Trademarks
The Artila logo is a registered trademark of Artila Inc. All other trademarks or registered marks in this manual belong to their respective manufacturers.

Disclaimer
Information in this document is subject to change without notice and does not represent a commitment on the part of Artila.

Artila provides this document as is, without warranty of any kind, either expressed or implied, including, but not limited to, its particular purpose. Artila reserves the right to make improvements and/or changes to this manual, or to the products and/or the programs described in this manual, at any time.

Information provided in this manual is intended to be accurate and reliable. However, Artila assumes no responsibility for its use, or for any infringements on the rights of third parties that may result from its use.

This product might include unintentional technical or typographical errors. Changes are periodically made to the information herein to correct such errors, and these changes are incorporated into new editions of the publication.
Document Amendment History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>V 1.0</td>
<td>2017 Feb.</td>
<td>Initial</td>
</tr>
<tr>
<td>V1.1</td>
<td>2017 Jul.</td>
<td>Add “WAPI (Web API) information”</td>
</tr>
</tbody>
</table>
# Table of Contents

1. **Introduction** ......................................................................................... 6  
   1.1 Features ............................................................................................. 6  
   1.2 Specification ....................................................................................... 6  
   1.3 Packing List ........................................................................................ 7  
   1.4 Optional Accessory ............................................................................ 7  

2. **Layout** ............................................................................................... 8  

3. **Pin Assignment and Definitions**........................................................... 9  
   3.1 Power Connector ............................................................................... 9  
   3.2 LED Status ......................................................................................... 9  
   3.3 Thermocouple Input (T/C1 to T/C3) .................................................... 9  
   3.4 Relay Output Connector (DO_OUT, DO_COM) ............................... 10  
   3.5 Digital Input Connector (DI1, DI2, DI_COM) ..................................... 10  
   3.6 Factory Default Settings ................................................................... 11  

4. **Manager Utility Software** ..................................................................... 12  
   4.1 Download Manager Utility ................................................................ 12  
   4.2 Manager Utility Installation and Execution ........................................ 13  
   4.3 Start-Up Manager Utility ................................................................... 13  
   4.4 Broadcast Search ............................................................................. 14  
   4.5 Configure the device ......................................................................... 14  
   4.5.1 Basic Settings & Advanced Options ................................................. 15  
   4.5.2 Alarm Setting ................................................................................ 16  
   4.5.3 Bluemix Command ....................................................................... 17  

5. **Connect to Watson IoT Platform & Work with Node-RED** ................. 18  
   5.1 Start to Use IBM Bluemix ................................................................. 18  
   5.1.1 Sin-Up IBM Bluemix .................................................................... 18  
   5.1.2 Log-in and setup .......................................................................... 19  
   5.1.3 Apps of Bluemix .......................................................................... 20  
   5.2 Device Registration .......................................................................... 21  
   5.3 Visual the data in Watson IoT Platform Dashboard .......................... 25  
   5.4 Working on Node-RED ..................................................................... 25  

6. **WAPI (Web API) on RIO-2018BM**...................................................... 27  
   6.1 Read Temperature Data ................................................................... 27  
   6.2 Read Digital Output value ................................................................. 27  
   6.3 Read Digital Input Value ................................................................... 27  
   6.4 Set Digital Output Value ................................................................... 28  
   6.4.1 GET Method ................................................................................ 28  
   6.4.2 POST Method ............................................................................. 28
6.5 NTP Time Synchronization............................................................................. 30
1. Introduction

RIO-2018BM is a thermocouple input remote I/O module supports IBM Bluemix and Web interface. RIO-2018BM has two models J and K to support J and K type thermocouple. In addition to the thermocouple input, RIO-2018BM also has two isolated digital input channels and one form C relay output. Therefore, it is suitable for temperature measurement and control. In addition to directly connect to IBM Watson IoT platform, data exchange that can be achieved by RESTful API for Web application access.

