User Guide

PIKA

LoRaWAN Converter

October 2024

1. Product Introduction

Welcome to the user manual for PIKA. This document is intended to provide you with all the information you need to get started with and use the software effectively.

1.1. Overview

PIKA: A Smart and User-Friendly Bridge from Modbus RS485 to LoRaWAN

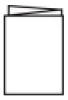
PIKA is a device that enables industrial data collection and transmission using the LoRaWAN protocol. It supports both RS485 and pulse inputs and can communicate with up to 8 devices on the same bus. PIKA can read up to 50 Modbus registers, supports importing and exporting Modbus register data in Excel files, and sends them to the Internet via LoRaWAN. PIKA also allows users to remotely control and monitor data from various RS485 devices in real-time. PIKA has a simple plug-and-play design that makes it easy to install and use.Additionally, with an IP67 protection rating, PIKA is suitable for outdoor installation, offering dust and water resistance to ensure stable operation even in harsh environmental conditions such as rain, dust, and high temperatures.

1.2. Functional Specifications

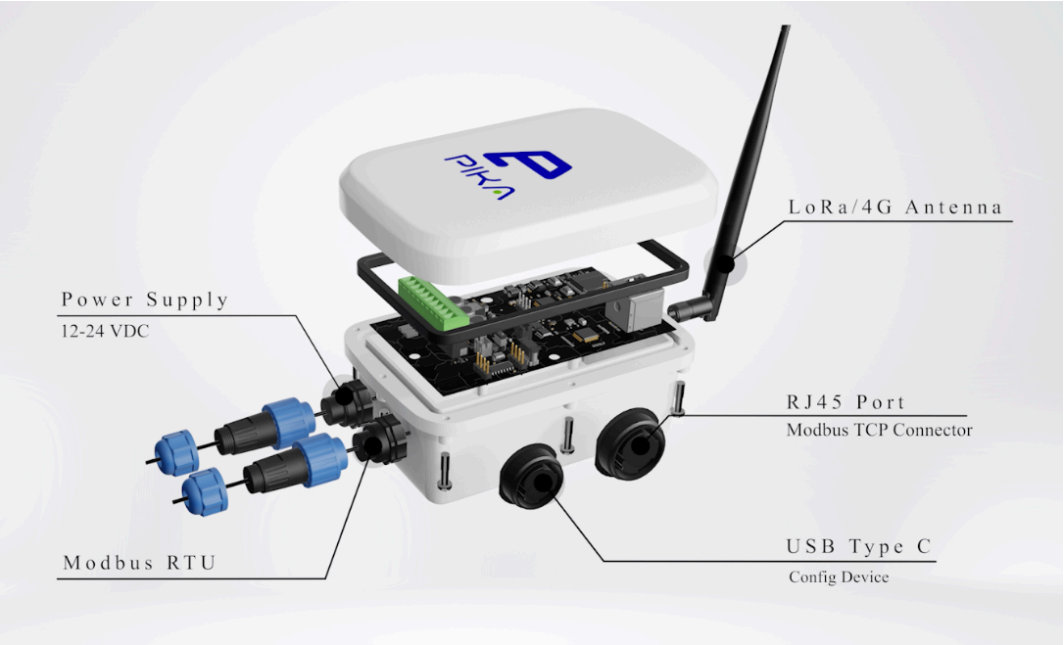
- **LoRaWAN Communications:** PIKA can connect to a LoRaWAN network and send data to the Internet via LoRaWAN gateways.
- **Modbus RTU Master:** PIKA can act as a Modbus RTU master and read data from up to 8 Modbus RTU slave devices on the same bus. It can read up to 50 Modbus registers from each device and convert them to LoRaWAN payloads.
- **Digital Pulse Signals Counter:** PIKA can also count digital pulse signals from devices such as water meters, gas meters, or electricity meters. It can send the pulse counts to the Internet via LoRaWAN.
- **Reporting at Set Intervals and Power Failure Alarm:** PIKA can report the data from Modbus RTU and pulse counter inputs at regular intervals that you can configure. It can also send an alarm message to the Internet when it detects a power failure.
- **Device Configuration through the WNESS Tool Software:** PIKA can be configured using the WNESS Tool software that runs on your PC. You can use the software to set up the LoRaWAN, Modbus RTU, pulse counter, device ID, and password parameters for your device.
- **Software Configuration:** LoRaWAN, Modbus RTU, Pulse Counter, Device ID & Password.

2. Hardware Introduction

2.1. Packing List:

No.	Description	
1	1 x Power Adapter	
2	1 x Cable type C usb	
3	2 x Waterproof connector	
4	1 x Quick Guide	 1 × Quick Guide
5	1 x PIKA device	
6	1 x Antenna	

2.2. Hardware Overview



- **Power Supply** : 12-24Vdc (Pin 1 : VCC, Pin 2 : GND)
- **Modbus RTU port** : Used to connect with devices according to the Modbus RTU standard (Pin 1 : A+, Pin 2 : B-)
- **RJ45 Port** : Used to connect with devices according to the Modbus TCP standard.
- **USB type C Port** : used for configuring the device.
- **Antenna :** Used to transmit data.

2.3. Dimensions (mm)

3. Operation Guide

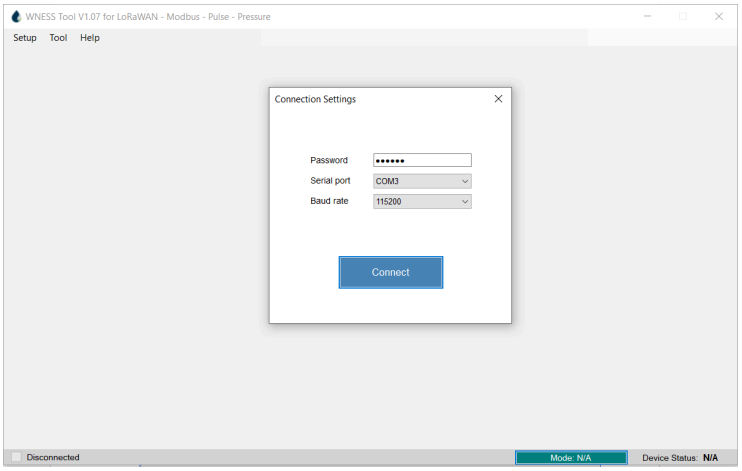
The Pika device operates in two modes: Stop Mode and Run Mode.

