EtherWAN

EDGE 1

IoT LPWA Solution

Industrial LoRa Edge Node

User's Guide

All Rights Reserved

Disclaimer of Liability

The information contained in this document is subject to change without notice. EtherWAN is not liable for any errors or omissions contained herein or for resulting damage in connection with the information provided in this manual.

Registered Trademarks

The following words and phrases are registered Trademarks of EtherWAN Systems Inc.

EtherWAN

All other Trademarks are property of their respective owners.

Warranty

For details on the EtherWAN warranty replacement policy, please visit our web site at:
www.etherwan.com

Contact EtherWAN Systems

8F., No.2, Alley 6, Lane 235, Baoqiao Rd.
Xindian District, New Taipei City 231
Taiwan
Tel: +886 -2- 6629-8986
Email: info@etherwan.com.tw

Preface

Audience

This guide is designed for the person who installs, configures, deploys, and maintains the Ethernet network. This document assumes the reader has moderate hardware, computer, and networking skills.

Document Revision Level

This section provides a history of the revision changes to this document.

Revision	Document Version	Date	Description
A	Version 1	01/10/2020	First release
B	Version 1	11/17/2020	Battery and Bluetooth removed from contents
C	Version 1	02/04/2021	Features extended

Preface 3
Chapter 1 Introduction 5
1.1 Introduction 5
1.2 Contents List 6
1.2.1 Package Contents 6
1.2.2 Optional Accessories 6
1.3 Hardware Configuration 7
1.4 LED Indication 8
1.5 Installation & Maintenance Notice 9
1.5.1 SYSTEM REQUIREMENTS 9
1.5.2 WARNING 9
1.5.4 Product Information for CE RED Requirements 11
1.6 Hardware Installation 12
1.6.1 Open the Top Cover 12
1.6.2 Install Battery (Optional Accessory) 14
1.6.3 Connecting to External Devices 17
1.6.4 Connecting Console Port for PC Configuration Tool 26
1.6.5 Power On the EDGE 1 27
1.6.6 Setup with Windows-based Configuration Tool 29
1.6.7 Device Mount and Screw Back the Top Cover 31
Chapter 2 Device Configuration 32
2.1 Device Status 32
2.2 LoRa Configuration 33
2.3 I/O Configuration 37
2.4 Modbus Configuration 40
2.5 Event Configuration 42
2.6 System Configuration 44
2.7 CLI Console Log 47
Chapter 3 Commands for the LoRa Node 48
3.1 Command Basics 48
3.2 Commands 50
Contact Information 59

Chapter 1 Introduction

1.1 Introduction

Congratulations on your purchase of this outstanding product: EDGE Series Industrial LoRa Edge Node. For IoT applications, EtherWAN LoRa Node is absolutely the right choice. With a built-in world-class LoRaWAN module, you can easily deploy the LoRa nodes with LoRaWAN compliant LoRa Gateway / NS / AS for a public or private LoRaWAN service.

The EDGE 1 is a cost-effective low complexity solution for simple data acquisition and wireless telemetry. LoRa and LoRaWAN are optimized for low bandwidth IoT traffic over wide area to transmit data at low data rates. It allows massive deployment of wireless IoT with carrier-level security. Thanks to the power saving technology, the EDGE 1 has ultra-low power consumption which allows it to operate on a single battery for years*[1].

Main Features:

- Simple device with various interfaces (AI / DI / RS485) for IoT field data acquisition.
- Transfer of field data to associated LoRa Network Server at pre-defined time interval, or on an event at the site.
- Automatic issuing low battery power alerts to remote server for device or battery replacement.
- Configure the LoRa node via a PC with a convenient configuration utility.
- Water-resistant, dust-resistant IP65 enclosure for installing in severe environments.

Before you install and use this product, please read this manual in detail to make full use of its functions.

1 The battery lifespan depends on actual usage (frequency of data logging, and data uploading) of the data logger.

1.2 Contents List

1.2.1 Package Contents

#Standard Package

Items	Description	Contents	Quantity
1	**EDGE 1 LoRa Node**		1pcs
2	**AI Jumper**		3pcs
3	**Water/Dust-proof Stopper**		3pcs

1.2.2 Optional Accessories

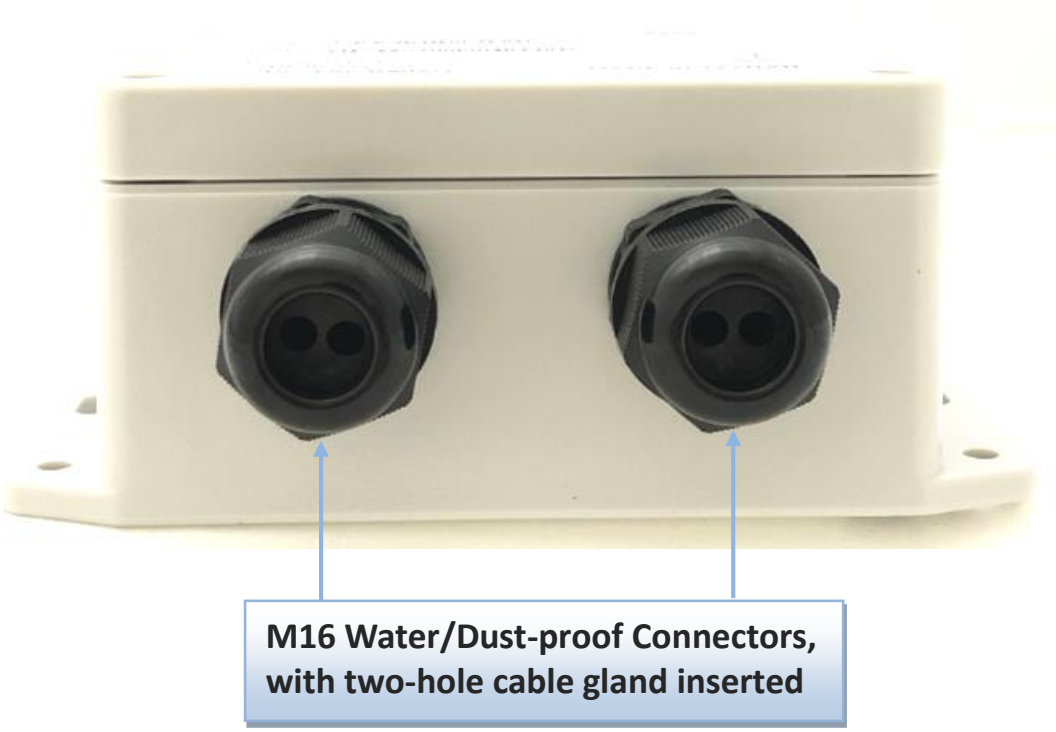
#Optional parts (these parts are sold separately)

Items	Description	Contents	Comments
1	**Battery**		1 pcs

These parts are sold separately. If necessary, please contact the manufacturer via info@etherwan.com.tw

1.3 Hardware Configuration

➢ **Front View**



1.4 LED Indication

LED Icon	Indication	LED Color	Description
LED	Device Status	Blue / Red	**Steady OFF:** Device is powered off. **Blue Flash per second:** Device is booting up with operation. **Red Flash:** Battery low. **Blue and Red Steady ON:** Device is in Recovery mode, or firmware upgrading.

1.5 Installation & Maintenance Notice

1.5.1 SYSTEM REQUIREMENTS

Network Requirements	• LoRaWAN compliant Gateway and Network Server
Configuration Tool Requirements	**Computer with the following:** • Windows®7 or Windows 10 • A USB 2.0 or later port for configuration

1.5.2 WARNING

Attention

- Only use the battery that comes with the package or a external DC Power Supply that complies with the device specifications. Using a different voltage rating power adaptor is dangerous and may damage the product.
- DO NOT remove or repair the control board by yourself. If the product is too hot or malfunctioning, turn off the device and have it repaired at a qualified service center.
- Place the product on a stable surface, or screw it to a solid plate or wall.

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

FOR PORTABLE DEVICE USAGE (<20m from body/SAR needed)

Radiation Exposure Statement:

The product comply with the FCC portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

FOR MOBILE DEVICE USAGE (>20cm/low power)

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

FOR COUNTRY CODE SELECTION USAGE (WLAN DEVICES)

Note: The country code selection is for non-US model only and is not available to all US model. Per FCC regulation, all WiFi product marketed in US must fixed to US operation channels only.

1.5.4 Product Information for CE RED Requirements

The following product information is required to be presented in product user manual for latest CE RED requirements. [2]

(1) Frequency Band & Maximum Power

1. Frequency Band for LoRa Connection

Band	Operating Frequency	Max. Output Power
AS923	920-925MHz	100 mW (20dBm)
EU868	863 - 870MHz	100 mW (20dBm)

(2) RF Exposure Statements

The antenna of the product, under normal use condition, is at least 20 cm away from the body of user.

(3) Unit Mounting Notice

The product is suitable for mounting at heights <= 2m (approx. 6 ft), or in a cabinet.
Ensure the unit is fixed tightly to reduce the likelihood of injury due to exposure to mechanical hazards if dropped.

(4) Manufacturer Information

Manufacturer Name: EtherWAN Systems, Inc.
Manufacturer Address: 8F, No.2, Alley 6, Lane 235, Baoqiao Rd., Xindian Dist., New Taipei City 231, Taiwan (R.O.C.)

2 The information presented in this section is ONLY valid for the EU/EFTA regional version. For those non-CE/EFTA versions, please refer to the corresponding product specification.

1.6 Hardware Installation

Hereunder list the available hardware ports of EDGE 1:

- **LoRa:** 1 LoRa node module, LoRaWAN protocol supported
- **Analog Input:** 3 AI ports (AI1, AI2 supports 0-10V / 4-20mA; AI3 supports 0-20V / 0-40mA)
- **Digital Input:** 2 DI ports (isolated, supports Pulse Counter, Logical Level)
- **Digital Output:** 1 DO port (isolated, Non-Relayed Output)
- **Field Bus:** 1 RS-485 for Modbus RTU
- **Console Port:** 1 Micro USB port for device configuration
- **Wake-up Port**: 1 dedicated DI for external device wake-up triggering.
- **Power Source :** 4000mAh 3.6V Li-SOCL2 battery (ER18505, A Size) – Option accessory, or external 5V~12V DC power.

This section describes how to install and configure the hardware.

1.6.1 Open the Top Cover

The EDGE series is designed for universal data logging use. There are various interfaces for connecting to your field devices, all enclosed with an IP65 grade enclosure. All the connection cables to the field devices must be wired properly through the M16 connectors.

Therefore, prior to connecting and configuring the EDGE 1, you have to open the top cover to get access to the control board.

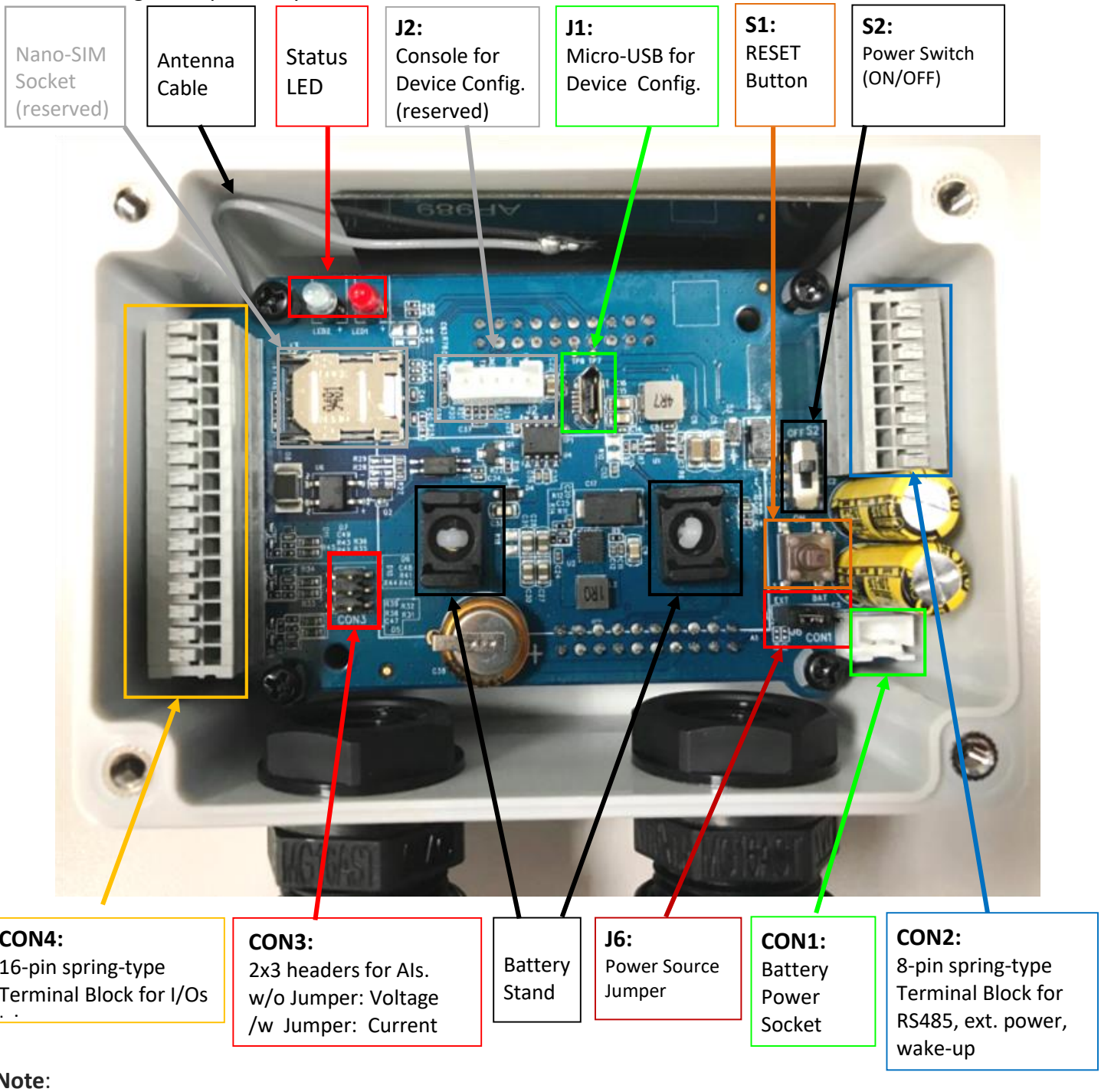
Unscrew the four screws and remove the top cover to the side carefully.

