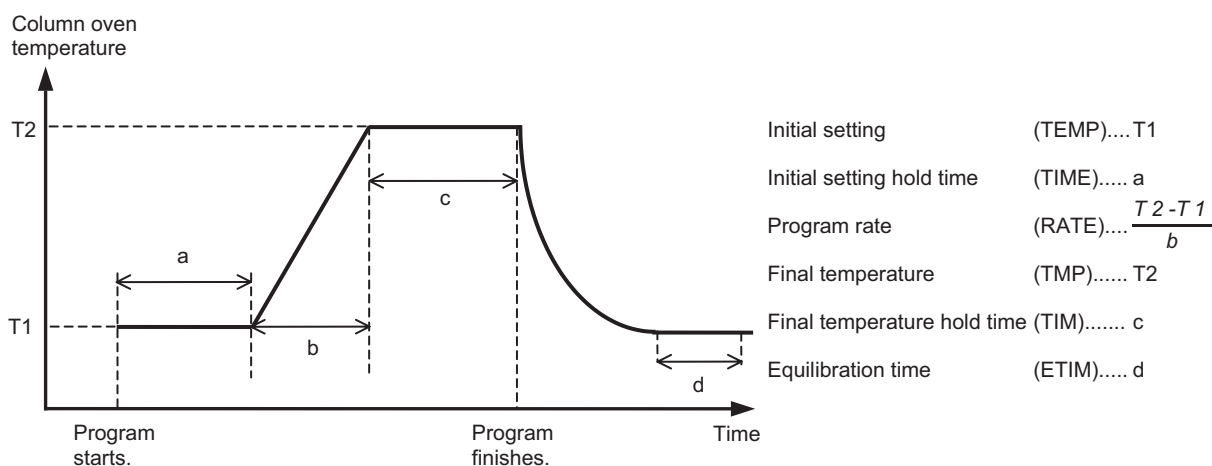
■ Program creation

1-ramp temperature program

Fig. 11.2.1   Temperature program (Example 1)

2-ramp temperature program

Fig. 11.2.2   Temperature program (Example 2)

Multiple-ramp temperature program (with temp increase /decrease)

Fig. 11.2.3   Temperature program (Example 3)

■ Allowable temperature settings and ranges for temperature programs

Item			Set Range	Control Range	Default value
Program rate	Heating Normal oven	Up to 200°C	0–250 °C/min	0–40°C/min	0°C/min
		Up to 350°C		0–15°C/min	
		Up to 450°C		0–7°C/min	
	Heating High power oven	Up to 200°C	0–250 °C/min	0–70°C/min	
		Up to 350°C		0–50°C/min	
		Up to 450°C		0–30°C/min	
	Cooling		−250–0 °C/min	Differ from the room temperature or the oven temperature.	
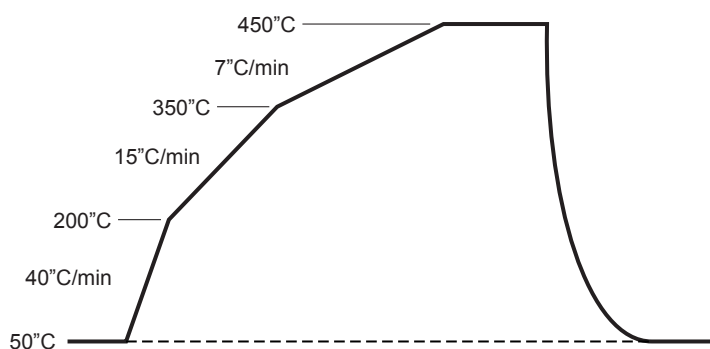
Fig. 11.2.4   Example of column oven temperature increase/decrease curve

12.1 **Introduction**

■ Types of injection ports described

There are six types of injection system available for gas Chromatography.
・Split injection system
・Splitless injection system
・Direct injection system (option)
・Packed column injection system (option)
・On-column injection system (option)
・Programmed temperature vaporization injection system (option)
In this manual, only the split, splitless and direct injection system are described.

For other systems, refer to the User's manual for each optional unit.

■ Injection system and injection port

Injection system	Injection port	Type of insert
Split injection system	Split/spitless injection port	Glass insert for split
Splitless injection system		Glass insert for splitless/WBI
Direct injection system	Direct injection port	Glass insert for splitless/WBI
Packed column injection system		Glass insert for packed column
On-column injection system	On-column injection port	Adapter for on-column
Programmed temperature vaporization injection system		Glass insert for PTV

Glass Insert and Packing Requirements

It is necessary to pack silica (glass) wool into the glass insert (liner) in order to sufficiently mix the vaporized sample and to prevent high-boiling point compounds from contaminating the capillary column.

■ Quantity of silica wool

Quantity of silica wool (standard) = Approx. 10 mg (for split)

= Approx. 2 mg (for splitless/WBI)

= Silica wool is not necessarily required when making direct injections. However, if the sample contains non-volatile compounds, less than 5 mg of silica wool can improve the chromatography.

NOTE For special samples, better results may be obtained by varying the amount of silica wool in the insert.
(1) Reduce the amount of silica wool for highly absorptive samples, such as agricultural samples.
(2) Increase the amount of silica wool when injecting solvents with a high latent heat of vaporization, such as water.

■ Position of silica wool

Split and splitless glass insets are shaped differently, as shown below. Place the silica wool 1−2 mm below the lowest point of the needle at injection. If the wool is too close or too far away from the needle, good reproducibility of results may not be obtained.

The recommended position of silica wool for each insert is shown below.
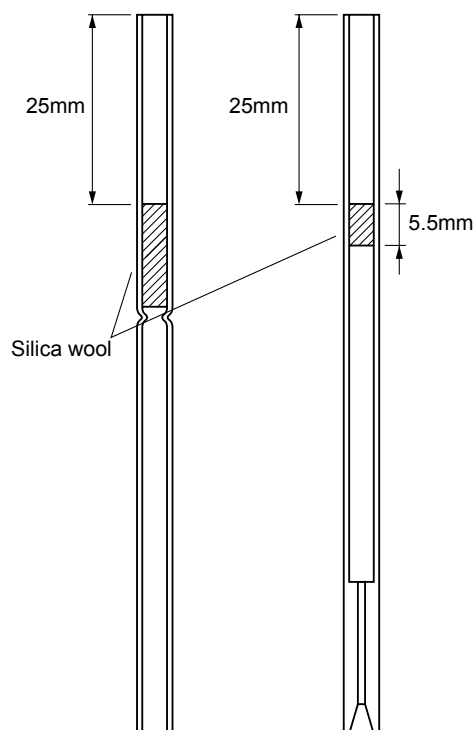
For split analysis   For splitless/WBI analysis

Fig. 12.2.1   Silica wool position for split and splitless inserts (AOC-20i)

NOTE The position of silica wool for being displayed fig. 12.2.1 is for injecting by Auto Injector for AOC-20i. During manual injections, the needle often goes further int the insert than for injection by an auto injector. However, ther is no need to change the silica wool position for manual injections. By plasing a septum on the needle, the length of the needle can be shortened to approximately 40 mm. (Alternatively, change the position of the silica wool for manual injections.)

<Example> Needle length

(a) Manual injection performed with an AOC 17/20 needle (43 mm length)

(b) Manual injection with a syringe with a 50 mm long needle
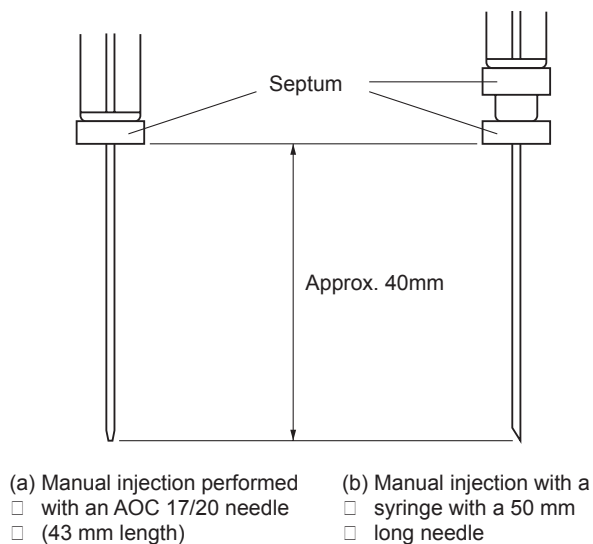
Fig. 12.2.2   Proper needle length for manual injections

■ Packing the silica wool

Pack silica wool evenly without making it too densely pacleed or too fluffy.

■ Applying and releasing pressure

If the column inlet pressure is released abruptly, the silica wool could change position, In particular, do not remove the septum or loosen the column nut when the injection port is under pressure.

12.3 Removing and inserting the glass insert

> **⚠ WARNING**
>
> Risk of burns.
> Do not perform injection port maintenance until the injection port temperature has dropped below 50°C .

> **⚠ CAUTION**
>
> Wait until the injection port has cooled to loosen screw and nuts to prevent them from binding.

■ Tool requied
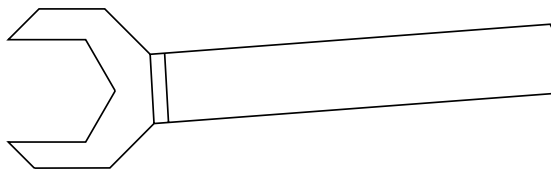
Fig. 12.3.1   Wrench for Glass insert nut (P/N 221-46977)

■ Removing the glass insert

The glass insert should be removed carefully to avoid breakage.

> **⚠ CAUTION**
>
> It is important to hold the septum nut while removing the glass insert nut. Otherwise, the gas tubing can pull out the insert, and the septum nut can break the insert.

(1) Hold the septum nut and remove the glass insert nut from the injection port. Lift the septum nut straight up and move it out of the way.

Septum nut

Glass insert nut
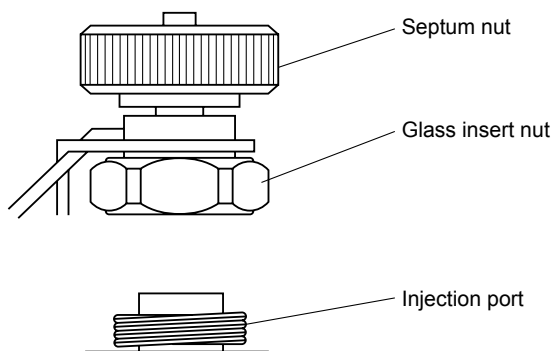
Injection port

Fig. 12.3.2

(2) Use tweezers to remove the glass insert.
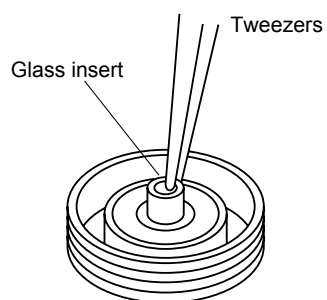
Fig. 12.3.3

■ Attaching a fluoride rubber O-ring

Use a fluorid rubber O-ring when the temperature of the injection port is 350°C or less. Attach the fluoride rubber O-ring as shown below and inset the glass inset in the injection port.

Fluoride rubber seals the injection port better than graphite, and is normally used. However, it tends to deteriorate and leak over prolonged periods at high (>350°C) temperatures. Check frequently for leaks.

Ensure that the inset is touching the bottom of the injection port. This will place the O-ring 3 mm from the top of the insert.

■ Attaching a graphite O-ring

Use a graphite O-ring when the temperature of the injection port is 350°C or higher. Attach the graphite O-ring shown as below and insert the glass insert in the injection port.

Although graphite O-rings are recommended for high temperatures, the sealing ability of graphite is inferior to that of rubber. Tighten the injection port nut securely. Ensure that the graphite O-ring is the correct size for the glass inset.

For split analysis   For splitless/WBI analysis
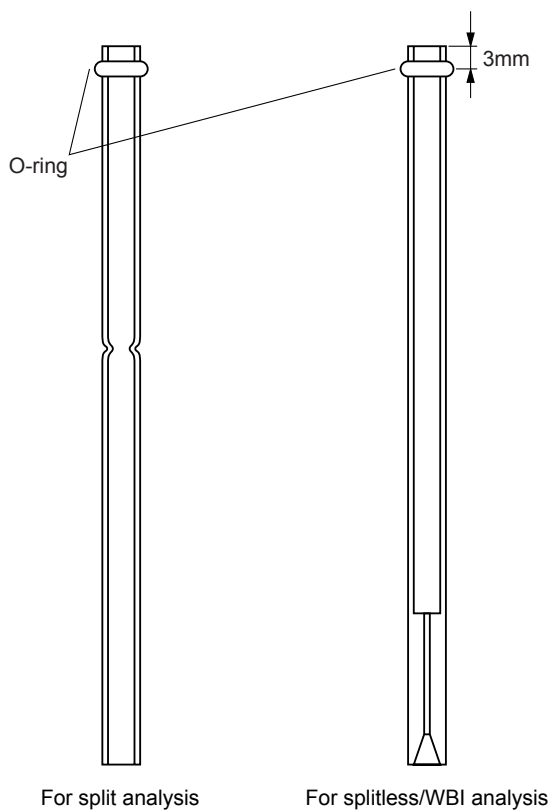
Fig. 12.3.4   Attaching graphite and fluoride rubber O-ring

■ Inserting the glass insert

Insert the glass insert according to the following procedure after attaching the fluoride rubber O-ring or graphite O-ring.

(1) Insert the glass insert into the injection port.

(2) Move the septum nut back over the glass insert and slowly tighten the glass insert nut by hand at first, then 1/3~1/2 turn with wrench.
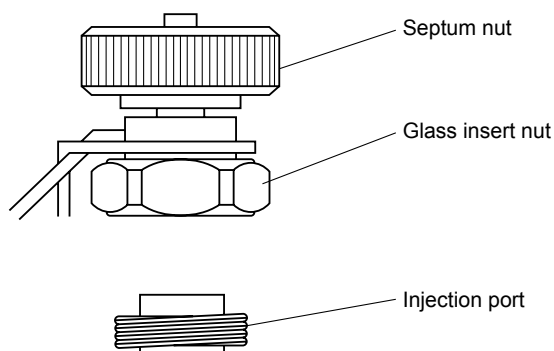
Fig. 12.3.5

NOTE   The position of the injection port components is shown below.
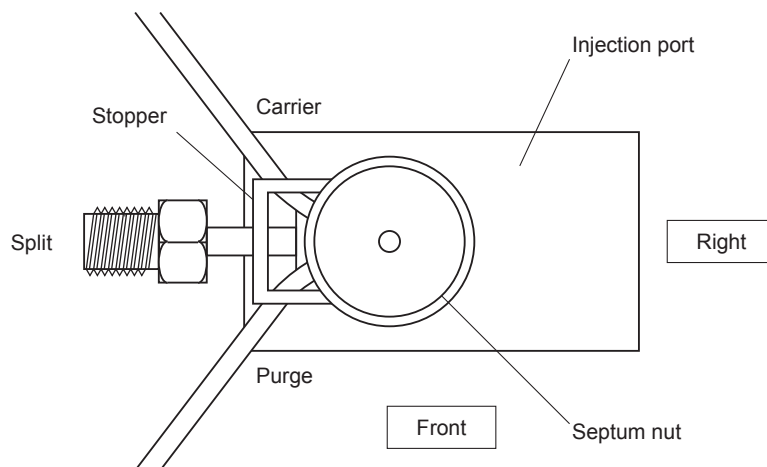
Fig. 12.3.6

■ If the glass insert breaks in the injection port

If the glass insert breaks in the injection port, take out the thermal insulation cup and the capillary adapter from within the oven and carefully remove the broken glass.
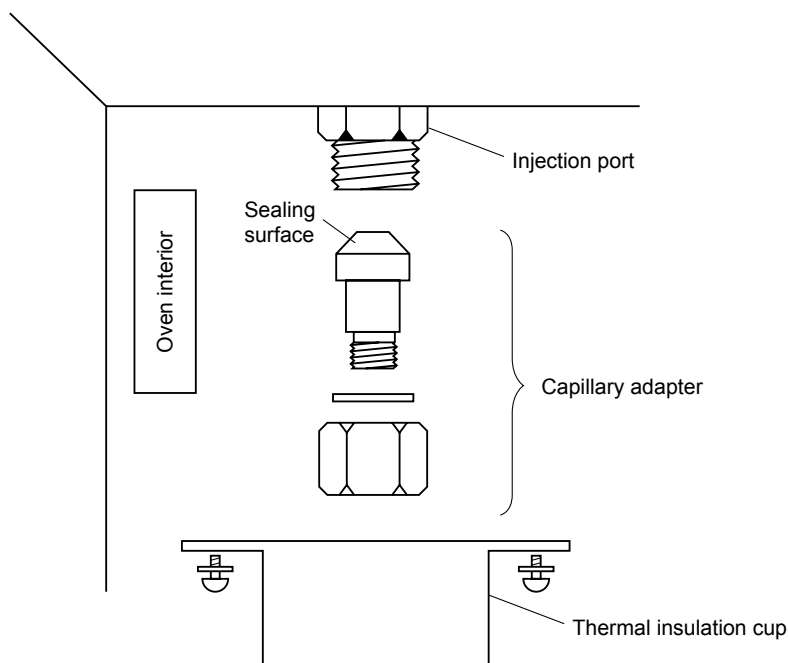
Fig. 12.3.7

NOTE   Re-install the capillary adapter without allowing leaks.
If glass chips, etc. are present on the seal face, the seal may be damaged and leaks can occur.

■ Checking for injection port leaks

Leaks can negatively impact reproducibility of results, and can waste carreier gas.

NOTE   Septum purge leaks do not affect performance. These error messages canbe cleaned.
(As for the following procedure, there could be cases in which the error message "purge leaks" etc. appears. However, it does not matter to the test. Then select "Reset Error".)

Check for leaks according to the following procedure.
(1) Turn off the system, and then turn on the system pressing "-" key and "0" key.
(2) Press [Start GC] (PF menu) from the [SYSTEM] key screen.
(3) Set the "Flow Control" to "Cont" from the [SYSTEM] key screen.
(4) Press [Stop GC] (PF menu) to stop the system temperature control.
(5) User the [MONIT] key to veryfy that the oven, injection portk and detector temperatures have dropped below 40°C.
(6) Press [Off] on the [FLOW] screen to stop AFC control. Carrier gas flow stops. Set the purge flow tate to 0 ml/min.
(7) Remove the capillary column, and seal the connections with a new graphite ferrule (with wire) and column nut.
(8) Install a blank nut (G-type) on both the split vent and purge vent.
(9) Verify that the gas cylinder pressure is above 300 kPa.
(10) Set the Split mode to "Direct" and Control mode to "Press" (from the [FLOW] key main screen).
(11) Set the inlet pressure to 150 kPa and set the purge flow to 500 ml/min. Press [On/Off] (PF menu) to start AFC control.

(12) Wait five minutes. Confirm that the inlet pressure is 125 and 175 kPa.
If the inlet pressure is above 175 kPa, loosen the column nut slightly to reduce the pressure.
If the inlet pressure is below 125 kPa, increase the pressure from the gas cylinder slightly.

(13) Verify that the total flow is less than 2 ml/min. If the flow is above 2 ml/min, a leak exists.

(14) Press [On/Off] (PF menu) on the [FLOW] key screen to stop AFC control.

(15) In case of fluoride rubber O-ring, verify that the pressures does not drop more than 215 kPa in one hour or 2.5 kPa in 10 minutes.
In case of graphite O-ring, verify that the pressure does not drop more than 21 kPa in one hour or 3.5 kPa in 10 minutes.
If it does, a leak exists.

(16) If there are no leaks, restore the connections and operational status of the GC-2010.

■ Resolving leaks

If the leak test procedure reveals the presence of an injection port leak, use the following procedure to resolve the problem.

Use Snoop or a similar leak detection fluid to check the column connection for leaks. Tighten the connections at the septum nut, injection port nut, split and purge vents (if the blank nuts are inplace for the leak test), and gas supply tubing.

NOTE   Take precautions when using Snoop or similar soap solution not to drip onto electronic parts or wiring. This could cause an electric shock. In some sensitive analyses, Snoop can interfere with proper detection. In those situations, use an electronic leak detector.

If a leak is found, replace the offending part.

Leaking part	Replacement
Near septum nut	Replace septum
Around injection port nut	Replace glass insert O-ring
At column connection	Replace graphite ferrule and column nut
At split or purge vent (during leak test)	Replace blank nut

⚠ **CAUTION**

Do not use the leak detecting fluid nor soapy water for gas leak check on the connections above the carrier and detector gas controllers (AFC/APC).
The drips may damage the controller.

12.4 Removing and installing the septum

> ## ⚠ WARNING
>
> Danger of burns.
> Do not perform injection port maintenance until the temperature has dropped below 50°C.

> ## ⚠ CAUTION
>
> Wait until the injection port has cooled to loosen screws and nuts to prevent them from binding.

■ Type of septum

The type of septum to install depends on the temperature of the injection port.
(1) Silicon rubber septum ⋯ When the temperature of the injection port is below 350°C.
(2) Low bleed septum ⋯ When the temperature of the injection port is above 350°C.

■ Removing the septum

Remove the septum according to the following procedure.
(1) Check the following items before removing the septum.
- The temperature of the column oven and injection port should be below 50°C. (Check this before setting the column inlet pressure to 0 kPa.)
- The column inlet pressure should be 0 kPa.

NOTE Removing the septum when the injection port is under pressure causes an abrupt pressure shift which can change the position of the glass wool in the insert.

(2) Remove the septum nut, and take out the needle guide and septum.

Septum nut
Needle guide
Septum
Top of Injection port
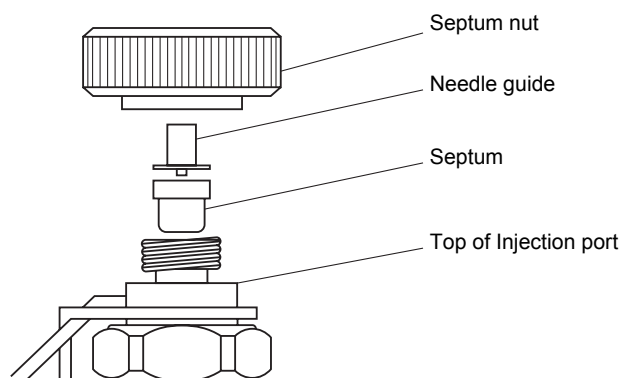
Fig. 12.4.1

■ Installing the new septum

(1) Insert the septum into the injection port.

NOTE Use tweezers to handle the septum. Touching the septum will contaminate it, causing ghost peaks.

Tweezers

Septum

Injection port

Do not touch
the septum.
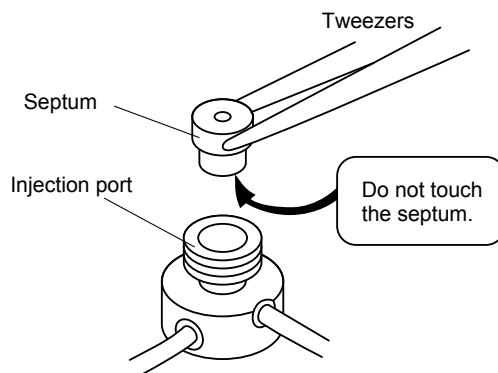
Fig. 12.4.2

(2) Replace the needle guide, then the septum nut. Tighten the septum nut by hand as far
as possible and return a semicircle.

Septum nut

Needle guide

Septum

Top of injection port
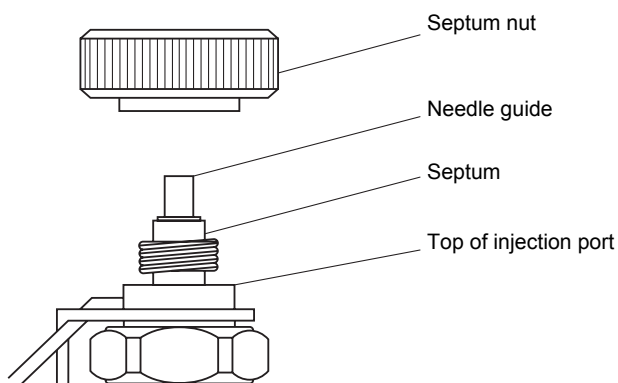
Fig. 12.4.3

◆◆➤ 12 Injection Port

$12._5$ Split/Splitless Injection System

■ Split injection system

In a split injection system, only a portion of the sample injected into the injection port is introduced into the capillary column. The remaining sample is sent to the split line due to high sample volume or concentration. (Refer to "3.4 AFC and APC control".)
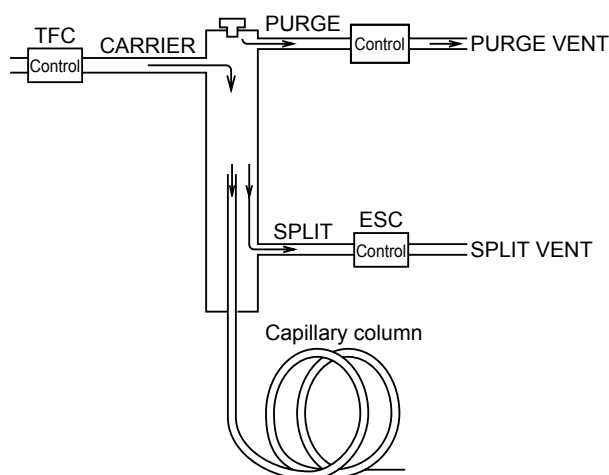
Fig. 12.5.1

■ Splitless injection system

The splitless injection system is used to analyze samples of low concentration.

In a splitless injection system, the split vent is closed and the initial temperature of the column oven is low. Then, after injection, and once the vaporized sample has moved to the column, the split vent is open and the column temperature increased so that the condensed sample inside the column is vaporized again and separated. (Refer to "3.4 AFC and APC control".)

(a) During sampling time

(b) After sampling time
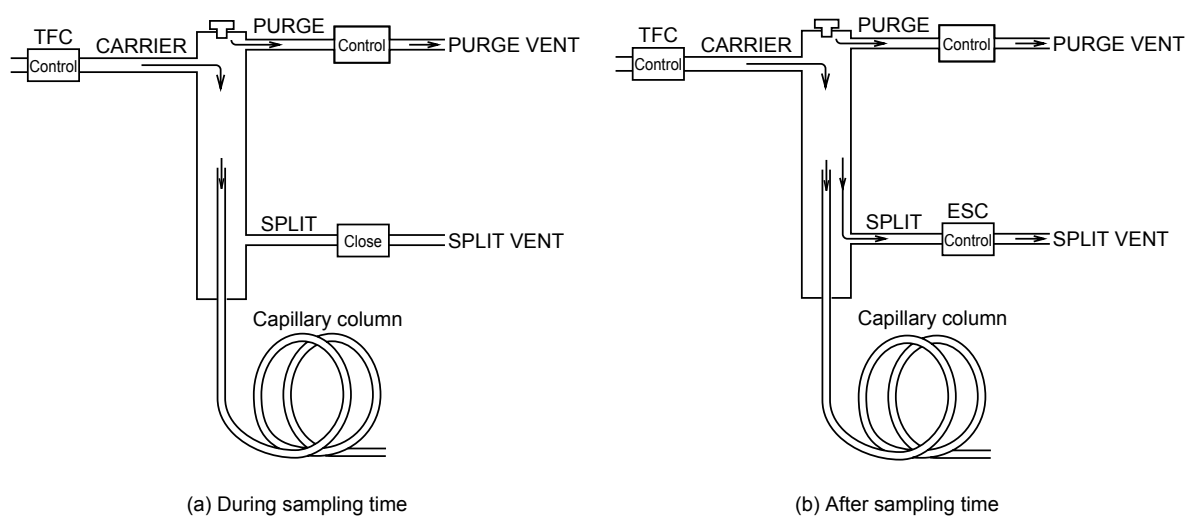
Fig. 12.5.2

12.5.1 Setting the temperature with [INJ] key

12.5.1.1 Screen description

Press the [INJ] key to display the main screen shown in Fig. 12.5.3 and to set the temperature of the injection port.
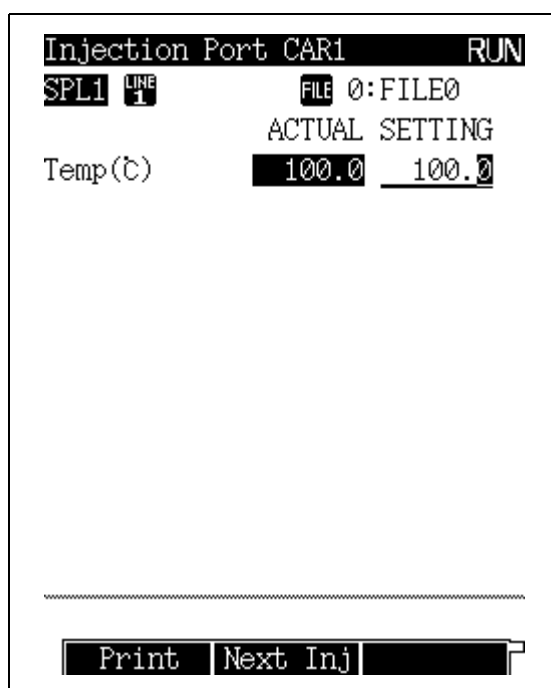
Fig. 12.5.3 [INJ] key main screen

12.5.1.2 Parameter list
TEMP

Range: 0.0−450.0°C, Default: 25.0°C

Set the temperature of the injection port.

Keep the injection port temperature as low as is practical to increase the service life of the temperature sensor. In order to instantly vaporize samples inside the injection port, set the injection port temperature approximately 30°C above the column oven temperature (final temp). Due to the minute quantity of sample injected, the sample vaporizes at temperatures lower than the boiling point of sample elements. To set the injection port maximum temperature limit, refer to "16.6.4 Setting the maximum temperature limits" in "16.6 GC Configuration".

12.5.1.3 PF menu

PF menu	Description	Reference section
Print	Prints the injection port temperature on Chromatopac.	───
Next Inj	Toggles among the setup screeens if two or more injection ports are installed in this system. The [INJ] key can also be used to switch screens.	───

12.5.2 Setting the flow rate with [FLOW] key

12.5.2.1 Screen description

Press the [FLOW] key to display the screen shown in Fig. 12.5.4 and to set the AFC (advanced flow controller) parameters. The AFC controls the pressure and the flow rate of the carrier gas.


```
Flow  CAR1                    RUN
SPL1  LINE                     On
       1
Inlet press(kPa) 100.0     100.0
Column flow(ml/min) 3.85    3.85
Liner vel(cm/s)   58.0      58.0
Split ratio       20.0      20.0
Total flow(ml/min) 83.9     83.9
Split mode                  SPLIT
Control mode                PRESS
Carrier gas type               He




Column  GasSaver  On/Off
```
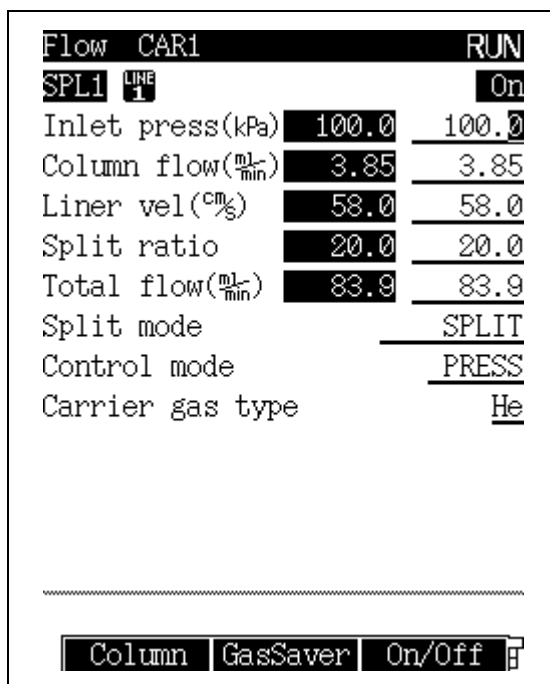
Fig. 12.5.4   [FLOW] key main screen

12.5.2.2 Parameter list

INLET PRESS

Range: 0.0−970.0 kPa (Refer to Fig. 3.5.1.), Default: 100 kPa

Set the column inlet pressure.

This sets the initial temperature of a pressure program.

When the control mode is set to "PRESS", the system controls the column inlet pressure so that it remains constant during an oven temperature program.

COLUMN FLOW RATE

Default:[1] 1.00 ml/min

Sets the carrier gas flow rate at the capillary column outlet (atmospheric pressure at 25°C).

When you set the carrier gas flow rate, the system calculates the column inlet pressure based on the inner diameter and the length of the column and the film thickness of the column. The column flow rate is set separately so that the carrier gas flow rate desired occures at the initial temperature in the oven temperature program.

LINEAR VELOCITY

Default:[2] 30.0 cm/s

Sets the average linear velocity of the carrier gas flowing in the capillary column.

When you set the linear velocity, the system calculates the column inlet pressure based on the inner diameter and the length of the column and the film thickness of the column.

The linear velocity is set separately so that the linear velocity desired occures at the initial temperature in the oven temperature program.

When the control mode is set to "VELOCITY", the column inlet pressure automatically changes so that the linear velocity remains constant even while the oven temperature program is running.

SPLIT RATIO

Range: -1.0/0.0−9999.9, Default: -1.0

The split ratio is "split flow rate / column flow rate."

When you set a split ratio, the system sets the total flow rate based on the calculated carrier gas flow rate and split flow rate, so that the desired split ratio occurs at the oven temperature.

Set the split ratio to "-1.0" to fix the total flow rate regardless of the oven temperature.

TOTAL FLOW RATE

Range: 0.0−1200.0 ml/min (Refer to Fig. 3.5.1.), Default: 500.0 ml/min

In split or splitless mode, the total flow rate is equivalent to "column flow rate + split flow rate + septum purge flow rate".

SPLIT MODE

Selection: SPLIT/SPLITLESS/DIRECT, Default: SPLIT

SPLIT: Controls the column inlet pressure and the total flow rate so that the column inlet pressure and split ratio occur as specified.

SPLITLESS: Closes the split flow line during the sampling time so that the set column inlet pressure is controlled by the Total Flow Controller.
Opens the split flow line and controls the Electronid Split Controller so that the preset column inlet pressure occurs (Refer to Fig. 12.5.2.) after the sampling time elapses.

DIRECT: Closes the split flow line and the set column inlet pressure (in pressure mode) or the set total flow rate (in flow rate mode) occurs. When making direct injection analyses, select WBI in the setup screen so that SPLIT mode is not available.

SAMPLING TIME

Range: 0.00−9999.99 min, Default: 1.00 min

Sets the sampling time for splitless analysis.

The sampling time indicates the period of time after analysis starts until the split flow line is opened.

NOTE When setting the sampling time, ensure that the program time is longer than the sampling time. Otherwise, the sampling time connot function correctly.

CONTROL MODE

Selection: PRESS/VELOCITY/FLOW (for direct injection mode), Default: PRESS

When the injection mode is set to "SPLIT" or "SPLITLESS"

PRESS: Controls the system so that the column inlet pressure remains constant.

VELOCITY: Controls the system so that the linear velocity remains constant.

When the injection mode is set to "DIRECT"

PRESS: Controls the system so that the column inlet pressure remains constant.

VELOCITY: Controls the system so that the linear velocity remains constant.

FLOW: Controls the system so that the flow rate remains constant.

CARRIER GAS TYPE

Selection: He/N2/H2/Ar, Default: He

Specify the carrier gas type supplied to the AFC.

This parameter is used for the measurement/control of the flow rate.

If this parameter is not set correctly, flow rate calculations may not be performed correctly.

(Example: If this parameter is set to "N2" when He is actually used, the displayed total flow rate, column flow rate and linear velocity are lower than the actual values.)

1 The column flow rate ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less and the calculated total flow rate is 1,200 ml/min.
2 The linear velocity ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less.

12.5.2.3 PF menu

PF menu	Description	Reference section
Column	Sets inner diameter, length and film thickness of capillary column. Values set here are used in column inlet pressure caluculations from column flow rate or linear velocity (or vice versa). If these parameters are not set correctly, calculations are not performed correctly.	12.5.3
Gas Saver	The gas saver saves carrier gas by reducing the split flow rate.	12.5.4
On/Off	Sets flow controller to be used to "On". Default value is "Off". When [Start GC] is pressed, the AFC in the current analytical line which is set to "On" starts. If AFC is set to "Off" during carrier gas control, the control stops. When it is set to "On" again, the carrier gas control restarts.	____
Press Prog	Sets the column inlet pressure program.	12.5.5
Flow Prog	Sets the total flow rate program.	12.5.6
Split Prog	Sets the split ratio program.	12.5.7
Purge	Sets the septum purge flow rate and program for flow rate.	12.5.8
Advanced	High Pressure Injection: Sets high pressure injection, where the column inlet pressure is kept at a high value for a certain period of time during injection. Splitter Fix: Keeps the split flow rate constant.	12.5.9
Offset	Performs offset calibration of the AFC sensor. This calibration contributes to good reproducibility of results.	3.6
Next Flow	Toggles among the AFC set up screens if two or more AFCs are installed in this system. The [FLOW] key can also be used to switch screens.	____

12.5.3 Setting column parameters

For capillary columns, the column inner diameter, length, and film thickness are used to calculate the column flow rate and linear velocity. Enter the column inlet pressure, and the column flow rate and linear velocity are calculated based on the column parameters. Alternatively, by entering the column flow rate and linear velocity valves, the column parameters are used to calculate the corresponding column inlet pressure.

12.5.3.1 Screen description

Select [Column] (PF menu) from the [FLOW] key main screen to display the Column Diam. screen shown in Fig. 12.5.5.

Fig. 12.5.5   Column setup screen

12.5.3.2 Parameter list
COLUMN I.D.
Range: 0.01−6.00 mm, Default: 0.32 mm
COLUMN LENGTH
Range: 0.1−250.0 m, Default: 25.0 m
FILM THICKESS
Range: 0.00−300.00 μm, Default: 0.50 μm

NOTE   Set these parameter values carefully to avoid calculation errors.

12.5.4 Gas saver

The gas saver function reduces the split ratio during a split of splitless analysis. This reduces the amount of carrier gas flowing through the split flow line, conserving carrier gas.

Even though this can change the split ratio, the column inlet pressure is kept at a constant value. In other words, changing the split ratio does not affect the carrier gas flow rate through in the column.

12.5.4.1 Screen description

Select [Gas Saver] (PF menu) from the [FLOW] key to display the Gas Saver screen shown in Fig. 12.5.6.

```
Gas Saver    CAR1      RUN
SPL1 LINE1
Gas saver            ◀▶ Off
Split ratio             5.0
Time(min)              1.00




        ⏎Return
```
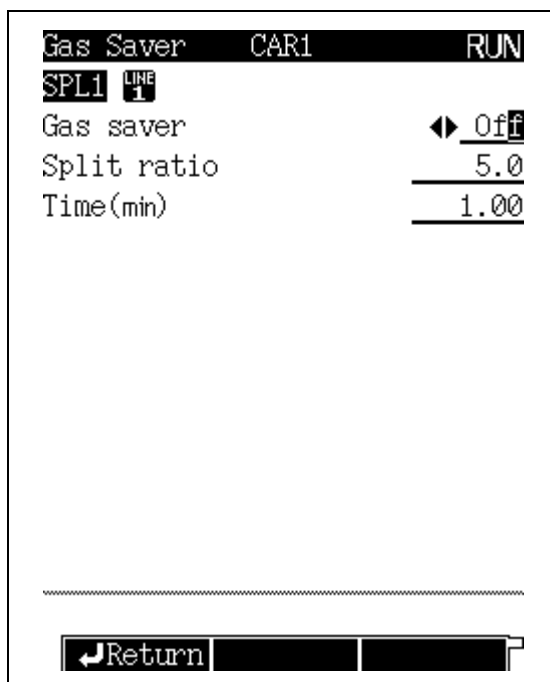
Fig. 12.5.6   Gas saver setup screen

12.5.4.2 Parameter list

GAS SAVER

Selection: On/Off, Default: Off
Select "On" to use the gas saver function.
Select "Off" to disable the gas saver function.

GAS SAVER SPLIT RATIO

Range: 0.0−9999.9, Default: 5.0
Set the split ratio which will reduce the split flow to conserve carrier gas.
Setting "0" closes the split flow line.

GAS SAVER START TIME

Range: 0.00−9999.99 min, Default: 1.00 min
Specify the period of time after analysis starts until the split ratio switches to gas saver mode.
This period of time should be longer than the time required for the sample to move from the injection port to the column.
Setting the gas saves start time too early can provide unpredictable quantitation results.

12.5.5 **Pressure program**

You can set a program to increase and decrease the column inlet pressure during analysis. If high-boiling point contaminants are clunting shorlty after the target compounds, a pressure program can be used so that the oven temperature does not need to be set higher than necessary. This prolongs column service life.

12.5.5.1 **Screen description**

Select [Press Prog] (PF menu) from the [FLOW] key main screen when the control mode is set to "PRESS," to display the carrier press screen shown in Fig. 12.5.7 appears.

> Up to 7 ramps of pressure increase or decrease can be set.

```
Carrier Press CAR1       READY
SPL1 LINE            FILE 0:FILE0
     1
Press monitor(kPa)         100.0
Program total(min)          0.00
      Rate(kPa ) Pres(kPa) Time(min)
          min
Init  -------    100.0      0.00
  1st      END

      Return Del Line Ins Line
```

Fig. 12.5.7   Pressure program setup screen

12.5.5.2 **Parameter list**

PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100 kPa

Set the initial pressure and the final pressure for each stage of the pressure program.

TIME

Range: 0.0–9999.99 min, Default: 1.00 min

Set the hold time for the initial pressure and the final pressure for each stage of the pressure program.

RATE

Range: END/-400.00–400.00 kPa/min, Default: END

Set the pressure program rate.

If you set the rate to "0", "END" appears and the program finishes at the previous ramp.

If you move the cursor to "END" and set any numeric value other than "0", the pressure and the time for that ramp can be enterd.

NOTE   The pressure increase/decrease program rate control range may be limited depending on the total flow rate setup value, the column in use and the purge flow rate.

12.5.5.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	――
Ins Line	Inserts a line in line at the current cursor position.	――
PRINT	Prints the pressure program to a Chromatopac.	――

12.5.5.4 Setting a pressure program

■ **Screen terminology**

<1-ramp pressure program>
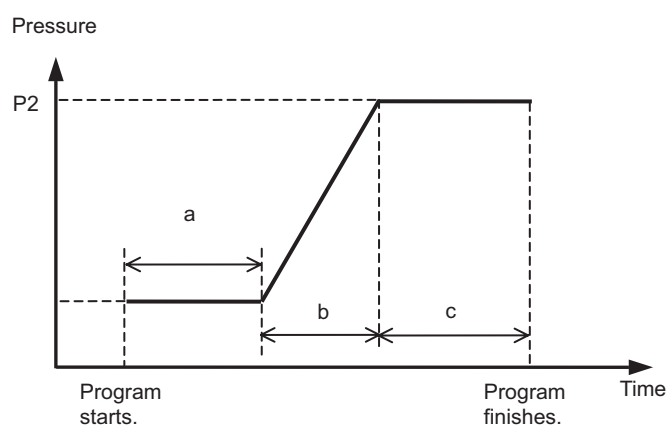
Pressure

Initial pressure	(PRSS).....	P1
Initial pressure hold time	(TIME)......	a
Program rate	(RATE).....	$\dfrac{P2-P1}{b}$
Final pressure	(PRS).......	P2
Final pressure hold time	(TIM)........	c

■ **Program creation**

<1-ramp pressure program>

Fig. 12.5.8   Pressure program example

12.5.6 Creating a Flow rate program

If the control mode is set to "FLOW", increase and decrease the total flow rate during analysis by making a flow rate program.
When you set a flow rate program for the APC, a corresponding pressure program is actually calculated based on of the pressure-flow rate calibration curve saved by the GC.

12.5.6.1 Screen description

Select [Flow Prog] (PF menu) from the [FLOW] key main screen while the control mode is set to "FLOW" to display the Carrier Flow screen shown in Fig. 12.5.9.

Up to 7 ramps of flow rate increase/decrease can be set.

Fig. 12.5.9   Flow rate program setup screen

12.5.6.2 Parameter list

FLOW RATE

Range: 0.00−970.0 ml/min (Refer to Fig. 3.5.1.), Default: 50 ml/min
Set the initial flow rate and the final flow rate for each stage of the total flow rate program.

TIME

Range: 0.0−9999.99 min, Default: 1.00 min
Set the hold time for the initial flow rate and the final flow rate for each stage of the flow rate program.

RATE

Range: END/-400.00−400.00 ml/min^2, Default: END
Set the flow rate program rate.
If you set the rate to "0", "END" appears and the program finishes at the previous ramp.
If you move the cursor to "END" and set any numeric value other than "0", the pressure and the time for that ramp can be entered.

NOTE   The control range of the flow rate program may be limited depending on the column in use, purge flow rate and gas restrictor.

12.5.6.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	——
Ins Line	Inserts a line in line at the current cursor position.	——
Print	Prints the flow rate program to a hromatopac.	——

12.5.6.4 Setting a flow rate program

■ Screen terminology

<1-ramp flow rate program>
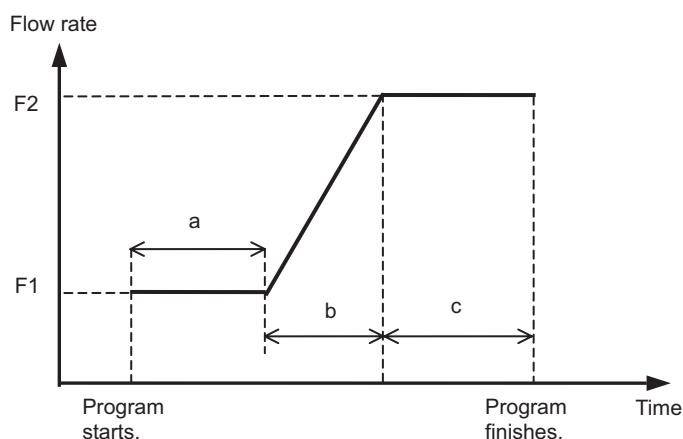
Initial flow rate (FLOW).... F1
Initial flow rate hold time (TIME)...... a

Program rate (RATE)...... $\dfrac{F2-F1}{b}$

Final flow rate (FLW)........ F2
Final flow rate hold time (TIM)......... c

■ Program creation

<1-ramp flow rate program>
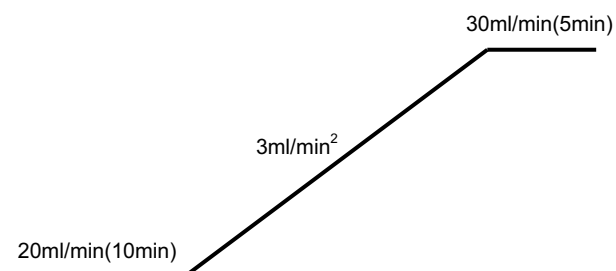
Fig. 12.5.10 Flow rate program example

12.5.7 Split ratio program

You can change the split ratio during a split analysis. In addition, you can set a split ratio program after the sampling time has elapsed during splitless analysis.

The split ratio program and the gas saver perform basically the same operation. However, the split ratio program is used for more general purposes.

12.5.7.1 Screen description

Select [Split Prog] (PF menu) from the [FLOW] key main screen when not in "DIRECT" mode to display the Split Ratio screen shown in Fig. 12.5.11.

A program can contain up to 7 ramps.

```
Split Ratio    CAR1      READY
SPL1 [LINE 1]         [FILE] 0:FILE0
Split ratio monitor       50.0
Program total(min)        0.00
           Time(min)   Split Ratio
Init    -------          50.0
 1st      0.00            END




~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

   ↵Return Del Line Ins Line
```

Fig. 12.5.11   Split ratio program setup screen

12.5.7.2 Parameter list

TIME

Range: 0.00−9999.99 min, Default: 0.00 min

Set this parameter to display the split ratio used previously in the Split Ratio column.

