RIO-2018

Analog Input Remote I/O Module

User Guide

Version 1.0

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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

- Opto-isolation: 2500Vrms

1.3 Packing List

- RIO-2018J / RIO-2018K: Analog Input Remote I/O Module
- Software utility download from Artila 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

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

2. Layout

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.

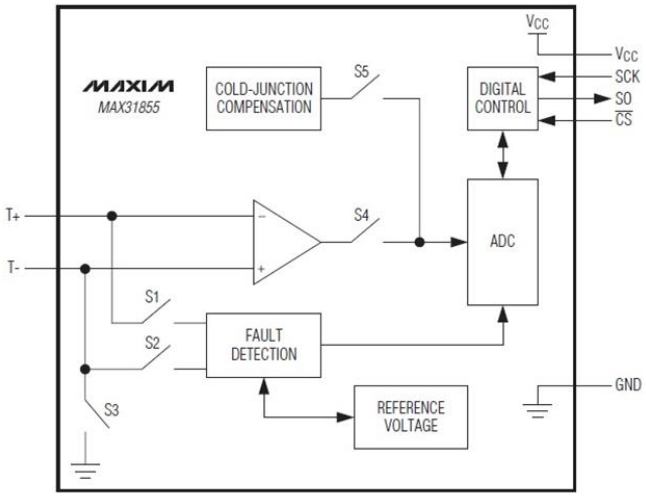
3.2 LED Status

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.

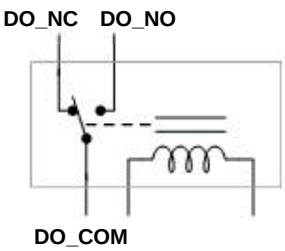
3.3 Thermocouple Input (T/C1 to T/C3)

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:

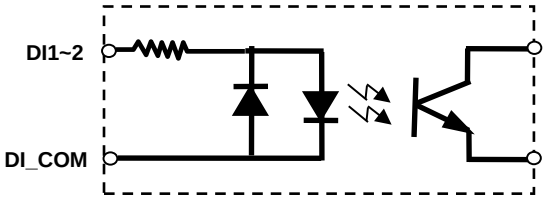
Logical High: 5~24Vdc

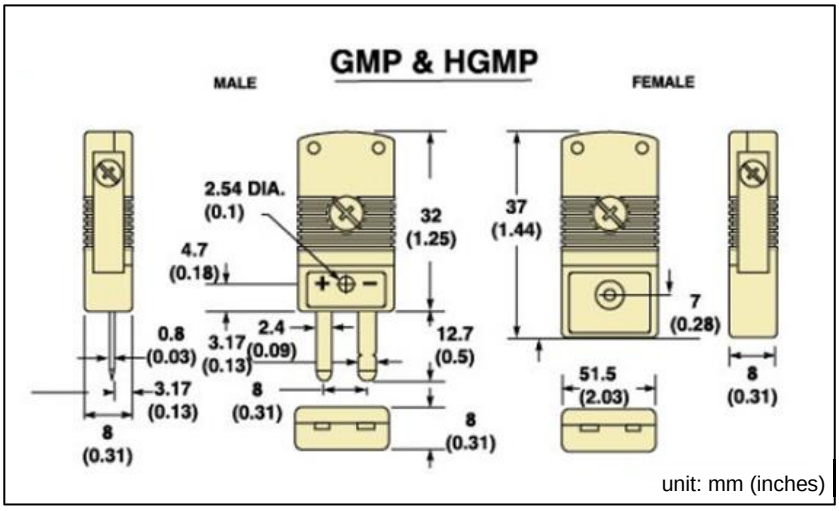
Logical Low: 0~1.5Vdc

Input resistance: 1.2KOhms@0.5W

Response time: 20μs

Isolation: 2500Vrms





Thermocouple connector

3.6 Factory Default Settings

IP Address: 192.168.2.127

Netmask: 255.255.255.0

Modbus port: 502

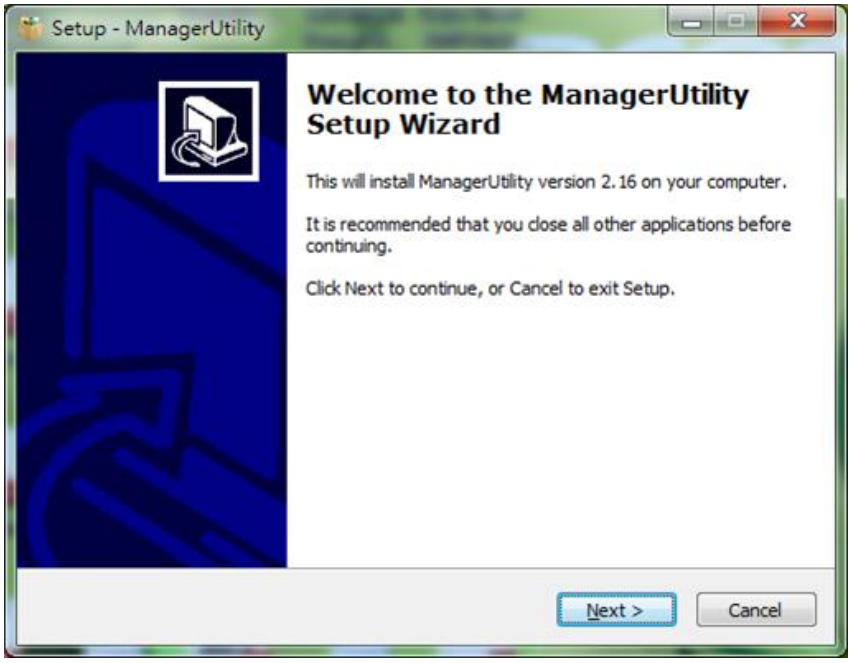
Web port: 5003

Telnet console port: 5001

Web console: http://192.168.2.127:5003/kcfg.html

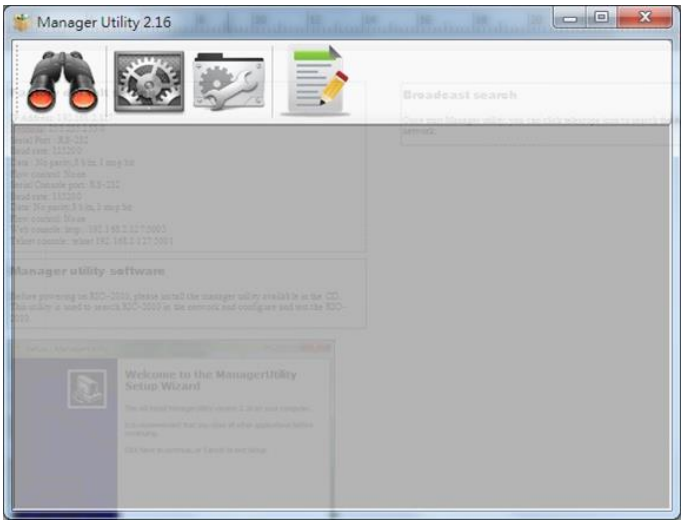
4. Manager Utility Software

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.



