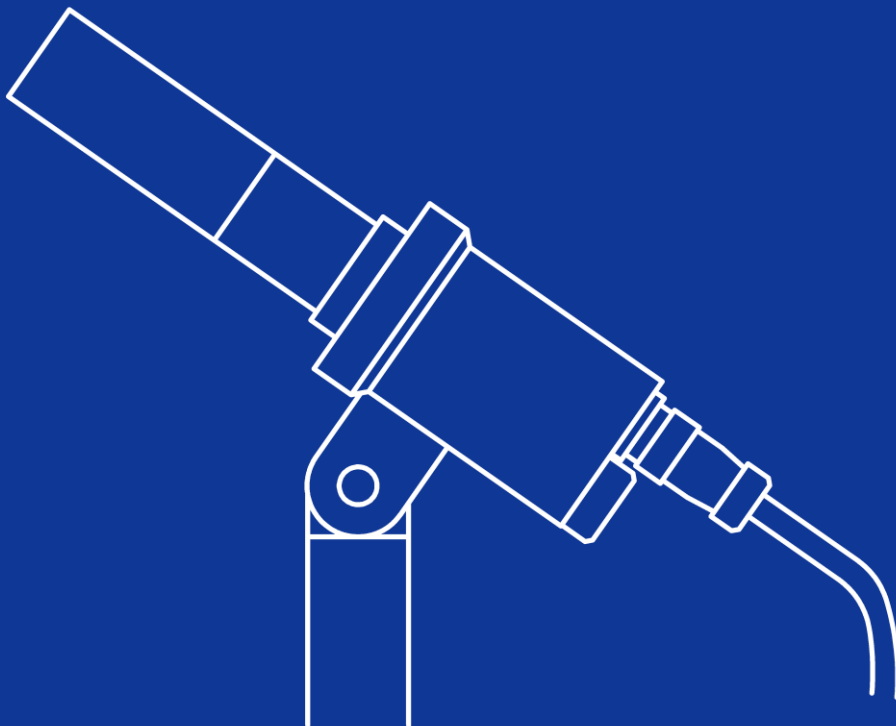


INSTRUCTION MANUAL

Sunshine Duration Meter

# MS-093



EKO

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## 2. Important User Information

Thank you for using EKO Products

Make sure to read this instruction manual thoroughly and to understand the contents before starting to operate the instrument. Keep this manual at safe and handy place for whenever it is needed.

For any questions, please contact us at one of the EKO offices given below:

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### 2-1. Contact Information

#### EKO INSTRUMENTS CO., LTD.

##### Asia, Oceania Region

www.eko.co.jp	EKO INSTRUMENTS Co., Ltd.	Tel: +81 (3) 3469-6711
info@eko.co.jp	1-21-8 Hatagaya, Shibuya-ku	Fax: +81 (3) 3469-6719
	Tokyo, 151-0072 Japan	

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##### Europe, Middle East, Africa, South America Region

www.eko-eu.com	EKO INSTRUMENTS Europe B.V.	Tel: +31 (0)70 3050117
info@eko-eu.com	Lulofsstraat 55, Unit 28,	Fax: +31 (0)70 3840607
	2521 AL Den Haag, The Netherlands	

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##### North America Region

www.eko-usa.com	EKO INSTRUMENTS USA Inc.	Tel: +1 408-977-7751
info@eko-usa.com	111 North Market Street, Suite 300	Fax: +1 408-977-7741
	San Jose, CA 95113 USA	

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### 2-2. Warranty and Liability

For warranty terms and conditions, contact EKO or your distributor for further details.

EKO guarantees that the product delivered to customer has been verified, checked and tested to ensure that the product meets the appropriate specifications. The product warranty is valid only if the product has been installed and used according to the directives provided in this instruction manual.

In case of any manufacturing defect, the product will be repaired or replaced under warranty. However, the warranty does not apply if:

- Any modification or repair was done by any person or organization other than EKO service personnel.
- The damage or defect is caused by not respecting the instructions of use as given on the product brochure or the instruction manual.

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## 2-3. About Instruction Manual

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This manual was issued: 2019/02/13

Version Number: 5

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## 2-4. Environment

### 1. WEEE Directive 2002/96/EC (Waste Electrical and Electronic Equipment)

This product is not subjected to WEEE Directive 2002/96/EC however it should not be mixed with general household waste. For proper treatment, recovery and recycling, please take this product(s) to designated collection points.

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

### 2. RoHS Directive 2002/95/EC

EKO Instruments has completed a comprehensive evaluation of its product range to ensure compliance with RoHS Directive 2002/95/EC regarding maximum concentration values for substances. As a result all products are manufactured using raw materials that do not contain any of the restricted substances referred to in the RoHS Directive 2002/95/EC at concentration levels in excess of those permitted under the RoHS Directive 2002/95/EC, or up to levels allowed in excess of these concentrations by the Annex to the RoHS Directive 2002/95/EC.

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## 2-5. CE Declaration



IMPORTANT USER INFORMATION

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### DECLARATION OF CONFORMITY

We: EKO INSTRUMENTS CO., LTD  
1-21-8 Hatagaya Shibuya-ku,  
Tokyo 151-0072 JAPAN

Declare under our sole responsibility that the product:

Product Name: Sunshine Duration Meter  
Model No.: MS-093

To which this declaration relates is in conformity with the following harmonized standards of other normative documents:

Harmonized standards:

EN 61326:1997+A1+A2 Class A (Emission)  
EN 61326:1997+A1+A2 (Immunity)  
EN61000-4-2 EN61000-4-3  
EN61000-4-4 EN61000-4-5  
EN61000-4-6 EN61000-4-11

Following the provisions of the directive:

EMC-directive: 89/336/EEC  
Amendment to the above directive: 93/68/EEC

Date: Oct. 8, 2008

Position of Authorized Signatory: Deputy General Manager of Quality Assurance Dept.

Name of Authorized Signatory: Shuji Yoshida

Signature of Authorized Signatory: 

## 3. Safety Information

EKO Products are designed and manufactured with consideration for safety; however, please make sure to read and understand this instruction manual thoroughly to be able to operate the instrument safely in the correct manner.



### WARNING CAUTION

Attention to user; pay attention to the instructions given on the instruction manual with this sign.



### 3-1. WARNING/CAUTION

#### 1. Setup and Handling

- Fasten this product securely on a stage with bolts and nuts to prevent from falling due to strong wind, earth quake and so on and causing unexpected accidents.
- Do not give an impact on exposed glass tube.
  - ◇ Do not hold the glass tube part when carrying. Glass tube part may break and lead to serious injury and/or accident by broken glass and/or dropping the electrical circuit part.
  - ◇ If any impact is given, the glass may break. Broken glass pieces may cause injury and/or accidents.
- Do not place fingers or any objects into operating blower fan, or unexpected accident may occur.

#### 2. Grounding

After newly setting up or moving the instrument to different measurement site, make sure to connect the grounding cable. When grounding cable is not properly connected, it may cause electrical shocks and/or leakage.

#### 3. Power Supply

Make sure to check the power source voltage of the product, and the power supply voltage type (AC or DC) match before turning on the power of this product.

## 4. Introduction

EKO Sunshine Duration Meter MS-093 has a specially designed and rotating mirror, which reflects the direct solar radiation onto an especially flat pyroelectric sensor. This sensor outputs a differential coefficient as voltage, which is proportional to the direct solar irradiance.

WMO defines the sunshine duration as time amount of direct solar irradiance which exceeds  $120\text{W}/\text{m}^2$ . MS-093 measures the direct solar irradiance that exceeds the threshold of  $120\text{W}/\text{m}^2$ , assuring reliable sunshine duration data can be obtained. Internal CPU processes the signal sent by the sensor then outputs a pulse as sunshine duration when the direct irradiance exceeds the threshold value.

