

THERMAL CONDUCTIVITY GAS ANALYZER <THERMOMAT>

DATA SHEET

ZAF-3

Thermal conductivity gas analyzer is a gas analyzer which quantitatively measures gas concentration by utilizing a causal relationship that the temperature of a heated platinum wire changes with gas concentration.

The analyzer continuously measures the concentration of gases such as H₂, He, and Ar with high stability.

FEATURES

1. Easy-to-see large LCD is helpful for efficient operation.
2. Measured value is output as a linearized output signal.
3. Line voltage lies within 100 V to 240 V AC, 50/60 Hz.
4. External dimensions are the same as those of the preceding type.
5. Zero point and span can be automatically calibrated (at option).
6. Other gases' interference is correctable (at option).
7. Communicable with other system through an RS-232C interface (MODBUS™)(at option).

SPECIFICATIONS

Standard Specifications

- Measuring principle:**
Measurement of thermal conductivity
- Measurable component:**
He, Ar, H₂, CH₄, CO₂
- Measurable range:**
Refer to Table 1
- Output signal:** 4 to 20 mA DC, 0 to 1 V DC, 0 to 10 mV DC
Isolated output
(Any one-output signal specifiable in CODE SYMBOLS)
- Allowable load resistance:**
550 Ω max. (in 4 to 20 mA DC output)
- Output resistance:**
100 kΩ (in 0 to 1 V DC or 0 to 10 mV DC output)
- Display unit:** LCD with backlight
- Display of measured value:**
Max. 4 digits
- Display language:**
English
- Output signal holding:**
In both manual and automatic calibrations, output value just before calibration can be held.
- Power supply:** 100 to 240 V AC, 50/60 Hz
- Power consumption:**
Approx. 50 VA
- Warm-up time:** At least 30 min
- Ambient temperature:**
-5 to 45°C



Ambient humidity:

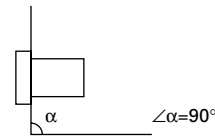
Less than 90% RH (condensation unallowable)

Storage conditions:

-20 to 60°C, less than 95% RH (condensation unallowable)

Mounting:

Flush mounting on panel



External dimensions (H x W x D):

240 x 192 x 213 mm

Mass:

Approx. 5 kg

Finish color:

Off-white (equivalent to 10Y7.5/0.5)

Housing:

Steel-plate case, indoor use type

Material of gas-contacting parts:

JIS SUS304, platinum, platinum iridium, silver, fluororubber, epoxy resin, nickel, tin

Gas inlet/outlet, purge port:

Rc1/4 or NPT1/4 (whichever specified)

External connection terminal:

M3.5 screw terminal (9-pin D-sub connector for RS-232C)

Purge gas flow rate:

Approx. 1 L/min (for measurement of combustible gases)

Performance

Repeatability: ±1% of F.S.

Linearity: ±2% of F.S.

Drift: Zero point : within ±2% of full scale/week (H₂ meter, reference gas N₂)

Span : within ±2% of full scale/week (H₂ meter, reference gas N₂)

Response time (90% response):

High speed within 10 sec (at flow rate 1L/min, allowed only for H₂ meter (reference gas N₂, without interference compensation)
Standard within 60 sec (at flow rate 0.4 L/min)

Other gases' interference:

Indication error of each measured value (vol%)

| Interference component | H ₂ meter | CH ₄ meter | Ar meter | CO ₂ meter |
|-----------------------------------|----------------------|-----------------------|----------|-----------------------|
| H ₂ 1% | - | +5.8 | -6.5 | -8.0 |
| CH ₄ 1% | +0.17 | - | -1.15 | -1.38 |
| SO ₂ 1% | -0.31 | -1.8 | +2.1 | +2.5 |
| Ar 1% | -0.15 | -0.87 | - | +1.2 |
| CO ₂ 1% | -0.125 | -0.725 | +0.83 | - |
| O ₂ 1% | +0.019 | +0.11 | -0.125 | -0.15 |
| H ₂ O 1.5°C saturation | - | - | - | -0.56 |

Standard Gas Measurement Conditions

Temperature: 0 to 50°C
Gas flow rate: Constant at 0.4 ± 0.05 L/min
 Constant at 1 ± 0.05 L/min(High response)
Dust: Less than 100 µg/Nm³ with a particle size of 0.3 µm max
Pressure: 10 kPa max
Mist: Unallowable
Oxygen gas: No oxygen should be contained in measured combustible gases.
Moisture: Below saturation at 2°C
Corrosive gas: Unallowable
Standard gases for calibration:
 Zero gas : same as reference gas or as specified
 Span gas : Concentration within 90 to 100% of measuring range (Positive range)
 Concentration beyond 100% is inapplicable

Installation Conditions

- The analyzer should not be exposed to direct sunlight or radiation from a hot object.
- A place subjected to heavy vibrations should be avoided. A location with clean atmosphere should be selected.
- Before measuring combustible gases, the existing gases should be purged from the analyzer using air or N₂.
- When the analyzer is installed outdoors, it should be sheltered with a housing or cover to protect it from rain and wind.

Optional Specifications

Relay contact output:

5 SPST relay contact outputs
 Relay contact capacity; 220 V AC/2 A (resistive load)
 Isolated with relay between contacts, and between contacts and internal circuit.
 Max. 5 points are selectable among those listed below.
 <1> Zero-side solenoid valve drive output for automatic calibration
 <2> Span-side solenoid valve drive output for automatic calibration

- <3> Suction pump OFF output in automatic calibration (reray "ON" immediately after turning on power supply)
- <4> Upper limit (1 point) concentration alarm output
- <5> Lower limit (1 point) concentration alarm output
- <6> Upper/Lower limit (1 point) concentration alarm output
- <7> Upper limit (1 point) and lower limit (1 point) concentration alarm output (Total 2 points)
- <8> High-high limit (1 point at each step) concentration alarm output (Total 2 points)
- <9> Low-low limit (1 point at each step) concentration alarm output (Total 2 points)
- <10> Analyzer error or automatic calibration error alarm output
- <11> Calibrating status output
- <12> Range information output (only with 2-range meter)

Contact input:

3 non-voltage contact inputs
 ON; 0 V, OFF; 5 V DC, current at ON; 5 mA
 Isolated with photo coupler between inputs and internal circuit. Not isolated between contact inputs.
 The following actions can be input
 <1> Remote holding of measured value output
 <2> Remote range changeover (only with 2-range meter)
 <3> Remote start of automatic calibration

Interference gas measured value input:

Analog input for H₂ meter interference correction (1 to 5 V DC, 1 range)
 Either CO₂ or CH₄ component of an external gas analyzer is to be input.
 Adjustment is required at Fuji Electric's factory.
 Details of measurement gas will be checked when receiving an order.

Automatic calibration function:

Zero and span calibrations are automatically carried out at the predetermined intervals.
 Calibration gases are flowed sequentially by driving the externally installed solenoid valves.

Communicating function:

RS-232C (9-pin D-sub output)
 Half duplex, asynchronous
 MODBUS™ protocol, communication
 speed 9600 bps

Contents of communication:

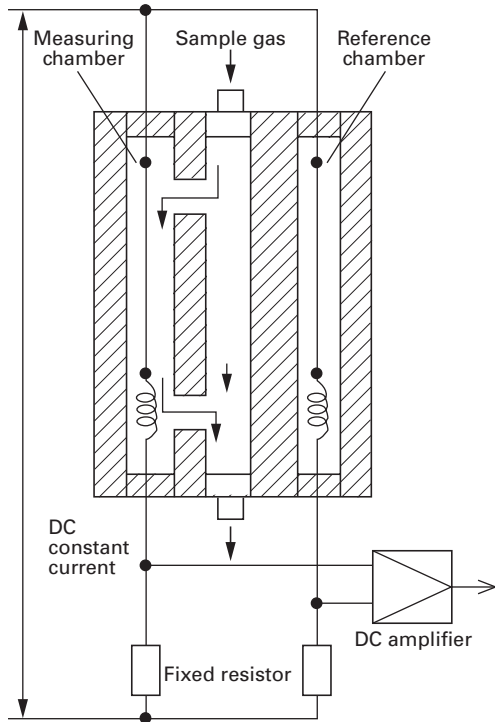
Reading/writing of measured concentration values and various set values, and output of device status

Remarks: For connection in RS-485, RS-232C/RS-485 converter should be provided separately

Explanation of Functions

| | |
|--|---|
| Output signal holding | When holding is set (user setting is turned ON), the latest measured value output just before output signal holding will be held during manual or automatic calibration, or by remote output holding input. In this status, indicated values will not be held. |
| Remote output holding input | Upon short-circuiting the remote output holding input terminal when holding is set (user setting is turned ON), the latest measured value output will be held. Holding continues while the contact input terminal is close-circuited. In this period, indicated values will not be held. |
| Remote range changeover input | When remote range setting is selected (user setting is turned ON) for two rang type, range will be changed over according to the external signal input (non-voltage contact) applied to the remote range changeover input terminal. In this mode, range cannot be changed manually. When close-circuiting the contact input terminal, the first range is selected, and the second range is selected at open circuit. |
| Range identification signal output | With two rang type, the current measuring range identification is output in contact signal. The contact output terminal is closed for the first range, and open for the second range. |
| Automatic calibration | Zero and span calibrations are automatically carried out by outputting the signal for driving the externally installed solenoid valves for calibration gases at the set start time and interval or through input of the remote calibration start signal. <ul style="list-style-type: none"> • Calibration channel: 1 component • Calibration accuracy: $\pm 0.2\%$ of F.S. • Zero calibration point settable range: 0 to 100% of F.S. • Span calibration point settable range: 1 to 100% of F.S. • Calibration interval settable range: 1 to 99 hours (1 hour step) or 1 to 40 days (1 day step) • Calibration gas injection time settable range: 60 to 599 sec (in sec) • Calibration start: Internal timer or remote calibration start input • Solenoid valve drive signal output: SPST contact (zero x 1, span x 1) • Suction pump OFF output in calibration: SPST contact (suction pump OFF x 1) • Remote calibration start input: No-voltage contact input Automatic calibration is started by applying a non-voltage rectangular wave to the remote calibration start input terminal (opened after close-circuiting for 1.5 sec or longer). When contacts open, automatic calibration is carried out once. <ul style="list-style-type: none"> • Automatic calibration error alarm output: SPST contact Contacts close when the quantity of zero or span calibration exceeds 50% of full scale from the level of previous calibration, and contacts open when there is no abnormalities. When automatic calibration is abnormal, measurement output depends on the previous calibration values. <ul style="list-style-type: none"> • Automatic calibration status output: SPST contact During automatic calibration, contacts close, and open when within 50%. |
| Upper/lower limit, upper limit and lower limit alarm output | Alarm contact output is issued with reference to the set upper/lower limit for alarm. Hysteresis is settable. When measuring value exceed alarm setting value, contacts close, and open when not exceeded. SPST contact |
| Analyzer error | When the analyzer or automatic calibration is abnormal, contacts close, and open when normal. SPST contact |
| Interference correction by interference gas measured value input | Correction is made using either CO ₂ or CH ₄ component for H ₂ measurement. Measured H ₂ gas concentration is corrected in response to a concentration change of interference gas within its concentration range measured and set in advance. External interference gas measured value input : 1 to 5 V DC, 1range Interference gas fluctuation range : Reference concentration $\pm 20\%$ F.S. H ₂ gas concentration correcting range : Reference concentration $\pm 25\%$ F.S. Correction accuracy : $\pm 5\%$ F.S. (Note 1) Enter in the sample gas component check list on the back cover. (Note 2) Correction accuracy value is larger when other interference gas is contained in the sample gas. |

MEASURING PRINCIPLE



This thermal conductivity gas analyzer measures gas concentration by utilizing the different thermal conductivities of 2 gas components. In the detector, there are reference and measuring chambers in each of which a thin platinum wire is stretched. The reference chamber is filled with reference gas and through the measuring chamber, sample gas is flowed. Each platinum wire composes a bridge circuit in combination with an external fixed resistor, and it is heated by flowing a constant current. When there is a change in the concentration of the component under measurement, the thermal conductivity of sample gas will change to affect the temperature of the platinum wire in the measuring chamber. The resulting thermal change is taken out as a change in electric resistance, according to which the concentration of measured gas is calculated.

Thermal Conductivity Ratio of Gases

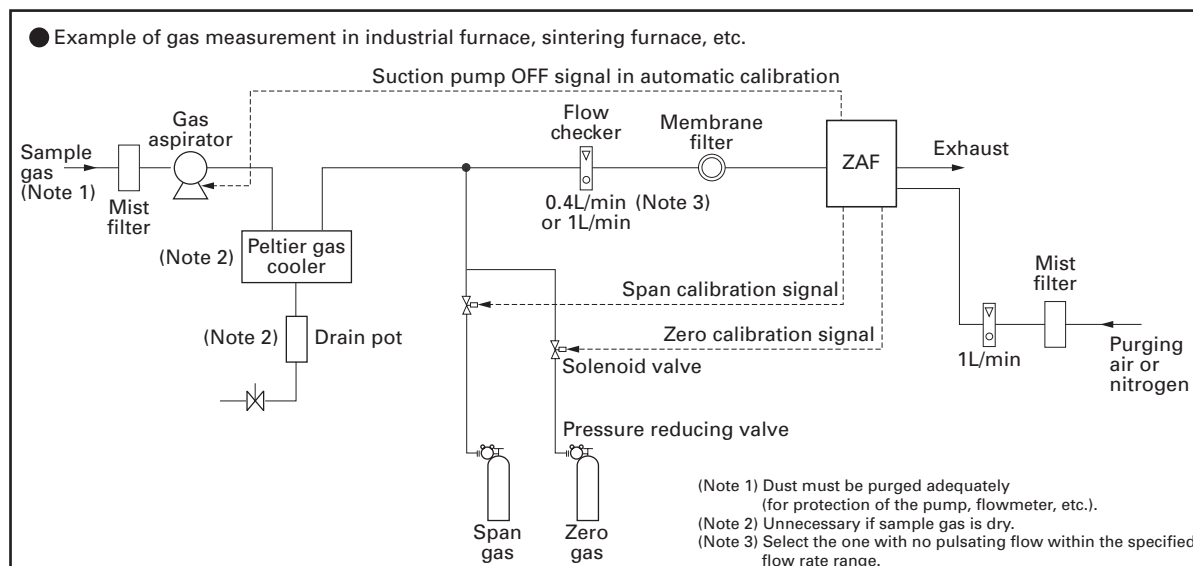
| Gases | Comparative thermal conductivity (0°C) when replacing thermal conductivity of air ($2.41 \times 10^{-2} \text{ w/(m.k)}$) with 1 |
|------------------------------------|--|
| Sulfur dioxide gas SO ₂ | 0.5 |
| Carbon dioxide gas CO ₂ | 0.7 |
| Argon Ar | 0.8 |
| Carbon monoxide CO | 0.9 |
| Steam (100°C) H ₂ O | 1.0 |
| Air | 1.0 |
| Nitrogen N ₂ | 1.1 |
| Oxygen O ₂ | 1.2 |
| Methane CH ₄ | 1.5 |
| Hydrogen H ₂ | 2.0 |

Table 1: Measurable Component and Measurable Range

| Measured gas | Reference gas component (Note 1) | Measurable range | Range ratio(Note 2) |
|-----------------|---|---|---------------------|
| H ₂ | N ₂ , (CO ₂ , Ar, He) | 0 to 3, 5, 10, 20, 50, 80, 100% 100 to 90, 100 to 80% | 1 : 10 |
| He | N ₂ , (CO ₂ , Ar) O ₂ , Air | 0 to 5, 10, 20, 30, 40, 50, 80, 100% 100 to 90, 100 to 80% | 1 : 10 |
| Ar | N ₂ , O ₂ , Air, (He) | 0 to 10, 20, 50, 80, 100% 100 to 90, 100 to 80% | 1 : 5 |
| CH ₄ | N ₂ , (CO ₂ , Ar, He) | 0 to 20, 40, 50, 60, 80, 100% 100 to 80% | 1 : 5 |
| CO ₂ | N ₂ , O ₂ , Air, (He) | 0 to 10, 20, 50, 100% 100 to 90, 80% | 1 : 5 |

(Note 1) Contact us for the components in the parentheses. H₂ contained in O₂ cannot be measured.
 (Note 2) Range ratio stands for maximum value.

GAS SAMPLING SYSTEM DIAGRAM (EXAMPLE)



CODE SYMBOLS

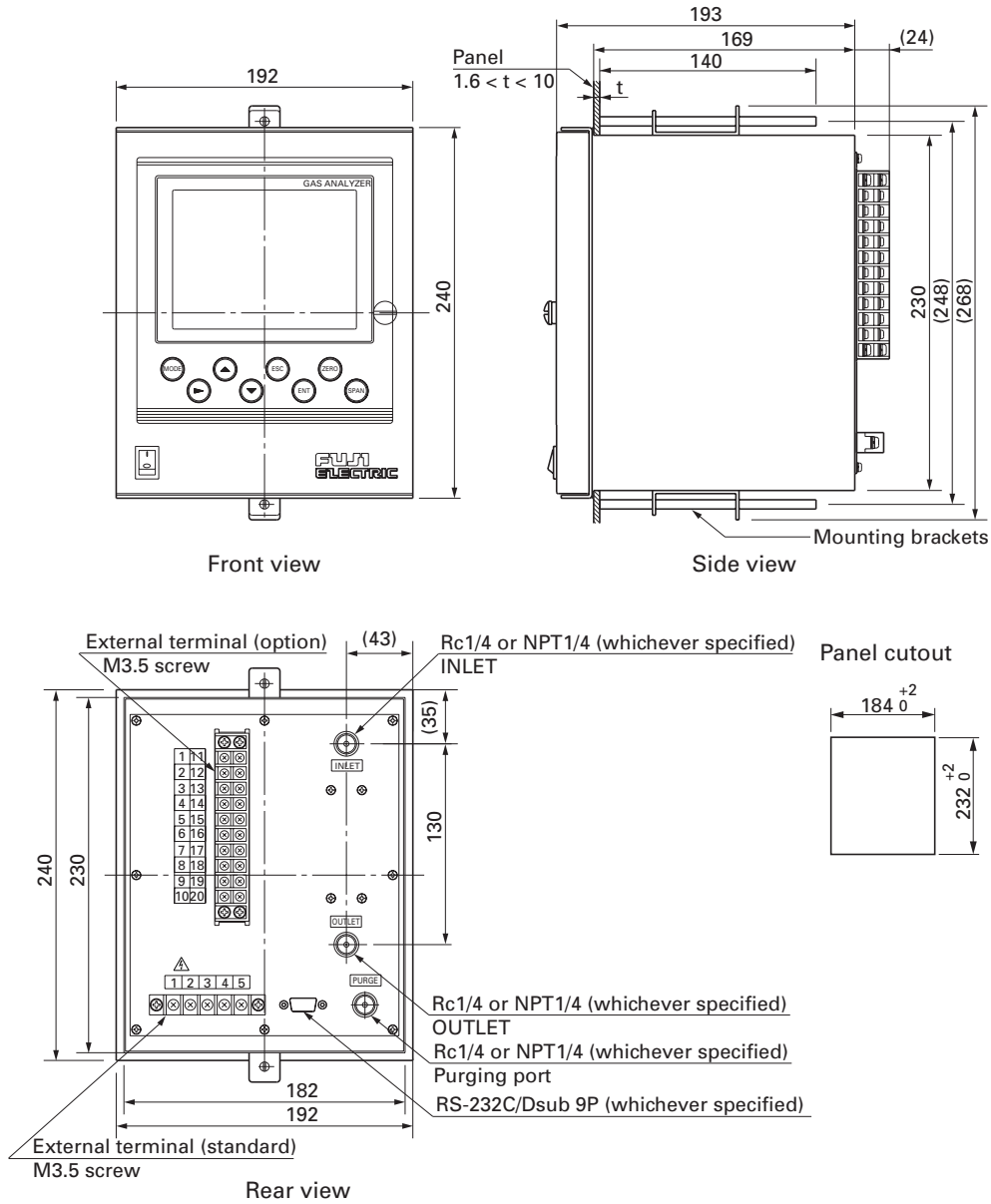
| Digit | Description | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | | | | | | | |
|-------|---|---|---|---|---|---|---|----|----|----|----|----|---|---|---|---|---|---|---|
| 4 | <Indication, response> (Note 1) Indication in English, standard response Indication in English, high-speed response | E | H | | | | | | | | | | | | | | | | |
| 5 | <Measured component> H ₂ Ar He CH ₄ CO ₂ (reference gas Ar unallowable) Other | K | L | M | E | A | Z | | | | | | | | | | | | |
| 6 | <Reference gas> (Note 2) N ₂ Air (incompatible with H ₂ /CH ₄ measurement) O ₂ (incompatible with H ₂ /CH ₄ measurement) Other | 4 | 5 | 6 | Z | | | | | | | | | | | | | | |
| 7 | <Power supply, connection port size> AC100 to 240V 50/60Hz, Rc1/4 AC100 to 240V 50/60Hz, NPT1/4 | | | | 0 | 1 | | | | | | | | | | | | | |
| 8 | <Revision No.> | | | | | 3 | | | | | | | | | | | | | |
| 9 | <Measuring range (1st range)> 0 to 3% (H ₂) 0 to 5% (H ₂ , He) 0 to 10% (H ₂ , He, Ar, CO ₂) 0 to 20% 0 to 30% 0 to 50% 0 to 80% 0 to 100% 100 to 90% (H ₂ , He, Ar) 100 to 80% (H ₂ , He, Ar, CH ₄) Other | | | | | | Q | L | M | N | V | P | T | J | 9 | 8 | Z | | |
| 10 | <Measuring range (2nd range)> (Note 3) None 0 to 5% (H ₂ , He) 0 to 10% (H ₂ , He, Ar) 0 to 20% (H ₂ , He, Ar, CO ₂) 0 to 30% 0 to 50% 0 to 80% 0 to 100% Other | | | | | | Y | L | M | N | V | P | T | J | Z | | | | |
| 11 | <Measured value output> DC4 to 20 mA DC0 to 1V DC4 to 20 mA + RS-232C communication DC 0 to 1 V DC + RS-232C communication DC0 to 10mV | | | | | | | | A | B | C | D | E | | | | | | |
| 12 | <Linearization> (Note 4) Provided | | | | | | | | A | | | | | | | | | | |
| 13 | <H ₂ meter interference corrective calculation> (Note 5) None Provided | | | | | | | | | | Y | A | | | | | | | |
| 14 | <Input/output contacts> None Automatic calibration Automatic calibration Concentration alarm Concentration alarm Contact output selection Contact output selection | | | | | | | | | | | | Y | A | B | C | D | E | F |

(Note 1) High-speed response is for H₂ meter used for reference gas N₂ only.
 (Note 2) Reference gas refers to gas other than the component to be measured in sample gas. ("Z" must be specified when interference gas is to be contained.)
 (Note 3) The ratio of maximum range to the first range is as given below.
 For CO₂, Ar or CH₄ measurement : 1st range x 5 (times)
 For He or H₂ measurement : 1st range x 10 (times)
 A range from 0 to ...% cannot be combined with that from 100 to ...%.
 1st range < 2nd range
 (Note 4) Specify Y if linearization in the 12th digit is not required.
 (Note 5) A CO₂ or CH₄ meter needs to be prepared separately. A reverse range such as 100 to 0% cannot be specified. Input signal is 1 to 5 V DC. Adjustment is required at Fuji Electric's factory. Details of measurement gas will be checked when receiving an order. Reverse range such as 100% to 0% cannot be specified. Cannot be specified if high-speed response is selected.

| Input/output contact specifications | | | 14th digit : A | 14th digit : B | 14th digit : C | 14th digit : D | 14th digit : E | 14th digit : F |
|---|---|---|-----------------------|---|---|---|---|----------------|
| | | | Automatic calibration | Concentration alarm | Concentration alarm | Concentration alarm | Contact output selection (Note 7) | |
| Contact output | Automatic calibration | Zero gas valve drive | ○ (DO1) | ○ (DO1) | — | — | ○ | ○ |
| | | Span gas valve drive | ○ (DO2) | ○ (DO2) | — | — | ○ | ○ |
| | | Suction pump OFF in automatic calibration | ● (DO3) | ● (DO3) | — | — | ● | ● |
| | Concentration alarm | Upper limit (1 point) concentration alarm | — | — | — | — | — | — |
| Lower limit (1 point) concentration alarm | | — | — | — | — | — | — | |
| Upper/lower limit (1 point as a set) concentration alarm | | — | — | Any one alarm settable on screen (DO1, 2) | Any one alarm settable on screen (DO1, 2) | Any one alarm settable on screen 2 Point (NO) Contact | Any one alarm settable on screen 2 Point (NC) Contact | |
| Upper limit (1 point) and lower limit (1 point) concentration alarm | | — | — | 2 Point (NO) Contact | 2 Point (NC) Contact | 2 Point (NO) Contact | 2 Point (NC) Contact | |
| Other | 2-step upper limit (1 point each) concentration alarm | — | — | — | — | — | — | |
| | 2-step lower limit (1 point each) concentration alarm | — | — | — | — | — | — | |
| Contact Input | Calibration status | ○ (DO4) | ● (DO4) | ○ (DO4) | ● (DO4) | ○ | ● | |
| | Range information (2-range meter) (Note 3) | — | — | ○ (DO3) | — | ○ | ○ | |
| | Analyzer error or automatic calibration error | ○ (DO5) | ● (DO5) | ○ (DO5) | ● (DO5) | ○ | ● | |
| Contact Input | Remote automatic calibration start (Note 4) | ○ (DI3) | ○ (DI3) | ○ (DI3) | ○ (DI3) | ○ (DI3) | ○ (DI3) | |
| | Remote range changeover (2-range meter) (Note 5) | ○ (DI2) | ○ (DI2) | ○ (DI2) | ○ (DI2) | ○ (DI2) | ○ (DI2) | |
| | Remote measured value output holding (Note 6) | ○ (DI1) | ○ (DI1) | ○ (DI1) | ○ (DI1) | ○ (DI1) | ○ (DI1) | |

(Note 1) Mark ○: Normally Open (NO) contact
 (Note 2) Mark ●: Normally Closed (NC) contact, after turning on power supply
 (Note 3) Low range : Contacts close, High range : Contacts open
 (Note 4) When contacts open 1.5 sec after their closure, automatic calibration starts.
 (Note 5) Contacts closed : Low range, Contacts open : High range
 (Note 6) Contacts closed : Holding, Contacts open : Holding canceled
 (Note 7) Up to 5 contact output points can be selected.

OUTLINE DIAGRAM (Unit : mm)



CONNECTION DIAGRAM

(Standard)

| | | |
|---|---|--|
| 1 | L | Power supply 100 to 240V AC, 50/60Hz |
| 2 | N | |
| 3 | E | Grounding terminal |
| 4 | + | Measured value output (as specified) 4 to 20mA DC 0 to 1V DC 0 to 10mV DC |
| 5 | - | |

(Option) 13th digit A and 14th digit A, B, C, D, E, F

| | | | |
|----|----|-----|------------------|
| 1 | 11 | DO1 | Contact output 1 |
| 2 | 12 | DO1 | |
| 3 | 13 | DO2 | Contact output 2 |
| 4 | 14 | DO2 | |
| 5 | 15 | DO3 | Contact output 3 |
| 6 | 16 | DO3 | |
| 7 | 17 | DO4 | Contact output 4 |
| 8 | 18 | DO4 | |
| 9 | 19 | DO5 | Contact output 5 |
| 10 | 20 | DO5 | |

| | | |
|--|------|------|
| Interference correcting input 1 to 5V DC | AIN+ | AIN- |
| Remote output holding | DI1 | DI1 |
| Remote range changeover | DI2 | DI2 |
| Remote automatic calibration start | DI3 | DI3 |

Refer to "Input/output contact specifications" in CODE SYMBOLS.

SCOPE OF DELIVERY

Analyzer main unit
Panel mounting brackets (1 set)
2 power fuses (250 V AC, 1 A)
Instruction Manual

ITEMS TO BE PREPARED SEPARATELY

Gas sampling equipment, standard gas, receiving instrument, etc.

With interference corrective calculation: CH₄ or CO₂ gas analyzer

ORDERING INFORMATION

1. Analyzer type
2. Gas component to be measured
3. Measuring range
4. Gas component other than measured
Very important information required to achieve intended accuracy of the instrument.
(Enter in "Table for checking sample gas component" on the next page.)

<Table for checking sample gas component of thermal conductivity gas analyzer (ZAF-3)>

Let us check your sample gas for safe use of Fuji Electric' gas analyzer.

Make entries where you can answer. If there is any question, contact our salesperson in charge of your company.

The analyzer may not provide full performance depending on other gas components contained in sample gas.

Date

| Item | Description |
|--|-------------|
| Name of customer at delivery destination | |
| Application, purpose | |
| Gas component to be measured | |

| Sample gas | Minimum concentration (%) | Normal concentration (%) | Maximum concentration (%) | Remarks |
|--------------------------|---------------------------|--------------------------|---------------------------|---------|
| Component to be measured | | | | |
| Other component gas | | | | |
| Other component gas | | | | |
| | | | | |
| | | | | |

| | | |
|------------------------|-----------------|--|
| Interference gas input | Measuring range | CO ₂ meter or CH ₄ meter |
| | 0- | |

| | |
|---------------------|--|
| Your question, etc. | |
|---------------------|--|

| | |
|----------------------|------------------|
| Customer information | Company name |
| | Section |
| | Address |
| | TEL |
| | Person in charge |

Fuji Electric's salesperson in charge of your company _____

⚠ Caution on Safety

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

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