➔

You can see there are many hardware connectors available for you to configure. There are two spring-type Terminal Blocks, Battery Stand, Power Socket and Switch, etc...

➢ Internal View

After removing the top cover, you can see all the available hardware connectors.



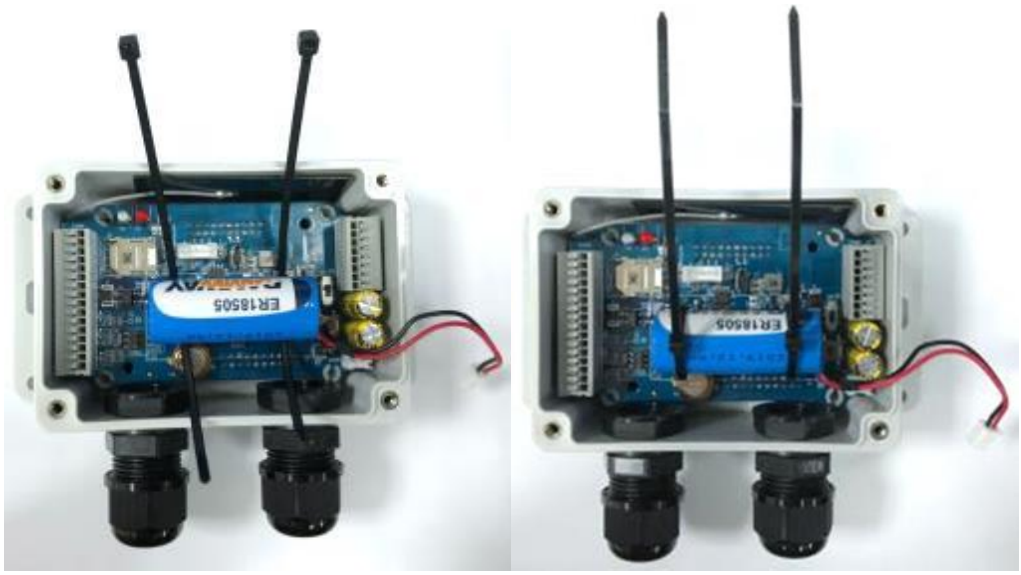
Note:

1. By default **S2** (Power Switch) is in **OFF** state, and **J6** (Power Source) is in **BAT** state.
2. Before proceed to the following H/W configuration details, be sure to keep **S2** at **OFF** state till the moment you finished the required configuration and need to Power Up the device.
3. The **RESET** button provides user with a quick way to reboot the device.

1.6.2 Install Battery (Optional Accessory)

Step 1:
Insert the two cable ties through the battery stands.

Step 2:
Load the battery over the stands as illustrated, and fasten each cable tie tightly.



Step 3:
Cut off the extra cable tie, and plug the power cable onto **CON1** (Battery Power Socket).

WARNING :

1. It is strictly forbidden to have the battery positive or negative short circuit, charging, discharging, heated over 100°C, removed, or disassembled. Doing any of these may cause explosion, combustion, internal acid leakage.
2. The Li-SOCL2 battery is an one-time use battery. DO NOT re-charge, crush, or disassemble the battery in any situation.
3. Discharged batteries are hazardous waste, and should be recycled or brought to a hazardous waste disposal facility.
4. Battery Replacement: You can purchase a new (full power) battery and replace it by yourself. The Battery Specification and Power pin must be compliant with the original design:
   A. 4000mAh 3.6V Li-SOCL2 battery (ER18505, A Size) with power cable.
   B. Re-use the power connecter: Red pin for V+, and Black pin for GND.
   C. Follow the Battery Installation procedure mentioned above.

Li-SOCL2 Battery Specification

If you purchase the battery from 3rd-party, please make sure it comply to the following electrical characteristics. Not only Nominal Capacity and Voltage, but also Max. Continuous Current andf Max. Pulse Capacity specifications are important.

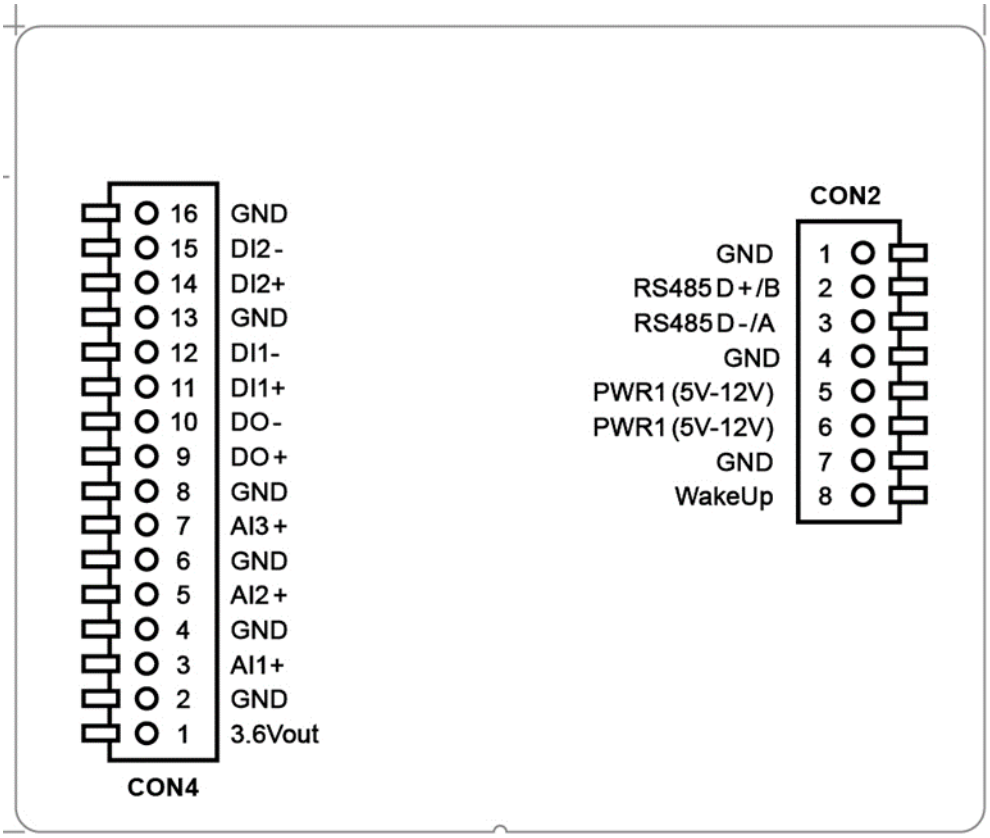
ELECTRICAL CHARACTERISTICS

Nominal Capacity (2mA ,+25℃ 2V cut off.The capacity restored by the cell varies according to current drain, temperature and cut-off)	4Ah
Nominal Voltage	3.6V
Max.Continuous Current	100mA
Max.Pulse Capability	200mA
Operating Temperature Range (Operation at temperature different from ambient may lead to reduced capacity and lower voltage plateau readings)	- 60℃～+85℃

1.6.3 Connecting to External Devices

There are many available I/O interfaces for connecting the EDGE 1 LoRa node with external devices.

As indicated in the I/O pinout sheet, you can easily find out the pin location and connect to your devices with appropriate conductive cables. However, there are only two dual-hole M16 water/dust-proof connectors for you to route the conductive cables out of the enclosure. That is, up to four cables can be routed to connect external devices.



In EDGE 1 RJ45 Model, Pin Assignment is:

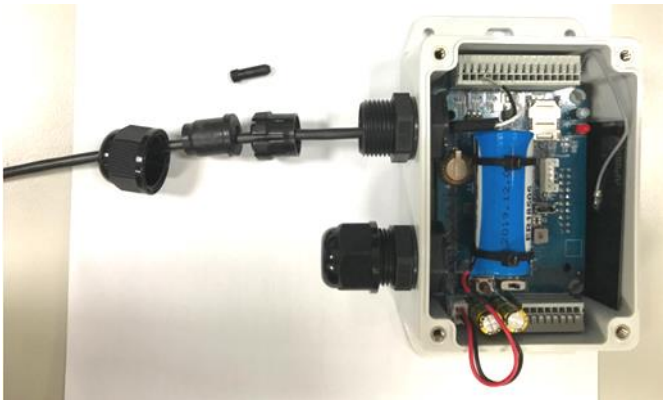
M16-L M16-R

M16 - L	1	2	3	4	5	6	7	8
PCB	CON4-3	CON4-4	CON4-9	CON4-10	CON4-11	CON4-12	CON4-14	CON4-15
Name	AI1+	AI1- (gnd)	DO+	DO-	DI1+	DI1-	DI2+	DI2-
Cable color	White-Orange	Orange	White-Green	Green	Blue	White-Blue	White-Brown	Brown

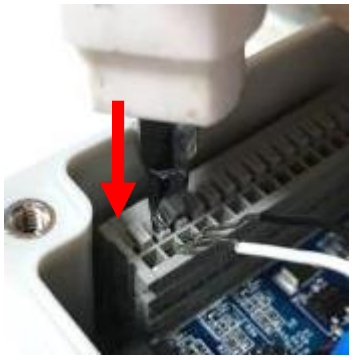
M16 - R	1	2	3	4	5	6	7	8
PCB	CON2-4	CON2-5	CON2-3	CON2-2	CON4-5	CON4-6	CON2-7 (CON4-8)	CON2-8 (CON4-7)
Name	GND	VDC+	RS485 D-	RS485 D+	AI2+	AI2- (gnd)	WakeUp - (AI3-gnd)	WakeUp + (AI3+)
Cable color	White-Orange	Orange	White-Green	Green	Blue	White-Blue	White-Brown	Brown

Run External cable to desired Connectors:

Step 1: **a)** Find a conductive cable with 15mm tinned terminals; **b)** Remove the external part of the M16 connector; **c)** Run the cable through the external parts as indicated below.



Step 2: **a)** Place the tinned terminal over the connector; **b)** Use a flathead screwdriver and push down the clip; **c)** Insert the tinned terminal to very bottom; **d)** Release and verify the terminal is well locked.



Screw back the External Parts of M16 Connector:

When you complete all the required hardware and software installation, make sure the device can function as planned. You are ready to lock the cables and external parts of the M16 connectors.

Step 1: a) Just keep required length of cable inside the enclosure; **b)** Insert the first cable gland part; **c)** Insert the second cable gland part; **d)** Insert the stopper if there is spare wire hole.
Verify all the inserted parts are in position.




Note:

1. Up to two cables can be run through the M16 connector. And to keep the IP65 water/dust-proof performance, all the cable gland parts and also the stopper are required to be installed properly.
2. However, if you intend to run more than two cables through the M16 connector, or IP65 is not so critical for the installation, you can decide not to put the cable glands, and skip step 1b) ~1d) for more IO flexibility.

Step 2: Place the last insert part of the M16 connector in position and fasten it in a clockwise direction.
You have to hold the wire to prevent it twisting while fastening the M16 external part.


Connect to devices via AIs (Analog Input) :

The EDGE 1 provides 3 AI ports for connecting to analog sensor/meters. To connect the device, you have to identify the type of your device and properly connect and configure the EDGE 1 so that it can get the correct readings from the connected devices.

AI1, AI2 supports either 0-10V voltage mode, or 4-20mA current mode analog signal; AI3 supports either 0-20V voltage mode, or 0-40mA current mode analog signal.
Since the EDGE 1 can not detect what kind of device is connected to, not only hardware configuration (**CON3**, **CON4**) is required, but also software configuration is mandatory.

CON3 is dedicated for AI configuration. There are 3 sets of jumper headers, one for each AI port (AI1, AI2, AI3).
Without Jumper : **Voltage mode -** (factory default)
With Jumper : **Current mode -** (You have to put the Jumper manually)

Pinout Definition @ CON4

Pin1	Pin2	Pin3	Pin4	Pin5	Pin6	Pin7	Pin8
3.6Vout	**GND**	**AI1+**	**GND**	**AI2+**	**GND**	**AI3+**	**GND**

Note: 3.6Vout @ CON4. 1 is only valid when external power source is applied. It is disabled for Battery power source.

Analog Input Specification

Mode	AI1, AI2 Specification		AI3 Specification	
	Range	Precision	Range	Precision
Voltage Mode	0-10V	+/- 10mV	0-20V	+/- 20mV
Current Mode	4-20mA	+/- 20 μ A	4-20mA	+/- 40 μ A

The EDGE 1 is designed with 12-bit ADCs (Analog-to-Digital Converter), considering hardware scaling and 0.1% resistance variation effects, the overall precision for the 0-10V is around +/-10mV.

