

GC-2014 Gas Chromatograph

INSTRUCTION MANUAL

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



ANALYTICAL & MEASURING INSTRUMENTS DIVISION

©2004-2006 Shimadzu Corporation. All rights are reserved, including those to reproduce this publication or parts thereof in any form without permission in writing from Shimadzu Corporation. Information in this publication is subject to change without notice and does not represent a commitment on the part of the vendor.

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.

About this USER's MANUAL

GC-2014 user's manual consists of the two separate manuals as described below.

Operation Manual Part number: 221-40607

It describes procedures necessary to operate the instrument.

Instruction Manual Part number: 221-40609 (this manual)

It describes the instrument's functions and how to use them.

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

WARNING LABELS

Label conventions for this manual are provided below.



WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or possibly death.



CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury or equipment damage.

NOTE

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

This page is intentionally left blank.

About this USER's MANUAL

1	Installation	
1.1	Verification of Installation Location	1
1.2	Power supply and wiring	4
1.3	Gas Supply Plumbing	7
2	Before Use	
2.1	Setting Analytical Flow Lines	17
2.2	Outputting Analog Signals to the Chromatopac	20
2.3	Outputting Digital Signals to a Personal Computer	23
2.4	Connecting a RS-232C Cable to the Chromatopac C-R8A	25
2.5	Connecting Auto Injector/Auto Sampler AOC-20 Series	27
2.6	Connecting the Relay Terminals	29
3	Installing Packed Columns and Setting Analytical Flow Lines	
3.1	Installation Location for Packed Columns	31
3.2	Dual-Column Packed FID Analysis	33
3.3	Single-Column Packed FID Analysis	36
3.4	Packed TCD Analysis	39
3.5	Packed Analysis Using the Single DET	42
4	Installing Capillary Columns and Setting Analytical Flow Lines	
4.1	Installation Location for Capillary Columns	47
4.2	Capillary Analysis Using the Dual FID (When a detector adapter with purge is used)	49
4.3	Capillary Analysis Using the Dual FID (When a makeup gas flow controller is used)	52
4.4	Capillary TCD Analysis	54
4.5	Single DET	58
5	Analysis	
5.1	Analysis Flow Chart	61
5.1.1	Preparation	61
5.1.2	Setting Parameters	61
5.1.3	Analysis	62

5.2	Notes for Analysis	63
------------	---------------------------	-----------

6 Basic Key Operation

6.1	Keypad Description and Operation	67
6.1.1	Keypad operation	68
6.1.2	Screen	69
6.1.3	Status indicators	70
6.2	Adjusting The Display	71
6.3	Basic Key Operations	72
6.3.1	Screen display	72
6.3.2	Moving the cursor	73
6.3.3	Entering numeric values	74
6.3.4	Changing a selection	74
6.3.5	Changing item names	75
6.4	Getting Help	77
6.4.1	Screen description	77
6.4.2	PF menu	77

7 Starting and Stopping the GC [SYSTEM]

7.1	[SYSTEM] Key Main Screen	79
7.1.1	Screen Description	79
7.1.2	Parameter	80
7.1.3	PF menu	81
7.2	Specifying Clean Up Parameters	82
7.2.1	Screen Description	82
7.2.2	Parameter list	83
7.2.3	PF menu	85
7.3	Specifying Start Procedures	86
7.3.1	Screen description	86
7.3.2	Parameter list	87
7.3.3	Example: starting the system with carrier gas flow	87
7.4	Specifying the Stop Procedures	88
7.4.1	Screen	88
7.4.2	Parameter list	88
7.4.3	System shut down examples	89

8 Setting the Analytical Parameters and File Management

8.1	[SET] Key Main Screen	91
8.1.1	Main screen	91
8.1.2	Parameter list	92
8.1.3	PF menu	94
8.2	File Management	95
8.2.1	Screen description	95
8.2.2	PF menu	95
8.2.3	Copying a file	96
8.2.4	Renaming a file	96
8.2.5	Initializing a file	97

Contents

8.3	Specifying the Analytical Flow Line Components ([Line Config])	98
8.3.1	Screen description	98
8.4	Changing Items Displayed with [Customiz]	101
8.4.1	Screen description	101

9 Monitoring the GC

9.1	[MONIT] key Main Screen	103
9.1.1	Screen description	103
9.1.2	Parameter list	105
9.1.3	PF menu	105
9.2	Monitoring the Temperature with [Temp Mon]	106
9.2.1	Screen description	106
9.2.2	PF menu	106
9.3	Monitoring the Flow Rate with [Flow Mon]	107
9.3.1	Screen description	107
9.3.2	PF menu	107
9.4	Zero Point Adjustment	108
9.4.1	Screen description	108

10 Starting and Stopping Analysis

10.1	Making an Injecting and Starting an Analysis	109
10.1.1	Verifying the gas chromatograph status	109
10.1.2	Making manual injection	110
10.1.3	Starting the analysis	111
10.2	Terminating the Analysis	112
10.2.1	Terminating the analysis	112
10.2.2	External devices	112

11 Creating an Oven Temperature Program

11.1	[COL] Key Main Screen	113
11.1.1	Screen description	113
11.1.2	Parameter list	114
11.1.3	PF menu	114
11.2	Temperature Programs	115
11.2.1	Isothermal analysis	115
11.2.2	Programmed analysis	115
11.2.3	Creating a temperature program	115

12 Injection Port

12.1	Packed Column Injection Port (Dual INJ)	119
12.1.1	Setting the temperature with [INJ] key	120
12.1.2	Setting the Flow Rate	122
12.1.3	Entering Columns Parameters	124
12.1.4	Creating a Flow Rate Program	125
12.2	Split/Splitless Injection System	126

Contents

12.2.1	Setting the temperature with [INJ] key	127
12.2.2	Setting the flow rate with [FLOW] key	129
12.2.3	Setting column parameters	133
12.2.4	Gas saver	134
12.2.5	Pressure program	135
12.2.6	Creating a Flow rate program	137
12.2.7	Split ratio program	139
12.2.8	Septum purge	141
12.2.9	High pressure injection and splitter fix mode	143
12.3	Direct Injection System	145
12.3.1	Setting the temperature	146
12.3.2	Setting the flow rate	147
12.4	AFC and APC Offset Calibration	149
12.5	Setting the Flow Rate Parameters	150

13 Detector

13.1	Hydrogen Flame Ionization Detector (FID)	153
13.1.1	Principle of FID operation	153
13.1.2	Setting the detector	154
13.1.3	Setting the Detector Gas (manual flow controller)	157
13.1.4	Setting the detector gas flows(APC)	159
13.1.5	Igniting and Extinguishing the FID	161
13.2	Thermal Conductivity Detector (TCD)	164
13.2.1	Principle of TCD operation	164
13.2.2	Setting the detector	165
13.2.3	TCD Zero Point Adjustment	169
13.3	Filter Signal Time Constant	170
13.4	Background Compensation	171

14 Diagnosis

14.1	Standard Diagnosis	173
14.1.1	Screen description	173
14.1.2	PF menu	173
14.1.3	Diagnosis Parameters	174
14.1.4	Diagnosis parameter list	175
14.1.5	Starting the diagnosis	177
14.1.6	PF menu	177
14.1.7	Stopping/exiting the diagnosis	178
14.1.8	PF menu	178
14.1.9	Diagnosis results	179
14.1.10	PF menu	179
14.2	Log Reading Menu	181
14.2.1	Screen description	181
14.2.2	Parameter list	181
14.2.3	GC Operation log	182
14.2.4	Analysis log	183
14.2.5	Parameter log	185
14.2.6	Error log	186
14.2.7	Diagnostic log	187
14.3	Analysis Counter	188

14.3.1	Screen description	188
14.3.2	Parameter list	189
14.3.3	PF menu	189
14.4	Coolant Consumption Counter	190
14.4.1	Screen description	190
14.4.2	Parameter list	191
14.4.3	PF menu	191
14.5	Standard Installation Test	192
14.5.1	Screen description	192
14.5.2	PF menu	192
14.5.3	Test procedure	193
14.6	Peak Generator	194
14.6.1	Screen description	194
14.6.2	Parameter list	194
14.6.3	PF menu	194

15 Optional Devices

15.1	Auto Injector Parameters	195
15.1.1	Screen description	195
15.1.2	Parameter list	196
15.1.3	PF menu	197
15.1.4	AOC priority analysis	198
15.1.5	Parameter list	198
15.1.6	PF menu	199
15.1.7	Other AOC parameters	199
15.1.8	Other AOC Parameter	200
15.1.9	PF menu	201
15.1.10	Auto-sampler carousel and other optional parameters	202
15.1.11	Parameter list	202
15.2	Setting AUX Temperature	203
15.2.1	Screen description	203
15.2.2	Parameter list	203
15.2.3	PF menu	203
15.2.4	On/Off setting	204
15.2.5	On/Off parameter list	204
15.3	Setting the AUX APC Parameters	205
15.3.1	Screen description	205
15.3.2	Parameter list	206
15.3.3	PF menu	206
15.4	Setting the AUX AMC Parameters	207
15.4.1	Screen description	207
15.4.2	Parameter list	208
15.4.3	PF menu	208
15.5	Setting the CRG Parameters	209
15.5.1	Screen description	209
15.5.2	Parameter list	210
15.5.3	PF menu	210

16 Special Functions

16.1	Time Scheduler	211
16.1.1	description Screen	211

16.1.2	Parameter list	211
16.1.3	Setting the mode	212
16.1.4	Editing a time schedule	213
16.1.5	PF menu	213
16.1.6	Creating a new time schedule	214
16.1.7	PF menu	214
16.1.8	Parameters available in the time scheduler	215
16.1.9	Changing schedule parameters	215
16.1.10	Time schedule example	216
16.1.11	Starting/stopping a time schedule	217
16.1.12	PF menu	217
16.1.13	Copying and deleting a time schedule	218
16.2	Batch Schedule	219
16.2.1	Screen description	219
16.2.2	Parameter list	220
16.2.3	PF menu	220
16.2.4	Creating a new batch schedule	221
16.2.5	Parameter list	222
16.2.6	PF menu	223
16.2.7	Editing a batch schedule	223
16.2.8	Batch processing Setup example	224
16.3	Time Program	225
16.3.1	Screen description	225
16.3.2	PF menu	225
16.3.3	Creating a new time program	226
16.3.4	PF menu	226
16.3.5	Time Program parameters	227
16.3.6	Editing a time program	228
16.3.7	Time program setup example	229
16.4	Pre-Run Program	231
16.4.1	Screen description	231
16.4.2	PF menu	231
16.4.3	Creating a new Pre-Run program	232
16.4.4	Editing a Pre-Run program	232
16.4.5	After Pre-Run program is finished	232
16.4.6	Pre-Run Program set up example	233
16.5	Direct Operation	234
16.5.1	Screen description	234
16.5.2	Parameter list	234
16.5.3	PF menu	234
16.6	GC Configuration	235
16.6.1	Screen description	235
16.6.2	Parameter list	235
16.6.3	Setting the date and time	236
16.6.4	Setting the maximum temperature limits	237
16.6.5	Setting transmission parameters	238
16.6.6	Setting the Ready Check Parameters	239
16.6.7	Parameter Configuration	241
16.6.8	Customizing Component Names	246
16.6.9	Setting the link device code	250
16.6.10	Temperature offset	251
16.6.11	Other Settings	252
16.7	Service and Maintenance	255
16.7.1	Screen description	255
16.7.2	Parameter list	255
16.7.3	INSTALLATION (POSITION)	256
16.7.4	INSTALLATION (PIPING)	258

Contents

16.7.5	INITIALIZATION	261
16.7.6	Power consumption	262
16.8	Stopwatch	263
16.8.1	Screen description	263
16.8.2	PF menu	263
16.8.3	Timing with inverse measurement	263
16.9	Key Lock and Parameter Lock	264
16.9.1	Screen description	264
16.9.2	Key locking	265
16.9.3	Parameter locking	266
16.10	ROM Version No.	269
16.10.1	Screen description	269
16.10.2	Parameter list	269

17 Printing

17.1	Printing	271
17.1.1	Connection to Chromatopac	271
17.1.2	Parameters to be printed	271
17.2	AOC commands	275
17.3	Program Parameters	277
17.4	Event No.	279

18 Error Messages

18.1	Error Messages	283
18.1.1	System errors	283
18.1.2	Temperature control errors	286
18.1.3	Pressure/flow rate errors	289
18.1.4	Communication errors	293
18.1.5	Detector errors	294
18.1.6	Program errors	296
18.1.7	Operations errors	297
18.1.8	Optional device error (AOC-20i/s)	300
18.1.9	Warning messages	301

19 Index

This page is intentionally left blank.

1.1

1 Installation

Verification of Installation Location

■ Installation location requirements

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

1. Ambient temperature and humidity

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

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

2. Installation location

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

(The GC-2014ATF model weighs approximately 50 kg.)

3. Corrosive gas and dust

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

4. Electro-magnetic fields and power supply noise

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

5. Other precautions

For optimal performance, avoid the following conditions during installation:

- (1) Fluctuating ambient temperature.
- (2) Temperature changes from heating or air conditioning.
- (3) Direct sunlight.
- (4) Vibrations.



■ Installation clearances



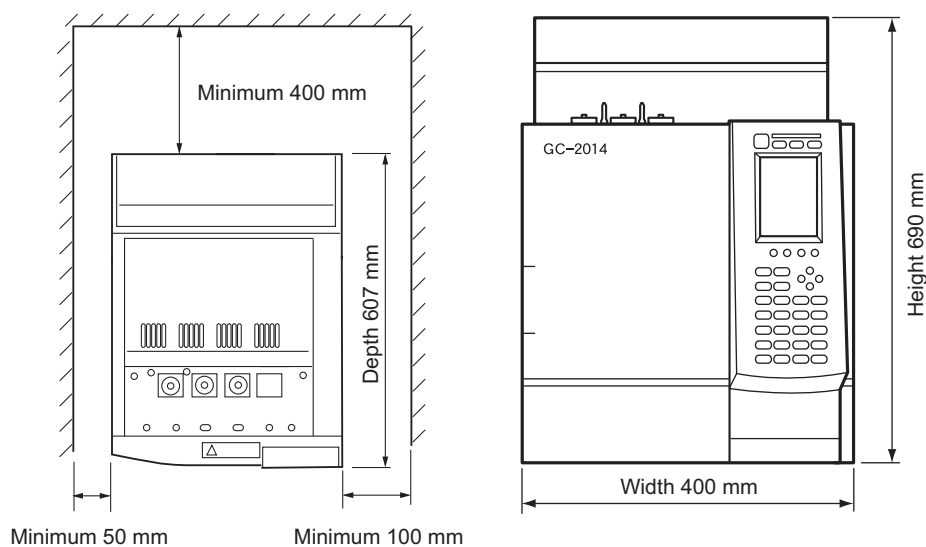
WARNING

Hot air

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

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

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



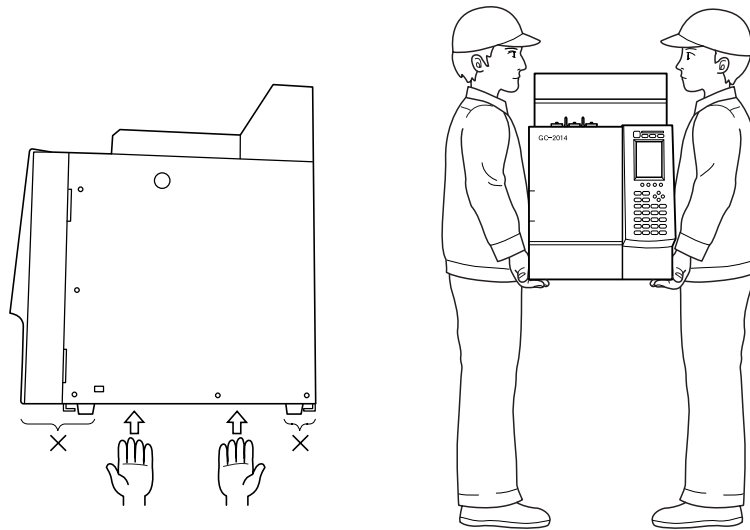
NOTE When the optional exhaust air duct (P/N 221-70675-91) is used, rear space of 200 mm or more is required.



■ Moving the GC

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

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



1 Installation

1.2 Power supply and wiring



WARNING

HIGH VOLTAGE

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

Before connecting the power supply, verify the following items.

■ Power supply voltage

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

Commended power voltage: 115 VAC \pm 5 %
230 VAC \pm 5 %
Frequency 50/60 Hz
Operating power voltage: 115 VAC \pm 10 %
230 VAC \pm 10 %
Frequency 50/60 Hz

■ Power supply capacity

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

Connect the power source to a terminal with sufficient capacity.

GC-2014ATF (TCD, FID models): 1,950 VA (115 V model)/2,750 VA (230 V model)

Optional temperature control block (INJ, etc.): 150 VA/pc

Maximum power is 2600 VA (115 V model), 3400 VA (230 V 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 230 V model uses a plug.

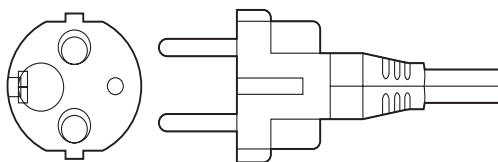


Fig. 1.2.1 Plug



WARNING

Make sure to ground the cable properly. Insufficient grounding may cause an electric shock in the event of a breakdown.
Be careful to wire the plug correctly, as outlined on the next page to avoid damage to the unit or supply fuse.



The power cable for 115 V model is color-coded as follows.

Black ... Connected to HOT of AC line.

White ... Connected to NEUTRAL of AC line.

Green ... Grounding (GROUND)

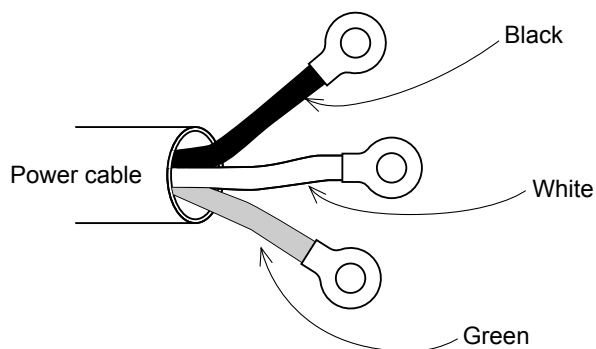


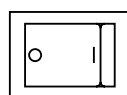
Fig. 1.2.2 Power cable

■ Symbol conventions

~ : AC

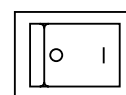
○ : Off, Open

| : On, Close



OFF status

Power switch



ON status

■ Heating energy generation

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

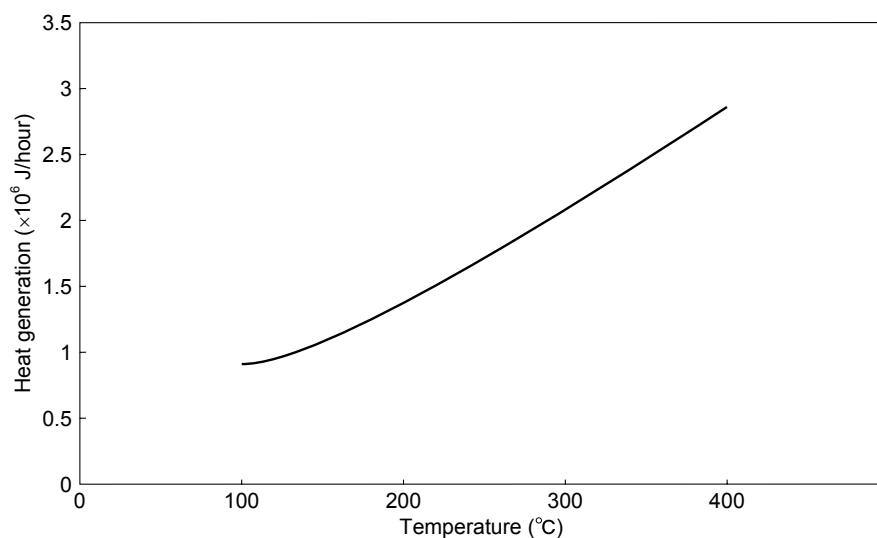


Fig. 1.2.3



■ Fuse

The following fuses are used in the GC-2014.

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

*Classification depending on "IEC127".

■ Allowing the GC to dry after transport.

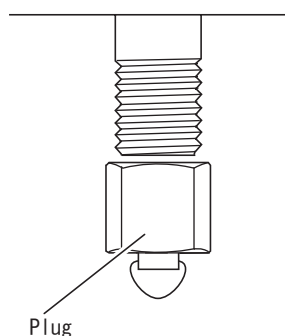


CAUTION

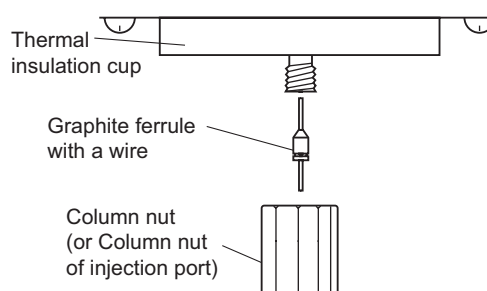
GC-2010 may get wet from humidity in some transport conditions. In such case "drying-out" is necessary to avoid a short circuit at the heater in the injection port or the detector.

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

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



When a packed column connecting joint is used



When a capillary column connecting joint is used

1.3 Gas Supply Plumbing

■ Supply gases



CAUTION

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

The following gases and associated purity values are required to maintain the optimum performance of the unit.

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

1. Gas types

•Carrier gas types

(Packed FID analysis)

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

(Packed TCD analysis)

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

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

(Capillary analysis)

Helium is the most suitable for separation.

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

•Makeup gas types

(Capillary FID)

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

(Capillary TCD)

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

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

2. Gas purity

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



3. Gas supply pressures

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

NOTE The relationship of kPa and bar is as follows

$$100 \text{ kPa} = 1 \text{ bar}$$

Convert units between kPa and kgf/cm² as follows.

$$1 \text{ kPa} = 1.02 \times 10^{-2} \text{ kgf/cm}^2$$

$$1 \text{ kgf/cm}^2 = 98.1 \text{ kPa}$$

Convert the units between kPa and psi as follows.

$$1 \text{ kPa} = 1.45 \times 10^{-1} \text{ psi}$$

$$1 \text{ psi} = 6.89 \text{ kPa}$$



■ 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 2 m 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 5 m of the equipment. Fire extinguishers must be present.

Secure gas cylinders firmly with cylinder clamps so they cannot fall over. Use oil-free pressure valves only. Never use tubing which has contacted oil. When finished with the gas, tighten the main valve of the cylinder immediately.



■ Precautions on handling hydrogen gas



WARNING

HYDROGEN GAS PRECAUTIONS

Hydrogen can explode if it is allowed to accumulate in a poorly ventilated area.

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

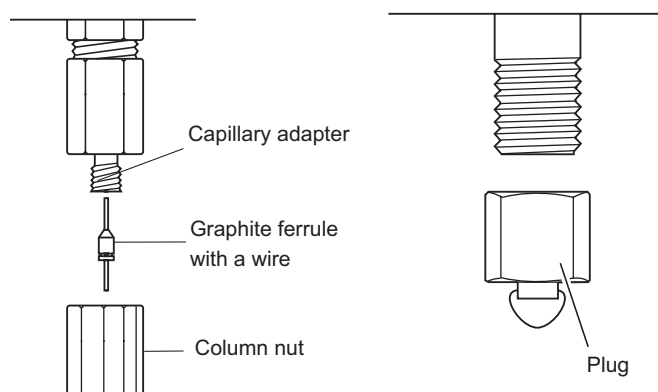


WARNING

HYDROGEN GAS HANDLING PRECAUTIONS

The accumulation of hydrogen gas inside the column oven can cause an explosion.

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



When a detector that uses hydrogen gas is not in use



CAUTION

Hydrogen gas supply precautions

Make sure that the supply pressure to the flow controller does not exceed 500 kPa.

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.



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.

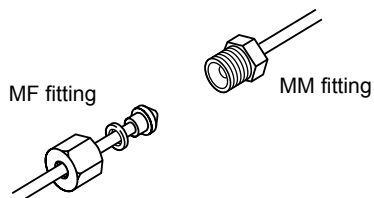


Fig. 1.3.1 Joining Type M fittings

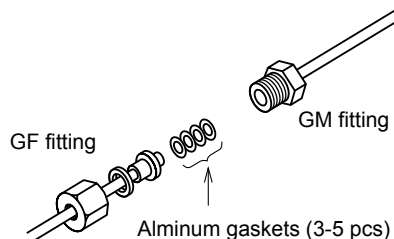


Fig. 1.3.2 Joining Type G fittings

Tightening the tubing connections

Tools

2 wrenches 10×12 (standard accessory)

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

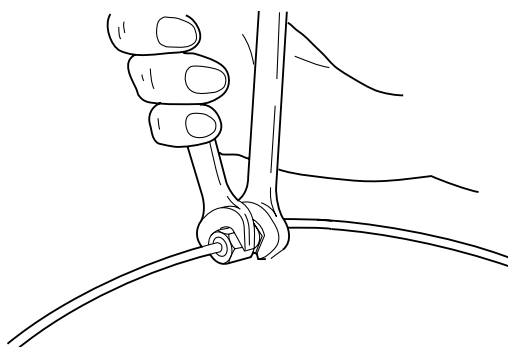


Fig. 1.3.3 Tightening the joints



■ Tubing between the gas cylinder and gas chromatograph

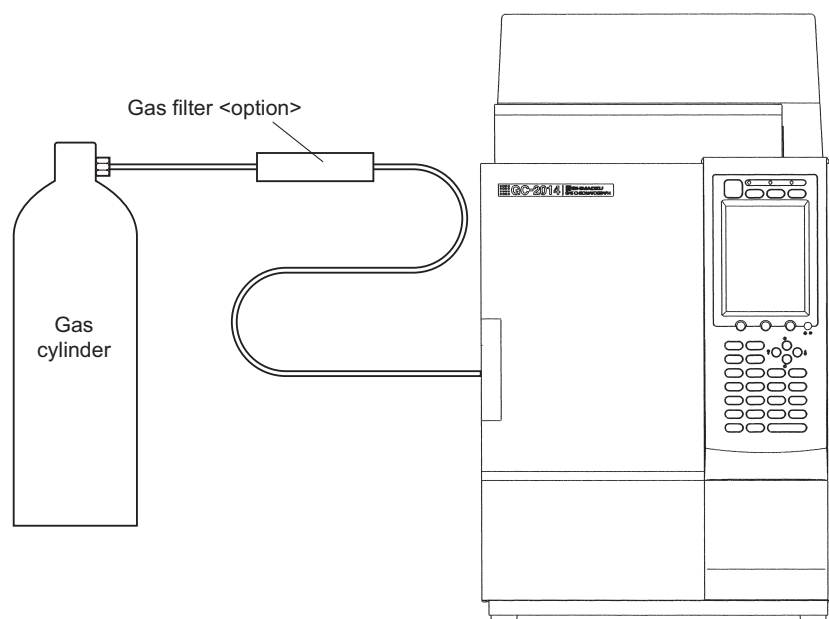


Fig. 1.3.4 Tubing between the gas cylinder and gas chromatograph

Use tubing with a 3 mm O.D. and 2 mm 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 30 mL/min carrier gas purging the filter.

Capacity: Approx. 200 mL

Absorbent: Molecular sieve 5 A

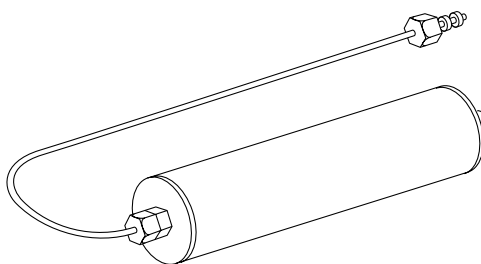


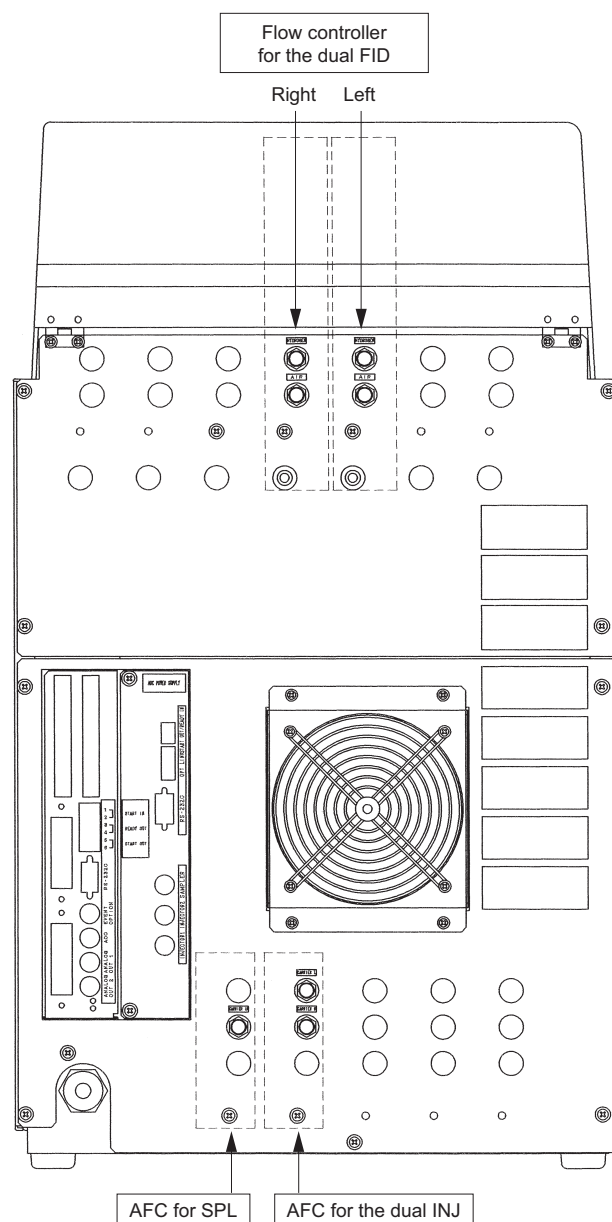
Fig. 1.3.5 Gas filter



■ Gas chromatograph tubing connections

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

Carrier gas	CARRIER
	(“L” and “R” mean the left and right side of dual INJ.)
Makeup gas	MAKE UP
Hydrogen	HYDROGEN
Air	AIR



Supply the carrier gas for the left inlet of the dual INJ to CARRIER L and the carrier gas for the right inlet of the dual INJ to CARRIER R.

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



■ Checking for gas leaks

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

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

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

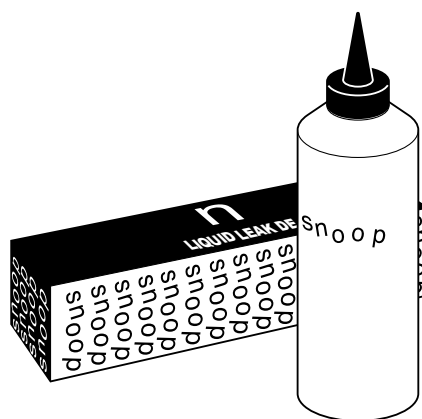


Fig. 1.3.7 Leak detecting fluid



This page is intentionally left blank.

2

Before Use

2.1 Setting Analytical Flow Lines

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

Setting analytical flow lines creates the following benefits during operation.

1. Conditions of analytical parameters for each line can be set and monitored.
For example, when the [SET] key of the gas chromatograph is pressed, temperatures of columns, injection ports, and detectors as well as carrier gas flow rate can be set and monitored on a single screen.
2. A protective mechanism operates to foster more stable operation conditions.
For example, when a carrier gas cylinder becomes empty while TCD is used, the flow controller detects an error and automatically lowers the column temperature and stops conduction to the TCD filament in order to prevent damage to the column and TCD filament.

The screenshot displays the 'Analysis Settings' screen for 'LINE 1'. The status at the top right is 'NOT READY'. The screen is divided into sections for 'Column Oven', 'Flow', 'INJ DINJ', and 'DET DTCD'. Each section shows a parameter name, a current value, and a target value. At the bottom, there are three menu options: 'File', 'LineConfig', and 'Customiz'.

Section	Parameter	Current Value	Target Value
Column Oven	Temp(°C)	0.0	25.0
	Flow		
Flow	Control Mode		Dual
	L.Inlet Prs(kPa)	0.0	
	L.Col. flow($\frac{ml}{min}$)	0.0	50.0
	R.Col. flow($\frac{ml}{min}$)	0.0	50.0
INJ DINJ	Temp(°C)	0.0	25.0
	DET DTCD		
DET DTCD	Temp(°C)	0.0	25.0

File LineConfig Customiz



■ Analytical flow lines

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

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

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

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

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

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

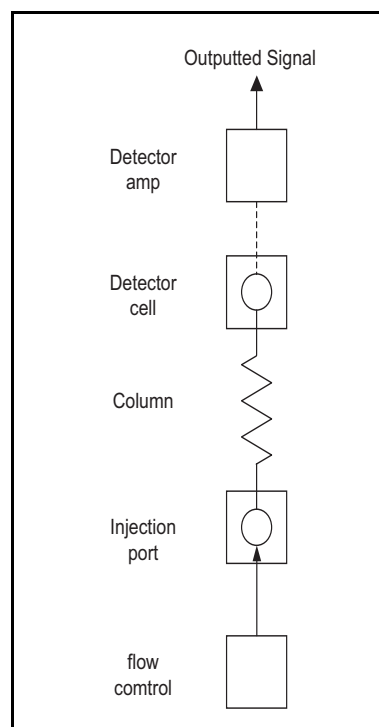


Fig. 2.1.1 Concept of analytical flow lines

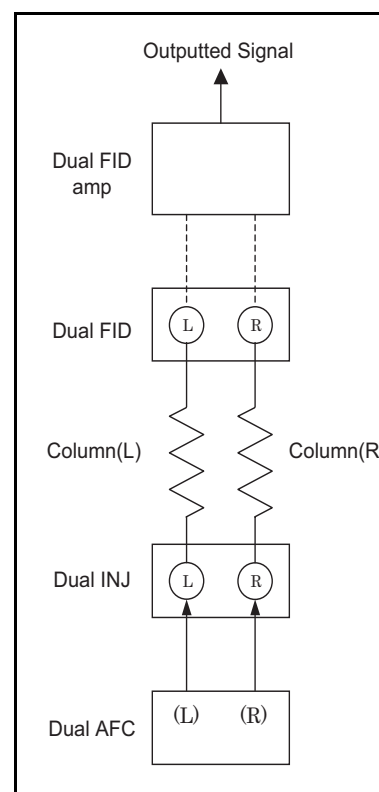


Fig. 2.1.2 An example of analytical flow lines



■ How to set lines

- (1) Press the [SET] key then press the [PF2] key (Line Config).
- (2) Move the cursor to the unit to be set in a line and select a line using [◀][▶] keys. Make sure to specify an injection port and a detector to which a column is connected in the same line. Any number from LINE1 through LINE4 can be selected.

The screenshot shows the 'Line Configuration' screen with three sections: 'Injector', 'Detector', and 'Option'. Each section has a 'LINE 1' label and a selection box. The 'Injector' section shows 'SPL' and 'DINJ'. The 'Detector' section shows 'DFID' and 'DTCD'. The 'Option' section shows 'AOC1' and 'AOC2'. At the bottom, there is a 'Return' button with a left arrow icon.

■ Precautions for setting analytical flow lines



CAUTION

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

1. Specify units to be used as part of a line.
Only units specified as part of a line are temperature-regulated.
Gas is controlled only for injection ports (flow controllers) specified as part of a line.
Examples
 - If an injection port that a column is connected is not specified as part of a line, carrier gas does not flow. If the column's temperature rises in this condition, the column may be damaged.
 - To keep feeding gas to units or maintain their temperature even though they will not be used for analysis for a while, specify the units as part of a line.
2. Remove the units not in use from a line.
Examples
 - If a detector without a column stays on a line, it may damage TCD filament or cause an error such as FID ignition error.
 - If the setting for the flow controller is turned OFF without removing an injector port without a column from a line, an error is detected and the protection mechanism works to lower the column temperature.
 - If a split/splitless injection port (SPL) without a column is not removed from a line, an error is detected and the protection mechanism works to lower the column temperature.

2.2 Before Use

2.2 Outputting Analog Signals to the Chromatopac

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

■ Connecting the Chromatopac signal cable

Connect the attached Chromatopac signal cable to the connector (ANALOG OUT1 or 2) on the back of the GC. (Fig. 2.2.1)

Using this cable, analog signals can be outputted and the Chromatopac can be started when the GC starts. (Refer to [“16.6.9 Setting the link device code”](#))

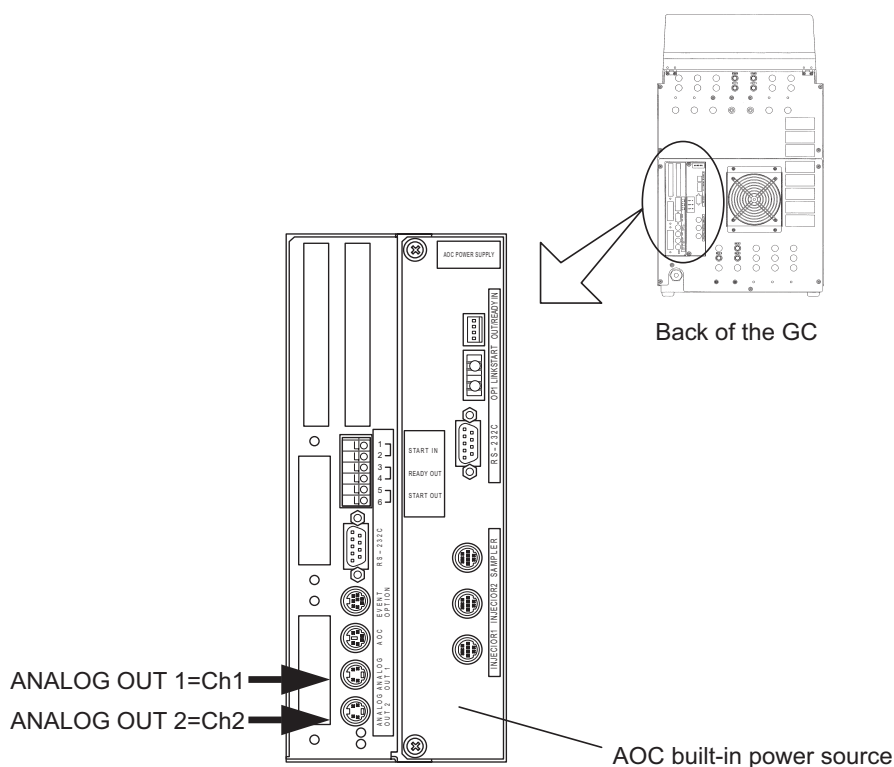


Fig. 2.2.1 Connecting the Chromatopac signal cable



■ Setting analog signal output

1. Set a line

- (1) Press the [SET] key then press the [PF2] key (Line Config).
- (2) Specify an injection port and detector to which a column is connected in the same line.
The screen on the right shows an example where a column is connected to the dual INJ and dual FID.

Line Configuration	
Injector	
_____	SPL
LINE 1 _____	DINJ
Detector	
LINE 1 _____	DFID
_____	DTCD
Option	
LINE 1 _____	AOC1
_____	AOC2
<div> <div>Return</div> <div></div> <div></div> </div>	

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

2. Set analog signal output.

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

“Signal Output Port”

Specify a connector number to output analog signals.

(ANALOG OUT 1 = Ch1, ANALOG OUT 2 = Ch2)

Channel number of a detector specified at the last is effective. (If TCD signal was outputted to Ch1 formerly and FID signal is newly specified to be outputted to Ch1 as shown in the screen on the right, TCD signal becomes OFF automatically.)

Detector	DET #2	NOT READY
DFID	LINE 1	On
Temp(°C)		300.0
Flame		Off
Signal Polarity		+
Filter Time Constant		200ms
Control Mode		Dual
<div> <div>Signal Output Port</div> <div>Ch1</div> </div>		
<div> <div>Background sig save</div> <div>Off</div> </div>		
<div> <div>Background sig comp.</div> <div>Off</div> </div>		
<div> <div>Det sig subtraction</div> <div>Off</div> </div>		
<div> <div>Signal Attenuation</div> <div>×2⁻¹</div> </div>		
<div> <div>Analog Signal Type</div> <div>Wide</div> </div>		
<div> <div>Ignite</div> <div>---</div> <div>Ign.Set</div> </div>		

**“Signal Attenuation” or “Signal Range”**

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

Signal attenuation: When analog signal type is wide

Output signal becomes smaller when the setting is changed from $\times 1 \rightarrow \times 2^{-1} \rightarrow \times 2^{-2} \rightarrow \times 2^{-3} \rightarrow \times 2^{-4}$

Signal range: When analog signal type is linear

Output signal becomes smaller when the setting is changed from $\times 1 \rightarrow \times 10^{-1} \rightarrow \times 10^{-2} \rightarrow \times 10^{-3} \rightarrow \times 10^{-4}$

“Analog Signal Type”

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

Wide : C-R8A, C-R7A, C-R7Aplus

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

■ Calibration of analog wide range signal

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

Perform calibration in the following cases.

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

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

The following is calibration procedures.

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

2.3 Before Use

2.3 Outputting Digital Signals to a Personal Computer

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

■ Connecting the RS-232C cable

Connect the RS-232C cable attached to GCsolution workstation to the connector on the back of the GC. (Fig. 2.3.1)

To connect one PC with more than one GCs, separate RS-232C cables are necessary and an expanded COM port needs to be attached to the PC.

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

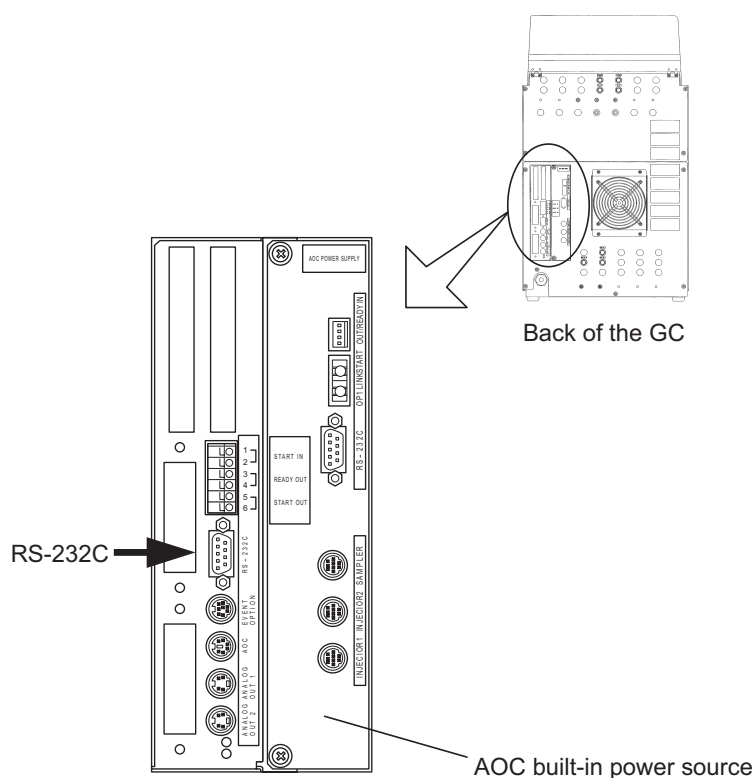


Fig. 2.3.1 Connection of RS-232C cable



■ Setting transmission parameters

- (1) Select "6. GC CONFIGURATION" on the [FUNC] key screen and then select "3. TRANSMISSION PARAMETER."
- (2) Set transmission parameters.
Protocol = LEVEL3
Baud rate (bps) = 115200
- (3) Press the [PF2] key (Apply).

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

Transmission Parameter	
Protocol	◀ LEVEL3
Baud Rate(bps)	115200
Stop Bit	-----
Parity	-----

↩Return	Apply	
---------	-------	--

2.4 Before Use

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

Connecting the GC-2014 and Chromatopac C-R8A with a RS-232C cable allows for various functions such as printing out parameters of the GC.

For detailed information about C-R8A, refer to its instruction manual.

■ Connecting RS-232C cable

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

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

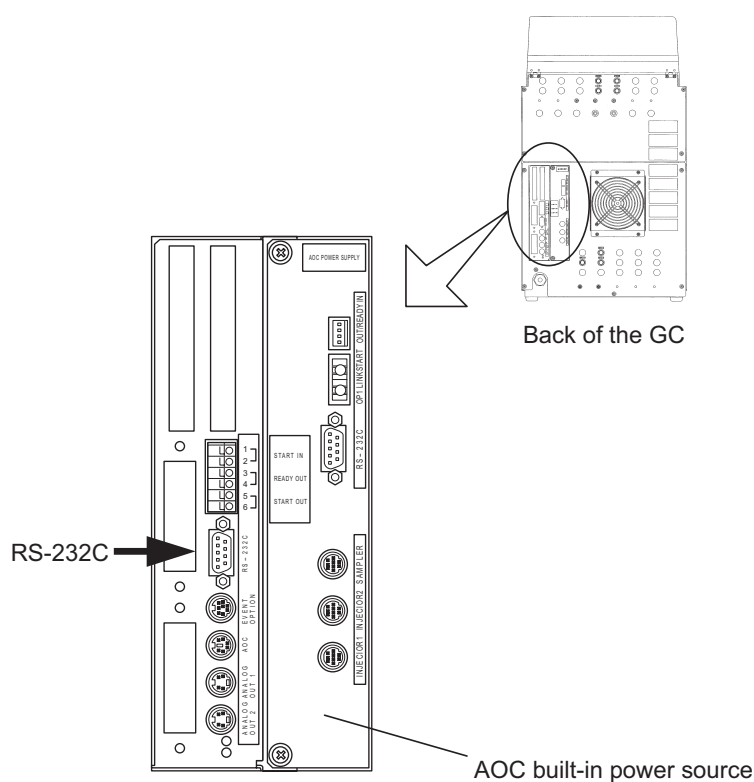


Fig. 2.4.1 Connection of RS-232C cable



■ Setting transmission parameters

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

1. Set transmission parameters for the GC

- (1) Select "6. GC CONFIGURATION" on the [FUNC] key screen and then select "3. TRANSMISSION PARAMETER."
- (2) Set transmission parameters.
Protocol = LEVEL2
Baud rate (bps) = 9600
Stop bit = 1 bit
Parity = EVEN
- (3) Press the [PF2] key (Apply).

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

Transmission Parameter	
Protocol	LEVEL2
Baud Rate(bps)	9600
Stop Bit	1bit
Parity	EVEN

Return Apply

2. Set transmission parameters for the C-R8A

- (1) Press the [CONFIG] key and then press the [T] key (T:TRS).
- (2) Press the [↓] key until the STD2 Port (RS-232C) Setup screen appears.

[PORT	MODE	#No.	BPS
STD2	12917	8	9600

- (3) Set transmission parameters.
MODE = 12917 (Protocol LEVEL2, Stop bit 1 bit, Parity EVEN)
#No. = 8 (logical port number)
BPS = 9600 (baud rate)
- (4) After completing setting, press the [EXIT] key and then press the [Y] key to save the settings.
- (5) After changing transmission parameters, reboot the C-R8A to enable the new settings.

■ Procedures to start digital transmission

After setting transmission parameters, start digital transmission.

1. Start digital transmission.

- (1) Type "OPEN TRS 8" using the C-R8A keyboard and press the [Enter] key.
- (2) The transmission port will open and transmission between the GC and C-R8A will start.

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

2.5

2 Before Use

Connecting Auto Injector/Auto Sampler AOC-20 Series

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

■ Cable connections

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

Connect the AOC power cable to the connector on the back of the GC and the auto injector or auto sampler.

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

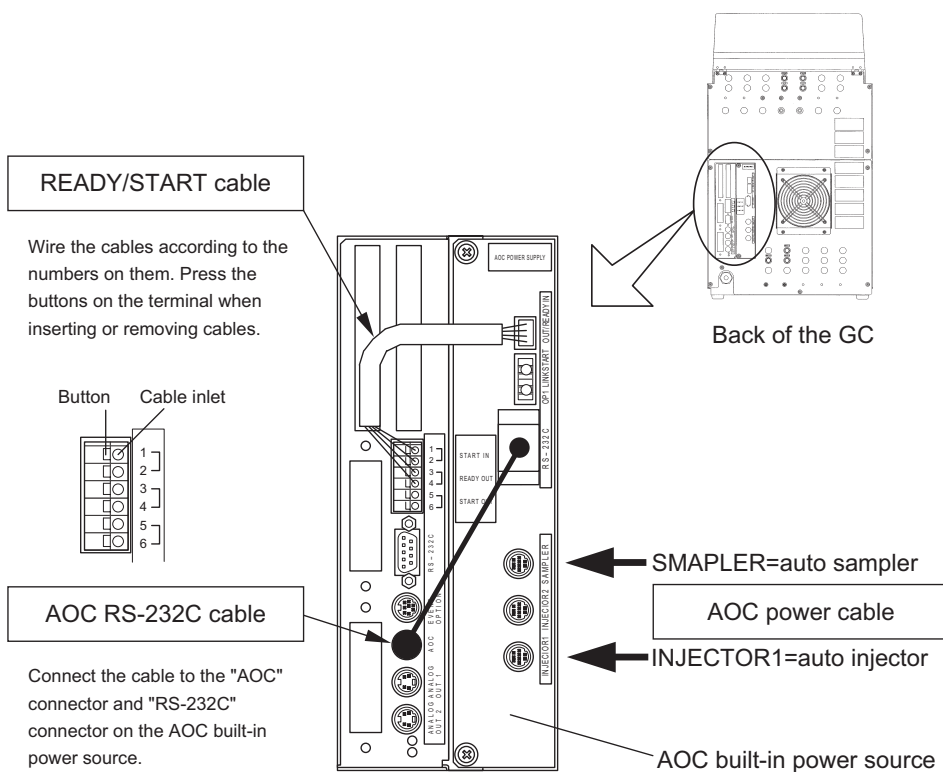


Fig. 2.5.1 Connection of the AOC-20 series



■ Setting AOC parameters

1. Set a line.

- (1) Press the [SET] key and then press the [PF2] key (Line Config).
- (2) Specify "AOC1" on the line with the injection port that the auto injector has been attached to.
- (3) The GC and AOC built-in power source will be automatically linked.

Line Configuration	
Injector	
LINE 1	SPL
LINE 1	DINJ
Detector	
LINE 1	DFID
	DTCD
Option	
LINE 1	AOC1
	AOC2
Return	

2. Set AOC parameters.

- (1) Press the [OPTION] key. If other option screens appear, press the [OPTION] key repeatedly until the AOC Parameter screen appears.
- (2) Set AOC parameters.
Parameters will be transmitted to the AOC as soon as they are set.