- The Stop Mode allows users to read and configure the device settings through software. In this mode, the device does not perform Modbus queries or send messages via LoRaWAN.
- In Run Mode, the device performs Modbus queries and sends messages via LoRaWAN at the configured interval. Users cannot configure the device in this mode.

Users can switch the device's mode using the software or by pressing a button on the circuit board.

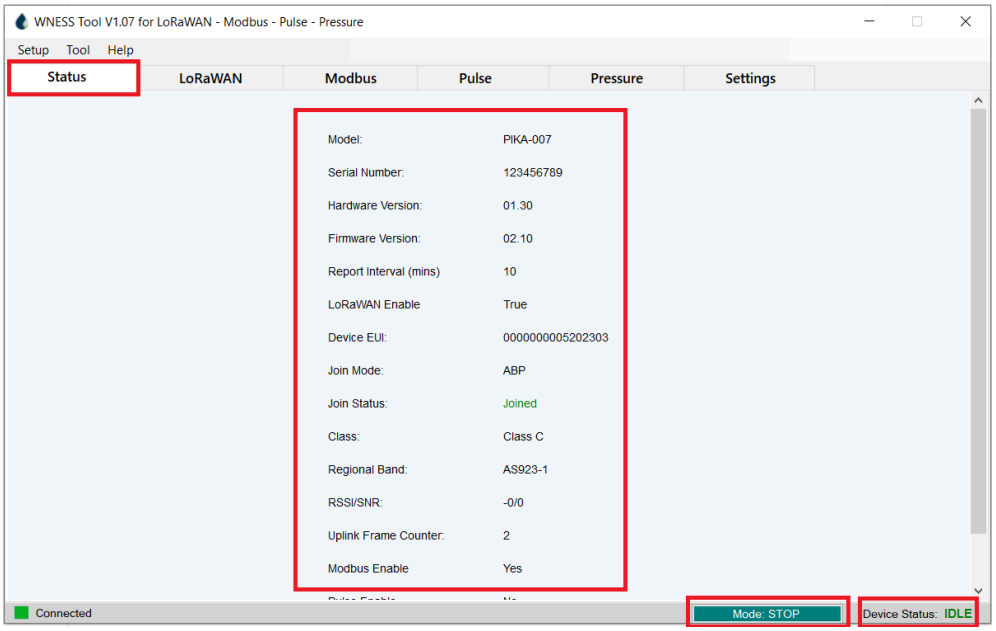
3.1. Connect to the software

1. Attach the antenna, power up the PIKA device, and connect it to your computer via the USB type-C port.
2. Wait about 1 minute for the device to complete the startup process.
3. Then, open the "WNESS_Tool.exe" software, enter the default password (123456), select the Serial port connected to the PIKA device, and click "Connect".



4. Once the software connects successfully, the device will automatically switch to Stop Mode if it is currently in Run Mode, the device parameters will be displayed in the "Status" tab.

   The software has configuration tabs including: Status, LoRaWAN, Modbus, Pulse, Pressure, and Settings.



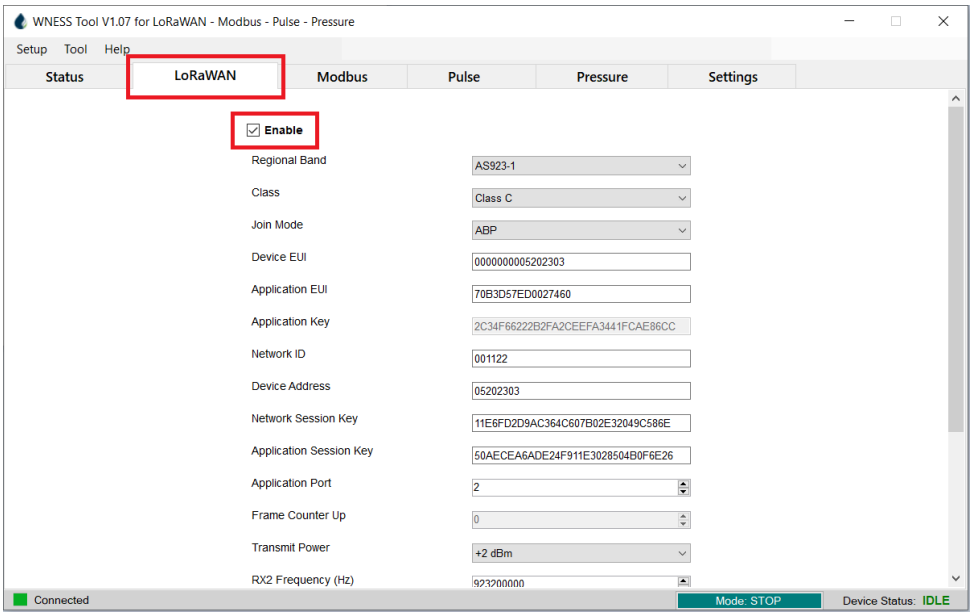
Users can click the “Mode: STOP” button in the bottom right corner of the software to switch the device's operating mode to RUN, enabling it to perform Modbus queries and send messages. Note that you can only press the mode switch button when the device status is IDLE.

However, before doing so, ensure that the device is in Stop Mode to configure other parameters.

3.2. LoRaWAN Settings

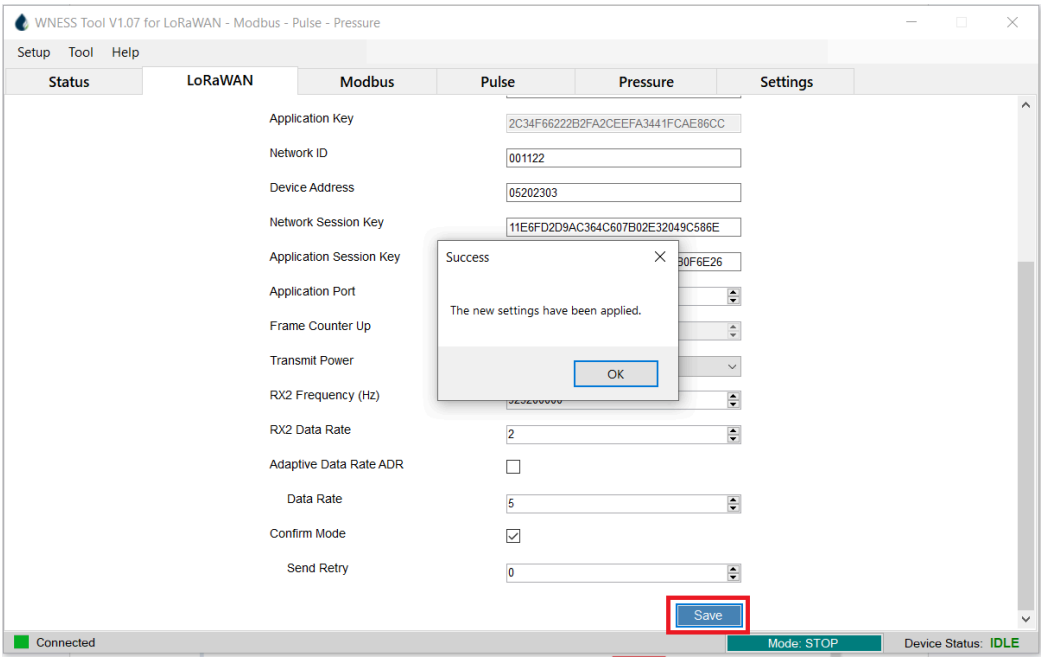
Tab “LoRaWan” is used for configuring the transmission parameters in the LoRaWAN network.

Click “Enable” to enable the feature to work.

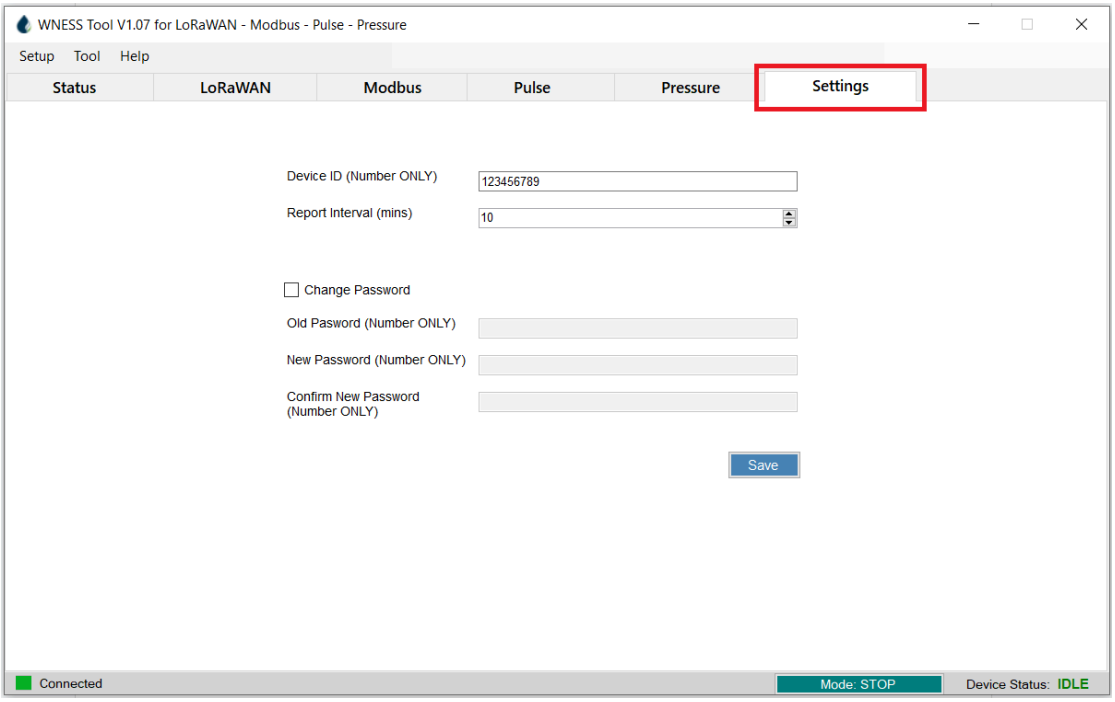


Parameters	Description
Regional Band	EU433, CN470, IN865, EU868, AU915, US915, KR920, RU864, and AS923-1/2/3/4. (Default AS923-2)
Class	A, B, C. (Default Class C)
Join Mode	OTAA and ABP modes are available. (Default ABP)
Device EUI	Set the device EUI, 16 digits.
App EUI	Set the device App EUI, 16 digits.
Application Key	Appkey for OTAA mode, 32 digits.
Device Address	DevAddr for ABP mode, 8 digits.
Network Session Key	Nwkskey for ABP mode, 32 digits.
Application Session Key	Appskey for ABP mode, 32 digits.
Application Port	The port is used for sending and receiving data. (Default 2)
Tx Power	The transmit power of device, 2dBm->16dBm (Default 16dBm)
RX2 Frequency	RX2 frequency to receive downlinks. Unit: Hz (Default 921400000)
RX2 Data Rate	RX2 data rate to receive downlinks. (Default 2)
ADR Mode	Allows the network server to adjust the data rate of the device.
Confirmed Mode	Configure the device to receive ACK packets from the network server.
Send retry	0-3. (Default 0)

Click the “Save” button at the bottom of the LoRaWAN settings tab to save the configuration.



