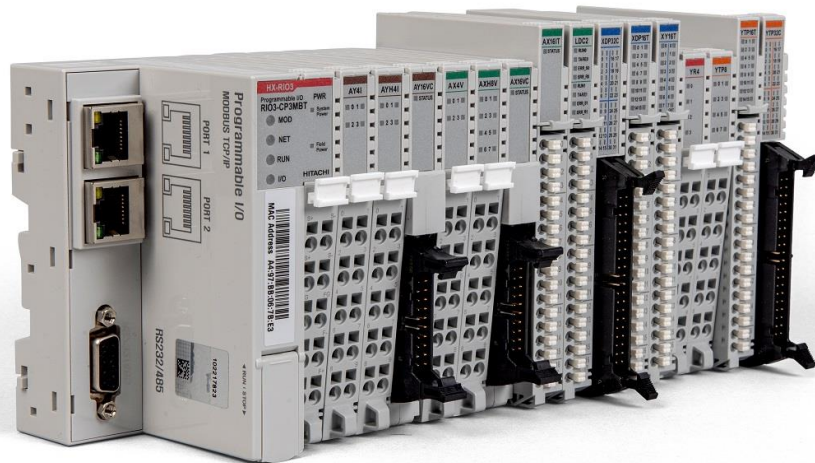


Special I/O Module

RIO3-CU24 User Manual



Version 1.01

DOCUMENT REVISION				
REV	PAGE	REMARKS	DATE	EDITOR
1.00	New Document		Aug 2021	Faber
1.01	6 14	Add Encoder 1x Data Size Specification Specification updated	Feb 2025	Lankala

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1 Important Notes

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid-State Controls describes some important differences between solid state equipment and hard-wired electromechanical devices.

Because of this difference, and because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will HITACHI be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any installation, HITACHI cannot assume responsibility or liability for actual use based on the examples and diagrams.

Warning!

- ✓ **If you don't follow the directions, it could cause a personal injury, damage to the equipment or explosion**
- ✓ Do not assemble the products and wire with power applied to the system. Else it may cause an electric arc, which can result into unexpected and potentially dangerous action by field devices. Arching is explosion risk in hazardous locations. Be sure that the area is non-hazardous or remove system power appropriately before assembling or wiring the modules.
- ✓ Do not touch any terminal blocks or IO modules when system is running. Else it may cause the unit to an electric shock or malfunction.
- ✓ Keep away from the strange metallic materials not related to the unit and wiring works should be controlled by the electric expert engineer. Else it may cause the unit to a fire, electric shock or malfunction.

Caution!

- ✓ **If you disobey the instructions, there may be possibility of personal injury, damage to equipment or explosion. Please follow below Instructions.**
- ✓ Check the rated voltage and terminal array before wiring. Avoid the circumstances over 50°C of temperature. Avoid placing it directly in the sunlight.
- ✓ Avoid the place under circumstances over 85% of humidity.
- ✓ Do not place Modules near by the inflammable material. Else it may cause a fire.
- ✓ Do not permit any vibration approaching it directly.
- ✓ Go through module specification carefully, ensure inputs, output connections are made with the specifications. Use standard cables for wiring.
- ✓ Use Product under pollution degree 2 environment.

1.1 Safety Instruction

1.1.1 Symbols

<p>DANGER</p> 	<p>Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death property damage, or economic loss.</p>
<p>IMPORTANT</p>	<p>Identifies information that is critical for successful application and understanding of the product.</p>
<p>ATTENTION</p> 	<p>Identifies information about practices or circumstances that can lead to personal injury, property damage, or economic loss.</p> <p>Attentions help you to identity a hazard, avoid a hazard, and recognize the consequences</p>

1.1.2 Safety Notes

<p>DANGER</p> 	<p>The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, GBUS Pin.</p>
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1.1.3 Certification

UL Listed Industrial Control Equipment, certified for U.S.

