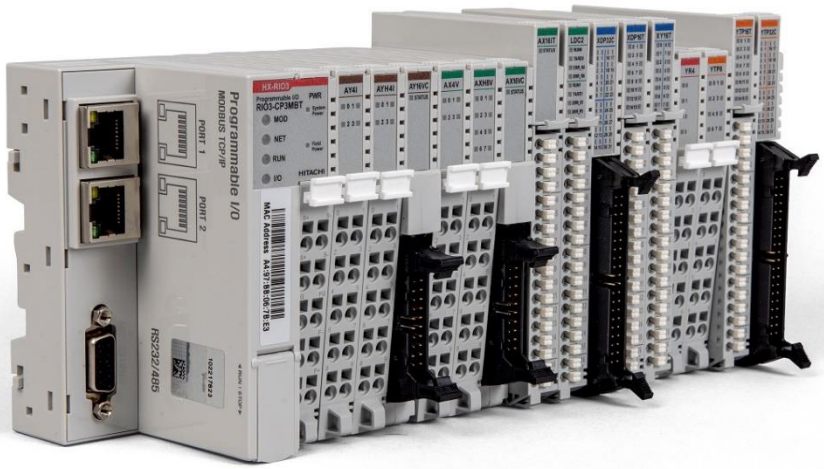
# Analog Input Module (RTD, TC)

## RIO3-RTD / RIO3-TC
## User Manual

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| DOCUMENT REVISION | | | | |
|---|---|---|---|---|
| **REV** | **PAGE** | **REMARKS** | **DATE** | **EDITOR** |
| 1.01 | | New Document | Nov 2020 | (OPR), (PF) |
| 1.01 | 34 | Remove product list table and add a reference | Aug 2021 | Faber |
| 1.02 | 12,19,27<br>10,16 | SW Filter add<br>Senor Type PT1000 350 ~850 add, Conversion time is revised. | Feb 2025 | Lankala |
| | 24 | TXK Type added, specification update | | |
| | | | | |
| | | | | |

# Table of Contents

# 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℃ 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

| | |
|---|---|
| DANGER  | 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 |
| IMPORTANT | Identifies information that is critical for successful application and understanding of the product. |
| ATTENTION  | Identifies information about practices or circumstances that can lead to personal injury, property damage, or economic loss.<br>Attentions help you to identity a hazard, avoid a hazard, and recognize the Consequences. |

### 1.1.2 Safety Notes

| | |
|---|---|
| DANGER  | 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, G-BUS Pin. |

### 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

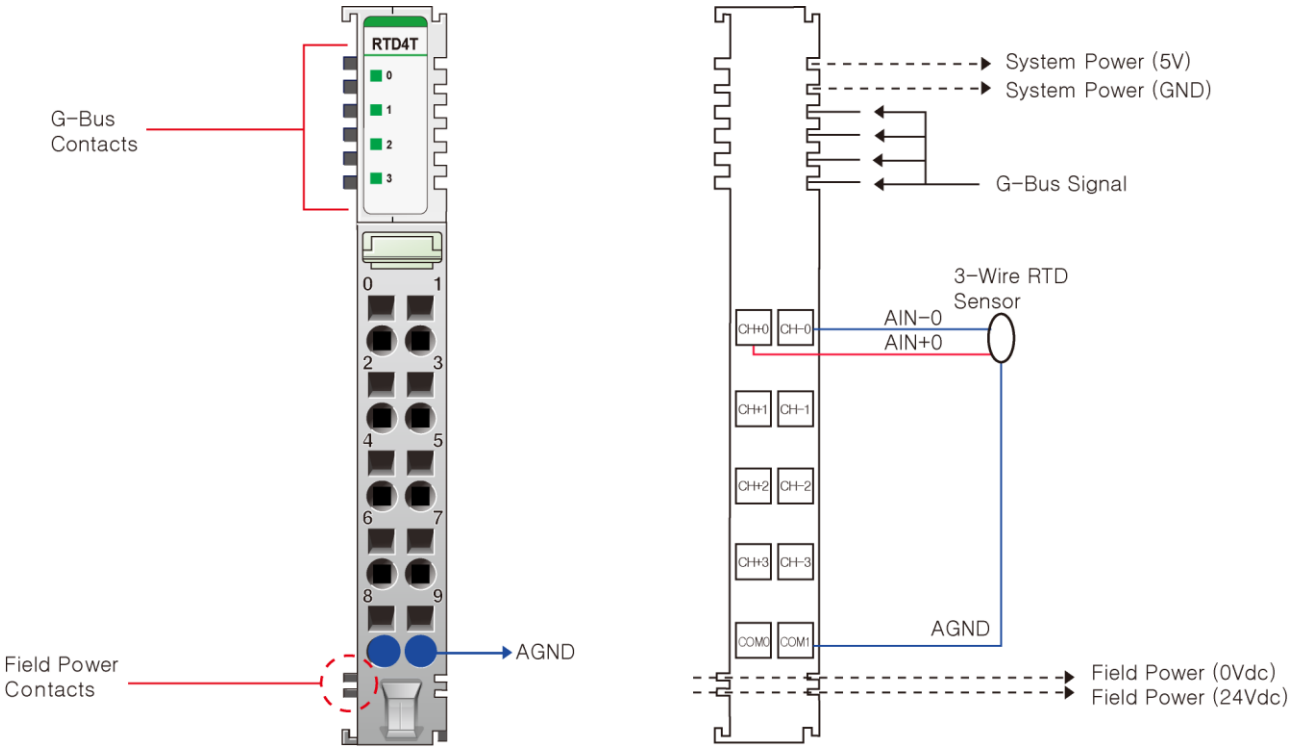
# 2 Analog Input Module List

| RIO3-Number | Description | ID (hex) |
|---|---|---|
| RIO3-RTD4T | Analog Input 4 Channels, RTD / Resistance Input, 10 RTB | 3704 |
| RIO3-RTD8C | Analog Input 8 Channels, RTD / Resistance Input, 20P Connector | 3708 |
| RIO3-TC4T | Analog Input 4 Channels, Thermocouple / mV Input, 10 RTB | 3804 |

# 3 Specification

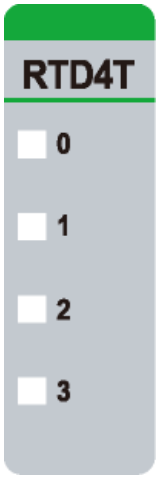
## 3.1 RIO3-RTD4T

### 3.1.1 Wiring Diagram




| Pin No. | Signal Description | Signal Description | Pin No. |
|---|---|---|---|
| 0 | RTD Channel 0+ | RTD Channel 0- | 1 |
| 2 | RTD Channel 1+ | RTD Channel 1- | 3 |
| 4 | RTD Channel 2+ | RTD Channel 2- | 5 |
| 6 | RTD Channel 3+ | RTD Channel 3- | 7 |
| 8 | AGND | AGND | 9 |

### 3.1.2 LED Indicator




| LED No. | LED Function / Description | LED Color |
|---|---|---|
| 0 | Input Channel 0 | Green |
| 1 | Input Channel 1 | Green |
| 2 | Input Channel 2 | Green |
| 3 | Input Channel 3 | Green |

### 3.1.3 Channel Status LED

| Status | LED | To indicate |
|---|---|---|
| No Signal | Off | Input Sensor Open or Input Range Over |
| On Signal | Green | Sensor Connected and Input Range Valid |

### 3.1.4 Environment Specification

| Environmental Specification | |
|---|---|
| Operation Temperature | -40℃ ~ 70℃ |
| UL Temperature | -20℃ ~ 60℃ |
| Storage Temperature | -40℃ ~ 85℃ |
| Relative Humidity | 5% ~ 90% non-condensing |
| Operating Altitude | 2,000m |
| Mounting | DIN Rail |
| **General Specification** | |
| Shock Operating | IEC 60068-2-27: 2008/ 15g, 11bs |
| Vibration Resistance | Based on IEC 60068-2-6<br>DNVGL-CG-0039: 2016/ Vibration Class B, 4g |
| Industrial Emissions | EN 61000-6-4: 2007 + A1: 2011 |
| Industrial Immunity | EN 61000-6-2: 2005 |
| Protection Class | Variable / IP20 |
| Installation Position | Vertical and horizontal installation is possible. |
| Product Certifications | CE, UL, EAC |

