FIRVENA

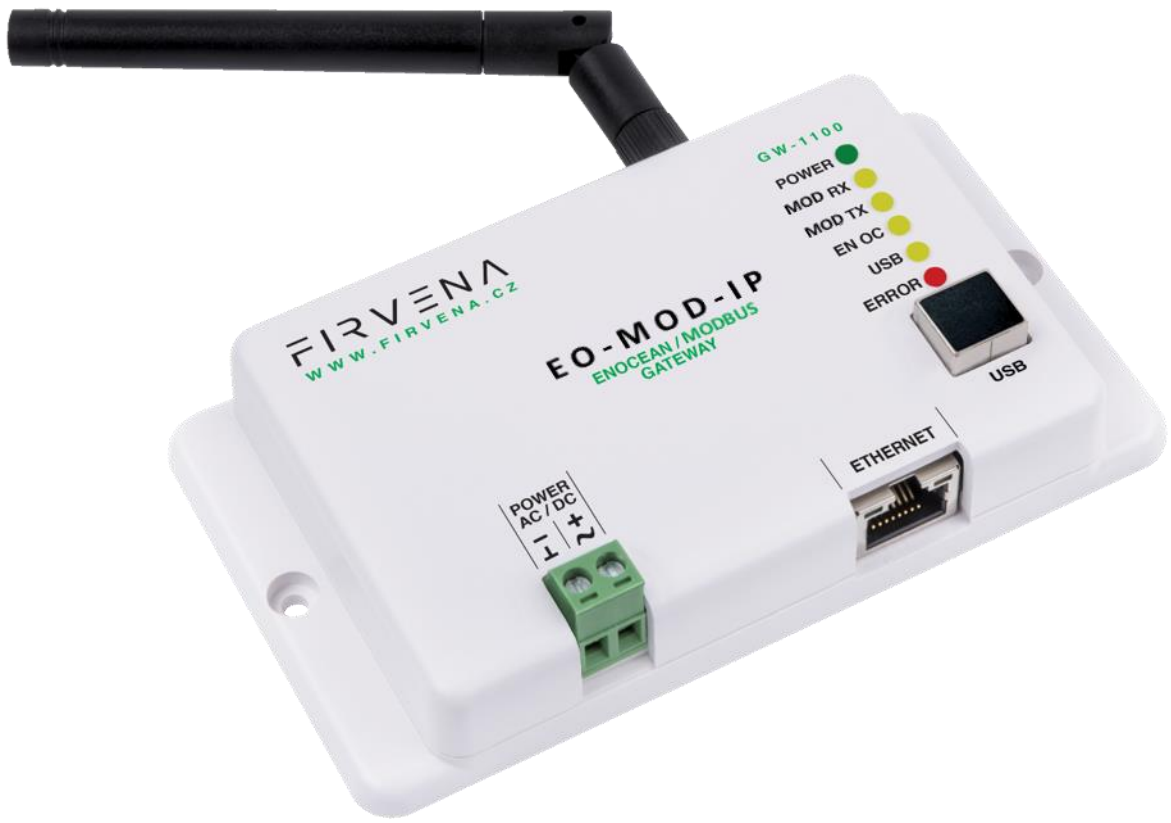
EnOcean to Modbus TCP/IP Gateway

EO-MOD-IP

868 MHz

User Manual V1.7

English



CONTENTS

TERMS AND ABBREVIATIONS

Term/Abbr.	Explanation
Channel number (CH)	Identifier of EnOcean device within the gateway
DHCP	Dynamic Host Configuration Protocol
EEP	EnOcean Equipment Pofiles
EURID	EnOcean Unique Radio Identifier
Label	User-friendly name of EnOcean device
IP	Internet Protocol
PoE	Power over Ethernet
RX	Receive, reception
Teach-in	Pairing of EnOcean devices
Telegram	EnOcean message
TX	Transmit, transmission
UPnP	Universal Plug and Play
Value index	Identifier of a data unit within the channel

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

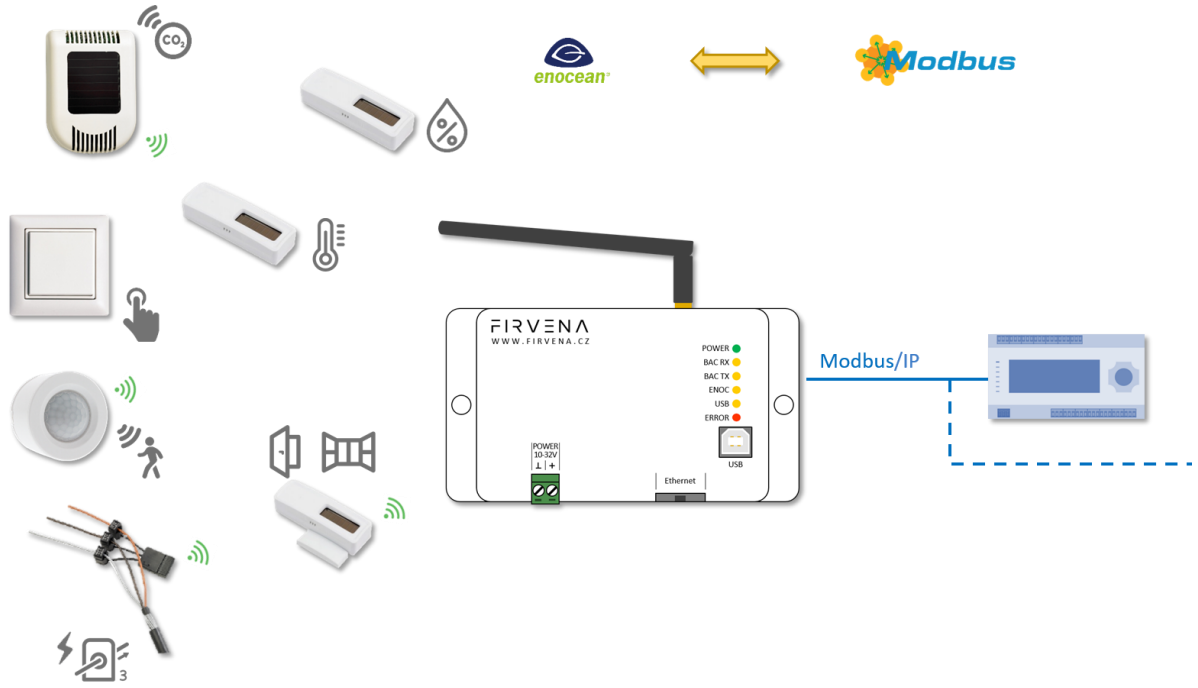
www.firvena.com

1 INTRODUCTION

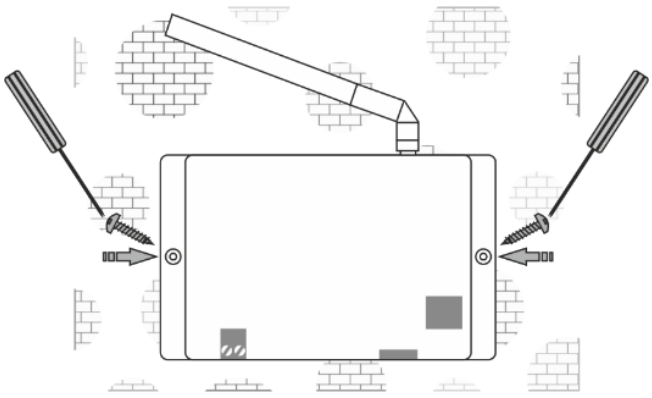
1.1 Description

The EO-MOD-IP device is a gateway between EnOcean and Modbus/IP communication protocols. The EnOcean is a set of technologies and communication protocol that enables the use of wireless and battery-free sensors, switches and actuators. The Modbus is a communication protocol that is simple to implement and is widely used in building automation systems. The EO-MOD-IP gateway can receive data from up to 40 EnOcean devices, store it and provide it through the Modbus interface to other devices connected to the network. It also allows bidirectional communication of EnOcean actuators such as switches, dimmers or heating valve controllers.

The first part, the manual describes the hardware of the gateway. Chapter 7 contains brief instructions for configuring the gateway, especially for connecting EnOcean devices. Chapter 8 describes the Modbus interface and explains how EnOcean devices are mapped to Modbus registers. For firmware update procedure refer to Chapter 9.



1.2 Installation instructions

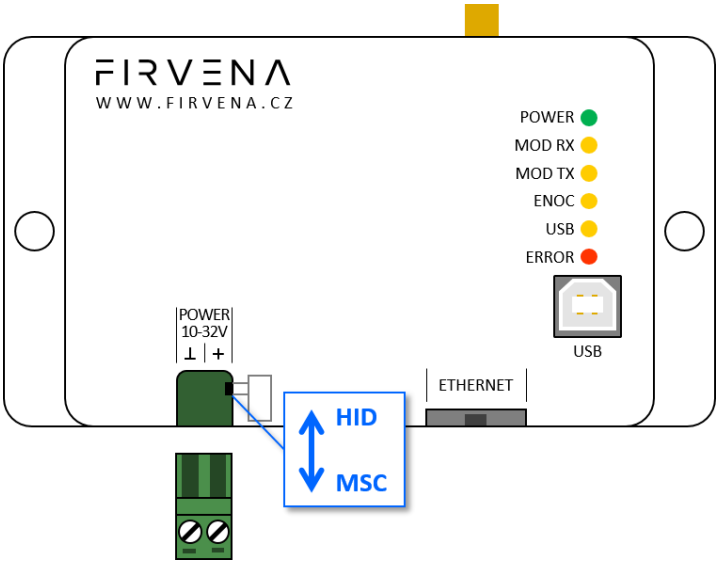


The gateway is fixed by using plastic anchors and Phillips screws to the wall or solid surfaces of suspended ceilings making sure that it is in a good radio position for receiving and transmitting signals. When located in shielded surfaces, the standard supplied antenna can be replaced with another permitted antenna type for the 868 MHz frequency with an SMA (Male) connector. External antenna with cable and magnetic base, type ANT-A1-SMA868-MAG2M is available at the manufacturer or distributor.

2 HARDWARE OVERVIEW

On the front panel, there are a power connector, RJ45 Ethernet connector, type B USB connector, antenna connector and LED indicators. The USB connector can be used for configuration and firmware update, and is also used by the *EO-BAC Tool* application. 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), activity in the EnOcean wireless network (ENOC), USB communication (USB) 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 (Web UI > 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 set the USB interface mode:

- **the "HID" position (default)** allows the connection of *EO-BAC Tool* application
- **the "MSC" position** allows access to filesystem

Case	LEDs		Behavior	Meaning
Power supply	POWER	🟢	Shining	Power supply connected and program running
DHCP	POWER	🟢	Goes off for 1 s	Network settings obtained from DHCP server
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
EnOcean	ENOC	🟡	Short blink	EnOcean telegram received or sent
USB	USB	🟡	Flashing irregularly	Indicates communication through the USB port
–	ERROR	🔴	Flashing regularly	A fatal error has occurred, the device is about to restart

3 TECHNICAL DATA

Category	Parameter	Value
Product	Product name	EO-MOD-IP
	Product title	EnOcean to Modbus TCP/IP Gateway
	Product ID	11.2
	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	80 mA / 24 V
	Rated input power	1.92 W / 24 V; PoE Active 1.8 W
Ethernet (Modbus/IP)	Speed	10, 100 Mbit/s
	Connector	RJ45
	PoE	✓
	PoE power supply	According to standard 802.3af, ACTIVE only
EnOcean	Frequency	868 MHz
	Maximum number of handled devices	40 (max. 20 with SmartACK)
	Repeater	✓
USB	Device class	Custom HID or Mass Storage
	Connector	Type B
	IP Code	IP20
Operating conditions	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
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.
UK CA	**UK Conformity Assessed (UKCA)** The device is compliant with the British Legislation UK Conformity Assessed (UKCA) and meets all relevant requirements.
enocean	**EnOcean Technology** The device is fully compatible with the EnOcean radio protocol and as such is certified by the EnOcean Alliance Level 2.