Connect to devices via DIs / DO (Digital Input / Digital Output) :

The EDGE 1 provides 2 DI ports and 1 DO port for connecting to those digital sensor/meter devices. To connect the device, you have to identify the type of your device and properly connect and configure the EDGE 1 so that it can get the correct readings from the connected devices.
The DI port supports either Pulse counter mode, or just a Dry contact. Since the EDGE 1 can not detect what kind of device is connected to, not only hardware configuration (**CON4**) is required, but also software configuration is mandatory.

Pinout Definition @ CON4

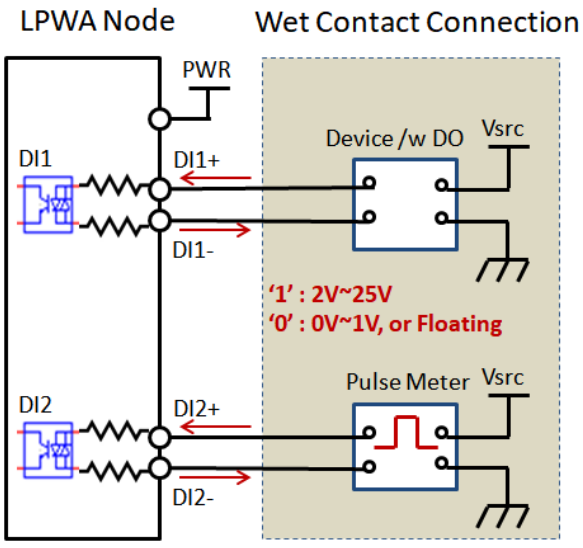
Pin9	Pin10	Pin11	Pin12	Pin13	Pin14	Pin15	Pin16
DO+	**DO-**	**DI1+**	**DI1-**	**GND**	**DI2+**	**DI2-**	**GND**

Digital I/O Specification

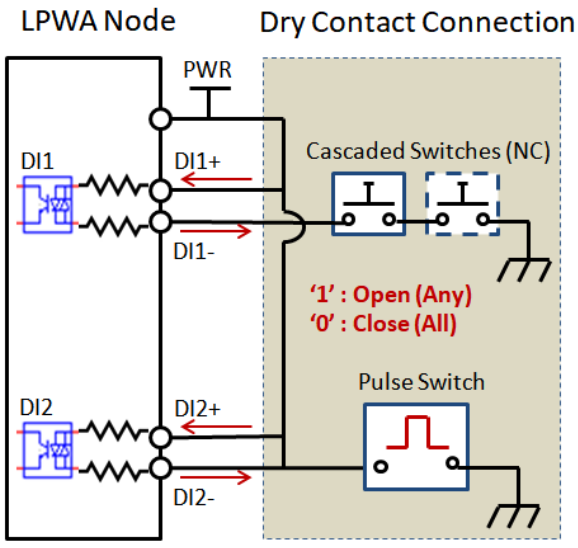
I / O	Specification	
Digital Input (Isolated)	Trigger Voltage (high)	Logic level 1: 2V~25V
	Normal Voltage (low)	Logic level 0: 0V~1V, or floating
Digital Output (Isolated)	Non-Relay mode	Maximum 24V/300mA (Depends on external device)

Example of Connection Diagram - DI

(1) DI with Wet Contact Connection

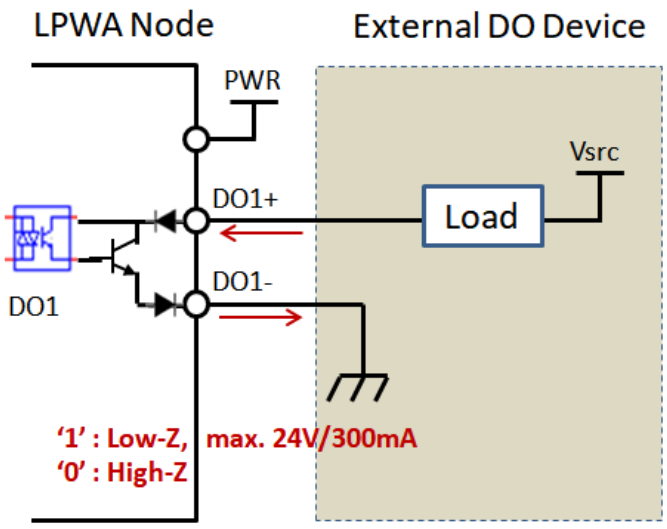


(2) DI with Dry Contact Connection

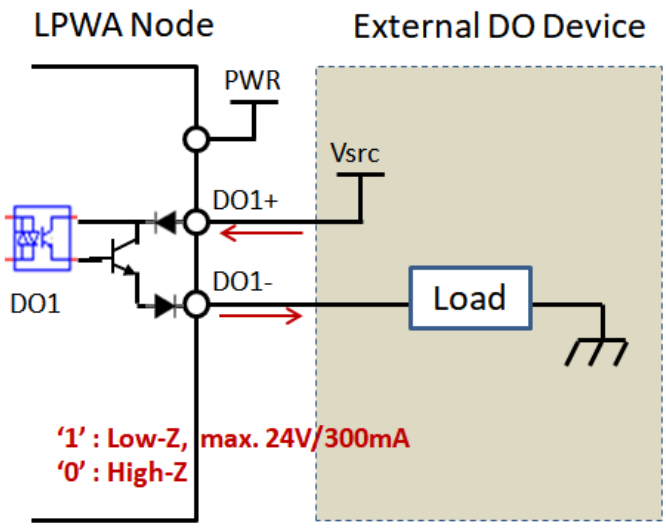


Example of Connection Diagram - DO

(1) Sink-type DO Connection



(2) Source-type DO Connection



Connect to Modbus RTU devices via RS-485 :

The EDGE 1 provides 1 RS-485 port and can support up to 8 cascaded Modbus RTU devices. Since the EDGE 1 can not detect what kind of device is connected to, not only hardware configuration (**CON2**) is required, but also software configuration is mandatory.

Pinout Definition @ CON2

Pin1	Pin2	Pin3	Pin4	Pin5	Pin6	Pin7	Pin8
GND	**RS-485 D+ (B)**	**RS-485 D- (A)**	GND	PWR1 (5V-12V)	PWR1 (5V-12V)	GND	WakeUp

Connect to external switch via WakeUp port :

Most of the time, the EDGE 1 data logger operates under sleep mode with ultra-low power consumption design. At that time, no one can wake it up till the scheduled time runs out.
If you still have to wake it up for some unexpected reason, for example, to change software configuration or upgrade new firmware, there is a manual wake-up mechanism for such kind of maintenance situations.

You can connect an external magnetic switch or some kind of switch and connect it to the WakeUp pin. Once the input status changes (OPEN→CLOSE), the EDGE 1 will detect it and enter WakeUp state accordingly.

Pinout Definition @ CON2

Pin1	Pin2	Pin3	Pin4	Pin5	Pin6	Pin7	Pin8
GND	RS-485 D+ (B)	RS-485 D- (A)	GND	PWR1 (5V-12V)	PWR1 (5V-12V)	**GND**	**WakeUp**

Connect to external DC Power Source:

EDGE 1 is designed with internal Battery Power source. It is suitable for infrequent data logging or data uploading applications.

However, there is an alternative external DC Power Source for those applications required instant or frequent data uploading. Instead of battery power source, you can decide to apply external DC power source to the EDGE 1 directly if there is available DC power source at the installation site.

Pinout Definition @ CON2

Pin1	Pin2	Pin3	Pin4	Pin5	Pin6	Pin7	Pin8
GND	RS-485 D+ (B)	RS-485 D- (A)	**GND**	**PWR1 (5V-12V)**	**PWR1 (5V-12V)**	**GND**	WakeUp

External DC Power Supply: DC 5-12V
Max. Power: 5W @ 5V / 1A

You can connect the external DC Power to Pin4, Pin5 at **CON2**. Pin6 and Pin7 are duplicated pins, you can just ignore them or provide power to another device via these extra pins.
Besides, change the Power Source Jumper to the left side (**EXT**) at **J6**, as illustrated below.

Note: The EDGE 1 won't go into sleep mode (ultra-low power consumption) when it is powered via external DC power source.

1.6.4 Connecting Console Port for PC Configuration Tool

After completing prior hardware configuration, you are almost finished with the hardware configuration procedure.
To make the EDGE 1 operate properly in according to attached external devices, you have to further configure software settings from a PC configuration tool.

The EDGE 1 provides one micro-USB port (**J1**) for device configuration. You have to connect the micro-USB port to the Configuration Port at **J1** and the Type A USB port for PC/NB that will run the configuration tool.

1.6.5 Power On the EDGE 1

Congratulations! You have just finished the required hardware installation procedure, and you are ready to power on the EDGE 1.

Please make sure the power source is properly installed:

For Battery Power: Battery power cable is plugged onto the Power Socket (**CON1**); and Power Source Jumper (**J6**) is placed at the right side (**BAT**).

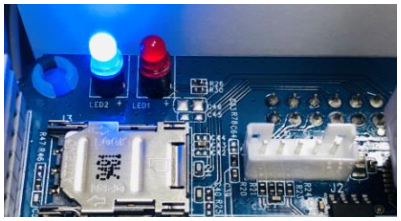
For External DC Power: External DC power cable is inserted into the external DC Power Port (**CON2**); and Power Source Jumper (**J6**) is placed at the left side (**EXT**).

Now, you can power on the EDGE 1 with Power Switch (**S2**). Switch it to the lower side (ON) and the EDGE 1 is powered on and start to boot up.

Then you can check the Status LED, it starts with RED light(LED1) and BLUE light(LED2) for 1~2 seconds. After a while, LED1 and LED2 will turn to OFF state , and the device is booting up. Finally, It will get ready and you can see the LED2 with BLUE light flashing once per second.

@ Power OFF

➔



@ Boot up and get ready

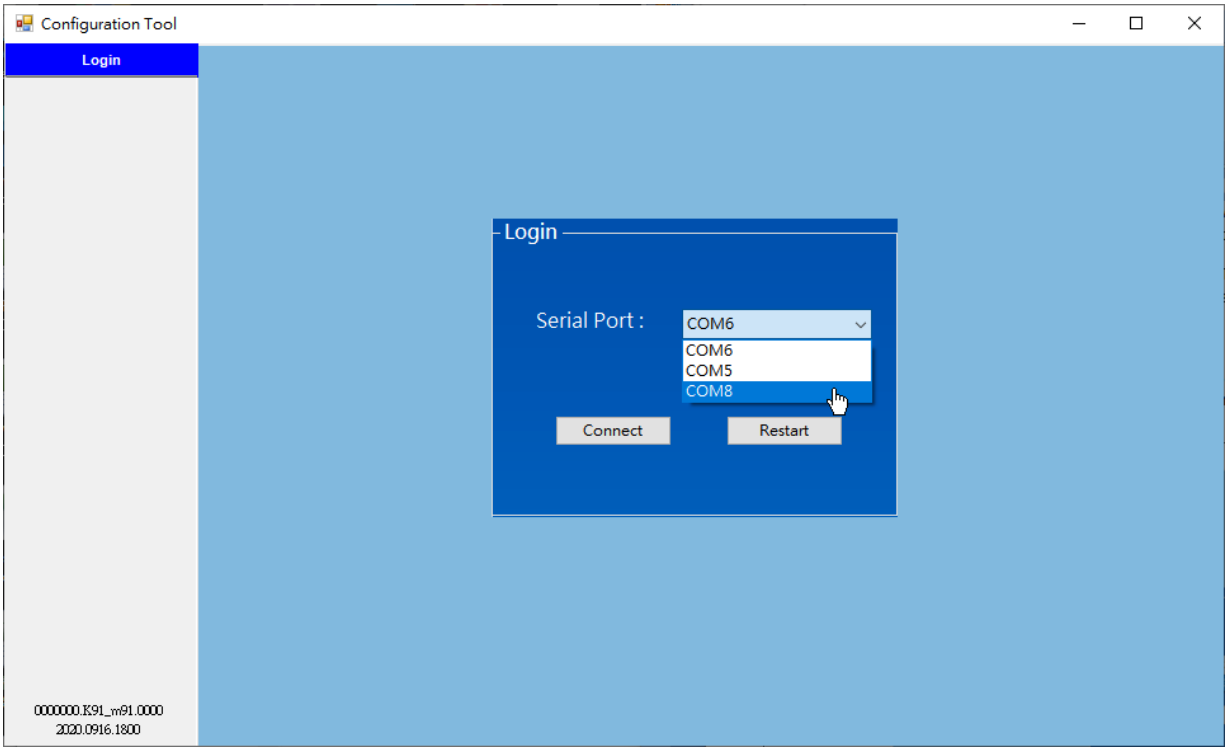
Note: If the EDGE 1 is powered with battery source, the LED will be forced to OFF state while the device get into sleep mode.

1.6.6 Setup with Windows-based Configuration Tool

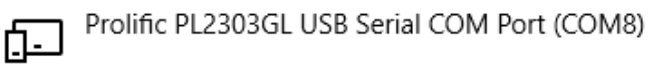
The EDGE 1 must be configured with a Windows configuration tool. Just find a computer with an available USB port, and plug in the USB-to-Micro USB cable.