## 3.1.5 Specification

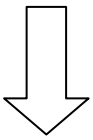
<table>
<tr><th colspan="2">Items</th></tr>
<tr><td colspan="2">Input Specification</td></tr>
<tr><td>Inputs Per Module</td><td>4 Channels</td></tr>
<tr><td>Indicators</td><td>4 Green Input Status LEDs</td></tr>
<tr><td>Sensor Types</td><td>RTD Input Range
<table>
<tr><th>RTD Input</th><th>Input Range</th></tr>
<tr><td>PT50, PT100, PT200, PT500, PT1000</td><td>-200~850℃</td></tr>
<tr><td>JPT50, JPT100, JPT200, JPT500, JPT1000</td><td>-200~640℃</td></tr>
<tr><td>NI100, NI200, NI500, NI1000</td><td>-60~250℃</td></tr>
<tr><td>NI120</td><td>-80~260℃</td></tr>
<tr><td>NI1000LG</td><td>-50~120℃</td></tr>
<tr><th>Resistance Input</th><th>Input Range</th></tr>
<tr><td>1Ω/bit</td><td>0~4000Ω</td></tr>
<tr><td>100mΩ/Bit</td><td>0~2000Ω</td></tr>
<tr><td>10mΩ/Bit</td><td>0~327Ω</td></tr>
<tr><td>20mΩ/Bit</td><td>0~620Ω</td></tr>
<tr><td>50mΩ/Bit</td><td>0~1200Ω</td></tr>
</table></td></tr>
<tr><td>Excitation Current</td><td>About 0.5mA</td></tr>
<tr><td>Connection Method</td><td>3-Wire</td></tr>
<tr><td>Conversion Time</td><td>55msec / All channel</td></tr>
<tr><td>Data Format</td><td>16 Bits singed Integer (2' complement)</td></tr>
<tr><td>Module Accuracy</td><td>PT1000 : ±0.3℃ at 50~150℃ @ 25℃<br>PT1000 : ±0.5℃ at 50~150℃ @ -40,70℃<br>PT1000 : ±0.5℃ at -200~250℃ @ 25℃<br>PT1000 : ±1℃ at 250~850℃ @ 25℃<br>Cu10 : ±2% Full Scale @ 25℃<br>Cu10 : ±4% Full Scale @ -40,70℃<br>Cu100 : ±0.3% Full Scale @ 25℃<br>Cu100 : ±0.5% Full Scale @ -40,70℃<br>All type Input Range<br>• ±0.1% Full Scale @ 25℃<br>• ±0.3% Full Scale @ -40℃~70℃</td></tr>
<tr><td>Resolution of Data</td><td>RTD Type: ±0.1℃ / F, Resistance Type: 1Ω, 100mΩ, 10mΩ, 20mΩ, 50mΩ</td></tr>
<tr><td>Calibration</td><td>Not Required</td></tr>
<tr><td>Diagnostic</td><td>Sensor open or range over, then conversion data = 0x8000 (-32768)</td></tr>
</table>

| General Specification | |
|---|---|
| Power Dissipation | Max. 130mA @ 5Vdc |
| Isolation | I/O to Logic: Photocoupler Isolation<br>Field power: Not Connected |
| UL Filed Power | Supply voltage: 24Vdc nominal, Class 2 |
| Field Power | Not used, Field Power passes through to the next module |
| Wiring | I/O Cable Max. 2.0mm$^2$ (AWG 14) |
| Torque | 0.8Nm (7lb-in) |
| Weight | 60g |
| Module Size | 12mm x 99mm x 70mm |
| **Environment Condition** | **Refer to 'Environment Specification'** |

## 3.1.6 Mapping Data into the Image Table

**Input Module Data**

| |
|---|
| Analog Input Ch0 |
| Analog Input Ch1 |
| Analog Input Ch2 |
| Analog Input Ch3 |



**Input Image Value**

| Bit No | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|
| Byte 0 | Analog Input Ch0 Low byte | | | | | | | |
| Byte 1 | Analog Input Ch0 High byte | | | | | | | |
| Byte 2 | Analog Input Ch1 Low byte | | | | | | | |
| Byte 3 | Analog Input Ch1 High byte | | | | | | | |
| Byte 4 | Analog Input Ch2 Low byte | | | | | | | |
| Byte 5 | Analog Input Ch2 High byte | | | | | | | |
| Byte 6 | Analog Input Ch3 Low byte | | | | | | | |
| Byte 7 | Analog Input Ch3 High byte | | | | | | | |

If the input of channel is open or over-ranged, its conversion data will be 0x8000 (-32678)

## 3.1.7 Configuration Parameter – 10 Bytes

| Byte | Decimal Bit | Description | Default Value |
|---|---|---|---|
| 0 | 00-07 | The selection Sensor Type<br>=00h:PT100, 0.00385, -200~850°C, 0.1°C /count<br>=01h:PT200, 0.00385, -200~850°C, 0.1°C/count<br>=02h:PT500, 0.00385, -200~850°C, 0.1°C/count<br>=03h:PT1000, 0.00385, -200~850°C, 0.1°C/count<br>=04h:PT50, 0.00385, -200~850°C, 0.1°C/count<br>=10h:JPT100, 0.003916, -200~640°C, 0.1°C/count<br>=11h:JPT200, 0.003916, -200~640°C, 0.1°C/count<br>=12h:JPT500, 0.003916, -200~640°C, 0.1°C/count<br>=13h:JPT1000, 0.003916, -200~640°C, 0.1°C/count<br>=14h:JPT50, 0.003916, -200~640°C, 0.1°C/count<br>=20h:NI100, 0.00618, -60~250°C, 0.1°C/count<br>=21h:NI200, 0.00618, -60~250°C, 0.1°C/count<br>=22h:NI500, 0.00618, -60~250°C, 0.1°C/count<br>=23h:NI1000, 0.00618, -60~250°C, 0.1°C/count<br>=30h:NI120, 0.00672, -80~260°C, 0.1°C/count<br>=40h:Cu10, 0.00427, -100~260°C, 0.1°C/count<br>=41h:Cu100, 0.00427, -100~260°C, 0.1°C/count<br>=53h:NI1000LG, 0.00500, -50~120°C, 0.1°C/count<br>=80h:Resistance Input, 1~2000Ω, 100mΩ /1count<br>=81h:Resistance Input, 1~327Ω, 10mΩ /1count<br>=82h:Resistance Input, 1~620Ω, 20mΩ /1count<br>=83h: Resistance Input, 1~1200Ω, 50mΩ/1count<br>=84h: Resistance Input, 1~4000Ω, 1Ω/1count<br>=Others: Reserved | 0: PT100 |
| 1 | 00 | Temperature Type<br>0: Celsius(°C), 1: Fahrenheit(°F) | 0: Celsius(°C) |
| | 01 | Reserved | 0 |
| | 02-03 | Data Resolution<br>00: 0.1℃, ℉ / Bit<br>01: 1℃, ℉ / Bit<br>10: *0.01℃, ℉/bit<br>11: Reserved | 0 |
| | 04 | Filter Type<br>0: Normal Filter, 1: Enhanced Filter | 0: Normal Filter |
| | 05-06 | SW Filter<br>0: Nomal Filter(Filter Time = 20)<br>1: **Fast Filter(Filter Time = 3)<br>2: Enhanced Filter(Filter Time = 40)<br>3: More Enhanced Filter(Filter Time = 80) | 0 |
| | 07 | Reserved | 0 |
| 2~3 | - | CH0 Offset Value | 0 |
| 4~5 | - | CH1 Offset Value | 0 |

