# Table of Contents

1. **Introduction** .......................................................................................................................... 1
   1.1 Features .............................................................................................................................. 1
   1.2 Specification ........................................................................................................................ 1
   1.3 Packing List ......................................................................................................................... 2
   1.4 Optional Accessory ............................................................................................................. 2

2. **Layout** .................................................................................................................................. 3

3. **Pin Assignment and Definition** ............................................................................................ 4
   3.1 Power Connector ................................................................................................................ 4
   3.2 LED Status .......................................................................................................................... 4
   3.3 Thermocouple Input (T/C1 to T/C3) .................................................................................... 4
   3.4 Relay Output Connector (DO_OUT, DO_COM) ................................................................... 4
   3.5 Digital Input Connector (DI1, DI2, DI_COM) ................................................................. 5
   3.6 Factory Default Settings ...................................................................................................... 5

4. **Manager Utility Software** .................................................................................................. 6
   4.1 Broadcast Search .............................................................................................................. 6
   4.2 Configure RIO-2018 ......................................................................................................... 7
   4.3 Basic Settings ..................................................................................................................... 7
   4.4 Advanced Options .............................................................................................................. 8
   4.5 Web Console ....................................................................................................................... 9
   4.6 How to Access the Data of RIO-2018 ................................................................................. 9
   4.7 Web-based I/O Control ..................................................................................................... 10
   4.8 AJAX Command .............................................................................................................. 10
   4.9 Convert HTML File to Anf Binary .................................................................................. 12
   4.10 Access RIO-2018 via Modbus TCP .............................................................................. 13
1. Introduction

RIO-2018 is a thermocouple input remote I/O module supports Modbus TCP and Web interface. RIO-2018 has two models J and K to support J and K type thermocouple. In addition to the thermocouple input, RIO-2018 also has two isolated digital input channels and one form C relay output. Therefore it is suitable for temperature measurement and control. RIO-2018 has a tiny web server built-in which allows user to access it through a web browser. A data exchange can be achieved by AJAX or Modbus TCP.

1.1 Features

- Remote Thermocouple Input Module with Web Access AJAX and Modbus TCP
- One 10/100Mbps Ethernet port
- 3 channels J or K type thermocouple input with cold junction compensation
- Two 2500Vrms isolated digital input (bipolar input photocouple)
- One Form C relay with contact rating 30VDC@1A or 125VAC@0.5A
- Support Web-based temperature monitoring and DIO control
- Optional DIN Rail mounting kit (DK-35A)
- Windows configuration utility included

1.2 Specification

- Ethernet:
  - 10/100Mbps, RJ45
  - Protection: 1500V Magnetic isolation
  - Protocol: Modbus / TCP, UDP, HTTP, DHCP
- Thermocouple input:
  - J type: Maxim MAX31855J converter with CJC
  - Range: -210°C to +1200°C
  - K type: Maxim MAX31855K converter with CJC
  - Range: 200°C to +1350°C
  - Resolution: 14-bit, 0.25°C
  - Connector: OMEGA PCC-SMP Thermocouple connector
  - Thermocouple fault detection
- Relay output:
  - Channel number: 1 form C
  - Contact rating: 30VDC@1A or 125VAC@0.5A
- Isolated digital input:
  - Channel number: 2
  - Logic high: 5~24VDC
  - Logic low: 0~1.5VDC
  - Input resistance: 1.2KOhm@0.5W
  - Response time: 20µs
1.3 Packing List

- Software utility download from Artlia FTP

1.4 Optional Accessory

- 5SRTC-GG-J-24-36 (91-5SRTC-J50)*: Standard Size Connector, J Thermocouple, Glass Braid Insulation, 24 AWG, 36 inch Length, 5 PACK
- 5SRTC-GG-K-24-36 (91-5SRTC-K50)*: Subminiature Connector, K Thermocouple, Glass Braid Insulation, 24 AWG, 36 inch Length, 5 PACK
- DK-35A (36-DK35A-000): DIN RAIL Mounting Kit
- PWR-12V-1A (31-62100-000): 110~240VAC to 12VDC 1A Power Adapter

*: Artlia generally suggests our customers to purchase this item from the original manufacturer directly.
2. Layout

- LAN
- 9~48VDC Power In
- Relay Output
- Digital In DI1 / DI2
- Thermocouple T/C1 ~ T/C3
- OMEGA PCC-SMP
3. Pin Assignment and Definition

3.1 Power Connector
Connecting 9~48VDC power line to the Power in terminal block. If the power is properly supplied, the Power LED will keep solid green color and a beep will be heard.

3.2 LED Status
The LED provides the RIO-2018 operation information. The LED status is described as follow:

- **Power LED**: Power LED keeps ON if power (+9VDC to +48VDC) is correct.
- **Ready LED**: Ready LED keeps ON when RIO-2018 firmware is ready for operation.
- **LAN LED**: Link and Activity LED will turn ON when the Ethernet cable is connected. When there is network data traffic, this LED will flash.

