User's
Manual

Model MG8E
Paramagnetic Oxygen Analyzer

IM 11P03A05-01E

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YOKOGAWA
Yokogawa Electric Corporation

IM 11P03A05-01E
3rd Edition

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INTRODUCTION

Safety, Protection, and Modification of the Product

- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this user's manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If this instrument is used in a manner not specified in this user's manual, the protection provided by this instrument may be impaired.
- If any protection or safety circuit is required for the system controlled by the product or for the product itself, prepare it separately.
- Be sure to use the spare parts approved by Yokogawa Electric Corporation (hereafter simply referred to as YOKOGAWA) when replacing parts or consumables.
- Modification of the product is strictly prohibited.
- The following symbols are used in the product and user's manual to indicate that there are precautions for safety:

Media No. IM 11P03A05-01E (CD) 3rd Edition :Jan. 2009 (YK)

Notes on Handling User's Manuals

- Please hand over the user's manuals to your end users so that they can keep the user's manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these user's manuals is not to warrant that the product is well suited to any particular purpose but rather to describe the functional details of the product.
- No part of the user's manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
- YOKOGAWA reserves the right to make improvements in the user's manuals and product at any time, without notice or obligation.
- If you have any questions, or you find mistakes or omissions in the user's manuals, please contact our sales representative or your local distributor.

Warning and Disclaimer

The product is provided on an "as is" basis. YOKOGAWA shall have neither liability nor responsibility to any person or entity with respect to any direct or indirect loss or damage arising from using the product or any defect of the product that YOKOGAWA can not predict in advance.

Notes on Hardware

Appearance and Accessories

Check the following when you receive the product:

- Appearance
- Standard accessories

Contact our sales representative or your local distributor if the product's coating has come off, it has been damaged, or there is shortage of required accessories.

Model and Suffix Codes

The name plate on the product contains the model and suffix codes. Compare them with those in the general specification to make sure the product is the correct one. If you have any questions, contact our sales representative or your local distributor.

Symbol Marks

Throughout this user's manual, you will find several different types of symbols are used to identify different sections of text. This section describes these icons.

WARNING

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

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

IMPORTANT

Indicates that operating the hardware or software in this manner may damage it or lead to system failure.

NOTE

Draws attention to information essential for understanding the operation and features.

TIP

Identifies additional information.

SEE ALSO

Identifies a source to be referred to.

Clicking a reference displayed in green can call up its source, while clicking a reference displayed in black cannot.

◆ After-sales Warranty

■ **Do not modify the product.**

■ **During the warranty period, for repair under warranty carry or send the product to the local sales representative or service office. Yokogawa will replace or repair any damaged parts and return the product to you. Before returning a product for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.**

- If we replace the product with a new one, we won't provide you with a repair report.
- Yokogawa warrants the product for the period stated in the pre-purchase quotation Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.

■ **In the following cases, customer will be charged repair fee regardless of warranty period.**

- Failure of components which are out of scope of warranty stated in instruction manual.
- Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa Electric did not supply.
- Failure due to improper or insufficient maintenance by user.
- Failure due to modification, misuse or outside-of-specifications operation which Yokogawa does not authorize.
- Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
- Failure caused by any usage out of scope of recommended usage.
- Any damage from fire, earthquake, storms and floods, lightning, disturbances, riots, warfare, radiation and other natural changes.

■ **Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.**

■ **Yokogawa Electric will not bear responsibility when the user configures the product into systems or resells the product.**

■ **Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair for this product, please contact the nearest sales office described in this instruction manual.**

Model MG8E
Paramagnetic Oxgen Analyzer

IM 11P03A05-01E 3rd Edition

CONTENTS

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1. NOTICE ON HANDLING

It is highly recommended that you read this instruction manual carefully before using this analyzer so that the analyzer an operate in the best condition. Instruments certified for their explosion-protected construction (flameproof instruments) are provided with a certification label and nameplate which describes their required specifications. All installation conditions should be provided in compliance with these specifications.

⚠ WARNING

Open circuit at non-hazardous location(*) before removing the MG8E cover.

(*) The nameplate of the MG8E says “Open circuit at non-hazardous location before removing cover” because the internal energy does not decrease below the specified value.

According to "USERS' GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry" (published by Tecnology Institution of Industrial Safety, in Japan) ,the expression “a non-hazardous area” is defined as “A non-hazardous area is considered a place where no occurrence of explosive gas atmosphere is guaranteed by the foreperson and confirmed by a written document.“

Therefore, if a non-hazardous area is secured, the work can be done on site.

1.1 Precaution in Unpacking

This analyzer is a precision instrument. Beware of the effect of shock on the analyzer, especially while unpacking, and avoid dropping it or letting it hit another object.

1.2 Check of Model Name and Specifications

Check that the model number and main specifications on the name plate of the analyzer match the specifications of your purchase order.

MG8	Applicable Range	Installation Site		Sample Gas					
		Hazardous Area	Non-hazardous Area*2	Class A and B hazardous gases*1 or Mixed gases of less than 4% hydrogen		Mixed gases of 4 to 100% hydrogen		Class C hazardous gas*1, excluding hydrogen*3	
				Atmosphere	Sample gas	Atmosphere	Sample gas	Atmosphere	Sample gas
MG8E used as flameproof (Exd II BT4X*4)	0-1 to 25% O_2 (Not applicable for 21-25% O_2)	OK	OK	OK	OK	NA	NA	NA	NA
MG8E used as non-flameproof	0-1 to 25% O_2	NA	OK	NA	OK	NA	OK	NA	NA
MG8G used as non-flameproof	0-5 to 25% O_2	NA	OK	NA	OK	NA	NA	NA	NA

*1: Refer to the Users Guide to Installing Explosionproof Electrical Apparatus at Plants, issued by the Technology Institution of Industrial Safety, Japan.
*2: The definition of the non-hazardous area is followed by the description in the Users Guide to Installing Explosionproof Electrical Apparatus at Plants, issued by
the Technology Institution of Industrial Safety, Japan: As a non-hazardous area is considered a place where no occurrence of explosive gas atmospheres is
guaranteed by the foreperson and confirmed by a written document.
*3: Acetylene, carbon disulfide, hydrogen, and ethyl nitrate.
*4: Exd II BT4X
(a) Structure: Flameproof
(b) Scope of area: Plants excluding hazardous areas in mining districts or hazardous areas in offices
(c) Scope of sample gas or vapor:
(c-1) Class A and B hazardous gases or vapor
(c-2) Gas or vapor with ignition temperature of 135°C or greater
(c-3) Hydrogen concentration must be below 4%. Not applicable for gases containing acetylene, carbon disulfide and ethyl nitrate.
(d) Operating conditions
(d-1) Before opening the cover, remove power and make sure of non-hazardous atmospheres.
(d-2) Do not use for measuring oxygen concentration of gases other than those containing air or oxygen equivalent to or less than air, or those mixed with flammable gas or vapor.

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2. OVERVIEW

The model MG8E paramagnetic oxygen analyzer continuously and selectively measures the oxygen concentration in sample gases. Its detector and converter are integrated together.

The analyzing cell in the detector has a special construction which is designed to be unaffected by other gases. It is highly sensitive and offers excellent response. Its detector has a sturdy construction to protect against vibration and shock. Gas flow ratio detection ensures long term stability and reliable measurement because sample gases do not directly come into contact with the sensor and thus components in sample gases do not stick to the sensor. Its analog output signals are isolated from the internal circuit. In addition to these features, its one-touch calibration function and self-diagnosis function provide high operability, maintainability, and reliability.

2.1 Standard System Configuration

The standard system configuration of the MG8E paramagnetic oxygen analyzer is shown in Figure 2.1.

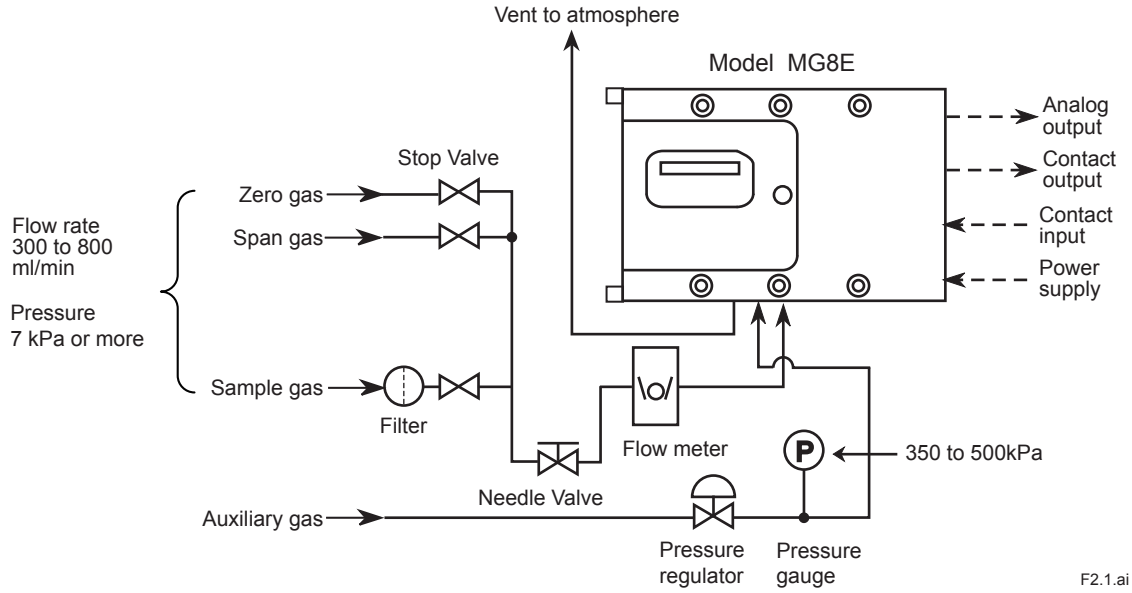


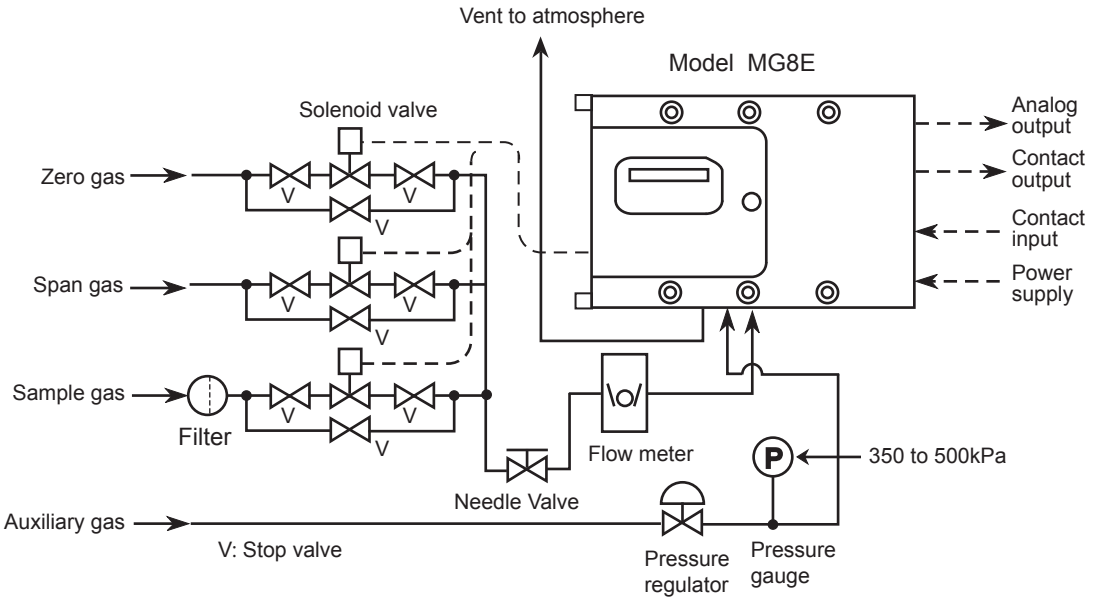
Figure 2.1 System Configuration Diagram

IMPORTANT

Auxiliary gas (N_2 gas) is required in accordance with the measurement principle of the instrument. Before supplying power to the instrument, be sure to introduce the auxiliary gas.

2.2 System Configuration with Automatic Calibration

The system configuration that includes an automatic calibration option is shown in Figure 2.2.



Note 1: Use a deenergize-to-open (energized-closed) solenoid valve for the sample gas, and a deenergized-to-close solenoid valve for the others.
Note 2: These valves are used upon failure of the solenoid valve.

F2.2.ai

Figure 2.2 System Configuration with Automatic Calibration

IMPORTANT

Auxiliary gas (N_2 gas) is required in accordance with the measurement principle of the instrument. Before supplying power to the instrument, be sure to introduce the auxiliary gas.

3. SPECIFICATIONS

3.1 Standard Specifications

Measurement Object:

Oxygen concentration in gaseous mixture

Measurement System:

Paramagnetic system

Measurement Range:

0-1 to 0-25 vol%O_2

3 ranges can be programmed arbitrarily within the above specified range.

Self-diagnostic content:

Sensor unit error, Constant temperature chamber error, Analog error, Memory error, Calibration coefficient error

Analog output signal:

4 to 20mA DC (load resistance: Maximum 550Ω)

Contact output:

Contact rating: 3A at 250 VAC or 30 VDC, dry contacts

Fail; 1 point, open or closed when error occurs, user configurable
Contact is activated when sensor unit error, constant temperature chamber error, analog error, memory error, or calibration coefficient error (when automatic or semiautomatic calibration is enabled) occurs

Low auxiliary gas pressure alarm; 1 point, closed when pressure drops
Factory default low limit pressure; 300kPa

Maintenance status; 1 point, closed during maintenance

Range answerback or high/low alarm; 2 points, normally deenergized (open)
Range answerback or high/low alarm contact output, user selectable

Output to Operate Solenoid Valve: 3points

Switching between zero and span calibration gas, and measured gas.

Maximum load : AC 1 A.

Contact input:

Input specification: Contact ON : 200Ω or less, Contact OFF : 100 kΩ or greater

Remote range switching: 2 points, Output ranges 1 to 3 can be switched by external contact signal.

Calibration start; 1 point, calibration start command by external contact signal

Measurement Gas Conditions:

Gas Flow ; Setting range : 300 to 800 ml/min (standard 600 ml/min)

Allowable range : ±10% of a set value

Pressure : Approx. 7 kPa (approx. 700 mmH_2O) in Analyzer inlet

Temperature: 0 to 50°C

Humidity : No moisture condensation in the flow path or the sensor

Operating Conditions:

- Measurement gas must be an explosive gas which has T4 ignition temperature and must be a hazardous gas less than or equal to the gas vapor-air mixtures.
- Oxygen concentration in the measurement gas must be less than a mixture of air with a flammable gas (Exd II BT4X). However, this is an exception if it is ascertained that the gas explosion characteristics are safer than the equivalent gas.

Auxiliary Gas:

Type ; N_2 gas (not containing O_2 gas equal to or greater than 0.1 % of the maximum concentration of the measurement range)

Pressure ; 350 to 500 kPa (average flow rate of approx. 35 ml/min. When sample gas contains hydrogen of 3% or greater, flow rate is approx. 55 ml/min)

Calibration gas:

Zero gas ; N_2 gas
Note: Zero gas should not contain O_2 gas with a concentration equal to or greater than 0.1% of the upper range value.

Span gas ; Dry air (instrument air O_2: 20.95 vol%) or standard gas containing O_2 gas with a concentration of 80 to 100% of the span value (balance nitrogen).

Calibration methods:

(1) Automatic calibration at set intervals by internal timer

(2) Semiautomatic calibration started by external contact input

(3) Manual calibration in the field

Warm-up Time:

Approx. 2.5 hours

Installation Conditions:

Ambient temperature: -5 to 55°C

Humidity; 10-95%RH (No condensing)

Vibration:

5 to 9 Hz : Vibration amplitude; 1.5 mm or less

9 to 150 Hz: Acceleration; 2 m/s2 or less

Power Supply:

100 to 115 V AC ±10%, 50 or 60 Hz

Power Consumption:

170 VA maximum, approx. 25 VA normally

Materials in Contact with Gas:

JIS SUS316 stainless steel, Fluorocarbon rubber, Hard glass

Structure:

flameproof (Exd II BT4X)

Dimensions :

440(W) x 370(H) x 325(D) mm

Color:

Door: Munsell 2.0GY7.5/0.9, epoxy resin baked

Case: Munsell 2.0GY3.1/0.5, epoxy resin baked

Weight :

Approx. 38 kg

3.2 Characteristics

Repeatability :

±1% or less of span

Linearity :

±1% or less of span

Response Time :

90% response within 3 sec; measured by analog output signal change after gas is fed through the analyzer inlet.

