Fuji Electric

Instruction Manual

INFRARED CO_2 CONTROLLER

TYPE: ZFP9-3

INZ-TN3ZFP9-E Fuji Electric Co., Ltd.

PREFACE

We are grateful for your purchase of Fuji Electric's Infrared CO_2 Controller (ZFP9).

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

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

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Request

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

Issued in June, 2016

CAUTION ON SAFETY

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

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

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

Caution on installation and transport of gas analyzer	
⚠ DANGER	• This unit is not explosion-proof type. Do not use it in a place with explosive gases to prevent explosion, fire or other serious accidents.
⚠ CAUTION	• This instrument is indoor use only. • Installation and maintenance must be carried out by qualified personnel only. • For installation, observe the rule on it given in the instruction manual and select a place where the weight of gas analyzer can be endured. Installation at an unsuited place may cause turnover or fall and there is a risk of injury. • For lifting the gas analyzer, be sure to wear protective gloves. Bare hands may invite an injury. • When carrying, be sure to close the cover. Do not carry the gas analyzer in unstable condition to avoid unexpected injury.

Caution on piping

⚠ DANGER

- In piping, the following precautions should be observed. Wrong piping may cause gas leakage. If the leaking gas contains a toxic component, there is a risk of serious accident being induced. Also, if combustible gas is contained, there is a danger of explosion, fire or the like occurring.
- Connect pipes correctly referring to the instruction manual.
- For piping, use a pipe and a pressure reducing valve to which oil and grease are not adhering. If such a material is adhering, a fire or the like accident may be caused.

Caution on wiring

⚠ CAUTION

- Install correctly according to regulation of each country, as not being External Disconnection Device for this instrument.
- Wiring is allowed only when all power supplies are turned off. This is required for preventing a shock hazard.
- Enforce construction of grounding wire by all means. If the specified grounding construction is neglected, a shock hazard or fault may be caused.
- Wires should be the proper one meeting the ratings of this instrument. If using a wire which cannot endure the ratings, a fire may occur.
- Establish an external over-current protection device (e.g. circuit-breaker) with a rating of no more than 5A as per the general product specification.
- Connect correctly wiring L (live)/N (neutral) to the power supply terminal.

Caution on use

⚠ DANGER

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

⚠ CAUTION

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

Caution on maintenance and inspection

⚠ DANGER

- When performing maintenance or inspection, be sure to completely purge the inside of the analyzer and the measuring gas line using a zero gas, to avoid poisoning, fire or explosion due to gas leakage.

⚠ CAUTION

- Before working, take off a wrist watch, finger ring or the like metallic accessories. And never touch the instrument with a wet hand. Otherwise, you will have a shock hazard.
- If the fuse is blown, eliminate the cause, and then replace it with the one of the same capacity and type as before (250VAC, T, 500mA.L). Otherwise, shock hazard or fault may be caused.

Others

⚠ CAUTION

- If the cause of any fault cannot be determined despite reference to the instruction manual, be sure to contact your dealer or Fuji Electric's technician in charge of adjustment. If the instrument is disassembled carelessly, you may have a shock hazard or injury.
- Do not use a replacement part other than specified by the instrument maker. Otherwise, adequate performance will not be provided. Besides, an accident or fault may be caused.
- Replacement parts such as a maintenance part should be disposed of as incombustibles.
- If you remove the dirt of the body, without the use of solvent etc., please wipe with damp cloth wet in water.

WARRANTY AND MAINTENANCE

1. Scope of application

To use this equipment, the following conditions must be met:

- the use of the equipment incurs no risk of a serious accident even if a failure or malfunction occurs on the equipment, and
- in case of product failure or malfunction, safety measures such as redundant design, prevention of malfunction, fail safe system, foolproof mechanism are provided outside of the equipment.

Be sure to use this instrument under the conditions or environment mentioned in this instruction manual. Please consult us for the use for the following applications:
Radiation-related facilities, systems related to charging or settlement, or other usages which may have large impact on lives, bodies, property, or other rights or interests.

2. Operating conditions and environment

Refer to CAUTION ON SAFETY and APPENDIX 1, SPECIFICATIONS.

3. Precautions and prohibitions

Refer to CAUTION ON SAFETY and APPENDIX 1, SPECIFICATIONS.

4. Warranty

4.1 Period of warranty

(1) Warranty period for this product including accessories is one year after delivery.

(2) Warranty period for the parts repaired by our service providers is six months after the completion of repair.

4.2 Scope of warranty

(1) If any failure or malfunction attributable to Fuji Electric occurs in the period of warranty, we shall provide the product after repairing or replacing the faulty part for free of charge at the place of purchase or delivery. The warranty does not apply to failure or malfunctions resulting from:

1) inappropriate conditions, environment, handling or usage that is not instructed in a catalog, instruction book or user's manual, or overuse of the product,

2) other devices not manufactured by Fuji Electric,

3) improper use, or an alteration or repair that is not performed by Fuji Electric,

4) inappropriate maintenance or replacement of expendable parts listed in the instruction book or the catalog,

5) damages incurred during transportation or fall after purchase,

6) any reason that Fuji Electric is not responsible for, including a disaster or natural disaster such as earthquake, thunder, storm and flood damage, or inevitable accidents such as abnormal voltage.

(2) Regardless of the time period of the occurrence, Fuji Electric is not liable for the damage caused by the factors Fuji Electric is not responsible for, opportunity loss of the purchaser caused by malfunction of Fuji Electric product, passive damages, damage caused due to special situations regardless of whether it was foreseeable or not, and secondary damage, accident compensation, damage to products that were not manufactured by Fuji Electric, and compensation towards other operations.

5. Failure diagnosis

Regardless of the time period of the occurrence, if any failure occurs, the purchaser shall perform a primary failure diagnosis. However, at the purchaser's request, Fuji Electric or our service providers shall provide the diagnosis service for a fee. In such a case, the purchaser shall be charged for the service.

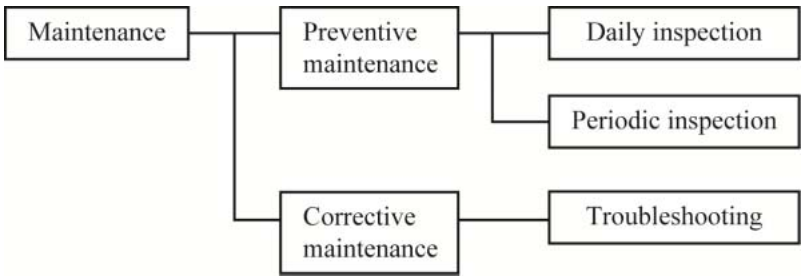
6. Service life

This product, excluding limited-life parts and consumable parts, is designed for a service life of 10 years under general operating conditions (with an average ambient temperature of 25°C).

The service life may be shortened depending on operating conditions and environment. To ensure the service life, it is important to perform planned maintenance of the product including limited-life parts and consumable parts.

7. Maintenance plan

Maintenance can be divided into "preventive maintenance" and "corrective maintenance". Preventive maintenance can further classified into "daily inspection" and "periodic inspection". Preventive maintenance is achieved through systematic implementation of "daily inspection" and "periodic inspection".



(1) Daily inspection

Be sure to perform daily inspection prior to operation to check for any problem in daily operation. For the specific items of daily inspection, refer to Chapter 5, MAINTENANCE.

