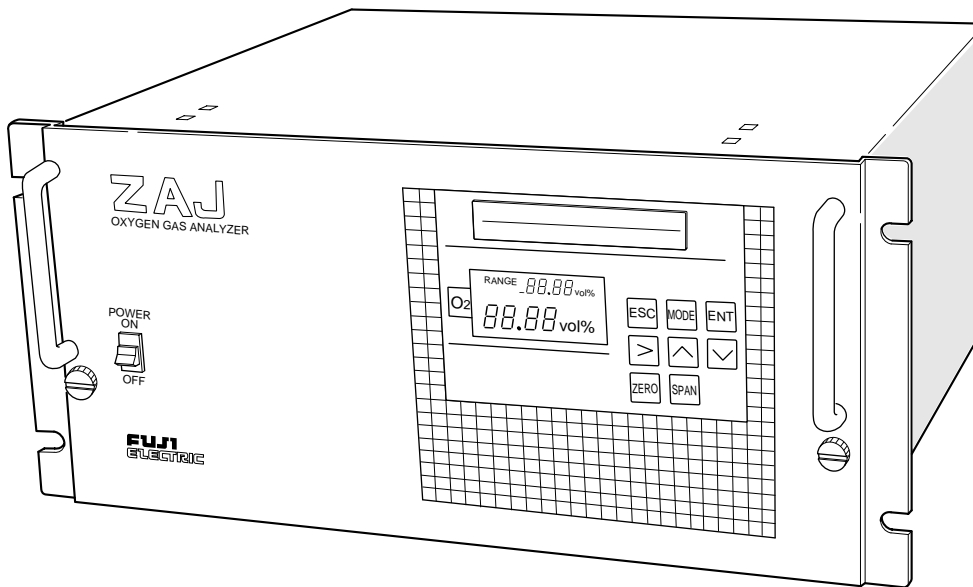




## Instruction Manual

# PARAMAGNETIC OXYGEN ANALYZER

TYPE: ZAJ



## PREFACE

We are grateful for your purchase of Fuji Electric's paramagnetic oxygen analyzer (ZAJ).

- First read this instruction manual carefully until an adequate understanding is acquired, and then proceed to installation, operation and maintenance of the gas analyzer. Wrong handling may cause an accident or injury.
- The specifications of this analyzer will be changed without prior notice for further product improvement.
- Modification of this gas analyzer is strictly prohibited unless a written approval is obtained from the manufacturer. Fuji Electric will not bear any responsibility for a trouble caused by such a modification.
- This instruction manual shall be stored by the person who actually uses the gas analyzer.
- After reading the manual, be sure to store it at a place easier to access.
- This instruction manual should be delivered to the end user without fail.

### Delivered items

Name	Q'ty	Remarks
Analyzer main frame	1	—
Filter	2	Spare
Restrictor	1	Spare
Packing	2	Spare (filter area)
Packing	4	Spare (for restrictor)
Fuse	2	2A
Instruction manual	1	—
Test report	1	—
Wrench	2	For reference gas joint

Manufacturer: Fuji Electric Instrumentation Co., Ltd.  
Type: Described in Fuji Electric's company nameplate on main frame  
Date of manufacture: Described in Fuji Electric's company nameplate on main frame  
Product nationality: Japan

### Request

- It is prohibited to transfer part or all of this manual without Fuji Electric's permission in written format.
- Description in this manual will be changed without prior notice for further improvement.

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## CAUTION ON SAFETY

**First of all, read this “Caution on safety” carefully, and then use the analyzer in the correct way.**

- The cautionary descriptions listed here contain important information about safety, so they should always be observed. Those safety precautions are ranked in 2 levels; DANGER and CAUTION.

 <b>DANGER</b>	<p>Wrong handling may cause a dangerous situation, in which there is a risk of death or heavy injury.</p>
 <b>CAUTION</b>	<p>Wrong handling may invite a dangerous situation, in which there is a possibility of medium-level trouble or slight injury or only physical damage is predictable.</p>

<b>Caution on installation and transport of gas analyzer</b>	
 <b>DANGER</b>	
<ul style="list-style-type: none"> <li>• This unit is not explosion-proof type. Do not use it in a place with explosive gases to prevent explosion, fire or other serious accidents.</li> </ul>	
 <b>CAUTION</b>	
<ul style="list-style-type: none"> <li>• This unit should be installed in a place which conforms to the conditions noted in the instruction manual. Otherwise, it may cause electric shocks, fire or malfunction of the unit.</li> <li>• During installation work, care should be taken to keep the unit free from entry of cable chips or other foreign objects. Otherwise, it may cause fire, trouble or malfunction of the unit.</li> <li>• For lifting the gas analyzer, be sure to wear protective gloves. Bare hands may invite an injury.</li> <li>• Before transport, fix the casing so that it will not open. Otherwise, the casing may be separated and fall to cause an injury.</li> <li>• The gas analyzer is heavy. It should be transported carefully by two or more persons if manually required. Otherwise, body may be damaged or injured.</li> </ul>	

### Caution on piping



- In piping, the following precautions should be observed. Wrong piping may cause gas leakage. If the leaking gas contains a toxic component, there is a risk of serious accident being induced. Also, if combustible gas is contained, there is a danger of explosion, fire or the like occurring.
- Connect pipes correctly referring to the instruction manual.
- Exhaust should be led outdoors so that it will not remain in the locker and installation room.
- Exhaust from the analyzer should be relieved in the atmospheric air in order that an unnecessary pressure will not be applied to the analyzer. Otherwise, any pipe in the analyzer may be disconnected to cause gas leakage.
- For piping, use a pipe and a pressure reducing valve to which oil and grease are not adhering. If such a material is adhering, a fire or the like accident may be caused.

### Caution on wiring



- The unit must be earthed as specified. Otherwise, it may cause electric shocks, malfunction, etc.
- Be sure to use a power supply of correct rating. Connection of power supply of incorrect rating may cause fire.
- Wiring work must be performed with the main power set to OFF to prevent electric shocks.
- Wires should be the proper one meeting the ratings of this instrument. If using a wire which cannot endure the ratings, a fire may occur.

### Caution on use



- When handling the standard gas such as calibration gas, read the instruction manual of the standard gas carefully and use the gas correctly.



- Avoid continuous operation with the casing drawn out. Otherwise, the casing may fall to cause an injury.
- During operation, avoid opening the casing and touching the internal parts. Otherwise, you may suffer a burn or shock hazard.

### Caution on maintenance and check



- Before working such as restrictor replacement with the casing open, be sure to turn off power supply, and perform air and N<sub>2</sub> gas purging of not only the analyzer inside, but also the sample gas line and reference gas line. In addition, carefully prevent oil and grease from adhering to the restrictor, filter, packing, etc. Otherwise, poisoning, fire or explosion may be caused due to gas leakage, etc.



- Before working, take off a wrist watch, finger ring or the like metallic accessories. And never touch the instrument with a wet hand. Otherwise, you will have a shock hazard.
- If the fuse is blown, eliminate the cause, and then replace it with the one of the same capacity and type as before. Otherwise, shock hazard or fault may be caused.

### Others



- If the cause of any fault cannot be determined despite reference to the instruction manual, be sure to contact your dealer or Fuji Electric's technician in charge of adjustment. If the instrument is disassembled carelessly, you may have a shock hazard or injury.
- Do not use a replacement part other than specified by the instrument maker. Otherwise, adequate performance will not be provided. Besides, an accident or fault may be caused.
- Replacement parts such as a maintenance part should be disposed of as incombustibles.

# 1. GENERAL AND PRINCIPLE OF OPERATION

## 1.1 General

The magnetic force type (pressure detection type) oxygen analyzer measures the oxygen content in sample gases by converting oxygen concentration into pressure depending on the magnetic property of oxygen. Because this analyzer detects a difference in oxygen concentration between sample gas and reference gas, **a cylinder for reference gas is indispensable.**

## 1.2 Principle of measurement

All gases have positive or negative magnetic susceptibilities as shown in Table 1-1.

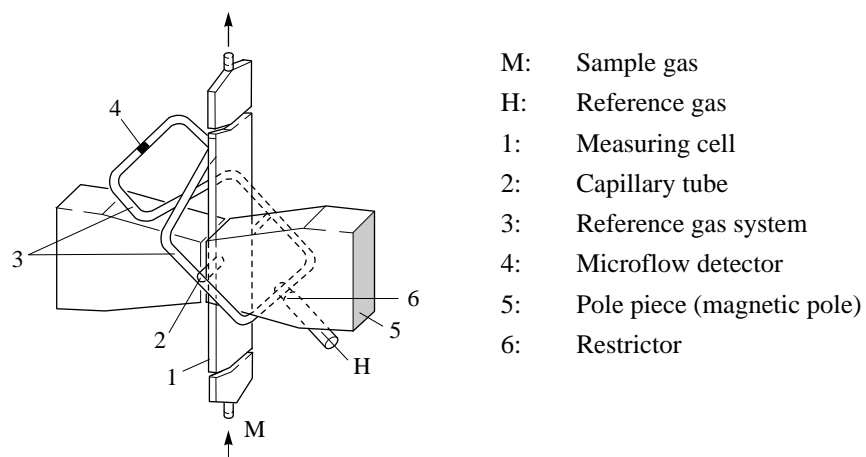
Among these gases, O<sub>2</sub>, NO and NO<sub>2</sub> have high positive magnetic susceptibilities and are attracted strongly by magnetic field, whereas the others are diamagnetic substances. NO and NO<sub>2</sub> may be contained in combustion gas at negligibly low concentrations.

It is therefore possible to measure O<sub>2</sub> contents in various types of gases by utilizing its magnetic susceptibility. Fig. 1-1 illustrates the principle to detect O<sub>2</sub> contained in a gas.

**Table 1-1 Relative susceptibilities of various gases**

Kind of gas	Relative susceptibility	Kind of gas	Relative susceptibility
Oxygen	+100	Nitrogen	-0.42
Air	+21 (dry air)	Chlorine	-0.13
Carbon dioxide	-0.61	Hydrogen	-0.12
Argon	-0.58	Acetylene	-0.38
Ammonia	-0.58	Nitrous oxide	-0.58
Ethane	-0.83	Nitrogen monoxide	+43.8
Methane	-0.37	Nitrogen dioxide	+28.0

Fig. 1-1 illustrates the principle of operation.



**Fig. 1-1 Conceptual diagram of detector**

In an ununiform magnetic field, oxygen molecule is attracted toward higher magnetic intensity and produces a pressure from a macroscopic viewpoint. This pressure is converted into an electrical signal by the microflow detector and then is amplified.

At this stage, a reference gas is flowed from outside to convert the pressure effectively into the electrical signal. Generally used as the reference gas is  $N_2$ , which contains oxygen at the standard differential concentration in case of the differential type.

Since the reference gas flows from between magnetic poles into the measuring cell, there are produced a pressure in the reference gas line of the pole piece due to diamagnetism of  $N_2$  and another pressure in the outflow port due to magnetism of  $O_2$ . Since the pressure due to  $O_2$  is far higher, a pressure is applied to the reference gas line. Since the other outflow port symmetrically arranged is located outside the magnetic field, a flow of the reference gas is produced in the pipe of reference gas system 3 and the microflow is converted into a signal by the detector.

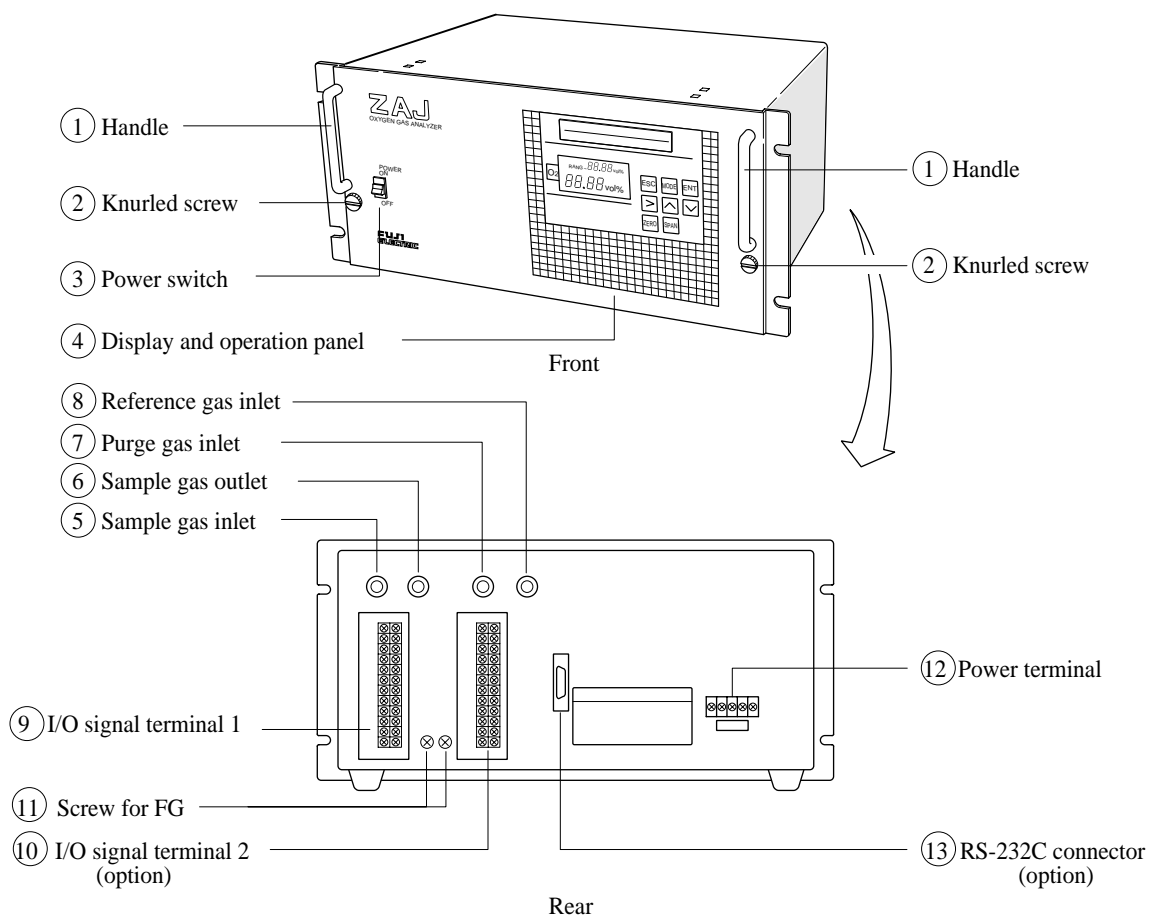
Since this pressure is proportional to the difference between concentration of oxygen contained in sample gas and that of oxygen contained in the reference gas (normally,  $N_2$  containing no oxygen), it is possible to detect concentration of oxygen. Since the magnetic field formed between the magnetic poles is intermittent, the microflow pulsates to produce alternating electric signals.

The high response speed has been achieved owing to a small capacity of the measuring cell and the quick response of the microflow detector.

Besides, the microflow due to magnetic force is unaffected by the thermal conductivity, viscosity and heat capacity of sample gas. This signifies that interference by other gases is minimum.

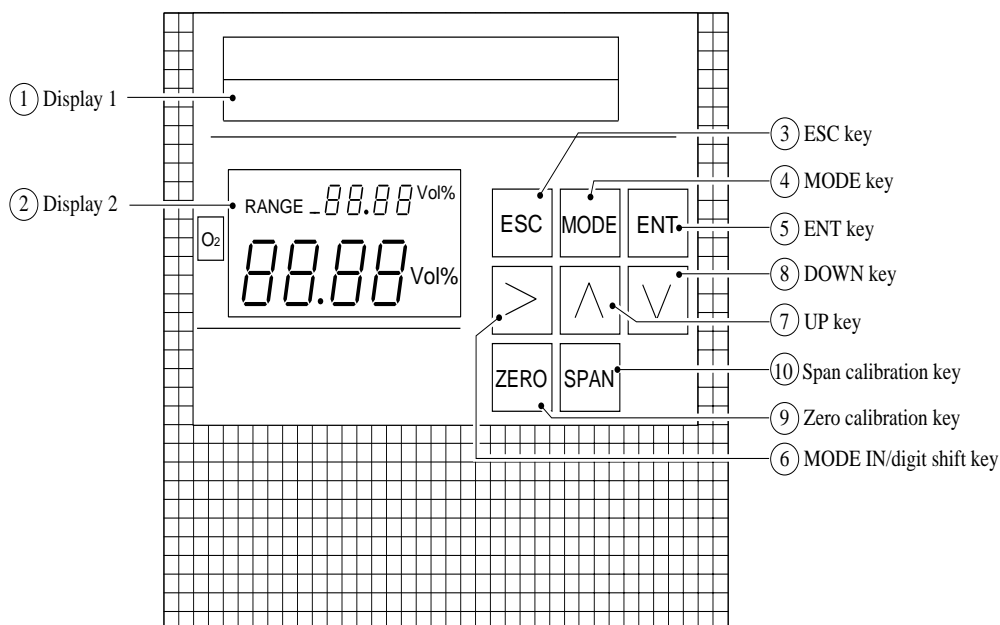
## 2. NAME AND EXPLANATION OF EACH PART

### 2.1 Name and explanation of each casing part



Name	Explanation
① Handle	Used for drawing out the inside of analyzer main frame (base).
② Knurled screw	Fastens the main frame and casing. Loosens when turned counter-clockwise.
③ Power switch	Turned on to activate all the internal circuits. After 3 to 4 sec, the display area lights up.
④ Display and operation panel	Displays gas concentration, measurement range, etc. Has keys necessary for routine operation and various settings. For details of the display and operation panel and its operation method, refer to "2.2" and "5," respectively.
⑤ Sample gas inlet	Port for connecting the sample gas injection pipe. Refer to "3.2."
⑥ Sample gas outlet	Port for connecting the pipe for discharging the gas after analysis. Refer to "3.2."
⑦ Purge gas inlet	Port for connecting the purge gas pipe. Refer to "3.2."
⑧ Reference gas inlet	Port for connecting the reference gas pipe. Refer to "3.2."
⑨ I/O signal terminal 1	Refer to "3.4.3."
⑩ I/O signal terminal 2 (option)	Refer to "3.4.3."
⑪ Screw for FG	Connects each shield of input and output cables.
⑫ Power terminal	Supplies power to the main frame. Refer to "3.4.2."
⑬ RS-232C connector (option)	RS-232C connector

## 2.2 Name and explanation of each display and operation panel part



Name	Explanation
① Display 1	Indicates the current mode and the next selection item. Also used to indicate the message for next operation and set various parameters.
② Display 2	Indicates measured concentration and measurement range. Also used for setting calibration concentration value.
③ <b>ESC</b> key	Used for returning to the previous screen or interrupting setting halfway.
④ <b>MODE</b> key	Used for mode changeover.
⑤ <b>ENT</b> key	Press after setting, and the set contents will be stored in memory and made effective. Also used as an execution key in calibration.
⑥ <b>MODE IN/digit shift key</b> ( <b>&gt;</b> )	Used for determining a selection item in each mode. Also used for digit shift in setting.
⑦ <b>UP key</b> ( <b>^</b> )	Used for changing selection item and incrementing a value in setting.
⑧ <b>DOWN key</b> ( <b>v</b> )	Used for changing selection item and decrementing a value in setting.
⑨ <b>ZERO</b> calibration key	Used for zero calibration.
⑩ <b>SPAN</b> calibration key	Used for span calibration.

### 3. INSTALLATION

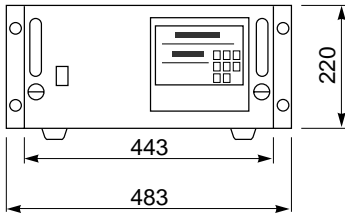
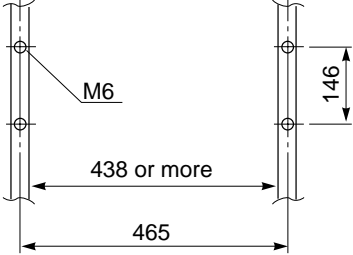
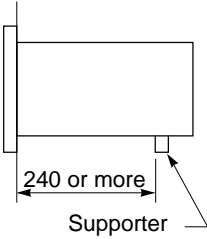
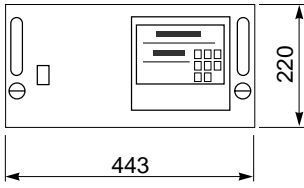
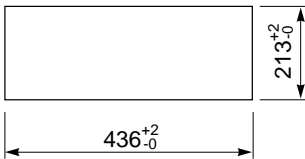
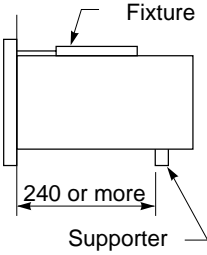
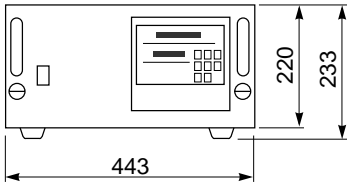
#### ⚠ CAUTION

- This analyzer weighs about 16 kg. Install it safely and securely to prevent falling.
- Before installation, make sure the knurled screw at the front face of analyzer is fixed securely. (If the knurled screw is loose, there is a risk of the internal block springing out toward you.)

#### 3.1 Mounting

The analyzer is mountable in any of the three ways below depending on type specification.

(Unit: mm)

Kind	External dimensions	Mounting dimensions	Mounting method
19-inch rack mounting	 <p>(H) 220 x (W) 483 x (D) 463</p>		 <p>Supporter</p>
Panel mounting	 <p>(H) 220 x (W) 443 x (D) 463</p>	<p>Panel cutout dimensions</p> 	 <p>Supporter</p>
Tabletop type	 <p>(H) 233 x (W) 443 x (D) 463</p>	<p>—————</p>	<p>—————</p>

#### 3.1.1 Caution on installation

- (1) The analyzer should be installed so that its front face becomes vertical.
- (2) 70% or more of the analyzer weight should be supported at the bottom of the casing.  
(For panel mounting and 19-inch rack mounting, prepare a supporter and support the rear of casing with the supporter.)

## 3.2 Piping

### DANGER

- Use a pipe with no oil or grease stuck to the inside.
- Pipe joint should be tightened securely not to cause gas leakage.
- Exhaust should be discharged at a safe outdoor location so that it will not remain inside the locker and installation room.
- Exhaust from the analyzer should be relieved in the atmospheric air in order that an unnecessary pressure will not be applied to the analyzer. (Otherwise, a pipe in the analyzer may be disconnected to cause gas leakage.)

#### (1) Piping method

In order to obtain a quick response from the measuring system, the sample gas line should have a small pipe diameter. The end of exhaust line should be open to the atmosphere.

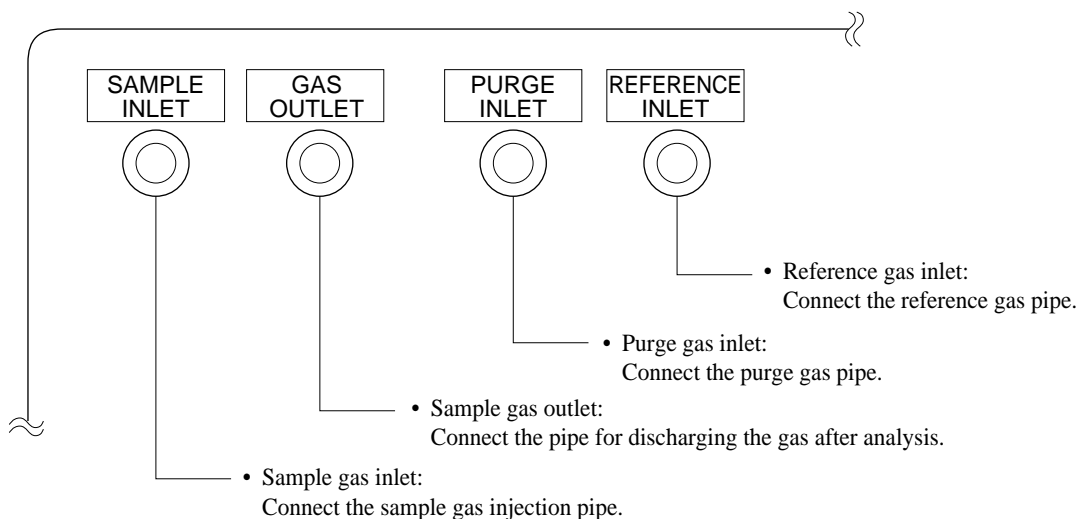
Further, be sure to provide a buffer tank (ZBH41) in the exhaust line shortly after the analyzer for preventing its output from fluctuating due to external disturbance such as large noise or strong wind.

The reference gas line should desirably be made of copper ( $\phi 6/\phi 4$ mm copper pipe) and as short as possible from the gas cylinder. If the gas pipe is long, the reference gas will take a long time to reach the detector at startup and a wait time will be required for setting the zero level as a reference value. In case the reference gas pipe is made of vinyl chloride, an indication error may be caused due to oxygen transmission through the pipe.

A pressure switch of 100 kPa should be provided with the reference gas line as shown in Fig. 3-2 so that an alarm signal is issued if reference gas pressure falls abnormally. Output becomes zero when the reference gas flow stops.

Upon issuance of an alarm signal, purge the sample gas line with the zero gas immediately (for about 20 minutes). This is necessary for protecting the detector element. If the reference gas stops flowing into the detector, the sample gas would enter the detector gradually through diffusion and corrode or deteriorate the detector element. After purging, pay attention not to allow corrosive gases to enter the analyzer until the normal reference gas pressure is regained.

Gas pipes should be connected as shown in Fig. 3-1.



**Fig. 3-1 Rear face of ZAJ**

Because temperature at some locations (inlet, outlet, etc.) of the sample gas line becomes equal to the ambient temperature, the dew point of the sample gas must be low than the ambient temperature. The sample gas, whose dew point is higher than the ambient temperature, it should be introduced into the analyzer after passing through a dehumidifier.

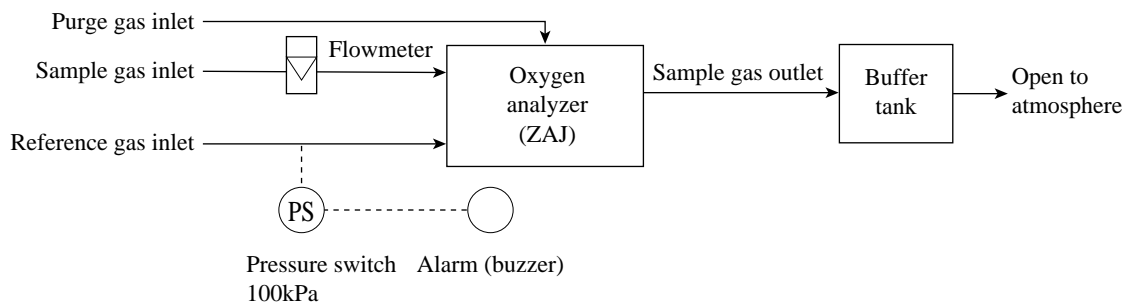
If sample gas contains dust, a filter should be provided for eliminating dust before flowing the sample gas into the analyzer main frame. For combining the analyzer with an existing gas sampling device, the contaminated pipe after the filter should be replaced with a new one. If the contaminated pipe is used, the analyzer may cause an error due to entrance of dust.

Bear in mind that sample gas must not contain a gas component which chemically affects stainless steel (SUS 304) or Teflon.

When sample gas contains a combustible gas component, it is recommended to purge the analyzer main frame with a protective gas ( $N_2$  or air for instrumentation, flow rate 1.0  $\ell$  /min) against the combustible gas component.

## (2) Piping diagram

Fig. 3-2 shows the piping diagram for ZAJ measurement.



**Fig. 3-2 Piping diagram**

### 3.3 Gas sampling

#### 3.3.1 Conditions of sample gas

- (1) The dust contained in sample gas should be eliminated completely with filters. The filter at the final stage should be capable of eliminating dust of 0.3 microne.
- (2) The dew point of sample gas must be lower than the ambient temperature for preventing formation of drain in the analyzer. If water vapor is contained in sample gas, its dew point should be reduced down to about 0°C through a dehumidifier.
- (3) If SO<sub>3</sub> mist is contained in sample gas, the mist should be eliminated with a mist filter, cooler, etc. Eliminate other mist in the same way.
- (4) If a large amount of highly corrosive gas such as Cl<sub>2</sub>, F<sub>2</sub> or HCl is contained in sample gas, the service life of analyzer will be shortened. So, avoid such gases.
- (5) Sample gas temperature is allowed within a range from 0 to 50°C. Pay attention not to flow hot gas directly into the analyzer.

#### 3.3.2 Flow rate of sample gas

Provide a flowmeter as shown in Fig. 3-2 “Piping diagram” on the previous page and measure the flow rate of sample gas.

Gas flow rate	Response speed
0.5 ℓ ±0.2 ℓ /min.	Beyond 2 sec
1.0 ℓ ±0.2 ℓ /min.	Within 2 sec

#### 3.3.3 Reference gas

This analyzer requires reference gas depending on measurement range. Select a proper reference gas cylinder as specified below.

Measurement range	Reference gas cylinder
0 to 2 ..... 100% O <sub>2</sub>	N <sub>2</sub> (*) ZBM n NY04-01
21 to 23 ..... 100% O <sub>2</sub>	Air: 21% O <sub>2</sub> , remainder N <sub>2</sub> (*)
21 to 19 ..... 0% O <sub>2</sub>	ZBM□RY04-01
100 to 98 ..... 0% O <sub>2</sub>	O <sub>2</sub> : 100% O <sub>2</sub> ZBM□SY04-01

For setting of measurement range, refer to “(3) Range value setting” in “5.3.6 Adjustment mode.”

Reference gas should be supplied to the analyzer according to the specifications given below.

Reference gas	Specification
Pressure	100kPa
Flow rate	5 to 15 ml /min.

Unless reference gas is flowed, not only measurement cannot be carried out, but also the detector element may become defective due to the corrosive gas component in sample gas. To prevent this, provide a pressure alarm in the reference gas line as instructed in “3.2 Piping.”

### 3.3.4 Preparation of standard gases

Prepare standard gases for zero and span calibrations.

	Specifications
Zero gas	<p>The same gas as reference gas</p> <ul style="list-style-type: none"> <li>For oxygen reference, use O<sub>2</sub> gas of purity 99.99% or higher in a range less than 10vol% of the full scale and that of purity 99.9% or higher in other range.</li> </ul>
Span gas	<p>O<sub>2</sub> gas corresponding to 90% or more of full scale in each range + remaining N<sub>2</sub></p> <ul style="list-style-type: none"> <li>For air-standard range, the concentration of span gas should be specified within 80 to 100% of the full scale. In this case, be sure to clearly mark “manufacture by weight method, accuracy within ○○% O<sub>2</sub>.” For accuracy, specify the O<sub>2</sub> concentration corresponding to the full scale in selected ZAJ range ±1%. Unless accuracy is given, concentration error becomes wider. For container, specify a 10 ℓ cylinder.</li> </ul> <p>Example) Description of 21 to 19% O<sub>2</sub> range</p> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; text-align: center;"> <p><b>19.0 to 19.4% O<sub>2</sub>, N<sub>2</sub> balance, manufacture by weight method</b>  <b>Accuracy within ±0.02% O<sub>2</sub>, 10 ℓ cylinder</b></p> </div>

### 3.3.5 Purging of instrument inside

The inside of instrument need not be purged generally except for the following cases.

- (1) A combustible gas component is contained in sample gas.
- (2) Corrosive gas is contained in the atmospheric air at the installation site.
- (3) The same gas as the sample gas component is contained in the atmospheric air at the installation site.

In such cases as above, the inside of analyzer should be purged with the air for instrumentation or N<sub>2</sub>.

Purging flow rate should be about 1 ℓ /min.

If dust or mist is contained in purging gas, it should be eliminated completely in advance.

## 3.4 Wiring

### CAUTION

- Wiring work is allowed only when all power supplies are turned off. Otherwise, shock hazard will be caused.
- Be sure to ground the analyzer.

### 3.4.1 Wiring method

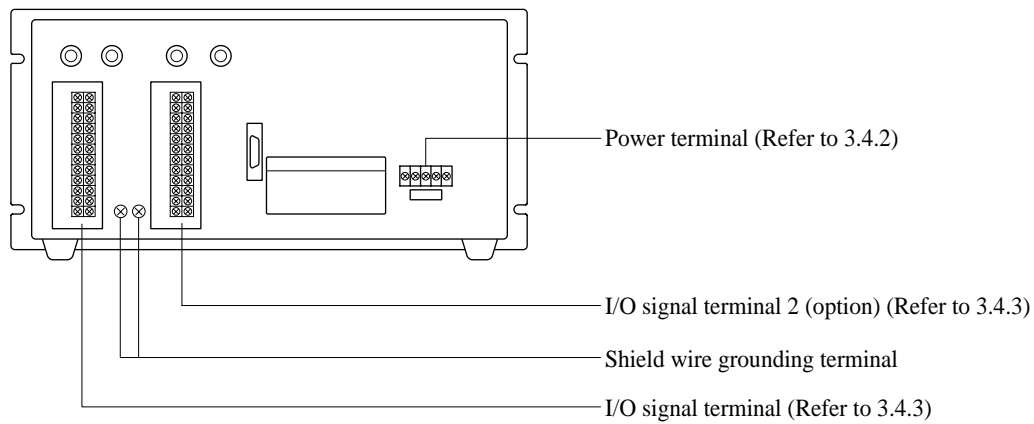
Each external terminal is provided on the rear face of the analyzer. (See Fig. 3-3.)

Wire each terminal, referring to Figs. 3-4 to 3-6.

Terminal screw is of M3.5 (except for the power terminal, which is of M4).

For connection of output signal, use a shielded wire in order to suppress the influence by external noise.

Fig. 3-3 Position of each external terminal



**Fig. 3-3** Each position of external terminals

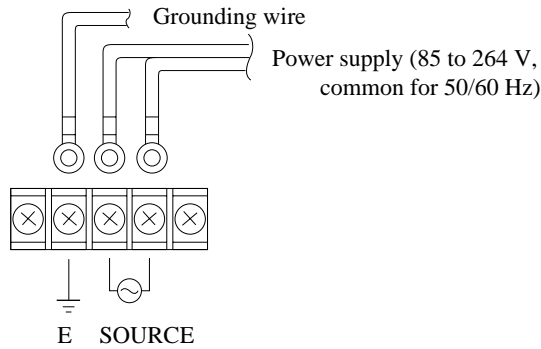
### 3.4.2 Power terminal

Power terminals are provided as shown in Fig. 3-4.

Connect power supply to the power supply terminals, and the grounding wire to the grounding terminal.

The grounding should be made securely.

For the wire to be connected to each terminal, use a solderless terminal (for M4).

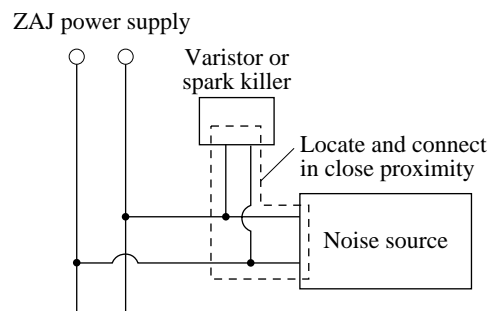


**Fig. 3-4 Power supply terminals**

#### When noise source is in the vicinity

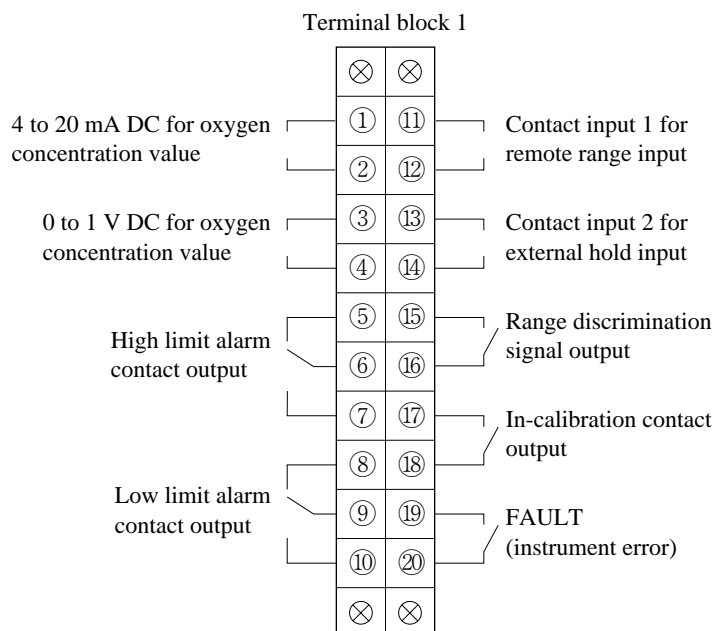
Do not install the analyzer near power noise generating electric equipment (such as high frequency furnace and electric welder). If the analyzer must be used near such equipment, a separate power line should be used for avoiding noise.

In case noise may enter from a relay, solenoid valve, etc. through power supply, connect a varistor (such as ENA211-2 made by Fuji Electric) or spark killer (like S1201 made by OKAYA) to the noise source as shown below. If the varistor or spark killer is located away from the noise source, no effect is obtainable. So, locate near the noise source.



### 3.4.3 I/O terminals

Fig. 3-5 shows a connection diagram of I/O signal terminals 1 and Fig. 3-6 shows that of I/O signal terminals 2. The contents of each connection are described on the lower side of this page.



**Fig. 3-5 I/O signal terminal block 1**

#### <High limit alarm contact output>

When the high limit is exceeded, terminals ⑤ and ⑥ are disconnected, and terminals ⑥ and ⑦ are connected. Normally, terminals ⑤ and ⑥ are connected, and terminals ⑥ and ⑦ are disconnected.

1c contact, 250 V AC, 2 A (resistance load)

#### <Low limit alarm contact output>

Below the low limit, terminals ⑧ and ⑨ are disconnected, and terminals ⑨ and ⑩ are connected.

1c contact, 250 V AC, 2 A (resistance load)

#### <Remote range input>

When there is no input between terminals ⑪ and ⑫, the first range is selected.

When 5 V DC is input between terminals ⑪ and ⑫, the second range is selected.

#### <External hold input>

When 5 V DC is input between terminals ⑬ and ⑭, instantaneous value output is held at the value just before input.

#### <Range discrimination signal output>

When the first range is selected, terminals ⑮ and ⑯ are disconnected.

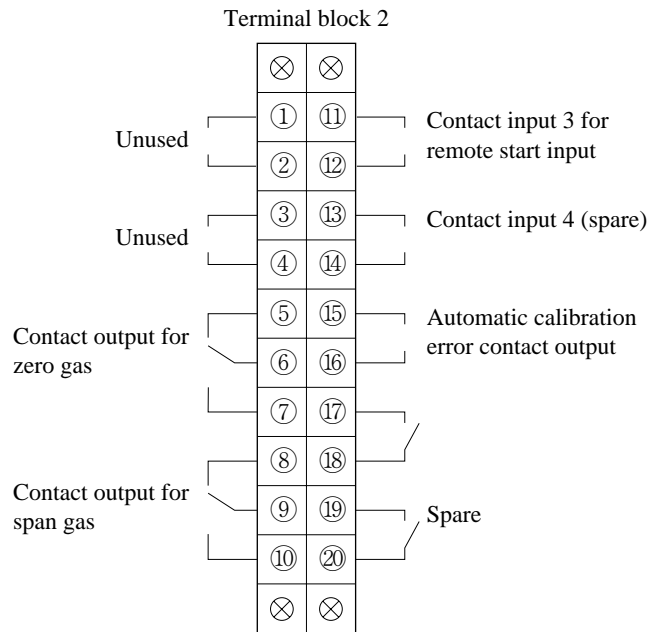
When the second range is selected, terminals ⑮ and ⑯ are connected.

1a contact, 250 V AC, 2 A (resistance load)

#### <In-calibration contact output>

While zero or span calibration is in progress, terminals ⑰ and ⑱ are connected.

1a contact, 250 V AC, 2 A (resistance load)



**Fig. 3-6 I/O signal terminal block 2**

**<FAULT>(instrument error)**

Contact output for indicating occurrence of an error in the analyzer. At error, terminals ⑱ and ⑳ are connected.

1a contact, 250 V AC, 2 A (resistance load)

**<Contact output for zero gas>**

Contact output for solenoid valve drive to flow zero gas.

1c contact, 250 V AC, 2 A (resistance load)

**<Contact output for span gas>**

Contact output for solenoid valve drive to flow span gas.

1c contact, 250 V AC, 2 A (resistance load)

**<Remote start input>**

Input for starting automatic calibration according to external signal.

For start, 5 V DC is input between terminals ① and ⑫ .

**<Automatic calibration error contact output>**

Contact output for indicating a calibration error in automatic calibration.

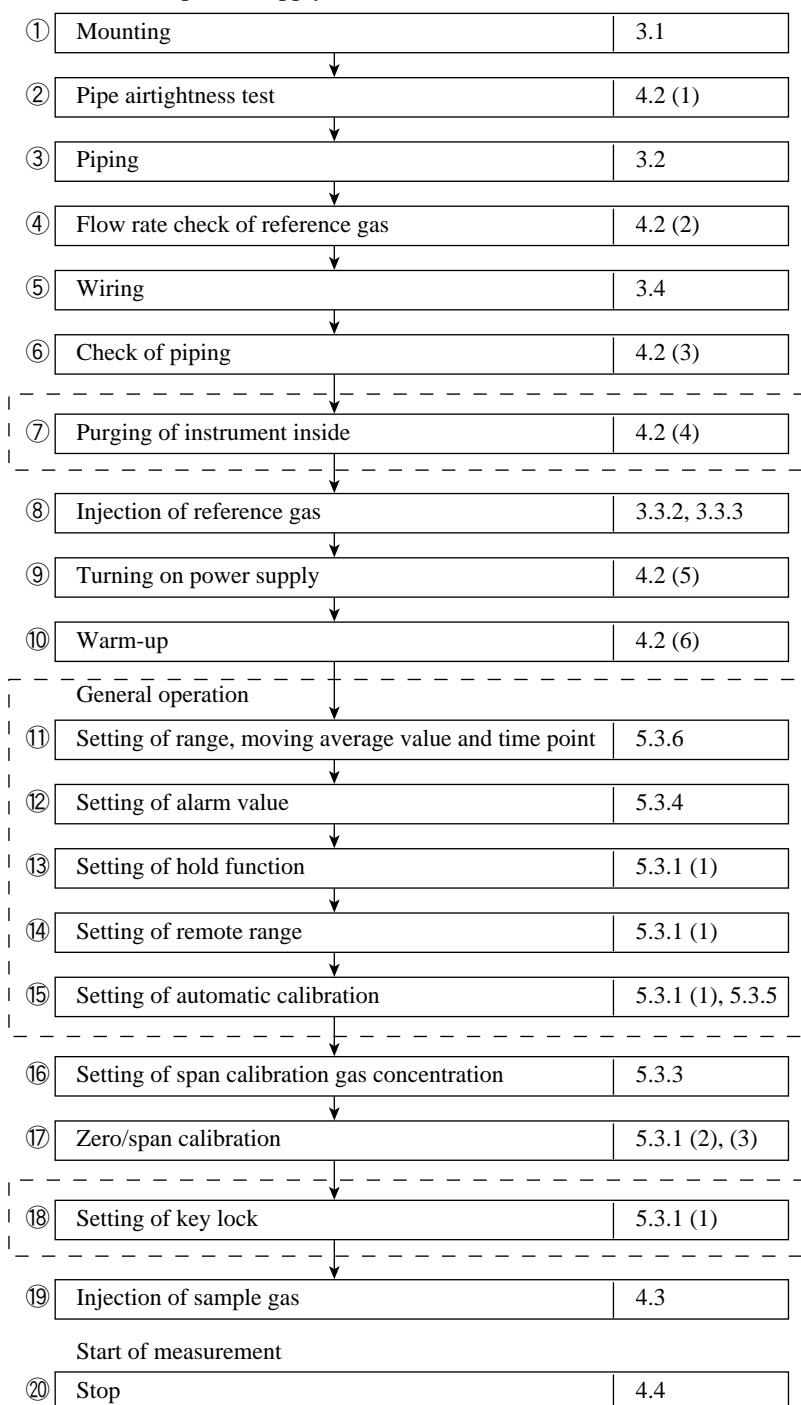
## 4. OPERATION

### ⚠ CAUTION

- Before operation, read the instruction manual carefully. After acquisition of an adequate understanding, you should start operation.

### 4.1 Operating procedure

Carry out operation in the procedure shown in Fig. 4-1. After confirming the operational preparations in ① to ⑧, turn on power supply for start.



The steps enclosed by dashed line should be effected as required.

Fig. 4-1 Operating procedure

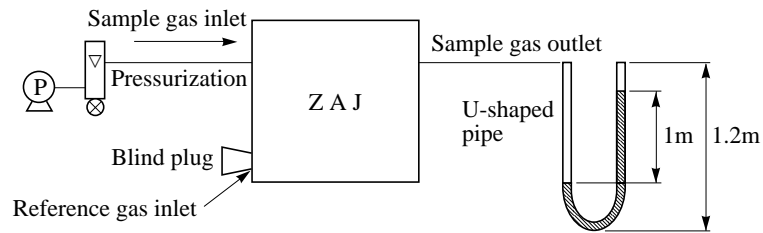
## 4.2 Preparations for operation

### (1) Pipe airtightness test

Sample gas line ..... See Fig. 4-2.

Close the reference gas inlet. Then, connect a U-shaped pipe (1.2m high) to the sample gas outlet, inject water and apply a pressure of 9.8 kPa from the sample gas inlet.

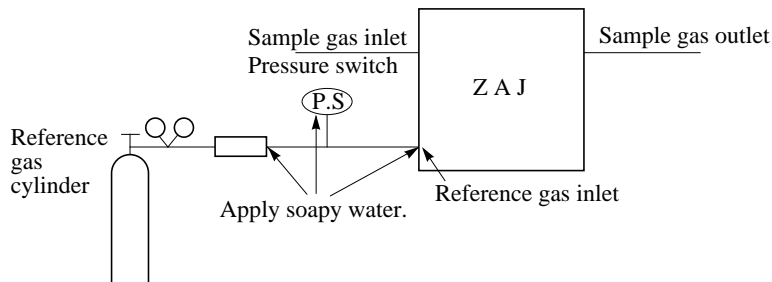
Close the inlet and wait for 2 minutes. Then, observe a pressure drop in 1 minute. When pressure drop lies within 98 Pa, airtightness is secured.



**Fig. 4-2 Airtightness test of sample gas line**

Reference gas line ..... See Fig. 4-3.

Open the main valve of reference gas cylinder and adjust the pressure regulator so that pressure becomes 100 kPa. Apply soapy water to each joint and make sure bubbles are not formed.

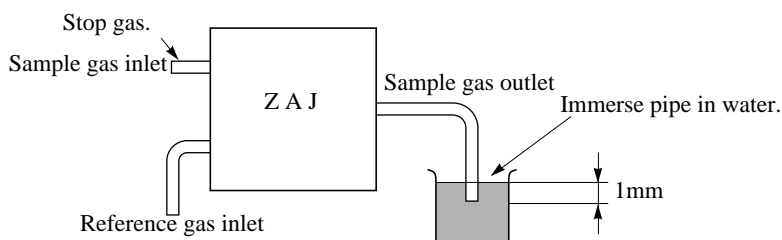


**Fig. 4-3 Airtightness test of reference gas line**

**(2) Flow rate check of reference gas**

When the sample gas inlet is closed to prevent the sample gas from entering, only the reference gas is discharged through the sample gas outlet. Therefore, the flow rate of reference gas can be checked.

Connect a pipe to the sample gas outlet and immerse its end in water at a depth of 1 mm as shown in Fig. 4-4. Then, check the formation of bubbles. When the inner diameter of the pipe is  $\phi 4$  mm, one or two bubbles must be discharged in one second.



**Fig. 4-4 How to measure flow rate of reference gas**

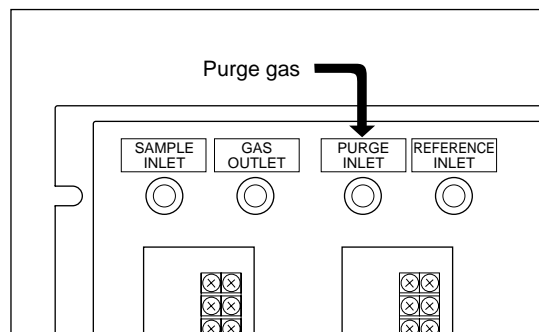
**(3) Check of piping**

Confirm that pipes are connected correctly.