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

AOC Parameters		NOT READY
AOC1	LINE 1	Inactive
Single AOC-20i		
Sample Wash		2
Number of Injection		1
Sample Size(μl)		1.0
Pre Solvent Wash		0
Solvent Wash		1
Pumping		5
Viscosity(s)		0.2
Dwell Time(s)		0.0
Inj. Speed(Plunger)		Fast
AOC POWER		On
Start --- OtherPara		

2.6

Before Use

Connecting the Relay Terminals

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

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

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

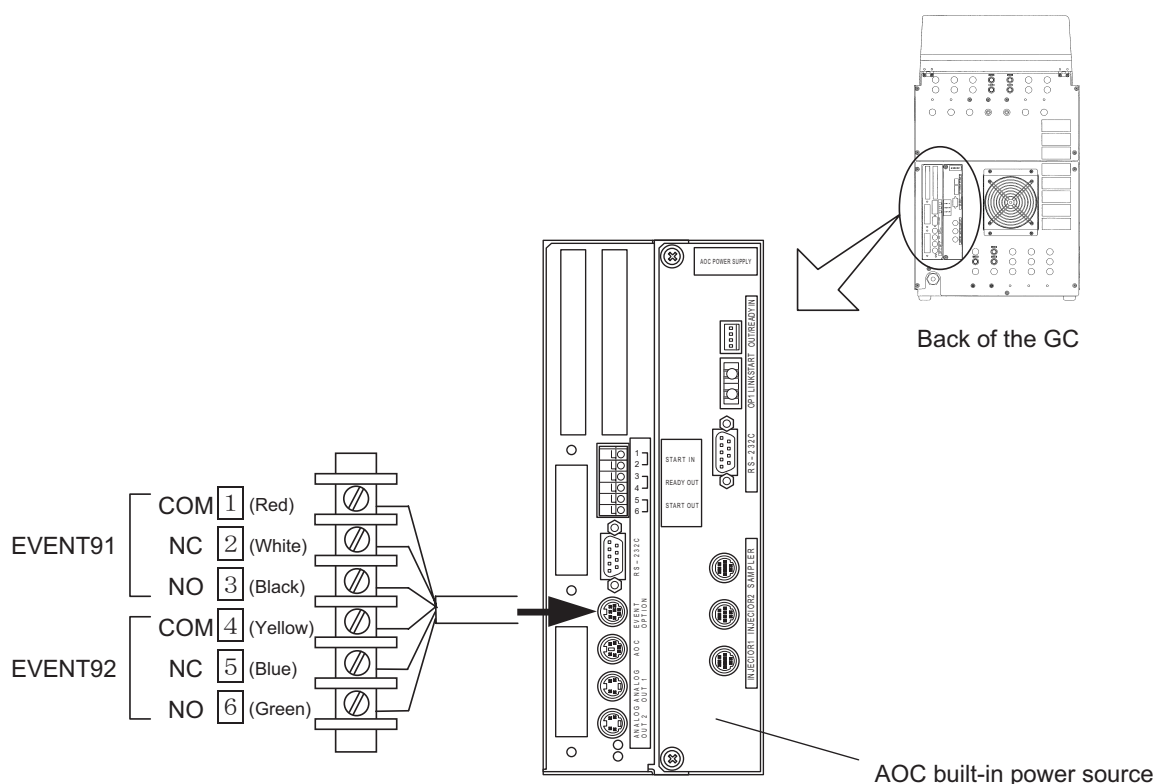


Fig. 2.6.1 Connecting a relay cable



This page is intentionally left blank.

3.1 Installing Packed Columns and Setting Analytical Flow Lines

3.1 Installation Location for Packed Columns

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

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

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

Installation location numbers indicate the positions of column connecting joints.

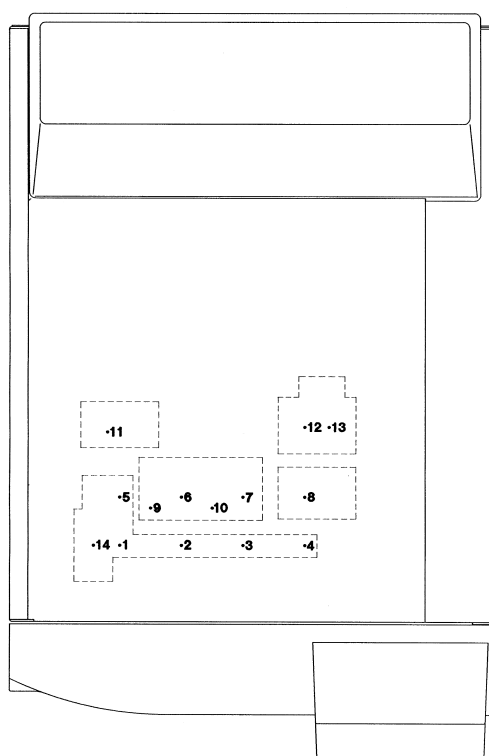


Fig. 3.1.1 Fig. 3.1.1 Installation location for injection ports/detectors for packed columns (layout viewed from the top of the unit)



3 Installing Packed Columns and Setting Analytical Flow Lines

3.1 Installation Location for Packed Columns

Check which units the joints found on the column oven correspond to.

Fig. 3.1.2 shows the layout for the GC-2014ATF+SPL model.

Left and right sides viewed from the front of the unit are indicated as L (left) and R (right) respectively.

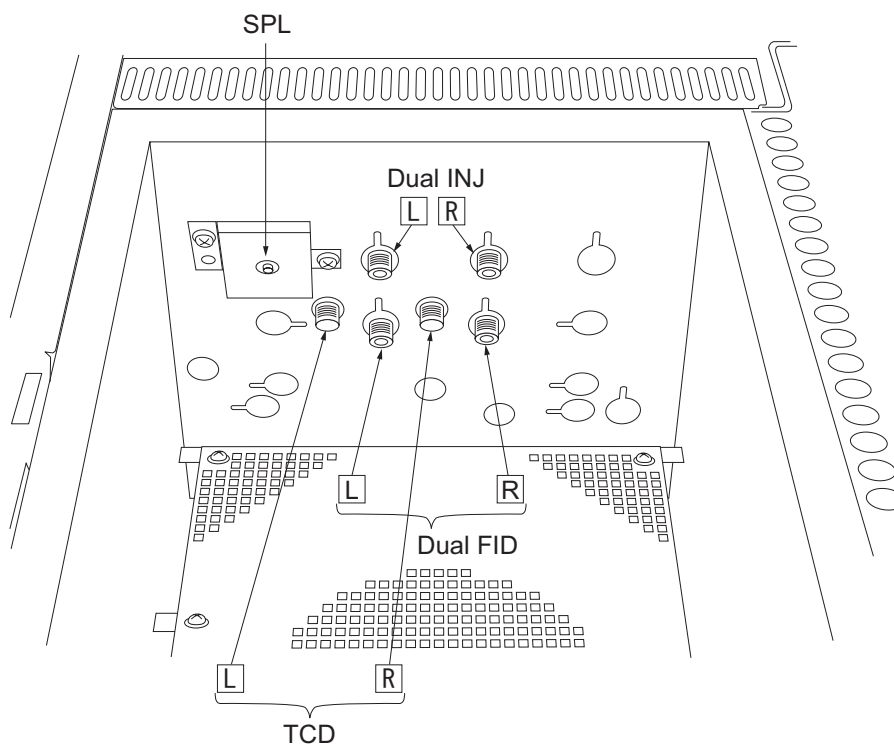


Fig. 3.1.2 Column connecting joints (GC-2014ATF+SPL model)

3

3 Installing Packed Columns and Setting Analytical Flow Lines

3.2 Dual-Column Packed FID Analysis

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

Dual-column configuration is used in following cases.

1. Same type of columns are connected to the left and right sides in order to background-compensate the increase of the baseline during programmed temperature analysis.
2. Different types of columns are connected to the left and right sides in order to obtain a different chromatogram when a sample is injected to the left (L) side and right (R) side of the dual INJ.

NOTE Do not cross the columns (L/R). It hinders correct analysis.

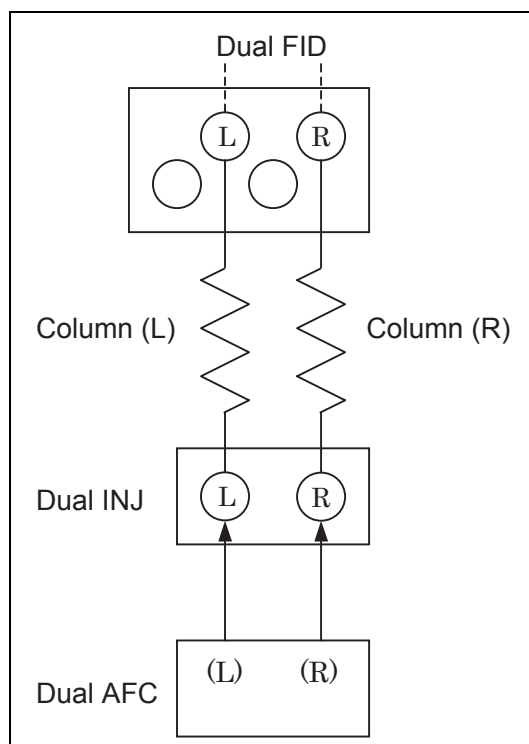


Fig. 3.2.1 Dual-column configuration



■ Setting analytical flow lines

Setting analytical flow lines is described below.

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

1. Set a line.

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

Line Configuration

Injector

SPL

LINE 1 DINJ

Detector

LINE 1 DFID

DTCD

Option

LINE 1 AOC1

AOC2

Return

2. Set the dual AFC.

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

Flow CAR2 NOT READY

DINJ LINE 1 Off

Control Mode Dual

Left

L.Inlet Prs(kPa) 0.0

L.Col. flow($\frac{\text{mL}}{\text{min}}$) 0.0 50.0

L.Carrier gas type N2

Right

R.Inlet Prs(kPa) 0.0

R.Col. flow($\frac{\text{mL}}{\text{min}}$) 0.0 50.0

R.Carrier gas type N2

Column --- On/Off



3. Set the dual FID.

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

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

Detector DET #2		READY
DFID	LINE 1	On
Temp(°C)	150.0	150.0
Flame		On
Signal Polarity		+
Filter Time Constant		1s
Control Mode		Dual
<hr/>		
Signal Output Port		Ch1
Background sig save		Off
Background sig comp.		Off
Det sig subtraction		Off
Signal Range		$\times 10^{-1}$
Analog Signal Type		Linear
<hr/>		
Ignite	---	Ign.Set

3

3 Installing Packed Columns and Setting Analytical Flow Lines

3.3 Single-Column Packed FID Analysis

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

Single-column configuration is used in following cases.

1. Background-compensation is unnecessary because the baseline level does not increase during isothermal analysis.
2. Background-compensation is unnecessary because the baseline level does not increase so much even during programmed temperature analysis.

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

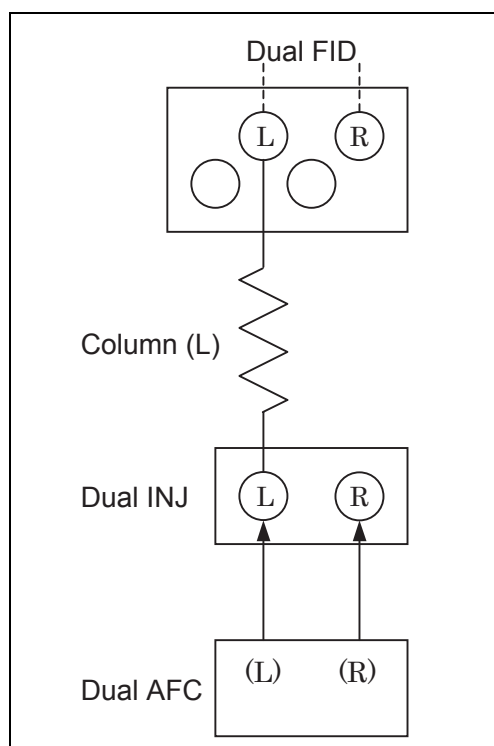


Fig. 3.3.1 Single-column configuration (FID)
(A column is connected to the left (L) sides.)



■ Setting analytical flow lines

Setting analytical flow lines is described below.

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

1. Set a line.

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

```

Line Configuration
-----
Injector
  LINE 1  SPL
          DINJ
-----
Detector
  LINE 1  DFID
          DTCD
-----
Option
  LINE 1  AOC1
          AOC2
-----
Return
  
```

2. Set the dual AFC.

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

```

Flow CAR2          NOT READY
DINJ LINE 1        On
Control Mode       Single L
                   Left
L.Inlet Prs(kPa)   150.0
L.Col. flow(ml/min) 50.0 50.0
L.Carrier gas type N2
-----
Column --- On/Off
  
```

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



3. Set the dual FID.

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

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

Signal Output Port		Ch1
Background sig save		Off
Background sig comp.		Off
Det sig subtraction		Off
Signal Attenuation		x1
Analog Signal Type		Wide

Ignite	---	Ign.Set F

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

3

3 Installing Packed Columns and Setting Analytical Flow Lines

3.4 Packed TCD Analysis

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

Dual-column configuration is used in following cases.

1. Almost equal columns are connected on the left and right sides to balance TCD's zero point for analysis.
2. Different types of columns are connected to the left and right sides in order to obtain a different chromatogram when a sample is injected to the L and R of the dual INJ.

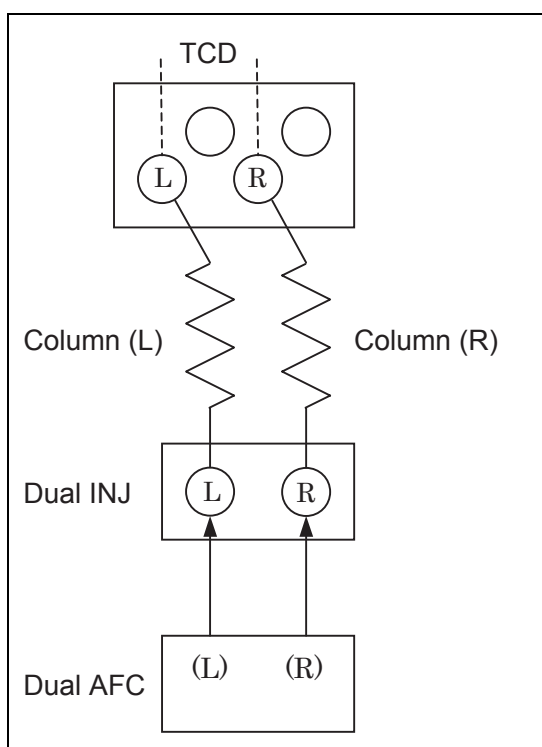


Fig. 3.4.1 Dual-column configuration (TCD)



CAUTION

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

NOTE

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



■ Setting analytical flow lines

Setting analytical flow lines is described below.

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

1. Set a line.

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

```
Line Configuration
Injector
  SPL
  LINE 1 DINJ
Detector
  DFID
  LINE 1 DTCD
Option
  LINE 1 AOC1
  AOC2

Return
```

2. Set the dual AFC.

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

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

Column --- On/Off
```



3. Set the TCD.

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

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

Detector DET #3		NOT READY
DTCD	LINE 1	On
Temp(°C)	0.0	300.0
Temp(°C)	0.0	300.0
Signal Polarity		+
Current(mA)		30
Filter Time Constant		1s
<hr/>		
Signal Output Port		Ch1
Background sig save		Off
Background sig comp.		Off
Det sig subtraction		Off
Signal Attenuation		x1
Analog Signal Type		Wide
<hr/>		
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		

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

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

Injection Monitor		READY
LINE 1	0000.00.00()	00:00:00
Ready for Injection Left Port:		
<div> <div>Retention Time</div> <div>-100 0 100</div> </div>		
<div> <div>8 2 Atten 4 6 Speed</div> <div>Scroll</div> </div>		
<div> <div>Temp Mon</div> <div>Flow Mon</div> <div>Zero Adj</div> </div>		

3

3 Installing Packed Columns and Setting Analytical Flow Lines

3.5 Packed Analysis Using the Single DET

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

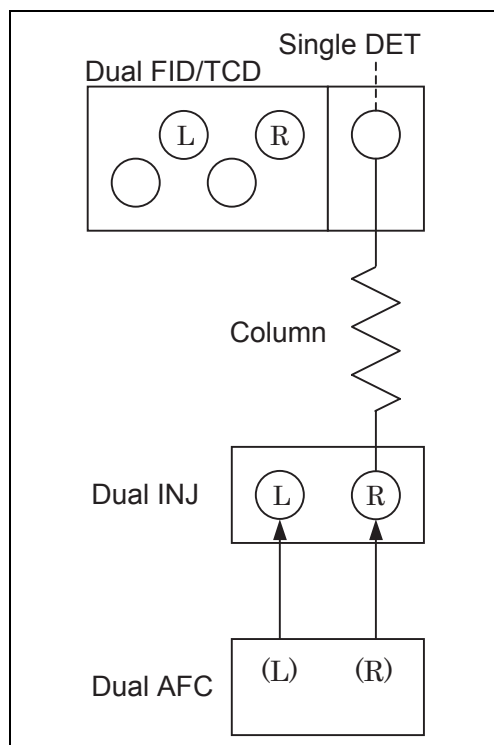


Fig. 3.5.1 Single DET configuration

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



CAUTION

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



■ Procedures to move the dual INJ



WARNING

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



CAUTION

Some insulation materials include ceramic fibers.
Refer to “When Handling Insulation” of “Introduction” in the GC-2014 Operation manual before you handle these materials.



CAUTION

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

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

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

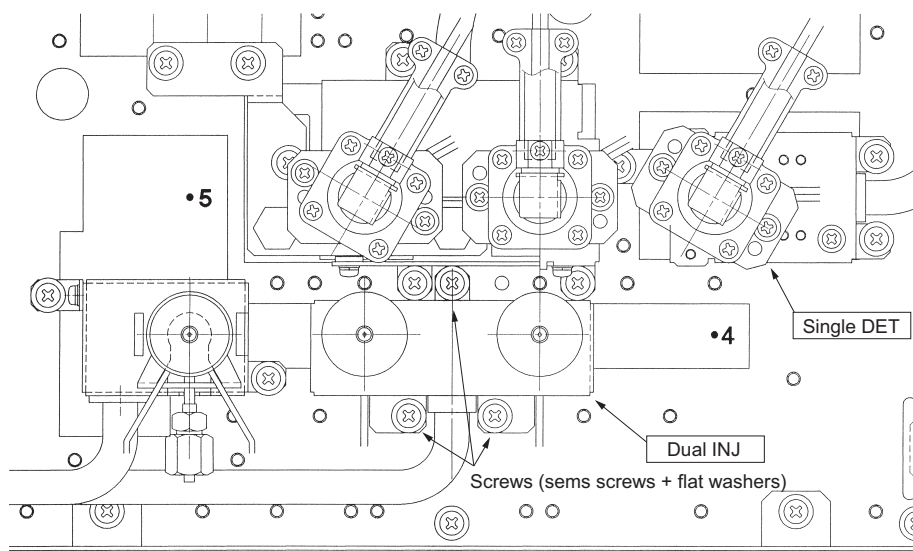


Fig.3.5.2 (a)



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

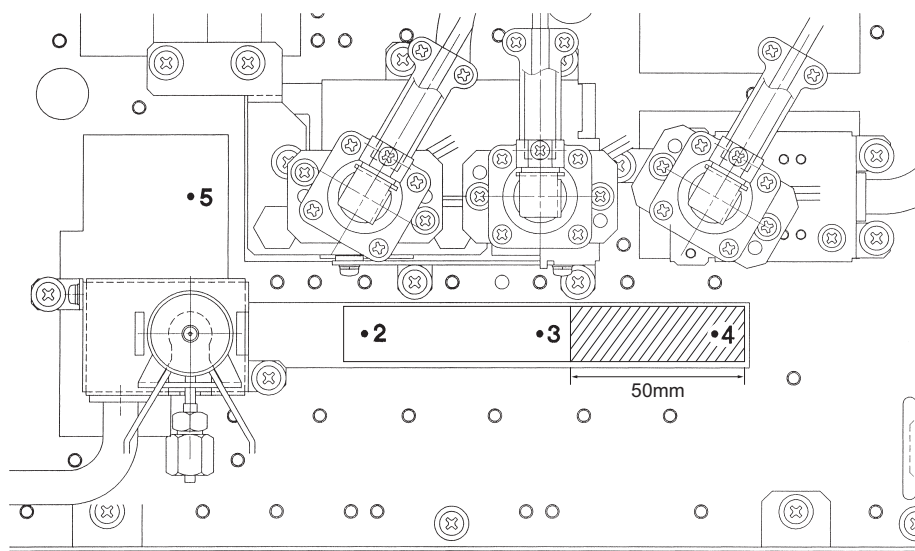


Fig.3.5.2 (b)

- (9) Insert the dual INJ on top of the heat insulator that has been taken out in step (6) and fasten it with three screws. (Refer to Fig. 3.5.2 (c)).
- (10) Connect the wiring that has been removed in step (4) to the dual INJ as it was originally.

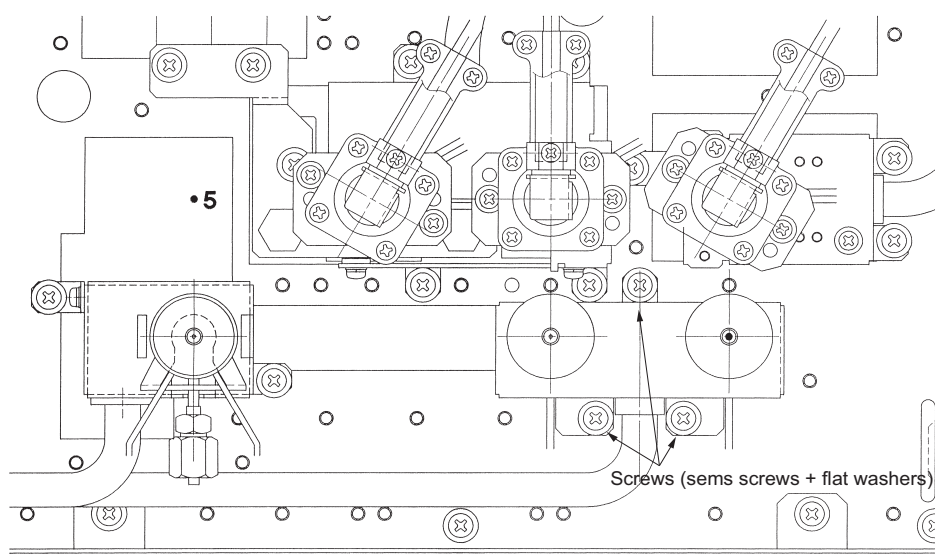


Fig.3.5.2 (c)



■ Setting analytical flow lines

Setting analytical flow lines is described below.

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

1. Set a line.

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

```

Line Configuration
-----
Injector
  LINE 1  SPL
  LINE 1  DINJ
-----
Detector
  LINE 1  SFID
  LINE 1  DFID
  LINE 1  DTCD
-----
Option
  LINE 1  AOC1
  LINE 1  AOC2
-----
Return
  
```

2. Set the dual AFC.

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

```

Flow CAR2 READY
DINJ LINE 1 On
Control Mode Single R
Right
R.Inlet Prs(kPa) 200.0
R.Col. flow(ml/min) 50.0 50.0
R.Carrier gas type N2
-----
Column --- On/Off
  
```

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



This page is intentionally left blank.

4.1

4 Installing Capillary Columns and Setting Analytical Flow Lines

Installation Location for Capillary Columns

Injection ports and detectors for capillary columns can be installed in positions described in Table 4.1.1 and Fig. 4.1.1.

(Injection ports and detectors that can be used for packed columns are included.)

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

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

Installation location numbers indicate the positions of column connecting joints.

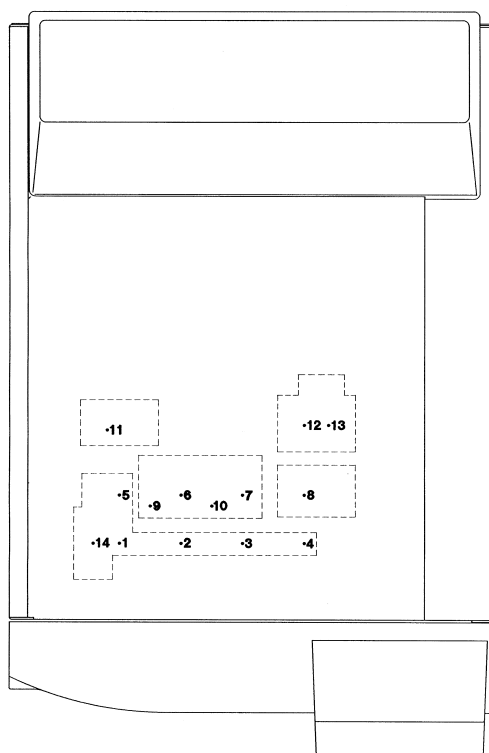


Fig. 4.1.1 Installation location for injection ports/detectors for capillary columns
(layout viewed from the top of the unit)



Check which units the joints found on the column oven correspond to.

Fig. 4.1.2 (a) and (b) show the layout for the GC-2014ATF+SPL model and GC-2014AFsc model. Left and right sides viewed from the front of the unit are indicated as L (left) and R (right) respectively.

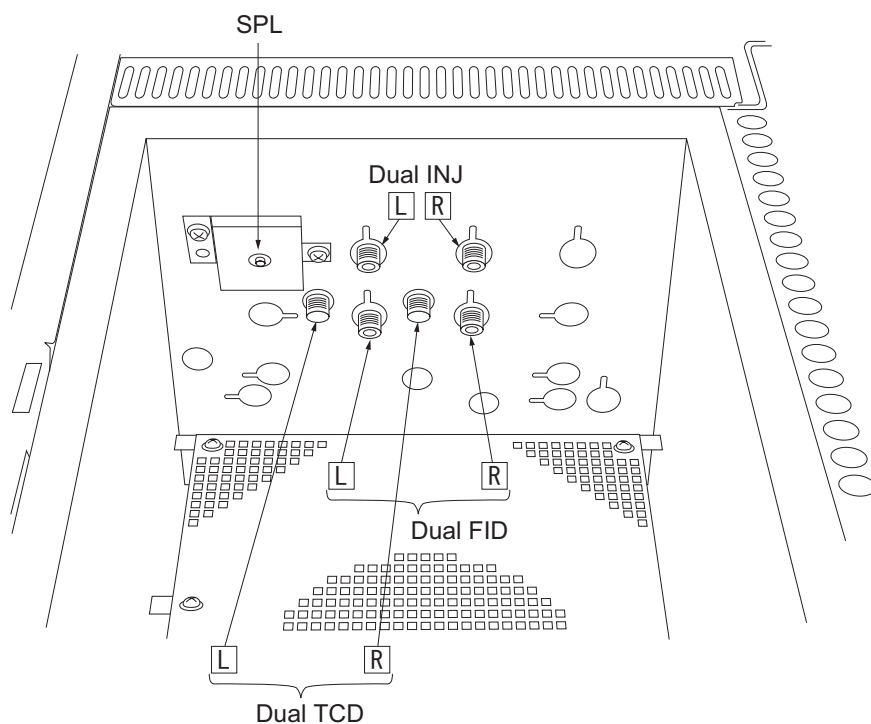


Fig.4.1.2 (a) Column connecting joints (GC-2014ATF+SPL model)

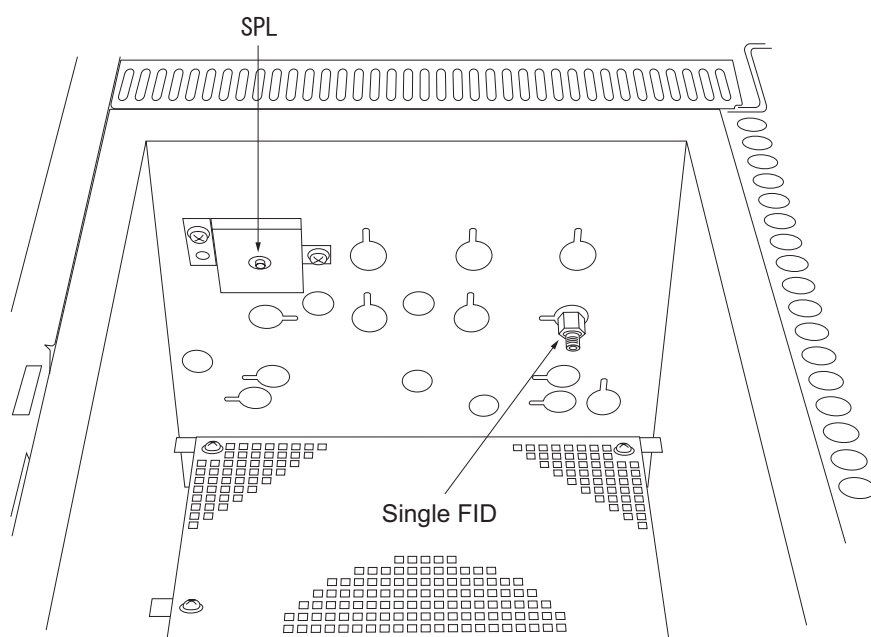


Fig.4.1.2 (b) Column connecting joints (GC-2014AFsc model)

4.2

4 Installing Capillary Columns and Setting Analytical Flow Lines

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

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

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

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

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

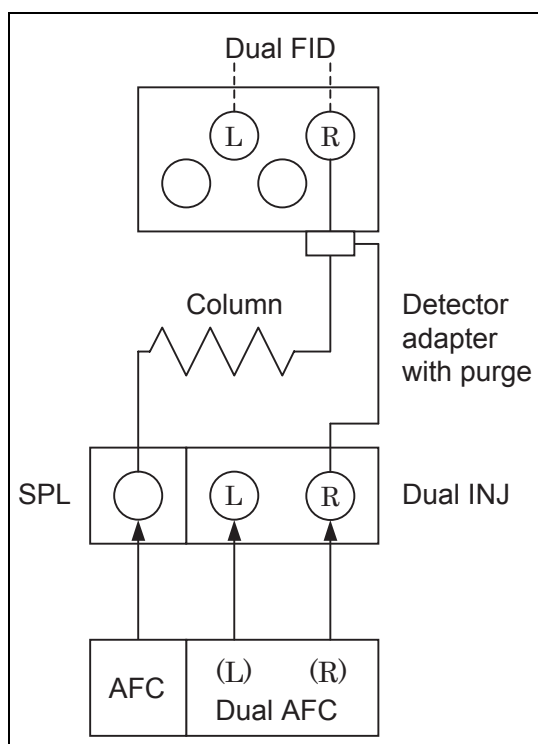


Fig. 4.2.1 Dual FID (detector adapter)



■ Setting analytical flow lines

Setting analytical flow lines is described below.

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

1. Change the dual AFC configuration.

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

Other Configurations

Language English

Backlight auto off (sec) 0

Pressure unit kPa

Beep volume Hig

Beep tone Hi

Atmospheric compensation Off

Zero at Ready On

Polarity in Ready Open

SPL Primary Press 500-900kPa

DAFC Unit AMC.LR

DTCD Preamplifier x1

Return

2. Set a line.

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

Line Configuration

Injector

LINE 1 SPL

Detector

LINE 1 DFID

DTCD

Option

LINE 1 AOC1

AOC2

Return

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



3. Set the makeup gas flow rate.

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

AUX AMC		READY
AMC.L		Off
Press(kPa)	0.0	
Flow($\frac{\text{ml}}{\text{min}}$)	0.0	30.0
		N ₂
<hr/>		
AMC.R		On
Press(kPa)	10.0	
Flow($\frac{\text{ml}}{\text{min}}$)	30.0	30.0
		He
<hr/>		
		▼
Offset	Next	On/Off

4. Set the dual FID.

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

Detector DET #2		READY
DFID	LINE 1	On
Temp(°C)	150.0	150.0
Flame		On
Filter Time Constant		200ms
Control Mode	◀ Single R	
<hr/>		
Signal Output Port		Ch1
Background sig save		Off
Background sig comp.		Off
Det sig subtraction		Off
Signal Attenuation		×1
Analog Signal Type		Wide
<hr/>		
Ignite	---	Ign.Set

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

4

4 Installing Capillary Columns and Setting Analytical Flow Lines

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

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

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

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

Although an adapter and column are connected to the right (R) side of the dual FID in the figure below, they can be connected to either side (L/R).

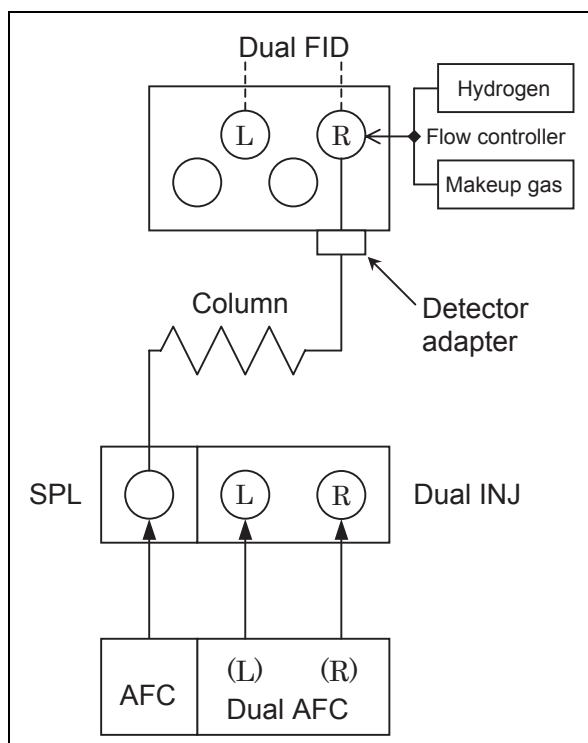


Fig. 4.3.1 Dual FID (flow controller)



■ Setting analytical flow lines

Setting analytical flow lines is described below.

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

1. Set a line.

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

```

Line Configuration
-----
Injector
LINE 1  SPL
        DINJ
-----
Detector
LINE 1  DFID
        DTCD
-----
Option
        AOC1
        AOC2
-----
Return
  
```

2. Set the dual FID.

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

```

Detector DET #2 NOT READY
DFID LINE 1 On
Temp(C) 0.0 150.0
Flame Off
Filter Time Constant 200ms
Control Mode Single R
-----
Signal Output Port Ch1
Background sig save Off
Background sig comp. Off
Det sig subtraction Off
Signal Attenuation x1
Analog Signal Type Wide
-----
Ignite --- Ign.Set
  
```

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

4.4

4 Installing Capillary Columns and Setting Analytical Flow Lines

Capillary TCD Analysis

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

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

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

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

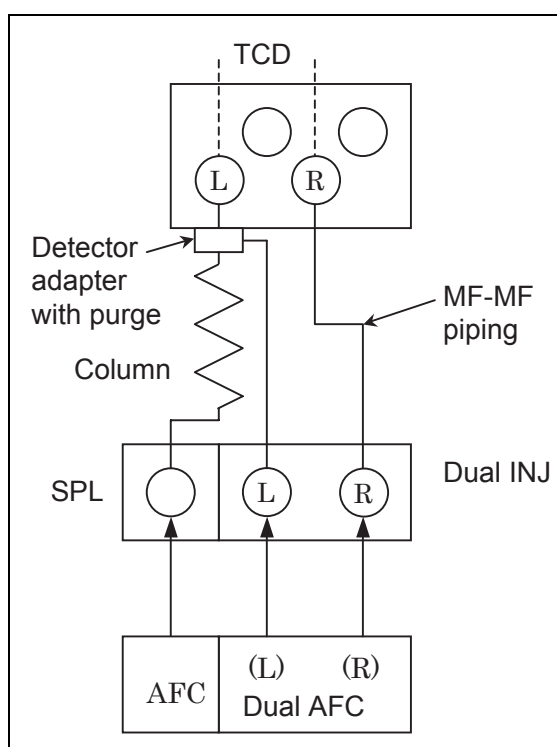


Fig. 4.4.1 Capillary TCD

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



CAUTION

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



■ Setting analytical flow lines

Setting analytical flow lines is described below.

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

1. Change the dual AFC configuration.

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

```

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

Return
    
```

2. Set a line.

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

```

Line Configuration
Injector
LINE 1  SPL
Detector
DFID
LINE 1  DTCD
Option
LINE 1  AOC1
AOC2

Return
    
```

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



3. Set the makeup gas/reference gas flow rates.

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

AUX AMC		NOT READY	
AMC.L		On	
Press(kPa)	0.0		
Flow($\frac{\text{mL}}{\text{min}}$)	0.0	30.0	
		He	
<hr/>			
AMC.R		On	
Press(kPa)	0.0		
Flow($\frac{\text{mL}}{\text{min}}$)	0.0	30.0	
		He	
<hr/>			
Offset		Next	On/Off

4. Set the TCD.

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

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

Detector DET #3		NOT READY	
DTCD <u>LINE 1</u>		On	
Temp(°C)	0.0	300.0	
Temp(°C)	0.0	300.0	
Signal Polarity		+	
Current(mA)		30	
Filter Time Constant		1s	
<hr/>			
Signal Output Port		Ch1	
Background sig save		Off	
Background sig comp.		Off	
Det sig subtraction		Off	
Signal Attenuation		x1	
Analog Signal Type		Wide	
<hr/>			
---		---	---



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

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

4.5 Single DET

To perform capillary analysis using a unit with the single DET (single FID, ECD, FPD, and capillary FTD), makeup gas is used as described below.

Install the detector adapter to the detector joint then install a column. Detector adapter comes with all single DET units listed above.

Single FID, ECD, and capillary FTD

A makeup gas flow controller comes with them.

FPD

Makeup gas is unnecessary.

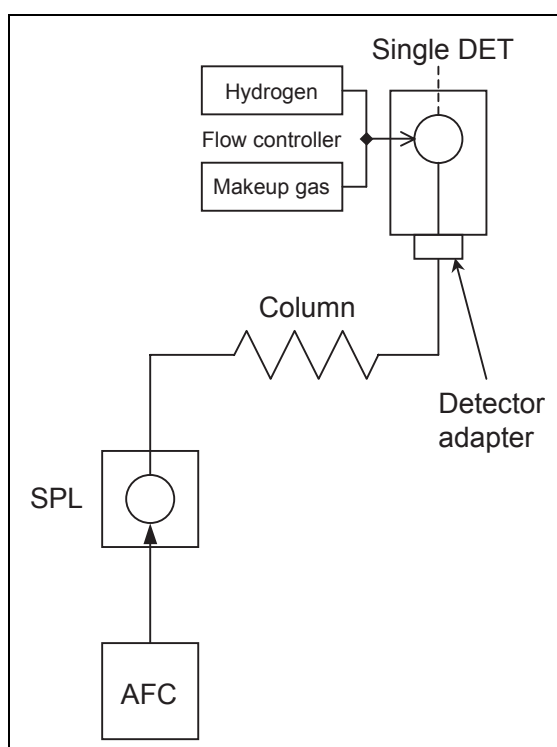


Fig. 4.5.1 Single DET (In case of FID)



■ Setting analytical flow lines

Setting analytical flow lines is described below.

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

1. Set a line.

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

The screenshot shows a terminal window titled "Line Configuration". It contains three sections, each with a header and a list of items:

- Injector**: A list with "LINE 1" and "SPL".
- Detector**: A list with "LINE 1" and "SFID".
- Option**: A list with "LINE 1" and "AOC1", followed by "AOC2" on the next line.

At the bottom of the screen, there is a "Return" button with a left-pointing arrow.



This page is intentionally left blank.

5 Analysis

5.1 Analysis Flow Chart

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

5.1.1 Preparation

Injection port preparation	Select an injection port suitable to the sample injection method. Confirm that the septum and insert are properly attached. Check dirt on the septum and the number of injections and replace it when necessary (after approximately 100 injections).
Column preparation	Attach the column to the injection port and detector correctly.
<u>When the above preparations are complete, turn ON the GC (power switch on the lower right side of the GC).</u>	

5.1.2 Setting Parameters

Set the column information and the flow rates	Set parameters on the [FLOW] key screen. Set the column inner diameter, column length, and the film thickness on [Column] (PF menu). For the SPL and WBL, set the purge flow rate on [Purge] as well. (When the column flow rate is set by the AFC, changing the column temperature changes the column flow rate.)
Set the temperature of the detector and the injection port	Set the temperatures on the [INJ] and [DET] key screens. (If the detector is set to "Off," turn it "On.") When the APC is used, set hydrogen, air, makeup gas, etc. from [DET Gas] (PF menu).
Set the COL temperature and the temperature program	From the screen of the [COL] key, set the column initial temperature and the temperature program. Temperature settings must be within the allowable column and detector ranges.
Start GC control	Press the [SYSTEM] key to display the main screen. Press [Start GC] (PF menu) to start GC control. Press the [MONIT] key, and ensure that the temperature of each zone, the gas flow rate, the gas pressure, etc. are correct.
Set the detector	From the screen of the [DET] key, set the range and the time filter constant. Ensure that the temperature of the detector is rising, then ignite the FID or set the TCD current value.

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

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

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



5.1.3 Analysis

Set the data processing unit

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

Check the baseline

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

Inject the sample

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



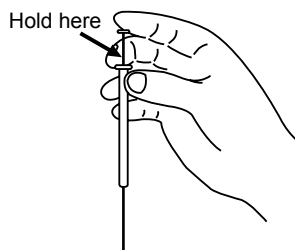
WARNING

Wear protective goggles when using a syringe to inject samples.

The syringe plunger could be expelled due to injection port back pressure. Sample could get into the eyes.

By holding and supporting the plunger from the side with your middle finger, you can smoothly inject the sample and keep the plunger in the syringe.

Do not bend the plunger when holding the syringe in this position.



(Example)
How to hold a syringe
when injection

5

5 Analysis

5.2 Notes for Analysis

■ Analytical column

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

■ Sample injection modes(Capillary column analysis)

[Split injection]

In capillary columns, the inner diameter is small and the sample load capacity is low. Unlike packed columns, only a small (1-2 μL) amount of sample can be injected at onetime. The split injection mode only allows part of the injected sample to enter the column. This method is useful for samples of high 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 in the column by temporarily suspending the split flow.

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

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

[Direct injection]

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

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



■ Setting the heated zone temperatures

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

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

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

■ Column temperature program

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

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

■ Injection counter

The injection port septum and the glass insert are required to be inspected and replaced periodically. The GC-2014 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-2014 is designed to control the temperatures so that the column temperature never exceeds the detector temperature, even if all temperatures are set to increase at the same time.

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



■ Shutting down the GC

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

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

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

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

■ Obtaining reproducible analysis results

Follow these suggestions to obtain reproducible results:

- Using an AOC-20i auto injector is suggested in order to inject a sample to obtain highly reproducible results.
- Do not increase the temperatures of unused injection ports.
- The GC is designed to perform optimally at room temperatures of 18-28 °C. Room temperatures above 28 °C will negatively impact reproducibility.



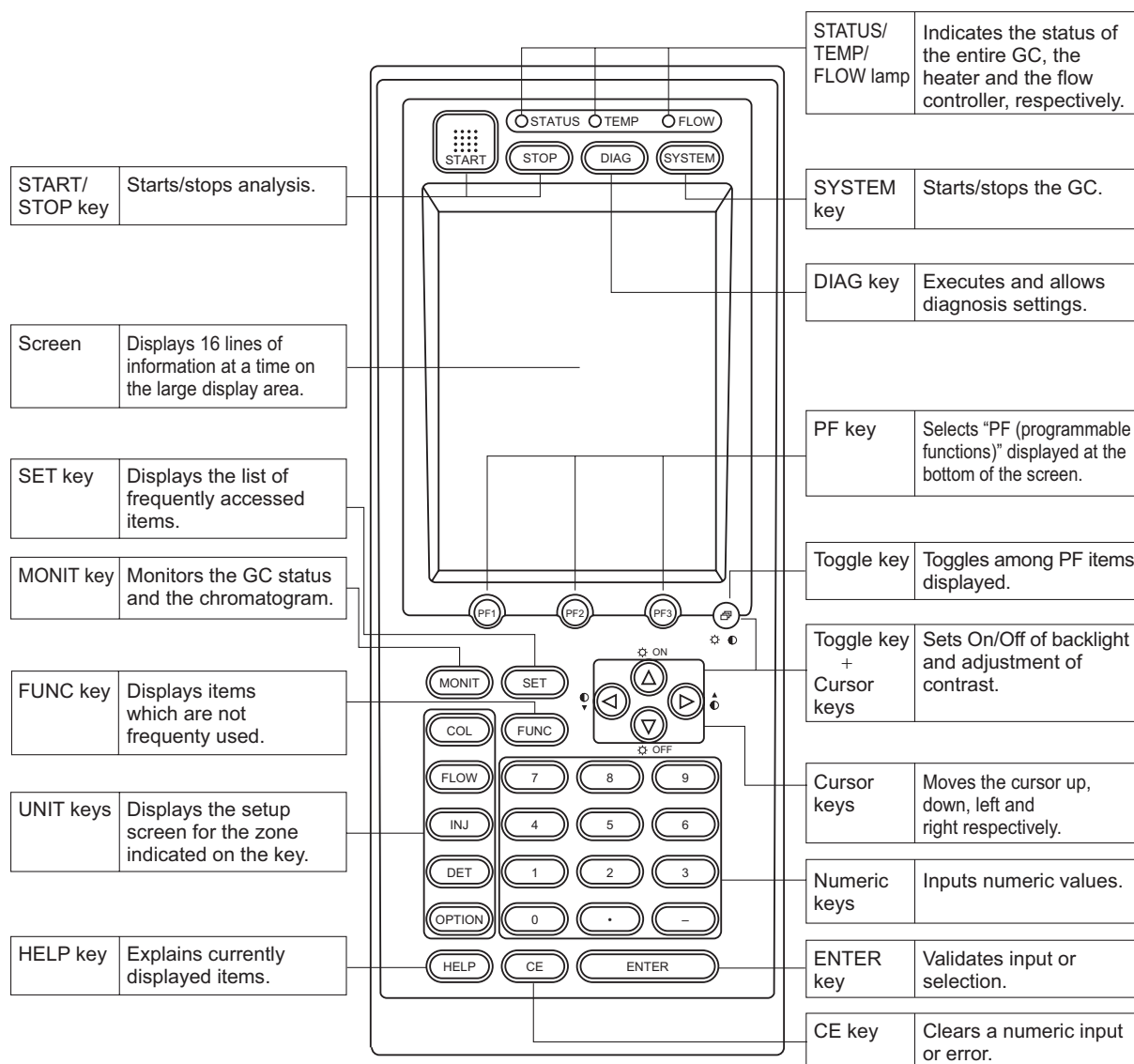
This page is intentionally left blank.

6.1

6 Basic Key Operation

Keypad Description and Operation

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





6.1.1 Keypad operation

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

Name	Function
START key	Starts the temperature program, pressure/flow rate program and time program. If a Pre-Run program is set, the Pre-Run program starts.
STOP key	Stops the program.
DIAG key	Performs unit self-diagnosis. Also, used for maintenance functions such as confirmation of various logs, part replacement status, and standard signal out put.
SYSTEM key	Starts/stops GC. Manages the analytical condition file.
PF key	Selects the PF menu displayed at bottom of the screen. (PF = programmable function)
Toggle key	Toggles through the PF menu displayed at bottom of the screen.
MONIT key	Monitors the GC status and analysis status. Displays the GC temperature, pressure and flow rate status for each heated zone, as well as chromatograms.
SET key	Accesses commonly-used items, such as temperature, pressure and flow rate for each component on one screen. Manages the analytical condition file like the [SYSTEM] key.
FUNC key	Accesses less frequently used items.
COL key	Sets the oven temperature program.
FLOW key	Sets the carrier gas flow rate parameters, such as pressure, flow rate and split ratio.
INJ key	Sets the temperature of injection port (or temperature program for an OCI/PTV).
DET key	Sets the detector temperature, range and current or other detector-related parameters.
OPTION key	Sets the parameters for auto injector, AUX temperature controller, AUX APC, AUX AMC, and CRG.
HELP key	Describes the procedure and suggests valid parameter ranges. Jumps to a desired item using an index function.
Cursor key [△], [▽], [◀] and [▶]	Moves cursor up, down, left and right. A blinking cursor indicates the location of parameter value entry. [◀] and [▶] keys may be used to change the selection.
Numeric keys [0] ~ [9]	Enter numeric values.
Clear key [CE] key	<ul style="list-style-type: none">• Clears the current numeric value.• Clears display and alarm during an error.
ENTER key	Validates parameter input or item selection.



6.1.2 Screen

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

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

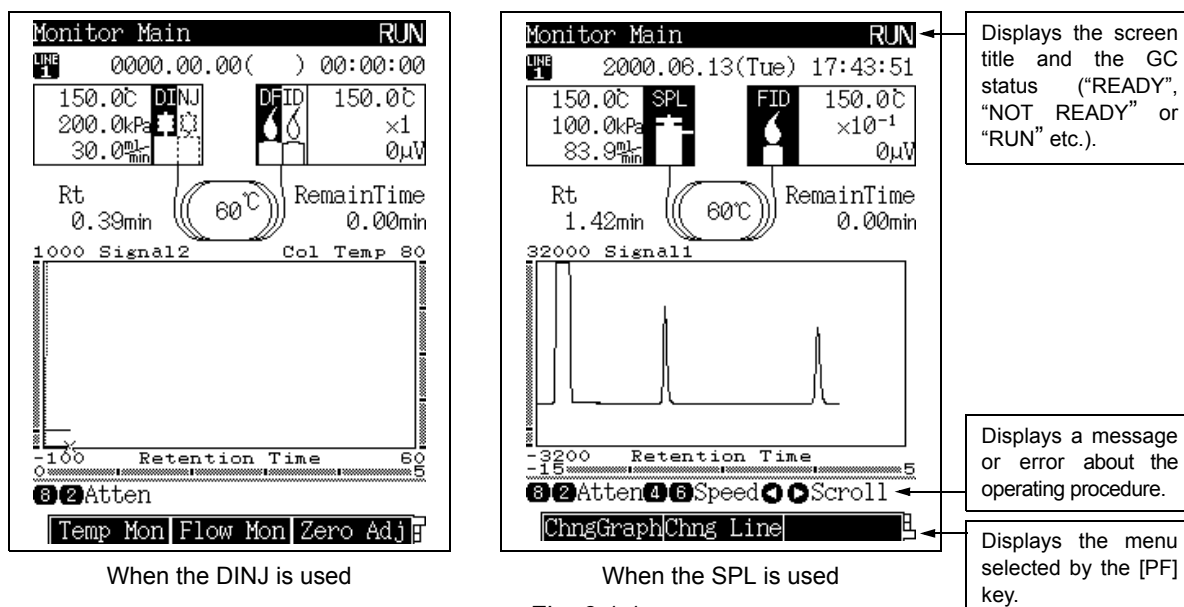


Fig. 6.1.1

■ [Return] (PF menu)

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

■ Actual and set values

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

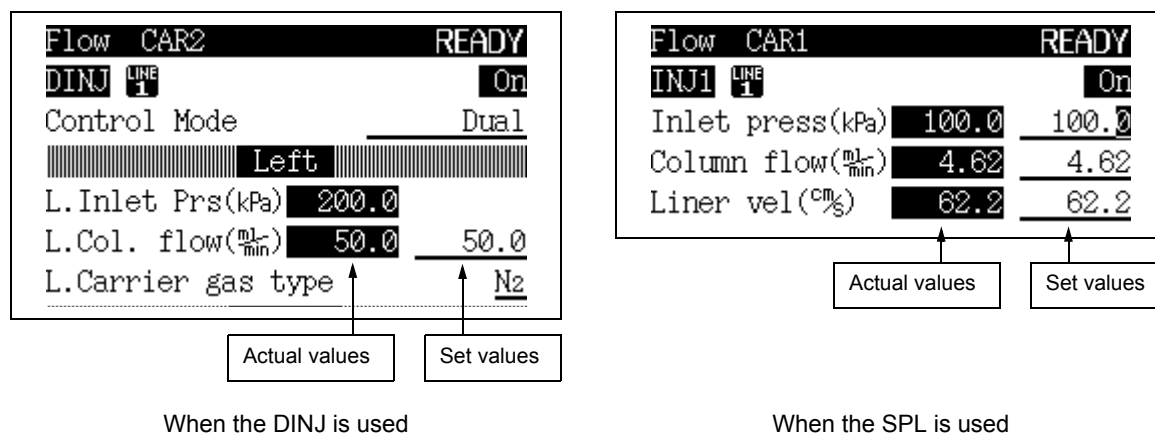


Fig. 6.1.2



6.1.3 Status indicators

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

■ STATUS indicator

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

■ TEMP indicator

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

■ FLOW indicator

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

6.2

6 Basic Key Operation

Adjusting The Display

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

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

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

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

To adjust the contrast the contrast, stand in front of the screen and press the [Toggle] + [<] or [>] keys.

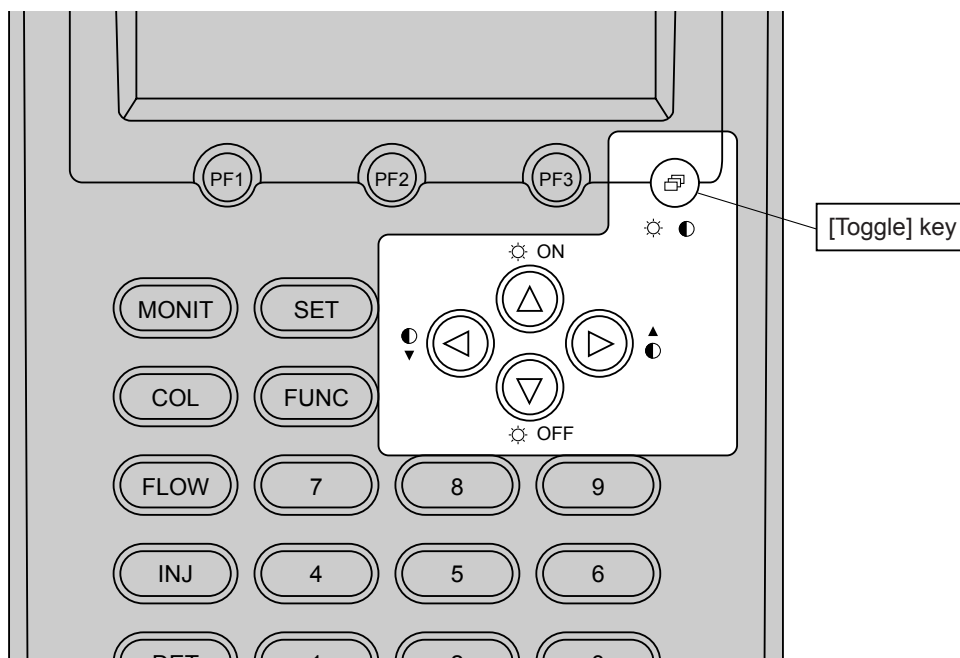


Fig. 6.2.1

6.3

6 Basic Key Operation

Basic Key Operations

6.3.1 Screen display

Use the following 10 keys to display the parameter and status screens:

[DIAG], [SYSTEM], [MONIT], [SET], [FUNC], [COL], [FLOW], [INJ], [DET] and [OPTION].

Access the main function screens by pressing one of these keys, then the secondary screens by selecting a PF menu item displayed at the bottom of the screen. (Because the PF menu includes direct operations, some PF menu items do not have secondary screens.)

■ PF menu item selection

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

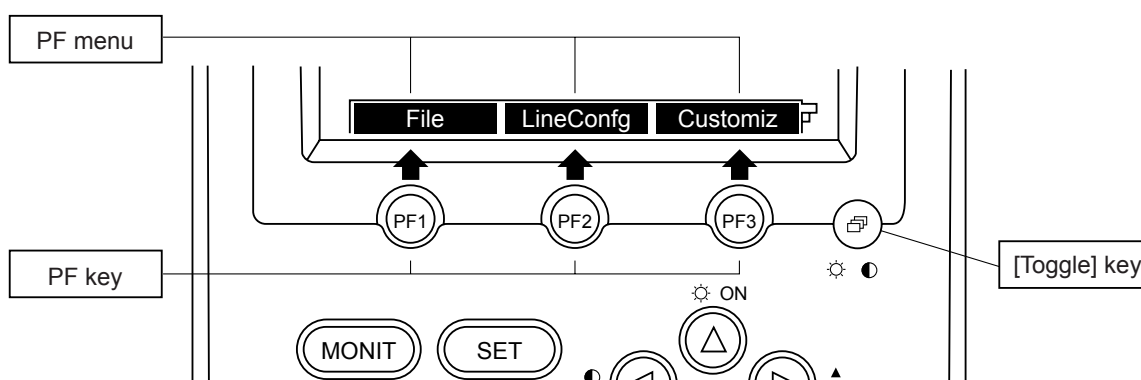
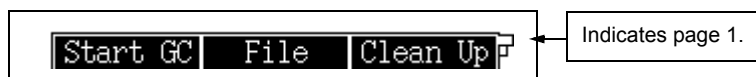


Fig. 6.3.1

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

Example:

1st page of PF menu



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





6.3.2 Moving the cursor

Use the four keys, [Δ], [∇], [\triangleleft] and [\triangleright] to move the cursor to an item to be set. However, for screens with listed items, only the [Δ] and [∇] keys may be available to move the cursor. The [\triangleleft] and [\triangleright] keys may perform a different function.

■ Moving the cursor using the [Δ], [∇], [\triangleleft] and [\triangleright] keys

Example: Main screen of the [COL] key

Rate(% _{min})	Temp(°C)	Time(min)
Init	60.0	2.00
1st	10.00	220.0
2nd	END	

Equilibration Time(min) 3.0

Del Line Ins Line Fan Off

Fig. 6.3.2

■ Moving the cursor using only the [Δ] and [∇] keys

Example: Main screen of the [FLOW] key

GC Start Sequence NOT READY

Current File 0:FILE0

Start GC Manual Start

Start Flow

Start Time(min) 10.0

Start Temp/Det Yes

Detector On

Auto ignite On

Clean Up Off

Stand By

Start GC File Clean Up

Fig. 6.3.3



6.3.3 Entering numeric values

Enter a numeric value using the following procedure:

- (1) Move the cursor to an item to be set.
- (2) Use the numeric keys to enter a number.
- (3) Press the [ENTER] key to validate the input.

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

6.3.4 Changing a selection

Parameters marked with “◀” and “▶” are changed by making another selection. Change the selection using the following procedure.

- (1) Move the cursor to the item.
- (2) Select a desired choice by pressing the [◀] and [▶] key.
- (3) Press the [ENTER] key to validate the selection.

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

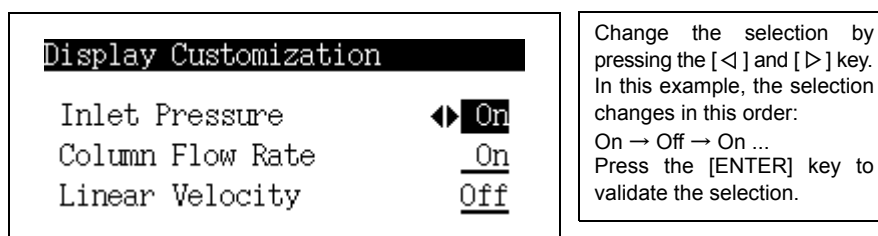


Fig. 6.3.4



6.3.5 Changing item names

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

- (1) Move the cursor to an item to be changed using the [Δ] and [∇] keys.
- (2) Move the cursor to a character to be changed using the [\triangleleft] and [\triangleright] 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.

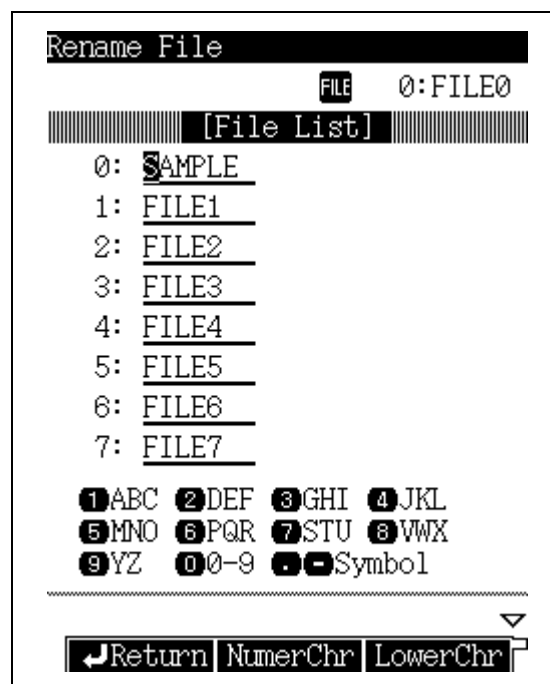


Fig. 6.3.5



■ Entering characters

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

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

Numeric mode

Press the [0] to [9] keys to input numbers “0” to “9”.

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

6.4

6 Basic Key Operation

Getting Help

The Help function describes items on the setup screens.

Understanding the items helps to quickly and efficiently set up analytical parameters and proceed analyses smoothly.

6.4.1 Screen description

If you do not know the meaning of an item on the screen, press the [HELP] key on the screen to display the item and its description. For example, the screen shown in Fig. 6.4.1 appears when the [HELP] key is pressed on the [DIAG] key screen.

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

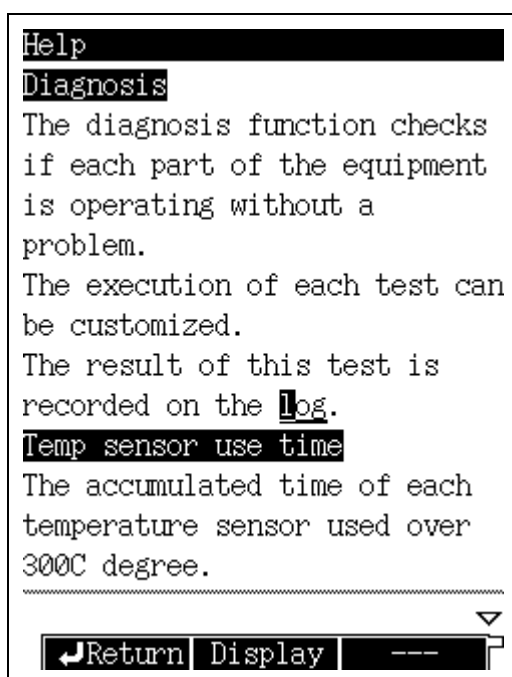


Fig. 6.4.1 Help screen

[Display]



[Back]

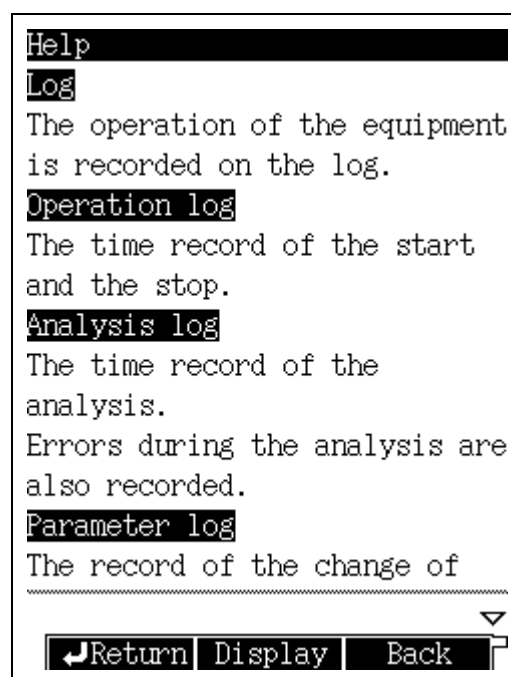


Fig. 6.4.2 Linked screen

6.4.2 PF menu

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



This page is intentionally left blank.

7 Starting and Stopping the GC [SYSTEM]

7.1 [SYSTEM] Key Main Screen

7.1.1 Screen Description

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

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

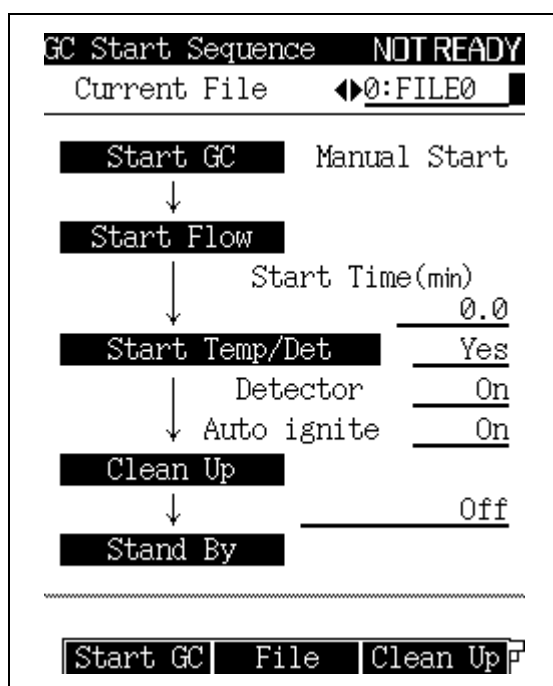


Fig. 7.1.1 Main screen accessed in system Off status

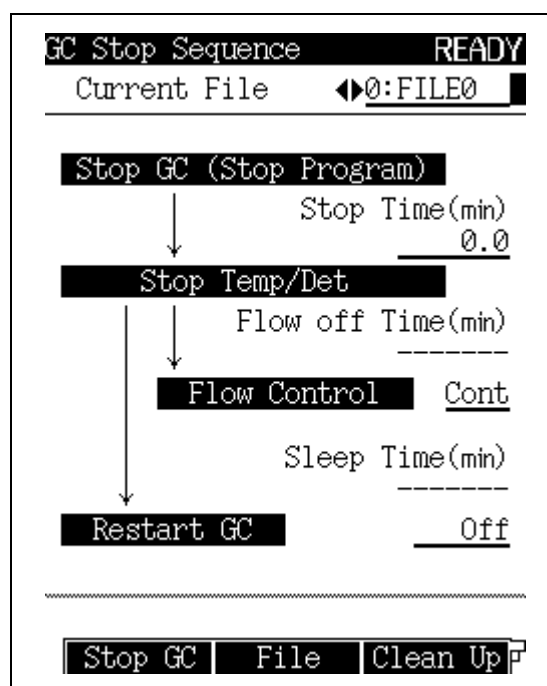


Fig. 7.1.2 Main screen accessed in system On status



7.1.2 Parameter

CURRENT FILE

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

Changes the currently loaded file.

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

START TIME

Range: 0.0–6000.0 min, Default: 0.0 min

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

START TEMP/DET

Selection: Yes/No, Default: Yes

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

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

DETECTOR

Selection: On/Off, Default: On

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

AUTO IGNIT

Selection: On/Off, Default: On

Ignites the FID/FPD detector automatically.

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

CLEAN UP

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

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

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

STOP TIME

Range: 0.0–6000.0 min, Default: 0.0 min

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

FLOW OFF TIME

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

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

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

FLOW CONTROL

Selection: End/Cont, Default: Cont

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

Select [Cont] to continue the carrier gas flow.

SLEEP TIME

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

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

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

RESTART GC

Selection: On/Off, Default: Off

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

Select [Off] to disable automatic GC restart.



7.1.3 PF menu

PF menu item	Description	Reference section
Start GC	Starts GC according to the parameters on the [SYSTEM] key main screen.	—
Stop GC	Starts GC according to the parameters on the [SYSTEM] key main screen. If no program is running, the stop time countdown begins immediately when [Stop GC] (PF menu) is selected. If [Stop GC] is selected while a program is running, the stop time countdown begins after the program finishes.	—
File	Displays the file list to change to another method file. On this sub screen, select files to load, edit, copy, initialize and rename.	8.2
Clean Up	Sets clean up parameters. In system ON status, select direct operation (PF menu) to run the clean up.	7.2
Start Seq	Sets the parameters for the next GC start up. Start time, detector and clean up parameters on this sub screen are immediately reflected on the [SYSTEM] key main screen.	7.3
Stop Seq	Sets the stop procedures. This item is not displayed in system ON status.	7.4
Maint INJ	Prepares the GC for maintenance of the injection port (replacement of septum, glass insert, etc.) . When GC is ready for maintenance, the message "GC is ready for maintenance" appears.	4.3 General maintenance procedures in the operation manual
Anal.	Restores the GC for analysis after performing injection port maintenance. When pressed after maintenance of injection port is completed.	—

7 Starting and Stopping the GC [SYSTEM]

7.2 Specifying Clean Up Parameters

7.2.1 Screen Description

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

Clean up should be performed to eliminate contamination before analysis.

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

Clean Up		READY
LINE 1	FILE 0:FILE0	
Column Oven		
Temp(℃)	25.0	25.0
Flow		
L.Col. flow($\frac{\text{mL}}{\text{min}}$)	50.0	50.0
R.Col. flow($\frac{\text{mL}}{\text{min}}$)	50.0	50.0
INJ DINJ		
Temp(℃)	250.0	250.0
DET DFID		
Temp(℃)	250.0	250.0
Return Temp Prog Flow Prog		

(a) DINJ

Clean Up		READY
LINE 1	FILE 0:FILE0	
Column Oven		
Temp(℃)	25.0	25.0
Flow		
Inlet press(kPa)	100.0	100.0
Split ratio	50.0	50.0
Purge flow($\frac{\text{mL}}{\text{min}}$)	3.0	3.0
INJ SPL		
Temp(℃)	250.0	250.0
DET DFID		
Temp(℃)	250.0	250.0
AMC AMC.L		
Flow($\frac{\text{mL}}{\text{min}}$)	50.0	50.0
Return Temp Prog PressProg		

(b) SPL

Fig. 7.2.1 Setting the clean up parameters



7.2.2 Parameter list

■ Main screen of clean up

• COLUMN OVEN

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

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

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

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

• FLOW

Dual packed INJ (DAFC is used)

L column flow rate, R column flow rate

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

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

SPL(AFC is used)

INLET PRESS

Range: 0.0–970.0 kPa (Refer to [Fig. 12.2.5.](#)), Default: 100.0 kPa

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

PURGE FLOW RATE

Range: Refer to [Fig. 12.2.15](#), Default: 3.0 ml/min

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

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0

Sets the split ratio for the clean up method.

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

• INJECTION PORT

Temperature

Range: 0.0–400.0 °C, Default: 250.0 °C

Sets the injection port temperature for the clean up method.

• DETECTOR

Temperature

Range: 0.0–400.0 °C (FID), Default: 250.0 °C

Sets the detector temperature for the clean up method.

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

Makeup flow rate

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

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

• AMC.L, AMC.R

Flow rate

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

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



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

• **AUXAPC**

Pressure

Range: 0.0–970.0 kPa, Default: 100.0 kPa

Sets the AUX APC pressure for the clean up method.

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

• **AUXAMC**

Flow rate

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

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

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

■ **Clean up column oven temperature program**

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

CLEAN UP RATE

Range: END/-250.00–250.00 °C/min, Default: END

Sets the rate of column temperature increase for the clean up program.

CLEAN UP TEMP

Range: 0.0–450.0 °C, Default: 25.0 °C

Sets the final temperature for the column oven temperature clean up program.

Do not exceed the maximum column temperature.

CLEAN UP TIME

Range: 0.00–9999.99 min, Default: 0.00 min

Sets the final temperature hold time for the clean up program.

■ **Clean up column inlet pressure program (when the AFC control mode is “pressure”)**

(The clean up pressure program 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. 12.2.5.) , Default: 0.0 kPa

Sets the final pressure for the column inlet pressure clean up program.

CLEAN UP TIME

Range: 0.00–9999.99 min, Default: 0.00 min

Sets the final pressure hold time for the clean up program.

■ **Clean up flow rate program (when the DAFC and AFC control mode is “flow rate”)**

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

CLEAN UP RATE

Range: END/-400.00–400.00 ml/min², Default: END

Sets the rate of total flow increase for the clean up program.

CLEAN UP FLOW RATE

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

(refer to Fig. 12.2.5), Default: 50.0 ml/min

Set the final flow rate for the total flow rate clean up program.



CLEAN UP TIME

Range: 0.00–9999.99 min, Default: 0.00 min

Sets the final flow rate hold time for the clean up program.

7.2.3 PF menu

PF menu	Description	Reference section
Temp Prog	Sets the column oven temperature for the clean up program.	11.2
Press Prog	Sets the column inlet pressure for the clean up program. It is displayed when the control mode is “pressure” on the [FLOW] key screen of the AFC.	12.5.5
Flow Prog	Sets the flow rate for the clean up program. Sets the column flow rate program for the DAFC and the total flow rate program for the AFC. Display is possible for the DAFC and when the control mode is set at “flow rate” on the [FLOW] key screen of the AFC.	12.5.6
Run	Displayed only while GC is in system ON status. Immediately runs the clean up program.	—
Stop	Stops clean up. This item is displayed only when the clean up program is in progress.	—
Next Line	Displays the clean up program set up screen for another analytical flow line.	—

7

7 Starting and Stopping the GC [SYSTEM]

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.

The screenshot displays the 'GC Start Sequence (Next Time)' screen. It features a vertical flowchart of steps: 'File Load' (with a dropdown set to '0:FILE0'), 'Start GC' (with a dropdown set to 'Manual Start'), 'Start Flow', 'Start Temp/Det', 'Clean Up', and 'Stand By'. To the right of the flowchart are settings for 'Start Time(min)' (0.0), 'Detector' (On), 'Auto ignite' (On), and 'Off'. At the bottom is a 'Return' button with a left arrow icon.

```
graph TD
    A[GC Start Sequence (Next Time)] --> B[File Load]
    B --> C[Start GC]
    C -- "(When next power on)" --> D[Start Flow]
    D --> E[Start Temp/Det]
    E --> F[Clean Up]
    F --> G[Stand By]
    G --> H[Return]
```

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

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



7.3.2 Parameter list

FILE LOAD

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

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

START GC

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

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

Select “Auto Start” to automatically start the GC.

Select “Manual Start” to start the GC by 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 elapses.

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

DETECTOR

Selection: On/Off, Default: On

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

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

AUTO IGNITE

Selection: On/Off, Default: On

Establishes FID/FPD ignition conditions.

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

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

CLEAN UP

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

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

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

7.3.3 Example: starting the system with carrier gas flow

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

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

7

7 Starting and Stopping the GC [SYSTEM]

.4 Specifying the Stop Procedures

7.4.1 Screen

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

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

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

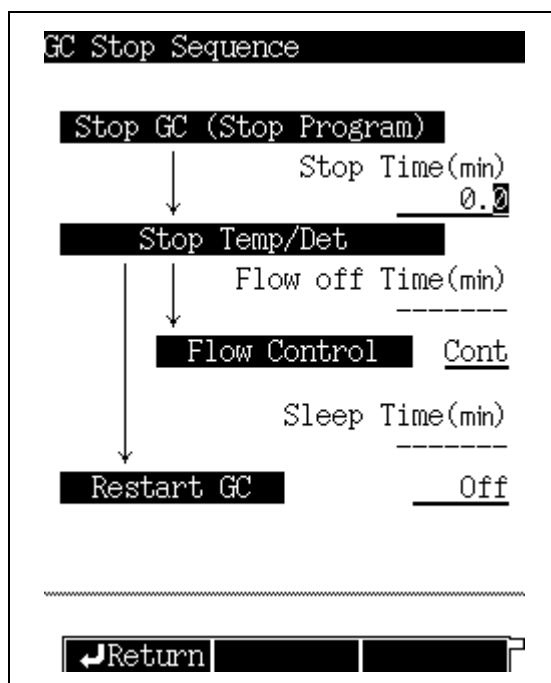


Fig. 7.4.1 Setting the stop procedures

7.4.2 Parameter list

STOP TIME

Range: 0.0–6000.0 min, Default: 0.0 min

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

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

FLOW OFF TIME

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

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

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

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



FLOW CONTROL

Selection: End/Cont, Default: Cont

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

Select "Cont" to continue the carrier gas flow.

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

SLEEP TIME

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

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

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

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

RESTART GC

Selection: On/Off, Default: Off

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

Select "Off" to not restart the GC automatically.

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

7.4.3 System shut down examples

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

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

STOP TIME	=	0 minutes
FLOW CONTROL	=	End
FLOW OFF TIME	=	Approx. 20 minutes
- A column is conditioned, then the column over is cooled. Carrier gas flow is then shut down.

STOP TIME	=	Column conditioning time
FLOW CONTROL	=	End
FLOW OFF TIME	=	Approx. 20 minutes
- At the end of an analysis, each heated zone is cooled, but carrier gas is kept flowing for rapid equilibration for the next day's analysis. The next day, the system is automatically restarted (15 hours = 900 minutes later), and temperature control resumes.

START TIME	=	0 minutes (because the carrier gas continued to flow)
STOP TIME	=	0 minutes
FLOW CONTROL	=	Cont (to keep carrier gas flow on)
RESTART GC	=	On
SLEEP TIME	=	900 minutes (at the end of the SLEEP TIME, the GC restarts)
- At the end of an analysis, each heated zone is cooled, and the carrier gas flow is stopped once the column oven is cool. The following day (15 hours = 900 minutes later), 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)



This page is intentionally left blank.

8.1 **[SET] Key Main Screen**

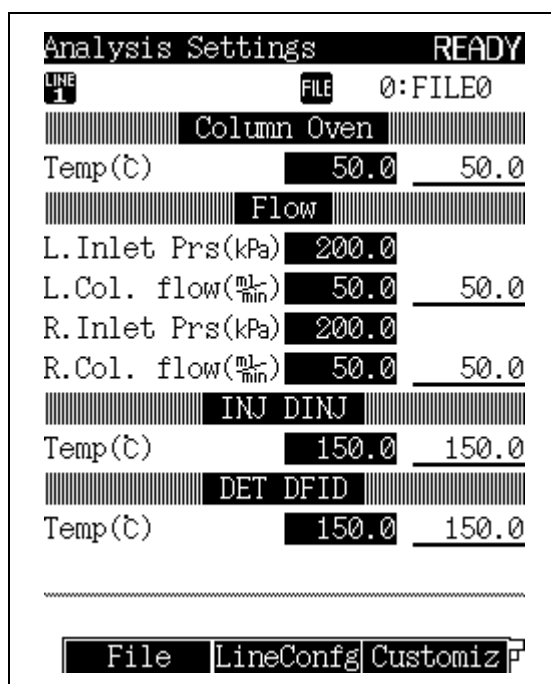
8.1.1 Main screen

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

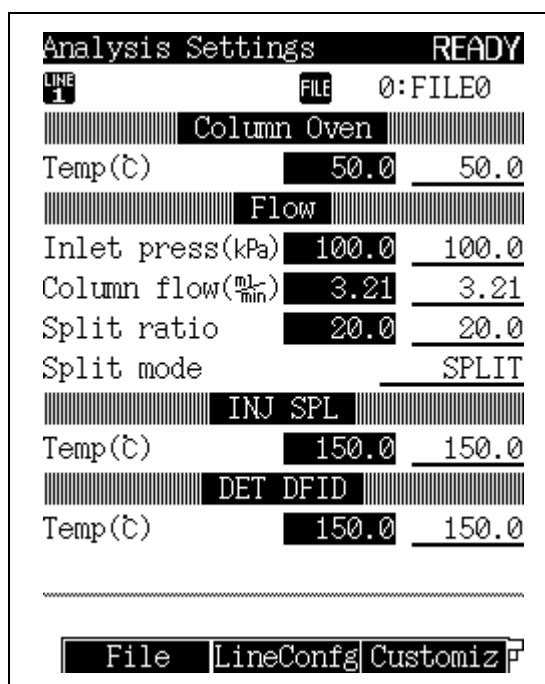
To make changes to the [COL], [FLOW], [INJ], and [DET] parameters, the [customiz] (PF menu) key is pressed. Changes to these parameters are reflected in the [SET] key main screen.

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

When the system is turned on, the temperatures are controlled for the components in the flow line. If the AFC is present, carrier gas is supplied to the injection port specified. If APC is present, detector gases are supplied to the detector specified. Temperatures are not controlled, and gases are not supplied, to components which are not part of the analytical flow line. Although two or more detectors can be set for a line, only one injection port can be set.



(a) When the DINJ is used



(b) When the SPL is used

Fig. 8.1.1 [SET] key main screen



8.1.2 Parameter list

• COLUMN OVEN

Range: 0.0–400.0 °C, Default: 25.0 °C

Sets the default temperature in the oven temperature program.

• Flow

When the packed INJ (DAFC) is used

L. inlet pressure, R. inlet pressure

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

L. column flow rate, R. column flow rate

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

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

When the SPL, etc. (AFC) is used

INLET PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 12.2.5.), Default: 100.0 kPa

Sets the column inlet pressure.

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

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

COLUMN FLOW RATE

Default:¹ 1.00 ml/min

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

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

LINEAR VELOCITY

Default:² 30.0 cm/s

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

When you set the linear velocity, the system calculates the column inlet pressure based on the inner diameter and the length of the column. The linear velocity is set separately so that the linear velocity desired 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. 12.2.5.), Default: 500.0 ml/min

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

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

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

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0

The split ratio is “split flow rate / column flow rate.”

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

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



PURGE FLOW RATE

Range: Refer to Fig. 12.2.15, Default: 3.0 ml/min

Set the septum purge flow rate.

SAMPLING TIME

Range: 0.00–9999.99 min, Default: 1.00 min

Sets the sampling time for splitless analysis.

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

SPLIT MODE

Selection: SPLIT/SPLITLESS/DIRECT, Default: SPLIT

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

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

Opens the split flow line and controls the Electronid Split Controller so that the preset column inlet pressure occurs (Refer to Fig. 12.2.2.) after the sampling time elapses.

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

CONTROL MODE

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

When the injection mode is set to “SPLIT” or “SPLITLESS”

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

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

When the injection mode is set to “DIRECT”

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

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

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

• INJECTION PORT TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

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

• DETECTOR TEMP

Range: 0.0–400.0 °C (in FID), Default: 25.0 °C

Set the detector temperature.

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

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



8.1.3 PF menu

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

8.2

8 Setting the Analytical Parameters and File Management

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 [Δ] and [∇] key; then press the [Load] (PF menu) key.

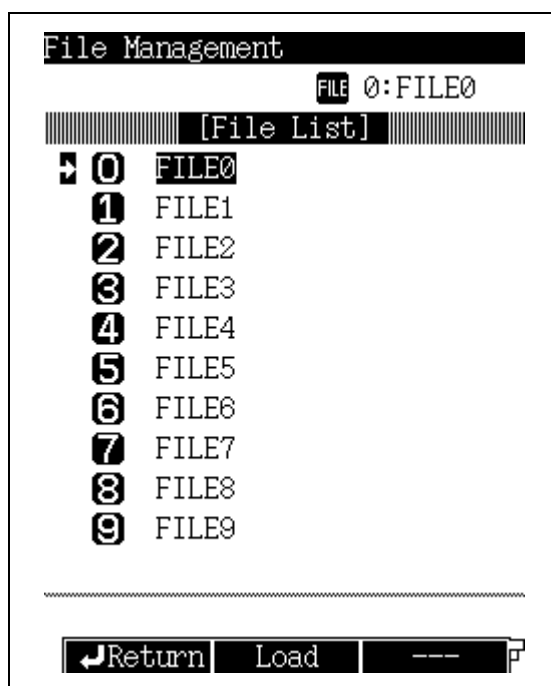


Fig. 8.2.1 File list screen

8.2.2 PF menu

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



8.2.3 Copying a file

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

Copy File

FILE 0:FILE0

Src. File : 0 Dst. File : 1

[File List]

0 FILE0
1 FILE1
2 FILE2
3 FILE3
4 FILE4
5 FILE5
6 FILE6
7 FILE7
8 FILE8
9 FILE9

File has been copied

Return Copy

Fig. 8.2.2 Copying File

8.2.4 Renaming a file

Select [Rename] (PF menu) on the file list screen to display the file rename screen shown in Fig. 8.2.3. Move the cursor using the [Δ] and [∇] keys to select the file to be renamed. Enter the new file name using the numeric keys and the [\triangleleft] and [\triangleright] keys. Refer to ["6.3.5 Changing item names"](#) for more information..

Rename File

FILE 0:FILE0

[File List]

0: SAMPLE
1: FILE1
2: FILE2
3: FILE3
4: FILE4
5: FILE5
6: FILE6
7: FILE7

1ABC 2DEF 3GHI 4JKL
5MNO 6PQR 7STU 8VWX
9YZ 00-9 Symbol

Return NumerChr LowerChr

Fig. 8.2.3 Renaming a file



8.2.5 Initializing a file

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

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

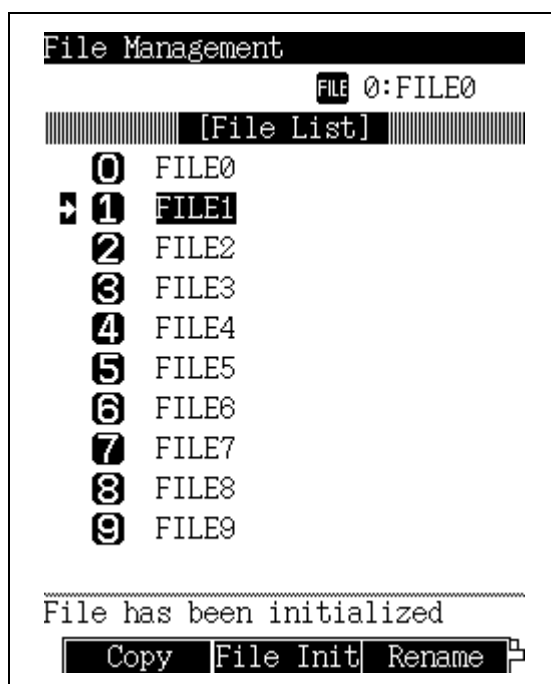


Fig. 8.2.4 Initializing a file

8

8 Setting the Analytical Parameters and File Management

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. When two injection ports or two option units are selected for a same line, the previous unit setting is cancelled.

The screenshot shows the 'Line Configuration' screen. It is divided into three main sections: 'Injector', 'Detector', and 'Option'. Each section has two lines for configuration, labeled 'LINE 1' and 'LINE 2'. The 'Injector' section shows 'SPL' for Line 1 and 'DINJ' for Line 2. The 'Detector' section shows 'DFID' for Line 1 and 'DTCD' for Line 2. The 'Option' section shows 'AOC1' and 'AOC2' for Line 1, and 'AOC2' for Line 2. At the bottom, there is a 'Return' button.

Component	Line 1	Line 2
Injector	SPL	DINJ
Detector	DFID	DTCD
Option	AOC1	AOC2

Fig. 8.3.1 Line configuration setup screen

NOTE "DINJ" is not displayed on the line configuration setup screen when "AMC.LR" is set for "DAFC unit" on "OTHER CONFIGURATIONS" (16.6.11).

AUX temperature control, AUX APC, AUX AMC, manual flow controllers and dual AFC set to "AMC.LR" can be set and controlled regardless to flow line configuration settings.



■ Line configuration examples

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

(1) To use only a SPL and FID

Select the SPL and DFID for Line 1. In this case, only the temperature of the SPL and DFID will be controlled. Carrier gas (including detector gas if APC is used for detector gas) will be supplied.

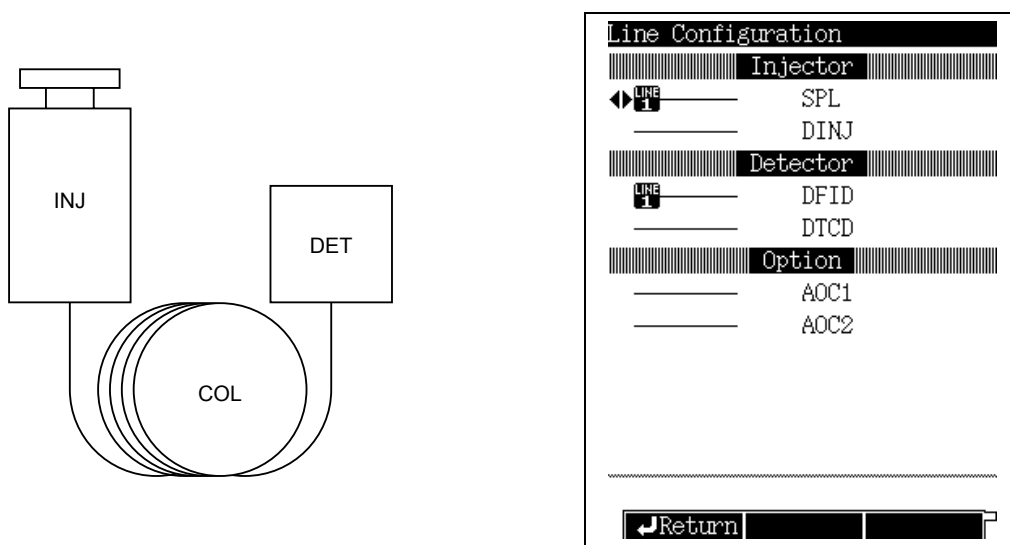


Fig. 8.3.2 Line configuration (Example 1)

(2) To use only a DINJ and DFID

Select the DINJ and DFID for Line 1. Two columns will make one line.

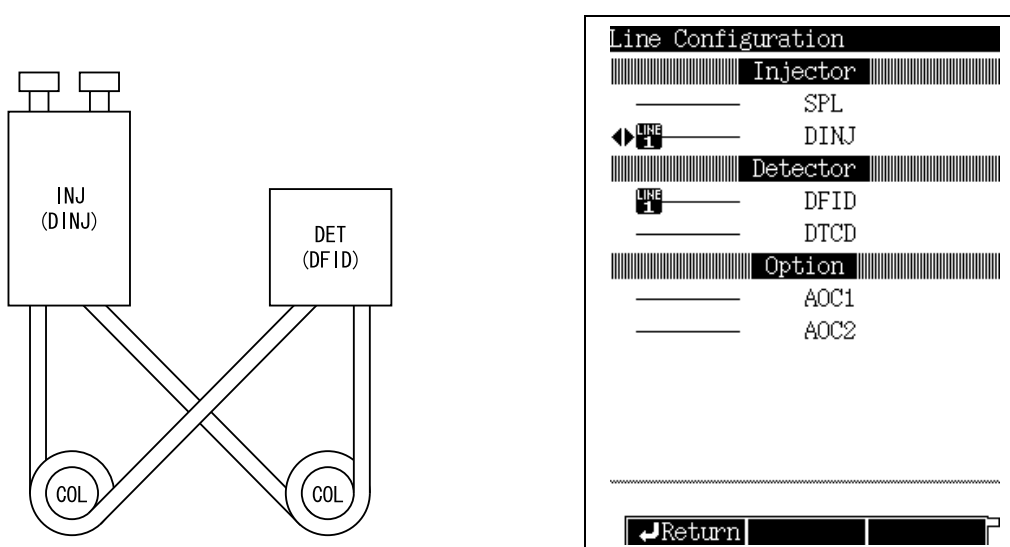


Fig. 8.3.3 Line configuration (Example 2)



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

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

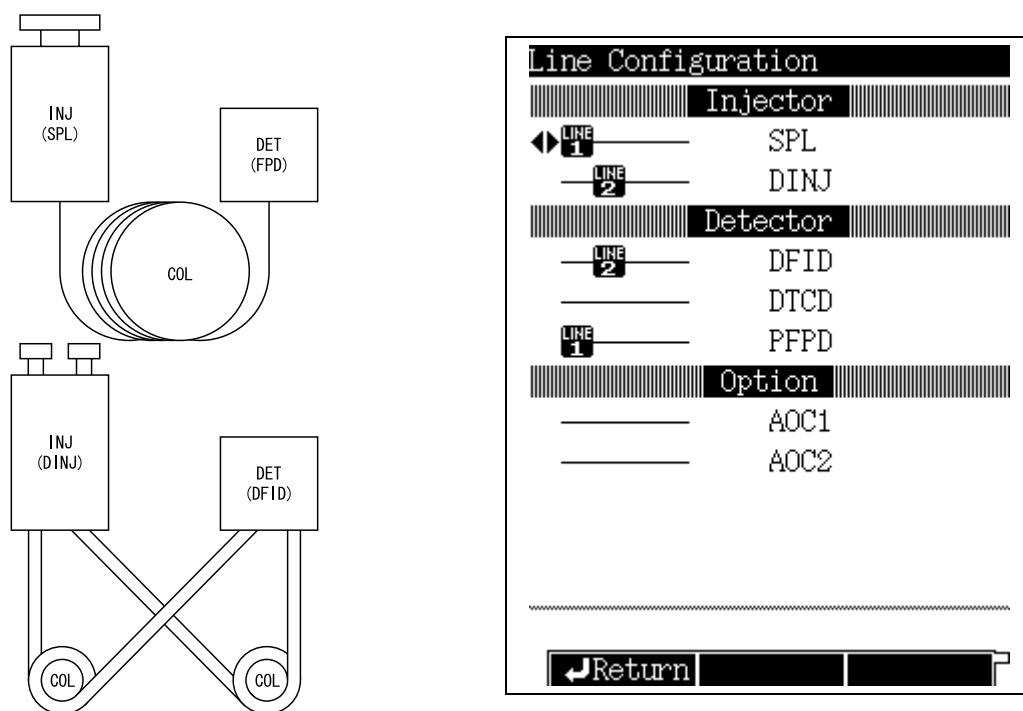


Fig. 8.3.4 Line configuration (Example 3)

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

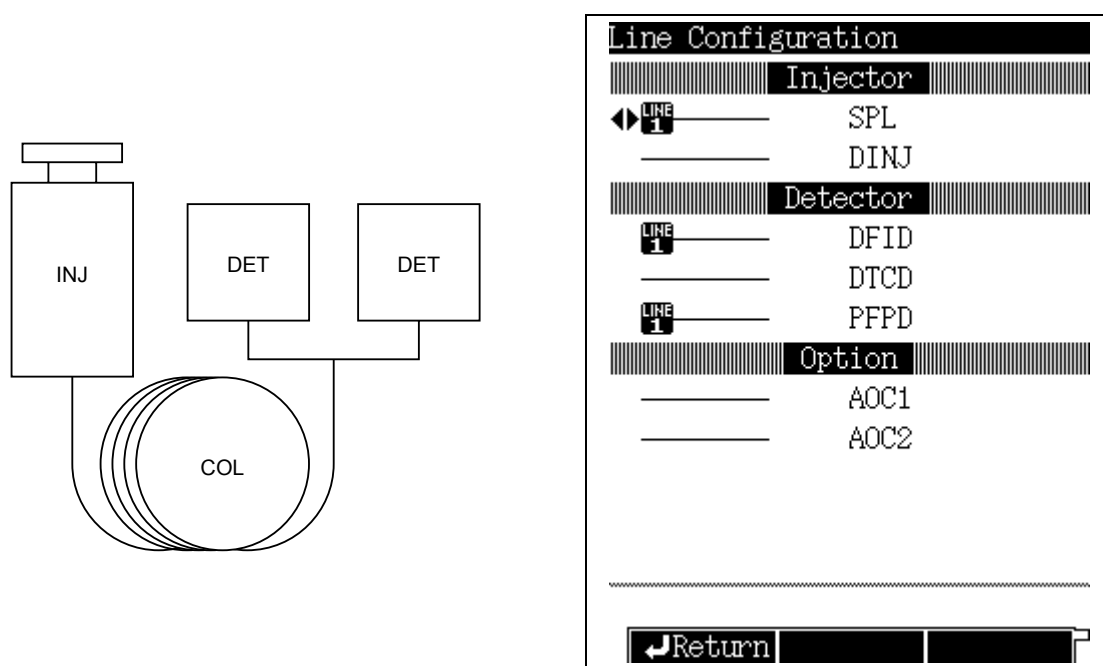


Fig. 8.3.5 Line configuration (Example 4)

8

8 Setting the Analytical Parameters and File Management

8.4 Changing Items Displayed with [Customiz]

8.4.1 Screen description

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

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

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

Move the cursor using the [Δ] and [∇] keys to select an item to be changed; select "On" or "Off" using the [\triangleleft] and [\triangleright] keys, then press the [ENTER] key to validate the selection. The default it setting displays the column inlet pressures, column flow rate, split ratio, sampling time and the split mode.

The screenshot shows a terminal-style interface with a title bar 'Display Customization'. Below it is a list of nine parameters, each followed by its current status. The status is underlined and preceded by a double arrow pointing right. At the bottom, there is a 'Return' button with a left arrow icon.

Parameter	Status
Inlet Pressure	On
Column Flow Rate	On
Linear Velocity	Off
Total Flow Rate	Off
Split Ratio	On
Septum Purge Flow Rate	Off
Sampling Time	On
Split Mode	On
Control Mode	Off

Return

Fig. 8.4.1 Customizing the [Set] key main screen



This page is intentionally left blank.

9.1

9 Monitoring the GC

[MONIT] key Main Screen

9.1.1 Screen description

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

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

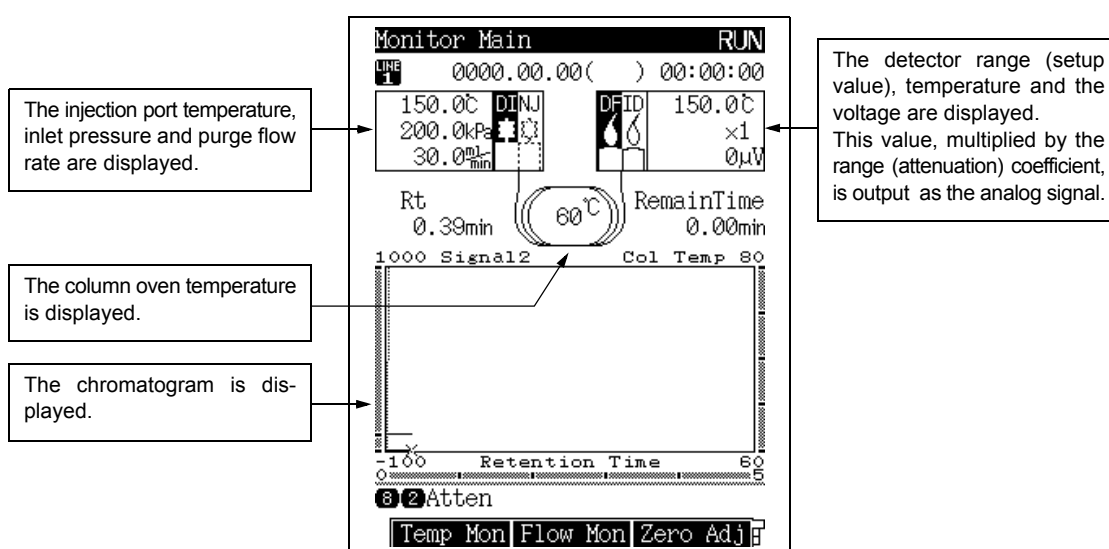


Fig. 9.1.1 [MONIT] key main screen

■ Detector status

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

For a FID:

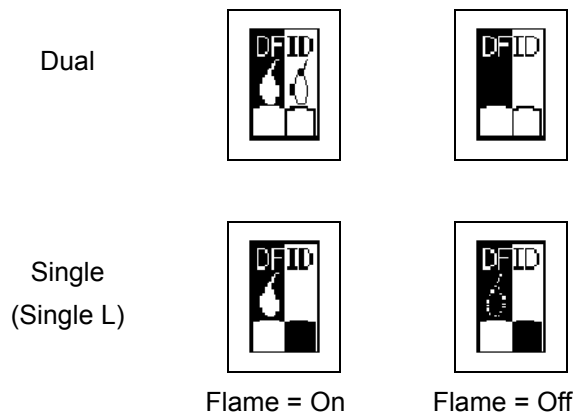


Fig. 9.1.2



■ Changing the monitor magnification (zoom)

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

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

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

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

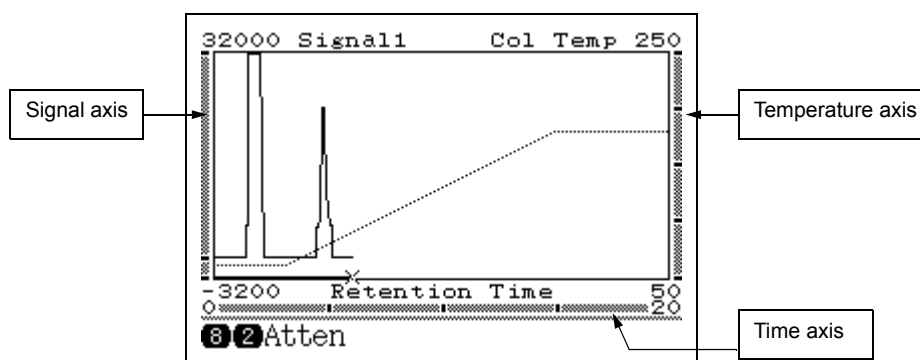
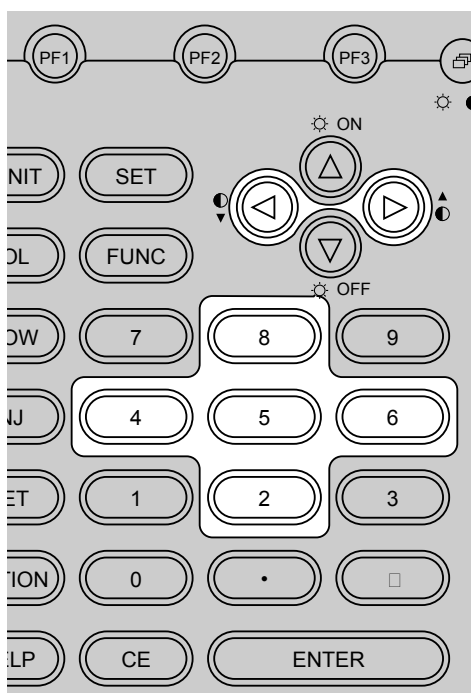


Fig. 9.1.3 Monitor screen (chromatogram and temperature program)



To magnify the time axis:

- 4** : Zooms the time axis scale.
- 6** : Unzooms the time axis scale.

To magnify the signal axis:

- 2** : Zooms the signal axis scale.
- 8** : Unzooms the signal axis scale.

To maximize the display:

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

Keys to move along the time axis

- ▶** : Moves the chromatogram in the + direction.
- ◀** : Moves the chromatogram in the - direction.



9.1.2 Parameter list

RETENTION TIME (Rt)

Retention time is the length of time from compound 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

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

9.2

9 Monitoring the GC

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.

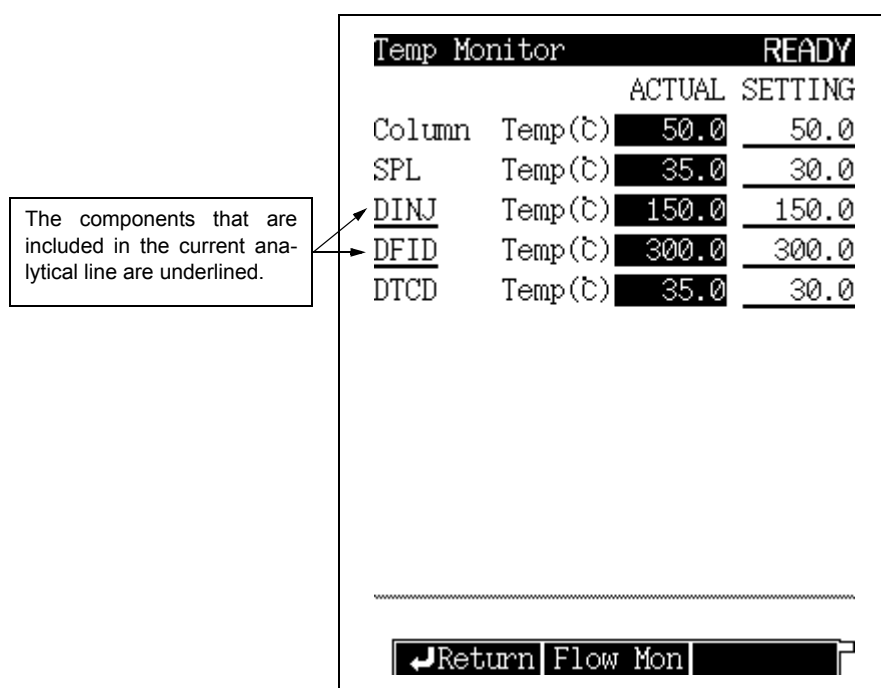


Fig. 9.2.1 Temperature monitor

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

9.2.2 PF menu

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

9.3

9 Monitoring the GC

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.

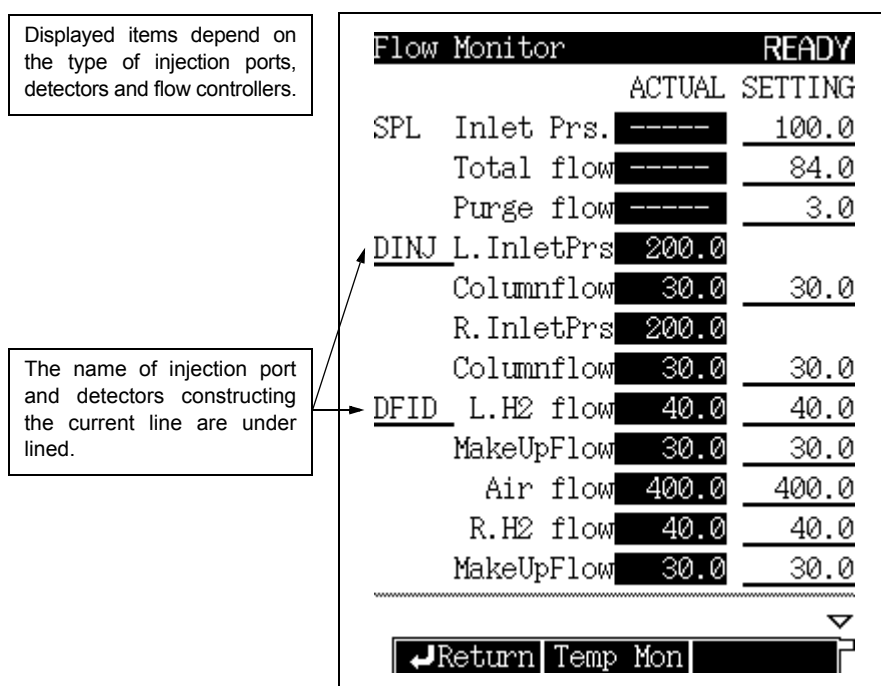


Fig. 9.3.1 Flow rate monitor

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

9.3.2 PF menu

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

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.

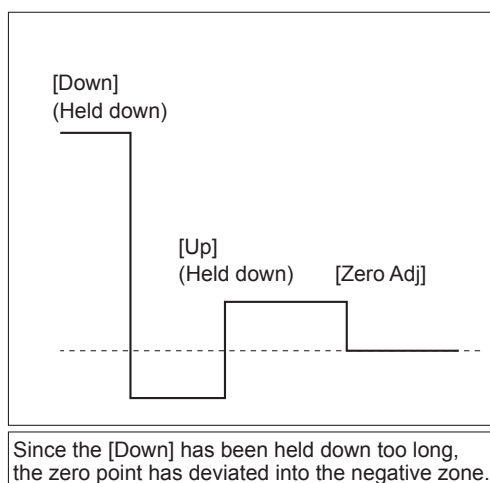


Fig. 9.4.1 Zero point adjustment

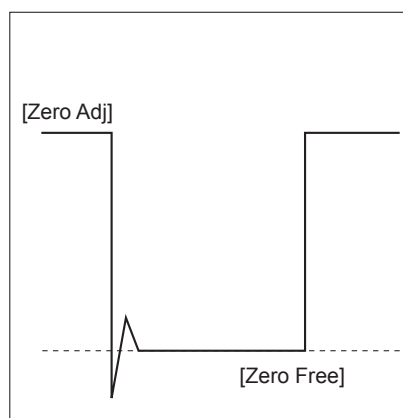


Fig. 9.4.2 Zero free adjustment

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

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

10.1 Starting and Stopping Analysis

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

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

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

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

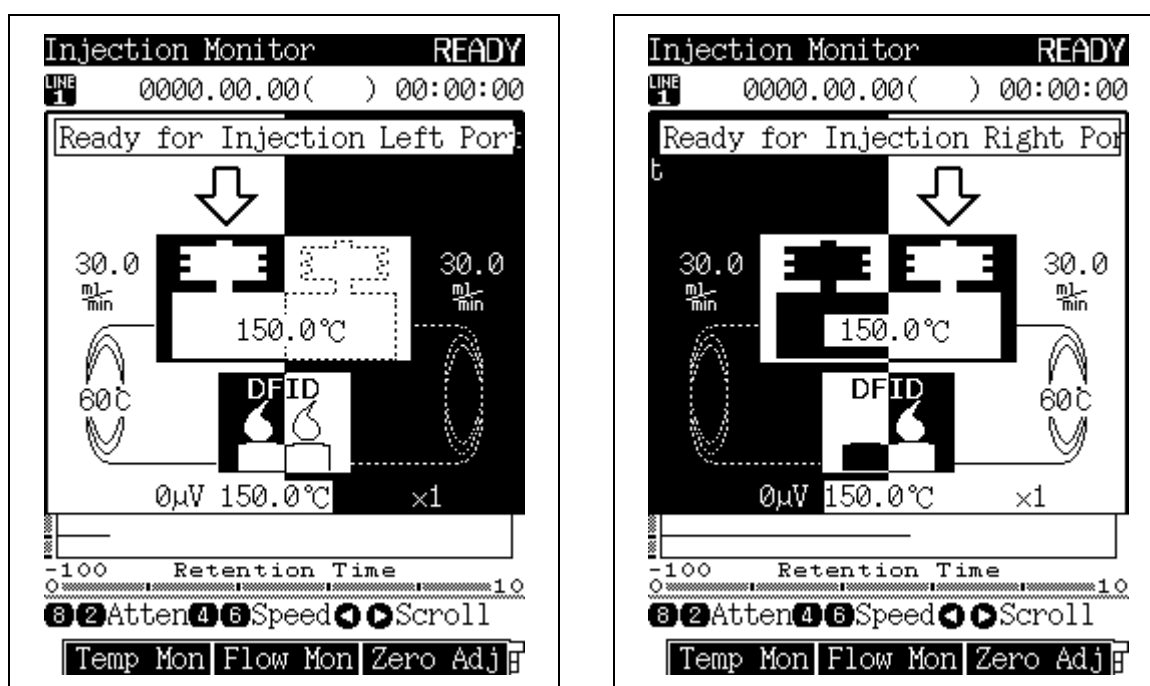


Fig. 10.1.1 Monitor injection screen



10.1.2 Making manual injection

■ Aspiration

1. Preparation

- 10 μ L Syringe
- Sample
- Rinse solvent
- Liquid waste container

2. Syringe handling precautions

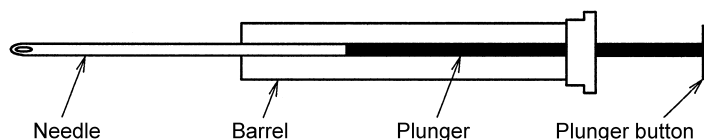


Fig. 10.1.2 Typical syringe

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

3. Solvent pre-wash

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

- (1) Place the syringe into the rinse solvent. Pull the plunger to aspirate approximately 10 μ L 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 μ L 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 μ L of sample.
- (3) Gently wipe the syringe needle with a lint-free wipe.
- (4) Aspirate an additional 0.5 μ L of air.

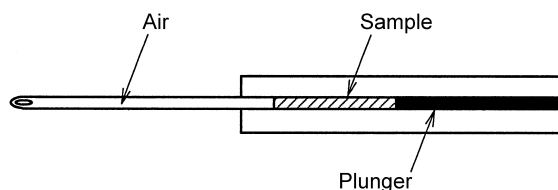
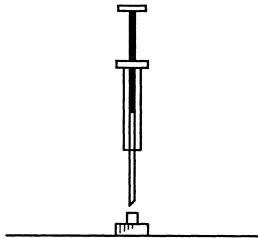
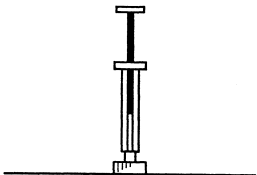
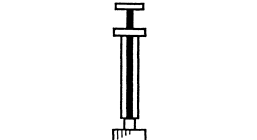
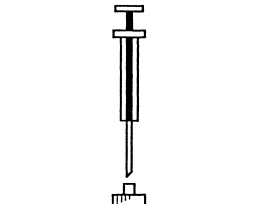


Fig. 10.1.3



■ Injection

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



WARNING

Wear protective goggles when handling samples.

10.1.3 Starting the analysis

Start an analysis program when the STATUS light is green.

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

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

10.2

10 Starting and Stopping Analysis

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

NOTE To prevent automatic start of Chromatopac, refer to [“16.6.9 Setting the link device code”](#)

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

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

Start analysis using the computer. Control for both the gas chromatograph and computer is automatically stopped after a series of process is complete.

To inject a sample manually, start analysis using the computer so that data can be taken in, inject the sample, and press the [START] key of the gas chromatograph.

To pause analysis, use the computer to stop it.

11.1

11 Creating an Oven Temperature Program

[COL] Key Main Screen

11.1.1 Screen description

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

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

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

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

Column	RUN	
Column	FILE 0:FILE0	
Temp Monit(°C)	60.0	
Temp program total(min)	2.00	
Rate(°C/min) Temp(°C) Time(min)		
Init	-----	60.0 2.00
1st	END	
Equilibration Time(min) 3.0		
Del Line Ins Line Fan Off		

Fig. 11.1.1 [COL] key main screen

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



11.1.2 Parameter list

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

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



CAUTION

Never increase the column oven temperature while air (oxygen) is mixed with the carrier gas. This can damage the column (especially for polar columns).

TIME

Range: 0.00–9999.99 min, Default: 0.00 min

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

RATE

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

Set the program rate for the oven temperature program.

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

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

EQUILIBRATION TIME

Range: 0.00–9999.99 min, Default: 3.00 min

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

11.1.3 PF menu

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

NOTE “Fan Off” cannot be operated when the column oven temperature setting value is 40° C or higher or a program is running.

11.2

11 Creating an Oven Temperature Program

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

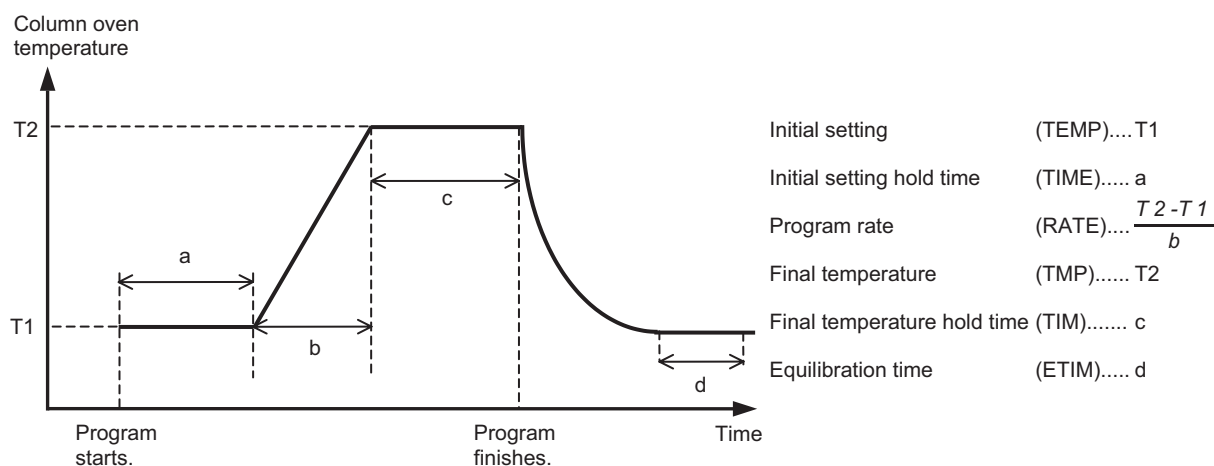
When the sample contains compounds over a wide boiling point range, isothermal analysis is insufficient for separating all the compounds. At lower temperatures, the high boiling point compounds will co-elute with wide peaks. Low concentrations of high boiling point compounds may never be detected. On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

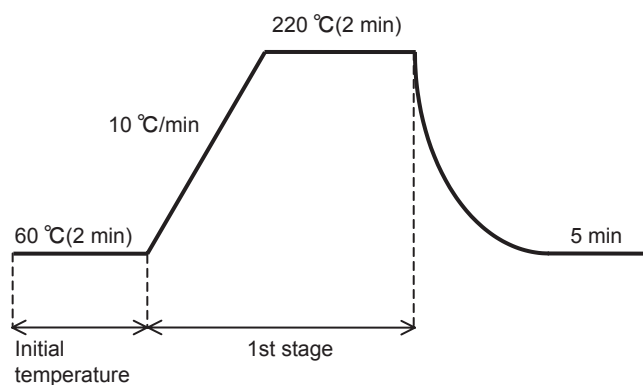
1-ramp temperature program





■ Program creation

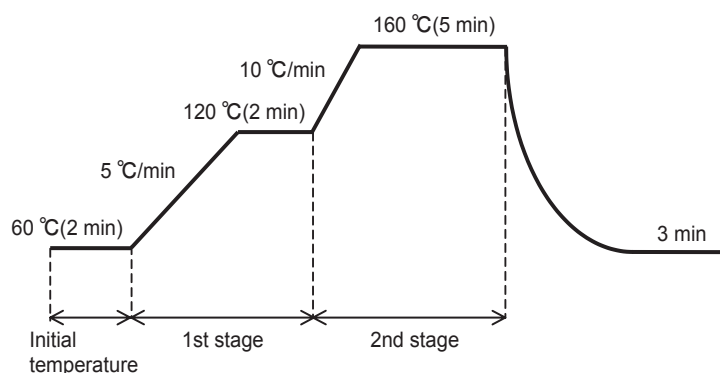
1-ramp temperature program



Column			RUN
Column	FILE	0:FILE0	
Temp Monit(°C)		60.0	
Temp program total(min)		20.00	
Rate(°C/min)			Temp(°C)
			Time(min)
Init	-----	60.0	2.00
1st	10.00	220.0	2.00
2nd	END		
Equilibration Time(min)			5.0
Del Line			Ins Line
Fan Off			

Fig. 11.2.1 Temperature program (Example 1)

2-ramp temperature program

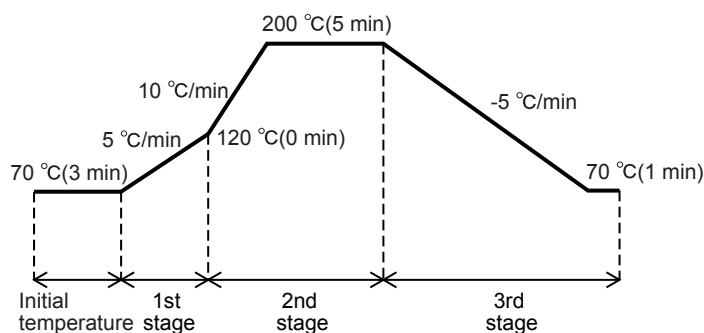


Column			RUN
Column	FILE	0:FILE0	
Temp Monit(°C)		60.0	
Temp program total(min)		25.00	
Rate(°C/min)			Temp(°C)
			Time(min)
Init	-----	60.0	2.00
1st	5.00	120.0	2.00
2nd	10.00	160.0	5.00
3rd	END		
Equilibration Time(min)			3.0
Del Line			Ins Line
Fan Off			

Fig. 11.2.2 Temperature program (Example 2)



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



Column			RUN
Column	FILE	0:FILE0	
Temp Monit(°C)		70.0	
Temp program total(min)		53.00	
Rate(°C/min)	Temp(°C)	Time(min)	
Init	70.0	3.00	
1st	5.00	120.0	0.00
2nd	10.00	200.0	5.00
3rd	-5.00	70.0	1.00
4th	END		
Equilibration Time(min)			0.0
Del Line			Ins Line
Fan Off			

Fig. 11.2.3 Temperature program (Example 3)

■ Allowable temperature settings and ranges for temperature programs

Item			Set Range	Control Range	Default value
Program rate	Heating 115 V model	Up to 150 °C	0-250 °C/min	0-30 °C/min	0 °C/min
		Up to 250 °C		0-20 °C/min	
		Up to 380 °C		0-10 °C/min	
		Up to 400 °C		0-7 °C/min	
	Heating 230 V model	Up to 150 °C	0-250 °C/min	0-60 °C/min	
		Up to 250 °C		0-40 °C/min	
		Up to 380 °C		0-20 °C/min	
		Up to 400 °C		0-15 °C/min	
	Cooling		-250-0 °C/min	Differ from the room temperature or the oven temperature.	

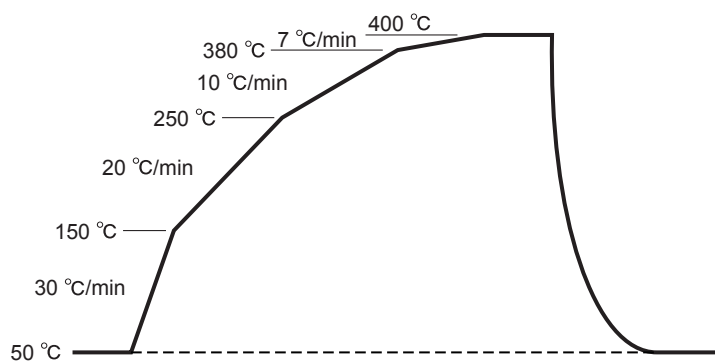


Fig. 11.2.4 Example of column oven temperature increase/decrease curve (115 V model)



This page is intentionally left blank.

12.1

12 Injection Port

Packed Column Injection Port (Dual INJ)

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

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

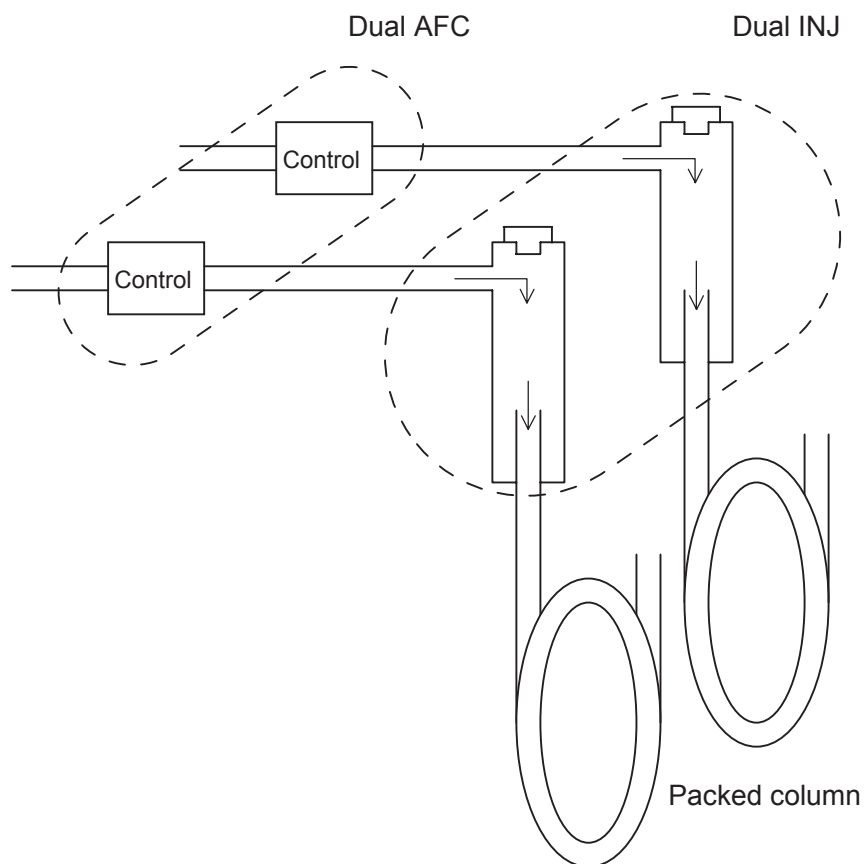


Fig. 12.1.1 Dual-column packed analysis



12.1.1 Setting the temperature with [INJ] key

12.1.1.1 Screen description

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

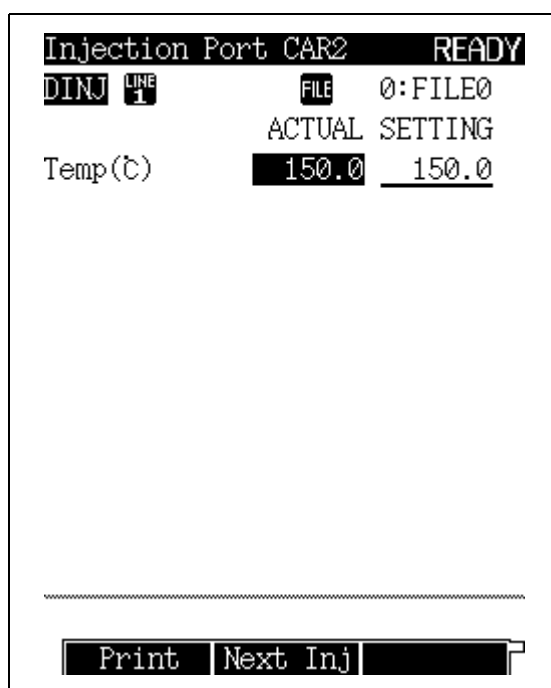


Fig. 12.1.2 [INJ] key main screen



12.1.1.2 Parameter list

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

Set the temperature of the injection port.

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

12.1.1.3 PF menu

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



12.1.2 Setting the Flow Rate

12.1.2.1 Screen description

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

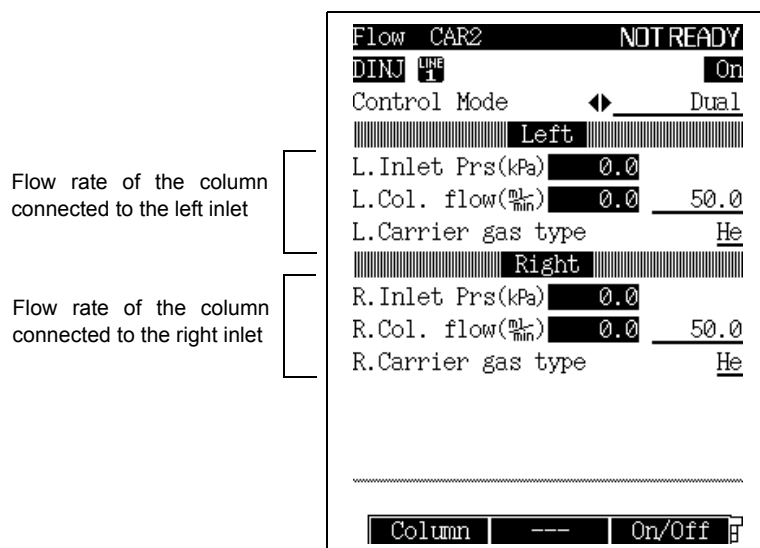


Fig. 12.1.3 FLOW key main screen

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

12.1.2.2 Parameter list

CONTROL MODE

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

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

COLUMN FLOW RATE

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

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

CARRIER GAS TYPE

Selection: He/N₂/H₂/Ar, Default: He

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



12.1.2.3 PF menu

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



12.1.3 Entering Columns Parameters

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

12.1.3.1 Screen description

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

Dimensions of a column connected to the left inlet	[]	<div><div>Column Diam. CAR2 READY</div><div>DINJ ^{LINE} 1</div><div>Left</div><div>L.Column i.d.(mm) 0.32</div><div>L.Column length(m) 25.0</div><div>L.Film thickness(μm) 0.50</div><div>Right</div><div>R.Column i.d.(mm) 0.32</div><div>R.Column length(m) 25.0</div><div>R.Film thickness(μm) 0.50</div><div>Return</div></div>
Dimensions of a column connected to the right inlet		

Fig. 12.1.4 Column parameters entering screen

12.1.3.2 Parameter list

COLUMN I.D. (internal diameter)

Range: 0.01–6.00 mm, Default: 0.32 mm

COLUMN LENGTH

Range: 0.1–250.0 m, Default: 25.0 m

FILM THICKNESS

Range: 0.00–300.00 μm, Default: 0.50 μm



12.1.4 Creating a Flow Rate Program

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

12.1.4.1 Screen description

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

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