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.

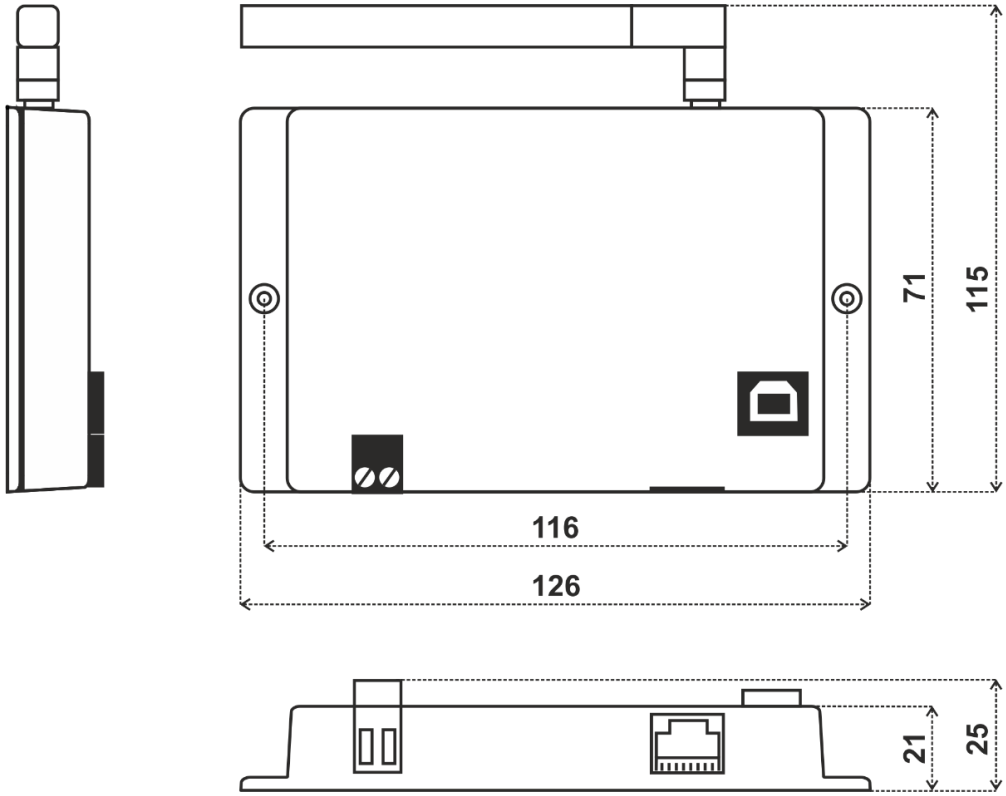
WARRANTY

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)

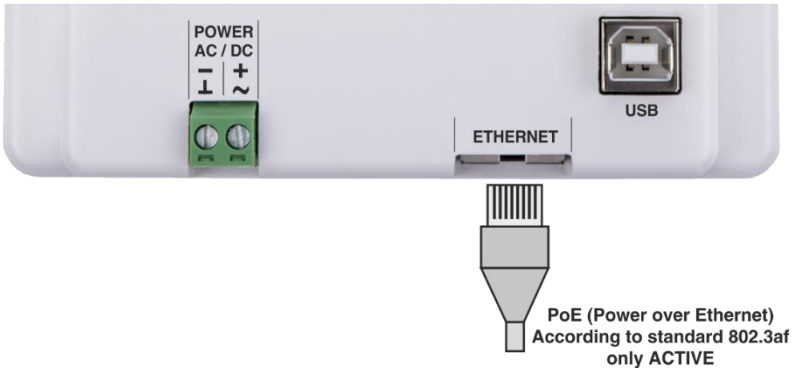


6 POWER SUPPLY

There are two possible power supply connections:

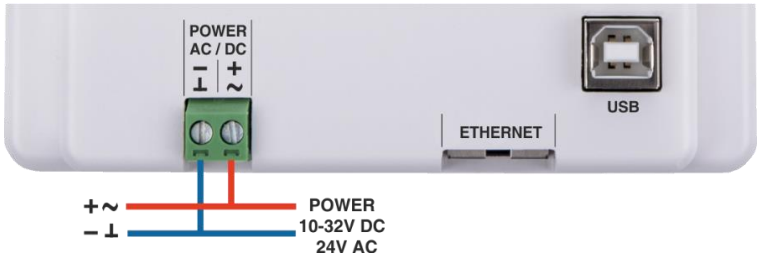
1. Power supply via PoE (Power over Ethernet):

The device supports PoE according to the 802.3af standard. Network elements must support this type of power interface. Passive PoE is not possible through the ETHERNET input. For passive PoE power supply, we recommend to use an appropriate splitter cable with connection to the POWER input.



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 (*Web UI*) that serves to configure it using a web browser. Alternatively, a desktop application *EO-BAC Tool* is available at www.firvena.com, -> SUPPORT/DOWNLOAD/EO-MOD-IP/APPLICATION, it requires USB connection to the gateway and Windows 7 or higher. The use of *EO-BAC Tool* becomes necessary, among other things, if the password to *Web UI* has been forgotten. The following part describes how to open *Web UI* for the first time.

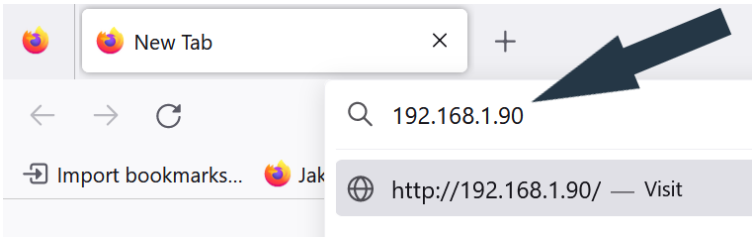
7.1 Accessing Web Interface

The IP address factory setting is:

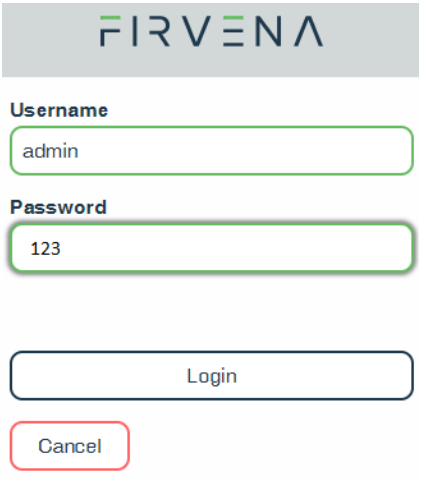
PARAMETER	VALUE
IP address	192.168.1.90
Subnet mask	255.255.255.0
Default gateway	192.168.1.1
DHCP	enabled

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 shortly turning off the green POWER light.

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 *Web UI* 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*).



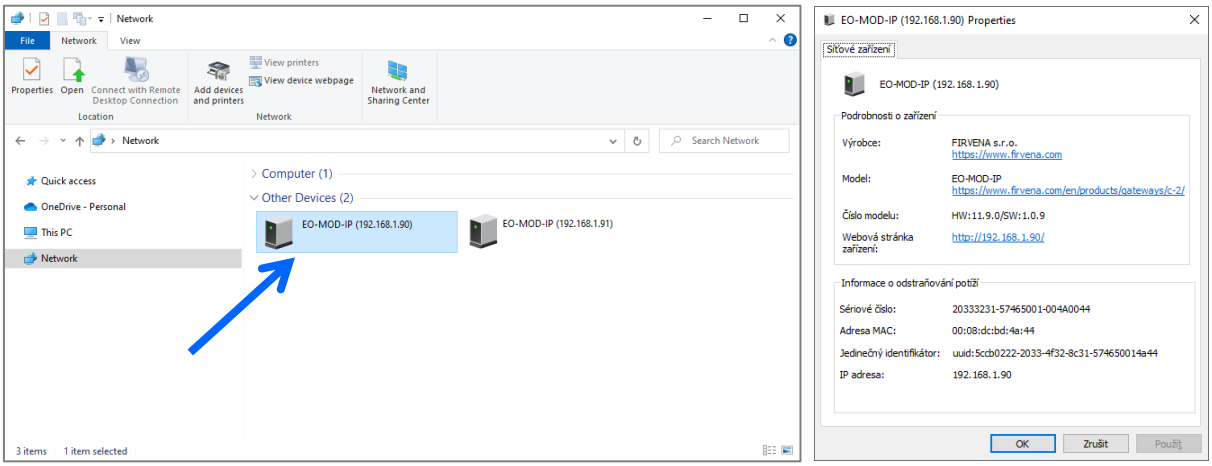
The main page opens in "view-only mode". Login is required for other pages and configuration changes. The default password is **"123",** you can change it in [Settings > Change Password]. If the password is lost, you need to perform a factory reset using the *EO-BAC Tool*.

There are several **options** to find out the currently valid IP of the gateway:

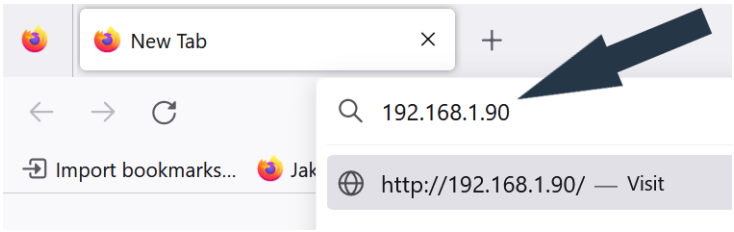
1. Network Discovery using UPnP

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

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



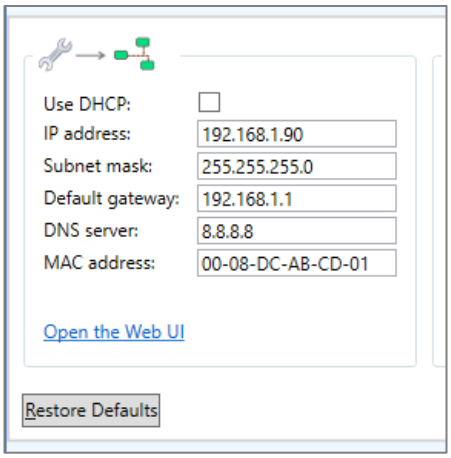
The gateway is under the group *"Other Devices"*. The description and IP address of the gateway are shown. Double click on the device item to open the *Web UI*. [Right click > Properties] will display additional information.