Drift and Influence in Ambient Temperature:

Item / Range	Drift (zero, span)	Influence in Ambient Temperature
0 – 1% O_2	2% or less of span / week	Variation of 2% or less of span / 10°C
0 – 2 to 4% O_2	1.5% or less of span / week	Variation of 1.5% or less of span / 10°C
0 – 5 to 25% O_2	1% or less of span / week	Variation of 1% or less of span / 10°C

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Influence in Measurement Gas Flow:

±1% or less of span/ ±10% of set value

Influence in Atmospheric Pressure:

±1% or less of span/ 10 hPa

3.3 Model and Suffix Code

Model MG8E Paramagnetic Oxygen Analyzer (Flameproof)

Model	Suffix Code	Option Code	Specification
MG8E	·····	·····	Paramagnetic oxygen analyzer
Measure-ment range	-1	·····	0 - 1 to 25 vol% O_2
	-2	·····	0 - 2 to 25 vol% O_2
	-5	·····	0 - 5 to 25 vol% O_2
Cell material	A	·····	Standard
	B	·····	Organic solvent resistant
Auxiliary gas	W	·····	N_2 gas
Flow rate of auxiliary gas	N	·····	35 ml/min
	H	·····	55 ml/min, when sample gas contains H_2 gas of 3% or greater and O_2 in He
Power supply	5	·····	100 - 115 V AC, 50 / 60 Hz
Language	-J	·····	Japanese
	-E	·····	English
Option		/B1	Balance gas: CO_2 (20%)+N_2

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(Note 1) For wiring to the MG8E paramagnetic oxygen analyzer, always use the specified external cable lead-in cable grands shown in the table below.
(Note 2) Two pressure packing adapters (part number :G9601AE) are mounted on the MG8E cable inlet ports for power supply and output signal. (Blind plugs are mounted on the remaining four cable inlet ports.)
(Note 3) If wiring to other than the power supply and output signal is necessary, prepare the following additional items as required.The number of external cable lead-in cable grands possible for mounting is as follows:
• Cable grounding : Up to 6 pieces
(Note 4) Material of measurement gas seal is Daielperfrow (tetrafluoroethylene/perfluoro methyl vinyl ether rubber) when cell material is organic solvent resistant.
(Note 5) Consult Yokogawa for balance gas other than option code "/B1."

External Cable Lead-in Cable Grands

Part No.	Part Name	Specification
G9601AE	Cable grands	Cable of 10 to 13.5 mm O. D.
K9356AG	Cable grands	Cable of 8.5 to 11 mm O. D.

T3.3.ai

STANDARD ACCESSORIES

Item	Parts No.	Qty	Description
Fuse	A1111EF	2	250V 2A
Hex-headwrench	—	1	
User's Manual	—	1	

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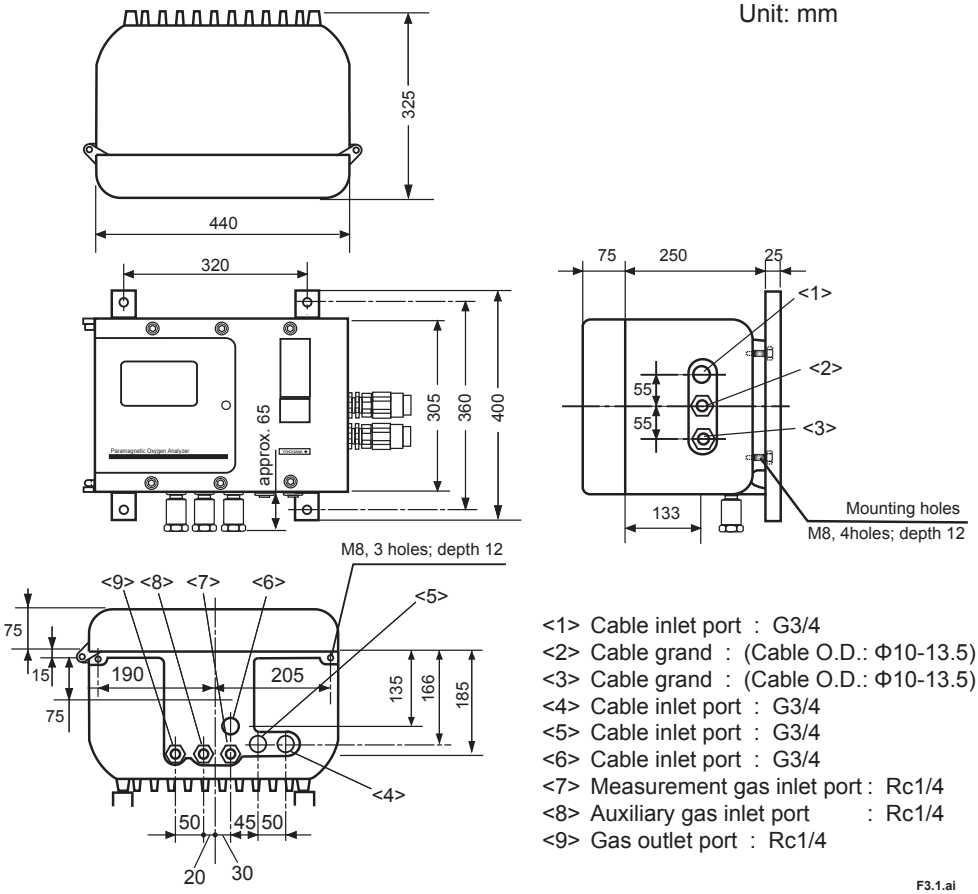
3.4 External Dimensions

Unit: mm



<1> Cable inlet port : G3/4
<2> Cable grand : (Cable O.D.: Φ10-13.5)
<3> Cable grand : (Cable O.D.: Φ10-13.5)
<4> Cable inlet port : G3/4
<5> Cable inlet port : G3/4
<6> Cable inlet port : G3/4
<7> Measurement gas inlet port : Rc1/4
<8> Auxiliary gas inlet port : Rc1/4
<9> Gas outlet port : Rc1/4

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4. INSTALLATION

This chapter describes installation for the analyzer and procedures and precautions for wiring and piping work. Follow the procedures outlined in this chapter as much as possible.

⚠ WARNING

Open circuit at non-hazardous location before removing the MG8E cover.

(*) The nameplate of the MG8E describes “Open circuit at non-hazardous location before removing cover” because the internal energy does not decrease below the specified value.

According to "USERS' GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry" (published by Tecnology Institution of Industrial Safety, in Japan) ,the expression “a non-hazardous area” is defined as “A non-hazardous area is considered a place where no occurrence of explosive gas atmosphere is guaranteed by the foreperson and confirmed by a written document.“

Therefore, if a non-hazardous area is secured, the work can be done on site.

4.1 Installation Location

The following conditions must be observed in selecting the location:

(1) A place that meets the explosion proof specifications

(2) Minimum influence from shock or vibration

(3) The least corrosive atmosphere

(4) A daytime variation in the ambient temperature of less than 15 °C. (In particular, avoid installing the analyzer in a location where the temperature may abruptly change.)

(5) No exposure to rain drop and direct sunlight (In a place where exposed to direct sunlight, provide a shade.)

(6) No exposure to high radiant heat, steam, or heat convection from a process plant

(7) Minimum influence from an electromagnetic field. Avoid as much as possible parallel wiring with power supply cables or areas close to motors, electromagnetic relays, or pumps.

(8) Easy implementation of maintenance and inspection

4.2 Mounting Procedure

The standard mounting of the analyzer is a wall-mounting.

Attach the mounting bracket to the back of the body using bolts (M8×14), lock washers, and flat washers.

Using the four mounting holes, fix the body to the wall in such a way that there is no gap between the body and the wall.

Note: In consideration of the instruments weight (approximately 38kg), use a channel steel support if necessary.
Securely fix the analyzer so that the mounting angle does not change. Vibration or fluctuation in the position of the analyzer may cause errors.

Unit: mm

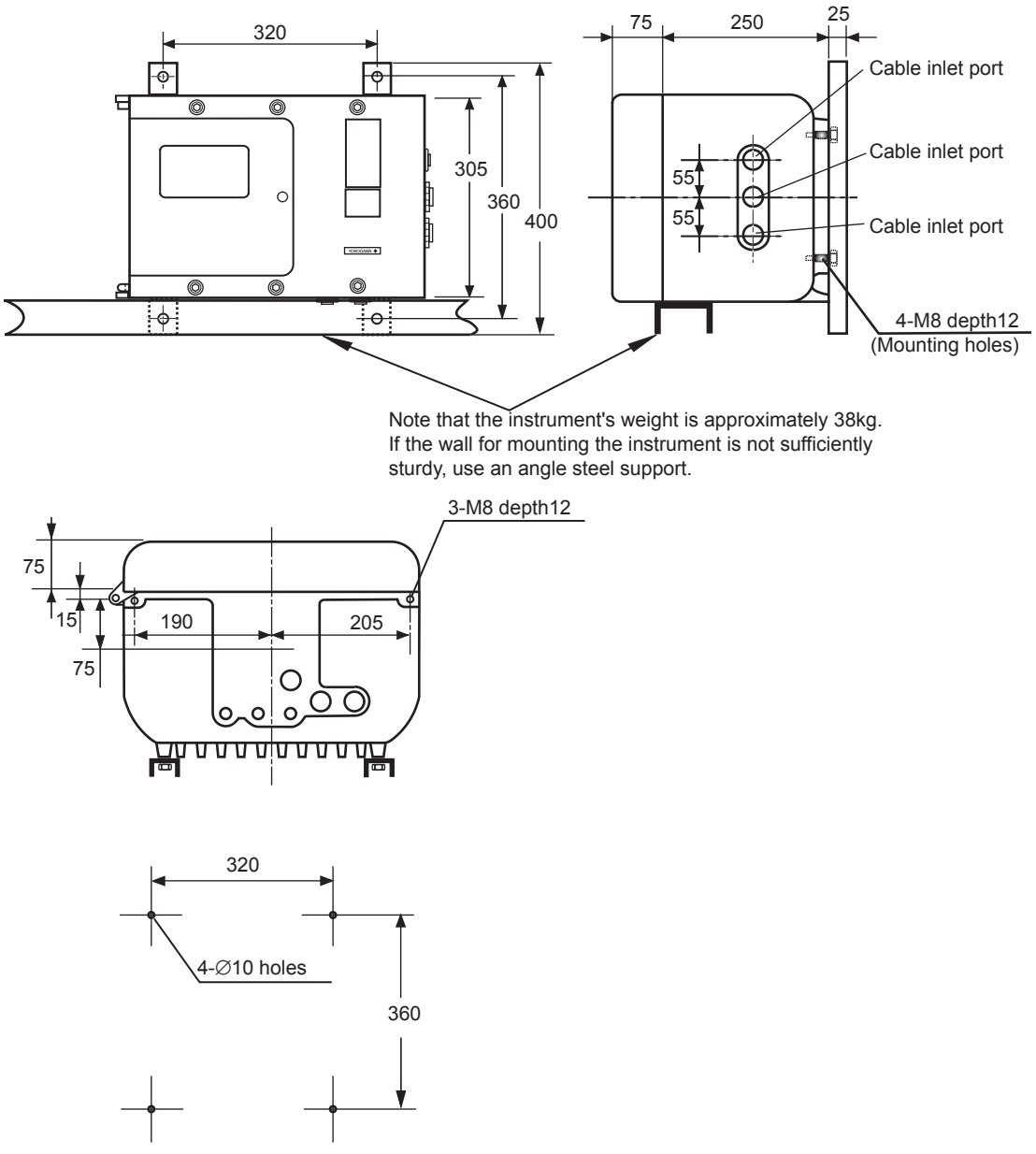

Figure 4.1 Mounting of Analyzer

5. NAMES OF COMPONENTS

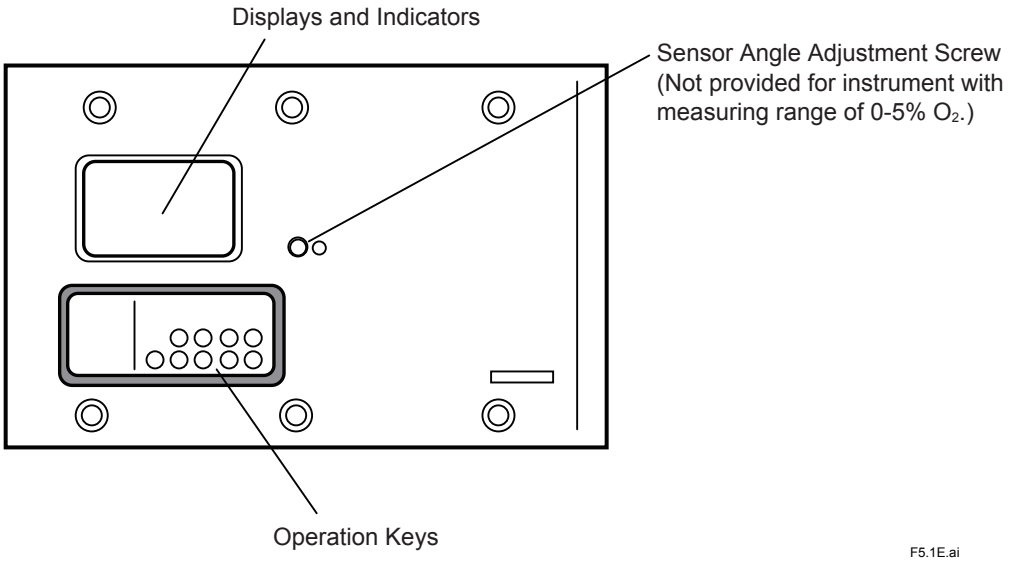

Figure 5.1 Operation Panel

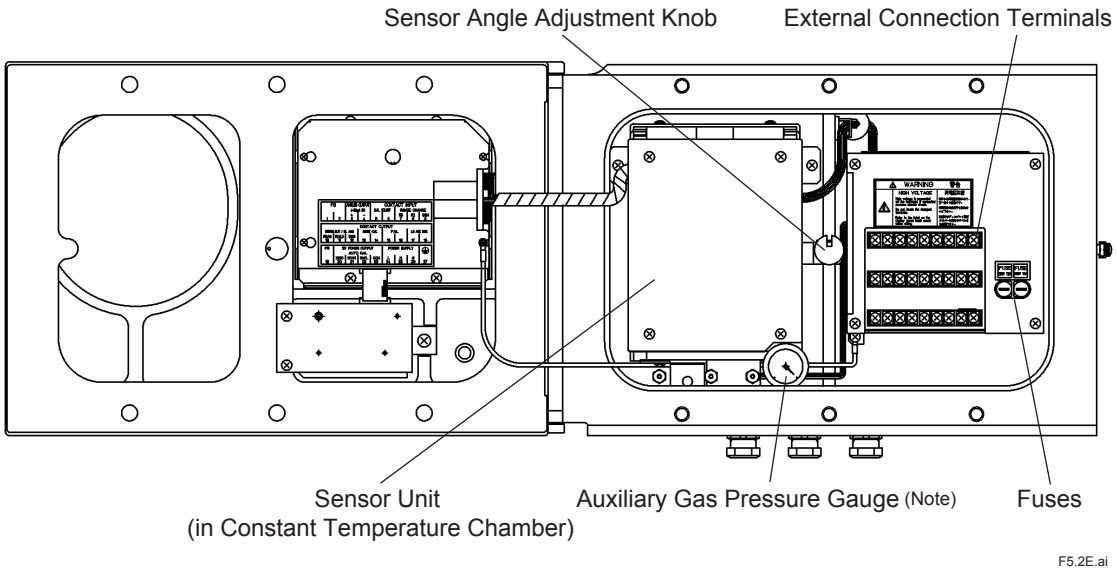

Figure 5.2 Inside of Analyzer

NOTE

Note: The auxiliary gas pressure gauge reads the secondary pressure of the pressure regulator in the sensor unit and needs no adjustment.

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6. PIPING

CAUTION

Before connecting pipes to the MG8E (including the gas sampling unit), thoroughly purge the pipes and make sure that there are no moist air and other contaminants trapped inside.

(1) Figure 6.1 shows the standard piping diagram. Connect metal piping tubes of approximately Ø6/Ø4 mm so that no leakage occurs.

(2) A pressure regulator and pressure gauge (range : 0 to 1MPa) should be provided on the auxiliary-gas line to set the desired pressure. For pressure setting, see (3) of Section 8.2, "Setting the Auxiliary Gas Pressure."

(3) Calibration gases are required for zero and span calibrations. Piping should be arranged to enable the inlet to switch between the sample gas and the calibration gas.

(4) Gas from the instrument should be vented to the atmosphere. The gas outlet should be designed so that the ingress of wind, rain and drain is prevented.

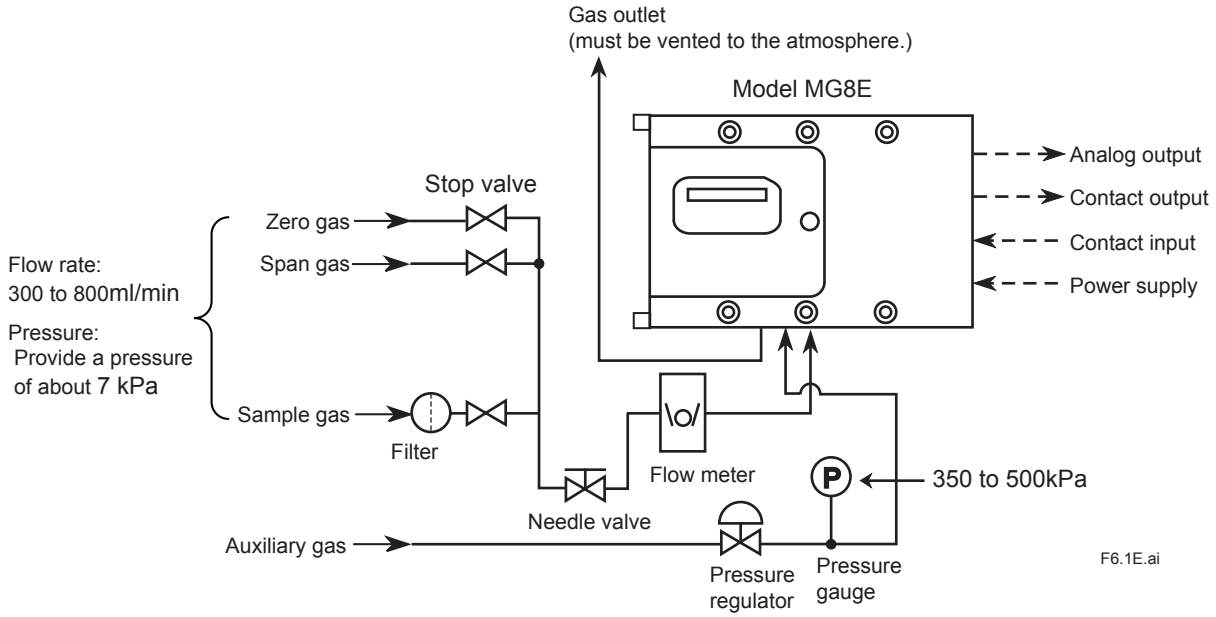

Figure 6.1 Piping Diagram

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7. WIRING

WARNING

Open circuit at non-hazardous location(*) before removing the MG8E cover.

(*) The nameplate of the MG8E says “Open circuit at non-hazardous location before removing cover” because the internal energy does not decrease below the specified value.

According to "USERS' GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry" (published by Tecnology Institution of Industrial Safety, in Japan) ,the expression “a non-hazardous area” is defined as “A non-hazardous area is considered a place where no occurrence of explosive gas atmosphere is guaranteed by the foreperson and confirmed by a written document.“

Therefore, if a non-hazardous area is secured, the work can be done on site.

7.1 External Connection Terminals

The external connection terminals are located inside the operation panel. To open the panel, loosen the two screws on the panel.

Figure 7.1 shows the diagram of the external connection terminals of the MG8E. The terminal numbers are indicated on the instrument. Be sure to make all connections correctly. The terminal screw thread is M4. Appropriate crimp terminals should be used. The FG terminals are connected to the case. Make sure that terminals G (26) and FG (27) should remain connected by a supplied jumper plate.

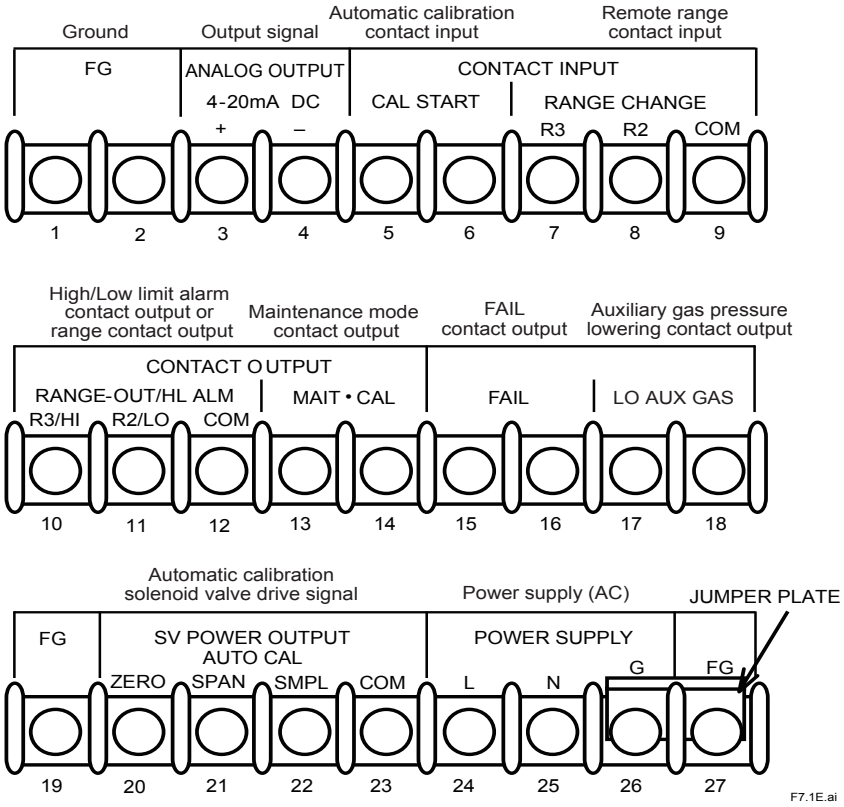

Figure 7.1 External Connection Terminals

7.2 Wiring Precautions

For external cable wiring use only the flameproof cable glands specified by Yokogawa (Table 7.1). For details about wiring for the flameproof or explosionproof equipment, refer to the relevant guides of the local and international standards to ensure proper wiring.

The following instructions must be observed when wiring:

(1) Turn off all the power before wiring.

(2) Do not route electrical wiring and wiring for large-capacity converters and motors or power wiring in the same wiring duct.

(3) The thread parts must be waterproofed. (Non-hardening silicone sealant is recommended.)

(4) To prevent errors due to noise, do not route signal cables and power cables in the same cable hole.

(5) When running cables in a place where ambient temperature is high or low, use cables suited for that condition.

(6) When running cables in an atmosphere where hazardous gas or liquid, or oil or solvent is present, use cables made of materials that can withstand such aggressive conditions.

(7) For wire termination use crimp terminals (M4 screws) with insulating sleeves.

7.3 Cable Specifications

(1) For the wiring, use PVC insulated PVC sheathed control cables (CVV), PVC insulated PVC sheathed shielded control cables (CVVS), or other suitable cables. If necessary, run the cable in a steel conduit or other suitable tube or duct for protection against damage. The thread parts must be waterproofed with a non-hardening sealant.

(2) Flameproof cable glands for cable wiring must be the ones specified by Yokogawa. Flameproof cable glands are available in two types for different port sizes (see table below).

(3) Measure the outside diameter of a cable to be used in two different directions in millimeters and take the average. From Table 7.1 select the cable gland with a diameter closest to the average.

(4) Analog output cables must have a shield wire, which should be connected to the FG terminal of the instrument.

(5) For the grounding, use 600 V PVC insulated wires.

Table 7.1 Types of Flameproof Packing Adapters and Appropriate Outside Diameters of Cable

Conduit Connection Size *	Appropriate Outside Diameters of Cable (mm)	Identification Mark on Packing	Part Number
G3/4	8.5 to 9 9.1 to 10 10.1 to 11	9Φ 10Φ 11Φ	K9356AG
G3/4	10 to 11 11.1 to 12 12.1 to 13.5	11Φ 12Φ 13.5Φ	G9601AE

*: For conduit connection sizes, see Section 3.4, “External Dimensions.”

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7.4 External Wiring

7.4.1 Power Wiring and Grounding

Connect a power line to terminals L (24) and N (25) of the instrument and a grounding wire to terminal FG (27) or the external grounding terminal at the bottom of the case. The ground resistance should be 100 Ω or less. The jumper plate between terminals G (26) and FG (27) must remain connected.

7.4.2 Analog Output Wiring

Connect an analog output cable to the ANALOG OUTPUT terminals, (3) and (4), and the shield wire to the FG terminal, (1) or (2), of the instrument. The load resistance including wiring resistance on the output should be 550 Ω or less.

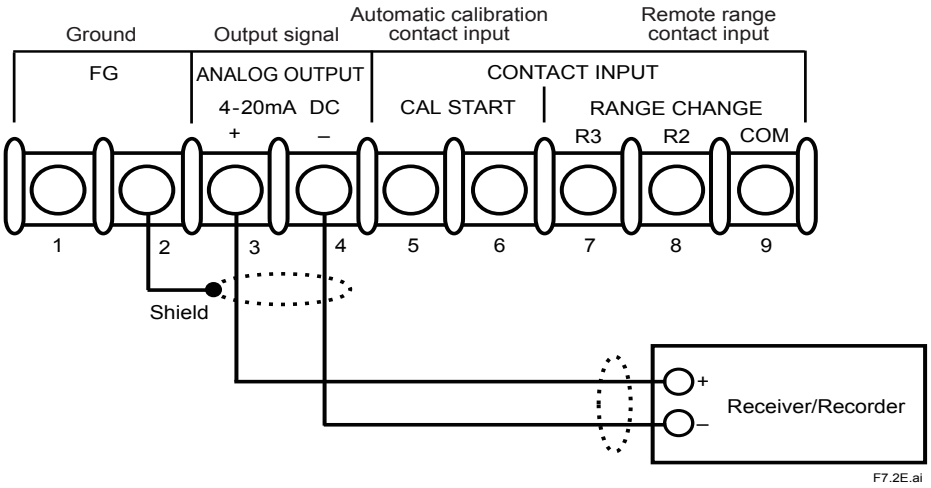


Figure 7.2 Analog Output Wiring

7.4.3 Wiring for Solenoid Valves for Automatic Calibration

This wiring is for the solenoid valves that switch zero, span, and sample gas lines in automatic or semiautomatic calibration. The power sources for solenoid valves are provided internally. Use solenoid valves that have the same power supply voltage and frequency specifications as the instrument. Use a normally open solenoid valve in sample gas line and normally closed solenoid valves for zero and span gas lines.

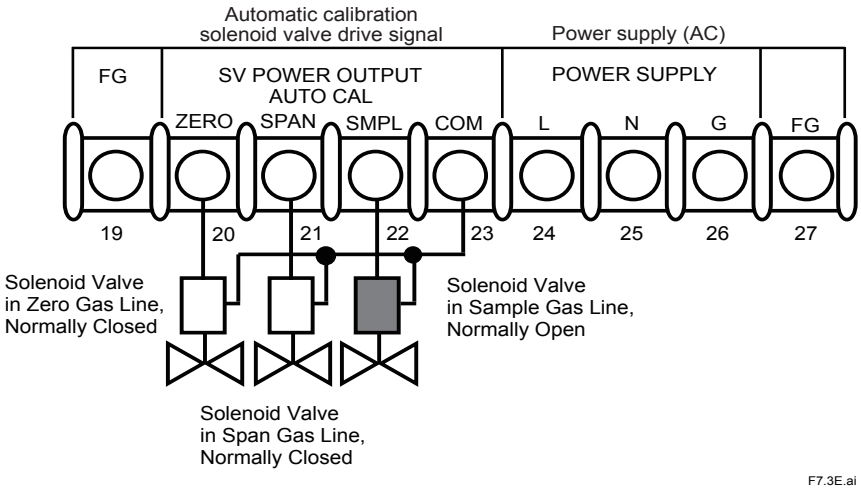


Figure 7.3 Solenoid Valve Wiring

IMPORTANT

The power sources for solenoid valves are provided internally. Use solenoid valves that have the same power supply voltage and frequency specifications as the instrument.

7.4.4 Contact Output Wiring

All outputs are voltage-free, dry contacts (mechanical relay contacts) and rated 3A at 250 V AC or 30 V DC.

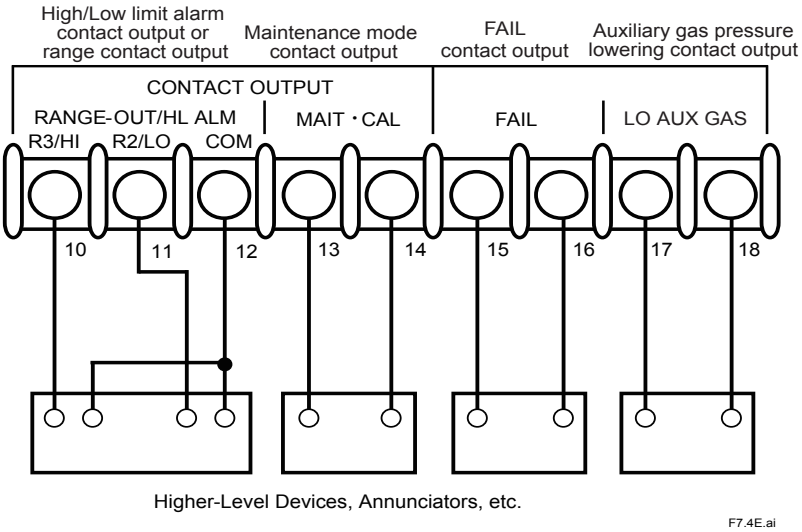


Figure 7.4 Contact Output Wiring

7.4.4.1 Wiring for High/Low Alarm Contact Output/Range Answerback Contact Output

Either high/low alarm contact output or range answerback contact output can be selected. For their detailed functions and setting procedures, refer to Chapter 11, Parameter Settings. Terminal 12 is a common terminal and the contact between terminals 10 and 12 and the one between terminals 11 and 12 will open or close in response to the instrument status. For external connections to higher-level devices or other instruments, refer to Figure 7.1. Both contacts are open when the instrument is not powered.

Terminal No.	High/Low Alarm Contact Output		Range Answerback Contact Output		
	High Alarm	Low Alarm	Range 1	Range 2	Range 3
10-12	Closed		Open	Open	Closed
11-12		Closed	Open	Closed	Open

7.4.4.2 Wiring for Maintenance Status Contact Output

The contact between terminals 13 and 14 is closed during maintenance. For its functions, refer to Chapter 11, Parameter Settings. The contact is open when the instrument is not powered.

7.4.4.3 Wiring for Fail Contact Output

The contact between terminals 15 and 16 will be activated when an error occurs. The output contact is user configurable to open or close when an error occurs. For the setting and functions, refer to Chapter 11, Parameter Settings. The contact is open when the instrument is not powered.

7.4.4.4 Wiring for Low Auxiliary Gas Pressure Alarm Contact Output

The contact between terminals 17 and 18 will close when the pressure of the auxiliary gas being supplied to the instrument drops to the specified pressure or below. For its functions, refer to Chapter 11, Parameter Settings. The contact is open when the instrument is not powered.

7.4.5 Contact Input Wiring

The input is designed to accept a voltage free contact. The contact will open or close in response to the resistance detected on the input. Note that the resistance includes wiring resistance.

Contact closes at 200 Ω or less

Contact opens at 100 kΩ or more

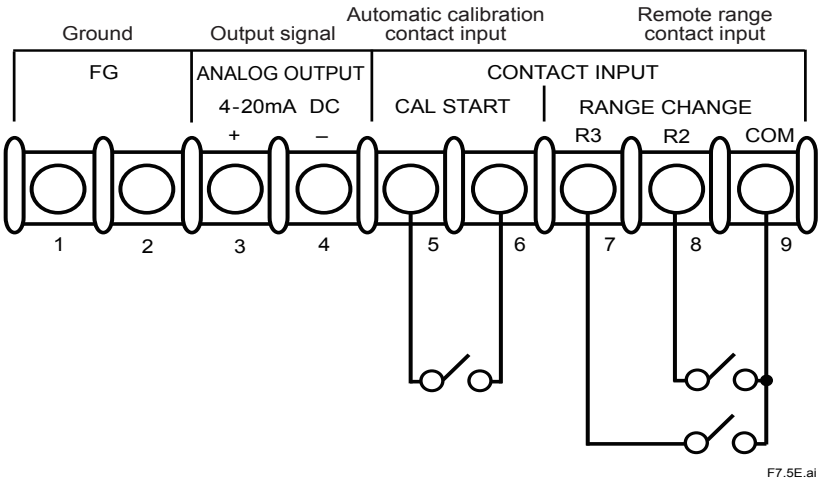


Figure 7.5 Contact Input Wiring

7.4.5.1 Wiring for Calibration Start Contact Input

A calibration will start when the contact between terminals 5 and 6 closes. For the setting and functions, refer to Chapter 12, Calibration.

7.4.5.2 Wiring for Remote Range Contact Input

The range will be switched externally by the state of the contacts between 7 and 9 and between 8 and 9. For the setting and functions, refer to Chapter 11, Parameter Settings.

Terminal No.	Remote Range Contact Input		
	Range 1	Range 2	Range 3
7-9	Open	Open	Closed
8-9	Open	Closed	Open

8. PREPARATIONS

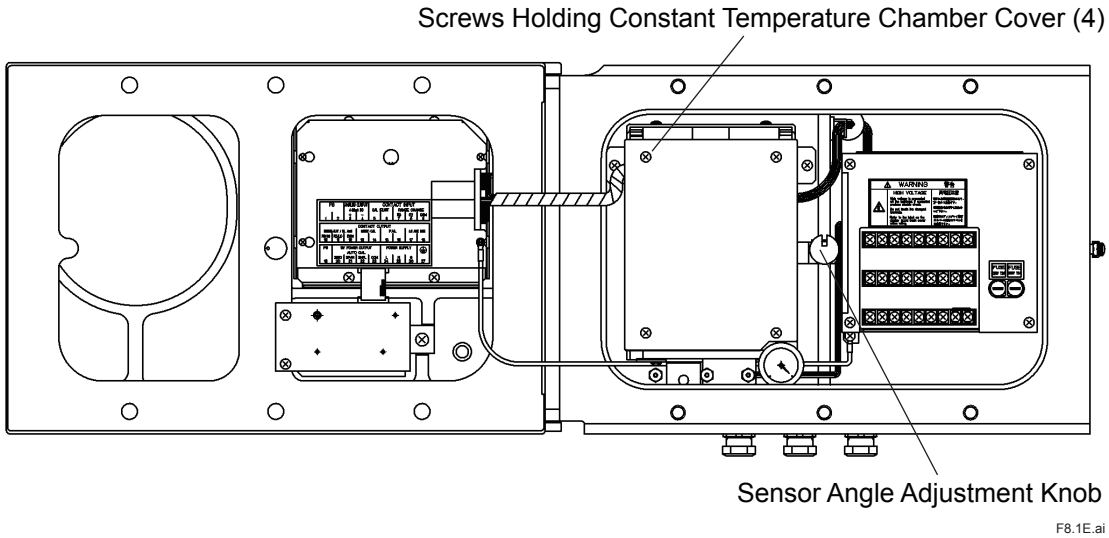
8.1 Adjustment of the Level in the Sensor Unit

After the installation is complete, adjust the angle of the sensor unit. The level adjustment is not needed here if the adjustment is conducted using the actual process gas when the instrument has reached a steady state after power up.

(1) Remove the four screws and remove the constant temperature chamber cover.

(2) Turn the adjustment knob until the air bubble is centered in the level that is installed in front of the sensor unit. Turn the knob clockwise to move the bubble to the right.

(3) Replace the constant temperature chamber cover. Be sure that cables are not caught in the cover. Make sure that the cover is installed securely. Otherwise, the temperature in the constant temperature chamber may become unstable, causing measurement errors.



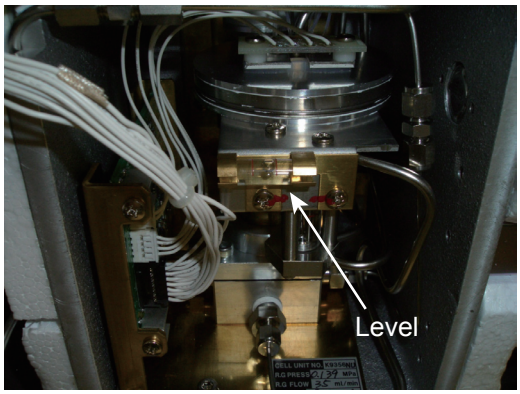


Figure 8.1 Level Adjustment

8.2 Checking the Auxiliary Gas Pressure

Supply the auxiliary gas at the specified pressure (350 to 00 kPa) to the instrument. Check that the needle on the pressure gauge that is installed in the instrument is in the center of the green zone. The pressure gauge measures the secondary pressure of the pressure regulator that is installed in the instrument to stabilize the auxiliary gas pressure. The pressure regulator is adjusted at the factory before shipment and needs no adjustment.

8.3 Checking Sample Gas

Do not introduce sample gas before the instrument has reached a steady state.

9. OPERATIONS

9.1 Operation Keys

The operation keys on the panel are shown in Figure 9.1 and their functions are summarized in Table 9.1.

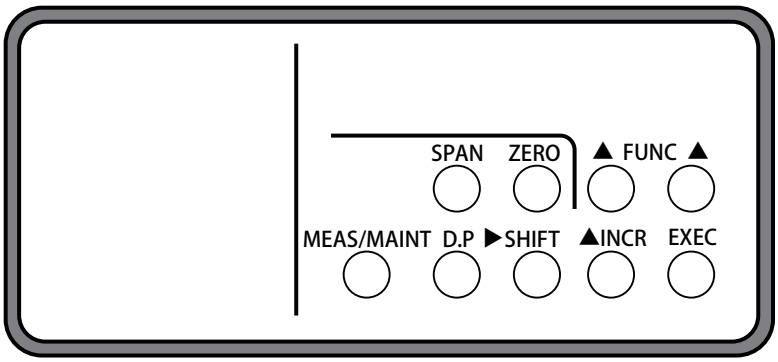


Figure 9.1 Operation Keys

Table 9.1 Operation Keys and Their Functions

Key	Function
MEAS/MAINT	Hold this key and press EXEC key to switch measurement (MEAS) mode and maintenance (MAINT) mode.
SPAN	Used to execute span calibration in calibration.Used to enter span gas concentration in setting.
ZERO	Used to execute zero calibration in calibration.Used to enter zero gas concentration in setting.
▲ FUNC ▲	Used to change the Function Number. Each press increases the number by one increment. The ten and ones digits change independently
D. P	Used to move the decimal point in setting.
▶ SHIFT	Used to blink digit on DATA display or to move blinking digit in setting.
▲ INCR	Each press increases the active value by one increment in setting.
EXEC	Used to confirm data entry or to execute function.

9.2 Displays and Indicators

The displays and indicators and their functions are summarized in Table 9.2. Also refer to Figure 9.2, Operation Panel.

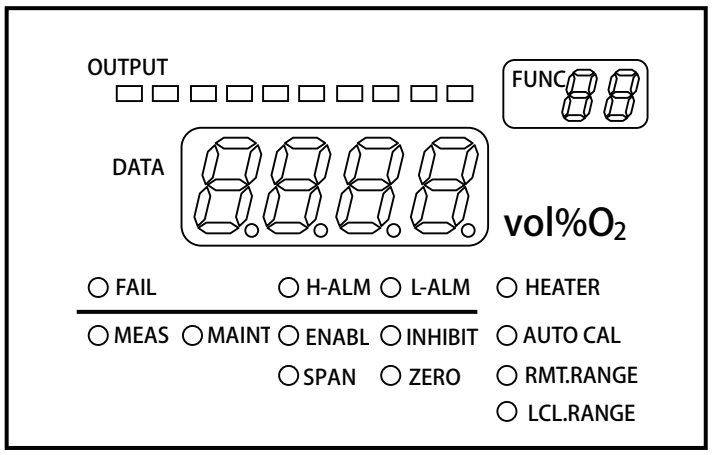


Figure 9.2 Displays and Indicators

Table 9.2 Displays and Indicators

Display/Indicator	Function
DATA (4-digit number)	Shows oxygen concentration in MEAS mode. Shows "–0.00" when measured concentration is below zero, regardless of value. Shows blinking value if auxiliary gas pressure falls below the setpoint when low auxiliary gas pressure alarm function is enabled. Shows setting parameters in MAINT mode.
FUNC (2-digit number)	Shows Function No. in MAINT mode. Blank in MEAS mode.
OUTPUT	Indicates analog output value in 10-level indicator bar. Indicator runs showing actual output value even while the analog output is being held.
FAIL	Lights when error occurs.
MEAS	Lights when instrument is in MEAS mode. Blinks when built-in atmospheric sensor failed.
MAINT	Lights when instrument is in MAINT mode. Blinks when instrument is in stabilization period after warm-up period.
H-ALM	Lights when measured oxygen concentration exceeds high limit alarm value.
L-ALM	Lights when measured oxygen concentration falls below low limit alarm value.
ENABLE	Lights when password entered is effective in MAINT mode.
INHIBIT	Lights when password is not effective in MAINT mode.
SPAN	Lights when span calibration is selected in calibration. Lights when span gas is selected in calibration gas concentration setting. Blinks when span calibration is required.
ZERO	Lights when zero calibration is selected in calibration. Lights when zero gas is selected in calibration gas concentration setting.
HEATER	Turns on and off in response to power on/off status of heater for constant temperature chamber.
AUTO CAL	Lights when automatic calibration function is enabled.
RMT.RANGE	Lights when range switching function at contact input is enabled.
LCL.RANGE	Lights when range switching function at contact input is disabled.

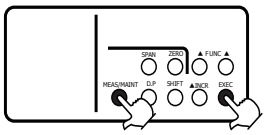
9.3 Basic Operations

This section describes the basic operations of the MG8E paramagnetic oxygen analyzer.

In this section " (pointer)" in the key operation fields indicates the key to be pressed and light gray characters in DATA fields indicate blinking characters on the display.

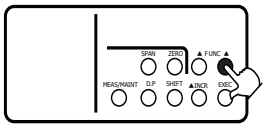
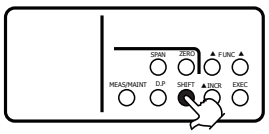
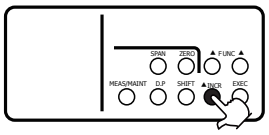
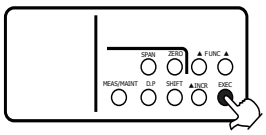
9.3.1 Switching from MEAS Mode to MAINT Mode

In MEAS mode the DATA display on the instrument shows oxygen concentrations in steady state and in MAINT mode operation parameters are set and confirmed or calibration is performed. When the instrument moves into steady state after a warm-up period, it is in MEAS mode. The instrument can be switched into MAINT mode from a warm-up period, stabilization period or steady state (MEAS mode).

Key Operation	FUNC	DATA	Procedure
	- -	CCCC	Press EXEC key while holding MEAS/ MAINT key.MAINT and INHIBIT lamps turn on.Maintenance status contact is activated.

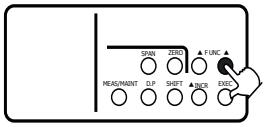
9.3.2 Entering the Password

A password is required when setting data or performing calibration in MAINT mode. A password for the instrument is "007" which cannot be changed. The following describes how to enter the password.

Key Operation	FUNC	DATA	Procedure
	00	P000	Press FUNC keys to show "00" on FUNC display.DATA display shows "P000" where the password is entered.
	00	P000	Press SHIFT key repeatedly to move the blinking digit to the rightmost digit.
	00	P007	Press INCR key repeatedly until "7" is displayed.
	00	P007	Press EXEC key to accept. The digit stops blinking.ENABLE lamp turns on, indicating that the password has become effective.

9.3.3 Changing the Function Number

Each function is assigned to the Function Numbers. Parameters can be viewed and set in the relevant Function Number. The Function Number can be changed using the FUNC keys when the instrument is in MAINT mode. The following describes how to change the Function Number.

Key Operation	FUNC	DATA	Procedure
	00	P007	Switch to MAINT mode.Enter the password.
	09	----	Press the left FUNC key to increase the tens digit, and press the right FUNC key to increase the ones digit on FUNC display. When the Function Number is displayed, the assigned parameter is shown on DATA display.

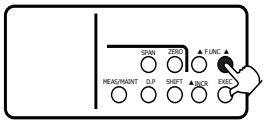
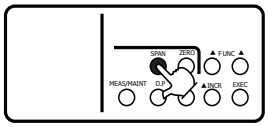
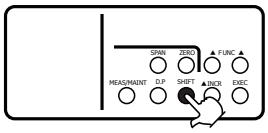
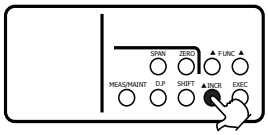
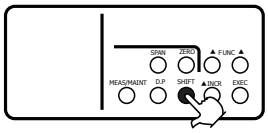
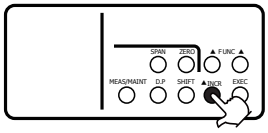
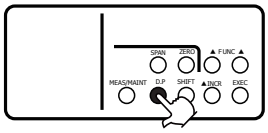
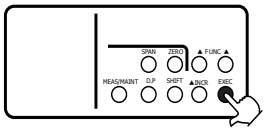
- The Function Number can be changed even if the password is not effective in MAINT mode. However, in some functions parameters are not shown unless the password is effective. In this case, the DATA display shows "----.". For details, refer to Table 9.3.
- In the Function Number to which no function is assigned, the DATA display shows "----."

9.3.4 Returning to MEAS Mode from MAINT mode

The instrument can be returned to MEAS mode from anywhere in MAINT mode by pressing the EXEC key while holding the MEAS/MAINT key.

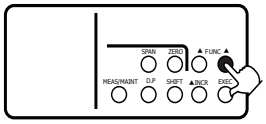
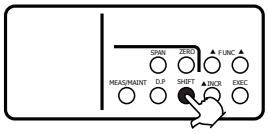
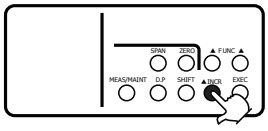
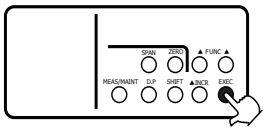
9.3.5 Entering Values

This section explains how to enter values. As an example, the procedure for changing oxygen concentration value in Function No. 02 is shown below. The concentration of span gas is changed from 20.95 to 0.980.

Key Operation	FUNC	DATA	Procedure
			Switch to MAINT mode. Enter the password.
	02	0.000	Press FUNC keys to show “02” on FUNC display. ZERO lamp turns on. DATA display shows “0.000.”
	02	20.95	Press SPAN key. SPAN lamp turns on. DATA display shows “20.95,” the default of span gas concentration. (The default is dependent on the specifications.)
	02	20.95	Press SHIFT key. The leftmost digit of “2” blinks, indicating that the digit can be changed.
	02	0.095	Press INCR key repeatedly until “0” is displayed.
	02	0.095	Press SHIFT key to move the blinking digit to the right.
	02	0.995	Press INCR key repeatedly until “9” is displayed.
	02	0.980	In the same manner, change the remaining digits. Press DP key to move the decimal point to the desired position.
	02	0.980	Press EXEC key to accept. The digit stops blinking, indicating that the change has been accepted.

9.3.6 Selecting Data

This section explains how to select and set one of parameters. As an example, selection of the range is shown below.

Key Operation	FUNC	DATA	Procedure
			Switch to MAINT mode. Enter the password.
	8 8	8	Press FUNC keys to show “11” on FUNC display. DATA display shows “1”, the currently selected range.
	8 8	8	Press SHIFT key. “1” blinks, indicating that the digit can be changed.
	8 8	3	Press INCR key to change the digit to the desired range number. The digit cycles through only the available values (in this case 1 through 3).
	8 8	3	Press EXEC key. The digit stops blinking, indicating that the change has been accepted.

9.3.7 Functions Numbers

The functions assigned to the Function Numbers are listed in Table 9.3. In some functions parameters are not shown unless the password is effective in MAINT mode.

Table 9.3 Function Numbers

Func No.	Function	Setting and Range	Password	
			Not Effective	Effective
00	Entering password		⊙	⊙
01	Executing calibrations	ZERO key: executes zero calibration SPAN key: executes span calibration	----	⊙
02	Setting calibration gas concentrations	ZERO key: for zero gas concentration, 0 to 6 SPAN key: for span gas concentration, 0.5 to 25	○	⊙
03	Checking calibration coefficients	ZERO key: displays zero calibration coefficient SPAN key: displays span calibration coefficient	○	○
04	Setting output hold function during calibration	0: enabled 1: disabled	○	⊙
05	Initializing calibration coefficient		----	⊙
10	Setting remote range switching contact input	1: disabled 2: enabled	○	⊙
11	Selecting range	1: range 1 2: range 2 3: range 3	○	⊙
12	Setting span for range 1	1 to 25% O_2	○	⊙
13	Setting span for range 2	1 to 25% O_2	○	⊙
14	Setting span for range 3	1 to 25% O_2	○	⊙
16	Fixed analog output	ZERO key: 4 mA SPAN key: 20 mA	----	○
20	Setting low limit alarm	0 to 25% O_2	○	⊙
21	Setting high limit alarm	0 to 25% O_2	○	⊙
22	Setting high/low limit alarm function	0: disabled 1: enabled	○	⊙
23	Setting low auxiliary gas pressure alarm function	0: disabled 1: enabled	○	⊙
30	Checking temperature (°C) of constant temperature chamber		○	○
31	Checking sensor emf (mV)		○	○
40	Executing error check		----	⊙
41	Resetting sensor emf error status		----	⊙
42	Resetting calibration coefficient error status		----	⊙
43	Setting output hold function when error occurs	1: enabled – output is held at last measured value 2: disabled 3: enabled – output is held at preset value	○	⊙
44	Setting preset value	–10 to 110%	○	⊙
45	Setting contact output status when error occurs	0: contact closes when error occurs 1: contact opens when error occurs	○	⊙
50	Setting initial wait time for automatic calibration	0 day 0 hour to 99 days 24 hours	○	⊙
51	Setting interval for automatic calibration	0 day 1 hour to 99 days 24 hours	○	⊙
52	Setting zero calibration time	1 to 99 minutes	○	⊙
53	Setting span calibration time	1 to 99 minutes	○	⊙
54	Setting purge time	0 to 99 minutes	○	⊙
55	Executing span calibration	0: not execute span calibration 1: executes span calibration	○	⊙
56	Setting the number of times of skipping span calibrations	0 to 99 times	○	⊙
57	Starting automatic calibration function	0: OFF 1: ON	○	⊙
58	Manual operations of solenoid valves	ZERO key: opens solenoid valve in zero gas line SPAN key: opens solenoid valve in span gas line	----	⊙
67	Checking error status	For service	○	○
98	Checking firmware revision		○	○
99	Initialization		----	⊙

○: Data can only be viewed.
⊙: Data can be changed or functions can be executed.
Note: Setting ranges depend on Model and Suffix Codes.

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10. START-UP

This chapter describes the procedures for supplying power, setting operation parameters, and manual calibration.

10.1 Supplying Power

Before supplying power to the instrument, make sure that:

(1) the installation, piping and wiring have been done correctly;

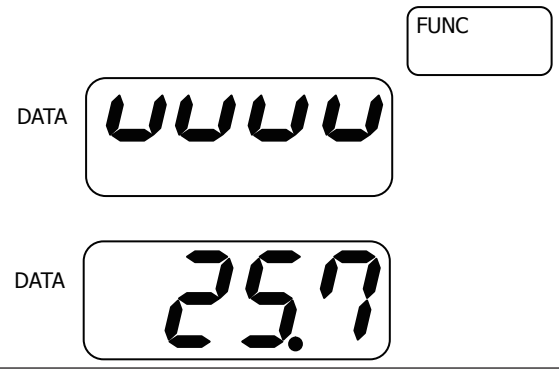
(2) the auxiliary gas is being supplied at the specified pressure;

(3) the supply voltage meets the instrument specifications; and

(4) no sample gas has been introduced.

(5) the case cover is securely closed and the six cover bolts are firmly tightened.

Then, supply power to the instrument. Upon power up, the instrument displays show as follows.

Display	Description
	All segments on both DATA and FUNC displays turn on for about two seconds.
	The firmware revision appears for about three seconds. (The number shown at left is an example.)
	The instrument enters a warm-up period. As shown at left, the DATA display alternates between “uuuu” and the current heater temperature during the warm-up.

10.2 Warm-up

After power up the instrument goes through a warm-up period and then reaches steady state where it is ready for measurement. This section describes how the instrument behaves during the warm-up period.

The instrument controls the temperature so that the temperature in the sensor unit is kept at 55 °C. It may take approximately 2.5 hours until the temperature in the sensor unit has stabilized at 55 °C. The required time varies depending on the temperature in the sensor unit at start-up or ambient temperature. At first the heater temperature rises to 60 °C to warm the sensor unit quickly, and then the heater temperature goes down to 55 °C as the sensor unit gets warmer.

When the temperature in the sensor unit approaches 55 °C, the DATA display shows oxygen concentrations and the MAINT lamp starts to blink. At the same time the instrument provides analog outputs corresponding to the output range. This period is called a stabilization period and in this period a temperature drift may occur since the temperature in the sensor unit has not completely stabilized. A calibration cannot be executed in this period. When the temperature in the sensor unit stabilized completely, the MAINT lamp stops blinking and the MEAS lamp turns on. This is a steady state. During a warm-up period the analog output is fixed at 4 mA. During warm-up and stabilization periods the maintenance status contact is activated. Figure 10.1 shows the temperatures of the heater and in the sensor unit during warm-up and stabilization periods.

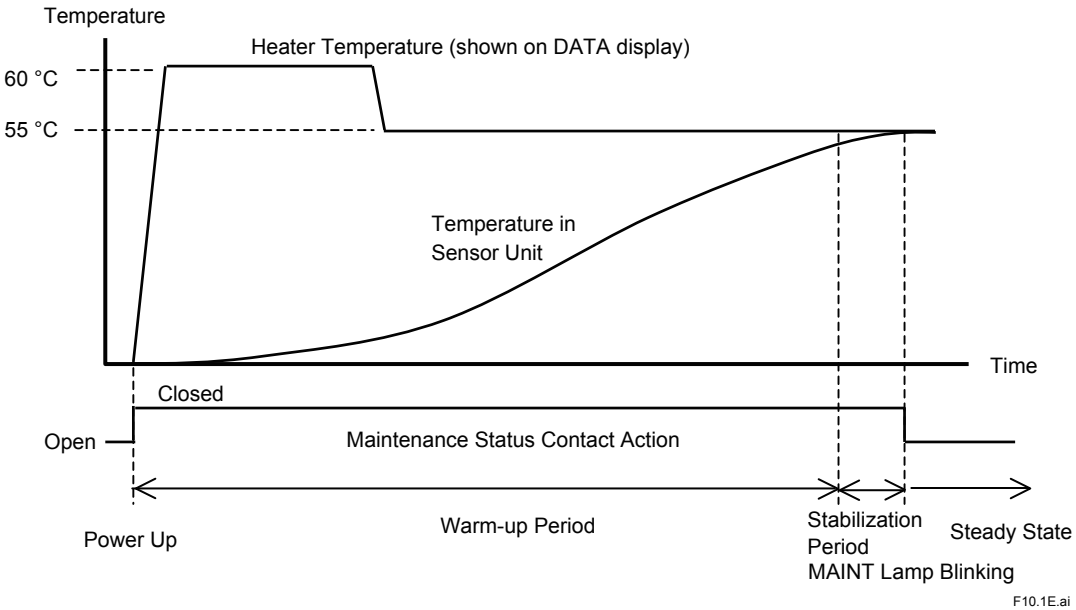


Figure 10.1 Temperatures of the Heater and in the Sensor Unit During Warm-up and Stabilization Periods

10.3 Analog Output Loop Check

A loop check is for checking wiring between the analog output (terminals 3 and 4) of the instrument and the terminals of a higher-level device.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “16.”

(3) Press the ZERO key to provide 4mA output from the output terminals.

(4) Press the SPAN key to provide 20 mA output from the output terminals.

10.4 Setting the Output Range

The three ranges should be preset to range 1, 2 and 3, respectively and one of the three ranges should be selected. The following describes how to set each range and how to select a range.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “12.”

(3) Set the upper range value for range 1 using the SHIFT and INCR keys. Press the EXEC key to accept.
For example, for the range of 0 to 25% O_2, enter “025.” Now range 1 is set to 0 to 25%.

(4) In the same manner, set the upper range values for ranges 2 and 3 in Function Numbers 13 and 14, respectively.

(5) Change the Function Number to “11.” Select the desired range – “1” for range 1, “2” for range 2, or “3” for range 3 – using the SHIFT and INCR keys. Press the EXEC key to accept.

NOTE

The setting range is determined by the measuring range specified in the Model and Suffix Codes.

10.5 Executing Calibrations

After start-up and switching to MEAS mode, zero and span calibrations must be executed. Always a zero calibration should be performed prior to a span calibration. Chapter 12, “Calibration” explains the calibration principle in detail. This section describes how to set the concentrations of calibration gases and how to perform zero and span calibrations manually.

10.5.1 Calibration Gas Requirements

As the zero gas, use nitrogen gas of 99.999% purity or more when the measuring range is under 0 to 5% O_2 or use nitrogen gas of 99.99% or more when the measuring range is 0 to 5% O_2 or more. As the span gas, use a gas with an oxygen concentration of 80 to 90% of the upper range value of set range (e.g., for the range of 0 to 25%, the span gas should be 20 to 25% oxygen).

10.5.2 Setting Calibration Gas Concentrations

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “02.”

(3) Press the SPAN key.

(4) Set the oxygen concentration of the span gas using the SHIFT, INCR, and DP keys. Press the EXEC key to accept. The setting range is 0.5 to 25% O_2.

10.5.3 Manual Calibration

A zero calibration should be performed first, and then a span calibration. Zero and span calibrations must be conducted in the first calibration after start-up and after the initialization of the calibration coefficient.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “01.” The DATA display shows the current oxygen concentration.

(3) Press the ZERO key. Turn off the sample gas flow and apply the zero gas at the specified flow rate in the sample gas line. When solenoid valves for automatic calibration are installed, pressing the ZERO key closes the solenoid valve in sample gas line and opens the solenoid valve in zero gas line.

(4) The oxygen concentration on the DATA display changes. When the reading has stabilized completely, press the EXEC key. The instrument is now calibrated to that value as the zero point.

(5) Press the SPAN key. Turn off the zero gas flow and apply the span gas at the specified flow rate. When solenoid valves for automatic calibration are installed, pressing the SPAN key closes the solenoid valve in zero gas line and opens the solenoid valve in span gas line.

(6) The oxygen concentration on the DATA display changes. When the reading has stabilized completely, press the EXEC key. The instrument is now calibrated to that value as the span point.

(7) Turn off the span gas flow. Apply the sample gas and switch to MEAS mode.

10.6 Adjustment for Interference Gas Compensation Using Process Gas

This adjustment is usually not required. If necessary, the sensor angle should be adjusted using the actual process gas by turning the adjustment screw on the case door. The adjustment screw is not provided if the instrument has a measuring range of 0 to 5% O_2 by the Model and Suffix Codes. Therefore the sensor angle of the instrument cannot be adjusted externally.

(1) After manual calibration, introduce the process gas.

(2) After the output has stabilized, turn the sensor angle adjustment screw in the center of the door until the output agrees with the oxygen concentration of the process gas.

(3) If the composition of the process gas has changed, this adjustment should be conducted after zero and span calibrations.

NOTE

The sensor angle is adjusted at the factory before shipment. Upon installation on site, the factory adjustment can be reproduced by the level adjustment in accordance with the procedure described in Section 8.1, Adjustment of the Level in the Sensor Unit. Only if the factory adjustment is not sufficient due to strong interference, the adjustment using the accrual process gas is needed. For details, refer to Chapter 16, Measurement Principle.

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11. PARAMETER SETTINGS

11.1 Output Hold

Analog output is held at a constant value when the instrument is in the following conditions.

- During a warm-up period, analog output is held at 4 mA.
- During calibration, analog output is held at the last measured value or is not held (user selectable).
- When an error occurs, analog output is held at the last measured value or at a preset value, or is not held (user selectable).

If more than one condition above occurs simultaneously, the output hold are prioritized in the following order.

1. When an error occurs
2. During calibration
3. During a warm-up period

11.1.1 Setting the Output Hold Function During Calibration

The output hold function during calibration can be set to “enabled” or “disabled.” When the function is set to “enabled,” the analog output is held at the last measured value during calibration; when set to “disabled,” the instrument outputs measured values during calibration. The hold function deactivated after the purge time has elapsed in calibration. The purge time is the amount of time for sample gas to flow through the sensor unit to purge calibration gas in the unit after calibration and it is user configurable. For the setting of the purge time, refer to Chapter 12, Calibration.

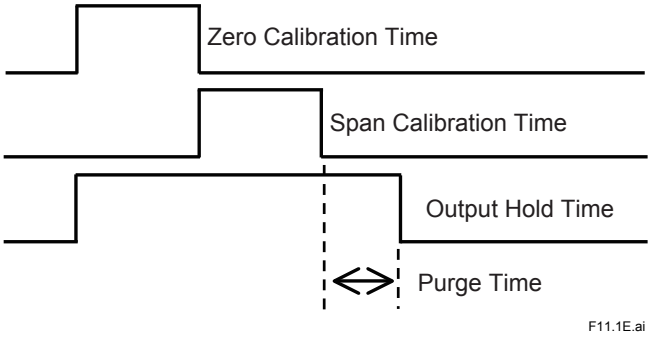

Figure 11.1 Output Hold During Calibration

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “04.”

(3) Set the output hold function during calibration using the SHIFT and INCR keys. To enable the function (i.e., the analog output is held at the last measured value), set to “0,” or to disable the function, set to “1.” Press the EXEC key to accept.

11.1.2 Setting the Output Hold Function When an Error Occurs

The output hold function when an error occurs is selectable to: “enabled” – the analog output is held at the last measured value or at a preset value, or “disabled” – the analog output continues to provide concentration values.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “43.”

(3) Set the output hold function when an error occurs using the SHIFT and INCR keys. To enable the function and hold the analog output at the last measured value, set to “1,” to enable the function and hold the analog output at a preset value, set to “3,” or to disable the function, set to “2.” Press the EXEC key to accept.

(4) To set a preset value, change the Function Number to “44.”

(5) Set the desired preset value using the SHIFT, INCR and DP keys. Press the EXEC key to accept.

A preset value is expressed as a percentage, where 4 mA is 0% and 20 mA is 100%. Enter “0” to set the preset value to 4 mA, or enter “100” to set to 20 mA. The setting range is from –10% (2.4 mA) to 110% (21.6 mA). The minus sign will appear by pressing the INCR key repeatedly when the leftmost digit is blinking. The number increases: “0,” “1,” “2,” … “9,” “–,” and returns to “0.”

11.2 Setting the Fail Contact

The Fail contact (terminals 15 and 16) is activated when an error occurs. The contact can be configured to open or close when an error occurs. The contact is open when the instrument is not powered. For details about errors, refer to Chapter 15, Troubleshooting.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “45.”

(3) Set the Fail contact state using the SHIFT and INCR keys. To set the contact to close when an error occurs, enter “0,” or to open when an error occurs, enter “1.” Press the EXEC key to accept.

11.3 Action of the Maintenance Status Contact

The maintenance status contact (terminals 13 and 14) is closed during the following states and is otherwise open. The contact is open when the instrument is not powered.

(1) Warm-up period

(2) Stabilization period

(3) MAINT mode
The MAINT lamp is lit while the instrument is in MAINT mode. MAINT mode starts when the MEAS/MAINT key is pressed and held then the EXEC key is pressed and ends when the same key operations are done to return to MEAS mode.

(4) Semiautomatic or automatic calibration
The maintenance status contact is closed during calibration including the purge time.

11.4 Setting the High/Low Limit Alarms

The contact is activated to give an alarm when the measured oxygen concentration is outside the limit. High and low alarm limit values can be set, respectively. When the measured value exceeds the high limit alarm value, the H-ALM lamp on the operation panel will turn on and the high limit alarm contact (terminals 10 and 12) will close. When the measured value falls below the low limit alarm value, the L-ALM lamp will turn on and low limit alarm contact (terminals 11 and 12) will close. The contacts are open when alarm is not generated and when the instrument is not powered. The following describes how to set the limit values.

(1) Switch to MAINT mode and enter the password.

(2) For the setting of the low limit alarm value, change the Function Number to “20,” and for the setting of the high limit alarm value, change to “21.”

(3) Set the desired value using the SHIFT, INCR and DP keys. Press the EXEC key to accept. The setting range is 0 to 100% O_2.

(4) Change the Function Number to “22.”

(5) Set to “1” using the SHIFT and INCR keys and press the EXEC key to accept. Now the high/low limit alarm function is enabled.

When setting the high/low limit alarms, note that:

- The alarm contact is activated when the measured value is equal to or higher than the high alarm setpoint or when the measured value is equal to or less than the low alarm setpoint.
- The alarm contact does not operate if the high limit alarm value has been set equal to or lower than the low limit alarm value.

NOTE

Either the high/low limit alarm function or the range switching answerback function can be assigned to this contact. When the high/low limit alarm function is set to “enabled” in Function No. 22, the output range answerback function is disabled.

11.5 Setting the Remote Range

The remote range function enables the preprogrammed three ranges to be switched remotely by the range switching contact input (terminals 7, 8 and 9). When the remote range function is enabled, the RMT.RANGE lamp is lit, the range selected in Function No. 11 is invalid, and the range selected externally is used. The following describes how to set the remote range function.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “10.”

(3) Set to “2” using the SHIFT and INCR keys. Press the EXEC key to accept. Now the remote range function is enabled.

The remote range contact states and ranges are shown in Table 11.1. When two contacts (terminals 7-9 and 8-9) are closed, the previously set range remains.

Table 11.1 Remote Range Contact States and Ranges

Terminal Number		Range Selected
7-9 (R3)	8-9 (R2)	
Open	Open	Range 1
Open	Closed	Range 2
Closed	Open	Range 3
Closed	Closed	Previous range

11.6 Setting the Range Switching Answerback Contact Output

The range switching answerback function enables the currently selected range to be output by the contact output (terminals 10, 11 and 12). Since either the range switching answerback function or the high/low limit alarm function can be assigned to this contact, the range switching answerback function cannot be used when the high/low limit alarm function is enabled.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “22.”

(3) Set to “0” to disable the high/low limit alarm function using the SHIFT and INCR keys. Press the EXEC key to accept. Now the range switching answerback function is enabled.

The range answerback contact states and ranges are shown in Table 11.2.

Table 11.2 Range Answerback Contact States and Ranges

Terminal Number		Range Selected
10-12 (R3)	11-12 (R2)	
Open	Open	Range 1
Open	Closed	Range 2
Closed	Open	Range 3

NOTE

When the range answerback function is enabled, the high/low limit alarm function is disabled.

11.7 Setting the Low Auxiliary Gas Pressure Alarm Function

Auxiliary gas is used in accordance with the measurement principle of the instrument. The pressure of the auxiliary gas is reduced to 180 kPa by a build-in pressure regulator. If the supply pressure drops below 180 kPa, the auxiliary gas flow will reduce, interfering with accurate measurement. If the pressure drops below approximately 300 kPa when the low auxiliary gas pressure alarm function is enabled, the DATA display will blink and the low auxiliary gas pressure contact (terminals 17 and 18) will close. The auxiliary gas cylinder should be replaced after the alarm occurs and before the pressure drops to approximately 180 kPa. The contact is open when the instrument is not powered.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “23.”

(3) Set to “1” using the SHIFT and INCR keys. Press the EXEC key to accept. Now the low auxiliary gas pressure alarm function is enabled.

IMPORTANT

The secondary pressure of the build-in pressure regulator varies with the instrument: there are variations from 180 kPa. Check the reading on the auxiliary gas pressure gauge when the gas is supplied at the specified pressure in advance.

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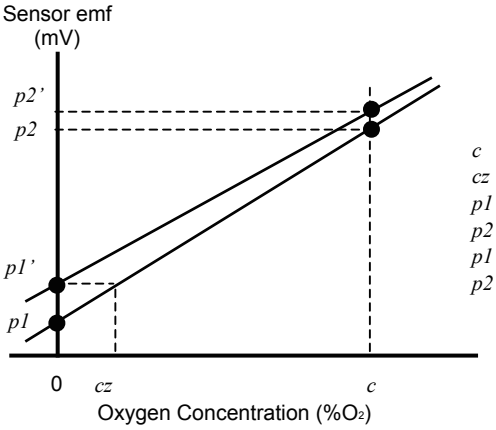
12. CALIBRATION

12.1 Overview

The instrument should be calibrated at two points using zero gas (nitrogen gas with an oxygen concentration of 0%) and span gas with a known oxygen concentration. Figure 12.1 shows the relationship between the sensor emf and the oxygen concentration.



c : oxygen concentration of span gas
cz : zero calibration coefficient
p1 : sensor emf at the initial zero calibration
p2 : sensor emf at the initial span calibration
p1' : sensor emf at zero calibration
p2' : sensor emf at span calibration

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Figure 12.1 Sensor emf vs. Oxygen Concentration

The ratio of the oxygen concentration to the sensor emf is calculated from the sensor emf values (***p1*** and ***p2***) obtained in calibration.

$$k = \frac{c}{p2 - p1}$$

Assuming that the sensor emf when sample gas is applied is ***ps***, the concentration of the sample gas, ***cs***, is obtained from the following equation.

$$cs = k \times (ps - p1)$$

Calibration is for obtaining ***k***.

When only a zero calibration is performed, the instrument is calibrated to the zero gas's value and the ratio of the oxygen concentration to the sensor emf, ***k***, that was obtained from the previous calibration, is used.

12.2 Calibration Coefficient

The calibration coefficient is a deviation from the initial calibration value.

12.2.1 Zero Calibration Coefficient

The zero calibration coefficient is the deviation between the sensor emf obtained when a zero calibration is performed and the initial calibration value, and is expressed as the one corrected for oxygen concentration. It is cz (% O_2) in Figure 12.1. When the zero calibration coefficient, cz, is outside of ±1.25% O_2, a zero calibration coefficient error will occur.

12.2.2 Span Calibration Coefficient

The span calibration coefficient is the deviation between the ratio of the oxygen concentration to the sensor emf, k', obtained when zero and span calibrations are performed and the initial calibration value, and is expressed as the ratio to the ratio obtained at the initial calibration, k.

$$\text{Span calibration coefficient} = \frac{k'}{k}$$

Where:

k : the ratio of the oxygen concentration to the sensor emf obtained at the initial calibration

k' : the ratio of the oxygen concentration to the sensor emf obtained in calibration

When the span calibration coefficient is outside the range of 0.9 to 1.09, a span calibration coefficient error will occur.

12.2.3 Checking the Calibration Coefficients

(1) Switch to MAINT mode. There is no need to enter the password.

(2) Change the Function Number to “03.”

(3) Press the ZERO key to check the zero calibration coefficient, and press the SPAN key to check the span calibration coefficient.

12.2.4 Initializing the Calibration Coefficients

By initializing the calibration coefficients, the zero calibration coefficient is reset to “0” and the span calibration coefficient to “1.” Based on the sensor emf obtained in the next calibration after the initialization, the calibration coefficients will be calculated. The calibration after the initialization should be performed with special care.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “05.” The DATA display shows “rES.”

(3) Press the EXEC key to initialize the calibration coefficients.

NOTE

- The calibration coefficients disolayed in Function No. 03 are still the previous ones after the initialization. They will be updated only after zero and span calibrations after the initialization.
- When the concentration of the zero gas is changed in Function No. 02, the zero reference will be changed. Accordingly the calibration coefficients will be initialized: this is the same action as the initialization by the above procedure.

12.3 Executing Calibrations

Zero and span calibrations must be performed after the power is turned off and restarted. Without valid calibration oxygen concentration cannot be measured accurately. Before calibration, the following should be checked.

(1) The auxiliary gas is being supplied at the specified pressure.

(2) Auxiliary gas and zero gas with proper nitrogen purities are used.

(3) The span gas concentration set in the instrument agrees with the actual gas concentration.

(4) Calibration gases flow at the specified flow rate without fluctuation.

12.3.1 Manual Calibration

A zero calibration should be performed first, and then a span calibration. A span calibration cannot be executed before a zero calibration. It is allowed to perform only a zero calibration, but not allowed to perform only a span calibration.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “01.” The DATA display shows the current oxygen concentration. The display may show the minus sign. The instrument determines the value even if the measured concentration is below zero. The measured concentration when zero gas is applied may be a negative value.

(3) Press the ZERO key. Turn off the sample gas flow and apply the zero gas at the specified flow rate in the sample gas line. When solenoid valves for automatic calibration are installed, pressing the ZERO key closes the solenoid valve in sample gas line and opens the solenoid valve in zero gas line.

(4) The oxygen concentration on the DATA display changes. When the reading has stabilized completely, press the EXEC key. The instrument is now calibrated to the value as the zero point.

(5) Press the SPAN key. Turn off the zero gas flow and apply the span gas at the specified flow rate. When solenoid valves for automatic calibration are installed, pressing the SPAN key closes the solenoid valve in zero gas line and opens the solenoid valve in span gas line.

(6) The oxygen concentration on the DATA display changes. When the reading has stabilized completely, press the EXEC key. The instrument is now calibrated to the value as the span point.

(7) Turn off the span gas flow. Apply the sample gas and switch to MEAS mode.

12.3.2 Semiautomatic Calibration

In the semiautomatic calibration zero and span calibrations are carried out under the preprogrammed conditions using the calibration start contact input (terminals 5 and 6). The instrument will start calibration when the dry (voltage free) contact connected to the input is closed. For the semiautomatic calibration, the following should be set.

- Zero calibration time (Function No. 52)
  The amount of time for zero gas to flow. The timer starts when the solenoid valve in zero gas line opens to allow the zero gas to flow through the sensor unit. Set the amount of time it takes for the reading to stabilize sufficiently. The setting range is from 1 to 99 minutes.
- Span calibration time (Function No. 53)
  The amount of time for span gas to flow. The timer starts when the solenoid valve in zero gas line closes and the solenoid valve in span gas line opens to allow the span gas to flow through the sensor unit. Set the amount of time it takes for the span gas to purge the zero gas in the sensor and for the reading to stabilize sufficiently. The setting range is from 1 to 99 minutes.
- Purge time (Function No. 54)
  The amount of time for sample gas to flow through the sensor unit to purge calibration gas after calibration. Set the amount of time it takes for the sample gas to purge the sensor unit completely. The setting range is from 0 to 99 minutes. The purge time is valid for manual calibration.

When the output hold function during calibration is set to “enabled,” the analog output will be held during the calibration including the purge time. Also, the maintenance status contact will be closed during the calibration including the purge time.

The zero calibration time, span calibration time and purge time can be set in Function Nos, 52, 53 and 54, respectively.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “52.”

(3) Set the zero calibration time using the SHIFT and INCR keys. Press the EXEC key to accept.

(4) In the same manner, set the span calibration time in Function No. 53 and the purge time in Function No. 54.

NOTE

- For semiautomatic calibration, wiring and piping for automatic calibration are required to be made.
- If the calibration start contact remains closed after calibration, the instrument will not accept the next calibration start contact input. The contact should be opened once and then closed again for the next calibration.
- During MAINT mode, the calibration start contact input signal is not accepted.
- During manual calibration or automatic calibration, the calibration start contact input signal is not accepted.
- If the instrument is switched to MAINT mode by key operation while a semiautomatic calibration is being conducted, the calibration will be aborted.

12.3.3 Automatic Calibration

Calibration can be automatically executed for preprogrammed calibration times at preprogrammed intervals. For the automatic calibration, the following should be set.

- For the zero calibration time (Function No. 52), span calibration time (Function No. 53), and purge time (Function No. 54), refer to Section 12.3.2, Semiautomatic Calibration.
- Initial wait time (Function No. 50)
  The amount of time until the first calibration is executed after the automatic calibration function was started. The setting range is from 0 day 0 hour to 99 days 24 hours. When the time is set to "00 day 00 hour," the initial wait time is equal to the time set as the calibration interval (Function No. 51).
- Calibration interval (Function No. 51)
  Set the time interval for automatic calibration. The setting range is from 0 day 1 hour to 99 days 24 hours.
- Execution of span calibration (Function No. 55)
  Set whether or not to execute span calibration. To execute only zero calibration and not to execute span calibration, set to "0." To execute both zero and span calibrations, set to "1."
- The number of times of skipping span calibrations (Function No. 56)
  The number of times of skipping span calibrations can be set only when "1" is set in Function No. 55. Setting to "0" here means that span calibration is not skipped, i.e., both zero and span calibrations are executed each time. Setting to "1" or greater means that span calibration is skipped the set number of times after the first zero and span calibrations. The setting range is from 0 to 99 times.
- Starting automatic calibration function (Function No. 57)
  Set to "1" to start the automatic calibration function. After the set initial wait time has elapsed, the first calibration starts.

Figure 12.2 shows the timing diagram when the number of times of skipping span calibrations (Function No. 56) is set to "2."

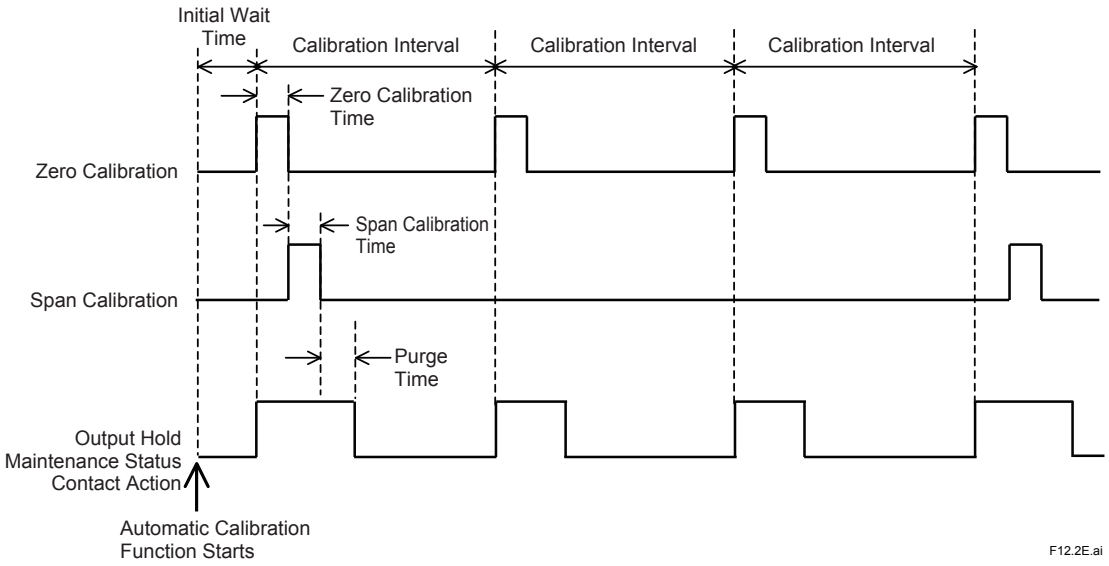

Figure 12.2 Timing Diagram for Automatic Calibration

The following describes how to set the automatic calibration. For the settings of the zero calibration time, span calibration time and purge time, refer to Section 12.3.2, Semiautomatic Calibration.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “50” to set the initial wait time. The DATA display shows “xx.xx.” The two left digits represent days (00 to 99 days) and the two right digits time (00 to 24 hours).

(3) Set the desired day and time using the SHIFT and INCR keys. Press the EXEC key to accept.

(4) Change the Function Number to “51” to set the calibration interval. The DATA display shows “xx.xx.” The two left digits represent days (00 to 99 days) and the two right digits time (00 to 24 hours). Note that the minimum interval is one hour and “00.00” will be rejected.

(5) Set the desired interval using the SHIFT and INCR keys. Press the EXEC key to accept.

(6) Change the Function Number to “55” to set whether or not to execute span calibration. Set to “0” not to execute span calibration or set to “1” to execute span calibration, using the SHIFT and INCR keys. Press the EXEC key to accept.

(7) When “1” is set in Function No. 55, the number of times of skipping span calibrations should be set in Function No. 56. Set the desired number of times of skipping span calibrations using the SHIFT and INCR keys. Press the EXEC key to accept. When “0” is set in Function No. 55, “—“ appears on the display and the number of times of skipping span calibrations cannot be set.

(8) Change the Function Number to “57.” Set to “1” to start the automatic calibration function. Press the EXEC key. The timer starts counting and the AUTO CAL lamp turns on.

NOTE

- For automatic calibration, wiring and piping for automatic calibration are required.
- If the time to start a calibration is reached while the instrument is in MAINT mode, the automatic calibration will be canceled.
- Likewise, if the time to start a calibration is reached during manual calibration or semiautomatic calibration, including the purge time, the automatic calibration will be canceled.
- If the instrument is switched to MAINT mode by key operation while an automatic calibration is being conducted, the automatic calibration is aborted.
- If the sum of the zero calibration time, span calibration time and purge time is longer than the calibration interval, the next calibration will be canceled.
- When the automatic calibration function is enabled, the internal timer runs even if the power supply to the instrument is interrupted. After power is restored, calibrations will be executed on schedule; there is no delay due to the power interruption. Note that the internal timer does not run when the power supply is interrupted during the calibration time.
- Once the automatic calibration function is turned off by setting in Function No. 57, the timer will be reset.
- It is recommended that after the settings for the automatic calibration have been completed manual calibration should be conducted once to verify whether the calibration is conducted properly.

13. OTHER FUNCTIONS

13.1 Checking the Temperature of the Constant Temperature Chamber (Function No. 30)

The temperature (°C) in the sensor unit can be checked in Function No. 30. It is stable at 55 °C after the instrument entered MEAS mode.

13.2 Checking the Sensor EMF (Function No. 31)

The sensor emf (mV) can be checked in Function No. 31. When the instrument is in a warm-up period, the DATA display will show "----."

13.3 Manual Operation of the Solenoid Valves for Automatic Calibration (Function No. 58)

When wiring and piping for the solenoid valves for automatic calibration have been installed, each solenoid valve can be operated manually. The DATA display shows oxygen concentrations. This manual operation can be used for checking readings.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to "58." The DATA display shows an oxygen concentration.

(3) Press the ZERO key to open the solenoid valve in zero gas line and close the solenoid valve in sample gas line.

(4) Press the SPAN key to open the solenoid valve in span gas line and close the solenoid valve in sample gas line.

(5) Change the Function Number to the one other than "58" to close the solenoid valves for calibration gas lines and open the solenoid valve in sample gas line.

13.4 Checking the Firmware Revision (Function No. 98)

The revision of the firmware installed on the instrument can be checked in Function No. 98.

13.5 Initializing Parameters (Function No. 99)

All parameters are initialized to the factory default settings which are summarized in Table 13.1.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “99.” The DATA display shows “rES.”

(3) Press the EXEC key. This has not yet changed the settings.

(4) Turn the power off and on again. Now the instrument has been initialized to the factory default settings.

Table 13.1 Factory Default Settings

Func No.	Function	Factory Default
00	Entering password	
01	Executing calibrations	
02	Setting calibration gas concentrations	ZERO key: 0.000, SPAN key: 20.95
03	Checking calibration coefficients	
04	Setting output hold function during calibration	0: enabled
05	Initializing calibration coefficient	
10	Setting remote range switching contact input	1: disabled
11	Selecting range	3: range 3
12	Setting span for range 1	Minimum range of the specified measuring range
13	Setting span for range 2	010 (0 to 10% range)
14	Setting span for range 3	025 (0 to 25% range)
16	Fixed analog output	
20	Setting low limit alarm	00.00
21	Setting high limit alarm	25.00
22	Setting high/low limit alarm function	0: disabled
23	Setting low auxiliary gas pressure alarm function	0: disabled
30	Checking temperature (°C) of constant temperature chamber	
31	Checking sensor emf (mV)	
40	Executing error check	
41	Resetting sensor emf error status	
42	Resetting calibration coefficient error status	
43	Setting output hold function when error occurs	1: enabled – at last measured value
44	Setting preset value	00.00
45	Setting contact output status when error occurs	0: contact closes when error occurs
50	Setting initial wait time for automatic calibration	00.00 (0 day 0 hour)
51	Setting interval for automatic calibration	30.00 (30 days 0 hour)
52	Setting zero calibration time	10 (10 minutes)
53	Setting span calibration time	10 (10 minutes)
54	Setting purge time	10 (10 minutes)
55	Executing span calibration	1: executes span calibration
56	Setting the number of times of skipping span calibrations	00 (no skipping)
57	Starting automatic calibration function	0: OFF
58	Manual operations of solenoid valves	
67	Checking error status	
98	Checking firmware revision	
99	Initialization	

14. INSPECTION AND MAINTENANCE

This chapter describes the inspection and maintenance procedures to ensure optimum performance of the instrument and to keep it in good operating condition.

WARNING

Open circuit at non-hazardous location(*) before removing the MG8E cover.

(*) The nameplate of the MG8E says “Open circuit at non-hazardous location before removing cover” because the internal energy does not decrease below the specified value.

According to “USERS' GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry” (published by Tecnology Institution of Industrial Safety, in Japan), the expression “a non-hazardous area” is defined as “A non-hazardous area is considered a place where no occurrence of explosive gas atmosphere is guaranteed by the foreperson and confirmed by a written document.”

Therefore, if a non-hazardous area is secured, the work can be done on site.

14.1 Checking the Auxiliary Gas

Check that the needle on the auxiliary gas pressure gauge that is installed in the instrument is in the center of the green zone. When the gas is supplied from a gas cylinder, check the pressure gauge attached to the cylinder. If the pressure is low, replace the gas cylinder. The primary pressure of the built-in pressure regulator for auxiliary gas must be at least 300 kPa. A low auxiliary gas pressure alarm will occur when the pressure drops below approximately 300 kPa. When using a 47-liter gas cylinder, replace it within 24 hours after the alarm.

IMPORTANT

After the gas cylinder is replaced, zero and span calibrations should be conducted. If air is trapped in the auxiliary gas line during replacement, the reading will fluctuate and it will take long time for the reading to stabilize. After the reading has stabilized completely, perform the calibrations.

14.2 Checking the Sample Gas

Check the flow rate of the sample gas on a timely basis.

14.3 Precautions When Stopping and Restarting the Operation

The most common failure or trouble occurs when stopping or restarting the operation. Extreme care should be taken.

(1) When sample gas contains corrosive components, turn off the sample gas flow with the auxiliary gas being supplied. After turning off the sample gas flow, allow nitrogen gas or instrument air to flow to purge the sample gas line.

(2) If possible, it is recommended that the auxiliary gas be allowed to flow while the operation is suspended..

(3) Before restarting the operation, check the sample gas line for moisture due to condensation. If moisture is present, remove the sample gas line from the instrument and allow instrument air to flow to purge the pipe completely. Moisture in the sensor unit may result in a failure, and in the worst case, the instrument will need to be serviced at the factory.

14.4 Fuse Replacement

Two fuses are installed for live and neutral, respectively, in the power unit in the instrument. If the fuse blows, replace it using the following procedure.

(1) Before replacement, turn off power to the instrument.

(2) Open the instrument cover. Pull the fuse out from the fuse holder which is located near the power switch as shown in Figure 14.1. Turn the cap counterclockwise until it stops using a flat head screwdriver of the appropriate size. Pull out the cap together with the fuse.

(3) Make sure that a new fuse is of the same rating. Attach the new fuse to the cap and insert it into the holder. Turn the cap clockwise while pushing it until it stops using the flat head screwdriver.

Fuse specifications:

Maximum rated voltage:	250 V
Maximum rated current:	2.0 A
Type:	Time-lag
Standards compliance:	UL, CSA, VDE
Part number:	A1111EF

The fuse deteriorates with time. It is recommended that the fuses be replaced every two years even if the fuse has not blown.

IMPORTANT

If the fuse blows again soon after replacement, there may be a malfunction in the circuit or in the external connections. Immediately turn off power to the instrument and investigate the cause.

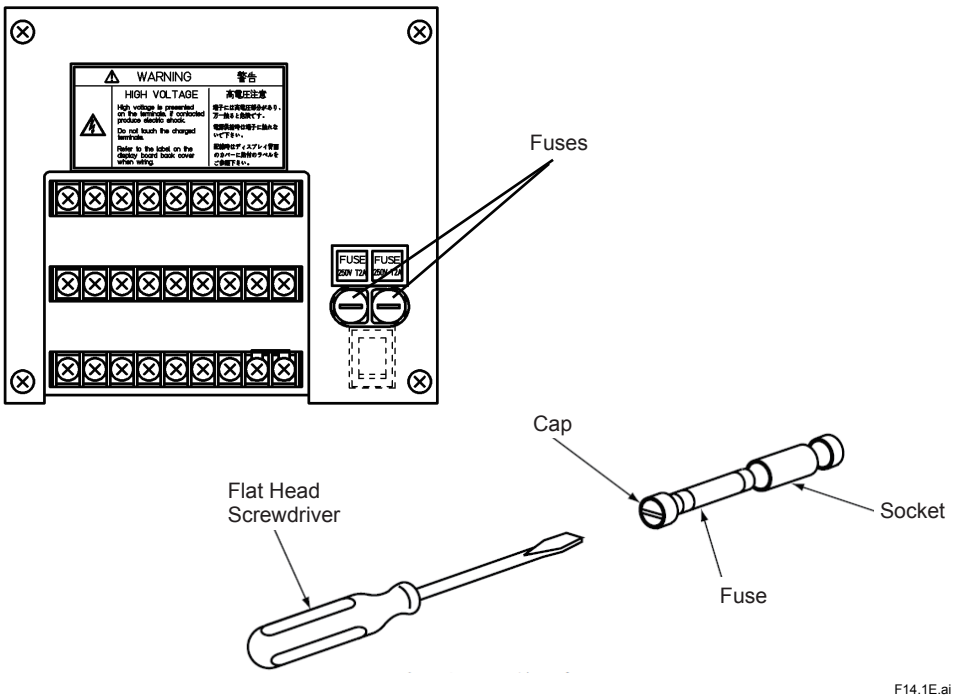

Figure 14.1 Fuse Removal

14.5 Other Instructions

(1) For inspection and maintenance of sampling systems, read corresponding user's manuals.

(2) For the cleaning and overhaul of the sensor unit, consult Yokogawa.

14.6 Replacing the Limited Life Component

The following component has a limited life. It is recommended that it should be replaced approximately every five years. As for the replacement, ask Yokogawa.

- Power unit (located on the back of the terminal block and normally not visible)

15. TROUBLESHOOTING

This chapter describes errors detected by the self-diagnostic function and troubles during measurement, such as output fluctuations.

WARNING

Open circuit at non-hazardous location(*) before removing the MG8E cover.

(*) The nameplate of the MG8E says “Open circuit at non-hazardous location before removing cover” because the internal energy does not decrease below the specified value.

According to “USERS' GUIDELINES for Electrical Installations for Explosive Gas Atmospheres in General Industry” (published by Tecnology Institution of Industrial Safety, in Japan), the expression “a non-hazardous area” is defined as “A non-hazardous area is considered a place where no occurrence of explosive gas atmosphere is guaranteed by the foreperson and confirmed by a written document.”

Therefore, if a non-hazardous area is secured, the work can be done on site.

15.1 Errors and Remedies

15.1.1 Checking the Error Code

An error will occur if a failure is detected in the sensor, constant temperature chamber, or analyzer's internal circuit. When an error occurs, the FAIL lamp turns on and the Fail contact is activated. As for the calibration coefficient error, the FAIL lamp turns on and the Fail contact is activated only when semiautomatic or automatic calibration function is enabled. To check an error code, follow the procedure below.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to "40." Press the EXEC key. The current error code will be displayed.

(3) If no error is being generated, the DATA display shows "oooo."

The types of errors detected by the self-diagnostic function and remedies are summarized in Table 15.1.

Table 15.1 Errors and Remedies

Error Type	Code	Description	Action	Remedy
	0000	No error is being generated.		
Sensor unit error	E-10	Sensor emf continues to exceed 400 mV for at least 10 seconds.		Remove the causes and reset the error status in Function No. 41.
	E-11	Sensor emf continues to fall below –50 mV for at least 10 seconds.		
Constant temperature chamber error	E-20	In stabilization period or steady state, heater temperature continues to fall below 50 °C for at least 10 seconds.	Turn off power to heater.	Remove the causes. Turn the power off and on again to restart. If error occurs again, contact Yokogawa Service.
	E-21	In stabilization period or steady state, heater temperature continues to exceed 60 °C for at least 10 seconds.		
	E-22	In warm-up period, heater temperature fails to rise.	Error code blinks on DATA display. Turn off power to heater.	
	E-23	In warm-up period, heater temperature continues to exceed 65 °C for at least 10 seconds.		
Analog error	E-30	Failure occurs in A/D converter on circuit.	Turn off power to heater.	Turn the power off and on again to restart. If error occurs again, contact Yokogawa Service.
	E-31 E-32 E-33	Voltage of sensor unit exceeds input range of A/D converter.		
Memory error	E-40	Failure occurs in memory device on circuit.	Turn off power to heater.	Turn the power off and on again to restart. If error occurs again, contact Yokogawa Service.
Calibration coefficient error	E-50	Zero calibration coefficient is outside of ±1.25% O_2.	In manual calibration, error code appears on DATA display*. In semiautomatic or automatic calibration, Fail contact is activated and FAIL lamp turns on.	Remove the causes. Recalibrate the instrument or reset the error status in Function No. 42.
	E-51	Span calibration coefficient is below 0.9 or above 1.09.		
Atmospheric sensor error	E-60	Atmospheric sensor output exceeds the normal range.	MEAS lamp blinks. Atmospheric compensation is disabled. FAIL lamp does not turn on and Fail contact is not activated.	Turn the power off and on again to restart. If error occurs again, contact Yokogawa Service.

* When a calibration coefficient error occurs during manual calibration, the Fail lamp dose not turn on and the Fail contact is not activated.

15.1.2 Error Descriptions

15.1.2.1 Sensor Unit Errors (E-10, E-11)

A sensor unit error occurs when the sensor emf is outside the range of –50 mV to 400 mV. Possible causes are:

(1) The pressure of the auxiliary gas dropped.
Check the auxiliary gas pressure.

(2) The flow rate of the sample gas was greater than the specified one.
Check the sample gas flow rate.

Remove the causes and then reset the error status using the following procedure.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “41.” The DATA display shows “rES.”

(3) Press the EXEC key to reset the sensor emf error status.

15.1.2.2 Constant Temperature Chamber Errors (E-20, E-21)

The temperature of the constant temperature chamber of the MG8E is normally stable at 55 °C during a stabilization period and in steady state. When a constant temperature chamber error occurs, turn the power off and on again to restart, and after the instrument enters a stabilization period, check the temperature of the constant temperature chamber in Function No. 30. If the temperature fluctuates, possible causes are:

(1) The power supply voltage fluctuates

(2) The ambient temperature is outside the specification range: –5 to 50 °C

15.1.2.3 Constant Temperature Chamber Errors (E-22, E-23)

A constant temperature chamber error, E-22 or E-23, occurs while the instrument is in a warm-up period. Turn the power off and on again. After the constant temperature chamber has cooled down sufficiently, restart the instrument. If the same error occurs, there may be a failure in components for temperature control. Contact Yokogawa Service.

(1) E-22: A possible cause is heater disconnection or action of the internal thermostat for over temperature protection.

(2) E-23: A possible cause is a failure in of parts for heater power control. When an E-23 error occurs, the internal thermostat may be activated at the same time. The internal thermostat is activated when the temperature reaches approximately 70 °C, but is not reset automatically even when the temperature drops.

15.1.2.4 Analog Errors (E-30, E-31, E-32, E-33)

An analog error occurs when there is a failure in the analog circuit. Turn the power off and on again to restart the instrument. If the error occurs again, contact Yokogawa Service.

15.1.2.5 Memory Error (E-40)

A memory error occurs if there is a failure in reading or writing the memory device. Turn the power off and on again to restart the instrument. If the error occurs again, contact Yokogawa Service.

15.1.2.6 Calibration Coefficient Errors (E-50, E-51)

A calibration coefficient error occurs if the calibration coefficient obtained in zero or span calibrations is outside the normal range. A zero calibration coefficient error occurs if the zero calibration coefficient is outside of ±1.25% O_2. A span calibration coefficient error occurs if the span calibration coefficient is outside the rage of 0.9 to 1.09. For details, refer to Chapter 12, Calibration.

Error notification and remedial actions are different when the error occurs during manual calibration and when it occurs during semiautomatic or automatic calibration. When the error occurs during manual calibration, the DATA display shows the error code, but the FAIL lamp does not turn on and the Fail contact is not activated. When the error occurs during semiautomatic or automatic calibration, the DATA display shows no error code, but the FAIL lamp turns on and the Fail contact is activated.

Possible causes are:

- The calibration gas concentration set in the instrument does not agree with the actual concentration of the calibration gas used.
- The pressure of the auxiliary gas was lower than the specified one.
- Zero or span gas was not being supplied.
- In manual calibration, a zero calibration was conducted with span gas flowing, or vice versa.

Remove the causes and reset the error status by performing zero and span calibration again. If the calibration coefficient is outside the specification range due to a sensor drift or characteristics change with time, initialize the calibration coefficients and perform zero and span calibration again.

When the error occurs during semiautomatic or automatic calibration, remove the causes and reset the error status using the following procedure.

(1) Switch to MAINT mode and enter the password.

(2) Change the Function Number to “42.” The DATA display shows “rES.”

(3) Press the EXEC key to reset the calibration coefficient error status.

15.2 Faulty Readings During Measurement

This section describes faulty readings during measurement and possible causes.

