Manual No. 3191E R7

OPERATION MANUAL FOR OXYGEN ANALYZER MODEL SH-204-AW (RX-501125-A)

READ THE OPERATION MANUAL.

ENERGY SUPPORT CORPORATION

Safetv Precautions

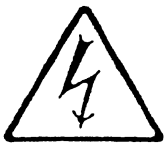
For safe operation of this equipment, be sure to observe the following precautions.

⚠ WARNING

1. When connecting cables to the terminals of the analyzer, take care to avoid electric shocks. Always turn the power OFF before connecting wiring.
2. Connect the ground wire to prevent electric shock accidents.
3. When working on the gas inlet and gas outlet pipes of the analyzer or disconnecting pipes for maintenance, always turn OFF the gas source valve to prevent gas intoxication or oxygen deficiency.
4. To prevent gas intoxication or oxygen deficiency accidents, test for gas leakage after working on the gas inlet and gas outlet pipes of the analyzer, and after maintenance.

⚠ CAUTION

1. To prevent electric shock, before you turn on the power switch always check that the power supply wiring is correctly and securely connected, and that the supply voltage matches the power source voltage of this device.
2. To prevent gas intoxication or oxygen deficiency, before you open the gas source valve always check that the gas inlet and outlet pipes of the analyzer are correctly and securely connected, and check that there is no gas leakage.
3. To prevent burns, do not touch the sensor, pump and surrounding areas as they are very hot during operation and for a while after stopping. If you must perform maintenance on them, wear heat resistant gloves and take care to avoid getting burned.
4. The electric shock warning mark shown at the right is attached near the power supply parts where there is a danger of receiving an electric shock. Even when there is no electric shock warning mark for the wiring, turn off the power first before starting work if you are not certain about the wiring circuits.



5. There is danger of gas intoxification if the sample gas has toxic contents, so always close the gas source valve before performing maintenance work on the piping system.
6. To operate this device safely and correctly, be sure to observe the Caution notices and operation instructions in this Operation Manual. Failure to strictly observe the instructions may result in electric shock, gas intoxification, oxygen deficiency, burns, damage or reduced function of the device itself, or damage to the final product (system, etc.)

Warranty

1. Warranty Period: For delivery as a separate part, this warranty is valid for 1 year from the date of delivery.
However, if the oxygen analyzer is installed in a device, the warranty is valid for the same warranty period that applies to the device. Delivery as a separate part means that ENERGY SUPPORT CORP. delivers the analyzer as a separate part, and installation in a device means that ENERGY SUPPORT CORP. combines the analyzer with a sampling flow or other device and the analyzer is delivered as part of the device.

2. Conditions: Provided that this product has been properly stored and installed after delivery to the customer, the manufacturer shall replace or repair this product free of charge to the customer if a breakdown or malfunction occurs during the above-mentioned warranty period, despite proper usage by the customer, due to defective design, manufacture or materials of this product that is the responsibility of the manufacturer.
Proper usage conditions are defined as follows:
① Installation conditions and usage conditions as specified in the Specifications and Warranty Booklet and this Operation Manual.
② Performance of periodic analyzer calibration and replacement of consumable parts.
③ Performance of periodic inspection and maintenance in accordance with the analyzer operating conditions.
However, this warranty does not cover the occurrence of the following events even if they occur during the validity period of this warranty.
1) Breakdown caused by operation errors (operation that is contrary to the instructions in the Operation Manual).
2) Breakdown caused by repairs, modification, disassembly or cleaning performed by other than the manufacturer.
3) Breakdown caused by fire or natural disasters (including lightning-induced power surges).
4) Breakdown caused by inadequate storage (storage under high temperature, high humidity conditions, etc.) or inadequate maintenance (mold growth, etc.).
NOTE: This warranty does not apply to consumable parts and parts subject to wear.

3. Scope: The scope of this warranty is limited to products provided by ENERGY SUPPORT CORP.

4. Disclaimer: ENERGY SUPPORT CORP. accepts no responsibility whatsoever for incidental damage resulting from breakdown of this product (such as damage or financial loss resulting from control or records based on this product, or damage or financial loss resulting from devices to which this product is installed). It is recommended that customers install appropriate safety devices.

Table of Contents

1. Introduction

1-1 Introduction

The SH-204-AW Oxygen Analyzer is a product of the latest ceramics production technology, using a thick film sensor and digital signal processing technology. This Operation Manual explains how to operate the SH-204-AW Oxygen Analyzer.

Please read this manual thoroughly to ensure long, successful operation of your SH-204-AW Oxygen Analyzer.

1-2 Usage Caution Notices

- Do not install the analyzer in a location subjected to vibration.
- Do not apply water or volatile fluids to the analyzer.
- Do not use sample gas containing corrosive gases (F, HF, CL_2, HCL, SO_2, H_2S, etc.) or poisonous materials (Si, Pb, P, Zn, Sn, As, etc.). These can shorten the life of the sensor.
- Do not use sample gas containing inflammable gas. The inclusion of inflammable gas can cause deviation in the oxygen concentration measurement value.
- The main applications for this oxygen analyzer include N_2 reflow furnaces, N_2 flow furnaces, air separation plants, gas purity control, inert gases for seals, and ambient oxygen concentration measurement for ferrite calcination furnaces. For other applications, please consult us.

1-3 Product Outline

The SH-204-AW Oxygen Analyzer has the following features.

- With one calibration of the air sample point, measurement from ppm - % is possible.
- The oxygen analyzer has a built-in pump. (No sampling device is necessary.)
- Compact size. (Small installation space.)
- Easy maintenance.
- Low power consumption by the sensor. (About 50 W for normal use.)
- Short warm up time.
- No power switch.

Operating Principles of the SH-204-AW Oxygen Analyzer

(1) Configuration and Functions (See diagram at right.)

①	Heater:	Heats the sensor to approximately 800℃.
②	Sensing cell:	Sets the oxygen concentration of the reference oxygen chamber to 100%, and measures the oxygen concentration of the gas detection chamber. (See below for detailed principles.)
③	Pumping cell:	Sets the oxygen concentration of the gas detection chamber to 0%. (See below for detailed principles.)
④	Gas detection chamber:	Inducts gas through the gas diffusion holes.
⑤	Reference oxygen chamber:	The oxygen concentration is set at approximately 100% by the reference oxygen microcurrent.

(2) Detection characteristics resulting from high temperature heating of the sensor:

① When a gas with a different oxygen concentration is put between the electrodes, oxygen ion conductivity occurs and electromotive force is generated. (Oxygen concentration cell effect)

② When current is applied between the electrodes, oxygen ions flow in the opposite direction in proportion to the current. (Oxygen pumping effect)

The sensing cell uses characteristics ① and ② above, and the pumping cell uses characteristic ② above.

(3) Sensing Cell Principles

① Minute current flows between the electrodes of the sensing cell. When current is applied between the electrodes, the oxygen inside the gas detection chamber is transferred to the reference oxygen chamber so that the oxygen concentration in the reference oxygen chamber is approximately 100%.

Note: The quantity of oxygen transferred from the gas detection chamber to the reference oxygen chamber is extremely small, so it does not affect the oxygen concentration in the gas detection chamber.

② The electromotive force in the following equation is generated between the electrodes of the sensing cell by the difference between the oxygen concentration in the gas detection chamber and the reference oxygen chamber.

The sensing cell measures the electromotive force generated between its electrodes and sends signals to the pumping cell so that the electromotive force reaches 450 mV (oxygen concentration of 0% in the gas detection chamber).

$$\text{Electromotive force}\quad E = -53.2 \times \log_{10} \frac{\text{Oxygen concentration in gas detection chamber}}{\text{Oxygen concentration in reference oxygen chamber}(100)}$$

$$450 = -53.2 \times \log_{10} \frac{X}{100}$$

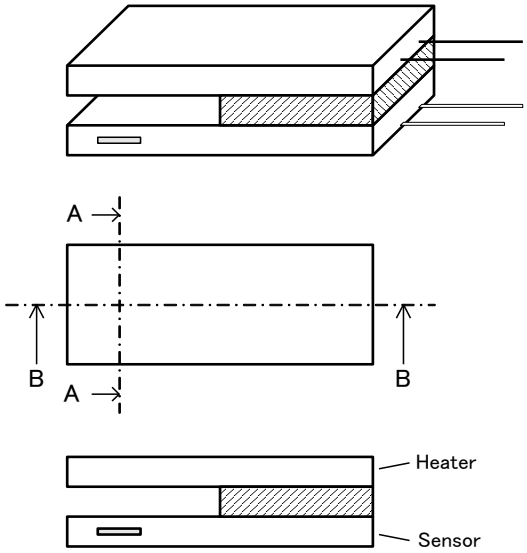
$$X = \text{approx. } 0.003\text{ppm} = 0\%$$

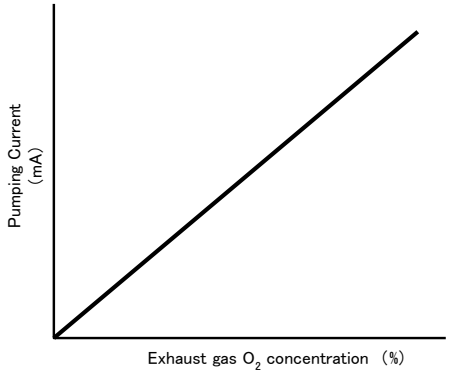
(4) Pumping Cell Principle

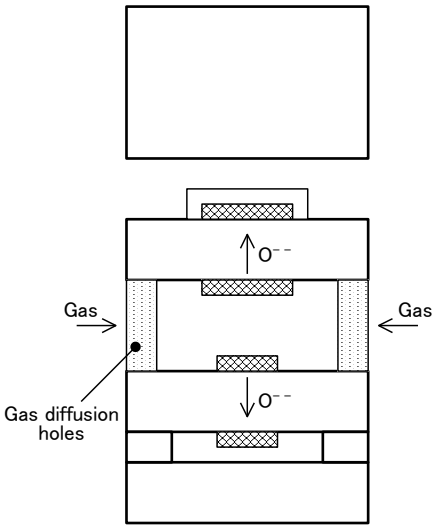
The pumping cell receives the signal from the sensing cell and applies current to the electrodes so that the oxygen concentration in the gas detection chamber reaches 0%.

The current applied and the oxygen concentration in the sample gas are proportional, so by measuring the current the oxygen concentration in the sample gas can be measured.

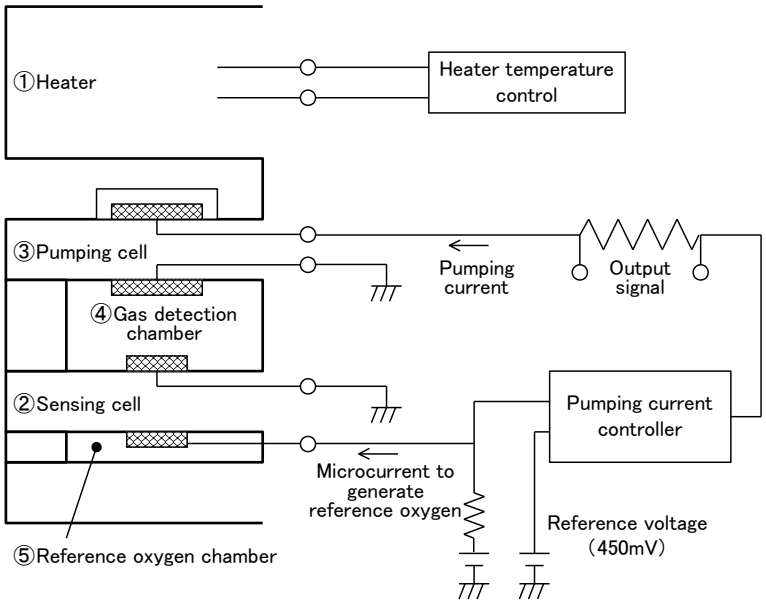
Sensor Element Construction







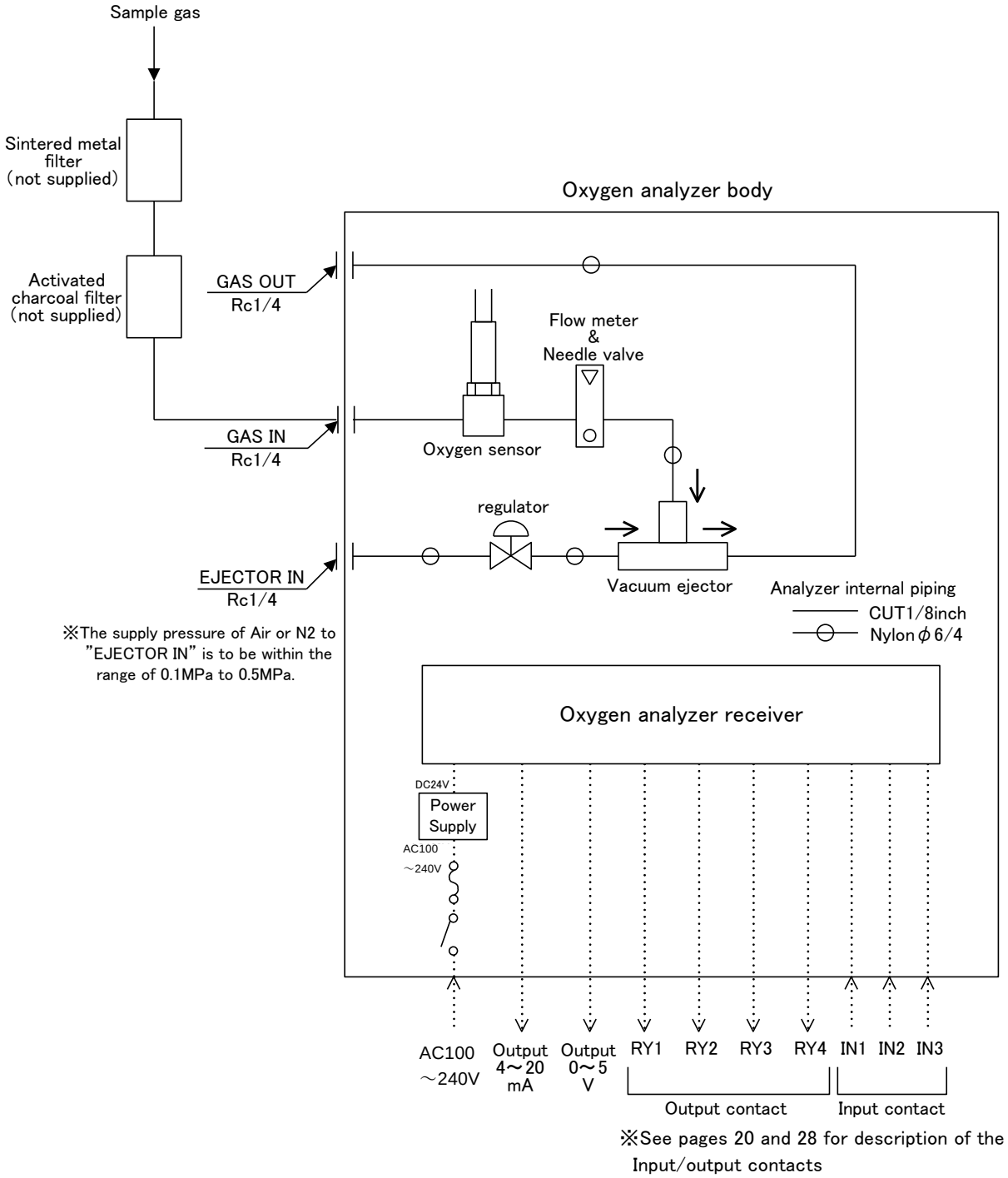
A－A



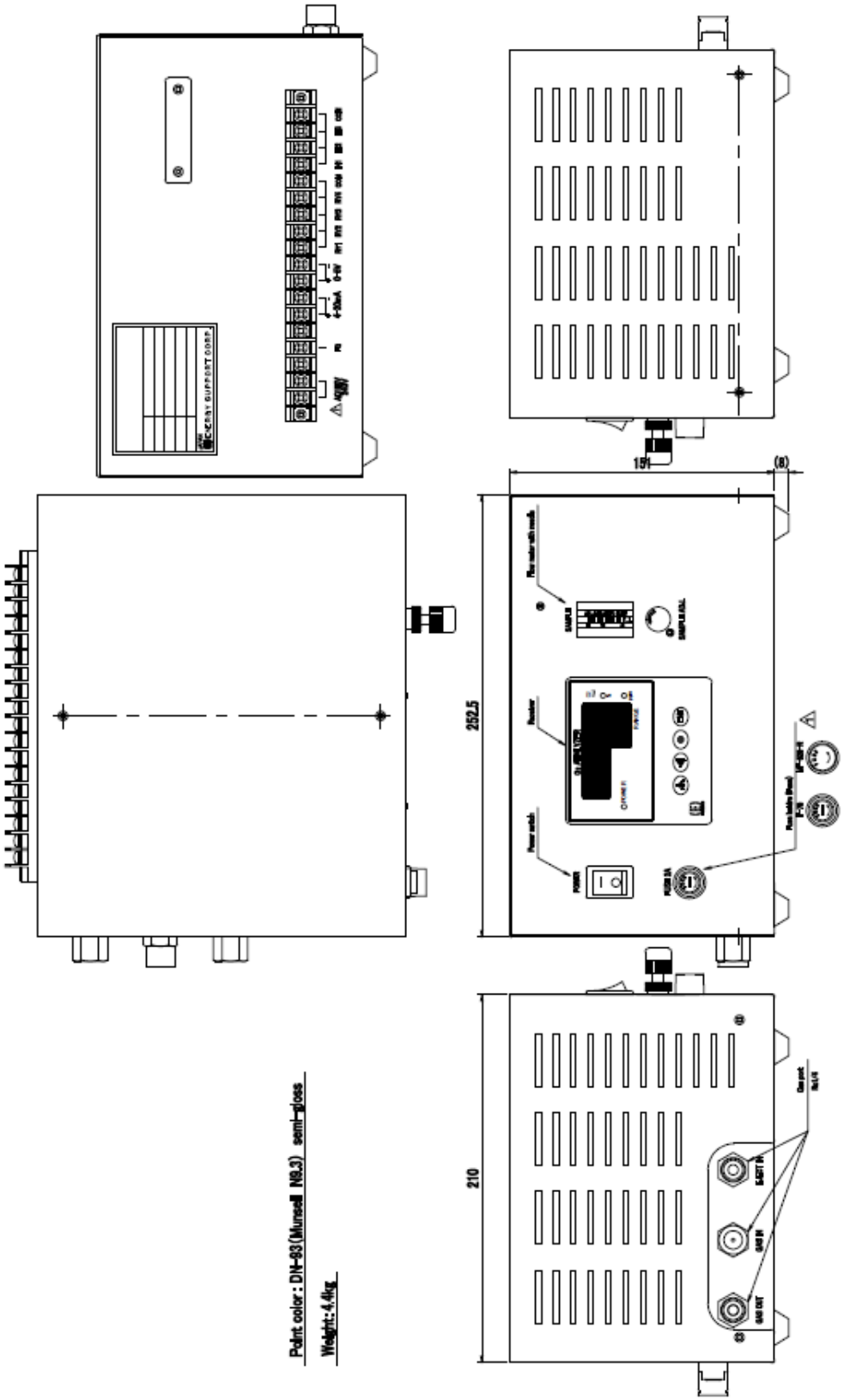
B－B

1-4 Components

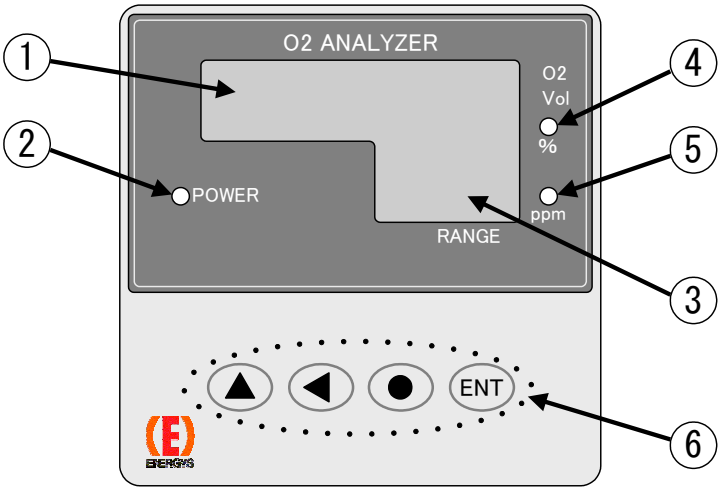
(1) Overall Configuration



(2) Oxygen Analyzer Body Exterior Diagram



(3) Receiver Operation Panel



Number	Name (Function)
1	POWER lamp (Illuminated when POWER is on.)
2	Display 1 (5 digits for Concentration, Data, Error display)
3	Display 2 (3 digits for Range, Concentration warning, Channel display)
4	% range lamp (Illuminated when % is measured.)
5	ppm range lamp (Illuminated when ppm is measured.)
6	Keys (For Calibration, Data setting)

2. Opening the Packaging

2-1 Checking the Components and Accessories

Part Name	Part Number	Qty.	Comments
Oxygen Analyzer	RX-501125-A	1	

2-2 Temporary Product Storage

When storing the product temporarily prior to installation, observe the following conditions.

- It is preferable to store the product inside a box, protected by polystyrene, etc.

Store the product in a location with the following features:

- Away from direct sunlight.
- The ambient temperature is between –10 ºC and 50 ºC, with little variation in temperature.
- There is little humidity and dust.
- The location is not exposed to rainfall.
- There is little mechanical vibration.
- There are no corrosive gases or dangerous gases.

3. Installation

3-1 Installation Conditions

This oxygen analyzer must be installed indoors. For safe, correct use of your oxygen analyzer, install the analyzer in a location with the following conditions to provide the best possible installation conditions.

- There is little vibration.
- It is not affected by corrosive gases (F, HF, CL_2, HCL, SO_2, H_2S, etc.), and will not interfere with maintenance personnel.
- Condensation is not caused by sudden temperature fluctuations.
- It is not affected by direct heat radiation.
- It is affected little by noise.
- There is little humidity and dust.
- The ambient temperature is between 0℃ and 45℃.

3-2 Installation Method

⚠ Installation Cautions

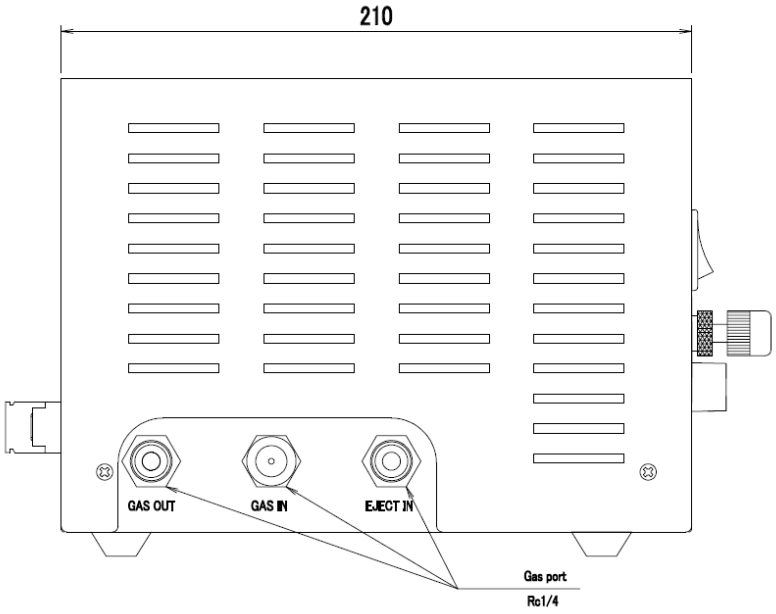
- This oxygen analyzer is a precision instrument. When installing it, avoid large shocks and applying a load upon it.
- The gas ports, flow meter needle valve, and the needle valve jut out from the panel, so they are easily damaged. Take care not to knock them during installation.
- An M4 tap is provided on each side of the oxygen analyzer body for use in securing the analyzer.

3-3 Piping and Wiring Methods

(1)Piping Arrangement

In the oxygen analyzer, GAS IN, GAS OUT and EJECT IN are installed as piping connections.

Size of these connections is Rc 1/ 4. Pay attention during piping work on each classification.



The piping is extremely important for performing precise measurement. Take care with the following items when connecting the piping.

① Pipe Material

- When using the ppm range: Use copper or stainless steel.
- When using the % range: Use pipes made of teflon, viton, vinyl, nylon or the like.

NOTE: • When using pipes made of organic materials, resin or rubber, select a material which can withstand the heat of the sample gas. Teflon and nylon piping are permeable to oxygen, so they are not suitable for measurement of oxygen concentration ≦ 1%.

• Never use silicone tubing or packing. Silicone tubing is permeable to atmospheric oxygen and increases the indicated value, and use of silicone tubing or packing can also cause rapid deterioration of the sensor.

② Oil Removal from Metal Pipes

- Clean oil or organic material off the interior of copper or stainless steel pipes with an evaporative cleaning solvent, then purge the pipe thoroughly using N_2 gas or air.

NOTE: The oil and organic material inside the metal pipe gradually mix into the measured sample gas when it flows, and they burn in the vicinity of the sensor when the sensor is heated to a high temperature, thus reducing the indicated value.

③ Do not create gas pockets in the pipe.

- Avoid providing large receptacles along the pipe.
- Keep the pipes as short and simple as possible.

NOTE: Creation of large gas pockets along the pipe route (filters or activated charcoal filter, etc.) or using long pipes increases the time taken to replace the measured gas, and increases wasted time and response time. Use the minimum required gas pockets and hose length.

④ Elimination of corrosive gas (F, HF, CL_2, HCL, SO_2, H_2S, etc.)

- If using an activated charcoal filter, pay attention to the life of the activated charcoal.
- If using cleaning by water, take care with the effect of the dissolved oxygen in the water and the replacement cycle.

⑤ Drain water removal

- If any drain water enters the sensor unit, the zirconia element is heated to high temperatures and the heat shock damages the zirconia element, making measurement impossible. Remove the drain water using a drain filter or drain trap, etc.
- If the condensation temperature of the sample gas is higher than the ambient temperature, install a drain trap or electronic cooler in the pipe to remove the drain water. Install the pipe so it is inclined downward to enable the drain water to flow smoothly.

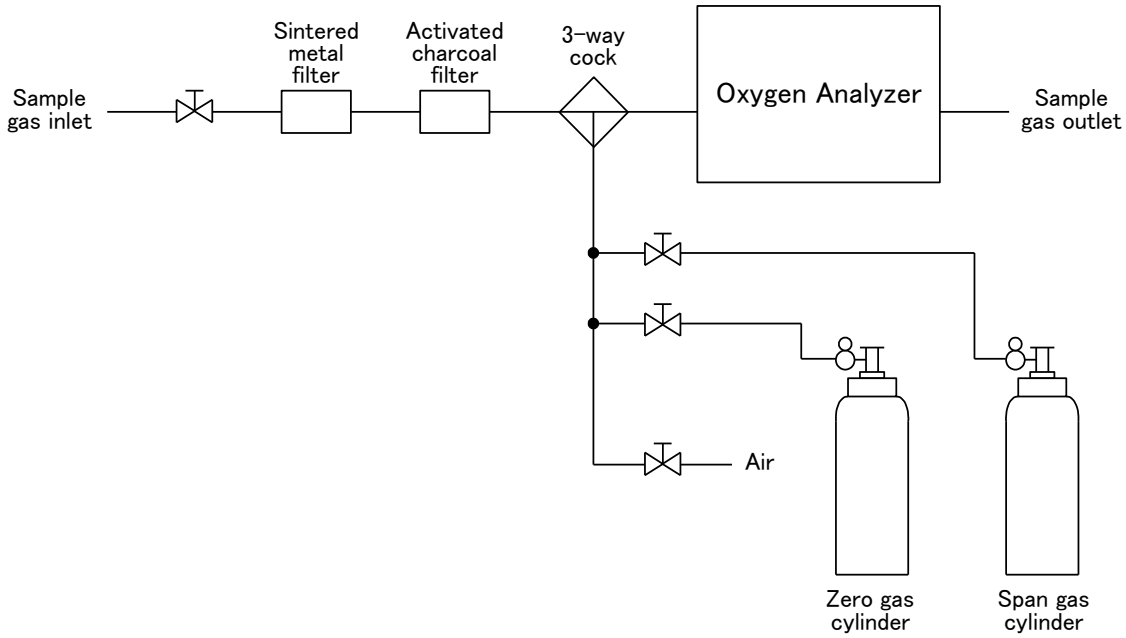
⑥ Dust and Mist Removal

Dust and mist can cause damage such as clogging the pipes or dirtying of the zirconia element, so remove them with a filter.

⑦ It could be very useful if you provide a 3-way ball valve at the front stage of the oxygen analyzer so that the pump inside the analyzer can suck in atmospheric air.

⑧ When using the range of 0 - 1000 ppm or less, it could be very useful if you install a standard gas cylinder in the piping.

Piping Arrangement Example

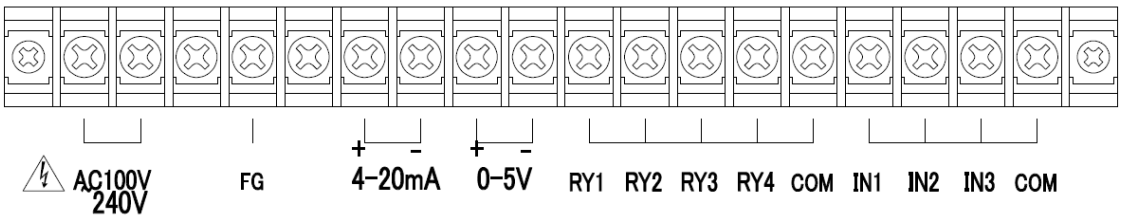


NOTE: If the sample gas pressure is above 50KPa, use the pressure regulator to set the pressure at 50KPa or less.

(2) Wiring Method

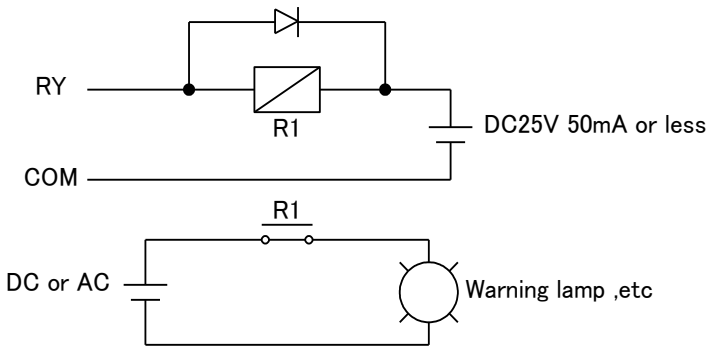
Wiring to the oxygen analyzer is connected to the terminal block using M4 screws. Make sure the polarity is correct when you connect wires to the terminal block.

Terminal Block Arrangement and Contents



AC100V ~240V : Power terminal (AC100V±10V, 50/60 Hz, max. 100VA)
FG : Casing grounding terminal
4 - 20 mA : Oxygen concentration output DC 4 - 20 mA (for selection range)
Non-insulated output, load resistance 600 Ω or less
0 – 5 V : Oxygen concentration output DC 0 - 5 V (for selection range)
Non-insulated output, load resistance 10K Ω or above
IN1 : No-voltage contact input terminal 1
IN2 : No-voltage contact input terminal 2
IN3 : No-voltage contact input terminal 3
COM : COM terminal for IN1 - 3
RY1 : Open collector output terminal 1 (permissible rating DC 25V, max.50 mA)
RY2 : Open collector output terminal 2 (permissible rating DC 25V, max.50 mA)
RY3 : Open collector output terminal 3 (permissible rating DC 25V, max.50 mA)
RY4 : Open collector output terminal 4 (permissible rating DC 25V, max.50 mA)
COM : COM terminal for RY1 - 4
*For detailed specifications of IN1- 3 and RY1 - 4, see the Operation Manual P.20 and P.28.

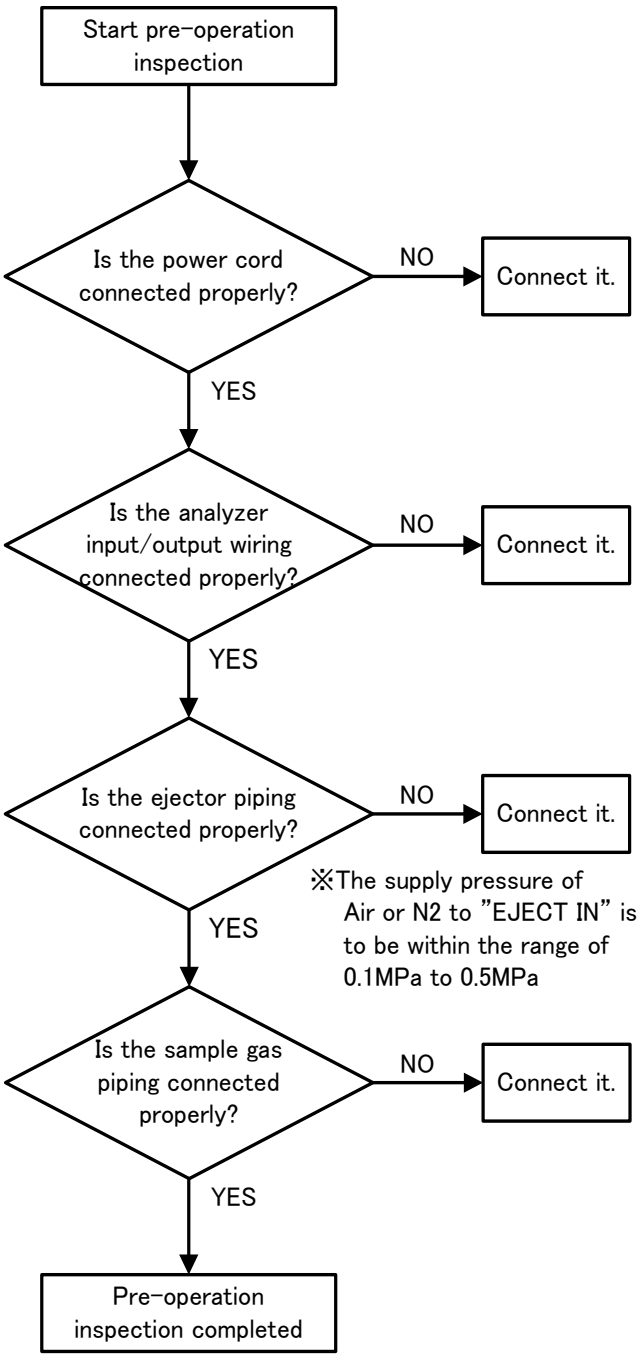
Example of Wiring Circuit to RY



4. Operation

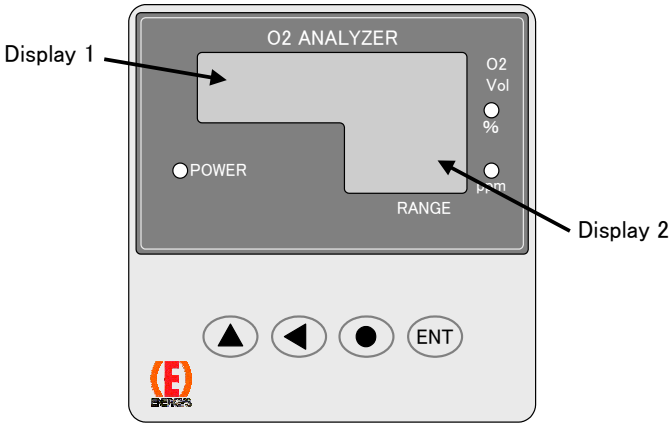
4-1 Operation Preparation

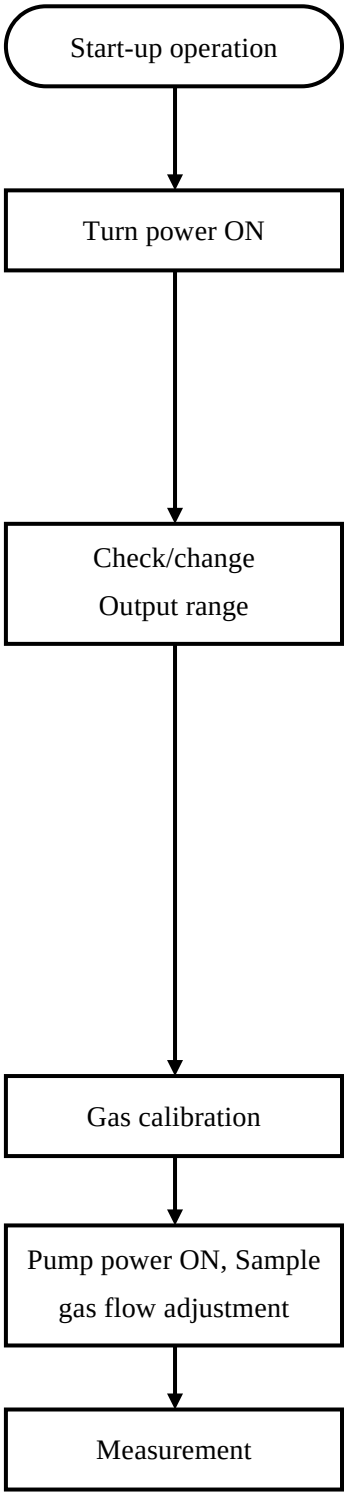
Before you turn the power ON, perform the following inspection.



4-2 Start-up

Perform the basic start-up operation as follows.





① When you turn ON the power to the analyzer, the POWER LED lights up and Display 1 starts the countdown. After 3 minutes, measurement can start. Display 1 displays the countdown as follows.
3.00 → 2.59 → ... → 0.01 → 0.00 → Concentration display

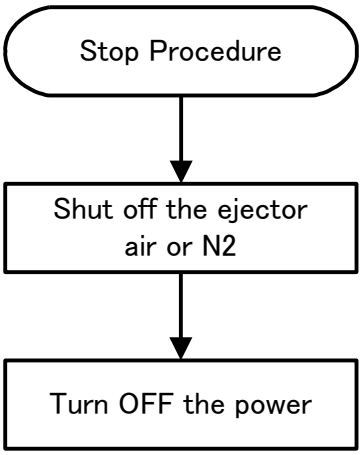
② Display 2 displays the output range No.
When range No. 1 is selected: 1
When range No. 2 is selected: 2
When range No. 3 is selected: 3
When range No. 4 is selected: 4
Checking and changing of each range is performed using the receiver setting data (CH030 - 037).
If the concentration warning is output, the range No. is not displayed, and AH (concentration high) or AL (concentration low) is displayed.
For details, see page 22, 4-4 Procedure During Operation, (2) Output Range Switching.

③ For gas calibration, see page 23, 4-4 Procedure During Operation, (4) Gas Calibration.

④ By flowing ejector N2 or air, adjust the flow of sample gas to be 0.5L/min with needle valve on the flow meter.

⚠ Inside of the ejector, pressure is adjusted by reducing 0.5MPa down to 0.2MPa with internal regulator, and if the readjustment is necessary, adjust it with internal regulator.

4-3 Stop Procedure



Turn OFF the power supply to the oxygen analyzer.

If operation is stopped for a short period such as 1 week or less, do not turn off the power.
If operation is stopped for a longer period, once the sample gas is replaced by ambient air, shut off the ejector then turn off the power.

4-4 Procedure During Operation

(1) Key Operation Method

Key operation is required to change the range and perform gas calibration when starting up. This operation is very important, so be sure to read these instructions.

⚠ Key operation may change the oxygen analyzer output, so when using the oxygen analyzer output signals for control purposes, always apply the control release device before operating the keys.

Key Functions

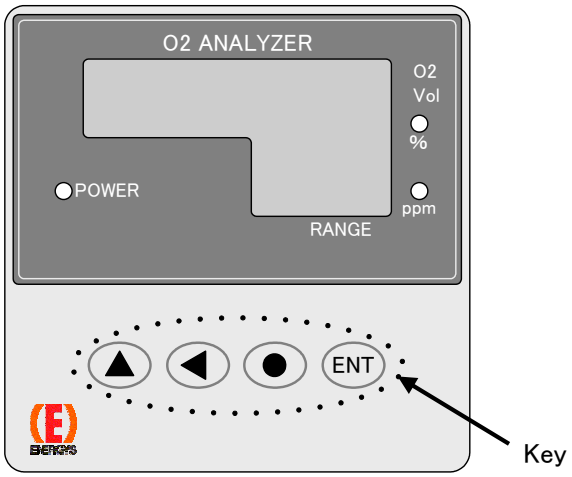
◀ key ·····Press this key to shift from the O_2 Concentration display to the data setting mode, or to move toward the left digit of the setting data. The currently changeable digit flickers.

▲ key ·····Press this key to change the value of the set CH and the set data.

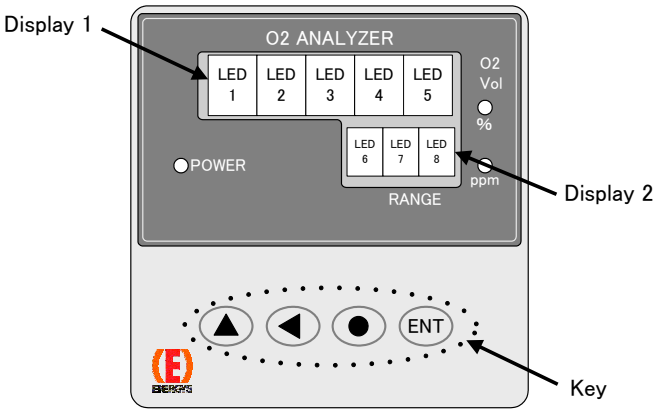
● key ·····Press this key in the following cases.

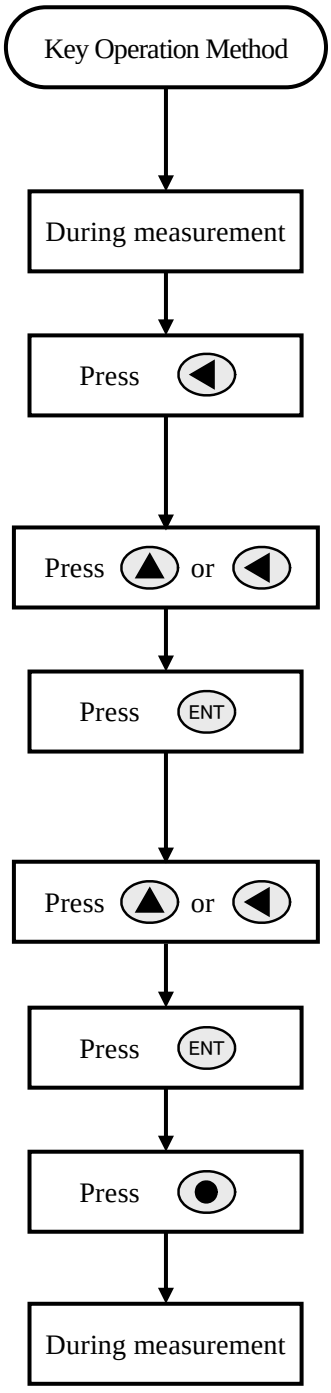
* To insert a decimal point after the flickering digit.
* To switch to the opposite sign when the set data has a plus or minus sign.
* To return to the O_2 Concentration display mode from the data setting mode.
* To clear an error when it has occurred.

ENT key ·····Press this key to save data in the receiver memory after changing the value of the set CH or set data.



Key Operation Method





Display 1 is the O_2 Concentration display
Display 2 is the Range or Concentration warning display.

① First press the ◀ key.
Display 2 will display the CH No. and LED 8 will flicker. Display 1 displays the data.

② Press ▲ or ◀ to set the CH No. of the data you wish to display on Display 2.

③ Press ENT .
LED 5 on Display 1 will flicker.
Display 2 will continue to display the CH No.

④ Press ▲ or ◀ to change the data displayed on Display 1.

⑤ Press ENT to save the data in the receiver memory.

⑥ Press ● to return to the O_2 Concentration display

Key operation is finished.
Using steps ① - ⑥ above, you can change the range and perform gas calibration.
The following page displays the System Data Table explaining which data is input to which CH.

System Data Table

CH No.	Function	Setting Data	RX-501125-A
000	Display selection	0: No display (--------) 1: Oxygen concentration 2: Icp 3: Vs 4: Ip1 5: Ip2 6: Vp 7: Vh 8: Ih 9: CPU Ih	1
001	Sensor output Vs monitor (μV)	- (* 2 - 9 are for checking use by ENERGY SUPPORT CORP.)	Monitor value
002	Sensor output Ip monitor (μA)	-	
003	Sensor output Ip monitor (μA)	-	
004	Sensor output Vp monitor (V)	-	
005	Sensor heater voltage monitor (V)	-	
006	Sensor heater current monitor (A)	-	
007	Sensor heater current monitor (A)	-	
008 | 015	Data for setting, checking by ENERGY SUPPORT CORP.		
016	Primary delay time (sec)	0 - 99	0
017 | 018	Data for setting, checking by ENERGY SUPPORT CORP.		
019	Sensor data continuous input	0: Default value 1: When 1 is input, continuous input of sensor data (CH250 - 261) is possible	0
020	Output range switching	1: No. 1 range 2: No. 2 range 3: No. 3 range 4: No. 4 range	Data is supplied for the current selected range
021 | 022	Data for setting, checking by ENERGY SUPPORT CORP.		
023	Output hold setting	0: No hold 1: Desired value 2: Value 5 sec. before error	1
024	Output hold value setting (%FS)	0 - 100	100
025	Data for setting, checking by ENERGY SUPPORT CORP.		
026	Auto range setting	0: Not in use. 1: Use	1
027	OUT 1 output adjustment	When adjusting output ZERO or SPAN, sets to this CH.	-
028	OUT 2 output adjustment		-
029	-	-	-

CH No.	Function	Setting Data	RX-501125-A
030	Output range No. 1 span value	1 - 99999 *Check the output range unit using CH034 - 037.	500
031	Output range No. 2 span value		5000
032	Output range No. 3 span value		5
033	Output range No. 4 span value		50
034	Output range No. 1 unit	0: Not in use 1: ppm 2: 2%	1
035	Output range No. 2 unit		1
036	Output range No. 3 unit		2
037	Output range No. 4 unit		2
038	—	—	—
039	—	—	—
040 | 089	Data for setting, checking by ENERGY SUPPORT CORP.		
090	Calibration point No. 1 standard gas concentration	0.00 – 9990.0	0.00
091	Calibration point No. 2 standard gas concentration		0.00
092	Calibration point No. 3 standard gas concentration		0.00
093	Air point concentration	0.00 – 99.90	20.60
094 | 142	Data for setting, checking by ENERGY SUPPORT CORP.		
143	Linearization table	Specific values for each sensor	See inspection data
144 | 183	Data for setting, checking by ENERGY SUPPORT CORP.		
184	Calibration mode selection	0: Air 1 point calibration 1: Air point + calibration point No. 1 2: Air point + calibration point No. 1, 2 3: Air point + calibration point No. 1, 2 ,3	0
185	Calibration point selection	0: Air 1 point calibration 1: Air point + calibration point No. 1 2: Air point + calibration point No. 2 3: Air point + calibration point No. 3	0
186	Calibration start	0: Default value 1: Calibration start	0
187 | 189	Data for setting, checking by ENERGY SUPPORT CORP.		
190	Heater control mode	0: Heater OFF 1: Constant voltage control 2: Constant resistance control 1 3: Constant resistance control 2	1 (Change not possible.)
191	Heater voltage set value (V)	5.00 – 11.00	10.00 (Change not possible.)
192 | 199	Data for setting, checking by ENERGY SUPPORT CORP.		

CH No.	Function	Setting Data	RX-501125-A
200	Contact output RY1 function setting	0: No contact output 1: Analyzer error 2: Range echo (2 range discrimination) 3: Range echo (discrimination of 3 ranges or more) 4: READY 5: Concentration max. alarm 6: Concentration min. alarm 7: Range echo (3 contacts)	1
201	Contact output RY2 function setting		7
202	Contact output RY3 function setting		7
203	Contact output RY4 function setting		7
204	Contact output RY1 movement setting	0: NO 1: NC	0
205	Contact output RY2 movement setting		0
206	Contact output RY3 movement setting		0
207	Contact output RY4 movement setting		0
208	Contact input IN1 movement setting	0: Not in use 1: Air 1 point calibration start	1
209	Contact input IN 2, 3 movement setting	0: Local range switching 1: Remote range switching	0
210 | 219	Data for setting, checking by ENERGY SUPPORT CORP.		
220	O2 concentration max. alarm setting value	0.0 – 9999.0	90.0
221	O2 concentration min. alarm setting value	0.0 – 9999.0	10.0
222	Oxygen max. alarm unit	0: Not in use. 1: ppm 2: %	0
223	Oxygen min. alarm unit		0
224 | 249	Data for setting, checking by ENERGY SUPPORT CORP.		
250	Sensor data 1 standard gas concentration (ppm)	0.0 – 9990.0	See inspection data
251	Sensor data 2 standard gas concentration (ppm)	0.0 – 9990.0	
252	Sensor data 3 standard gas concentration (ppm)	0.0 – 9990.0	
253	Sensor data 4 standard gas concentration (ppm)	0.0 – 9990.0	
254	Sensor data 5 standard gas concentration (ppm)	0.0 – 9990.0	
255	Sensor data 6 standard gas concentration (%)	0.00 – 99.90	
256	Sensor data 1 (μA)	-999.0 – 999.0	
257	Sensor data 2 (μA)	-999.0 – 999.0	
258	Sensor data 3 (μA)	-999.0 – 999.0	
259	Sensor data 4 (μA)	-999.0 – 999.0	
260	Sensor data 5 (μA)	-999.0 – 999.0	
261	Sensor data 6 (mA)	-99.90 – 99.90	
262 | 289	—	—	—

CH No.	Function	Setting Data	RX-501125-A
290	Communication setting	2:RS-232C 4:RS-232C	Option
291	Bit rate setting	0:1200 1:2400 2:4800 3:9600	
292	Data length setting	0:8 bit 1:7 bit	
293	Parity setting	0:Even parity 1:Odd parity	
294	Parity mode setting	0:No check 1:Check used	
295	Stop bit length setting	0:1 bit 1:2 bit	
296 ｜ 297	—	—	—
298	Positive/negative offset	-9999～9999	0
299	Unit of positive/negative offset	0:Not used 1:ppm 2:%	0
300 ｜ 309	—	—	—
310	Data setting change password	0: Data change prohibited 201: Data change possible 204: Default data	204
311	Storage of default values and reset	0: OFF 1: Reset to factory default values 204:Storage of current setting values	0

Caution notices when changing data settings

Do not make changes to CH190 - 191. It will change the heater voltage supplied to the sensor, which could damage the sensor.

Do not operate CH311 so as to store or reset CH of the factory default values(Range, input and output of contacts, sensor data etc.), except in case of necessity.

(2) Output Range Switching

The output range switching method can be made from 3 methods: range switching by key operation, by contact input, or by auto range switching.

① Range switching by key operation (Local range switching)

By inputting 0 for CH026 and 0 for CH209, you can change output range 1 - 4 for CH020. You can select the same range No. as the input data, e.g. if you input "1", you get range 1, and if you input "2", you get range 2.

Because switching of the sensor output detection circuit occurs inside the receiver for the ppm range and % range, performing ppm measurement in the % range will cause the analyzer display to waver greatly. When performing ppm measurement, switch to the ppm range.

② Range switching using contact input (Remote range switching)

By inputting 0 for CH026 and 1 for CH209, the output range is switched in accordance with the no-voltage contact input that is input to IN2 and IN3 of the analyzer terminal block. The contact input and selected range are related as shown below.

Contact Input		Selected Range
IN2-COM1	IN3-COM1	
ON	ON	No.1
OFF	ON	No.2
ON	OFF	No.3
OFF	OFF	No.4

③ Auto range switching

By inputting 1 for CH026, you can make the setting so that the output range switches in accordance with the measurement value. When 1 is input for CH026, auto range switching is given priority even if 1 is input to CH026.

When using auto range switching, use all 4 ranges.

Example

When the following ranges are set for the Range No.:

Range No.	Range Setting
1	0～500ppm
2	0～5000ppm
3	0～5%
4	0～50%

The ranges are selected for each measurement concentration as follows:

Measurement Concentration		Range automatically selected
When concentration drops	When concentration increases	
0～450ppm	0～500ppm	1
450～4500ppm(0.45%)	500～5000ppm (0.5%)	2
0.45～4.5%	0.5～5%	3
4.5～50%	5～50%	4

⚠ When the range switches between the ppm range and % range, switching of the sensor output detection circuit occurs inside the receiver, so deviation occurs between the detected oxygen output in the ppm range and the detected oxygen output in the % range.

Accordingly, when indication is stable at about 90% FS in the ppm range, range switching may occur repeatedly between the ppm range and % range.

(3) Output range setting

The output range can be set as desired up to 4 ranges, setting the range span value for CH030 - 033, and setting the unit for CH034 - 037.

For output range No. 1, range span value setting is CH030, unit setting is CH034.
For output range No. 2, range span value setting is CH031, unit setting is CH035.
For output range No. 3, range span value setting is CH032, unit setting is CH036.
For output range No. 4, range span value setting is CH033, unit setting is CH037.

When setting the unit, inputting 0 is “Not in use”, 1 is ppm, and 2 is %.

Example

To set 0 - 1000 ppm for output range No. 1, input 1000 for CH030 and 1 for CH035.

⚠ The span value for the output range is a minimum of 100 ppm. To set 1000 ppm or less requires recalibration using the standard gas.

(4) Gas Calibration

The 0 - 1000 ppm range and above can be used for air 1 point calibration. For the 0 - 1000 ppm range or less, perform 1 - 3 point standard gas calibration in accordance with the usage condition.

① Air 1 point calibration (0 - 1000 ppm range and above)

(a) By operating the ejector close to the actual measuring condition where sintered alloy filter and activated carbon filter are attached in front of the analyzer, indication is stabilised by suctioning the air. In actual operation, under the analyzer being attached to the furnace and inside of the furnace being in air filled condition, the ejector is started and sample gas flow volume can be adjusted.

(b) Input 0 to CH184 to set the calibration mode to air 1 point calibration.

(c) Input 0 to CH185 to set the calibration point to air point.

(d) Input 1 to CH186 to start calibration.

This procedure performs calibration for ppm - %. The default value of 0 is set for CH184 and CH185. As long as the setting data is not changed, steps (b) and (c) are not required. By inputting 1 to CH208, steps (b) - (d) are automatically performed by temporarily shorting between IN1 - COM on the analyzer terminal board.

Because the oxygen concentration of the atmospheric air changes slightly, the accuracy of air 1 point calibration is ±2 - 3% FS.

② Air point + calibration point No. 1

(a) Input the standard gas concentration used for calibration to CH090. Use standard gas with 5000 ppm or less.
(b) Input 1 to CH184 to set the calibration mode to air 1 point calibration.
(c) Shut off the ejector, then pump standard gas to the analyzer to stabilize the indication.
(d) Input 1 to CH185 to set the calibration point to No. 1.
(e) Input 1 to CH186 to start calibration.
(f) Induct air into the analyzer to stabilize the indication.
(g) Input 0 to CH185 to set the calibration point to air point.
(h) Input 1 to CH186 to start calibration.
(f) - (h) are for % calibration. For ppm measurement, these are not always necessary.

③ Air point + calibration point No. 1, 2

(a) Input the standard gas concentration used for calibration to CH090 and CH091. Use standard gas with 5000 ppm or less, and input concentration for CH090 that is less than the CH091 concentration.
(b) Input 2 to CH184 to set the calibration mode to air point + calibration point No. 1, 2.
(c) Shut off the ejector, then pump the standard gas set for CH090 to the analyzer to stabilize the indication.
(d) Input 1 to CH185 to set the calibration point to No. 1.
(e) Input 1 to CH186 to start calibration. Although error E-55 may occur at this time, continue with the following procedure.
(f) Pump the standard gas set for CH091 to the analyzer to stabilize the indication.
(g) Input 2 to CH185 to set the calibration point to No. 2.
(h) Input 1 to CH186 to start calibration.
(i) Induct air into the analyzer to stabilize the indication.
(j) Input 0 to CH185 to set the calibration point to air point.
(k) Input 1 to CH186 to start calibration.
(i) - (k) are for % calibration. For ppm measurement, these are not always necessary.

④ Air point + calibration point No. 1, 2, 3

(a) Input the standard gas concentration used for calibration to CH090, 091 and 092. Use standard gas with 5000 ppm or less, and input concentration for CH090 that is less than the CH091 concentration, and CH091 concentration that is less than the CH092 concentration.
(b) Input 3 to CH184 to set the calibration mode to air point + calibration point No. 1, 2, 3.
(c) Shut off the ejector, then pump the standard gas set for CH090 to the analyzer to stabilize the indication.
(d) Input 1 to CH185 to set the calibration point to No. 1.
(e) Input 1 to CH186 to start calibration. Although error E-55 may occur at this time, continue with the following procedure.
(f) Pump the standard gas set for CH091 to the analyzer to stabilize the indication.
(g) Input 2 to CH185 to set the calibration point to No. 2.
(h) Input 1 to CH186 to start calibration. Although error E-57 may occur at this time, continue with the following procedure.
(i) Pump the standard gas set for CH092 to the analyzer to stabilize the indication.
(j) Input 3 to CH185 to set the calibration point to No. 3.
(k) Input 1 to CH186 to start calibration.
(l) Induct air into the analyzer to stabilize the indication.
(m) Input 0 to CH185 to set the calibration point to air point.
(n) Input 1 to CH186 to start calibration.

(l) - (n) are for % calibration. For ppm measurement, these are not always necessary.

4-5 Operation for when an Error Occurs

If an error code occurs, the error code is displayed on Display 1, and the O_2 Vol display stops displaying the normal value. If this occurs, follow the steps explained in 5-2 Troubleshooting on page 29. After you clear the error contents, press the  key or turn OFF the analyzer power supply (power supply reset) to restore the measurement condition.

4-6 Applied Operations

(1) Primary delay time setting

With the data value input to CH016 (unit: seconds), primary delay can be applied to the concentration output signal. The setting range is 0 - 99 seconds.

(2) Output hold setting

If an error occurs for the sensor or receiver while CH023 is selected, this sets how the concentration output signal is to be held. The relationship between the input data and hold contents is shown in the table below.

Input Data	Hold Function
0	Hold not applied when error occurs in sensor or receiver.
1	Hold applied using the value set for CH024 when sensor or receiver error occurs.
2	Hold applied using the value 5 seconds before the error occurred in the sensor or receiver.

(3) Output hold value setting

If a sensor or receiver error occurs during warming up (receiver countdown display) or when 1 is input to CH023, hold is applied to the concentration output signal using the data set for CH024 (unit:% FS). For example, to hold current output of 4 - 20 mA at 12mA, the setting is 50% FS.

(4) Current output adjustment

① Connect an ammeter to check 4 - 20 mA+ and 4 - 20 mA- on the analyzer terminal board.

② When CHO27 is called up, the display shows "cAL 1".

③ When you press the ENT key, 0 is displayed on display 1. Each time you press the ● display 1 can be switched to 0 and 100. When 0 is displayed, output ZERO adjustment is possible, and when 100 is displayed, output SPAN adjustment is possible using the following procedure.

④ The output value can be increased using the ▲ key when display 1 indicates 0 or 100, and reduced using the ◀ key. Perform adjustment while using the ammeter to check the output.

⑤ When you have finished ZERO and SPAN adjustment in steps ④, press the ENT key to return to the CH setting mode.

(5) Voltage output adjustment

① Connect a voltmeter to check 0 - 5 V+ and 0 - 5 V- on the analyzer terminal board.

② When CHO28 is called up, the display shows "cAL 2".

③ When you press the ENT key, 0 is displayed on display 1. Each time you press the ● key, display 1 can be switched to 0 and 100. When 0 is displayed, output ZERO adjustment is possible, and when 100 is displayed, output SPAN adjustment is possible using the following procedure.

④ The output value can be increased using the ▲ key when display 1 indicates 0 or 100, and reduced using the ◀ key. Perform adjustment while using the voltmeter to check the output.

⑤ When you have finished ZERO and SPAN adjustment in steps ④, press the ENT key to return to the CH setting mode.

(6) Concentration alarm setting

Set the concentration max. alarm on CH220, and set the setting value unit on CH222.

Set the concentration min. alarm on CH221, and set the setting value unit on CH223.

When setting the unit, inputting 0 is "Not in use", 1 is ppm, and 2 is %.

To output the concentration alarm contact output, set the concentration warning for RY1 - 4 in 4-6 Applied Operations (9) on page 28.

(7) Positive/negative Offset

This function is used to add/subtract a certain value to/from the actual indication of gas concentration for display and output purposes.

①Enter the value of addition or subtraction in CH298.

The setting range is from -9999 to +9999.

Use the ● key to switch between positive (+) and negative (-).

②Select the unit of the value entered in ①.

[0: Not used, 1: ppm, 2: %]

Note)・For calibration, enter “0(Not used)” for CH299.

・When the positive/negative offset is applied, all the software functions such as concentration alarm, emergency hold, or auto-range will be executed based on the offset value.

(8) Storage of default values and restoration function

Factory default values and current setting values are to be stored.

Storage and reset are applied in one lump for all data regarding ranges, contact input and output, calibration data, sensor data, upper and lower abnormality of concentration. Individual storage and reset is not possible.

① Reset to default values

・Enter “1” to CH311 and restore default values with “ENT” key.

② Storage of current setting values

・Enter “204” to CH311 and store current setting data with “ENT” key.

Note) In case of storing setting values, original factory default data are rewritten by current setting values, therefore if relevant data are stored under changed condition from default values, it will be impossible to restore to factory default data again.

(9) Contact output (RY1 - 4) setting

The contact output contents are set using CH200 - 203, and the contact output movement settings are set using CH204 - 207.

RY1 contact output functions are set at CH200, and the contact output operation settings are set using CH204.

RY2 contact output functions are set at CH201, and the contact output operation settings are set using CH205.

RY3 contact output functions are set at CH202, and the contact output operation settings are set using CH206.

RY4 contact output functions are set at CH203, and the contact output operation settings are set using CH207.

When 0 is input for the movement setting, the No. is set, and when 1 is set, NC is set. See the table below for the difference between the contact output functions and the contact operation No. and NC settings.

CH 200 - 203 input data	Contact output functions		Contact output operation CH 204 - 207 input data			
			0 (NO) setting		1 (NC) setting	
0	No contact output		OFF		ON	
1	Analyzer error	During warming up, measurement	OFF		ON	
		During analyzer error	ON		OFF	
2	Range echo (2 range discrimination)	When No. 1 (NO. 3) range is selected.	ON		OFF	
		When No. 2 (NO. 4) range is selected.	OFF		ON	
3	Range echo (discrimination of 3 ranges or more)		RY (N)	RY (N+1)	RY (N)	RY (N+1)
		No. 1 range is selected	ON	ON	OFF	OFF
		No. 2 range is selected	OFF	ON	ON	OFF
		No. 3 range is selected	ON	OFF	OFF	ON
		No. 4 range is selected	OFF	OFF	ON	ON
4	READY	During warming up	ON		OFF	
		After warming up	OFF		ON	
5	Concentration max. alarm	During warming up	OFF		ON	
		Concentration higher than set value	ON		OFF	
		Concentration lower than set value	OFF		ON	
6	Concentration min. alarm	During warming up	OFF		ON	
		Concentration higher than set value	OFF		ON	
		Concentration lower than set value	ON		OFF	
7	Range echo (3 contacts)		RY2	RY3	RY4	RY2	RY3	RY4
		No. 1 range is selected	ON	ON	OFF	OFF	OFF	ON
		No. 2 range is selected	OFF	OFF	ON	ON	ON	OFF
		No. 3 range is selected	ON	OFF	ON	OFF	ON	OFF
		No. 4 range is selected	OFF	ON	ON	ON	OFF	OFF

⚠ When using range echo with discrimination of 3 ranges or more, it is necessary to use 2 adjacent contact outputs, e.g. RY1, RY2.

For the wiring to RY, see the wiring circuit example on page 12.

(10)Setting the data setting change password

By setting 0 for CH310, changing the setting data can be prohibited. Setting 201 for CH310 makes it possible to change the data.

5. Maintenance

The following maintenance and inspection procedures are important in order to maintain normal functioning and accurate measurement. Make sure you thoroughly understand the procedure before performing maintenance.

Sensor replacement cautions

- To prevent gas intoxication or oxygen deficiency, before you replace the sensor always stop the supply of sample gas.
- There is a danger of getting burned, so before you replace the sensor turn off the power and allow the analyzer to cool down first. If you must work while the analyzer is still hot, wear heat resistant gloves and work carefully to avoid burns.

5-1 Daily and Periodic Inspection

Sample gas flow rate check	Frequency	Once or more per week.
	Method	Check the sample gas flow meter float.
Gas calibration	Frequency	Once or more per month. (Periodic calibration is recommended to suit the operating conditions.)
	Method	Perform gas calibration in accordance with section 4-4 (4).
Sensor replacement	Frequency	2 years
	Method	Replace when necessary. (See 5-2 Troubleshooting.) See section 5-4 for the replacement method.

5-2 Troubleshooting

Phenomenon	Cause	Countermeasure	Remarks
Unable to change data.	0 is input for CH310.	Input 201 for CH310.	
	Receiver problem	Request repair by ENERGY SUPPORT CORP.	
Analyzer output, display value does not change.	Analyzer error occurring	Turn power OFF, then ON again after 10 seconds. Or push ◉ key to reset.	Take countermeasures in accordance with error code.
	Receiver problem	Request repair by ENERGY SUPPORT CORP.	
Analyzer output, display value error	Sample gas flow rate is outside range.	Readjust sample gas flow rate.	Adjustment to stipulated flow volume (0.5L/min)
	Sample gas pipe leak	Check for leaks, tighten sample gas pipe joints.	
	Pipe leak inside analyzer	Tighten joints, etc.	
	Gas calibration error	Perform gas calibration	
	Sensor deterioration	Replace the sensor	
Analyzer output, display value is zero	Sample gas flow rate is outside range	Readjust sample gas flow rate	Adjustment to stipulated flow volume (0.5L/min)
	Flammable gas included in sample gas	Eliminate flammable gas from sample gas	
	Sensor deterioration	Replace the sensor	
Analyzer output and display value do not match	Output adjustment is inaccurate	Perform output adjustment for CH027, 028	
Analyzer output and display value do not match	Output range is different.	Change output range (CH020, 026). Check output range setting (CH030 - 037) and reset.	
	Receiver problem	Request repair by ENERGY SUPPORT CORP.	
Slow response	Residual air effect inside sampling pipe, analyzer	N_2 purge of sampling pipe, pipes inside analyzer	
	Sample gas flow rate is insufficient.	Readjust sample gas flow rate	Adjustment to stipulated flow volume (0.5L/min)
	Blockage of sample gas pipe	Clean pipe or install new pipe	
	Primary delay time setting value is too large (CH016)	Check CH016 data, set it to 0 sec	

Error Code	Description	Possible cause	Action
E-01 E-02 E-03	Abnormality in ROM, RAM, and/or EEPROM	Receiver abnormality, or temporary malfunction due to external noise	Turn off the power and then, after 10 seconds, turn it back on.
E-04	Heater current excessively high	Sensor heater abnormality Heater wiring error Receiver abnormality	Press the DOT ⦿ key, or turn off the power and then, after 10 seconds, turn it back on. To clear the error display, press the DOT ⦿ key after the cause of the error has been eliminated (e.g. after a sensor has been replaced). Check the heater resistance (normally about 3Ω). Check the heater voltage (normally about 10.5V).
E-05	Heater current excessively low		
E-06	Heater voltage excessively high		
E-07	Heater voltage excessively low		
E-20	Heater temperature not high enough		
E-08	VS voltage excessively high	Sensor heater abnormality Heater wiring error Receiver abnormality	Press the DOT ⦿ key, or turn off the power and then, after 10 seconds, turn it back on. To clear the error display, press the DOT ⦿ key after the cause of the error has been eliminated (e.g. after a sensor has been replaced). Check the VS voltage (normally about 450 mV). Check the IP current （normally ±10mA）. Check the VP voltage (normally ±5V).
E-09	VS voltage excessively low		
E-10	IP current excessively high		
E-11	IP current excessively low		
E-12	VP voltage excessively high		
E-13	VP voltage excessively low		
E-14	Heater terminals (S+, S-) not closed	Defective contact in wiring between S+ and S-	Press the DOT ⦿ key to clear the error display. Check the wiring and return to normal condition.
E-21	Data out of the specified range	Data entry error	Press the DOT ⦿ key to clear the error display. Enter data within the specified range.
E-35 ～48	Calibration error	Sensor abnormality Calibration gas concentration setting error	Press the DOT ⦿ key to clear the error display. Make sure that the standard gas concentration setting value is correct and that the calibration gas flow rate is normal. Then perform the calibration again. Check the IP current with N_2 (normally ± 0.5mA). Check the following value. (IPAir－IPN2／21＝ka) （normally 0.1～0.5）
E-60	All output ranges are “Not used”.	Range entry error	Press the DOT ⦿ key to clear the error display. Change any one of the output ranges (No.1～4) into other than “Not used”.
E-63	“Not used” range is selected.	Range entry error or range selection error	Press the DOT ⦿ key to clear the error display. Select a range other than “Not used”.

⚠ **The O_2 analyzer needs to be sent to the maker for repair if all the actions listed above should fail.**

5-3 Supply Parts List

Part Name	Part No.	Remarks
Oxygen sensor	RX-731004	Sample gas flow rate 0.5L/min.

5-4 Sensor Replacement Procedure

Replace the sensor using the following procedure.

(1) Turn the analyzer power OFF, then remove the case cover.

(2) Disconnect the connector connecting the sensor to the receiver.

(3) The sensor is screwed into the cell support bracket, so remove the sensor using a spanner applied to the hexagonal part of the sensor (22 mm across opposite sides).

(4) Screw the new sensor into the cell support bracket and connect the connector to the receiver. Do not forget to install the sensor packing.

(5) Install the case cover, then turn the analyzer power ON.

(6) After sensor warming up is finished, CH250 is automatically selected when you input 1 to CH019. The sensor is supplied with the data, so the data is input from CH250 to CH261. When 1 has been input to CH019, pressing the ENT key after the data is input makes continuous input possible from CH250 to CH261. There is no need to reset the CH. Input is possible using normal key operation.

(7) Performing air 1 point calibration makes it possible to perform measurement in the 0 - 1000 ppm range or above. If using the 0 - 1000 ppm or less range, perform calibration using standard gas. For the gas calibration method, see page 22, 4-4 Procedure During Operation, (4) Gas Calibration.

6. Reference Material

6-1 Standard Specifications

Model	SH-204-AW
Measurement Principle	Zirconia limiting current method
Sampling system	Ejector suction system
Measurement Range	RX-501125-A:0 - 500, 5,000 ppm O_2, 0 - 5, 50% O_2
Output	DC 4 - 20 mA (non-insulated output, load resistance 600 Ω or less) DC 0 - 5 V (non-insulated output, load resistance 10 KΩ or above)
Repeatability	±1%FS
Linearity	±5%FS
Drift	±2%FS/WEEK
Response Time	30 sec. or less (0 - 1,000 ppm range, 90% response for calibration gas switching)
Ambient Temperature	0 - 45ºC
Humidity	90% RH or less
Power	AC100~240V±10% 50/60Hz
Sensor Heater voltage	DC10.0V
Sample Gas Flow	0.5±0.1L/min
Sample Gas Temperature	0 - 50ºC
Sample Gas Composition	Must not include flammable gases. Must not include corrosive gases. Condensation must not occur within the ambient temperature range. The dust quantity must be 1 mg/Nm^3 or less. NOTE: Inclusion of corrosive gases (F, HF, CL_2, HCL, SO_2, H_2S, etc.) or poisonous materials (Si, Pb, P, Zn, Sn, As, etc.) can cause sensor deterioration in a short time. In particular, when silicone materials (in paints, mold release agents, packing, piping materials, etc.) are heated, Si may be easily generated in large amounts. Accordingly, when starting up a newly installed furnace or one just repaired, remove the sensor first and reinstall it after you have heated up the furnace sufficiently. Also periodically exchange the filter (activated charcoal, etc.) used to eliminate corrosive gases and poisonous materials in accordance with its usage severity.
Installation Conditions	When you install the oxygen analyzer to the measurement object, make sure the installation location fulfils the following conditions to avoid damaging the analyzer and causing mis-operation. • There is little mechanical vibration. • It is not affected by corrosive gases (F, HF, CL_2, HCL, SO_2, H_2S, etc.), and it does not interfere with maintenance personnel. • Condensation does not occur due to sudden temperature fluctuations. • It is not affected by direct heat radiation. • It is affected little by noise. • There is little humidity and dust. • The ambient temperature is between 0º and 45ºC.

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.
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