SPLIT RATIO

Range: -1.0/0.0−9999.9, Default: -1.0

Set the split ratio.

If the split ratio is set to "-1.0", the total flow rate remains constant regardless of the oven temperature.

12.5.7.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	――
Ins Line	Inserts a line in line at the current cursor position.	――
Print	Prints the split ratio through to a Chromatopac.	――

12.5.7.4 Setting a split ratio program

■ Screen terminology

<1-ramp program>
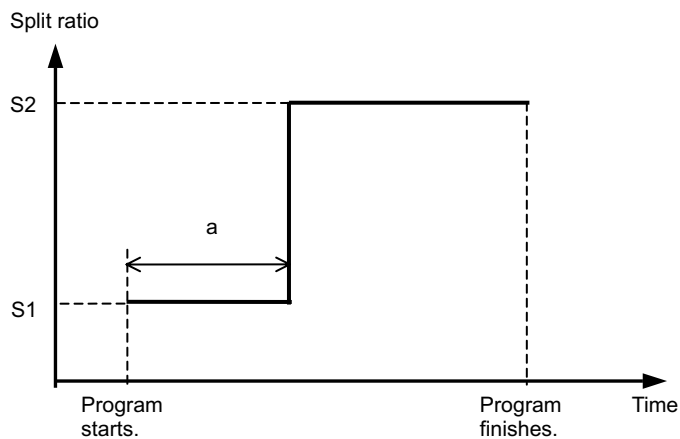
Initial ratio	（SPLIT）	……S1
Initial program run time	（TIME）	……a
Final ratio	（SPLT）	……S2

■ Program creation

<1-ramp program>

Fig. 12.5.12   Example of split ratio program

12.5.8 Septum purge

Set the septum purge flow rate. The septum purge removes contamination from the injection port at the septum.

The septum purge flow rate is set here. In addition, you can create a program to change the septum purge flow rate during analysis.

12.5.8.1 Screen description

Select [Purge] (PF menu) from the [FLOW] key main screen to display the septum purge screen shown in Fig. 12.5.13.

A program can contain up to 7 ramps.

Fig. 12.5.13   Septum purge setup screen

12.5.8.2 Parameter list

FLOW RATE

Refer to Fig. 3.5.3, Default:[1] 3.0 ml/min

Set the initial flow rate of the flow rate program and the final flow rate for each stage.

Even if no program is set, specify septum purge flow rate in the initial flow rate column.

TIME

Range: 0.00−9999.99 min, Default: 0.00 min

Set the initial flow rate for the flow rate program and the hold time of the final pressure at each stage.

RATE

Range: END/-400.00−400.00 kPa/min[2], Default: END

Set the program rate for the flow rate program.

If you set the rate to "0", "END" appears and the program finishes at the previous ramp.

If you move the cursor to "END" and set any numeric value other than "0", the pressure and the time for that ramp can be entered.

1 The purge flow rate range is from 0 to the total flow rate subtracted by the column flow rate and the split flow rate.

12.5.8.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	――
Ins Line	Inserts a line in line at the current cursor position.	――
On/Off	Set On for septum purge flow.	――

12.5.9 High pressure injection and splitter fix mode

■ High Pressure Injection

High pressure injection is a split/splitless injection method which keeps the column inlet pressure at a value higher than the analysis pressure for a specified period of time while the sample is injected. Then, the column inlet pressure returns to the normal analysis value.

High pressure injection is effective especially for the splitless injection system. High pressure injections, can reduce the total gas volume and improve percent recovery valves.

■ Splitter Fix

If the injected sample consists of a solvent with a high vaporization expansion coefficient, the pressure inside the injection port drastically increases when the solvent vaporizes. This can result in too much solvent being diverted from the column, reducing sensitivity.

Sending power to the split flow valve at sample injection can keep the split ratio at its designated valve.

12.5.9.1 Screen description

Select [Advanced] (PF menu) from the [FLOW] key main screen when not in "DIRECT" mode to open the advanced screen shown in Fig. 12.5.14.
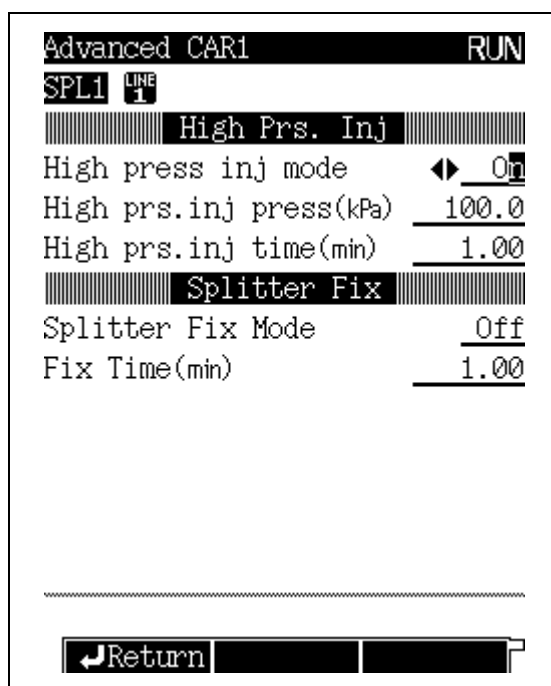
Fig. 12.5.14   Setup screen for high pressure injection and splitter fix mode

12.5.9.2 Parameter list

■ High Pressure Injection

HIGH PRESS INJECTION MODE

Select One of the following three modes.

Off : Disables high pressure injection.

On : Sets the column inlet pressure to high value immediately.

Auto : Immediately sets the column inlet pressure to high pressure. When analysis is finished and the GC returns to the ready status, the column inlet pressure automatically increases.
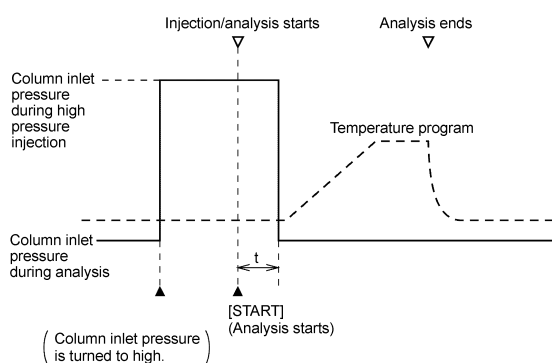
HIGH PRESS INJECTION MODE = On
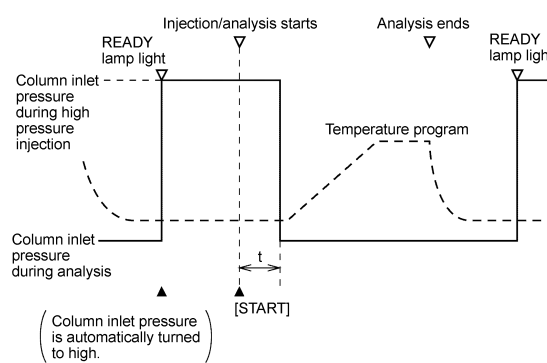
HIGH PRESS INJECTION MODE = Auto

HIGH PRESS INJECTION PRESS

Range: 0.0−970.0 kPa (Refer to Fig. 3.5.1.), Default: 100.0 kPa

Set the column inlet pressure for high pressure injection.

HIGH PRESS INJECTION TIME

Range: 0.00−9999.99 min, Default: 1.00 min

Set the period of time after analysis starts until the column inlet pressure returns to the original value.

Usually, set this equal to the sampling time.

■ Splitter Fix

SPLITTER FIX MODE

Selection: Off/On/Auto, Default: Off

Select one of the following three modes.

Off : Disables splitter fix mode.

On : Fixes the split flow line immediately.

Auto : Automatically enters splitter fix mode after analysis finishes and the system returns to ready status.

FIX TIME

Range: 0.0−9999.99 min, Default: 0.10 min

Set the period of time to be in splitter fix mode.

When "SPLITTER FIX MODE" is set to "On", indicate the period of time after "SPLITTER FIX MODE" is set to "On" to exit splitter fix mode.

When "SPLITTER FIX MODE" is set to "Auto", set the period of time after the analysis starts to exit splitter fix mode.

NOTE Using splitter fix mode for long periods of time may interfere with constant pressure, negatively affecting reproducibility of results.

12.*6* Direct Injection System

■ Direct injection system

In a direct injection system, a wide-bore (0.53 mm or greater) column is used. Nearly the entire amount of sample injected is inrtoduced on the column. This usually results in better sensitivity than narrow-bore columns with split injections. However, peak shapes are broad, which decreases resolution and can lead to a higher S/N ratio.

The direct injection system uses a WBI (wide-bore injection) injection port. When WBI is specified, DIRECT injection mode is automatically used and split mode is not available on the [INJ] key main screen.
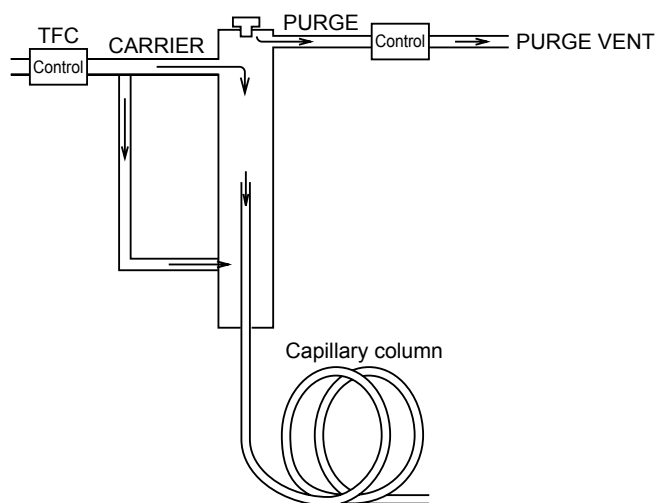
Fig. 12.6.1

12.6.1 Setting the temperature

12.6.1.1 Screen description

Press the [INJ] key to display the injection port main screen shown in Fig. 12.6.2 and to set the injection port temperature.


```
Injection Port CAR2      RUN
WBI2            FILE 0:FILE0
                ACTUAL SETTING
Temp(C)          100.0   100.0



   ∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿
      Print  Next Inj
```
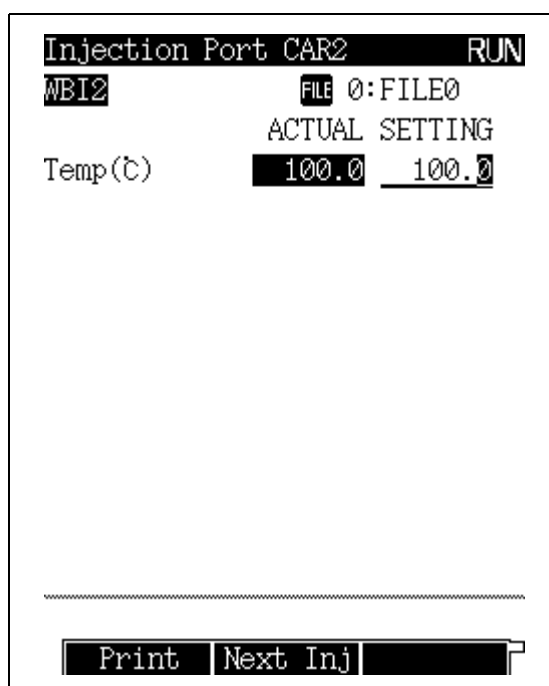
Fig. 12.6.2   [INJ] key main screen

12.6.1.2 Parameter list
TEMP

Range: 0.0–450.0°C, Default: 25.0°C

Set the injection port temperature.

Keep the injection port at the lowest practical temperature for the analysis; this prolongs the service life of the temperature sensor. To instantly vaporize the injected sample, set the injection port temperature approximately 30°C higher than the final column oven temperature. Because the sample quantity is usually minute, the sample is vaporized at temperatures lower than the boiling point of sample compounds. To set the maximum temperature limit, refer to "16.6.4 Setting the maximum temperature limits" in "16.6 GC Configuration".

12.6.1.3 PF menu

PF menu	Description	Reference section
Print	Prints the temperature program to a Chromatopac.	――
Next Inj	Toggles to the next setup screen when two or more injection ports are installed in this system. The [INJ] key can also be used to switch screens.	――

12.6.2 Setting the flow rate

12.6.2.1 Screen description

Press the [FLOW] key to display the main Flow Screen shown in Fig. 12.6.3. Set the AFC parameters to control the carrier gas pressure and the flow rate.
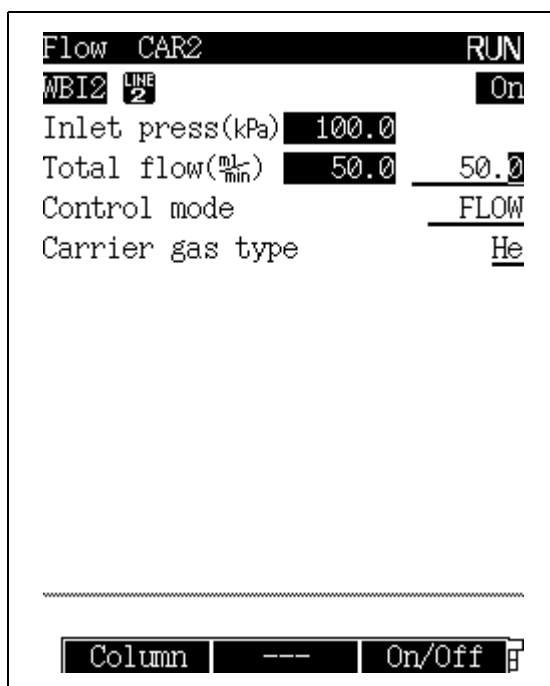
Fig. 12.6.3   [FLOW] key main screen

12.6.2.2 Parameter list

INLET PRESS

Range: 0.0−970.0 kPa (Refer to Fig. 3.5.1.), Default: 100.0 kPa

Set the column inlet pressure.

When creating a pressure program, this specifies the initial pressure.

When the control mode is set to "PRESS", the system controls the column inlet pressure so that it remains constant during a temperature program.

Normally, when using a wide bore column, set the column inlet pressure to a low pressure (20−40 kPa).

COLUMN FLOW RATE

Default:[1] 1.00 ml/min

Set the carrier gas flow rate at the capillary column exit (atmospheric pressure at 25°C). When you set the carrier gas flow rate, the system calculates the column inlet pressure based on the inner diameter, the length and the film thickness of the column. The column flow rate is set separately so that the carrier gas flow rate desired occurs at the initial temperature in the oven temperature program.

LINEAR VELOCITY

Default:[2] 30.0 cm/s

Set the average linear velocity of the carrier gas flowing in the capillary column.

When you set the linear velocity, the system calculates the column inlet pressure based on the inner diameter, the length and the film thickness of the column. The linear velocity is set separately so that the linear velocity desired occurs at the initial temperature in the oven temperature program.

If you set the control mode to "VELOCITY", the column inlet pressure automatically changes so that the linear velocity remains constant during the oven temperature program.

TOTAL FLOW RATE

Range: 0.0−1200.0 ml/min (Refer to Fig. 3.5.1.), Default: 50.0 ml/min

Set the total flow rate, which is the sum of "column flow rate + split flow rate + septum purge flow rate".

CONTROL MODE

Selection: PRESS/VELOCITY/FLOW, Default: PRESS

PRESS: Controls the system so that the column inlet pressure remains constant.

VELOCITY: Controls the system so that the linear velocity remains constant.

FLOW: Controls the system so that the set flow rate remains constant.

CARRIER GAS TYPE

Selection: He/N2/H2/Ar, Default: He

Specify the carrier gas type supplied to the AFC.

This parameter is used for the measurement/control of the flow rate.

If this parameter is set incorrectly, flow rate calckulations may not be performed incorrectly.

(Example: If this parameter is set to "N2" when He is actually used, the displayed total flow rate, column flow rate and linear velocity are lower than the actual values.)

1 The column flow rate ranges is from 0 to the value at which the calculated column inlet pressure is 970 kPa or less and the calculated total flow rate is 1,200 ml/min or less.

2 The linear velocity ranges is from 0 to the value at which the calculated column inlet pressure is 970 kPa or less.

12.6.2.3 PF menu

PF menu	Description	Reference section
Column	Sets inner diameter, length and film thickness of capillary column. Values set here are used in column inlet pressure caluculations from column flow rate or linear velocity (or vice versa). If these parameters are not set correctly, calculations are not performed correctly.	12.5.3
On/Off	Sets flow controller to be used to "On". Default value is "Off". When [Start GC] is pressed, the AFC in the current analytical line which is set to "On" starts. If AFC is set to "Off" during carrier gas control, the control stops. When it is set to "On" again, the carrier gas control restarts.	――
Press Prog	Sets the column inlet pressure program.	12.5.5
FLOW Prog	Sets the total flow rate program.	12.5.6
Purge	Sets the septum purge flow rate and the flow rate program.	12.5.8
Offset	Performs offset calibration of the AFC sensor. This calibration contributes to good reproducibility of results.	3.6
Next Flow	Toggles among the AFC setup screens if two or more AFCs are installed in this system. The [FLOW] key can also be used to Switch screens.	――

■ **Linear velocity and carrier gas selection**

In capillary analysis, the type and the flow rate of the carrier gas have a considerable effect on the column efficiency. The figure below shows changes in the HETP (Height Equivalent to Theoretical Plate) at different linear velocity valves for nitrogen, helium and hydrogen carrier gas.
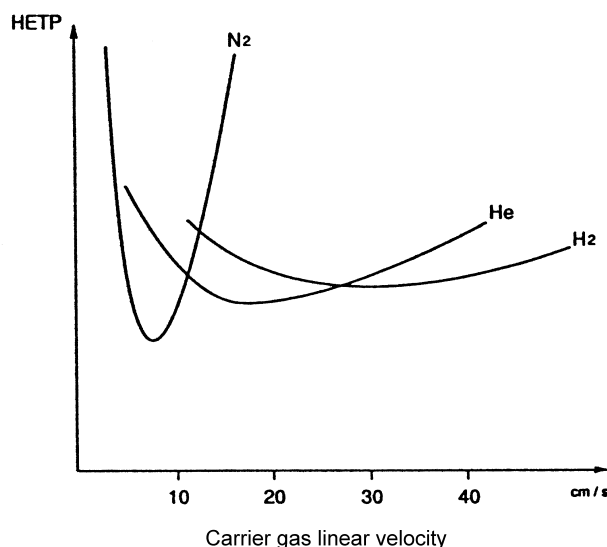
Fig. 12.7.1   Effect on linear velocity and HETP for various carrier gases (H-V curve)

The graph above shows that the lowest HETP values are obtained when nitrogen is used as the carrier gas and the linear velocity is set to a value a little less than 10 cm/s. However, nitrogen is not a good carrier gas for capillary analysis for the following reasons.
(1) If the linear velocity deviates only slighty from the optimum value, the HETP increases dramatically.
(2) To obtain the optional linear velocity, the flow rate must be low, resulting in long analysis times.

Helium is frequently used as the carrier gas because the HETP is low over a considerably wider linear velocity range starting at 20 cm/s.
The column efficiency of hydrogen is good at higher linear velocities than for helium. For this reason, hydrogen can be used for rapid analyses. However, hydrogen is seldom used in reality because it is extremely flammable, and therfore too dangerous.

■ **Efficiency of an analysis**

Usually, analyses are performed with a flow rate that is higher than the optimal flow rate, as long as separation of conpounds is sufficient. This reduces the analysis time. For general analyses on this system, setting the linear velocity to 30 cm/s is recommended.
The tables below show the column inlet pressure at which the linear velocity becomes approximately 30 cm/s. Use the tables as the guideline for setting the column inlet pressure. However, the inlet pressure also depends on the column type.

Example 1: Column oven temperature = 50°C(carrier gas = helium)

I.D. of column	Film thickness	Length 30m	60m
0.25mm	0.25μm	100kPa	210kPa
0.32mm	0.25μm	60kPa	120kPa
0.53mm	1.5μm	20kPa	40kPa

Example 2: Column oven temperature = 200°C (carrier gas = helium)

I.D. of column	Film thickness	Length 30m	60m
0.25mm	0.25μm	130kPa	275kPa
0.32mm	0.25μm	80kPa	160kPa
0.53mm	1.5μm	30kPa	60kPa

NOTE   Fig. 12.7.2 shows the relationship between the column flow rate and the column inlet pressure.
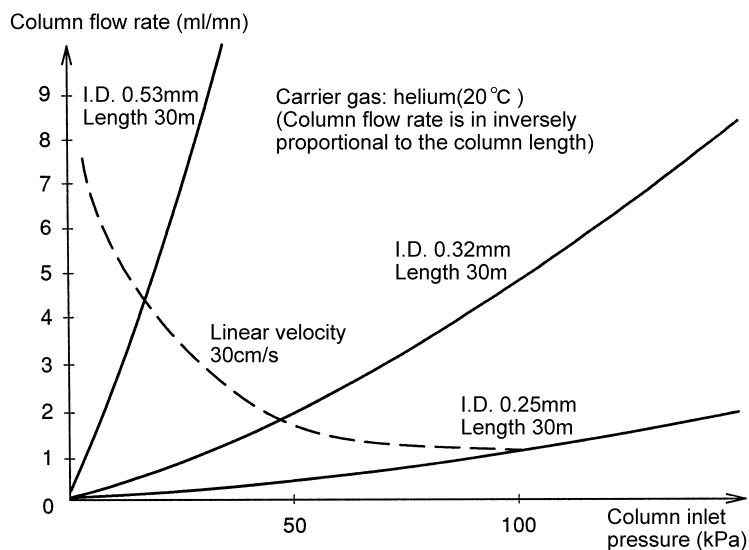
$$Fc = \frac{60\,\pi\,d^4}{256\mu L} \times \frac{(P + P_0)^2 - P_0^2}{P_0} \times 10^3$$

Fc   : Column flow rate [ml/min]
d   : Column I.D [mm]
L   : Column length [m]
P   : Column inlet pressure [kPa]
P_0 : Column outlet pressure = atmospheric pressure [kPa]
μ   : Viscosity coefficient (19.4μPa•s (helium, 20°C))

Fig. 12.7.2

13.1 **Introduction**

■ Detectors

This manual describes the operating of an FID and TCD. Consult the Operation Manual for information on other types of detectors. Common GC detectors are listed below.

- ・ Hydrogen flame ionization detector (FID)
- ・ Thermal conductivity detector (TCD)
- ・ Electron capture detector (ECD) (option)
- ・ Flame thermionic detector (FTD) (option)
- ・ Flame photometric detector (FPD) (option)

13.*2* Hydrogen flame ionization detector (FID)

13.2.1 Principle of FID operation

In the hydrogen flame ionization detector (FID), hydrogen gas is mixed with the column outlet gas at a certain ratio as shown in Fig. 13.2.1.The gas mixture combusts in the air atmosphere. An electrode exists at each end of the FID jet, and DC voltage is applied between the electrodes.

If only pure carrier gas (nitrogen, helium or argon) and hydrogen gas are mixed, little current is produced between the electrodes. When an organic compound is mixed with the carrier gas, current is produced proportionally to the amount of organic compound present.

This is because ions (mainly carbon ions) are generated when an organic compound combusts within the hydrogen flame, and the generated ions are captured by the collector. For isomers, the ion quantity generated is almost proportional to the number of carbons contained in the compound. However, carbon atoms in a "C=O" form do not create a signal. The presence o halogens in the compound decreases sensitivity.

Because the ion current obtained by the FID is very low, it is amplified into a proper voltage, then output to a Chromatopac or personal computer.
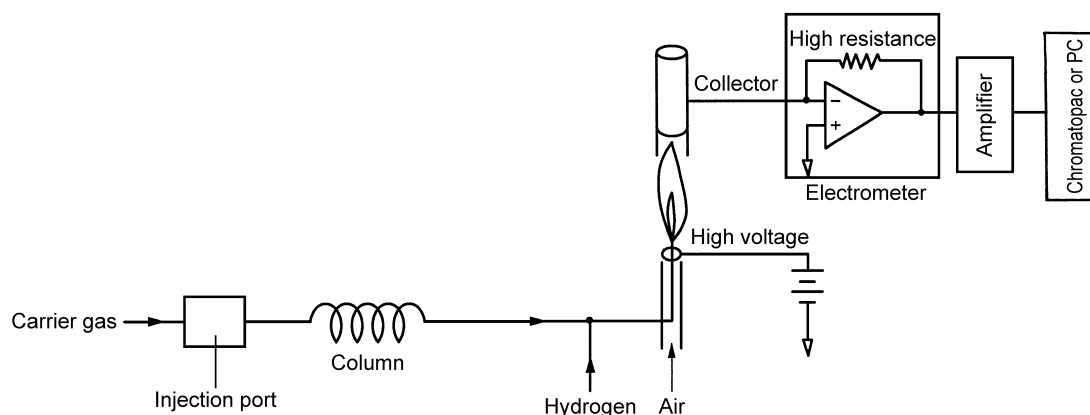
Fig. 13.2.1

13.2.2 Setting the detector

13.2.2.1 Screen description

Press the [DET] key to display the detector main screen shown in Fig.13.2.2. Here, set the detector temperature, the detector gas flow rate, etc.

When the detector is configured in the analytical line, the output signal settings appear in the lower portion of the screen.

For the detector signal output, refer to "13.5 Setting the Output Signals".

```
Detector  DET #1        RUN
FID1 ██              ◀▶ On
Temp(℃)      300.0    300.0
Flame                   On
Filter Time Constant  200ms

Signal Output Port      Ch1
Background sig.save     Off
Background sig comp.    Off
Det sig subtraction     Off
Signal Range          ×10⁻¹
Analog Signal Type    Linear


  Ignite | Det Gas | Ign.Set
```
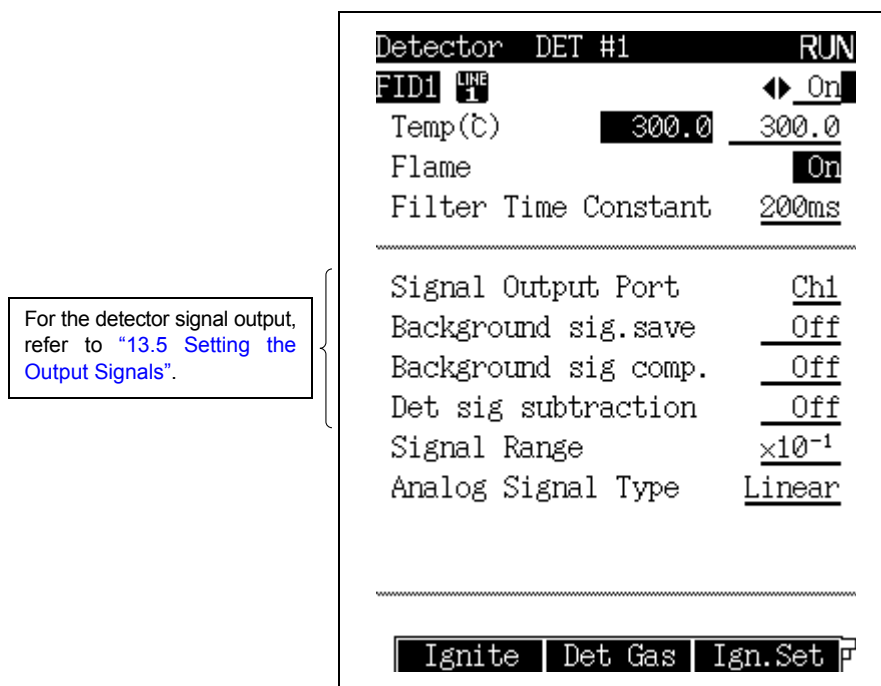
Fig. 13.2.2   [DET] key main screen

13.2.2.2 Parameter list

DETECTOR CONTROLLER

Selection: On/Off, Default: On

When a detector is set to "On", its current and voltage are controlled.

When a detector is configured in an analytical line and set to "On" here, the detector is controlled and its signal monitored. However, even if a detector is set to "Off", the gas flow is controlled, and the temperature increases to the set value if the detector is configured in an analytical line.

TEMP

Range: 0.0–450.0°C, Default: 25.0°C

Set the detector temperature. Normally, set the detector temperature approximately 30°C higher than the final column oven temperature to prevent contamination by high boiling point compounds.To set the maximum temperature limit, refer to "16.6.4 Setting the maximum temperature limits" in "16.6 GC Configuration".

FLAME

Selection: On/Off, Default: Off (When the AUTO IGNIT is set to On, the FLAME is set to On.)

Select "On" to ignite the flame.

Select "Off" to extinguish the flame.

FILTER TIME CONSTANT

Selection: 4 ms/5 ms/10 ms/20 ms/50 ms/100 ms/200ms/500 ms/1 s/2 s, Default: 200 ms

This constant affects the processing of the detector signal.

As the time constant increases, noise as well as the peak height are reduced.

Select the optimum value in accordance with the peak half width. (Refer to "13.4 Filter Signal Time Constant".)

SIGNAL OUTPUT PORT

Selection: Off/Ch1/Ch2/Ch3/Ch4, Default: (Channel is automatically assigned.)

Select the digital and analog signals output channels. Four channels are available.

However, for analog output, only Ch1 and Ch2 are available as standard.

BACKGROUND SIG. SAVE

Selection: Off/Buff 1/Buff 2, Default: Off

Background baseline signals can be saved for the purpose of background subtraction.

BACKGROUND SIG COMP.

Selection: Off/Buff 1/Buff 2, Default: Off

Subtracts the saved background signal baseline from the actual baseline. This produces a stable baseline despite considerable baseline fluctuations

DET SIG SUBTRACTION

Selection: Off/DET# 1/DET# 2/DET# 3/DET# 4, Default: Off

Subtracts the detector signal of one detector from the signal of another detector. This function is mainly used in a dual column flow line to subtract the data acquired without an injection from the data acquired with an injection. The background signal is eliminated.

For the details on "SIGNAL OUTPUT PORT", "BACKGROUND SIG. SAVE", "BACKGROUND SIG COMP." and "DET SIG SUBTRACTION", refer to "13.5 Setting the Output Signals".

SIGNAL RANGE

Selection: $\times 1/\times 10^{-1}/\times 10^{-2}/\times 10^{-3}/\times 10^{-4}$, Default: $/\times 10^{-1}$

Multiplies the analog signal by the coefficient "10^{-x}" for a linear analog signal type.

If the data processing unit is saturated, for example, change the setting from "$\times 1$" to "$\times 10^{-1}$", from "$\times 10^{-2}$" to "$\times 10^{-3}$". In case of the digital signal, the signal is always output with "$\times 1$".

SIGNAL ATTENUATION

Selection: $\times 1/\times 2^{-1}/\times 2^{-2}/\times 2^{-3}/\times 2^{-4}$, Default: $/\times 2^{-1}$

Multiplies the analog signal by the coefficient "2^{-x}" for a wide analog signal type.

If the data processing unit is saturated, for example, change the setting from "$\times 1$" to "$\times 2^{-1}$", from "$\times 2^{-2}$" to "$\times 2^{-3}$". In case of the digital signal, the signal is always output with "$\times 1$".

ANALOG SIGNAL TYPE

Selection: Linear/Wide, Default: Linear

Set this item when the GC is connected to a Chromatopac in analog format.

When the GC is connected to a C-R8A, the value set here does not affect the signal because they are connected by a digital RS-232C cable.

Wide ... Select wide when connecting the GC to the C-R7A/CR-7A plus.

The signal, multiplied by 1/2, is output from the GC; then, the signal received by the Chromatopac is multiplied by 2.

When connecting the GC to a C-R7A/CR-7A plus for the first time, or replacing the Chromatopac, set the detector signal output to "Off" and perform calibration. (For the calibration procedure, refer to "2.7 Connecting external device cables".)

Linear ... Select linear when connecting the GC to any Chromatopac other than the C-R8A/C-R7A/CR-7A plus.

When connecting the GC to a C-R7A/CR-7A plus and setting the "ANALOG SIGNAL TYPE" to "Linear", the optional signal cable (linear, P/N 221-47251-92) is required.

13.2.2.3 PF menu

PF menu	Description	Reference section
Ignite	Reduces the air flow rate, heats filament, and ignites detector when pressed when "FLAME" was set to "Off". If "AUTO IGNIT" is set to "On" on the [SYSTEM] key screen, the detector is automatically ignited after each setting reached the setting value.	13.2.2.4
Det Gas	Sets the flow rate of makeup gas, hydrogen and air if the advanced Pressure Control (APC) is installed.	13.2.3
Ign. Set	If the Advanced Pressure Control (APC) is installed, you can set automatic ignition and automatic re-ignition. Default value is "On".	─────
Next Det	Toggles to the setup screen of another installed detector. The [DET] key can also be used to switch screens.	─────

13.2.2.4 Igniting the FID

■ Ignition procedure

(1) When "DETECTOR" is set to "On" and "AUTO IGNITE" is set to "On" on the [SYSTEM] key main screen.

On the [DET] key main screen, set the detector to "On".

↓

Press [Start GC] (PF menu).
 ([SYSTEM] key main screen)

↓

GC control starts. The FID ignites once it has reached the set temperature.

↓

The baseline should indicate whether ignition was successful.

↓

The message "Ignition finished." appears, and the ignition is completed.
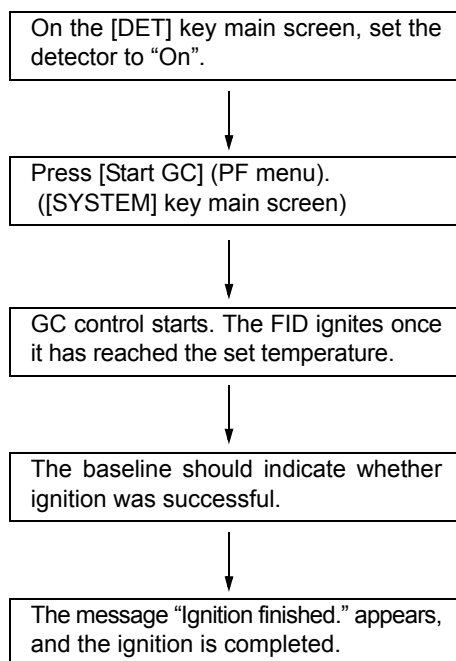
(2) When "DETECTOR" is set to "On" and "IGNITE" is set to "Off" on the [SYSTEM] key main screen.

On the [DET] key main screen, set the detector to "On".

↓

Press [Start GC] (PF menu).
([SYSTEM] key main screen)

↓

Wait until the detector temperature increases to the temperature set.

↓

Press [Ignit] (PF menu) to ignite the FID.

↓

The baseline should indicate whether ignition was successful.

↓

The message "Ignition finished." appears, and the ignition is completed.
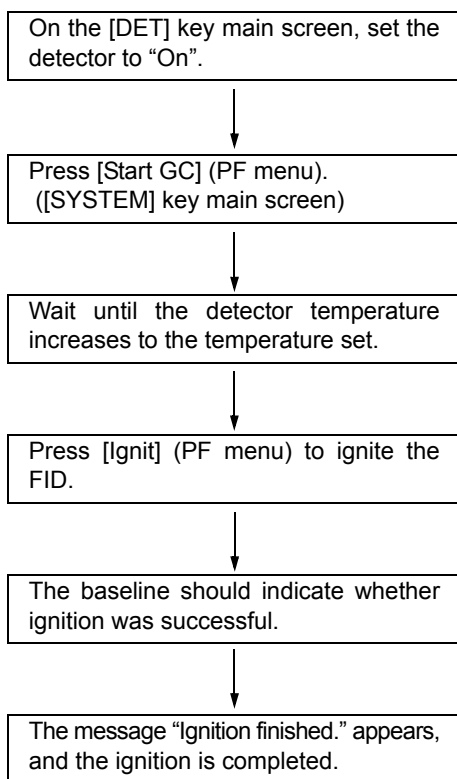
(3) When "DETECTOR" is set to "Off" on the [SYSTEM] key main screen.

Press [Start GC] (PF menu) on the [SYSTEM] key main screen.

↓

Set "DETECTOR" of the FID to "On".

↓

Wait until the detector temperature increases to the temperature set.

↓

Press [Ignit] (PF menu) to ignite the FID.

↓

The baseline should indicate whether ignition was successful.

↓

The message "Ignition finished." appears, and the ignition is completed.
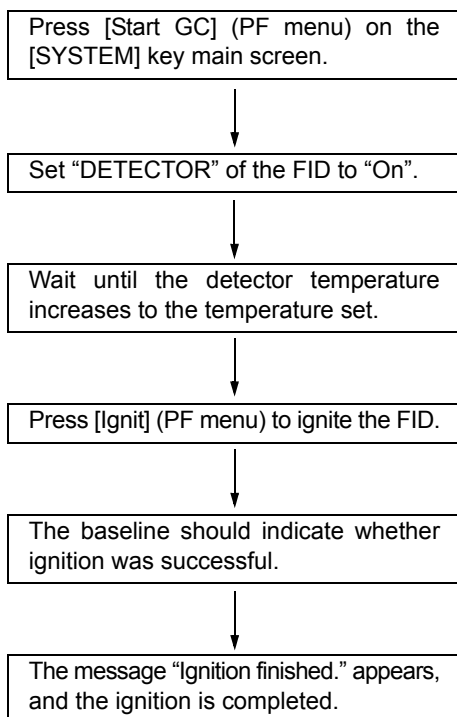
■ Ignition troubleshooting

When ignition has failed and the message "Ignition failed." appears, check the following items.

Cause	Solution
Column is not connected.	Connect the column for FID to be ignited, and ensure that carrier gas is flowing.
Hydrogen is not supplied.	Supply hydrogen.
Hydrogen flow rate is incorrect.	Set the hydrogen flow rate to a proper value.
Air is not supplied.	Supply air.
Air flow rate is incorrect.	Set the air flow rate to a proper value.
Unused FID/FPD is set to "On".	Set unused detectors to "Off".
FID jet is clogged.	Clean the FID jet.
	Replace the FID jet.
Igniter filament is broken.	Replace the igniter.

13.2.2.5 Extinguishing the FID

This section describes how to extinguish the FID when the Advanced Pressure Control (APC) is installed.

■ Auto extinguisher

From the [SYSTEM] key main screen, press [STOP GC] (PF menu).
The detector temperature gradually decreases, supply of hydrogen and air is stopped, and the flame is automatically extinguished.
When a time program is running or a stop time has been set, the detector gas is shut off at the end of the program, extinguishing the FID fmame.

■ Manual extinguishment

To extinguish the detector flame without waiting automatic extinguishment, set the gas control of "H2" and "Air" to "Off" on the [Det Gas] (PF menu) screen. The detector gas is shut off, extinguishing the FID flame.

⚠ **CAUTION**

The cover of FID detector should be raised and set up using tweezers for prevention of a scald in case of maintenance and inspection. Put down the cover on its side using tweezers in case of analysis.

Cover
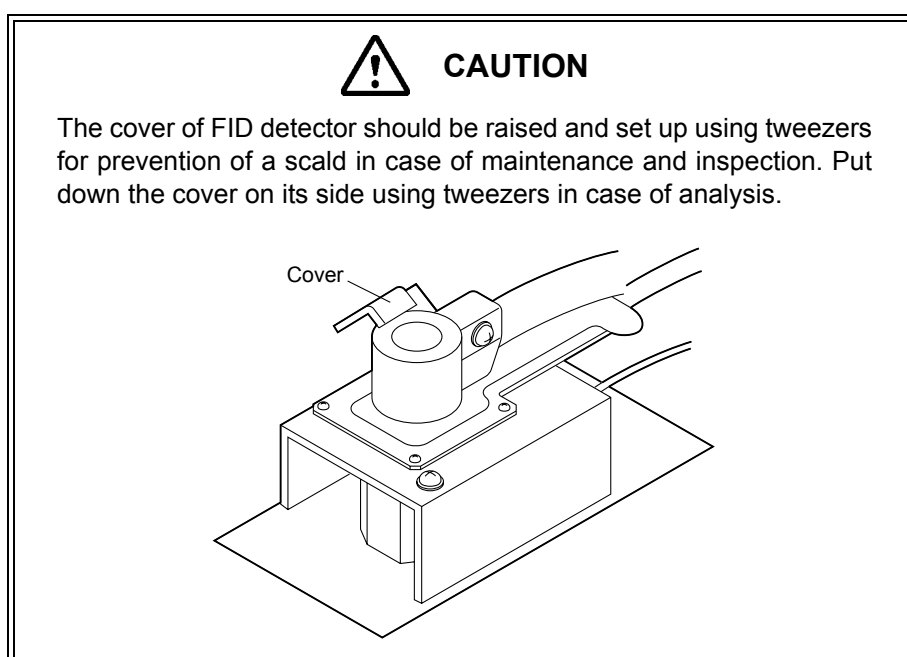
13.2.3 Setting the detector gas flows

The FID detector gas consists of makeup gas, hydrogen and air. The makeup gas is inert gas supplied to the detector to prevent peak tailing and optimize FID sensitivity. Usually, the carrier gas is used as the makeup gas. Hydrogen gas and air are supplied to be combusted inside the detector, creating the FID flame.

13.2.3.1 Screen description

Select [Det Gas] (PF menu) from the [DET] key main screen to display the flow screen shown in Fig. 13.2.3.
When the "Start Flow" status is selected on the [SYSTEM] key screen, the makeup gas flow starts. Just before the ignition procedure begins, hydrogen and air flow starts. Selecting "Stop Temp/Det" status from the [SYSTEM] key main screen, gas flow stop.

Refer to "OPTIMAL FLOW" in "13.2.3.2 Parameter list", and check whether the flow rate of each detector gas is set correctly. If not, set it to the correct value.

Fig. 13.2.3   Setting the detector gas flows

13.2.3.2 Parameter list

H₂

Range: 0.0−200.0 ml/min, Default: 40.0 ml/min

MAKE UP

Range: 0.0−100.0 ml/min, Default: 30.0 ml/min

Make up gas is supplied to the detector to optimize its sensitivity. For the FID, both nitrogen and helium can be used. Selecting nitrogen is recommended because it offers higher sensitivity.

GAS TYPE

Selection: N₂/He/Ar, Default: He

Set the type of gas used as the makeup gas.

Do not use hydrogen for make up gas.

Air

Range: 0.0−1000.0 ml/min, Default: 400.0 ml/min

OPTIMAL FLOW (Refer to Fig. 3.4.5-Fig. 3.4.7.)

Normally, set the flow rate of the makeup gas, hydrogen and air as follows to maximize the FID sensitivity.

Makeup gas (N₂)	: Approx. 30 ml/min
Makeup gas (He)	: Approx. 30 ml/min
Hydrogen	: Approx. 40 ml/min
Air	: Approx. 400 ml/min

13.2.3.3 PF menu

PF menu	Description	Reference section
Program	The flow rate of makeup gas, hydrogen and air supplied to detector can be controlled by a program.	13.2.3.4
On/Off	Select "Off" to stop gas flow. Select "On" to restart the gas flow. Default value is "On".	____
Offset	Performs offset calibration of APC sensor. This calibration improves the reproducibility of results.	3.6

13.2.3.4 Flow rate program for detector gas

Press [Program] (PF menu) from [Det Gas] (PF menu) to display the Detector gas screen shown in Fig. 13.2.4. Here, set a flow rate program for detector gas.

The flow rate program procedure is the same for the makeup gas, hydrogen gas and air. For the flow rate program setting procedure, refer to "12.5.6 Creating a Flow rate program".

A 7 ramp program can be set.

```
Detector Hydrogen    NOT READY
FID 1 LINE         FILE 0:FILE0
        1
Flow monitor(mL/min)        47.0
Program total(min)         0.00
    Rate(mL/min²) Flow(mL/min) Time(min)
Init   -------     47.0       0.00
  1st      END
```

Set the program for hydrogen and air the same way. Press the appropriate PF menu to set the programs.

```
    ↵Return MakUpProg Air Prog
```
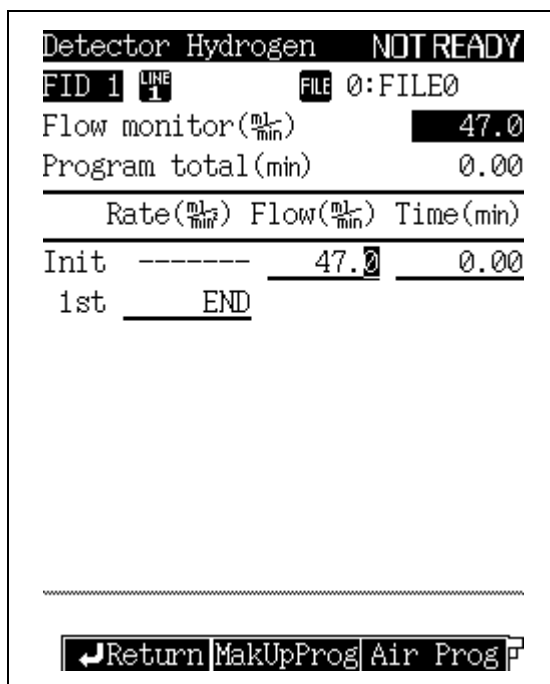
Fig. 13.2.4   Detector gas program

13.2.3.5 Detector gas program parameters

FLOW RATE

The range and the default valve differs for each gas. See "13.2.3.2 Parameter list".

Set the default flow rate and the final flow rate for each stage of the detector gas flow rate program.

TIME

Range: 0.00−9999.99 min, Default: 0.00 min

Set the retention time for the initial flow rate and the final flow rate for each ramp of the detector gas flow rate program.

RATE

Range: END/-400.0−400.0 ml/min^2, Default: END

Set the program rate of the detector gas flow rate program. If you set the rate to "0", "END" appears and the program ends at the previous ramp. Move the cursor to "END" and set any numeric value other than "0", to enter the pressure and the time for that ramp.

13.2.3.6 PF menu

PF menu	Description	Reference section
Make Up Prog	Displays the setup screen of the flow rate program for makeup gas.	――
H2 Prog	Displays the setup screen of the flow rate program for hydrogen gas.	――
Air Prog	Displays the setup screen of the flow rate program for air.	――
Del Line	Deletes a line at the current cursor position.	――
Ins Line	Inserts a line in line at the current cursor position.	――

13.3 Thermal conductivity detector (TCD)

13.3.1 Principle of TCD operation

The thermal conductivity detector (TCD) can detect all compounds except the carrier gas itself.

The metallic TCD filament is heated by the application of current. The carrier gas used has a high thermal conductivity, such as helium. As sample compounds pass the filament, the filament temperature increases, because the thermal conductivity of the sample compounds is less than that of the carrier gas. The filament temperature changes affect its resistance; the resistance is measured and produces a chromatogram.

A reference filament also exists, where only carrier gas flows, to eliminate background resistance fluctions.
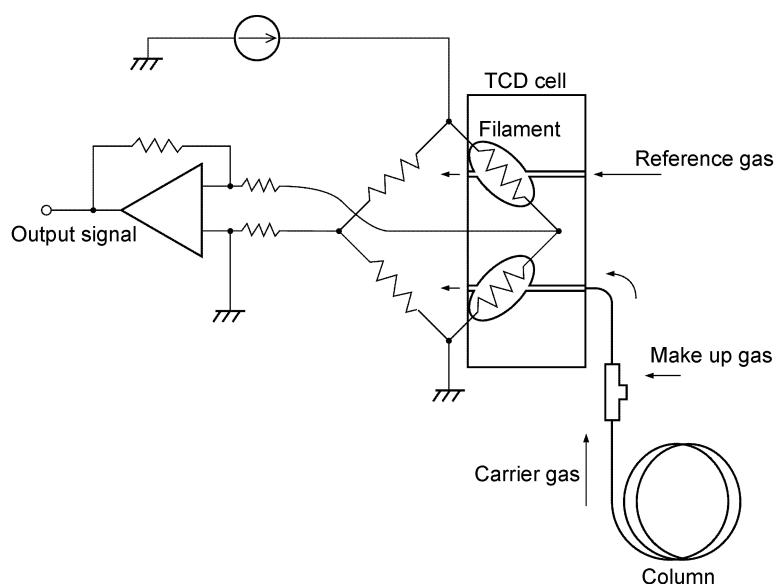
Fig. 13.3.1

13.3.2 Setting the detector

13.3.2.1 Screen description

Press the [DET] key to display the Detector main screen shown in Fig. 13.3.2. Here, set the detector temperature, the detector gas flow rate, etc.