(2) Periodic inspection

Periodic inspection is to replace limited-life parts before their service lives are over, thus preventing failure. Recommended inspection interval is 6 months to 12 months. If you are using the instrument under harsh environment, we recommend you to shorten the inspection interval. For the specific items of periodic inspection, refer to Chapter 5, MAINTENANCE.

(3) Corrective maintenance

Corrective maintenance is a measure to be taken after a trouble has occurred. If the measures mentioned in this instruction manual do not solve the problem, please contact one of our sales offices or service offices.

8. Limited-life parts and consumable parts

This product contains the following limited-life parts and consumable parts which may affect the service life of the product itself.

(1) Aluminum electrolytic capacitor
- Design life: 10 years under general working conditions (annual average of ambient temperature: 25°C)
- Symptoms when a capacitor loses its capacity: deterioration of power quality, malfunction
- Factors which affect the life: temperature. The life is shortened by half when the temperature rises by 10°C. (Arrhenius' law)
- Replacement: Estimate the lifetime of capacitor according to your operating environment, and have the capacitor replaced or overhauled at appropriate time, at least once in 10 years.
  Do not use capacitors beyond its lifetime. Otherwise, electrolyte leakage or depletion may cause odor, smoke, or fire. Please contact Fuji Electric or its service providers when an overhaul is required.

(2) Pump
- Design life: approx. three years for continuous use
- Symptoms when the pump is depleted: decrease of the amount of suction
- Factors which affect the life: diaphragm degradation over time
- Replacement: Estimate the lifetime according to your operating environment, and replace it at appropriate time, in reference to Chapter 5.2, Replacement of Pump.

(3) Filter

Replace filters periodically, in reference to Chapter 5.1, Replacement of Membrane Filter Paper.

9. Spare parts and accessories

Refer to APPENDIX 1, SPECIFICATIONS.

10. Period for repair and provision of spare parts after product discontinuation (maintenance period)

The discontinued models (products) can be repaired for five years from the date of discontinuation. Also, most spare parts used for repair are provided for five years from the date of discontinuation. However, some electric parts may not be obtained due to their short life cycle. In this case, repair or provision of spare parts may be difficult even in the above period.
Please contact one of our sales offices or service offices for further information.

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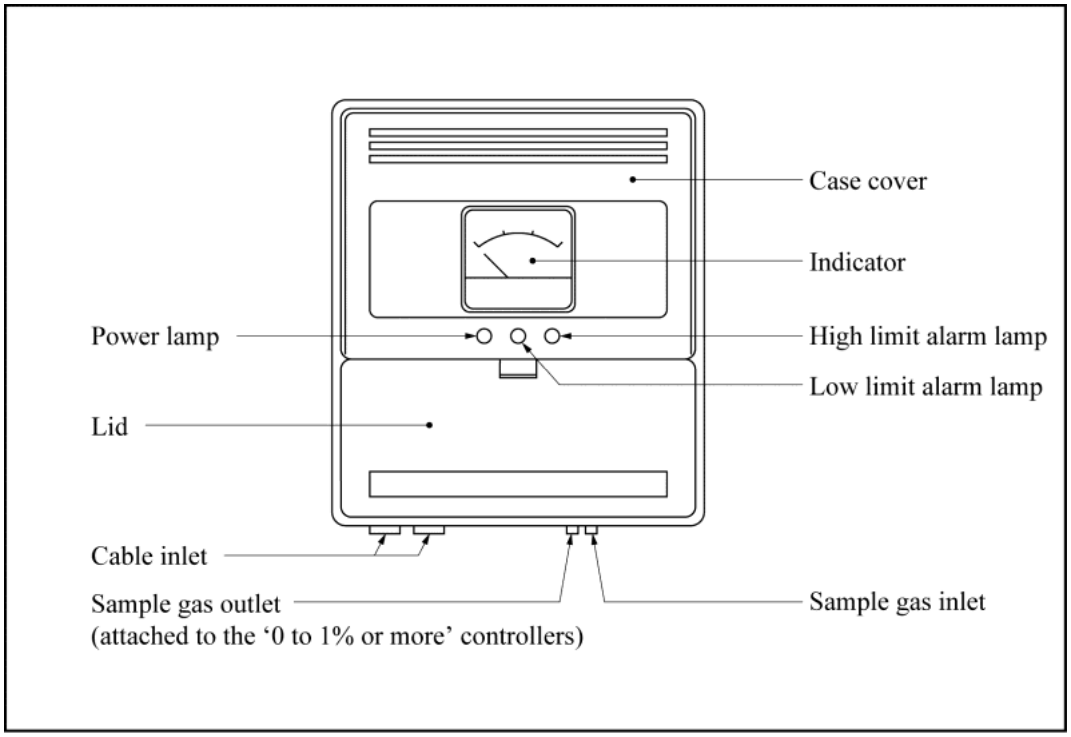
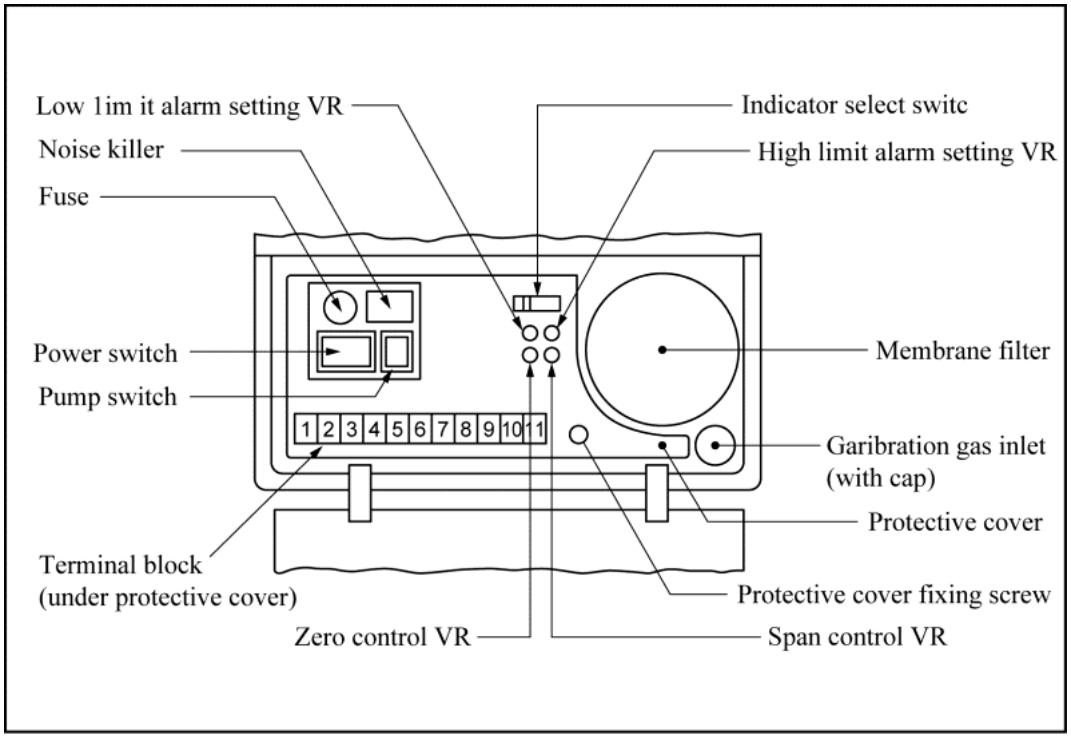
1. NAMES OF COMPONENTS

(1) External view



(2) Internal view of CO_2 controller (with lid open)



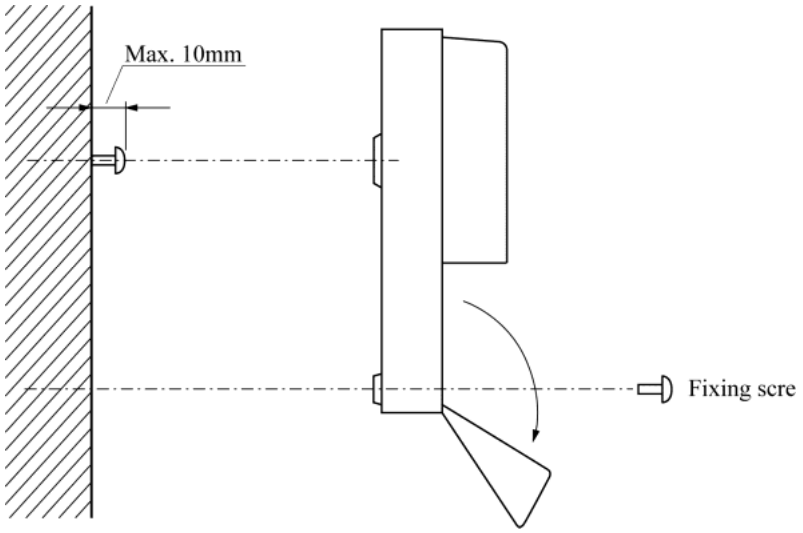
2. INSTALLATION

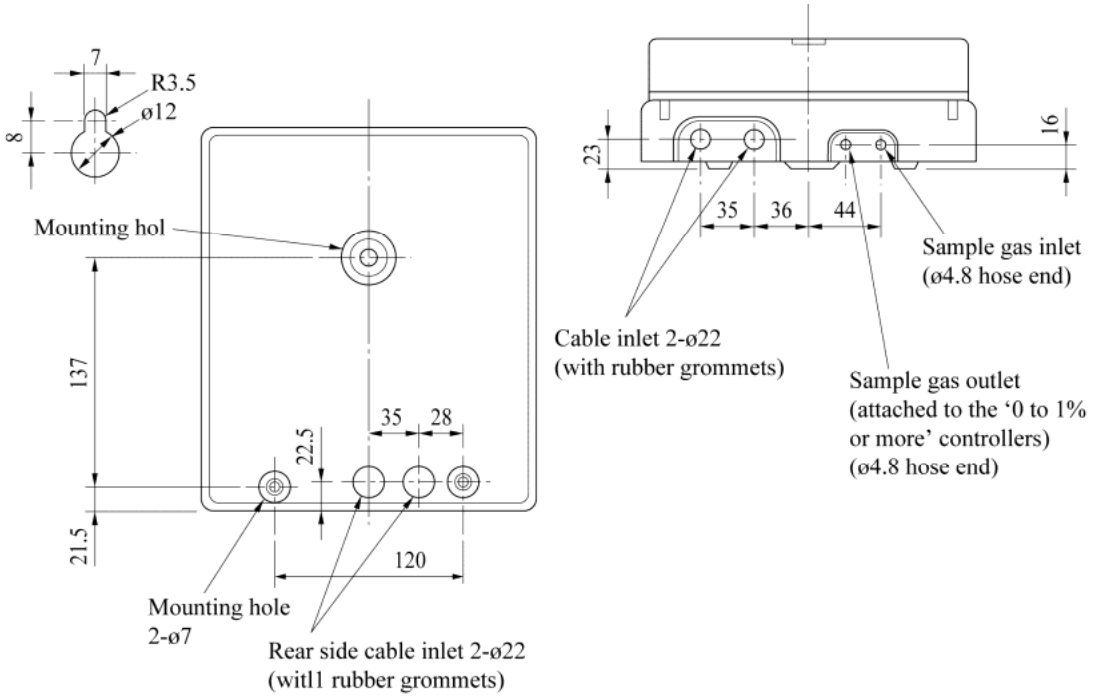
2.1 Mounting Procedures

⚠ CAUTION

- The unit must be mounted safety and security to prevent it from falling down.

For installing the CO_2 controller, select a location which is free from high temperature, high humidity, corrosive gas or severe external vibration.
Tighten the upper mounting screw until it reaches 10mm (max.) deep from the wall surface, then insert the upper mounting hole located on the rear of the main unit case.
Next, remove the protection cover and tighten the unit with screws at the lower mounting (holes. 2 places). When tightening, make sure that the unit is not tilted





2.2 Wiring

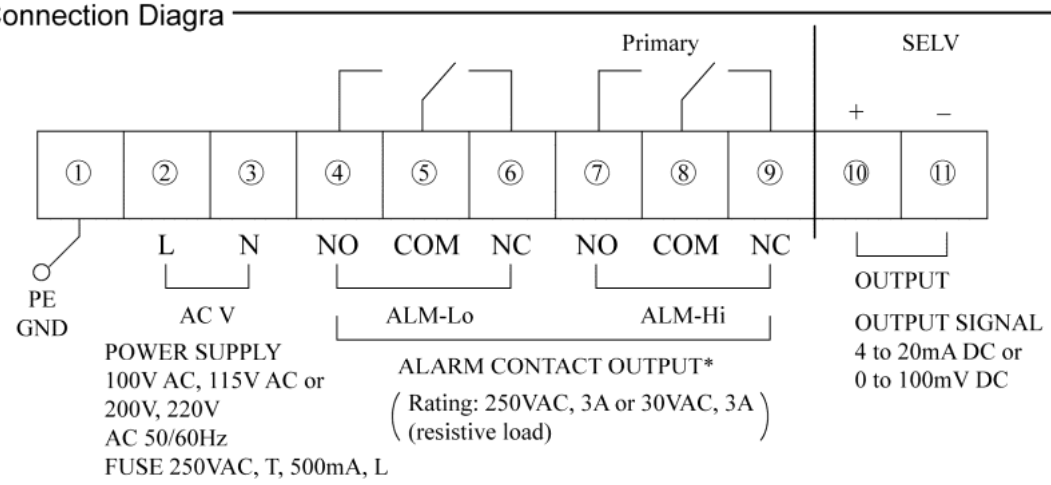
⚠ CAUTION

- Before starting a wiring work, be sure to turn OFF all the power to prevent a risk of electric shocks.
- Install correctly according to regulation of each country, as not being External Disconnection Device for this instrument.
- Establish an external over-current protection device (e.g. circuit breaker) with a rating of no more than 5A as per the general product specification.
- Connect correctly wiring L(live)/N(neutral) to the power supply terminal

- The unit must be earthed (Class-D grounding)

Analog output and digital input of this instrument are Safe Separated (SELV) circuit.
The over voltage category of this instrument is II.
For connecting external wires to the CO_2 controller, remove the protective cover
Then, connect the wires correctly to the terminal block as shown below.

Connection Diagra

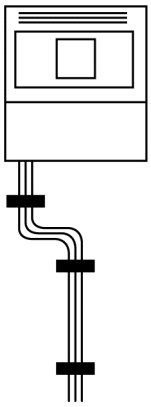


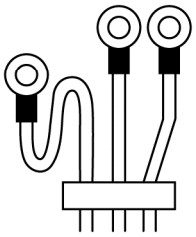
*Alarm outpu

Low limit alarm:	Electrical continuity establishes between 4 and 5 when sample gas concentration is lower than a preset value, or between 5 and 6 when sample gas concentration exceeds the preset value.
Higll lim it alarm:	Electrical continuity establishes between 8 and 9 when sample gas concentration is lower than a preset value, or between 7 and 8 when sample gas concentration exceeds the preset value.

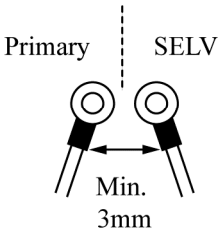
Use vinyl sheath insulation wires at least 1.25mm^2 for the power source and controlled output. For providing measured value output, use a shielded two-core cable and connect the shield ground to the ground terminal. If the measured value output is free from inductive interference, a vinyl sheath insulation wire may be used as the measured value output cable. Do not pass the measured value output cable in parallel with the power source wire or controlled output wire, or through the same conduit tube.

Fix external wiring on wall.
Don't contact primary power supply wiring and output signal wiring.
And connect Earth wiring slackly.





Reinforced insulation must be maintained over safe separation on termination of wires/crimps.

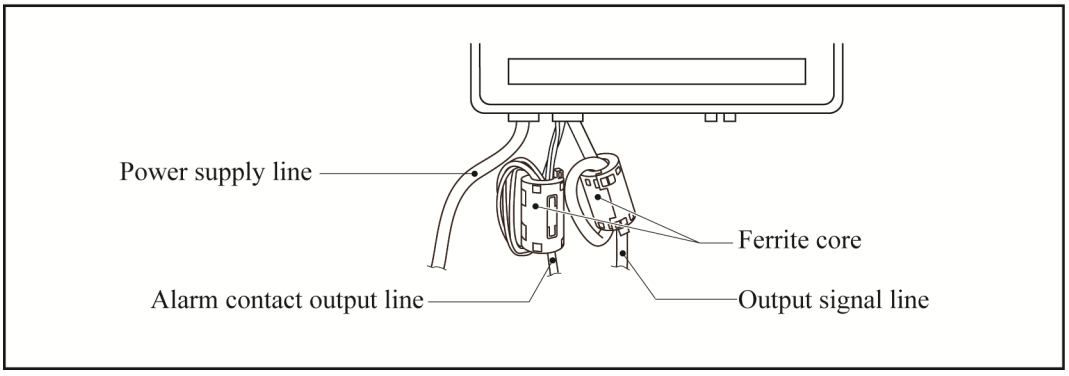


Crimped ring-terminals with insulating sleeve

Insertion method of attached ferrite core.

Because of the increase the noise resistance of this unit,

please insert the attached ferrite cores with one turn for the output signal line, and the alarm contact output line each other. (See figure below)

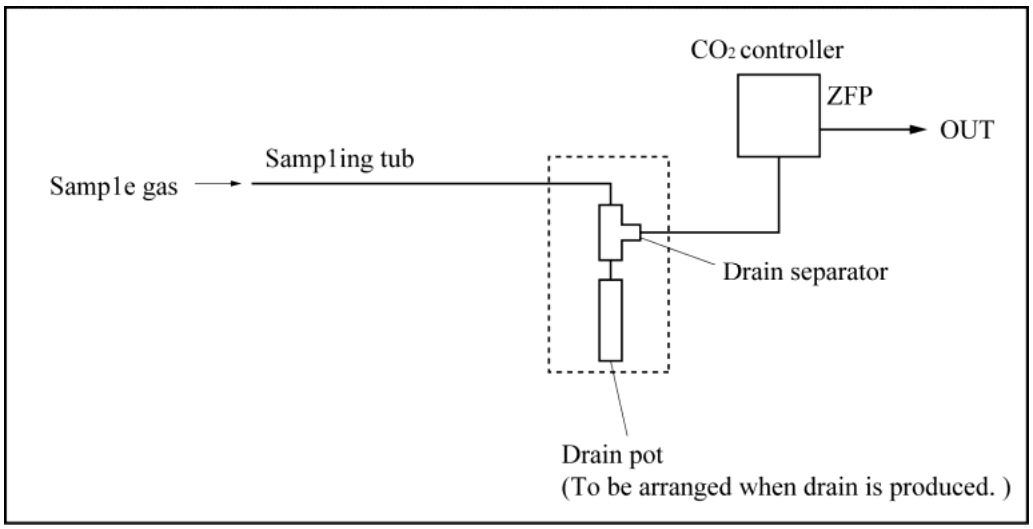


2.3 Piping

⚠ DANGER

- For the inside of piping, Use pipes that do not cause deposits of oil or fat.
- Piping joints must be tightened firmly to avoid gas leakag.

The CO_2 contoroller has built-in sampling pump and membrane filter so that as ampling system can be composed simply by connecting an external pipe.
Lay an external pipe from the gas sampling point to the CO_2, controller and connect it to the sample gas inlet which is eqipped with a ø4.8/ ø3 hose end. The gas pipe must be of the type matched with the joint. When drain is produced in the pipe due to temperature difference among the gas sampling point, external pipe and CO_2, controller, arrange a drain pot in the course of the pipe to prevent drain from entering the CO_2, controller.



3. OPERATION

Turn ON the power switch. The indicator pointer overshoots upward and downward several times and controlled output is switched. However, the indicator stabilizes soon after.
Then, turn ON the pump switch to start the built-in pump for aspirating sample gas.
The CO_2 controller stabilizes about 30 minutes after turning ON the power switch, and indicates gas concentrations accurately.

While CO_2 concentration is lower than the preset low limit alarm value, terminals ④ and ⑤ are conductive and the low limit alarm lamp lights.
When CO_2 concentration exceeds the preset high limit alarm value, terminals ⑦ and ⑧ become conductive and the high limit alarm lamp lights.

This controlled output signal is used for controlling the instrument connected to the CO_2 controller.

4. ADJUSTMENT

The CO_2 controller requires adjustment before it is operated for the first time after installation at the site or after it has been rested for a long time. The adjustment should be attempted with the CO_2 controller kept in well stabilized condition (warm it up for at least 30 minutes after turning ON the power switch)

4.1 Calibration

4.1.1 Zero Calibration

Be sure to turn OFF the pump switch

(1) Calibration using sprayer type zero gas cylinder

Insert the nozzle of the gas cylinder into the calibration gas inlet and depress the cylinder to flow the zero gas. For economy of the zero gas, do not keep the gas cylinder in depressed condition, but repeat depressing and releasing operations at short time intervals until indication becomes stabilized.
The indicator should read zero while the zero gas is being flowed. If it is miscalibrated, turn the zero control VR as slowly as possible considering the time lag between the adjustment and indicator reading.

(2) Calibration using high-pressure zero gas cylinder (Use pressure regulator).

After disconnecting the external pipe from the sample gas inlet, flow the zero gas through the sample gas inlet. On the secondary side of the pressure regulator, adjust pressure to 0.1MPa (lkg/cm^2) or less and set flow rate at 0.5 to 1 L /min.
Calibrate the zero level by turning the zero control VR in the same procedures as those instructed in step (1) above.
The zero gas can be flowed through the calibration gas inlet. For this purpose, however, it is necessary to connect a soft tube to the calibration gas inlet and adjust secondary gas pressure to 0.2 to 0.3MPa (2 to 3kg/cm^2). In this case, take care to prevent the pipe from being disconnected or allowing gas leak due to the high pressure.

(3) Calibration using outdoor air as zero gas (simple calibration method)

Turn ON the pump switch to take up the outdoor air, and adjust the zero control VR for indication of 0.033% (330ppm). At this time, care should be taken not to allow CO_2 gas in human breath to get in the calibration gas (outdoor air).

4.1.2 Span Calibration

The CO_2 controller usually requires no span calibration since span is calibrated with the zero level.
If it is necessary to calibrate the span, it should be adjusted after zero calibration.
Be sure to turn OFF the pump switch.
Flow span gas in the same procedures as those for the zero calibration, and turn the span control VR until the indicator reads concentration of the span gas.

4.2 Alarm point setting

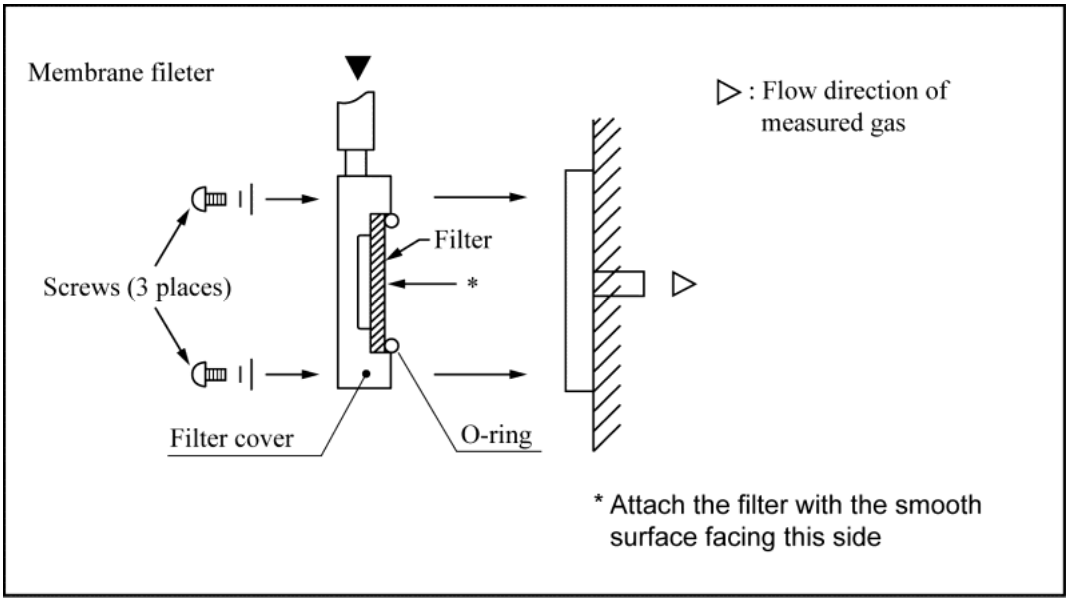
Set the indicatorselect switch at its “ALM-Lo” position and adjust low limit alarm setting VR in order to set the indicator pointer to the desired low limit alarm value.
Then, set the indicator select switch at its “ALM-Hi” position and adjust high limit alarm setting VR to set the indicator pointer to the desired high limit alarm value.

Note) The high limit alarm value cannot be set below the low limit alarm value.
Set the low limit alarm first to avoid the setting errors

5. MAINTENANCE

5.1 Replacement of Membrane Filter Paper

The built-in membrane filter paper should be replaced with a new one every six month or so.
Be sure to turn OFF the pump switch before proceeding to replacement of the filter paper.
After opening the lid and removing the three screws from the filter, take off the filter cover. For reassembly, set a new filter paper in the cover and place the O-ring on it. Tighten the screws until the filter cover is brought into close contact.
Take care not to mistake the position of the filer paper for that of the O-ring.

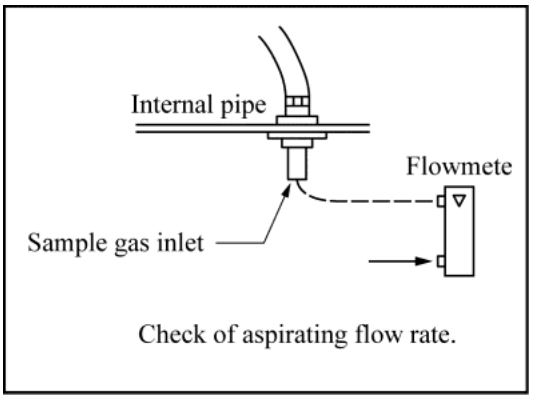


5.2 Replacement of Pump

When the flow rate is extremely low (0.2 L/min or less), check to see if the filter or piping is clogged or disconnected. If it is normal, replace the pump with a new one.
calibrated every six months.

(1) Check flow rate

Flow rate should be checked once a year or when the indication of CO_2 concentration is abnormal (slow response, causing abnormal indication of CO_2 concentration) with a flowmeter connected to the sample gas inlet.



(2) Replacing procedures

① Be sure to turn OFF the power switch before proceeding to replacement of the pump.

② Remove the protection cover and case cover.

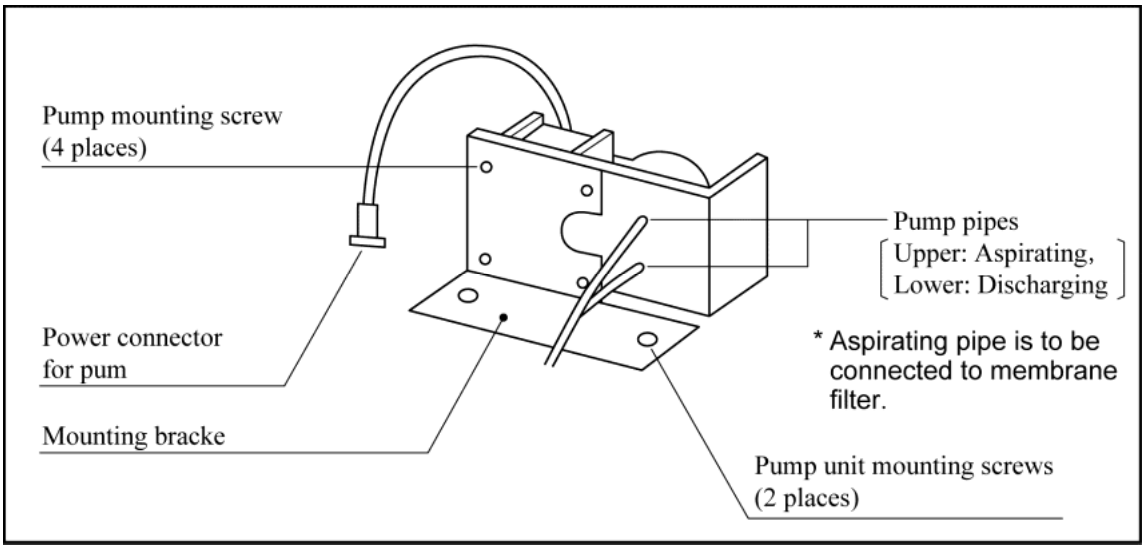
③ Remove tubes connected to the pump inlet and outlet.
(After replacing the pump, make sure that these tubes are connected correctly.)

④ Remove the pump connector (CN4) from the printed circuit board.

⑤ Remove the mounting bracket and then remove the pump by loosening the pump mounting screws.

⑥ Mount a new pump in reverse order of dismounting procedures given above.

⑦ Connect the pipes in initial condition while taking care not to twist or fold. Care should be taken not to pinch the tubes and lead-wires when the case cover is mounted.



APPENDIX 1 SPECIFICATIONS

(1) Function specification

- Measuring method: NDIR single beam method
- Gas measured: CO_2 in air
- Measuring rang: 0 to 0.2%, 0 to 0.3%, 0 to 1%, 0 to 5%, 0 to 10%, 0 to 2%
  CO_2 (as specified by code symbols)
- Output signal: 4 to 20mA DC non-linear (maximum load resistance 350Ω), or, 0 to 100mV DC non-linear (output resistance 100Ω)
  Note) Only for the '0 to 0.2%' controller; 4 to 20mA DC linear (maximum load resistance 350Ω), or 0 to 100mV DC linear (output resistance 100Ω) can be provided
- Alarm function:
  - Alarm setting range; 0 to 100%FS
  - Setting method; Set value is shown in the indicator by using the builtin high/low limit setting volume control.
  - Output; Relay contact (1c × 2 set)
    250V AC, 3A or 30V DC, 3A (resistive load)
    The voltage resistance between coil and contact is 3000 V AC, reinforced insulation.
  - Alarm hysteresis width; ±4% of the scale length (near the scale length 50%)
  - Indication;
    • High limit indication lamp (red)
    This lamp lights when the CO_2 gas concentration exceeds the high limit.
    • Low limit indication lamp (red)
    This lamp lights when the CO_2 gas concentration is less than the low limit.
- Indicator: CO_2 gas concentration physical scale, moving coil type, JIS class 2-5
- Power source: 100V, 115V, 200V, 220V AC ±10%, 50/60H
  (as specified by code symbols)
- Power consumption: Approx. 18VA
- Ambient temperature: 0 to 40°C
- Ambient humidity: 90%RH or less
- Temperature for storage 20 to 50°C
- Gas sampling Built-in suction pump and membrane filter Sampling flow rate;
  approx. 0.6 L/min

(2) Performance specificaiton

- Repeatability: ±1% of full scale
- Zero point drift: ±10% of full scale/6 months
- Response time: Approx. 10 sec. (90% response)
- Warm-up time: Approx. 30 min
- Linearity accuracy: ±3% of full scale
  Note) Only for the '0 to 0.2%' controller, linear outputs can be provided.

(3) Structure and material

- Type of case: Indoor, dust-proof type (IPX0)
- Material of case: Case and cover (ABS resin)
Base plate (steel)
- Surface color: Case (Munsell 3.1Y7.0/1.1)
Lid (Munsell 9.2YR4/1)
- Material of parts exposed to gas: SUS304, anti-corrosive aluminum
- Mounting method: Wall mounting type
- Outline dimensions: 220 × 257 × 85mm (W × H × D)
- Mass: Approx. 3kg
- Piping method: Hose end ø4.8 (at the sample gas inlet)
- Wiring method: M3 screw terminals

(4) Scope of delivery

- CO_2 controller unit: 1
- Filter paper: 5
- Fuse (250VAC.T.500mA.L): 2
- Ferrite core: 2

(5) Option

Standard gas for zero/span calibration (type: ZBM)
Pressure controller for the above standard gas (type: ZBD610)
Flowmeter for the above standard gas (type: ZBD472)

(6) EC Directive Compliance

The product comforms to the requirements of the Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU.
It conforms to use the following harmonized standard
LVD: EN61010-1: 2010
"Safety requirements for electrical equipment for measurement, control and laboratory use"
Installation Category II,
Pollution Degree 2
Altitude up to 2000m
EMC: EN61326-1：2013、EN61326-2-3：2013
"Electrical equipment for measurement, control and laboratory use - EMC requirement"
EN61000-3-2: 2014, EN61000-3-3: 2013 "Electromagnetic compatibility (EMC) "

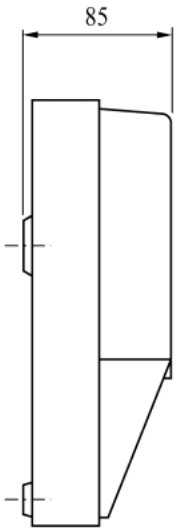
APPENDIX 2 TYPE SPECIFICATION

Z	F	P	9				3	Description
								Measuring range
				A				0 to 0.3%
				B				0 to 1%
				C				0 to 5%
				D				0 to 10%
				E				0 to 20%
				G				0 to 0.2%
								Output
					A			0 to 100mV DC non-linear
					B			4 to 20mV DC non-linear
					C			0 to 100mV DC linear*
					D			4 to 20mV DC non-linear*
								Power source
						1		100V AC 50/60
						2		115V AC 50/60
						4		230V AC 50/60
						5		200V AC 50/60

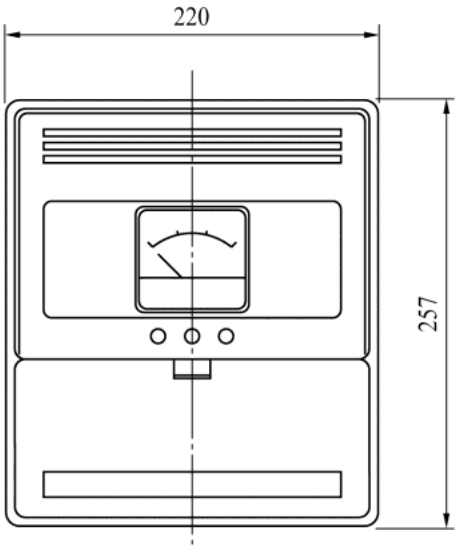
* Type specification:
  Fifth digit; G
  Only for the '0 to 0.2%' controller, linear outputs can be provided

APPENDIX 3 OUTLINE DIMENSIONS

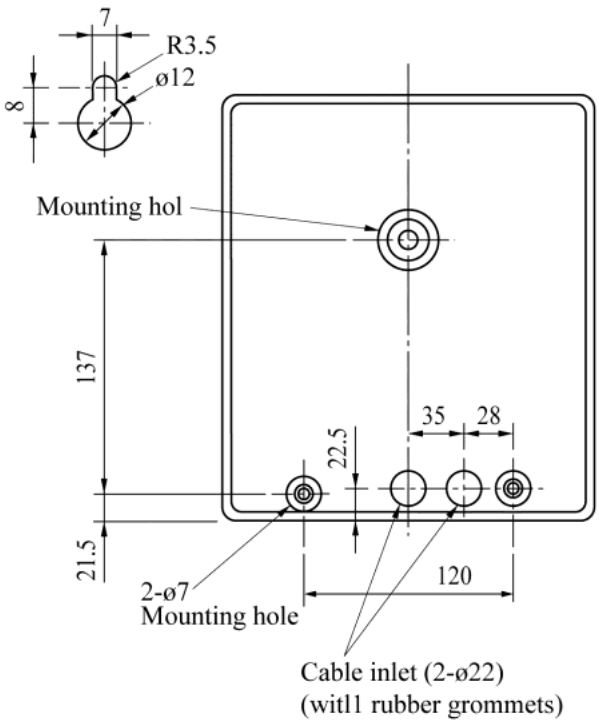
(in mm)



