CKD

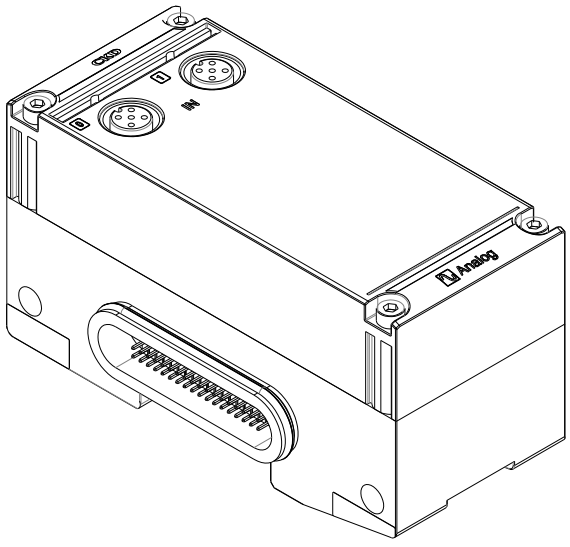
Remote I/O

RT Series

Analog I/O Unit

INSTRUCTION MANUAL

SM-A46347-A/1



- Read this Instruction Manual before using the product.
- Read the safety notes carefully.
- Keep this Instruction Manual in a safe and convenient place for future reference.

CKD Corporation

PREFACE

Thank you for purchasing CKD's "**RT Series**". This Instruction Manual contains basic matters such as installation and usage instructions in order to ensure optimal performance of the product. Please read this Instruction Manual thoroughly and use the product properly.
Keep this Instruction Manual in a safe place and be careful not to lose it.

Product specifications and appearances presented in this Instruction Manual are subject to change without notice.

- This product is intended to be used by persons with sufficient knowledge and experience in the following areas.
  CKD shall not be responsible for accidents caused by persons who selected or used the product without knowledge or sufficient training with respect to them.
  - Electricity (qualified electrician or equivalent)
  - The industrial network communications used
  - FA systems in general
  - Each of the systems that use manifold solenoid valves, IO-Link, etc.
- Since there are a wide variety of customer applications, it is impossible for CKD to be aware of all of them.
  Depending on the application or usage, the product may not be able to exercise its full performance or an accident may occur. It is the responsibility of the customer to check the product specifications and decide how the product shall be used in accordance with the application and usage.

SAFETY INFORMATION

When designing and manufacturing any device incorporating the product, the manufacturer has an obligation to ensure that the device is safe. To that end, make sure that the safety of the machine mechanism of the device, the pneumatic or water control circuit, and the electric system that controls such mechanism is ensured.

To ensure the safety of device design and control, observe organization standards and relevant laws and regulations, which include the following:

ISO 4414, JIS B 8370, JFPS 2008 (the latest edition of each standard),
the High Pressure Gas Safety Act, Industrial Safety and Health Act, other safety rules, organization standards, and relevant laws and regulations.

In order to use our products safely, it is important to select, use, handle, and maintain the products properly.
Observe the warnings and precautions described in this Instruction Manual to ensure device safety.

Although various safety measures have been adopted in the product, improper handling may lead to an accident. To avoid this:

Thoroughly read and understand this Instruction Manual before using the product.

To explicitly indicate the severity and likelihood of potential harm or damage, precautions are classified into three categories: "DANGER", "WARNING", and "CAUTION".

⚠ **DANGER**	Indicates an imminent hazard. Improper handling will cause death or serious injury to people.
⚠ **WARNING**	Indicates a potential hazard. Improper handling may cause death or serious injury to people.
⚠ **CAUTION**	Indicates a potential hazard. Improper handling may cause injury to people or damage to property.

Precautions classified as "CAUTION" may still lead to serious results depending on the situation.
All precautions are equally important and must be observed.

Other general precautions and tips on using the product are indicated by the following icon.

	Indicates general precautions and tips on using the product.

Precautions on Product Use

⚠ DANGER

Do not use the product for the following applications:

- Medical devices involved in sustaining or managing people's lives or physical health
- Mechanisms and mechanical devices used for the purpose of moving and transporting people
- Important safety parts for mechanical devices

⚠ WARNING

The product must be handled by a qualified person who has extensive knowledge and experience.

The product is designed and manufactured as a device or part for general industrial machinery.

Use the product within the specifications.

The product must not be used beyond its specifications.
This product is intended for use in general industrial machinery, equipment or parts. It is not intended for use outdoors (except for products with outdoor specifications) or for use under the following conditions or environments.

- Use for applications where safety is required
- In applications for nuclear power, railroad systems, aviation, ships, vehicles, and medical equipment
- In applications for equipment that directly touches beverages or food
- For safety measures for amusement equipment, emergency shut-off circuits, press machines, or brake circuits
- Use for applications where life or assets could be significantly affected, and special safety measures are required

(An exception will be made if the customer consults with CKD prior to use and understands the specifications of the product. However, even in that case, safety measures must be taken to avoid danger in case of a possible failure.)

Never modify or additionally machine this product.

These may cause failure or malfunction. In addition, they are not covered by our warranty.

Do not handle the product or remove pipes and devices until safety is confirmed.

The product may operate in an unexpected way, causing injury to people or damage to facilities.

- Inspect and service the machine and devices only after confirming the safety of the entire system. Also, turn off the energy source (air supply or water supply) and power to the relevant facility. Release compressed air from the system and use extreme care to avoid water or electric leakage.
- Since there may be hot or live parts even after operation has stopped, use extreme care when handling the product or removing pipes and devices.
- When starting or restarting a machine or device that has pneumatic components, make sure that a safety measure (such as a pop-out prevention mechanism) is in place and system safety is secured.

Observe the warnings and cautions on the following pages to prevent accidents.

⚠ CAUTION

Do not use the product for transactions.

Do not use the product for commerce transactions because it does not comply with the Japanese Measurement Act and each country's laws and regulations equivalent to the Japanese Measurement Act.

Do not use the product for precise measurements.

The product is designed as a device for general industrial machinery, so operating the product for precise measurements will not be guaranteed.
In addition, CKD cannot respond to calibration and other requests.

⚠ CAUTION

Use the product in a specified manner.

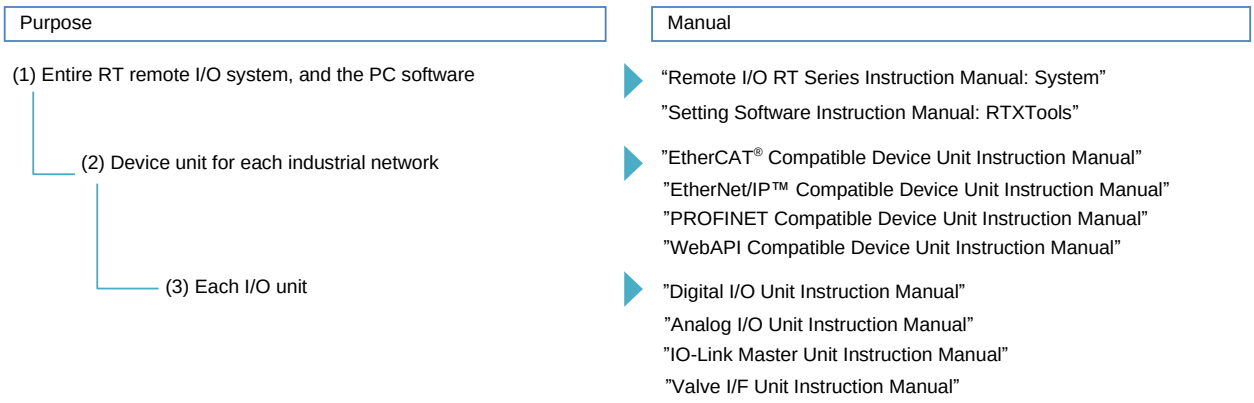
If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CONTENTS

INSTRUCTION MANUAL FOR THIS PRODUCT

The manuals related to the Remote I/O RT Series are separated by purpose as follows.
(1) Entire RT remote I/O system, and the PC software
(2) Device unit for each industrial network
(3) Each I/O unit

"Remote I/O RT Series Instruction Manual: System Construction" is mandatory. Other manuals are not mandatory but must be referred to according to the units used.



List of Related Instruction Manuals

Instruction Manual No.	Instruction Manual name	Description
SM-A46342-A	Remote I/O RT Series Instruction Manual: System Construction	Instruction manual for the entire remote I/O RT Series system Includes explanations of the PC software RTXTools, the power supply unit RT-XP24A01N, and the End unit RT-XEE□N00N.
SM-A90084-A	Setting software Instruction Manual: RTXTools	Instruction manual for RTXTools: setting software
SM-A46343-A	EtherCAT® Compatible Device unit Instruction Manual	Instruction manual for the EtherCAT compatible device unit RT-XTECN00N
SM-A71112-A	EtherNet/IP™ Compatible Device unit Instruction Manual	Instruction manual for the EtherNet/IP compatible device unit RT- XTENN00N
SM-A87934-A	PROFINET Compatible Device unit Instruction Manual	Instruction manual for the PROFINET compatible device unit RT-XTEPN00N
SM-A95119-A	WebAPI Compatible Device unit Instruction Manual	Instruction manual for the WebAPI compatible device unit RT-XTEAN00N
SM-A46344-A	IO-Link Master Unit Instruction Manual	Instruction manual for the IO-Link master unit RT-XLMSA08N
SM-A46345-A	Digital I/O Unit Instruction Manual	Instruction manual for the digital I/O unit RT-X□DG□□□□
SM-A46347-A	Analog I/O Unit Instruction Manual (this manual)	Instruction manual for the analog I/O unit RT-X□AGA0 2N
SM-A46346-A	Valve I/F Unit Instruction Manual	Instruction manual for the valve I/F unit TVG□P-TB-□-KA1□

Always read the instruction manual for each product connected to the remote I/O RT Series.
The product types that can be connected are:
- Upper master units in each industrial network (connected to a device unit)
- IO-Link devices (connected to the IO-Link master unit)
- Manifold solenoid valves (connected to the valve I/F unit)
- Other sensors/actuators (connected to a digital I/O unit, analog I/O unit, or IO-Link master unit)

A video is available to show how to assemble the units, install the software, and how the LEDs blink. If necessary, refer to the video at the following URL