For the first time to set up the EDGE 1 with this Configuration Tool, you have to download it from the vendor and install it to a desktop or notebook computer for further device configuration.

When you execute the Configuration Tool, you will see the login dialog. Click the drop-down menu next to the “Serial Port”. Choose the COM port that is bound to the EDGE 1 console port, and then click the **Connect** button.



If you are not sure which COM port is the correct one, please check the Device Management setting for the PC/NB, find out the device named “Prolific PL2303GL USB Serial COM Port(COMx)” from the “Bluetooth and Other Devices” page. The COMx is the right port for device configuration.



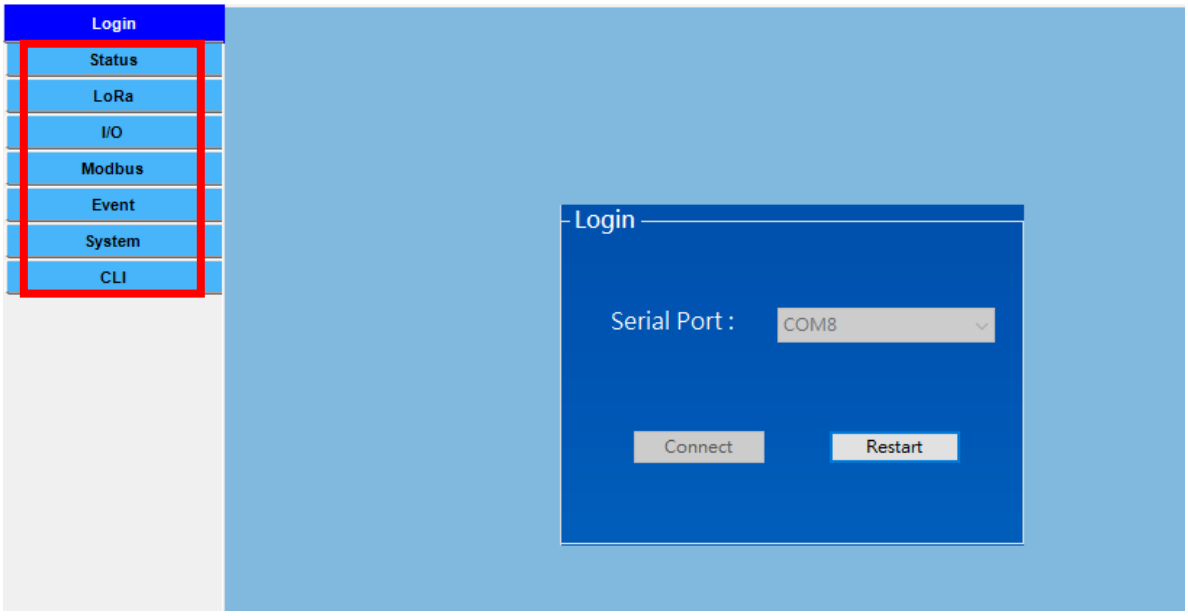
Note:

1. Use external DC power source to power on the EDGE 1 while configuring via the Windows Configuration Tool. With DC power source, the device won’t get into sleep mode, so you can configure it without time and

power consumption considerations.

2.Or, if DC Power Source is not available at the installation site, you are suggested to **configure the device with a prepared configuration file to prevent unexpected battery power loss.** Restore the prepared configuration file, and quickly edit the settings unique to a certain device.

If the connection succeeded, a list of menu items appears on the left side under the Login Tab.



Now, you have already logged in to the EDGE 1 console, and you can proceed with the required software configuration steps one by one. Refer to the following Chapter for details.

1.6.7 Device Mount and Screw Back the Top Cover

The EDGE series product must be configured with a Windows configuration tool. Just find a PC or laptop with an available USB port, and plug in a USB-to-Micro USB cable.

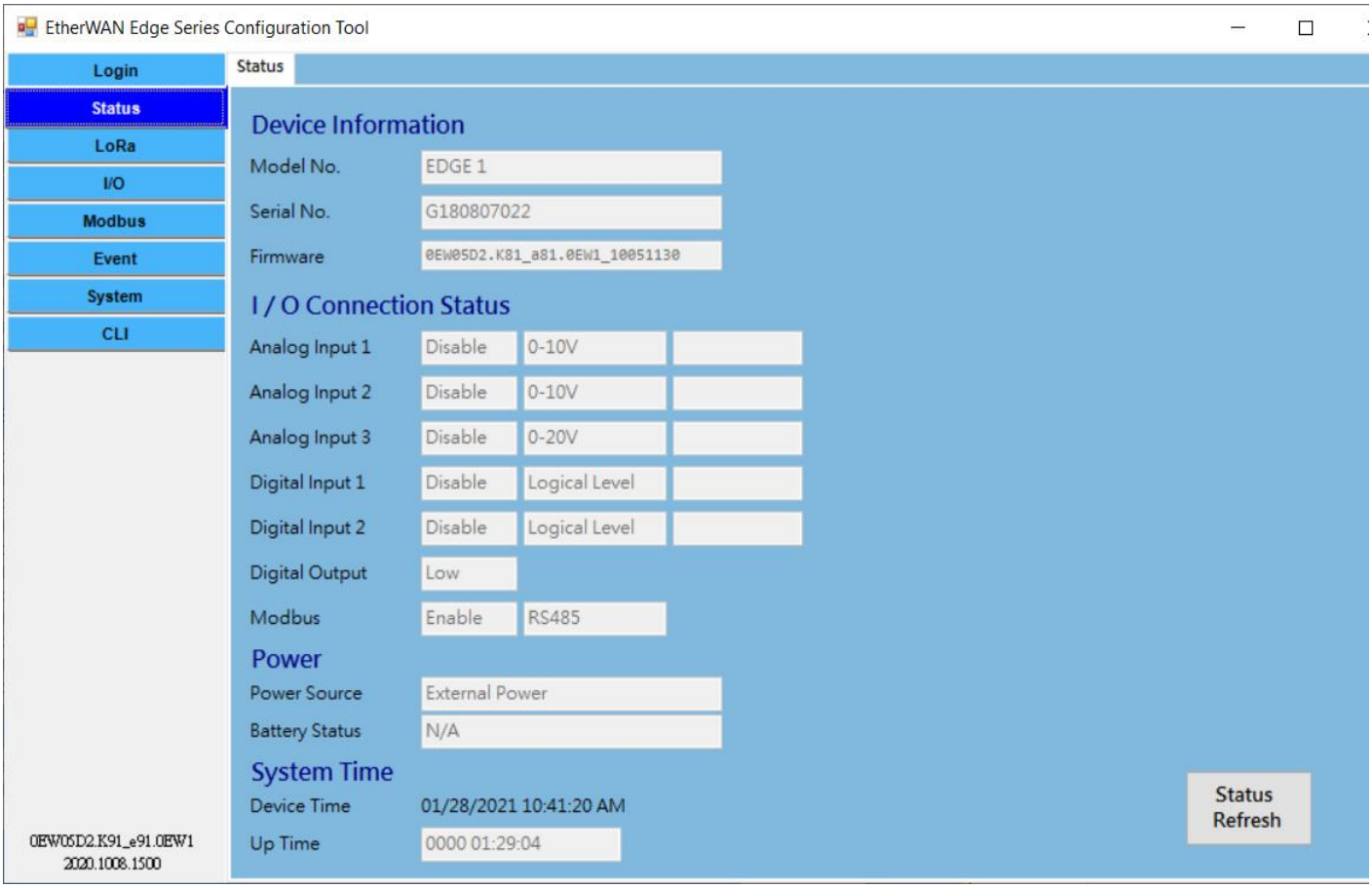
- After you finished all the software configurations, you are ready to use the EDGE 1 and make it operate as expected. You must take the following actions:

    1. **Power Off the EDGE 1, and remove the USB cable.**
    2. **Mount the EDGE 1 base enclosure on the planned location.**
    3. **Make sure all the wiring cables are running in position through the M16 connectors;**
    4. **Fasten tightly the external parts on the M16 connectors, holding the internal cables to prevent from twisted along with the cable gland with care.**
    5. **Power On the EDGE 1, and wait until the Status LED turns BLUE light flashing to make sure it booted up without problem.**
    6. **Screw back the Top cover with care. Make sure the surrounding rubber pad is fully in position to keep the IP65 performance for water and dust resistance.**

Chapter 2 Device Configuration

2.1 Device Status

Click on **Status** menu item, and the EDGE 1's device information and status will display on configuration area which is located in the right-hand side. If the device status doesn't appear or you want to get the updated status, click **Status Refresh** button located at the lower right corner to refresh the status immediately.



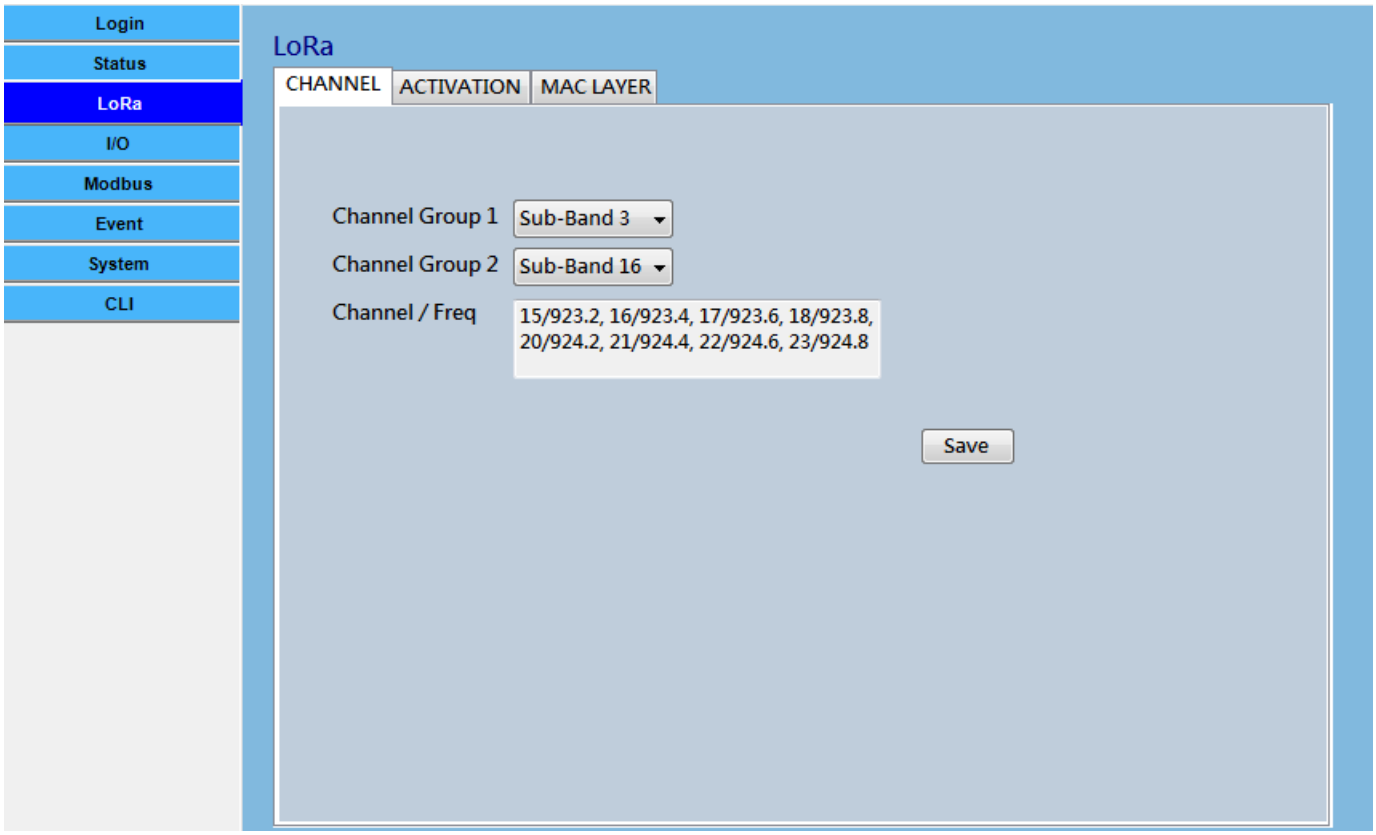
You can see the **Device Information** (Device Name, Series No., and Firmware Version), **I/O Connection Status** (Analog Input 1~3, Digital Input 1~2, and Modbus), **Power** Information (Power Source, and Battery Status), and **System Time**.

2.2 LoRa Configuration

In the LoRa Configuration page, you can configure the channel, activation settings and MAC Layer settings.

Channel Configuration

There are Channel Groups 1 and 2. The display will show the supported Sub-Band depending on the area of the LoRa specification． Channel/Freq will show the detail frequencies of the selected channel.



Activation Configuration

Prior to connect the LoRa Node to a certain LoRaWAN Network Server, you can configure device activation settings for how it connect to the network and how the remote gateway and network server can identify the LoRa Node.

Most of the settings have proper default settings, it can work well without any modification. You can just provide the required EUI, address, or Key to the network server while registering the LoRa Nodes for your IoT application.

TX Confirm: Specify whether the TX Confirm (ACK response from network server) is applied or not for each data uplink transmission. By default, **Confirm** is selected.
Un Confirm: No ACK response is required. The LoRa Node won't check whether the transmitted data is received by network server or not. The data will be sent out only once.
Confirm: An ACK response is required. The LoRa Node will listen whether the transmitted data is received or not. If no ack response appeared, the LoRa Node will retry to send out the same data until selected **TX Retry** counts. After specified retrials, if there is still no any ack response, the data will be discard directly.

TX Retry: Select a desired retrial counts (0~7) if TX Confirm is required.

Activation: Specify the desired activation method for the LoRa node to connect to a network. **OTAA** (Over-the-Air Activation) and **ABP** (Activation by Personalization) are supported. By default, **ABP** is selected.
OTAA: OTAA is the preferred and most secure way to connect with network server. Devices perform a join-procedure with the network server, during which a dynamic Device Address is assigned and security keys (Network Session Key, APP Session Key) are negotiated with the device.
ABP: ABP is a simpler activation method with fixed device address and security keys. For some device, it is manufactured with a hardcode Device Address as well as the security keys in the device. This means it can't worked with OTAA method. This strategy might seem simpler, because you skip the join procedure.

DeviceEUI: This is a unique and read-only ID (64-bit) for the LoRa node. It is hardcoded by the device manufacture.

AppEUI: This is an application ID (64-bit) for the LoRa node. A network server can use this AppEUI for specific application identification.

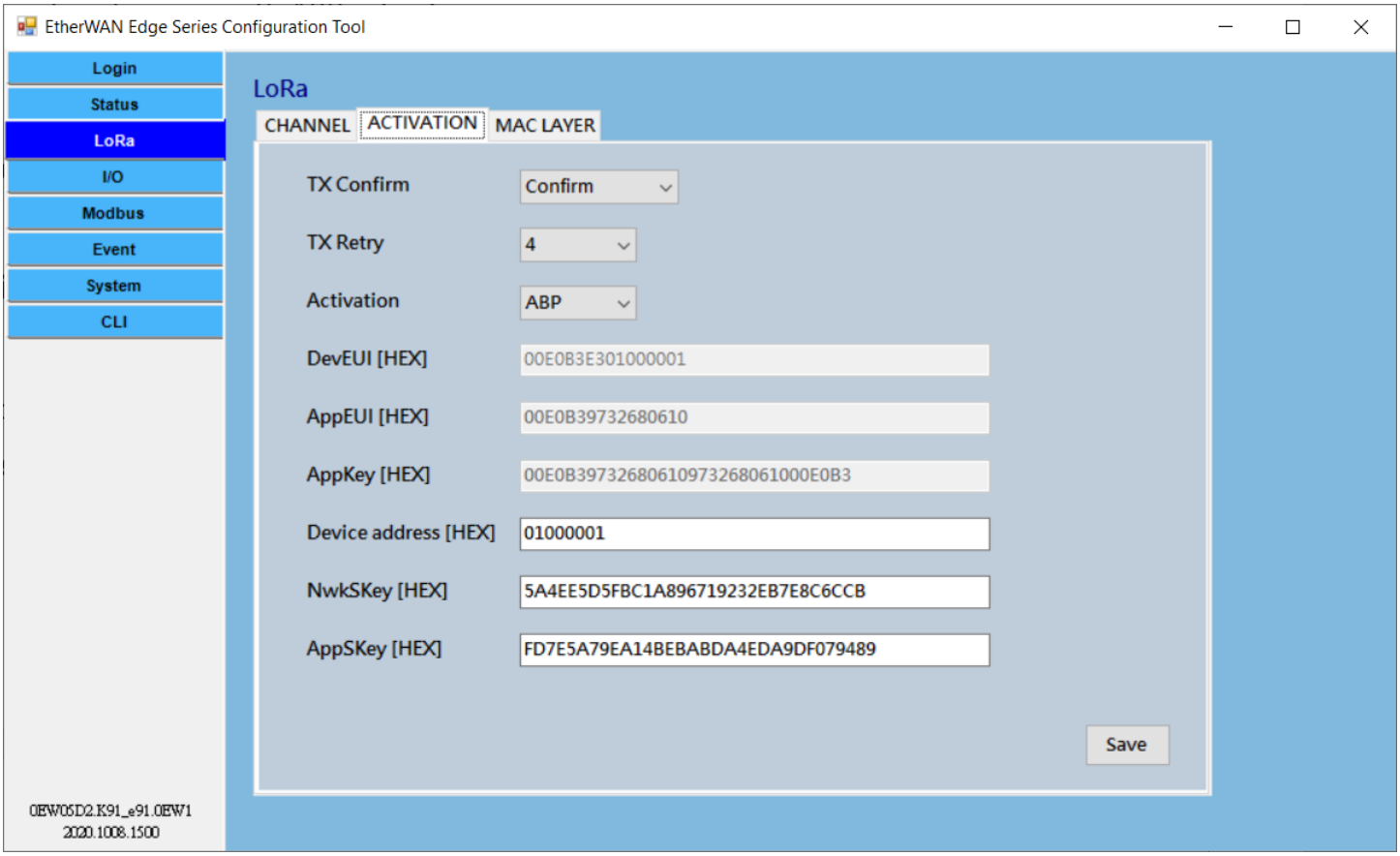
AppKey: This is an application Key (128-bit) for the LoRa node. A network server can use this AppKey to generate required NwkSKey and AppSKey for further data transmission with OTAA activation.

Device Address: This is a 32-bit (8 Hex digits) Device Address. You can provide it for registering to a network server with ABP activation.

NwkSKey: This is a 128-bit (32 Hex digits) Network Session Key. You can provide it for registering to a network server with ABP activation.

AppSKey: This is a 128-bit (32 Hex digits) Application Session Key. You can provide it for registering to a network server with ABP activation.

Finally, click **Save** button to store the configuration in the device.



MAC Layer Configuration

Prior to connect the LoRa Node to a certain LoRaWAN Network Server, you can configure device MAC Layer settings for how it connect to the network.

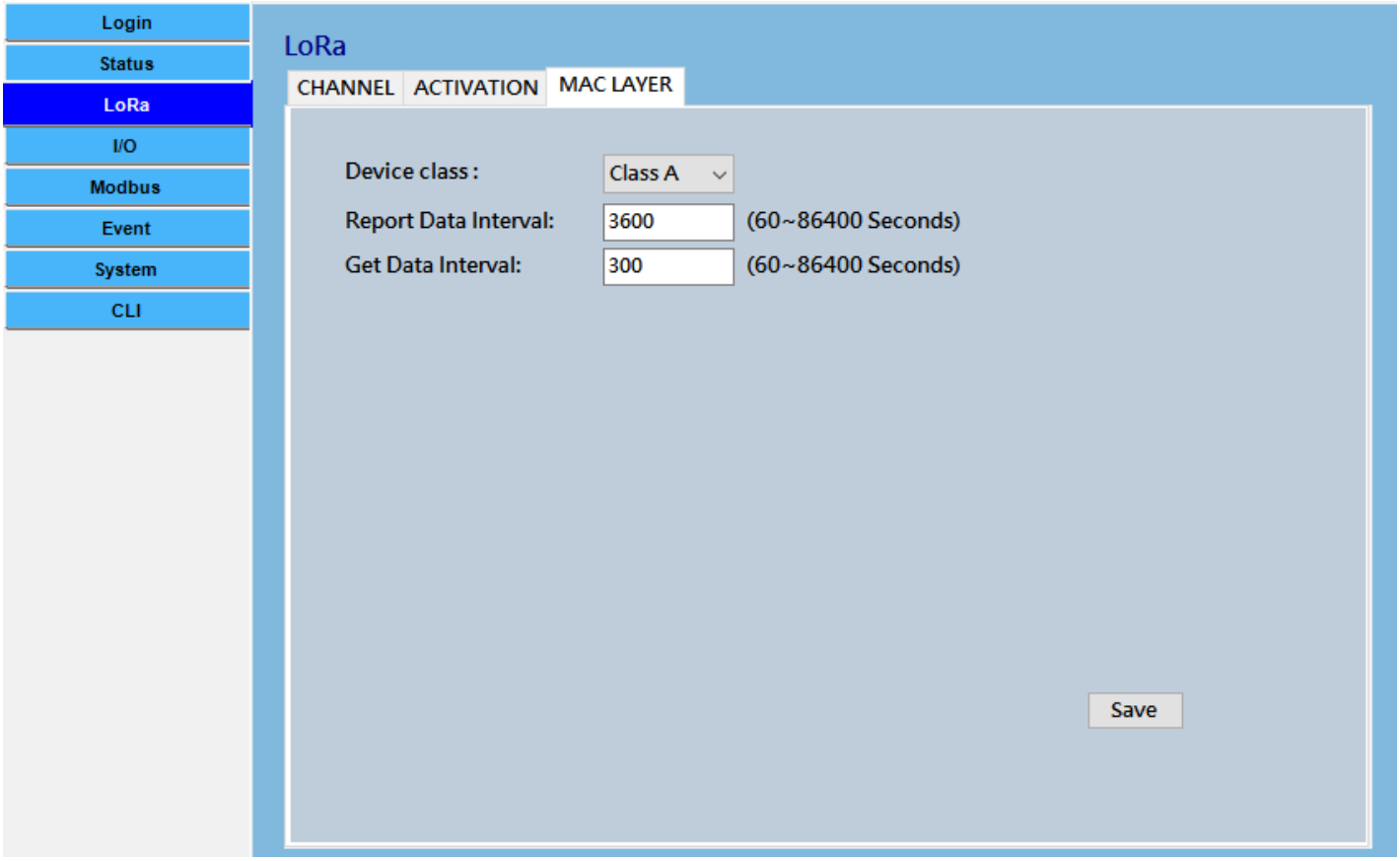
Device Class: Specify the device class for the LoRaWAN node. The EDGE 1 LoRa Node supports two types of device class.

Class A: A is suitable for Battery powered device. Each device uplink to the gateway / network server and is followed by two short downlink receive windows, then, go to sleep situation. At any time a LoRaWAN node can broadcast a signal, after this uplink transmission (tx) the node will listen for a response from gateway / network server.

Class C: C is for **C**(continuous). Same as A, but Class C devices will listen continuously for responses from the gateway / network server. Hence, these devices use more power and are often mains power.

Report Data Interval: Specify the time interval between two successive data uplinks. By default, 3600 seconds is configured. It means, the node will transmit the record data of connected sensor/meters on every 3600 seconds time interval.

Get Data Interval: Specify the time interval which the node will get the status of connected sensor/meters on every designed time interval. By default, 300 seconds is configured.

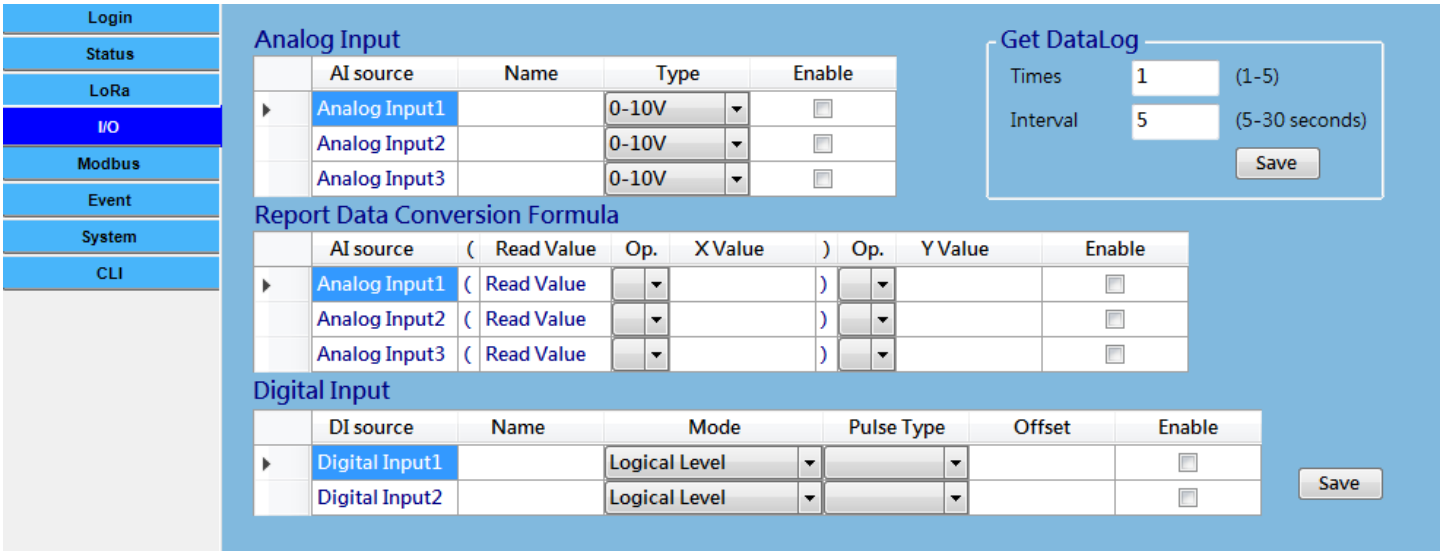


Finally, click **Save** button to store the configuration in the device.

Note: DO NOT choose the Class C device type while it is powered by internal battery. The device won't get into sleep mode if it is configured as Class C device, and it will continuously drain away the battery power even it is idle and just listens for the command from network server.

2.3 I/O Configuration

In the I/O Configuration screen, you can configure the Analog Inputs (AIs) and Digital Inputs (DIs). There are 3 sets of AIs and 2 sets of DIs.



According to the hardware configuration you already finished, you have to further configure the settings for the device firmware, so that the EDGE 1 will know what kind of input device is connected to each port.