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

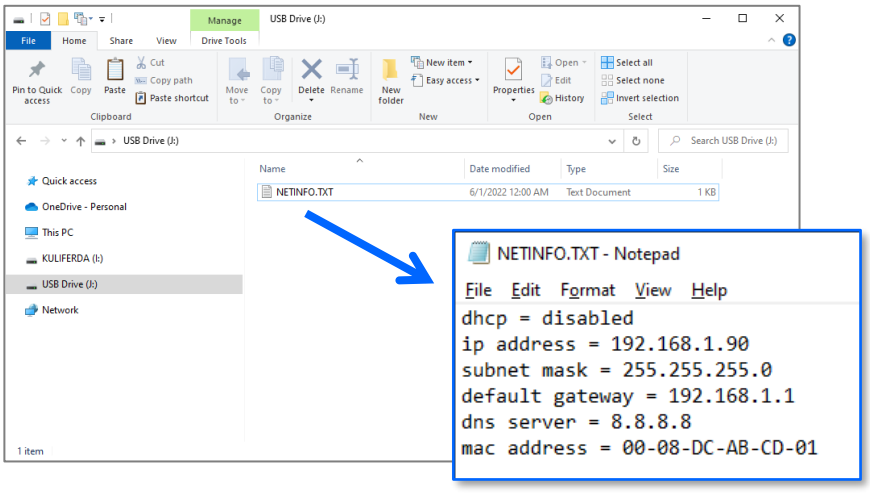
2. Using EO-BAC Tool

In the *USB HID* mode (see Ch. 2), the gateway presents itself as a Custom HID USB device. Connect the gateway to your computer using USB and use the *EO-BAC Tool*.



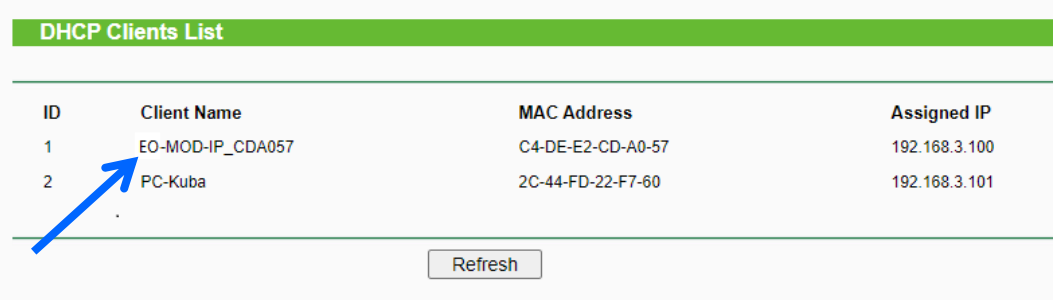
3. USB MSC

In the *USB MSC* mode (see Ch. 2), the gateway presents itself as an external USB drive. Connect the gateway to your computer using USB. Find a file named NETINFO.TXT in the root directory and open it. The file contains the current IP address. To access the *Web UI*, enter the IP address to the address bar of your web browser.



4. 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 *"EO-MOD-IP_XXXXXX"*. To access the *Web UI*, enter the IP address to the address bar of your web browser.

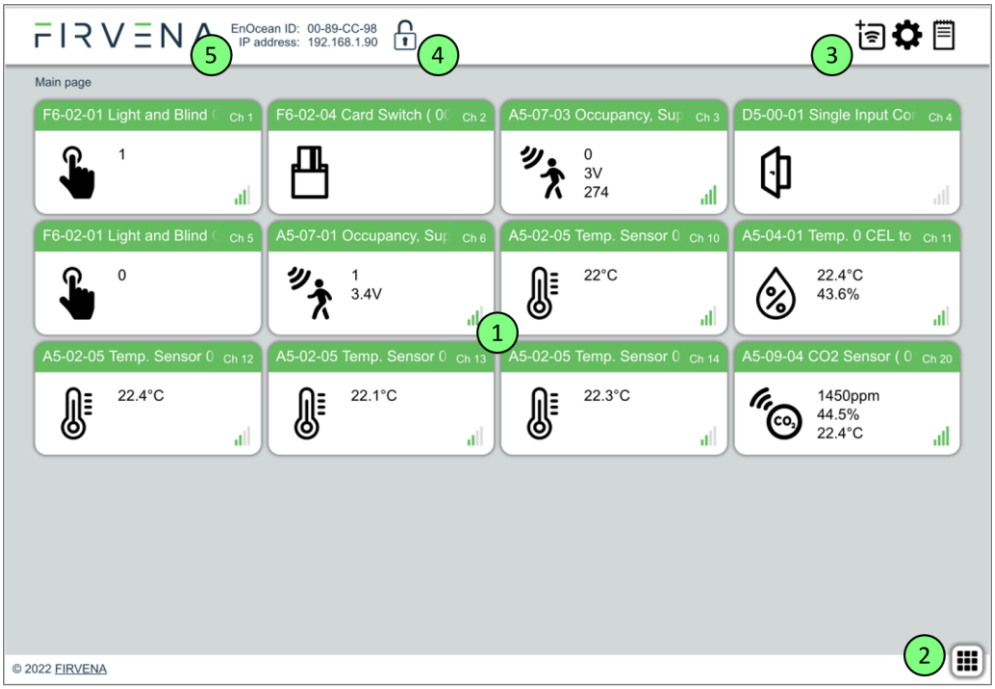


7.2 Web UI

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

The *Web UI* is used to configure the gateway. The main purpose of the application is to manage EnOcean 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 EnOcean 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 new device
   - Settings
   - Telegram log
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].

7.2.2 Assigning EnOcean elements – unidirectional

This teach-in procedure is only applicable for unidirectional communication when the gateway only receives data.

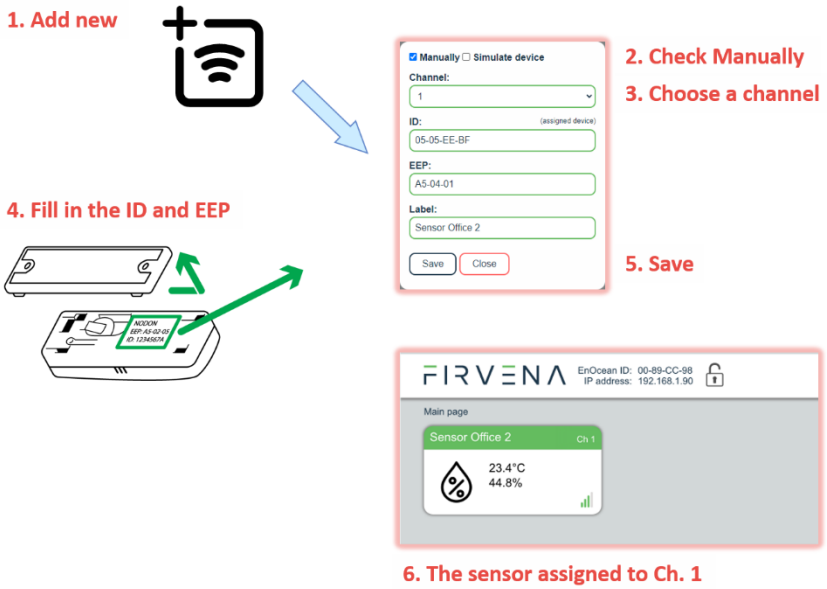
Let's have a humidity sensor (A5-04-01) we want to assign to the channel 1. The procedure is as follows:

1. Click the "Add new" icon, a dialog box appears.
2. Push the pairing button to transmit a teach-in telegram.
3. The received telegram is displayed in the dialog box.
4. Select the channel number 1.
5. Click "Save" to confirm changes
6. Now the sensor is assigned to channel 1 and its data is available through the Modbus interface.

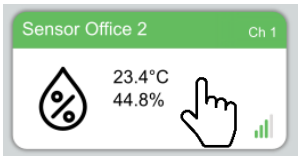
Optionally, the *Label* can be set for the device. The *Label* text is used in the *Channel labels* registers (see Ch. 8.2.5). If the *Label* field is left empty, the default text will be used.

The knowledge of EEP allows the gateway to interpret the received data correctly. Some types of EnOcean devices do not provide the EEP information in their teach-in telegram or even not have a special telegram for teach-in (e.g. buttons and switches). In that case, the EEP must be set manually, it is usually given by a label on the device or a datasheet.

Devices can also by assigned manually by entering the ID and EEP.



Click on the channel box to view more settings and status information:



7.2.3 Assigning EnOcean elements – bidirectional

This teach-in procedure is applicable for EnOcean devices with bidirectional communication profiles when the gateway is supposed to receive data from the device and also transmit data to the assigned device.

Let's have a valve actuator (A5-20-01) we want to assign to the channel 1. The procedure is as follows:

1. Click the "Add new" icon, a dialog box appears.
2. Check "LRN enable"
3. Select the channel number 1.

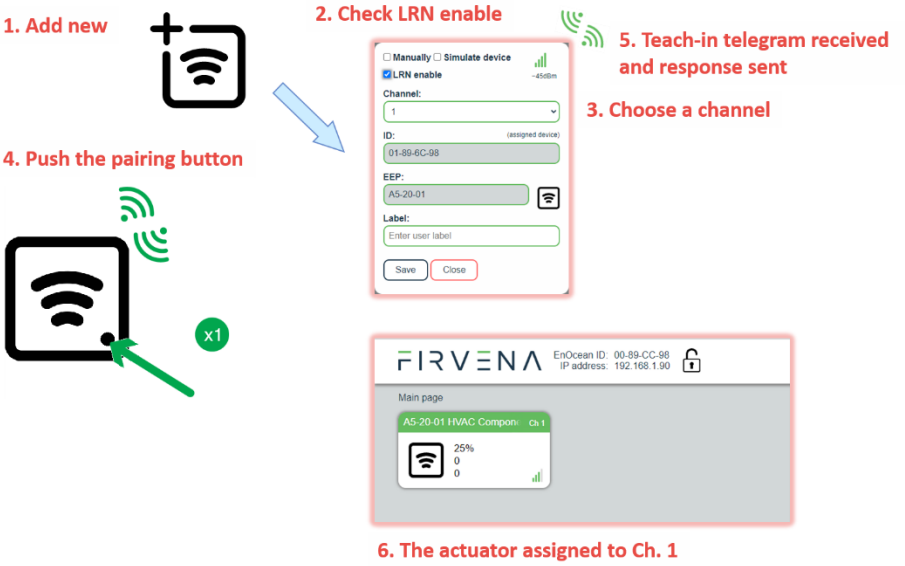
Channel 1 is now in the teach-in mode.

4. Push the pairing button to transmit a teach-in telegram from the actuator.
5. Gateway receives the telegram and sends a teach-in response.
6. The device is automatically saved to the selected channel and its data is available through the Modbus interface.

To change the Label, enter the new text and click "Save".

Notes:

- *The device being assigned usually signals successful teach-in, e.g. by flashing LED. If it signals an error, the teach-in must be repeated.*



7.2.4 Assigning Smart ACK devices

To assign a Smart ACK device to the gateway, the procedure is the same as for bidirectional profiles (7.2.3). Repeaters are not supported, there must be a direct connection between the gateway and the Smart ACK device.