See UL File E196687

CE Certificate

EN 61000-6-2; Industrial Immunity

EN 61000-6-4; Industrial Emissions

Reach, RoHS (EU, CHINA), EAC

2 RIO3-CU24

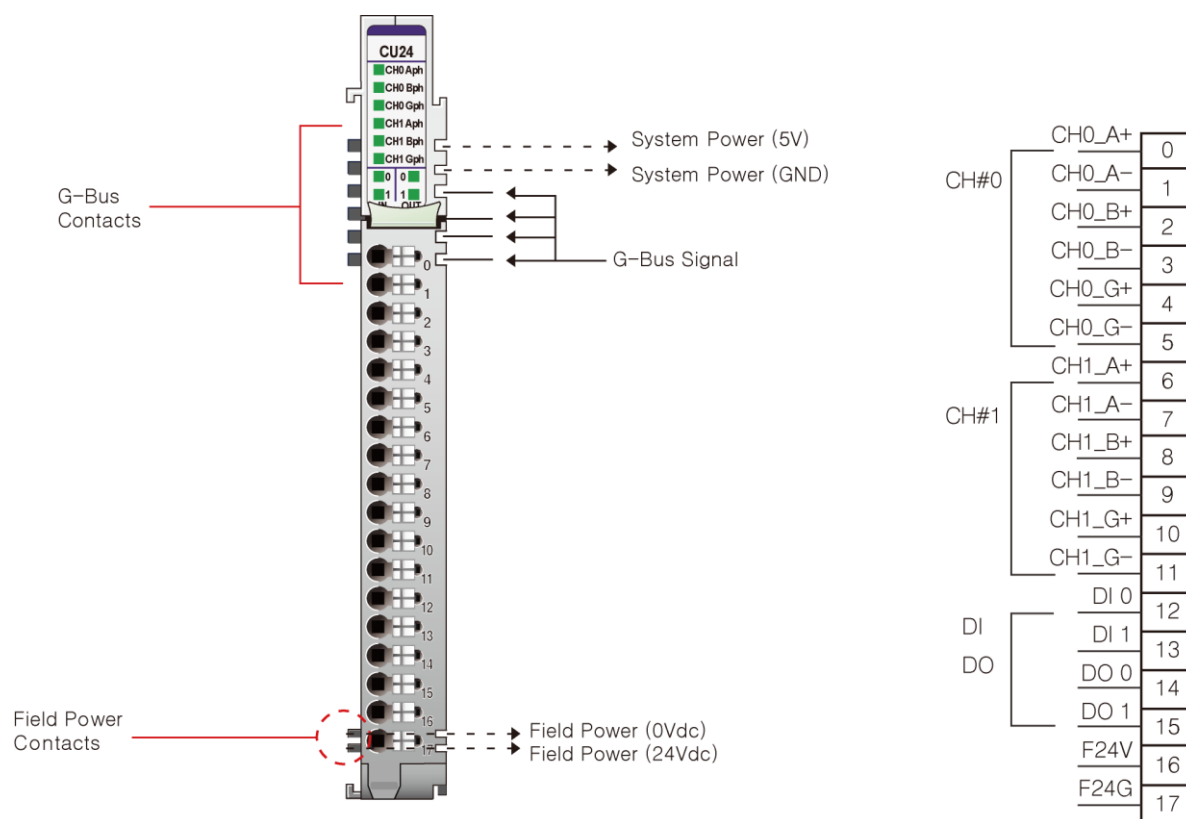
2.1 Specification

Items		Specification
Input specification		
Number of channels		2 channels - Encoder, High Speed Counter, Frequency measurement Pulse width & Period measurement
Indicators		6 green terminal input
Input voltage		5~24Vdc nominal (Max 28.8Vdc)
Input current		4mA @ 5Vdc 11mA @ 24Vdc
Min on-state voltage		≥4.8Vdc
Input frequency	Counter Mode	0~500kHz
	Encoder Mode	0~350kHz @Encoder 1x 0~750kHz @Encoder 2x, Encoder 4x
Counting mode	Counter Mode	1-Input Mode : Up,Down, Frequency Measurement, Pulse Width & Period measurement 2-Input Mode : Up/Inhibit, Up/Reset, Down/Inhibit, Down/Reset, UP/Down,Clock/Direction
	Encoder Mode	2-Input Mode : Encoder 1x, Encoder 2x, Encoder 4x
Gate Function Mode		Store/Continue Store/Wait/Resume Store-Reset/Wait/Start Store-Reset/Start
Counter size	Encoder 1x	31bit-wide/channel
	Others (Mode)	32bit-wide/channel
Digital Input Specification		
Input per module		2-point sink type
Indicators		2 green terminal input LEDs
Input On-state Voltage		24Vdc nominal 15Vdc~28.8Vdc
On-stat Current		2.3mA @ 24Vdc 2.7mA @ 28.8Vdc
Input Signal Delay		OFF to ON : Max. 0.3ms ON to OFF : Max. 0.3ms
Nominal Input Impedance		11.7kΩ
Digital Output Specification		
Output per module		2-point source type
Indicators		2 green terminal output LEDs
Output Voltage Range		24Vdc nominal 15Vdc ~ 28.8Vdc
On-state Voltage Drop		Max 0.5Vdc @25°C

