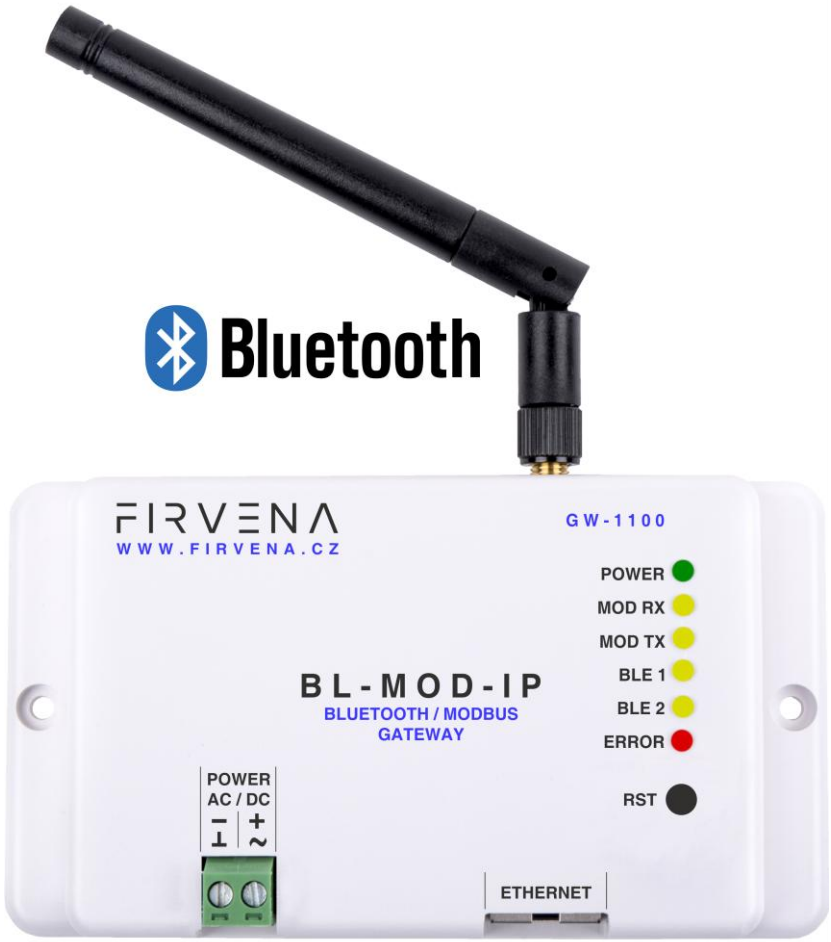
FIRVENA

Bluetooth LE to Modbus/IP Gateway

BL-MOD-IP

User Manual V1.2

English



CONTENTS

TERMS AND ABBREVIATIONS

Term/Abbr.	Explanation
AC	Alternating Current
Bluetooth LE (BLE)	Bluetooth Low Energy, wireless communication standard
Channel number (CH)	Identifier of Bluetooth device within the gateway
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
Label	User-friendly name of Bluetooth device
mDNS	Multicast Domain Name System protocol
MQTT	Message Queuing Telemetry Transport
IP	Internet Protocol
JSON	JavaScript Object Notation, text data format
PoE	Power over Ethernet
RX	Receive, reception
SNTP	Simple Network Time Protocol
SSDP	Simple Service Discovery Protocol
TX	Transmit, transmission
UPnP	Universal Plug and Play
WebUI	Web User Interface, user interface of the gateway

THANK YOU

Thank you for purchasing our product! We believe in your satisfaction with the product that aligns with the company philosophy of the highest care and precision. In case of interesting ideas and concepts, please contact firvena@firvena.cz

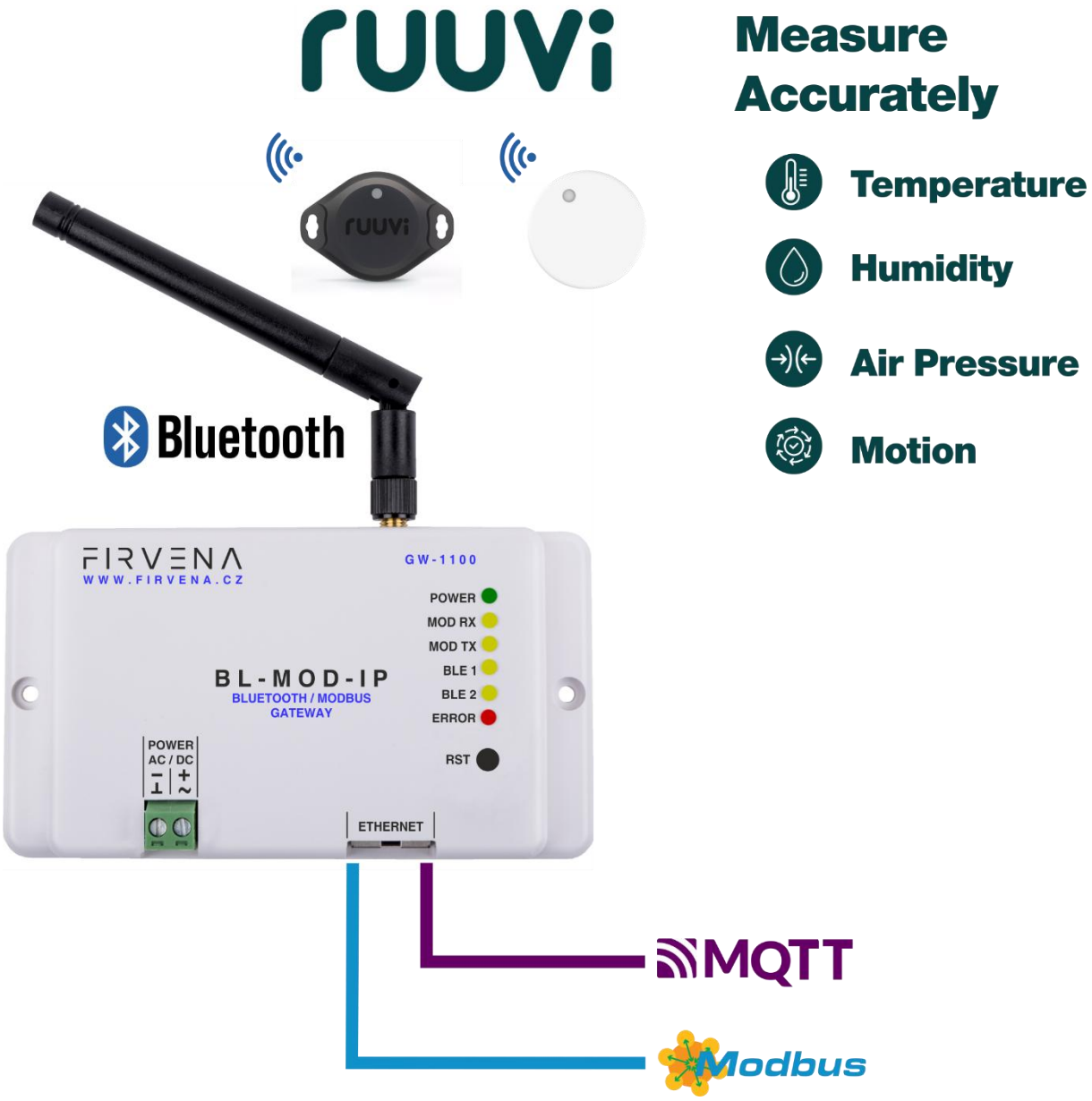
www.firvena.com

1 INTRODUCTION

The BL-MOD-IP device is a gateway for wireless Bluetooth Low Energy (BLE) sensors. It collects data from Bluetooth sensors and passes it on using the Modbus TCP/IP communication protocol. The network connection is possible through Ethernet interface. It can by powered using both active and passive PoE or using an external power adapter.