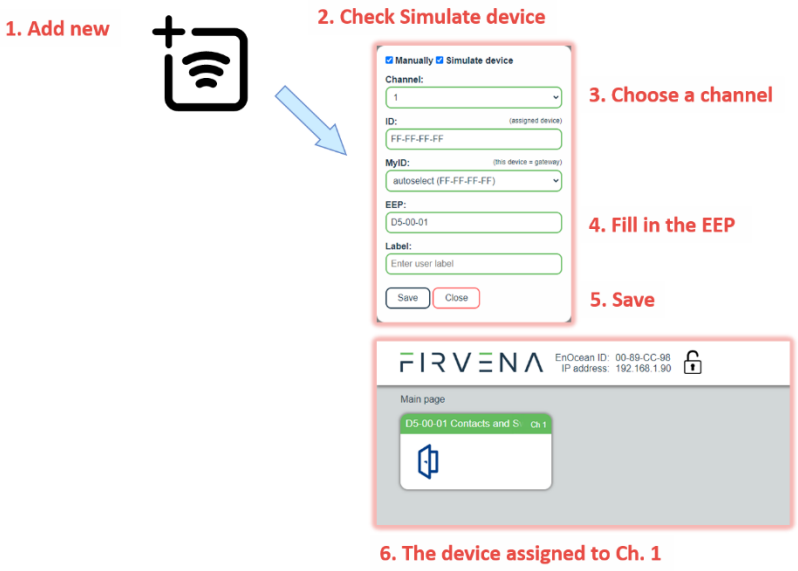
7.2.5 Definition of Virtual Device

The gateway can be used to simulate a real EnOcean device. This function is necessary when controlling actuators that do not implement any bidirectional profile, typically some types of relay switches.

For example, we want to control a relay switch that supports reception of a Door/Window Contact D5-00-01. The procedure is as follows.

First, define a virtual device of type D5-00-01, for example at channel 1:

1. Click the “Add new” icon, a dialog box appears.
2. Check “Simulate device”
3. Select a channel number (channel 1)
4. Select the type of device (D5-00-01)
5. Click “Save” to confirm changes
6. The device is saved to the selected channel and its data is available through the Modbus interface.

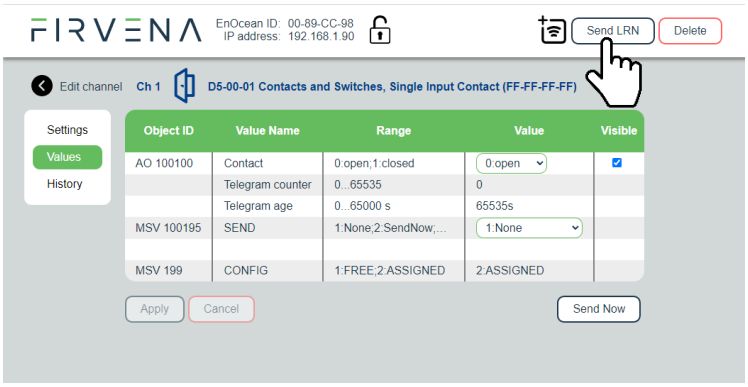


Second, pair the virtual device with the relay switch:

1. Click on the channel 1 box to see channel details
2. Put the relay switch to the pairing mode (follow the procedure given by the manufacturer of the switch)
3. In channel details click on the “Send LRN” button
4. The gateway will transmit a teach-in telegram of the virtual device
5. The switch will receive the teach-in telegram and save the virtual device

Third, test the connection:

1. Navigate to [Edit channel > Values]
2. Set the data to be transmitted (0:closed or 1:open)
3. Use “Send Now” to transmit a data telegram



Notes:

- *Each virtual device must have a unique ID, This is given by the MyID setting.*
- *To enable receiving the actual state of the switch, assign it to a different channel.*

7.2.6 Channel Details

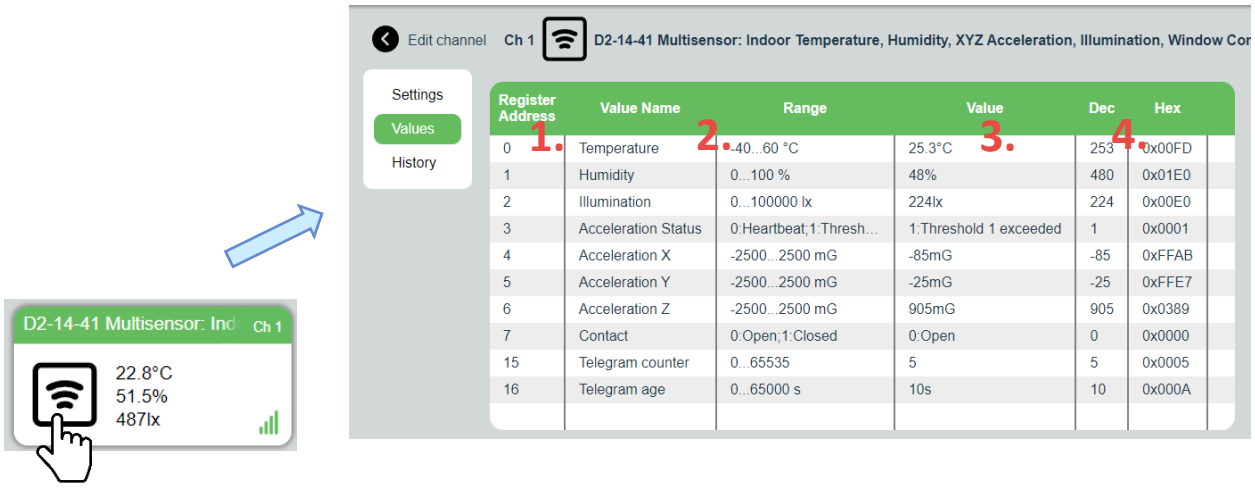
When you click on the channel box, the “Edit channel” view is shown. There are three tabs:

1. Settings – configuration of the channel
2. Values – actual data of the assigned device
3. History – short history of the first three RX values

In the channel box, the first three RX values are displayed. To view all actual data of the assigned device, open the “Values” tab. Here you can find:

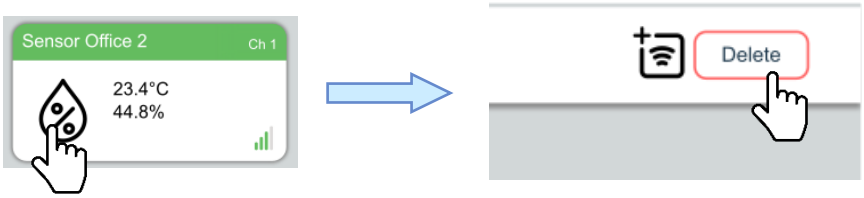
1. Address of the Modbus register
2. Value name and range info
3. Actual data
4. Actual data encoded to registers

For bidirectional EEPs and virtual devices, TX data can also be entered and sent using this view.



7.2.7 Removing EnOcean elements

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



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

7.2.8 Backup and Restore

The configuration of the gateway can be exported to a file for later recovery or reuse. The backup file is compatible with the file used by *EO-BAC Tool* application.

To back up the configuration:

1. Navigate to [Settings > Backup and 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 “Gateway Settings” are preserved.*

7.3 Steps – How to …

7.3.1 Enable EnOcean Repeater

The repeater mode is changed in [Web UI > Settings > EnOcean].

If turned on, the gateway forwards received telegrams in the EnOcean network.

Value	Meaning
1 – OFF (default)	Off
2 – LEVEL1	Level 1 (only original telegrams)
3 – LEVEL2	Level 2 (original and once repeated telegrams)
Value	Meaning

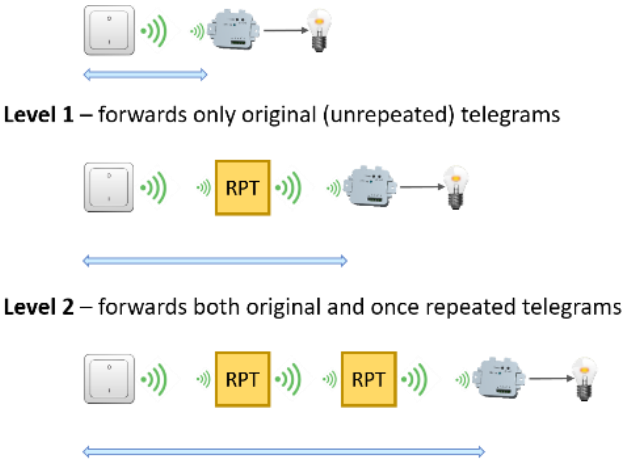


Fig. 7.1 Repeater function

8 MODBUS INTERFACE

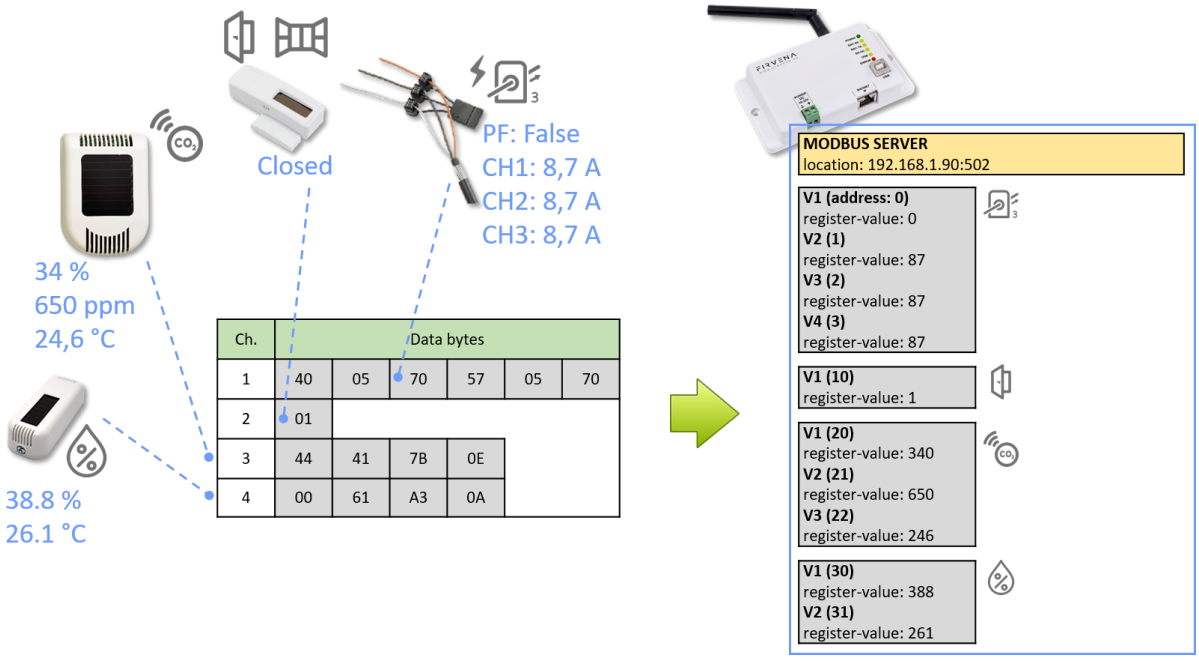
The gateway is a Modbus TCP/IP server, it processes requests sent by clients. By default, the Modbus server listens on TCP port 502 and UDP port 502 (there is a limit of four simultaneous TCP connections). Each Modbus server may provide different services, which are identified by function codes in Modbus. The definitions of standard services are described by the application layer specification – see [7], for more information about Modbus over TCP/IP see [8].

This chapter describes how the data of EnOcean 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 EnOcean Devices

EnOcean devices are mapped as a set of Modbus registers. The gateway can handle up to 40 EnOcean devices. To assign an EnOcean device, the teach-in procedure has to be carried out (see Ch. 7.2). The assigned EnOcean devices are identified by *Channel* (CH1…40) within the gateway, the *Channel* is selected by user during teach-in procedure.

Data fields received in a telegram are divided into individual Modbus registers so that they can be accessed using Modbus standard functions from the network. The gateway contains a database of supported EnOcean products, the meaning of individual data registers depends on the type of EnOcean device (EEP) that is assigned to the channel during teach-in procedure.