For Analog Input ports, you can specify an optional **Name** for identification, and the **type** for each connected port. And then click **Enable** check boxes for those connected ports. The available AI types can be ***0-10V***, ***0-20V***, or ***4-20mA***, but it depends on specific product specification.

In addition, the AI value read from A/D converter can be further transform to a physical value for the real world, like the temperature, or water level. You can specify a simple data conversion formula with the base format:

Physical Value = (*Read Value* Op.1 *X*) Op.2 *Y* , where

Read Value: the input value (ex. 7.5V or 12.4mA) for a certain AI signal.
Op.1 and Op.2: both op. can be '+' or '*';
X and *Y*: both values can be any real number range from -65535.00 to 65535.00.

For Digital Input ports, you can specify an optional **Name** for identification, and the **Mode** (***Logical Level***, or ***Pulse Counter***) for each connected port. And then click **Enable** check boxes for those connected ports.

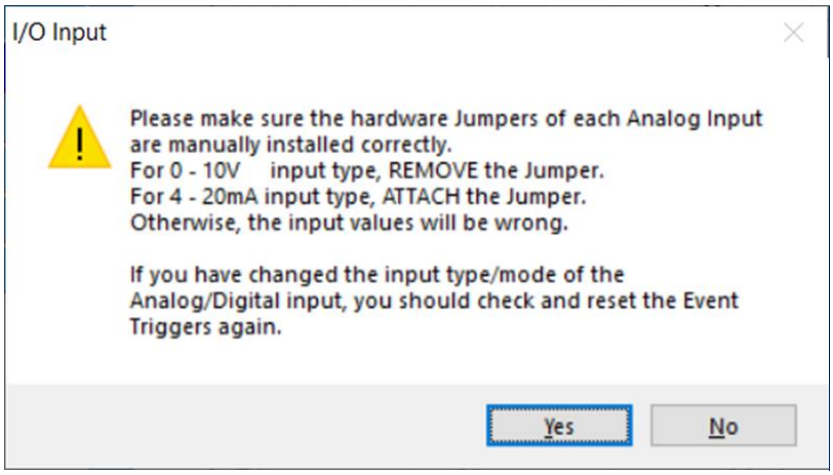
If ***Pulse Counter*** mode is selected, some additional fields (**pulse type** and **Offset** value) have to be defined.

Pulse Type: It can be **Change**, **Rising**, or **Falling**. On each pulse event, the corresponding internal counter will be increased by 1 automatically.

Offset: Enter the Offset value for initial reading of the connected device (pulse meter). It is very likely that the initial reading for the connected device is a non-zero value, so you have to enter the initial value as an offset for the further readings.

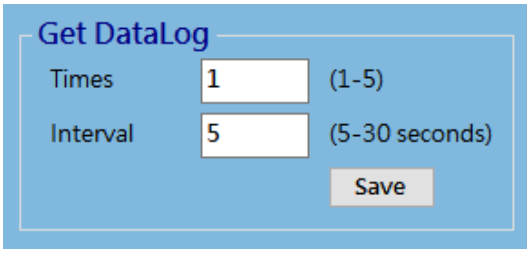
With the settings, the LoRa node will activate 32-bit counters to count the pulse behavior, record the counter value plus the Offset as the actual value on each data upload time slot.

Finally, click **Save** button to store the configuration in the device. Prior to storing the I/O settings, the following dialog will appear for you to double confirm the settings of Analog Input type that the hardware configuration and software configuration are consistent.



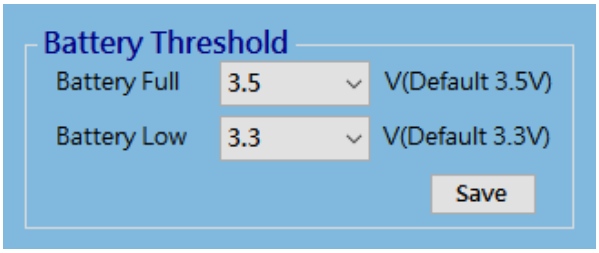
After you confirm the settings are correct, click **Yes** button to store the configuration in the device.

Moreover, you can specify the behavior of data logging from the Get DataLog window. Once the scheduled time is up, the EDGE 1 will get and log all the AIs/DIs input values.

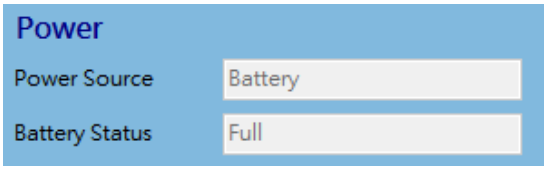


Times: Specify the data logging counts for each schedule timeup.
Interval: Specify the time interval between two data logging.

For models with battery power options, there is a Battery Threshold configuration. You can define the Battery Full and Battery Low voltage.



You can check the battery status at the Status Page.



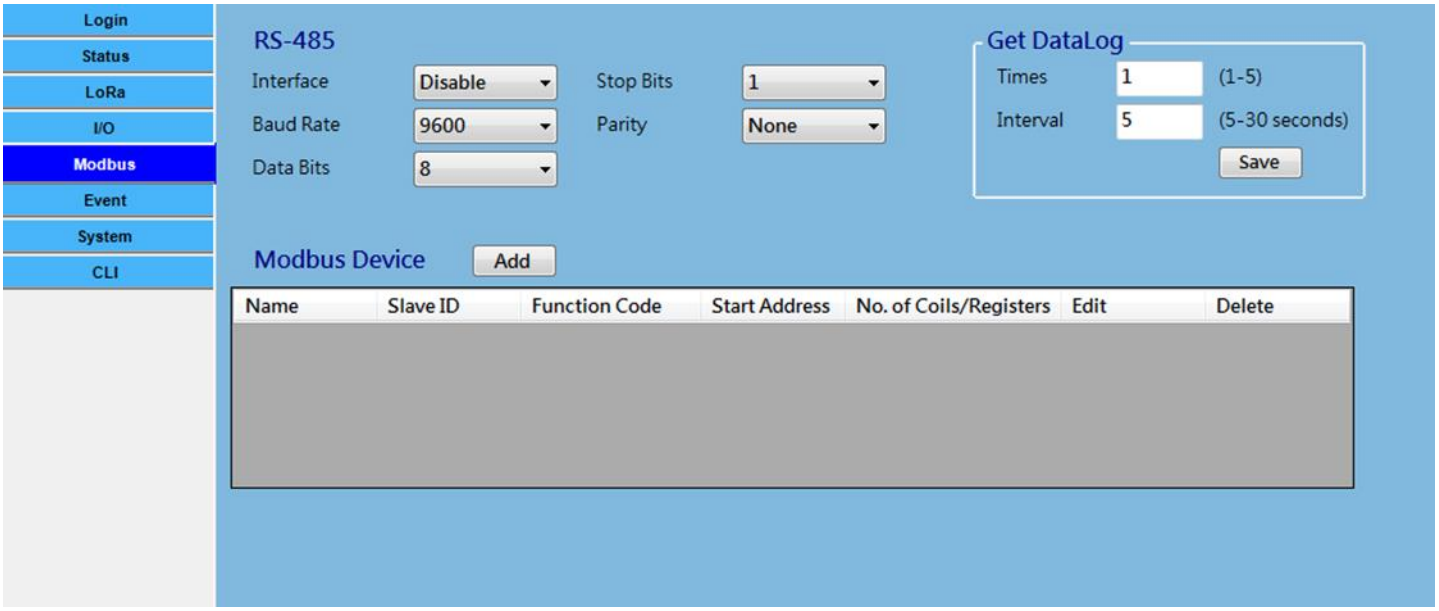
Full: for voltage >= Battery Full threshold.
Good: for voltage between Battery Full and Low thresholds.
Low: for voltage <= Battery Low threshold.

The EDGE 1 will issue Battery Low event to remote server if it detects the battery voltage approaches the Low threshold.
Each time when the EDGE 1 is waked up to send the stored log to remote server, and if the Battery Low threshold is triggered, the EDGE 1 will automatically issue a Battery Low event and will not uplink filed data to LoRa Gateway for power saving.

So, when the administrator notices that Battery Low events are issued, he has to dispatch battery replacement task prior to the EDGE 1 using up the battery power and failing to operate properly.

2.4 Modbus Configuration

The EDGE series product provides one RS-485 port for connecting with Modbus RTU Slave devices. It can handle up to eight sets of cascaded Modbus devices.



RS-485 Serial Port Configuration

Prior to configuring how to access the Modbus devices, you need to define the physical communication port first. In RS-485 configuration, you can enable the **Interface**, and then select desired values for **Baud Rate, Data Bits, Stop Bits**, and **Parity** settings.

Interface: By default, the interface is disabled. You can enable it and set the interface parameter to comply with the devices to be connected.

Baud Rate: Select the appropriate baud rate for serial device communication. It can be 1200 / 2400 / 4800 / 9600 / 19200 / 38400 / 57600 / 115200. It depends on the cable length and the installed environment. The longer cable length will result in lower baud rate for it. By default, 9600 is selected.

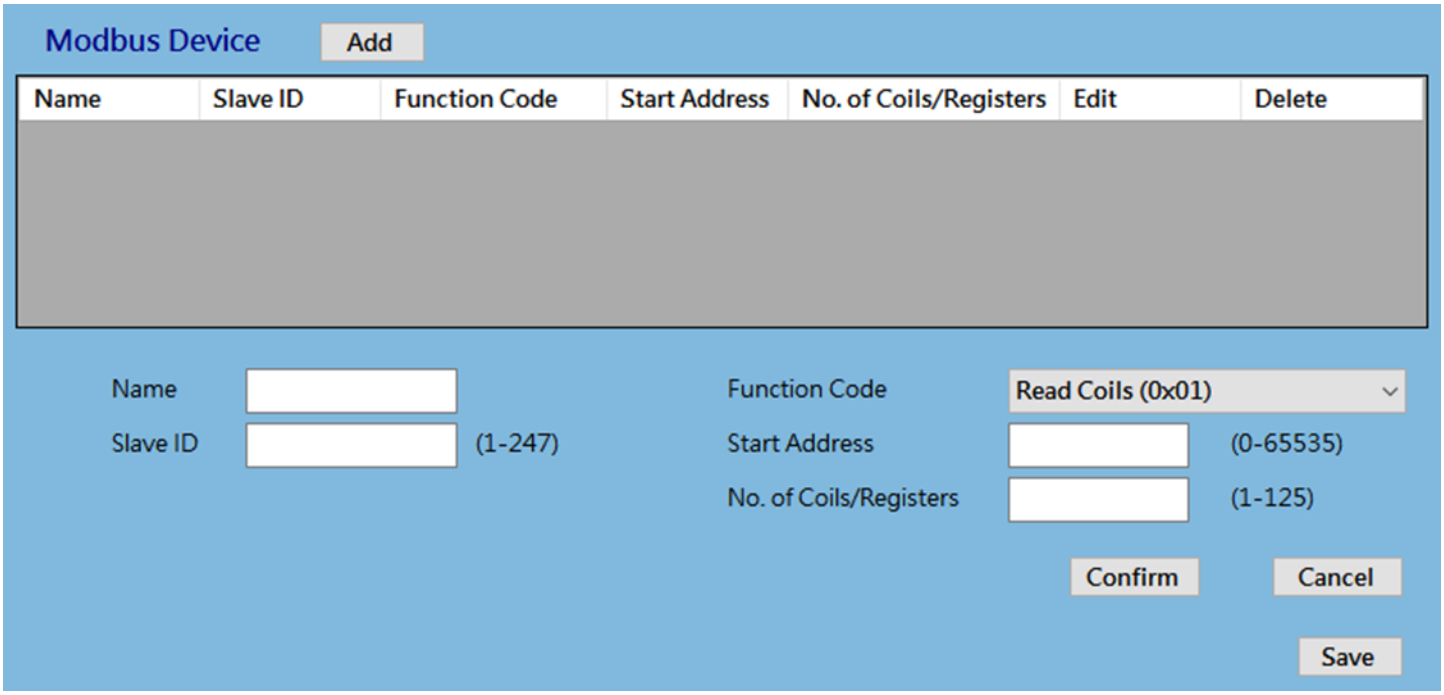
Data Bits: Select 7 or 8 for data bits. 8 is selected by default.

Stop Bits: Select 1 or 2 for data bits. 1 is selected by default.

Parity: Select None / Even / Odd for Parity bit. None is selected by default.

Modbus Device Configuration

Click **Add** button to enter required information or values for each Modbus device. The data fields are **Name**, **Slave ID**, **Function Code**, **Start Address**, and **No. of Coils/Registers**. When you entered the required settings for a Modbus device, click **Confirm** button to update the information to the device list. In addition, you can also click **Edit** or **Delete** button to modify the information or values in the device list.

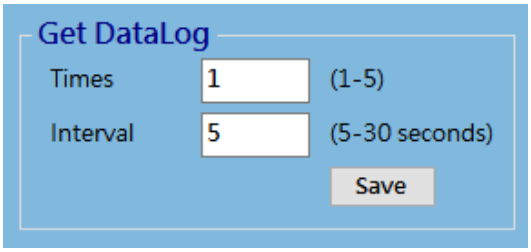


Name: Enter a name as the identifier of the Modbus RTU slave device.
Slave ID: Specify a unique ID for the slave device. It can be 1 - 247.
Function Code: Specify a certain read function for the EDGE 1 to issue and record the responses from slave device. It can be **Read Coils (0x01)**, **Read Discrete Input (0x02)**, **Read Holding Registers (0x03)**, and **Read Input Registers (0x04)**.
Start Address: Enter the Start Address of registers to apply with the specified function code. It can be 0 - 65535.
No. of Coils/Registers: Enter the number of coils (registers) to apply with the specified function code. It can be 1 - 125.

Check the document of the connected Modbus devices for how to get the desired data through Modbus commands.

Finally, click **Save** button to store the configuration in the device.

Moreover, you can specify the behavior of data logging from the Get DataLog window. Once the scheduled time is up, EDGE 1 will get and log all the Modbus RTU values.



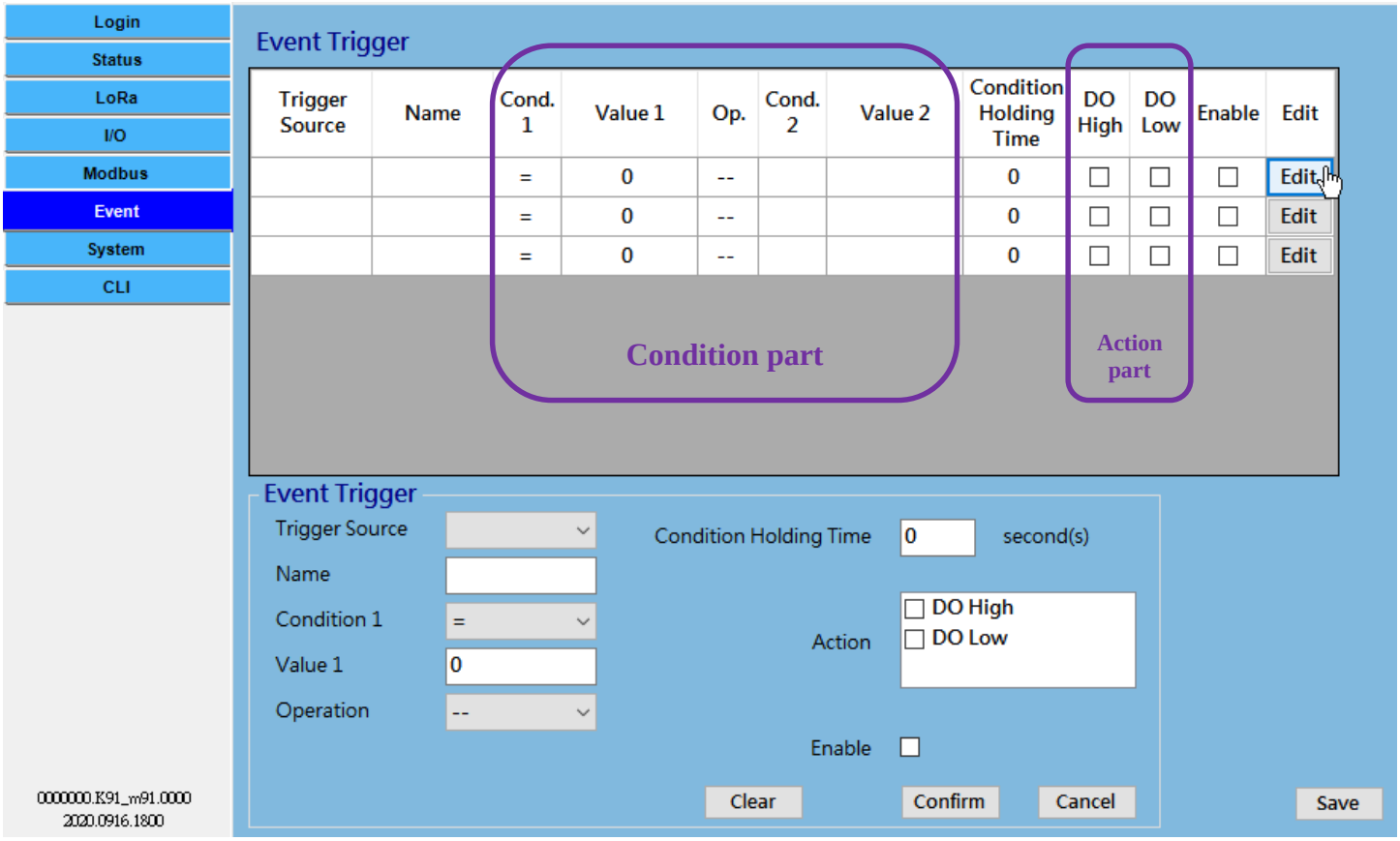
Times: Specify the data logging counts for each schedule time up.
Interval: Specify the time interval between two data logging.

2.5 Event Configuration

The Event Trigger function can use a certain input signal (device) as trigger source for an event rule. If there is any enabled event rule, EDGE 1 will check the trigger source once per second to determine if the event is triggered or not. When the designated condition matches, the event rule will be triggered and corresponding event action will take place accordingly.

EDGE 1 supports up to 3 event rules. Click the **Edit** button to edit a specific event trigger. For each event rule (If *condition* then *action*), you have to specify the condition part, min. holding time, and the action part.

Condition part: (*condition 1*) **AND** / **OR** (*condition 2*)
min. Condition Holding Time: Above *Condition* remains **TRUE** for at least T_{hold} (condition hold time)
Action part: Make **DO High**, **DO Low** till the condition **FALSE**



Trigger Source: Available trigger source can be **AI**s, **DI**s, and **Modbus**. For specific product, there is an additional **Alert** pin that can be monitored all the time, even EDGE 1 is in sleep mode. You can select one of them as the event trigger source.

Name: Specify a name as the identifier of the event rule.

Cond.1/2: Up to two conditions can be defined in an event rule. For each condition, five comparison operators. “>”,”>=”,”=”,”<” and “<=” can be selected. Select an operator and enter a threshold value for comparison.

Value1/2: Enter the threshold value of condition 1/2 for comparison.

Operation: If cond.2 exists, specify the logic operation (**AND**, **OR**) for cond.1 and cond.2.

Condition Holding Time: Enter a time interval in second, as the threshold of required minimum condition hold time ($T_{hold)}$. The condition must remain TRUE for at least the specified duration.

Action: The supported event action can be **DO High**, or **DO Low**. Select one action for each event rule. When the event happens (condition TRUE for the T_{hold} duration), the specified action will be take accordingly.

Enable: Check **Enable** to activate the event rule.

Finally, click **Save** button to store the configuration in the device.

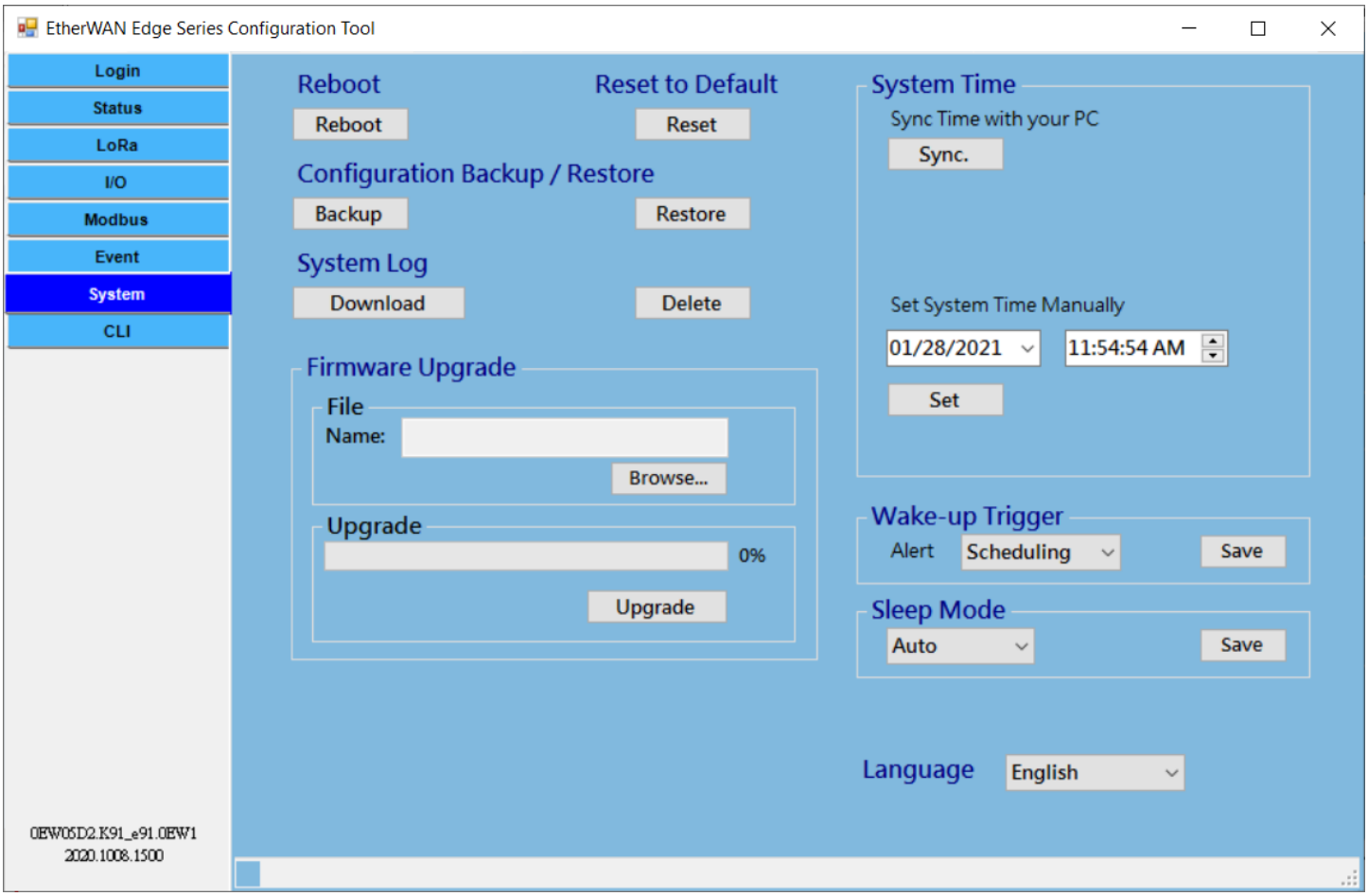
Warning:

It is NOT recommended to use battery power to power on the EDGE 1 while event trigger function is used for your deployed application. EDGE 1 will be wake up once per second to check if there is any event to be triggered. It is a power consuming operation.

So, EXTERNAL DC POWER SOURCE IS RECOMMENDED! Otherwise, you will suffer from short battery life problem, and have to pay for overhead cost for new battery exchange.

2.6 System Configuration

System Configuration allows the device administrator / installer to manage the EDGE 1. There are settings / function buttons for **Reboot**, **Reset to Default**, **Configuration Backup / Restore**, **System Log**, **Firmware Upgrade**, **System Time**, **Wake-up Trigger** and **Sleep Mode**.



Reboot or **Reset to Default**

For some special reason or situation, you may need to reboot the EDGE 1 or reset the device configuration to its default value.

Click **Reboot** or **Reset** button, and wait a while for the device to reboot.

Configuration Backup / Restore

In addition to the factory default settings, you can also customize a special configuration setting as a customized default value. With this customized default value, you can reset the device to the expected default

setting if needed.

Click **Backup** button to store the device configuration settings into a configuration file (.bin) for later use.

Click **Restore** button to restore the device settings to a certain backup copy, or quickly duplicate a device's configuration file to other devices with the same configuration for a certain application. In such case, ensure to set the unique Device ID for separate devices.

System Log

For some device maintenance purpose, you may need to get the system log for troubleshooting. You can do it through the configuration tool, click **Download Log** or **Delete** button.

Click **Download Log** button to store the System Log into a log file (.txt) for troubleshooting.

Click **Delete** button to erase the existing system logs. Please use the delete function with care, all the device system log, including data log will be erased. If required, download log first and then delete out-of-date log.

Firmware Upgrade

If new firmware is available, you can manually upgrade it for feature enhancement or bug resolving.

Click **Browse** button to identify the file location / file name of the new firmware image (.bin).

Click **Upgrade** button to start upgrading the new firmware to the device. DO NOT turn off the EDGE 1, or disconnect the USB cable while upgrading new firmware, doing so is very likely to damage the device.

Once the Firmware Upgrade is completed, the device will be reboot with the new firmware immediately.

System Time

System time is a vital element for the LoRa Node. Both data logging and data uploading tasks need to be triggered at a certain time. You have to make sure the device is configured with correct time setting. Click **Sync.** button to synchronize the system time with your PC that is running the configuration tool. You can also set the date and time for the device manually.

Wake-Up Trigger

Most of the time, the EDGE 1 operates under sleep mode with ultra-low power consumption design. At that time, no one can wake it up until the scheduled time is reached.
However, there is a manually Wake-Up Trigger mechanism for you to wake up the device for some unexpected reason, for example, to change software configuration or upgrade new firmware.

Alert has 3 settings:

Disable: Disable wake up trigger function.
Scheduling: Followed by **Data Interval** setting, which is at "LoRa" page and "MAC LAYER" setting "Get/Report Data Interval" to read field data and uplink field data.
Data Action: Once WakeUp pin continues short, it triggers continued field data reading and uplink field

data content to LoRa gateway until WakeUp pin is open.