```

Carrier Flow CAR2 READY
DINJ 1 FILE 0:FILE0
L.Flow monitor( $\frac{\text{ml}}{\text{min}}$ ) 30.0
L.Program total(min) 0.00
-----
Rate( $\frac{\text{ml}}{\text{min}}$ ) Flow( $\frac{\text{ml}}{\text{min}}$ ) Time(min)
Init ----- 30.0 0.00
1st END
-----
Return Del Line Ins Line
  
```

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

12.1.4.2 Parameter list

FLOW RATE

Range: 0.00–100.0 ml/min, Default: 50 ml/min

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

TIME

Range: 0.00–9999.99 min, Default: 0.00 min

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

RATE

Range: END/-400.00 – +400.00 ml/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 final flow rate and time for that ramp can be entered.

12.1.4.3 PF menu

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

12.2

12 Injection Port

Split/Splitless Injection System

■ Split injection system

In a split injection system, only a portion of the sample injected into the injection port is introduced into the capillary column. The remaining sample is sent to the split line due to high sample volume or concentration.

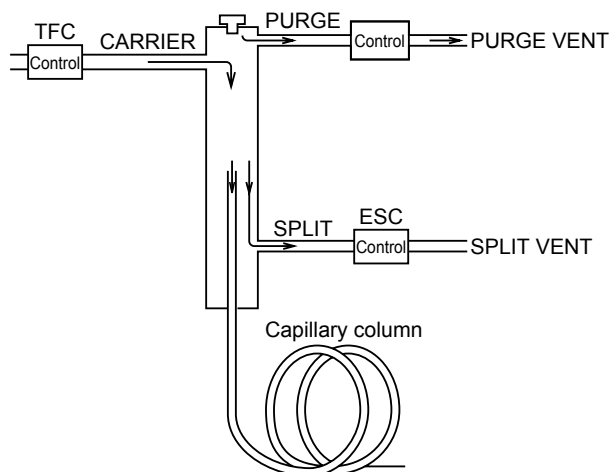


Fig. 12.2.1

■ Splitless injection system

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

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

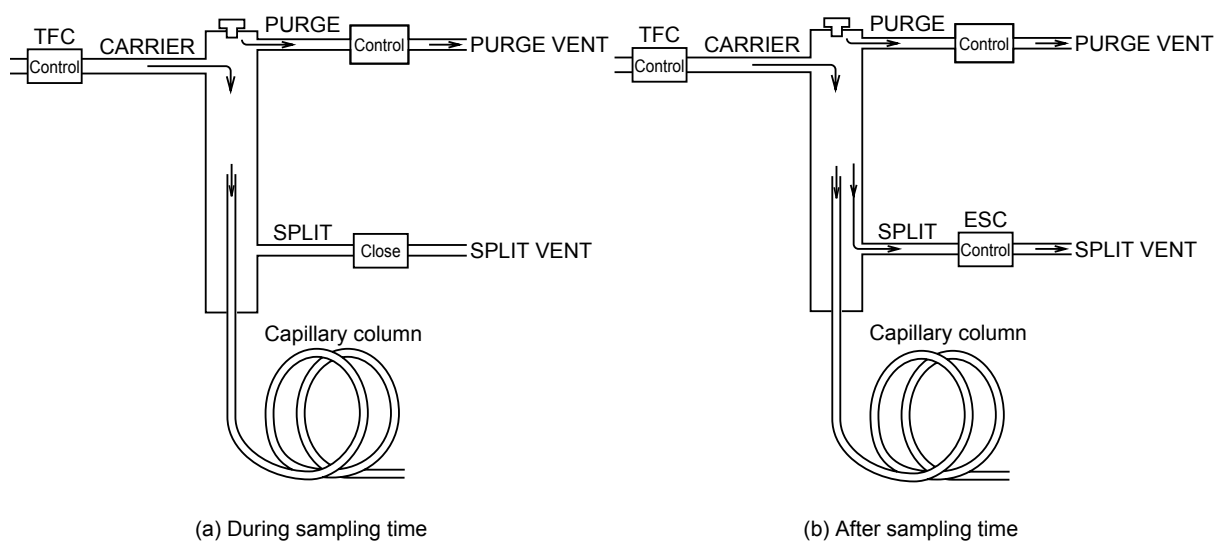


Fig. 12.2.2



12.2.1 Setting the temperature with [INJ] key

12.2.1.1 Screen description

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

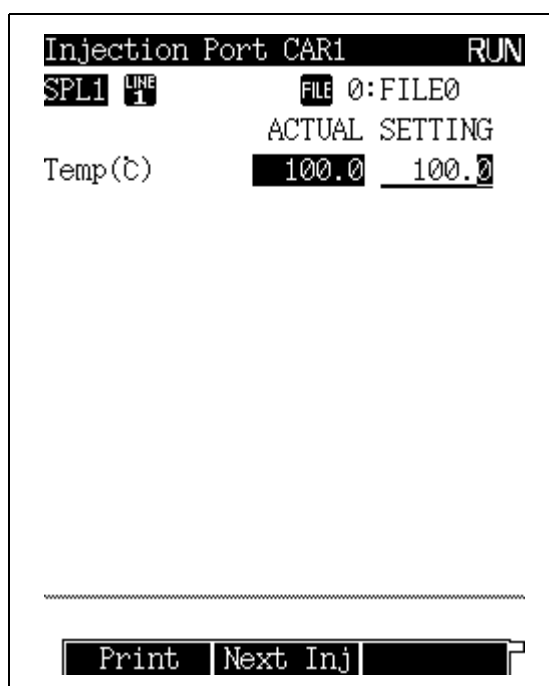


Fig. 12.2.3 [INJ] key main screen



12.2.1.2 Parameter list

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

Set the temperature of the injection port.

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

12.2.1.3 PF menu

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



12.2.2 Setting the flow rate with [FLOW] key

12.2.2.1 Screen description

Press the [FLOW] key to display the screen shown in Fig. 12.2.4 and to set the AFC (advanced flow controller) parameters. The AFC controls the pressure and the flow rate of the carrier gas.

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

Column	GasSaver	On/Off
--------	----------	--------

Fig. 12.2.4 [FLOW] key main screen

12.2.2.2 Parameter list

INLET PRESS

Range: 0.0–970.0 kPa (Refer to NOTE 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

Range: (Refer to NOTE 2), 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

Range: (Refer to NOTE 3), 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 NOTE 1), Default: 500.0 ml/min

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

SPLIT MODE

Selection: SPLIT/SPLITLESS/DIRECT, Default: SPLIT

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

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

Opens the split flow line and controls the Electronid Split Controller so that the preset column inlet pressure occurs (Refer to [Fig. 12.2.2.](#)) after the sampling time elapses.

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

SAMPLING TIME

Range: 0.00–9999.99 min, Default: 1.00 min

Sets the sampling time for splitless analysis.

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

NOTE When setting the sampling time, ensure that the program time is longer than the sampling time. Otherwise, the sampling time 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 during an oven temperature program.

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

When the injection mode is set to "DIRECT"

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

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



CARRIER GAS TYPE

Selection: He/N₂/H₂/Ar, Default: He

Specify the carrier gas type supplied to the AFC.

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

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

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

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

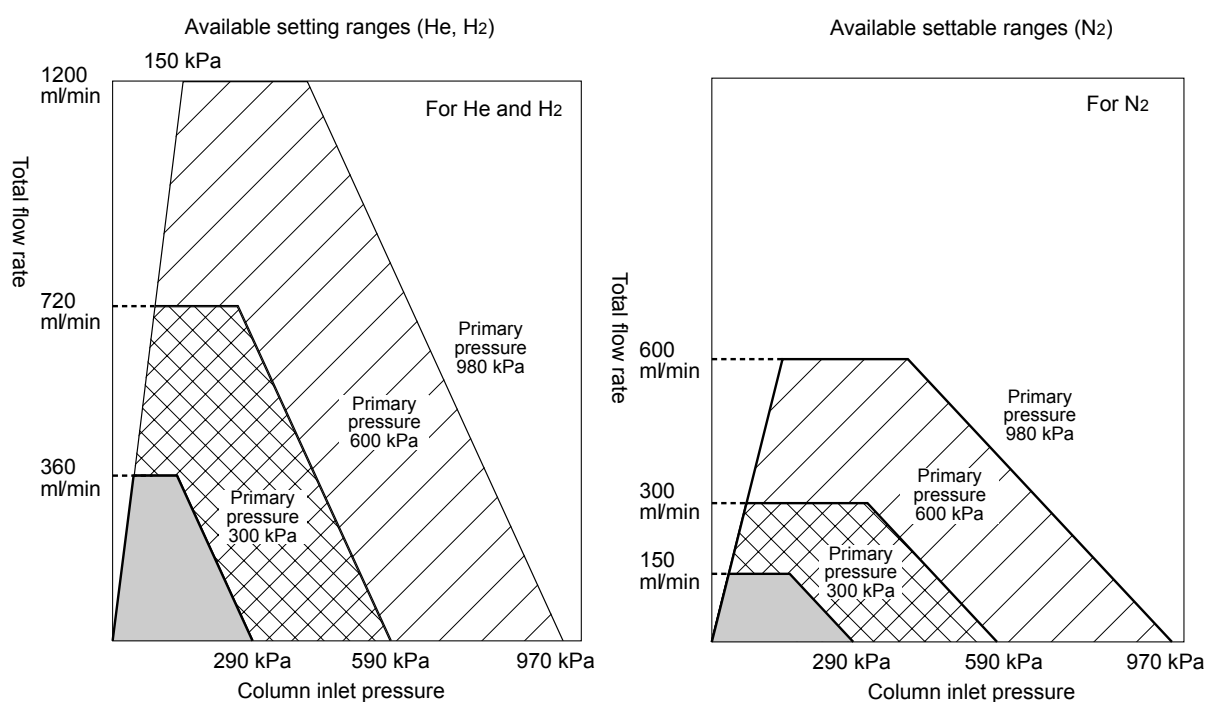


Fig. 12.2.5 Available setting ranges for the AFC

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



12.2.2.3 PF menu

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



12.2.3 Setting column parameters

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

12.2.3.1 Screen description

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

The screenshot shows a terminal-style interface for setting column parameters. At the top, it says 'Column Diam. CAR1' and 'RUN'. Below that, 'SPL 1' and 'LINE 1' are displayed. The main section lists three parameters with their current values: 'Column i.d.(mm)' is 0.32, 'Column length(m)' is 25.0, and 'Film thickness(μm)' is 0.50. Each value is underlined. At the bottom, there is a 'Return' button with a left-pointing arrow.

Column i.d.(mm)	0.32
Column length(m)	25.0
Film thickness(μm)	0.50

Fig. 12.2.6 Column setup screen

12.2.3.2 Parameter list

COLUMN I.D.

Range: 0.01–6.00 mm, Default: 0.32 mm

COLUMN LENGTH

Range: 0.1–250.0 m, Default: 25.0 m

FILM THICKNESS

Range: 0.00–300.00 μm, Default: 0.50 μm

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



12.2.4 Gas saver

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

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

12.2.4.1 Screen description

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

```
Gas Saver    CAR1    RUN
SPL1 LINE 1
Gas saver    ◀▶ Off
Split ratio  5.0
Time(min)    1.00

-----
Return
```

Fig. 12.2.7 Gas saver setup screen

12.2.4.2 Parameter list

GAS SAVER

Selection: On/Off, Default: Off

Select "On" to use the gas saver function.

Select "Off" to disable the gas saver function.

GAS SAVER SPLIT RATIO

Range: 0.0–9999.9, Default: 5.0

Set the split ratio which will reduce the split flow to conserve carrier gas.

Setting "0" closes the split flow line.

GAS SAVER START TIME

Range: 0.00–9999.99 min, Default: 1.00 min

Specify the period of time after analysis starts until the split ratio switches to gas saver mode.

This period of time should be longer than the time required for the sample to move from the injection port to the column.

Setting the gas saves start time too early can provide unpredictable quantitation results.



12.2.5 Pressure program

You can set a program to increase and decrease the column inlet pressure during analysis. If high-boiling point contaminants are clunting 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.

12.2.5.1 Screen description

Select [Press Prog] (PF menu) from the [FLOW] key main screen when the control mode is set to "PRESS," to display the carrier press screen shown in Fig. 12.2.8 appears.

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

```

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

Fig. 12.2.8 Pressure program setup screen

12.2.5.2 Parameter list

PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 12.2.5.), Default: 100 kPa

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

TIME

Range: 0.0–9999.99 min, Default: 1.00 min

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

RATE

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

Set the pressure program rate.

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

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



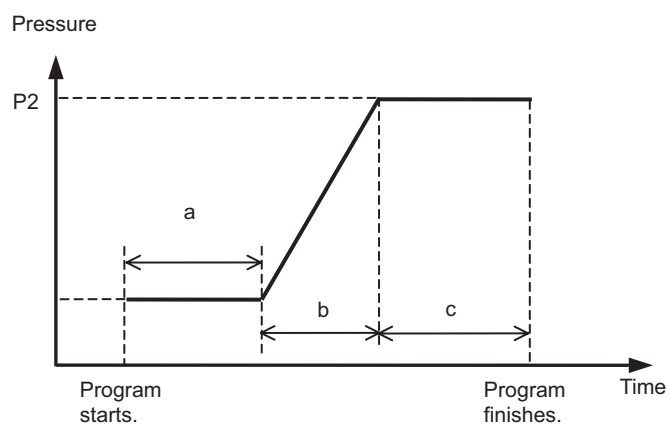
12.2.5.3 PF menu

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

12.2.5.4 Setting a pressure program

■ Screen terminology

<1-ramp pressure program>



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

■ Program creation

<1-ramp pressure program>



Carrier Press CAR1			READY
SPL1	LINE 1	FILE	0:FILE0
Press monitor(kPa)			60.0
Program total(min)			17.00
<hr/>			
	Rate($\frac{kPa}{min}$)	Pres(kPa)	Time(min)
<hr/>			
Init	-----	60.0	2.00
1st	4.00	100.0	5.00
2nd	END		
<hr/>			
.....			
<hr/>			
Return Del Line Ins Line			

Fig. 12.2.9 Pressure program example



12.2.6 Creating a Flow rate program

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

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

12.2.6.1 Screen description

Select [Flow Prog] (PF menu) from the [FLOW] key main screen while the control mode is set to “FLOW” to display the Carrier Flow screen shown in Fig. 12.2.10.

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

```

Carrier Flow CAR1    READY
SPL1 LINE 1        FILE 0:FILE0
Flow monitor(ml/min) 50.0
Program total(min)   0.00
-----
Rate(ml/min) Flow(ml/min) Time(min)
Init ----- 50.0 0.00
1st  END
-----
Return Del Line Ins Line
  
```

Fig. 12.2.10 Flow rate program setup screen

12.2.6.2 Parameter list

FLOW RATE

Range: 0.00–970.0 ml/min (Refer to Fig. 12.2.5.), Default: 50 ml/min

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

TIME

Range: 0.0–9999.99 min, Default: 1.00 min

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

RATE

Range: END/-400.00–400.00 ml/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.



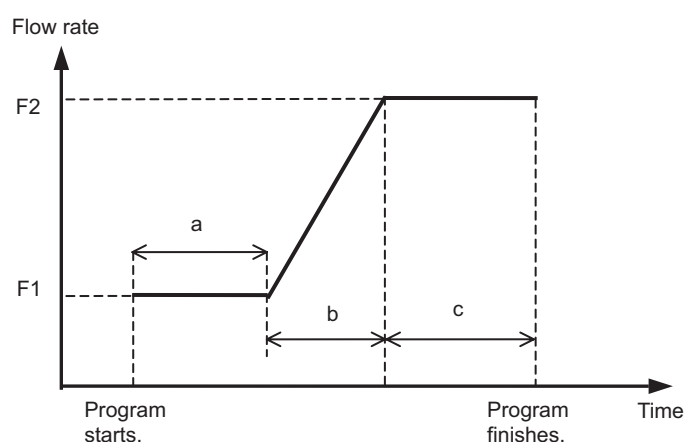
12.2.6.3 PF menu

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

12.2.6.4 Setting a flow rate program

■ Screen terminology

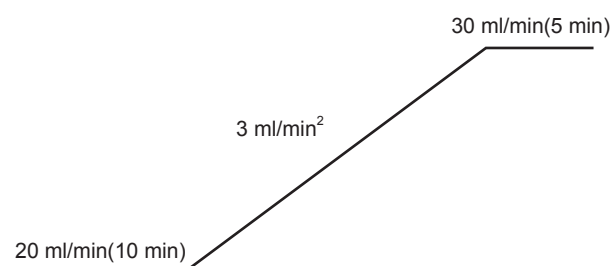
<1-ramp flow rate program>



Initial flow rate (FLOW).... F1
Initial flow rate hold time (TIME)..... a
Program rate (RATE)..... $\frac{F2 - F1}{b}$
Final flow rate (FLW)..... F2
Final flow rate hold time (TIM)..... c

■ Program creation

<1-ramp flow rate program>



Carrier Flow CAR1 READY			
SPL1	LINE 1	FILE	0:FILE0
Flow monitor($\frac{\text{ml}}{\text{min}}$)		20.0	
Program total(min)		23.33	
	Rate($\frac{\text{ml}}{\text{min}}$)	Flow($\frac{\text{ml}}{\text{min}}$)	Time(min)
Init	-----	20.0	10.00
1st	3.00	30.0	10.00
2nd	END		
Return Del Line Ins Line			

Fig. 12.2.11 Flow rate program example



12.2.7 Split ratio program

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

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

12.2.7.1 Screen description

Select [Split Prog] (PF menu) from the [FLOW] key main screen when not in "DIRECT" mode to display the Split Ratio screen shown in Fig. 12.2.12.

```

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

A program can contain up to 7 ramps.

Fig. 12.2.12 Split ratio program setup screen

12.2.7.2 Parameter list

TIME

Range: 0.00–9999.99 min, Default: 0.00 min

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

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0

Set the split ratio.

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

12.2.7.3 PF menu

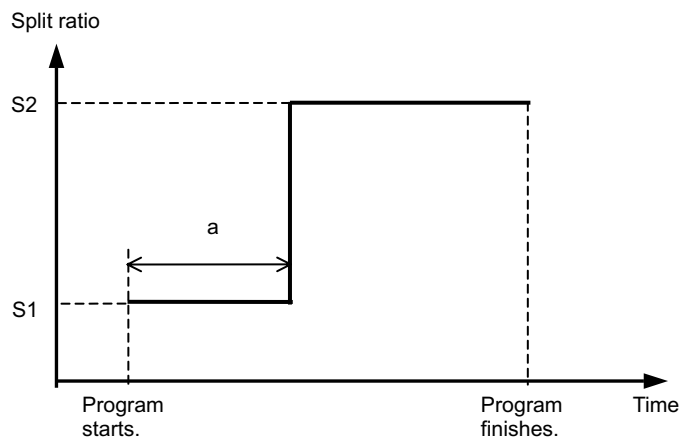
PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	—
Ins Line	Inserts a line in line at the current cursor position.	—
Print	Prints the split ratio through to a Chromatopac.	—



12.2.7.4 Setting a split ratio program

■ Screen terminology

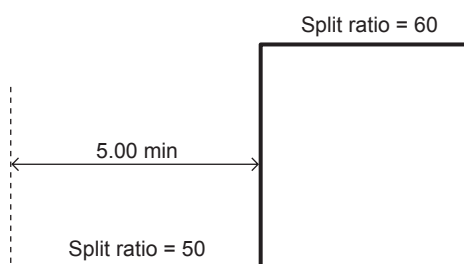
<1-ramp program>



Initial ratio (SPLIT)S1
Initial program run time (TIME)a
Final ratio (SPLT)S2

■ Program creation

<1-ramp program>



Split Ratio		CAR1	READY
SPL1	LINE 1	FILE	0:FILE0
Split ratio monitor		50.0	
Program total(min)		5.00	
		Time(min)	Split Ratio
Init	-----	50.0	
1st	5.00	60.0	
2nd	0.00	END	

Return Del Line Ins Line

Fig. 12.2.13 Example of split ratio program



12.2.8 Septum purge

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

The septum purge flow rate is set here.

12.2.8.1 Screen description

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

Septum Purge CAR1 READY

SPL LINE 1 On

Purge flow(ml/min) 3.0 3.0

Return --- On/Off

Fig. 12.2.14 Septum purge setup screen



12.2.8.2 Parameter list

FLOW RATE

Range: Refer to Fig. 12.2.15, Default: 3.0 ml/min

Sets the septum purge flow rate.

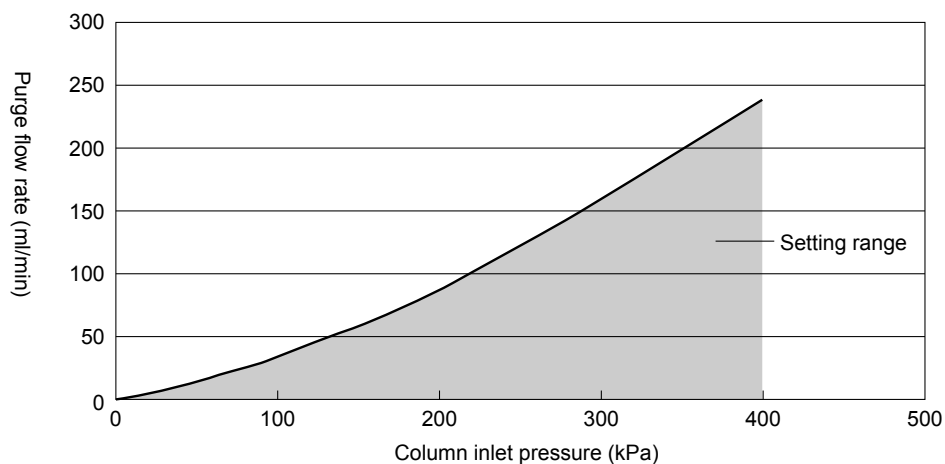


Fig. 12.2.15 Available setting range for the purge flow rate

12.2.8.3 PF menu

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



12.2.9 High pressure injection and splitter fix mode

■ High Pressure Injection

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

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

■ 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 value.

12.2.9.1 Screen description

Select [Advanced] (PF menu) from the [FLOW] key main screen when not in "DIRECT" mode to open the advanced screen shown in Fig. 12.2.16.

The screenshot shows a terminal-style interface for the 'Advanced CAR1' screen. At the top right is the status 'RUN'. Below the title, 'SPL1' and 'LINE 1' are displayed. The 'High Prs. Inj' section is highlighted with a box and contains three settings: 'High press inj mode' set to 'On', 'High prs.inj press(kPa)' set to '100.0', and 'High prs.inj time(min)' set to '1.00'. Below this, the 'Splitter Fix' section is also highlighted with a box and contains two settings: 'Splitter Fix Mode' set to 'Off' and 'Fix Time(min)' set to '1.00'. At the bottom, there is a 'Return' button with a left-pointing arrow.

```
Advanced CAR1                                RUN
SPL1 LINE 1
High Prs. Inj
High press inj mode      On
High prs.inj press(kPa) 100.0
High prs.inj time(min)  1.00
Splitter Fix
Splitter Fix Mode        Off
Fix Time(min)            1.00
Return
```

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



12.2.9.2 Parameter list

■ High Pressure Injection

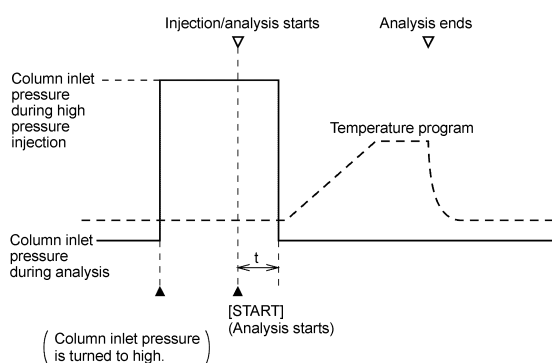
HIGH PRESS INJECTION MODE

Select One of the following three modes.

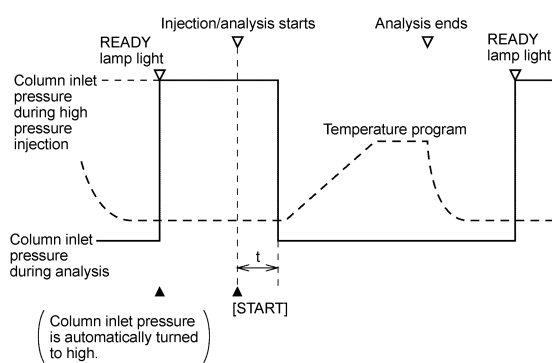
Off : Disables high pressure injection.

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

Auto : Immediately sets the column inlet pressure to high pressure. When analysis is finished and the GC returns to the ready status, the column inlet pressure automatically increases.



HIGH PRESS INJECTION MODE = On



HIGH PRESS INJECTION MODE = Auto

HIGH PRESS INJECTION PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 12.2.5.), Default: 100.0 kPa

Set the column inlet pressure for high pressure injection.

HIGH PRESS INJECTION TIME

Range: 0.00–9999.99 min, Default: 1.00 min

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

Usually, set this equal to the sampling time.

■ Splitter Fix

SPLITTER FIX MODE

Selection: Off/On/Auto, Default: Off

Select one of the following three modes.

Off : Disables splitter fix mode.

On : Fixes the split flow line immediately.

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

FIX TIME

Range: 0.0–9999.99 min, Default: 0.10 min

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

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

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

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

12.3

12 Injection Port

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.

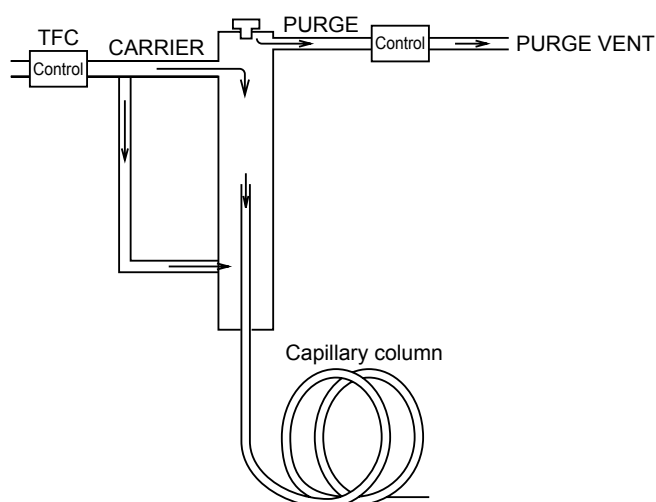


Fig. 12.3.1



12.3.1 Setting the temperature

12.3.1.1 Screen description

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

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

-----
Print  Next Inj
```

Fig. 12.3.2 [INJ] key main screen

12.3.1.2 Parameter list

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

Set the injection port temperature.

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

12.3.1.3 PF menu

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



12.3.2 Setting the flow rate

12.3.2.1 Screen description

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

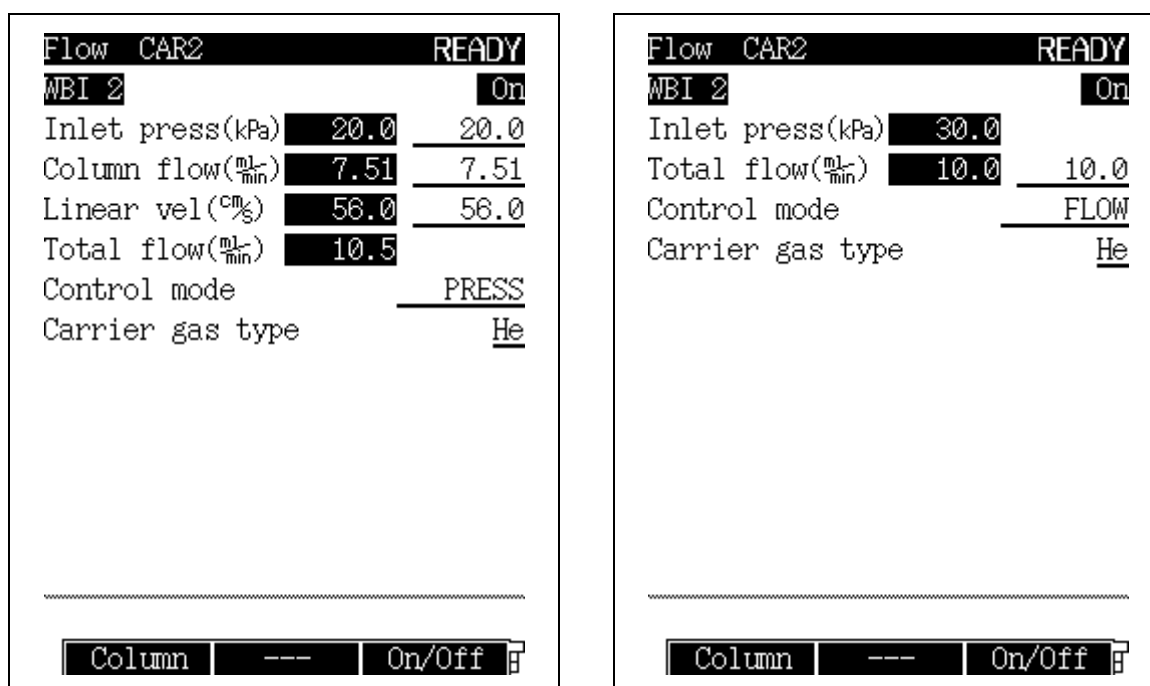


Fig. 12.3.3 [FLOW] key main screen

12.3.2.2 Parameter list

INLET PRESS

Range: 0.0–970.0 kPa, Default: 100.0 kPa

Set the column inlet pressure.

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

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

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

COLUMN FLOW RATE

Default:(Refer to NOTE 1) 1.00 ml/min

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

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

LINEAR VELOCITY

Default:(Refer to NOTE 2) 30.0 cm/s

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



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

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

TOTAL FLOW RATE

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

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

CONTROL MODE

Selection: PRESS/VELOCITY/FLOW, Default: PRESS

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

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

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

CARRIER GAS TYPE

Selection: He/N₂/H₂/Ar, Default: He

Specify the carrier gas type supplied to the AFC.

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

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

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

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

12.3.2.3 PF menu

PF menu	Description	Reference section
Column	Sets inner diameter, length and film thickness of capillary column. Values set here are used in column inlet pressure calculations from column flow rate or linear velocity (or vice versa). If these parameters are not set correctly, calculations are not performed correctly.	12.2.3
On/Off	Set the flow controller to be used to “On.” When the GC starts, the AFC in the current analytical line which is set to be “On” is controlled.	—
Press Prog	Sets the column inlet pressure program.	12.2.5
FLOW Prog	Sets the total flow rate program.	12.2.6
Purge	Sets the septum purge flow rate.	12.2.8
Offset	Performs offset calibration of the AFC sensor. This calibration contributes to good reproducibility of results.	12.4
Next Flow	Toggles among the AFC setup screens if two or more AFCs are installed in this system. The [FLOW] key can also be used to Switch screens.	—

12.4

12 Injection Port

AFC and APC Offset Calibration

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

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

Calibration procedures are as follows.

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

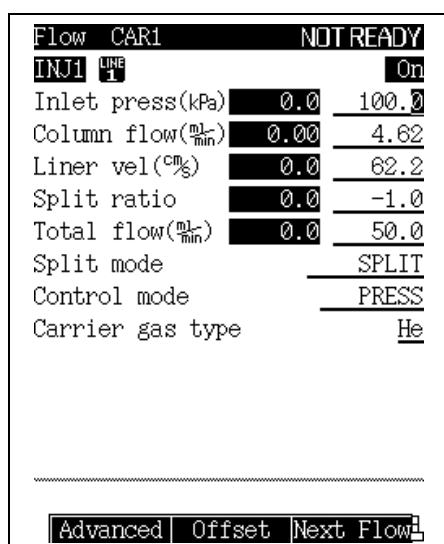


Fig. 12.4.1 (AFC)

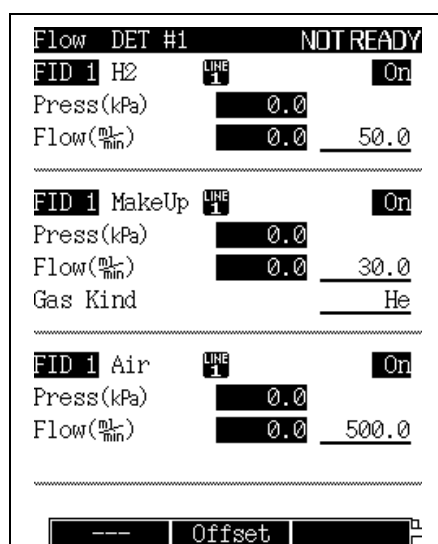


Fig. 12.4.2 (APC)

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

Setting the Flow Rate Parameters

■ 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.

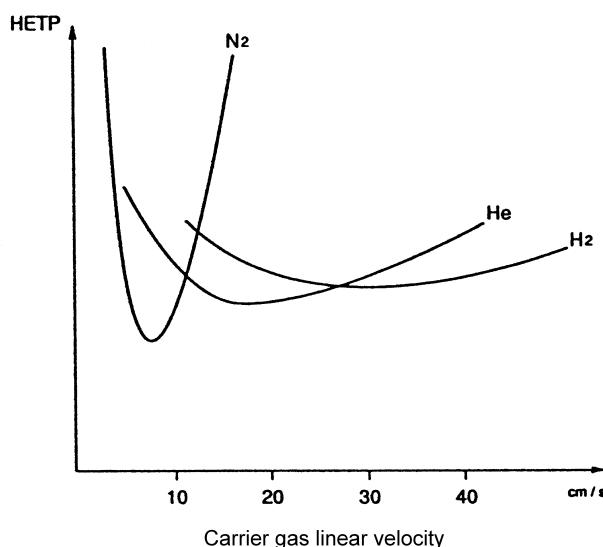


Fig. 12.5.1 Effect on linear velocity and HETP for various carrier gases (H-V curve)

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

- (1) If the linear velocity deviates only 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.



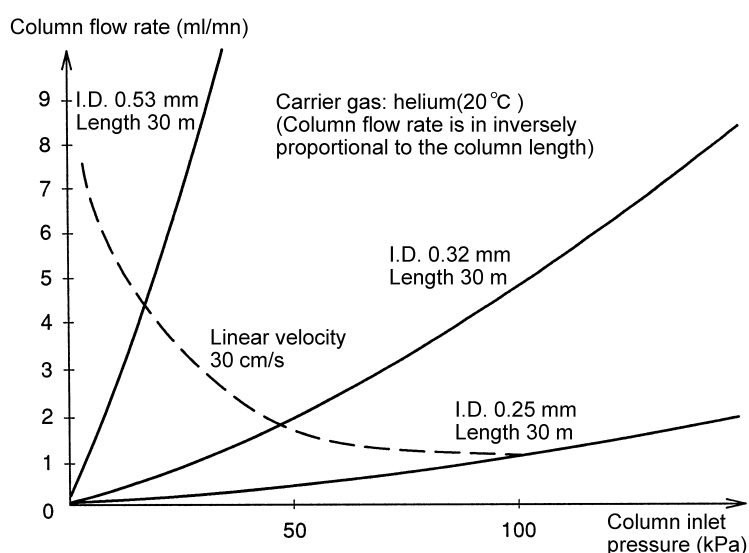
Example 1: Column oven temperature = 50 °C(carrier gas = helium)

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

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

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

NOTE Fig. 12.5.2 shows the relationship between the column flow rate and the column inlet pressure.



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

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]
 μ : Viscosity coefficient (19.4 μPa•s (helium, 20 °C))

Fig. 12.5.2



This page is intentionally left blank.

Hydrogen Flame Ionization Detector (FID)

13.1.1 Principle of FID operation

In the hydrogen flame ionization detector (FID), hydrogen gas is mixed with the column outlet gas at a certain ratio as shown in Fig. 13.1.1. The gas mixture combusts in the air atmosphere. An electrode exists at each end of the FID jet, and DC voltage is applied between the electrodes.

If only pure carrier gas (nitrogen, helium or argon) and hydrogen gas are mixed, little current is produced between the electrodes. When an organic compound is mixed with the carrier gas, current is produced proportionally to the amount of organic compound present.

This is because ions (mainly carbon ions) are generated when an organic compound combusts within the hydrogen flame, and the generated ions are captured by the collector. For isomers, the ion quantity generated is almost proportional to the number of carbons contained in the compound. However, carbon atoms in a "C=O" form do not create a signal. The presence 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.

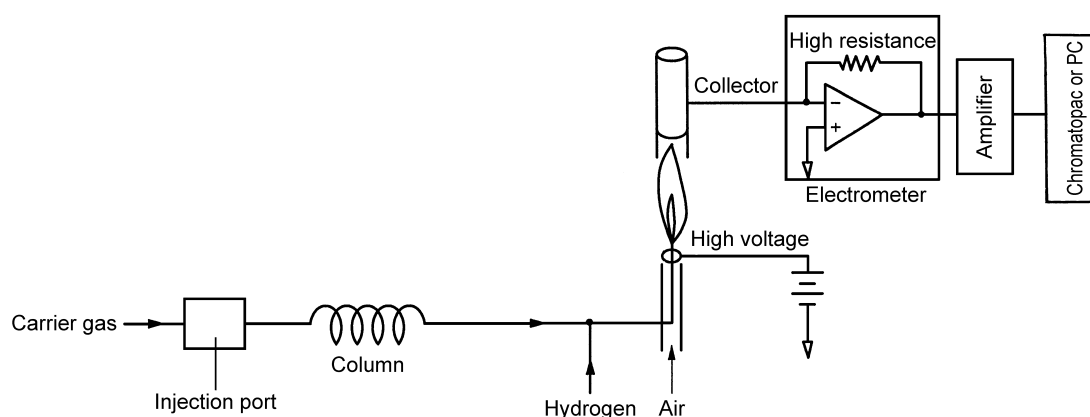


Fig. 13.1.1



13.1.2 Setting the detector

13.1.2.1 Screen description

Press the [DET] key to display the detector main screen shown in Fig.13.1.2. Here, set the detector temperature, the detector gas flow rate, etc.

When the detector is configured in the analytical line, the output signal settings appear in the lower portion of the screen.

Detector DET #2		READY
DFID		On
Temp(°C)	150.0	150.0
Flame		On
Signal Polarity		+
Filter Time Constant		1s
Control Mode		Dual
<hr/>		
Signal Output Port		Ch1
Background sig save		Off
Background sig comp.		Off
Det sig subtraction		Off
Signal Range		$\times 10^{-1}$
Analog Signal Type		Linear
<hr/>		
Ignite	---	Ign.Set

(a) Dual FID

Detector DET #1		READY
SFID		On
Temp(°C)	300.0	300.0
Flame		On
Filter Time Constant		200ms
<hr/>		
Signal Output Port		Ch1
Background sig save		Off
Background sig comp.		Off
Det sig subtraction		Off
Signal Range		$\times 10^{-1}$
Analog Signal Type		Linear
<hr/>		
Ignite	Det Gas	Ign.Set

(b) Single FID

Fig. 13.1.2 [DET] key main screen

13.1.2.2 Parameter list

DETECTOR CONTROLLER

Selection: On/Off, Default: On

When a detector is set to "On", its current and voltage are controlled.

When a detector is configured in an analytical line and set to "On" here, the detector is controlled and its signal monitored. However, even if a detector is set to "Off", the gas flow is controlled, and the temperature increases to the set value if the detector is configured in an analytical line.

TEMP

Range: 0.0–400 °C, Default: 25.0 °C

Set the detector temperature. Normally, set the detector temperature approximately 30 °C higher than the final column oven temperature to prevent contamination by high boiling point compounds. To set the maximum temperature limit, refer to ["16.6.4 Setting the maximum temperature limits"](#) in "16.6 GC Configuration".

FLAME (monitor only)

Selection: On/Off

Select "On" to ignite the flame.

Select "Off" to extinguish the flame.



SIGNAL POLARITY

(Displayed only when Dual is selected for the control mode of the dual FID)

Selection: +/-, Default: +

Set to + to output after subtracting the right side cell signal from the left side cell signal of the dual FID and set to - for the opposite.

FILTER TIME CONSTANT

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

Default: 200 ms (single FID), 1 s (dual FID)

This constant affects the processing of the detector signal.

As the time constant increases, noise as well as the peak height are reduced.

Select the optimum value in accordance with the peak half width. (Refer to ["13.3 Filter Signal Time Constant"](#).)

CONTROL MODE

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

Set to Dual when connecting two columns to the dual FID and Single L or R when connecting one column.

SIGNAL OUTPUT PORT

Selection: Off/Ch1/Ch2/Ch3/Ch4, Default: (Channel is automatically assigned.)

Select the digital and analog signals output channels. Four channels are available.

However, for analog output, only Ch1 and Ch2 are available as standard.

BACKGROUND SIG. SAVE

Selection: Off/Buf 1/Buf 2, Default: Off

Background baseline signals can be saved for the purpose of background subtraction.

BACKGROUND SIG COMP.

Selection: Off/Buf 1/Buf 2, Default: Off

Subtracts the saved background signal baseline from the actual baseline. This produces a stable baseline despite considerable baseline fluctuations

DET SIG SUBTRACTION

Selection: Off/DET# 1/DET# 2/DET# 3/DET# 4, Default: Off

Subtracts the detector signal of one detector from the signal of another detector. This function is mainly used in a dual column flow line to subtract the data acquired without an injection from the data acquired with an injection. The background signal is eliminated.

For the details on background save and background compensation, refer to ["13.4 Background Compensation"](#).

SIGNAL RANGE

Selection: $\times 1/\times 10^{-1}/\times 10^{-2}/\times 10^{-3}/\times 10^{-4}$, Default: $/\times 10^{-1}$

Multiplies the analog signal by the coefficient "10-x" for a linear analog signal type.

If the data processing unit is saturated, for example, change the setting from " $\times 1$ " to " $\times 10^{-1}$ ", from " $\times 10^{-2}$ " to " $\times 10^{-3}$ ". In case of the digital signal, the signal is always output with " $\times 1$ ".

SIGNAL ATTENUATION

Selection: $\times 1/\times 2^{-1}/\times 2^{-2}/\times 2^{-3}/\times 2^{-4}$, Default: $/\times 2^{-1}$

Multiplies the analog signal by the coefficient "2-x" for a wide analog signal type.

If the data processing unit is saturated, for example, change the setting from " $\times 1$ " to " $\times 2^{-1}$ ", from " $\times 2^{-2}$ " to " $\times 2^{-3}$ ". In case of the digital signal, the signal is always output with " $\times 1$ ".

ANALOG SIGNAL TYPE

Selection: Linear/Wide, Default: Linear

Set this item when the GC is connected to a Chromatopac in analog format.

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

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



When connecting the GC to a C-R7A/CR-7A plus for the first time, or replacing the Chromatopac, set the detector signal output to “Off” and perform calibration. (For the calibration procedure, refer to [“2.2 Outputting Analog Signals to the Chromatopac”](#).)

Linear...Select linear when connecting the GC to any Chromatopac other than the C-R8A/C-R7A/CR-7A plus.

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

13.1.2.3 PF menu

PF menu	Description	Reference section
Ignite	Reduces the air flow rate, heats filament, and ignites detector when pressed when “FLAME” was set to “Off”. If “AUTO IGNIT” is set to “On” on the [SYSTEM] key screen, the detector is automatically ignited after each setting reached the setting value.	13.2.2.4
Det Gas	Sets the flow rate of makeup gas, hydrogen and air if the advanced Pressure Control (APC) is installed.	13.2.3
Ign. Set	If the Advanced Pressure Control (APC) is installed, you can set automatic ignition and automatic re-ignition. Default value is “On”.	_____
Next Det	Toggles to the setup screen of another installed detector. The [DET] key can also be used to switch screens.	_____
VLV On or VLV Off	When the optional solenoid valve to shut off supply gas is installed, hydrogen and air are shut off by the valve until ignition. Opens the solenoid valve when “VLV On” is displayed and closes the valve when “VLV Off” is displayed.	_____



13.1.3 Setting the Detector Gas (manual flow controller)

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

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

Set the detector gas flow rate following the procedures described below.

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

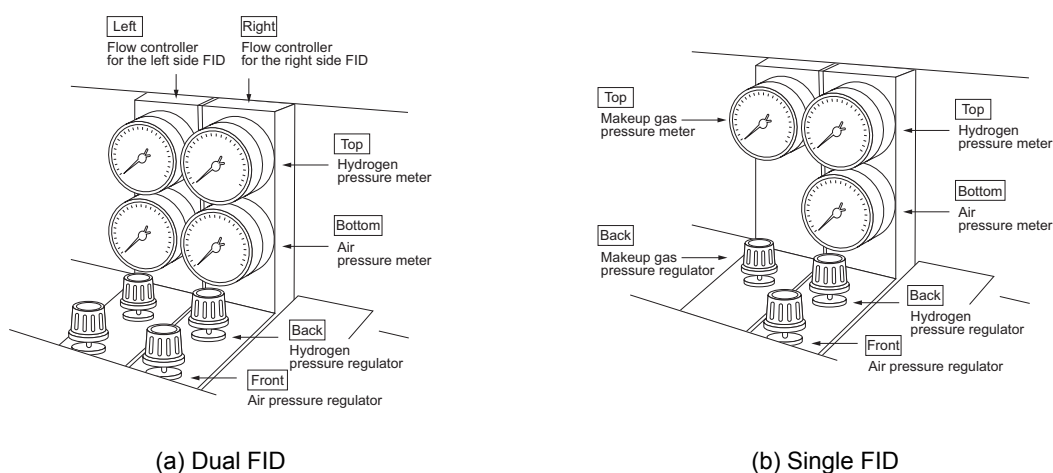


Fig. 13.1.3 Manual flow controller for FID

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

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

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

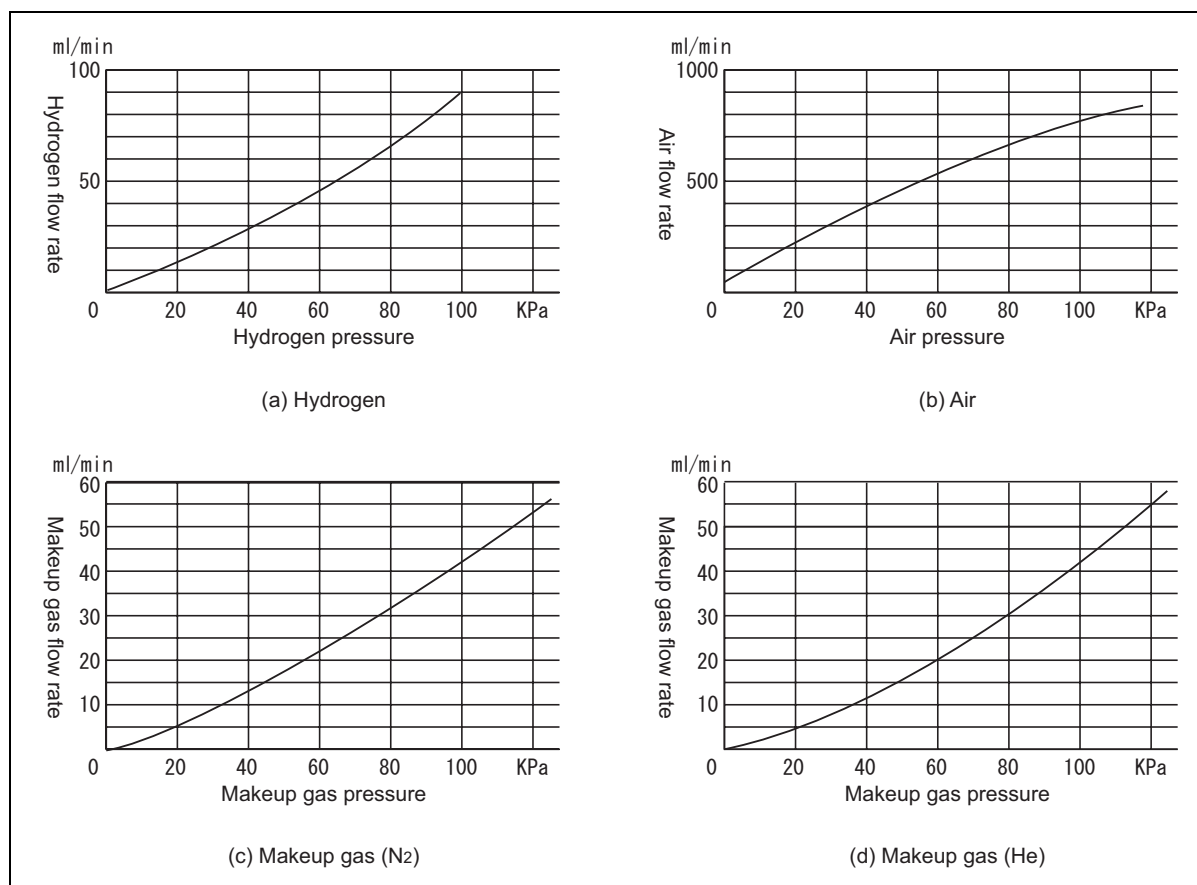


Fig. 13.1.4 Pressure-flow rate calibration curves (examples)



13.1.4 Setting the detector gas flows(APC)

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

13.1.4.1 Screen description

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

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

Flow DET #2		READY
DFID H2	LINE 1 On	
L.Press(kPa)	137.0	
L.Flow($\frac{\text{mL}}{\text{min}}$)	40.0	40.0

DFID MakeUp	LINE 1 On	
L.Press(kPa)	75.0	
L.Flow($\frac{\text{mL}}{\text{min}}$)	30.0	30.0
L.Gas Kind		He

DFID Air	LINE 1 On	
L.Press(kPa)	40.0	
L.Flow($\frac{\text{mL}}{\text{min}}$)	400.0	400.0

Return Next Flow On/Off		

Flow DET #1		READY
SFID H2	LINE 1 On	
Press(kPa)	137.0	
Flow($\frac{\text{mL}}{\text{min}}$)	40.0	40.0

SFID MakeUp	LINE 1 On	
Press(kPa)	75.0	
Flow($\frac{\text{mL}}{\text{min}}$)	30.0	30.0
Gas Kind		He

SFID Air	LINE 1 On	
Press(kPa)	40.0	
Flow($\frac{\text{mL}}{\text{min}}$)	400.0	400.0

Return --- On/Off		

Fig. 13.1.5 Setting the detector gas flows

**13.1.4.2 Parameter list****H₂**

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

MAKE UP

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

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

GAS TYPE

Selection: 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 rate)

13.1.4.3 PF menu

PF menu	Description	Reference section
Next Flow	Switches screens to set detector gas for the left (L) and right (R) side detectors during the dual mode of the dual FID with APC.	12.4
On/Off	Select "Off" to stop gas flow. Select "On" to restart the gas flow. Default value is "On".	—
Offset	Performs offset calibration of APC sensor. This calibration improves the reproducibility of results.	3.6



13.1.5 Igniting and Extinguishing the FID

13.1.5.1 Confirmation prior to FID ignition

Confirm the following points prior to FID ignition.

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

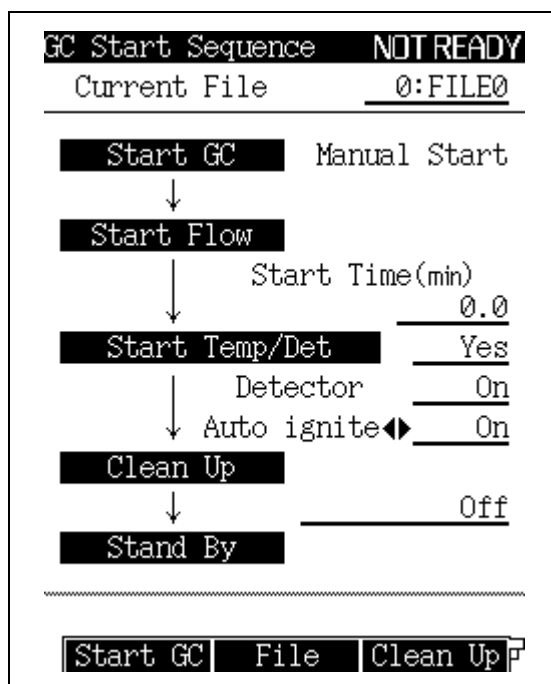
13.1.5.2 FID ignition procedures

■ Automatic ignition

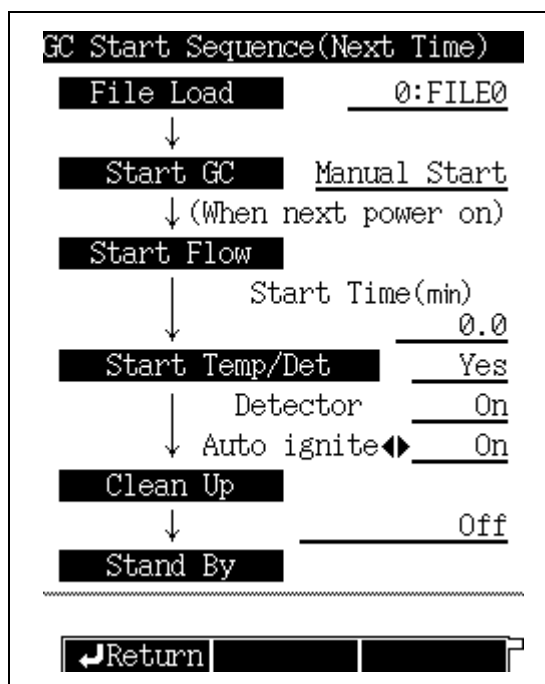
The system starts and the FID is ignited automatically.

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

START TEMP/DET	Yes
DETECTOR	On
AUTO IGNITE	On



(a) Main screen



(b) [Start Seq] (PF menu)

Fig. 13.1.6 Setting starting procedures (automatic ignition)

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



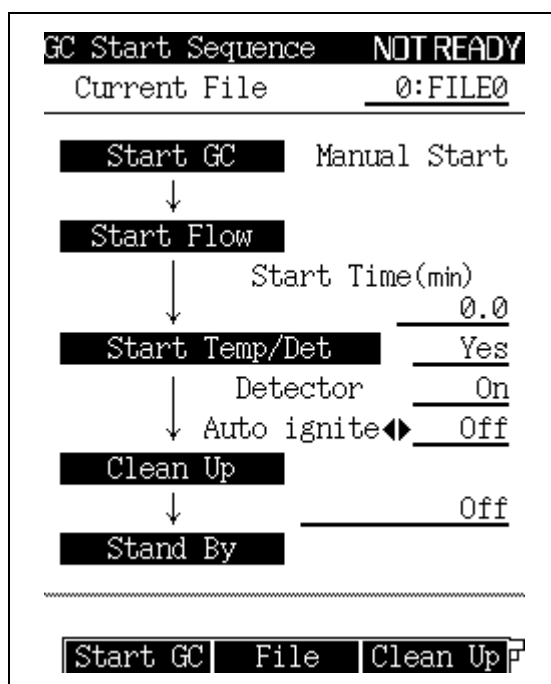
3. After the GC starts, gas control starts. Temperature/detector control starts after the start time passes. When the detector's temperature becomes READY, the FID is ignited automatically.

■ Manual ignition

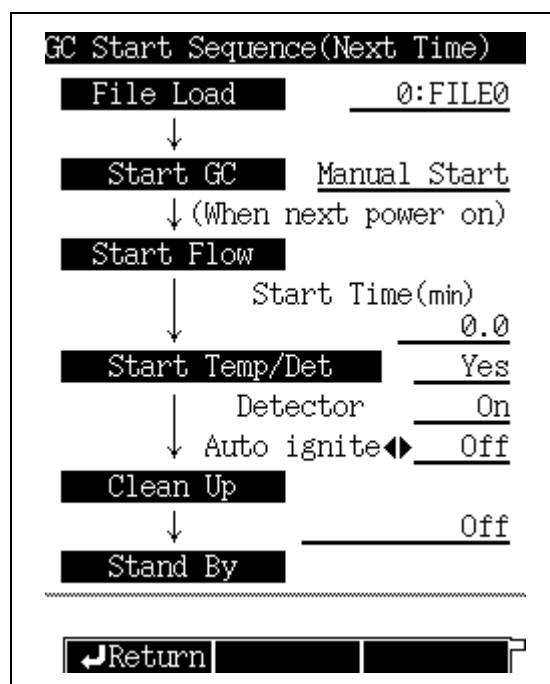
The FID is ignited by key operation.

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

START TEMP/DET	Yes
DETECTOR	On
AUTO IGNITE	Off



(a) Main screen



(b) [Start Seq] (PF menu)

Fig. 13.1.7 Setting starting procedures (manual ignition)

2. Start the GC.
GC starts when [Start GC] (PF menu) is pressed in manual starting and when the power is turned on in automatic starting.
3. After the GC starts, gas control starts. Temperature/detector control starts after the start time passes.
4. After the detector's temperature becomes 100 °C or higher, press [Ignite] (PF menu) on the [DET] key main screen.



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

START TEMP/DET	___ Yes
DETECTOR	___ Off
AUTO IGNITE	___ Off

Always set to On when only FID is used.

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

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

13.1.5.3 Extinguishing the FID

■ Manual flow controller

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

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

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

■ APC

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

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

13.2

13 Detector

Thermal Conductivity Detector (TCD)

13.2.1 Principle of TCD operation

The thermal conductivity detector (TCD) can detect all compounds except the carrier gas itself.

The metallic TCD filament is heated by the application of current. The carrier gas used has a high thermal conductivity, such as helium. As sample compounds pass the filament, the filament temperature increases, because the thermal conductivity of the sample compounds is less than that of the carrier gas. The filament temperature changes affect its resistance; the resistance is measured and produces a chromatogram.

A reference filament also exists, where only carrier gas flows, to eliminate background resistance fluctuations.

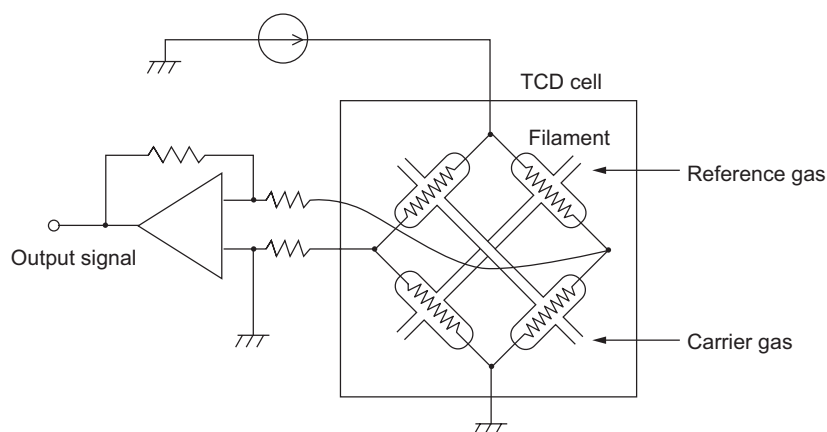


Fig. 13.2.1

The TCD sensitivity is proportional to the difference in thermal conductivity between the sample and the carrier gas. Because the thermal conductivity of the sample is lower than that of the carrier gas, the TCD sensitivity increases as the thermal conductivity of the carrier gas increases.

For high sensitivity analysis, use helium with a purity of 99.9995 % or more.

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

Gas		Thermal conductivity	Gas		Thermal conductivity
Simple compounds	He	1499	Inorganic compounds	CO ₂	166.2
	H ₂	1815		H ₂ O	181
	N ₂	259.8	Organic compounds	acetone	115
	Ar	177.2		hexane	128



13.2.2 Setting the detector

13.2.2.1 Screen description

Press the [DET] key to display the Detector main screen shown in Fig. 13.3.2. Here, set the detector temperature, the detector gas flow rate, etc.

When the detector is configured in the analytical line, the output signal settings appear in the lower portion of the screen.

```
Detector DET #3 NOT READY
DTCD LINE 1 ◀ On
Temp(℃) 300.0 300.0
Temp(℃) 300.0 300.0
Signal Polarity +
Current(mA) 30
Filter Time Constant 1s
-----
Signal Output Port Ch1
Background sig save Off
Background sig comp. Off
Det sig subtraction Off
Signal Attenuation x1
Analog Signal Type Wide
-----
--- --- ---
```

Fig. 13.2.2 [DET] key main screen

13.2.2.2 Parameter list

DETECTOR CONTROLLER

Selection: On/Off, Default: On

When a detector is set to "On", its current and voltage are controlled.

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

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

Set the detector temperature. The TCD sensitivity is proportional to the difference in temperature between the detector and the filament. Accordingly, the sensitivity increases as the detector temperature decreases. However, the detector is normally set approximately 10 °C higher than the final column oven temperature: this prevents contamination in the TCD cell.

To set the maximum temperature limit, refer to ["16.6.4 Setting the maximum temperature limits"](#).



SIGNAL POLARITY

Selection: +/-, Default: +

When analyzing compounds with a thermal conductivity higher than the carrier gas, baseline peaks are inverted (negative). When this occurs, switch to a polarity of “-” to produce positive peaks.

CURRENT

Range: 0–200 mA, Default: 0 mA

The TCD sensitivity is approximately proportional to the cube of the current.

If the sensitivity is insufficient, increase the current within the range shown in Fig. 13.2.3. The maximum operating current is determined by the detector temperature and the carrier gas type. Keeping the current higher than necessary shortens the filaments life and can cause baseline drift.



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.

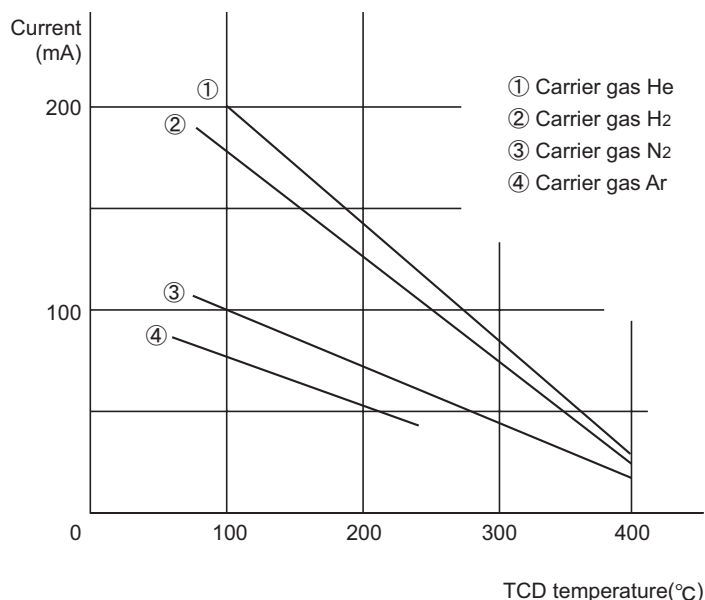


Fig. 13.2.3 Maximum operating current

**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: 1 s

This constant affects the processing of the detector signal.

As the time constant increases, noise as well as the peak height are reduced.

Select the optimum value in accordance with the peak half width. (Refer to [“13.3 Filter Signal Time Constant”](#).)

SIGNAL OUTPUT PORT

Selection: Off/Ch1/Ch2/Ch3/Ch4, Default: (Channel is automatically assigned.)

Select the digital and analog signals output Channels. Four channels are available.

However, for analog output, only Ch1 and Ch2 are available as standard.

BACKGROUND SIG. SAVE

Selection: Off/Buf 1/Buf 2, Default: Off

Background baseline signals can be saved for the purpose of background subtraction.

BACKGROUND SIG COMP.

Selection: Off /Buf 1/Buf 2, Default: Off

Subtracts the saved background signal baseline from the actual baseline. This produces a stable baseline despite considerable baseline fluctuations.

DET SIG SUBTRACTION

Selection: Off /DET#1/DET#2/DET#3/DET#4, Default: Off

Subtracts the detector signal of one detector from the signal of another detector.

For the details on background save and background compensation, refer to [“13.4 Background Compensation”](#).

SIGNAL RANGE

Selection: $\times 1/\times 10^{-1}/\times 10^{-2}/\times 10^{-3}/\times 10^{-4}$, Default: $\times 10^{-1}$

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

SIGNAL ATTENUATION

Selection: $\times 1/\times 2^{-1}/\times 2^{-2}/\times 2^{-3}/\times 2^{-4}$, Default: $\times 2^{-1}$

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

ANALOG SIGNAL TYPE

Selection: Linear/Wide, Default: Linear

Set this item when the GC is connected to a Chromatopac in analog format.

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

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

When connecting the GC to a C-R7A/CR-7A plus for the first time, or replacing the Chromatopac, set the detector signal output to “Off” and perform calibration. (For the calibration procedure, refer to [“2.2 Outputting Analog Signals to the Chromatopac”](#).)

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

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

**13.2.2.3 PF menu**

PF menu	Description	Reference section
Next Det	Toggles to the setup screen of another detector. The [DET] key can also be used to switch screens.	—



13.2.3 TCD Zero Point Adjustment

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

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

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

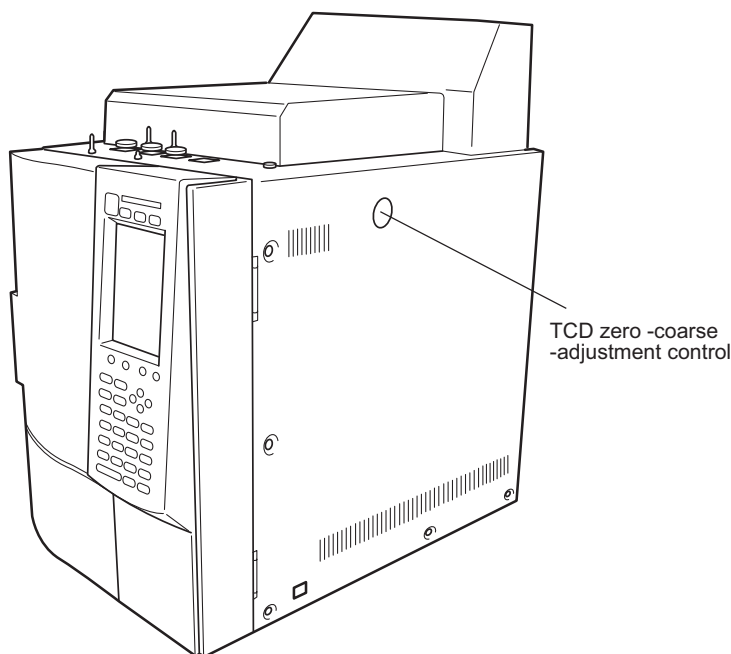


Fig. 13.2.4

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

13.3

13 Detector

Filter Signal Time Constant

■ Selecting the filter time constant

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

Fig. 13.3.1 shows the relationship between the peak half width and the time constant where the S/N ratio is 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."

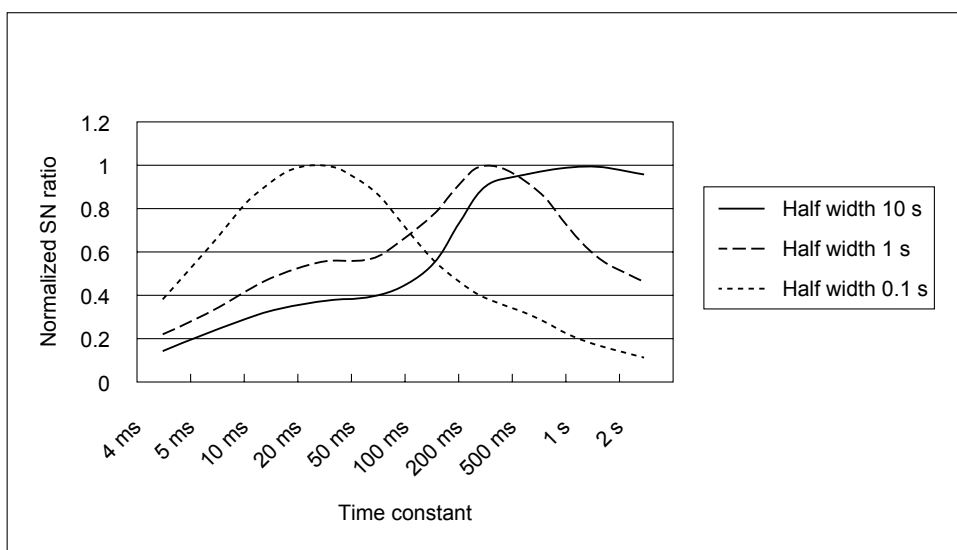


Fig. 13.3.1 Relationship between time constant and S/N ratio

13.4

13 Detector

Background Compensation

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

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

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

Detector	DET #1	READY
SFID	LINE 1	On
Temp(°C)	150.0	150.0
Flame		On
Filter Time Constant		200ms

Signal Output Port		Ch1
Background sig save	◀	Buff1
Background sig comp.		Off
Det sig subtraction		Off
Signal Attenuation		$\times 2^{-1}$
Analog Signal Type		Wide

Ignite Det Gas Ign.Set F		

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

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

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

Detector	DET #1	READY
SFID	LINE 1	On
Temp(°C)	150.0	150.0
Flame		On
Filter Time Constant		200ms

Signal Output Port		Ch1
Background sig save		Off
Background sig comp.	◀	Buff1
Det sig subtraction		Off
Signal Attenuation		$\times 2^{-1}$
Analog Signal Type		Wide

Ignite Det Gas Ign.Set F		

4. Inject a sample and execute analysis. A signal after subtracting the background is outputted.

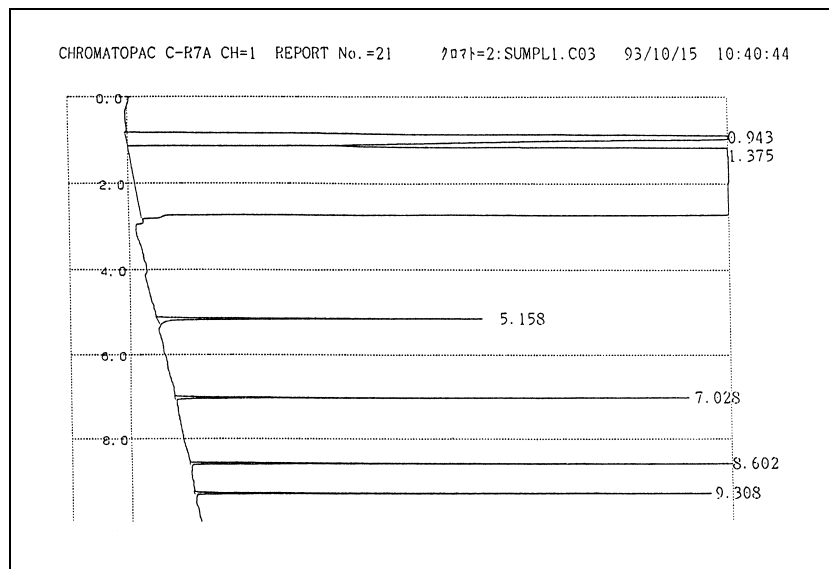


Fig. 13.4.1 Example of programmed analysis without compensation

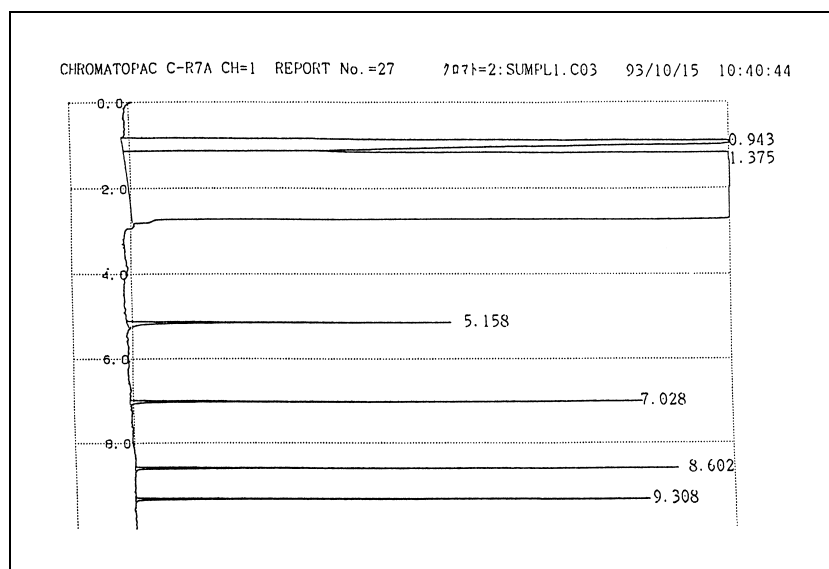


Fig. 13.4.2 Example of programmed analysis with compensation

14.1

14 Diagnosis

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.

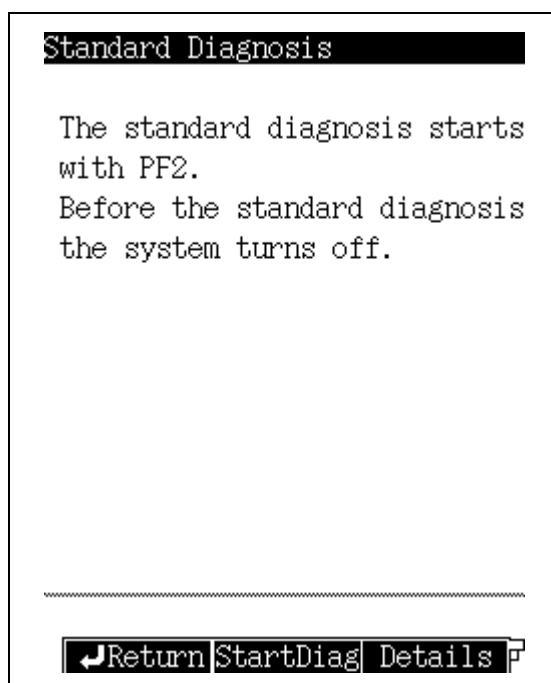


Fig. 14.1.1 Diagnosis main screen

14.1.2 PF menu

PF menu	Description	Reference section
Start Diag	Starts standard diagnosis program.	14.1.5
Details	Displays result of the most recent diagnosis. However, if standard diagnosis has not been executed since the power has been turned on, default values are displayed. [Print] (PF menu) prints out the displayed diagnosis results.	14.1.9
Diag Param	Determines setup values used for diagnostic reference and selects diagnosis items.	14.1.3



14.1.3 Diagnosis Parameters

Press [Diag Param] (PF menu) from the Standard Diagnosis main screen to display the Diagnosis Parameters screen shown in Fig. 14.1.2.

Select the items to be checked during the self-test.

Diagnosis Parameters NOT READY	
Counter for Septum	<u>Yes</u>
Counter for Insert	<u>Yes</u>
CRG Use Time	<u>No</u>
Temp Sensor Diag	<u>Yes</u>
LCD Use Time	<u>Yes</u>
Fan Use Time	<u>Yes</u>
DC Voltage	<u>Yes</u>
Room Tempetature	<u>No</u>
Atmospheric Press.	◀ <u>No</u>
Primary Press.	<u>Yes</u>
CPU Registor	<u>Yes</u>
Real Time Clock Registor	<u>Yes</u>

Return

Fig. 14.1.2 Diagnosis setup screen



14.1.4 Diagnosis parameter list

For each item, specify whether it is to be checked or tested. Test items are marked “Yes”. Items which are ignored are marked “No”. Each item is marked either “Yes” or “No”. For example, if the septum counter is marked “Yes”, both the INJ1 and INJ2 will be checked.



CAUTION

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

COUNTER FOR SEPTUM

COUNTER FOR INSERT

Verifies whether the preset number of injections has been exceeded.

The “ANALYSIS COUNTER” limit is displayed.

CRG USE TIME

Verifies whether the valve “On” time exceeds the preset operating time.

The “COOLANT CONSUMPTION” limit is displayed.

TEMP SENSOR USE TIME

The operating time for the temperature sensor in use at 300 °C or above is displayed. Refer to the guidelines for operating time.

TEMP SENSOR DIAG

Verifies whether spiking noise has been generated, to detect deterioration of the platinum sensor.

LCD USE TIME

Verifies whether the accumulated backlight ON time exceeds the preset operating time.

The limit 15,000 hours.

FAN USE TIME

Verifies whether the accumulated fan operating time exceeds the preset operating time.

The limit is 43,800 hours.

DC VOLTAGE (5 VDC, 24 VDC, -15 VDC, FTD 24 VDC)

Verifies whether each DC voltage has 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.



DETECTOR IGNITE

Checks that the ignition pulse is normal.

DETECTOR IGNITION

Verifies whether the ignition operation is normally executed.

ECD FREQUENCY

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

CARRIER GAS ROM, DETECTOR GAS ROM, APC ROM, AMC ROM

Verifies whether the data saved in the ROM on the flow controller PCB can be read correctly.

**CARRIER GAS AD CONVERTER, DETECTOR AD CONVERTER,
APC AD CONVERTER, AMC AD CONVERTER**

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

GAS CONTROL

Checks if carrier gas, detector gas, AUX APC, and AUX AMC are normally controlled.

OVER TEMP PROTECTION

Ensure that the overheat protection circuit is normal.

CPU PERIPHERAL

RESET IC

Verifies that the reset circuit works normally.

WATCH DOG TIMER

Ensures that the IC which checks for software problems is functioning normally.

ROM

Checks that the ROM is intact.

RAM

Verifies whether the RAM can be correctly written and read.



14.1.5 Starting the diagnosis

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

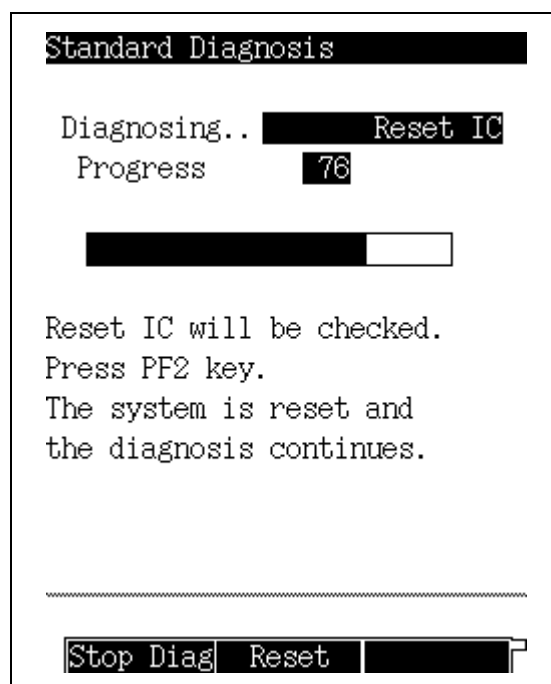


Fig. 14.1.3 Starting the Diagnosis

14.1.6 PF menu

PF menu	Description	Reference section
Stop Diag	Stops the diagnosis. If the program is stopped, items not yet executed are canceled.	14.1.7
Reset	Before 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.	—



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.

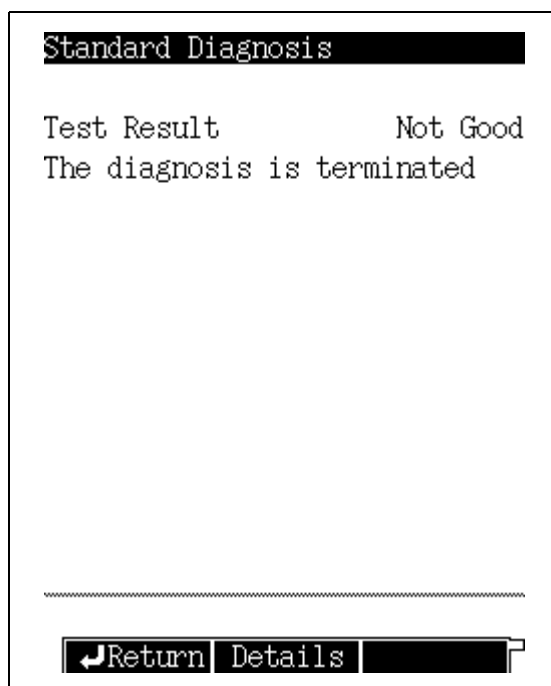


Fig. 14.1.4 Diagnosis stops

14.1.8 PF menu

PF menu	Description	Reference section
Details	When the diagnosis is stopped, diagnosis results up to that time are displayed. When the diagnosis ends, the diagnosis results of all items are displayed. Press [Print] (PF menu) to print out the displayed diagnosis results.	14.1.9



14.1.9 Diagnosis results

Press [Details] (PF menu) from the screen shown in Fig. 14.1.4 once the standard diagnosis is have stopped or ended; the Test Result screen shown in Fig. 14.1.5 appears.

Press [Details] (PF menu) from the standard diagnosis screen shown in Fig. 14.1.4 to display the results of the last test since the power was turned on. Once the power is turned off, the diagnosis results are cleared.

The screenshot shows a terminal-style interface for a 'Diagnosis Report'. At the top, the title 'Diagnosis Report' is displayed. Below it, a summary line shows 'Test Result' as 'Good'. A horizontal line separates this from the main data section. The first section is titled 'Temp Sensor Diag' and lists several components with their status: 'Column' (Good), 'SPL1' (Good), 'FID1' (Good), 'WBI2' (Good), 'TCD2' (Good), 'AUX3' (Good), 'AUX4' (Good), and 'AUX5' (Good). The second section is titled 'LCD Use Time'. At the bottom of the screen, there are two buttons: 'Return' and 'Print'.

Diagnosis Report	
Test Result	Good
Temp Sensor Diag	
Column	Good
SPL1	Good
FID1	Good
WBI2	Good
TCD2	Good
AUX3	Good
AUX4	Good
AUX5	Good
LCD Use Time	
Return Print	

Fig. 14.1.5 Diagnosis results

14.1.10 PF menu

PF menu	Description	Reference section
Print	Prints out the results of the diagnosis to a Chromatopac.	—



■ diagnosis results

- Good : Displayed when the diagnosis result satisfies the requirements.
- Not Good : Displayed when the diagnosis result does not satisfy the 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”

Diagnosis item	Countermeasures
SEPTUM COUNTER	Replace the septum. (Refer to “4.4 Septum” in the operation manual.)
INSERT COUNTER	Replace the glass insert. (Refer to “4.6 Glass Insert” in the operation manual.)
ROOM TEMPERATURE	Check the operation range.
ATMOSPHERIC PRESS	Check the operation range.
GAS PRIMARY PRESS	Increase supply pressure from the gas cylinder. For example, adjust the regulator.
DETECTOR IGNITION	Refer to “5.1 Troubleshooting” operation manual.
ANY OTHER ITEM	Contact your Shimadzu representative.

14.2

14 Diagnosis

Log Reading Menu

14.2.1 Screen description

Select "2. LOG READING MENU" from the [DIAG] key main screen to display the Log Reading Menu screen shown in Fig. 14.2.1.

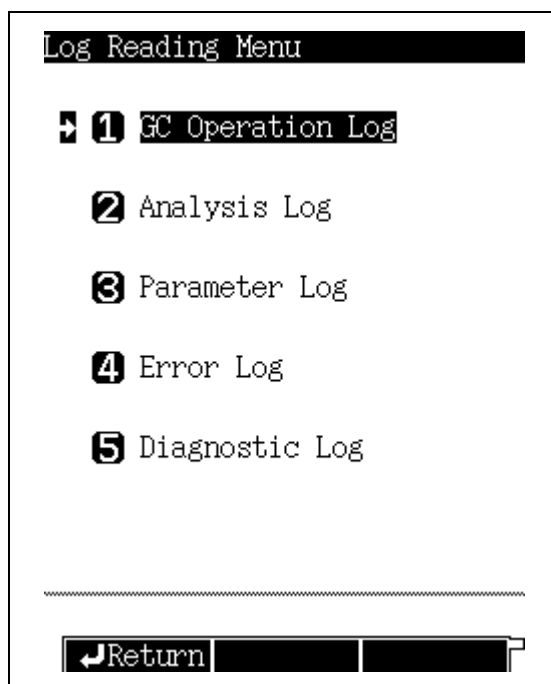


Fig. 14.2.1 Log reading menu main screen

14.2.2 Parameter list

GC OPERATION LOG

Displays the power On/Off log and the system On/Off log.

ANALYSIS LOG

Displays the analysis log. This log records whether analyses were finished and whether controls deviated from their target valves.

PARAMETER LOG

Displays the key operation log and the parameter change log.

ERROR LOG

Displays the log of displayed error messages.

DIAGNOSTIC LOG

Displays the diagnosis log.



14.2.3 GC Operation log

Select "1. GC OPERATION LOG" to display the system On/Off log and the heater On/Off log.

(1) Screen description

Select "2. LOG READING MENU" from the [DIAG] key main screen, then select "1. GC OPERATION LOG". The screen shown in Fig. 14.2.2 appears.

Up to 50 logs are stored. If the number of logs exceeds 50, existing logs are deleted starting with the oldest.

GC Operation Log (1 / 6)		
Start Time	Stop Time	
08.12 08:00-		System
08.12 07:50-08.12 07:50		System
08.12 07:50-		Power
08.11 20:10-08.11 20:20		System
08.11 08:00-08.11 20:10		System
08.11 07:50-08.11 20:30		Power

⏮Return Clear Log Print⏭		

Fig. 14.2.2 Operation log screen

[NOTE] If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	—
Print	Prints the the operation log to a Chromatopac.	—



14.2.4 Analysis log

When “2. ANALYSIS LOG” is selected, the analysis log is displayed. This log records whether analyses were allowed to finish and whether monitored valves exceeded their set valves.

(1) Screen description

Select “2. LOG READING MENU” from the [DIAG] key main screen, then select “2. ANALYSIS LOG” to display the screen shown in Fig. 14.2.3.

25–545 logs are saved. The number of saved logs depends on the size of each log. If the number of logs exceeds the capacity, existing logs are deleted starting from the oldest.

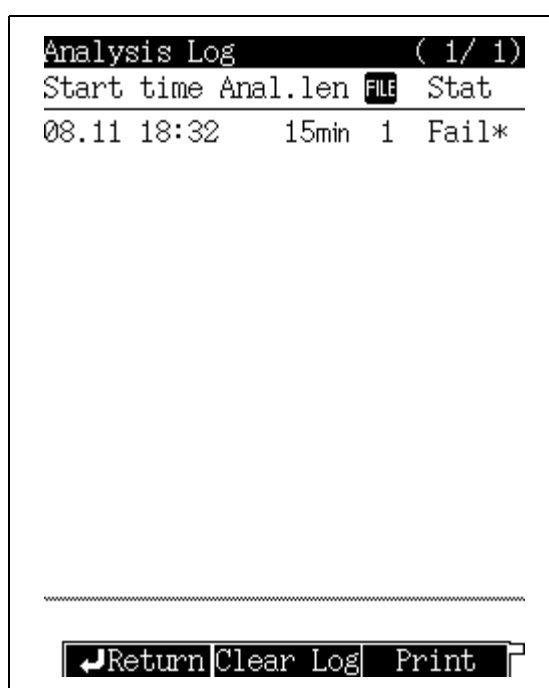


Fig. 14.2.3 Analysis log screen

NOTE During a temperature program, if the rate of temperature increase is too great, the GC may not be within the Ready range. When this occurs, the analysis log shows “Fail”.

NOTE If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message “Clear log with PF2” appears. Press [Clear Log] (PF menu) to clear the log.	—
Print	Prints the analysis log to a Chromatopac.	—



(3) Analysis log details

On the analysis log main screen, use the cursor to select a log item with “*” on the right and press the [ENTER] key to display the screen shown in Fig. 14.2.4.

The screen provides details about each error when the monitored value deviated from the set value, and for which an alarm or warning was issued during the analysis.

Analysis Log (details) (1/30)		
Error Time	SET	ACT
Room temp range error		
1.20min	25.0℃	25.5℃
DetAPC3 PCB error		
3.30min	130	151
DET#4 PCB error		
2.50min	100	111
CAR1 WBI PCB error		
1.20min	25	25
APC7-9 PCB error		
2.50min	100	111
COL A/D error		
3.30min		
Return		

Fig. 14.2.4 Details screen



14.2.5 Parameter log

When “3. PARAMETER LOG” is selected, parameter names and new values are displayed when parameters are changed. In addition, the direct operation of valves, etc. are also displayed.

(1) Screen description

Select “2. LOG READING MENU” from the [DIAG] key main screen, then select “3. PARAMETER LOG”. The screen shown in Fig. 14.2.5 appears.

Up to 50 logs are saved. If the number of logs exceeds 50, existing logs are deleted starting from the oldest.

Parameter Log (1/50)		
Time changed	Name	Value
08.12 08:00	P1DD	9999
08.12 08:00	CNA7	0
08.12 08:00	APR7	-20.50
08.12 08:00	CFP8	-120.0
08.12 08:00	DLW1	789
08.12 08:00	APG1	35
08.12 08:00	FTV3	120
08.12 08:00	SSY2	100
08.12 08:00	SCC1	300
08.12 08:00	M4PR	300.0
08.12 07:55	G2PR	1.0
08.10 08:57	CITP	200.0
<div> Return Clear Log Print </div>		

Fig. 14.2.5 Parameter log screen

NOTE If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message “Clear log with PF2” appears. Press [Clear Log] (PF menu) to clear the log.	—
Print	Prints the parameter log to a Chromatopac.	—



14.2.6 Error log

When “4. ERROR LOG” is selected, the log of all errors which have been displayed is shown.

(1) Screen description

Select “2. LOG READING MENU” from of the [DIAG] key main screen, then select “4. ERROR” to display the screen shown in Fig. 14.2.6.

Up to 100 logs are saved. If the number of logs exceeds 100, existing logs are deleted starting from the oldest.

Error Log (1/100)		
Time occurred	Code	Value
Modification during analysis		
06.13 18:15	E4301	69
Modification during analysis		
06.13 18:13	E4301	26669
Modification during analysis		
06.13 18:13	E4301	26668
Modification during analysis		
06.13 18:13	E4301	26667
Modification during analysis		
06.13 18:13	E4301	26627
Modification during analysis		
06.13 18:10	E4301	89
.....		
Return Clear Log Print		

Fig. 14.2.6 Error log screen

NOTE If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message “Clear log with PF2” appears. Press [Clear Log] (PF menu) to clear the log.	—
Print	Prints the error log to a Chromatopac.	—



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.

Diagnostic Log (1/10)	
Diag date	Status
98.08.12 08:00	Good
98.08.12 07:50	Good
98.08.12 07:50	Good
98.08.12 07:50	Not Good
98.08.11 20:30	Not Good
98.08.11 20:20	Good
98.08.11 20:10	Good
98.08.11 20:10	Good
98.08.11 08:00	Good
98.08.11 07:50	Not Good
<div> Return Clear Log Print </div>	

Fig. 14.2.7 Diagnosis log screen

NOTE If there are more items than items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message “Clear log with PF2” appears. Press [Clear Log] (PF menu) to clear the log.	—
Print	Prints the diagnosis log to a Chromatopac.	—

14.3

14 Diagnosis

Analysis Counter

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.

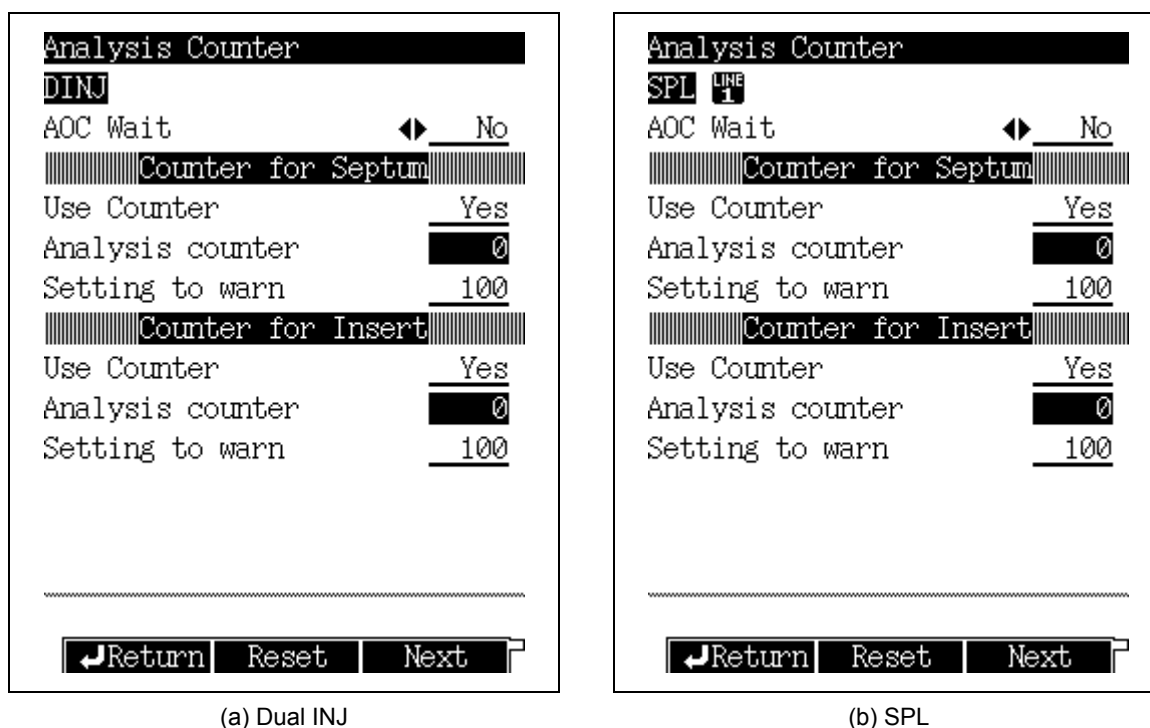


Fig. 14.3.1 Analysis counter screen

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



14.3.2 Parameter list

AOC WAIT

Selection: Yes/No, Default: No

When the threshold is exceeded during batch processing, select “Yes” to temporarily pause, the AOC operation when the analysis counter has exceed the limit.

USE COUNTER

Selection: Yes/No, Default: Yes

ANALYSIS COUNTER

Selection: 0

SETTING TO WARN

Range: 0–9999, Default: 100

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

14.3.3 PF menu

PF menu	Description	Reference section
Reset	Resets analysis number counter of the current item.	—
Next	Displays the setup screen of the analysis counter of another injection port.	—

14.4

14 Diagnosis

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.

The screenshot shows a menu titled "Coolant Consumption". It has two sections: "Column" and "WBI2". Each section has three items: "Use Counter", "Consumption(min)", and "Setting to warn(min)". The "Column" section has "Use Counter" set to "Yes", "Consumption(min)" set to "0", and "Setting to warn(min)" set to "100". The "WBI2" section has "Use Counter" set to "No", "Consumption(min)" set to "0", and "Setting to warn(min)" set to "0". At the bottom, there are two buttons: "Return" and "Reset".

Coolant Consumption	
Column	
Use Counter	Yes
Consumption(min)	0
Setting to warn(min)	100
WBI2	
Use Counter	No
Consumption(min)	0
Setting to warn(min)	0
Return Reset	

Fig. 14.4.1 Coolant consumption sets screen screen



14.4.2 Parameter list

USE COUNTER

Selection: Yes/No, Default : Yes

CONSUMPTION

Default: 0 min

The total time that the CRG is "On" is displayed.

Refer to "[15.5 Setting the CRG Parameters](#)".

SETTING TO WARN

Range: 0–9999 min, Default : 100 min

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

PF menu	Description	Reference section
Reset	Resets the Use counter.	—

14.5

14 Diagnosis

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.

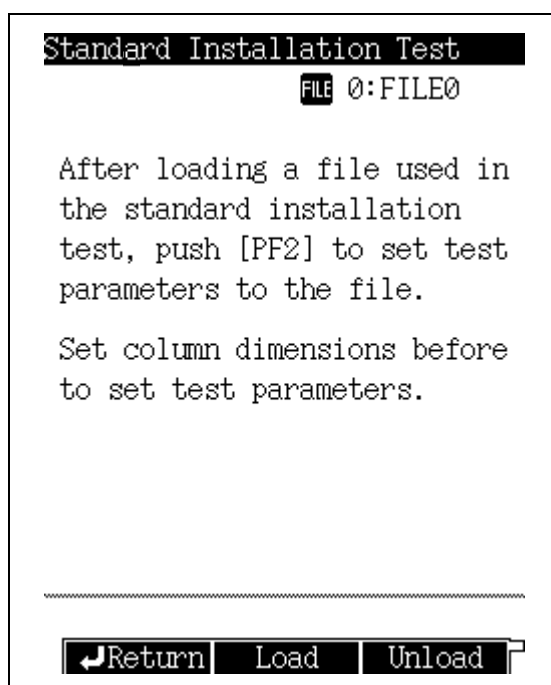


Fig. 14.5.1 Standard installation test main screen

14.5.2 PF menu

PF menu	Description	Reference section
Load	Automatically sets the analytical conditions of the standard installation test. When [Load] (PF menu) is pressed, "TEST" is displayed for the used file name.	—
Unload	Returns analytical conditions to their former status.	—



14.5.3 Test procedure

- (1) Specify the analytical conditions file of the standard installation test.
Example: Load "File 1" using [File] (PF menu) of the [SET] key.
- (2) Configure the injection port and the detector used to execute the standard installation test in an analytical here.
However, if two or more analytical lines have been configured, the lowest No. analytical line is set with the test conditions.
In the standard installation test, only one detector can be set per analytical line. If two or more detectors are set, an error message appears.
- (3) Set the dimensions of the column installed.
Example: Set the dimensions of the column using [Column] of the [FLOW] key.
- (4) Press [Load] (PF menu) to load the analytical conditions of the standard installation test.
- (5) If the analytical condition need to be changed for the installation test, change the parameters.
- (6) Make an injection, then verify whether the data has been acquired correctly.
- (7) When analysis finishes, press [Unload] (PF menu) to return the analytical conditions to their former status.

14.6

14 Diagnosis

Peak Generator

Select "6. PEAK GENERATOR" to generate electronic peaks to confirm of the operation of the data processing unit.

14.6.1 Screen description

Select "6. PEAK GENERATOR" from the [DIAG] key screen to display the Peak generator screen shown in Fig. 14.6.1.

```
Peak Generator
Peak Generator      On
Mode                Noise

Ch1 Standard Signal  On
Ch2 Standard Signal ◀ Off
Ch3 Standard Signal  Off
Ch4 Standard Signal  Off

-----
Return PeakInfo
```

Fig. 14.6.1 Peak generator setup screen

14.6.2 Parameter list

PEAK GENERATOR

Range: On/Off, Default: Off

MODE

Range: Noise/No Noise/Trunc, Default: Noise

Ch1–Ch4 STANDARD SIGNAL

Range: On/Off, Default: Off

14.6.3 PF menu

PF menu	Description	Reference section
Peak Info	Specify the parameters (retention time, full width at half height and peak height) of the peaks to be generated.	—

15.1

15 Optional Devices

Auto Injector Parameters

From the gas chromatograph, specify the parameters of the Shimadzu AOC-20i Auto Injector and the AOC-20s Auto Sampler Carousel, which automatically inject liquid samples into the gas chromatograph. For detailed setting procedures, refer to AOC-20 user's manual.

15.1.1 Screen description

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

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

The AOC status is displayed.

Fig. 15.1.1 AOC setup screen

■ AOC STATUS

The AOC status can be monitored.

Screen display	Description
Inactive	AOC is not operating.
Taking vial	A vial is being picked up from the tray.
Preparation	AOC is operating (before injection).
Rinse	AOC is operating (after injection).
Putting vial	A vial is being returned to the tray.
Wait	AOC is waiting for analysis.



15.1.2 Parameter list

SAMPLE WASH

Range: 0–99, Default: 2

Set the number of times to rinse the syringe with sample before injection.

NUMBER OF INJECTION

Range: 0–99, Default: 1

Set the number of times the sample should be injected.

SAMPLE SIZE

Range: 0.1–8.0 µl, Default: 1.0 µl

Set the sample injection amount.

PRE SOLVENT WASH

Range: 0–99, Default: 0

Set the number of times to rinse the syringe with solvent before injection.

This item is valid only when the injection mode is set to “0 (normal)”.

SOLVENT WASH

Range: 0–99, Default: 1

Set the number of times to rinse the syringe with solvent after injection.

PUMPING

Range: 0–99, Default: 5

Set the number of times to raise and lower the plunger with the needle inside the sample to eliminate 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 value set here or 4 seconds, whichever is longer.

The wait time during rinsing with solvent is always 0.2 seconds.

DWELL TIME

Range: 0.0–99.9 sec, Default: 0.0 sec

Set the length of time for the syringe to remain in the injection port after injection.

INJ. SPEED (PLUNGER)

Selecton: Slow/Middle/Fast, Default: Fast

Specifies the plunger speed during injection.

AOC POWER

Selection: On/Off, Default: On

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



15.1.3 PF menu

PF menu	Description	Reference section
Start	Starts AOC. The GC also starts when AOC injects a sample.	—
Stop	Temporarily stops the AOC. If [Start] (PF menu) is pressed in stop status, the AOC resumes the operation before [Stop] (PF menu) was pressed.	—
Priority	Sets up a Priority analysis.	15.1.4
Other Para	Sets AOC options and customization.	15.1.7
Sampler	Sets the auto sampler, sub injector and bar code reader.	15.1.10
Reset	Resets AOC to the status before control was started.	—
Upload	Loads parameters from the AOC to the AOC setup screen of the gas chromatograph.	—
Print	Prints the parameters on the Chromatopac.	—
Next	Toggles the screen among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.	—



15.1.4 AOC priority analysis

Select [Priority] (PF menu) from the AOC main screen to display the AOC priority sample screen shown in Fig. 15.1.2.

The batch can only be interrupted when the AOC is operating.
Enter the sample injection No., and press [Set] (PF menu).

AOC Priority Sample RUN

Preparation

Injection Sample 5

Return Set

Fig. 15.1.2 Priority analysis setup screen

15.1.5 Parameter list

INJECTION SAMPLE

INJECTION SAMPLE NUMBER

[NOTE] Enter the sample vial No. designated for priority analysis.

- When an auto sampler carousel is not in use,
Short rack No. 1–6
Long rack No. 1–12
- When an auto sampler corousel is installed, No. 1–150 (maximum)

When an auto sampler carousel, the allowable vial No. range depends on the vial rack type and the number of racks. A value of 0 (default) indicates no priority sample.



15.1.6 PF menu

PF menu	Description	Reference section
Set	Analyzes the vial No. specified after the analysis of the current sample is finished.	—

15.1.7 Other AOC parameters

Select [OtherPara] (PF menu) from the AOC main screen to display the other parameters screen shown in Fig. 15.1.3.

Specify options and AOC custom parameters.

AOC Other Parameters READY

AOC1 LINE 1 Inactive

Single AOC-20i

Inj. Speed(Syringe) ◀ Fast

Using 3 Solvent Vials Yes

Solvent Select All

Air Suction No

Plunger Suction Speed Fast

Speed of Plunger Fast

Syringe Height(↑) 0

Syringe Height(↓) 0

Syringe Height(Inj) 0

Multi-Inj. 1

Kinds of Vials 1.5ml

Return InjMode

Fig. 15.1.3 Additional AOC parameter setup



15.1.8 Other AOC Parameter

INJ. SPEED (SYRINGE)

Selection: Slow/Fast, Default: Fast

Set the syringe injection speed.

USING 3 SOLVENT VIALS

Selection: Yes/No, Default: No

Specifies whether three solvent vials are present and the autosampler carousel is not in use.

This item is only available when "USE OF THE SAMPLER" in [Sampler] (PF menu) is set to "Not Use".

SOLVENT SELECT

Selection: All/A only/B only/C only, Default: All

This item is available when "USING 3 SOLVENT VIALS" is set to "Yes" or "USE OF THE SAMPLER" in [Sampler] (PF menu) is set to "Use".

All: Three solvent types are used.

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

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

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

For the details, refer to Fig. 3.4.1 in "3.4 Auto Sampler" in the AOC-20 User's Manual.

AIR SUCTION

Selection: Yes/No, Default: No

Set whether or not 1 µl of air is aspirated into the syringe after aspirating sample.

This type of injection is useful for samples with a wide boiling point range, when compound discrimination problems can occur.



CAUTION

When the column initial temperature is high or when a PEG-based, polar column is used, the column life may be shortened by injecting air.

PLUNGER SUCTION SPEED

Selection: Slow/Middle/Fast, Default: Fast

Set the plunger speed during sample injection.

SPEED OF PLUNGER

Selection: Slow/Middle/Fast, Default: Fast

Set the plunger speed during rinsing with sample or pumping.

SYRINGE HEIGHT (↑)

Range: 0–20 mm, Default: 0 mm

Set the syringe height when it moves down to a sample vial (moves syringe up from default).

SYRINGE HEIGHT (↓)

Range: 0–2 mm (1.5 ml vial)/0–10 mm (4 ml vial), Default: 0 mm

Set the syringe height when it moves down to a sample vial (moves syringe down from default).

SYRINGE HEIGHT (INJ)

Range: 0–22 mm, Default: 0 mm

Set the syringe height when it moves down during sample injection (moves syringe up from default).

**MULTI-INJ**

Range: 1–99, Default: 1

Set the number of times to inject each sample.

KINDS OF VIALS

Selection: 1.5 ml/4 ml, Default: 1.5 ml

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

PF menu	Description	Reference section
Inj Mode	For details, refer to “3.3.3 Injection mode” in AOC-20 User’s Manual.	—



15.1.10 Auto-sampler carousel and other optional parameters

Select [Sampler] (PF menu) from the AOC main screen to display the sampler screen shown in Fig. 15.1.4.

Specify the options installed on the AOC, such as sampler carousel.

When AOC1 and AOC2 are selected for the analytical line in "Line configuration" of the [SET] key, both "USE OF THE SAMPLER" and "USE OF THE SUB AOC" are automatically set to "Use".

The screenshot shows a terminal-style interface for the 'Sampler' screen. At the top left is the label 'Sampler' and at the top right is the status 'READY'. Below the status is a label 'Inactive'. The main area contains three configuration items: 'Use of the Sampler' with a double-headed arrow and the value 'Use', 'Use of the Sub AOC' with the value 'Not Use', and 'Bar Code Reader' with the value 'Not Use'. The values 'Use' and 'Not Use' are underlined. At the bottom, there is a horizontal line of dots and a 'Return' button with a left arrow icon.

Fig. 15.1.4 Sampler carousel and other options setup

15.1.11 Parameter list

USE OF THE SAMPLER

Selection: Use/Not Use, Default: Not Use

USE OF THE SUB AOC

Selection: Use/Not Use, Default: Not Use(Set to "Not Use" because it is not used by GC-2014.)

BAR CODE READER

Selection: Use/Not Use, Default: Not Use

Select "Use" when the Bar Code reader is installed.

15.2

15 Optional Devices

Setting AUX Temperature

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

15.2.1 Screen description

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

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

AUX Temperature		READY
Name	ACTUAL	SETTING
OTHER	25.0	25.0

Print Next On/Off

Fig. 15.2.1 Main screen to set AUX temperature

15.2.2 Parameter list

TEMPERATURE SETTING VALUE

Range: 0.0–400.0 °C, Default: 25.0 °C

15.2.3 PF menu

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



15.2.4 On/Off setting

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

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

↩Return

Fig. 15.2.2 Screen to set On/Off of AUX temperature

15.2.5 On/Off parameter list

TEMPERATURE CONTROL

Selection: On/Off, Default: On

Temperature is controlled when On is selected.

15.3

15 Optional Devices

Setting the AUX APC Parameters

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

15.3.1 Screen description

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

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

The screenshot displays the 'AUX APC' main screen. At the top, it says 'AUX APC' and 'READY'. Below this, there are three sections for APC 1, APC 2, and APC 3. Each section has a status 'On' and a 'Press(kPa)' field set to '100.0'. To the right of the pressure field is a gas type field set to 'He'. A double-headed arrow is positioned between the gas type fields of APC 1 and APC 2. At the bottom of the screen, there is a navigation bar with three buttons: 'Offset', 'Next', and 'On/Off'.

Fig. 15.3.1 AUX APC main screen



15.3.2 Parameter list

PRESS

Range: 0.0–400.0 kPa, Default: 100 kPa

Set the pressure when the control mode is set to “PRESS”.

GAS TYPE

Selection: He/N₂/H₂/Ar, Default: He

Set the type of gas supplied to the APC. If the gas type is set incorrectly, the flow rate can not be set as specified in “FLOW” mode. This is because a restrictor is used to calculate the flow rate.

15.3.3 PF menu

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

15.4

15 Optional Devices

Setting the AUX AMC Parameters

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

15.4.1 Screen description

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

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

AUX AMC		READY
AMC.L		On
Press(kPa)	150.0	
Flow($\frac{\text{ml}}{\text{min}}$)	30.0	30.0
		◀▶ N ₂

AMC.R		On
Press(kPa)	150.0	
Flow($\frac{\text{ml}}{\text{min}}$)	30.0	30.0
		N ₂

AMC1		Off
Press(kPa)	0.0	
Flow($\frac{\text{ml}}{\text{min}}$)	0.0	0.0

Offset		Next
		On/Off

Fig. 15.4.1 AUX AMC main screen



15.4.2 Parameter list

FLOW RATE

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

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

GAS TYPE

Selection: He/N₂/H₂/Ar, Default: He

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

15.4.3 PF menu

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

15.5

15 Optional Devices

Setting the CRG Parameters

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

15.5.1 Screen description

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

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

The screenshot shows the CRG main screen with the following layout:

- At the top left is the label **CRG**, and at the top right is the status **READY**.
- Below this is a section for **Column Oven**. It contains two rows: "Valve" with the value "On" and "CRG" with the value "Use".
- A horizontal dotted line separates this section from the next.
- Below the line is a section for **INJ2**. It also contains two rows: "Valve" with the value "Off" (indicated by a double arrow pointing left) and "CRG" with the value "Not Use".
- At the bottom of the screen, there is a "Next" button and a small icon of a right-pointing arrow.

Fig. 15.5.1 CRG main screen

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



15.5.2 Parameter list

COLUMN OVEN

VALVE Selection: On/Off, Default: Off

CRG Selection: Use/Not Use, Default: Not Use

When the CRG is connected to the column oven, the column oven temperature control range is extended to -99.0 –+400.0 °C from (room temperature + 4 °C)–+400.0 °C.

When using the CRG, set “VALVE” to “On” and “CRG” to “Use”.

When using valve control only, set “VALVE” to “On” and set “CRG” to “Not Use”.

INJ 2

VALVE Selection: On/Off, Default: Off

CRG Selection: Use/ Not Use, Default: Not Use

When the PTV is installed on INJ2, the injection port temperature control range is extended to -99.0–+400.0 °C from 0.0–400.0 °C

When using the CRG, set “VALVE” to “On” and “CRG” to “Use”.

When using valve control only, set “VALVE” to “On” and set “CRG” to “Not Use”.

15.5.3 PF menu

PF menu	Description	Reference section
Next	Toggles the screen among AOC parameters → AUX temperature → AUX APC → AUX AMC → CRG screens in this order.	—

16.1

16 Special Functions

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.

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

Select function

Version

Time Scheduler
Inactive
Schedule
No.0

➔ 1 Mode
2 Edit
3 Start/Stop
4 Copy
5 Delete

Return

Fig. 16.1.1 Time scheduler menu

16.1.2 Parameter list

MODE

Select whether the same schedule will be executed every day or a different schedule will be executed on each day of the week.

EDIT

Edit the schedule.

START/STOP

Set the schedule start/stop procedure.

COPY

Copy the contents of a schedule to a specified schedule.

DELETE

Delete the contents of a specified schedule.



16.1.3 Setting the mode

Select "1. MODE" from the time scheduler menu to display the mode setup screen shown in Fig. 16.1.2.

Select whether to use the same schedule every day or to use a different schedule on each day of the week. Up to 8 schedules can be set with the time scheduler.

Time Scheduler
Inactive Schedule No.0

Mode ◀▶ Number
Schedule Number No.0

Return

The schedule number can be set only when in Number mode.

Fig. 16.1.2 Mode setup screen

NOTE When the time scheduler is operating, the mode cannot be changed.

■ Schedule number and day of the week

The table below shows the relationship between the schedule number and the day of the week.

Mode 1 (schedule number)	Mode 2 (day)
No. 0	Sun.
No. 1	Mon.
No. 2	Tue.
No. 3	Wed.
No. 4	Thu.
No. 5	Fri.
No. 6	Sat.
No. 7	—



16.1.4 Editing a time schedule

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

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

```
Time Scheduler
Inactive Schedule No.0

Schedule Number  ◀▶ No.2

Return Edit
```

Fig. 16.1.3 Schedule number selection screen

```
Time Schedule NOT READY
Inactive Schedule No.0

Time Function Value
1 07:00 Start GC
2 19:00 Stop GC

Return New Del Line
```

Fig. 16.1.4 Schedule edit screen

16.1.5 PF menu

PF menu	Description	Reference section
New	Creates a new time schedule.	16.1.6
Del Line	Deletes a schedule line at the current cursor position.	



16.1.6 Creating a new time schedule

Select [New] (PF menu) from the time schedule screen to display the Time Schedule screen shown in Fig. 16.1.5.

Set an item using the [Δ] 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.

```
Time Schedule NOT READY
Inactive Schedule No.0
Time Function Value
1 05:00 Start GC

GC Start/Stop
Stop GC

Prev Page Finish Cancel
```

Fig. 16.1.5 Creating a new schedule

16.1.7 PF menu

PF menu	Description	Reference section
Finish	Validates the time schedule.	—
Prev Page	Returns to previous setup screen.	—
Next Page	Moves to next item. The cursor can also be moved to next item by pressing [ENTER] key.	—
Cancel	Cancels the time schedule currently being created.	—



16.1.8 Parameters available in the time scheduler

Parameter			Description
Stop	NUMBER OF TIMES OF RUN	Time scheduler stop	Specifies the number of times the program can execute before the schedule stops or switches to another file. If greater than 2, The choices are “Continuous” or “Pause at each run”. For an AOC, select “Continuous”. When “Pause at each run” is chosen, the program executes at set intervals continuously at set intervals.
		Schedule 0-9 Load	If another program (such as a temperature program) is running when time schedule execution time expires, priority is given to the running program. When the current program finishes, the time schedule stops or file is changed to another file.
GC Start/Stop			Sets start/stop of gas chromatograph.

16.1.9 Changing schedule parameters

To change the contents of an existing time schedule, move the cursor using the [Δ] 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
```

```
Edit program
  Stop
  ▸ GC Start/Stop
```

```
GC Start/Stop
  ◀▶ Start GC
```

• Second program

4. Time: 19:00



5. Start/stop



6. Stop



7. Setting is completed.

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

```
Edit program
  Program start
  ▸ GC Start/Stop
  Other
```

```
GC Start/Stop
  ◀▶ Stop GC
```

	Time	Function	Value
1	07:00	Start GC	
2	19:00	Stop GC	



16.1.11 Starting/stopping a time schedule

Select “3. START/STOP” from the time scheduler menu when no time schedule is executing to display the screen shown in Fig. 16.1.6.

Select “3. START/STOP” while a time schedule is executing to display the screen shown in Fig. 16.1.7.

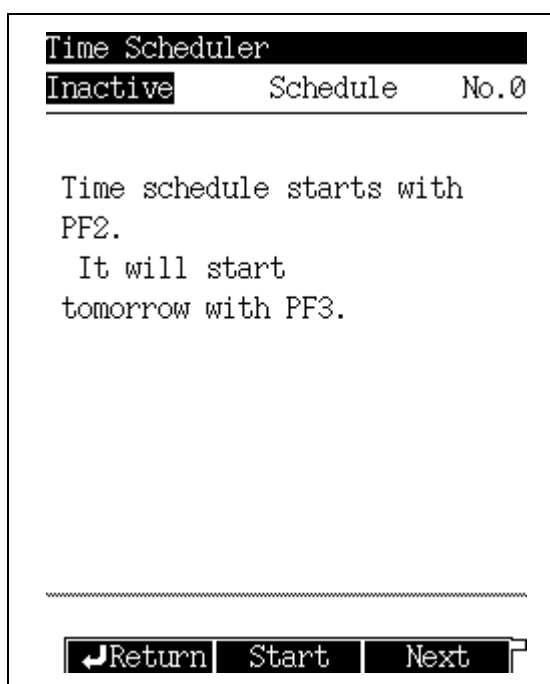


Fig. 16.1.6 Schedule start screen

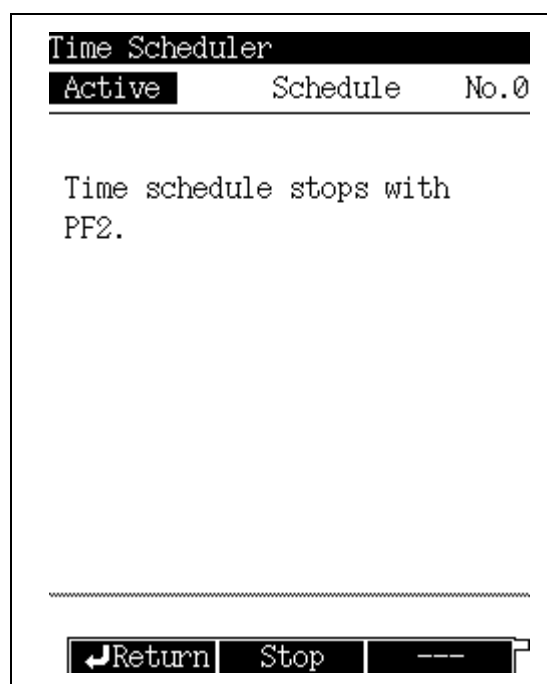


Fig. 16.1.7 Schedule stop screen

16.1.12 PF menu

PF menu	Description	Reference section
Start	Starts a time schedule. This item is displayed when no time schedule is running. If mode is set to “number”, the same schedule will be executed on following day and beyond when schedule finishes. If mode is set to “day”, the schedule for the current day is executed, and the schedule for each day will be executed on the following day and beyond.	—
Next	Runs the selected schedule on the following day. If mode is set to “day”, the schedule for the next day is executed.	—
Stop	Stops the current schedule. This item is displayed when a time schedule is running.	—



16.1.13 Copying and deleting a time schedule

Select “4. COPY” or “5. DELETE” from the time scheduler menu screen to display the time schedule copy screen or the time schedule delete screen shown in Fig. 16.1.8 or Fig. 16.1.9.

To copy, specify the copy source schedule and the copy destination schedule, then press [Copy] (PF menu).

To delete, specify a schedule number to be deleted, then press [Delete] (PF menu).

NOTE A currently running schedule cannot be copied or deleted.

```
Time Scheduler
Active      Schedule  No.0
-----
Copy
Src.        No.0
Dst.        ◀ No.3

Schedule has been copied.
Return Copy [ ]
```

Fig. 16.1.8 Schedule copy screen

```
Time Scheduler
Active      Schedule  No.0
-----
Delete
Schedule Number ◀ No.4

Schedule has been cleared.
Return Delete [ ]
```

Fig. 16.1.9 Schedule delete screen

16.2

16 Special Functions

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.

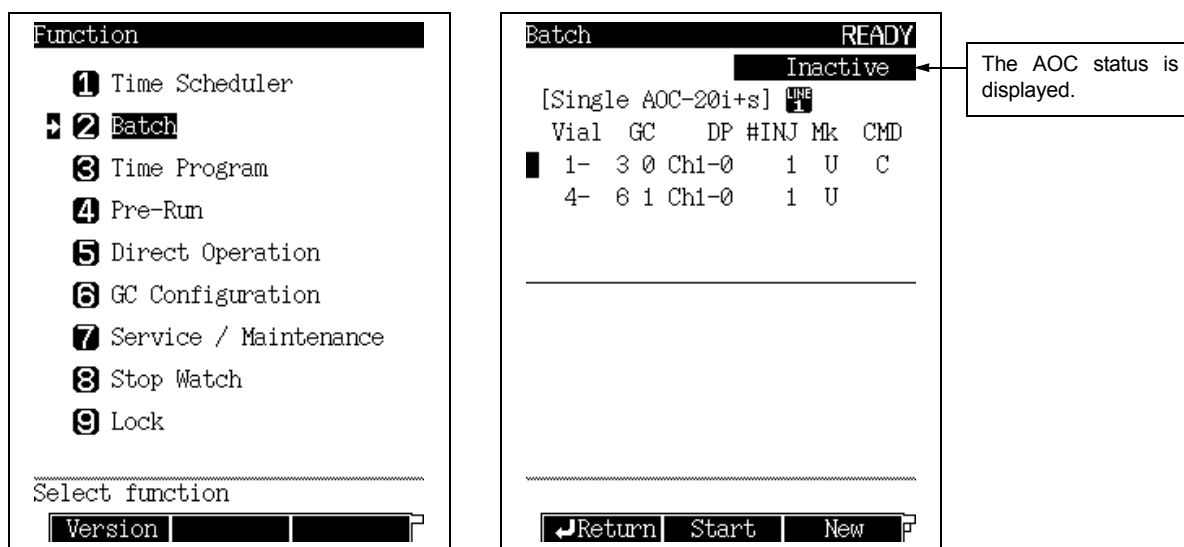


Fig. 16.2.1 Batch schedule screen

■ AOC status

The AOC status is displayed on the Batch screen..

Screen display	Description
Inactive	AOC is not operating.
Taking vial	Auto sampler arm is picking up a vial.
Preparation	AOC is operating (before injection).
Rinse	AOC is operating (after injection).
Putting vial	Auto sampler arm is returning a vial to the tray.
Wait	AOC is waiting for analysis.



16.2.2 Parameter list

- Vial** Initial No. and final vial No.
Example: 1-9 (Analysis starts from vial No. 1 and ends at vial No. 9.)
- GC** GC method file for analyses
- DP** Channel No. of chromatopac and file No.
Example: 1-5 (Channel 1 and data processing file No. 5 are used.)
This setting is ignored when using GC solution software.
- #INJ** Number of times to inject
- Mk** "U" is displayed when "SAMPLE TYPE" is set to "Unknown".
"S" is displayed when "SAMPLE TYPE" is set to "Standard".
- CMD** "S" is displayed when "SLOPE TEST" is set to "On".
"C" is displayed when "CLEAN UP" is set to "On".

16.2.3 PF menu

PF menu	Description	Reference section
Start	Starts the batch schedule.	—
Stop	Stops the batch schedule.	—
New	Creates a new batch schedule.	16.2.4 16.2.7
Del line	Deletes the line at the current cursor position.	—
Print	Prints the schedule to a Chromatopac.	—



16.2.4 Creating a new batch schedule

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

Set an item using the [Δ] 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.

The screenshot displays a terminal-style interface for creating a new batch schedule. At the top, 'Batch' is followed by 'READY' in a black box. Below this, 'Inactive' is shown in a black box. The main section is titled '[Single AOC-20i+s] LINE 1'. It contains a table with columns: Vial, GC, DP, #INJ, Mk, and CMD. Two rows of data are shown: '1- 3 0 Chi-0 1 U C' and '4- 6 1 Chi-0 1 U'. A horizontal line separates this from the bottom section. The bottom section has labels 'Vial', 'Start vial No.' (with value 7), 'Final vial No.' (with value 9 in a black box), and 'Sample' (with value 'Inject sample' in a black box). At the very bottom, three buttons are shown in black boxes: 'Finish', 'Next Page', and 'Cancel'.

Vial	GC	DP	#INJ	Mk	CMD
1-	3	0	Chi-0	1	U C
4-	6	1	Chi-0	1	U

Vial	
Start vial No.	7
Final vial No.	9
Sample	Inject sample

Finish Next Page Cancel

Fig. 16.2.2 New batch schedule screen



16.2.5 Parameter list

START VIAL NO.

Range: 1 Default: 0

FINAL VIAL NO.

Range: 1 Default: 0

- 1: With no auto sampler
 Short rack ... 1–6
 Long rack ... 1–12
With auto sampler 1–150 (maximum)

When the auto sampler is used, the possible depends on the vial rack type and the number of racks.

The default, "0", indicates that the setting is not given.

SAMPLE

Inject sample

The specified sample vial No. is analysed.

Without sample

Vials are not used for samples. Instead samples are introduced from a gas sampler with a valve.

GC FILE NO.

Range: FILE 0–9, Default: FILE0

Set the file No. of the GC method to be used.

CHANNEL NO.

Range: Ch1/Ch2, Default: Ch 1

Set the channel No. connecting the GC to the Chromatopac. This setting is ignored when using GC solution software.

DATA PROCESSOR FILE NO.

Range: FILE 0–9, Default: FILE0

Specify a data processor (Chromatopac) data integration file. –This setting is ignored when using GC solution software.

NUMBER OF INJECTION

Range: 0–99, Default: 0

Set the number of times to inject each sample.

SAMPLE TYPE

Unknown Select this item to analyze a sample of unknown concentration.

Analyze a standard and create a calibration curve before analyzing an unknown sample.

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

SLOPE TEST

Range: On/Off, Default: Off

When "On" is selected, the slope test is performed before running the batch schedule.

CLEAN UP

Range: On/Off, Default: Off

When "On" is selected, clean up is performed before running the batch schedule.



16.2.6 PF menu

PF menu	Description	Reference section
Finish	Validates the schedule.	—
Prev Page	Returns to previous setup screen.	—
Next Page	Moves to setup screen for next item.	—
Cancel	Cancels the schedule being created.	—

16.2.7 Editing a batch schedule

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

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

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

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



16.2.8 Batch processing Setup example

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

Screen display

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

```
Vial
Start vial No.      _1
Final vial No.     _3
Sample             ◀▶ Inject sample
```

2. GC file No.: FILE2

```
GC file No.
  0:FILE0
  1:FILE1
  2:FILE2
  3:FILE3
```

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

```
Dataprocessor
Channel No.      ◀▶ Ch1
File No.         _0
```

4. Number of injections: 1
Sample type: Standard

```
Sample
Number of Injection _1
Sample type         ◀▶ Standard
```

5. Slope test: Off
Clean up: On

```
Command
Slope test         Off
Clean up           ◀▶ On
```

6. The batch is set up.

```
[Single AOC-20i+s] LINE 1
Vial GC  DP #INJ Mk  CMD
1-  3 2 Ch1-0   1  S   C
```

16.3

16 Special Functions

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.

Function

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

.....

Select function

Version

Time Program **READY**

LINE 1 FILE 0:FILE0

GC Analysis Time(min) 5.00

Time(min) Function Value

1	1.00	FID1	
	Range		$\times 10^{-2}$
2	5.00	FID1	
	Zero Adj		

.....

Return New Del Line

Fig. 16.3.1 Time program main screen

16.3.2 PF menu

PF menu	Description	Reference section
New	Creates a new time program.	16.3.3
Del Line	Deletes the time program line at the current cursor position.	—
Chng Line	Moves the cursor to the next line.	—
Print	Prints the program to the Chromatopac.	—



16.3.3 Creating a new time program

Select [New] (PF menu) from the time program screen to display the time program edit screen shown in Fig. 16.3.2.

Set an item using the [Δ] and [∇] keys and the [ENTER] key. When [Finish] (PF menu) becomes available and the items have been set, press [Finish] to validate the program.

At the top of the screen, the contents of the set program are displayed. At the bottom of the screen, the program edit screen is displayed.

Up to 100 lines are available for one program.

The possible program execution time ranges from 0.00 to 9999.00 minutes.

