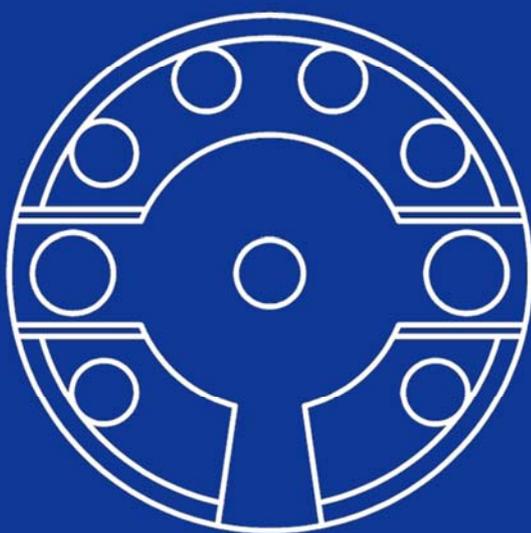


INSTRUCTION MANUAL

Modbus Signal Converter

MC-20



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:

2-1. Contact Information

EKO INSTRUMENTS CO., LTD.

Asia, Oceania Region

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

Europe, Middle East, Africa, South America Region

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info@eko-eu.com	Lulofsstraat 55, Unit 32,	Tel: +31 (0)70 3050117
	2521 AL, Den Haag, The Netherlands	Fax: +31 (0)70 3840607

North America Region

www.eko-usa.com	EKO INSTRUMENTS USA Inc.	
info@eko-usa.com	95 South Market Street, Suite 300	Tel: +1 408-977-7751
	San Jose, CA 95113 USA	Fax: +1 408-977-7741

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.

2-3. About Instruction Manual

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This manual was issued: 2017/05/23
Version Number: 5

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.

2-5. CE Declaration



IMPORTANT USER INFORMATION



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: Modbus Signal Converter

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

Harmonized standards:

EN 61326-1:2013 Class A (Emission)

EN 61326-1:2013 (Immunity)

Test was done in this condition which are signal cable length is under 3m and used the metal box.

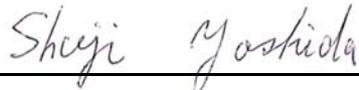
Following the provisions of the directive:

EMC-directive: 89/336/EEC 2014/108/EC

Date: Mar. 6, 2015

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

- Do not install MODBUS 485 RTU CONVERTER in a place which MODBUS 485 RTU CONVERTER may get wet or soaked in water.
- Do not install MODBUS 485 RTU CONVERTER in direct sun light.
- Although this product is tested to meet EMC Directive compliance requirements, it may not fully satisfy its primary specification/performance when using this product near following locations where strong electromagnetic wave is generated. Please pay attention to the installation environment.
 - Outdoor: High voltage power line, power receiver/distribution facility, etc.
 - Indoor: Large-size chiller, large rotation device, microwave, etc.

2. Power Supply

- Always check the voltage and AC/DC type for the specified supply power before connecting the MODBUS 485 RTU CONVERTER. If wrong type of power supply is connected, it may cause MODBUS 485 RTU CONVERTER malfunction and lead to accidents.
- Use with fuse 0.5A connected in series on the power supply cable. Depending on the power supply connected, large current may flow when the internal malfunction occur, and may lead to generating heat and fire.

4. Introduction

The Modbus Signal Converter MC-20 is a digital signal converter which converts the analogue signals from pyranometers, Pt-100 or 10k Ω NTC temperature sensor into a digital signal, and transmits and receives data with serial communication method. Since it is compatible with RS-485 communication, it is possible to connect with PV monitoring devices which have this communication function. By setting the pyranometer sensitivity on signal converter, the voltage signal output from pyranometer can be converted to solar irradiance. The settings for the measurements and communication can be changed by using the setup software.

Also, this signal converter can be integrated in a IP65 Converter Box (optional) for outdoor installation..

4-1. Main Functions

- This Signal Converter measures the voltage signal and resistance value to output solar irradiance and temperature.
 - Sensors compatible to this Signal Converter are pyranometer, Pt-100, 10k Ω NTC thermistor.
 - Up to 100 Signal Converters can be connected in one system.
 - In combination with a pyranometer, sensitivity is pre-set.
 - The Signal Converter settings can be easily changed with EKO Sense Configurator software.
- *Open protocol for serial communication developed by Modicon

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
Modbus Signal Converter Main Unit	1 unit	
L-Shape Tab Terminal (male)	6pcs	
Plug-Type Crimping Terminal (female)	6pcs	
Terminal for Communication Terminal	3pcs	
Double Sems Screw for Installation	2pcs	
Inspection Report	1	
Instruction Manual	1	Not included in the package. Please download from EKO Website

5. Getting Started

5-1. Parts Name

Each part name and its main functions are described below.

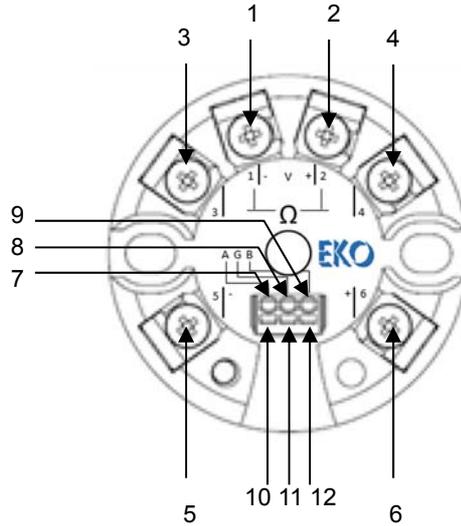


Figure 5-1. Parts Name

Table 5-1. Parts Name and Terminal Numbers

No.	Terminals No.	Measurement Mode 1	Measurement Mode 2	Measurement Mode 3	Measurement Mode 4	Measurement Mode 5
		Pyranometer & NTC	Pyranometer & 2-wire Pt-100	2-wire Pt-100	3-wire Pt-100	4-wire Pt-100
1	1	Pyranometer Voltage Signal Input Terminal (-)		Not Connected	Pt-100(A) Connection Terminal	
2	2	Pyranometer Voltage Signal Input Terminal (+)		Not Connected	Pt-100(B) Connection Terminal	
3	3	NTC Thermistor Connection Terminal	Pt-100(A) Connection Terminal			
4	4	NTC Thermistor Connection Terminal	Pt-100(B) Connection Terminal		Not Connected	Pt-100(B) Connection Terminal
5	5	Power Supply Input Terminal (-)				
6	6	Power Supply Input Terminal (+)				
7	A	Communication Control Terminal (+)				
8	G	Grounding Terminal				
9	B	Communication Control Terminal (-)				

5-2. Setup

1. Installation

- 1) MC-20 where it will not get wet or get soaked in water.
- 2) Keep MC-20 away from direct sunlight.
- 3) Use provided double sems screws incase the converter is installed on installation base with screws.
The maximum torque for tightening the sems screws is $0.4N \cdot m$.

NOTE: MC-20 is paired with the pyranometer which is purchased together; when connecting with the pyranometer, make sure to connect with the right pyranometer. Use the pyranometer with same serial number stated on the MC-20 inspection report.

Install the Signal Converter MC-20 after installing the pyranometer.



NOTE: In industrial environments to reduce potential EMI effects, the cable between pyranometer and converter need to be less than 1m.



NOTE: Make sure that the power supply is switched off during installation of the pyranometer output cable.

2. Electrical Connection

- 1) Connect the attached L-Shaped tab terminals (male) to the terminal numbers 1 through 6 on the converter.
- 2) Attach the provided plug-type crimping terminals (female) to the input and power supply cable ends by crimping. (Please use crimping tool that is for crimping terminal with insulating coating applicable for 1.25mm^2)
- 3) Attach the attached pin terminals to the RS485 communication line ends by crimping. There are 3 communication line: (+), (-), and (G).
(Please use crimping tool that is for crimping terminal (with insulating sleeve pin terminal) applicable for 0.5mm^2).
- 4) Connect the L-Shaped tab terminal (male) attached to the MC-20 and plug-type crimping terminals (female) together, and connect the crimping terminal for communication terminal to Communication Control Terminal (+) and (-), as well as to grounding terminal.
- 5) Follow Figure 5-3 for wiring. (Depending on the measurement mode, the signal input terminal wiring method changes. See Figure 5-4.) When connecting to devices such as PC, which has USB interface, use RS-485/USB converter. Recommended power supply voltage is DC 24V.



NOTE: When taking measurement with 2-wire Pt-100, error in temperature measurement will occur due to the resistance values between the wires in Pt-100 cable. To minimize the measurement error, make the cable length as short as possible.

(Example) In case the EKO Radiation Shield with Temperature Sensor MT-052-A is connected with MC-20, the measurement error per meter for MT-052 cable: 0.33°C

- 6) Prepare a 0.5A fuse, and connect it to power supply line in series. Depending on the connecting power supply, large amount of current will flow when internal malfunction occur and may lead to generating heat and fire.

- 7) To remove the communication cable from the terminal, insert a flathead screwdriver with size less than 1mm width into the hole for removing each communication cables then pull out the cable.



Figure 5-2. How to Remove Communication Cables

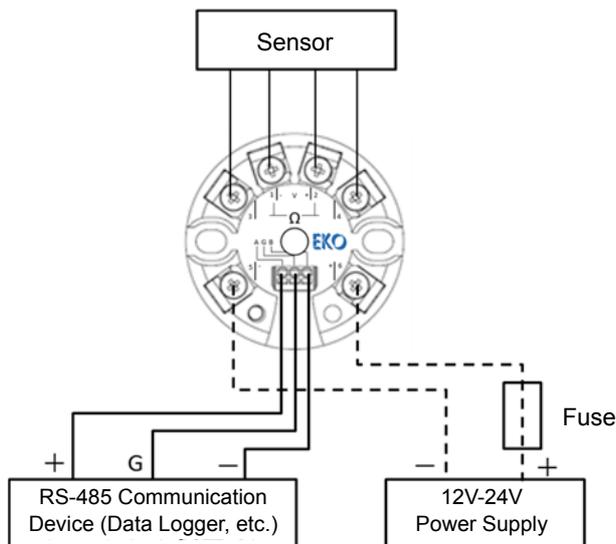


Figure 5-3. Wiring Example

Measurement Mode	Measurement Mode 1		Measurement Mode 2
Connecting Sensors	Pyranometer	Pyranometer & NTC	Pyranometer & 2-wire Pt-100
Connection Diagram			
Measurement Mode	Measurement Mode 3	Measurement Mode 4	Measurement Mode 5
Connecting Sensors	2-wire Pt-100	3-wire Pt-100	4-wire Pt-100
Connection Diagram			

Figure 5-4. Measurement Mode and Measuring Device Connection Terminals

6. Software

6-1. Software Overview

EKO Sense Configurator software is used for changing Signal Converter settings and easy data checking.