**(4) Purging of instrument inside**

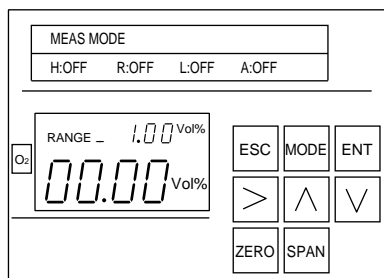
For installation at a place where the atmospheric air contains combustible gas, corrosive gas or much dust, the inside of the instrument should be purged with  $N_2$  or air (purging flow rate 1.0  $\ell$  /min).

If a combustible gas component is contained, flowing of the purge gas should be started at about 3 hours before turning on power supply.

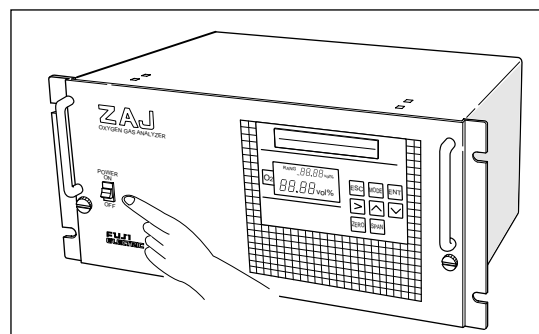


**(5) Turning on power supply**

When turning on the power switch, the initial screen in measurement mode is displayed.



(Initial screen in full option status)



**(6) Warm-up**

After turning on power supply, warm up the instrument. When indication has stabilized (after about 2 hours), warm-up is completed.

**(7) Setting of calibration gas concentration (should be performed before calibration)**

Then, set the concentration of calibration gas. For procedure, refer to “5.3.3.”

**(8) Zero calibration**

Carry out zero calibration with the zero calibration gas flowed. For procedure, refer to “5.3.1 (2)” and “5.3.3.”

**(9) Span calibration**

Carry out span calibration with the span calibration gas flowed. For procedure, refer to “5.3.1 (3)” and “5.3.3.”

**4.3 Start of measurement**

Flow the sample gas.

**4.4 Stop**

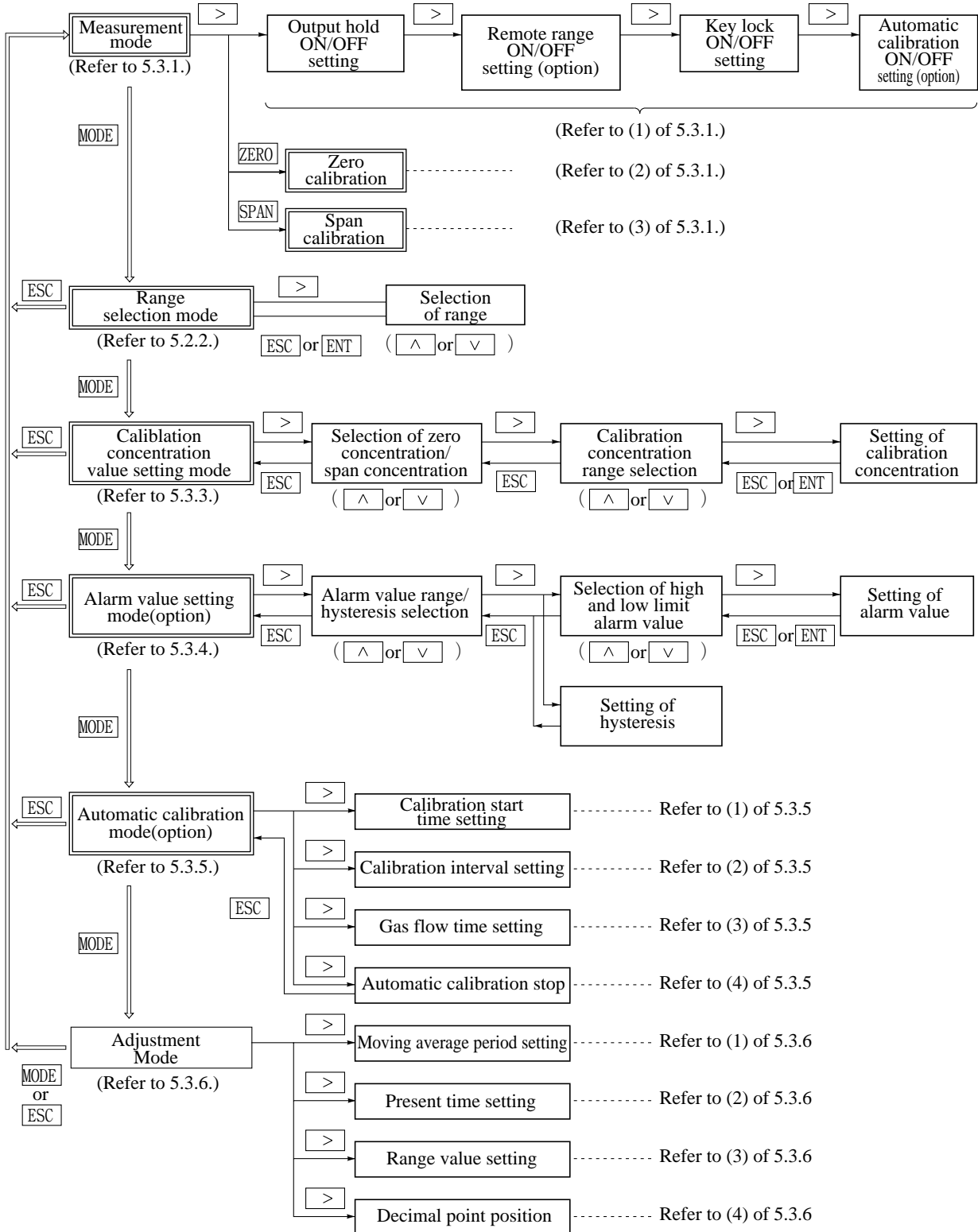
Stop injection of the sample gas and flow dry nitrogen gas through the sample gas inlet for 10 minutes to purge the inside of measuring cell. Then, stop the flow of reference gas. (The detector element may become defective due to sample gas.) Turn off the power switch.

*\* Even when power supply is turned off, the set values are retained in memory. As for automatic calibration start time in automatic calibration function, the value at power OFF will be backed up. Therefore, when turning on power supply again, automatic calibration starts after the remaining time of the previous calibration. However, back-up becomes ineffective after 72 hours. In this case, correct value should be input newly after turning on power supply again.*

## 5. OPERATION OF DISPLAY AND OPERATION PANEL

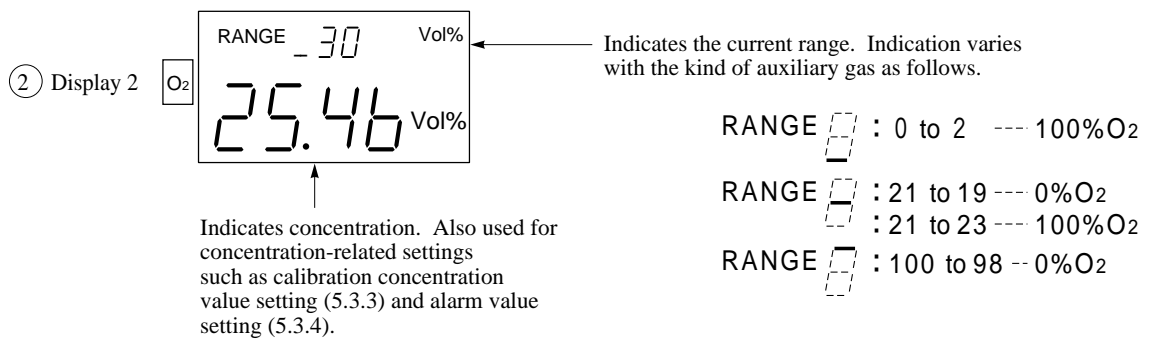
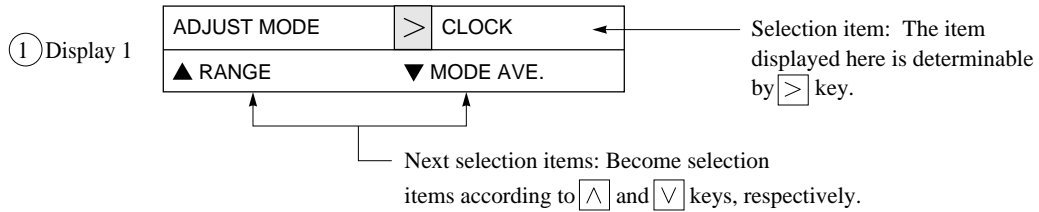
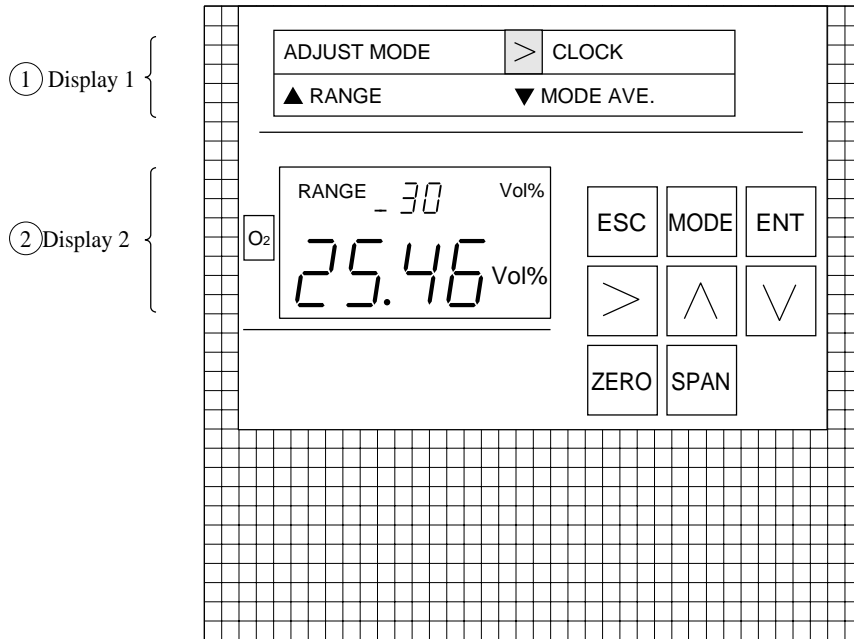
### 5.1 Outline of display and operation panel

Display appears in the following sequence.



\*) When an option is not provided, its function will not be indicated.

## 5.2 Advice on operation



## 5.3 General operation

### 5.3.1 Measurement mode

Turning on power supply calls the initial screen of measurement mode.

During routine measurement, this mode should be kept.

In this mode, the following operations can be carried out.

- ① ON/OFF setting of each parameter (hold, remote range, key lock and automatic calibration)
- ② Zero calibration
- ③ Span calibration

\* R:OFF and A:OFF will not be indicated when the optional remote range changeover and automatic calibration functions are not provided.

\* When indication surpasses the specified range, only bars (---) are indicated for concentration.

Initial screen of measurement mode (display 1)

MEAS MODE			
H:ON	R:OFF	L:OFF	A:OFF

#### (1) ON/OFF setting of each parameter

##### [Procedure]

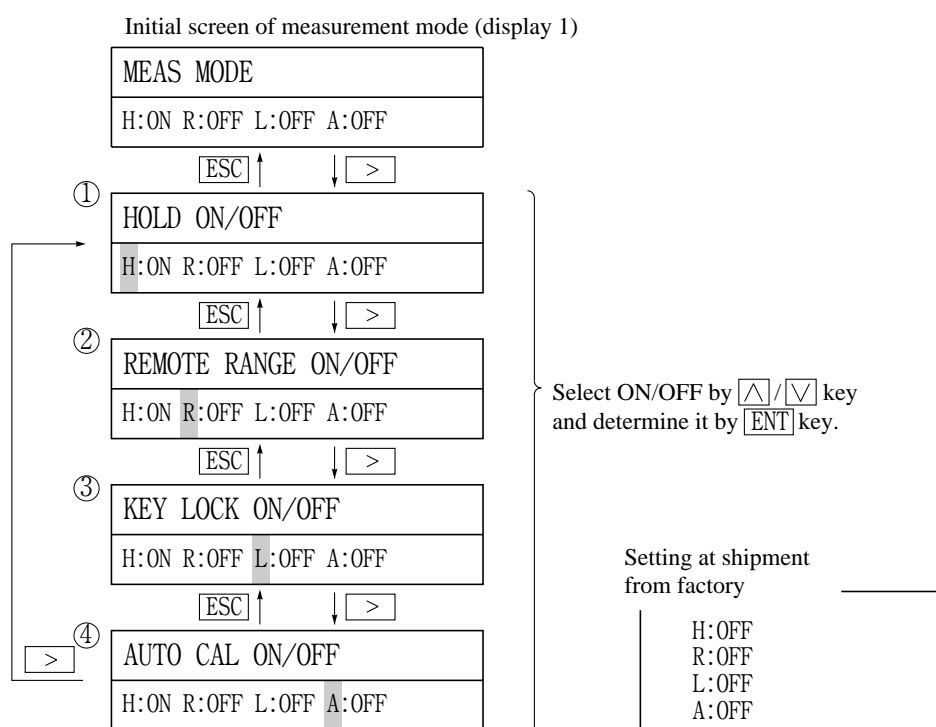
- ① H (HOLD) ON/OFF status is settable. For operation at ON, refer to “Hold operation” in 5.4.1.
- ② R (REMOTE RANGE) ON/OFF status is settable. ON validates input of external signal (refer to “3.4.3”) and OFF invalidates it.
- ③ L (KEY LOCK) ON/OFF status is settable. When ON is set, operations other than key lock OFF become impossible.

(In the key lock status, entrance into the “KEY LOCK ON/OFF” screen is allowed by pressing the  key on the initial screen of measurement mode. When selecting OFF by the  /  key and pressing the  key, all keys become usable again.)

- ④ ON/OFF setting of A (AUTO CAL)

ON validates the automatic calibration parameters set in the automatic calibration mode. For operation at ON, refer to “5.4.3.”

At OFF, automatic calibration will not be performed though automatic calibration parameters are set in the automatic calibration mode.

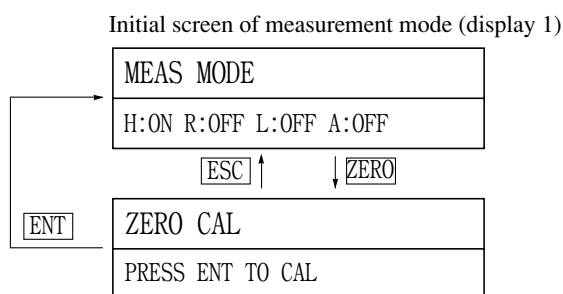


## (2) Zero calibration (manual calibration)

Used for adjustment of zero point.

### Procedure:

- ① Press the **ZERO** key on the initial screen of measurement mode, and the zero calibration ready status will be assumed.
- ② Flow the zero calibration gas. When indication has stabilized, the **ENT** key should be pressed for calibration of display range.  
After calibration, the initial screen of measurement mode will return.
- ③ For interrupting calibration, press the **ESC** key.



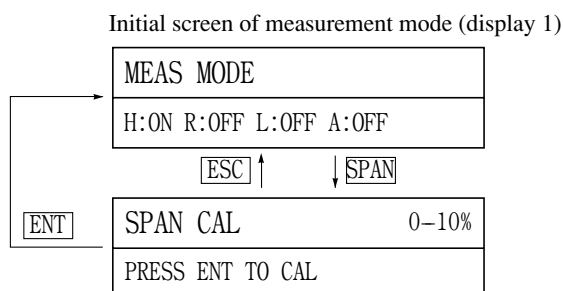
\* During calibration, the in-calibration contact output and zero gas contact turn on in (1), and turn off in (2).

## (3) Span calibration (manual calibration)

Used for adjustment of span point.

### Procedure:

- ① Press the **SPAN** key on the initial screen of measurement mode, and the span calibration ready status will be assumed.
- ② Flow the span calibration gas. When indication has stabilized, the **ENT** key should be pressed for calibration of display range.  
After calibration, the initial screen of measurement mode will return.
- ③ For interrupting calibration, press the **ESC** key.



\* During calibration, the in-calibration contact output and span gas contact turn on in (1), and turn off in (2).

## Point of (2) and (3)

In calibration, the range under measurement is calibrated. For calibration of other range, it should be selected in the range selection mode before calibration (refer to “5.3.2”).

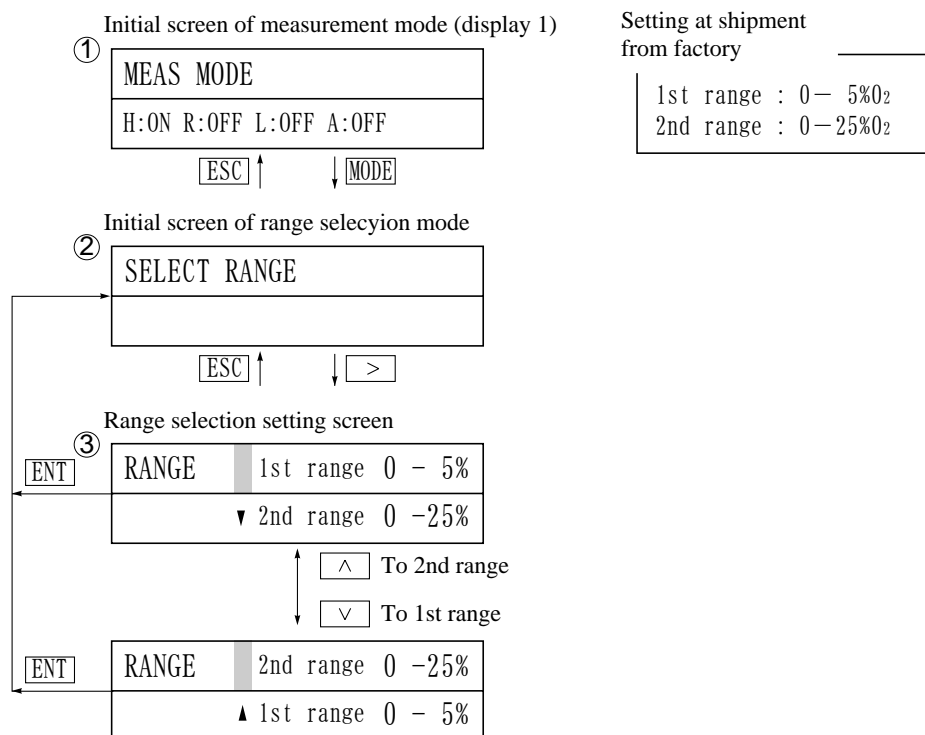
- (1) When performing calibration after a change in measurement range setting, “AUTO ZERO (SPAN) CAL ERR” may be indicated. This does not indicate that the instrument is abnormal. So, perform calibration forcibly.
- (2) The same procedure as above is applicable after setting of calibration concentration value has been changed.

### 5.3.2 Range selection mode

In this mode, measurement range (indication range) is selectable.

#### Procedure:

- ① Press the **MODE** key once on the initial screen of measurement mode, and the initial screen of range selection mode will appear.
- ② Press the **>** key on the initial screen of range selection mode, and the range selection setting screen will be displayed.
- ③ On the range selection setting screen, select either first range or second range by the **^** or **v** key. Then, press the **ENT** key, and the range will change and the initial screen of range selection mode will return.
- ④ For halfway interruption, press the **ESC** key.



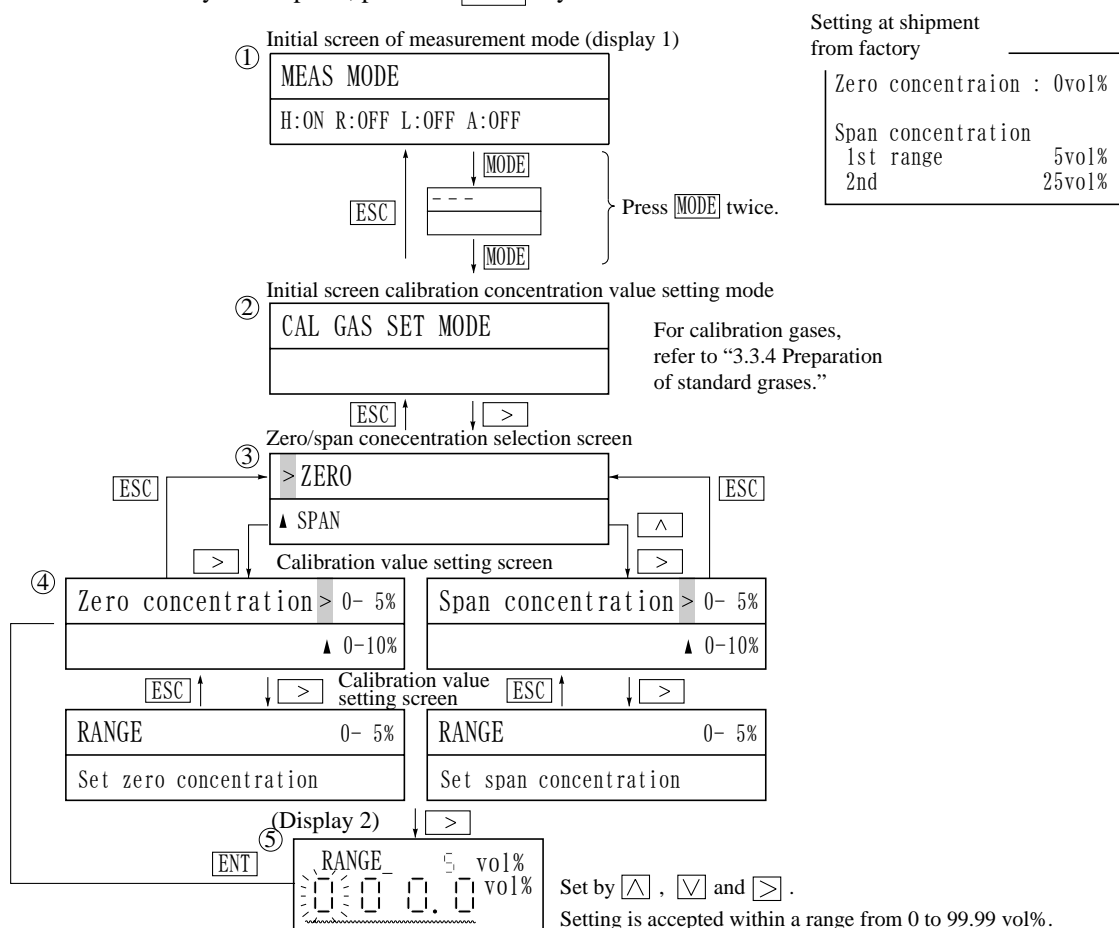
### 5.3.3 Calibration concentration value setting mode (common for manual and automatic calibrations)

Gas concentration in the gas cylinder used for calibration is settable.

Set the same value as of the reference gas concentration for zero calibration, and the gas concentration in the span gas cylinder for span calibration.

**Procedure:**

- ① Press the **MODE** key twice on the initial screen of measurement mode, and the initial screen of calibration concentration value setting mode will appear.
  - ② Press the **>** key on the initial screen of calibration concentration value setting mode, and the zero/span concentration selection screen will appear.
  - ③ On the zero/span concentration selection screen, select zero or span concentration by the **^** or **v** key, and then press the **>** key for entrance into the calibration concentration range selection screen.
  - ④ On the calibration concentration range selection screen, select either first or second range by the **^** or **v** key, and then press the **>** key for entrance into the calibration value setting screen.
  - ⑤ Calibration concentration value is now settable in display 2. The changeable digit flickers. Set a desired value by the **^** or **v** key with the digit shifted by the **>** key in order, and then determine the input value by the **ENT** key.
- After determination, the calibration concentration range selection screen will return.
- ⑥ For halfway interruption, press the **ESC** key.



**Point**

Whenever changing a calibration concentration value, carry out calibration using the calibration gas of the newly set concentration.

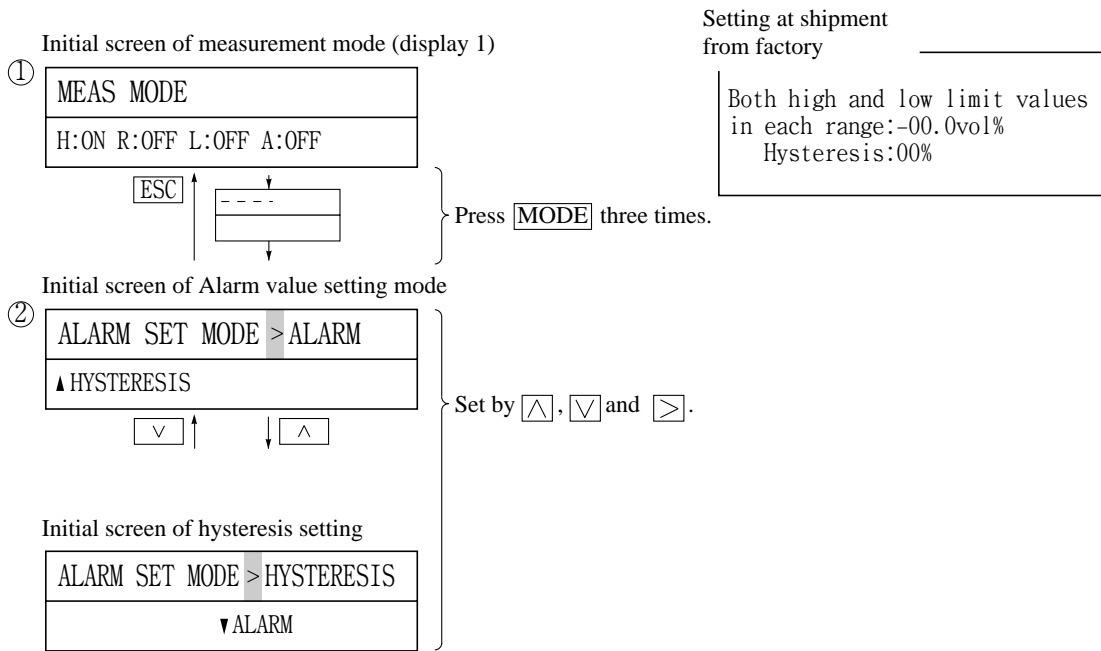
### 5.3.4 Alarm value setting mode (option)

The high and low limit alarms are settable for each range, according to which contact output for alarm will be issued.

**Procedure:**

- ① Press the **MODE** key three times on the initial screen of measurement mode, and the initial screen of alarm value setting mode will appear.
- ② The alarm value setting mode has the setting items below:
  - 1) Alarm value
  - 2) Hysteresis

From the initial screen of alarm value setting mode, select each setting item by the **▲**/**▼** key and enter into each setting screen by the **▶** key.



#### (1) Alarm value setting

Press the **▶** key, and the alarm value range selection screen will be displayed.

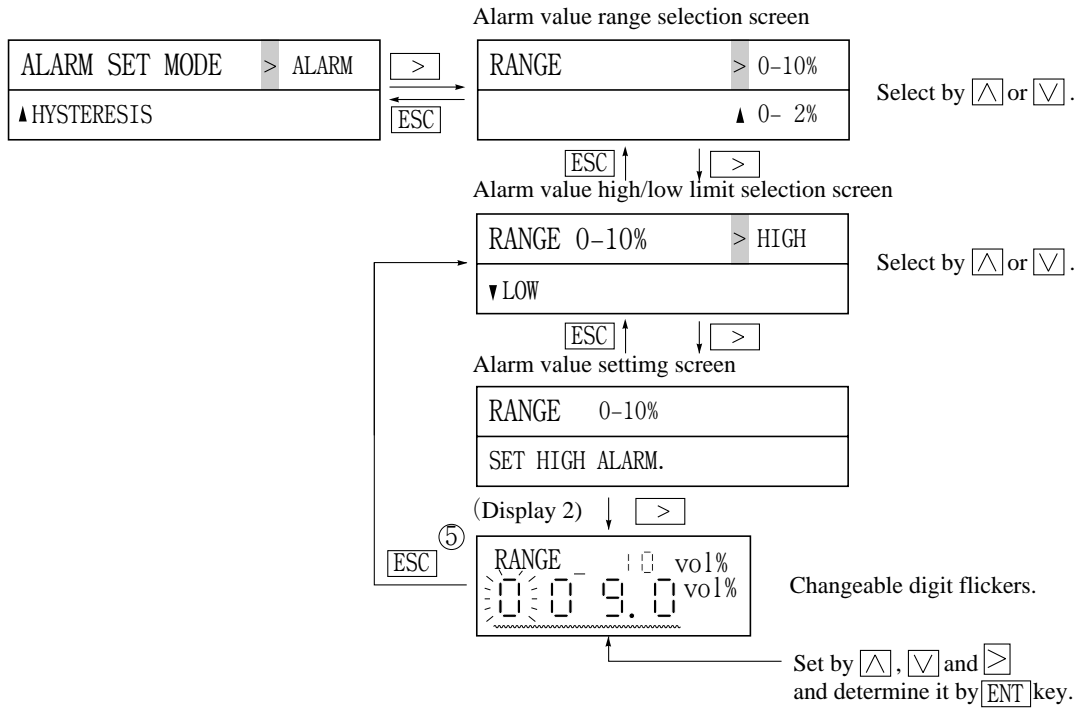
On the alarm value range selection screen, select a desired range by the **▲** or **▼** key, and then press the **▶** key for entrance into the alarm value high/low limit selection screen.

On the alarm value high/low limit selection screen, select the high/low limit value by the **▲**/**▼** key, and press the **▶** key for entrance into the alarm value setting screen.

On the alarm value setting screen, alarm value is now settable in display 2. Set a desired value by the **▲** or **▼** key with the digit shifted by the **▶** key in order, and then determine the input value by the **ENT** key.

After determination, the alarm value high/low limit selection screen will return.

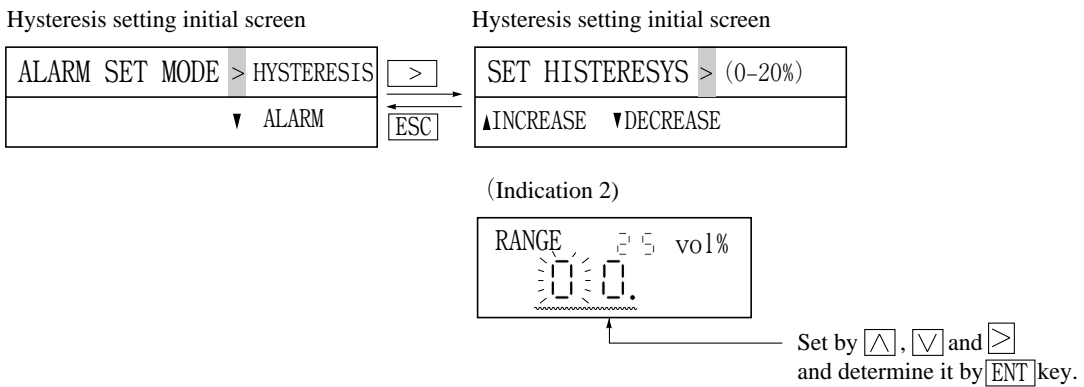
For halfway interruption, press the **ESC** key.



## (2) Hysteresis setting

Setting digit is selectable by the > key. The ▲ key increments value and the ▼ key decrements it. After setting, determine it by the ENT key. On determination, the initial screen of alarm value setting mode returns. For halfway stop, press the ESC key.

Setting is allowed within a range from 0 to 20% FS.



## POINT

For details of alarm operation, refer to "Alarm operation" in 5.4.2.

### 5.3.5 Automatic calibration mode (option)

Each parameter of automatic calibration is settable.