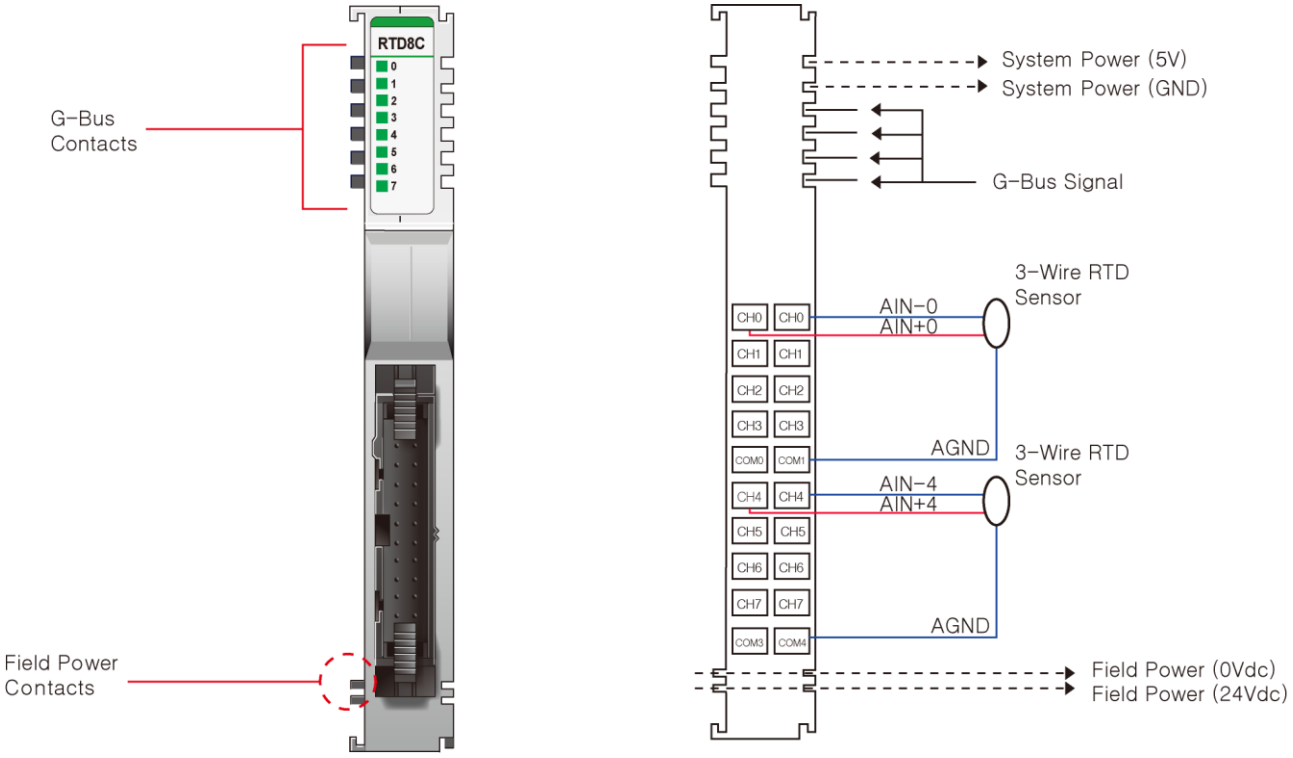
| | | | |
|---|---|---|---|
| 6~7 | - | CH2 Offset Value | 0 |
| 8~9 | - | CH3 Offset Value | 0 |

### 3.1.8 Data Value

| Resistance Temperature Detector Input Range | |
|---|---|
| **Type** | **Input Range** |
| PT100 | -200 ~ 850 ℃ |
| PT200 | -200 ~ 850 ℃ |
| PT500 | -200 ~ 850 ℃ |
| PT1000 | -200 ~ 850 ℃ |
| PT50 | -200 ~ 850 ℃ |
| JPT100 | -200 ~ 640 ℃ |
| JPT200 | -200 ~ 640 ℃ |
| JPT500 | -200 ~ 640 ℃ |
| JPT1000 | -200 ~ 640 ℃ |
| JPT50 | -200 ~ 640 ℃ |
| NI100 | -60 ~ 250 ℃ |
| NI200 | -60 ~ 250 ℃ |
| NI500 | -60 ~ 250 ℃ |
| NI1000 | -60 ~ 180 ℃ |
| NI120 | -80 ~ 260 ℃ |
| NI1000LG | -50 ~ 120 ℃ |
| **Resistance Input Range** | |
| **Type** | **Input Range** |
| 1Ω/Bit | 0~4000 Ω |
| 100mΩ/Bit | 0 ~ 2000 Ω |
| 10mΩ/Bit | 0 ~ 327 Ω |
| 20mΩ/Bit | 0 ~ 620 Ω |
| 50mΩ/Bit | 0 ~ 1200 Ω |

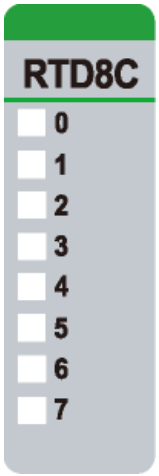
## 3.2 RIO3-RTD8C

### 3.2.1 Wiring Diagram




| Pin No. | Signal Description | Signal Description | Pin No. |
|---|---|---|---|
| 0 | RTD Channel 0+ | RTD Channel 0- | 1 |
| 2 | RTD Channel 1+ | RTD Channel 1- | 3 |
| 4 | RTD Channel 2+ | RTD Channel 2- | 5 |
| 6 | RTD Channel 3+ | RTD Channel 3- | 7 |
| 8 | AGND | AGND | 9 |
| 10 | RTD Channel 4+ | RTD Channel 4- | 11 |
| 12 | RTD Channel 5+ | RTD Channel 5- | 13 |
| 14 | RTD Channel 6+ | RTD Channel 6- | 15 |
| 16 | RTD Channel 7+ | RTD Channel 7- | 17 |
| 18 | AGND | AGND | 19 |

## 3.2.2 LED Indicator




| LED No. | LED Function / Description | LED Color |
|---|---|---|
| 0 | Input Channel 0 | Green |
| 1 | Input Channel 1 | Green |
| 2 | Input Channel 2 | Green |
| 3 | Input Channel 3 | Green |
| 4 | Input Channel 4 | Green |
| 5 | Input Channel 5 | Green |
| 6 | Input Channel 6 | Green |
| 7 | Input Channel 7 | Green |

## 3.2.3 Channel Status LED

| Status | LED | To indicate |
|---|---|---|
| No Signal | Off | Input Sensor Open or Input Range Over |
| On Signal | Green | Sensor Connected and Input Range Valid |

## 3.2.4 Environment Specification

| Environmental Specification | |
|---|---|
| Operation Temperature | -40℃ ~ 70℃ |
| UL Temperature | -20℃ ~ 60℃ |
| Storage Temperature | -40℃ ~ 85℃ |
| Relative Humidity | 5% ~ 90% non-condensing |
| Operating Altitude | 2,000m |
| Mounting | DIN Rail |
| **General Specification** | |
| Shock Operating | IEC 60068-2-27: 2008/ 15g, 11bs |
| Vibration Resistance | Based on IEC 60068-2-6, 4g |
| Industrial Emissions | EN61000-6-4/A11: 2011 |
| Industrial Immunity | EN61000-6-2: 2005 |
| Protection Class | Variable / IP20 |
| Installation Position | Vertical and horizontal installation is possible. |
| Product Certifications | CE, UL |

## 3.2.5 Specification

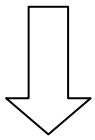
<table>
<tr><th colspan="2">Items</th></tr>
<tr><td colspan="2">Input Specification</td></tr>
<tr><td>Inputs Per Module</td><td>8 Channels</td></tr>
<tr><td>Indicators</td><td>8 Green Input Status LEDs</td></tr>
<tr><td>Sensor Types</td><td>RTD Input Range
<table>
<tr><th>RTD Input</th><th>Input Range</th></tr>
<tr><td>PT100, PT200, PT500, PT50, PT1000</td><td>-200 ~ 850℃</td></tr>
<tr><td>JPT100, JPT200, JPT500, JPT50, JPT1000</td><td>-200 ~ 640℃</td></tr>
<tr><td>NI100, NI200, NI500</td><td>-60 ~ 250℃</td></tr>
<tr><td>NI1000</td><td>-60 ~ 180℃</td></tr>
<tr><td>NI120</td><td>-80 ~ 260℃</td></tr>
<tr><td>NI1000LG</td><td>-50 ~ 120℃</td></tr>
<tr><th>Resistance Input</th><th>Input Range</th></tr>
<tr><td>1Ω/bit</td><td>0~4000Ω</td></tr>
<tr><td>100mΩ/Bit</td><td>0 ~ 2000Ω</td></tr>
<tr><td>10mΩ/Bit</td><td>0 ~ 327Ω</td></tr>
<tr><td>20mΩ/Bit</td><td>0 ~ 620Ω</td></tr>
<tr><td>50mΩ/Bit</td><td>0 ~ 1200Ω</td></tr>
</table></td></tr>
<tr><td>Excitation Current</td><td>About 0.5mA</td></tr>
<tr><td>Connection Method</td><td>3-Wire</td></tr>
<tr><td>Conversion Time</td><td>110msec / All channel</td></tr>
<tr><td>Data Format</td><td>16 Bits singed Integer (2' complement)</td></tr>
<tr><td>Module Accuracy</td><td>PT1000 : ± 0.3℃ at 50~150℃ @ 25℃<br>PT1000 : ± 0.5℃ at 50~150℃ @ -40,70℃<br>PT1000 : ± 0.5℃ at -200~250℃ @ 25℃<br>PT1000 : ± 1℃ at 250~850℃ @ 25℃<br>Cu10 : ± 2% Full Scale @ 25℃<br>Cu10 : ± 4% Full Scale @ -40,70℃<br>Cu100 : ± 0.3% Full Scale @ 25℃<br>Cu100 : ± 0.5% Full Scale @ -40,70℃<br>All type Input Range<br>• ± 0.1% Full Scale @ 25℃<br>• ± 0.3% Full Scale @ -40℃~70℃</td></tr>
<tr><td>Resolution of Data</td><td>RTD Type : ±0.1℃ / F, Resistance Type : 1Ω , 100mΩ, 10mΩ, 20mΩ, 50mΩ</td></tr>
<tr><td>Calibration</td><td>Not Required</td></tr>
</table>

| | |
|---|---|
| Diagnostic | Sensor open or range over, then conversion data = 0x8000 (-32768) |
| **General Specification** | |
| Power Dissipation | Max. 120mA @ 5Vdc |
| Isolation | I/O to Logic: Isolation<br>Field power: Not Connected |
| UL Field Power | Supply voltage: 24Vdc nominal, Class 2 |
| Field Power | Not used, Field Power passes through to the next module |
| Wiring | Connector Type, up to AWG22<br>Module Connector: HIF3BA-20D-2.54DSA |
| Weight | 60g |
| Module Size | 12mm x 99mm x 70mm |
| **Environment Condition** | **Refer to 'Environment Specification'** |

## 3.2.6 Mapping Data into the Image Table

**Input Module Data**

| |
|---|
| Analog Input Ch0 |
| Analog Input Ch1 |
| Analog Input Ch2 |
| Analog Input Ch3 |
| Analog Input Ch4 |
| Analog Input Ch5 |
| Analog Input Ch6 |
| Analog Input Ch7 |



**Input Image Value**

| Bit No | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|
| Byte 0 | Analog Input Ch0 Low byte | | | | | | | |
| Byte 1 | Analog Input Ch0 High byte | | | | | | | |
| Byte 2 | Analog Input Ch1 Low byte | | | | | | | |
| Byte 3 | Analog Input Ch1 High byte | | | | | | | |
| Byte 4 | Analog Input Ch2 Low byte | | | | | | | |
| Byte 5 | Analog Input Ch2 High byte | | | | | | | |
| Byte 6 | Analog Input Ch3 Low byte | | | | | | | |
| Byte 7 | Analog Input Ch3 High byte | | | | | | | |
| Byte 8 | Analog Input Ch4 Low byte | | | | | | | |
| Byte 9 | Analog Input Ch4 High byte | | | | | | | |
| Byte 10 | Analog Input Ch5 Low byte | | | | | | | |
| Byte 11 | Analog Input Ch5 High byte | | | | | | | |
| Byte 12 | Analog Input Ch6 Low byte | | | | | | | |

| | |
|---|---|
| Byte 13 | Analog Input Ch6 High byte |
| Byte 14 | Analog Input Ch7 Low byte |
| Byte 15 | Analog Input Ch7 High byte |

If the input of channel is open or over-ranged, its conversion data will be 0x8000(-32678)

### 3.2.7 Configuration Parameter – 18 Bytes

| Byte | Decimal Bit | Description | Default Value |
|---|---|---|---|
| 0 | 00-07 | The selection Sensor Type<br>=00h:PT100, 0.00385, -200~850°C, 0.1°C /count<br>=01h:PT200, 0.00385, -200~850°C, 0.1°C/count<br>=02h:PT500, 0.00385, -200~850°C, 0.1°C/count<br>=03h:PT1000, 0.00385, -200~850°C, 0.1°C/count<br>=04h:PT50, 0.00385, -200~850°C, 0.1°C/count<br>=10h:JPT100, 0.003916, -200~640°C, 0.1°C/count<br>=11h:JPT200, 0.003916, -200~640°C, 0.1°C/count<br>=12h:JPT500, 0.003916, -200~640°C, 0.1°C/count<br>=13h:JPT1000, 0.003916, -200~640°C, 0.1°C/count<br>=14h:JPT50, 0.003916, -200~640°C, 0.1°C/count<br>=20h:NI100, 0.00618, -60~250°C, 0.1°C/count<br>=21h:NI200, 0.00618, -60~250°C, 0.1°C/count<br>=22h:NI500, 0.00618, -60~250°C, 0.1°C/count<br>=23h:NI1000, 0.00618, -60~250°C, 0.1°C/count<br>=30h:NI120, 0.00672, -80~260°C, 0.1°C/count<br>=40h:Cu10, 0.00427, -100~260°C, 0.1°C/count<br>=41h:Cu100, 0.00427, -100~260°C, 0.1°C/count<br>=53h:NI1000LG, 0.00500, -50~120°C, 0.1°C/count<br>=80h:Resistance Input, 1~2000Ω, 100mΩ /1count<br>=81h:Resistance Input, 1~327Ω, 10mΩ /1count<br>=82h:Resistance Input, 1~620Ω, 20mΩ /1count<br>=83h: Resistance Input, 1~1200Ω, 50mΩ/1count<br>=84h:Resistance Input, 1~4000Ω, 1Ω /1count<br>=Others: Reserved | 0: PT100 |
| 1 | 00 | Temperature Type<br>0: Celsius(°C), 1: Fahrenheit(°F) | 0: Celsius(°C) |
| | 01 | Reserved | 0 |
| | 02-03 | Data Resolution<br>00: 0.1℃, ℉/bit<br>01: 1℃, ℉/bit<br>10: *0.01℃, ℉/bit<br>11: Reserved | 0 |
| | 04 | Filter Type<br>0: Normal Filter, 1: Enhanced Filter | 0: Normal Filter |
| | 05-06 | SW Filter<br>0: Nomal Filter(Filter Time = 20)<br>1: **Fast Filter(Filter Time = 3)<br>2: Enhanced Filter(Filter Time = 40)<br>3: More Enhanced Filter(Filter Time = 80) | 0 |
| | 07 | Reserved | 0 |
| 2~3 | - | CH0 Offset Value | 0 |

| | | | |
|---|---|---|---|
| 4~5 | - | CH1 Offset Value | 0 |
| 6~7 | - | CH2 Offset Value | 0 |
| 8~9 | - | CH3 Offset Value | 0 |
| 10~11 | - | CH4 Offset Value | 0 |
| 12~13 | - | CH5 Offset Value | 0 |
| 14~15 | - | CH6 Offset Value | 0 |
| 16~17 | - | CH7 Offset Value | 0 |

