Fuji Electric

BIOMASS GAS ANALYZER

DATA SHEET ZPAF

This gas analyzer (ZPAF) can simultaneously measure the concentration of CH_4,CO_2,H_2S and O_2 components in sample gas. CO_2 and CH_4 are measured by non-dispersion infrared method (NDIR), O_2 is measured by fuel cell , and H_2S is measured by constant-potential electrolytic method.
ZPAF provides high-stability and ease-of-maintenance incorporated into a space-saving design. all these features make ZPAF ideal for biogas plants.

FEATURES

1. Compact and lightweight
   133 (H) × 483 (W) × 382 (D) mm, 9 kg
2. Easy maintenance
   Thanks to the use of single-beam system, optical adjustment is not required.
3. User-friendly operation
   Clear and easy-to-read display facilitates operation.
4. Extensive functions
   Various optional functions are available such as auto calibration control, high and low concentration alarms, remote range switch, and range identification signal,etc.

SPECIFICATIONS

Standard Specifications

Principle of measurement:

CH_4, CO_2 ;
Non-dispersion infrared-ray absorption method
Single light source and single beams (single beam system)
O_2 ;Fuel cell O_2 analyzer
H_2S ;Constant-potential electrolytic method

Measurable gas components and measuring range:

	1st range	2nd range
CH_4	0 - 20 vol%	0 - 100 vol%
CO_2	0 - 20 vol%	0 - 100 vol%
H_2S	0 - 500 ppm	0 - 2000 ppm 0 - 5000 ppm
O_2 (Built in fuel cell)	0 - 10 vol%	0 - 25 vol%

- Max. 4 components ncluding O_2.
- Two measurement ranges are provided for each component, and a user can switch between them.

Measured value indication:

Digital indication in 4 digits
(LCD panel with LED back light)

- Instantaneous value of each component

Analog output signals:

4 to 20mA DC or 0 to 1V DC, isolated internally from circuit and ground. Output lines are non-isolated each other.; 12 outputs max.
Allowable load 550Ω for 4 to 20mA DC
Allowable load 100KΩ for 0 to 1V DC

Digital output: (Option)

1c contact (24V DC/1A, resistive load) max.15 outputs
Instrument error, calibration error, range identification, auto calibration status, solenoid valve drive for auto calibration, High/Low limit alarm contact output.
* All relay contacts are isolated mutually and from the internal circuit.

Digital input: (Option)

Voltage contact (supply 12-24VDC (15mA Max.)) Max. 9 inputs
Remote range change over, auto calibration remote start, remote hold, Isolated from the internal circuit with photocoupler.

Power supply:

Voltage rating ; 100V to 240V AC
Allowable range ; 85V to 264V AC
Frequency ; 50Hz/60Hz
Power consumption ; 100VA max.

Ambient temperature:

5˚C to 40˚C (CH_4, CO, and 0-2000 ppm H_2S analyzers)
15˚C to 40˚C (other than the above)

Ambient humidity:

RH 90% max., no condensation

Storage conditions:

Ambient temperature ; –20˚C to 50˚C
Ambient humidity ; 90% RH max., non-condensing

Dimensions (H × W × D):

133 x 483 x 382mm

Mass: Approx. 9 kg max.

Finish color: Front panel; Cool gray (PANTON 1C-F)

Enclosure: Steel casing, for indoor use

Material of gas-contacting parts:
Gas inlet/outlet; SUS304
Sample cell; SUS304,chloroprene rubber
Infrared-ray transmitting window; CaF2
Internal piping;Toaron,Teflon, Polypropylene
Solenoid valve: SUS316, fluororubber
Fuel cell O_2 analyzer cell : ABS resin

Gas inlet/outlet: Rc1/4 or NPT1/4 internal thread

Analyzer purge gas flow rate: 1L/min (Analyzer purge with N_2 or air is indispensable)

Life time of fuel cell O_2 analyzer: 2 years

Life time of constant-potential electrolytic H2S sensor: 1 year (under an average ambient temperature of 35˚C)

Standard Functions

Output signal holding:
Output signals are held unchanged during manual and auto calibrations by activation of holding (turning "ON" its setting).
The values held are those just before start calibration mode or setting value.
Usage is selectable.
Indication of instantaneous values will not be held.

Switch ranges: The switch ranges function is available in manual, auto, and remote modes. Only preset switch method is effective.

Manual: Allows range to switch by key operation.

Auto: Automatically switched from first range to second range when the measured value exceeds 90%FS of first range.
Automatically switched from second range to first range when the measured value drops to 80% or less first range.

Remote: Voltage contact input

(Option) Allows range to switch via an external signal when remote range switch input is received.
When the contact input terminals for each component are input voltage, the first range is selected, and it is switched to the second range when the terminals are open.

* These switch range value are settable between the first range and second range values (low/high range values).

Optional Functions

Remote output holding:
Output signal is held at the last value or preset value by voltage input to the remote output holding input terminals.
Holding is maintained while the voltage is input to the terminals. Indication of instantaneous values are not held.

Range identification signal:
The present measuring range is identified by a contact position.
The contact output terminals close for each component when the first range is selected, and open when the second range is selected.

Auto calibration:
Auto calibration is carried out periodically at the preset cycle.
When a standard gas cylinder for calibration and a solenoid valve for opening/closing the gas flow line are prepared externally by the customer, calibration will be carried out with the solenoid valve drive contacts for zero calibration and each span calibration turned on/off sequentially at the set auto calibration timing.

Auto calibration cycle setting:
Auto calibration cycle is set.
Setting is variable within 1 to 99 hours (in increments of 1 hour) or 1 to 40 days (in increments of 1 day).

Gas flow time setting:
The time for flowing each calibration gas in auto calibration is set.
Settable within 60 to 900 seconds (in increments of 1 second)

Auto calibration remote start:
Auto calibration starts by opening the auto calibration remote start input terminal after short circuiting for 1.5 sec or longer.
Auto calibration starts when contacts open.

Auto zero calibration:
Auto zero calibration is carried out periodically at the preset cycle.
This cycle is independent from "Auto calibration" cycle.
When zero calibration gas and solenoid valve for opening/closing the calibration gas flow line are prepared externally by the customer, zero calibration will be carried out at the set auto zero calibration timing.

Auto zero calibration cycle setting:
Auto zero calibration cycle is set.
Setting is variable within 1 to 99 hours (in increments of 1 hour) or 1 to 40 days (in increments of 1 day)

Gas flow time setting:
The timing for flowing zero gas in auto zero calibration is set.
Settable within 60 to 900 seconds (in increments of 1 second)

High/low limit alarm:
Alarm contact output turns on when measurement value reaches the preset high or low limit alarm value.
Contacts close when the instantaneous value of each channel exceeds the high alarm limit value or falls below the low alarm limit value.

Instrument error contact output:
Contacts turn on at occurrence of analyzer error No. 1, 2, 3 or 10.

Calibration error contact output:
Contacts turn on at occurrence of manual or auto calibration error (any of errors No. 4 to 9).

Auto calibration status contact outputs:
Contacts turn on during auto calibration.

Communication function:

RS-485 (9pins D-sub connector)
Half-duplex bit serial
Start-stop synchronization
Modbus RTU™ protocol
Contents : Read/Write parameters
Read measurement concentration and instrument status
Remark : When connecting via RS-232C interface, an RS-232C ↔ RS-485 converter should be used.

Performance

Repeatability: ±0.5% of full scale (H_2S: ±2.0 %FS)
Linearity: ±1% of full scale (H_2S: ±2.0 %FS)
Zero drift: ±2% of full scale/week
Span drift: ±2% of full scale/week
*H_2S analyzer (0-2000 ppm range): ±2.5 % of FS/week)
*H_2S analyzer (0-5000 ppm range): ±5 % of FS/day)

Response time (for 90% FS response) :

1 to 15 sec electrical response. Within 10-30 seconds including replacement time of sampling gas.
*H_2S analyzer (0-2000 ppm range): within 180 s
*H_2S analyzer (0-5000 ppm range): within 300 s

EC Directive Compliance

The product conforms to the requirements of the Low Voltage Directive 2006/95/EC and EMC directive 89/336/EEC (as amended by Directive 92/31/EEC), both as amended by Directive 93/68/EEC.
It conforms to following standards for product safety and electromagnetic compatibility ;

EN61010-1:2010,EN62311:2008
Safety requirements for electrical equipment for measurement, control and laboratory use.
"Installation Category II"
"Pollution Degree 2"
EN61326-1:2006, EN61326-2-3:2006,
EN61000-3-2:2006, A1:2009,A2:2009
EN61000-3-3:2008
Electrical equipment for measurement, control and laboratory use — EMC requirements.
CE

Requirements for Sample Gas

Flow rate: 0.5 ±0.2L / min (including purge gas for H_2S measurement)
Temperature: 10 to 50˚C
Pressure: 10 kPa or less (Gas outlet side should be open to the atmospheric air.)
Dust: 100 µg/Nm^3 or less in particle size of 0.3 µm or smaller
Mist: Unallowable
Moisture: Less than the content saturated at 2°C
Corrosive component: 1 ppm or less
(H_2S scrubber is required on pipings for NDIR and O_2 measurement.)

Standard gas for calibration:

1) Infrared-ray measurable component, standard O_2
Zero gas ; Dry air
Span gas ; Each sample gas having concentration 90 to 100% of its measuring range (recommended).
2) H_2S measurement
Zero gas: air *
Span gas: concentration of 90 to 100 % of its measuring range
Purge gas: air *
*Use moist air saturated at the temperature from 2°C through room temperature. Do not use air which includes H_2S nor dry air saturated below 2°C.

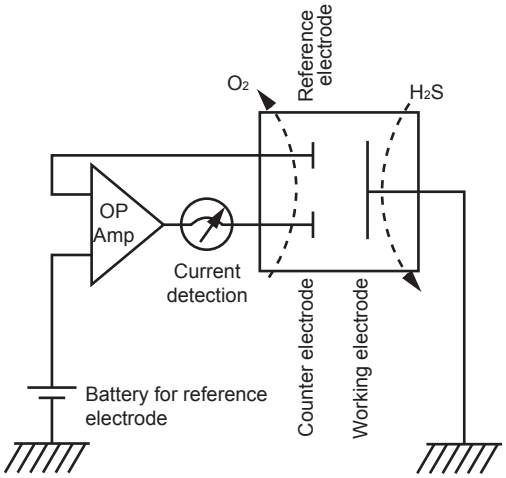
Installation Requirements

- Indoor use (Select a place where the equipment does not receive direct sunlight, draft/rain or radiation from hot substances. If such a place cannot be found, a roof or cover should be prepared for protection.)
- Avoid a place where unit receives heavy vibration
- Select a place where atmospheric air is clean
- Analyzer purge with N_2 or air is indispensable.
- Handle H_2S with great care as it is toxic, flammable, and corrosive.
- For safety, install an H_2S alarm around the analyzer.

Items to be Prepared Saparately

- Constant-potential electrolytic H_2S sensor (for replacement):
  TQ503691C1 (for 0-2000 ppm range)
  TQ503691C3 (for 0-5000 ppm range)
- Galvanic O_2 sensor (for replacement): TQ503691C2

Principle diagram of constant-potential electrolytic measurement (For H_2S)

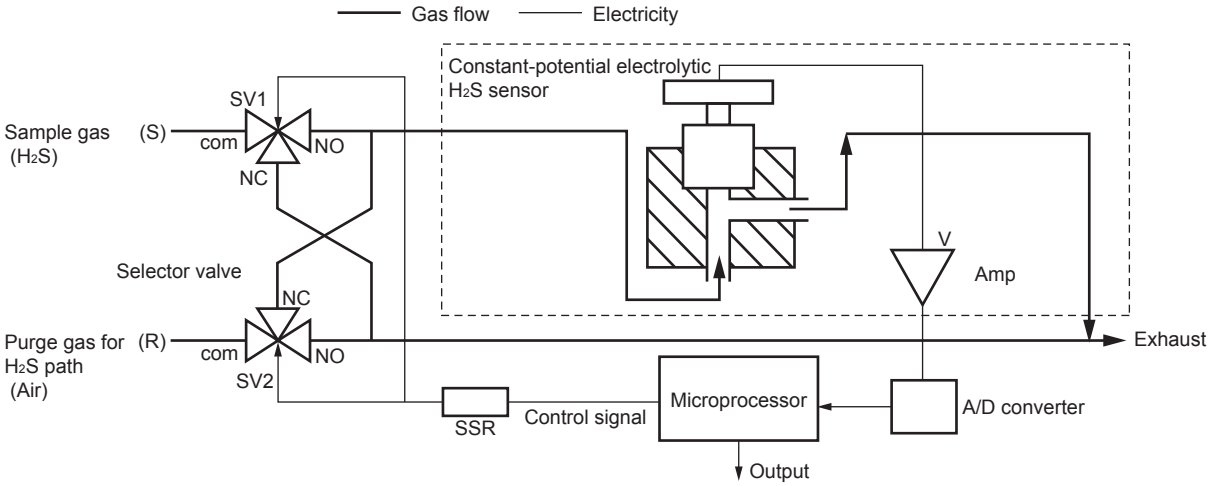


(1) Reaction at the working electrode
$H_2S + 4H_2O \rightarrow H_2SO_4 + 8H^+ + 8e^-$

(2) Reaction at the counter electrode
$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$

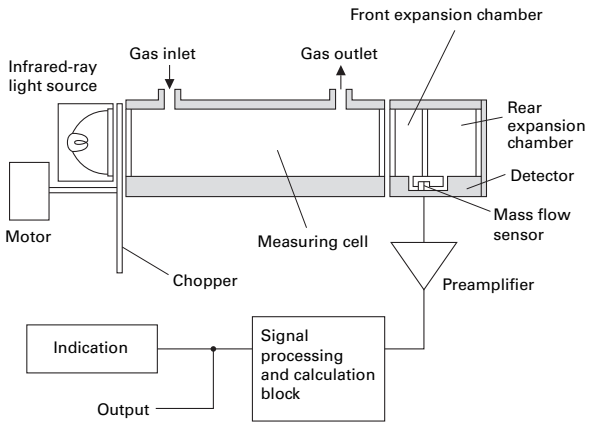
(3) Total reaction
$H_2S + 2O_2 \rightarrow H_2SO_4$

Principle diagram of H_2S measurement

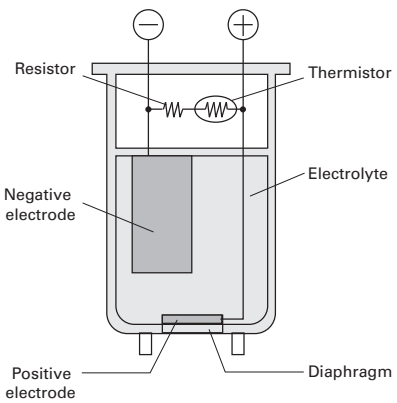


As the H_2S sensor uses constant-potential electrolytic method, there must be oxygen included in the sample gas. Therefore, air is supplied to the sensor at regular intervals to enable gas analysis in biogas plants where oxygen is absent, and thus stable readings are provided.

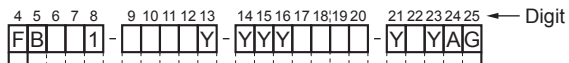
Principle diagram of NDIR type measurement (For CO_2, CH_4)



Principle diagram of fuel cell type measurment (For O_2)



CODE SYMBOLS



Digit	Description		Note
4	Specification	Biomas gas	F
5	Installation	19-inch rack mounting	B
6	Measured component (CH_4, CO_2)	None CO_2 (1st component) CH_4 (1st component) CO_2 (1st component) + CH_4 (2nd component)	Y D E L
7	Measured component (O_2, H_2S)	H_2S O_2 + H_2S	6 7
8	Revision code		1
9	Measuring range (1st component, 1st range)	None 0 to 20 vol.%	Y N
10	Measuring range (1st component, 2nd range)	None 0 to 100 vol.%	Y R
11	Measuring range (2nd component, 1st range)	None 0 to 20 vol.%	Y N
12	Measuring range (2nd component, 2nd range)	None 0 to 100 vol.%	Y R
13	–		Y
14	–		Y
15	–		Y
16	–		Y
17	Measuring range (O_2, H_2S)	0 to 10/25 vol.% O_2 0 to 500ppm/2000ppm H_2S 0 to 500ppm/5000ppm H_2S C+T C+V	C T V U W
18	Gas connection	Rc1/4 NPT 1/4	1 2
19	Output signal	0 to 1V DC 4 to 20mA DC 0 to 1V DC + RS-485 communication 4 to 20mA DC + RS-485 communication	A B C D
20	Language/Power cable	Japanese/cable rated 125 V (PSE) English/cable rated 125 V (UL) English/cable rated 250 V (CEE) Chinese/cable rated 250 V (CCC)	J E U C
21	–		Y
22	Optional functions (DIO)	FAULT / Auto calibration / H/L alarm / Range ID/ Remote range – – – – ○ – – – ○ ○ – – ○ – ○ – ○ – – ○ ○ ○ ○ – ○ – ○ ○ ○ ○ – ○ ○ ○ ○ ○	Y A B C D E F G H
23	–		Y
24	Unit	ppm, vol.%	A
25	Adjustment	For biogas	G