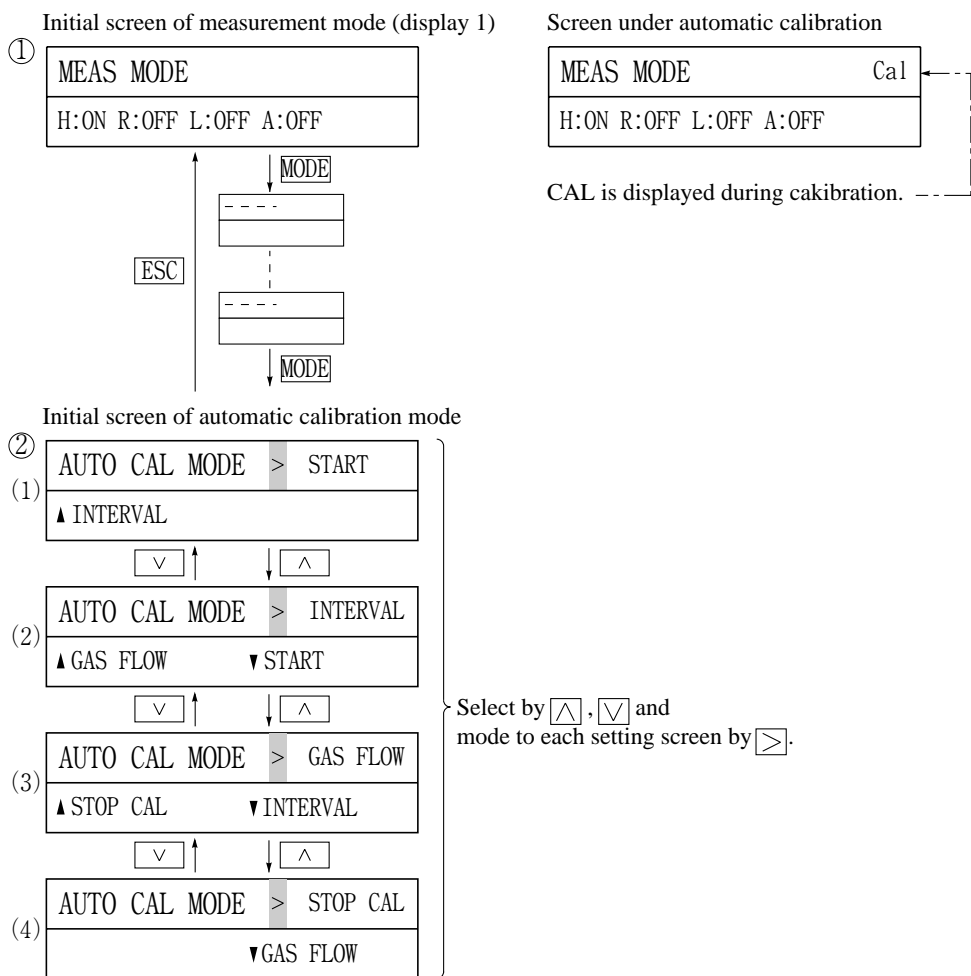
**Procedure:**

- ① Press the **MODE** key several times on the initial screen of measurement mode, and the initial screen of automatic calibration mode will appear.
- ② The automatic calibration mode has the following parameters.
  - 1) Calibration start time setting (time point of the first calibration)
  - 2) Calibration interval setting (execution interval of automatic calibration)
  - 3) Gas flowing time setting (calibration gas flowing time)
  - 4) Stop of automatic calibration

Setting at shipment from factory

Calibration start time : SUN 00:00  
 Calibration interval : 0 HOUR  
 Gas flowing time : 0 MIN, 0 SEC

On the initial screen of automatic calibration mode, select each parameter by the **▲** or **▼** key, and press the **▶** key for entrance into each setting screen.

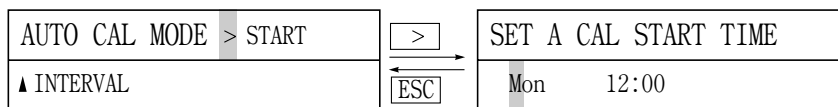


**Point**

Automatic calibration is carried out in the selected (displayed) one of the two ranges.  
 For details of automatic calibration, refer to "Automatic calibration process" in 5.4.3.

**(1) Calibration start time setting**

Set a day of the week by the  $\uparrow/\downarrow$  key. Then, move the cursor to the hour digits by the  $\rightarrow$  key and set the present hour. Next, move the cursor to the minute digits by the  $\rightarrow$  key and set a minute. After setting, press the  $\text{ENT}$  key for determination.

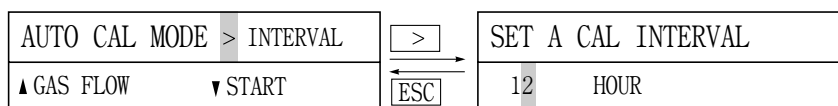


Set by  $\uparrow$ ,  $\downarrow$  and  $\rightarrow$ , and determine by  $\text{ENT}$ .

\* Time must be set on the 24-hour scale.

**(2) Calibration interval setting**

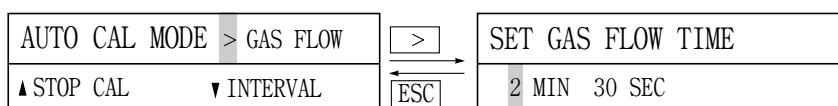
Set a time interval by the  $\uparrow/\downarrow$  key and determine it by the  $\text{ENT}$  key. Interval is settable in 1-hour steps within a range from 0 to 168 hours.



Set by  $\uparrow/\downarrow$  and determine by  $\text{ENT}$ .

**(3) Gas flowing time setting**

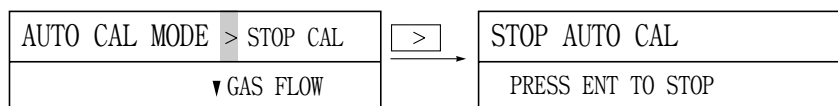
Set a minute value by the  $\uparrow/\downarrow$  key, move the cursor to the second value position and set a second value. Then, press the  $\text{ENT}$  key for determination. Gas flowing time is settable in 1-second steps within a range from 0 minute and 0 second to 60 minutes and 59 seconds.



Set by  $\uparrow$ ,  $\downarrow$  and  $\rightarrow$  and determine by  $\text{ENT}$ .

**(4) Stop of automatic calibration**

During execution of automatic calibration, the current automatic calibration can be forcibly stopped by pressing the  $\text{ENT}$  key on the automatic calibration stop screen.



$\text{ENT}$  for forcible stop

**Point**

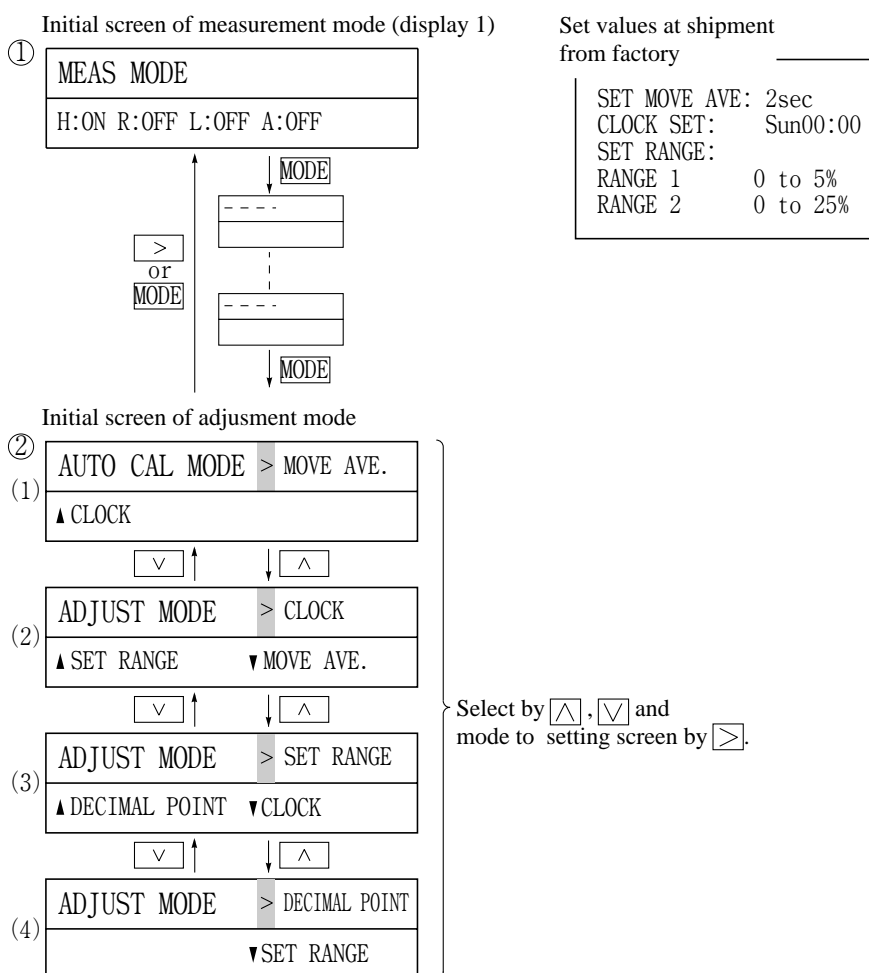
Each value set in the automatic calibration mode is effective when automatic calibration is set at ON in “5.3.1 (1) - (4).”

### 5.3.6 Adjustment mode

The adjustment mode is to set or adjust the moving average time, present time and range value before measurement.

**Procedure:**

- ① Press the **MODE** key several times on the initial screen of measurement mode, and the initial screen of adjustment mode will appear.
  - ② This mode has the setting screens listed below.
    - 1) SET MOVE AVE. (The moving average value in this set period is output. This setting is for smoothing output signals.)
    - 2) CLOCK SET (setting of present time)
    - 3) SET RANGE (setting of range value used for measurement)
    - 4) SET DECIMAL (setting of decimal point position and the number of digits in concentration display)
- On the initial screen of adjustment mode, select a parameter by the **▲** **▼** key and press the **▶** key for entrance into the setting screen.



**Point**

When the moving average period is set at a larger value, the electric system has a greater time constant, so that the change of concentration output will become smooth.

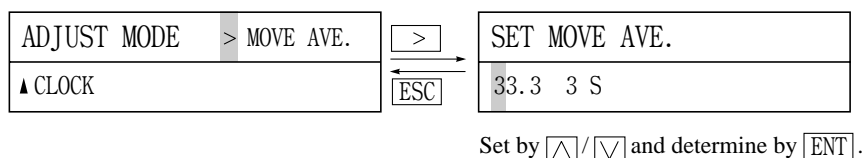
For obtaining an instrument response within 2 seconds, set the moving average time to 0 second.

**(1) Moving average period setting**

Digit is selectable by the  $\boxed{>}$  key. The  $\boxed{\wedge}$  key increments value and the  $\boxed{\vee}$  key decrements it. After setting, press the  $\boxed{ENT}$  key for determination. Upon determination, the initial screen of adjustment mode returns.

For halfway interruption, press the  $\boxed{ESC}$  key.

This period is settable within 0 to 99.9 sec.

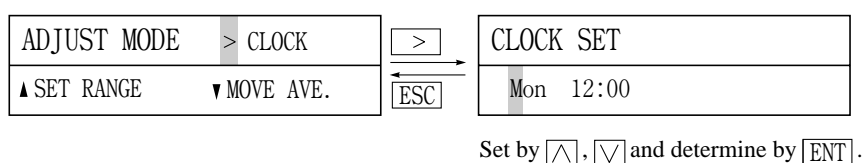


**(2) Present time setting**

Each input position of day (in a week) and time point is selectable by the  $\boxed{>}$  key. The  $\boxed{\wedge}$  key increments each numerical and the  $\boxed{\vee}$  key decrements it.

After setting, press the  $\boxed{ENT}$  key for determination. Upon determination, the initial screen of adjustment mode returns.

For halfway interruption, press the  $\boxed{ESC}$  key.



\* The clock is effective for 48 hours after turning off power supply.

**(3) Range value setting**

Press the  $\boxed{>}$  key for entrance into the range value selection screen. On this screen, select RANGE 1 or RANGE 2 and press the  $\boxed{>}$  key for entrance into the range value setting screen.

Digit is selectable by the  $\boxed{>}$  key. The  $\boxed{\wedge}$  key increments value and the  $\boxed{\vee}$  key decrements it.

<Example> Range value setting

0 to 100 (when reference gas is N<sub>2</sub>)

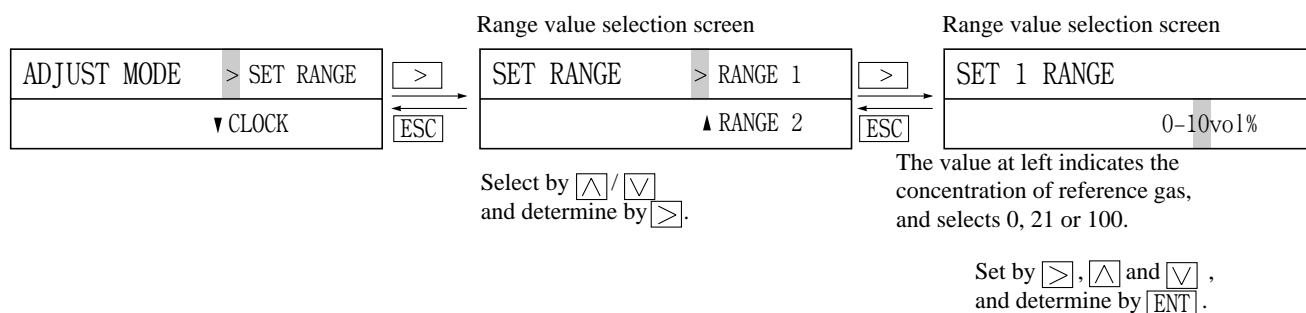
21 to 25 (when reference gas is dry air)

100 to 90 (when reference gas is 100% O<sub>2</sub>)

After setting, press the  $\boxed{ENT}$  key for determination. Upon determination, the initial screen of adjustment mode returns.

For halfway interruption, press the  $\boxed{ESC}$  key.

Settable range is as follows; 0 to 2 ...100 vol%, 21 to 19...0 vol%, 21 to 23...100 vol% or 100 to 98...0 vol%.



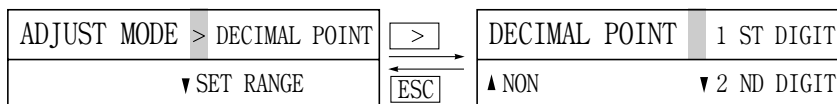
**(4) Decimal point position**

Press the  key for entrance into the decimal point position selecting screen. On this screen, select NO, 1 DIGIT or 2 DIGITS by the / key, and then determine it by .

On selection of NO, indication is made in ..... vol%.

On selection of 1 DIGIT, indication is made in ..... .vol%.

On selection of 2 DIGITS, indication is made in ..... .vol%.



Select by / and determine by .

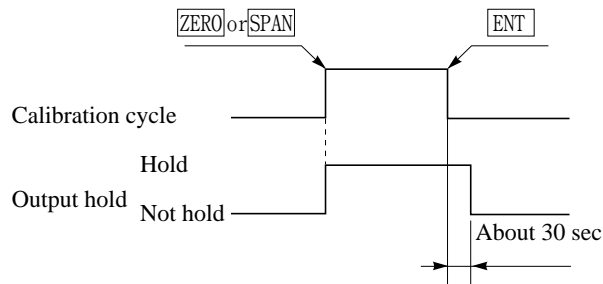
## 5.4 Timing of output

The subsection describes the timings of each output hold, alarm and automatic calibration.

### 5.4.1 Output hold

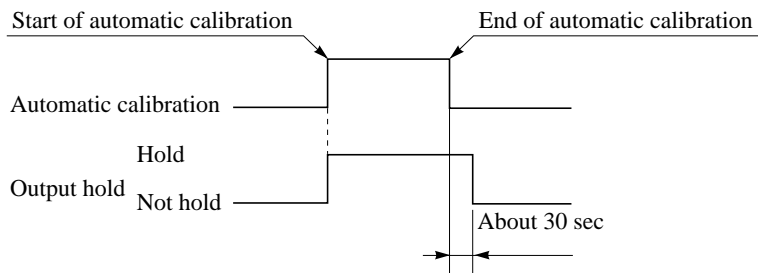
#### (1) Output hold in manual calibration

<Timing>



#### (2) Output hold in automatic calibration

<Timing>



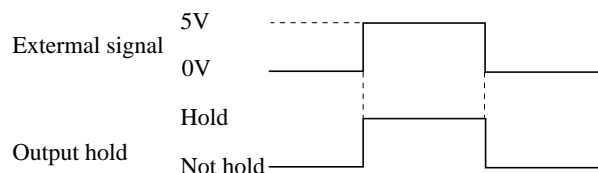
### Point

The above operations (1) and (2) are effective only when ON is set in hold ON/OFF setting. (Refer to "5.3.1 (1)-(1).")

