

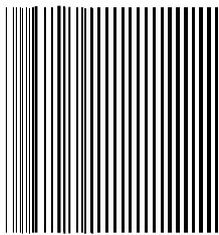
**IM Series
Infrared Multiple-constituents Analyzer
Mirror Type Moisture Meter/Detector Unit**

Model: IRMA11 □□□□

IRMA12□□□□

IRMA13□□□□

Instruction Manual



INSTRUCTIONS

Store this manual in a readily accessible location for future reference.

This manual should be provided to the end user.

Preface

Thank you for purchasing the IM series infrared multiple-constituents analyzer [Mirror type moisture meter/Detector unit IRMA1100, IRMA1200, IRMA1300]. Read this manual carefully to ensure that you use this product correctly and safely.

◆ Regarding this manual

- (1) This manual should be provided to the end user.
- (2) Read this manual carefully to gain a thorough understanding of how to operate this product before starting operation.
- (3) This manual describes the functions and maintenance of this product. Store it in a readily accessible location for future reference.
- (4) If you have unclear points or need technical assistance, please contact your sales agent of CHINO Corporation.

Notices

1. The contents of this manual are subject to change without notice.
2. Every effort has been made to ensure that the details of this manual are accurate. However, should any errors be found or importance information be omitted, please contact your nearest agent of CHINO Corporation.
3. Under absolutely no circumstances may the contents of this manual, in part or in whole, be transcribed or copied without permission.

Be sure to read the following safety instructions before attempting to install, operate or store this product.

1. Working conditions and environment

- 1) This product is installed using the mounting screw holes (four M8 screw holes) on its top surface. Refer to [3. Installation] and fix the detector unit firmly.
- 2) Do not place this product on a desk and the like. This product may fall, causing serious personal injury and serious damage to this product.
- 3) Do not use this product in a location where volatile, corrosive or flammable gas is present, or in a location where moisture, chemical or seawater is splashed.

2. Symbols used in this manual

The following symbols are used depending on important degrees of warnings/cautions to operate this product safely and to avoid malfunctions or unexpected situation.

Important degree	Symbols	Contents
1		This symbol is indicated with a title for an explanation with Warning
2		Indicates important information that must be observed to avoid the risk of fire or electric shock or other dangers that may result in serious personal injury or death, or damage to this product.
3		Indicates important information that must be observed to avoid the risk of personal injury or malfunctions of this product.
4		Indicates supplementary information that the operator is recommended to understand.
5		Indicates supplementary information or a reference to an operation.

Warnings and Cautions

Please observe the following safety precautions fully to use this product correctly. In addition, please read this manual carefully and store it in a readily accessible location for future reference.

The  mark indicates actions that are prohibited during an operation.

 Warning (May cause death or serious personal injury)	
	Do not operate this product in a location where flammable or volatile gas is present. The use of this product in such environment may result in the risk of explosion. 
	If this product emits any smoke, abnormal noise or unusual odor, immediately turn off power. Do not continue to use this product as it may result in the risk of fire or electric shock. Turn off the power source to this product and contact your nearest sales agent of CHINO Corporation. Do not repair this product yourself as it may be dangerous. 
	Never touch the internal parts of this product. If you touch the inside of this product, it may result in personal injury by electric circuits or a moving part Even when you open the case of this product for maintenance works, never touch the internal parts. 
	Do not attempt to repair or modify this product. Repairing or modification must be carried out by service personnel authorized by CHINO Corporation. If you repair or modify this product yourself, it may not fulfill this product's functions, or it may result in the risk of electric shock or damage to this product. 
	Do not touch, with wet hands, the power terminals or plugs of the power cord. If you touch, with wet hands, the power terminals or plugs of the power cord, it may result in the risk of electric shock. 
	If you notice something suspicious, immediately turn off power. If the temperature of the power cord or other cable is high abnormally, turn off the power source to this product immediately and contact your nearest sales agent of CHINO Corporation. 
	Confirm the grounding. To avoid the risk of electric shock, before supplying the power to this product, make sure that the power terminals and the protective ground terminal have been wired correctly and reliably.

 Caution (May cause personal injury or property damage)	
	Confirm the specifications (Model code) of this product. Before using this product, check that the model code shown in the serial number plate matches your order.
	Separate precautionary safety measures should be provided before using this product. When this product is used in equipment that needs security measures, provide separate safety measures with the equipment before using this product, responding to phenomena resulting from erroneous operations or malfunctions of this product or malfunctions of related instruments.
	Use crimp type lugs for termination of wires. To avoid dropping-out or short-circuit of wires, use crimp type lugs for their termination.
	Confirm the power to this product. Before supplying the power to this product, make sure that the power voltage matches the rated voltage to this product and that the power terminals and the protective ground terminal have been wired correctly and reliably.
	Do not continue to use this product remaining malfunctioned. Do not continue to use this product remaining malfunctioned as it may result in the risk of fire or electric shock. Contact your nearest sales agent of CHINO Corporation for repairing. 
	Comply with the descriptions in this manual. Comply with the descriptions and handling instructions in this manual to ensure that you use this product correctly and safely. Failure to comply with the descriptions and instructions may result in damage to or functional decline of this product or damage to the equipment.

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1. Introduction

1.1 General

The IM series infrared multiple-constituents analyzer [Mirror type moisture meter/detector unit IRMA1100/IRMA1200/IRMA1300] is a reflective type non-contact on-line moisture meter using the principles of infrared absorption by moisture. This moisture meter is configured with a detector unit, an operator interface/display unit and accessories.

The detector unit is provided with 99 built-in calibration curves and outputs a linear analog signal proportional to moisture content of a sampled material.

As the stand alone detector unit provides function keys, a data display and a digital signal for communication, it can be operated on its own or with a personal computer.

The operator interface/display unit can communicate with up to nine (9) detector units, and displays the moisture content value digitally as well as accessing to various parameters of the detector unit.

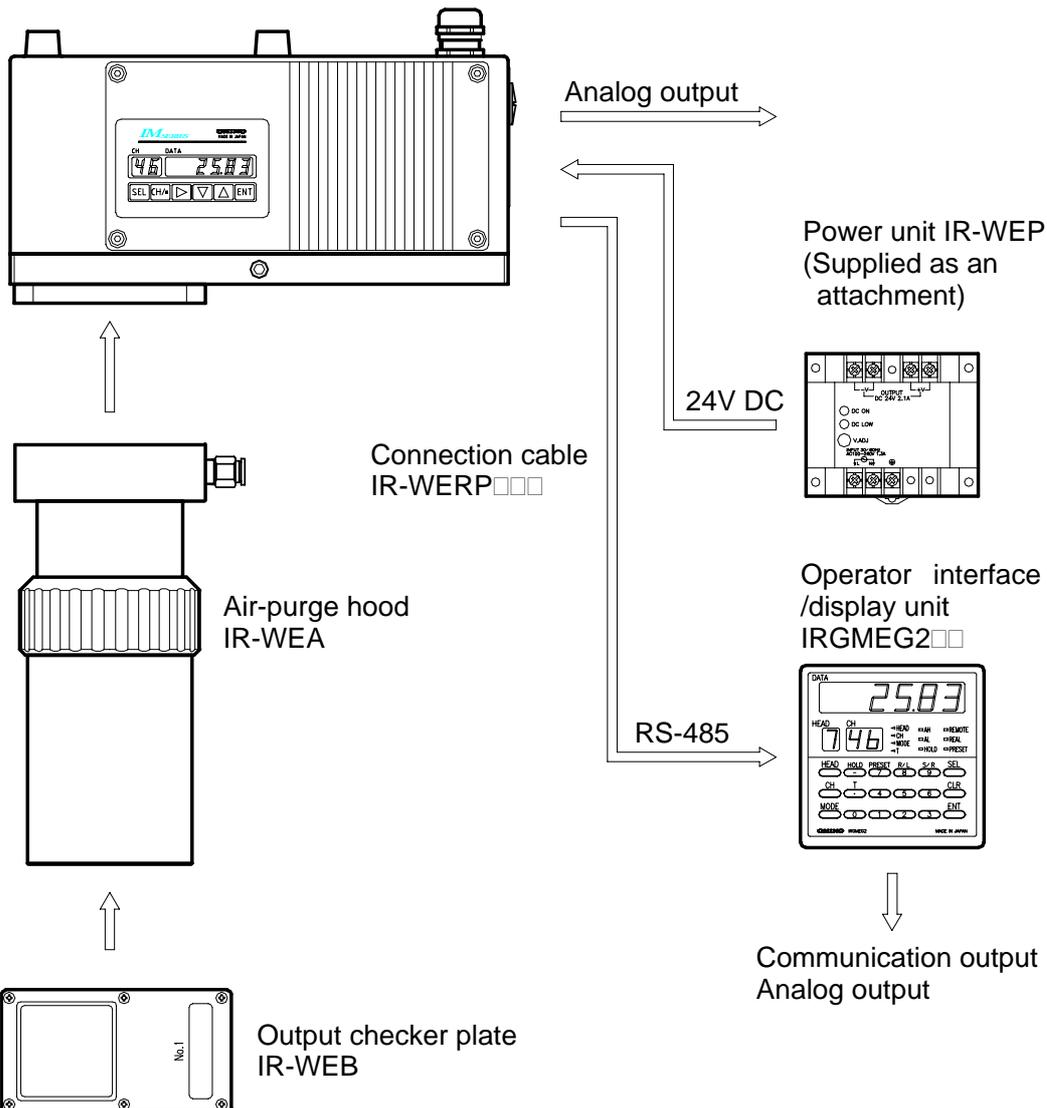
Accessories including cables, connecting the detector unit to the operator interface/display unit or to the power unit, the air-purge hood for shielding all extraneous light and for air-purging to keep the measuring window and the sight path clean, and the output checker plate for your own calibration are available.

This manual describes about the detector unit and accessories.

The instruction manual is separately available for the operator interface/display unit.

1.2 Configuration

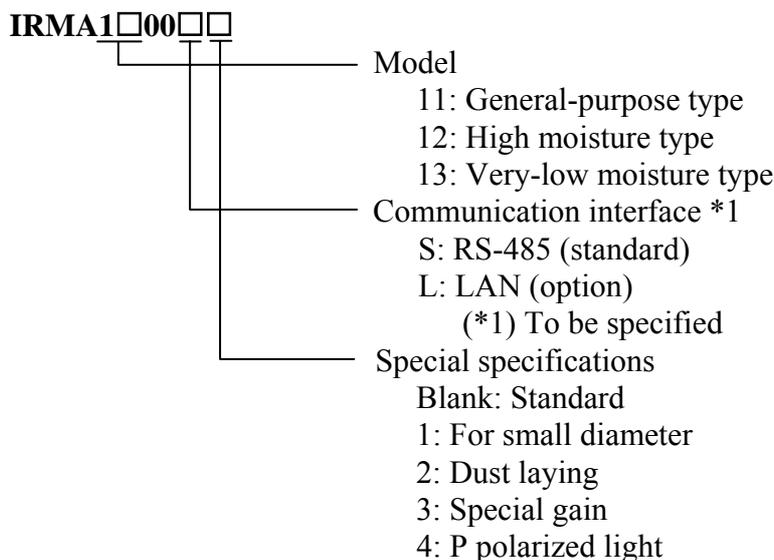
Detector unit
IRMA1100, 1200, 1300



2. Models and accessories

2.1 Models

2.1.1 Detector unit



2.1.2 Accessories

Name	Model
Cable	IR-WERP□□□
Air-purge hood	IR-WEA (For IRMA1100/IRMA1200) IR-WEA3 (For IRMA1300)
Output checker plate	IR-WEB (For IRMA1100/IRMA1200) IR-WEB3 (For IRMA1300)
Installation adapter	IR-WED1
Air-cooling box	IR-WEX
Relaying box	IR-WEE□

2.2 Attachments

Name	Quantity	Remarks
Power unit	1 set	IR-WEP (Omron S82K-05024)
Fuse	2 pieces	SB10 (Nagasawa)
Flathead screwdriver	1 piece	For connection to the terminal board
Hexagon wrench (3mm width across flats)	1 piece	For removing/attaching the terminal cover or the data display cover
Hexagon wrench (4mm width across flats)	1 piece	For removing/attaching the air-purge hood
Instruction manual	1 copy	This document
Instruction manual for communications	1 copy	

3. Installation

(Refer to [5. Names and functions].)

3.1 Setting dipswitches



Remarks

Set the internal dipswitches before setting the detector unit.

3.1.1 Connecting this detector unit to the operator interface/display unit

It is not required to change the settings of the internal dipswitches of this detector unit.

Reference

The above has been set as the default settings at shipment.

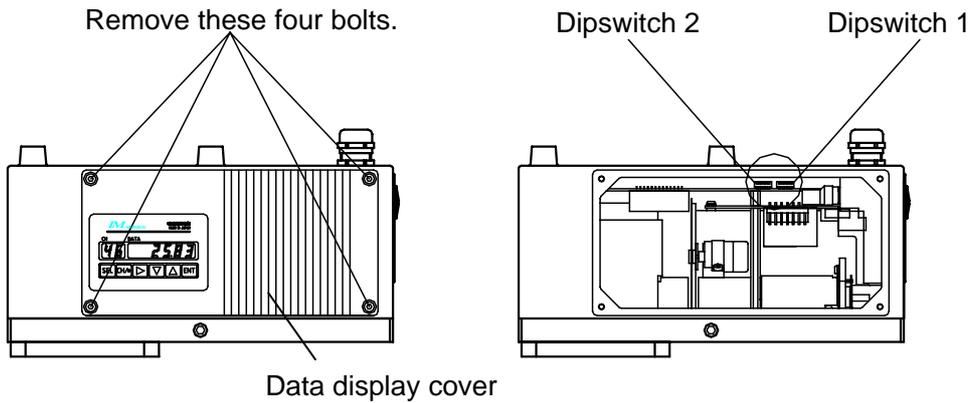
3.1.2 Connecting this detector unit to a personal computer

Setting the dipswitch 2 in this detector unit is required.

- (1) Loosen four pieces of the M4 hexagon socket cap screws fixing the data display cover.
- (2) The data display cover is connected with internal components by cables. Remove the data display cover carefully not to damage to the cables.
- (3) Set No.3 of the dipswitch 2 to ON (upper side).

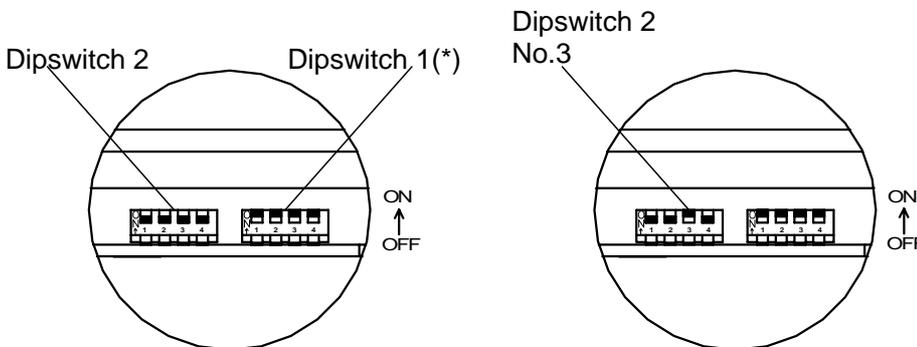
Warning

Make sure to turn off the power source to this unit before removing the data display cover.



[For connecting the detector to the operator interface/display unit (IRGMEG2) (default settings at shipment)]

[For connecting the detector to a personal computer]



Caution

(*) Do not change the setting of the dipswitch 1.

3. Installation

(Refer to [5. Names and functions].)

3.2 Mounting the air-purge hood IR-WEA or IR-WEA3

The air-purge hood is used to shield against the extraneous light, including electric lamps, flames and direct sunlight, onto the measuring area. In addition, it is used to clear water droplets, dust, smoke and steam from the sight path between this detector unit and the measuring area. The hood length is adjustable.

3.2.1 Mounting the hood on this detector unit

Position 4 pieces of hexagon cap screws of the air-purge hood with the screw holes of the air-purge fixing flange of this detector unit and then tighten the screws with the hexagon wrench (4mm width across flats) to fix the hood.

3.2.2 Adjusting the hood length

Loosen the hood length adjustment ring by turning counterclockwise and adjust the hood length. After the length is adjusted, turn the ring clockwise until tight to fix the hood.

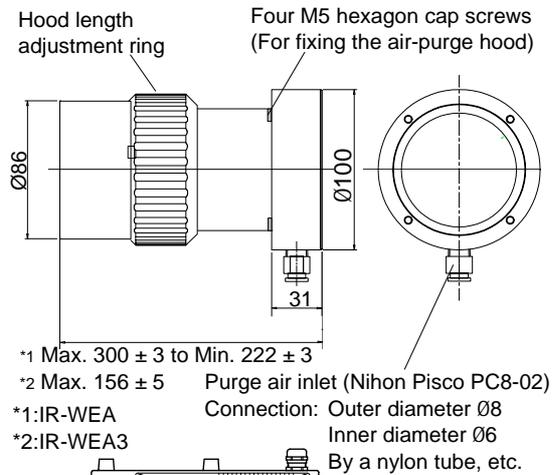
3.2.3 Purge air

When the air-purging is required, supply dry air, not containing oil, dust, etc., from a purge air inlet. Use a nylon tube of $\phi 6\text{mm}$ in outer diameter and $\phi 4\text{mm}$ in inner diameter for connecting to the purge air inlet.