### 3.2.8 Data Value

| Resistance Temperature Detector Input Range | |
|---|---|
| **Type** | **Input Range** |
| PT100 | -200 ~ 850 ℃ |
| PT200 | -200 ~ 850 ℃ |
| PT500 | -200 ~ 850 ℃ |
| PT1000 | -200 ~ 850 ℃ |
| PT50 | -200 ~ 850 ℃ |
| JPT100 | -200 ~ 640 ℃ |
| JPT200 | -200 ~ 640 ℃ |
| JPT500 | -200 ~ 640 ℃ |
| JPT1000 | -200 ~ 640 ℃ |
| JPT50 | -200 ~ 640 ℃ |
| NI100 | -60 ~ 250 ℃ |
| NI200 | -60 ~ 250 ℃ |
| NI500 | -60 ~ 250 ℃ |
| NI1000 | -60 ~ 180 ℃ |
| NI120 | -80 ~ 260 ℃ |
| NI1000LG | -50 ~ 120 ℃ |
| **Resistance Input Range** | |
| **Type** | **Input Range** |
| 1Ω/Bit | 0~4000 Ω |
| 100mΩ/Bit | 0 ~ 2000Ω |
| 10mΩ/Bit | 0 ~ 327Ω |
| 20mΩ/Bit | 0 ~ 620Ω |
| 50mΩ/Bit | 0 ~ 1200Ω |

## 3.3 RIO3-TC4T

### 3.3.1 Wiring Diagram

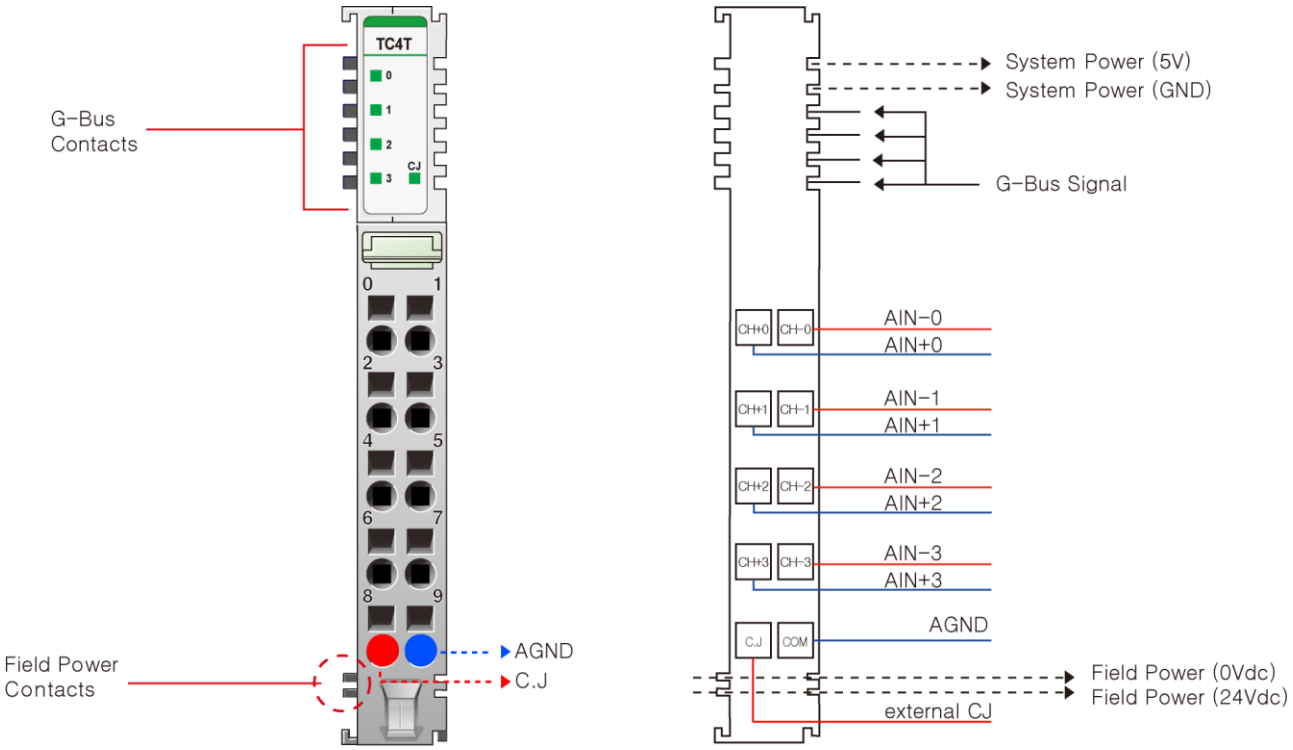
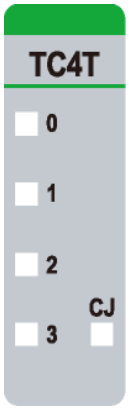



**Figure 1. Customer Wiring to Mounting Base**

| Pin No. | Signal Description | Signal Description | Pin No. |
|---|---|---|---|
| 0 | TC Channel 0+ | TC Channel 0- | 1 |
| 2 | TC Channel 1+ | TC Channel 1- | 3 |
| 4 | TC Channel 2+ | TC Channel 2- | 5 |
| 6 | TC Channel 3+ | TC Channel 3- | 7 |
| 8 | CJ | AGND | 9 |

### 3.3.2 LED Indicator




| LED No. | LED Function / Description | LED Color |
|---|---|---|
| 0 | Input Channel 0 | Green |
| 1 | Input Channel 1 | Green |
| 2 | Input Channel 2 | Green |
| 3 | Input Channel 3 | Green |
| CJ | Input Channel CJ | Green |

### 3.3.3 Channel Status LED

| Status | LED | To indicate |
|---|---|---|
| No Signal | Channel LED Off, CJ LED Off | Input Sensor Open or Input Range Over |
| Normal Operation | | Normal Operation |
| On Signal | Channel LED On, CJ LED Off | Sensor Connected and Input Range Valid |
| Normal Operation | | Normal Operation |
| On Signal | Channel LED On, CJ LED On | Sensor Connected and Input Range Valid |
| Normal Operation | | Normal Operation |
| Connected External CJC | | External CJ Enable |

## 3.3.4 Environment Specification

| **Environmental Specification** | |
|---|---|
| Operation Temperature | -40℃ ~ 70℃ |
| UL Temperature | -20℃ ~ 60℃ |
| Storage Temperature | -40℃ ~ 85℃ |
| Relative Humidity | 5% ~ 90% non-condensing |
| Operating Altitude | 2,000m |
| Mounting | DIN Rail |
| **General Specification** | |
| Shock Operating | IEC 60068-2-27: 2008/ 15g, 11bs |
| Vibration Resistance | Based on IEC 60068-2-6, 4g |
| Industrial Emissions | EN61000-6-4/A11: 2011 |
| Industrial Immunity | EN61000-6-2: 2005 |
| Protection Class | Variable / IP20 |
| Installation Position | Vertical and horizontal installation is possible |
| Product Certifications | CE, UL |