When the detector is configured in the analytical line, the output signal settings appear in the lower portion of the screen.

For output of the detector signal, refer to "13.5 Setting the Output Signals".
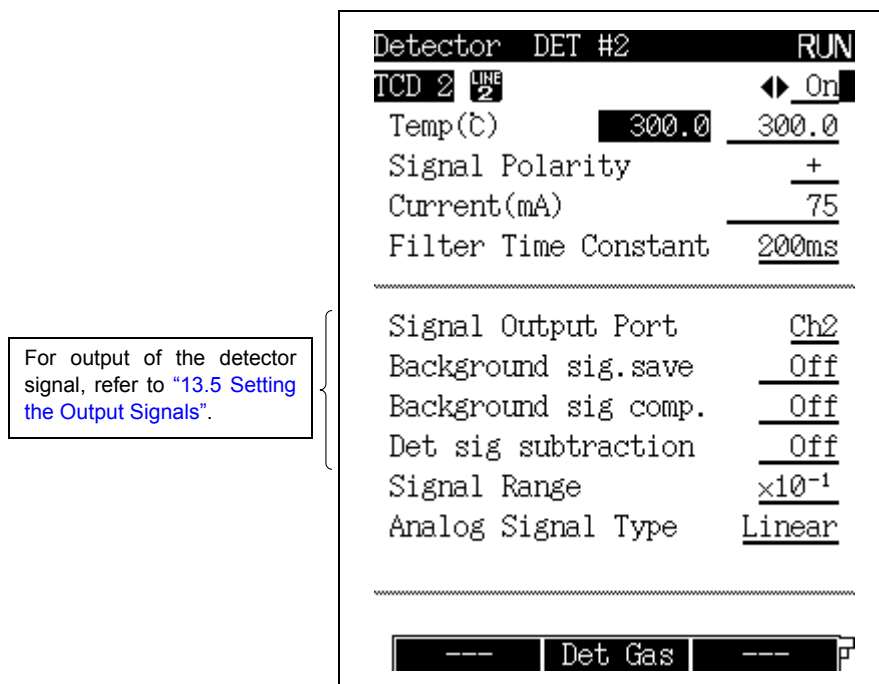
Fig. 13.3.2   [DET] key main screen

13.3.2.2 Parameter list

DETECTOR CONTROLLER

Selection: On/Off, Default: On

When a detector is set to "On", its current and voltage are controlled.

When a detector is configured in an analytical line and set to "On", the detector is controlled and its signal monitored. However, even if a detector is set to "Off", the gas flow is controlled, and the temperature increases to the set value if the detector is configured in an analytical line.

TEMP

Range: 0.0–400.0°C, Default: 25.0°C

Set the detector temperature. The TCD sensitivity is proportional to the difference in temperature between the detector and the filament. Accordingly, the sensitivity increases as the detector temperature decreases. However, the detector is normally set approximately 10°C higher than the final column oven temperature: this prevents contamination in the TCD cell.

To set the maximum temperature limit, refer to "16.6.4 Setting the maximum temperature limits".

SIGNAL POLARITY

Selection: +/-, Default: +

When analyzing compounds with a thermal conductivity higher than the carrier gas, baseline peaks are inverted (negative). When this occurs, switch to a polarity of "-" to produce positeve peaks.

CURRENT

Range: 0−100 mA, Default: 0 mA

The TCD sensitivity is approximately proportional to the cube of the current.

If the sensitivity is insufficient, increase the current within the range shown in the figure below. The maximum operating current is determined by the detector temperature and the carrier gas type. Keeping the current highre than necessary shortens the filaments life and can cause baseline drift.

⚠ **CAUTION**

If the current is turned on before the carriergas + make up gas has completely replaced the air, the filament can be blown.

Ensure that the current is set to "0" at first. Press the [SYSTEM] key main screen, allow carrier gas to flow for approximately 10 minutes, then set the current.

⚠ **CAUTION**

To avoid broken filaments and poor performance, set the current below the valves indicated by the curves below.

The current setted should be below the curve in the diagram for the selected gas type in order to prevent damage to the filament or deterioration of TCD performance.
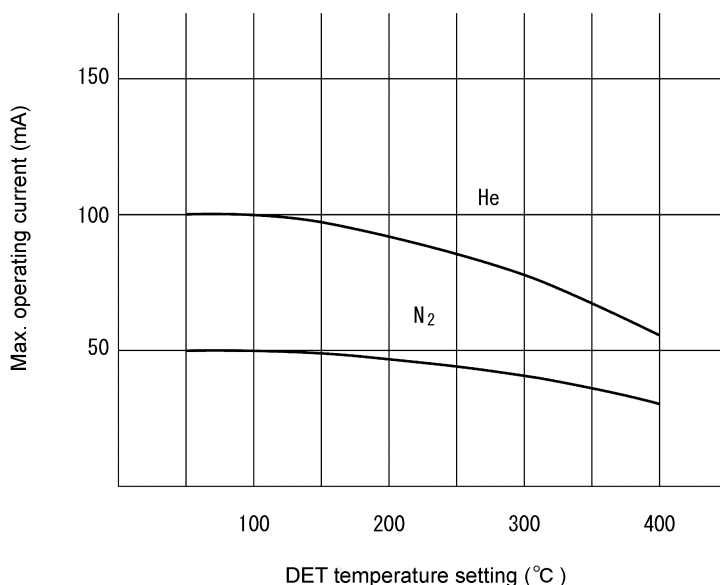
Fig. 13.3.3 Maximum operating current

FILTER TIME CONSTANT

Selection: 4 ms/5 ms/10 ms/20 ms/50 ms/100 ms/200ms/500 ms/1 s/2 s, Default: 200 ms

This constant affects the processing of the detector signal.

As the time constant increases, noise as well as the peak height are reduced.

Select the optimum value in accordance with the peak half width. (Refer to "13.4 Filter Signal Time Constant".)

SIGNAL OUTPUT PORT

Selection: Off/Ch1/Ch2/Ch3/Ch4, Default: (Channel is automatically assigned.)

Select the digital and analog signals output Channels. Four channels are available. However, for analog output, only Ch1 and Ch2 are available as standard.

BACKGROUND SIG. SAVE

Selection: Off/Buff 1/Buff 2, Default: Off

Background baseline signals can be saved for the purpose of background subtraction.

BACKGROUND SIG COMP.

Selection: Off /Buff 1/Buff 2, Default: Off

Subtracts the saved background signal baseline from the actual baseline. This produces a stable baseline despite considerable baseline fluctuations.

DET SIG SUBTRACTION

Selection: Off /DET#1/DET#2/DET#3/DET#4, Default: Off

Subtracts the detector signal of one detector from the signal of another detector. This function is mainly used in a dual column flow line to subtract the data acquired without an injection from the data acquired with an injection. The background signal is eliminated.

For the details on "SIGNAL OUTPUT PORT", "BACKGROUND SIG. SAVE", "BACKGROUND SIG COMP." and "DET SIG SUBTRACTION", refer to "13.5 Setting the Output Signals".

SIGNAL RANGE

Selection: $\times 1/\times 10^{-1}/\times 10^{-2}/\times 10^{-3}/\times 10^{-4}/$, Default: $\times 10^{-1}$

Multiplies the analog signal by the coefficient "10^{-x}" for a linear analog signal type. If the data processing unit is saturated, for example, change the setting from "$\times 1$" to "$\times 10^{-1}$", from "$\times 10^{-2}$" to "$\times 10^{-3}$". In case of the digital signal, the signal is always output with "$\times 1$".

SIGNAL ATTENUATION

Selection: $\times 1/\times 2^{-1}/\times 2^{-2}/\times 2^{-3}/\times 2^{-4}/$, Default: $\times 2^{-1}$

Multiplies the analog signal by the coefficient "2^{-x}" for a wide analog signal type. If the data processing unit is saturated, for example, change the setting from "$\times 1$" to "$\times 2^{-1}$", from "$\times 2^{-2}$" to "$\times 2^{-3}$". In case of the digital signal, the signal is always output with "$\times 1$".

ANALOG SIGNAL TYPE

Selection: Linear/Wide, Default: Linear

Set this item when the GC is connected to a Chromatopac in analog format. When the GC is connected to a C-R8A, the value set here does not affect the signal because they are connected by a digital RS-232C cable.

Wide ... Select wide when connecting the GC to the C-R7A/CR-7A plus.

The signal, multiplied by 1/2, is output from the GC; then, the signal received by the Chromatopac is multiplied by 2.

When connecting the GC to a C-R7A/CR-7A plus for the first time, or replacing the Chromatopac, set the detector signal output to "Off" and perform calibration. (For the calibration procedure, refer to "2.7 Connecting external device cables".)

Linear ... Select linear when connecting the GC to any Chromatopac other than the C-R7A/CR-7A plus.

When connecting the GC to a C-R7A/CR-7A plus and setting the "ANALOG SIGNAL TYPE" to "Linear", the optional signal cable (linear, P/N 221-47251-92) is required.

13.3.2.3 PF menu

PF menu	Description	Reference section
Det Gas	Sets the makeup gas flow rate supplied from the reference cell to the sample cell if the Advanced Pressure Control (APC) is installed.	13.3.3
Next Det	Toggles to the setup screeen of another detector. The [DET] key can also be used to switch screens.	――

13.3.3 Setting the detector gas flows

The gas tubing is routed so that the reference gas effluent is used as the makeup gas of the TCD. Helium and nitrogen are available as the makeup gas.

The TCD sensitivity is proportional to the difference in thermal conductivity between the sample and the carrier gas. Because the thermal conductivity of the sample is lower than that of the carrier gas, the TCD sensitivity increases as the thermal conductivity of the carrier gas increases.

For high sensitivity analysis, use helium with a purity of 99.9995% or more.

Thermal conductivity k ($\times 10^{-4} Wm^{-1}K^{-1}$) at room temperature, 300 K

Gas		Thermal conductivity	Gas		Thermal conductivity
Simple compounds	He	1499	Inorganic compounds	CO_2	166.2
	H_2	1815		H_2O	181
	N_2	259.8	Organic compounds	acetone	115
	Ar	177.2		hexane	128

13.3.3.1 Screen description

Select [Det Gas] (PF menu) from the [DET] key main screen to display the flow screen shown in Fig. 13.3.4

When the "Start Flow" status is selected on the [SYSTEM] key screen, the makeup gas flow starts. When the stop time elapses and the detector temperature drops to the value set by [Stop Seq] (PF menu) on the [Det Gas] (PF menu), the makeup gas flow stops.
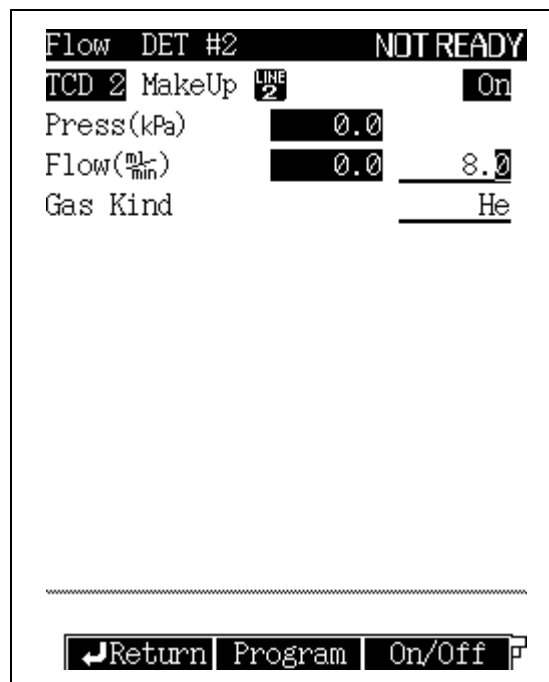
Refer to "OPTIMAL FLOW" in "13.3.3.2 Parameter list", and check whether the flow rate of each detector gas is set correctly. If not, set it to the correct value.

Fig. 13.3.4   Setting the detector gas flows

13.3.3.2 Parameter list

Make Up

Range: 0.0–20.0 ml/min, Default: 8.0 ml/min

Because the thermal conductivity of the sample is lower than that of the carrier gas, the sensitivity increases as the thermal conductivity of the carrier gas increases.

For high sensitivity analysis, use helium with purity of 99.9995% or more.

GAS TYPE

Selection: N2/He/Ar, Default: He

OPTIMAL FLOW (Refer to Fig. 3.4.8.)

Normally, set the flow rate of the makeup gas to approx. 8ml/min (Helimu) to maximize the TCD sensitivity.

NOTE   If the makeup gas flow is set below the optimal rate (8ml/min for Helimu), sensitivity increases. However, the reference filament can break, and peak tailing may occur. The baseline may be come elevated after the solvent peak has eluted (depending on solvent type).

13.3.3.3 PF menu

PF menu	Description	Reference section
Program	The flow rate of makeup gas supplied to detector can be controlled by a program.	13.3.3.4
On/Off	Select "Off" to stop the gas flow. Select "On" to restart the gas flow. Default value is "On".	——
Stop Seq	For a TCD, the filament life can be shotened if the makeup gas flows stops as soon as the stop time has elapsed. Therfore, the stop sequence contains a step where the makeup gas continues to flow after the stop time, until the detector temperature drops to a specified valve. The default valve is 50°C	——
Offset	Performs offset calibration of APC sensor. This calibration improves the reproducibility of results.	3.6

13.3.3.4 Flow rate program for detector gas

Press [Program] (PF menu) from [Det Gas] (PF menu) to display the Detector Make up screen shown in Fig. 13.3.5. Here, set a flow rate program for detector gas.

A 7 ramp program can be set.
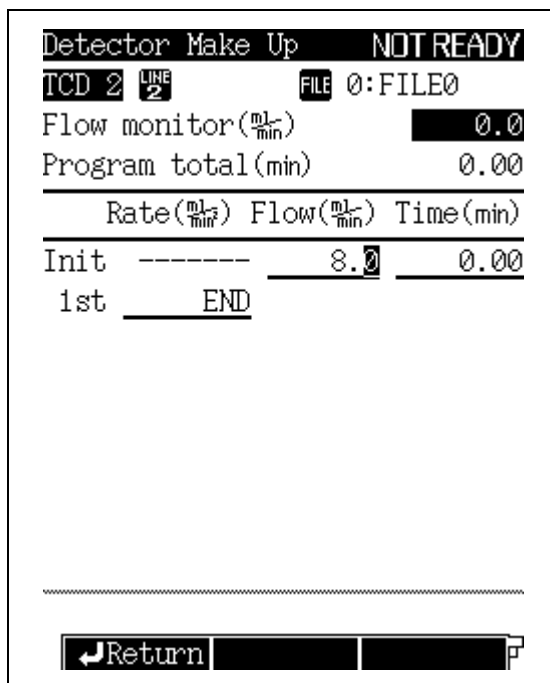
Fig. 13.3.5   Detector gas program

13.3.3.5 Detector gas program parameters

FLOW RATE

Range: 0.0–20.0 ml/min, Default: 8.0 ml/min

Set the default flow rate and the final flow rate for each stage of the detector gas flow rate program.

TIME

Range: 0.00–9999.99 min, Default: 0.00 min

Set the retention time for the initial flow rate and the final flow rate for each ramp of the detector gas flow rate program.

RATE

Range: END/-400.0–400.0 ml/min^2, Default: END

Set the program rate of the detector gas flow rate program.

If you set the rate to "0", "END" appears and the program ends at the previous ramp. Move the cursor to "END" and set any numeric value other than "0" to enter the pressure and the time for that ramp.

13.3.3.6 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	——
Ins Line	Inserts a line in line at the current cursor position.	——

13.4 **Filter Signal Time Constant**

■ Selecting the filter time constant

Normally, analyes can be performed with the time constant set to the default value. However, in order to improve the S/N ratio, the time constant can be changed by measuring the half width of a test peak.

Fig. 13.4.1 shows the relationship between the peak half width and the time constant where the S/N ratio is maximaized. For example, if the half width of a peak is "0.1 sec", the S/N ratio is maximaized when the time constant is set to "20 ms."
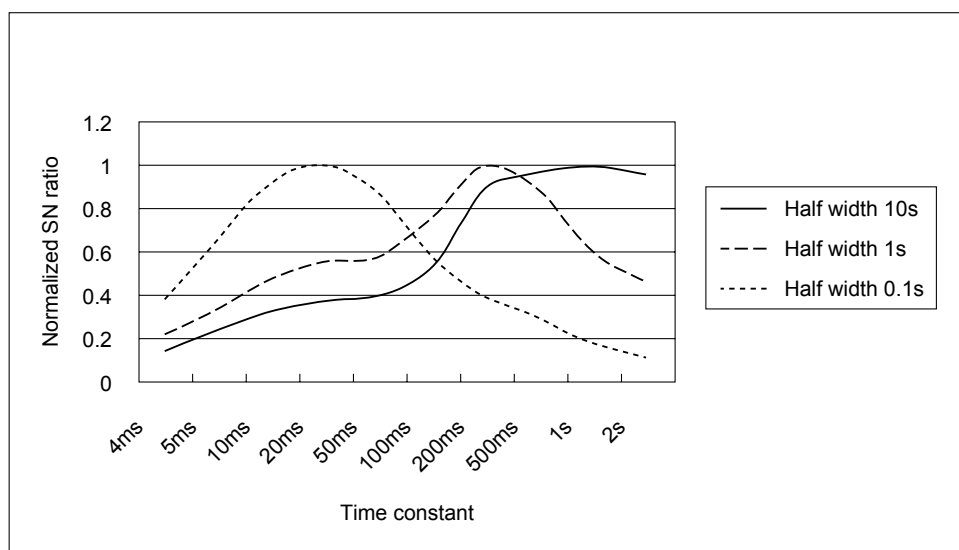
Fig. 13.4.1　Relationship between time constant and S/N ratio

13.*5* Setting the Output Signals

13.5.1 Detector signal output

⇨ RS-232C

⇨ ch1

⇨ ch2
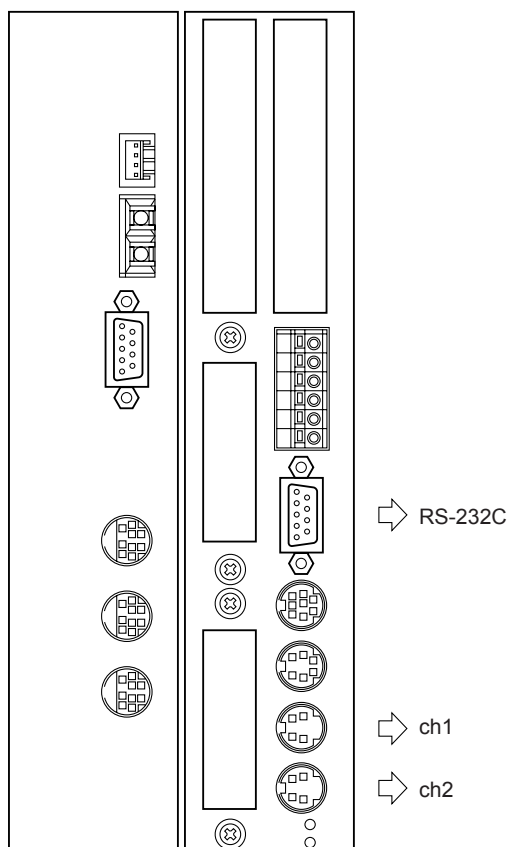
Fig. 13.5.1   Location of connector

Set the detector signal (digital and analog signals) output from the gas chromatograph. There are four signal output channels. Ch3 and Ch4 are available optionally.

Both digital and analog signals can be output from one channel. Even if two or more channels are set, signals can be output from each channel at the same time.

Detector signals are transferred through an RS-232C cable (for digital signals, only when the C-R8A or a personal computer are used) and the chromatopac signal cable (for analog signals).

13.5.2 Background compensation

If the baseline fluctuates considerably during programmed analysis, the baseline fluctuation can be saved as a background baseline by the GC. After wards, the background is subtracked from the baseline. (background compensation).

This section describes how to save the background baseline and perform background compensation

(1) Setting the signal output channel
    On the [DET] key main screen, set "SIGNAL OUTPUT PORT" from "Off" to Channel 1-4. ("Ch3" and "Ch4" for analog signal are available optionally.)

(2) Background storage setup
    On the [DET] key main screen, set "BACKGROUND SIG. SAVE" from "Off" to "Buff 1" (or "Buff 2") to save the background baseline.

(3) Saving the background baseline
    Without making an injection, press the [START] key on the gas chromatograph to execute analysis. The background baseline is saved.

(4) Background compensation settings
    On the [DET] key main screen, set "BACKGROUND SIG. COMP." from "No" to "Buff 1" (or "Buff 2") the same selectio from in "BACKGRND SAVE".

(5) Analysis
    Make an injection, and press the [START] key to execute analysis. Because background compensation is in efffect, large baseline fluctuations are now eliminated.
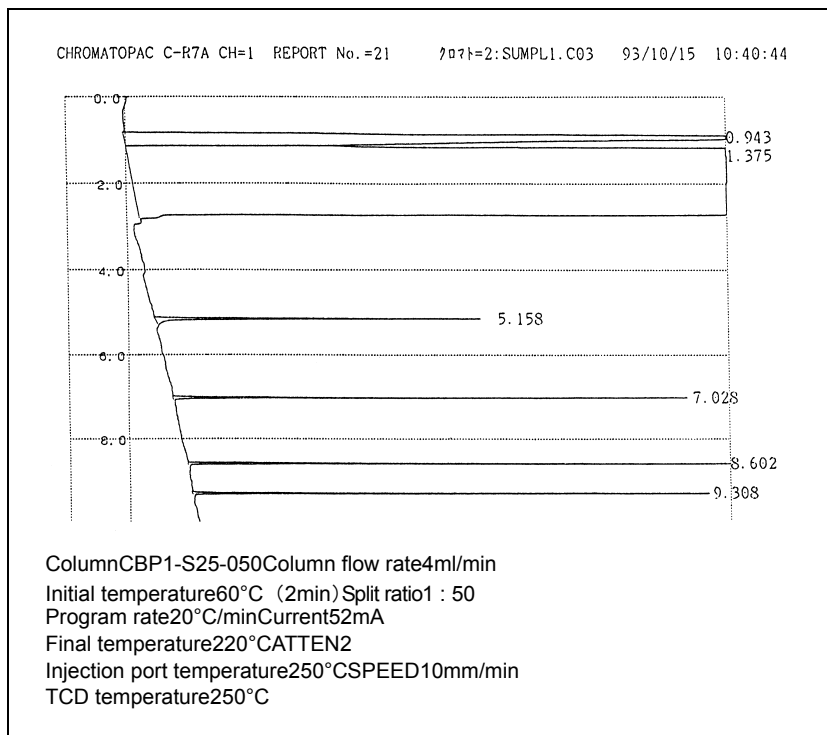
Fig. 13.5.2   Example of programmed analysis without compensation
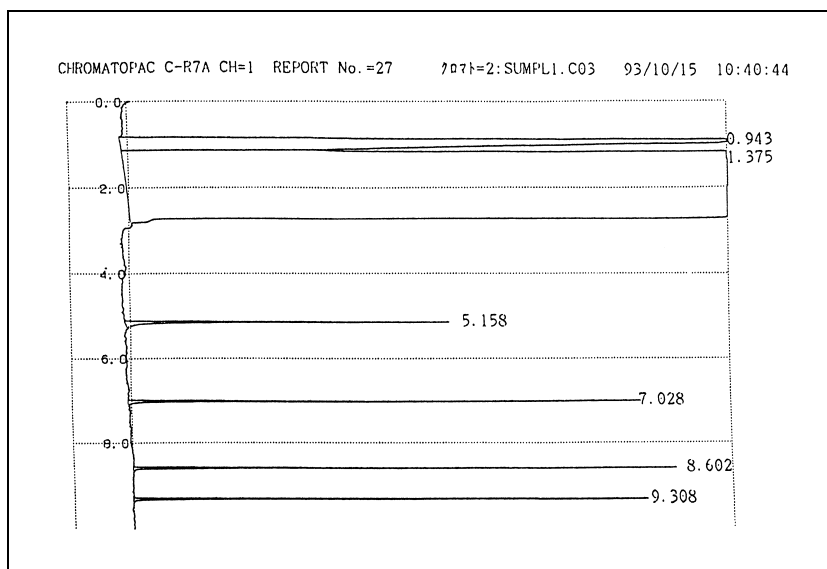
Fig. 13.5.3   Example of programmed analysis with compensation

13.5.3 Detector signal subtraction

When high sensitivity analysis or high temperature analysis is executed with a packed column, stationary liquid vapor released from the column packing is often contained in the carrier gas, making the background signal unstable.

If this is the case, set up dual analytical flow lines with an injection port, column, and detector. One flow line should have carrier gas flowing but no injections are made. The other flow line recieves the sample injections. The difference in detector signal between the reference and sample signal is acquired. This eliminates background noise and provides a stable signal.

14.1

Standard Diagnosis

Each part of the gas chromatograph is checked for problems with the self-diagnosis function.
Perform the standard diagnosis periodicaslly to maintain optimal performance and prevent failures.

14.1.1 Screen description

Select "STANDARD DIAGNOSIS" from the [DIAG] key main screen to display the Standard Diagnosis screen shown in Fig. 14.1.1.

```
Standard Diagnosis

The standard diagnosis starts
with PF2.
Before the standard diagnosis
the system turns off.




~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   ↵Return StartDiag Details ⬚
```
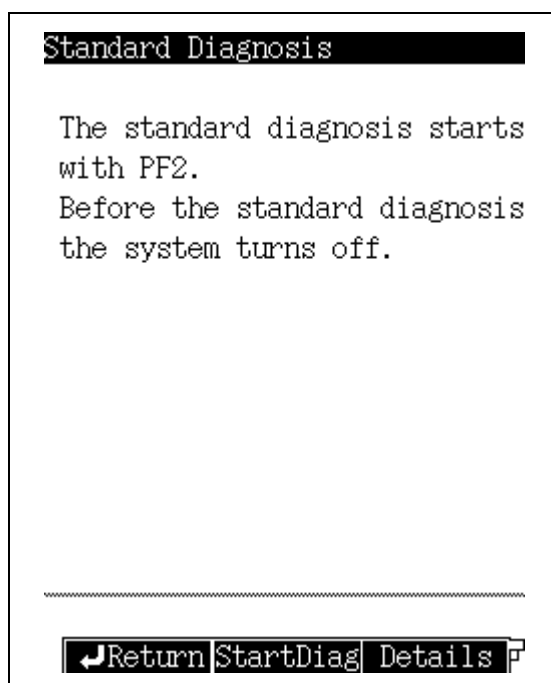
Fig. 14.1.1   Diagnosis main screen

14.1.2 PF menu

PF menu	Description	Reference section
Start Diag	Starts standard diagnosis program.	14.1.5
Details	Displays result of the most recent diagnosis. However, if standard diagnosis has not been executed since the power has been turned on, default values are displayed. [Print] (PF menu) prints out the displayed diagnosis results.	14.1.9
Diag Param	Determines setup values used for diagnostic reference and selects diagnosis items.	14.1.3

14.1.3 Diagnosis Parameters

Press [Diag Param] (PF menu) from the Standard Diagnosis main screen to display the Diagnosis Parameters screen shown in Fig. 14.1.2.
Select the items to be checked during the self-test.


```
Diagnosis Parameters NOT READY

Counter for Septum           No
Counter for Insert         ◀▶ No
CRG Use Time                Yes
Temp Sensor Diag            Yes
LCD Use Time                Yes
Fan Use Time                Yes
DC Voltage                  Yes
Room Tempetature            Yes
Atmospheric Press.          Yes
Primary Press.              Yes
CPU Registor                Yes
Real Time Clock Registor    Yes
                             ▽
  ↵Return
```
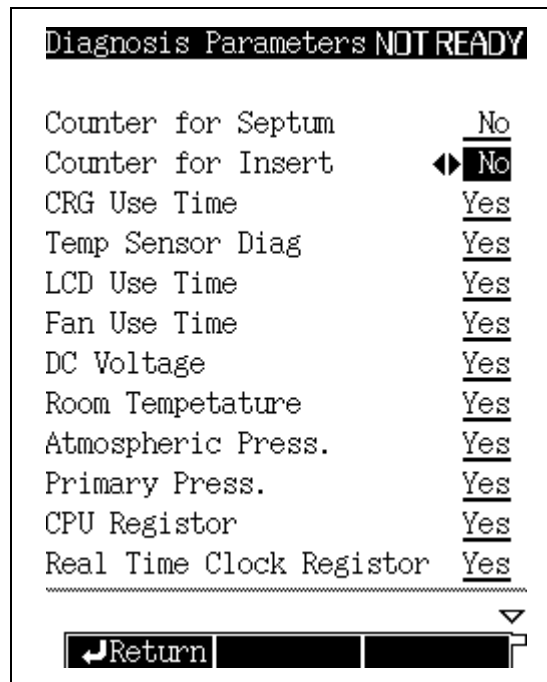
Fig. 14.1.2   Diagnosis setup screen

14.1.4   Diagnosis parameter list

For each item, specify whether it is to be checked or tested. Test items are marked "Yes". Items which are ignored are marked "No". Each item is marked either "Yes" or "No". For example, if the septum counter is marked "Yes", both the INJ1 and INJ2 will be chacked.

> ⚠ **CAUTION**
>
> At the time of Diagnosis, set the Split mode to "SPLIT". When WBI column is used, set the split mode to "DIRECT".

COUNTER FOR SEPTUM
COUNTER FOR INSERT
Verifies whether the preset number of injections has been exceeded.
The "ANALYSIS COUNTER" limit is displayed.

CRG USE TIME
Verifies whether the valve "On" time exceeds the preset operating time.
The "COOLANT CONSUMPTION" limit is displayed.

TEMP SENSOR USE TIME
The operating time for the temperature sensor in use at 300°C or above is displayed. Refer to the guidelines for operating time.

TEMP SENSOR DIAG
Verifies whether spiking noise has been generated, to detect deterioration of the platinum sensor.

LCD USE TIME
Verifies whether the accumulated backlight ON time exceeds the preset operating time.
The limit 15,000 hours.

FAN USE TIME
Verifies whether the accumulated fan operating time exceeds the preset operating time.
The limit is 43,800 hours.

DC VOLTAGE (5 VDC, 24 VDC, -15 VDC, FTD 24 VDC)
Verifies whether each DC voltage has exeeded its limit.

ROOM TEMPERATURE
Verifies whether the current room temperature is within the optimal range.
The range is 5 to 40°C.

ATMOSPHERIC PRESS
Verifies whether the atmospheric pressure is within the optimal range.

PRIMARY PRESS
Verifies whether the gas supply pressure is within the maximum set pressure.

CPU REGISTER
REAL TIME CLOCK REGISTER
Verifies that each register is correctly written and read.

DETECTOR ROM
Verifies that the data saved in the detector ROM is read correctly.

DETECTOR ADC REGISTER
Verifies that the data saved in the detector A/D converter register is read correctly.

DETECTOR HV SOURCE
Verifies whether the detector high voltage power supply is within the threshold.

DETECTOR IGNITE

Checks that the ignition pulse is normal.

DETECTOR IGNITION

Verifies whether the ignition operation is normally executed.

ECD FREQUENCY

Verifies whether the frequency of the pulse voltage applied to the ECD is below the limit.

CARRIER GAS ROM, DETECTOR GAS ROM, APC ROM

Verifies whether the data saved in the ROM on the flow controller PCB can be read correctly.

CARRIER GAS AD CONVERTER, DETECTOR AD CONVERTER, APC AD CONVERTER

Verifies whether the contents of the A/D converter on the flow controller PCB can be read correctly.

GAS CONTROL

Checks that the pressure flow rate is normally controlled.

OVER TEMP PROTECTION

Ensure that the overheat protection circuit is normal.

CPU PERIPHERAL

RESET IC

Verifies that the reset circuit works normally.

WATCH DOG TIMER

Ensures that the IC which checks for software problems is functioning normally.

ROM

Checks that the ROM is intact.

RAM

Verifies whether the RAM can be correctly written and read.

14.1.5   Starting the diagnosis

Press [Start Diag] (PF menu) from the standard diagnosis main screen shown in Fig. 14.1.1 to start diagnosis and to display the screen shown in Fig. 14.1.3.
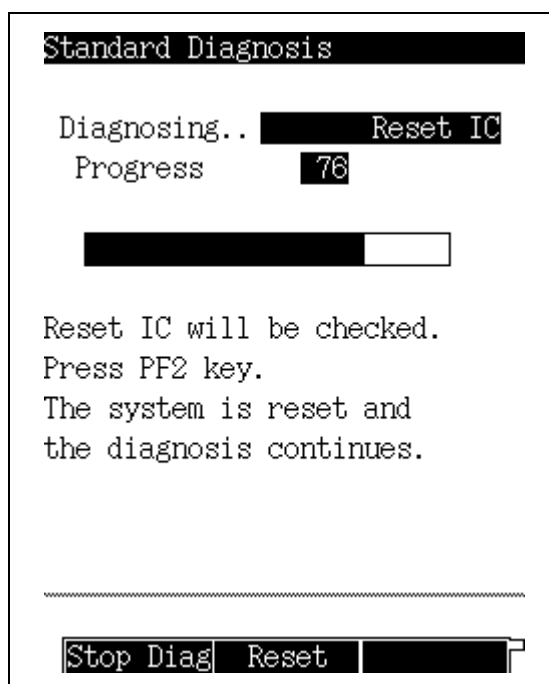
Fig. 14.1.3   Starting the Diagnosis

14.1.6 PF menu

PF menu	Description	Reference section
Stop Diag	Stops the diagnosis. If the program is stopped, items not yet executed are canceled.	14.1.7
Reset	Before stariting the IC diagnosis, the message "Reset IC will be checked. Press PF2 key." appears. Press [Reset] (PF menu) to check whether reset IC is functioning normally.	⎯⎯

14.1.7 Stopping/exiting the diagnosis

Press [Stop Diag] (PF menu) during diagnosis to display the diagnosis stop screen shown in Fig. 14.1.4.
When the diagnostics are allowed to complete, the total diagnosis results (Test Result) and the number of abnormalities (Number of NG) are displayed.

```
Standard Diagnosis

Test Result         Not Good
The diagnosis is terminated




 ↵Return  Details
```
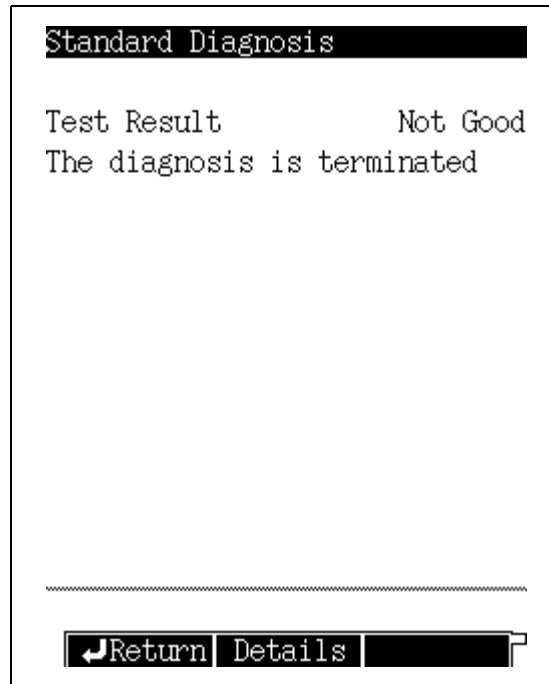
Fig. 14.1.4   Diagnosis stops

14.1.8 PF menu

PF menu	Description	Reference section
Details	When the diagnosis is stopped, diagnosis results up to that time are displayed. When the diagnosis ends, the diagnosis results of all items are displayed. Press [Print] (PF menu) to print out the displayed diagnosis results.	14.1.9

14.1.9 Diagnosis results

Press [Details] (PF menu) from the screen shown in Fig. 14.1.4 once the standard diagnosis is have stopped or ended; the Test Result screen shown in Fig. 14.1.5 appears.

Press [Details] (PF menu) from the standard diagnosis screen shown in Fig. 14.1.4 to display the results of the last test since the power was turned on. Once the power is turned off, the diagnosis results are cleared.

```
┌──────────────────────────────┐
│ Diagnosis Report             │
│                              │
│                              │
│ Test Result        Good      │
│ ───────────────────────────  │
│                              │
│ ▓▓▓▓▓▓▓▓Temp Sensor Diag▓▓▓▓ │
│ █Column            Good      │
│  SPL1              Good      │
│  FID1              Good      │
│  WBI2              Good      │
│  TCD2              Good      │
│  AUX3              Good      │
│  AUX4              Good      │
│  AUX5              Good      │
│ ▓▓▓▓▓▓▓▓ LCD Use Time ▓▓▓▓▓▓ │
│                          ⇕   │
│  ┌────────┬───────┬───────┐  │
│  │↵Return │ Print │       │  │
│  └────────┴───────┴───────┘  │
└──────────────────────────────┘
```
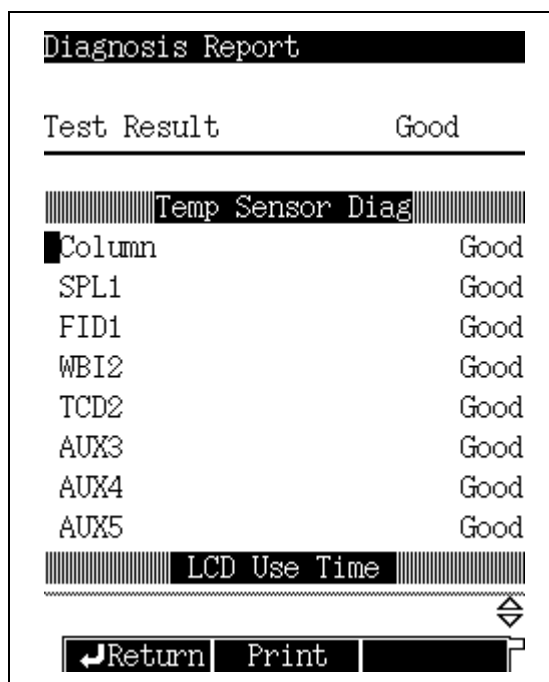
Fig. 14.1.5   Diagnosis results

14.1.10 PF menu list

PF menu	Description	Reference section
Print	Prints out the results of the diagnosis to a Chromatopac.	――

■ diagnosis results

・Good	: Displayed when the diagnosis result satisfies the requirements.
・Not Good	: Displayed when the diagnosis result does not satisfy the requirements.
・N/T (= Not Tested)	: Displayed when the diagnostic test was stopped or when an item is excluded from the test.
・N/A (= Not Applicable)	: Displayed when diagnostic test is disabled for the item (ignition test for a TCD, for example).
・N/S (= Not Selected)	: Displayed when the diagnosis were not perfomed on an item because it has not been configured in an analytical line. Certain diagnosis items can be performed for components which have not been configured. For example, for a detector not configured in any line, Make Up Gas Control is not checked, but its detector ROM check can be executed.
・N/I (= Not Installed)	: Displayed when the diagnosis item is not installed.

■ Troubleshooting items which are "Not Good"

Diagnosis item	Countermeasures
SEPTUM COUNTER	Replace the septum. (Refer to "18.3 Inspection and Maintenance: Septum".)
INSERT COUNTER	Replace the glass insert. (Refer to "18.5 Inspection and Maintenance: Glass Insert".)
ROOM TEMPERATURE	Check the operation range.
ATMOSPHERIC PRESS	Check the operation range.
GAS PRIMARY PRESS	Increase supply pressure from the gas cylinder. For example, adjust the regulator.
DETECTOR IGNITION	Refer to "19 Troubleshooting".
ANY OTHER ITEM	Contact your Shimadzu representative.

14.2 Log Reading Menu

14.2.1 Screen description

Select "2. LOG READING MENU" from the [DIAG] key main screen to display the Log Reading Menu screen shown in Fig. 14.2.1.
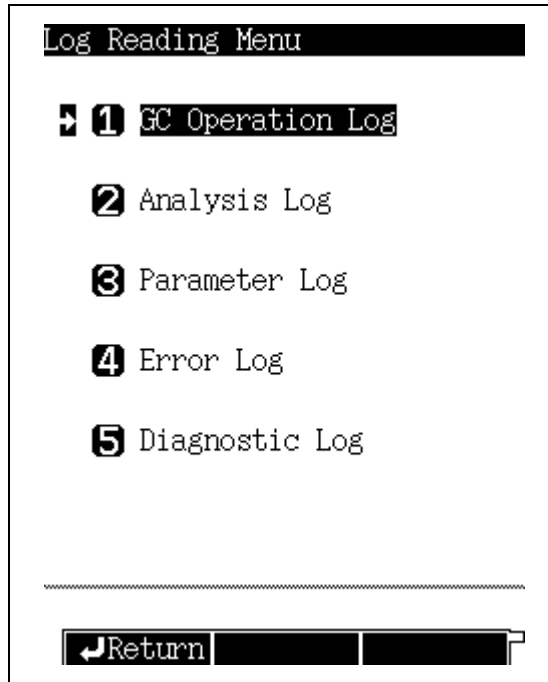
Fig. 14.2.1　Log reading menu main screen

14.2.2 Parameter list

GC OPERATION LOG
Displays the power On/Off log and the system On/Off log.
ANALYSIS LOG
Displays the analysis log. This log records whether analyses were finished and whether controls deviated from their target valves.
PARAMETER LOG
Displays the key operation log and the parameter change log.
ERROR LOG
Displays the log of displayed error messages.
DIAGNOSTIC LOG
Displays the diagnosis log.

14.2.3 GC Operation log

Select "1. GC OPERATION LOG" to display the system On/Off log and the heater On/Off log.

(1) Screen description
Select "2. LOG READING MENU" from the [DIAG] key main screen, then select "1. GC OPERATION LOG". The screen shown in Fig. 14.2.2 appears.
Up to 50 logs are stored. If the number of logs exceeds 50, existing logs are deleted starting with the oldest.

```
GC Operation Log       ( 1/ 6)
Start Time  Stop Time

08.12 08:00-            System
08.12 07:50-08.12 07:50 System
08.12 07:50-            Power
08.11 20:10-08.11 20:20 System
08.11 08:00-08.11 20:10 System
08.11 07:50-08.11 20:30 Power




⏎Return Clear Log  Print
```
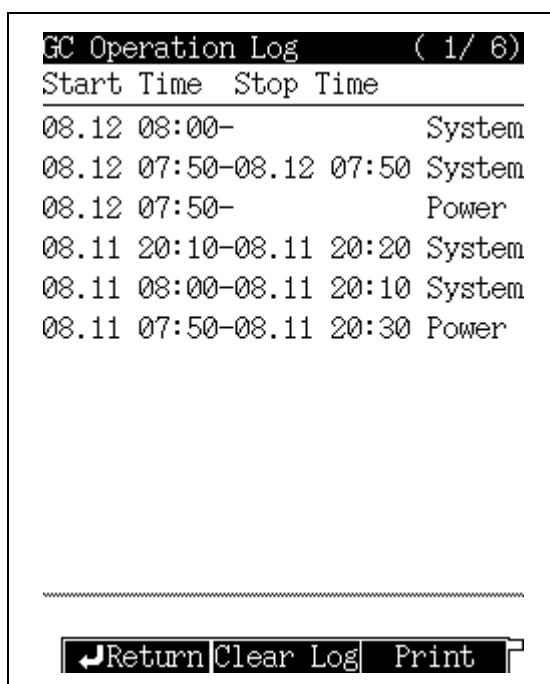
Fig. 14.2.2   Operation log screen

NOTE | If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the the operation log to a Chromatopac.	——

14.2.4 Analysis log

When "2. ANALYSIS LOG" is selected, the analysis log is displayed. This log records whether analyses were allowed to finish and whether monitored valves exceeded their set valves.

(1) Screen description
Select "2. LOG READING MENU" from the [DIAG] key main screen, then select "2. ANALYSIS LOG" to display the screen shown in Fig. 14.2.3.
25−545 logs are saved. The number of saved logs depends on the size of each log. If the number of logs exceeds the capacity, existing logs are deleted starting from the oldest.

```
Analysis Log          ( 1/ 1)
Start time Anal.len FILE  Stat
 08.11 18:32    15min  1   Fail*




┘Return Clear Log  Print
```
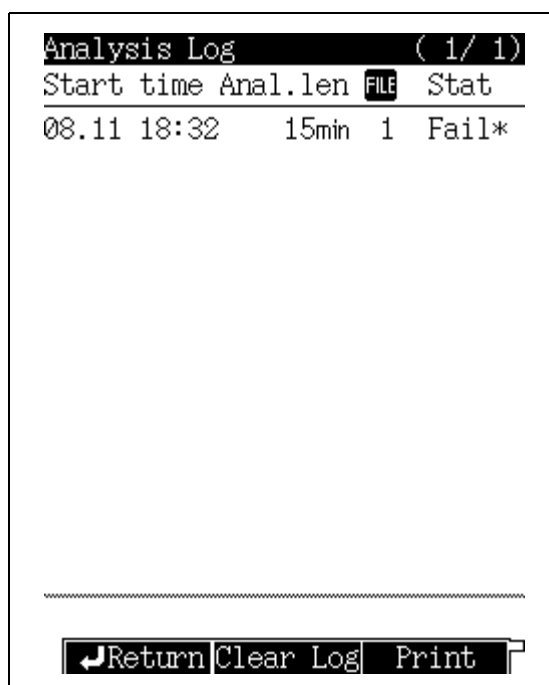
Fig. 14.2.3   Analysis log screen

NOTE During a temperature program, if the rate of temperature increase is too great, the GC may not be within the Ready range. When this occurs, the analysis log shows "Fail".

NOTE If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the analysis log to a Chromatopac.	——

(3) Analysis log details

On the analysis log main screen, use the cursor to select a log item with "∗" on the right and press the [ENTER] key to display the screen shown in Fig. 14.2.4.

The screen provides details about each error when the monitored value deviated from the set value, and for which an alarm or warning was issued during the analysis.

```
Analysis Log (details) ( 1/30)
Error Time    SET       ACT
─────────────────────────────
Room temp range erorr
    1.20min    25.0℃     25.5℃

DetAPC3 PCB error
    3.30min     130       151

DET#4 PCB error
    2.50min     100       111

CAR1 WBI PCB error
    1.20min      25        25

APC7-9 PCB error
    2.50min     100       111

COL A/D error
    3.30min
─────────────────────────────
                             ▽
  ↵Return
```

Fig. 14.2.4   Details screen

14.2.5 Parameter log

When "3. PARAMETER LOG" is selected, parameter names and new values are displayed when parameters are changed. In addition, the direct operation of valves, etc. are also displayed.

(1) Screen description
Select "2. LOG READING MENU" from the [DIAG] key main screen, then select "3. PARAMETER LOG". The screen shown in Fig. 14.2.5 appears.
Up to 50 logs are saved. If the number of logs exceeds 50, existing logs are deleted starting from the oldest.

```
Parameter Log          ( 1/50)
Time changed    Name     Value
  08.12 08:00   P1DD      9999
  08.12 08:00   CNA7         0
  08.12 08:00   APR7    -20.50
  08.12 08:00   CFP8    -120.0
  08.12 08:00   DLW1       789
  08.12 08:00   APG1        35
  08.12 08:00   FTV3       120
  08.12 08:00   SSY2       100
  08.12 08:00   SCC1       300
  08.12 08:00   M4PR     300.0
  08.12 07:55   G2PR       1.0
  08.10 08:57   CITP     200.0
                                ▽
   ↵Return Clear Log   Print
```

Fig. 14.2.5   Parameter log screen

NOTE   If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the parameter log to a Chromatopac.	——

14.2.6 Error log

When "4. ERROR LOG" is selected, the log of all errors which have been displayed is shown.

(1) Screen description
Select "2. LOG READING MENU" from of the [DIAG] key main screen, then select "4. ERROR" to display the screen shown in Fig. 14.2.6.
Up to 100 logs are saved. If the number of logs exceeds 100, existing logs are deleted starting from the oldest.

```
Error Log              ( 1/100)
Time occured    Code    Value

Modification during analysis
 06.13 18:15  E4301        69

Modification during analysis
 06.13 18:13  E4301     26669

Modification during analysis
 06.13 18:13  E4301     26668

Modification during analysis
 06.13 18:13  E4301     26667

Modification during analysis
 06.13 18:13  E4301     26627

Modification during analysis
 06.13 18:10  E4301        89
                              ▽
  ⏎Return Clear Log  Print
```

Fig. 14.2.6   Error log screen

NOTE   If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menut

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the error log to a Chromatopac.	——

14.2.7 Diagnostic log

When "5. DIAGNOSTIC LOG" is selected, the resulst of the standard diagnosis are displayed. The results of the last diagnosis are shown in the [Details] (PF menu) screen described in "14.1 Standard Diagnosis".

(1) Screen description
Select "2. LOG READING MENU" from of the [DIAG] key main screen, then select "5. DIAGNOSTIC LOG". The screen shown in Fig. 14.2.7 appears.
Up to 50 logs are saved. If the number of logs exceeds 50, existing logs are deleted starting from the oldest.

```
Diagnostic Log        ( 1/10)
 Diag date           Status
  98.08.12 08:00      Good
  98.08.12 07:50      Good
  98.08.12 07:50      Good
  98.08.12 07:50      Not Good
  98.08.11 20:30      Not Good
  98.08.11 20:20      Good
  98.08.11 20:10      Good
  98.08.11 20:10      Good
  98.08.11 08:00      Good
  98.08.11 07:50      Not Good



  ↵Return Clear Log  Print
```

Fig. 14.2.7   Diagnosis log screen

NOTE   If there are more items than items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	____
Print	Prints the diagnosis log to a Chromatopac.	____

14.*3* Analysis Counter

Use the analysis counter to set the replacement timing of the septum, and the glass insert, when the counter exeeds the limit, an error message is displayed.

14.3.1 Screen description

Select "3. ANALYSIS COUNTER" from the [DIAG] key main screen to display the screen shown in Fig. 14.3.1.

```
Analysis Counter
SPL1 LINE
              1
AOC Wait          ◀▶    No
░░░░░░░░Counter for Septum░░░░░░░░
Use Counter            Yes
Analysis counter         0
Setting to warn        100
░░░░░░░░Counter for Insert░░░░░░░░
Use Counter            Yes
Analysis counter         0
Setting to warn        100



~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ↵Return   Reset    Next
```

Fig. 14.3.1   Analysis counter screen

14.3.2 Parameter list

AOC WAIT

Selection: Yes/No, Default: No

When the threshold is exceeded during batch processing, select "Yes" to temporarily pause, the AOC operation when the analysis counter has exeed the limit.

USE COUNTER

Selection: Yes/No, Default: Yes

ANALYSIS COUNTER

Selection: 0

SETTING TO WARN

Range: 0–999, Default: 100

NOTE The septum/glass insert replacement interval depends on the type of analysis. Periodically replace the septum and the glass insert even if the warning message is not displayed.

14.3.3 PF menu

PF menu	Description	Reference section
Reset	Resets analysis number counter of the current item.	——
Next	Displays the setup screen of the analysis counter of another injection port.	——

14.*4* Coolant Consumption Counter

The coolant consumption display allows you to confirm the total time that the CRG has been "On"
(The CRG is an optional accessory.)
If the coolant consumption exceeds the time limit specified (setting to warn), a warning message
is displayed. Replace the gas supply.

14.4.1 Screen description

Select "4. COOLANT CONSUMPTION" from the [DIAG] key main screen to display the
Coolant consumption screen shown in Fig. 14.4.1.

```
Coolant Consumption
||||||||||||||||| Column |||||||||||||||||
Use Counter                      Yes
Consumption(min)                   0
Setting to warn(min)             100
||||||||||||||||||| WBI2 |||||||||||||||||||
Use Counter            ◀▶         No
Consumption(min)                   0
Setting to warn(min)               0



   ↵Return   Reset
```

Fig. 14.4.1   Coolant consumption sets screen screen

14.4.2 Parameter list

USE COUNTER
 Selection: Yes/No, Default : Yes
CONSUMPTION
Default: 0min
The total time that the CRG is "On" is displayed.
Refer to "15.3 Setting the CRG Parameters".
SETTING TO WARN
Range: 0–9999min, Default : 100min

NOTE The coolant consumption time depends on the gas cylinder volume and the number of analyses which
requier CRG. Set the warning time according to the analysis conditions.

14.4.3 PF menu

PF menu	Description	Reference section
Reset	Resets the Use counter.	――――

14.5 Standard Installation Test

After the system has been installed by your Shimadzu representative, the standard installation test is performed to check whether the system is functioning properly.

14.5.1 Screen description

Select "5. STANDARD INSTALLATION" from the [DIAG] key screen to display the Standard installation screen shown in Fig. 14.5.1.
The installation test can be performed at any time to check for proper functioning. From this screen, load the analytical conditions of the standard installation test.

```
Standard Installation Test
            FILE 0:FILE0

After loading a file used in
the standard installation
test, push [PF2] to set test
parameters to the file.

Set column dimensions before
to set test parameters.




⏎Return   Load   Unload
```
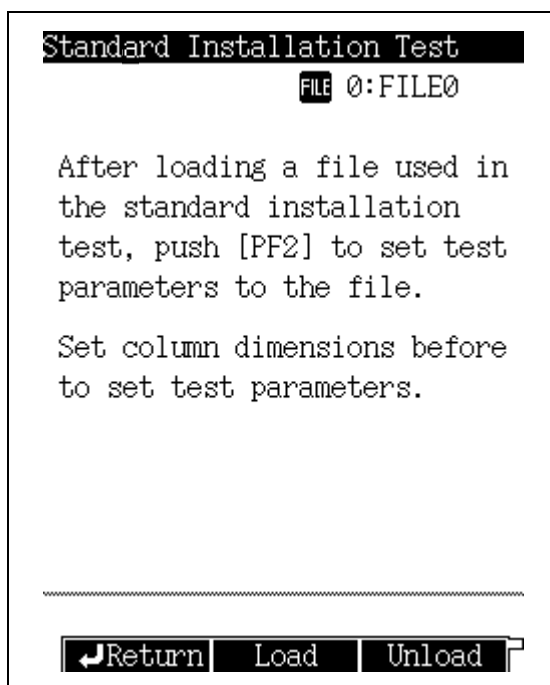
Fig. 14.5.1   Standard installation test main screen

14.5.2 PF menu

PF menu	Description	Reference section
Load	Automatically sets the analytical conditions of the standard installation test. When [Load] (PF menu) is pressed, "TEST" is displayed for the used file name.	――
Unload	Returns analytical conditions to their former status.	――

14.5.3 Test procedure

(1) Specify the analytical conditions file of the standard installation test.
Example: Load "File 1" using [File] (PF menu) of the [SET] key.

(2) Configure the injection port and the detector used to execute the standard installation test in an analytical here.
However, if two or more analytical lines have been configured, the lowest No. analytical line is set with the test conditions.
In the standard installation test, only one detector can be set per analytical line. If two or more detectors are set, an error message appears.

(3) Set the dimensions of the column installed.
Example: Set the dimensions of the column using [Column] of the [FLOW] key.

(4) Press [Load] (PF menu) to load the analytical conditions of the standard installation test.

(5) If the analytical condition need to be changed for the installation test, change the parameters.

(6) Make an injection, then verify whether the data has been acquired correctly.

(7) When analysis finishes, press [Unload] (PF menu) to return the analytical conditions to their former status.

14.6 **Peak Generator**

Select "6. PEAK GENERATOR" to generate electronic peaks to confirm of the operation of the data processing unit.

14.6.1 Screen description

Select "6. PEAK GENERATOR" from the [DIAG] key screen to display the Peak generator screen shown in Fig. 14.6.1.

```
Peak Generator
Peak Generator            On
Mode                   Noise

Ch1 Standard Signal       On
Ch2 Standard Signal  ◆   Off
Ch3 Standard Signal      Off
Ch4 Standard Signal      Off




∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼∼

  ↵Return PeakInfo
```
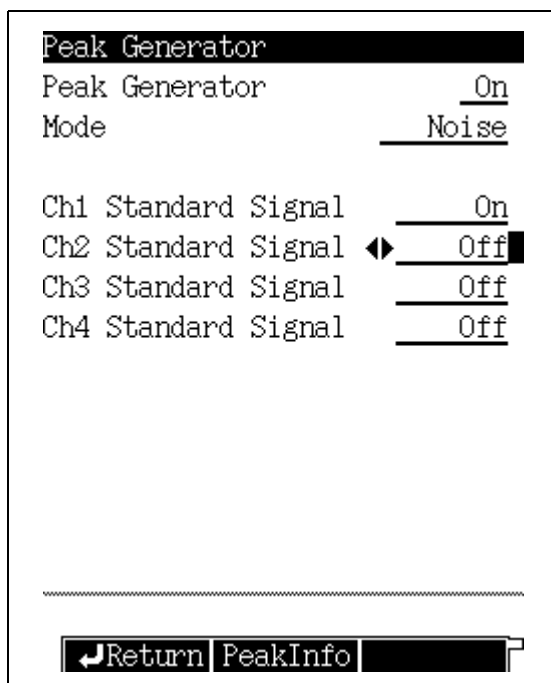
Fig. 14.6.1   Peak generator setup screen

14.6.2 Parameter list

PEAK GENERATOR
Range: On/Off, Default: Off
MODE
Range: Noise/No Noise/Trunc, Default: Noise
Ch1−Ch4 STANDARD SIGNAL
Range: On/Off, Default: Off

14.6.3 PF menu

PF menu	Description	Reference section
Peak Info	Specify the parameters (retention time, full width at half height and peak height) of the peaks to be generated.	___

From the gas chromatograph, specify the parameters of the Shimadzu AOC-20i Auto Injector and the AOC-20s Auto Sampler Carousel, which automatically inject liquid samples into the gas chromatograph. For detailed setting procedures, refer to the User's Manual for AOC-20 and the User's Manual for AOC-20 Dual Injection System.

15.1.1 Screen description

After installing the auto injector on the gas chromatograph, access the line configuration screen from the [SET] key, and then select AOC1 for the analytical line (select AOC2 in addition, for the analytical line for dual injection systems.)

Press the [OPTION] key again or press [Next] (PF menu) several times on the [OPTION] key screen to display the AOC parameter screen shown in Fig. 15.1.1. The screen toggles among the AOC parameters → AUX APC → CRG screens.
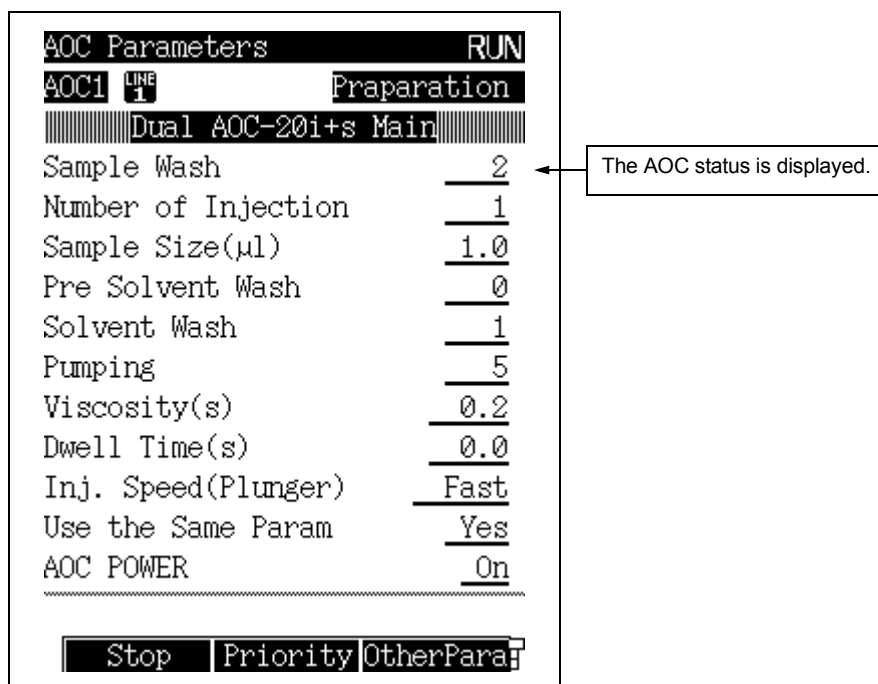
Fig. 15.1.1   AOC setup screen

■ AOC STATUS

The AOC status can be monitored.

Screen display	Description
Inactive	AOC is not operating.
Taking vial	A vial is being picked up from the tray.
Preparation	AOC is operating (before injection).
Rinse	AOC is operating (after injection).
Putting vial	A vial is being returned to the tray.
Wait	AOC is waiting for analysis.

15.1.2 Parameter list

SAMPLE WASH

Range: 0−99, Default: 2

Set the number of times to rinse the syringe with sample before injection.

NUMBER OF INJECTION

Range: 0−99, Default: 1

Set the number of times the sample should be injected.

SAMPLE SIZE

Range: 0.1−8.0 μl, Default: 1.0 μl

Set the sample injection amount.

PRE SOLVENT WASH

Range: 0−99, Default: 0

Set the number of times to rinse the syringe with solvent before injection.

This item is valid only when the injection mode is set to "0 (normal)".

SOLVENT WASH

Range: 0−99, Default: 1

Set the number of times to rinse the syringe with solvent after injection.

PUMPING

Range: 0−99, Default: 5

Set the number of times to raise and lower the plunger with the needle inside the sample to eleminate syringe air bubbles.

VISCOSITY

Range: 0.0−99.9 sec, Default: 0.2 sec

During rinsing with sample and pumping, the system waits for the specified period of time. When aspirating sample before injection, the system waits for either the valve set here or 4 seconds, which ever is longer.

The wait time during rinsing with solvent is always 0.2 seconds.

DWELL TIME

Range: 0.0−99.9 sec, Default: 0.0 sec

Set the length of time for the syringe to remain in the injection port after injection.

INJ. SPEED (PLUNGER)

Selecton: Slow/Middle/Fast, Default: Fast

Specifies the plunger speed during injection.

USE THE SAME PARAM

Selection: Yes/No, Default: No

This item is displayed on the main parameter setup screen when a dual injector is used.

Select "Yes" to operate the sub AOC with same parameters as those of the main AOC.

AOC POWER

Selection: On/Off, Default: On

Turns the AOC power on and off (built-in GC-2010 power supply).

15.1.3 PF menu

PF menu	Description	Reference section
Start	Starts AOC and gas chromatograph.	——
Stop	Temporarily stops the AOC. If [Start] (PF menu) is pressed in stop status, the AOC resumes the operation before [Stop] (PF menu) was pressed.	——
Priority	Sets up a Priority analysis.	15.1.4
Other Para	Sets AOC options and customization.	15.1.7
Sampler	Sets the auto sampler, sub injector and bar code reader.	15.1.10
Reset	Resets AOC to the status before control was started.	——
Upload	Loads parameters from the AOC to the AOC setup screen of the gas chromatograph.	——
Main/Sub	Toggles between the main AOC setup screen and the sub AOC setup screen. Available only when an AOC 1 and AOC 2 are configured in the analytical line and sub AOC is set to "Use" in [Sampler] (PF menu).	——
Print	Prints the parameters on the Chromatopac.	——
Next	Toggles among these screens, in order: AOC parameters → AUX APC → CRG.	——

15.1.4 AOC priority analysis

Select [Priority] (PF menu) from the AOC main screen to display the AOC priority sample screen shown in Fig. 15.1.2.
The batch can only be interrupted when the AOC is operating.
Enter the sample injection No., and press [Set] (PF menu).

```
AOC Priority Sample        RUN
                    Praparation

   Injection Sample         5




~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ⏎Return   Set            ⌐
```
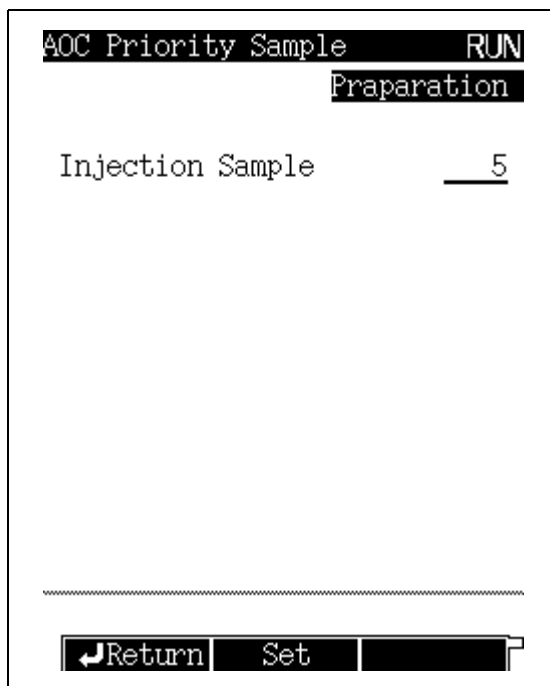
Fig. 15.1.2   Priority analysis setup screen

15.1.5 Parameter list

INJECTION SAMPLE
INJECTION SAMPLE NUMBER

NOTE   Enter the sample vial No. designated for priority analysis.
・ When an auto sampler carousel is not in use,
Short rack No. 1−6
Long rack No. 1−12
・ When an auto sampler corousel is installed, No. 1−150 (maximum)

When an auto sampler carousel, the allowable vial No. range depends on the vial rack type and the number of racks. A valve of 0 (default) indicates no priority sample.

15.1.6 PF menu

PF menu	Description	Reference section
Set	Analyzes the vial No. specified after the analysis of the current sample is finished.	――

15.1.7 Other AOC parameters

Select [OtherPara] (PF menu) from the AOC main screen to display the other parameters screen shown in Fig. 15.1.3.
Specify options and AOC custom parameters.
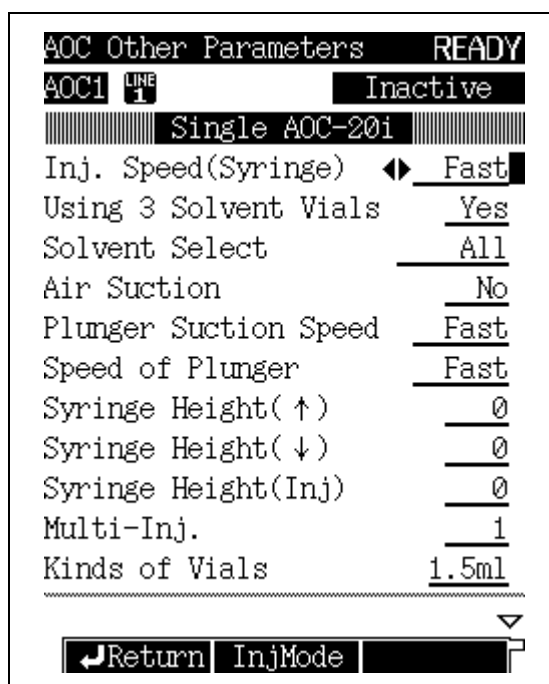
Fig. 15.1.3   Additional AOC parameter setup

15.1.8 Other AOC Parameter

INJ. SPEED (SYRINGE)
Selection: Slow/Fast, Default: Fast
Set the syringe injection speed.

USING 3 SOLVENT VIALS
Selection: Yes/No, Default: No
Specifies whether three solvent vials are present and the autosampler carousel is not in use.
This item is only available when "USE OF THE SAMPLER" in [Sampler] (PF menu) is set to
"Not Use".

SOLVENT SELECT
Selection: All/A only/B only/C only, Default: All
This item is available when "USING 3 SOLVENT VIALS" is set to "Yes" or "USE OF THE
SAMPLER" in [Sampler] (PF menu) is set to "Use".
All: Three solvent types are used.
For the details, refer to Fig. 3.4.1 in "3.4 Auto Sampler" in the AOC-20 User's Manual.

AIR SUCTION
Selection: Yes/No, Default: No
Set whether or not 1 µl of air is aspirated into the siringe after aspirating sample.

This type of injection is useful for samples with a wide boiling point range, when compound
discrimination problems can occur.

⚠️ **CAUTION**

When the column initial temperature is high or when a PEG-based,
polar column is used, the column life may be shortened by injecting
air.

PLUNGER SUCTION SPEED
Selection: Slow/Middle/Fast, Default: Fast
Set the plunger speed during sample injection.

SPEED OF PLUNGER
Selection: Slow/Middle/Fast, Default: Fast
Set the plunger speed during rinsing with sample or pumping.

SYRINGE HEIGHT (↑)
Range: 0–20 mm, Default: 0 mm
Set the syringe height when it moves down to a sample vial (moves syringe up from default).

SYRINGE HEIGHT (↓)
Range: 0–2 mm (1.5 ml vial)/0–10 mm (4 ml vial), Default: 0 mm
Set the syringe height when it moves down to a sample vial (moves syringe down from
default).

SYRINGE HEIGHT (INJ)
Range: 0–22 mm, Default: 0 mm
Set the syringe height when it moves down during sample injection (moves syringe up from
default).

MULTI-INJ
Range: 1–99, Default: 1
Set the number of times to inject each sample.

KINDS OF VIALS

Selection: 1.5 ml/4 ml, Default: 1.5 ml

Specyfy the vial type.

RACK

Selection: Short/Long, Default: Short

Set the rack type.

KINDS OF THE SYRINGE

Selection: 10 µl/50 µl/250 µl, Default: 10 µl

Set the syringe type.

SUCTION VOLUME FOR WASHING

Selection: 80%/60%, Default: 80%

Set the aspiration volume during sample wash and pumping.

RACK POSITION

Range: 0−2, Default: 1

Set the rack position while sampler is used.

15.1.9 PF menu

PF menu	Description	Reference section
Inj Mode	For details, refer to "3.3.3 Injection mode" in AOC-20 User's Manual.	────

15.1.10 Auto-sampler carousel and other optional parameters

Select [Sampler] (PF menu) from the AOC main screen to display the sampler screen shown in Fig. 15.1.4.
Specify the options installed on the AOC, such as sampler carousel.
When AOC1 and AOC2 are selected for the analytical line in "Line configuration" of the [SET] key, both "USE OF THE SAMPLER" and "USE OF THE SUB AOC" are automatically set to "Use".
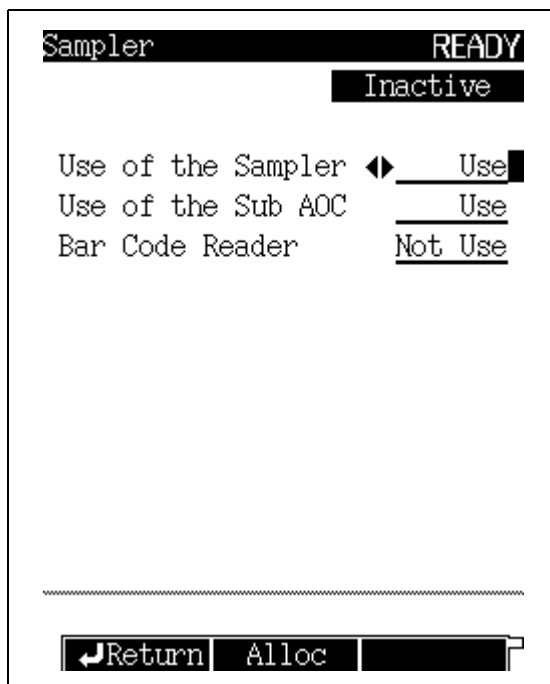
Fig. 15.1.4   Sampler carousel and other options setup

15.1.11 Parameter list

USE OF THE SAMPLER
Selection: Use/Not Use, Default: Not Use
This item automatically set to "Use" when "USE OF THE SUB AOC" is set to "Use".
USE OF THE SUB AOC
Selection: Use/Not Use, Default: Not Use
BAR CODE READER
Selection: Use/Not Use, Default: Not Use
Select "Use" when the Bar Code reader is installed.

15.1.12 PF menu

PF menu	Description	Reference section
Alloc	When "Use of the Sub AOC" is set "Use", [Alloc](PF menu) is displayed. For details, refer to "3.4 Division of Sample" in AOC-20 Dual Injection System User's Manual.	――

15.2 Setting the AUX APC Parameters

The pressure, the flow rate and the gas type can be set for the AUX APC.

15.2.1 Screen description

If an AUX APC is installed, press the [OPTION] key from the [OPTION] key main screen, or press [NEXT] (PF menu) until the AUX APC screen, show in fig. 15.2.1, appears.

The [NEXT] (PF menu) key toggles among the AOC parameters → AUX APC → CRG screens, in that order.

Fig. 15.2.1   AUX APC main screen

15.2.2 Parameter list

PRESS

Range: 0.0–400.0 kPa, Default: 100 kPa

Set the pressure when the control mode is set to "PRESS".

FLOW RATE

Range: 0.0–1200.0 ml/min, Default: 50 ml/min

Set the flow rate when the control mode is set to "FLOW".

CONTROL MODE

Selection: PRESS/FLOW, Default: PRESS

PRESS: Controls the system to obtain the preset pressure.

FLOW: Controls the system to obtaint the preset flow rate.

> NOTE When using the AUX APC in flow mode, a restrictor is used to ensure that the actual flow rate is equal to the set flow rate. Confirm the actual flow rate with a flow meter.

GAS TYPE

Selection: He/N2/H2/Ar, Default: He

Set the type of gas supplied to the APC. If the gas type is set incorrectly, the flow rate can not be set as specified in "FLOW" mode. This is because a restrictor is used to calculate the flow rate.

15.2.3 PF menu list

PF menu	Description	Reference section
Program	Displays the pressure or flow rate program setup screen for the AUX APC.	15.2.4
Resistor	In flow mode, the difference between the set and actual value can be eliminated by installing a restrictor in the flow line. On the resistor screen, enter the i.d., length, and resitance of the restrictor tubing.	15.2.5
On/Off	Set APC to be used to "On". Default value is "On".	——
Offset	Performs offset calibration of APC sensor to improve the reproducibility of results.	3.6
Next	Toggles among AOC parameters → AUX APC → CRG screens, in that order.	——

15.2.4 Setting a program

A pressure of flow rate program can also be created for the AUX APC. Set the control mode to "Pressure" on the AUX APC main screen, select the desired APC, and then press [Program] (PF menu). The APC program screen, shown in Fig .15.2.2, opens.

Similarly, a flow rate program can be creaded by selecting "FLOW" mode and pressing [Program] (PF menu). This opens the flow rate program screen.

For the program setting procedure, refer to "12.5.5 Pressure program" and "12.5.6 Creating a Flow rate program".

A program can contain up to 7 ramps of pressure or flow rate increase/decrease.

Fig. 15.2.2　APC pressure program setup

15.2.5 Using restrictor tubing

Select the desired APC from the main APC screen. Then press [Resistor] (PF menu) from the AUX APC main screen to display the restrictor tube setup screen shown in Fig.15.2.3. The difference between set and actual flow rates can be eliminated by installing a restrictor. Enter the restricto's inner diameter, length, and resistance.

```
AUX APC                    READY
APC1
Inner diameter(mm)         0.00
Length(m)                  0.00
Resistance               4500.0




 ↵Return                        
```

Fig. 15.2.3   Restrictor setup screen

NOTE   If the necessary pressure to flow rate conversion information is not saved in the GC, the actual and measured flow rate may still not be equivalent.

15.2.6 Parameter list

INNER DIAMETER
Range: 0.01−6.00mm, Default: 0.00
LENGTH
Range: 0.1 −250.0m, Default: 0.00
RESISTANCE
Range: 0.01−100000.0, Default: 1000.0
When the inner diameter and the length have been entered, the resistance is automatically calculated. Alternatively, enter only the resistance.

NOTE   The resistance is calculated according to this formula: $\dfrac{(\text{i.d. (mm)})^4}{\text{length (m)}} \times 10^6$.

Resistance valves greater than 10^5 can not be calculated.

15.3 Setting the CRG Parameters

The CRG (option) allows temperatures below room temperature to be set. The CRG can be connected to the column oven or the INJ2.

15.3.1 Screen description

Press the [OPTION] key from the [OPTION] key main screen, or press [NEXT] (PF menu) until the CRG screen, shown in Fig.15.3.1, appears.

The [NEXT] (PF menu) key toggles among the AOC parameters → AUX APC → CRG screens, in that order.

```
CRG                     READY
Column Oven
    Valve                 On
    CRG                   Use
··································
WBI2
    Valve              ◆▶Off
    CRG              Not Use




··································
   Next                     
```
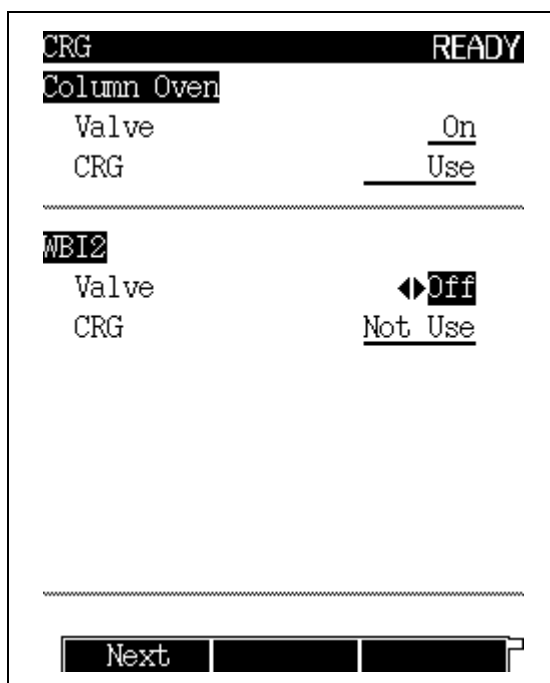
Fig. 15.3.1   CRG main screen

NOTE   If the CRG is turned off after a negative temperature valve has been set, the temperature cannot be achieved, and the GC cannnot become ready. When turning off the CRG, ensure that the temperature valve is set properly.

15.3.2 Parameter list

COLUMN OVEN

VALVE   Selection: On/Off, Default: Off

CRG   Selection: Use/Not Use, Default: Not Use

When the CRG is connected to the column oven, the column oven temperature control range is extended to -99.0−+450.0°C.

When using the CRG, set "VALVE" to "On" and "CRG" to "Use".

When using valve control only, set "VALVE" to "On" and set "CRG" to "Not Use".

INJ 2

VALVE   Selection: On/Off, Default: Off

CRG   Selection: Use/ Not Use, Default: Not Use

When the PTV is installed on INJ2 and the CRG is connected, the injection port temperature control range is extended to -99.0−+450.0°C.

When using the CRG, set "VALVE" to "On" and "CRG" to "Use".

When using valve control only, set "VALVE" to "On" and set "CRG" to "Not Use".

15.3.3 PF menu

PF menu	Description	Reference section
Next	Toggles among the AOC parameters → AUX APC → CRG screens, inthat order.	——

16.*1*   **Time Scheduler**

Use the Time scheduler to establish a weekly or daily schedule of automated GC operations.

16.1.1   description Screen

Select "1. TIME SCHEDULER" from the [FUNC] key main screen to display the Time scheduler menu shown in Fig. 16.1.1.

```
Time Scheduler
Inactive      Schedule    No.0


  ↕ ❶ Mode
    ❷ Edit
    ❸ Start/Stop
    ❹ Copy
    ❺ Delete




  ↵Return
```

Fig. 16.1.1   Time scheduler menu

16.1.2 Parameter list

MODE
Select whether the same schedule will be executed every day or a different schedule will be executed on each day of the week.

EDIT
Edit the schedule.

START/STOP
Set the schedule start/stop procedure.

COPY
Copy the contents of a schedule to a specified schedule.

DELETE
Delete the contents of a specified schedule.

16.1.3 Setting the mode

Select "1. MODE" from the time scheduler menu to display the mode setup screen shown in Fig. 16.1.2.
Select whether to use the same schedule every day or to use a different schedule on each day of the week. Up to 8 schedules can be set with the time scheduler.

```
Time Scheduler
Inactive      Schedule    No.0

Mode              ◀▶Number
Schedule Number        No.0




┌─────────────────────────┐
│ ┘Return │        │      │
└─────────────────────────┘
```
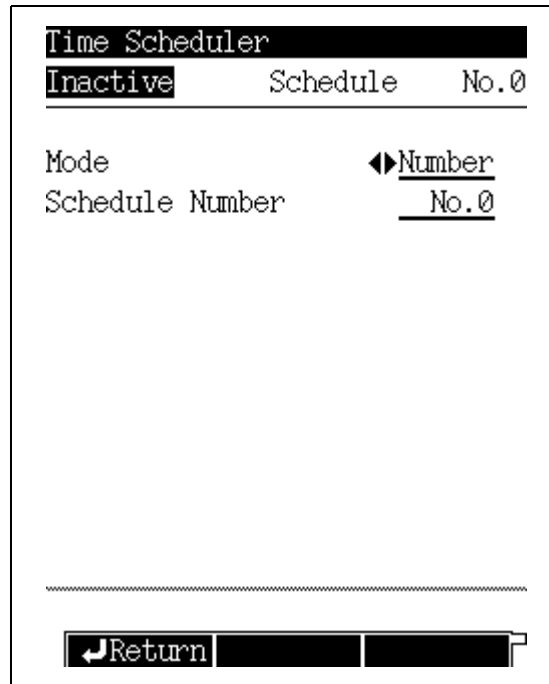
The schedule number can be set only when in Number mode.

Fig. 16.1.2   Mode setup screen

NOTE   When the time scheduler is operating, the mode cannot be changed.

■ Schedule number and day of the week

The table below shows the relationship between the schedule number and the day of the week.

Mode 1 (schedule number)	Mode 2 (day)
No. 0	Sun.
No. 1	Mon.
No. 2	Tue.
No. 3	Wed.
No. 4	Thu.
No. 5	Fri.
No. 6	Sat.
No. 7	———

16.1.4 Editing a time schedule

Select "2. EDIT" from the time scheduler menu to display the schedule number or the day of the week setup screen shown in Fig. 16.1.3. Before editing a schedule, select the schedule number or the day of the week, and press [Edit] (PF menu). Then, the schedule edit screen shown in Fig. 16.1.4 appears.

You do not have to set schedules in the order of execution time. After editing time schedules, they are automatically sorted. More than one schedule can be set to the same time. These schedules will be executed at the same time.
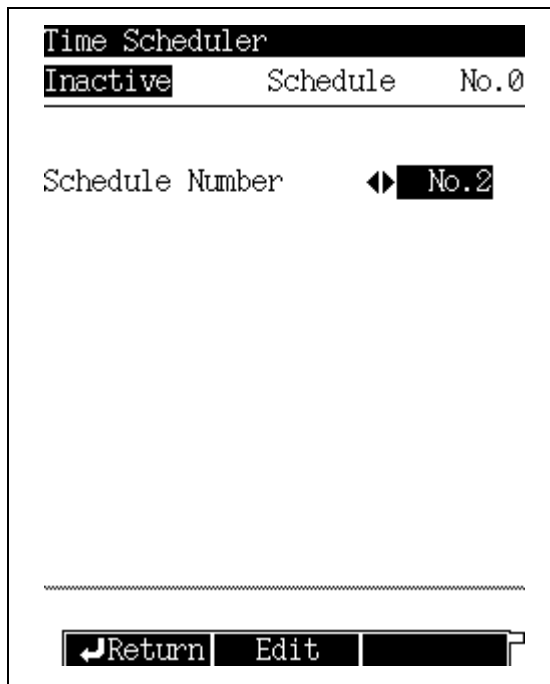
Fig. 16.1.3   Schedule number selection screen   Fig. 16.1.4   Schedule edit screen
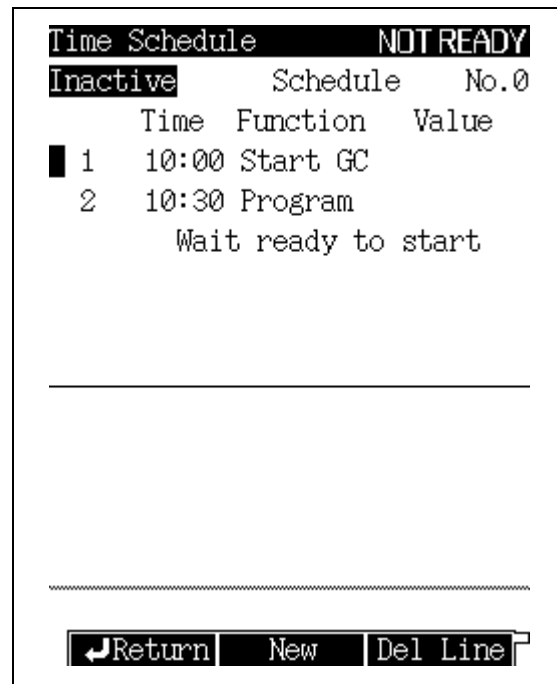
16.1.5 PF menu

PF menu	Description	Reference section
New	Creates a new time schedule.	16.1.6
Del Line	Deletes a schedule line at the current cursor position.	

16.1.6 Creating a new time schedule

Select [New] (PF menu) from the time schedule screen to display the Time Schedule screen shown in Fig. 16.1.5.

Set an item using the [△] and [▽] keys and [ENTER] key. When [Finish] (PF menu) appears after you have set items, press [Finish] to validate the schedule.

In the upper half of the screen, the contents of the set schedule are displayed. In the lower half of the screen, the schedule edit screen is displayed.

Up to 100 lines are available per schedule.

The schedule execution time range is from 00:00 to 23:59. The unit is 1 minute.

Fig. 16.1.5   Creating a new schedule

16.1.7 PF menu

PF menu	Description	Reference section
Finish	Validates the time schedule.	——
Prev Page	Returns to previous setup screen.	——
Next Page	Moves to next item. The cursor can also be moved to next item by pressing [ENTER] key.	——
Cancel	Cancels the time schedule currently being created.	——

16.1.8 Parameters available in the time scheduler

Parameter			Description
Relay[1]			
Detector	Zero Adj		Turns zero adjustment for each detector on/off.
	Flame		Turns ignition on/off.
	FTD		Turns voltage feedback on/off to make current constant for each detector.
	Detector controller		Turns control of each detector on/off during analysis program.
Flow controller	Splitter Ctrl		Opens/closes splitter.
	Air(value)		Opens/closes air solenoid valve.
	Flow controller On/Off		Turns control of flow controller on/off.
	High press inj mode		Turns high pressure injection mode on/off.
	Gas saver		Turns gas saver split rate function on/off for each injection port.
Temperature			Turns all heated zones on/off.
Stop	NUMBER OF TIMES OF RUN	Time scheduler stop	Specifies the number of times the program can execute before the schedule stops or switches to another file. If greater than 2, The choices are "Continuous" or "Pause at each run". For an AOC, select "Continuous". When "Pause at each run" is chosen,the program executes at set intervals continuously at set intervals.
		Schedule 0-9 Load	If another program (such as a temperature program) is running when time schedule execution time expires, priority is given to the running program. When the current program finishes, the time schedule stops or file is changed to another file.
File load			Selects the next file when switching to another file.
Program start	Program		Starts gas chromatograph after reaching ready status, or starts it immediately.
	Clean Up		Starts clean up program after reaching ready status, or starts it immediately.
	Pre-Run program		Starts Pre-Run program after reaching ready status, or starts it immediately.
GC Start/Stop			Sets start/stop of gas chromatograph.
Other			Set the parameter to input event No. (Refer to "17.4 Event No.".)

1: "Relay" Description

Relay	Relay	Switch point	Event 91,92	V91−92	Point A or B
			PRG	V93−94	Point A or B
		On/Off point	Event1−16	On or Off	
	AC On/Off	Blower	On or Off		
		Cooling Fan	On or Off		
		CRG INJ	On or Off		
		CRG Colum	On or Off		

AC On/Off: The power supplied to the AC connector on the power controller PCB is turned on/off.
Event of On/Off point: The relay contact on the PRG PCB (option) is turned on/off.
Event91 and Event92: Switches A-contact and B-contact for each relay on the CPU PCB (offered as standard).
PRG Event: Switches A-contact and B-contact for each relay on the PRG PCB (option).
Blower, Cooling Fan, CRG INJ and CRG Column: Turns the power of each option on/off.

16.1.9 Changing schedule parameters

To change the contents of an existing time schedule, move the cursor using the [△] and [▽] keys to select the schedule to be changed, and press the [ENTER] key.

- To change the time:
  When the Time Schedule select screen appears, enter new numeric values and press [Finish] (PF menu), if you would like to change only the time.
- To change the parameters:
  Move the cursor, change the parameter, and then press [Finish] (PF menu) to complete the change.
- To cancel any changes:
  If you have changed the schedule but would like to return to the former schedule, press [Cancel] (PF menu) before pressing [Finish] (PF menu). The schedule returns to its former status.

16.1.10 Time schedule example

Example: 7:00 System starts.
19:00 System stops.

・First program   Screen display

1. Time: 7:00

```
Edit program
Time[hh:mm]          _7:00
```

2. Start/stop

```
Edit program
    Program start
 ▶ GC Start/Stop
    Other
```

3. Start

```
GC Start/Stop
                  ◀▶Start GC
```

・Second program

4. Time: 19:00

```
Edit program
Time[hh:mm]          19:00
```

5. Start/stop

```
Edit program
    Program start
 ▶ GC Start/Stop
    Other
```

6. Stop

```
GC Start/Stop
                  ◀▶ Stop GC
```

7. Setting is completed.

```
     Time  Function   Value
  1  07:00 Start GC
  2  19:00 Stop GC
```

16.1.11 Starting/stopping a time schedule

Select "3. START/STOP" from the time scheduler menu when no time schedule is executing to display the screen shown in Fig. 16.1.6.

Select "3. START/STOP" while a time schedule is executing to display the screen shown in Fig. 16.1.7.

```
Time Scheduler
Inactive     Schedule    No.0


Time schedule starts with
PF2.
 It will start
tomorrow with PF3.




⏎Return   Start    Next
```
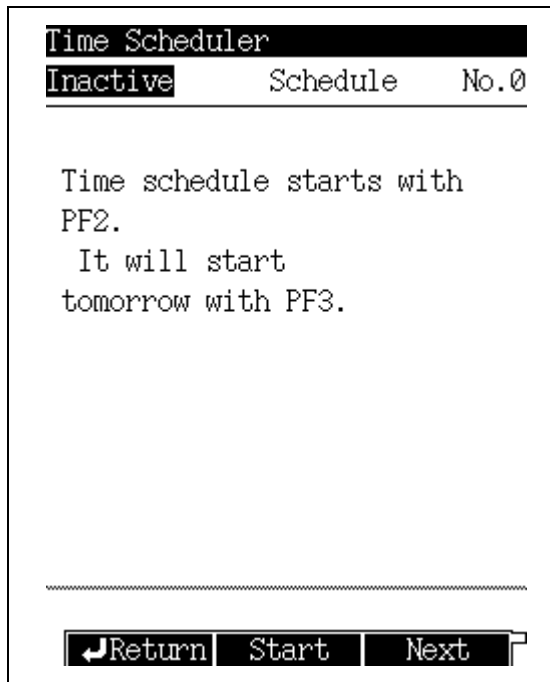
Fig. 16.1.6   Schedule start screen

```
Time Scheduler
Active       Schedule    No.0


Time schedule stops with
PF2.




⏎Return   Stop    ---
```
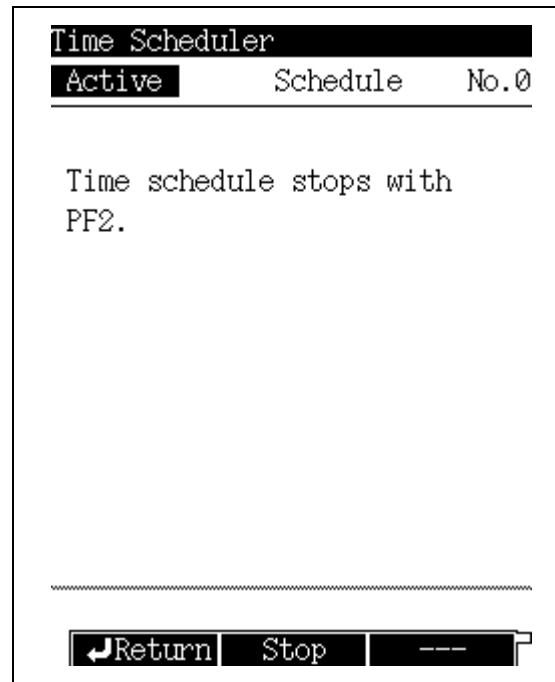
Fig. 16.1.7   Schedule stop screen

16.1.12 PF menu

PF menu	Description	Reference section
Start	Starts a time schedule. This item is displayed when no time schedule is running. If mode is set to "number", the same schedule will be executed on following day and beyond when schedule finishes. If mode is set to "day", the schedule for the current day is executed, and the schedule for each day will be executed on the following day and beyond.	——
Next	Runs the selected schedule on the following day. If mode is set to "day", the schedule for the next day is executed.	——
Stop	Stops the current schedule. This item is displayed when a time schedule is running.	——

16.1.13 Copying and deleting a time schedule

Select "4. COPY" or "5. DELETE" from the time scheduler menu screen to display the time schedule copy screen or the time schedule delete screen shown in Fig. 16.1.8 or Fig. 16.1.9. To copy, specify the copy source schedule and the copy destination schedule, then press [Copy] (PF menu).
To delete, specify a schedule number to be deleted, then press [Delete] (PF menu).

NOTE   A currently running schedule cannot be copied or deleted.

```
Time Scheduler
 Active       Schedule    No.0
Copy
  Src.          No.0
  Dst.      ◆▶  No.3




Schedule has been copied.
 ↵Return   Copy
```

```
Time Scheduler
 Active       Schedule    No.0
Delete
Schedule Number    ◆▶  No.4




Schedule has been cleared.
 ↵Return   Delete
```
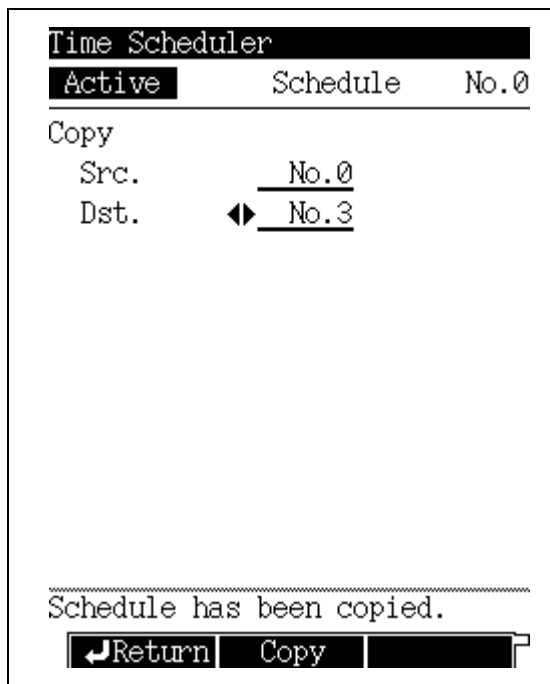
Fig. 16.1.8   Schedule copy screen   Fig. 16.1.9   Schedule delete screen
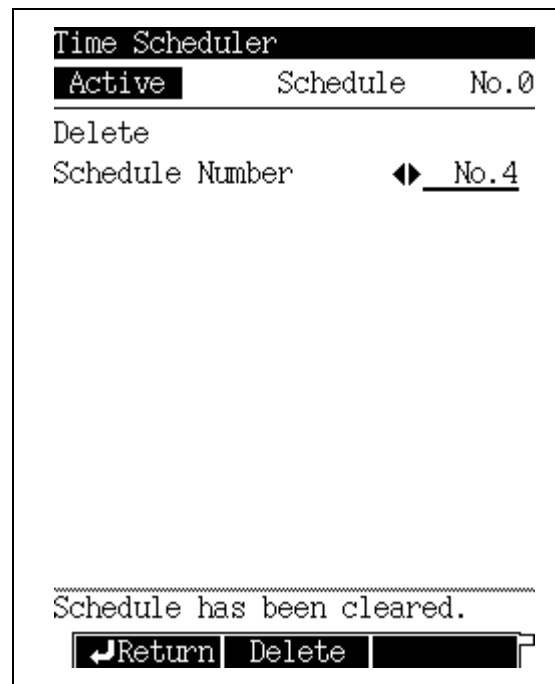
16.2 **Batch Schedule**

Use the batch schedule to continuously and automatically perform analyses.
A batch is useful for switching methods automatically during the analyses.

16.2.1 Screen description

Select "2. BATCH" from the [FUNC] key screen, the Batch screen shown in Fig. 16.2.1 appears.

```
Batch                    READY
                      Inactive  ◄─── The AOC status is displayed.
[Single AOC-20i+s] LINE
                    1
Vial  GC    DP #INJ Mk  CMD
■ 1-  3 0 Ch1-0    1  U   C
  4-  6 1 Ch1-0    1  U




    ↵Return   Start    New
```
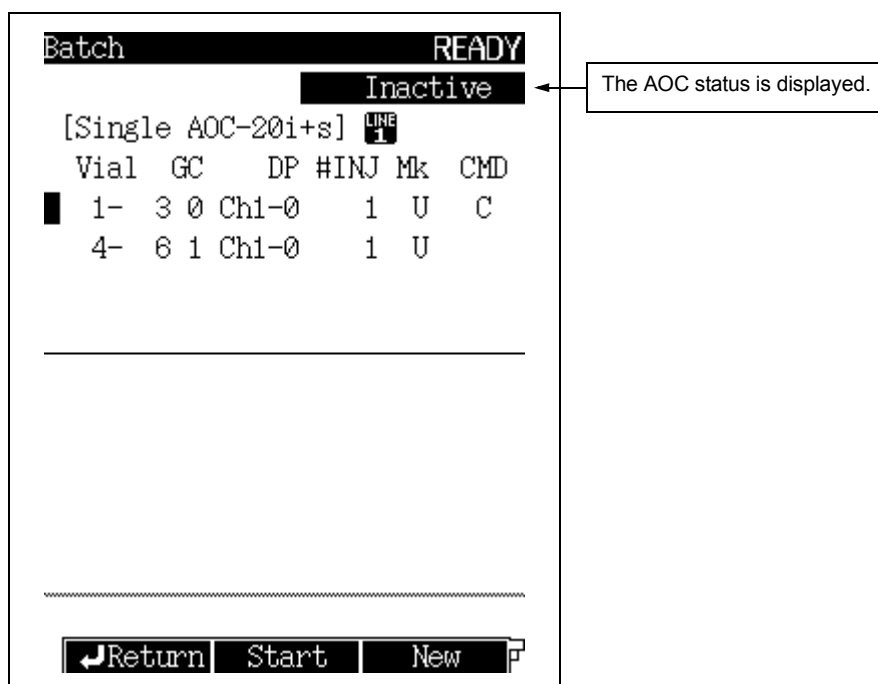
Fig. 16.2.1   Batch schedule screen

■ AOC status

The AOC status is displayed on the Batch screen..

Screen display	Description
Inactive	AOC is not operating.
Taking vial	Auto sampler arm is picking up a vial.
Preparation	AOC is operating (before injection).
Rinse	AOC is operating (after injection).
Putting vial	Auto sampler arm is returning a vial to the tray.
Wait	AOC is waiting for analysis.

16.2.2 Parameter list

Vial   Initial No. and final vial No.
Example: 1-9 (Analysis starts from vial No. 1 and ends at vial No. 9.)

GC   GC method file for analyses

DP   Channel No. of chromatopac and file No.
Example: 1-5 (Channel 1 and data processing file No. 5 are used.)
This setting is ignored when using GC solution software.

#INJ   Number of times to inject

Mk   "U" is displayed when "SAMPLE TYPE" is set to "Unknown".
"S" is displayed when "SAMPLE TYPE" is set to "Standard".

CMD   "S" is displayed when "SLOPE TEST" is set to "On".
"C" is displayed when "CLEAN UP" is set to "On".

16.2.3 PF menu

PF menu	Description	Reference section
Start	Starts the batch schedule.	——
Stop	Stops the batch schedule.	——
New	Creates a new batch schedule.	16.2.4 16.2.7
Del line	Deletes the line at the current cursor position.	——
Print	Prints the schedule to a Chromatopac.	——

16.2.4 Creating a new batch schedule (for single injector)

Select [New] (PF menu) from the batch schedule screen to display the new batch schedule screen shown in Fig. 16.2.2.

Set an item using the [$\triangle$] and [$\triangledown$] keys and [ENTER] key. When [Finish] (PF menu) becomes available and the items have been set, press [Finish] to validate the schedule.

At the top of the screen, the contents of the set schedule are displayed. At the bottom of the screen, the schedule can be edited.

Up to 100 lines are available per schedule.

Fig. 16.2.2   New batch schedule screen (for single injector)

16.2.5 Parameter list

START VIAL NO.

Range:[1] Default: 0

FINAL VIAL NO.

Range:[1] Default: 0

1: With no auto sampler
Short rack ... 1−6
Long rack ... 1−12
With auto sampler 1−150 (maximum)

When the auto sampler is used, the possible depends on the vial rack type and the number of racks.

The default, "0", indicates that the setting is not given.

SAMPLE

Inject sample

The specified sample vial No. is analysed.

Without sample

Vials are not used for samples. Instead samples are introduced from a gas sampler with a valve.

GC FILE NO.

Range: FILE 0−9, Default: FILE0

Set the file No. of the GC method to be used.

CHANNEL NO.

Range: Ch1/Ch2, Default: Ch 1

Set the channel No. connecting the GC to the Chromatopac. This setting is ignored when using GC solution software.

DATA PROCESSOR FILE NO.

Range: FILE 0−9, Default: FILE0

Specify a date processor (Chromatopac) date integration file. −This setting is ignored when using GC solution software.

NUMBER OF INJECTION

Range: 0−99, Default: 0

Set the number of times to inject each sample.

SAMPLE TYPE

Unknown   Select this item to analyze a sample of unknown concentration.
Analyze a standard and create a calibration curve before analyzing an unknown sample.

Standard   Select this item to analyze a standard of known concentration.

SLOPE TEST

Range: On/Off, Default: Off

When "On" is selected, the slope test is performed before running the batch schedule.

CLEAN UP

Range: On/Off, Default: Off

When "On" is selected, clean up is performed before running the batch schedule.

16.2.6 PF menu list

PF menu	Description	Reference section
Finish	Validates the schedule.	——
Prev Page	Returns to previous setup screen.	——
Next Page	Moves to setup screen for next item.	——
Cancel	Cancels the schedule being created.	——

16.2.7 Creating a new batch schedule (for dual injectors)

Select [New] (PF menu) from the batch schedule screen to display the new batch schedule screen shown in Fig. 16.2.3.

The vial set up screens are divided into main set up and sub set up screens.

Once the main injector setup is complete, the sub injector setup screen appears. On the screen, two lines (one for the main and the other for the sub) make one schedule.

Set an item using the [△] and [▽] keys and [ENTER] key. When [Finish] (PF menu) becomes available and the items have been set, press [Finish] to validate the schedule.

The dual injector parameters are the same as the single injector parameters.

Fig. 16.2.3   New batch schedule screen (for dual injector)

16.2.8   Editing a batch schedule

To change an existing batch processing schedule, move the cursor using the [△] and [▽] keys to the schedule to be edited and press the [ENTER] key. The schedule to be edited appears on the edit screen.

To change the vial number, enter the new number from the edit screen and press [Finish] (PFmenu).

To change the other parameters, move the cursor and make the change from the edit screen, and then press [Finish] (PFmenu).

To cancel the edits and restore the original batch schedule, press [Cancel] (PFmenu) before pressing [Finish](PFmenu).

16.2.9 Batch processing Setup example

Example 1: For single AOC
Sample vials No. 1 to 3 are analyzed. The GC method file No. 2 is used. The Chromatopac data processing file No. 0 is set to Ch 1.
A standard of known concentration is injected once.
Clean up is performed, but the slope test is not performed.

Screen display

1. Start vial No.: 1
   Final vial No.: 3

```
Vial
Start vial No.        1
Final vial No.        3
Sample      ◀▶ Inject sample█
```

2. GC file No.: FILE2

```
GC file No.
   0:FILE0
   1:FILE1
 ▶ 2:FILE2
   3:FILE3
```

3. Data processing file No.:
   Ch 1, FILE0

```
Dataprocessor
Channel No.        ◀▶Ch1█
File No.             0
```

4. Number of injections: 1
   Sample type: Standard

```
Sample
Number of Injection     1
Sample type      ◀▶Standard█
```

5. Slope test: Off
   Clean up: On

```
Command
Slope test          Off
Clean up      ◀▶ On█
```

6. The batch is set up.

```
[Single AOC-20i+s] █
 Vial  GC    DP #INJ Mk  CMD
  1-  3 2 Ch1-0    1  S   C
```

Example 2: For dual AOC
The main tower set up is identical to Example 1.
Sub injector settings are given below.
Vials No. 76 to 78 are analyzed. Chromatopac data processing file No. 0 is set for the Ch 2.
A standard of known concentration is injected once.
Clean up is performed, but the slope test is not performed.

・Sub injector settings   Screen display

1. Start vial No.: 76
   End vial No.: 78

```
🔲 Vial
Start vial No.          76
Final vial No.          78
Sample     ◀▶ Inject sample■
```

2. GC file No.: FILE2

```
🔲 GC file No.
↘ 2:FILE2
```

3. Data processing file No.:
   Ch 2, FILE0

```
🔲 Dataprocessor
Channel No.            Ch2
File No.               0
```

4. Number of injections: 1
   Sample type: Standard

```
🔲 Sample
Number of Injection      1
Sample type     ◀▶Standard■
```

5. Slope test: Off
   Clean up: On

```
🔲 Command
Slope test            Off
Clean up       ◀▶ On■
```

6. The batch is set up.

```
[Dual AOC-20i+s] 🔲 🔲
 Vial  GC    DP  #INJ Mk  CMD
 1-  3 2 Ch1-0   1  S   C
 76- 78 2 Ch2-0   1  S   C
```

16.3 Time Program

Use a time program to execute zero point adjustment and relay control during analysis.

16.3.1 Screen description

Select "3. TIME PROGRAM" from the [FUNC] key screen to display the time program screen shown in Fig. 16.3.1.
A time program starts as soon as analysis starts.
Time programs do not need to be set up in order. After you finish editing time programs, they are automatically sorted.
More than one step can be set for the same time. The specified actions are executed at the same time.

```
Time Program              READY
 LINE                FILE  0:FILE0
  1
GC Analysis Time(min)      5.00
      Time(min) Function  Value
   1    1.00 FID1
         Range            ×10⁻²
 █ 2    5.00 FID1
            Zero Adj
    _____

    ~~~~~~~~~~~~~~~~~~~~~~~~~~~
   ↵Return   New   Del Line⯈
```
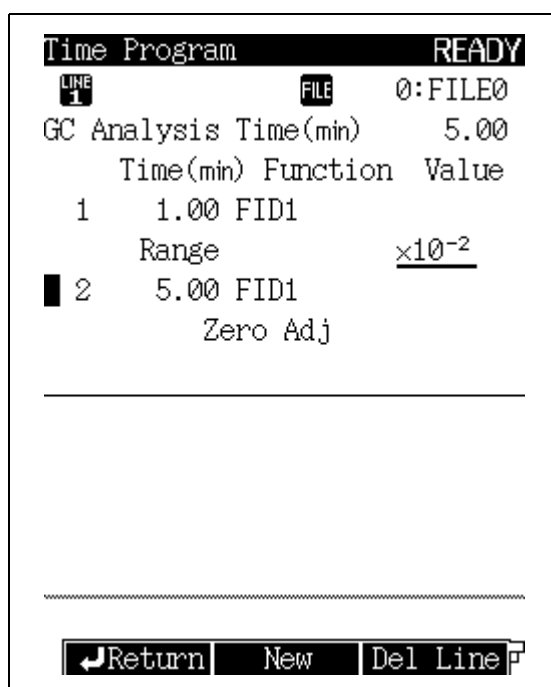
Fig. 16.3.1   Time program main screen

16.3.2 PF menu

PF menu	Description	Reference section
New	Creates a new time program.	16.3.3
Del Line	Deletes the time program line at the current cursor position.	――
Chng Line	Moves the cursor to the next line.	――
Print	Prints the program to the Chromatopac.	――

16.3.3 Creating a new time program

Select [New] (PF menu) from the time program screen to display the time program edit screen shown in Fig. 16.3.2.

Set an item using the [△] and [▽] keys and the [ENTER] key. When [Finish] (PF menu) becomes available and the items have been set, press [Finish] to validate the program.

At the top of the screen, the contents of the set program are displayed. At the bottom of the screen, the program edit screen is displayed.

Up to 100 lines are available for one program.

The possible program execution time ranges from 0.00 to 9999.00 minutes.

Fig. 16.3.2   Time program edit screen

16.3.4 PF menu

PF menu	Description	Reference section
Finish	Validates the time program.	――
Prev Page	Returns to previous setup screen.	――
Next Page	Moves to next item.	――
Cancel	Cancels the time program being created.	――

16.3.5 Time Program parameters

Parameter			Description
Relay[1]			
Detector	Range		Sets range or attenuation for the detector configured in the analytical line.
	Polarity		Changes the polarity between "+" and "-" for TCD configured in the analytical line.
	Current		Sets current for the detector configured in the analytical line.[2]
	Zero Adj		Turns on/off zero adjustment for the detector configured in the analytical line.
	Flame		Ignites / Extinguishes the flame.
	FTD		Turns on/off voltage feedback to make current constant for FTD configured in the analytical line.
	Detector controller		Turns on/off control of detector configured in the analytical line during analysis program.
Flow controller	Splitter Ctrl		Opens/closes splitter.
	Flow controller On/Off		Turn carrier gas, septum purge, detector gas and APC on/off.
	High press inj mode		Turns high pressure injection mode on/off.
	Gas saver		Turns gas saver function on/off.
Temperature	DET1, DET2, AUX3, AUX4, AUX5		Use a time program to change temperature of heated zones, which cannot be programmed.
Stop	NUMBER OF TIMES OF RUN	End of program	Specify the number of times to execute the GC program. Then, either the program stops or the next file is executed. If greater than 2, the choices are "continuous" or "pause at each run." For an AOC, select "continuous". When "pause at each run" is selected, the program executes continuously at set intervals. If another program (such as a temperature program) is running when time program execution time expires, priority is given to running the program. When the current program finishes, the time program stops or file is changed to another file.
		0: FILE 0–9 Load	
Other			Set the parameter to input event No..(Refer to "17.4 Event No.".)

1: "Relay" description

Relay	Relay	Switch point	Event 91,92	V91–92	Point A or B
			PRG	V93–94	Point A or B
		On/Off point	Event 1–16	On or Off	
	AC On/Off	Oven Exhaust Fan	On or Off		
		Cooling Fan	On or Off		
		CRG INJ	On or Off		
		CRG Colum	On or Off		

AC On/Off: Turns the power supplied to the AC connector on the power controller PCB on/off.
Event of On/Off point: Turns the relay contact on the PRG PCB (option) on/off.
Event91 and Event92: Switches a-contact and b-contact of each relay on the CPU PCB (standard).
Event of PRG: Switches a-contact and b-contact of each relay on the PRG PCB (option).
Blower, Cooling Fan, CRG INJ and CRG Column: Turns the power of each option on/off.

2: Current range

Detector type	Current
FTD	0.00–10.00　（pA）
ECD	0.00–2.00　　（nA）
TCD	0–100　　　（mA）

16.3.6　Editing a time program

To change the contents of an existing time program, move the cursor using the [△] and [▽] keys to the program line to be edited changed and press the [ENTER] key.
To change only the time, enter the new time from the edit screen and press [Finish] (PF menu).
To change the other parameters, move the cursor and make the changes from the edit screen, and then press [Finish] (PF menu).
To cancel the edits and restore the original time program, press [Cancel] (PF menu) before pressing [Finish] (PF menu).

16.3.7 Time program setup example

Example 1: When both positive and negative peaks appear on the chromatogram
Four minutes after the program execution starts, the polarity of the detector DET 1 (TCD) is switched from plus to minus. Two minutes later (six minutes after the program execution starts), the polarity is switched back to plus.

・First program   Screen display
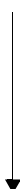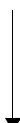
1. Time: 4.0 min

```
Edit program
Time(min)            4.00
```

2. Detector

```
Edit program
   Relay
 ▶ Detector
   Flow controller
```

3. Polarity

```
Detector
   Range
 ▶ Polarity
   Current
```

4. DET 1

```
Polarity
 ▶ TCD2
```

5. - (minus)

```
TCD2 Polarity

              ◆▶ −
```

・Second program

6. Time: 6.0 min

          Steps 2–4 are repeated.

```
Edit program
Time(min)            6.00
```

7. + (plus)

```
TCD2 Polarity

              ◆▶ +
```

8. The time program is set up.

```
    Time(min) Function  Value
 1    4.00 TCD2
             Polarity −
 2    6.00 TCD2
             Polarity +
```

Example 2: Two AOC analyses use File No.0, then file No.1 is used.
(The execution time is set to 30 min.)

Screen display

1. Time: 30 min

```
Edit program
Time(min)            30.00
```

2. Stop

```
Edit program
   Temperature
 ⤵ Stop
   Other
```

3. Run: 2 times

```
End of program
Run      2 times
```

4. File 1 is loaded.

```
End of program
   End of program
   0:FILE0 Load
 ⤵ 1:FILE1 Load
```

5. Pause at each run(AOC)

```
End of program
   Continuous
 ⤵ Pause at each run(AOC)
```

6. The time program is set up.

```
    Time(min) Function  Value
 1   30.00     End


   _____

End of program    30.00(min)
    Run    2times
    Next file          FILE1
    Pause at each run
```

16.4 Pre-Run Program

The Pre-Run program controls flow controllers and relays before the analysis starts.

16.4.1 Screen description

Select "4. PRE-RUN" from the [FUNC] key screen to display the Pre-Run screen shown in Fig. 16.4.1. A Pre-Run program is executed after the [START] key is pressed, but before an analysis.

While the Pre-Run program is running, the elapsed time is displayed in the "Time" field on the [MONIT] key screen.

Program steps do not need to be entered in order. After you finish editing the Pre-Run program, programs are automatically sorted.

More than one step can be set for the same time. The specified actions are executed at the same time.

Fig. 16.4.1　Pre-Run program main screen

16.4.2 PF menu

PF menu	Description	Reference section
New	Creates a new Pre-Run program.	16.4.3
Del Line	Deletes the program at the current cursor position.	——
Chng Line	Changes over the screen of Pre-Run program every line.	——
Print	Prints the program to the Chromatopac.	——

16.4.3 Creating a new Pre-Run program

Create a Pre-Run program following the same procedure described in "16.3.3. Creating a new time program" in "16.3 Time Program".

The parameters are equivalent to those shown in "16.3.5. Time Program Parameters" except for "STOP". The "STOP" parameter is described below.

Up to 100 lines are available for the Pre-Run program.

The possible Pre-Run program execution time ranges from 0.00 to 9999.00 minutes.

Parameter		Description
End of program	Auto	The AOC starts after the Pre-Run program is finished. If there is no AOC, the GC starts.
	Manual (Stop program)	After the Pre-Run program is finished, the system becomes ready.
	GC starts	After the Pre-Run program is finished, the GC starts. For example, select this item to activate a gas sampler, switch the valve and introduce the gas sample in to the GC as soon as the program stops.
	AOC/HSS starts	After the Pre-Run program is finished, the AOC/HSS starts. After sample is injected, GC starts.
	Clean up	After the Pre-Run program stops, clean up starts. After clean up finishes, the system becomes ready.

NOTE   In the following case, "AUTO" of the "STOP" parameter is carried out when the pre-run program is finished.
- There is no "STOP" parameter in the pre-run program.
- Running the Batch Schedule.

16.4.4 Editing a Pre-Run program

To change the contents of the existing Pre-Run program, move the cursor using the [△] and [▽] keys to the program line to be edited and press the [ENTER] key.

To change only the time, enter the new time from the edit screen and press [Finish] (PF menu).

To change the other parameters, move the cursor and make the changes from the edit screen, and then press [Finish] (PF menu).

To cancel the edits and restore the original time program, press [Cancel] (PF menu) before pressing [Finish] (PF menu).

16.4.5 After Pre-Run program is finished

When the Pre-Run program is finished, certain events automatically return to their pre-programs status.

These events are listed below..

Event No.	Description
131−134	Turn detector controller on/off.
141−146	Turn carrier gas and septum purge on/off.
147−158	Turn detector gas on/off.
171	Turns high pressure injection on/off.
181−198	Turn AUX APC on/off.

For details about the event No., refer to

16.4.6 Pre-Run Program set up example

Switches B-contact of Event 91 four minutes in to the program.

Screen display

1. Time : 4.0min

```
Edit program
Time(min)          4.00
```

2. Relay

```
Edit program
▶ Relay
  Detector
  Flow controller
```

3. Relay

```
Relay
▶ Relay
  AC On/Off
```

4. Switch point

```
Relay
▶ Switch point
  On/Off point
```

5. Event 91, 92

```
Switch point
▶ Event91,92
  AUX I/O
```

6. Event 91

```
Event91,92
▶ V91
  V92
```

7. Point B

```
Event91
              ◀▶ Point B
```

8. Setting is completed

```
    Time(min) Function  Value
1    4.00 V91      B
```
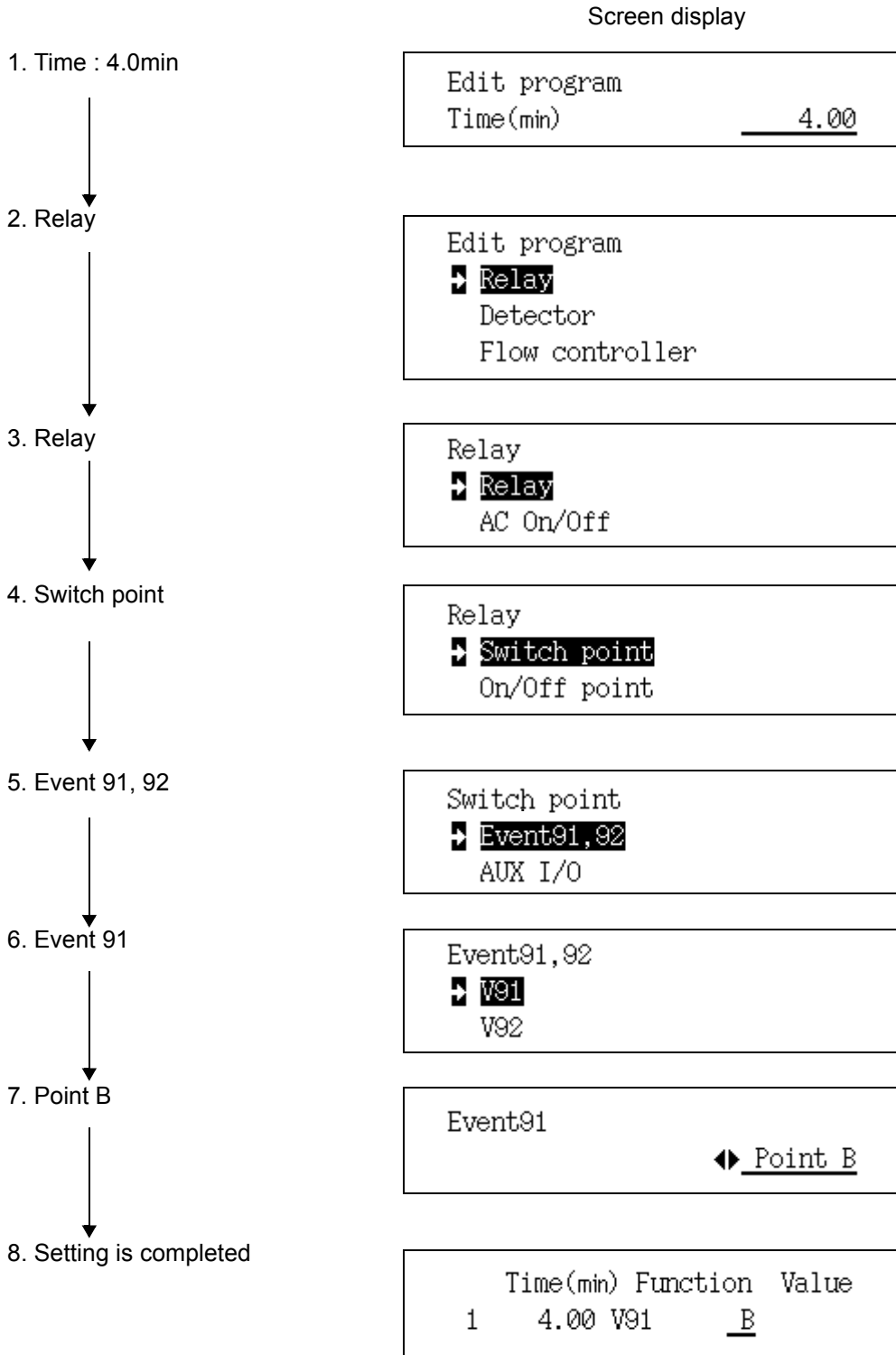
16. *5* **Direct Operation**

16.5.1 Screen description

Select "5. DIRECT OPERATION" from the [FUNC] key screen to display the screen shown in Fig. 16.5.1.
Input the event No. and press the [Execute] key to execute the specified event.
For a description of the event No., refer to "17.4 Event No."

```
┌─────────────────────────────┐
│ Direct              READY   │
│                             │
│ Event                   9█  │
│                             │
│                             │
│                             │
│                             │
│                             │
│                             │
│ ～～～～～～～～～～～～～～～ │
│  ⏎Return  Execute          │
└─────────────────────────────┘
```
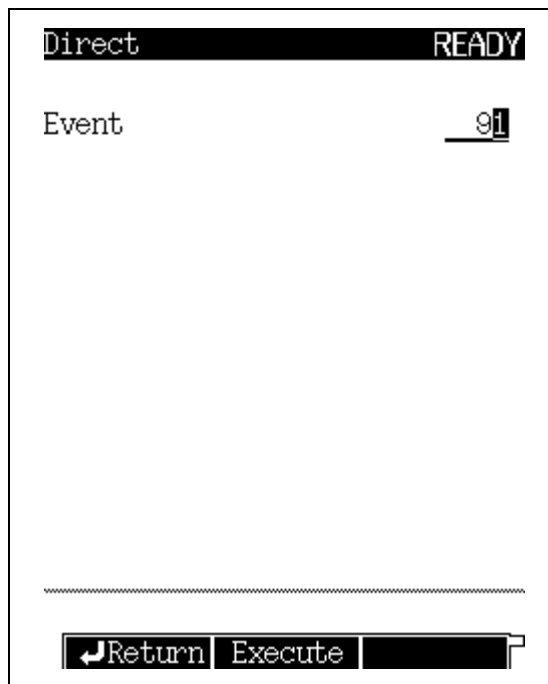
Fig. 16.5.1   Direct operation setup screen

16.5.2 Parameter list

EVENT
Range: -500−+500, Default: ---
Runs the operation assigned to the event No.
Refer to "17.4 Event No."

16.5.3 PF menu

PF menu	Description	Reference section
Execute	Runs the specified operation. Input event No. to be run, and press [Execute] (PF menu).	──

*16.*6   **GC Configuration**

16.6.1   Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen to display the GC configuration screen shown in Fig. 16.6.1.

```
GC Configuration
    1 Date/Time Setting
    2 Max. Temperature
  ↕ 3 Transmission Parameter
    4 Ready Check
    5 Signal Setting
    6 Port Name Customization
    7 Link Device Code
    8 Temperature Offset
    9 Other Configurations

Select function
   ↵Return                    ⌐
```
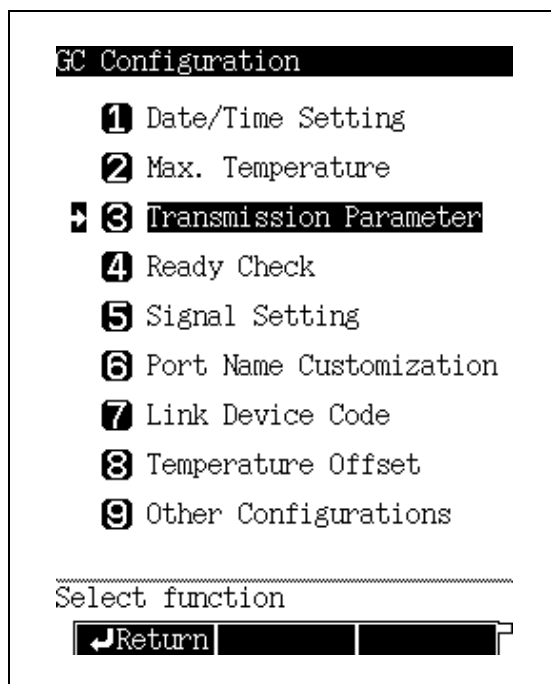
Fig. 16.6.1   GC Configuration setup screen

16.6.2   Parameter list

DATE/TIME SETTING
Set the date and the time.
MAX. TEMPERATURE
Set the maximum temperature limit for each headed zone.
TRANSMISSION PARAMETER
Set the parameters related to transmission.
READY CHECK
Indicate the conditions, which should be satisfied in order for the system to be ready and the STATUS light to illuminate.
SIGNAL SETTING
Set the signals which can be output from the gas chromatograph.
PORT NAME CUSTOMIZATION
Customize the names of various GC items.
LINK DEVICE CODE
Set the link device code the GC is linked to a Chromatopac.

TEMPERATURE OFFSET

Set the temperature offset for each heated zone.

OTHER CONFIGURATIONS

Specify the configuration of miscellaneous setup items.

16.6.3   Setting the date and time

16.6.3.1   Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "1. DATE/TIME SETTING",to display the Date/Time setting screen shown in Fig. 16.6.2.

The date and the time can be set. This setting is automatically saved, even when the GC power is off.

```
Date/Time Setting
    2000.06.14(Wed) 13:15:50   ◄──   The current date and time
                                      are displayed.


        · Date [yyyy.mm.dd]
               2000. 6.14



        · Time   [hh:mm:ss]
               13:15:50



       ↵Return
```
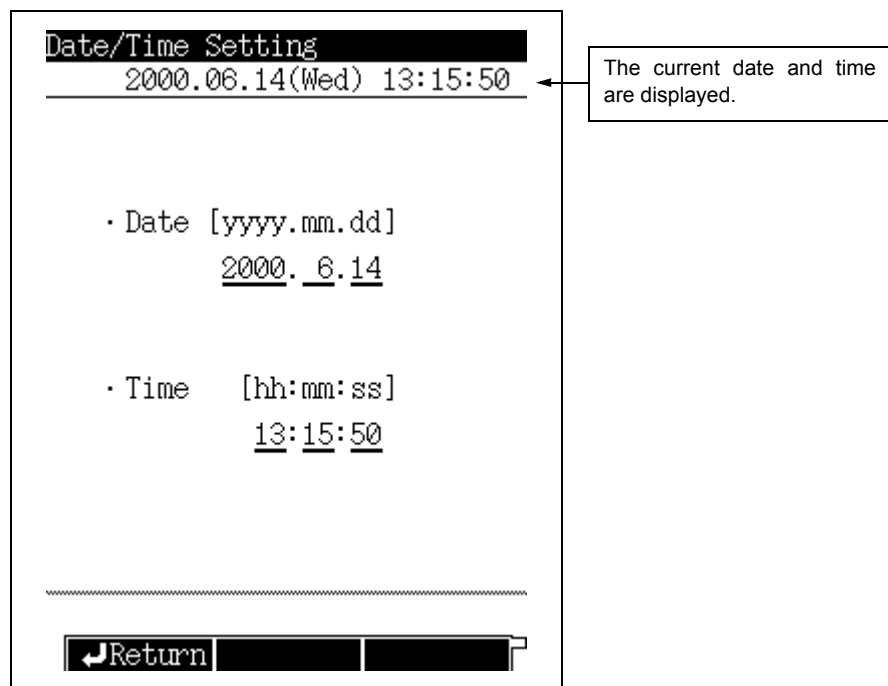
Fig. 16.6.2   Date/time setup screen

16.6.3.2   Parameter list

DATE

Range: 2000.01.01−2099.12.31

TIME

Range: 00:00:00−23:59:59

16.6.4 Setting the maximum temperature limits

16.6.4.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "2. MAX TEMPERATURE" to display the Max. Temperature screen shown in Fig. 16.6.3.
Set the maximum temperature limits of 8 heated zones.

```
Max. Temperature


Column     Max.Temp(℃)     400.0
SPL1       Max.Temp(℃)     470.0
WBI1       Max.Temp(℃)     470.0
FID1       Max.Temp(℃)     470.0
ECD1       Max.Temp(℃)   -------
AUX3       Max.Temp(℃)   -------
AUX4       Max.Temp(℃)   -------
AUX5       Max.Temp(℃)   -------




~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

    ↵Return  Protect
```
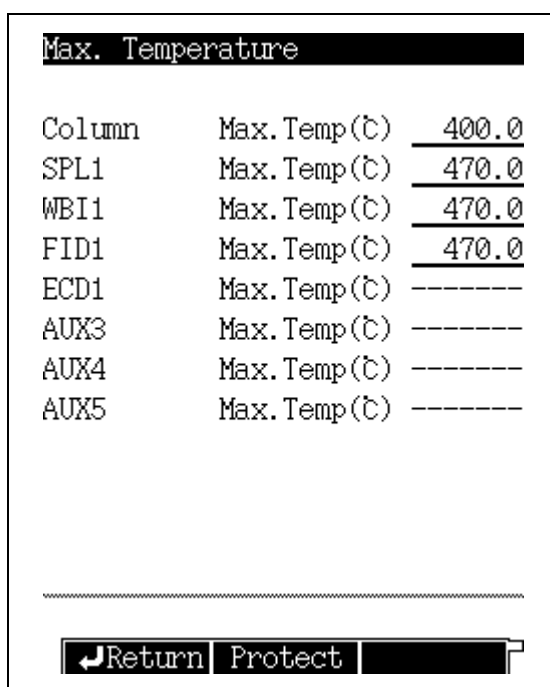
Fig. 16.6.3   Maximum temperature setup screen

16.6.4.2 Parameter list

COLUMN

Range: 0.0–470.0°C, Default: 400.0°C
In order to protect the column, do not allow the maximum oven temperature to exceed the maximum column temperature.

INJ1/DET1/DET2

Range: 10.0–470.0°C, Default: 470.0°C

INJ2

Range: 0.0–470.0°C, Default: 470.0°C

AUX3/AUX4/AUX5

Range: 10.0–470.0°C, Default: 470.0°C
AUX3, AUX4 and AUX5 are available optionally.
If the are installed, the AUX temperature control unit (P/N 221-48458-91) is required.

16.6.4.3 PF menu list

PF menu	Description	Reference chapter
Protect	Protection against contamination	——

Selection: Yes/No, Default: Yes
When "Yes" is selected, the Detector temperature setting value must be bigger than the Oven temperature setting value.

16.6.5 Setting transmission parameters

16.6.5.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "3. TRANSMISSION PARAMETER", to display the Transmission Parameter screen shown in Fig.16.6.4.

```
Transmission Parameter
Protocol          ◀▶   None
Baud Rate(bps)          9600
Stop Bit                1bit
Parity                  NONE




⌐




↵Return   Apply
```
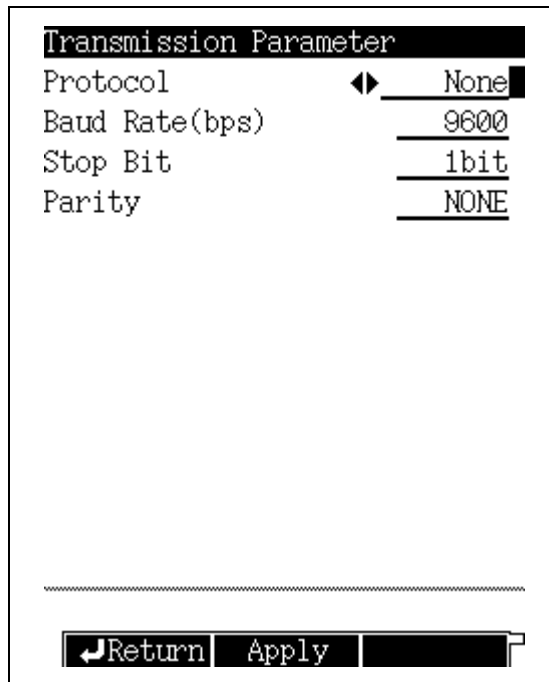
Fig. 16.6.4   Transmission parameter setup screen

16.6.5.2 Parameter list

PROTOCOL

Selection: None/LEVEL1/LEVEL2/LEVEL3, Default: LEVEL2

BAUD RATE

Selection: 2400/4800/9600/19200/38400/57600/115200 bps, Default: 9600 bps
Set the communication speed.

STOP BIT

Selection: 1 bit/ 2 bit, Default: 1 bit

PARITY

Selection: NONE/EVEN/ODD, Default: NONE
"STOP BIT" and "PARITY" can be set when "PROTOCOL" is set to "None" or "LEVEL1" or "LEVEL2".
Set to "EVEN" in case of connecting a Chromatopac.

NOTE   Refer to "2.7 Connecting external device cables".

16.6.5.3 PF menu

PF menu	Description	Reference section
Apply	Down loads the parameters immediately.	――

16.6.6   Setting the Ready Check Parameters

The Ready Check verifies whether the preset analytical conditions have been met.
When the selected items reach the specified settings, the STATUS light illuminates.

16.6.6.1   Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "4.
READY CHECK", to display the ready check screen shown in Fig.16.6.5
Set each parameter to "yes" or "no". All parameters with "yes" must reach their initial
parameter starts in order for the GC to be ready and the STATUS light to turn green.

Fig. 16.6.5   Ready Check setup screen

16.6.6.2   Parameter list
TEMP. PORT
TEMP

Selection: Yes/No, Default: Yes
Indicate which headed zones should be included in the ready check.

CARRIER GAS

Selection: Yes/No, Default: Yes

SEPTUM PURGE

Selection: Yes/No, Default: Yes
Indicate which injection port septum purge flow lines should included in the check.
The displayed items depend on the injection port type.

DET FLOW GAS
MAKE UP

Selection: Yes/No, Default: Yes

HYDROGEN

Selection: Yes/No, Default: Yes

AIR

Selection: Yes/No, Default: Yes

Indicate which detector APC zones should be included in the check.

The displayed items depend on the detector type.

AUX APC

APC1−APC18 PRESS/FLOW

Selection: Yes/No, Default: Yes

This item is available only when optional APC units are installed.

DETECTOR

CONTROLLER

Selection: Yes/No, Default: Yes

This item is available only when the FID is installed.

DRIFT

Selection: Yes/No, Default: No

This item compares the baseline drift to the drift limit for 10 minutes.

Once the GC becomes ready, the GC re-evaluates of the ready status 10 minutes later.

WAIT SIGNAL

Selection: Yes/No, Default: Yes

The wait signal applies to all detectors configured in analytical lines.

| NOTE | User-specified names are used in this screen. |

16.6.6.3 PF menu

PF menu	Description	Reference section
Drift	Set the baseline drift limit.	――

16.6.7 Parameter Configuration

Signals are output from four gas chromatograph channels.
To assign detector channels, see "13 Detector".
This section describes the detector signal configuration as well as the configuration of various other parameters which can be monitored on the screen.

16.6.7.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "5. SIGNAL SETTING", to display the signal settings screen shown in Fig. 16.6.6.
This screen allows you to adjust the GC signal parameters.

Use the cursor to select the desired channel.
Press [ENTER] to open that channel's setup screen.
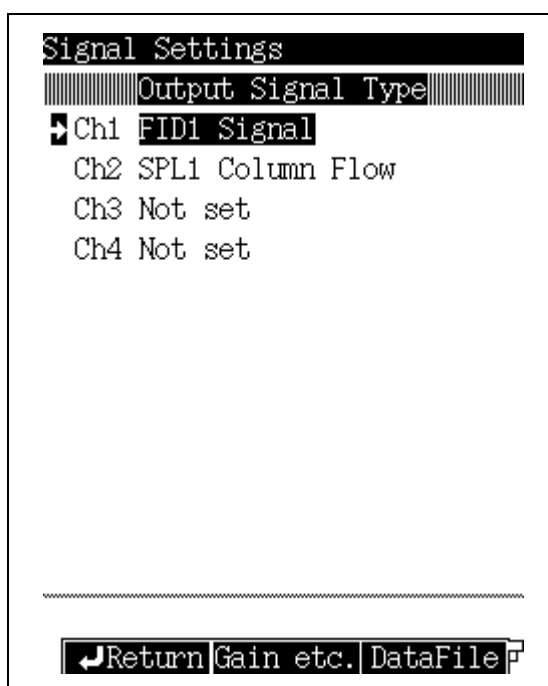
Fig. 16.6.6   Signal setup screen

16.6.7.2 PF menu

PF menu	Description	Reference section
Gain etc.	Sets the signal gain and offset for each detector.	16.6.7.6
Data File	Sets the format of digital signals. When GC is linked to a personal computer, this item is automatically set to "PC". When link is ended, this item automatically reverts to "Chromatopac".	――
Det Sig	Sets signal output channels for all detectors. The signal out put channels can also be specified for installed detectors which have not been configured in an analytical line. If two or more detectors are set to one channel, data can be output to either channel without switching the output signal cable simply by changing the analytical line configuration.	――

16.6.7.3 Selecting the detector signals

Select the signal type from the main screen, and then press "DET SIG" to display the screen shown in Fig. 16.6.7.

Select the type of signal to output. For a description of the settings, refer to "13.5 Setting the Output Signals" in "13. Detector".

For detector signal subtraction, also specify the channels (1-4) for the subtraction.

For background signal compensation, also specify the background signal No.(1 or 2).

The currently set channel No. is displayed.

When saving the background signal, specify which signal (1 or 2) should be saved.

```
Signal Setting     Channel 1
    Det Sig        Temp
    Flow
||||||||Output Signal Type||||||||
  Detector Signal
  Background sig.save
  Background sig comp.
  Det sig subtraction

  Back Ground Number  ◀▶Buff1

         ↵Return  Next Ch
```

Fig. 16.6.7   Detector signal setup screen

16.6.7.4 Selecting the temperature control signal

Select the signal type from the main screen, and then press "TEMP" to display the screen shown in Fig. 16.6.8.

Select the temperature control signal to be output.

The currently set channel No. is displayed.

```
Signal Setting     Channel 1
    Det Sig        Temp
    Flow
||||||||Signal Select(Temp.)||||||||
  Column    Temp.
 ↴ SPL1     Temp. LINE
  WBI2      Temp.      1
  FID1      Temp. LINE
  TCD2      Temp.      1
 (AUX3      Temp.)
 (AUX4      Temp.)
 (AUX5      Temp.)


         ↵Return  Next Ch
```
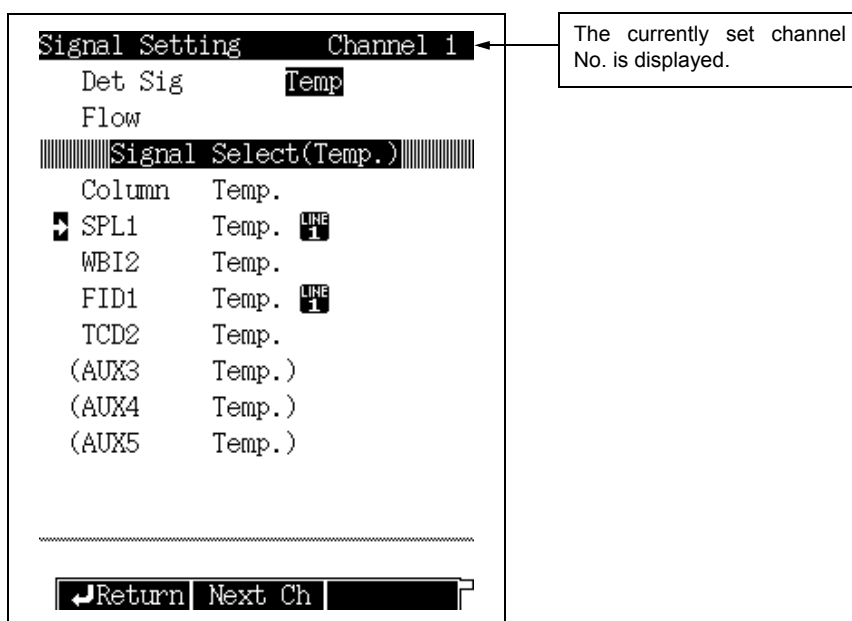
Fig. 16.6.8   Temperature control signal setup screen

16.6.7.5 Selecting the flow signal

Select the signal type from the main screen and then press "FLOW" to display the screen shown in Fig. 16.6.9.

Select the flow signal to be output.

Select the carrier gas, detector gas and APC gas items. The APC gas can be set when the APC is installed as an option in any location other than the flow controller or the detector gas.

■ Carrier gas

If you select the carrier gas for the flow signal selection, the screen shown in Fig. 16.6.9 appears.

The currently set channel No. is displayed.

Select an item to be output from each area.
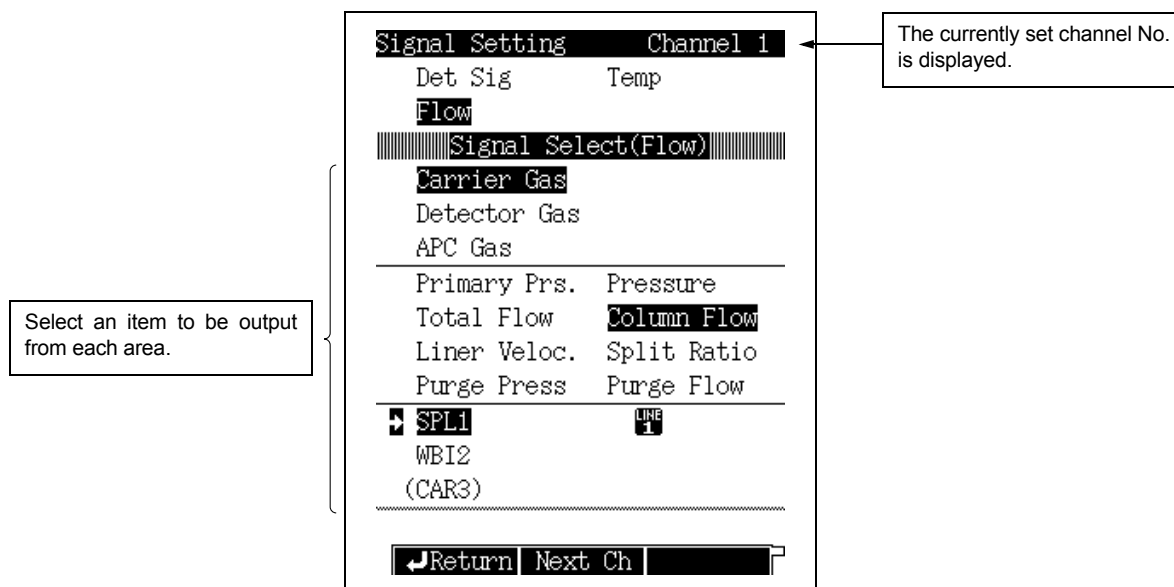
Fig. 16.6.9   Carrier gas signal setup screen

■ Detector gas

If you select the detector gas for the flow signal selection, the screen shown in Fig. 16.6.10 appears.

The currently set channel No. is displayed.

Select an item to be output from each area.
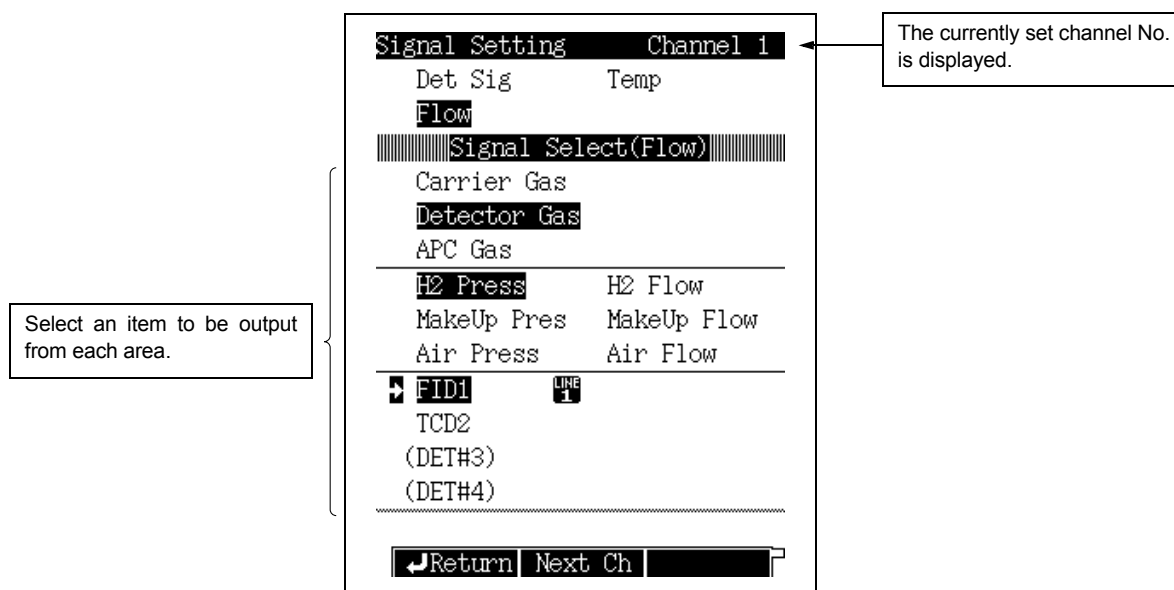
Fig. 16.6.10   Detector gas signal setup screen

■ APC gas

If you select the APC gas for the flow signal selection to display the screen shown in Fig. 16.6.11.

Select an item to be output from each area.

The currently set channel No. is displayed.
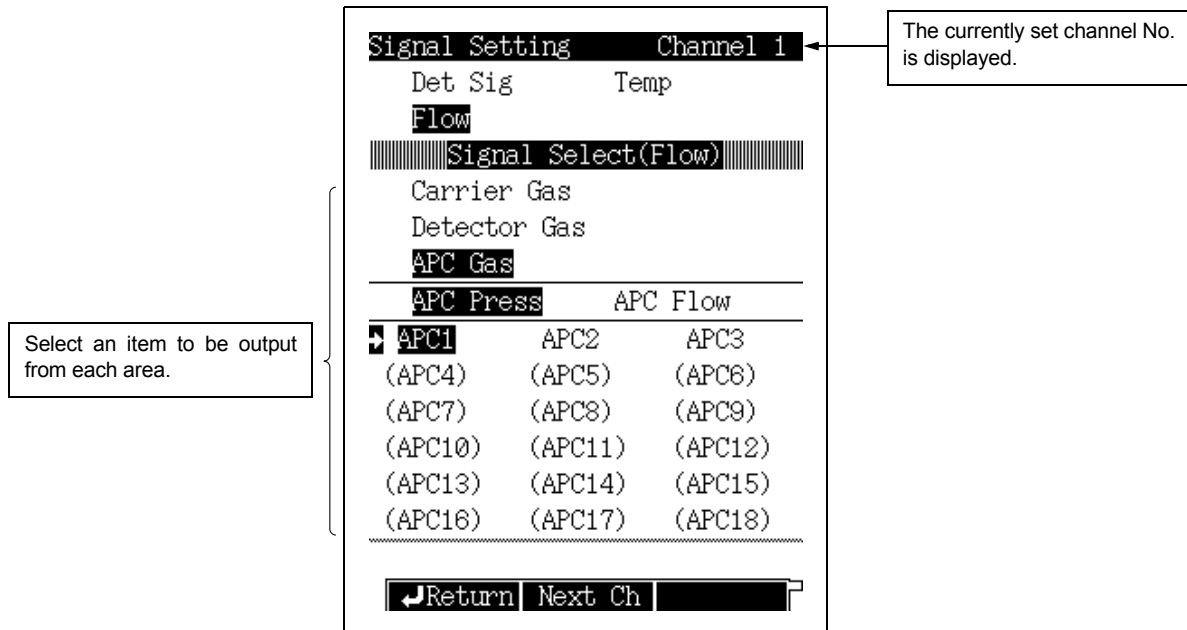
Fig. 16.6.11   APC gas signal setup screen

16.6.7.6   Signal offset

When you select [Gain etc.] (PF menu) from the signal setup main screen, the Gain and offset screen shown in Fig. 16.6.12 appears. Set the offset and the the detector signal gain here.

Select [Sig. Ch] (PF menu), to set the gain and the offset for any signal other than defector signals (such as temperature or pressure). In addition, you can set the time constant and the zero adjustment of the signal for each channel.
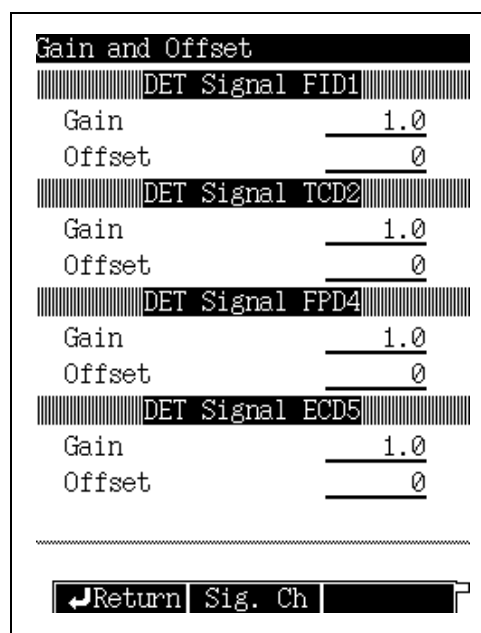
Fig. 16.6.12   Detector signal gain and offset screen

16.6.8 Customizing Component Names

16.6.8.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, amd then select "6. PORT NAME CUSTOMIZATION", the Name customization screen shown in Fig. 16.6.13 appears.

Specify the names of GC components (8 characters, alphanumeric and symbols).

To customize the name, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".
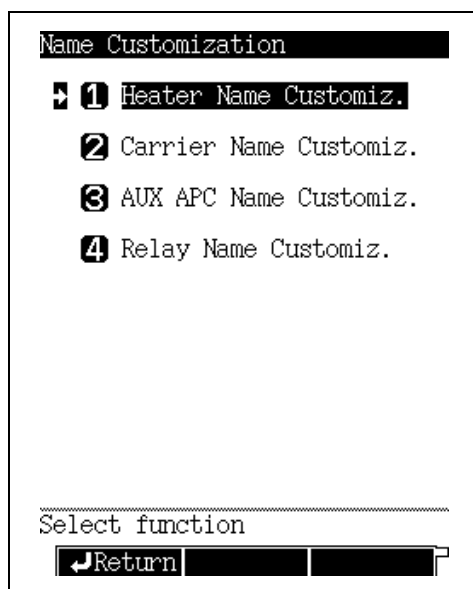
Fig. 16.6.13   Name setup screen

16.6.8.2 Customization example

If the "Heater Name" and "Carrier Name" are customized, the "Line Configuration" screen changes as shown in Fig. 16.6.14.

The INJ2 and DET1 names were changed from "Heater Name Customiz".

The port name was changed using "Carrier Name Customiz". There is no injection port in INJ2, amd there is only a carrier flow controller.
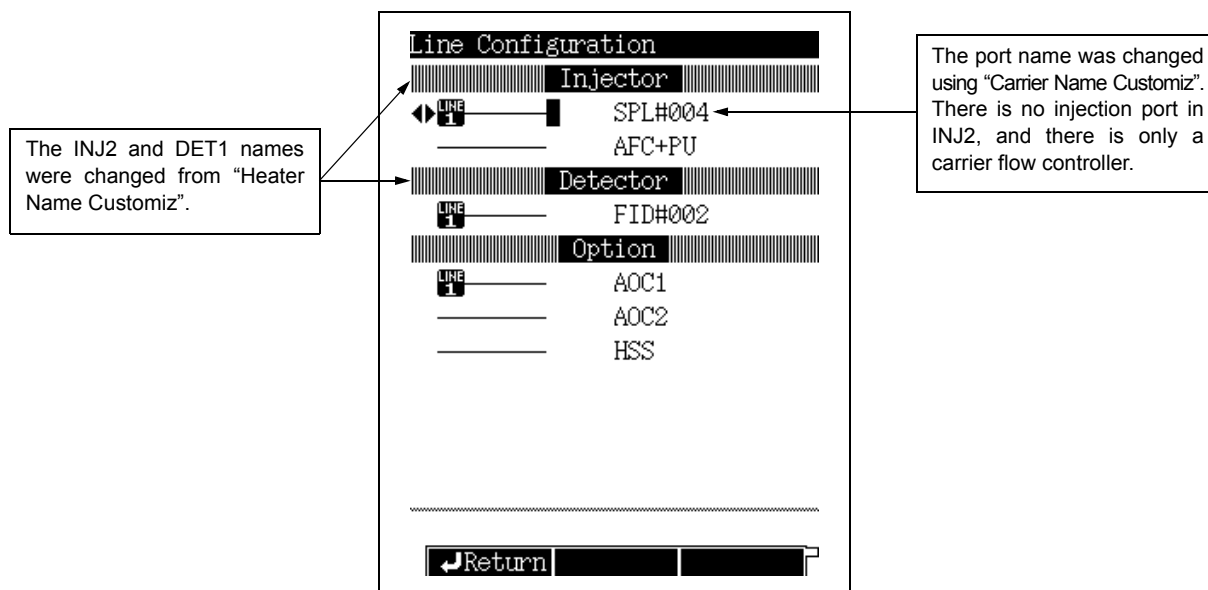
Fig. 16.6.14   Name customization example

16.6.8.3 Heater Name Customization

Select "6. GC CONFIGURATION" from, the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally, select "1. HEATER NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.15.

Only listed heated zone names can be changed.

To change the names, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

Fig. 16.6.15   Heater port name setup screen

16.6.8.4 Carrier Name Customization

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally select "CARRIER NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.16.

To change the names, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

Fig. 16.6.16   Carrier name setup screen

16.6.8.5 AUX APC Name Customization

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally "AUX APC NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.17.

Only listed APC options can be named.

To change the names, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

Fig. 16.6.17   AUX APC name setup screen

16.6.8.6 Relay Name Customization

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally "RELAY NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.18.

Only listed relays can be named

To change the names, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

Fig. 16.6.18   Relay name setup screen

16.6.9 Setting the link device code

When the gas chromatograph is linked to a Chromatopac, the link device code must be set. The link device code specifies which GC channel should start when the GC [START] key is pressed.

16.6.9.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "7. LINK DEVICE CODE", to open the screen shown in Fig. 16.6.19.
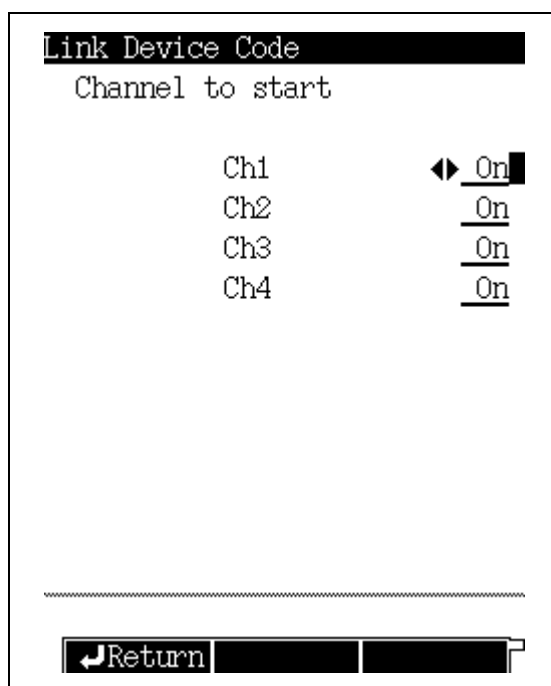
Fig. 16.6.19   Link device code setup screen

16.6.9.2 Parameter list
CHANNEL TO START

Ch1−Ch4 Selection: On/Off, Default: On
Set "On" or "Off" for the start signal of each channel.

16.6.10 Temperature offset

If the actual temperature of the various heated zones (as measured by a thermocouple) differs flow the set temperature, set a temperature offset value to compensate.

16.6.10.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key and select "8. TEMPERATURE OFFSET" to display the temperature offset screen shown in Fig. 16.6.20.

```
┌─────────────────────────────┐
│ Temperature Offset          │
│ Column                 1.00 │
│ SPL1      [LINE 1]     0.00 │
│ WBI2                   0.00 │
│ FID1      [LINE 1]     0.00 │
│ TCD2                   0.00 │
│                             │
│                             │
│                             │
│                             │
│                             │
│                             │
│                             │
│ ┌──────┐                    │
│ │↵Return│                   │
└─────────────────────────────┘
```
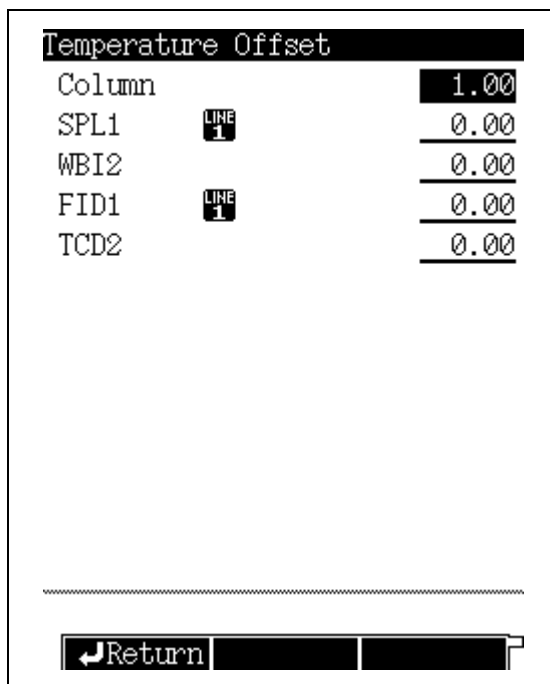
Fig. 16.6.20   Offset set up screen

16.6.10.2 Parameter list
COLUMN/INJ1/INJ2/DET1/DET2/AUX3/AUX4/AUX5

Range: -10.00−+10.00, Default: 0.00

The temperature of each heated zone can be offset, Uninstalled ports are not displayed. For example, when "-1°C" is obtained by subtracting the column oven temperature measured by thermocouple from the gas chromatograph value with an offset value of "0", input "-1" as the offset value.

16.6.11 Other Settings

16.6.11.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "9. OTHER CONFIGURATIONS" to open the configurations screen shown in Fig. 16.6.21.

```
Other Configurations
Language          ◆▶English
Backlight auto off (sec)    0
Pressure unit           kPa
Beep volume             Hig
Beep tone                Hi
Atmospheric compensation  On
Zero at Ready             On
Polarity in Ready       Open
SPL 1 Primary Press
                   500-900kPa
WBI 2 Primary Press
                   500-900kPa


  ↵Return
```
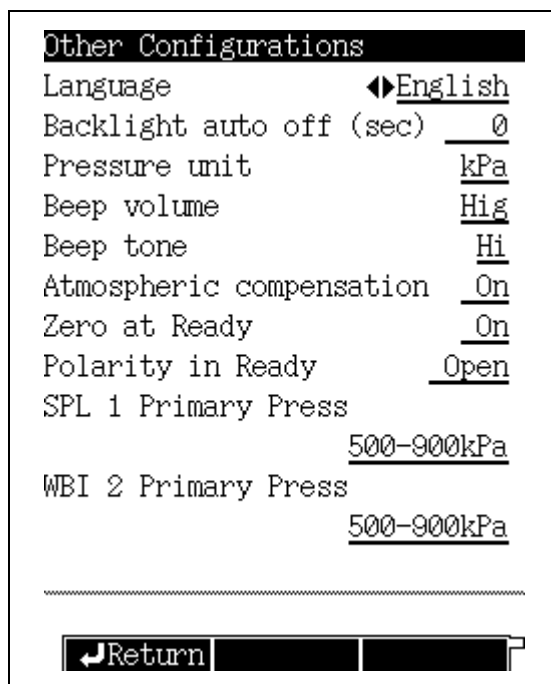
Fig. 16.6.21   Setup screen of other configuration

16.6.11.2 Parameter list

LANGUAGE

Selection: Alt./English, Default: English

Switch between Japanese (Alt.) and English screen languages.

BACK LIGHT AUTO OFF

Range: 0–9999 (sec)., Default: 0 (sec)

Set the period of time when the backlight LCD display automatically turns off.

PRESSURE UNIT

Selection: kPa/bar/psi., Default: kPa

Set the pressure units for display.

	Range (kPa = 1)	Increase quantity
kPa	1	0.1
bar	1/100	0.01
psi	1/6.895	0.1

NOTE   In the case that the presssure unit of "bar" or "psi" are used, pay attention to the following.

- The range of the primary pressure is not displayed in the value of "bar", "psi". Set up it with the value that consults the following table and transformed into "kPa".

kPa	bar	psi
300 - 500	3.00 - 5.00	43.5 - 72.5
500 - 900	5.00 - 9.00	72.5 - 130.5
900 - 980	9.00 - 9.80	130.5 - 142.1

- The pressure axis on the screen after pressing [MONIT] key is displayed in the value of "kPa" regardless of the "pressure unit" sets.
- The setting value, measured value of the primary pressure of the diagnosis result of the standard diagnosis is displayed in the value of "kPa" regardless of the "pressure unit" sets.
- The display, printing of each log file is displayed in the value of "kPa" regardless of the "pressure unit" sets.

BUZZER VOLUME

Selection: Off/Low/Mid/Hig, Default: Low

BUZZER TONE

Selection: Lo/Hi, Default: Hi

Use a different tone for different GCs to be able to discern which GC has a problem.

ATMOSPHERIC COMPENSATION

Selection: On/Off, Default: Off

Select "On" to compensate for higher altitudes when in linear velocity mode.

ZERO TO READY

Selection: On/Off, Default: On

Set "On" for, the gas chromatograph to automatically perform zero adjustment when the GC is ready.

POLARITY IN READY

Selection: Open/Close, Default: Open

Set the polarity of GC ready signal.

INJ1/INJ2 PRIMARY PRESS

Selection: 300–500 kPa/500–900 kPa/900–980 kPa, Default: 500–900 kPa

Select the pressure range of the carrier gas cylinder.

If the wrong range is selected, error messages are not displayed correctly.

Example: If the gas cylinder pressure supplied to the GC-2010 is 700 kPa, select "500–900 kPa".

16.7 Service and Maintenance

16.7

16.7.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen to display the Service/
Maintenance screen shown in Fig. 16.7.1.

```
Service/Maintenance
↕ ❶ Installation(Position)
  ❷ Installation(Piping)
  ❸ Initialize
  ❹ Power Consumption
  ❺ Service



Select function
  ↵Return                    ⌐
```
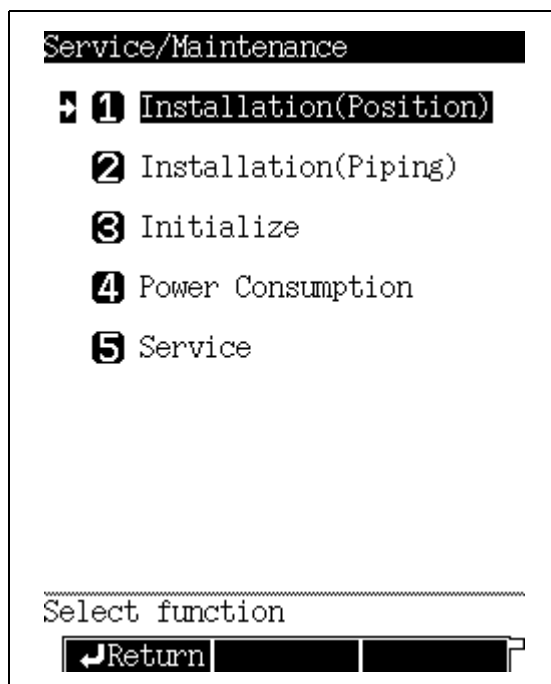
Fig. 16.7.1   Service/maintenance menu screen

16.7.2 Parameter list

INSTALLATION (POSITION)
Specify the heated zone locations for installed components.
INSTALLATION (PIPING)
Set the installation status of the carrier gas and the detector gas flow controllers.
INITIALIZE
Initialize the RAM, configuration, and installation settings.
POWER CONSUMPTION
Displays the power consumption of all heated zones.
SERVICE
Reserved for the use of shimadzu service personnel during maintenance or inspections.

16.7.3 INSTALLATION (POSITION)

16.7.3.1 Screen Description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "1. INSTALLATION (POSITION)", to open the GC installation screen shown in Fig. 16.7.2 appears.

After installing injection ports and detectors, specify the location of installed components by entering the headed zone number while. referring to Fig. 16.7.3.

The component type of installed injectors and detectors is automatically determined.

Enter the heated zone number to specify the unit installation position in a number. (Refer to Fig. 16.7.3.)

```
GC Installation
   Port    Type    Position
   INJ1    SPL         7
   INJ2    WBI         6
   DET1    FID         2
   DET2    TCD         4
   AUX3    ---        --
   AUX4    ---        --
   AUX5    ---        --



  ↵Return
```

Fig. 16.7.2   GC installation setup screen

16.7.3.2 **Parameter list**
INSTALLATION POSITION
Range: 0–9, Default: 0
Specify the component installation location by entering a numeric value from 1 to 8 as shown in Fig. 16.7.3.
Set "0" when a unit is not installed.
Set "9" when a unit is installed in a position not shown in Fig. 16.7.3.

Top view
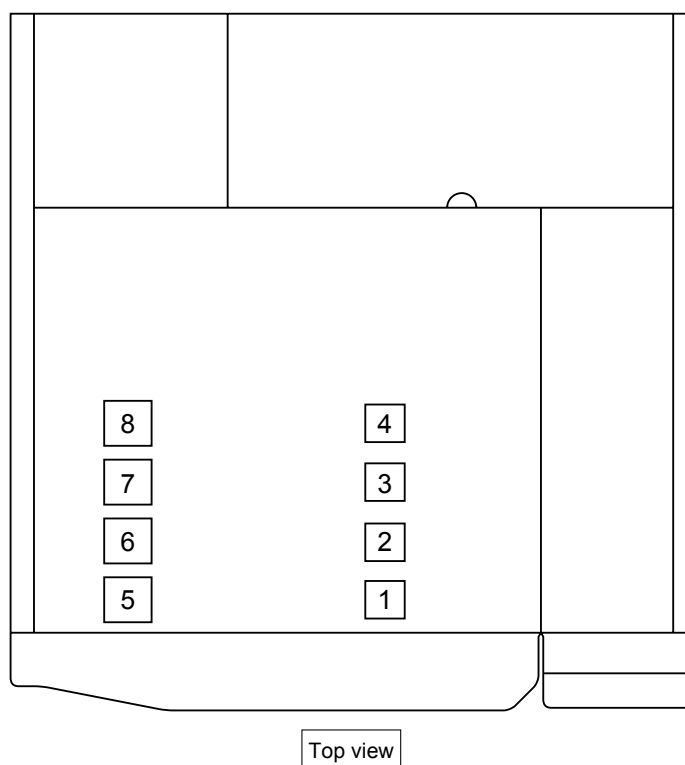
Fig. 16.7.3   Component installation location

NOTE   Changes are not in effect until the GC has been turned off and on.

16.7.4 INSTALLATION (PIPING)

16.7.4.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "2. INSTALLATION (PIPING)", to open the Installation (Piping) Screen shown in Fig. 16.7.4.

In the carrier gas, flow controller fields, specify where the flow controller injection port tubing is connected.

In the detector gas flow controller fields, specify the detector configuration including detector type and flow control unit.

Fig. 16.7.4   Installation status setup screen

Fig. 16.7.5   Installation status setup screen (continued)

16.7.4.2 Parameter list

■ Carrier gas flow controller settings

The names CAR1, CAR2 and CAR3 are automatically assigned in ascending order of the slot No. for each installed AFC.

Specify the flow controller carrier gas settings for each CAR.

UNIT TYPE

For, display only.

When an AFC is installed, this is automatically displayed.

If a manual flow controller is installed, specify the installation Slot No. (See below.) "SPLITTER" is automatically displayed for the Unit Type.

SLOT NO.

Selection: NON/SLOT1/ SLOT3/SLOT5/ SLOT6, Default: NON

This item can be set only when a manual flow controller is installed.

Select the Slot No. where the manual flow controller is installed.

Slot No. which have already been set cannot be selected.

The slot No. of an installed AFC is automatically recognized and displayed.

TEMP. PORT

Selection: NON/INJ1/ INJ2/DET1/DET2/AUX3/AUX4/AUX5, Default: NON
Specify the injection port heated zone where the flow controller tubing is connected.
This assosiates the flow controller to an injection port.

■ **Detector gas flow controller settings**

When installing detector flow control units, the names DET#1 to DET#4 are automatically assigned starting with the one nearest to the GC.
Specify the to flow controller detector gas settings for each detector No. (DET#1 to DET#4).

CONT. TYPE

For display only.
The type of each installed detector control unit is automatically recognized and displayed.

DET APC No.

For display only.
When the slot No. is selected for each installed detector gas flow controller, the name DET APC 1 to DET APC 4 is automatically assigned to each flow controller.

UNIT TYPE

When an APC is installed, the APC type is displayed for the Slot No. selected.
"APC (1ch)" indicates an APC for ECD/TCD. "APC (2ch)" indicates an APC for FPD.
"APC (3ch)" indicates an APC for FID/FTD.
When manual flow controllers are selected, "DET GAS" is automatically displayed.

SLOT NO.

Selection: NON/SLOT1/ SLOT2/SLOT3/ SLOT4/SLOT5/ SLOT6/SLOT7/ SLOT8, Default: NON
When a manual flow controller is installed, specify the installation location Slot No. (SLOT1, SLOT3, SLOT5 and SLOT7 are available).
When a APC is installed, select an available Slot No..
Slot No. which have already been set cannot be selected.

HEATER PORT

Specify the detector heated zone where the flows controller tubing is connected.
This assosiates the flow controller to a detector.

NOTE   Changes are not in effect until the GC has been turned off and on.

16.7.5 INITIALIZATION

16.7.5.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "3. INITIALIZE", to display the Initialization screen shown in Fig. 16.7.6.

When you move the arrow cursor and press the [ENTER] key, the initialization confirmation screen (Fig. 16.7.7) appears. On this screen, press the [INIT] (PF menu) key to initialize the selected item.

```
Initialization

↕ ❶ Initialize Configuration
  ❷ Initialize Installation
  ❸ Initialize RAM
  ❹ Initialize all




Select function
 ↵Return              ⌐
```

```
Initialize Configuration

  Configuration parameters
  are initialized with PF2.





 ↵Return   INIT        ⌐
```
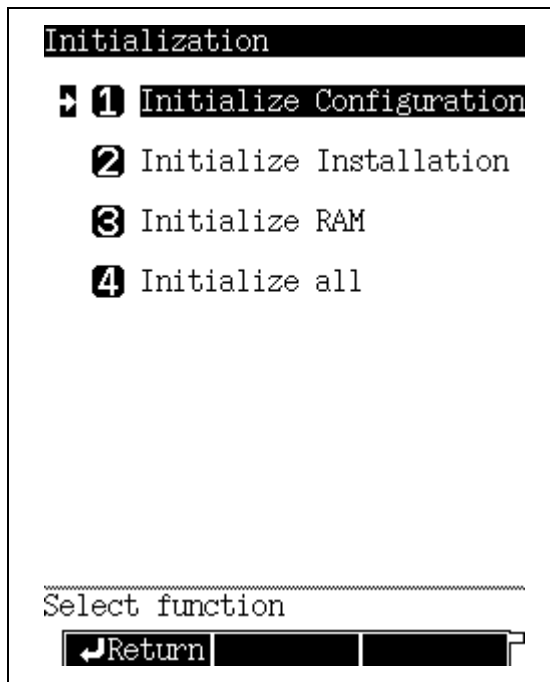
Fig. 16.7.6   Initialization menu screen   Fig. 16.7.7   Initialization confirmation screen
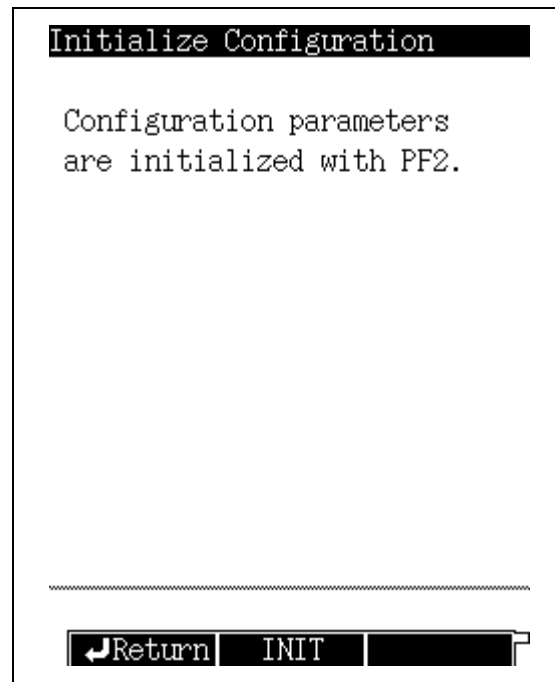
16.7.5.2 Parameter list

INITIALIZE CONFIGURATION

This item initializes configuration settings such as heated zone temperature limits and ready check parameters. However the column temperature limit is saved in the analysis file and is not reset. Analysis files 0−9 cannot be initializend.

INITIALIZE INSTALLATION

This item initializes the installation settings of injection ports, flow controllers, etc.

INITIALIZE RAM

This item initializes the RAM, erasing all data, including analysis files 0−9, configuration and installation settings.

Initialize the RAM when there is a RAM problem.

INITIALIZE ALL

This item initializes all settings including.

Analysis files 0−9

16.7.6 Power consumption

16.7.6.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "4. POWER CONSUMPTION", to open the Power consumption screen shown in Fig 16.7.8.

```
┌──────────────────────────────────┐
│ Power Consumption                │
│                                  │
│ Approx. power consumption(W)     │
│                            0     │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│ ⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐⌐   │
│ ↵Return                      ⌐   │
└──────────────────────────────────┘
```
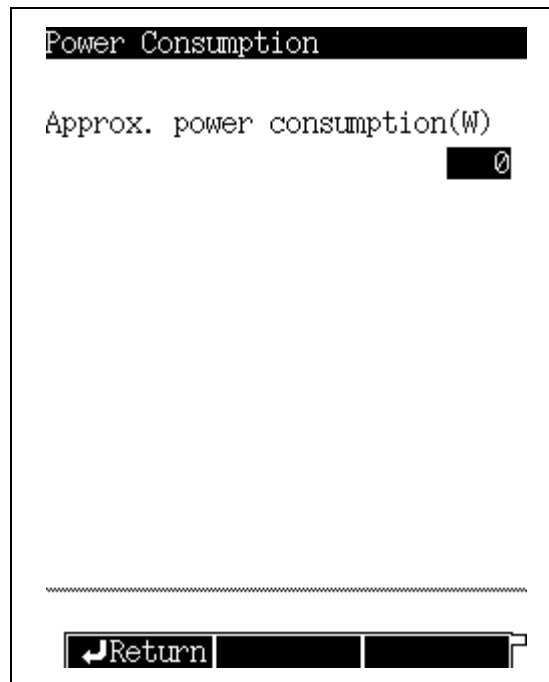
Fig. 16.7.8   Power consumption monitoring screen

16.7.6.2 Parameter list
APPROX. POWER CONSUMPTION

The calculated total power consumption of all heated zones is displayed.

16.*8* **Stopwatch**

16.8.1 Screen description

Select "8. STOP WATCH" from the [FUNC] key screen to display the stopwatch screen shown in Fig. 16.8.1.
The stopwatch can display elapsed time up to 99 : 99 : 99.9 in units of 0.1 second. When the counted time exceeds 99 : 99 : 99.9, the stopwatch is reset and the time restants at 0.0 seconds.
The stopwatch can function even when other keys are pressed. However, once the stop key is pressed, the stopwatch is reset to 0.0 seconds if another key is pressed.


```
Stop Watch
     2000.06.14(Wed) 13:37:47


Lapse Time [hh:mm:ss.s]
              00:00:02.6

Reciprocal(/min)     22.7




~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ↵Return|  Start  |        |
```
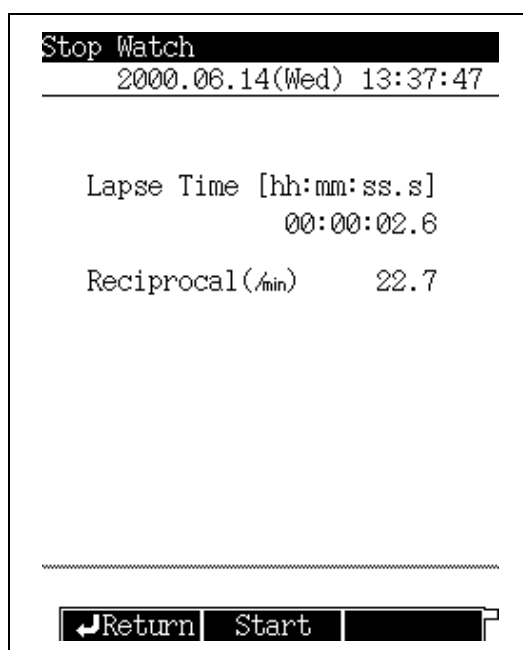
Fig. 16.8.1   Stop watch screen

16.8.2 PF menu

PF menu	Description	Reference section
Start	Starts timing. If "Start" is pressed again when the timing has stopped, the stopwatch is reset to 0.0 seconds.	——
Stop	Stops counting.	——

16.8.3 Timing with inverse measurement

When using a bubble film flow meter of V ml, obtain the flow rate using the inverse number.

V x (Inverse number of measurement time) ml/min

16.*9* **Key Lock and Parameter Lock**

16.9.1 Screen description

Select "9. LOCK" from the [FUNC] key screen to display the Lock screen shown in Fig. 16.9.1.

If either key lock or parameter lock has already been activated, the Unlock screen appeares instead.
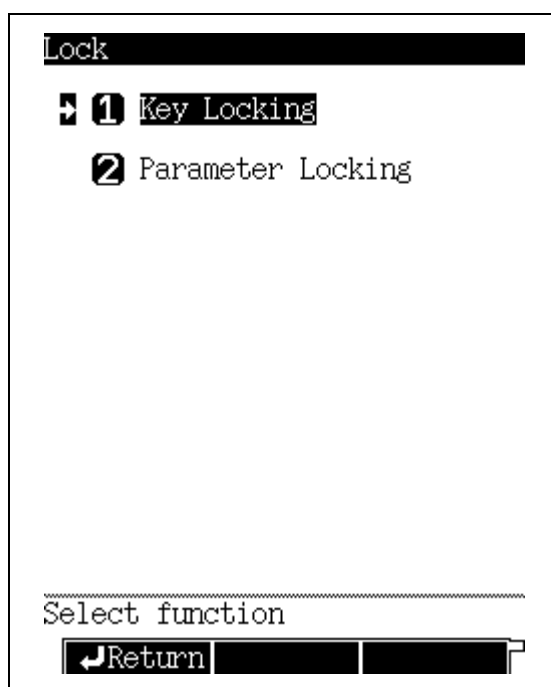
Fig. 16.9.1 Lock menu screen

16.9.2 Key locking

Select "9. LOCK" from the [FUNC] key screen, and then select "1. KEY LOCKING" to display the Key locking screen shown in Fig. 16.9.2. This screen indicates that the current status is "not locked".

When keys are locked, key operations are disabled. This function is useful to prevent analysis mistakes because no key operation is accepted. When the keys are locked, an icon indicating the lock status is displayed at the lower left corner of the screen.

When the keys are locked, analyses can still be started and stopped, and parameters can be monitored.

```
┌──────────────────────────────┐
│ Key Locking                  │
│                              │
│                              │
│   Press [PF2] key to entering│
│   KEY-LOCK mode.             │
│                              │
│                              │
│                              │
│                              │
│                              │
│                              │
│                              │
│                              │
│                              │
│  ⏎Return   Lock          ⌐  │
└──────────────────────────────┘
```
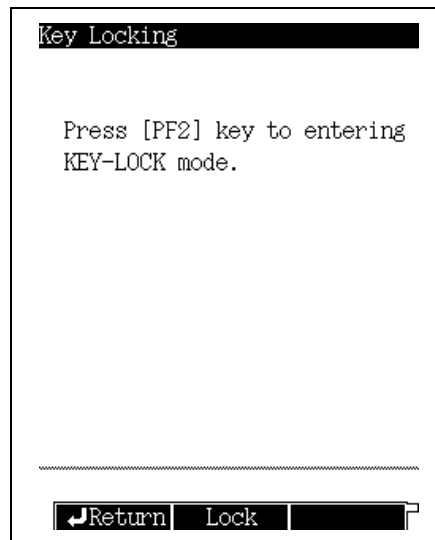
Fig. 16.9.2   Key Locking main screen

■ Unlocking keys

Press the [FUNC] key when the keys are locked, to open the screen shown in Fig. 16.9.3. Once the keys are unlocked, the screen shown in Fig. 16.9.1 appears.

```
┌──────────────────────────────┐
│ Key Locking                  │
│                              │
│                              │
│   Press [PF2] key to remove  │
│   KEY-LOCK mode.             │
│                              │
│                              │
│                              │
│                              │
│                              │
│                              │
│                              │
│                              │
│                              │
│  🔒     Unlock           ⌐  │
└──────────────────────────────┘
```

This screen is displayed when the current status is "locked".
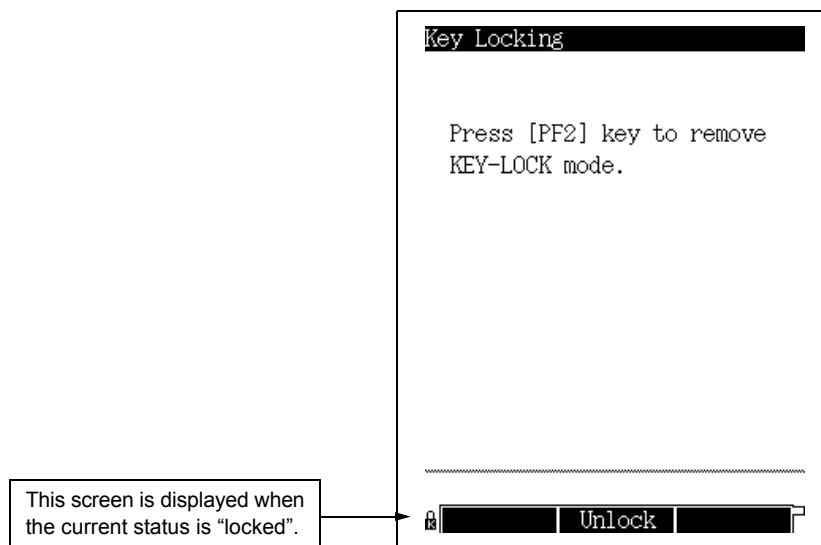
Fig. 16.9.3   Key unlock screen

16.9.3 Parameter locking

Select "9. LOCK" from the [FUNC] key screen, and then select "2. PARAMETER LOCKING" to display the screen shown in Fig. 16.9.4.

The parameter lock function prevents unauthorized parameter changes (for analytical conditions such as temperature, pressure and flow rate). Setup values can be monitored, but cannot be changed.

When the password is to be required, set "USE PASSWORD" to "USE", enter a password, then press [Lock] (PF menu).

The parameter lock function is also available without password.

```
Parameter Locking

Use Password            Use
Password               ***

  Press [PF2] key to entering
  PARAMETER-LOCK mode.




  ⏎Return   Lock  |Password
```

Press [Password] (PF menu) to display the password setup screen.

Fig. 16.9.4   Parameter locking main screen

■ Setting a password

Select [Password] (PF menu) from the screen shown in Fig. 16.9.4 to display the password screen shown in Fig. 16.9.5. The password is a number ranging from 1 to 9999. The factory set password is "2010".

< Setting a password >
Enter each requierd password, and press [Set] (PF menu).
Enter the new password twice to confirm it.

```
┌──────────────────────────────────────┐
│ Parameter Locking                      │
│                                        │
│                                        │
│ Old Password                    ****   │
│ New Password                    ****   │
│ Confirm new password             **    │
│                                        │
│                                        │
│                                        │
│                                        │
│                                        │
│                                        │
│                                        │
│                                        │
│                                        │
│                                        │
│ ┌──────────┬──────────┬──────────┐    │
│ │ ↵Return  │   Set    │          │    │
│ └──────────┴──────────┴──────────┘    │
└──────────────────────────────────────┘
```

Fig. 16.9.5   Password setup screen

NOTE   If the "Old Password" or "Confirm new password" is incorrect, an error message appears. Confirm the password to be input, entering it correctly.

NOTE   Only the system supervisor should have password access. Change the factory-set password promptly. Do not forget your password, and keep it secure.

■ Unlocking the parameters (without password)

If parameters are locked and no password is required, when you select "9. LOCK" from the [FUNC] key screen, the screen shown in Fig. 16.9.6 appears.
When the parameter are unlocked, the screen shown in Fig. 16.9.4 appears.

This screen is displayed when parameters are locked.
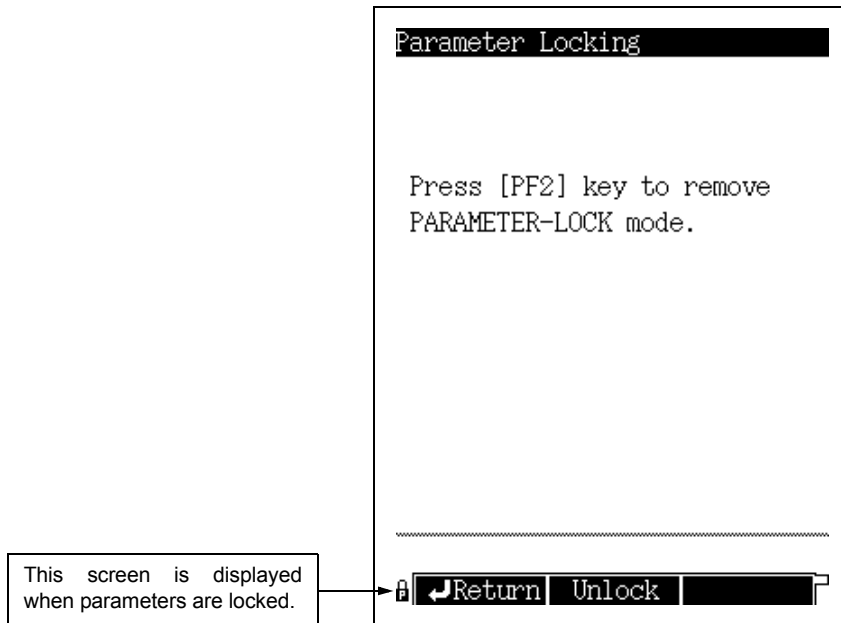
Fig. 16.9.6   Parameter unlock screen (without password)

■ Unlocking parameters (with password)

If parameters are locked and a password is set, when you select "9. LOCK" from the [FUNC] key screen, the screen shown in Fig. 16.9.7 appears.
When you input the correct password and press the [Unlock] (PF menu) key, the parameters are unlocked and the screen shown in Fig. 16.9.4 appears.

This screen is displayed when parameters are locked.
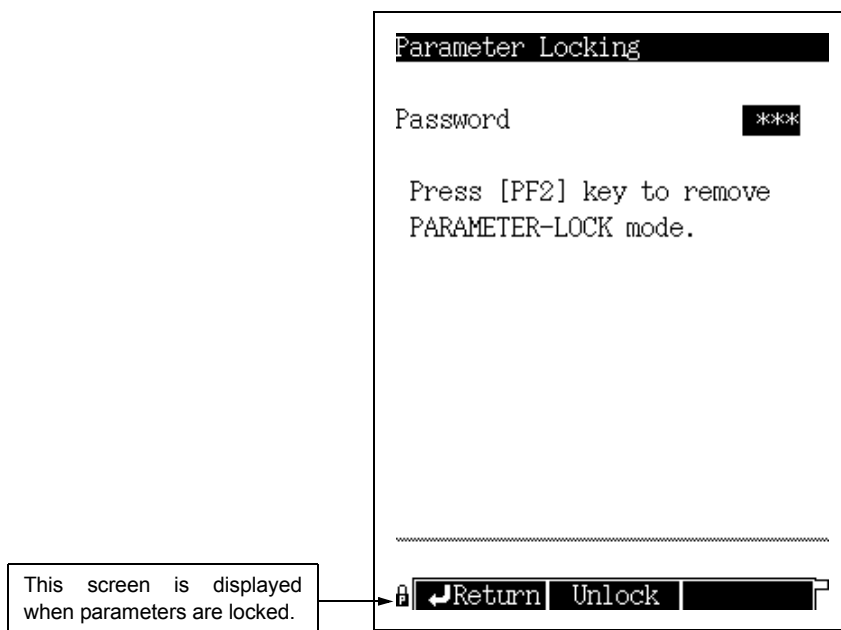
Fig. 16.9.7   Parameter unlock screen (when a password is set)

16.*10* ROM Version No.

The system ROM version No. can be displayed.

16.10.1 Screen description

Press [Version] (PF menu) from the [FUNC] key screen to display the version screen shown in Fig. 16.10.1.

```
┌──────────────────────────────────┐
│ Version                          │
│                                  │
│ Version              0.0202      │
│ Build No                372      │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~  │
│ ↵Return                      ┐   │
└──────────────────────────────────┘
```
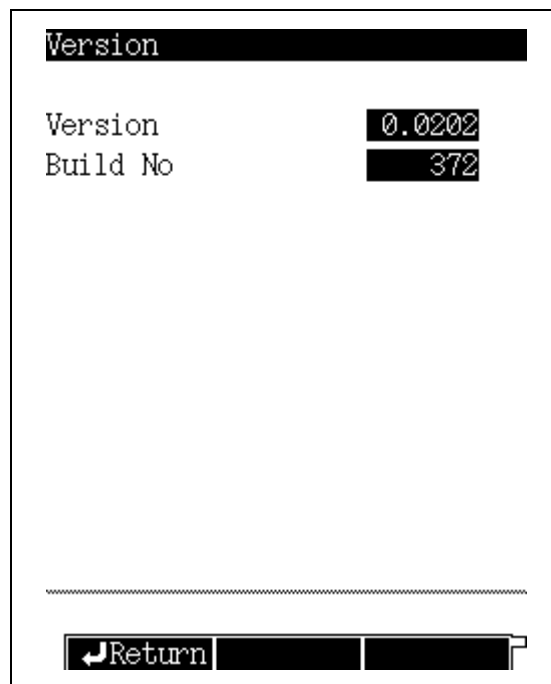
Fig. 16.10.1   ROM version No. screen

16.10.2 Parameter list

VERSION
BUILD NO.
The ROM version may be required during system maintenance.