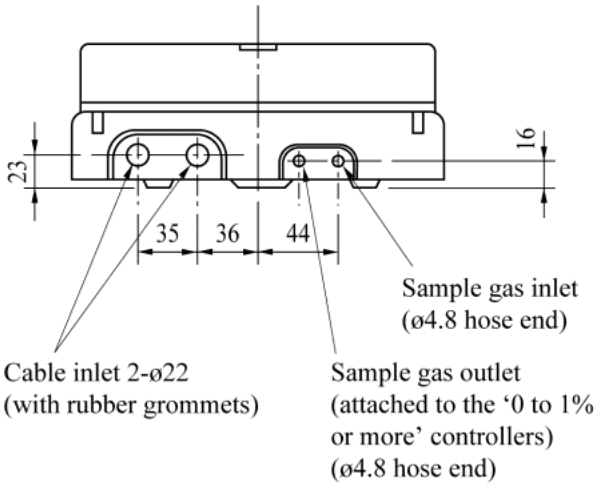
Left side view



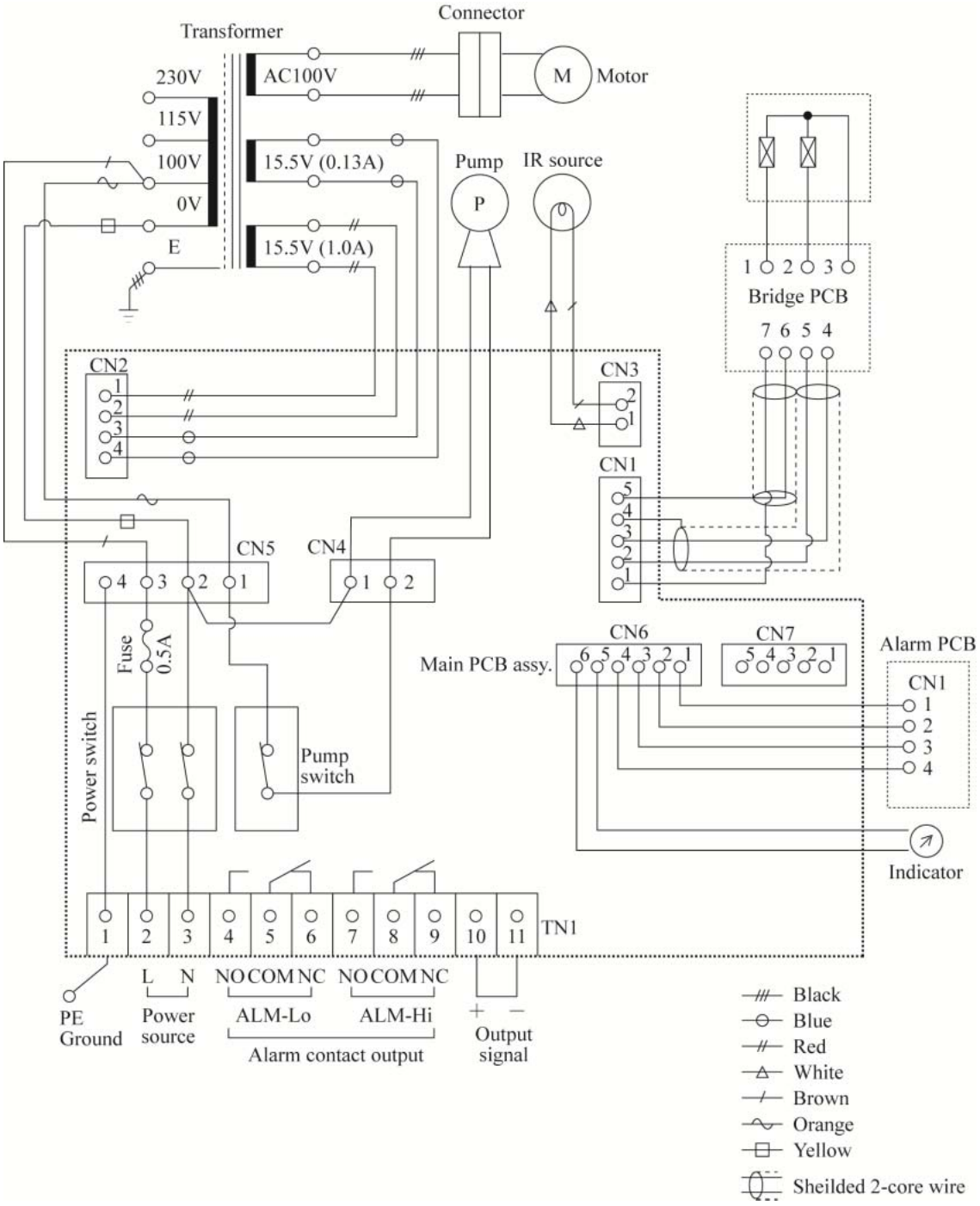
Front view



Rear view



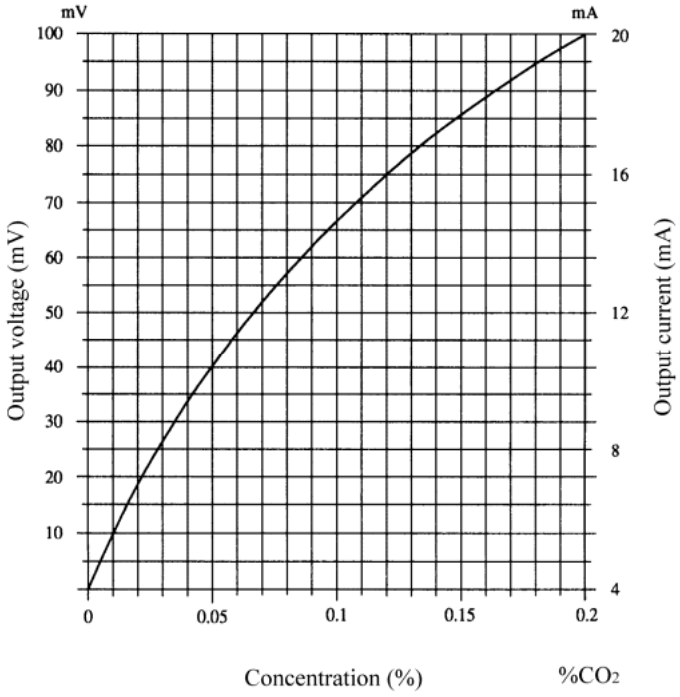
APPENDIX 4 CONNECTION DIAGRAM



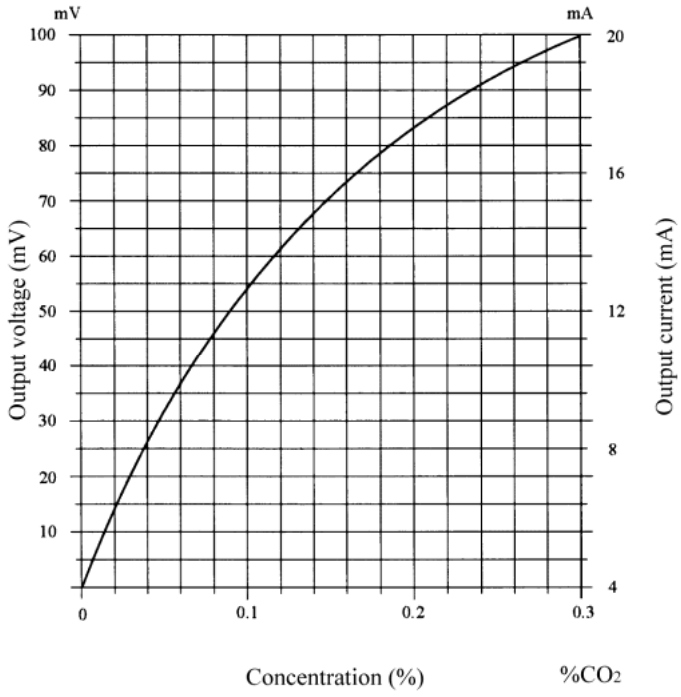
APPENDIX 5 CALIBRATION CURVE

Note: Errors between the following calibration curves and the indicated values are with in ±2% all over the full scale

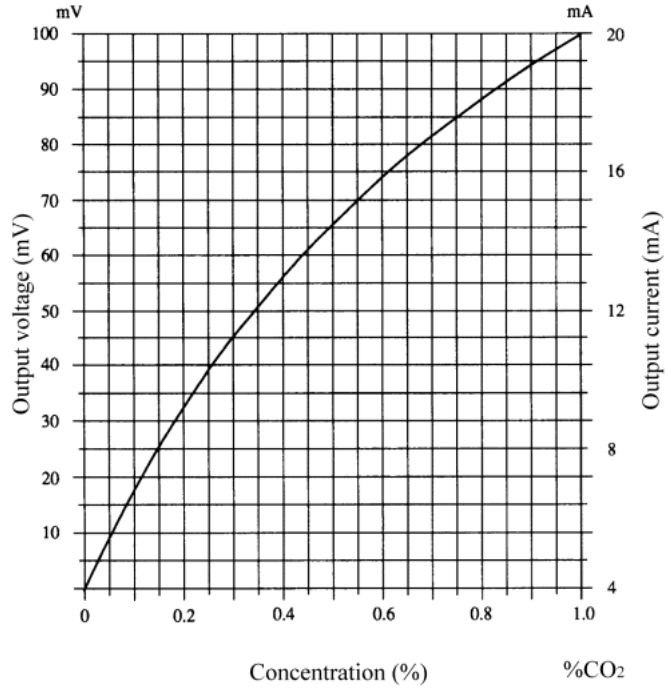
(1) CO_2 gas '0 to 0.2%' controller



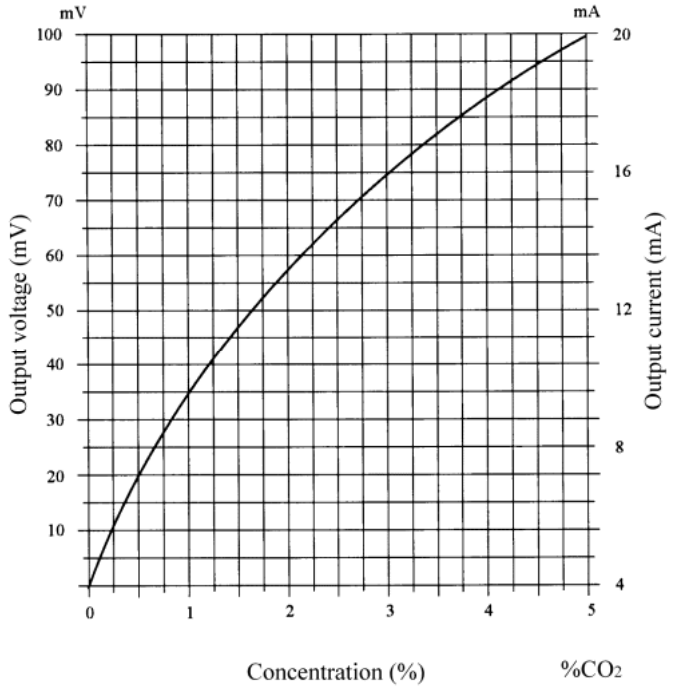
(2) CO_2 gas '0 to 0.3%' controller



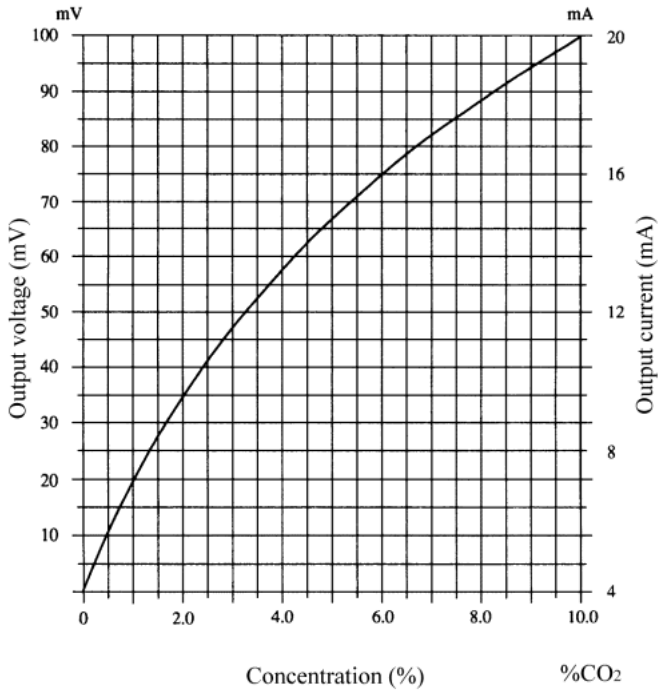
(3) CO_2 gas '0 to 1%' controller



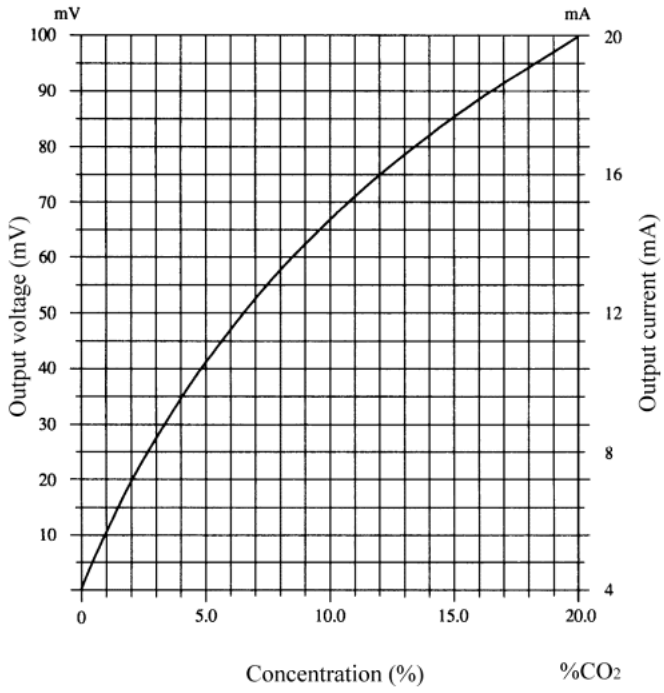
(4) CO_2 gas '0 to 5%' controller



(5) CO_2 gas '0 to 10%' controller



(6) CO_2 gas '0 to 20%' controller



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