## 3.3.5 Specification

<table>
<tr><th>Items</th><th>Specification</th></tr>
<tr><td colspan="2">Input Specification</td></tr>
<tr><td>Inputs Per Module</td><td>4 Channels</td></tr>
<tr><td>Indicators</td><td>4 Green Input Status LEDs , 1 Green Input CJ Status LED</td></tr>
<tr><td>Sensor Types</td><td>Thermal Couple Input Range
<table>
<tr><th>Type</th><th>Maximum Input Range</th><th>Recommended Input Range</th></tr>
<tr><td>K</td><td>-270 ~ 1372℃</td><td>-200 ~1200℃</td></tr>
<tr><td>J</td><td>-210 ~ 1200℃</td><td>-40 ~ 1100℃</td></tr>
<tr><td>T</td><td>-270 ~ 400℃</td><td>-200 ~ 350℃</td></tr>
<tr><td>B</td><td>30 ~ 1820℃</td><td>600 ~ 1700℃</td></tr>
<tr><td>R</td><td>-50 ~ 1768℃</td><td>0 ~ 1600℃</td></tr>
<tr><td>S</td><td>-50 ~ 1768℃</td><td>0 ~ 1600℃</td></tr>
<tr><td>E</td><td>-270 ~ 1000℃</td><td>-200 ~ 800℃</td></tr>
<tr><td>N</td><td>-270 ~ 1300℃</td><td>-200 ~ 1250℃</td></tr>
<tr><td>L</td><td>-200 ~ 900℃</td><td>-100 ~ 850℃</td></tr>
<tr><td>U</td><td>-200 ~ 600℃</td><td>-100 ~ 550℃</td></tr>
<tr><td>C</td><td>0 ~ 2310℃</td><td>100 ~ 2100℃</td></tr>
<tr><td>D</td><td>0 ~ 2490℃</td><td>100 ~ 2200℃</td></tr>
<tr><td>TXK</td><td>-200 ~ 800°c</td><td>-200 ~ 800°c</td></tr>
<tr><td>10uV Input</td><td colspan="2">-81.0 ~ 81.0mV, 10uV/1 Count</td></tr>
<tr><td>1uV Input</td><td colspan="2">-32.7 ~ 32.7mV, 1uV/1 Count</td></tr>
<tr><td>2uV Input</td><td colspan="2">-65.5 ~ 65.5mV, 2uV/1 Count</td></tr>
</table></td></tr>
<tr><td>Cold Junction Module Accuracy<br>(Need 20 minute preheating to get enhanced accuracy.)</td><td>Recommend Input Range<br>- ±0.1% Recommended Scale @ 25℃ ambient<br>- ±0.3% Recommended Scale @ -40℃ ~ 70℃<br>T,B,R,S,L,U,D Type Recommend Input Range<br>- ±0.3% Recommended Scale @ 25℃<br>- ±0.5% Recommended Scale @ -40℃ ~ 70℃<br>External Cold Junction(PT100)<br>- ± 3℃ Recommended Scale @ -40℃ ~ 60℃</td></tr>
<tr><td>Connection Method</td><td>2-Wire</td></tr>
<tr><td>Conversion Time</td><td>Average Conversion Time < 30ms</td></tr>
<tr><td>Data Format</td><td>16 Bits Integer (2' complement )</td></tr>
<tr><td>Calibration</td><td>Not Required</td></tr>
</table>

| | |
|---|---|
| Cold Junction Temperature | Internal<br>- TMP275AIDGKR: -40℃ ~ 125℃<br>External<br>- PT100: -45℃ ~ 95℃ |
| Calibration | Not Required |
| Diagnostic | Sensor open or range over, then conversion data = 0x8000 (-32768)<br>*Connected External CJ: CJ LED On.<br>Not Connected External CJ: CJ LED Off. |

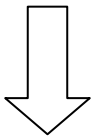
| **General Specification** | |
|---|---|
| Power Dissipation | Max. 130mA @ 5Vdc |
| Isolation | I/O to Logic: Isolation<br>Field power: Not Connected |
| UL Field Power | Supply voltage : 24Vdc nominal, Class 2 |
| Field Power | Not used, Field Power passes through to the next module |
| Wiring | I/O Cable Max. 2.0mm$^2$ (AWG 14) |
| Torque | 0.8Nm (7lb-in) |
| Weight | 60g |
| Module Size | 12mm x 99mm x 70mm |
| **Environment Condition** | **Refer to 'Environment Specification'** |

* To increase precision of measurement, the connection between RIO3-TC4T and compensation reference sensor is recommended using by terminal block.

## 3.3.6 Mapping Data into the Image Table

**Input Module Data**

| |
|---|
| Analog Input Ch0 |
| Analog Input Ch1 |
| Analog Input Ch2 |
| Analog Input Ch3 |



**Input Image Value**

| Bit No | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|
| Byte 0 | Analog Input Ch0 Low byte | | | | | | | |
| Byte 1 | Analog Input Ch0 High byte | | | | | | | |
| Byte 2 | Analog Input Ch1 Low byte | | | | | | | |
| Byte 3 | Analog Input Ch1 High byte | | | | | | | |
| Byte 4 | Analog Input Ch2 Low byte | | | | | | | |
| Byte 5 | Analog Input Ch2 High byte | | | | | | | |
| Byte 6 | Analog Input Ch3 Low byte | | | | | | | |
| Byte 7 | Analog Input Ch3 High byte | | | | | | | |

If the input of channel is open or over-ranged, its conversion data will be 0x8000 (-32678)

## 3.3.7 Configuration Parameter – 8 Bytes

| Byte | Decimal Bit | Description | Default Value |
|---|---|---|---|
| 0 | 00-07 | The selection **Sensor Type**<br>=00h: Type K, 0.1°C/count<br>=01h: Type J, 0.1°C/count<br>=02h: Type T, 0.1°C/count<br>=03h: Type B, 0.1°C/count<br>=04h: Type R, 0.1°C/count<br>=05h: Type S, 0.1°C/count<br>=06h: Type E, 0.1°C/count<br>=07h: Type N, 0.1°C/count<br>=08h: Type L; 0.1°C/count<br>=09h: Type U, 0.1°C/count<br>=0Ah: Type C, 0.1°C/count<br>=0Bh: Type D, 0.1°C/count<br>=0Ch: Type TXK, 0.1°C/count<br>=80h: 10uV Input, -81.0~81.0mV, 10uV / 1count<br>=81h: 1uV Input, -32.7~32.7mV, 1uV / 1count<br>=82h: 2uV Input, -65.5~65.5mV, 2uV / 1count<br>=Others: Reserved | 00: Type K |
| 1 | 00 | Temperature Type<br>0: Celsius(°C), 1: Fahrenheit(°F) | 00: Celsius (°C)<br>Cold Junction Compensation<br>0.1℃<br>Normal Filter |
| | 01* | 0: Cold Junction Compensation<br>1: Disable Cold Junction Compensation | |
| | 02 | Data Resolution<br>0: 0.1℃, ℉/bit, 1: 1℃, ℉/bit | |
| | 03 | Reserved | |
| | 04 | Filter Type<br>0: Normal Filter, 1: Enhanced Filter | |
| | 05-06 | SW Filter<br>0: Nomal Filter(Filter Time = 20)<br>1: *Fast Filter(Filter Time = 3)<br>2: Enhanced Filter(Filter Time = 40)<br>3: More Enhanced Filter(Filter Time = 80) | |
| | 07 | Reserved | |
| 2 | 00-07 | Internal Cold Junction[1] Offset Data Low Byte | 0000 |
| 3 | 00-07 | Internal Cold Junction[1] Offset Data High Byte | |
| 4 | 00-07 | Internal Cold Junction[2] Offset Data Low Byte | 0000 |
| 5 | 00-07 | Internal Cold Junction[2] Offset Data High Byte | |
| 6 | 00-07 | External Cold Junction Offset Data Low Byte | 0000 |
| 7 | 00-07 | External Cold Junction Offset Data High Byte | |

- Unit of Cold Junction Temperature is 0.1℃/℉. Value 254 means 25.4℃ or 25.4℉
- *0: Compensation ColdJunction Temperature = ColdJunction Temperature–ColdJunction Temperature Offset
- *1: Compensation Cold Junction Temperature = Cold Junction Temperature Offset
- *If you set a fast filter, the specification accuracy may not be met.