Chapters 2–6 describe hardware features of the gateway. The second part of this manual focuses on software features. Chapter 7 is dedicated to the web user interface that is used to set up the gateway. Chapter 8 describes the Modbus interface and explains how the data of Bluetooth devices is translated into the Modbus data model. For firmware update procedure refer to Chapter 10.

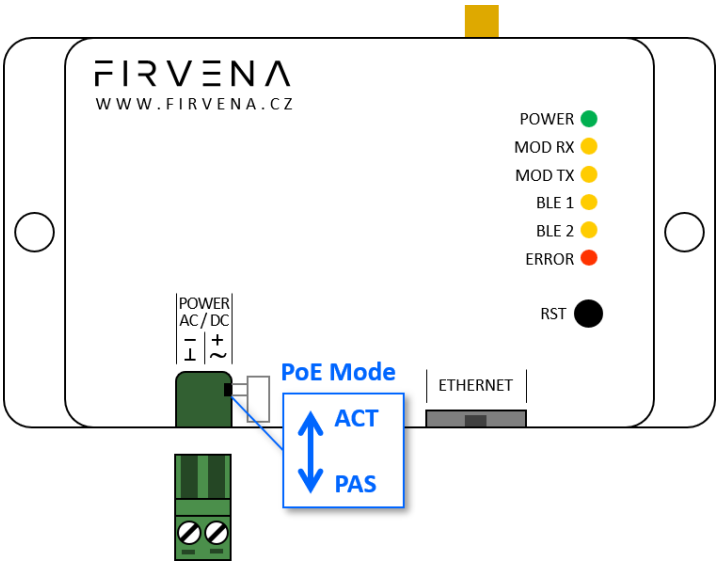
In addition to Modbus, the MQTT communication can also be used to collect data from sensors. MQTT is described in Chapter 9.



2 HARDWARE OVERVIEW

On the front panel, there are a power connector, RJ45 Ethernet connector, antenna connector, LED indicators and reset button. The reset button can be used to reset the configuration in case the password is lost. The green POWER terminal block is removable, making it easier to handle the device when cables are connected.

The LEDs indicate: the connection of power supply (POWER), activity in the Modbus network (MOD RX, MOD TX), Bluetooth activity (BLE1, BLE 2) and error states (ERROR). The LEDs are very useful when testing or commissioning but because the emitted light can be disruptive during normal operation, the LEDs can be deactivated [WebUI > Settings > LED Indication].



There is a switch to the right of the POWER terminal block that is only accessible after pulling out the POWER terminal block. This is used to switch between active and passive **PoE modes**:

- **the "ACT" position (default)** enables the use of ACTIVE power supply
- **the "PAS" position** enables the use of PASSIVE power supply

Case	LEDs		Behavior	Meaning
Power supply	POWER	🟢	Shining	Power supply connected and program running
Firmware update	POWER	🟢	Flashing irregularly	Indicates data transfer during firmware update
Modbus communication	MOD RX	🟡	Short blink	Communication in the Modbus network – received a packet
	MOD TX	🟡	Short blink	Communication in the Modbus network – sent a packet
Bluetooth scan	BLE 1	🟡	Shining	Active scan running
	BLE 2	🟡	Short blink	A Bluetooth device discovered
–	ERROR	🔴	Flashing regularly	A fatal error has occurred, the device is about to restart
Ethernet connector	Left	🟢	Steady/Blinking	Link/Activity
	Right	🟡	Steady	Status of the IP stack: off – not ready | on – ready, IP address configured, long delay after ethernet connection indicates a DHCP problem

Reset button functions:

- *Software restart:* short press
- *Reset network configuration:* hold 3 s (until green POWER starts blinking) -> confirm by short press.
  It returns the factory network configuration and enables DHCP. The previous configuration will be restored after the next software restart. This is useful if you are unable to connect to the *WebUI* after changing the network settings.
- *Factory reset:* hold 10 s (until green POWER starts blinking faster) -> confirm by short press
  It clears all configuration and returns the gateway to the factory state. This is the only way to reset the password.

3 TECHNICAL DATA

Category	Parameter	Value
Product	Product name	BL-MOD-IP
	Product title	Bluetooth LE to Modbus/IP Gateway
	Vendor name	FIRVENA s.r.o.
Electrical data	Rated supply voltage	24 V DC / 24 V AC
	Supply voltage range	10–32 V DC / 24 V AC (± 10 %)
	Rated input current	70 mA / 24 V
	Rated input power	1.68 W / 24 V
Ethernet (Modbus/IP)	Speed	10, 100 Mbit/s
	Connector	RJ45
	PoE	✓
	PoE power supply	According to standard 802.3af, active or passive
Bluetooth	Frequency	2.4 GHz
	Version	4.2
	Maximum number of devices	Modbus: up to 100 devices can be configured MQTT: no limit specified if the gateway just forwards advertisement packets
Operating conditions	IP Code	IP20
	Operating temperature	−20 to +70 °C
	Relative humidity	max. 80 %
Dimensions in mm	Dimensions without antenna	Width=126, Height=71, Depth=25
Weight	Weight without antenna	115 g
Box material		ABS, white

Product conformity and certification	
RoHS	**ROHS Directive** The device is manufactured in accordance with the directive 2015/863/EU (RoHS 3) of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
CE	**EMC - Declaration of Conformity** The device is compliant with the directive 2014/53/EU, 2011/65/EU RoHS. Approvals tests ČSN EN 55032, ČSN EN 55035, ČSN EN 6100-4-2, ČSN EN 6100-4-3, ČSN EN 6100-4-4, ČSN EN 6100-4-5, ČSN EN 6100-4-6, ČSN EN 6100-4-11, ČSN EN IEC 6100-6-2.
UKCA	**UK Conformity Assessed (UKCA)** The device is compliant with the British Legislation UK Conformity Assessed (UKCA) and meets all relevant requirements.