```
Time Program                                READY
LINE 1                                     FILE 0:FILE0
GC Analysis Time(min)                      5.00
  Time(min) Function Value
  1    1.00 FID1
  2    5.00 FID1
    Range                x10-2
    Zero Adj

Edit program
  Relay
  Detector
  ▸ Flow controller

Prev Page Next Page Cancel
```

Fig. 16.3.2 Time program edit screen

16.3.4 PF menu

PF menu	Description	Reference section
Finish	Validates the time program.	—
Prev Page	Returns to previous setup screen.	—
Next Page	Moves to next item.	—
Cancel	Cancels the time program being created.	—



16.3.5 Time Program parameters

Parameter			Description
Relay ^{NOTE 1)}			
Detector	Range		Sets range or attenuation for the detector configured in the analytical line.
	Polarity		Changes the polarity between “+” and “-” for TCD configured in the analytical line.
	Current		Sets current for the detector configured in the analytical line. ^{NOTE 2)}
	Zero Adj		Turns on/off zero adjustment for the detector configured in the analytical line.
	Flame		Ignites / Extinguishes the flame.
	FTD		Turns on/off voltage feedback to make current constant for FTD configured in the analytical line.
	Detector controller		Turns on/off control of detector configured in the analytical line during analysis program.
Flow controller Refer to NOTE 3).	Splitter Ctrl		Opens/closes splitter.
	Flow controller On/Off		Turn carrier gas, septum purge, detector gas, APC, and AMC (AUX AMC and AMC. LR) on/off.
	High press inj mode		Turns high pressure injection mode on/off.
	Gas saver		Turns gas saver function on/off.
Temperature	INJ1, INJ2, DET1, DET2, AUX3, AUX4, AUX5		Use a time program to change temperature of heated zones, which cannot be programmed.
Stop	NUMBER OF TIMES OF RUN	End of program	Specify the number of times to execute the GC program. Then, either the program stops or the next file is executed. If greater than 2, the choices are “continuous” or “pause at each run.” For an AOC, select “continuous”. When “pause at each run” is selected, the program executes continuously at set intervals. If another program (such as a temperature program) is running when time program execution time expires, priority is given to running the program. When the current program finishes, the time program stops or file is changed to another file.
		0: FILE 0–9 Load	
Other			Set the parameter to input event No..(Refer to “17.4 Event No.”.)

NOTE 1) “Relay” description

Relay	Relay	Switch point	Event 91,92	V91–92	Point A or B	
			PRG	V93–94	Point A or B	
		On/Off point	Event 1–16	On or Off		
	AC On/Off	Oven Exhaust Fan	On or Off			
		Cooling Fan	On or Off			
		CRG INJ	On or Off			
		CRG Colum	On or Off			

AC On/Off: Turns the power supplied to the AC connector on the power controller PCB on/off.

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

Event91 and Event92: Switches a-contact and b-contact of each relay on the CPU PCB (standard).

Event of PRG: Switches a-contact and b-contact of each relay on the PRG PCB (option).

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



NOTE 2) Current range

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

NOTE 3) When the dual AFC is used

1. There is no settings for “splitter ctrl”, “high press inj mode”, and “gas saver”.
2. Septum purge cannot be selected on “flow controller On/Off”.

16.3.6 Editing a time program

To change the contents of an existing time program, move the cursor using the [Δ] and [∇] keys to the program line to be edited changed and press the [ENTER] key.

To change only the time, enter the new time from the edit screen and press [Finish] (PF menu).

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

To cancel the edits and restore the original time program, press [Cancel] (PF menu) before pressing [Finish] (PF menu).



16.3.7 Time program setup example

Example 1: When both positive and negative peaks appear on the chromatogram

Four minutes after the program execution starts, the polarity of the detector DET 1 (TCD) is switched from plus to minus. Two minutes later (six minutes after the program execution starts), the polarity is switched back to plus.

• First program

Screen display

1. Time: 4.0 min



2. Detector



3. Polarity



4. DET 1



5. - (minus)

Edit program
Time(min) _____

4.00

Edit program
Relay
Detector
Flow controller

Detector
Range
Polarity
Current

Polarity
TCD2

TCD2 Polarity

◀ -

• Second program

6. Time: 6.0 min



Steps 2–4 are repeated.

7. + (plus)



8. The time program is set up.

Edit program
Time(min) _____

6.00

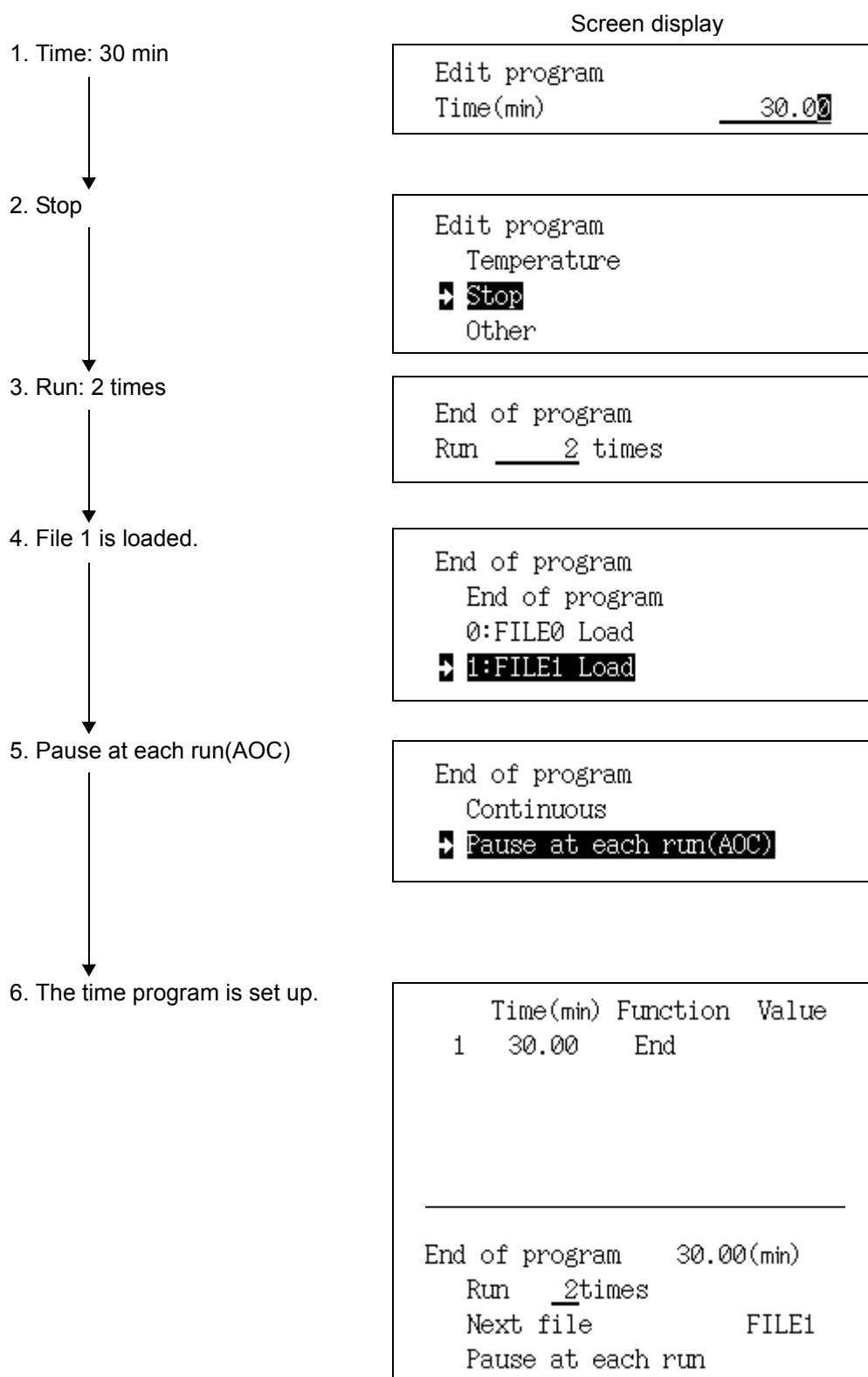
TCD2 Polarity

◀ +

	Time(min)	Function	Value
1	4.00	TCD2	
		Polarity	-
2	6.00	TCD2	
		Polarity	+



Example 2: Two AOC analyses use File No.0, then file No.1 is used.
(The execution time is set to 30 min.)



16.4

16 Special Functions

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.

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

Select function

Version

Pre-Run	NOT READY
LINE 1	FILE 0:FILE0
Program time(min)	5.00
Time(min) Function Value	
1 3.00 V91	A
2 5.00 SPL1	
Carrier Gas	On

Return New Del Line

Fig. 16.4.1 Pre-Run program main screen

16.4.2 PF menu

PF menu	Description	Reference section
New	Creates a new Pre-Run program.	16.4.3
Del Line	Deletes the program at the current cursor position.	—
Chng Line	Changes over the screen of Pre-Run program every line.	—
Print	Prints the program to the Chromatopac.	—



16.4.3 Creating a new Pre-Run program

Create a Pre-Run program following the same procedure described in “16.3.3. Creating a new time program” in “16.3 Time Program”.

The parameters are equivalent to those shown in “16.3.5. Time Program Parameters” except for “STOP”. The “STOP” parameter is described below.

Up to 100 lines are available for the Pre-Run program.

The possible Pre-Run program execution time ranges from 0.00 to 9999.00 minutes.

Parameter		Description
End of program	Auto	The AOC starts after the Pre-Run program is finished. If there is no AOC, the GC starts.
	Manual (Stop program)	After the Pre-Run program is finished, the system becomes ready.
	GC starts	After the Pre-Run program is finished, the GC starts. For example, select this item to activate a gas sampler, switch the valve and introduce the gas sample in to the GC as soon as the program stops.
	AOC/HSS starts	After the Pre-Run program is finished, the AOC/HSS starts. After sample is injected, GC starts.
	Clean up	After the Pre-Run program stops, clean up starts. After clean up finishes, the system becomes ready.

NOTE In the following case, “AUTO” of the “STOP” parameter is carried out when the pre-run program is finished.

- There is no “STOP” parameter in the pre-run program.
- Running the Batch Schedule.

16.4.4 Editing a Pre-Run program

To change the contents of the existing Pre-Run program, move the cursor using the [Δ] and [∇] keys to the program line to be edited and press the [ENTER] key.

To change only the time, enter the new time from the edit screen and press [Finish] (PF menu).

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

To cancel the edits and restore the original time program, press [Cancel] (PF menu) before pressing [Finish] (PF menu).

16.4.5 After Pre-Run program is finished

When the Pre-Run program is finished, certain events automatically return to their pre-programs status.

These events are listed below..

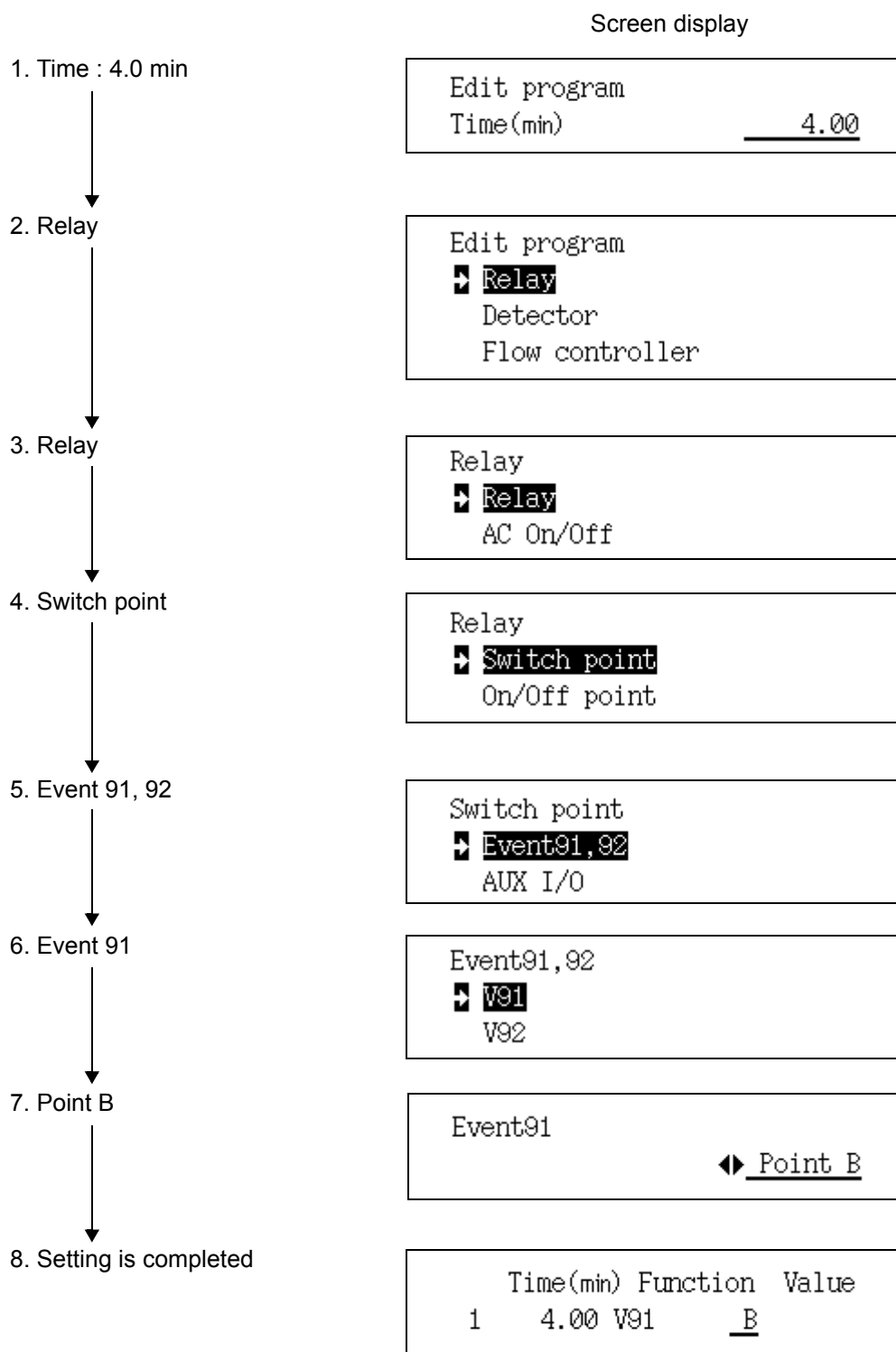
Event No.	Description
131–134	Turn detector controller on/off.
141–146	Turn carrier gas and septum purge on/off.
147–158	Turn detector gas on/off.
171	Turns high pressure injection on/off.
181–198	Turn AUX APC on/off.
201–210	Turn AUX AMC on/off.

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



16.4.6 Pre-Run Program set up example

Example: Switches B-contact of Event 91 four minutes in to the program.



16.5

16 Special Functions

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."

<div>Function</div> <div><div>1 Time Scheduler</div><div>2 Batch</div><div>3 Time Program</div><div>4 Pre-Run</div><div>5 Direct Operation</div><div>6 GC Configuration</div><div>7 Service / Maintenance</div><div>8 Stop Watch</div><div>9 Lock</div></div> <div>Select function</div> <div>Version</div>	<div>Direct</div> <div>READY</div> <div>Event</div> <div>91</div> <div>Return Execute</div>
---	---

Fig. 16.5.1 Direct operation setup screen

16.5.2 Parameter list

EVENT

Range: -500--+500, Default: ---

Runs the operation assigned to the event No.

Refer to "17.4 Event No."

16.5.3 PF menu

PF menu	Description	Reference section
Execute	Runs the specified operation. Input event No. to be run, and press [Execute] (PF menu).	—

16.6

16 Special Functions

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.

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

Select function

Version

GC Configuration
1 Date/Time Setting
2 Max. Temperature
3 Transmission Parameter
4 Ready Check
5 Signal Setting
6 Port Name Customization
7 Link Device Code
8 Temperature Offset
9 Other Configurations

Select function

Return

Fig. 16.6.1 GC Configuration setup screen

16.6.2 Parameter list

DATE/TIME SETTING

Set the date and the time.

MAX. TEMPERATURE

Set the maximum temperature limit for each headed zone.

TRANSMISSION PARAMETER

Set the parameters related to transmission.

READY CHECK

Indicate the conditions, which should be satisfied in order for the system to be ready and the STATUS light to illuminate.

SIGNAL SETTING

Set the signals which can be output from the gas chromatograph.

PORT NAME CUSTOMIZATION

Customize the names of various GC items.

LINK DEVICE CODE

Set the link device code the GC is linked to a Chromatopac.



TEMPERATURE OFFSET

Set the temperature offset for each heated zone.

OTHER CONFIGURATIONS

Specify the configuration of miscellaneous setup items.

16.6.3 Setting the date and time

16.6.3.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "1. DATE/TIME SETTING", to display the Date/Time setting screen shown in Fig. 16.6.2. The date and the time can be set. This setting is automatically saved, even when the GC power is off.

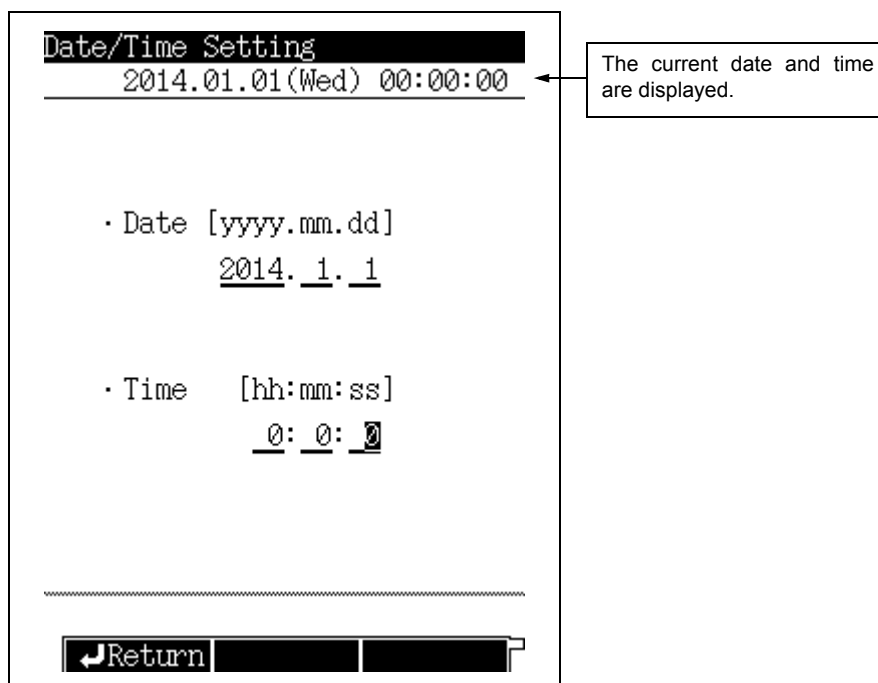


Fig. 16.6.2 Date/time setup screen

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.

Component	Max. Temp (°C)	Value
Column	Max. Temp (°C)	400.0
SPL	Max. Temp (°C)	420.0
DINJ	Max. Temp (°C)	420.0
DFID	Max. Temp (°C)	420.0
DTCD	Max. Temp (°C)	420.0
AUX3	Max. Temp (°C)	-----
AUX4	Max. Temp (°C)	-----
AUX5	Max. Temp (°C)	-----

Return Protect

Fig. 16.6.3 Maximum temperature setup screen

16.6.4.2 Parameter list

COLUMN

Range: 0.0–420.0 °C, Default: 400.0 °C

In order to protect the column, do not allow the maximum oven temperature to exceed the maximum column temperature.

INJ1/DET1/DET2

Range: 10.0–420.0 °C, Default: 420.0 °C

INJ2

Range: 0.0–420.0 °C, Default: 420.0 °C

AUX3/AUX4/AUX5

Range: 10.0–420.0 °C, Default: 420.0 °C

AUX3, AUX4 and AUX5 are available optionally.

If they are installed, the AUX temperature control unit (P/N 221-48458-91) is required.

16.6.4.3 PF menu list

PF menu	Description	Reference chapter
Protect	Protection against contamination	—

Selection: Yes/No, Default: Yes

When "Yes" is selected, the Detector temperature setting value must be bigger than or equal to the Oven temperature setting value.

When "No" is selected, the Detector temperature setting value may be smaller than the Oven temperature setting value.



16.6.5 Setting transmission parameters

16.6.5.1 Screen description

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then select “3. TRANSMISSION PARAMETER”, to display the Transmission Parameter screen shown in Fig.16.6.4.

Transmission Parameter

Protocol ◀ None

Baud Rate(bps) 9600

Stop Bit 1bit

Parity NONE

Return Apply

Fig. 16.6.4 Transmission parameter setup screen

16.6.5.2 Parameter list

PROTOCOL

Selection: None/LEVEL1/LEVEL2/LEVEL3, Default: LEVEL2

BAUD RATE

Selection: 2400/4800/9600/19200/38400/57600/115200 bps, Default: 9600 bps

Set the communication speed.

STOP BIT

Selection: 1 bit/ 2 bit, Default: 1 bit

PARITY

Selection: NONE/EVEN/ODD, Default: NONE

“STOP BIT” and “PARITY” can be set when “PROTOCOL” is set to “None” or “LEVEL1” or “LEVEL2”.

Set to “EVEN” in case of connecting a Chromatopac.

[NOTE] Refer to [“2.3 Outputting Digital Signals to a Personal Computer”](#) and [“2.4 Connecting a RS-232C Cable to the Chromatopac C-R8A”](#).

16.6.5.3 PF menu

PF menu	Description	Reference section
Apply	Down loads the parameters immediately.	—



16.6.6 Setting the Ready Check Parameters

The Ready Check verifies whether the preset analytical conditions have been met. When the selected items reach the specified settings, the STATUS light illuminates.

16.6.6.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "4. READY CHECK", to display the ready check screen shown in Fig.16.6.5.

Set each parameter to "yes" or "no". All parameters with "yes" must reach their initial parameter starts in order for the GC to be ready and the STATUS light to turn green.

Ready Check			READY
Heater Port			
	Column Temp		Yes
LINE 1	SPL Temp		Yes
LINE 2	DINJ Temp		Yes
LINE 1	DFID Temp		Yes
LINE 2	DTCD Temp		Yes
Carrier Gas			
LINE 1	SPL		Yes
LINE 2	DINJ		Yes
Detector			
LINE 1	DFID Drift		No
LINE 2	DTCD Drift		No
	Wait Signal		Yes
Return			Drift

Fig. 16.6.5 Ready Check setup screen

16.6.6.2 Parameter list

HEATER PORT

TEMP

Selection: Yes/No, Default: Yes

Indicate which headed zones should be included in the ready check.

CARRIER GAS

Selection: Yes/No, Default: Yes

SEPTUM PURGE

Selection: Yes/No, Default: Yes

Indicate which injection port septum purge flow lines should included in the check.

The displayed items depend on the injection port type.

DET FLOW GAS

MAKE UP

Selection: Yes/No, Default: Yes

HYDROGEN

Selection: Yes/No, Default: Yes



AIR

Selection: Yes/No, Default: Yes

Indicate which detector APC zones should be included in the check.

The displayed items depend on the detector type.

AUX APC

APC1–APC15 PRESS

Selection: Yes/No, Default: Yes

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

AUX AMC

AMC1–AMC10 FLOW

Selection: Yes/No, Default: Yes

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

DETECTOR

CONTROLLER

Selection: Yes/No, Default: Yes

This item is available only when the FID is installed.

DRIFT

Selection: Yes/No, Default: Yes

This item compares the baseline drift to the drift limit for 10 minutes.

Once the GC becomes ready, the GC re-evaluates of the ready status 10 minutes later.

WAIT SIGNAL

Selection: Yes/No, Default: Yes

The wait signal applies to all detectors configured in analytical lines.

NOTE User-specified names are used in this screen.

16.6.6.3 PF menu

PF menu	Description	Reference section
Drift	Set the baseline drift limit.	—



16.6.7 Parameter Configuration

Signals are output from four gas chromatograph channels.

To assign detector channels, see “13 Detector”.

This section describes the detector signal configuration as well as the configuration of various other parameters which can be monitored on the screen.

16.6.7.1 Screen description

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then select “5. SIGNAL SETTING”, to display the signal settings screen shown in Fig. 16.6.6.

This screen allows you to adjust the GC signal parameters.

Use the cursor to select the desired channel.
Press [ENTER] to open that channel's setup screen.

```

Signal Settings
-----
Output Signal Type
Ch1 DFID Signal
Ch2 DTCD Signal
Ch3 Not set
Ch4 Not set

-----
Return Gain etc. DataFile
  
```

Fig. 16.6.6 Signal setup screen

16.6.7.2 PF menu

PF menu	Description	Reference section
Gain etc.	Sets the signal gain and offset for each detector.	16.6.7.6
Data File	Sets the format of digital signals. When GC is linked to a personal computer, this item is automatically set to “PC”. When link is ended, this item automatically reverts to “Chromatopac”.	—
Det Sig	Sets signal output channels for all detectors. The signal out put channels can also be specified for installed detectors which have not been configured in an analytical line. If two or more detectors are set to one channel, data can be output to either channel without switching the output signal cable simply by changing the analytical line configuration.	—



16.6.7.3 Selecting the detector signals

Select the signal type from the main screen, and then press “DET SIG” to display the screen shown in Fig. 16.6.7.

Select the type of signal to output. For a description of the settings, refer to “[13 Detector](#)”.

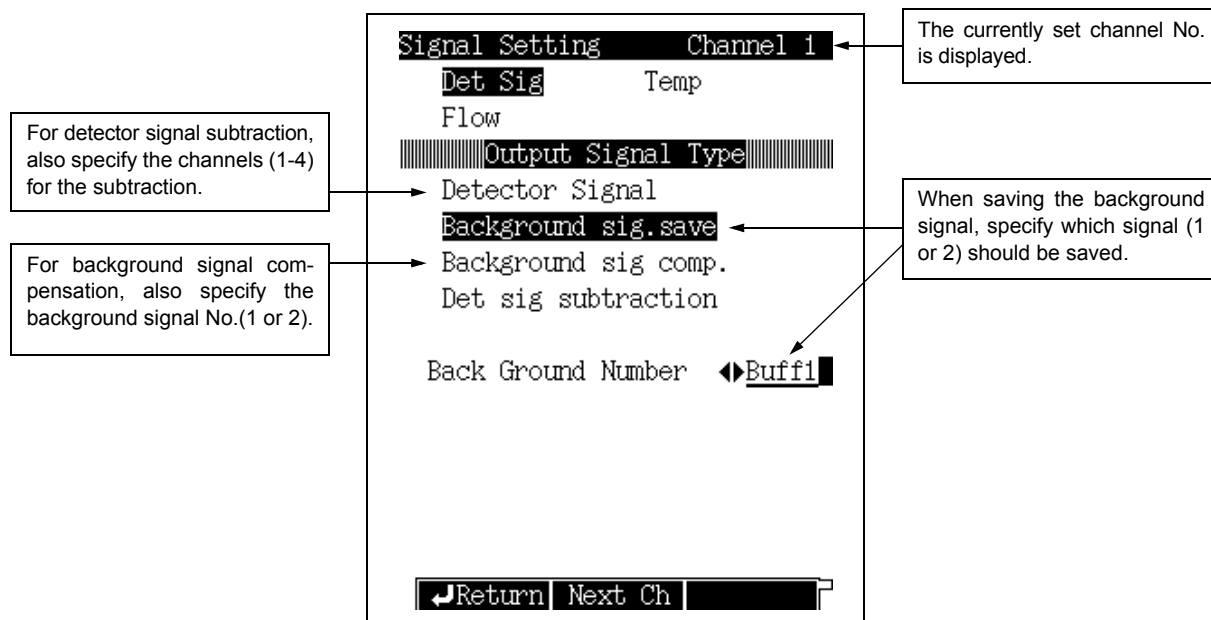


Fig. 16.6.7 Detector signal setup screen

16.6.7.4 Selecting the temperature control signal

Select the signal type from the main screen, and then press “TEMP” to display the screen shown in Fig. 16.6.8.

Select the temperature control signal to be output.

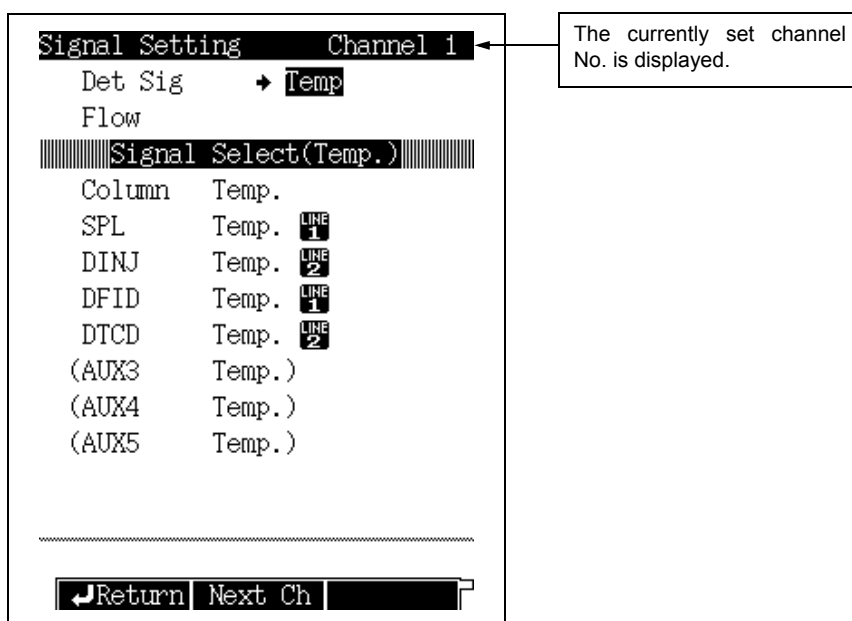


Fig. 16.6.8 Temperature control signal setup screen



16.6.7.5 Selecting the flow signal

Select the signal type from the main screen and then press “FLOW” to display the screen shown in Fig. 16.6.9.

Select the flow signal to be output.

Select the carrier gas, detector gas and APC gas items. The APC gas can be set when the APC is installed as an option in any location other than the flow controller or the detector gas.

■ Carrier gas

If you select the carrier gas for the flow signal selection, the screen shown in Fig. 16.6.9 appears.

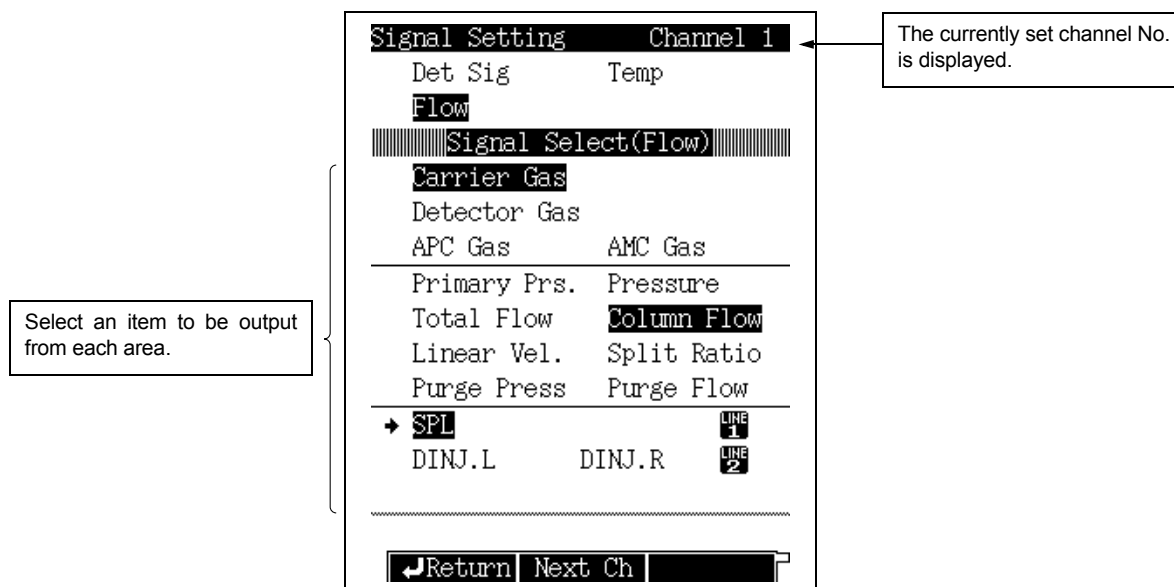


Fig. 16.6.9 Carrier gas signal setup screen

■ Detector gas

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

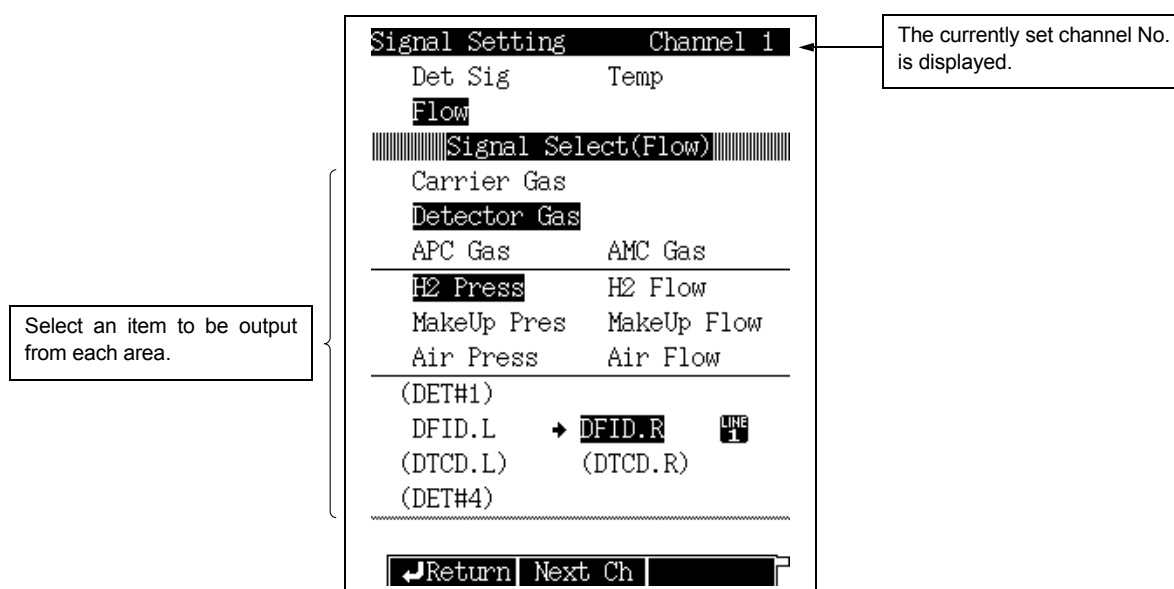


Fig. 16.6.10 Detector gas signal setup screen



■ APC gas

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

Signal Setting Channel 1

Det Sig Temp

Flow

Signal Select(Flow)

Carrier Gas

Detector Gas

APC Gas AMC Gas

APC Press

→ APC 1 APC 2 APC 3
(APC 4) (APC 5) (APC 6)
(APC 7) (APC 8) (APC 9)
(APC 10) (APC 11) (APC 12)
(APC 13) (APC 14) (APC 15)
(APC 16) (APC 17) (APC 18)

Return Next Ch

Select an item to be output from each area.

The currently set channel No. is displayed.

Fig. 16.6.11 APC gas signal setup screen

■ AMC gas

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

Signal Setting Channel 1

Det Sig Temp

Flow

Signal Select(Flow)

Carrier Gas

Detector Gas

APC Gas AMC Gas

APC Press AMC Press

(AMC.L) (AMC.R)
→ AMC1 AMC2
(AMC3) (AMC4)
(AMC5) (AMC6)
(AMC7) (AMC8)
(AMC9) (AMC10)

Return Next Ch

Select an item to be output from each area.

The currently set channel No. is displayed.

Fig. 16.6.12 AMC gas signal setup screen



16.6.7.6 Signal offset

When you select [Gain etc.] (PF menu) from the signal setup main screen, the Gain and offset screen shown in Fig. 16.6.12 appears. Set the offset and the the detector signal gain here.

Select [Sig. Ch] (PF menu), to set the gain and the offset for any signal other than 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.

Gain and Offset

=====DET Signal DFID=====

Gain 1.00

Offset 0

=====DET Signal DTCD=====

Gain 1.00

Offset 0

⏮Return Sig. Ch ⏭

Signal Except Detectors

=====Signal Output Ch1=====

Gain 1.00

Offset 0

Time Constant 1s

Signal 0

=====Signal Output Ch2=====

Gain 1.00

Offset 0

Time Constant 20ms

Signal 0

=====Signal Output Ch3=====

Gain 1.00

Offset 0

⏮Return Zero Adj ZeroFree ⏭

Fig. 16.6.13 Detector signal gain and offset screen

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



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 “6.3.5 Changing item names” in “5.3 Basic Key Operations”.

Name Customization

- ➔ 1 Heater Name Customiz.
- 2 Carrier Name Customiz.
- 3 AUX APC Name Customiz.
- 4 AUX AMC Name Customiz.
- 5 Relay Name Customiz.

Select function

Return

Fig. 16.6.14 Name setup screen

16.6.8.2 Customization example

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

Line Configuration

Injector

LINE 1 SPL#004
AFC+PV

Detector

LINE 1 DFID#02

Option

LINE 1 AOC1
AOC2

Return

The INJ2 and DET1 names were changed from “Heater Name Customiz”.

The port name was changed using “Carrier Name Customiz”. There is no injection port in INJ2, and there is only a carrier flow controller.

Fig. 16.6.15 Name customization example



16.6.8.3 Heater Name Customization

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then “6. PORT NAME CUSTOMIZATION”, and finally, select “1. HEATER NAME CUSTOMIZ”, to open the screen shown in Fig. 16.6.16.

Only listed heated zone names can be changed.

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

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

1 ABC	2 DEF	3 GHI	4 JKL
5 MNO	6 PQR	7 STU	8 VWX
9 YZ	0 0-9	Symbol	

Return	NumerChr	LowerChr
--------	----------	----------

Fig. 16.6.16 Heater port name setup screen

16.6.8.4 Carrier Name Customization

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then “6. PORT NAME CUSTOMIZATION”, and finally select “CARRIER NAME CUSTOMIZ”, to open the screen shown in Fig. 16.6.17.

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

Carrier Name Customization		
Port	Type	Name
CAR1	(AFC+PU)	<u>SAMPLE</u>
CAR2	(DAFC)	<u>CAR2</u>
CAR3	(---	<u>CAR3</u>

1 ABC	2 DEF	3 GHI	4 JKL
5 MNO	6 PQR	7 STU	8 VWX
9 YZ	0 0-9	Symbol	

Return	NumerChr	LowerChr
--------	----------	----------

Fig. 16.6.17 Carrier name setup screen



16.6.8.5 AUX APC Name Customization

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then “6. PORT NAME CUSTOMIZATION”, and finally “3. AUX APC NAME CUSTOMIZ”, to open the screen shown in Fig. 16.6.18.

Only listed APC options can be named.

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

Port	Name
APC1	SAMPLE
APC2	APC2
APC3	APC3
APC4	APC4
APC5	APC5
APC6	APC6
APC7	
APC8	
APC9	

1 ABC 2 DEF 3 GHI 4 JKL
5 MNO 6 PQR 7 STU 8 VWX
9 YZ 0 0-9 Symbol

Return NumerChr LowerChr

Fig. 16.6.18 AUX APC name setup screen

16.6.8.6 AUX AMC Name Customization

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

Only listed AMC options can be named.

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

Port	Name
AMC.L	
AMC.R	
AMC1	SAMPLE
AMC2	AMC2
AMC3	
AMC4	
AMC5	
AMC6	
AMC7	

1 ABC 2 DEF 3 GHI 4 JKL
5 MNO 6 PQR 7 STU 8 VWX
9 YZ 0 0-9 Symbol

Return NumerChr LowerChr

Fig. 16.6.19 AUX AMC name setup screen



16.6.8.7 Relay Name Customization

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then “6. PORT NAME CUSTOMIZATION”, and finally “RELAY NAME CUSTOMIZ”, to open the screen shown in Fig. 16.6.20.

Only listed relays can be named.

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

Relay	Name
STD Relay	
EVENT 91	SAMPLE
EVENT 92	V92

1 ABC 2 DEF 3 GHI 4 JKL
5 MNO 6 PQR 7 STU 8 VWX
9 YZ 0 0-9 Symbol

Return NumerChr LowerChr

Fig. 16.6.20 Relay name setup screen



16.6.9 Setting the link device code

When the gas chromatograph is linked to a Chromatopac, the link device code must be set. The link device code specifies which GC channel should start when the GC [START] key is pressed.

16.6.9.1 Screen description

Select “6. GC CONFIGURATION” from the [FUNC] key screen, and then select “7. LINK DEVICE CODE”, to open the screen shown in Fig. 16.6.21.

Link Device Code	
Channel to start	
Ch1	<u>On</u>
Ch2	<u>On</u>
Ch3	◀ <u>Off</u>
Ch4	<u>Off</u>

Return

Fig. 16.6.21 Link device code setup screen

16.6.9.2 Parameter list

CHANNEL TO START

Ch1–Ch4 Selection: On/Off, Default: On

Set “On” or “Off” for the start signal of each channel.



16.6.10 Temperature offset

If the actual temperature of the various heated zones (as measured by a thermocouple) differs 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. 16.6.22.

The screen displays the following data:

Temperature Offset		
Column		-1.00
SPL	LINE 1	0.00
DINJ		0.00
DFID	LINE 1	0.00
DTCD		0.00

At the bottom, there is a dotted line and a button labeled "Return" with a left arrow icon.

Fig. 16.6.22 Offset set up screen

16.6.10.2 Parameter list

COLUMN/INJ1/INJ2/DET1/DET2/AUX3/AUX4/AUX5

Range: -10.00~+10.00, Default: 0.00

The temperature of each heated zone can be offset, Uninstalled ports are not displayed. For example, when "-1 °C" is obtained by subtracting the column oven temperature measured by thermocouple from the gas chromatograph value with an offset value of "0", input "-1" as the offset value.



16.6.11 Other Settings

16.6.11.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "9. OTHER CONFIGURATIONS" to open the configurations screen shown in Fig. 16.6.23.

Other Configurations	
Language	◀English
Backlight auto off (sec)	0
Pressure unit	kPa
Beep volume	Hig
Beep tone	Hi
Atmospheric compensation	Off
Zero at Ready	On
Polarity in Ready	Open
DINJ Primary Press	500-900kPa
DAFC Unit	DAFC
DTCD Preamplifier	x1
GC Start	SYSTEM Key Screen

Return

Fig. 16.6.23 Setup screen of other configuration



16.6.11.2 Parameter list

LANGUAGE

Selection: Alt./English, Default: English

Switch between Japanese (Alt.) and English screen languages.

BACK LIGHT AUTO OFF

Range: 0–9999 (sec)., Default: 0 (sec)

Set the period of time when the backlight LCD display automatically turns off.

PRESSURE UNIT

Selection: kPa/bar/psi., Default: kPa

Set the pressure units for display.

	Range (kPa = 1)	Increase quantity
kPa	1	0.1
bar	1/100	0.01
psi	1/6.895	0.1

NOTE In the case that the 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”.

kPa	bar	psi
300 - 500	3.00 - 5.00	43.5 - 72.5
500 - 900	5.00 - 9.00	72.5 - 130.5
900 - 980	9.00 - 9.80	130.5 - 142.1

- The pressure axis on the screen after pressing [MONIT] key is displayed in the value of “kPa” regardless of the “pressure unit” sets.
- The setting value, measured value of the primary pressure of the diagnosis result of the standard diagnosis is displayed in the value of “kPa” regardless of the “pressure unit” sets.
- The display, printing of each log file is displayed in the value of “kPa” regardless of the “pressure unit” sets.

BEEP VOLUME

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

BEEP TONE

Selection: Lo/Hi, Default: Hi

Use a different tone for different GCs to be able to discern which GC has a problem.

ATMOSPHERIC COMPENSATION

Selection: On/Off, Default: Off

Select “On” to compensate for higher altitudes when in linear velocity mode.

ZERO AT READY

Selection: On/Off, Default: On

Set “On” for, the gas chromatograph to automatically perform zero adjustment when the GC is ready.

POLARITY IN READY

Selection: Open/Close, Default: Open

Set the polarity of GC ready signal.

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-2014 is 700 kPa, select “500–900 kPa”. This is not displayed when the carrier gas flow controller is DAFC.



DAFC UNIT

Selection: DAFC/AMC. LR, Default: DAFC

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

Set the DAFC unit prior to starting GCsolution.

DTCD PREAMPLIFIER

Selection: x1/x10, Default: x1

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

GC START

Selection: SYSTEM Key Screen/ SET Key Screen/ MONIT Key Screen/,

Default: SYSTEM Key Screen

Select the screen, which is displayed automatically after pressing the "Start GC" key (PF1 key of the [SYSTEM] key main screen).

16.7

16 Special Functions

Service and Maintenance

16.7.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen to display the Service/Maintenance screen shown in Fig. 16.7.1.

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

Select function

Version

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

Select function

Return

Fig. 16.7.1 Service/maintenance menu screen

16.7.2 Parameter list

INSTALLATION (POSITION)

Specify the heated zone locations for installed components.

INSTALLATION (PIPING)

Set the installation status of the carrier gas and the detector gas flow controllers.

INITIALIZE

Initialize the RAM, configuration, and installation settings.

POWER CONSUMPTION

Displays the power consumption of all heated zones.

SERVICE

Reserved for the use of shimadzu service personnel during maintenance or inspections.



16.7.3 INSTALLATION (POSITION)

16.7.3.1 Screen Description

Select “7. SERVICE/MAINTENANCE” from the [FUNC] key screen, and then select “1. INSTALLATION (POSITION)”, to open the GC installation screen shown in Fig. 16.7.2 appears.

After installing injection ports and detectors, specify the location of installed components by entering the headed zone number while referring to Fig. 16.7.3.

The component type of installed injectors and detectors is automatically determined.

GC Installation		
Port	Type	Position
INJ1	SPL	<u>1</u>
INJ2	DINJ	<u>2</u>
DET1	DFID	<u>6</u>
DET2	DTCD	<u>9</u>
AUX3	---	--
AUX4	---	--
AUX5	---	--

Enter the heated zone number to specify the unit installation position in a number. (Refer to Fig. 16.7.3.)

Return

Fig. 16.7.2 GC installation setup screen

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



16.7.3.2 Parameter list

INSTALLATION POSITION

Range: 0–15, Default: 0

Specify the component installation location by entering a numeric value from 1 to 8 as shown in Fig. 16.7.3.

Set “0” when a unit is not installed.

Set “15” when a unit is installed in a position not shown in Fig. 16.7.3.

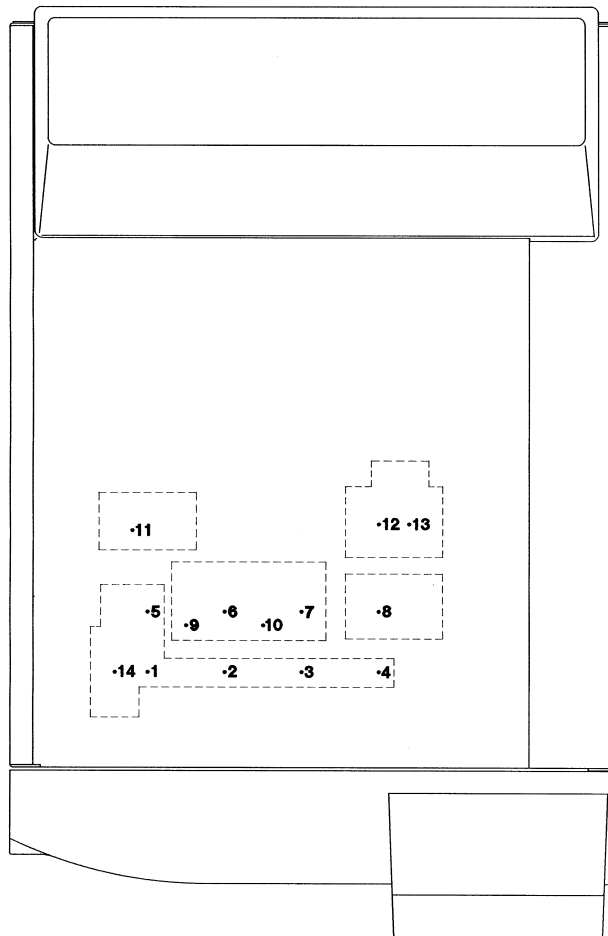


Fig. 16.7.3 Component installation location

NOTE Changes are not in effect until the GC has been turned off and on.



16.7.4 INSTALLATION (PIPING)

16.7.4.1 Screen description

Select “7. SERVICE/MAINTENANCE” from the [FUNC] key screen, and then select “2. INSTALLATION (PIPING)”, to open the Installation (Piping) Screen shown in Fig. 16.7.4.

In the carrier gas, flow controller fields, specify where the flow controller injection port tubing is connected.

In the detector gas flow controller fields, specify the detector configuration including detector type and flow control unit.

Carrier gas flow controller settings		Detector gas flow controller settings		
Installation(Piping)		Installation(Piping)		
CAR1		DET#3		
Unit Type	AFC+PU	Cont. Type	TCD-L	
Slot No.	SLOT2	DET APC No.	-----	
Heater Port	INJ1	DET APC No.	-----	
CAR2		Unit Type		-----
Unit Type	DAFC	Slot No.	NON	
Slot No.	SLOT3	Slot No.	NON	
Heater Port	INJ2	Heater Port	DET1	
CAR3		Heater Port		DET2
Unit Type	-----	DET#4		-----
Slot No.	-----	Cont. Type	NON	
Heater Port	NON	DET APC No.	-----	
DET#1		Unit Type		-----
Return		Return		

Fig. 16.7.4 Installation status setup screen

16.7.4.2 Parameter list

■ Carrier gas flow controller settings

The names CAR1, CAR2 and CAR3 are automatically assigned in ascending order of the slot No. for each installed AFC.

Specify the flow controller carrier gas settings for each CAR.

UNIT TYPE

For, display only.

When an AFC is installed, this is automatically displayed.

If a manual flow controller is installed, specify the installation Slot No.(See below.)

“SPLITTER” is automatically displayed for the Unit Type.

SLOT NO.

Selection: NON/MSLOT1–7, Default: NON

This item can be set only when a manual flow controller is installed.

Select the Slot No. where the manual flow controller is installed.

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

When an AFC is installed, its SLOT no. 2–6 is automatically recognized and displayed.



TEMP. PORT

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

Specify the injection port heated zone where the flow controller tubing is connected.

This 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

For display only.

When an APC is installed, the APC type is displayed for the Slot No. selected.

“APC (1ch)” indicates an APC for ECD/TCD. “APC (2ch)” indicates an APC for FPD.

“APC (3ch)” indicates an APC for FID/FTD.

When manual flow controllers are selected, “DET GAS” is automatically displayed.

SLOT NO.

Selection: NON/SLOT2–6/MSLOT1–7, Default: NON

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

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

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

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

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

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

HEATER PORT

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

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

This associates the flow controller to a detector.

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

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

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



Installation(Piping)	
DETH#2	
Cont. Type	WDFID
DET APC No.	DetAPC 1
DET APC No.	DetAPC 2
Unit Type	DET-GAS
Slot No.	MSLOT4
Slot No.	MSLOT5
Heater Port	DET1
DETH#3	
Cont. Type	TCD-L
DET APC No.	-----
DET APC No.	-----
Unit Type	-----
Return	

Manual flow controller

Installation(Piping)	
DETH#2	
Cont. Type	WDFID
DET APC No.	DetAPC 1
DET APC No.	DetAPC 2
Unit Type	APC(3ch)
Slot No.	SLOT4
Slot No.	SLOT5
Heater Port	DET1
DETH#3	
Cont. Type	TCD-L
DET APC No.	-----
DET APC No.	-----
Unit Type	-----
Return	

APC

Fig. 16.7.5 Setup for detector gas flow controller

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



16.7.5 INITIALIZATION

16.7.5.1 Screen description

Select “7. SERVICE/MAINTENANCE” from the [FUNC] key screen, and then select “3. INITIALIZE”, to display the Initialization screen shown in Fig. 16.7.6.

When you move the arrow cursor and press the [ENTER] key, the initialization confirmation screen (Fig. 16.7.7) appears. On this screen, press the [INIT] (PF menu) key to initialize the selected item.

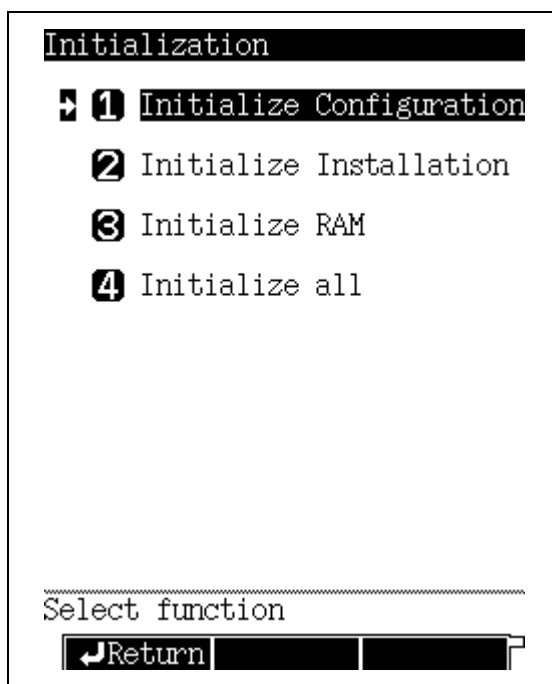


Fig. 16.7.6 Initialization menu screen

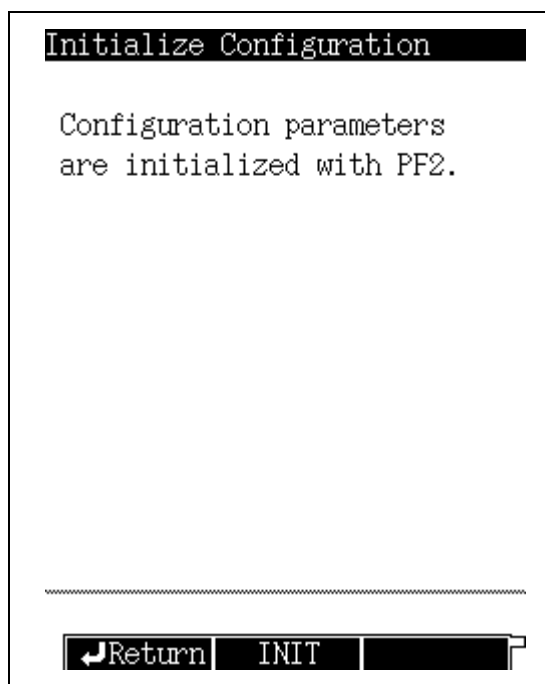


Fig. 16.7.7 Initialization confirmation screen

16.7.5.2 Parameter list

INITIALIZE CONFIGURATION

This item initializes configuration settings such as heated zone temperature limits and ready check parameters. However the column temperature limit is saved in the analysis file and is not reset. Analysis files 0–9 cannot be 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.

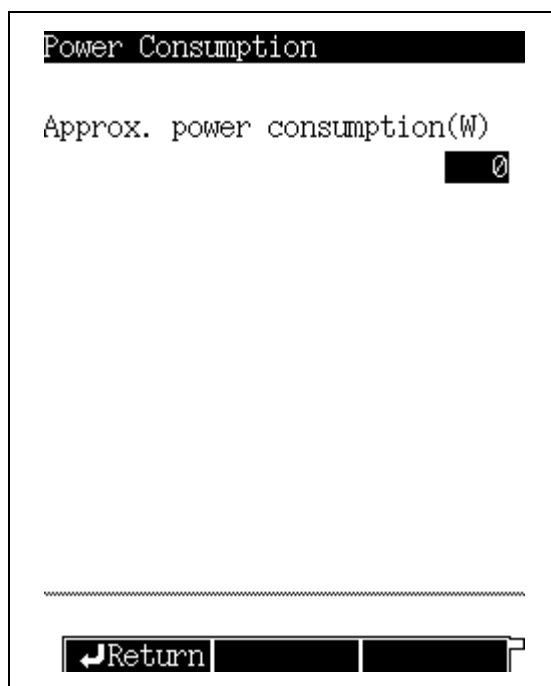


Fig. 16.7.8 Power consumption monitoring screen

16.7.6.2 Parameter list

APPROX. POWER CONSUMPTION

Approximate total power consumption of all working heaters is displayed.

16.8

16 Special Functions

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 restarts 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.

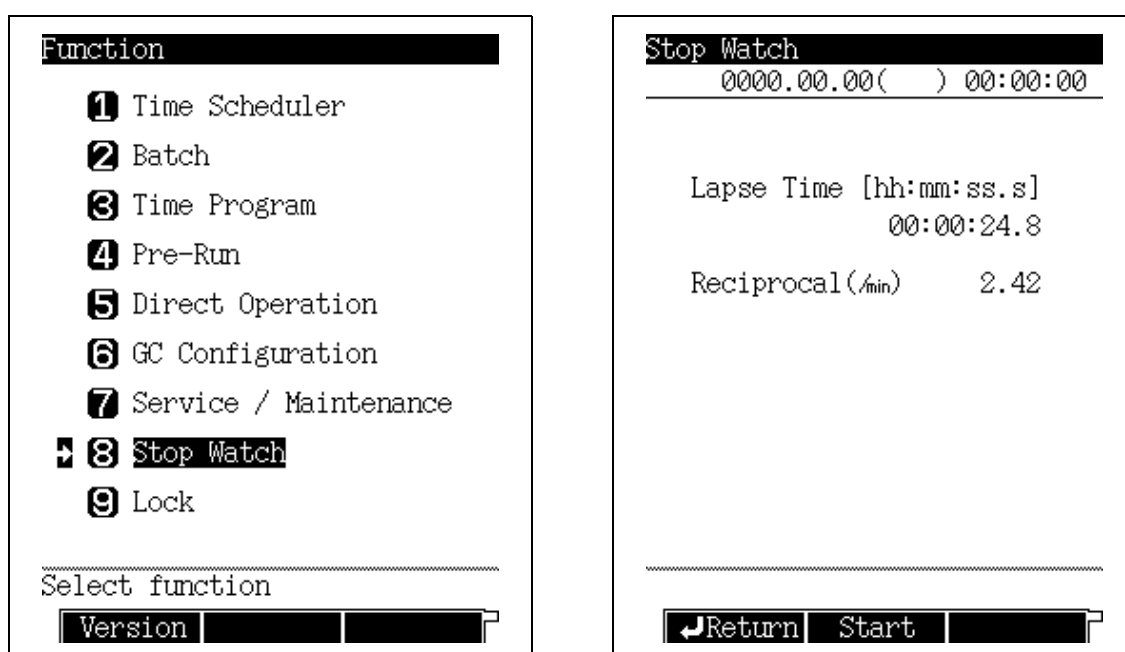


Fig. 16.8.1 Stop watch screen

16.8.2 PF menu

PF menu	Description	Reference section
Start	Starts timing. If "Start" is pressed again when the timing has stopped, the stopwatch is reset to 0.0 seconds.	—
Stop	Stops counting.	—

16.8.3 Timing with inverse measurement

When using a bubble film flow meter of V ml, obtain the flow rate using the reciprocal number.

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

16.9

16 Special Functions

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.

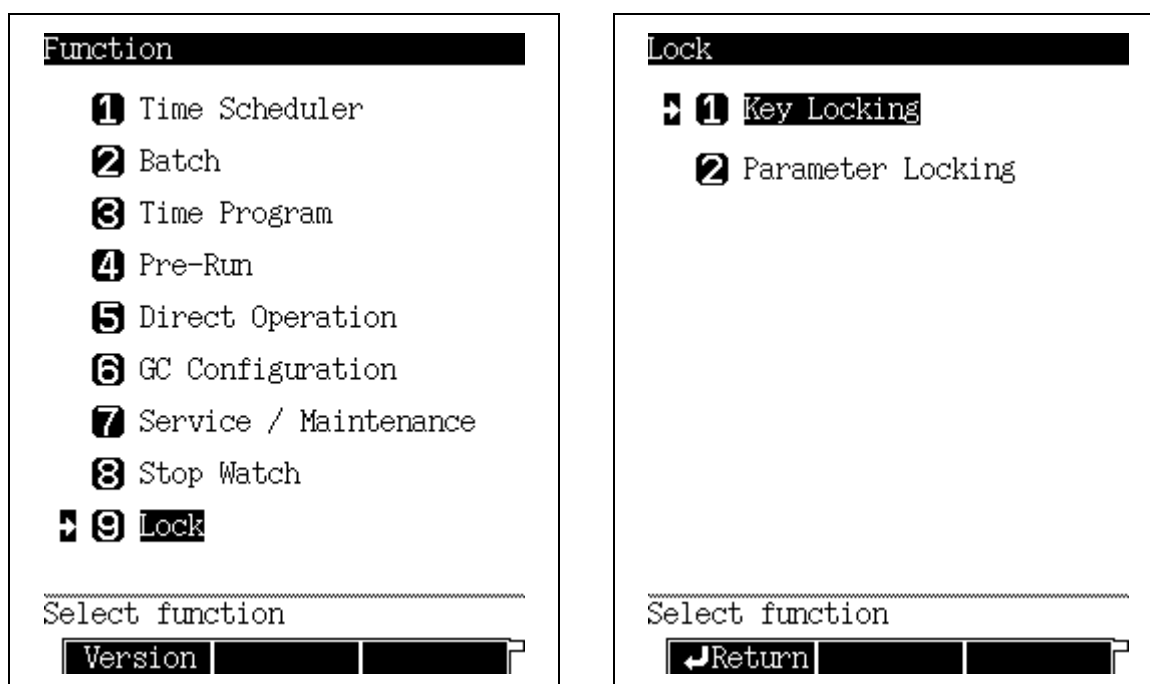


Fig. 16.9.1 Lock menu screen



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.

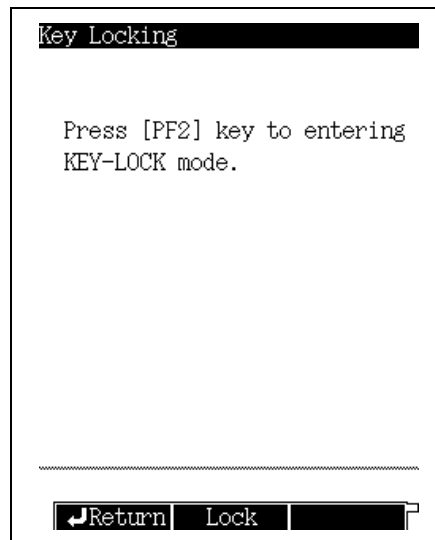


Fig. 16.9.2 Key Locking main screen

■ Unlocking keys

Press the [FUNC] key when the keys are locked, to open the screen shown in Fig. 16.9.3. Once the keys are unlocked, the screen shown in Fig. 16.9.1 appears.

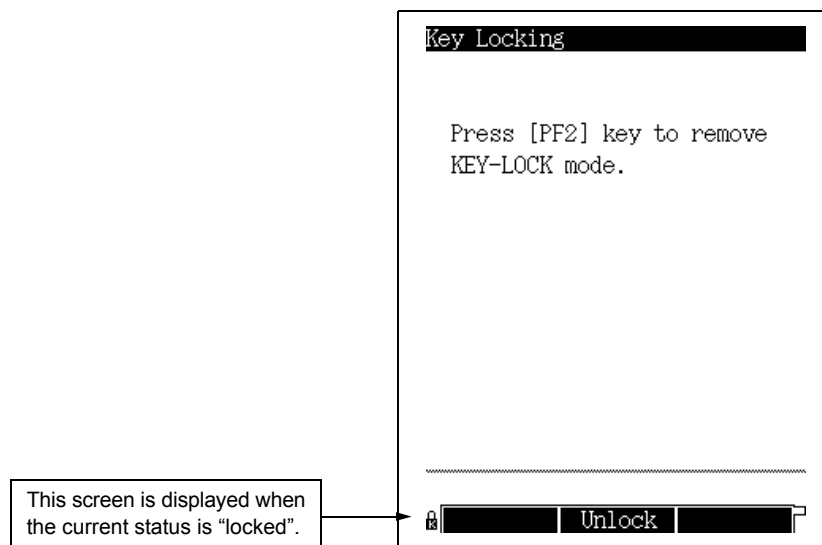


Fig. 16.9.3 Key unlock screen



16.9.3 Parameter locking

Select "9. LOCK" from the [FUNC] key screen, and then select "2. PARAMETER LOCKING" to display the screen shown in Fig. 16.9.4.

The parameter lock function prevents unauthorized parameter changes (for analytical conditions such as temperature, pressure and flow rate). Setup values can be monitored, but cannot be changed.

When the password is to be required, set "Use Password" to "USE", enter a password, then press [Lock] (PF menu).

The parameter lock function is also available without password.

Parameter Locking

Use Password Use
Password ***

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

Return Lock Password

Press [Password] (PF menu) to display the password setup screen.

Fig. 16.9.4 Parameter locking main screen



■ Setting a password

Select [Password] (PF menu) from the screen shown in Fig. 16.9.4 to display the password screen shown in Fig. 16.9.5. The password is a number ranging from 1 to 9999. The factory set password is “2014”.

< Setting a password >

Enter each required password, and press [Set] (PF menu).

Enter the new password twice to confirm it.

```

Parameter Locking

Old Password      ****
New Password      ****
Confirm new password  **

-----

Return Set
  
```

Fig. 16.9.5 Password setup screen

NOTE If the “Old Password” or “Confirm new password” is incorrect, an error message appears. Confirm the password to be input, entering it correctly.

NOTE Only the system supervisor should have password access. Change the factory-set password promptly. Do not forget your password, and keep it secure.



■ Unlocking the parameters (without password)

If parameters are locked and no password is required, when you select “9. LOCK” from the [FUNC] key screen, the screen shown in Fig. 16.9.6 appears.

When the parameter are unlocked, the screen shown in Fig. 16.9.4 appears.

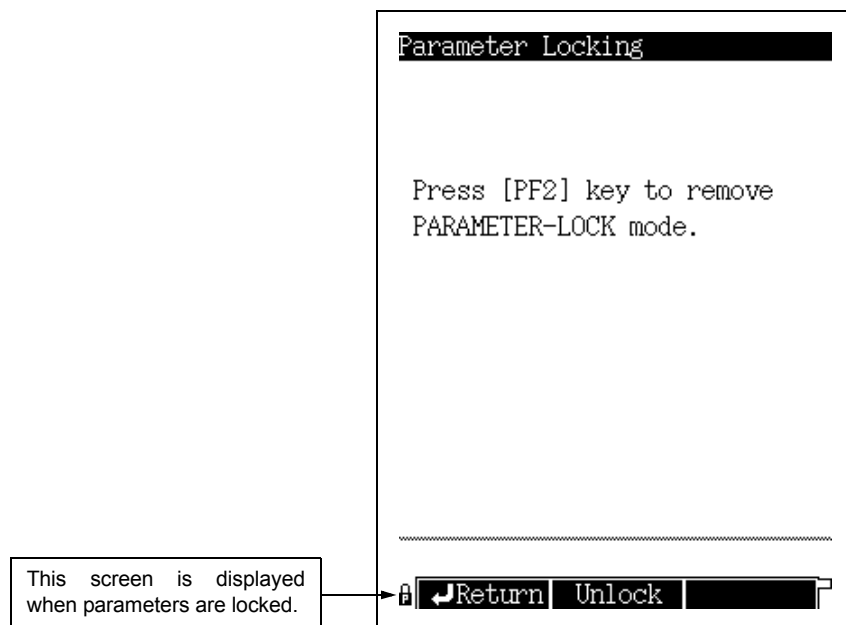


Fig. 16.9.6 Parameter unlock screen (without password)

■ Unlocking parameters (with password)

If parameters are locked and a password is set, when you select “9. LOCK” from the [FUNC] key screen, the screen shown in Fig. 16.9.7 appears.

When you input the correct password and press the [Unlock] (PF menu) key, the parameters are unlocked and the screen shown in Fig. 16.9.4 appears.

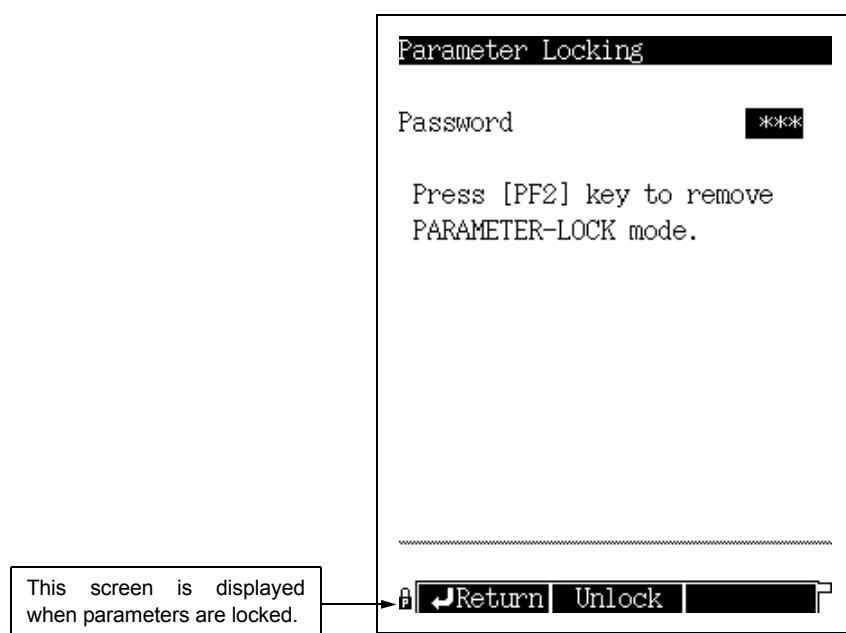


Fig. 16.9.7 Parameter unlock screen (when a password is set)

16.10

16 Special Functions

ROM Version No.

The system ROM version No. can be displayed.

16.10.1 Screen description

Press [Version] (PF menu) from the [FUNC] key screen to display the version screen shown in Fig. 16.10.1.

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

Select function

Version

Version
Version 1.1100
Build No 44

Return

Fig. 16.10.1 ROM version No. screen

16.10.2 Parameter list

VERSION
BUILD NO.

The ROM version may be required during system maintenance.



This page is intentionally left blank.

17.1

17 Printing

Printing

17.1.1 Connection to Chromatopac

Connect the gas chromatograph to the Chromatopac, then press [Print] (PF menu) from the GC screen to print to the Chromatopac.

For the GC and Chromatopac connection, refer to ["2.4 Connecting a RS-232C Cable to the Chromatopac C-R8A"](#).

17.1.2 Parameters to be printed

17.1.2.1 Program

The current file program can be printed.

This includes the following screens: temperature program (COL, INJ1, INJ2), pressure program (CAR1, CAR2, CAR3), flow rate program (CAR1, CAR2, CAR3) and split ratio program (CAR1, CAR2.)

Press [Print] (PF menu) from any screen to print the same parameters for a saved program.

- COLUMN OVEN TEMP PROGRAM -			
	RATE	TEMP	TIME
0	-----	100.0	1.00
1	6.00	220.0	25.00
- INJ1 TEMP PROGRAM -			
	RATE	TEMP	TIME
0	-----	25.0	0.00
- INJ1 PRESSURE PROGRAM -			
	RATE	TEMP	TIME
0	-----	100.0	0.00
- INJ1 SPRIT RATIO -			
	TIME	RATE	
0	-----	-1.0	
- END -			

Fig. 17.1.1



17.1.2.2 AOC parameters

The current file's AOC parameters and the parameters of AOC settings can be printed. The AOC2 parameters can be printed when an AOC2 is configured in the analytical line. All printed items are listed by command name. To match command names to screen items, refer to [“17.2 AOC commands”](#).

- AOC PARAMETER -		
	AOC1	AOC2
WRPT	2	2
WMOD	1	1
REPT	1	1
IVOL	1.0	1.0
WPRS	0	0
PUMP	5	5
WTPP	0.2	0.2
WAIT	0.0	0.0
ISPD	2	2
SSPD	1	1
SAND	0	0
SOLV	0	0
SINT	0	0
SSNO	0	0
SNO2	0	0
AAIR	0	0
USPD	2	2
DSPD	2	2
HIGH	0	0
LOWS	0	0

Fig. 17.1.2

17.1.2.3 Main parameters

Press [Print] (PF menu) from the [SET] key to print the temperature values for all heated zones, the CAR1/2 pressure value, and the total flow rate value from the current file.

- GC PARAMETER 0:FILE0 -		
COLUMN OVEN	TEMP	25.0
INJ1	TEMP	25.0
DET1	TEMP	25.0
INJ1	PRESS	100.0
INJ1	FLOW	50.0
- END -		

Fig. 17.1.3



17.1.2.4 Time program and Pre-Run program

The time programs and Pre-Run programs can be printed as Event No. or parameter names. To match Event No. and parameter names to screen items, refer to [“17.3 Program Parameters”](#) and [“17.4 Event No.”](#)

NOTE For all functions treated as events in the printout, the line No. is displayed as “0” regardless of the line number.

- GC TIME PROGRAM -			
TIME	FUNC	VALUE	LINE
0.0	EVNT	91.0	0
2.0	D1RG	1.0	1
3.0	D1RG	0.0	1
200.0	STOP	1990.0	0
- END -			

Fig. 17.1.4

17.1.2.5 Batch schedule

Press [Print] (PF menu) to print the batch schedule as shown below.

- GC SAMPLE SCHEDULER -						
START	FINAL	GC-FILE	DP-FILE	#INJ	MK	COMNAD
1	5	0	Ch.1-2	1	STANDARD	STEST
6	15	0	Ch.1-2	3	UNKNOWN	
- END -						

Fig. 17.1.5



17.1.2.6 Log

From each screen of the GC operation log, the analysis log, the parameter log, the error log and the diagnostic log, press [Print] (PF menu) to print the parameters displayed on the screen.

For the analysis log, only the list screen is printed. The contents of the detailed analysis screen are not printed.

For example, press [Print] (PF menu) from the error log screen, to obtain the following printed results.

NOTE The log items are printed in chronological order, starting from the oldest.

- GC ERROT LOG -			
TIME	OCCURED	CODE	ERROR MESSAGE (VALUE)
200.05.16	14:21	[E1020]	DET1 sensor down error (530.00)
200.05.16	14:27	[E0031]	INJ-DET2 A/D error
200.05.16	14:27	[E0032]	AUX1-AUX3 A/D error
200.05.16	14:27	[E0011]	CAR1 AFC PCB error (7.00)
200.05.16	14:27	[E0030]	COL A/D error
200.05.16	14:27	[E0001]	DC 5 V range error (8.43)
200.05.16	14:27	[E0002]	DC 24 V range error (20.34)
200.05.16	14:27	[E0034]	Battery voltage error (0.26)
200.05.16	14:27	[E0005]	Room temp range error (84.27)
200.05.16	14:27	[E1019]	INJ1 sensor down error (530.00)
200.05.16	14:27	[E1018]	COL sensor down error (530.00)
200.05.16	14:27	[E1020]	DET1 sensor down error (530.00)
200.05.16	14:28	[E0031]	INJ1-DET2 A/D error
200.05.16	14:28	[E0032]	AUX1-AUX3 A/D error
200.05.16	14:28	[E0011]	CAR1 AFC PCB error (7.00)

Fig. 17.1.6

17.2

17 Printing

AOC commands

When you press [Print] from the AOC, all items are printed as command names. The list below shows correspondence of command names to item names.

The setup values, such as "Fast" and "Yes/No" are printed as numbers. Correspondence of setup values to numbers is shown in the range and default columns in the list below.

■ Command list

Command name	Item	Range	Default
WRPT	Sample Wash	0–99	2
WMOD	Solvent Wash	0–99	1
REPT	Number of Injection	1–99	1
IVOL	Sample Size	0.1–8.0	1.0
WPRS	Pre solvent Wash	0–99	0
PUMP	Pumping	0–99	5
WTPP	Viscosity	0.0–99.9	0.2
WAIT	Dwell Time	0.0–99.9	0
ISPD	Inj. Speed (Plunger)	Slow: 0, Fast: 2	Fast: 2
SSPD	Inj. Speed (Syringe)	Slow: 0, Fast: 1	Fast: 1
SAND	Inj. Mode	0–4	0
SOLV	Solvent selection	All: 0, only A: 1, only B: 2, only C: 3	All: 0
SINT	Priority Sample No.	1	0
*SSNO	Injected sample No. (Only this sample is analyzed.)	1	0
*SNO2	Injected sample No. (for sub AOC)	1	0
AAIR	Air Aspiration	No: 0, Yes: 1	No: 0
USPD	Plunger Aspiration Speed	Slow: 0, Middle : 1, Fast: 2	Fast: 2
DSPD	Speed of Plunger	Slow: 0, Middle : 1, Fast: 2	Fast: 2
HIGH	Syringe Height (↑)	0–20	0
LOWS	Syringe Height (↓)	1.5 ml vial: 0–2 4 ml vial: 0–10	0
INJH	Syringe Height (Inj)	0–22	0
STRI	Multi - Inj	1–99	1
*FSAM	Final sample No. (Samples after that are not analyzed.)	1	0
*WKEY	Washing with solvent before injection in solvent flush mode	0, 1	0
*UVOL	Aspiration volume during pumping	8 µl: 0, 6 µl: 1	8 µl: 0
SLMD	Using 3 Solvent Vials	No: 0, Yes: 1	No: 0
VIAL	Vial size	1.5 ml:0, 4 ml:1	1.5 ml:0
*CKTR	With/without tray check	With: 0, Without: 1	Without: 0
*TANL	Analysis time	0–655	0
*TSTR	Analysis start time	0.0–99.9	0.0
LSYR	Syringe Volume	10 µl: 0, 50 µl: 1, 250 µl: 2	10 µl: 0



Command name	Item	Range	Default
SAMU	Use of the sampler	Not use: 0, Use: 1	Not use: 0
SUBU	Use of the sub AOC	Not use: 0, Use: 1	Not use: 0
BARC	Bar Code Reader	Not use: 0, Use: 1	Not use: 0
SPMD	Distribution of sample for dual AOC	0–8	0
PAR1	Use of Same Param	No: 0, Yes: 1	No: 0
*GLPM	Setting of validation mode	0, 1	0
*GRPT	Number of times of GLP sample discharge	1–99	50
*GVOL	GLP sample discharge volume	1–80	20
*GPMP	Number of times of pumping after second GLP	0–5	1
*ATSP	Automatic stop function	Off: 0, On: 1	On: 1
*ARSG	Ready signal polarity	Open: 0, Close: 1	Open: 0
TLET	Rack	Short: 0, Long: 1	Short: 0
TSEL	Rack position while sampler is used	0–2	1

1: Without autosampler, short rack: 1–6
Without autosampler, long rack: 1–12
With autosampler: 1–150

NOTE Command names marked with “*” cannot be set on the GC screen.

17.3

17 Printing

Program Parameters

Press [Print] from a time program or Pre-Run program to print the program as event No. or parameter names.

This paragraph describes the parameter names and the display when a program stops.

■ Event No. (EVNT)

Refer to “17.4 Event No.”.

■ Temperature

Heated zone names from a temperature program are printed with the parameter names shown below.

Column temperature	: CITP
INJ1	: INJT
INJ2	: AITP
DET1	: DETT
DET2	: AUXT
AUX3	: TCDT
AUX4	: AX4T
AUX5	: AX5T

■ Detector range, polarity and current value

Detector range, polarity and the current value from a program are printed with the parameter names shown below.

Range of DET #1	: D1RG
Range of DET #2	: D2RG
Range of DET #3	: D3RG
Range of DET #4	: D4RG
Polarity of DET #1	: D1PL
Polarity of DET #2	: D2PL
Polarity of DET #3	: D3PL
Polarity of DET #4	: D4PL
Current value of DET #1	: D1CR
Current value of DET #2	: D2CR
Current value of DET #3	: D3CR
Current value of DET #4	: D4CR



■ Time program STOP and repetitions

When a time program STOP value is specified, it is printed with the four digits described below.

[1] [2] [3] [4]

- Digit [1] value
 - 0: Continuous
When a program finishes, the next program automatically starts without waiting for the start command.
 - 1: Pause at each run (AOC)
When a program finishes, the GC waits for the start command.
- Digit [2] and [3] 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 (START)

Pre-Run program values are printed with numbers 0–4, described below.

- 0: Auto
- 1: Manual (Stop program)
- 2: GC start
- 3: AOC/HSS start
- 4: Clean up

17.4

17 Printing

Event No.

Many parameters are printed with event No. The list below shows the correspondence of event No. to functions.

■ Event No. list

No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
0	Reverses contact status of Events 1 to 16 and Events 91 to 96.	Opens contact of Events 1 to 16 and switches contact of events 91 to 96 to N/C type (normal).
1	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
2	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
3	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
4	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
5	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
6	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
7	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
8	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
9	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
10	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
11	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
12	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
13	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
14	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
15	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
16	Turns on contact of one contact in one circuit (option PRG).	Turns off contact of one contact in one circuit (option PRG).
51	Performs zero adjustment of DET #1.	Frees zero adjustment of DET #1.
52	Performs zero adjustment of DET #2.	Frees zero adjustment of DET #2.
53	Performs zero adjustment of DET #3.	Frees zero adjustment of DET #3.
54	Performs zero adjustment of DET #4.	Frees zero adjustment of DET #4.
61	Turns on CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1.	Turns off CAR1 gas saver. Returns split ratio to value of analysis parameter.



No.	Meaning of “Event xx” (Example: Event 1)	Meaning of “Event-xx” (Example: Event -1)
62	Turns on CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 2.	Turns off CAR1 gas saver. Returns split ratio to value of analysis parameter.
63	Turns on CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 1.	Turns off CAR2 gas saver. Returns split ratio to value of analysis parameter.
64	Turns on CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 2.	Turns off CAR2 gas saver. Returns split ratio to value of analysis parameter.
71	Ignites frame.	Extinguishes frame.
81	Turns on feedback of FTD 1.	Turns off feedback of FTD 1.
82	Turns on feedback of FTD 2.	Turns off feedback of FTD 2.
83	Turns on feedback of FTD 3.	Turns off feedback of FTD 3.
84	Turns on feedback of FTD 4.	Turns off feedback of FTD 4.
91	N/O contact between two contacts in one circuit	N/C contact between two contacts in one circuit
92	N/O contact between two contacts in one circuit	N/C contact between two contacts in one circuit
93	N/O contact between two contacts in one circuit (option PRG)	N/C contact between two contacts in one circuit (option PRG)
94	N/O contact between two contacts in one circuit (option PRG)	N/C contact between two contacts in one circuit (option PRG)
103	Closes CAR1 splitter control.	Opens CAR1 splitter control.
104	Closes CAR2 splitter control.	Opens CAR2 splitter control.
105	Turns On AC blower.	Turns Off AC blower.
106	Closes air (solenoid valve).	Opens air (solenoid valve).
109	Turns On AC CRG INJ.	Turns Off AC CRG INJ.
110	Turns On AC CRG Column.	Turns Off AC CRG Column.
111	Turns On AC Cooling fan.	Turns Off AC Cooling fan.
131	Turns On DET #1 detector controller.	Turns Off DET #1 detector controller.
132	Turns On DET #2 detector controller.	Turns Off DET #2 detector controller.
133	Turns On DET #3 detector controller.	Turns Off DET #3 detector controller.
134	Turns On DET #4 detector controller.	Turns Off DET #4 detector controller.
141	Turns On CAR1* carrier gas.	Turns Off CAR1* carrier gas.
142	Turns On CAR1 septum purge	Turns Off CAR1 septum purge.
143	Turns On CAR2** carrier gas.	Turns Off CAR2** carrier gas.
144	Turns On CAR2 septum purge.	Turns Off CAR2 septum purge.
145	Turns On CAR3*** carrier gas.	Turns Off CAR3*** carrier gas.
146	Turns On CAR3 septum purge.	Turns Off CAR3 septum purge.
147	Turns On DET #1 makeup gas.	Turns Off DET #1 makeup gas.
148	Turns On DET #1 H2.	Turns Off DET #1 H2.
149	Turns On DET #1 Air.	Turns Off DET #1 Air.
150	Turns On DET #2 makeup gas.	Turns Off DET #2 makeup gas.
151	Turns On DET #2 H2.	Turns Off DET #2 H2.
152	Turns On DET #2 Air.	Turns Off DET #2 Air.
153	Turns On DET #3 makeup gas.	Turns Off DET #3 makeup gas.
154	Turns On DET #3 H2.	Turns Off DET #3 H2.

When the dual AFC (DAFC) is used as flow controller, the following carrier gas is turned On/Off.

* CAR1 L side ** CAR2 L side

*** When CAR1 is DAFC: CAR1 R side, When CAR1 is AFC and CAR2 is DAFC: CAR2 R side.



No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
155	Turns On DET #3 Air.	Turns Off DET #3 Air.
156	Turns On DET #4 makeup gas.	Turns Off DET #4 makeup gas.
157	Turns On DET #4 H2.	Turns Off DET #4 H2.
158	Turns On DET #4 Air.	Turns Off DET #4 Air.
161	Turns On CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR1 gas saver. Returns split ratio to value of analysis parameter.
162	Turns On CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 2. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR1 gas saver. Returns split ratio to value of analysis parameter.
163	Turns On CAR2 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 1. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR2 gas saver. Returns split ratio to value of analysis parameter.
164	Turns On CAR1 gas saver. Sets split ratio to value of CAR2 gas saver split ratio 2. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR2 gas saver. Returns split ratio to value of analysis parameter.
171	Turns On CAR1/CAR2/CAR3 high pressure injection mode.	Turns Off CAR1/CAR2/CAR3 high pressure injection mode. Returns column input pressure to value of analysis parameter.
181	Turns On APC1 flow controller.	Turns Off APC1 flow controller.
182	Turns On APC2 flow controller.	Turns Off APC2 flow controller.
183	Turns On APC3 flow controller.	Turns Off APC3 flow controller.
184	Turns On APC4 flow controller.	Turns Off APC4 flow controller.
185	Turns On APC5 flow controller.	Turns Off APC5 flow controller.
186	Turns On APC6 flow controller.	Turns Off APC6 flow controller.
187	Turns On APC7 flow controller.	Turns Off APC7 flow controller.
188	Turns On APC8 flow controller.	Turns Off APC8 flow controller.
189	Turns On APC9 flow controller.	Turns Off APC9 flow controller.
190	Turns On APC10 flow controller.	Turns Off APC10 flow controller.
191	Turns On APC11 flow controller.	Turns Off APC11 flow controller.
192	Turns On APC12 flow controller.	Turns Off APC12 flow controller.
193	Turns On APC13 flow controller.	Turns Off APC13 flow controller.
194	Turns On APC14 flow controller.	Turns Off APC14 flow controller.
195	Turns On APC15 flow controller.	Turns Off APC15 flow controller.
196	Turns On APC16 flow controller.	Turns Off APC16 flow controller.
197	Turns On APC17 flow controller.	Turns Off APC17 flow controller.
198	Turns On APC18 flow controller.	Turns Off APC18 flow controller.
201	Turns On AMC1 flow controller.	Turns Off AMC1 flow controller.
202	Turns On AMC2 flow controller.	Turns Off AMC2 flow controller.
203	Turns On AMC3 flow controller.	Turns Off AMC3 flow controller.
204	Turns On AMC4 flow controller.	Turns Off AMC4 flow controller.



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

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

18.1

18 Error Messages

Error Messages

This system is programmed to self-diagnose certain errors. When an error is detected, an alarm sounds and one of the error messages shown below is displayed. The detected errors are recorded in the “Error Log”.

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

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

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

18.1.1 System errors

Power supply failure

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

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

Room temperature sensor/atmospheric pressure sensor error

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

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



PCB failure

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

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

Clock reset

Code	Message	CS
0029	Clock is initialized	No

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

A/D converter failure, feedback loop communication error

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

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

Low voltage of CPU board battery

Code	Message	CS
0034	Battery voltage error	No

The battery on CPU board is dead. It must be replaced. Turn off the system and contact your Shimadzu representative.

**Cooling fan error**

Code	Message	CS
0035	Cooling fan error	No

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

Damaged in electronics

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

A repair is necessary. Contact your Shimadzu representative.

Abnormal PRG current

Code	Message	CS
0039	PRG current error	Yes

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

Flow controller AMC board failure

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

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



18.1.2 Temperature control errors

Heat loss

Code	Message	CS
1001	Heat is escaping	Yes

This message appears when heat loss is substantial. The oven door may be open or the insulation has a hole. If the column oven door is open, close it and select "Reset Error." If the insulation has a hole in it, turn off the power of the unit, repair the hole, and then restart the system.

This error may not occur even when the door is open when the column oven temperature is set at a certain range or the temperature around the unit is a certain level.

Temperature increase limit over

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

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

**Temperature sensor errors**

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

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

Unstable temperature with CRG

Code	Message	CS
1034	COL CRG cannot be controlled	Yes

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



Overheat

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

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

Relay/heater control circuit errors

Code	Message	CS
1045	COL relay error	No
1046	INJ1-DET2 relay error	No
1047	AUX3-AUX5 relay error	No
1048	Heater controller error	No

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

Detector temperature setting error

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

These messages appear when the Detector temperature setting value is smaller than that of the Oven. Increase the Detector temperature.

To have the Detector temperature lower than the column oven temperature, set "No" on Protection against contamination (PF menu) on the screen to set the maximum temperature on configuration setting.



18.1.3 Pressure/flow rate errors

Leaks

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

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

NOTE

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

(Example) If the purge flow rate is too low because of the leakage of carrier gas line, the message "Purge leaks" appears in stead of the indication of ESC or TFC leakage.



Valve leak errors

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

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

**Abnormal component operation**

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

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



AFC leaks

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

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

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

AFC valve leak errors

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

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

Abnormal component operation

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

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

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

Control setting errors

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

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

**Abnormal component operation**

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

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

18.1.4 Communication errors

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

Code	Message	CS
4001	Time out	No
4002	Parity error	No
4003	Message is not accepted	No
4004	Data is invalid	No
4005	Command is invalid	No
4006	Data is out of range	No
4007	TRS port is shut down	No
4008	TRS file error	No

One of these messages appears during a link failure or communication failure. (When a communication error occurs, the link is automatically disconnected.)

When one of these messages appears, check the connection status, and reset the link.



AOC communication errors

Code	Message	CS
4009	AOC command is invalid	No
4010	AOC data is out of range	No
4011	AOC time out	No
4012	AOC2 TRS error	No
4013	AOC link error	No

One of these messages appears during a link failure or communication failure. (When a communication error occurs, the link is automatically disconnected.)

When one of these messages appears, check the connection status, and reset the link.

18.1.5 Detector errors

Over current

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

Current of the detector is abnormal. If the resistance of the filament becomes abnormally high when the TCD or the FTD is in use, the protection circuit is actuated to prevent damage to the filament, and an alarm sounds.

If either error has occurred, turn off the system.

Possible reasons for the protection circuit to be activated are described below.

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

Correct the error then turn on the system. If the system does not recover after several resets, or the reason for the error cannot be located, contact your Shimadzu representative.

**Detector flame error**

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

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

FPD errors

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

There is a problem with the FPD detector. Refer to FPD User's Manual.

Errors 4125-4128, that are related to abnormal current, cannot be recovered without turning off the system once.

TCD errors

Code	Message	CS
4201	TCD signal is out of range	No
4202	TCD signal zero error	No

The difference in filament resistance is high between the TCD cells, and the detector cannot be zeroed. If the zero point cannot be adjusted even by turning the adjuster on the right side of the unit, the detector control unit may have failed. The system cannot be used in this condition. Turn off the system and contact your Shimadzu representative.



Detector ignition errors

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

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

Even when one of these messages appears, hydrogen gas keeps flowing when a manual flow controller is used. Shut off the hydrogen gas for safety then check the following items.

- (1) The column is connected
- (2) Hydrogen is supplied at proper flow rate
- (3) Air is supplied at proper flow rate
- (4) Filament of the igniter is intact
- (5) The jet of the FID is not clogged
- (6) Unused FID is not set to On

Code	Message	CS
4207	H ₂ , AIR APC are not ready	No

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

18.1.6 Program errors

Set value change

Code	Message	CS
4301	Settings were changed	No

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

Time over errors

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

These messages appear when the program execution time exceeds the maximum allowable value (9999.99 min). Change the program so that its total execution time does not exceed "9999.99 min." Although the program can be executed even after this error occurs, it is discontinued at 9999.99 min.



18.1.7 Operations errors

Value outside of range was entered

Code	Message	CS
5001	Input parameter out of range	No

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

File operation errors

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

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

Overflow of calculated pressure value

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

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

Overflow of calculated flow rate value

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

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



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

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



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

The pressure calculated from the flow rate you have input is outside the set range. Change the conditions and enter a new value.

Overflow of calculated pressure value during a linear velocity program

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

The carrier gas pressure calculated from the linear velocity you have input is outside the set range. Change the conditions and enter a new value.

Overflow of calculated flow rate value in programs

Code	Message	CS
5073	CAR1 calc. flow out of range	No
5074	CAR2 calc. flow out of range	No
5075	CAR1 calc. ratio out of range	No
5076	CAR2 calc. ratio out of range	No
5077	CAR1 calc. flow out of range	No
5078	CAR2 calc. flow out of range	No

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



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

Code	Message	CS
6001	AOC1 rack error	No
6002	AOC1 syringe error	No
6003	AOC1 plunger error	No
6004	AOC1 can not start	No
6005	AOC1 RAM initialized	No
6006	AOC1 ROM error	No
6007	AOC1 CH2 command error	No
6008	AOC1 sample vial is not set	No
6009	AOC1 RAM error	No
6010	AOC1 installation error	No
6011	AOC1 CH1 error	No
6012	AOC1 CH2 error	No
6013	AOC1 waste vial is not set	No
6014	AOC-20s rotating error	No
6015	AOC-20s exp. and ctrl. error	No
6016	AOC-20s up/down error	No
6017	AOC-20s can not start	No
6018	AOC-20s vial setting error	No
6019	AOC-20s vial returning error	No
6020	AOC-20s holding error	No
6021	AOC-20s sample vial removed	No
6022	AOC-20s vial is not set	No
6023	AOC2 rack error	No
6024	AOC2 syringe error	No
6025	AOC2 plunger error	No
6026	AOC2 can not start	No
6027	AOC2 RAM initialized	No
6028	AOC2 ROM error	No
6029	AOC2 CH2 command error	No
6030	AOC2 sample vial is not set	No
6031	AOC2 RAM error	No
6032	AOC2 installation error	No
6033	AOC2 CH1 error	No
6034	AOC2 CH2 error	No
6035	AOC2 waste vial is not set	No

One of these messages appears when an error has occurred in the AOC-20i auto injector or AOC-20s auto sampler.

For details, refer to the AOC-20i/s User's Manual.



18.1.9 Warning messages

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

These messages appear when the time or the count exceeds the set value. Replace the subject component and reset the count on the menu of the DIAG key screen.

Code 9002 warning requires component replacement and counter reset by a serviceperson. Contact your Shimadzu representative.

Code	Message	CS
9010	System is not ready	No

This message appears when the system was started before it was ready. Normally, do not start analysis until the system is ready.

If this message appears when all the parameters including temperature and flow rate are ready, check the ready setting for unused components and check the equilibration time.

Code	Message	CS
9011	Ignition finished (retried)	No

This message appears when ignition sequence was re-attempted because the ignition failed. This does not stop the execution of analysis. If this message appears frequently, check "DETECTOR IGNITE" and "DETECTOR IGNITION" by the standard diagnosis procedure. Also check for gas leaks and verify the gas flow rates. If set values are correct, contact your Shimadzu representative.

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

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



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

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

19 Index

A

Actual (current) values	69
AD CONVERTER	176
AFC	129
analysis counter	188
ANALOG SIGNAL TYPE	155, 167
Analysis counter	188
Analysis log	183
AOC	195
AOC commands	275
APC	159
ATMOSPHERIC COMPENSATION	253
ATMOSPHERIC PRESS	175
AUTO IGNIT	80
Auto Injector	195
automatic ignition	156
automatic re-ignition	156
AUX AMC	207
AUX APC	205

B

BACK LIGHT AUTO OFF	253
BACKGROUND SIG COMP.	155, 167
BACKGROUND SIG. SAVE	155, 167
batch schedule	219
BAUD RATE	238
BEEP	253

C

CARRIER GAS TYPE	131, 148
CE key	67, 68
Changing item names	75
Checking	15
Chng Graph	105
chromatogram	103
CLEAN UP	80
Clean up	82
Clear key	68
COL key	68, 113
COLUMN FLOW RATE	92, 122, 129, 147
Column inner diameter (I.D.)	133
COLUMN LENGTH	133
COLUMN OVEN	92, 114
Computer for Insert	188
Computer for Septum	188
CONTROL MODE	93, 122, 130, 148
Coolant Consumption Counter	190
COUNTER FOR INSERT	175
COUNTER FOR SEPTUM	175
CPU	176
CPU REGISTOR	175
CRG	190, 207

CRG USE TIME	175
CURRENT	166
CURRENT FILE	80
cursor	73
Cursor key	68
Cursor keys	67

D

DATE	236
day	212
DC VOLTAGE	175
DET key	68, 154, 165
DET SIG SUBTRACTION	155, 167
DETECTOR	80
DETECTOR ADC REGISTER	175
DETECTOR CONTROLLER	154, 165
Detector Gas	157, 159
DETECTOR HV SOURCE	175
DETECTOR IGNITE	176
DETECTOR IGNITION	176
DETECTOR ROM	175
detector signals	242
DETECTOR TEMP	93
DIAG key	67, 68, 173
Diagnostic log	187
DRIFT	240
drying-out	6
dual AFC	122
Dual FID	154

E

ECD FREQUENCY	176
ENTER	67
ENTER key	68
Entering numeric values	74
EQUILIBRATION TIME	114
Error log	186
Event No.	279

F

Fan Off	114
Fan On	114
FAN USE TIME	175
FID	153
File	95
file copy	96
file initialization	97
FILE LOAD	87
FILM THICKNESS	124, 133
FILTER TIME CONSTANT	155, 167, 170
FLOW CONTROL	80
FLOW key	68, 129

FLOW lamp	67
FLOW lights	70
FLOW OFF TIME	80
Flow Rate	122
Flow rate program	137
flow signal	243
FUNC key	67, 68, 211
Fuse	6

G

GAS CONTROL	176
gas filter	13
Gas saver	134
GC CONFIGURATION	235
GC OPERATION LOG	182

H

Heating energy generation	5
Help	77
HELP key	67, 68, 77
HETP	150
High Pressure Injection	143
Hydrogen flame ionization detector	153
hydrogen gas	10

I

INITIALIZATION	261
INJ key	68
INLET PRESS	92, 129, 147
Inlet pressures	122
INSTALLATION (PIPING)	258
INSTALLATION (POSITION)	256
isothermal analysis	115

K

Key locking	265
-------------	-----

L

LANGUAGE	253
LCD USE TIME	175
leaks	15
LINEAR VELOCITY	92, 129, 147
link device code	250
Load	95
LONGEST PROGRAM TIME	105

M

Maint INJ	81
MAKE UP	160
MONIT key	67, 68, 103
monitor injection screen	109
Monitoring the Flow Rate	107
Monitoring the Temperature	106

N

N/A	180
N/I	180
N/S	180
N/T	180

O

Offset	123, 132, 148, 160
OPTION key	68
Optional Devices	195
Oven Temperature	113
OVER TEMP PROTECTION	176

P

Parameter locking	266
Parameter log	185
PARITY	238
password	267
Peak Generator	194
PF key	67, 68, 72
PF menu	72
power cable	4
Power consumption	262
power supply	4
Pre-Run program	231
Pressure program	135
PRESSURE UNIT	253
PRIMARY PRESS	175, 253
primary pressure	253
Printing	271
Programmed analysis	115
PROTOCOL	238
PURGE FLOW RATE	93
purge flow rate	148

R

RAM	176
Ready Check	239
REAL TIME CLOCK REGISTOR	175
REMAIN TIME	105



RESET IC	176, 177
RESTART GC	80
RETENTION TIME (Rt)	105
ROM	176
ROOM TEMPERATURE	175

S

SAMPLING TIME	93, 130
Schedule number	212
Screen	67, 69
Septum purge flow rate	93
septum purge flow rate	93, 141
SET key	68, 91
set values	69
SIGNAL ATTENUATION	155, 167
SIGNAL OUTPUT PORT	155, 167
SIGNAL POLARITY	155, 166
SIGNAL RANGE	155, 167
SLEEP TIME	80
Split injection system	126
SPLIT MODE	93, 130
SPLIT RATIO	92, 130
Split ratio program	139
Splitless injection system	126
Splitter Fix	143
Standard Diagnosis	173
Standard Installation Test	192
START key	67, 68, 111, 112
start procedure	86
START TEMP/DET	80
START TIME	80
Starting an Analysis	109
STATUS	70
STATUS lamp	67
STOP BIT	238
STOP key	67, 68, 112
stop procedure	88
STOP TIME	80
Stopping Analysis	112
Stopwatch	263
SYSTEM key	67, 68

T

TCD	164
TEMP	70, 114, 154, 165
TEMP lamp	67
TEMP SENSOR DIAG	175
TEMP SENSOR USE TIME	175
temperature control signal	242
Temperature offset	251
temperature program	115
Thermal Conductivity Detector	164

TIME	236
Time Program	225
Time Scheduler	211
Toggle key	68, 72
TOTAL FLOW RATE	92, 130, 148

U

UNIT key	67
----------	----

V

VALVE	210
VLV Off	156
VLV On	156, 157

W

WATCH DOG TIMER	176
-----------------	-----

Z

Zero Adj	105, 108
Zero Free	105, 108
Zero free	108

Symbol

	68, 72
	67, 68



This page is intentionally left blank.