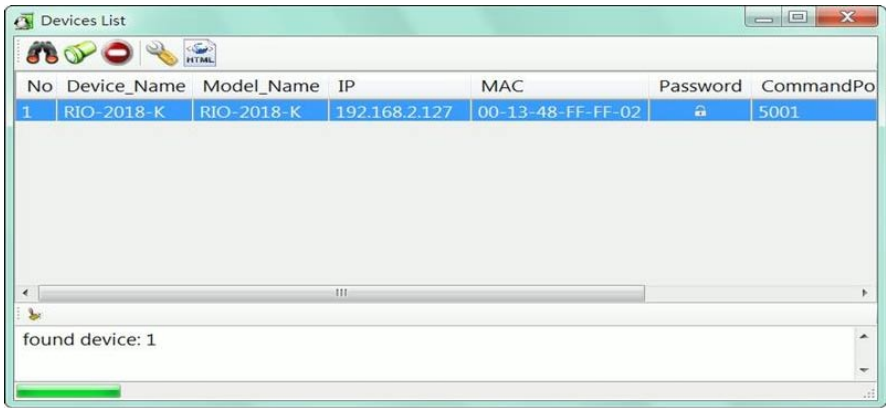
4.1 Broadcast Search

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



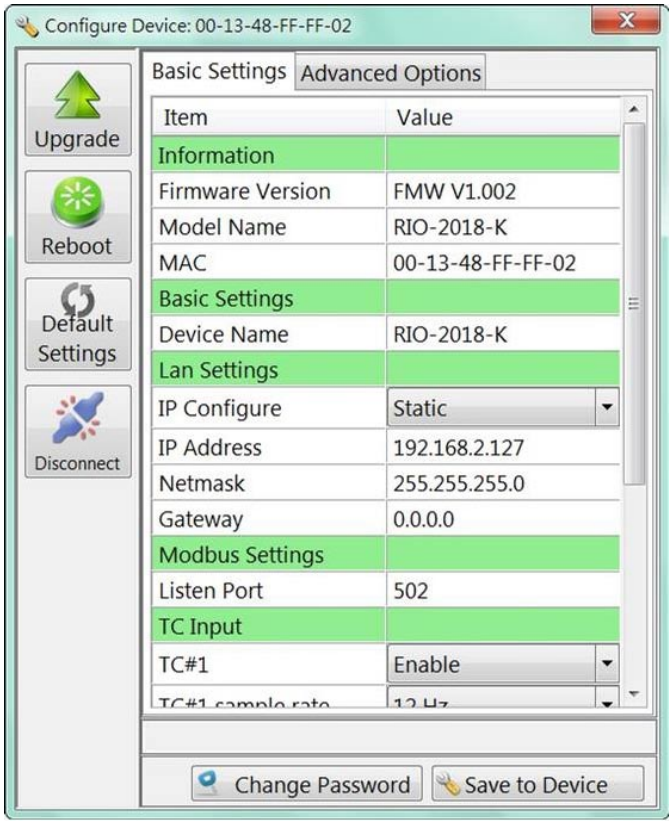
4.2 Configure RIO-2018

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:

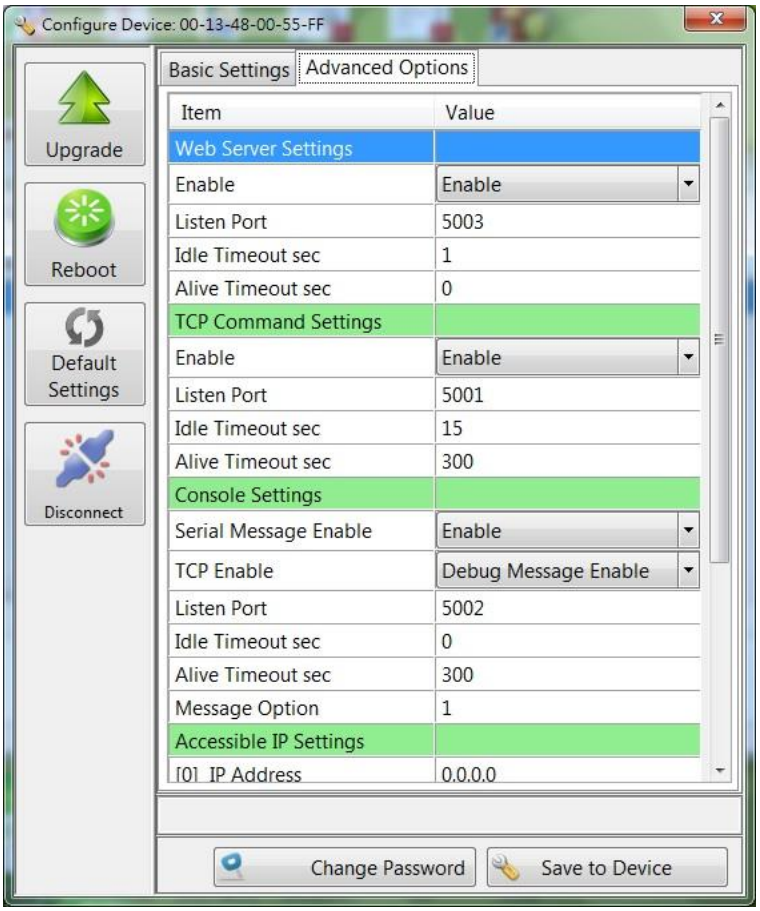


- **Modbus settings:**
  - Listen Port: Modbus TCP listen port
- **TC Input:** Thermocouple Input setting
  - TC#: Enable/Disable TC channels
  - Sample rate: 1~12Hz
- **DO power on value:**
  - Low: Relay is de-energized