4 SAFETY INFORMATION AND WARNINGS

Please follow the general safety regulations. This device may only be installed by a qualified person (accredited electrician) and after reading these instructions. Improper installation can result in health, property or equipment damage.

The product meets the general safety regulations. The protection Cover IP 20 allows installation only in normal, dry space.

The gateway must be powered from a safe voltage source that meets the requirements for input voltage range and must be installed in accordance with national and general safety standards.

Follow the safety instructions and applicable standards for the country and location of installation. The product may only be used in accordance with this manual.

To avoid the risk of electrical shock or fire, the maximum operating parameters of the gateway must not be exceeded.

Use only unmodified products.

Only cable types with sufficient cross-section and insulation properties may be used for the connection.

STORAGE

The device must be stored in a temperature range 0-40 °C and a relative humidity of up to 80 %, and non-condensing spaces. Products must not be exposed shock, harmful vapors or gases.

REPAIRS

Products are repaired by the manufacturer. Products to be repaired are shipped in a package that ensures shock absorption and protects the products against damage during shipment.

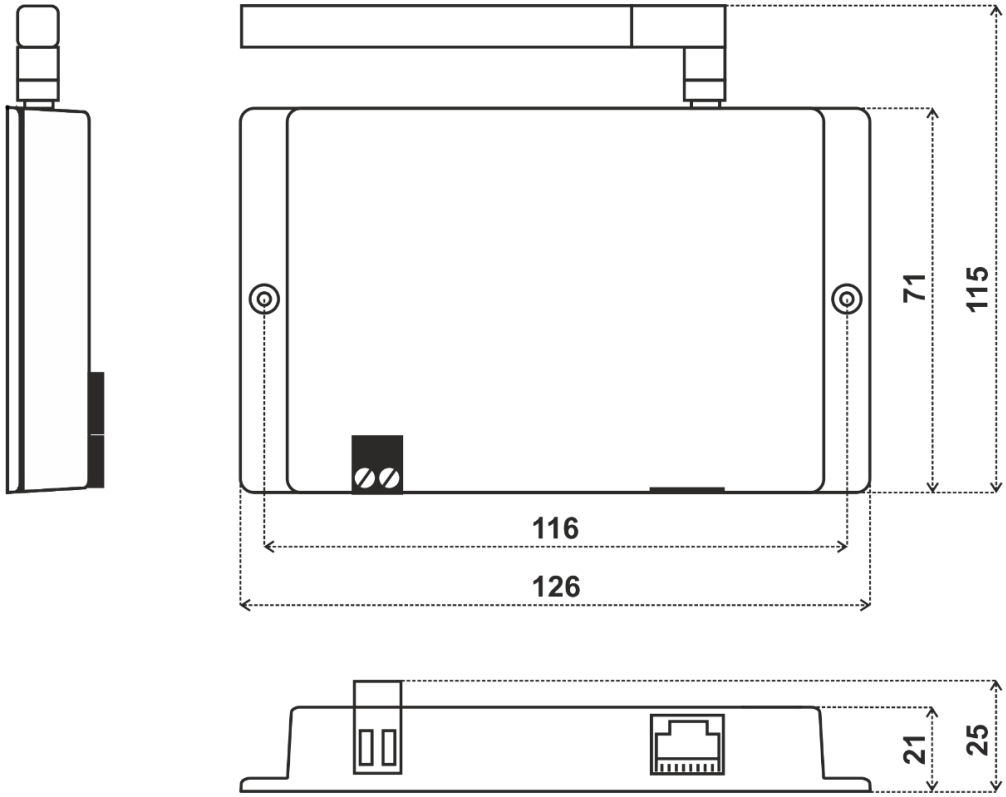
WARRANTY

The product is warranted 24 months from the date of delivery that is mentioned on the delivery note. The manufacturer only guarantees properties and parameters that are explicitly described in the technical documentation. Claims, complaints and returns must be directed exclusively to the manufacturer. The complaint must contain the exact product identification, delivery note number and defects description. The manufacturer is not responsible for defects caused by improper storage, improper external connection, damages caused by external influences especially due to unacceptable size, incorrect adjustment, improper installation, incorrect operation or normal wear and tear.

PRODUCT DISPOSAL

The product does not belong to municipal waste. The product must be disposed to the separate waste collection with the possibility of recycling, according to local regulations and legislation. The product contains electronic components.

5 DIMENSIONS (IN MM)

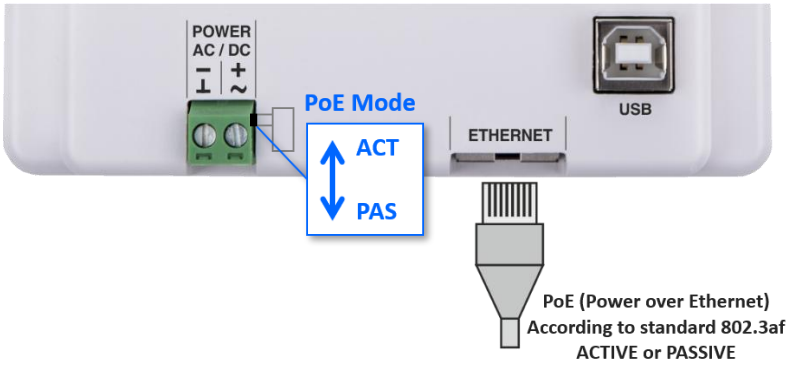


6 POWER SUPPLY

There are two possible power supply connections:

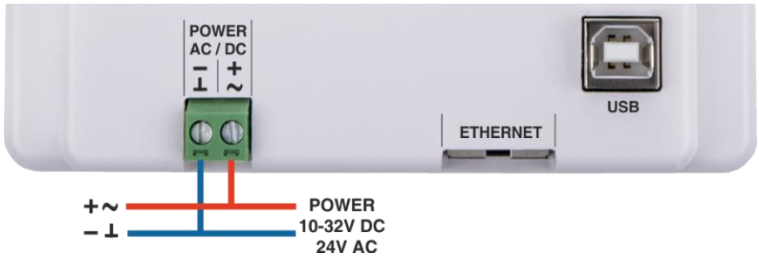
1. Power supply via PoE (Power over Ethernet):

The device supports PoE according to the 802.3af standard. Network elements must support this type of power interface. Passive PoE is also possible through the ETHERNET input. Passive PoE mode must be activated manually by the switch next to the POWER connector.



2. Power supply from an external source:

The gateway must be powered from a safe voltage source that meets input voltage range requirements. The electrical installation must be in accordance with national requirements and safety standards.



7 CONFIGURATION

The gateway has an integrated web application (*WebUI*) that serves to configure it using a web browser. The following part describes how to open *WebUI* for the first time.