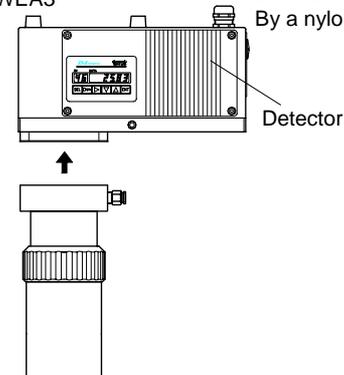
The air-purge inlet is PL6-01M (Nihon Pisco).

Purge air flow: 5 to 200Nl/min

Purge air pressure: 200kPa (2kgf/cm²) or lower



- *1 Max. 300 ± 3 to Min. 222 ± 3
 - *2 Max. 156 ± 5
 - *1:IR-WEA
 - *2:IR-WEA3
- Purge air inlet (Nihon Pisco PC8-02)
 Connection: Outer diameter $\phi 8$
 Inner diameter $\phi 6$
 By a nylon tube, etc.

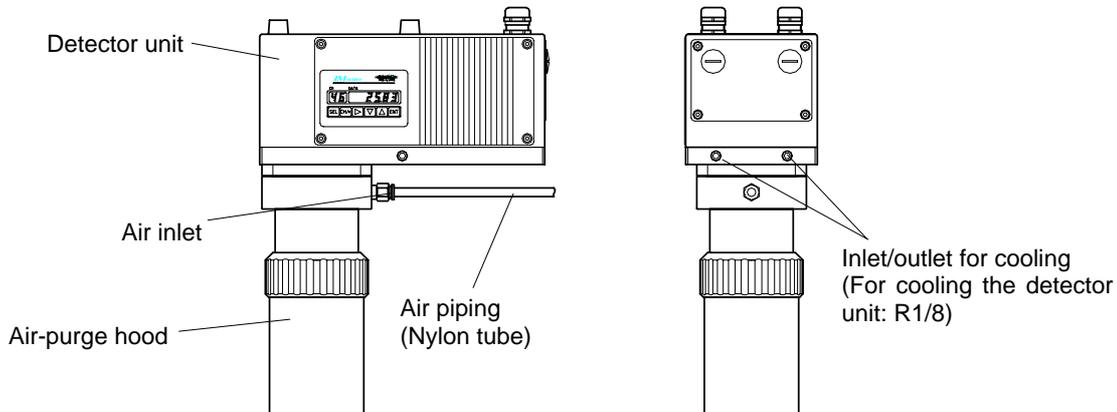


3.3 Cooling this detector unit (water-cooling or air-cooling)

The inlet and outlet for cooling are provided on the side of this detector unit. Let the purified cooling water flow through the inlet and outlet. The recommended water volume is about 0.5 to 1Nl/min and the maximum pressure is 200kPa (2kgf/cm²) or lower.

In the environment where the cooling water can not be used, this detector unit can be cooled by feeding cooling air through the inlet and outlet. When the cooling air is shared with the purge air, connect the air outlet of this detector unit and the purge air inlet of the air-purge hood with a tube.

The recommended air flow in the case is about 50 to 200Nl/min.



Caution

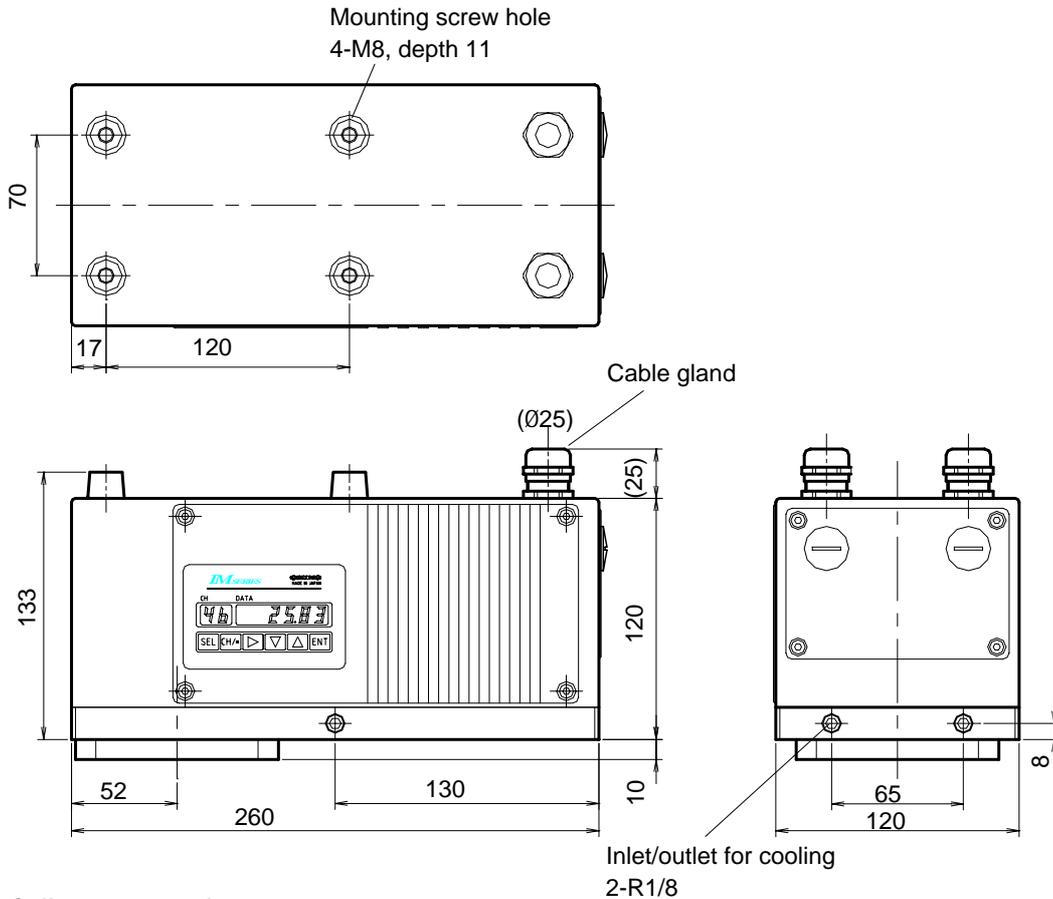
It is recommended that this detector unit is usually cooled with water or air to ensure its reliability. When this detector unit is used in ambient environments higher than 45°C, be sure to cool it down with water or air. In addition, monitor constantly if the supply of the cooling water or cooling air is adequate.

3. Installation (Refer to [5. Names and functions].)

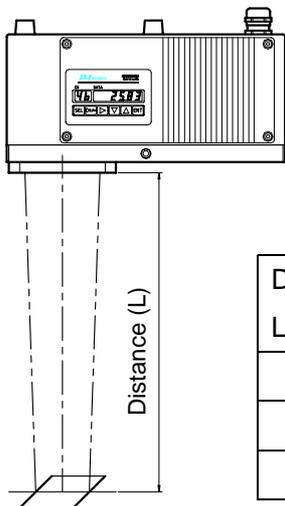
3.4 Installing this detector unit

Four pieces of the mounting screw holes (M8, 11mm in depth) are provided on the top surface of this detector unit. Fix this detector unit to a mounting plate or alternatives with four M8 bolts. The external views and mounting dimensions are shown in the following figure.

- (1) For the IRMA1100 and IRMA1200, place this detector unit with the distance of 300mm from the measuring surface. (This detector unit can be placed from 200 to 400mm.)
For the IRMA1300, place this detector unit with the distance of 200mm from the measuring surface. (This detector unit can be placed from 160 to 300mm)
- (2) The target spot can be confirmed by the visible light irradiated from this detector unit to the measuring surface.
- (3) Prepare a mounting plate in accordance with the conditions at an installation place. Decide the dimensions of the mounting plate in consideration of the space for wiring, etc.



Relation of distance and target area



[IRMA1100, IRMA1200]
< Standard type >

Distance L (mm)	Target area (mm)
200	30
300	50
400	70

[IRMA1100, IRMA1200]
< Small diameter type >

Distance L (mm)	Target area (mm)
200	30
300	30
400	40

[IRMA1300]
< Standard type >

Distance L (mm)	Target area (mm)
160	30
200	30
300	30

3. Installation

(Refer to [5. Names and functions].)

3.5 Cautions before installation

3.5.1 Vibration or shock

Use this detector unit in a location with minimal vibration or shock. If it is forced to use this detector unit in a location where the mounting plate is subject to vibration or is not stable, separate the mounting plate from the vibration source or take measures against vibration by inserting a vibration proof rubber sheet between this detector unit and the mounting plate or other measures.

3.5.2 Magnetic disturbances

This detector unit is designed to withstand magnetic disturbances. However, install it as far away from induction heating oscillators or power lines as possible.

3.5.3 Working temperature and humidity

The working temperature of 10 to 30°C is optimal for this detector unit. When this detector unit is used in ambient environments higher than 45°C, be sure to cool it down by water or air. When the ambient temperature of the detector unit is lower than 10°C, prevent condensation from forming on the cover glass.

The low working humidity is preferable. In the high humid environment, condensation may form on the cover glass by water steam and result in measuring errors.

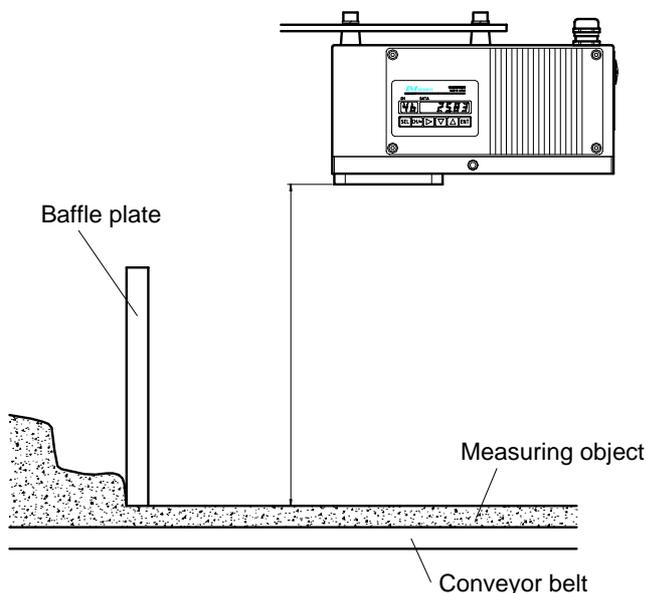
3.5.4 Sight path

Use this detector unit in a location where water droplets, dust, smoke and steam are not contained in the sight path between this detector unit and the measuring area. If these cannot be prevented from being contained and their effects are not eliminated, mount the air-purge hood on this detector unit or use effective alternatives to provide a clear sight path to the measuring area.

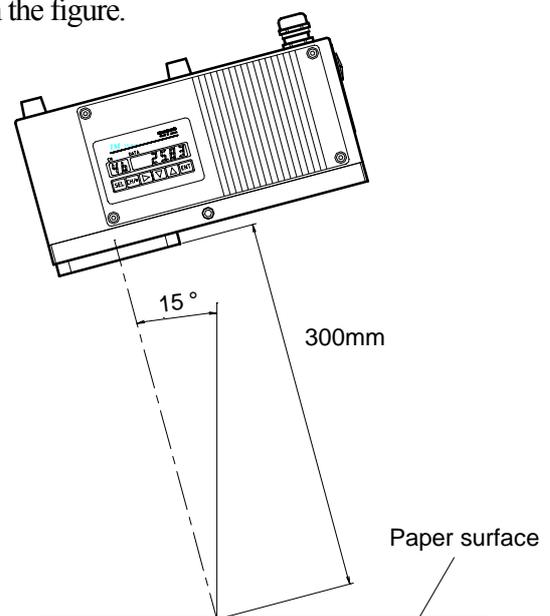
The dc light like the natural light onto the measuring area will not cause any disturbances in measurements, but incorrect measurements are produced by the ac light including electric lamps and flames or direct sunlight. In such cases, shield against the disturbance light to prevent it from irradiating directly onto the measuring area.

3.5.5 Installation (for objects of powders or granular substances)

When this detector unit is installed for on-line measurements, select such place as a hopper outlet or a place just after the change of conveyor belts where there is little difference between the surface and the interior of measuring objects. If such a place cannot be selected, measure the objects by facing the interior to the surface by using a baffle plate as shown below.



[For objects of powder or granular substances]



[For objects in sheet such as paper, etc.]

4. Connections



4.1 Laying cables

For laying cables, be careful of the following points.

- (1) Separate cables from induction heating oscillators or power lines.
- (2) Keep cables not to get water- or oil-stained.
- (3) Don't bend cables extremely or apply any excessive force to them.
- (4) For a permanent layout, protect cables with conduits, etc.

4.2 Single-detector-unit connection

The internal terminal board is accessible by removing the terminal board cover of the detector unit. Lead in cables through the upper cable glands, and connect them to respective terminals.

Lead in the exclusive cable IR-WERP (φ10mm outer diameter) through the cable gland 1.

Lead in a signal cable through the cable grand 2.

Reference

Make sure to use the signal cable with the outer diameter of φ7.0 to 12.5mm.

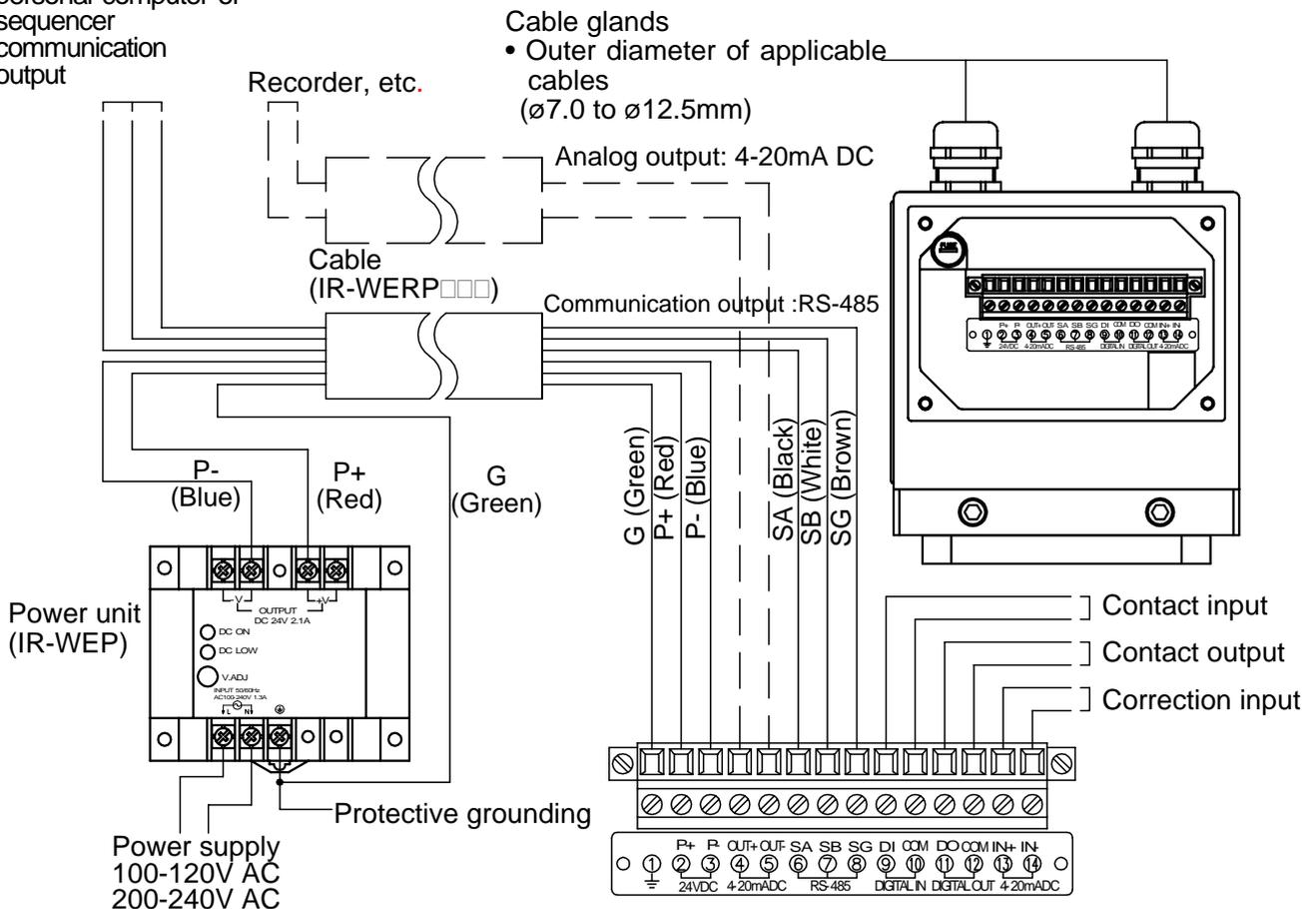
Warning

For avoiding the risk of electric shock, make sure to turn off the power source to this detector unit before wiring to the power terminals.

Caution

Use cables suiting to the applicable outer diameter of the cable gland; otherwise waterproofing of the detector unit may deteriorate. Tighten the cable glands with the nuts and fix the terminal board cover securely after wiring.