EKO Sunshine Duration Meter MS-093 is a one-of-a-kind high performance instrument, which is used worldwide in many applications such as ASOS (Automated Surface Observing System) by NOAA (National Oceanic and Atmospheric Administration).

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### 4-1. Main Functions

#### 1. Very Precise Sunshine Duration Measurement

MS-093 uses pyroelectric sensor, which is one of thermal sensor; minimize the diffused sun light by extracting this sensor output as derivative to the time and outputs the non-voltage contact pulse as output of sunshine duration above the given threshold ( $120\text{W}/\text{m}^2$ ). Also the pyroelectric sensor has flat characteristics thus it can correspond to the changes of solar spectral distribution changes by the climate.

#### 2. Mirror

The mirror inside the sensor head rotates 100 times per hour<sup>\*1</sup> by the pulse motor, and it reflects the direct incident light to the light receiving element which uses the pyroelectric sensor at the rate of once per 36 seconds<sup>\*1</sup>.

This mirror has diffuse characteristics only in the declination direction, thus it does not affect the output signal by the declination changes. Without making any adjustments with mirror to the declination changes ( $\pm 23.5^\circ\text{C}$ ), the light is directed to the center of the sensor; therefore, it does not require any data correction or declination adjustments throughout the year.

#### 3. Lightning Protection

As the countermeasures for induced lightning and lightning surge, MS-093 uses surge protector and does not use microcomputer to prevent program going out of control.

In case of lightning surge which is unexpectedly large is applied to MS-093, latch-up phenomenon occurs in the IC used on the internal circuit, and it sometimes causes to stop the mirror rotation. In order to restart the measurements automatically, EKO recommends to use Reset Box (optional), which detects the mirror rotation automatically and resets the power supply when the mirror is stopped.

<sup>\*1</sup>MS-093 also has a version with 120 revolutions per hour. With this version, the sunshine detection is calculated once per 30 seconds.

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## 4-2. Package Contents

Check the package contents first; if any missing item or damage is noticed, please contact EKO immediately.

Table 4-1 Package Contents

Standard Items	Qty.	Remarks
MS-093 Main Unit	1	With Sensor Cable, Standard cable length: 10m Fixing Screws (M5 x 2)
Latitude Fixing Screw & Hexagon Wrench	1 Set	Includes: 1 set of screw, 1 hexagon wrench
Reset Box	1	Optional, Cable length: 1m
Power Box	1	Optional, Cable length: 2.5m
Pulse Output Cable	1	Optional, Cable length: 1.5m
Blower fan	1	Optional, DC12V
Base Plate	1	Optional
Base Plate Fixing Bolts & Nuts	1 Set	Optional, Includes: 2 sets of bolts & Nuts
Inspection Report	1	
Instruction Manual	1	



# 5. Getting Started

## 5-1. Sunshine Duration Meter Configuration

Each part name and its main functions are described below.

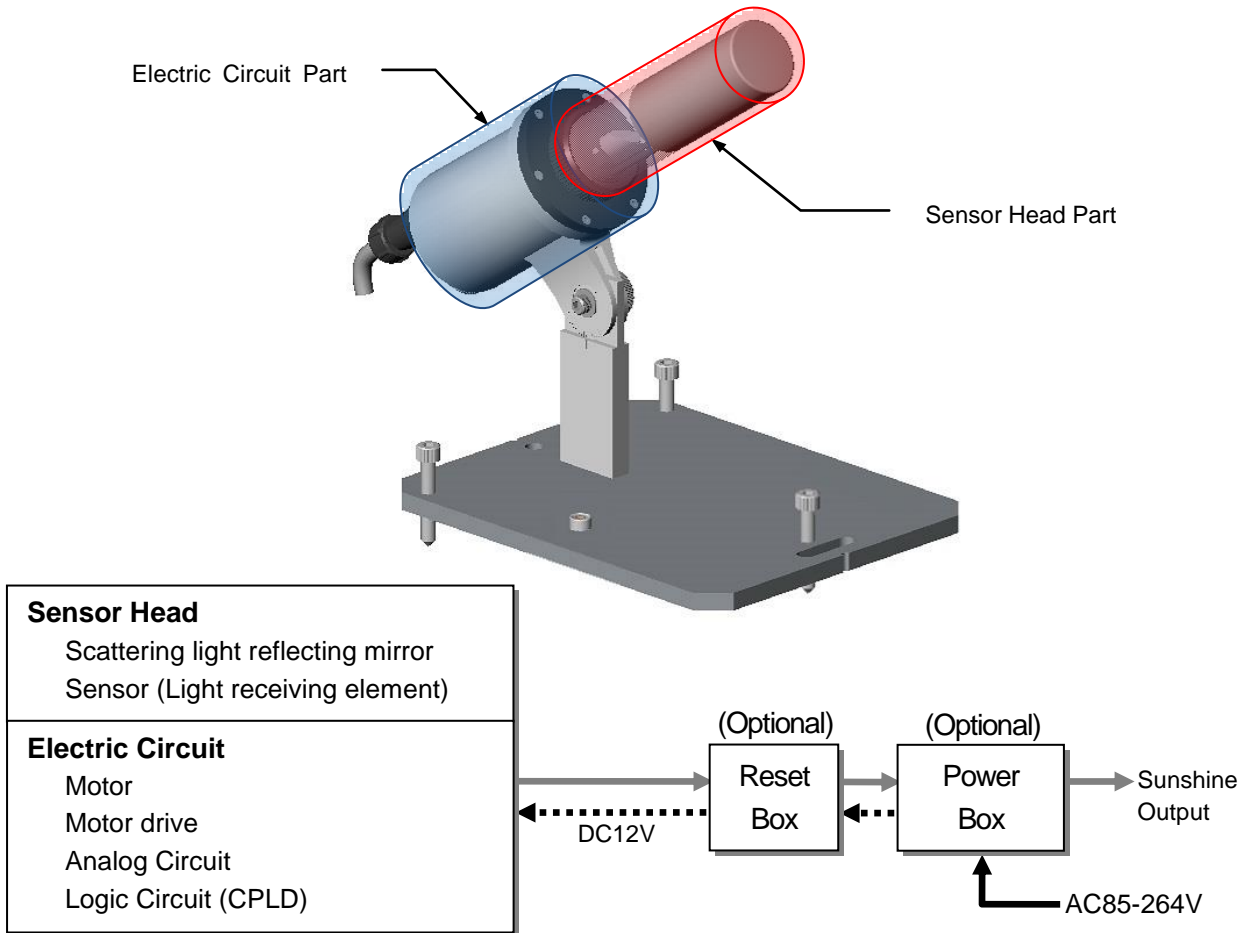


Figure 5-1. Sunshine Duration Meter Configuration

### 1. Sensor Head Part

The sensor head part is constructed with scattering light reflecting mirror which rotates along the axis of the body and light receiving element.

### 2. Electric Circuit Part

The electric circuit part contains control circuit components such as motor and CPLD.

### 3. Reset Box (Optional)

This unit monitors the movement of the mirror, and when the mirror rotation stopped, it resets the power to restart the mirror rotation.

### 4. Power Box (Optional)

The power box supplies power to the MS-093 Sunshine Duration Meter main unit by generating DC12V from the AC85-264V.

## 5-2. Parts Name and Descriptions

### 1. Sunshine Duration Meter Main Unit

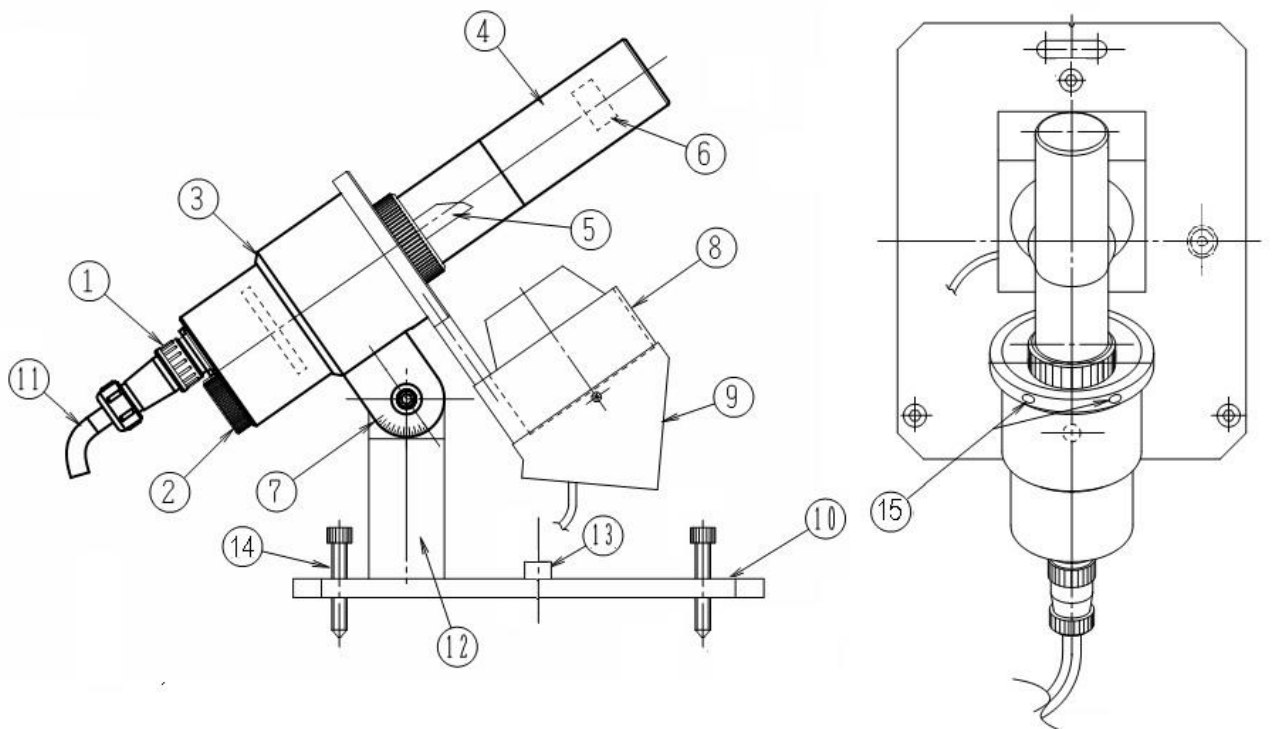


Table 5-1. MS-093 Parts Name

1	Sensor Cable Connector	7	Latitude Scale Plate	13	Spirit Level
2	Drying Cartridge	8	Blower fan Unit (Optional)	14	Leveling Feet
3	Electric Circuit Part	9	Blower fan Unit Skirt	15	Blower fan Fixing Screws
4	Glass Tube Cover	10	Base Plate (Optional)		
5	Reflecting Mirror	11	Sensor Cable		
6	Light Receiving Element	12	Sensor Stand		

## 2. Reset Box (Optional)

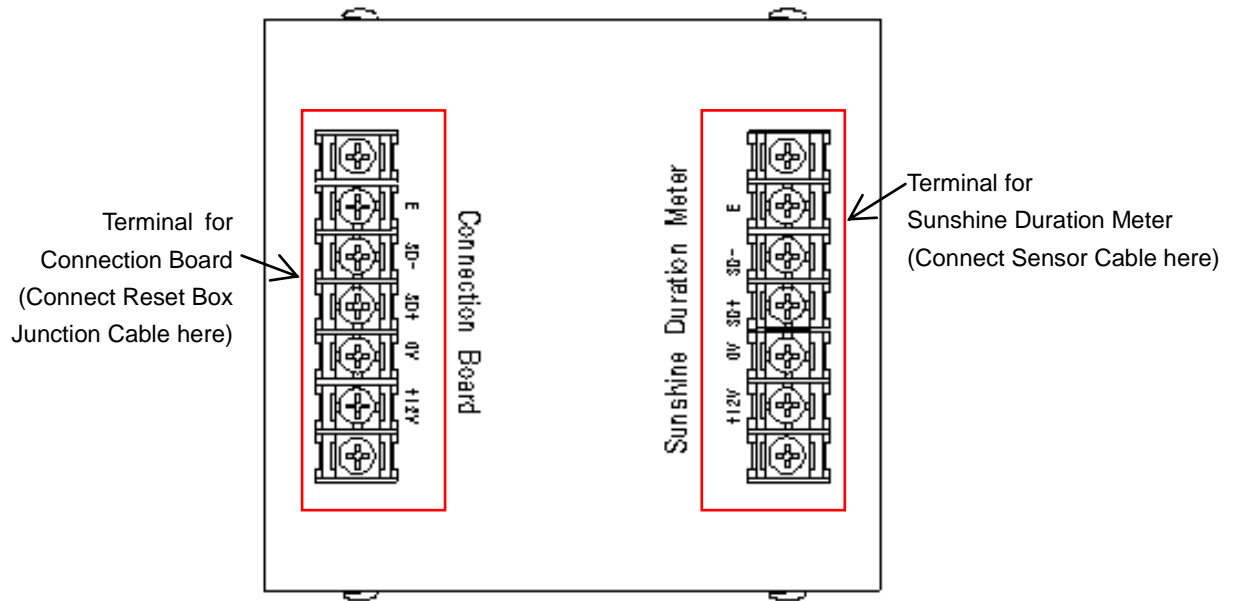


Figure 5-3. Reset Box: Parts Name

NOTE: If Power Box is used, connect one end of the Reset Box Junction Cable to Power Box Terminal; if Power Box is not used, connect the Reset Box Junction Cable directly to DC Power Supply and Data Logger. (See [Table 5-3. Cable Colors and Outputs] for details.)

## 3. Power Box (Optional)

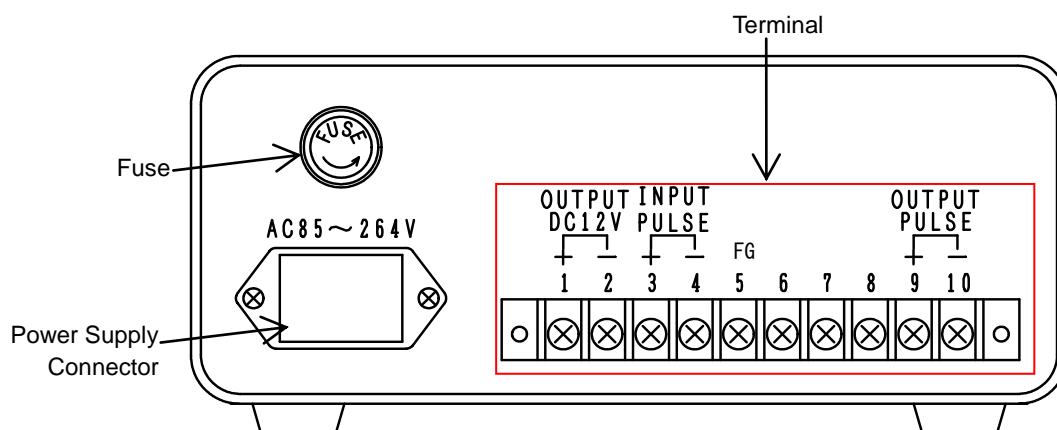


Figure 5-4. MS-093 Power Box Parts Name

## 5-3. Installation

### 1. Preparation: Orientation

The ideal mounting position for the Sunshine Duration Meter is a location which has a free field-of-view without any obstructions (such as buildings, trees, and mountain). In practice, it might be difficult to find such locations; therefore, some practical recommendations on how to minimize undesired effects of reflecting or obstructing surfaces are given next:

- Select a mounting position which it is free from obstructions at 5° above horizon.
- The setup location should be easily accessible for periodic maintenance (Sensor cleaning, check for level and cable condition, etc.) of the Sunshine Duration Meter.
- Avoid to place the Sunshine Duration Meter in the area of surrounding objects e.g. towers, poles, walls or billboards with bright colors that can reflect solar radiation onto the sunshine duration meter.

The Sunshine Duration Meter is installed in North/South direction.

Table 5-2. Orientation of Sunshine Duration Meter

Installing Location	Direction of Connector Side	Direction of Glass Tube Side
Northern Hemisphere	South	North
Southern Hemisphere	North	South

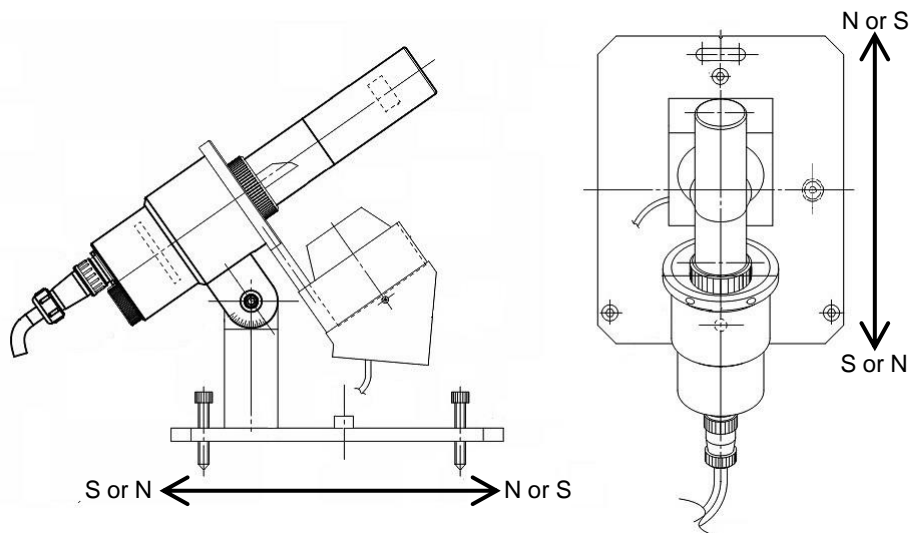


Figure 5-5. Checking the Orientation

There are following other methods to check the North/South direction:

- ◇ Using accurate terrain map  
By referencing a mountain, a building, or a tower which can be seen in far location from the installation site, figure out the direction of the object from the site on an accurate terrain map (such as Google Map), the accurate north/south direction can be determined by using protractor.
- ◇ Determining the true North-South direction from the solar position at the time of meridian  
Meridian information can be looked up on websites. It can also be determined by using shade of a straight stick standing perpendicular to the ground or a string with weight hanging which is created at the time of meridian.

## 2. Preparation: Installation Base

Prepare the installation base for mounting the Sunshine Duration Meter, according to the verified orientation in above step.

➤ Mounting without the Base Plate (optional)

- 1) There are mounting holes already provided on the bottom side of the Sensor Stand as shown in below figure. Prepare the holes corresponding to the drawing on the mounting stage in the correct orientation (see above step for how to check the orientation of North/South direction).
- 2) Place the Sunshine Duration Meter on the mounting stage in the correct orientation and fix it with 2 fixing screws (M5) attached.

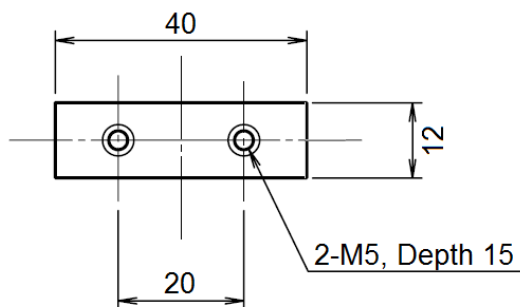


Figure 5-6. Positions of Holes on the Bottom of Sensor Stand

➤ Mounting on the Base Plate (optional):

When optional Base Plate is used, install it on the installation base in the following procedure.

NOTE: Below procedure explains the installation in Northern Hemisphere. In case of installation in Southern Hemisphere, the North and South would be in opposite positions.

- 1) First draw a line on the mounting base in the direction of North/South direction. There are 2 fixing holes provided on the Base Plate; use the hole on South side as the starting point of the line. (See previous section for determining the North/South direction)
- 2) Attach the Sensor Stand on the Base Plate in advance. Place the Base Plate with Sensor Stand on the mounting base so that the N side of the North/South indicator of the Base Plate is facing towards North and match the position of holes on the Base Plate and the fixing holes. The hole on the North side of the Base Plate is shaped wider; adjust the Base Plate position so that the North/South line drawn in earlier step comes in the center of this wide hole.
- 3) Insert the fixing bolts in the fixing holes and fasten enough that the bolts does not come off.
- 4) Level the Base Plate using leveling feet; the air bubble in the spirit level should be positioned within the center circle.
- 5) Fasten the bolts securely as making sure the level and North/South orientation of the Base Plate are maintained.
- 6) After the bolts are tightened securely, check the level and North/South orientation of the Base Plate once again.

## 3. Mounting the Sunshine Duration Meter

Place the main unit of the Sunshine Duration Meter in the North/South orientation on the installation base (optional Base Plate) which is prepared in the step 1 and 2 above.

Adjust the Latitude Scale Plate to the appropriate position for the installing site and fasten the fixing bolt on the Latitude Scale Plate.

## 4. Mounting Blower Fan (Optional)

Follow below procedure to install the optional Blower Fan:

- 1) If the latitude of the installation site is less than 30 degrees, remove the Blower Fan Skirt which is attached by 2 screws.
- 2) Loosen the Blower Fan Fixing Screws first, then place the Blower Fan on the black part of the Sunshine Duration Meter; be careful with Glass Tube Cover. Adjust the Blower Fan position so that the air outlet side of the Blower Fan should come directly under the Reflecting Mirror; fasten the Blower Fan with Fan Fixing Screws.  
→In case of use in snowy region and the snow accumulates above the Glass Tube Cover, tilt the Blower Fan by 30 degrees in East direction from the position directly under the Reflecting Mirror to achieve the effects of the Blower Fan.
- 3) Connect the power cable for the Blower Fan to DC12V.

## 5. Connecting Cables

- 1) Connect the sensor cable to the Sunshine Duration Meter connector.  
This connector is waterproof; make sure to securely fasten the connector till the connector ring is completely closed.
- 2) When Reset Box is used, connect the Sunshine Duration Meter Sensor Cable to the “Sunshine Duration Meter” side terminal. Also, connect the Reset Box Junction Cable to the Power Supply part.
- 3) If Reset Box is not used, connect the Sensor Cable to the Power.

The cable colors and their definition of signals are as follows:

Table 5-3. Cable Colors and Outputs

Connector Pin No.	Cable Color	Definition of Signals	Reset Box Terminal	Power Box	
				Terminal No.	Terminal Names
1	Red	Power Supply +12V	+12V	1	OUT PUT DC12V +
2	Green	Power Supply 0V	0V	2	OUT PUT DC12V -
3	White	Sunshine Duration Pulse +	SD+	3	IN PUT PULSE +
4	Black	Sunshine Duration Pulse -	SD-	4	IN PUT PULSE -
5	Shield Cable	FG	E	5	FG
—	—	Sunshine Duration Pulse +	—	9	OUT PUT PULSE +
—	—	Sunshine Duration Pulse -	—	10	OUT PUT PULSE -

Connect the Sunshine Duration Meter, Power Box and, and data logger in following manner in order to obtain the signal from the Power Box.

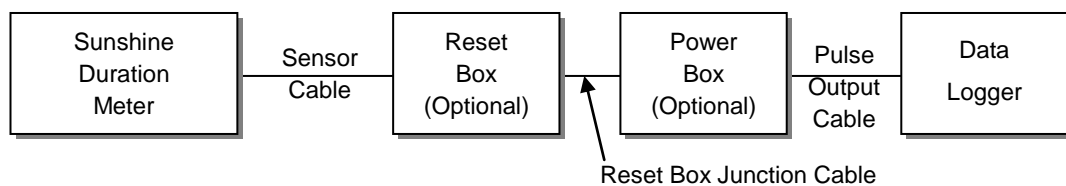


Figure 5-7. Cable Connection

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## 5-4. Measurement/Operations

### 1. Measurement

Sunshine duration is defined as there is a count of sunshine duration when there is irradiance of more than  $120\text{W/m}^2$  in DNI (Direct Normal Incidence). MS-093 takes samplings for 36 seconds to take the sunshine duration measurement. Therefore, when maximum of 100 times of sunshine duration signals are counted within 1 hour, the result of sunshine duration will be 1 hour; when 50 times of sunshine duration signals are counted within 1 hour, the result of sunshine duration will be 0.5 hours.

The sunshine duration signals from MS-093 uses non-voltage contact signal, and it makes the contact for 1 second when sunshine is detected. When taking measurement by connecting to a data logger, MS-093 cannot be connected to an analog voltage input channel, thus it needs to be connected to a channel which can measure non-voltage contact pulse input.

### 2. Operation

When the MS-093 is connected with power, the mirror starts to rotate.

Mirror rotates once by the 36 seconds cycle. When the mirror faces in the direction of the sun, the pyroelectric sensor responds; however, it does not output the sunshine duration output pulse at that moment.

The pulse contact is made at the last one second of the 36 seconds cycle from the power is turned on.

In case of there is no sunshine, the sunshine duration output contact remains in break condition.

## 6. Measurement Principle

### 1. Sensor Head

The reflecting mirror inside the sensor head rotates 100 times per hour by pulse motor; direct solar radiation is reflected onto the light receiving element which uses pyroelectric element in the rate of once per every 36 seconds. This pyroelectric element outputs voltage which is proportional to the changes (micro coefficient) in the thermal energy against this reflecting light.

### 2. Electric Circuit

Inside the analog circuit, the output from pyroelectric element is applied to the comparator circuit as it is enhanced by the amplifier. The comparator circuit is setup with reference voltage, which is equivalent to the threshold value ( $120\text{W/m}^2$ ) standardized by WMO (World Meteorological Organization), by adjusting the trimmer resistance; when DNI (Direct Normal Incidence) exceeds this threshold value, it is determined as there is sunshine. Moreover, when the logic circuit recognizes the “sunshine” from the logic values which determine either “sunshine” or “no sunshine”, the non-voltage contact is made for one second; such measurement is processed once every 36 seconds, and its result will be the output of Sunshine Duration Meter.

### 3. Reset Box

The reflecting mirror rotates at slow speed of 36 seconds cycle. This rotation movement is created by the half-step drive method using 4-phase stepping motor, and there are cases that current runs through the 4 coils in the stepping motor by 2-phases at once and by just 1-phase at once. These conditions are repeated by every one step, thus the current flow in the power supply line fluctuates in constant cycle. By monitoring this current fluctuation, it determines whether the mirror is rotating, and when the mirror stops, the power supply is reset to automatically start the mirror operation.

### 4. Power Supply

A commercial power supply generates DC12V from AC100V~240V by switching power supply, then supply this power to the MS-093.



# 7. Maintenance & Troubleshooting

## 7-1. Maintenance

To maintain accurate measurement, it is necessary to check and do the following.

With routine maintenance and periodical calibration, MS-093 can be used for a long period of time as more than 10 years. Depending on the installation and operating environment, such as near heavy traffic road and airport, MS-093 may get more impact from the environment. It is highly recommended to perform proper maintenance for the installation and operating environment.

Table 7-1. Maintenance Items

Check Items	Frequency	How To	Effects
Clean Glass Cover	Several times per 1 week	Wipe the dirt on the glass cover by soft cloth and alcohol	Solar radiation is blocked by the dirt on the glass cover and cause decrease in output.
Check Glass Cover Condition	Every Week	Check glass cover for any movement, scratch and/or crack.	Water may leak inside by rain drops and condensation causing damages to the sensor and internal parts.
Check Mirror Rotation Condition	Every Month	Check the reflecting mirror for its movement; make sure it is rotating smoothly and not stopped or rotating irregularly.	MS-093 may not output any sunshine signal, or may cause misjudgment between sunshine/not sunshine.
Check Horizontal Level	Every Week	Check and make sure the MS-093 base plate is in horizontal position and adjust the level as necessary	Measurement error corresponding to the shifted incident angle will be accounted in the measurements.
Check Sensor Latitude and Tilt Condition	Every Month	Check the latitude scale to check for any shifts in the sensor position.	Measurement error corresponding to the shifted incident angle will be accounted in the measurements.
Check Sensor Installation Direction	Every Month	Check the direction of MS-093 installation direction. Make sure it is facing towards the right direction.	Measurement error corresponding to the shifted direction angle will be accounted in the measurements.
Check Silica Gel Condition	Every Month	Check the silica gel color change from blue to reddish color. If the color had been changed, replace with new silica gel.	Condensation may occur inside the glass cover due to humidity and may lead to misjudgment of sunshine/no-sunshine. Leaving the without replacing silica gel may lead to damaging the MS-093
Calibration	Every 2 Years	Contact EKO for calibration.	May lead to misjudgment of sunshine/no-sunshine.
Overhauling	Every 2 Years	Contact EKO for overhaul service to replace packing and O-rings which are used in parts of MS-093 and are consumable parts.	Water leakage inside the sensor may occur easily, and lead to misjudgment of sunshine/no-sunshine if not treated.

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## 7-2. Calibration

It is recommended to recalibrate the instrument once every 2 years. For further information about the calibration and recalibration, please contact EKO.

MS-093 is calibrated by comparison measurement against the reference unit Sunshine Duration Meter which is calibrated at JMA (Japan Meteorological Agency) under 500W halogen lamp.

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## 7-3. Troubleshooting

Check the following items in case of trouble with the instrument. If any questions should remain, contact EKO for further technical support.

Table 7-2. Troubleshooting

Failure	Action
MS-093 does not output sunshine signal	<p>Check reflecting mirror; make sure the reflecting mirror is rotating.</p> <p>a) If the reflecting mirror is stopped</p> <ul style="list-style-type: none"><li>• Check the sensor cable and output cable connection; make sure they are connected properly and not disconnected.</li><li>• Check the voltage between the power terminal +12V and 0V terminals on the power supply box rear panel; there should be about 12V output.</li></ul> <p>b) If reflecting mirror is rotating</p> <ul style="list-style-type: none"><li>• Check the connection and settings on the data logger.</li></ul>
Mirror stopped rotating	<ul style="list-style-type: none"><li>• When Reset Box is not used: Check the power supply; make sure the power supply voltage is DC +12V. If the power supply is in proper condition, turn OFF the power once and put it back ON again. If the mirror starts to rotate after the power is back ON, check the output. If the mirror does not start rotating or there is no output although the mirror is rotating, contact EKO for repair.<ul style="list-style-type: none"><li>➤ It is recommended to use the Reset Box</li></ul></li><li>• When Reset Box is already used If there is any periodical strong noise from power source cable, the Reset Box function does not work. If the mirror rotation is stopped and Reset Box does not function, it may be affected by a strong noise source. Remove such noise source and supply stable power source.</li></ul>
Sunshine signal is output during the night time.	<ul style="list-style-type: none"><li>• Check and make sure the MS-093 properly connected to ground.</li><li>• When the MS-093 is connected to data logger along with other instruments, and if the input channel COM terminal on the data logger is communized with other channel, the connection maybe interrupted by the other instrument. Check the input format and grounding connection for the other instruments.</li></ul>
Condensation inside the glass cover	<p>Gently remove the glass cover and wipe inside with soft cloth to remove the condensation. Then replace the silica gel.</p>

# 8. Specification

## 8-1. Specifications

### 1. MS-093 Sunshine Duration Meter Main Unit

Table 8-1. Main Unit Specification

Items	Specifications
Wavelength Range	300 to 2,500nm
Mirror Rotation Speed	100 revolutions/hour (Optional: 120 revolutions/hour)
Sunshine Duration Threshold	Direct Solar Irradiance 120W/m <sup>2</sup>
Sunshine Duration Measurement Error	Within ±10% against the Sunshine Duration Threshold
Temperature response	±5% (-20 to 40°C)
Power Voltage	DC10.5 to 12.5V
Consumption Current	380mA to 450mA
Operation Temperature Range	-40 to 60°C
Sunshine Duration Outputs	Output: Non-voltage contact output Pulse Width: 1±0.05sec. Voltage Resistance: 60V Sunshine: Make contact for one second every 36 seconds 1pulse/36 sec., 100pulse/hour No Sunshine: Contact remains in break condition
Weight	2.1kg
Materials	Body: A6063BD Glass Tube: Borosilicate Glass (Hard Glass) Sensor Cover: SUS

### 2. Reset Box (Optional)

Figure 8-2. Reset Box Specification

Items	Specifications
Detection Time of Stopped Mirror	Approximately 7.5 Sec.
Power Supply Reset Time	Approximately 20 Sec. (Mirror does not rotate for same length of time when the power is turned on for the first time.)
Dimension	130(D) x90(W) x 47(H)mm
Weight	Approximately 560g
Cable Length	1m

### 3. Power Box (Optional)

Table 8-3. Power Box Specifications

Items	Specifications
Power Voltage	AC85 ~ 264V (50/60Hz)
Output Voltage	DC12V
Fuse	2A (φ5.2 x 20, N-type)
Power Consumption	11VA
Size	200 W x 140 D x 80 H
Weight	Approximately 1.1kg

### 4. Blower Fan Unit (Optional)

Table 8-4. Blower Fan Unit Specification

Items	Specifications
Maximum Wind Flow Rate	Approximately 1m <sup>3</sup> /min
Maximum Static Pressure	Approximately 3.3mm H <sub>2</sub> O
Noise	Approximately 40phon
Rotation Frequency	Approximately 2,700rpm
Power Voltage	DC12V
Power Cable	10m (non-treated cable ends)
Power Consumption	16W
Weight	Approximately 1.7kg

## 8-2. Cables

### 1. Sensor Cable

Cable Model: Nanaboshi NJW-2012-PF

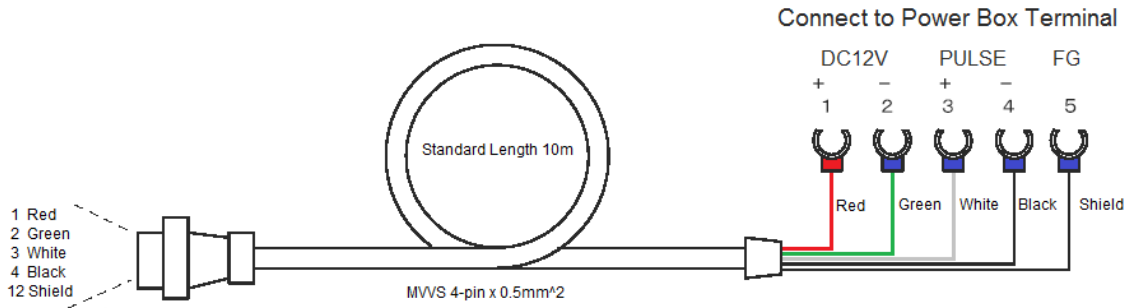


Figure 8-1. Sensor Cable

### 2. Power Cable (Optional)

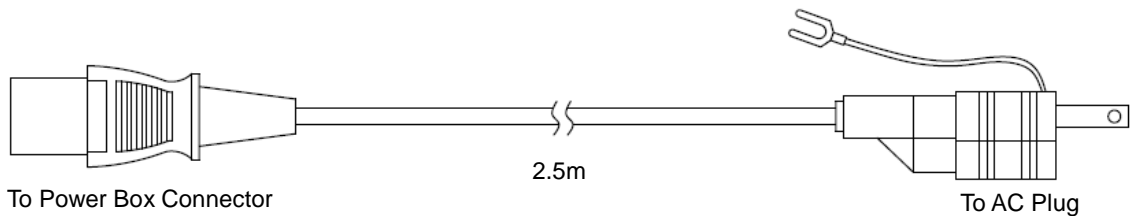


Figure 8-2. Power Cable

### 3. Reset Box Junction Cable (Optional)

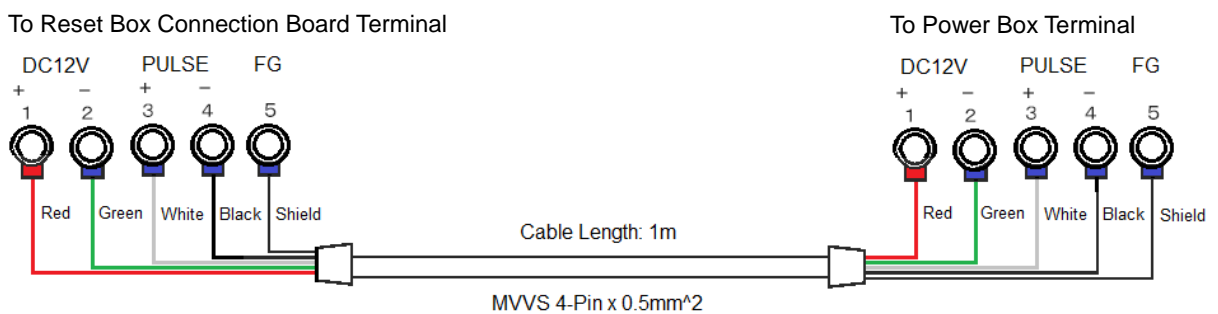


Figure 8-3. Reset Box Junction Cable

### 4. Pulse Output Cable (Optional)

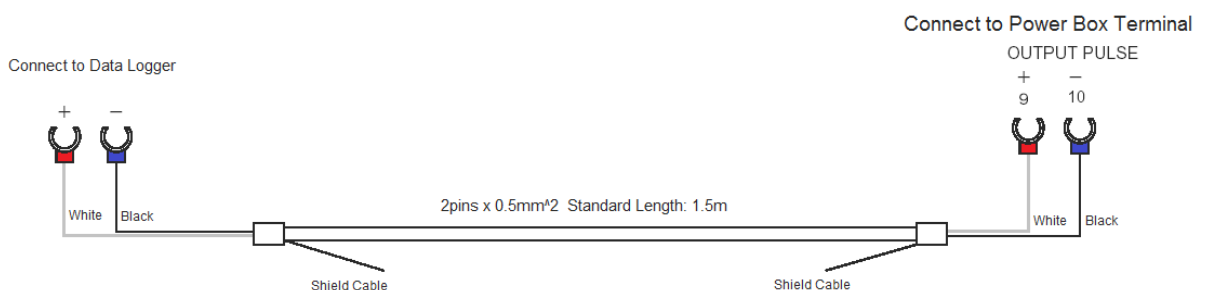


Figure 8-4. Pulse Output Cable (Optional)

## 8-3. Dimensions

### 1. Sunshine Duration Meter MS-093

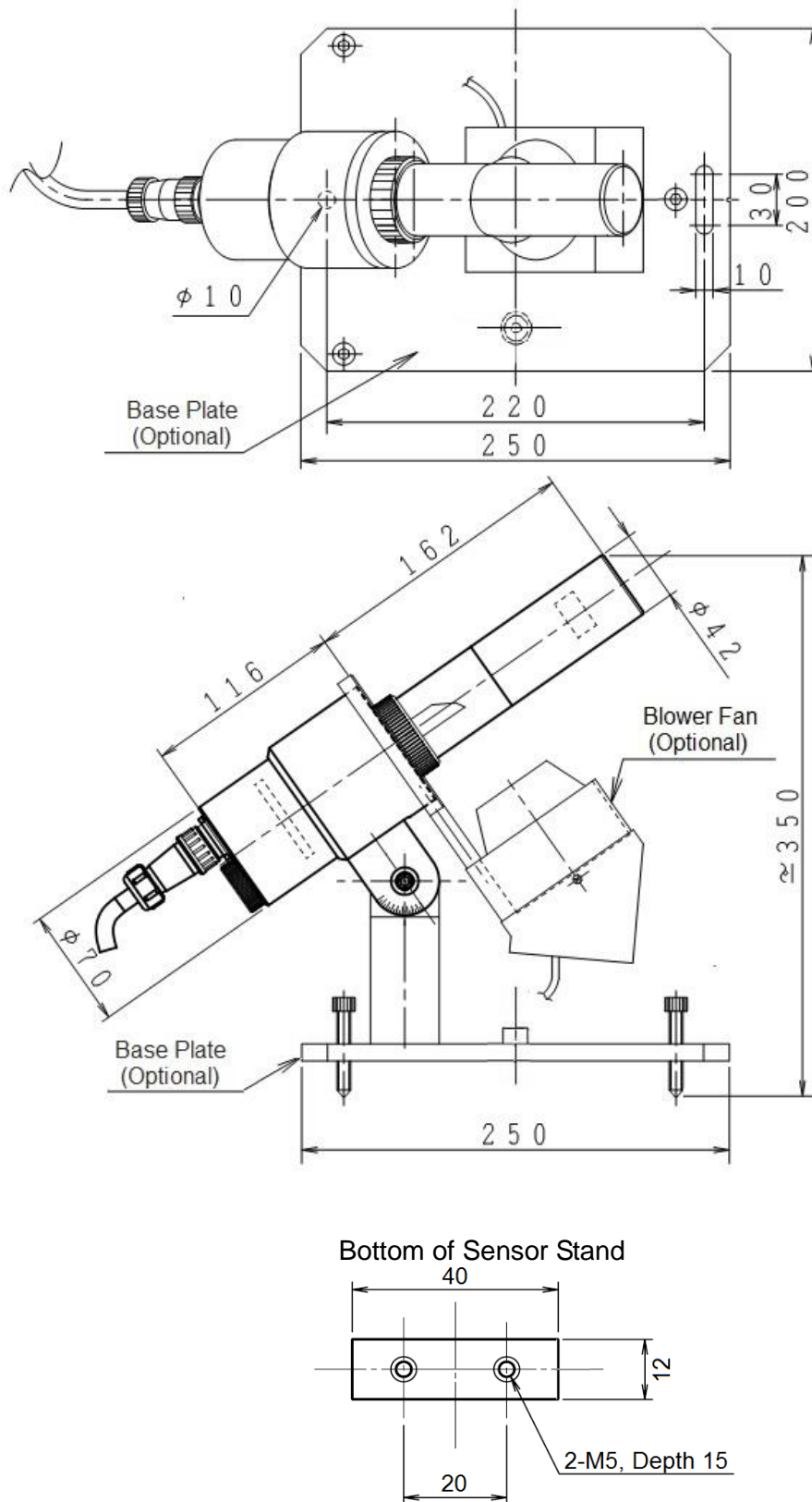


Figure 8-5. MS-093 Dimension

## 2. Reset Box (Optional)

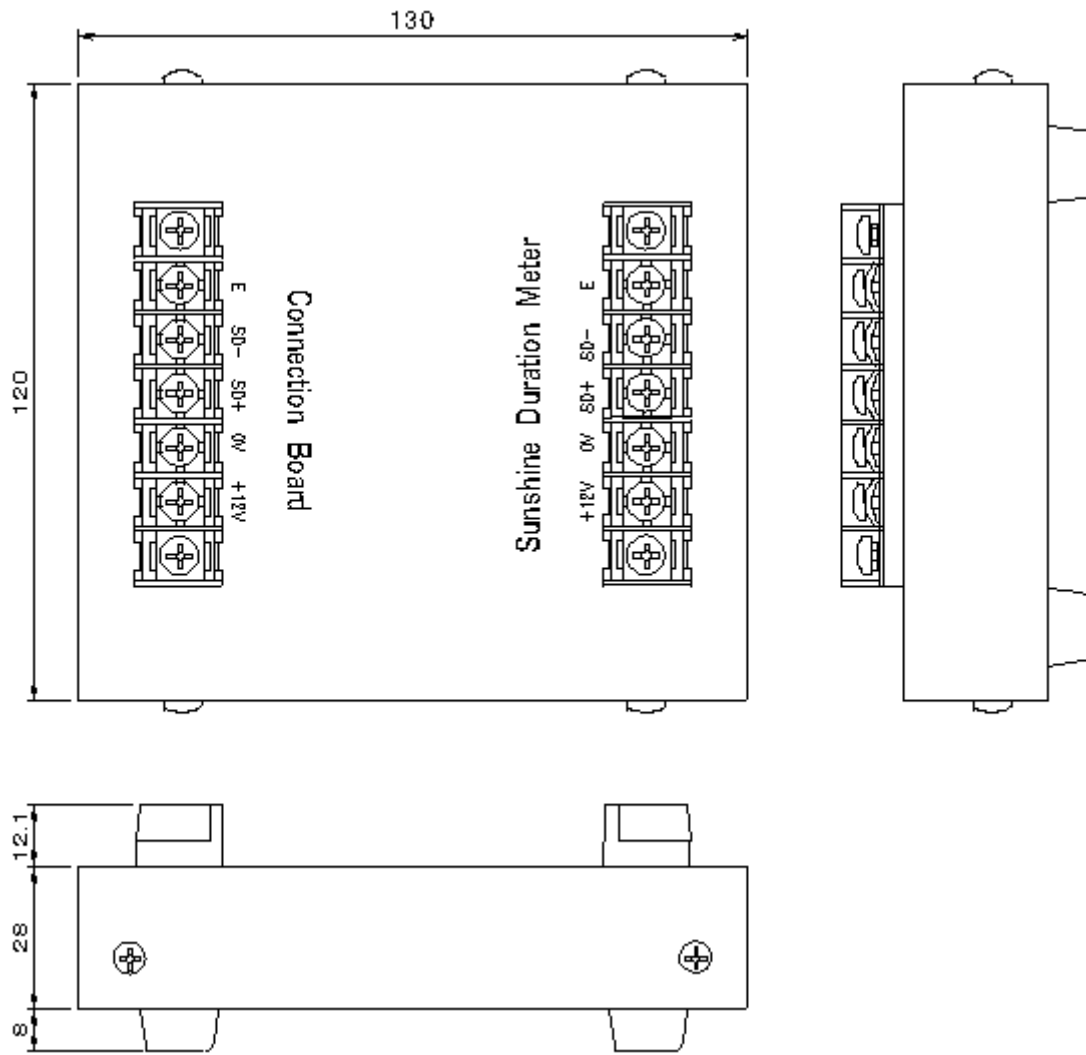


Figure 8-6. Reset Box Dimension

### 3. Power Box (Optional)

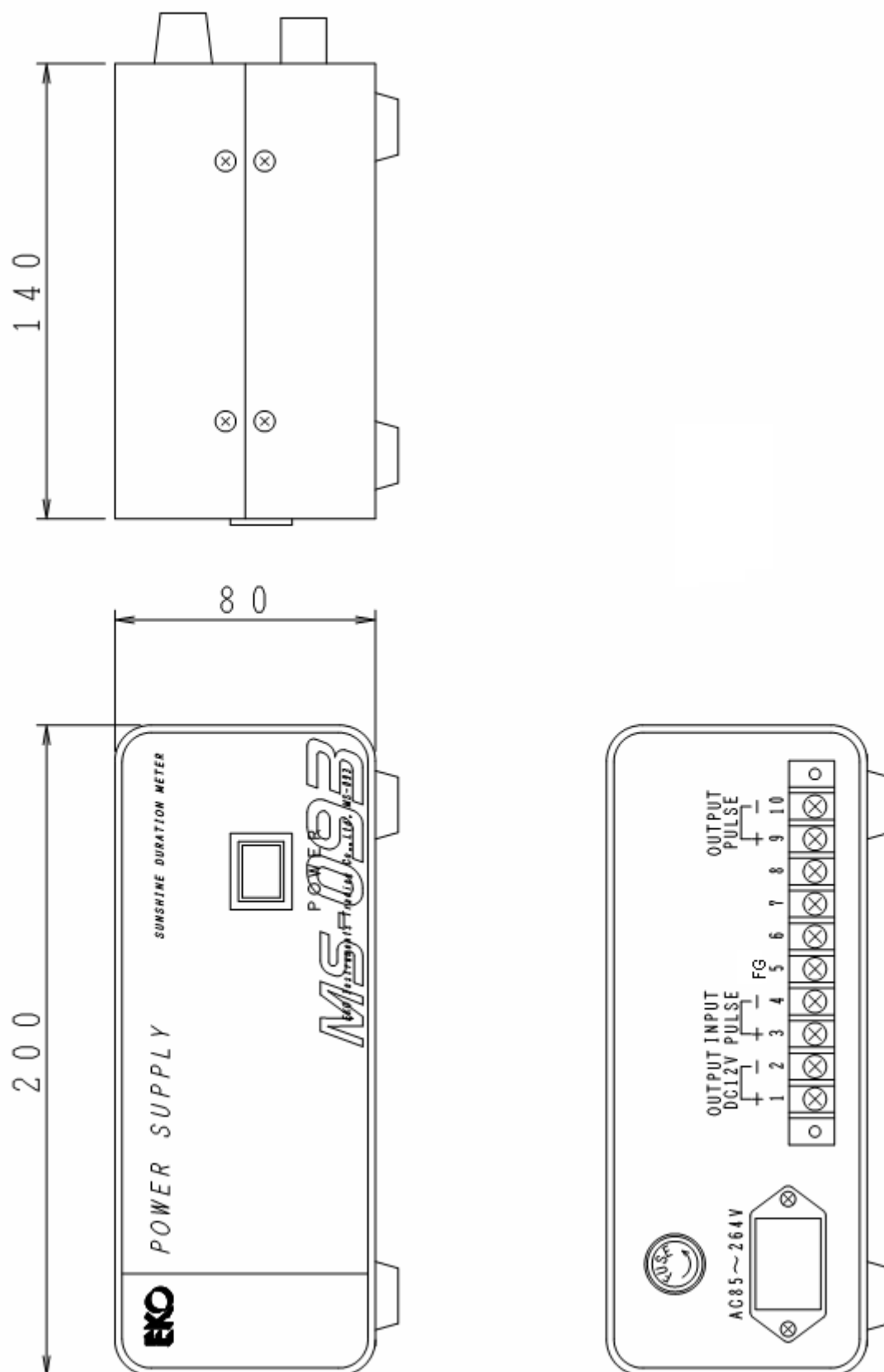


Figure 8-7. Power Box Dimension



## 8-4. Accessories List

Table 8-5. Accessories List

Optional Items	Remarks
Reset Box	Cable Length: 1m
Power Supply Box	
Power Cable	Cable Length: 2.5m
Sensor Cable	Cable Length: 10m
Pulse Output Cable	Cable Length: 1.5m
Blower Fan Unit	Cable Length: 10m, DC12V
Base Plate	
Base Plate Fixing Bolts & Nuts	1 set (includes bolts and nuts 2pcs each)

Table 8-6. Consumable Parts List

Parts Name	Used Parts	Qty.	Remarks
O-Ring KS-16	Drying Cartridge	1	Material: Silicon
O-Ring G-40	Sensor Glass Tube	1	Material: Silicon
O-Ring G-60	Motor Base	1	Material: Silicon
Connector Packing for NJW-2012RM	Output Connector	1	Nanaboshi Electric MFG Co., LTD
Silica Gel	Drying Cartridge		Round type

# APPENDIX

## A-1. Radiometric Terms

Table A-1. Definitions of Terms

Terms	Definitions
Global Solar Irradiance, Global Horizontal Irradiance (GHI)	Hemispherical solar irradiance received on a horizontal plane surface, expressed in units of $W/m^2$ or $kW/m^2$ .
Pyranometer	A radiometer designed to measure the hemispheric solar irradiance over the wavelength range of about 300 to 3,000nm.
Direct Solar Irradiance, Direct Normal Irradiance (DNI)	Normal-incidence solar irradiance received over a small solid angle which includes the circum solar irradiance, expressed in units of $W/m^2$ or $kW/m^2$ .
Pyrheliometer	A radiometer which measures the direct solar irradiance over a certain solid angle including the circumsolar irradiance.
Diffused Solar Irradiance, Diffused Horizontal Irradiance (DHI)	Hemispherical solar irradiance without the direct solar irradiance, i.e. indirect irradiance of the scattered solar radiation (by air molecules, aerosol particles, clouds, etc.), expressed in units of $W/m^2$ or $kW/m^2$ .
Absolute Radiometer	Radiometer which can measure the direct solar radiation (irradiance) in absolute value.
World Meteorological Organization (WMO)	Specialized agency of United nations, who has authoritative role in standardization and control over international meteorological related activities
World Radiation Reference (WRR)	Radiometric reference instrument system which has an uncertainty of less than $\pm 0.3\%$ , expressed in SI units. This reference is maintained by the World Meteorological Organization (WMO), and it has been issued since January 1, 1980
ISO9060	An ISO norm (International Standard). ISO9060 defines the pyranometer and pyrheliometer characteristics, their requirements and corresponding categories. Global pyranometers are subdivided into 3 classes in this standard.
Right Ascension & Declination	Astronomical position is expressed with right ascension and declination. Extending the earth equator line to the sky; stating the equator line in the sky as $0^\circ$ (zero degree) and the declination in the sky Arctic Pole would be $90^\circ$ in the northern hemisphere.
Pyroelectric Element Pyroelectric Sensor	Sensor applying the pyroelectric effect. Pyroelectric element is a sensor applying the phenomenon of increase and decrease of electric charge which is charged on the surface of material, such as lead zirconium titanate (PZT), that spontaneous polarization occur according to the temperature change, by using light source which contains infrared It has characteristics of less long wavelength dependency with relatively long response time, and it is used for infrared sensor for human detection.



**EKO Asia, Oceania**

1-21-8 Hatagaya,  
Shibuya-ku, Tokyo  
151-0072 Japan  
P. +81.3.3469.6711  
F. +81.3.3469.6719  
info@eko.co.jp  
www.eko.co.jp

**EKO North America**

111 North Market Street,  
Suite 300, San Jose,  
CA 95113, USA  
P. +1-408-977-7751  
F. +1-408-977-7741  
info@eko-usa.com  
www.eko-usa.com

**EKO Europe,  
Middle East, Africa,  
South America**

Lulofsstraat 55, Unit 28,  
2521 AL, Den Haag,  
The Netherlands  
P. +31 (0)70 3050117  
F. +31 (0)70 3840607  
info@eko-eu.com  
www.eko-eu.com