RT product page:
https://www.ckd.co.jp/kiki/en/product/detail/1064

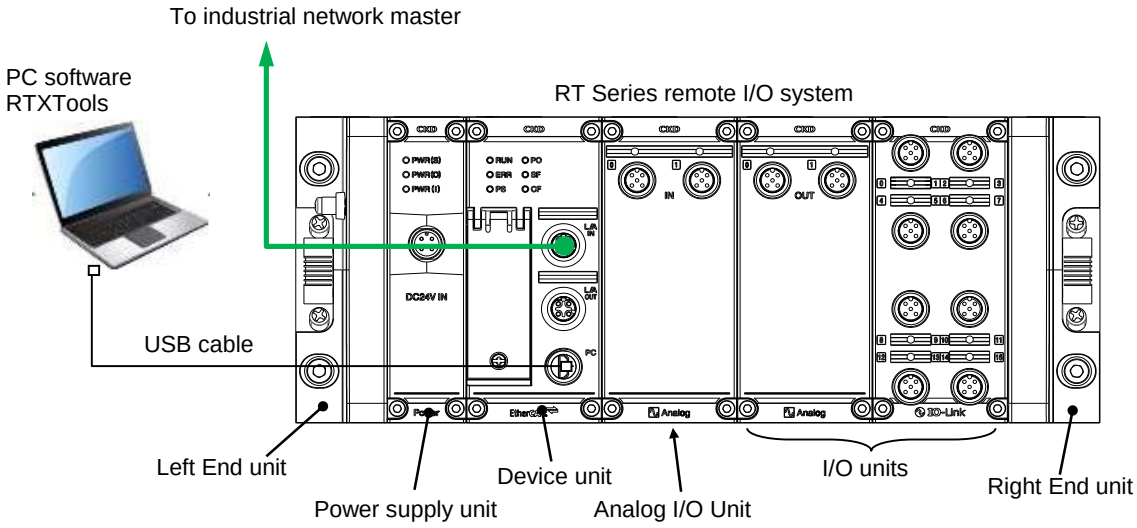
TERMS RELATED TO THE ANALOG I/O UNIT

Term	Definition
Data format	Refers to the format on the A/D conversion to process data for analog inputs, and the format on the D/A conversion from process data for analog outputs.
Byte order function	Function to set a byte order when a device unit transmits or receives analog input or output values of an analog I/O unit in connected I/O units to/from the upper master.
Power line error	Refers to a short circuit, disconnection, or overheating in the analog input or output units' power line (pin 1 line of each connector).

1. PRODUCT OVERVIEW

The RT Series analog I/O unit is an I/O unit that performs analog signal input and output with sensors, actuators, and so on in Remote I/O RT Series systems.

If connecting the PC software (free of charge) to the device unit via USB, it is possible to check the information and status of the entire remote I/O RT Series, and the settings and status of each unit.



1.1 Features

Features include the following:

1.1.1 Analog input unit

- Supports eight types of analog input signals, including 4 mA to 20 mA, and 0 V to 10 V.
- Analog input signals can be converted into various process data formats.
- Whether to supply the external device with the power for analog input signals can be selected.
- The cycle at which analog inputs are sampled can be set in the range of 1 ms to 65535 ms.
- Average value of analog inputs for each specified sampling time can be entered.
- It can output an error for the max/min ranges of analog inputs.
- It can output an error for the user set value upper/lower limit in analog inputs.

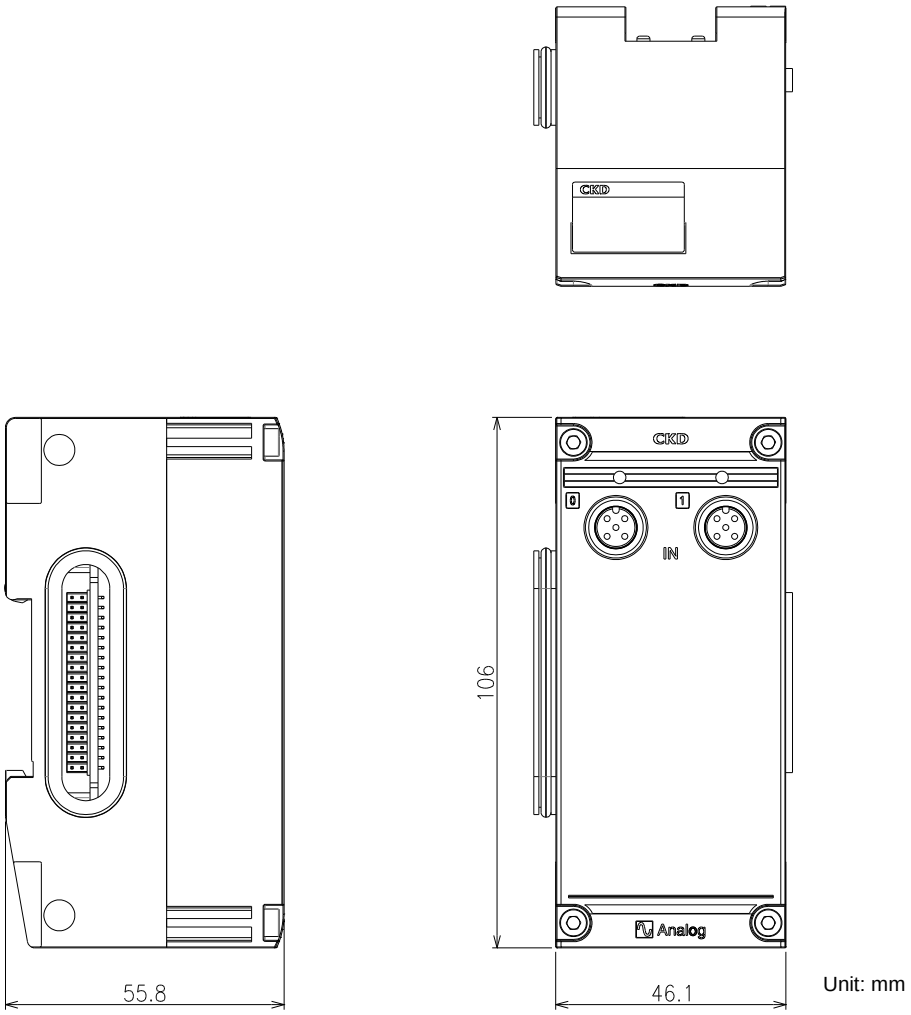
1.1.2 Analog output unit

- Supports five types of analog output signals, including 4 mA to 20 mA, and 0 V to 10 V.
- Various process data formats can be converted into analog output signals.
- Whether to supply the external device with the power for analog output signals can be selected.
- It can output an error for the max/min range of analog outputs.
- It can output an error for the user set value upper/lower limit in analog outputs.

1.2 External Dimensions

1.2.1 Analog input unit

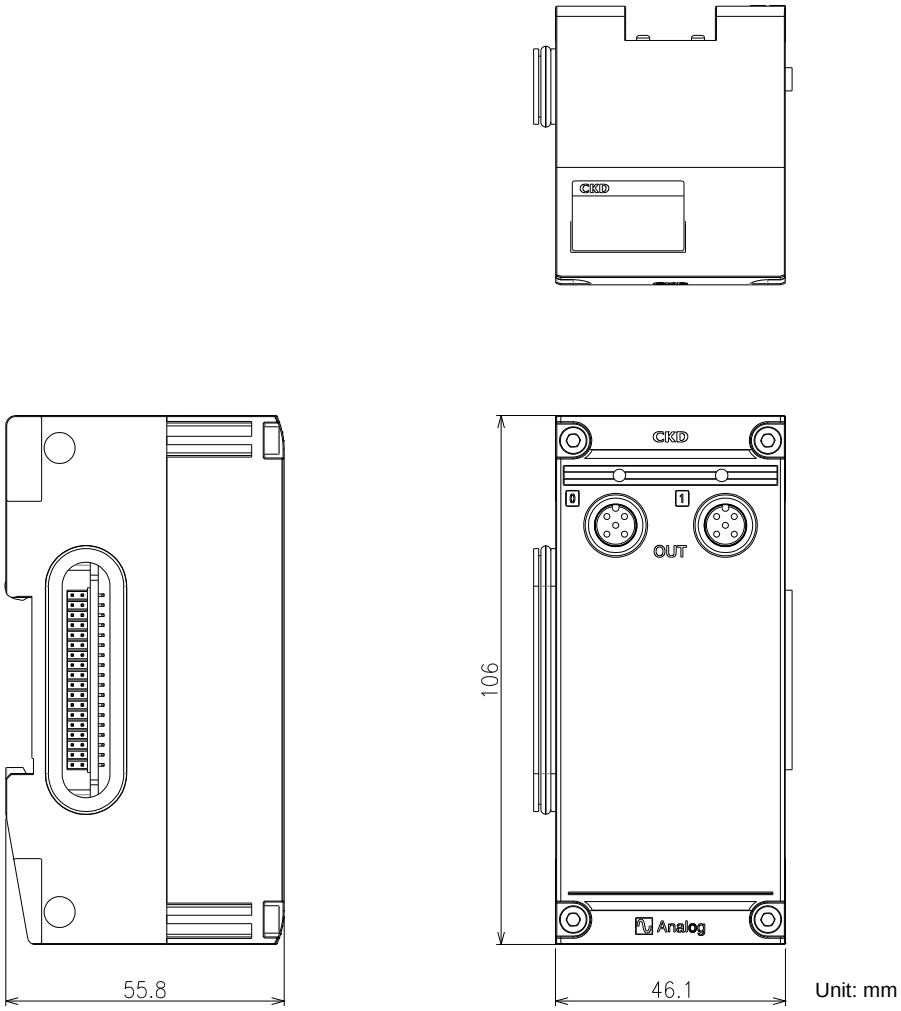
■ M12 connector x 2-CH type



Unit: mm

1.2.2 Analog output unit

■ M12 connector x 2-CH type

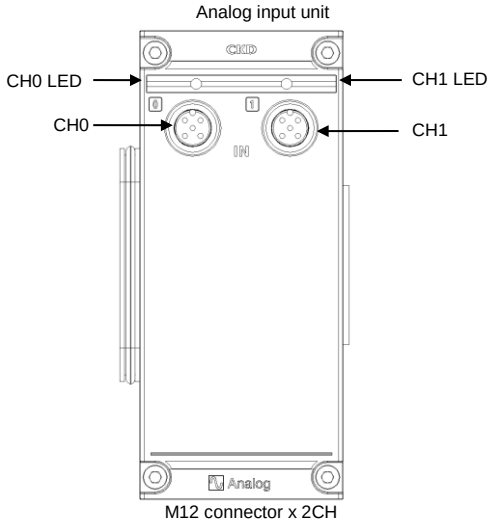


Unit: mm

1.3 Names and Functions of Each Part

1.3.1 Analog input unit

■ M12 connector x 2-CH type



■ LED

Specification list

Unit's number of points	Name	Description
2-CH input	0 to 1	Indicates the status of each CH in analog input.

Status list

Status	Meaning
Red on	Internal bus communication disconnected (Note 1)
Red blinking (fast)	Hardware error (Note 1)
Red blinking (slow)	Power line error detection
Yellow blinking (fast)	Max/min range error triggered
Yellow blinking (slow)	User set value upper/lower limit error triggered
Green blinking (slow)	Input power supply OFF error
Green on	Input power supply is ON
Off	Power OFF or CH disable status

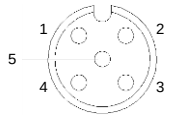
Note 1: It will still be on for the CH set to disable.

Note: All the LEDs will light up green for about 0.5 seconds on startup.