On-state Min. Current	1mA per channel
Off-state Leakage Current	Max. 20uA
Output Signal Delay	OFF to ON : Max. 0.3ms ON to OFF : Max. 0.3ms
Output Current Rating	Max. 0.3A / Channel
Protection	Reverse voltage protection Short circuit protection
General specification	
Power dissipation	Max. 120mA @ 5Vdc
Isolation	I/O to Logic : photocoupler isolation
UL field power	Supply Voltage : 24Vdc nominal, Class 2
Field power	Supply voltage : 24Vdc nominal Voltage range : 15~28.8Vdc Power dissipation : 15mA@24Vdc
Wiring	I/O Cable Max. 0.75mm ² (AWG 18)
Weight	63g
Module size	12mm x 109mm x 70mm
Environment condition	Refer to '3. Environment Specification'

*Encoder x1 Mode Input frequency : ~350kHz

2.2 Wiring Diagram



Pin No.	Signal Description	Signal Description	Pin No.
0	Aph Input+ Ch# 0	/Aph Input - Ch# 0	1
2	Bph Input+ Ch# 0	/Bph Input - Ch# 0	3
4	Gph Input+ Ch# 0	/Gph Input - Ch# 0	5
6	Aph Input+ Ch# 1	/Aph Input - Ch# 1	7
8	Bph Input+ Ch# 1	/Bph Input - Ch# 1	9
10	Gph Input+ Ch# 1	/Gph Input - Ch# 1	11
12	Input Channel 0	Input Channel 1	13
14	Output Channel 0	Output Channel 1	15
16	Field Power 24V	Common(Field Power 0V)	17

2.3 LED Indicator

2.3.1 LED Indicator



LED No.	LED Function / Description	LED Color
0	Aph Input Ch# 0	Green
1	Bph Input Ch# 0	Green
2	Gph Input Ch# 0	Green
3	Aph Input Ch# 1	Green
4	Bph Input Ch# 1	Green
5	Gph Input Ch# 1	Green
6	Input Channel 0	Green
7	Input Channel 1	Green
8	Output Channel 0	Green
9	Output Channel 1	Green

2.3.2 Channel Status LED

Status	LED is	To indicate
No Signal	Off	Normal Operation
On Signal	Green	Normal Operation