Sleep Mode

Sleep mode is designed for power saving when device is powered by battery. Once connected to external power, device is always on.

Auto: Always wakeup when externally powered; If it connected by battery power, EDGE 1 awakes to operate by schedule or short WakeUp pin.

Manual with **Enable**: For both external power and battery power, device is always in scheduled awake.

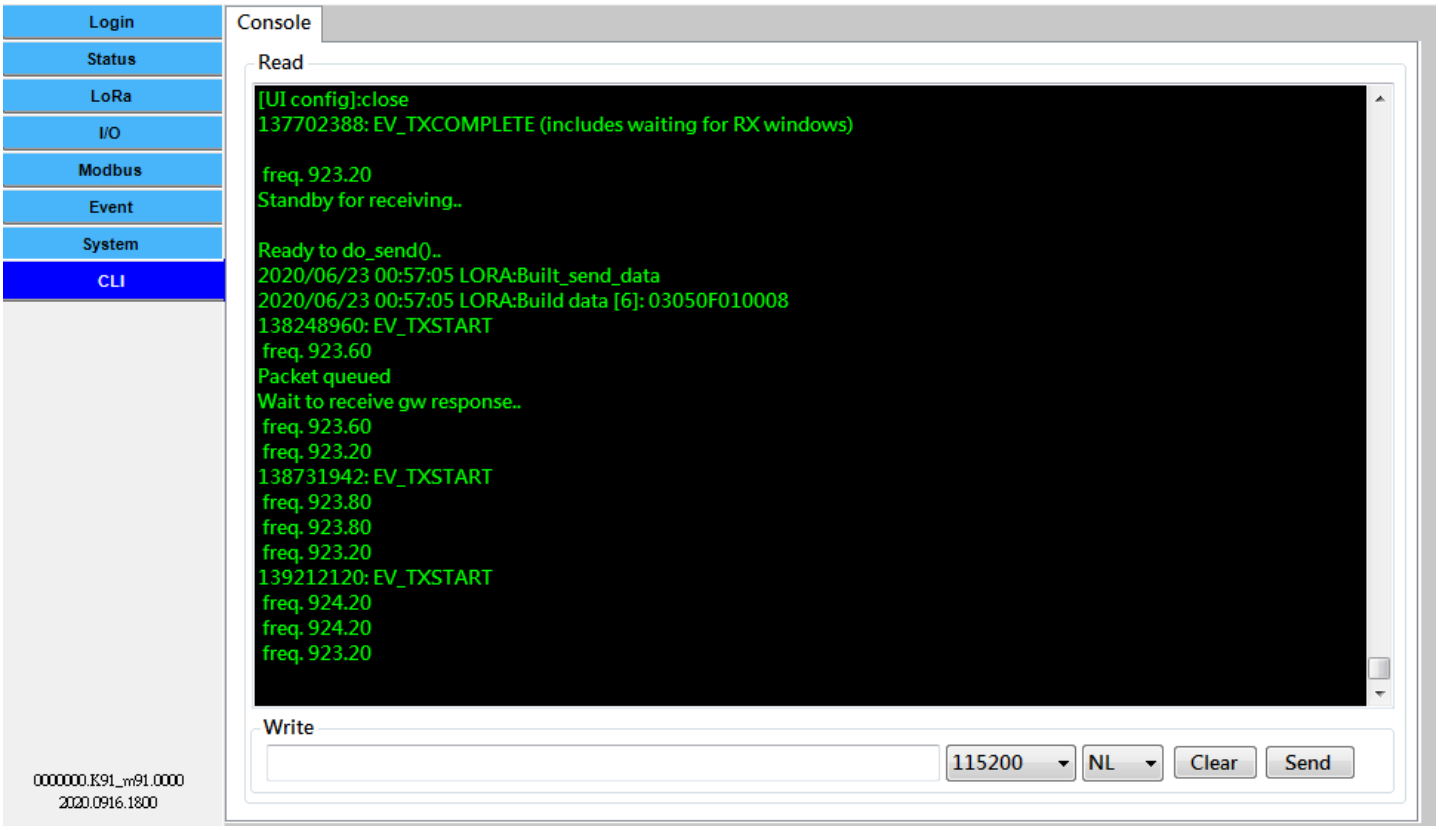
Manual with **Disable**: For both external power and battery power connection, device is always up.

Language

Supports English and Japanese.

2.7 CLI Console Log

The system console log will show at this configuration page. It can help to monitor the system operation and event. When some issue happens, capture this console log and consult with device vendor.



Chapter 3 Commands for the LoRa Node

The EDGE 1 is a LoRaWAN compliant LoRa node. With proper configuration, it can automatically send out (report) the status (data) of all the connected meter/sensors to a registered LoRa Network Server through a certain LoRaWAN gateway(s) at a designated time interval. Moreover, it also can listen for the commands issued from network server, and take expected action immediately.

3.1 Command Basics

Each command is composed with a formatted data stream. The basic format is outlined as:

Command	Total length	Data[]	Checksum

Command : 1 byte Command code for the followed data stream.
Total Length: 1 byte length for the complete command stream, excluding the checksum byte, i.e., Length of Command + Total Length + Data[]
Data[]: accompanied data bytes for the issued command.
Checksum: Checksum byte for the complete command stream (Command + Total Length + Data[]).

Direction:

The MSB of the Command code is defined as a Direction bit. '0' for uplink direction, and '1' for downlink.

For example, command code 0x01 is an uplink command issued from a LoRa node to network server; and 0x81 is a downlink command issued from network server to a LoRa node.

Data Alignment:

Big endian alignment is adapted for the data elements in the byte streams. To extract the value for a multi-byte element, like word, Integer, or double word, big endian alignment is required.

Checksum Calculation:

A simple checksum calculation is introduced to check the correctness of the command stream that is transmitted and received wirelessly. Hereunder is the algorithm for Checksum Calculation:

```
char count_chksum(char *buf, int len){
  char ret;
  int i;

  ret = 0;
```

```
  for(i=0; i<len; i++){
    ret ^= buf[i];
  }
  return ret;
}
```

3.2 Commands

0x01 – Report all Inputs:

0x01	Total length	Data[i] length	Data[i] value[]	…	Checksum
1 byte	1 byte	1 byte	n byte		1 byte

Command: 0x01
Purpose: A LoRa node is Uploading the status (data) of all input ports to network server.

Sequence: DI[1] / DI[2] / AI[1] / AI[2] / AI[3] / Modbus[1] / Modbus[2] / Modbus[3]

Note 1: There is maximum limit on the payload size. This command may not be used for some Modbus device configuration that has many registers to read.

For example, the packet "01150100000101000009010303 00FA03C8DB64000093" is composed of

Command byte – 0x01

Total Length – 0x15

Checksum - 0x93

Data[] – "0100000101000009010303 00FA03C8DB640000", where

DI[1]: length=0x01, value=0x00
DI[2]: length=0x00, Nothing
AI[1]: length=0x01, value=0x01
AI[2]: length=0x00, Nothing
AI[3]: length=0x00, Nothing
Modbus[1]: length=0x09, value=0x01030300FA03C8DB64
Modbus[2]: length=0, Nothing
Modbus[3]: length=0, Nothing

0x02 – Report all Enabled Inputs:

0x02	Total length	Port ID[i]	Data[i] length	Data[i] value[]	…	Checksum
1 byte	1 byte	1 byte	1 byte	1 byte * n		1 byte

Command: 0x02
Purpose: A LoRa node is Uploading the status (data) of all enabled input ports to network server.
Port ID[i]: Identifier for each input port. Only those enabled input ports will appear in the payload.

DI-1	0x10
DI-2	0x11
AI-1	0x30
AI-2	0x31
AI-3	0x32
Modbus-1	0x50
Modbus-2	0x51
Modbus-3	0x52
Modbus-4	0x53
Modbus-5	0x54
Modbus-6	0x55
Modbus-7	0x56
Modbus-8	0x57

Data[i] Length: the data length of the corresponding input port.
Data[i] Value: the data of the corresponding input port.

For example, the packet "020E3002000031020000320200003D" is composed of

Command byte – 0x02

Total Length – 0x0E

Port ID[1] – 0x30 /* Port AI-1 */

Data[1] Length – 0x02

Data[1] Value – 0x0000

…

Checksum - 0x3D

0x03 – Report each Enabled Input:

0x03	Total length	Port ID[i]	Data[i] length	Data[i] value[]	…	Checksum
1 byte	1 byte	1 byte	1 byte	1 byte * n		1 byte

Command: 0x03
Purpose: A LoRa node is Uploading the status (data) of all enabled input ports to network server.
Similar to 0x02, but due to payload limitation issue on low data rate connection, up to 4 separate packets could be transmitted. One for all DIs/AIs, and one for each Modbus device.
Port ID[i]: Identifier for each input port. Only those enabled input ports will appear in the payload.

DI-1	0x10
DI-2	0x11
AI-1	0x30
AI-2	0x31
AI-3	0x32
Modbus-1	0x50
Modbus-2	0x51
Modbus-3	0x52
Modbus-4	0x53
Modbus-5	0x54
Modbus-6	0x55
Modbus-7	0x56
Modbus-8	0x57

Data[i] Length: the data length of the corresponding input port.
Data[i] Value: the data of the corresponding input port.

For example, the packet1 “030A1002010231021F3307”, Packet2 “030D500901030300FA03C8DB64D8” are composed of

Command byte – 0x03

Packet1 Total Length – 0x0A

Port ID[1] – 0x10 /* Port DI-1 */; Data[1] Length – 0x02, Data[1] Value – 0x0102

Port ID[1] – 0x31 /* Port AI-1 */; Data[1] Length – 0x02, Data[1] Value – 0x1F33

Checksum - 0x07

Packet2 Total Length – 0x0D

Port ID[1] – 0x50 /* Port Modbus-1 */;

Data[1] Length – 0x09

Data[1] Value –0x01030300FA03C8DB64

Checksum - 0xD8

0x81 – Get all Inputs:

0x81	Total length	Checksum
1 byte	1 byte	1 byte

Command: 0x81
Purpose: A network server is asking for the LoRa node to get the status (data) of all input ports.

Note 1: There is maximum limit on the payload size. This command may not be used for some Modbus device configuration that has many registers to read.

For example, the packet "810283" is composed of

Command byte – 0x81

Total Length – 0x02

Checksum = 0x83

0x82 – Get all enabled Inputs:

0x82	Total length	Checksum
1 byte	1 byte	1 byte

Command: 0x82
Purpose: A network server is asking for the LoRa node to get the status (data) of all enabled input ports.

For example, the packet “820280” is composed of

Command byte – 0x82

Total Length – 0x02

Checksum = 0x80

0x84 – Set Value:

0x84	Total length	Device ID	Data length	Datavalue[]	…	Checksum
1 byte	1 byte	1 byte	1 byte	1 byte * n		1 byte

Command: 0x84
Purpose: A network server is asking for the LoRa node to set the value (data) of specific enabled output port.

Device ID: Identifier for each output port. Only those enabled output port will appear in the payload.

Modbus-1	0x50
Modbus-2	0x51
Modbus-3	0x52
Modbus-4	0x53
Modbus-5	0x54
Modbus-6	0x55
Modbus-7	0x56
Modbus-8	0x57
DO	0x70

Data Length: the data length of the corresponding output port.
Data Value: the data of the corresponding output port.

For a Modbus type port, the data format is composed of

Slave ID	Function call	Start Address	Data Length	Data
1 byte	1 byte	2 bytes	2 bytes	<50 bytes

Example1, the packet "8405700101F1" is composed of

Command byte – 0x84

Total Length – 0x05

Device ID – 0x70 /* Port DO */

Data Length – 0x01

Data Value – 0x01

Checksum - 0xF1

Example2, the packet "840B50071105000100010 1CD" is composed of

Command byte – 0x84

Total Length – 0x0B

Device ID – 0x50 /* Port Modbus-1 */; Data Length – 0x07, Data Value – 0x11050001000101, where

Slave ID=0x11, Function Code=0x05, Start Address=0x0001, Length=0x0001, Data=0x01

Checksum - 0xCD

Note: User can skip the Checksum, just Total Length decrease 2

Example 3, the packet "8403700101" is composed of

Command byte – 0x84

Total Length – 0x03

Device ID – 0x70 /* Port DO */

Data Length – 0x01

Data Value – 0x01 /* Active to Short */

Example 4, the packet "840A50080606000100025678" is composed of

Command byte – 0x84

Total Length – 0x0A

Device ID – 0x50 /* Port Modbus-1 */; Data Length – 0x08, Data Value – 0x0606000100025678, where

Slave ID=0x06, Function Code=0x06, Start Address=0x0001, Length=0x0002, Data=0x5678

0x70 – Low Power Warning:

0x70	Total length	Checksum
1 byte	1 byte	1 byte

Command: 0x70
Purpose: A LoRa node is alerting to the network server with low battery power warning.

For example, the packet “700272” is composed of

Command byte – 0x70 stands for “Low Power Warning”

Total Length – 0x02

Checksum = 0x72

Contact Information

EtherWAN System, Inc.

www.etherwan.com

USA Office

2301 E. Winston Road
Anaheim, CA 9280
Tel: +1-714-779-3800
Email: info@etherwan.com

Pacific Rim Office

8F., No.2, Alley 6, Lane 235, Baoqiao Rd.
Xindian District, New Taipei City 231
Taiwan
Tel: +886 -2- 6629-8986
E-mail: info@etherwan.com.tw

February 8, 2021