

Column Oven

For Shimadzu Ultra High Performance Liquid Chromatograph

# CTO-40C

## Instruction Manual

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

This page is intentionally left blank.

# Introduction

## Read this Instruction Manual thoroughly before using the product.

Thank you for purchasing this product.

This instruction manual describes the basic operation, and accessories and options for this product. Read this manual thoroughly before using the product and operate the product in accordance with the instructions in this manual.

The following instruction manuals are included with the product.

Document Name	Document No.	Description
Instruction Manual (PDF)	228-92375	This instruction manual.
System Guide (PDF)	228-92352	This manual provides details on how to use the system: system performance optimization, analysis procedure, troubleshooting, validation, installation, etc.
Safety Guideline (Booklet/PDF)	228-92326	This manual describes the precaution instructions to ensure safe operation.

Read "Safety Guideline" thoroughly before using the product.

"Safety Guideline" describes the information about the warranty, after-sales service, safety instructions and precautions to ensure safe operation of the instrument.

Keep this manual for future reference.

### IMPORTANT

- If the user or usage location changes, ensure that the manual is always kept together with the product.
- If any manual or a product warning label is lost or damaged, immediately contact your Shimadzu representative to request a replacement.
- To ensure safe operation, read the accompanying booklet "Safety Guideline" before using the product.
- To ensure safe operation, contact your Shimadzu representative if product installation, adjustment, re-installation (after the product is moved), or repair is required.

**Notice**

- Information in this manual 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 manual despite the utmost care taken in its production will be corrected as soon as possible, although not necessarily immediately after detection.
- All rights are reserved, including those to reproduce this manual or parts thereof in any form without permission from Shimadzu Corporation.
- Prominence, Nexera, and LabSolutions are trademarks of Shimadzu Corporation. Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries.  
Third-party trademarks and trade names may be used in this publication to refer to either the entities or their products/services, whether or not they are used with trademark symbol "TM" or "®".

## Indications Used in This Manual

Precaution symbols are indicated using the following conventions:

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

The following symbols are used in this manual:

Indication	Meaning
 Prohibition	Indicates an action that must not be performed.
 Instruction	Indicates an action that must be performed.
 <b>Hint</b>	Indicates information provided to improve product performance.
 Reference	Indicates the location of related reference information.

## Electromagnetic Compatibility

Descriptions in this section apply only to the following model:

- 228-65202-58 CTO-40C

This product complies with European standard EN61326, class B for electromagnetic interference (Emissions) and industrial electromagnetic environment (Immunity).

### ■ EN55011 Emissions (Electromagnetic Interference)

This is a class B product. When this product causes an electromagnetic disturbance to devices being used near this product, create an appropriate distance between those devices and this product in order to eliminate the disturbance.

# Contents

---

<b>Introduction</b>	Indications Used in This Manual .....	<b>ii</b>
	Electromagnetic Compatibility .....	<b>iii</b>
<hr/>		
<b>1   Overview</b>	1.1 Features .....	<b>1</b>
	1.2 Component Parts .....	<b>2</b>
	1.3 Optional Parts .....	<b>2</b>
<hr/>		
<b>2   Parts Identification and Function</b>	2.1 Front .....	<b>8</b>
	2.2 Interior .....	<b>9</b>
	2.3 Back .....	<b>10</b>
	2.4 Name and Functions of the Operation Panel .....	<b>11</b>
	2.4.1 Display Area .....	<b>13</b>
	2.4.2 Operation Area .....	<b>14</b>
<hr/>		
<b>3   Operation</b>	3.1 Settings for the Basic Operation .....	<b>16</b>
	3.1.1 Prior to Key Operation .....	<b>16</b>
	3.1.2 Temperature Control Operation .....	<b>16</b>
	3.2 Types of Screens .....	<b>19</b>
	3.3 Monitoring Screens .....	<b>20</b>
	3.4 Auxiliary Functions Screen (FUNCTION) .....	<b>21</b>
	3.4.1 Auxiliary Functions (FUNCTION) List .....	<b>21</b>
	3.4.2 [PARAMETER] Setting Group .....	<b>24</b>
	3.4.3 [SYSTEM] Setting Group .....	<b>25</b>
	3.4.4 [UTILITY] Setting Group .....	<b>29</b>
	3.5 VP Functions Screen .....	<b>32</b>
	3.5.1 List of VP Functions .....	<b>32</b>
	3.5.2 Product Information Group (PRODUCT INFO) .....	<b>33</b>
	3.5.3 Maintenance Information Group (MAINTENANCE) .....	<b>34</b>
	3.5.4 Validation Support Information Group (VALIDATION) .....	<b>36</b>
	3.5.5 Calibration Support Information Group (CALIBRATION) .....	<b>39</b>
	3.6 Creating Time Program .....	<b>43</b>

---

3.6.1	Time Program Command List .....	43
3.6.2	Time Program Setting Screen .....	44
3.6.3	Creating a Time Program .....	45
3.6.4	Deleting a Step .....	47
3.6.5	Starting and Stopping a Time Program .....	48
3.6.6	Special Commands Used in Time Programs .....	49
3.7	Connection with the System Controller .....	50
3.7.1	Setting the Instrument .....	50
3.7.2	Basic Parameters .....	50
3.7.3	Limitations of Compatible Mode .....	50
3.8	Connection to External Input/Output Terminals .....	51
3.8.1	External Input/Output Terminals .....	51
3.8.2	Connection of Remote Cable .....	52

## 4 Maintenance

4.1	Periodic Inspection and Maintenance .....	53
4.1.1	Prior to Inspection and Maintenance .....	54
4.1.2	List of Periodic Inspection and Maintenance .....	54
4.1.3	Check After Inspection and Maintenance .....	54
4.2	Temperature Accuracy Calibration .....	55
4.3	Gas Sensor Calibration .....	58
4.4	Leak Sensor Calibration .....	60
4.5	Cleaning the Leak Tray .....	61
4.6	Replacing the Air Filter .....	62
4.7	Cleaning the Exterior .....	63

## 5 Technical Information

5.1	Specifications .....	64
5.2	Maintenance Parts .....	65
5.2.1	Consumable Parts .....	65
5.2.2	Replacement Parts .....	65

Index .....	66
-------------	----

This page is intentionally left blank.

# 1 Overview

The Shimadzu CTO-40C column oven was developed to maintain the temperature of the LC system column and flow lines at a constant temperature, in order to provide heightened analysis reproducibility and separation performance. The oven is an air-circulated thermostatic chamber for the Shimadzu High Performance Liquid Chromatography system.

Excluding the thermostatic chamber, the other instruments necessary for high performance liquid chromatography such as a solvent delivery unit, autosampler, detector, and system controller are sold separately.

For instruments that suit your purpose of use, contact your Shimadzu representative.

## 1.1 Features

- **In addition to columns, the thermostatic chamber allows installation of flow line parts in it including a manual injector, mixer, and automatic column switch valves.**

The main purpose of this column oven is to keep the column temperature constant. The thermostatic chamber can store flow line parts in it including a manual injector, mixer, and automatic column switch valves as well as columns. Installing these in the oven isolates them from the influence of ambient temperature and makes for more stable analysis. Shorter plumbing distances also reduce dead volume in the flow lines.

- **Time program functions are available for setting the temperature even in standalone use.**

The oven has a built-in CPU, allowing the set temperature to be controlled by a time program, even when the oven is controlled locally. Use of a system controller (SCL-40 etc.) permits finer control, like starting analysis when temperature stabilizes and stopping analysis when leaks or problems are detected.

- **The automatic speed control of the air circulation fan provides a stable temperature control.**

The speed of the air circulation fan is automatically controlled based on the temperature setting. At high temperatures, the air circulation ratio is increased to keep the temperature constant, and at temperatures close to the ambient temperature, the air circulation ratio is decreased to suppress heat generation due to the air circulation. The fan speed is controlled so as to remain constant even when there are fluctuations in the power supply. This enables stable temperature control.

- **The built-in thermal fuse and leak sensor ensure safety.**

To ensure safe use, the thermal fuse cuts off the power to the heater if the temperature rises abnormally. In addition, if some liquid leaks inside, the gas sensor (flammable organic solvent) or liquid leak sensor (aqueous solvent) issues an error to automatically stop temperature control.

## 1.2 Component Parts

This instrument consists of the standard parts listed below. Check the parts against this list after unpacking.

No.	Part Name	Part No.	Q'ty	Remark
-	Main Unit CTO-40C	-	1	-
-	Safety Guideline (Booklet)	228-92326	1	Contains cautions for use regarding the instrument.
-	Instruction Manual/ System Guide (CD-ROM)	228-92350-41	1	The paper based Instruction Manual (228-92375) and System Guide (228-92352) are available for a fee.
1	Filter holder	228-72234	1	▶▶ Reference System Guide "7 Installation"
2	Air filter	228-72570-01	1	
3	Drain Tube	228-25162-03	1	
4	Rubber column clamp	228-72586	4	
5	Clamp CKN-10-R	072-60330-53	1	
6	Clamp DKN-10GSP	072-60319-01	1	

## 1.3 Optional Parts

Optional parts which can be added to the column oven are listed below.

For information about other optional units listed below, contact your Shimadzu representative.

For optional parts for the whole LC system, refer to System Guide. For columns, refer to Shimadzu's column catalog.

### ■ Parts for the oven

Option	Part No.	Features
Active preheater	228-72084-41	The preheating unit heats the mobile phase before it enters columns by independent heating control. The unit controls the temperature gradient in columns so that sharp peaks are obtained.
Column clamp B5	228-15617-41	Can fix one column with an outer diameter of 6.5 mm to 9.5 mm. (Metal)
Column clamp B8	228-15617-42	Can fix one column with an outer diameter of 9.5 mm to 12.7 mm. (Metal)
Column catch	228-28637-91	Can fix two columns with an outer diameter of 6.5 mm to 12.7 mm. (Metal)
Remote Cable	228-28253-91	Used for connection of an external device.

## ■ CMD (Column Management Device)

The device stores information on a column and is capable of managing the column in combination with the database of a PC workstation. One CMD chip is required for each column. For details, refer to the instruction manual of the LabSolutions chromatography data system.

▶▶ Reference System Guide "3.9 Column Management"

Option	Part No.	Features
CMD (Column Management Device)	228-37281-41	The device is stored column-related information. One CMD chip is required for each column.
CMD cable (150 mm)	228-39991	The cable connects a CMD chip with the instrument.
CMD cable (400 mm)	228-39991-01	

## ■ Automatic column switch valve

Two valves can be installed with one on the lower-left part and the other on the lower-right part.

Option	Part No.	Features
FCV-0206	228-65603-58	The valve with two positions and six ports automatically switches between two columns. The withstand pressure is 44 MPa.
FCV-0206H	228-65607-58	The valve with two positions and six ports automatically switches between two columns. The withstand pressure is 80 MPa.
FCV-0206H3	228-65624-58	The valve with two positions and six ports automatically switches between two columns. The withstand pressure is 130 MPa.
FCV-0206H2i	228-65630-58	The valve with two positions and six ports automatically switches between two columns. The withstand pressure is 105 MPa. This is an inert specification that does not use stainless steel or other metals for the flow line material.
FCV-0607	228-65604-58	The valve with six positions and seven ports automatically switches between six columns. The withstand pressure is 44 MPa.
FCV-0607H	228-65608-58	The valve with six positions and seven ports automatically switches between six columns. The withstand pressure is 80 MPa.
FCV-0607H3	228-65625-58	The valve with six positions and seven ports automatically switches between six columns. The withstand pressure is 130 MPa.
FCV-0607H2i	228-65631-58	The valve with six positions and seven ports automatically switches between six columns. The withstand pressure is 105 MPa. This is an inert specification that does not use stainless steel or other metals for the flow line material.
FCV-DR	228-65602-58	The unit drives the previously listed valves. (One unit is required for each valve.)

5.2.

Option	Part No.	Features
FCV-12AHi	228-65622-58	The valve with two positions and six ports contains no metal as a material in its parts that come in contact with liquid and automatically switches between two columns. (Including the driving unit)
FCV-14AHi	228-65623-58	The valve with six positions and seven ports contains no metal as a material in its parts that come in contact with liquid and automatically switches between six columns. (Including the driving unit)
FCV-36AH	228-45206-41	The valve with two positions and ten ports automatically switches between two columns. The withstand pressure is 100 MPa. (Including the driving unit)
Manifold	228-72436-41	The part joins tubes of column outlets to enable one valve to switch between columns. PEEK resin and stainless steel are used for wetted parts.  ▶▶ Reference Safety Guideline "5. Precautions for Mobile Phase Selection and Use"
Manifold 6IN-10OUT,PEEK	228-54450-42	The part joins tubes of column outlets to enable one valve to switch between columns. PEEK resin is used for a wetted part. This item is dedicated to the CTO-40C and cannot be installed on the CTO-40S.  ▶▶ Reference Safety Guideline "5. Precautions for Mobile Phase Selection and Use"
FCV installation kit (CTO-40C)	228-72589-41	The common installation kit is required for installing the previously listed valves in the instrument. (Only one unit is required for this instrument.)
FCV tubing two-piece kit (ID 0.3)	228-72437-41	The tubing kit is required for installing two columns.
FCV tubing two-piece kit (ID 0.1)	228-72437-42	The tubing kit is required for installing two columns.
FCV tubing two-piece kit (ID 0.1 300 mm Nexlock)	228-72437-49	The tubing kit is required for installing two columns. (This Nexlock tubing comes with finger tight fittings.)
Two-piece set of PEEK lined SS tube for FCV (ID 0.1 300 mm)	228-72437-52	The tubing kit is required for installing two columns. (This is an inert specification that does not use stainless steel or other metals for the flow line material.)
FCV tubing six-piece kit (ID 0.3)	228-72437-43	The tubing kit is required for installing two to six columns.
FCV tubing six-piece kit (ID 0.1)	228-72437-44	The tubing kit is required for installing two to six columns.
FCV tubing six-piece kit (ID 0.1 300 mm Nexlock)	228-72437-50	The tubing kit is required for installing two to six columns. (This Nexlock tubing comes with finger tight fittings.)

Option	Part No.	Features
Six-piece set of PEEK lined SS tube for FCV (ID 0.1 300 mm)	228-72437-53	The tubing kit is required for installing two to six columns. (This is an inert specification that does not use stainless steel or other metals for the flow line material.)

### ■ Gradient mixer

The instrument can store one of the following mixers coming with a mixer detection device.

For how to select a mixer, refer to System Guide.

Connecting a mixer detection device to the instrument requires a separate CMD cable (150 mm).

Option	Part No.	Features
MIXER SUS316L ASSY (With a mixer detection device)	228-72654-41	The general-purpose mixer, where stainless steel is used for the wetted part material, is intended for both high and low pressure gradient analysis. The capacity can switch between three settings of 0.5 mL, 1.7 mL, and 2.6 mL.
MIXER PEEK (With a mixer detection device)	228-72654-42	The non-metal gradient mixer does not contain any metal as a material in its parts that come in contact with liquid. The capacity can switch between two settings of 0.4 mL and 1.6 mL. The mixer can be used for both high and low pressure gradient analysis.
MIXER MR 20 $\mu$ L (With a mixer detection device)	228-72652-41	The mixer is intended exclusively for high pressure gradient analysis with high performance and a small internal capacity of 20 $\mu$ L, where stainless steel is used for the wetted part material.
MIXER MR 40 $\mu$ L (With a mixer detection device)	228-72652-42	The mixer is intended exclusively for high pressure gradient analysis with high performance and a small internal capacity of 40 $\mu$ L, where stainless steel is used for the wetted part material.
MIXER MR 100 $\mu$ L (With a mixer detection device)	228-72652-43	The mixer is intended exclusively for high pressure gradient analysis with high performance and a small internal capacity of 100 $\mu$ L, where stainless steel is used for the wetted part material.
MIXER MR 180 $\mu$ L II (With a mixer detection device)	228-72652-44	The mixer is intended exclusively for high pressure gradient analysis with high performance and a small internal capacity of 180 $\mu$ L, where stainless steel is used for the wetted part material.
MIXER MR 20 $\mu$ L INERT (With a mixer detection device)	228-65081-41	The mixer is intended exclusively for high pressure gradient analysis with high performance and a small internal capacity of 20 $\mu$ L, where a high corrosion resistance metal is used for the wetted part material.

Option	Part No.	Features
MIXER MR 180 $\mu$ L INERT (With a mixer detection device)	228-65081-42	The mixer is intended exclusively for high pressure gradient analysis with high performance and a small internal capacity of 180 $\mu$ L, where a high corrosion resistance metal is used for the wetted part material.
MIXER MR 300 LPGE (With a mixer detection device)	228-72653-42	The high performance mixer is intended exclusively for low pressure gradient analysis with an internal capacity of 300 $\mu$ L, where stainless steel is used for the wetted part material.
MIXER MR 40 LPGE INERT (With a mixer detection device)	228-65081-43	The high performance mixer is intended exclusively for low pressure gradient analysis with an internal capacity of 40 $\mu$ L, where a high corrosion resistance metal is used for the wetted part material.
MIXER MR 300 LPGE INERT (With a mixer detection device)	228-65081-44	The high performance mixer is intended exclusively for low pressure gradient analysis with an internal capacity of 300 $\mu$ L, where a high corrosion resistance metal is used for the wetted part material.

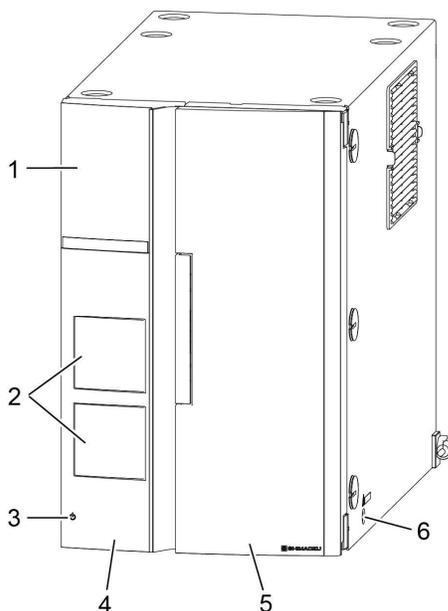
## ■ Manual injector

Option	Part No.	Features
Injector for general analysis 7725 type	228-32210-91	The manual injector is intended for general analysis. The standard sample loop has a volume of 20 $\mu\text{L}$ .
Injector for general analysis 7725i type	228-32210-93	The manual injector consists of the 7725-type injector above and a position sensing switch. This injector can send signals synchronized with sample injection to the system controller.
Semi micro injector 8125 type	228-23200-91	The manual injector is intended for semi-micro columns. The standard sample loop has a volume of 5 $\mu\text{L}$ . This injector has a built-in position sensing switch and can send signals synchronized with sample injection to the system controller.
Non-metal manual injector 9725i type	228-32650-93	The injector does not contain any metal as a material in its parts that come in contact with liquid. The maximum operating temperature is 60 °C. With a position sensing switch, this injector can send signals synchronized with sample injection to the system controller.
Manual injector installation kit *1	228-72432-42	The kit is required for installing the manual injectors to the door of the instrument.

\*1 If the manual injector is installed, the left side of the instrument needs space of 30 mm to avoid the handle part of the manual injector.

# 2 Parts Identification and Function

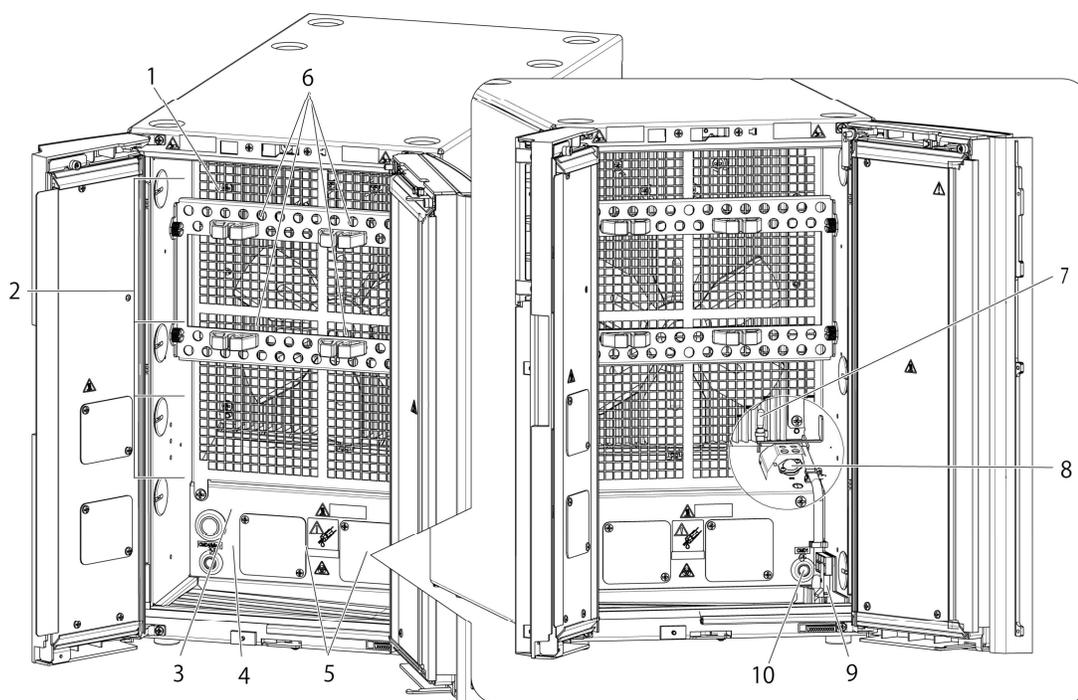
## 2.1 Front



No.	Name	Function
1	Operation panel	Configure or operate the instrument with the operation keys. Touching any other point than the display area on the operation panel displays the operation keys.
2	Manual injector (optional) positions	Manual injectors (optional) can be installed here after removing the covers.
3	 (Power button)	Switches ON/OFF the power. When the power is ON, the switch illuminates in white, and when the power is OFF, the switch illuminates in orange. Even when the power is OFF, the standby current is fed to the instrument. For the main power, see "2.3 Back" P.10. Note that, with a system controller SCL-40 or CBM-40 connected, the switch does not illuminate and the operation to the switch is ignored by default setting.  ▶▶ Reference "Setting the Power Button 《POWER BUTTON》" P.25
4	Left door	The door of the column temperature control part. Open the door when setting a column.
5	Right door	
6	Drain hole	The hole on the right of the instrument drains dew water and mobile phase leaking inside.

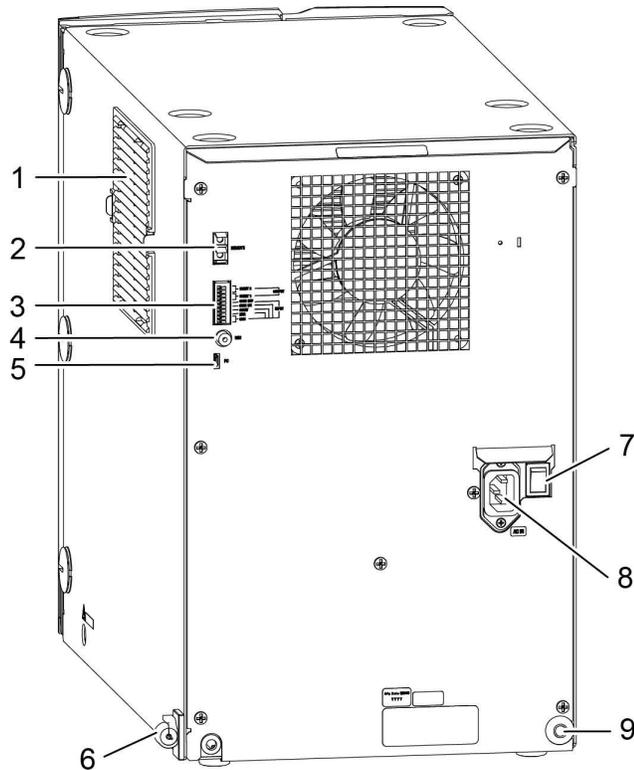
 **NOTE** The right and left doors have a built-in sensor. Opening the door during temperature control causes the control to be stopped and the [DOOR] indicator on the display area to blink. Closing the door causes the temperature control to be resumed.

## 2.2 Interior



No.	Name	Function
1	Column bracket	Used for fixing columns.
2	Tube cap	Removing the caps allows inserting tubes.
3	Optional hole cap	Used for installation of an optional active preheater and multi-column rack.
4	[CMD4/Mixer] connector	The connector is for a mixer detection device (optional). ([CMD4] is a future expanded function.)
5	Automatic column switch valve (optional) installation part	Allows installation of the optional automatic column switch valves.
6	Column clamp	Used for fixing tubes.
7	Thermosensor	The sensor is for temperature measurement.
8	Gas sensor	The sensor detects organic solvent vapors.
9	Liquid leak sensor	The sensor detects leakage of aqueous solvent.
10	[CMD1] connector	The connector is for a column management device (CMD) (optional).

## 2.3 Back



No.	Name	Function
1	Air filter	Prevents dust from entering the instrument.
2	[REMOTE] connector	Connect to the system controller.
3	External input/output terminals	Connect to external equipment.
4	[REC] connector	The connector outputs the signal of column oven temperature (100 °C/mV).
5	[PC] connector	Connector for service personnel. Normally, this is not used.
6	Room temperature sensor	Monitors the room temperature.
7	Main power switch	It turns on/off the power to the instrument.*1
8	Power cord connector	Connect the power cord.
9	External-device hole cap	Used for attaching an external device.

\*1 Normally use  (power button) of the operation panel or system controller to turn ON/OFF the power. If the system controller is connected and the main power switch is on, the user can use  (power button) of the system controller to turn ON/OFF the power from the front of the instrument. If the instrument is not used for a long time, turn off the main power switch. Before turning off the main power switch, be sure to turn OFF the power using the power button.

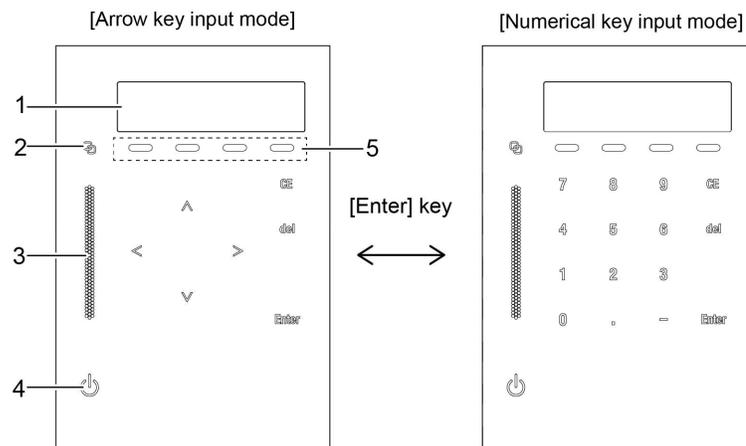
## 2.4 Name and Functions of the Operation Panel

This instrument is controlled through the keypad of the operation area. The display area allows verification of the instrument status.

The operation area has two input modes: [Arrow key input mode] to enable screen transfer, and [Numerical key input mode] to enable value input.

In a screen where the numeric keys are available, pressing [Enter] switches the operation area between the modes.

**NOTE** When turning off the main power switch on the back of the instrument after changing the parameters via panel operation, be sure to turn OFF the power with the power button at the front of the instrument, and turn off the main power switch. Otherwise, some of the changed parameters may return to their original values.