- High: Relay is energized

4.4 Advanced Options

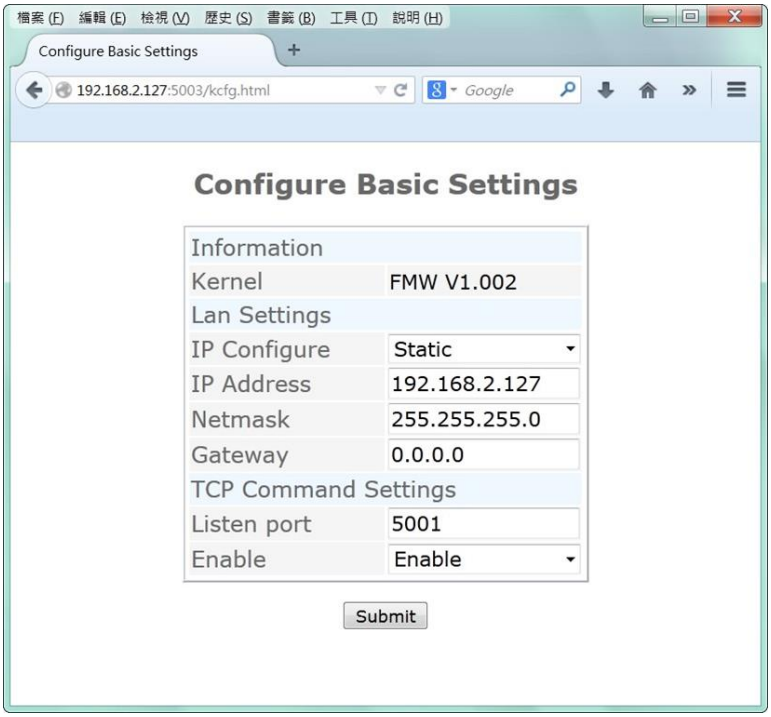
The Advanced options allow user to configure following settings:



- **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

RIO-2018 web console page is at http://192.168.2.127:5003/kcfg.html.



- **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).

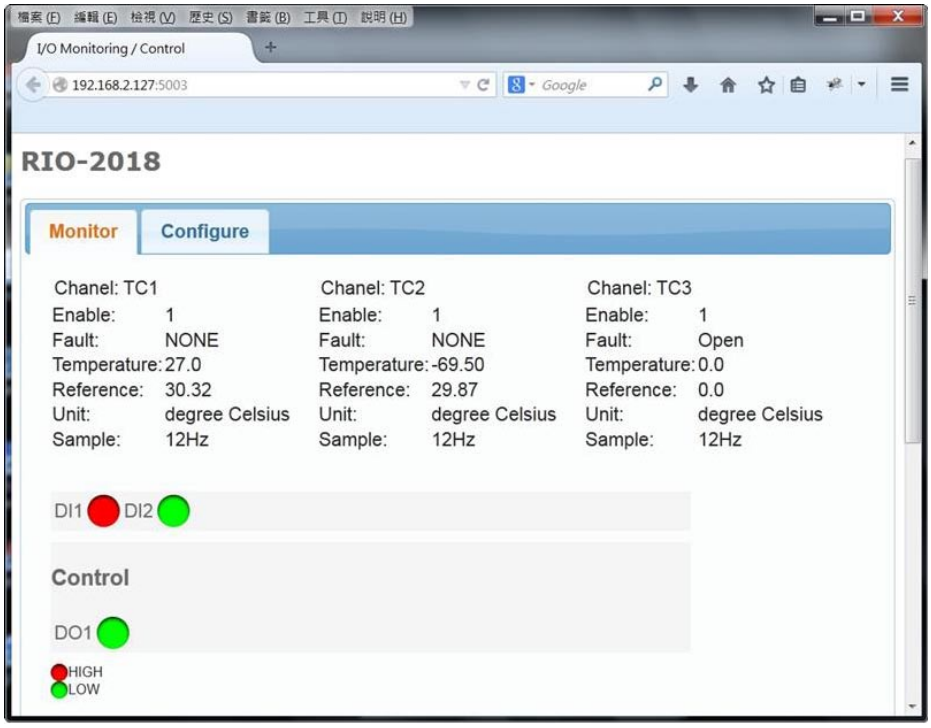
4.6 How to Access the Data of RIO-2018

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 on line 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.