6-2. Installation

Follow below procedure to install the Signal Converter Configurator Software:

- 1) Download the latest version of Signal Converter Configurator Software from the EKO Website.
MC-20 product page: <http://eko-eu.com/>
- 2) When the installer file is executed, following Welcome Window appears. Click [Next] button
(Depending on the operating system, message for installation authorization may appear.)

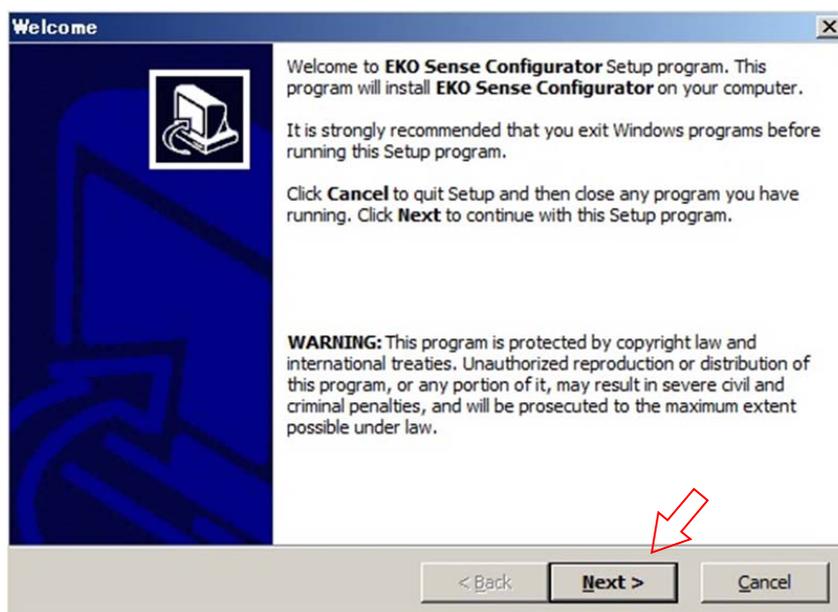


Figure 6-1. Welcome Window

- 3) Assign the folder for installation, and click [Next] button.

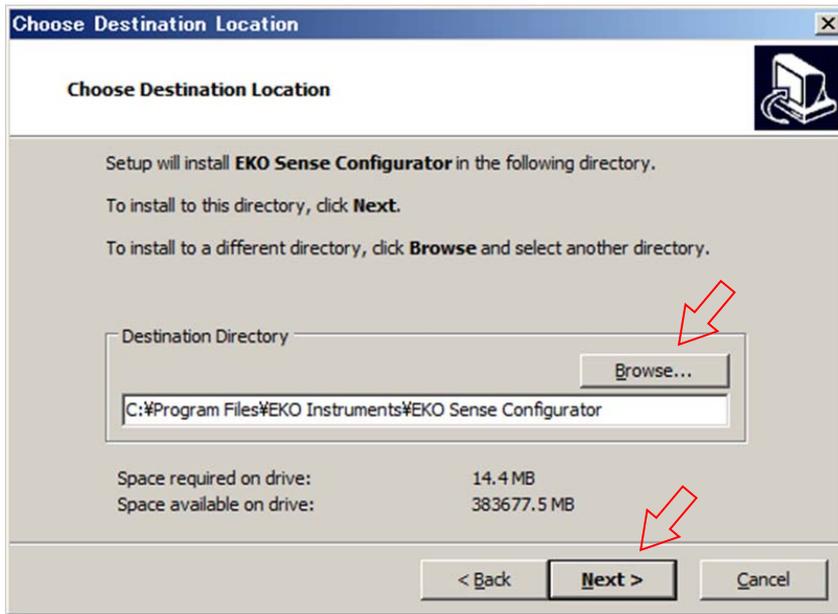


Figure 6-2. Choose Destination Location Window

- 4) In the following window, decide whether to add short cut for this software to Windows Start Menu and on Desktop. As default setting, the shortcuts are added to the Start Menu and Desktop. Remove the checks from the checkboxes as necessary, then click [Next] button.

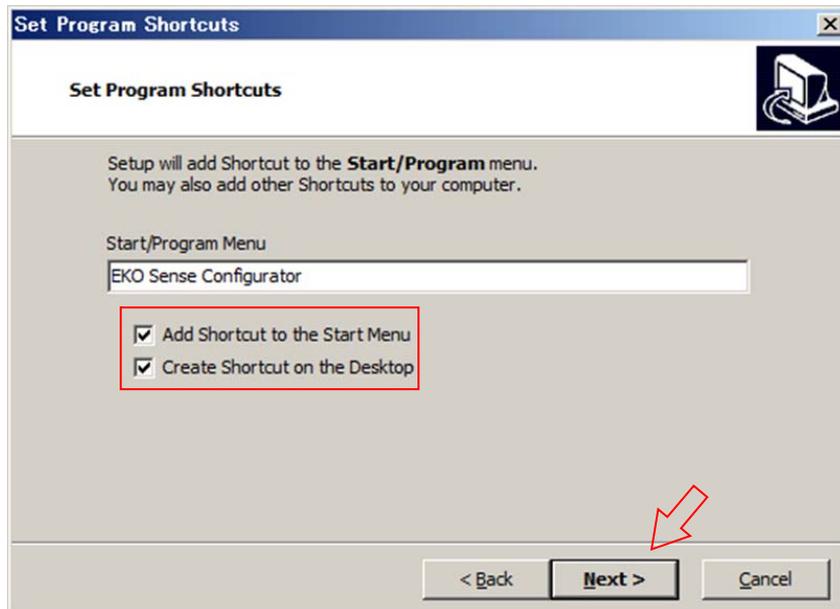


Figure 6-3. Set Program Shortcuts Window

- 5) In the following window, click [Next] button to start the files required for the software to be copied to your computer

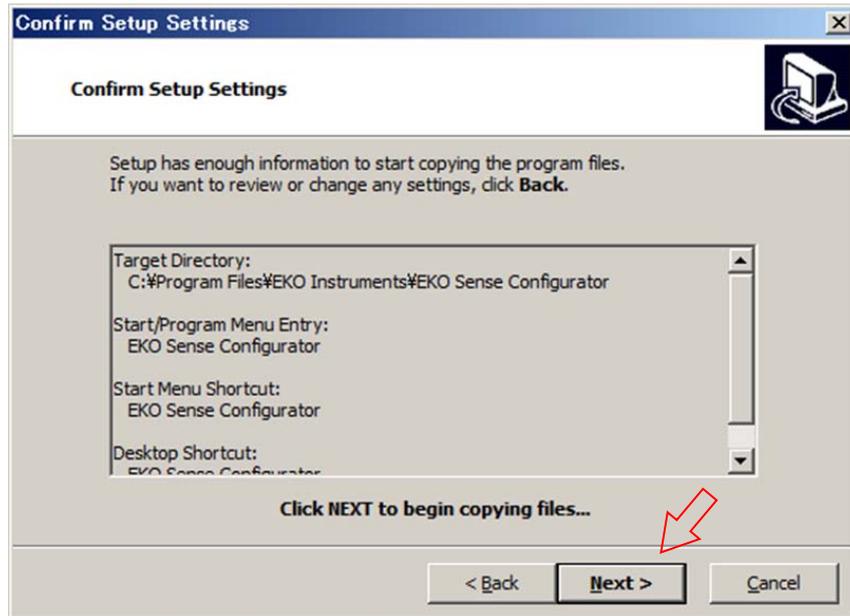


Figure 6-4. Confirm Setup Settings Window

- 6) When all the files are copied to your computer, following window appears. By clicking [Finish] button, the software installation is finished and software starts up. If you don't want to start the software immediately, place a check on checkbox before clicking the [Finish] button.

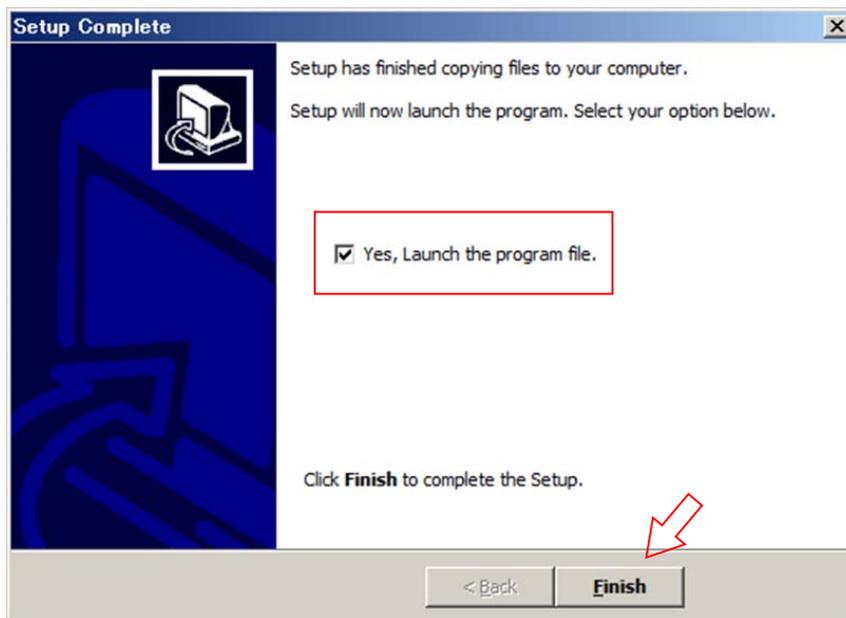


Figure 6-5. Setup Complete Window

6-3. Electrical Connection

As shown in Figure 6-6, connect the Signal Converter to PC in one-on-one pair. When connecting with PC without RS-485 communication port, use RS-485/USB converter. Configuration can be done regardless the sensor is connected or not.

NOTE: Configuration Cable (RS-485/USB converter and communication cable) is an optional item.

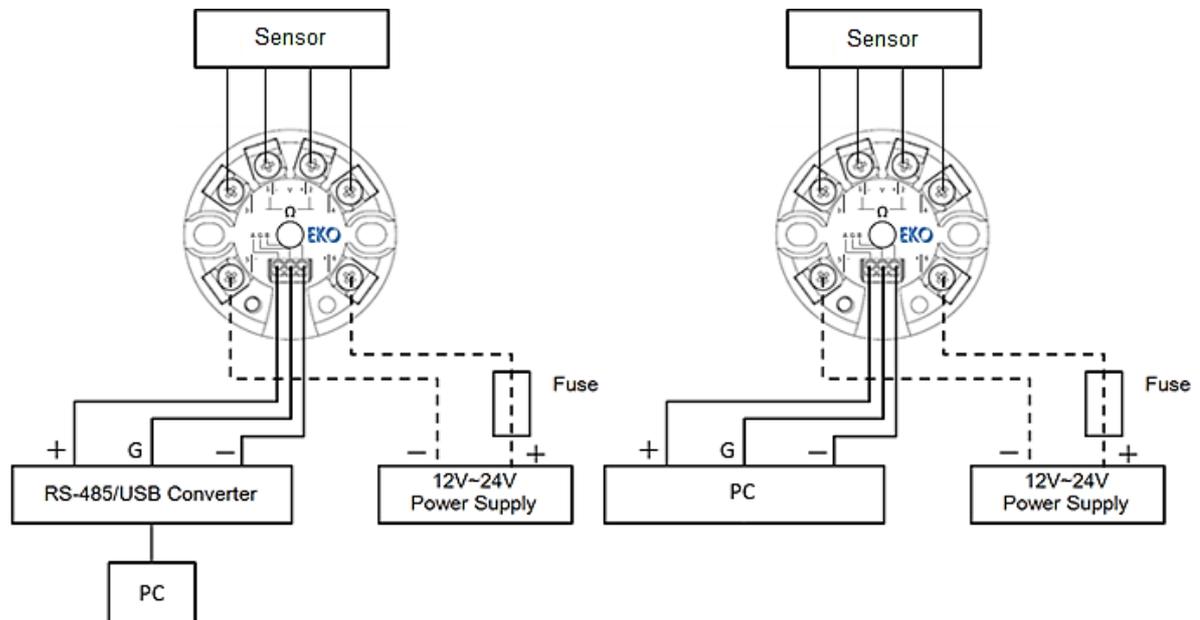


Figure 6-6. Wiring for Converter Setting

6-4. Software Operation

1. Signal Converter Setting

- 1) Startup the software (EKO Sense Configurator). Initial setting of the language is English at the time of software startup. If necessary, change the language setting from the tool bar at the top of the window (Tools → Language). (There are English, Portuguese, Spanish, and Japanese available.)

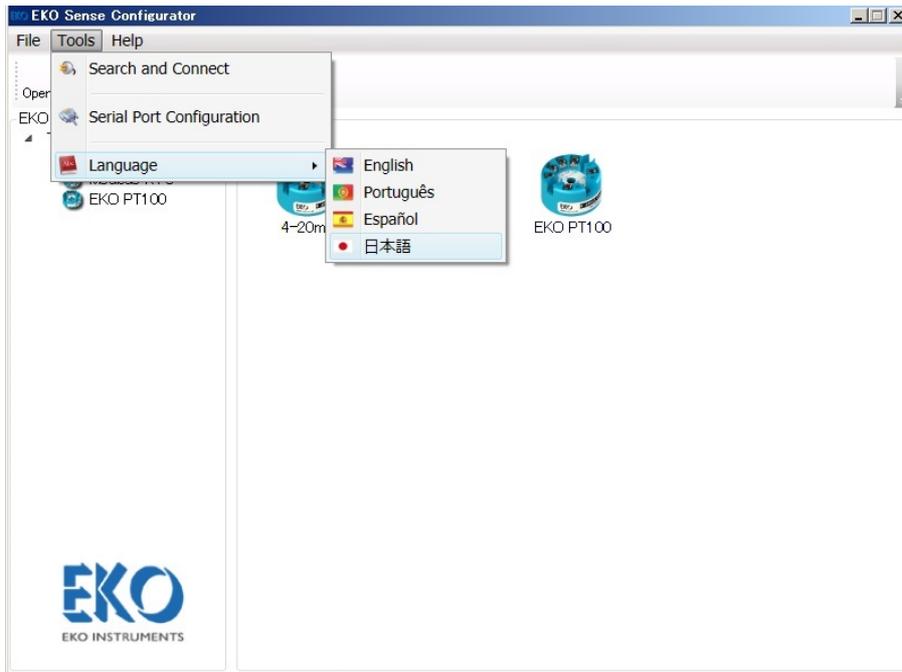


Figure 6-7. Language Setting Window

- 2) Next, select the product that you want to change configuration. Select “4-20mA” from the list.

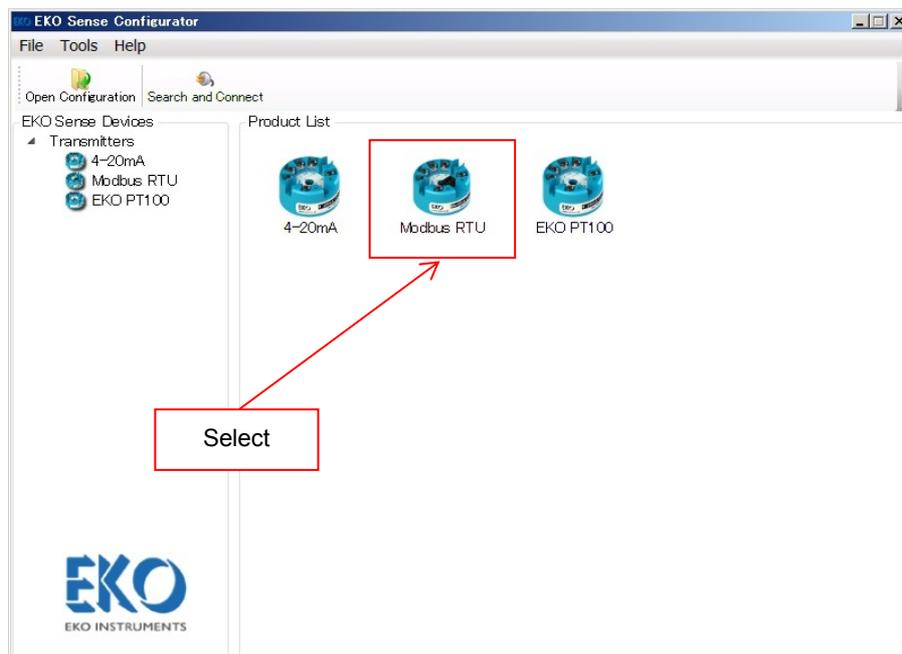


Figure 6-8. Product List Window

3) Window shown on Figure 6-9 appears when “Modbus RTU” is selected.

Items for communication settings are as described in Table 6-1.

After selecting the Port Number to be used, place a check for “Configuration” mode checkbox. When there is no Port Number available, click [Refresh Serial Ports] button then select a Port Number.

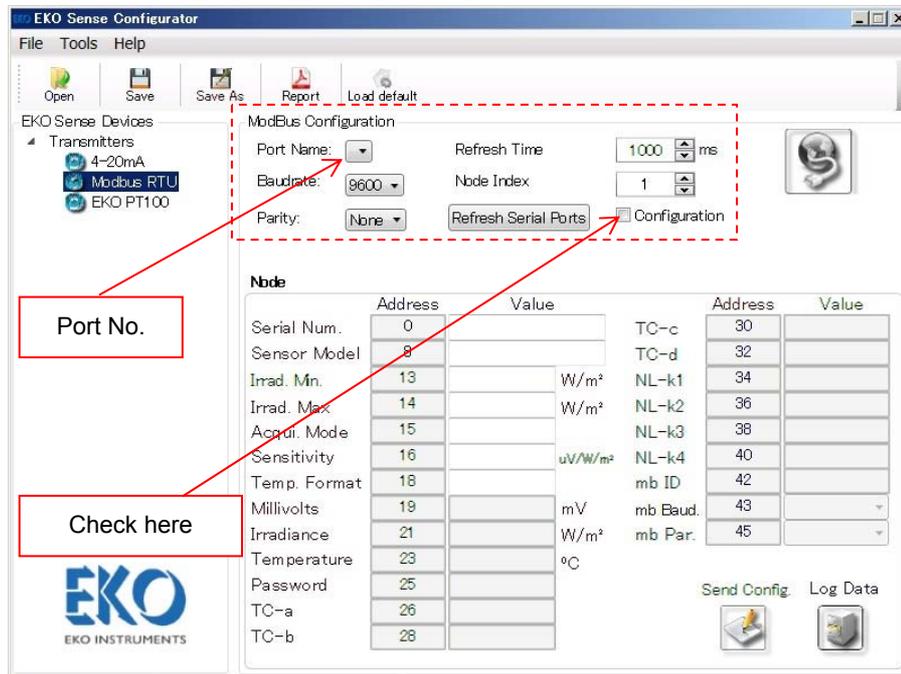


Figure 6-9. Configuration Window (Communication Setting)

Table 6-1. Communication Setting Items

Items	Contents	Default Values
Port	Port number that is connected	No Settings
Baud Rate	Communication Speed [bps]	9600
Parity	Parity Bit	None
Data Refresh Time	Communication Interval with MC-20 [msec.]	1000
Node Index	Node Number	1

- 4) Next, turn ON the Signal Converter power supply.
- 5) Within 5 seconds after the Signal Converter power turned ON, click [Connect] button. The communication starts and when connection is established, "Reading Success" indication appears.

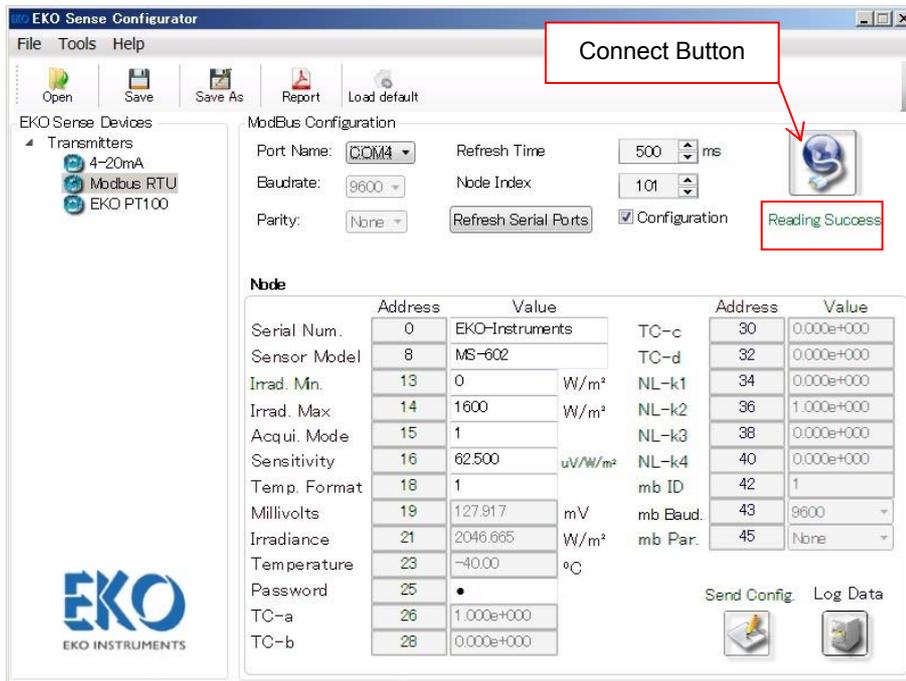


Figure 6-10. Configuration Window (Connection Complete)

- 6) After confirming the “Reading Success”, click the [Connect] button again; it indicates as “Communication OFF” for a second.

In this condition, the addresses 0 to 18 are configurable. (See Table 6-2. for software address and their setting details)

If mouse pointer is placed on the “Value” columns for each item, configurable values appear.

After changing the values, click [Send Config] button then status indicates as “Writing Success”, and configurations are reflected on the Signal Converter.

To verify the written configurations are reflected, click [Connect] button. The status changes to “Reading Success” and currently configured contents in the Signal Converter are displayed.

Click [Connect] button again to continue change the settings to change the status indication to “Communication OFF”

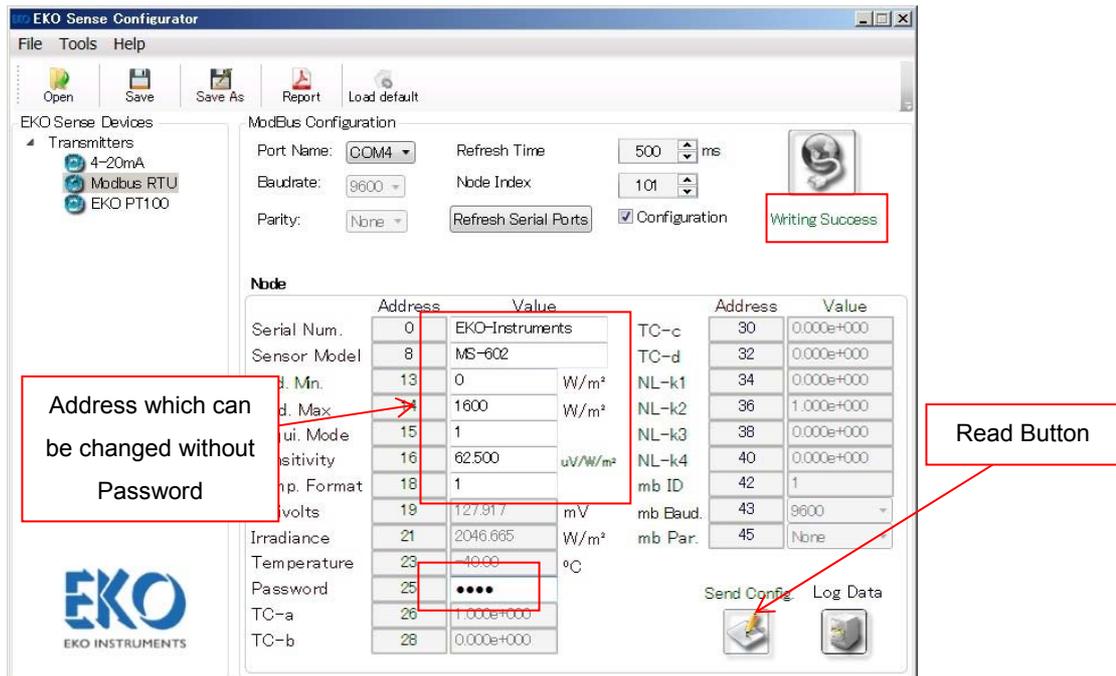


Figure 6-11. Configuration Window (Entering Password)

To change the communication control settings, password is required.

Making sure the status is indicating “Communication OFF”, enter the password [8355] in the Password box under Address 25 then click [Send Config.] button.

When status shows “Reading Success”, click [Connect] button to verify the entered password is correct. Status indicates as “Reading Success”; if the password is correct, configurations from Address 26 and on becomes configurable as shown on Figure 6-12.

To change the values for Addresses 26 and on, click [Connect] button again and change the status indication to “Communication OFF”.

If mouse pointer is placed on the “Value” columns for each item, configurable values appear.

After changing the values, click [Send Config.] button then status indicates as “Writing Success”, and configurations are reflected on the Signal Converter.

To verify the written configurations are reflected, click [Connect] button. The status changes to “Reading Success” and currently configured contents in the Signal Converter are displayed.

Click [Connect] button again to continue change the settings to change the status indication to “Communication OFF”

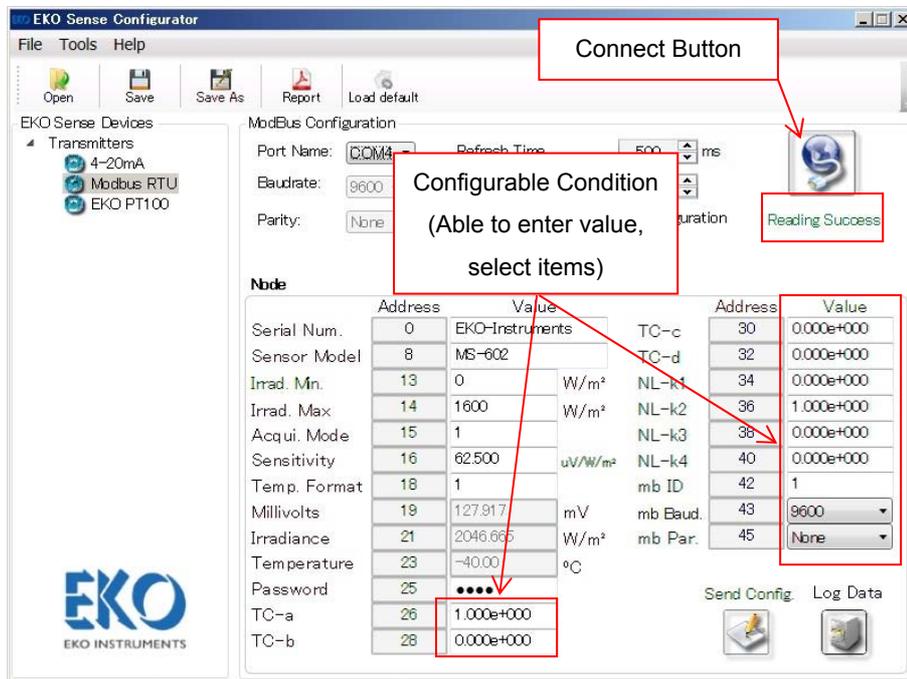


Figure 6-12. Configuration Window (After Password verification)

- 7) After completed configuration, make sure the Signal Converter is not communicating (the status should indicate as “Writing Success” or “Communication OFF”) then turn OFF the Signal Converter power. (If “Reading Success” is indicated, click [Connect] button; when the status shows “Communication OFF”, turn OFF the power)
- 8) To check the operation with configuration values written in the Signal Converter on actual communication conditions, match the setting values for baud rate, node index, and parity in the “Communication Settings” on the window to the values written in the Signal Converter. Also make sure the “Configuration” checkbox is unchecked.

For 5 seconds after Signal Converter power is turned ON, the communication is in standby condition. After 5 seconds, click [Connect] button. If the status indicates as “Reading Success”, the Signal Converter is operating with the set configuration.

If “Timeout” or “Error” is indicated, there are some misconfiguration in the communication control setting, so go back to step 6) in 6-4, 1., and change the configuration according to the instruction.

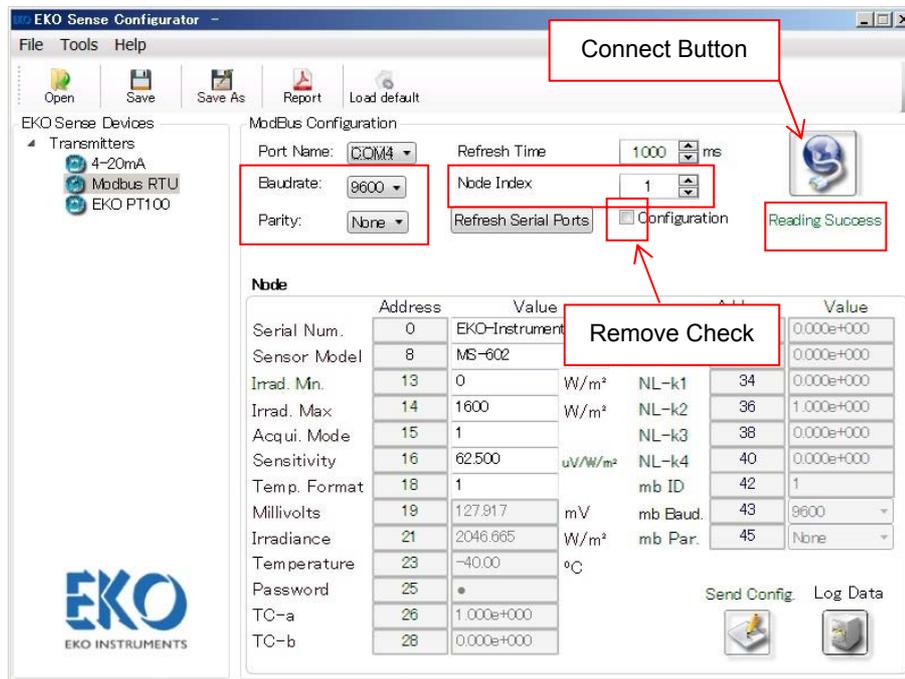


Figure 6-13. Confirming Communication Setting

Table 6-2. Signal Converter Configuration Items

Displayed Address	Address	Items	Remarks
0	0 - 7	Serial Number	Up to 16 alphanumeric characters
8	8 - 12	Pyranometer Model Name	Up to 16 alphanumeric characters
13	13	Minimum Solar Irradiance Output	
14	14	Maximum Solar Irradiance Output	
15	15	Measurement Mode	See Table 9-5.a)
16	16, 17	Pyranometer Sensitivity	See Table 9-5. b)
18	18	Temperature Unit	See Table 9-5. c)
19	19, 20	Input Voltage	Read Only, Sensor Output
21	21, 22	Solar Irradiance	Read Only
23	23, 24	Temperature	Read Only
25	25	Password	8355 (non-changeable)
26	26, 27	Temperature Response Correction Factor	See Table 9-5. h)
28	28, 29	Same as above	Same as above
30	30, 31	Same as above	Same as above
32	32, 33	Same as above	Same as above
34	34, 35	Linearity Correction Factor	See Table 9-5. i)
36	36, 37	Same as above	Same as above
38	38, 39	Same as above	Same as above
40	40, 41	Same as above	Same as above
42	42	Node Number	Configurable in range from 1 to 100
43	43, 44	Baud Rate	4800, 9600, 19200, 38400, 56000, 57600, 115200 bps
45	45	Parity Bit	None/Odd/Even
-	46 - 63	Not Available (Reserved)	Do not write

2. Save and Reading Signal Converter Settings

- 1) To save the configurations to a file, click the “Save As” button at the top of the software window, and assign the location to be saved and file name. The file is created in XML format. To overwrite the changes to already existing file, click “Save” button.
- 2) If there is already saved file, this file can be readout. Click “Open” button and select the XML file. The readout settings will be displayed on the window.

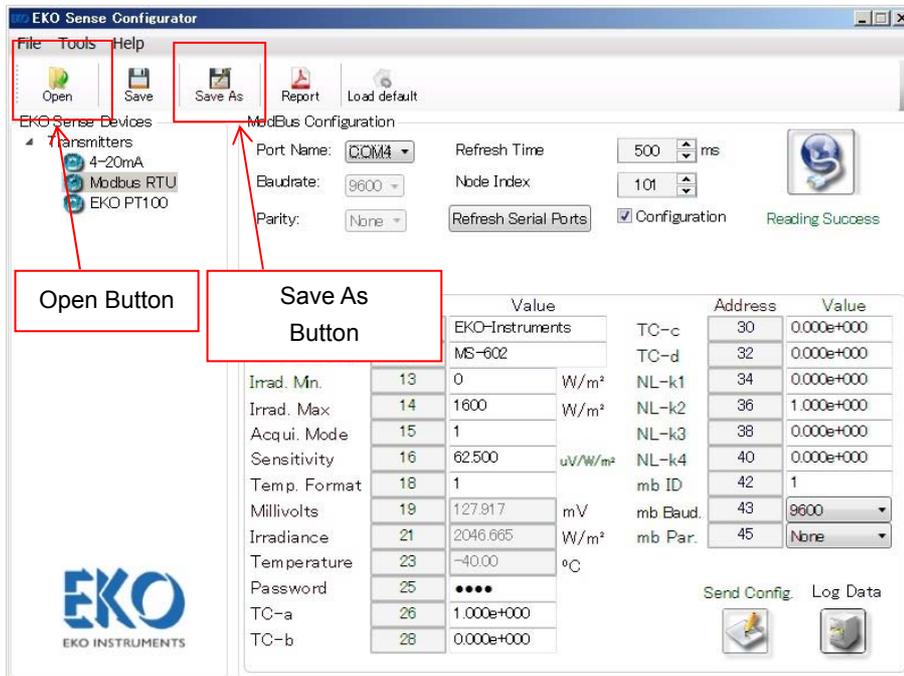


Figure 6-14. Saving and Reading Settings

3. Create PDF File for Converter Settings

To create a report of the setting contents in PDF file, click “Report” button on top of the software window. After clicking this button, assign the location for saving this file and file name.

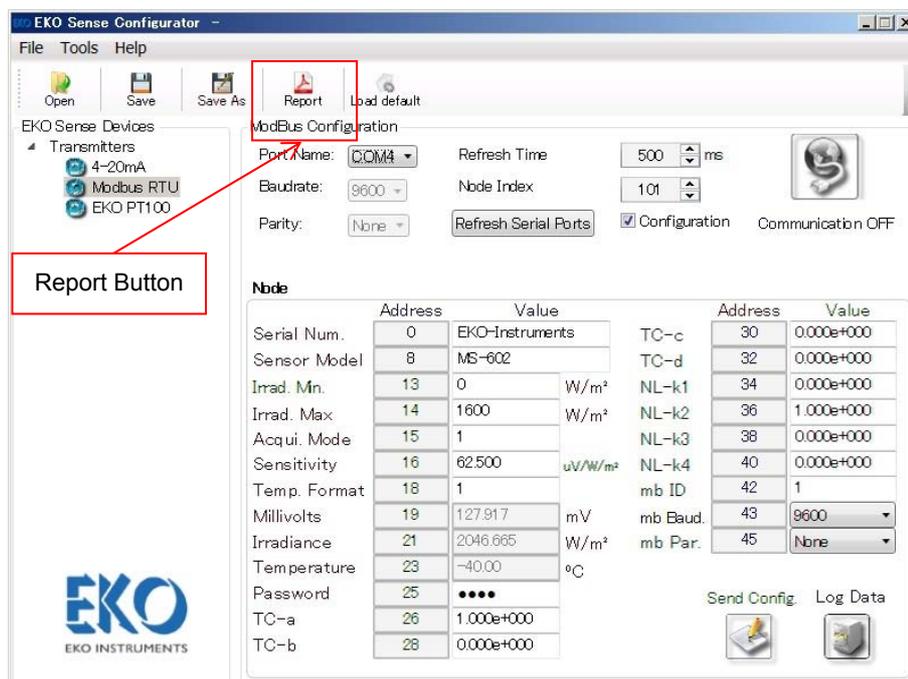


Figure 6-15. Creating PDF Report with Configured Contents

4. Default Setting

Connect to Signal Converter with measurement mode and click the “Load Default” button; the default setting which was configured before shipment is written to the Signal Converter. (This function is available only when the Signal Converter is connected with measurement mode.) The default settings are as follows:

Basic Settings

- Serial No.: EKO Instruments
- Pyranometer Model Name: MS-602
- Min. Solar Irradiance: 0
- Max. Solar Irradiance: 1600
- Measurement Mode: 1
- Sensitivity: 63.5

Detailed Settings

- TC-a: 1
- TC-b: 0
- TC-c: 0
- TC-d: 0
- NL-k1: 0
- NL-k2: 1
- NL-k3: 0
- NL-k4: 0
- Node: 1
- Communication Speed: 9600
- Parity: None

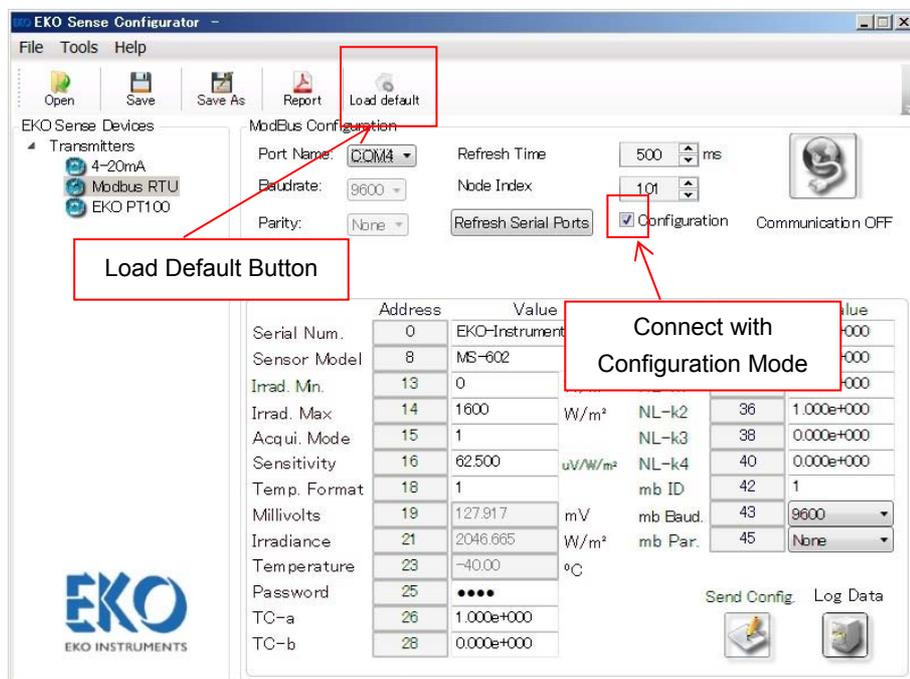


Figure 6-16. Load Default Setting

5. Measurement Data Real Time Display

As described in the step 8) in 6-4, 1., after communication setting, click [Connect] button to bring the Signal Converter in connected condition. At this point, the Signal Converter measurement data is displayed in real time in interval setup in “Data Refresh Time”. The “Data Refresh Time” can be setup between 500 and 3000ms.