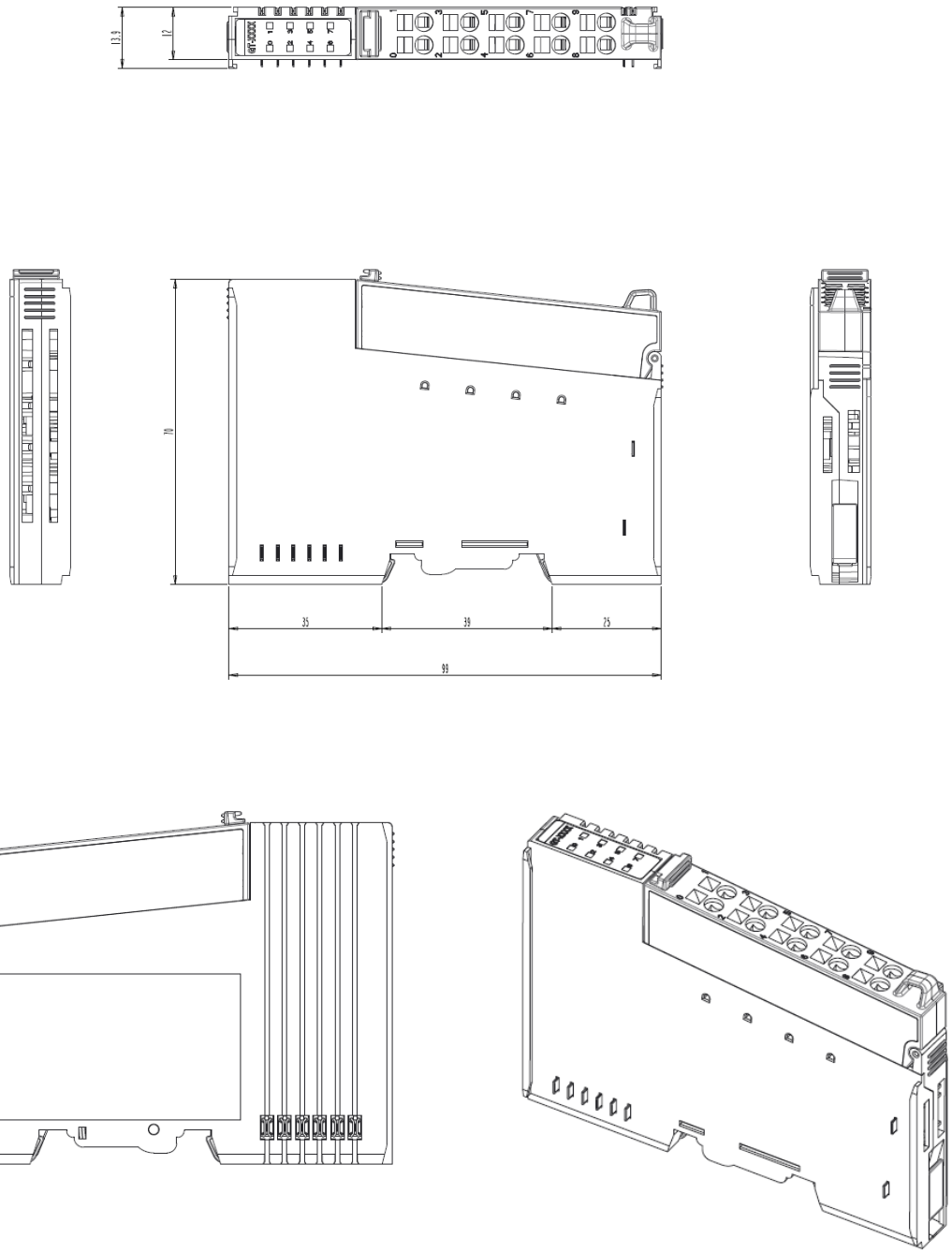
## 3.3.8 Data Value

| Thermocouple Input Range | | |
|---|---|---|
| **Type** | **Maximum Input Range** | **Recommended Input Range** |
| Type K | -270 ~ 1372 ℃ | -200 ~ 1200 ℃ |
| Type J | -210 ~ 1200 ℃ | -40 ~ 1100 ℃ |
| Type T | -270 ~ 400 ℃ | -200 ~ 350 ℃ |
| Type B | 30 ~ 1820 ℃ | 600 ~ 1700 ℃ |
| Type R | -50 ~ 1768 ℃ | 0 ~ 1600 ℃ |
| Type S | -50 ~ 1768 ℃ | 0 ~ 1600 ℃ |
| Type E | -270 ~ 1000 ℃ | -200 ~ 800 ℃ |
| Type N | -270 ~1300 ℃ | -200 ~ 1250 ℃ |
| Type L | -200 ~ 900 ℃ | -100 ~ 850 ℃ |
| Type U | -200 ~ 600 ℃ | -100 ~ 550 ℃ |
| Type C | 0 ~ 2310 ℃ | 100 ~ 2100 ℃ |
| Type D | 0 ~ 2490 ℃ | 100 ~ 2200 ℃ |
| 10uV | -81.0 ~ 81.0mV, 10uV / 1 Count | |
| 1uV | -32.7 ~ 32.7mV, 1uV / 1 Count | |
| 2uV | -65.5 ~ 65.5mV, 2uV / 1 Count | |