3.3. General Settings



Parameters	Description
Device ID	*Show the SN of the device.*
Reporting Interval	*Transmit data to the network server every 1-1000 minutes. (Default: 15 mins.)*
Change Password	*Change the password to log in to the software. (Default password: 123456)*

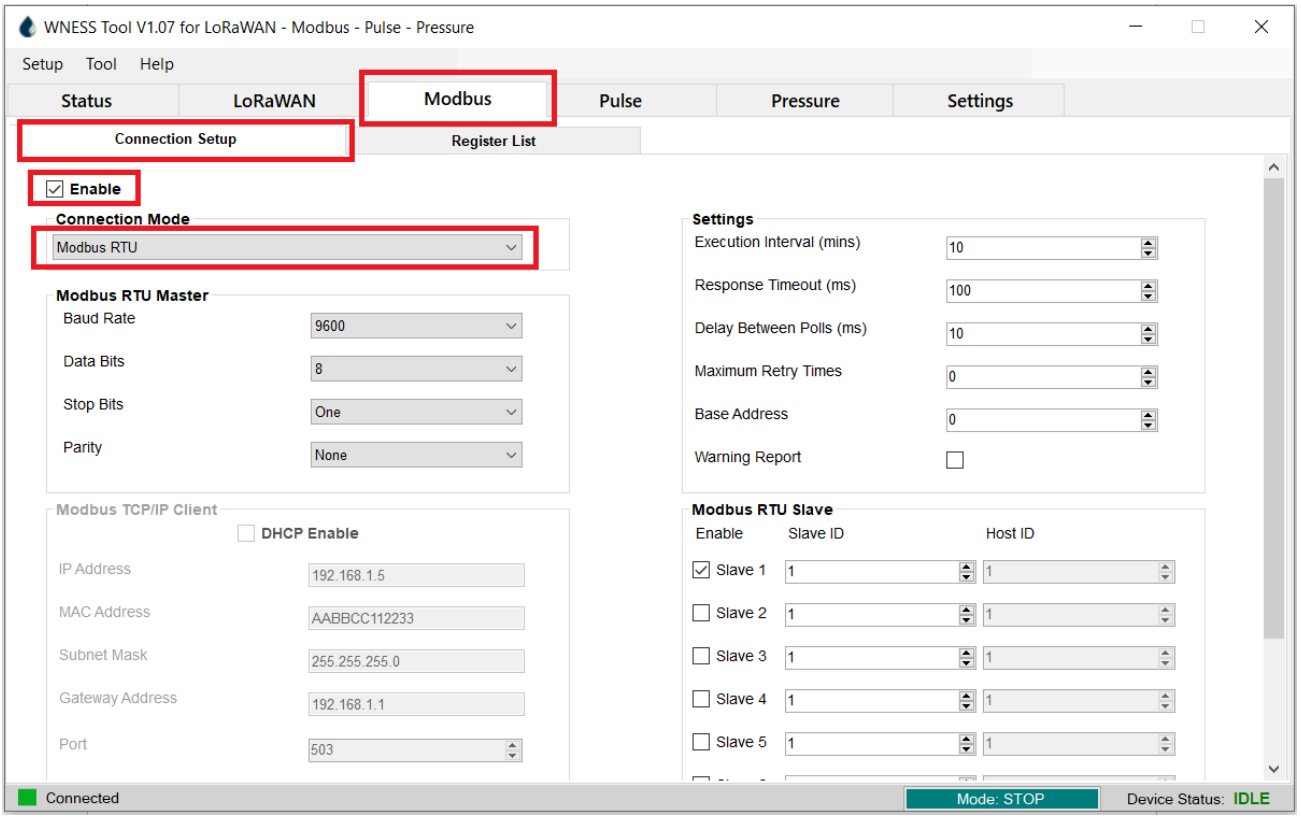
Click the “Save” button to save the configuration.

3.4. Modbus Settings

3.4.1. Modbus RTU Connection Settings

PIKA has a single port, labeled as RS485, which is intended for connecting Modbus RTU devices.

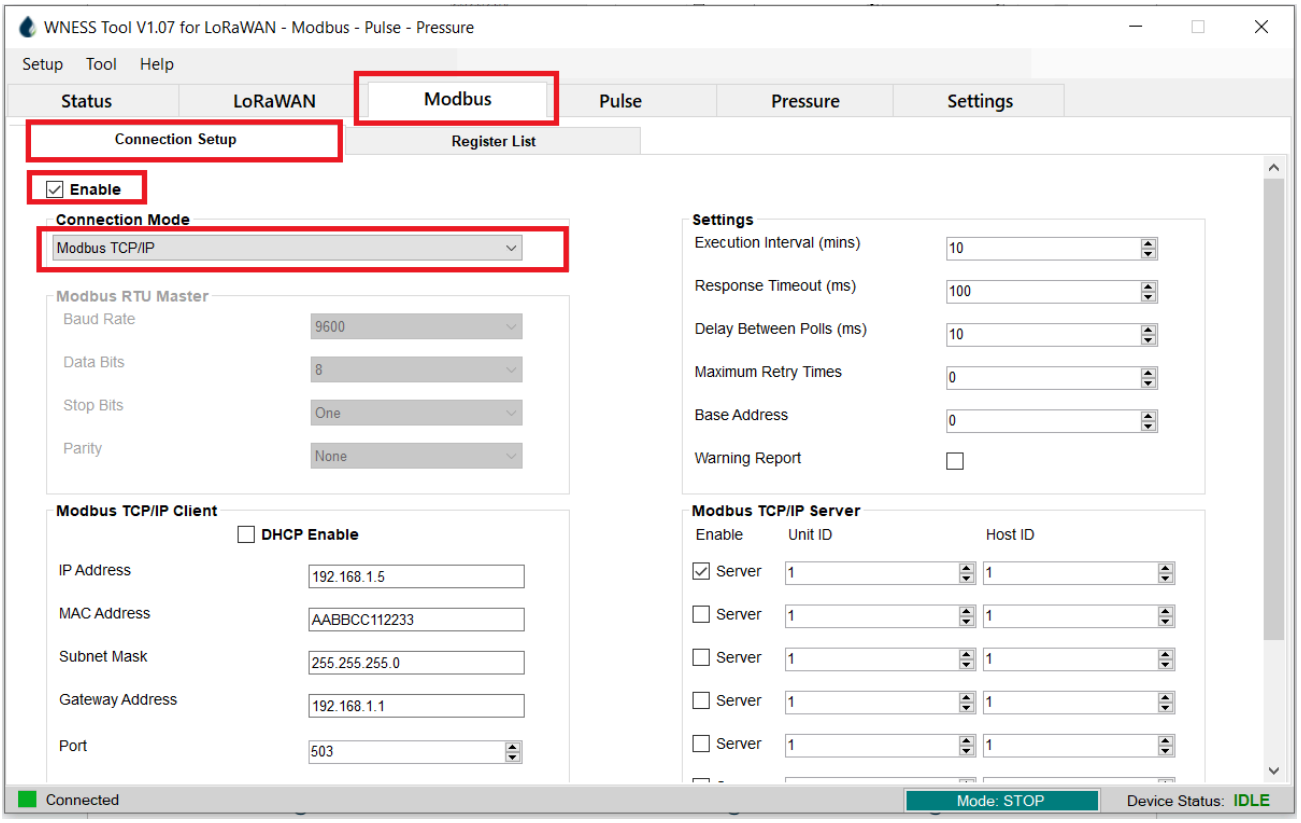
1. To connect your device, you need to plug it into the RS485 port "A, B" in the terminal block.
2. Once connected, navigate the software to the Modbus tab, choose the "Connection setup" section.
3. Ensure that the Modbus function is active by checking the Enable box and selecting Modbus RTU as the Connection Mode.
4. Set the Modbus parameters to match the device you want to query.
5. Click the “Save” button at the bottom of the tab to save the configuration.



Parameters	Description
Connection Mode	Modbus RTU or Modbus TCP/IP. (Default Modbus RTU)
Baud Rate	1200/2400/4800/9600/19200/38400/57600/115200 are available. (Default 9600).
Data Bit	8 bits / 9 bits is available. Choose 9 bits when using Parity. (Default 8).
Stop Bit	One bit / Two bits are available. (Default One).
Parity	None, Odd and Oven are available. (Default None).
Execution Interval (min)	The execution interval between each Modbus query. (Default 15 mins).
Response Timeout (ms)	The maximum response time that the PIKA waits for the reply to the Modbus command. If it does not get a response after the max response time, it is determined that the command has timed out. (Default 1000 ms).
Delay Between Polls (ms)	Delay time between Modbus query commands. (Default 300 ms).
Max Retry Times	Set the retry times after the device fails to query data from the Modbus devices. (Default 0).
Base Address	Offset address of the Modbus Registers. 0 or 1 are available. (Default 0).
Slave ID	Modbus Slave ID 0-255. Pika supports querying up to 8 Modbus devices on the same bus with different slave ID, using the same Modbus registers configuration.

3.4.2. Modbus TCP Connection Settings (Optional)

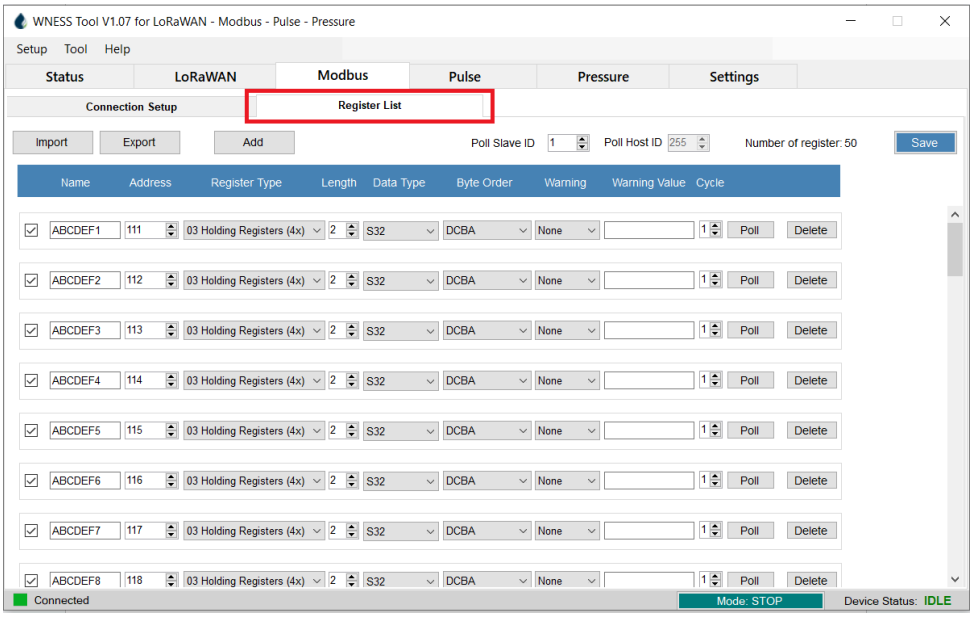
1. Connect the Modbus TCP/IP device to the RJ45 port.
2. In tab Modbus Connection setup, selecting Modbus TCP/IP as the Connection Mode.
3. Set the Modbus parameters to match the device you want to query.
4. Click “Save” at the bottom of the tab to save the configuration.


WNESS Tool V1.07 for LoRaWAN - Modbus - Pulse - Pressure
Setup
Tool
Help
Status
LoRaWAN
Modbus
Pulse
Pressure
Settings
Connection Setup
Register List
Enable
Connection Mode
Modbus TCP/IP
Modbus RTU Master
Baud Rate
9600
Data Bits
8
Stop Bits
One
Parity
None
Modbus TCP/IP Client
DHCP Enable
IP Address
192.168.1.5
MAC Address
AABBCC112233
Subnet Mask
255.255.255.0
Gateway Address
192.168.1.1
Port
503
Settings
Execution Interval (mins)
10
Response Timeout (ms)
100
Delay Between Polls (ms)
10
Maximum Retry Times
0
Base Address
0
Warning Report
Modbus TCP/IP Server
Enable
Unit ID
Host ID
Server
Connected
Mode: STOP
Device Status: IDLE