7.1 Accessing Web Interface

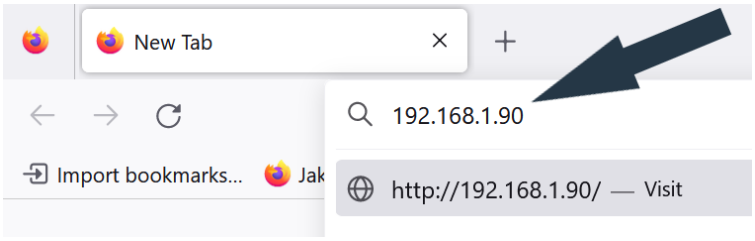
The factory IP address setting is:

PARAMETER	VALUE
DHCP	**enabled**
IP address	192.168.1.90
Subnet mask	255.255.255.0
Default gateway	192.168.1.1

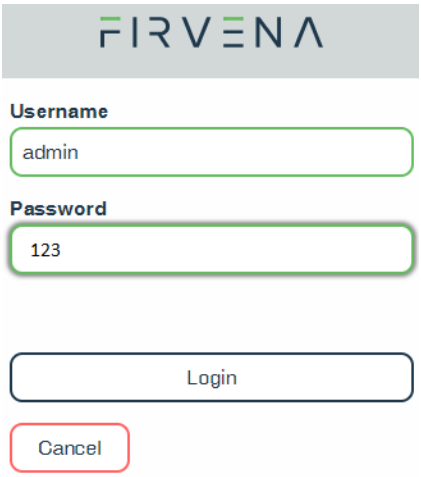
Note:
The default IP address does not work immediately but only after a timeout of 10 seconds if DHCP fails. The DHCP query is then repeated every 60 s. Do not use the default IP address with DHCP enabled in normal operation, because the communication is blocked every time the gateway tries to contact a DHCP server.

Switch on the gateway and connect it to a local network via the ETHERNET connector or directly to a computer with an Ethernet adapter. The DHCP client is enabled by default, so the gateway automatically obtains the IP address and other network parameters from a DHCP server if available. The gateway signals DHCP success by turning on the right yellow LED of the ETHERNET connector.

If the configuration via DHCP fails, because there is no DHCP server in the network or you connect the gateway directly to a computer, the default network configuration is used after 10 seconds. In this case, change Ethernet adapter settings so that your computer has the same subnet mask and a different IP address, e.g. 192.168.1.95.



The *WebUI* is available on HTTP port 80, if you know the IP address of the gateway, simply enter "*http://<IP Address>*" into the address bar of your web browser (e.g. *http://192.168.1.90*).



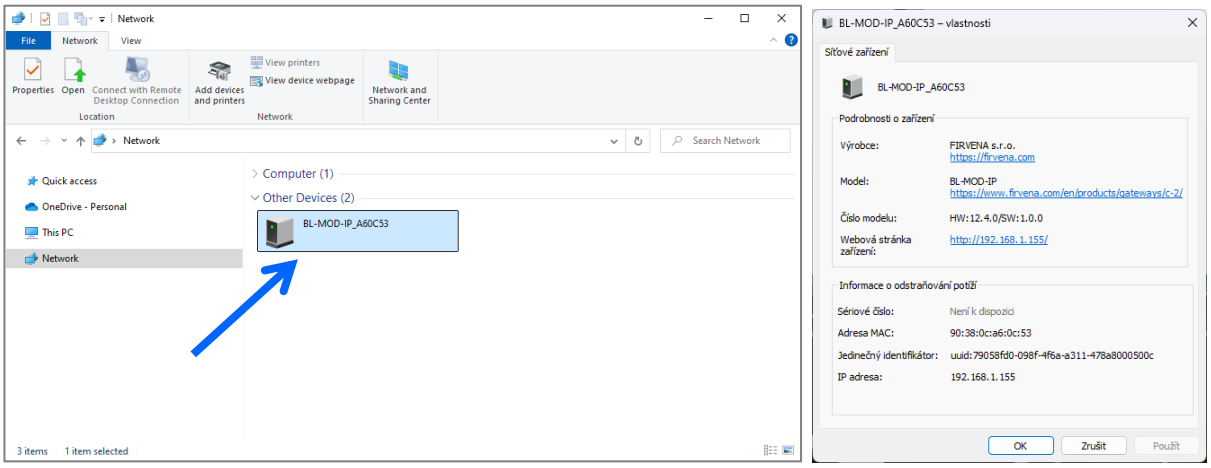
The main page opens in "view-only mode". Login is required for other pages and configuration changes. The default password is **"123"**, you can change it in [Settings > Change Password]. If the password is lost, you need to perform a factory reset using the reset button.

There are several **options** to find out the current IP address of the gateway:

1. Discovery using UPnP

This method is recommended when using the Windows operating system and SSDP messages are allowed in the network to which the gateway is connected.

Open the *Network* item in the *File Explorer*:



The gateway is under the group *"Other Devices"*. The name of the gateway is shown. Double click on the device item to open the *WebUI*. [Right click > Properties] will display additional information.

If the gateway is not shown, try to refresh the list: [Click on the list > press F5 key] or [Right click > Refresh].

2. Bonjour (mDNS)

The gateway replies to the hostname *"blmod"*. To access the *WebUI*, open your web browser and type the address *"http://blmod.local"* (*"http://blmod"*, *"blmod.local"* and sometimes *"blmod"* works too).

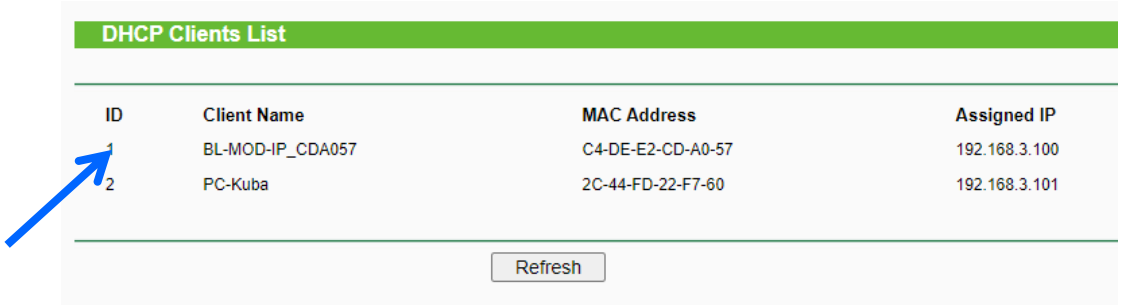
If multiple gateways are connected in the network, the gateway with the highest IP address number is "blmod" and the others are numbered, e.g.:

- 192.168.1.70 -> blmod-2.local
- 192.168.1.71 -> blmod.local

Multicast DNS is a communication protocol used to translate a text address to numerical IP address within small networks. Client sends a query addressed to all devices in the local network, the device with the queried hostname will send its IP address back to the client.

3. DHCP server

If you have access to the local DHCP server (usually through the configuration interface of your router), the IP address should be in DHCP clients list, look for the host name *"BL-MOD-IP_XXXXXX"*. To access the *WebUI*, enter the IP address to the address bar of your web browser.