17.1 Printing

17.1.1 Connection to Chromatopac

Connect the gas chromatograph to the Chromatopac, then press [Print] (PF menu) from the GC screen to print to the Chromatopac.

For the GC and Chromatopac connection, refer to "2.7 Connecting external device cables".

17.1.2 Parameters to be printed

17.1.2.1 Program

The current file program can be printed.

This includes the following screens: temperature program (COL, INJ1, INJ2), pressure program (CAR1, CAR2, CAR3), flow rate program (CAR1, CAR2, CAR3) and split ratio program (CAR1, CAR2.)

Press [Print] (PF menu) from any screen to print the same parameters for a saved program.

```
        - COLUMN OVEN TEMP PROGRAM -
              RATE       TEMP      TIME
        0     -------    100.0     1.00
        1      6.00      220.0    25.00
        - INJ1 TEMP PROGRAM -
              RATE       TEMP      TIME
        0     -------     25.0     0.00
        - INJ1 PRESSURE PROGRAM -
              RATE       TEMP      TIME
        0     -------    100.0     0.00
        - INJ1 SPRIT RATIO -
              TIME       RATE
        0     -------     -1.0
        - END -
```

Fig. 17.1.1

17.1.2.2 AOC parameters

The current file's AOC parameters and the parameters of AOC settings can be printed.
The AOC2 parameters can be printed when an AOC2 is configured in the analytical line.
All printed items are listed by command name. To match command names to screen
items, refer to "17.2 AOC commands".

```
       - AOC PARAMETER -
                  AOC1   AOC2
         WRPT       2      2
         WMOD       1      1
         REPT       1      1
         IVOL     1.0    1.0
         WPRS       0      0
         PUMP       5      5
         WTPP     0.2    0.2
         WAIT     0.0    0.0
         ISPD       2      2
         SSPD       1      1
         SAND       0      0
         SOLV       0      0
         SINT       0      0
         SSNO       0      0
         SNO2       0      0
         AAIR       0      0
         USPD       2      2
         DSPD       2      2
         HIGH       0      0
         LOWS       0      0
```

Fig. 17.1.2

17.1.2.3 Main parameters

Press [Print] (PF menu) from the [SET] key to print the temperature valves for all heated
zones, the CAR1/2 pressure value, and the total flow rate value from the current file.

```
    - GC PARAMETER 0:FILE0 -
    COLUMN OVEN   TEMP     25.0
    INJ1          TEMP     25.0
    DET1          TEMP     25.0
    INJ1          PRESS   100.0
    INJ1          FLOW     50.0
    - END -
```

Fig. 17.1.3

17.1.2.4 Time program and Pre-Run program

The time programs and Pre-Run programs can be printed as Event No. or parameter names. To match Event No. and parameter names to screen items, refer to "17.3 Program Parameters" and "17.4 Event No."

NOTE | For all functions treated as events in the printout, the line No. is displayed as "0" regardless of the line number.

```
- GC TIME PROGRAM -
      TIME      FUNC     VALUE      LINE
       0.0      EVNT      91.0        0
       2.0      D1RG       1.0        1
       3.0      D1RG       0.0        1
     200.0      STOP    1990.0        0
- END -
```

Fig. 17.1.4

17.1.2.5 Batch schedule

Press [Print] (PF menu) to print the bach schedule as shown below.

```
- GC SAMPLE SCHEDULER -
  START    FINAL    GC-FILE    DP-FILE    #INJ      MK        COMNAD
    1        5         0        Ch.1-2      1     STANDARD     STEST
    6       15         0        Ch.1-2      3     UNKNOWN
- END -
```

Fig. 17.1.5

17.1.2.6 Log

From each screen of the GC operation log, the analysis log, the parameter log, the error log and the diagnostic log, press [Print] (PF menu) to print the parameters displayed on the screen.

For the analysis log, only the list screen is printed. The contents of the detailed analysis screen are not printed.

For example, press [Print] (PF menu) from the error log screen, to obtain the following printed results.

NOTE   The log items are printed in chronological order, starting from the oldest.

```
- GC ERROT LOG -
  TIME  OCCURED          CODE           ERROR MESSAGE (VALUE)
  200.05.16 14:21        [E1020]        DET1 sensor down error (530.00)
  200.05.16 14:27        [E0031]        INJ-DET2 A/D error
  200.05.16 14:27        [E0032]        AUX1-AUX3 A/D error
  200.05.16 14:27        [E0011]        CAR1 AFC PCB error (7.00)
  200.05.16 14:27        [E0030]        COL A/D error
  200.05.16 14:27        [E0001]        DC5V range error (8.43)
  200.05.16 14:27        [E0002]        DC24V range error (20.34)
  200.05.16 14:27        [E0034]        Battery voltage error (0.26)
  200.05.16 14:27        [E0005]        Room temp range error (84.27)
  200.05.16 14:27        [E1019]        INJ1 sensor down error (530.00)
  200.05.16 14:27        [E1018]        COL sensor down error (530.00)
  200.05.16 14:27        [E1020]        DET1 sensor down error (530.00)
  200.05.16 14:28        [E0031]        INJ1-DET2 A/D error
  200.05.16 14:28        [E0032]        AUX1-AUX3 A/D error
  200.05.16 14:28        [E0011]        CAR1 AFC PCB error (7.00)
```

Fig. 17.1.6

17.1.2.7 Diagnosis results

Press [Print] (PF menu) from the detailed results screen of the standard diagnosis to print a report similar to the ones shown below.

The date, the version No. and the installation status, which are not displayed on the screen, are also printed.

```
- GC DIAGNOSIS REPORT -
  DATE                   2000.06.15 14:35
  GC SERIAL NUMBER       "C11123380069SM"
  ROM VERSION            0.0202
  DET#1                  FID WIDE
  DET#2                  NON
  DET#3                  NON
  DET#4                  NON
  CAR1                   AFC+PU
  CAR2                   NON
  CAR3                   NON
  DET APC 1              APC(3Ch)
  DET APC 2              NON
  DET APC 3              NON
  DET APC 4              NON
  TEST RESULT            Not Good
  - INJ1 Septum Counter -
  Threshold              100
  Count value            0
  Judgement              Good
```

Fig. 17.1.7

AOC commands

When you press [Print] from the AOC, all items are printed as command names. The list below shows correspondence of command names to item names.

The setup values, such as "Fast" and "Yes/No" are printed as numbers. Correspondence of setup values to numbers is shown in the range and default columns in the list below.

■ Command list

Command name	Item	Range	Default
WRPT	Sample Wash	0–99	2
WMOD	Solvent Wash	0–99	1
REPT	Number of Injection	1–99	1
IVOL	Sample Size	0.1–8.0	1.0
WPRS	Pre solvent Wash	0–99	0
PUMP	Pumping	0–99	5
WTPP	Viscosity	0.0–99.9	0.2
WAIT	Dwell Time	0.0–99.9	0
ISPD	Inj. Speed (Plunger)	Slow: 0, Fast: 2	Fast: 2
SSPD	Inj. Speed (Syringe)	Slow: 0, Fast: 1	Fast: 1
SAND	Inj. Mode	0–4	0
SOLV	Solvent selection	All: 0, only A: 1, only B: 2, only C: 3	All: 0
SINT	Priority Sample No.	1	0
*SSNO	Injected sample No. (Only this sample is analyzed.)	1	0
*SNO2	Injected sample No. (for sub AOC)	1	0
AAIR	Air Aspiration	No: 0, Yes: 1	No: 0
USPD	Plunger Aspiration Speed	Slow: 0, Middle : 1, Fast: 2	Fast: 2
DSPD	Speed of Plunger	Slow: 0, Middle : 1, Fast: 2	Fast: 2
HIGH	Syringe Height (↑)	0–20	0
LOWS	Syringe Height (↓)	1.5 ml vial: 0–2 4 ml vial: 0–10	0
INJH	Syringe Height (Inj)	0–22	0
STRI	Multi - Inj	1–99	1
*FSAM	Final sample No. (Samples after that are not analyzed.)	1	0
*WKEY	Washing with solvent before injection in solvent flush mode	0, 1	0
*UVOL	Aspiration volume during pumping	8 µl: 0, 6 µl: 1	8 µl: 0
SLMD	Using 3 Solvent Vials	No: 0, Yes: 1	No: 0
VIAL	Vial size	1.5 ml:0, 4ml:1	1.5 ml:0
*CKTR	With/without tray check	With: 0, Without: 1	Without: 0
*TANL	Analysis time	0–655	0
*TSTR	Analysis start time	0.0–99.9	0.0
LSYR	Syringe Volume	10µl: 0, 50µl: 1, 250µl: 2	10µl: 0

Command name	Item	Range	Default
SAMU	Use of the sampler	Not use: 0, Use: 1	Not use: 0
SUBU	Use of the sub AOC	Not use: 0, Use: 1	Not use: 0
BARC	Bar Code Reader	Not use: 0, Use: 1	Not use: 0
SPMD	Distribution of sample for dual AOC	0−8	0
PAR1	Use of Same Param	No: 0, Yes: 1	No: 0
*GLPM	Setting of validation mode	0, 1	0
*GRPT	Number of times of GLP sample discharge	1−99	50
*GVOL	GLP sample discharge volume	1−80	20
*GPMP	Number of times of pumping after second GLP	0−5	1
*ATSP	Automatic stop function	Off: 0, On: 1	On: 1
*ARSG	Ready signal polarity	Open: 0, Close: 1	Open: 0
TLET	Rack	Short: 0, Long: 1	Short: 0
TSEL	Rack position while sampler is used	0−2	1

1: Without autosampler, short rack: 1−6
   Without autosampler, long rack: 1−12
   With autosampler: 1−150

NOTE   Command names marked with " * " cannot be set on the GC screen.

17.3 Program Parameters

Press [Print] from a time program or Pre-Run program to print the program as event No. or parameter names.
This paragraph describes the parameter names and the display when a program stops.

■ Event No. (EVNT)

Refer to "17.4 Event No."

■ Temperature

Heated zone names from a temperature program are printed with the parameter names shown below.

Column temperature	: CITP
INJ2	: AITP (Pre-Run program only)
DET1	: DETT
DET2	: AUXT
AUX3	: TCDT
AUX4	: AX4T
AUX5	: AX5T

■ Detector range, polarity and current value

Detector range, polarity and the current value from a program are printed with the parameter names shown below.

Range of DET #1	: D1RG
Range of DET #2	: D2RG
Range of DET #3	: D3RG
Range of DET #4	: D4RG
Polarity of DET #1	: D1PL
Polarity of DET #2	: D2PL
Polarity of DET #3	: D3PL
Polarity of DET #4	: D4PL
Current value of DET #1	: D1CR
Current value of DET #2	: D2CR
Current value of DET #3	: D3CR
Current value of DET #4	: D4CR

■ Time program STOP and repetitions

When a time program STOP value is specified, it is printed with the four digits described below.

① ② ③ ④

・ Digit 1] value
  0: Continuous
  When a program finishes, the next program automatically starts without waiting for the start command.
  1: Pause at each run (AOC)
  When a program finishes, the GC waits for the start command.

・ Digit 2] and 3] valves
  Number of times of run (00–99)
  "00" indicates 1 repetition.
  When both digits 2] and 3] are set to "0", nothing is printed but the number of repetition times is set to "1".

・ Digit 4] value
  File No. to switch to after repetitious run is finished (0–9)
  In order to stop the program, input the current file No.

■ Pre-Run program (STRT)

Pre-Run program values are printed with numbers 0–4, described below.

0: Auto
1: Manual (Stop program)
2: GC start
3: AOC/HSS start
4: Clean up

17.4 Event No.

Many parameters are printed with event No. The list below shows the correspondence of event No. to functions.

■ Event No. list

No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
0	Reverses contact status of Events 1 to 16 and Events 91 to 96.	Opens contact of Events 1 to 16 and switches contact of events 91 to 96 to N/C type (normal).
1	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
2	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
3	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
4	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
5	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
6	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
7	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
8	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
9	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
10	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
11	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
12	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
13	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
14	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
15	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
16	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
51	Performs zero adjustment of DET #1.	Frees zero adjustment of DET #1.
52	Performs zero adjustment of DET #2.	Frees zero adjustment of DET #2.
53	Performs zero adjustment of DET #3.	Frees zero adjustment of DET #3.
54	Performs zero adjustment of DET #4.	Frees zero adjustment of DET #4.
61	Turns on CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1.	Turns off CAR1 gas saver. Returns split ratio to value of analysis parameter.

No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
62	Turns on CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 2.	Turns off CAR1 gas saver. Returns split ratio to value of analysis parameter.
63	Turns on CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 1.	Turns off CAR2 gas saver. Returns split ratio to value of analysis parameter.
64	Turns on CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 2.	Turns off CAR2 gas saver. Returns split ratio to value of analysis parameter.
71	Ignites frame.	Extinguishes frame.
81	Turns on feedback of FTD 1.	Turns off feedback of FTD 1.
82	Turns on feedback of FTD 2.	Turns off feedback of FTD 2.
83	Turns on feedback of FTD 3.	Turns off feedback of FTD 3.
84	Turns on feedback of FTD 4.	Turns off feedback of FTD 4.
91	N/O contact between two contacts in one circuit	N/C contact between two contacts in one circuit
92	N/O contact between two contacts in one circuit	N/C contact between two contacts in one circuit
93	N/O contact between two contacts in one circuit (option PRG)	N/C contact between two contacts in one circuit (option PRG)
94	N/O contact between two contacts in one circuit (option PRG)	N/C contact between two contacts in one circuit (option PRG)
103	Closes CAR1 splitter control.	Opens CAR1 splitter control.
104	Closes CAR2 splitter control.	Opens CAR2 splitter control.
105	Turns On AC blower.	Turns Off AC blower.
106	Closes air (solenoid valve).	Opens air (solenoid valve).
107	Closes air (solenoid valve). (only in 17A mode)	Opens air (solenoid valve). (only in 17A mode)
109	Turns On AC CRG INJ.	Turns Off AC CRG INJ.
110	Turns On AC CRG Column.	Turns Off AC CRG Column.
111	Turns On AC Cooling fan.	Turns Off AC Cooling fan.
131	Turns On DET #1 detector controller.	Turns Off DET #1 detector controller.
132	Turns On DET #2 detector controller.	Turns Off DET #2 detector controller.
133	Turns On DET #3 detector controller.	Turns Off DET #3 detector controller.
134	Turns On DET #4 detector controller.	Turns Off DET #4 detector controller.
141	Turns On CAR1 carrier gas.	Turns Off CAR1 carrier gas.
142	Turns On CAR1 septum purge	Turns Off CAR1 septum purge.
143	Turns On CAR2 carrier gas.	Turns Off CAR2 carrier gas.
144	Turns On CAR2 septum purge.	Turns Off CAR2 septum purge.
145	Turns On CAR3 carrier gas.	Turns Off CAR3 carrier gas.
146	Turns On CAR3 septum purge.	Turns Off CAR3 septum purge.
147	Turns On DET #1 makeup gas.	Turns Off DET #1 makeup gas.
148	Turns On DET #1 H2.	Turns Off DET #1 H2.
149	Turns On DET #1 Air.	Turns Off DET #1 Air.
150	Turns On DET #2 makeup gas.	Turns Off DET #2 makeup gas.
151	Turns On DET #2 H2.	Turns Off DET #2 H2.
152	Turns On DET #2 Air.	Turns Off DET #2 Air.
153	Turns On DET #3 makeup gas.	Turns Off DET #3 makeup gas.
154	Turns On DET #3 H2.	Turns Off DET #3 H2.
155	Turns On DET #3 Air.	Turns Off DET #3 Air.

No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
156	Turns On DET #4 makeup gas.	Turns Off DET #4 makeup gas.
157	Turns On DET #4 H2.	Turns Off DET #4 H2.
158	Turns On DET #4 Air.	Turns Off DET #4 Air.
161	Turns On CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR1 gas saver. Returns split ratio to value of analysis parameter.
162	Turns On CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 2. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR1 gas saver. Returns split ratio to value of analysis parameter.
163	Turns On CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 1. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR2 gas saver. Returns split ratio to value of analysis parameter.
164	Turns On CAR1 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 2. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR2 gas saver. Returns split ratio to value of analysis parameter.
171	Turns On CAR1/CAR2/CAR3 high pressure injection mode.	Turns Off CAR1/CAR2/CAR3 high pressure injection mode. Returns column input pressure to value of analysis parameter.
181	Turns On APC1 flow controller.	Turns Off APC1 flow controller.
182	Turns On APC2 flow controller.	Turns Off APC2 flow controller.
183	Turns On APC3 flow controller.	Turns Off APC3 flow controller.
184	Turns On APC4 flow controller.	Turns Off APC4 flow controller.
185	Turns On APC5 flow controller.	Turns Off APC5 flow controller.
186	Turns On APC6 flow controller.	Turns Off APC6 flow controller.
187	Turns On APC7 flow controller.	Turns Off APC7 flow controller.
188	Turns On APC8 flow controller.	Turns Off APC8 flow controller.
189	Turns On APC9 flow controller.	Turns Off APC9 flow controller.
190	Turns On APC10 flow controller.	Turns Off APC10 flow controller.
191	Turns On APC11 flow controller.	Turns Off APC11 flow controller.
192	Turns On APC12 flow controller.	Turns Off APC12 flow controller.
193	Turns On APC13 flow controller.	Turns Off APC13 flow controller.
194	Turns On APC14 flow controller.	Turns Off APC14 flow controller.
195	Turns On APC15 flow controller.	Turns Off APC15 flow controller.
196	Turns On APC16 flow controller.	Turns Off APC16 flow controller.
197	Turns On APC17 flow controller.	Turns Off APC17 flow controller.
198	Turns On APC18 flow controller.	Turns Off APC18 flow controller.

18.1 Maintenance Parts

> The following tables list maintenance parts and their part numbers (P/N). All parts are consumables. Miscellaneous maintenance part are listed in "18.1.8 Miscellaneous."

18.1.1 Septum

Parts name	P/N	Purpose
Silicon rubber septa (with 20pcs)	201-35584	Injection port septa (Up to 350°C)
Septa for high temperature (with 20pcs)	221-48398-91	Injection port septa (above 350°C)

18.1.2 O-ring for glass insert

Part name	P/N	Purpose
Fluoride rubber O-ring (with 5pcs)	036-11203-84	standard (Up to 450°C)
Graphite O-ring (for splitless/WBI) (with 4pcs)	221-47222-91	For high temperature (350°C to 450°C)
Graphite O-ring (for split) (with 4pcs)	221-48393-91	For high temperature (350°C to 450°C)

18.1.3 Glass insert

Part name	P/N	Purpose
Glass insert (For split)	221-41444-01	For split injection technique
Glass insert (For splitless)	221-48335-01	For splitless injection technique
Silica wool (with 2g)	201-48600	Packed in glass insert

18.1.4 Graphite ferrule

Part name	P/N	Purpose
Graphite ferrule G0.5 (with 10pcs)	221-32126-05	Capillary column installation
Graphite ferrule G0.8 (with 10pcs)	221-32126-08	Wide bore column installation

18.1.5 Capillary column

To select a capillary column, refer to a column manufactuer's catarog.

18.1.6 Flow controller

Part name	P/N	Purpose
Molecular sieve filter	221-34121-93	For removing contamination in carrier gas
Trap (SPLIT)	221-42559-92	Split flow line trap
Trap (PURGE)	221-42559-92	Septum purge flow line trap
Aluminum gaskets	201-35183	For tubing connections

18.1.7 Hydrogen flame ionization detector (FID)

Part name	P/N	Purpose
Jet	221-48258-91	Jet for FID
Igniter	221-41847-93	Igniter for FID

18.1.8 Miscellaneous

Part	Name	P/N
ASSY	Key operation section PCB	221-46260-91
	Key operation section LCD	221-48721-91
	Key operation section key rubber 1 (upper)	221-46470
	Key operation section key rubber 2 (lower)	221-46471
	Temperature sensor (for column)	221-43695-91
	Thermocouple (for column)	221-43696-91
FPD detector	Filter (S)	221-46310-01
	Filter (P)	221-46310-02
	Filter (Sn)	221-46310-03
	Quartz cylinder	221-46552
FTD detector	FTD collector ASSY	221-45586-91

18.2 Inspection and Maintenance Intervals

Periodical inspection and maintenance are required to maintain the gas chromatograph in the good condition. Perform the periodical inspection and maintenance described in this section to obtain optimal analysis results reproducibility.

The recommended inspection interval for each part is described below.

18.2.1 Glass insert

Inspect the glass insert before starting a series of analysis.
Take care of dirt and silica wool position.
An inser counter feature is available in the GC.
Refer to the diagnosis item list in "14.1 Standard Diagnosis".

18.2.2 Septum

Replace the septum periodically.
The guideline for replacement is 100 injection.
A septum counter feature is available in the GC.
Refer to diagnosis item list in "14.1 Standard Diagnosis".

18.2.3 O-ring for glass insert

Replace the O-ring when replacing the glass insert or if there is a carries gas leak.

18.2.4 Graphite ferrule

Replace the graphite ferrule if a carries gas leak is not stopped by tightening.
Replace the ferrule if it is completely compressed.

18.2.5 Capillary column

Condition the column if it has not been used for a long time or if ghost peaks are present.

18.2.6 Flow controller

Condition or replace the carrier gas molecular sieve filter if the baseline is unstable.
Every 6 months, check the split flow line and the septum purge flow line traps and replace any saturated traps.

18.2.7 Hydrogen flame ionization detector (FID)

Rinse or replace the igniter and the jet if ignition is not smooth or no peaks are obtained.

18.2.8 Cleaning the Unit

If the exterior unit surfaces become dirty, clean using a neutral detergent.

18.*3* Inspection and Maintenance: Septum

> ⚠ **WARNING**
>
> Danger of burns.
> Do not perform injection port maintenance until the tempelature of the injection on port has dropped below 50°C.

> ⚠ **CAUTION**
>
> Wait until the injection port has cooled to loosen screws and nuts to prevent them from binding.

Repeated injections can deteriorate the septum, inerfering with its sealing ability and causing carrier gas leaks. This can cause retention time shifts and poor producibility. In addition, septum fragments can fall into the glass insert, causing ghost peakes. Periodically inspect and replace the septum as described in this section.

18.3.1 Inspection/maintenance cycle

The guideline for inspection/maintenance is 100 injections.
Septun replacement is recomended evely 100 injections.
In addition, perform inspection and maintenance in the following cases.

・When the retention time/shifts/reproducibility is poor
・When ghost peaks are detected

If ghost peaks are obtained although no septum fragments are found in the glass insert, ensure that new septa are conditioned properly.

18.3.2 Inspection/maintenance

■ Preparing the gas chromatograph

Select "Maint INJ" (PF menu) from the [SYSTEM] key main screen.
If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 51°C.
When the message "GC is ready for maintenance" appears on the screen, injection port inspection/maintenance can begin.
Lift up the entire INJ/DET cover, and remove it. Because the detector is hot, use tweezers or pliers to handle the detector cover.

| NOTE | For "Maint INJ", refer to "7 Starting and Stopping the GC [SYSTEM]". |

■ Conditioning the septum

For high sensitivity analysis, impurities from the septum may be detected as ghost peaks. Condition the septum as described below.

(1) Soak the septum in hexane for 10 to 15 hours.
The septum will absorb hexane and swell into approximately twice its size. Therefore, use a container with a wide opening and a lid.

(2) Take out the septum, and put it into a rinse container.
Pay strict attention when handling a septum swollen with hexane because it can easily crumble.

(3) Let the septum air dry in a clean area.

(4) After drying, bake the septum at 130 to 150°C for approximately 2 hours.

NOTE   Store the septum in a clean, sealed containes to prevent contamination.

■ Inspection

When inspecting only the septum, remove the septum nut above the septum, take out the septum, then condition it or replace it with a new one.
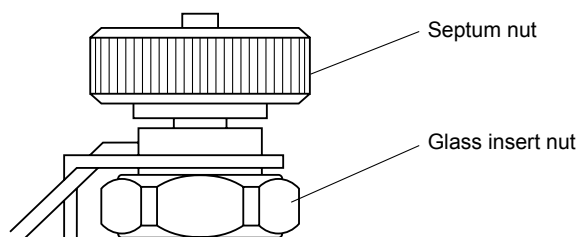
Fig. 18.3.1

■ Septum installation

Install the conditioned septum or a new septum using the following procedure.
When using an autosampler, tighten the septum nut by hand until it touches the nut below the screw, then loosen a half turn. When performing mamual injections, you can extend the life of the septum by tightening the septum nut by one thread after approximately 10 injections. When the injection port is hot, the septum nut is also hot. When tightening the septum nut, wear gloves to prevent burns.

■ Restarting the gas chromatograph main body

Using tweezers, replace the derector cover, then the INJ/DET cover.
When starting up the GC again, select [Anal.] (PF menu). The GC automatically flows the carrier gas for 5 minutes, and then restores the temperatures set prior to maintenance.
When the STATUS indicator light turns green and the baseline becomes stable, you can start analysis.

18.4 Inspection and Maintenance: O-ring for glass insert

> ⚠ **WARNING**
>
> Danger of burns.
> Do not perform injection port maintenance until the tempelature of the injection on port has dropped below 50°C.

> ⚠ **CAUTION**
>
> Wait until the injection port has cooled to loosen screws and nuts to prevent them from binding.

| NOTE | For the details on handling the glass insert and O-ring, refer to "12 Injection Port" |

18.4.1 Inspection/maintenance cycle

Two types of O-rings are available for the glass insert and the fluoride rubber type is usually used. But when the fluoride rubber type is used for long hours at more than 350°C, the time duration being leaktight is rather short so check for leakage every week. When operating the system for long hours at more than 350°C, the graphite type is recommended. But the graphite type has a little less sealing effect than the fluoride rubher type. The fluoride rubber type can be used for sevaral glass insert replacements, but graphite type can be used only once. However, replacing the O-ring when replacing the glass insert is recommended.

Normally, rubber O-ring is used. If the rubber O-ring is used above 350°C for an extended period, it deteriosates rapidly. Use a graphite ferrule on the glass insert in this case, although its sealing ability is inferior to the rubber type. Perform inspection and maintenance of the O-ring when the following problem occurs.

・When the carrier gas leaks

To stop leaks, tighten the glass insert nut. If the leak contnues, inspect the O-ring and replace if necessary.

18.4.2 Inspection/maintenance

■ Preparing the gas chromatograph

Select "Maint INJ" (PF menu) from the [SYSTEM] key main screen.

If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 51°C.

When the message "GC is ready for maintenance" appears on the screen, injection port inspection/maintenance can begin.

Lift up the entire INJ/DET cover, and remove it. Because the detector is hot, use tweezers or pliers to handle the detector cover.

| NOTE | For "Maint INJ", refer to "7 Starting and Stopping the GC [SYSTEM]". |

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⚠ CAUTION

Handle graphite O-rings with care to prevent it from breaking.

</div>

■ Replacing the O-ring

Take out the glass insert, remove the O-ring, and install a new O-ring.

NOTE   Refer to "18.5 Inspection and Maintenance: Glass Insert" to remove and install the glass insert.

(1) Fluoride rubber O-ring
Place the fluoride rubber O-ring approximately 4 mm from the top of the glass insert. When inserting the glass insert in the injection port, push the glass insert in until the glass insert touches the bottom of the injection port. This correctly places the O-ring 3mm from the top of the glass insert.

(2) Graphite O-ring
Insert the glass insert in the injection port, place a graphite O-ring on it, and then tighten the glass insert nut.

NOTE   Use the correct graphite O-ring for the glass insert type.

■ Leak check

A leak will affect reproduceability and carrier gas will be wasted.

Confirm whether there is a leak or not according to the following procedure:
(As for the following procedure, there could be cases in which the error message "purge leaks" etc. appears. However, it does not matter to the test. Then, select "Reset Error".)

(1) Set the "Flow Control" to "Cont" on the screen after pressing [SYSTEM] key.
(2) Push the [Stop GC] (PF menu), and the system stops.
(3) Wait that all oven temperature, injection port temperature and detector temperature is below 40degrees on the screen after pressing the [MONIT] key.
(4) Push the [On/Off] (PF menu) on the screen after pressing the [FLOW] key, and the control of AFC stops.
Set the purge flow rate to "0 ml/min".
(5) Remove the capillary column, and blank off with the graphite ferrules and column nut.
(6) Install the blind (G-type blank nut) to the split vent and purge vent port.
(7) Make sure that the supply pressure to the carrier gas (the pressure from a gas cylinder) is above 300 kPa.
(8) Set the "Split mode" to "DIRECT" and "Control mode" to "PRESS" on the screen of the after pressing the [FLOW] key.
(9) Set the inlet pressure to 150 kPa. Push the [On/Off] (PF menu), and the control of AFC starts.
(10) Wait for five minutes. Confirm that the inlet pressure is 125 ~ 175 kPa. If the inlet pressure is above 175 kPa, unfasten the column a little nut and set the pressure free.
If the inlet pressure is below 125 kPa, raise the supply pressure a little.
(11) Confirm that the total flow is below 2 ml/min. If the total flow is above 2 ml/min, then there is a leak somewhere.
(12) Push the [On/Off] (PF menu) on the screen of the [FLOW] key, and the control of AFC starts.

(13) In case of fluoride rubber O-ring, confirm that the pressure does not drop more than 15 kPa per hour or 2.5 kPa in 10 minutes.

In case of graphite O-ring, confirm that the pressure does not drop more than 21 kPa per hour or 3.5 kPa in 10 minutes.

If the pressure has dropped more than the above specified values, there is a leak somewhere.

(14) When the leak check has passed set the system back into operating status.

■ Possible leak positions

In case the leak check conditions has failed check the following items on the GC for possible leaks:

septum injection inlet, around the injection port, the connection of piping, split vent (around the blind plug), purge vent (around the blind plug) and the connection of column with a leak detector or snoop.

In case you have localized a leak in one of the above positions do the following according to the leak localization:

- Septum injection inlet : replace septum.
- Around the injection port : replace O-ring of glass insert.
- Split vent : replace blind plug seal.
- Purge bent : replace blind plug seal.
- Connection of column : replace graphite ferrules and column nut.

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⚠ CAUTION

Do not use the leak detecting fluid nor soapy water for gas leak check on the connections above the carrier and detector gas controllers (AFC/APC).
The drips may damage the controller.

</div>

NOTE When you use snoop liquid etc., take care that the liquid is not splashed to the electric wiring and detector. There is a risk to get an electrical shock.

When using snoop liquid for detecting leaks there is always a possibility that a part of the liquid creeps into the pipings which in case of trace analysis can give ghost peaks which may interfere your peaks of interest. Then it is recommended to use a leak detector instead.

18.*5* Inspection and Maintenance: Glass Insert

<div style="border:1px solid black; padding:10px;">

⚠ **WARNING**

Danger of burns.
Do not perform injection port maintenance until the tempelature of the injection on port has dropped below 50°C.

</div>

<div style="border:1px solid black; padding:10px;">

⚠ **CAUTION**

Wait until the injection port has cooled to loosen screws and nuts to prevent them from binding.

</div>

| NOTE | For the details of handling of the glass insert, refer to "12 Injection Port". |

18.5.1 Inspection/maintenance cycle

Inspect the glass insert before starting a series of analysis.
In addition, inspect and maintain the glass insert if the following problems occur.

・If the retention time shifts or reproducibility is poor.

・If ghost peaks are detected.

When the problems above occur, the silica wool may have moved, or become dirty, or the glass insert could be dirty.

18.5.2 Inspection/maintenance

■ Preparing the gas chromatograph

Select "Maint INJ" (PF menu) from the [SYSTEM] key main screen.
If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 51°C.
When the message "GC is ready for maintenance" appears on the screen, injection port inspection/maintenance can begin.
Lift up the entire INJ/DET cover, and remove it. Because the detector is hot, use tweezers or pliers to handle the detector cover.

| NOTE | For "Maint INJ", refer to "7 Starting and Stopping the GC [SYSTEM]". |

■ Removing the glass insert

Remove the glass insert using the following procedure.
Loosen and remove the glass insert nut while holding the septum nut. Remove the septum nut assenbly by lifting it straight up and moving it to the side.
The glass insert could break if the septum nut assenbly is not lifted straight up.
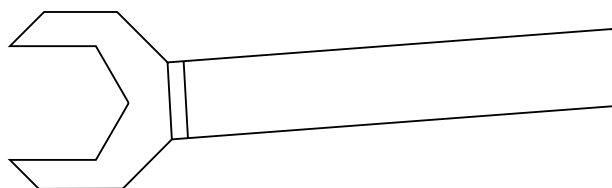
Fig. 18.5.1   Tool: Glass insert wrench, standard accessory Part No. 221-46977
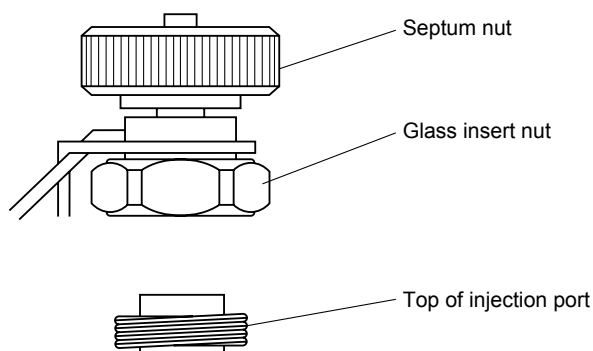
Fig. 18.5.2

(2)   Use tweezers to lift the glass insert out of the injection port.
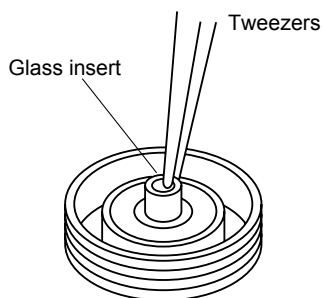
Fig. 18.5.3

■ Cleaning the glass insert

NOTE   Remove the O-ring before rising the glass insert with solvent. After cleaning, use a new O-ring.

(1)   Removing the silica wool.
Septum fragments and other contaminants on the silica wool affect reproducibility. Ghost peaks may also be present.
Push silica wool out using a thin, long wire.

> ⚠ **WARNING**
>
> Use a hood when cleaning the insert with reagents like organic solvent and acid.
> Wear protective clothing, such as goggles, gloves, and a lab coat.
> If reagents get on to the skin or in the eyes, flush with copious amounts of water and consult a medical professional.

(2) Removing particles from the glass insert

After removing the silica wool, rinse the interior of the insert by wiping with gauze soaked in solvent (such as acetone), etc. or soak the insert in organic solvent and clean with an ultrasonic cleaning unit.

(3) If the the glass insert is extremely dirty

If particles and stains cannot be removed, soak the glass insert in an aqueous solution of alkaline detergent for glass for approximately 1 day; rinse the insert with large amounts of water, then, rinse it with organic solvent such as acetone, and let it air dry.

If the glass insert still cannot be cleaned, you can soak it in an aqueous solution of 1N nitric acid for 7 to 8 hours, then wash, rinse and air dry as described above.

■ Silica wool packing

To repack the silica wool in the glass insert, see "12.2 Glass Insert and Packing Requirements".

18.6
Inspection and Maintenance: Graphite Ferrule

> ⚠️ **WARNING**
>
> Risk of burns.
> Do not perform maintenance until the temperature of the injection port, detector, and oven have doopped below 50°C.

> ⚠️ **CAUTION**
>
> Wait until the heated zones have cooled to loosen screws and nuts to present them from binding.

NOTE   For the details on handling of the graphite ferrule, refer to "4 Installing the column".

18.6.1 Inspection/maintenance cycle

A graphite ferrule is used at both ends of the capillary column.
In the following situations, inspect or replace the graphite ferrule.
・When a new graphite ferrule is being installed.
・When ghost peaks are detected during temperature increase.
・When the baseline drifts significantly during temperature increase.

18.6.2 Inspection/maintenance

■ Troubleshooting

(1) Check for carrier gas leaks
Deteriocating ferrules can cause carrier gas leaks and poor reproducibility.
Check the condition of the graphite ferrule. If it is in poor condition, replace it with a new graphite ferrule.

Indicates deterioration

New graphite ferrule   Graphite ferrule in poor condition
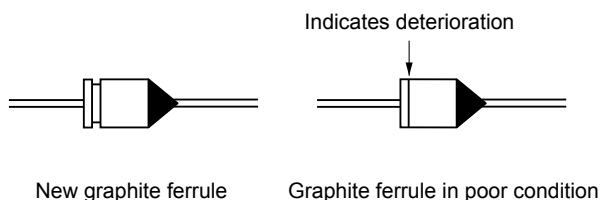
Fig. 18.6.1   Graphite ferrule

(2) Check for the source of contamination.
Ghost peaks can be caused by a poorly made column inlet connection.
Baseline drift can be caused by a poor connection at the column outlet (provided the column has been sufficiently conditioned).
If a contaminated graphite ferrule is causing problems, condition the graphite ferrule using the procedure described below.

■ Preparing the gas chromatograph

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port , the column oven and detector automatically decrease.

Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column oven are 50°C or less.

Press the [FLOW] key, and select [Off] (PF menu). The injection port/detector inspection/ maintenance can begin.

■ Conditioning the graphite ferrule

If a contaminated graphite ferrule is causing problems, condition the graphite ferrule using this procedure.

Condition the graphite ferrule just before using the system if possible. Otherwise, the ferrule may become re-contaminated.

Hold the graphite ferrule in the blue flame of a gas burner for 1 to 2 seconds until that it becomes red hot.

⚠ **CAUTION**

Do not get burned when holding the graphite ferrule.
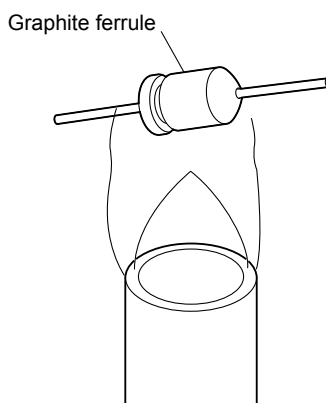
Graphite ferrule

Fig. 18.6.2   Conditioning the graphite ferrule

18.*7* Inspection and Maintenance: Capillary Column

⚠ **WARNING**

Risk of burns. Do not perform maintenance until the temperature of the injection port, detecor, and oven have dropped below 50°C

NOTE   For the details on removing the capillary column, refer to "4 Installing the column".

18.7.1 Inspection/maintenance cycle

In the following situations, inspect and/or maintain the capillary column.
・ When using a new column or a column which has not been used for a long time
・ When ghost peaks are detected
・ When the baseline is unstable

18.7.2 Inspection/maintenance

■ Troubleshooting

Check whether the baseline is unstable or ghost peaks are present.
A contaminated column can cause an unstable baseline or ghost peaks. If these problems occur, the column should be conditioned.

■ Preparing the gas chromatograph main body

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port, the column oven and detector automatically decrease.
Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column are below 50°C
Press the [FLOW] key, and select [Off] (PF menu). The inspection/maintenance can then begin.

NOTE   For the details on handling the capillary column, refer to "4 Installing the column".

■ Conditioning the capillary column

Condition the capillary column using the following procedure.
(1) Setting the carrier gas
To condition the column, use the an aleysis flow rate. However, reduce the split ratio to conserve carrier gas.
(2) Setting the column oven temperature
Set the column oven to a temperature approximately 30°C higher than the column operating temperature during analyses.
Do not exceed the maximum column temperature limit.
(3) Setting the injection port temperature and the detector temperature
Use the same temperatures normally set for analyses.
Set the detector to a temperature approximately 30°C higher than the column operating temperature.

(4) Conditioning time

Generally condition the column for 2 to 3 hours usually.

If the column is considerably contaminated, increase the conditioning time.

NOTE Centain column liquid phases can be easily damaged.
Verify the maximum column temperatures limit before use and conditioning. High temperatures can damage the column, particularly if oxygen is present in the colums. Use of an oxygen trap is recommended.
Avoid rapid temperature increases, especially for polar columns.

18.*8* Inspection and Maintenance: Flow Controller

Three areas in the flow controller should be inspected: the molecurar sieve filter and two traps (PURGE and SPLIT) in case of split/speitless. And two areas should be inspected in case of WBI.

Part name	Part No.	Reference No.
Molecular sieve filter	221-34121-93	①
Trap (PURGE)	221-42559-92	②
Trap (SPLIT)	221-42559-92	③
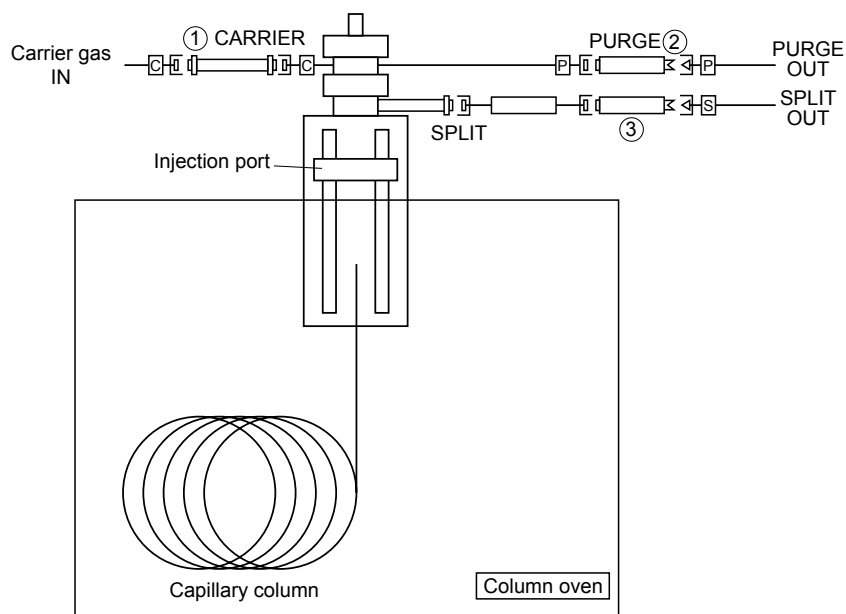
Fig. 18.8.1   Filter locations (split/splitless)
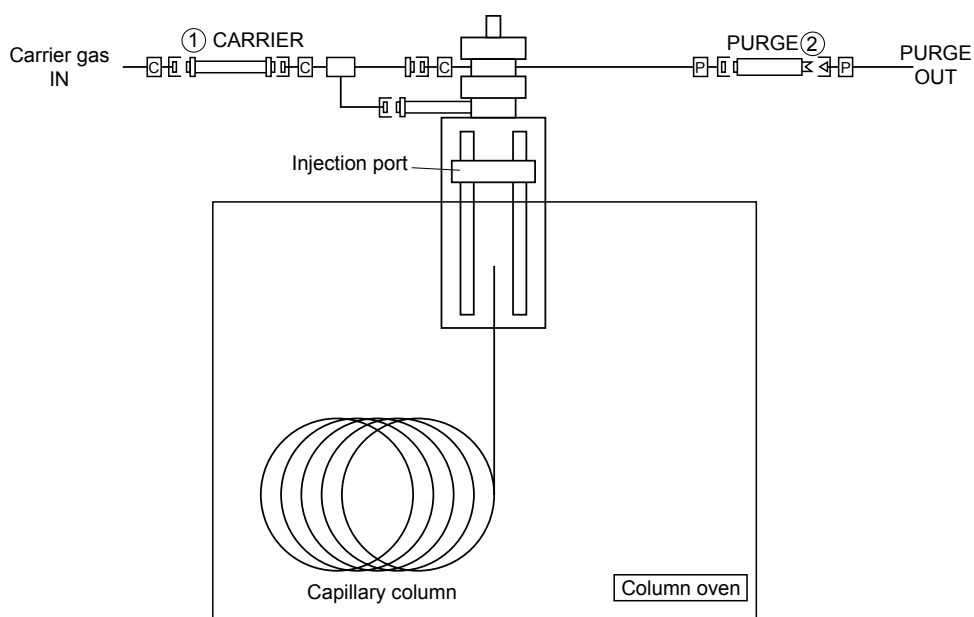
Fig. 18.8.2   Filter locations (WBI)

18.8.1 Inspection/maintenance cycle

Replace the purge and split vent traps periodically. The guideline for replacement is usually 6 months. However, when analyzing many samples whith high boiling point compounds, or compounds which are solid at room temperature, you should replace the traps more frequently.

And in the following cases, you should inspect and maintain the filter and the traps.

- ・ When the baseline is unstable or there is significant noise.
  These problems occur when the molecular sieve filter is saturated. Replace or regenerate it.

- ・ The replacement cycle of each trap is 6 months. However, if the traps is clogged, replace it. The following section describes how to decide that a trap is clogged.

18.8.2 Inspection/maintenance

■ Trap inspection

The procedure below describes how to inspect the trap when capillary column is used. (The procedure for wide bore columns is described in parentheses.)

(1) Set the purge flow rate to "0". For the procedure, refer to "12.5.8 Septum purge".

(2) Leave the column installed. (For wide bore columns, disconnect the column at the injection port only, and attach a sealing plug to the injection port.)

(3) Set the Split mode to "SPL".

(4) Set the column inlet pressure and the total flow rate to the following values.
    Column inlet pressure (PRSS) = 0 (kPa)
    Total flow rate (FLOW) = 400 (mL/min)
    For details, refer to "8 Setting the Analytical Parameters and File Management".

(5) Monitor the column inlet pressure. If the measured value is 50 kPa or more, replace the trap (SPLIT).

(6) When replacing the split vent trap, replace the purge vent trap also.

■ Trap replacement

Perform the following procedure to replace the trap.

(1) Stop the carrier gas flow.

(2) Remove the panel from the INJ/DET unit.

(3) To prevent confusion, replace one trap at a time.

(4) Disconnect the blank nut from a new trap.
    This blank nut is no longer required. It sealed the trap.

(5) Install the new trap.
    The tubing codes indicate they should be used to filter the following flow lines.

    S ... Split flow line
    P ... Septum purge flow line
    C ... Carrier gas inlet flow line

■ Molecular sieve filter regeneration

Regenerate the molecular sieve filter using the following procedure.

(1) Stop the carrier gas flow.

(2) Remove the panel from the INJ/DET unit.

(3) Remove the molecular sieve filter.

(4) Regenerate the molecular sieve filter under the following conditions.

Nitrogen or Helium gas flow direction ... Reverse of operation direction
Gas flow rate ... 10 to 20 mL/min
Temperature ... 300°C
Time ... 3 to 4 hours

(5) After regeneration, immediately reinstall the molecular sieve filter into the gas chromatograph so that it does not become contaminated.

18.*9*   Inspection and Maintenance: FID

> ⚠ **WARNING**
>
> Verify that the following items have been checked before starting FID inspection/maintenance.
> 1. Stop the supply of hydrogen gas, and extinguish the hydrogen flame.
> 2. Set the detector temperature to 50°C or less.
> 3. Turn off the power of the FID.
> 4. Remove the capillary column from the FID.
>
> Risk of burns. Do not perforem maintenance until the temperature has dropped below 50°C

> ⚠ **CAUTION**
>
> When the FID is hot, do not loosen screws and nuts or move parts to prevent binding.

NOTE   For correct FID handling procedures, refer to "13 Detector".

18.9.1 Inspection/maintenance cycle

When the following problems occur, inspect the FID and perform maintenance if necessary.
・When the FID cannot be ignited
・When peaks do not appear
・When noise is high
・When the peak shape is abnormal

18.9.2 Inspection/maintenance

a) Inspection and replacement of the igniter are described.

■ Troubleshooting

Check for blown filaments.
Replace the igniter with a new one, if the filament is blown.