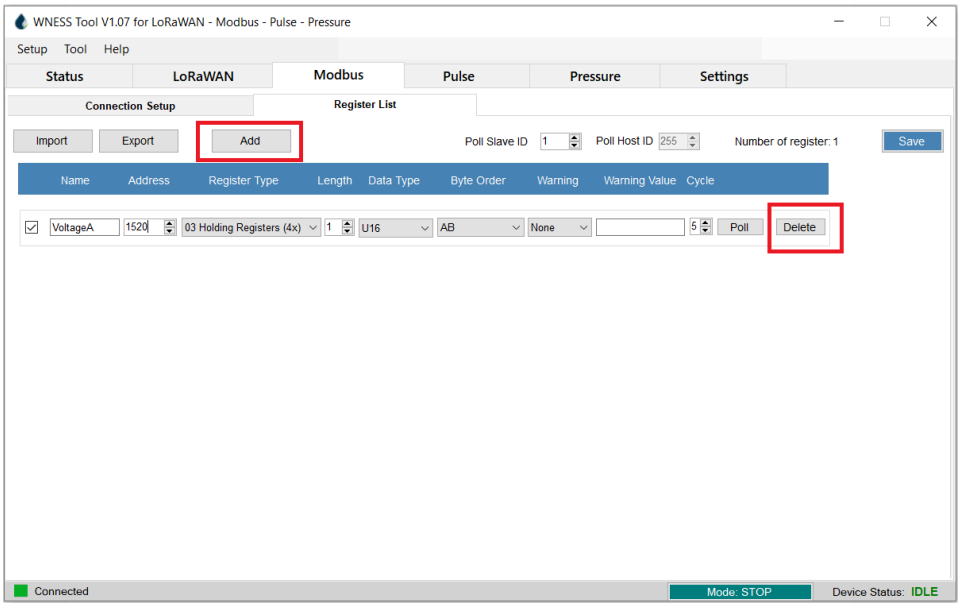
Modbus TCP Parameters	Description
IP Address	Modbus device IP address.
MAC Address	Modbus device MAC address.
Subnet Mask	Default 255.255.255.0
Gateway Address	Set the Gateway Address to the same layer as Modbus device IP address.
Port	Modbus device port. Default 502.
Connect Timeout (ms)	Pika's network timeout when attempting to connect to the Modbus device.
Unit ID	The Unit ID of Modbus device 0-255.
Host ID	The fragment of an IP address. For example, if the Modbus device's IP address is 192.168.1.15, then the Host ID is 15.

3.4.3. Modbus Registers Settings

Choose the "Register List" section to configure Modbus registers:



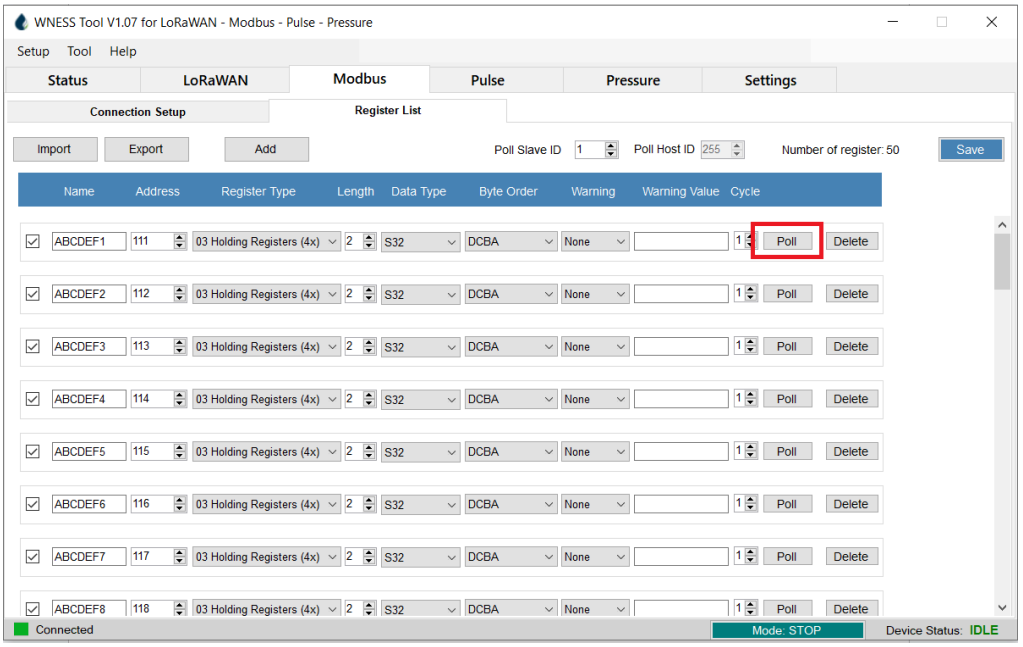
1. Click the “Add” button to add a new Modbus Register to the Register List. You can add up to 50 registers to the list.
2. Click the 'Delete' button in the Register definition row to remove it from the Register List.



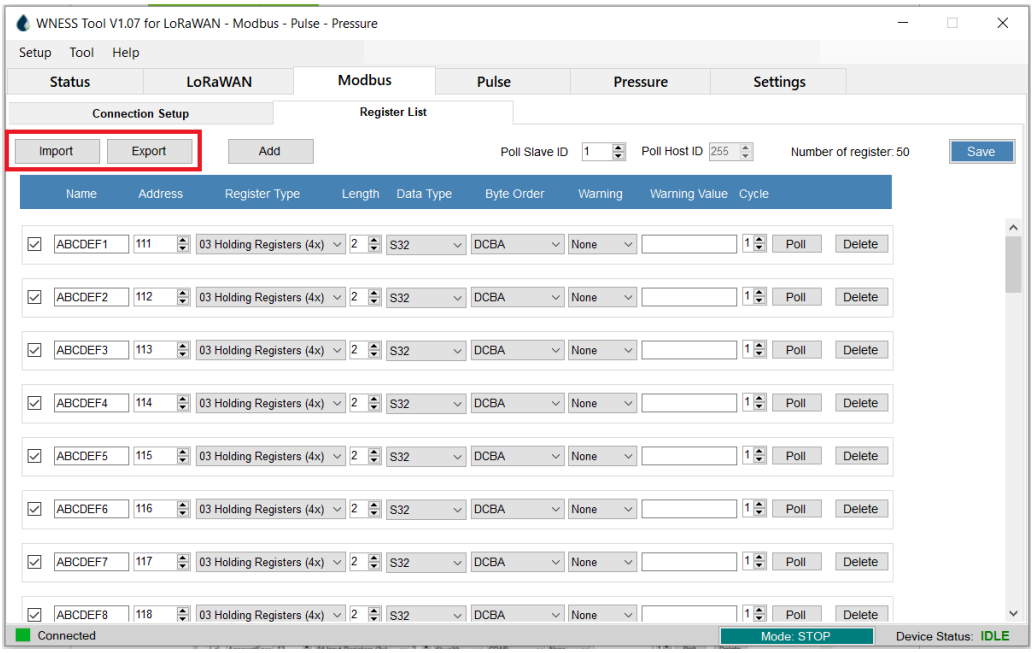
Modbus Register definition

Parameters	Description
Poll Slave ID	Modbus ID for testing the Modbus query function (Poll), same Slave ID.
Name	User-customized name for the Modbus register.
Address	The starting Modbus register address for reading.
Register Type	Modbus register function code 03 / 04
Length	Number of Modbus registers want to query 1 - 4.
Data Type	Select the data type of Modbus register. Support: Hex/U16/S16/U32/S32/Float32/U64/S64/Double64.
Byte Order	Set the Mobus data reading byte order
Warning	None, With, Without.
Warning Value	Input data to warning.
Cycle	Number of warning repetitions 1->5.