4. Reset network settings

If all above options fail, try to reset the network configuration using the reset button (see Ch. 2). It is possible that the gateway has an incorrect static IP address configured.

7.2 WebUI

This chapter is a brief guide to the use of the *WebUI* application.

The *WebUI* is used to configure the gateway. The main purpose of the application is to manage Bluetooth devices connected to the gateway. The application is also a useful verification tool whereby you can evaluate whether your system works well. It allows to see the states, measured quantities, communication intervals or signal strength of the connected Bluetooth devices.

7.2.1 Main Page Overview

1. Dashboard – overview of configured channels
2. Toggles dashboard view:
    - Detailed – more information, only configured channels are displayed
    - Condensed – less information, both configured and empty channels are displayed
3. Menu items:
    - Add a single device by scanning or manually entering
    - Add multiple devices by scanning or importing a CSV file
    - Settings
4. Login button:
    - Locked – configuration locked and cannot be changed, only dashboard is accessible
    - Unlocked – configuration of the gateway can be changed
5. Gateway identification

The main page is accessible without a password. The default password is “123”, you can change it in [Settings > Change Password].

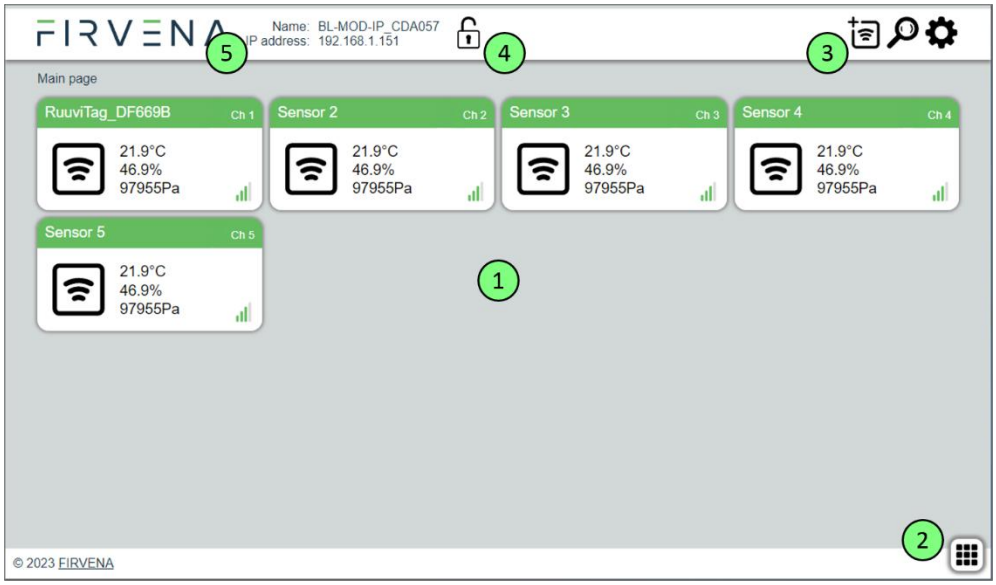


Fig. 7.1 Main page overview

7.2.2 Assigning Bluetooth sensors

To add a single sensor by scanning:

1. Click the *"Scan"* menu item
2. In the dialog box use "Start scan"

   Now the gateway is discovering nearby devices. Scanning stops when a supported device that is not assigned to any channel is found or after 30 seconds.

3. Select the channel number, e.g. 1.
4. Optionally, you can set the *Label* (it can also be set later).
5. Click *"Save"* to confirm changes
6. Now the sensor is assigned to channel 1 and its data is available through the Modbus interface.
7. Click on the channel box to view more settings and status information.

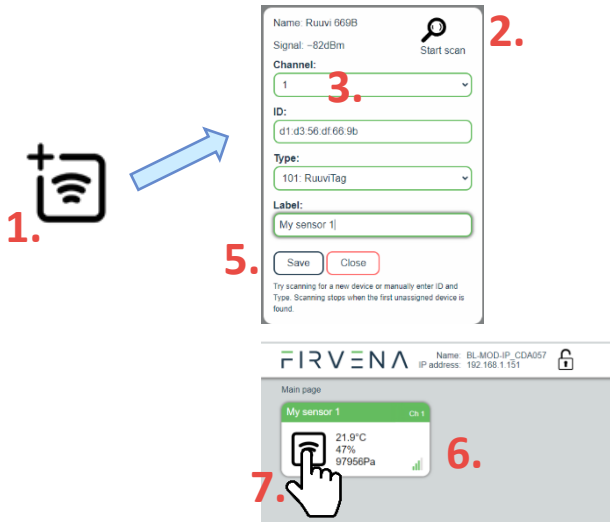


Fig. 7.2 Adding a single sensor

The *Label* text is used in the *Channel labels* registers (see Ch. 8.2.3). If the *Label* field is left empty, the default text will be used.

A device can also by assigned manually if you know its Bluetooth address. Enter the address to the *ID* field and select device type.

Scanning for multiple sensors:

1. Click the *"Scan"* menu item
2. Set the scan filter
3. Use *"Start scan"*

   Now the gateway is discovering nearby devices. Scanning stops by *"Stop scan"* button or after 30 seconds.

4. Select devices
5. Click *"Save"* to assign the selected devices to channels
   a. Append: preserves previously saved devices, free channels are used, writes from the first free channel up
   b. Overwrite: deletes previously saved devices, writes from the CH1 up