4.8 AJAX Command

- **Fetch All Value:**

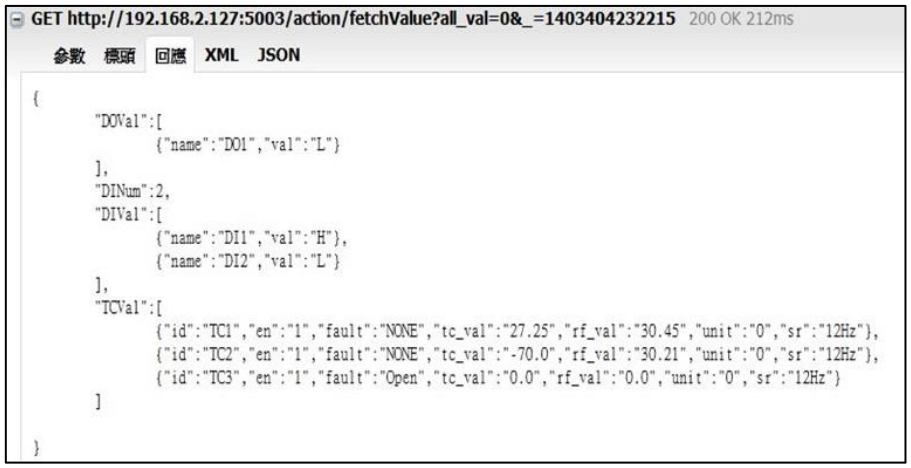
To get all value and settings of analog and digital channels of RIO-2018, you can use

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

For example:

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

The response data in **JSON** format as follow:



- **Set Relay Output:** http://URL:port/action/CtrlDO

- **GET Thermocouple:**

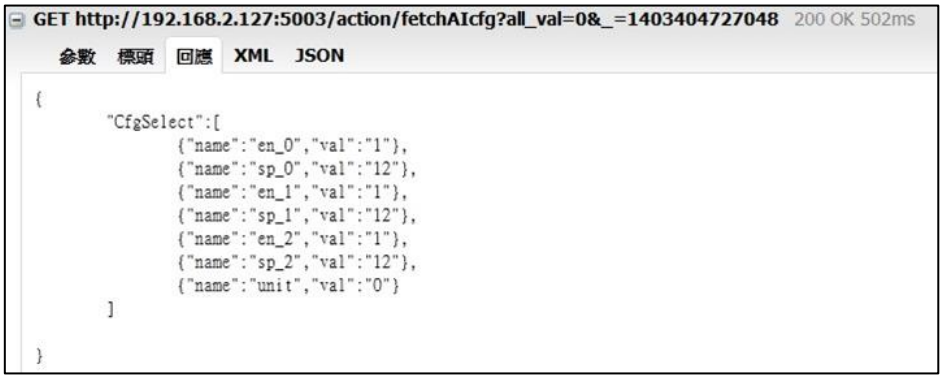
Settings can be done by command:

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:



en_x: 0: disable, 1: enable

sp_x: sampling rate: 1~12 (Hz)

unit: 0: degree Celcius, 1: Fahrenheit

- **SET Thermocouple:**

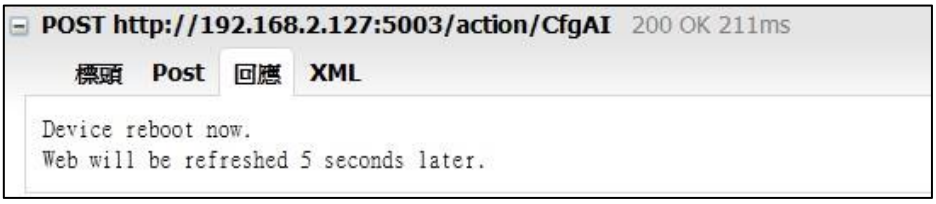
Settings can be done by command:

POST URL:port/action/CfgAI

For example:

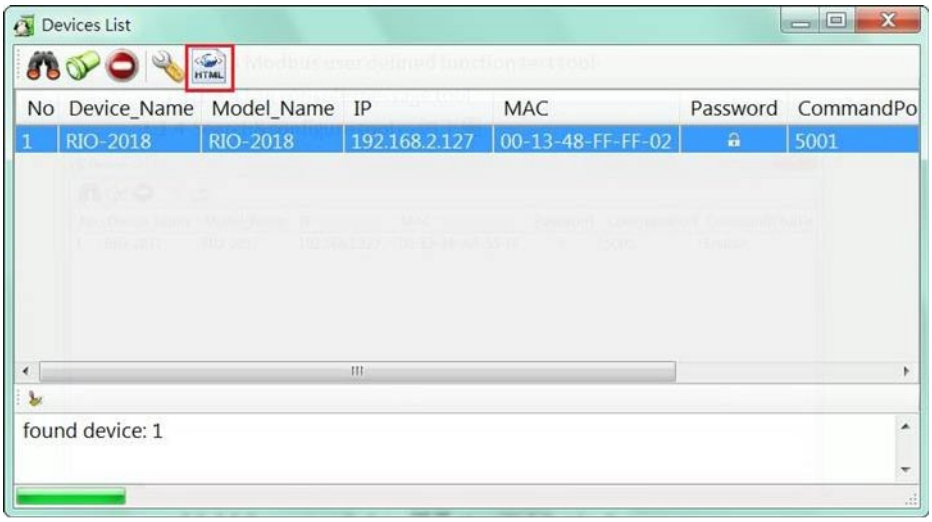
POST http://192.168.2.127:5003/action/CfgAI

add ***&save=1*** will save the configuration and reboot RIO-2018 and RIO-2018 will response.



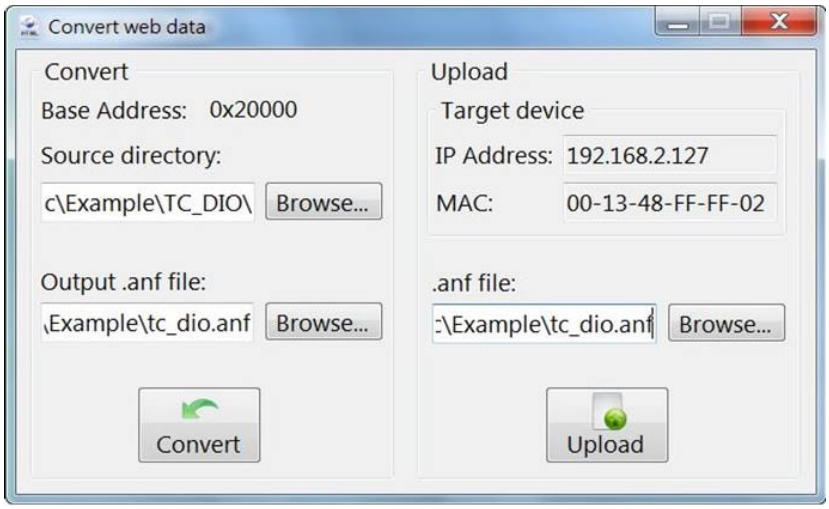
4.9 Convert HTML File to Anf Binary

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:

Register Map

Starting address	Stoping address		
0x0000	0x000F	Temp sensor 1	RIO-2010 only
0x0010	0x001F	Temp sensor 2	RIO-2010 only
0x0020	0x002F	Temp sensor 3	RIO-2010 only
0x0100	0x0105	AI1	RIO-2017 only
0x0106	0x010B	AI2	RIO-2017 only
0x010C	0x0111	AI3	RIO-2017 only
0x0112	0x0117	AI4	RIO-2017 only
0x0118	0x011D	AI5	RIO-2017 only
0x011E	0x0123	AI6	RIO-2017 only
0x0124	0x012B	AI7	RIO-2017 only
0x012A	0x012F	AI8	RIO-2017 only
0x0200	0x0209	TC1	RIO-2018 only
0x020A	0x0213	TC2	RIO-2018 only
0x0214	0x021D	TC3	RIO-2018 only

Thermocouple (TC) Holding Register

Register[0] Hi	TC enable/disable	0x01: enable 0x00: disable	
Register[0] Lo	TC Sign flag	0x00: + 0x01: -	
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: + 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.