1.1 Features

- Remote Analog Input Module with TLS MQTT for Bluemix and Web RESTful API
- One 10/100Mbps Ethernet port
- 3 channels J or K type thermocouple input with cold junction compensation
- Two 2500Vrms isolated digital input (bipolar input photo-couple)
- 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: MQTT, UDP, HTTP, DHCP
    (MQTT Port is Fixed at 8883)

- 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
Power:
- 9~48VDC power input
- Terminal block

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
- Software utility download from Artila Web (http://www.artila.com/download)

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 original manufacturer directly.
2. Layout

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

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-2018BM operation information. The LED status is described as following:

- **Power LED**: Power LED keeps ON if power (+9VDC to +48VDC) is correct.
- **Ready LED**: Ready LED keeps ON when RIO-2018BM 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-2018BM. 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.

![Relay Output Connector Diagram]

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

![Digital Input Connector Diagram]

Thermocouple connector

![Thermocouple Connector Diagram]

unit: mm (inches)
3.6 Factory Default Settings

- **IP Address**: 192.168.2.127
- **Netmask**: 255.255.255.0
- **Web port**: 5003
- **Telnet console port**: 5001
4. Manager Utility Software

Manager Utility is a software provided by Artila that is used to configure and test devices though networking. Please install “Manager Utility” on PC before start up RIO-2018BM.

4.1 Download Manager Utility

You may visit Artila website: http://www.artila.com/, click “Download”

Select “RIO/RIO-2018BM” at Download page that shows the product series.

http://www.artila.com/download/RIO/RIO-2018BM/

Index of /download/RIO

- Parent Directory
- RIO-2010/
- RIO-2010BM.zip
- RIO-2010PG.zip
- RIO-2010PG/
- RIO-2015PG.zip
- RIO-2017/
- RIO-2017BM.zip
- RIO-2018/
- RIO-2018BM.zip

Apache Server at www.artila.com Port 80

You may also go for RIO-2018BM product page at “Remote I/O”

Welcome to Artila Electronics

Artila Electronics is founded by professionals with more than 15 years of experience in industrial computer field. Artila focuses on developing easily accessible, flexible, programmable industrial ARM-based embedded Linux solutions, including embedded ARM9/Linux single board computers / box computers / system on modules, and serial-to-Ethernet embedded modules.

Apart from standard products, Artila Electronics is highly willing to accept OEM / ODME requests to design and manufacture customized hardware and software.

Inelligent IoT Gateway  IoT Device Platform Programmable Automation Controller Remote I/O Industrial Communication Gateway

click “resource button” to download Artila Manager utility
4.2 Manager Utility Installation and Execution

Install Manager Utility in your Windows-based computer and run the software.

4.3 Start-Up Manager Utility

After completed Installation of Manager Utility, you may see an icon on PC.

Click it to execute Manager Utility. It shows the home page as following:

- **Broadcast Search and device configuration**
- **Modbus test (NOT Available for RIO-XXXXBM series)**
- **Modbus user define test (NOT Available for RIO-XXXXBM series)**
- **Log (NOT Available for RIO-XXXXBM series)**
4.4 Broadcast Search

Start-up the Manager utility software and click telescope icon ⬇️ to search the RIO device in the network.

![Devices List](image)

4.5 Configure the device

Double-click the RIO device at previous figure, it will go to “Configure Device” page

**Command Button:**

- : Device firmware upgrade
- : Device Reboot
- : Set device to default setting (device will reboot)
- : Disconnect networking
- : Password setting (Default: NO password)
4.5.1 Basic Settings & Advanced Options

User can upgrade firmware, reboot/disconnect device, set to default setting, change device name/password and other basic setting easily via remote operating. After configured, be sure to press “Save to Device” to save all settings.

- **Device Name**: user configurable device name
- **IP Configure**: Static IP or DHCP
- **Analog Input / Al#**: Analog input range setting
- **DO Power on Value / DO#**: Digital Output setting
- **Bluemix Settings**
  Input Bluemix related information after registration.
- **NTP Settings**
  Clock Synchronization setting
- **Web Server Settings**
  - Enable: Enable or Disable Web server
  - Listen Port: Web server port
  - Alive Timeout sec: disconnect connection while no data on line, time out and no response to Ack signal
- **TCP Command**
  - Enable: Enable or Disable TCP command port
  - Listen Port: TCP command port number
  - 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

- **Console Settings**
  Console setting is used for designer to perform system debug, Currently it is not available for user’s application

- **Accessible IP Settings**
  Access control setting. Let user configure the IP address and Netmask range and masters only with these IP address can access the device.
  User can setup three IP Address / Netmask (Maximum)

- **DHCP Options**
  - LinkDown Renew sec: Setting the time period while device linkdown. after then, it will renew IP automatically.
  - Continue Discover: While device fails to get IP,
    - OFF: back to default setting (static IP)
    - ON: Keep-on discover

4.5.2 Alarm Setting
User can setup for alarm conditions and action via DO.
4.5.3 Bluemix Command

Setup “Factory Reset” function of Bluemix to:

- **NONE**: No action
- **DO**: Low
- **DO**: High
5. Connect to Watson IoT Platform & Work with Node-RED

Securely connect the RIO-2018BM device to IBM Bluemix Watson IoT platform and visualize data by the dashboard of Watson IoT platform and then use Node-RED application to receive events from RIO-2018BM.

5.1 Start to Use IBM Bluemix

5.1.1 Sign-Up IBM Bluemix

To use Watson IoT platform, you need to register your device first. Please visit IBM Bluemix website for registration at https://console.ng.bluemix.net/.

Press “Sign Up” or “Create a free account” to sign up your IBMID and create your Bluemix account.

After confirm Account via email, the registration has been completed.
5.1.2 Log-in and setup
At first Log-in, it needs to setup some information step by step.

Create Organization and Space
Remember to select the Region (US South) where Watson IoT platform is available.
After completed the settings, press “I’m Ready” to explore Bluemix.

5.1.3 Apps of Bluemix
Get started with one of the options that follow,

or go to the catalog to create an app at https://console.ng.bluemix.net/
5.2 Device Registration
To register devices at following website:
https://console.ng.bluemix.net/catalog/?category=apps&taxonomyNavigation=apps

Select "Internet of Things Platform" at IBM Bluemix Catalog.

Press "Create" at bottom to get into Watson IoT Platform.
After Pressing “Launch”, you may start to manage device under Watson IoT Platform.

Remember to use RIO-2018BM MAC address which can be found in the Manager utility as Device ID. For example: 001348023F83

Add Device

Device Info

Device ID is the only required information, however other fields are populated according to the attributes set in the selected device type. These values can be overridden, and attributes not set in the device type can be added.

Device ID

Enter device ID (required):

+ Additional fields
Also, enter Token string, for example: artila@rio2018, at following page.

Add Device

Security

You have two options:

Auto-generated authentication token

Allow the service to generate an authentication token for you. The token will be 13 characters long and will contain a mix of alphanumeric characters and symbols. The token will be returned to you at the end of the registration process.

Self-provided authentication token

Provide your own authentication token for this device. The token must be between 8 and 36 characters long, and should contain a mix of lower and upper case letters, numbers, and symbols (hyphen, underscore, exclamation point, ampersand, at sign, question mark, period, right and left parentheses are permitted). The token should be free of repetition, dictionary words, user names, and other predefined sequences.

Provide a token (optional) Enter authentication token here

Then, the device has been registered.

Device 001348023F83

Device

Your Device Credentials

You have registered your device to the organization. To get it connected, you need to add those credentials to your device. Once you’ve added these, you should see the messages sent from your device in the ‘Sensor Information’ section on this page.

<table>
<thead>
<tr>
<th>Organization ID</th>
<th>Device Type</th>
<th>Device ID</th>
<th>Authentication Method</th>
<th>Authentication Token</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>001348023F83</td>
<td></td>
<td>artila@rio2017</td>
</tr>
</tbody>
</table>
Fill-in the registration information of device in Watson to the Manager utility in this case as following and save to device.

Then, the Devices page will display all devices that you have registered also online/offline status.

Once connected shown as below, it can start to transit events from RIO device to Watson IoT Platform.
5.3 Visual the data in Watson IoT Platform Dashboard

With the new boards and cards capability in the Watson Internet of Things platform, you can build your own Custom dashboard without writing any code. You can use the boards as the landing page of interest and then make use of the cards within them to:

(1) Create visualization charts for the real time data from your devices
(2) Create Gauges for visualizing physical quantities like Temperature.
(3) Create Donuts charts, bar charts to display the current value of the data points
(4) See the Data and storage consumption of your devices
(5) List of registered devices and etc..

5.4 Working on Node-RED

Create a Node-RED application to receive events from RIO-2018BM. In the Bluemix catalog, select the Node-RED Starter under the Boilerplate category as shown below,

https://console.ng.bluemix.net/catalog/?category=apps&taxonomyNavigation=apps
(1) Open Node-RED flow editor
(2) Add an ibmiot input node and configure it to use API key authentication. Set the Device Type field to match the type you used to register your device with. Leave the Device Id and Event fields set to all.

(3) The API key is required and can be generated by Watson IoT Platform

(4) Attach the debug node to the IBM IoT node as shown below to output the data points in the debug panel.
6. WAPI (Web API) on RIO-2018BM

6.1 Read Temperature Data

- Command: `http://localHost:5003/wapi/v1/get/TC`
- Response(JSON):

```
{ "type": "TC", "action": "GET", "date": "Tue Nov 22 13:36:47 CCT 2016", "TCVal": [ { "id": "TC1", "en": "1", "fault": "NONE", "tc_val": "20.06", "tc_raw": "20.19", "rf_val": "24.11", "unit": "C", "sr": "12Hz" }, { "id": "TC2", "en": "0", "fault": "NONE", "tc_val": "0.00", "tc_raw": "0.00", "rf_val": "0.00", "unit": "C", "sr": "1Hz" }, { "id": "TC3", "en": "0", "fault": "NONE", "tc_val": "0.00", "tc_raw": "0.00", "rf_val": "0.00", "unit": "C", "sr": "1Hz" } ] }
```

6.2 Read Digital Output value

- Command: `http://localHost:5003/wapi/v1/get/DO`
- Response(JSON):

```
{ "type": "DigitalOutput", "action": "GET", "date": "Tue Nov 22 13:36:28 CCT 2016", "response": [ { "items": 1, "data": [ { "key": "DO1", "val": "L" } ] } ] }
```

6.3 Read Digital Input Value

- Command: `http://localHost:5003/wapi/v1/get/DI`
- Response(JSON):

```
{ "type": "DigitalInput", "action": "GET", "date": "Tue Nov 22 13:36:05 CCT 2016", "response": [ { "items": 2, "data": [ { "key": "DI1", "val": "H" }, { "key": "DI2", "val": "L" } ] } ] }
```
6.4  Set Digital Output Value

6.4.1 GET Method

- Set Individual DO Value:
  - Command:  [http://localHost:5003/wapi/v1/set_do?DO1=H](http://localHost:5003/wapi/v1/set_do?DO1=H);
  - Response(JSON):

- Set All channel of DO value:
  - Response(JSON):

6.4.2 POST Method

- Command:  [http://localHost/wapi/v1/set_do](http://localHost/wapi/v1/set_do)
  - Set individual DO value:
    - Content of Request:  DO1=L
  - Set All DO Channel value
    - Content of Request:  ALL=H
6.5 NTP Time Synchronization

- **GET Method:**
  - Command: [http://localHost:5003/wapi/v1/ntp_now](http://localHost:5003/wapi/v1/ntp_now)

- NTP configuration settings in Manager utility: