

# IN-SITU ZIRCONIA OXYGEN ANALYZER

## <HART communication>

**DATA SHEET**
**ZFK8, ZKM-2, ZTA**

This oxygen analyzer is used to continuously measure oxygen concentration in combustion exhaust gas of industrial boilers or furnaces, and is ideally suited for combustion management and control.

The analyzer system is comprised of the detector and converter coupled together as a complete system. Detector setting configuration includes the detector flow guide tube and detector sensor. The flow guide tube is inserted directly into the gas and directs gas to the sensor for measurement. The converter (ZKM) is comprised of the signal processor, input/output and communications, display and system controls.

The converter provided with an unconventional sensor-diagnostic function ensures long-term stable detecting operation.

### FEATURES

**1. No need for gas sampling devices**

Since the sensor unit is directly inserted into a flue, gas-sampling devices such as gas aspirator and dehumidifier are not required, which ensures fast response.

**2. Easy maintenance**

The sensor in a unit structure mounted to the detector can be replaced easily. Since the detector and the flow guide tube are installed separately, you can easily replace the filter at the tip of the detector and can maintain the detector and the flow guide tube separately according to the degree of corrosion.

**3. High reliability ensured by the sensor diagnostic function**

To check the degree of sensor depletion due to gas components in the target gas, the converter is equipped with the sensor diagnostic function, so that you know when to replace the sensor.

**4. Improved safety**

The converter cuts off the power supply for the detector when detecting a burnout of thermocouple for heater control. The converter also cuts off the power supply at emergency, in response to an external contact input. These functions along with the key lock function are equipped as standard to ensure improved safety.

**5. Simple operation**

A user can operate the converter or make various settings on an interactive basis. Display language is available in English, Japanese, or Chinese.

**6. HART communication is available as an option**

The HART communication enables remote control.

\*HART® is a registered trademark of the HART Communication Foundation.



General-use detector  
(ZFK8)



High-temperature detector  
(ZTA)



<IP66>  
Converter (ZKMA)



<IP67>  
Converter (ZKMB)

### SPECIFICATIONS

**General Specifications**

**Measuring object:** Oxygen in noncombustible gas

**Measuring method:**

Directly insert type zirconia system

**Measuring range:** 0 to 2 ... 50 vol% O<sub>2</sub>  
(in 1 vol% O<sub>2</sub> steps)

**Repeatability:** Within ±0.5%FS

**Linearity:** Within ±2%FS

**Response time:** Within 4 to 7 sec, for 90% (from calibration gas inlet)

**Warmup time:** More than 10 min

**Analog output:** 4 to 20mA DC (allowable load resistance less than 500Ω) or 0 to 1V DC (output resistance more than 100Ω)

**Digital input (option):** RS-485 or HART communication

**Power supply:** Rated voltage;  
100 to 120V AC (operating voltage 90 to 132V AC)  
200 to 240V AC (operating voltage 190 to 264V AC)  
Rated frequency; 50/60Hz

**Power consumption:**

During warm-up 255VA

During operation 70VA

[ When the power supply voltage ]  
is 100 or 220 V AC

**Detector Specifications (ZFK)**

**Measured gas temperature:**

Flow guide tube system; -10 to +600°C  
(for general-use, corrosive gas)  
Ejector system; -10 to +1500°C (for  
high-temperature gas)  
-10 to +800°C (for general-use)

**Measured gas pressure:**

-3 to +3kPa

**Flow guide tube:**

With or without blow-down nozzle  
Flange; JIS5K 65A FF  
(JIS5K-80AFF for high particulate gas)  
Insertion length; 0.3, 0.5, 0.75, 1m

**Ejector (general-use):**

Probe for guiding measured gas to  
detector  
Flange; JIS10K 65A RF  
Insertion length; 0.5, 0.75, 1, 1.5m (ac-  
cording to customer's specification)

**Ejector air inlet flow rate:**

5 to 10 L/min

**Ejector exhaust gas processing:**

Into furnace, returned to flue

**Ejector heater temperature drop alarm output:**

Alarm output when below 100°C Me-  
chanical thermostat  
N.O. (1a) contact, 200V AC, 2A

**Operating temperature:**

-10 to +60°C for Primary detecting ele-  
ment  
-5 to +100°C for ejector section  
125°C or less at detector flange surface  
with power applied

**Storage temperature:**

Sensing element: -20 to +70°C  
Ejector: -10 to +100°C

**Structure:**

Dust/rain-proof structure(IEC IP66  
equivalent)

**Filter:**

Alumina(filtering accuracy 50µm) and  
quartz paper

**Main materials of gas-contacting parts:**

Detector; Zirconia, SUS316, platinum  
Flow guide tube; SUS304 or SUS316  
Ejector (general use); SUS316, SUS304  
Ejector; (for high temperature) SiC,  
SUS316, SUS304

**Calibration gas inlet:**

φ6mm tube join, φ1/4-inch tube join, or  
ball valve (as specified)

**Reference air inlet (option):**

φ6mm tube join or φ1/4-inch tube join (as  
specified)

**Detector mounting:**

Horizontal plane ±45°, ambient sur-  
rounding air should be clean.

**Outer dimensions:** (L × max. dia.) 210mm × 100mm (de-  
tector)

**Mass (approx.) {weight}:**

Detector; 1.6kg  
Ejector; 15kg (insertion length 1m)  
Flow guide tube (general-use, 1m); 5kg

**Finish color:**

Silver and SUS metallic color

**Calibration gas flow:**

1.5 to 2 L/min

**Blowdown air inlet pressure:**

200 to 300kPa {2 to 3 kgf/cm<sup>2</sup>}

**Converter specification (ZKM)**

**Concentration value indication:**

Digital indication in 4 digits

**Contact output signal:**

(1) Contact specification; 6 points, 1a 250V AC/3A or 30V DC/3A

(2) Contact function;

- Under maintenance
- Under blowdown <sup>Note3)</sup>
- Span calibration gas valve
- Zero calibration gas valve
- Instrument anomalies <sup>Note1)</sup>
- Alarm <sup>Note2)</sup>
- Range identification output <sup>Note4)</sup>

Note1) The following Instrument errors (1) Thermocou-  
ples break (2) Sensor break (3) Temperature fault  
(4) Calibration fault (5) Zero/span adjustment fault  
(6) Output error turn the contact-ON

Note2) Alarm selects just one as mentioned below (1)  
High (2) Low (3) Upper and Lower (4) High-high  
(5) Low-low, it turns ON while operating.

Note3) Under blow down is available in case of option,  
and it turns ON while operating.

Note4) It turns ON during range selection, and turns OFF  
when the range 1 is selected.

**Contact input signal:**

(1) Contact specification; 3points (the following option)  
ON; 0V (10mA or less), OFF; 5V

(2) Contact function;

- External hold
- Calculation reset
- Heater OFF
- Blow down (option)
- Inhibition of calibration
- Calibration start
- Range change

**Calibration method:**

- (a) Manual calibration with key operation
- (b) Auto. calibration (option)  
Calibration cycle; 00 day 00 hour to  
99 days 23 hours
- (c) All calibration

**Calibration gas:**

- Available range settings  
Zero gas; 0.010 to 25.00% O<sub>2</sub>  
Span gas; 0.010 to 50.00% O<sub>2</sub>
- Recommended calibration gas concen-  
tration  
Zero gas; 0.25 to 2.0% O<sub>2</sub>  
Span gas; 20.6 to 21.0% O<sub>2</sub>  
(oxygen concentration in the air)

**Blowdown:**  
(option)

A function for blowing out with com-  
pressed air dust that has deposited in  
the flow guide tube. Blowdown can be  
performed for a predetermined time and  
at predetermined intervals.  
Blowdown cycle; 00 hour 00 minute to  
99 hours 59 minutes  
Blowdown time; 0 minute 00 second  
to 0 minutes 999  
seconds

**Output signal hold:**

Output signal is held during calibration, processing diagnosis of sensor, warm-up, PID auto tuning, under set up maintenance mode "available" and blowdown. The hold function can also be released.

**Valve and Flow meter (option):**

Selects zero or span gas during manual zero or span calibration. Mounted on the side of the converter.

**Communication function:**

HART communication (option)  
RS485 (MODBUS) (option)

**Combustion efficiency display (option):**

This function calculates and displays combustion efficiency from oxygen concentration and measured gas temperature.

Thermocouple (R) or thermocouple (K) is required for temperature measurement.

Range: 0 to 1000°C, Accuracy: ±5°C.

On the version with combustion efficiency display, an alarm function of "rich mode" indication is also available.

**Operating temperature:**

-20 to +55°C

**Operating humidity:**

95% RH or less, non condensing

**Storage temperature:**

-30 to +70°C

**Storage humidity:** 95% RH or less, non condensing

**Enclosure:**

Dust-proof, rainproof  
(corresponding to IP66 or IP67 of IEC)  
\*when the specified cable gland is attached.

**Material:**

Aluminum case

**Outer dimensions (H x W x D):**

170 X 159 X 70mm (IP66, Bench type)  
220 X 230 X 95mm (IP67)

**Mass {weight}:**

IP66: Approx. 2kg (excluding cable and detector)  
IP67: Approx. 4.5kg (excluding cable and detector)  
Cable: Approx. 4kg/m (with rainproof flexible conduit)

**Finish color:**

Case: Silver  
Cover: Munsell 6PB 3.5/10.5 (blue)

**Mounting method:** Mounted flush on panel or on pipe

**Electrical Safety:**

Overvoltage category  
; II power supply input  
; I relay interfaces  
(IEC1010-1)  
External overcurrent protective device  
; 10A  
Equipment interfaces are safety separated (SELV)

**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"  
"Altitude up to 2187 yard (2,000 m)"  
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. EMS requirements.



ZFK, ZKM

## CODE SYMBOLS

(Detector)

ZFK 

4	5	6	7	8
8	R			5

 - 

9	10	11	12	13

 - 

14	15	16

Digit	Description		Note	Code
6	Calibration gas inlet	For ø 6mm tube (SUS)		1
		For ø 1/4 inch tube (SUS)		2
		With ball valve		3
7	Power supply	100 to 120 V AC 50/60 Hz		1
		200 to 240 V AC 50/60 Hz		2
8	Revision No.			5
9	Flow guide tube			
10	flange	application		
11	no tube			0Y0
		SUS304 general use 300 mm		5A3
		SUS304 general use 500 mm		5A5
		SUS304 general use 750 mm		5A7
		SUS304 general use 1000 mm		5A1
		SUS316 for corrosive gas 300 mm		5B3
		SUS316 for corrosive gas 500 mm		5B5
		SUS316 for corrosive gas 750 mm		5B7
		SUS316 for corrosive gas 1000 mm		5B1
		SUS316 with blowdown nozzle 300 mm		5C3
		SUS317 with blowdown nozzle 500 mm		5C5
		SUS318 with blowdown nozzle 750 mm		5C7
		SUS319 with blowdown nozzle 1000 mm		5C1
		SUS316 for high particulate 300 mm		6D3
		SUS317 for high particulate 500 mm		6D5
		SUS318 for high particulate 750 mm		6D7
		SUS319 for high particulate 1000 mm		6D1
		SUS316 for high particulate with cover 300 mm		6E3
		SUS317 for high particulate with cover 500 mm		6E5
		SUS318 for high particulate with cover 750 mm		6E7
		SUS319 for high particulate with cover 1000 mm		6E1
Others			ZZZ	
12	Heat-retaining cover	Without		Y
		With		A
13	Reference gas inlet	None		Y
		For ø 6 mm tube (SUS)		A
		For ø 1/4 inch tube (SUS)		B
14	Filter spec	Standard		1
15	Instruction manual language	Japanese		J
		English		E
		Chinese		C
16	Specification nameplate	Standard (100 to 120 V AC 50/60 Hz)		1
		Standard (200 to 240 V AC 50/60 Hz)		2

(Ejector)

ZTA 

4	5	6	7	8
		1	1	

Digit	Description		Note	Code
4	Measured gas temperature	For high temperature (+1500°C max.)		1
		General use (+800°C max.)		2
5	—	—		1
6	Insertion length [mm]	500		B
		750		C
		1000		D
		1500		E
		—		
7	Power supply voltage	100V/115 V AC 50/60Hz		1
		200V/220 V AC 50/60Hz		3
		230 V AC 50/60Hz		5
		—		1

(Replacement Detector element)

Power supply	Code symbols
100 to 120V AC	ZFK8YY15-0Y0YY-0YY
200 to 240V AC	ZFK8YY35-0Y0YY-0YY



(Converter)

ZKM 

4	5	6	7	8
		2		

 - 

9	10	11	12	13
		1		

 - YR 

14	15	16

Digit	Description		Note	Code
4	Enclosure	IP66		A
		IP67		B
5	Analog output signal	4 to 20 mA DC		B
		0 to 1 V DC		E
6	Communication function	None		Y
		RS-485		2
		HART		3
7	Mounting bracket	None		Y
		Mounting on panel surface		1
		Pipe mounting		2
8	Revision No.			2
9	Optional functions	None		Y
		Combustion efficiency display	Note 2	1
		Blowdown		2
		Auto calibration		3
		Combustion efficiency display + Blowdown	Note 2	4
		Combustion efficiency display + Auto calibration	Note 2	5
		Blowdown + Auto calibration	Note 2	6
Combustion efficiency display + Blowdown + Auto calibration	Note 2	7		
10	Language	Japanese		J
		English		E
		Chinese		C
11	Selector valve/flowmeter	None		Y
		With valve		1
		With valve + flowmeter		2
12	—	—		1
13	Cable gland	Without		Y
		With		A
14	—	—		Y
15	—	—		R
16	Thermocouple for combustion efficiency display	None		Y
		Type R thermocouple		R
		Type K thermocouple		K

Note 2) On the version with combustion efficiency display, an alarm function of "rich mode" indication is also available.

(Dedicated cable)

ZRZ 

4	5	6	7	8	9
K	R		1		

Digit	Description		Note	Code
4	Connectable device	ZKM		K
5	Type	R thermocouple		R
6	Length	Rainproof flexible conduit		
		None	6 m	YA
		None	10 m	YB
		None	15 m	YC
		None	20 m	YD
		None	30 m	YE
		None	40 m	YF
		None	50 m	YG
		None	60 m	YH
		None	70 m	YJ
		None	80 m	YK
		None	90 m	YL
		None	100 m	YM
		6 m	6 m	Note 1
10 m	10 m	Note 1	BB	
15 m	15 m	Note 1	CC	
20 m	25 m	Note 1	DD	
8	Revision No.	—		1
9	Cable end treatment	None		0
		One side (detector side)		1
		Both sides		2

Note 1) For connection between detector and converter, use a rainproof flexible conduit.

## SCOPE OF DELIVERY

	Description	Q'ty	
Detector (ZFK)	Detector main unit	1	
	Viton O ring	1	
	Mounting screw (M5 x 16)	6	
	Thermal sticker	1	
	Ceramic filter	1	
	Instruction manual	1	
	Flow guide tube (as specified)	1	
	Heat-retaining cover (as specified)	1	
	Reference gas inlet port (as specified)	2	
Converter (ZKM)	Converter main unit	1	
	Fuse (2.5A)	2	
	Ferrite core	1	
	Instruction manual	1	
	Metal fittings	<For panel mounting> M8 sems screw (stainless steel)	4
		<For pipe mounting> U bolt (stainless steel)	2
		M8 nut and washer (stainless steel)	4
Support (stainless steel)		2	
Ejector (ZTA)	Ejector main unit	1	
	Insertion tube	1	
	Packing	1	
	M16 nut and washer (stainless steel)	4	
Dedicated cable (ZRZ)	Cable (of the specified length)	1	

### Items to be prepared separately:

- (1) Standard gas for calibration
  - Type ZBM□NSH4-01 (up to 5% O<sub>2</sub> range)
  - Type ZBM□NSJ4-01 (over 5% O<sub>2</sub> range)
- (2) Pressure regulator for standard gas (type ZBD61003)
- (3) Flowmeter
  - Type; ZBD42203, 0.2 to 2L/min (for calibrating gas)
  - Type; ZBD42403, 1 to 10L/min (for ejector)

## CAUTIONS

- If combustible gas (CO, H<sub>2</sub> etc.) exists in the measured gas, error will occur due to burning at the sensor section. The inclusion of corrosive gas (Si vapor, alkaline metal, P, Pb etc.) will shorten the life of the sensor.
- When the measured gas temperature is high (+300°C or higher), the flange should be separated from the furnace wall in order to bring the detector flange surface temperature below the specified value +125°C). The flow guide should be attached in the direction in which the gas flow to the detector decreases.
- When much dust is included in the gas, the flow guide tube should be attached at an inclination so that the flow goes from below to above. And the flow guide tube should be attached in the direction in which the gas flow to the detector decreases.
- In the case of a refuse incinerator, automatic blow down of the flow guide should not be performed (to prevent corrosion of the flow guide tube due to drainage). Blow-down should be performed manually when change in the indication has become very little with the furnace stopped.

## DEVICE CONFIGURATION

The device to be combined differ according to the conditions of the gas to be measured. Select the devices to be combined with reference to the following table.

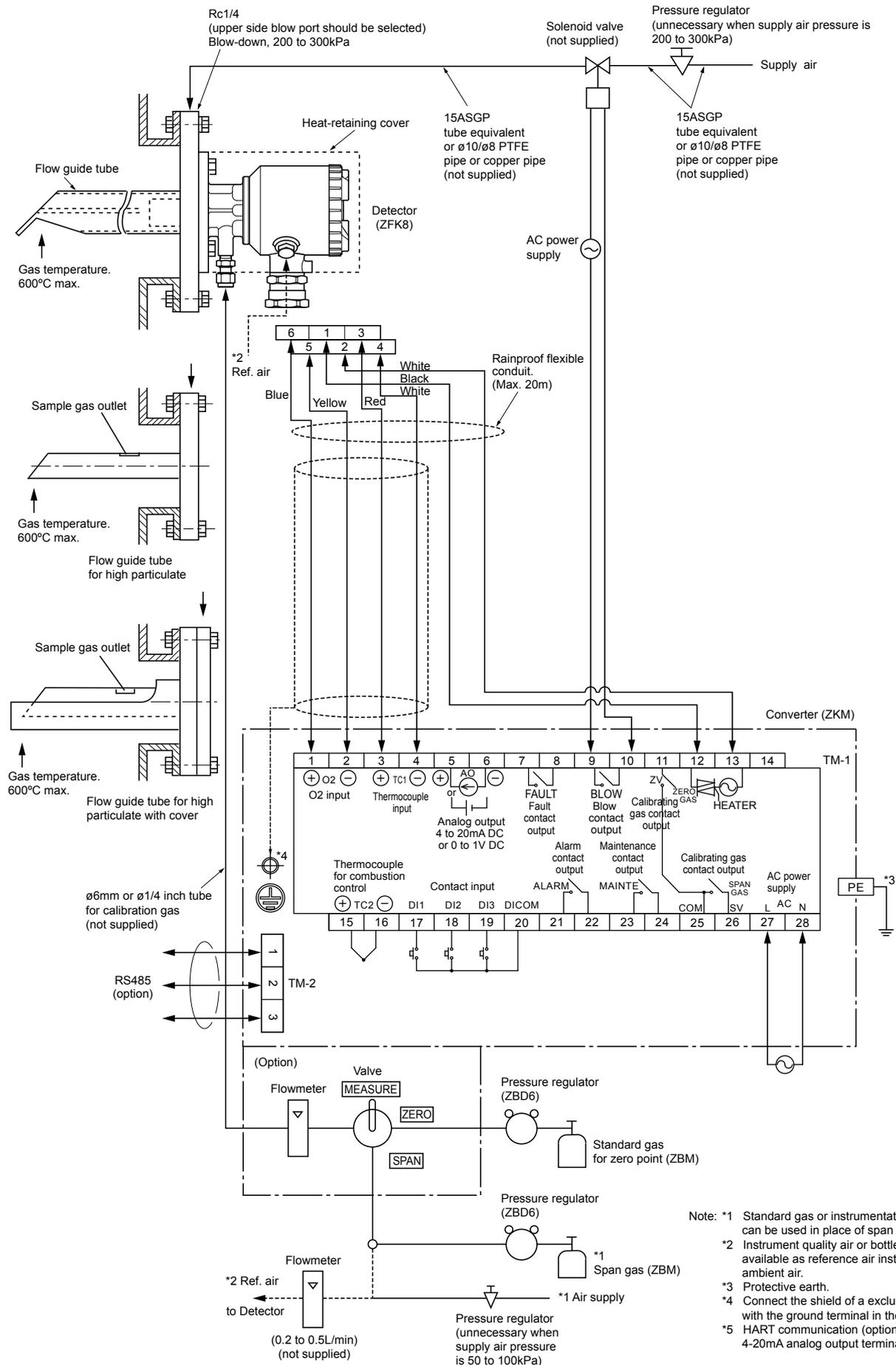
Application	Measured gas					Device configuration		
	Temperature	Gas Flow	DUST	Heat-retaining cover	Note	Detector type	Converter type	Ejector type
General-use (boiler)	600°C or less	5 to 20m/s	Less than 0.2g/Nm <sup>3</sup>	—	Fuel; gas, oil	ZFK8R□□5-□A <sup>5</sup> □□-1□	ZKM	—
			Less than 10g/Nm <sup>3</sup>	—	Fuel: coal with blow down	ZFK8R□□5-□C <sup>5</sup> □□-1□	ZKM	—
For corrosive gas (refuse incinerator)	600°C or less	5 to 20m/s	Less than 1g/Nm <sup>3</sup>	—	Included low moisture	ZFK8R□□5-□B <sup>5</sup> □□-2□	ZKM	—
			Less than 10g/Nm <sup>3</sup>	—	Included low moisture with blow down	ZFK8R□□5-□C <sup>5</sup> □□-2□	ZKM	—
			Less than 25g/Nm <sup>3</sup>	no	Included low moisture with blow down	ZFK8R□□5-□D <sup>5</sup> □□-2□	ZKM	—
			Less than 25g/Nm <sup>3</sup>	yes	Included high moisture with blow down	ZFK8R□□5-□E <sup>5</sup> □□-2□	ZKM	—
General-use (boiler)	800°C or less	Less than 1m/s	Less than 1g/Nm <sup>3</sup>	—	SUS316 tube with blow down	ZFK8R□□5-0Y0□□-1□	ZKM	ZTA2
	1500°C or less	Less than 1m/s	Less than 1g/Nm <sup>3</sup>	—	SIC tube with blow down	ZFK8R□□5-0Y0□□-1□	ZKM	ZTA1

Note (1) Dust volume is approximate value.

(2) Instrument quality air or bottled air is available as reference air by selecting detector with reference air inlet.

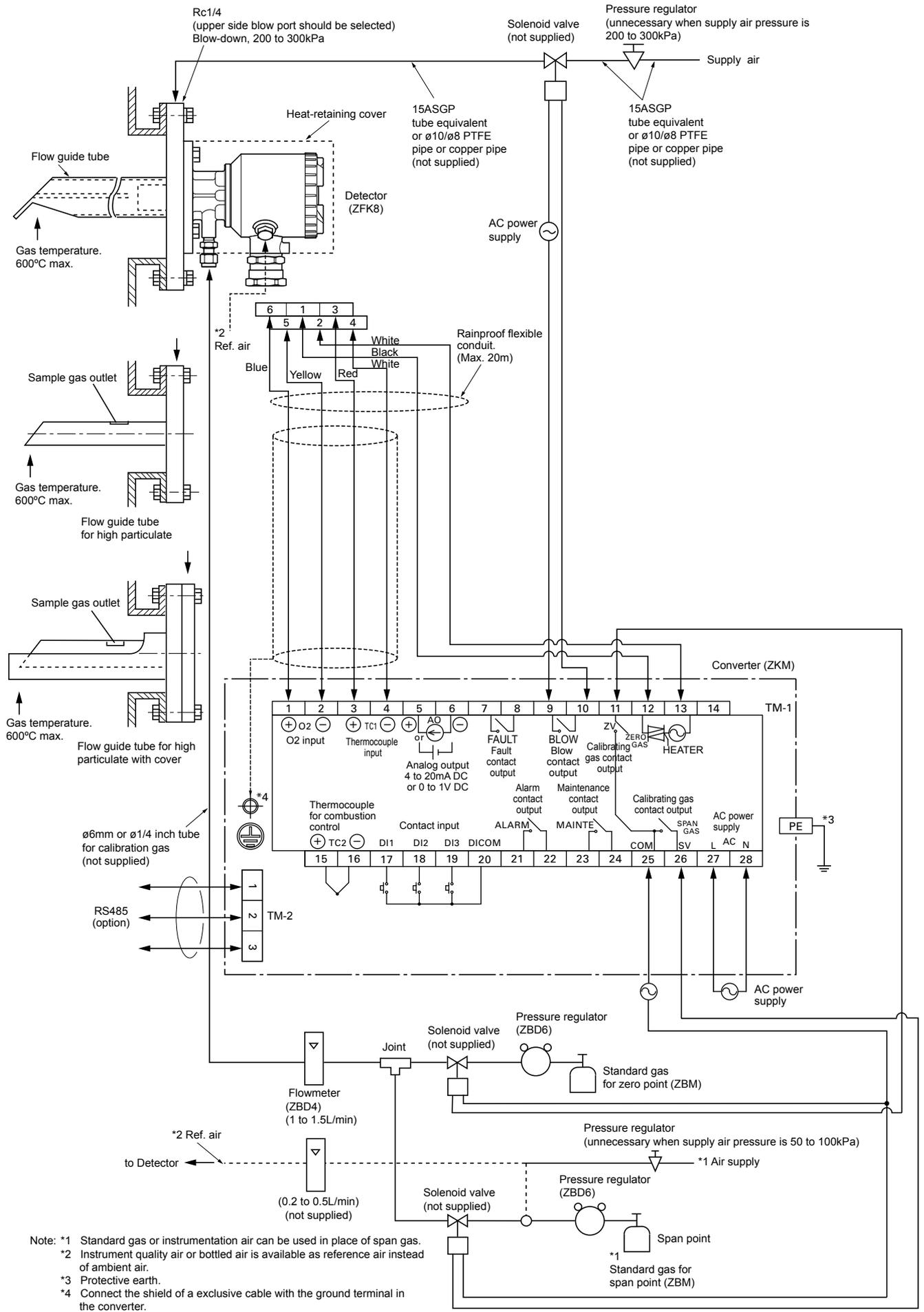
# CONFIGURATION

## Flow guide tube system (with valve)



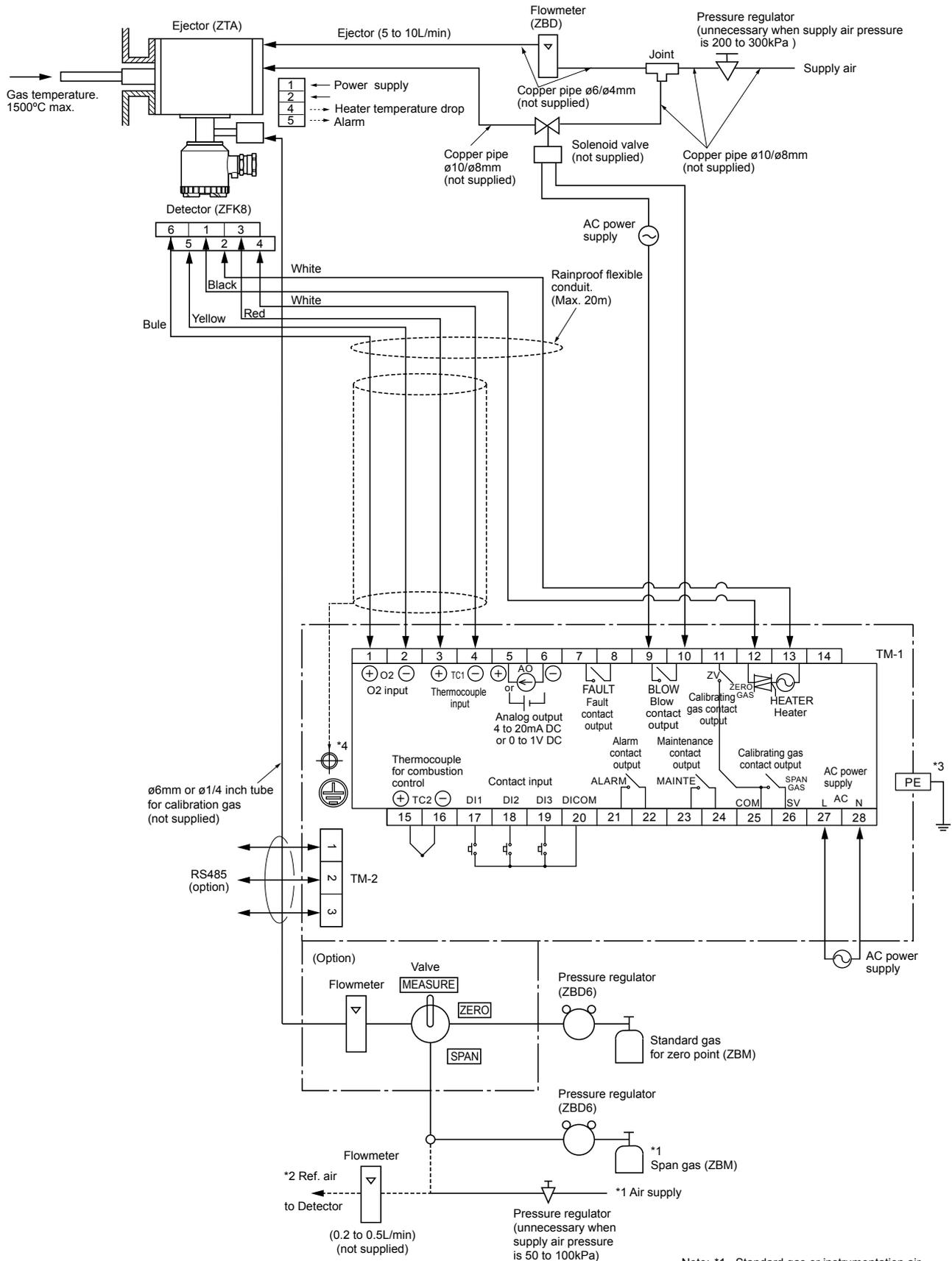
- Note: \*1 Standard gas or instrumentation air can be used in place of span gas.  
 \*2 Instrument quality air or bottled air is available as reference air instead of ambient air.  
 \*3 Protective earth.  
 \*4 Connect the shield of a exclusive cable with the ground terminal in the converter.  
 \*5 HART communication (option) uses a 4-20mA analog output terminal.