(This function is for easy checking of data. Do not use this function for actual operation)

Items which can be displayed are as follows:

- Address 19: Input Voltage
- Address 21: Solar Irradiance
- Address 23: Temperature

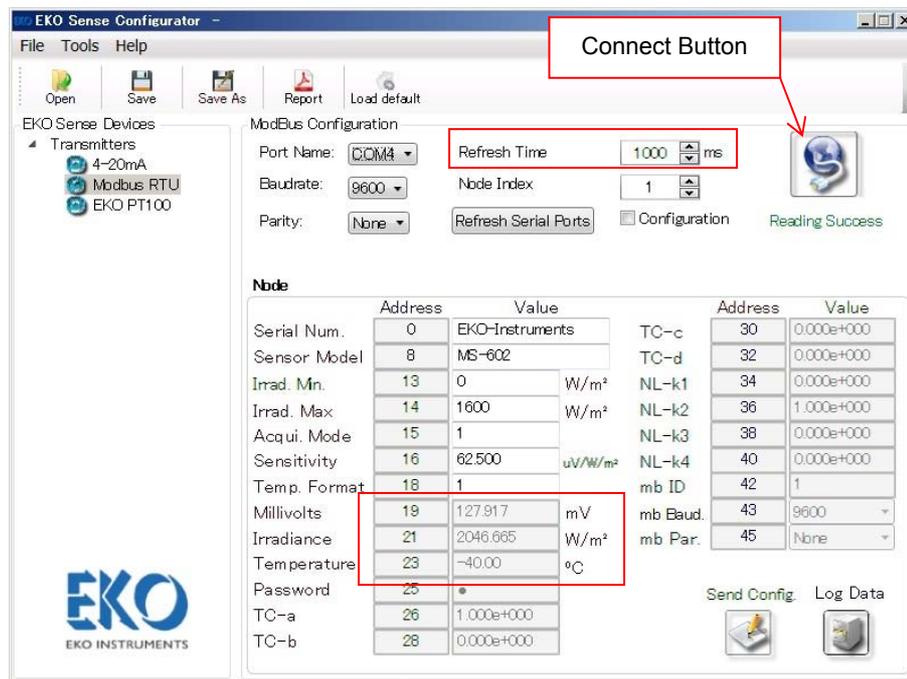


Figure 6-17. Measurement Data Real Time Display

6. Simple Logging Function

This function saves the Signal Converter measurement data which is displayed in the interval of “Data Refresh Time” setup in the section 5 in section 6-4. **(This function is an easy logging function. Do not use this function for actual operation)**

While Signal Converter is in connected condition, click the [Connect] button to change the status to “未接続”. Click the “Log Data” button at the right bottom of the software window; window for assigning the location to save the log file for saving the measurement data, so assign the file name and click [Save] button.

After saving the log file, click [Connect] button again. When the status becomes “接続完了”, it starts to save the measurement data to the log file. While the Signal Converter is connected, the measurement data are recorded in the log file.

To stop logging the measurement data to log file, click [Connect] button to change the status to “未接続” and click the [Log Data] button

Recorded items are as followings:

- Date
 - Time
 - Min. Solar Irradiance(W/m²)
 - Max. Solar Irradiance(W/m²)
 - Pyranometer Sensitivity (μV/W/m²)
 - Input Voltage (mV)
 - Solar Irradiance (W/m²)
 - Temperature (°C)
- } Timestamp

} Setting Values

} Measured Values

Log file is created in CSV format with semi-column separation

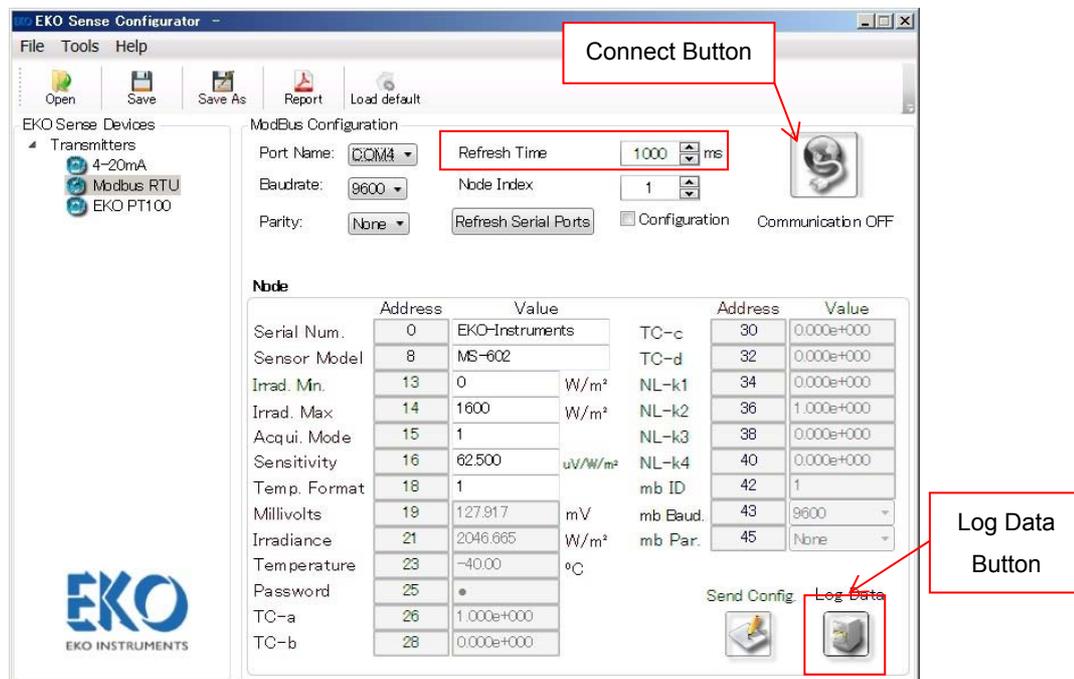


Figure 6-18. Easy Logging Function

7. Connect to Peripheral Device

7-1. Electrical Connection

1. How To Connect the Signal Converter

This Signal Converter MC-20 can be connected with devices that communicate with Modbus RTU protocol using RS-485. Maximum of 100 units can be connected, and individual address can be assigned.

To connect with RS-485 Communication Network:

Follow the wiring shown in Figure 7-1 for connections. Master represents device such as data logger.

Slaves represent the devices including MC-20 that have Modbus RTU communication function. Connect the Master + and – to A and B on the MC-20,

Connect 120Ω termination resistance at the network terminal.

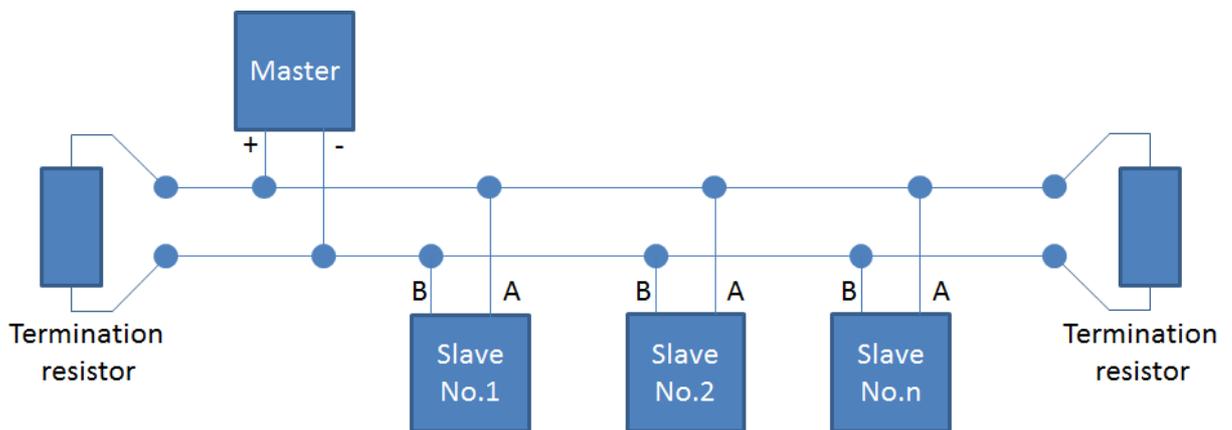


Figure 7-1. Connection to RS-485 Communication Network

2. Communication with Signal Converter

This Signal Converter MC-20 becomes available for communication 5 seconds after it is powered ON.

8. Troubleshooting

8-1. Troubleshooting

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

Table 8-1. Troubleshooting

Failure	Action
There is no output from the signal converter.	Check the power supply cable connection, and make sure there are no disconnections and pyranometer is surely connected. Check to make sure appropriate power supply voltage is supplied.
Output value from the signal converter is not appropriate.	Check the pyranometer serial number; make sure it is same as the serial number stated on the inspection report.
Signal converter output is unstable.	Check for any loose wire/cable connections.
No connection possible	Check the communication setting (Baud rate, Node Index., and Parity). Make sure the proper connections.
No change to made to converter settings	Settings will only be active after writing the new settings.
Log data function doesn't display any measured data	Check the connection

9. Specification

9-1. Main Unit

Table 9-1. Main Unit Specification

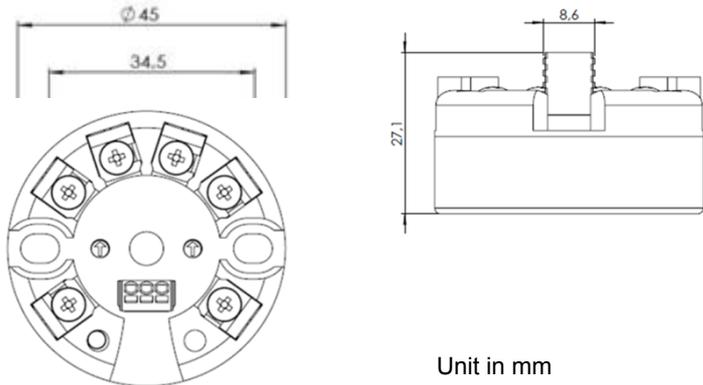
Characteristics	Details
Input Range	DC 0 to 100mV
Temperature measurement range	-40 to + 80°C
Communication Method	RS-485 (Modbus RTU)
Resolution	<5μV
Temperature measurement accuracy	Pt-100 : <0.15°C 、 NTC*1 : <1°C
Input Impedance	> 10MΩ
Temperature Response (-20~50°C)	< 0.2%
Accuracy Assured Operating Temperature Range*2	-20 to +50°C
Operating Temperature Range	-40 to +80°C
Operating Humidity Range	≤95RH% (no condensation)
Response Time	1sec. (99% Output)
Non-Linearity	<0.1% (0-100mV)
Zero Offset	<5μV (Output offset value when 0mV is input)
Power Supply Voltage Conversion Error	<0.05% (When supply voltage changed from 12V to 24V)
Power Supply	DC 12 to 24 V ±10%*3
Average Power Consumption	<0.3W
Dimension	φ45 × 27.1mm
Weight	0.03kg

*1 Connectable 10kΩ thermistor is only 44031 (Measurement Specialties Inc.).

*2 When the Signal Converter is used in ambient temperature over the Accuracy Assured Operating Temperature Range, the measurement error may increase.

*3 Recommended power supply voltage is DC 24V.

9-2. Dimensions



Unit in mm

Figure 9-1. Dimensions

Table 9-5. Register Map

Address	Data Type	Descriptions	Notes
0	UINT16※1	Serial Number 1th /2nd ASCII Code	
1	UINT16	Serial Number 3th/4th ASCII Code	
2	UINT16	Serial Number 5th/6th ASCII Code	
3	UINT16	Serial Number 7th/8th ASCII Code	
4	UINT16	Serial Number 9th/10th ASCII Code	
5	UINT16	Serial Number 11th/12th ASCII Code	
6	UINT16	Serial Number 13th/14th ASCII Code	
7	UINT16	Serial Number 15th/16th ASCII Code	
8	UINT16	Pyranometer Model 1st/2nd ASCII Code	
9	UINT16	Pyranometer Model 3th/4th ASCII Code	
10	UINT16	Pyranometer Model 5th/6th ASCII Code	
11	UINT16	Pyranometer Model 7th/8th ASCII Code	
12	UINT16	Pyranometer Model 9th/10th ASCII Code	
13	UINT16	Irradiance Minimum Output	
14	UINT16	Irradiance Maximum Output	
15	UINT16	Measurement Mode	a)
16, 17	FLOAT※2※3	Pyranometer Sensitivity	b)
18	UINT16	Unit for Temperature	c)
19, 20	FLOAT	Input Voltage	d)
21, 22	FLOAT	Irradiance	e)
23, 24	FLOAT	Measuring Temperature	f)
25	UINT16	Password	g)
26, 27	FLOAT	Temperature Correction Factor1 – a	h)
28, 29	FLOAT	Temperature Correction Factor2 – b	h)
30, 31	FLOAT	Temperature Correction Factor3 – c	h)
32, 33	FLOAT	Temperature Correction Factor4 – d	h)
34, 35	FLOAT	Linearity Correction Factor 1 - k1	i)
36, 37	FLOAT	Linearity Correction Factor 2 - k2	i)
38, 39	FLOAT	Linearity Correction Factor 3 - k3	i)
40, 41	FLOAT	Linearity Correction Factor 4 - k4	i)
42	UINT16	Node Number	—
43,44	FLOAT	Communication Speed (Baud Rate)	—
45	UINT16	Parity Bit	—
46~63	—	Not Available (Reserved)	—

※1: Integer without 16 bits symbol.

※2: Single precision floating point number

※3: Order of the FLOAT register is LOW → HIGH

Details of each data contents are as follows:

a) Measurement mode (See Table 5-1):

- 1: mV + NTC Thermistor
- 2: mV 2-Wire + PT100
- 3 : 2-Wire PT100
- 4: 3-Wire PT100
- 5 - 4-Wire PT100

b) Sensitivity in $\mu\text{V}/\text{W}/\text{m}^2$

Sensitivity of the pyranometer to be connected.

c) Temperature Units

1 – Celsius ($^{\circ}\text{C}$), 2 – Fahrenheit (F), 3 – Kelvin (K)

d) Input Voltage

This register shows the acquired millivolts with three decimals (ex: 1.254mV)

e) Solar Irradiance

This register shows the irradiance calculated from the input voltage up to two decimals

Calculation formula is as follows:

$$I_r = V / S$$

Where:

I_r : Solar Irradiance

V: Input Voltage

S: Sensitivity

f) Temperature

This register shows measured temperature ($^{\circ}\text{C}$) value up to 2 decimal points.

g) Password:

8355

h) Temperature Response Correction Factor

Temperature Correction formula is as follows:

$$\text{ETC}(E,T) = E / \text{TC1}(T)$$

$$\text{TC1}(T) = a + b \times T + c \times T^2 + d \times T^3$$

Where:

ETC (E,T): Temperature Correction Result

E: Pyranometer Voltage Signal

TC1(T): Temperature Correction Factor

T: Measured Temperature

a,b,c, d: Parameters for Temperature Correction Factor

Initial settings are as follows; these settings are the same as when the correction function is not used:

a: 1, b:0, c: 0, d: 0

i) Linearity Correction Factor

Linearity Correction formula is as follows:

$$I=(k1+(k2 \times ETC(E,T)+(k3 \times ETC(E,T)^2)+(k4 \times ETC(E,T)^3))/S$$

Where:

- I: Linearity Correction Result
- ETC(E,T): Temperature Correction Result from above (h).
- S: Pyranometer Sensitivity
- k1, k2, k3, k4: Linearity Correction Factor

Initial settings are as follows; these settings are the same as when the correction function is not used:

k1: 0, k2: 0, k3: 0. k4: 0

Data Examples:

Data frame from Master to the Slave Node No. 0x01 for inquiring the solar irradiance

Node No.	Function No.: Readout Holding Register	Starting Register No. (High)	Starting Register No. (Low)	Readout Register Value (High)	Readout Register Value (Low)		
0x01	0x03	0x00	0x15	0x00	0x02	CRC	CRC

*0xXX is hexadecimal

Response data frame from Node No. 0x01 to Master

Node No.	Function No.: Holding Register Readout	Data Length	Register No. 21 (0x15) High Data	Register No. 21 (0x15) Low Data	Register No. 22 (0x16) High Data	Register No. 22 (0x16) Low Data		
0x01	0x03	0x04	0x??	0x??	0x??	0x??	CRC	CRC

Data Conversion

- a. To Convert Data for Address Numbers 0 to 12

MC-20 Output Data Format: UNIT16 (hexadecimal)

Data Format after conversion: ASCII

Convert according to the ASCII Code Table

Example: Converting data for Pyranometer Model Number (Addresses 8 to 12)

Conversion Result: MS-80_ _ _ _ _

Address No.	8		9		10		11		12	
MC-20 Output Data	4d	53	2d	38	30	20	20	20	20	20
Conversion Result	M	S	-	8	0	_	_	_	_	_

- b. To Convert Data for Address Numbers 13 to 15, 18, 25, 42 and 45,

MC-20 Output Data Format: UNIT16 (hexadecimal)

Data Format after conversion: Decimal

Convert the hexadecimal to decimal.

Example: Convert data for Minimum Irradiance and Maximum Irradiance (Address No. 13 to 14)

Conversion Result: Minimum Irradiance: 0W/m², Maximum Irradiance: 1,600W/m²

Address No.	13		14	
MC-20 Output Data	00	00	06	40
Conversion Result	0		1,600	

- c. To Convert Data for Address Numbers 16 to 17, 19 to 24, 26 to 41 and 43 to 44.

MC-20 Output Data Format: FLOAT (hexadecimal)

Data Format after conversion: Decimal

Example: Convert data for Temperature (Address No. 23 to 24)

For FLOAT format data, data for No. 23 is LOW, and data for No. 24 is HIGH. With No. 24 at the top, connect the No. 23 data to make one data for before conversion.

Next, calculate the data before conversion according to the IEEE754 standard.

Conversion Result: 25.256°C

Address No	23		24	
Output Data	0c	49	41	ca
Data Before Conversion	41ca0c49			
Conversion Result	25.256			

9-4. Software Specification

Table 9-6. Software Specification

Items	Details
Name of Program	EKO Sense Configurator
Applicable OS	Microsoft 社 Windows XP/Vista/7/8/8.1
Number of Licenses	No Limitation
Operation Environment	CPU: Applicable OS is operational Memory: Applicable OS is operational Hard Disk Capacity: More than 100MB Display Resolution: More than 800x600

9-5. Accessories List

Table 9-7. Optional Items

Standard Items	Remarks
Signal Converter Box 1	Box for 1 unit signal converter (Includes: 4pcs M4 screws, 4pcs Mounting Feet, 3pcs Blind Bar)
Signal Converter Box 2	Box for 2 units of signal converter (Includes: 4pcs M4 screws, 4pcs Mounting Feet, 4pcs Blind Bar)
Cable for Converter Setup	RS-485/USB converter (1m), communication cable (0.5m), DC

APPENDIX

A-1. Optional Items

1. Signal Converter Configurator Cable

RS-485/USB Converter and connection cable for connection between Signal Converter and PC to configure Signal Converter. RS-485/USB Converter and RS-485 Communication Cable are used in combination.

Table A-1. Package Contents

Items	Qty	Remarks
RS-485/USB Converter	1pc	Cable Length: 1m
RS-485 Communication Cable	1pc	Cable Length: 0.5m
CD	1	Manual, Driver

1) Specifications

Table A-2. Specifications of Cable for Converter Setting

Items	Details
Applicable OS	Microsoft ® Windows XP/Vista/7/8/8.1
Interface	USB1.1
Weight	0.15 kg
Number of Pins	3
Cable Length	1.5m (RS-485/USB converter 1m, communication cable 0.5m)

2) Wiring

As shown on Figure A-1, connect the +, -, and G wires to the Signal Converter terminals A, B, and G. Connect the other end to terminals +, -, and G terminals on RS-485/USB Converter (See Figure A-2). Then connect the USB cable of the RS-485/USB Converter to PC.

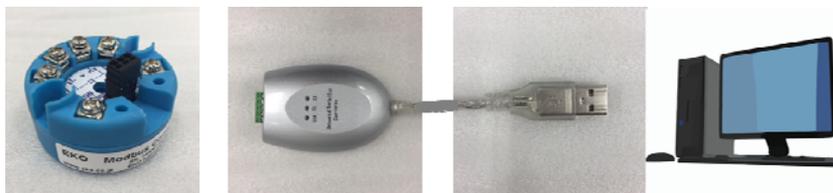


Figure A-1. Connection between Signal converter and PC

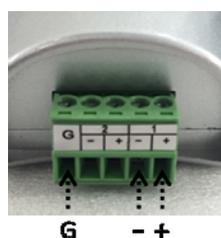


Figure A-2. RS-485/USB Converter Terminal Positions

2. Signal Converter Box

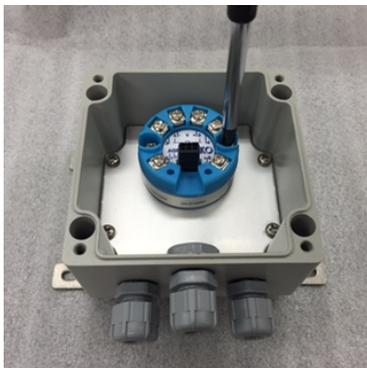
Signal Converter Box is a metal waterproof box with IP65 for outdoor application. There are converter box for 1 unit of Signal Converter and 2 units of Signal Converter available for your application needs. There are 3 cable glands (for running cables through the side of box) provided on the Converter Box1, 4 cable glands on the Converter Box2

Table A-3. Packaging Contents

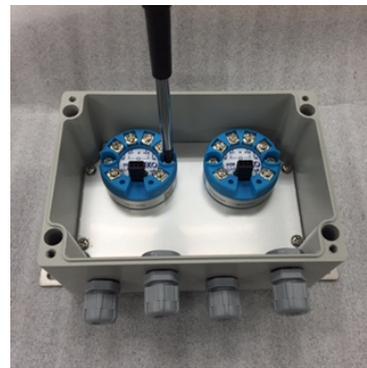
Converter Box1			Converter Box2		
Items	Qty	Remarks	Items	Qty	Remarks
Converter Box1	1pc	For 1 Signal Converter	Converter Box2	1pc	For 2 Signal Converters
M4 Screws	4pcs	For Mounting Feet	M4 Screws	4pcs	For Mounting Feet
Mounting Feet	4pcs		Mounting Feet	4pcs	
Blind Bar	3pcs		Blind Bar	4pcs	

1) Wiring Procedure

Open the Signal Converter Box lid and use provided M4 screws (20mm length) to fix the Signal Converter inside the Converter Box as shown below Figure A-3. (Maximum torque for screw is $0.4\text{N} \cdot \text{m}$).