#### (3) Remote control of output hold

Output holding function according to external signal

<Timing>



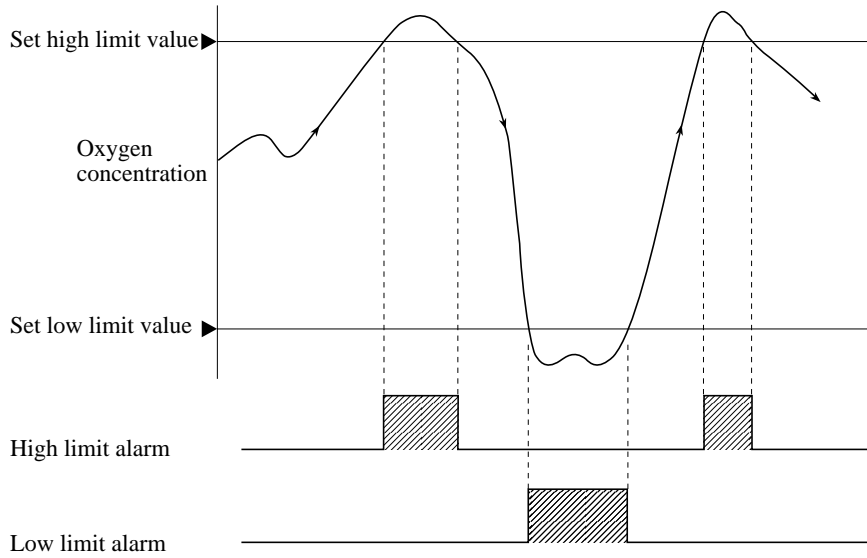
### Point

In (3) above, hold function is carried out according to input of external signal irrespective of whether hold setting is ON or OFF.

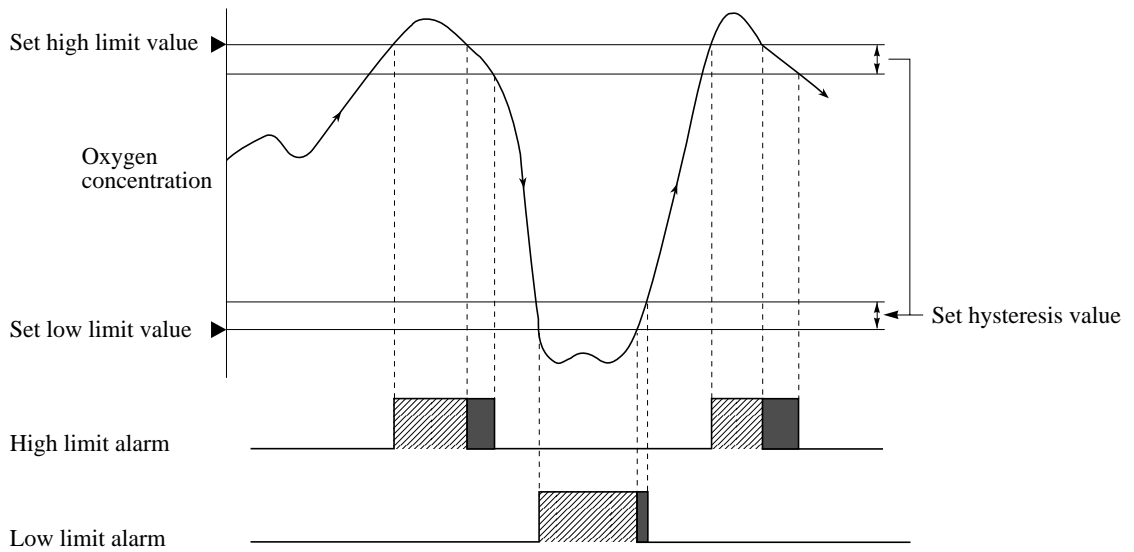
## 5.4.2 Alarm

### (1) Alarm (■: Alarm causing point)

1) When hysteresis is set at 0:



2) When hysteresis is set at  $\chi\%$  (set value is given by  $FS \times \chi/100$ ):



- ■: When returning to the normal range from a range above the set alarm value, alarm will not be released before the width set for hysteresis.
- When you want to disable alarm function, alarm limit value should be set to “-0.01 to -9.99.”

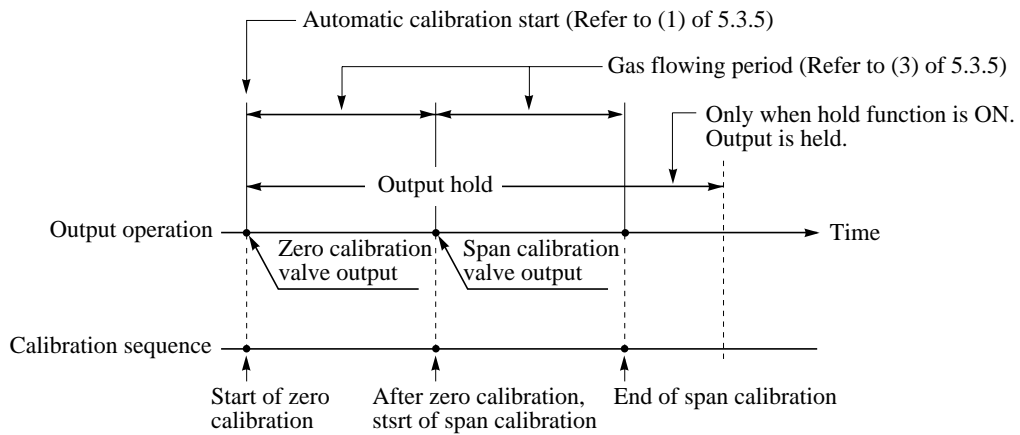
### 5.4.3 Automatic calibration

This analyzer is capable of automatically calibrating zero and span points at option while introducing standard gases in order with an externally installed solenoid valve driven according to the calibration gas contact output signal from the I/O terminals on the rear panel.

#### (1) Operation of automatic calibration

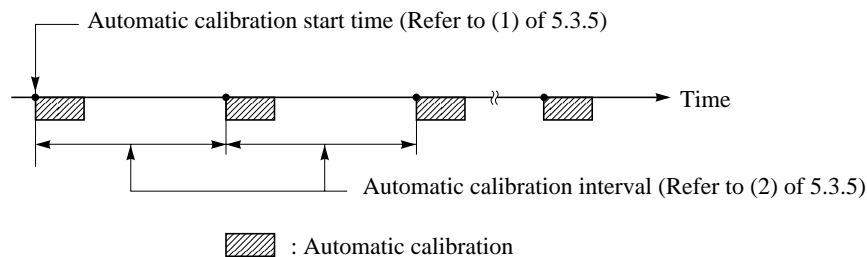
Automatic calibration starts at the set start time as shown in Fig. 5-1. Only present range will be calibrated in the order of zero calibration and span calibration.

- (1) Automatic calibration flow is following, zero gas is introduced into the cell according to the contact output signal for zero gas and it is flowed for the set gas flowing period.
- (2) Zero calibration is carried out, and then span gas is flowed for the set gas flowing period according to the contact output signal for span gas.
- (3) Span calibration is carried out. When the hold function is set at ON, output will be held during calibration and for about 30 seconds after calibration. Output will not be held when the hold function is set at OFF.



**Fig. 5-1 Operation Chart of Automatic Calibration**

- (4) In a cyclic of automatic calibration, the first automatic calibration cycle is effected at the automatic calibration start time, and the second automatic calibrations onward are performed after the set automatic calibration interval period as shown in Fig. 5-2.



**Fig. 5-2 Automatic calibration cycle**

- (5) Automatic calibration can be started by applying input signal (pulse voltage of 5 V DC, 100 msec or more) to the remote start input terminal irrespective of whether AUTO CAL is set ON or OFF.

#### Point

- 1) For halfway interruption of automatic calibration, execute STOP CAL in the automatic calibration mode. (Refer to (4) of 5.3.5.)
- 2) Automatic calibration will not become effective unless ON is selected in AUTO CAL ON/OFF setting after necessary values have been set in the automatic calibration mode. (Refer to 5.3.1 (1)-(4).)

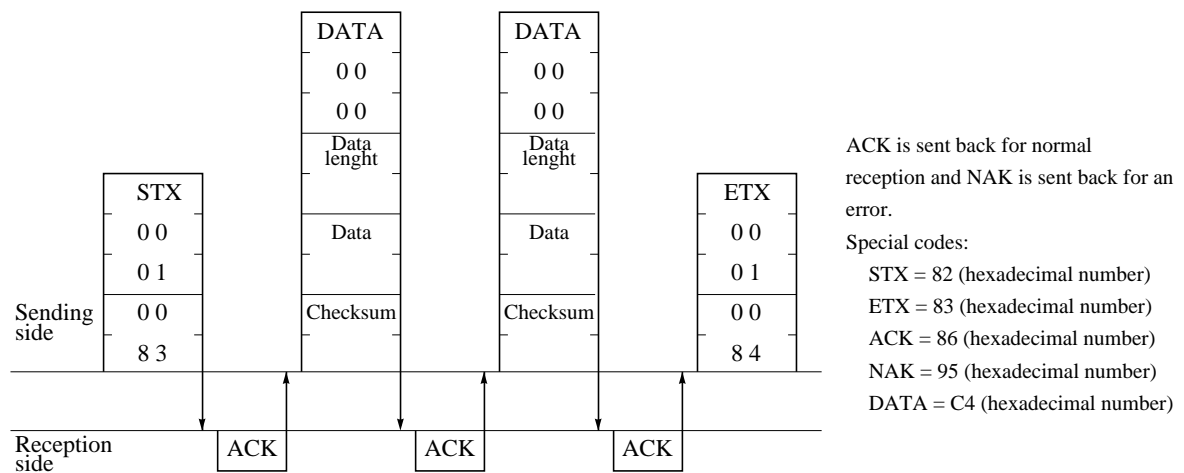
## 6. RS-232C TRANSMISSION (OPTION)

### 6.1 Specifications of ZAJ transmission (via RS-232C)

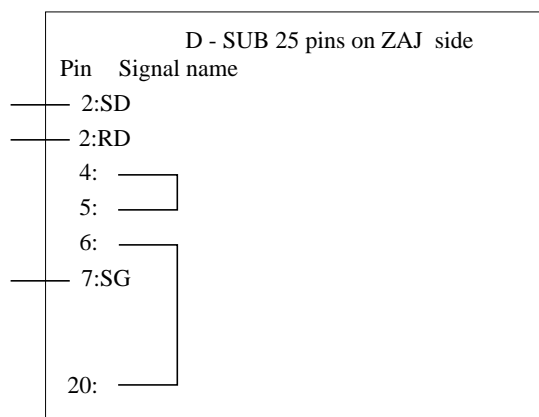
- Transmission specifications

Classification	Item	Description
Specifications	Signal level	Conforming to EIA RS-232C, non-isolated between input and output signals
	Transmission system	Asynchronous, half-duplex, 2 wires
	Connectable distance	Max. 15 m
	Transmission speed	Fixed at 9600 bps
	Transmission procedure	Handshaking (ACK, NAK)
	Data length	8 bits
	Parity	Non
	Start bit	1
	Stop bit	1
Contents	Reception	Measurement range, calibration gas concentration and range changeover
	Sending	Oxygen concentration and measurement range

### 6.2 Transmission protocol



### 6.3 Connection of transmission cable



## 6.4 Explanation of commands

### 6.4.1 Oxygen concentration reading

Function	Sending "measured value (oxygen concentration)" of analyzer to personal computer side												
Data flow on transmission line	* Numerals are hexadecimal.												
PC → ZAJ	82	00	01	00	83	(STX)							
ZAJ → PC	86	(ACK)											
PC → ZAJ	C4	00	00	00	0A	82	C0	00	0E	0E	14	(DATA)	
	00	0E	0E	16	**	**	Checksum					Note 1)	
ZAJ → PC	86	(ACK)											
PC → ZAJ	83	00	01	00	84	(ETX)							
ZAJ → PC	86	(ACK)											
ZAJ → PC	82	00	01	00	83	(STX)							
PC → ZAJ	86	(ACK)											
ZAJ → PC	C4	00	00	00	03	00	00	21	**	**	(DATA)		
											Checksum		
											1st digit display		
											2nd digit display		
											3rd digit display		
											4th digit display		
PC → ZAJ	86	(ACK)											
ZAJ → PC	83	00	01	00	84	(ETX)							
PC → ZAJ	86	(ACK)											
											Decimal point position 01:None 21:One decimal place (0.0) 31:Two decimal place (0.00)		
											Oxygen concentration: BCD 4 digits unit: vol%		

data	Contents
0 to 9	0 to 9
a	- (minus)
b	Over-scale
c	Under-scale
f	Space

Note 1) Checksum calculation method

All the data are added in the unit of byte from the head of sending data to the beginning of checksum to obtain word data.

Example) Sending data

For 

C4	00	00	00	02	00	00	21
----	----	----	----	----	----	----	----

Checksum (words)

$$C4 + 00 + 00 + 00 + 02 + 00 + 00 + 21 = E7 \rightarrow 00E7$$

### 6.4.2 Measurement range reading

Function	Sending "measurement range" of analyzer to personal computer side																					
Data flow on transmission line	* Numerals are hexadecimal.																					
PC → ZAJ	82 00 01 00 83 (STX)																					
ZAJ → PC	86 (ACK)																					
PC → ZAJ	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td>C4</td><td>00</td><td>00</td><td>00</td><td>0A</td><td>82</td><td>C0</td><td>00</td><td>0E</td><td>00</td><td>0A</td> </tr> <tr> <td>00</td><td>0E</td><td>00</td><td>0A</td><td>**</td><td>**</td><td colspan="4"></td> </tr> </table> (DATA) <div style="text-align: center; margin-left: 100px;">             Checksum         </div>	C4	00	00	00	0A	82	C0	00	0E	00	0A	00	0E	00	0A	**	**				
C4	00	00	00	0A	82	C0	00	0E	00	0A												
00	0E	00	0A	**	**																	
ZAJ → PC	86 (ACK)																					
PC → ZAJ	83 00 01 00 84 (ETX)																					
ZAJ → PC	86 (ACK)																					
ZAJ → PC	82 00 01 00 83 (STX)																					
PC → ZAJ	86 (ACK)																					
ZAJ → PC	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td>C4</td><td>00</td><td>00</td><td>00</td><td>02</td><td>00</td><td>00</td><td>**</td><td>**</td> </tr> </table> (DATA) <div style="text-align: center; margin-left: 150px;">             Checksum             <div style="margin-left: 100px;">   </div> </div>	C4	00	00	00	02	00	00	**	**												
C4	00	00	00	02	00	00	**	**														
PC → ZAJ	86 (ACK)																					
ZAJ → PC	83 00 01 00 84 (ETX)																					
PC → ZAJ	86 (ACK)																					

### 6.4.3 Measurement range value reading

Function	Sending "measurement range" of analyzer to personal computer side																						
Data flow on transmission line	* Numerals are hexadecimal.																						
PC → ZAJ	<table border="1"><tr><td>82</td><td>00</td><td>01</td><td>00</td><td>83</td></tr></table> (STX)	82	00	01	00	83																	
82	00	01	00	83																			
ZAJ → PC	<table border="1"><tr><td>86</td></tr></table> (ACK)	86																					
86																							
PC → ZAJ	<table border="1"> <tr> <td>C4</td><td>00</td><td>00</td><td>00</td><td>0A</td><td>82</td><td>C0</td><td>00</td><td>0E</td><td>00</td><td>1A</td> </tr> <tr> <td>00</td><td>0E</td><td>00</td><td>1F</td><td>**</td><td>**</td><td colspan="5">(DATA)</td> </tr> </table> <p style="text-align: center;">Checksum</p>	C4	00	00	00	0A	82	C0	00	0E	00	1A	00	0E	00	1F	**	**	(DATA)				
C4	00	00	00	0A	82	C0	00	0E	00	1A													
00	0E	00	1F	**	**	(DATA)																	
ZAJ → PC	<table border="1"><tr><td>86</td></tr></table> (ACK)	86																					
86																							
PC → ZAJ	<table border="1"><tr><td>83</td><td>00</td><td>01</td><td>00</td><td>84</td></tr></table> (ETX)	83	00	01	00	84																	
83	00	01	00	84																			
ZAJ → PC	<table border="1"><tr><td>86</td></tr></table> (ACK)	86																					
86																							
ZAJ → PC	<table border="1"><tr><td>82</td><td>00</td><td>01</td><td>00</td><td>83</td></tr></table> (STX)	82	00	01	00	83																	
82	00	01	00	83																			
PC → ZAJ	<table border="1"><tr><td>86</td></tr></table> (ACK)	86																					
86																							
ZAJ → PC	<table border="1"> <tr> <td>C4</td><td>00</td><td>00</td><td>00</td><td>06</td><td>00</td><td>15</td><td>00</td><td>33</td><td>00</td><td>01</td> </tr> <tr> <td>**</td><td>**</td><td colspan="9">(DATA)</td> </tr> </table> <p style="text-align: center;">Checksum</p> <div style="text-align: right; margin-right: 100px;"> <p>Note 2)</p> <p>1st range value</p> <p>2nd range value</p> <p>Auxiliary gas concentration (0.0 vol%)</p> </div>	C4	00	00	00	06	00	15	00	33	00	01	**	**	(DATA)								
C4	00	00	00	06	00	15	00	33	00	01													
**	**	(DATA)																					
PC → ZAJ	<table border="1"><tr><td>86</td></tr></table> (ACK)	86																					
86																							
ZAJ → PC	<table border="1"><tr><td>83</td><td>00</td><td>01</td><td>00</td><td>84</td></tr></table> (ETX)	83	00	01	00	84																	
83	00	01	00	84																			
PC → ZAJ	<table border="1"><tr><td>86</td></tr></table> (ACK)	86																					
86																							

Note 2) Range calculation method

With the readout numeral (hexadecimal number) changed to decimal number, "1" is subtracted from it and it is then divided by "2" to obtain a range value.

Example) Readout numerals

$$0015 \text{ (hexadecimal number)} \rightarrow 21 \text{ (decimal number)} \rightarrow (21-1)/2 = 10 \text{ (vol\%)}$$

$$0033 \text{ (hexadecimal number)} \rightarrow 51 \text{ (decimal number)} \rightarrow (51-1)/2 = 25 \text{ (vol\%)}$$

$$00C9 \text{ (hexadecimal number)} \rightarrow 101 \text{ (decimal number)} \rightarrow (101-1)/2 = 50 \text{ (vol\%)}$$

## 7. CHECK AND MAINTENANCE

### DANGER

- Before working such as restrictor replacement with the casing open, be sure to turn off power supply, and perform air or N<sub>2</sub> gas purging of not only the analyzer inside, but also the sample gas line and reference gas line. In addition, carefully prevent oil and grease from adhering to the restrictor, filter, packing, etc. Otherwise, poisoning, fire or explosion may be caused due to gas leakage, etc.

### CAUTION

- Before working, take off a wrist watch, finger ring or the like metallic accessories. And never touch the instrument with a wet hand. Otherwise, you will have a shock hazard.
- If the fuse is blown, eliminate the cause, and then replace it with the one of the same capacity and type as before. Otherwise, shock hazard or fault may be caused.

### CAUTION

- If the cause of any fault cannot be determined despite reference to the instruction manual, be sure to contact your dealer or Fuji Electric's technician in charge of adjustment. If the instrument is disassembled carelessly, you may have a shock hazard or injury.
- Do not use a replacement part other than specified by the instrument maker. Otherwise, adequate performance will not be provided. Besides, an accident or fault may be caused.
- Replacement parts such as a maintenance part should be disposed of as incombustibles.

## 7.1 Check

### 7.1.1 Check of reference gas flow rate

Every 6 months, stop sample gas and check the flow of reference gas by the method shown in “Fig. 4-4 of 4.3 (2).”

In case reference gas is not flowing though its pressure is at the determined level, the reference gas line filter or restrictor may be clogged. In this case, the filter or restrictor should be replaced with a new one (referring to “7.2.1” or “7.2.2”).

## 7.2 Maintenance

### 7.2.1 Replacement of filter (sintered metal)

The filter should be replaced when it is clogged (see Fig. 7-1).

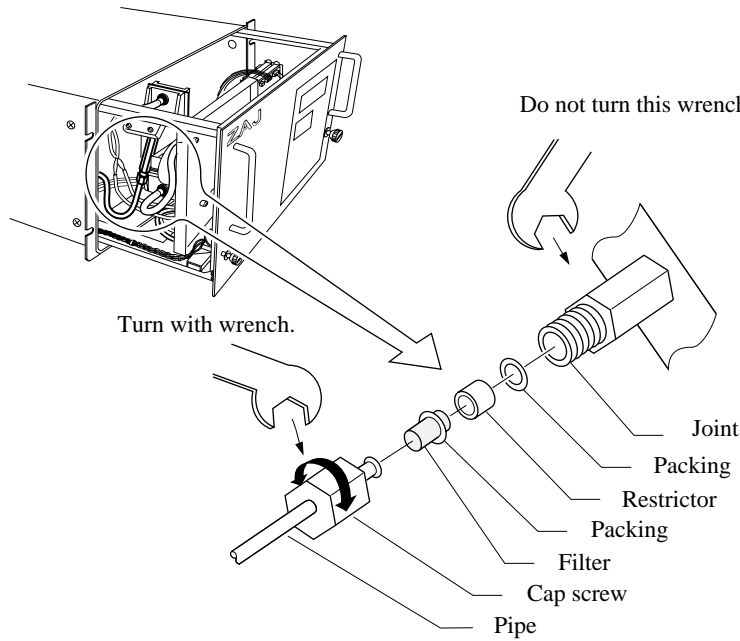
When loosening or tightening the cap screw, the joint should be held with a wrench (special tool). This is required for protecting the airtightness of the joint.

### 7.2.2 Replacement of restrictor

The restrictor should be replaced when it is clogged (see Fig. 7-1).

Since the bore diameter in the restrictor is small, the restrictor should be handled with utmost care not to clog the bore with dust, etc.

Never touch the restrictor directly (use a pincette). If the restrictor is dropped or touched in error, rinse it with acetone for about 10 seconds and mount it after drying.



**Fig. 7-1 Replacement of filter and restrictor**

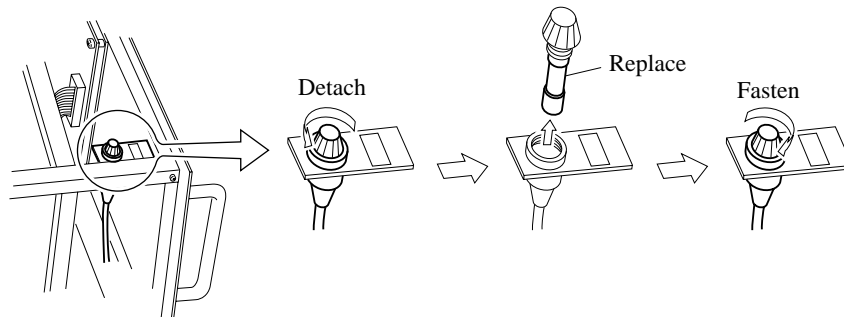
### 7.2.3 Replacement of reference gas cylinder

When replacing the reference gas cylinder, carefully prevent dust from entering the pipe.

If dust is sticking to the connection port, it should be eliminated completely before connection.

### 7.2.4 Replacement of fuse

Before replacing the fuse, be sure to turn off the primary power supply and the power switch.



### 7.2.5 Spare parts

No.	Item	Order code	Recommendation cycle of replacement	Note
1	Restrictor	TK708941C1	1 piece/ 2 -year	
2	Filter	TK708922P2	1 piece/ 2 -year	
3	Packing	TK722676P4	3 piece/ 2 -year	For filter For restrictor
4	Fuse	757642	1 piece/ 2 -year	2A, ø6.4×30

\* Restrictor ,filter and packing are used for the reference gas line.

Try checking the flow rate of reference gas. If it is no problem that these parts do not need to be replace.

### **CAUTION**

Before operating the analyzer after a long shutdown, maintenance and check by an authorized technician is required.

## 8. ERROR CODES AND COUNTERMEASURES

This analyzer has the self-diagnosis function, by which an error code will be displayed if an error occurs on the instrument.

When an error code is displayed, check and take necessary measure with reference to the table below.

Error code	Error message	Cause	Check and measures
Err1	AUTO ZERO CAL ERR	Calibration value is widely different from previous value.	<ul style="list-style-type: none"> <li>• Confirm the set zero or span calibration value.</li> <li>• Confirm the gas concentration in gas cylinder.</li> <li>• Confirm the range.</li> </ul>
Err2	AUTO SPAN CAL ERR		
Err3	INPUT OVER ERR	Sensor input value is abnormal.	<ul style="list-style-type: none"> <li>• Check if gas outside effective range is flowing.</li> </ul>
Err4	INPUT UNDER ERR		
Err5	OUTPUT DEVICE ERR	Output printed circuit board is abnormal.	<ul style="list-style-type: none"> <li>• Check if the connector of output printed circuit board is unplugged.</li> <li>• Replace the output printed circuit board.</li> <li>• Contact the nearest Fuji representative.</li> </ul>

### Procedure:

- (1) Suppose that an error code is presented in display 1 because of an error.

Display 1

MEAS MODE	Err1

- (2) Press the **ENT** key and check and take necessary measure according to the error message.

Display 1

PRES ENT TO CANC ERR
▲ E1: AUTO ZERO CAL ERR

└─Displayed when other error has concurred.

Other error will be displayed by pressing the **^** key.

- (3) Press the **ENT** key, and error indication will be erased. However, the same error will be indicated again so far as its cause is not eliminated.
- (4) Turn on power supply again. If normal operation can be confirmed, there is no problem.
  - If an error occurs, the contact output of FAULT (terminal block 1 - 19, pin No. 20) turns on.

***For manual calibration***

- (1) If an error occurs in manual calibration, the following message appears in display 1.

ZERO CALIBRATION ERROR
CAL: ZERO    NO CAL: ESC

- (2) For continuing calibration forcibly, press the ZERO ( SPAN ) key.  
(3) For interrupting calibration and canceling error, press the ESC key.

**Point**

When performing calibration after a change in measurement range setting, Err1 or Err2 may be indicated. This does not indicate that the instrument is abnormal. So, retry calibration once more.

- (1) When performing calibration after a change in measurement range setting, “AUTO ZERO (SPAN) CAL ERR” may be indicated. This does not indicate that the instrument is abnormal. So, perform calibration forcibly.
- (2) The same procedure as above is applicable after setting of calibration concentration value has been changed.

## 9. SPECIFICATIONS

- Measurement range:
  - (1) When reference gas is N<sub>2</sub>:
    - 0 to 2 ..... 100% O<sub>2</sub>
    - Discretionary setting (1% O<sub>2</sub> step)
  - (2) When reference gas is air (21% O<sub>2</sub>):
    - 21 to 23 ..... 100% O<sub>2</sub>
    - or 21 to 19 ..... 0% O<sub>2</sub>
    - Discretionary setting (1% O<sub>2</sub> step)
  - (3) When reference gas is 100% O<sub>2</sub>:
    - 100 to 98 ..... 0% O<sub>2</sub>
    - Discretionary setting (1% O<sub>2</sub> step)
- Number of measurement ranges: 2 ranges
- Measurement system: Paramagnetic (pressure detection type)
- Output signal: 4 to 20 mA DC (load resistance 550Ω or less)/0 to 1 V DC (load resistance 550Ω or more)
- Repeatability:
  - Within ±5% of full scale (range width 10% O<sub>2</sub> or more)
  - Within ±1.0% of full scale (range width less than 10% O<sub>2</sub>)
- Zero drift:
  - Within ±1.0% of full scale/week (range width 10% O<sub>2</sub> or more)
  - Within ±1.5% of full scale/week (range width less than 10% O<sub>2</sub>)
- Span drift: Within ±2.0% of full scale/week
- Response time:
  - Within 2 sec (for range width 5.0% O<sub>2</sub> or more, within 3 sec for range width less than 5.0%)
- Sample gas temperature: 0 to 40°C
- Sample gas flow rate:
  - 0.5 ℓ ± 0.2 ℓ /min (for response time beyond 2 sec)
  - 1.0 ℓ ± 0.2 ℓ /min (for response time within 2 sec)
- Pressure loss: 2.8 kPa (about 280 mmH<sub>2</sub>O) (at sample gas flow rate 1.0 ℓ /min)
- Reference gas: N<sub>2</sub>, O<sub>2</sub> or air
- Reference gas pressure: 98 kPa (1.0 kgf/cm<sup>2</sup>) (at reference gas flow rate 5 to 15 ml /min)
- Purging gas flow rate: 1 ℓ /min, N<sub>2</sub> or air (flowed for purging corrosive ambient gas)
- Warm-up time: 2 hours
- Temperature characteristic: 1.5% of full scale/10°C (zero point)
- Interference due to coexisting gas: Deviation in O<sub>2</sub> % of zero point are in the following table caused by flowing interference component gas concentration.

Interfering gas	Deviation in O <sub>2</sub> %	Interfering gas	Deviation in O <sub>2</sub> %
NO	+43.00	C <sub>3</sub> H <sub>4</sub>	-0.44
NO <sub>2</sub>	+28.00	H <sub>2</sub> S	-0.39
He	+0.30	HCl	-0.30
H <sub>2</sub>	+0.24	CO <sub>2</sub>	-0.27
Ne	+0.13	NH <sub>3</sub>	-0.26
HF	+0.10	C <sub>2</sub> H <sub>2</sub>	-0.24
CO	+0.01	Ar	-0.22
n-C <sub>7</sub> H <sub>16</sub>	-2.10	SO <sub>2</sub>	-0.22
Xe	-0.95	N <sub>2</sub> O	-0.20
C <sub>3</sub> H <sub>8</sub>	-0.86	CH <sub>4</sub>	-0.20
C <sub>3</sub> H <sub>6</sub>	-0.55	H <sub>2</sub> O	-0.02
C <sub>2</sub> H <sub>6</sub>	-0.46		

- Indication: Display 1 ..... Message indication, 24 characters x 2 lines on liquid crystal display  
Display 2 ..... Concentration indication: 4-digit LCD  
Range indication: 4-digit LCD
- Calibration function: Calibration method ..... Manual calibration (by key operation), automatic calibration  
Automatic calibration interval ..... 0 to 168 hours (in 1-hour steps)  
Auto calibration start time ..... To be specified in Monday to Sunday, 0 to 23 hours, 0 to 59 min.  
Calibration gas flowing time ..... To be specified in 0 to 60 min, 0 to 59 sec  
Calibration gas concentration ..... Zero gas: 0.00 to 99.99% O<sub>2</sub> (0.01% O<sub>2</sub> step)  
Span gas: 0.00 to 99.99% O<sub>2</sub> (0.01% O<sub>2</sub> step)
- Output hold: Output can be held in calibration.
- Alarm output: High limit alarm ..... Settable from 0.0 to 110.0% O<sub>2</sub>  
Low limit alarm ..... Settable from 0.0 to 100.0% O<sub>2</sub>  
Hysteresis ..... Settable from 0.0 to 20.0% of full scale
- Moving average period: 0 to 99.9 sec
- Contact output: 1a contact ..... Range discrimination signal, in-calibration signal, instrument error, automatic calibration error  
1c contact ..... Zero calibration valve, span calibration valve, high limit alarm, low limit alarm  
Contact capacity ..... 250 V AC, 2 A (resistance load)
- Contact input: Remote range, external hold, automatic calibration remote start  
Voltage input ..... 5 V DC, status detection
- Power supply: 85 to 264 V AC, 50/60 Hz
- Power consumption: About 90 VA
- Ambient temperature: -5 to 40°C
- Ambient humidity: 90% RH or less
- Casing: Made of steel plates, indoor type
- External dimensions (H x W x D): Rack-mount type ..... 220 x 483 x 463 [mm]  
Panel-mount type ..... 220 x 443 x 463 [mm]  
Tabletop type ..... 233 x 443 x 463 [mm]
- Weight: About 20 kg

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## **Fuji Electric Systems Co., Ltd.**

### **Head Office**

Gate City Ohsaki, East Tower, 11-2, Osaki 1-chome,  
Shinagawa-ku, Tokyo 141-0032, Japan  
<http://www.fesys.co.jp/eng>

### **Instrumentation Div.**

#### **International Sales Dept.**

No.1, Fuji-machi, Hino-city, Tokyo 191-8502, Japan  
Phone: 81-42-585-6201, 6202 Fax: 81-42-585-6187  
<http://www.fic-net.jp/eng>

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