2.4 IO Input Image Data – 10byte

Bit No	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Current Counter Value CH#0 LL when IDS = 0 Store Counter Value CH#0 LL when IDS = 1							
Byte 1	Current Counter Value CH#0 LH when IDS = 0 Store Counter Value CH#0 LH when IDS = 1							
Byte 2	Current Counter Value CH#0 HL when IDS = 0 Store Counter Value CH#0 HL when IDS = 1							
Byte 3	Current Counter Value CH#0 HH when IDS = 0 Store Counter Value CH#0 HH when IDS = 1							
Byte 4	Current Counter Value CH#1 LL when IDS = 0 Store Counter Value CH#1 LL when IDS = 1							
Byte 5	Current Counter Value CH#1 LH when IDS = 0 Store Counter Value CH#1 LH when IDS = 1							
Byte 6	Current Counter Value CH#1 HL when IDS = 0 Store Counter Value CH#1 HL when IDS = 1							
Byte 7	Current Counter Value CH#1 HH when IDS = 0 Store Counter Value CH#1 HH when IDS = 1							
Byte 8		SGIN CH#0	SBIN CH#0	SAIN CH#0	SDN CH#0	SUP CH#0	Out Status CH#0	Inp Status CH#0
Byte 9		SGIN CH#1	SBIN CH#1	SAIN CH#1	SDN CH#1	SUP CH#1	Out Status CH#1	Inp Status CH#1

- Each channel has 4-byte Input
- Counter value represents counter, frequency(Hz), pulse width (0.1usec) or pulse period (0.1usec). (When IDS = 0)
- IDS : Input Data Selection (Setting by Output Data)

- Status Bit

The Status High can only read.

SUP : Status Counter Up

SDN : Status Counter Down

SAIN : Status A Terminal Input

SBIN : Status B Terminal Input

SGIN : Status G Terminal Input

*In Encoder x1/x2/x4 Mode, SUP/SDN bit does not operate.

2.5 IO Output Image Data – 12byte

Bit No	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Gate Function Ch#0				Count Mode Ch#0			
Byte 1	Gate Function Ch#1				Count Mode Ch#1			
Byte 2	-	-	HRST 0	CR 0	CS 0	HP 0*	DO 0	IDS 0
Byte 3	-	-	HRST 1	CR 1	CS 1	HP 1	DO 1	IDS 1
Byte 4	Preset Value CH#0 LL **							
Byte 5	Preset Value CH#0 LH							
Byte 6	Preset Value CH#0 HL							
Byte 7	Preset Value CH#0 HH							
Byte 8	Preset Value CH#1 LL							
Byte 9	Preset Value CH#1 LH							
Byte 10	Preset Value CH#1 HL							
Byte 11	Preset Value CH#1 HH							

- Count Mode Ch#0, 1 : Count Mode for Ch#0, Ch#1 respectively
- HRST 0, 1 : current counter value, stored counter value Reset for Ch#0, Ch#1
- CR 0,1 : Counter Reset for Ch#0, Ch#1
- CS 0,1 : Counter Stop (Inhibit Input) for Ch#0, Ch#1
- HP 0,1 : Homing Position Enable/Disable, when this function is enabled, the counter value set to preset value when a signal is detected on input channel
- DO 0, 1 : General purpose Digital Output
- IDS : Input Data Selection (0 : Current counter value, 1 : Store counter value)

*When the HP Bit 1 → 0, counter reset is implemented.

If you want to use the HP Function(Homing Position), always keep it at 1.

**If the presetvalue exceeds the data size (in Encoder 1x mode), it operates with the value from which the HP function was previously performed.

■ Gate Mode Ch#0, Ch#1

Value	Description
B' 0000 (0x0)	Gate Function Disabled
B' 0001 (0x1)	Store/Continue
B' 0010 (0x2)	Store/Wait/Resume-
B' 0011 (0x3)	Store-Reset/Wait/Start-
B' 0100 (0x4)	Store-Reset/Start
Others	Gate Function Disabled