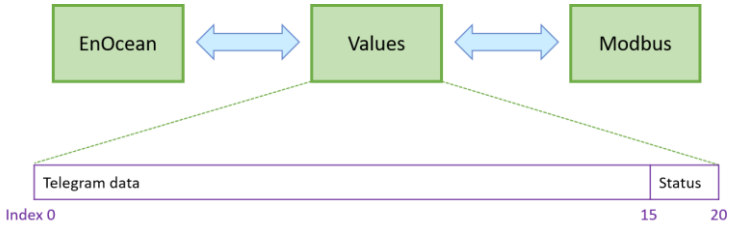
Three types of data fields are distinguished:

- **Numeric value:** usually a measured physical quantity such as temperature, humidity, etc.
- **Enumeration:** defined as a list of items that express a state or configuration of the device
- **Boolean:** two-state enumeration whose items can be interpreted as true/false, such as on/off, enabled/disabled, open/closed, etc.

In addition, two directions are distinguished:

- **RX:** data received by the gateway (incoming telegrams)
- **TX:** data transmitted by the gateway (outgoing telegrams)

The data fields are stored internally as *Values*. The *Values* are identified by *Value index*, 15 *Values* is reserved per channel (indexes 0 to 14):



The *Values* from *Telegram data* range represent a model of EnOcean telegram. For simple devices (such as sensors with unidirectional communication) the model of telegram can also be assumed to be a model of EnOcean device. Some more complex EEP definitions consist of several types of telegrams that represent different commands, so the device cannot be described by a single telegram. Special mapping is created for these devices.

For direction "RX", all used *Values* are mapped to *RX Values* registers (starting at address 0). For direction "TX" all used *Values* are mapped to *TX Values* registers (starting at address 1000). If the channel is not occupied the associated *Value* registers are zeroed.

The mapped data fields from EnOcean telegram are indexed in the same order as they appear in the EEP definition – see [3].

Besides the data values, there are also helper values for each channel that provide status information:

Index	Name	Meaning	Value Range
RX			
15	Telegram counter	Number of received telegrams	0…65535 (overflows to zero)
16	Telegram age	Time elapsed since the last telegram	0…65000 s (65535: no telegram, 65001: range exceeded)
17	Signal	Signal strength (RSSI value measured by the EnOcean transceiver)	0…−255 dBm
18	reserved		
19	Error	Enumeration of channel state and error codes	See Ch. 8.2.1
TX			
15	Telegram counter	Number of sent telegrams	0…65535 (overflows to zero)
16	Telegram age	Time elapsed since the last telegram	0…65000 s (65535: no telegram, 65001: range exceeded)
17	Send option	Data transmission control	See Ch. 8.2.2
18	reserved		

The table below shows mapping examples for individual EnOcean devices, more examples are also in ANNEX A.

		Register		
CH1	Value 1	0	Temperature	A5-02-05 Temperature Sensors, Temperature Sensor Range 0°C to +40°C 
	Value 2	1		
	Value 3	2		
	Value 4	3		
	Value 5	4		
	...	...	...	
	Value 16	15	T. Counter	
	Value 17	16	T. Age	
	Value 18	17	Signal	
	Value 19	18		
	Value 20	19	Error	
CH2	Value 1	0	Humidity	A5-09-04 Gas Sensor, CO2 Sensor 
	Value 2	1	Concentration	
	Value 3	2	Temperature	
	Value 4	3	H-Sensor	
	Value 5	4	T-Sensor	
	...	...	...	
	Value 16	15	T. Counter	
	Value 17	16	T. Age	
	Value 18	17	Signal	
	Value 19	18		
	Value 20	19	Error	
...				
CH40	Value 1	0	Power Fail	D2-32-02 A.C. Current Clamp, 3 channels 
	Value 2	1	Divisor	
	Value 3	2	Channel 1	
	Value 4	3	Channel 2	
	Value 5	4	Channel 3	
	...	...	...	
	Value 16	15	T. Counter	
	Value 17	16	T. Age	
	Value 18	17	Signal	
	Value 19	18		
	Value 20	19	Error	

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. Readonly 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.

Area name	Address range	Access	Description	Channel	Base address
RX Values	0…799	R	Last received telegram – values extracted from raw data	CH1	0
				CH2	20
				…	
				CH40	780
Reserved					
TX Values	1000…1799	R/W	Telegram to send – values are built into raw data	CH1	1000
				CH2	1020
				…	
				CH40	1780
Reserved					
RX Raw data	2000…2799	R	Last received telegram – raw data as received in telegram	CH1	2000
				CH2	2020
				…	
				CH40	2780
Reserved					
Channel config	4000…4399	R, P	Channel configuration (i.e. assignment of EnOcean device)	CH1	4000
				CH2	4010
				…	
				CH40	4390
Reserved					
Channel labels	10000…13999	R, P	User defined descriptions for channels	CH1	10000
				CH2	10100
				…	
				CH40	13900
Reserved					
Value descriptors	20000… 32000	R, P	Description of values (e.g. type, unit, multiplier, range)	CH1	20000
				CH2	20300
				…	
				CH40	31700
Reserved					

8.2.1 RX Values

20 registers are reserved for each channel. When the gateway receives a data telegram from a device that is assigned to a channel, it uses the database of supported devices to convert the data contents into *RX Values*. The received data fields are stored in registers from V1 up. The number of data fields depends on the type of EnOcean device, which is specified during the commissioning phase. For devices that use the EEP protocol, the device type is given by RORG, FUNC and TYPE (see [2], [3]).

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

Group	Offset	Access	Name	Description	Value range
Values	0	R	V1	Value 1	Depends on device type
	1	R	V2	Value 2	
	2	R	V3	Value 3	
	3	R	V4	Value 4	
	…	R			
	14	R	V15	Value 15	
Status	15	R	Telegram counter	Number of received telegrams	0…65535 (overflows to zero)
	16	R	Telegram age	Time elapsed since the last telegram	0…65000 s (65535: no telegram, 65001: range exceeded)
	17	R	Signal	Signal strength (RSSI value measured by the EnOcean transceiver)	0…–255 dBm (decimal value without minus)
	18	R	Reserved		
	19	R	Error	Enumeration of channel state and error codes	See table below

Error register	
Value	**Meaning**
0 – OK	Telegram OK, data has been stored in Values
1 – ASSIGNED	Device assigned, waiting for the first data telegram
3 – NOT SUPPORTED	Device assigned, unsupported device type, data cannot be converted to Values
7 – TIMEOUT	120 minutes without a telegram received
255 – FREE	The channel is not configured, no device assigned

8.2.2 TX Values

20 registers are reserved for each channel. When the send condition is true, the gateway uses the database of supported devices to convert the *TX Values* into the raw data contents and sends a data telegram. The data fields to send are stored in registers from V1 up. The number of data fields depends on the type of EnOcean device, which is specified during the commissioning phase. For devices that use the EEP protocol, the device type is given by RORG, FUNC and TYPE (see [2], [3]).

The registers can be set individually by the function 6 or all at once by function 16. It is possible to set more channels using a single request, the starting address must be the base address of the first channel being written, unused and readonly registers can be set to any value in the request.

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

Group	Offset	Access	Name	Description	Value range
Values	0	R/W	V1	Value 1	Depends on device type
	1	R/W	V2	Value 2	
	2	R/W	V3	Value 3	
	3	R/W	V4	Value 4	
	…	R/W			
	14	R/W	V15	Value 15	
Status	15	R	Telegram counter	Number of sent telegrams	0…65535 (overflows to zero)
	16	R	Telegram age	Time elapsed since the last telegram	0…65000 s (65535: no telegram, 65001: range exceeded)
	17	R/W	Send option	Data transmission control	See table below
	18	R	Reserved		
	19	R	Reserved		

Send option register	
Value	**Meaning**
0 – NotChange	Writing this value has no effect, the send option will not change
1 – None (default)	Transmitting disabled
2 – SendNow	Transmit once immediately, the send option will not change
3 – OnReceived	Automatic response when telegram received from the assigned device (default for A5-20-01, etc.)
4…10	Reserved
11 – OnWriteV1	Transmit when register V1 written[1)]
…	
25 – OnWriteV15	Transmit when register V15 written
26 – OnWriteAny	Transmit when any register V1…V15 written

1) When using function 16, the telegram is sent after all registers updated.

8.2.3 RX Raw Data

20 registers are reserved for each channel. These registers contain the payload bytes of the last received telegram. The length of the data varies depending on the telegram type, which is identified by the RORG byte (see [2] > Chapter 3). In most cases, it is not necessary to use these registers and *Value* registers should be used instead.

$$\text{Address} = \text{BaseAddress} + \text{Offset}$$
$$\text{BaseAddress} = 2000 + 20 \cdot (\text{ChannelNumber} - 1)$$

Raw data – RPS, 1BS				
Offset	Access	Name	Description	Value range
0	R	RORG	RORG byte	0xF6: RPS, 0xD5: 1BS
1	R	DB_0	Data byte 0	0…0xFF
2	R	Status	ERP1 Status byte	Bits 3…0: Repeater count
3…19		Reserved		
Raw data – 4BS				
Offset	Access	Name	Description	Value range
0	R	RORG	RORG byte	0xA5: 4BS
1	R	DB_3	Data byte 3	0…0xFF
2	R	DB_2	Data byte 2	0…0xFF
3	R	DB_1	Data byte 1	0…0xFF
4	R	DB_0	Data byte 0	0…0xFF
5	R	Status	ERP1 Status byte	Bits 3…0: Repeater count
6…19		Reserved		

Raw data – VLD, MSC					
Offset	Type	Access	Name	Description	Value range
0	UINT8	R	RORG	RORG byte	0xD2: VLD, 0xD1: MSC
1	UINT8	R	Data length (N)	Number of bytes in the Data array	1…14
2…8	UINT8[14]	R	Data	Data bytes DB_(N–1)…DB_0	HI: DB_(N–1); LO: DB_(N–2)[1)] … HI: DB_3; LO: DB_2 HI: DB_1; LO: DB_0
9	UINT8	R	Status	ERP1 Status byte	Bits 3…0: Repeater count
10…19			Reserved		

1) HI is the high byte of the register (bits 15…8), LO is the low byte of the register (bits 7…0).

8.2.4 Channel Config

10 registers are reserved for each channel. Sender ID identifies the EnOcean device that the channel is listening to. The EEP identifies the type of the device and is needed for conversion of raw data to *Values*.

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

Group	Offset		Access	Name	Description	Value range	Default
ID	0	Bits 15…8	R, P	ID3	Sender ID_3 (MSB)	0…0xFF	0xFF
		Bits 7…0	R, P	ID2	Sender ID_2	0…0xFF	0xFF
	1	Bits 15…8	R, P	ID1	Sender ID_1	0…0xFF	0xFF
		Bits 7…0	R, P	ID0	Sender ID_0 (LSB)	0…0xFF	0xFF
EEP	2		R, P	RORG		0…0xFF	0x00
	3		R, P	FUNC		0…0xFF	0x00
	4		R, P	TYPE		0…0xFF	0x00
	5…9			Reserved			

8.2.5 Channel Labels

100 registers are reserved for each channel. The channel label is designed to store text information, it can be a user-friendly name that helps to identify the data or EnOcean device. The maximum size of Label is 126 bytes. The UTF-8 encoding is used because it is compatible with ASCII encoding, ASCII characters (Unicode 0x0000 to 0x007F) are encoded into one byte in UTF-8 (0x00 to 0x7F).

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

$$\text{BaseAddress} = 10000 + 100 \cdot (\text{ChannelNumber} - 1)$$

Offset	Type	Access	Name	Description	Value range	Default
0	UINT8	R, P	Encoding	Character encoding of Label	0: UTF-8	0: UTF-8
1	UINT8	R, P	Label length (N)	Number of bytes in the Label array	0…126	
2…64	UINT8[126]	R, P	Label	Array of bytes b0…b(N–1)	HI: b0; LO: b1 HI: b2; LO: b3 … HI: b(N–2); LO: b(N–1)	1)
65…99			Reserved			

1) Default label is "{EEP} {Title} (SenderID)", e.g. "A5-02-05 Temperature Sensors, Temperature Sensor Range 0°C to +40°C (05-0C-54-74)"

8.2.6 Value Descriptors

$$\text{Address} = \text{BaseAddress} + \text{Offset}$$
$$\text{BaseAddress} = 20000 + 300 \cdot (\text{ChannelNumber} - 1)$$

Group		Offset	Access	Name	Description	Value range
RX	Value 1	0	R	Value ID	e.g. 3704 -> Channel 37, Value 4	100…4000
		1	R	Type	Type of the value	0:none; 1:UINT16; 2:INT16; 3:UINT32_MSB 4:UINT32_LSB
		2	R	Min	Minimum valid value	
		3	R	Max	Maximum valid value	
		4	R	Step	Conversion of register value: Value = Register · Step	1:1; 2:0.1; 3:0.01; 4:0.001;
		5	R	Unit	Unit of measurement	See below
		6…9			Reserved	
	Value 2	10…19				
	…					
	Value 15	140…149				
TX	Value 1	150	R	Value ID	e.g. 13704 -> TX, Channel 37, Value 4	10100…14000
		…				
	Value 2	160…169				
	…					
	Value 15	290…299				

Type 0:none means that the corresponding *Value* register is unused.

Conversion example for temperature -10…30 °C stored in register RX.CH37.V1. Descriptors are as follows:

Group		Offset	Access	Name	Dec (s16)	Hex (u16)	Interpreted value
RX	Value 1	0	R	Value ID	3701	0x0E75	
		1	R	Type	2	0x0002	INT16
		2	R	Min	-100	0xFF9C	-10°C
		3	R	Max	300	0x012C	30°C
		4	R	Step	2	0x0002	0.1
		5	R	Unit	62	0x005F	°C
		6…9					

Value of register is interpreted as follows:

Dec (s16)	Hex (u16)	Interpreted value
227	0x00E3	Register · Step = 22.7°C
-51	0xFFCD	Register · Step = -5.1°C

Codes for units are listed in ANNEX B (compatible with BACnet Engineering Units enumeration).

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.

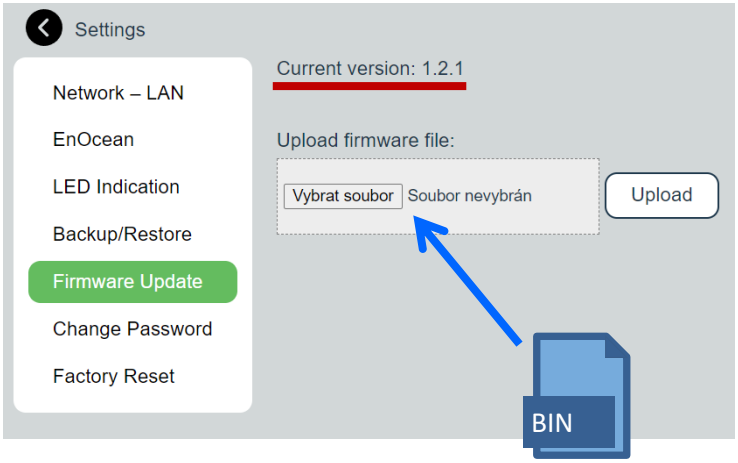
9 FIRMWARE UPDATE

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 upgraded via gateway's web interface or via the USB port in "MSC" mode.

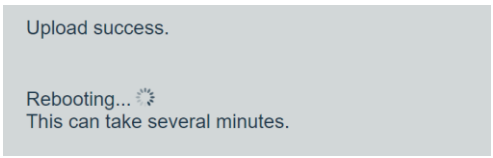
9.1 Over Network

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. When the upload is complete, the gateway reboots and the connection with *Web UI* is lost:

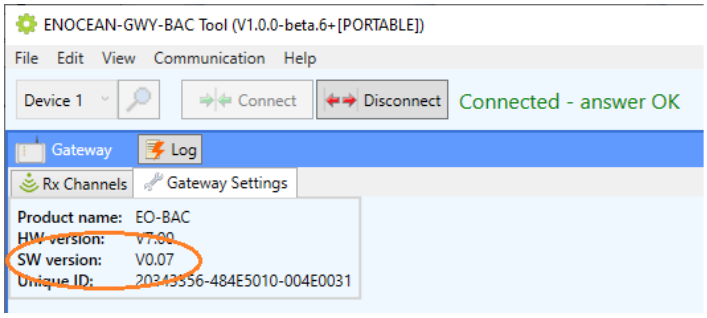


   The connection should resume within several minutes.

4. Check the installed version number.

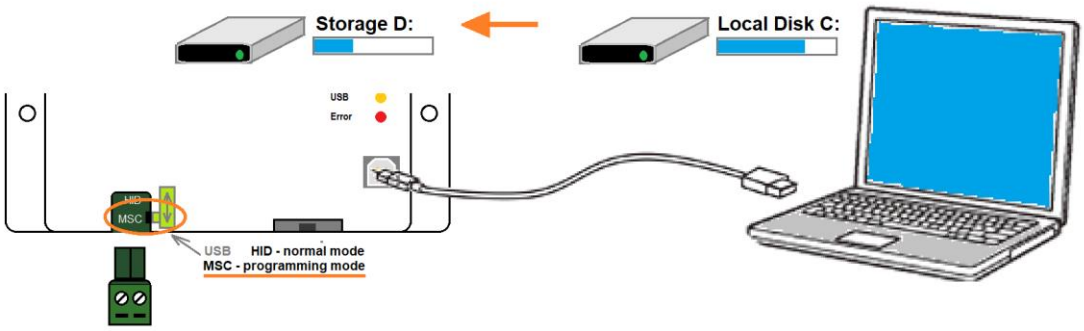
9.2 Over USB

The number of firmware version can be determined using the *EO-BAC Tool*:

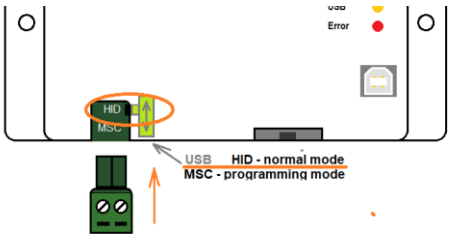


To update firmware in the gateway:

- Unplug the POWER connector
- Set the left switch to the "MSC" position
- Connect the gateway to a computer using a USB cable with type B connector
- The device appears as an external disk, copy the new firmware file to the disk



- Set the left switch back to the “HID” position, the gateway reboots
- Now, the gateway checks the file and overwrites the current firmware with the new one
- The result is indicated by LEDs
- Disconnect the USB cable and plug the POWER connector back



REFERENCES

[1] EnOcean Technical Specifications (https://www.enocean-alliance.org/specifications/)

[2] EnOcean Equipment Profiles (EEP) (https://www.enocean-alliance.org/wp-content/uploads/2020/07/EnOcean-Equipment-Profiles-3-1.pdf)

[3] Communication telegrams defined in EnOcean equipment profiles (http://tools.enocean-alliance.org/EEPViewer/)

[4] Smart Acknowledge – Bidirectional communication with energy harvesting devices (https://www.enocean-alliance.org/wp-content/uploads/2020/04/SmartAcknowledge_Specification_v1.7.pdf)

[5] EnOcean Unique Radio Identifier – EURID Specification (https://www.enocean-alliance.org/wp-content/uploads/2021/03/EURID-v1.2.pdf)

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

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

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

REVISION HISTORY

Date	Version	Description
2022-04-01	V1.0	Initial release
2022-08-05	V1.1	Added bidirectional communication
2022-11-01	V1.2	Added Ch. 7.2.5 Updated figures Updated ANNEX A
2022-12-14	V1.3	Chapters rearranged Added Ch. 4, 6
2023-01-23	V1.4	Extended 0 (D2-01-XX)
2023-03-24	V1.5	Updated figures Revised Ch. 7.1, 8(Accessing Web Interface, Modbus Interface) Added description of Edit channel view (Ch. 7.2.6) Added description of LED functions (Ch. 2)
2023-05-25	V1.6	Values correction
2023-11-01	V1.7	General corrections Added Ch. 7.3.1 (Repeater description)

ANNEX A MAPPING EXAMPLES OF ENOCEAN DEVICES

A.1 Basic Examples

RX Values:

Ch.	Device	Register	Value Name	Range	Value	Dec	Hex
1	A5-02-05 	0	Temperature	0…40 °C	22.4°C	224	0x00E0
		15	Telegram counter	0…65535	12	12	0x000C
		16	Telegram age	0…65000 s	252s	252	0x00FC
		17	Signal	0…−255dBm	−49dBm	49	0x0031
		19	Error		0 (OK)		
2	00-00-00	20	None		0		
		…	…		…		
		34	None		0		
		35	Telegram counter	0…65535	0		
		36	Telegram age	0…65000 s	65535		
		37	Signal	0…−255dBm	0		
		39	Error		255 (FREE)		
…							
32	D5-00-01 	620	Contact	0:open, 1:closed	1		
		635	Telegram counter	0…65535	50		
		636	Telegram age	0…65000 s	10s		
		637	Signal	0…−255dBm	−58dBm		
		639	Error		0 (OK)		
…							
39	00-00-00						
40	A5-09-04 	780	Humidity	0…100 %	45%	450	0x01C2
		781	Concentration	0…2550 ppm	1451ppm	1451	0x05AB
		782	Temperature	0…51 °C	23.2°C	232	0x00E8
		783	H-Sensor	0:Not available, 1:Available	1		
		784	T-Sensor	0:Not available, 1:Available	1		
		795	Telegram counter	0…65535	50		
		796	Telegram age	0…65000 s	10s		
		797	Signal	0…−255dBm	−52dBm		
		7999	Error		0 (OK)		

A.2 RPS Buttons and Switches

The following example applies to F6-02-01, F6-02-02, F6-02-03 and F6-02-04

Ch.	Device	Register	Value Name	Range	Value	Dec	Hex
1	F6-02-02 	0	BI	0:released, 1:pressed	1		
		1	B0	0:released, 1:pressed	0		
		2	AI	0:released, 1:pressed	0		
		3	A0	0:released, 1:pressed	0		
		4	Rocker B	-1:null, 0:off, 1:on	1		
		5	Rocker A	-1:null, 0:off, 1:on	0		
2	00-00-00						
…							

V4 and V5 remember the rocker state for channel A and B, this is out of the EEP definition. Rocker B goes 1:on when BI was pressed, Rocker B goes 0:off when B0 was pressed. When no telegram has been received yet, rocker has the initial value -1:null.

A.3 A5-20-01 HVAC Components, Battery Powered Actuator

The actuator wakes up periodically, transmits the actual value and waits for a response with a new setpoint, which must be sent within 1 second. The response is built from *TX Values* registers. The response also contains other settings, e.g. Set point type selection, Set point inverse, Summer mode, Service mode.