Operator interface/display unit, personal computer or sequencer communication output



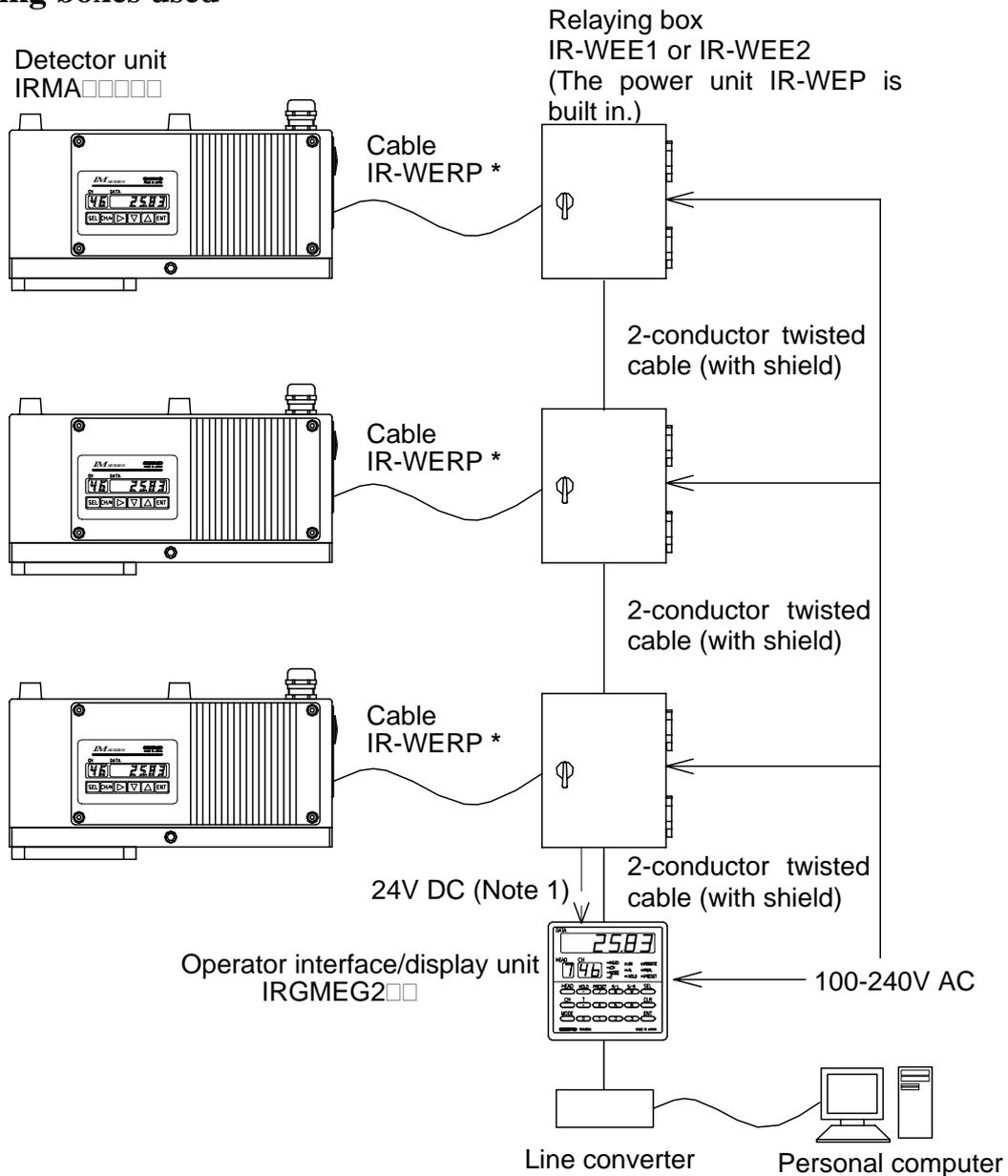
4. Connections

4.3 Multiple-detector-units connection

By using the operator interface/display unit, you can connect the detector unit up to 9 sets. Two connection systems are available. One is for utilizing the relaying box (IR-WEE□) and the other is without using it

 **Caution** For either connecting method, before connecting to the operator interface/display unit or before turning on the power to the operator interface/display unit, set the detector unit numbers not to overlap them each other. Refer to [6.2 Setting detector unit numbers] for the details.

4.3.1 Relaying boxes used



(Note 1) Operator interface/display unit IRGMEG2□□V (complying with CE): 24V DC

 **Caution**

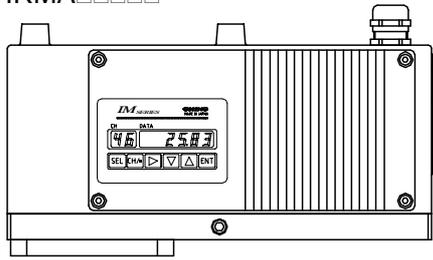
1. Wire the exclusive cable (marked with *) as short as possible in 10m.
2. For wiring to the relaying box, refer to the separate manual for the relaying box.

4. Connections



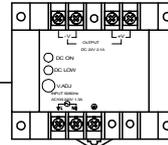
4.3.2 Relaying boxes not used

Detector unit
IRMA□□□□□



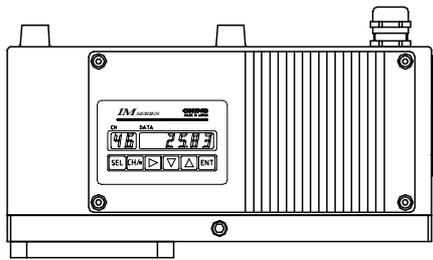
Cable
IR-WERP *

Power unit
IR-WEP



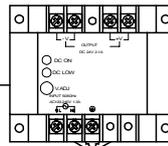
2-conductor twisted cable
(with shield)

Connect the power wires of P+ (red), P- (blue), and G (green external shield) of the exclusive cable IR-WERP to the power unit.
Connect the signal wires of SA (black), SB (white) and SG (brown internal shield) to the 2-conductor twisted cable (with shield).

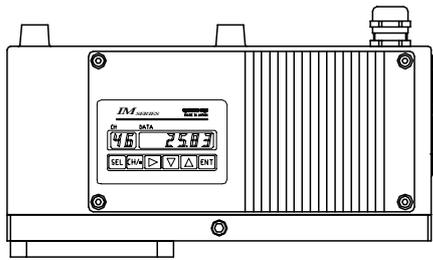


Cable
IR-WERP *

Power unit
IR-WEP

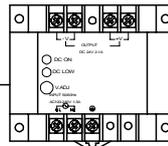


2-conductor twisted cable
(with shield)



Cable
IR-WERP *

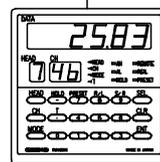
Power unit
IR-WEP



2-conductor twisted cable
(with shield)

24V DC
(Note 1)

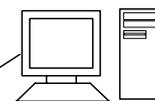
Connect the signal wires of SA (black), SB (white) and SG (brown internal shield) of the exclusive cable IR-WERP and the wires of SA, SB and SG of the 2-conductor twisted cable (with shield) to respective terminals of this detector unit.
(For the signal wire of the exclusive cable, take off the rod shaped tip on its top, strip the cover and then insert them to the terminal together with the twisted cable.



Operator
interface/display unit
IRGMEG2□□

100-240V AC

Line converter

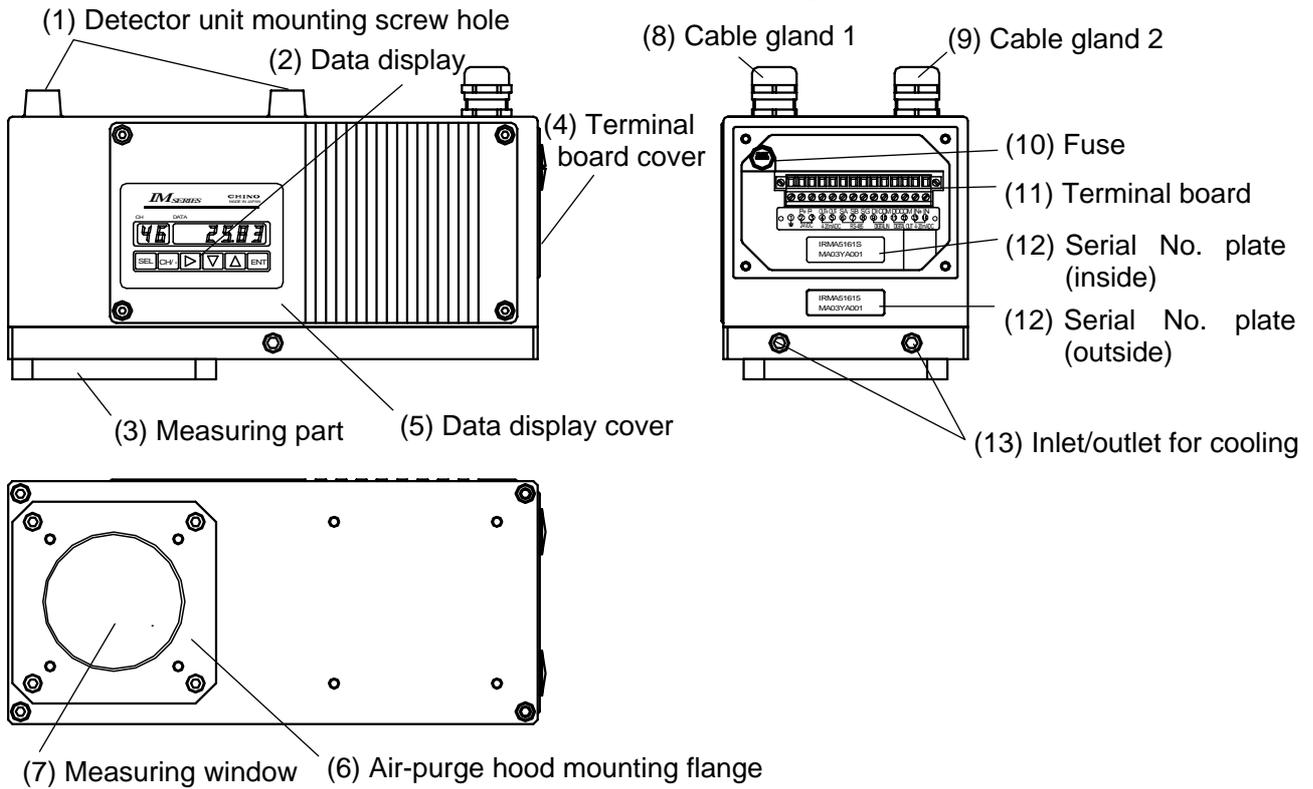


Personal computer

(Note 1) Operator interface/display unit IRGMEG2□V (complying with CE): 24V DC

5. Names and Functions

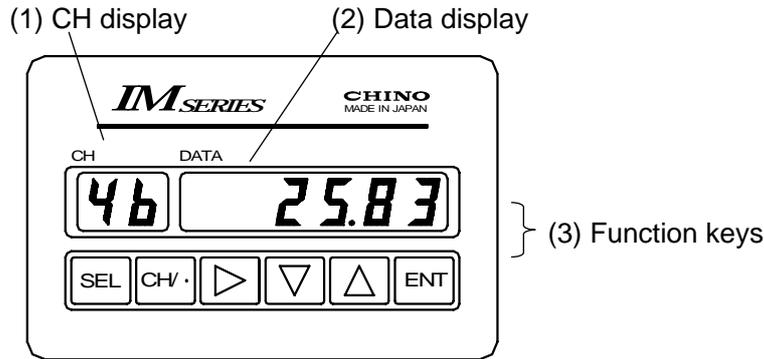
5.1 Names and functions of detector unit components



Names	Functions
(1) Detector unit mounting screw holes	Four M8 screw holes (11mm in depth) for fixing this detector unit to a mounting plate, etc.
(2) Data display	Displays a calibration curve number, a measured value, etc.
(3) Measuring part	The optical assembly, the detector element and the electric circuits are built in.
(4) Terminal board cover	It is fixed with four M4 hexagon socket cap screws and can be removed for wiring. The terminal board and the fuse are built in. The serial number plate showing the model number is pasted on the lower side.
(5) Date display cover	It is fixed with four M4 hexagon socket cap screws. The lamp, the motor and the power board, which are consumables, are built in. For the replacement of these parts, refer to [9. Inspection and maintenance 9.4.2-9.4.4].
(6) Air-purge hood mounting flange	This flange with four M5 screw holes is for mounting the air-purge hood.
(7) Measurement window	It is for irradiating and receiving light.
(8) Cable gland 1	It is for leading in a cable. The outer diameter of its applicable cable is $\phi 8.5$ to 10.5mm. Ordinary this cable gland is sealed by a rubber. Take off the rubber for leading in a cable. The exclusive cable IR-WERP is lead in through this cable gland.
(9) Cable gland 2	It is for leading in a signal cable. The outer diameter of its applicable cable is $\phi 8.5$ to 10.5mm. Ordinary this cable gland is sealed by a rubber. Take off the rubber for leading in a cable.
(10) Fuse	The fuse (10A in capacity) is fitted on the fuse holder.
(11) Terminal board	This internal terminal board for wiring of connection cables is accessible by opening this terminal board cover.
(12) Serial number plate	Two serial number plates indicating the model number and the serial number of this detector unit are pasted on the inside and outside of this detector unit.
(13) Inlet/outlet for cooling	These inlet and outlet are for water or air used to cool this detector unit. The nominal diameter of the inlet and outlet is R1/8.

5. Names and Functions

5.2 Names and functions of data display



Names	Functions
(1) CH display	Displays a calibration curve number in the measurement mode or a setting data name in the setting mode.
(2) Data display	Displays a measured value in the measurement mode or a setting data in the setting mode.
(3) Function keys	<p>SEL For entering into the setting mode or switching setting screens</p> <p>CH/ . For setting a calibration curve number in the measurement mode or entering a decimal point in the setting mode; When the key is pressed again, the decimal point disappears.</p> <p> For entering a setting data in the setting mode or changing the digit of a setting data</p> <p> For changing a setting data in the setting mode</p> <p> For changing a setting data in the setting mode</p> <p>ENT For storing a setting data in the setting mode</p>

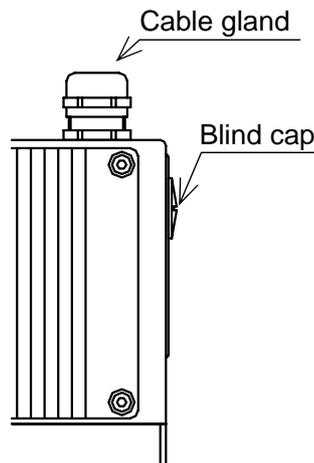
5.3 Terminal portion

The mounting direction of the cable gland is selectable in the following two kinds. Make sure to use the blind cap to cover the place not mounting the cable gland.

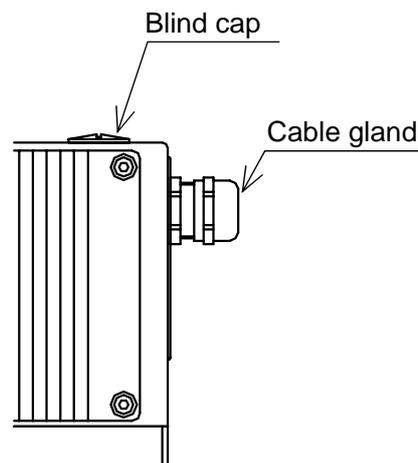
(1) Vertical direction of a cable: Default direction at shipment

(2) Horizontal direction of a cable: It is effective when there is no space above this detector unit.

(1) Cable – Vertical direction



(2) Cable – Horizontal direction



6. Operation

6.1 Confirmation before operation

Check the following two points before turning on the power.

- 1) Have the dipswitches been set? (Refer to [3.1 Setting dipswitches].)
- 2) Are all of connections correct? (Refer to [4. Connections])

6.2 Setting detector unit numbers

Detector unit numbers are for identifying each detector unit in the multiple-detector connections. Up to nine (9) detector units can be connected. Set the detector unit numbers before connecting to the operator interface/display unit.

Reference

The default number of this detector unit at shipment is “1”.
When this detector unit is used with a number other than 1, set the detector unit number by following procedure.

- 1) Enter into the operation condition setting mode by pressing **SEL** key and **ENT** key simultaneously for 2 seconds.
- 2) Press **SEL** key 4 times to display “Hn” in the CH display.
- 3) Press **▶** key. A numeric blinks for entering a detector unit number.
- 4) Change the numeric by **▲** key, **▼** key or **▶** key.
Press **▲** key to increase the numeric.
Press **▼** key to decrease the numeric.
Press **▶** key to shift the blinking digit.
- 5) Press **ENT** key. The numeric stops blinking and the detector unit number is stored.
- 6) Press **SEL** key for 2 seconds. The mode returns to the measurement mode.

CH	DATA
t	0.0

CH	DATA
H n	1

Detector unit number setting mode Blinking

CH	DATA
H n	4

Detector unit number

Reference

The settings shown in the next paragraph can also be executed via the operator interface/display unit (sold separately).
Refer to the separate manual for the operator interface/display unit.

6.3 Setting calibration curve data

Remarks

The settings shown below can also be executed via this detector unit or the operator interface/display unit (sold separately).

The output characteristics of this detector unit depend upon measuring objects. It may also change according to the process conditions or the measuring conditions of samples.

Accordingly, for accurate measurements, it is required to perform beforehand sample tests of each object and obtain a relationship (This is called as the calibration curve.) between the moisture content (%H₂O) obtained by a drying method or other measuring methods and the absorbance “x” measured by this detector unit.

Reference

The absorbance “x” is the ratio of the absorbed amount of the light having the wavelength S of 1.43, 1.94 or 3μm, which is absorbed in a measuring object, to that of the light having the reference wavelength R not absorbed.

Reference

This paragraph describes the setting method of calibration curve data, assuming that calibration curves have been already created. When the calibration curves have not been created yet, refer to [7. Procedure for creating calibration curves].

6. Operation

6.3.1 Data for setting

The followings are the setting data for calibration curve.