■ Count Mode Ch#0, Ch#1

Value	Count Mode	Description
B' 0000 (0x0)	Up	Up Counter - Aph Input acts as Up Clock - Bph Input is not used
B' 0001 (0x1)	Down	Down Counter - Aph Input acts as Down Clock - Bph Input is not used
B' 0010 (0x2)	-	-
B' 0011 (0x3)	-	-
B' 0100 (0x4)	Up Clock & Inhibit	Up Counter with Inhibit - Aph Input acts as Up Clock Input - Bph Input acts as Inhibit function for Up Clock Input
B' 0101 (0x5)	Up Clock & Reset	Up Counter with Reset - Aph Input acts as Up Clock Input - Bph Input acts as Reset function to Counter
B' 0110 (0x6)	Down Clock & Inhibit	Down Counter with Inhibit - Aph Input acts as Down Clock Input - Bph Input acts as Inhibit function for Down Clock Input
B' 0111 (0x7)	Down Clock & Reset	Down Counter with Reset - Aph Input acts as Down Clock Input - Bph Input acts as Reset function to Counter
B' 1000 (0x8)	Up Clock & Down Clock	Up & Down Counter - Aph Input acts as Up Clock Input - Bph Input acts as Down Clock Input
B' 1001 (0x9)	Clock & Direction	Up & Down with Direction - Aph Input acts as Clock Input - Bph Input acts as Direction Input (Low = Up Count, High = Down Count)
B' 1010 (0xA)	Encoder 1x (*)	Encoder 1x - Aph Input acts as Encoder's A phase Input - Bph Input acts as Encoder's B phase Input
B' 1011 (0xB)	Encoder 2x	Encoder 2x - Aph Input acts as Encoder's A phase Input - Bph Input acts as Encoder's B phase Input
B' 1100 (0xC)	Encoder 4x	Encoder 4x - Aph Input acts as Encoder's A phase Input - Bph Input acts as Encoder's B phase Input
B' 1101 (0xD)	Frequency Measurement 1sec Update	Simple Frequency Measurement, updated by 1sec, Hz Unit - Aph Input acts as Frequency Input - Bph Input is not used
B' 1110 (0xE)	Pulse Width Measurement (**)	Simple Pulse Width Measurement, 0.1usec Unit - Pulse Width(32bit), if 1234, then Pulse High(On) width is 123.4usec (*3) - Aph Input acts as Pulse Input - Bph Input is not used
B' 1111 (0xF)	Pulse Width & Period Measurement (***)	Simple Pulse Width & Period Measurement, 0.1usec Unit, - Available in case of Pulse Input $\geq 200\text{Hz}$ ($\leq 2.5\text{msec}$, Pulse On Width) - Pulse Width(16bit, Low Word) + Pulse Period(16bit, High Word) (*4) - Aph Input acts as Pulse Input - Bph Input is not used

* Frequency range of the Encoder x1 mode is different from Encoder x2/x4 mode frequency range.
(Encoder 1x : ~350kHz / Encoder 2x/4x : ~750kHz)

** Pulse Width, B' 1110(0xE) measures Aph Input's High(On) Pulse Width(32bit) in 0.1usec unit.

*** Pulse Width & Period, B' 1111(0xF) measures Aph's Pulse High(On) Width(16bit) & Period(16bit) in 0.1usec unit.

2.6 Configuration Parameter Data – 4byte

Bit No	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Reserved							
Byte 1	Reserved							
Byte 2	Reserved							
Byte 3	Reserved							

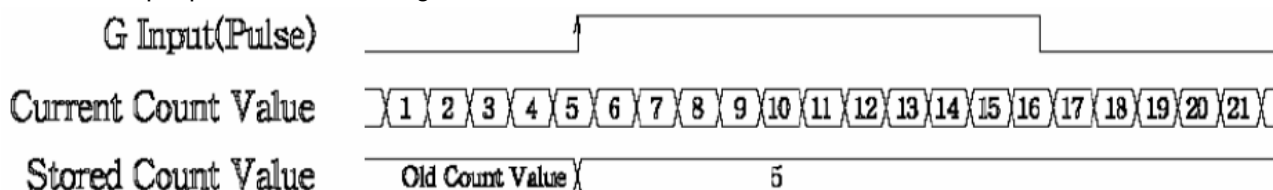
■ Gate Mode (Gate Function)

This Gate Function will operate in one of five modes (Store/Continue, Store/Wait/Resume, Store-Reset/Wait/ and Store-Reset/Start).

* Store/Continue

When G ph are raising edge, The Stored Count Value register will get counting value by Current Count Value register. Next Current Count Value will do counting continue.

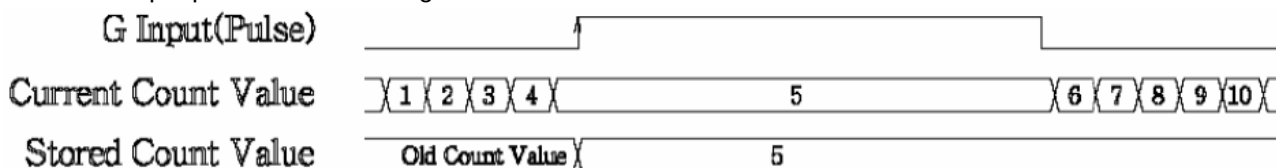
Below example picture shows timing waveforms of Store/Continue.



* Store/Wait/Resume

When G Ph are rising edge, The Stored Count Value register will get counting value by Current Count Value register and waits the Current Count Value until falling edge. Next G Ph will be falling edge and Current Count Value register resume counting.

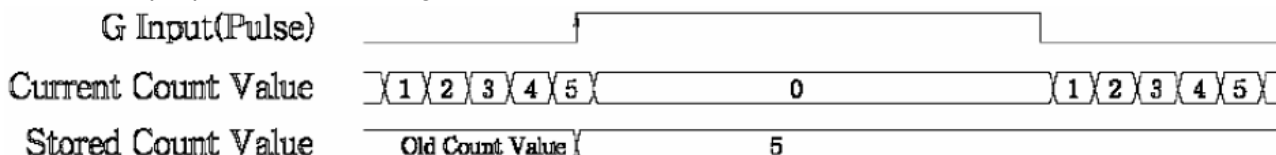
Below example picture shows timing waveforms of Store/Wait/Resume.



* Store-Reset/Wait/Start

When G Ph are rising edge, The Stored Count Value register will get counting value by Current Count Value register and Current Count Value register reset at the same time. The Current Count Value register wait until G Ph falling edge. Next Current Count Value register start counting.

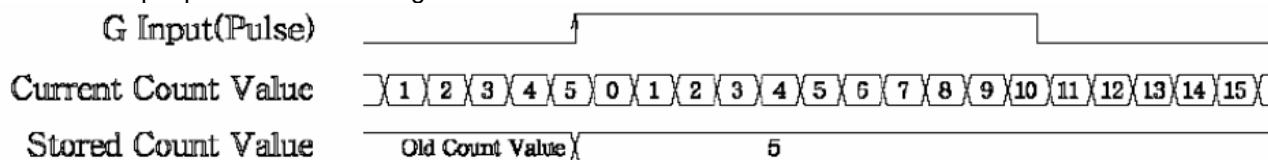
Below example picture shows timing waveforms of Store-Reset/Wait/Start.



* Store-Reset/Start

When G Ph are rising edge, The Stored Count Value register will get counting value by Current Count Value register and Current Count Value register reset at the same time and the register start counting.

Below example picture shows timing waveforms of Store-Reset/Start.

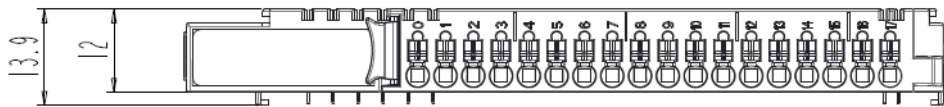
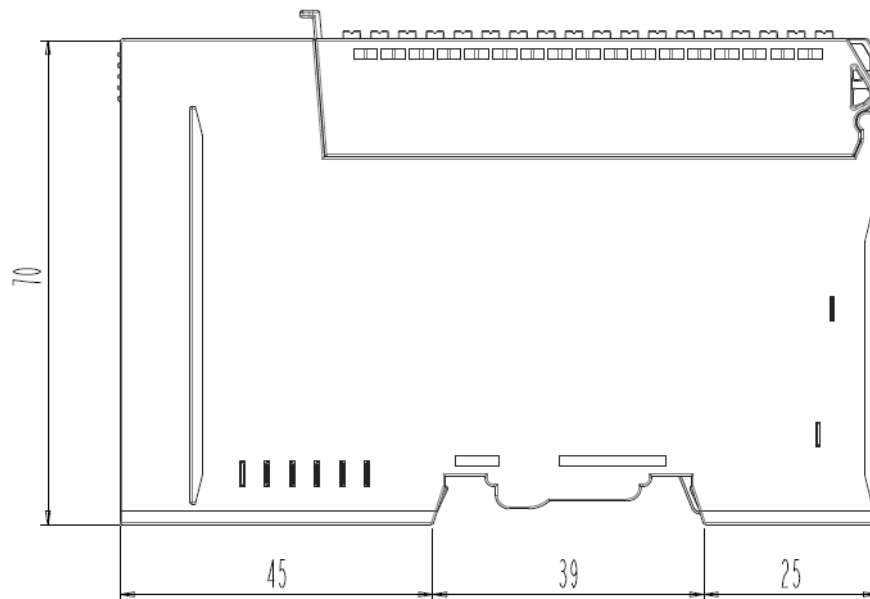
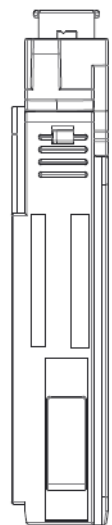


3 Environment Specification

Environmental specification	
Operating Temperature	-40°C ~ 60°C
UL Temperature	-20°C ~ 60°C
Storage Temperature	-40°C ~ 85°C
Relative Humidity	5% ~ 90% non-condensing
Mounting	DIN rail
General specification	
Shock Operating	IEC 60068-2-27: 2008/15g, 11ms
Vibration Resistance	Based on IEC 60068-2-6, 4g
Industrial Emissions	EN61000-6-4/A11: 2011
Industrial Immunity	EN61000-6-2: 2005
Installation Position	Vertical and horizontal installation is possible
Product Certifications	CE, UL, UKCA

4 Dimension

4.1 18-Pts. Spring Type



Dimensions in mm

5 Mounting

Caution!

Hot surface!

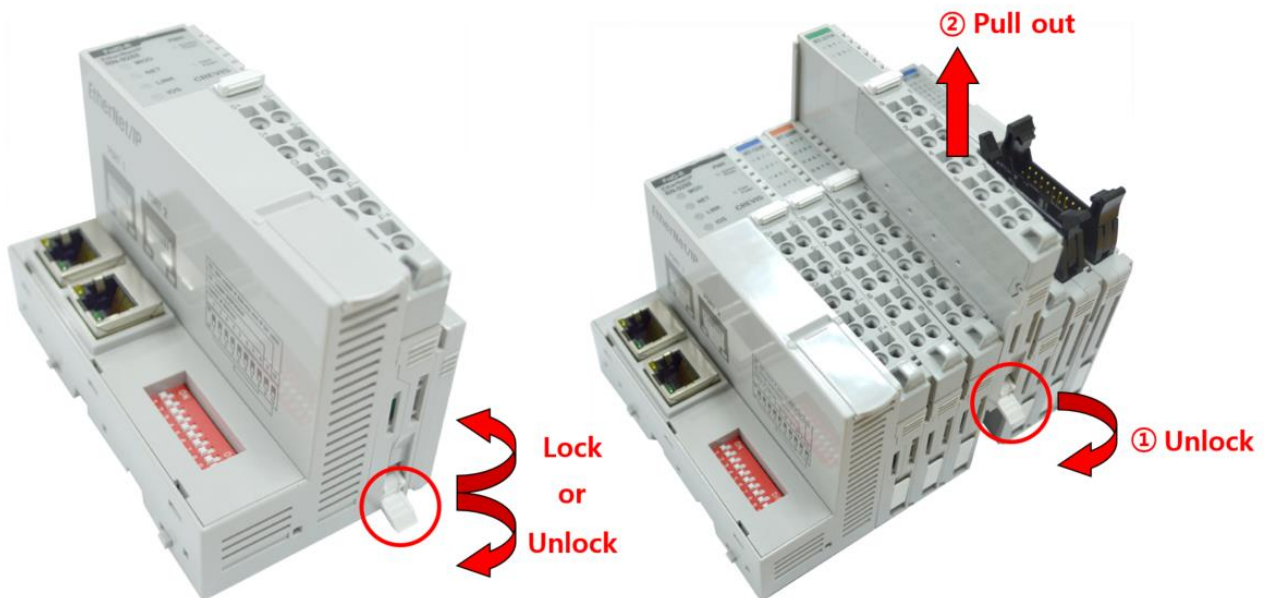
The surface of the housing can become hot during operation. If the device was operated at high ambient temperatures, allow it to cool off before touching it.