Direction RX (from actuator):

Ch.	Device	Register	Value Name	Range	Value	Dec	Hex
1	A5-20-01 	0	Current Value	0...100 %	25%	25	0x0019
		1	Service On	1:on	0	0	0x0000
		2	Energy input enabled	1:true	0	0	0x0000
		3	Energy Storage	1:true	1	1	0x0001
		4	Battery capacity	0:true	1	1	0x0001
		5	Contact, cover open	1:true	0	0	0x0000
		6	Failure temperature sensor, out off range	1:true	0	0	0x0000
		7	Detection, window open	1:true	0	0	0x0000
		8	Actuator obstructed	1:true	0	0	0x0000
		9	Temperature	0...40 °C	22.59°C	226	0x00E2
2	00-00-00						
…							

Direction TX (to actuator):

Ch.	Device	Register	Value Name	Range	Value	Dec	Hex
1	A5-20-01	1000	Valve position or Temperature Setpoint	0...100 %	25%	25	0x0019
		1001	Temperature from RCU	0...40 °C	0°C	0	0x0000
		1002	Summer mode	0...1	0	0	0x0000
		1003	Setpoint selection	0...1	0	0	0x0000
		1004	Set point inverse	0...1	0	0	0x0000
			SEND		3 (OnReceive)		
2	00-00-00						
...							

A.4 D2-01-XX Electronic switches and dimmers with Energy Measurement and Local Control

Device types from the D2-01-XX group share the same telegram definitions – see the profile D2-01-00 (http://tools.enocean-alliance.org/EEPViewer/profiles/D2/01/00/D2-01-00.pdf). There are several messages distinguished by the Command ID data field. Each type supports only certain commands and functions, e.g. type 0x02 has one dimmable output, type 0x12 has two relay outputs without dimming function or type 0x0B supports energy and power measurements.

The gateway creates a universal interface for all device types from the D2-01-XX group, regardless of the features supported by a particular type.

A.4.1 Example with NodOn Micro Smart Plug (D2-01-0E) – Measurements

This actuator has one output channel and supports energy and power measurements.

Incoming data

Registers 1…6 contains data from the status message CMD 4, registers 7…10 from the measurement message CMD 7. The register 0 indicates which CMD was received last.

Register	Value Name	Range	Value	Dec	Hex
0	Command ID	4:Status Response;7...	4:Status Response	4	0x0004
1	I/O channel (STATUS)	0...31	0	0	0x0000
2	Output value	0...127 %	100%	100	0x0064
3	Power Failure	0:Disabled / not supp...	0:Disabled / not supported (PFD=0)	0	0x0000
4	Over current switch off	0:Ready / not suppor...	0:Ready / not supported	0	0x0000
5	Error level	0:Hardware OK;1:Ha...	3:Not supported	3	0x0003
6	Local control	0:Disabled / not supp...	1:Enabled	1	0x0001
7	I/O channel (MEASUREMENT)	0...31	0	0	0x0000
8	Unit	0:Energy [Ws];1:Ener...	3:Power [W]	3	0x0003
9	Measurement value (MSB)	0...65535	0	0	0x0000
10	Measurement value (LSB)	0...65535	9	9	0x0009
15	Telegram counter	0...65535	19	19	0x0013
16	Telegram age	0...65000 s	31s	31	0x001F

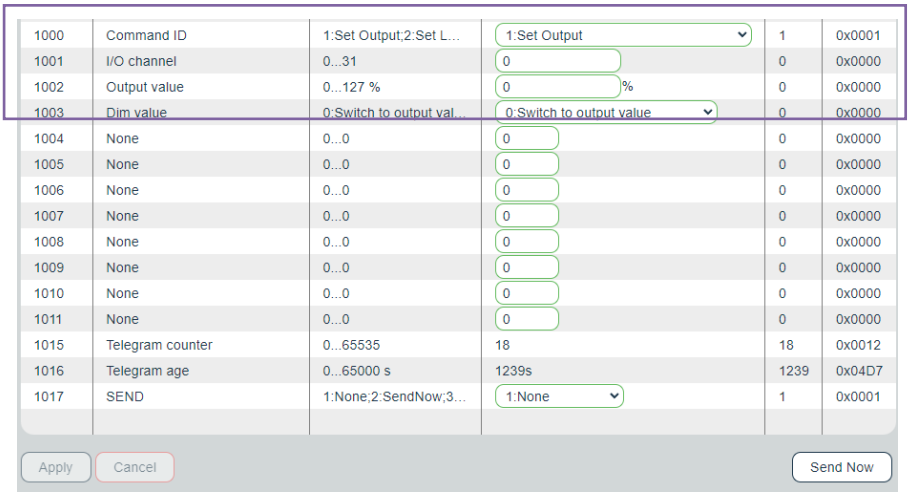
CMD4 – status

CMD7 – measurement

The most important is *CMD4 -> Output value*, which indicates the ON/OFF state of the actuator.

Outgoing data

It is possible to transmit different commands. The command is switched by the *Command ID* value, which is always at the first position (register 1000). The meaning of the values from register 1001 up depends on the *Command ID*. The default command is CMD1.



1000	Command ID	1:Set Output;2:Set L...	1:Set Output	1	0x0001
1001	I/O channel	0...31	0	0	0x0000
1002	Output value	0...127 %	0 %	0	0x0000
1003	Dim value	0:Switch to output val...	0:Switch to output value	0	0x0000
1004	None	0...0	0	0	0x0000
1005	None	0...0	0	0	0x0000
1006	None	0...0	0	0	0x0000
1007	None	0...0	0	0	0x0000
1008	None	0...0	0	0	0x0000
1009	None	0...0	0	0	0x0000
1010	None	0...0	0	0	0x0000
1011	None	0...0	0	0	0x0000
1015	Telegram counter	0...65535	18	18	0x0012
1016	Telegram age	0...65000 s	1239s	1239	0x04D7
1017	SEND	1:None;2:SendNow;3...	1:None	1	0x0001

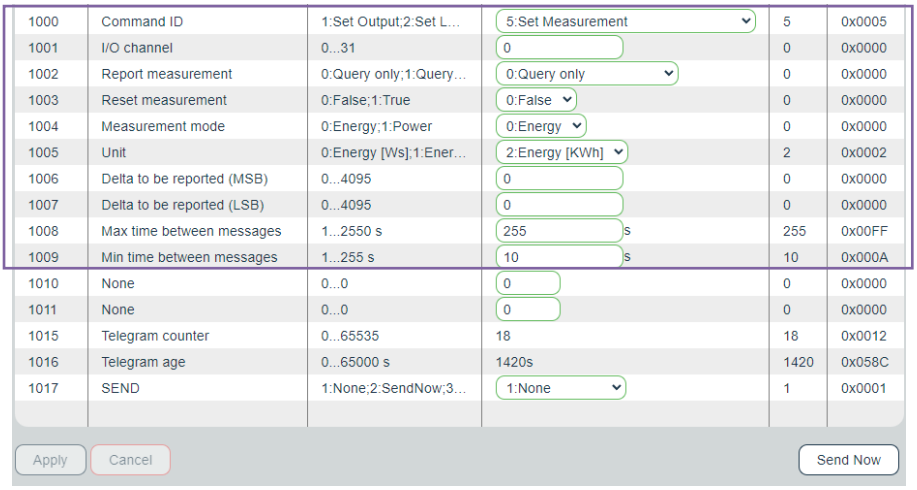
Apply Cancel Send Now

CMD1 – set output

The most important is CMD 1, which is used to switch ON/OFF the output (0% => OFF; 100% => ON). The *Output value in percent* and *Dim value* is only applicable to devices with the dimming feature supported. The value 127% corresponds to *0x7F: Output value not valid / not applicable*.

Setting up the measurement through Modbus interface in Web UI

1. Go to Edit channel -> Values
2. Set Command ID (register 1000) to CMD 5 – Set Measurement
3. Confirm “Apply”
4. The UI gets updated:



1000	Command ID	1:Set Output;2:Set L...	5:Set Measurement	5	0x0005
1001	I/O channel	0...31	0	0	0x0000
1002	Report measurement	0:Query only;1:Query...	0:Query only	0	0x0000
1003	Reset measurement	0:False;1:True	0:False	0	0x0000
1004	Measurement mode	0:Energy;1:Power	0:Energy	0	0x0000
1005	Unit	0:Energy [Ws];1:Ener...	2:Energy [KWh]	2	0x0002
1006	Delta to be reported (MSB)	0...4095	0	0	0x0000
1007	Delta to be reported (LSB)	0...4095	0	0	0x0000
1008	Max time between messages	1...2550 s	255 s	255	0x00FF
1009	Min time between messages	1...255 s	10 s	10	0x000A
1010	None	0...0	0	0	0x0000
1011	None	0...0	0	0	0x0000
1015	Telegram counter	0...65535	18	18	0x0012
1016	Telegram age	0...65000 s	1420s	1420	0x058C
1017	SEND	1:None;2:SendNow;3...	1:None	1	0x0001

Apply Cancel Send Now

CMD5 – set measurement

5. Enter inputs, there are several parameters according to the EEP specification.
6. “Send Now” will transmit the telegram to the actuator.

The type D2-01-0E supports measurement report on query (CMD 6) or automatic reporting based on the configuration sent in the CMD 5.

The power and energy measurements are configured and reported separately, determined by CMD 5 -> *Measurement mode* and *Unit*; CMD 4 -> *Unit*.

The measured value is 4 byte in size, split into two 16-bit values (Measurement value = 256 * MSB + LSB), the physical unit is indicated by the *Unit* value.

A.4.2 Example with NodOn Relay Switch (D2-01-12) – Controlling the output

This actuator has two output channels, the example shows switching ON of the second channel. TX data are first prepared by writing into the TX data registers, then the control telegram (CMD1 – Set output) is sent by writing *Send option = 2:SendNow*. The actuator returns a status message (CMD4 – Status response), the message says the channel 2 (numbered from zero) is ON.

The *Send option* can also be configured so that the gateway sends when *Output value* is written (*Send option = 13:OnWriteV2*).

Dim value is not supported by this type and is ignored.

Direction TX (to actuator):

Ch.	Device	Register	Value Name	Range	Value	Dec	Hex
1	D2-01-12	1000	Command ID	1:Set Output;2:Set Local; …	1	1	0x0001
		1002	I/O channel	0...31	1	1	0x0001
		1003	Output value	0...127 %	100%	100	0x0064
		1001	Dim value	0:Switch to output value;1:Dim to output value – timer 1; …	0	0	0x0000
		1017	SEND	Send option for Device1	2 (SendNow)	2	0x0002
2	00-00-00						
…							

Direction RX (from actuator):

Ch.	Device	Register	Value Name	Range	Value	Dec	Hex
1	D2-01-12 	0	Command ID	4:Status Response; 7:Measurement Response;	4	4	0x0004
		1	I/O channel	0...31	1	1	0x0001
		2	Output value	0...127 %	100%	100	0x0064
		…	Other values				
2	00-00-00						
…							

A.5 D2-11-XX Bidirectional Room Operating Panel (Smart ACK)

What is Smart ACK?

EnOcean sensors are in sleep mode most of the time to reduce power consumption, so they cannot receive any telegram. The Smart ACK protocol enables bidirectional communication with energy self-sufficient devices. For example, Room Operating Panels D2-11-XX utilize the Smart ACK communication to receive data, which is used to show symbols on the display or override some parameters.

The Smart ACK protocol is described in [4]. When a message is sent to a Smart ACK Sensor, a device called "Post Master" stores it in a "Mailbox" until the sensor is ready to receive telegrams. When the sensor wakes up, it checks the Mailbox. The Post Master sends the message buffered in the Mailbox or Mailbox Empty message if the Mailbox is empty. The sensor receives the response from Post Master and returns to sleep mode. The Mailbox is established in Post Master during teach-in process.

The gateway does not support repeaters, there must be a direct connection between the gateway and the Smart ACK device, i.e. Post Master and Mailbox are located in the gateway.

A.5.1 Example with Thermokon SR06 LCD (D2-11-07)

Direction RX (from sensor):

The sensor sends two types of messages, ID 0 or ID 2. When Message ID is 0, only Set Point Type is valid, other values should be ignored.

Communication is initiated by the sensor on heartbeat (default 1000 s), change of measured value or button press (parameter change), which is indicated by TelegramType.

Ch.	Device	Reg.	Value Name	Range	Value	Dec	Hex
1	D2-11-07 	0	Set Setpoint type	0:Temperature correction;1:Temperature setpoint	1	1	0x0001
		1	Telegram Type	0:Heartbeat;1:Change of temperature or humidity value;2:User caused parameter change	2	2	0x0002
		2	Message ID	0:ID-0;2:ID-2	2	2	0x0002
		3	Temperature	0...40 °C	23.84°C	238	0x00EE
		4	Humidity	0...100 %	0%	0	0x0000
		5	Setpoint offset	0...255	170	170	0x00AA
		6	Basesetpoint	15...30 °C	21°C	21	0x0015
		7	Valid temperature correction	1:-1...1K;2:-2...2K;3:-3...3K;4:-4...4K;5:-5...5K;6:-6...6K;7:-7...7K;8:-8...8K;9:-9...9K;10:-10...10K	3	3	0x0003
		8	Fan speed	0:Auto;1:Speed 0;2:Speed 1;3:Speed 2;4:Speed 3;7:Not available	7	7	0x0007
		9	Occupancy state	0:State Unoccupied;1:State Occupied	0	0	0x0000
2	00-00-00						
...							

Direction TX (to sensor):

The gateway responds with message ID 1. Settings are changed by writing these values and SendOption = 2:SendNow, changes will apply next time the sensor wakes up. Without a response, the sensor uses the last settings.

SetPointType, TemperatureCorrection, BaseSetpoint and ValidTemperatureCorrection must be mirrored from RX data if no change is required.

Ch.	Device	Register	Value Name	Range	Value	Dec	Hex
1	D2-11-07	1000	Set Setpoint type	0:Temperature correction;1:Temperature setpoint	1	1	0x0001
		1001	Display heating symbol	0:Heating symbol off;1:Heating symbol on	0	0	0x0000
		1002	Display cooling symbol	0:Cooling symbol off;1:Cooling symbol on	0	0	0x0000
		1003	Display window open symbol	0:Window open symbol off;1:Window open symbol on	1	1	0x0001
		1004	Message ID	1:ID-1	1	1	0x0001
		1005	Temperature correction	0...255	128	128	0x0080
		1006	Basesetpoint	15...30 °C	21°C	21	0x0015
		1007	Valid temperature correction	1:-1...1K;2:-2...2K;3:-3...3K;4:-4...4K;5:-5...5K;6:-6...6K;7:-7...7K;8:-8...8K;9:-9...9K;10:-10...10K	3	3	0x0003
		1008	Fan speed	0:Auto;1:Speed 0;2:Speed 1;3:Speed 2;4:Speed 3;7:Not available	0	0	0x0000
		1009	Occupancy state	0:State Unoccupied;1:State Occupied	0	0	0x0000
		1017	SEND		2 (SendNow)	2	0x0002
2	00-00-00						
...							

A.6 D2-15-00 People Activity Sensor

Ch.	Device	Register	Value Name	Range	Value	Dec	Hex
1	D2-15-00 	0	Presence	0:Present;1:Not Present;2:Not detectable;3:Presence Detector error	0	0	0x0000
		1	Energy Storage Status	0:High;1:Medium;2:Low;3:Critical	0	0	0x0000
		2	Pir Update Rate	1...16 s	1s	1	0x0001
		3	Pir Counter	0...65535	7568	7568	0x1D90
		4	Activity	0...100 %	52%	52	0x0034
2	00-00-00						
…							

The Activity is computed by gateway based on two subsequent values of the Pir Counter. When the Pir Update Rate is 1s and the sensor transmits data every 2 minutes, 100% corresponds to the Pir Counter increment of 120.

$$Activity[\%] = \frac{(PIRCounterCurrent - PIRCounterLast) \cdot PIRUpdateRate[s]}{TelegramAgeLast[s] - TelegramAgeCurrent[s]}$$

ANNEX B ENUMERATION OF UNITS

Units are represented by 16-bit codes compatible with the BACnet Engineering Units enumeration. There are also several proprietary codes defined.

```
/*000*/"m2",
/*001*/"ft2",
/*002*/"mA",
/*003*/"A",
/*004*/"Ohm",
/*005*/"V",
/*006*/"kV",
/*007*/"MV",
/*008*/"VA",
/*009*/"kVA",
/*010*/"MVA",
/*011*/"var",
/*012*/"kvar",
/*013*/"Mvar",
/*014*/"°",
/*015*/"[?]",
/*016*/"J",
/*017*/"kJ",
/*018*/"Wh",
/*019*/"kWh",
/*020*/"Btu",
/*021*/"UK",
/*022*/"th",
/*023*/"J/kg",
/*024*/"[?]",
/*025*/"cph",
/*026*/"cpm",
/*027*/"Hz",
/*028*/"g/kg",
/*029*/"%",
/*030*/"mm",
/*031*/"mm",
/*032*/"Inch",
/*033*/"[?]",
/*034*/"w/f2",
/*035*/"[?]",
/*036*/"lm",
/*037*/"lx",
/*038*/"fc",
/*039*/"kg",
/*040*/"[?]",
/*041*/"t",
/*042*/"kg/s",
/*043*/"kg/min",
/*044*/"kg/h",
/*045*/"[?]",
/*046*/"[?]",
/*047*/"W",
/*048*/"kW",
/*049*/"MW",
/*050*/"Btu/h",
/*051*/"hp",
/*052*/"[?]",
/*053*/"Pa",
/*054*/"kPa",
/*055*/"Bar",
/*056*/"[?]",
/*057*/"[?]",
/*058*/"[?]",
/*059*/"[?]",
/*060*/"[?]",
/*061*/"[?]",
/*062*/"°C",
/*063*/"K",
/*064*/"°F",
/*065*/"[?]",
/*066*/"[?]",
/*067*/"Years",
/*068*/"Months",
/*069*/"Weeks",
/*070*/"Days",
/*071*/"h",
/*072*/"min",
/*073*/"s",
/*074*/"m/s",
/*075*/"km/h",
/*076*/"ft/s",
/*077*/"ft/min",
/*078*/"[?]",
/*079*/"[?]",
/*080*/"[?]",
/*081*/"[?]",
/*082*/"l",
/*083*/"[?]",
/*084*/"[?]",
/*085*/"m3/s",
/*086*/"[?]",
/*087*/"l/s",
/*088*/"l/min",
/*089*/"[?]",
/*090*/"°",
/*091*/"°C/h",
/*092*/"°C/min",
/*093*/"[?]",
/*094*/"[?]",
/*095*/"",
/*096*/"ppm",
/*097*/"ppb",
/*98*/"%",
/*99*/"%/s",
/*100*/"[?]",
/*101*/"[?]",
/*102*/"[?]",
/*103*/"rad",
/*104*/"[?]",
/*105*/"[?]",
/*106*/"[?]",
/*107*/"[?]",
/*108*/"[?]",
/*109*/"[?]",
/*110*/"[?]",
/*111*/"[?]",
/*112*/"[?]",
/*113*/"[?]",
/*114*/"[?]",
/*115*/"inch2",
/*116*/"cm2",
/*117*/"[?]",
/*118*/"cm",
/*119*/"[?]",
/*120*/"[?]",
/*121*/"°K",
/*122*/"kOhm",
/*123*/"MOhm",
/*124*/"mV",
/*125*/"kJ/kg",
/*126*/"MJ",
/*127*/"[?]",
/*128*/"[?]",
/*129*/"kHz",
/*130*/"MHz",
/*131*/"[?]",
/*132*/"mW",
/*133*/"hPa",
/*134*/"mBar",
/*135*/"m3/h",
/*136*/"l/h",
/*137*/"[?]",
/*138*/"[?]",
/*139*/"[?]",
/*140*/"[?]",
/*141*/"[?]",
/*142*/"[?]",
/*143*/"[?]",
/*144*/"[?]",
/*145*/"mOhm",
/*146*/"MWh",
/*147*/"kBtu",
/*148*/"[?]",
/*149*/"[?]",
/*150*/"[?]",
/*151*/"[?]",
/*152*/"[?]",
/*153*/"N",
/*154*/"g/s",
/*155*/"g/min",
/*156*/"t/h",
/*157*/"[?]",
/*158*/"[?]",
/*159*/"ms",
/*160*/"Nm",
/*161*/"mm/s",
/*162*/"[?]",
/*163*/"[?]",
/*164*/"[?]",
/*165*/"[?]",
/*166*/"[?]",
/*167*/"[?]",
/*168*/"[?]",
/*169*/"A/m2",
/*170*/"F",
/*171*/"H",
/*172*/"[?]",
/*173*/"S",
/*174*/"S/m",
/*175*/"T",
/*176*/"[?]",
/*177*/"[?]",
/*178*/"Wb",
/*179*/"cd",
/*180*/"cd/m2",
/*181*/"K/h",
/*182*/"K/min",
/*183*/"J/s",
/*184*/"rad/s",
/*185*/"m2/N",
/*186*/"kg/m3",
/*187*/"Ns",
/*188*/"N/m",
/*189*/"W/m/K",
/*190*/"uS",
/*191*/"[?]",
/*192*/"[?]",
/*193*/"km",
/*194*/"um",
/*195*/"g",
/*196*/"mg",
/*197*/"mm",
/*198*/"mm/s",
/*199*/"dB",
/*200*/"dBmV",
/*201*/"dBV",
/*202*/"mS",
/*203*/"W/hr",
/*204*/"kWhr",
/*205*/"[?]",
/*206*/"[?]",
/*207*/"[?]",
/*208*/"g/g",
/*209*/"kg/kg",
/*210*/"g/kg",
/*211*/"mg/g",
/*212*/"mg/kg",
/*213*/"g/ml",
/*214*/"g/l",
/*215*/"mg/l",
/*216*/"ug/l",
/*217*/"g/m3",
/*218*/"mg/m3",
/*219*/"ug/m3",
/*220*/"[?]",
/*221*/"g/cm3",
/*222*/"Bq",
/*223*/"[?]",
/*224*/"[?]",
/*225*/"Gy",
/*226*/"mGy",
/*227*/"[?]",
/*228*/"Sv",
/*229*/"[?]",
/*230*/"[?]",
/*231*/"[?]",
/*232*/"[?]",
/*233*/"[?]",
/*234*/"pH",
/*235*/"[?]",
/*236*/"[?]",
```

Proprietary:

```
//Decibel milliwats
/*256*/"dBm",
//G-Force
/*257*/"G",
//G-Force milli
/*258*/"mG",
```