3.3 Thermocouple Input (T/C1 to T/C3)
The thermocouple input is connected to MAX31855 with Cold Junction Compensated Thermocouple to Digital Converter. The connector is OMEGA PCC-SMP. Please make sure the type of thermocouple matches the model of RIO-2018. Refer to data sheet of MAX31855 for the technical specification of thermocouple measurement.

3.4 Relay Output Connector (DO_OUT, DO_COM)
The relay provides normal open output (NO) and normal close (NC) as shown. It can switch voltage source up to 30VDC@1A or 125VAC@0.5A.
3.5 Digital Input Connector (DI1, DI2, DI_COM)
The two channels isolated input are equipped with 2500Vrms photo coupler isolator. The two channels form a group and share the same common ground. The specification of the isolated input channels are:

- Logical High: 5~24Vdc
- Logical Low: 0~1.5Vdc
- Input resistance: 1.2KOhms@0.5W
- Response time: 20µs
- Isolation: 2500Vrms

![Diagram of Digital Input Connector](image)

3.6 Factory Default Settings

- **IP Address**: 192.168.2.127
- **Netmask**: 255.255.255.0
- **Modbus port**: 502
- **Web port**: 5003
- **Telnet console port**: 5001

![Thermocouple connector diagram](image)
4. Manager Utility Software

Before powering on RIO-2018, please install the manager utility available from Artila Website download section. This utility is used to search RIO-2018 in the network and configure and test the RIO-2018.

4.1 Broadcast Search

Once start Manager utility, you can click telescope icon to search the RIO-2018 in the network.
4.2 Configure RIO-2018

Once RIO-2018 is discovered, Manager will show following information.

4.3 Basic Settings

Click the RIO-2018 will open the windows to configure. The Basic settings allows user to configure following settings:

- **Modbus settings:**
  - Listen Port: Modbus TCP listen port
- **TC Input:** Thermocouple Input setting
  - TC#: Enable/Disable TC channels
  - Sample rate: 1~12Hz
- **DO power on value:**
  - Low: Relay is de-energized
High: Relay is energized

4.4 Advanced Options

The Advanced options allow user to configure following settings:

- **Web Server Settings**
  - Enable: Enable/Disable
  - Listen Port: Web listen port

- **TC Input**: Thermocouple Input setting
  - TC#: Enable/Disable TC channels
  - Sample rate: 1~12Hz

- **Idle Timeout sec**: disconnect connection while no data on line and time out occur

- **Alive Timeout sec**: disconnect connection while no data on line, time out and no response to Ack signal
4.5 Web Console


- **TCP Command Settings**: TCP Command port is used to configure RIO-2018 by text command. Please refer the TCP command sets for the information of the text command. User can use TCP command port to develop a user application software to configure RIO-2018.
- **Console Settings**: Console port is reserved for debug. It is not open to customer's application.
- **Access IP settings**: Configure the IP address or Netmask which are allowed to access RIO-2018.
- **DHCP option**:
  - Linkdown renew sec: Linkdown and time is out, RIO-2018 will request a new IP address.
- **Continue Discover**: On/Off, if failing in obtain IP address after power up, RIO-2018 will continuously request IP (On) or use static IP (Off).

4.6 How to Access the Data of RIO-2018

There are three way to access RIO-2018:

1. **Modbus**: user can use Modbus TCP to access RIO-2018. Using the holding register of RIO-2018, user can read the data of thermocouple channels and control the relay On/Off. The register format of RIO-2018 is available in the appendix.
2. **Web interface**: RIO-2018 support AJAX interface. It is designed for user to develop Web based application. A demo web page is available for your reference.
3. **X86 and Matrix ARM Linux API**: For users who want to develop their own application software using C language, they can use AIO library which is bundled with RIO-2018. Please refer the online help of the API for the information of using the AIO library.
4.7 Web-based I/O Control
In addition to Modbus TCP, user can also use Web port to access data and information of RIO-2018. RIO-2018 uses AJAX scheme to read and write I/O of the RIO-2018. Use GET request together with command parameter, you can retrieve data and information from the web server of RIO-2018. Use mouse to click the DO icon can trigger DO on/off.

![Image of RIO-2018 Web-based I/O Control]

4.8 AJAX Command
- Fetch All Value:
To get all value and settings of analog and digital channels of RIO-2018, you can use

```plaintext
GET URL:port/action/fetchValue?all_val=0
```

For example:

```plaintext
GET http://192.168.2.127:5003/action/fetchValue?all_val=0
```

The response data in JSON format as follow:

```json
GET http://192.168.2.127:5003/action/fetchValue?all_val=0
```

```json
{
  "DOVal": [
    {"name":"DO1","val":"L"},
    {"name":"DO1","val":"H"},
    {"name":"DO2","val":"L"},
    {"name":"DO2","val":"H"}
  ],
  "TCVal": [
    {"id":1,"TC1","em":"1","fault":"NONE","te_val":27.0,"rf_val":30.45,"unit":0,"sr":12Hz},
    {"id":2,"TC2","em":"1","fault":"NONE","te_val":70.0,"rf_val":30.21,"unit":0,"sr":12Hz},
    {"id":3,"TC3","em":"1","fault":"Open","te_val":0.0,"rf_val":0.0,"unit":0,"sr":12Hz}
  ]
}
```
- **Set Relay Output**: http://URL:port/action/CtrlDO

- **GET Thermocouple**:  
  Settings can be done by command:  
  
  \[
  GET URL:port/action/fetchAIcfg?all_val=0
  \]
  
  For example:  
  
  \[
  GET http://192.168.2.127:5003/action/fetchAIcfg?all_val=0
  \]
  
  The response data in **JSON** format as follow:

  ```json
  
  {    
    "CfgSelect": [      
      {       
        "name": "en_0", "val": "1"      
      },      
      {       
        "name": "sp_0", "val": "12"      
      },      
      {       
        "name": "en_1", "val": "1"      
      },      
      {       
        "name": "sp_1", "val": "12"      
      },      
      {       
        "name": "en_2", "val": "1"      
      },      
      {       
        "name": "sp_2", "val": "12"      
      },      
      {       
        "name": "unit", "val": "0"      
      }
    ]
  }
  
  en_x: 0: disable, 1: enable  
  sp_x: sampling rate: 1~12 (Hz)  
  unit: 0: degree Celsius, 1: Fahrenheit

- **SET Thermocouple**:  
  Settings can be done by command:  
  
  \[
  POST URL:port/action/CfgAI
  \]
  
  For example:  
  
  \[
  POST http://192.168.2.127:5003/action/CfgAI
  \]
add **save=1** will save the configuration and reboot RIO-2018 and RIO-2018 will response.

### 4.9 Convert HTML File to Anf Binary

User can customize web page to access RIO-2018. Once ready, you can use Manager utility to convert the web files to binary file (.anf) to upload to RIO-2018. First to create a folder to save all the Web files and then click the HTML icon to convert web data to .anf file and upload to RIO-2018.

The default web page source is available at Artila Web for download.
Click the HTML icon and use following tool to convert the folder of Web page files to a binary file with extension of anf and upload it to web server of RIO-2018.

4.10 Access RIO-2018 via Modbus TCP
RIO-2018 supports Modbus TCP access. The Holding register is as follow:

<table>
<thead>
<tr>
<th>Starting address</th>
<th>Stoping address</th>
<th>Temp sensor 1</th>
<th>RIO-2010 only</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0000</td>
<td>0x000F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x0010</td>
<td>0x001F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x0020</td>
<td>0x002F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temp sensor 2</th>
<th>RIO-2010 only</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0100</td>
<td>0x0105</td>
</tr>
<tr>
<td>0x0106</td>
<td>0x010B</td>
</tr>
<tr>
<td>0x011C</td>
<td>0x0111</td>
</tr>
<tr>
<td>0x0112</td>
<td>0x0117</td>
</tr>
<tr>
<td>0x0118</td>
<td>0x011D</td>
</tr>
<tr>
<td>0x011E</td>
<td>0x0123</td>
</tr>
<tr>
<td>0x0124</td>
<td>0x012B</td>
</tr>
<tr>
<td>0x012A</td>
<td>0x012F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AI1</th>
<th>RIO-2017 only</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI2</td>
<td>RIO-2017 only</td>
</tr>
<tr>
<td>AI3</td>
<td>RIO-2017 only</td>
</tr>
<tr>
<td>AI4</td>
<td>RIO-2017 only</td>
</tr>
<tr>
<td>AI5</td>
<td>RIO-2017 only</td>
</tr>
<tr>
<td>AI6</td>
<td>RIO-2017 only</td>
</tr>
<tr>
<td>AI7</td>
<td>RIO-2017 only</td>
</tr>
<tr>
<td>AI8</td>
<td>RIO-2017 only</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC1</th>
<th>RIO-2018 only</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC2</td>
<td>RIO-2018 only</td>
</tr>
<tr>
<td>TC3</td>
<td>RIO-2018 only</td>
</tr>
</tbody>
</table>
## Thermocouple (TC) Holding Register

| Register[0] Hi | TC enable/disable | 0x01: enable  
| Register[0] Lo | TC Sign flag | 0x00: +  
| Register[1] Hi | TC integer Hi | degree Celsius  
| Register[1] Lo | TC integer Lo | degree Celsius  
| Register[2] Hi | TC decimal Hi | degree Celsius  
| Register[2] Lo | TC decimal Lo | degree Celsius  
| Register[3] Hi | Reference integer | degree Celsius  
| Register[3] Lo | Reference decimal | degree Celsius  
| Register[4] Hi | Reference Sign flag | 0x00: +  
| Register[4] Lo | Fault | 0x01: -  
| Register[4] Lo | Fault | 0x00: None  
| | | 0x01: Open  
| | | 0x02: short to GND  
| | | 0x03: short to VCC  

Please refer to Modbus TCP function list for more information.