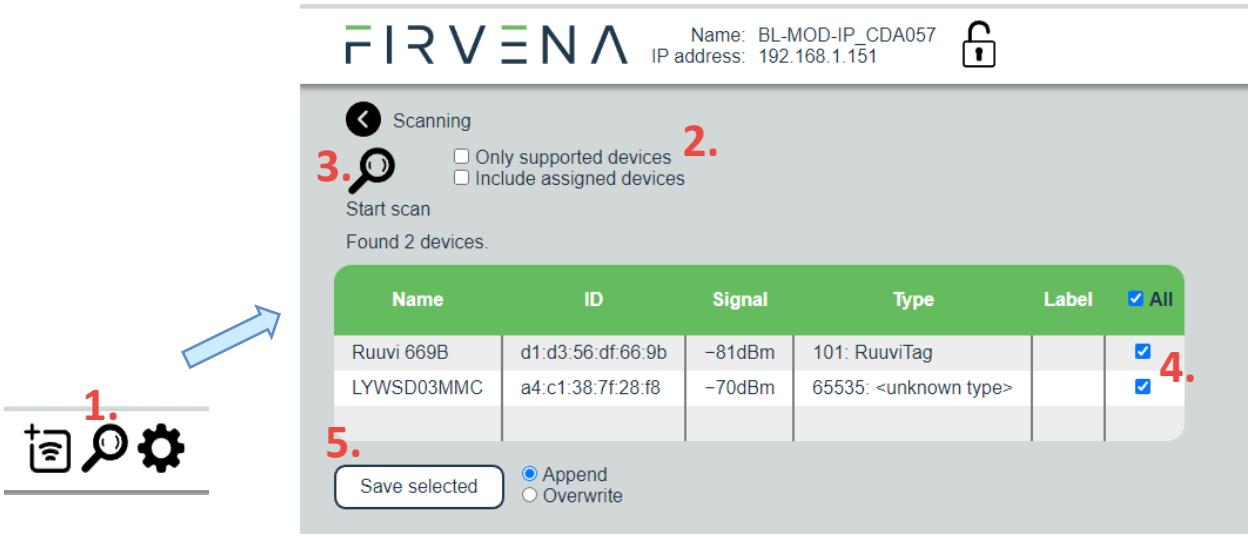


Fig. 7.3 Scanning for multiple sensors

7.2.3 Channel Details

1. Address of the register
2. Actual data
3. Actual data encoded to registers

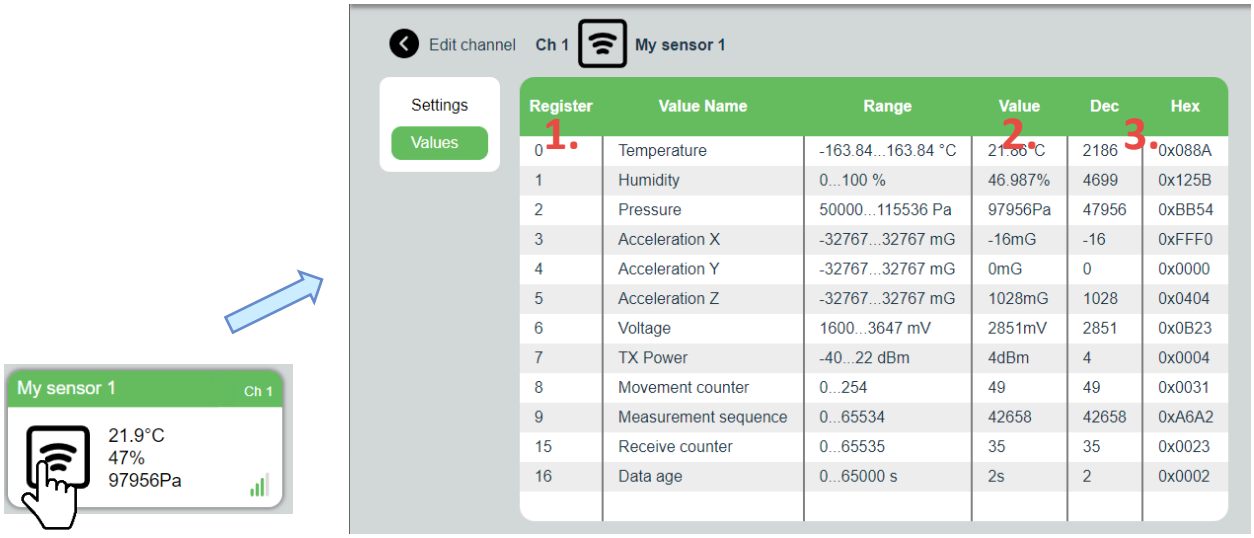
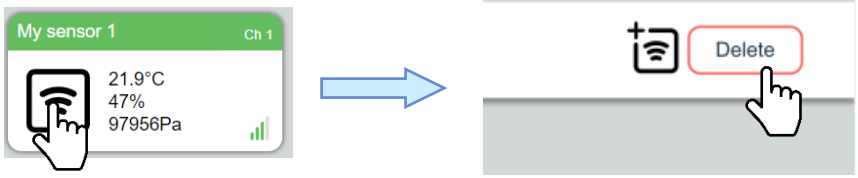


Fig. 7.4 Scanning for multiple sensors

7.2.4 Removing Bluetooth Devices

1. Click on a channel box.
2. Click on the *“Delete”* button.



To remove all devices, use [Settings > Factory Reset > Reset Channels].

7.2.5 Backup and Restore

The configuration of the gateway can be exported to a file for later recovery or reuse.

To back up the configuration:

1. Navigate to [Settings > Backup/Restore].
2. Click on *Download*.
3. A file named “config.json” is downloaded.

To restore the configuration:

1. Navigate to [Settings > Backup and Restore].
2. Select a file or drag it to the dashed rectangle.
3. Click on *Upload*.

Notes:

- *Only channels are restored, the other settings are preserved.*

8 MODBUS INTERFACE

The gateway is a Modbus TCP/IP server, it processes requests sent by clients. By default, the Modbus server listens on TCP port 502 and UDP port 502. Each Modbus server may provide different services, which are identified by function codes in Modbus. The definitions of standard services are described by the application layer specification – see [2], for more information about Modbus over TCP/IP see [3].

This chapter describes how the data of Bluetooth devices is translated into the Modbus data model and how this data can be accessed by standard function codes. A complete list of Modbus registers is also available.

8.1 Mapping of Devices

Several tables of Modbus registers are defined – see Tab. 8.1. These tables contain records related to individual Bluetooth devices. Bluetooth devices must first be assigned to *Channels* using the *WebUI* – see 7. The *Channel number* gives the position of a Bluetooth device in a table. The maximum number of *Channels* is 100.

The gateway contains a database of supported Bluetooth devices. The last known data of each device is converted to an array of registers called *Values* – see 8.2.1. The interpretation of these registers depends on the type of Bluetooth device. The list of supported devices as well as description of their values is in ANNEX A.

The diagram in Fig. 8.1 shows an overview of the data items available on the Modbus side and their location when a Bluetooth sensor is assigned. Fig. 8.2 shows a more detailed example where the sensor is assigned to channel number 5.

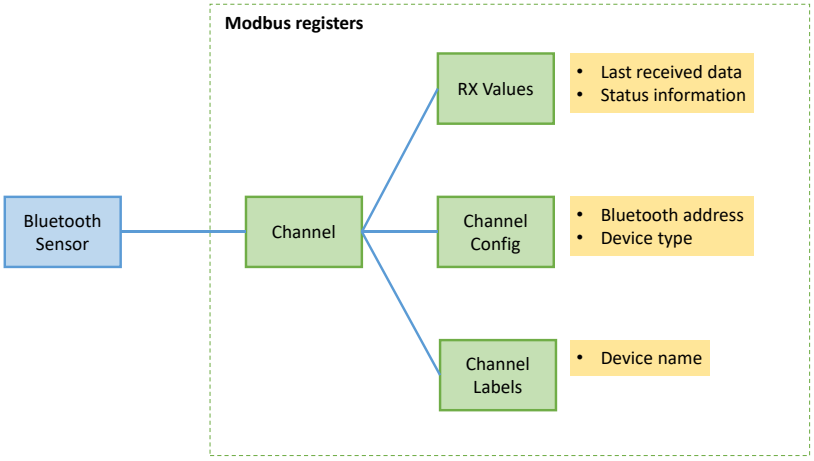


Fig. 8.1 Mapping of a sensor – overview

Table	Address	Register name		Description
RX Values	80	V1	Temperature	Last received data, interpretation of values given by Channel Config -> Device type
	81	V2	Humidity	
	82	V3	Battery voltage	
	83	V4	None	
	...	...	...	
	94	V15	None	
	95	Receive counter		Incremented on data refresh
	96	Data age		Time elapsed since the last data refresh
	97	Signal		Signal strength indication
	98	Reserved		
	99	Status		Channel status and error indication
...	...			
Channel Config	4080	Bluetooth address		Unique identifier of the assigned device
	4081			
	4082			
	4083	Device type		Type of the assigned device
	4084	Reserved		
	...	...		
	4089	Reserved		
...	...			
Channel Labels	10160	Label length		Number of bytes in the Label array
	10161	Label		Short text description of the channel
	10162			
	...			
	10199			

Fig. 8.2 Mapping of a sensor – detail

8.2 Modbus Registers

The registers are divided into several areas according to their use. All registers can be read by Modbus function 3 or 4. Read-only registers are marked as “R”, writable registers are marked as “R/W”. “P” marks persistent (non-volatile) registers whose values are retained when the gateway is turned off.

Tab. 8.1 Register map

Area name	Address range	Access	Description	Channel	Base address
RX Values	0…1999	R	Last received data and channel status	CH1	0
				CH2	20
				…	
				CH100	1980
Reserved					
Channel Config	4000…4999	R, P	Channel configuration (assignment of Bluetooth device)	CH1	4000
				CH2	4010
				…	
				CH100	4990
Gateway Settings	5000…5099	–	Information and settings concerning the gateway itself	–	–
Reserved					
Channel Labels	10000…13999	R, P	User defined descriptions of channels	CH1	10000
				CH2	10040
				…	
				CH100	13960
Reserved					

8.2.1 RX Values

For each channel, 20 registers are reserved. When the gateway receives data from the assigned device, and it supports the device, it converts the data contents into *RX Values*. The received data fields are stored in registers from V1 up. The number of values and their meaning depends on the type of Bluetooth device and is indicated by the *Device type* register. The device type is determined either automatically or manually during commissioning.

$$\text{Address} = \text{BaseAddress} + \text{Offset}$$
$$\text{BaseAddress} = 0 + 20 \cdot (\text{ChannelNumber} - 1)$$

Tab. 8.2 RX Values

Group	Offset	Access	Name	Description	Value range
Values	0	R	V1	Value 1	Depends on device type, see 0
	1	R	V2	Value 2	
	2	R	V3	Value 3	
	3	R	V4	Value 4	
	…	R			

	14	R	V15	Value 15	
Status	15	R	Receive counter	Incremented on values refresh	0…65535 (overflows to zero)
	16	R	Timestamp HI	UNIX Timestamp (seconds since 1 Jan 1970 00:00:00 UTC)	UINT32, 0…2^{32}–1 s (0: time not configured)
	17	R	Timestamp LO		
	18	R	Signal	Signal strength (RSSI value)	0…200 => 0…–200 dBm (255: no data, initial value after reset)
	19	R	Status	Enumeration of channel state and error codes	See Tab. 8.3

Tab. 8.3 RX Values – Status register

Status register	
Value	**Meaning**
0 – OK	Data OK, data has been stored in Values
1 – ASSIGNED	Device assigned, waiting for the first data
7 – TIMEOUT	120 minutes without data received
254 – NOT SUPPORTED	Device assigned, unsupported device type
255 – FREE	The channel is not configured, no device assigned

The data content of registers 0…14 is valid if *Status* is 0, or *Status* is 7 and *Signal* is not 255.

Timestamp example (Timestamp = HI · 65536 + LO):

Offset	**Name**	**Value**	**Interpretation**
16	Timestamp HI	25485 (0x638D)	1670223852 (0x638D97EC) 5 Dec 2022 07:04:12 UTC
17	Timestamp LO	38892 (0x97EC)	

8.2.2 Channel Config

For each channel, 10 registers are reserved. The *Bluetooth address* uniquely identifies a device within the Bluetooth environment. The *Device type* register helps to interpret the *Values* registers; a complete list of device type codes is in 0.

$$\text{Address} = \text{BaseAddress} + \text{Offset}$$
$$\text{BaseAddress} = 4000 + 10 \cdot (\text{ChannelNumber} - 1)$$

Tab. 8.4 Channel config

Offset	**Type**	**Access**	**Name**	**Description**	**Example***
0	UINT8[6]	R, P	Bluetooth address	Unique identifier of the assigned device, array of bytes b0…b5	0xD1D3
1					0x56DF
2					0x669B
3	ENUM	R, P	Device type	Type of the assigned device	101
4…9			Reserved		

**Example: Bluetooth address = D1:D3:56:DF:66:9B; Device type = RuuviTag.*

8.2.3 Channel Labels

For each channel, 40 registers are reserved. These registers are designed to store a friendly name of the assigned Bluetooth device that helps to identify it. The maximum size of *Label* is 78 bytes.

$$\text{Address} = \text{BaseAddress} + \text{Offset}$$
$$\text{BaseAddress} = 10000 + 40 \cdot (\text{ChannelNumber} - 1)$$

Tab. 8.5 Channel labels

Offset	Type	Access	Name	Description	Example*
0	UINT8	R, P	Label length (N)	Number of bytes in the Label array	9
1…39	UINT8[78]	R, P	Label	Array of bytes b0…b(N−1)	0x4D79 (“My”)
					0x2073 (“ s“)
					0x656E (“en”)
					0x736F (“so”)
					0x7200 (“r”)
					0x0000
					…
					0x0000

**Example: Label = “My sensor”.*
Default label is composed of device type title and the last three bytes of the Bluetooth address, e.g. “RuuviTag_DF669B”

8.2.4 Gateway Settings

$$\text{Address} = \text{BaseAddress} + \text{Offset}$$
$$\text{BaseAddress} = 5000$$

Tab. 8.6 Gateway Settings

Offset	Type	Access	Name	Description
0	UINT8	R, P	Gateway name	Number of characters
1…19	UINT8[38]	R, P		Friendly name of the gateway, up to 38 characters
…			Reserved	
70	UINT16	R/W	Command	See Tab. 8.7
71…74	UINT64	R/W	Command parameter	

Tab. 8.7 Command register

Command register		
Command	**Parameter**	**Meaning**
0x11AA	–	Software restart of the gateway

8.3 Supported Function Codes

According to the application layer specification, a client can read a maximum of 125 registers and write a maximum of 123 registers in a single request.

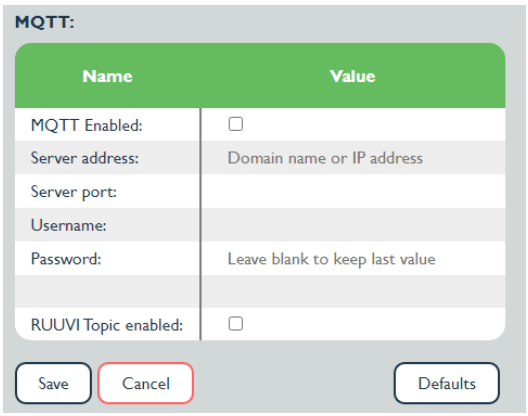
Inside the defined areas, the server allows reading any register, it returns zeros for unused registers. Outside these areas, all requests end with exception code 02.

Code	Name	Description
3 (0x03)	Read Holding Registers	Reads a continuous block of registers starting at a given address. Zero values are returned for unused registers within a defined area.
6 (0x06)	Write Single Register	Writes any writable register.
16 (0x10)	Write Multiple Registers	Writes a block of writable registers, behaviour may differ depending on the area.

9 MQTT Client

More information about the MQTT protocol can be found in [4].

MQTT Client configuration is in [Settings > Protocols > MQTT]:



MQTT is disabled by default. Tick *"MQTT Enabled"* and specify the address and port of the server (i.e. MQTT Broker) you want to connect and credentials of your account.

Currently, gateway supports only TCP transport.

Messages are published with QoS = 1 and Retained = false.

The list of MQTT topics where the gateway publish data:

Topic	Description
firvena/<GatewayName>	Hello message on MQTT connect
firvena/<GatewayName>/periodic	Status message published every 5 seconds
firvena/<GatewayName>/ruuvi/<SensorMacAddress>	RuuviTag advertisement packets are published here, only when *"RUUVI Topic enabled"* ticked, see 0

The list of MQTT topics that the gateway subscribes and through which it receives data:

Topic	Description
firvena/<GatewayName>/button	Receives button pressed event from UI, just for testing, it resets the counter in the status message

Gateway name setting is changed by [Settings > Network > Gateway name].

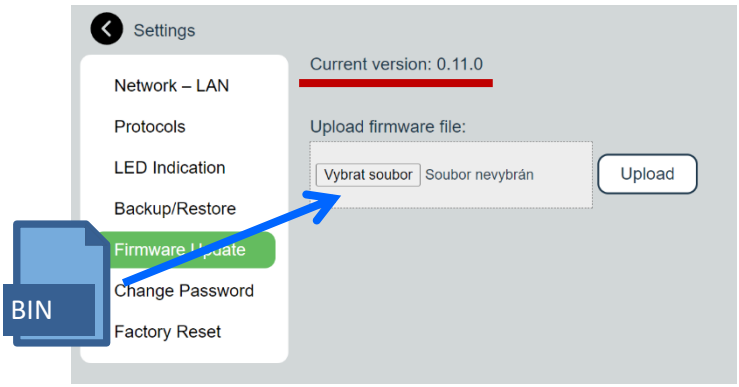
10 FIRMWARE UPDATE

The firmware is constantly being improved and extended to support new features and devices. The latest version is available for download on FIRVENA website in the Downloads section. Firmware can be updated manually via the *WebUI*.

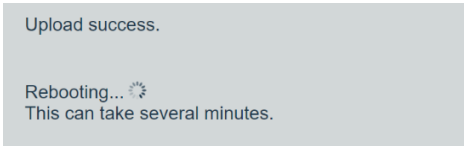
The installed version number is shown in [Settings > Firmware Update]:

To update firmware:

1. Download the zip file and extract the file with **.bin** extension.
2. Use *"Choose file"* or drag the **.bin** file to the dashed rectangle and use the *"Upload"* command.



3. The green POWER light should be flashing irregularly now, indicating uploading.
4. When the upload is complete, the gateway reboots and the connection with *WebUI* is lost:



   The connection should resume within one minute.

5. Check the installed version number.

REFERENCES

[1] Modbus Protocol Specifications and Implementation Guides: https://modbus.org/specs.php

[2] Modbus Application Protocol Specification: https://modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf

[3] Modbus TCP/IP Implementation Guide: https://modbus.org/docs/Modbus_Messaging_Implementation_Guide_V1_0b.pdf

[4] Introduction to MQTT by HiveMQ: https://www.hivemq.com/mqtt-essentials/

REVISION HISTORY

Date	Version	Description
2023-02-23	V1.0	Initial release
2023-09-27	V1.1	Updated to match firmware V0.11.0 and hardware HW12.3 Added MQTT, time synchronization and reset button. Changes in Modbus interface.
2025-10-10	V 1.2	Updated figures, changed style Updated to firmware V1.0.0 and hardware HW12.4

ANNEX A SUPPORTED DEVICES

Encoding of Value registers

1. Sign: indicates if the value of register is encoded unsigned (uint16, 0…65535) or encoded signed using two's complement (int16, −32768…32767).
2. Step: conversion constant to units of measurement.
3. Offset: a constant that has to be added to the encoded value, rarely used, mostly offset = 0

$$\text{Value} = \text{RegisterValue} \cdot \text{Step} + \text{Offset}$$

Examples:

Value name	Sign	Step	Offset	Register value			Value
				Hex (u16)	Dec (u16)	Dec (s16)	
Temperature	•	0.01 °C		0xFB2C	64300	−1236	−12.36 °C
				0x08B6	2230	2230	22.3 °C
Humidity		0.01 %		0x11D3	4563	4563	45.63 %
Pressure		1 Pa	50000 Pa	0xB5C3	46531	−19005	96531 Pa

A.1 101: RuuviTag

Gateway passively listens to broadcasts sent by sensors, supports data format 5.

	Value name	Range	Sign	Step	Offset
V1	Temperature	-163.84...163.84 °C	•	0.01	
V2	Humidity	0...100 %		0.01	
V3	Pressure	50000...115536 Pa		1	50000
V4	Acceleration X	-32767...32767 mG	•	1	
V5	Acceleration Y	-32767...32767 mG	•	1	
V6	Acceleration Z	-32767...32767 mG	•	1	
V7	Voltage	1600...3647 mV		1	
V8	TX Power	-40...22 dBm	•	1	
V9	Movement counter	0...254		1	
V10	Measurement sequence	0...65534		1	

ANNEX B RUUVI MQTT

The gateway can forward BLE advertisement packets from RuuviTag sensors to MQTT Broker, the JSON format is described here: [MQTT: Time-stamped data from Bluetooth-sensors]. It publishes data from all received RuuviTag sensors, regardless of whether the sensor is assigned to it or not.

The MQTT topic is firvena/<GatewayName>/ruuvi/<SensorMacAddress>, e.g. firvena/BL-MOD-IP_CDA057/ruuvi/ C8:25:2D:8E:9C:2C

Gateway name setting is changed by [Settings > Network > Gateway name].

The topic can be disabled by [Settings > Protocols > MQTT > RUUVI Topic enabled].

Example JSON data recorded in NodeRED: