Manual No.3001E R3

Model DGO-201

Oxygen Analyzer Receiver

Instruction Manual

Please read this manual carefully before using this product.

Energy Support Corporation

1. Precautions for Safe Use

For safety purposes, the equipment is provided with warning labels and caution messages are specified in the instructional manual as described below. Please fully understand the meanings of the messages to ensure safe use.

1-1 Caution message

⚠	85 to 132 VAC is applied to the power terminal block. To avoid electrical shock when checking the wiring, turn off the external power supply.

1-2 Warning message

⚠ CAUTION	* Be sure to turn the external power supply off when working.

⚠ WARNING ⚠ ELECTRIC SHOCK	* Touching power supply terminal block, switches and other electric devices may result in electric shock. • Be sure to turn the power off when inspecting, handling with wet hands will cause danger.

● The meaning of the signal words are described below.

WARNING Indicates a potentially hazardous situation which may result in death or serious injury if it fails to be avoided.

CAUTION Indicates a potentially hazardous situation which may result in moderate or minor injury if it fails to be avoided.

These signal words are also used for unsafe actions.

2. General

2-1 Introduction

This instruction manual describes the methods for installation, operation, and inspection of the model DGO-201 receiver for zirconia O_2 (oxygen) analyzers. Please read this manual carefully before use to fully understand it.

Other models whose specifications are different from those of your equipment are also described in this manual.

Therefore, it should be noted that some of the information contained in this manual is not related to your equipment.

For detailed information on your zirconia O_2 analyzer, please refer to its instruction manual.

2-2 Product warranty

(1) Warranty period: As described in the completion document.
If no completion document is available, the warranty period shall be 1 year after delivery.

(2) Conditions: If this product fails or malfunctions due to a design, manufacturing or material defect in the product that we are responsible for even though it has been used correctly used during this warranty period after delivery followed by correct storage and installation until commissioning, we will replace or repair the product free of charge.

[1] This assumes that the product is installed and used exactly as described in the specification and instruction manual.

[2] The analyzer must be regularly calibrated and its consumable parts (transmitter, etc.) must be replaced at regular intervals.

[3] The operating status of the analyzer shall be checked and maintained as required.

Note: The consumable parts and other similar parts are not covered by the warranty.

(3) Warranty coverage: Only the product that we delivered to you is covered by the warranty.
We do not assume responsibility for any incidental damage (i.e., any loss/lost profit, etc. resulting from control by use of our product or from recorded results or any loss/lost profit, etc. from equipment used with our product).

2-3 Contents

2-4 Precautions for use

The model DGO-201 receiver for zirconia O_2 analyzers must be used under the following environmental conditions:

- Place away from direct sunlight
- Place at ambient temperatures ranging from -10 to +50ºC with little change in temperature (± 10ºC/day)
- Place with little moisture/dust
- Place with little mechanical vibration
- Place with little electromagnetic field effect
- Corrosive gas free place

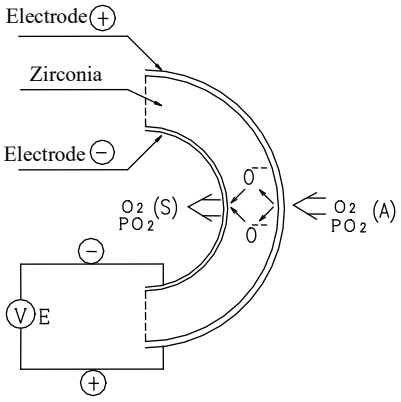
2-5 Product outline

The model DGO-201 receiver for zirconia O_2 analyzers is designed for monitoring/controlling the atmosphere in a heating furnace by measuring the concentration of oxygen in the exhaust gas from the boiler/furnace.

It has the following excellent functions and features:

- O_2 measurements can be taken at up to 4 points.
- Automatic calibration and automatic purge function settings are available.
- Functions and errors are indicated by LEDs.
- Average value calculation and exclusion function are provided.
- Output signal first-order lag and hold functions are provided.
- Wet/Dry calculation function is provided.
- Each sensor signal value can be displayed.
- Small, lightweight, and easy to maintain.

2-6 Operating principle of zirconia oxygen analyzer



Assuming PO_2 (A) > PO_2 (S)

Positive electrode: O_2+4e-O_2-

Negative electrode: $2O-O_2+4e$

A cubic solid solution consisting of zirconia (ZrO_2) combined with additives such as calcia (CaO), yttria (Y_2O_3), etc. becomes a solid electrolyte, which conducts oxygen ions (O^-) at high temperature. The electromotive force calculated from the formula described below is generated due to oxygen ion conduction by providing a pair of electrodes (porous material) opposed to this solid electrolyte and applying a gas with a different oxygen partial pressure to each of the electrode.

$$E = -\frac{RT}{4F} \ln\left(\frac{PO_2(S)}{PO_2(A)}\right)$$

Where E: Electromotive force generated between electrodes (mV)

R: Gas constant ($8.314 \cdot J/mol^{-1} \cdot K^{-1}$)

T: Absolute temperature of solid electrolyte (normally 923K) ≒ Detection unit heater control temperature

F: Faraday constant ($9.649 \times 10^4 C \cdot mol^{-1}$)

PO_2(A): O_2 partial pressure in reference air (concentration 21.0vol%)

PO_2(S): O_2 partial pressure in sample gas (indicated concentration vol%)

Assign each constant to the formula above to obtain the following equation:

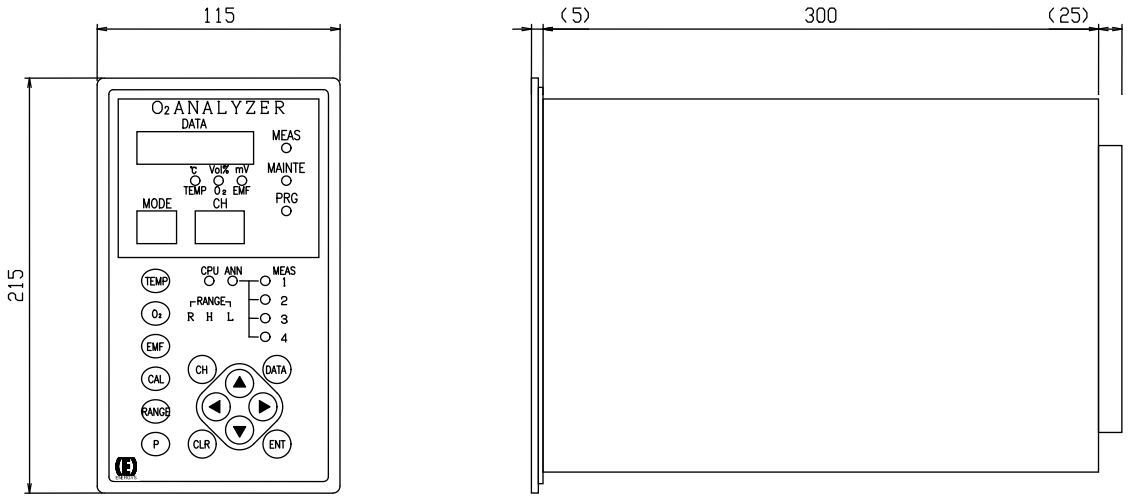
$$PO_2(S) = 21.0 \cdot \text{Antilog}\left(-\frac{E}{0.0496 \cdot T}\right)$$

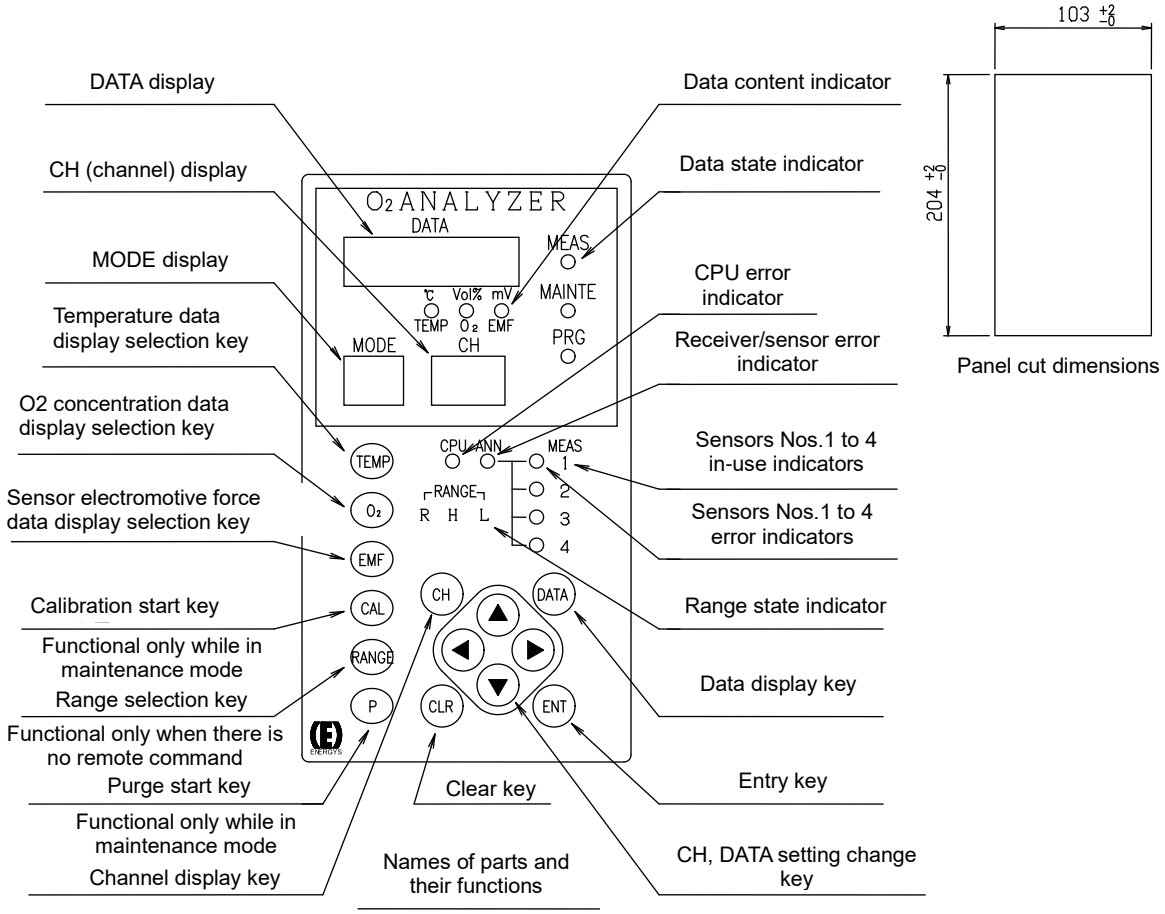
Using this equation, find PO_2 in the sample by measuring the electromotive force E.

This electromotive force E is calculated by the open logarithm transformation circuit in the receiver and the result is displayed/output as O_2 partial pressure (vol%) that can be directly read.

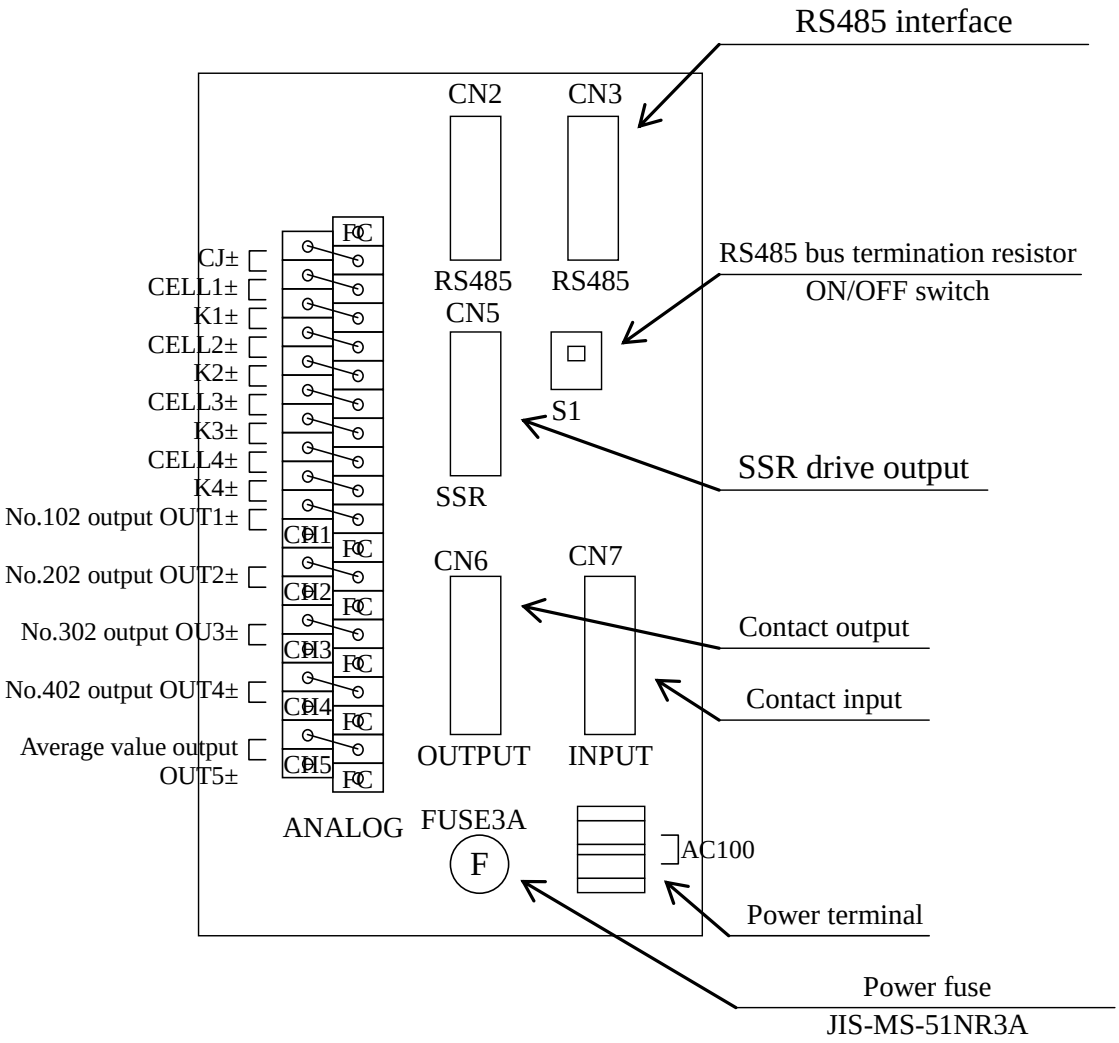
2-7 Names of parts and their functions

(1) External view

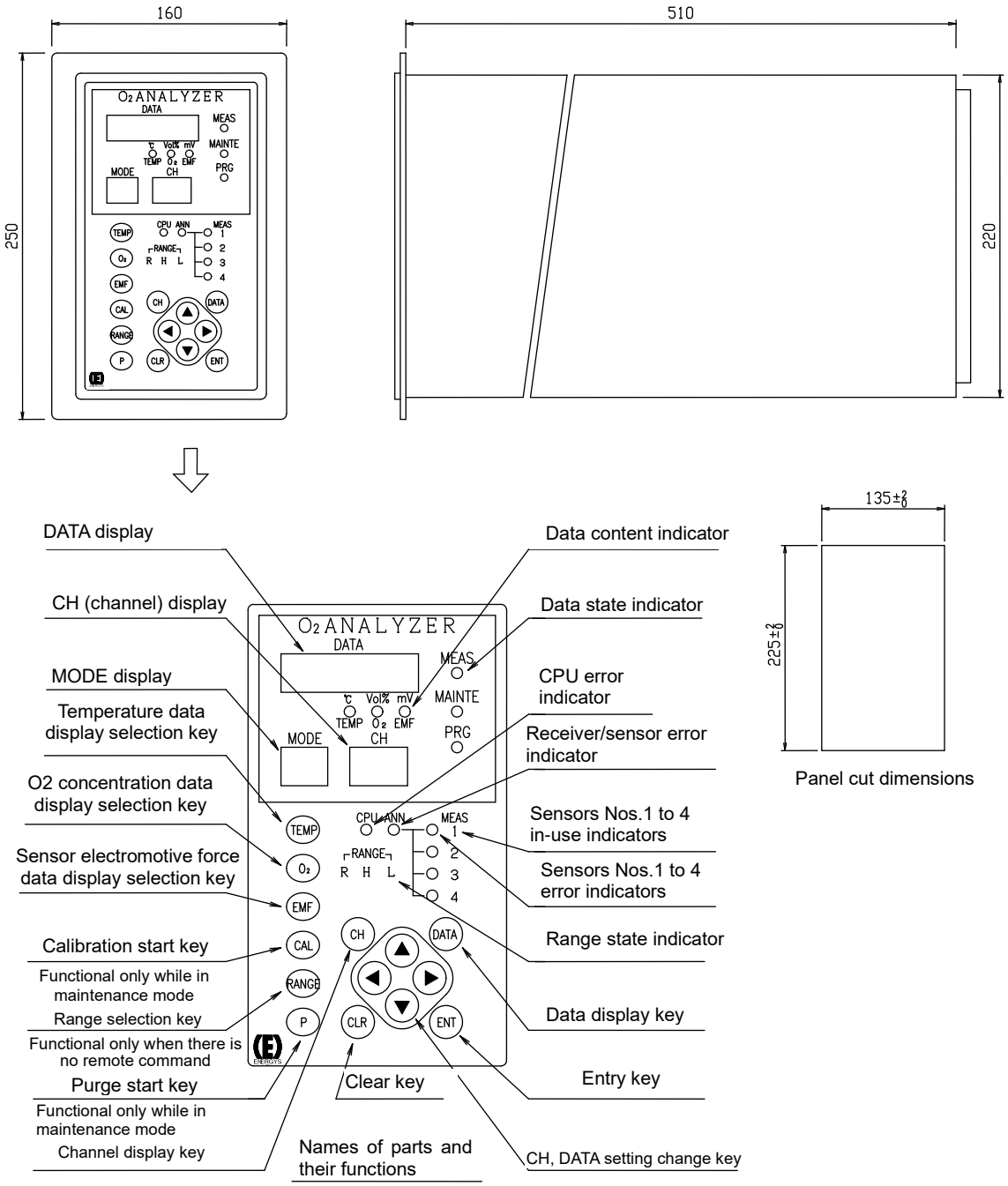




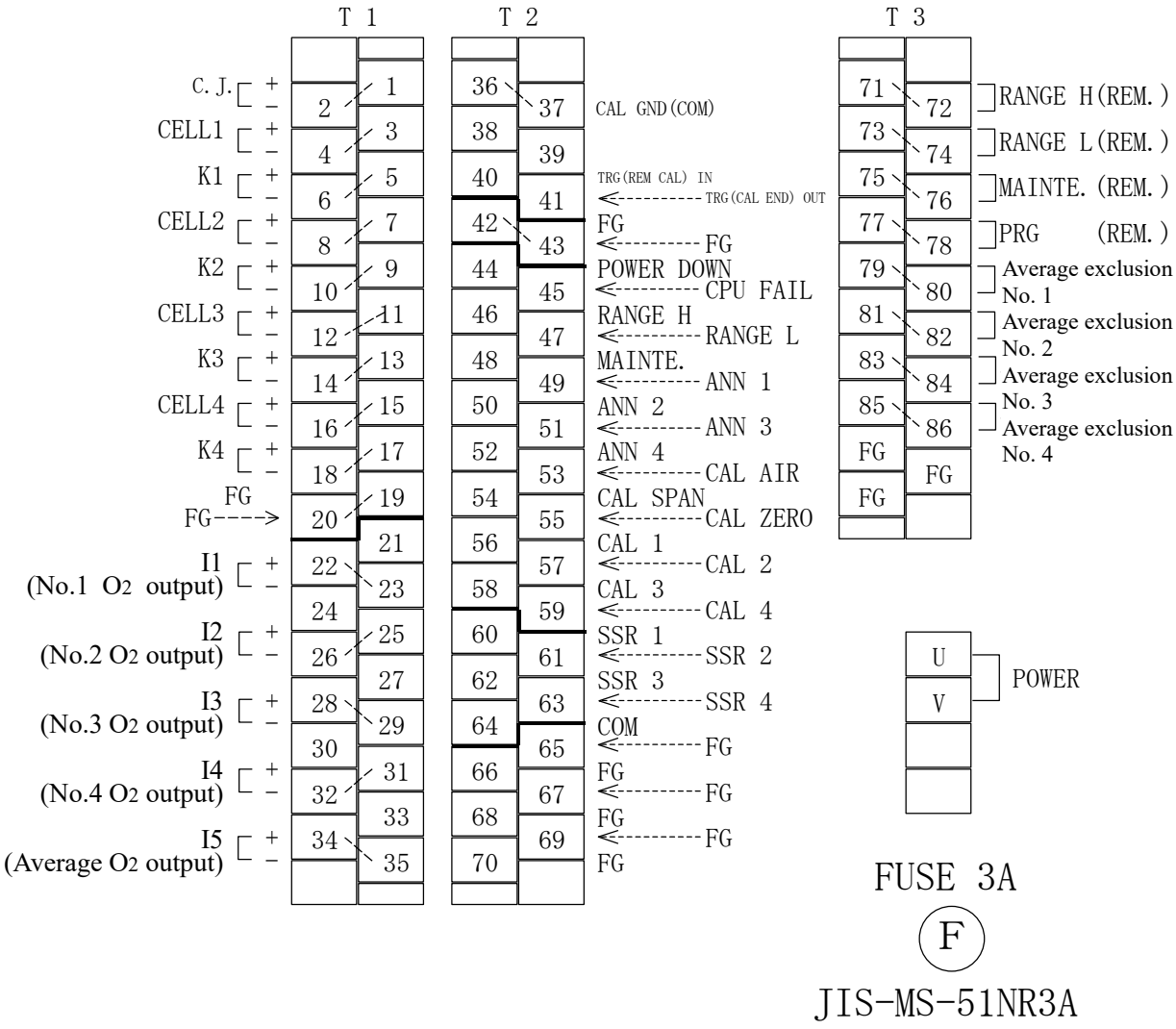
(2) Arrangement of terminal blocks on rear panel of measuring instrument



External view of DGO-III replacement compatible product



Arrangement of terminal blocks on rear panel of DGO-III replacement compatible product



(4) Functional description of each part

Name	Function
DATA display	Displays O_2 concentration at each measurement point, average O_2 concentration, setting data in PRG mode, etc.
MODE display	Shows information on DATA display and error (See page 11 for details)
CH (channel) display	Displays the sensor number corresponding to the O_2 concentration shown on the display and the channel number of the system data when in PRG mode. (See page 11 for details)
Average value calculation LED	The sensor number included in the average value calculation is illuminated.
CPU failure LED	Comes on if a CPU functional error occurs.
ANN LED	Comes on if an error occurs in sensors Nos. 1 to 4 or receiver.
MEAS. LED	Indicates measurement in progress.
MAINTE. LED	Lit during temperature rising and calibration or with MAINTE. mode selected.
PRG. LED	Comes on when PRG mode is selected.
RANGE L LED	Comes on when Low range is selected.
RANGE H LED	Comes on when High range is selected.
RANGE R LED	Lit while external range switching input is in use.
CAL. Key	Used to perform one-push calibration. (See page 27 for details)
P Key	Used to perform one-push purge.. (See page 30 for details)
O_2 Key	Used to display individual or average O_2 concentration.
EMF Key	Used to display electromotive force (EMF) of sensors Nos. 1 to 4.
TEMP Key	Used to display temperature (TEMP) of sensors Nos. 1 to 4.
CH Key	Used to input a channel number. (See page 32 for details)
RANGE Key	Used to switch the range. (External range is given priority.)
DATA Key	Used to change data.
ENT Key	Used to enter data.
CLR Key	Used to release error display or clear displayed data.
▲ ▼ Key	Used to increase/decrease a setting value.
◀ ▶ Key	Used to change the digit position of the setting value to be changed.

(5) Display indication code

[1] MODE display

It consists of a 2-digit 7-segment LED display and indicates the content of the data shown on the DATA display using a code

[2] Channel (CH) display

It consists of a 2-digit 7-segment LED display and indicates the corresponding sensor number and average O_2 concentration using a code.

[3] DATA display

It consists of a 4-digit 7-segment LED display and displays average, specific O_2 concentration, error code, etc.

The codes that may be shown on the MODE display and CH display and their meanings are described below.

Normally, the following two codes are used for indication of operating status.

MODE display	Meaning of code
HU	During heat rising
01	O_2 concentration indication
02	Sensor electromotive force (EMF) indication
03	Sensor temperature (TEMP) indication
07	Range switching indication
10	Manual calibration indication
C1	Air calibration in progress
C2	Zero gas calibration in progress
C3	Span gas calibration in progress
C0	Calibration recovery in progress
P1	Purge in progress
P2	Purge not in service
P0	Purge recovery in progress
E1 to E9 E-	Error occurring See page 41.

CH indicator	Meaning of code
01	Corresponds to sensor No. 1.
02	Corresponds to sensor No. 2.
03	Corresponds to sensor No. 3.
04	Corresponds to sensor No. 4.
0A	Corresponds to average O_2/n sensor. (n corresponds to the sensor used with the receiver.)
00	Corresponds to average O_2/all sensors. * (Only master machine can be selected.)
1 to 56	Channel number in PRG mode

* If two or more receivers are connected, the average among all sensors is available from the receiver set as master machine.
Master machine: CH No. 94 = 1
Other receivers: CH No. 94 = 2 to 9
00 indication: CH No. 96 = 1: Average in machine itself
= 2: Average among all connected sensors
= 3: Average of averages in connected machines

Note: DGO-III replacement compatible product has only an average function for the machine itself. The compatible replacement is not equipped with purge output.

2-8 Temporary storage of product

Observe the following precautions when temporarily storing the product:

- It is desirable to store the product protected with foamed styrol.
- Store it in a place away from direct sunlight.
- Store it in a place at ambient temperatures ranging from -10 to +50ºC with little change in temperature.
- Store it in a place with little moisture/dust.
- Store it in a place protected from rainwater, etc.
- Store it in a place with little mechanical vibration.
- Store it in a place with no corrosive/hazardous gas.

3. Installation

3-1 Installation conditions

The analyzer is a precision machine. To ensure correct use of this machine, observe the following precautions when determining the most appropriate installation place:

- Place with little vibration. (0.1G or less)
- Corrosive gases (SO_2, $H2_S$, etc.)
- Place away from high radiant heat.
- Place with little electromagnetic field effect.
- Place with little moisture/dust.
- Place with little voltage variation.
- Place with little power frequency variation.
- Place at ambient temperatures ranging from -10 to +50ºC (away from direct sunlight).

3-2 Installation method

Precautions for installation

[1] This analyzer is a precision machine. When installing it, handle it carefully to avoid excessive impact loads.

[2] Since it is fragile, do NOT bring it into contact with other parts when installing it.

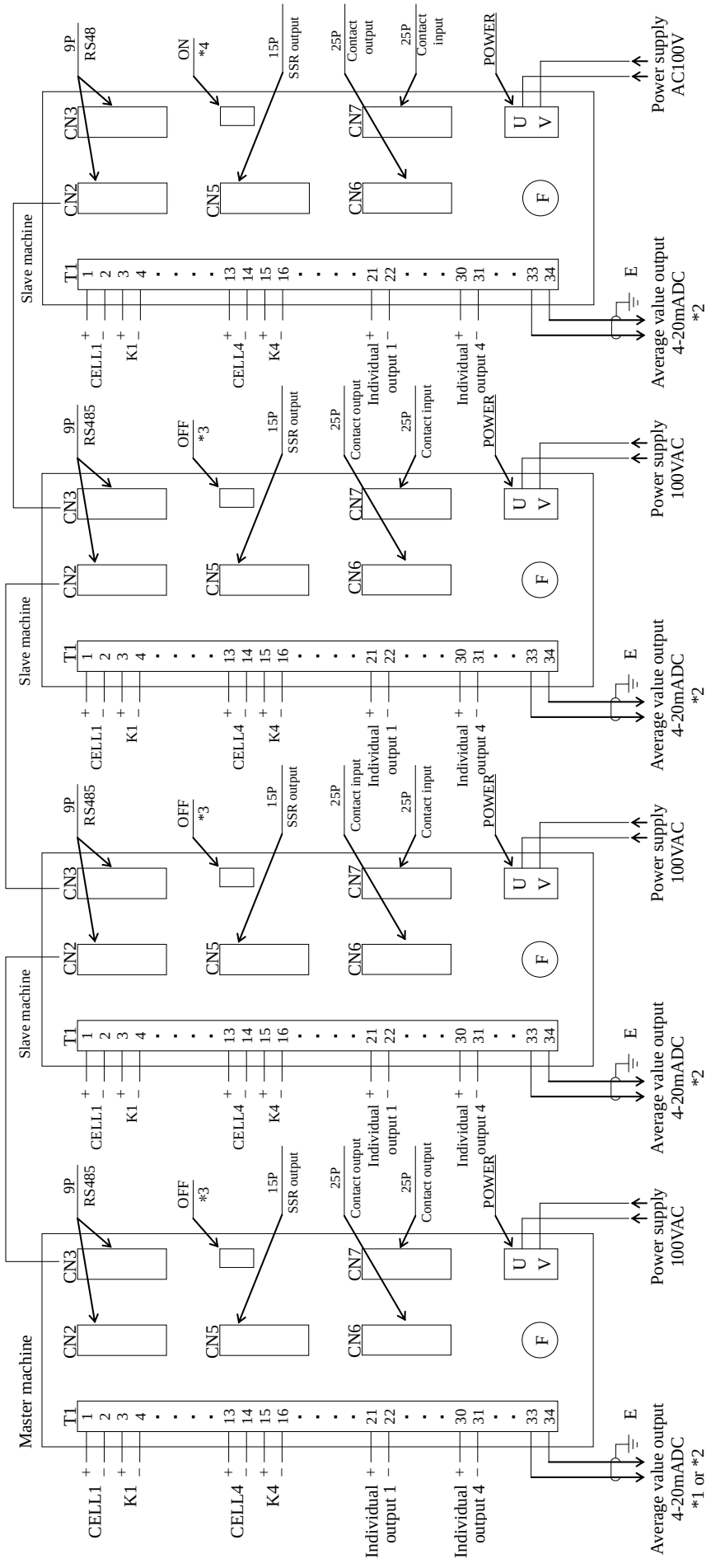
3-3 Wiring method

Perform wiring using the terminal block connectors.

Please take necessary dust/drip-proof measures during installation work.

Perform detailed wiring in accordance with the circuit diagram attached to the delivery drawing.

Example of wiring (see the circuit diagram attached to the delivery drawing for details)



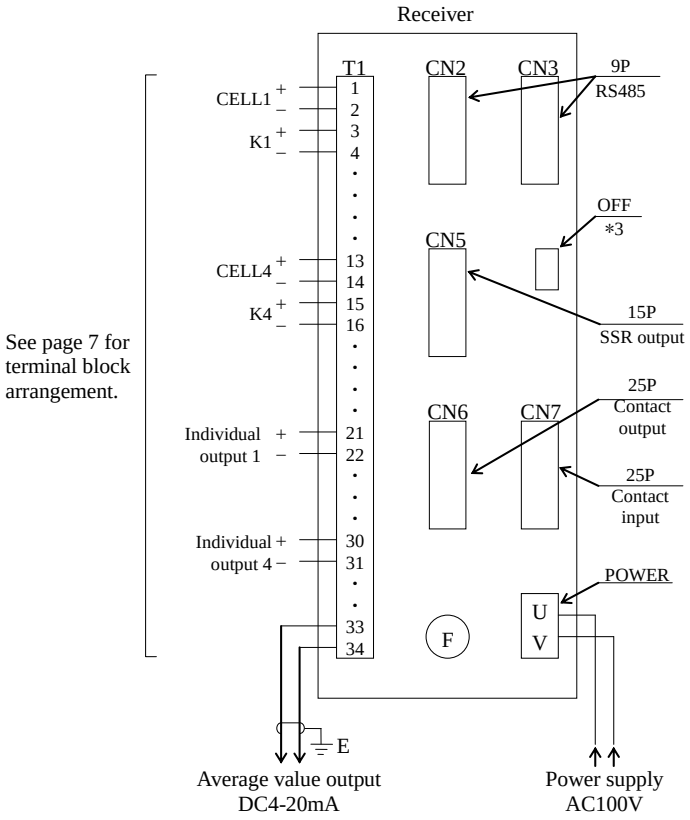
* 1. Average value output (master machine)
CH96 setting 1: Average value output in effective system for machine itself
CH96 setting 2: Average value output in effective system for all connected machines
CH96 setting 3: Average value output of averages in each connected machine

* 2. Average value output in effective system for machine itself

* 3. RS485 bus termination resistor switch

* 4. RS485 bus termination resistor switch, only last termination “ON”

layout of connectors (see the circuit diagram attached to the delivery drawing for details)



CN5
15P
SSR output

1	SSR1
2	SSR2
3	SSR3
4	SSR4
5	COM
6	COM
7	COM
8	COM
9	
10	
11	
12	
13	
14	
15	

CN6
25P
Contact output

1	CAL1
2	CAL2
3	CAL3
4	CAL4
5	CAL-ZERO
6	CAL-SPAN
7	CAL-AIR
8	ANN1
9	ANN2
10	ANN3
11	ANN4
12	MAINTE
13	RANGE-L
14	RENGE-H
15	CAL-END
16	POWER-DO
17	WN
18	CPU-FAIL
19	PURGE1
20	PURGE2
21	PURGE3
22	PURGE4
23	
24	
25	COM

CN7
25P
Contact output

1	Exclusion 1
2	Exclusion 2
3	Exclusion 3
4	Exclusion 4
5	PRG
6	MAINTE
7	RANGE-L
8	RANGE-H
9	REM-CAL
10	REM-PUR
11	GE
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	COM
23	COM
24	
25	

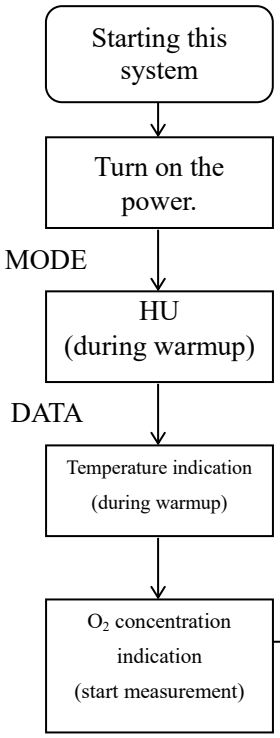
4. Receiver Function List

Item	Description
Average value calculation function	Calculates each average O_2 concentration and continuously displays/outputs calculation results. (Only the master machine can display/output total average calculation results when 2 to 9 receivers are connected.) Master machine: CH No. 94 = 1 Other receivers: CH No. 95 = 2 to 9 Display output function: CH No. 96 = 1 Average in machine itself (same as other receivers) CH No. 96 = 2 Average among all connected sensors CH No. 96 = 3 Average of averages in connected machines Note: DGO-III replacement compatible product has only an average function for the machine itself.
Average value exclusion function	If an error occurs on a channel, the channel will be automatically excluded from average calculation during calibration or with the external exclusion input on. The maximum and minimum values of measurements can also be excluded from average value calculation.
Automatic calibration function	Automatically opens/closes the solenoid valve at preset intervals and performs air, zero, (span gas) calibration.
Automatic purge function	Automatically opens/closes the solenoid valve and performs purge. Note: DGO-III replacement compatible product is not equipped with a purge output port.
First-order lag calculation function	Can perform first-order lag calculation from 0 to 99 seconds through a data setting.
Output hold function	1. When hold 1 is selected; If an error occurs on a channel, its output will be held at preset value 1. During calibration on a channel, its output will be held at preset value 2. 2. When hold 2 is selected; If an error occurs on a channel, its output will be held at preset 1. During calibration on a channel, its output is held at the O_2 value obtained just before the start of calibration. 3. When hold OFF is selected; If an error occurs on a channel, its output will be held at the O_2 value obtained just before the detection. During calibration on a channel, it outputs the O_2 value corresponding to the calibration gas.
WET/DRY Calculation function	Calculates, displays, and outputs the DRY O_2 value corrected for the water content in the exhaust gas, if DRY calculation is on.
Self-diagnosis function	Automatically detects failure locations by self-diagnosis and outputs error indication and alarm contacts.

5. Operation

5-1 Starting the receiver

The basic procedure for starting the receiver is described below.



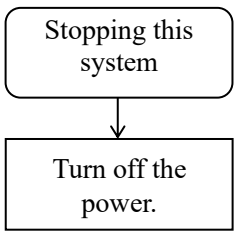
[1] Power on

When the external power switch is turned on, the receiver starts counting down for warmup with "HU" shown on its MODE display; it can take measurements when the detector heater setting temperature is reached.

Check data for each channel (pages 33 to 40)

Note: Normally, data appropriate for the specifications was set prior to shipment from the manufacturer.
If there is a change in calibration gas concentration, it is necessary to change the settings.

5-2 Stopping the receiver



⚠ When turning off the power to the receiver and heater, make sure that the sensor in the transmitter is in the air atmosphere. If not, the sensor may degrade.

Set the receiver's power switch and the heater's power switch to OFF.

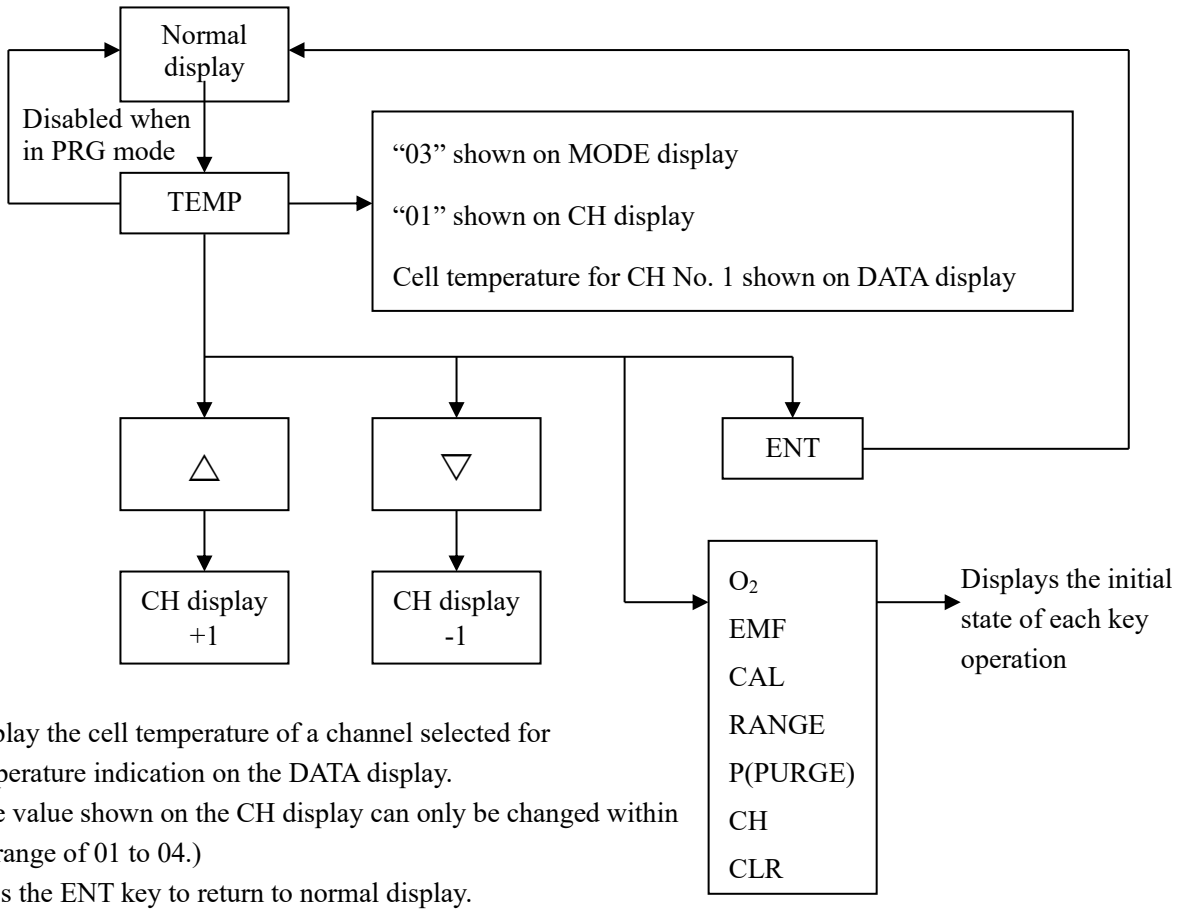
⚠ When inspecting the terminals of the analyzer and receiver or performing maintenance such as removal of wiring, be sure to set the external power (main power supply) switch to OFF beforehand.

5-3 Key operation

(1) How to operate each key:

[1] TEMP key

(MEAS and MAINTE mode)

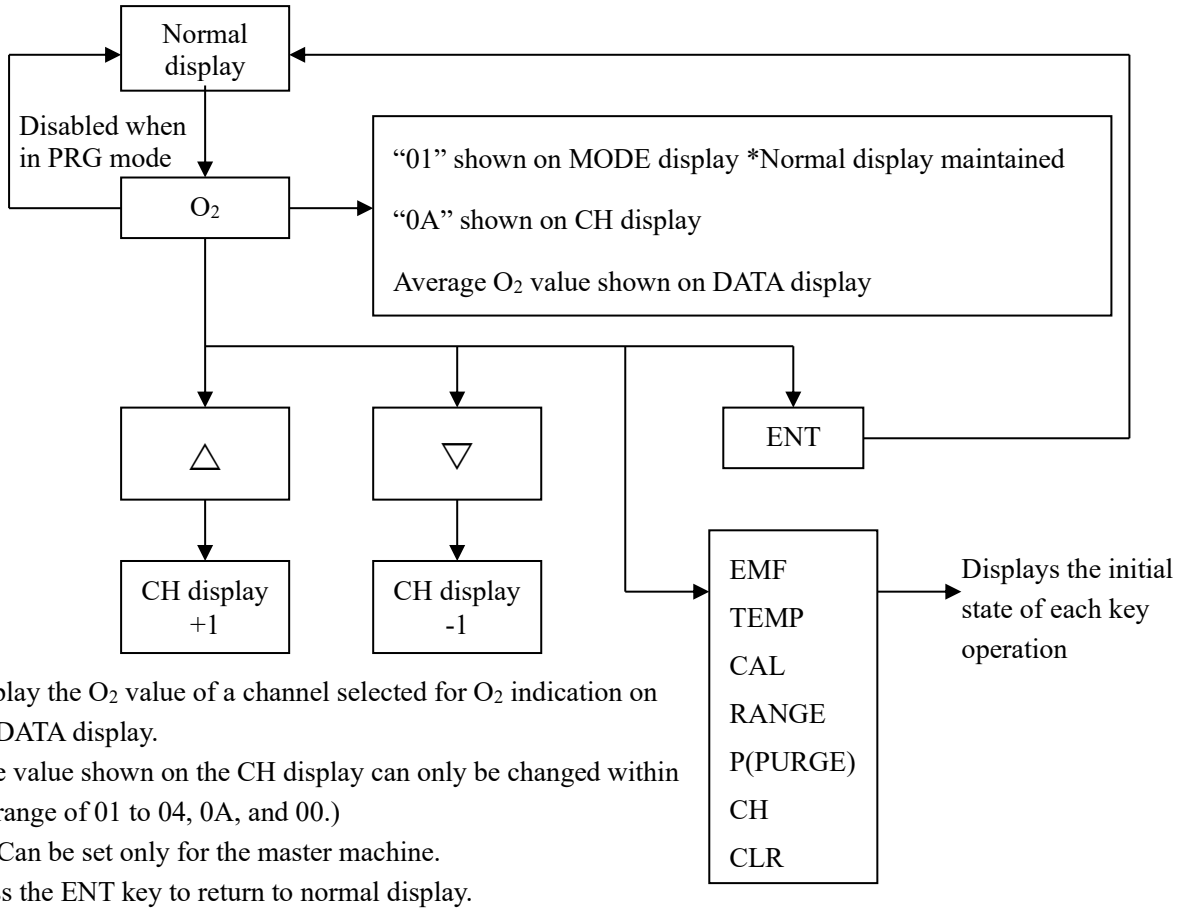


Display the cell temperature of a channel selected for temperature indication on the DATA display.
(The value shown on the CH display can only be changed within the range of 01 to 04.)
Press the ENT key to return to normal display.

* If a particular channel is not selected for system data CH No. 27, "_ _ _ _ _" will appear on the DATA display.

[2] O_2 key

(MEAS and MAINTE mode)



Display the O_2 value of a channel selected for O_2 indication on the DATA display.
(The value shown on the CH display can only be changed within the range of 01 to 04, 0A, and 00.)
00: Can be set only for the master machine.
Press the ENT key to return to normal display.

* If a particular channel is not selected for system data CH No. 27, or if any faulty channels are externally excluded, "_ _ _ _ _" will appear on the DATA display.

If a faulty channel is selected while in O_2 display mode, an error number will be shown on the DATA display as illustrated in the table below.

Table 1: Faulty channel(s) shown on DATA display

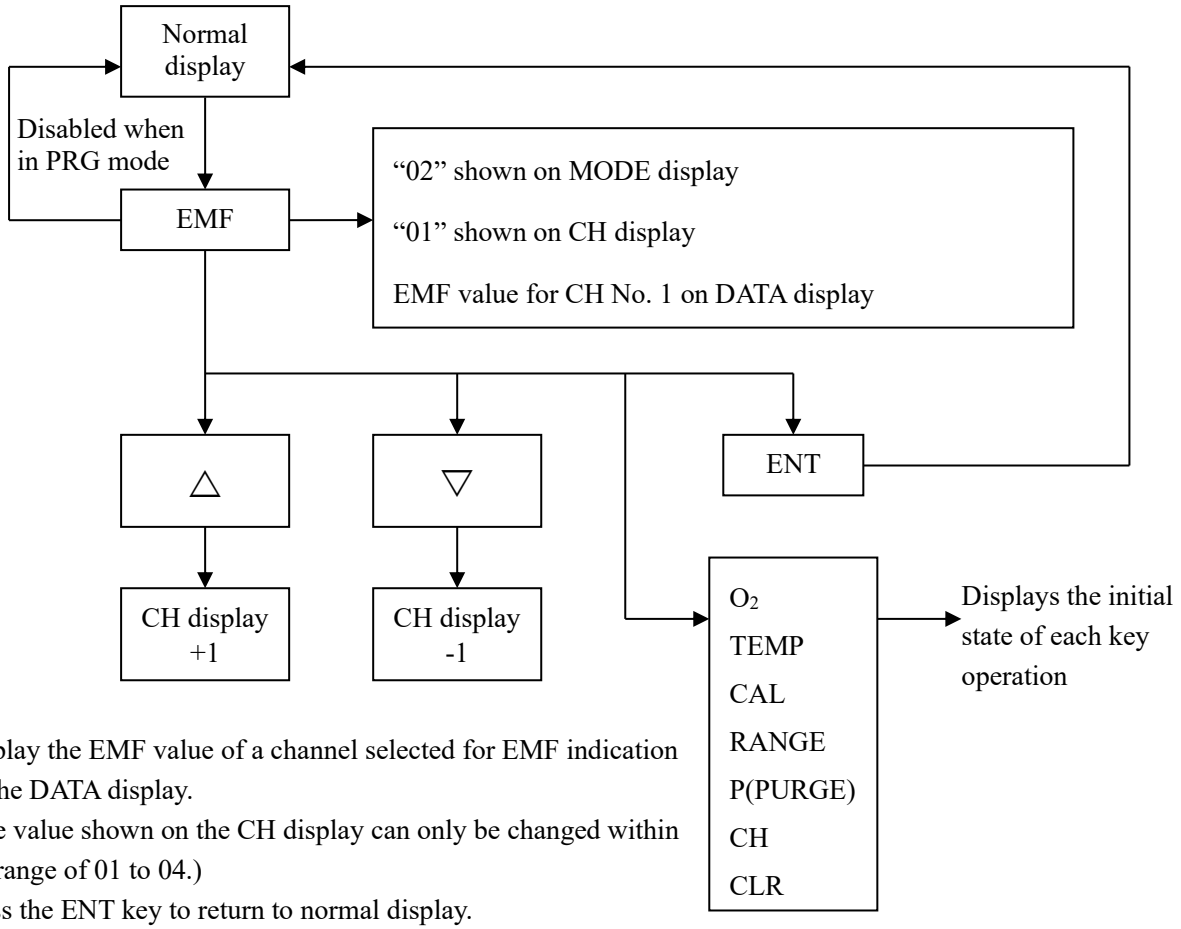
Memory 1 error	E-10 displayed for all channels
Memory 2 error	E-13 displayed for all channels
Thermocouple error	E1 displayed only for faulty channel(s)
Heat rise error	E2 displayed only for faulty channel(s)
Sensor temperature low error	E3 displayed only for faulty channel(s)
Sensor temperature high error	E4 displayed only for faulty channel(s)
Sensor error	E5 displayed only for faulty channel(s)
Early sensor detection error	EA displayed only for faulty channel(s)
Air calibration error	E6 displayed only for faulty channel(s)
Zero and span calibration error	E7 displayed only for faulty channel(s)
Purge error	E8 displayed only for faulty channel(s)
Thermistor error	E9 displayed for all channels

Power turned off: Display off, CPU error: ?? (unforeseeable)

See page 42 for error descriptions and error numbers.

[3] EMF key

(MEAS and MAINTE mode)

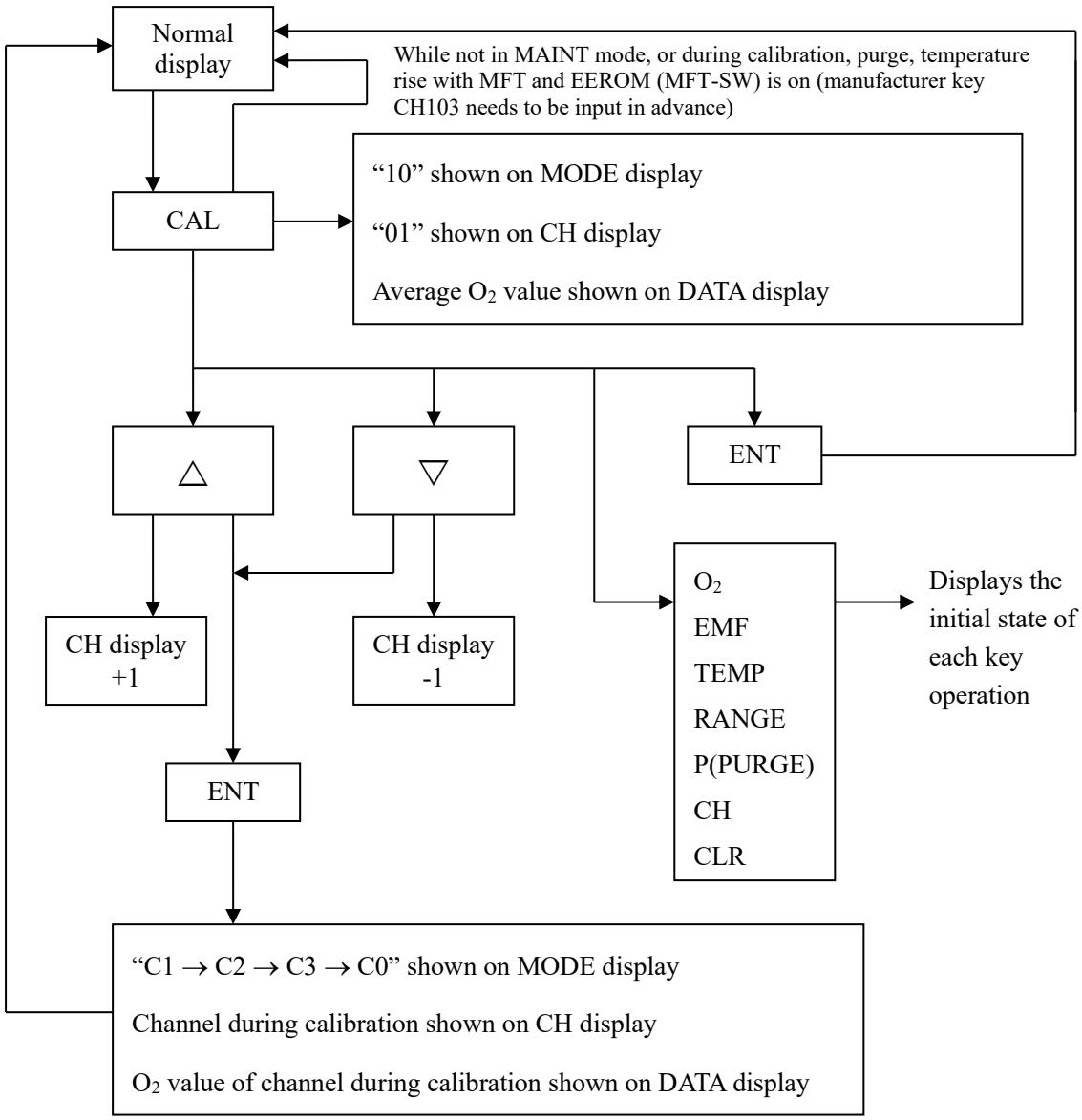


Display the EMF value of a channel selected for EMF indication on the DATA display.
(The value shown on the CH display can only be changed within the range of 01 to 04.)
Press the ENT key to return to normal display.

* If a particular channel is not selected for system data CH No. 27, "_ _ _ _ _" will appear on the DATA display.

[4] CAL key

(MAINTE mode)

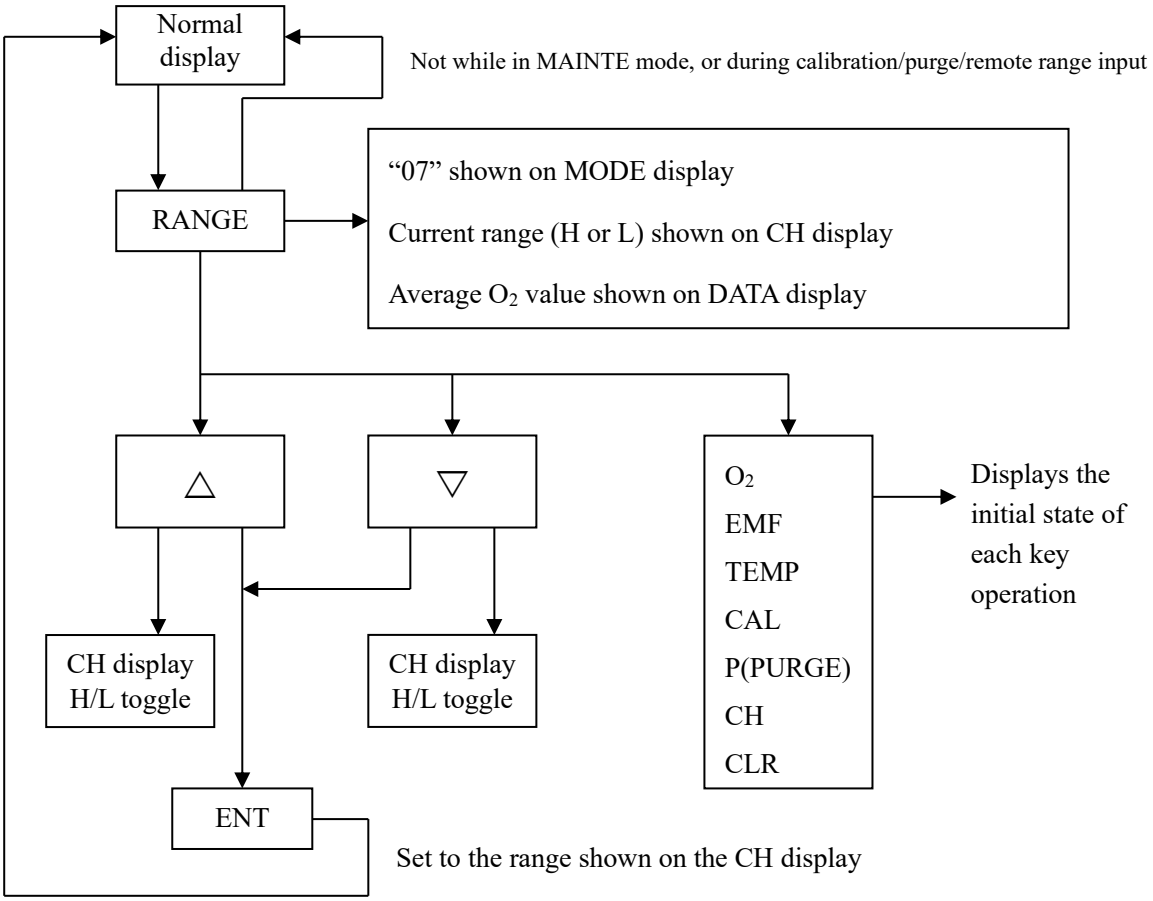


Calibration channel selection
(The value shown on the CH display can only be changed within the range of 01 to 04 and 0A. If you set 0A, all channels will be selected.)
The state of calibration "C1 → C2 → C3 → C0" is shown on the MODE display.

* A channel not selected for CH No. 27 or a faulty channel (described in [2] table 1), channel cannot be selected.
* The information shown on the display during calibration is the same as that shown during automatic calibration.

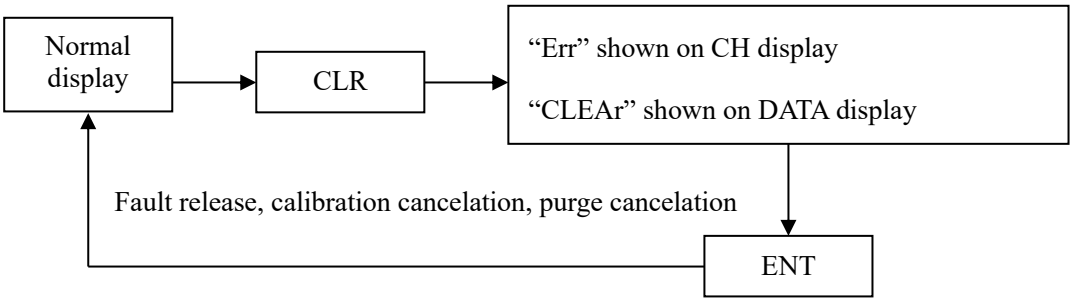
[5] RANGE key

(MAINTE mode)

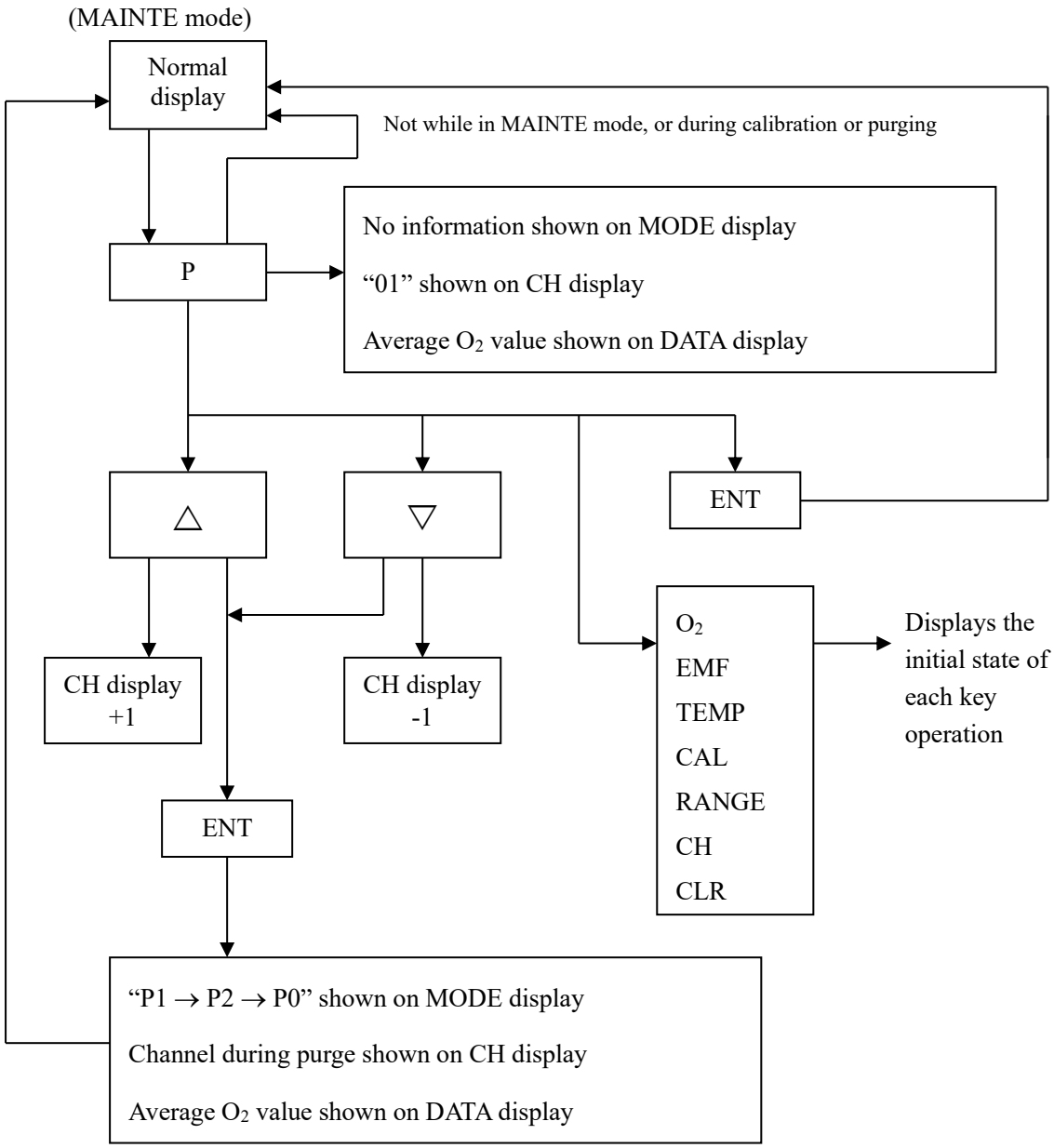


[6] CAL key (MEAS and MAINTE mode)

(fault release for E1 to E9 and E-(n), calibration, purge cancelation)



[7] P (purge) key



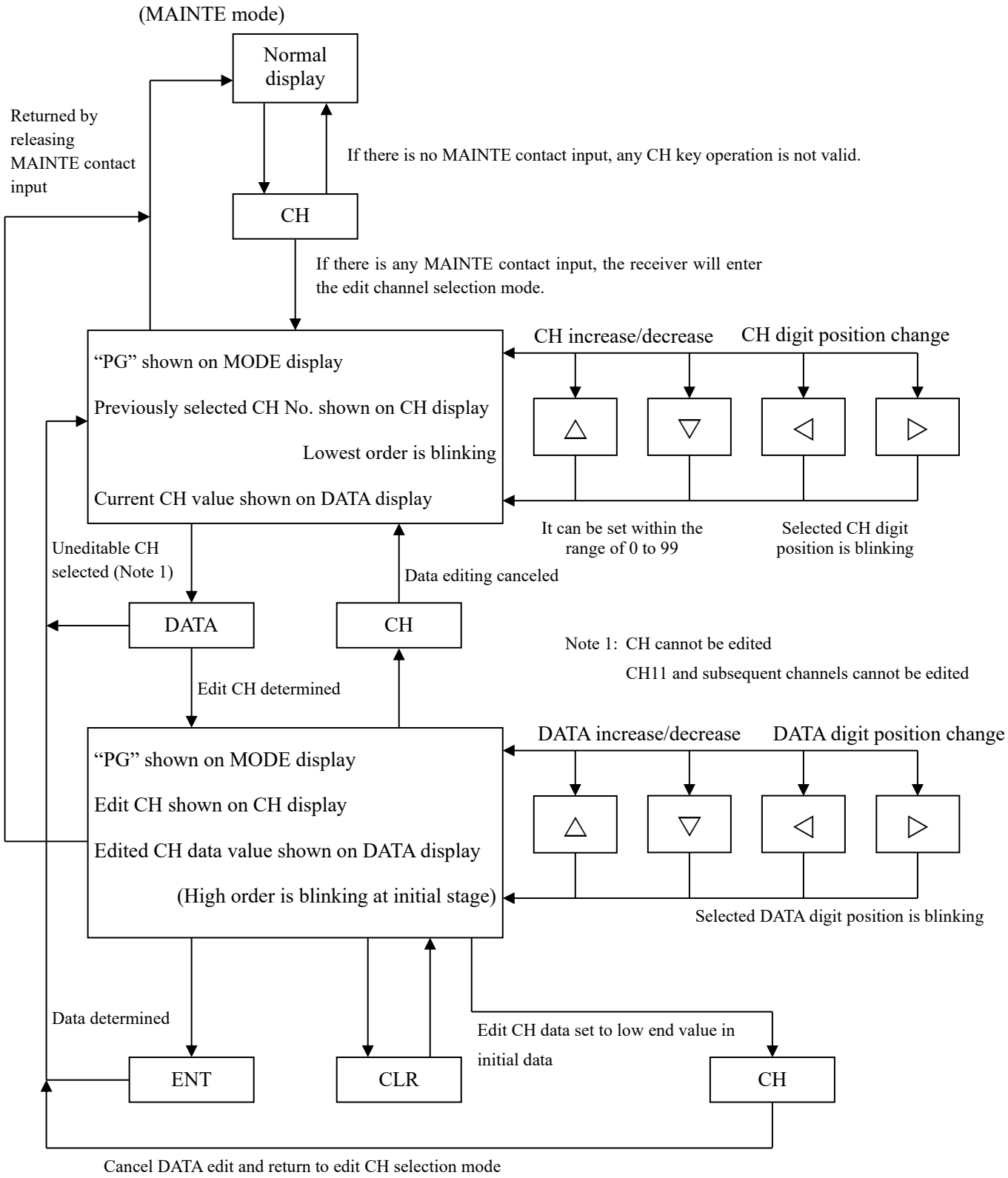
Purge channel selection
(The value shown on the CH display can only be changed within the range of 01 to 04 and 0A. If you set 0A, all channels will be selected.)
The state of purge "P1 → P2 → P0" is shown on the MODE display.

＊ A channel not selected for CH No. 27 cannot be selected.

＊ The information shown on the display during purge is the same as that shown during automatic purge.

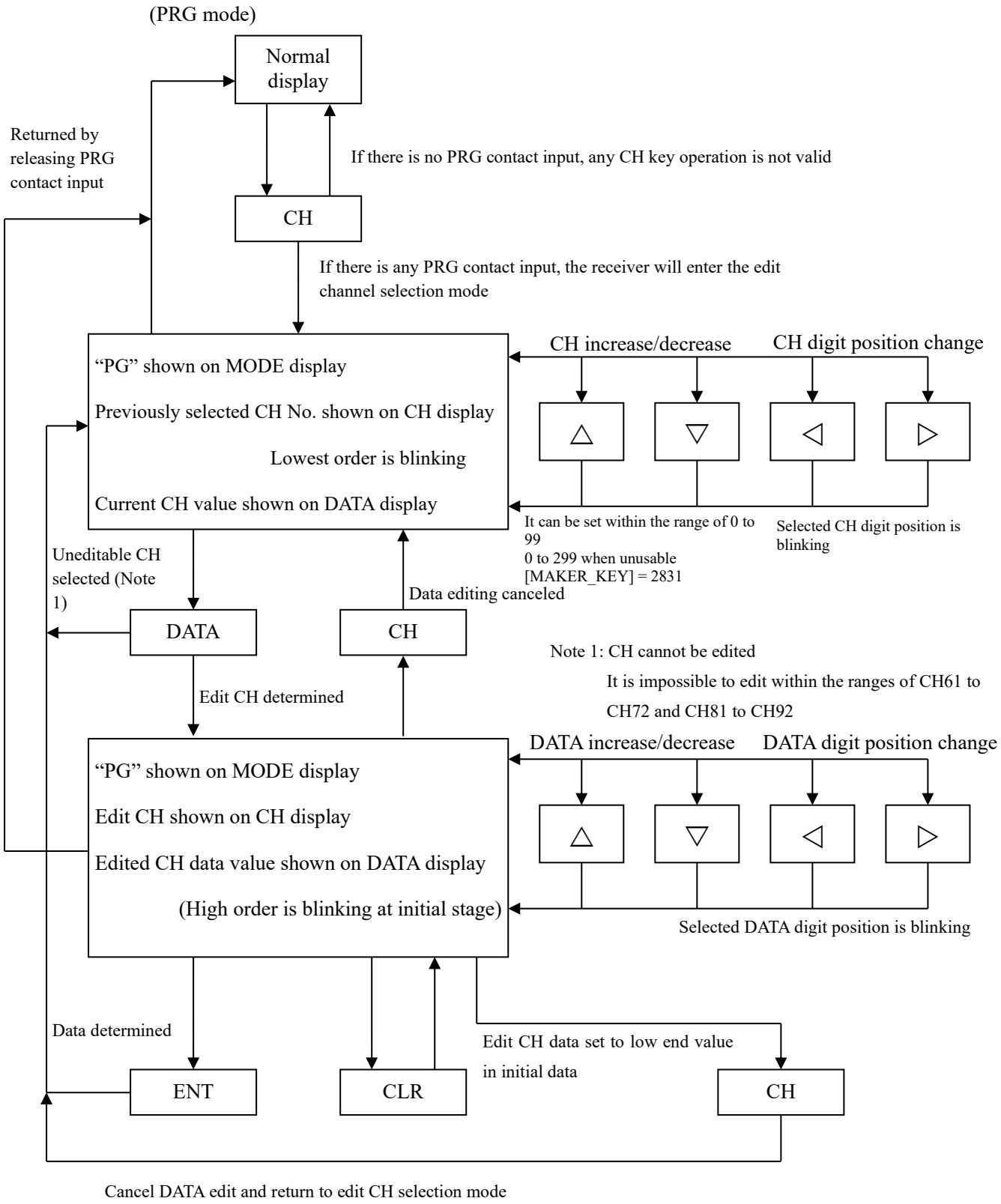
＊ DGO-III replacement compatible product is not equipped with a purge output port: this function cannot be used.

[8] CH, DATA key



∗ When in MAINTE mode, the O_2, EMF, TEMP, CAL, RANGE, P (purge) keys can be used; it is possible to switch to another mode in any of the situations described above. When in edit channel selection mode, use the ENT key to return to normal display.

[9] CH, DATA key



∗ Any key operation other than those above is invalid while in PRG mode.

(2) Range switching method

Follow the procedure below to switch the range using the keys.

You can switch the range with this method only while in MAINTE mode.

If an external range is used, this operation cannot be performed.

Item	Key operation procedure	DISPLAY			Remarks
		MODE	CH	DATA	
Range switched from H to L	RANGE △▽	07	H L	O_2 indication	Note: This operation can be performed only while in MAINTE mode. LED indication changes: H → L → H Only external switching can be performed while LED R is lit.
Range switched from L to H	△▽ ENT	07	L H	O_2 indication	

(3) O_2 concentration indication, sensor electromotive force (EMF) indication

Sensor temperature (TEMP) indication, etc. switching method

[1] O_2 concentration indication switching ····· Switch the individual and average O_2 concentration indications for sensors Nos. 1 to 4.

[2] Sensor electromotive force (EMF) indication switching · Display electromotive force (EMF) of sensors Nos. 1 to 4.

[3] Sensor temperature (TEMP) indication switching ····· Display temperatures of sensors Nos. 1 to 4.

Item	Key operation procedure	DISPLAY			Remarks
		MODE	CH	DATA	
1. Individual O_2 concentration indication switching Example: Switching from average O_2 concentration indication to O_2 concentration indication for each sensor	O_2 △ ▽	01	0A 01 02 03 04	Average value O_2 indication CH1 O_2 indication CH2 O_2 indication CH3 O_2 indication CH4 O_2 indication	It can be performed while in MEAS/MAINTE mode. However, it can be performed only while in MAINTE mode if heat rising, calibration, error is occurring.
2. Average O_2 concentration indication switching Example: Switching from sensor 2 O_2 concentration indication to average O_2 concentration indication	O_2 △ ▽	01	02 03 04 0A (00)	CH2 O_2 indication CH3 O_2 indication CH4 O_2 indication Average value O_2 indication (total average value)	Same as above 00: Master machine only
3. Sensor electromotive force indication switching	EMF △ ▽	02	01 02 03 04	CH1 EMF indication CH2 EMF indication CH3 EMF indication CH4 EMF indication	Same as above
4. Sensor temperature indication switching	TEMP △ ▽	03	01 02 03 04	CH1 temperature indication CH2 temperature indication CH3 temperature indication CH4 temperature indication	Same as above

(4) Gas calibration method

There are two types of gas calibration: manual calibration (manual start) and automatic calibration (automatic start).

- Automatic calibration needs no extra operation except for initial settings (calibration intervals, gas concentration) because it starts automatically at-timer-preset intervals.
- Manual calibration is performed by automatically switching each calibration gas solenoid in accordance with the key operation described below. (This operation occurs regardless of the intervals of automatic calibration.)

If CH No. 26 setting = OFF, sensors that caused an alarm or are excluded from average are not calibrated.

If CH No. 26 setting = 1, only sensors selected for CH.No. 27 that caused an alarm or are excluded from average are also calibrated at the same timing as under normal conditions.

If CH No. 26 setting = 2, sensors that caused an alarm or are excluded from average will also be calibrated at 4 points at the same timing as under normal conditions.

Note: All the MAINTE relays are on during calibration.

Precautions for gas calibration in relation to receiver calibration

If a DGO-III receiver and a DGO-201 receiver are used in combination inside the panel, please edit CH settings in accordance with your calibration sequence and operation method as described below.

- To start calibrating the receivers at the same time:

  DGO-201 ••• CH No. 26 must be set to 1 or 2.

  DGO-III ••• CH No. 26 must be set to OFF.

  For CH No. 27, use the same receiver settings under the same flow conditions.

  In addition, the calibration time setting for DGO-201 receiver CH No. 10 must be 5 seconds longer than that for DGO-III.

- To start each receiver in sequence:

  DGO-201 ••• CH No. 26 must be set to OFF.

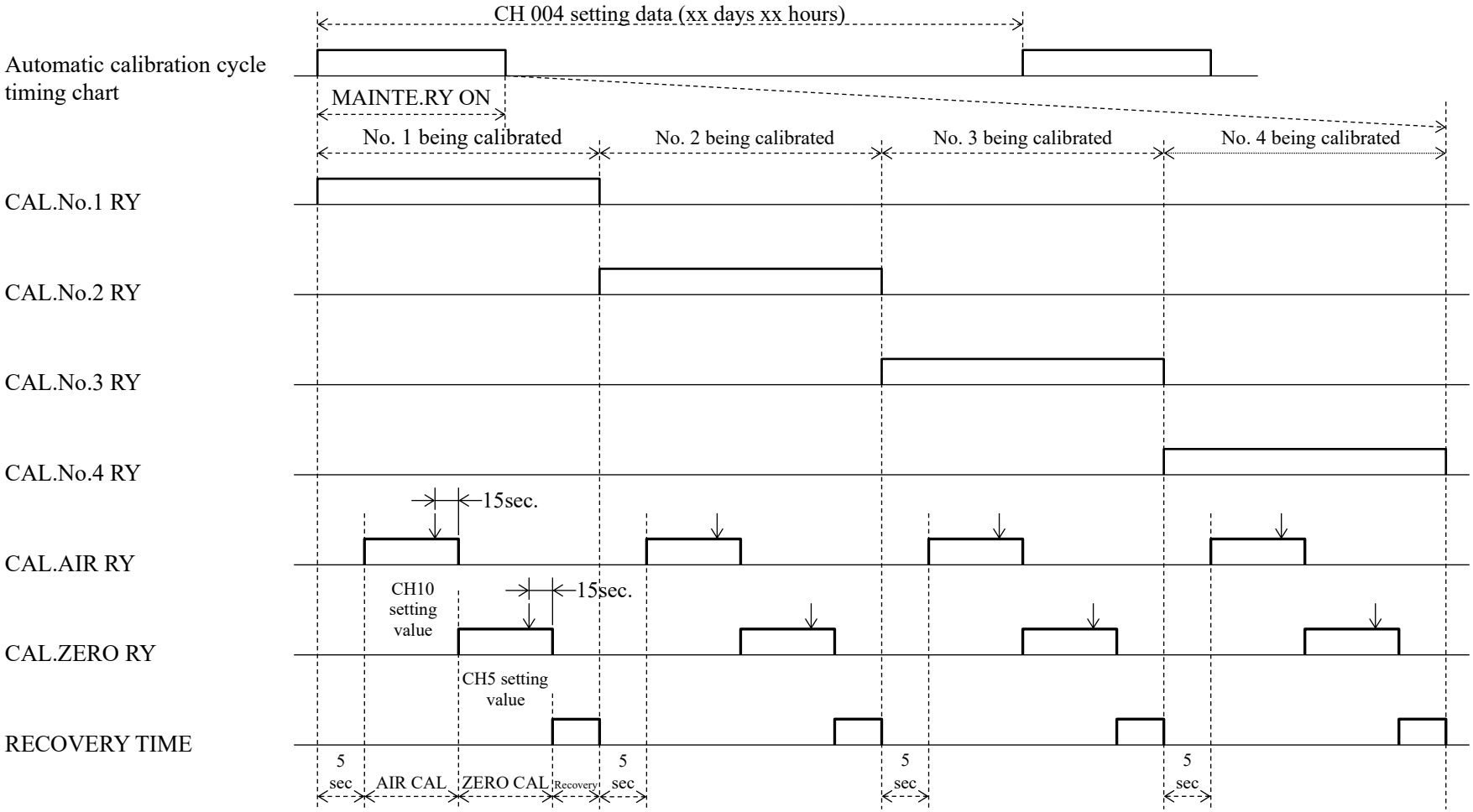
  DGO-III ••• CH No. 26 must be set to ON.

  CAUTION: Do NOT perform calibration using another receiver during calibration.

[1] Manual calibration (individual calibration/overall calibration) key operation and sequence

Key operation	DISPLAY			Sequence	Remarks
	MODE	CH	DATA		
CAL 1 (OR (2) OR (3) OR (4)) ENT	10 C1 C2 C3 C0 01	 01 ⋮ 0A	 CH1 O_2 indication ⋮ Average value O_2 indication	Start of calibration of sensor No. 1 No. 1 calibration air in progress No. 1 calibration zero in progress No. 1 calibration span in progress Recovery in progress Calibration completed	Key operation for individual manual calibration (It is intended to calibrate a particular sensor.) Note: This operation can be performed only while in MAINTE mode.
CAL 0 ENT	10 C1 C2 C0 C1 C0 C1 C0 01	 01 ⋮ 02 ⋮ 03 ⋮ 04 ⋮ 04 0A	 CH1 O_2 indication ⋮ CH2 O_2 indication ⋮ CH3 O_2 indication ⋮ CH4 O_2 indication ⋮ CH4 O_2 indication Average value O_2 indication	Start of calibration of sensor No. 1 No. 1 calibration air in progress No. 1 calibration zero in progress No. 1 recovery in progress No. 2 calibration air in progress ⋮ No. 3 recovery in progress ⋮ No. 4 calibration air in progress ⋮ No. 4 recovery in progress Calibration completed	Key operation for overall manual calibration (It is intended to calibrate all of sensors Nos.1 to 4 consecutively.) In the case of 3-point calibration, span calibration is also performed as described in the example above. Automatic calibration is performed at-preset intervals in a similar manner. Note: This operation can be performed only while in MAINTE mode.

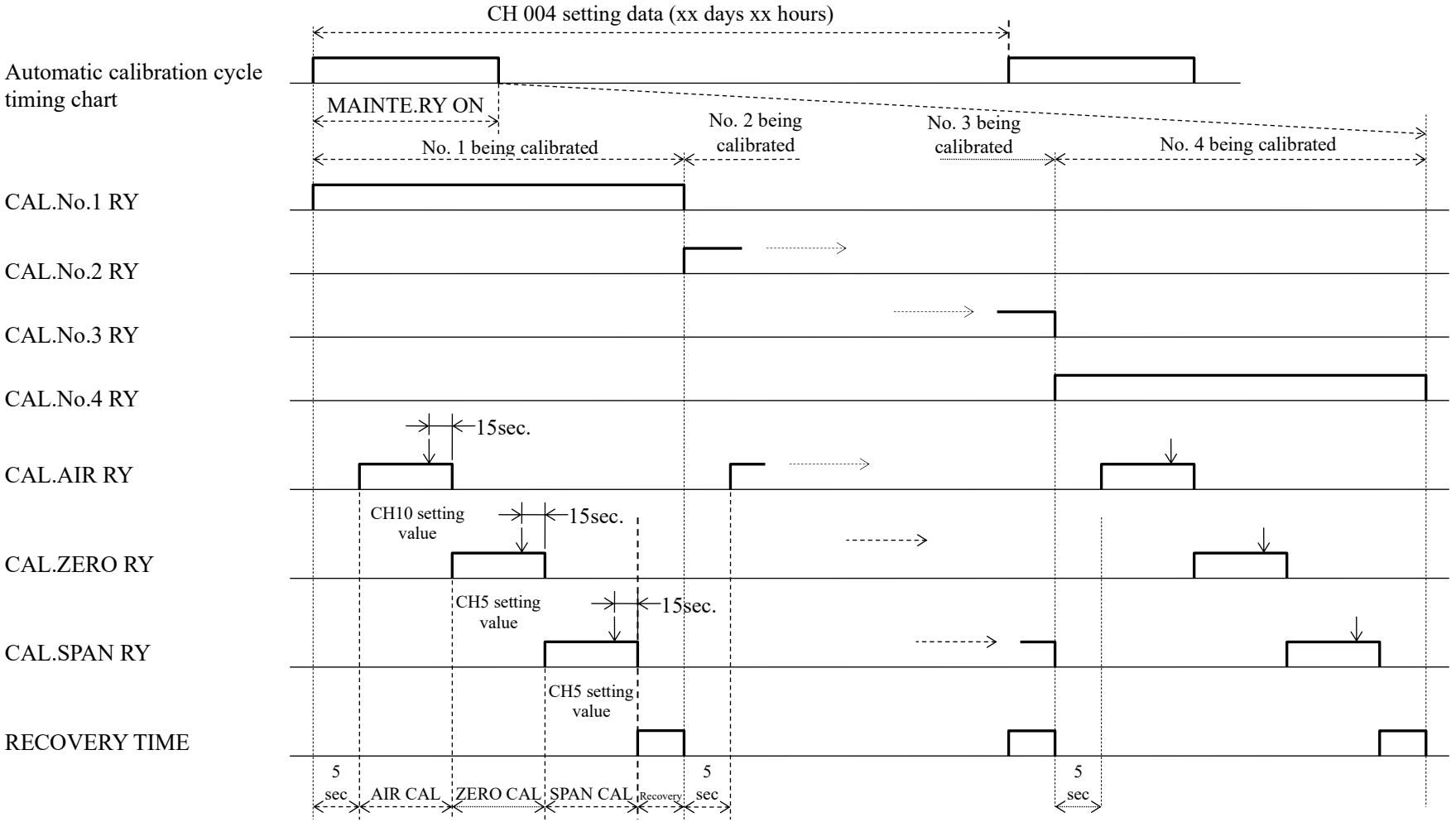
[2] Calibration operation timing chart (2-point calibration when CH024 DATA OFF)



[2] Calibration operation timing chart (2-point calibration when CH.024 DATA = OFF)

Notes: 1. If an external interval timer is provided for automatic calibration, calibration will be triggered by the timer.
2. Individual manual calibration also occurs at similar timing; one of sensors Nos. 1 to 4 is calibrated.
3. If CH No. 26 is OFF, sensors that caused an error or are excluded from average are not calibrated.
If CH No. 26 setting is 1 or 2, sensors that caused an error or are excluded from average will be calibrated at the timing described above.
(Only CH No. 27 selected sensor if CH No. 26 setting is 1)
4. If a calibration trigger occurs during purge, calibration will start after completion of purge. (Manual calibration is invalid.)

[3] Calibration operation timing chart (3-point calibration)



[3] Calibration operation timing chart (3-point calibration when CH.024 DATA ON)

Notes: 1. If an external interval timer is provided for automatic calibration, calibration will be triggered by the timer.
2. Individual manual calibration also occurs at similar timing; one of sensors Nos. 1 to 4 is calibrated.
3. If CH No. 26 is OFF, sensors that caused an error or are excluded from average are not calibrated.
If CH No. 26 setting is 1 or 2, sensors that caused an error or are excluded from average will be calibrated at the timing described above.
(Only CH No. 27 selected sensor if CH No. 26 setting is 1)
4. If a calibration trigger occurs during purge, calibration will start after completion of purge. (Manual calibration is invalid.)

(5) Purge method

There are two types of purge operation: manual purge (manual start) and automatic purge (automatic start).

- Automatic purge needs no extra operation except for initial settings (purge intervals, purge ON/OFF) because it starts automatically at-timer-preset intervals.
- Manual calibration is performed by automatically switching each line gas solenoid in accordance with the key operation described below. (This operation occurs regardless of the intervals of automatic purge.)

Note: All the MAINTE relays are on during purge.

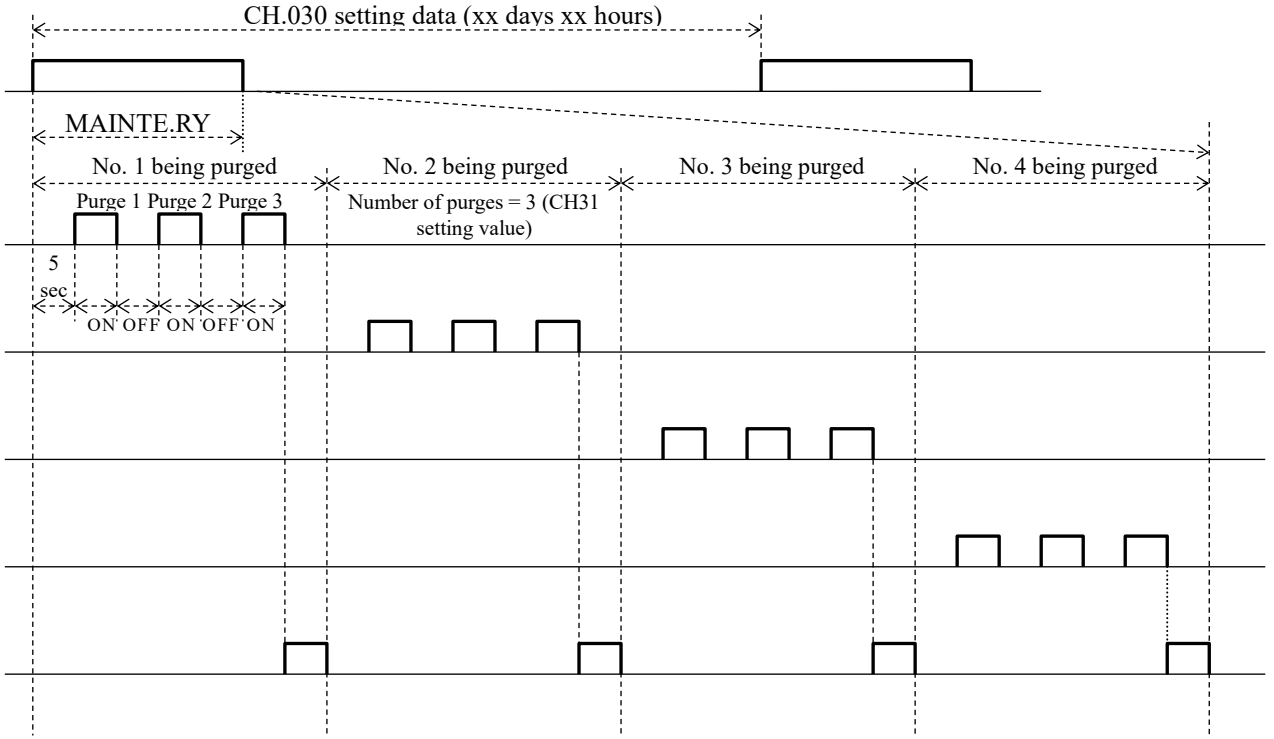
DGO-III replacement compatible product is not equipped with a purge output port: this function cannot be used.

[1] Manual purge (individual purge/overall purge) key operation and sequence

Key operation	DISPLAY			Sequence	Remarks
	MODE	CH	DATA		
P	10				Individual manual purge key operation
1 (OR)	P1	01	Average value O_2 indication	Start of No. 1 purge (ON)	
(2) OR	P2	⋮	⋮	End of No. 1 purge (OFF)	(It is intended to purge a particular sensor.)
(3) OR	P0	01		Recovery in progress	Note: This operation can be performed only while in MAINTE mode.
(4) ENT	01	0A	Average value O_2 indication	Purge completed	
P	10				
0	P1	01	Average value O_2 indication	Start of No. 1 purge (ON)	Overall manual purge key operation
ENT	P2	⋮	⋮	End of No. 1 purge (OFF)	(It is intended to purge all of sensors Nos.1 to 4 consecutively.)
	P0			No. 1 recovery in progress	
	P1	02	Average value O_2 indication	Start of No. 2 purge (ON)	
	⋮	⋮	⋮	⋮	
	P0	03	Average value O_2 indication	No. 3 recovery in progress	
	⋮	⋮	⋮	⋮	Automatic purge is performed at-preset intervals in a similar manner.
	P1	04	Average value O_2 indication	Start of No. 4 purge (ON)	
	P2	04	Average value O_2 indication	End of No. 4 purge (OFF)	
	P0	04	Average value O_2 indication	No. 4 recovery in progress	
	⋮	⋮	⋮	⋮	Note: This operation can be performed only while in MAINTE mode.
	01	0A	Average value O_2 indication	Purge completed	

[2] Purge operation timing chart

Automatic purge cycle timing chart



Notes: 1. If an external interval timer is provided for automatic purge, purge will be triggered by the timer.

2. Individual manual purge also occurs at similar timing; one of sensors Nos. 1 to 4 is purged.

3. If a purge trigger occurs during calibration, purge will start after completion of calibration.
(Manual calibration is invalid.)

4. DGO-III replacement compatible product is not equipped with a purge output port: this function cannot be used.

5-4 Key operation and information displayed in PRG mode

CH Nos. 1 to 10 can be set while in MAINTE mode as in PRG mode.

Data can be checked while in MAINTE mode .

Item	Key operation	DISPLAY			Remarks
		MODE	CH	DATA	
1. Calibration gas concentration air settings (20.90%)	CH 01 DATA △▽ 20.90 ENT	PG	01	Existing setting data 20.90 20.90	Instrumentation air ≈ 20.90% O_2 Atmospheric air ≈ 20.60% O_2 Be sure to check them before calibration.
2. Calibration gas concentration zero setting (ex. 1.35%)	CH 02 DATA △▽ 1.35 ENT	PG	02	Existing setting data 1.35 1.35	Be sure to check the O_2 concentration before calibration.
3. Calibration gas concentration span setting (ex. 9.68%)	CH 03 DATA △▽ 9.68 ENT	PG	03	Existing setting data 9.68 9.68	Be sure to check the O_2 concentration before calibration. Valid only when 3-point calibration selected 0 is acceptable when DATA for 2-point calibration is selected
4. Automatic calibration function Interval setting (ex. 20 days, 6 hours)	CH 04 DATA △▽ 20.06 ENT	PG	04	Existing setting data 20.06 20.06	Setting range: 0 to 99 days Time: 1 to 23 hours See the automatic timing charts on pages 28 and 29.
5. Calibration time setting (zero span gas) (ex. 3 minutes 00 seconds)	CH 05 DATA △▽ 3.00 ENT	PG	05	Existing setting data 3.00 3.00	Setting range: 0 to 99 minutes 1 to 59 seconds See the automatic timing charts on pages 28 and 29.
6. Calibration/purge recovery time setting (zero span gas) (ex. 1 minute 00 seconds)	CH 06 DATA △▽ 1.00 ENT	PG	06	Existing setting data 1.00 1.00	Setting range: 0 to 99 minutes 1 to 59 seconds See the calibration timing charts and purge timing chart on pages 28, 29, and 31.
7. First-order lag calculation time constant setting (ex. 3 seconds)	CH 07 DATA △▽ 3 ENT	PG	07	Existing setting data 3 3	Setting range: 0 to 99 seconds

Item	Key operation	DISPLAY			Remarks
		MODE	CH	DATA	
8. Hold value setting (preset 1) (ex. 100%)	CH 08 DATA △▽ 100 ENT	PG	08	Existing setting data 100 100	Note: All current outputs of Nos. 1 to 4 and average O_2 value are held at preset 1 data when PRG mode is selected.
9. Hold value setting (preset 2) (ex. 50%)	CH 09 DATA △▽ 50 ENT	PG	09	Existing setting data 50 50	
10. Calibration time setting (air) (ex. 3 minutes 00 seconds)	CH 10 DATA △▽ 3.00 ENT	PG	10	Existing setting data 〃 3.00 3.00	Setting range: 2 to 60 minutes 0 to 59 seconds
11. Low range span setting (ex. 5%)	CH 11 DATA △▽ 5 ENT	PG	11	Existing setting data 5 5	Normally, it does not need to be changed because it is set in accordance with the specifications prior to shipment.
12. Low range zero setting (ex. 0%)	CH 12 DATA △▽ 0 ENT	PG	12	Existing setting data 0 0	Same as above
13. High range span setting (ex. 25%)	CH 13 DATA △▽ 25 ENT	PG	13	Existing setting data 25 25	Same as above
14. High range zero setting (ex. 0%)	CH 14 DATA △▽ 0 ENT	PG	14	Existing setting data 0 0	Same as above

Item	Key operation	DISPLAY			Remarks
		MODE	CH	DATA	
15. Sensor temperature low error setting (ex. 600ºC)	CH 15 DATA △▽ 600 ENT	PG	15	Existing setting data 600 600	Setting range: 300ºC to 1000ºC Its factory setting corresponds to the temperature set for the connected transmitter (ex. 650ºC). Normally, it does not need to be changed.
16. Sensor temperature high error setting (ex. 700ºC)	CH 16 DATA △▽ 700 ENT	PG	16	Existing setting data 700 700	same as above
17. Purge error	CH 17 DATA △▽ -10 ENT	PG	17	Existing setting data -10 -10	Setting range: -50 to 0 mV Its factory setting corresponds to the offset value error limit for the connected transmitter. Normally, it does not need to be changed.
18. WET/DRY calculation switching	CH 21 DATA △▽ △ ENT	PG	21	OFF(ON) 〃 ON(OFF) ON(OFF)	Set it to ON or OFF to enable or disable DRY calculation, respectively. Toggle between ON and OFF using the △▽ keys.
19. Gaseous/solid, liquid fuel switching	CH 22 DATA △▽ ON(OFF) ENT	PG	22	OFF(ON) 〃 ON(OFF) ON(OFF)	When performing DRY calculation, set it to ON or OFF for solid/liquid or gaseous fuel, respectively. Toggle between ON and OFF using the △▽ keys.
20. Automatic calibration With/Without setting	CH 23 DATA △▽ ON(OFF) ENT	PG	23	OFF(ON) 〃 ON(OFF) ON(OFF)	Set it to ON or OFF to enable or disable automatic calibration calculation, respectively. Toggle between ON and OFF using the △▽ keys.
21. Calibration 2-point/3-point switching	CH 24 DATA △▽ ON(OFF) ENT	PG	24	OFF(ON) 〃 ON(OFF) ON(OFF)	Set it to ON or OFF to perform air/span/zero 3-point or air/zero 2-point calibration, respectively. Toggle between ON and OFF using the △▽ keys.
22. Output hold function selection (ex. hold 2 selected)	CH 25 DATA △▽ ON (1 or 2) ENT	PG	25	OFF (1 or 2) 〃 2 (1 or OFF) 2 (1 or OFF)	When hold 1 is selected; When error occurs ••• Preset 1 used During calibration ••• Preset 2 used When hold 2 is selected; When error occurs ••• Preset 1 used During calibration ••• O_2 value obtained just before start of calibration When hold OFF selected; When error occurs ••• O_2 value obtained just before occurrence During calibration ••• O_2 value corresponding to calibration gas is output Hold will be performed respectively. Switch OFF·1·2 using △▽ keys.

Item	Key operation	DISPLAY			Remarks
		MODE	CH	DATA	
23. Calibration operation selection	CH 26 DATA △▽ ON (1 or 2) ENT	PG	26	OFF (1 or 2) 1 or 2 (OFF) 1 or 2 (OFF)	Normally, it does not need to be changed because it is set in accordance with the specifications prior to shipment. OFF: Lines not measured skipped 1: Only sensors with CH27 selected 2: Sensors with CH27 not selected are also calibrated. (4-point)
24. Sensors Nos. 1 to 4 operation selection (ex.) No.1 to No.3 On No.4 Off	CH 27 DATA △▽ 1110 ENT	PG	27	1111 1110 1110	DATA display [1] [1] [1] [0] Sensor No. 1/No. 2/No. 3/No. 4
25. Output timing shift	CH 28 DATA △▽ 3 ENT	PG	28	Existing setting data 3 0003	Normally, it is set to 3 seconds. Setting range: 0 to 30 seconds Note: The previous value is hold during CH 99 error display delay.
26. Purge switch DGO-III replacement compatible product is not equipped with a purge output port: this setting cannot be used.	CH 29 DATA △▽ AON/ON ENT	PG	29	OFF/ON/AON AON/ON/OFF AON/ON/OFF	Normally, it does not need to be changed because it is set in accordance with the specifications prior to shipment. OFF: [1] Purge function available only for external input ON: [2] Manual purge function available + [1] AON: Automatic timer-triggered purge function available + [2]
27. Automatic purge Interval setting (ex. 10 days, 6 hours)	CH 30 DATA △▽ 10.0 6 ENT	PG	30	Existing setting data 10.00 10.06	Setting range: 0 to 99 days Time: 0 to 23 hours See the purge timing chart on page 32.
28. Number of purges (ex. 5 times)	CH 31 DATA △▽ 5 ENT	PG	31	Existing setting data 5 0005	Setting range: 1 to 99 cycles See the purge timing chart on page 32.
29. Purge ON time setting (ex. 10 seconds)	CH 32 DATA △▽ 10 ENT	PG	32	Existing setting data 10 10	Setting range: 1 to 99 seconds See the purge timing chart on page 32.
30. Purge OFF time setting (ex. 10 seconds)	CH 33 DATA △▽ 10 ENT	PG	33	Existing setting data 10 10	Setting range: 1 to 99 seconds See the purge timing chart on page 32.

Item	Each component	Key operation	DISPLAY			Remarks
			MODE	CH	DATA	
31. Each component setting in gaseous fuel	CO2 (ex.1Vo1%)	CH34 DATA △▽ → 1 ENT	PG	34	Existing setting data 1 1	It needs to be set if DRY calculation ON and solid/liquid fuel OFF.
	CO (ex.1Vo1%)	CH35 DATA △▽ → 1 ENT	PG	35	Existing setting data 1 1	Same as above
	H2 (ex.1Vo1%)	CH36 DATA △▽ → 1 ENT	PG	36	Existing setting data 1 1	Same as above
	CH4 (ex.80Vo1%)	CH37 DATA △▽ → 80 ENT	PG	37	Existing setting data 80 80	Same as above
	C2H6 (ex.10Vo1%)	CH38 DATA △▽ → 10 ENT	PG	38	Existing setting data 10 10	Same as above
	C3H8 (ex.2Vo1%)	CH39 DATA △▽ → 2 ENT	PG	39	Existing setting data 2 2	Same as above
	C4H10 (ex.1Vo1%)	CH40 DATA △▽ → 1 ENT	PG	40	Existing setting data 1 1	Same as above
	C5H12 (ex.1Vo1%)	CH41 DATA △▽ → 1 ENT	PG	41	Existing setting data 1 1	Same as above
	N2 (ex.1Vo1%)	CH42 DATA △▽ → 1 ENT	PG	42	Existing setting data 1 1	Same as above
	O2 (ex.1Vo1%)	CH43 DATA △▽ → 1 ENT	PG	43	Existing setting data 1 1	Same as above
	H2O (ex.1Vo1%)	CH44 DATA △▽ → 1 ENT	PG	44	Existing setting data 1 1	Same as above

Item	Each component	Key operation	DISPLAY			Remarks
			MODE	CH	DATA	
32. Each component setting in solid/liquid fuel	C (ex.80wt%)	CH45 DATA △▽ →80 ENT	PG	45	Existing setting data 80 80	It needs to be set if DRY calculation ON and solid/liquid fuel O.
	H (ex.10wt%)	CH46 DATA △▽ →10 ENT	PG	46	Existing setting data 10 10	Same as above
	S (ex.2wt%)	CH47 DATA △▽ →2 ENT	PG	47	Existing setting data 2 2	Same as above
	N (ex.2wt%)	CH48 DATA △▽ → 2 ENT	PG	48	Existing setting data 2 2	Same as above
	H2O (ex.2wt%)	CH49 DATA △▽ → 2 ENT	PG	49	Existing setting data 2 2	Same as above
	O (ex.2wt%)	CH50 DATA △▽ → 2 ENT	PG	50	Existing setting data 2 2	Same as above

Item	Key operation	DISPLAY			Remarks
		MODE	CH	DATA	
33. Temperature control P constant setting (ex.20%)	CH51 DATA △▽ 20 ENT	PG	51	Default value data 20 20	Set to 20% prior to shipment. Setting range: 0% to 100% Normally, it does not need to be changed.
34. Temperature control I constant setting (ex.80%)	CH52 DATA △▽ 80 ENT	PG	52	Default value data 80 80	Set to 80 seconds prior to shipment. Setting range: 0 to 2000 seconds Normally, it does not need to be changed.
35. Temperature control D constant setting (ex. 0 seconds)	CH53 DATA △▽ 0 ENT	PG	53	Default value data 0 0	Set to 0 seconds prior to shipment. Setting range: 0 to 2000 seconds Normally, it does not need to be changed.
36. Heater control temperature setting (ex.650ºC)	CH55 DATA △▽ 650 ENT	PG	55	Default value data 650 650	Its factory setting corresponds to the temperature set for the connected transmitter (ex. 650ºC). Setting range: 500ºC to 800ºC Normally, it does not need to be changed.
37. Heat rise error time setting (ex. 10 minutes)	CH56 DATA △▽ 10 ENT	PG	56	Default value data 10 10	Set to 10 minutes prior to shipment. Setting range :5 to 60 minutes Normally, it does not need to be changed.
38. Sensor electromotive force monitoring during previous calibration CH.No.61 to 72 (ex.) No. 1 air EMF CH61 No. 4 span EMF CH72	CH 61	PG	61	Sensor EMF indication	Select a CH number to display its sensor electromotive force obtained during the previous calibration.
	CH 72	PG	72	Sensor EMF indication	
39. Acceptable calibration range (air) setting (ex.±10mV)	CH73 DATA △▽ 10 ENT	PG	73	Default value data 10 10	Set to ±10 mV prior to shipment. Setting range: ±5 to 50 mV Normally, it does not need to be changed.
40. Acceptable calibration range (zero/span) setting (ex.±30%)	CH74 CH75 DATA △▽ 30 ENT	PG	Zero 74 Span 75	Default value data 30 30	Set to ±30% prior to shipment. Setting range: ±15% to 50% Normally, it does not need to be changed.

Item	Key operation	DISPLAY			Remarks	
		MODE	CH	DATA		
41. O2 value monitoring just before calibration CHNo.81 to 92	CH81	PG	81	Air O2	Sensor No. 1	Select a CH number to display its O2 value obtained just before calibration.
	CH82	PG	82	Zero gas O2		
	CH83	PG	83	span gas O2		
	CH84	PG	84	Air O2	Sensor No. 2	
	CH85	PG	85	Zero gas O2		
	CH86	PG	86	span gas O2		
	CH87	PG	87	Air O2	Sensor No. 3	
	CH88	PG	88	Zero gas O2		
	CH89	PG	89	span gas O2		
	CH90	PG	90	Air O2	Sensor No. 4	
	CH91	PG	91	Zero gas O2		
	CH92	PG	92	span gas O2		
42. Switch CH100 and subsequent permission switches	CH93	PG	93	****	Switch CH100 and subsequent switches are reserved for the manufacturer.	
43. Measuring instrument setting	CH94 DATA △▽ 1 ENT	PG	94	Default value data 1 1	Set to 1 for master machine (The compatible replacement is not equipped with this function.) Setting range: 1 to 9 Normally, it does not need to be changed.	
44. Number of connected measuring instruments (total number including the machine itself)	CH95 DATA △▽ 1 ENT	PG	95	Default value data 1 1	Can be used only for master machine (The compatible replacement is not equipped with this function.) Setting range: 1 to 9 Normally, it does not need to be changed.	
45. Average value output selection 1: Average in machine itself 2: Average among all connected machines 3: Average of averages in connected machines	CH96 DATA △▽ 1 ENT	PG	96	Default value data 1 1	Can be used only for master machine (The compatible replacement is not equipped with this function.) Setting range: 1 to 3 Normally, it does not need to be changed.	
46. Sensor error detection electromotive force (ex.-20mV)	CH97 DATA △▽ -20 ENT	PG	97	Default value data -20 -20	Set to -20 mV prior to shipment. Normally, it does not need to be changed; it may be changed for early detection of sensor errors. (setting value to be discussed separately) Setting range: -5 to -20 mV	
47. Sensor error detection sensitivity (ex.100%)	CH97 DATA △▽ 100 ENT	PG	98	Default value data 100 100	Set to 100% prior to shipment. Normally, it does not need to be changed; it may be changed for early detection of sensor errors. (setting value to be discussed separately) Setting range: 10% to 100%	
48. Error indication delay time	CH99 DATA △▽ 2 ENT	PG	99	Default value data 2 0002	Normally, it is set to 2 seconds. Setting range: 0 to 30 seconds Note: If it is longer than the output timing time for CH28, the hold value is used as output value.	

5-5 System data setting error

Error code	Description
E-33	The following order does not apply: Calibration air gas O_2 concentration > Span gas O_2 concentration > Calibration zero gas O_2 concentration.
E-37	Automatic calibration interval exceeds Calibration time x (Number of calibration points) + (Calibration recovery) x 4.
E-40	Ranger L zero and span exceeds 100%; or span and zero are same.
E-41	Ranger H zero and span exceeds 100%; or span and zero are same.
E-42	Total gaseous fuel is 100% or more.
E-43	Total of solid and liquid fuel is 100% or more.
E-45	Sensor temperature low error is higher than - 20ºC of Heater temperature setting.
E-46	Sensor temperature high error is lower than +10ºC of Heater temperature setting.
E-54	Automatic calibration interval exceeds (Purge ON time + Purge OFF time) x Number of purges + Purge recovery) x 4.

Note: This error code is displayed when switched from PRG mode to MEAS and MAINTE mode. If an error code is displayed, review the data for the corresponding channel and reset it.

5-6 Alarm display and operation

Note: --blank

Error description	MODE display	CH indicator	Contact output	Current output	Remarks
1. Power off error	--	--	POWER DOWNN RY OFF	0 mA output	All displays and LEDs are off.
2. CPU error	??	??	CPU FAIL RY ON	Unforeseeable	Normally, it is reset and restarted.
3. Memory 1 error	E-	10	ANN1 to 4 RY ON	4 mA output	ROM or RAM error Measurement canceled
4. Memory 2 error	E-	13	〃	〃	Data cannot be updated. Measurement canceled
5. Thermocouple error	E1	0(n)	Corresponding ANN RY ON	Corresponding output is on hold	(n) indicates a sensor number (i.e., 1, 2, 3, or 4). Corresponding sensor measurement canceled and temperature control stopped
6. Heat rise error	E2	0(n)	〃	〃	Same as above
7. Sensor temperature low error	E3	0(n)	〃	〃	Same as above
8. Sensor temperature high error	E4	0(n)	〃	〃	Same as above
9. Sensor error	E5	0(n)	〃	〃	(n) indicates a sensor number (i.e., 1, 2, 3, or 4). Corresponding sensor measurement canceled and temperature control going on
10. Early sensor detection error	EA	0(n)	〃	〃	Same as above
11. Air calibration error	E6	0(n)	〃	〃	Same as above
12. Zero and span calibration error	E7	0(n)	〃	〃	Same as above
13. Purge error	E8	0(n)	ANN1 to 4 RY ON	〃	Sensor error (filter clogged) during purge Corresponding sensor measurement canceled and temperature control continues
14. Thermistor error	E9	0A	〃	4 mA output	Thermistor disconnected/short-circuited Corresponding sensor measurement canceled and temperature control continues

[1] Error retention: Of the error indications described above, E1 to E9 continue to be displayed. Therefore, clear the error indication after inspection and correction of the faulty part.
To clear the error indication, press the CLR and ENT keys while in MEAS. or MAINTE. mode.
(See [4] for details.)

[2] With E1 to E9 or during startup, the corresponding individual output is held at preset value when hold ON. When hold OFF, the output is held at the O_2 value obtained just before detection of the error.
By average value output, the average values in sensors than those during temperature rising/calibration or during occurrence of one of errors E1 to E9 are output. Outputs 4 mA if all the sensors meet the conditions described above.

[3] Error indication clearing: If any of errors E1 to E9 occur, inspect and correct the faulty parts and then perform the error reset operations described below.

Key operation procedure	DISPLAY			Remarks
	MODE	CH	DATA	
CLR ENT	E( )	0( )	Average value O_2 indication	Error displayed
	c1	r	Err	"Clear error" displayed.
	01	0A	Average value O_2 indication	Press the entry key to clear the error. If the faulty state continues, the error will be displayed again.

Note: If you turn off the power to the receiver and turn it back on, this operation will not be needed.

6. Troubleshooting

(1) Inspection items and corrective action against each error

(2) Failure and countermeasure

[1] E1 Thermocouple error

(i) Short the receiver thermocouple's terminal block with the receiver power on (heater power switch off).

(Receiver thermocouple terminals: K1+ and K1-, K2+ and K2-, K3+ and K3-, K4+ and K4-
Compatible replacement: No.1 = 5 and 6, No.2 =9 and 10, No.3 = 13 and 14, No.4 = 17 and 18)

In this condition, press the CLR and ENT keys to perform error recovery reset. If E1 does not disappear. there may be a fault in the internal electronic circuit of the receiver. If E1 disappears when the terminal block is shorted, there may be a fault in the thermocouple.

(ii) Inspection of thermocouple

Remove the wire originating from the thermocouple on the corresponding channel at the probe transmitter's terminal block and check the continuity of the thermocouple. If no current is flowing through the thermocouple (i.e., infinite resistance), it may be disconnected (broken wire). Contact the manufacturer.

If current is flowing through the thermocouple, there may a fault such as contact failure between the receiver and probe transmitter.

Inspect and repair.

[2] E2 Heat rise error

(i) Heater resistance check (see the delivery drawing for terminal numbers (terminal No.○-○).

Turn off the heater switch on the probe transmitter that caused the E2 error.

Remove the corresponding probe transmitter's heater wires (No. 1 ○-○, No.2 ○-○, No.3○-○, No.4○-○) from the terminal block externally connected to the analyzer panel and check the heater resistance using a digital multimeter, etc. *See the circuit diagrams for terminal numbers.

If the measured value is 10Ω to 30Ω, inspect it as described in (ii) and subsequent paragraphs.

If the measured value is more than 30Ω, also measure the heater resistance on the probe transmitter.

If the measured value is 10Ω to 20Ω, there may be contact failure at the wire crimp area, etc. between the panel and probe transmitter. Inspect and repair the wiring.

If the measured value is more than 30Ω, the probe transmitter may have a broken heater wire; contact the manufacturer.

(ii) Check the voltage applied to the heater (see the delivery drawing for terminal numbers (terminal No.○-○).

Put the probe transmitter and the wires inside the panel back into place and turn on the heater switch.

Reset the alarm by pressing the CLR key and then the ENT key and restart the temperature rise.

Measure the corresponding probe transmitter's heater voltage on the terminal block externally connected to the analyzer panel (No. 1 ○-○, No.2 ○-○, No.3○-○, No.4○-○) using a digital multimeter, etc.

It is normally approx. 30 to 40 VAC during heat rise.
It is 20 to 30 VAC during temperature control.
} Under normal conditions

If it is 30 VAC or less even with measurement during temperature rise, the power line may be faulty. Check the voltage, etc. of the main power supply and repair the faulty area.

If temperature rise is not completed within about 10 minutes even if the measured value within the range expected under normal conditions, the receiver may be faulty; contact the manufacturer.

[3] E3 Temperature low error

(i) Check the sensor temperature (power remains on after occurrence of error).

Check the corresponding probe transmitter's sensor temperature using the keys.

Reset the alarm by using the CLR and ENT keys and check to see if temperature rise is possible.

At this point, if the sensor temperature does not rise from normal temperature or sample gas temperature, the heater may have a broken wire; check the heater resistance as described in (ii).

(ii) Heater resistance check (see the delivery drawing for terminal numbers (terminal No.○-○).

Turn off the corresponding probe transmitter's heater power switch and remove the wires originating from the terminal block externally connected to the analyzer panel (No. 1 ○-○, No.2 ○-○, No.3○-○, No.4○-○) and check the resistance between wires (heater resistance) using a digital multimeter, etc. Normally, the heater resistance is approximately 15 to 30 Ω. If the heater resistance is infinite, measure the heater resistance on the transmitter's heater terminal block. At this point, if the heater resistance is 10 to 20Ω. the heater cable between the transmitter and receiver is faulty (broken etc.), replace it. If the heater resistance is infinite even when measured on the transmitter, the heater has a broken wire: replace the heater.

(iii) No fault is found by making checks as described in (i) and (ii).

Put the wires back into place, turn off the heater power switch off and then on again, press the CRL and ENT keys on the receiver panel to restart temperature rise.

Measure the thermocouple electromotive force.

Measure the thermocouple electromotive force.on the receiver terminal block using a digital multimeter.

Receiver thermocouple terminals: K1+ and K1-, K2+ and K2-, K3+ and K3-, K4+ and K4-
Compatible replacement: No.1 = 5 and 6, No.2 =9 and 10, No.3 = 13 and 14, No.4 = 17 and 18

Find the temperature corresponding to this measured value referring to the conversion table (attached sheet) and compare it with the temperature indicated on the receiver.

If the reading on the multimeter is not consistent with the value indicated on the receiver, turn off the heater power switch.

There may be a faulty in the internal circuit of the receiver, contact the manufacturer.

[4] E4 Temperature high error

(i) Check the power supply voltage.

Use a digital multimeter, etc. to verify whether the corresponding probe transmitter's heater voltage is within 35±10 VAC on the terminal block externally connected to the analyzer.

If it is not within 35±10 VAC, check and repair the power supply.

(ii) Check the corresponding probe transmitter's sensor temperature using the keys.

(iii) Record the sensor temperature reading and check for variations in the reading.

(iv) Measure the thermocouple electromotive force.

Measure the thermocouple electromotive force.on the receiver terminal block using a digital multimeter.

(Receiver thermocouple terminals: K1+ and K1-, K2+ and K2-, K3+ and K3-, K4+ and K4-
Compatible replacement: No.1 = 5 and 6, No.2 =9 and 10, No.3 = 13 and 14, No.4 = 17 and 18)

Find the temperature corresponding to this measured value referring to the conversion table (attached sheet) and compare it with the temperature indicated on the receiver.

If the reading on the multimeter is not consistent with the value indicated on the receiver, turn off the heater power switch.

There may be a faulty in the internal circuit of the receiver, contact the manufacturer.

[5] E5, EA Sensor (early detection) error

(i) Short the corresponding probe cell input on the receiver terminal block. Display the corresponding sensor's EMF value. If the reading is below -20 mV, there may be a fault in the internal electronic circuit of the receiver.

If the EMF reading is 0 mV when shorted, there may be a fault in the sensor.

Receiver thermocouple terminals: CELL1+ and CELL1-, CELL2+ and CELL2-, CELL3+ and CELL3-, Cell4+ and Cell4-

Compatible replacement terminals: No. 1 = 3 and 4, No. 2 = 7 and 8, No. 3 = 11 and 12, No. 4 = 15 and 16

(ii) Sensor check

Check the continuity of the sensor cable between the transmitter and receiver.

Remove the cell wires from the corresponding probe transmitter terminal block and short the ⊕ and ⊖ wires.

Remove the cell input wires from the receiver and check the continuity of the cable.

If the cable resistance is less than a few ohms, the sensor may be producing an abnormal electromotive force due to its degradation; it needs to be replaced.

If the cable resistance is more than a few ohms, there may a broken wire or poor contact.

Check and repair the cable line.

(iii) Sensor resistance check

Verify that the sensor temperature is equal to the temperature set for the connected transmitter (ex. 650ºC) on the receiver with the heater switch on.

Remove the cell wires (⊕ and ⊖ wires) from the probe transmitter terminal block (pay attention to the AC voltage being applied to the heater) and measure the sensor resistance between Cell ⊕ and ⊖ of the probe transmitter terminal block using a digital multimeter. (Take two measurements for ⊕ polarity and ⊖ polarity.)

If the measured value is approximately 50 kΩ, there may a broken lead wire in the probe transmitter; it needs to be repaired.

(iv) Sensor error and early sensor detection error

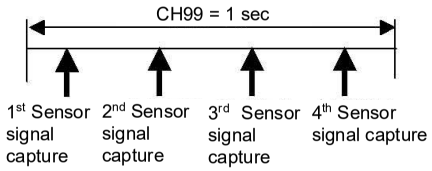
Initial setting is sensor error: E5. (CH97:-2 0 mV. CH98: 100%) The receiver has a function for early detection of sensor errors; CH97: faulty sensor electromotive force and CH98: sensor error detection sensitivity can be set.

It is effective for early detection of sensor errors in combustion control, etc.

If this function is used (changes made to the initial settings), an early sensor detection error: EA will be displayed.

See the next page for a general description of the early sensor error detection function.

Upper limit alarm detected electromotive force (CH97): -15mV
Alarm detection range (CH98): 25%
Error output delay time (CH99): 1 sec



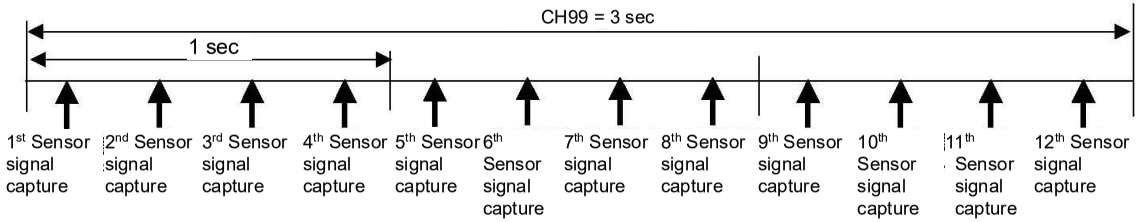
Example)

		Detected electromotive force (mV)				
		Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5
Capture	1st	-18	-3	-18	-3	-3
	2nd	-3	-18	-18	-18	-18
	3rd	-4	-4	-3	-18	-3
	4th	-3	-3	-4	-4	-18
ANN alarm		ANN output	ANN output	ANN output	ANN output	ANN output

Alarm range (CH98): 25% is defined as follows;
ANN output if electromotive force exceeded once or more during CH99 = 1 sec＝4 times of capturing

---

Upper limit alarm detected electromotive force (CH97): -15mV
Alarm detection range (CH98): 75%
Error output delay time (CH99): 3 sec



Example)

		Detected electromotive force (mV)					
		Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5	Pattern 6
Capture	1st	-18	-3	-18	-18	-18	-18
	2nd	-18	-18	-18	-18	-18	-18
	3rd	-18	-4	-3	-18	-18	-18
	4th	-18	-18	-4	-18	-14	-3
	5th	-18	-18	-18	-18	-18	-18
	6th	-18	-18	-18	-18	-10	-18
	7th	-18	-18	-3	-18	-18	-18
	8th	-18	-18	-18	-18	-18	-14
	9th	-18	-18	-18	-18	-9	-9
	10th	-3	-3	-18	-18	-18	-10
	11th	-3	-18	-18	-18	-3	-14
	12th	-3	-3	-18	-18	-18	-18
ANN alarm		ANN output	ANN output	ANN output	ANN output	–	–

Alarm range (CH98): 75% is defined as follows;
ANN output if electromotive force exceeded 9 times or more during CH99 = 3 sec＝4 times/sec (12 times of capturing)

[6] E6 Air calibration error

(i) Air concentration setting value check

Verify whether air point O_2 concentration 20.6% (20.90%) is correctly set CH for No. 1.

If not, correct the setting and perform gas calibration again in accordance with the instruction manual.

(ii) Sensor electromotive force check

[1] Sensor electromotive force check during gas calibration

Use the keys to check the sensor electromotive force during gas calibration.

Correct gas calibration can be performed if sensor electromotive force is with the range of -10 to +10 mV.

[2] If the sensor electromotive force is outside the range of -10 to +10 mV in [1], measure the sensor input voltage on the receiver terminal bock using a digital multimeter, etc.

If the sensor electromotive force reading on the receiver is not consistent with the measured voltage value, there may be a fault in the internal electronic circuit of the receiver.

If they are consistent with each other, there may be a fault in the transmitter; inspect it as described in (2) - [2].

[7] E7 Zero and span gas calibration error

(i) Zero and span gas concentration setting value check

Check the gas concentration value in the standard cylinder for zero gas and span gas. Verify whether the correct zero and span gas concentration values are set for CH Nos. 2 and 3 in PRG mode. If they are not correct, reset them correctly and recalibrate the corresponding probe transmitter as described on page 28.

(ii) Sensor electromotive force check

[1] When performing gas calibration as described in (i), check the sensor electromotive force. Also check the sensor electromotive force during zero/span gas feed.

If the sensor electromotive force is within ±30% of sensor electromotive force, gas calibration can be performed.

[2] If the sensor electromotive force is outside the ±30% range in [1], measure the sensor input voltage on the receiver terminal bock using a digital multimeter, etc.

If the sensor electromotive force reading on the receiver is not consistent with the measured voltage value, there may be a fault in the internal electronic circuit of the receiver.

If they are consistent with each other, there may be a fault in the transmitter; inspect it as described in [5] (ii) on page 49.

[8] E8 Purge error

(i) Check for sensor error “E5 Sensor error (i).”

(ii) Sensor check

The sensor filter may have got clogged during purge.

The filter needs to be replaced.

[9] E9. Thermistor error

The thermistor may have a broken wire or may be short circuited.

Measure the thermistor resistance value.

(Standard product: P7 terminal block arrangement diagram “C.J±” part is a thermistor,)

(DGO-III replacement compatible product: P9 terminal block arrangement diagram “C.J±” part is a thermistor,)

To measure the resistance value, remove the thermistor positive terminal and measure the resistance of the thermistor.

It is acceptable if it is within the range of approximately 3 to 50 kΩ.

[10] E10 Memory 1 error (memory IC error)

E13 Memory 2 error (EEPROM malfunction)

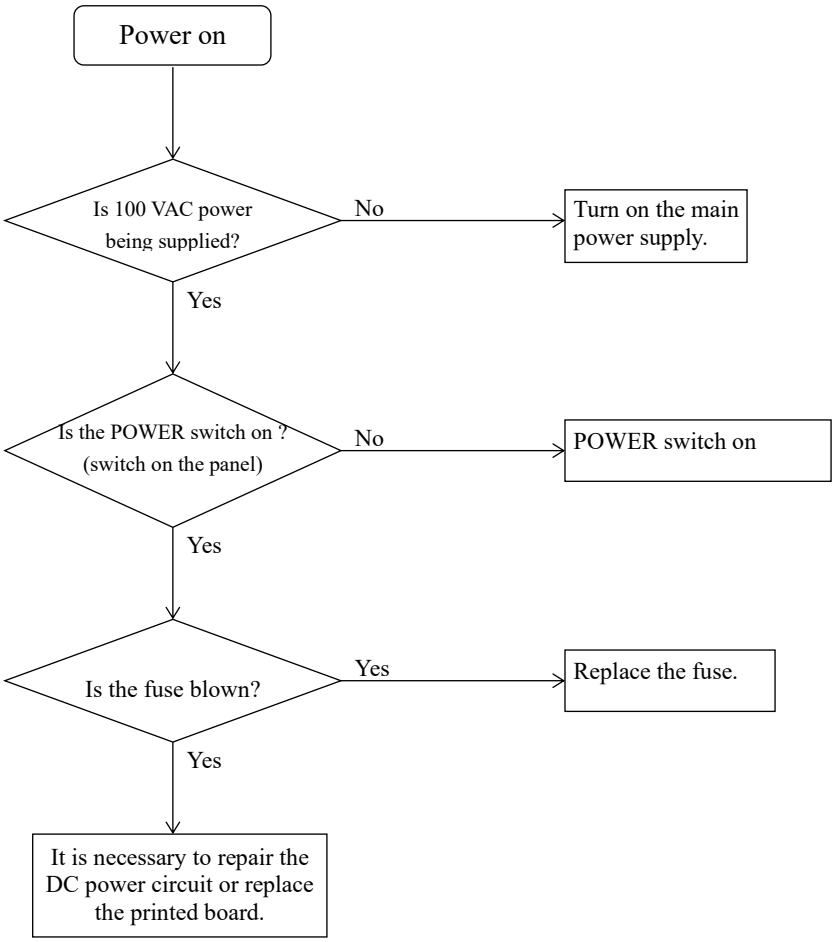
?? CPU error

These error codes may be displayed if there is a fault in the receiver or digital circuit.

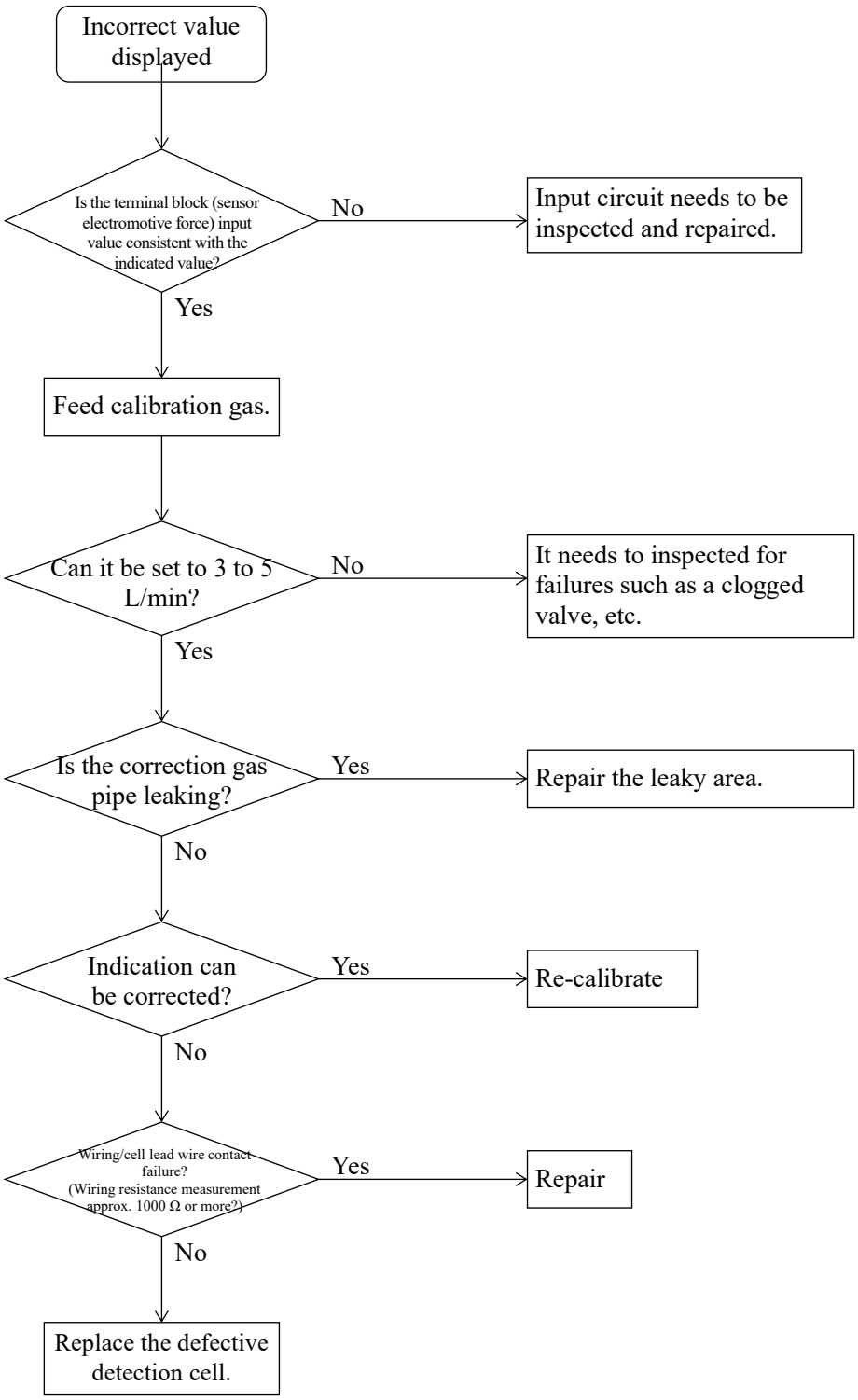
Such an error may occur due to Instantaneous noise, etc. If this is the case, turn off the power to the receiver and turn it back on. If the receiver returns to normal operation after this operation, the error is thought to have occurred due to external noise. Consider taking measures against noise. If it does not return to normal operation after its power is turned off and back on, there may be a faulty in the internal circuit of the receiver, contact the manufacturer.

(2) Failure and countermeasure

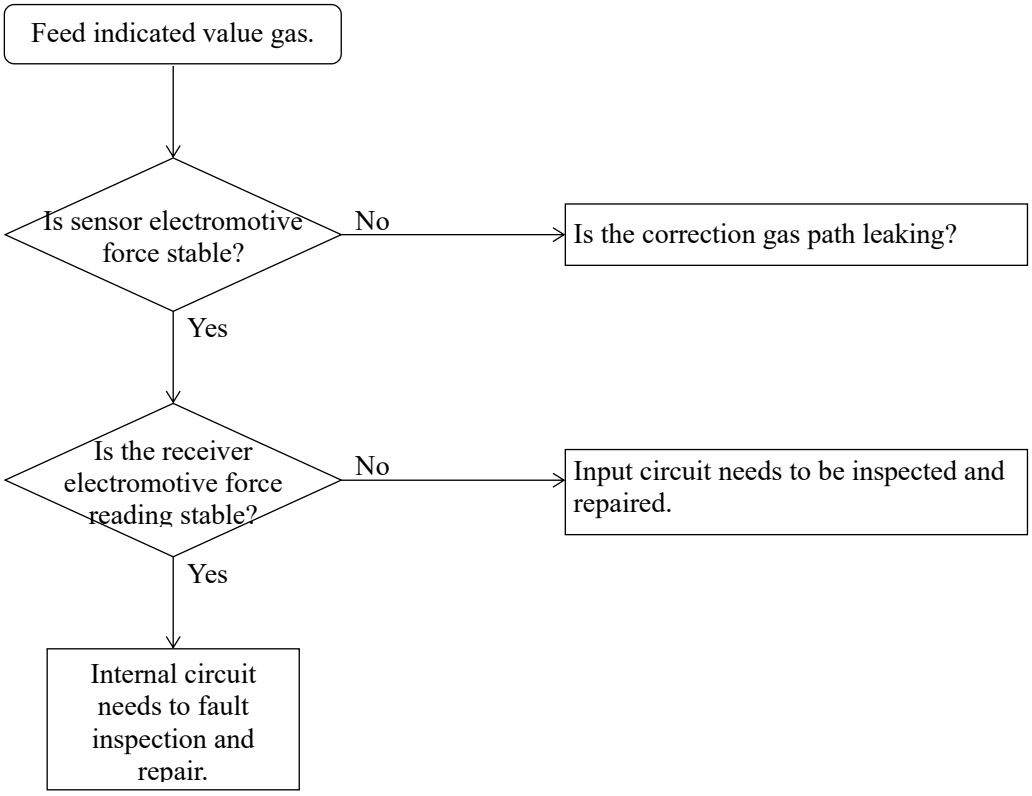
[1] No information displayed after power on.



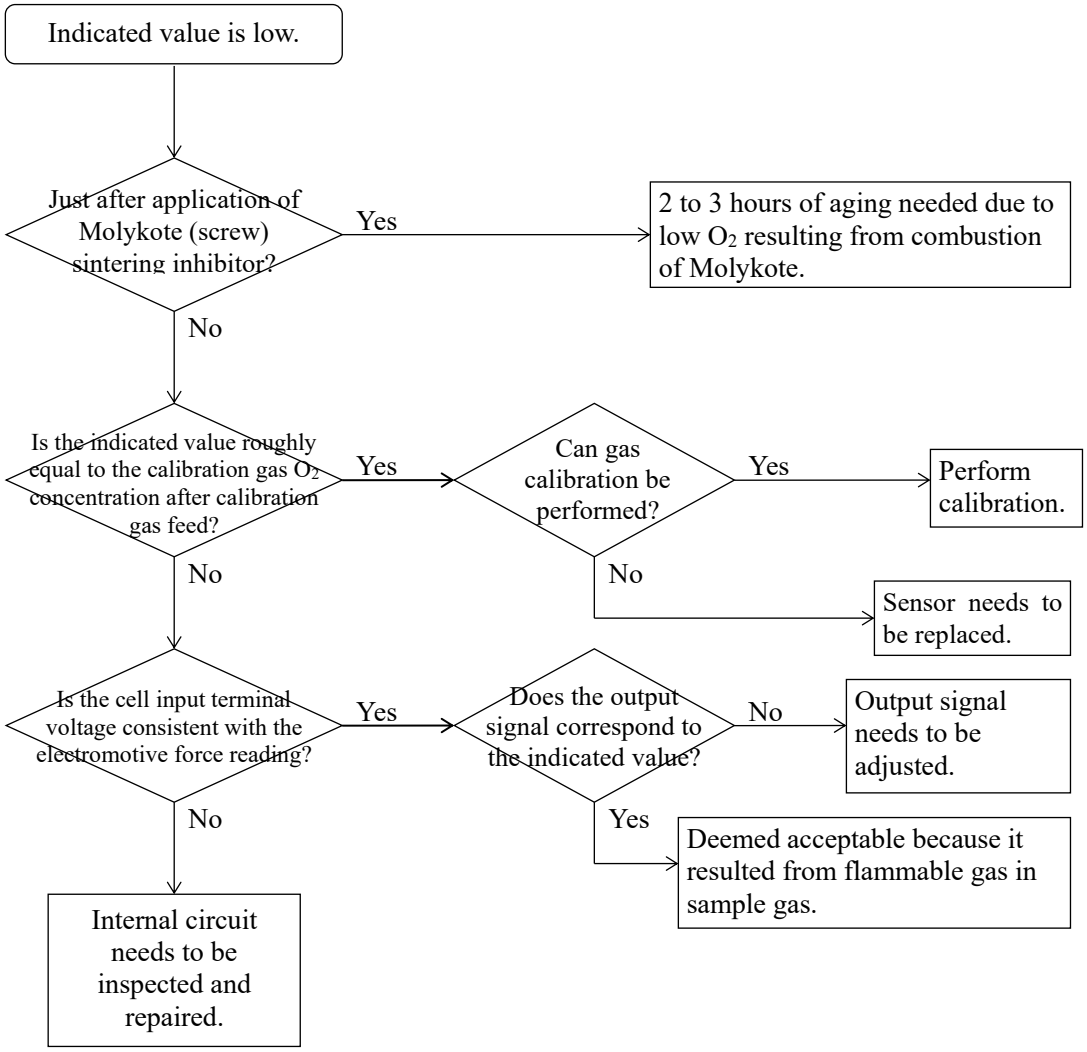
[2] Incorrect value displayed after calibration gas fed.



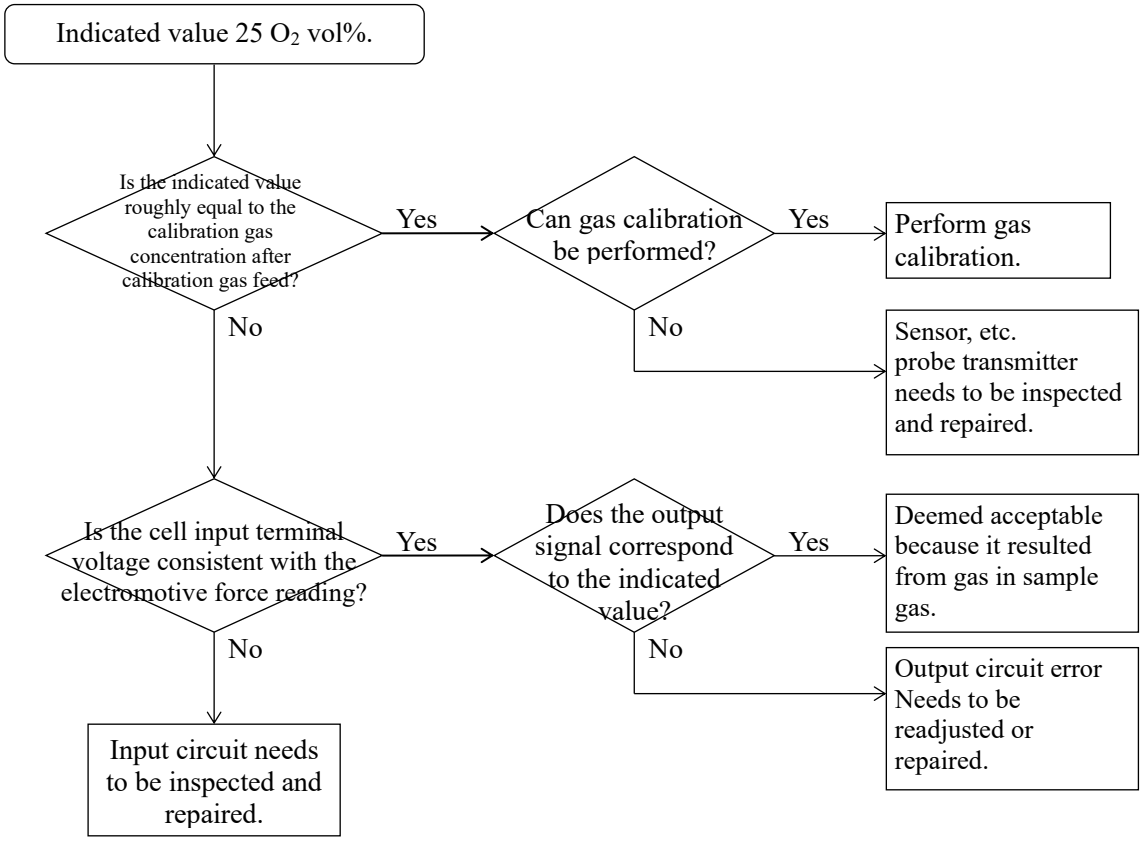
[3] Display “pulsates” after calibration gas fed



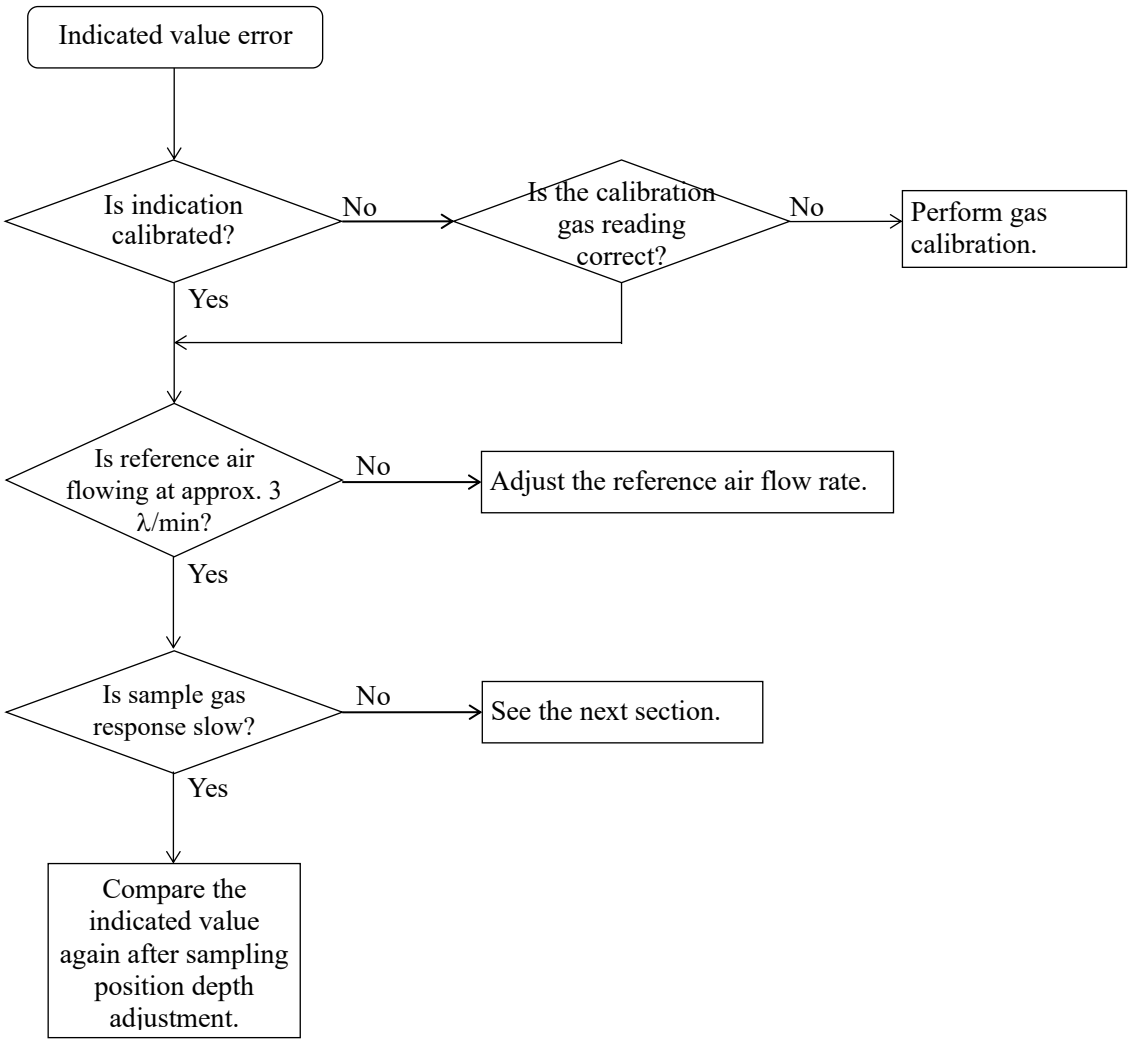
[4] Sample gas reading is low.



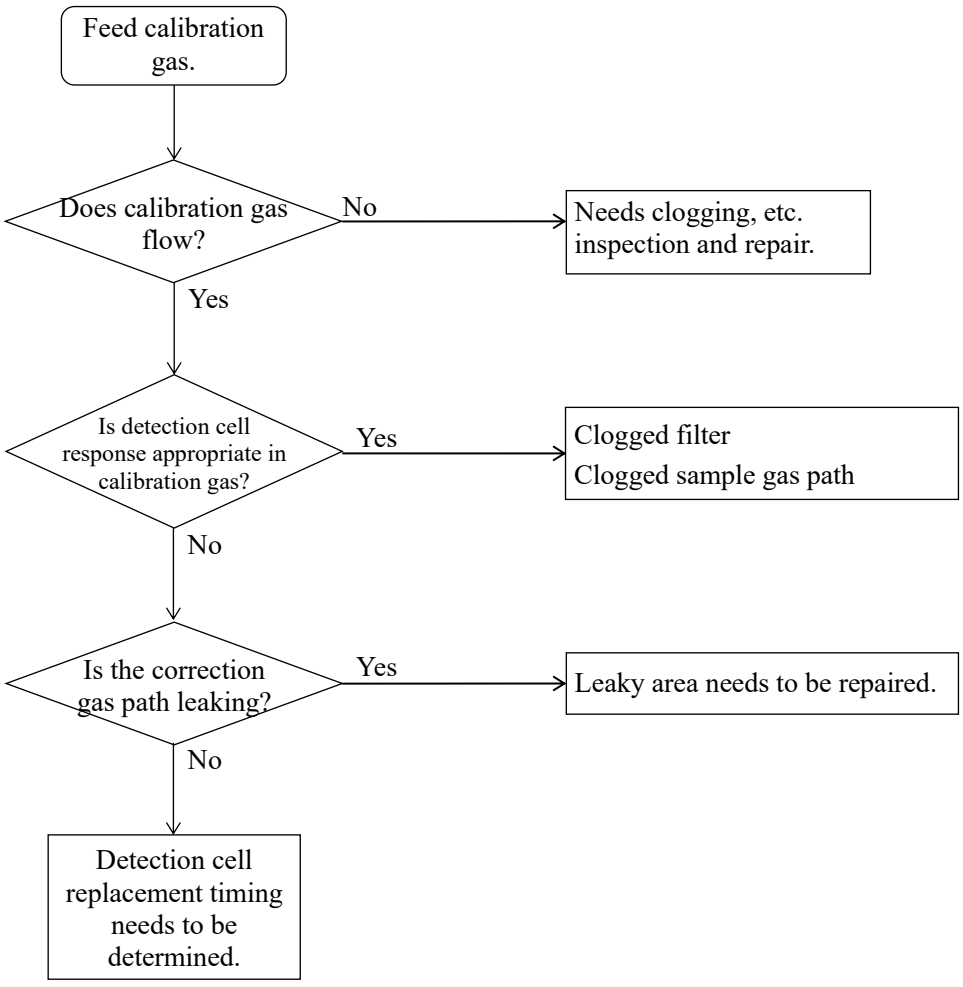
[5] Sample gas reading is 25% O_2 or more.



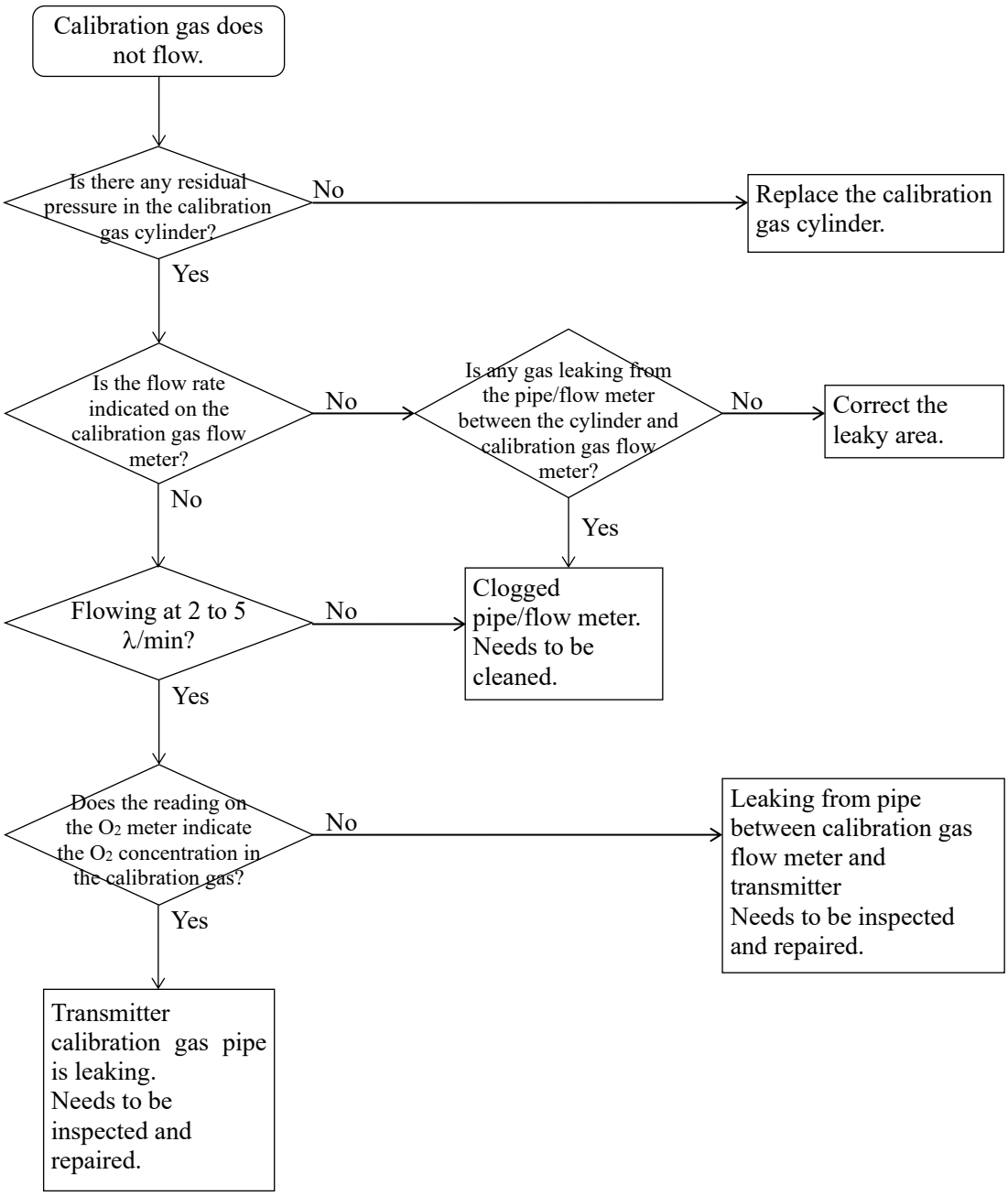
[6] Indicated value is high (low) compared to other instruments.



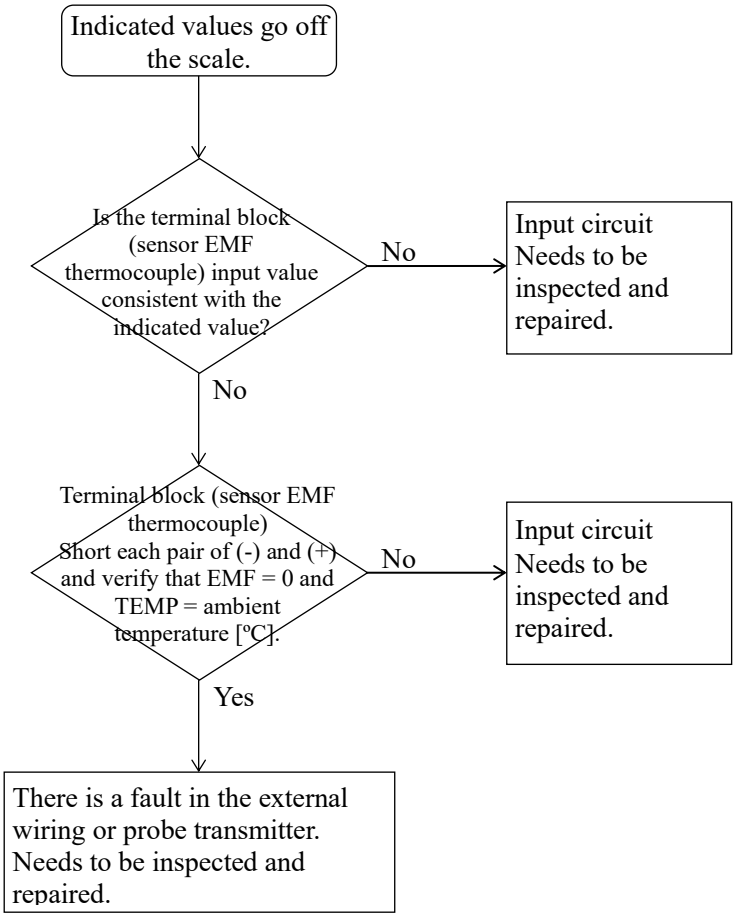
[7] Response speed is very low.



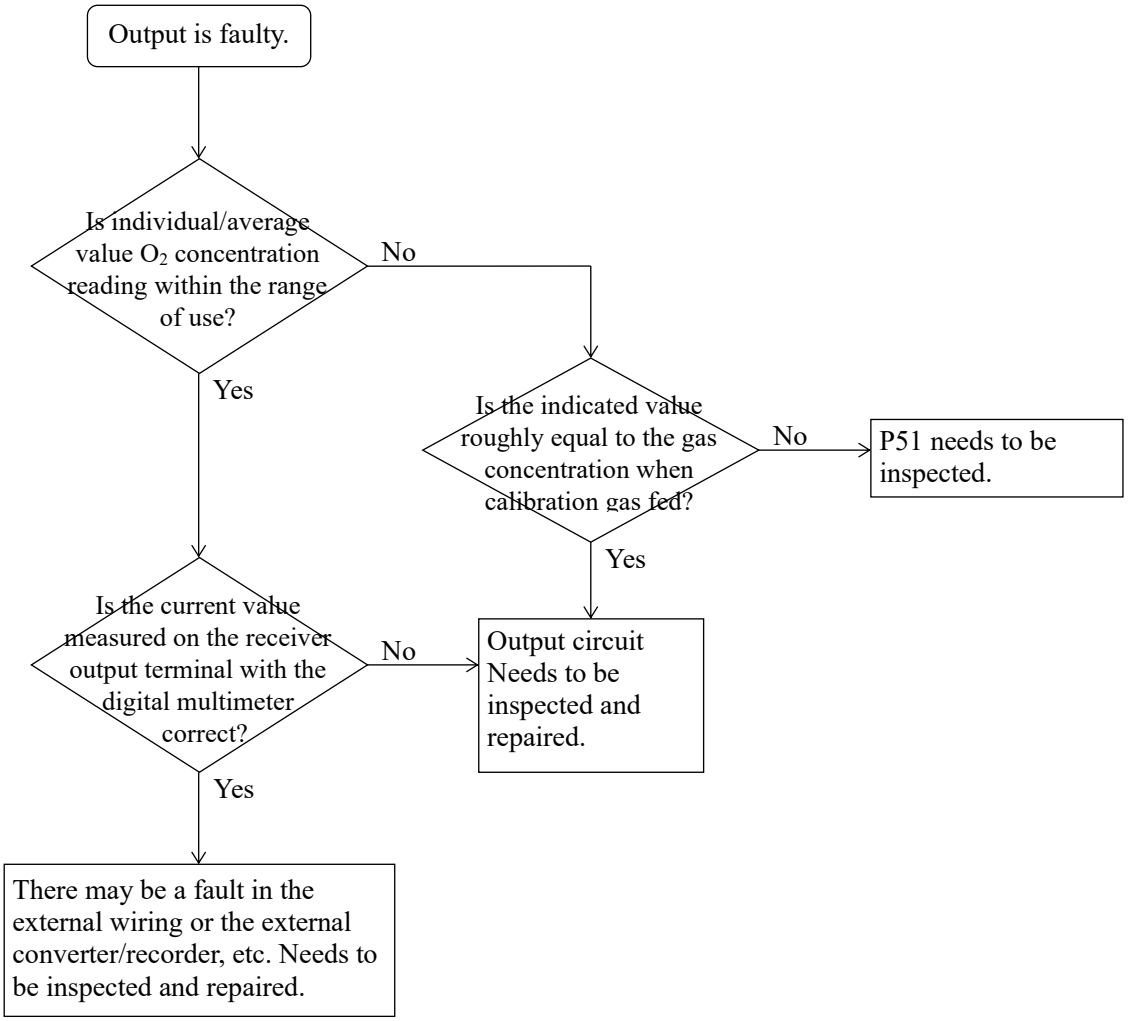
[8] Calibration gas does not flow.



[9] All indicated values (EMF, TEMP, indication) go off the scale.



[10]Current output is zero or remains off the scale.



Channel Data List (Initial values may differ according to delivery specifications.)

CH	Description	Initial value	Range	Remarks	Setting value
001	Calibration air gas concentration	20.90	1.00 to 100.00	[%]	
002	Calibration zero gas concentration	1.500	0.001 to 25.000	[%]	
003	Calibration span gas calibration	9.50	0.01 to 100.00	[%]	
004	Automatic calibration interval	10D00H	00D01H to 99D23H	Date and time	
005	Calibration time	03M00S	01M00S to 99M59S	Minutes and seconds	
006	Calibration, purge recovery time	01M00S	00M00S to 99M59S	Minutes and seconds	
007	First-order lag time constant	1	0 to 99	[sec]	
008	Hold data (preset 1)	0.0	0.0 to 100.0	[%]	
009	Hold data (preset 2)	0.0	0.0 to 100.0	[%]	
010	Calibration time (air induction time)	03M00S	01M00S to 99M59S	Minutes and seconds	
011	Low range span	5.00	0.00 to 100.00	[%]	
012	Low range zero	0.00	0.00 to 100.00	[%]	
013	High range span	25.0	0.00 to 100.00	[%]	
014	High range zero	0.00	0.00 to 100.00	[%]	
015	Sensor temperature low error	600	300 to 1000	[ºC]	
016	Sensor temperature high error	700	300 to 1000	[ºC]	
017	Purge error	-10	-50 to 0	[mV]	
018	-	-	-	-	
019	-	-	-	-	
020	-	-	-	-	
021	DRY calculation switch	OFF	ON/OFF	ON for DRY calculation	
022	Gaseous/solid and liquid fuel switch	OFF	ON/OFF	ON for solid and liquid fuel	
023	Automatic calibration switch	OFF	ON/OFF	ON for timer calibration	
024	3-point calibration switch	ON	ON/OFF	ON for 3-point calibration	
025	Output hold switch	OFF	OFF/1/2	OFF/Hold 1/Hold 2	
026	Calibration operation selection switch	OFF	1/2/OFF	OFF to skip and interlock channels not measured. 1 to operate only CH 27 sensor. 2 to operate all four sensors.	
027	Sensors Nos. 1 to 4 operation selection switch	1111	0000 to 1111	MSB is sensor No. 1	
028	Output timing shift	3	0 to 30	[sec]	
029	Purge switch	OFF	ON/OFF/AON	OFF for external input only, ON manually is also possible, and timer can also be used with AON	
030	Automatic purge interval	07D00H	00D01H to 99D23H	Date and time	
031	Number of purges	5	1 to 99	(Number of) times	
032	Purge ON time	10	1 to 99	[sec]	
033	Purge OFF time	10	1 to 99	[sec]	
034	CO2 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
035	CO content in liquid fuel	0.00	0.00 to 100.00	[%]	
036	H2 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
037	CH4 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
038	C2H6 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
039	C3H8 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
040	C4H10 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
041	C5H12 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
042	N2 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
043	O2 content in gaseous fuel	0.00	0.00 to 100.00	[%]	
044	H2O content in gaseous fuel	0.00	0.00 to 100.00	[%]	
045	C content in solid/liquid fuel	0.00	0.00 to 100.00	[%]	
046	H content in solid/liquid fuel	0.00	0.00 to 100.00	[%]	
047	S content in solid/liquid fuel	0.00	0.00 to 100.00	[%]	
048	N content in solid/liquid fuel	0.00	0.00 to 100.00	[%]	
049	H2O content in solid/liquid fuel	0.00	0.00 to 100.00	[%]	
050	O content in solid/liquid fuel	0.00	0.00 to 100.00	[%]	

CH	Description	Initial value	Range	Remarks	Setting value
051	Temperature control P constant setting	20.0	0.0 to 100.0	[%]	
052	Temperature control I constant setting	80.0	0 to 2000	[sec]	
053	Temperature control D constant setting	0.0	0 to 2000	[sec]	
054	-	-	-	-	
055	Heater temperature setting	650	500 to 800	[ºC]	
056	Heat rise error time setting	10	5 to 60	[min]	
057	-	-	-	-	
058	-	-	-	-	
059	-	-	-	-	
060	-	-	-	-	
061	Sensor No. 1 air calibration EMF	0.00	-50.00 to 150.00	[mV]	
062	Sensor No. 1 zero calibration EMF	52.10	-50.00 to 150.00	[mV]	
063	Sensor No. 1 span calibration EMF	15.39	-50.00 to 150.00	[mV]	
064	Sensor No. 2 air calibration EMF	0.00	-50.00 to 150.00	[mV]	
065	Sensor No. 2 zero calibration EMF	52.10	-50.00 to 150.00	[mV]	
066	Sensor No. 2 span calibration EMF	15.39	-50.00 to 150.00	[mV]	
067	Sensor No. 3 air calibration EMF	0.00	-50.00 to 150.00	[mV]	
068	Sensor No. 3 zero calibration EMF	52.10	-50.00 to 150.00	[mV]	
069	Sensor No. 3 span calibration EMF	15.39	-50.00 to 150.00	[mV]	
070	Sensor No. 4 air calibration EMF	0.00	-50.00 to 150.00	[mV]	
071	Sensor No. 4 zero calibration EMF	52.10	-50.00 to 150.00	[mV]	
072	Sensor No. 4 span calibration EMF	15.39	-50.00 to 150.00	[mV]	
073	Acceptable calibration range (air)	10.0	5.0 to 20.0	[mV]	
074	Acceptable calibration range (zero)	30.0	15.0 to 50.0	[%]	
075	Acceptable calibration range (span)	30.0	15.0 to 50.0	[%]	
076	-	-	-	-	
077	-	-	-	-	
078	-	-	-	-	
079	-	-	-	-	
080	-	-	-	-	
081	Sensor No. 1 air oxygen concentration	20.60	0.00 to 200.00	[%]	
082	Sensor No. 1 zero oxygen concentration	1.500	0.000 to 50.000	[%]	
083	Sensor No. 1 span oxygen concentration	9.50	0.00 to 200.00	[%]	
084	Sensor No. 2 air oxygen concentration	20.60	0.00 to 200.00	[%]	
085	Sensor No. 2 zero oxygen concentration	1.500	0.000 to 50.000	[%]	
086	Sensor No. 2 span oxygen concentration	9.50	0.00 to 200.00	[%]	
087	Sensor No. 3 air oxygen concentration	20.60	0.00 to 200.00	[%]	
088	Sensor No. 3 zero oxygen concentration	1.500	0.000 to 50.000	[%]	
089	Sensor No. 3 span oxygen concentration	9.50	0.00 to 200.00	[%]	
090	Sensor No. 4 air oxygen concentration	20.60	0.00 to 200.00	[%]	
091	Sensor No. 4 zero oxygen concentration	1.500	0.000 to 50.000	[%]	
092	Sensor No. 4 span oxygen concentration	9.50	0.00 to 200.00	[%]	
093	Switch CH100 and subsequent switches that can be used	-	—	—	
094	Machine setting	1	1 to 9	(Master when 1)	
095	Number of machines	1	1 to 9	(Available only for master machine, including machine itself)	
096	Average value output selection switch	1	1 to 3	(Available only for master machine)	
097	Sensor error detection electromotive force	-20	-20 to -5	[mV]	
098	Sensor error detection sensitivity	100	10 to 100	[%]	
099	Error indication delay time	2	1 to 30	[sec]	

The contents of this manual are subject to change without notice for improvement.

ENERGY SUPPORT

For inquiries regarding product handling, please contact us or our distributors.
Inquiry form URL：https://www.energys.co.jp/english/inq/all.php
ENERGY SUPPORT CORPORATION
1, Aza Kamikobarii, Inuyama, Aichi 484-8505 Japan