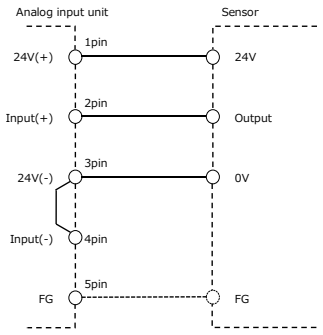
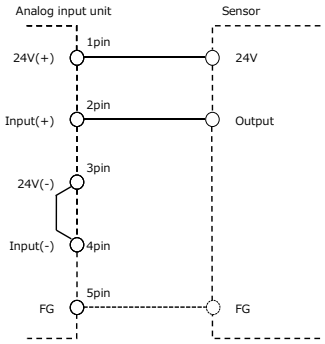
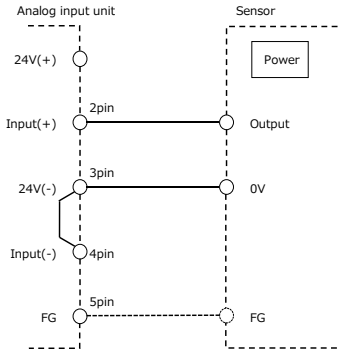
A video is available to show how the LEDs actually blink. If necessary, refer to the video at the following URL

RT product page:
https://www.ckd.co.jp/kiki/en/product/detail/1064

■ Connector

M12(A) 5-pin female	Pin number	Description
	1	Unit/input 24 V (+)
	2	Analog input signal (+)
	3	Unit/input 24 V (-)
	4	Analog input signal (-)
	5	FG (connected to FG of internal bus for improving noise resistance)

■ External wiring

For sensors of which output signal is based on 0 V	For 2-wire sensors	For sensors using the external power supply
		

Note: Whether the input power is supplied from the analog input unit depends on the "input power supply ONOFF setting".

■ Recommended cables

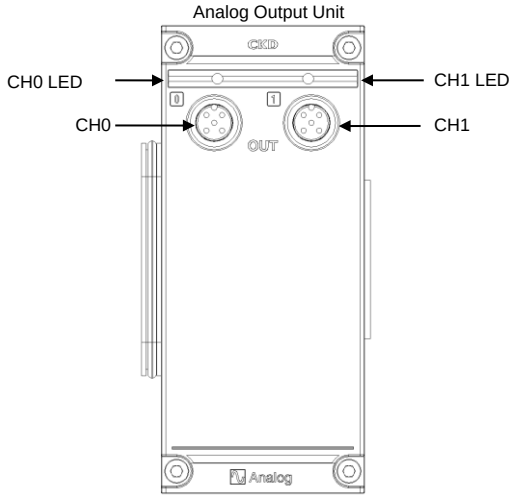
Product name	Specifications	Number of cores	Cable extraction method	Manufacturer	OMRON Corporation model No.
XS2H cable with round waterproof connector at one end (M12 straight to open-end-cable)	M12 plug (male) to open-end-cable, for DC	4 cores	Straight to open-end-cable	OMRON Corporation	XS2H-D421-☐
XS2H cable with round waterproof connector at one end (M12 straight to open-end-cable)	M12 plug (male) to open-end-cable, for DC	5 cores	Straight to open-end-cable	OMRON Corporation	XS2H-D521-☐

■ Waterproof cap

Always put a waterproof cap on unused M12 connectors.
A waterproof cap (RT-CM12) must be used properly to achieve a degree of protection of IP65/IP67.
Purchase RT-CM12 separately.

1.3.2 Analog output unit

■ M12 connector x 2-CH type



M12 connector x 2CH

■ LED

Specification list

Number of CH on a unit	Name	Description
2-CH output	0 to 1	Indicates the status of each CH in analog output.

Status list

Status	Meaning
Red on	Internal bus communication disconnected (Note 1)
Red blinking (fast)	Hardware error (Note 1)
Red blinking (slow)	Power line error detection
Yellow on	Output power supply voltage error
Yellow blinking (fast)	Max/min range error triggered
Yellow blinking (slow)	User set value upper/lower limit error triggered
Green blinking (slow)	Output power supply is OFF
Green on	Output power supply is ON
Off	Power OFF or CH disable status

Note 1: It will still be on for the CH set to disable.

Note: All the LEDs will light up green for about 0.5 seconds on startup.

A video is available to show how the LEDs actually blink. If necessary, refer to the video at the following URL

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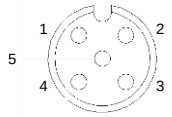
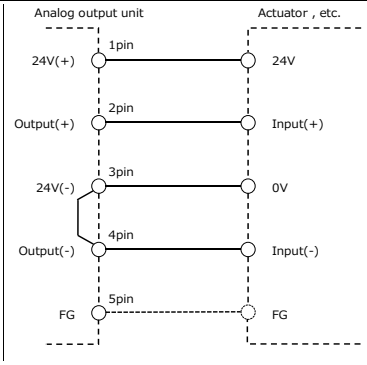
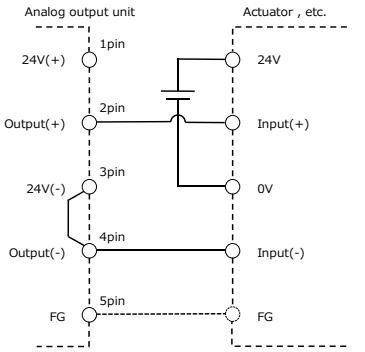
■ Connector

M12(A) 5-pin female	Pin number	Description
	1	Output 24 V (+)
	2	Analog output signal (+)
	3	Output 24 V (-)
	4	Analog output signal (-)
	5	FG (connected to FG of internal bus for improving noise resistance)

■ External wiring

With power supply for output	No power supply for output
If the analog output unit's power supply controls actuators, etc.	If the power supply to actuators, etc. controls actuators, etc.
	

Note: Whether the output power is supplied from the analog output unit depends on the "Output power supply ONOFF setting".

■ Recommended cables

Product name	Specifications	Number of cores	Cable extraction method	Manufacturer	OMRON Corporation model No.
XS2H cable with round waterproof connector at one end (M12 straight to open-end-cable)	M12 plug (male) to open-end-cable, for DC	4 cores	Straight to open-end-cable	OMRON Corporation	XS2H-D421-☐
XS2H cable with round waterproof connector at one end (M12 straight to open-end-cable)	M12 plug (male) to open-end-cable, for DC	5 cores	Straight to open-end-cable	OMRON Corporation	XS2H-D521-☐

■ Waterproof cap

Always put a waterproof cap on unused M12 connectors.
A waterproof cap (RT-CM12) must be used properly to achieve a degree of protection of IP65/IP67.
RT-CM12 is available for purchase separately.

1.4 Unit Specifications

1.4.1 Analog input unit

<table>
<tr><th colspan="2">Item</th><th>Description</th></tr>
<tr><td colspan="2">Type</td><td>Analog input unit</td></tr>
<tr><td colspan="2">Model No.</td><td>RT-AAGA02N</td></tr>
<tr><td rowspan="13">Input specifications</td><td>Number of input CHs</td><td>2-CH</td></tr>
<tr><td>Input type</td><td>Voltage or current</td></tr>
<tr><td>Input range</td><td>For each CH, the following can be set:
-10 VDC to +10 VDC (factory setting), -5 VDC to +5 VDC, 0 VDC to 10 VDC, 0 VDC to 5 VDC, 1 VDC to 5 VDC
-20 mA DC to +20 mA DC, 4 mA DC to 20 mA DC, 0 mA DC to 20 mA DC</td></tr>
<tr><td>Input connector</td><td>M12(A) 5-pin female</td></tr>
<tr><td>CH number per connector</td><td>1-CH</td></tr>
<tr><td>Number of connectors</td><td>2 connectors</td></tr>
<tr><td>Supplied power (Unit/input)</td><td>24 VDC ± 10% 2 A
Note: The "input power supply ONOFF setting" can set the supplied power as 0 V.</td></tr>
<tr><td>Maximum supplied current to sensor</td><td>0.5 A per connector</td></tr>
<tr><td>Protection functions</td><td>
<table>
<tr><th rowspan="2">Protection functions</th><th colspan="2">Power line</th></tr>
<tr><th>Unit/input</th><th>Internal power supply</th></tr>
<tr><td>Short circuit protection and detection</td><td>Yes</td><td>No</td></tr>
<tr><td>Disconnection detection</td><td>Yes</td><td>No</td></tr>
<tr><td>Overcurrent protection</td><td>Yes</td><td>No</td></tr>
<tr><td>Overheating protection and detection</td><td>Yes</td><td>No</td></tr>
<tr><td>Overvoltage protection</td><td>Yes</td><td>No</td></tr>
<tr><td>Low voltage protection (reset function)</td><td>No</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Resolution</td><td>12bit/16bit (depending on data format settings for each CH)</td></tr>
<tr><td>Maximum rated input signal</td><td>Voltage: ± 15 V
Current: ± 40 mA</td></tr>
<tr><td>Input impedance</td><td>Voltage: 100 kΩ
Current: 50 Ω</td></tr>
<tr><td>Absolute accuracy (25°C)</td><td>Voltage: ± 0.5% FS or less
Current: ± 0.6% FS or less</td></tr>
<tr><td>Linearity (25°C)</td><td>± 0.05% FS or less</td></tr>
<tr><td>Repeatability (25°C)</td><td>± 0.15% FS or less</td></tr>
<tr><td>Sampling cycle</td><td>Can be specified between 1 ms and 65535 ms</td></tr>
<tr><td>Minimum sampling period</td><td>1 ms or 2 ms (depending on the CH enable/disable setting)</td></tr>
<tr><td>Disconnection detection current</td><td>0.08 mA / connector</td></tr>
<tr><td colspan="2">LED</td><td>Same as the number of input CH</td></tr>
<tr><td colspan="2">Working temperature range</td><td>-10°C to 55°C</td></tr>
<tr><td colspan="2">Relative humidity</td><td>30% to 85% RH</td></tr>
<tr><td colspan="2">Ambient atmosphere</td><td>No corrosive gases or heavy dust</td></tr>
<tr><td colspan="2">Installation location</td><td>Indoor use</td></tr>
<tr><td colspan="2">Altitude</td><td>Up to 2000 m</td></tr>
<tr><td colspan="2">Pollution degree</td><td>3</td></tr>
<tr><td colspan="2">Degree of protection</td><td>IP65/IP67 (when connected to other units)</td></tr>
<tr><td colspan="2">Current consumption</td><td>Unit/input power supply: 70 mA or less (24 V equivalent)
Output power supply: 5 mA or less (24 V equivalent)</td></tr>
<tr><td colspan="2">Size (W x H x D)</td><td>46.1 x 106 x 55.8 (mm)</td></tr>
</table>

Item	Description
Net weight	Approx. 230 g (including RT-TR-1)
Standard accessories	RT-TR-1 (Two tie rods for I/O unit)

Note 1: IP65/IP67 is not part of the UL certification.