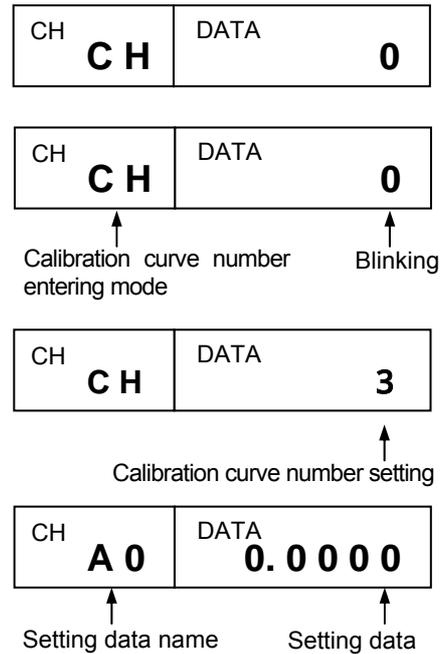
Setting data name	Display	Setting range of data	Default value	Remarks	
(1) Calibration curve No.	CH	1 to 99	1		
(2) Polynomial coefficient a_0	A0	0 to ± 9999.9	0.0000	Effective numeric: 5 digits	
	Polynomial coefficient a_1	A1	0 to ± 9999.9	1.0000	Effective numeric: 5 digits
	Polynomial coefficient a_2	A2	0 to ± 9999.9	0.0000	Effective numeric: 5 digits
	Polynomial coefficient a_3	A3	0 to ± 9999.9	0.0000	Effective numeric: 5 digits
(3) Correction expression coefficient b_0	b0	0 to ± 9999.9	0.0000	Effective numeric: 5 digits	
	Correction expression coefficient b_1	b1	0 to ± 9999.9	1.0000	Effective numeric: 5 digits
	Correction expression coefficient b_2	b2	0 to ± 9999.9	0.0000	Effective numeric: 5 digits
(4) Low limit moisture output	Lo	0 to 9999.9	0.00	Specify the number of decimal places.	
	High limit moisture output	Hi	0 to 9999.9	100.00	Specify the number of decimal places.
(5) Low limit moisture alarm	AL	0 to 9999.9	0.00	Specify the number of decimal places.	
	High limit moisture alarm	AH	0 to 9999.9	100.00	Specify the number of decimal places.
(6) Preset moisture	PS	0 to 9999.9	0.00	Specify the number of decimal places.	
(7) Water absorbance	Ab	0 to ± 9999.9	0.00	Effective numeric: 5 digits	

Data name	Function
(1) Calibration curve No.	An optional number from 1 to 99 can be designated as the calibration curve. Ordinary It is designated sequentially from "1".
(2) Polynomial coefficient " a_0 to a_3 "	Assume that the calibration curve is represented by the third-degree or lower-degree polynomial of $y = a_3x^3 + a_2x^2 + a_1x + a_0$, where, "y" is the moisture content (%H ₂ O) and "x" is the absorbance ("CH0" data of this detector unit).
(3) Correction xpression coefficient " b_0 to b_2 "	These coefficients are provided for the quadratic expression correction (zero and span correction) with reference to the moisture content "y". Assuming that the moisture content after the correction be "Y", we obtain " $Y = b_2y^2 + b_1y + b_0$ ".
(4) Low limit moisture output /High limit moisture output	These specify moisture contents at a low limit output and a high limit output on the analog output scaling. The output is scaled to 4mA at the low limit moisture content and 20mA at the high limit moisture content.
(5) Low limit moisture alarm /High limit moisture alarm	The low limit alarm is activated when the measured value is lower than the low limit alarm setpoint of moisture content and the high limit alarm is activated when the measured value is higher than the high limit alarm setpoint of moisture content. Use the operator interface/display unit when the alarm outputs are required.
(6) Preset moisture	By turning on the preset output by key operations or through communications, the moisture content being set as a preset value is displayed and outputted, regardless of the measured value.
(7) Water absorbance	Decide the water absorbance to compute the surface water ratio for measuring the moisture content of sands, etc. [This setting is only enable when the surface water ratio computation shown in (11) of "6.4.1 Setting data" is set to ON.] The relation between the measured moisture content (%: mass basis moisture content), the surface water ratio (%) and the water absorbance (%) is; <ul style="list-style-type: none"> • Surface water ratio = (Moisture content – Water absorbance) / (1 + (Water absorbance / 100))

6. Operation

6.3.2 Procedure for setting

- 1) Press **SEL** key for 2 seconds to enter into the calibration curve setting mode “CH”.
- 2) Press **▶** key. A numeric blinks for entering a calibration curve number.
- 3) Change the numeric by **▲** key, **▼** key or **▶** key.
 Press **▲** key to increase the numeric.
 Press **▼** key to decrease the numeric.
 Press **▶** key to shift the blinking digit.
- 4) Press **ENT** key. The numeric stops blinking and the calibration curve number is stored.
- 5) Press **SEL** key to enter into the setting mode “A0” for polynomial coefficient a_0 .
- 6) Enter into a numeric setting mode by pressing **▶** key. Change the numeric by **▲** key or **▼** key and store it by pressing **ENT** key. For entering a decimal point, press **CH/·** key at the blinking digit.
- 7) Press **SEL** key to enter into the next data setting mode.
- 8) Repeat the above procedure from 2) to 7) to set all data.
- 9) After the above setting procedure is completed, return to the measurement mode by pressing **SEL** key for two seconds. The automatic return is made if no key is pressed for one minute.



6.3.3 Correcting calibration curves

Remarks The settings shown in the next paragraph can also be executed via the operator interface/display unit (sold separately).

If the actual moisture content does not correspond with the moisture content on the calibration curve being preset due to the difference of one-line and off-line measurements, or other causes, correct it with the correction coefficients b_0 , b_1 and b_2 in [6.3 Setting calibration curve data]. These coefficients are provided for the quadratic expression correction against the measured value “y”. Assuming that the measured value after correction be “Y”, we obtain,

$$Y = b_2y^2 + b_1y + b_0$$

Usually, the shift correction is done with b_0 only. ($b_1 = 1, b_2 = 0$)

Remarks [Example]
 When the measured moisture content before correction is 15 (%H₂O) and the actual moisture content is 13 (%H₂O), “-2%H₂O should be set.
 ($b_2 = 0, b_1 = 1, b_0 = -2$)

6. Operation

6.4 Setting operating conditions

Set the operating conditions including time constant and hold function.

Remarks

The settings shown in the next paragraph can also be executed via the operator interface/display unit (sold separately).

6.4.1 Data for setting

Set the following data in the operating condition setting mode.

Setting data name	Display	Setting range of data	Default value	Remarks
(1) Time constant	t	0.0 to 99.9	0.2	Unit: Second
(2) Hold ON/OFF	Hd	ON, OFF	OFF	
(3) Preset output ON/OFF	PS	ON, OFF	OFF	
(4) Number of decimal places	dt	0 to 4	1	
(5) Contact output: Selection of contact output enabled/disabled and output item	do	none ALArM Error	nonE	NonE: No output ALArM: High/low alarm Error: Self-diagnosed error
(6) Contact input: Selection of contact input enabled/disabled and input item	di	none HoLd PrSEt SMt.rL	nonE	NonE: No output HoLd: Hold PrSEt: Preset SMt.rL: Smoothing/real
(7) Communication protocol	Pt	Rtu Priv*	Rtu	Rtu: MODBUS RTU mode Priv:* This is NOT used with this detector unit.
(8) Detector number	Hn	1 to 9 1 to 247 1 to 31*	1	Operator interface/display unit MODBUS RTU mode * This is NOT used with this detector unit.
(9) Communication speed	SP	9600, 19200	9600	
	Parity	P	nonE odd EVEN	nonE: No parity odd: Odd parity EVEN: Even parity
	Data length	d	7, 8	These parameters are for the private protocol "Priv" in the above [(7) Communication protocol] and are NOT used with this detector unit.
	Stop bit length	Sb	1, 2	
	BCC enabled/disabled	bC	ON, OFF	
(10) Sample temperature correction ON/OFF	St	ON, OFF	OFF	
The following settings can be executed at "ON".				
·Correction input scaling L	tL	-999 to 999	0	
·Correction input scaling H	tH	-999 to 999	100	
(11) Surface water ratio computation ON/OFF	Sd	ON, OFF	OFF	
(12) Engineering mode	ENG			
The following settings can be executed by pressing [ENT] key.				
Processing mode 1: Weight $\alpha 1$	1A	0 to 1.000	0.500	0.5: 3-wavelength processing 0 or 1: 2-wavelength processing
Processing mode 1: Calibration constant $k 1$	1K	0 to ± 9.9999	1.0000	

6. Operation

6.4.1-1) Descriptions of setting data

Setting data name		Description
(1)	Time constant	If the measured value fluctuates noticeably, the signal can be set to be dull by delaying the response of this detector unit. The smoothing time (equivalent to the time constant of analog instruments) can be set in 0.1-second increment.
(2)	Hold ON/OFF	By setting it to ON, the measured value is held. At the same time, the analog output is also held.
(3)	Preset output ON/OFF	By turning on the preset output, this detector unit displays the preset value and the analog output becomes the value corresponding to the preset value.
(4)	Number of decimal places	For the setting the number of decimal places of displayed data
(5)	Contact output : Selection of contact output enabled/disabled and output item	Select whether the contact output is enabled or disabled, and select the output item. (1) NonE: Disabled (2) ALArM: Outputs the high/low alarm, by the contact, of the calibration curve number being set (3) Error: It is outputted when an abnormality is detected by the self-diagnosis function shown in [9.2 Self-diagnosis function].
(6)	Contact input : Selection of contact input enabled/disabled and output item	Select whether the contact input is enabled or disabled, and select the output item. (1) NonE: Disabled (2) HoLd: The analog signal is held by the latest value.(Holding by the signal H) (3) PrSEt: The analog signal is set to a fixed value of 4-20mA. (Fixing by the signal H) (4) SMt.rL: Switching of Smoothing or Real (Real by signal H)
(7)	Detector number	This is a number for identifying each detector in the multiple-detector-units connection. This setting has been completed in [6.2 Setting detector unit numbers].
(8)	Protocol	Rtu: MODBUS RTU mode Priv: Exclusive mode - *This is NOT used with this detector unit.
(9)	Communications speed, Parity, Data length, Stop bit length, BCC enabled /disabled	When this detector unit is connected with the operator interface/display unit, skip these settings. These are for communications with a personal computer, a sequencer or other similar devices. Set them corresponding to a master unit. • Communications speed: Select 9600 or 19200bps. • Parity: Select No, Even or Odd. • Data length: The data length of the MODBUS RTU mode is fixed to 8 bits. No need to select. • Stop bit length: The stop bit length of the MODBUS RTU mode is automatically set with the setting of the parity. (EVEN or odd parity: 1 bit, No parity: 2 bits) • BCC enabled/disabled: *This is NOT used with this detector unit.

6. Operation

Setting data name		Description
(10)	Sample temperature correction ON/OFF	<p>When calibration curves change by sample temperatures, this function enables to change the calibration curve to the other one by measuring the sample temperature.</p> <p>As the input of the sample temperature, a radiation thermometer or a temperature/voltage converter with the output of 4 to 20mADC can be used.</p> <p>When the sample temperature correction is set to ON, the following settings are required. · Correction input scaling L, Correction input scaling H</p> <p>These are used for scaling of 4 to 20mA correction input.</p>
(11)	Surface water ratio computation ON/OFF	<p>For the computation of the moisture content of sands, etc., select the surface water coefficient computation is enabled or disabled. Set it to ON for enabling.</p>
(12)	Engineering mode	<p>(1) Weight α_1: The 3-wavelength processing or 2-wavelength processing can be switched by changing of the setting of the weight α_1.</p> <p>When α_1 is set to 0.5, the processing becomes the 3-wavelength processing that is the ratio processing of three (3) wavelengths.</p> <p>When α_1 is set to 0 or 1, the processing becomes the 2-wavelength processing.</p> <p>(α_1: 1 - the ratio processing of λ_1 and λ_2, α_1: 0 - the ratio processing of λ_2 and λ_3)</p> <p>(2) Calibration constant K1 : This is the value obtained in [6.5 Calibration] and has been stored automatically.</p>

6. Operation

6.4.2 Procedure for setting operation conditions

- 1) Press **SEL** key and **ENT** key simultaneously for 2 seconds to enter into the operation condition setting mode.
- 2) Press **▶** key. A numeric blinks for entering a setting data.
- 3) Change the numeric by **▲** key, **▼** key or **▶** key.
 Press **▲** key to increase the numeric.
 Press **▼** key to decrease the numeric.
 Press **▶** key to shift the blinking digit.
 For entering the decimal point, press **CH/.** key at the blinking digit.
- 4) Press **ENT** key. The numeric blinking stops and the data is stored.
- 5) Press **SEL** key to enter into the setting mode of the next setting data. Repeat the above procedures from 2) to 4) to set all setting data except the engineering mode.

CH	t	DATA	0.0
----	---	------	-----

Setting data name

CH	t	DATA	0.0
----	---	------	-----

Blinking

CH	H d	DATA	ON
----	-----	------	----

Next setting data name

Blinking

6.4.3 Setting data in the engineering mode

- 1) For the setting of the [Weight $\alpha 1$] and the [Calibration constant k1] in the engineering mode, press **SEL** key several times to enter into the engineering mode “Eng” shown right.
- 2) Press **ENT** key in this engineering mode to enter into the setting mode “1A” of the weight $\alpha 1$.
- 3) Change the numeric by **▲** key, **▼** key or **▶** key.
 Press **▲** key to increase the numeric.
 Press **▼** key to decrease the numeric.
 Press **▶** key to shift the blinking digit.
 For entering the decimal point, press **CH/.** key at the blinking digit.
- 4) Press **ENT** key to store the weight $\alpha 1$.
- 5) Then press **SEL** key to enter into the setting mode “1k” of the calibration constant K1.
- 6) Change the numeric by **▲** key, **▼** key or **▶** key.
 Press **▲** key to increase the numeric.
 Press **▼** key to decrease the numeric.
 Press **▶** key to shift the blinking digit.
 For entering the decimal point, press **CH/.** key at the blinking digit.
- 7) Press **ENT** key to store the calibration constant K1.
- 8) Then press **SEL** key to display “2A”, “2K”, “3A” and “3K” and skip them.

CH		DATA	Eng
----	--	------	-----

Engineering mode

Press **ENT** key.

CH	1 A	DATA	0.500
----	-----	------	-------

Weight $\alpha 1$ setting mode

Press **ENT** key.

Press **SEL** key.

CH	1 K	DATA	1.000
----	-----	------	-------

Calibration constant K1 setting mode

6. Operation

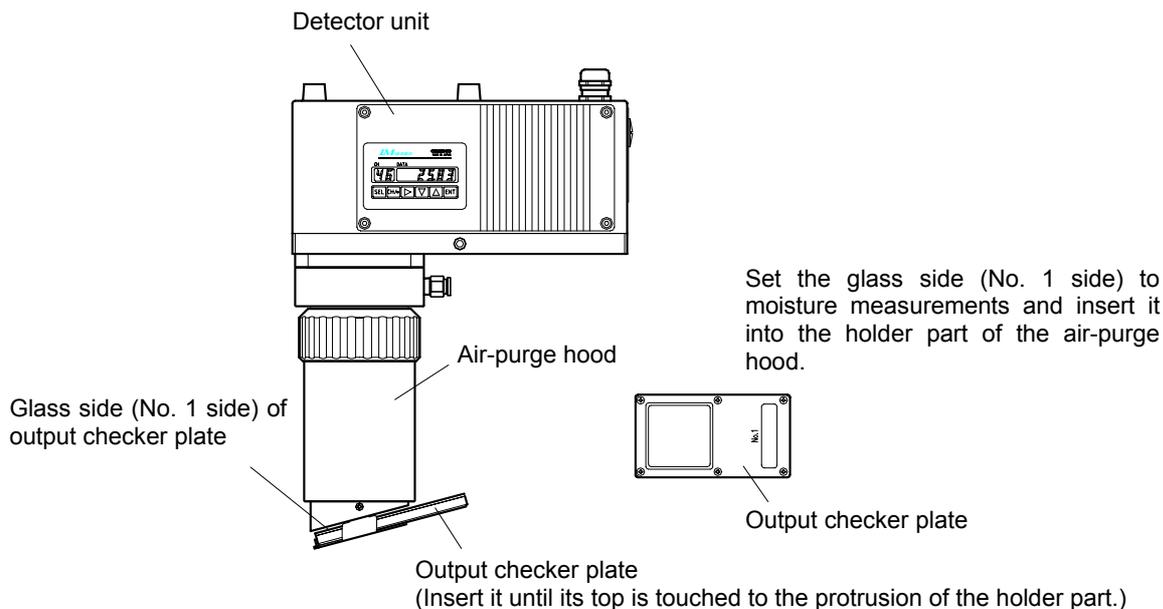
6.5 Calibration (Absorbance display mode settings)

For using this detector unit accurately, the periodical calibration (once in three months) is recommended.

The calibration is executed by using the output checker plate.

Remarks Supply the power to this detector unit for one hour or longer before calibration.

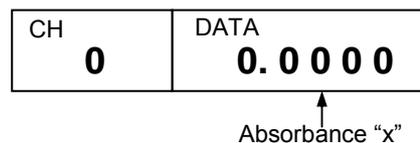
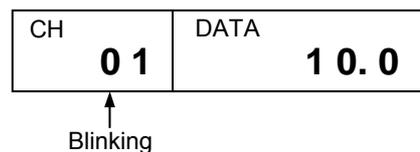
Mount the output checker plate to the top of the air-purge hood and measure the No. 1 side of the output checker plate.



6.5.1 Absorbance display mode settings

With the following procedure, enter into the absorbance display mode by setting the calibration curve number to "0".

- 1) Press **CH/** key. The numeric in the CH display blinks for entering a calibration curve number.
- 2) Press **▢** key to enter a numeric.
- 3) Change the numeric to "0" by using **▽** key.
- 4) Press **ENT** key. The numeric stops blinking and "0" is displayed.



6.5.2 Calibration

- 1) Execute the calibration by pressing three keys of **SEL**, **▽**, and **ENT** simultaneously.
When the displayed absorbance "x" is within 0.0000 ± 0.0010 for IRMA1100 and IRMA1200 and within 0.0000 ± 0.0050 for IRMA1300, the calibration is completed.
- 2) By pressing **CH/** Key, the numeric in the "CH" display blinks. Set the last calibration curve number to return to the measurement mode.

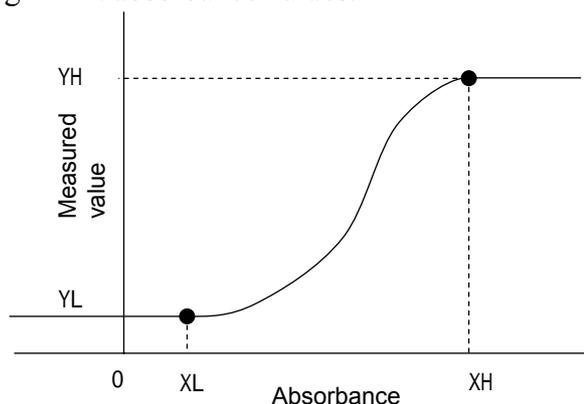
6. Operation

6.6 Setting output limit values of calibration curves

The measured value can be fixed by low limit and high limit absorbance values.

When the absorbance becomes less than the low limit absorbance value, the measured value is fixed to YL as shown right.

Also, when the absorbance becomes more than the high limit absorbance value, the measured value is fixed to YH.



6.6.1 Data for setting limit values of calibration curves

Set the following data for the calibration curve output limit values.

	Setting data name	Display	Setting range of data	Default value	Remarks
(1)	Calibration curve number	CH	1 to 99	1	
(2)	Output limit processing enabled/disabled	LM	OFF, ON	OFF	0: OFF, 1: ON
(3)	Low limit absorbance value	XL	0 to ±9999.9	0.0000	Effective numeric: 5 digits
	Low limit measured value	YL	0 to ±9999.9	0.0000	Effective numeric: 5 digits
(4)	High limit absorbance value	XH	0 to ±9999.9	9.9999	Effective numeric: 5 digits
	High limit measured value	YH	0 to ±9999.9	9999.9	Effective numeric: 5 digits

Setting data name	Description
(1) Calibration curve number	Any calibration curve number in 1 to 99 can be specified, but it is normally specified from 1 sequentially.
(2) Output limit processing enabled/disabled	Set the output limit processing enabled or disabled. When ON (enabled) is set, the measured value is outputted corresponding to the limit values being set. When OFF (disabled) is set, the measured value is outputted corresponding to the calibration curve data.
(3) Low limit absorbance value XL Low limit measured value YL	Enter data to fix the measured value at the low limit side.
(4) High limit absorbance value XL High limit measured value YL	Enter data to fix the measured value at the high limit side.

6. Operation

6.6.2 Procedure for setting data for output limit values of calibration curves

6.6.2-1 Setting the calibration curve numbers (CH)

1) Press **SEL** key and **CH/** key simultaneously for 2 seconds to display "CH" in the CH display for entering the calibration curve number setting mode for the calibration curve output limit values.

CH	DATA
CH	1

↑ Calibration curve number setting for calibration curve output limit value ↑ Calibration curve number

2) Set a calibration curve number.

ENT

6.6.2-2 Enabling/disabling the output limit processing (LM)

1) Press **SEL** key to enter the output limit processing enabled/disabled "LM" setting mode.

Press **▶** key to enter a setting data.

Change the setting data by **▲** key, **▼** key, or **▶** key.

Press **ENT** key to store the setting data.

CH	DATA
LM	OFF

↑ Setting data name ↑ Setting data

6.6.2-3 Setting a low limit absorbance value (XL) and a low limit measured value (YL)

1) After the above setting, press **SEL** key to enter the low limit absorbance value "XL" setting mode.

Press **▶** key to enter a setting data.

Change the setting data by **▲** key, **▼** key, or **▶** key.

Press **ENT** key to store the setting data.

CH	DATA
XL	0.0

2) After the above setting, press **SEL** key to enter the low limit measured value "YL" setting mode.

Press **▶** key to enter a setting data.

Change the setting data by **▲** key, **▼** key, or **▶** key.

Press **ENT** key to store the setting data.

CH	DATA
YL	0.0

6.6.2-4 Setting a high limit absorbance value (XH) and a high limit measured value (YH)

1) After the above setting, press **SEL** key to enter the high limit absorbance value "XH" setting mode.

Press **▶** key to enter a setting data.

Change the setting data by **▲** key, **▼** key, or **▶** key.

Press **ENT** key to store the setting data.

CH	DATA
XH	1.000

2) After the above setting, press **SEL** key to enter the high limit measured value "YH" setting mode.

Press **▶** key to enter a setting data.

Change the setting data by **▲** key, **▼** key, or **▶** key.

Press **ENT** key to store the setting data.

CH	DATA
YH	50.0

6.6.2-5 Setting output limit values to other calibration curve numbers

1) After the above setting (6.6.2-1 to 6.6.2-4), press **SEL** key to return to the calibration curve number setting mode.

Enter other calibration curve number for setting output limit values.

Repeat the above procedure (6.6.2-1 to 6.6.2-4) to set output limit values to other calibration curve numbers.

Remarks

After the above setting procedure is completed, return to the measurement mode by pressing **SEL** key for two seconds. The automatic return is made if no key is pressed for one minute.

7. Procedure for creating calibration curves

The output characteristics of the infrared moisture meter depend upon measuring objects. It may also change according to the process conditions or the measuring conditions of samples.

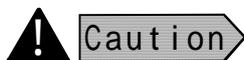
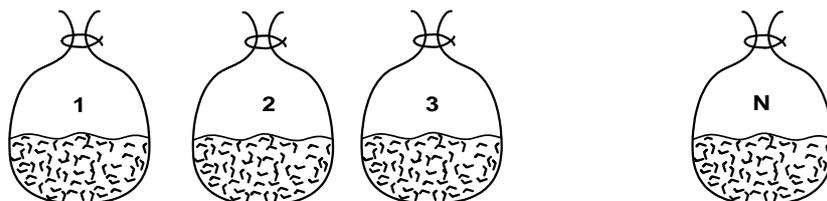
Accordingly, for accurate measurements, it is required to perform beforehand sample tests of each object and obtain a relationship (This is called as the calibration curve.) between the moisture content (%H₂O) obtained by a drying method or other measuring methods and the absorbance “x” measured by this detector unit.

This chapter describes the measurements of the moisture content by the drying method. However, the same creation method of the calibration curves is applied to the measurements of the moisture content by the Karl Fischer method or other methods.

7.1 Sample preparation

7.1.1 Powders or granular substances

- (1) Take a sample of about 2 to 4 liters from the measuring object.
- (2) Dry up the sample up to the absolute dry condition by a dryer. Particularly be careful with the heating temperature so as not to denature the sample.
- (3) Divide the dried sample into every 100 to 200cc. It is recommended to divide it into many samples, but 5 to 6 samples are ordinary used.
- (4) Add water to these 5 to 6 samples bit by bit so that the moisture content of each sample divides the measuring range almost evenly.
- (5) Stir each sample with water added sufficiently, put it into a polyethylene bag and then seal it tightly. Leave each sample for about 2 days until its moisture content is stabilized.



Caution

For a sample cannot be measured because it cannot be heated or it is hardened by adding water, adjust the moisture contents according to the procedure for papers shown in Para. [7.1.2]

7.1.2 Papers (sheet materials)

- (1) Cut a sample to have a size of about 100 x 100mm. (Number of samples: 9 sheets)
- (2) Divide 9 sample sheets into 3 groups with 3 sheets in each group. Adjust the moisture content of each group under the following conditions.

Drying: Leave the samples in a desiccator containing silica gel for 2 days. In case of papers, the moisture content becomes about 4%H₂O.

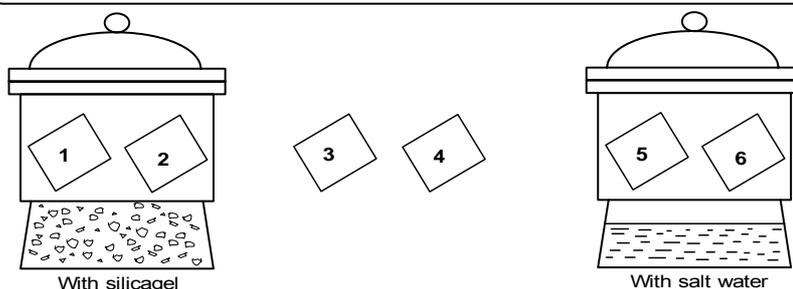
In the air: Leave the samples in an indoor atmosphere.
In case of papers, the moisture content becomes about 7%H₂O in summer or about 5%H₂O in winter.

Moistening: Leave the samples in a desiccator containing salt water for 2 days.
In case of papers, the moisture content becomes 8 to 9%H₂O normally or maximum about 11% H₂O.



Caution

Wear clean gloves not to touch the samples by hands directly. It is convenient for you to mark the samples for identifying their front/back surfaces and their measurement sequence.



7. Procedure for creating calibration curves

7.2 Sample measurement

Be careful with the following cautions in measurements.

- (1) Before measurements, warm up this detector unit more than 1 hour.
- (2) Place samples at the same position as in actual measurements, set the calibration curve number to 0, and then read the display (absorbance "x").
- (3) Perform the measurements rapidly.
- (4) The visible light is irradiated from this detector unit. Confirm that the samples cover the measurement area completely.

7.2.1 Sample measurement for powders or granular substances

- (1) Prepare the same quantity of trays (Ø100 to 150mm in diameter, about 20mm in depth) as samples.
- (2) Weigh each tray (weight W_0).
- (3) Empty the sample sealed from the polyethylene bag and then spread it on the tray until its surface becomes flat and its bottom cannot be seen.
- (4) Put the tray at the measuring position, set the calibration curve number of this detector unit to 0, and then read its display (absorbance "x"). If the measured value cannot be read easily, delay the response with the smoothing function.
- (5) Stir the sample rapidly with a spoon and measure it by this detector unit again. Repeat this measurement 2 or 3 times per sample.
- (6) Weigh the tray with the sample put on (weight W_1).
- (7) Perform the same measurements on all samples.
- (8) Put all samples with trays into a dryer, and dry them until they become in the absolute dry condition (Drying for more than 2 hours at 105 to 110°C is usually required.).
- (9) Cool them down after drying and weigh each tray with the sample put on (weight W_2).
- (10) Record the measured values in the following table every measurement and obtain the moisture contents by the following formula.

$$\frac{W_1 - W_2}{W_1 - W_0} \times 100 (\%H_2O)$$

No.	Absorbance "x"	W_0	W_1	W_2	Moisture content (% H_2O)
1	x_1				y_1
2	x_2				y_2
3	x_3				y_3
:	:				:
n	x_n				y_n

7. Procedure for creating calibration curves

7.2.2 Sample measurement for papers (sheet materials)

- (1) Weigh a sample before measurements (weight W_1).
- (2) Hold the sample by a paper holder, put it by tilting at 15° to the measuring position, set the calibration curve number of this detector unit to 0, and then read its display (absorbance " x ").
- (3) Weigh the sample after the above measurement (weight W_2). Perform the measurements from (1) to (3) as quickly as possible.
- (4) Perform the same measurements on all samples. For these measurements, the same surface (front or back) of the samples should be measured and the same measurement sequence should be taken.
- (5) Put all samples into a dryer, and dry them until they become in the absolute dry condition (Drying for more than 2 hours at 105°C is usually required.).
- (6) After drying, put all samples into a desiccator containing silica gel, and allow them natural-cooling.
- (7) Weigh each sample (weight W_3).
- (8) Record the measured value in the following table every measurement, and obtain the moisture contents by the following formula.

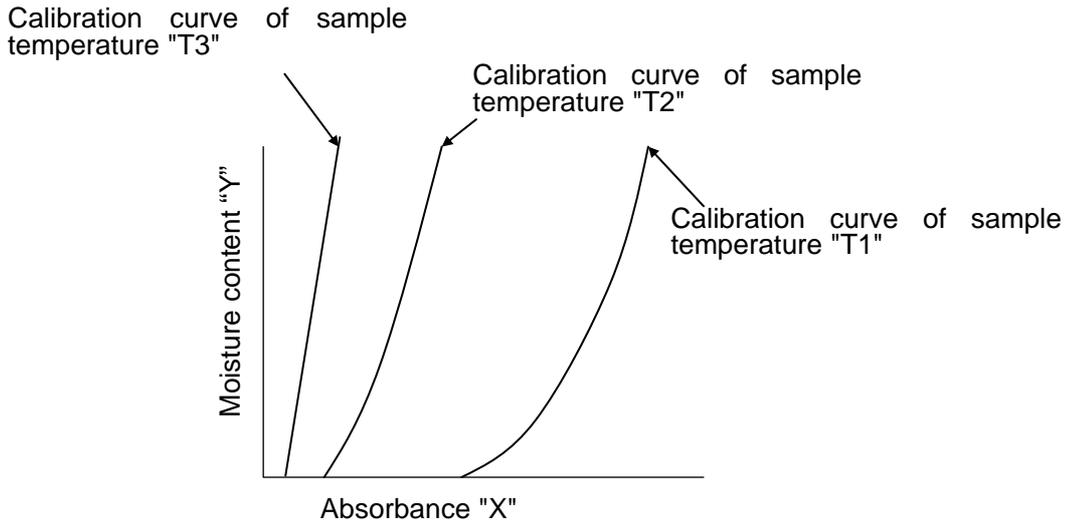
$$\frac{(W_1 + W_2)/2 - W_3}{(W_1 + W_2)/2} \times 100 (\%H_2O)$$

No.	Absorbance " x "	W_1	W_2	W_3	Moisture content ($\%H_2O$)
1	x_1				y_1
2	x_2				y_2
3	x_3				y_3
:	:				:
n	x_n				y_n

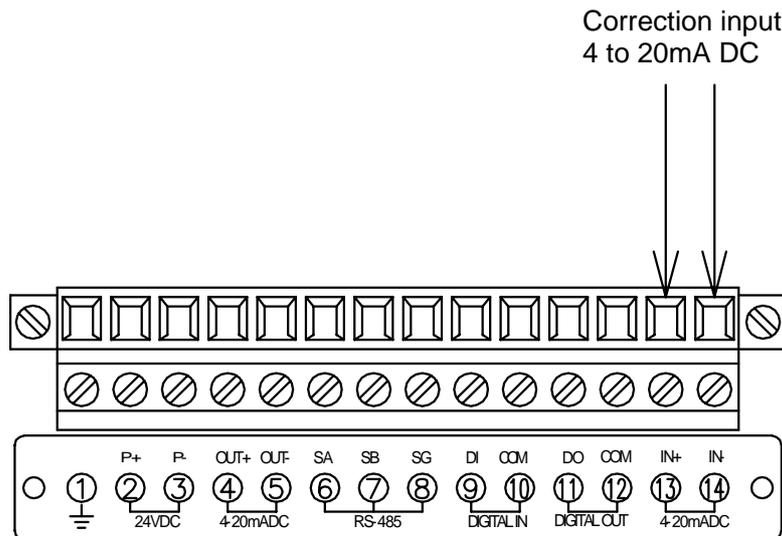
8. Sample temperature correction function

8.1 General

When a calibration curve changes depending on the sample temperature T_s , this function enables to switch the calibration curve to other one corresponding to the sample temperature measured. For the input of the sample temperature, a radiation thermometer or a temperature/voltage converter with the output of 4 to 20mADC can be used. By utilizing this function, 10 calibration curves in one group (9 calibration curves only in the group 10) can be switched corresponding to the sample temperature T_s . 99 calibration curves are available and up to 10 groups can be set accordingly.



8.2 Wiring this detector unit



8. Sample temperature correction function

8.3 Enabling/disabling the sample temperature correction function

Execute this setting with either this detector unit or the operator interface/display unit. When the correction is disabled, the operation is normal which means the calibration curve is not switched corresponding to the sample temperature measured. When it is enabled, the calibration curve is switched with the sample temperature.

8.3.1 Setting with this detector unit

- (1) Press **SEL** key and **ENT** key simultaneously for 2 seconds to enter into the operating condition setting mode.
- (2) Press **SEL** key several times to enter into the sample temperature correction enabled/disabled setting mode (St).

CH St	DATA OFF
--------------	-----------------

- (3) Select the sample temperature correction enabled or disabled.
 - ▣ ▣ ENT** (OFF) Correction OFF (disabled)
 - ▣ ▣ ENT** (ON) Correction ON (enabled)
- * When you go on setting the sample temperature scaling, skip the next (4) and proceed to (2) of [8.4 Setting a sample temperature scaling (8.4.1 Setting with this detector unit)].
- (4) Press **SEL** key for 2 seconds. The mode returns the measurement mode.