3. Check Modbus Connection: Click the “Poll” button in every single register definition row to check if PIKA can read correct data from Modbus devices. If there is no response, the device will return “Modbus Connection: Failed-Timeout- No Response”
4. Click the “save” button to save the configuration.



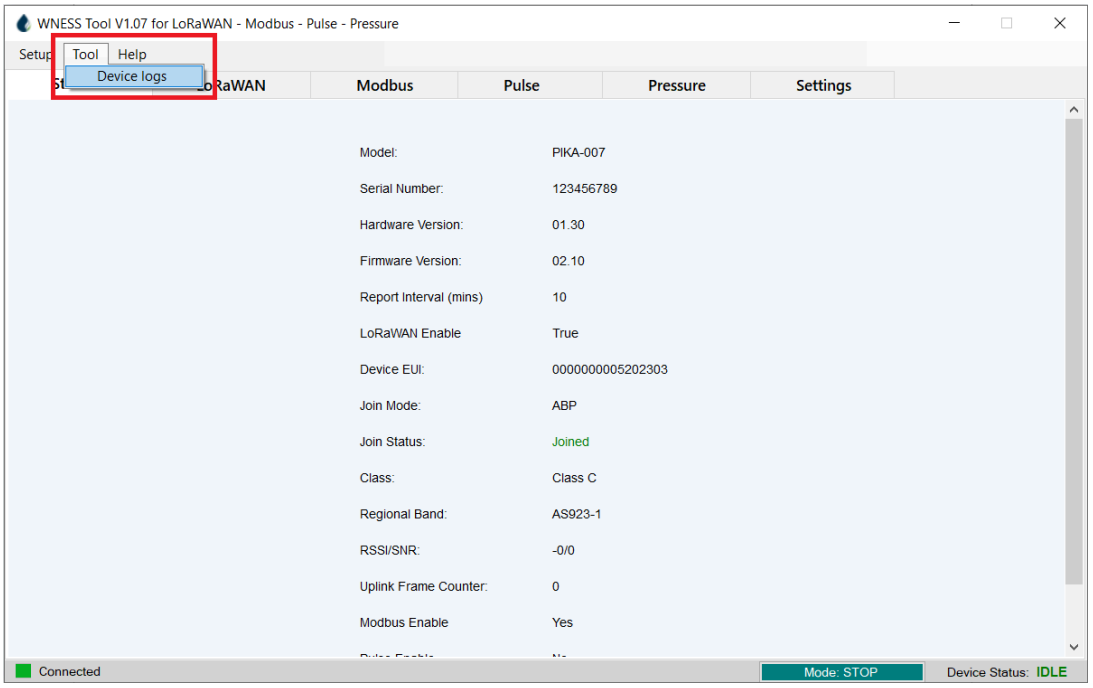
The software comes with a feature to export and import Modbus Register List to/from .csv file format. Simply click on the option you need and follow the prompts to complete the process.

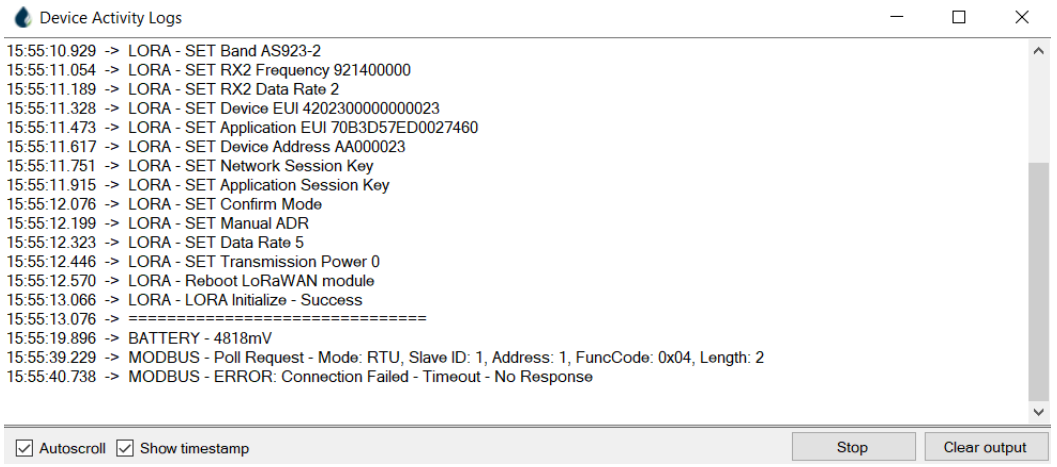


Once the configuration for PIKA is complete, users can click the 'Mode: STOP' button in the bottom right corner of the software to switch to RUN mode, allowing the device to start querying Modbus and sending messages.

3.4.4. Device Log Tool

The software features a tool that allows viewing PIKA's real-time activity logs, offering easy and flexible debugging. Click on "Tool" and then select "Device Logs" to enable this tool.





4. LoRaWAN Payload Format – Uplink Message

All LoRaWAN payload messages are encoded using TLV (Type-Length-Value) format. The TLV structure consists of three components: Type, Length, and Value.

- Type: Specifies the type of data contained in the TLV structure and has a length of 4 bits.
- Length: Indicates the length of the data in bytes and also has a length of 4 bits.
- Value: Is the actual data being transmitted.

Due to the length limitation of the LoRaWAN payload, outgoing messages can be fragmented into multiple packets. These packets must be reassembled on the server side with the same Payload ID.

