GC-2014 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

About this USER's MANUAL

GC-2014 user's manual consists of the two separate manuals as described below.
  Operation Manual   Part number: 221-40607
        It describes procedures necessary to operate the instrument.
  Instruction Manual   Part number: 221-40609 (this manual)
        It describes the instrument's functions and how to use them.

Safety precautions are included in the operation manual. Please read them before using the instrument.

WARNING LABELS

Label conventions for this manual are provided below.

⚠ **WARNING**   Indicates a potentially hazardous situation which, if not avoided, could result in moderate to serious injury or possibly death.

⚠ **CAUTION**   Indicates a potentially hazardous situation which, if not avoided, may result in minor injury or equipment damage.

NOTE   Emphasizes additional information that is provided to ensure the proper use of this instrument.

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1.1 Verification of Installation Location

■ Installation location requirements

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

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. Installation location

Install the unit on a firm, stable and flat base.
(The GC-2014ATF model weighs approximately 50 kg.)

3. Corrosive gas and dust

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

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.

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

Hot air is exhausted from the vent. Do not place flammable materials where they will be exposed to the heat.

Hot air is vented at the back of the unit when the column oven cools. Consider the following during installation.

1. Do not place flammable materials behind the unit.
2. Allow a clearance of 400mm or more between the back cover and the wall.
3. Allow a clearance of 50mm or more on the left side.
4. Allow a clearance of 100mm or more on the right side in order to have a space to open/ close the oven door.
5. Reserve extra space for maintenance and inspection behind the unit.

Minimum 400mm

Depth 607mm

Minimum 50mm   Minimum 100mm

GC-2014

Height 690mm

Width 400mm
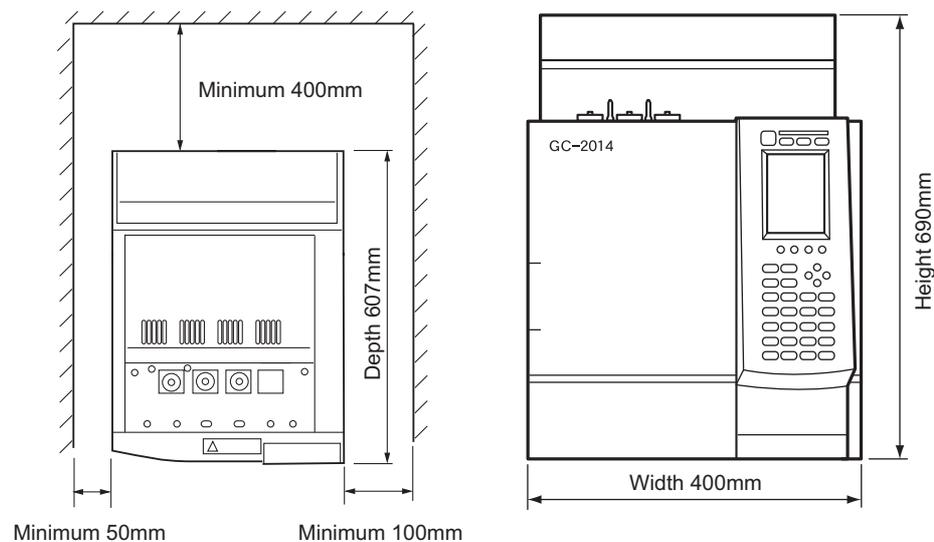
NOTE When the optional exhaust air duct (P/N 221-70675-91) is used, rear space of 200mm or more is required.

■ Moving the GC

Move the GC carefully so it does not get bumped or jarred.
1. The GC weighs approximately 50kg (GC-2014ATF).
2. Two people must carry the GC, one on the left and one on the right, with their hands between the rubber legs on the left and right side of the unit.
3. Do not hold the oven door when carrying the GC because it may break the door.
4. Do not put your hands on the rubber legs or along the front/rear direction of the unit because your fingers may get trapped under the unit when placing it on a table.
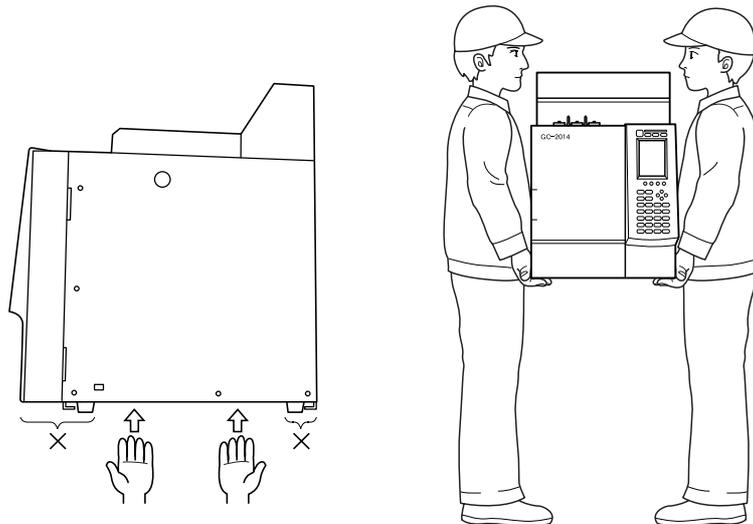
Power supply and wiring

┌───┐
│   ⚠ **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.

GC-2014ATF (TCD, FID models):1,950VA (115V model)/2,750VA (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.
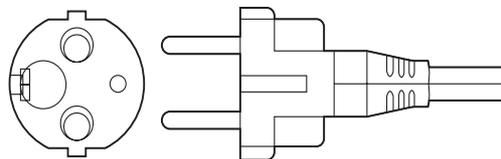
Fig. 1.2.1   Plug

┌───┐
│   ⚠ **WARNING**   │
│   │
│ Make sure to ground the cable properly. Insufficient   │
│ grounding may cause an electric shock in the event of a   │
│ breakdown.   │
│ 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)
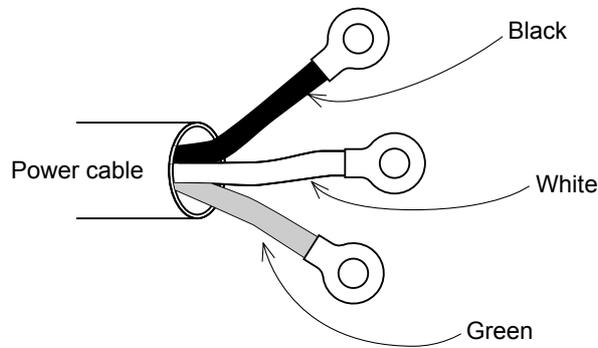
Fig. 1.2.2   Power cable

■ Symbol conventions

∼ : AC
○ : Off, Open
│ : On, Close
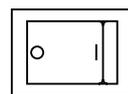
Power switch
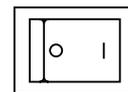
OFF status   ON status

■ Heating energy generation

The following graph shows the heating values generated by the unit.
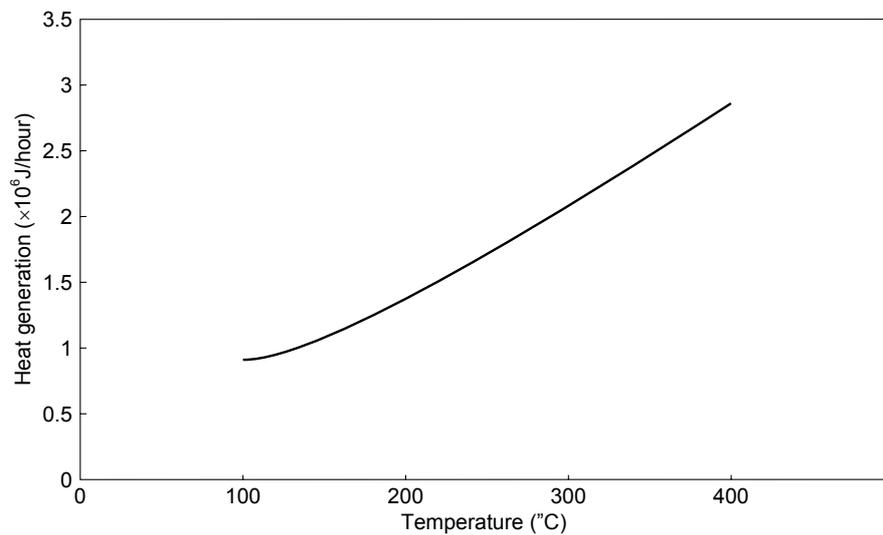
Fig. 1.2.3

■ Fuse

The following fuses are used in the GC-2014.

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.

<div>

⚠ **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.

</div>

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 detector without attaching a column. (Refer to the figure below.)
(2) Remove the injection ports (INJ) and detectors (DET) from all configured analytical flow lines to prevent the heater from turning ON.
(3) Set the column oven temperature to 300°C and start the GC.
(4) Keep the column temperature at 300°C for 2 hours or more.

Plug
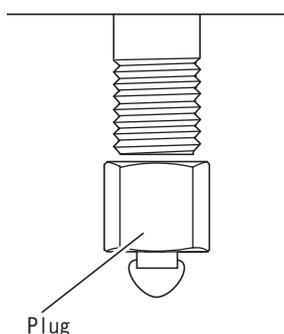
When a packed column connecting joint is used

Thermal insulation cup

Graphite ferrule with a wire

Column nut (or Column nut of injection port)
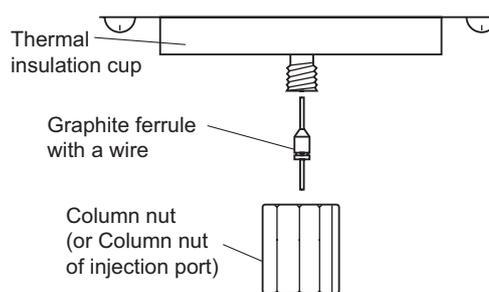
When a capillary column connecting joint is used

■ Supply gases

┌───┐
⚠ **CAUTION**

1. Gas supply pressure should not exceed the maximum pressure listed below.
   Excessive pressure may break pressure control valve or other parts.
2. When sharing a gas source with other instruments, check specifications of all instruments to be used including this unit and supply gas so that requirements of all the instruments can be satisfied at the same time.
└───┘

The following gases and associated purity values are required to maintain the optimum performance of the unit.
For detectors other than FID and TCD, refer to the instruction manual corresponding to each detector.

1. Gas types
•Carrier gas types

(Packed FID analysis)

Both helium and nitrogen can be used. Nitrogen is more reasonable in terms of price.

(Packed TCD analysis)

Using helium or hydrogen as carrier gas helps analyzing other materials at high sensitivity. Because hydrogen is flammable, helium is generally used for safety.

However, to analyze helium or hydrogen, use nitrogen or argon as carrier gas. Nitrogen is convenient to analyze minor components in the air because the nitrogen peak is not detected when it is used as carrier gas.

(Capillary analysis)

Helium is the most suitable for separation.

Although nitrogen, which is more reasonable than helium, can also be used, the optimum separation conditions may not be reached.

•Makeup gas types

(Capillary FID)

Both helium and nitrogen can be used. Nitrogen has a slightly higher sensitivity.

(Capillary TCD)

The same gas is used as makeup gas and reference gas for capillary TCD.

Select a type of gas by the same method to select carrier gas.

2. Gas purity
Helium (carrier gas, makeup gas)　　: 99.995% or higher
Nitrogen (carrier gas, makeup gas)　: 99.995% or higher
Argon (carrier gas, makeup gas)　　 : 99.995% or higher
Hydrogen (FID detector gas)　　　　 : 99.995% or higher
Air (FID detector gas)　　　: Dry air (oil and other organic components eliminated)
Compressed air(must be suppressed by an oil-free compressor and dehumidified)

3. Gas supply pressures

Carrier gas	300 - 980kPa (Hydrogen: 300 - 500kPa)
Makeup gas	300 - 980kPa
Hydrogen	300 - 500kPa
Air	300 - 500kPa

NOTE 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 ventilated 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 regulator valves not in use and stop gas supply. (When a manual regulator valve is used, turn its control to make the pressure zero. For APC, turn off the APC for hydrogen gas.) Seal the column connection.

Capillary adapter

Graphite ferrule
with a wire

Column nut

Plug
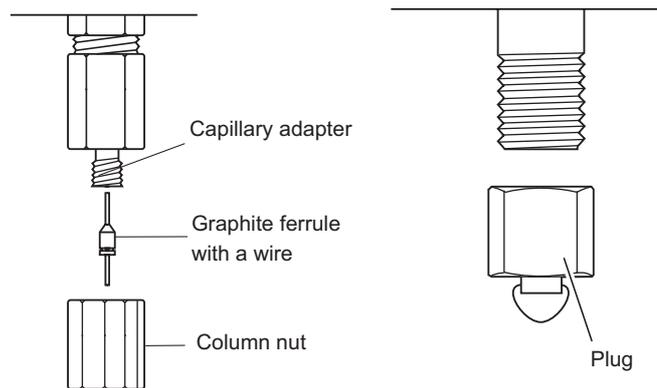
When a detector that uses hydrogen gas is not in use

⚠ **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.

⚠ **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 G. 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.

MF fitting
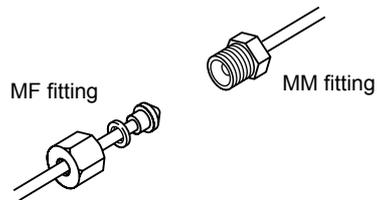
MM fitting

Fig. 1.3.1   Joining Type M fittings

GF fitting

GM fitting

Alminum gaskets (3-5pcs)
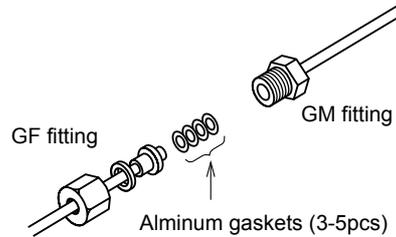
Fig. 1.3.2   Joining Type G fittings

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.
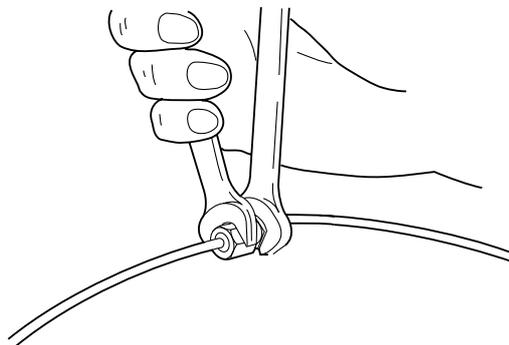
Fig. 1.3.3   Tightening the joints

■ Tubing between the gas cylinder and gas chromatograph
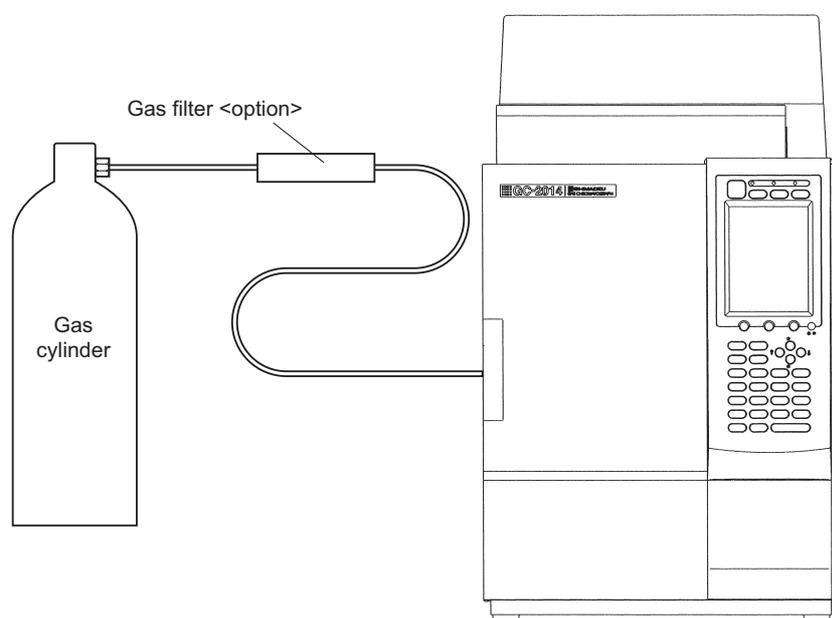
Fig. 1.3.4   Tubing between the gas cylinder and gas chromatograph

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
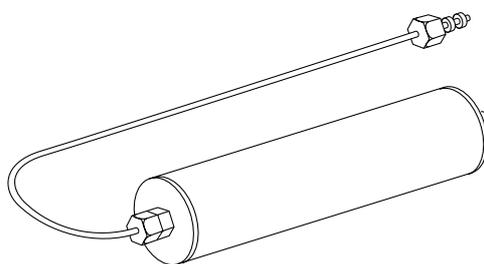
Fig. 1.3.5   Gas filter

■ 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
　　　　　　　　　　　　　　　 ("L" and "R" mean the left and right side of dual INJ.)
Makeup gas .... MAKE UP
Hydrogen .... HYDROGEN
Air .... AIR
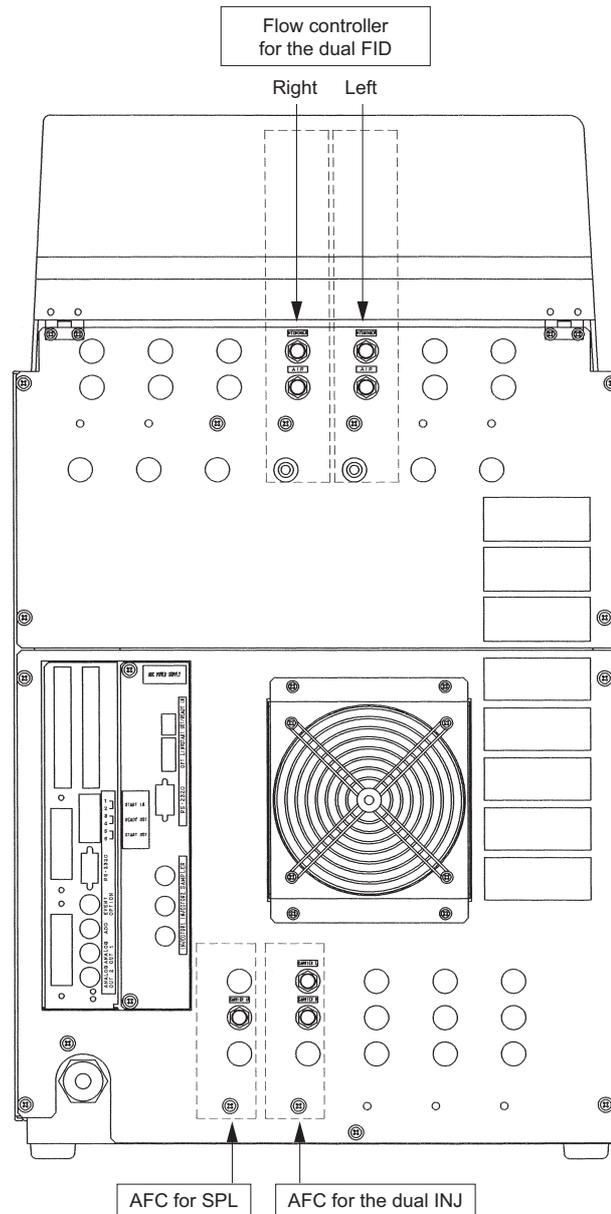
Supply the carrier gas for the left inlet of the dual INJ to CARRIER L
and the carrier gas for the right inlet of the dual INJ to CARRIER R.

Fig. 1.3.6　Plumbing (Example of the GC-2014ATF+SPL model)

■ 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)
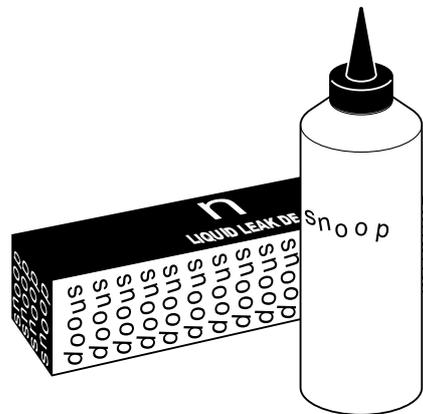
Fig. 1.3.7   Leak detecting fluid

2.1 **Setting Analytical Flow Lines**

GC-2014 does not operate normally without setting analytical flow lines. Always set analytical flow lines before using the unit. Refer to "Chapter 3. Installing Packed Columns and Setting Analytical Flow Lines" and "Chapter 4. Installing Capillary Columns and Setting Analytical Flow Lines" for detailed descriptions.

Setting analytical flow lines creates the following benefits during operation.

1. Conditions of analytical parameters for each line can be set and monitored.
   For example, when the [SET] key of the gas chromatograph is pressed, temperatures of columns, injection ports, and detectors as well as carrier gas flow rate can be set and monitored on a single screen.

2. A protective mechanism operates to foster more stable operation conditions.
   For example, when a carrier gas cylinder becomes empty while TCD is used, the flow controller detects an error and automatically lowers the column temperature and stops conduction to the TCD filament in order to prevent damage to the column and TCD filament.

```
Analysis Settings    NOT READY
[LINE 1]              [FILE]  0:FILE0
|||||||||||||| Column Oven ||||||||||||||
Temp(°C)              0.0    25.0
|||||||||||||||||| Flow ||||||||||||||||||
Control Mode                 Dual
L.Inlet Prs(kPa)      0.0
L.Col. flow(mL/min)   0.0    50.0
R.Inlet Prs(kPa)      0.0
R.Col. flow(mL/min)   0.0    50.0
|||||||||||||||| INJ DINJ ||||||||||||||||
Temp(°C)              0.0    25.0
|||||||||||||||| DET DTCD ||||||||||||||||
Temp(°C)              0.0    25.0

        File   LineConfg Customiz
```
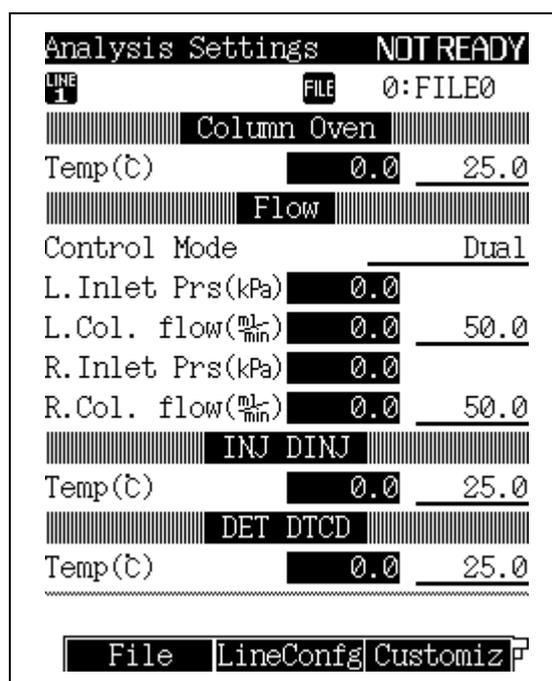
■ Analytical flow lines

An analytical flow line consists of the flow controller, injection port, column, detector cell, and detector amp as shown in Fig. 2.1.1. During analysis, the flow controller feeds carrier gas to the injection port, a sample injected to the injection port goes through the column to reach to the detector cell, and a detected signal is amplified by the detector amp to be outputted.

In order to allow the gas chromatograph to recognize these units as an analytical flow line, specification for the connection between them is necessary.

For regular analysis, specify the combination between an injection port and detector to which a column is connected. (Refer to the following page for setting procedures.)

NOTE Connections of the flow controller(s) and injection port(s) and connections of detector cell(s), and detector amplifier(s) are specified by a serviceperson at shipment or installation. They do not need to be specified for regular analysis.

Fig. 2.1.2 shows a representative example of the line configuration for packed column FID analysis using the GC-2014.

In this example, the dual INJ and dual FID are connected with two columns and the difference between two FID signals is outputted from the dual FID amp. Two columns are used because the dual INJ and dual FID are recognized as a single unit respectively. However, this is considered to be a single line.
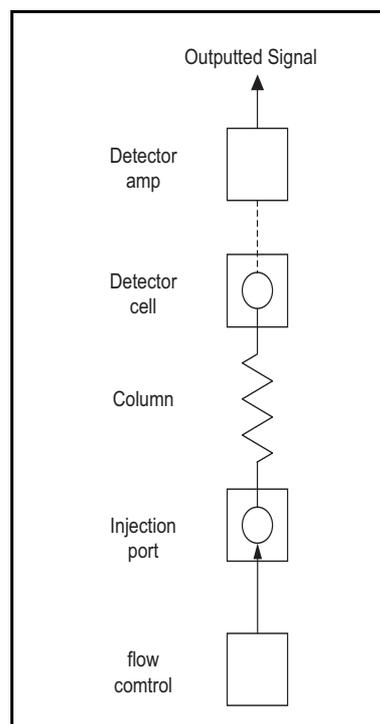
Fig. 2.1.1   Concept of analytical flow lines
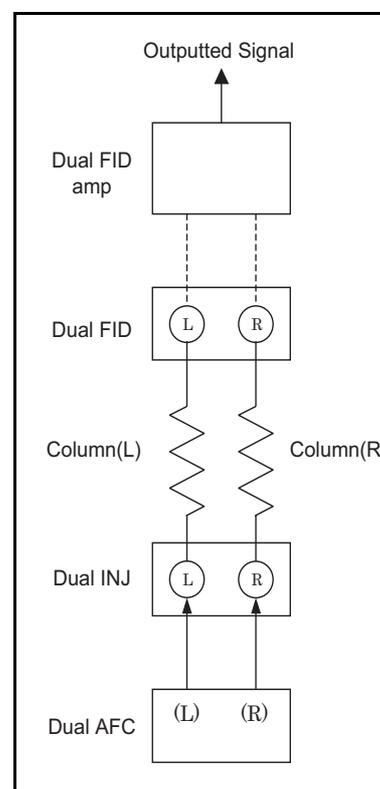
Fig. 2.1.2   An example of analytical flow lines

■ How to set lines

(1) Press the [SET] key then press the [PF2] key (Line Config).

(2) Move the cursor to the unit to be set in a line and select a line using [◁] [▷] keys. Make sure to specify an injection port and a detector to which a column is connected in the same line. Any number from LINE1 through LINE4 can be selected.

```
Line Configuration
|||||||||||||||    Injector    |||||||||||||||
———————              SPL
LINE
 1  ——              DINJ
|||||||||||||||    Detector    |||||||||||||||
LINE
 1  ——              DFID
———————              DTCD
|||||||||||||||     Option     |||||||||||||||
◀▶ LINE
   1  ——            AOC1
———————              AOC2


∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿

 ↵Return
```
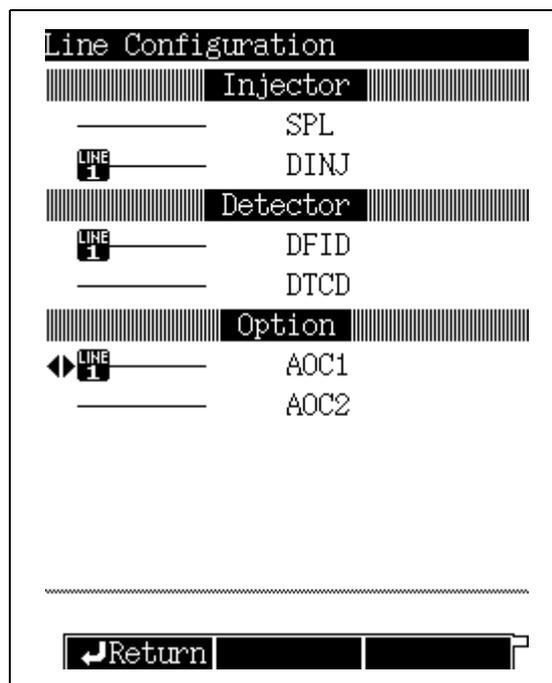
■ Precautions for setting analytical flow lines

> ⚠ **CAUTION**
>
> Set analytical flow lines correctly.
> Incorrectly set analytical flow lines hinder the unit's normal operation and may also damage columns or detectors at worst.

1. Specify units to be used as part of a line.
   Only units specified as part of a line are temperature-regulated.
   Gas is controlled only for injection ports (flow controllers) specified as part of a line.
   Examples
   • If an injection port that a column is connected is not specified as part of a line, carrier gas does not flow. If the column's temperature rises in this condition, the column may be damaged.
   • To keep feeding gas to units or maintain their temperature even though they will not be used for analysis for a while, specify the units as part of a line.

2. Remove the units not in use from a line.
   Examples
   • If a detector without a column stays on a line, it may damage TCD filament or cause an error such as FID ignition error.
   • If the setting for the flow controller is turned OFF without removing an injector port without a column from a line, an error is detected and the protection mechanism works to lower the column temperature.
   • If a split/splitless injection port (SPL) without a column is not removed from a line, an error is detected and the protection mechanism works to lower the column temperature.

2.2 Outputting Analog Signals to the Chromatopac

GC-2014 can output analog signals for two channels, and detector signals to be outputted to each channel can be set using keys. When a detector is changed, output can be changed using keys without changing the connection on the back of the GC.

■ Connecting the Chromatopac signal cable

Connect the attached Chromatopac signal cable to the connector (ANALOG OUT1 or 2) on the back of the GC. (Fig. 2.2.1)
Using this cable, analog signals can be outputted and the Chromatopac can be started when the GC starts. (Refer to "16.6.9 Setting the link device code")

Back of the GC

ANALOG OUT 1=Ch1
ANALOG OUT 2=Ch2

AOC built-in power source
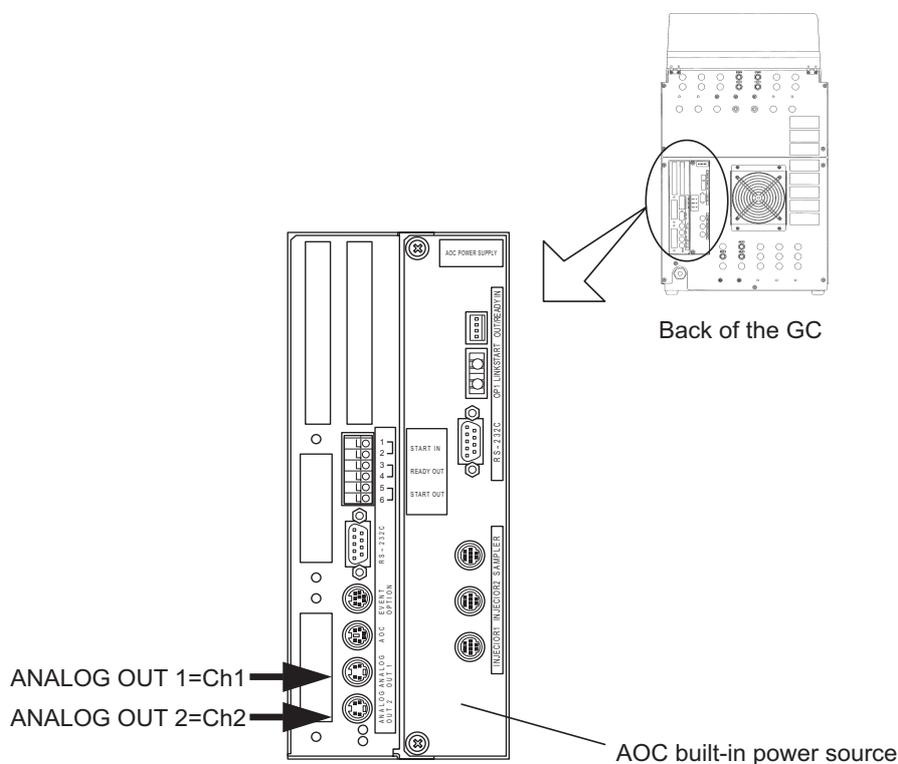
Fig. 2.2.1　Connecting the Chromatopac signal cable

■ **Setting analog signal output**

1. Set a line

(1) Press the [SET] key then press the [PF2] key (Line Config).

(2) Specify an injection port and detector to which a column is connected in the same line.

The screen on the right shows an example where a column is connected to the dual INJ and dual FID.

```
Line Configuration
▓▓▓▓▓▓▓▓▓▓ Injector ▓▓▓▓▓▓▓▓▓▓
    ─────────        SPL
 🔲─────────         DINJ
▓▓▓▓▓▓▓▓▓▓ Detector ▓▓▓▓▓▓▓▓▓▓
 🔲─────────         DFID
    ─────────        DTCD
▓▓▓▓▓▓▓▓▓▓  Option  ▓▓▓▓▓▓▓▓▓▓
◀▶🔲─────────        AOC1
    ─────────        AOC2




    ↵Return
```

NOTE Without specifying a detector in a line, the screen to set analog signal output below does not appear.

2. Set analog signal output.

(1) Press the [DET] key.

(2) The outlined part is a parameter for analog signal output for all detectors.
Set the parameter following the description below.
For "Background signal save/ compensation" and "Detector signal subtraction," refer to "Chapter 13 Detector [DET]."

"Signal Output Port"

Specify a connector number to output analog signals.
(ANALOG OUT 1 = Ch1, ANALOG OUT 2 = Ch2)
Channel number of a detector specified at the last is effective. (If TCD signal was outputted to Ch1 formerly and FID signal is newly specified to be outputted to Ch1 as shown in the screen on the right, TCD signal becomes OFF automatically.)

```
Detector  DET #2    NOT READY
DFID 🔲                    ◀▶ On
Temp(C)          ▓▓▓▓       300.0
Flame                       Off
Signal Polarity              +
Filter Time Constant       200ms
Control Mode                Dual
................................
Signal Output Port          Ch1
Background sig save         Off
Background sig comp.        Off
Det sig subtraction         Off
Signal Attenuation         ×2⁻¹
Analog Signal Type         Wide
................................

  Ignite      ───    Ign.Set
```

"Signal Attenuation" or "Signal Range"

Names of items automatically change according to types of analog signals as listed below. Set multiplying power (attenuation rate) of output signals for all types. Change the setting when the peak obtained by the data processing unit is saturated.

Signal attenuation: When analog signal type is wide

Output signal becomes smaller when the setting is changed from x 1 → x 2^{-1} → x 2^{-2} → x 2^{-3} → x 2^{-4}

Signal range: When analog signal type is linear

Output signal becomes smaller when the setting is changed from x1 → x10^{-1} → x10^{-2} → x 10^{-3} → x 10^{-4}

"Analog Signal Type"

Set a signal type according to the type of Chromatopac to be connected. If this is set incorrectly, data cannot be processed correctly.

Wide : C-R8A, C-R7A, C-R7Aplus
Linear: Chromatopacs other than C-R8A, C-R7A, C-R7Aplus

■ Calibration of analog wide range signal

When the GC is connected to the Chromatopac (C-R8A, C-R7A, C-R7Aplus) with a chromatopac signal cable and the "analog signal type" described above is set to "Wide," calibration is necessary in order to match the zero level of the GC and Chromatopac.

Perform calibration in the following cases.
• When the GC and Chromatopac are connected for the first time (during installation)
• When the GC or Chromatopac is changed with other instrument.
• When a connection channel number is changed by switching a connector on the GC side
• When a two-channel board is installed on the Chromatopac and a connection channel number is changed by switching a connector on the Chromatopac side

NOTE Calibration is not necessary when a detector is changed (e.g. when signal to be outputted to Ch1 is changed from TCD to FID).

The following is calibration procedures.
(1) Press the [DET] key on the GC to turn OFF the detector control.
(2) Load the BASIC calibration program.
    C-R7A, C-R7Aplus: Type "LOAD "ZCALIB"" on the [Win3] key screen.
    C-R8A: Type "LOAD "8.ZCALIB.BAS"" when key input is possible.
(3) Press the [RUN] key of the Chromatopac.
(4) Enter the Chromatopac channel number when the following sentence is displayed.
    C-R7A, C-R7Aplus: "Channel No. (1:CH1 2:CH2) : ?"
    C-R8A: "CH No. (1:CH1 2:CH2) : ?"
(5) Enter "Y" when the sentence below is displayed to save calibration results on the Chromatopac. If they are not saved on the disk, calibration is required again when starting the Chromatopac after turning its power off.
    C-R7A, C-R7Aplus: "Save to disk (Y: Yes N: No) : ?"
    C-R8A: "Save to the disk (Y: Save N: No) : ?"
(6) Press the [DET] key of the GC to turn ON the detector control.

2.3 Outputting Digital Signals to a Personal Computer

GC-2014 can be directly connected to a personal computer to output digital signals.
GCsolution software allows a PC to control the unit and take data.
For operation of GCsolution, refer to its instruction manual.

■ Connecting the RS-232C cable

Connect the RS-232C cable attached to GCsolution workstation to the connector on the back of the GC. (Fig. 2.3.1)
To connect one PC with more than one GCs, separate RS-232C cables are necessary and an expanded COM port needs to be attached to the PC.

NOTE AOC built-in power source has the same connector. Connect the cables correctly.

Back of the GC

RS-232C

AOC built-in power source
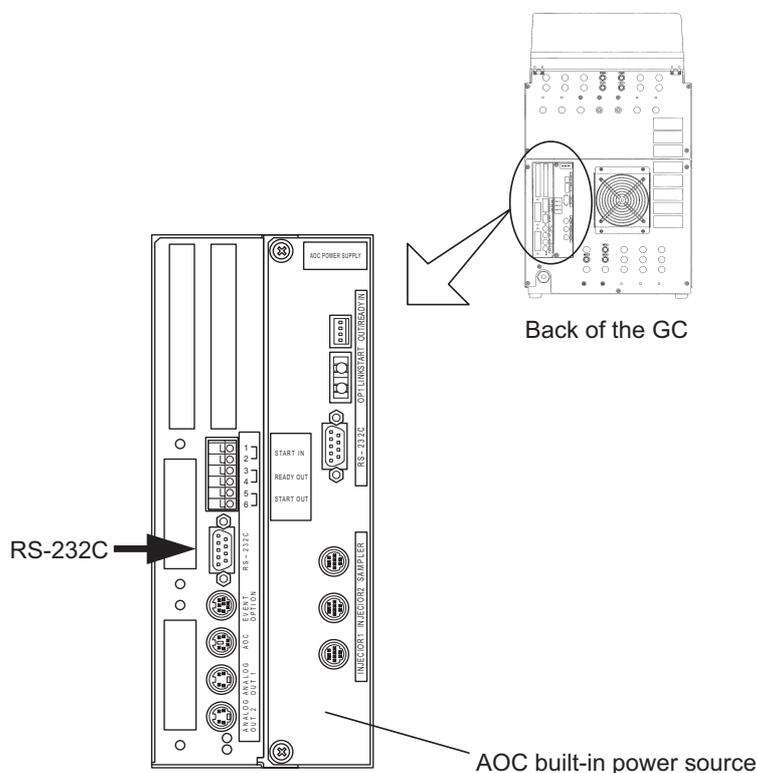
Fig. 2.3.1　Connection of RS-232C cable

■ **Setting transmission parameters**

(1) Select "6. GC CONFIGURATION" on the [FUNC] key screen and then select "3. TRANSMISSION PARAMETER."

(2) Set transmission parameters.
Protocol = LEVEL3
Baud rate (bps) = 115200

(3) Press the [PF2] key (Apply).

NOTE Turning ON the power of the GC is not necessary.

```
Transmission Parameter
Protocol          ◄► LEVEL3
Baud Rate(bps)        115200
Stop Bit             -------
Parity               -------




        ↵Return   Apply
```

2.4 Connecting a RS-232C Cable to the Chromatopac C-R8A

Connecting the GC-2014 and Chromatopac C-R8A with a RS-232C cable allows for various functions such as printing out parameters of the GC.
For detailed information about C-R8A, refer to its instruction manual.

■ Connecting RS-232C cable

Connect an optional RS-232C cable to the connector on the back of the GC. (Fig. 2.4.1)

NOTE AOC built-in power source has the same connector. Connect the cables correctly.

Back of the GC

RS-232C

AOC built-in power source

Fig. 2.4.1   Connection of RS-232C cable

■ Setting transmission parameters

Set transmission parameters when performing digital-transmission between the GC and Chromatopac for the first time. (This is not required for each operation.)

1. Set transmission parameters for the GC

(1) Select "6. GC CONFIGURATION" on the [FUNC] key screen and then select "3. TRANSMISSION PARAMETER."

(2) Set transmission parameters.
   Protocol = LEVEL2
   Baud rate (bps) = 9600
   Stop bit = 1bit
   Parity = EVEN

(3) Press the [PF2] key (Apply).

NOTE Turning ON the power of the GC is not necessary.
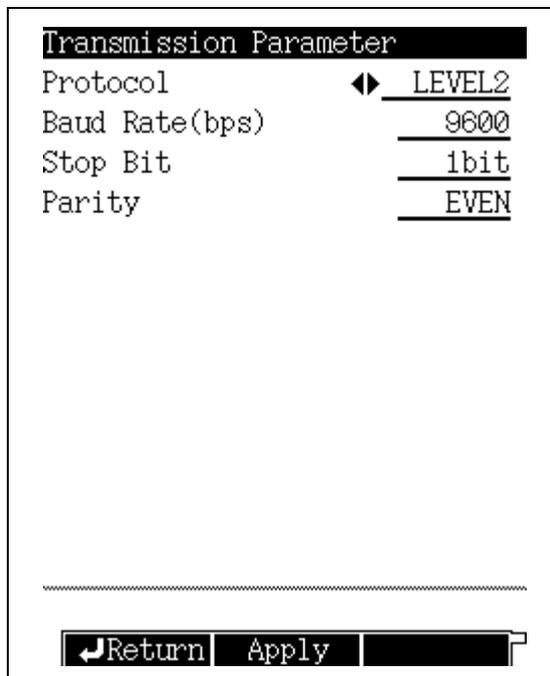
```
Transmission Parameter
Protocol          ◀▶   LEVEL2
Baud Rate(bps)          9600
Stop Bit                1bit
Parity                  EVEN




┌┘Return │  Apply  │
```

2. Set transmission parameters for the C-R8A

(1) Press the [CONFIG] key and then press the [T] key (T:TRS).

(2) Press the [↓] key until the STD2 Port (RS-232C) Setup screen appears.

[PORT	MODE	#No.	BPS	]
STD2	12917	8	9600	

(3) Set transmission parameters.
   MODE = 12917 (Protocol LEVEL2, Stop bit 1bit, Parity EVEN)
   #No. = 8 (logical port number)
   BPS = 9600 (baud rate)

(4) After completing setting, press the [EXIT] key and then press the [Y] key to save the settings.

(5) After changing transmission parameters, reboot the C-R8A to enable the new settings.

■ Procedures to start digital transmission

After setting transmission parameters, start digital transmission.

1. Start digital transmission.

(1) Type "OPEN TRS 8" using the C-R8A keyboard and press the [Enter] key.

(2) The transmission port will open and transmission between the GC and C-R8A will start.

NOTE To turn OFF the power of the GC or Chromatopac after opening the transmission port, type "CLOSE TRS 8" using the C-R8A keyboard and press the [Enter] key.

2.5 **Connecting Auto Injector/Auto Sampler AOC-20 Series**

Connecting the GC-2014 and the auto injector/auto sampler power source unit using an AOC RS-232C cable allows AOC parameters to be set using the GC's keyboard.
Refer to AOC-20 user's manual for details about AOC-20.

■ **Cable connections**

Connect the READY/START cable attached to the AOC built-in power source and the AOC RS-232C cable to the connectors on the back of the GC. (Fig. 2.5.1)
Connect the AOC power cable to the connector on the back of the GC and the auto injector or auto sampler.

NOTE There are two identical RS-232C connectors. Make sure to make the correct connections.

READY/START cable

Wire the cables according to the numbers on them. Press the buttons on the terminal when inserting or removing cables.

Button   Cable inlet

AOC RS-232C cable

Connect the cable to the "AOC" connector and "RS-232C" connector on the AOC built-in power source.

Back of the GC

SMAPLER=auto sampler

AOC power cable

INJECTOR1=auto injector

AOC built-in power source

Fig. 2.5.1   Connection of the AOC-20 series

■ Setting AOC parameters

1. Set a line.

    (1) Press the [SET] key and then press the [PF2] key (Line Config).

    (2) Specify "AOC1" on the line with the injection port that the auto injector has been attached to.

    (3) The GC and AOC built-in power source will be automatically linked.

```
┌─────────────────────────────┐
│ Line Configuration          │
│ ▓▓▓▓▓▓▓▓▓ Injector ▓▓▓▓▓▓▓▓▓ │
│ ──────────      SPL         │
│ [LINE 1]───      DINJ       │
│ ▓▓▓▓▓▓▓▓▓ Detector ▓▓▓▓▓▓▓▓▓ │
│ [LINE 1]───      DFID       │
│ ──────────      DTCD        │
│ ▓▓▓▓▓▓▓▓▓ Option ▓▓▓▓▓▓▓▓▓▓▓ │
│ ◄►[LINE 1]───    AOC1       │
│ ──────────      AOC2        │
│                             │
│ ┌──────────┐                │
│ │ ↵Return  │             ┌─ │
│ └──────────┘             └─ │
└─────────────────────────────┘
```
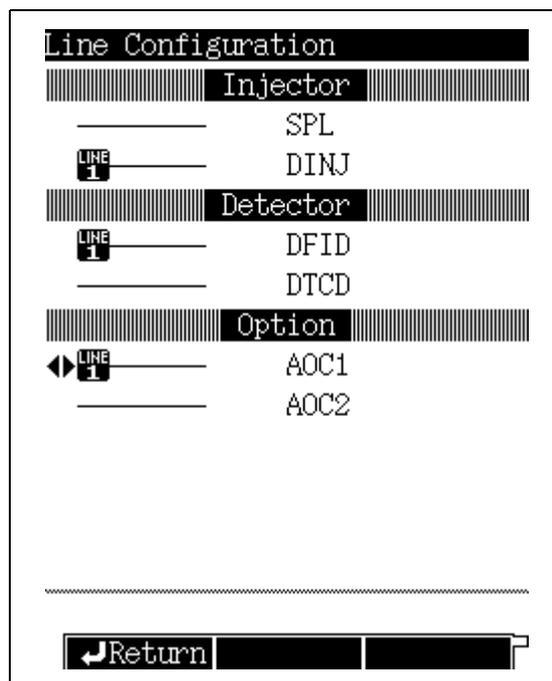
2. Set AOC parameters.

    (1) Press the [OPTION] key. If other option screens appear, press the [OPTION] key repeatedly until the AOC Parameter screen appears.

    (2) Set AOC parameters.
Parameters will be transmitted to the AOC as soon as they are set.

NOTE For detailed information about setting AOC parameters, refer to "15.1 Auto Injector Parameters" or AOC-20 user's manual.
If the AOC Parameter screen is not displayed, check the connection of RS-232C cable and settings for line configuration.

```
┌─────────────────────────────┐
│ AOC Parameters     NOT READY │
│ AOC1 [LINE 1]        Inactive│
│ ▓▓▓▓▓▓▓ Single AOC-20i ▓▓▓▓▓ │
│ Sample Wash              2   │
│ Number of Injection      1   │
│ Sample Size(μl)        1.0   │
│ Pre Solvent Wash         0   │
│ Solvent Wash             1   │
│ Pumping                  5   │
│ Viscosity(s)           0.2   │
│ Dwell Time(s)          0.0   │
│ Inj. Speed(Plunger)   Fast   │
│ AOC POWER               On   │
│                              │
│ ┌──────┐ ┌─────┐ ┌─────────┐ │
│ │Start │ │ --- │ │OtherPara│ │
│ └──────┘ └─────┘ └─────────┘ │
└─────────────────────────────┘
```
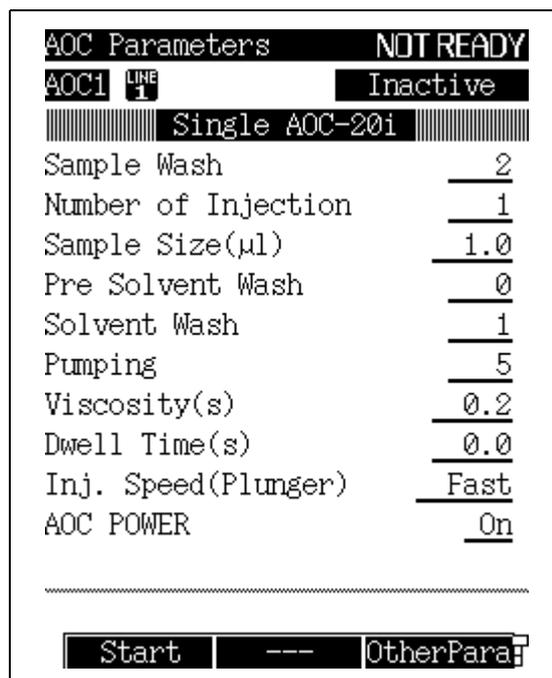
2.6 Connecting the Relay Terminals

By using the optional relay cable (P/N221-48568-91), relay that operates according to event commands can be used.

For detailed information about setting events, refer to "16.3 Time Program" or "16.5 Direct Operation".

For example, if the cable is connected to 1COM and 3NO found in Fig. 2.6.1, they are connected by EVENT91 and disconnected by EVENT-91. If it is connected to 1COM and 2NC, they will be connected by EVENT-91 and disconnected by EVENT91.

Back of the GC

AOC built-in power source
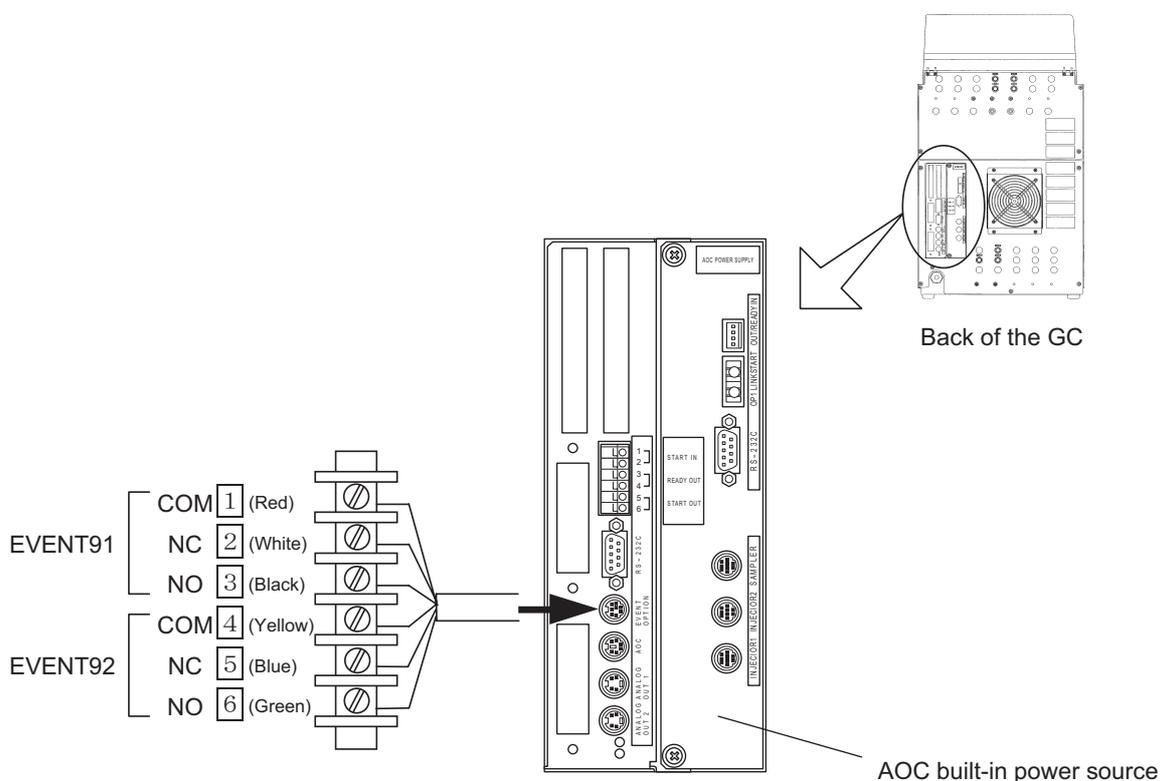
Fig. 2.6.1   Connecting a relay cable

3.1 Installation Location for Packed Columns

Injection ports and detectors for packed columns can be installed in positions described in Table 3.1.1 and Fig. 3.1.1.

Table 3.1.1 Installation location for injection ports/detectors for packed columns

	Name	Possible installation location
Injection ports	Dual INJ	1-2, 2-3, 3-4
	Single INJ	1, 4
Detectors	Dual FID	6-7
	TCD	9-10
	Single DET	5, 6, 7, 8

Installation location numbers indicate the positions of column connecting joints.
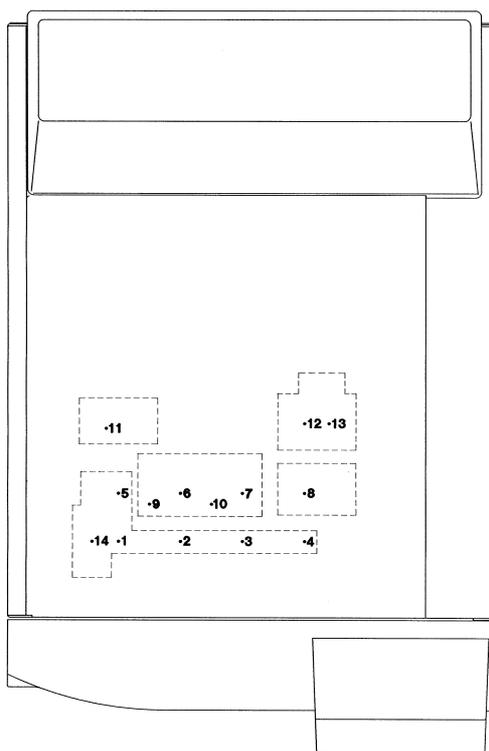
Fig. 3.1.1   Fig. 3.1.1 Installation location for injection ports/detectors for packed columns (layout viewed from the top of the unit)

Check which units the joints found on the column oven correspond to.
Fig. 3.1.2 shows the layout for the GC-2014ATF+SPL model.
Left and right sides viewed from the front of the unit are indicated as L (left) and R (right) respectively.
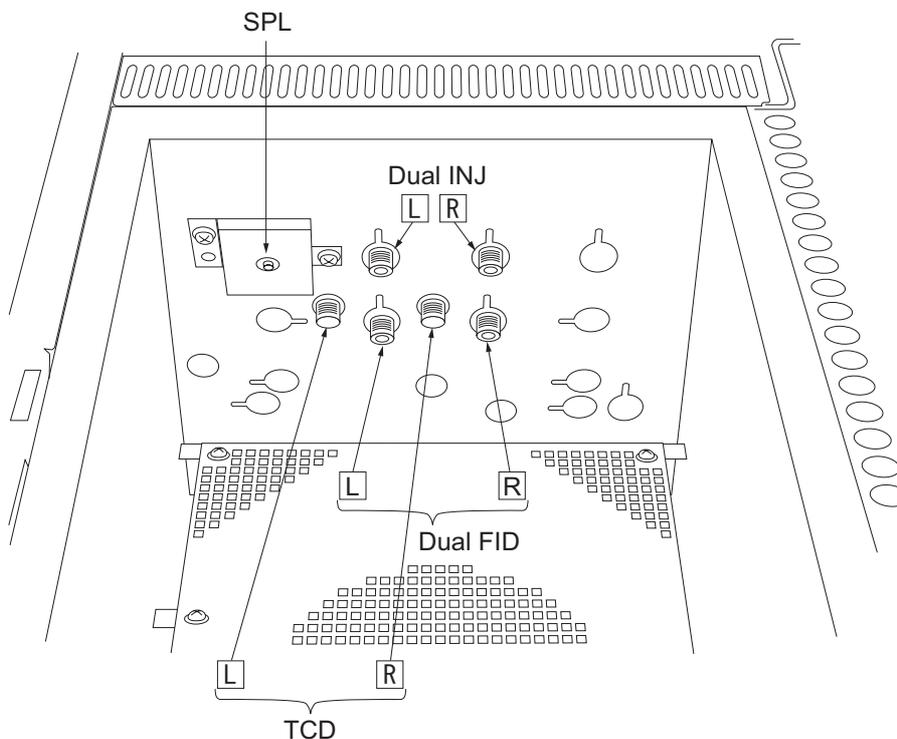
Fig. 3.1.2   Column connecting joints (GC-2014ATF+SPL model)

Dual-Column Packed FID Analysis

Connecting the left (L) sides and right (R) sides of the dual INJ and dual FID with columns respectively allows for analysis with the dual-column configuration.

Dual-column configuration is used in following cases.
1. Same type of columns are connected to the left and right sides in order to background-compensate the increase of the baseline during programmed temperature analysis.

2. Different types of columns are connected to the left and right sides in order to obtain a different chromatogram when a sample is injected to the left (L) side and right (R) side of the dual INJ.

NOTE   Do not cross the columns (L/R). It hinders correct analysis.
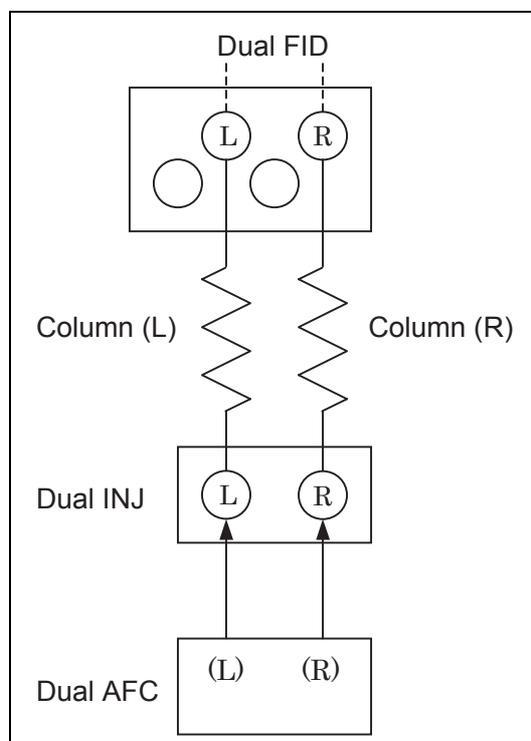
Fig. 3.2.1   Dual-column configuration

■ Setting analytical flow lines

Setting analytical flow lines is described below.

For procedures to install columns and input analytical conditions, refer to the operation manual.

1. Set a line.
   (1) Press the [SET] key and then press the [PF2] key (Line Config).
   (2) Set the dual INJ (DINJ) and dual FID (DFID) on a same line.
        LINE1 is specified in the example below. Lines 1 through 4 can be selected.

2. Set the dual AFC.
   (1) Press the [FLOW] key.
   (2) Set "Control mode" to "Dual."

3. Set the dual FID.
 - (1) Press the [DET] key.
 - (2) Set "Control mode" to "Dual."
 - (3) Set "Signal polarity" as described below.

| + | : The FID (L) - FID (R) signal is outputted.
(When a sample is injected into the dual INJ (L))
| − | : The FID (R) - FID (L) signal is outputted.
(When a sample is injected into the dual INJ (R))

```
Detector  DET #2          READY
DFID [LINE 1]             ◆ On
 Temp(°C)        150.0    150.0
 Flame                     On
 Signal Polarity            +
 Filter Time Constant      1s
 Control Mode            Dual

 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  │   ---  │ Ign.Set
```
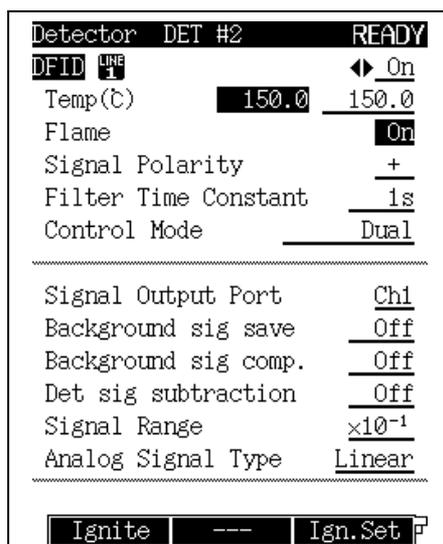
3.3 Single-Column Packed FID Analysis

Connecting either of the left (L) sides or right (R) sides of the dual INJ and dual FID with a column allows for analysis with the single-column configuration.

Single-column configuration is used in following cases.
1. Background-compensation is unnecessary because the baseline level does not increase during isothermal analysis.
2. Background-compensation is unnecessary because the baseline level does not increase so much even during programmed temperature analysis.

NOTE 1. When single-column configuration is set, unspecified flow controller does not supply gases. Make sure to remove unspecified column to prevent deterioration.
2. Make sure to stop the FID detector gas supply (hydrogen and air) on unspecified side. (Turn the control of the flow controller to set the pressure to zero.)
3. Do not cross the columns (L/R). It hinders correct analysis.
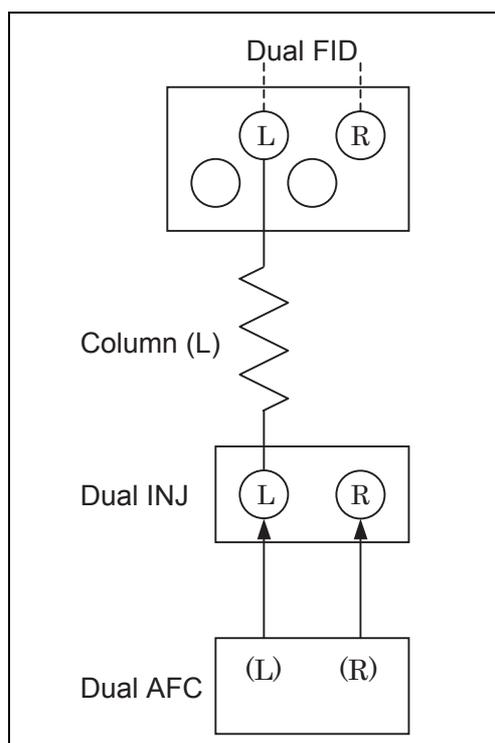
Fig. 3.3.1　Single-column configuration (FID)
(A column is connected to the left (L) sides.)

■ Setting analytical flow lines

Setting analytical flow lines is described below.

For procedures to install columns and input analytical conditions, refer to the operation manual.

1. Set a line.

(1) Press the [SET] key and then press the [PF2] key (Line Config).

(2) Set the dual INJ (DINJ) and dual FID (DFID) on a same line.

LINE1 is specified in the example below. Lines 1 through 4 can be selected.

```
Line Configuration
▓▓▓▓▓▓▓▓▓▓  Injector  ▓▓▓▓▓▓▓▓▓▓
─────────       SPL
LINE
 1 ───────      DINJ
▓▓▓▓▓▓▓▓▓▓  Detector  ▓▓▓▓▓▓▓▓▓▓
LINE
 1 ───────      DFID
─────────       DTCD
▓▓▓▓▓▓▓▓▓▓   Option   ▓▓▓▓▓▓▓▓▓▓
◆▶ LINE
    1 ──────    AOC1
─────────       AOC2




┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈
 ↵Return
```

2. Set the dual AFC.

(1) Press the [FLOW] key.

(2) Set "Control mode" as described below.

```
Flow  CAR2           NOT READY
DINJ LINE                   On
     1
Control Mode      ◆▶  Single L
▓▓▓▓▓▓▓▓▓▓▓▓  Left  ▓▓▓▓▓▓▓▓▓▓▓▓
L.Inlet Prs(kPa) 150.0
L.Col. flow(mL/min)  50.0    50.0
L.Carrier gas type           N₂




┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈
 Column │ --- │ On/Off
```

Set to "Single L" when the column is connected to the left (L) side of the dual INJ and "Single R" when it is connected to the right (R) side.

3. Set the dual FID.
   (1) Press the [DET] key.
   (2) Set "Control mode" as described below.

```
Detector  DET #2     NOT READY
DFID 🔲                        On
 Temp(℃)           150.0    150.0
 Flame                       Off
 Filter Time Constant         1s
 Control Mode      ◀▶  Single L

 Signal Output Port          Ch1
 Background sig save          Off
 Background sig comp.         Off
 Det sig subtraction         Off
 Signal Attenuation           ×1
 Analog Signal Type         Wide


  Ignite  |   ---   | Ign.Set
```

Set to "Single L" when the column is connected to the left (L) side of the dual FID and "Single R" when it is connected to the right (R) side.

3.4 **Packed TCD Analysis**

Connecting the left (L) sides and right (R) sides of the dual INJ and TCD with columns respectively allows for analysis with the dual-column configuration.

Dual-column configuration is used in following cases.
1. Almost equal columns are connected on the left and right sides to balance TCD's zero point for analysis.
2. Different types of columns are connected to the left and right sides in order to obtain a different chromatogram when a sample is injected to the L and R of the dual INJ.
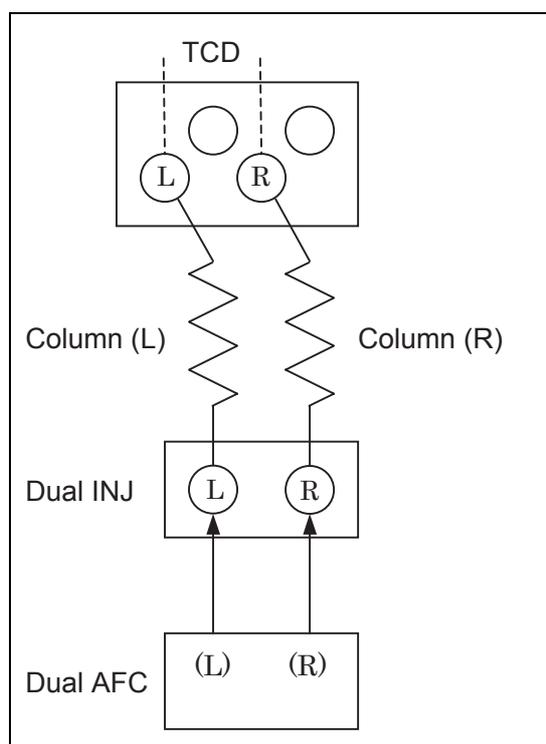
Fig. 3.4.1   Dual-column configuration (TCD)

⚠ **CAUTION**

1. Carrier gas has to be fed to both of left and right (L/R) sides of the TCD. Using the TCD without carrier gas will damage the filament.
2. During analysis with a single column, connect a pipe to the other flow path instead of a column and feed carrier gas.

NOTE 1. Do not cross the columns (L/R). It hinders correct analysis.
2. If left and right columns are extremely different (e.g. liquid quantity, flow rate), zero point may not be achieved by turning the control on the right side of the GC unit. In this case, adjust the column flow rate on the side that a sample is not analyzed (reference side).

■ **Setting analytical flow lines**

Setting analytical flow lines is described below.
For procedures to install columns and input analytical conditions, refer to the operation manual.

1. Set a line.
  (1) Press the [SET] key and then press the [PF2] key (Line Config).
  (2) Set the dual INJ (DINJ) and TCD (DTCD) on a same line.
      LINE1 is specified in the example below. Lines 1 through 4 can be selected.

```
Line Configuration
▓▓▓▓▓▓▓▓▓▓ Injector ▓▓▓▓▓▓▓▓▓▓
    ─────────        SPL
 ▐LINE
  1├─────            DINJ
▓▓▓▓▓▓▓▓▓▓ Detector ▓▓▓▓▓▓▓▓▓▓
    ─────────        DFID
◀▶▐LINE
   1├────            DTCD
▓▓▓▓▓▓▓▓▓▓ Option ▓▓▓▓▓▓▓▓▓▓
 ▐LINE
  1├─────            AOC1
    ─────────        AOC2



       ┘Return
```

2. Set the dual AFC.
  (1) Press the [FLOW] key.
  (2) Set "Control mode" to "Dual."

```
Flow  CAR2           NOT READY
DINJ ▐LINE                   On
      1
Control Mode      ◀▶___     Dual
▓▓▓▓▓▓▓▓▓▓▓ Left ▓▓▓▓▓▓▓▓▓▓▓
L.Inlet Prs(kPa)  0.0
L.Col. flow(mL/min) 0.0   50.0
L.Carrier gas type          He
▓▓▓▓▓▓▓▓▓▓▓ Right ▓▓▓▓▓▓▓▓▓▓▓
R.Inlet Prs(kPa)  0.0
R.Col. flow(mL/min) 0.0   50.0
R.Carrier gas type          He



   Column    ---    On/Off
```

3. Set the TCD.
  (1) Press the [DET] key.
  (2) Set "Signal polarity" as described below.

  | + | : The TCD (L) - TCD (R) signal is outputted.
  (When a sample, which a plus peak is detected, is injected into the dual INJ (L))
  | − | : The TCD (R) - TCD (L) signal is outputted.
  (When a sample, which a plus peak is detected, is injected into the dual INJ (R))

```
Detector   DET #3     NOT READY
DTCD  LINE1              ◆▶ On
  Temp(℃)        0.0    300.0
  Temp(℃)        0.0    300.0
  Signal Polarity         +
  Current(mA)            30
  Filter Time Constant   1s

  Signal Output Port     Ch1
  Background sig save     Off
  Background sig comp.    Off
  Det sig subtraction     Off
  Signal Attenuation      ×1
  Analog Signal Type      Wide

    ---      ---      ---
```
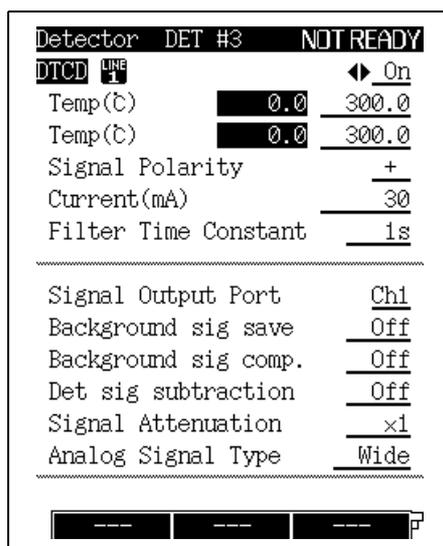
NOTE TCD signals do not necessarily have a plus peak because they are determined by relationship of heat conduction between a substance to be analyzed and carrier gas. However, the data processing unit normally calculates the area of a plus peak. When a minus peak is detected, "signal polarity" needs to be inverted into a plus peak. In this case, inject a sample into the opposite inlet of the one instructed on the popup screen shown below.

"Signal polarity" can be changed using the time program during analysis. (For detailed descriptions about setting the time program, refer to "16.3 Time Program")

```
Injection Monitor      READY
LINE1  0000.00.00(   ) 00:00:00
Ready for Injection Left Port

           ⬇

  0.0              0.0
  ml/min           ml/min
          0.0℃
   0℃    DTCD

    0μV    0.0℃      ×1

-100    Retention Time      10
❶❷Atten❹❻Speed◀ ▶Scroll
  Temp Mon Flow Mon Zero Adj
```
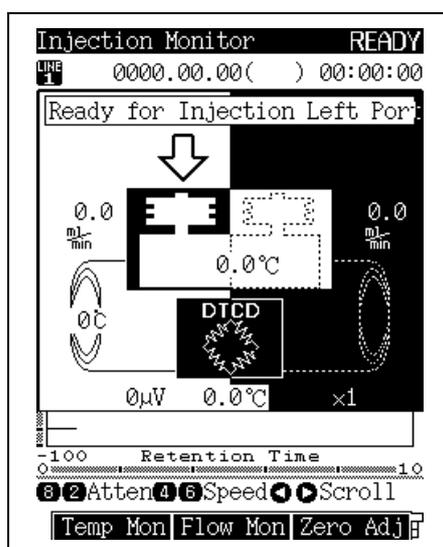
3. 5 **Packed Analysis Using the Single DET**

To perform glass packed column analysis using the unit with the single DET (single FID, ECD, FPD, and FTD for packed analysis), move the dual INJ to the front of the single DET prior to connecting a column.
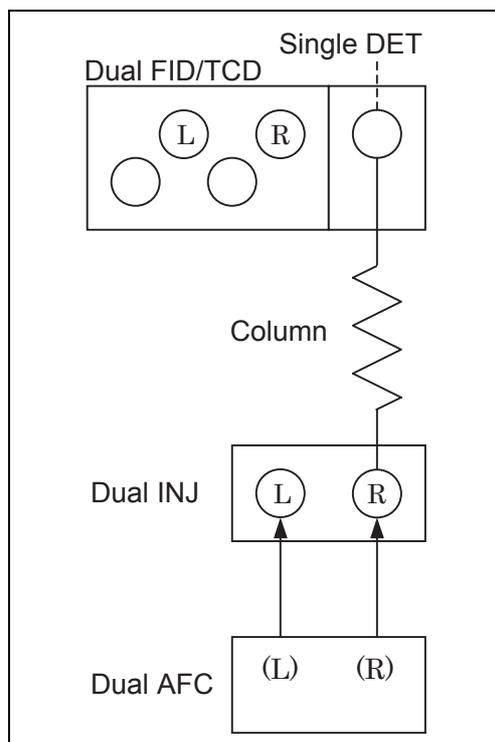
Fig. 3.5.1   Single DET configuration

NOTE 1. When a SUS column is used, the dual INJ does not need to be moved.
2. If the single packed INJ is installed in front of the single DET, analysis can be performed without moving the dual INJ. For detailed descriptions, refer to instruction manual of the single packed INJ.

⚠ **CAUTION**

Dual INJ is set on the single mode so carrier gas is not fed to the unspecified port (L on the figure above). Do not connect a column to the port.

■ Procedures to move the dual INJ

⚠ **WARNING**

Carry out the procedures after the injection port becomes 40°C or less to prevent burns.

⚠ **CAUTION**

When cutting a heat insulator, handle a cutting knife, etc. with care.

Move the dual INJ following the procedures below. Perform backward processes to return it to its original position.

(1) Set the dual INJ temperature at room temperature or lower and wait until it becomes 40°C or less.
(2) Turn OFF the power of the GC unit.
(3) Remove the column connected to the dual INJ.
(4) Detach wiring connected to the dual INJ in order to improve workability.
(5) Unfasten the three screws that fasten the dual INJ (Fig. 3.5.2 (a)) and pull the dual INJ upward.
    (Sems screws with a flat washer are used. Be careful not to drop flat washers.)
(6) Take out the heat insulator laid on the bottom of the dual INJ using tweezers or other similar tools.)
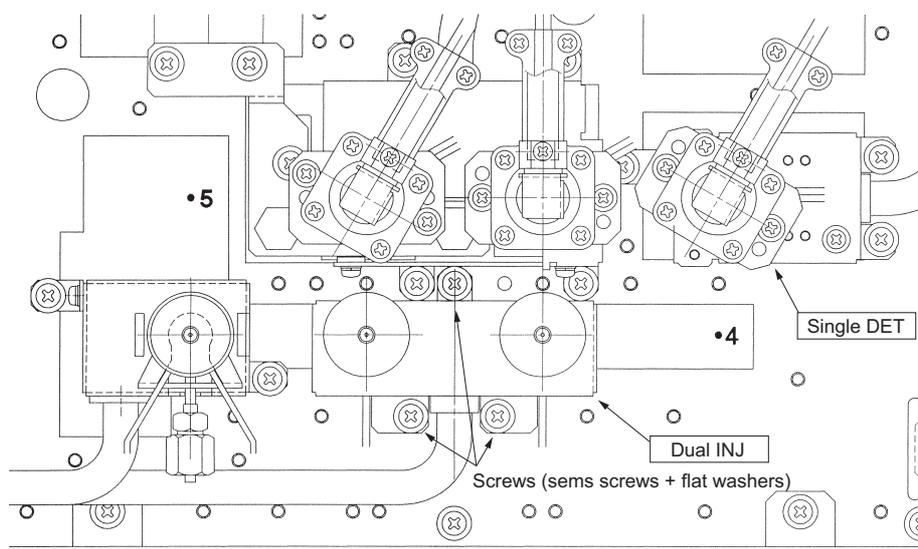
Fig.3.5.2 (a)

(7) Cut out the heat insulator using a cutting knife, etc. as shown in Fig. 3.5.2 (a).
(The heat insulator is approximately 3cm thick. Cut the sheet metal on the bottom of the heat insulator as well.)

(8) Move the cut heat insulator to the left.
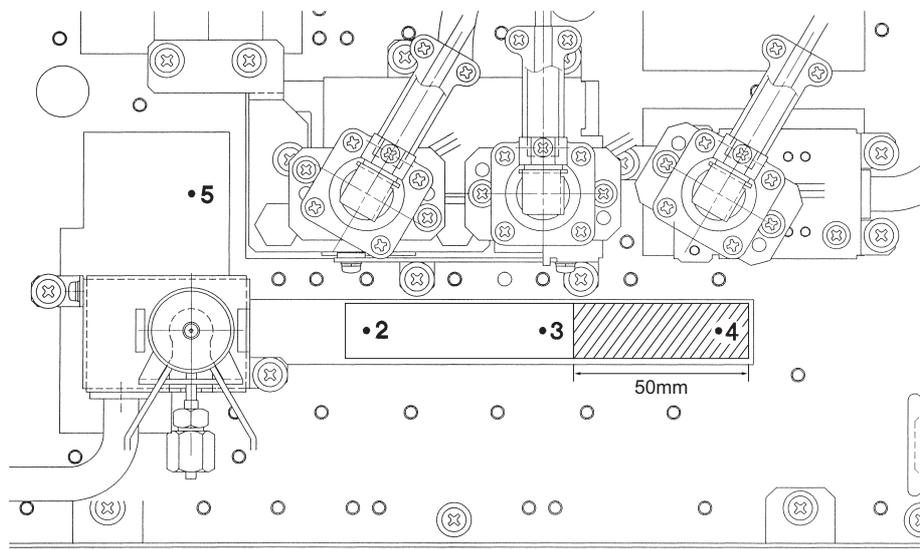
Fig.3.5.2 (b)

(9) Insert the dual INJ on top of the heat insulator that has been taken out in step (6) and fasten it with three screws. (Refer to Fig. 3.5.2 (c)).

(10) Connect the wiring that has been removed in step (4) to the dual INJ as it was originally.
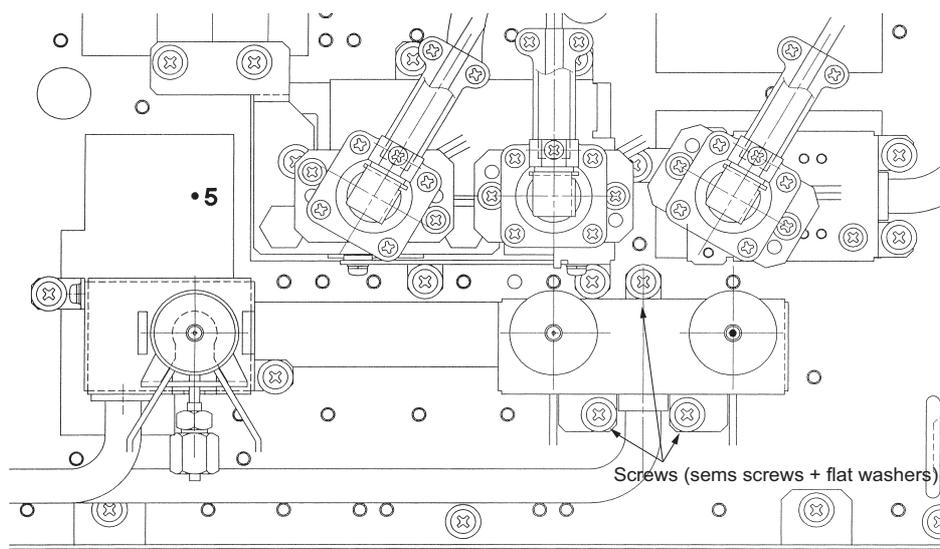
Fig.3.5.2 (c)

■ Setting analytical flow lines

Setting analytical flow lines is described below.

For procedures to install columns and input analytical conditions, refer to the operation manual.

1. Set a line.

(1) Press the [SET] key and then press the [PF2] key (Line Config).

(2) Set the dual INJ (DINJ) and single DET (PECD in the screen below) on a same line.
     LINE1 is specified in the example below. Lines 1 through 4 can be selected.

```
Line Configuration
||||||||||||||||| Injector |||||||||||||||||
─────────         SPL
LINE1─────         DINJ
|||||||||||||||||| Detector ||||||||||||||||
◀▶LINE1────        SFID
─────────         DFID
─────────         DTCD
|||||||||||||||||| Option |||||||||||||||||||
LINE1─────         AOC1
─────────         AOC2



..................................

| ↵Return |        |          |
```

2. Set the dual AFC.

(1) Press the [FLOW] key.

(2) Set "Control mode" as described below.

```
Flow  CAR2                READY
DINJ LINE1                    On
Control Mode      ◀▶  Single R
|||||||||||||| Right |||||||||||||||||
R.Inlet Prs(kPa) 200.0
R.Col. flow(mL/min) 50.0      50.0
R.Carrier gas type            N2





..................................

| Column |   ---   | On/Off |
```
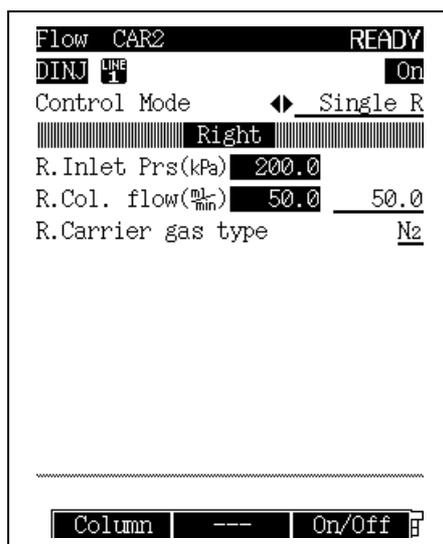
Set to "Single L" when the column is connected to the left (L) side of the dual INJ and "Single R" when it is connected to the right (R) side.

4.1 Installation Location for Capillary Columns

Injection ports and detectors for capillary columns can be installed in positions described in Table 4.1.1 and Fig. 4.1.1.
(Injection ports and detectors that can be used for packed columns are included.)

Table 4.1 Installation location for injection ports/detectors for capillary columns

	Name	Possible installation location
Injection ports	SPL	1, 4
	WBI	1, 4
	Dual INJ	1-2, 2-3, 3-4
	Single INJ	1, 4
Detectors	Dual FID	6-7
	Single DET	5, 6, 7, 8
	FTD-2014c	11, 12
	TCD	9-10

Installation location numbers indicate the positions of column connecting joints.
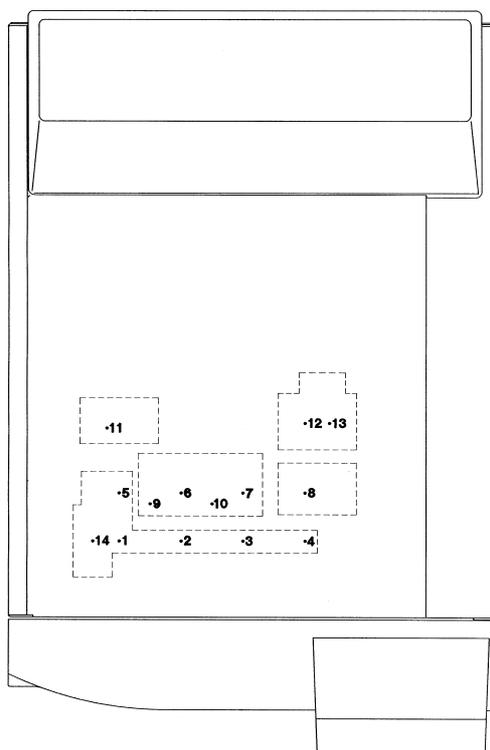
Fig. 4.1.1   Installation location for injection ports/detectors for capillary columns
(layout viewed from the top of the unit)

Check which units the joints found on the column oven correspond to.
Fig. 4.1.2 (a) and (b) show the layout for the GC-2014ATF+SPL model and GC-2014AFsc model. Left and right sides viewed from the front of the unit are indicated as L (left) and R (right) respectively.
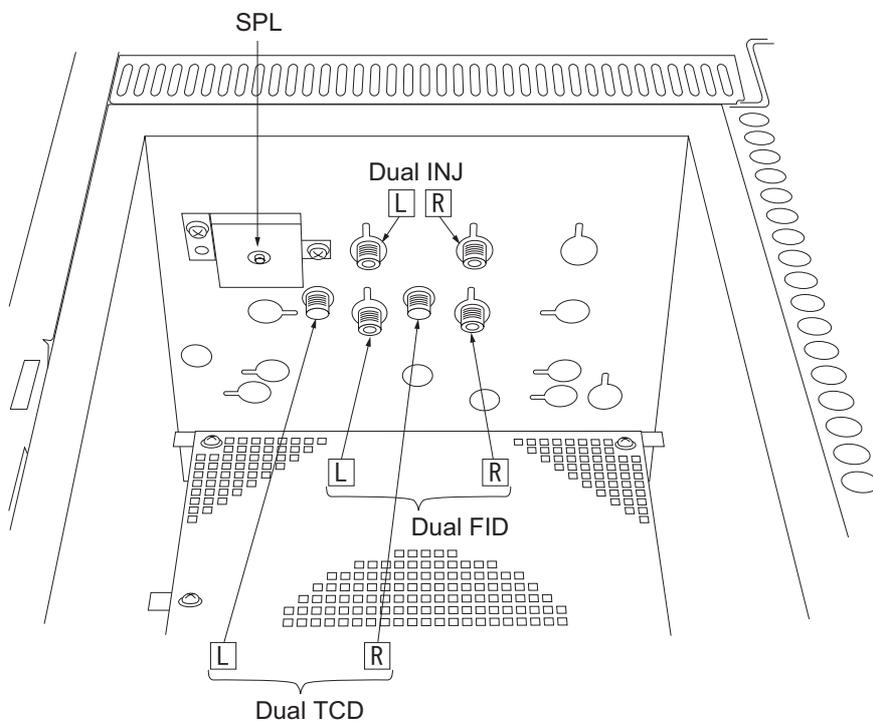
Fig.4.1.2 (a)   Column connecting joints (GC-2014ATF+SPL model)
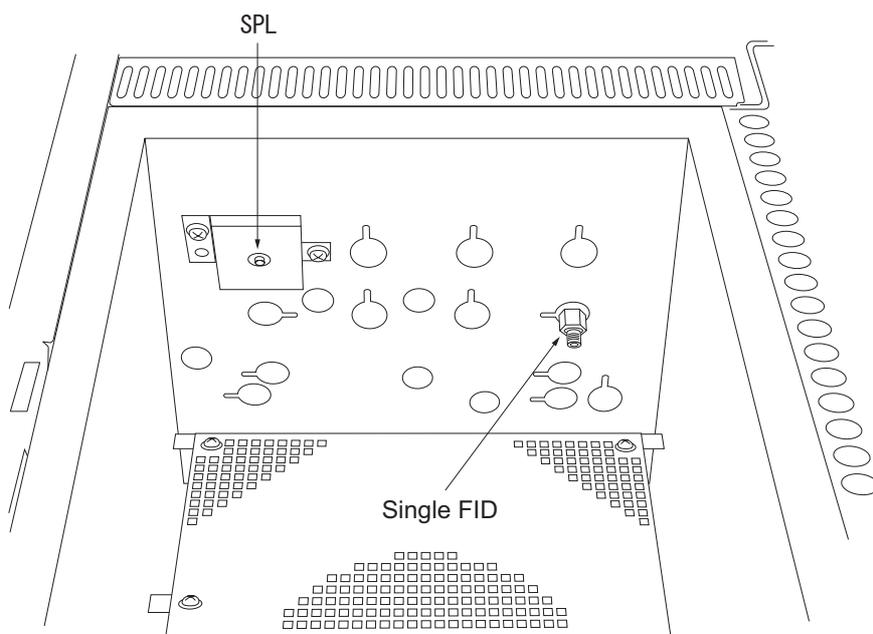
Fig.4.1.2 (b)   Column connecting joints (GC-2014AFsc model)

4.2 Capillary Analysis Using the Dual FID (When a detector adopter with purge is used)

To perform capillary analysis using a unit with the dual FID, makeup gas needs to be supplied to the FID that a column is connected to.

In order to supply makeup gas, attach a detector adopter with purge (P/N 221-34012-91) to the joint of the dual FID. Connect the purge piping of the adopter to the dual INJ so that makeup gas is supplied from the dual AFC through the dual INJ.

(The dual AFC is off the line and operates as an independent mass flow controller.)

Although an adopter and column are connected to the right (R) sides of the dual INJ and dual FID in the figure below, they can be connected to either side (L/R).
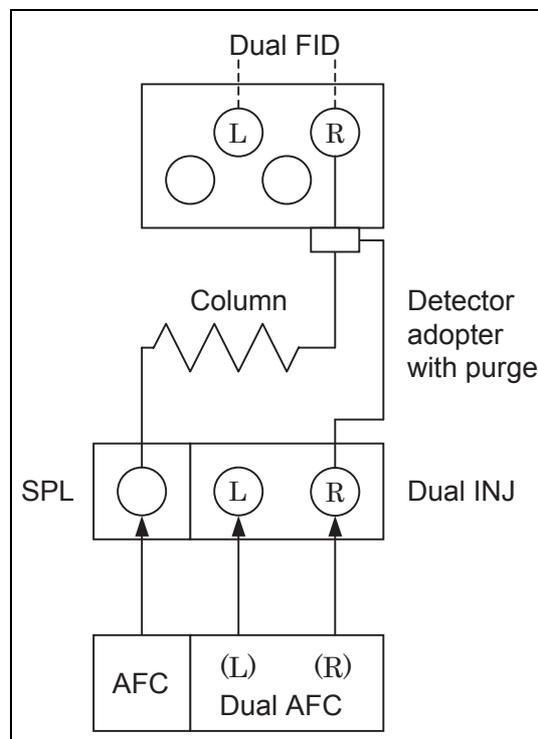
Fig. 4.2.1   Dual FID (detector adopter)

■ Setting analytical flow lines

Setting analytical flow lines is described below.
For procedures to install an adopter and columns and input analytical conditions, refer to the operation manual.

1. Change the dual AFC configuration.
- (1) Select "6. GC CONFIGURATION" on the [FUNC] key screen and then select "9. Other configuration."
- (2) Specify "AMC.LR" at "DAFC unit."

```
Other Configurations
Language              English
Backlight auto off (sec)   0
Pressure unit             kPa
Beep volume               Hig
Beep tone                  Hi
Atmospheric compensation  Off
Zero at Ready              On
Polarity in Ready        Open
SPL Primary Press
                   500-900kPa
DAFC Unit          ◆▶AMC.LR
DTCD Preamplifier          x1


 ↵Return
```

2. Set a line.
- (1) Press the [SET] key and then press the [PF2] key (Line Config).
- (2) Set the SPL and dual FID (DFID) on a same line.
  LINE1 is specified in the example below. Lines 1 through 4 can be selected.

```
Line Configuration
▓▓▓▓▓▓▓▓▓▓ Injector ▓▓▓▓▓▓▓▓▓▓
◆▶🔲—————     SPL
▓▓▓▓▓▓▓▓▓▓ Detector ▓▓▓▓▓▓▓▓▓▓
🔲—————      DFID
—————       DTCD
▓▓▓▓▓▓▓▓▓▓ Option ▓▓▓▓▓▓▓▓▓▓
🔲—————      AOC1
—————       AOC2



 ↵Return
```
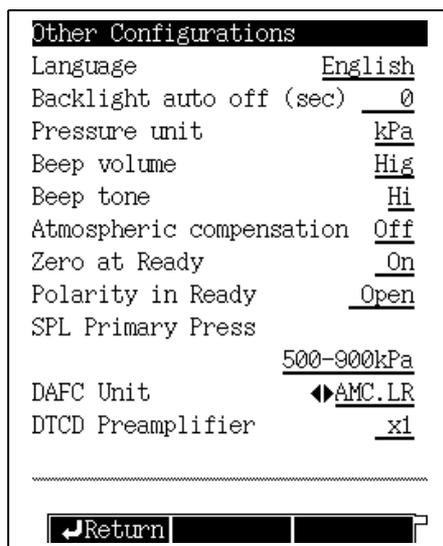
NOTE If the dual AFC is specified for AMC.LR, the indication of DINJ disappears.

3. Set the makeup gas flow rate.
    (1) Press the [OPTION] key.
    (2) Set AMC.L when the detector adopter is connected to the left (L) side of the dual INJ
        and set AMC.R when it is connected to the right (R) side.
        Start control and set the makeup gas flow rate and gas type.

```
AUX AMC                    READY
AMC.L                        Off
Press(kPa)        0.0
Flow(ml/min)      0.0        30.0
                             N2


AMC.R                        On
Press(kPa)       10.0
Flow(ml/min)     30.0        30.0
                             He




                               ▽
  Offset  |  Next  |  On/Off
```

4. Set the dual FID.
    (1) Press the [DET] key.
    (2) Set "Control mode" as described below.

```
Detector  DET #2           READY
DFID 器1                       On
  Temp(℃)         150.0    150.0
  Flame                      On
  Filter Time Constant     200ms
  Control Mode    ◆▶ Single R

  Signal Output Port         Ch1
  Background sig save         Off
  Background sig comp.        Off
  Det sig subtraction         Off
  Signal Attenuation          ×1
  Analog Signal Type         Wide



  Ignite  |  ---  |  Ign.Set
```

        Set to "Single L" when the column is connected to the left (L) side of the dual FID and "Single
        R" when it is connected to the right (R) side.

4.3 Capillary Analysis Using the Dual FID (When a makeup gas flow controller is used)

To perform capillary analysis using a unit with the dual FID, makeup gas needs to be supplied to the FID that a column is connected to.

In order to supply makeup gas, the optional makeup gas flow controller (P/N 221-70877-91: 1 flow path, 221-70877-92: 2 flow paths) are used.

Prior to installing a column, install the detector adopter (P/N 221-33193-91) to the detector's joint.

Although an adopter and column are connected to the right (R) side of the dual FID in the figure below, they can be connected to either side (L/R).
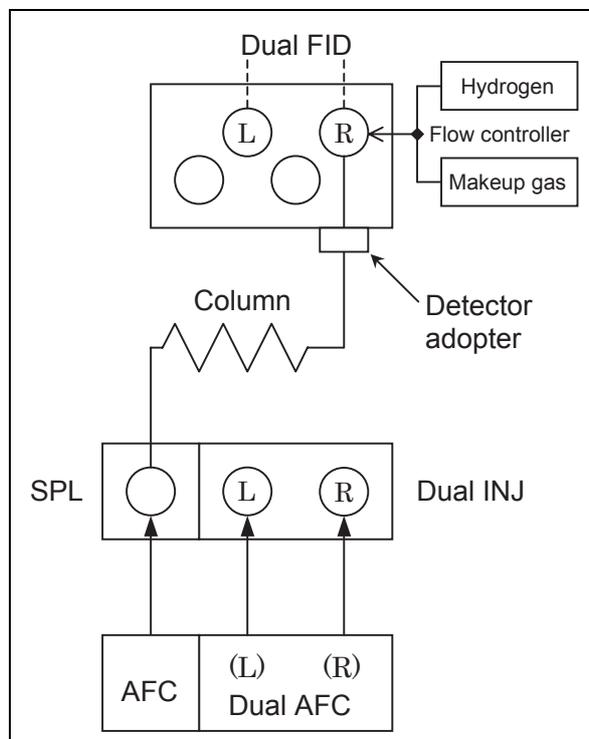
Fig. 4.3.1   Dual FID (flow controller)

■ **Setting analytical flow lines**

Setting analytical flow lines is described below.
For procedures to install an adopter and columns and input analytical conditions, refer to the operation manual.

1. Set a line.
- (1) Press the [SET] key and then press the [PF2] key (Line Config).
- (2) Set the SPL and dual FID (DFID) on a same line.
    LINE1 is specified in the example below. Lines 1 through 4 can be selected.

```
Line Configuration
|||||||||||||||||||| Injector ||||||||||||||||||||
◆▶[LINE 1]————        SPL
        ————        DINJ
|||||||||||||||||||| Detector ||||||||||||||||||||
[LINE 1]————        DFID
        ————        DTCD
|||||||||||||||||||| Option ||||||||||||||||||||
        ————        AOC1
        ————        AOC2




    ↵Return
```

2. Set the dual FID.
- (1) Press the [DET] key.
- (2) Set "Control mode" as described below.

```
Detector   DET #2    NOT READY
DFID [LINE 1]                    On
    Temp(℃)        0.0    150.0
    Flame                  Off
    Filter Time Constant   200ms
    Control Mode    ◆▶ Single R

    Signal Output Port      Ch1
    Background sig save      Off
    Background sig comp.     Off
    Det sig subtraction      Off
    Signal Attenuation       ×1
    Analog Signal Type      Wide



    Ignite  |  ---  | Ign.Set
```
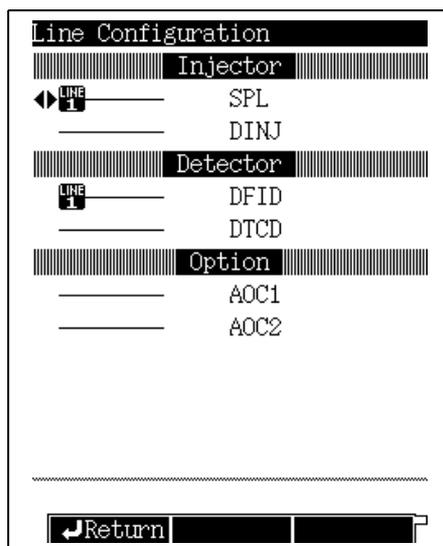
Set to "Single L" when the column is connected to the left (L) side of the dual FID and "Single R" when it is connected to the right (R) side.

4.4 Capillary TCD Analysis

To perform capillary analysis using a unit with the TCD, makeup gas needs to be supplied to the TCD joint that a column is connected to and carrier gas (called reference gas) also needs to be supplied to the TCD joint that a column is not connected.

In order to supply makeup gas, install the detector adopter with purge (P/N 221-34012-91) to the TCD joint. Connect the purge piping of the adopter to the dual INJ so that makeup gas is supplied from the dual AFC through the dual INJ.

(The dual AFC is off the line and operates as an independent mass flow controller.)

Reference gas is supplied from the dual AFC when the dual INJ and TCD are connected with a MF-MF joint.
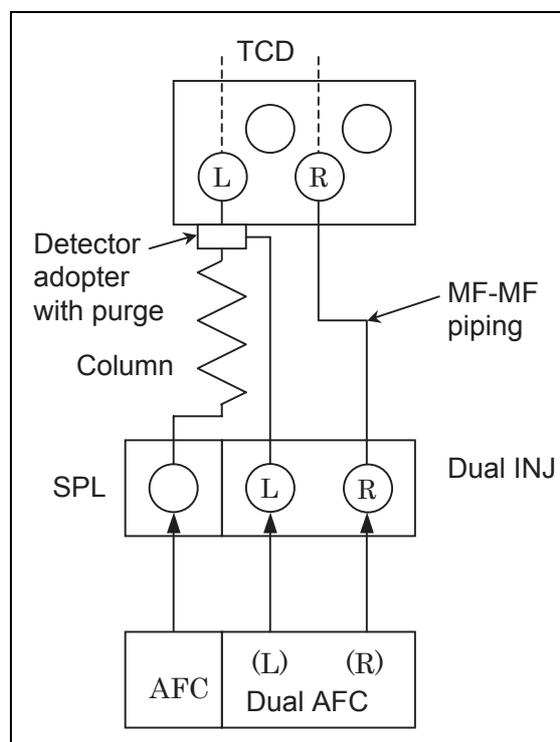
Fig. 4.4.1   Capillary TCD

The figure above shows an example where makeup gas and reference gas are connected to the left (L) and right (R) sides of the dual INJ respectively and a column and reference gas piping are connected to the left (L) and right (R) sides of the TCD respectively. They can be connected to either side (L/R).

> ## ⚠ CAUTION
> 1. Carrier gas (makeup gas and reference gas) has to be fed to both of left and right (L/R) sides of the TCD. Using the TCD without carrier gas will damage the filament.
> 2. When makeup gas and reference gas are supplied from the dual AFC, TCD filament's protection mechanism does not work even if an error occurs.

■ Setting analytical flow lines

Setting analytical flow lines is described below.

For procedures to install columns and input analytical conditions, refer to the operation manual.

1. Change the dual AFC configuration.
   (1) Select "6. GC CONFIGURATION" on the [FUNC] key screen and then select "9. Other configuration."
   (2) Specify "AMC.LR" at "DAFC unit."

```
Other Configurations
Language             English
Backlight auto off (sec)   0
Pressure unit            kPa
Beep volume              Hig
Beep tone                 Hi
Atmospheric compensation Off
Zero at Ready             On
Polarity in Ready       Open
SPL Primary Press
                   500-900kPa
DAFC Unit          ◆AMC.LR
DTCD Preamplifier        x1


    ↵Return
```

2. Set a line.
   (1) Press the [SET] key and then press the [PF2] key (Line Config).
   (2) Set the SPL and dual TCD (DTCD) on a same line.
        LINE1 is specified in the example below. Lines 1 through 4 can be selected.

```
Line Configuration
||||||||||||| Injector |||||||||||||
LINE1 ───────   SPL
||||||||||||| Detector |||||||||||||
      ───────   DFID
◆ LINE1 ──────  DTCD
|||||||||||||  Option  |||||||||||||
LINE1 ───────   AOC1
      ───────   AOC2



    ↵Return
```

NOTE If the dual AFC is specified for AMC.LR, the indication of DINJ disappears.

3. Set the makeup gas/reference gas flow rates.
   (1) Press the [OPTION] key.
   (2) The left (L) side of the dual INJ corresponds to AMC.L and the right (R) side corresponds to AMC.R. Start controlling both AMC.L and AMC.R and set the flow rates and gas types according to the connection of detector adopter and reference gas piping.

```
AUX AMC              NOT READY
AMC.L                      On
Press(kPa)       0.0
Flow(ml/min)     0.0     30.0
                         He

AMC.R                      On
Press(kPa)       0.0
Flow(ml/min)     0.0     30.0
                         He




                           ▽
  Offset   Next   On/Off
```

4. Set the TCD.
   (1) Press the [DET] key.
   (2) Set "Signal polarity" as described below.

   [+] : The TCD (L) - TCD (R) signal is outputted.
          (When a column is connected to TCD (L) and a sample that a plus peak is detected is injected)
   [−] : The TCD (R) - TCD (L) signal is outputted.
          (When a column is connected to TCD (R) and a sample that a plus peak is detected is injected)

```
Detector  DET #3    NOT READY
DTCD  1               ◆ On
Temp(℃)          0.0    300.0
Temp(℃)          0.0    300.0
Signal Polarity          +
Current(mA)             30
Filter Time Constant    1s

Signal Output Port      Ch1
Background sig save     Off
Background sig comp.    Off
Det sig subtraction     Off
Signal Attenuation      ×1
Analog Signal Type      Wide


  ---     ---     ---
```

NOTE TCD signals do not necessarily have a plus peak because they are determined by relationship of heat conduction between a substance to be analyzed and carrier gas. However, the data processing unit normally calculates the area of a plus peak. When a minus peak is detected, "signal polarity" needs to be inverted into a plus peak.

"Signal polarity" can be changed using the time program during analysis. (For detailed descriptions about setting the time program, refer to "16.3 Time Program.")

4.5 Single DET

To perform capillary analysis using a unit with the single DET (single FID, ECD, FPD, and capillary FTD), makeup gas is used as described below.
Install the detector adapter to the detector joint then install a column. Detector adapter comes with all single DET units listed above.

Single FID, ECD, and capillary FTD
A makeup gas flow controller comes with them.
FPD
Makeup gas is unnecessary.
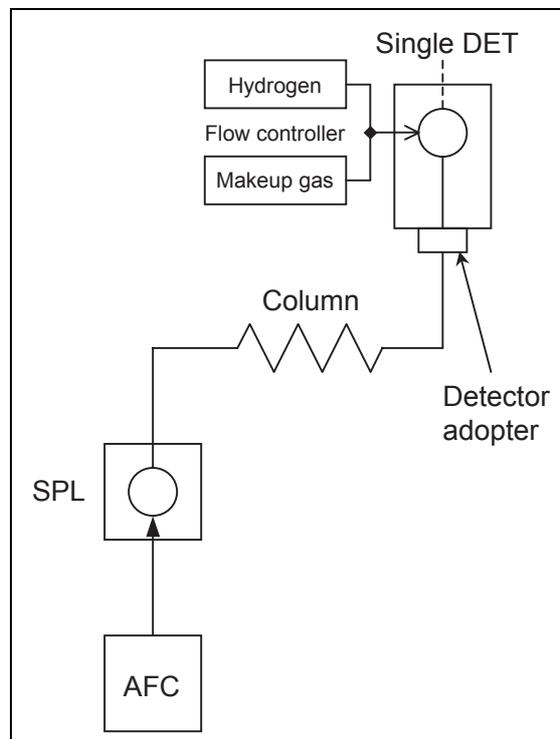
Fig. 4.5.1   Single DET (In case of FID)

■ **Setting analytical flow lines**

Setting analytical flow lines is described below.

For procedures to install columns and input analytical conditions, refer to the operation manual.

1. Set a line.

(1) Press the [SET] key and then press the [PF2] key (Line Config).

(2) Set the SPL and single DET (SFID in the screen below) on a same line.
LINE1 is specified in the example below. Lines 1 through 4 can be selected.

```
 Line Configuration
|||||||||||||||||||  Injector  |||||||||||||||||||
◆▶LINE──────      SPL
   1
|||||||||||||||||||  Detector  |||||||||||||||||||
   LINE──────      SFID
   1
|||||||||||||||||||   Option   |||||||||||||||||||
   LINE──────      AOC1
   1
   ──────          AOC2




~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ↵Return                                      P
```
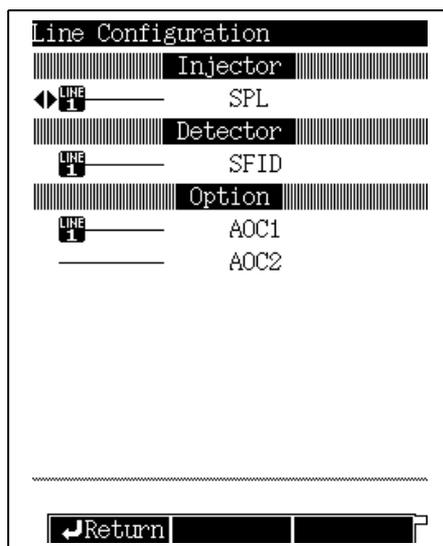
5.1 Analysis Flow Chart

For detailed descriptions about analysis procedures, refer to the operation manual.

5.1.1 Preparation

Injection port preparation

Select an injection port suitable to the sample injection method. Confirm that the septum and insert are properly attached.
Check dirt on the septum and the number of injections and replace it when necessary (after approximately 100 injections).

Column preparation

Attach the column to the injection port and detector correctly.

When the above preparations are complete, turn ON the GC (power switch on the lower right side of the GC).

5.1.2 Setting Parameters

Set the column information and the flow rates

Set parameters on the [FLOW] key screen. Set the column inner diameter, column length, and the film thickness on [Column] (PF menu). For the SPL and WBL, set the purge flow rate on [Purge] as well.
(When the column flow rate is set by the AFC, changing the column temperature changes the column flow rate.)

Set the temperature of the detector and the injection port

Set the temperatures on the [INJ] and [DET] key screens. (If the detector is set to "Off," turn it "On.") When the APC is used, set hydrogen, air, makeup gas, etc. from [DET Gas] (PF menu).

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.
When the dual packed INJ is used, a monitor injection screen to show the inlet to be used appears.

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

5.1.3   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.
When the baseline is stable, you can start analysis. Press [Zero Adg] (PF menu) to zero the detector output if necessary.

Inject the sample

Aspirate the sample in the syringe, inject it into the GC injection port, and press [START] to analyze it.

⚠ **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
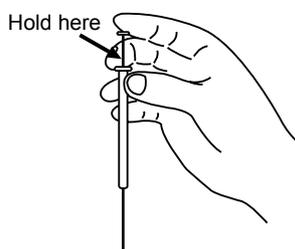
(Example)
How to hold a syringe when injection

5.2 Notes for Analysis

■ Analytical column

- Make sure that carrier gas is flowing through the column before increasing the column oven temperature because the column cannot separate compounds properly when its liquid phase is oxidized. This is especially important for polar columns. Press the [SYSTEM] key and set a start time so 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.
  Therefore, when analyzing an unknown sample, begin by analyzing it on a neutral column with a higher allowable temperature limit. Switch to a more polar column if necessary.

■ Sample injection modes(Capillary column analysis)

[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-2014 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-2014 is designed to control the temperatures so that the column temperature never exceeds 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:

· Using an AOC-20i auto injector is suggested in order to inject a sample to obtain highly reproducible results.

· Do not increase the temperatures of unused 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.

6.1 Keypad Description and Operation

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

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

6.1.1   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 auto injector, AUX temperature controller, AUX APC, AUX AMC, and 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.

6.1.2   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, " $\triangle$ " and " $\triangledown$ " are displayed in the message line. Scroll through the screen by moving the cursors.

| When the DINJ is used | When the SPL is used |

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.
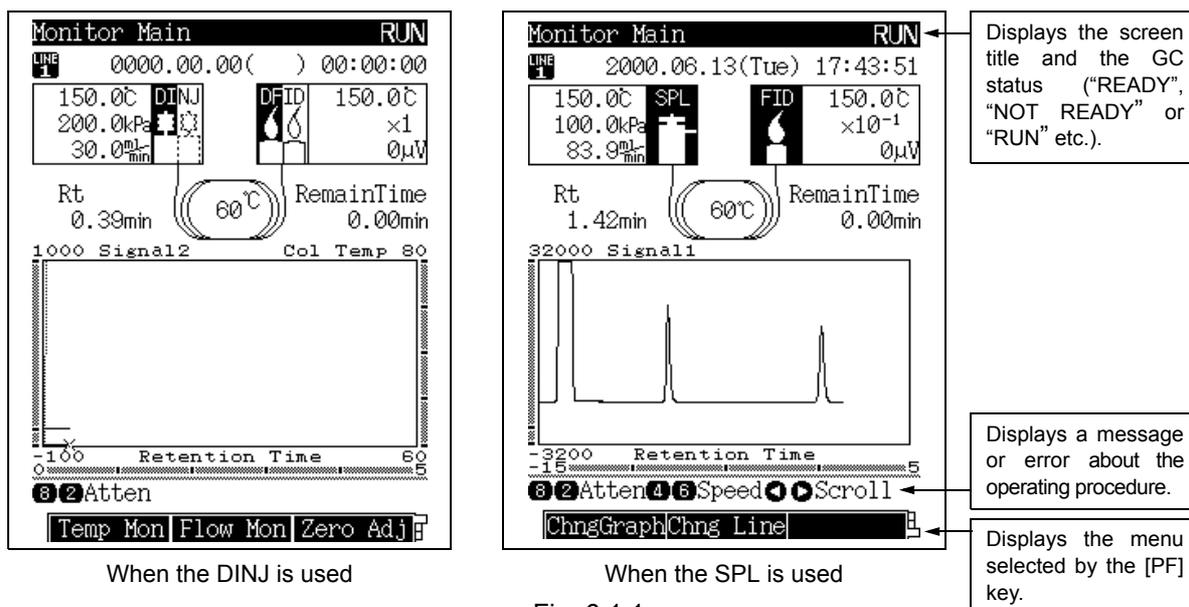
Fig. 6.1.1

■ [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.

When the DINJ is used   When the SPL is used
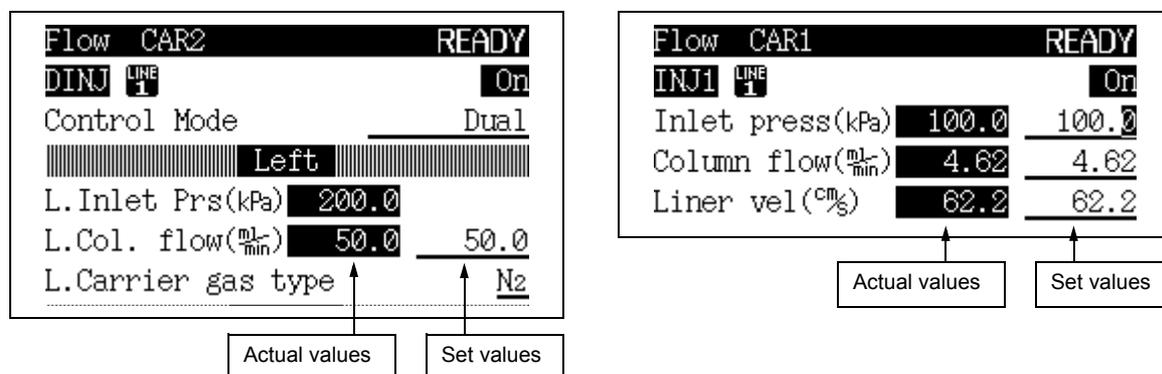
Fig. 6.1.2

6.1.3   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.

6.2 Adjusting The Display

NOTE In the following procedure, [Toggle] + [▽] key indicates that [▽] key is pressed while pressing and holding the [Toggle] key.

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.
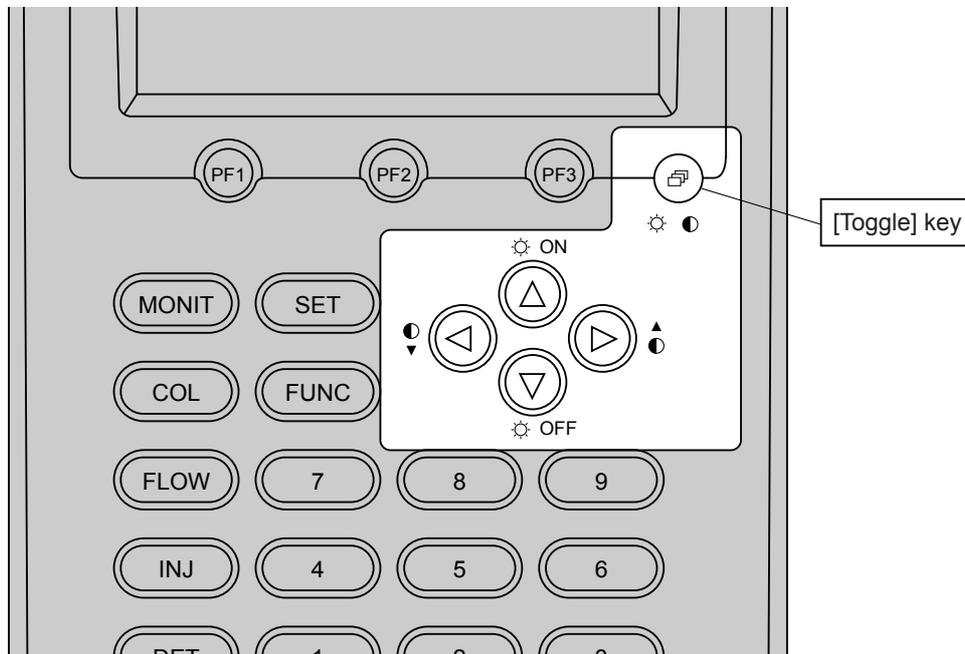
Fig. 6.2.1

6.3 **Basic Key Operations**

6.3.1 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.
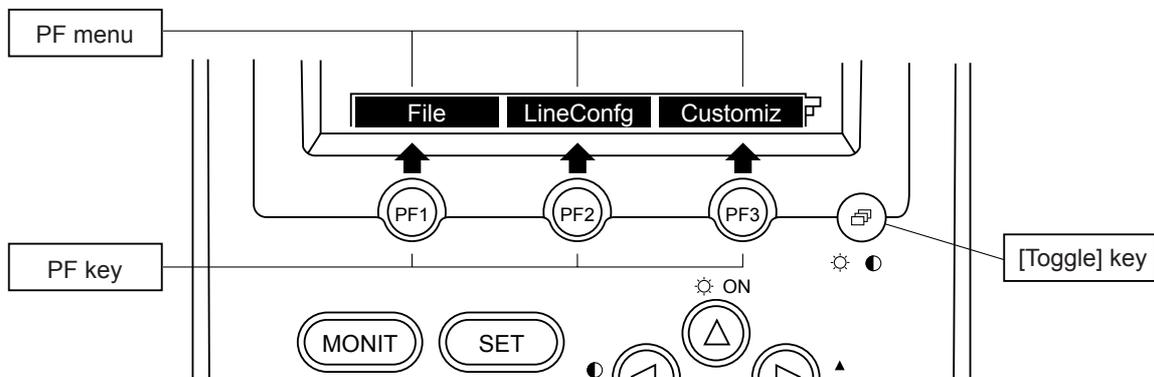
Fig. 6.3.1

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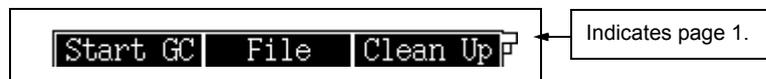
Press the [Toggle] key to display the 2nd page.

Indicates page 2.
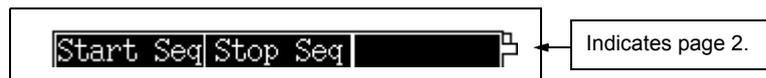
6.3.2   Moving the cursor

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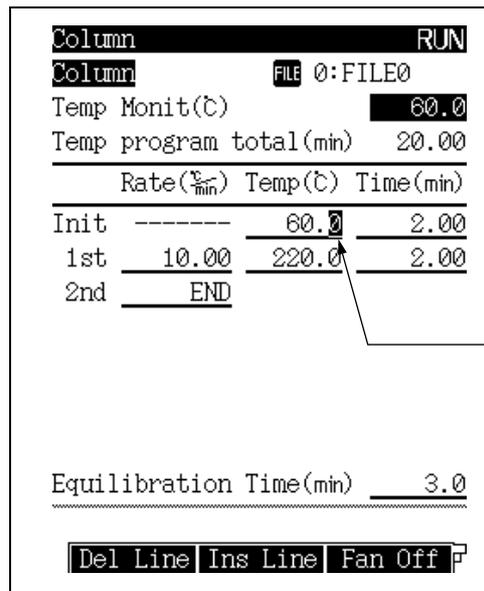
Move the cursor using the
[△], [▽], [◁] and [▷] keys.

Fig. 6.3.2

■ Moving the cursor using only the [△] and [▽] keys
Example: Main screen of the [FLOW] key
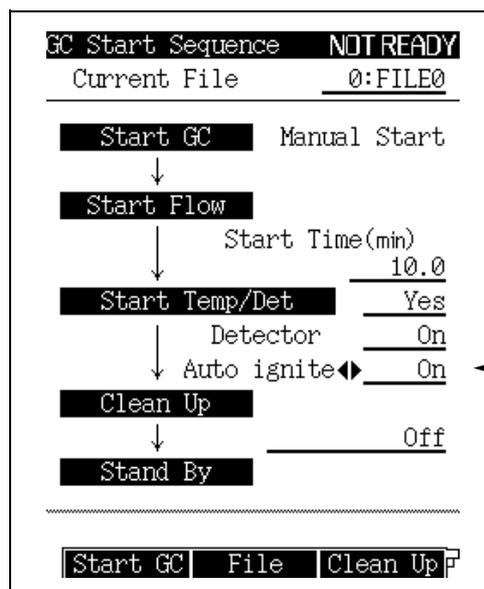
Move the cursor to each
parameter using the [△]
and [▽] keys.

Items marked with " ◁ " and
" ▷ " use the [◁] and [▷]
keys to change the selection.
In this case, the selection is
changed from On → Off → On.

Fig. 6.3.3

6.3.3 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.

6.3.4 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.
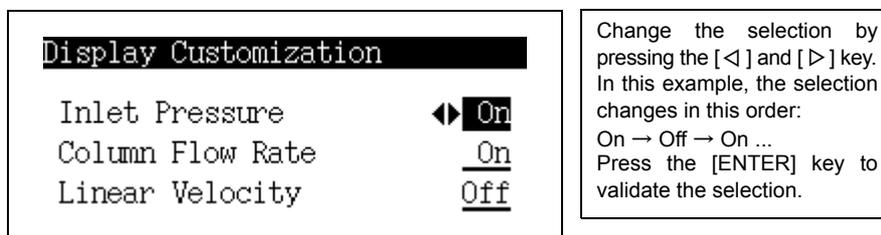
Fig. 6.3.4

6.3.5 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:FILE0
||||||||||||[File List]||||||||||||||
    0: SAMPLE
    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│NumerChr│LowerChr┃
```
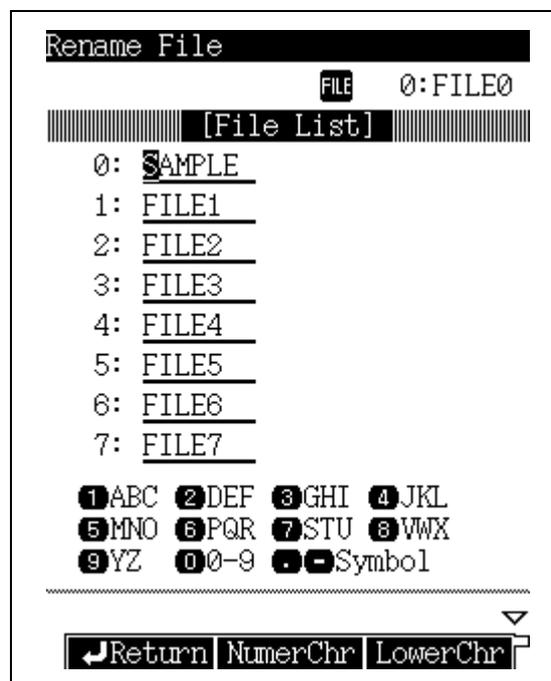
Fig. 6.3.5

■ **Entering characters**

Initially, the character input screen is in the upper case mode. Press [LowerChr] (PF menu) to select the lower case mode. Press [NumerChr] (PF menu) to select the 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.

6.4 Getting Help

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

6.4.1 Screen description

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, the screen shown in Fig. 6.4.1 appears when the [HELP] key is pressed on the [DIAG] key screen.

Items which may be difficult to understand are linked to further descriptions. Set the cursor on one of these underlined items and press [Display] (PF menu) to access to the linked descriptions. Fig. 6.4.2 shows the pop-up screen linked to the word "log" on the screen shown in Fig. 6.4.1.

| Help |
| Diagnosis |
| The diagnosis function checks if each part of the equipment is operating without a problem. |
| The execution of each test can be customized. |
| The result of this test is recorded on the log. |
| Temp sensor use time |
| The accumulated time of each temperature sensor used over 300C degree. |
| ↵Return Display --- |

[Display] →

[Back] ←

| Help |
| Log |
| The operation of the equipment is recorded on the log. |
| Operation log |
| The time record of the start and the stop. |
| Analysis log |
| The time record of the analysis. |
| Errors during the analysis are also recorded. |
| Parameter log |
| The record of the change of |
| ↵Return Display Back |

Fig. 6.4.1　Help screen

Fig. 6.4.2　Linked screen

6.4.2 PF menu

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

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.
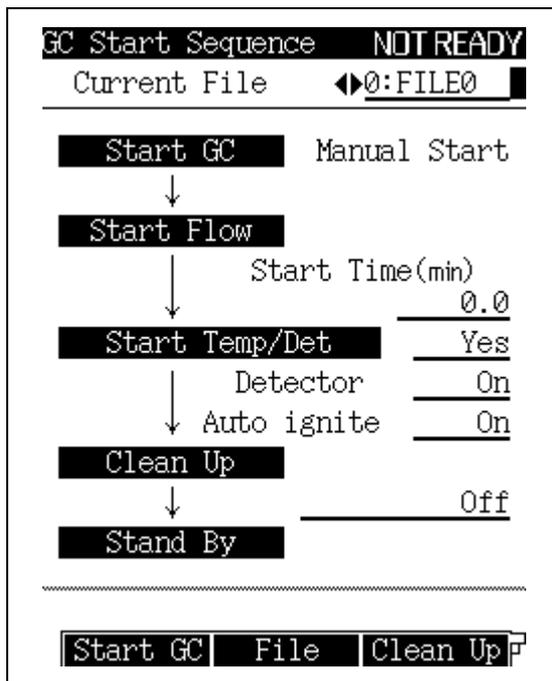
Fig. 7.1.1   Main screen accessed in system Off status
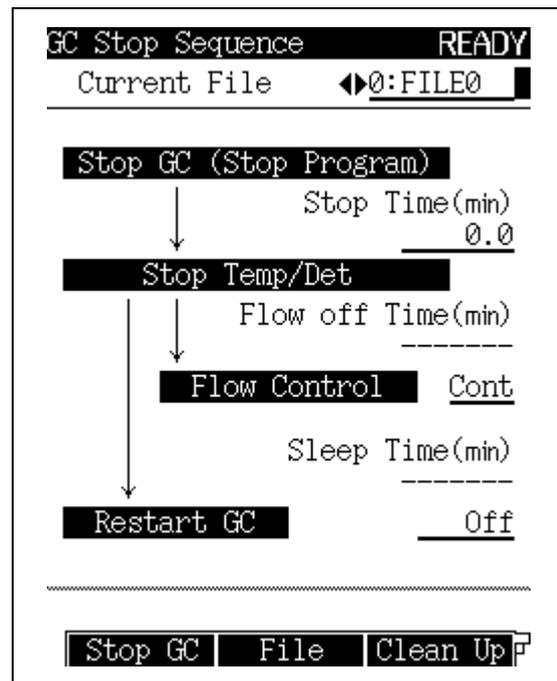
Fig. 7.1.2   Main screen accessed in system On status

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.	4.3 General maintenance procedures in the operation manual
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.

```
Clean Up                    READY
LINE                   FILE   0:FILE0
1
|||||||||||||||||| Column Oven ||||||||||||||||||
Temp(℃)              25.0      25.0
|||||||||||||||||||||| Flow ||||||||||||||||||||||
L.Col. flow(mL/min)   50.0      50.0
R.Col. flow(mL/min)   50.0      50.0
|||||||||||||||||||| INJ DINJ ||||||||||||||||||
Temp(℃)             250.0     250.0
|||||||||||||||||||| DET DFID ||||||||||||||||||
Temp(℃)             250.0     250.0



                                      ▽
    ↵Return|Temp Prog|Flow Prog
```
(a) DINJ

```
Clean Up                    READY
LINE                   FILE   0:FILE0
1
|||||||||||||||||| Column Oven ||||||||||||||||||
Temp(℃)              25.0      25.0
|||||||||||||||||||||| Flow ||||||||||||||||||||||
Inlet press(kPa)    100.0     100.0
Split ratio          50.0      50.0
Purge flow(mL/min)    3.0       3.0
||||||||||||||||||||| INJ SPL |||||||||||||||||||||
Temp(℃)             250.0     250.0
|||||||||||||||||||| DET DFID ||||||||||||||||||
Temp(℃)             250.0     250.0
|||||||||||||||||||| AMC AMC.L ||||||||||||||||||
Flow(mL/min)         50.0      50.0
                                      ▽
    ↵Return|Temp Prog|PressProg
```
(b) SPL

Fig. 7.2.1   Setting the clean up parameters

7.2.2　Parameter list

■ Main screen of clean up

• COLUMN OVEN

TEMP

Range: 0.0−400.0°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.

• FLOW

Dual packed INJ (DAFC is used)

L column flow rate, R column flow rate

Range: 0.0−100.0 ml/min, Default: 50.0 ml/min

Sets the initial pressure for the clean up column flow rate.

SPL(AFC is used)

INLET PRESS

Range: 0.0−970.0 kPa (Refer to Fig.12.2.5.), 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.12.2.15, 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

Temperature

Range: 0.0−400.0°C, Default: 250.0°C

Sets the injection port temperature for the clean up method.

• DETECTOR

Temperature

Range: 0.0−400.0°C (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.

Makeup flow rate

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

This sets the flow rate of an inert gas supplied to the detector side during clean up.

• AMC.L, AMC.R

Flow rate

Range: 0.0−100.0 ml/min, Default: 50.0 ml/min

Sets the AMC.L, R flow rate for the clean up method. (Usually equivalent to the flow rate of the inert gas supplied to the detector.)

This item is only valid when DAFC is set to AMC.LR.

• AUXAPC

Pressure

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.

• AUXAMC

Flow rate

Range: 0.0–100.0 ml/min, Default: 50.0 ml/min

Sets the AUXAMC flow rate for the clean up method. This item is only valid when an AUX AMC has been installed.

NOTE When a manual flow controller is used, turn the control of the pressure regulator to set a pressure.

■ 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   (when the AFC control mode is "pressure")

(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. 12.2.5.) , 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 flow rate program   (when the DAFC and AFC control mode is "flow rate")

(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: 0.0–100.0 ml/min (DAFC), 0.0–1,200.0 ml/min (AFC)

(refer to Fig. 12.2.5), 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. It is displayed when the control mode is "pressure" on the [FLOW] key screen of the AFC.	12.5.5
Flow Prog	Sets the flow rate for the clean up program. Sets the column flow rate program for the DAFC and the total flow rate program for the AFC. Display is possible for the DAFC and when the control mode is set at "flow rate" on the [FLOW] key screen of the AFC.	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 Specifying the Stop Procedures

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.
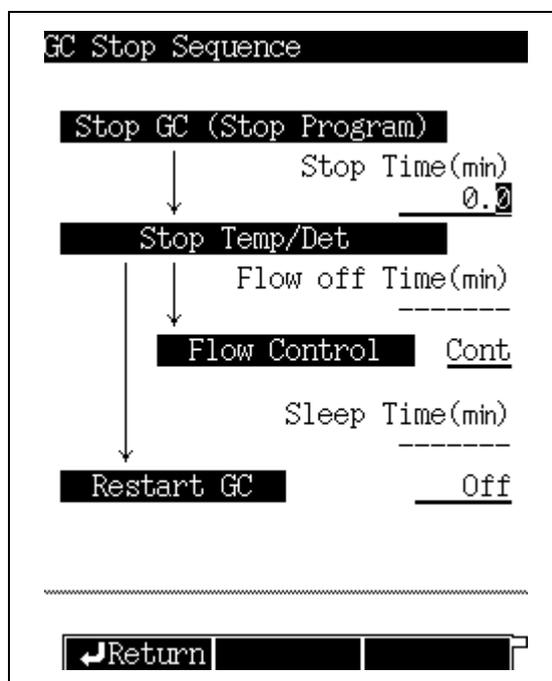
Fig. 7.4.1   Setting the stop procedures

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 of a line that consists of an injection port, detectors, and options connected to a column (two columns for the dual packed column INJ). The combination can be changed on the [Line Config] (PF menu) sub screen.

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.Temperatures are not controlled, and gases are not supplied, to components which are not part of the analytical flow line. Although two or more detectors can be set for a line, only one injection port can be set.
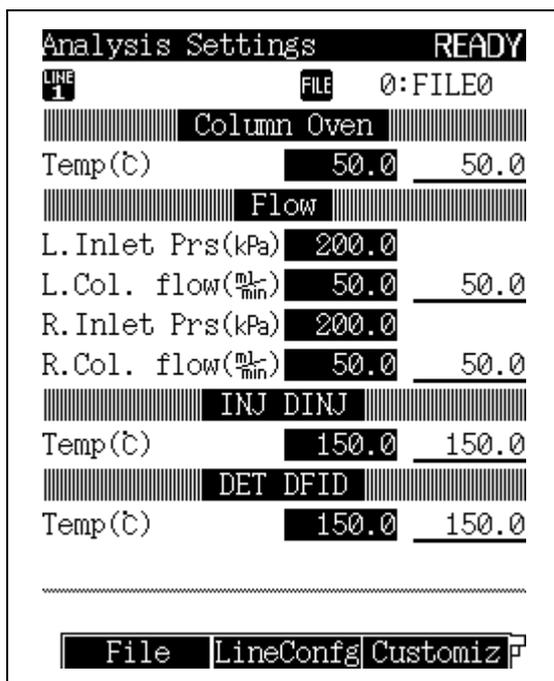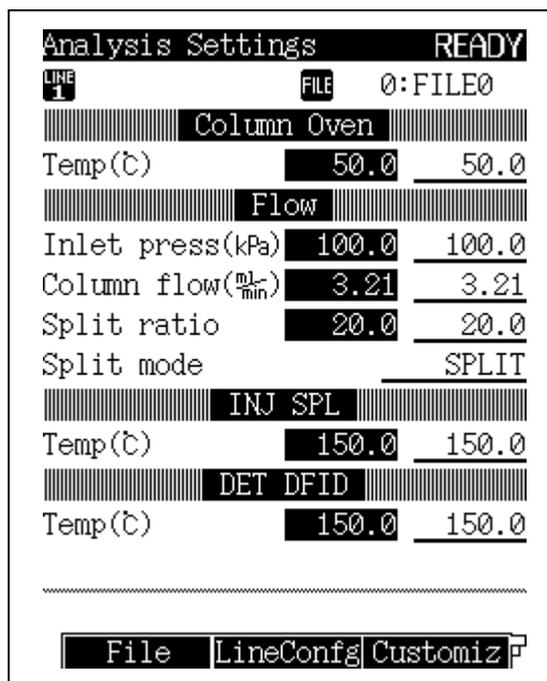
(a) When the DINJ is used   (b) When the SPL is used

Fig. 8.1.1   [SET] key main screen

8.1.2   Parameter list

• COLUMN OVEN

Range: 0.0–400.0°C, Default: 25.0°C

Sets the default temperature in the oven temperature program.

• Flow

When the packed INJ (DAFC) is used

L. inlet pressure, R. inlet pressure

Column inlet pressures are indicated. (L: left side, R: right side)

L. column flow rate, R. column flow rate

Range: 0.0–100.0 ml/min, Default: 50 ml/min

Enter the column flow rate. Set the initial flow rate to set a flow rate program. When the control mode is set to "Single L" or "Single R," only the specified side is displayed.

When the SPL, etc. (AFC) is used

INLET PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 12.2.5.), 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. 12.2.5.), 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

Range: Refer to Fig. 12.2.15, Default: 3.0ml/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. 12.2.2.) 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: 0.0–400.0°C, Default: 25.0°C

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

• DETECTOR TEMP

Range: 0.0–400.0°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.	——

8.2.1 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    ---
```
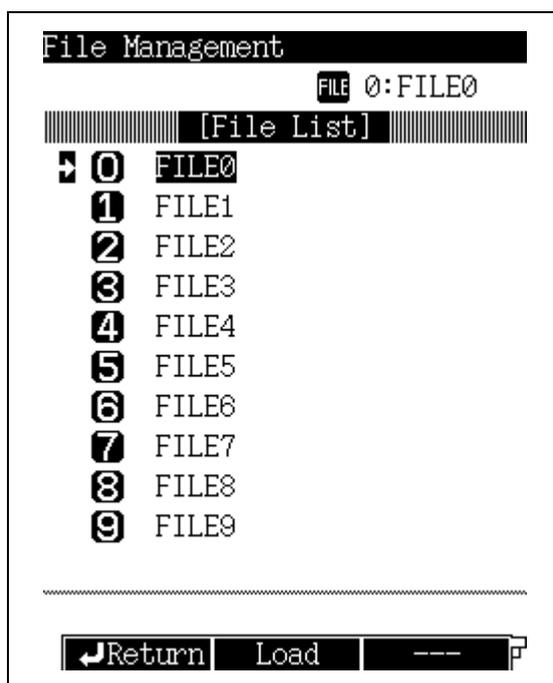
Fig. 8.2.1   File list screen

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.

```
Copy File
                    FILE 0:FILE0
Src. File : 0  Dst. File : 1
||||||||||||| [File List] |||||||||||||
   0   FILE0
   1   FILE1
   2   FILE2
   3   FILE3
   4   FILE4
   5   FILE5
   6   FILE6
   7   FILE7
   8   FILE8
   9   FILE9
File has been copied
  ↵Return  Copy
```
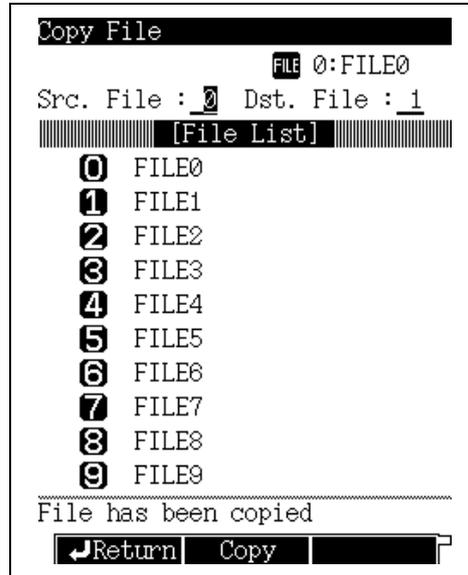
Fig. 8.2.2   Copying File

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 "6.3.5 Changing item names" for more information..

```
Rename File
                    FILE   0:FILE0
||||||||||||| [File List] |||||||||||||
   0:  SAMPLE
   1:  FILE1
   2:  FILE2
   3:  FILE3
   4:  FILE4
   5:  FILE5
   6:  FILE6
   7:  FILE7

   1ABC 2DEF 3GHI 4JKL
   5MNO 6PQR 7STU 8VWX
   9YZ  00-9  Symbol
                         ▽
  ↵Return NumerChr LowerChr
```
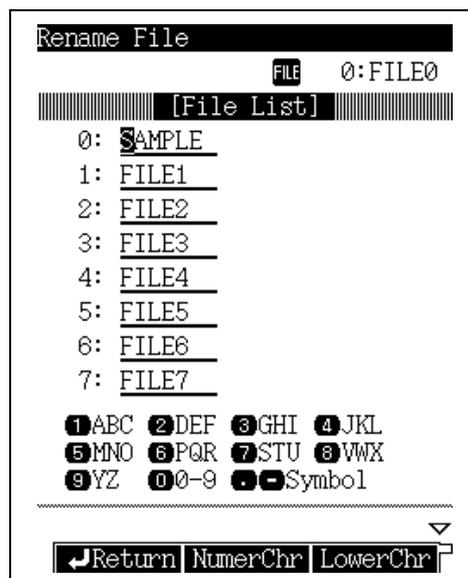
Fig. 8.2.3   Renaming a file

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.
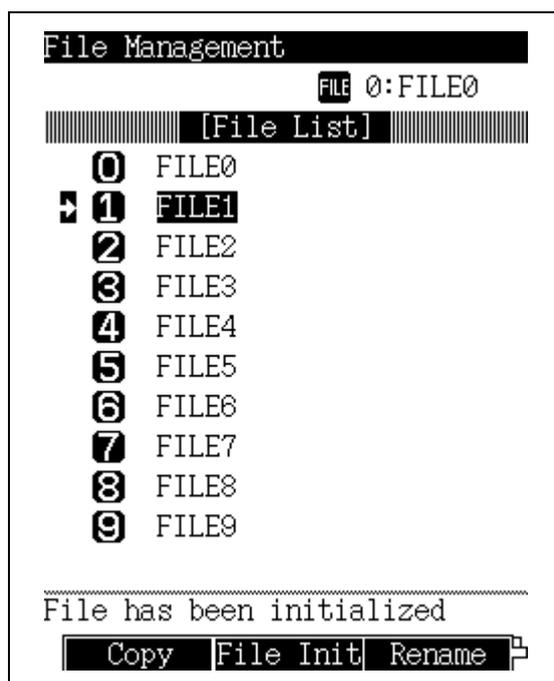
Fig. 8.2.4   Initializing a file

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 [△] and [▽] keys. Use the [◁] and [▷] to specify the analytical flow line (1-4) to which the component belongs. Press [Enter] to validate the selection. When two injection ports or two option units are selected for a same line, the previous unit setting is cancelled.
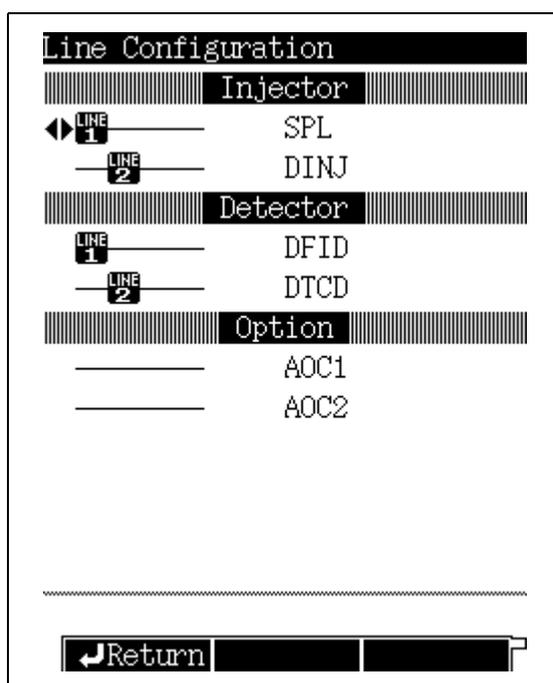
Fig. 8.3.1   Line configuration setup screen

NOTE   "DINJ" is not displayed on the line configuration setup screen when "AMC.LR" is set for "DAFC unit" on "OTHER CONFIGURATIONS" (16.6.11).
AUX temperature control, AUX APC, AUX AMC, manual flow controllers and dual AFC set to "AMC.LR" can be set and controlled regardless to flow line configuration settings.

■ Line configuration examples

SPL (split/splitless injection port) and DINJ (dual packed INJ) are installed as the injection port. DFID (dual hydrogen flame ionization detector) and DTCD (thermal conductivity detector) are installed as the detector.

(1) To use only a SPL and FID
Select the SPL and DFID for Line 1. In this case, only the temperature of the SPL and DFID will be controlled. Carrier gas (including detector gas if APC is used for detector gas) will be supplied.
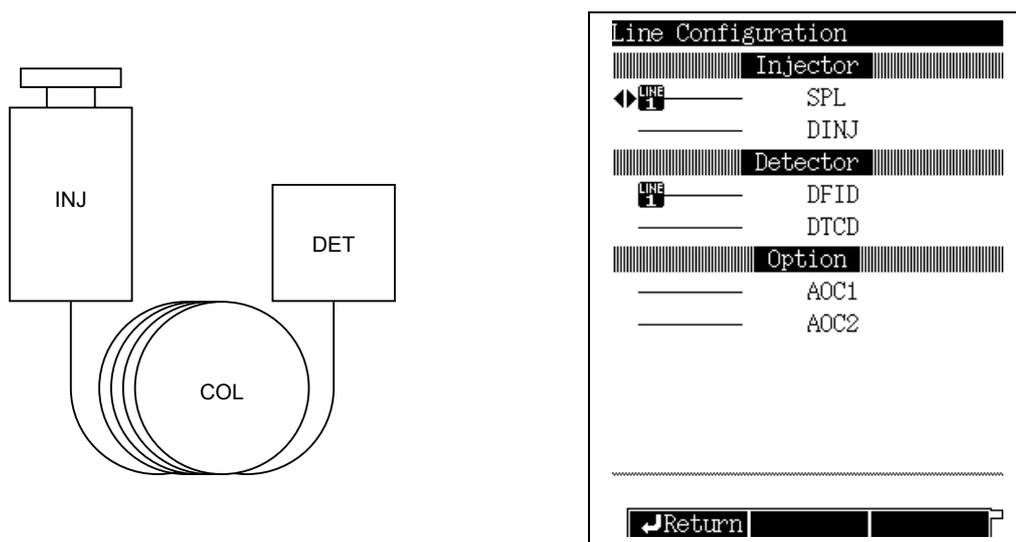
Fig. 8.3.2   Line configuration (Example 1)

(2) To use only a DINJ and DFID
Select the DINJ and DFID for Line 1. Two columns will make one line.
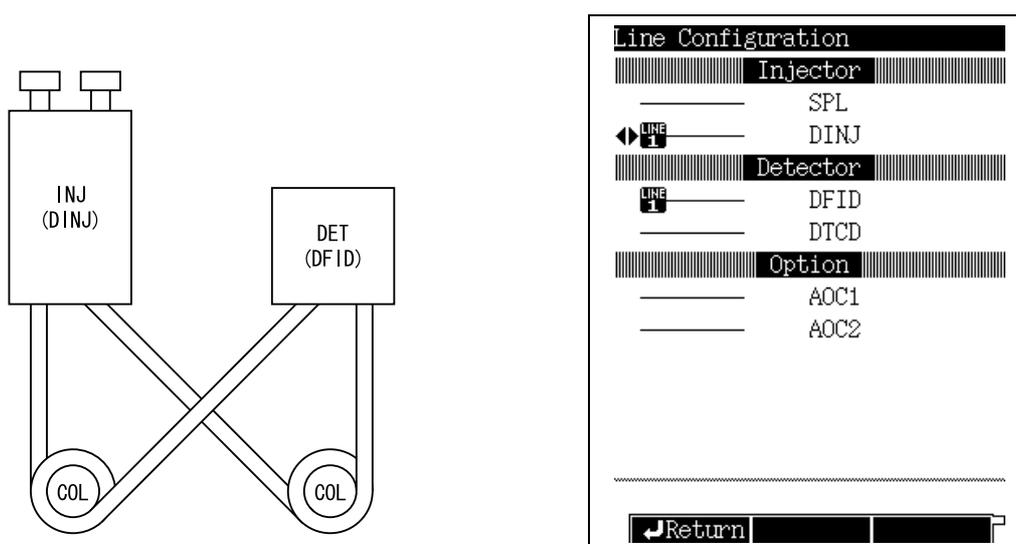
Fig. 8.3.3   Line configuration (Example 2)

In the following examples, the PFPD (packed column flame photometric detector) is installed as an additional detector.

(3) To use a SPL and FPD for one line and a DINJ and DFID for another line
Select the SPL and FID for Line 1 and the DINJ and DFID for Line 2.
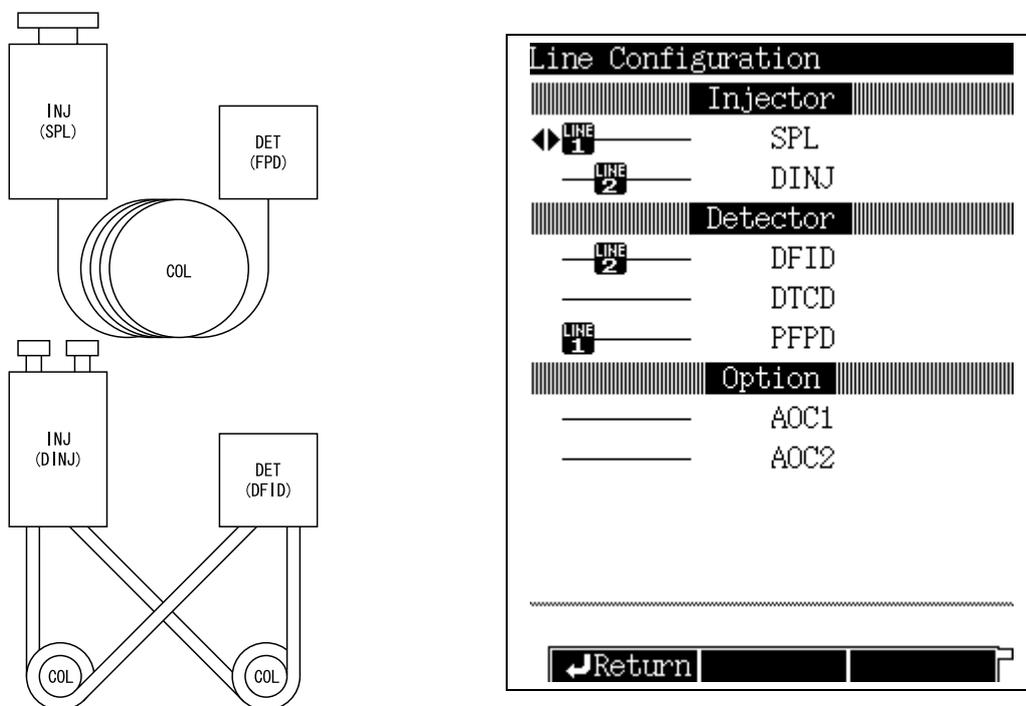
Fig. 8.3.4   Line configuration (Example 3)

(4) When using a single column connected to two detectors:
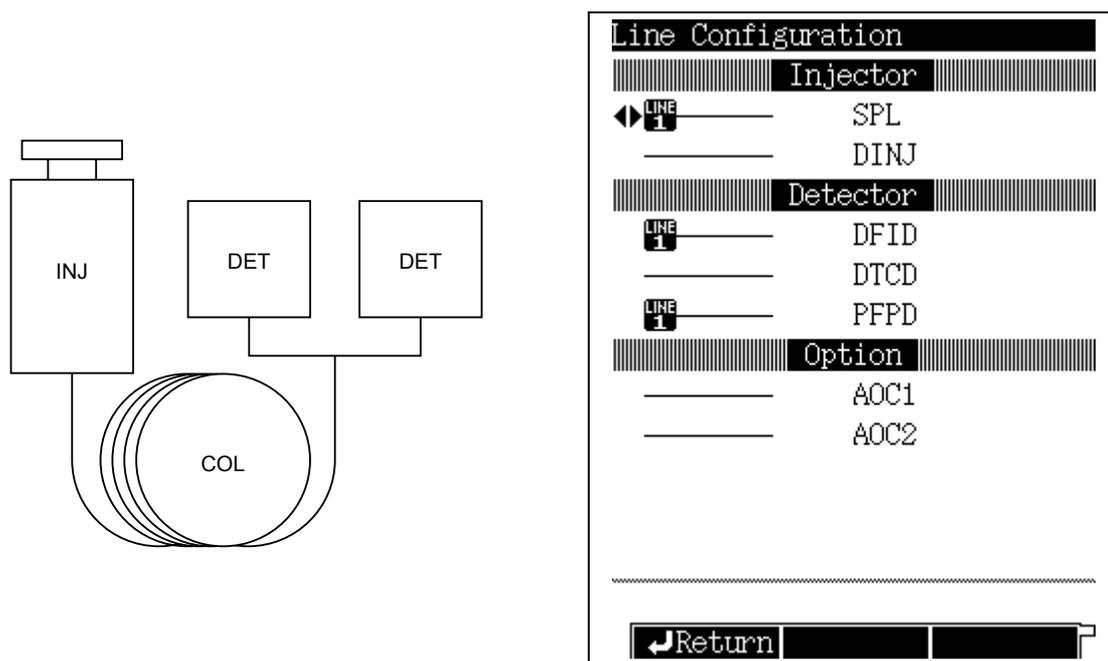
Fig. 8.3.5   Line configuration (Example 4)

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.

Settings are the same for all lines. However, for the dual AFC, only column inlet pressure, column flow rate, and control mode are displayed. For the AFC, when the sampling time is set to "On," the sampling time is only displayed on the SPLITLESS injection mode.

Move the cursor using the [$\triangle$] and [$\triangledown$] keys to select an item to be changed; select "On" or "Off" using the [$\triangleleft$] and [$\triangleright$] 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.
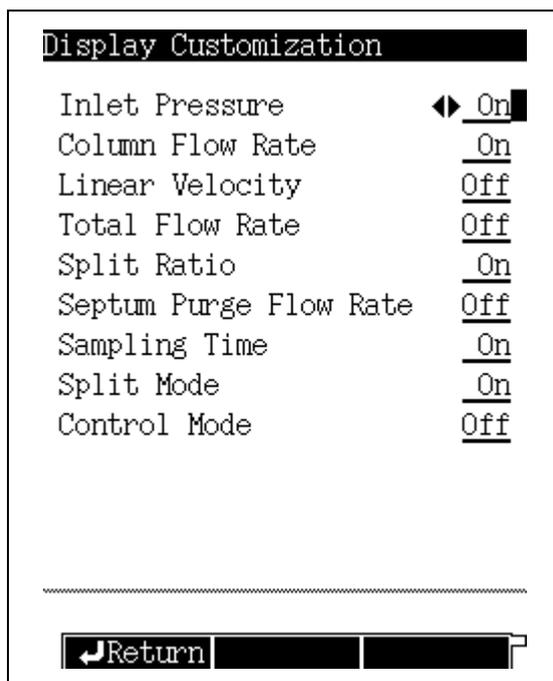
Fig. 8.4.1   Customizing the [Set] key main screen

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.

```
Monitor Main              RUN
LINE      0000.00.00(  ) 00:00:00
 1
 150.0℃ DINJ    DFID    150.0℃
 200.0kPa                   ×1
 30.0ml/min               0μV

 Rt                  RemainTime
 0.39min    60℃      0.00min
1000 Signal2        Col Temp 80




-100    Retention Time    60
                               5
❽❷Atten
 Temp Mon│Flow Mon│Zero Adj│
```

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:

Dual

Single
(Single L)

Flame = On   Flame = Off
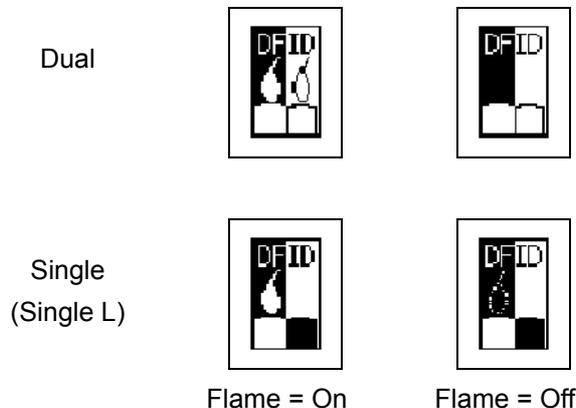
Fig. 9.1.2

■ 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.
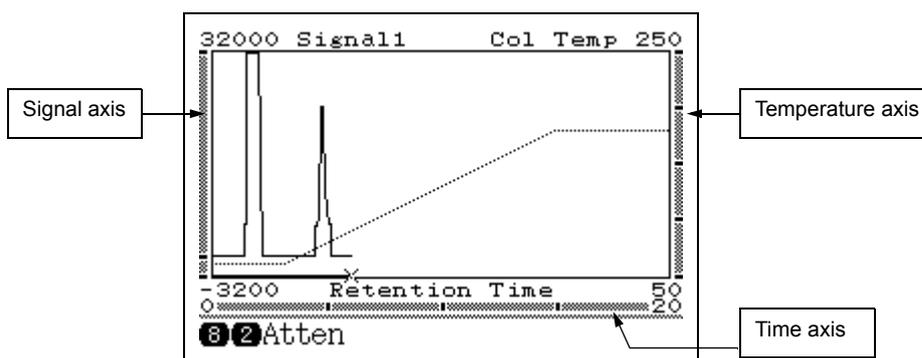
Fig. 9.1.3   Monitor screen (chromatogram and temperature program)
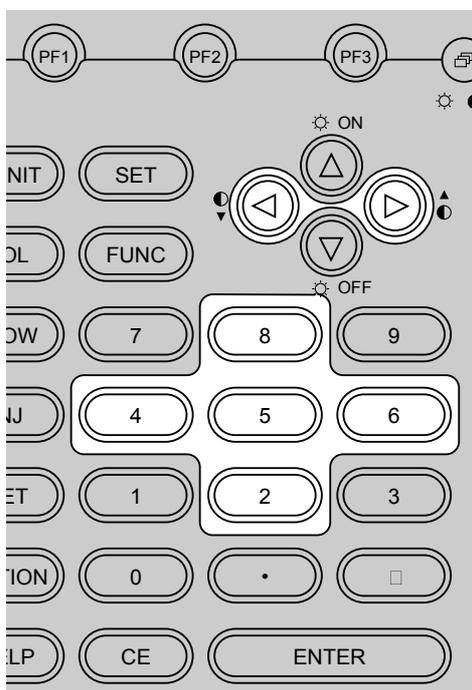
To magnify the time axis:

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.

The components that are included in the current analytical line are underlined.

```
Temp Monitor              READY
                    ACTUAL  SETTING
Column    Temp(℃)    50.0     50.0
SPL       Temp(℃)    35.0     30.0
DINJ      Temp(℃)   150.0    150.0
DFID      Temp(℃)   300.0    300.0
DTCD      Temp(℃)    35.0     30.0




⏎Return  Flow Mon
```
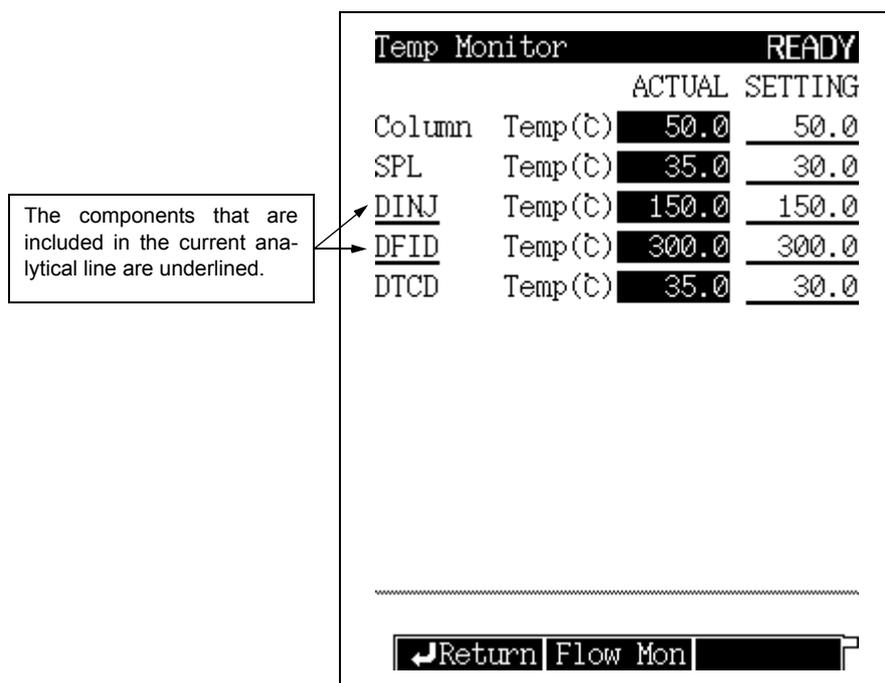
Fig. 9.2.1   Temperature monitor

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.	

```
Flow Monitor              READY
                  ACTUAL  SETTING
SPL   Inlet Prs. -----     100.0
      Total flow -----      84.0
      Purge flow -----       3.0
DINJ L.InletPrs  200.0
     Columnflow   30.0      30.0
     R.InletPrs   200.0
     Columnflow   30.0      30.0
DFID  L.H2 flow   40.0      40.0
     MakeUpFlow   30.0      30.0
       Air flow  400.0     400.0
     R.H2 flow    40.0      40.0
     MakeUpFlow   30.0      30.0
                            ▽
  ↵Return Temp Mon
```

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

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.
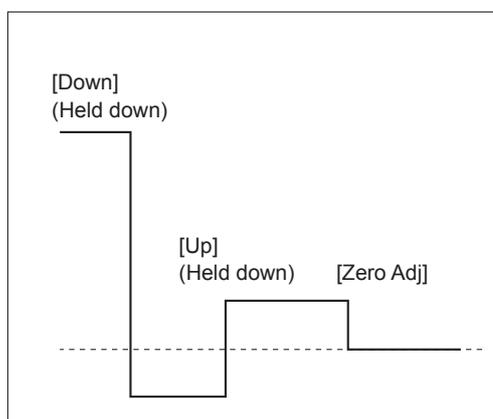
Since the [Down] has been held down too long, the zero point has deviated into the negative zone.

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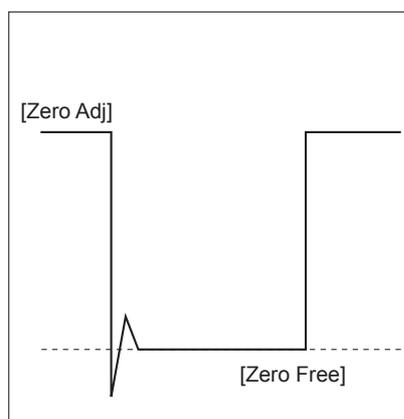
Fig. 9.4.2   Zero free adjustment

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.
For the TCD, press [Zero Free] first, turn the TCD zero point rough adjuster on the right side of the unit to set the baseline close to 0μ V, and then press [Zero Adj].

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-cause-adjustment control if necessary. (For a description of the items which determine the Ready Status, refer to "16.6.6 Setting the Ready Check Parameters".)

For the dual packed INJ, the STATUS light becomes green and also the monitor injection screen appears. Inject a sample following the directions displayed on the screen.

NOTE | Instructions on the monitor injection screen are based on the polarity settings of the detector. When settings are opposite from polarity in order to invert the peak, for example to analyze hydrogen using nitrogen carrier gas on the TCD, inject a sample into the opposite inlet of the one instructed on the screen.

Regular key operation is possible when the monitor injection screen is displayed. If there is no key operation for a minute, the screen display automatically returns to the monitor injection screen.
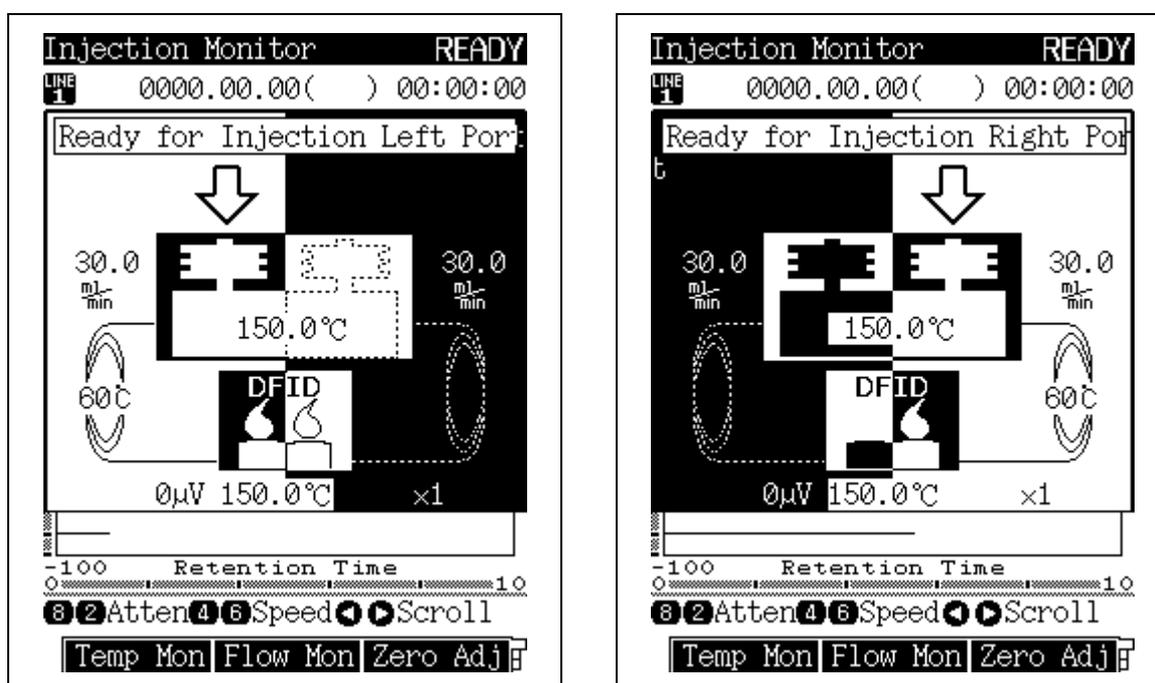
Fig. 10.1.1   Monitor injection screen

10.1.2 Making manual injection

■ Aspiration

1. **Preparation**
   ・ 10 µL Syringe
   ・ Sample
   ・ Rinse solvent
   ・ Liquid waste container
2. **Syringe handling precautions**
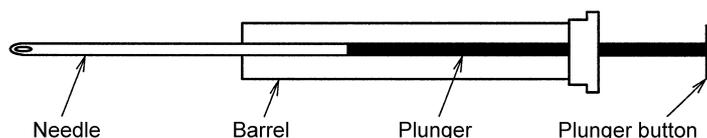
Fig. 10.1.2   Typical syringe

   ・ 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. 10.1.3

■ **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

Start an analysis program when the STATUS light is green.
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.

10.2.1 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.
  The [STOP] key of the Chromatopac needs to be pressed as well.

NOTE To prevent automatic start of Chromatopac, 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).

Start analysis using the computer. Control for both the gas chromatograph and computer is automatically stopped after a series of process is complete.
To inject a sample manually, start analysis using the computer so that data can be taken in, inject the sample, and press the [START] key of the gas chromatograph.
To pause analysis, use the computer to stop it.

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(C)           60.0
Temp program total(min)  2.00
      Rate(C/min) Temp(C) 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: 0.0−400.0°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" cannot be operated when the column oven temperature setting value is 40°C or higher or a program is 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)....	$\dfrac{T2-T1}{b}$
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 115V model	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 230V model	Up to200°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.	
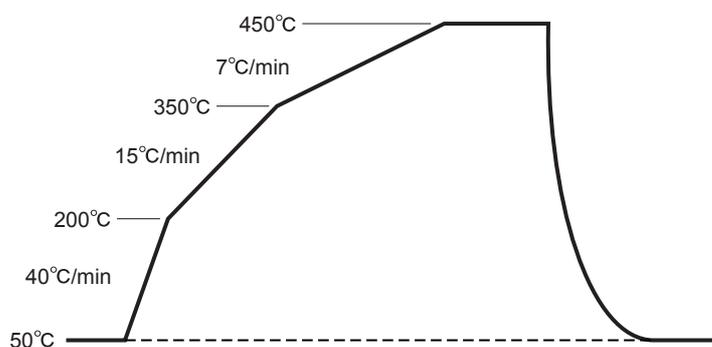
Fig. 11.2.4   Example of column oven temperature increase/decrease curve (115V model)

During analysis using packed columns, a sample is injected into an injection port and the entire evaporated sample is injected to the columns. A mass flow controller is used to control the column flow rate so gas is supplied at a specified flow rate even when the column flow path resistance and temperature change.

The GC-2014 packed model has an injection port that two packed columns can be attached to (dual INJ) as standard. An injection port that only one column is attached to (single INJ) is available as an option. For the single INJ, refer to its instruction manual.
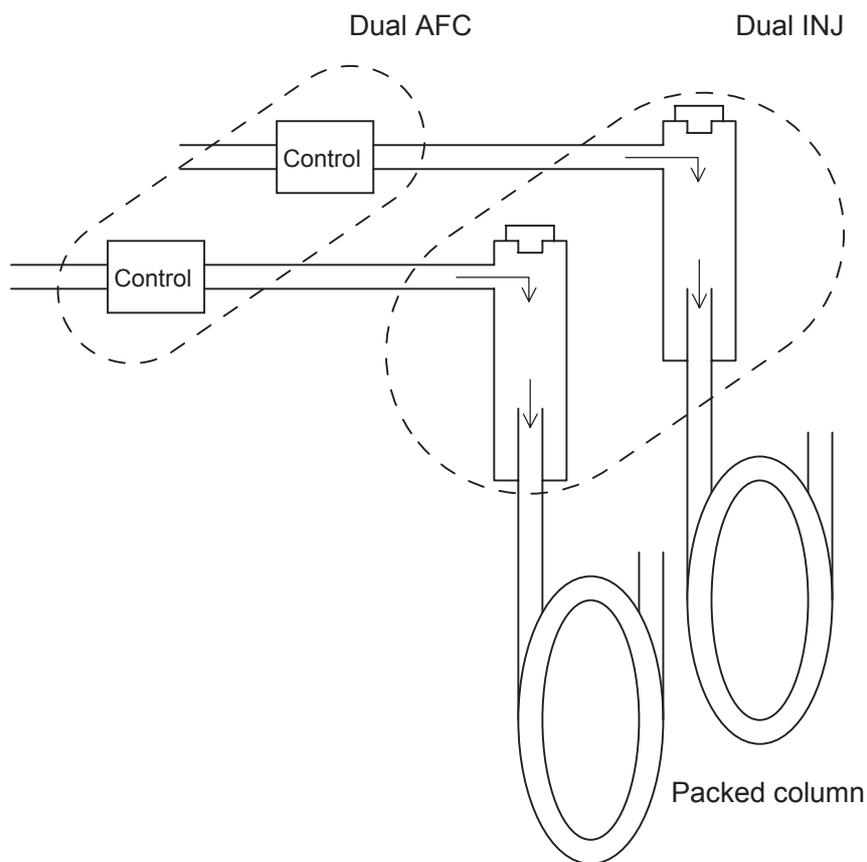
Fig. 12.1.1   Dual-column packed analysis

12.1.1 Setting the temperature with [INJ] key

12.1.1.1 Screen description

Press the [INJ] key to display the main screen shown in Fig. 12.1.2 and to set the temperature of the injection port.
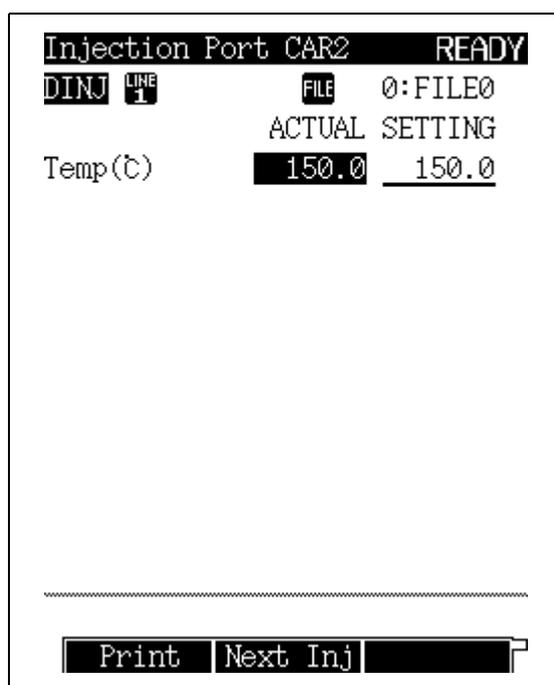
Fig. 12.1.2 [INJ] key main screen

12.1.1.2 Parameter list

TEMP

Range: 0.0−400.0°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".

12.1.1.3 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.	――

12.1.2 Setting the Flow Rate

12.1.2.1 Screen description

Press the [FLOW] key to display the screen shown in Fig. 12.1.3 and to set parameters for the dual AFC (Advanced Flow Controller) that controls carrier gas flow rate.

Flow rate of the column connected to the left inlet

Flow rate of the column connected to the right inlet

```
Flow  CAR2              NOT READY
DINJ ▤              On
Control Mode        ◆▶     Dual
▥▥▥▥▥▥▥▥▥▥ Left ▥▥▥▥▥▥▥▥▥▥
L.Inlet Prs(kPa)    0.0
L.Col. flow(㎖/min)  0.0    50.0
L.Carrier gas type           He
▥▥▥▥▥▥▥▥▥▥ Right ▥▥▥▥▥▥▥▥▥
R.Inlet Prs(kPa)    0.0
R.Col. flow(㎖/min)  0.0    50.0
R.Carrier gas type           He



┌ Column ┐┌  ---  ┐┌ On/Off ┐
```
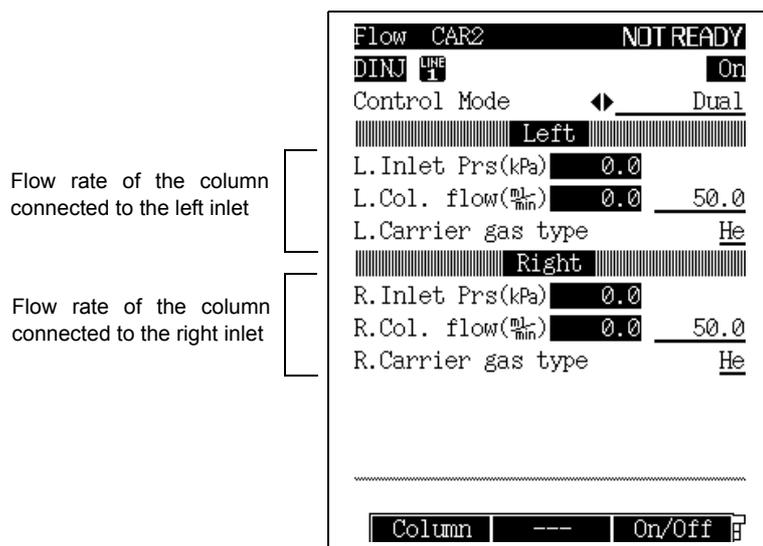
Fig. 12.1.3   FLOW key main screen

NOTE 1. When the control mode is set to "Single L" or "Single R," parameters of only specified side are displayed.
2. Inlet pressures can be monitored but cannot be set.

12.1.2.2 Parameter list

CONTROL MODE

Selection: Dual/Single L/Single R, Default: Dual

When the control mode is set to "Dual," flow controllers on both left and right inlets are controlled. When it is set to "Single L" or "Single R," a flow controller on either left or right inlet is controlled.

COLUMN FLOW RATE

Range: 0.0−100.0 ml/min, Default 50.0 ml/min

Set the flow rate of gas to be supplied to columns connected to left and right inlets. A mass flow controller is used to control the column flow rate so gas is supplied at a specified flow rate even when the column resistance changes due to a column replacement or the column temperature changes.

CARRIER GAS TYPE

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

Specify the type of carrier gas supplied to the AFC. This parameter is used for the measurement/control of the flow rate. If this parameter is not set correctly, calculations may not be performed correctly.

12.1.2.3 PF menu

PF menu	Description	Reference section
Column	Sets inner diameter, length, and film thickness of a column used. Values entered here are simply for notes and they are not used for flow rate calculations.	12.1.3
On/Off	Set the flow controller to be used to "On." When the GC starts, the AFC in the current analytical line which is set to be "On" is controlled.	――
L Flow prog.	Sets the flow rate program for the flow controller on the left inlet.	12.1.4
R Flow prog.	Sets the flow rate program for the flow controller on the right inlet.	
Offset	Performs offset calibration of the AFC sensor. This calibration contributes to good reproducibility of results.	12.4
Next Flow	Toggles among the AFC set up screens when two or more AFCs are installed in the system. The [FLOW] key can also be used to switch screens.	――

12.1.3 Entering Columns Parameters

Set values for column dimensions are not used for calculation for controlling the dual AFC. Values entered here are simply for notes.

12.1.3.1 Screen description

Select [Column] (PF menu) on the [FLOW] key main screen to display the screen shown in Fig. 12.1.4.
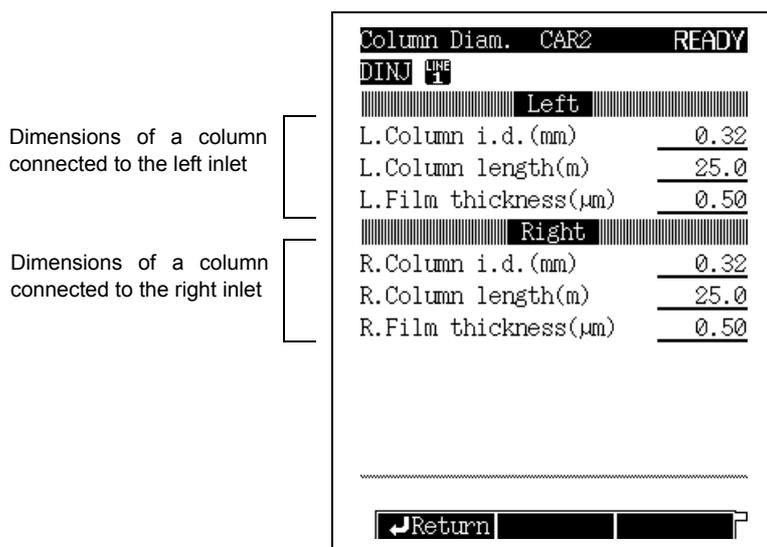
Fig. 12.1.4   Column parameters entering screen

12.1.3.2 Parameter list

COLUMN I.D. (internal diameter)
Range: 0.01–6.00 mm, Default: 0.32 mm
COLUMN LENGTH
Range: 0.1–250.0 m, Default: 25.0 m
FILM THICKNESS
Range: 0.00–300.00 μm, Default: 0.50 μm

12.1.4 Creating a Flow Rate Program

Column flow rate can be increased or decreased during analysis by making a flow rate program.

12.1.4.1 Screen description

Select [L. Flow Prog] or [R Flow Prog] (PF menu) on the [FLOW] key main screen to display the screen shown in Fig. 12.1.5.

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

```
Carrier Flow  CAR2        READY
DINJ ▊       FILE  0:FILE0
L.Flow monitor(㎖/min)       30.0
L.Program total(min)         0.00
     Rate(㎖/min²) Flow(㎖/min) Time(min)
Init  -------     30.0      0.00
 1st      END


↵Return Del Line Ins Line▛
```

Fig. 12.1.5   Flow rate program setup screen (e.g. L flow rate program)

12.1.4.2 Parameter list
FLOW RATE

Range: 0.00−100.0 ml/min, Default: 50 ml/min
Set the initial flow rate and the final flow rate for each stage of the flow rate program.

TIME

Range: 0.00−9999.99 min, Default: 0.00 min
Set the hold time for the initial flow rate and 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 final flow rate and time for that ramp can be entered.

12.1.4.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	⎯⎯
Ins Line	Inserts a line above the line that the cursor is positioned.	⎯⎯
Print	Prints the flow rate program through a Chromatopac.	⎯⎯

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.
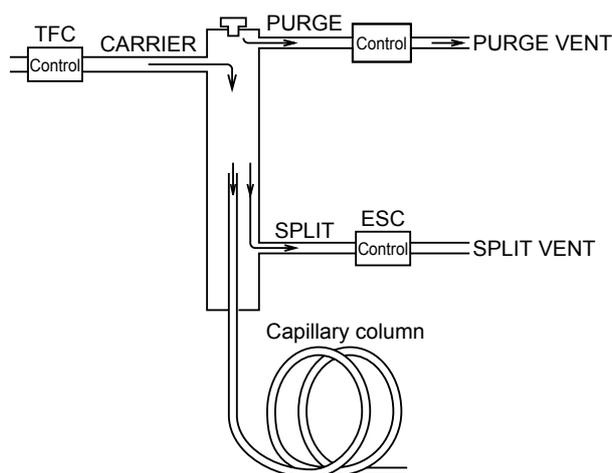
Fig. 12.2.1

■ 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.

(a) During sampling time

(b) After sampling time
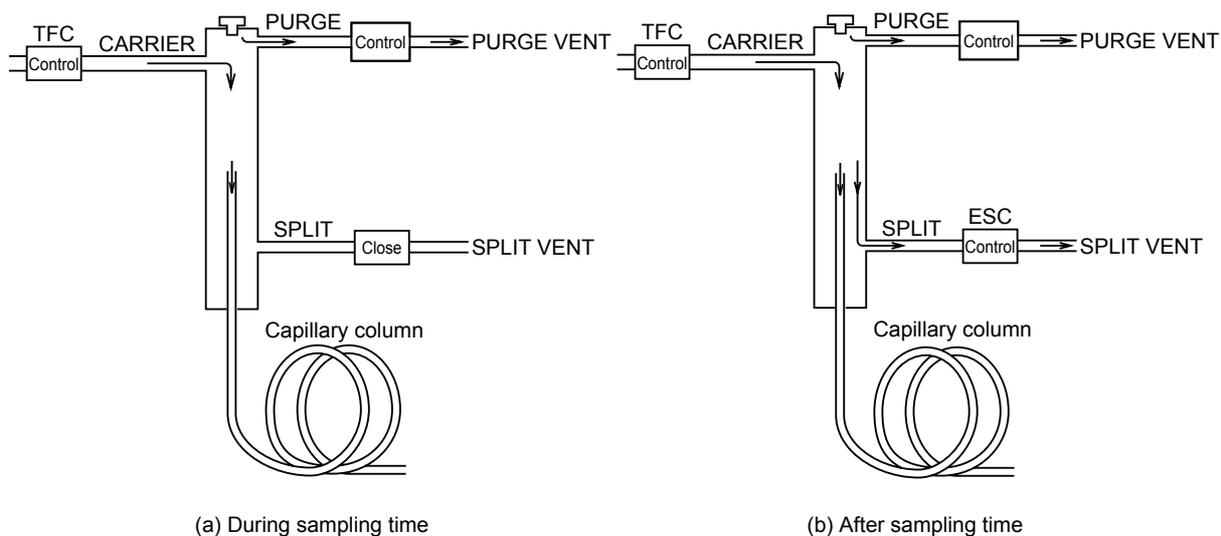
Fig. 12.2.2

12.2.1 Setting the temperature with [INJ] key

12.2.1.1 Screen description

Press the [INJ] key to display the main screen shown in Fig. 12.2.3 and to set the temperature of the injection port.

```
┌─────────────────────────────────┐
│ Injection Port CAR1        RUN   │
│ SPL1 LINE1          FILE 0:FILE0 │
│                 ACTUAL  SETTING  │
│ Temp(C)         100.0    100.0   │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ │
│    Print  Next Inj               │
└─────────────────────────────────┘
```
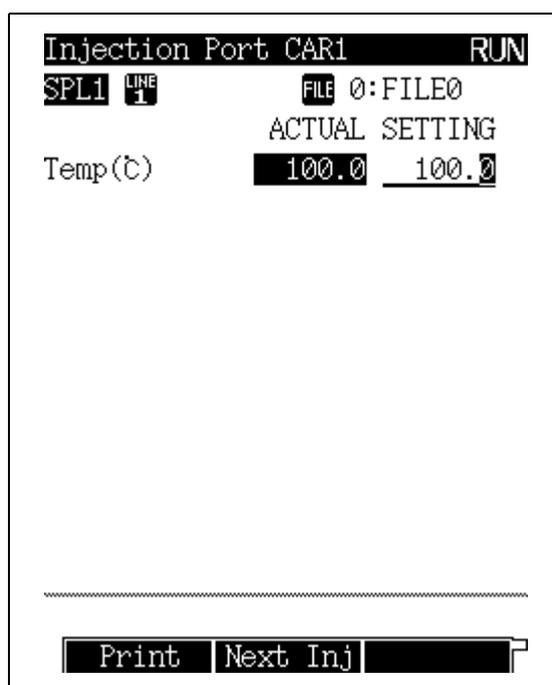
Fig. 12.2.3   [INJ] key main screen

12.2.1.2 Parameter list

TEMP

Range: 0.0−400.0°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".

12.2.1.3 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.	────

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 NOTE 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. 12.2.2.) 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 during an oven temperature program.

VELOCITY: Controls the system so that the linear velocity remains constant during an oven temperature program.

When the injection mode is set to "DIRECT"

PRESS:　Controls the system so that the column inlet pressure remains constant during an oven temperature program.

VELOCITY: Controls the system so that the linear velocity remains constant during an oven temperature program.

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.)

NOTE 1. Set the column inlet pressure and total flow rate so that they are within the ranges shown in Fig. 12.2.5.
The ranges differ according to the columns to be used and purge flow rates.
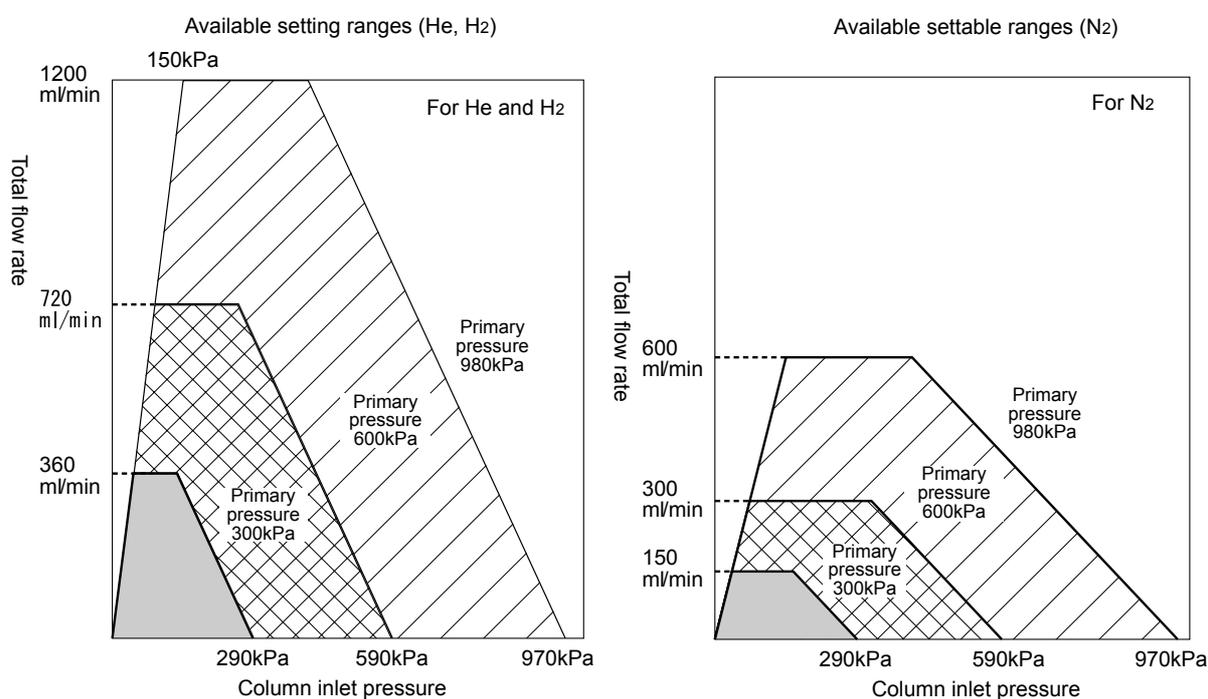
Fig. 12.2.5   Available setting ranges for the AFC

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

12.2.2.3 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	Set the flow controller to be used to "On." When the GC starts, the AFC in the current analytical line which is set to be "On" is controlled.	——
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.	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.	——

12.2.3 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.

12.2.3.1 Screen description

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

```
┌──────────────────────────────────┐
│ Column Diam.  CAR1        RUN     │
│ SPL 1  [LINE 1]                   │
│ Column i.d.(mm)          0.32     │
│ Column length(m)         25.0     │
│ Film thickness(μm)       0.50     │
│                                   │
│                                   │
│                                   │
│                                   │
│                                   │
│                                   │
│                                   │
│ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~  │
│  ↵Return                          │
└──────────────────────────────────┘
```

Fig. 12.2.6   Column setup screen

12.2.3.2 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 THICKNESS

Range: 0.00−300.00 μm, Default: 0.50 μm

Set the internal diameter, the length and film thickness of the capillary column in use. These parameter values are used for calculation (or the backward calculation) of the column head pressure based on the column flow rate or the linear velocity.

12.2.4 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.

12.2.4.1 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
```
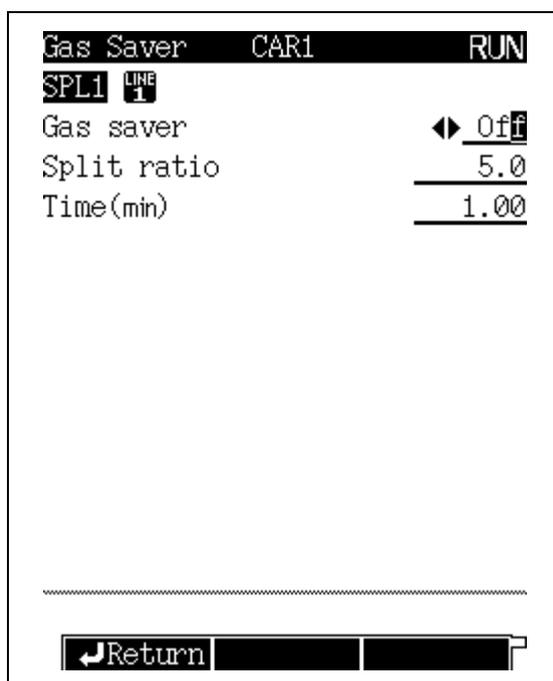
Fig. 12.2.7   Gas saver setup screen

12.2.4.2 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.

12.2.5 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.

12.2.5.1 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. 12.2.8 appears.

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

Fig. 12.2.8   Pressure program setup screen

12.2.5.2 Parameter list

PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 12.2.5.), 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.

12.2.5.3 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.	——

12.2.5.4 Setting a pressure program

■ Screen terminology

<1-ramp pressure program>
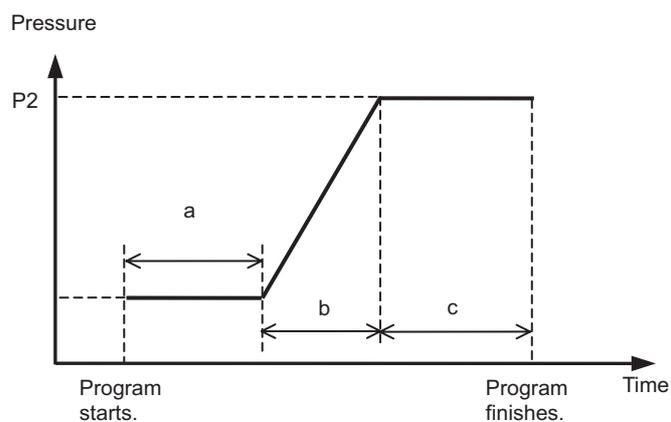
Pressure

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>

100kPa(5min)

4kPa/min

60kPa(2min)
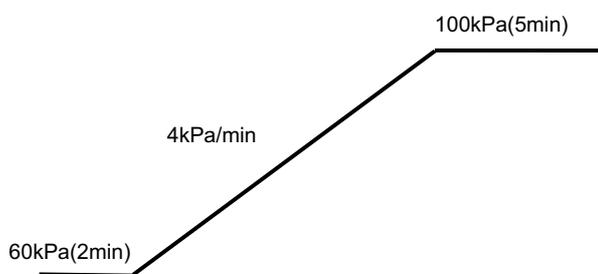
```
Carrier Press CAR1       READY
SPL1 LINE          FILE 0:FILE0
    1
Press monitor(kPa)         60.0
Program total(min)        17.00
      Rate(kPa/min) Pres(kPa) Time(min)
Init  -------    60.0     2.00
 1st     4.00   100.0     5.00
 2nd     END
```

```
 Return Del Line Ins Line
```

Fig. 12.2.9 Pressure program example

12.2.6 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.

12.2.6.1 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. 12.2.10.

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

Fig. 12.2.10   Flow rate program setup screen

12.2.6.2 Parameter list

FLOW RATE

Range: 0.00−970.0 ml/min (Refer to Fig.12.2.5.), 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.

12.2.6.3 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.	——

12.2.6.4 Setting a flow rate program

■ Screen terminology

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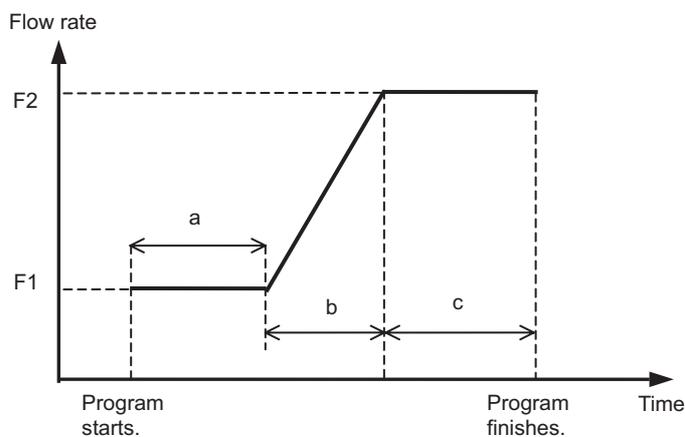
Initial flow rate   (FLOW).... F1
Initial flow rate hold time (TIME)...... a

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>
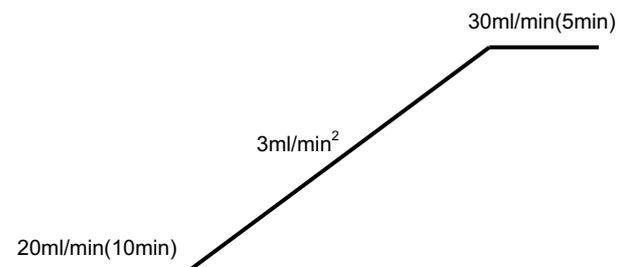
Fig. 12.2.11   Flow rate program example

12.2.7 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.

12.2.7.1 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. 12.2.12.

A program can contain up to 7 ramps.

Fig. 12.2.12   Split ratio program setup screen

12.2.7.2 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.

12.2.7.3 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.	――

12.2.7.4　Setting a split ratio program

■ Screen terminology

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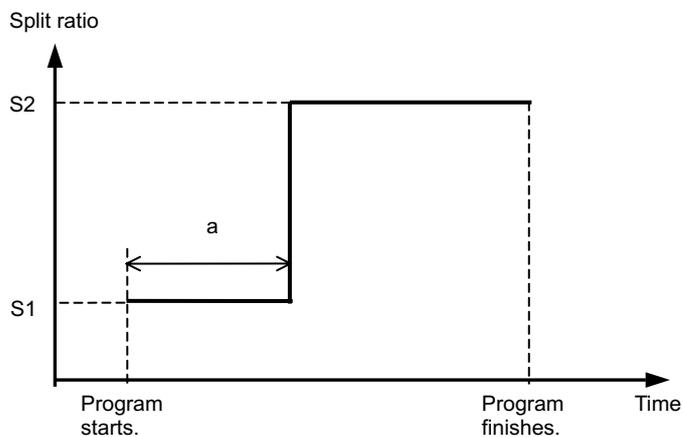
Initial ratio	（SPLIT）	······S1
Initial program run time	（TIME）	······a
Final ratio	（SPLT）	······S2

■ Program creation

<1-ramp program>

Fig. 12.2.13　Example of split ratio program

12.2.8 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.

12.2.8.1 Screen description

Select [Purge] (PF menu) from the [FLOW] key main screen to display the septum purge screen shown in Fig. 12.5.13.
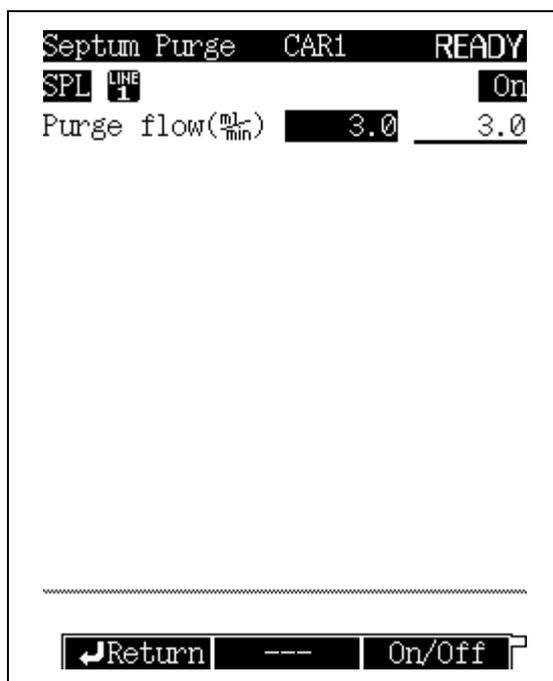
Fig. 12.2.14   Septum purge setup screen

12.2.8.2 Parameter list
FLOW RATE

Range: Refer to Fig. 12.2.15, Default: 3.0 ml/min
Sets the septum purge flow rate.
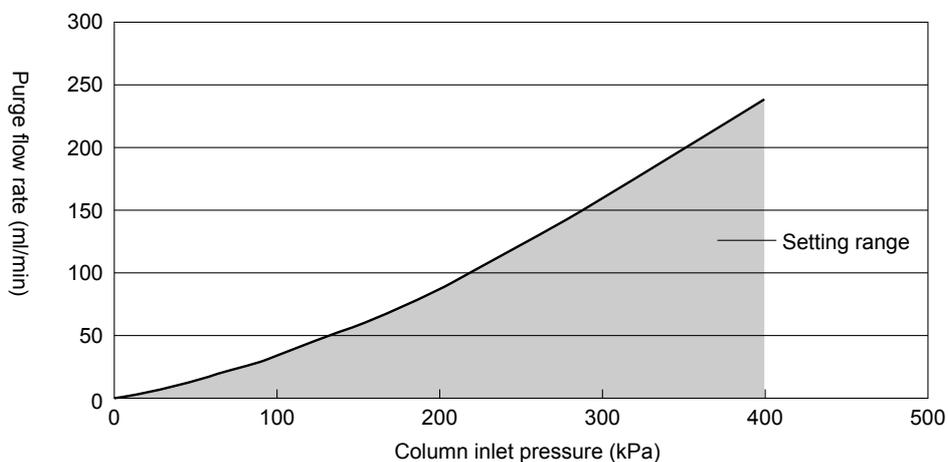
Fig. 12.2.15   Available setting range for the purge flow rate

12.2.8.3 PF menu

PF menu	Description	Reference section
On/Off	Set to "On" when the septum purge flow rate is applied	――

12.2.9 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.

12.2.9.1 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. 12.2.16.

Fig. 12.2.16 Setup screen for high pressure injection and splitter fix mode

12.2.9.2 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
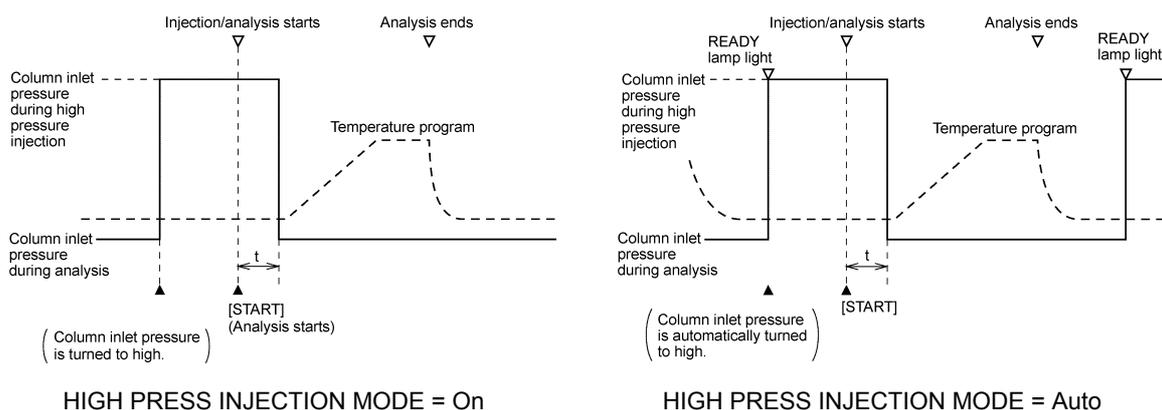
HIGH PRESS INJECTION PRESS

Range: 0.0−970.0 kPa (Refer to Fig. 12.2.5.), 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.*3* **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.
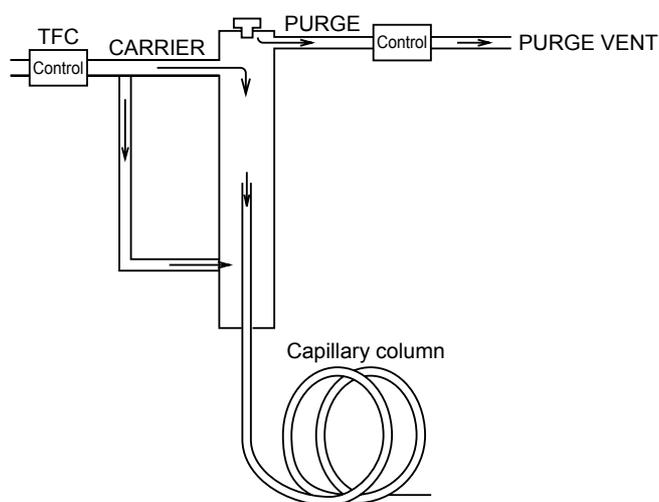
Fig. 12.3.1

12.3.1 Setting the temperature

12.3.1.1 Screen description

Press the [INJ] key to display the injection port main screen shown in Fig. 12.3.2 and to set the injection port temperature.

```
Injection Port CAR2      RUN
WBI 2            FILE  0:FILE0
                 ACTUAL SETTING
Temp(C)          100.0   100.0




                                    
      Print  Next Inj
```
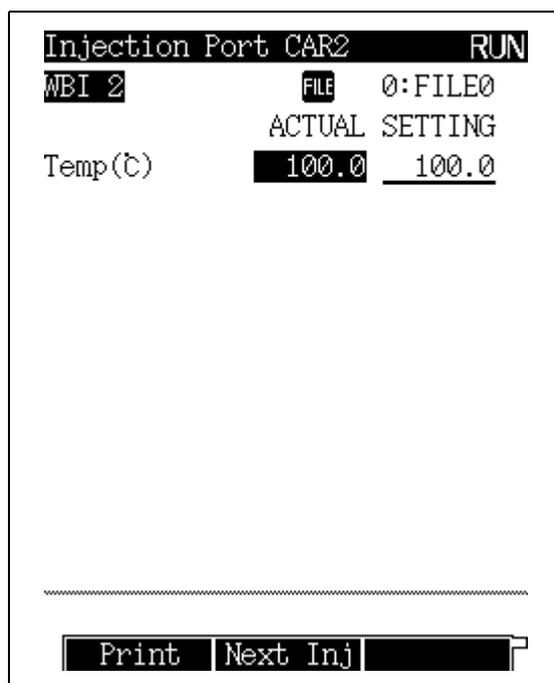
Fig. 12.3.2   [INJ] key main screen

12.3.1.2 Parameter list
TEMP

Range: 0.0–400.0°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".

12.3.1.3 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.	——

12.3.2 Setting the flow rate

12.3.2.1 Screen description

Press the [FLOW] key to display the main Flow Screen shown in Fig. 12.3.3. Set the AFC parameters to control the carrier gas pressure and the flow rate.

```
Flow  CAR2               READY
WBI 2                       On
Inlet press(kPa)  20.0    20.0
Column flow(ml/min)  7.51  7.51
Linear vel(cm/s)  56.0    56.0
Total flow(ml/min)  10.5
Control mode             PRESS
Carrier gas type            He




~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 Column      ---      On/Off
```

```
Flow  CAR2               READY
WBI 2                       On
Inlet press(kPa)  30.0
Total flow(ml/min)  10.0   10.0
Control mode              FLOW
Carrier gas type             He




~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 Column      ---      On/Off
```
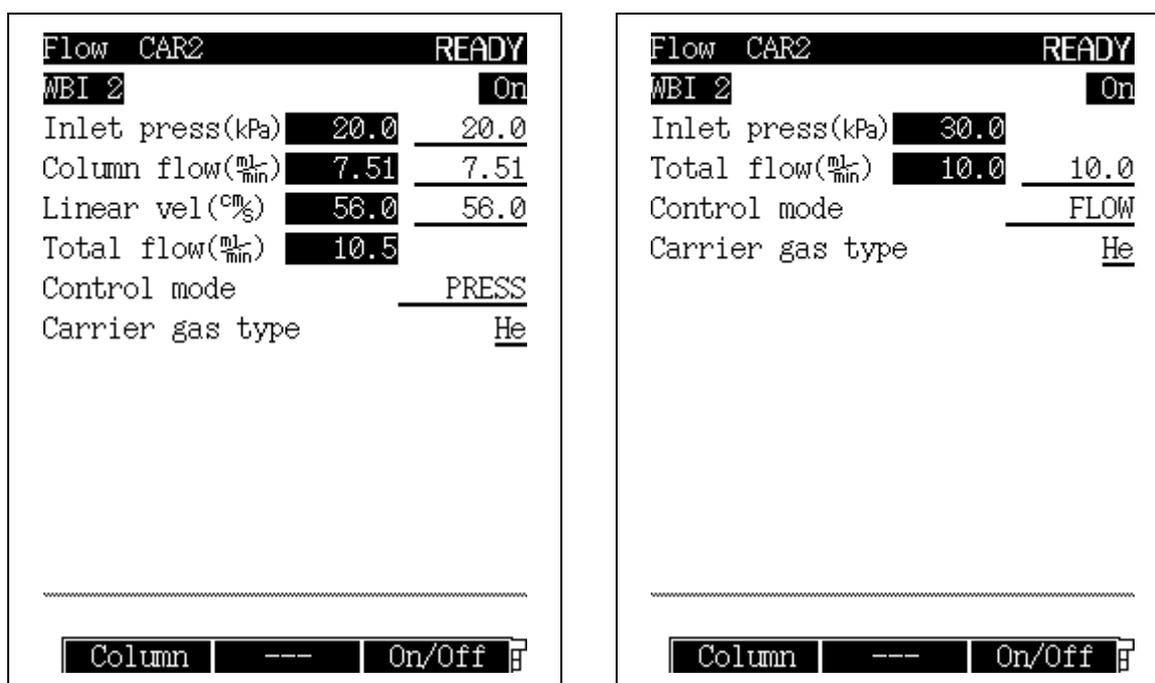
Fig. 12.3.3   [FLOW] key main screen

12.3.2.2 Parameter list

INLET PRESS

Range: 0.0−970.0 kPa, 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:(Refer to NOTE 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:(Refer to NOTE 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 during an oven temperature program.

VELOCITY: Controls the system so that the linear velocity remains constant during an oven temperature program.

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.)

NOTE   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.

12.3.2.3 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.	12.2.3
On/Off	Set the flow controller to be used to "On." When the GC starts, the AFC in the current analytical line which is set to be "On" is controlled.	────
Press Prog	Sets the column inlet pressure program.	12.2.5
FLOW Prog	Sets the total flow rate program.	12.2.6
Purge	Sets the septum purge flow rate.	12.2.8
Offset	Performs offset calibration of the AFC sensor. This calibration contributes to good reproducibility of results.	12.4
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.	────

12.4 AFC and APC Offset Calibration

The pressure and flow rate sensors of AFC and APC may become slightly off after long periods of use. If the sensor values deviate, "0.5 kPa" or "0.5 ml/min" is indicated for pressure or flow rate instead of zero even when there is no gas flowing.

In this case, perform the offset (zero point) calibration. Calibration is especially effective when data reproducibility is important.

Calibration procedures are as follows.
1. Set the temperatures of the injection port, column oven, and detector low and wait until they become 40°C or lower.
   (AFC calibration is performed when there is no gas flowing. Stopping gas when parts' temperatures are high may cause deterioration of columns.)
2. Press the [SYSTEM] key, select "Start Seq" (PF menu), and check the mode to start the GC when the power is turned on. If it is not set to "Manual Start," change it.
3. Turn off the power and reboot it.
   Rebooting leaves the unit at the state of SYSTEM OFF.
   Do not shut off gas supply by turning off the main valve or by any other measures. Performing calibration without primary pressure makes the zero point off.
4. To perform AFC calibration, completely empty out the gas by detaching the septum of the injection port.
   To perform APC calibration, wait until when the pressure or flow rate does not fluctuate.
5. Press the toggle key on each flow controller's parameter setup screen until the "Offset" PF menu is displayed. For AFC, press the [FLOW] key once and the toggle key twice.
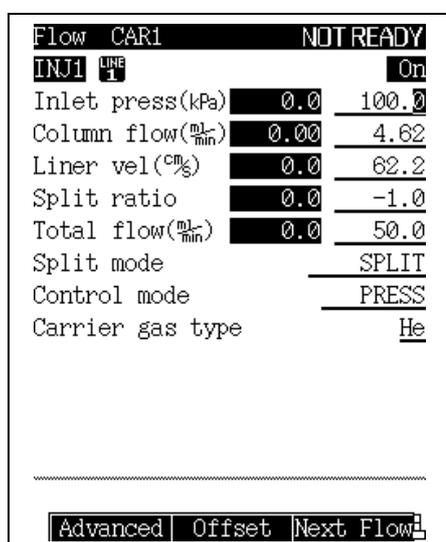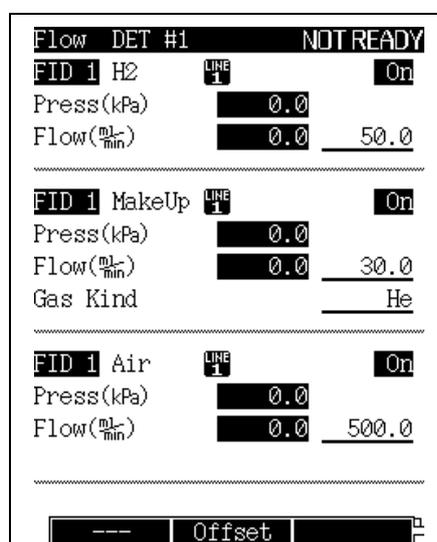
Fig. 12.4.1   (AFC)   Fig. 12.4.2   (APC)

6. Press "Offset" (PF menu).
   The message "Zero Calibration Start" appears. Approximately 10 seconds later, the message "Zero calibration completed" appears indicating that the calibration is complete.
7. Return the septum of the injection port to its original position if it has been detached.

■ **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.
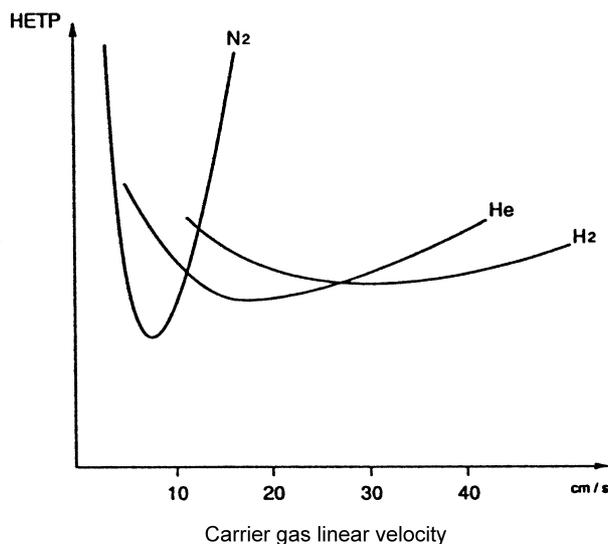
Fig. 12.5.1   Effect on linear velocity and HETP for various carrier gases (H-V curve)

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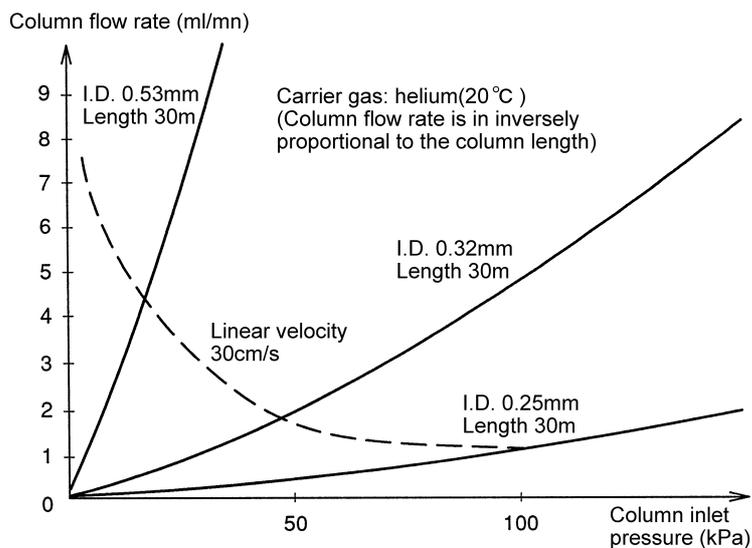
$$Fc = \frac{60\,\pi\,d^4}{256\mu L} \times \frac{(P + P_0)^2 - P_0^2}{P_0} \times 10^3$$

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. 12.5.2

13.*1* Hydrogen Flame Ionization Detector (FID)

13.1.1 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. 13.1.1.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.
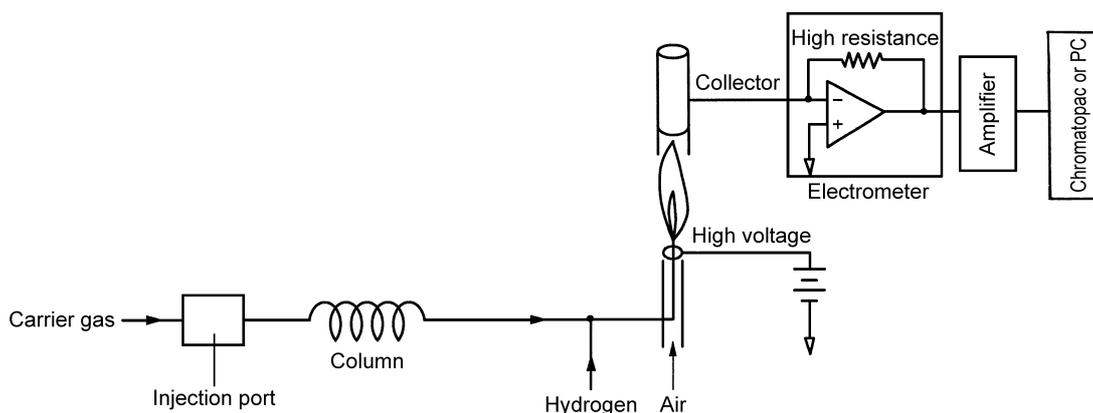
Fig. 13.1.1

13.1.2　Setting the detector

13.1.2.1　Screen description

Press the [DET] key to display the detector main screen shown in Fig.13.1.2. 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.

Detector DET #2	READY
DFID LINE 1	◆ On
Temp(℃) 150.0	150.0
Flame	On
Signal Polarity	+
Filter Time Constant	1s
Control Mode	Dual
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	---	Ign.Set

Detector DET #1	READY
SFID LINE 1	◆ 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
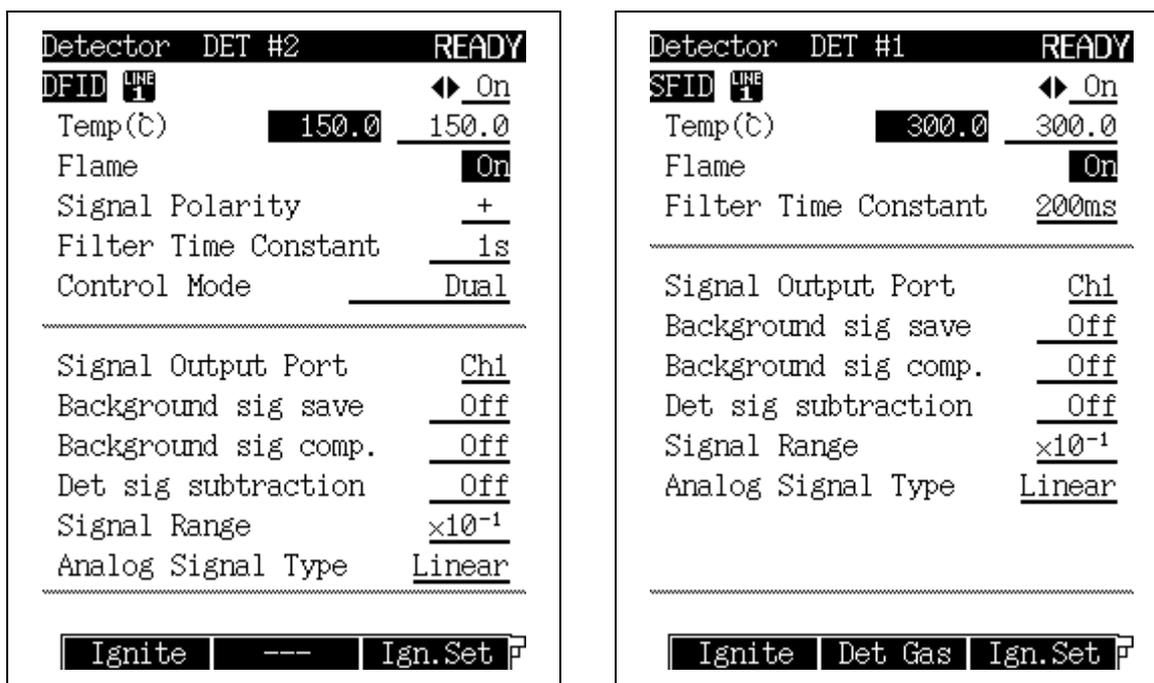
(a) Dual FID   (b) Single FID

Fig. 13.1.2　[DET] key main screen

13.1.2.2　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: 0.0−400°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 (monitor only)

Selection: On/Off

Select "On" to ignite the flame.

Select "Off" to extinguish the flame.

SIGNAL POLARITY
(Displayed only when Dual is selected for the control mode of the dual FID)
Selection: +/-, Default: +
Set to + to output after subtracting the right side cell signal from the left side cell signal of the dual FID and set to - for the opposite.

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 (single FID), 1 s (dual FID)
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 "13.3 Filter Signal Time Constant".)

CONTROL MODE
Selection: Dual/single L/single R, Default: Dual
Set to Dual when connecting two columns to the dual FID and Single L or R when connecting one column.

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 background save and background compensation, refer to "13.4 Background Compensation".

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.
Wide ... Select wide when connecting the GC to the C-R8A/C-R7A/C-R7A plus.
The GC outputs square root of the original signal to the Chromatopac, and the received signals are squared in the Chromatopac.

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 "2.2 Outputting Analog Signals to the Chromatopac".)

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 the C-R8A/C-R7A/C-R7A plus and setting the "ANALOG SIGNAL TYPE" to "Linear," the optional signal cable (linear P/N 221-47251-92) is required.

13.1.2.3 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.	─────
VLV On or VLV Off	When the optional solenoid valve to shut off supply gas is installed, hydrogen and air are shut off by the valve until ignition. Opens the solenoid valve when "VLV On" is displayed and closes the valve when "VLV Off" is displayed.	─────

13.1.3 Setting the Detector Gas (manual flow controller)

Hydrogen and air are supplied to the FID as detector gas. For capillary analysis, makeup gas is required to prevent peak tailing and optimize FID sensitivity.
GC-2014 has flow controllers according to models as described below.

> Models with the dual FID (GC-2014AF, GC2014ATF, etc.)
>   Two flow paths of manual flow controllers with hydrogen and air
> Models with the single FID (GC-2014AFsc, etc.)
>   One flow path of manual flow controller with hydrogen and air
>   One flow path of manual flow controller for makeup gas

Set the detector gas flow rate following the procedures described below.
1. Turn the main valve of the gas cylinder to supply gas to the GC.
2. Open the flow controller cover on the top of the back of the unit.
    Layouts for the models with the dual FID and models with the single FID are as shown in Fig. 13.1.3 (a) and Fig. 13.1.3 (b) respectively.

(a) Dual FID   (b) Single FID
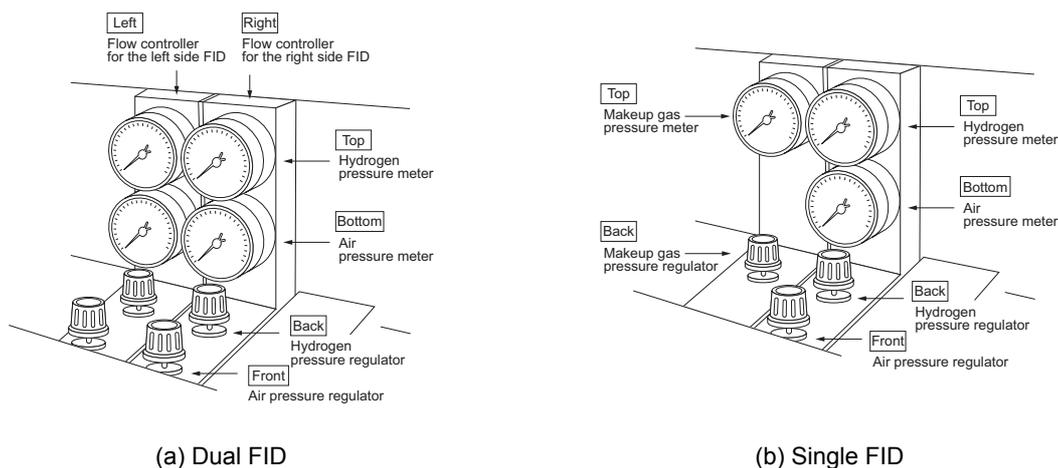
Fig. 13.1.3   Manual flow controller for FID

3. When the optional solenoid valve to shut off supply gas (P/N 221-70782-91) is installed, hydrogen and air are shut off by the valve until ignition. To adjust the pressure, press the [VLV On] key on the [DET] key main screen to open the solenoid valve.
4. Turn the pressure regulators to set the pressure as described below.

Hydrogen	55 kPa (Approx. 40 ml/min)
Air	40 kPa (Approx. 400 ml/min)
Makeup gas (nitrogen)	75 kPa (Approx. 30 ml/min)
Makeup gas (helium)	80 kPa (Approx. 30 ml/min)

NOTE Pressure-flow rate calibration curves for each flow controller are shown in Fig. 13.1.4. These curves slightly differ according to units.
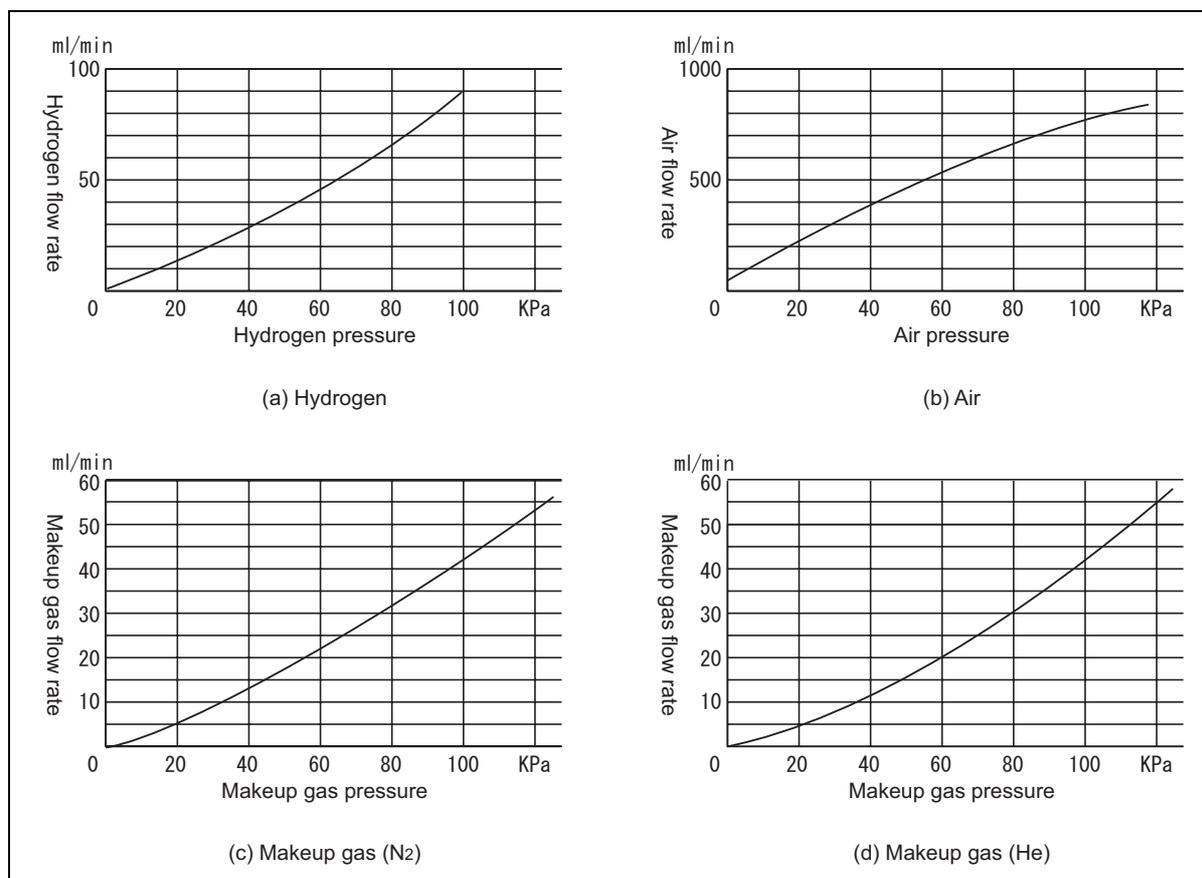
Fig. 13.1.4   Pressure-flow rate calibration curves (examples)

13.1.4 Setting the detector gas flows(APC)

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.

13.1.4.1 Screen description

Select [Det Gas] (PF menu) from the [DET] key main screen to display the flow screen shown in Fig. 13.1.5.

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.
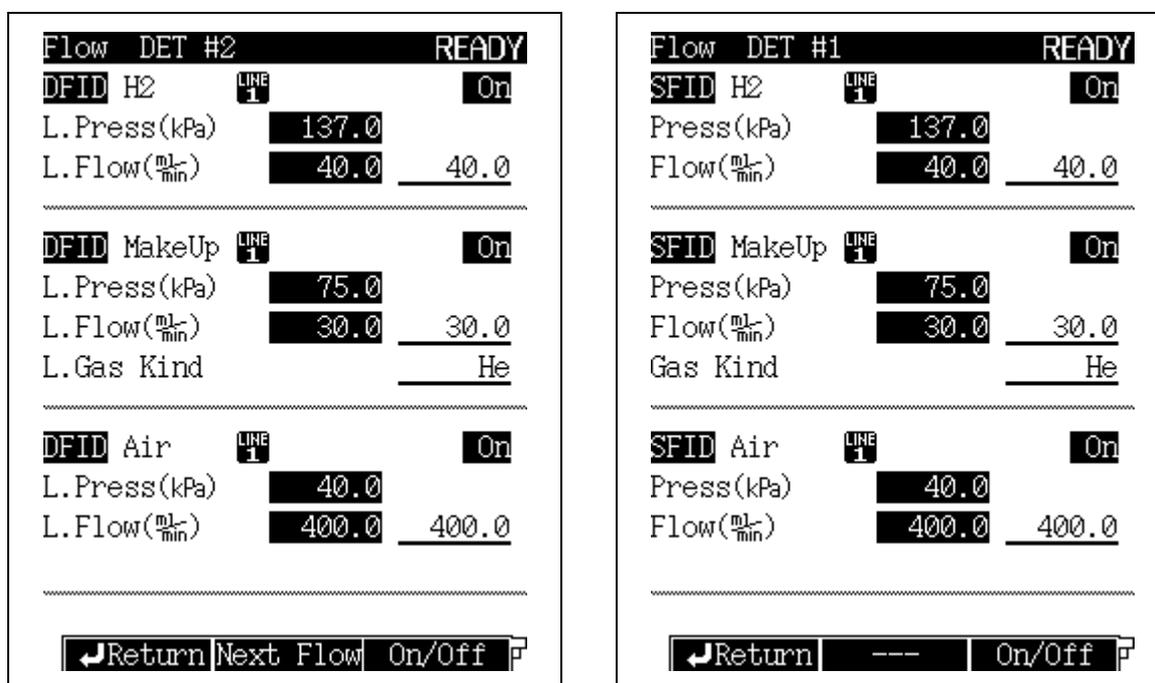
Fig. 13.1.5   Setting the detector gas flows

13.1.4.2 Parameter list

H$_2$

Range: 0.0−200.0 ml/min, Default: 40.0 ml/min(optimal flow rate)

MAKE UP

Range: 0.0−100.0 ml/min, Default: 30.0 ml/min(optimal flow rate)

Makeup gas is inert gas to be supplied to the detector to optimize its sensitivity during capillary analysis. Nitrogen and helium can be used for the FID. Using nitrogen is recommended because it offers higher sensitivity. Set the value to zero for packed analysis.

GAS TYPE

Selection: N$_2$/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 rate)

13.1.4.3 PF menu

PF menu	Description	Reference section
Next Flow	Switches screens to set detector gas for the left (L) and right (R) side detectors during the dual mode of the dual FID with APC.	12.4
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

13.1.5 Igniting and Extinguishing the FID

13.1.5.1 Confirmation prior to FID ignition

Confirm the following points prior to FID ignition.

1. Connect the column.
2. Specify the FID to be ignited in a flow line. (Refer to "8.3 Specifying the Analytical Flow Line Components ([Line Config])")
3. Set the FID to be ignited to On. (Refer to "13.1.2 Setting the Detector.")
4. Turn the main valve of the gas cylinder to supply gas.
5. Set the flow rate of the detector gas. For APC, press [On/Off] (PF menu) on the screen to set the detector gas so that all gas control is turned on.
   (Refer to "13.1.3 Setting the Detector Gas (manual flow controller)" or "13.1.4 Setting the detector gas flows(APC)".)

13.1.5.2 FID ignition procedures

■ Automatic ignition

The system starts and the FID is ignited automatically.

1. Press the [SYSTEM] key and set the following parameters. Change other parameters if necessary.

START TEMP/DET	Yes
DETECTOR	On
AUTO IGNITE	On
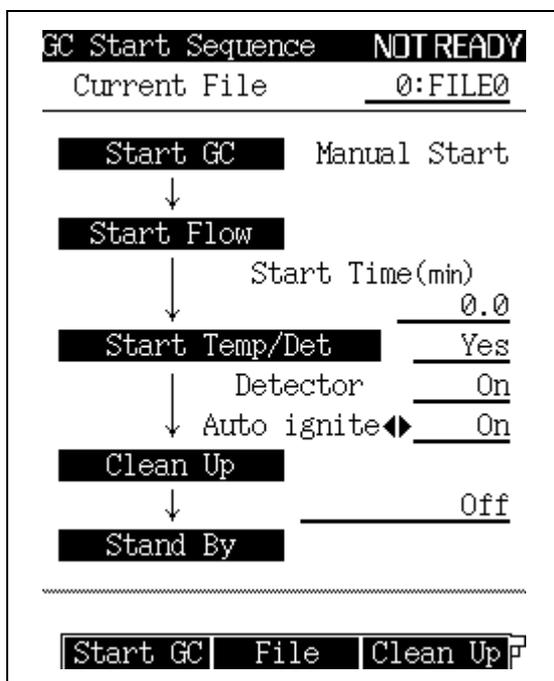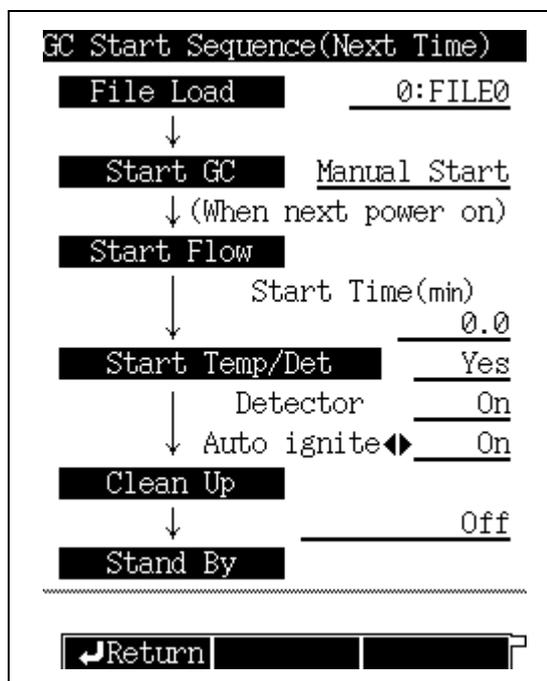
(a) Main screen   (b) [Start Seq] (PF menu)

Fig. 13.1.6   Setting starting procedures (automatic ignition)

2. Start the GC.
   GC starts when [Start GC] (PF menu) is pressed in manual starting and when the power is turned on in automatic starting.

3. After the GC starts, gas control starts. Temperature/detector control starts after the start time passes. When the detector's temperature becomes READY, the FID is ignited automatically.

■ Manual ignition

The FID is ignited by key operation.

1. Press the [SYSTEM] key and set the following parameters. Change other parameters if necessary.

START TEMP/DET	Yes
DETECTOR	On
AUTO IGNITE	Off
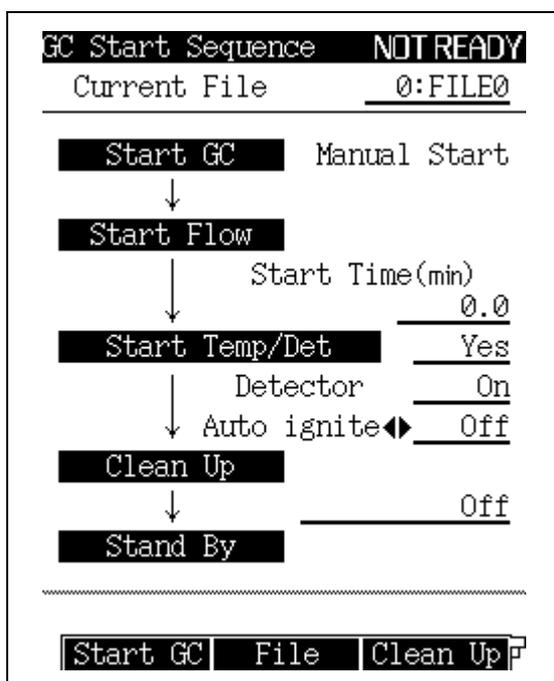
(a) Main screen
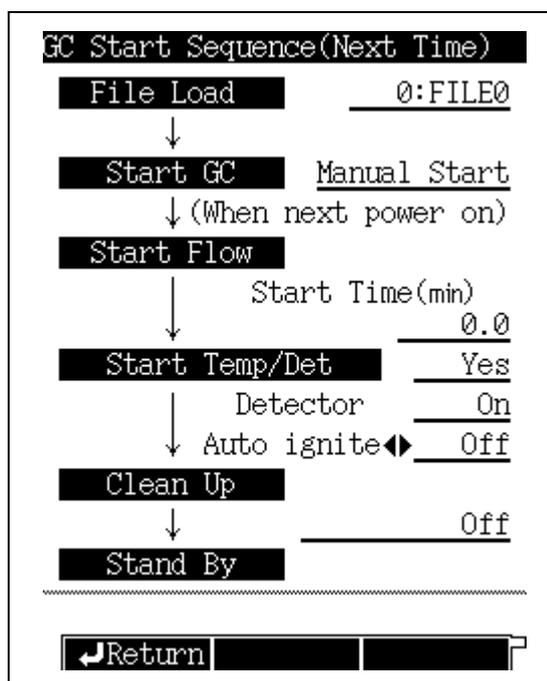
(b) [Start Seq] (PF menu)

Fig. 13.1.7   Setting starting procedures (manual ignition)

2. Start the GC.
    GC starts when [Start GC] (PF menu) is pressed in manual starting and when the power is turned on in automatic starting.

3. After the GC starts, gas control starts. Temperature/detector control starts after the start time passes.

4. After the detector's temperature becomes 100°C or higher, press [Ignite] (PF menu) on the [DET] key main screen.

NOTE | If the detector is set to Off when setting GC starting procedures, the setting for all detectors specified in a respective flow line automatically becomes Off.

START TEMP/DET	Yes
DETECTOR	Off
AUTO IGNITE	Off

Always set to On when only FID is used.

To set to Off while using detectors other than FID at the same time, set the detector to On on the [DET] key screen and then operate the ignition.

NOTE | 1. The messages "ignition finished" and "ignition finished (retried)" mean that ignition has been carried out properly.
2. The message "DET#1, ignition failed" or other similar messages mean that ignition has failed. In this case, the unit's conditions are as follows.
　・Hydrogen and air continue to be supplied when the manual flow controller is used.
　・When the optional solenoid valve to shut off supply gas is installed, hydrogen and air are shut off by the valve.
　・When the APC is used, APC's valve is closed to shut off hydrogen and air supply.
3. Potential causes of ignition failure are listed below. Remove the cause then ignite the FID.
　・Column is not connected.
　・Detector gas is not supplied.
　・Detector gas flow rate is not proper.
　・Unused detector (FID or FPD) is set to "On."
　・FID jet is clogged. → Clean or replace the FID jet.
　・Igniter filament is broken. → Replace the igniter.
4. When the optional solenoid valve to shut off supply gas is installed or ignition is carried out immediately after opening the gas cylinder's main valve, the message "(retried)" or "ignition failed" may be displayed because hydrogen in the piping is not completely replaced.

13.1.5.3 Distinguishing the FID

■ Manual flow controller

Distinguish the FID flame by closing the main valve of the hydrogen cylinder to shut off gas supply.

■ When the manual flow controller and the solenoid valve to shut off supply gas are installed

Press [Stop GC] (PF menu) on the [SYSTEM] key main screen. The solenoid valves close when the detector control ends to shut off gas supply, distinguishing the FID flame.

■ APC

Press [Stop GC] (PF menu) on the [SYSTEM] key main screen. APC control ends when the detector control ends to shut off gas supply, distinguishing the FID flame.

To distinguish the flame before the GC stops, press the [DET] key, select [DET Gas] (PF menu), and set the control of hydrogen and air to Off on the screen. Gas supply is shut off, extinguishing the FID flame.

13.2 Thermal Conductivity Detector (TCD)

13.2.1 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.
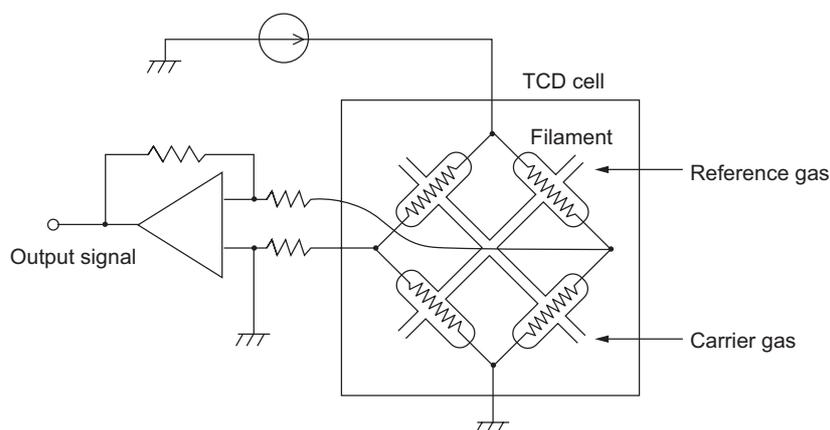
Fig. 13.2.1

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

13.2.2 Setting the detector

13.2.2.1 Screen description

Press the [DET] key to display the Detector main screen shown in Fig. 13.3.2. 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.

```
Detector  DET #3    NOT READY
DTCD  [LINE 1]            ◀▶ On
Temp(℃)         300.0    300.0
Temp(℃)         300.0    300.0
Signal Polarity             +
Current(mA)                30
Filter Time Constant       1s
------------------------------
Signal Output Port        Ch1
Background sig save       Off
Background sig comp.      Off
Det sig subtraction       Off
Signal Attenuation         ×1
Analog Signal Type       Wide
------------------------------
  ----      ----      ----
```

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", the detector is controlled and its signal monitored. However, the temperature increases up to the set value if the detector is configured in the flow line even if detector control is Off.

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: 0–200 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 Fig. 13.2.3. 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.

---

① Carrier gas He
② Carrier gas H_2
③ Carrier gas N_2
④ Carrier gas Ar
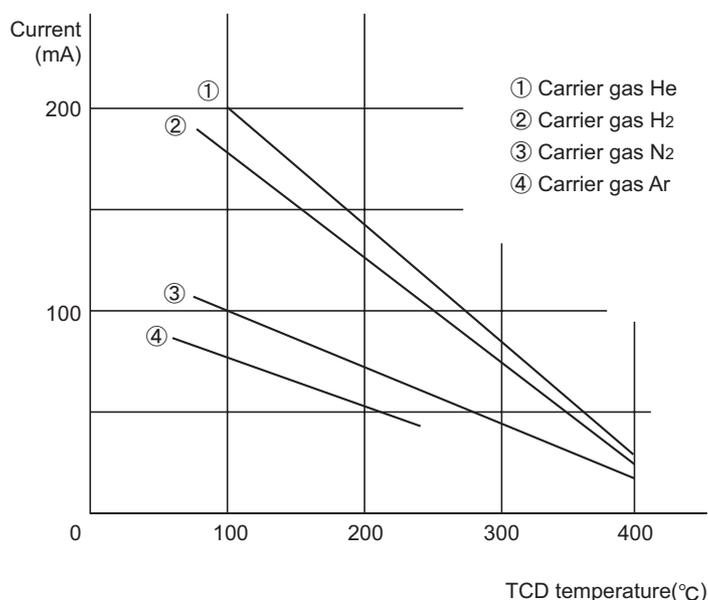
Fig. 13.2.3   Maximum operating current

FILTER TIME CONSTANT

Selection: 4 ms/5 ms/10 ms/20 ms/50 ms/100 ms/200ms/500 ms/1 s/2 s, Default: 1s

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 "13.3 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.

For the details on background save and background compensation, refer to "13.4 Background Compensation".

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.

Wide ... Select Wide when connecting the GC to the C-R8A/C-R7A/C-R7A plus.

The GC outputs square root of the original signals to the Chromatopac, and the received signals are squared in the Chromatopac.

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 "2.2 Outputting Analog Signals to the Chromatopac".)

Linear...Select linear when connecting the GC to any Chromatopac other than the C-R7A/CR-7A plus.

When connecting the GC to the C-R8A/C-R7A/C-R7A 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
Next Det	Toggles to the setup screeen of another detector. The [DET] key can also be used to switch screens.	――

13.2.3 TCD Zero Point Adjustment

Press [Zero Adj] (PF menu) on the [MONIT] key main screen to automatically start zero point adjustment. When the TCD is used, the balance between sample and reference sides becomes off after a column is replaced so the baseline may go off-scale. In this case, carry out a zero-coarse-adjustment following the procedures described below.

NOTE   TCD zero-coarse-adjustment is usually unnecessary when starting the unit after stopping it to leave the lab on the previous day. It takes a while for the TCD baseline to stabilize. Even if the baseline is off-scale when starting the unit, it goes close to zero when it stabilizes in many cases. Wait until the baseline stabilizes.

1. Press [Zero Free] (PF menu) on the [MONIT] key main screen.
2. Turn the TCD zero-coarse-adjustment control shown on Fig. 13.2.4 to make the baseline close to zero. It takes a while for the baseline to move after the control is turned. Turn the control slowly.

TCD zero -coarse -adjustment control
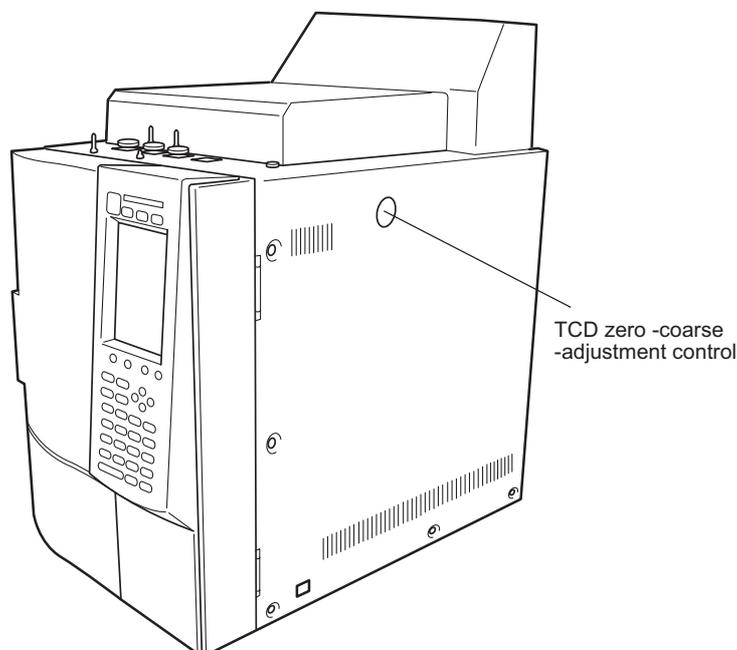
Fig. 13.2.4

3. Press [Zero Adj] (PF menu) on the [MONIT] key main screen.

13.*3* **Filter Signal Time Constant**

■ Selecting the filter time constant

Normally, analysis can be performed with the time constant set to the default value (dual FID, TCD: 1 s, single FID: 200 ms). In order to improve the S/N ratio, the time constant can be changed by measuring the peak half width.

Fig. 13.3.1 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."
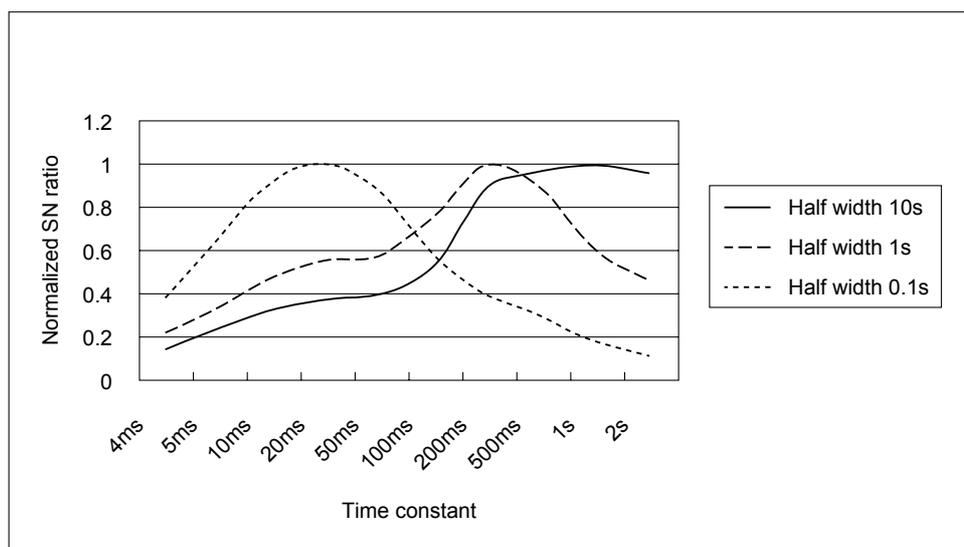
Fig. 13.3.1   Relationship between time constant and S/N ratio

13.4 **Background Compensation**

If the baseline drifts considerably during programmed temperature analysis, the baseline drift can be saved as a background baseline in GC's waveform memory (background save). Afterwards, the background can be subtracted from the signal (background compensation). The below is background compensation procedures.

1. Set background storage.
   Select where the background baseline should be saved on the [DET] key main screen. Either "Buff 1" or "Buff 2" can be selected.

   BACKGROUND SIG. SAVE Buff 1 (or Buff 2)
   BACKGROUND SIG. COMP. Off

```
Detector   DET #1           READY
SFID [LINE 1]                         On
 Temp(°C)          150.0    150.0
 Flame                         On
 Filter Time Constant       200ms
.............................................
 Signal Output Port            Ch1
 Background sig save      ◄►Buff1
 Background sig comp.          Off
 Det sig subtraction          Off
 Signal Attenuation           ×2⁻¹
 Analog Signal Type          Wide



.............................................
   Ignite │ Det Gas │ Ign.Set ⏏
```

2. Execute analysis without sample injection. Baseline fluctuation is saved in "Buff 1" or "Buff 2" as background.

3. Set background compensation.
   Set the background to be subtracted as the baseline fluctuation on the [DET] key main screen.

   BACKGROUND SIG. SAVE Off
   BACKGROUND SIG. COMP. Buff 1 (or Buff 2)

```
Detector   DET #1           READY
SFID [LINE 1]                         On
 Temp(°C)          150.0    150.0
 Flame                         On
 Filter Time Constant       200ms
.............................................
 Signal Output Port            Ch1
 Background sig save          Off
 Background sig comp.     ◄►Buff1
 Det sig subtraction          Off
 Signal Attenuation           ×2⁻¹
 Analog Signal Type          Wide



.............................................
   Ignite │ Det Gas │ Ign.Set ⏏
```

4. Inject a sample and execute analysis. A signal after subtracting the background is outputted.
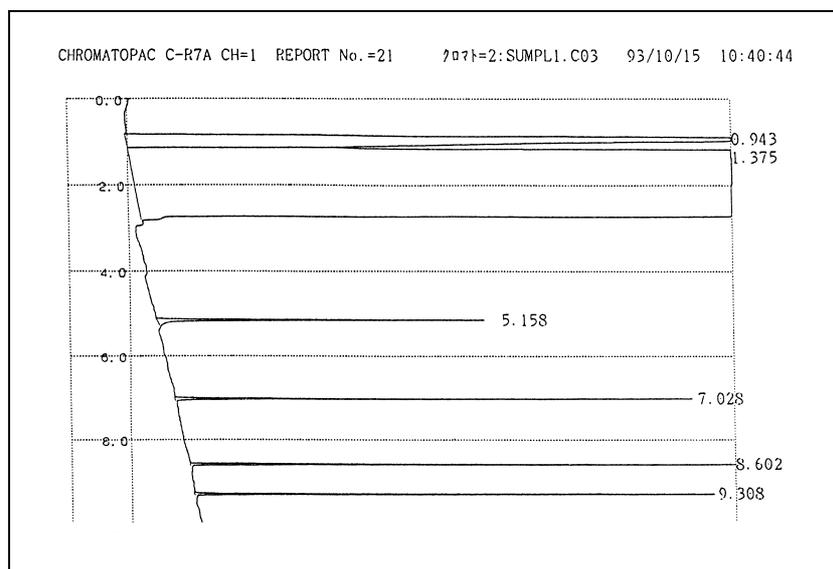
Fig. 13.4.1   Example of programmed analysis without compensation
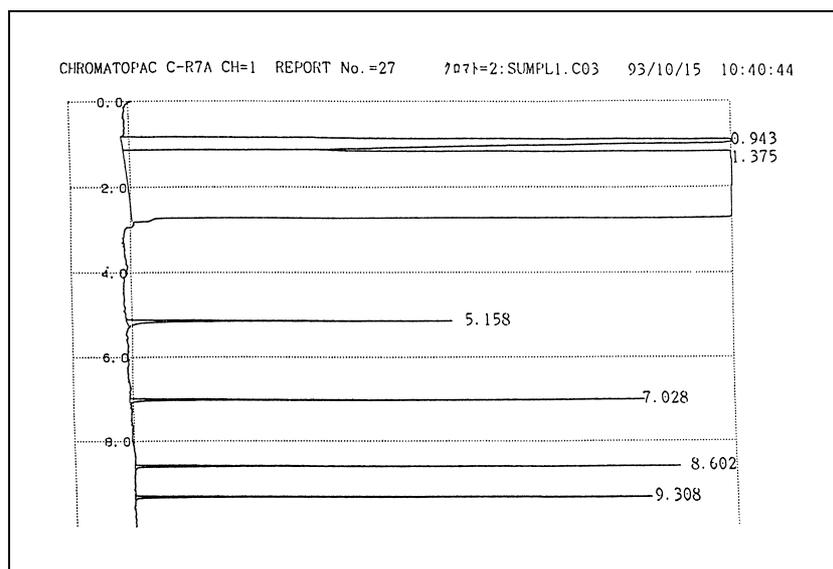
Fig. 13.4.2   Example of programmed analysis with compensation

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.
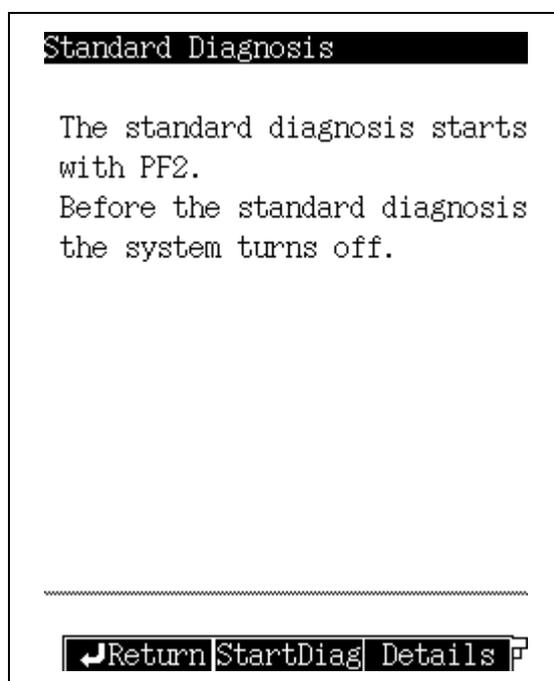
Fig. 14.1.1   Diagnosis main screen

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          Yes
Counter for Insert          Yes
CRG Use Time                 No
Temp Sensor Diag            Yes
LCD Use Time                Yes
Fan Use Time                Yes
DC Voltage                  Yes
Room Tempetature             No
Atmospheric Press.      ◀▶  No
Primary Press.              Yes
CPU Registor                Yes
Real Time Clock Registor    Yes
                             ▽
    ↵Return
```
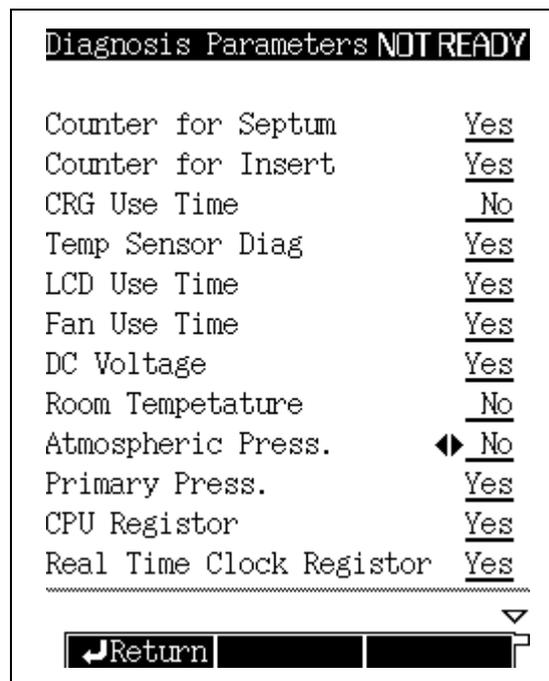
Fig. 14.1.2   Diagnosis setup screen

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, AMC 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, AMC AD CONVERTER

Verifies whether the contents of the A/D converter on the flow controller PCB can be read correctly.

GAS CONTROL

Checks if carrier gas, detector gas, AUX APC, and AUX AMC are 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              ┐    │
└─────────────────────────────────────┘
```
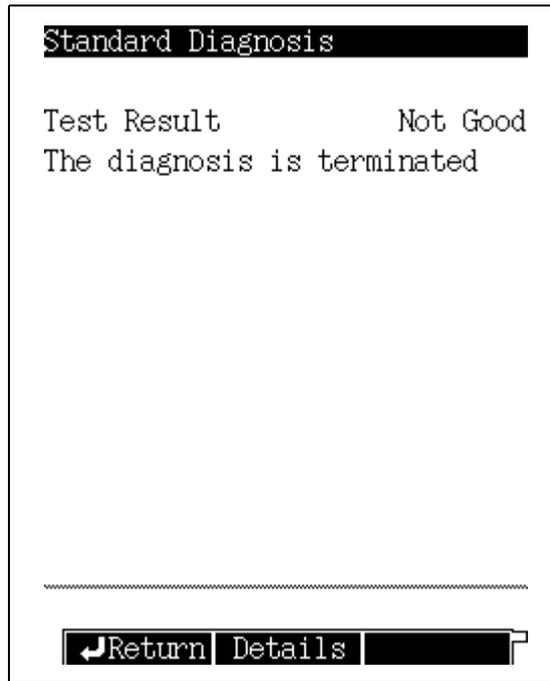
Fig. 14.1.4   Diagnosis stops

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
```
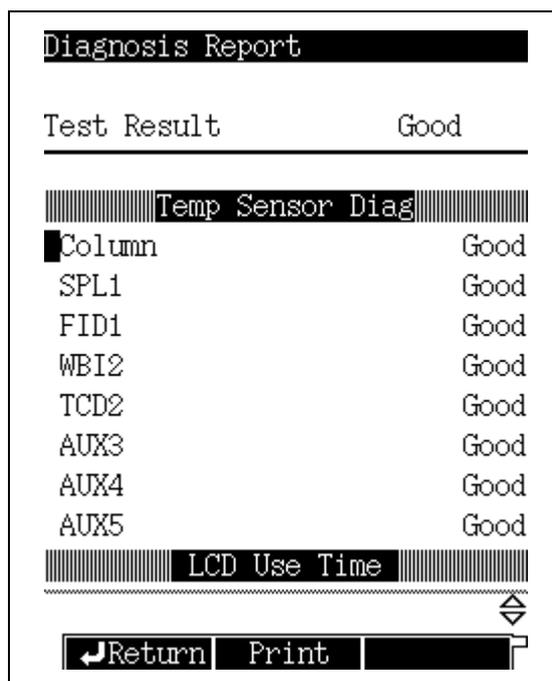
Fig. 14.1.5   Diagnosis results

14.1.10 PF menu

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 require-ments.

    ・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 "4.4 Septum" in the operation manual.)
INSERT COUNTER	Replace the glass insert. (Refer to "4.6 Glass Insert" in the operation manual.)
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 "5.1 Troubleshooting" operation manual.
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.
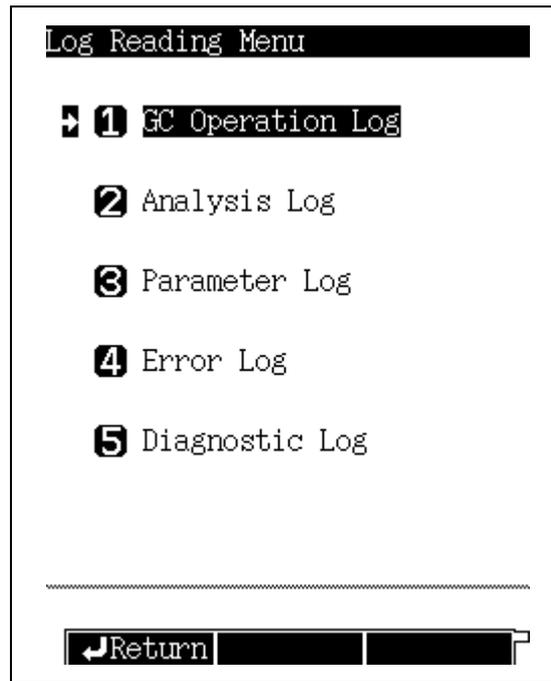
Fig. 14.2.1   Log reading menu main screen

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
```
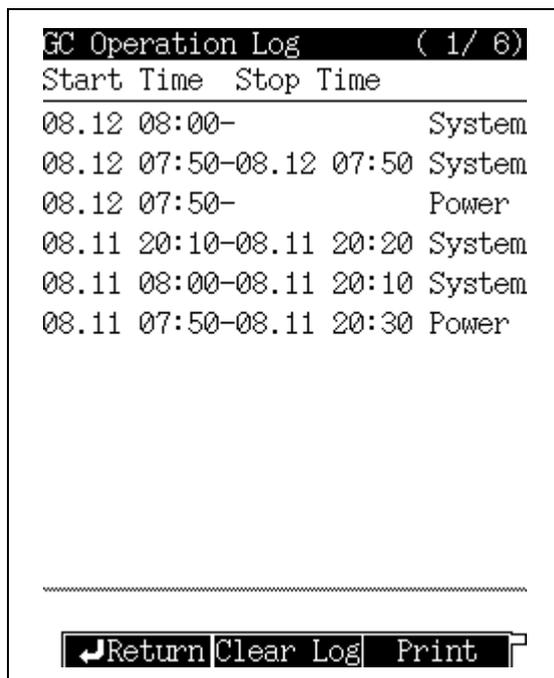
Fig. 14.2.2   Operation log screen

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
```
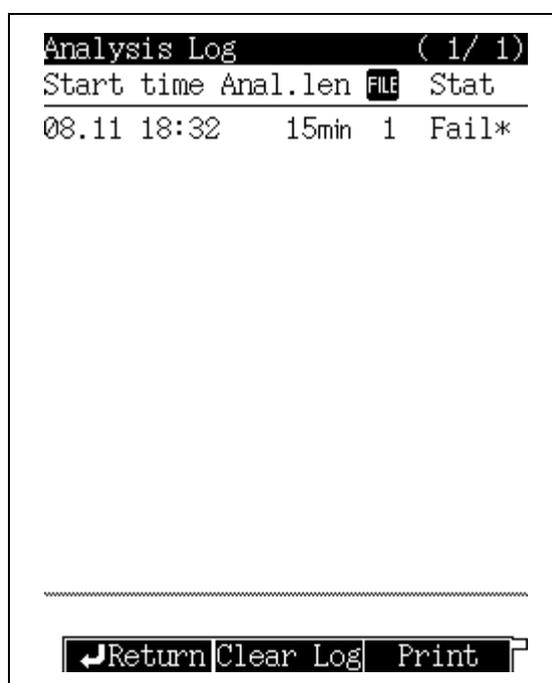
Fig. 14.2.3   Analysis log screen

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
```
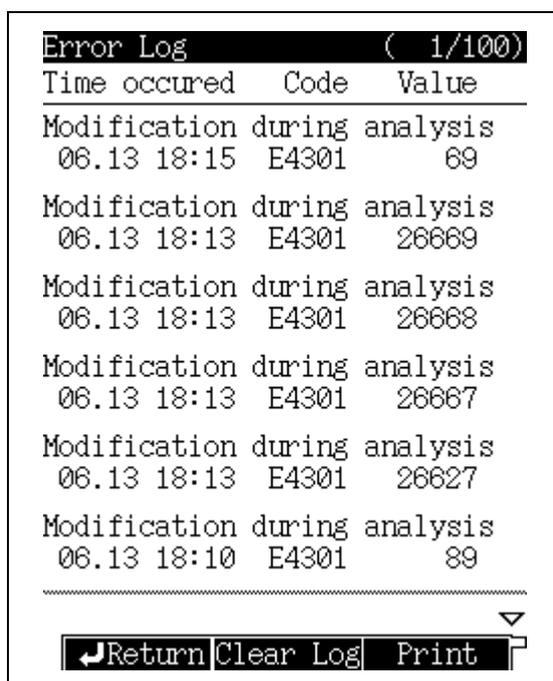
Fig. 14.2.6   Error log screen

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.

(a) Dual INJ   (b) SPL
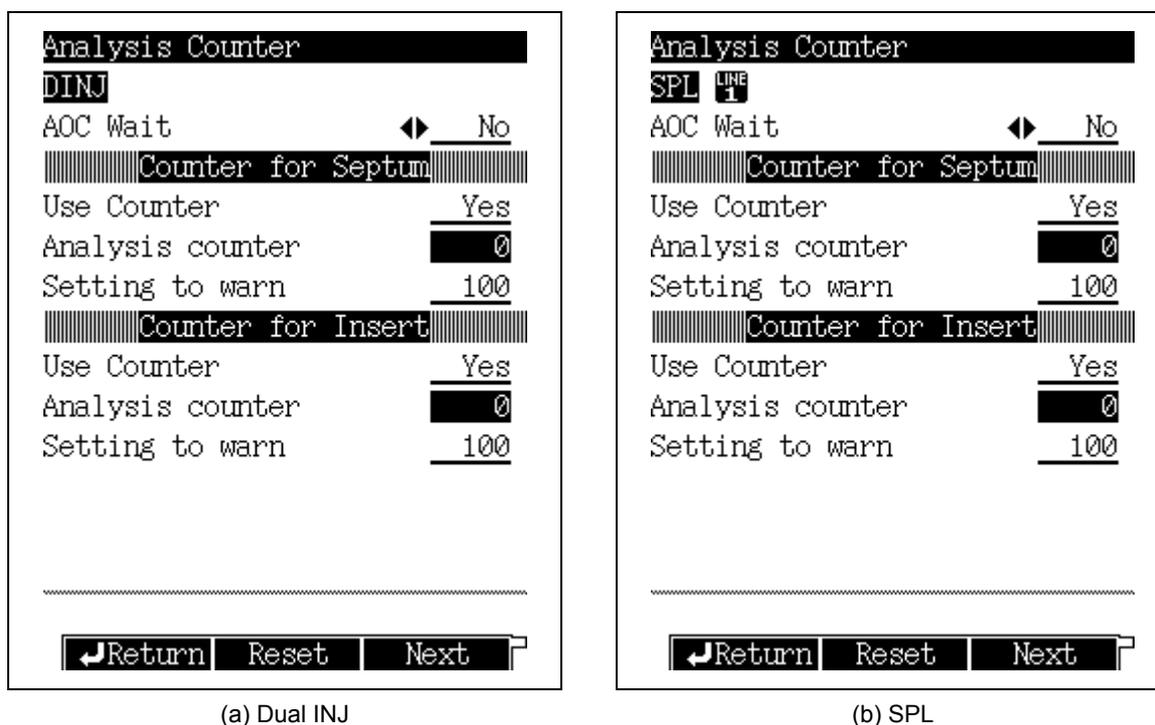
Fig. 14.3.1   Analysis counter screen

NOTE When the dual INJ (DINJ) is used, the number of analyses is indicated as follows:
Dual mode: The value counted on the L (left) inlet is indicated when the signal polarity of the detector (DFID, DTCD) is +. The value counted on the R (right) inlet is indicated when the signal polarity is -.
Single mode: The value counted on the selected inlet (L or R) is indicated.

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: 0–9999, 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 "15.5 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
```
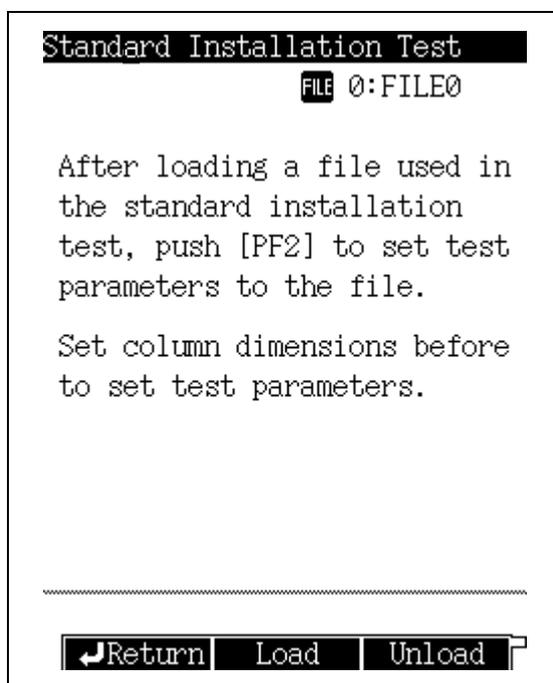
Fig. 14.5.1   Standard installation test main screen

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│            ┐  │
└──────────────────────────────────┘
```
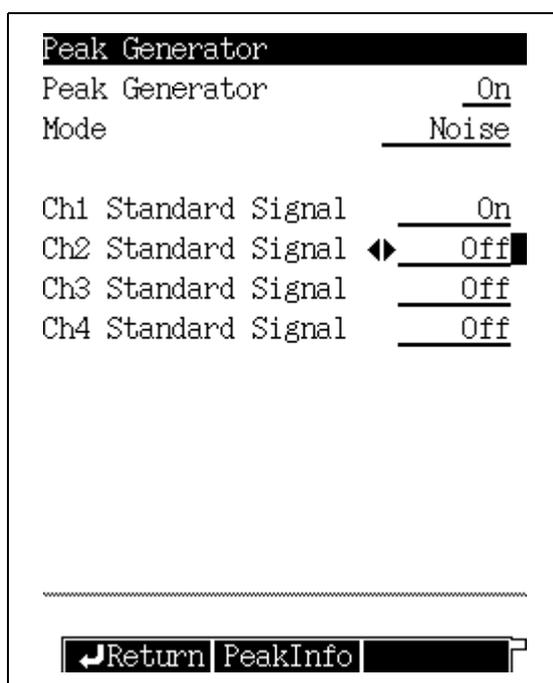
Fig. 14.6.1   Peak generator setup screen

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 AOC-20 user's manual.

15.1.1 Screen description

After installing the auto injector on the GC, access the line configuration screen from the [SET] key, and then select AOC 1 for the analytical line. (Refer to "8.3 Specifying the Analytical Flow Line Components ([Line Config])") Then, press the [OPTION] key. If the screen shown in Fig. 15.1.1 does not appear, press the [OPTION] key again or [NEXT] (PF menu) to display it.

The screen toggles among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.
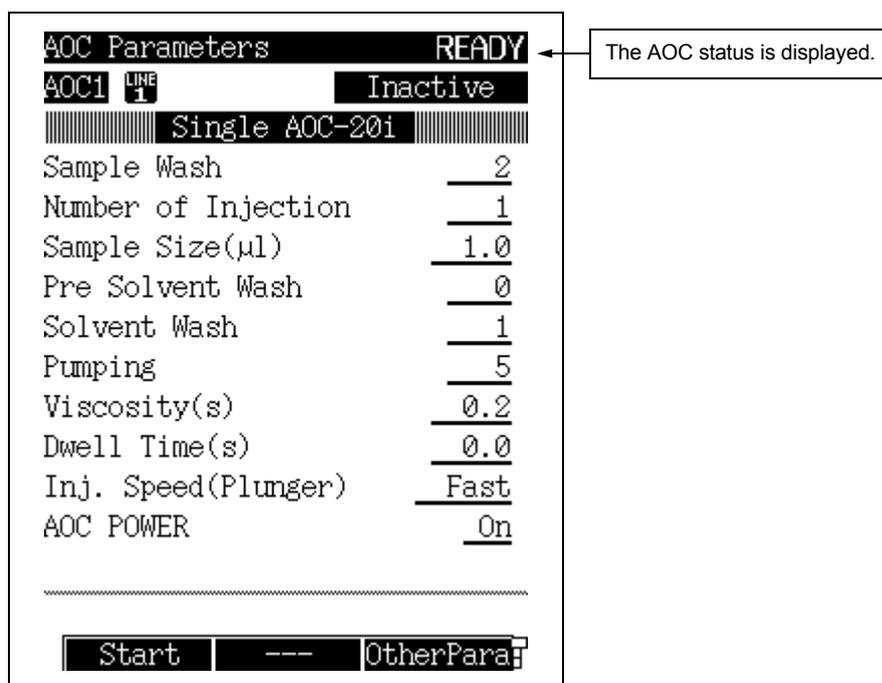
Fig. 15.1.1   AOC setup screen

■ 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.

AOC POWER

Selection: On/Off, Default: On

Turns the AOC power on and off (built-in GC-2014 power supply).

15.1.3 PF menu

PF menu	Description	Reference section
Start	Starts AOC. The GC also starts when AOC injects a sample.	——
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.	——
Print	Prints the parameters on the Chromatopac.	——
Next	Toggles the screen among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.	——

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
```
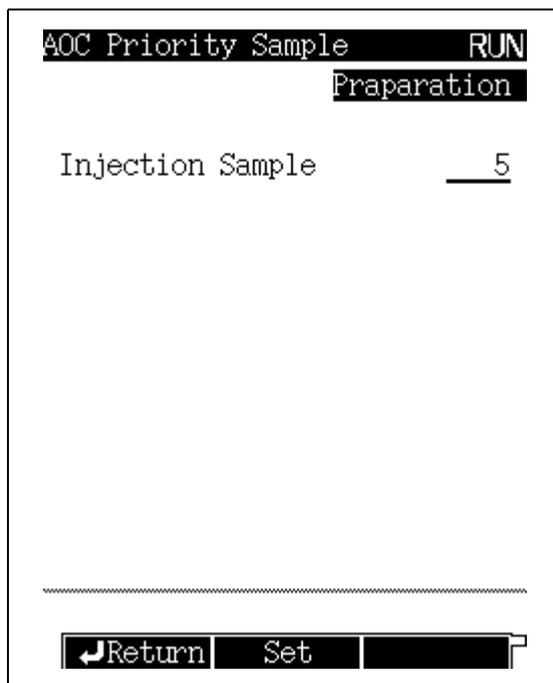
Fig. 15.1.2   Priority analysis setup screen

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.
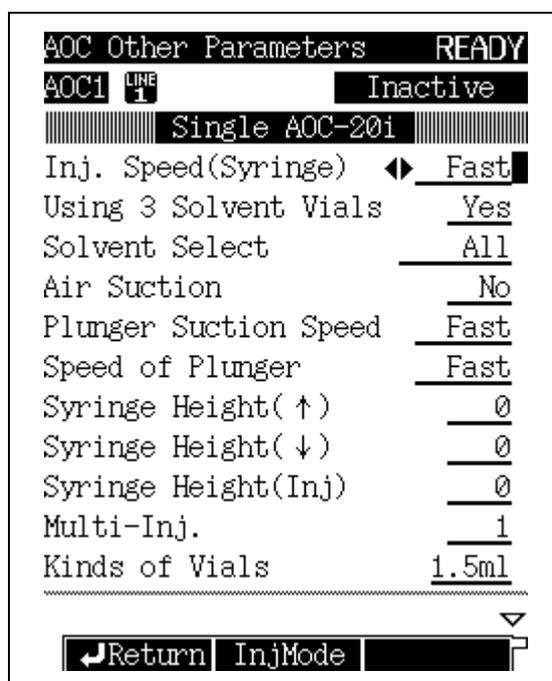
Fig. 15.1.3   Additional AOC parameter setup

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.

A only: Only the solvent in the vial A is used.

B only: Only the solvent in the vial B is used.

C only: Only the solvent in the vial C is 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".
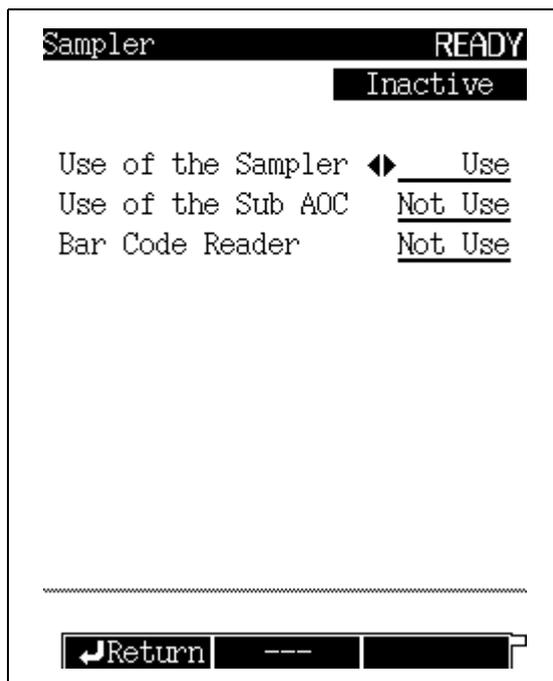
Fig. 15.1.4   Sampler carousel and other options setup

15.1.11 Parameter list

USE OF THE SAMPLER
Selection: Use/Not Use, Default: Not Use
USE OF THE SUB AOC
Selection: Use/Not Use, Default: Not Use(Set to "Not Use" because it is not used by GC-2014.)
BAR CODE READER
Selection: Use/Not Use, Default: Not Use
Select "Use" when the Bar Code reader is installed.

*15.*2   Setting AUX Temperature

Temperature controller used for parts other than the column oven, injection port, and detector can be set.

15.2.1 Screen description

When an optional device such as heater is installed, press the [OPTION] key to display the screen shown in Fig. 15.2.1. If a different screen appears, press the [OPTION] key again or [NEXT] (PF menu) to display the correct screen.

The screen toggles among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.

Fig. 15.2.1   Main screen to set AUX temperature

15.2.2 Parameter list

TEMPERATURE SETTING VALUE
Range: 0.0–400.0°C, Default: 25.0°C

15.2.3 PF menu

PF menu	Description	Reference section
Print	Prints each temperature through a Chromatopac.	17.1
NEXT	Toggles the screen among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.	____
On/Off	Displays a sub screen to set a used unit to On.	15.2.4

15.2.4 On/Off setting

When "On/Off" (PF menu) is pressed on the main screen to set AUX temperature, the screen to set On/Off appears.

```
AUX Temp. On/Off          READY
 Name                  Control
 OTHER              ◀▶ On




                                    




  ⏎Return                         ⌐
```
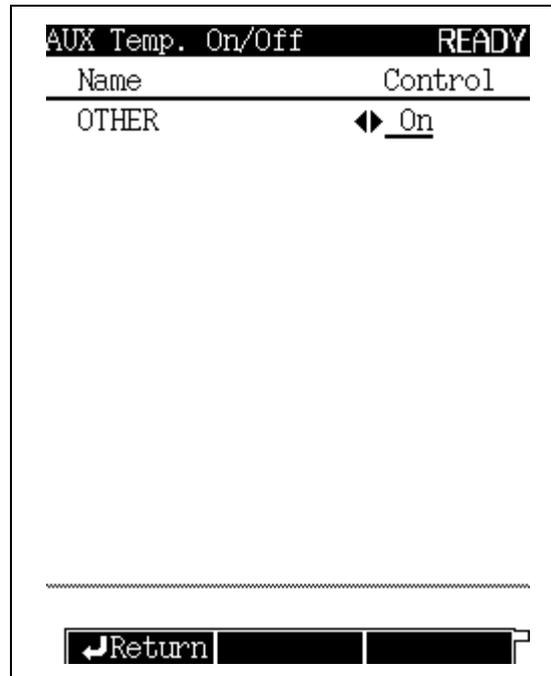
Fig. 15.2.2   Screen to set On/Off of AUX temperature

15.2.5 On/Off parameter list

TEMPERATURE CONTROL
Selection: On/Off, Default: On
Temperature is controlled when On is selected.

15.3 **Setting the AUX APC Parameters**

The pressure, the flow rate and the gas type can be set for the AUX APC.

15.3.1 Screen description

When the optional AUX APC is installed, press the [OPTION] key to display the screen shown in Fig. 15.3.1. If a different screen appears, press the [OPTION] key again or [NEXT] (PF menu) to display the correct screen.

The screen toggles among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.

```
┌─────────────────────────────────┐
│ AUX APC                   READY  │
│ APC 1                        On  │
│ Press(kPa)      100.0      100.0 │
│                    ◀▶         He │
│ ───────────────────────────────  │
│ APC 2                        On  │
│ Press(kPa)      100.0      100.0 │
│                              He  │
│ ───────────────────────────────  │
│ APC 3                        On  │
│ Press(kPa)      100.0      100.0 │
│                              He  │
│                                  │
│ ───────────────────────────────  │
│  ┌────────┬────────┬─────────┐   │
│  │ Offset │  Next  │ On/Off  │   │
│  └────────┴────────┴─────────┘   │
└─────────────────────────────────┘
```
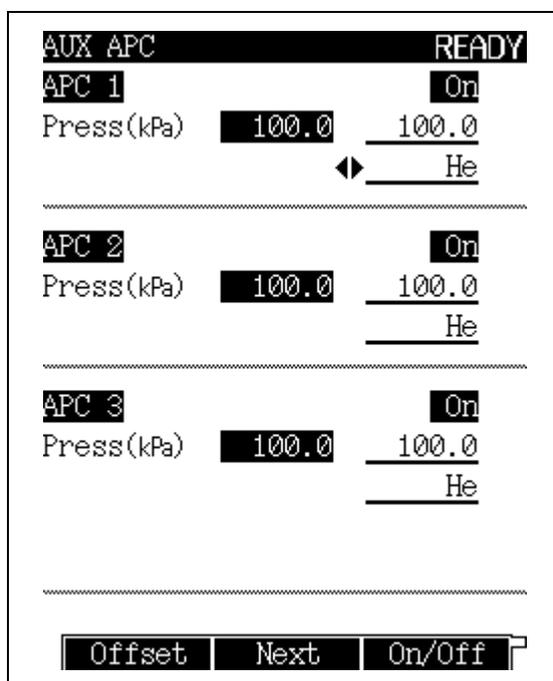
Fig. 15.3.1 AUX APC main screen

15.3.2 Parameter list

PRESS

Range: 0.0–400.0 kPa, Default: 100 kPa

Set the pressure when the control mode is set to "PRESS".

GAS TYPE

Selection: He/N_2/H_2/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.

15.3.3 PF menu

PF menu	Description	Reference section
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.	____
On/Off	Set APC to be used to "On". Default value is "On".	____

15.4 Setting the AUX AMC Parameters

Flow rate and gas type can be set for the AUX AMC.

15.4.1 Screen description

When the DAFC unit on other configurations is set to "AMC, LR" and/or the optional AUX AMC is installed, press the [OPTION] key to display the screen shown in Fig. 15.4.1. If a different screen appears, press the [OPTION] key again or [NEXT] (PF menu) to display the correct screen.

The screen toggles among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.
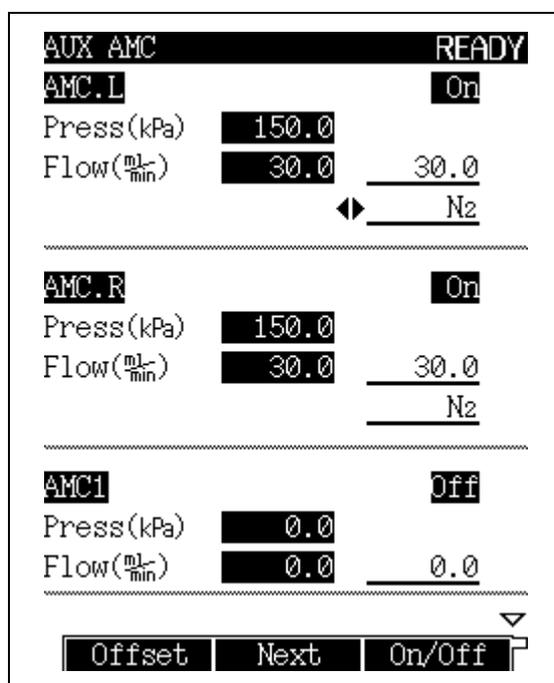
Fig. 15.4.1   AUX AMC main screen

15.4.2 Parameter list

FLOW RATE

Range: 0.0–100.0 ml/min, Default: 50 ml/min

Set the flow rate when the control mode is set to "FLOW".

GAS TYPE

Selection: He/N_2/H_2/Ar, Default: He

Set the type of gas supplied to the AMC. This parameter is used to calculate the flow rate.

15.4.3 PF menu

PF menu	Description	Reference section
Offset	Performs offset calibration of AMC sensor to improve the reproducibility of results.	——
Next	Toggles the screen among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.	3.6
On/Off	Set the AMC to be used to "On." Default is "On."	——

*15.*5 **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.

15.5.1 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 screen toggles among AOC parameters → setting AUX temperature → AUX APC → AUX AMC → CRG screens in this order.
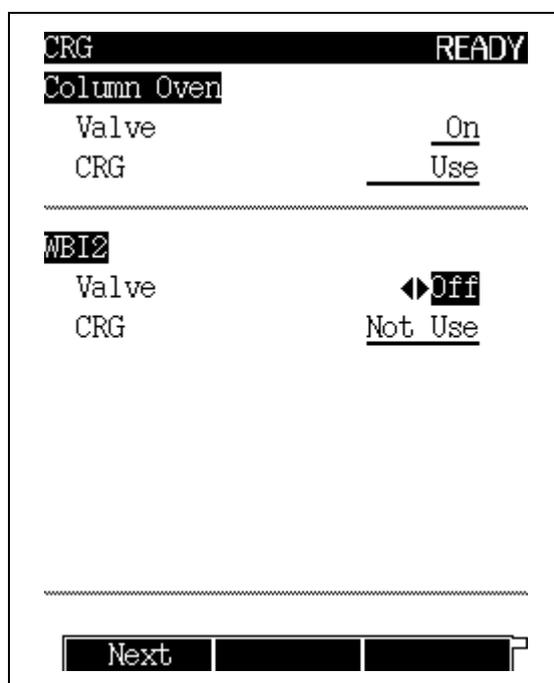
Fig. 15.5.1   CRG main screen

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.

15.5.2 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 −+400.0°C from (room temperature + 4°C)− +400.0°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, the injection port temperature control range is extended to -99.0−+400.0°C from 0.0−400.0°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".

15.5.3 PF menu

PF menu	Description	Reference section
Next	Toggles the screen among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this 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.
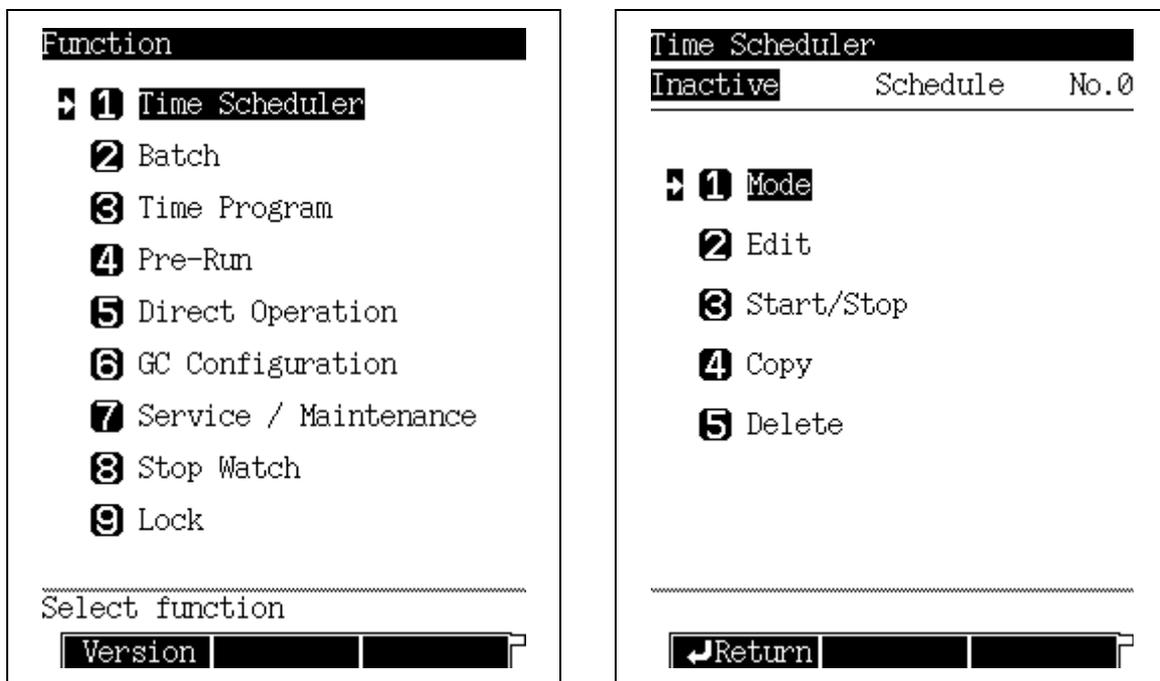
Fig. 16.1.1   Time scheduler menu

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                      ┌ │
└─────────────────────────────────┘
```
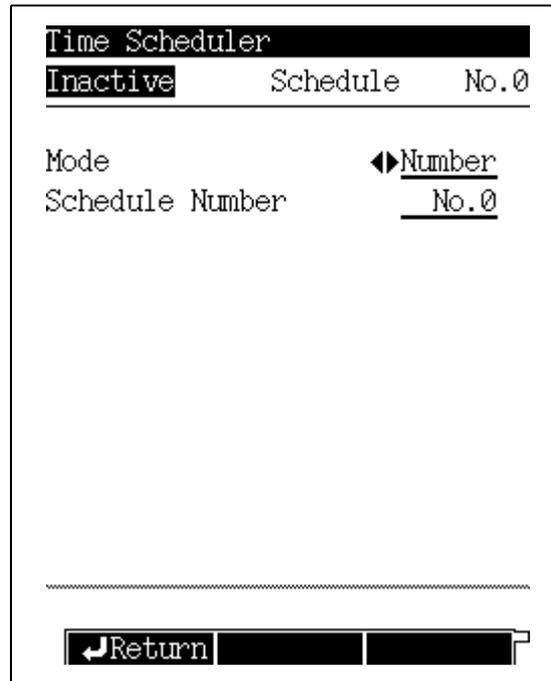
The schedule number can be set only when in Number mode.

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.

```
Time Scheduler
Inactive      Schedule      No.0


Schedule Number        ◄► No.2
```
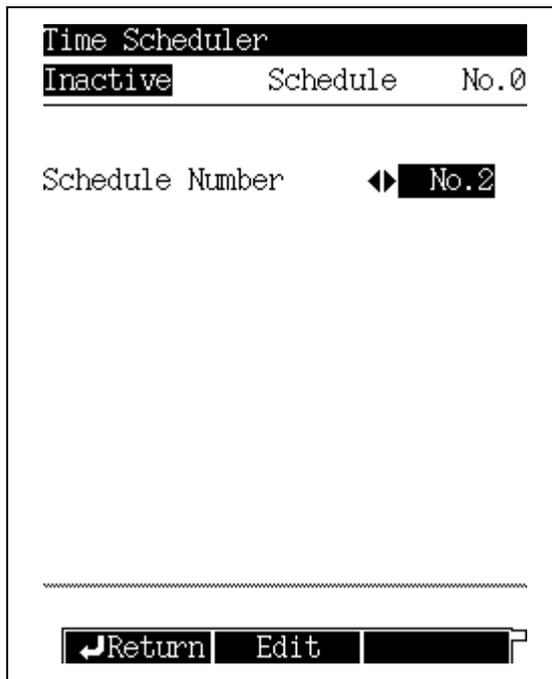
Fig. 16.1.3   Schedule number selection screen

```
Time Schedule        NOT READY
Inactive        Schedule      No.0
        Time  Function    Value
  1    07:00 Start GC
  2    19:00 Stop GC
```
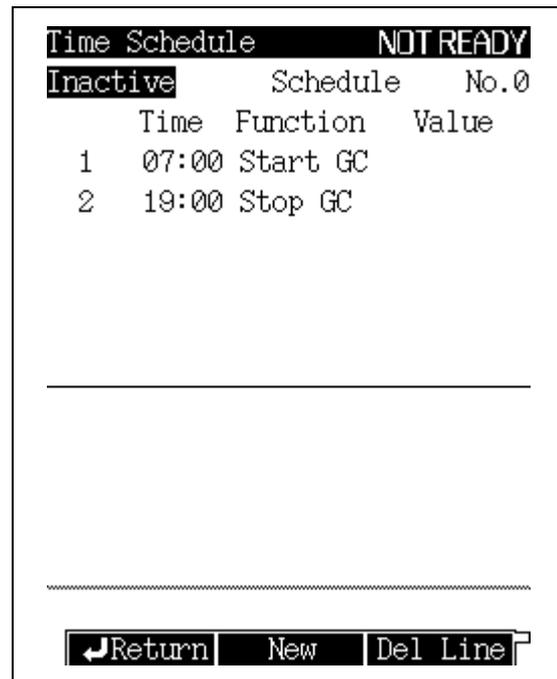
Fig. 16.1.4   Schedule edit screen

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
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.
GC Start/Stop			Sets start/stop of gas chromatograph.

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
  Stop
  GC Start/Stop
```

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
```
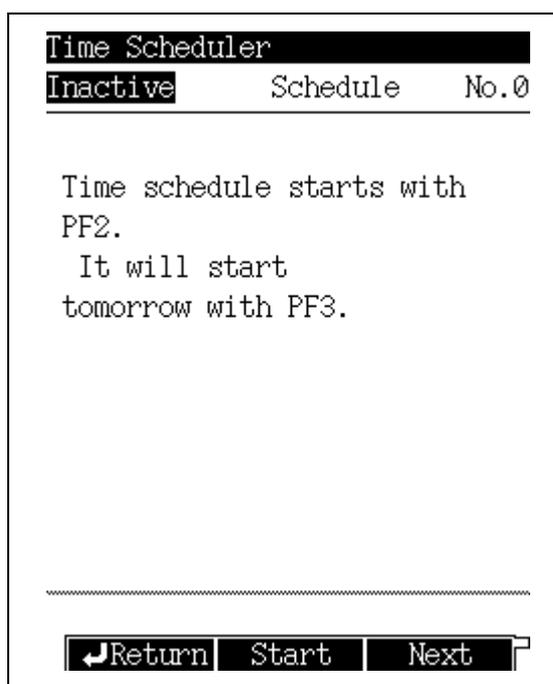
Fig. 16.1.6   Schedule start screen

```
Time Scheduler
Active      Schedule   No.0


Time schedule stops with
PF2.






~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ↵Return  Stop    ---
```
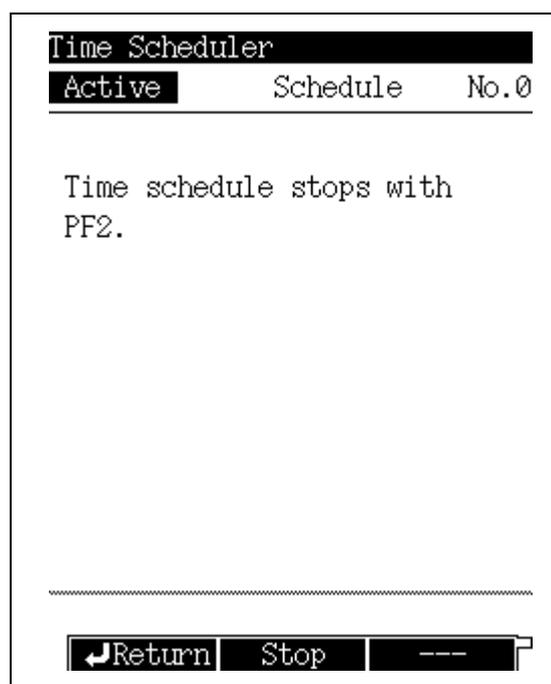
Fig. 16.1.7   Schedule stop screen

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.

```
Function
   1  Time Scheduler
 ▶ 2  Batch
   3  Time Program
   4  Pre-Run
   5  Direct Operation
   6  GC Configuration
   7  Service / Maintenance
   8  Stop Watch
   9  Lock

Select function
 Version
```

```
Batch                  READY
                   Inactive
[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
```

The AOC status is displayed.
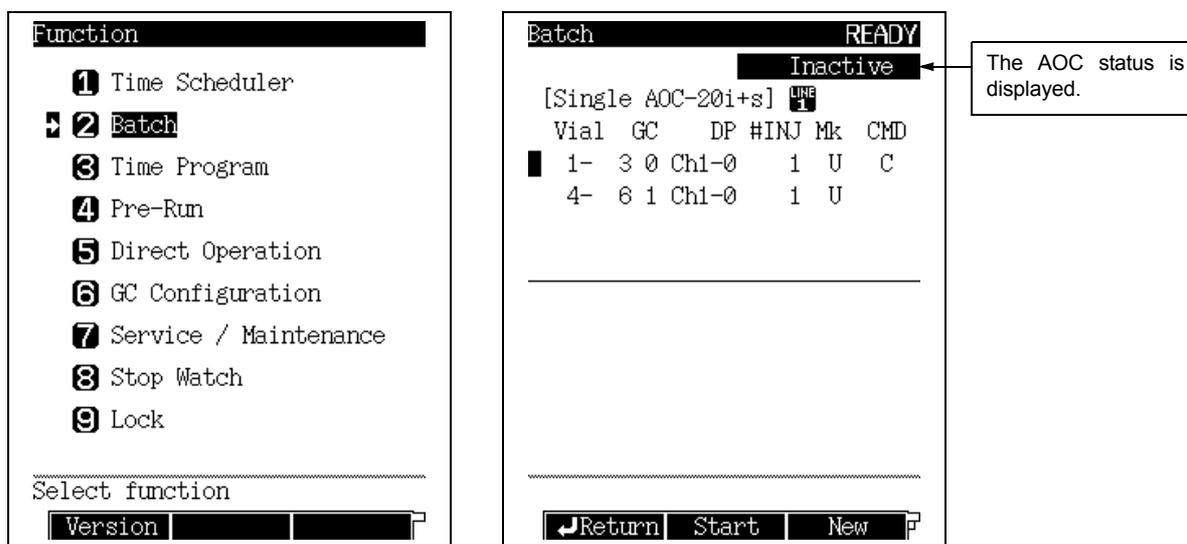
Fig. 16.2.1   Batch schedule screen

■ **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

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 [△] and [▽] 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.

```
Batch                    READY
                      Inactive
 [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

 Vial
 Start vial No.            7
 Final vial No.            9
 Sample        Inject sample
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Finish Next Page Cancel
```

Fig. 16.2.2   New batch schedule screen

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

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 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).

16.2.8　Batch processing Setup example

Example　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
```

*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.
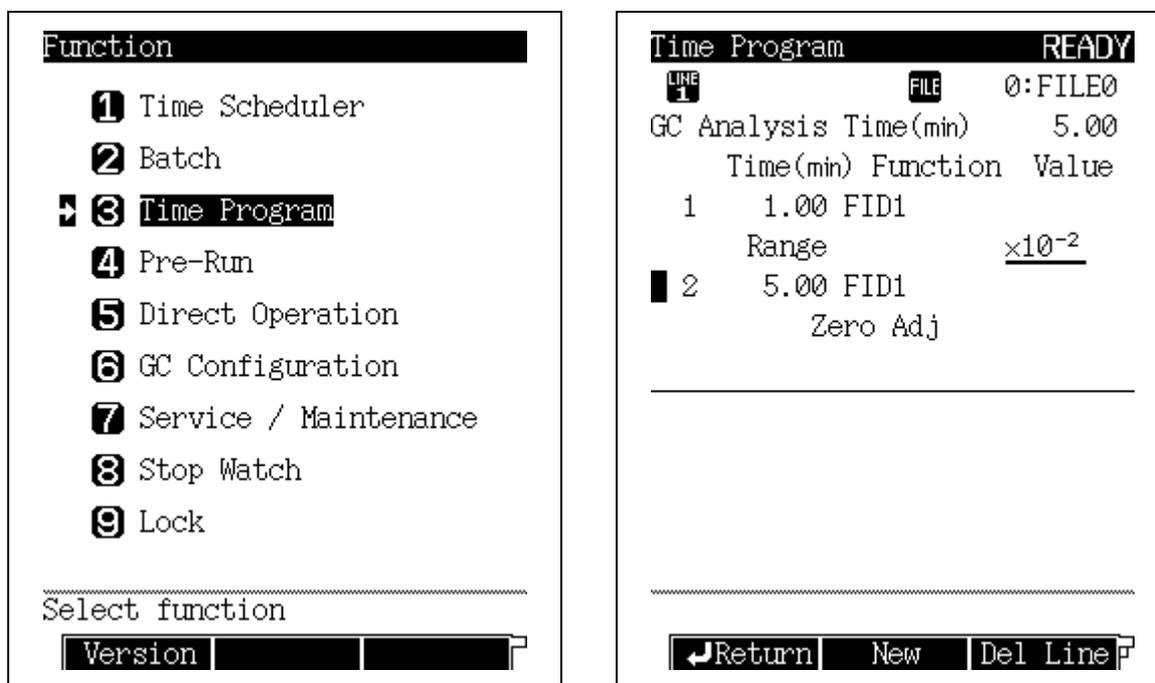
Fig. 16.3.1   Time program main screen

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.

```
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
  ─────────────────────────────

Edit program
   Relay
   Detector
 ⤵ Flow controller
 ∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿∿
                          ▽
 ┌─────────┬─────────┬────────┐
 │Prev Page│Next Page│ Cancel │
```
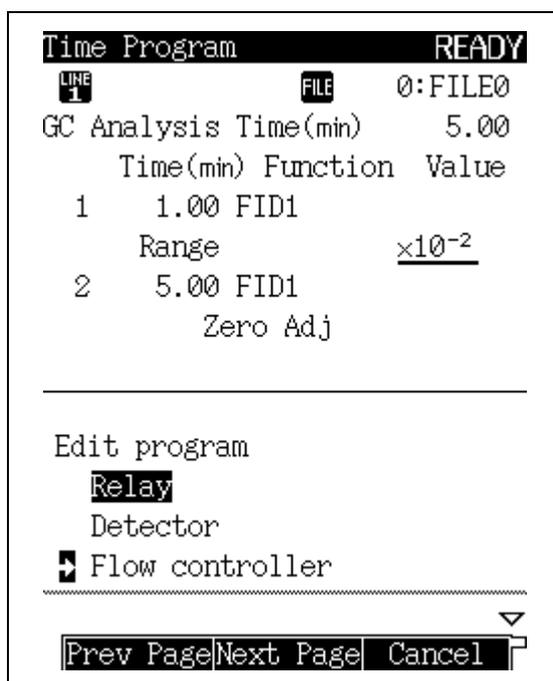
Fig. 16.3.2   Time program edit screen

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 NOTE 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. NOTE 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 Refer to NOTE 3).	Splitter Ctrl		Opens/closes splitter.
	Flow controller On/Off		Turn carrier gas, septum purge, detector gas, APC, and AMC (AUX AMC and AMC. LR) on/off.
	High press inj mode		Turns high pressure injection mode on/off.
	Gas saver		Turns gas saver function on/off.
Temperature	INJ1, INJ2, 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.
		0: FILE 0–9 Load	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.
Other			Set the parameter to input event No..(Refer to "17.4 Event No.".)

NOTE 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.

NOTE 2) Current range

Detector type	Current
FTD	0.00–10.00 (pA)
ECD	0.00–2.00 (nA)
TCD	0–200 (mA)

NOTE 3) When the dual AFC is used
1. There is no settings for "splitter ctrl", "high press inj mode", and "gas saver".
2. Septum purge cannot be selected on "flow controller On/Off".

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
```
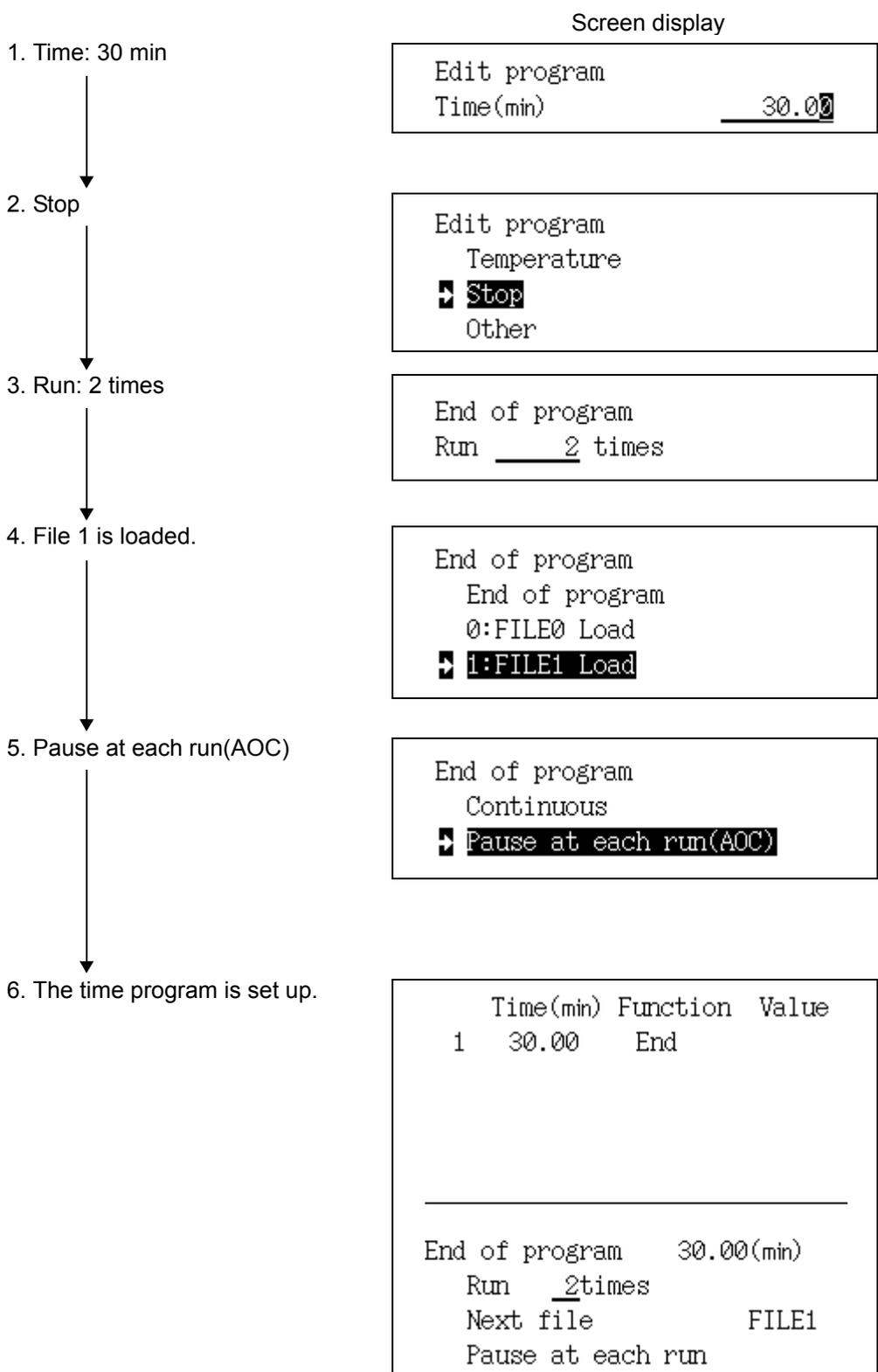
16.4 **Pre-Run Program**

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.
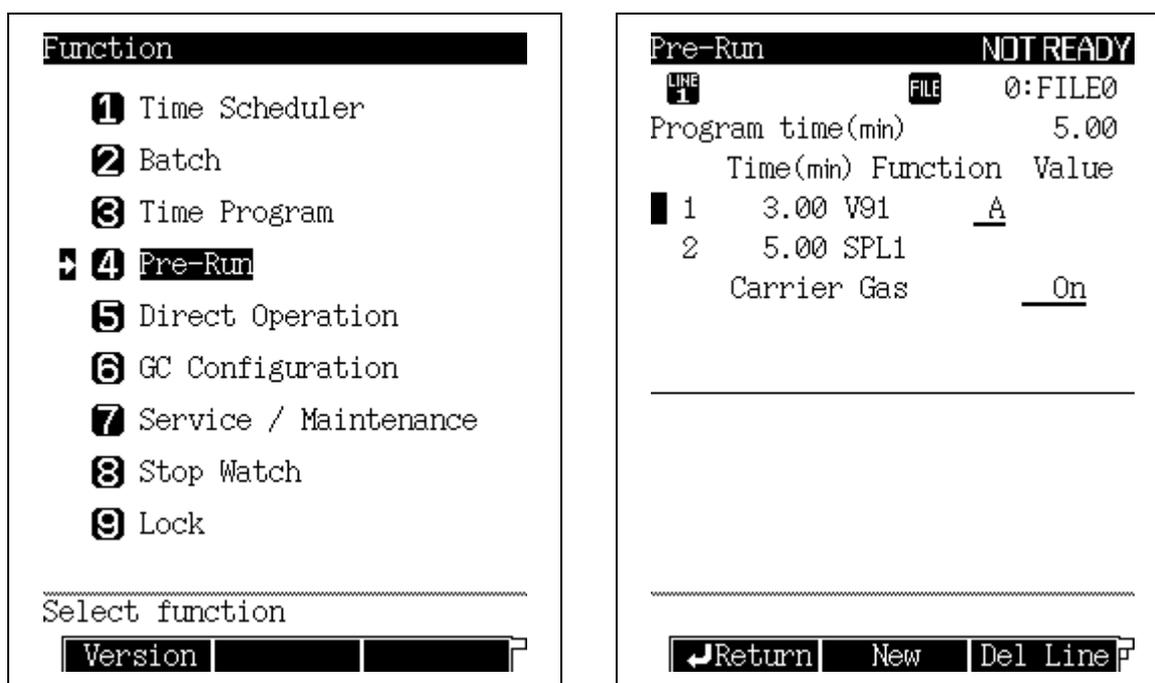
Fig. 16.4.1   Pre-Run program main screen

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.
201-210	Turn AUX AMC on/off.

For details about the event No., refer to "17.4 Event No.".

16.4.6 Pre-Run Program set up example

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
```
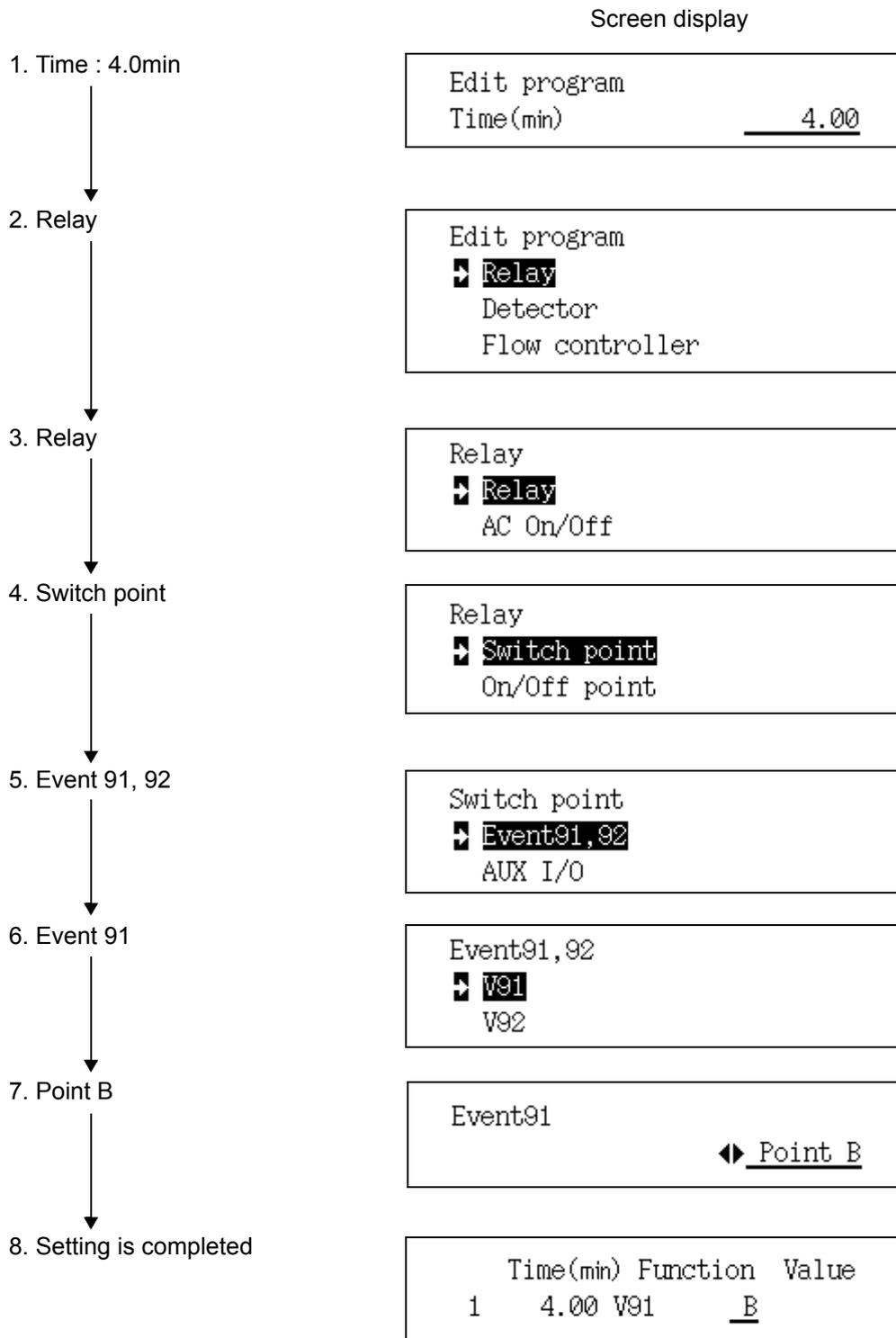
Direct Operation

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.".

```
Function                          Direct               READY

   1 Time Scheduler              Event                    91
   2 Batch
   3 Time Program
   4 Pre-Run
 ↕ 5 Direct Operation
   6 GC Configuration
   7 Service / Maintenance
   8 Stop Watch
   9 Lock

Select function
 Version                          ↵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.
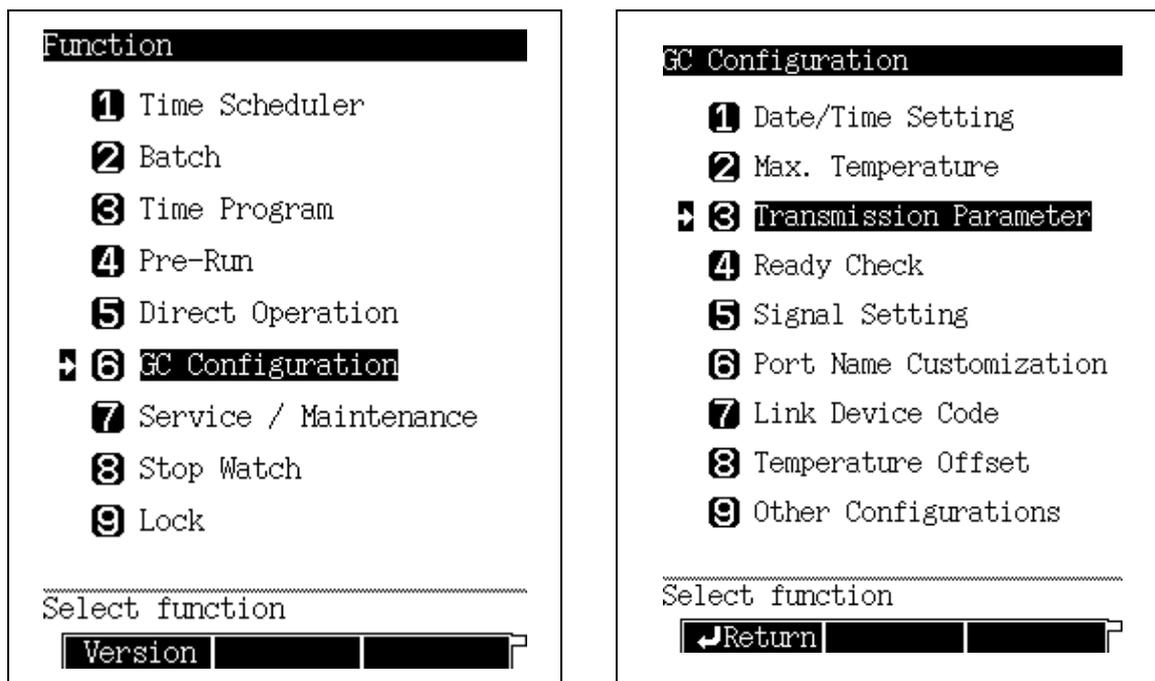
Fig. 16.6.1   GC Configuration setup screen

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.
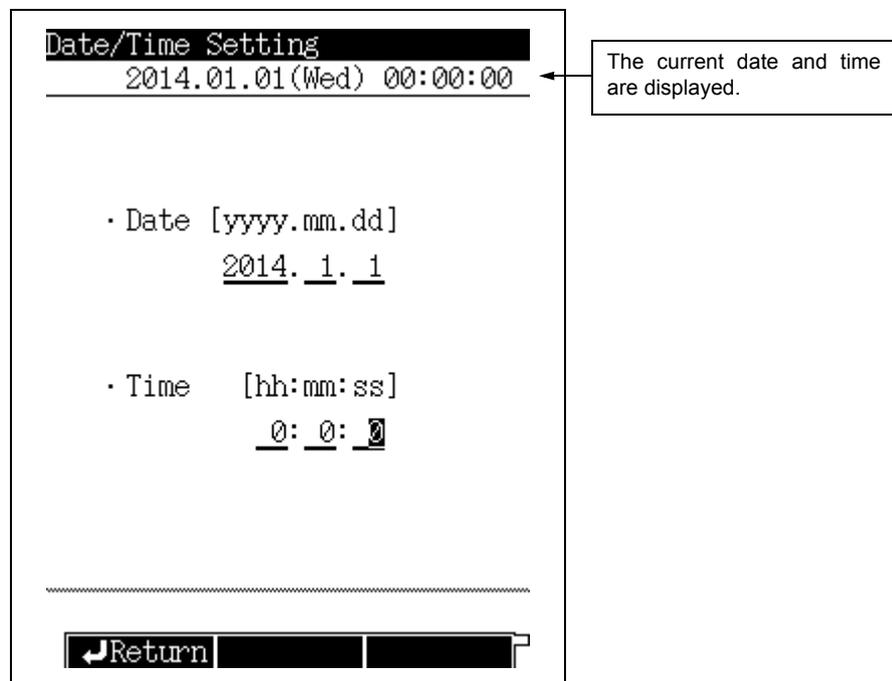
Fig. 16.6.2   Date/time setup screen

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
SPL         Max.Temp(℃)     420.0
DINJ        Max.Temp(℃)     420.0
DFID        Max.Temp(℃)     420.0
DTCD        Max.Temp(℃)     420.0
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: 0.0–420.0°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: 10.0–420.0°C, Default: 420.0°C

INJ2

Range: 0.0–420.0°C, Default: 420.0°C

AUX3/AUX4/AUX5

Range: 10.0–420.0°C, Default: 420.0°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 or equal to the Oven temperature setting value.
When "No" is selected, the Detector temperature setting value may be smaller 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
```
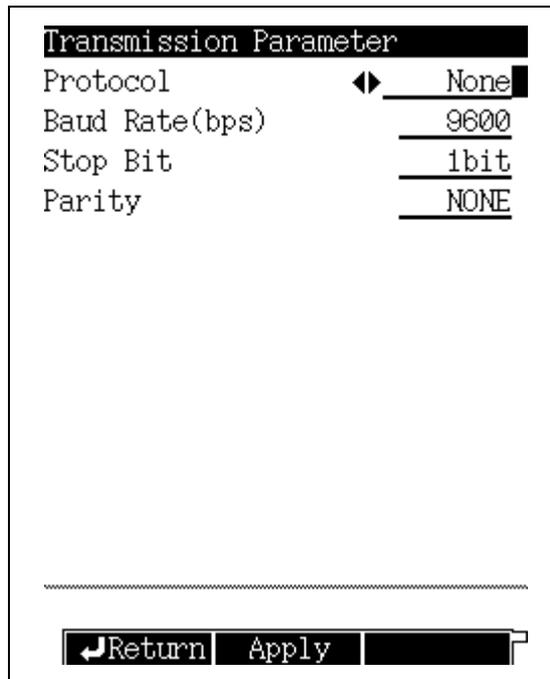
Fig. 16.6.4   Transmission parameter setup screen

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 "2.3 Outputting Digital Signals to a Personal Computer" and "2.4 Connecting a RS-232C Cable to the Chromatopac C-R8A".

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

HEATER 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−APC15 PRESS

Selection: Yes/No, Default: Yes

This item is available only when optional APC units are installed.

AUX AMC

AMC1−AMC10 FLOW

Selection: Yes/No, Default: Yes

This item is available only when optional AMC 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: Yes

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.

```
Signal Settings
||||||||||Output Signal Type|||||||||||
→Ch1 DFID Signal
 Ch2 DTCD Signal
 Ch3 Not set
 Ch4 Not set




 ↵Return Gain etc. DataFile⌐
```
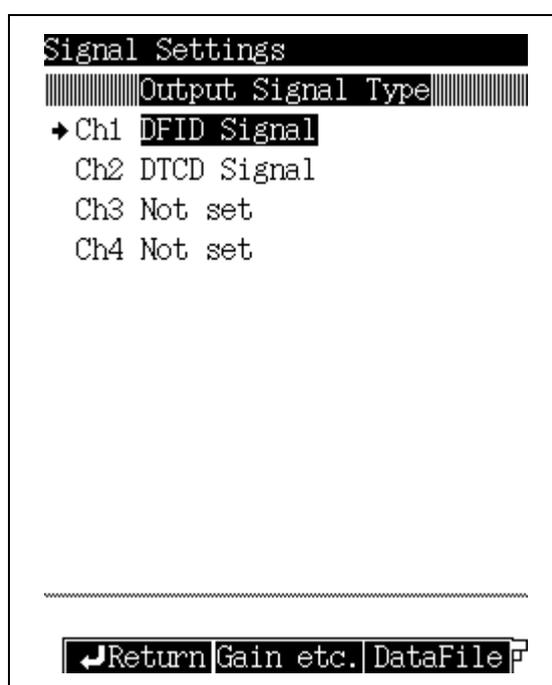
Fig. 16.6.6   Signal setup screen

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 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.
  SPL      Temp. [LINE 1]
  DINJ     Temp. [LINE 2]
  DFID     Temp. [LINE 1]
  DTCD     Temp. [LINE 2]
  (AUX3    Temp.)
  (AUX4    Temp.)
  (AUX5    Temp.)

     ↵Return  Next Ch
```
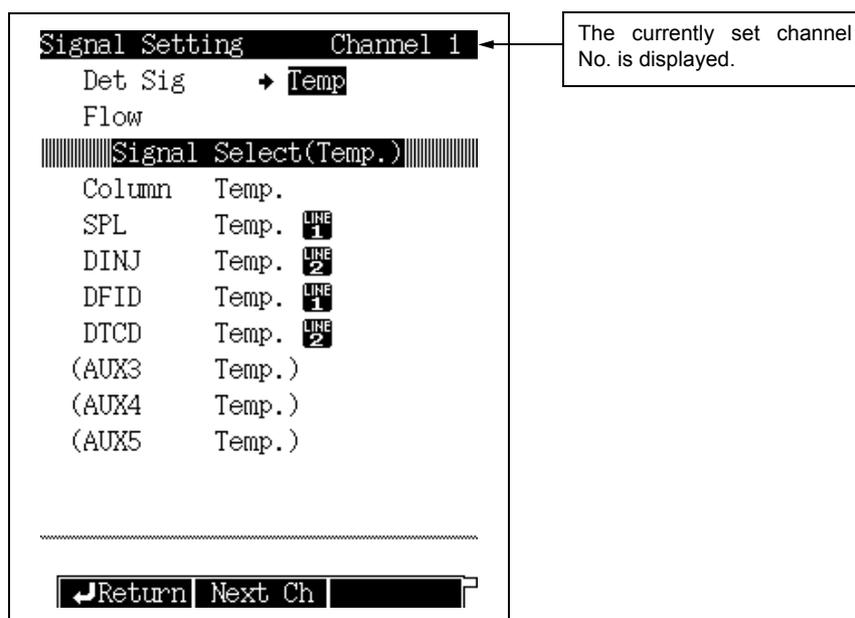
Fig. 16.6.8   Temperature control signal setup screen

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.
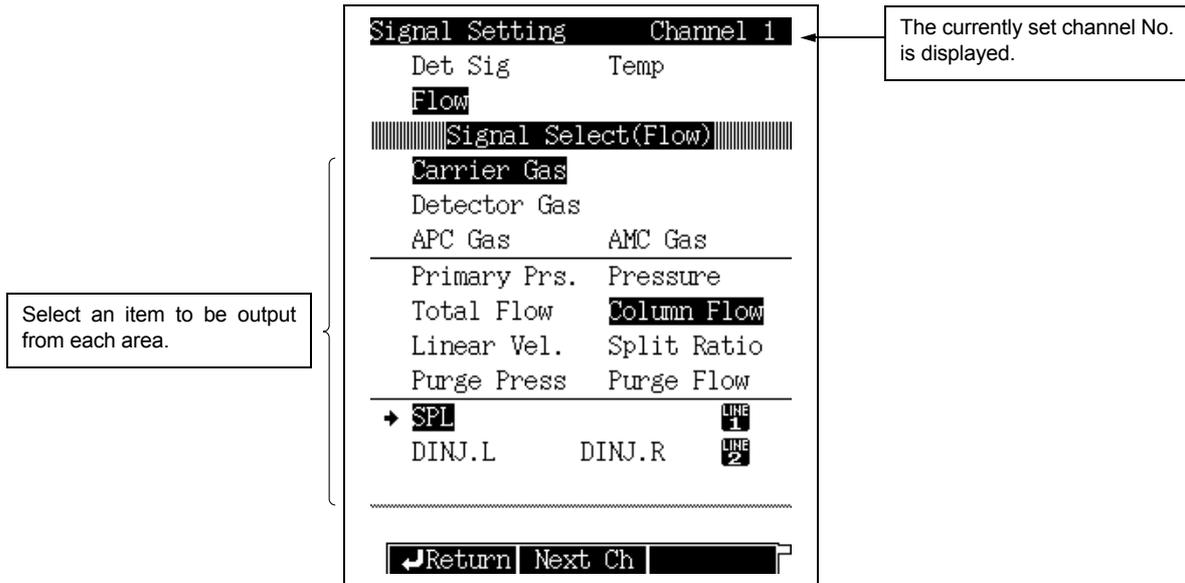
Fig. 16.6.9   Carrier gas signal setup screen

■ Detector gas

If you select the detector gas for the flow signal selection, the screen shown in Fig. 16.6.10 appears.
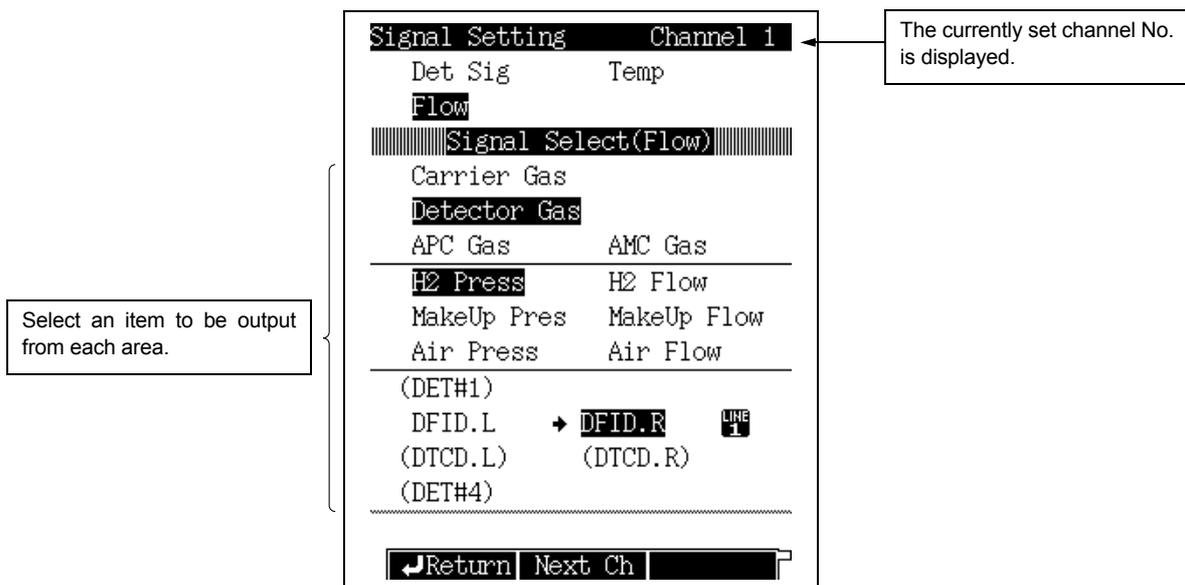
Fig. 16.6.10   Detector gas signal setup screen

■ APC gas

If you select the APC gas for the flow signal selection to display the screen shown in Fig. 16.6.11.

The currently set channel No. is displayed.

Select an item to be output from each area.
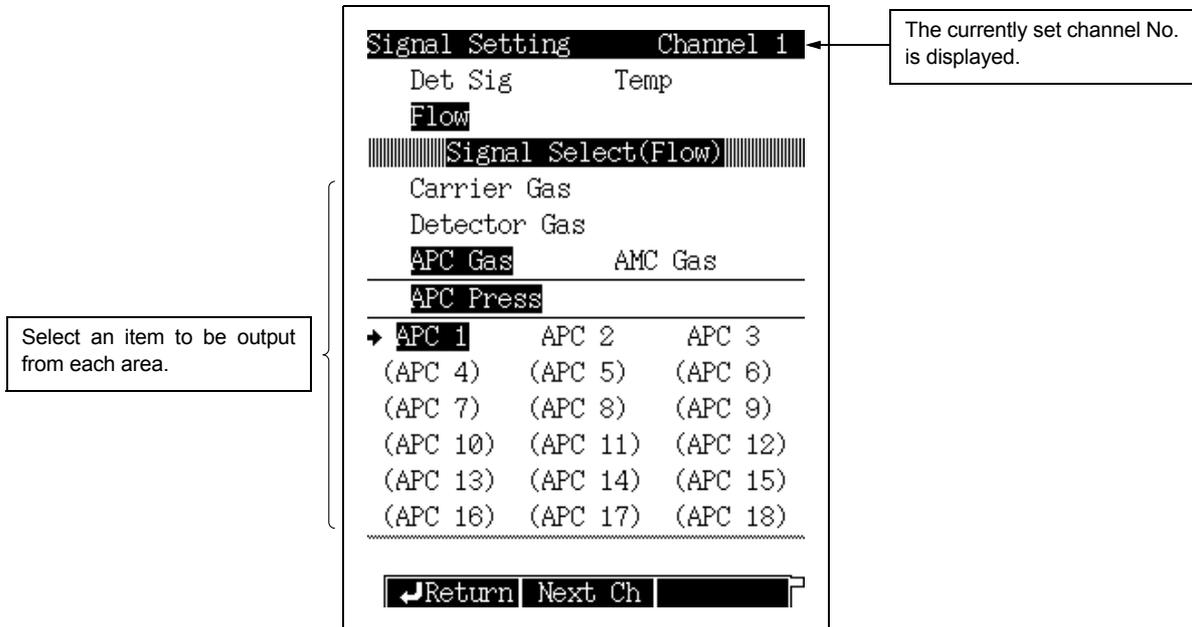
Fig. 16.6.11   APC gas signal setup screen

■ AMC gas

If you select the AMC gas for the flow signal selection, the screen shown in Fig. 16.6.12 appears.

The currently set channel No. is displayed.

Select an item to be output from each area.
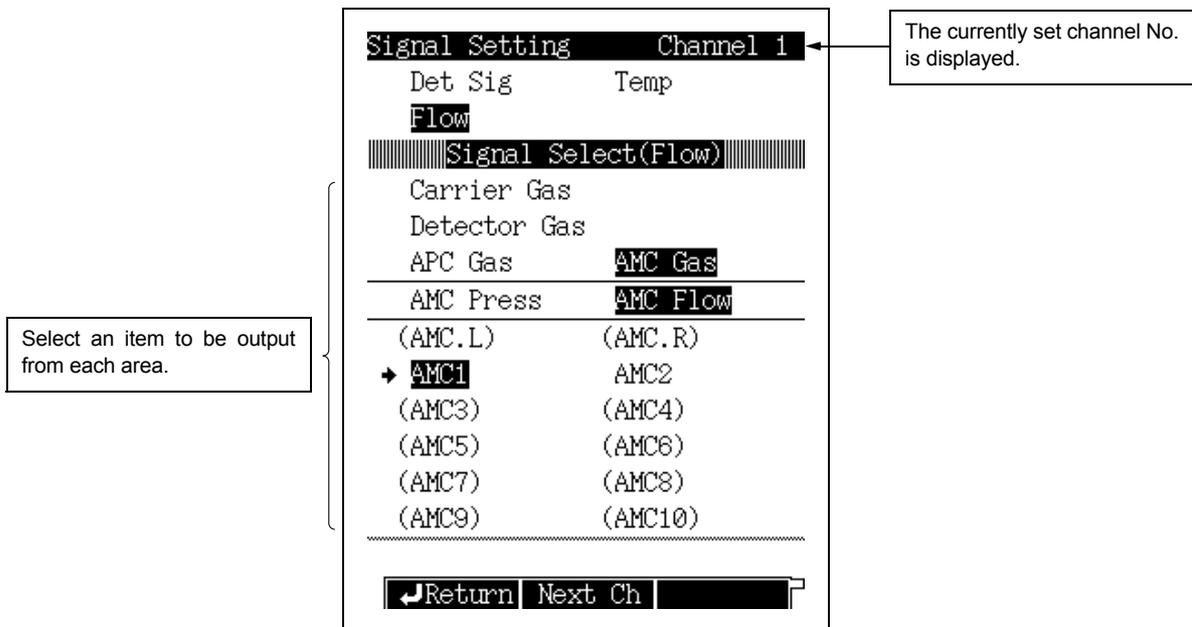
Fig. 16.6.12   AMC gas signal setup screen

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.

```
Gain and Offset
▓▓▓▓▓▓▓DET Signal DFID▓▓▓▓▓▓▓
  Gain                    1.00
  Offset                     0
▓▓▓▓▓▓▓DET Signal DTCD▓▓▓▓▓▓▓
  Gain                    1.00
  Offset                     0




 ⏎Return  Sig. Ch
```

```
Signal Except Detectors
▓▓▓▓▓▓▓Signal Output Ch1▓▓▓▓▓▓▓
  Gain                    1.00
  Offset                     0
  Time Constant             1s
  Signal                     0
▓▓▓▓▓▓▓Signal Output Ch2▓▓▓▓▓▓▓
  Gain                    1.00
  Offset                     0
  Time Constant           20ms
  Signal                     0
▓▓▓▓▓▓▓Signal Output Ch3▓▓▓▓▓▓▓
  Gain                    1.00
  Offset                     0
                             ▽
 ⏎Return Zero Adj ZeroFree
```
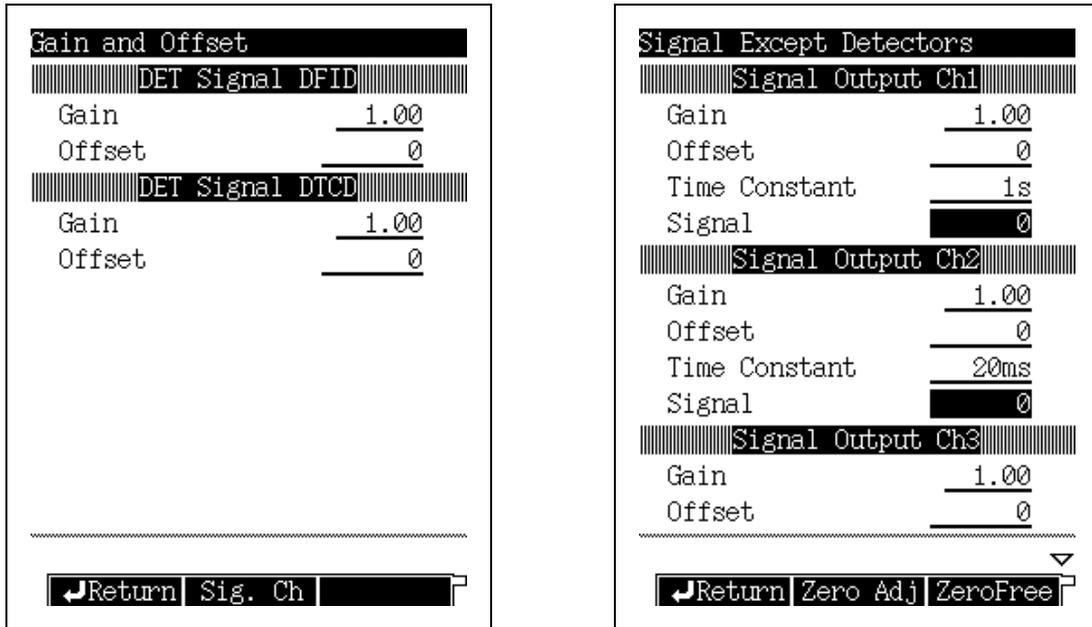
Fig. 16.6.13   Detector signal gain and offset screen

	Range	Default
Gain offset	0.00-100.00 -999999-9999999	1.00 0
Time constant	4ms, 5ms, 10ms, 20ms, 50ms, 100ms, 200ms, 500ms, 1s, 2s	50ms

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 "6.3.5 Changing item names" in "5.3 Basic Key Operations".
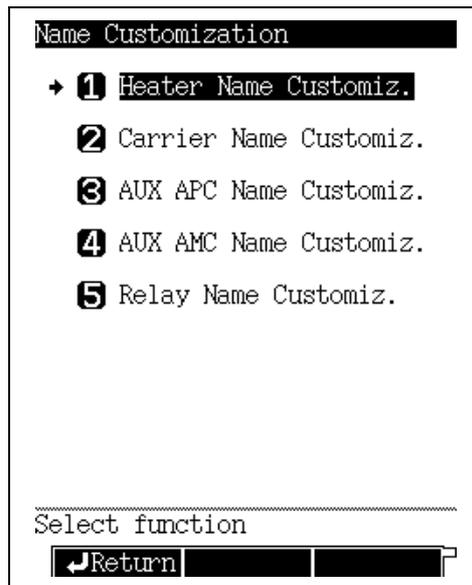
Fig. 16.6.14   Name setup screen

16.6.8.2 Customization example

If the "Heater Name" and "Carrier Name" are customized, the "Line Configuration" screen changes as shown in Fig. 16.6.15.

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, and there is only a carrier flow controller.
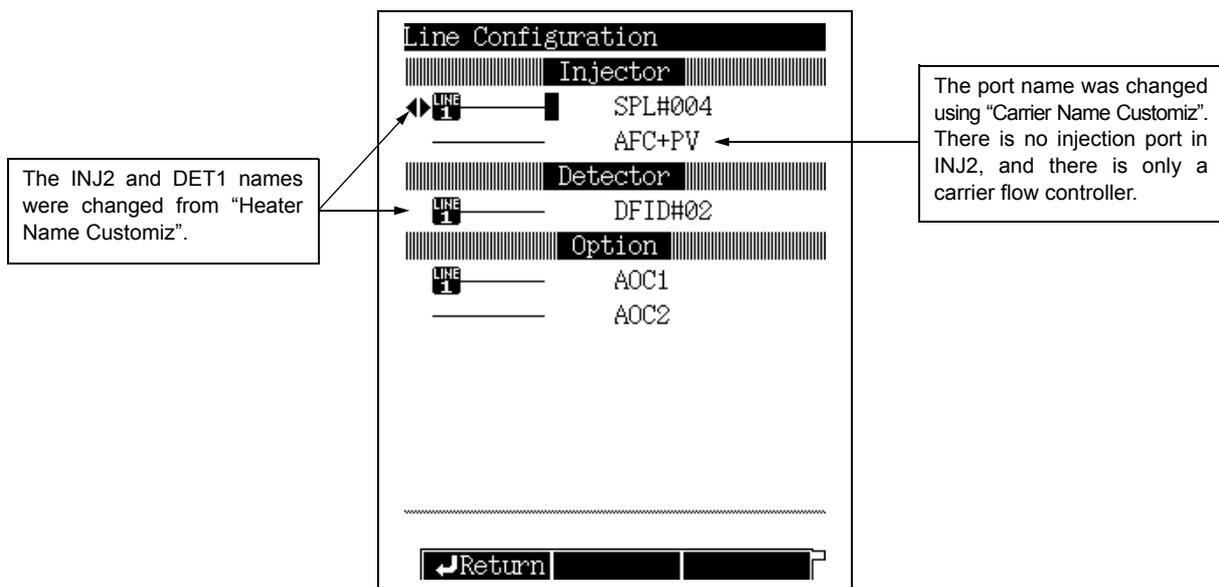
Fig. 16.6.15   Name customization example

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. 16.6.16.

Only listed heated zone names can be changed.

To change the names, refer to "6.3.5 Changing item names" in "6.3 Basic Key Operations".

```
Heater Name Customization
Port      Type        Name
INJ1     (SPL)        SAMPLE
INJ2     (DINJ)       DINJ
DET1     (DFID)       DFID
DET2     (DTCD)       DTCD
AUX3     (---)        -------
AUX4     (---)        -------
AUX5     (---)        -------


    ❶ABC ❷DEF ❸GHI ❹JKL
    ❺MNO ❻PQR ❼STU ❽VWX
    ❾YZ  ❿0-9 ⬛⬛Symbol


    ↵Return│NumerChr│LowerChr
```

Fig. 16.6.16   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. 16.6.17.

To change the names, refer to "6.3.5 Changing item names" in "6.3 Basic Key Operations".

```
Carrier Name Customization
Port      Type        Name
CAR1    (AFC+PU)      SAMPLE
CAR2    (DAFC)        CAR2
CAR3    (---)         CAR3






    ❶ABC ❷DEF ❸GHI ❹JKL
    ❺MNO ❻PQR ❼STU ❽VWX
    ❾YZ  ❿0-9 ⬛⬛Symbol


    ↵Return│NumerChr│LowerChr
```

Fig. 16.6.17   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 "3. AUX APC NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.18.

Only listed APC options can be named.

To change the names, refer to "6.3.5 Changing item names" in "6.3 Basic Key Operations".

Fig. 16.6.18 AUX APC name setup screen

16.6.8.6 AUX AMC Name Customization

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally "4. AUX AMC NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.19.

Only listed AMC options can be named.

To change the names, refer to "6.3.5 Changing item names" in "6.3 Basic Key Operations".

Fig. 16.6.19 AUX AMC name setup screen

16.6.8.7 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. 16.6.20.

Only listed relays can be named.

To change the names, refer to "6.3.5 Changing item names" in "6.3 Basic Key Operations".

```
Relay Name Customization
  Relay           Name
▓▓▓▓▓▓▓▓▓▓▓ STD Relay ▓▓▓▓▓▓▓▓▓▓▓
  EVENT 91      SAMPLE
  EVENT 92      V92____




      ❶ABC ❷DEF ❸GHI ❹JKL
      ❺MNO ❻PQR ❼STU ❽VWX
      ❾YZ  ❿0-9 ❿⊟Symbol


      ↵Return NumerChr LowerChr
```
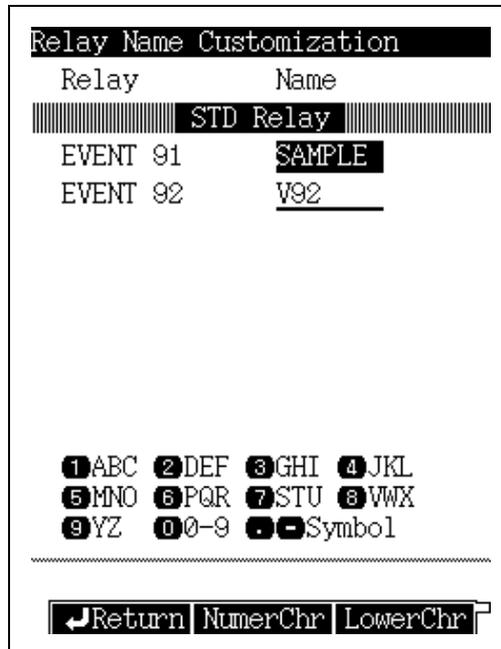
Fig. 16.6.20   Relay name setup screen

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. 16.6.21.
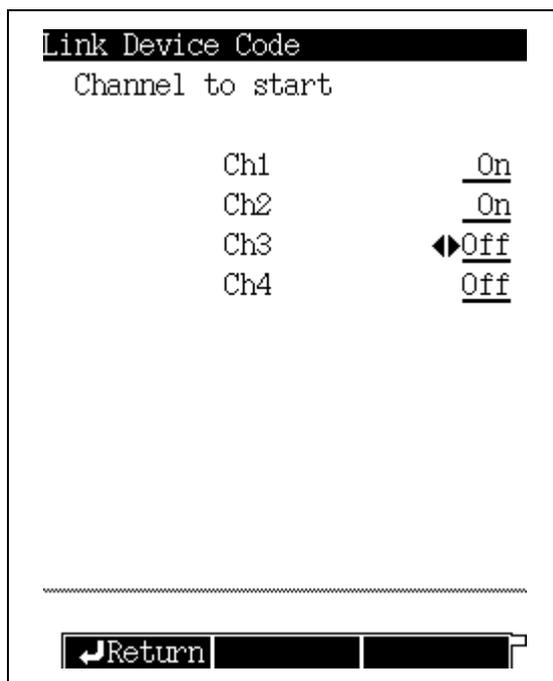
Fig. 16.6.21   Link device code setup screen

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. 16.6.22.
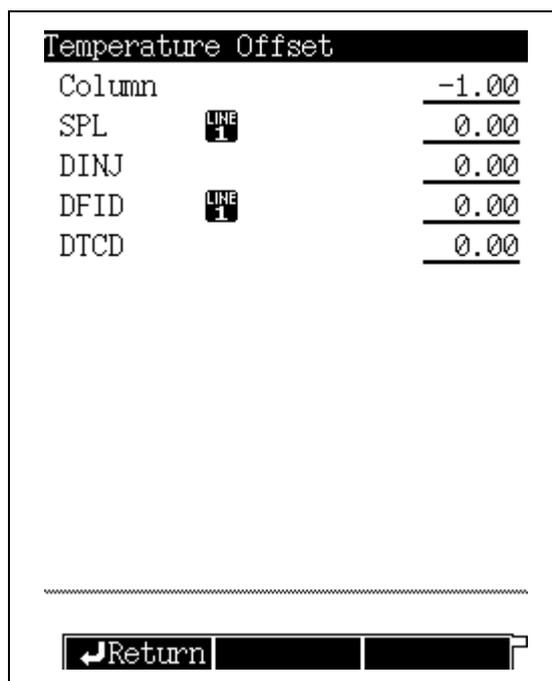
Fig. 16.6.22   Offset set up screen

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. 16.6.23.
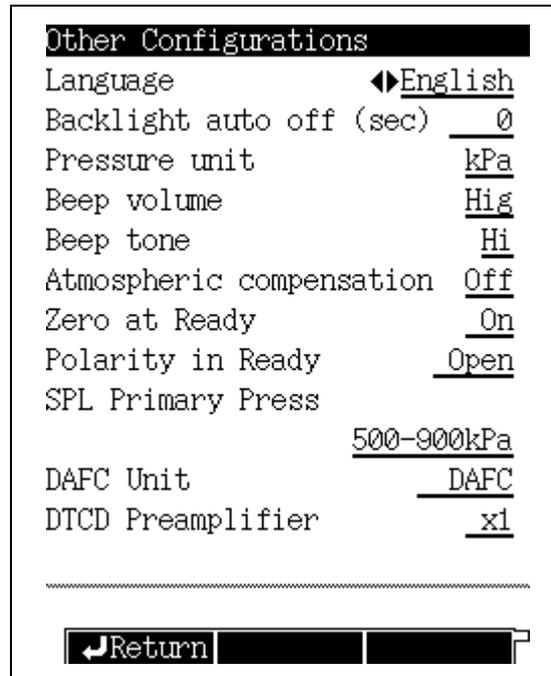
Fig. 16.6.23   Setup screen of other configuration

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.

BEEP VOLUME

Selection: Off/Low/Mid/Hig, Default: Low

BEEP 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 AT 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.

SPL 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-2014 is 700 kPa, select "500−900 kPa". This is not displayed when the carrier gas flow controller is DAFC.

DAFC UNIT

Selection: DAFC/AMC. LR, Default: DAFC

When using the dual AFC as an AMC for detector makeup gas, set to AMC. LR. If AMC. LR is set, the injection port connected to the dual AFC becomes off from the flow line and is not displayed on the flow line configuration screen (8.3.1)

Set the DAFC unit prior to starting GCsolution.

DTCD PREAMPLIFIER

Selection: x1/x10, Default: x1

When it is set to x10, TCD output is amplified ten times.

16.*7* Service and Maintenance

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.

```
Function
    1  Time Scheduler
    2  Batch
    3  Time Program
    4  Pre-Run
    5  Direct Operation
    6  GC Configuration
 ↕  7  Service / Maintenance
    8  Stop Watch
    9  Lock

Select function
 Version              ⌐
```

```
Service/Maintenance
 ↕  1  Installation(Position)
    2  Installation(Piping)
    3  Initialize
    4  Power Consumption
    5  Service




Select function
 ↵Return              ⌐
```
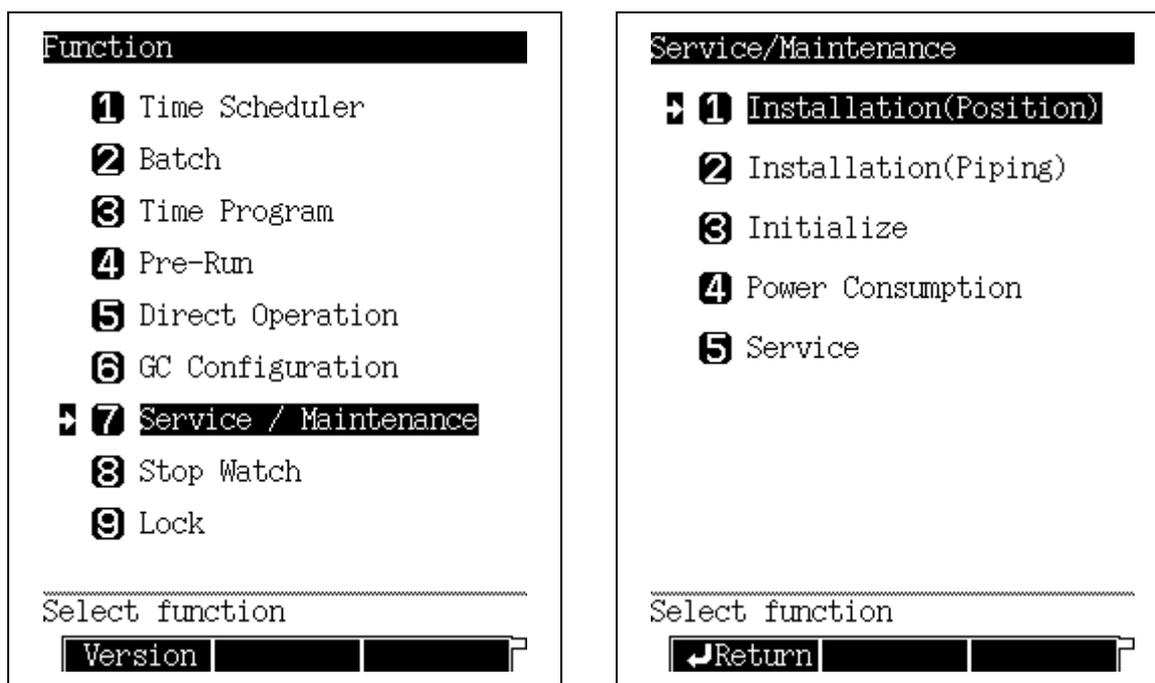
Fig. 16.7.1   Service/maintenance menu screen

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          1
  INJ2     DINJ         2
  DET1     DFID         6
  DET2     DTCD         9
  AUX3     ---         --
  AUX4     ---         --
  AUX5     ---         --




  ↵Return
```

Fig. 16.7.2   GC installation setup screen

NOTE Set the left installation position for units with two column installation positions such as DINJ and DFID.

16.7.3.2 Parameter list

INSTALLATION POSITION

Range: 0−15, 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 "15" when a unit is installed in a position not shown in Fig. 16.7.3.
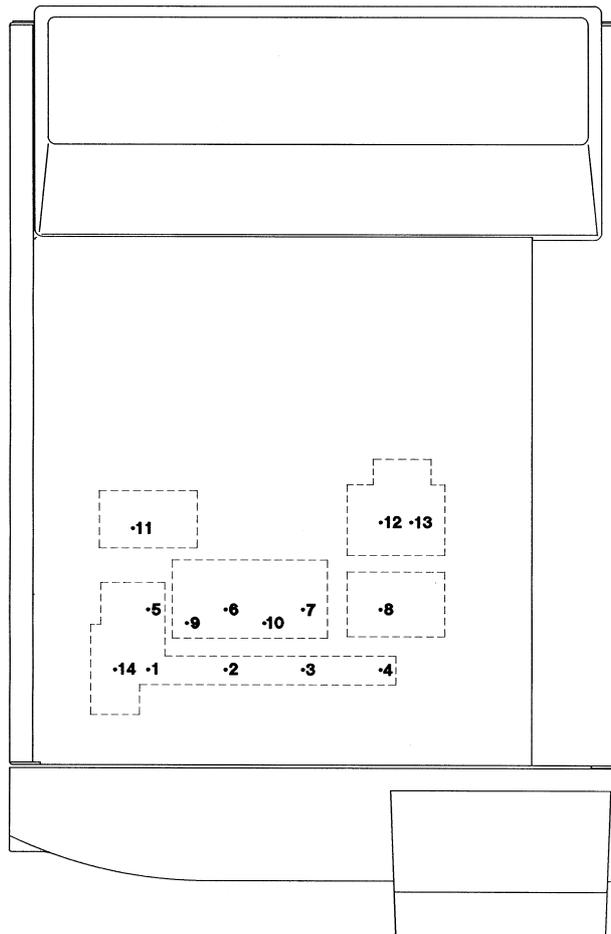
Fig. 16.7.3   Component installation location

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

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/MSLOT1−7, 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.

When an AFC is installed, its SLOT no. 2−6 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

For display only.

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/SLOT2−6/MSLOT1−7, Default: NON

When a manual flow controller is installed, specify the installation location slot no. from among MSLOT1−7.

When a APC is installed, select an available Slot No..

Slot No. which have already been set cannot be selected.

When CONT. TYPE is WDFID (for dual FID) or TCD-L (for packed TCD), two DET APC numbers and slots are displayed. Only the upper lines can be set. When a manual flow controller is used, enter the smaller slot no. among the pair (2 slots). (Example: If MSLOT4 and MSLOT 5 are available, specify MSLOT4.)

Two units of the same type of APCs need to be installed on slots next to each other because piping for two units is set. An APC for the L side is installed on the slot with the smaller number so set the slot no. on the L side to the upper line. An APC installed on the next slot is automatically set on the R side. For example, when the L side is set on SLOT4, the R side is set on SLOT5.

Setting slots for TCD-L detector gas is unnecessary because makeup gas is usually not used for packed TCD.

HEATER PORT

Selection: NON/INJ1/INJ2/DET1/DET2/AUX3/AUX4/AUX5, Default: NON

Specify the detector heated zone where the flows controller tubing is connected.

This assosiates the flow controller to a detector.

When CONT. TYPE is WDFID, only heater ports that the DFID is connected to can be set for piping.

When CONT. TYPE is TCD-L, piping of two units of heater ports need to be set. The upper line is for the pre heater and the lower line is for the TCD cell. A port that the DFID (or a pre heater unit without the FID cell) is connected to can be set for the pre heater and a port that the DTCD is connected to can be set for the TCD cell.

Only heater port that the DFID is connected to is shared for temperature regulation of the DFID and TCD-L pre heater (set for both).

```
Installation(Piping)              Installation(Piping)
▓▓▓▓▓▓▓▓▓▓ DET#2 ▓▓▓▓▓▓▓▓▓▓       ▓▓▓▓▓▓▓▓▓▓ DET#2 ▓▓▓▓▓▓▓▓▓▓
  Cont. Type        WDFID          Cont. Type        WDFID
  DET APC No.     DetAPC 1         DET APC No.     DetAPC 1
  DET APC No.     DetAPC 2         DET APC No.     DetAPC 2
  Unit Type        DET-GAS         Unit Type        APC(3ch)
  Slot No.       ◆ MSLOT4          Slot No.       ◆  SLOT4
  Slot No.         MSLOT5          Slot No.          SLOT5
  Heater Port        DET1          Heater Port        DET1
▓▓▓▓▓▓▓▓▓▓ DET#3 ▓▓▓▓▓▓▓▓▓▓       ▓▓▓▓▓▓▓▓▓▓ DET#3 ▓▓▓▓▓▓▓▓▓▓
  Cont. Type        TCD-L          Cont. Type        TCD-L
  DET APC No.    ----------        DET APC No.    ----------
  DET APC No.    ----------        DET APC No.    ----------
  Unit Type      ----------        Unit Type      ----------
                            ⇕                             ⇕
  ↵Return                          ↵Return
```

　　　　Manual flow controller　　　　　　　　　　　　　APC

Fig. 16.7.5　Setup for detector gas flow controller

NOTE Changes are not in effect until the GC has been turned off and on.
　　　Manual flow controller slot numbers are MSLOT1 to 7 from the left viewed from the back of the unit.
　　　AFC and APC slot numbers are SLOT2 to 6 from the left viewed from the back of the unit. (SLOT1 is not available.)

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
```
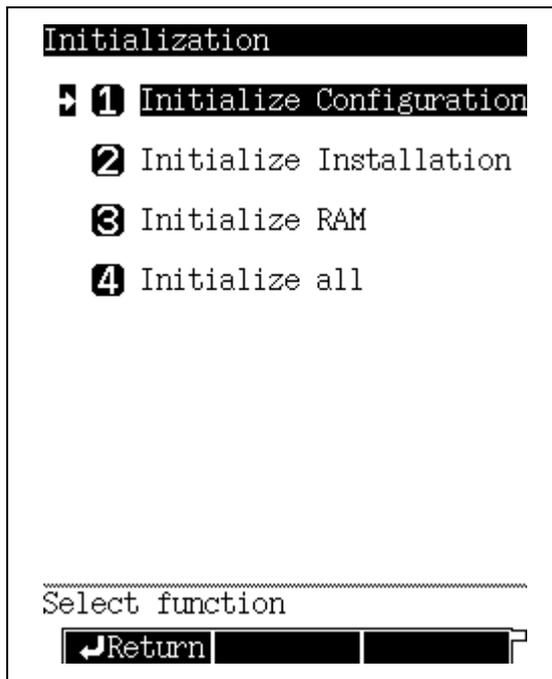
Fig. 16.7.6   Initialization menu screen   Fig. 16.7.7   Initialization confirmation screen
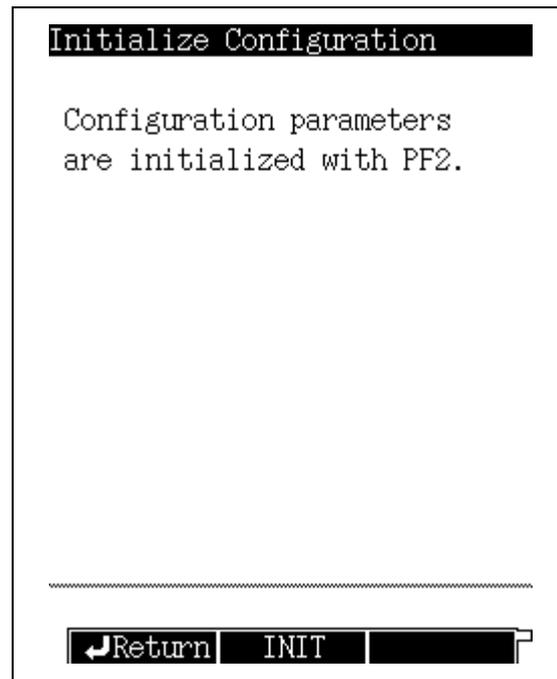
16.7.5.2 Parameter list

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                        │
└─────────────────────────────────┘
```
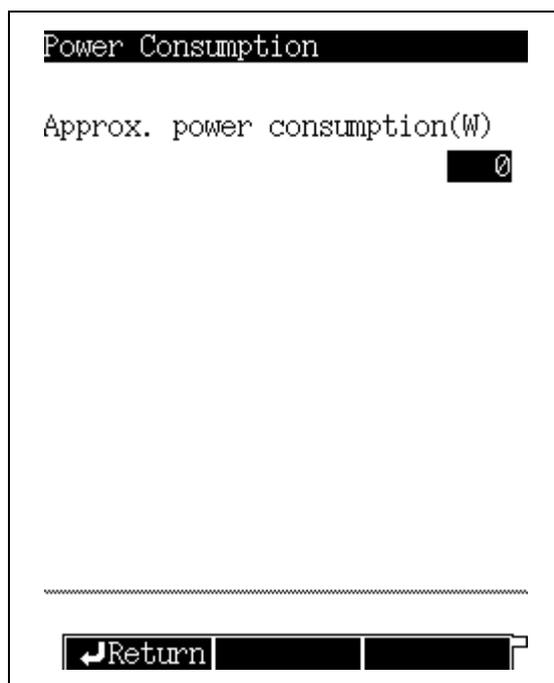
Fig. 16.7.8   Power consumption monitoring screen

16.7.6.2 Parameter list

APPROX. POWER CONSUMPTION

Approximate total power consumption of all working heaters 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.

```
Function                          Stop Watch
                                     0000.00.00(   ) 00:00:00
  🔟 Time Scheduler
  🔟 Batch
  🔟 Time Program                  Lapse Time [hh:mm:ss.s]
  🔟 Pre-Run                                     00:00:24.8
  🔟 Direct Operation              Reciprocal(/min)    2.42
  🔟 GC Configuration
  🔟 Service / Maintenance
  🔟 Stop Watch
  🔟 Lock

Select function
 Version                           ↵Return  Start
```
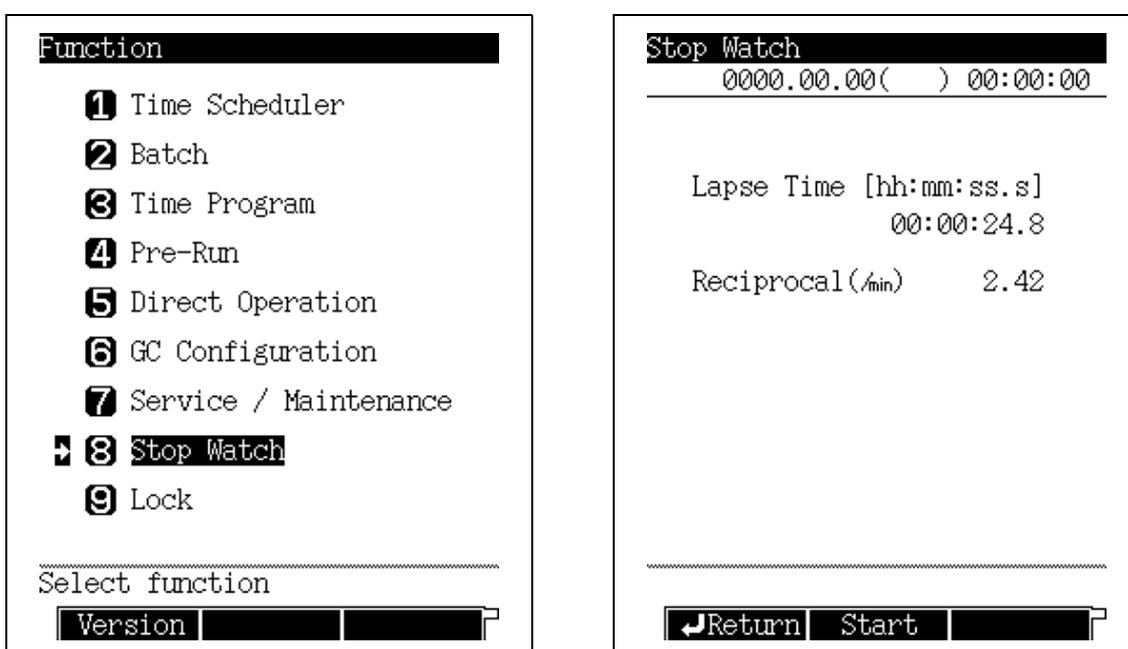
Fig. 16.8.1   Stop watch screen

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 reciprocal number.

$$V \times (\text{Reciprocal number of measurement time}) \text{ ml/min}$$

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.
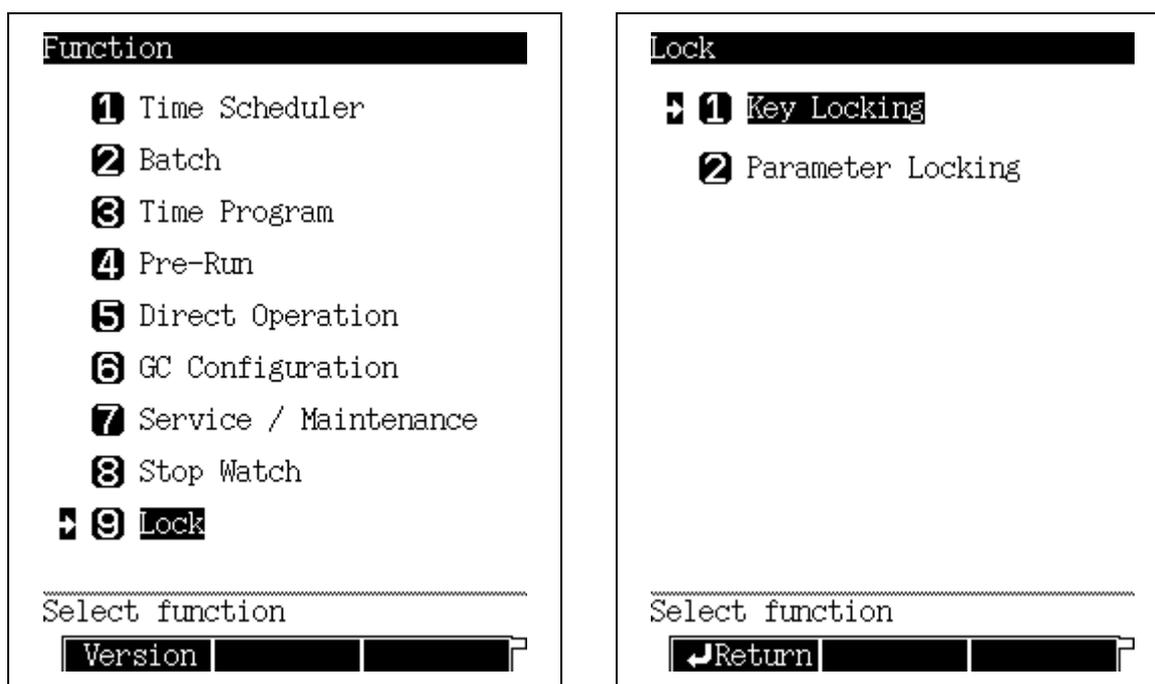
Fig. 16.9.1   Lock menu screen

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  │       ⌐
```
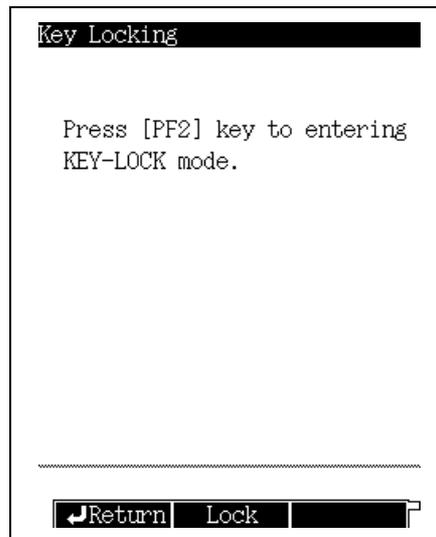
Fig. 16.9.2   Key Locking main screen

■ 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".
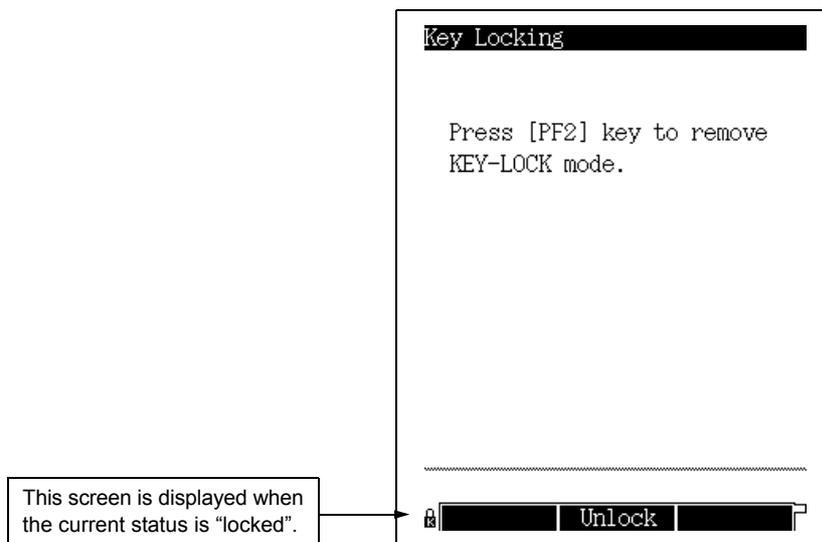
Fig. 16.9.3   Key unlock screen

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.
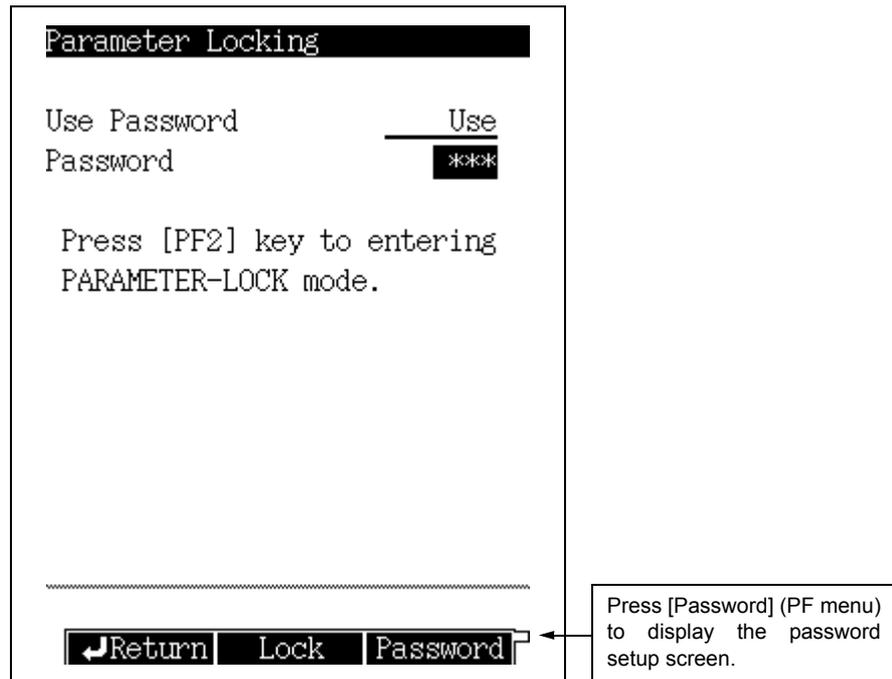
Fig. 16.9.4   Parameter locking main screen

■ 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 "2014".

＜ 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.

```
Parameter Locking



  Press [PF2] key to remove
  PARAMETER-LOCK mode.






```

```
This screen is displayed
when parameters are locked.
```
→ 🔒 ↵Return   Unlock
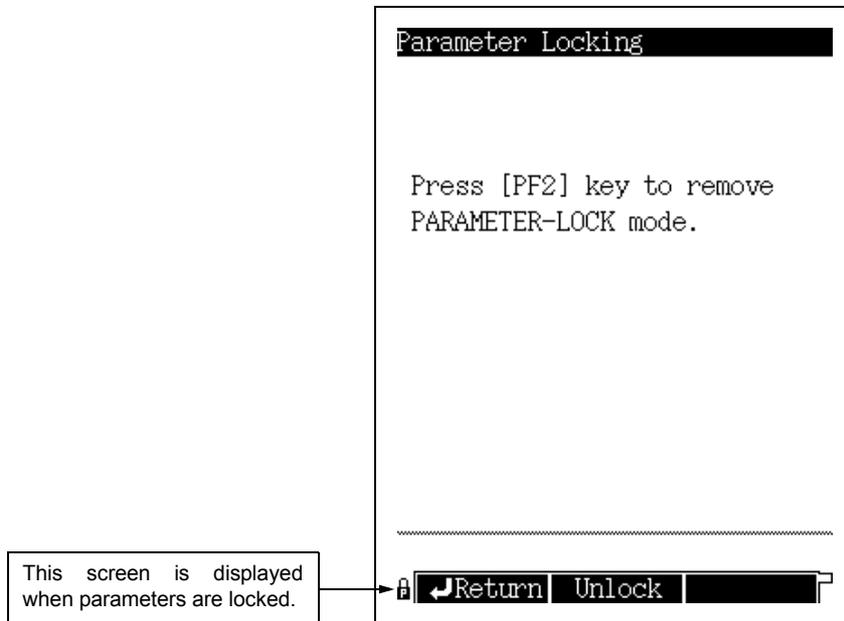
Fig. 16.9.6   Parameter unlock screen (without password)

■ 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.

```
Parameter Locking

Password                 ***

  Press [PF2] key to remove
  PARAMETER-LOCK mode.





```

```
This screen is displayed
when parameters are locked.
```
→ 🔒 ↵Return   Unlock
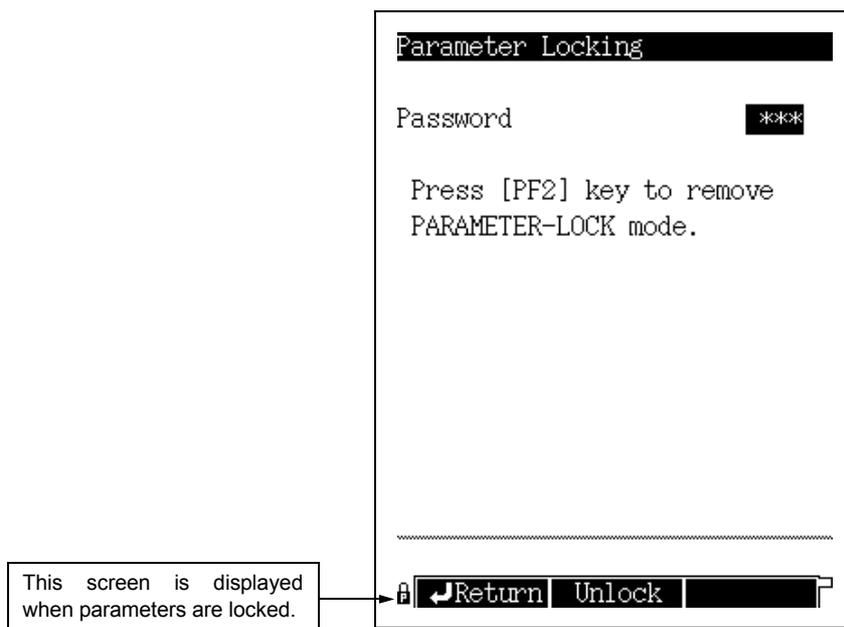
Fig. 16.9.7   Parameter unlock screen (when a password is set)

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.

```
Function
 ↕ ❶ Time Scheduler
   ❷ Batch
   ❸ Time Program
   ❹ Pre-Run
   ❺ Direct Operation
   ❻ GC Configuration
   ❼ Service / Maintenance
   ❽ Stop Watch
   ❾ Lock

 Select function
 ┌─────────┬─────────┬─────────┬──┐
 │ Version │         │         │  │
```

```
Version

 Version          1.1100
 Build No            44




 ┌─────────┬─────────┬─────────┬──┐
 │ ↵Return │         │         │  │
```
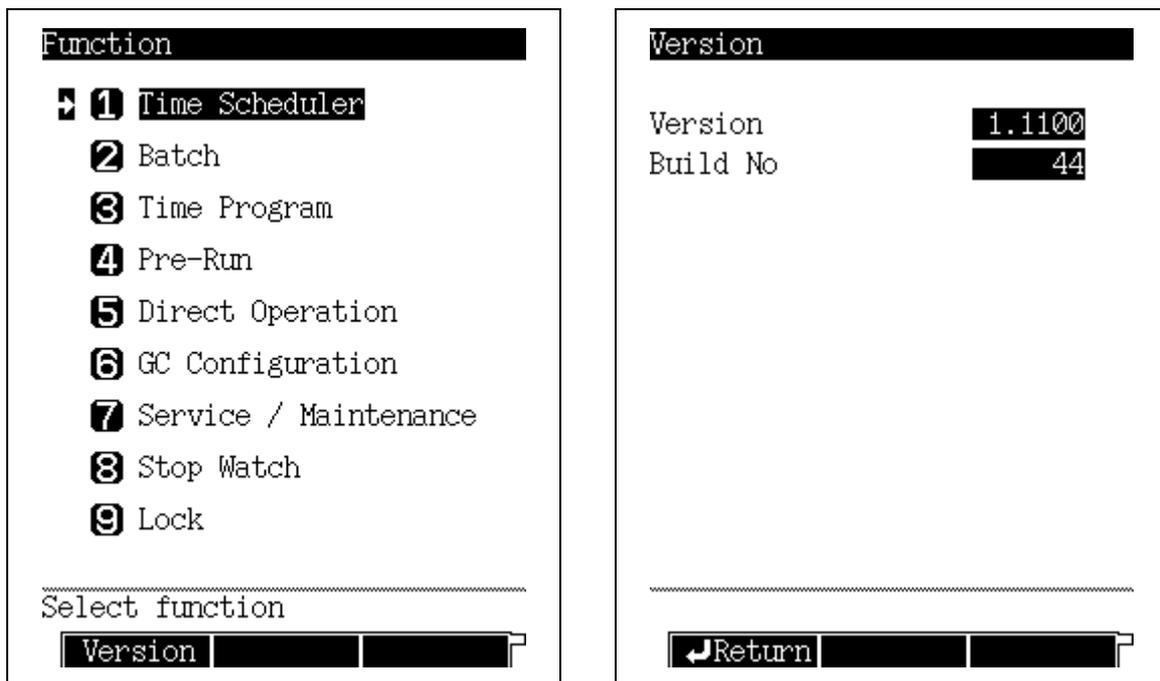
Fig. 16.10.1   ROM version No. screen

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 "2.4 Connecting a RS-232C Cable to the Chromatopac C-R8A".

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

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.

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
INJ1	: INJT
INJ2	: AITP
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 (START)

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).
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.

When the dual AFC (DAFC) is used as flow controller, the following carrier gas is turned On/Off.
* CAR1 L side   ** CAR2 L side
*** When CAR1 is DAFC: CAR1 R side, When CAR1 is AFC and CAR2 is DAFC: CAR2 R side.

No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
155	Turns On DET #3 Air.	Turns Off DET #3 Air.
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.
201	Turns On AMC1 flow controller.	Turns Off AMC1 flow controller.
202	Turns On AMC2 flow controller.	Turns Off AMC2 flow controller.
203	Turns On AMC3 flow controller.	Turns Off AMC3 flow controller.
204	Turns On AMC4 flow controller.	Turns Off AMC4 flow controller.

No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
205	Turns On AMC5 flow controller.	Turns Off AMC5 flow controller.
206	Turns On AMC6 flow controller.	Turns Off AMC6 flow controller.
207	Turns On AMC7 flow controller.	Turns Off AMC7 flow controller.
208	Turns On AMC8 flow controller.	Turns Off AMC8 flow controller.
209	Turns On AMC9 flow controller.	Turns Off AMC9 flow controller.
210	Turns On AMC10 flow controller.	Turns Off AMC10 flow controller.

For dual AFC, there are no gas saver, splitter, septum purge, or high pressure injection modes.

18.1 **Error Messages**

This system is programmed to self-diagnose 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".

For errors of which the "CS" column in the table below shows Yes, a screen to confirm about resetting them appears. When the confirmation screen appears, select one of the following actions:

Reset Error	Resets the system parameters, restoring the conditions prior to the error. System control resumes. If the cause of the error has been corrected, the error does not occur any more.
Ignore Error	Select this to keep the system as it is for a while for some reason, for example, in order to remove the cause of the error.

Codes shown in the tables below identify errors. Provide the code when calling service representative about an error. These codes are also recorded in the error log.

18.1.1 **System errors**

Power supply failure

Code	Message	CS
0001	DC 5V is out of range	No
0002	DC 24V is out of range	No
0003	DC -15V is out of range	No

If the above error messages appear, the hardware has failed. The GC system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

Room temperature sensor/atmospheric pressure sensor error

Code	Message	CS
0005	Room temperature is out of range	No
0006	Atm. pressure is out of range	No

The room temperature or atmospheric pressure is out of the performance range. If this error occurs even though the actual room temperature/atmospheric pressure is within the range, the sensors may have failed. The system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

PCB failure

Code	Message	CS
0007	DET#1 PCB error	No
0008	DET#2 PCB error	No
0009	DET#3 PCB error	No
0010	DET#4 PCB error	No
0011	CAR1 AFC PCB error	No
0012	CAR2 AFC PCB error	No
0013	Det APC1 PCB error	No
0014	Det APC2 PCB error	No
0015	Det APC3 PCB error	No
0016	Det APC4 PCB error	No
0023	APC 1-3 PCB error	No
0024	APC 4-6 PCB error	No
0025	APC 7-9 PCB error	No
0026	APC 10-12 PCB error	No
0027	APC 13-15 PCB error	No
0028	APC 16-18 PCB error	No

If the above error messages appear, the hardware has failed. The GC system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

Clock reset

Code	Message	CS
0029	Clock is initialized	No

The built-in clock has been reset. As a result, other saved parameters may have changed. Check the configuration, installation, and flow rate settings. Initialize the parameters or reset them if necessary. If the same message is displayed repeatedly, the hardware has failed. The GC system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

A/D converter failure, feedback loop communication error

Code	Message	CS
0030	COL A/D conv. error	No
0031	INJ1-DET2 A/D error	No
0032	AUX3-AUX5 A/D error	No
0033	Loop back test error	No

If the above error messages appear, the hardware has failed. The GC system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

Low voltage of CPU board battery

Code	Message	CS
0034	Battery voltage error	No

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
0035	Cooling fan error	No

The GC cooling fan is out of order. The system cannot perform fully in this condition. Turn off the system and contact your Shimadzu representative.

Damaged in electronics

Code	Message	CS
0036	ROM error	No
0037	RAM error	No
0038	CPU register error	No

A repair is necessary. Contact your Shimadzu representative.

Abnormal PRG current

| Code	Message	CS
0039	PRG current error	Yes

Electric current in the optional PRG board is abnormal. The system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

Flow controller AMC board failure

Code	Message	CS
0040	CAR1 DAFC PCB error	No
0041	CAR2 DAFC PCB error	No
0042	AMC 1-2 PCB error	No
0043	AMC 3-4 PCB error	No
0044	AMC 5-6 PCB error	No
0045	AMC 7-8 PCB error	No
0046	AMC 9-10 PCB error	No
0047	CAR1 SAFC PCB error	No
0048	CAR2 SAFC PCB error	No

If the above error messages appear, the hardware has failed. The GC system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

18.1.2 Temperature control errors

Heat loss

Code	Message	CS
1001	Heat is escaping	Yes

This message appears when heat loss is substantial. The oven door may be open or the insulation has a hole. If the column oven door is open, close it and select "Reset Error." If the insulation has a hole in it, turn off the power of the unit, repair the hole, and then restart the system.
This error may not occur even when the door is open when the column oven temperature is set at a certain range or the temperature around the unit is a certain level.

Temperature increase limit over

Code	Message	CS
1002	COL temp exceed the limit	Yes
1003	INJ1 temp exceed the limit	Yes
1004	DET1 temp exceed the limit	Yes
1005	INJ2 temp exceed the limit	Yes
1006	DET2 temp exceed the limit	Yes
1007	AUX3 temp exceed the limit	Yes
1008	AUX4 temp exceed the limit	Yes
1009	AUX5 temp exceed the limit	Yes

These messages appear when the maximum temperature limit has been exceeded. Press "Ignore Error" and change the maximum limit temperature. If the confirmation screen to reset the error appears again, press "Reset Error."

Temperature sensor errors

Code	Message	CS
1010	COL sensor is short circuit	Yes
1011	INJ1 sensor is short circuit	Yes
1012	DET1 sensor is short circuit	Yes
1013	INJ2 sensor is short circuit	Yes
1014	DET2 sensor is short circuit	Yes
1015	AUX3 sensor is short circuit	Yes
1016	AUX4 sensor is short circuit	Yes
1017	AUX5 sensor is short circuit	Yes
1018	COL sensor is down	Yes
1019	INJ1 sensor is down	Yes
1020	DET1 sensor is down	Yes
1021	INJ2 sensor is down	Yes
1022	DET2 sensor is down	Yes
1023	AUX3 sensor is down	Yes
1024	AUX4 sensor is down	Yes
1025	AUX5 sensor is down	Yes
1026	COL sensor is error	Yes
1027	INJ1 sensor is error	Yes
1028	DET1 sensor is error	Yes
1029	INJ2 sensor is error	Yes
1030	DET2 sensor is error	Yes
1031	AUX3 sensor is error	Yes
1032	AUX4 sensor is error	Yes
1033	AUX5 sensor is error	Yes

When one of these messages appears, the temperature sensor may have failed. The sensor cannot be used in this condition and replacement or repair is required. Turn off the system and contact your Shimadzu representative.

Unstable temperature with CRG

Code	Message	CS
1034	COL CRG cannot be controlled	Yes

This message appears when cooling is impossible because of insufficient coolant, etc.
If there is no coolant, turn off the system, replace the coolant, and then restart the system.
This message may appear when cooling is impossible because the oven door is open. In this case, close the door and press "Reset Error."

Overheat

Code	Message	CS
1036	Overheat is sensed	Yes
1037	COL temp controller broken	No
1038	INJ1 temp controller broken	No
1039	DET1 temp controller broken	No
1040	INJ2 temp controller broken	No
1041	DET2 temp controller broken	No
1042	AUX3 temp controller broken	No
1043	AUX4 temp controller broken	No
1044	AUX5 temp controller broken	No

An error may have occurred in the temperature control circuit.
Turn off the system and contact your Shimadzu representative.

Relay/heater control circuit errors

Code	Message	CS
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.

Detector temperature setting error

Code	Message	CS
1049	DET#1 set temp is low	No
1050	DET#2 set temp is low	No
1051	DET#3 set temp is low	No
1052	DET#4 set temp is low	No

These messages appear when the Detector temperature setting value is smaller than that of the Oven. Increase the Detector temperature.
To have the Detector temperature lower than the column oven temperature, set "No" on Protection against contamination (PF menu) on the screen to set the maximum temperature on configuration setting.

18.1.3 Pressure/flow rate errors

Leaks

Code	Message	CS
2005	CAR1 purge leaks	Yes
2006	CAR2 purge leaks	Yes
2007	CAR3 purge leaks	Yes
2014	DetAPC1 makeup gas leaks	Yes
2015	DetAPC1 hydrogen leaks	Yes
2016	DetAPC1 air leaks	Yes
2017	DetAPC2 makeup gas leaks	Yes
2018	DetAPC2 hydrogen leaks	Yes
2019	DetAPC2 air leaks	Yes
2020	DetAPC3 makeup gas leaks	Yes
2021	DetAPC3 hydrogen leaks	Yes
2022	DetAPC3 air leaks	Yes
2023	DetAPC4 makeup gas leaks	Yes
2024	DetAPC4 hydrogen leaks	Yes
2025	DetAPC4 air leaks	Yes
2026	APC1 leaks	Yes
2027	APC2 leaks	Yes
2028	APC3 leaks	Yes
2029	APC4 leaks	Yes
2030	APC5 leaks	Yes
2031	APC6 leaks	Yes
2032	APC7 leaks	Yes
2033	APC8 leaks	Yes
2034	APC9 leaks	Yes
2035	APC10 leaks	Yes
2036	APC11 leaks	Yes
2037	APC12 leaks	Yes
2038	APC13 leaks	Yes
2039	APC14 leaks	Yes
2040	APC15 leaks	Yes
2041	APC16 leaks	Yes
2042	APC17 leaks	Yes
2043	APC18 leaks	Yes

The pressure cannot reach the set value. Check whether gas is supplied and whether gas is leaking from connections.

NOTE Gas may be leaking in locations other than the ones displayed.
(Example)   If the purge flow rate is too low because of the leakage of carrier gas line, the message "Purge leaks" appears in stead of the indication of ESC or TFC leakage.

Valve leak errors

Code	Message	CS
2048	CAR1 purge valve leaks	Yes
2049	CAR2 purge valve leaks	Yes
2050	CAR3 purge valve leaks	Yes
2057	DetAPC1 makeup valve leaks	Yes
2058	DetAPC1 hydrogen valve leaks	Yes
2059	DetAPC1 air valve leaks	Yes
2060	DetAPC2 makeup valve leaks	Yes
2061	DetAPC2 hydrogen valve leaks	Yes
2062	DetAPC2 air valve leaks	Yes
2063	DetAPC3 makeup valve leaks	Yes
2064	DetAPC3 hydrogen valve leaks	Yes
2065	DetAPC3 air valve leaks	Yes
2066	DetAPC4 makeup valve leaks	Yes
2067	DetAPC4 hydrogen valve leaks	Yes
2068	DetAPC4 air valve leaks	Yes
2069	APC1 valve leaks	Yes
2070	APC2 valve leaks	Yes
2071	APC3 valve leaks	Yes
2072	APC4 valve leaks	Yes
2073	APC5 valve leaks	Yes
2074	APC6 valve leaks	Yes
2075	APC7 valve leaks	Yes
2076	APC8 valve leaks	Yes
2077	APC9 valve leaks	Yes
2078	APC10 valve leaks	Yes
2079	APC11 valve leaks	Yes
2080	APC12 valve leaks	Yes
2081	APC13 valve leaks	Yes
2082	APC14 valve leaks	Yes
2083	APC15 valve leaks	Yes
2084	APC16 valve leaks	Yes
2085	APC17 valve leaks	Yes
2086	APC18 valve leaks	Yes

Gas is flowing even if the pressure is set at 0 kPa or the flow rate is set at 0 ml/min. If there is no problem with the gas supply, an AFC/APC value error may have occurred. Turn off the system and contact your Shimadzu representative.

Abnormal component operation

Code	Message	CS
2091	CAR1 purge is out of control	Yes
2092	CAR2 purge is out of control	Yes
2093	CAR3 purge is out of control	Yes
2100	DetAPC1 makeup gas is out of ctrl	Yes
2101	DetAPC1 hydrogen is out of control	Yes
2102	DetAPC1 air is out of control	Yes
2103	DetAPC2 makeup gas is out of ctrl	Yes
2104	DetAPC2 hydrogen is out of control	Yes
2105	DetAPC2 air is out of control	Yes
2106	DetAPC3 makeup gas is out of ctrl	Yes
2107	DetAPC3 hydrogen is out of control	Yes
2108	DetAPC3 air is out of control	Yes
2109	DetAPC4 makeup gas is out of ctrl	Yes
2110	DetAPC4 hydrogen is out of control	Yes
2111	DetAPC4 air is out of control	Yes
2112	APC1 is out of control	Yes
2113	APC2 is out of control	Yes
2114	APC3 is out of control	Yes
2115	APC4 is out of control	Yes
2116	APC5 is out of control	Yes
2117	APC6 is out of control	Yes
2118	APC7 is out of control	Yes
2119	APC8 is out of control	Yes
2120	APC9 is out of control	Yes
2121	APC10 is out of control	Yes
2122	APC11 is out of control	Yes
2123	APC12 is out of control	Yes
2124	APC13 is out of control	Yes
2125	APC14 is out of control	Yes
2126	APC15 is out of control	Yes
2127	APC16 is out of control	Yes
2128	APC17 is out of control	Yes
2129	APC18 is out of control	Yes

Verify whether gas is supplied stably at the required pressure. If there is no problem with the gas supply, the control system, such as the APC, may have failed. Turn off the system and contact your Shimadzu representative.

AFC leaks

Code	Message	CS
2130	CAR1 AFC leaks	Yes
2131	CAR2 AFC leaks	Yes

The pressure cannot reach the set value. Check whether gas is supplied and whether gas is leaking from connections.

NOTE Gas may be leaking in locations other than the ones displayed.

AFC valve leak errors

Code	Message	CS
2132	CAR1 AFC valve leaks	Yes
2133	CAR2 AFC valve leaks	Yes

Gas is flowing even if the pressure is set at 0 kPa or the flow rate is set at 0 ml/min. If there is no problem in the gas supply, an AFC value error may have occurred. Turn off the system and contact your Shimadzu representative.

Abnormal component operation

Code	Message	CS
2134	CAR1 AFC is out of control	Yes
2135	CAR2 AFC is out of control	Yes
2136	CAR1 AFC is out of control	Yes
2137	CAR2 AFC is out of control	Yes
2138	CAR1 prim is out of range	No
2139	CAR2 prim is out of range	No
2140	CAR3 prim is out of range	No

Verify whether gas is supplied stably 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.
When errors 2138-2140 occur, carrier gas is not properly supplied. Check the gas remaining in the gas cylinder and piping connections.

Control setting errors

Code	Message	CS
2141	CAR1 is not controlled	No
2142	CAR2 is not controlled	No
2143	CAR1 is not controlled	No

These messages appear when the temperature control starts without carrier gas control. Set the setting of the flow controller to "On" or remove unused carrier gas line from the line configuration.

Abnormal component operation

Code	Message	CS
2144	CAR1. L DAFC is out of control	Yes
2145	CAR1. R DAFC is out of control	Yes
2146	CAR2. L DAFC is out of control	Yes
2147	CAR2. R DAFC is out of control	Yes
2148	AMC.L is out of control	Yes
2149	AMC.L is out of control	Yes
2150	AMC.R is out of control	Yes
2151	AMC1 is out of control	Yes
2152	AMC2 is out of control	Yes
2153	AMC3 is out of control	Yes
2154	AMC4 is out of control	Yes
2155	AMC5 is out of control	Yes
2156	AMC6 is out of control	Yes
2157	AMC7 is out of control	Yes
2158	AMC8 is out of control	Yes
2159	AMC9 is out of control	Yes
2160	AMC10 is out of control	Yes
2161	CAR1 SAFC is out of control	Yes
2162	CAR2 SAFC is out of control	Yes

Verify whether gas is supplied stably 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.

18.1.4 Communication errors

External device communication errors (i.e., Chromatopac)

Code	Message	CS
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 appears during a link failure or communication failure. (When a communication error occurs, the link is automatically disconnected.)
When one of these messages appears, check the connection status, and reset the link.

AOC communication errors

Code	Message	CS
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 appears during a link failure or communication failure. (When a communication error occurs, the link is automatically disconnected.)
When one of these messages appears, check the connection status, and reset the link.

18.1.5 Detector errors

Over current

Code	Message	CS
4101	DET#1 TCD cell error	Yes
4102	DET#2 TCD cell error	Yes
4103	DET#3 TCD cell error	Yes
4104	DET#4 TCD cell error	Yes
4105	DET#1 FTD current error	Yes
4106	DET#2 FTD current error	Yes
4107	DET#3 FTD current error	Yes
4108	DET#4 FTD current error	Yes

Current of the detector is abnormal. 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 set current value exceeds the maximum operating current.
• Gas is not flowing.
• Gas is leaking.
• A significant amount of air is present in the flow line (for TCD).

Correct the 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.

Detector flame error

Code	Message	CS
4109	DET#1 flame is out	No
4110	DET#2 flame is out	No
4111	DET#3 flame is out	No
4112	DET#4 flame is out	No

The detector flame (FID, FPD) has been extinguished. Check the gas supply, and ignite the detector again. If the flame error occurs repeatedly, the hardware has failed. The system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

FPD errors

Code	Message	CS
4113	DET#1 FPD battery error	Yes
4114	DET#2 FPD battery error	Yes
4115	DET#3 FPD battery error	Yes
4116	DET#4 FPD battery error	Yes
4117	DET#1 FPD temperature error	Yes
4118	DET#2 FPD temperature error	Yes
4119	DET#3 FPD temperature error	Yes
4120	DET#4 FPD temperature error	Yes
4121	DET#1 FPD cooling fan error	Yes
4122	DET#2 FPD cooling fan error	Yes
4123	DET#3 FPD cooling fan error	Yes
4124	DET#4 FPD cooling fan error	Yes
4125	DET#1 FPD current error	Yes
4126	DET#2 FPD current error	Yes
4127	DET#3 FPD current error	Yes
4128	DET#4 FPD current error	Yes

There is a problem with the FPD detector. Refer to FPD User's Manual.
Errors 4125-4128, that are related to abnormal current, cannot be recovered without turning off the system once.

TCD errors

Code	Message	CS
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. If the zero point cannot be adjusted even by turning the adjuster on the right side of the unit, the detector control unit may have failed. The system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

Detector ignition errors

Code	Message	CS
4203	DET#1 ignition failed	No
4204	DET#2 ignition failed	No
4205	DET#3 ignition failed	No
4206	DET#4 ignition failed	No

These messages appear when the FID or FPD do not ignite within a certain time after the key is pressed.

Even when one of these messages appears, hydrogen gas keeps flowing when a manual flow controller is used. Shut off the hydrogen gas 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 of the igniter is intact

(5) The jet of the FID is not clogged

(6) Unused FID is not set to On

Code	Message	CS
4207	H_2, AIR APC are not ready	No

This message appears when the APC (used to control detector gas) for hydrogen or air is not Ready at the time of ignition. Check that the gas supply pressure is stable and whether or not gas is leaking. If there is no problem with the gas supply, the hardware has failed. The system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.

18.1.6 Program errors

Set value change

Code	Message	CS
4301	Settings were changed	No

This message appears when a set value was changed while the program is running. If the parameter or event has not yet been executed, the new value is used for the analysis.

Time over errors

Code	Message	CS
4302	Program time is over	No
4303	Clean up time is over	No
4304	Pre-run prog. time is over	No

These messages appear 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." Although the program can be executed even after this error occurs, it is discontinued at 9999.99 min.

18.1.7 Operations errors

Value outside of range was entered

Code	Message	CS
5001	Input parameter out of range	No

When the numeric value entered is out of the valid range, this message or valid setting range is displayed. Enter a valid number.

File operation errors

Code	Message	CS
5002	Invalid file no.	No
5003	This file is now used	No

These massages appear when an incorrect file operation was attempted.
Press another key, and continue operation.

Overflow of calculated pressure value

Code	Message	CS
5006	CAR1 calc. prss out of range	No
5007	CAR2 calc. prss out of range	No
5008	CAR3 calc. prss out of range	No

The carrier gas pressure is calculated from the linear velocity, flow rate, or the split ratio. The value you have input is outside the set range. Change the conditions so that the pressure is within the set range, and enter a new value.

Overflow of calculated flow rate value

Code	Message	CS
5009	CAR1 calc. flow out of range	No
5010	CAR2 calc. flow out of range	No
5011	CAR3 calc. flow out of range	No

The carrier gas total flow rate is calculated from the split ratio or the pressure. The value you have input is outside the set range. Change the conditions and enter a new value.

Overflow of calculated APC pressure value   MUP=makeup, HGN=hydrogen, AIR=air, PUR=purge

Code	Message	CS
5012	MUP1 calc. prss out of range	No
5013	HGN1 calc. prss out of range	No
5014	AIR1 calc. prss out of range	No
5015	MUP2 calc. prss out of range	No
5016	HGN2 calc. prss out of range	No
5017	AIR2 calc. prss out of range	No
5018	MUP3 calc. prss out of range	No
5019	HGN3 calc. prss out of range	No
5020	AIR3 calc. prss out of range	No
5021	MUP4 calc. prss out of range	No
5022	HGN4 calc. prss out of range	No
5023	AIR4 calc. prss out of range	No
5024	APC1 calc. prss out of range	No
5025	APC2 calc. prss out of range	No
5026	APC3 calc. prss out of range	No
5027	APC4 calc. prss out of range	No
5028	APC5 calc. prss out of range	No
5029	APC6 calc. prss out of range	No
5030	APC7 calc. prss out of range	No
5031	APC8 calc. prss out of range	No
5032	APC9 calc. prss out of range	No
5033	APC10 calc. prss out of range	No
5034	APC11 calc. prss out of range	No
5035	APC12 calc. prss out of range	No
5036	APC13 calc. prss out of range	No
5037	APC14 calc. prss out of range	No
5038	APC15 calc. prss out of range	No
5039	APC16 calc. prss out of range	No
5040	APC17 calc. prss out of range	No
5041	APC18 calc. prss out of range	No
5042	PUR1 calc. prss out of range	No
5043	PUR2 calc. prss out of range	No
5044	PUR3 calc. prss out of range	No
5045	MUP1 calc. prss out of range	No
5046	MUP2 calc. prss out of range	No
5047	MUP3 calc. prss out of range	No
5048	MUP4 calc. prss out of range	No
5049	APC1 calc. prss out of range	No
5050	APC2 calc. prss out of range	No
5051	APC3 calc. prss out of range	No
5052	APC4 calc. prss out of range	No
5053	APC5 calc. prss out of range	No
5054	APC6 calc. prss out of range	No

Code	Message	CS
5055	APC7 calc. prss out of range	No
5056	APC8 calc. prss out of range	No
5057	APC9 calc. prss out of range	No
5058	APC10 calc. prss out of range	No
5059	APC11 calc. prss out of range	No
5060	APC12 calc. prss out of range	No
5061	APC13 calc. prss out of range	No
5062	APC14 calc. prss out of range	No
5063	APC15 calc. prss out of range	No
5064	APC16 calc. prss out of range	No
5065	APC17 calc. prss out of range	No
5066	APC18 calc. prss out of range	No
5067	PUR1 calc. prss out of range	No
5068	PUR2 calc. prss out of range	No
5069	PUR3 calc. prss out of range	No

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 pressure value during a linear velocity program

Code	Message	CS
5070	CAR1 calc. prss out of range	No
5071	CAR2 calc. prss out of range	No
5072	CAR3 calc. prss out of range	No

The carrier gas pressure calculated from the linear velocity 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
5073	CAR1 calc. flow out of range	No
5074	CAR2 calc. flow out of range	No
5075	CAR1 calc. ratio out of range	No
5076	CAR2 calc. ratio out of range	No
5077	CAR1 calc. flow out of range	No
5078	CAR2 calc. flow out of range	No

The carrier gas total flow rate calculated from the split ratio program you have input is outside the set range. Change the conditions and enter a new value.

18.1.8 Optional device error (AOC-20i/s)

Code	Message	CS
6001	AOC1 rack error	No
6002	AOC1 syringe error	No
6003	AOC1 plunger error	No
6004	AOC1 can not start	No
6005	AOC1 RAM initialized	No
6006	AOC1 ROM error	No
6007	AOC1 CH2 command error	No
6008	AOC1 sample vial is not set	No
6009	AOC1 RAM error	No
6010	AOC1 installation error	No
6011	AOC1 CH1 error	No
6012	AOC1 CH2 error	No
6013	AOC1 waste vial is not set	No
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
6023	AOC2 rack error	No
6024	AOC2 syringe error	No
6025	AOC2 plunger error	No
6026	AOC2 can not start	No
6027	AOC2 RAM initialized	No
6028	AOC2 ROM error	No
6029	AOC2 CH2 command error	No
6030	AOC2 sample vial is not set	No
6031	AOC2 RAM error	No
6032	AOC2 installation error	No
6033	AOC2 CH1 error	No
6034	AOC2 CH2 error	No
6035	AOC2 waste vial is not set	No

One of these messages appears when an error has occurred in the AOC-20i auto injector or AOC-20s auto sampler.
For details, refer to the AOC-20i/s User's Manual.

18.1.9 Warning messages

Code	Message	CS
9000	COL CRG use time is over	Yes
9001	INJ2 CRG use time is over	Yes
9002	Fan use time is over	Yes
9004	CAR1 septum counter is over	No
9005	CAR2 septum counter is over	No
9006	CAR3 septum counter is over	No
9007	CAR1 insert counter is over	No
9008	CAR2 insert counter is over	No
9009	CAR3 insert counter is over	No

These messages appear when the time or the count exceeds the set value. Replace the subject component and reset the count on the menu of the DIAG key screen.
Code 9002 warning requires component replacement and counter reset by a serviceperson. Contact your Shimadzu representative.

Code	Message	CS
9010	System is not ready	No

This message appears when the system was started before it was ready. Normally, do not start analysis until the system is ready.
If this message appears when all the parameters including temperature and flow rate are ready, check the ready setting for unused components and check the equilibration time.

Code	Message	CS
9011	Ignition finished (retried)	No

This message appears when ignition sequence was re-attempted because the ignition failed. This does not stop the execution of analysis. If this message 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.

Code	Message	CS
9012	COL sensor use time is over	Yes
9013	INJ1 sensor use time is over	Yes
9014	DET1 sensor use time is over	Yes
9015	INJ2 sensor use time is over	Yes
9016	DET2 sensor use time is over	Yes
9017	AUX3 sensor use time is over	Yes
9018	AUX4 sensor use time is over	Yes
9019	AUX5 sensor use time is over	Yes

These messages appear when the sensor use time exceeds the preset value. Component replacement and reset by a serviceperson are required. Contact your Shimadzu representative.

Code	Message	CS
9020	Temperature is not controlled	No
9021	Detector is not controlled	No
9022	FID/FPD is not installed	No

These messages appear when the detector (FID, FPD) cannot be ignited. Check the detector's line configuration and set detector control and temperature control to "On" before ignition.

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