1.4.2 Analog output unit

<table>
<tr><th colspan="2">Item</th><th>Description</th></tr>
<tr><td colspan="2">Type</td><td>Analog output unit</td></tr>
<tr><td colspan="2">Model No.</td><td>RT-BAGA02N</td></tr>
<tr><td rowspan="12">Output specifications</td><td>Number of output CHs</td><td>2-CH</td></tr>
<tr><td>Output type</td><td>Voltage or current</td></tr>
<tr><td>Output range</td><td>For each CH, the following can be set:
-0 VDC to 10 VDC (factory setting), 0 VDC to 5 VDC, 1 VDC to 5 VDC
-4 mA DC to 20 mA DC, 0 mA DC to 20 mA DC</td></tr>
<tr><td>Output connector</td><td>M12(A) 5-pin female</td></tr>
<tr><td>CH number per connector</td><td>1-CH</td></tr>
<tr><td>Number of connectors</td><td>2 connectors</td></tr>
<tr><td>Supplied power (For unit/input)</td><td>24 VDC ± 10% 2 A</td></tr>
<tr><td>Supplied power (For output)</td><td>24 VDC ± 10% 2 A
Note: The "output power supply ONOFF setting" can set the supplied power as 0 V.</td></tr>
<tr><td>Maximum load current</td><td>0.5 A per CH</td></tr>
<tr><td>Protection functions</td><td>
<table>
<tr><th rowspan="2">Protection functions</th><th colspan="2">Power line</th></tr>
<tr><th>For output</th><th>Internal power supply</th></tr>
<tr><td>Short circuit protection and detection</td><td>Yes</td><td>No</td></tr>
<tr><td>Disconnection detection</td><td>Yes</td><td>No</td></tr>
<tr><td>Overcurrent protection</td><td>Yes</td><td>No</td></tr>
<tr><td>Overheating protection and detection</td><td>Yes</td><td>No</td></tr>
<tr><td>Overvoltage protection</td><td>Yes</td><td>No</td></tr>
<tr><td>Low voltage protection (reset function)</td><td>No</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Resolution</td><td>12bit/16bit (depending on data format settings for each CH)</td></tr>
<tr><td>Load impedance</td><td>Voltage: 1 kΩ or less
Current: 600 Ω or less</td></tr>
<tr><td>Absolute accuracy (25°C)</td><td>Voltage: ± 0.5% FS or less
Current: ± 0.6% FS or less</td></tr>
<tr><td>Linearity (25°C)</td><td>± 0.05% FS or less</td></tr>
<tr><td>Repeatability (25°C)</td><td>± 0.15% FS or less</td></tr>
<tr><td>Disconnection detection current</td><td>0.08 mA / connector</td></tr>
<tr><td colspan="2">LED</td><td>Same as the number of output CH</td></tr>
<tr><td colspan="2">Working temperature range</td><td>-10°C to 55°C</td></tr>
<tr><td colspan="2">Relative humidity</td><td>30% to 85% RH</td></tr>
<tr><td colspan="2">Ambient atmosphere</td><td>No corrosive gases or heavy dust</td></tr>
<tr><td colspan="2">Installation location</td><td>Indoor use</td></tr>
<tr><td colspan="2">Altitude</td><td>Up to 2000 m</td></tr>
<tr><td colspan="2">Pollution degree</td><td>3</td></tr>
<tr><td colspan="2">Degree of protection</td><td>IP65/IP67 (when connected to other units)</td></tr>
<tr><td colspan="2">Current consumption</td><td>Unit/input power supply: 25 mA or less (24 V equivalent)
Power for output: 65 mA or less (24 V equivalent)</td></tr>
</table>

Item	Description
Size (W x H x D)	46.1 mm x 106 mm x 55.8 mm
Mass	Approx. 230 g (including RT-TR-1)
Standard accessories	RT-TR-1 (Two tie rods for I/O unit)

Note 1: IP65/IP67 is not part of the UL certification.

2. INSTRUCTIONS FOR USE

2.1 Analog Input Unit

Instructions		Reference
Prior checking	Check the input range and data format.	"3.1 Analog Input Unit's Setting" "7. APPENDIX 1: DETAILS OF THE DATA FORMAT"
↓	↓	-
Hardware installation and wiring	Connect the analog input unit to the remote I/O.	"Remote I/O RT Series Instruction Manual: System Construction"
	↓	-
	Connect the external input devices.	"1.3 Names and Functions of Each Part"
↓	↓	-
Analog input unit's setting	Supply 24 V power to the power supply unit. Note: If there is more than one power supply unit, power them all on within 3 seconds.	"Remote I/O RT Series Instruction Manual: System Construction"
	↓	-
	Connect the PC software to the device unit with a USB cable.	"3.1.3 List of settings" "Remote I/O RT Series Instruction Manual: System Construction"
	↓	
	Configure the CH-each settings of the analog input unit via the PC software (or the industrial network's message communication).	
	↓	
	Transfer the settings to the device unit by clicking the "Set all items" button in the PC software.	
↓	↓	-
Forced input setting	Set the forced input setting using the PC software, and check the changes in the analog input value on the analog input unit.	"Remote I/O RT Series Instruction Manual: System Construction"
↓	↓	-
Checking the input operation	Check the LED on the analog input unit.	"6.1.2 Troubleshooting from the LED display"

2.2 Analog Output Unit

Instructions		Reference
Prior checking	- Check the output range and data format. - Check the setting if the output operation is specified individually by unit in the event of a communication error.	"3.2 Analog Output Unit's Setting" "7. APPENDIX 1: DETAILS OF THE DATA FORMAT"
↓	↓	-
Hardware installation and wiring	Connect the analog output unit to the remote I/O.	"Remote I/O RT Series Instruction Manual: System Construction"
	↓	-
	Connect the external output devices.	"1.3 Names and Functions of Each Part"
↓	↓	-
Analog output unit's setting	Supply 24 V power to the power supply unit. Note: If there is more than one power supply unit, power them all on within 3 seconds.	"Remote I/O RT Series Instruction Manual: System Construction"
	↓	-
	Connect the PC software to the device unit with a USB cable.	"3.2.3 List of settings" "Remote I/O RT Series Instruction Manual: System Construction"
	↓	
	Configure the CH-each settings of the analog output unit via the PC software (or the industrial network's message communication).	
	↓	
	Transfer the settings to the device unit by clicking the "Set all items" button in the PC software.	
↓	↓	-
Forced output setting	Set the forced output setting using the PC software, and check the changes in the analog output value on the analog output unit.	"Remote I/O RT Series Instruction Manual: System Construction"
↓	↓	-
Checking the input/output operation	Check the LED on the analog output unit.	"6.2.2 Troubleshooting from the LED display"

3. SETTINGS

⚠WARNING

Check the settings of each unit before operating the system.
If the units have incorrect settings, they may malfunction. This could result in injury to people or damage to equipment.

3.1 Analog Input Unit's Setting Method

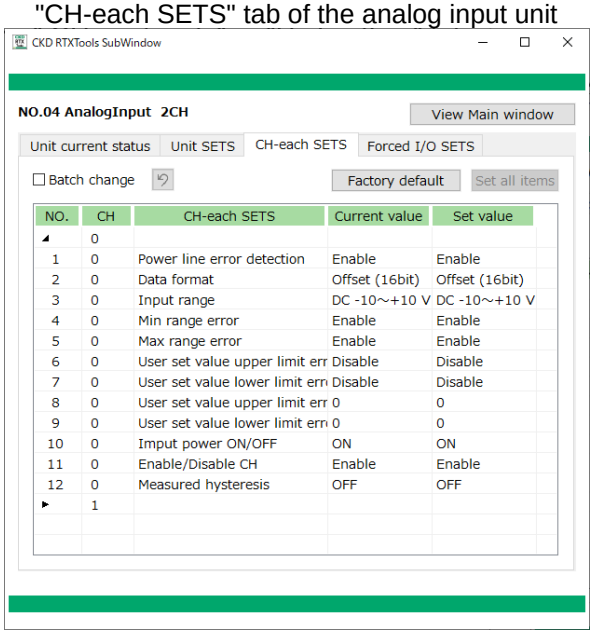
There are two ways to configure the analog input unit's settings: using the PC software and using industrial network communication.

3.1.1 Using PC software

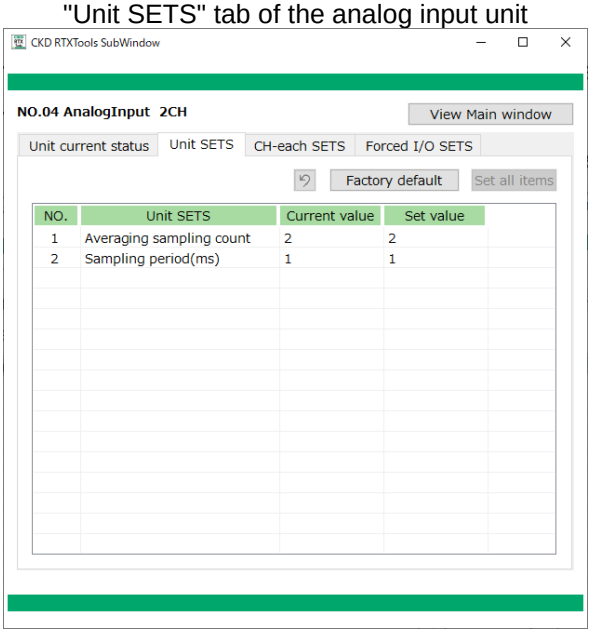
1 Select the analog input unit in the "Unit configuration" main tab and click the "Settings" button.

2 Select the " CH-each SETS" or "Unit SETS" tab.

"CH-each SETS" tab of the analog input unit



"Unit SETS" tab of the analog input unit



3.1.2 Using industrial network communication

Message communication commands from the upper master are used to set up the analog input unit's objects.
E.g.) In the case of EtherCAT, SDO communication commands are used to set up the analog input unit's object dictionary.

3.1.3 List of settings

The following can be set for all CH (per unit).

CH-common setting	Description	Value	Factory setting	Setting required
Averaging sampling count	Sets the average sampling count of the analog input.	0: Twice 1: 4 times 2: 8 times 3: 16 times	0: Twice	-
Sampling period	Sets the sampling period of the analog input.	It can be set from 1 ms to 65535 ms. If the minimum sampling period is 2 ms, the actual period is 2 ms even when 1 is set.	1 ms	-

The following can be set for each CH.

CH-each setting	Description	Value	Factory setting	Setting required
Enable/Disable CH	It's possible to set it so the target CH is not used. When CH is disabled, the behavior of the corresponding CH is as follows: - Input power supply: OFF - Process data: 0x0000	0: Disable 1: Enable	1: Enable	●
Input range	Select the analog input signal of the analog input unit from the list on the right.	0: -10 VDC to +10 VDC 1: -5 VDC to +5 VDC 2: 0 VDC to 10 VDC 3: 0 VDC to 5 VDC 4: 1 VDC to +5 VDC 10: -20 mA DC to +20 mA DC 11: 4 mA DC to 20 mA DC 12: 0 mA DC to 20 mA DC	0: -10 VDC to +10 VDC	●
Data format	Sets how the analog input is converted to process data.	0: Offset 12 (12bit) 1: Offset 16 (16bit) 2: Signed magnitude A (12bit) 3: Signed magnitude B (13bit) 4: Signed magnitude C (13bit) 5: Signed magnitude D (14bit) 6: Signed magnitude E (16bit) 7: Signed two's complement (16bit)	1: Offset 16 (16bit)	●
Input power supply ONOFF	Sets whether to supply the external device with the input power supply during analog input. Is set according to the need for the external device's signal power supply.	0: OFF (not supplied) 1: ON (supplied)	1: ON (supplied)	●
Power line error detection	Enable or disable power line error detection. The error detection is set for each CH. Note: If a device is connected that does not use an input power supply, set the "power line error detection setting" to "Disable".	0: Disable 1: Enable	1: Enable	-
Max range error	Sets whether to use the max range error for the analog input.	0: Disable 1: Enable	1: Enable	
Min range error	Sets whether to use the min range error for the analog input.	0: Disable 1: Enable	1: Enable	-

CH-each setting	Description	Value	Factory setting	Setting required
User set value upper limit error	Sets whether to use the user set value upper limit error in analog inputs.	0: Disable 1: Enable	0: Disable	-
User set value lower limit error	Sets whether to use the user set value lower limit error in analog inputs.	0: Disable 1: Enable	0: Disable	-
User set value upper limit error threshold	Sets the threshold of the user set value upper limit error in analog inputs.	Threshold setting used for the user set value upper limit error detection	0x0000	-
User set value lower limit error threshold	Sets the threshold of the user set value lower limit error in analog inputs.	Threshold setting used for the user set value lower limit error detection	0x0000	-
Measured hysteresis	Sets whether to perform hysteresis processing on the measured values.	0: OFF (Do not perform hysteresis processing) 1: ON (Perform hysteresis processing)	0: OFF (Do not perform hysteresis processing)	-

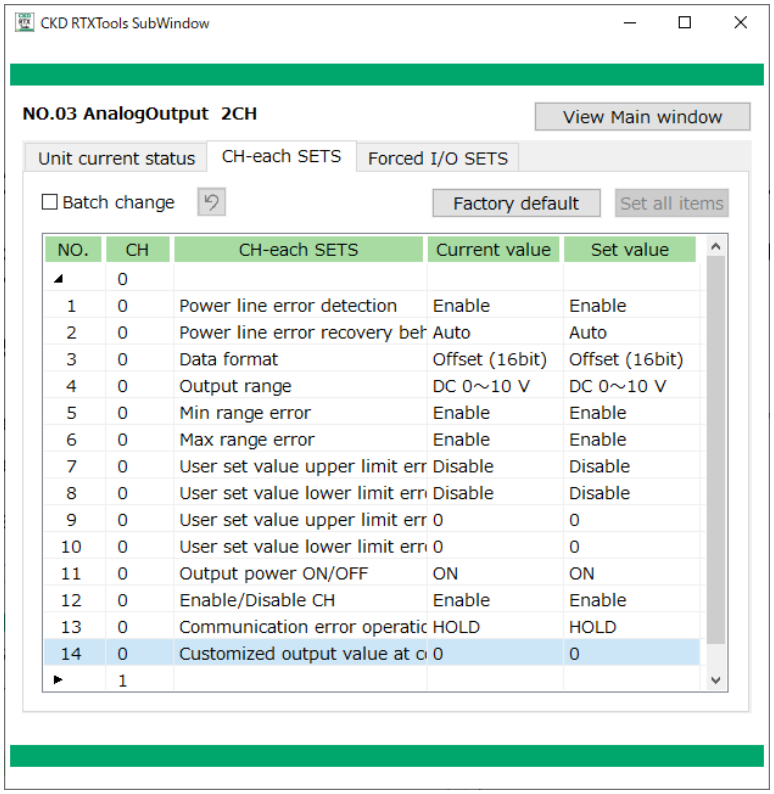
3.2 Analog Output Unit's Setting Method

There are two ways to configure the analog input unit's settings: using the PC software and using industrial network communication.

3.2.1 Using PC software

1. Select the analog input unit in the "Unit configuration" main tab and click the "Settings" button.
2. Select the " CH-each SETS" tab.

"CH-each SETS" tab of the analog output unit



3.2.2 Using industrial network communication

Message communication commands from the upper master are used to set up the analog output unit's objects.
E.g.) In the case of EtherCAT, SDO communication commands are used to set up the analog output unit's object dictionary.

3.2.3 List of settings

The following can be set for each CH.

CH-each setting	Description	Value	Factory setting	Setting required
Communication error operation	If the device unit's DIP switch setting SW3 (output settings in the event of a communication error / priority to hardware) is OFF, the output operation in the event of a communication (upper communication or internal bus communication) error is set on the Analog	0: OFF (output power supply is OFF, analog output is updated) 1: User (user setting) 2: HOLD	2: HOLD	-

CH-each setting	Description	Value	Factory setting	Setting required
	output unit side.			
Customized output value at communication error	Sets the customized output value when the “Communication error operation“ is "User setting".	0x0000 to 0xFFFF	0x0000	Required if the [communication error operation] is "User setting" (●)

The following can be set for each CH.

CH-each setting	Description	Value	Factory setting	Setting required
Enable/Disable CH	It's possible to set it so the target CH is not used as a unit. When CH is disabled, the behavior of the corresponding CH is as follows: - Output power supply: OFF - Process data: The lower limit value of the set range	0: Disable 1: Enable	1: Enable	●
Output range	Select the analog output signal of the analog output unit from the list on the right.	2: 0 VDC to 10 VDC 3: 0 VDC to 5 VDC 4: 1 VDC to +5 VDC 11: 4 mA DC to 20 mA DC 12: 0 mA DC to 20 mA DC	2: 0 VDC to 10 VDC	●
Data format	Sets how the analog output is converted to process data.	0: Offset 12 (12bit) 1: Offset 16 (16bit) 2: Signed magnitude A (12bit) 3: Signed magnitude B (13bit) 4: Signed magnitude C (13bit) 6: Signed magnitude E (16bit) 7: Signed two's complement (16bit)	1: Offset 16 (16bit)	●
Output power supply ONOFF	Sets whether to supply the external device with the output power supply during analog output. Is set according to the need for the external device's signal power supply.	0: OFF (not supplied) 1: ON (supplied)	1: ON (supplied)	●
Power line error detection	Enable or disable power line error detection. The error detection is set for each CH. Note: If a device is connected that does not use the output power supply, set the "power line error detection setting" to "Disable".	0: Disable 1: Enable	1: Enable	-
Power line error recovery operation	Set whether to maintain the behavior as during the power line error when it has been recovered from, or return to normal from the most recent data update after recovery.	0: Auto (Do not maintain the same behavior as during the error) 1: Manual (Maintain the same behavior as during the error)	0: Auto (Do not maintain the same behavior as during the error)	-
Max range error	Sets whether to use the max range error for the analog output.	0: Disable 1: Enable	1: Enable	-
Min range error	Sets whether to use the min range error for the analog output.	0: Disable 1: Enable	1: Enable	-
User set value upper limit error	Sets whether to use the user set value upper limit error in analog outputs.	0: Disable 1: Enable	0: Disable	-
User set value lower limit error	Sets whether to use the user set value lower limit error in analog outputs.	0: Disable 1: Enable	0: Disable	-
User set value upper limit error threshold	Sets the threshold of the user set value upper limit error in analog outputs.	Threshold setting used for the user set value upper limit error detection	0x0000	-
User set value lower limit error threshold	Sets the threshold of the user set value lower limit error in analog outputs.	Threshold setting used for the user set value lower limit error detection(Note 1)	0x0000	-

Note 1: Refer to 7.1.2 Analog output for detail.

4. I/O ASSIGNMENT

4.1 Analog Input Unit

The table below shows the cyclic communication area assigned to the upper master for an analog input unit.

4.1.1 Description of the process data assignment

The I/O assignment size varies depending on the input CH number on a unit. In addition, the format after the A/D conversion varies depending on each CH's data format setting. Refer to "7. APPENDIX 1: DETAILS OF THE DATA FORMAT" for more information.

■ For analog input units with 2-CH input

Data	Description	Size	Module name in the ESI file
Analog input	This is the value that was inputted in an analog way. According to the data format of each CH, the analog input values are converted into digital values.	Fixed at 2 bytes per CH (1 word)	Model No. of each unit

	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CH0	Analog input value for CH0 (the format depends on the settings)															
CH1	Analog input value for CH1 (the format depends on the settings)															

4.1.2 Process data name

In the upper configuration tool, the following is displayed based on the ESI file:

E.g.)

Unit model No. (Module name)	Data size	Data	Data name in the ESI file for EtherCAT	Data type
RT-AAGA02N	4 bytes	Input CH0	Channel 0	WORD
		Input CH1	Channel 1	WORD

4.2 Analog Output Unit

The table below shows the cyclic communication area assigned to the upper master for an analog output unit.

4.2.1 Description of the process data assignment

The I/O assignment size varies depending on the output CH number on a unit. In addition, the format after the D/A conversion varies depending on each CH's data format setting. Refer to "7. APPENDIX 1: DETAILS OF THE DATA FORMAT" for more information.

■ For analog output units with 2-CH output

Data	Description	Size	Module name in the ESI file
Analog output	This is the value that was outputted in an analog way. According to the data format of each CH, the analog output values are converted into digital values.	Fixed at 2 bytes per CH (1 word)	Model No. of each unit

	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CH0	Analog output value for CH0 (the format depends on the settings)															
CH1	Analog output value for CH1 (the format depends on the settings)															

4.2.2 Process data name

In the upper configuration tool, the following is displayed based on the ESI file:

E.g.)

Unit model No. (Module name)	Data size	Data	Data name in the ESI file for EtherCAT	Data type
RT-BAGA02N	4 bytes	Output CH0	Channel 0	WORD
		Output CH1	Channel 1	WORD

5. FUNCTIONS

5.1 Analog Input Unit

5.1.1 Function list

Function	Description	Related settings
Input range switching	Selects the analog input signal of the analog input unit from the following. - -10 VDC to +10 VDC (factory setting) - -5 VDC to +5 VDC - 0 VDC to 10 VDC - 0 VDC to 5 VDC - 1 VDC to 5 VDC - -20 mA DC to +20 mA DC - 4 mA DC to 20 mA DC - 0 mA DC to 20 mA DC	[Input range]
Process data format conversion selection	Selects how the analog input is converted to process data from the following (Note 1). - Offset 12 (12bit) - Offset 16 (16bit) (factory setting) - Signed magnitude A (12bit) - Signed magnitude B (13bit) - Signed magnitude C (13bit) - Signed magnitude D (14bit) - Signed magnitude E (16bit) - Signed two's complement (16bit)	[Data format]
Input power supply ONOFF setting	Sets whether to supply the external device with input power according to the need for the external device's signal power supply.	[Input power supply ONOFF]
Sampling period setting	Sets the sampling period of the analog input. It can be set from 1 ms to 65535 ms (factory setting: 1 ms). If the minimum sampling period is 2 ms, the actual period is 2 ms even when "1" is set. For the minimum sampling period, refer to "5.1.1 Function list ■ Minimum sampling period".	[Sampling period]
Power line error detection	Detects short circuits, disconnections, and overheating in the analog input unit's power line (pin 1 line of each connector). Whether detection is performed depends on the "Power line error detection" setting.	[Power line error detection]
Average filter	Sets the average sampling count for the analog input from the following: 2 (factory setting), 4, 8, 16 times	[Average sampling count]
Forced input setting	Forces the analog input unit's input signal be set to any value (regardless of actual input value) from the PC software.	No
Max/min range error	An error function for the selected max or min range. If the analog input value is +5% of or more than the selected max range, a max range error will be triggered. If the analog input value is -5% of or less than the selected min range, a min range error will be triggered. Hysteresis processing also exists in the error depending on the hysteresis setting function on the measured values.	[Max range error] [Min range error]
User set value upper/lower limit error	An error function for the user set upper or lower limit. It can trigger an error when the set threshold is exceeded. Hysteresis processing also exists in the error depending on the hysteresis setting function on the measured values.	[User set value upper limit error/upper limit error threshold] [User set value lower limit error/lower limit error threshold]
Hysteresis setting on the measured values	Sets whether to have a range of measured values when the device returns from the error status to the non-error status in the max/min range and user set value upper/lower limit errors.	[Measured hysteresis]
CH disable setting	It's possible to set it so the target CH is not used as a unit. No internal power is used with the disable setting.	[Enable/Disable CH]

Function	Description	Related settings
CH diagnostic information for the unit	The diagnostic information for each of the analog input unit's CH. 16 bit per CH, and each bit corresponds to an error type. If an error is detected, the corresponding bit is 1 (ON). The information can be read from the PC software or upper master. The types of errors are as follows: Bit: Error description (genres of device diagnostics) 15: Power line error (unit input) 14: Max range error (unit input) 13: Min range error (unit input) 12: User set value upper limit error (unit input) 11: User set value lower limit error (unit input) 10: Set parameter check (system error) 9: Hardware error (hardware)	No

Note 1: Process data format

Name	Effective bit number	Remarks
Offset 12	12	The entire range is equally divided into 4096 parts to represent the measured value.
Offset 16	16	The entire range is equally divided into 65536 parts to represent the measured value.
Signed magnitude A	12	1bit sign and 11bit magnitude.
Signed magnitude B	13	1bit sign and 12bit magnitude. Right-aligned.
Signed magnitude C	13	1bit sign and 12bit magnitude. Left-aligned.
Signed magnitude D	14	1bit sign and 12bit magnitude. With power line error detection status.
Signed magnitude E	16	1bit sign and 15bit magnitude.
Signed 2's complement	16	1bit sign and 15bit 2's complement format value

Refer to "7. APPENDIX 1: DETAILS OF THE DATA FORMAT" for more information.

■ Minimum sampling period

Depending on the enable/disable status of each CH, the cycle time varies as follows.

CH enable/disable status		Minimum sampling period	
CH0	CH1	CH0	CH1
CH disabled	CH disabled	-	-
CH disabled	CH enabled	-	1 ms
CH enabled	CH disabled	1 ms	-
CH enabled	CH enabled	2 ms	2 ms

Byte order function of the device unit:
Sets which order to use for the byte order for the analog I/O unit's analog input value when the device unit transmits or receives to/from the upper master: Big endian or little endian.
- Big endian: In order starting from high-order to low-order bytes (factory setting)
- Little endian: In order starting from low-order to high-order bytes

5.2 Analog Output Unit

5.2.1 Function list

Function	Description	Related settings
Output range switching	Selects the analog output signal of the analog output unit from the following. - 0 VDC to 10 VDC (factory setting) - 0 VDC to 5 VDC - 1 VDC to 5 VDC - 4 mA DC to 20 mA DC - 0 mA DC to 20 mA DC	[Output range]
Process data format conversion selection	Selects how the analog output is converted to process data from the following (Note1). - Offset 12 (12bit) - Offset 16 (16bit) (factory setting) - Signed magnitude A (12bit) - Signed magnitude B (13bit) - Signed magnitude C (13bit) - Signed magnitude D (14bit) - Signed magnitude E (16bit) - Signed two's complement (16bit)	[Data format]
Output power supply ONOFF setting	Sets whether to supply the external device with output power according to the need for the external device's signal power supply.	[Output power supply ONOFF]
Power line error detection	Detects short circuits, disconnections, and overheating in the analog output unit's power line (pin 1 line of each connector). Whether detection is performed depends on the "Power line error detection" setting.	[Power line error detection])
Power line error recovery operation setting	Specifies whether to maintain the same behavior as during the power line error when it has been recovered from, or return to normal from the most recent data update after recovery. If it maintains the same behavior as during the error, it will wait for the user to turn the power off and on again.	[Power line error recovery operation]
Forced output setting	Forces the analog output unit’s output signal to be set to any value (regardless of actual output value) from the PC software.	No
Max/min range error	An error function for the selected max or min range. If the analog output value is +5% or more than the selected max range, a max range error will be triggered. If the analog output is -5% or less than the selected min range, a min range error will be triggered.	[Max range error] [Min range error]
User set value upper/lower limit error	An error function for the user set upper or lower limit. It can trigger an error when a set threshold is exceeded.	[User set value upper limit error / upper limit error threshold] [User set value lower limit error/ lower limit error threshold]
Communication error operation setting	If the device unit's DIP switch setting SW3 (output settings in the event of a communication error / priority to hardware) is OFF, the output operation in the event of a communication (upper communication or internal bus communication) error is set individually on the Analog output unit side.	[Communication error operation] [Customized output value at communication error]
CH disable setting	It's possible to set it so the target CH is not used as a unit. No internal power is used with the disable setting.	[Enable/Disable CH]
CH diagnostic information for the unit	The diagnostic information for each of the analog output unit's CH. 16 bit per CH, and each bit corresponds to an error type. If there is an error, the corresponding bit is 1 (ON). The information can be read from the PC software or upper master. The types of errors are as follows: Bit: Error description (genres of device diagnostics) 15: Power line error (unit output) 14: Max range error (unit output) 13: Min range error (unit output) 12: User set value upper limit error (unit output) 11: User set value lower limit error (unit output) 10: Set parameter check (system error) 9: Hardware error (hardware) 8: Power line error maintained at power line error recovery (Operation waiting)	No

Note 1: Process data format

Name	Effective number of bits	Remarks
Offset 12	12	The entire range is equally divided into 4096 parts to represent the measured value.
Offset 16	16	The entire range is equally divided into 65536 parts to represent the measured value.
Signed magnitude A	12	1bit sign and 11bit magnitude.
Signed magnitude B	13	1bit sign and 12bit magnitude. Right-aligned.
Signed magnitude C	13	1bit sign and 12bit magnitude. Left-aligned.
Signed magnitude E	16	1bit sign and 15bit magnitude.
Signed two's complement	16	1bit sign and 15bit two's complement format value

Refer to "7. APPENDIX 1: DETAILS OF THE DATA FORMAT" for more information.

Byte order function of the device unit:
Sets which order to use for the byte order for the analog I/O unit's analog output value when the device unit transmits or receives to/from the upper master: Big endian or little endian.
- Big endian: In order starting from high-order to low-order bytes (factory setting)
- Little endian: In order starting from low-order to high-order bytes

6. TROUBLESHOOTING

6.1 Analog Input Unit

6.1.1 Unit errors (CH diagnostic information)

The information can be read from the PC software or upper master.

■ Error codes displayed in the PC software

The CH diagnostic information can be found in the following screen of the PC software as a hexadecimal "error code" with the corresponding bit set to 1 (ON).

- "Code" in the "Error" main tab
- "Error Code" (in the error log)

■ Reading the diagnostic information area with message communication from the upper master

(For EtherCAT) The CH diagnostic information is also stored in the diagnostic information area below in the object dictionary of the EtherCAT device unit. The information can be read CH-by-CH from the upper master via SDO communication.

Index	Sub-Index	Description	Data type	Reading/writing attributes	Value	Initial value
0xAXX1	0	Number of entries	UNSIGNED8	RO	2	2
	1	CH diagnostic information 0	WORD	RO		0x0000
	2	CH diagnostic information 1	WORD	RO		0x0000

Note: "XX" in Index above is the unit position number (0x00 to 0x11).

For analog input units, the following errors can be found:

Bit	Error name	Description	CH-each / CH-common	"Error type" in the device unit's "Remote I/O diagnostic information"
15	Power line error detection	1 (ON): when the "Power line error detection setting" of the analog input unit is "Enable" and the power supply line (pin 1 line of each connector) to the external input device has an error (short circuit, disconnection, or overheating).	CH-each	Unit input error
14	Max range error	1 (ON): when the analog input value exceeds the selected max range.	CH-each	Unit input error
13	Min range error	1 (ON): when the analog input value falls below the selected min range.	CH-each	Unit input error
12	User set value upper limit error	1 (ON): when the analog input value exceeds the user set upper limit value within the range.	CH-each	Unit input error
11	User set value lower limit error	1 (ON): when the analog input value falls below the user set lower limit value within the range.	CH-each	Unit input error
10	Set parameter check	Automatically checks for incorrect data when updating various settings (Note 1). If it is incorrect, the set value will not be updated.	CH-each	System error
9	Hardware error	1 (ON): when the analog input unit is in a hardware error state.	CH-common	Hardware error
8 to 0	Reserved	Fixed at 0.	-	-

Note 1: One of the following cases:

- The threshold of the user set value upper limit error is below the threshold of the user set value lower limit error.
- The threshold of the user set value upper or lower limit error is being set in a format that is not the set data format or is outside the range.

6.1.2 Troubleshooting from the LED display

■ If the LEDs are normal but not behaving as intended

Analog input unit LEDs on each CH	Problem	Cause	Action
Green on or green blinking (slow)	The analog input value is incorrect.	The input range switching setting does not match with the analog input signal.	Change the input range switching setting to the correct input range.
		The data format setting does not match with the system data format.	Change the data format setting to the correct format.
	The analog input value on the upper master is incorrect. The high and low order bytes are reversed.	The byte order of the device unit does not match with the system data format.	Change the byte order setting of the device unit.
Green blinking (slow)	The analog input value is incorrect.	The "Input power supply ONOFF setting" is "OFF (not supplied)" even though the connected external device requires a power supply for the analog signal.	Change the "Input power supply ONOFF setting" to "ON (supplied)".

■ Normal condition

Analog input unit LEDs for each point	Problem
Green on or green blinking (slow)	Input power supply is ON or OFF.
Off	Power OFF or CH disable status.

EtherCAT compatible example	Analog input unit LEDs on each CH	Problem	Cause	Action
CF: Yellow on	Undefined	The analog inputs are not updated.	The output is being forced from the PC software.	Cancel the forced output from the PC software.

■ Error condition

Analog input unit LEDs on each CH	Problem	CH diagnostic information	Cause	Action
Red on	When the PC software is connected to the device unit, the "Unit Configuration" main tab is not displayed, and the "Error" main tab is displayed instead.	-	The analog input unit is disconnected from the internal bus communication. The device unit has failed to automatically recognize the analog input unit at startup (The device unit has a "unit configuration error" (system error)).	- Check the connection between the units. - Check that the number of I/O units connected to the device unit is 17 or less.
	The RT remote I/O's unit configuration cannot be checked from the upper master's configuration tool.			
	The upper master cannot control the analog input unit.		The analog input unit is disconnected from the internal bus communication.	- Check whether there is a process data overflow in the device unit. - If the problem persists, contact CKD.

Analog input unit LEDs on each CH	Problem	CH diagnostic information	Cause	Action
Red blinking (fast)	A hardware error has occurred. At the moment, analog inputs on all CHs are 0x0000 (not updated).	Hardware error (Hardware error)	A hardware error has occurred in the analog input unit.	- Turn the power OFF then ON again. - If the problem persists, contact CKD.
Red blinking (slow)	An error in the analog input unit's input power supply line has been detected. At the moment, analog inputs are 0x0000 (not updated).	Power line error detection (unit input error)	A short circuit, disconnection, or overheating has been detected in the input power supply line of the analog input unit when the "Power line error detection setting" of the analog input unit is "Enable".	Check the input power supply line of the analog input unit.
			If the sensor is using the external power supply, the "Input power supply ONOFF setting" is "ON" (supplied).	Set the " Input power supply ONOFF setting" to "OFF" (not supplied).
Yellow blinking (fast)	The analog input value is updated but remains as the upper or lower limit value.	Max or min range error (Unit input error)	The input signal of the analog input unit has exceeded the selected max or min range.	Check if the analog input value is within the selected max or min range, and then take necessary actions.
Yellow blinking (slow)	The analog input value is updated but exceeds the user set value upper or lower limit.	User set value upper limit error or User set value lower limit error (Unit input error)	The input signal of the analog input unit has exceeded the threshold of the user set value upper or lower limit error.	Check if the analog input value is within the threshold of the upper or lower limit set by the user, and then take necessary actions.
Off	The power of remote I/O is ON and normal, but its CH does not operate.	-	In the "Enable/Disable CH setting", the CH is set as "Disable".	Change the setting of CH to "Enable".

6.2 Analog Output Unit

6.2.1 Unit errors (CH diagnostic information)

The information can be read from the PC software or upper master.

■ Error codes displayed in the PC software

The CH diagnostic information can be found in the following screen of the PC software as a hexadecimal "error code" with the corresponding bit set to 1 (ON).

- "Code" in the "Error" main tab
- "Error Code" (in the error log)

■ Reading of the diagnostic information area by SDO communication from the upper master

(For EtherCAT) The CH diagnostic information is also stored in the diagnostic information area below in the object dictionary of the EtherCAT device unit. The information can be read CH-by-CH from the upper master via SDO communication.

Index	Sub-Index	Description	Data type	Reading/writing attributes	Value	Initial value
0xAXX1	0	Number of entries	UNSIGNED8	RO	2	2
	1	CH diagnostic information 0	WORD	RO		0x0000
	2	CH diagnostic information 1	WORD	RO		0x0000

Note: "XX" in Index above is the unit position number (0x00 to 0x11).

For analog output units, the following errors can be found:

Bit	Error name	Description	CH-each / CH-common	"Error type" in the device unit's "Remote I/O diagnostic information"
15	Power line error detection	1 (ON): when the "Power line error detection setting" of the analog output unit is "Enable" and the power supply line (pin 1 line of each connector) to the external output device has an error (short circuit, disconnection, or overheating).	CH-each	Unit output error
14	Max range error	1 (ON): when the analog output value exceeds the selected max range.	CH-each	Unit output error
13	Min range error	1 (ON): when the analog output value falls below the selected min range.	CH-each	Unit output error
12	User set value upper limit error	1 (ON): when the analog output value exceeds the user set upper limit value within the range.	CH-each	Unit output error
11	User set value lower limit error	1 (ON): when the analog output value falls below the user set lower limit value within the range.	CH-each	Unit output error
10	Set parameter check	Automatically checks for incorrect data when updating various settings (Note 1). If it is incorrect, the set value will not be updated. (Note 2)	CH-each	System error
9	Hardware error	1 (ON): when the analog output unit is in a hardware error state.	CH-common	Hardware error
8	On power line error recovery, same behavior maintained as during error	When the " Power line error recovery operation setting" of the analog output unit is ON (Manual), the forced zero status is maintained even after the power line error resume. The system is waiting for the user to turn the power off and on again.	CH-each	Operation waiting
7 to 0	Reserved	Fixed at 0.	-	-

Note 1: One of the following cases:
- The threshold of the user set value upper limit error is below the threshold of the user set value lower limit error.
- The threshold of the user set value upper or lower limit error is being set in a format that is not the set data format or is outside the range.
- If “Communication error operation“ is "user setting", the “Customized output value at communication error” is being set in a format that is not the set format or is outside the range (“Communication error operation“ is automatically OFF at this time).

Note 2: The function becomes OFF when changing “Communication error operation“. :

6.2.2 Troubleshooting from the LED display

■ If the LEDs are normal but not behaving as intended

Analog output unit LEDs on each CH	Problem	Cause	Action
Green on or green blinking (slow)	The analog output value is incorrect.	The output range switching setting does not match with the analog output signal of the system.	Change the output range switching setting to the correct output range.
		The data format setting does not match with the system data format.	Change the data format setting to the correct format.
	The analog output value on the upper master is incorrect. The high and low order bytes are reversed.	The byte order of the device unit does not match with the system data format.	Change the byte order setting of the device unit.
Green blinking (slow)	The analog output value is incorrect.	The "Output power supply ONOFF setting" is "OFF (not supplied)" even though the connected external device requires a power supply for the analog signal.	Change the "Output power supply ONOFF setting" to "ON (supplied)".

■ Normal condition

Analog output unit LEDs on each CH	Problem
Green on or green blinking (slow)	Output power supply is ON or OFF
Off	Power is OFF, or output is OFF.

Device unit EtherCAT compatible example	Analog output unit LEDs on each CH	Problem	Cause	Action
ERR: Red blinking (twice)	Undefined	A communication error (application watchdog timeout) occurred in the device unit. At the moment, analog outputs are 0x0000.	The DIP switch setting SW3 on the device unit is OFF, and the "Communication error operation setting" on the analog output unit is "0" (the output power supply is OFF and the analog output is updated).	If wanting the analog output to be something other than 0x0000, set the "Communication error operation setting" of the analog output unit to "1" (user setting) or "2" (HOLD). When setting it to "1" (user set), set the "Customized output value at communication error".
		A communication error (application watchdog timeout) occurred in the device unit. At the moment, the analog output depends on the "Communication error operation setting".	The DIP switch setting SW3 of the device unit is ON (output settings in the event of a communication error/ priority to hardware), and the SW4 is OFF (Clear).	Review the settings of the DIP switches and the analog output unit of the device unit related to the functions for setting the communication error output. To hold the analog output value and if other I/O units are in the same condition, set the device unit DIP switch setting SW4 to ON (Hold).

Device unit EtherCAT compatible example	Analog output unit LEDs on each CH	Problem	Cause	Action
SF: Red blinking (fast)	Undefined	An internal bus error has occurred in the device unit. At the moment, the analog output depends on the "Communication error operation setting".	The DIP switch setting SW3 on the device unit is OFF, and the "Communication error operation setting" on the analog output unit is "0" (the output power supply is OFF and the analog output is updated).	If wanting the analog output to be something other than 0x0000, set the "Communication error operation setting" of the analog output unit to "1" (user setting) or "2" (HOLD). When setting it to "1" (user setting), set the " Customized output value at communication error ".
CF: Yellow on		The analog output value is not updated.	The output is being forced from the PC software.	Cancel the forced output from the PC software.

■ Error condition

Analog output unit LEDs on each CH	Problem	CH diagnostic information	Cause	Action
Red on	When the PC software is connected to the device unit, the "Unit Configuration" main tab is not displayed, and the "Error" main tab is displayed instead.	-	The analog output unit is disconnected from the internal bus communication. The device unit has failed to automatically recognize the analog output unit at startup (The device unit has a "unit configuration error" (system error)).	Check the connection between the units. - Check that the number of I/O units connected to the device unit is 17 or less.
	The RT remote I/O's unit configuration cannot be checked from the upper master's configuration tool.			
	The upper master cannot control the analog output unit.		The analog output unit is disconnected from the internal bus communication.	Check whether there is a process data overflow in the device unit. If the problem persists, contact CKD.
Red blinking (fast)	A hardware error has occurred. At the moment, the output power supplies for all the CHs are OFF (the analog output value is updated).	Hardware error (Hardware error)	A hardware error has occurred in the analog output unit.	Turn the power OFF then ON again. If the problem persists, contact CKD.
Red blinking (slow)	An error in the analog output unit's output power line has been detected. At the moment, the output power supply is OFF (the analog output value is updated).	Power line error detection (unit output error)	A short circuit, disconnection, or overheating has been detected in the output power line of the analog output unit when the "Power line error detection setting" of the analog output unit is "Enable".	Check the output power line of the analog output unit.
	An error in the analog output unit's output power line has been detected. At the moment, the output power supply is ON (the analog output value is updated).		When a device without an output power supply like an actuator is connected, the "Output power supply ONOFF setting" is "ON" (supplied).	Set the "Output power supply ONOFF setting" to "OFF" (not supplied).

Analog output unit LEDs on each CH	Problem	CH diagnostic information	Cause	Action
-	An error in the analog output unit's CH output power line has been recovered from. However, the output power supply is OFF (the analog output is updated).	On manual output	When the "Power line error recovery operation setting" of the analog output unit is 1 (Manual), the behavior in the event of an error is maintained even after the power line error resume. Or this occurs when operating manually by detecting disconnection.	Turn the power OFF then ON again.
Yellow on	An error in the output power supply voltage has been detected.	Output power supply voltage error Note: Not included in the CH diagnostic information for the analog output unit.	This occurs if the device unit detects an "output power supply voltage error".	Check the output power supply voltage to the power supply unit closest to the device unit.
Yellow blinking (fast)	The analog output value is not updated.	Max or min range error (Unit output error)	The output signal of the analog output unit has exceeded the selected max or min range. Note: This occurs when the value which goes beyond a limit has been set.	Check if the analog output value is within the selected max or min range, and then take necessary actions.
Yellow blinking (slow)	The analog output value is not updated.	User set value upper limit error or User set value lower limit error (Unit output error)	The output signal of the analog output unit has exceeded the threshold of the user set value upper or lower limit. Note: This occurs when the value which goes beyond a limit has been set.	Check if the analog output value is within the threshold of the upper or lower limit set by the user, and then take necessary actions.
Off	The power of remote I/O is ON and normal, but its CH does not operate.	-	In the "Enable/Disable CH setting", the CH is set as "Disable".	Change the setting of CH to "Enable".

7. APPENDIX 1: DETAILS OF THE DATA FORMAT

This section shows the details of the following data format:
- Bit configuration for each data format during the A/D conversion of analog input or D/A conversion of analog output.
- The value after the A/D conversion or before the D/A conversion for each data format.

7.1 Bit Configuration for Each Data Format

The bit configuration for each data format on analog input and output is as follows:

7.1.1 Analog input

■ Offset 12 (12bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	MSB	After A/D conversion										LSB

■ Offset 16 (16bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	MSB	After A/D conversion														LSB

■ Signed magnitude A (12bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	Sign	MSB	After A/D conversion									LSB

■ Signed magnitude B (13bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign	0	0	0	MSB	After A/D conversion										LSB

■ Signed magnitude C (13bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign	MSB	After A/D conversion										LSB	0	0	0

■ Signed magnitude D (14bit) (analog input only)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign	MSB	After A/D conversion										LSB	0	D (Note 1)	0

Note 1: D means power line error detection status. 0: No error, 1: With error

■ Signed magnitude E (16bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign	MSB	After A/D conversion													LSB

■ Signed two's complement (16bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign	MSB	After A/D conversion (two's complement)													LSB

7.1.2 Analog output

■ Offset 12 (12bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	MSB	Before D/A conversion										LSB

■ Offset 16 (16bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	MSB	Before D/A conversion														LSB

■ Signed magnitude A (12bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	Sign (Note 1)	MSB	Before D/A conversion									LSB

■ Signed magnitude B (16bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign (Note 1)	0	0	0	MSB	Before D/A conversion										LSB

■ Signed magnitude C (16bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign (Note 1)	MSB	Before D/A conversion										LSB	0	0	0

■ Signed magnitude E (16bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign (Note 1)	MSB	Before D/A conversion													LSB

■ Signed two's complement (16bit)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Sign (Note 1)	MSB	Before D/A conversion (two's complement)													LSB

Note 1: The sign bit is ignored, considered as "0", and converted to analog signals.

7.2 Analog Value / Process Data Conversion Table

Values after the A/D conversion or before the D/A conversion (or bit values if signed) are shown below for each data format when the analog values are 100%, 75%, 50%, 25%, or 0%. The gaps between values are interpolated linearly.

If the input or output value exceeds the max range, the value indicates when it is 100%. If the input or output value falls below the min range, the value indicates when it is 0%.

Format	Offset 12			Offset 16		
Analog value	Sign bit	After the A/D conversion or before the D/A conversion		Sign bit	After the A/D conversion or before the D/A conversion	
		Hexadecimal	Decimal			
100%	No	0xFFF	4095	No	0xFFFF	65535
75%		0xC00	3072		0xC000	49152
50%		0x800	2048		0x8000	32768
25%		0x400	1024		0x4000	16384
0%		0x000	0		0x0000	0

Format	Signed magnitude A			Signed magnitude B			Signed magnitude C		
Analog value	Sign bit	After the A/D conversion or before the D/A conversion		Sign bit	After the A/D conversion or before the D/A conversion		Sign bit	After the A/D conversion or before the D/A conversion	
		Hexadecimal	Decimal		Hexadecimal	Decimal		Hexadecimal	Decimal
100%	0	0x7FF	2047	0	0x7FF	2047	0	0xFFF	4095
75%	0	0x400	1024	0	0x400	1024	0	0x800	2048
50%	0	0x000	0	0	0x000	0	0	0x000	0
25%	1	0x400	1024	1	0x400	1024	1	0x800	2048
0%	1	0x7FF	2047	1	0x7FF	2047	1	0xFFF	4095

Format	Signed magnitude D (Note 1)			Signed magnitude E			Signed two's complement (Note 2)		
Analog value	Sign bit	After A/D conversion		Sign bit	After the A/D conversion or before the D/A conversion		Sign bit	After the A/D conversion or before the D/A conversion	
		Hexadecimal	Decimal		Hexadecimal	Decimal		Hexadecimal	Decimal
100%	0	0xFFF	4095	0	0x7FFF	32767	0	0x7FFF	32767
75%	0	0x800	2048	0	0x4000	16384	0	0x4000	16384
50%	0	0x000	0	0	0x0000	0	0	0x0000	0
25%	1	0x800	2048	1	0x4000	16384	1	0x4000	49152 (-16384)
0%	1	0xFFF	4095	1	0x7FFF	32767	1	0x0000	32768 (-32768)

Note 1: Analog input only

Note 2: The values in the parentheses are for two's complement.

8. APPENDIX 2: LIST OF INPUT/OUTPUT OPERATIONS IN THE EVENT OF AN ERROR IN THIS PRODUCT

This section lists the operation of the analog I/O unit in the event of an error and in the event of an error recovery.

8.1 Communication Error

■ On occurrence

Upper communication error

<table>
<tr><th colspan="4">Device unit</th><th colspan="2">Operations performed by analog I/O unit</th></tr>
<tr><th colspan="2">DIP switch setting SW3 (output settings in the event of a communication error / priority to hardware)</th><th colspan="2">DIP switch setting SW4 (HOLD/CLEAR)</th><th>Analog input unit</th><th>Analog output unit</th></tr>
<tr><td rowspan="2">ON</td><td rowspan="2">Set for all units at once</td><td>ON</td><td>Hold all outputs (HOLD)</td><td rowspan="3">(There are no special behaviors.)</td><td>Holds the last output value.</td></tr>
<tr><td>OFF</td><td>Clear all outputs (CLEAR)</td><td>Turns OFF the output power supply.
(The analog output is updated.)</td></tr>
<tr><td>OFF</td><td>Set individually for each unit</td><td colspan="2">-</td><td>Depends on the "Communication error operation setting" of the analog output unit (user setting / OFF / HOLD specification).
- User setting: Outputs the ”Customized output value at communication error”.
- OFF: Turns OFF the output power supply. (The analog output is updated.)
- HOLD: Holds the last output value.</td></tr>
</table>

Internal bus communication error

<table>
<tr><th colspan="4">Device unit</th><th colspan="2">Operations performed by analog I/O unit</th></tr>
<tr><th colspan="2">DIP switch setting SW3 (output settings in the event of a communication error / priority to hardware)</th><th colspan="2">DIP switch setting SW4 (HOLD/CLEAR)</th><th>Analog input unit</th><th>Analog output unit</th></tr>
<tr><td rowspan="2">ON</td><td rowspan="2">Set for all units at once</td><td>ON</td><td>Hold all outputs (HOLD)</td><td rowspan="3">Uses the last input value as it is.</td><td>Holds the output power supply.
(The analog output is updated.)</td></tr>
<tr><td>OFF</td><td>Clear all outputs (CLEAR)</td><td>Turns OFF the output power supply.
(The analog output is updated.)</td></tr>
<tr><td>OFF</td><td>Set individually for each unit</td><td colspan="2">-</td><td>Depends on the "Communication error operation setting" of the analog output unit (user setting / OFF / HOLD specification).
- User setting: Outputs the “Customized output value at communication error”.
- OFF: Turns OFF the output power supply. (The analog output is updated.)
- HOLD: Holds the last output value.</td></tr>
</table>

■ On recovery

Upper communication error

Device unit				Operations performed by analog I/O unit	
DIP switch setting SW3 (output settings in the event of a communication error / priority to hardware)		DIP switch setting SW4 (HOLD/CLEAR)		Analog input unit	Analog output unit
ON	Set for all units at once	ON	Hold all outputs (HOLD)	Recovers automatically.	Recovers automatically.
		OFF	Clear all outputs (CLEAR)		
OFF	Set individually for each unit	-			

Internal bus communication error

Device unit				Operations performed by analog I/O unit	
DIP switch setting SW3 (output settings in the event of a communication error / priority to hardware)		DIP switch setting SW4 (HOLD/CLEAR)		Analog input unit	Analog output unit
ON	Set for all units at once	ON	Hold all outputs (HOLD)	Does not recover.	Does not recover.
		OFF	Clear all outputs (CLEAR)		
OFF	Set individually for each unit	-			

8.2 Power Line Error

8.2.1 Analog input unit

■ On occurrence

Analog input unit's setting Power line error detection setting	Operations performed by analog input unit
Enable	Inputs the minimum (absolute) value of the operating range format.
Disable	

■ On recovery

Analog input unit's setting Power line error detection setting	Operations performed by analog input unit
Enable	Recovers automatically. However, if it is disconnected, (because of detection at startup) it does not recover automatically.
Disable	

8.2.2 Analog output unit

■ On occurrence

Analog input unit's setting Power line error detection setting	Operations performed by analog input unit
Enable	Turns OFF the output power supply. Signals are output according to the process data.
Disable	

■ On recovery

Analog input unit's setting Power line error detection setting	Operations performed by analog input unit
Enable	Depends on the "Power line error recovery operation setting" (Auto/Manual specification).
Disable	

8.3 Memory Error

■ On occurrence

Operations performed by analog I/O unit	
Analog input unit	Analog output unit
Inputs the minimum (absolute) value of the operating range format.	Turns OFF the output power supply. (The analog output is updated.)

■ On recovery

Operations performed by analog I/O unit	
Analog input unit	Analog output unit
Recovers automatically.	Depends on the "Power line error recovery operation setting" (Auto/Manual specification).

9. WARRANTY PROVISIONS

9.1 Warranty Conditions

■ Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified below, CKD will promptly provide a replacement for the faulty product or a part thereof or repair the faulty product at one of CKD's facilities free of charge.
However, when the following items apply, they are excluded from the scope of this warranty.

- Failure caused by handling or use of the product under conditions and in environments not conforming to those stated in the catalog, the Specifications, or the Instruction Manual.
- Failure caused by use of the product exceeding its durability (cycles, distance, time, etc.) or caused by consumable parts. (Note1)
- Failure caused by incorrect use such as careless handling or improper management.
- Failure not caused by the product.
- Failure caused by use not intended for the product
- Failure caused by modifications/alterations or repairs not carried out by CKD
- Failure that could have been avoided if the customer's machinery or device, into which the product is incorporated, had functions and structures generally provided in the industry
- Failure caused by reasons unforeseen at the level of technology available at the time of delivery
- Failure caused by acts of nature and disasters beyond control of CKD.

Note 1: For details on the durability and consumable parts, contact your nearest CKD sales office.

The warranty stated herein covers only the delivered product itself. Any loss or damage induced by failure of the delivered product is excluded from this warranty.

■ Confirmation of product compatibility

It is the responsibility of the customer to confirm compatibility of the product with any system, machinery, or device used by the customer.

■ Others

The terms and conditions of this warranty stipulate basic matters.
When the terms and conditions of the warranty described in individual specification drawings or the Specifications are different from those of this warranty, the specification drawings or the Specifications shall have a higher priority.

9.2 Warranty Period

The product specified herein is warranted for one (1) year from the date of delivery to the location specified by the customer.