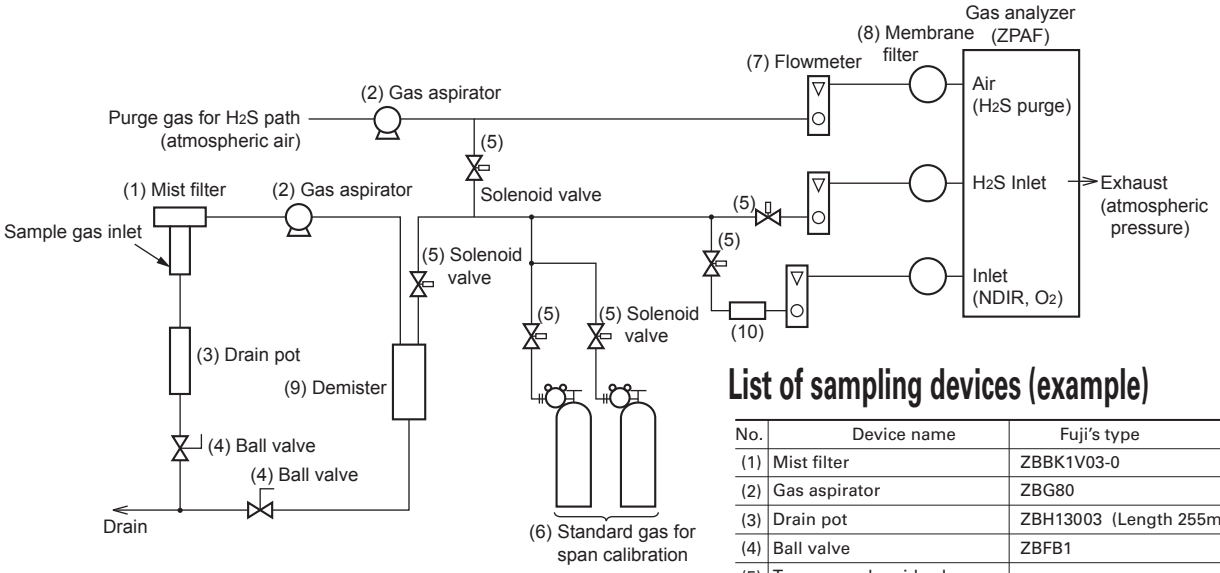
Component	1st range	2nd range
CH_4	0 to 20 vol.%	0 to 100 vol.%
CO_2	0 to 20 vol.%	0 to 100 vol.%
H_2S	0 to 500 ppm	0 to 2000 ppm 0 to 5000 ppm
O_2	0 to 10 vol.%	0 to 25 vol.%

SCOPE OF DELIVERY

Item	Q'ty	Note
Gas analyzer	1	
Replacement fuse	2	250 V AC/2A, delay type
Connector for analog output	1	D-sub connector, 25-pin, male
Connector for digital I/O	1	D-sub connector, 25-pin, male
RS-485 connector	1	D-sub connector, 9-pin, male
Power cable (2m)	1	of specified rating

Examples of sampling system configuration including gas analyzer (for reference only)

To measure low moisture content (saturated at room temperature or lower) sample gas (CO, CO_2, CH_4)



List of sampling devices (example)

No.	Device name	Fuji's type
(1)	Mist filter	ZBBK1V03-0
(2)	Gas aspirator	ZBG80
(3)	Drain pot	ZBH13003 (Length 255mm)
(4)	Ball valve	ZBFB1
(5)	Two-way solenoid valve	
(6)	Standard gas for calibration	ZBM□Y04-0□ (Codes in □ to be selected depending on application)
(7)	Flow meter	ZBD42203
(8)	Membrane filter	ZBBM2V03-0
(9)	Demister	ZBH35003
(10)	H_2S scrubber	ZBBB4V03

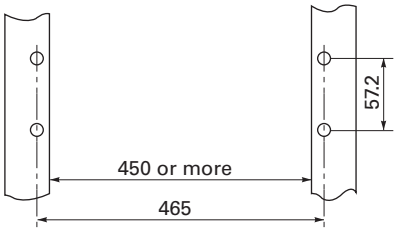
Note) The above is a typical configuration example.
As configuration may differ depending on measuring objects, please consult us.

Mounting method

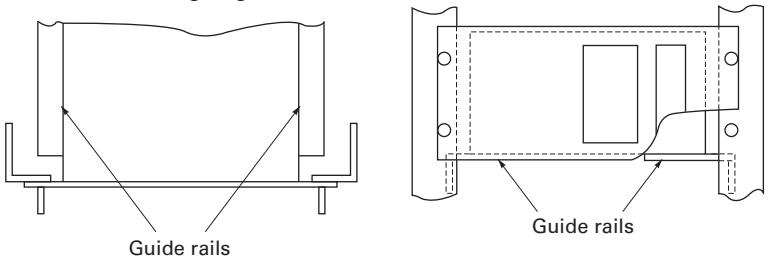
The analyzer weight should be supported at the bottom of the case.

19-inch rack mounting type

<Rack dimensions>

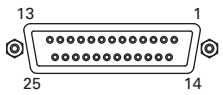


Mounting diagram



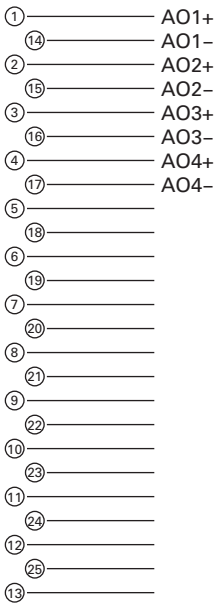
EXTERNAL CONNECTION

<Analog output> A/O connector

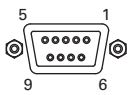


D-sub 25pins female

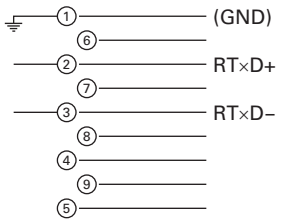
* In standard, displayed Channel No. and Analog Output No. are same.



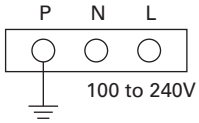
<RS485 communication signal>



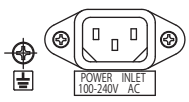
D-sub 9pins female



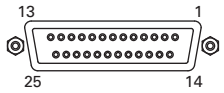
<Screw terminal (M4)>



<Power inlet>

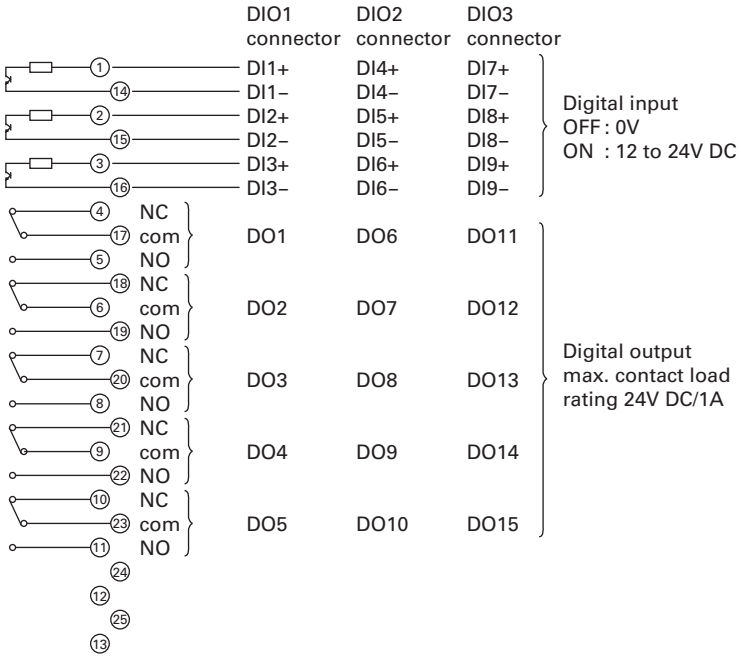


<Digital I/O> DIO 1 to 3 connector (option)



D-sub 25pins female

* DIO 1 to 3 are all as same connector.



Contents of digital input signal

DI1	Remote hold
DI2	Average value reset
DI3	A. cal. start
DI4	A. zero. cal. start
DI5	Remote range Ch1
DI6	Remote range Ch2
DI7	Remote range Ch3
DI8	Remote range Ch4
DI9	Remote range Ch5

Allocation table of digital input signal

22th digit →	A	B	C	D	E	F	G	H	Y
DI1	○	○	○	○	○	○	○	○	
DI2	○	○	○	○	○	○	○	○	
DI3		○			○		○	○	
DI4		○			○		○	○	
DI5				○		○	○	○	
DI6				○*		○*	○*	○*	
DI7				○*		○*	○*	○*	
DI8				○*		○*	○*	○*	
DI9				○*		○*	○*	○*	

○ sign shows the function is valid.
* : The function might be invalid depending on the number of measurable components.
For example: DI5 corresponds to 1st component, DI6 corresponds to 2nd components.

Contents of digital output signal

	Independent on the number of component	1-component analyzer		2-component analyzer	3-component analyzer
22th digit →	A, C	B, E	D, F, G, H	B, D, E, F, G, H	B, D, E, F, G, H
DO1	Instrument error	Instrument error	Instrument error	Instrument error	Instrument error
DO2	Calibration error	Calibration error	Calibration error	Calibration error	Calibration error
DO3		A.cal.status	(A.cal.status)	(A.cal.status)	(A.cal.status)
DO4		For zero gas	(For zero gas)	(For zero gas)	(For zero gas)
DO5		For span gas Ch1	(For span gas Ch1)	(For span gas Ch1)	(For span gas Ch1)
DO6	(Alarm1)	(Alarm1)		(For span gas Ch2)	(For span gas Ch2)
DO7	(Alarm2)	(Alarm2)			(For span gas Ch3)
DO8	(Alarm3)	(Alarm3)			(Range identification Ch1)
DO9	(Alarm4)	(Alarm4)		(Range identification Ch1)	(Range identification Ch2)
DO10	(Alarm5)	(Alarm5)	Range identification Ch1	(Range identification Ch2)	(Range identification Ch3)
DO11			(Alarm1)	(Alarm1)	(Alarm1)
DO12			(Alarm2)	(Alarm2)	(Alarm2)
DO13			(Alarm3)	(Alarm3)	(Alarm3)
DO14			(Alarm4)	(Alarm4)	(Alarm4)
DO15			(Alarm5)	(Alarm5)	(Alarm5)

	4-component analyzer			
22th digit →	B, E	D, F	G	H
DO1	Instrument error	Instrument error	Instrument error	Instrument error
DO2	Calibration error	Calibration error	Calibration error	Calibration error
DO3	A.cal.status		A.cal.status	A.cal.status
DO4	For zero gas		For zero gas	For zero gas
DO5	For span gas Ch1		For span gas Ch1	For span gas Ch1
DO6	For span gas Ch2		For span gas Ch2	For span gas Ch2
DO7	For span gas Ch3	Range identification Ch1	For span gas Ch3	For span gas Ch3
DO8	For span gas Ch4	Range identification Ch2	For span gas Ch4	For span gas Ch4
DO9		Range identification Ch3		Range identification Ch1
DO10		Range identification Ch4		Range identification Ch2
DO11	(Alarm1)	(Alarm1)		(Alarm1)
DO12	(Alarm2)	(Alarm2)	Range identification Ch1	(Alarm2)
DO13	(Alarm3)	(Alarm3)	Range identification Ch2	(Alarm3)
DO14	(Alarm4)	(Alarm4)	Range identification Ch3	Range identification Ch3
DO15	(Alarm5)	(Alarm5)	Range identification Ch4	Range identification Ch4

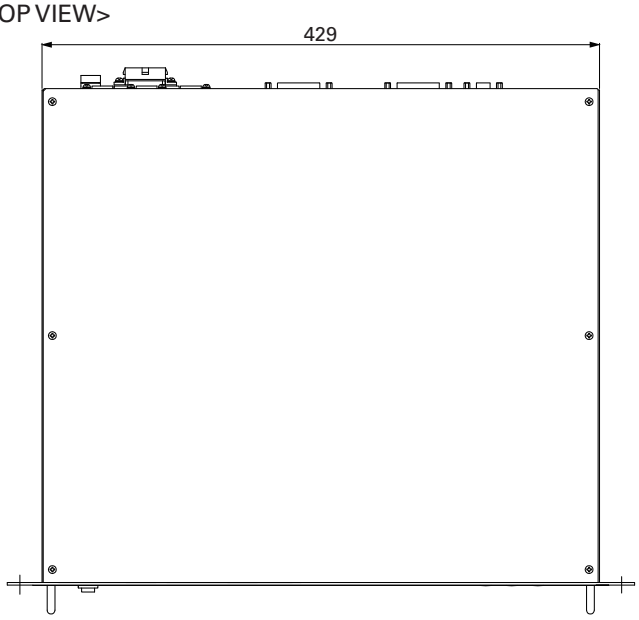
The items in the parentheses may not be available depending on the selected type on 22th digit.

The normal open side (NO) of digital output is close when the function is active without range ID.

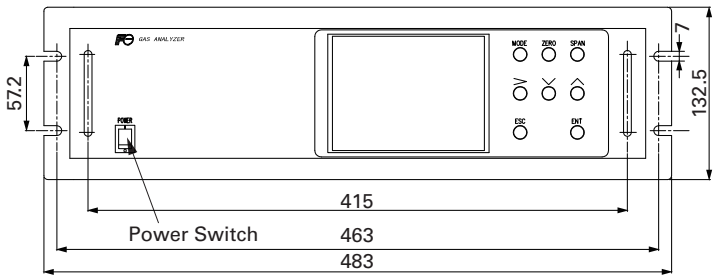
In case of range ID, normal open (NO) side is close with First range.
The normal close (NC) side is close with Second range.

OUTLINE DIAGRAMS (Unit : mm)

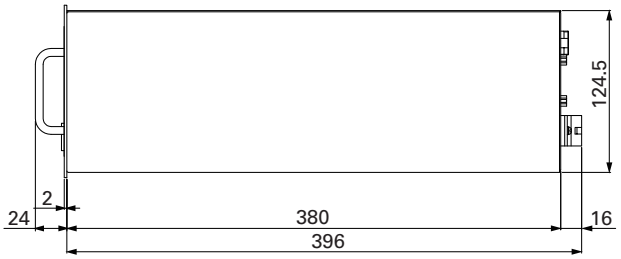
<TOP VIEW>



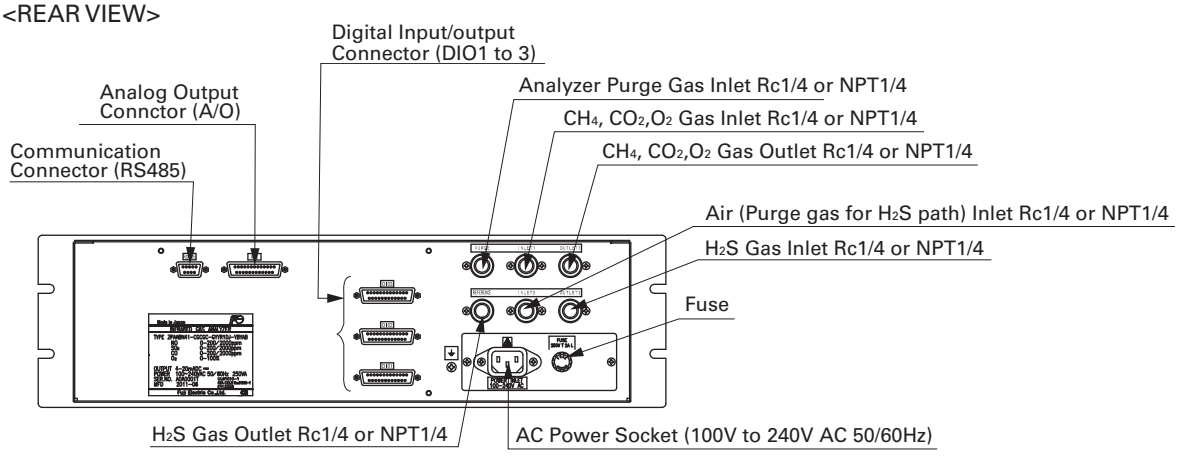
<FRONT VIEW>



<SIDE VIEW>



<REAR VIEW>



⚠ Caution on Safety

*Before using this product, be sure to read its instruction manual in advance.

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