Converter Box1



Converter Box2

Figure A-3. Installing inside the Converter Box

Wire the Signal Converter according to the Figure 5-2 shown in section 5-2; however, when installing 2 Signal Converters in the Signal Converter Box 2, separate the power supply cable and signal cable for wiring. (See Figure A4).

Insert the cables through the cable glands, and securely close the cable gland cover.

For the cable glands not used, insert the attached Blind Bar instead of cable then close the cable gland cover securely. If Blind Bar is not used and/or cable gland cover is not securely closed, water may enter inside the Converter Box and lead to malfunctions of Signal Converters and electrical leakage.

Measurement instrument and grounding line of the power supply should be connected to one of the screws fixed on the base plate.

Moreover, the Signal converter should be grounded when it is used.

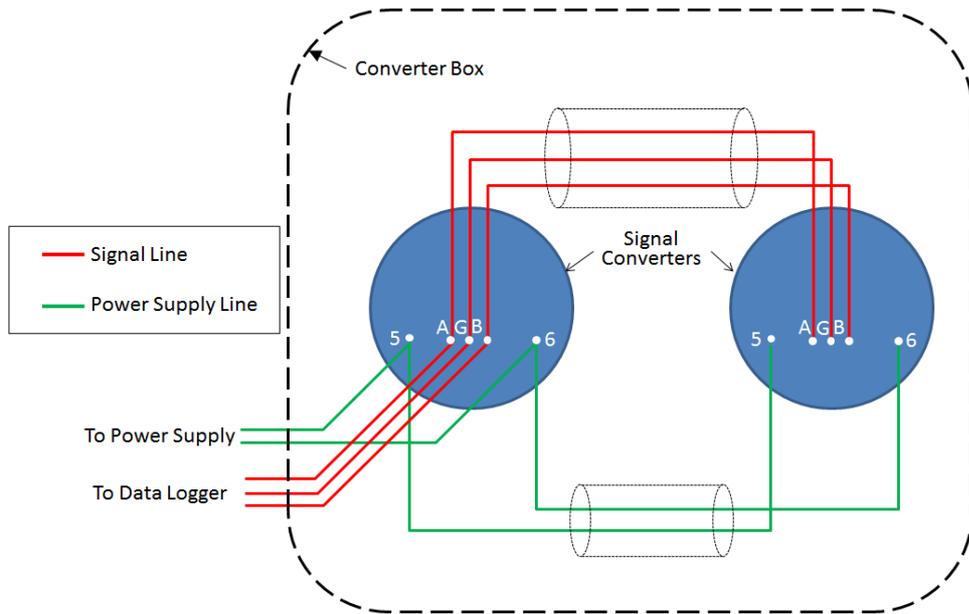


Figure A-4. 2 units of Signal Converter in Converter Box2:
Power Supply Line and Signal Line Wiring

Table A-4. Converter Box Specification

Items	Converter Box1	Converter Box2
Capacity (Allowable Signal Converter Quantity)	1 unit	2 units
Number of Cable Glands	3	4
Applicable Cable Diameter for the Cable Gland	φ3 to 7mm	φ3 to 7mm
Material	Aluminum Die-Casting	Aluminum Die-Casting
Environmental Protection	IP65	IP65
Dimensions	90 x 90 x 60 (mm)	100 x 140 x 70 (mm)
Weight	465g	705g

2) Dimension Drawings

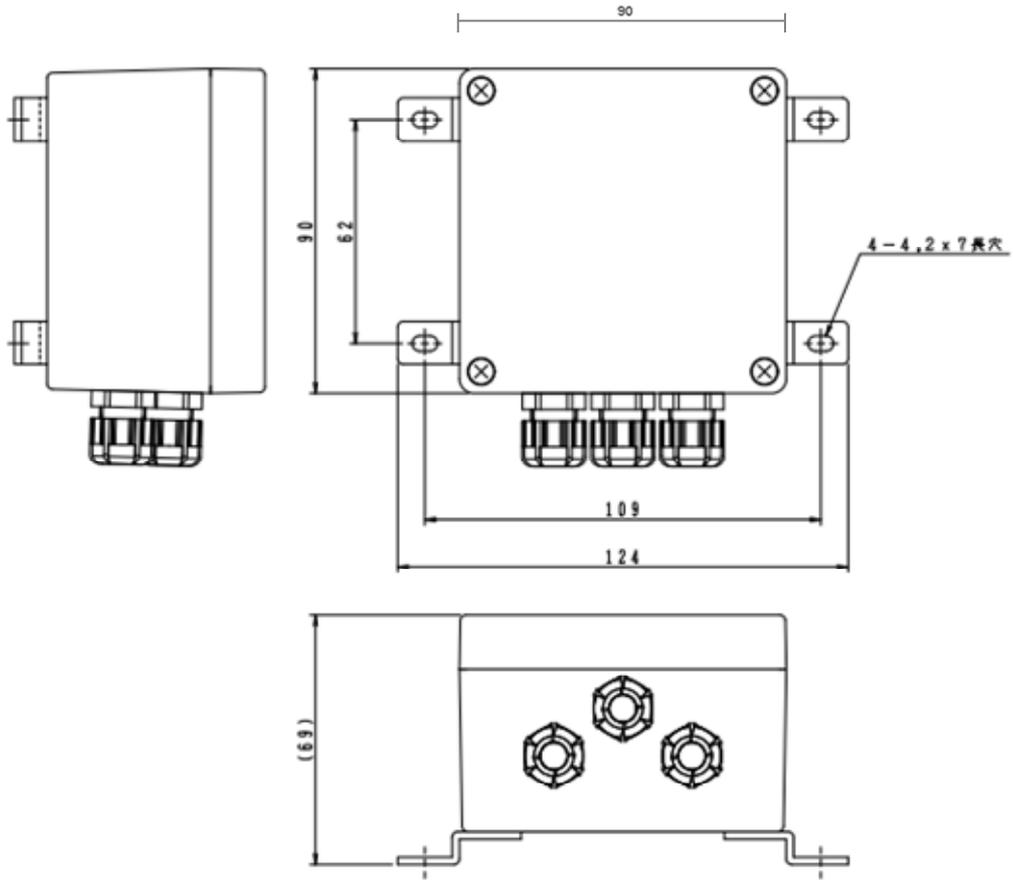


Figure A-5. Converter Box 1

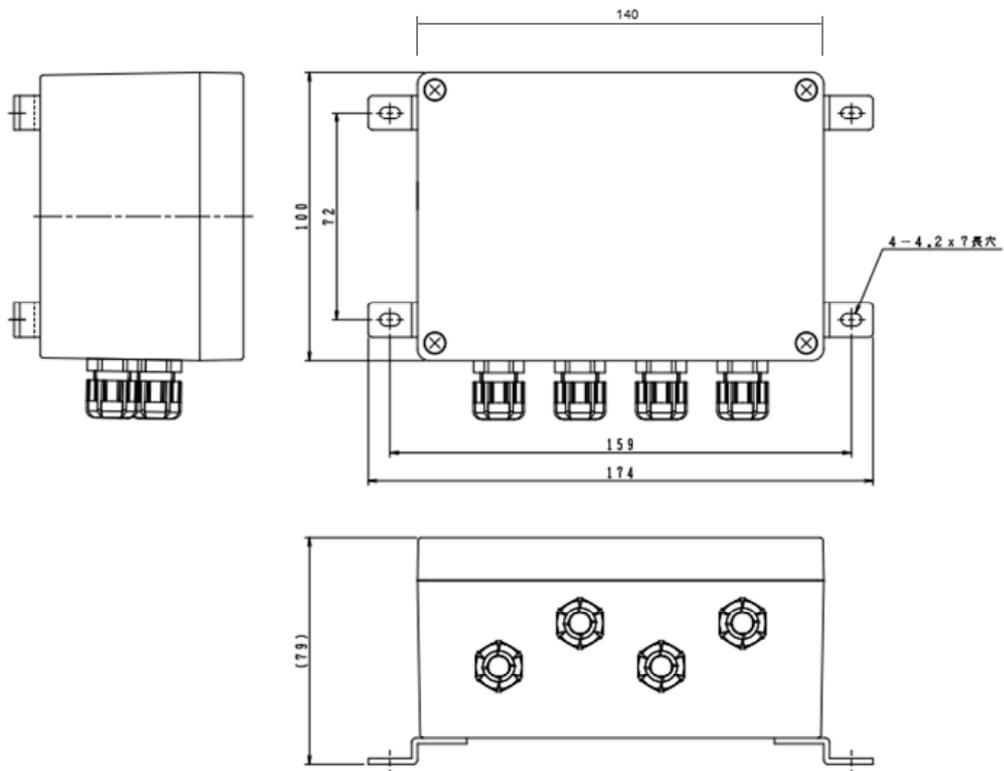


Figure A-6. Converter Box 2

3) Installation

When installing the Converter Box, use the provided mounting feet and M4 screws for fixing the converter box. The installation feet hole pitches are as provided in Table A-5.

Table A-5. Mounting Feet Installation Pitch

Items	Left & Right Hole Pitch	Top & Bottom Hole Pitch
Converter Box1	109mm	62mm
Converter Box2	159mm	72mm

※Mounting feet positions when the cable glands on the converter box facing the ground.



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