8.3.2 Setting with the operator interface/display unit

- (1) Set the calibration curve number to 0.
 - CH 0 ENT**
- (2) Enter into the sample temperature correction enabled/disabled setting mode (St).
 - MODE 1 9 ENT**
- (3) Select the sample temperature correction enabled or disabled.
 - 0 ENT** (OFF) Correction OFF (disabled)
 - 1 ENT** (ON) Correction ON (enabled)
- * When you go on setting the sample temperature scaling, skip the next (4) and proceed to (2) of [8.4 Setting a sample temperature scaling (8.4.2 Setting with the operator interface/display unit)].
- (4) Return the calibration curve number to the original one.

8.4 Setting a sample temperature scaling (4 to 20mA DC only)

When a radiation thermometer or a thermoelectric converter is used, matching the temperature range for its 4 to 20mADC output to the temperature range for 4 to 20mADC input of this detector unit is required.

Carry out the scaling with either this detector unit or the operator interface/display unit, following the procedure shown below.

8.4.1 Setting with the detector unit

- (1) Press **SEL** key and **ENT** key simultaneously for 2 seconds to enter into the operating condition setting mode.
- (2) Press **SEL** key several times to enter into the sample temperature scaling low limit (tL) setting mode.

CH tL	DATA 0.0
--------------	-----------------

- (3) Set the sample temperature scaling low limit (tL). (Setting range: -999.9 to 999.9)
- (4) Press **SEL** key once to enter into the sample temperature scaling high limit (tH) setting mode.
- (5) Set the sample temperature scaling high limit (tH). (Setting range: -999.9 to 999.9)

8.4.2 Setting with the operator interface/display unit

- (1) Set the calibration curve number to 0.
 - CH 0 ENT**
- (2) Enter into the sample temperature scaling setting mode
 - MODE 2 1 ENT**
- (3) Set the sample temperature scaling low limit (tL). (Setting range: -999.9 to 999.9)
- (4) Press **SEL** key once to enter into the sample temperature scaling high limit (tH) setting mode.
- (5) Set the sample temperature scaling high limit (tH). (Setting range: -999.9 to 999.9)

8. Correction function by sample temperature from external input

8.5 Setting sample temperature

The following key operation is common to this detector unit or the operator interface/display unit.

- (1) Press SEL key for 2 seconds to enter into the calibration curve setting mode.
- (2) Press SEL key several times to enter into the sample temperature setting mode (tS).
- (3) Set the sample temperature. (Setting range: -999.9 to 999.9)

CH t S	DATA 999.9
---------------	-------------------

8.6 Setting calibration curve data

- (1) Specify a group for calibration curve number to be used.
The groups are from 1 to 10 and each one corresponds to the following calibration curve numbers respectively.

Group 1: Calibration curve number 1 to 10	Group 6: Calibration curve number 51 to 60
Group 2: Calibration curve number 11 to 20	Group 7: Calibration curve number 61 to 70
Group 3: Calibration curve number 21 to 30	Group 8: Calibration curve number 71 to 80
Group 4: Calibration curve number 31 to 40	Group 9: Calibration curve number 81 to 90
Group 5: Calibration curve number 41 to 50	Group 10: Calibration curve number 91 to 99

- (2) Example: Assuming that the group 1 has been selected,
Set the following calibration curve at the sample low limit temperature T1 to the calibration curve No. 1.

$$y = a3x^3 + a2x^2 + a1x + a0$$

Only the calibration curve by polynomial expression can be used.

Further, set the sample temperature T1. For its setting, refer to [8.5 Setting sample temperature].

- (3) Set the calibration curves at the sample temperature Ti (i = 2 to 10) to the calibration curve numbers 2 to 10.

However, Ti should fulfill the following expression.

$$T1 \text{ (Sample low limit temperature)} \leq T2 \leq \dots \leq T9 \leq T10 \text{ (Sample high limit temperature)}$$

- (4) Enter 999.9 into the Ti not used. Be careful that, if this value is not entered, a calibration curve not used is computed as a data.

* The default of the sample temperature Ti is 999.9.

- (5) For the correction expression coefficients b1 and b0 and the constants (low limit range, high limit range, low limit alarm, high limit alarm and preset value), the values for the first calibration curve number in a group are used.

Group 1: Calibration curve number 1	Group 6: Calibration curve number 51
Group 2: Calibration curve number 11	Group 7: Calibration curve number 61
Group 3: Calibration curve number 21	Group 8: Calibration curve number 71
Group 4: Calibration curve number 31	Group 9: Calibration curve number 81
Group 5: Calibration curve number 41	Group 10: Calibration curve number 91

8. Correction function by sample temperature from external input

8.7 Measurement

- (1) When ON (enabled) is selected in the sample temperature correction and one calibration curve number in a group is set, the calibration curve number is automatically switched corresponding to the sample temperature.

For example, when the sample temperature T_s fulfills the following expression, the calibration curve number becomes “ i ”.

$$T_1 \leq \dots \leq T_i \leq T_s < T_{i+1} \leq \dots \leq T_{10}$$

- (2) However, the measured value Y is not the measured value Y_i on the calibration curve No. “ i ” but becomes the following value interpolated from the measured value Y_i and the measured value Y_{i+1} on the calibration curve No. “ $i+1$ ”.

$$Y = (Y_{i+1} - Y_i) \times \frac{T_s - T_i}{T_{i+1} - T_i} + Y_i$$

- (3) When the sample temperature T_s is lower than the sample temperature of the first calibration curve number in the group or when it is higher than the sample temperature of the last calibration curve number, the following error display appears.

However, the calibration curve, of which sample temperature is set as 999.9, is ignored.

- * For the sample temperature lower than the sample temperature of the first calibration curve number in the group Er15 (Sample temperature too low)
- * For the sample temperature higher than the sample temperature of the last calibration curve number in the group Er14 (Sample temperature too high)

8.8 Displaying sample temperature T_s

8.8.1 Displaying with this detector unit

- (1) Set the calibration curve number to 0.

CH **0** **ENT**

- (2) Press **Δ** key for 2 seconds to display the sample temperature.

- (3) For canceling of the sample temperature display, press **SEL** key for 2 seconds or press **CH** key for 2 seconds

8.8.2 Displaying with the operator interface/display unit

- (1) Set the calibration curve number to 0.

CH **0** **ENT**

- (2) Display the sample temperature.

MODE **2** **0** **ENT**

- (3) For canceling of the sample temperature display, press **SEL** key for 2 seconds or press **CH** key for 2 seconds

9. Inspection and maintenance

9.1 Periodical inspection

The following inspections are required periodically.

(1) Cleaning the cover glass surface

Keep the cover glass surface of this detector unit clean all times. Wipe off dirt and flogging with gauze or cloths like that.

It is more effective to impregnate the gauze with alcohol.

(2) Installation

Check this detector unit is correctly installed and fixed securely.

(3) Connections

Check the connections to all terminals of this detector unit, the operator interface/display unit, a receiving instrument or other instruments are fixed securely.

(4) Purge air

Check flow, pressure and cleanness of air supplied for air-purging are adequate.

(5) Calibration

For maintaining the accuracy of this detector unit, the calibration of the unit once in 3 months is recommended by using the output checker plate (Model IR-WEB or IR-WEB3: sold separately).

9.2 Self-diagnosis function

The self-diagnosis function is built in this detector unit. When an abnormal condition occurs, the corresponding error number is displayed.

All error numbers are common to this detector unit and the operator interface/display unit.

Error No.	Item	Contents	Measures	Diagnosed abnormal condition*
----	High limit over range	Measured value is higher than the displaying range.	Check the calibration curve data. Check the output by the output checker plate.	—
----	Low limit over range	Measured value is lower than the displaying range.	Check the calibration curve data. Check the output by the output checker plate.	—
Er01	Nonvolatile memory abnormal	Writing to or reading from the nonvolatile memory is disabled.	Return this detector unit to CHINO.	○
Er03	Motor rotation abnormal	The motor stops or rotates abnormally.	Replace the motor.	○
Er06	Computation error	Overflow happened in computation	Check the output by the output checker plate.	○
Er07	Element temperature abnormal	The element temperature is abnormal.	Return this detector unit to CHINO.	○
Er12	Ambient temperature too high	The ambient temperature of the detector unit is high	Lower the ambient temperature.	—
Er13	Ambient temperature too low	The ambient temperature of the detector unit is low	Raise the ambient temperature.	—
Er14	Sample temperature too high	The sample temperature is higher than the correction range	Widen the correction range.	—
Er15	Sample temperature too low	The sample temperature is lower than the correction range	Widen the correction range.	—
Er16	Sample low reflection	The reflection rate of the sample is low or the lamp is burned out.	Close the distance to the sample. If the lamp is burned out, replace it.	—
Er17	Sample high reflection	The reflection rate of the sample is high.	Incline or extend the distance to the sample.	—
Er20	Number of calibration curves insufficient for sample temperature correction	The number of calibration curves is insufficient for the sample temperature correction..	Set two calibration curves setting sample temperature or more.	—

(Note) For the items filled with ○ in the self-diagnosed abnormal condition, a self-diagnosed abnormal condition alarm is outputted from this detector unit and the operator interface/display unit.

9. Inspection and maintenance

9.3 Measures against troubles not included with self-diagnosis

If a trouble occurred, take remedial measures referring to the corresponding items of this manual after checking the following points. For the troubles of the operator interface/display unit, refer to the separate manual of the operator interface/display unit.

9.3.1 No display on this detector unit appears.

- (1) Is the power normal?
- (2) Is the fuse normal?
- (3) Are cables connected securely?
- (4) Is the connector connecting the data display cover and the internal CPU board connected securely?
- (5) Turn off the power once and then turn on it.
- (6) If the trouble cannot be repaired by the above checks, the power unit in this detector unit may be defective.

9.3.2 Measured value remains unchanged.

- (1) Is HOLD set to OFF?
- (2) Is PRESET set to OFF?
- (3) Are the calibration curve data correct?
- (4) Turn off the power once and then turn on it.
- (5) Does the data display with the calibration curve number 0 by using the output checker plate change?
- (6) When the data remains unchanged, initialize the RAM. If this phenomenon is not still recovered, return this detector unit to CHINO.

9.3.3 Measured value fluctuates.

- (1) Is the measuring surface flat?
- (2) Is the measuring position correct? Make sure that the detector unit does not measure such bottom face as a conveyor belt, etc.
- (3) Make sure that any disturbance light is not irradiated onto the measuring surface.
- (4) Is the smoothing time proper? Certain smoothing time is necessary in stable measurements.
- (5) Make sure that any noise source does not exist around this detector unit or connection cables.
- (6) Does the data display with the calibration curve number 0 by using the output checker plate fluctuate?
- (7) When the data fluctuates, initialize the RAM. If this phenomenon is not still recovered, return this detector unit to CHINO.

9.3.4 Measured value is slightly higher or lower than the actual value.

- (1) Is the calibration curve number correct?
- (2) Are the calibration curve data correct?
- (3) Are HOLD and PRESET set to OFF?
- (4) Is the measuring position correct?
- (5) Is the cover glass surface of this detector unit clean?
- (6) Correct the calibration curve. (Refer to [6.3.3 Correcting calibration curves].)

9. Inspection and maintenance

9.4 Maintenance parts

9.4.1 List of maintenance parts

The replacing intervals are reference values. They are subjected to the working conditions.

Article name	Quantity	Replacing interval	Remarks
Lamp (with rubber sheet)	1	5 years	
Motor (with connector)	1	3 years	
Power board	1	5 years	3 years when the ambient temperature is 40°C or higher
Fuse	2		Supplied as an attachment

Warning

For replacing maintenance parts, make sure to turn off the power source to this detector unit.

9.4.2 Replacing a lamp

Warning

For replacing the lamp, make sure to turn off the power source to this detector unit.

- (1) Turn off the power source to this detector unit.
- (2) Loosen four M4 hexagon socket cap screws fixing the data display cover and remove the data display cover slightly.

Caution

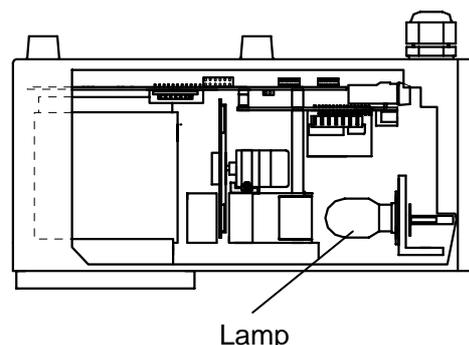
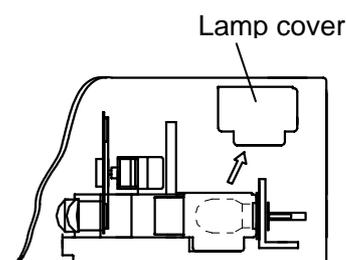
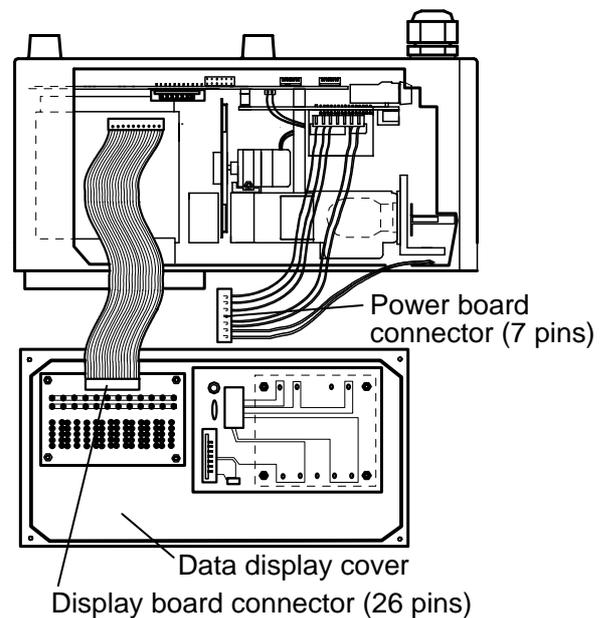
As the data display cover is connected with internal components by cables, carefully remove the cover not to scratch the cables.

- (3) Disconnect the cable connector (26 pins) at the display board and the connector (7 pins) at the power board, and then remove the data display cover from this detector unit completely.
- (4) Loosen M3 pan screws fixing the lamp cover, and remove the lamp cover upward.
- (5) Turn the lamp bulb counterclockwise viewed from the filament side about 30 degree, and pull the lamp from the socket.
(If the lamp is not turned easily, turn the lamp bulb by wrapping the rubber sheet around it, which is attached to a new replacement lamp.)

Caution

As the lamp bulb becomes hot after energization, replace it after cooling it down enough.

- (6) Position the new lamp with the crena portion of the flange, insert it into the back of the socket, and then turn it clockwise viewed from the filament side about 30 degree.
- (7) Mount the lamp cover, and then mount the data display cover (including the connections of 2 connectors). The replacement of the lamp is completed.



9. Inspection and maintenance

9.4.3 Replacing a motor

Warning For replacing the motor, make sure to turn off the power source to this detector unit.

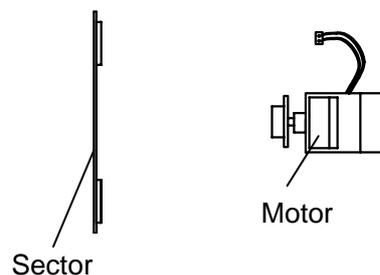
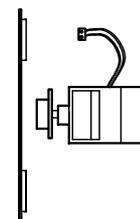
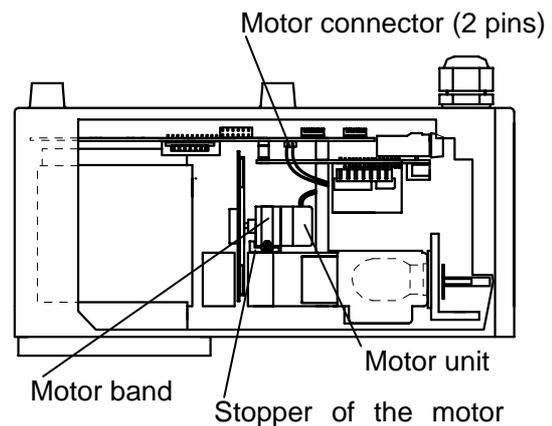
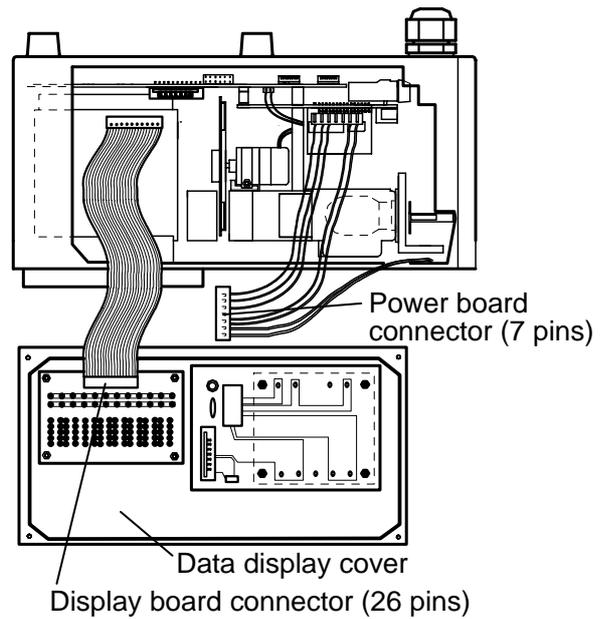
- (1) Turn off the power source to this detector unit.
- (2) Loosen four M4 hexagon socket cap screws fixing the data display cover and remove the data display cover slightly.

Caution As the data display cover is connected with internal components by cables, carefully remove the cover not to scratch the cables.

- (3) Disconnect the cable connector (26 pins) at the display board and the connector (7 pins) at the power board, and then remove the data display cover from this detector unit completely.
- (4) Remove the motor connector (2 pins).
- (5) Loosen the fixing screws (M3 pan screws) of the motor band fixing the motor and remove the motor by pulling the motor band upward while pressing the motor.
- (6) Make the motor unit stand as shown in the figure and hold the sector lightly. Remove 4 pieces of M2 screws and separate the sector from the motor.

- (7) Make the new motor stand, too, and mount it to the sector. Note that the sector has front and back sides.
- (8) Place the motor unit to make the top of the motor touch the stopper of the motor mounting base, cover the motor with the motor band, and then fix the motor by screwing the fixing screws of the motor band.
- (9) Connect the motor connector, and then mount the data display cover (including the connections of 2 connectors). The replacement of the motor is completed.

Caution Never scratch the optical filter attached to the sector during the replacement of the motor.



9. Inspection and maintenance

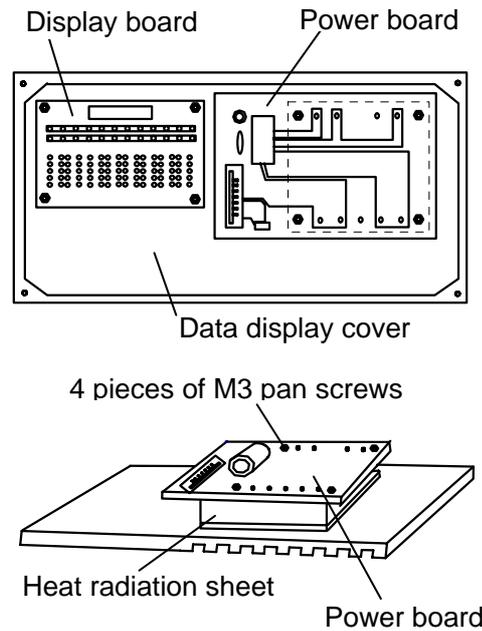
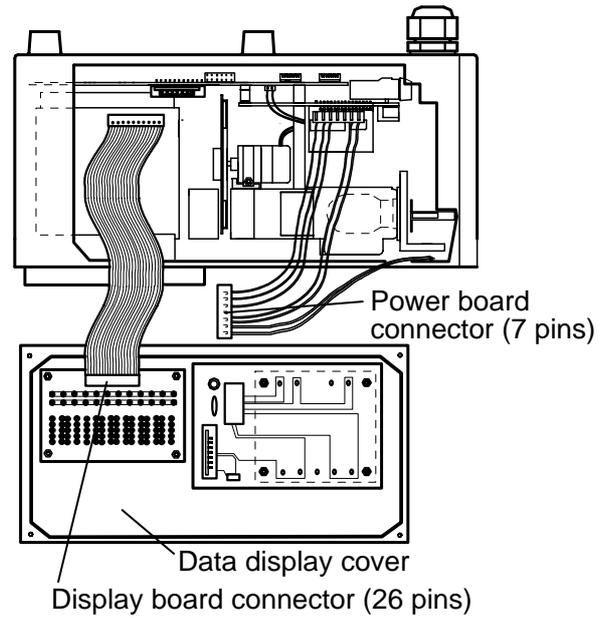
9.4.4 Replacing a power board

Warning For replacing the power board, make sure to turn off the power source to this detector unit.

- (1) Turn off the power source to this detector unit.
- (2) Loosen four M4 hexagon socket cap screws fixing the data display cover and remove the data display cover slightly

Caution As the data display cover is connected with internal components by cables, carefully remove the cover not to scratch the cables.

- (3) Disconnect the cable connector (26 pins) at the display board and the connector (7 pins) at the power board, and then remove the data display cover from this detector unit completely.
- (4) Remove the power board by loosening 4 pieces of M3 pan screws fixing it. At the same time, replace the heat radiation sheet (about 60mm², 0.5mm thickness), which is slipped with the power board, with a new heat radiation sheet.
- (5) Fix the new power board, while slipping the new heat radiation sheet, with 4 pieces of M3 pan screws.
- (6) Connect the cable connector (26 pins) at the display board and the connector (7 pins) at the power board, and then fix the data display cover. The replacement of the power board is completed.

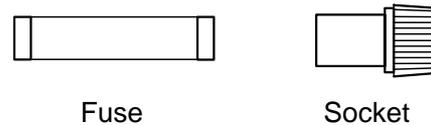
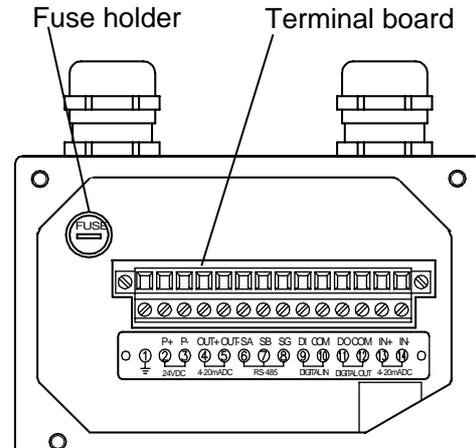


9. Inspection and maintenance

9.4.5 Replacing a fuse

Warning For replacing the fuse, make sure to turn off the power source to this detector unit.

- (1) Turn off the power source to this detector unit.
- (2) Loosen four M4 hexagon socket cap screws fixing the terminal board cover and remove the terminal board cover.
- (3) Push the socket of the fuse holder a little with a flathead screwdriver and turn it counterclockwise about 90 degrees.
- (4) Pull out the fuse forward.
- (5) Insert the new fuse into the back of the socket, push the socket a little with a flathead screwdriver, and then turn it clockwise about 90 degrees.
- (6) Mount the terminal board cover. The replacement of the fuse is completed.



9.5 Ram clearing

If an abnormal condition of this detector unit is not recovered by all means, initialization of the RAM is required.

Caution For initializing the RAM, make sure to turn off the power source to this detector unit. As the stored contents of the RAM are initialized, record the calibration curve data, etc. before initialization.

9.5.1 Ram clearing

- (1) Turn on the power by pressing **[SEL]** key and **[▶]** key simultaneously.
- (2) The contents of the RAM are initialized. Set the calibration curve data, etc. again.

10. Specifications

10.1 Detector unit: IRMA1100, IRMA1200, IRMA1300

Model	IRMA2100	IRMA2200	IRMA1300
Measuring system	Infrared reflection type 3-wavelength system		Infrared reflection type 2-wavelength system
Lamp	Tungsten-filament lamp		
Measurement distance	300mm (200 to 300mm adjustable)		200mm (160 to 300mm adjustable)
Measurement area	50 x 50mm (at the measuring distance 300mm)		30 x 30mm (at the measuring distance 200mm)
Reproducibility	With the output checker plate Detector unit output (absorbance “x”): Within ± 0.003		With the output checker plate Detector unit output (absorbance “x”): Within ± 0.015
	(Under same ambient temperature and the humidity) The above reproducibility is specified with the output checker plate and it is different from the reproducibility in the actual measurement.		
Stability under the EMC test environment	Detector unit output (absorbance “x”) : Within ± 0.01		Detector unit output (absorbance “x”) : Within ± 0.1
Output signal	Analog signal: 4-20mADC and $\pm 0.2\%$ of full scale (Load resistance: 500 Ω or less)		
Communication output	RS-485 (MODBUS) ... Standard Ethernet (LAN) ... Option One of the above outputs is to be specified.		
Output update cycle	28ms.		
Display	Data: LED 5 digits, Calibration curve number, others: LED 2 digits		
Setting	By keys or through communication.		
Processing function	2-color, 3-color ratio processing and multiple regression processing		
Number of calibration curve	99 (maximum)		
Calibration curve	First-degree to cubic polynomial and multiple regression With calibration curve correction (First to second-degree correction)		
Smoothing processing	0 to 99.9 seconds		
Calibration	The calibration is enabled by the output checker plate.		
Detector unit number setting	For the multiple-detector-units connection, detector unit numbers can be specified by key operation.		
Calibration curve number setting	Calibration curve numbers can be specified by key operation.		
Self-diagnosis function	Contact and communication output at self-diagnosed abnormal conditions		
Correction input function	Correction of measured data with an external 4-20mADC input (1 input) (Sample temperature correction, others)		
External Di/o	Di (contact input): One function selected from the preset, the data hold or the real/smooth switching can be inputted via the contact input. Do (contact output): One function selected from the self-diagnosis function (1 Form B) or the high/low alarms (1 Form A) can be outputted as the contact output.		
Working temperature range	0 to 50°C [The cooling by water or air is necessary if the working temperature is higher than 45°C.]		
Power voltage	24VDC [The power voltage is supplied from the power unit IR-WEP (supplied as an attachment). Power to the power unit: 100 to 240VAC, 50/60Hz]		
Permissible voltage fluctuation	18 to 30VDC (For products conforming to CE: Within 24VDC $\pm 10\%$)		
Power consumption	Approx. 36VA (maximum)		
Connection	Terminal connections		
Case	Aluminum dust- and splash-proof structure (IEC529, IP65)		
Weight	Approx. 4.3kg		
Installation method	Bolt suspension method with 4 pieces of M8 bolts		

10. Specifications

10.2 Attachments

10.2.1 Power unit IR-WEP

The power of 24VDC is supplied to the detector unit. This unit is supplied with the detector unit as an attachment.

Output voltage	24VDC
Output current	2.1A
Working temperature range	-10 to 50°C
Power supply	100 to 240VAC (universal power supply), 47 to 450Hz
Allowable voltage fluctuation	85 to 264V AC
Power consumption	Approx. 160VA (maximum)
Case	Resin
Mounting	Wall mounting type (DIN rail mounting)
Weight	Approx. 380g

10.2.2 Connection cable IR-WERP

It is the exclusive cable for connecting the detector unit to the operator interface/display unit or the power unit.

Structure	4-core cab tire cable (with double shield)
Outside diameter	Ø10.5mm
Length	Maximum length 200m
Connection	Both ends - tips

10.2.3 Air-purge hood IR-WEA (For IRMA1100, IRMA1200) IR-WEA3 (For IRMA1300)

It is used to shield against extraneous lights and clear the measurement window and the sight path. The output checker plate can be attached at the top of the hood.

Purge air	Flow: 5 to 200Nℓ/min Pressure: Maximum 200kPa (Use instrumentation air not containing oil or dust.)
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10.2.4 Output checker plate IR-WEB (For IRMA1100, IRMA1200) IR-WEB3 (For IRMA1300)

Use it to check the detector output at site.
Attach it to the top of the air-purge hood.

10.2.5 Installation adaptor IR-WED1

It is used to replace an IR-M series moisture meter, which has already been installed, with the IM series infrared multiple constituents analyzer without any change of the installation place.

Material	Aluminum
Weight	About 0.8kg

10. Specifications

10.2.6 Air-cooling box IR-WEX

It is used to protect the detector unit from dusts and cool the detector unit by air. (The detector unit is housed in this air-cooling box.)

Working temperature	0 to 55°C
Material	SUS304 (air-cooling portion) Iron (mounting metal portion)
Air	Flow: 100 to 500Nℓ/min
Weight	About 14kg

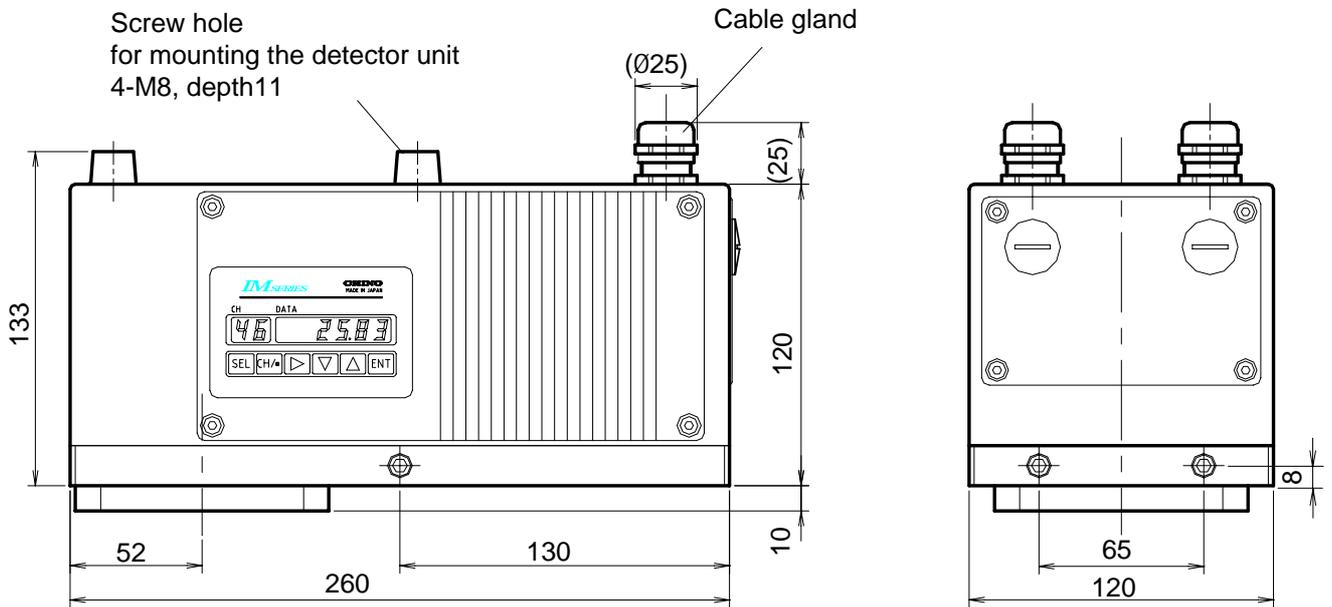
10.2.7 Relaying box IR-WEE□

It is used as a relaying terminal for the multiple-detector-units connection and a power unit is built in. The steel case and the SUS case are available. The SUS case is the splash-proof construction.

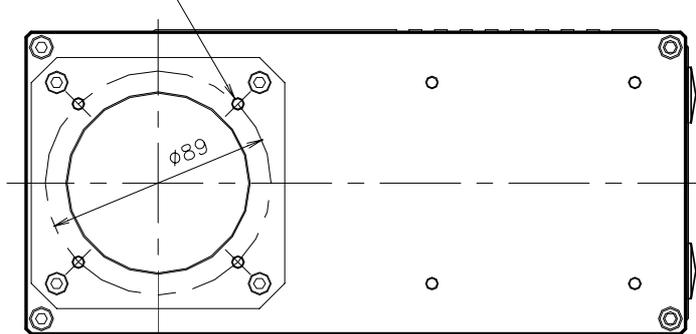
	IR-WEE1	IR-WEE2
Working temperature range	0 to 50°C	0 to 50°C
Case	Steel	SUS304
Color	5Y7/1 (light beige)	-
Weight	Approx. 4kg (including the power unit)	Approx. 4kg (including the power unit)

11. Outside dimensions

11.1 Detector unit IRMA1100, IRMA1200, IRMA1300



For mounting the air-purge hood
4-M5, depth 6.5

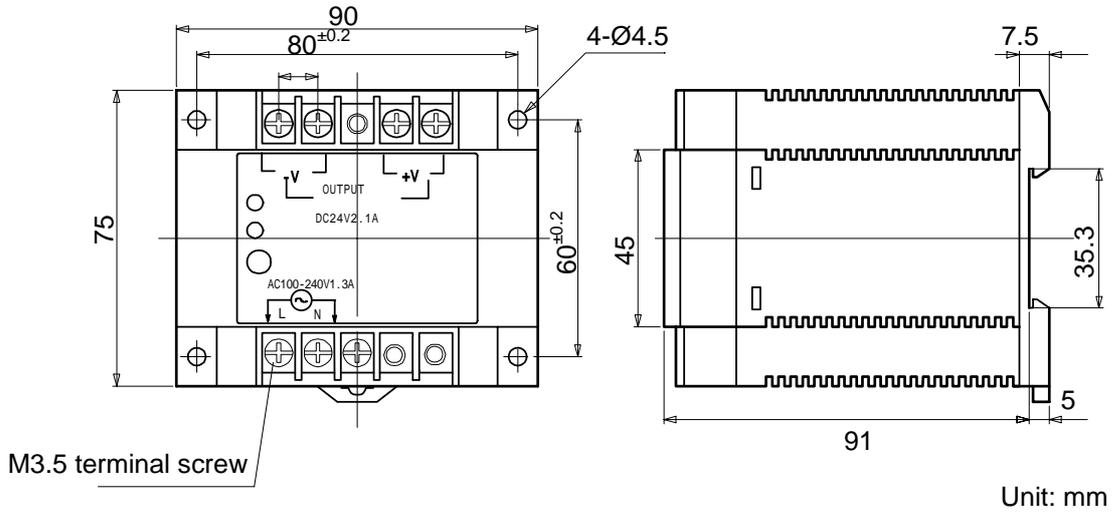


Unit: mm

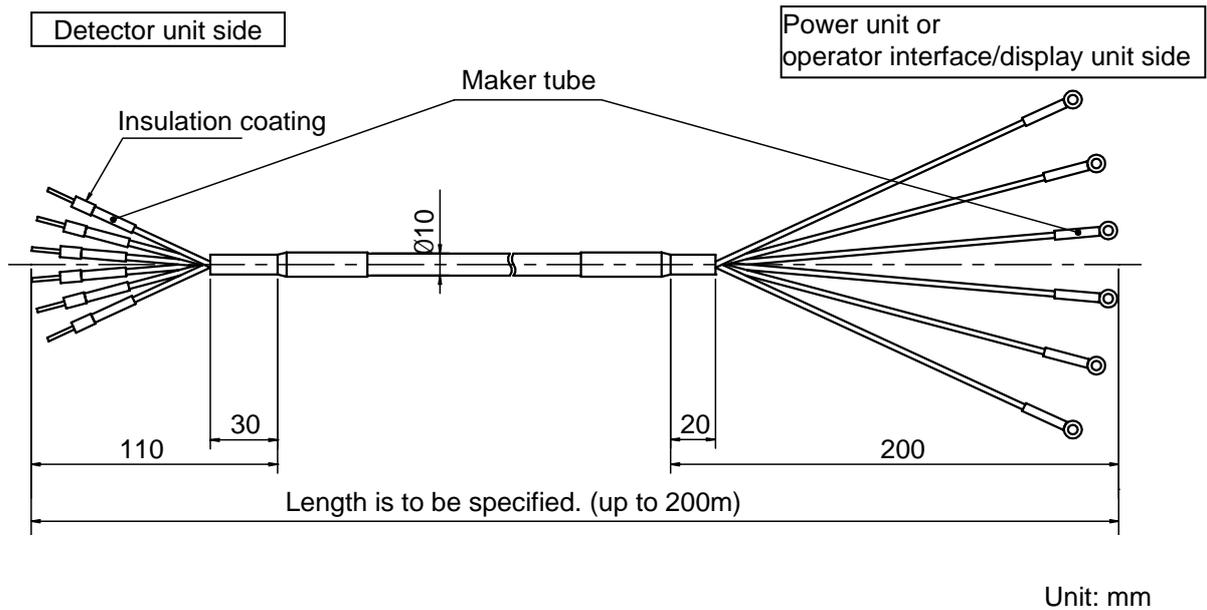
11. Outside dimensions

11.2 Attachments

11.2.1 Power unit (conforming to CE) IR-WEP

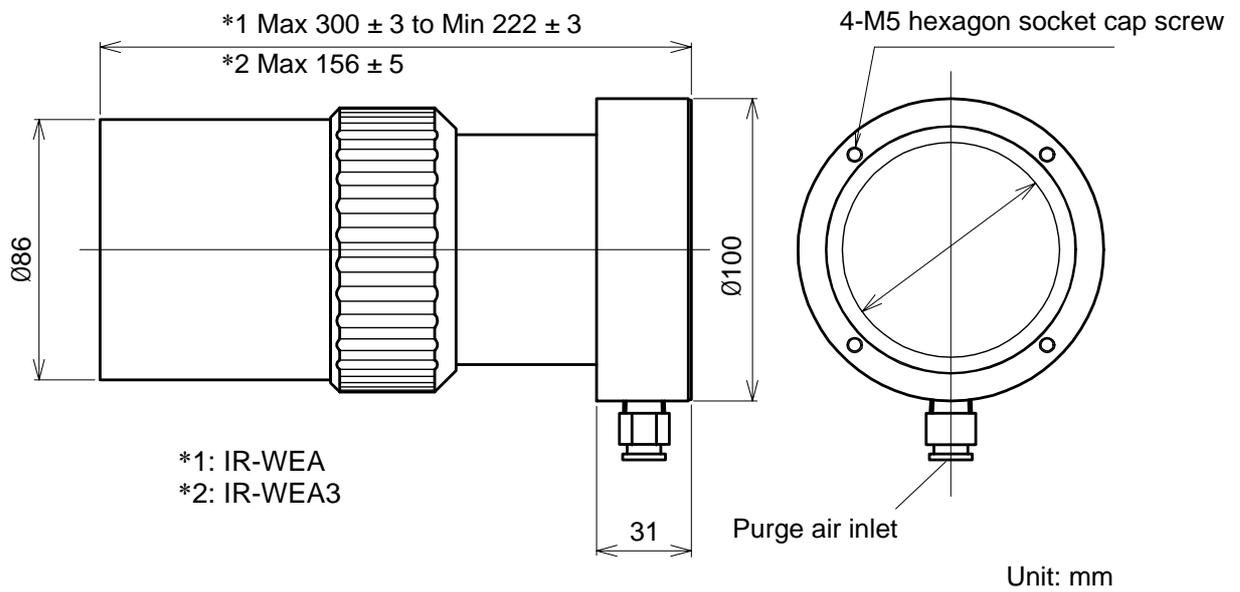


11.2.2 Connection cable IR-WERT

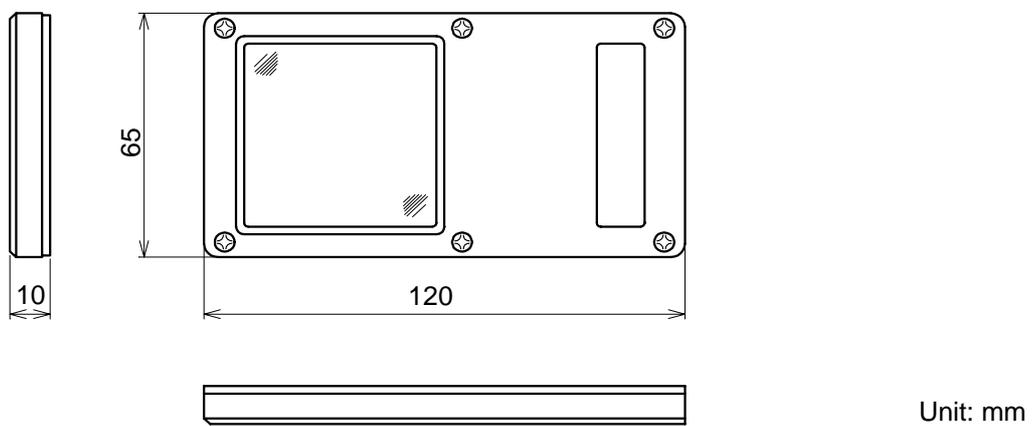


11. Outside dimensions

**11.2.3 Air-purge hood IR-WEA (For IRMA1100, IRMA1200)
IR-WEA3 (For IRMA1300)**

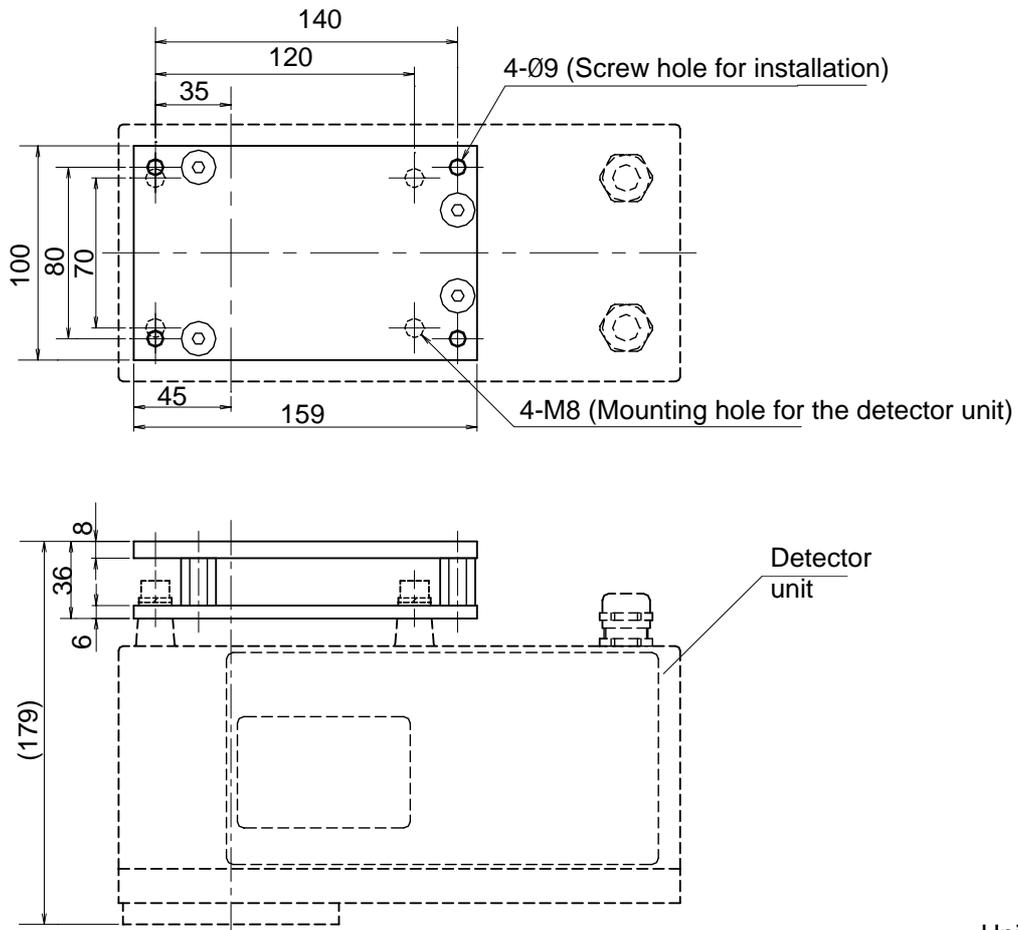


**11.2.4 Output checker plate IR-WEB (For IRMA1100, IRMA1200)
IR-WEB3 (For IRMA1300)**



11. Outside dimensions

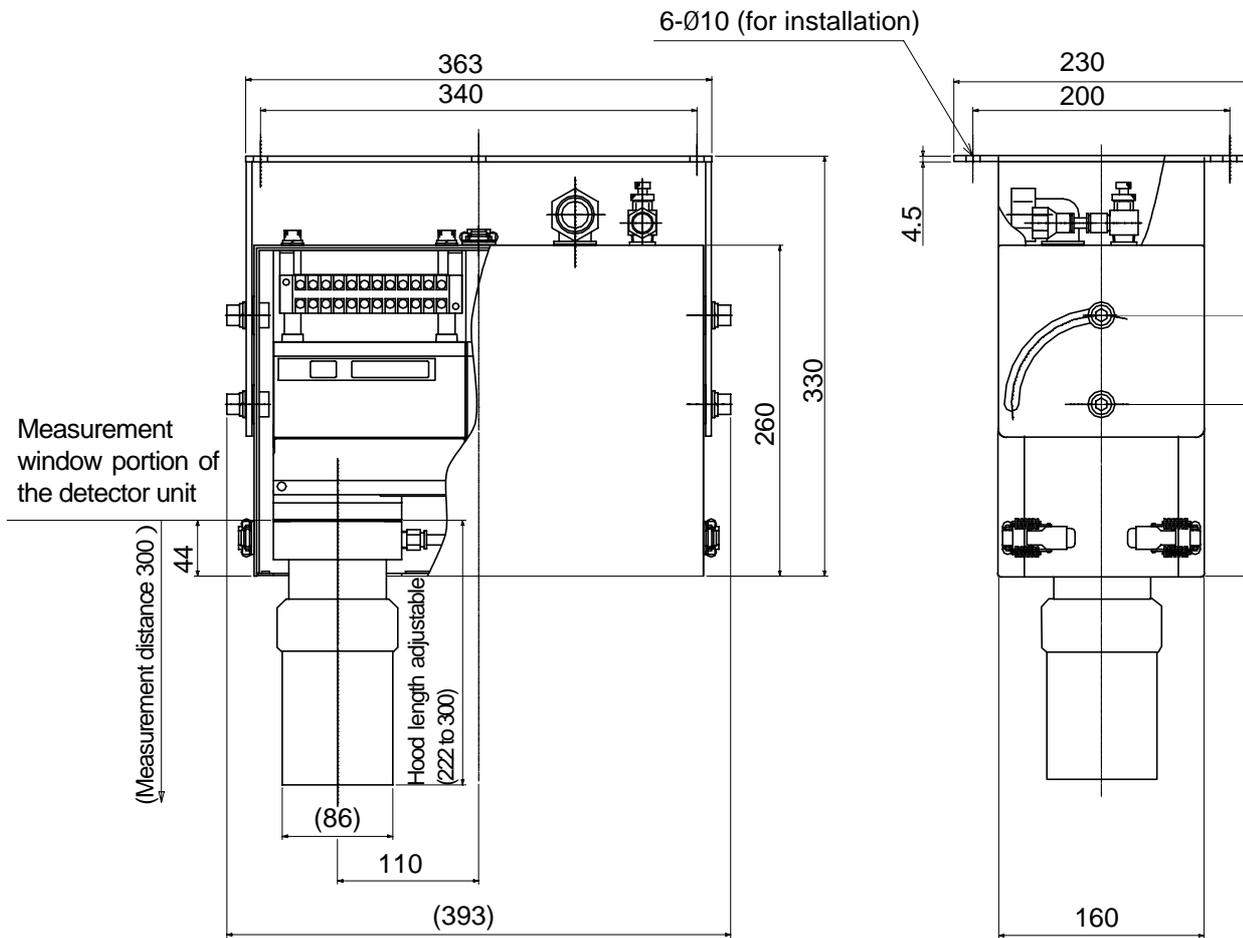
11.2.5 Installation adaptor IR-WED1



Unit: mm

11. Outside dimensions

11.2.6 Air-cooling box IR-WEX

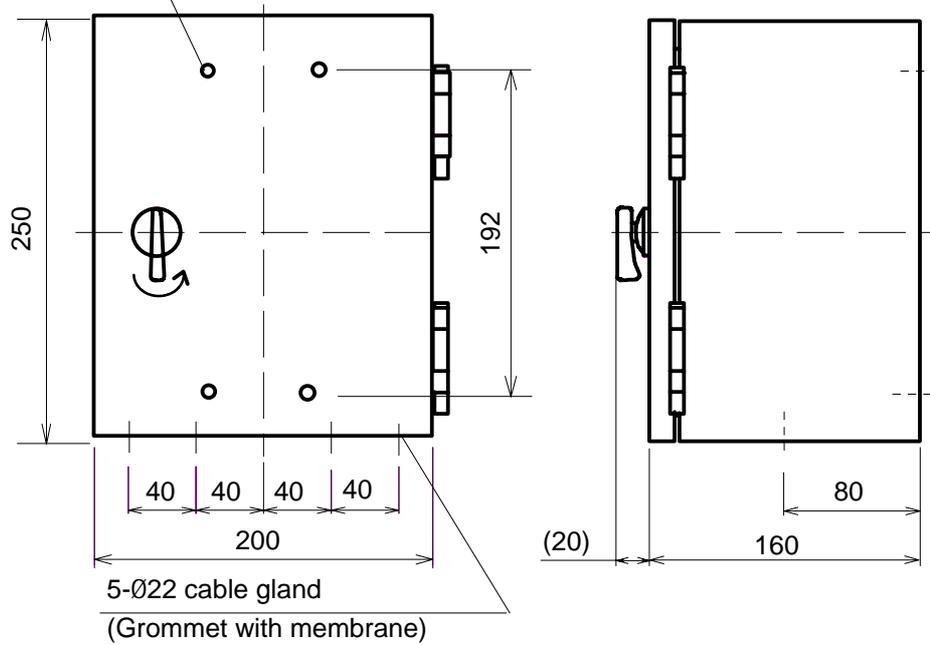


11. Outside dimensions

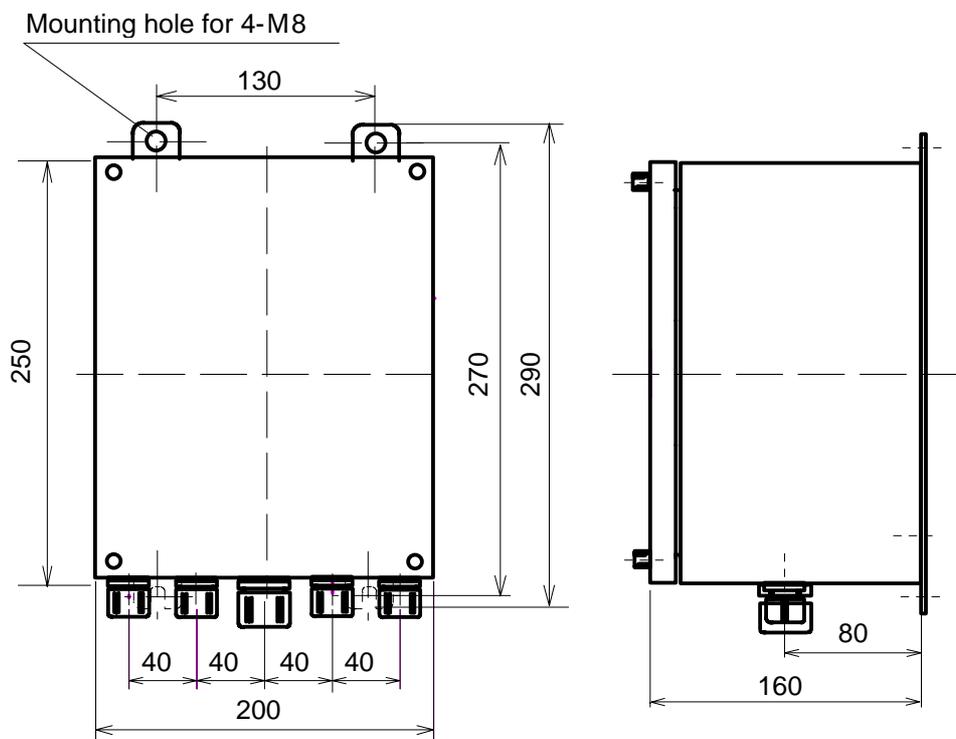
11.2.7 Relaying box IR-WEE□

4-Ø8 (installation hole)

(Open the door and install.)



IR-WEE1



IR-WEE2

Unit: mm

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INE-471-P0 Jul-'04 IM Series Infrared Multiple-constituents Analyzer Mirror Type Moisture Meter/Detector Unit

Models IRMA11□□□□, IRMA12□□□□, IRMA13□□□□ Printed in Japan