The format of the first LoRaWAN message packet sent is as follows:

Packet 1:

	8 bits	
Define	**Type(4 bits) high**	**Length(4 bits) low**
Device Model	1	1
Status	2	2
Warning	3	2
Firmware Version	4	1
Pulse Value	5	4
LoRaWAN RSSI	6	1
Pressure Value	7	4
Temperature Value	8	4
Reserved	9	
Reserved	10	
Reserved	11	
Reserved	12	
Payload ID	13	4
Modbus Slave ID	14	1
Register 0	15	2-10
Register 1	15	2-10

Register list

Register ...	15	2-10
Register ...	15	2-10
Register ...	15	2-10

Below is the format of the fragmented LoRaWAN message packets sent:

Packet 2 - Packet n:

	8 bits	
Define	**Type(4 bits) high**	**Length(4 bits) low**
Payload ID	13	4
Modbus Slave ID	14	1
Register list Register 0	15	2-10
Register 1	15	2-10
Register ...	15	2-10
Register ...	15	2-10
Register ...	15	2-10

4.1. Device Model

Pika's Model: type 1 (0x01) has length of 1 byte.

Device Model

Define	Value
PIKA-001	*0x01*
PIKA-002	*0x02*
...	*...*

4.2. Status

Pika's Status: type 2 (0x02) has a length of 2 bytes, which includes the Battery Voltage for the battery-powered version. The voltage is stored in the 9 least significant bits.

Status

Byte high		Byte low
Bit 7 - Bit 1	*Bit 0*	*Bit 7 - Bit 0*
Reserved	*Battery voltage*	

4.3. Warning

Pika's Warning: type 3 (0x03) is represented as a bit field with a length of 2 bytes. If the bit value is 1, it indicates the presence of a warning, while 0 indicates no warning. The warnings that can be identified include MODBUS Connection Error, MODBUS Exception Error, MODBUS Parse Data Error, Low Battery Warning, Power Outage Warning. When connecting the pressure sensor to Pika, additional warnings include: I2C Sensor Error, Low Pressure Warning, High Pressure Warning, Low Temperature Warning, High Temperature Warning.

Warning

Byte low							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
High Pressure Warning	Low Pressure Warning	I2C Sensor Error	Power Outage Warning	Low Battery Warning	Modbus Parse Error	Modbus Exception Error	Modbus Connection Error
Byte high							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	High Temperature Warning	Low Temperature Warning

4.4. Firmware Version

Pika's Firmware Version: type 4 (0x04) has length of 1 byte.

Firmware Version

Define	**Value**
V 01.5	0x0F
V 12.8	0x80
...	...

4.5. Pulse Value

Pulse Value: type 5 (0x05). Available when the pulse counter function is enabled, the pulse value is represented in 4 bytes.

4.6. LoRaWAN RSSI

LoRaWAN RSSI: type 6 (0x06) has length of 1 byte, provides the RSSI value on Pika reception in dBm when the connection is successful, note that this RSSI value is from the last received packet and is always negative.

4.7. Pressure Value

Pressure Value: type 7 (0x07). Available when connecting the I2C pressure sensor to Pika, the value is represented in 4 bytes, the unit is mbar.

4.8. Temperature Value

Temperature Value: type 8 (0x08). Available when connecting the I2C pressure sensor to Pika, this value is the internal temperature of the sensor and is represented in 4 bytes, the unit is millidegree Celsius.

4.9. Payload ID

Payload ID: type 13 (0x0D) has length of 4 bytes. The Payload ID is a number used to identify and reassemble the fragmented packets of Pika's outgoing messages on the server. Each outgoing LoRaWAN message from Pika has a unique Payload ID, and all fragmented packets of a single message share the same Payload ID.

4.10. Modbus Slave ID

Modbus Slave ID: type 14 (0x0E) has length of 1 byte, containing the Modbus ID of the device being queried.

4.11. Modbus Register Value

The Modbus Register Value with Type 15 (0x0F) has a variable Length depending on the value of the register. The Length includes 2 bytes for the register address plus the length of the register value.

If the register value is 0, then the length is only 2 bytes, indicating that it only includes the length of the 2-byte register address, and there is no length for the register value.

Register 0,1,...,n				
Define	**Type**	**Length**	**Value**	
Register X	15 (0x0A)	2 bytes address + value length	2 bytes register address	Register value: 0 - 8 bytes

Example:

Define	Type Length Value - Raw (Hex)	Type (Dec)	Length (Dec)	Value (Hex)	Value (Dec)
LoRa Payload Raw Data	11012200003100D463B06FB4E101FA0000D68DD689D67ED67AF60001D689D67EFA0002D67ED67AD676D662FA0003D67AD676D662D65F				
Device Model	0x1101	1	1	0x01	WNESS05-001
Status	0x220000	2	2	0x0000	
Warning	0x3100	3	1	0x00	No warning
Payload ID	0xD463B06FB4	13	4	0x63B06FB4	1672507316
Modbus Slave ID	0xE101	14	1	0x01	Slave ID: 01
Register 0	0xFA0000D68DD689D67ED67A	15	10	0x0000D68DD689D67ED67A	Register Address: 0x0000, Register value: 0xD68DD689D67ED67A
Register 1	0xF60001D689D67E	15	6	0x0001D689D67E	Register Address: 0x0001, Register value: 0xD689D67E
Register 2	0xFA0002D67ED67AD676D662	15	10	0x0002D67ED67AD676D662	Register Address: 0x0002, Register Value: D67ED67AD676D662

Register 3	0xFA0003D67AD676D662D65F	15	10	0x0003D67AD676D662D65F	Register Address: 0x0003, Register Value: D67AD676D662D65F

5. LoRaWAN Payload Format – Downlink Command

PIKA devices can be configured using downlink commands, which are encoded using TLV (Type-Length-Value), similar to uplink messages.

These commands are sent in hexadecimal format.

5.1. Report Interval Update

Below is an example of an update Report Interval:

Report Interval Update

Lora Raw data	0x0102000A
Type (1 byte)	0x01
Length (1 byte)	0x02
Value (2 bytes)	0x000A = 10 minutes

5.2. Send Uplink Now

Send this Downlink command to the device to have it transmit an Uplink message immediately afterward.

Send Uplink Now - Only available in Class C

Lora Raw data	0x0302ABCD
Type (1 byte)	0x03
Length (1 byte)	0x02
Value (2 bytes)	0xABCD = Report Key

-END-