GC-2010 Gas Chromatograph

INSTRUCTION MANUAL

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

SHIMADZU CORPORATION
ANALYTICAL & MEASURING INSTRUMENTS DIVISION
KYOTO, JAPAN
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Any errors or omissions which may have occurred in this publication despite the utmost care taken in its production will be corrected as soon as possible, but not necessarily immediately upon detection.

Note that Shimadzu does not have any obligation concerning the effects resulting from the application of the contents of this manual.
WARNING LABELS

Label conventions for this manual are provided below.

⚠️ WARNING
Indicates a potentially hazardous situation which could result in death or serious injury.

⚠️ CAUTION
Indicates a potentially hazardous situation which could result in minor or moderate injury and property damage.

NOTE
Emphasizes essential information.

Safety Precautions

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

1. Use the system only for its intended purpose.
2. Follow the procedures described in this Instruction Manual.
3. Observe all warnings and precautions.
4. Never disassemble or modify the system without our permission.
5. Contact your Shimadzu representative for system repairs.
**System WARNING labels**

![Warning label](image)

**WARNING**

**DO NOT TOUCH**

High temperature injection ports, detectors and top cover.

![Warning label](image)

**WARNING**

**WARNING WHEN USING HYDROGEN**

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

![Warning label](image)

**WARNING**

**HOT AIR EXHAUST**

Keep temperature sensitive materials away from opening.

![Warning label](image)
**WARNING**

**HIGH VOLTAGE**

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

---

**WARNING**

**WARNINGS WHEN USING HYDROGEN**

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

1. Connect gas lines correctly. Do not connect the hydrogen line to the air inlet, or hydrogen will leak excessively.
2. When the device is not in use, the main valve of the hydrogen gas cylinder or generator must be closed. Also, make sure that there is no gas leakage from the main valve of the supply.
3. The flow line for hydrogen gas should be checked for leakage whenever it is used.
4. To prevent buildup of explosive concentrations in case the hydrogen gas leaks, the room in which the device is used should be well ventilated.
5. When analysis is complete, close the main valve of the hydrogen gas container immediately before performing other procedures.
Follow these procedures in the event of an emergency (if an abnormality is detected in the GC-2010 gas chromatograph, for example).

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

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

**Fig. Power switch and power cable**
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The GC-2010 is a state-of-the-art, advanced gas chromatograph which embraces the concepts of flexibility, user-friendliness, and security. It meets and exceeds user demands for high performance, advanced (functionality), high reliability, and high productivity. These concepts are illustrated by the following features, which include high processing speed and digitized signals.

### 1.1.1 Basic performance

1. Improved reproducibility
   - Good reproducibility is obtained even for solvents like acetone, which have large expansion volumes.
2. Reduced differences among units
   - Sensitivity differences between detectors have been reduced.
3. Improved detector sensitivity
   - The sensitivity of the FPD (flame photometric detector) is now five times better than previous models.
4. Increased oven cooling speed
   - The oven cooling speed is now 1.6 times faster than previous models.

### 1.1.2 Operation

1. Intelligent diagnosis
   - The diagnosis function has improved considerably, with an advanced alarm system.
2. Large LCD (liquid crystal display)
   - An improved, much larger 16-line LCD (240 × 320 dots), means that analysis parameters and programs can now be listed, improving operation. The display can switch between Japanese and English.

### 1.1.3 High speed analysis enabled

1. Digitized detector signals
   - Detector signals are digitized to enable high speed analysis.
2. High pressure injection mode
   - The high pressure injection mode (standard) enables high speed analysis.
# Specifications

## 1.2.1 Column oven

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (mm)</td>
<td>280(W) × 280 (H) × 175 (D)</td>
</tr>
<tr>
<td>Volume (L)</td>
<td>13.7</td>
</tr>
<tr>
<td>Range of temperature</td>
<td>Room temperature +4°C to 450°C, -50°C to 450°C (When liquid carbon dioxide gas is used.)</td>
</tr>
<tr>
<td>Accuracy of temperature</td>
<td>±1% (K) (Calibrated at 0.01°C)</td>
</tr>
<tr>
<td>Deviation of temperature</td>
<td>Within ±0.05°C</td>
</tr>
<tr>
<td>Temperature coefficient</td>
<td>0.01°C/°C</td>
</tr>
<tr>
<td>Cooling speed</td>
<td>Approximately 6 minutes cooling from 450°C to 50°C.</td>
</tr>
<tr>
<td>Overheat protection</td>
<td>Programmable up to 470°C (A fixed circuit provides protection at 500°C)</td>
</tr>
</tbody>
</table>

## 1.2.2 Temperature program

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program ramps</td>
<td>20 ramps in total (Heating and cooling available)</td>
</tr>
<tr>
<td>Setting</td>
<td>0.1°C increments</td>
</tr>
<tr>
<td>Program setting</td>
<td>-250 to 250°C/min, 0.01°C/min increments</td>
</tr>
<tr>
<td>Total time of total program</td>
<td>Up to 9999.99 minutes</td>
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## 1.2.3 Injection port

<table>
<thead>
<tr>
<th>Specification</th>
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<tbody>
<tr>
<td>Range of temperature</td>
<td>Up to 450°C</td>
</tr>
<tr>
<td>Temperature setting</td>
<td>0.1°C increments</td>
</tr>
<tr>
<td>Overheat protection</td>
<td>Programmable up to 470°C</td>
</tr>
<tr>
<td>Injection unit</td>
<td>Split/Splitless injection, Direct injection</td>
</tr>
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## 1.2.4 Detector

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen flame ionization detector (FID)</td>
<td></td>
</tr>
<tr>
<td>Range of temperature</td>
<td>Up to 450°C, 0.1°C increments</td>
</tr>
<tr>
<td>Overheat protection</td>
<td>Programmable up to 470°C</td>
</tr>
<tr>
<td>Minimum detection</td>
<td>3pg C/s</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>10^7</td>
</tr>
<tr>
<td>Jet material</td>
<td>Fused quartz</td>
</tr>
<tr>
<td>Time constant</td>
<td>4 ms to 2 s selectable</td>
</tr>
</tbody>
</table>
1.2 Specifications

○ Thermal conductivity detector (TCD)
  Amplifier: With differential type filament protective circuit, tungsten rhenium filament, dual-element configuration
  Power: Constant current
  Dynamic range: $10^5$
  Sensitivity: $20,000 \text{mV} \cdot \text{ml/mg}$
  Maximum temperature: $400^\circ\text{C}$

1.2.5 Auxiliary heated zone

AUX3 to AUX5: Available (optional)

1.2.6 Carrier gas flow control unit

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

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

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

1.2.7 Detector gas flow controller

Range: 0 to 1200 ml/min (Air), 0.1 ml/min increments
  0 to 200 ml/min (H₂)
  0 to 100 ml/min (Makeup He)
  Program ramps: 7 ramps possible
  Program rate: -400 to 400 ml/min/min, 0.01 ml/min/min increments

1.2.8 Display

Back-light LCD $240 \times 320$ dot, 16 lines
The display can be switched between Japanese and English.
### 1.2.9 Dimensions, weight and power supply

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (mm)</td>
<td>515 (W) × 440 (H) × 530 (D) mm</td>
</tr>
<tr>
<td>Weight</td>
<td>30 kg</td>
</tr>
<tr>
<td>Power supply</td>
<td>100 VAC (standard model and FID detector), 1800 VA, 50/60 Hz</td>
</tr>
<tr>
<td></td>
<td>230 VAC (standard model with FID detector), 2600 VA, 50/60 Hz</td>
</tr>
</tbody>
</table>
2.1 Shipment Verification

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

1. GC-2010 main body
2. Quick reference (Part Number 221-40450)
3. Instruction manual CD-ROM (Part Number 221-40442)
4. Standard accessories

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Part No.</th>
<th>Qty'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools</td>
<td>Wrench 6 × 8</td>
<td>086-03003</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Wrench 10 × 12</td>
<td>086-03011</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Wrench for Glass insert nut</td>
<td>221-46977</td>
<td>1</td>
</tr>
<tr>
<td>Parts</td>
<td>Branch tube</td>
<td>221-09688-91</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Injection port Column nut</td>
<td>221-16325-01</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Column nut</td>
<td>221-32705</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ferrule adjuster (for SPL) (SPL Column insertion jig)</td>
<td>221-41532-91</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Column hanger *</td>
<td>221-47159</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Injection port cover **</td>
<td>221-43597</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>G-type blank nut (with 2pcs)</td>
<td>221-35566-92</td>
<td>1</td>
</tr>
</tbody>
</table>

| Consumables| Silicon rubber septum (with 20pcs)   | 201-35584   | 1    |
|           | Silica wool stuffing (with 2g)        | 221-48600   | 1    |
|           | Graphite ferrule 0.5, for capillary (with 10pcs) | 221-32126-05| 1    |
|           | Aluminum gaskets (with 100pcs)       | 201-35183   | 1    |
|           | Glass insert, for split              | 221-41444-01| 1    |
|           | Glass insert, for splitless          | 221-48335-01| 1    |
|           | Fluoride rubber O-ring, for glass insert (with 5pcs) | 036-11203-84| 1    |

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

5. FID accessories (only for models with FID)

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
<th>Qty'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromatopac signal cable</td>
<td>221-47251-91</td>
<td>1</td>
</tr>
<tr>
<td>Ferrule adjuster (for FID)</td>
<td>221-41532-92</td>
<td>1</td>
</tr>
</tbody>
</table>

6. TCD accessories (only for models with TCD)

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
<th>Qty'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrule adjuster (for TCD)</td>
<td>221-48610-01</td>
<td>1</td>
</tr>
<tr>
<td>CAUTION label TCD-2010</td>
<td>221-42741</td>
<td>1</td>
</tr>
<tr>
<td>Card case, A6</td>
<td>038-03055</td>
<td>1</td>
</tr>
<tr>
<td>Chromatopac signal cable</td>
<td>221-47251-91</td>
<td>1</td>
</tr>
</tbody>
</table>
2 Installation
2.1 Shipment Verification

Fig. 2.1.1 Standard Accessories

- Wrench 6x9
  P/N:086-03003

- Wrench 10x12
  P/N:086-03011

- Wrench for Glass insert nut
  P/N:221-46977

- Graphite ferrule 0.5
  for capillary(10pcs)
  P/N:221-32126-05

- Silica wool
  (2grams)
  P/N:221-48600

- Injection port cover
  P/N:221-43597

- Glass insert for split
  P/N:221-4144-01

- Glass insert for splitless
  P/N:221-48335-01

- Silicon rubber seatum(20pcs)
  P/N:201-35584

- Fluoride rubber O-ring(5pcs)
  P/N:036-11203-04

- Aluminum gaskets(100pcs)
  P/N:201-35183

- Branch tube
  P/N:221-09688-91

- G-type blank nut
  P/N:221-35566-92

- Column nut
  P/N:221-32705

- Column nut of injection port
  P/N:221-16325-01

- Fitting adjuster (For SPL)
  P/N:221-41532-91

- Fitting adjuster (For Detector)
### AOC-20i Parts list for GC-2010

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

#### Standard Auto injector accessories

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
<th>Qty'</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Auto injector</td>
<td>221-44527-30</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2 User’s manual</td>
<td>221-40268</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

#### AOC power supply

**For 115V model (P/N 221-48401-91)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
<th>Qty'</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 AOC cable</td>
<td>221-44819</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2 Rack (short)</td>
<td>221-45608-91</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3 Large Vial Holder (for solvent/waste)</td>
<td>221-34949-01</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4 Small Vial Holder</td>
<td>221-45609-92</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5 Syringe (10µl)</td>
<td>221-34618</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6 Cable</td>
<td>072-60330-01</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7 Needle guide</td>
<td>221-44584</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>8 Plunger holder</td>
<td>221-44790</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>9 Barrel holder</td>
<td>221-44780</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>10 Plunger Knob</td>
<td>037-02820</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>11 Large Vial (4ml)</td>
<td>221-34267-91</td>
<td>1 set (5pcs)</td>
<td></td>
</tr>
<tr>
<td>12 Large Cap (for 4ml)</td>
<td>221-34268-91</td>
<td>1 set (5pcs)</td>
<td></td>
</tr>
<tr>
<td>13 Large Septum (for 4ml)</td>
<td>221-34269-91</td>
<td>1 set (15pcs)</td>
<td></td>
</tr>
<tr>
<td>14 Small Vial (1.5ml)</td>
<td>221-34272-91</td>
<td>1 set (20pcs)</td>
<td></td>
</tr>
<tr>
<td>15 Small Cap (for 1.5ml)</td>
<td>221-34273-91</td>
<td>1 set (20pcs)</td>
<td></td>
</tr>
<tr>
<td>16 Large Septum (for 1.5ml)</td>
<td>221-41239-92</td>
<td>1 set (40pcs)</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
<th>Qty'</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 AOC power supply</td>
<td>221-48402-38</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2 READY/START cord</td>
<td>221-48405-91</td>
<td>1</td>
<td>Accessories for power supply (P/N 221-48403-91)</td>
</tr>
<tr>
<td>3 RS-232C cable for AOC</td>
<td>221-48406-91</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

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

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

■ Front

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

WARNING
HIGH TEMPERATURE
Danger of burns. Keep the column oven door closed when the oven is at high temperature. Keep the injection port cover on when making manual injections.
### Oven interior

**WARNING**

**HIGH TEMPERATURE**

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

---

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Column connection (injection port side)</td>
<td>Attaches the column to the injection port. (close-up ①).</td>
</tr>
<tr>
<td>2</td>
<td>Column connection (detector side)</td>
<td>Attaches the column to the detector (close-up ②).</td>
</tr>
<tr>
<td>3</td>
<td>Column hanger</td>
<td>Install the capillary column here. (Attaches to the top of the oven (close-up ③).)</td>
</tr>
</tbody>
</table>
2.2 Component description

- Close-up 1 (injection port side)
  - Capillary column
  - Graphite ferrule
  - Injection port column nut

- Close-up 2 (detector side)
  - Column nut
  - Column nut (with split)

- Close-up 3 (column hanger)
WARNING
HIGH VOLTAGE

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

HIGH TEMPERATURE

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

HIGH PRESSURE GAS

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

---

Fig. 2.2.3
## 2 Installation

### 2.2 Component description

**CAUTION**

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

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

* Only for units with AOC-20i.

**NOTE**

The symbol ↓ indicates the functional ground terminal.
2 Installation

2.2 Component description

- **Entire unit**

  **WARNING**
  **HIGH VOLTAGE**
  Danger of electrical shock.
  Only qualified service personnel may remove the side covers.

  **HIGH TEMPERATURE**
  Danger of burns. Never touch the top cover, the injection ports and detectors — while they are hot.

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

---

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

2.3 Installation site

- **Installation location requirements**
  Consider the following points to ensure safe and appropriate unit operation when selecting the installation site.

### 2.3.1 Ambient temperature and humidity

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

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

### 2.3.2 Installation location

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

### 2.3.3 Corrosive gas and dust

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

### 2.3.4 Electro-magnetic fields and power supply noise

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

### 2.3.5 Other precautions

For optimal performance, avoid the following conditions during installation:

1. Fluctuating ambient temperature.
2. Temperature changes from heating or air conditioning.
3. Direct sunlight.
4. Vibrations.
2.3 Installation site

- **Installation clearances**

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

  ![Diagram of installation clearances]

  **Fig. 2.3.1**

  - **Minimum 300mm**
  - **Minimum 100mm**
  - **Depth 530mm**
  - **Height 440mm**
  - **Width 515mm**

  **2.3.6 Rear clearance**

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

  **2.3.7 Left clearance**

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

2.4 Moving the GC

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

⚠️ CAUTION

Move the GC carefully so it does not get bumped or jarred.
2.5 Power supply and wiring

### 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.

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

---

**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.

---

**CAUTION**

Be careful to wire the plug correctly, as outlined on the next page to avoid damage to the unit or supply fuse.
The power cable for 115V model is color-coded as follows.
Black ... Connected to HOT of AC line.
White ... Connected to NEUTRAL of AC line.
Green ... Grounding (GROUND)

![Power cable](image)

**Symbol conventions**
- ~ : AC
- ○ : Off, Open
- | : On, Close

**Heating energy generation**
The following graph shows the heating values generated by the unit.

![Heating energy graph](image)
Fuse

The following fuses are used in the GC-2010.

| Fuse, No. | Rated current/voltage | Type *
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>115V model</td>
<td>230V model</td>
</tr>
<tr>
<td>F1, F2</td>
<td>15A/250V</td>
<td>10A/250V</td>
</tr>
<tr>
<td>F3, F4</td>
<td>5A/250V</td>
<td>3.15A/250V</td>
</tr>
<tr>
<td>F5, F6</td>
<td>5A/250V</td>
<td>5A/250V</td>
</tr>
</tbody>
</table>

*Classification depending on “IEC127”.

Allowing the GC to dry after transport.

CAUTION

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

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

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

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

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

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

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

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

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

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

Convert units between kPa and kgf/cm² as follows.
- 1kPa = 1.02 × 10⁻²kgf/cm²
- 1kgf/cm² = 98.1kPa

Convert the units between kPa and psi as follows.
- 1kPa = 1.45 × 10⁻¹psi
- 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 pressure regulator valves when not in use, and seal the column connection.

Capping the Detector Fitting.
2 Installation
2.6 Gas supply plumbing

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

CAUTION
Hydrogen gas supply precautions
Make sure that the supply pressure to the flow controller does not exceed 500kPa. If the flow controller fails with a hydrogen gas supply pressure over 500 kPa, a dangerous situation exists. Large amounts of leaking hydrogen could cause the FID flame to expand out of the detector. Hydrogen gas is lighter than air. If it leaks, it can accumulate near the ceiling. Pay strict attention to ventilation so that leaking hydrogen is vented out of the room and cannot accumulate.

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

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

There are two types connections in the Gas Chromatograph: Type M and Type 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.

![Fig. 2.6.1 Joining Type M fittings](image)

![Fig. 2.6.2 Joining Type G fittings](image)

Tightening the tubing connections

Tools

2 wrenches 10×12 (standard accessory)

Use the 12mm wrench for Type M connections and the 10mm wrench for type G connections.

![Fig. 2.6.3 Tightening the joints](image)
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
Gas chromatograph tubing connections

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

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

<Ex 1> When Carrier gas and Makeup gas are identical

Fig. 2.6.6 When Carrier gas and Makeup gas are identical

<Ex 2> When Carrier gas and Makeup gas are different

Fig. 2.6.7 When Carrier gas and Makeup gas are different
■ Checking for gas leaks

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

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

<Option> “Snoop” Gas leak detecting fluid (P/N 670-11514)

![Leak detecting fluid]

CAUTION

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

Connecting the RS-232C cable

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

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

RS-232C cable connection parameters

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

<table>
<thead>
<tr>
<th>PORT</th>
<th>MODE</th>
<th>No.</th>
<th>BPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD2</td>
<td>12917</td>
<td>8</td>
<td>9600</td>
</tr>
</tbody>
</table>

Power cycle the C-R8A after changing transmission parameters.

For GC-2010 data transmission parameters, refer to “16.6.5 Setting transmission parameters”.

Input “OPEN GCLC 8,1,1” on the C-R8A keyboard, and press the ENTER key to open the transmission port and start transmission of the detector signal.

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

---

2.7.1 Connecting the RS-232C cable

Fig. 2.7.1 Connecting the RS-232C cable
Connecting the Chromatopac signal cable

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

Fig. 2.7.2 Connecting the Chromatopac signal cable
Calibration of analog wide range signal

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

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

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

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

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

The maximum difference between the signal level GC and Chromatopac is equal or less than ±5% (±50µV, in case signal level is form −1000 to 1000µV).

In case of SYSTEM Off and/or Detector controller Off, the detector signal level on screen of the [MONIT] key is 0µV but Chromatopac shows −1000µVe when the signal type is “Wide”.

NOTE

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

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

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

### Cable connections

Connect the cables as follows.

The AOC-20 power source is housed within the unit.

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

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

- **AOC cable**
  - Connect the auto injector to INJECTOR 1 for single AOC
  - Wrap the cable around Ferrite core near the connector (power source side) as shown below.

![Diagram](Fig. 2.7.3)

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

### Turning the AOC power on and off

When using the AOC-20i with the GC-2010, the AOC power is turned on and off along with the GC power. However, for units with the AOC-20 power supply installed in the GC-2010, turn the AOC-20 on and off from the AOC parameter screen, accessed from the [OPTION] key. (Refer to “15.1 Auto Injector Parameters”.)
2 Installation
2.7 Connecting external device cables

Installing the AOC-20s

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

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

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

   ![Fig. 2.7.4](image)

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

   ![Fig. 2.7.5](image)
Connecting the relay terminals
Connect the 8PIN relay cable (P/N 221-48568-91).
The relay terminal can be opened and closed by EVENT91 and 92. (Refer to “16.3 Time Program”.)

**EVENT91**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>red COM</td>
</tr>
<tr>
<td>No.2</td>
<td>white NC  Conducted to Pin No. 1 COM at EVENT-91</td>
</tr>
<tr>
<td>No.3</td>
<td>black NO  Conducted to Pin No. 1 COM at EVENT91</td>
</tr>
</tbody>
</table>

**EVENT92**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.4</td>
<td>yellow COM</td>
</tr>
<tr>
<td>No.5</td>
<td>blue NC   Conducted to Pin No. 4 COM at EVENT-92</td>
</tr>
<tr>
<td>No.6</td>
<td>black NO   Conducted to Pin No. 4 COM at EVENT92</td>
</tr>
</tbody>
</table>

**OPTION**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.7</td>
<td>brown (GROUND)</td>
</tr>
<tr>
<td>No.8</td>
<td>gray (GROUND)</td>
</tr>
</tbody>
</table>
2 Installation
2.7 Connecting external device cables
The AFC (Advanced Flow Controller) is an electronic flow controller which sets and controls carrier gas pressures and flow rates based on entered parameters. The APC (Advanced Pressure Controller) is an electronic flow controller for controlling detector gas pressures. The AUX APC can control the gas pressure of other optional devices.
3.2 Definition of Terms

■ Column inlet pressure

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

■ Total flow rate

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

■ Column flow rate

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

The column flow rate can be calculated with the following equation:

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

where

- \( F_c \): Column flow rate (ml/min)
- \( d \): Column inner diameter (mm)
- \( L \): Column length (m)
- \( P \): Column inlet pressure (kPa)
- \( P_0 \): Column outlet pressure (atmospheric pressure) (kPa)
- \( \mu \): Viscosity coefficient (* 19.4 \mu \text{Pa}\cdot\text{sec, helium at } 20^\circ\text{C})

* The viscosity coefficient depends the column oven temperature.

■ Linear velocity

Linear velocity indicates how many cm the carrier gas moves inside the column.

The terms “VELOCITY”, “linear velocity” in this instruction manual indicate the average linear velocity inside the column.

The average linear velocity can be obtained with the following equation:

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

where

\[ K = \frac{D^4 \times 10^4}{L} \]

\( V \): Average linear velocity

■ Split ratio

For the GC-2010, split ratio refers to \( \frac{\text{split flow}}{\text{column flow}} \)
3.3 Flow Line Diagram

Note: This figure illustrates an FID or FTD detector example. For ECD or TCD detectors, the APC controls only the makeup gas. For FPD detector, the APC controls only hydrogen and air.

Fig. 3.3.1
3.4 AFC and APC control

3.4.1 AFC Control

AFC Control is illustrated in the following sections.

<table>
<thead>
<tr>
<th>Control mode</th>
<th>Split mode</th>
<th>Split</th>
<th>Splitless</th>
<th>DIRECT(\footnote{1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>Section 3.4.2</td>
<td>Section 3.4.3</td>
<td>Section 3.4.4</td>
<td></td>
</tr>
<tr>
<td>Flow rate</td>
<td>-----</td>
<td>-----</td>
<td>Section 3.4.4</td>
<td></td>
</tr>
<tr>
<td>Linear velocity</td>
<td>Section 3.4.2</td>
<td>Section 3.4.3</td>
<td>Section 3.4.4</td>
<td></td>
</tr>
</tbody>
</table>

3.4.2 Split mode: “SPLIT” (AFC)

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

Fig.3.4.1 shows the control status with a split ratio of 1:40, a velocity of 30 cm/sec, a purge flow rate of 3 ml/min, and a column oven temperature of 50°C. The column inlet pressure is calculated based on the linear velocity, the oven temperature, the column inner diameter, and the column length, and is automatically set to 49.6 kPa. In the same way, the column flow rate is automatically set to 1.67 ml/min, and the total flow rate is set to 69.8 ml/min (\(= 1.67 \text{ ml/min} \times 40 + 3 \text{ ml/min} (= \text{purge flow rate})\)).

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

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

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

\footnote{1} When WBI Injection is used, do not select Split mode or Splitless mode.
3.4 AFC and APC control

Fig. 3.4.1 Split control

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

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

The control method changes only during the sampling time. During sampling time, the AFC controls the TFC (Total Flow Controller) so that the output from the column inlet pressure sensor becomes constant, and then controls the column inlet pressure. After the sampling time, the AFC controls the total flow rate to keep it at a constant value using the TFC (Total Flow Controller) inside the AFC. As in split mode, the ESC (Electronic Split Controller) is controlled to maintain the column inlet pressure constant.

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

When the sampling time expires, control is identical to the split mode, shown in Fig. 3.4.1. When the Control mode is set to “PRESS”, the column inlet pressure is controlled to remain at 49.6 kPa regardless of the column oven temperature. When the Control mode is set to “VELOCITY”, the column inlet pressure is set to a value which keeps the linear velocity constant despite changes in the column oven temperature. Even if the column oven temperature changes, as in programmed temperature analysis, the linear velocity is always kept constant. Generally, when the column oven temperature increases, the viscosity of the carrier gas also increases, and does not flow as easily. Regardless of the Control mode, the ESC controls the column inlet pressure and the TFC controls the total flow rate as shown in Fig. 3.4.1. (after the sampling time).

![Diagram of AFC and APC control](image)

**Fig. 3.4.2 Splitless control (during sampling time)**
3.4.4 Split mode: “DIRECT”

The AFC offers three types of DIRECT mode, FLOW, PRESS and VELOCITY. When the Control mode is set to “FLOW”, the TFC controls the total flow rate as shown in Fig. 3.4.3. At that time, the column inlet pressure varies depending on the column type, the purge flow rate and the column oven temperature. When the Control mode is set to “PRESS”, the AFC controls the TFC (Total Flow Controller) to keep the column inlet pressure constant. The control method is equivalent to the sampling time in SPLITLESS mode. The control diagram is shown in Fig.3.4.2. When the Control mode is set to “VELOCITY”, the column inlet pressure is set to a value which keeps the linear velocity constant despite changes in the column oven temperature. Even if the column oven temperature changes, as in programmed temperature analysis, the linear velocity is always kept constant. Generally, when the column oven temperature increases, the viscosity of the carrier gas also increases, and does not flow as easily.

Fig. 3.4.3 Direct Control
3.4.5 Control by APC

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

![Diagram of APC control](image)

Fig. 3.4.4

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

3.4 AFC and APC control

Fig. 3.4.6

H₂

Flow rate (ml/min)
Pressure (kPa)

0 50 100 150 200 250 300 350 400 450 500

Makeup gas (FID)

Flow rate (ml/min)
Pressure (kPa)

0 50 100 150 200 250 300 350 400 450 500

Makeup gas (TCD)

Flow rate (ml/min)
Pressure (kPa)

0 20 40 60 80 100 120

Fig. 3.4.8
AFC and APC Control Ranges

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

The allowable pressure and flow rate settings are limited by the primary pressure, as shown in Fig. 3.5.1, Fig. 3.5.2. In addition, the pressure settings are limited by the column type and the purge flow rate.

*NOTE* When options are added to the flow line, the range above becomes narrow.
The allowable pure flow rate setting depends on the column inlet pressure. Figure 3.5.3 shows the range of purge flow rates permitted.

Fig. 3.5.3

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

Air (detector = FID) : 0 to 1,000 ml/min
H₂ (detector = FID) : 0 to 200 ml/min
Makeup gas (detector = FID) : 0 to 100 ml/min
Makeup gas (detector = TCD) : 0 to 20 ml/min
AFC and APC Offset Calibration

The AFC and APC pressure and flow rate sensors can be calibrated (zeroed). This calibration is required to correct minute deviations of the sensor values which may occur after long periods of use. If the sensor values deviate, "0.5 kPa" or "0.5 ml/min" could be displayed, for example, even through there is no actual pressure of flow. When data reproducibility is important, perform the offset calibration.

For the AFC, perform the offset calibration using the following procedure.
(In the case of WBI analysis, remove the WBI column from the injection port before the following procedure. After the procedure attach the column to injection port as before.)

1. Press [SYSTEM] key, toggle key, PF1 key, and change “Start GC” to “Manual Start” (refer to Fig. 3.6.1 or 3.6.2). If “Manual Start” was already set, proceed to the next step.
2. Turn off the power. Wait until the column oven, the injection port and the detector have cooled down to 50°C or less.
3. Turn on the power. Wait for approximately 1 minute.
4. Press the [FLOW] key once and the toggle key twice, in that order. Then, the Fig. 3.6.2 opens.
5. Press the PF2 key. The message “Zero Calibration Start” appears at the bottom of the monitor. Approximately 10 seconds later, the message “Zero calibration completed” appears. Calibration of the AFC is complete.
6. Return the “Start GC” setting to its original status.

NOTE Refer to “5 Basic Key Operation”.

![Fig. 3.6.1]
Perform the offset calibration of the APC using the following procedure.

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

![Flow DET #1 NOT READY](image)

<table>
<thead>
<tr>
<th>Flow DET #1</th>
<th>NOT READY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FID 1 H2</td>
<td>On</td>
</tr>
<tr>
<td>Press (kPa)</td>
<td>0.0</td>
</tr>
<tr>
<td>Flow (%)</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>50.0</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>FID 1 MakeUp</th>
<th>On</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press (kPa)</td>
<td>0.0</td>
</tr>
<tr>
<td>Flow (%)</td>
<td>0.0</td>
</tr>
<tr>
<td>Gas Kind</td>
<td>He</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>FID 1 Air</th>
<th>On</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press (kPa)</td>
<td>0.0</td>
</tr>
<tr>
<td>Flow (%)</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>500.0</td>
</tr>
</tbody>
</table>

---

Fig. 3.6.3
4 Installing the column

4.1 Capillary Column Overview

Two types of columns can be installed in a gas chromatograph. The first type, the capillary column, chemically fuses the liquid phase to the interior of the column wall. The other type, the packed column, fills the interior of the column with packing material, with the liquid phase coating the particles. This type of column is becoming obsolete.

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

4.2 Location of Heated Zones

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

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

Fig. 4.2.1  Location of heated zones
Insert the column hanger into hanger slots inside the column oven as shown. The hanger is a standard accessory. Squeeze the top of the hanger in order to insert in the slots. When one hanger is installed, insert it in the back slots. Install two hangers in both the front and back slots.

Fig. 4.3.1
4 Installing the column

4.4 Proper Placement of graphite Ferrules

4.4.1 Placing graphite ferrules on the column

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

The graphite adjuster marked with an “S” or “F” to indicate whether it is for the injection port or detector side.
- S: For Split/spiltless injection port
- F: For FID (detector)

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

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

3. Because graphite may be present on the column end, the column must be clipped as shown below.
   - Clip the column so it is flush with the end of the jig.
   - The edge of the cut must be completely straight.
4.4 Proper Placement of graphite Ferrules

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

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

![Figure 4.4.6](image)

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

### 4.4.2 Positioning the graphite ferrule

Position the ferrules as shown below (Fig. 4.4.7).

If the adjusters were used to fasten the ferrules to the column as described in the previous section, the ferrules should already be in the proper location.

In the split injection method using the wide bore column, fix the graphite ferrule at a place 15mm from the column end. The ferrule adjuster included in the accessories is not available for this case.
4.5 Installing the column

4.5.1 Installing the capillary column

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

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

4.5.2 Removing the capillary column

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

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

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

- **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 frequently used.
- **UNIT keys**: Displays the setup screen for the zone indicated on the key.
- **HELP key**: Explains currently displayed items.
- **START** and **STOP** keys:
  - **START** starts/stops the GC.
  - **STOP** executes and allows diagnosis settings.
- **MONIT** key:
  - **PF (programmable functions)** displayed at the bottom of the screen.
- **SYSTEM** key:
  - **PF key**: Selects "PF (programmable functions)" displayed at the bottom of the screen.
  - **Toggle key**: Toggles among PF items displayed.
  - **Cursor keys**: Sets On/Off of backlight and adjustment of contrast.
- **UNIT keys**: Displays the setup screen for the zone indicated on the key.
- **HELP key**: Explains currently displayed items.

** STATUS/TEMP/FLOW lamp**
- Indicates the status of the entire GC, the heater and the flow controller, respectively.
- **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**: 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.
### 5.1.1 Keypad operation

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

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

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

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

**[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.
5.1.3 Status indicators

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

■ STATUS indicator

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

■ TEMP indicator

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

■ FLOW indicator

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

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. 5.2.1](image-url)
5.3 Basic Key Operations

5.3.1 Screen display

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

PF menu item selection

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

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

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

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

Moving the cursor using the [△], [▽], [<] and [>] keys

Example: Main screen of the [COL] key

Moving the cursor using only the [△] and [▽] keys

Example: Main screen of the [FLOW] key
5.3.3 Entering numeric values

Enter a numeric value using the following procedure:
(1) Move the cursor to an item to be set.
(2) Use the numeric keys to enter a number.
(3) Press the [ENTER] key to validate the input.

**NOTE**
The value becomes valid when the [ENTER] key is pressed.
If you move the cursor or display another screen before pressing the [ENTER] key, the value is deleted.
To clear a value before pressing the [ENTER] key, press the [CE] key.

5.3.4 Changing a selection

Parameters marked with “<” and “>” are changed by making another selection. Change the selection using the following procedure.
(1) Move the cursor to the item.
(2) Select a desired choice by pressing the [<] and [>] key.
(3) Press the [ENTER] key to validate the selection.

**NOTE**
The selection change becomes valid when the [ENTER] key is pressed.
If you move the cursor or display another screen before pressing the [ENTER] key, the change is not made.
To clear the selection before pressing the [ENTER] key, press the [CE] key.

---

**Display Customization**

<table>
<thead>
<tr>
<th>Item</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>On</td>
</tr>
<tr>
<td>Column Flow Rate</td>
<td>On</td>
</tr>
<tr>
<td>Linear Velocity</td>
<td>Off</td>
</tr>
</tbody>
</table>

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

Fig. 5.3.4
5.3.5 Changing item names

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

1. Move the cursor to an item to be changed using the [△] and [▽] keys.
2. Move the cursor to a character to be changed using the [<] and [>] keys.
3. Input a character as described in the following section on entering characters. The character input procedure described below.
4. Press the [ENTER] key to validate the input.
5. Repeat steps (2) to (4) to enter a name.
6. Press the [CE] key to delete one character at the cursor’s current position.

![Image of file list]

Fig. 5.3.5
### Entering characters

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

**Alphabetic mode (upper case/ lower case)**

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

**Numeric mode**
Press the [0] to [9] keys to input numbers “0” to “9”.
Press the [-] and [ · ] keys to toggle the symbols.
5.4 Getting Help

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

5.4.1 Screen Help

If you do not know the meaning of an item on the screen, press the [HELP] key on the screen to display the item and its description. For example, Fig. 5.4.1 displays the Diagnosis Help text.

Items which may be difficult to understand are linked to further descriptions. Access these underlined item descriptions by pressing [Display] (PF Menu) with the cursor on the item. Fig. 5.4.2 shows the pop-up screen linked to the word “Log”.

Fig. 5.4.1 Help screen

<table>
<thead>
<tr>
<th>Help menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return</td>
<td>Returns to the screen displayed before [HELP] key was pressed.</td>
</tr>
<tr>
<td>Display</td>
<td>Displays the explanation on item at the cursor position.</td>
</tr>
<tr>
<td>Back</td>
<td>Returns to the previous screen.</td>
</tr>
</tbody>
</table>
### 6.1 Analysis Flow Chart

#### 6.1.1 Preparation

<table>
<thead>
<tr>
<th>Glass insert preparation</th>
<th>Confirm that the insert is appropriate for the injection mode, that the silica wool has not moved, and that the glass insert O-ring has not deteriorated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septum preparation</td>
<td>After approximately 100 injections, replace the septum.</td>
</tr>
<tr>
<td>Column preparation</td>
<td>Attach the column to the hanger, install the hanger, and verify the proper position of the graphite ferrules. Tighten the injection port and detector column nuts.</td>
</tr>
</tbody>
</table>

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

#### 6.1.2 Setting Parameters

<table>
<thead>
<tr>
<th>Set the column information and the flow rates</th>
<th>From the [FLOW] key screen, set the column inlet pressure, the injection mode, the split ratio, the sampling time, etc. From the [Column] (PF menu), set the column inner diameter, the column length and the film thickness. From the [Purge] (PF menu), set the purge flow rate. Changing the column temperature after the flow rate has been set may change the flow rate.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the temperature of the detector and the injection port</td>
<td>From the screens of the [INJ] and [DET] keys, set the temperatures. If the detector is set to “Off”, turn it “On”. From [DET Gas] (PF menu), set hydrogen, air, makeup gas, etc.</td>
</tr>
<tr>
<td>Set the COL temperature and the temperature program</td>
<td>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.</td>
</tr>
<tr>
<td>Start GC control</td>
<td>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.</td>
</tr>
<tr>
<td>Set the detector</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

The default zero parameter, “Zero at Ready” zeroes the detector signal when the GC is ready.
### 6.1.3 Analysis

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

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

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

---

**WARNING**

Wear protective goggles when using a syringe to inject samples. The syringe plunger could be expelled due to injection port back pressure. Sample could get into the eyes. By holding and supporting the plunger from the side with your middle finger, you can smoothly inject the sample and keep the plunger in the syringe. Do not bend the plunger when holding the syringe in this position.
Glass insert (liner)
- There are two types of glass inserts, one for split analysis and the other for splitless/WBI analysis. Select the correct type based on the sample injection method. A glass insert for split analysis can be used for splitless analysis. However, when injecting thermolabile samples, or samples that are highly absorptive or of low concentration, use the splitless insert.
- The position of the glass wool in the insert directly affects the reproducibility of results. For the AOC-20i auto injector, the glass wool is normally positioned 25 mm from the upper end of the glass insert.
- Samples come into direct contact with the inner surface of the glass insert and the silica wool. On these hot surfaces, unstable compounds may be decomposed or adsorbed. If this occurs, use deactivated lineas and glass wool.

Analytical column
- Verify that carrier gas is flowing through the column before increasing the column oven temperature. Otherwise, the column liquid phase becomes oxidized, and cannot separate compounds properly. This is especially important for polar columns. Press the [SYSTEM] key, and set a start time. This ensures that carrier gas flows for the set time prior to temperature control of the heated zones.
- Selection of the analysis column is very important in GC analysis. In general, select a liquid phase whose polarity and chemical characteristics are similar to those of the analysis target compound to obtain good peak shape. However, highly polar columns require low temperatures and do not last long. Therefore, when analyzing an unknown sample, begin by analyzing it on a neutral column at higher temperatures. Switch to a more polar column if necessary.

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

[Split injection]
In capillary columns, the inner diameter is small and the sample load capacity is low. Unlike packed columns, only a small (1-2 µL) amount of sample can be injected at one time. The split injection mode only allows part of the injected sample to enter the column. This method is useful for samples of high concentration 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 into 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 pattern, use an initial program with a temperature increase rate of approximately 10°C/min. Based on the results, check the temperature range in which the peaks appear, then examine the analytical conditions. This procedure facilitates time program development.

Injection counter

The injection port septum and the glass insert are required to be inspected and replaced periodically. The GC-2010 provides 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 compounds 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 startup 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 according 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 damage and the detector from contamination. The GC-2010 controls the temperatures so that the column temperature never increases above the detector temperature, even if all temperatures are set to increase at the same time. A clean up method uses higher oven temperatures than those used for the analysis. After set bake-out time, return the temperatures to their normal analytical parameter.
## Shutting down the GC

To shut down the system, select [Stop GC] (PF menu) on the [SYSTEM] key screen. Then, the system stops temperature control after the period of time set as the stop time, flows the carrier gas for the period of time set as the flow-off time, then stops. When shutting down the GC, the temperature of each part should be decreased at first, then the carrier gas should be stopped so that the column can be protected. It is convenient to use the stop time and the flow-off time. Do not turn off the power, before select [Stop GC] (PF menu).

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

## Obtaining reproducible analysis results

Follow these suggestions to obtain reproducible results:

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

7.1 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](image1)

![Fig. 7.1.2 Main screen accessed in system On status](image2)
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

<table>
<thead>
<tr>
<th>PF menu item</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start GC</td>
<td>Starts GC according to the parameters on the [SYSTEM] key main screen.</td>
<td>————</td>
</tr>
<tr>
<td>Stop GC</td>
<td>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.</td>
<td>————</td>
</tr>
<tr>
<td>File</td>
<td>Displays the file list to change to another method file. On this sub screen, select files to load, edit, copy, initialize and rename.</td>
<td>8.2</td>
</tr>
<tr>
<td>Clean Up</td>
<td>Sets clean up parameters. In system ON status, select direct operation (PF menu) to run the clean up.</td>
<td>7.2</td>
</tr>
<tr>
<td>Start Seq</td>
<td>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.</td>
<td>7.3</td>
</tr>
<tr>
<td>Stop Seq</td>
<td>Sets the stop procedures. This item is not displayed in system ON status.</td>
<td>7.4</td>
</tr>
<tr>
<td>Maint INJ</td>
<td>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.</td>
<td>18.3, 18.4, 18.5</td>
</tr>
<tr>
<td>Anal.</td>
<td>Restores the GC for analysis after performing injection port maintenance. When pressed after maintenance of injection port is completed.</td>
<td>————</td>
</tr>
</tbody>
</table>
7.2 Specifying Clean Up Parameters

7.2.1 Screen Description

Select [Clean Up] (PF menu) from the [SYSTEM] key main screen to display the clean up parameter setup screen shown in Fig. 7.2.1. The parameters set for the clean up program are set by including "Clean Up Para" as part of the GC start procedure. Clean up should be performed to eliminate contamination before analysis. Reform the clean up when the gas chromatograph has not been used for a while or if a new column has been installed.

![Fig. 7.2.1 Setting the clean up parameters](image-url)
7.2.2 Parameter list

Main screen of clean up

COLUMN OVEN TEMP
Range: 0.0–450.0°C, Default: 25.0°C
Sets the default value of the column oven temperature for the clean up method.
The clean up oven temperature should be 20 to 30°C higher than the temperature program used for actual analysis. (Neither temperature should exceed the maximum temperature indicated on the column).
If the clean up oven temperature exceeds the maximum column temperature, indicate that the regular analysis parameters should be used for clean up by setting “Analysis Para” for the start procedure.

INLET PRESS
Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100.0 kPa
Sets the default value of the column inlet pressure for the clean up method.

PURGE FLOW RATE
Range: Refer to Fig. 3.5.3, Default: 3.0 ml/min
Sets the septum purge flow rate for the clean up method. The septum purge removes contamination in the injection port near the septum. If the split ratio is set to “-1.0”, the total flow rate remains fixed regardless of the oven temperature.

SPLIT RATIO
Range: -1.0/0.0–9999.9, Default: -1.0
Sets the split ratio for the clean up method.
Set the split ratio to “-1.0” for the total flow rate to remain fixed regardless of the oven temperature.

INJECTION PORT TEMP
Range: 0.0–450.0°C, Default: 250.0°C
Sets the injection port temperature for the clean up method.

DETECTOR TEMP
Range: 0.0–450.0°C (in FID), Default: 250.0°C
Sets the detector temperature for the clean up method.
For any detector other than an FID, its set temperature must be within the valid range of the detector.

MAKE UP FLOW RATE
The range and default value depends upon the kind of detector. Refer to the values given for each detector.
Make up gas is inert gas which maximizes detector sensitivity. This sets its flow rate for the clean up method. Each type of detector requires different flow rates of make up gas.

AUX APC PRESS
Range: 0.0–970.0 kPa, Default: 100.0 kPa
Sets the AUX APC pressure for the clean up method.
This item is only valid when an AUX APC has been installed.
Starting and Stopping the GC [SYSTEM]
7.2 Specifying Clean Up Parameters

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

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

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

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

Clean up column Inlet pressure program
(The clean up pressure program consists of a single program ramp.)

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

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

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

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

CLEAN UP RATE
Range: END/-400.00–400.00 ml/min², Default: END
Sets the rate of total flow increase for the clean up program.

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

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

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

![Fig. 7.3.1 Setting the start procedures for the next GC restart](image-url)
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**
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 pressing [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 elapsed.
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](image)

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), carrier 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)
7 Starting and Stopping the GC [SYSTEM]
7.4 Specifying the Stop Procedures
8 Setting the Analytical Parameters and File Management

8.1 [SET] Key Main Screen

8.1.1 Main screen

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

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

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

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

![Fig. 8.1.1  [SET] key main screen](image)
8.1.2 Parameter list

COLUMN OVEN
   Range: 0.0–450.0°C, Default: 25.0°C
   Sets the default temperature in the oven temperature program.

INLET PRESS
   Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100.0 kPa
   Sets the column inlet pressure.
   The initial pressure must be set in order to create a pressure program.
   When the control mode is set to “pressure”, the system keeps the column inlet pressure at a constant value while the oven temperature program is running.

COLUMN FLOW RATE
   Default: 1.00 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 occurs at the initial temperature in the oven temperature program.

LINEAR VELOCITY
   Default: 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 occurs at the initial temperature in the oven temperature program.
   When the control mode is set to “linear velocity”, the column inlet pressure automatically changes so that the linear velocity remains constant even while the oven temperature program is running.

TOTAL FLOW RATE
   Range: 0.0–1200.0 ml/min (Refer to Fig. 3.5.1.), Default: 500.0 ml/min
   The total flow rate varies depending on the injection mode as follows:
   In split or splitless mode, the total flow rate is equivalent to “column flow rate + split flow rate + septum purge flow rate”.
   In direct mode, the total flow rate is equivalent to “column flow rate + septum purge flow rate”.

SPLIT RATIO
   Range: -1.0/0.0–9999.9, Default: -1.0
   The split ratio is “split flow rate / column flow rate.”
   When you set a split ratio, the system sets the total flow rate based on the calculated carrier gas flow rate and split flow rate, so that the desired split ratio occurs at the oven temperature.
   Set the split ratio to “-1.0” to fix the total flow rate regardless of the oven temperature.

PURGE FLOW RATE
   Default: 3.0 ml/min
   Set the septum purge flow rate.

SAMPLING TIME
   Range: 0.00–9999.99 min, Default: 1.00 min
   Sets the sampling time for splitless analysis.
   The sampling time indicates the period of time after analysis starts until the split flow line is opened.
8 Setting the Analytical Parameters and File Management

8.1 [SET] Key Main Screen

**SPLIT MODE**
Selection: SPLIT/SPLITLESS/DIRECT, Default: SPLIT

- **SPLIT**: Controls the column inlet pressure and the total flow rate so that the column inlet pressure and split ratio occur as specified.
- **SPLITLESS**: Closes the split flow line during the sampling time so that the set column inlet pressure is controlled by the Total Flow Controller. Opens the split flow line and controls the Electronid Split Controller so that the preset column inlet pressure occurs (Refer to Fig. 12.5.2.) after the sampling time elapses.
- **DIRECT**: Closes the split flow line and the set column inlet pressure (in pressure mode) or the set total flow rate (in flow mode) occurs. When making direct injection analyses, select WBI in the setup screen so that SPLIT mode is not available.

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

- **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°C to 450.0°C, Default: 25.0°C
Set the injection port temperature (the default temperature for a programmable injection port).

**DETECTOR TEMP**
Range: 0.0°C to 450.0°C (in FID), Default: 25.0°C
Set the detector temperature. Allowable temperature ranges vary for each detector. Refer to range specified for the detector(s) in use.

1. The column flow rate ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less and the calculated total flow rate is 1,200 ml/min.
2. The linear velocity ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less.
3. The purge flow rate ranges from 0 to the total flow rate subtracted by the column flow rate and the split flow rate.
### 8.1.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>File</td>
<td>Displays file list to change the current file. On this sub screen, you can select files to load, copy, initialize and rename.</td>
<td>8.2</td>
</tr>
<tr>
<td>Line Config</td>
<td>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.</td>
<td>8.3</td>
</tr>
<tr>
<td>Customiz</td>
<td>Set the parameters displayed on the [SET] key main screen.</td>
<td>8.4</td>
</tr>
<tr>
<td>Print</td>
<td>Prints temperature, pressure and total flow rate on a Chromatopac.</td>
<td>———</td>
</tr>
<tr>
<td>Next Line</td>
<td>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.</td>
<td>———</td>
</tr>
</tbody>
</table>
8.2 File Management

8.2.1 Screen description

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

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

![File Management Screen](image)

Fig. 8.2.1 File list screen

8.2.2 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>Selects the current file.</td>
<td></td>
</tr>
<tr>
<td>Copy</td>
<td>Copies file name and file contents from the source file to a destination file.</td>
<td>8.2.3</td>
</tr>
</tbody>
</table>
| File Init | Initializes file name and file contents.  
The current file cannot be initialized. | 8.2.5 |
| Rename  | Changes the file name. | 8.2.4 |
8.2.3 Copying a file

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

![Fig. 8.2.2 Copying File](image)

8.2.4 Renaming a file

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

![Fig. 8.2.3 Renaming a file](image)
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 initialized, 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 Config] (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 detectors can be included in an analytical flow line. Temperatures are not controlled, and gases are not supplied, to components which are not part of the analytical flow line.

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. If more than one injection port is specified for an analytical flow line, the most recent selection applies.

![Fig. 8.3.1 Line configuration setup screen](image-url)
Line configuration examples
Suppose that a SPL (split/splitless injection port), a WBI (direct injection port), a FID (hydrogen flame ionization detector) and a TCD (thermal conductivity detector) are installed.
(1) When using only the SPL and the FID
Select the SPL and the FID for line 1.
In this case, only the temperature of the SPL and the FID will be controlled. Carrier gas and detector gas will be supplied.

Fig. 8.3.2 Line configuration (Example 1)
(2) When using a SPL and FID for one line, and a WBI and TCD on an other line, select the SPL and the FID for line 1, and the WBI and TCD for line 2.

![Line Configuration](image1)

Fig. 8.3.3 Line configuration (Example 2)

(3) When using a single column connected to two detectors:

![Line Configuration](image2)

Fig. 8.3.4 Line configuration (Example 3)
8.4 Changing Items Displayed with [Customiz]

8.4.1 Screen description

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

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

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

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

The default setting displays the column inlet pressures, column flow rate, split ratio, sampling time and the split mode.

```
Display Customization

<table>
<thead>
<tr>
<th>Item</th>
<th>On/off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td></td>
</tr>
<tr>
<td>Column Flow Rate</td>
<td>On</td>
</tr>
<tr>
<td>Linear Velocity</td>
<td>Off</td>
</tr>
<tr>
<td>Total Flow Rate</td>
<td>Off</td>
</tr>
<tr>
<td>Split Ratio</td>
<td>On</td>
</tr>
<tr>
<td>Septum Purge Flow Rate</td>
<td>Off</td>
</tr>
<tr>
<td>Sampling Time</td>
<td>On</td>
</tr>
<tr>
<td>Split Mode</td>
<td>On</td>
</tr>
<tr>
<td>Control Mode</td>
<td>Off</td>
</tr>
</tbody>
</table>
```

Fig. 8.4.1 Customizing the [Set] key main screen
8 Setting the Analytical Parameters and File Management
8.4 Changing Items Displayed with [Customize]
9.1 Monitoring the GC

9.1.1 [MONIT] key Main Screen

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.

Detector status

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

For a FID:

![FID]

Flame = On

Flame = Off
Changing the monitor magnification (zoom)

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

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

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

NOTE

If the temperature (or pressure, flow) program is displayed, the time axis (x-axis) cannot be changed.

Fig. 9.1.2 Monitor screen (chromatogram and temperature program)

To magnify the time axis:
- 4 : Zooms the time axis scale.
- 6 : Unzooms the time axis scale.

To magnify the signal axis:
- 2 : Zooms the signal axis scale.
- 8 : Unzooms the signal axis scale.

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

Keys to move along the time axis
- : Moves the chromatogram in the + direction.
- : Moves the chromatogram in the - direction.
9.1.2 Parameter list

**RETENTION TIME (Rt)**
Retention time is the length of time from compound injection 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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp Mon</td>
<td>Displays the current and set temperatures of column, injection port and detector.</td>
<td>9.2</td>
</tr>
<tr>
<td>Flow Mon</td>
<td>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 type of flow controller installed.</td>
<td>9.3</td>
</tr>
<tr>
<td>Zero Adj</td>
<td>Automatically moves the baseline to zero point.</td>
<td>9.4</td>
</tr>
<tr>
<td>Zero Free</td>
<td>Returns to the baseline level before zero point adjustment.</td>
<td>9.4</td>
</tr>
<tr>
<td>Up</td>
<td>Moves the baseline up by 100 μV from current level.</td>
<td>9.4</td>
</tr>
<tr>
<td>Down</td>
<td>Moves the baseline down by 100 μV from current level.</td>
<td>9.4</td>
</tr>
<tr>
<td>Chng Graph</td>
<td>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.</td>
<td>—</td>
</tr>
<tr>
<td>Chng Line</td>
<td>Displays the monitor screen for another configured analytical line. Switch between monitored lines by pressing [MONIT] key from the monitor screen.</td>
<td>—</td>
</tr>
</tbody>
</table>
9.2 Monitoring the Temperature with [Temp Mon]

9.2.1 Screen description

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

![Temp Monitor Screen](image)

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

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

9.2.2 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Mon</td>
<td>Monitor pressure and flow rate for the injection ports and detectors.</td>
<td>9.3</td>
</tr>
</tbody>
</table>
9.3 Monitoring the Flow Rate with [Flow Mon]

9.3.1 Screen description

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

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

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

---

**Fig. 9.3.1 Flow rate monitor**

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

9.3.2 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp Mon</td>
<td>Monitor temperature of the column oven, injection ports and detectors.</td>
<td>9.2</td>
</tr>
</tbody>
</table>
9 Monitoring the GC

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.

![Fig. 9.4.1 Zero point adjustment](image1)

![Fig. 9.4.2 Zero free adjustment](image2)

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

10.1.1 Verifying the gas chromatograph status

(1) Ensure that the STATUS indicator light is green.
(2) When the STATUS light is green, perform a zero point adjustment (See “9.4 Zero Point Adjustment”).
(For a description of the items which determine the Ready Status, refer to “16.6.6 Setting the Ready Check Parameters”.)

10.1.2 Making manual injection

- **Aspiration**

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

  2. **Syringe handling precautions**

     - 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 approximately 10 µl of sample.
     (2) Expel the sample into the liquid waste container.
5. Preparing to inject
   (1) With the needle in the sample vial, pump the plunger to eliminate air bubbles inside
   the syringe.
   (2) When air bubbles are eliminated, aspirate exactly 1 µl of sample.
   (3) Gently wipe the syringe needle with a lint-free wipe.
   (4) Aspirate an additional 0.5 µl of air.

![Fig. 10.1.2](image)

### Injection

<table>
<thead>
<tr>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirate sample.</td>
</tr>
<tr>
<td>Insert syringe until it touches needle guide.</td>
</tr>
<tr>
<td>Push plunger to inject sample.</td>
</tr>
<tr>
<td>Promptly pull out syringe.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>At same time, press [START] key of gas chromatograph.</td>
</tr>
</tbody>
</table>

**WARNING**

Wear protective goggles when handling samples.

10.1.3 Starting the analysis

A green STATUS light indicates that the GC is ready for analysis.
Press the [START] key to start the temperature program, the time program, the pressure program and the flow rate program.
Any pre-set programs execute prior to the start of the analysis programs.
### 10.2 Terminating the Analysis

#### 10.2.1 Terminating the analysis

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

#### 10.2.2 External devices

- **When the gas chromatograph is connected to a Chromatopac**
  - Key operation of the gas chromatograph
    - Press the [START] key of the gas chromatograph to start the Chromatopac automatically.
    - Pressing the GC [STOP] key, however, does not stop the Chromatopac.
  
  **NOTE**
  
  To stop the Chromatopac from starting automatically, refer to "16.6.9 Setting the link device code".

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

- **When the gas chromatograph is linked to a personal computer (pc)**.
  - Press the GC [START] key or the PC [STOP] key to start both units.
  - However, each unit must be stopped individually. Stopping one unit does not affect the other.
  - However, the end of a batch sequence signals both units to stop.
10 Starting and Stopping Analysis

10.2 Terminating the Analysis
11.1 Creating an Oven Temperature Program

11.1.1 [COL] Key Main Screen

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.

![Fig. 11.1.1: [COL] Key main screen](image)

**Up to 20 temperature increase/decrease ramps can be set.**

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

TEMP
Range: 0.0–450.0°C, Default: 25.0°C
Set the initial and the final temperature for each ramp of in the oven temperature program. The column oven temperature should never exceed the maximum operating temperature of the column. Keep the column temperature as low as possible to prolong the column life and reduce detector noise. To set the maximum over temperature, refer to “16.6.4 Setting the maximum temperature limits”

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 before the system is considered Ready. This allows for even temperature distribution.

11.1.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Del Line</td>
<td>Deletes the current line.</td>
<td>—</td>
</tr>
<tr>
<td>Ins Line</td>
<td>Inserts a line in line at the current cursor position.</td>
<td>—</td>
</tr>
<tr>
<td>Fan Off</td>
<td>Stops the fan operation.</td>
<td>—</td>
</tr>
<tr>
<td>Fan On</td>
<td>Restarts the fan operation.</td>
<td>—</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the column oven program from a Chromatopac.</td>
<td>—</td>
</tr>
</tbody>
</table>

NOTE: “Fan Off” can not be operated in the following case.
• Oven temperature setting value ≥ 50 deg
• Program running
11.2 Temperature Programs

11.2.1 Isothermal analysis

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

11.2.2 Programmed analysis

When the sample contains compounds over a wide boiling point range, isothermal analysis is insufficient 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

![Diagram of 1-ramp temperature program]

- Initial setting (TEMP)....T1
- Initial setting hold time (TIME)..... a
- Program rate (RATE).... \( \frac{T_2-T_1}{b} \)
- Final temperature (TMP)...... T2
- Final temperature hold time (TIM)...... c
- Equilibration time (ETIM)..... d
### Program creation

1. ramp temperature program

#### Example 1

**Initial temperature**

**1st stage**

**2nd stage**

**220°C (2 min)**

**Equilibration Time (min): 5.0**

#### Example 2

**Initial temperature**

**1st stage**

**2nd stage**

**160°C (5 min)**

**Equilibration Time (min): 3.0**

---

**Fig. 11.2.1** Temperature program (Example 1)

**Fig. 11.2.2** Temperature program (Example 2)
Multiple-ramp temperature program (with temp increase /decrease)

![Graph of temperature program](image)

**Fig. 11.2.3** Temperature program (Example 3)

### Allowable temperature settings and ranges for temperature programs

<table>
<thead>
<tr>
<th>Item</th>
<th>Set Range</th>
<th>Control Range</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program rate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating Normal oven</td>
<td>Up to 200°C</td>
<td>0–250 °C/min</td>
<td>0–40°C/min</td>
</tr>
<tr>
<td></td>
<td>Up to 350°C</td>
<td>0–15°C/min</td>
<td>0–7°C/min</td>
</tr>
<tr>
<td></td>
<td>Up to 450°C</td>
<td>0°C/min</td>
<td></td>
</tr>
<tr>
<td>Heating High power oven</td>
<td>Up to 200°C</td>
<td>0–250 °C/min</td>
<td>0–70°C/min</td>
</tr>
<tr>
<td></td>
<td>Up to 350°C</td>
<td>0–50°C/min</td>
<td>0–30°C/min</td>
</tr>
<tr>
<td></td>
<td>Up to 450°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling</td>
<td>−250–0 °C/min</td>
<td>Differ from room</td>
<td></td>
</tr>
</tbody>
</table>

Differ from the room temperature or the oven temperature.

![Graph of column oven temperature increase/decrease curve](image)

**Fig. 11.2.4** Example of column oven temperature increase/decrease curve
12.1 Introduction

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

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

- **Injection system and injection port**

<table>
<thead>
<tr>
<th>Injection system</th>
<th>Injection port</th>
<th>Type of insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split injection system</td>
<td>Split/spitless injection port</td>
<td>Glass insert for split</td>
</tr>
<tr>
<td>Splitless injection system</td>
<td>Split/spitless injection port</td>
<td>Glass insert for splitless/WBI</td>
</tr>
<tr>
<td>Direct injection system</td>
<td>Direct injection port</td>
<td>Glass insert for splitless/WBI</td>
</tr>
<tr>
<td>Packed column injection system</td>
<td>Direct injection port</td>
<td>Glass insert for packed column</td>
</tr>
<tr>
<td>On-column injection system</td>
<td>On-column injection port</td>
<td>Adapter for on-column</td>
</tr>
<tr>
<td>Programmed temperature vaporization injection system</td>
<td>On-column injection port</td>
<td>Glass insert for PTV</td>
</tr>
</tbody>
</table>
It is necessary to pack silica (glass) wool into the glass insert (liner) in order to sufficiently mix the vaporized sample and to prevent high-boiling point compounds from contaminating the capillary column.

### Quantity of Silica Wool

Quantity of silica wool (standard) = Approx. 10 mg (for split)  
= Approx. 2 mg (for splitless/WBI)  
= Silica wool is not necessarily required when making direct injections. However, if the sample contains non-volatile compounds, less than 5 mg of silica wool can improve the chromatography.

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

### Position of Silica Wool

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

![Silica wool position for split and splitless inserts (AOC-20i)](image-url)

**Fig. 12.2.1** Silica wool position for split and splitless inserts (AOC-20i)
The position of silica wool for being displayed in fig. 12.2.1 is for injecting by Auto Injector for AOC-20i. During manual injections, the needle often goes further into the insert than for injection by an auto injector. However, there is no need to change the silica wool position for manual injections. By placing a septum on the needle, the length of the needle can be shortened to approximately 40 mm. (Alternatively, change the position of the silica wool for manual injections.)

Example> Needle length

![Diagram of needle length](image)

(a) Manual injection performed with an AOC 17/20 needle (43 mm length)  
(b) Manual injection with a syringe with a 50 mm long needle

Fig. 12.2.2 Proper needle length for manual injections

- **Packing the silica wool**
  Pack silica wool evenly without making it too densely packed or too fluffy.

- **Applying and releasing pressure**
  If the column inlet pressure is released abruptly, the silica wool could change position. In particular, do not remove the septum or loosen the column nut when the injection port is under pressure.
12.3 Removing and inserting the glass insert

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

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

**Tool required**
![Wrench for Glass insert nut (P/N 221-46977)](image)

**Removing the glass insert**
The glass insert should be removed carefully to avoid breakage.

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

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

![Diagram showing injection port, septum nut, and glass insert nut](image)

Fig. 12.3.2
(2) Use tweezers to remove the glass insert.
### Attaching a fluoride rubber O-ring

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

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

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

### Attaching a graphite O-ring

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

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

![Fig. 12.3.4 Attaching graphite and fluoride rubber O-ring](image-url)
**Inserting the glass insert**

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

1. Insert the glass insert into the injection port.
2. Move the septum nut back over the glass insert and slowly tighten the glass insert nut by hand at first, then 1/3~1/2 turn with wrench.

![Diagram of injection port components](image)

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

![Diagram showing the position of injection port components](image)
If the glass insert breaks in the injection port

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

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

Checking for injection port leaks

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

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

Check for leaks according to the following procedure.
(1) Turn off the system, and then turn on the system pressing “-” key and “0” key.
(2) Press [Start GC] (PF menu) from the [SYSTEM] key screen.
(3) Set the “Flow Control” to “Cont” from the [SYSTEM] key screen.
(4) Press [Stop GC] (PF menu) to stop the system temperature control.
(5) User the [MONIT] key to verify that the oven, injection port and detector temperatures have dropped below 40°C.
(7) Remove the capillary column, and seal the connections with a new graphite ferrule (with wire) and column nut.
(8) Install a blank nut (G-type) on both the split vent and purge vent.
(9) Verify that the gas cylinder pressure is above 300 kPa.
(10) Set the Split mode to “Direct” and Control mode to “Press” (from the [FLOW] key main screen).
(11) Set the inlet pressure to 150 kPa and set the purge flow to 500 ml/min. Press [On/Off] (PF menu) to start AFC control.
(12) Wait five minutes. Confirm that the inlet pressure is 125 and 175 kPa.
   If the inlet pressure is above 175 kPa, loosen the column nut slightly to reduce the pressure.
   If the inlet pressure is below 125 kPa, increase the pressure from the gas cylinder slightly.
(13) Verify that the total flow is less than 2 ml/min. If the flow is above 2 ml/min, a leak exists.
(14) Press [On/Off] (PF menu) on the [FLOW] key screen to stop AFC control.
(15) In case of fluoride rubber O-ring, verify that the pressures does not drop more than 215 kPa in one hour or 2.5 kPa in 10 minutes.
   In case of graphite O-ring, verify that the pressure does not drop more than 21 kPa in one hour or 3.5 kPa in 10 minutes.
   If it does, a leak exists.
(16) If there are no leaks, restore the connections and operational status of the GC-2010.

Resolving leaks

If the leak test procedure reveals the presence of an injection port leak, use the following procedure to resolve the problem.
Use Snoop or a similar leak detection fluid to check the column connection for leaks. Tighten the connections at the septum nut, injection port nut, split and purge vents (if the blank nuts are inplace for the leak test), and gas supply tubing.

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

<table>
<thead>
<tr>
<th>Leaking part</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near septum nut</td>
<td>Replace septum</td>
</tr>
<tr>
<td>Around injection port nut</td>
<td>Replace glass insert O-ring</td>
</tr>
<tr>
<td>At column connection</td>
<td>Replace graphite ferrule and column nut</td>
</tr>
<tr>
<td>At split or purge vent (during leak test)</td>
<td>Replace blank nut</td>
</tr>
</tbody>
</table>

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

⚠️ WARNING

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

⚠️ CAUTION

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

■ Type of septum

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

■ Removing the septum

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

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

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

![Diagram of injection port components]

Fig. 12.4.1
■ Installing the new septum

(1) Insert the septum into the injection port.

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

![Diagram of injection port and septum](image)

Fig. 12.4.2

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

![Diagram of septum nut and needle guide](image)

Fig. 12.4.3
### Split/Splitless Injection System

#### Split injection system

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

![Diagram of Split Injection System](image1)

#### Splitless injection system

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

![Diagram of Splitless Injection System](image2)
12.5.1 Setting the temperature with [INJ] key

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

Fig. 12.5.3 [INJ] key main screen
12.5.1.2 Parameter list

**TEMP**
Range: 0.0–450.0°C, Default: 25.0°C
Set the temperature of the injection port.
Keep the injection port temperature as low as is practical to increase the service life of the temperature sensor. In order to instantly vaporize samples inside the injection port, set the injection port temperature approximately 30°C above the column oven temperature (final temp). Due to the minute quantity of sample injected, the sample vaporizes at temperatures lower than the boiling point of sample elements. To set the injection port maximum temperature limit, refer to “16.6.4 Setting the maximum temperature limits” in “16.6 GC Configuration”.

12.5.1.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Print</td>
<td>Prints the injection port temperature on Chromatopac.</td>
<td>———</td>
</tr>
<tr>
<td>Next Inj</td>
<td>Toggles among the setup screens if two or more injection ports are installed in this system. The [INJ] key can also be used to switch screens.</td>
<td>———</td>
</tr>
</tbody>
</table>
12.5.2 Setting the flow rate with [FLOW] key

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

![Flow Control Screen](image)

**Fig. 12.5.4  [FLOW] key main screen**

12.5.2.2 Parameter list

**INLET PRESS**
Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100 kPa
Set the column inlet pressure.
This sets the initial temperature of a pressure program.
When the control mode is set to “PRESS”, the system controls the column inlet pressure so that it remains constant during an oven temperature program.

**COLUMN FLOW RATE**
Default: 1.00 ml/min
Sets the carrier gas flow rate at the capillary column outlet (atmospheric pressure at 25°C).
When you set the carrier gas flow rate, the system calculates the column inlet pressure based on the inner diameter and the length of the column and the film thickness of the column. The column flow rate is set separately so that the carrier gas flow rate desired occurs at the initial temperature in the oven temperature program.

**LINEAR VELOCITY**
Default: 30.0 cm/s
Sets the average linear velocity of the carrier gas flowing in the capillary column.
When you set the linear velocity, the system calculates the column inlet pressure based on the inner diameter and the length of the column and the film thickness of the column.
The linear velocity is set separately so that the linear velocity desired occurs at the initial temperature in the oven temperature program. When the control mode is set to "VELOCITY", the column inlet pressure automatically changes so that the linear velocity remains constant even while the oven temperature program is running.

**SPLIT RATIO**
Range: -1.0/0.0–9999.9, Default: -1.0
The split ratio is “split flow rate / column flow rate.” When you set a split ratio, the system sets the total flow rate based on the calculated carrier gas flow rate and split flow rate, so that the desired split ratio occurs at the oven temperature.
Set the split ratio to “-1.0” to fix the total flow rate regardless of the oven temperature.

**TOTAL FLOW RATE**
Range: 0.0–1200.0 ml/min (Refer to Fig. 3.5.1.), Default: 500.0 ml/min
In split or splitless mode, the total flow rate is equivalent to “column flow rate + split flow rate + septum purge flow rate”.

**SPLIT MODE**
Selection: SPLIT/SPLITLESS/DIRECT, Default: SPLIT
SPLIT: Controls the column inlet pressure and the total flow rate so that the column inlet pressure and split ratio occur as specified.
SPLITLESS: Closes the split flow line during the sampling time so that the set column inlet pressure is controlled by the Total Flow Controller. Opens the split flow line and controls the Electronid Split Controller so that the preset column inlet pressure occurs (Refer to Fig. 12.5.2.) after the sampling time elapses.
DIRECT: Closes the split flow line and the set column inlet pressure (in pressure mode) or the set total flow rate (in flow rate mode) occurs. When making direct injection analyses, select WBI in the setup screen so that SPLIT mode is not available.

**SAMPLING TIME**
Range: 0.00–9999.99 min, Default: 1.00 min
Sets the sampling time for splitless analysis. The sampling time indicates the period of time after analysis starts until the split flow line is opened.

**NOTE**
When setting the sampling time, ensure that the program time is longer than the sampling time. Otherwise, the sampling time cannot function correctly.

**CONTROL MODE**
Selection: PRESS/VELOCITY/FLOW (for direct injection mode), Default: PRESS
When the injection mode is set to “SPLIT” or “SPLITLESS”
PRESS: Controls the system so that the column inlet pressure remains constant.
VELOCITY: Controls the system so that the linear velocity remains constant.
When the injection mode is set to “DIRECT”
PRESS: Controls the system so that the column inlet pressure remains constant.
VELOCITY: Controls the system so that the linear velocity remains constant.
FLOW: Controls the system so that the flow rate remains constant.
CARRIER GAS TYPE
Selection: He/N2/H2/Ar, Default: He
Specify the carrier gas type supplied to the AFC.
This parameter is used for the measurement/control of the flow rate.
If this parameter is not set correctly, flow rate calculations may not be performed correctly.
(Example: If this parameter is set to “N2” when He is actually used, the displayed total flow rate, column flow rate and linear velocity are lower than the actual values.)

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

12.5.2.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column</td>
<td>Sets inner diameter, length and film thickness of capillary column. Values set here are used in column inlet pressure calculations from column flow rate or linear velocity (or vice versa). If these parameters are not set correctly, calculations are not performed correctly.</td>
<td>12.5.3</td>
</tr>
<tr>
<td>Gas Saver</td>
<td>The gas saver saves carrier gas by reducing the split flow rate.</td>
<td>12.5.4</td>
</tr>
<tr>
<td>On/Off</td>
<td>Sets flow controller to be used to “On”. Default value is “Off”. When [Start GC] is pressed, the AFC in the current analytical line which is set to “On” starts. If AFC is set to “Off” during carrier gas control, the control stops. When it is set to “On” again, the carrier gas control restarts.</td>
<td>12.5.5</td>
</tr>
<tr>
<td>Press Prog</td>
<td>Sets the column inlet pressure program.</td>
<td>12.5.6</td>
</tr>
<tr>
<td>Flow Prog</td>
<td>Sets the total flow rate program.</td>
<td>12.5.7</td>
</tr>
<tr>
<td>Split Prog</td>
<td>Sets the split ratio program.</td>
<td>12.5.8</td>
</tr>
<tr>
<td>Purge</td>
<td>Sets the septum purge flow rate and program for flow rate.</td>
<td>12.5.9</td>
</tr>
</tbody>
</table>

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.

Offset
Performs offset calibration of the AFC sensor. This calibration contributes to good reproducibility of results.

Next Flow
Toggles among the AFC set up screens if two or more AFCs are installed in this system.
The [FLOW] key can also be used to switch screens.
12.5.3 Setting column parameters

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

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

![Column setup screen](image)

Fig. 12.5.5  Column setup screen

12.5.3.2 Parameter list

- **COLUMN I.D.**  
  Range: 0.01–6.00 mm, Default: 0.32 mm

- **COLUMN LENGTH**  
  Range: 0.1–250.0 m, Default: 25.0 m

- **FILM THICKNESS**  
  Range: 0.00–300.00 µm, Default: 0.50 µm

**NOTE**  
Set these parameter values carefully to avoid calculation errors.
12.5.4 Gas saver

The gas saver function reduces the split ratio during a split of splitless analysis. This reduces the amount of carrier gas flowing through the split flow line, conserving carrier gas. Even though this can change the split ratio, the column inlet pressure is kept at a constant value. In other words, changing the split ratio does not affect the carrier gas flow rate through in the column.

12.5.4.1 Screen description

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

12.5.4.2 Parameter list

**GAS SAVER**
Selection: On/Off, Default: Off
Select “On” to use the gas saver function.
Select “Off” to disable the gas saver function.

**GAS SAVER SPLIT RATIO**
Range: 0.0–9999.9, Default: 5.0
Set the split ratio which will reduce the split flow to conserve carrier gas.
Setting “0” closes the split flow line.

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

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

12.5.5.1 Screen description

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

![Pressure program setup screen](image)

Fig. 12.5.7 Pressure program setup screen

12.5.5.2 Parameter list

**PRESS**
- Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100 kPa
- Set the initial pressure and the final pressure for each stage of the pressure program.

**TIME**
- Range: 0.0–9999.99 min, Default: 1.00 min
- Set the hold time for the initial pressure and the final pressure for each stage of the pressure program.

**RATE**
- Range: END/-400.00–400.00 kPa/min, Default: END
- Set the pressure program rate.
  - If you set the rate to “0”, “END” appears and the program finishes at the previous ramp.
  - If you move the cursor to “END” and set any numeric value other than “0”, the pressure and the time for that ramp can be entered.

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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Del Line</td>
<td>Deletes a line at the current cursor position.</td>
<td></td>
</tr>
<tr>
<td>Ins Line</td>
<td>Inserts a line in line at the current cursor position.</td>
<td></td>
</tr>
<tr>
<td>PRINT</td>
<td>Prints the pressure program to a Chromatopac.</td>
<td></td>
</tr>
</tbody>
</table>

12.5.5.4 Setting a pressure program

Screen terminology

<1-ramp pressure program>

![Diagram of pressure program]

- Initial pressure (PRSS): \( P_1 \)
- Initial pressure hold time (TIME): \( a \)
- Program rate (RATE): \( \frac{P_2 - P_1}{b} \)
- Final pressure (PRS): \( P_2 \)
- Final pressure hold time (TIM): \( c \)

Program creation

<1-ramp pressure program>

```
Carrier Press CARL READY

SPL: 0:FILE0

Press monitor(kPa) 50.0
Program total(min) 17.00

<table>
<thead>
<tr>
<th>Rate(kPa)</th>
<th>Pres(kPa)</th>
<th>Time(min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Init</td>
<td>60.0</td>
<td>2.00</td>
</tr>
<tr>
<td>1st</td>
<td>4.00</td>
<td>10.00</td>
</tr>
<tr>
<td>2nd</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
```

Fig. 12.5.8 Pressure program example
12.5.6 Creating a Flow rate program

If the control mode is set to “FLOW”, increase and decrease the total flow rate during analysis by making a flow rate program.

When you set a flow rate program for the APC, a corresponding pressure program is actually calculated based on of the pressure-flow rate calibration curve saved by the GC.

12.5.6.1 Screen description

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

![Fig. 12.5.9 Flow rate program setup screen](image)

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

12.5.6.2 Parameter list

**FLOW RATE**

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

**TIME**

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

**RATE**

- Range: END/-400.00–400.00 ml/min², Default: END
- Set the flow rate program rate.
- If you set the rate to “0”, “END” appears and the program finishes at the previous ramp.
- If you move the cursor to “END” and set any numeric value other than “0”, the pressure and the time for that ramp can be entered.

**NOTE**

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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Del Line</td>
<td>Deletes a line at the current cursor position.</td>
<td>——</td>
</tr>
<tr>
<td>Ins Line</td>
<td>Inserts a line in line at the current cursor position.</td>
<td>——</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the flow rate program to a chromatopac.</td>
<td>——</td>
</tr>
</tbody>
</table>

12.5.6.4 Setting a flow rate program

Screen terminology

<1-ramp flow rate program>

![Flow rate program example](image)

Program creation

<1-ramp flow rate program>

![Flow rate program example](image)

Fig. 12.5.10 Flow rate program example
12.5.7 Split ratio program

You can change the split ratio during a split analysis. In addition, you can set a split ratio program after the sampling time has elapsed during splitless analysis. The split ratio program and the gas saver perform basically the same operation. However, the split ratio program is used for more general purposes.

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

A program can contain up to 7 ramps.

12.5.7.2 Parameter list
TIME
Range: 0.00–9999.99 min, Default: 0.00 min
Set this parameter to display the split ratio used previously in the Split Ratio column.

SPLIT RATIO
Range: -1.0/0.0–9999.9, Default: -1.0
Set the split ratio. If the split ratio is set to “-1.0”, the total flow rate remains constant regardless of the oven temperature.

12.5.7.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Del Line</td>
<td>Deletes a line at the current cursor position.</td>
<td>——</td>
</tr>
<tr>
<td>Ins Line</td>
<td>Inserts a line in line at the current cursor position.</td>
<td>——</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the split ratio through to a Chromatopac.</td>
<td>——</td>
</tr>
</tbody>
</table>
12.5.7.4 Setting a split ratio program

Screen terminology

1-ramp program

Program creation

1-ramp program

Fig. 12.5.12 Example of split ratio program
12.5.8  Septum purge

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

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

12.5.8.1  Screen description

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

![Septum Purge setup screen](image)

A program can contain up to 7 ramps.

Fig. 12.5.13  Septum purge setup screen
12.5.8.2 Parameter list

**FLOW RATE**
Refer to Fig. 3.5.3, Default: 3.0 ml/min
Set the initial flow rate of the flow rate program and the final flow rate for each stage. Even if no program is set, specify septum purge flow rate in the initial flow rate column.

**TIME**
Range: 0.00–9999.99 min, Default: 0.00 min
Set the initial flow rate for the flow rate program and the hold time of the final pressure at each stage.

**RATE**
Range: END/-400.00–400.00 kPa/min², Default: END
Set the program rate for the flow rate program.
If you set the rate to “0”, “END” appears and the program finishes at the previous ramp. If you move the cursor to “END” and set any numeric value other than “0”, the pressure and the time for that ramp can be entered.

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

12.5.8.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Del Line</td>
<td>Deletes a line at the current cursor position.</td>
<td>——</td>
</tr>
<tr>
<td>Ins Line</td>
<td>Inserts a line in line at the current cursor position.</td>
<td>——</td>
</tr>
<tr>
<td>On/Off</td>
<td>Set On for septum purge flow.</td>
<td>——</td>
</tr>
</tbody>
</table>
12.5.9 High pressure injection and splitter fix mode

High Pressure Injection
High pressure injection is a split/splitless injection method which keeps the column inlet pressure at a value higher than the analysis pressure for a specified period of time while the sample is injected. Then, the column inlet pressure returns to the normal analysis value. High pressure injection is effective especially for the splitless injection system. High pressure injections can reduce the total gas volume and improve percent recovery valves.

Splitter Fix
If the injected sample consists of a solvent with a high vaporization expansion coefficient, the pressure inside the injection port drastically increases when the solvent vaporizes. This can result in too much solvent being diverted from the column, reducing sensitivity. Sending power to the split flow valve at sample injection can keep the split ratio at its designated valve.

Screen description
Select [Advanced] (PF menu) from the [FLOW] key main screen when not in “DIRECT” mode to open the advanced screen shown in Fig. 12.5.14.

![Setup screen for high pressure injection and splitter fix mode](image)

Fig. 12.5.14 Setup screen for high pressure injection and splitter fix mode
12.5.9.2 Parameter list

■ High Pressure Injection

HIGH PRESS INJECTION MODE
Select One of the following three modes.
Off : Disables high pressure injection.
On : Sets the column inlet pressure to high value immediately.
Auto : Immediately sets the column inlet pressure to high pressure. When analysis is finished and the GC returns to the ready status, the column inlet pressure automatically increases.

HIGH PRESS INJECTION PRESS
Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100.0 kPa
Set the column inlet pressure for high pressure injection.

HIGH PRESS INJECTION TIME
Range: 0.00–9999.99 min, Default: 1.00 min
Set the period of time after analysis starts until the column inlet pressure returns to the original value.
Usually, set this equal to the sampling time.

■ Splitter Fix

SPLITTER FIX MODE
Selection: Off/On/Auto, Default: Off
Select one of the following three modes.
Off : Disables splitter fix mode.
On : Fixes the split flow line immediately.
Auto : Automatically enters splitter fix mode after analysis finishes and the system returns to ready status.

FIX TIME
Range: 0.0–9999.99 min, Default: 0.10 min
Set the period of time to be in splitter fix mode.
When “SPLITTER FIX MODE” is set to “On”, indicate the period of time after “SPLITTER FIX MODE” is set to “On” to exit splitter fix mode.
When “SPLITTER FIX MODE” is set to “Auto”, set the period of time after the analysis starts to exit splitter fix mode.

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

**Direct injection system**

In a direct injection system, a wide-bore (0.53 mm or greater) column is used. Nearly the entire amount of sample injected is introduced 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.

![Diagram of direct injection system](image-url)
12.6.1 Setting the temperature

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

![INJ] key main screen

---

12.6.1.2 Parameter list
**TEMP**
Range: 0.0–450.0°C, Default: 25.0°C
Set the injection port temperature.
Keep the injection port at the lowest practical temperature for the analysis; this prolongs the service life of the temperature sensor. To instantly vaporize the injected sample, set the injection port temperature approximately 30°C higher than the final column oven temperature. Because the sample quantity is usually minute, the sample is vaporized at temperatures lower than the boiling point of sample compounds. To set the maximum temperature limit, refer to "16.6.4 Setting the maximum temperature limits" in "16.6 GC Configuration".

12.6.1.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Print</td>
<td>Prints the temperature program to a Chromatopac.</td>
<td>____</td>
</tr>
<tr>
<td>Next Inj</td>
<td>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.</td>
<td>____</td>
</tr>
</tbody>
</table>
12.6.2 Setting the flow rate

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

<table>
<thead>
<tr>
<th>Flow CAR2</th>
<th>RUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web</td>
<td>Or</td>
</tr>
<tr>
<td>Inlet press(kPa)</td>
<td>100.0</td>
</tr>
<tr>
<td>Total flow(%)</td>
<td>50.0</td>
</tr>
<tr>
<td>Control mode</td>
<td>FLOW</td>
</tr>
<tr>
<td>Carrier gas type</td>
<td>He</td>
</tr>
</tbody>
</table>

Fig. 12.6.3  [FLOW] key main screen

12.6.2.2 Parameter list

**INLET PRESS**
- Range: 0.0–970.0 kPa (Refer to Fig. 3.5.1.), Default: 100.0 kPa
- Set the column inlet pressure.
- When creating a pressure program, this specifies the initial pressure.
- When the control mode is set to “PRESS”, the system controls the column inlet pressure so that it remains constant during a temperature program.
- Normally, when using a wide bore column, set the column inlet pressure to a low pressure (20–40 kPa).

**COLUMN FLOW RATE**
- Default: 1.00 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: 30.0 cm/s
- Set the average linear velocity of the carrier gas flowing in the capillary column.
When you set the linear velocity, the system calculates the column inlet pressure based on the inner diameter, the length and the film thickness of the column. The linear velocity is set separately so that the linear velocity desired occurs at the initial temperature in the oven temperature program.

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

**TOTAL FLOW RATE**

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

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

**CONTROL MODE**

Selection: PRESS/VELOCITY/FLOW, Default: PRESS

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

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

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

**CARRIER GAS TYPE**

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

Specify the carrier gas type supplied to the AFC.

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

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

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

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

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

### 12.6.2.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column</td>
<td>Sets inner diameter, length and film thickness of capillary column.</td>
<td>12.5.3</td>
</tr>
<tr>
<td></td>
<td>Values set here are used in column inlet pressure calculations from column flow rate or linear velocity (or vice versa).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If these parameters are not set correctly, calculations are not performed correctly.</td>
<td></td>
</tr>
<tr>
<td>On/Off</td>
<td>Sets flow controller to be used to “On”. Default value is “Off”. When [Start GC] is pressed, the AFC in the current analytical line which is set to “On” starts. If AFC is set to “Off” during carrier gas control, the control stops. When it is set to “On” again, the carrier gas control restarts.</td>
<td>---</td>
</tr>
<tr>
<td>Press Prog</td>
<td>Sets the column inlet pressure program.</td>
<td>12.5.5</td>
</tr>
<tr>
<td>FLOW Prog</td>
<td>Sets the total flow rate program.</td>
<td>12.5.6</td>
</tr>
<tr>
<td>Purge</td>
<td>Sets the septum purge flow rate and the flow rate program.</td>
<td>12.5.8</td>
</tr>
<tr>
<td>Offset</td>
<td>Performs offset calibration of the AFC sensor. This calibration contributes to good reproducibility of results.</td>
<td>3.6</td>
</tr>
<tr>
<td>Next Flow</td>
<td>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.</td>
<td>---</td>
</tr>
</tbody>
</table>
### 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 values for nitrogen, helium and hydrogen carrier gas.

![HETP vs Carrier Gas Linear Velocity](image)

**Fig. 12.7.1** Effect on linear velocity and HETP for various carrier gases (H-V curve)

The graph above shows that the lowest HETP values are obtained when nitrogen is used as the carrier gas and the linear velocity is set to a value a little less than 10 cm/s. However, nitrogen is not a good carrier gas for capillary analysis for the following reasons.

1. If the linear velocity deviates only slightly 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 therefore 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 compounds 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)

<table>
<thead>
<tr>
<th>I.D. of column</th>
<th>Film thickness</th>
<th>30m</th>
<th>60m</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25mm</td>
<td>0.25µm</td>
<td>100kPa</td>
<td>210kPa</td>
</tr>
<tr>
<td>0.32mm</td>
<td>0.25µm</td>
<td>60kPa</td>
<td>120kPa</td>
</tr>
<tr>
<td>0.53mm</td>
<td>1.5µm</td>
<td>20kPa</td>
<td>40kPa</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>I.D. of column</th>
<th>Film thickness</th>
<th>30m</th>
<th>60m</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25mm</td>
<td>0.25µm</td>
<td>130kPa</td>
<td>275kPa</td>
</tr>
<tr>
<td>0.32mm</td>
<td>0.25µm</td>
<td>80kPa</td>
<td>160kPa</td>
</tr>
<tr>
<td>0.53mm</td>
<td>1.5µm</td>
<td>30kPa</td>
<td>60kPa</td>
</tr>
</tbody>
</table>

NOTE: Fig. 12.7.2 shows the relationship between the column flow rate and the column inlet pressure.

![Fig. 12.7.2](image)

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

- \(F_c\): 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]
- \(\mu\): Viscosity coefficient (19.4µPa•s (helium, 20°C))

Fig. 12.7.2
12.7 Setting the Flow Rate Parameters
13 Detector

13.1 Introduction

■ Detectors

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

- Hydrogen flame ionization detector (FID)
- Thermal conductivity detector (TCD)
- Electron capture detector (ECD) (option)
- Flame thermionic detector (FTD) (option)
- Flame photometric detector (FPD) (option)
In the hydrogen flame ionization detector (FID), hydrogen gas is mixed with the column outlet gas at a certain ratio as shown in Fig. 13.2.1. The gas mixture combusts in the air atmosphere. An electrode exists at each end of the FID jet, and DC voltage is applied between the electrodes.

If only pure carrier gas (nitrogen, helium or argon) and hydrogen gas are mixed, little current is produced between the electrodes. When an organic compound is mixed with the carrier gas, current is produced proportionally to the amount of organic compound present. This is because ions (mainly carbon ions) are generated when an organic compound combusts within the hydrogen flame, and the generated ions are captured by the collector. For isomers, the ion quantity generated is almost proportional to the number of carbons contained in the compound. However, carbon atoms in a “C=O” form do not create a signal. The presence of halogens in the compound decreases sensitivity.

Because the ion current obtained by the FID is very low, it is amplified into a proper voltage, then output to a Chromatopac or personal computer.

Fig. 13.2.1
13.2.2 Setting the detector

13.2.2.1 Screen description
Press the [DET] key to display the detector main screen shown in Fig.13.2.2. Here, set the detector temperature, the detector gas flow rate, etc. When the detector is configured in the analytical line, the output signal settings appear in the lower portion of the screen.

![Detector main screen](image)

For the detector signal output, refer to "13.5 Setting the Output Signals".

13.2.2.2 Parameter list

**DETECTOR CONTROLLER**
Selection: On/Off, Default: On
When a detector is set to “On”, its current and voltage are controlled.
When a detector is configured in an analytical line and set to “On” here, the detector is controlled and its signal monitored. However, even if a detector is set to “Off”, the gas flow is controlled, and the temperature increases to the set value if the detector is configured in an analytical line.

**TEMP**
Range: 0.0–450.0°C, Default: 25.0°C
Set the detector temperature. Normally, set the detector temperature approximately 30°C higher than the final column oven temperature to prevent contamination by high boiling point compounds. To set the maximum temperature limit, refer to “16.6.4 Setting the maximum temperature limits” in “16.6 GC Configuration”.

**FLAME**
Selection: On/Off, Default: Off (When the AUTO IGNIT is set to On, the FLAME is set to On.)
Select “On” to ignite the flame.
Select “Off” to extinguish the flame.

**FILTER TIME CONSTANT**
Selection: 4 ms/5 ms/10 ms/20 ms/50 ms/100 ms/200 ms/500 ms/1 s/2 s, Default: 200 ms
This constant affects the processing of the detector signal.
As the time constant increases, noise as well as the peak height are reduced.
Select the optimum value in accordance with the peak half width. (Refer to “13.4 Filter Signal Time Constant”.)

**SIGNAL OUTPUT PORT**
Selection: Off/Ch1/Ch2/Ch3/Ch4, Default: (Channel is automatically assigned.)
Select the digital and analog signals output channels. Four channels are available. However, for analog output, only Ch1 and Ch2 are available as standard.

**BACKGROUND SIG. SAVE**
Selection: Off/Buff 1/Buff 2, Default: Off
Background baseline signals can be saved for the purpose of background subtraction.

**BACKGROUND SIG COMP.**
Selection: Off/Buff 1/Buff 2, Default: Off
Subtracts the saved background signal baseline from the actual baseline. This produces a stable baseline despite considerable baseline fluctuations.

**DET SIG SUBTRACTION**
Selection: Off/DET# 1/DET# 2/DET# 3/DET# 4, Default: Off
Subtracts the detector signal of one detector from the signal of another detector. This function is mainly used in a dual column flow line to subtract the data acquired without an injection from the data acquired with an injection. The background signal is eliminated.

For the details on “SIGNAL OUTPUT PORT”, “BACKGROUND SIG. SAVE”, “BACKGROUND SIG COMP.” and “DET SIG SUBTRACTION”, refer to “13.5 Setting the Output Signals”.

**SIGNAL RANGE**
Selection: \( \times 1/\times 10^{-1}/\times 10^{-2}/\times 10^{-3}/\times 10^{-4} \), Default: /\times 10^{-1}
Multiplies the analog signal by the coefficient \(10^{-x}\) for a linear analog signal type. If the data processing unit is saturated, for example, change the setting from \(\times 1\) to \(\times 10^{-1}\), from \(\times 10^{-2}\) to \(\times 10^{-3}\). In case of the digital signal, the signal is always output with \(\times 1\).

**SIGNAL ATTENUATION**
Selection: \( \times 1/\times 2^{-1}/\times 2^{-2}/\times 2^{-3}/\times 2^{-4} \), Default: /\times 2^{-1}
Multiplies the analog signal by the coefficient \(2^{-x}\) for a wide analog signal type. If the data processing unit is saturated, for example, change the setting from \(\times 1\) to \(\times 2^{-1}\), from \(\times 2^{-2}\) to \(\times 2^{-3}\). In case of the digital signal, the signal is always output with \(\times 1\).

**ANALOG SIGNAL TYPE**
Selection: Linear/Wide, Default: Linear
Set this item when the GC is connected to a Chromatopac in analog format.
When the GC is connected to a C-R8A, the value set here does not affect the signal because they are connected by a digital RS-232C cable.
Wide ... Select wide when connecting the GC to the C-R7A/CR-7A plus. The signal, multiplied by 1/2, is output from the GC; then, the signal received by the Chromatopac is multiplied by 2.
When connecting the GC to a C-R7A/CR-7A plus for the first time, or replacing the Chromatopac, set the detector signal output to “Off” and perform calibration. (For the calibration procedure, refer to “2.7 Connecting external device cables”.)
Linear ... Select linear when connecting the GC to any Chromatopac other than the C-R8A/C-R7A/CR-7A plus.
When connecting the GC to a C-R7A/CR-7A plus and setting the “ANALOG SIGNAL TYPE” to “Linear”, the optional signal cable (linear, P/N 221-47251-92) is required.
### 13.2.2.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignite</td>
<td>Reduces the air flow rate, heats filament, and ignites detector when pressed when “FLAME” was set to “Off”. If “AUTO IGNITE” is set to “On” on the [SYSTEM] key screen, the detector is automatically ignited after each setting reached the setting value.</td>
<td>13.2.2.4</td>
</tr>
<tr>
<td>Det Gas</td>
<td>Sets the flow rate of makeup gas, hydrogen and air if the advanced Pressure Control (APC) is installed.</td>
<td>13.2.3</td>
</tr>
<tr>
<td>Ign. Set</td>
<td>If the Advanced Pressure Control (APC) is installed, you can set automatic ignition and automatic re-ignition. Default value is “On”.</td>
<td>——</td>
</tr>
<tr>
<td>Next Det</td>
<td>Toggles to the setup screen of another installed detector. The [DET] key can also be used to switch screens.</td>
<td>——</td>
</tr>
</tbody>
</table>

### 13.2.2.4 Igniting the FID

**Ignition procedure**

1. When “DETECTOR” is set to “On” and “AUTO IGNITE” is set to “On” on the [SYSTEM] key main screen.

   - On the [DET] key main screen, set the detector to “On”.

   - Press [Start GC] (PF menu), ([SYSTEM] key main screen)

   - GC control starts. The FID ignites once it has reached the set temperature.

   - The baseline should indicate whether ignition was successful.

   - The message “Ignition finished.” appears, and the ignition is completed.
(2) When “DETECTOR” is set to “On” and “IGNITE” is set to “Off” on the [SYSTEM] key main screen.

On the [DET] key main screen, set the detector to “On”.

Press [Start GC] (PF menu). ([SYSTEM] key main screen)

Wait until the detector temperature increases to the temperature set.

Press [Ignit] (PF menu) to ignite the FID.

The baseline should indicate whether ignition was successful.

The message “Ignition finished.” appears, and the ignition is completed.

(3) When “DETECTOR” is set to “Off” on the [SYSTEM] key main screen.

Press [Start GC] (PF menu) on the [SYSTEM] key main screen.

Set “DETECTOR” of the FID to “On”.

Wait until the detector temperature increases to the temperature set.

Press [Ignit] (PF menu) to ignite the FID.

The baseline should indicate whether ignition was successful.

The message “Ignition finished.” appears, and the ignition is completed.
### Ignition troubleshooting

When ignition has failed and the message “Ignition failed.” appears, check the following items.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column is not connected.</td>
<td>Connect the column for FID to be ignited, and ensure that carrier gas is flowing.</td>
</tr>
<tr>
<td>Hydrogen is not supplied.</td>
<td>Supply hydrogen.</td>
</tr>
<tr>
<td>Hydrogen flow rate is incorrect.</td>
<td>Set the hydrogen flow rate to a proper value.</td>
</tr>
<tr>
<td>Air is not supplied.</td>
<td>Supply air.</td>
</tr>
<tr>
<td>Air flow rate is incorrect.</td>
<td>Set the air flow rate to a proper value.</td>
</tr>
<tr>
<td>Unused FID/FPD is set to “On”.</td>
<td>Set unused detectors to “Off”.</td>
</tr>
<tr>
<td>FID jet is clogged.</td>
<td>Clean the FID jet.</td>
</tr>
<tr>
<td>Igniter filament is broken.</td>
<td>Replace the FID jet.</td>
</tr>
</tbody>
</table>

#### 13.2.2.5 Extinguishing the FID

This section describes how to extinguish the FID when the Advanced Pressure Control (APC) is installed.

### Auto extinguisher

From the [SYSTEM] key main screen, press [STOP GC] (PF menu). The detector temperature gradually decreases, supply of hydrogen and air is stopped, and the flame is automatically extinguished.

When a time program is running or a stop time has been set, the detector gas is shut off at the end of the program, extinguishing the FID flame.

### Manual extinguishment

To extinguish the detector flame without waiting automatic extinguishment, set the gas control of “H2” and “Air” to “Off” on the [Det Gas] (PF menu) screen. The detector gas is shut off, extinguishing the FID flame.

---

**CAUTION**

The cover of FID detector should be raised and set up using tweezers for prevention of a scald in case of maintenance and inspection. Put down the cover on its side using tweezers in case of analysis.
13.2.3 Setting the detector gas flows

The FID detector gas consists of makeup gas, hydrogen and air. The makeup gas is inert gas supplied to the detector to prevent peak tailing and optimize FID sensitivity. Usually, the carrier gas is used as the makeup gas. Hydrogen gas and air are supplied to be combusted inside the detector, creating the FID flame.

13.2.3.1 Screen description

Select [Det Gas] (PF menu) from the [DET] key main screen to display the flow screen shown in Fig. 13.2.3.

When the “Start Flow” status is selected on the [SYSTEM] key screen, the makeup gas flow starts. Just before the ignition procedure begins, hydrogen and air flow starts. Selecting “Stop Temp/Det” status from the [SYSTEM] key main screen, gas flow stop.

Refer to “OPTIMAL FLOW” in “13.2.3.2 Parameter list”, and check whether the flow rate of each detector gas is set correctly. If not, set it to the correct value.

![Fig. 13.2.3 Setting the detector gas flows](image-url)
### 13.2.3.2 Parameter list

**H₂**
Range: 0.0–200.0 ml/min, Default: 40.0 ml/min

**MAKE UP**
Range: 0.0–100.0 ml/min, Default: 30.0 ml/min
Make up gas is supplied to the detector to optimize its sensitivity. For the FID, both nitrogen and helium can be used. Selecting nitrogen is recommended because it offers higher sensitivity.

**GAS TYPE**
Selection: N₂/He/Ar, Default: He
Set the type of gas used as the makeup gas.
Do not use hydrogen for make up gas.

**Air**
Range: 0.0–1000.0 ml/min, Default: 400.0 ml/min

**OPTIMAL FLOW** (Refer to Fig. 3.4.5-Fig. 3.4.7.)
Normally, set the flow rate of the makeup gas, hydrogen and air as follows to maximize the FID sensitivity.
- Makeup gas (N₂) : Approx. 30 ml/min
- Makeup gas (He) : Approx. 30 ml/min
- Hydrogen : Approx. 40 ml/min
- Air : Approx. 400 ml/min

### 13.2.3.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program</td>
<td>The flow rate of makeup gas, hydrogen and air supplied to detector can be controlled by a program.</td>
<td>13.2.3.4</td>
</tr>
<tr>
<td>On/Off</td>
<td>Select “Off” to stop gas flow. Select “On” to restart the gas flow. Default value is “On”.</td>
<td>—</td>
</tr>
<tr>
<td>Offset</td>
<td>Performs offset calibration of APC sensor. This calibration improves the reproducibility of results.</td>
<td>3.6</td>
</tr>
</tbody>
</table>
13.2.3.4 Flow rate program for detector gas

Press [Program] (PF menu) from [Det Gas] (PF menu) to display the Detector gas screen shown in Fig. 13.2.4. Here, set a flow rate program for detector gas. The flow rate program procedure is the same for the makeup gas, hydrogen gas and air. For the flow rate program setting procedure, refer to "12.5.6 Creating a Flow rate program".

A 7 ramp program can be set.

Set the program for hydrogen and air the same way. Press the appropriate PF menu to set the programs.

Fig. 13.2.4 Detector gas program
### 13.2.3.5 Detector gas program parameters

**FLOW RATE**

The range and the default valve differs for each gas. See “13.2.3.2 Parameter list”.

Set the default flow rate and the final flow rate for each stage of the detector gas flow rate program.

**TIME**

Range: 0.00–9999.99 min, Default: 0.00 min

Set the retention time for the initial flow rate and the final flow rate for each ramp of the detector gas flow rate program.

**RATE**

Range: END/-400.0–400.0 ml/min², Default: END

Set the program rate of the detector gas flow rate program. If you set the rate to “0”, “END” appears and the program ends at the previous ramp. Move the cursor to “END” and set any numeric value other than “0”, to enter the pressure and the time for that ramp.

### 13.2.3.6 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make Up Prog</td>
<td>Displays the setup screen of the flow rate program for makeup gas.</td>
<td>———</td>
</tr>
<tr>
<td>H2 Prog</td>
<td>Displays the setup screen of the flow rate program for hydrogen gas.</td>
<td>———</td>
</tr>
<tr>
<td>Air Prog</td>
<td>Displays the setup screen of the flow rate program for air.</td>
<td>———</td>
</tr>
<tr>
<td>Del Line</td>
<td>Deletes a line at the current cursor position.</td>
<td>———</td>
</tr>
<tr>
<td>Ins Line</td>
<td>Inserts a line in line at the current cursor position.</td>
<td>———</td>
</tr>
</tbody>
</table>
13.3 Thermal conductivity detector (TCD)

13.3.1 Principle of TCD operation

The thermal conductivity detector (TCD) can detect all compounds except the carrier gas itself. The metallic TCD filament is heated by the application of current. The carrier gas used has a high thermal conductivity, such as helium. As sample compounds pass the filament, the filament temperature increases, because the thermal conductivity of the sample compounds is less than that of the carrier gas. The filament temperature changes affect its resistance; the resistance is measured and produces a chromatogram. A reference filament also exists, where only carrier gas flows, to eliminate background resistance fluctuations.

Fig. 13.3.1
13.3.2 Setting the detector

13.3.2.1 Screen description
Press the [DET] key to display the Detector main screen shown in Fig. 13.3.2. Here, set the detector temperature, the detector gas flow rate, etc. When the detector is configured in the analytical line, the output signal settings appear in the lower portion of the screen.

![Detector main screen](image)

**For output of the detector signal, refer to “13.5 Setting the Output Signals”**.

13.3.2.2 Parameter list

**DETECTOR CONTROLLER**
Selection: On/Off, Default: On
When a detector is set to “On”, its current and voltage are controlled. When a detector is configured in an analytical line and set to “On”, the detector is controlled and its signal monitored. However, even if a detector is set to “Off”, the gas flow is controlled, and the temperature increases to the set value if the detector is configured in an analytical line.

**TEMP**
Range: 0.0–400.0°C, Default: 25.0°C
Set the detector temperature. The TCD sensitivity is proportional to the difference in temperature between the detector and the filament. Accordingly, the sensitivity increases as the detector temperature decreases. However, the detector is normally set approximately 10°C higher than the final column oven temperature: this prevents contamination in the TCD cell.
To set the maximum temperature limit, refer to “16.6.4 Setting the maximum temperature limits”.

---

**Fig. 13.3.2  [DET] key main screen**

Detector | DET #2 | RUN
--- | --- | ---
TCD 2 | | On
Temp (°C) | 300.0 | 300.0
Signal Polarity | + | |
Current (mA) | 75 | |
Filter Time Constant | 200ms | |

Signal Output Port | Ch2
Background sig. save | Off
Background sig comp. | Off
Det sig subtraction | |
Signal Range | x10⁻¹
Analog Signal Type | Linear

---

For output of the detector signal, refer to “13.5 Setting the Output Signals”.
13.3 Thermal conductivity detector (TCD)

**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 positive peaks.

**CURRENT**
Range: 0–100 mA, Default: 0 mA
The TCD sensitivity is approximately proportional to the cube of the current.
If the sensitivity is insufficient, increase the current within the range shown in the figure below. The maximum operating current is determined by the detector temperature and the carrier gas type. Keeping the current higher than necessary shortens the filaments life and can cause baseline drift.

![Fig. 13.3.3 Maximum operating current](Image)

**CAUTION**
If the current is turned on before the carrier gas + 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 values indicated by the curves below.

The current setted should be below the curve in the diagram for the selected gas type in order to prevent damage to the filament or deterioration of TCD performance.
FILTER TIME CONSTANT
- Selection: 4 ms/5 ms/10 ms/20 ms/50 ms/100 ms/200 ms/500 ms/1 s/2 s, Default: 200 ms
- This constant affects the processing of the detector signal.
- As the time constant increases, noise as well as the peak height are reduced.
- Select the optimum value in accordance with the peak half width. (Refer to “13.4 Filter Signal Time Constant”.)

SIGNAL OUTPUT PORT
- Selection: Off/Ch1/Ch2/Ch3/Ch4, Default: (Channel is automatically assigned.)
- Select the digital and analog signals output Channels. Four channels are available. However, for analog output, only Ch1 and Ch2 are available as standard.

BACKGROUND SIG. SAVE
- Selection: Off/ Buff 1/Buff 2, Default: Off
- Background baseline signals can be saved for the purpose of background subtraction.

BACKGROUND SIG COMP.
- Selection: Off /Buff 1/Buff 2, Default: Off
- Subtracts the saved background signal baseline from the actual baseline. This produces a stable baseline despite considerable baseline fluctuations.

DET SIG SUBTRACTION
- Selection: Off /DET#1/DET#2/DET#3/DET#4, Default: Off
- Subtracts the detector signal of one detector from the signal of another detector. This function is mainly used in a dual column flow line to subtract the data acquired without an injection from the data acquired with an injection. The background signal is eliminated.
- For the details on “SIGNAL OUTPUT PORT”, “BACKGROUND SIG. SAVE”, “BACKGROUND SIG COMP.” and “DET SIG SUBTRACTION”, refer to “13.5 Setting the Output Signals”.

SIGNAL RANGE
- Selection: $\times 1/\times 10^{-1}/\times 10^{-2}/\times 10^{-3}/\times 10^{-4}$, Default: $\times 10^{-1}$
- Multiplies the analog signal by the coefficient $10^{-x}$ for a linear analog signal type. If the data processing unit is saturated, for example, change the setting from $\times 1$ to $\times 10^{-1}$, from $\times 10^{-2}$ to $\times 10^{-3}$. In case of the digital signal, the signal is always output with $\times 1$.

SIGNAL ATTENUATION
- Selection: $\times 1/\times 2^{-1}/\times 2^{-2}/\times 2^{-3}/\times 2^{-4}$, Default: $\times 2^{-1}$
- Multiplies the analog signal by the coefficient $2^{-x}$ for a wide analog signal type. If the data processing unit is saturated, for example, change the setting from $\times 1$ to $\times 2^{-1}$, from $\times 2^{-2}$ to $\times 2^{-3}$. In case of the digital signal, the signal is always output with $\times 1$.

ANALOG SIGNAL TYPE
- Selection: Linear/Wide, Default: Linear
- Set this item when the GC is connected to a Chromatopac in analog format. When the GC is connected to a C-R8A, the value set here does not affect the signal because they are connected by a digital RS-232C cable.
- Wide ... Select wide when connecting the GC to the C-R7A/CR-7A plus.
  - The signal, multiplied by 1/2, is output from the GC; then, the signal received by the Chromatopac is multiplied by 2.
  - When connecting the GC to a C-R7A/CR-7A plus for the first time, or replacing the Chromatopac, set the detector signal output to “Off” and perform calibration. (For the calibration procedure, refer to “2.7 Connecting external device cables”.)
- Linear ... Select linear when connecting the GC to any Chromatopac other than the C-R7A/CR-7A plus.
When connecting the GC to a C-R7A/CR-7A plus and setting the “ANALOG SIGNAL TYPE” to “Linear”, the optional signal cable (linear; P/N 221-47251-92) is required.

### 13.3.2.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Det Gas</td>
<td>Sets the makeup gas flow rate supplied from the reference cell to the sample cell if the Advanced Pressure Control (APC) is installed.</td>
<td>13.3.3</td>
</tr>
<tr>
<td>Next Det</td>
<td>Toggles to the setup screen of another detector. The [DET] key can also be used to switch screens.</td>
<td>——</td>
</tr>
</tbody>
</table>
13.3.3 Setting the detector gas flows

The gas tubing is routed so that the reference gas effluent is used as the makeup gas of the TCD. Helium and nitrogen are available as the makeup gas. The TCD sensitivity is proportional to the difference in thermal conductivity between the sample and the carrier gas. Because the thermal conductivity of the sample is lower than that of the carrier gas, the TCD sensitivity increases as the thermal conductivity of the carrier gas increases. For high sensitivity analysis, use helium with a purity of 99.9995% or more.

Thermal conductivity k ($10^{-4}$Wm$^{-1}$K$^{-1}$) at room temperature, 300 K

<table>
<thead>
<tr>
<th>Gas</th>
<th>Thermal conductivity</th>
<th>Gas</th>
<th>Thermal conductivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple compounds</td>
<td></td>
<td>Inorganic compounds</td>
<td></td>
</tr>
<tr>
<td>He</td>
<td>1499</td>
<td>CO$_2$</td>
<td>166.2</td>
</tr>
<tr>
<td>H$_2$</td>
<td>1815</td>
<td>H$_2$O</td>
<td>181</td>
</tr>
<tr>
<td>N$_2$</td>
<td>259.8</td>
<td>acetone</td>
<td>115</td>
</tr>
<tr>
<td>Ar</td>
<td>177.2</td>
<td>hexane</td>
<td>128</td>
</tr>
</tbody>
</table>

13.3.3.1 Screen description

Select [Det Gas] (PF menu) from the [DET] key main screen to display the flow screen shown in Fig. 13.3.4. When the “Start Flow” status is selected on the [SYSTEM] key screen, the makeup gas flow starts. When the stop time elapses and the detector temperature drops to the value set by [Stop Seq] (PF menu) on the [Det Gas] (PF menu), the makeup gas flow stops.

Refer to “OPTIMAL FLOW” in “13.3.3.2 Parameter list”, and check whether the flow rate of each detector gas is set correctly. If not, set it to the correct value.

Fig. 13.3.4 Setting the detector gas flows
13.3.3.2 Parameter list

Make Up
Range: 0.0–20.0 ml/min, Default: 8.0 ml/min
Because the thermal conductivity of the sample is lower than that of the carrier gas, the sensitivity increases as the thermal conductivity of the carrier gas increases. For high sensitivity analysis, use helium with purity of 99.9995% or more.

GAS TYPE
Selection: N₂/He/Ar, Default: He

OPTIMAL FLOW (Refer to Fig. 3.4.8.)
Normally, set the flow rate of the makeup gas to approx. 8ml/min (Helimu) to maximize the TCD sensitivity.

NOTE If the makeup gas flow is set below the optimal rate (8ml/min for Helimu), sensitivity increases. However, the reference filament can break, and peak tailing may occur. The baseline may be come elevated after the solvent peak has eluted (depending on solvent type).

13.3.3.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program</td>
<td>The flow rate of makeup gas supplied to detector can be controlled by a program.</td>
<td>13.3.3.4</td>
</tr>
<tr>
<td>On/Off</td>
<td>Select “Off” to stop the gas flow. Select “On” to restart the gas flow. Default value is “On”.</td>
<td>3.6</td>
</tr>
<tr>
<td>Stop Seq</td>
<td>For a TCD, the filament life can be shortened if the makeup gas flows stops as soon as the stop time has elapsed. Therefore, the stop sequence contains a step where the makeup gas continues to flow after the stop time, until the detector temperature drops to a specified value. The default value is 50°C.</td>
<td>3.6</td>
</tr>
<tr>
<td>Offset</td>
<td>Performs offset calibration of APC sensor. This calibration improves the reproducibility of results.</td>
<td>3.6</td>
</tr>
</tbody>
</table>
13.3.3.4 Flow rate program for detector gas
Press [Program] (PF menu) from [Det Gas] (PF menu) to display the Detector Make up screen shown in Fig. 13.3.5. Here, set a flow rate program for detector gas.

A 7 ramp program can be set.

Fig. 13.3.5 Detector gas program
13.3.3.5 Detector gas program parameters

FLOW RATE
Range: 0.0–20.0 ml/min, Default: 8.0 ml/min
Set the default flow rate and the final flow rate for each stage of the detector gas flow rate program.

TIME
Range: 0.00–9999.99 min, Default: 0.00 min
Set the retention time for the initial flow rate and the final flow rate for each ramp of the detector gas flow rate program.

RATE
Range: END/-400.0–400.0 ml/min², Default: END
Set the program rate of the detector gas flow rate program.
If you set the rate to “0”, “END” appears and the program ends at the previous ramp.
Move the cursor to “END” and set any numeric value other than “0” to enter the pressure and the time for that ramp.

13.3.3.6 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Del Line</td>
<td>Deletes a line at the current cursor position.</td>
<td>――</td>
</tr>
<tr>
<td>Ins Line</td>
<td>Inserts a line in line at the current cursor position.</td>
<td>――</td>
</tr>
</tbody>
</table>
### Selecting the filter time constant

Normally, analyses can be performed with the time constant set to the default value. However, in order to improve the S/N ratio, the time constant can be changed by measuring the half width of a test peak.

Fig. 13.4.1 shows the relationship between the peak half width and the time constant where the S/N ratio is maximized. For example, if the half width of a peak is “0.1 sec”, the S/N ratio is maximized when the time constant is set to “20 ms.”

![Fig. 13.4.1 Relationship between time constant and S/N ratio](image)

**Fig. 13.4.1  Relationship between time constant and S/N ratio**
13.5 Setting the Output Signals

13.5.1 Detector signal output

Set the detector signal (digital and analog signals) output from the gas chromatograph. There are four signal output channels. Ch3 and Ch4 are available optionally. Both digital and analog signals can be output from one channel. Even if two or more channels are set, signals can be output from each channel at the same time. Detector signals are transferred through an RS-232C cable (for digital signals, only when the C-R8A or a personal computer are used) and the chromatopac signal cable (for analog signals).
13.5.2 Background compensation

If the baseline fluctuates considerably during programmed analysis, the baseline fluctuation can be saved as a background baseline by the GC. Afterwards, the background is subtracted from the baseline. (background compensation).

This section describes how to save the background baseline and perform background compensation.

1) Setting the signal output channel
   On the [DET] key main screen, set “SIGNAL OUTPUT PORT” from “Off” to Channel 1-4. (“Ch3” and “Ch4” for analog signal are available optionally.)

2) Background storage setup
   On the [DET] key main screen, set “BACKGROUND SIG. SAVE” from “Off” to “Buff 1” (or “Buff 2”) to save the background baseline.

3) Saving the background baseline
   Without making an injection, press the [START] key on the gas chromatograph to execute analysis. The background baseline is saved.

4) Background compensation settings
   On the [DET] key main screen, set “BACKGROUND SIG. COMP.” from “No” to “Buff 1” (or “Buff 2”) the same selection from in “BACKGRND SAVE”.

5) Analysis
   Make an injection, and press the [START] key to execute analysis. Because background compensation is in effect, large baseline fluctuations are now eliminated.
Fig. 13.5.2 Example of programmed analysis without compensation

Fig. 13.5.3 Example of programmed analysis with compensation
13.5.3 Detector signal subtraction

When high sensitivity analysis or high temperature analysis is executed with a packed column, stationary liquid vapor released from the column packing is often contained in the carrier gas, making the background signal unstable. If this is the case, set up dual analytical flow lines with an injection port, column, and detector. One flow line should have carrier gas flowing but no injections are made. The other flow line receives the sample injections. The difference in detector signal between the reference and sample signal is acquired. This eliminates background noise and provides a stable signal.
13 Detector
13.5 Setting the Output Signals
14 Diagnosis

14.1 Standard Diagnosis

Each part of the gas chromatograph is checked for problems with the self-diagnosis function. Perform the standard diagnosis periodically to maintain optimal performance and prevent failures.

14.1.1 Screen description

Select “STANDARD DIAGNOSIS” from the [DIAG] key main screen to display the Standard Diagnosis screen shown in Fig. 14.1.1.

```
Standard Diagnosis

The standard diagnosis starts with PF2.
Before the standard diagnosis the system turns off.
```

Fig. 14.1.1 Diagnosis main screen

14.1.2 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Diag</td>
<td>Starts standard diagnosis program.</td>
<td>14.1.5</td>
</tr>
<tr>
<td>Details</td>
<td>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.</td>
<td>14.1.9</td>
</tr>
<tr>
<td>Diag Param</td>
<td>Determines setup values used for diagnostic reference and selects diagnosis items.</td>
<td>14.1.3</td>
</tr>
</tbody>
</table>
14.1.3 Diagnosis Parameters

Press [Diag Param] (PF menu) from the Standard Diagnosis main screen to display the Diagnosis Parameters screen shown in Fig. 14.1.2.
Select the items to be checked during the self-test.

![Diagnosis Parameters NOT READY]

Counter for Septum: No
Counter for Insert: No
CRG Use Time: Yes
Temp Sensor Diag: Yes
LCD Use Time: Yes
Fan Use Time: Yes
DC Voltage: Yes
Room Temperature: Yes
Atmospheric Press.: Yes
Primary Press.: Yes
CPU Register: Yes
Real Time Clock Register: Yes

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 checked.

**COUNTER FOR SEPTUM**
Verifies whether the preset number of injections has been exceeded. The “ANALYSIS COUNTER” limit is displayed.

**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 exceeded 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.

---

**CAUTION**
At the time of Diagnosis, set the Split mode to “SPLIT”. When WBI column is used, set the split mode to “DIRECT”.

---
14 Diagnosis
14.1 Standard Diagnosis

**DETECTOR IGNITE**
Checks that the ignition pulse is normal.

**DETECTOR IGNITION**
Verifies whether the ignition operation is normally executed.

**ECD FREQUENCY**
Verifies whether the frequency of the pulse voltage applied to the ECD is below the limit.

**CARRIER GAS ROM, DETECTOR GAS ROM, APC ROM**
Verifies whether the data saved in the ROM on the flow controller PCB can be read correctly.

**CARRIER GAS AD CONVERTER, DETECTOR AD CONVERTER, APC AD CONVERTER**
Verifies whether the contents of the A/D converter on the flow controller PCB can be read correctly.

**GAS CONTROL**
Checks that the pressure flow rate is normally controlled.

**OVER TEMP PROTECTION**
Ensure that the overheat protection circuit is normal.

**CPU PERIPHERAL**

**RESET IC**
Verifies that the reset circuit works normally.

**WATCH DOG TIMER**
Ensures that the IC which checks for software problems is functioning normally.

**ROM**
Checks that the ROM is intact.

**RAM**
Verifies whether the RAM can be correctly written and read.
14.1.5 Starting the diagnosis

Press [Start Diag] (PF menu) from the standard diagnosis main screen shown in Fig. 14.1.1 to start diagnosis and to display the screen shown in Fig. 14.1.3.

Fig. 14.1.3  Starting the Diagnosis

14.1.6 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop Diag</td>
<td>Stops the diagnosis. If the program is stopped, items not yet executed are canceled.</td>
<td>14.1.7</td>
</tr>
<tr>
<td>Reset</td>
<td>Before starting 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.</td>
<td>____</td>
</tr>
</tbody>
</table>
### 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.

![Diagnosis stop screen](image)

**Fig. 14.1.4  Diagnosis stops**

### 14.1.8 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Details</td>
<td>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.</td>
<td>14.1.9</td>
</tr>
</tbody>
</table>
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]

**Fig. 14.1.5 Diagnosis results**

14.1.10 PF menu list

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Print</td>
<td>Prints out the results of the diagnosis to a Chromatopac.</td>
<td>———</td>
</tr>
</tbody>
</table>
## Diagnosis results

- **Good**: Displayed when the diagnosis result satisfies the requirements.
- **Not Good**: Displayed when the diagnosis result does not satisfy the requirements.
- **N/T (= Not Tested)**: Displayed when the diagnostic test was stopped or when an item is excluded from the test.
- **N/A (= Not Applicable)**: Displayed when diagnostic test is disabled for the item (ignition test for a TCD, for example).
- **N/S (= Not Selected)**: Displayed when the diagnosis were not performed 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”

<table>
<thead>
<tr>
<th>Diagnosis item</th>
<th>Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEPTUM COUNTER</td>
<td>Replace the septum. (Refer to “18.3 Inspection and Maintenance: Septum”.).</td>
</tr>
<tr>
<td>INSERT COUNTER</td>
<td>Replace the glass insert. (Refer to “18.5 Inspection and Maintenance: Glass Insert”.).</td>
</tr>
<tr>
<td>ROOM TEMPERATURE</td>
<td>Check the operation range.</td>
</tr>
<tr>
<td>ATMOSPHERIC PRESS</td>
<td>Check the operation range.</td>
</tr>
<tr>
<td>GAS PRIMARY PRESS</td>
<td>Increase supply pressure from the gas cylinder. For example, adjust the regulator.</td>
</tr>
<tr>
<td>DETECTOR IGNITION</td>
<td>Refer to “19 Troubleshooting”.</td>
</tr>
<tr>
<td>ANY OTHER ITEM</td>
<td>Contact your Shimadzu representative.</td>
</tr>
</tbody>
</table>
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.

![Log Reading Menu](image)

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.

![Operation log screen](image)

**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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Log</td>
<td>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.</td>
<td>____</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the operation log to a Chromatopac.</td>
<td>____</td>
</tr>
</tbody>
</table>
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 Screen](image)

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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Log</td>
<td>Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message &quot;Clear log with PF2&quot; appears. Press [Clear Log] (PF menu) to clear the log.</td>
<td></td>
</tr>
<tr>
<td>Print</td>
<td>Prints the analysis log to a Chromatopac.</td>
<td></td>
</tr>
</tbody>
</table>
(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.

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Time</th>
<th>SET</th>
<th>ACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room temp range err</td>
<td>1.20min</td>
<td>25.0°C</td>
<td>25.5°C</td>
</tr>
<tr>
<td>DetAPC3 PCB error</td>
<td>3.30min</td>
<td>130</td>
<td>151</td>
</tr>
<tr>
<td>DETH4 PCB error</td>
<td>2.50min</td>
<td>100</td>
<td>111</td>
</tr>
<tr>
<td>CAR1 WBI PCB error</td>
<td>1.20min</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>APC7-8 PCB error</td>
<td>2.50min</td>
<td>100</td>
<td>111</td>
</tr>
<tr>
<td>COL A/D error</td>
<td>3.30min</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 Screen](image)

**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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Log</td>
<td>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.</td>
<td>—</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the parameter log to a Chromatopac.</td>
<td>—</td>
</tr>
</tbody>
</table>
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 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 screen](image)

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 menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Log</td>
<td>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.</td>
<td>___</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the error log to a Chromatopac.</td>
<td>___</td>
</tr>
</tbody>
</table>
14.2.7 Diagnostic log

When “5. DIAGNOSTIC LOG” is selected, the result 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.

<table>
<thead>
<tr>
<th>Diagnostic Log</th>
<th>(1/10)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diag date</strong></td>
<td><strong>Status</strong></td>
</tr>
<tr>
<td>98.08.12 08:00</td>
<td>Good</td>
</tr>
<tr>
<td>98.08.12 07:50</td>
<td>Good</td>
</tr>
<tr>
<td>98.08.12 07:50</td>
<td>Good</td>
</tr>
<tr>
<td>98.08.12 07:50</td>
<td>Not Good</td>
</tr>
<tr>
<td>98.08.11 20:30</td>
<td>Not Good</td>
</tr>
<tr>
<td>98.08.11 20:20</td>
<td>Good</td>
</tr>
<tr>
<td>98.08.11 20:10</td>
<td>Good</td>
</tr>
<tr>
<td>98.08.11 20:10</td>
<td>Good</td>
</tr>
<tr>
<td>98.08.11 08:00</td>
<td>Good</td>
</tr>
<tr>
<td>98.08.11 07:50</td>
<td>Not Good</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Log</td>
<td>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.</td>
<td>——</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the diagnosis log to a Chromatopac.</td>
<td>——</td>
</tr>
</tbody>
</table>
Use the analysis counter to set the replacement timing of the septum, and the glass insert, when the counter exceeds 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.

![Fig. 14.3.1 Analysis counter screen](image)
14 Diagnosis
14.3 Analysis Counter

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 exceeded the limit.

USE COUNTER
Selection: Yes/No, Default: Yes

ANALYSIS COUNTER
Selection: 0

SETTING TO WARN
Range: 0–999, Default: 100

NOTE The septum/glass insert replacement interval depends on the type of analysis. Periodically replace the
septum and the glass insert even if the warning message is not displayed.

14.3.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reset</td>
<td>Resets analysis number counter of the current item.</td>
<td>——</td>
</tr>
<tr>
<td>Next</td>
<td>Displays the setup screen of the analysis counter of another injection port.</td>
<td>——</td>
</tr>
</tbody>
</table>
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.
14.4.2 Parameter list

**USE COUNTER**
Selection: Yes/No, Default: Yes

**CONSUMPTION**
Default: 0min
The total time that the CRG is “On” is displayed.
Refer to “15.3 Setting the CRG Parameters”.

**SETTING TO WARN**
Range: 0–9999min, Default: 100min

**NOTE**
The coolant consumption time depends on the gas cylinder volume and the number of analyses which require CRG. Set the warning time according to the analysis conditions.

14.4.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reset</td>
<td>Resets the Use counter.</td>
<td></td>
</tr>
</tbody>
</table>
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 Screen](image)

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.

---

![PF menu](image)

Fig. 14.5.1 Standard installation test main screen

14.5.2 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>Automatically sets the analytical conditions of the standard installation test. When [Load] (PF menu) is pressed, “TEST” is displayed for the used file name.</td>
<td>——</td>
</tr>
<tr>
<td>Unload</td>
<td>Returns analytical conditions to their former status.</td>
<td>——</td>
</tr>
</tbody>
</table>
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 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 Screen](image)

**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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Info</td>
<td>Specify the parameters (retention time, full width at half height and peak height) of the peaks to be generated.</td>
<td></td>
</tr>
</tbody>
</table>
From the gas chromatograph, specify the parameters of the Shimadzu AOC-20i Auto Injector and the AOC-20s Auto Sampler Carousel, which automatically inject liquid samples into the gas chromatograph. For detailed setting procedures, refer to the User’s Manual for AOC-20 and the User’s Manual for AOC-20 Dual Injection System.

15.1.1 Screen description

After installing the auto injector on the gas chromatograph, access the line configuration screen from the [SET] key, and then select AOC1 for the analytical line (select AOC2 in addition, for the analytical line for dual injection systems.) Press the [OPTION] key again or press [Next] (PF menu) several times on the [OPTION] key screen to display the AOC parameter screen shown in Fig. 15.1.1. The screen toggles among the AOC parameters → AUX APC → CRG screens.

![Fig. 15.1.1 AOC setup screen](image)

**AOC STATUS**

The AOC status can be monitored.

<table>
<thead>
<tr>
<th>Screen display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>AOC is not operating.</td>
</tr>
<tr>
<td>Taking vial</td>
<td>A vial is being picked up from the tray.</td>
</tr>
<tr>
<td>Preparation</td>
<td>AOC is operating (before injection).</td>
</tr>
<tr>
<td>Rinse</td>
<td>AOC is operating (after injection).</td>
</tr>
<tr>
<td>Putting vial</td>
<td>A vial is being returned to the tray.</td>
</tr>
<tr>
<td>Wait</td>
<td>AOC is waiting for analysis.</td>
</tr>
</tbody>
</table>
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
elemate 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)
  Selection: Slow/Middle/Fast, Default: Fast
  Specifies the plunger speed during injection.

USE THE SAME PARAM
  Selection: Yes/No, Default: No
  This item is displayed on the main parameter setup screen when a dual injector is used.
  Select “Yes” to operate the sub AOC with same parameters as those of the main AOC.

AOC POWER
  Selection: On/Off, Default: On
  Turns the AOC power on and off (built-in GC-2010 power supply).
## 15.1.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Starts AOC and gas chromatograph.</td>
<td>15.1.3</td>
</tr>
<tr>
<td>Stop</td>
<td>Temporarily stops the AOC. If [Start] (PF menu) is pressed in stop status, the AOC resumes the operation before [Stop] (PF menu) was pressed.</td>
<td>15.1.4</td>
</tr>
<tr>
<td>Priority</td>
<td>Sets up a Priority analysis.</td>
<td>15.1.4</td>
</tr>
<tr>
<td>Other Para</td>
<td>Sets AOC options and customization.</td>
<td>15.1.7</td>
</tr>
<tr>
<td>Sampler</td>
<td>Sets the auto sampler, sub injector and bar code reader.</td>
<td>15.1.10</td>
</tr>
<tr>
<td>Reset</td>
<td>Resets AOC to the status before control was started.</td>
<td>15.1.10</td>
</tr>
<tr>
<td>Upload</td>
<td>Loads parameters from the AOC to the AOC setup screen of the gas chromatograph.</td>
<td>15.1.10</td>
</tr>
<tr>
<td>Main/Sub</td>
<td>Toggles between the main AOC setup screen and the sub AOC setup screen. Available only when an AOC 1 and AOC 2 are configured in the analytical line and sub AOC is set to “Use” in [Sampler] (PF menu).</td>
<td>15.1.10</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the parameters on the Chromatopac.</td>
<td>15.1.10</td>
</tr>
<tr>
<td>Next</td>
<td>Toggles among these screens, in order: AOC parameters → AUX APC → CRG.</td>
<td>15.1.10</td>
</tr>
</tbody>
</table>
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).

![Priority analysis setup screen](image)

Fig. 15.1.2  Priority analysis setup screen

15.1.5 Parameter list

**INJECTION SAMPLE**

**INJECTION SAMPLE NUMBER**

 liberté 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 carousel 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 value of 0 (default) indicates no priority sample.
15.1.6 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set</td>
<td>Analyzes the vial No. specified after the analysis of the current sample is finished.</td>
<td>——</td>
</tr>
</tbody>
</table>

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.

![AOC Other Parameters](image)

Fig. 15.1.3 Additional AOC parameter setup
15.1.8 Other AOC Parameter

**INJ. SPEED (SYRINGE)**
Selection: Slow/Fast, Default: Fast
Set the syringe injection speed.

**USING 3 SOLVENT VIALS**
Selection: Yes/No, Default: No
Specifies whether three solvent vials are present and the autosampler carousel is not in use.
This item is only available when “USE OF THE SAMPLER” in [Sampler] (PF menu) is set to “Not Use”.

**SOLVENT SELECT**
Selection: All/A only/B only/C only, Default: All
This item is available when “USING 3 SOLVENT VIALS” is set to “Yes” or “USE OF THE SAMPLER” in [Sampler] (PF menu) is set to “Use”.
All: Three solvent types are used.
For the details, refer to Fig. 3.4.1 in “3.4 Auto Sampler” in the AOC-20 User’s Manual.

**AIR SUCTION**
Selection: Yes/No, Default: No
Set whether or not 1 µl of air is aspirated into the syringe after aspirating sample.
This type of injection is useful for samples with a wide boiling point range, when compound discrimination problems can occur.

\[ \text{CAUTION}\]
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
Specify 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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inj Mode</td>
<td>For details, refer to “3.3.3 Injection mode” in AOC-20 User’s Manual.</td>
<td>———</td>
</tr>
</tbody>
</table>
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”.

---

**USE OF THE SAMPLER**

Selection: Use/Not Use, Default: Not Use

This item automatically set to “Use” when “USE OF THE SUB AOC” is set to “Use”.

**USE OF THE SUB AOC**

Selection: Use/Not Use, Default: Not Use

**BAR CODE READER**

Selection: Use/Not Use, Default: Not Use

Select “Use” when the Bar Code reader is installed.

---

15.1.12 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alloc</td>
<td>When “Use of the Sub AOC” is set “Use”, [Alloc](PF menu) is displayed. For details, refer to “3.4 Division of Sample” in AOC-20 Dual Injection System User’s Manual.</td>
<td></td>
</tr>
</tbody>
</table>
15 Optional Devices

15.2 Setting the AUX APC Parameters

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

15.2.1 Screen description

If an AUX APC is installed, press the [OPTION] key from the [OPTION] key main screen, or press [NEXT] (PF menu) until the AUX APC screen, shown in fig. 15.2.1, appears.

The [NEXT] (PF menu) key toggles among the AOC parameters → AUX APC → CRG screens, in that order.

![AUX APC main screen](image)

Fig. 15.2.1 AUX APC main screen
15.2.2 Parameter list

PRESS
Range: 0.0–400.0 kPa, Default: 100 kPa
Set the pressure when the control mode is set to “PRESS”.

FLOW RATE
Range: 0.0–1200.0 ml/min, Default: 50 ml/min
Set the flow rate when the control mode is set to “FLOW”.

CONTROL MODE
Selection: PRESS/FLOW, Default: PRESS
PRESS: Controls the system to obtain the preset pressure.
FLOW: Controls the system to obtain the preset flow rate.

NOTE When using the AUX APC in flow mode, a restrictor is used to ensure that the actual flow rate is equal to the set flow rate. Confirm the actual flow rate with a flow meter.

GAS TYPE
Selection: He/N2/H2/Ar, Default: He
Set the type of gas supplied to the APC. If the gas type is set incorrectly, the flow rate cannot be set as specified in “FLOW” mode. This is because a restrictor is used to calculate the flow rate.

15.2.3 PF menu list

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program</td>
<td>Displays the pressure or flow rate program setup screen for the AUX APC.</td>
<td>15.2.4</td>
</tr>
<tr>
<td>Resistor</td>
<td>In flow mode, the difference between the set and actual value can be eliminated by installing a restrictor in the flow line. On the resistor screen, enter the i.d., length, and resistance of the restrictor tubing.</td>
<td>15.2.5</td>
</tr>
<tr>
<td>On/Off</td>
<td>Set APC to be used to “On”. Default value is “On”.</td>
<td>3.6</td>
</tr>
<tr>
<td>Offset</td>
<td>Performs offset calibration of APC sensor to improve the reproducibility of results.</td>
<td>3.6</td>
</tr>
<tr>
<td>Next</td>
<td>Toggles among AOC parameters → AUX APC → CRG screens, in that order.</td>
<td>15.2.4</td>
</tr>
</tbody>
</table>
15.2.4 Setting a program

A pressure of flow rate program can also be created for the AUX APC. Set the control mode to “Pressure” on the AUX APC main screen, select the desired APC, and then press [Program] (PF menu). The APC program screen, shown in Fig. 15.2.2, opens.

Similarly, a flow rate program can be created by selecting “FLOW” mode and pressing [Program] (PF menu). This opens the flow rate program screen.

For the program setting procedure, refer to “12.5.5 Pressure program” and “12.5.6 Creating a Flow rate program”.

![APC pressure program setup](image)

A program can contain up to 7 ramps of pressure or flow rate increase/decrease.

Fig. 15.2.2 APC pressure program setup
15.2.5 Using restrictor tubing

Select the desired APC from the main APC screen. Then press [Resistor] (PF menu) from the AUX APC main screen to display the restrictor tube setup screen shown in Fig. 15.2.3. The difference between set and actual flow rates can be eliminated by installing a restrictor. Enter the restrictor's inner diameter, length, and resistance.

![Restrictor setup screen](image)

Fig. 15.2.3 Restrictor setup screen

**NOTE** If the necessary pressure to flow rate conversion information is not saved in the GC, the actual and measured flow rate may still not be equivalent.

15.2.6 Parameter list

**INNER DIAMETER**
- Range: 0.01–6.00mm, Default: 0.00

**LENGTH**
- Range: 0.1 –250.0m, Default: 0.00

**RESISTANCE**
- Range: 0.01–100000.0, Default: 1000.0

When the inner diameter and the length have been entered, the resistance is automatically calculated. Alternatively, enter only the resistance.

**NOTE** The resistance is calculated according to this formula: \[ \frac{(\text{i.d. (mm)})^2}{\text{length (m)}} \times 10^6. \]

Resistance values greater than \(10^6\) cannot be calculated.
15.3 Setting the CRG Parameters

The CRG (option) allows temperatures below room temperature to be set. The CRG can be connected to the column oven or the INJ2.

15.3.1 Screen description

Press the [OPTION] key from the [OPTION] key main screen, or press [NEXT] (PF menu) until the CRG screen, shown in Fig.15.3.1, appears.

The [NEXT] (PF menu) key toggles among the AOC parameters → AUX APC → CRG screens, in that order.

Fig. 15.3.1 CRG main screen

**NOTE** If the CRG is turned off after a negative temperature valve has been set, the temperature cannot be achieved, and the GC cannot become ready. When turning off the CRG, ensure that the temperature valve is set properly.
15.3.2 Parameter list

COLUMN OVEN
VALVE Selection: On/Off, Default: Off
CRG Selection: Use/Not Use, Default: Not Use
When the CRG is connected to the column oven, the column oven temperature control range is extended to -99.0°C to +450.0°C.
When using the CRG, set “VALVE” to “On” and “CRG” to “Use”.
When using valve control only, set “VALVE” to “On” and set “CRG” to “Not Use”.

INJ 2
VALVE Selection: On/Off, Default: Off
CRG Selection: Use/Not Use, Default: Not Use
When the PTV is installed on INJ2 and the CRG is connected, the injection port temperature control range is extended to -99.0°C to +450.0°C.
When using the CRG, set “VALVE” to “On” and “CRG” to “Use”.
When using valve control only, set “VALVE” to “On” and set “CRG” to “Not Use”.

15.3.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next</td>
<td>Toggles among the AOC parameters → AUX APC → CRG screens, in that order.</td>
<td>———</td>
</tr>
</tbody>
</table>
16.1 Time Scheduler

Use the Time scheduler to establish a weekly or daily schedule of automated GC operations.

16.1.1 description Screen

Select “1. TIME SCHEDULER” from the [FUNC] key main screen to display the Time scheduler menu shown in Fig. 16.1.1.

![Time Scheduler Menu](image)

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.

![Mode setup screen](image)

**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.

<table>
<thead>
<tr>
<th>Mode 1 (schedule number)</th>
<th>Mode 2 (day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 0</td>
<td>Sun.</td>
</tr>
<tr>
<td>No. 1</td>
<td>Mon.</td>
</tr>
<tr>
<td>No. 2</td>
<td>Tue.</td>
</tr>
<tr>
<td>No. 3</td>
<td>Wed.</td>
</tr>
<tr>
<td>No. 4</td>
<td>Thu.</td>
</tr>
<tr>
<td>No. 5</td>
<td>Fri.</td>
</tr>
<tr>
<td>No. 6</td>
<td>Sat.</td>
</tr>
<tr>
<td>No. 7</td>
<td></td>
</tr>
</tbody>
</table>
16.1.4 Editing a time schedule

Select “2. EDIT” from the time scheduler menu to display the schedule number or the day of the week setup screen shown in Fig. 16.1.3. Before editing a schedule, select the schedule number or the day of the week, and press [Edit] (PF menu). Then, the schedule edit screen shown in Fig. 16.1.4 appears.

You do not have to set schedules in the order of execution time. After editing time schedules, they are automatically sorted. More than one schedule can be set to the same time. These schedules will be executed at the same time.

Fig. 16.1.3 Schedule number selection screen

Fig. 16.1.4 Schedule edit screen

16.1.5 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>Creates a new time schedule.</td>
<td>16.1.6</td>
</tr>
<tr>
<td>Del Line</td>
<td>Deletes a schedule line at the current cursor position.</td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finish</td>
<td>Validates the time schedule.</td>
<td></td>
</tr>
<tr>
<td>Prev Page</td>
<td>Returns to previous setup screen.</td>
<td></td>
</tr>
<tr>
<td>Next Page</td>
<td>Moves to next item. The cursor can also be moved to next item by pressing [ENTER] key.</td>
<td></td>
</tr>
<tr>
<td>Cancel</td>
<td>Cancels the time schedule currently being created.</td>
<td></td>
</tr>
</tbody>
</table>
### 16.1.8 Parameters available in the time scheduler

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay1</td>
<td></td>
</tr>
<tr>
<td>Relay1</td>
<td></td>
</tr>
<tr>
<td>Detector</td>
<td></td>
</tr>
<tr>
<td>Zero Adj</td>
<td>Turns zero adjustment for each detector on/off.</td>
</tr>
<tr>
<td>Flame</td>
<td>Turns ignition on/off.</td>
</tr>
<tr>
<td>FTD</td>
<td>Turns voltage feedback on/off to make current constant for each detector.</td>
</tr>
<tr>
<td>Detector controller</td>
<td>Turns control of each detector on/off during analysis program.</td>
</tr>
<tr>
<td>Flow controller</td>
<td></td>
</tr>
<tr>
<td>Splitter Ctrl</td>
<td>Opens/closes splitter.</td>
</tr>
<tr>
<td>Air (value)</td>
<td>Opens/closes air solenoid valve.</td>
</tr>
<tr>
<td>Flow controller On/Off</td>
<td>Turns control of flow controller on/off.</td>
</tr>
<tr>
<td>High press inj mode</td>
<td>Turns high pressure injection mode on/off.</td>
</tr>
<tr>
<td>Gas saver</td>
<td>Turns gas saver split rate function on/off for each injection port.</td>
</tr>
<tr>
<td>Temperature</td>
<td>Turns all heated zones on/off.</td>
</tr>
<tr>
<td>Stop</td>
<td></td>
</tr>
<tr>
<td>NUMBER OF TIMES OF RUN</td>
<td>Time scheduler stop</td>
</tr>
<tr>
<td>File load</td>
<td>Selects the next file when switching to another file.</td>
</tr>
<tr>
<td>Program start</td>
<td></td>
</tr>
<tr>
<td>Program</td>
<td>Starts gas chromatograph after reaching ready status, or starts it immediately.</td>
</tr>
<tr>
<td>Clean Up</td>
<td>Starts clean up program after reaching ready status, or starts it immediately.</td>
</tr>
<tr>
<td>Pre-Run program</td>
<td>Starts Pre-Run program after reaching ready status, or starts it immediately.</td>
</tr>
<tr>
<td>GC Start/Stop</td>
<td>Sets start/stop of gas chromatograph.</td>
</tr>
<tr>
<td>Other</td>
<td>Set the parameter to input event No. (Refer to “17.4 Event No.”.)</td>
</tr>
</tbody>
</table>
1: “Relay” Description

<table>
<thead>
<tr>
<th>Relay</th>
<th>Switch point</th>
<th>Event 91,92</th>
<th>V91–92</th>
<th>Point A or B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRG</td>
<td>V93–94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On/Off point</td>
<td>Event 1–16</td>
<td>On or Off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blower</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling Fan</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRG INJ</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRG Column</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AC On/Off: The power supplied to the AC connector on the power controller PCB is turned on/off.

Event of On/Off point: The relay contact on the PRG PCB (option) is turned on/off.

Event 91 and Event 92: Switches A-contact and B-contact for each relay on the CPU PCB (offered as standard).

PRG Event: Switches A-contact and B-contact for each relay on the PRG PCB (option).

Blower, Cooling Fan, CRG INJ and CRG Column: Turns the power of each option on/off.

16.1.9 Changing schedule parameters

To change the contents of an existing time schedule, move the cursor using the [△] and [▽] keys to select the schedule to be changed, and press the [ENTER] key.

- To change the time:
  When the Time Schedule select screen appears, enter new numeric values and press [Finish] (PF menu), if you would like to change only the time.

- To change the parameters:
  Move the cursor, change the parameter, and then press [Finish] (PF menu) to complete the change.

- To cancel any changes:
  If you have changed the schedule but would like to return to the former schedule, press [Cancel] (PF menu) before pressing [Finish] (PF menu). The schedule returns to its former status.
16.1.10 Time schedule example

Example: 7:00 System starts.
19:00 System stops.

- **First program**

1. Time: 7:00
2. Start/stop
3. Start

- **Screen display**

   - Edit program
     - Time [hh:mm] 7:00

- **Second program**

4. Time: 19:00
5. Start/stop
6. Stop

- **Screen display**

   - Edit program
     - Time [hh:mm] 19:00

7. Setting is completed.

<table>
<thead>
<tr>
<th>Time Function</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>07:00 Start GC</td>
</tr>
<tr>
<td>2</td>
<td>19:00 Stop GC</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Next</td>
<td>Runs the selected schedule on the following day. If mode is set to “day”, the schedule for the next day is executed.</td>
<td></td>
</tr>
<tr>
<td>Stop</td>
<td>Stops the current schedule. This item is displayed when a time schedule is running.</td>
<td></td>
</tr>
</tbody>
</table>
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.

![Schedule copy screen](image1)

![Schedule delete screen](image2)
16 Special Functions

16.2 Batch Schedule

Use the batch schedule to continuously and automatically perform analyses. A batch is useful for switching methods automatically during the analyses.

16.2.1 Screen description

Select “2. BATCH” from the [FUNC] key screen, the Batch screen shown in Fig. 16.2.1 appears.

![Batch screen](image)

**AOC status**

The AOC status is displayed on the Batch screen.

<table>
<thead>
<tr>
<th>Screen display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>AOC is not operating.</td>
</tr>
<tr>
<td>Taking vial</td>
<td>Auto sampler arm is picking up a vial.</td>
</tr>
<tr>
<td>Preparation</td>
<td>AOC is operating (before injection).</td>
</tr>
<tr>
<td>Rinse</td>
<td>AOC is operating (after injection).</td>
</tr>
<tr>
<td>Putting vial</td>
<td>Auto sampler arm is returning a vial to the tray.</td>
</tr>
<tr>
<td>Wait</td>
<td>AOC is waiting for analysis.</td>
</tr>
</tbody>
</table>
### 16.2.2 Parameter list

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Example</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vial</td>
<td>Initial No. and final vial No.</td>
<td>1-9 (Analysis starts from vial No. 1 and ends at vial No. 9.)</td>
<td></td>
</tr>
<tr>
<td>GC</td>
<td>GC method file for analyses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP</td>
<td>Channel No. of chromatopac and file No.</td>
<td>1-5 (Channel 1 and data processing file No. 5 are used.)</td>
<td>This setting is ignored when using GC solution software.</td>
</tr>
<tr>
<td>#INJ</td>
<td>Number of times to inject</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mk</td>
<td>“U” is displayed when “SAMPLE TYPE” is set to “Unknown”. “S” is displayed when “SAMPLE TYPE” is set to “Standard”.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMD</td>
<td>“S” is displayed when “SLOPE TEST” is set to “On”. “C” is displayed when “CLEAN UP” is set to “On”.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 16.2.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Starts the batch schedule.</td>
<td></td>
</tr>
<tr>
<td>Stop</td>
<td>Stops the batch schedule.</td>
<td></td>
</tr>
<tr>
<td>New</td>
<td>Creates a new batch schedule.</td>
<td>16.2.4</td>
</tr>
<tr>
<td>Del line</td>
<td>Deletes the line at the current cursor position.</td>
<td>16.2.7</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the schedule to a Chromatopac.</td>
<td></td>
</tr>
</tbody>
</table>


16.2.4 Creating a new batch schedule (for single injector)

Select [New] (PF menu) from the batch schedule screen to display the new batch schedule screen shown in Fig. 16.2.2.

Set an item using the [△] 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 Schedule Screen]

Fig. 16.2.2 New batch schedule screen (for single injector)
16.2.5 Parameter list

**START VIAL NO.**
Range: 1 Default: 0

**FINAL VIAL NO.**
Range: 1 Default: 0
1: With no auto sampler
   - Short rack ... 1–6
   - Long rack ... 1–12
With auto sampler 1–150 (maximum)

When the auto sampler is used, the possible depends on the vial rack type and the number of racks.
The default, “0”, indicates that the setting is not given.

**SAMPLE**

Inject sample
The specified sample vial No. is analysed.

Without sample
Vials are not used for samples. Instead samples are introduced from a gas sampler with a valve.

**GC FILE NO.**
Range: FILE 0–9, Default: FILE0
Set the file No. of the GC method to be used.

**CHANNEL NO.**
Range: Ch1/Ch2, Default: Ch 1
Set the channel No. connecting the GC to the Chromatopac. This setting is ignored when using GC solution software.

**DATA PROCESSOR FILE NO.**
Range: FILE 0–9, Default: FILE0
Specify a date processor (Chromatopac) date integration file. This setting is ignored when using GC solution software.

**NUMBER OF INJECTION**
Range: 0–99, Default: 0
Set the number of times to inject each sample.

**SAMPLE TYPE**

Unknown Select this item to analyze a sample of unknown concentration.
   Analyze a standard and create a calibration curve before analyzing an unknown sample.

Standard Select this item to analyze a standard of known concentration.

**SLOPE TEST**
Range: On/Off, Default: Off
When “On” is selected, the slope test is performed before running the batch schedule.

**CLEAN UP**
Range: On/Off, Default: Off
When “On” is selected, clean up is performed before running the batch schedule.
### 16.2.6 PF menu list

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finish</td>
<td>Validates the schedule.</td>
<td></td>
</tr>
<tr>
<td>Prev Page</td>
<td>Returns to previous setup screen.</td>
<td></td>
</tr>
<tr>
<td>Next Page</td>
<td>Moves to setup screen for next item.</td>
<td></td>
</tr>
<tr>
<td>Cancel</td>
<td>Cancels the schedule being created.</td>
<td></td>
</tr>
</tbody>
</table>

### 16.2.7 Creating a new batch schedule (for dual injectors)

Select [New] (PF menu) from the batch schedule screen to display the new batch schedule screen shown in Fig. 16.2.3.

The vial set up screens are divided into main set up and sub set up screens. Once the main injector setup is complete, the sub injector setup screen appears. On the screen, two lines (one for the main and the other for the sub) make one schedule. Set an item using the [△] and [▽] keys and [ENTER] key. When [Finish] (PF menu) becomes available and the items have been set, press [Finish] to validate the schedule.

The dual injector parameters are the same as the single injector parameters.

---

![Batch Schedule Screen](image)

**Fig. 16.2.3** New batch schedule screen (for dual injector)
16.2.8 Editing a batch schedule

To change an existing batch processing schedule, move the cursor using the [△] and [▽] keys to the schedule to be edited and press the [ENTER] key. The schedule to be edited appears on the edit screen.

To change the vial number, enter the new number from the edit screen and press [Finish] (PFmenu).

To change the other parameters, move the cursor and make the change from the edit screen, and then press [Finish] (PFmenu).

To cancel the edits and restore the original batch schedule, press [Cancel] (PFmenu) before pressing [Finish] (PFmenu).
16.2.9 Batch processing Setup example

Example 1: For single AOC
Sample vials No. 1 to 3 are analyzed. The GC method file No. 2 is used. The Chromatopac data processing file No. 0 is set to Ch 1.
A standard of known concentration is injected once.
Clean up is performed, but the slope test is not performed.

Screen display

1. Start vial No.: 1
   Final vial No.: 3

2. GC file No.: FILE2

3. Data processing file No.: Ch 1, FILE0

4. Number of injections: 1
   Sample type: Standard

5. Slope test: Off
   Clean up: On

6. The batch is set up.
Example 2: For dual AOC
The main tower set up is identical to Example 1.
Sub injector settings are given below.
Vials No. 76 to 78 are analyzed. Chromatopac data processing file No. 0 is set for the Ch 2.
A standard of known concentration is injected once.
Clean up is performed, but the slope test is not performed.

- Sub injector settings

1. Start vial No.: 76
   End vial No.: 78

2. GC file No.: FILE2

3. Data processing file No.:
   Ch 2, FILE0

4. Number of injections: 1
   Sample type: Standard

5. Slope test: Off
   Clean up: On

6. The batch is set up.
16 Special Functions

16.3 Time Program

Use a time program to execute zero point adjustment and relay control during analysis.

16.3.1 Screen description

Select “3. TIME PROGRAM” from the [FUNC] key screen to display the time program screen shown in Fig. 16.3.1.

A time program starts as soon as analysis starts.

Time programs do not need to be set up in order. After you finish editing time programs, they are automatically sorted.

More than one step can be set for the same time. The specified actions are executed at the same time.

![Time Program screen](image)

Fig. 16.3.1 Time program main screen

16.3.2 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>Creates a new time program.</td>
<td>16.3.3</td>
</tr>
<tr>
<td>Del Line</td>
<td>Deletes the time program line at the current cursor position.</td>
<td>——</td>
</tr>
<tr>
<td>Chng Line</td>
<td>Moves the cursor to the next line.</td>
<td>——</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the program to the Chromatopac.</td>
<td>——</td>
</tr>
</tbody>
</table>
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 Edit Screen](image)

Fig. 16.3.2 Time program edit screen

16.3.4 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finish</td>
<td>Validates the time program.</td>
<td>——</td>
</tr>
<tr>
<td>Prev Page</td>
<td>Returns to previous setup screen.</td>
<td>——</td>
</tr>
<tr>
<td>Next Page</td>
<td>Moves to next item.</td>
<td>——</td>
</tr>
<tr>
<td>Cancel</td>
<td>Cancels the time program being created.</td>
<td>——</td>
</tr>
</tbody>
</table>
### 16.3.5 Time Program parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay1</td>
<td><strong>Detector</strong></td>
</tr>
<tr>
<td>Range</td>
<td>Sets range or attenuation for the detector configured in the analytical line.</td>
</tr>
<tr>
<td>Polarity</td>
<td>Changes the polarity between “+” and “-” for TCD configured in the analytical line.</td>
</tr>
<tr>
<td>Current</td>
<td>Sets current for the detector configured in the analytical line.2</td>
</tr>
<tr>
<td>Zero Adj</td>
<td>Turns on/off zero adjustment for the detector configured in the analytical line.</td>
</tr>
<tr>
<td>Flame</td>
<td>Ignites / Extinguishes the flame.</td>
</tr>
<tr>
<td>FTD</td>
<td>Turns on/off voltage feedback to make current constant for FTD configured in the analytical line.</td>
</tr>
<tr>
<td>Detector controller</td>
<td>Turns on/off control of detector configured in the analytical line during analysis program.</td>
</tr>
<tr>
<td>Flow controller</td>
<td><strong>Splitter Ctrl</strong></td>
</tr>
<tr>
<td></td>
<td>Opens/closes splitter.</td>
</tr>
<tr>
<td>Flow controller On/Off</td>
<td>Turn carrier gas, septum purge, detector gas and APC on/off.</td>
</tr>
<tr>
<td>High press inj mode</td>
<td>Turns high pressure injection mode on/off.</td>
</tr>
<tr>
<td>Gas saver</td>
<td>Turns gas saver function on/off.</td>
</tr>
<tr>
<td>Temperature DET1, DET2, AUX3, AUX4, AUX5</td>
<td>Use a time program to change temperature of heated zones, which cannot be programmed.</td>
</tr>
<tr>
<td>Stop</td>
<td><strong>NUMBER OF TIMES OF RUN</strong></td>
</tr>
<tr>
<td></td>
<td>End of program</td>
</tr>
<tr>
<td></td>
<td>0: FILE 0–9 Load</td>
</tr>
<tr>
<td>Other</td>
<td>Set the parameter to input event No..(Refer to “17.4 Event No.”.)</td>
</tr>
</tbody>
</table>

1: “Relay” description

<table>
<thead>
<tr>
<th>Relay</th>
<th>Switch point</th>
<th>Event 91,92</th>
<th>V91–92</th>
<th>Point A or B</th>
<th>PRG</th>
<th>V93–94</th>
<th>Point A or B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On/Off point</td>
<td>Event 1–16</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oven Exhaust Fan</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC On/Off</td>
<td>Cooling Fan</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRG INJ</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRG Colum</td>
<td>On or Off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
AC On/Off: Turns the power supplied to the AC connector on the power controller PCB on/off.
Event of On/Off point: Turns the relay contact on the PRG PCB (option) on/off.
Event91 and Event92: Switches a-contact and b-contact of each relay on the CPU PCB (standard).
Event of PRG: Switches a-contact and b-contact of each relay on the PRG PCB (option).
Blower, Cooling Fan, CRG INJ and CRG Column: Turns the power of each option on/off.

2: Current range

<table>
<thead>
<tr>
<th>Detector type</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTD</td>
<td>0.00–10.00   (pA)</td>
</tr>
<tr>
<td>ECD</td>
<td>0.00–2.00    (nA)</td>
</tr>
<tr>
<td>TCD</td>
<td>0–100        (mA)</td>
</tr>
</tbody>
</table>

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

1. Time: 4.0 min

   2. Detector

   3. Polarity

   4. DET 1

   5. - (minus)

- Second program

6. Time: 6.0 min

   Steps 2–4 are repeated.

7. + (plus)

8. The time program is set up.

Screen display:

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>4.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector</td>
<td></td>
</tr>
<tr>
<td>Polarity</td>
<td></td>
</tr>
<tr>
<td>DET 1</td>
<td></td>
</tr>
<tr>
<td>TCD2 Polarity</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Function</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TCD2</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>TCD2</td>
<td>+</td>
</tr>
</tbody>
</table>
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
   - End of program
     - End of program
     - 0: FILE0 Load
       - 1: FILE1 Load

4. File 1 is loaded.
   - End of program
     - Continuous
       - Pause at each run (AOC)

5. Pause at each run (AOC)

6. The time program is set up.
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.

![Pre-Run program main screen](image)

Fig. 16.4.1 Pre-Run program main screen

16.4.2 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>Creates a new Pre-Run program.</td>
<td>16.4.3</td>
</tr>
<tr>
<td>Del Line</td>
<td>Deletes the program at the current cursor position.</td>
<td>——</td>
</tr>
<tr>
<td>Chng Line</td>
<td>Changes over the screen of Pre-Run program every line.</td>
<td>——</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the program to the Chromatopac.</td>
<td>——</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of program</td>
<td></td>
</tr>
<tr>
<td>Auto</td>
<td>The AOC starts after the Pre-Run program is finished. If there is no AOC, the GC starts.</td>
</tr>
<tr>
<td>Manual (Stop program)</td>
<td>After the Pre-Run program is finished, the system becomes ready.</td>
</tr>
<tr>
<td>GC starts</td>
<td>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 into the GC as soon as the program stops.</td>
</tr>
<tr>
<td>AOC/HSS starts</td>
<td>After the Pre-Run program is finished, the AOC/HSS starts. After sample is injected, GC starts.</td>
</tr>
<tr>
<td>Clean up</td>
<td>After the Pre-Run program stops, clean up starts. After clean up finishes, the system becomes ready.</td>
</tr>
</tbody>
</table>

**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..

<table>
<thead>
<tr>
<th>Event No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>131–134</td>
<td>Turn detector controller on/off.</td>
</tr>
<tr>
<td>141–146</td>
<td>Turn carrier gas and septum purge on/off.</td>
</tr>
<tr>
<td>147–158</td>
<td>Turn detector gas on/off.</td>
</tr>
<tr>
<td>171</td>
<td>Turns high pressure injection on/off.</td>
</tr>
<tr>
<td>181–198</td>
<td>Turn AUX APC on/off.</td>
</tr>
</tbody>
</table>

For details about the event No., refer to “17.4 Event No.”
16.4.6 Pre-Run Program set up example

Switches B-contact of Event 91 four minutes into the program.

Screen display

1. Time : 4.0min

2. Relay

3. Relay

4. Switch point

5. Event 91, 92

6. Event 91

7. Point B

8. Setting is completed

<table>
<thead>
<tr>
<th>Time(min)</th>
<th>Function</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V01</td>
<td>4.00</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
16.5 Direct Operation

16.5.1 Screen description

Select “5. DIRECT OPERATION” from the [FUNC] key screen to display the screen shown in Fig. 16.5.1. Input the event No. and press the [Execute] key to execute the specified event. For a description of the event No., refer to “17.4 Event No.”

---

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

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Execute</td>
<td>Runs the specified operation. Input event No. to be run, and press [Execute] (PF menu).</td>
<td>——</td>
</tr>
</tbody>
</table>
16.6 GC Configuration

16.6.1 Screen description

Select “6. GC CONFIGURATION” from the [FUNC] key screen to display the GC configuration screen shown in Fig. 16.6.1.

![GC Configuration setup screen](image)

**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.
16.6 GC Configuration

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 Screen](image)

Fig. 16.6.3 Maximum temperature setup screen

16.6.4.2 Parameter list

**COLUMN**
Range: 0.0–470.0°C, Default: 400.0°C
In order to protect the column, do not allow the maximum oven temperature to exceed the maximum column temperature.

**INJ1/DET1/DET2**
Range: 10.0–470.0°C, Default: 470.0°C

**INJ2**
Range: 0.0–470.0°C, Default: 470.0°C

**AUX3/AUX4/AUX5**
Range: 10.0–470.0°C, Default: 470.0°C
AUX3, AUX4 and AUX5 are available optionally.
If the are installed, the AUX temperature control unit (P/N 221-48458-91) is required.

16.6.4.3 PF menu list

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect</td>
<td>Protection against contamination</td>
<td></td>
</tr>
</tbody>
</table>

Selection: Yes/No, Default: Yes
When “Yes” is selected, the Detector temperature setting value must be bigger than the Oven temperature setting value.
16.6.5 Setting transmission parameters

16.6.5.1 Screen description
Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then select “3. TRANSMISSION PARAMETER”, to display the Transmission Parameter screen shown in Fig. 16.6.4.

![Transmission Parameter Screen](image)

16.6.5.2 Parameter list

**PROTOCOL**
- Selection: None/LEVEL1/LEVEL2/LEVEL3, Default: LEVEL2

**BAUD RATE**
- Selection: 2400/4800/9600/19200/38400/57600/115200 bps, Default: 9600 bps
- Set the communication speed.

**STOP BIT**
- Selection: 1 bit/ 2 bit, Default: 1 bit

**PARITY**
- Selection: NONE/EVEN/ODD, Default: NONE
- “STOP BIT” and “PARITY” can be set when “PROTOCOL” is set to “None” or “LEVEL1” or “LEVEL2”.
- Set to “EVEN” in case of connecting a Chromatopac.

**NOTE** Refer to “2.7 Connecting external device cables”.

16.6.5.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply</td>
<td>Down loads the parameters immediately.</td>
<td>————</td>
</tr>
</tbody>
</table>
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](image)

16.6.6.2 Parameter list

**TEMP. PORT**

**TEMP**
Selection: Yes/No, Default: Yes
Indicate which headed zones should be included in the ready check.

**CARRIER GAS**
Selection: Yes/No, Default: Yes

**SEPTUM PURGE**
Selection: Yes/No, Default: Yes
 Indicates which injection port septum purge flow lines should included in the check.
The displayed items depend on the injection port type.

**DET FLOW GAS**

**MAKE UP**
Selection: Yes/No, Default: Yes

**HYDROGEN**
Selection: Yes/No, Default: Yes
AIR
Selection: Yes/No, Default: Yes
Indicate which detector APC zones should be included in the check.
The displayed items depend on the detector type.

AUX APC
APC1–APC18 PRESS/FLOW
Selection: Yes/No, Default: Yes
This item is available only when optional APC units are installed.

DETECTOR
CONTROLLER
Selection: Yes/No, Default: Yes
This item is available only when the FID is installed.

DRIFT
Selection: Yes/No, Default: No
This item compares the baseline drift to the drift limit for 10 minutes.
Once the GC becomes ready, the GC re-evaluates of the ready status 10 minutes later.

WAIT SIGNAL
Selection: Yes/No, Default: Yes
The wait signal applies to all detectors configured in analytical lines.

NOTE User-specified names are used in this screen.

### 16.6.6.3 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drift</td>
<td>Set the baseline drift limit.</td>
<td>______</td>
</tr>
</tbody>
</table>


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.

![Fig. 16.6.6 Signal setup screen](image)

**PF menu**

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain etc.</td>
<td>Sets the signal gain and offset for each detector.</td>
<td>16.6.7.6</td>
</tr>
<tr>
<td>Data File</td>
<td>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”.</td>
<td></td>
</tr>
<tr>
<td>Det Sig</td>
<td>Sets signal output channels for all detectors. The signal output 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.</td>
<td></td>
</tr>
</tbody>
</table>
16.6.7.3 Selecting the detector signals
Select the signal type from the main screen, and then press “DET SIG” to display the screen shown in Fig. 16.6.7.
Select the type of signal to output. For a description of the settings, refer to “13.5 Setting the Output Signals” in “13. Detector”.

![Detector signal setup screen](image1)

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).

When saving the background signal, specify which signal (1 or 2) should be saved.

---

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.

![Temperature control signal setup screen](image2)

The currently set channel No. is displayed.

---

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).
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.

![Carrier gas signal setup screen](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.

![Detector gas signal setup screen](Fig. 16.6.10 Detector gas signal setup screen)
16 Special Functions
16.6 GC Configuration

■ APC gas

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

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 detector signal gain here.

Select [Sig. Ch] (PF menu), to set the gain and the offset for any signal other than detector signals (such as temperature or pressure). In addition, you can set the time constant and the zero adjustment of the signal for each channel.

Fig. 16.6.11 APC gas signal setup screen

Fig. 16.6.12 Detector signal gain and offset screen
16.6.8 Customizing Component Names

16.6.8.1 Screen description
Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then select “6. PORT NAME CUSTOMIZATION”, the Name customization screen shown in Fig. 16.6.13 appears.
Specify the names of GC components (8 characters, alphanumeric and symbols).
To customize the name, refer to “5.3.5 Changing item names” in “5.3 Basic Key Operations”.

![Fig. 16.6.13 Name setup screen](image1)

16.6.8.2 Customization example
If the “Heater Name” and “Carrier Name” are customized, the “Line Configuration” screen changes as shown in Fig. 16.6.14.

![Fig. 16.6.14 Name customization example](image2)

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.
16.6.8.3 Heater Name Customization
Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then “6. PORT NAME CUSTOMIZATION”, and finally, select “1. HEATER NAME CUSTOMIZ”, to open the screen shown in Fig. 16.6.15.

![Heater port name setup screen](image)

Only listed heated zone names can be changed.

To change the names, refer to “5.3.5 Changing item names” in “5.3 Basic Key Operations”.

16.6.8.4 Carrier Name Customization
Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then “6. PORT NAME CUSTOMIZATION”, and finally select “CARRIER NAME CUSTOMIZ”, to open the screen shown in Fig. 16.6.16.

![Carrier name setup screen](image)

To change the names, refer to “5.3.5 Changing item names” in “5.3 Basic Key Operations”.

---

Only listed heated zone names can be changed.
16.6.8.5 **AUX APC Name Customization**

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then “6. PORT NAME CUSTOMIZATION”, and finally “AUX APC NAME CUSTOMIZ”, to open the screen shown in Fig. 16.6.17.

![AUX APC name setup screen](image)

Only listed APC options can be named.

To change the names, refer to “5.3.5 Changing item names” in “5.3 Basic Key Operations”.

16.6.8.6 **Relay Name Customization**

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then “6. PORT NAME CUSTOMIZATION”, and finally “RELAY NAME CUSTOMIZ”, to open the screen shown in Fig. 16.6.18.

![Relay name setup screen](image)

Only listed relays can be named.

To change the names, refer to “5.3.5 Changing item names” in “5.3 Basic Key Operations”.
16.6.9 Setting the link device code

When the gas chromatograph is linked to a Chromatopac, the link device code must be set. The link device code specifies which GC channel should start when the GC [START] key is pressed.

16.6.9.1 Screen description

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then select “7. LINK DEVICE CODE”, to open the screen shown in Fig. 16.6.19.

![Fig. 16.6.19 Link device code setup screen](image)

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 from the set temperature, set a temperature offset value to compensate.

16.6.10.1 Screen description

Select “6. GC CONFIGURATION” from the [FUNC] key and select “8. TEMPERATURE OFFSET” to display the temperature offset screen shown in Fig. 16.6.20.

![Temperature Offset Screen](image)

Fig. 16.6.20 Offset setup screen

16.6.10.2 Parameter list

**COLUMN/INJ1/INJ2/DET1/DET2/AUX3/AUX4/AUX5**

Range: -10.00 to +10.00, Default: 0.00

The temperature of each heated zone can be offset. Uninstalled ports are not displayed. For example, when “-1°C” is obtained by subtracting the column oven temperature measured by thermocouple from the gas chromatograph value with an offset value of “0”, input “-1” as the offset value.
16.6.11 Other Settings

16.6.11.1 Screen description
Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then select “9. OTHER CONFIGURATIONS” to open the configurations screen shown in Fig. 16.6.21.

![Other Configurations Table]

Fig. 16.6.21 Setup screen of other configuration
16.6.11.2 Parameter list

**LANGUAGE**
Selection: Alt./English, Default: English
Switch between Japanese (Alt.) and English screen languages.

**BACK LIGHT AUTO OFF**
Range: 0–9999 (sec), Default: 0 (sec)
Set the period of time when the backlight LCD display automatically turns off.

**PRESSURE UNIT**
Selection: kPa/bar/psi, Default: kPa
Set the pressure units for display.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range (kPa = 1)</th>
<th>Increase quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>kPa</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>bar</td>
<td>1/100</td>
<td>0.01</td>
</tr>
<tr>
<td>psi</td>
<td>1/6.895</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**NOTE** In the case that the pressure 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”.

<table>
<thead>
<tr>
<th>Range (kPa)</th>
<th>bar</th>
<th>psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 - 500</td>
<td>3.00 - 5.00</td>
<td>43.5 - 72.5</td>
</tr>
<tr>
<td>500 - 900</td>
<td>5.00 - 9.00</td>
<td>72.5 - 130.5</td>
</tr>
<tr>
<td>900 - 980</td>
<td>9.00 - 9.80</td>
<td>130.5 - 142.1</td>
</tr>
</tbody>
</table>

- The pressure axis on the screen after pressing [MONIT] key is displayed in the value of “kPa” regardless of the “pressure unit” sets.
- The setting value, measured value of the primary pressure of the diagnosis result of the standard diagnosis is displayed in the value of “kPa” regardless of the “pressure unit” sets.
- The display, printing of each log file is displayed in the value of “kPa” regardless of the “pressure unit” sets.

**BUZZER VOLUME**
Selection: Off/Low/Mid/Hig, Default: Low

**BUZZER TONE**
Selection: Lo/Hi, Default: Hi
Use a different tone for different GCs to be able to discern which GC has a problem.

**ATMOSPHERIC COMPENSATION**
Selection: On/Off, Default: Off
Select “On” to compensate for higher altitudes when in linear velocity mode.

**ZERO TO READY**
Selection: On/Off, Default: On
Set “On” for, the gas chromatograph to automatically perform zero adjustment when the GC is ready.

**POLARITY IN READY**
Selection: Open/Close, Default: Open
Set the polarity of GC ready signal.

**INJ1/INJ2 PRIMARY PRESS**
Selection: 300–500 kPa/500–900 kPa/900–980 kPa, Default: 500–900 kPa
Select the pressure range of the carrier gas cylinder.
If the wrong range is selected, error messages are not displayed correctly.
Example: If the gas cylinder pressure supplied to the GC-2010 is 700 kPa, select “500–900 kPa”.

Example: If the gas cylinder pressure supplied to the GC-2010 is 700 kPa, select “500–900 kPa”.

Example: If the gas cylinder pressure supplied to the GC-2010 is 700 kPa, select “500–900 kPa”.
16.7 Service and Maintenance

16.7.1 Screen description

Select “7. SERVICE/MAINTENANCE” from the [FUNC] key screen to display the Service/Maintenance screen shown in Fig. 16.7.1.

![Service/Maintenance Screen]

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.

<table>
<thead>
<tr>
<th>Port</th>
<th>Type</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>INJ1</td>
<td>SPL</td>
<td>7</td>
</tr>
<tr>
<td>INJ2</td>
<td>WBI</td>
<td>6</td>
</tr>
<tr>
<td>DET1</td>
<td>FID</td>
<td>2</td>
</tr>
<tr>
<td>DET2</td>
<td>TCD</td>
<td>4</td>
</tr>
<tr>
<td>AUX3</td>
<td>---</td>
<td>--</td>
</tr>
<tr>
<td>AUX4</td>
<td>---</td>
<td>--</td>
</tr>
<tr>
<td>AUX5</td>
<td>---</td>
<td>--</td>
</tr>
</tbody>
</table>

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.)

Fig. 16.7.2 GC installation setup screen
16.7.3.2 Parameter list

**INSTALLATION POSITION**

- **Range:** 0–9, **Default:** 0
- Specify the component installation location by entering a numeric value from 1 to 8 as shown in Fig. 16.7.3.
- Set “0” when a unit is not installed.
- Set “9” when a unit is installed in a position not shown in Fig. 16.7.3.

![Component installation location diagram](image)

**NOTE** Changes are not in effect until the GC has been turned off and on.
16.7.4 INSTALLATION (PIPING)

### 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.

#### Parameter list

##### Carrier gas flow controller settings

The names CAR1, CAR2 and CAR3 are automatically assigned in ascending order of the slot No. for each installed AFC.

Specify the flow controller carrier gas settings for each CAR.

- **UNIT TYPE**
  - For, display only.
  - When an AFC is installed, this is automatically displayed.
  - If a manual flow controller is installed, specify the installation Slot No. (See below.) "SPLITTER" is automatically displayed for the Unit Type.

- **SLOT NO.**
  - Selection: NON/SLOT1/ SLOT3/SLOT5/ SLOT6, Default: NON
  - This item can be set only when a manual flow controller is installed.
  - Select the Slot No. where the manual flow controller is installed.
  - Slot No. which have already been set cannot be selected.
  - The slot No. of an installed AFC is automatically recognized and displayed.
**TEMP. PORT**
Specify the injection port heated zone where the flow controller tubing is connected. This associates the flow controller to an injection port.

**Detector gas flow controller settings**
When installing detector flow control units, the names DET#1 to DET#4 are automatically assigned starting with the one nearest to the GC. Specify the to flow controller detector gas settings for each detector No. (DET#1 to DET#4).

**CONT. TYPE**
For display only.
The type of each installed detector control unit is automatically recognized and displayed.

**DET APC No.**
For display only.
When the slot No. is selected for each installed detector gas flow controller, the name DET APC 1 to DET APC 4 is automatically assigned to each flow controller.

**UNIT TYPE**
When an APC is installed, the APC type is displayed for the Slot No. selected.
“APC (1ch)” indicates an APC for ECD/TCD. “APC (2ch)” indicates an APC for FPD. “APC (3ch)” indicates an APC for FID/FTD.
When manual flow controllers are selected, “DET GAS” is automatically displayed.

**SLOT NO.**
When a manual flow controller is installed, specify the installation location Slot No. (SLOT1, SLOT3, SLOT5 and SLOT7 are available).
When a APC is installed, select an available Slot No..
Slot No. which have already been set cannot be selected.

**HEATER PORT**
Specify the detector heated zone where the flow controller tubing is connected. This associates the flow controller to a detector.

**NOTE** Changes are not in effect until the GC has been turned off and on.
16.7.5 INITIALIZATION

16.7.5.1 Screen description
Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "3. INITIALIZE", to display the Initialization screen shown in Fig. 16.7.6.
When you move the arrow cursor and press the [ENTER] key, the initialization confirmation screen (Fig. 16.7.7) appears. On this screen, press the [INIT] (PF menu) key to initialize the selected item.

![Initialization menu screen](Fig. 16.7.6 Initialization menu screen)

![Initialization confirmation 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 initialized.

**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 Screen]

Fig. 16.7.8 Power consumption monitoring screen

16.7.6.2 Parameter list
- APPROX. POWER CONSUMPTION
  The calculated total power consumption of all heated zones is displayed.
16.8 Stopwatch

16.8.1 Screen description

Select “8. STOP WATCH” from the [FUNC] key screen to display the stopwatch screen shown in Fig. 16.8.1. The stopwatch can display elapsed time up to 99 : 99 : 99.9 in units of 0.1 second. When the counted time exceeds 99 : 99 : 99.9, the stopwatch is reset and the time rests at 0.0 seconds. The stopwatch can function even when other keys are pressed. However, once the stop key is pressed, the stopwatch is reset to 0.0 seconds if another key is pressed.

![Stop Watch Screen](image)

Fig. 16.8.1 Stop watch screen

16.8.2 PF menu

<table>
<thead>
<tr>
<th>PF menu</th>
<th>Description</th>
<th>Reference section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Starts timing. If “Start” is pressed again when the timing has stopped, the stopwatch is reset to 0.0 seconds.</td>
<td></td>
</tr>
<tr>
<td>Stop</td>
<td>Stops counting.</td>
<td></td>
</tr>
</tbody>
</table>

16.8.3 Timing with inverse measurement

When using a bubble film flow meter of V ml, obtain the flow rate using the inverse number.

\[ V \times \text{(Inverse number of measurement time)} \text{ ml/min} \]
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 appears instead.

![Lock menu screen](image)

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.

**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.
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.

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

Press [Password] (PF menu) to display the password setup screen.

Fig. 16.9.4 Parameter locking main screen
16 Special Functions
16.9 Key Lock and Parameter Lock

Setting a password
Select [Password] (PF menu) from the screen shown in Fig. 16.9.4 to display the password screen shown in Fig. 16.9.5. The password is a number ranging from 1 to 9999. The factory set password is “2010”.

Setting a password
Enter each required password, and press [Set] (PF menu).

Enter the new password twice to confirm it.

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 unlock screen (without password)](image1)

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 unlock screen (when a password is set)](image2)
The system ROM version No. can be displayed.

### 16.10.1 Screen description

Press [Version] (PF menu) from the [FUNC] key screen to display the version screen shown in Fig. 16.10.1.

![Version screen](image)

Fig. 16.10.1  ROM version No. screen

### 16.10.2 Parameter list

<table>
<thead>
<tr>
<th>VERSION</th>
<th>BUILD NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.020C</td>
<td>372</td>
</tr>
</tbody>
</table>

The ROM version may be required during system maintenance.
17.1 Printing

17.1.1 Connection to Chromatopac

Connect the gas chromatograph to the Chromatopac, then press [Print] (PF menu) from the GC screen to print to the Chromatopac.

For the GC and Chromatopac connection, refer to "2.7 Connecting external device cables".

17.1.2 Parameters to be printed

17.1.2.1 Program

The current file program can be printed.

This includes the following screens: temperature program (COL, INJ1, INJ2), pressure program (CAR1, CAR2, CAR3), flow rate program (CAR1, CAR2, CAR3) and split ratio program (CAR1, CAR2).

Press [Print] (PF menu) from any screen to print the same parameters for a saved program.

```
- COLUMN OVEN TEMP PROGRAM -
  RATE  TEMP  TIME
  0      100.0 1.00
  1  6.00  220.0 25.00

- INJ1 TEMP PROGRAM -
  RATE  TEMP  TIME
  0      25.0 0.00

- INJ1 PRESSURE PROGRAM -
  RATE  TEMP  TIME
  0      100.0 0.00

- INJ1 SPRIT RATIO -
  TIME  RATE
  0      -1.0

- END -
```

Fig. 17.1.1
17.1.2.2 AOC parameters
The current file's AOC parameters and the parameters of AOC settings can be printed. The AOC2 parameters can be printed when an AOC2 is configured in the analytical line. All printed items are listed by command name. To match command names to screen items, refer to “17.2 AOC commands”.

![AOC Parameter Table](image)

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 Table](image)

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.

<table>
<thead>
<tr>
<th>TIME</th>
<th>FUNC</th>
<th>VALUE</th>
<th>LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>EVNT</td>
<td>91.0</td>
<td>0</td>
</tr>
<tr>
<td>2.0</td>
<td>D1RG</td>
<td>1.0</td>
<td>1</td>
</tr>
<tr>
<td>3.0</td>
<td>D1RG</td>
<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>200.0</td>
<td>STOP</td>
<td>1990.0</td>
<td>0</td>
</tr>
</tbody>
</table>

- END -

Fig. 17.1.4

17.1.2.5 Batch schedule
Press [Print] (PF menu) to print the batch schedule as shown below.

<table>
<thead>
<tr>
<th>START</th>
<th>FINAL</th>
<th>GC-FILE</th>
<th>DP-FILE</th>
<th>#INJ</th>
<th>MK</th>
<th>COMNAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>0</td>
<td>Ch.1-2</td>
<td>1</td>
<td>STANDARD</td>
<td>STEST</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>0</td>
<td>Ch.1-2</td>
<td>3</td>
<td>UNKNOWN</td>
<td></td>
</tr>
</tbody>
</table>

- 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.

<table>
<thead>
<tr>
<th>TIME</th>
<th>CODE</th>
<th>ERROR MESSAGE (VALUE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200.05.16 14:21</td>
<td>[E1020]</td>
<td>DET1 sensor down error (530.00)</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E0031]</td>
<td>INJ-DET2 A/D error</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E0032]</td>
<td>AUX1-AUX3 A/D error</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E0011]</td>
<td>CAR1 AFC PCB error (7.00)</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E0030]</td>
<td>COL A/D error</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E0001]</td>
<td>DC5V range error (8.43)</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E0002]</td>
<td>DC24V range error (20.34)</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E0034]</td>
<td>Battery voltage error (0.26)</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E0005]</td>
<td>Room temp range error (84.27)</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E1019]</td>
<td>INJ1 sensor down error (530.00)</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E1018]</td>
<td>COL sensor down error (530.00)</td>
</tr>
<tr>
<td>200.05.16 14:27</td>
<td>[E1020]</td>
<td>DET1 sensor down error (530.00)</td>
</tr>
<tr>
<td>200.05.16 14:28</td>
<td>[E0031]</td>
<td>INJ1-DET2 A/D error</td>
</tr>
<tr>
<td>200.05.16 14:28</td>
<td>[E0032]</td>
<td>AUX1-AUX3 A/D error</td>
</tr>
<tr>
<td>200.05.16 14:28</td>
<td>[E0011]</td>
<td>CAR1 AFC PCB error (7.00)</td>
</tr>
</tbody>
</table>

Fig. 17.1.6

17.1.2.7 Diagnosis results
Press [Print] (PF menu) from the detailed results screen of the standard diagnosis to print a report similar to the ones shown below.
The date, the version No. and the installation status, which are not displayed on the screen, are also printed.

- GC DIAGNOSIS REPORT -
  DATE 2000.06.15 14:35
  GC SERIAL NUMBER “C11123380069SM”
  ROM VERSION 0.0202
  DET#1 FID WIDE
  DET#2 NON
  DET#3 NON
  DET#4 NON
  CAR1 AFC+PU
  CAR2 NON
  CAR3 NON
  DET APC 1 APC(3Ch)
  DET APC 2 NON
  DET APC 3 NON
  DET APC 4 NON
  TEST RESULT Not Good

- INJ1 Septum Counter -
  Threshold 100
  Count value 0
  Judgement Good

Fig. 17.1.7
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

<table>
<thead>
<tr>
<th>Command name</th>
<th>Item</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRPT</td>
<td>Sample Wash</td>
<td>0–99</td>
<td>2</td>
</tr>
<tr>
<td>WMOD</td>
<td>Solvent Wash</td>
<td>0–99</td>
<td>1</td>
</tr>
<tr>
<td>REPT</td>
<td>Number of Injection</td>
<td>1–99</td>
<td>1</td>
</tr>
<tr>
<td>IVOL</td>
<td>Sample Size</td>
<td>0.1–8.0</td>
<td>1.0</td>
</tr>
<tr>
<td>WPRS</td>
<td>Pre solvent Wash</td>
<td>0–99</td>
<td>0</td>
</tr>
<tr>
<td>PUMP</td>
<td>Pumping</td>
<td>0–99</td>
<td>5</td>
</tr>
<tr>
<td>WTPP</td>
<td>Viscosity</td>
<td>0.0–99.9</td>
<td>0.2</td>
</tr>
<tr>
<td>WAIT</td>
<td>Dwell Time</td>
<td>0.0–99.9</td>
<td>0</td>
</tr>
<tr>
<td>ISPD</td>
<td>Inj. Speed (Plunger)</td>
<td>Slow: 0, Fast: 2</td>
<td>Fast: 2</td>
</tr>
<tr>
<td>SSPD</td>
<td>Inj. Speed (Syringe)</td>
<td>Slow: 0, Fast: 1</td>
<td>Fast: 1</td>
</tr>
<tr>
<td>SAND</td>
<td>Inj. Mode</td>
<td>0–4</td>
<td>0</td>
</tr>
<tr>
<td>SOLV</td>
<td>Solvent selection</td>
<td>All: 0, only A: 1, only B: 2, only C: 3</td>
<td>All: 0</td>
</tr>
<tr>
<td>SINT</td>
<td>Priority Sample No.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>*SSNO</td>
<td>Injected sample No. (Only this sample is analyzed.)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>*SNO2</td>
<td>Injected sample No. (for sub AOC)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>AAIR</td>
<td>Air Aspiration</td>
<td>No: 0, Yes: 1</td>
<td>No: 0</td>
</tr>
<tr>
<td>USPD</td>
<td>Plunger Aspiration Speed</td>
<td>Slow: 0, Middle: 1, Fast: 2</td>
<td>Fast: 2</td>
</tr>
<tr>
<td>DSPD</td>
<td>Speed of Plunger</td>
<td>Slow: 0, Middle: 1, Fast: 2</td>
<td>Fast: 2</td>
</tr>
<tr>
<td>HIGH</td>
<td>Syringe Height (↑)</td>
<td>0–20</td>
<td>0</td>
</tr>
<tr>
<td>LOWS</td>
<td>Syringe Height (↓)</td>
<td>1.5 ml vial: 0–2, 4 ml vial: 0–10</td>
<td>0</td>
</tr>
<tr>
<td>INJH</td>
<td>Syringe Height (Inj)</td>
<td>0–22</td>
<td>0</td>
</tr>
<tr>
<td>STRI</td>
<td>Multi - Inj</td>
<td>1–99</td>
<td>1</td>
</tr>
<tr>
<td>*FSAM</td>
<td>Final sample No. (Samples after that are not analyzed.)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>*WKEY</td>
<td>Washing with solvent before injection in solvent flush mode</td>
<td>0, 1</td>
<td>0</td>
</tr>
<tr>
<td>*UVOL</td>
<td>Aspiration volume during pumping</td>
<td>8 µl: 0, 6 µl: 1</td>
<td>8 µl: 0</td>
</tr>
<tr>
<td>SLMD</td>
<td>Using 3 Solvent Vials</td>
<td>No: 0, Yes: 1</td>
<td>No: 0</td>
</tr>
<tr>
<td>VIAL</td>
<td>Vial size</td>
<td>1.5 ml: 0, 4 ml: 1</td>
<td>1.5 ml: 0</td>
</tr>
<tr>
<td>*CKTR</td>
<td>With/without tray check</td>
<td>With: 0, Without: 1</td>
<td>Without: 0</td>
</tr>
<tr>
<td>*TANL</td>
<td>Analysis time</td>
<td>0–855</td>
<td>0</td>
</tr>
<tr>
<td>*TSTR</td>
<td>Analysis start time</td>
<td>0–99.9</td>
<td>0.0</td>
</tr>
<tr>
<td>LSYR</td>
<td>Syringe Volume</td>
<td>10 µl: 0, 50 µl: 1, 250 µl: 2</td>
<td>10 µl: 0</td>
</tr>
</tbody>
</table>
### Command AOC commands

<table>
<thead>
<tr>
<th>Command name</th>
<th>Item</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMU</td>
<td>Use of the sampler</td>
<td>Not use: 0, Use: 1</td>
<td>Not use: 0</td>
</tr>
<tr>
<td>SUBU</td>
<td>Use of the sub AOC</td>
<td>Not use: 0, Use: 1</td>
<td>Not use: 0</td>
</tr>
<tr>
<td>BARC</td>
<td>Bar Code Reader</td>
<td>Not use: 0, Use: 1</td>
<td>Not use: 0</td>
</tr>
<tr>
<td>SPMD</td>
<td>Distribution of sample for dual AOC</td>
<td>0–8</td>
<td>0</td>
</tr>
<tr>
<td>PAR1</td>
<td>Use of Same Param</td>
<td>No: 0, Yes: 1</td>
<td>No: 0</td>
</tr>
<tr>
<td>*GLPM</td>
<td>Setting of validation mode</td>
<td>0, 1</td>
<td>0</td>
</tr>
<tr>
<td>*GRPT</td>
<td>Number of times of GLP sample discharge</td>
<td>1–99</td>
<td>50</td>
</tr>
<tr>
<td>*GVOL</td>
<td>GLP sample discharge volume</td>
<td>1–80</td>
<td>20</td>
</tr>
<tr>
<td>*GPMP</td>
<td>Number of times of pumping after second GLP</td>
<td>0–5</td>
<td>1</td>
</tr>
<tr>
<td>*ATSP</td>
<td>Automatic stop function</td>
<td>Off: 0, On: 1</td>
<td>On: 1</td>
</tr>
<tr>
<td>*ARSG</td>
<td>Ready signal polarity</td>
<td>Open: 0, Close: 1</td>
<td>Open: 0</td>
</tr>
<tr>
<td>TLET</td>
<td>Rack</td>
<td>Short: 0, Long: 1</td>
<td>Short: 0</td>
</tr>
<tr>
<td>TSEL</td>
<td>Rack position while sampler is used</td>
<td>0–2</td>
<td>1</td>
</tr>
</tbody>
</table>

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
- INJ2: AITP (Pre-Run program only)
- DET1: DETT
- DET2: AUXT
- AUX3: TCDT
- AUX4: AX4T
- AUX5: AX5T

### Detector range, polarity and current value
Detector range, polarity and the current value from a program are printed with the parameter names shown below.
- Range of DET #1: D1RG
- Range of DET #2: D2RG
- Range of DET #3: D3RG
- Range of DET #4: D4RG
- Polarity of DET #1: D1PL
- Polarity of DET #2: D2PL
- Polarity of DET #3: D3PL
- Polarity of DET #4: D4PL
- Current value of DET #1: D1CR
- Current value of DET #2: D2CR
- Current value of DET #3: D3CR
- Current value of DET #4: D4CR
**Time program STOP and repetitions**

When a time program STOP value is specified, it is printed with the four digits described below.

1 2 3 4

- **Digit 1** value
  - 0: Continuous
    - When a program finishes, the next program automatically starts without waiting for the start command.
  - 1: Pause at each run (AOC)
    - When a program finishes, the GC waits for the start command.

- **Digit 2** and **3** values
  - Number of times of run (00–99)
    - "00" indicates 1 repetition.
    - When both digits 2 and 3 are set to "0", nothing is printed but the number of repetition times is set to "1".

- **Digit 4** value
  - File No. to switch to after repetitious run is finished (0–9)
    - In order to stop the program, input the current file No.

**Pre-Run program (STRT)**

Pre-Run program values are printed with numbers 0–4, described below.

0: Auto
1: Manual (Stop program)
2: GC start
3: AOC/HSS start
4: Clean up
Many parameters are printed with event No. The list below shows the correspondence of event No. to functions.

### Event No. list

<table>
<thead>
<tr>
<th>No.</th>
<th>Meaning of “Event xx” (Example: Event 1)</th>
<th>Meaning of “Event-xx” (Example: Event -1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Reverses contact status of Events 1 to 16 and Events 91 to 96.</td>
<td>Opens contact of Events 1 to 16 and switches contact of events 91 to 96 to N/C type (normal).</td>
</tr>
<tr>
<td>1</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>2</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>3</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>4</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>5</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>6</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>7</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>8</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>9</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>10</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>11</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>12</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>13</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>14</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>15</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>16</td>
<td>Turns on contact of one contact in one circuit (option PRG).</td>
<td>Turns off contact of one contact in one circuit (option PRG).</td>
</tr>
<tr>
<td>51</td>
<td>Performs zero adjustment of DET #1.</td>
<td>Frees zero adjustment of DET #1.</td>
</tr>
<tr>
<td>52</td>
<td>Performs zero adjustment of DET #2.</td>
<td>Frees zero adjustment of DET #2.</td>
</tr>
<tr>
<td>53</td>
<td>Performs zero adjustment of DET #3.</td>
<td>Frees zero adjustment of DET #3.</td>
</tr>
<tr>
<td>54</td>
<td>Performs zero adjustment of DET #4.</td>
<td>Frees zero adjustment of DET #4.</td>
</tr>
<tr>
<td>61</td>
<td>Turns on CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1.</td>
<td>Turns off CAR1 gas saver. Returns split ratio to value of analysis parameter.</td>
</tr>
<tr>
<td>No.</td>
<td>Meaning of “Event xx” (Example: Event 1)</td>
<td>Meaning of “Event-xx” (Example: Event -1)</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>62</td>
<td>Turns on CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 2.</td>
<td>Turns off CAR1 gas saver. Returns split ratio to value of analysis parameter.</td>
</tr>
<tr>
<td>63</td>
<td>Turns on CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 1.</td>
<td>Turns off CAR2 gas saver. Returns split ratio to value of analysis parameter.</td>
</tr>
<tr>
<td>64</td>
<td>Turns on CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 2.</td>
<td>Turns off CAR2 gas saver. Returns split ratio to value of analysis parameter.</td>
</tr>
<tr>
<td>71</td>
<td>Ignites frame.</td>
<td>Extinguishes frame.</td>
</tr>
<tr>
<td>81</td>
<td>Turns on feedback of FTD 1.</td>
<td>Turns off feedback of FTD 1.</td>
</tr>
<tr>
<td>82</td>
<td>Turns on feedback of FTD 2.</td>
<td>Turns off feedback of FTD 2.</td>
</tr>
<tr>
<td>83</td>
<td>Turns on feedback of FTD 3.</td>
<td>Turns off feedback of FTD 3.</td>
</tr>
<tr>
<td>84</td>
<td>Turns on feedback of FTD 4.</td>
<td>Turns off feedback of FTD 4.</td>
</tr>
<tr>
<td>91</td>
<td>N/O contact between two contacts in one circuit</td>
<td>N/C contact between two contacts in one circuit</td>
</tr>
<tr>
<td>92</td>
<td>N/O contact between two contacts in one circuit</td>
<td>N/C contact between two contacts in one circuit</td>
</tr>
<tr>
<td>93</td>
<td>N/O contact between two contacts in one circuit (option PRG)</td>
<td>N/C contact between two contacts in one circuit (option PRG)</td>
</tr>
<tr>
<td>94</td>
<td>N/O contact between two contacts in one circuit (option PRG)</td>
<td>N/C contact between two contacts in one circuit (option PRG)</td>
</tr>
<tr>
<td>103</td>
<td>Closes CAR1 splitter control.</td>
<td>Opens CAR1 splitter control.</td>
</tr>
<tr>
<td>104</td>
<td>Closes CAR2 splitter control.</td>
<td>Opens CAR2 splitter control.</td>
</tr>
<tr>
<td>105</td>
<td>Turns On AC blower.</td>
<td>Turns Off AC blower.</td>
</tr>
<tr>
<td>106</td>
<td>Closes air (solenoid valve).</td>
<td>Opens air (solenoid valve).</td>
</tr>
<tr>
<td>107</td>
<td>Closes air (solenoid valve). (only in 17A mode)</td>
<td>Opens air (solenoid valve). (only in 17A mode)</td>
</tr>
<tr>
<td>109</td>
<td>Turns On AC CRG INJ.</td>
<td>Turns Off AC CRG INJ.</td>
</tr>
<tr>
<td>110</td>
<td>Turns On AC CRG Column.</td>
<td>Turns Off AC CRG Column.</td>
</tr>
<tr>
<td>111</td>
<td>Turns On AC Cooling fan.</td>
<td>Turns Off AC Cooling fan.</td>
</tr>
<tr>
<td>131</td>
<td>Turns On DET #1 detector controller.</td>
<td>Turns Off DET #1 detector controller.</td>
</tr>
<tr>
<td>132</td>
<td>Turns On DET #2 detector controller.</td>
<td>Turns Off DET #2 detector controller.</td>
</tr>
<tr>
<td>133</td>
<td>Turns On DET #3 detector controller.</td>
<td>Turns Off DET #3 detector controller.</td>
</tr>
<tr>
<td>134</td>
<td>Turns On DET #4 detector controller.</td>
<td>Turns Off DET #4 detector controller.</td>
</tr>
<tr>
<td>141</td>
<td>Turns On CAR1 carrier gas.</td>
<td>Turns Off CAR1 carrier gas.</td>
</tr>
<tr>
<td>142</td>
<td>Turns On CAR1 septum purge.</td>
<td>Turns Off CAR1 septum purge.</td>
</tr>
<tr>
<td>143</td>
<td>Turns On CAR2 carrier gas.</td>
<td>Turns Off CAR2 carrier gas.</td>
</tr>
<tr>
<td>144</td>
<td>Turns On CAR2 septum purge.</td>
<td>Turns Off CAR2 septum purge.</td>
</tr>
<tr>
<td>145</td>
<td>Turns On CAR3 carrier gas.</td>
<td>Turns Off CAR3 carrier gas.</td>
</tr>
<tr>
<td>146</td>
<td>Turns On CAR3 septum purge.</td>
<td>Turns Off CAR3 septum purge.</td>
</tr>
<tr>
<td>147</td>
<td>Turns On DET #1 makeup gas.</td>
<td>Turns Off DET #1 makeup gas.</td>
</tr>
<tr>
<td>148</td>
<td>Turns On DET #1 H2.</td>
<td>Turns Off DET #1 H2.</td>
</tr>
<tr>
<td>149</td>
<td>Turns On DET #1 Air.</td>
<td>Turns Off DET #1 Air.</td>
</tr>
<tr>
<td>150</td>
<td>Turns On DET #2 makeup gas.</td>
<td>Turns Off DET #2 makeup gas.</td>
</tr>
<tr>
<td>151</td>
<td>Turns On DET #2 H2.</td>
<td>Turns Off DET #2 H2.</td>
</tr>
<tr>
<td>152</td>
<td>Turns On DET #2 Air.</td>
<td>Turns Off DET #2 Air.</td>
</tr>
<tr>
<td>153</td>
<td>Turns On DET #3 makeup gas.</td>
<td>Turns Off DET #3 makeup gas.</td>
</tr>
<tr>
<td>154</td>
<td>Turns On DET #3 H2.</td>
<td>Turns Off DET #3 H2.</td>
</tr>
<tr>
<td>155</td>
<td>Turns On DET #3 Air.</td>
<td>Turns Off DET #3 Air.</td>
</tr>
<tr>
<td>No.</td>
<td>Meaning of “Event xx” (Example: Event 1)</td>
<td>Meaning of “Event-xx” (Example: Event -1)</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>156</td>
<td>Turns On DET #4 makeup gas.</td>
<td>Turns Off DET #4 makeup gas.</td>
</tr>
<tr>
<td>157</td>
<td>Turns On DET #4 H2.</td>
<td>Turns Off DET #4 H2.</td>
</tr>
<tr>
<td>158</td>
<td>Turns On DET #4 Air.</td>
<td>Turns Off DET #4 Air.</td>
</tr>
<tr>
<td>161</td>
<td>Turns On CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1. When GC becomes</td>
<td>Turns Off CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1. When GC becomes</td>
</tr>
<tr>
<td></td>
<td>ready, split ratio returns to value of analysis parameter.</td>
<td>ready, split ratio returns to value of analysis parameter.</td>
</tr>
<tr>
<td>162</td>
<td>Turns On CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 2. When GC becomes</td>
<td>Turns Off CAR1 gas saver. Sets split ratio to value of analysis parameter.</td>
</tr>
<tr>
<td></td>
<td>ready, split ratio returns to value of analysis parameter.</td>
<td></td>
</tr>
<tr>
<td>163</td>
<td>Turns On CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 1. When GC becomes</td>
<td>Turns Off CAR2 gas saver. Sets split ratio to value of analysis parameter.</td>
</tr>
<tr>
<td></td>
<td>ready, split ratio returns to value of analysis parameter.</td>
<td></td>
</tr>
<tr>
<td>164</td>
<td>Turns On CAR1 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 2. When GC becomes</td>
<td>Turns Off CAR2 gas saver. Sets split ratio to value of analysis parameter.</td>
</tr>
<tr>
<td></td>
<td>ready, split ratio returns to value of analysis parameter.</td>
<td></td>
</tr>
<tr>
<td>171</td>
<td>Turns On CAR1/CAR2/CAR3 high pressure injection mode.</td>
<td>Turns Off CAR1/CAR2/CAR3 high pressure injection mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns column input pressure to value of analysis parameter.</td>
</tr>
<tr>
<td>181</td>
<td>Turns On APC1 flow controller.</td>
<td>Turns Off APC1 flow controller.</td>
</tr>
<tr>
<td>182</td>
<td>Turns On APC2 flow controller.</td>
<td>Turns Off APC2 flow controller.</td>
</tr>
<tr>
<td>183</td>
<td>Turns On APC3 flow controller.</td>
<td>Turns Off APC3 flow controller.</td>
</tr>
<tr>
<td>184</td>
<td>Turns On APC4 flow controller.</td>
<td>Turns Off APC4 flow controller.</td>
</tr>
<tr>
<td>185</td>
<td>Turns On APC5 flow controller.</td>
<td>Turns Off APC5 flow controller.</td>
</tr>
<tr>
<td>186</td>
<td>Turns On APC6 flow controller.</td>
<td>Turns Off APC6 flow controller.</td>
</tr>
<tr>
<td>187</td>
<td>Turns On APC7 flow controller.</td>
<td>Turns Off APC7 flow controller.</td>
</tr>
<tr>
<td>188</td>
<td>Turns On APC8 flow controller.</td>
<td>Turns Off APC8 flow controller.</td>
</tr>
<tr>
<td>189</td>
<td>Turns On APC9 flow controller.</td>
<td>Turns Off APC9 flow controller.</td>
</tr>
<tr>
<td>190</td>
<td>Turns On APC10 flow controller.</td>
<td>Turns Off APC10 flow controller.</td>
</tr>
<tr>
<td>191</td>
<td>Turns On APC11 flow controller.</td>
<td>Turns Off APC11 flow controller.</td>
</tr>
<tr>
<td>192</td>
<td>Turns On APC12 flow controller.</td>
<td>Turns Off APC12 flow controller.</td>
</tr>
<tr>
<td>193</td>
<td>Turns On APC13 flow controller.</td>
<td>Turns Off APC13 flow controller.</td>
</tr>
<tr>
<td>194</td>
<td>Turns On APC14 flow controller.</td>
<td>Turns Off APC14 flow controller.</td>
</tr>
<tr>
<td>195</td>
<td>Turns On APC15 flow controller.</td>
<td>Turns Off APC15 flow controller.</td>
</tr>
<tr>
<td>196</td>
<td>Turns On APC16 flow controller.</td>
<td>Turns Off APC16 flow controller.</td>
</tr>
<tr>
<td>197</td>
<td>Turns On APC17 flow controller.</td>
<td>Turns Off APC17 flow controller.</td>
</tr>
<tr>
<td>198</td>
<td>Turns On APC18 flow controller.</td>
<td>Turns Off APC18 flow controller.</td>
</tr>
</tbody>
</table>
18.1 Maintenance Parts

The following tables list maintenance parts and their part numbers (P/N). All parts are consumables. Miscellaneous maintenance parts are listed in “18.1.8 Miscellaneous.”

### 18.1.1 Septum

<table>
<thead>
<tr>
<th>Parts name</th>
<th>P/N</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon rubber septa (with 20pcs)</td>
<td>201-35584</td>
<td>Injection port septa (Up to 350°C)</td>
</tr>
<tr>
<td>Septa for high temperature (with 20pcs)</td>
<td>221-48398-91</td>
<td>Injection port septa (above 350°C)</td>
</tr>
</tbody>
</table>

### 18.1.2 O-ring for glass insert

<table>
<thead>
<tr>
<th>Part name</th>
<th>P/N</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride rubber O-ring (with 5pcs)</td>
<td>036-11203-84</td>
<td>standard (Up to 450°C)</td>
</tr>
<tr>
<td>Graphite O-ring (for splitless/WBI) (with 4pcs)</td>
<td>221-47222-91</td>
<td>For high temperature (350°C to 450°C)</td>
</tr>
<tr>
<td>Graphite O-ring (for split) (with 4pcs)</td>
<td>221-48393-91</td>
<td>For high temperature (350°C to 450°C)</td>
</tr>
</tbody>
</table>

### 18.1.3 Glass insert

<table>
<thead>
<tr>
<th>Part name</th>
<th>P/N</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass insert (For split)</td>
<td>221-41444-01</td>
<td>For split injection technique</td>
</tr>
<tr>
<td>Glass insert (For splitless)</td>
<td>221-48335-01</td>
<td>For splitless injection technique</td>
</tr>
<tr>
<td>Silica wool (with 2g)</td>
<td>201-48600</td>
<td>Packed in glass insert</td>
</tr>
</tbody>
</table>

### 18.1.4 Graphite ferrule

<table>
<thead>
<tr>
<th>Part name</th>
<th>P/N</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphite ferrule G0.5 (with 10pcs)</td>
<td>221-32126-05</td>
<td>Capillary column installation</td>
</tr>
<tr>
<td>Graphite ferrule G0.8 (with 10pcs)</td>
<td>221-32126-08</td>
<td>Wide bore column installation</td>
</tr>
</tbody>
</table>

### 18.1.5 Capillary column

To select a capillary column, refer to a column manufacturer’s catalog.
### 18.1.6 Flow controller

<table>
<thead>
<tr>
<th>Part name</th>
<th>P/N</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular sieve filter</td>
<td>221-34121-93</td>
<td>For removing contamination in carrier gas</td>
</tr>
<tr>
<td>Trap (SPLIT)</td>
<td>221-42559-92</td>
<td>Split flow line trap</td>
</tr>
<tr>
<td>Trap (PURGE)</td>
<td>221-42559-92</td>
<td>Septum purge flow line trap</td>
</tr>
<tr>
<td>Aluminum gaskets</td>
<td>201-35183</td>
<td>For tubing connections</td>
</tr>
</tbody>
</table>

### 18.1.7 Hydrogen flame ionization detector (FID)

<table>
<thead>
<tr>
<th>Part name</th>
<th>P/N</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jet</td>
<td>221-48258-91</td>
<td>Jet for FID</td>
</tr>
<tr>
<td>Igniter</td>
<td>221-41847-93</td>
<td>Igniter for FID</td>
</tr>
</tbody>
</table>

### 18.1.8 Miscellaneous

<table>
<thead>
<tr>
<th>Part</th>
<th>Name</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSY</td>
<td>Key operation section PCB</td>
<td>221-46260-91</td>
</tr>
<tr>
<td></td>
<td>Key operation section LCD</td>
<td>221-48721-91</td>
</tr>
<tr>
<td></td>
<td>Key operation section key rubber 1 (upper)</td>
<td>221-46470</td>
</tr>
<tr>
<td></td>
<td>Key operation section key rubber 2 (lower)</td>
<td>221-46471</td>
</tr>
<tr>
<td></td>
<td>Temperature sensor (for column)</td>
<td>221-43695-91</td>
</tr>
<tr>
<td></td>
<td>Thermocouple (for column)</td>
<td>221-43696-91</td>
</tr>
<tr>
<td>FPD detector</td>
<td>Filter (S)</td>
<td>221-46310-01</td>
</tr>
<tr>
<td></td>
<td>Filter (P)</td>
<td>221-46310-02</td>
</tr>
<tr>
<td></td>
<td>Filter (Sn)</td>
<td>221-46310-03</td>
</tr>
<tr>
<td></td>
<td>Quartz cylinder</td>
<td>221-46552</td>
</tr>
<tr>
<td>FTD detector</td>
<td>FTD collector ASSY</td>
<td>221-45586-91</td>
</tr>
</tbody>
</table>
18.2 Inspection and Maintenance Intervals

Periodical inspection and maintenance are required to maintain the gas chromatograph in the good condition. Perform the periodical inspection and maintenance described in this section to obtain optimal analysis results reproducibility.

The recommended inspection interval for each part is described below.

18.2.1 Glass insert

Inspect the glass insert before starting a series of analysis. Take care of dirt and silica wool position. An inser counter feature is available in the GC. Refer to the diagnosis item list in "14.1 Standard Diagnosis".

18.2.2 Septum

Replace the septum periodically. The guideline for replacement is 100 injection. A septum counter feature is available in the GC. Refer to diagnosis item list in "14.1 Standard Diagnosis".

18.2.3 O-ring for glass insert

Replace the O-ring when replacing the glass insert or if there is a carries gas leak.

18.2.4 Graphite ferrule

Replace the graphite ferrule if a carries gas leak is not stopped by tightening. Replace the ferrule if it is completely compressed.

18.2.5 Capillary column

Condition the column if it has not been used for a long time or if ghost peaks are present.

18.2.6 Flow controller

Condition or replace the carrier gas molecular sieve filter if the baseline is unstable. Every 6 months, check the split flow line and the septum purge flow line traps and replace any saturated traps.

18.2.7 Hydrogen flame ionization detector (FID)

Rinse or replace the igniter and the jet if ignition is not smooth or no peaks are obtained.

18.2.8 Cleaning the Unit

If the exterior unit surfaces become dirty, clean using a neutral detergent.
18.3 Inspection and Maintenance: Septum

Repeated injections can deteriorate the septum, interfering with its sealing ability and causing carrier gas leaks. This can cause retention time shifts and poor producibility. In addition, septum fragments can fall into the glass insert, causing ghost peaks. Periodically inspect and replace the septum as described in this section.

18.3.1 Inspection/maintenance cycle

The guideline for inspection/maintenance is 100 injections. Septum replacement is recommended every 100 injections. In addition, perform inspection and maintenance in the following cases.
- When the retention time/shifts/reproducibility is poor
- When ghost peaks are detected
If ghost peaks are obtained although no septum fragments are found in the glass insert, ensure that new septa are conditioned properly.

18.3.2 Inspection/maintenance

Preparing the gas chromatograph

Select “Maint INJ” (PF menu) from the [SYSTEM] key main screen. If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 51°C. When the message “GC is ready for maintenance” appears on the screen, injection port inspection/maintenance can begin. Lift up the entire INJ/DET cover, and remove it. Because the detector is hot, use tweezers or pliers to handle the detector cover.

NOTE For “Maint INJ”, refer to “7 Starting and Stopping the GC [SYSTEM]".
■ Conditioning the septum
For high sensitivity analysis, impurities from the septum may be detected as ghost peaks. Condition the septum as described below.
(1) Soak the septum in hexane for 10 to 15 hours.
   The septum will absorb hexane and swell into approximately twice its size. Therefore, use a container with a wide opening and a lid.
(2) Take out the septum, and put it into a rinse container.
   Pay strict attention when handling a septum swollen with hexane because it can easily crumble.
(3) Let the septum air dry in a clean area.
(4) After drying, bake the septum at 130 to 150°C for approximately 2 hours.

NOTE Store the septum in a clean, sealed container to prevent contamination.

■ Inspection
When inspecting only the septum, remove the septum nut above the septum, take out the septum, then condition it or replace it with a new one.

■ Septum installation
Install the conditioned septum or a new septum using the following procedure.
When using an autosampler, tighten the septum nut by hand until it touches the nut below the screw, then loosen a half turn. When performing manual injections, you can extend the life of the septum by tightening the septum nut by one thread after approximately 10 injections. When the injection port is hot, the septum nut is also hot. When tightening the septum nut, wear gloves to prevent burns.

■ Restarting the gas chromatograph main body
Using tweezers, replace the detector cover, then the INJ/DET cover. When starting up the GC again, select [Anal.] (PF menu). The GC automatically flows the carrier gas for 5 minutes, and then restores the temperatures set prior to maintenance. When the STATUS indicator light turns green and the baseline becomes stable, you can start analysis.
18.4 Inspection and Maintenance: O-ring for glass insert

### 18.4.1 Inspection/maintenance cycle

Two types of O-rings are available for the glass insert and the fluoride rubber type is usually used. But when the fluoride rubber type is used for long hours at more than 350°C, the time duration being leaktight is rather short so check for leakage every week. When operating the system for long hours at more than 350°C, the graphite type is recommended. But the graphite type has a little less sealing effect than the fluoride rubber type. The fluoride rubber type can be used for several glass insert replacements, but graphite type can be used only once. However, replacing the O-ring when replacing the glass insert is recommended. Normally, rubber O-ring is used. If the rubber O-ring is used above 350°C for an extended period, it deteriorates rapidly. Use a graphite ferrule on the glass insert in this case, although its sealing ability is inferior to the rubber type. Perform inspection and maintenance of the O-ring when the following problem occurs.

- When the carrier gas leaks
  To stop leaks, tighten the glass insert nut. If the leak continues, inspect the O-ring and replace if necessary.

### 18.4.2 Inspection/maintenance

#### Preparing the gas chromatograph

Select “Maint INJ” (PF menu) from the [SYSTEM] key main screen. If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 51°C. When the message “GC is ready for maintenance” appears on the screen, injection port inspection/maintenance can begin. Lift up the entire INJ/DET cover, and remove it. Because the detector is hot, use tweezers or pliers to handle the detector cover.

**NOTE** For “Maint INJ”, refer to “7 Starting and Stopping the GC [SYSTEM]”.

---

**WARNING**

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

**CAUTION**

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

**NOTE** For the details on handling the glass insert and O-ring, refer to “12 Injection Port”.

---

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18.4 Inspection and Maintenance: O-ring for glass insert

**Replacing the O-ring**

Take out the glass insert, remove the O-ring, and install a new O-ring.

**NOTE** Refer to “18.5 Inspection and Maintenance: Glass Insert” to remove and install the glass insert.

1. Fluoride rubber O-ring
   Place the fluoride rubber O-ring approximately 4 mm from the top of the glass insert. When inserting the glass insert in the injection port, push the glass insert in until the glass insert touches the bottom of the injection port. This correctly places the O-ring 3 mm from the top of the glass insert.

2. Graphite O-ring
   Insert the glass insert in the injection port, place a graphite O-ring on it, and then tighten the glass insert nut.

**NOTE** Use the correct graphite O-ring for the glass insert type.

---

**Leak check**

A leak will affect reproducibility and carrier gas will be wasted.

Confirm whether there is a leak or not according to the following procedure: (As for the following procedure, there could be cases in which the error message “purge leaks” etc. appears. However, it does not matter to the test. Then, select “Reset Error”.)

1. Set the “Flow Control” to “Cont” on the screen after pressing [SYSTEM] key.
2. Push the [Stop GC] (PF menu), and the system stops.
3. Wait that all oven temperature, injection port temperature and detector temperature is below 40 degrees on the screen after pressing the [MONIT] key.
   - Set the purge flow rate to “0 ml/min”.
5. Remove the capillary column, and blank off with the graphite ferrules and column nut.
6. Install the blind (G-type blank nut) to the split vent and purge vent port.
7. Make sure that the supply pressure to the carrier gas (the pressure from a gas cylinder) is above 300 kPa.
8. Set the “Split mode” to “DIRECT” and “Control mode” to “PRESS” on the screen of the after pressing the [FLOW] key.
9. Set the inlet pressure to 150 kPa. Push the [On/Off] (PF menu), and the control of AFC starts.
10. Wait for five minutes. Confirm that the inlet pressure is 125 ~ 175 kPa. If the inlet pressure is above 175 kPa, unfasten the column a little nut and set the pressure free. If the inlet pressure is below 125 kPa, raise the supply pressure a little.
11. Confirm that the total flow is below 2 ml/min. If the total flow is above 2 ml/min, then there is a leak somewhere.

---

**CAUTION**

Handle graphite O-rings with care to prevent it from breaking.
(13) In case of fluoride rubber O-ring, confirm that the pressure does not drop more than 15 kPa per hour or 2.5 kPa in 10 minutes.
    In case of graphite O-ring, confirm that the pressure does not drop more than 21 kPa per hour or 3.5 kPa in 10 minutes.
    If the pressure has dropped more than the above specified values, there is a leak somewhere.

(14) When the leak check has passed set the system back into operating status.

Possible leak positions
In case the leak check conditions has failed check the following items on the GC for possible leaks:
septum injection inlet, around the injection port, the connection of piping, split vent (around the blind plug), purge vent (around the blind plug) and the connection of column with a leak detector or snoop.
In case you have localized a leak in one of the above positions do the following according to the leak localization:

- Septum injection inlet : replace septum.
- Around the injection port : replace O-ring of glass insert.
- Split vent : replace blind plug seal.
- Purge bent : replace blind plug seal.
- Connection of column : replace graphite ferrules and column nut.

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

NOTE
When you use snoop liquid etc., take care that the liquid is not splashed to the electric wiring and detector. There is a risk to get an electrical shock.
When using snoop liquid for detecting leaks there is always a possibility that a part of the liquid creeps into the pipings which in case of trace analysis can give ghost peaks which may interfere your peaks of interest. Then it is recommended to use a leak detector instead.
18.5 Inspection and Maintenance: Glass Insert

**NOTE**
For the details of handling of the glass insert, refer to "12 Injection Port".

### 18.5.1 Inspection/maintenance cycle

Inspect the glass insert before starting a series of analysis. In addition, inspect and maintain the glass insert if the following problems occur.

- If the retention time shifts or reproducibility is poor.
- If ghost peaks are detected.

When the problems above occur, the silica wool may have moved, or become dirty, or the glass insert could be dirty.

### 18.5.2 Inspection/maintenance

**Preparing the gas chromatograph**

Select "Maint INJ" (PF menu) from the [SYSTEM] key main screen. If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 51°C. When the message "GC is ready for maintenance" appears on the screen, injection port inspection/maintenance can begin. Lift up the entire INJ/DET cover, and remove it. Because the detector is hot, use tweezers or pliers to handle the detector cover.

**NOTE**
For "Maint INJ", refer to "7 Starting and Stopping the GC [SYSTEM]".

**Removing the glass insert**

Remove the glass insert using the following procedure.

Loosen and remove the glass insert nut while holding the septum nut. Remove the septum nut assembly by lifting it straight up and moving it to the side. The glass insert could break if the septum nut assembly is not lifted straight up.
18.5 Inspection and Maintenance: Glass Insert

Fig. 18.5.1 Tool: Glass insert wrench, standard accessory Part No. 221-46977

Fig. 18.5.2

(2) Use tweezers to lift the glass insert out of the injection port.

Fig. 18.5.3

■ Cleaning the glass insert

**NOTE** Remove the O-ring before rising the glass insert with solvent. After cleaning, use a new O-ring.

(1) Removing the silica wool.
   - Septum fragments and other contaminants on the silica wool affect reproducibility.
   - Ghost peaks may also be present.
   - Push silica wool out using a thin, long wire.
(2) Removing particles from the glass insert
After removing the silica wool, rinse the interior of the insert by wiping with gauze soaked in solvent (such as acetone), etc. or soak the insert in organic solvent and clean with an ultrasonic cleaning unit.

(3) If the glass insert is extremely dirty
If particles and stains cannot be removed, soak the glass insert in an aqueous solution of alkaline detergent for glass for approximately 1 day; rinse the insert with large amounts of water, then, rinse it with organic solvent such as acetone, and let it air dry. If the glass insert still cannot be cleaned, you can soak it in an aqueous solution of 1N nitric acid for 7 to 8 hours, then wash, rinse and air dry as described above.

**Silica wool packing**
To repack the silica wool in the glass insert, see “12.2 Glass Insert and Packing Requirements”.

⚠️ **WARNING**
Use a hood when cleaning the insert with reagents like organic solvent and acid.
Wear protective clothing, such as goggles, gloves, and a lab coat.
If reagents get on to the skin or in the eyes, flush with copious amounts of water and consult a medical professional.
18.6 Inspection and Maintenance: Graphite Ferrule

**WARNING**

Risk of burns.
Do not perform maintenance until the temperature of the injection port, detector, and oven have dropped below 50°C.

**CAUTION**

Wait until the heated zones have cooled to loosen screws and nuts to prevent them from binding.

**NOTE** For the details on handling of the graphite ferrule, refer to "4 Installing the column".

### 18.6.1 Inspection/maintenance cycle

A graphite ferrule is used at both ends of the capillary column.
In the following situations, inspect or replace the graphite ferrule.
- When a new graphite ferrule is being installed.
- When ghost peaks are detected during temperature increase.
- When the baseline drifts significantly during temperature increase.

### 18.6.2 Inspection/maintenance

**Troubleshooting**

1. Check for carrier gas leaks
   Deteriorating ferrules can cause carrier gas leaks and poor reproducibility.
   Check the condition of the graphite ferrule. If it is in poor condition, replace it with a new graphite ferrule.

   ![New graphite ferrule](image1) ![Graphite ferrule in poor condition](image2)

   **Fig. 18.6.1 Graphite ferrule**

2. Check for the source of contamination.
   Ghost peaks can be caused by a poorly made column inlet connection.
   Baseline drift can be caused by a poor connection at the column outlet (provided the column has been sufficiently conditioned).
   If a contaminated graphite ferrule is causing problems, condition the graphite ferrule using the procedure described below.
Preparing the gas chromatograph

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port, the column oven and detector automatically decrease.

Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column oven are 50°C or less.


Conditioning the graphite ferrule

If a contaminated graphite ferrule is causing problems, condition the graphite ferrule using this procedure.

Condition the graphite ferrule just before using the system if possible. Otherwise, the ferrule may become re-contaminated.

Hold the graphite ferrule in the blue flame of a gas burner for 1 to 2 seconds until that it becomes red hot.

CAUTION

Do not get burned when holding the graphite ferrule.

Fig. 18.6.2  Conditioning the graphite ferrule
18.7 Inspection and Maintenance: Capillary Column

WARNING
Risk of burns. Do not perform maintenance until the temperature of the injection port, detector, and oven have dropped below 50°C

NOTE For the details on removing the capillary column, refer to "4 Installing the column".

18.7.1 Inspection/maintenance cycle

In the following situations, inspect and/or maintain the capillary column.
- When using a new column or a column which has not been used for a long time
- When ghost peaks are detected
- When the baseline is unstable

18.7.2 Inspection/maintenance

Troubleshooting
Check whether the baseline is unstable or ghost peaks are present. A contaminated column can cause an unstable baseline or ghost peaks. If these problems occur, the column should be conditioned.

Preparing the gas chromatograph main body
If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port, the column oven and detector automatically decrease. Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column are below 50°C
Press the [FLOW] key, and select [Off] (PF menu). The inspection/maintenance can then begin.

NOTE For the details on handling the capillary column, refer to "4 Installing the column".

Conditioning the capillary column
Condition the capillary column using the following procedure.
(1) Setting the carrier gas
To condition the column, use the an alysis flow rate. However, reduce the split ratio to conserve carrier gas.
(2) Setting the column oven temperature
Set the column oven to a temperature approximately 30°C higher than the column operating temperature during analyses.
Do not exceed the maximum column temperature limit.
(3) Setting the injection port temperature and the detector temperature
Use the same temperatures normally set for analyses.
Set the detector to a temperature approximately 30°C higher than the column operating temperature.
(4) Conditioning time

Generally condition the column for 2 to 3 hours usually.

If the column is considerably contaminated, increase the conditioning time.

**NOTE**

Certain column liquid phases can be easily damaged.

Verify the maximum column temperatures limit before use and conditioning. High temperatures can damage the column, particularly if oxygen is present in the columns. Use of an oxygen trap is recommended.

Avoid rapid temperature increases, especially for polar columns.
Three areas in the flow controller should be inspected: the molecular sieve filter and two traps (PURGE and SPLIT) in case of split/splitless. And two areas should be inspected in case of WBI.

<table>
<thead>
<tr>
<th>Part name</th>
<th>Part No.</th>
<th>Reference No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular sieve filter</td>
<td>221-34121-93</td>
<td>①</td>
</tr>
<tr>
<td>Trap (PURGE)</td>
<td>221-42559-92</td>
<td>②</td>
</tr>
<tr>
<td>Trap (SPLIT)</td>
<td>221-42559-92</td>
<td>③</td>
</tr>
</tbody>
</table>

Fig. 18.8.1  Filter locations (split/splitless)

Fig. 18.8.2  Filter locations (WBI)
18.8.1 Inspection/maintenance cycle

Replace the purge and split vent traps periodically. The guideline for replacement is usually 6 months. However, when analyzing many samples with high boiling point compounds, or compounds which are solid at room temperature, you should replace the traps more frequently.

And in the following cases, you should inspect and maintain the filter and the traps.
- When the baseline is unstable or there is significant noise.
  These problems occur when the molecular sieve filter is saturated. Replace or regenerate it.
- The replacement cycle of each trap is 6 months. However, if the traps is clogged, replace it. The following section describes how to decide that a trap is clogged.

18.8.2 Inspection/maintenance

**Trap inspection**

The procedure below describes how to inspect the trap when capillary column is used. (The procedure for wide bore columns is described in parentheses.)

(1) Set the purge flow rate to “0”. For the procedure, refer to “12.5.8 Septum purge”.
(2) Leave the column installed. (For wide bore columns, disconnect the column at the injection port only, and attach a sealing plug to the injection port.)
(3) Set the Split mode to “SPL”.
(4) Set the column inlet pressure and the total flow rate to the following values.
   - Column inlet pressure (PRSS) = 0 (kPa)
   - Total flow rate (FLOW) = 400 (mL/min)
   For details, refer to “8 Setting the Analytical Parameters and File Management”.
(5) Monitor the column inlet pressure. If the measured value is 50 kPa or more, replace the trap (SPLIT).
(6) When replacing the split vent trap, replace the purge vent trap also.

**Trap replacement**

Perform the following procedure to replace the trap.

(1) Stop the carrier gas flow.
(2) Remove the panel from the INJ/DET unit.
(3) To prevent confusion, replace one trap at a time.
(4) Disconnect the blank nut from a new trap.
   This blank nut is no longer required. It sealed the trap.
(5) Install the new trap.
   The tubing codes indicate they should be used to filter the following flow lines.
   - S ... Split flow line
   - P ... Septum purge flow line
   - C ... Carrier gas inlet flow line
Molecular sieve filter regeneration

Regenerate the molecular sieve filter using the following procedure.

1. Stop the carrier gas flow.
2. Remove the panel from the INJ/DET unit.
3. Remove the molecular sieve filter.
4. Regenerate the molecular sieve filter under the following conditions.
   - Nitrogen or Helium gas flow direction ... Reverse of operation direction
   - Gas flow rate ... 10 to 20 mL/min
   - Temperature ... 300°C
   - Time ... 3 to 4 hours
5. After regeneration, immediately reinstall the molecular sieve filter into the gas chromatograph so that it does not become contaminated.
18.9 Inspection and Maintenance: FID

**WARNING**
Verify that the following items have been checked before starting FID inspection/maintenance.
1. Stop the supply of hydrogen gas, and extinguish the hydrogen flame.
2. Set the detector temperature to 50°C or less.
3. Turn off the power of the FID.
4. Remove the capillary column from the FID.
Risk of burns. Do not perform maintenance until the temperature has dropped below 50°C.

**CAUTION**
When the FID is hot, do not loosen screws and nuts or move parts to prevent binding.

**NOTE** For correct FID handling procedures, refer to “13 Detector”.

### 18.9.1 Inspection/maintenance cycle
When the following problems occur, inspect the FID and perform maintenance if necessary.
- When the FID cannot be ignited
- When peaks do not appear
- When noise is high
- When the peak shape is abnormal

### 18.9.2 Inspection/maintenance

a) Inspection and replacement of the igniter are described.

#### Troubleshooting
Check for blown filaments.
Replace the igniter with a new one, if the filament is blown.

#### Removing and installing the igniter
Loosen the igniter mounting screw shown in Fig. 18.9.1, and pull out the igniter in the direction indicated by arrow.
When replacing the igniter, detach the cables at the connection.
Install a new igniter by connecting the cable, inserting the igniter, and tightening the screw.
b) Replacement and inspection of the FID jet are described below.

**Troubleshooting**

1. Checking whether the jet is clogged
   - If the jet is clogged, ignition may be difficult or peaks may not appear.
   - If the tip of the jet is clogged, clean the jet by inserting a slender, long rod into the tip.

2. Checking whether the jet is dirty
   - If the jet is dirty, noise may be significant.
   - If the jet is dirty, wipe off dirt with a cotton swab soaked in organic solvent (such as acetone), etc.

3. Checking whether the jet is damaged
   - If the jet is damaged, the peak shape may be abnormal.
   - Replace the jet.

---

**CAUTION**

The quartz FID jet can be broken easily. Treat it gently.

---

**Preparing the gas chromatograph**

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port, the column oven and detector automatically decreases. Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column oven has dropped below 50°C.

Press the [FLOW] key, and select [Off] (PF menu). The inspection/maintenance can begin.
**Removing the FID**

Remove the FID parts using the following procedure.

1. Removing the igniter and the FID collector
   - The igniter is integrated into the FID collector. Remove them together. Loosen and remove the two collector screws. Lift the collector and its screws up at the same time.

   ![Fig. 18.9.3 Removing igniter and FID collector](image)

2. Removing the FID high voltage unit
   1. Lift the high voltage plate up.
   2. Then pull the high voltage cable and its spring out horizontally as shown in Fig 18.9.4.

   ![Fig. 18.9.4 Removing the FID high voltage unit](image)

**Removing the FID jet**

Remove the FID jet using a hexnut screwdriver.

![Fig. 18.9.5 Hexnut screwdriver (option, part No. 670-18800)](image)
### 18.9 Inspection and Maintenance: FID

**Fig. 18.9.6** Removing the FID jet

- **Installing the FID jet**
  
  Tighten the FID jet securely using a hexnut screwdriver

- **Fig. 18.9.7** Installing FID jet

  - Reinstall other parts in reverse order.
This section describes possible problems, causes and solutions. They are divided by analytical procedure. If the problem is not solved by following the recommended solutions, or if other problems occur, contact your Shimadzu representative.

19.1.1 Gas and pressure settings
   19.1.1.1 When the pressure/flow rate cannot be set or does not reach the set value
   19.1.1.2 Continual gas leaks

19.1.2 Temperature control
   19.1.2.1 When the temperature does not increase or reach the set value

19.1.3 Detector
   19.1.3.1 FID
      1. The FID flame does not ignite properly
      2. The FID baseline is fluctuating
      3. Baseline noise is high
   19.1.3.2 TCD
      1. The detector can not be zeroed
      2. Fluctuating baseline
      3. Baseline noise is high

19.1.4 Chromatogram and data
   19.1.4.1 No peaks or extremely small peaks
   19.1.4.2 Presence of ghost peaks
   19.1.4.3 Abnormal peak shape
   19.1.4.4 Poor retention time reproducibility
   19.1.4.5 Poor peak area reproducibility
## 19.1.1 Gas and pressure settings

### 19.1.1.1 When the pressure/flow rate cannot be set or does not attain the set value

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No gas is supplied.</td>
<td>Open gas cylinder main valve to supply gas.</td>
</tr>
<tr>
<td>Supply pressure is low.</td>
<td>Set carrier gas supply pressure to 300 to 980 kPa. Hydrogen: 300 to 500 kPa Air: 300 to 500 kPa Makeup gas: 300 to 980 kPa</td>
</tr>
<tr>
<td>Gas leaks</td>
<td>Check for gas leaks, and tighten leaking connections. Replace gasket or septum. (Refer to “2.6 Gas supply plumbing” in the Instruction Manual.)</td>
</tr>
<tr>
<td>AFC/APC: Incorrect valve set. Set value is outside controllable range.</td>
<td>Set pressure to proper value. (Refer to “3 AFC, APC” in the Instruction Manual.)</td>
</tr>
<tr>
<td>Carrier gas, column length and inner diameter are incorrect.</td>
<td>Set carrier gas, column length and inner diameter. (Refer to “12.5.2” and “12.6.2 Setting the flow rate” and “12.5.3 Setting column parameters” in the Instruction Manual.)</td>
</tr>
<tr>
<td>Total flow rate is set too low, and pressure cannot increase. (In this case, measured flow rate of split vent is extremely low.)</td>
<td>Increase the total flow rate. (Refer to “3 AFC, APC” in the Instruction Manual.)</td>
</tr>
<tr>
<td>Split vent trap is clogged. (Even if total flow rate is set high, the measured flow rate from the split vent is low.)</td>
<td>Replace trap. (Refer to “18.8 Inspection and Maintenance: Flow Controller”</td>
</tr>
</tbody>
</table>

### 19.1.2 Continual gas leaks

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part is incorrectly installed.</td>
<td>Install part correctly. (Refer to “2.6 Gas supply plumbing” in the Instruction Manual.)</td>
</tr>
<tr>
<td>Graphite ferrule or other seal is damaged.</td>
<td>Replace damaged gasket part with a new one.</td>
</tr>
</tbody>
</table>

If tubing or connections are damaged, replace them. If the problem can not be solved, contact your Shimadzu representative.
19.1.2 Temperature control

19.1.2.1 When the temperature does not increase or reach the set value

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater control is set to “Off”</td>
<td>Set control to “On” on COL/INJ/DET setup screen.</td>
</tr>
<tr>
<td>Because start time is set to a high value (or “9999”), heating has not started yet.</td>
<td>Set start time to a lower value. (Note: Immediately after this setup value is changed, the new value is in effect.)</td>
</tr>
<tr>
<td>Heat loss is being caused by an open oven door or insulation out of place.</td>
<td>Close the oven door. Replace the insulation.</td>
</tr>
<tr>
<td>Because maximum temperature is set to a very low value, an overheating error has occurred.</td>
<td>Increase the maximum temperature setting.</td>
</tr>
<tr>
<td>Because DET actual temperature is lower than the set value of COL temperature. (According to keep the detector clean, column oven temperature can not exceed DET actual temperature.)</td>
<td>Set DET temperature larger than COL temperature.</td>
</tr>
</tbody>
</table>

Only an oven with the CRG option can attain a temperature below room temperature. The lower temperature setting may cause an error if the CRG option is removed or turned off. Change the temperature setting.

19.1.3 Detector

19.1.3.1 FID

1. The FID flame does not ignite properly

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column is not connected.</td>
<td>Connect the column.</td>
</tr>
<tr>
<td>Hydrogen gas is not supplied or its flow rate is incorrect.</td>
<td>Supply hydrogen gas, or set its flow rate to a proper value.</td>
</tr>
<tr>
<td>Air is not supplied or its flow rate is incorrect.</td>
<td>Supply air, or set its flow rate to a proper value.</td>
</tr>
</tbody>
</table>

Refer to “18.9 Inspection and Maintenance: FID”, and inspect the FID.
If a jet is clogged, clean or replace it.
A defective ignitor filament must be replaced. Contact your Simadzu representative.

**WARNING**

If the FID ignition has failed, shut off the hydrogen gas supply immediately and inspect the FID.
2. The FID baseline is fluctuating

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier gas leaks.</td>
<td>Tighten leaking connections. Replace tubing or septum. (Refer to &quot;2.6 Gas supply plumbing&quot; in Instruction Manual.)</td>
</tr>
<tr>
<td>Carrier gas quality is poor.</td>
<td>Replace carrier gas with higher purity gas. Provide a molecular sieve filter in the carrier gas flow line.</td>
</tr>
<tr>
<td>Molecular sieve filter is saturated.</td>
<td>Recondition the molecular sieve filter.</td>
</tr>
<tr>
<td>Injection port is contaminated.</td>
<td>Clean or inspect the glass insert. (Refer to &quot;18.5 Inspection and Maintenance: Glass Insert&quot; in Instruction Manual.)</td>
</tr>
<tr>
<td>Compressed air is contaminated (the baseline fluctuates according to the compressor pressure).</td>
<td>Install a silica gel trap on either end of the pressure regulator. Use air from a gas cylinder instead (with the FID on).</td>
</tr>
<tr>
<td>Hydrogen gas has not been flowing long enough to replace the air in the tubing.</td>
<td>Wait for 30 to 60 minutes to allow the air to be completely replaced with hydrogen.</td>
</tr>
<tr>
<td>Room temperature is not within the recommended range and/or is fluctuating considerably.</td>
<td>Keep the room temperature within the recommended range and move the system away from heat or A/C vents, etc.</td>
</tr>
</tbody>
</table>

3. Baseline noise is high

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier gas quality is poor.</td>
<td>Replace carrier gas with higher purity gas. Provide a molecular sieve filter in the carrier gas flow line.</td>
</tr>
<tr>
<td>Hydrogen gas quality is poor.</td>
<td>Replace hydrogen gas with higher purity gas.</td>
</tr>
<tr>
<td>The quartz jet is dirty.</td>
<td>Inspect, clean, or replace the jet.</td>
</tr>
</tbody>
</table>

If the jet is damaged, replace it. If the collector is coated with white powder, contact your Shimadzu representative for replacement.

19.1.3.2 TCD

1. The detector cannot be zeroed

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data processing unit is not connected properly.</td>
<td>Connect them properly.</td>
</tr>
<tr>
<td>Current is &quot;Off&quot;</td>
<td>Turn the current on.</td>
</tr>
<tr>
<td>Current value is too high.</td>
<td>Set current to a lower value.</td>
</tr>
</tbody>
</table>

Turning on the TCD current when oxygen is present in the cell can oxidize or blow out the filament, making it impossible to zero the detector. The cell must be replaced; contact your Shimadzu representative.
2. Fluctuating baseline

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier gas or makeup gas is contaminated.</td>
<td>Sufficiently purge air inside flow lines. Replace tubing.</td>
</tr>
<tr>
<td></td>
<td>Use higher purity gas.</td>
</tr>
<tr>
<td>Current value is too high.</td>
<td>Reduce the current.</td>
</tr>
<tr>
<td>Injection port (glass insert or silica wool) or column is dirty.</td>
<td>Clean or replace glass insert.</td>
</tr>
<tr>
<td></td>
<td>Condition column.</td>
</tr>
<tr>
<td>Cell is dirty.</td>
<td>Condition cell.*</td>
</tr>
<tr>
<td></td>
<td>Make several solvent injections.</td>
</tr>
<tr>
<td>Temperature in room where system is installed deviates from the commended range and/or considerably fluctuating.</td>
<td>Keep the room temperature within the commended range and reduce fluctuation of the room temperature by making sure that system is not directly exposed to air conditioner wind etc.</td>
</tr>
</tbody>
</table>

* Cell conditioning procedure
  ① Remove the column and seal the detector by installing a new graphite ferrule (with its wire) in the column nut.
  ② Set the current value to “0 mA”.
  ③ Begin makeup gas flow (at the flow rate used in analysis).
  ④ Set the detector temperature 30°C higher than the analysis temperature. (However, the detector temperature cannot exceed 400°C, the maximum operating temperature.)

The conditioning time varies depending on the degree of contamination, but is approximately 1 to 12 hours.

The baseline may fluctuate because the temperature of a heated zone or the flow rate is not stable. Check the monitor display. If this problem occurs, contact your Shimadzu representative.

3. Baseline noise is high

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier gas or makeup gas is contaminated.</td>
<td>Sufficiently purge air inside flow lines. Replace tubing.</td>
</tr>
<tr>
<td>Gas leaks.</td>
<td>Check for leaks in injection port and column connection area.</td>
</tr>
<tr>
<td>Current value is too high.</td>
<td>Reduce the current.</td>
</tr>
<tr>
<td>Makeup gas flow rate too low.</td>
<td>Increase flow rate.</td>
</tr>
</tbody>
</table>

Excessively high current can damage the filament and cause significant noise. Contact your Shimadzu representative for cell replacement.
## 19.1.4 Chromatogram and data

### 19.1.4.1 No peaks or extremely small peaks

Peaks may not be able to be detected because of high noise. Refer to 19.1.3.1.3 and 19.1.3.2.3, “baseline noise is high.”

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier gas is not flowing.</td>
<td>Start carrier gas flow.</td>
</tr>
<tr>
<td>Carrier gas leaks.</td>
<td>Tighten leaking connectors.</td>
</tr>
<tr>
<td>Split ratio is large.</td>
<td>Reduce split ratio.</td>
</tr>
<tr>
<td>Sample concentration is low. Or injection volume is</td>
<td>Increase sample concentration or injection volume.</td>
</tr>
<tr>
<td>too low.</td>
<td></td>
</tr>
<tr>
<td>Wrong column is used.</td>
<td>Replace existing column with one appropriate for the compounds analyzed (more polar, less polar, etc.)</td>
</tr>
<tr>
<td>Column temperature is too low.</td>
<td>Increase column temperature.</td>
</tr>
<tr>
<td>Signal cable of detector is connected incorrectly.</td>
<td>Connect signal cable correctly.</td>
</tr>
<tr>
<td>Detector is set to “Off”.</td>
<td>Set detector to “On”.</td>
</tr>
<tr>
<td>Detector parameter have been set incorrectly.</td>
<td>Increase range and attenuation sensitivity.</td>
</tr>
<tr>
<td>Hydrogen flame is extinguished.</td>
<td>Check hydrogen/air flow rate, then ignite.</td>
</tr>
<tr>
<td>Zero level far below “0”.</td>
<td>Press “MONIT” key then press “ZERO Adj” (PF menu) to execute zero point adjustment.</td>
</tr>
</tbody>
</table>

If the jet or the cable is damaged, contact your Shimadzu representative for replacement.

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range is not “×1”.</td>
<td>Set range to “×1”.</td>
</tr>
<tr>
<td>Current set value is too low.</td>
<td>Increase current setting. (Decrease TCD thermostatic oven temperature, and increase maximum working current.)</td>
</tr>
<tr>
<td>Makeup gas flow rate is too high.</td>
<td>Set it to the proper value.</td>
</tr>
<tr>
<td>Split ratio is too high (for split analysis).</td>
<td>Decrease split ratio.</td>
</tr>
<tr>
<td>Carrier gas leaks.</td>
<td>Check for injection port and column connection leaks.</td>
</tr>
<tr>
<td>Capillary column is installed incorrectly.</td>
<td>Install column correctly.</td>
</tr>
<tr>
<td>Column is contaminated.</td>
<td>Condition column.</td>
</tr>
<tr>
<td>Carrier gas or makeup gas is contaminated.</td>
<td>Sufficiently purge air inside flow line. Replace tubing. Use higher purity gas.</td>
</tr>
<tr>
<td>Sample concentration is low. Or injection volume is</td>
<td>Increase sample concentration or injection volume.</td>
</tr>
<tr>
<td>too low.</td>
<td></td>
</tr>
<tr>
<td>Wrong column is used.</td>
<td>Replace existing column with one appropriate for the compounds analyzed (more polar, less polar, etc.)</td>
</tr>
<tr>
<td>Another analytical condition, such as temperature or</td>
<td>Change the analytical conditions.</td>
</tr>
<tr>
<td>column flow rate is incorrect.</td>
<td></td>
</tr>
</tbody>
</table>
### 19.1.4.2 Presence of ghost peaks

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septum purge is not flowing.</td>
<td>Flow septum purge.</td>
</tr>
<tr>
<td>Peaks of previous analysis is detected.</td>
<td>Increase column oven temperature to maximum temperature in analysis to eliminate sample remaining inside column.</td>
</tr>
<tr>
<td>Sample is contaminated.</td>
<td>Prepare sample newly.</td>
</tr>
<tr>
<td>Micro syringe is dirty.</td>
<td>Clean micro syringe. Or replace it with a new one.</td>
</tr>
<tr>
<td>Carrier gas purity is low.</td>
<td>Replace carrier gas with one of higher purity. Provide molecular sieve filter in carrier gas flow line.</td>
</tr>
<tr>
<td>Substances of high boiling point accumulated at column inlet end are flowing out.</td>
<td>Condition column.</td>
</tr>
<tr>
<td>Injection port is dirty.</td>
<td>Clean or replace glass insert. (Refer to “18.5 Inspection and Maintenance: Glass Insert&quot; in Instruction Manual.)</td>
</tr>
<tr>
<td>Tubing, pressure regulator, etc. are contaminated with oil, etc.</td>
<td>Replace tubing, pressure regulator, etc. with clean ones.</td>
</tr>
<tr>
<td>Septum chips are present inside glass insert or column.</td>
<td>Clean or replace glass insert. Fold tip of capillary column, and take off folded portion.</td>
</tr>
</tbody>
</table>

### 19.1.4.3 Abnormal peak shape

- **Fronting** (leading): The peak increases slowly. The first half peak area is higher.
- **Tailing**: Once the peak has eluted, the baseline does not immediately return to its zero level. The second half peak area is higher.

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fronting: the column Column is overloaded.</td>
<td>Dilute sample. Decrease injection volume, or increase split ratio. Use a column with a greater film thickness.</td>
</tr>
<tr>
<td>Peaks are co-eluting</td>
<td>Decrease column oven temperature. Replace column to obtain better separation.</td>
</tr>
<tr>
<td>Tailing, fronting Injection port temperature is low.</td>
<td>Increase injection port temperature.</td>
</tr>
<tr>
<td>Tailing Column is contaminated.</td>
<td>Condition column. (Refer to “18.7 Inspection and Maintenance: Capillary Column” in Instruction Manual.)</td>
</tr>
<tr>
<td>Tailing Glass insert is damaged.</td>
<td>Replace glass insert. (Refer to “18.5 Inspection and Maintenance: Glass Insert” in Instruction Manual.)</td>
</tr>
<tr>
<td>Tailing Septum purge is not flowing or is too low.</td>
<td>Verify septum purge flow. Increase septum purge flow rate. (Refer to “3 AFC, APC” in Instruction Manual.)</td>
</tr>
<tr>
<td>Tailing Septum fragments are present inside glass insert or column.</td>
<td>Clean or replace glass insert. Clip the injection port end of the column.</td>
</tr>
</tbody>
</table>
### 19.1.4.4 Poor retention time reproducibility

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The carrier gas cylinder is almost empty.</td>
<td>Replace the gas cylinder with one of at least 3 MPa pressure.</td>
</tr>
<tr>
<td>Carrier gas flow rate is fluctuating due to a gas leak.</td>
<td>Tighten leaking connections. Replace tubing or septum.</td>
</tr>
<tr>
<td>Column is overloaded.</td>
<td>Dilute sample. Increase split ratio. Use a column with a thicker film.</td>
</tr>
<tr>
<td>Room temperature is not within the recommended range or is considerably fluctuating.</td>
<td>Keep the room temperature within the recommended range or reduce temperature fluctuations.</td>
</tr>
<tr>
<td>Syringe tip is clogged, and sample is not properly injected.</td>
<td>Clean or replace syringe.</td>
</tr>
</tbody>
</table>

If the gas supply pressure is fluctuating due to failure of the gas cylinder pressure regulator, repair or replace it. Contact your Shimadzu representative.

### 19.1.4.5 Poor peak area reproducibility

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The carrier gas cylinder is almost empty.</td>
<td>Replace the gas cylinder with one of at least 3 MPa pressure.</td>
</tr>
<tr>
<td>Carrier gas flow rate is fluctuating due to a gas leak.</td>
<td>Tighten leaking connections. Replace tubing.</td>
</tr>
<tr>
<td>Sample is not injected completely.</td>
<td>Perform injections accurately. Replace the syringe with a new one.</td>
</tr>
<tr>
<td>Column is overloaded.</td>
<td>Dilute sample. Increase split ratio. Use a column with a thicker film.</td>
</tr>
<tr>
<td>Room temperature is not within the recommended range or is considerably fluctuating.</td>
<td>Keep the room temperature within the recommended range or reduce temperature fluctuations.</td>
</tr>
<tr>
<td>Syringe tip is clogged, and sample cannot be aspirated well.</td>
<td>Clean or replace syringe.</td>
</tr>
<tr>
<td>Syringe tip is clogged, and sample is not properly injected.</td>
<td>Clean or replace syringe.</td>
</tr>
<tr>
<td>Syringe plunger is stiff, and does not move smoothly.</td>
<td>Clean syringe barrel and plunger. Re-pack the silica wool.</td>
</tr>
<tr>
<td>Silica wool inside glass insert is packed incorrectly.</td>
<td>Clean or replace syringe.</td>
</tr>
</tbody>
</table>

If the gas supply pressure is fluctuating due to failure of the gas cylinder pressure regulator, repair or replace it. Contact your Shimadzu representative.
The system is programmed to diagnosis certain errors. When an error is detected, an alarm sounds and one of the error messages shown below is displayed. The detected errors are recorded in the “Error Log”.

When confirmation screens are shown select one of the following actions:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
</table>
| Reset Error  | Resets the system parameters, restoring the conditions prior to the error. System control resumes. Remove the cause of the error before selecting “reset”.
| Ignore Error | Keep the system as it is. Check for the error to resolve it.                 |

The codes provided with the errors help the service representative identify the errors. Provide the code when calling about an error. These codes are also recorded in the error log.

### 19.2.1 System errors

#### Power supply failure

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC 5V is out of range</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>DC 24V is out of range</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>DC -15V is out of range</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>DC 24V (FTD) is out of range</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

#### PCB failure

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-10</td>
<td>DET#n PCB error</td>
<td>No</td>
<td>n=1-4</td>
</tr>
<tr>
<td>11-12</td>
<td>CARm AFC PCB error</td>
<td>No</td>
<td>m=1-2</td>
</tr>
<tr>
<td>13-16</td>
<td>Det APCn PCB error</td>
<td>No</td>
<td>n=1-4</td>
</tr>
<tr>
<td>17-19</td>
<td>CARx AMC PCB error</td>
<td>No</td>
<td>x=1-3</td>
</tr>
<tr>
<td>20-22</td>
<td>CARx WBI PCB error</td>
<td>No</td>
<td>x=1-3</td>
</tr>
<tr>
<td>23-28</td>
<td>APC a-b PCB error</td>
<td>No</td>
<td>a-b= 1-3, 4-6, 7-9, 10-12, 13-15, 16-18</td>
</tr>
</tbody>
</table>

#### A/D converter failure

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>COL A/D conv. error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>INJ1 - DET2 A/D error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>AUX1 - AUX3 A/D error</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

#### Feed back loop communication error

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>Loop back test error</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

If the above error messages appear, the hardware has failed. The GC system cannot be used in the event of these total errors. Turn off the the system, and contact your Shimadzu representative.
Room temperature sensor/atmospheric pressure sensor error.

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Room temperature is out of range</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Atm. pressure is out of range</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

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

Low voltage of CPU board battery

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>Battery voltage error</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

The battery on CPU board is dead. It must be replaced. Turn off the system, and contact your Shimadzu representative.

Cooling fan error

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>Cooling fan error</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

The GC cooling fan is out of order. Turn off the system, and contact your Shimadzu representative.

Damaged in electronics

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>ROM error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>RAM error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>CPU register error</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Clock reset

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>Clock is initialized</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

The built-in clock has reset. As a result, other saved parameters may have changed. Check the installation, temperature and flow rate settings. Initialize the parameters or reset them if necessary.

if the same message is displayed repeatedly, the hardware has failed. The system cannot be used. Turn off the system, and contact your Shimadzu representative.

19.2.2 Operations errors

Value outside of range was entered

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5001</td>
<td>Input parameter out of range</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

The numeric value entered is out of the valid range. Enter a valid number.
File operation errors

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5002</td>
<td>Invalid file no.</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>5003</td>
<td>This file is now used</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>5004</td>
<td>File initialize failure</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>5005</td>
<td>File can’t be copied</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

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

Overflow of calculated pressure value

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5006-5008</td>
<td>CARx calc. prss out of range</td>
<td>No</td>
<td>x=1-3</td>
</tr>
<tr>
<td>5070-5072</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Overflow of calculated flow rate value

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5009-5011</td>
<td>CARx calc. flow out of range</td>
<td>No</td>
<td>x=1-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Overflow of calculated APC pressure value

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5012, 5015</td>
<td>MUPn calc. prss out of range</td>
<td>No</td>
<td>n=1-4 make up gas</td>
</tr>
<tr>
<td>5018, 5021</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5045-5048</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5013, 5016</td>
<td>HGNn calc. prss out of range</td>
<td>No</td>
<td>n=1-4 Hydrogen</td>
</tr>
<tr>
<td>5019, 5022</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5014, 5017</td>
<td>AIRn calc. prss out of range</td>
<td>No</td>
<td>n=1-4 Air</td>
</tr>
<tr>
<td>5020, 5023</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5024-5041</td>
<td>APCy calc. prss out of range</td>
<td>No</td>
<td>y=1-18 AUX APC</td>
</tr>
<tr>
<td>5049-5066</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5042-5044</td>
<td>PURx calc. prss out of range</td>
<td>No</td>
<td>x=1-3 septum purge</td>
</tr>
<tr>
<td>5056-5069</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The pressure calculated from the flow rate you have input is outside the set range. Change the conditions, and enter a new value.

Overflow of calculated flow rate value in programs

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5073, 5074</td>
<td>CAR m calc:flow out of range</td>
<td>No</td>
<td>m=1-2</td>
</tr>
<tr>
<td>5077, 5078</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5075, 5076</td>
<td>CAR m calc:ratio out of range</td>
<td>No</td>
<td>m=1-2</td>
</tr>
</tbody>
</table>

The carrier gas total flow rate calculated from the split ratio program you have input is outside the set range.
19.2.3 Optional device error (AOC-20i/s)

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>6001, 6023</td>
<td>AOCm rack error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6002, 6024</td>
<td>AOCm syringe error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6003, 6025</td>
<td>AOCm plunger error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6004, 6026</td>
<td>AOCm can not start</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6005, 6027</td>
<td>AOCm RAM initialized</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6006, 6028</td>
<td>AOCm ROM error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6007, 6029</td>
<td>AOCm CH2 command error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6008, 6030</td>
<td>AOCm sample vial is not set</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6009, 6031</td>
<td>AOCm RAM error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6010, 6032</td>
<td>AOCm installation error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6011, 6033</td>
<td>AOCm CH1 error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6012, 6034</td>
<td>AOCm CH2 error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6013, 6035</td>
<td>AOCm waste vial is not set</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6014</td>
<td>AOC-20s rotating error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6015</td>
<td>AOC-20s exp. and ctrl. Error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6016</td>
<td>AOC-20s up/down error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6017</td>
<td>AOC-20s can not start</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6018</td>
<td>AOC-20s vial setting error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6019</td>
<td>AOC-20s vial returning error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6020</td>
<td>AOC-20s holding error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6021</td>
<td>AOC-20s sample vial removed</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6022</td>
<td>AOC-20s vial is not set</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

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

19.2.4 Communication errors

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4001</td>
<td>Time out</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4002</td>
<td>Parity error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4003</td>
<td>Message is not accepted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4004</td>
<td>Data is invalid</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4005</td>
<td>Command is invalid</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4006</td>
<td>Data is out of range</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4007</td>
<td>TRS port is shut down</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4008</td>
<td>TRS file error</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

One of these messages appear during a link failure or communication failure. (When a communication error occurs, the link is automatically disconnected.) When one of these messages appear, check the connection status, and reset the link.
AOC communication errors

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4009</td>
<td>AOC command is invalid</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4010</td>
<td>AOC data is out of range</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4011</td>
<td>AOC time out</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4012</td>
<td>AOC2 TRS error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4013</td>
<td>AOC link error</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

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

19.2.5 Detector errors

Over current

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4101-4104</td>
<td>DET#n TCD cell error</td>
<td>Yes</td>
<td>n=1-4</td>
</tr>
<tr>
<td>4105-4108</td>
<td>DET#n FTD current error</td>
<td>Yes</td>
<td>n=1-4</td>
</tr>
</tbody>
</table>

Abnormal detector current. If the resistance of the filament becomes abnormally high when the TCD or the FTD is in use, the protection circuit is actuated to prevent damage to the filament, and an alarm sounds. If either error has occurred, turn off the system.

Possible reasons for the protection circuit to be activated are described below. The current value set exceeds the maximum operating current.
- The makeup gas is not flowing.
- A gas leak has occurred.
- A significant amount of air is present in the flow line (for TCD).

Remove the cause of error, then turn on the system. If the system does not recover after several resets, or the reason for the error cannot be located, contact your Shimadzu representative.

Detector flame error

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4109-4112</td>
<td>DET#n flame is out</td>
<td>No</td>
<td>n=1-4</td>
</tr>
</tbody>
</table>

The detector flame (FID) 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. Turn off the system, and contact your Shimadzu representative.
19 Troubleshooting

19.2 Error Messages

**FPD errors**

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4113-4116</td>
<td>DET#n FPD Battery error</td>
<td>Yes</td>
<td>n=1-4</td>
</tr>
<tr>
<td>4117-4120</td>
<td>DET#n FPD temperature error</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4121-4124</td>
<td>DET#n FPD cooling fan error</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4125-4128</td>
<td>DET#n FPD current error</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

FPD operation is abnormal. Refer to FPD User’s Manual. If ERROR 4125-4128 occurs, turn off the system. Otherwise, the system status can not be restored.

**TCD errors**

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4201</td>
<td>TCD signal is out of range</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4202</td>
<td>TCD signal zero error</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

The difference in filament resistance is high between the TCD cells, and the detector cannot be zeroed. The detector control unit may have failed. The system cannot be used. Turn off the system, and contact your Shimadzu representative.

**Detector ignition errors**

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4203-4206</td>
<td>DET#n ignition failed</td>
<td>No</td>
<td>n=1-4</td>
</tr>
</tbody>
</table>

This message appears when the FID does not ignite within a certain time. When the message appears, hydrogen gas flow does not stop automatically for manual flow control. Shut off the hydrogen gas first for safety, then check the following items.

(1) The column is connected
(2) Hydrogen is supplied at proper flow rate
(3) Air is supplied at proper flow rate
(4) Filament in igniter is intact
(5) The jet in the FID is not clogged
(6) Unused FID is not set to On

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4207</td>
<td>H2, AIR APC are not ready</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

This message appears when the APC for hydrogen or air is not Ready at the time of ignition. Check whether the gas supply pressure is stable and whether gas does not leak. If there is not problem with the gas supply, the hardware has failed. Turn off the system, and contact your Shimadzu representative.

**19.2.6 Other errors**

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4301</td>
<td>Settings were changed</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

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.
19 Troubleshooting
19.2 Error Messages

This message appears when the program execution time exceeds the maximum allowable value (9999.99 min). Change the program so that its total execution time does not exceed “9999.99 min”.

The program continues running after this error occurs, and stops at 9999.99 min.

Temperature control errors

This message appears when large heat loss is occurring. The oven door may be open, or the insulation may not be in place.

If the column over door is open, close it and select “Reset Error”.
If the insulation has been disturbed, replace the insulation, and then restart the system.

Temperature sensor errors

When one of these messages appear, the temperature sensor may have failed.
The sensor cannot be used. Replace or repair it. Turn off the system, and contact your Shimadzu representative.

Unstable temperature with CRG

This message appears when the column over or the INJ2 cannot be cooled down because the column oven door remains open or insufficient coolant (also for INJ2) is preventing the oven CRG from cooling.

If the column oven door is open, close it and select “Reset Error”.
Turn off the system, replace the coolant, and then restart the system.

<table>
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<tr>
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<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4302</td>
<td>Program time is over</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4303</td>
<td>Clean up time is over</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4304</td>
<td>Pre-run prog. time is over</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4303</td>
<td>Clean up time is over</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4304</td>
<td>Pre-run prog. time is over</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>Heat is escaping</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1002-1009</td>
<td>xxx temp exceed the limit</td>
<td>Yes</td>
<td>xxx=COL, INJ1, DET1, INJ2, DET2, AUX3, AUX4, AUX5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1010-1017</td>
<td>xxx sensor is short circuit</td>
<td>Yes</td>
<td>xxx=COL, INJ1, DET1, INJ2, DET2, AUX3, AUX4, AUX5</td>
</tr>
<tr>
<td>1018-1025</td>
<td>xxx sensor is down</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>1026-1033</td>
<td>xxx sensor is error</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1034</td>
<td>COL CRG cannot be controlled</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>1035</td>
<td>INJ2 CRG cannot be controlled</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
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19.2 Error Messages

Overheat

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<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1036</td>
<td>Overheat is sensed</td>
<td>Yes</td>
<td>Overheat detected by thermocouple</td>
</tr>
<tr>
<td>1037-1044</td>
<td>xxx temp controller broken</td>
<td>Yes</td>
<td>xxx=COL, INJ1, DET1, INJ2, DET2, AUX3, AUX4, AUX5</td>
</tr>
</tbody>
</table>

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

Relay/heater control errors

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1045</td>
<td>COL relay error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>1046</td>
<td>INJ1-DET2 relay error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>1047</td>
<td>AUX3-AUX5 relay error</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>1048</td>
<td>Heater controller error</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1049-1052</td>
<td>DET#n set temp is low</td>
<td>No</td>
<td>n=1-4</td>
</tr>
</tbody>
</table>

This message appears when the Detector temperature setting value is smaller than that of the Oven.
If this message appears, change the setting value of the Detector temperature.
If set the setting of Protection against contamination to “No”, need not to change the setting value of the Detector temperature. (Refer to 16.6.4.3)

Pressure/flow rate control errors

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<thead>
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<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2007</td>
<td>CARx purge leaks</td>
<td>Yes</td>
<td>x=1-3</td>
</tr>
<tr>
<td>2014, 2017, 2020, 2023</td>
<td>DetAPC n makeup gas leaks</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2015, 2018, 2021, 2024</td>
<td>DetAPC n hydrogen leaks</td>
<td>Yes</td>
<td>n=1-4</td>
</tr>
<tr>
<td>2016, 2018, 2022, 2025</td>
<td>DetAPC n air leaks</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2026-2043</td>
<td>APC y leaks</td>
<td>Yes</td>
<td>y=1-18</td>
</tr>
</tbody>
</table>

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

**NOTE** Gas leaks may be occurring in several locations.
(Example) If the purge flow rate is too low, the message “Purge leaks” may appear. If the carrier gas is also leaking, the ESC or TFC error message may not be displayed first.
### Pressure/flow rate control errors (valve leak error)

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>2048-2050</td>
<td>CARx purge valve leaks</td>
<td>Yes</td>
<td>x=1-3</td>
</tr>
<tr>
<td>2057, 2060</td>
<td>DetAPC n makeup valve leaks</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2063, 2066</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2058, 2061</td>
<td>DetAPC n hydrogen valve leaks</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2064, 2067</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2059, 2062</td>
<td>DetAPC n air valve leaks</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2065, 2068</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2069-2086</td>
<td>APC y valve leaks</td>
<td>Yes</td>
<td>y=1-18</td>
</tr>
<tr>
<td>2132, 2133</td>
<td>CAR m AFC valve leaks</td>
<td>Yes</td>
<td>m=1-2</td>
</tr>
</tbody>
</table>

Gas is flowing even though the set value is 0 kPa (or ml/min).
If gases are supplied, an AFC/APC valve error may have occurred.
Turn off the system, and contact your Shimadzu representative.

### Abnormal component operation

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>2091-2093</td>
<td>CARx purge is out of control</td>
<td>Yes</td>
<td>x=1-3</td>
</tr>
<tr>
<td>2100, 2103</td>
<td>DetAPCn makeup gas is out of control</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2106, 2109</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2101, 2104</td>
<td>DetAPCn hydrogen is out of control</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2107, 2110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2102, 2105</td>
<td>DetAPCn air is out of control</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2108, 2111</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2112-2129</td>
<td>APCy is out of control</td>
<td>Yes</td>
<td>y=1-18</td>
</tr>
<tr>
<td>2130, 2131</td>
<td>CARm AFC leaks</td>
<td>Yes</td>
<td>m=1-2</td>
</tr>
<tr>
<td>2134-2137</td>
<td>CARm AFC is out of control</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2138-2140</td>
<td>CARx prim is out of range</td>
<td>No</td>
<td>x=1-3</td>
</tr>
</tbody>
</table>

Verify whether a continuous supply of gas is available at the required pressure.
If there is no problem in the gas supply, the control system, such as the APC, may have failed.
Turn off the system, and contact your Shimadzu representative.

### This message appears when the temperature control starts without carrier gas control.

This message appears when the temperature control starts without carrier gas control.
If this message appears, set the setting of the flow controller to “On” or remove the flow controller from the line configuration.
### 19.2.7 Warning messages

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000</td>
<td>COL CRG use time is over</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9001</td>
<td>INJ2 CRG use time is over</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9002</td>
<td>Fan use time is over</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9003</td>
<td>LCD backlight use time is over</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9004-9006</td>
<td>CARx septum counter is over</td>
<td>No</td>
<td>x=1-3</td>
</tr>
<tr>
<td>9007-9009</td>
<td>CARx insert counter is over</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9012-9019</td>
<td>xxx sensor use time warning</td>
<td>Yes</td>
<td>xxx=COL, INJ1, DET1, INJ2, DET2, AUX3, AUX4, AUX5</td>
</tr>
</tbody>
</table>

These message appear when the time or the count exceed the set value, but does not indicate any error. Refer to "14 Diagnosis", and clear the message.
In case of "xxx sensor use time warning", turn off the power, and contact your Shimadzu representative.

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>9010</td>
<td>System is not ready</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Message</th>
<th>CS</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>9011</td>
<td>Ignition finished(retried)</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Ignition sequence was re-attempted, because the ignition failed initially.
This does not affect the 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.
20.1 Key Function List

**SYSTEM**
The parameter related to start and stop of the GC can be set. And on the sub screen, the file management, the clean up and the maintenance of injection port can be set.

**SET**
The parameters which are frequently set can be set. And on the screen of [LineConfig], the combination of injection ports, detectors, etc. can be changed.

**MONIT**
The status of the injection port, the column, the detector configured and the chromatogram etc. in each line can be monitored.

**COL**
The oven temperature or the oven temperature program can be set.

**INJ**
The injection port temperature can be set.

**FLOW**
The parameters of the AFC which controls the pressure and the flow rate of the carrier gas can be set.

**DET**
The detector temperature, the detector gas flow rate, the detector signal output, etc. can be set.

**OPTION**

- **AOC parameters**
The Auto Injector AOC-20i and the Auto Sampler AOC-20s used to automatically inject liquid sample to the gas chromatograph can be set.

- **AUX APC**
The AUX APC (option) can be set.

- **CRG**
The CRG (option) can be set.

**DIAG**

1. **Standard Diagnosis**
Diagnose each part of the gas chromatograph to check for abnormality. By executing standard diagnosis periodically, the system can be managed and the failures can be prevented.

2. **Log Reading Menu**

   1. **GC operation Log**
   Display the power On/Off log and the system On/Off log.

   2. **Analysis Log**
   Display the log on whether analysis was executed to the end and whether the control was not deviated from the target value.

   3. **Parameter Log**
   Display the key operation log and the parameter change log.

   4. **Error Log**
   Display the log of displayed error messages.

   5. **Diagnostic Log**
   Display the diagnosis log.

3. **Analysis Countur**
The replacement timing of the septum or the glass insert can be displayed as a warning message.

4. **Coolant Consumption**
The total time that the CRG is "On" can be confirmed. If the consumption counter is larger than the time of setting to warm, the warning message is displayed.
The key operations of the gas chromatograph can be automated by setting the weekly or daily schedule using the timer.

Use batch schedule when the analytical condition is changed on the midway (for example, when running continuous analysis in which used files are changed over).

Use time program when the parameter is changed during analysis.

Use Pre-Run program when the parameter is changed before analysis is started.

Input the event No. and run at once.

Use to set the date and the time.

Use to set the maximum temperature of each heater ports.

Use to set the parameter related to transmission.

Use to set the items, which should be satisfied to light the STATUS indicator lamp and make the system ready.

Use to set the signals, which can be output from the gas chromatograph.

Use to change heater ports name, carrier ports name, AUX APC name, relay name displayed on the screen.

Use to set the link device code when using it.

Use to set the temperature offset for each heater port.

Use to set the language and the beep etc.

Use to set the flow controller or initialize etc.

The stop watch can be used.

The key locking and the parameter locking can be used.
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</tr>
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<td>5</td>
</tr>
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