No.	Name	Description
1	Display area	Displays various screens and settings. ▶▶ Reference "2.4.1 Display Area" P.13
2	Link LED	Illuminates when controlled by the system controller.
3	Status LED	<ul style="list-style-type: none"> <li>• Blue: analysis in progress</li> <li>• Green: analysis ready (Temperature control stabilized)</li> <li>• Yellow: preparation for analysis in progress (Temperature control yet to be stabilized)</li> <li>• Red: error</li> <li>• Orange: sleep mode</li> </ul>

No.	Name	Description
4	 (Power button) *1	<p>Switches ON/OFF the power.</p> <ul style="list-style-type: none"> <li>• To turn the power ON: Press and hold the power button for at least 3 seconds.</li> <li>• To turn the power OFF: Holding down the power button 3 seconds or more displays the confirmation screen. Holding it down again 1 second turns off the power. The button cannot be used by default setting if the instrument is connected with the system controller SCL-40/CBM-40.</li> </ul> <p> <b>Hint</b> If the system controller SCL-40 is connected, pressing the power button of SCL-40 turns off the power of the entire system. When a CBM-40 or CBM-40lite is used, pressing the power button of the solvent delivery unit having a CBM in it turns off the power to the whole system. <a href="#">"Setting the Power Button 《POWER BUTTON》" P.25</a></p>
5	Direct key	<p>Temperature control start/stop, and time program start/stop can be performed directly.</p> <p>▶▶ <a href="#">Reference "2.4.2 Operation Area" P.14</a></p>

\*1 There is the power button in the lower left in the front of this instrument, not on the operation panel.

## 2.4.1 Display Area

In this section the display on the initial screen is described.

```

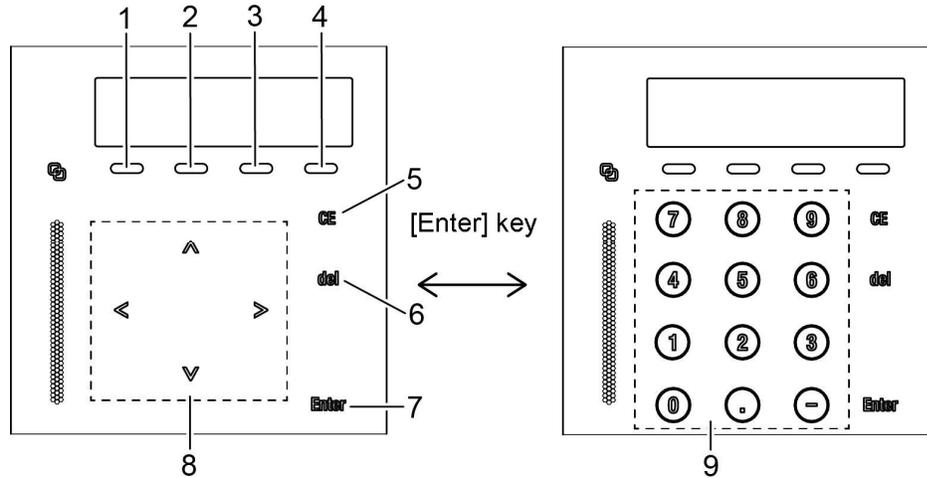
SET   ACTUAL  T.MAX
40    40.0    90
OVEN  READY  RUN  DOOR

```

Display	Function
SET	Displays the setting temperature.
ACTUAL	Displays the current operation temperature in the oven.
T.MAX	Displays the upper limit value of the temperature.
OVEN	<p>When the oven temperature is in adjustment, the word [OVEN] is highlighted.</p> <p>The direct key under the display enables to start or stop the temperature control, thus pressing it while the temperature control is stopped starts the adjustment, and pressing it while the adjustment is activated stops the adjustment.</p>
READY / WAIT	<p>Once the temperature control is completed and stabilized, the word [READY] is highlighted.</p> <p>While the temperature control is in preparation, [WAIT] blinks.</p> <p>While the temperature control is stopped, nothing is displayed.</p> <p> <b>Hint</b> Users can change the condition to display [READY].  <a href="#">"Setting the temperature ready check 《READY CHECK》" P.27</a></p>
RUN	<p>Highlighted during execution of a time program.</p> <p>The direct key under the indicator starts or stops a time program.</p>
DOOR	<p>Blinks when the front door of the oven unit is opened. When the door is open, the temperature control is paused.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> <b>NOTE</b> When the oven temperature is 60 °C or higher, a warning message is displayed. Closing the door clears the warning message and resumes the temperature control.</p> </div>

## 2.4.2 Operation Area

Use the keys on the front to operate or configure the instrument. When you touch the key, the status LED lights up and accepts input.

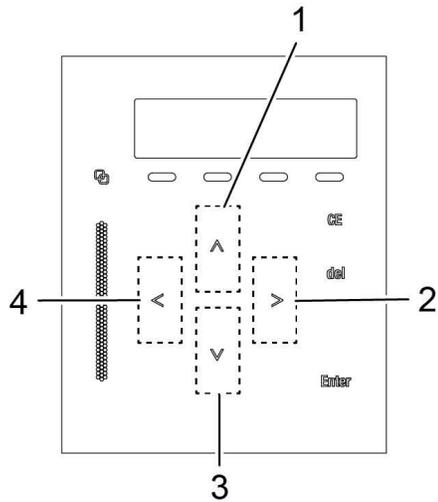


No.	Key	Name	Function
1	[OVEN]	Oven key	Starts or stops the temperature control.
2	—	—	Not used.
3	[RUN]	Run key	Starts or stops a time program. <b>Hint</b> When a system controller is connected or no time program is set, operation to [RUN] is ignored.
4	—	—	Not used.
5	[CE]	Clear key	This key is used for the following. <ul style="list-style-type: none"> <li>To initialize the screen.</li> <li>To clear the values input up to that time while entering the values.</li> <li>To clear error message and cancel alarms.</li> </ul>
6	[del]	Delete key	This key is used for the following. <ul style="list-style-type: none"> <li>To delete input values.</li> <li>To delete a line of the displayed time program while creating it.</li> </ul>
7	[Enter]	Enter key	Confirms input values of the setting items.
8	[↑][→] [↓][←]	Arrow keys	Switches the display screen.
9	[.] to [9]	Numeric keys	Inputs values for the setting items.

**Regarding the acceptable part of the arrow keys on the touch panel.**

When operating the arrow keys, it responds by touching the part including the upper and lower range of each key indication on the operation panel.

No.	Description
1	Acceptable part of [↑] key input.
2	Acceptable part of [→] key input.
3	Acceptable part of [↓] key input.
4	Acceptable part of [←] key input.



# 3 Operation

## 3.1 Settings for the Basic Operation

Operating the instrument requires setting the column temperature and the upper temperature limit to protect the columns. See the product specifications before use.

▶▶ Reference "5.1 Specifications" P.64

### 3.1.1 Prior to Key Operation

Touching the operation area of the operation panel displays the operation keys that allow the user to perform key operation.

### 3.1.2 Temperature Control Operation

The following is an example operation procedure. The operation temperature of 55 °C and an upper temperature limit of 70 °C are used in this example.

1

Display the initial screen (the screen that is displayed when the power is turned ON).

```
SET    ACTUAL  T . MAX
 40    28 . 1  105
OVEN                      RUN
```



**Hint** If the initial screen is not displayed, press [CE] to display the initial screen.

2

Press [→] three times.

The [PARAMETER] setting group of the [FUNCTION] setting group is selected and then the [SET TEMP] screen is displayed.

```
>FUNCTION
  VP
```

```
>PARAMETER
  SYSTEM
```

```
SET TEMP                      40
Input 4 - 100
```

3

Press [Enter].

The cursor starts blinking and activates the numeric keypad. Now the values can be entered.

```
SET TEMP                      ■40
Input 4 - 100
```

4

Set the operating temperature to 55 °C by using the numeric keypad, and press [Enter].

The operating temperature is fixed to 55 °C.

 **Hint** To cancel the input value, press [CE].

```
SET TEMP      55
Input 4 - 100
```

5

Press [↓] once and on the [T.MAX] screen, press [Enter].

The cursor starts blinking and activates the numeric keypad. Now the values can be entered.

```
T . MAX      05
Input 5 - 105
```

6

Set the temperature to 70 °C by using the numeric keypad, and press [Enter].

The upper temperature limit is fixed to 70 °C.

 **Hint** In case the actual temperature exceeds the upper temperature limit (T. MAX) during temperature control, [ERR OVER T.MAX] appears in the screen and the temperature control stops. Pressing [CE] clears the error.

```
T . MAX      70
Input 5 - 105
```

```
ERROR [0x940B]
OVER T . MAX
```

7

Press [CE] to return to the initial screen.

Once the setting is complete, the operating temperature is displayed in the initial screen.

 **Hint** Pressing the [←] key 3 times also returns to the initial screen.

```
SET   ACTUAL   T . MAX
 55   28.1     70
OVEN          RUN
```

8

Press [OVEN].

Pressing the direct key under the [OVEN] indicator displays the confirmation screen.

```
ENTER : OVEN ON
CE    : CANCEL
```

 **NOTE** Pressing the [CE] key in the confirmation screen or not operating the screen for a few seconds causes the panel to display the previous screen without the temperature control started.

 **Hint** Users can change the setting so that temperature control is started by only pressing [OVEN] without the confirmation screen displayed.

▶▶ Reference "Setting the direct key mode 《DIRECT KEY MODE》" P.31

3

9

**Press [Enter].**

[OVEN] highlights the word "OVEN" by inverting the colors, and the oven temperature (ACTUAL) approaches to the set temperature.

When the oven temperature becomes stable, the display changes from [WAIT] to [READY].

SET	ACTUAL	T . MAX
55	30 . 2	70
OVEN	WAIT	RUN

SET	ACTUAL	T . MAX
55	55 . 0	70
OVEN	READY	RUN

 **Hint** To stop the temperature control, press [OVEN]. The confirmation screen is displayed. Pressing [Enter] returns the display to the original state and the temperature control stops.

 **NOTE** Beware of burns when the operating temperature is high (approx. 60 °C or higher).

## 3.2 Types of Screens

Turning ON the power displays the initial screen.

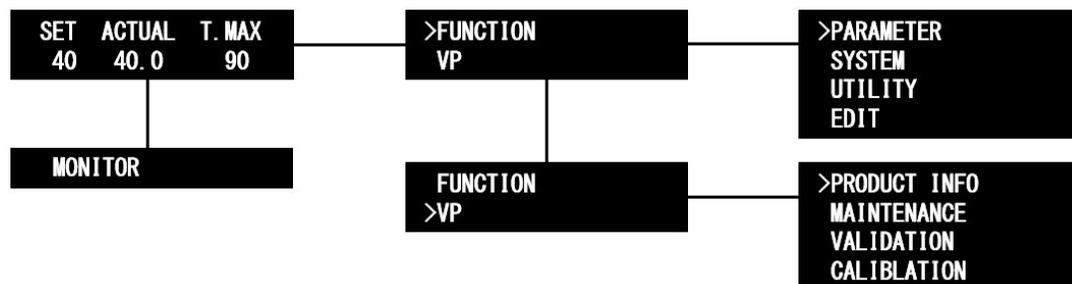
By pressing the [↓] and [→] keys on the initial screen, the screen can be switched from the initial screen to one of three screens below:

```

SET    ACTUAL  T. MAX
40     28.1    105
OVEN                      RUN
  
```

Display Screen	Description
Monitor screen	Displays the status of the instrument. ▶▶ Reference "3.3 Monitoring Screens" P.20
Auxiliary functions screen	Configure various parameter settings and perform operations. ▶▶ Reference "3.4.1 Auxiliary Functions (FUNCTION) List" P.21
VP function screen	Support the validation of the instrument with functions for displaying and checking instrument information. ▶▶ Reference "3.5 VP Functions Screen" P.32

Pressing [→] on the initial screen displays the screen to select the auxiliary functions screen [FUNCTION] or VP functions screen [VP]. Move the cursor to the desired option with [↓] or [↑] and press [→] to display the screen. Press [CE] to return to the initial screen.



## 3.3 Monitoring Screens

This section describes the monitoring screens.

Press [↓] on the initial screen to show the various types of information.

Name	Description	Reference
ROOM	Displays the room temperature.	P.20
VALVE	Displays the flow line of automatic column switch valve.	P.20
TIME	Displays the time that elapsed after a time program was started.	P.20
LEAK SENSOR LEVEL	Displays the detected values of the liquid leak sensor and the gas sensor.	P.20

### ■ Displaying the room temperature 《ROOM》

Displays the room temperature (°C).

```
SET  ACTUAL  ROOM
40   28.1    25.1
```

### ■ Displaying the flow line of automatic column switch valve 《VALVE》

The panel displays the flow lines of automatic column switch valves when they are installed.

```
SET  ACTUAL  VALVE
40   28.1    1 -
```



**Hint** The left value below [VALVE] indicates the flow line of the switching valve installed on the left of the instrument (VALVE1). The right value under [VALVE] indicates the flow line of the valve installed on the right (VALVE2). Without a valve installed, "-" is displayed. The example shows that the flow line of the [VALVE1] (left) is "1" and that [VALVE2] (right) is not installed.

### ■ Displaying the program elapsed time 《TIME》

While a time program is running, the panel displays the time that elapsed after the program was started.

```
SET  ACTUAL  TIME
40   28.1    0.00
```

### ■ Displaying the detected concentration values of the liquid leak sensor and the gas sensor 《LEAK SENSOR LEVEL》

Displays the detected concentration values of the liquid leak sensor and the gas sensor.

```
LEAK SENSOR LEVEL
Liq:100 Gas:6500
```

Display	Description
Liq	Displays the detected value of the liquid leak sensor.
Gas	Displays the detected value of the gas sensor.

## 3.4 Auxiliary Functions Screen (FUNCTION)

The auxiliary function has four setting groups. Switch the groups with [↑] or [↓] and press [→] to enter the screen of the desired setting group. Press [CE] to return to the initial screen.

Setting Group Name	Description
PARAMETER	The group allows the user to set analysis parameters.
SYSTEM	The group allows the user to set parameters related to the entire system operation and parameters of connection with external equipment.
UTILITY	The group allows the user to set parameters not related to the analysis result such as parameters of display and buzzer.
EDIT	Time programs can be edited.

3

### 3.4.1 Auxiliary Functions (FUNCTION) List

#### ■ [PARAMETER] setting group

Name	Description	Remark	Ref.
SET TEMP	Sets the operating temperature.	Initial value: 40 Set value: 4 to 100 °C	P.24
T.MAX	Sets the upper temperature.	Initial value: 105 Set value: 5 to 105 °C	P.24
EVENT1	Sets the relay contact output 1.	Initial value: 0 Set value: 0: Off 1: On	P.24
EVENT2	Sets the relay contact output 2.	Initial value: 0 Set value: 0: Off 1: On	P.24
VALVE1 (LEFT)	Sets the flow line of the automatic column switch valve 1 (at the left part).	Initial value: 1 Set value: 2-position valve: 0 to 1 6-position valve: 1 to 6	P.24
VALVE2 (RIGHT)	Sets the flow line of the automatic column switch valve 2 (at the right part).	Initial value: 1 Set value: 2-position valve: 0 to 1 6-position valve: 1 to 6	P.24

## ■ [SYSTEM] setting group

Name	Description	Remark	Ref.
LOCAL MODE	Selects independent operation or control via system controller.	Initial value: 0 Set value: 0: Remote 1: Local	P.25
LINK ADDRESS	Sets address of the instrument for control via system controller.	Initial value: 6 Set value: 1 to 12	P.25
POWER BUTTON	Sets whether to enable individual operation from the power button on the front of the instrument even when connected to the system controller SCL-40/CBM-40.	Initial value: 0 Set value: 0: CBM 1: Module	P.25
SELECT EVENT1	Use the [EVENT1] output as a start signal of a time program.	Initial value: 0 Set value: 0: Event 1: Start	P.26
SELECT EVENT2	Use the [EVENT2] output as a stop signal of external equipment in case of an error.	Initial value: 0 Set value: 0: Event 1: Error	P.26
COOLER MODE	Changes the operation mode of the cooler.	Initial value: 2 Set value: 0: Off 1: On 2: Auto	P.27
READY CHECK	Sets whether to wait for displaying [READY] until the oven temperature stabilizes at the set temperature or not.	Initial value: 1 Set value: 0: Off 1: On	P.27
READY RANGE	Sets the ready range. When the oven temperature is within this range (°C), it is considered to be at the set temperature.	Initial value: 1.0 Set value: 0.1 to 1.0 °C	P.27
WAIT TIME	Sets the time (min) to elapse since the oven temperature reaches the set temperature range until [READY] is displayed.	Initial value: 5 Set value: 0 to 10 minutes	P.28
FAN SPEED	Selects a rotation speed of the fan inside the oven.	Initial value: 0 Set value: 0 to 3	P.28
ACTIVE PREHEATER	Sets the active preheater (optional).	Initial value: 0 Set value: 0: Off 1: On	P.28
MIXER VOL	Displays or sets the volume of the connected gradient mixer (optional).	-	P.29

### ■ [UTILITY] setting group

Name	Description	Remark	Ref.
KEY CLOSE	Disables the key input.	-	P.29
BRIGHTNESS	Sets the brightness of display screen.	Initial value: 4 Set value: 1 to 4	P.30
BEEP MODE	Sets the operation of buzzer.	Initial value: 0 Set value: 0: ON 1: Alarm 2: OFF	P.30
VOLUME	Sets the buzzer volume.	Initial value: 2 Set value: 1 to 3	P.30
DISP OFF TIME	The operation panel turns into the sleep mode after the time set here elapses.	Initial value: 1 Set value: 0 to 10 min	P.30
DIRECT KEY MODE	Specifies whether to display the confirmation screen when the direct key is operated.	Initial value: 0 Set value: 0: Display 1: Do not display	P.31

### ■ [EDIT] group

Use this group to create a time program.

▶▶ Reference "3.6 Creating Time Program" P.43

### 3.4.2 [PARAMETER] Setting Group

This setting group is relevant to analysis parameters.

#### ■ Setting the operating temperature 《SET TEMP》

Input the value (temperature) with the numeric keypad and press [Enter].

```
SET TEMP          40
Input 4 - 100
```

#### ■ Setting the upper temperature 《T.MAX》

Input the value with the numeric keypad and press [Enter].

```
T.MAX            105
Input 5 - 105
```

#### ■ Setting the EVENT1 output terminal 《EVENT1》

#### ■ Setting the EVENT2 output terminal 《EVENT2》

Sets "ON" (close)/"OFF" (open) of the [EVENT1] and [EVENT2] output (relay contact) on the back of the instrument.

Input the value with the numeric keypad and press [Enter].

```
EVENT1          0
0:Off 1:On
```

Set Value	EVENT1 and EVENT2 Output
0	Relay OFF
1	Relay ON

#### ■ Setting the flow line of the automatic column switch valve 1 (at the left part) 《VALVE1 (LEFT)》

#### ■ Setting the flow line of the automatic column switch valve 2 (at the right part) 《VALVE2 (RIGHT)》

Input the value with the numeric keypad and press [Enter].

```
VALVE1 (LEFT)   1
2-Pos: Input 0 - 1
```



**Hint** The instrument automatically recognizes whether the valves are installed and what type of valve they are. When no automatic column switch valve is installed, the panel displays [Not Installed].

```
VALVE2 (RIGHT)
Not Installed
```

### 3.4.3 [SYSTEM] Setting Group

The group allows configuring external device connection and analysis system operation as a whole.

#### ■ Selecting the local mode 《LOCAL MODE》

When the system controller is connected, the user can select whether to operate the instrument independently or with the system controller.

```
LOCAL MODE 0
0: Remote 1: Local
```

Input the value with the numeric keypad and press [Enter].

Set Value	Mode	Function
0	Remote	The instrument is operated with the system controller. (Initial value)
1	Local	The instrument is operated independently (local mode).

#### ■ Setting the link address 《LINK ADDRESS》

Sets the address (channel No.) used to connect with the system controller.

```
LINK ADDRESS 6
Input 1 - 12
```

Input the value with the numeric keypad and press [Enter].

#### ■ Setting the Power Button 《POWER BUTTON》

Sets the power button on the front of the instrument.

```
POWER BUTTON 0
0: CBM 1: Module
```

Input the value with the numeric keypad and press [Enter].

Set Value	Function
0	Operation of the power button from the instrument is disabled according to the control of the system controller only. (Initial value)
1	In addition to being controlled by the system controller, it is also possible to turn off the power individually from the instrument.



#### Hint

When the instrument is connected to the system controller SCL-40/CBM-40, the power control of the instrument follows the system controller, and the shutdown and startup functions operate from the system controller throughout the system.

**NOTE** If you turn off the power to the instrument individually with the setting [1], the connection to the system controller will also be lost. Therefore, the system startup function does not turn on the instrument. you need to turn the power on again by pressing and holding the power button on the instrument. The system shutdown function is still enabled with setting [1]. However, if the power is turned off by the shutdown function, turning on the power by pressing the power button of the instrument is disabled, and the system must be started up from the system controller.

**NOTE** If the [OPERATION MODE] is set to [1] and connected as CTO-20AC, the power control function by the system controller is not available. Therefore, you can always operate the power button of the instrument regardless of the setting of this function.

▶▶ Reference "Setting the operation mode 《OPERATION MODE》 " P.39

### ■ Setting the function of the EVENT1 output terminal 《SELECT EVENT1》

Sets the control mode of the [EVENT1] output (relay 1).

Input the value with the numeric keypad and press [Enter].

**SELECT EVENT1 0**  
**0: Event 1: Start**

Set Value	Function
0	The EVENT1 output is controlled with the [EVENT1] set value.
1	The EVENT1 output is used as a start signal of a time program.

**NOTE** If the [SELECT EVENT1] function is used, the corresponding [EVENT1] parameter is disabled.

### ■ Setting the function of the EVENT2 output terminal 《SELECT EVENT2》

Sets the control mode of the [EVENT2] output (relay 2).

Input the value with the numeric keypad and press [Enter].

**SELECT EVENT2 0**  
**0: Event 1: Error**

Set Value	Function
0	The EVENT2 output is controlled with the [EVENT2] set value.
1	The EVENT2 output is used as an error output signal.

**NOTE** If the [SELECT EVENT2] function is used, the corresponding [EVENT2] parameter is disabled.

### ■ Setting the operation mode of the cooler 《COOLER MODE》

Select a cooler operation mode from the three modes below. (Initial value is 2: Auto)

**COOLER MODE 2**  
0 : Off 1 : On 2 : Auto

Input the value with the numeric keypad and press [Enter].

Set Value	Cooler	Function
0	OFF	Force OFF
1	ON	Force ON
2	AUTO	Automatic operation

▼ **NOTE** Selecting the automatic operation causes the cooler to be turned on or off automatically when the difference between the temperature setting and the room temperature is between 10 °C and 14 °C. The temperature inside the oven may temporarily show uneven dispersion when the cooler is turned on or off. Select "Force ON" for a high-sensitive analysis that can be affected by this temporary change.

### ■ Setting the temperature ready check 《READY CHECK》

Sets whether to wait for displaying [READY] until the oven temperature stabilizes at the set temperature or not.

**READY CHECK 1**  
0 : Off 1 : On

Input the value with the numeric keypad and press [Enter].

Set Value	Function
0	Always displays [READY] regardless of ON/OFF of temperature control, [READY RANGE], or [WAIT TIME].
1	Waits until temperature control stabilizes according to [READY RANGE] and [WAIT TIME].

### ■ Setting the stable temperature range 《READY RANGE》

Sets the temperature range (°C) to determine that the oven temperature has reached the set temperature.

**READY RANGE 1.0**  
Input 0.1 - 1.0

When the oven temperature is within this range, it is considered to have reached the set temperature.

Input the value with the numeric keypad and press [Enter].

### ■ Setting the wait time to display READY «WAIT TIME»

Sets the time (min) to elapse since the oven temperature reaches the set temperature range until [READY] is displayed.

**WAIT TIME 5**  
**Input 0 - 10min**

Input the value with the numeric keypad and press [Enter].

**NOTE** Setting the time to "0" causes [READY] to be displayed immediately after the temperature reaches the range specified by [READY RANGE].

### ■ Setting the fan rotation speed «FAN SPEED»

Sets the rotation speed of the stirring fan inside the oven.

**FAN SPEED 0**  
**0:Auto 1:L 2:M 3:H**

Input the value with the numeric keypad and press [Enter].

Set Value	Function
0	Auto: Automatic control (Initial value) Automatically determines the rotation speed according to the set temperature and the ambient temperature. Normally, this setting is used.
1	Low: Provides a better cooling performance when the set temperature is lower than the ambient temperature.
2	Medium
3*1	High: Reduces dispersion in temperature inside the oven when the set temperature is high.

\*1 For analysis systems with an electric conductivity detector or differential refractometer which are susceptible to wind inside the oven, it is recommended to use the setting "3: High".

### ■ Setting the active preheater «ACTIVE PREHEATER»

Sets the active preheater (optional).

Input the value with the numeric keypad and press [Enter].

**ACTIVE PREHEATER 1**  
**0:Off 1:On**

Set Value	Function
0	Stops controlling the active preheater.
1	Controls the active preheater (Initial value).

**Hint** Setting the value to "1" causes the temperature of the active preheater to be controlled to the set temperature of the oven. Note that turning OFF the temperature control of the oven stops the temperature control of the active preheater.

**NOTE** When the oven temperature is above 85 °C, the active preheater is not controlled at above 85 °C. Even so, you can use as passive preheater by the heat of the oven at above 85 °C.

**Hint** When the active preheater is not installed, the panel displays [Not Installed].

```
ACTIVE PREHEATER
Not Installed
```

### ■ Displaying and setting the volume of a mixer 《MIXER VOL》

When a mixer information device is connected, the panel displays the volume of the mixer.

```
MIXER VOL :      40 uL
(Identified Mixer)
```

When a variable-volume mixer is connected, the panel displays the screen to select a volume of the mixer.

```
MIXER VOL (mL)      0
0 : 0.5  1 : 1.7  2 : 2.6
```

Input the value with the numeric keypad and press [Enter].

**Hint** A mixer volume is used for calculating the gradient delay time of the analysis system.

**Hint** When no mixer information device is connected, the panel displays [Not Identify].

```
MIXER VOL      ---
(Not Identify)
```

**NOTE** CTO-20AC compatible mode does not support any mixer information devices.

▶▶ Reference "3.7.3 Limitations of Compatible Mode" P.50

## 3.4.4 [UTILITY] Setting Group

This setting group is relevant to the display monitor.

### ■ Disabling the key entry 《KEY CLOSE》

Press [Enter] to disable key input.

```
KEY CLOSE
Enter to Close
```

From this point, keypad input is disabled.

 **Hint** To cancel this function, press [Enter] while pressing [CE].

**KEY CLOSING**  
CE+Enter to Open

■ **Setting the brightness of display screen 《BRIGHTNESS》**

Sets the brightness of the display screen. Input the value with the numeric keypad and press [Enter].

The value range is 1 to 4. A larger setting value increases the brightness.

**BRIGHTNESS** 4  
Input 1 - 4

■ **Setting the operation of buzzer 《BEEP MODE》**

Sets the buzzer sound. Input the value with the numeric keypad and press [Enter].

**BEEP MODE** 0  
0:On 1:Alarm 2:Off

Set Value	Function
0	The key input sound, as well as the alarm sound to go off when an error occurs, are activated. (Initial value)
1	Only the alarm sound that goes off when an error occurs is activated.
2	All the buzzer sounds are deactivated.

■ **Setting the buzzer volume 《VOLUME》**

Sets the buzzer sound level. A larger setting value increases the sound level. Input the value with the numeric keypad and press [Enter].

**VOLUME** 2  
Input 1 - 3

■ **Setting the wait time to sleep mode 《DISP OFF TIME》**

Sets the time to elapse before the operation panel automatically turns into the sleep mode, when no operations are performed on the instrument.

Input the value with the numeric keypad and press [Enter].

The setting range is from 0 to 10 (min), in which the step can be set by minute.

If 0 (min) is input, the operation panel does not turn into the sleep mode.

**DISP OFF TIME** 1  
Input 0 - 10min

 **NOTE** Setting "0" minutes causes the display screen to be always on. If the display screen is always on, some dots frequently lighting will deteriorate in brightness in a shorter time.

### ■ Setting the direct key mode 《DIRECT KEY MODE》

Specifies whether to display the confirmation screen when the direct key is operated.

```
DIRECT KEY MODE 0
0:Confirm 1:Direct
```

Input the value with the numeric keypad and press [Enter].

Set Value	Function
0	Displays the confirmation screen. (Initial value).
1	The relevant operation is immediately executed without the confirmation screen displayed.

 **Hint** Displaying the confirmation screen helps prevent improper operations.

## 3.5 VP Functions Screen

The VP functions screen has four setting groups. Switch the groups with [↑] or [↓] and press [Enter] to enter the screen of the desired setting group. Press [CE] to return to the initial screen.

Setting Group Name	Description
PRODUCT INFO	The group is relevant to information of the instrument.
MAINTENANCE	The group is relevant to maintenance of the instrument.
VALIDATION	The group allows the user to check whether the instrument is operating correctly.
CALIBRATION	The group is for calibration of the instrument.

### 3.5.1 List of VP Functions

#### ■ Product information group [PRODUCT INFO]

Name	Function	Ref.
SERIAL NUMBER	Displays the serial number of the instrument.	P.33
Version	Displays the version number.	P.34

#### ■ Maintenance information group [MAINTENANCE]

Name	Function	Ref.
TOTAL OP TIME	Displays the total operation time of the instrument.	P.34
VALVE1 ROTOR USED VALVE2 ROTOR USED	Displays and resets the number of uses and estimated replacement time of the rotor seals of the automatic column switch valves installed.	P.34
VALVE1 STATOR USED VALVE2 STATOR USED	Displays and resets the number of uses and estimated replacement time of the stator seals of the automatic column switch valves installed.	P.35
PART REPLACEMENT	Enter the new part after replacing an old part.	P.35
MAINTENANCE LOG	Displays the maintenance log.	P.35
OPERATION LOG	Displays the log of password change, parameter reset, etc.	P.36
ERROR LOG	Displays the error log.	P.36

### ■ Validation support information group [VALIDATION]

Name	Function	Ref.
DATE	Displays and sets the date.	P.36
TIME	Displays and sets the time.	P.37
MEMORY CHECK	Runs the memory (ROM/RAM) check.	P.37
LEAK SENSOR CHECK	Runs the leak sensor check.	P.37
GAS SENSOR CHECK	Runs the gas sensor check.	P.38
TEMPERATURE CHECK	Checks the precision and accuracy of temperature control.	P.38

### ■ Calibration support information group [CALIBRATION]

Name	Function	Ref.
Input PASSWORD*1	Input a password.	P.39
OPERATION MODE	Selects an operation mode.	P.39
DATE FORMAT	Changes the displayed order of year, month and day.	P.39
INITIALIZE PARAM	Initializes parameters.	P.40
PARAMETER LOCK	Prohibits change of parameters.	P.40
PARTS MGMT TOOL	Sets the usage of the parts management tool.	P.40
PASSWORD SETTING	Changes the password.	P.40
LEAK THOLD	Sets the operation level of the leak sensor.	P.41
GAS SENS CALIB	Runs the gas sensor calibration.	P.41
TEMP1 CALIB	Runs the 1st-point temperature calibration.	P.41
TEMP2 CALIB	Runs the 2nd-point temperature calibration.	P.41
VALVE1 ROTOR VALVE2 ROTOR	Sets the estimated replacement time of the rotor seals of the automatic column switch valves installed.	P.42
VALVE1 STATOR VALVE2 STATOR	Sets the estimated replacement time of the stator seals of the automatic column switch valves installed.	P.42

\*1 In the calibration support group, an invalid password prevents the user from going further than [OPERATION MODE] even if the user presses [Enter].

## 3.5.2 Product Information Group (PRODUCT INFO)

The group is relevant to information of the instrument.

### ■ Displaying the serial number 《SERIAL NUMBER》

Displays the serial number of the instrument.

**SERIAL NUMBER**  
**L000000000**

### ■ Displaying the version number 《Version》

Displays the instrument name (model name) and version.

CTO-40C  
Version : V1.00

## 3.5.3 Maintenance Information Group (MAINTENANCE)

The group is relevant to maintenance information of the instrument.

### ■ Displaying the total operation time 《TOTAL OP TIME》

Displays the total cumulative operating time of the instrument.

TOTAL OP TIME  
12h

### ■ Displaying the number of uses of the rotor seals of the automatic column switch valves 《VALVE1 ROTOR USED》 《VALVE2 ROTOR USED》

Displays the number of uses and estimated replacement time of the rotor seals of the automatic column switch valves installed.

VALVE1 ROTOR USED  
10 / 50000

After replacing the rotor of a valve, press [del]. This resets the number of uses to "0" and then the reset date is recorded in a maintenance log.

 **Hint** [VALVE1] indicates the valve installed on the left part of the instrument and [VALVE2] the one installed on the right part.  
When an automatic column switch valve is not installed, the panel does not display the corresponding data.

 **Hint** For a valve for LC-30A series or earlier (FCV-xxAH), the number is increased every time the flow line is switched.  
For a valve for LC-40 series, the number is increased every time the position is rotated by an angle equivalent to 120° (0 -> 1 -> 0 in case of 2-position valves and 1 -> 3 or 1 -> 2 -> 1 in case of 6-position valves).

 **NOTE** For a valve for LC-40 series, if the Parts Management Tool is used, users cannot reset the number of uses with the operation panel. Reset it through the tool. If you wish to manage the data directly with the instrument without using Parts Utility, some settings need changing.

▶▶ **Reference** "Setting the usage of parts management tool 《PARTS MGMT TOOL》" P.40

## ■ Displaying the number of uses of the stator seals of the automatic column switch valves 《VALVE1 STATOR USED》 《VALVE2 STATOR USED》

Displays the number of uses and estimated replacement time of the stator seals of the automatic column switch valves installed.

```
VALVE1 STATOR USED
10 / 50000
```

After replacing the stator of a valve, press [del]. This resets the number of uses to "0" and then the reset date is recorded in a maintenance log.

 **Hint** [VALVE1] indicates the valve installed on the left part of the instrument and [VALVE2] the one installed on the right part.  
When an automatic column switch valve is not installed, the panel does not display the corresponding data.

 **Hint** For a valve for LC-30A series or earlier (FCV-xxAH), the number of uses of the stator seals can not be managed by users and not displayed on the display panel.

 **NOTE** If the Parts Management Tool is used, users cannot reset the number of uses with the operation panel. Reset it through the tool. If you wish to manage the data directly with the instrument without using Parts Utility, some settings need changing.

▶▶ Reference "Setting the usage of parts management tool 《PARTS MGMT TOOL》" P.40

## ■ Inputting a replacement part number 《PART REPLACEMENT》

Input a part number when replacing a general part.

```
PART REPLACEMENT
P/N: - -
```

Pressing [Enter] and inputting a part number with the numeric keypad saves the data in a maintenance log.

```
PART REPLACEMENT
SAVED
```

 **NOTE** If the Parts Management Tool is used, users cannot input a part number with the operation panel. Use Parts Utility. If you wish to manage the data directly with the instrument without using Parts Utility, some settings need changing.

▶▶ Reference "Setting the usage of parts management tool 《PARTS MGMT TOOL》" P.40

## ■ Displaying the maintenance log 《MAINTENANCE LOG》

Displays twenty records of previously replaced parts with the dates of their replacement.

```
>MAINTENANCE LOG
# 1 18-05-12
RV1 ROTOR REPLACED
```

After pressing [→], press [↓] several times to display the replaced parts in order.

The example indicates that the rotor seal of the automatic column switch valve 1 was replaced on May 12, 2018.

### ■ Displaying the operation log 《OPERATION LOG》

Displays ten records of previous modifications such as password change and parameter reset with the dates of the modifications.

After pressing [→], press [↓] several times to display the operation log records in order.

The example indicates that the password was changed on May 12, 2018.

```
>OPERATION LOG
#1 18-05-12
CHANGE PASSWORD
```

### ■ Displaying the error log 《ERROR LOG》

Displays ten records of previous errors with the dates of the errors.

After pressing [→], press [↓] several times to display the error log records in order.

The example indicates that the upper temperature limit error of error code [0x940B] occurred on May 12, 2018.

```
>ERROR LOG
#1 [940B] 18-05-12
OVER T.MAX
```

## 3.5.4 Validation Support Information Group (VALIDATION)

The group allows the user to check whether the equipment is operating correctly.

### ■ Entering date 《DATE》

This allows the user to view or input the date in this screen.

Press [Enter] and input a date in the order of year, month, and day with the numeric keypad.

```
DATE
YY-MM-DD 18-05-12
```

 **Hint** You can change the display order of year, month, and day.

▶▶ **Reference** ["Changing the displayed order of year, month and day 《DATE FORMAT》" P.39](#)

 **Hint** When the instrument is controlled by a system controller, the date is automatically transmitted during link-up.  
The date display returns to the initial value [00-00-00] when the power is turned OFF.  
When the power is OFF by using  (power button), the setting is not returned.

### ■ Entering time 《TIME》

This allows the user to view or input the time in this screen.

Press [Enter] and input a time in the order of hour, minute, and second in two digits with the numeric keypad.

**TIME**  
**HH : MM : SS 00-00-00**

- Hint** When the instrument is controlled by a system controller, the time is automatically transmitted during link-up.  
The time display returns to the initial value [00:00:00] when the power is turned OFF.  
When the power is OFF by using  (power button), the setting is not returned.

### ■ Checking the memory 《MEMORY CHECK》

Runs the memory check on ROM and RAM.  
Pressing [Enter] starts the memory check.

After the check, the result is displayed.

**MEMORY CHECK**  
**Enter to Start**

**MEMORY CHECK**  
**ROM OK / RAM OK**

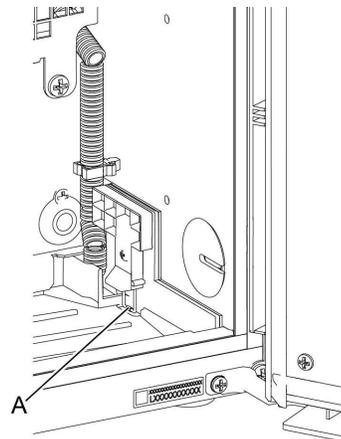
### ■ Checking the leak sensor 《LEAK SENSOR CHECK》

Runs the liquid leak sensor check.

By using a syringe, soak the sensor unit at the bottom of the leak sensor (A) in water, and press [Enter].

- Hint** Use the syringe (part No. 228-66048) attached to the liquid delivery unit, etc.

**LEAK SENSOR CHECK**  
**Soak and Enter**



Wait for approximately 30 seconds at maximum. The diagnosis result is displayed.

- ▶▶ **Reference** In case of [NO GOOD], see "4.4 Leak Sensor Calibration" P.60.

**LEAK SENSOR CHECK**  
**Checking . . .**  
**LEAK SENSOR CHECK**  
**SENSOR GOOD**

NOTE After dampening the leak sensor for a check purpose, completely wipe off moisture. When wiping off moisture, do not press the leak sensor. When a sensor unit touches a wall, the sensor sensitivity is lowered.

▶▶ Reference "4.5 Cleaning the Leak Tray" P.61

### ■ Checking the gas sensor 《GAS SENSOR CHECK》

Runs the gas sensor check.

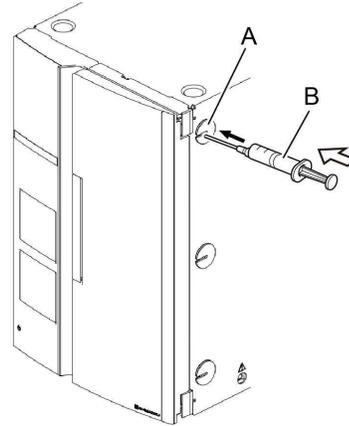
**GAS SENSOR CHECK**  
**Inject and Enter**

Before the check, make the temperature become stable by 40 °C.

NOTE Heat up in the chamber so that ethanol may tend to volatilize.

With the microsyringe (B), inject approximately 100 µL of ethanol through the tubing hole (A) on the upper part of the right side.

NOTE Use a micro syringe which has a capacity of 100 µL (Part No. 670-12554-04 ,etc.).



Wait for approximately 30 seconds at maximum. The diagnosis result is displayed.

▶▶ Reference In case of [NO GOOD], see "4.3 Gas Sensor Calibration" P.58.

**GAS SENSOR CHECK**  
**Checking . . .**  
**GAS SENSOR CHECK**  
**SENSOR GOOD**

### ■ Checking the temperature control accuracy 《TEMPERATURE CHECK》

▶▶ Reference System Guide "4 Hardware Validation"

**TEMPERATURE CHECK**  
**Enter to Start**

### 3.5.5 Calibration Support Information Group (CALIBRATION)

The group is for calibration of the instrument.

**NOTE** The instrument is tuned before shipment. Do not modify values unnecessarily.

#### ■ Inputting the password 《Input PASSWORD》

The password must be input by the system administrator.

Input the five-digit numbers by using the numeric keypad, and press [Enter].

**Input PASSWORD**

**Hint** Be sure to input the five numbers. The default password is [00000].  
When the password matches, the [OPERATION MODE] screen below appears on the screen.  
If the password does not match, the user cannot go further.

#### ■ Setting the operation mode 《OPERATION MODE》

Sets the value according to the connected system controller.

Input the value with the numeric keypad and press [Enter].

**OPERATION MODE 0**  
**0 : 40C 1 : 20AC**

Set Value	System Controller
0	SCL-40/CBM-40 Identified and operated as CTO-40C.
1*1	CBM-20A/CBM-20Alite Identified and operated as CTO-20AC.

\*1 Select it when the system controller or workstation does not support CTO-40C.

#### ■ Changing the displayed order of year, month and day 《DATE FORMAT》

Changes the displayed order of year, month and day.

Input the value with the numeric keypad and press [Enter].

**DATE FORMAT 0**  
**0 : YMD 1 : DMY 2 : MDY**

Set Value	Format
0	Year, month, and day (YMD)
1	Day, month, and year (DMY)
2	Month, day, and year (MDY)

### ■ Initializing the parameters 《INITIALIZE PARAM》

Pressing [Enter] initializes the setting parameters.

After the parameter initialization is completed, the instrument is automatically restarted.

```
INITIALIZE PARAM
Enter to Init
```

### ■ Setting the parameter lock 《PARAMETER LOCK》

To allow the parameter change only to the system administrator, the screen access to the auxiliary function setting screen and the VP functions screen are locked.

When this function is set to [1:On], the password screen is displayed before access to the setting screens. When this setting is changed or inputting the password releases the lock to access the setting screen, such operation is recorded in the operation log.

▶▶ Reference "Displaying the operation log 《OPERATION LOG》" P.36

```
PARAMETER LOCK 0
0:Off 1:On
```

### ■ Setting the usage of parts management tool 《PARTS MGMT TOOL》

Sets the usage of the parts management tool.

The default setting is [1:Use]. When this function is set to [0:NotUse], the management of parts like LC-20/30 series is possible. However the traceability of parts cannot be unitarily managed.

▶▶ Reference System Guide "Parts Management Tool"

When the setting is changed, the change is recorded in the operation log.

▶▶ Reference "Displaying the operation log 《OPERATION LOG》" P.36

```
PARTS MGMT TOOL 1
0:NotUse 1:Use
```

### ■ Changing the password 《PASSWORD SETTING》

Enables change to the password.

```
PASSWORD SETTING
Enter to Change
```

1

Press [Enter].

The input screen is displayed.

```
Input New PASSWORD
```

2

Input the five-digit numbers by using the numeric keypad, and press [Enter].

**3**

To confirm, input the same password that was input in the step 2 again.

When the input is completed and the password is changed, "PASSWORD CHANGED" is displayed.

 **Hint** If the password input is not correct, "PASSWORD WRONG" is displayed. At this stage, the password has not been changed yet.

Input Again

PASSWORD SETTING  
PASSWORD CHANGED

Input Again  
PASSWORD WRONG

**4**

Press [Enter].

The initial screen is displayed.

#### ■ Setting the operation level of leak sensor 《LEAK THOLD》

Sets the threshold value of the leak sensor. Input the value with the numeric keypad and press [Enter].

Adjust it when a leak sensor check results in a fail.

▶▶ Reference "4.4 Leak Sensor Calibration" P.60

LEAK THOLD 150  
Actual Level 100

#### ■ Calibrating the gas sensor 《GAS SENS CALIB》

Runs the gas sensor calibration.

Adjust it when a gas sensor check results in a fail.

▶▶ Reference "4.3 Gas Sensor Calibration" P.58

GAS SENS CALIB  
Enter to Start

#### ■ Calibrating the first-point temperature 《TEMP1 CALIB》

Runs the 1st-point temperature calibration.

▶▶ Reference "4.2 Temperature Accuracy Calibration" P.55

TEMP1 CALIB : 40.0  
Enter to Calibrate

#### ■ Calibrating the second-point temperature 《TEMP2 CALIB》

Runs the 2nd-point temperature calibration.

▶▶ Reference "4.2 Temperature Accuracy Calibration" P.55

TEMP2 CALIB : 40.0  
Enter to Calibrate

**3**

### ■ Setting the estimated replacement time of the rotor seals of the automatic column switch valves 《VALVE1 ROTOR》 《VALVE2 ROTOR》

Sets the estimated replacement time of the rotor seals of the automatic column switch valves installed.

```
VALVE1 ROTOR
Alert Lvl 100000
```

Input the value with the numeric keypad and press [Enter].

-  **Hint** [VALVE1] indicates the valve installed on the left part of the instrument and [VALVE2] the one installed on the right part.  
When an automatic column switch valve is not installed, the panel does not display the corresponding data.

### ■ Setting the estimated replacement time of the stator seals of the automatic column switch valves 《VALVE1 STATOR》 《VALVE2 STATOR》

Sets the estimated replacement time of the stator seals of the automatic column switch valves installed.

```
VALVE1 STATOR
Alert Lvl 100000
```

Input the value with the numeric keypad and press [Enter].

-  **Hint** [VALVE1] indicates the valve installed on the left part of the instrument and [VALVE2] the one installed on the right part.  
When an automatic column switch valve is not installed, the panel does not display the corresponding data.  
For a valve for LC-30A series or earlier (FCV-xxAH), the number of uses of the stator seals can not be managed and not displayed.

## 3.6 Creating Time Program

The instrument allows users to run a time program with such parameters as temperature settings, start/stop of temperature control, and flow line settings of automatic column switch valves.

Users can create a time program of a maximum of 100 steps, which remains stored even after the power is turned off.

### 3.6.1 Time Program Command List

The commands for the time program are listed below.

Command	Description	Setting Range	Remark	Ref.															
TEMP	Sets the temperature (It changes in steps.)	4 to 100 °C	Causes the temperature to immediately change to a specified temperature when the specified time comes.	P.45															
TEMP.L	Sets the temperature (It changes linearly.)	4 to 100 °C	Causes the temperature to gradually change to a specified temperature until the specified time.	P.45															
ON	Turns on the temperature control.	—	—	—															
OFF	Turns off the temperature control.	—	—	—															
EVENT	Turns on/off the event output.	0, 1, 2, 12	<table border="1"> <thead> <tr> <th>Set Value</th> <th>EVENT 1</th> <th>EVENT 2</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>OFF</td> <td>OFF</td> </tr> <tr> <td>1</td> <td>ON</td> <td>OFF</td> </tr> <tr> <td>2</td> <td>OFF</td> <td>ON</td> </tr> <tr> <td>12</td> <td>ON</td> <td>ON</td> </tr> </tbody> </table>	Set Value	EVENT 1	EVENT 2	0	OFF	OFF	1	ON	OFF	2	OFF	ON	12	ON	ON	—
			Set Value	EVENT 1	EVENT 2														
			0	OFF	OFF														
			1	ON	OFF														
2	OFF	ON																	
12	ON	ON																	
VALVE1	Sets the flow line of the automatic column switch valve 1.	0 to 1 or 1 to 6	The setting range depends on what type of valve is installed.	—															
VALVE2	Sets the flow line of the automatic column switch valve 2.			—															
LOOP	Repeats a program the specified number of times from the first step.	0 to 255	The program is stopped after repeating the specified number of times. (Setting the value to "0" causes 256 repetitions.)	P.49															
STOP	Stops the program.	—	—	P.49															

### 3.6.2 Time Program Setting Screen

To create a time program, access the edit screen as described below.

1

Press [CE].

The initial screen is displayed.

```
SET   ACTUAL   T. MAX
40    28.1     90
```

2

Press [→] twice.

The auxiliary functions screen [FUNCTION] is displayed.

```
>PARAMETER
SYSTEM
```

3

Press [↓] several times until [EDIT] is displayed in the screen.

Move the cursor to [EDIT].

```
UTILITY
>EDIT
```



**Hint** Pressing [↑] changes the menu in the reverse order.

4

Press [→].

The panel displays the number of steps of the time program.

```
USED   LEFT
10     90
```



**Hint** The panel displays the number of steps already set as [USED] and the number of steps yet to be set as [LEFT].  
The example in the figure indicates that 10 steps are already set and the remaining 90 steps can be added to the program.

5

Press [↓] or [↑].

The panel displays the time program already created.

```
10.00   TEMP   40
1 /     90
```

The numerator in the lower line indicates the number of the step that is already set and the denominator the number of steps that can be added to the program.



**Hint** Pressing [↓] or [↑] repeatedly allows displaying other steps.  
When there is no step created in a time program, pressing [↓] or [↑] does not change the screen.  
Pressing [del] in the screen allows deleting the step displayed.

6

Press [Enter].

This displays the time program setting screen.

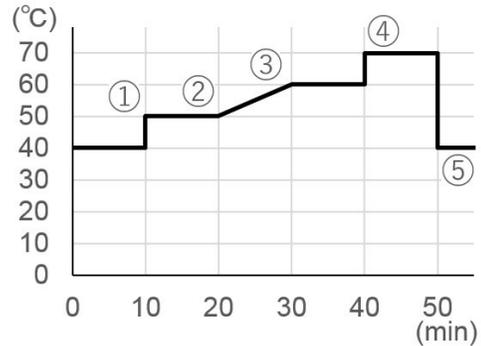
```
TIME   FUNC   VALUE
0.01 - 999.99min
```

### 3.6.3 Creating a Time Program

As an example, this section describes how to create a time program that changes the operating temperature as shown in the figure.

Set the temperature setting to 40 °C in advance and configure the program according to the table below.

Step	TIME (minutes)	FUNC (command)	VALUE (set value)
①	10.00	TEMP	50 °C
②	20.00	TEMP	50 °C
③	30.00	TEMP.L	60 °C
④	40.00	TEMP	70 °C
⑤	50.00	STOP	-



1

**Display the time program setting screen.**

▶▶ Reference "3.6.2 Time Program Setting Screen" P.44

```
TIME  FUNC  VALUE
0.01 - 999.99min
```

To set step 1

2

**Press [1], [0], and [Enter].**

This displays the command selection screen with the cursor at the [TEMP] command.

```
10.00>TEMP
Select Command
```

3

**Press [Enter].**

This selects the [TEMP] command and then displays the temperature setting input screen.

```
10.00 TEMP
Input 4 - 100
```



**Hint** The command selection screen allows selecting another command with [↓] or [↑].

4

**Press [5], [0], and [Enter].**

This sets the temperature setting to 50 °C and finishes setting step 1.

```
10.00 TEMP 50
1 / 99
```



**Hint** If you input an incorrect value, press [del] in the screen, which allows deleting one step.

To set step 2

5

Press [Enter].

This displays the time program setting screen again.

```

■IME   FUNC  VALUE
0.01 - 999.99min
    
```

6

Press [2], [0], [Enter], [Enter], [5], [0], and [Enter].

Set step 2 in the same way as step 1.

```

20.00  TEMP      50
      2 / 98
    
```

To set step 3

7

Press [Enter].

This displays the time program setting screen.

```

■IME   FUNC  VALUE
0.01 - 999.99min
    
```

8

Press [3], [0], and [Enter].

This displays the command selection screen with the cursor at the [TEMP] command.

```

30.00>TEMP
Select Command
    
```

9

Press [↓].

This changes the command to [TEMP.L].

```

30.00>TEMP.L
Select Command
    
```

10

Press [Enter].

This selects the [TEMP.L] command and then displays the temperature setting input screen.

```

10.00 TEMP.L  ■
Input 4 - 100
    
```

11

Press [6], [0], and [Enter].

This finishes setting step 3.

```

30.00  TEMP.L      60
      3 / 97
    
```

To set step 4

12

Press [Enter].

This displays the time program setting screen.

```

■IME   FUNC  VALUE
0.01 - 999.99min
    
```

13

Set step 4.



**Hint** Set it in the same way as step 1.

```

40.00  TEMP      70
      4 / 96
    
```

## To set step 5

14

Press [Enter].

This displays the time program setting screen.

```

TIME    FUNC  VALUE
0.01 - 999.99min
  
```

15

Press [5], [0], and [Enter].

This displays the command selection screen with the cursor at the [TEMP] command.

```

50.00>TEMP
Select Command
  
```

16

Press [↓] repeatedly until the [STOP] command is displayed.



**Hint** [↑] changes the command in the reverse order.

```

50.00>STOP
Select Command
  
```

17

Press [Enter].

This finishes setting step 5 and therefore setting all the steps.

```

50.00  STOP
5 / 95
  
```



**NOTE** When inputting multiple steps, the user does not need to input the data in order of time because they are automatically sorted.

## 3.6.4 Deleting a Step

To delete a step, display it and press [del].

See the following example of deleting the first step of the program created in "3.6.3 Creating a Time Program" P.45.

1

In the same manner as creating the program, display the desired step.



**Hint** To delete step 2 or a subsequent step, press [↓] or [↑] repeatedly until the desired step is displayed.

```

10.00  TEMP  50
1 / 95
  
```

2

Press [del].

This deletes the first step of the program and moves the second step up to the first step.

```

20.00  TEMP  50
1 / 96
  
```

3

### 3.6.5 Starting and Stopping a Time Program

#### ■ Starting a time program

Pressing the direct key under the [RUN] indicator highlights the [RUN] indicator and then starts the program.

SET	ACTUAL	T . MAX
40	40 . 0	90
OVEN	READY	RUN

 **Hint** The monitoring screen allows checking how much time has elapsed after the program was started.

▶▶ Reference "Displaying the program elapsed time <<TIME>>" P.20

#### ■ Stopping a time program

There are three ways to stop the program.

- Press [RUN] again while the program is running to force it to stop.
- Use the [STOP] command to stop the program at a specified time.
- Use the [LOOP] command to stop the program after repeating it a specified number of times.

The highlight is removed from the [RUN] indicator and the program is stopped.

SET	ACTUAL	T . MAX
40	69 . 8	90
OVEN	WAIT	RUN

 **NOTE** After the program is stopped, the settings are set back to the original values before the program was started.

## 3.6.6 Special Commands Used in Time Programs

This section explains special commands used in time programs.

### ■ Setting a loop count for a time program 《LOOP》

Repeats a program a specified number of times.

The settings in the following table allows repeating steps 1 and 2 on a 50-minute cycle three times.

Step	TIME	FUNC	VALUE
1	10.00	VALVE1	2
2	30.00	VALVE1	3
3	50.00	LOOP	3

```
50.00 LOOP
Input 0 - 255
```

- NOTE
- If [VALVE1] is set to "1" before the time program is started, the operation of valve 1 switches in the order of 1 -> 2 -> 3 -> 1 -> 2 -> 3 -> 1 -> 2 -> 3 -> 1 over 150 minutes before the program is stopped. While the [LOOP] command is repeating the cycle, the value is set back to the initial value "1" every time the cycle is repeated. After the program is stopped, the setting is set back to the original value before the program was started.
  - The time program is stopped after the cycle is repeated the number of times specified by the [LOOP] command. Steps that follow the [LOOP] command are not executed.
  - Setting the [LOOP] command setting value to "0" causes the cycle to be repeated 256 times.

### ■ Stopping a time program 《STOP》

Stops a time program at a specified time as the last step of the program.

```
50.00>STOP
Select Command
```

- NOTE
- Running a time program that has no step of the [STOP] or [LOOP] command causes the program to keep running endlessly even after the command at the last step is executed.

## 3.7 Connection with the System Controller

### 3.7.1 Setting the Instrument

To control the instrument from the system controller SCL-40/CBM-40/CBM-40lite, set the parameters as follows:

Setting Parameter	Set Value	Reference
LOCAL MODE	0 : Remote	▶▶ Reference "Selecting the local mode 《LOCAL MODE》" P.25
LINK ADDRESS	Link address	▶▶ Reference "Setting the link address 《LINK ADDRESS》" P.25
OPERATION MODE	0 : 40C* <sup>1</sup> 1 : 20AC* <sup>2</sup>	▶▶ Reference "Setting the operation mode 《OPERATION MODE》" P.39

\*1 Causes the system controller to identify the instrument as CTO-40C. This setting should be used normally.

\*2 Causes the system controller to identify the instrument as CTO-20AC. Use this setting when connecting the instrument to a system controller or workstation incompatible with LC-40 series.

### 3.7.2 Basic Parameters

SCL-40, CBM-40, and CBM-40lite can connect to a maximum of four column ovens. The system controllers configure the settings such as the operating temperature, upper temperature limit, automatic column switch valves 1 and 2, ON/OFF of temperature control, and time program. Additionally, the workstations support column management functions. For details, refer to the instruction manuals of the system controllers and workstations.

### 3.7.3 Limitations of Compatible Mode

Setting [OPERATION MODE] to "1" enables the instrument to operate as CTO-20AC so that the system controllers and workstations incompatible with LC-40 series can control the instrument. This mode, however, has the following limitations.

#### 1) Operating temperature

The maximum possible settings for the operating temperature is 85 °C.

#### 2) Automatic column switch valve

The instrument manages automatic column switch valves as [VALVE1 (left)] and [VALVE2 (right)] while CTO-20AC manages [RV.L (left)] and [RV.R (right)].

Consider VALVE1 as RV.L and VALVE2 as RV.R when configuring the settings.

#### 3) Power management functions

The mode does not allow system controllers to manage the power. Even when the instrument is connected to a system controller, the power button on the front of the instrument is enabled and users need to turn on/off the power by hand with the button.

## 3.8 Connection to External Input/Output Terminals

The external input/output terminals are connected to an event output device or the other external devices with an optional remote cable.

Details of remote cable signals and wiring are described below.

### ⚠ WARNING

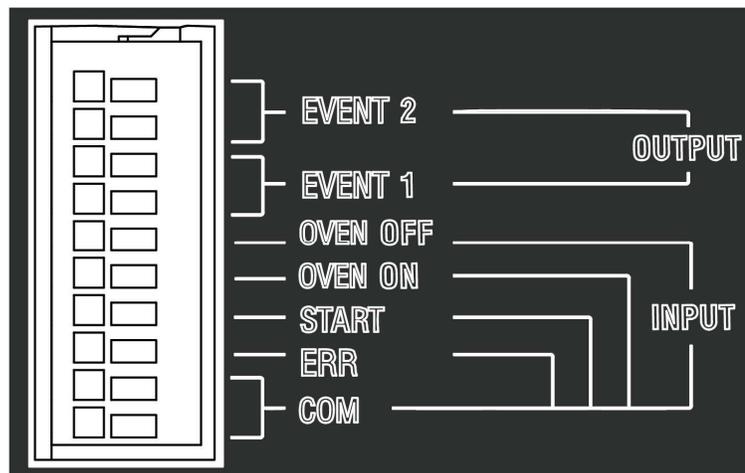


Instruction

- Before connecting the cable, turn OFF the power and unplug the instrument.
  - Use only the specified cable.
  - Connect as specified.
- Otherwise, fire, electric shock, or malfunction may occur.

3

### 3.8.1 External Input/Output Terminals

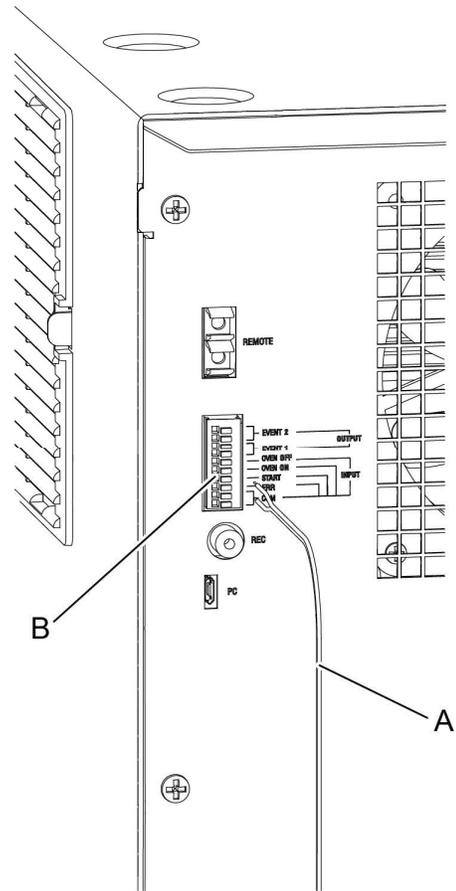


Signal Name	Description	Remark
EVENT2	Relay contact outputs. They can be turned on/off with a time program or the set values of the [EVENT] auxiliary function.	The rated values of the relay contacts are 30 VDC and 0.2 A.
EVENT1		
OVEN OFF	The external contact signal stops the temperature control of the instrument.	The signals and the COMMON terminal are short-circuited through contacts of external equipment and thus operation is controlled. The short-circuit time (tc) should satisfy the following. 0.5 sec < tc < 10 sec
OVEN ON	The external contact signal starts the temperature control of the instrument.	
START	A time program of the instrument is started with an external contact signal. If a start signal is received while a time program is in progress, a time program starts from 0 minutes.	
ERR	The instrument is set to the error detection status by receiving the external error signal.	
COM	COMMON terminal for [OVEN ON], [OVEN OFF], [START] and [ERR].	

## 3.8.2 Connection of Remote Cable

1

Insert the optional remote cable (A) into the external input/output terminals (B).



**NOTE** When connecting two or more circuits to the terminals, purchase additional options or use the wires shown below.

- Cable with single wire:  $\varnothing 0.4$  to  $\varnothing 1.2$  (AWG26 to 16)
- Cable with stranded wire:  $0.3 \text{ mm}^2$  to  $1.25 \text{ mm}^2$  (AWG22 to 16), diameter of single wire of  $\varnothing 0.18$  or thicker

To prevent disconnection, the cable with stranded wire is recommended.

**NOTE** When using the [EVENT1] or [EVENT2] signal, set [EVENT1] or [EVENT2] and [SELECT EVENT1] or [SELECT EVENT2] in the auxiliary functions.

- Reference "Setting the EVENT1 output terminal 《EVENT1》" P.24  
 "Setting the EVENT2 output terminal 《EVENT2》" P.24  
 "Setting the function of the EVENT1 output terminal 《SELECT EVENT1》" P.26  
 "Setting the function of the EVENT2 output terminal 《SELECT EVENT2》" P.26

# 4 Maintenance

## 4.1 Periodic Inspection and Maintenance

It is necessary to perform periodic inspections of this instrument to ensure its safe use. It is possible to have these periodic inspections performed by Shimadzu service personnel on a contractual basis.

For information regarding the maintenance inspection contract, contact your Shimadzu representative.

### WARNING



Instruction

Be sure to turn OFF the power to the rear of the instrument and pull out the plug from the power supply before inspection/maintenance unless otherwise instructed.

Otherwise, fire, electric shock or malfunction may occur.

### CAUTION



Prohibition

Never remove the cover.

This may cause injury or a malfunction of the device. Contact your Shimadzu representative if the main cover must be removed.



Instruction

For parts replacement, use parts and tools listed in "[1.2 Component Parts](#)" and "[5.2 Maintenance Parts](#)".

If any other parts or tools are used, part damage, injury, and malfunction may occur.

### 4.1.1 Prior to Inspection and Maintenance

- Replace the mobile phase solvent in the flow lines with water.
- Wipe away any dirt from the left and right doors and the main cover.
- Wipe away any dirt from the control panel with tissue paper or a soft cloth moistened with water.

### 4.1.2 List of Periodic Inspection and Maintenance

**NOTE** The maintenance and replacement periods listed in this table are presented only as guidelines. These are not guarantee periods. These will vary depending on usage conditions.

Inspection/ Maintenance Item	1 Year	2 Years	3 Years	Remark	Ref.
Air filter replacement	✓				P.62

### 4.1.3 Check After Inspection and Maintenance

After inspection and maintenance, check any leakage during pumping.

## 4.2 Temperature Accuracy Calibration

Re-calibration is required if the temperature accuracy of [TEMPERATURE CHECK] fails the temperature control function test of the component validation.

▶▶ Reference "Checking the temperature control accuracy 《TEMPERATURE CHECK》" P.38

1-point calibration or 2-point calibration can be performed at any temperature. If the oven is always to be used at the same temperature, 1-point calibration at that temperature is sufficient. If the oven is to be used at a wide range of temperatures, 2-point calibration is recommended.

The first calibration temperature must be no greater than 60 °C and the second calibration temperature must be at least 20 °C higher than the first calibration temperature. Before delivery, the CTO-40C is calibrated at 40 °C and 80 °C respectively. The procedure for performing temperature calibration at 40 °C and 80 °C is described below.

▼ NOTE The temperature accuracy calibration must be performed by the system administrator.

▼ NOTE To calibrate the temperature accuracy, turn ON [READY CHECK], and set [READY RANGE] to [0.1] °C and [WAIT TIME] to [10] minutes.

▶▶ Reference "Setting the temperature ready check 《READY CHECK》" P.27  
 "Setting the stable temperature range 《READY RANGE》" P.27  
 "Setting the wait time to display READY 《WAIT TIME》" P.28

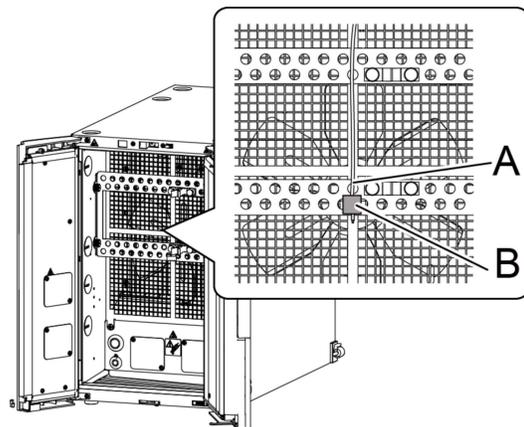
### ■ Preparation

1

**Fix the thermocouple of the thermometer for calibration at the place specified in the figure.**

Fix the thermocouple (A) of the thermometer at the place on the column bracket specified in the figure with a 1 cm<sup>2</sup> piece of aluminum tape (B).

▼ NOTE Use the thermometer for calibration and thermocouple that were calibrated in advance by the separately specified method.



## ■ 1st point of calibration

- 2** Perform temperature control at the first calibration temperature (40 °C) and wait until [READY] is displayed.

```

SET   ACTUAL   T . MAX
 40   40 . 0   1 0 5
OVEN  READY   RUN

```

- 3** Press [→] on the initial screen.

 **Hint** If the initial screen is not displayed, press [CE] to display the initial screen.

- 4** Press [↓] once, move the cursor to [VP] and press [→].

- 5** Press [↓] several times, move the cursor to [CALIBRATION] and press [→].

- 6** Input the password.

- 7** Press [↓] several times until [TEMP1 CALIB :] is displayed.

```

TEMP1 CALIB : 40.0
Enter to Calibrate

```

 **Hint** As the temperature has been set to 40 °C, [TEMP1 CALIB : 40.0] is displayed.

- 8** Press [Enter].

```

REF . TEMP1 CALIB
40.0 -> ■ 0.0

```

 **Hint** Pressing [Enter] without [READY] displays [Oven Not Ready], in which this screen cannot be reached.

- 9** Read the thermometer for calibration and input the measured value with the numeric keypad before pressing [Enter].

```

REF . TEMP1 CALIB
Calibrated

```

This completes the first point of calibration.

 **Hint** If the temperature measured by the instrument differs by 10 °C or more from the one inputted as a calibration temperature, the accuracy cannot be calibrated.

```

REF . TEMP1 CALIB
Calibration Fail

```

This completes the procedure for 1st point calibration.

## ■ 2nd point of calibration

- 10** Change the temperature setting to the temperature for the second calibration point (80 °C) and wait until [READY] is displayed.

```
SET  ACTUAL  T. MAX
80   80.0   105
OVEN  READY  RUN
```

- 11** Display the [CALIBRATION] group in the same way as steps 3 to 6.

- 12** Press [↓] several times until [TEMP2 CALIB :] is displayed.

```
TEMP2 CALIB : 80.0
Enter to Calibrate
```

 **Hint** As the temperature has been set to 80 °C, [TEMP2 CALIB : 80.0] is displayed.

- 13** Press [Enter].

```
REF. TEMP2 CALIB
80.0 -> ■80.0
```

-  **NOTE** This screen is not displayed in the following cases:
- Pressing [Enter] without [READY] displayed causes [Oven Not Ready] to be displayed.
  - If the temperature setting is not higher than the temperature for the first calibration point by at least 20 °C, [Out-of-range temp.] is displayed.

- 14** Read the thermometer for calibration and input the measured value with the numeric keypad before pressing [Enter].

```
REF. TEMP2 CALIB
Calibrated
```

This completes the second point of calibration.

 **Hint** If the temperature measured by the instrument differs by 10 °C or more from the one inputted as a calibration temperature, the accuracy cannot be calibrated.

```
REF. TEMP2 CALIB
Calibration Fail
```

This completes the calibration of temperature accuracy.  
The calibration result is stored even when the power of the instrument is turned to OFF.

## 4.3 Gas Sensor Calibration

Re-calibration is required if the result of [GAS SENSOR CHECK] fails the component validation.

▶▶ Reference "Checking the gas sensor «GAS SENSOR CHECK» " P.38

**NOTE** The gas sensor calibration must be performed by the system administrator. The gas sensor detects volatile gas generated from leaked organic solvents when the tubing such as a column causes a leakage. When the output value from the sensor exceeds the level set at "threshold value", an error occurs and temperature control stops. The gas sensor is influenced by the concentration of organic solvent gas around the instrument. Be sure to perform sensitivity adjustment in a well-ventilated room with clean air.

- 1 Perform the temperature control at the set temperature (40 °C), and wait until [READY] is displayed.

```

SET    ACTUAL    T . MAX
 40    40 . 0    1 0 5
OVEN  READY  RUN
  
```

- 2 Press [→] on the initial screen.

**Hint** If the initial screen is not displayed, press [CE] to display the initial screen.

- 3 Press [↓] once, move the cursor to [VP] and press [→].

- 4 Press [↓] several times, move the cursor to [CALIBRATION] and press [→].

- 5 Input the password.

- 6 Press [↓] several times until [GAS SENS CALIB] is displayed.

```

GAS SENS CALIB
Enter to Start
  
```

- 7 Press [Enter].  
[GAS SENS LVL (the value of the gas sensor)] is displayed.

```

GAS SENS LVL 6384
Enter to Calib Dry
  
```

**Hint** You can cancel calibration by pressing [CE] on the screen in step 7-10.

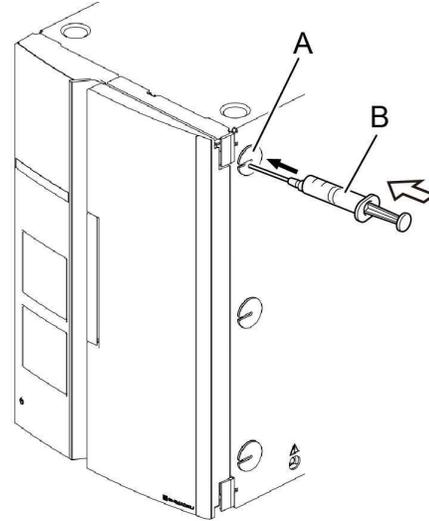
- 8 Press [Enter].  
The gas sensor value at a dry state is corrected to 6500.

```

GAS SENS LVL 6500
Inject EtOH 50uL
  
```

- 9** With the microsyringe (B), inject approximately 100  $\mu\text{L}$  of ethanol through the tubing hole (A) on the upper part of the right side.

**NOTE** CTO-40C has a internal volume larger than CTO-40S and therefore must be calibrated with 100  $\mu\text{L}$  of ethanol injected.



- 10** Increase in the gas sensor value is detected and then a calibration value is automatically calculated.

**D : 5494    W : 34506**  
**Enter to Calibrate**

**Hint** [D:] shows the value measured in a dry state and [W:] the value measured when ethanol was detected.  
 If a regular sensor is calibrated correctly, the D value will be 4,500 - 13,000 and the W value will be more than 1,500 greater than the D value. (A larger W value is better.)  
 You can cancel calibration by pressing [CE] on this screen.

- 11** Press [Enter].  
 The calibration is completed.

**GAS SENS LVL 6988**  
**Calibrated**

## 4.4 Leak Sensor Calibration

Re-calibration is required if the result of [LEAK SENSOR CHECK] fails the component validation.

▶▶ Reference "Checking the leak sensor «LEAK SENSOR CHECK» " P.37

■ **NOTE** The leak sensor calibration must be performed by the system administrator. The leak sensor detects leaked mobile phase when the tubing such as a column causes the leakage. When the output value from the sensor exceeds the level set at "threshold value", an error occurs and temperature control stops.

**1** Press [→] on the initial screen.

💡 **Hint** If the initial screen is not displayed, press [CE] to display the initial screen.

**2** Press [↓] once, move the cursor to [VP] and press [→].

**3** Press [↓] several times, move the cursor to [CALIBRATION] and press [→].

**4** Input the password.

**5** Press [↓] several times until [LEAK THOLD] is displayed.

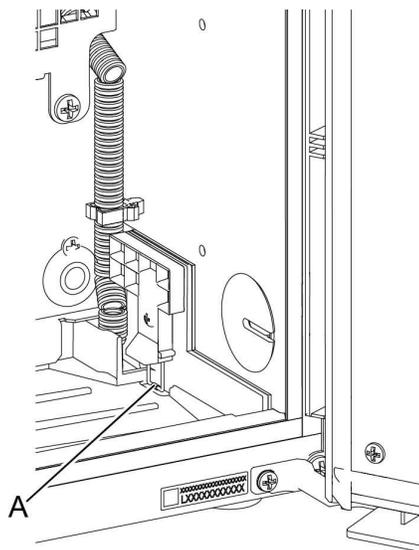
**LEAK THOLD** 150  
**Actual Level** 100

**6** Soak the sensor unit (A) at the bottom of the leak sensor in water.

The leak sensor value (Actual Level) increases by detecting water.

**7** Read the maximum value of the leak sensor value (Actual Level).

Example: Here, the maximum value is [160].



8

**Wipe off the moisture around the leak sensor.**

The leak sensor value (Actual Level) decreases.

**NOTE** When wiping off moisture, do not press the leak sensor. When a sensor unit touches a wall, the sensor sensitivity is lowered.

9

**From the value read in step 7, calculate the threshold value of the leak sensor.**

How to obtain the leak sensor threshold:

$(\text{Maximum value} - 100) \times 0.7 + 100$

In the example screen here, [142] is calculated.

10

Press [Enter], input the value calculated in the step 9, and press [Enter].

The new "threshold value" is saved.

```
LEAK THOLD   142
Actual Level  100
```

## 4.5 Cleaning the Leak Tray

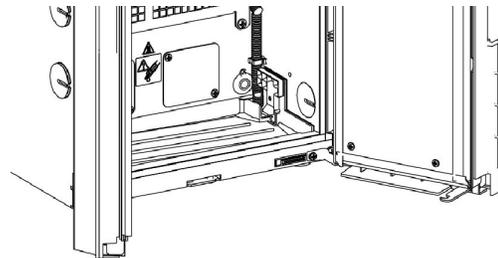
4

**NOTE** If leak occurred, wipe off leak in the leak tray completely as below. Leak of mobile phase solution used as buffer solution may dry and crystallize, clogging the leak tray. If the leak tray is contaminated by such crystallized buffer solution, wipe off the leak tray with wiper paper soaked in water in the same manner as below.

1

**Wipe off leak around the leak sensor or on the leak tray completely with wiper paper.**

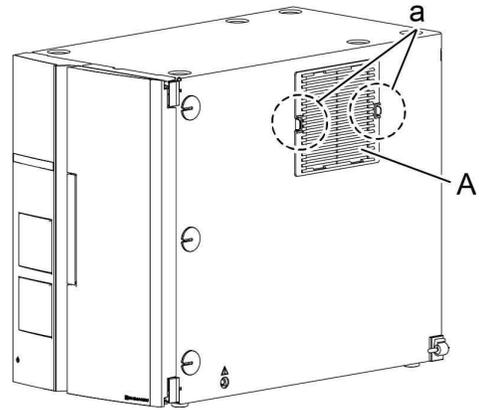
**NOTE** Do not bend or pull the leak sensor. If there is contamination such as crystallized buffer solution, wipe it off with wiper paper soaked in water.



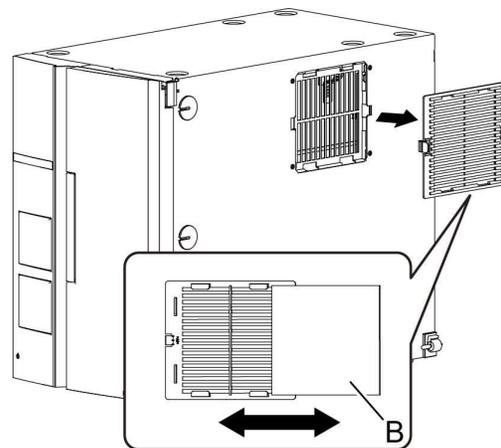
## 4.6 Replacing the Air Filter

The section explains how to replace the air filter on the right side of the instrument.

- 1 Remove the filter holder (A) on the right side by pressing its right and left knobs (a).

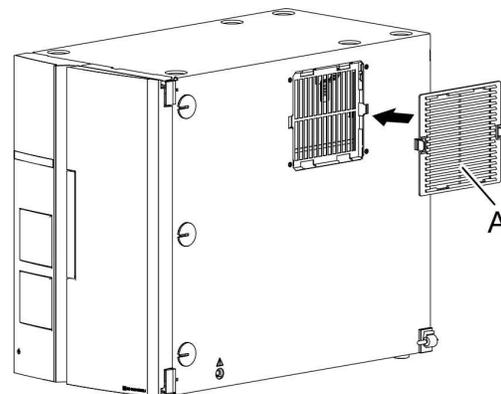


- 2 Remove the air filter (B) and then attach a new air filter (B) to the filter holder (A).



- 3 Attach the filter holder (A) to the right side.

**NOTE** The filter holder (A) has its upper side and lower side and therefore can be attached only in a certain orientation.



## 4.7 Cleaning the Exterior

If the exterior of the instrument is dirty, clean it with a dry soft cloth or tissue paper. If it is very dirty, clean it as below.

**1**

**Clean with a cloth soaked in diluted neutral detergent and wrung tightly.**

**2**

**Wipe off detergent with a cloth soaked in water and wrung tightly and then wipe off water with a dry cloth.**

**NOTE** Do not leave the exterior wet and do not use alcohol or thinner for cleaning. Doing so may cause rust or discoloration.

# 5 Technical Information

## 5.1 Specifications

The performance data given below is based at room temperature of 25 °C.

Item	Specification
Type	Air circulation
Temperature control range	(Room temperature* - 10 °C) to (100 °C) * Room temperature means the ambient temperature at the CTO-40C.  <div style="border: 1px solid black; padding: 5px;"> <p><b>NOTE</b> The upper limit is 85 °C when an automatic column switch valve or column management device (CMD) is connected.</p> </div>
Temperature setting range	4 °C to 100 °C in 1 °C steps
Temperature control precision	0.1 °C (± 0.05 °C)
Ambient temperature range	4 °C to 35 °C
Size and number of columns stored	Six columns up to 250 mm or three 250 mm to 300 mm columns
Safety measures	<ul style="list-style-type: none"> <li>• Upper temperature limit can be set to prevent inadvertent accidents.</li> <li>• Equipped with the thermal fuse to prevent overheating at breakage</li> <li>• Incorporating the gas sensor</li> <li>• Incorporating the liquid leak sensor</li> </ul>
Time program functions	Change the temperature setting (in steps or linearly), start or stop temperature control, change the flow lines of automatic column switch valves, and repeat a program, 100 steps, 0.01 to 999.99 min
Dimensions	W 250 mm × H 415 mm × D 500 mm (Excluding a protrusion)
Mass	21 kg

Item	Specification				
	Part No.	Power Supply Voltage* <sup>1</sup> (indicated on the instrument)	Power Consumption	Frequency	Rated Breaking Capacity* <sup>2</sup>
Power Supply	228-65202-58	100-120 VAC / 220-240 VAC Automatic switching (100-120 V~ / 220-240 V~ AUTO)	400 VA	50/60 Hz	50 A
	*1 Mains supply voltage fluctuations are not to exceed 10 % of the nominal supply voltage.				
	*2 Connect the instrument to a power outlet that is equipped with a circuit breaker that shuts off the current at the described value or less.				
Installation Environment (IEC)	Installation Category II, Pollution Degree 2, Altitude 2000 m or lower Install inside the room.				

## 5.2 Maintenance Parts

### 5.2.1 Consumable Parts

Part Name	Part No.	Remarks
Air filter	228-72570-01	Filter only

### 5.2.2 Replacement Parts

Part Name	Part No.	Remarks
Filter holder	228-72234	
Tube cap	228-72351	The tube hole cap
Guide	228-72350	For tube cap
Insulator for pipe	228-23848-01	Heat insulation material for the tubing hole
Injector hole cover	228-72042	