■ Removing and installing the igniter

Loosen the igniter mounting screw shown in Fig. 18.9.1, and pull out the igniter in the direction indicated by arrow.
When replacing the igniter, detach the cables at the connection.
Install a new igniter by connecting the cable,inserting the igniter,and tightening the screw.
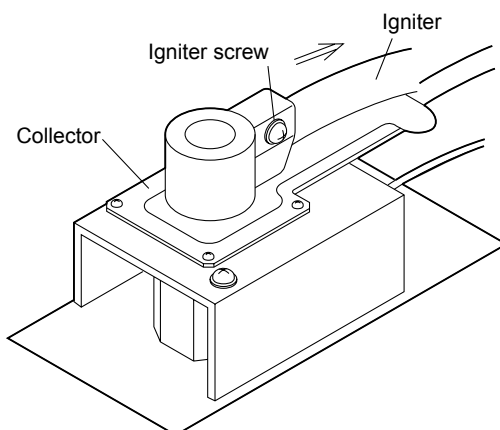
Fig. 18.9.1

b) Replacement and inspection of the FID jet are described below.

■ Troubleshooting

(1) Checking whether the jet is clogged
   If the jet is clogged, ignition may be difficult or peaks may not appear.
   If the tip of the jet is clogged, clean the jet by inserting a slender, long rod into the tip.
(2) Checking whether the jet is dirty
   If the jet is dirty, noise may be significant.
   If the jet is dirty, wipe off dirt with a cotton swab soaked in organic solvent (such as acetone), etc.
(3) Checking whether the jet is damaged
   If the jet is damaged, the peak shape may be abnormal.
   Replace the jet.

⚠ CAUTION

The quartz FID jet can be broken easily. Treat it gently.
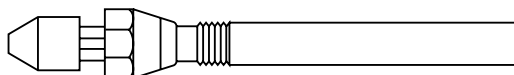
Fig. 18.9.2   Jet (part No. 221-48258-91)

■ Preparing the gas chromatograph

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port , the column oven and detector automatically decreases.
Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column oven has dropped below 50°C.
Press the [FLOW] key, and select [Off] (PF menu). The inspection/maintenance can begin.

■ Removing the FID

Remove the FID parts using the following procedure.

(1) Removing the igniter and the FID collector

The igniter is integrated into the FID collector. Remove them together. Loosen and remove the two collector screws. Lift the collector and its screws up at the same time.
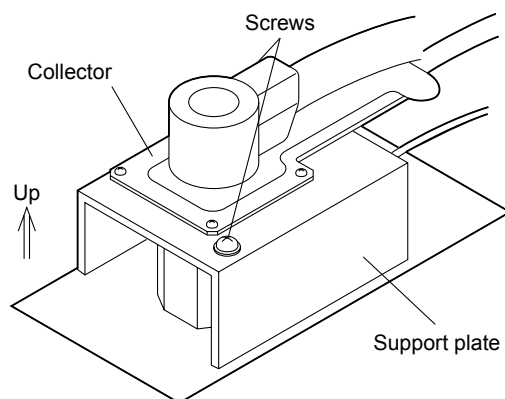
Fig. 18.9.3　Removing igniter and FID collector

(2) Removing the FID high voltage unit
① Lift the high voltage plate up.
② Then pull the high voltage cable and its spring out horizontally as shown in Fig 18.9.4.
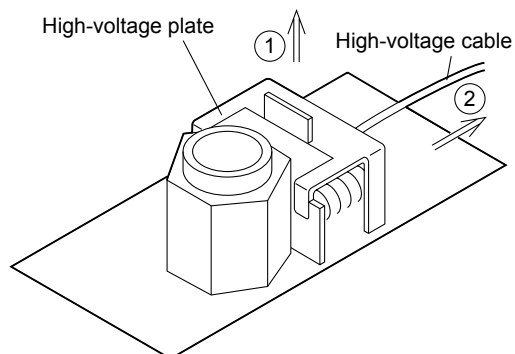
Fig. 18.9.4　Removing the FID high voltage unit

■ Removing the FID jet

Remove the FID jet using a hexnut screwdriver.
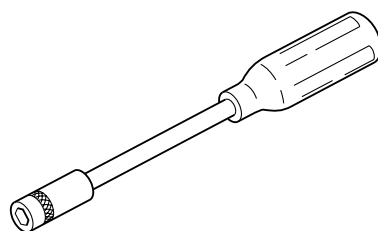
Fig. 18.9.5　Hexnut screwdriver (option, part No. 670-18800)
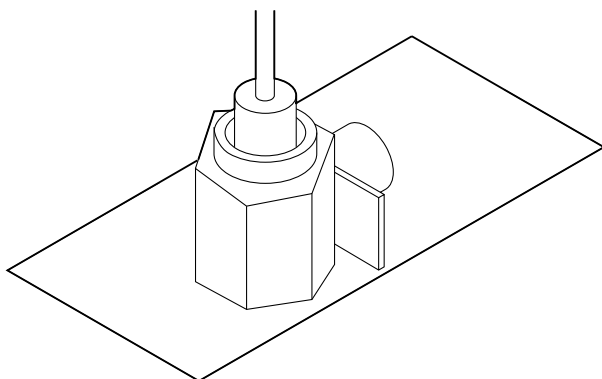
Fig. 18.9.6   Removing the FID jet

■ Installing the FID jet

Tighten the FID jet securely using a hexnut screwdriver

Hexnut screwdriver

Fix here

Jet
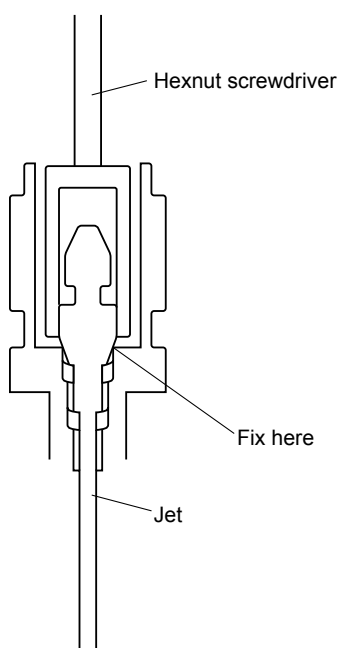
Fig. 18.9.7   Installing FID jet

・Reinstall other parts in reverse order.

19.*1* **Troubleshooting**

This section describes possible problems, causes and solutions. They are divided by analytical procedure.
If the problem is not solved by following the recommended solutions, or if other problems occur, contact your shimadzu representative.

19.1.1   Gas and pressure settings
   19.1.1.1   When the pressure/flow rate cannot be set or does not reach the set value
   19.1.1.2   Continual gas leaks

19.1.2   Temperature control
   19.1.2.1   When the temperature does not increase or reach the set value

19.1.3   Detector
   19.1.3.1   FID
         1.   The FID flame does not ignite properly
         2.   The FID baseline is fluctuating
         3.   Baseline noise is high
   19.1.3.2   TCD
         1.   The detector can not be zeroed
         2.   Fluctuating baseline
         3.   Baseline noise is high

19.1.4   Chromatogram and data
   19.1.4.1   No peaks or extremely small peaks
   19.1.4.2   Presence of ghost peaks
   19.1.4.3   Abonormal peak shape
   19.1.4.4   Poor retention time reproducibility
   19.1.4.5   Poor peak area reproducibility

19.1.1 Gas and pressure settings

19.1.1.1 When the pressure/flow rate cannot be set or does not attain the set value

Possible Cause	Solution
No gas is supplied.	Open gas cylinder main valve to supply gas.
Supply pressure is low.	Set carrier gas supply pressure to 300 to 980 kPa. Hydrogen: 300 to 500 kPa Air: 300 to 500 kPa Makeup gas: 300 to 980 kPa
Gas leaks	Check for gas leaks, and tighten leaking connections. Replace gasket or septum. (Refer to "2.6 Gas supply plumbing" in the Instruction Manual.)
AFC/APC: Incorrect valve set. Set value is outside controllable range.	Set pressure to proper value. (Refer to "3 AFC, APC" in the Instruction Manual.)
Carrier gas, column length and inner diameter are incorrect.	Set carrier gas, column length and inner diameter. (Refer to "12.5.2" and "12.6.2 Setting the flow rate" and "12.5.3 Setting column parameters" in the Instruction Manual.)
Total flow rate is set too low, and pressure cannot increase. (In this case, measured flow rate of split vent is extremely low.)	Increase the total flow rate. (Refer to "3 AFC, APC" in the Instruction Manual.)
Split vent trap is clogged. (Even if total flow rate is set high, the measured flow rate from the split vent is low.)	Replace trap. (Refer to "18.8 Inspection and Maintenance: Flow Controller")

19.1.1.2 Continual gas leaks

Possible Cause	Solution
Part is incorrectly installed.	Install part correctly. (Refer to "2.6 Gas supply plumbing" in the Instruction Manual.)
Graphite ferrule or other seal is damaged.	Replace damaged gasket part with a new one.

If tubing or connections are damaged, replace them.
If the problem can not be solved, contact your shimadzu representative.

19.1.2 Temperature control

19.1.2.1 When the temperature does not increase or reach the set value

Possible Cause	Solution
GC has not started yet. (Press [SYSTEM] key to display GC startup procedure screen.)	Press [SYSTEM] key, and press [Start GC] (PF menu).
Heater control is set to "Off"	Set control to "On" on COL/INJ/DET setup screen.
Because start time is set to a high value (or "9999"), heating has not started yet.	Set start time to a lower value. (Note: Immediately after this setup value is changed, the new value is in effect.)
Heat loss is being coused by an open oven door or insulation out of place.	Close the oven door. Replace the insulation.
Because maximum temperature is set to a very low value, an overheat error has occured.	Increase the maximum temperature setting.
Because DET actual temperature is lower than the set value of COL temperature. (According to keep the detector clean, column oven temperature can not exceed DET actual temperarture.)	Set DET temperature larger than COL temperature.

Only an oven with the CRG option can attain a temperature below room temperature. The lower temperature setting may cause an error if the CRG option is removed or turned off. Change the temperature setting.

19.1.3 Detector

19.1.3.1 FID

1. The FID flame does not ignite properly

Possible Cause	Solution
Column is not connected.	Connect the column.
Hydrogen gas is not supplied or its flow rate is incorrect.	Supply hydrogen gas, or set its flow rate to a proper value.
Air is not supplied or its flow rate is incorrect.	Supply air, or set its flow rate to a proper value.

Refer to "18.9 Inspection and Maintenance: FID", and inspect the FID.
If a jet is clogged, clean or replace it.
A defective lgnitor filament must be replaced. Contact your Simadzu representative.

⚠ **WARNING**

If the FID ignition has failed, shut off the hydrogen gas supply immediately and inspect the FID.

2. The FID baseline is fluctuating

Possible Cause	Solution
Carrier gas leaks.	Tighten leaking connections. Replace tubing or septum. (Refer to "2.6 Gas supply plumbing" in Instruction Manual.)
Carrier gas quality is poor.	Replace carrier gas with higher purity gas. Provide a molecular sieve filter in the carrier gas flow line.
Molecular sieve filter is saturated.	Recondition the molecular sieve filter.
Injection port is contaminated.	Clean or inspect the glass insert. (Refer to "18.5 Inspection and Maintenance: Glass Insert" in Instruction Manual.)
Compressed air is contaminated (the baseline fluctuates according to the compressor pressure).	Install a silica gel trap on either end of the pressure regulator. Use air from a gas cylinder instead (with the FID on).
Hydrogen gas has not been flowing long enough to replace the air in the tubing.	Wait for 30 to 60 minutes to allow the air to be completely replaced with hydrogen.
Room temperature is not within the recommended range and/or is fluctuating considerably.	Keep the room temperature within the recommended range and move the system away from heat or A/C vents, etc.

3. Baseline noise is high

Possible Cause	Solution
Carrier gas quality is poor.	Replace carrier gas with higher purity gas. Provide a molecular sieve filter in the carrier gas flow line.
Hydrogen gas quality is poor.	Replace hydrogen gas with higher purity gas.
The quartz jet is dirty.	Inspect, clean, or replace the jet.

If the jet is damaged, replace it. If the collector is coated with white powder, contact your shimadzu representative for replacement.

19.1.3.2 TCD

1. The detector cannot be zeroed

Possible Cause	Solution
Data processing unit is not connected properly.	Connect them properly.
Current is "Off"	Turn the current on.
Current value is too high.	Set current to a lower value.

Turning on the TCD current when oxygen is present in the cell can oxidize or blow out the filament, making it impossible to zero the detestor. the cell must be replaced; contact your Shimadzu reprensentative.

2. Fluctuating baseline

Possible Cause	Solution
Carrier gas or makeup gas is contaminated.	Sufficiently purge air inside flow lines. Replace tubing. Use higher purity gas.
Current value is too high.	Reduce the current.
Injection port (glass insert or silica wool) or column is dirty.	Clean or replace glass insert. Condition column.
Cell is dirty.	Condition cell.* Make several solvent injections.
Temperature in room where system is installed deviates from the commended range and/or considerably fluctuating.	Keep the room temperature within the commended range and reduce fluctuation of the room temperature by making sure that system is not directly exposed to air conditioner wind etc.

* Cell conditioning procedure
① Remove the column and seal the detector by installing a new graphite ferrule (with its wire) in the column nut.
② Set the current value to "0 mA".
③ Begin makeup gas flow (at the flow rate used in analysis).
④ Set the detector temperature 30°C higher than the analysis temperature.
(However, the detector temperature cannot exceed 400°C, the maximum operating temperature.)
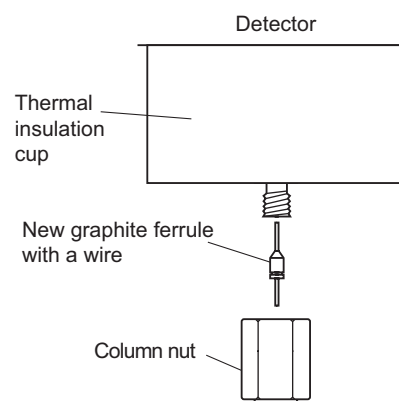
The conditioning time varies depending on the degree of contamination, but is approximately 1 to 12 hours.

Detector

Thermal insulation cup

New graphite ferrule with a wire

Column nut

The baseline may fluctuate because the temperature of a heated zone or the flow rate is not stable. Check the monitor display. If this problem occurs, contact your Shimadzu representative.

3. Baseline noise is high

Possible Cause	Solution
Carrier gas or makeup gas is contaminated.	Sufficiently purge air inside flow lines. Replace tubing. Use higher purity gas.
Gas leaks.	Check for leaks in injection port and column connection area.
Current value is too high.	Reduce the current.
Makeup gas flow rate too low.	Increase flow rate.

Excessively high current can damage the filament and cause significant noise. Contact your Shimadzu representative for ceel replacement.

19.1.4 Chromatogram and data

19.1.4.1 No peaks or extremely small peaks

Peaks may not be able to be detected because of high noise.
Refer to 19.1.3.1.3 and 19.1.3.2.3, "baseline noise is high."

FID detector

Possible Cause	Solution
Carrier gas is not flowing.	Start carrier gas flow.
Carrier gas leaks.	Tighten leaking connectors.
Split ratio is large.	Reduce split ratio.
Sample concentration is low. Or injection volume is too low.	Increase sample concentration or injection volume.
Wrong column is used.	Replace existing column with one appropriate for the compounds analyzed (more polar, less polar, etc.)
Column temperature is too low.	Increase column temperature.
Signal cable of detector is connected incorrectly.	Connect signal cable correctly.
Detector is set to "Off".	Set detector to "On".
Detector parameter have been is set incorrectly.	Increase range and attenuation sensitivity.
Hydrogen flame is extinguished.	Check hydrogen/air flow rate, then ignite.
Zero level far below "0".	Press "MONIT" key then press "ZERO Adj" (PF menu) to execute zero point adjustment.

If the jet or the cable is damaged, contact your Simadzu repretetative for replacement.

TCD detector

Possible Cause	Solution
Range is not "×1".	Set range to "×1".
Current set value is too low.	Increase current setting. (Decrease TCD thermostatic oven temperature, and increase maximum working current.)
Makeup gas flow rate is too high.	Set it to the proper value. He: Approx. 7.5 mL/min N2: Approx. 8.0 mL/min
Split ratio is too high (for split analysis).	Decrease split ratio.
Carrier gas leaks.	Check for injection port and column connection leaks.
Capillary column is installed incorrectly.	Install column correctly.
Column is contaminated.	Condition column.
Carrier gas or makeup gas is contaminated.	Sufficiently purge air inside flow line. Replace tubing. Use higher purity gas.
Sample concentration is low. Or injection volulme is too low.	Increase sample concentration or injection volume.
Wrong column is used.	Replace existing column with one appropriate for the compounds analyzed (more polar, less polar, etc.)
Another analytical condition, such as temperature or column flow rate is incorrect.	Change the analytical conditions.

19.1.4.2 Presence of ghost peaks

Possible Cause	Solution
Septum purge is not flowing.	Flow septum purge.
Peaks of previous analysis is detected.	Increase column oven temperature to maximum temperature in analysis to eliminate sample remaining inside column.
Sample is contaminated.	Prepare sample newly.
Micro syringe is dirty.	Clean micro syringe. Or replace it with a new one.
Carrier gas purity is low.	Replace carrier gas with one of higher purity. Provide molecular sieve filter in carrier gas flow line.
Substances of high boiling point accumulated at column inlet end are flowing out.	Condition column.
Injection port is dirty.	Clean or replace glass insert. (Refer to "18.5 Inspection and Maintenance: Glass Insert" in Instruction Manual.)
Tubing, pressure regulator, etc. are contaminated with oil, etc.	Replace tubing, pressure regulator, etc. with clean ones.
Septum chips are present inside glass insert or column.	Clean or replace glass insert.Fold tip of capillary column, and take off folded portion.

19.1.4.3 Abnormal peak shape

Fronting(leading) : The peak increases slowly. The first half peak area is higher.

Tailing : Once the peak has eluted, the baseline does not immediately return to its zero level. The secoud half paek area is higher.

Fronting   Tailing
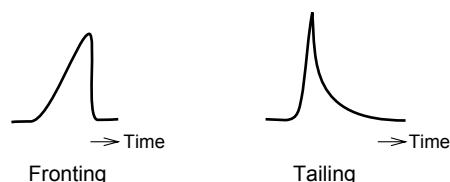
Possible Cause	Solution
Fronting: the column Column is overloaded.	Dilute sample. Decrease injection volume, or increase split ratio. Use a column with a greater film thickness.
Peaks are co-eluting	Decrease column oven temperature. Replace column to obtain better separation.
Tailing, fronting Injection port temperature is low.	Increase injection port temperature.
Tailing Column is contaminated.	Condition column. (Refer to "18.7 Inspection and Maintenance: Capillary Column" in Instruction Manual.)
Tailing Glass insert is damaged.	Replace glass insert. (Refer to "18.5 Inspection and Maintenance: Glass Insert" in Instruction Manual.)
Tailing Septum purge is not flowing or is too low.	Verify septum purge flow. Increase septum purge flow rate. (Refer to "3 AFC, APC" in Instruction Manual.)
Tailing Septum fragments are present inside glass insert or column.	Clean or replace glass insert. Clip the injection port end of the column.

19.1.4.4 Poor retention time reproducibility

Possible Cause	Solution
The carrier gas cylinder is almost empty.	Replace the gas cylinder with one of at least 3 MPa pressure.
Carrier gas flow rate is fluctuating due to a gas leak.	Tighten leaking connections. Replace tubing or septum.
Column is overloaded.	Dilute sample. Increase split ratio. Use a column with a thicker film.
Room temperature is not within the recommended range or is considerably fluctuating.	Keep the room temperature within the recommended range or reduce temperature fluctuations.
Syringe tip is clogged, and sample is not properly injected.	Clean or replace syringe.

If the gas supply pressure is fluctuating due to failure of the gas cylinder pressure regulator, repair or replace it. Contact your Shimadzu representative.

19.1.4.5 Poor peek area reproducibility

Possible Cause	Solution
The carrier gas cylinder is almost empty.	Replace the gas cylinder with one of at least 3 MPa pressure.
Carrier gas flow rate is fluctuating due to a gas leak.	Tighten leaking connections. Replace tubing.
Sample is not injected completely.	Perform injections accurately. Replace the syringe with a new one.
Column is overloaded.	Dilute sample. Increase split ratio. Use a column with a thicker film.
Room temperature is not within the recommanded range or is considerably fluctuating.	Keep the room temperature within the recommended range or reduce temperature fluctuations.
Syringe tip is clogged, and sample cannot be aspicated well.	Clean or replace syringe.
Syringe tip is clogged, and sample is not property injected.	Clean or replace syringe.
Syringe plunger is stiff, and does not move smoothly.	Clean syringe barrel and plunger. Clean or replace syringe.
Silica wool inside glass insert is packed incorrectly.	Re-pack the silica wool.

If the gas supply pressure is fluctuating due to failure of the gas sylinder pressure regulator, repair or replace it. Contact your Shimadzu representative.

19.2 Error Messages

The system is programmed to diagnosis certain errors. When an error is detected, an alarm sounds and one of the error messages shown below is displayed. The detected errors are recorded in the "Error Log".

When confirmation screens are shown select one of the following actions:

Reset Error	Resets the system parameters, restoring the conditions prior to the error. System control resumes. Remove the cause of the error before selecting "reset".
Ignore Error	Keep the system as it is. Check for the error to resolve it.

The codes provided with the errors help the service representative identify the errors.

Provide the code when calling about an error. These codes are also recorded in the error log.

19.2.1 System errors

Power supply failure

Code	Message	CS	Note
1	DC 5V is out of range	No	
2	DC 24V is out of range	No	
3	DC -15V is out of range	No	
4	DC 24V (FTD) is out of range	No	

PCB failure

Code	Message	CS	Note
7-10	DET#n PCB error	No	n=1-4
11-12	CARm AFC PCB error	No	m=1-2
13-16	Det APCn PCB error	No	n=1-4
17-19	CARx AMC PCB error	No	x=1-3
20-22	CARx WBI PCB error	No	x=1-3
23-28	APC a-b PCB error	No	a-b= 1-3, 4-6, 7-9, 10-12, 13-15, 16-18

A/D converter failure

Code	Message	CS	Note
30	COL A/D conv. error	No	
31	INJ1 - DET2 A/D error	No	
32	AUX1 - AUX3 A/D error	No	

Feed back loop communication error

Code	Message	CS	Note
33	Loop back test error	No	

If the above error messages appear, the hardware has failed. The GC system cannot be used in the event of these total errors. Turn off the the system, and contact your Shimadzu representative.

Room temperature sensor/atmospheric pressure sensor error.

Code	Message	CS	Note
5	Room temperature is out of range	Yes	
6	Atm. pressure is out of range	Yes	

The room temperature or the atmospheric pressure is out of the AFC performance range.
If this error occurs although the actual room temperature/atmospheric pressure is within the range, the AFC sensors may have faild. The system cannot be used. Turn off the system, and contact your Shimadzu representative.

Low voltage of CPU board battery

Code	Message	CS	Note
34	Battery voltage error	Yes	

The battery on CPU board is dead. it must be replaced.
Turn off the system, and contact your Shimadzu representative.

Cooling fan error

Code	Message	CS	Note
35	Cooling fan error	No	

The GC cooling fan is out of order. Turn off the system, and contact your Shimadzu representative.

Damaged in electronics

Code	Message	CS	Note
36	ROM error	No	
37	RAM error	No	
38	CPU register error	No	

Clock reset

Code	Message	CS	Note
29	Clock is initialized	No	

The built-in clock has reset. As a result, other saved parameters may have changed. Check the installation, temperature and flow rate settings. Initialize the parameters or reset them if necessary.
if the same message is displayed repeatedly, the hardware has failed. The system cannot be used. Turn off the system, and contact your Shimadzu representative.

19.2.2 Operations errors

Value outside of range was entered

Code	Message	CS	Note
5001	Input parameter out of range	No	

The numeric value entered is out of the valid range. Enter a valid number.

File operation errors

Code	Message	CS	Note
5002	Invalid file no.	No	
5003	This file is now used	No	
5004	File initialize failure	No	
5005	File can't be copied	No	

These messages appear when an incorrect file operation was attempted.
Press another key, and continue operation.

Overflow of calculated pressure value

Code	Message	CS	Note
5006-5008 5070-5072	CARx calc. prss out of range	No	x=1-3

The carrier gas pressure calculated from the linear velocity, the flow rate or the split ratio.
You have input is outside the set range. Change the conditions so that the pressure is within
the set range, and enter the new value.

Overflow of calculated flow rate value

Code	Message	CS	Note
5009-5011	CARx calc. flow out of range	No	x=1-3

The carrier gas total flow rate calculated from the split ratio or the pressure you have input is
outside the set range. Change the conditions, and enter a new value.

Overflow of calculated APC pressure value

Code	Message	CS	Note
5012, 5015 5018, 5021 5045-5048	MUPn calc. prss out of range	No	n=1-4 make up gas
5013, 5016 5019, 5022	HGNn calc. prss out of range	No	n=1-4 Hydrogen
5014, 5017 5020, 5023	AIRn calc. prss out of range	No	n=1-4 Air
5024-5041 5049-5066	APCy calc. prss out of range	No	y=1-18 AUX APC
5042-5044 5067-5069	PURx calc. prss out of range	No	x=1-3 septum purge

The pressure calculated from the flow rate you have input is outside the set range. Change
the conditions, and enter a new value.

Overflow of calculated flow rate value in programs

Code	Message	CS	Note
5073, 5074 5077, 5078	CAR m calc.flow out of range	No	m=1-2
5075, 5076	CAR m calc.ratio out of range	No	m=1-2

The carrier gas total flow rate calculated from the split ratio program you have input is out-
side the set range.

19.2.3 Optional device error (AOC-20i/s)

Code	Message	CS	Note
6001, 6023	AOCm rack error	No	
6002, 6024	AOCm syringe error	No	
6003, 6025	AOCm plunger error	No	
6004, 6026	AOCm can not start	No	
6005, 6027	AOCm RAM initialized	No	
6006, 6028	AOCm ROM error	No	
6007, 6029	AOCm CH2 command error	No	
6008, 6030	AOCm sample vial is not set	No	
6009, 6031	AOCm RAM error	No	
6010, 6032	AOCm installation error	No	
6011, 6033	AOCm CH1 error	No	m=1-2
6012, 6034	AOCm CH2 error	No	1: Main AOC,
6013, 6035	AOCm waste vial is not set	No	2: SUB AOC
6014	AOC-20s rotating error	No	
6015	AOC-20s exp. and ctrl. Error	No	
6016	AOC-20s up/down error	No	
6017	AOC-20s can not start	No	
6018	AOC-20s vial setting error	No	
6019	AOC-20s vial returning error	No	
6020	AOC-20s holding error	No	
6021	AOC-20s sample vial removed	No	
6022	AOC-20s vial is not set	No	

One of the these messages appear when an error has occurred in the AOC-20i auto injector or the AOC-20s auto sampler.
For details, refer to the AOC-20 User's Manual.

19.2.4 Communication errors

External device communication error (i.e., Chromatopac)

Code	Message	CS	Note
4001	Time out	No	
4002	Parity error	No	
4003	Message is not accepted	No	
4004	Data is invalid	No	
4005	Command is invalid	No	
4006	Data is out of range	No	
4007	TRS port is shut down	No	
4008	TRS file error	No	

One of these messages appear during a link failure or communication failure. (When a communication error occurs, the link is automatically disconnected.)
When one of these messages appear, check the connection status, and reset the link.

AOC communication errors

Code	Message	CS	Note
4009	AOC command is invalid	No	
4010	AOC data is out of range	No	
4011	AOC time out	No	
4012	AOC2 TRS error	No	
4013	AOC link error	No	

One of these messages appear during a link failure or communication failure.(When a communication error occurs, the link is automatically disconnected.)
When one of these messages appear, check the connection status, and reset the link.

19.2.5 Detector errors

Over current

Code	Message	CS	Note
4101-4104	DET#n TCD cell error	Yes	n=1-4
4105-4108	DET#n FTD current error	Yes	n=1-4

Abnormal detector current.
If the resistance of the filament becomes abnormally high when the TCD or the FTD is in use, the protection circuit is actuated to prevent damage to the filament, and an alarm sounds.
If either error has occurred, turn off the system.

Possible reasons for the protection circuit to be activated are described below. The current value set exceeds the maximum operating current.
  The makeup gas is not flowing.
  A gas leak has occurred.
  A significant amount of air is present in the flow line (for TCD).

Remove the cause of error, then turn on the system.
If the system does not recover after several resets, or the reason for the error cannot be located, contact your Shimadzu representative.

Detecher flame error

Code	Message	CS	Note
4109-4112	DET#n flame is out	No	n=1-4

The detector flame (FID) has been extinguished.
Check the gas supply, and ingnite the detector again.
If the flame error occurs repeatedly, the hardware has failed. The system cannot be used.
Turn off the system, and contact your Shimadzu representative.

FPD errors

Code	Message	CS	Note
4113-4116	DET#n FPD Battery error	Yes	n=1-4
4117-4120	DET#n FPD temperature error	Yes	
4121-4124	DET#n FPD cooling fan error	Yes	
4125-4128	DET#n FPD current error	Yes	

FPD operation is abnormal. Refer to FPD User's Manual.
If ERROR 4125-4128 occures, turn off the system.
Otherwise, the system status can not be restored.

TCD errors

Code	Message	CS	Note
4201	TCD signal is out of range	No	
4202	TCD signal zero error	No	

The difference in filament resistance is high between the TCD cells, and the detector cannot be zeroed.
The detector control unit may have failed.
The system cannot be used. Turn off the system, and contact your Shimadzu representative.

Detector ignition errors

Code	Message	CS	Note
4203-4206	DET#n ignition failed	No	n=1-4

This message appears when the FID does not ignite within a certain time.
When the message appears, hydorogen gas flow does not stop automatically for manual flow control.
Shut off the hydrogen gas first for safety, then check the following items.

(1) The column is connected
(2) Hydrogen is supplied at proper flow rate
(3) Air is supplied at proper flow rate
(4) Filament in igniter is intact
(5) The jet in the FID is not clogged
(6) Unused FID is not set to On

Code	Message	CS	Note
4207	H2, AIR APC are not ready	No	

This message appears when the APC for hydrogen or air is not Ready at the time of ignition.
Check whether the gas supply pressure is stable and whether gas does not leak.
If there is not problem with the gas supply, the hardwere has failed. Turn off the system, and contact your Shimadzu representative.

19.2.6 Other errors

Code	Message	CS	Note
4301	Settings were changed	No	

This message appears when a set value was changed while the program is running. If the paramenter or event has not yet been executed, the new value is used for the analysis.

Code	Message	CS	Note
4302	Program time is over	No	
4303	Clean up time is over	No	
4304	Pre-run prog. time is over	No	

This message appears when the program execution time exceeds the maximum allowable value (9999.99 min). Change the program so that its total execution time does not exceed "9999.99 min".

The program continues running after this error occurs, and stops at 9999.99 min.

Temperature control errors

Code	Message	CS	Note
1001	Heat is escaping	Yes	

This message appears when large heat loss is occurring. The oven door may be open, or the insulation may not be in place.

If the column over door is open, close it and select "Reset Error".

If the insulation has been disturbed, replace the insulation, and then restart the system..

Code	Message	CS	Note
1002-1009	xxx temp exceed the limit	Yes	xxx= COL, INJ1, DET1, INJ2, DET2, AUX3, AUX4, AUX5

This message appears when the maximum temperature limit has been exceeded. Change the maximam limit temperature if necessary.

Temperature sensor errors

Code	Message	CS	Note
1010-1017	xxx sensor is short circuit	Yes	xxx= COL, INJ1, DET1, INJ2, DET2, AUX3, AUX4, AUX5
1018-1025	xxx sensor is down	Yes	
1026-1033	xxx sensor is error	Yes	

When one of these messages appear, the temperature sensor may have failed.

The sensor cannot be used. Replace or repair it. Turn off the system, and contact your Shimadzu representative.

Unstable temperature with CRG

Code	Message	CS	Note
1034	COL CRG cannot be controlled	Yes	
1035	INJ2 CRG cannot be controlled	Yes	

This message appears when the column over or the INJ2 cannot be cooled down because the column oven door remains open or insufficient coolant (also for INJ2) is preventing the oven CRG from cooling.

If the column oven door is open, close it and select "Reset Error".

Turn off the system, replace the coolant, and then restart the system.

Overheat

Code	Message	CS	Note
1036	Overheat is sensed	Yes	Overheat detected by thermocouple
1037-1044	xxx temp controller broken	Yes	xxx=COL, INJ1, DET1, INJ2, DET2, AUX3, AUX4, AUX5

An error may have occurred in the temperature control circuit.
Turn off the system, and contact your Shimadzu representative.

Relay/heater control errors

Code	Message	CS	Note
1045	COL relay error	No	
1046	INJ1-DET2 relay error	No	
1047	AUX3-AUX5 relay error	No	
1048	Heater controller error	No	

An error may have occurred in the control circuit. Turn off the system, and contact your Shimadzu representative.

Code	Message	CS	Note
1049-1052	DET#n set temp is low	No	n=1-4

This message appears when the Detector temperature setting value is smaller than that of the Oven.
If this message appears, change the setting value of the Detector temperature.
If set the setting of Protection against contamination to "No", need not to change the setting value of the Detector temperature. (Refer to 16.6.4.3)

Pressure/flow rate control errors

Code	Message	CS	Note
2005-2007	CARx purge leaks	Yes	x=1-3
2014, 2017 2020, 2023	DetAPC n makeup gas leaks	Yes	
2015, 2018 2021, 2024	DetAPC n hydrogen leaks	Yes	n=1-4
2016, 2018 2022, 2025	DetAPC n air leaks	Yes	
2026-2043	APC y leaks	Yes	y=1-18

The prressure cannot reach the set value. Check whether gas is supplied and whether gas is leaking from connections.

NOTE   Gas leaks may be occurring in several locations.
(Example) If the purge flow rate is too low,the message "Purge leaks" may appear. If the carrier gas is also leaking, the ESC or TFC error message may not be displayed first.

Pressure/flow rate control errors (valve leak error)

Code	Message	CS	Note
2048-2050	CARx purge valve leaks	Yes	x=1-3
2057, 2060 2063, 2066	DetAPC n makeup valve leaks	Yes	
2058, 2061 2064, 2067	DetAPC n hydrogen valve leaks	Yes	n=1-4
2059, 2062 2065, 2068	DetAPC n air valve leaks	Yes	
2069-2086	APC y valve leaks	Yes	y=1-18
2132, 2133	CAR m AFC valve leaks	Yes	m=1-2

Gas is flowing even though the set value is 0 kPa (or ml/min).
If gases are supplied, an AFC/APC valve error may have occurred.
Turn off the system, and contact your Shimadzu representative.

Abnormal component operation

Code	Message	CS	Note
2091-2093	CARx purge is out of control	Yes	x=1-3
2100, 2103 2106, 2109	DetAPCn makeup gas is out of control	Yes	
2101, 2104 2107, 2110	DetAPCn hydrogen is out of control	Yes	n=1-4
2102, 2105 2108, 2111	DetAPCn air is out of control	Yes	
2112-2129	APCy is out of control	Yes	y=1-18
2130, 2131	CARm AFC leaks	Yes	m=1-2
2134-2137	CARm AFC is out of control	Yes	
2138-2140	CARx prim is out of range	No	x=1-3

Verify whether a continuous supply of gas is available at the required pressure.
If there is no problem in the gas supply, the control system, such as the APC, may have failed.
Turn off the system, and contact your Shimadzu representative.

Code	Message	CS	Note
2141, 2142	CARm is not controlled	No	m=1-2

This message appears when the temperature control starts without carrier gas control.
If this message appears, set the setting of the flow controller to "On" or remove the flow controller from the line configuration.

19.2.7 **Warning messages**

Code	Message	CS	Note
9000	COL CRG use time is over	No	
9001	INJ2 CRG use time is over	No	
9002	Fan use time is over	No	
9003	LCD backlight use time is over	No	
9004-9006	CARx septum counter is over	No	x=1-3
9007-9009	CARx insert counter is over	No	
9012-9019	xxx sensor use time warning	Yes	xxx=COL, INJ1, DET1, INJ2, DET2, AUX3, AUX4, AUX5

These message appear when the time or the count exceed the set value, but does not indicate any error. Refer to "14 Diagnosis", and clear the message.

In case of "xxx sensor use time warning",Turn off the power, and contact your Shimadzu representative.

Code	Message	CS	Note
9010	System is not ready	No	

This message appears when the system was started before it was ready. Normally, do not start the system until it is ready.

If this message appears when all the parameters are ready, check the ready setting for unused components and check the equilibration time.

Code	Message	CS	Note
9011	Ignition finished(retried)	No	

Ignition sequence was re-attempted, because the ignition failed initially.
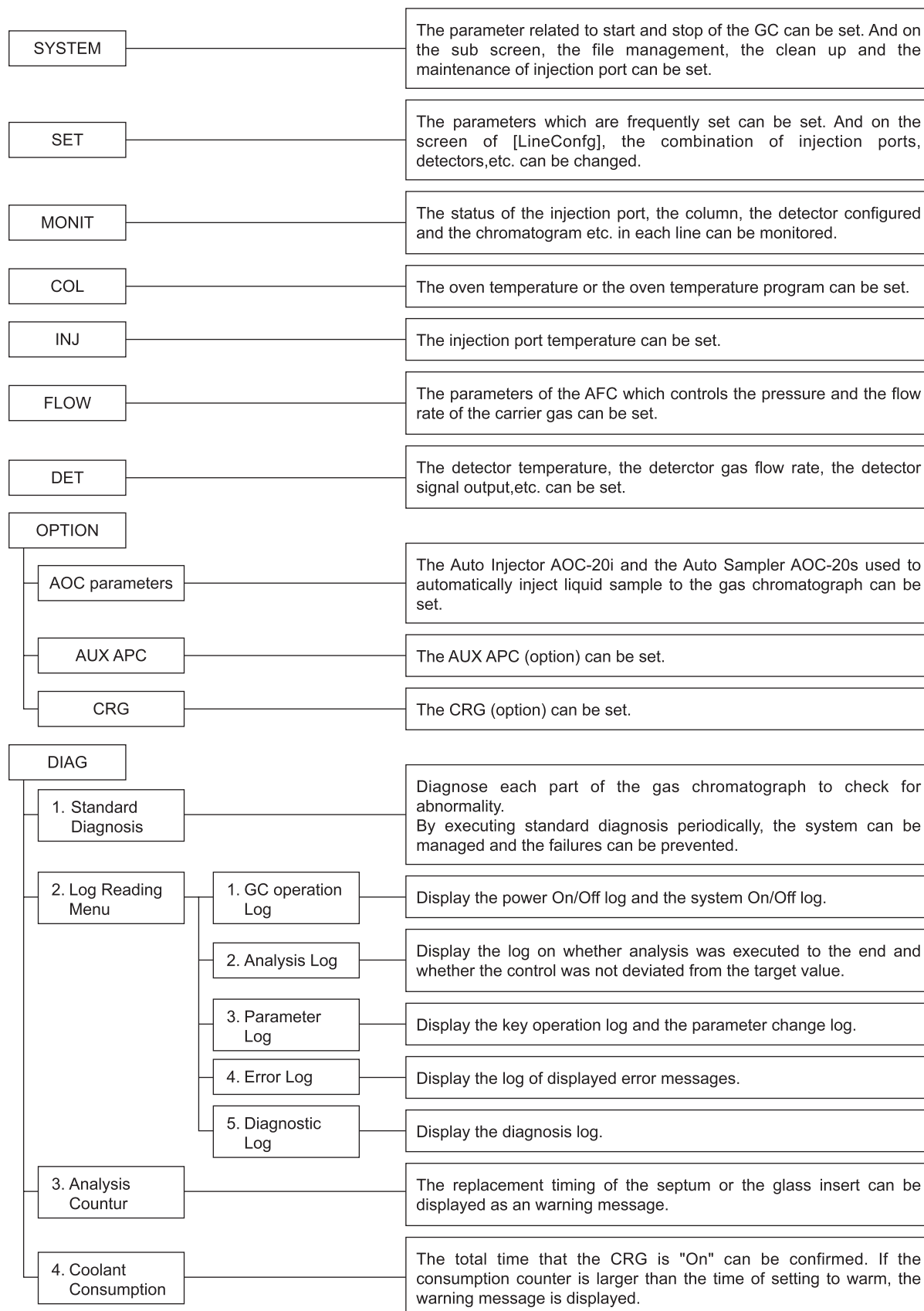
This does not affect the analysis. If this massage appears frequently, check "DETECTOR IGNITE" and "DETECTOR IGNITION" by the standard diagnosis procedure.
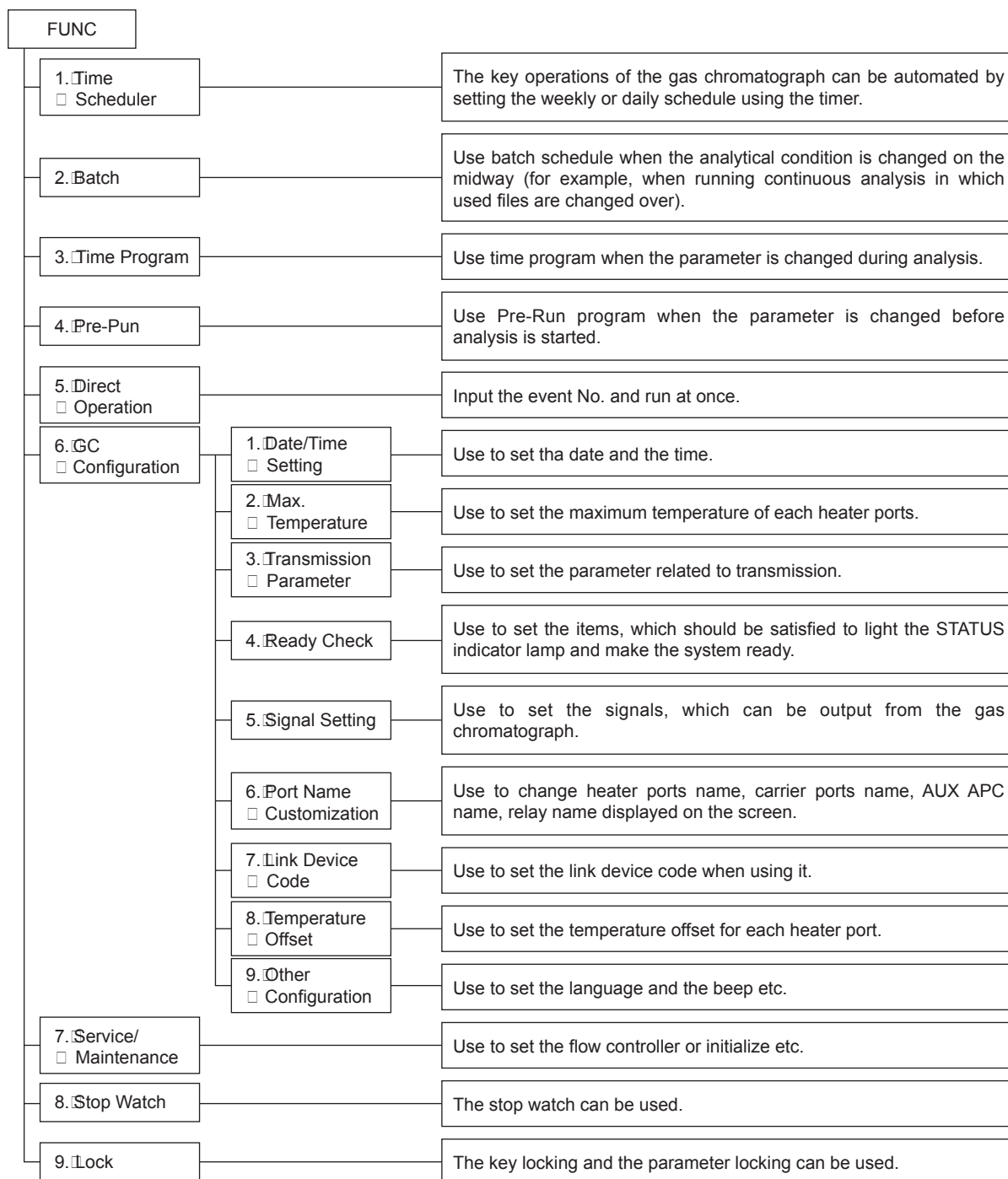
Also check for gas leaks and verify the gas flow rates. If set values are correct, contact your Shimadzu representative.

20.1 Key Function List

SYSTEM	The parameter related to start and stop of the GC can be set. And on the sub screen, the file management, the clean up and the maintenance of injection port can be set.
SET	The parameters which are frequently set can be set. And on the screen of [LineConfg], the combination of injection ports, detectors,etc. can be changed.
MONIT	The status of the injection port, the column, the detector configured and the chromatogram etc. in each line can be monitored.
COL	The oven temperature or the oven temperature program can be set.
INJ	The injection port temperature can be set.
FLOW	The parameters of the AFC which controls the pressure and the flow rate of the carrier gas can be set.
DET	The detector temperature, the deterctor gas flow rate, the detector signal output,etc. can be set.

OPTION

AOC parameters	The Auto Injector AOC-20i and the Auto Sampler AOC-20s used to automatically inject liquid sample to the gas chromatograph can be set.
AUX APC	The AUX APC (option) can be set.
CRG	The CRG (option) can be set.

DIAG

1. Standard Diagnosis		Diagnose each part of the gas chromatograph to check for abnormality. By executing standard diagnosis periodically, the system can be managed and the failures can be prevented.
2. Log Reading Menu	1. GC operation Log	Display the power On/Off log and the system On/Off log.
	2. Analysis Log	Display the log on whether analysis was executed to the end and whether the control was not deviated from the target value.
	3. Parameter Log	Display the key operation log and the parameter change log.
	4. Error Log	Display the log of displayed error messages.
	5. Diagnostic Log	Display the diagnosis log.
3. Analysis Countur		The replacement timing of the septum or the glass insert can be displayed as an warning message.
4. Coolant Consumption		The total time that the CRG is "On" can be confirmed. If the consumption counter is larger than the time of setting to warm, the warning message is displayed.

```
FUNC
  │
  ├── 1. Time          ──────────────  The key operations of the gas chromatograph can be automated by
  │      Scheduler                    setting the weekly or daily schedule using the timer.
  │
  ├── 2. Batch         ──────────────  Use batch schedule when the analytical condition is changed on the
  │                                   midway (for example, when running continuous analysis in which
  │                                   used files are changed over).
  │
  ├── 3. Time Program  ──────────────  Use time program when the parameter is changed during analysis.
  │
  ├── 4. Pre-Pun       ──────────────  Use Pre-Run program when the parameter is changed before
  │                                   analysis is started.
  │
  ├── 5. Direct        ──────────────  Input the event No. and run at once.
  │      Operation
  │
  ├── 6. GC            ─── 1. Date/Time      ──────  Use to set tha date and the time.
  │      Configuration       Setting
  │                    │
  │                    ├── 2. Max.           ──────  Use to set the maximum temperature of each heater ports.
  │                    │      Temperature
  │                    │
  │                    ├── 3. Transmission   ──────  Use to set the parameter related to transmission.
  │                    │      Parameter
  │                    │
  │                    ├── 4. Ready Check    ──────  Use to set the items, which should be satisfied to light the STATUS
  │                    │                             indicator lamp and make the system ready.
  │                    │
  │                    ├── 5. Signal Setting ──────  Use to set the signals, which can be output from the gas
  │                    │                             chromatograph.
  │                    │
  │                    ├── 6. Port Name      ──────  Use to change heater ports name, carrier ports name, AUX APC
  │                    │      Customization          name, relay name displayed on the screen.
  │                    │
  │                    ├── 7. Link Device    ──────  Use to set the link device code when using it.
  │                    │      Code
  │                    │
  │                    ├── 8. Temperature    ──────  Use to set the temperature offset for each heater port.
  │                    │      Offset
  │                    │
  │                    └── 9. Other          ──────  Use to set the language and the beep etc.
  │                           Configuration
  │
  ├── 7. Service/      ──────────────  Use to set the flow controller or initialize etc.
  │      Maintenance
  │
  ├── 8. Stop Watch    ──────────────  The stop watch can be used.
  │
  └── 9. Lock          ──────────────  The key locking and the parameter locking can be used.
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21 Index

V

W

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