15.2.1 Fluctuations in Readings

- Check that the flow rate of the sample gas is the specified one and is stable.
- Check the piping joints or connections in the line between the auxiliary gas cylinder and the analyzer for leaks.
- Check that the temperature of the constant temperature chamber is stable.
- Check the power supply voltage for fluctuations.
- Check that the analyzer is not exposed to direct sunlight or radiant heat from a heat source such as a furnace.

15.2.2 Drift in Readings

Check that the supply pressure of the auxiliary gas is appropriate. If the auxiliary gas pressure falls below the specified supply pressure, the output will drift as the pressure drops.

15.2.3 Short-Term Shift in Readings

Check that the flow rate of the sample gas is the specified one and is stable. If the flow of the sample gas containing oxygen is turned off, the reading will shift toward 0% O_2.

15.3 When Calibration Cannot Be Executed

- Check that the password has been entered correctly and that the ENABLE lamp is lit.
- Check that the instrument is in steady state. If the MAINT lamp blinks in MEAS mode, the instrument is in a stabilization period and calibration cannot be executed.
- Check that the calibration gas concentrations are set properly.

15.4 In the Event of Power Failure

15.4.1 Instantaneous Power Failure

The instrument will not be affected and will continue to work if the duration of a power failure is 80 ms or shorter. Even if the duration of a power failure is the above-mentioned time or less, the instrument may be restarted if the power failure occurs during the warm-up period because of the amount of time that the heater is turned on.

15.4.2 When the Power Returns

If the temperature of the constant temperature chamber remains at 50 °C or higher when the power returns from a relatively short-term (a few minutes) power failure, the instrument will returns to MEAS mode in about 30 seconds. This applies only when the instrument was in steady state before the power failure.

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16. MEASUREMENT PRINCIPLE

16.1 Measurement Principle

A diagram of the principle is shown in figure 16.1.

When the sample gas contains no oxygen molecules, the right and left flow rates of the auxiliary gas (N_2), Q_L and Q_R are equal, or $Q_R = Q_L$.

If oxygen molecules are included in the gas, flow rate Q_L on the magnetic field-generating side is less than Q_R due to the force with which the magnetic field acts on the oxygen molecules, establishing $Q_R > Q_L$.

The difference in the flow rate, $\Delta Q = Q_R - Q_L$ is proportional to the percentage of oxygen molecules in the measuring gas.

The thermister sensor is operated in the constant-resistance circuit to convert the flow rates (velocity) into electric signals, the difference of which is obtained by amplifier A as an oxygen signal.

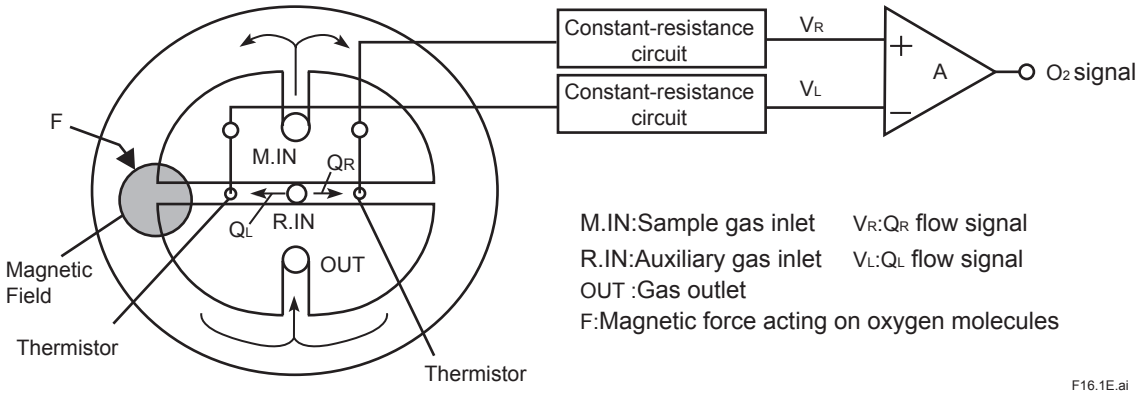

Figure 16.1 Measurement Principle

16.2 Principle of Interference-gas Compensation

Although measurements by the magnetic oxygen analyzer utilize the intense paramagnetic property of oxygen, gases other than oxygen also have a slight paramagnetic property. Hence, a small indication error occurs due to their magnetic susceptibilities for various process gases.

This error may become a problem at low concentration ranges. The model MG8 magnetic oxygen analyzer cancels this error caused by paramagnetism of the process gas by utilizing the difference in density between the measuring and reference gases.

The error is compensated by changing the cell angle (inclination). The measuring gas stream is divided into stream A and stream B as shown in Figure 16.2. The auxiliary gas (normally nitrogen gas) is introduced from the center of the cell and its stream is divided into the right and left. Since a magnetic field exists at only the one auxiliary gas outlet, if there is a gas other than nitrogen having a different magnetic susceptibility, then an error occurs because it affects the auxiliary gas flow ratio of the two streams. The analyzer compensates for this interference by changing the cell angle.

For example, if carbon dioxide which has a smaller susceptibility than nitrogen is passed through the cell, the indication deflects to a negative value. If the cell is tilted (angled) to compensate the indication as shown in Figure 16.3, a counterforce acts to supply more auxiliary gas into path A due to the higher density of carbon dioxide, thus changing the flow ratio of the auxiliary gas. By changing the cell angle so that the change in the auxiliary gas flow ratio due to gas susceptibility cancels out the flow ratio change due to the density difference, the interference error can be compensated.

The model MG8 magnetic oxygen analyzer is shipped after adjusting the cell inclination in the final adjustment stage using the magnetic characteristics and density of the measuring gas of the user. In this case, the inclination is stored using a built-in level (containing a bubble in a glass tube).

When this analyzer is installed at the user's site, turning the rotary knob so that the bubble of this level returns to the center reproduces the adjustment when shipped.

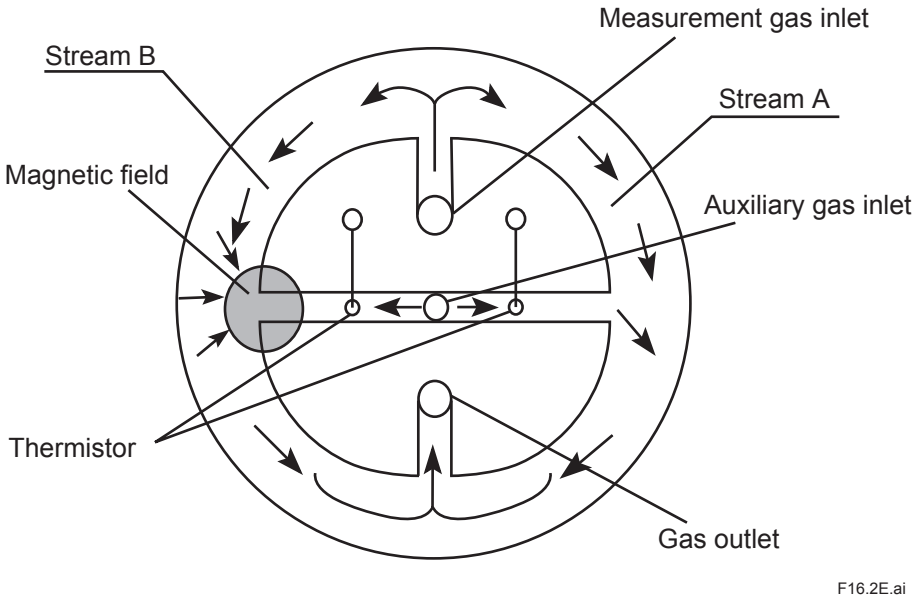

Figure 16.2 Top of Cell

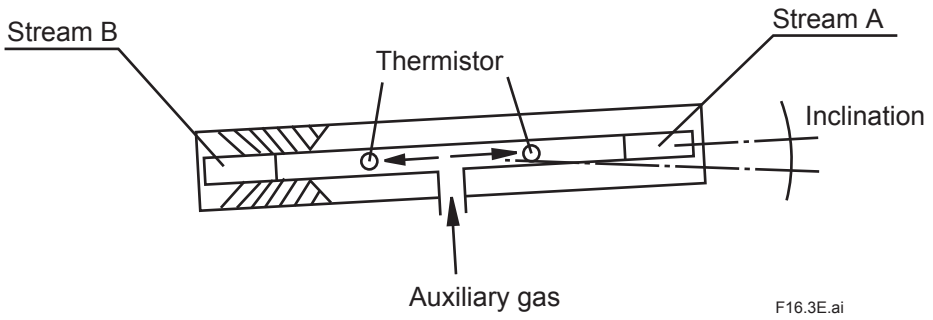

Figure 16.3 Cross Section of Cell

● How to adjust the sensor angle

If necessary, for example, if the composition of the process gas has changed, the sensor angle should be adjusted using the procedure described in Section 10.6, Adjustment for Interference Gas Compensation Using Process Gas. On the MG8E analyzer the sensor angle can be adjusted externally without compromising the explosionproof integrity of the enclosure, i.e., the sensor angle can be adjusted using the adjustment screw on the case door without opening the case. However, the adjustment screw is not provided if the instrument has a measuring range of 0-5% O_2 by the Model and Suffix Codes. In this case, make sure that the installation site meets the requirements for nonhazardous areas. Then, open the door of the explosionproof enclosure and adjust the sensor angle.

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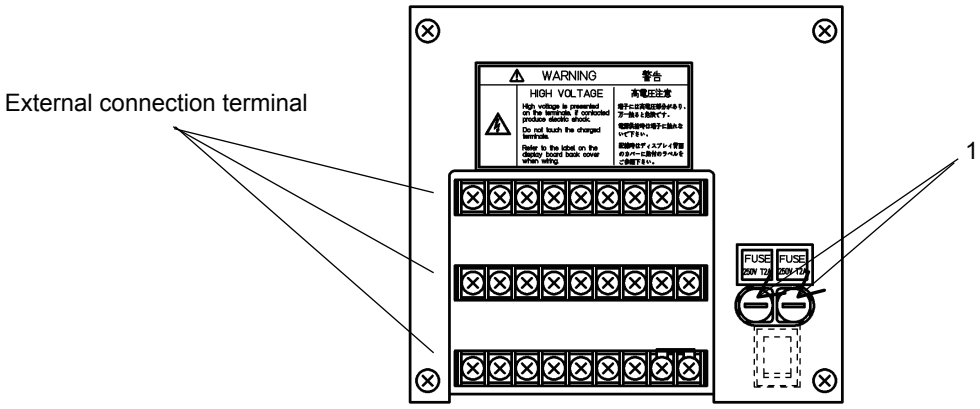
Customer Maintenance Parts List

MG8G
MG8E
Paramagnetic Oxygen Analyzer



Item	Parts No.	Qty	Description
1	A1111EF	2	Fuse

Revision Information

- Title : Model MG8E Paramagnetic Oxygen Analyzer User's Manual
- Manual No. : IM 11P03A05-01E

Jan 2009/3rd Edition

Style Change S3 and Doc No change to 11P03A05-01E from 11P3A5-01E

May 2008/2nd Edition

Revised and Corrected over all, IM Format and Style renewal (As a result of changing Data Source from paper to electric files and of applying Indesign software)

Outline of change

Chapter "Introduction" is newly added.
Chapter 1: Description with WARNING (p1-1) and Table (p1-2) are added.
Chapter 3: Rearrangement of sections and subsections
Subsection 3.1.1: Some specifications are changed or added (e.g.: Contact Output, analog output signal, Installation conditions, color)
Subsection 3.1.2: Expression of each characteristic is changed.
Section 3.2 "Model and Suffix code" is added.
Chapter 4: Auxiliary gas pressure is changed. Flow rate and pressure is added.
Description with CAUTION is added.
Chapter 6: Descriptions with WARNING(p6-1, 6-2, 6-7) or CAUTION(p6-8) are added.
Fig 6.3: description about Fail contact output is changed.
Note 5: description of 3rd paragraph is changed.
Table 6.1: Connection size and Part Number is changed.
Chapter 7: Figure 7.1: Explanation about Cell-angle adjustment is added.

Chapter 8: Descriptions with WARNING (p8-1) and CAUTION (p8-3, 8-4, 8-8) are added.
Section 8.1: Arrangement of subsection
Subsection 8.1.3: description is changed.
Subsection 8.2.2: Procedure and Status of Item 2 is changed.
Chapter 9:
Section 9.1: Item (3) is added to the description of FUNCTION No.02.
Section 9.3: Item <4> is added to the description of E- - 2.
About E- - 5, description of item (1) is changed.
Chapter 10: Arrangement of sections and subsections
Description with CAUTION (p10-4) is added.
Parts of description are changed or added (in subsection 10.2.5, 10.7.2, 10.7.4 and 10.7.5)
Chapter 11: Description with WARNUNG (p11-1) is added
Section 11.2: Description is added and changed.
Chapter 12: Description with WARNUNG (p12-1) is added
Section 12.1, 12.2, 12.5, 12.6, 12.7: Description is added and changed.
Section 12.8 is newly added.
CMPL : On page 2, parts No. of item 3 is changed.
Revision Information is newly added.

Apr. 1994/1st Edition

Newly published

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IA Div., Product Business Center
Yokogawa Electric Corporation
■ Published by Yokogawa Electric Corporation
2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, JAPAN
■ Printed by KOHOKU PUBLISHING & PRINTING INC.

User's Manual

Model MG8E Paramagnetic Oxygen Analyzer

Supplement

Thank you for selecting our MG8E Paramagnetic Oxygen Analyzer.
In User's Manual, IM 11P03A05-01E, 3rd Edition, supplied with the product, some revisons/additions have been made.
Please replace the corresponding pages in your copy with attached, revised pages.

Note

Revisions

P.3-2,	Section 3.1,	"Standard Specifications," Installation Conditions: Changed of ambient temperature.
P.3-3,	Section 3.1,	"Standard Specifications," Power Supply: Description changes.
	Section 3.1,	"Standard Specifications," : Addition of "KC Marking".

YOKOGAWA
Yokogawa Electric Corporation

IM 11P03A05-01E
3rd Edition

Measurement Gas Conditions:

Gas Flow ; Setting range : 300 to 800 ml/min (standard 600 ml/min)

Allowable range : ±10% of a set value

Pressure : Approx. 7 kPa (approx. 700 mmH_2O) in Analyzer inlet

Temperature: 0 to 50°C

Humidity : No moisture condensation in the flow path or the sensor

Operating Conditions:

- Measurement gas must be an explosive gas which has T4 ignition temperature and must be a hazardous gas less than or equal to the gas vapor-air mixtures.
- Oxygen concentration in the measurement gas must be less than a mixture of air with a flammable gas (Exd II BT4X). However, this is an exception if it is ascertained that the gas explosion characteristics are safer than the equivalent gas.

Auxiliary Gas:

Type ; N_2 gas (not containing O_2 gas equal to or greater than 0.1 % of the maximum concentration of the measurement range)

Pressure ; 350 to 500 kPa (average flow rate of approx. 35 ml/min. When sample gas contains hydrogen of 3% or greater, flow rate is approx. 55 ml/min)

Calibration gas:

Zero gas ; N_2 gas
Note: Zero gas should not contain O_2 gas with a concentration equal to or greater than 0.1% of the upper range value.

Span gas ; Dry air (instrument air O_2: 20.95 vol%) or standard gas containing O_2 gas with a concentration of 80 to 100% of the span value (balance nitrogen).

Calibration methods:

(1) Automatic calibration at set intervals by internal timer

(2) Semiautomatic calibration started by external contact input

(3) Manual calibration in the field

Warm-up Time:

Approx. 2.5 hours

Installation Conditions:

Ambient temperature: -5 to 50°C

Humidity; 10-95%RH (No condensing)

Vibration:

5 to 9 Hz : Vibration amplitude; 1.5 mm or less

9 to 150 Hz: Acceleration; 2 m/s2 or less

Power Supply:

Power supply Voltage 100 to 115 V AC;

Rated voltage range: 100 to 115 V AC

Allowable voltage range: 90 to 127 V AC

Rated frequency; 50 to 60 Hz

Allowable frequency range: 48 to 63 Hz

Power Consumption:

170 VA maximum, approx. 25 VA normally

KC Marking:

Korea Electromagnetic Conformity Standard

Materials in Contact with Gas:

JIS SUS316 stainless steel, Fluorocarbon rubber, Hard glass

Structure:

flameproof (Exd II BT4X)

Dimensions :

440(W) x 370(H) x 325(D) mm

Color:

Door: Munsell 2.0GY7.5/0.9, epoxy resin baked

Case: Munsell 2.0GY3.1/0.5, epoxy resin baked

Weight :

Approx. 38 kg