*1℉ = 1.8℃ + 32*

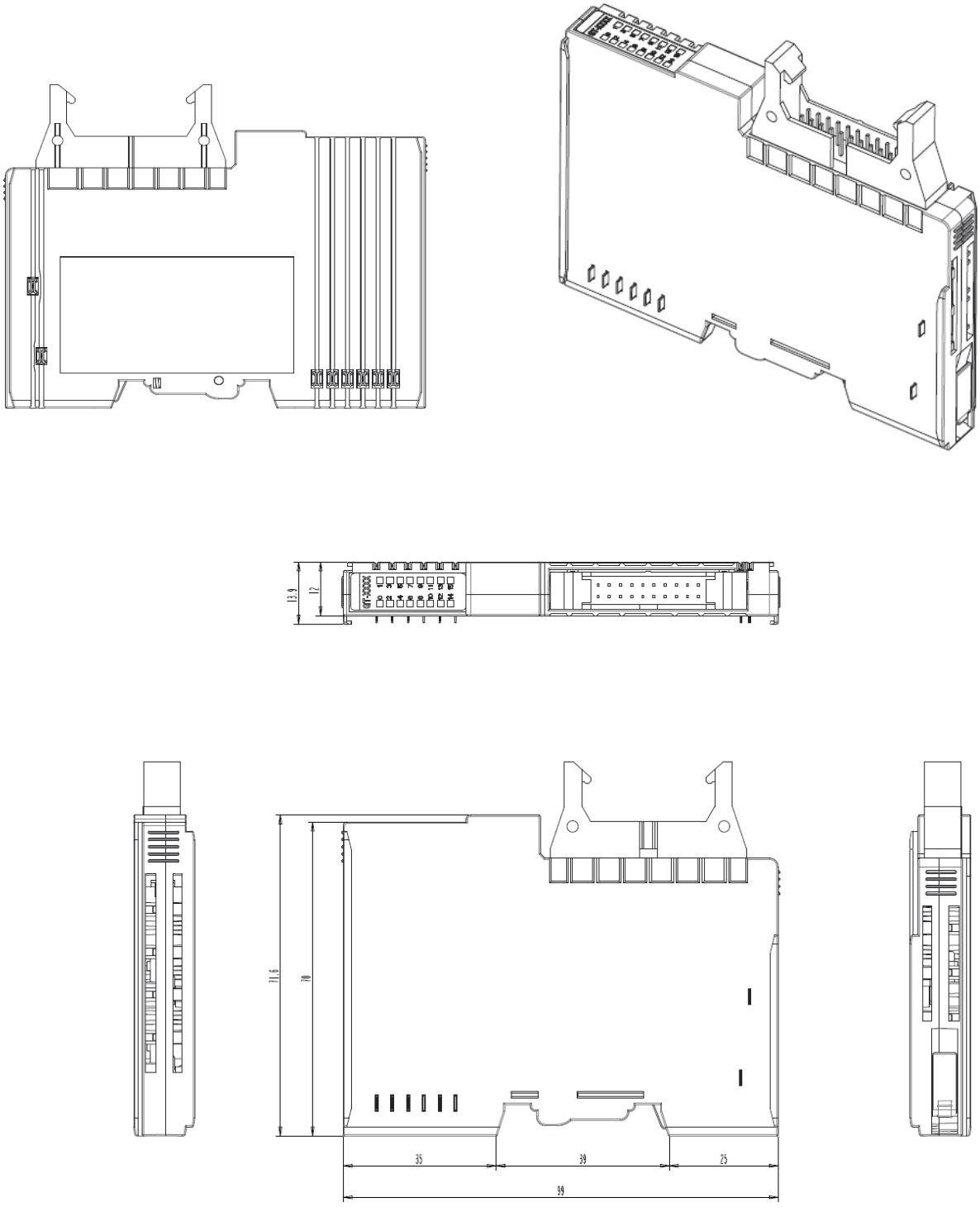
# 4 Dimension

## 4.1 10-Pts. Spring Type




*Dimension in mm*

## 4.2 20-Pin Connector Type




*Dimension in mm*

# 5 Mounting

**Caution!**

**Hot surface!**

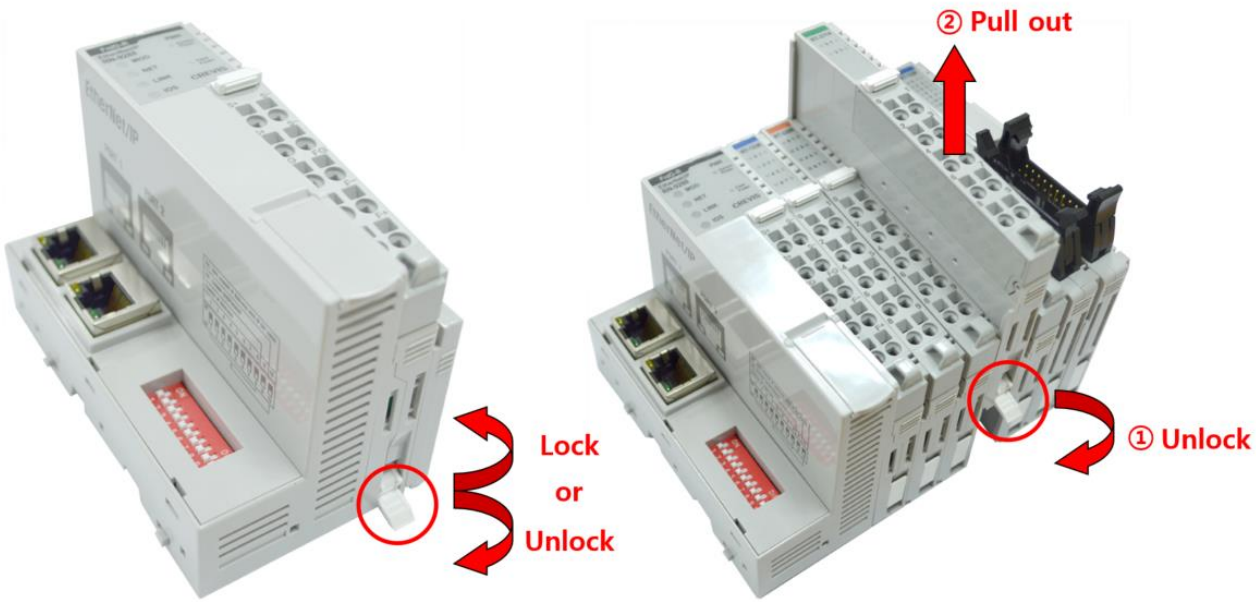
The surface of the housing can become hot during operation. If the device was operated at high ambient temperatures, allow it to be cool before touching it.

**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.

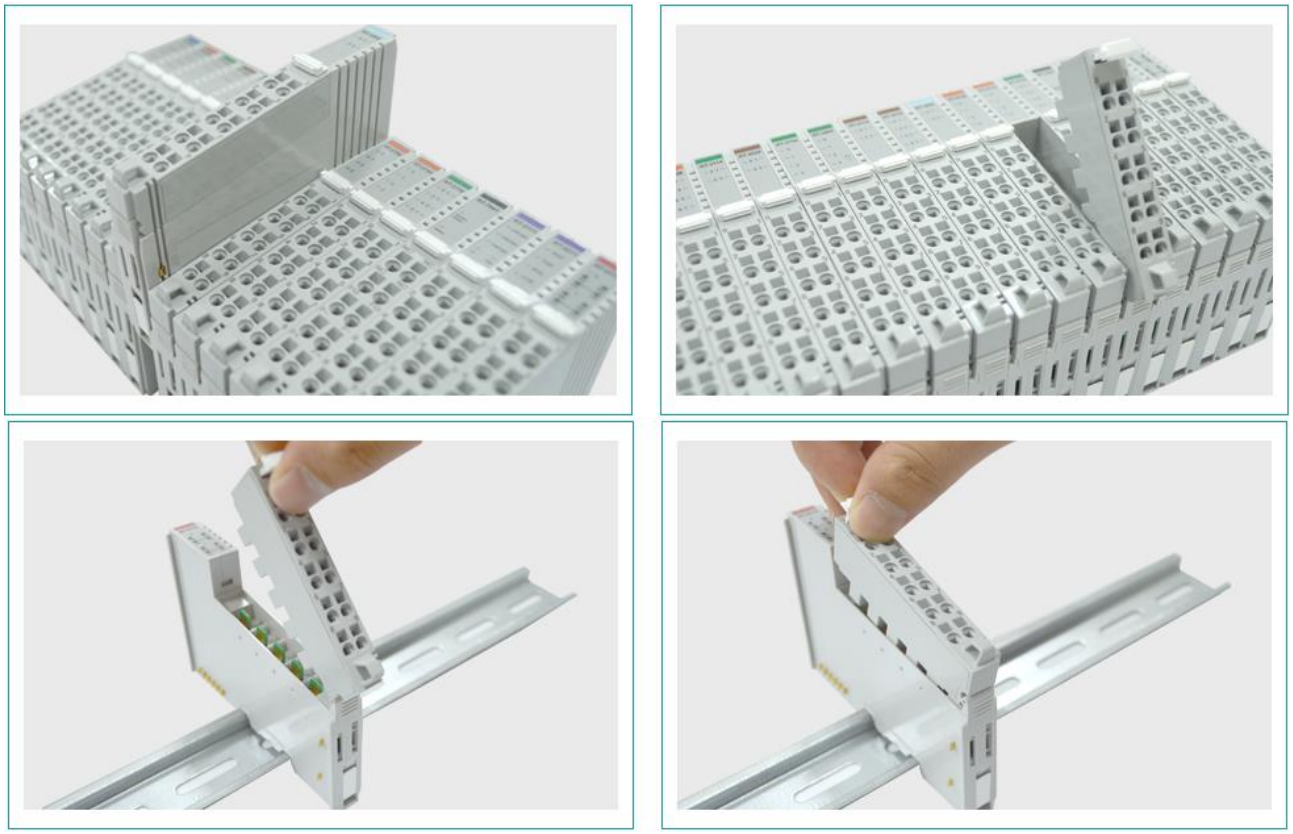
## 5.1 I/O Inserting and Removing Devices




As above figure in order to safeguard the RIO3-Series 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-Series 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.
There is a locking switch on the RTB for the easy combination and easy removal.
Easy combination and easy removal for I/O 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.