Notice!

Perform work on devices only if they are de-energized!

Working on energized devices can damage them. Therefore, turn off the power supply before working on the devices.

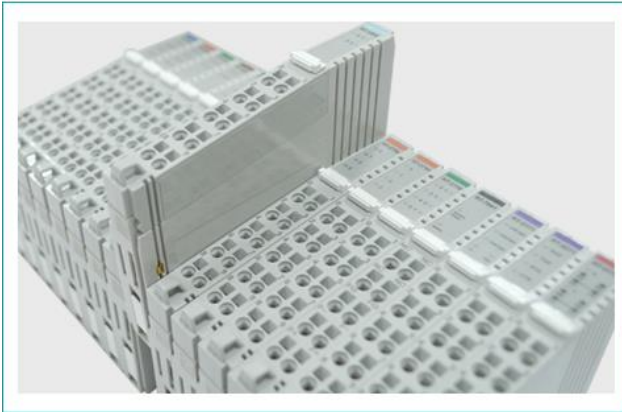
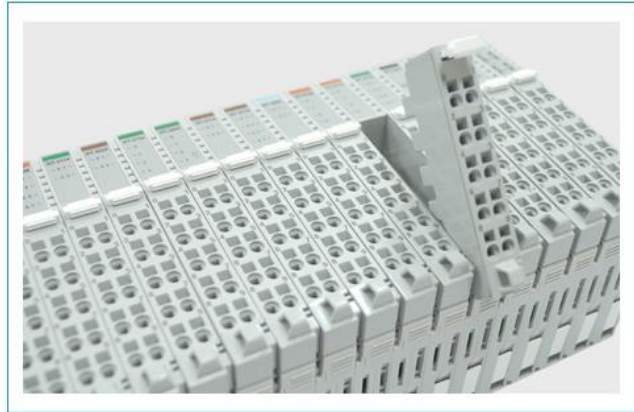
5.1 I/O Inserting and Removing Devices



As above figure in order to safeguard the RIO3-Module from jamming, it should be fixed onto the DIN rail with locking lever. To do so, fold on the upper of the locking lever.

To pull out the RIO3-Module, unfold the locking lever as below figure.

5.2 RTB (Removable Terminal Block)



Whole terminal block can be combined and removed for the convenience of its maintenance.
There is a locking switch on the RTB for the easy combination and easy removal.
Easy combination and easy removal for IO modules on the din rail through One Touch Locking Switch.

6 G-Bus Pin Description

Communication between the Network Adapter and the expansion module as well as system / field power supply of the bus modules is carried out via the internal bus. It is comprised of 6 data pin and 2 field power pin.



*Please refer to the table below regarding the pin description from P1 to P8.

No.	Description
P1	Field Power (VCC)
P2	Field Power (GND)
P3	GBUS CLK
P4	GBUS MISO
P5	GBUS MOSI
P6	GBUS Token
P7	System Power (GND)
P8	System Power (VCC)

DANGER



Do not touch data and field power pins in order to avoid soiling and damage by ESD noise.

APPENDIX A

A.1. Product List

Please refer the separate HX-RIO3 product list document

A.2. Glossary

System Power: The power for starting up CPU.

Field Power: The power for input and output line.

Terminator Resistor: Resistor for prevention reflected wave.

EDS: Electronic Data Sheet.

Sink: The method of in/output power supply if a device has no power source.

Source: The method of in/output power supply if a device has the power source.