# Flow guide tube system



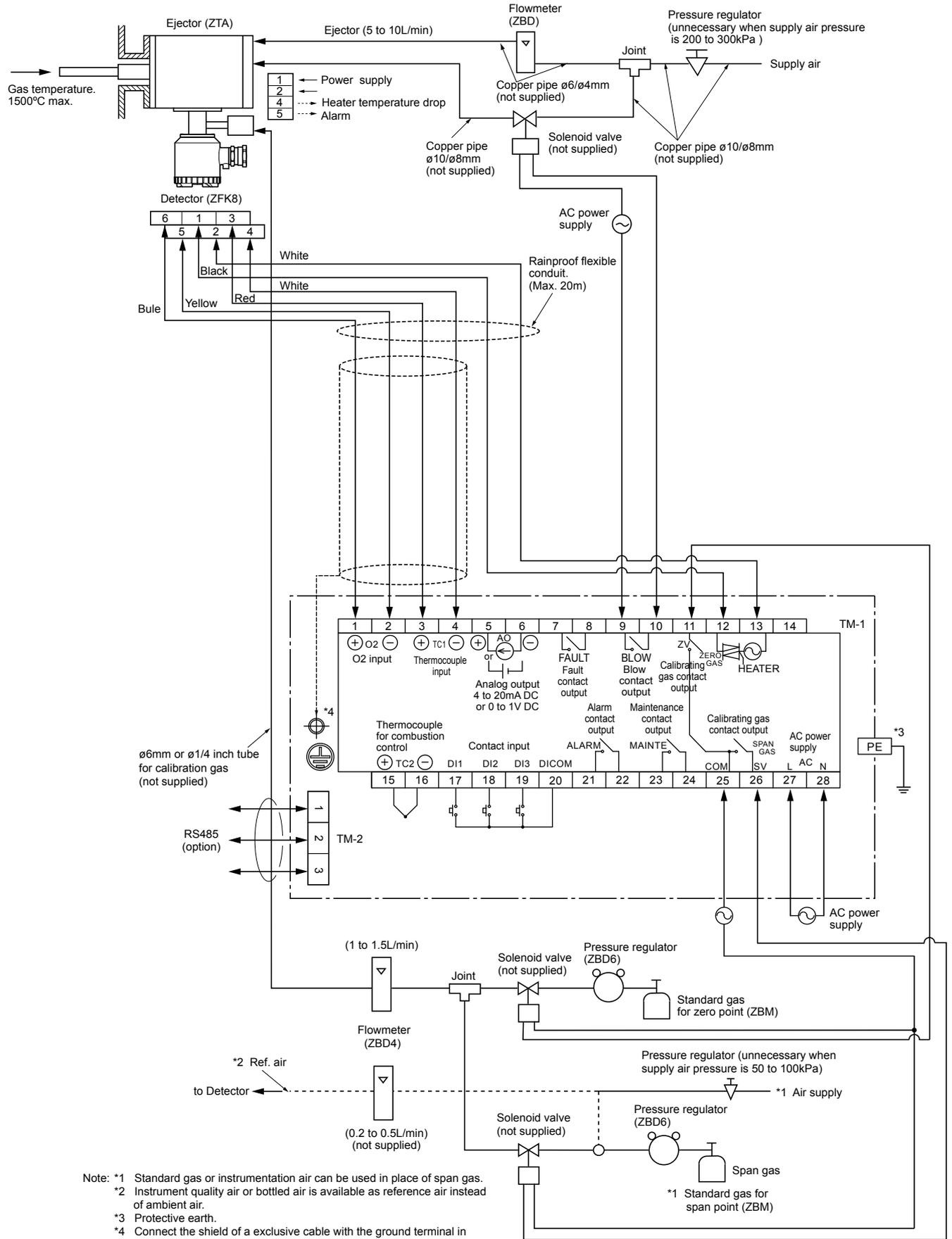
- Note: \*1 Standard gas or instrumentation air can be used in place of span gas.  
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 \*3 Protective earth.  
 \*4 Connect the shield of a exclusive cable with the ground terminal in the converter.  
 \*5 HART communication (option) uses a 4-20mA analog output terminal.

Ejector system (with valve)



- Note: \*1 Standard gas or instrumentation air can be used in place of span gas.  
 \*2 Instrument quality air or bottled air is available as reference air instead of ambient air.  
 \*3 Protective earth.  
 \*4 Connect the shield of a exclusive cable with the ground terminal in the converter.  
 \*5 HART communication (option) uses a 4-20mA analog output terminal.

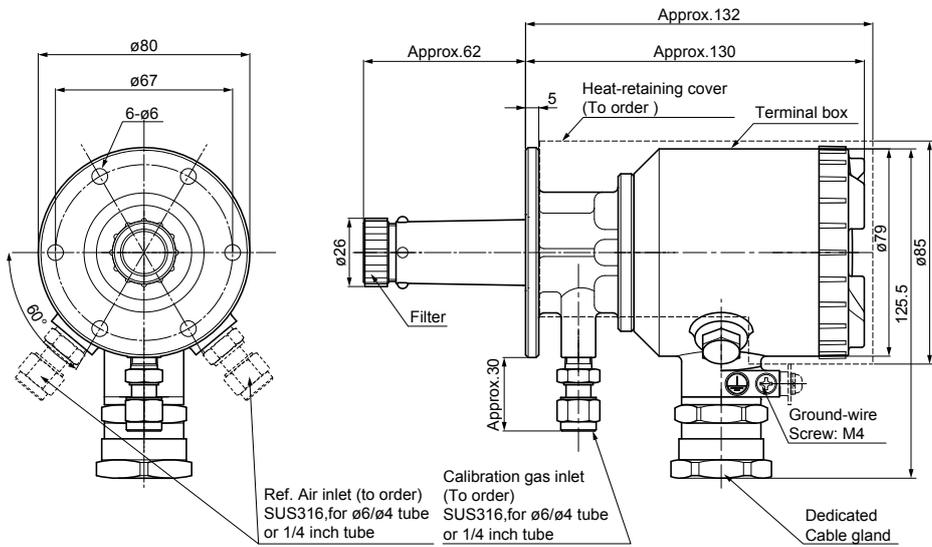
# Ejector system



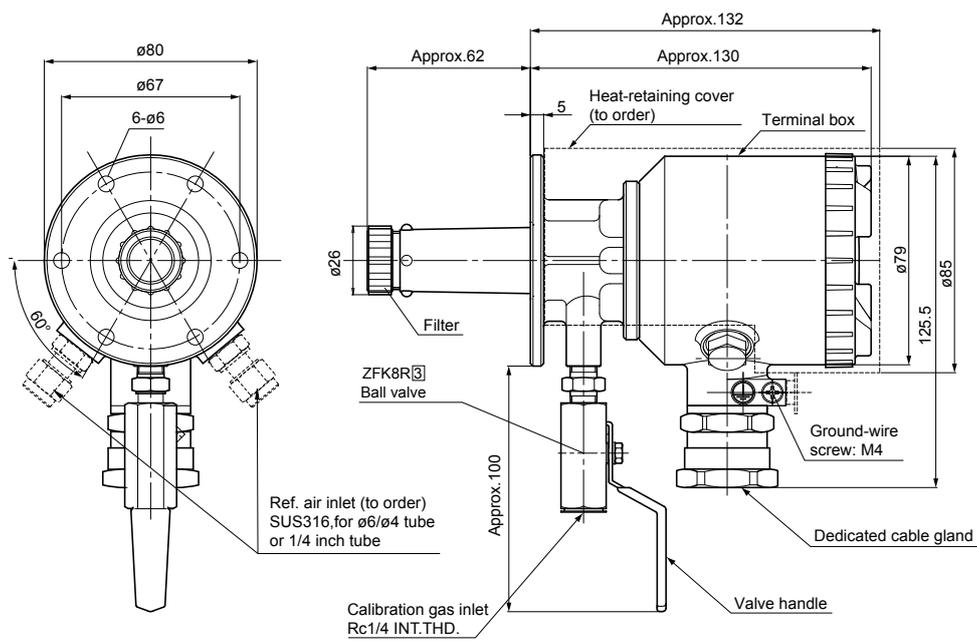
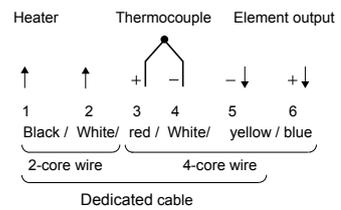
- Note: \*1 Standard gas or instrumentation air can be used in place of span gas.  
 \*2 Instrument quality air or bottled air is available as reference air instead of ambient air.  
 \*3 Protective earth.  
 \*4 Connect the shield of an exclusive cable with the ground terminal in the converter.  
 \*5 HART communication (option) uses a 4-20mA analog output terminal.

OUTLINE DIAGRAM (Unit:mm)

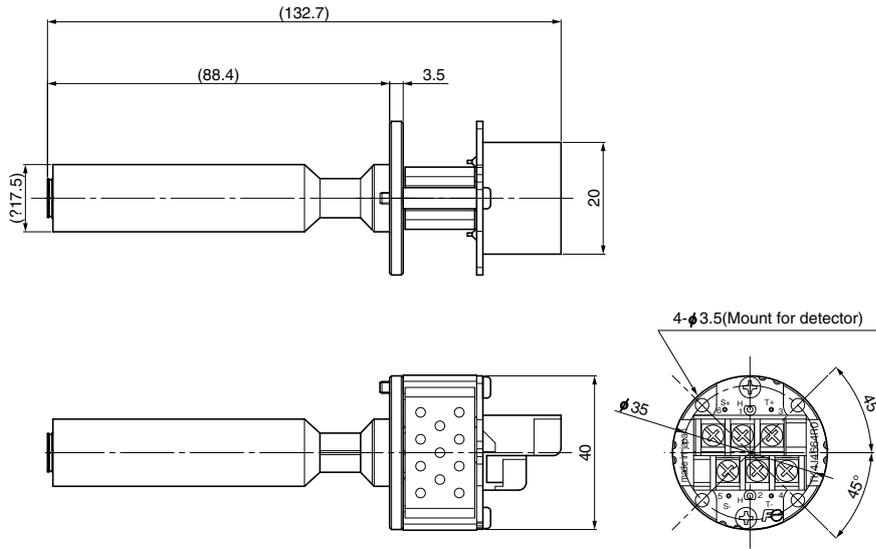
Detector (ZFK8)



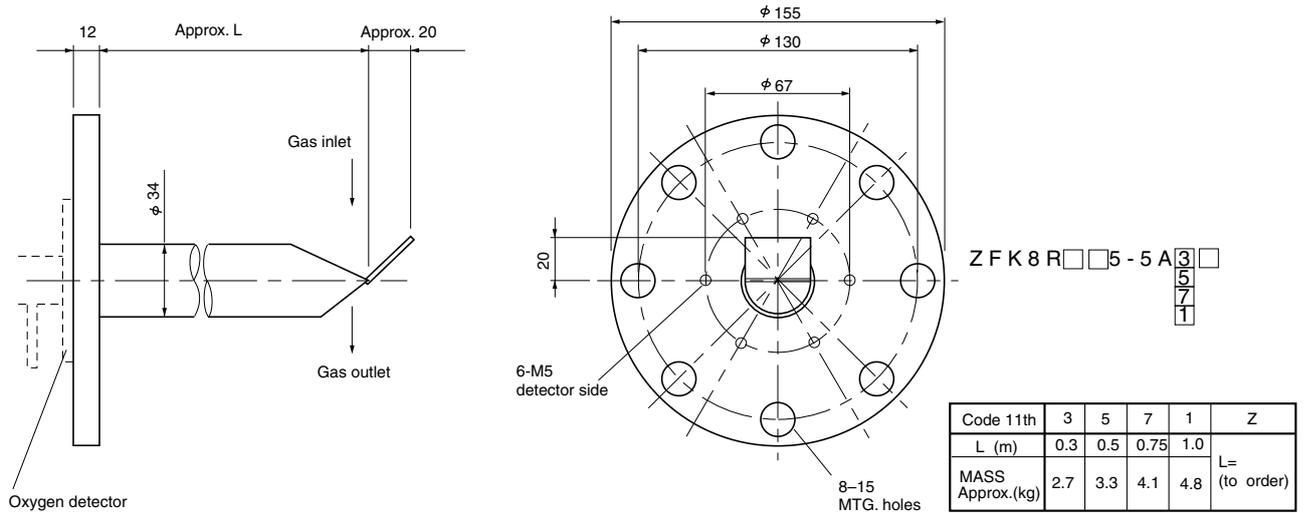
EXTERNAL CONNECTION DIAGRAM



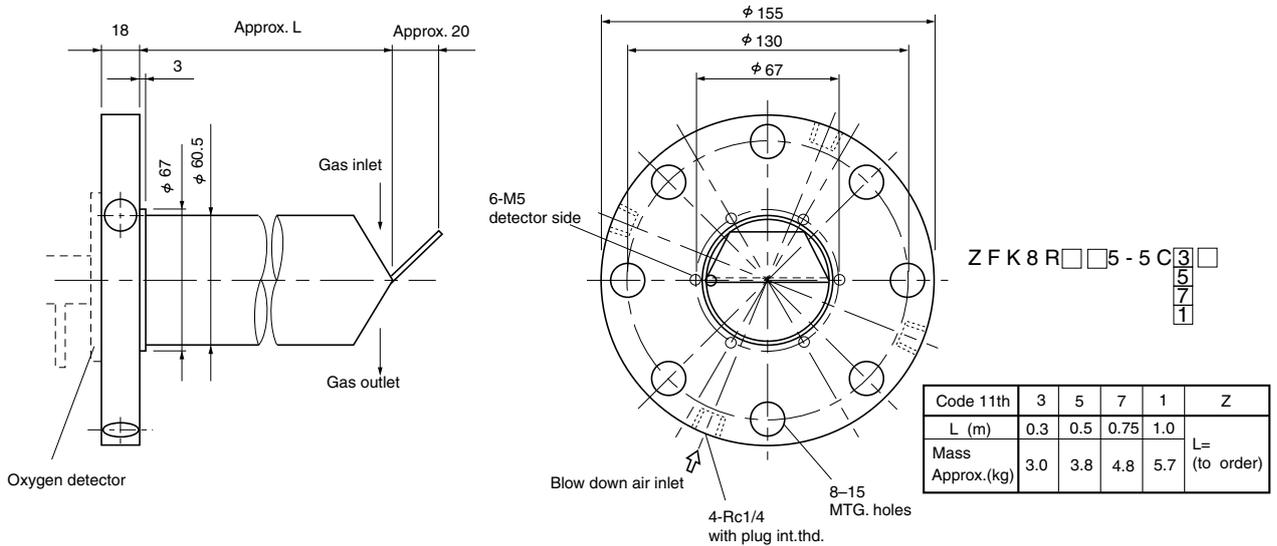
### Sensor unit (ZFK8YY)



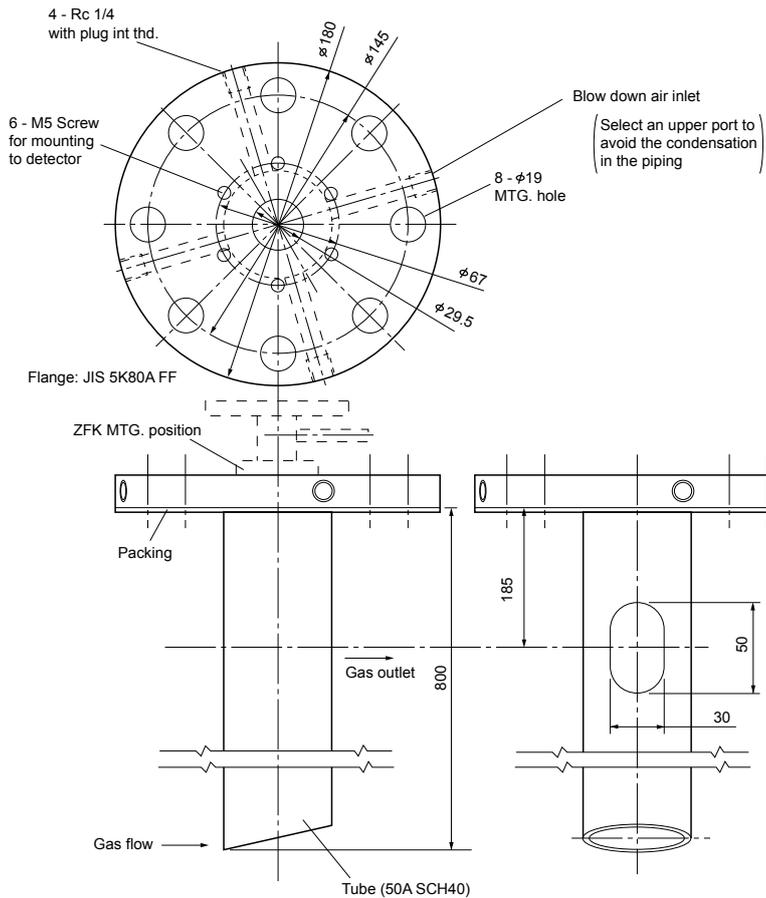
### Flow guide tube



### Flow guide tube (with blow-down nozzle)



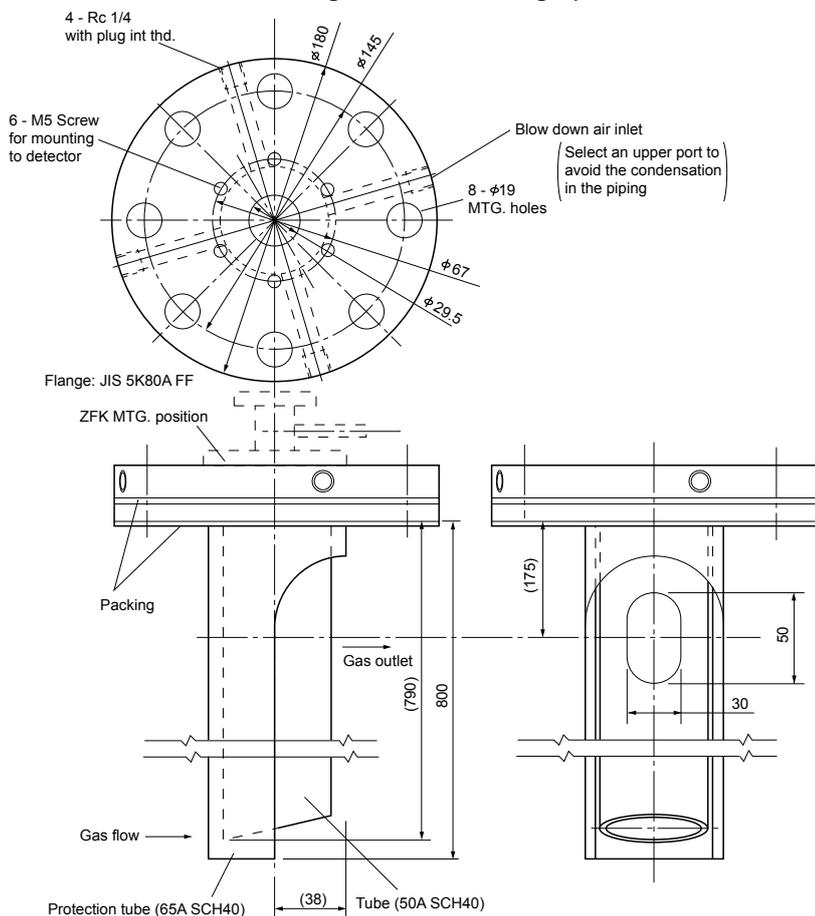
Flow guide tube (for high particulate)



ZFK8R□□5-6D $\begin{matrix} 3 \\ 5 \\ 7 \\ 1 \end{matrix}$ □

Code 11th	3	5	7	1	Z
L (m)	0.3	0.5	0.75	1.0	L= (to order)
Mass Approx.(kg)	4.5	5.6	7.0	8.3	

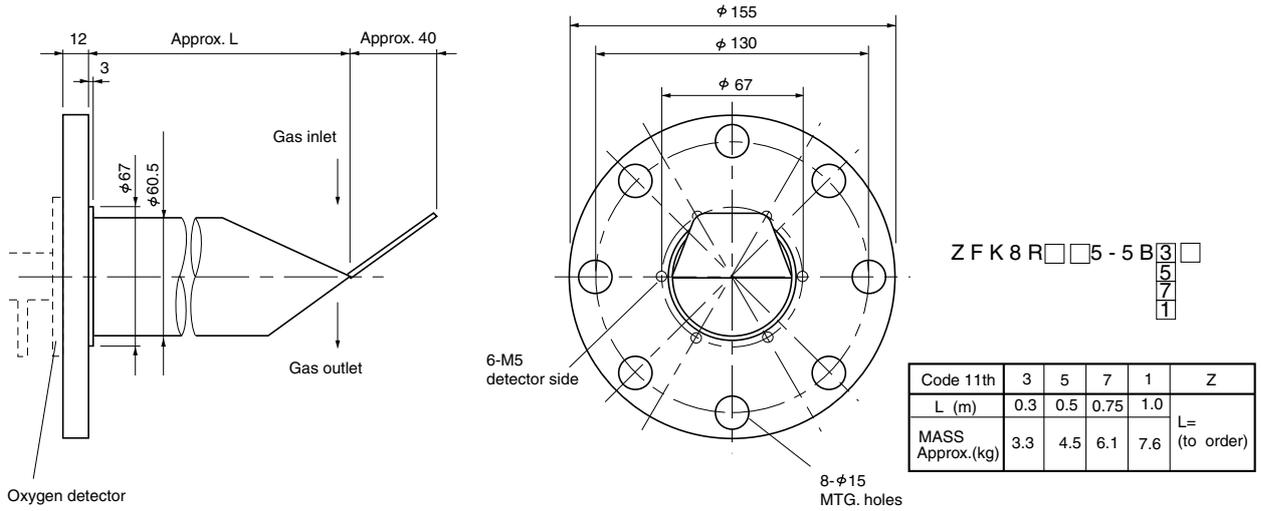
Flow guide tube (for high particulate with cover)



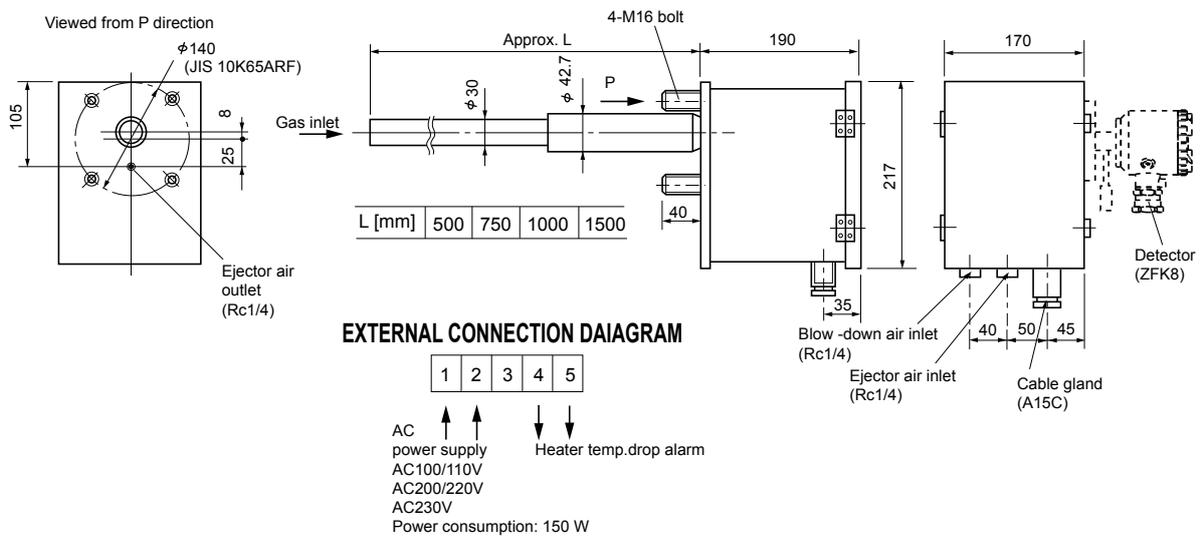
ZFK8R□□5-6E $\begin{matrix} 3 \\ 5 \\ 7 \\ 1 \end{matrix}$ □

Code 11th	3	5	7	1	Z
L (m)	0.3	0.5	0.75	1.0	L= (to order)
Mass Approx.(kg)	7.1	9.0	11.4	13.6	

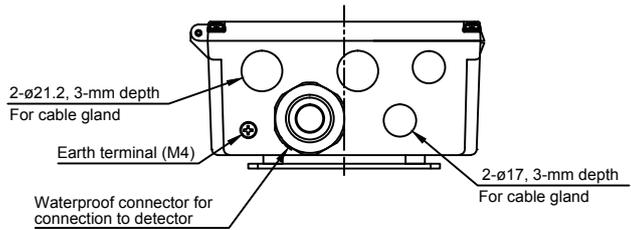
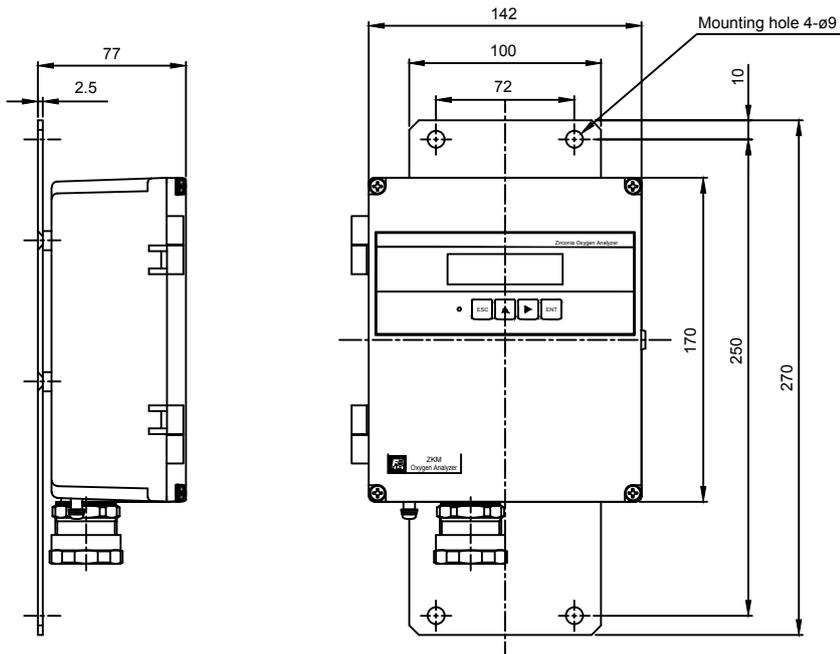
### Flow guide tube (for corrosive gas)



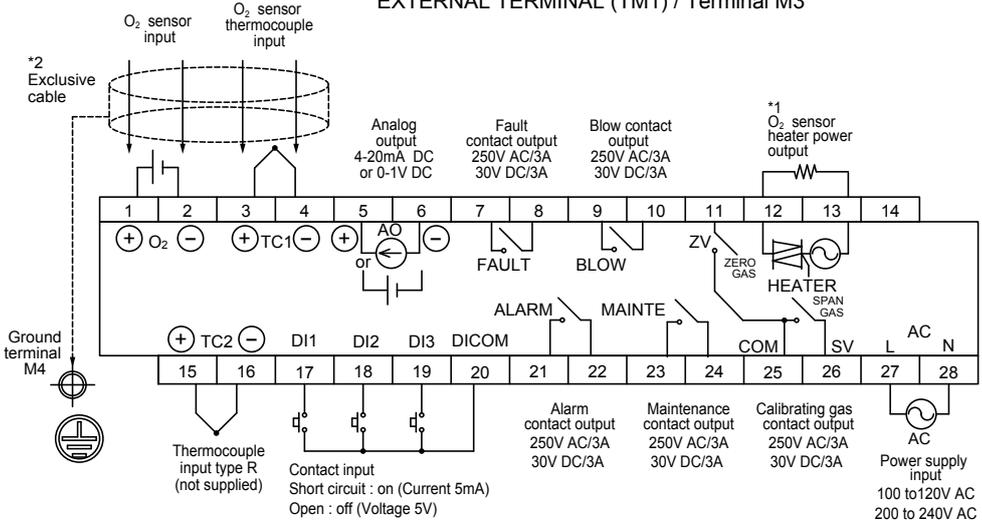
### Ejector (ZTA)



Converter (ZKMA)  
<IP66 enclosure>



EXTERNAL TERMINAL (TM1) / Terminal M3

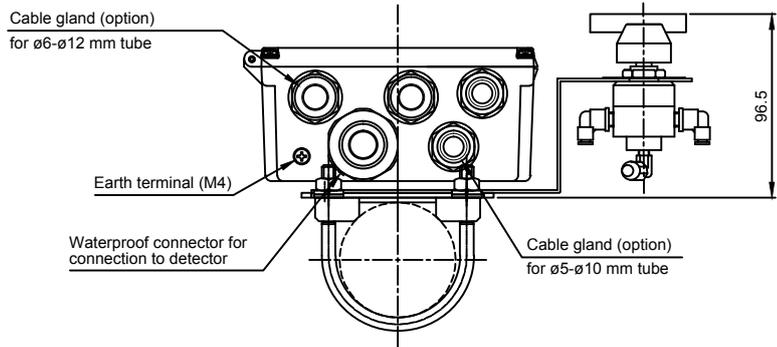
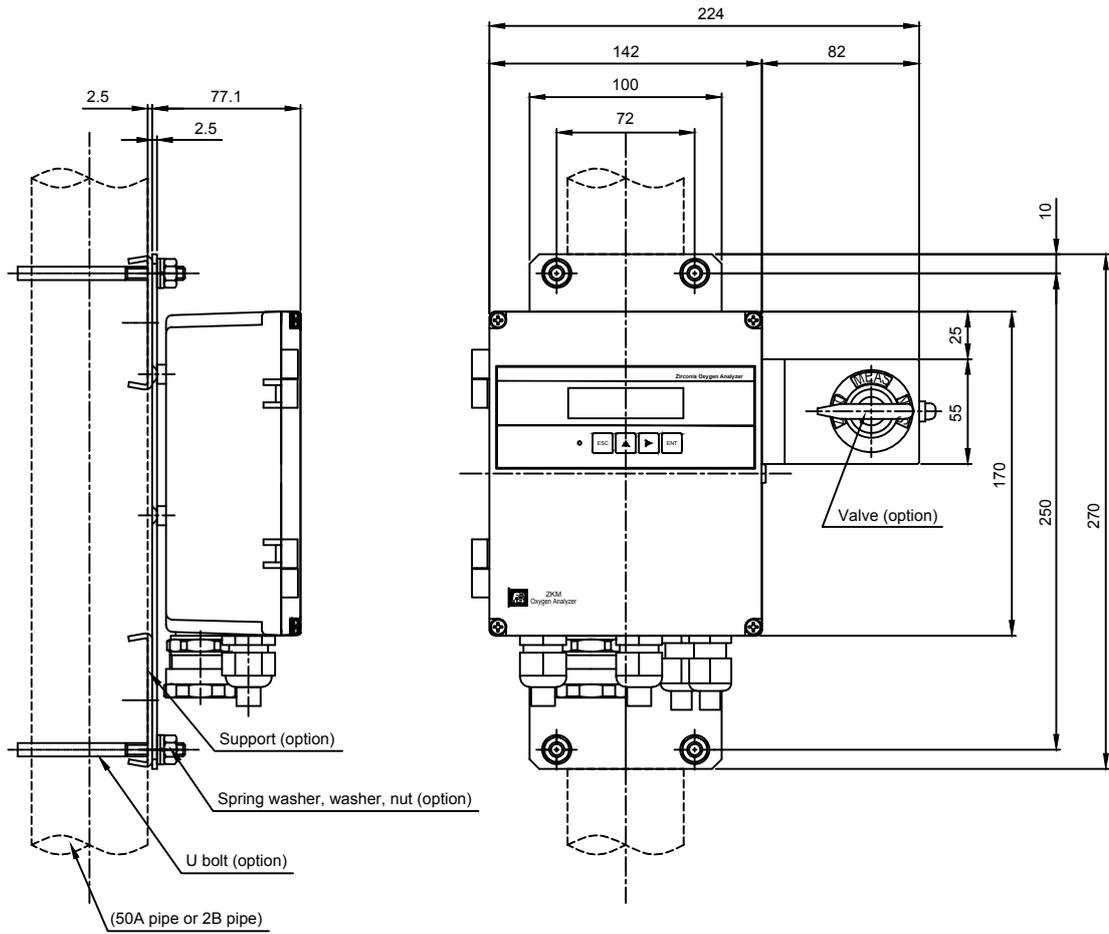


RS485 communication (option) terminal

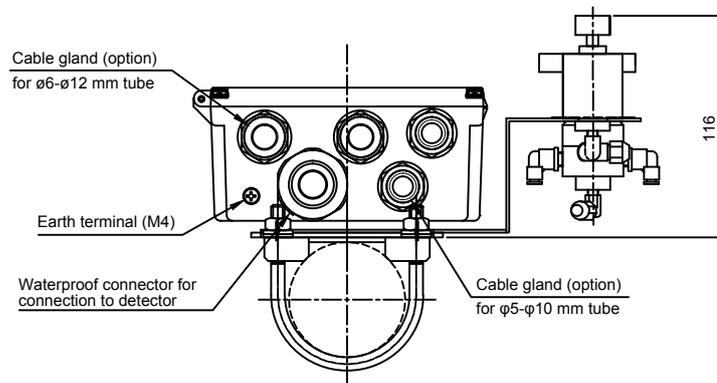
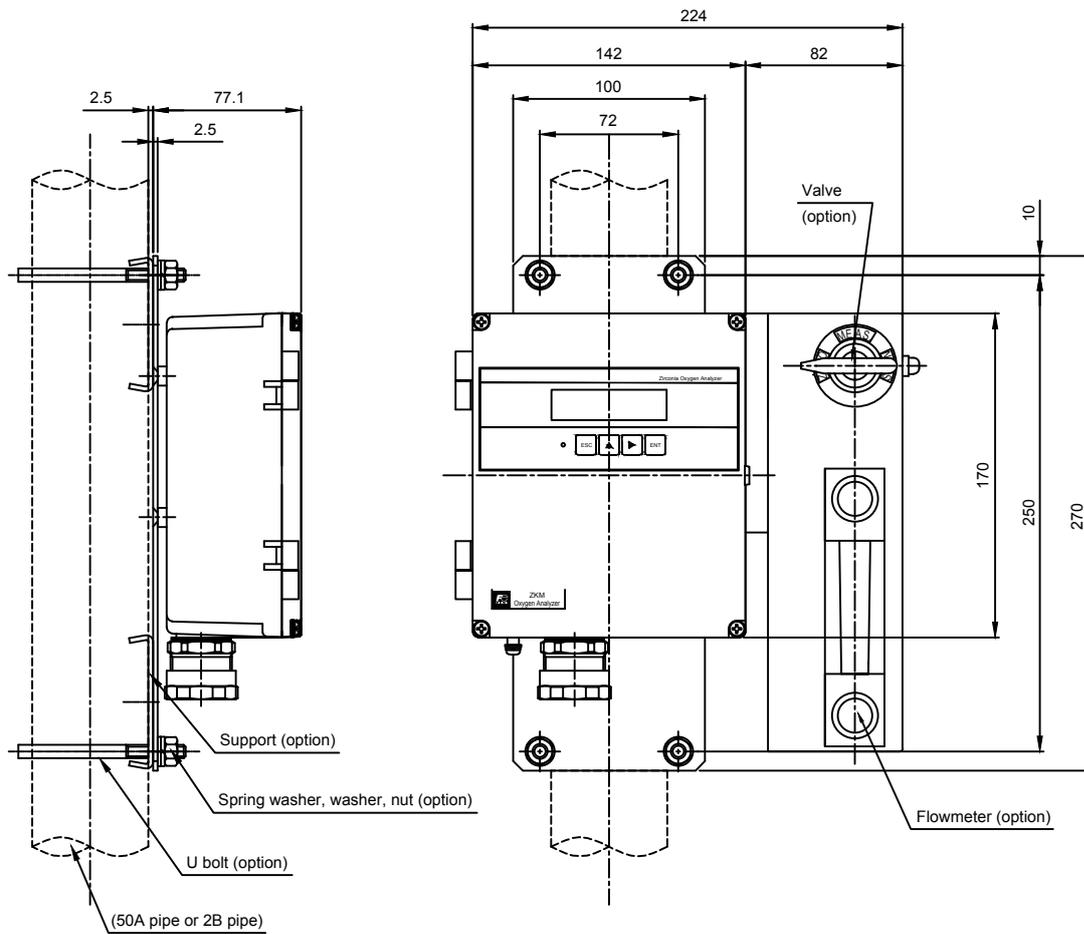
1	2	3
GND	TRX+	TRX-

- Note 1) The heater power supply is the same as the converter power supply.
- Note 2) Be sure to connect the shield of the cable to the ground in the main body.
- Note 3) HART communication (option) uses a 4-20 mA analog output.

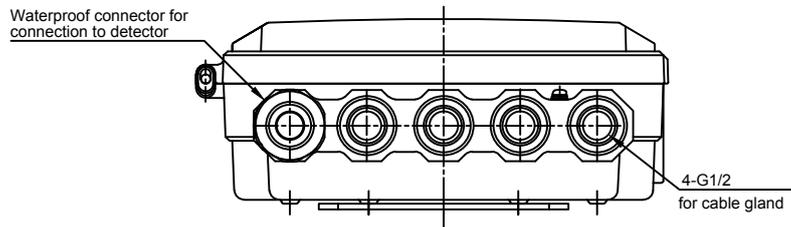
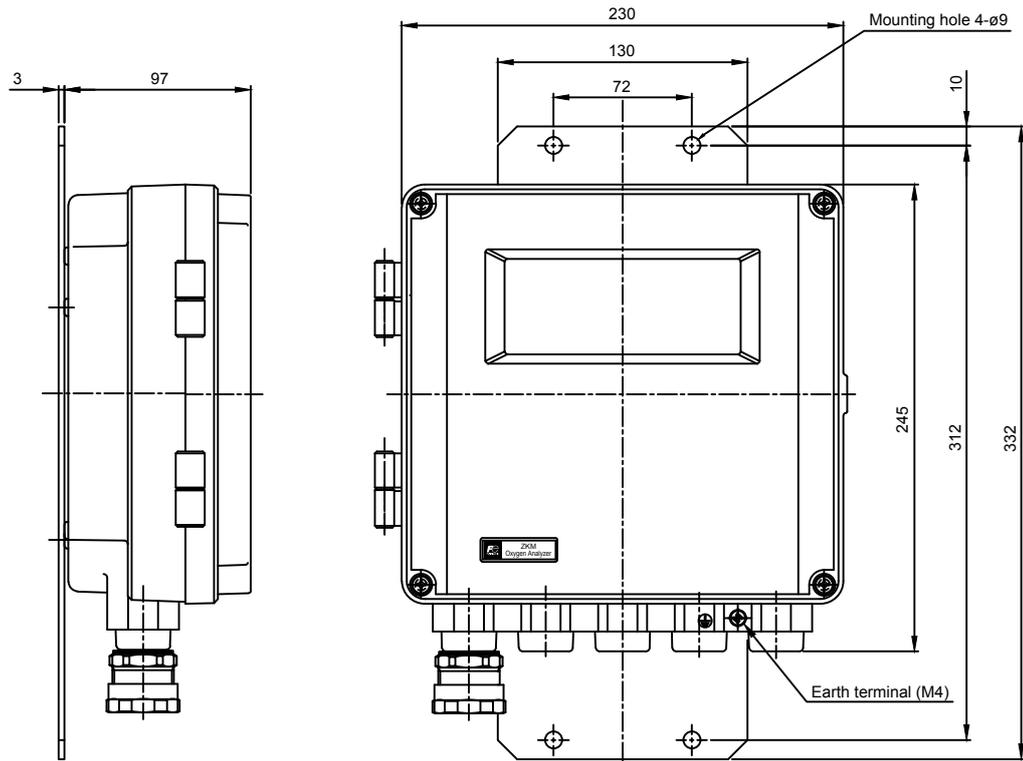
Converter (ZKMA)  
 <IP66 enclosure> with selector valve



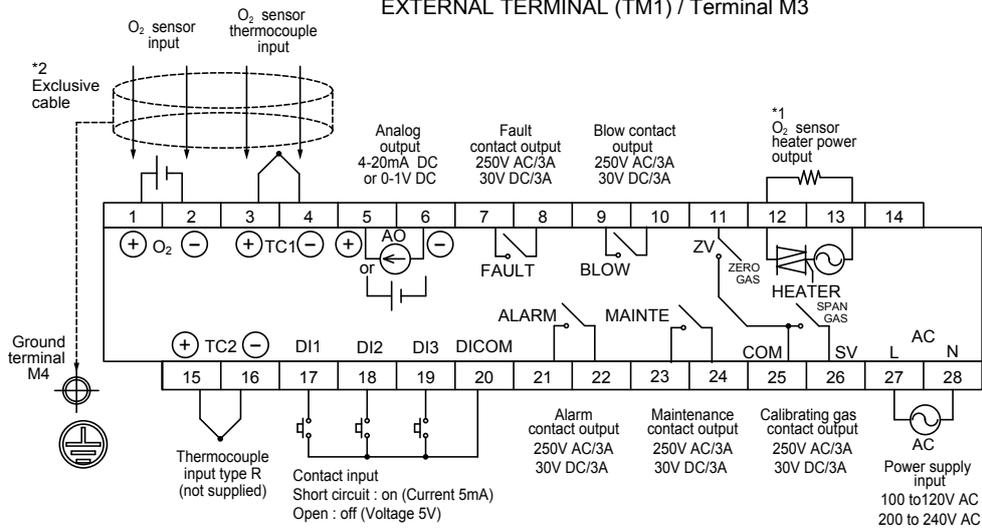
Converter (ZKMA)  
 <IP66 enclosure> with selector valve and flowmeter



Converter (ZKMB)  
<IP67 enclosure>



EXTERNAL TERMINAL (TM1) / Terminal M3

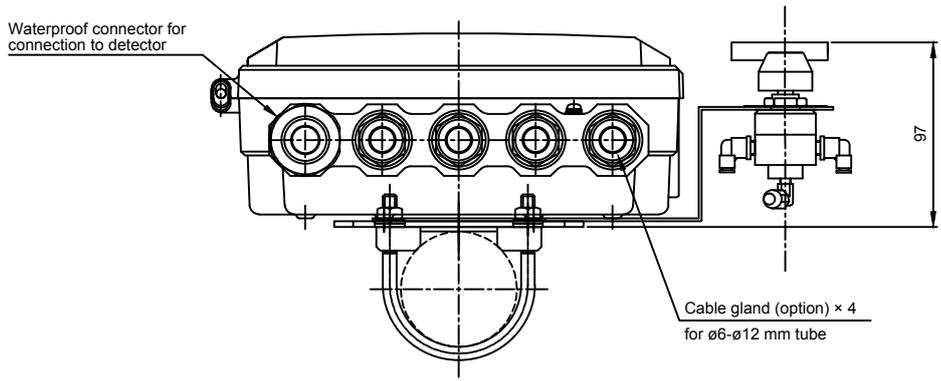
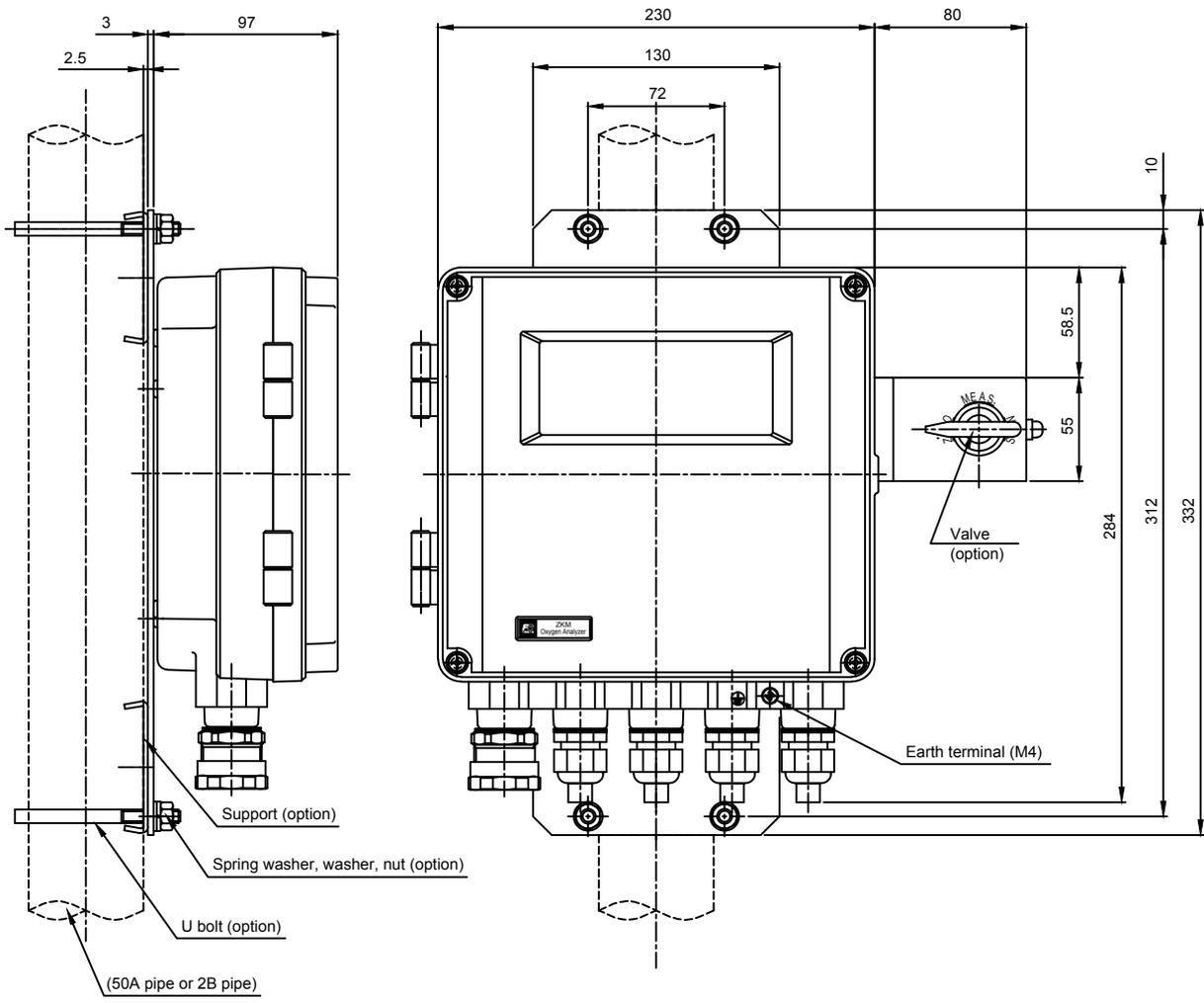


RS485 communication (option) terminal

1	2	3
GND	TRX+	TRX-

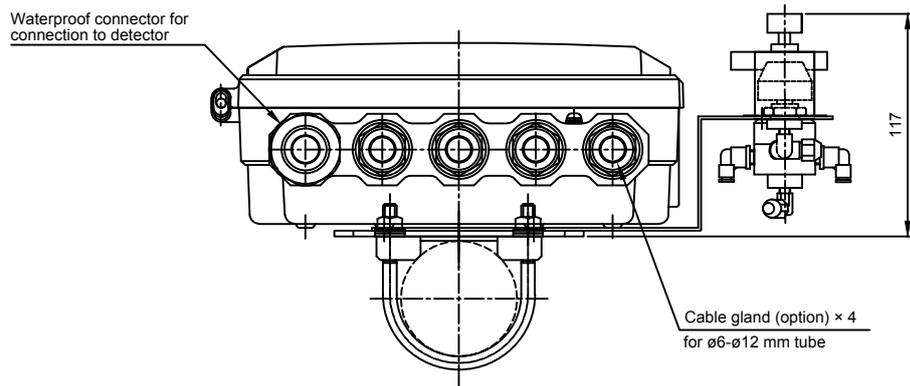
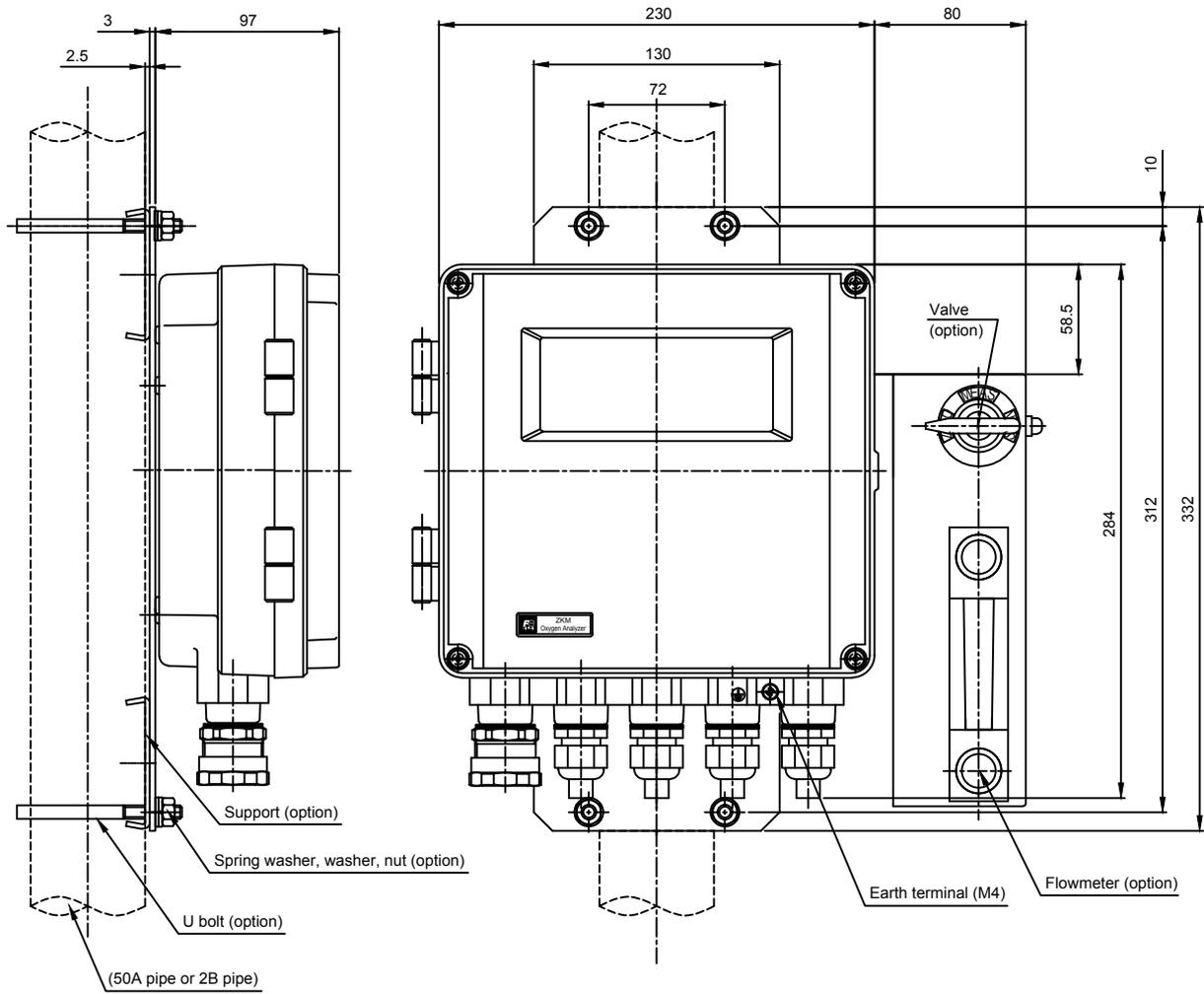
- Note 1) The heater power supply is the same as the converter power supply.  
 Note 2) Be sure to connect the shield of the cable to the ground in the main body.  
 Note 3) HART communication (option) uses a 4-20 mA analog output.

Converter (ZKMB)  
 <IP67 enclosure> with selector valve



Converter (ZKMB)

<IP67 enclosure> with selector valve and flowmeter



⚠ Caution on Safety

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

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