User Manual

EE240

Wireless Sensor Network for Humidity, Temperature and CO_2

YOUR PARTNER IN SENSOR TECHNOLOGY

E+E ELEKTRONIK® Ges.m.b.H.

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EMC note USA (FCC):

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

EMC note Canada (ICES-003):

CAN ICES-3 (A) / NMB-3 (A)

CONTENT

1 General

This user manual serves for ensuring proper handling and optimal functioning of the device. The user manual shall be read before commissioning the equipment and it shall be provided to all staff involved in transport, installation, operation, maintenance and repair. The user manual may not be used for the purposes of competition without the written consent of E+E Elektronik® and may not be forwarded to third parties. Copies may be made for internal purposes. All information, technical data and diagrams included in these instructions are based on the information available at the time of writing.

Disclaimer

The manufacturer or his authorized agent can be only be held liable in case of willful or gross negligence. In any case, the scope of liability is limited to the corresponding amount of the order issued to the manufacturer. The manufacturer assumes no liability for damages incurred due to failure to comply with the applicable regulations, operating instructions or the specified operating conditions. Consequential damages are excluded from the liability.

1.1 Explanation of Symbols

This symbol indicates safety information.

It is essential that all safety information is strictly observed. Failure to comply with this information can lead to personal injuries or damage to property. E+E Elektronik® assumes no liability if this happens.

This symbol indicates instructions.

The instructions shall be observed in order to reach optimal performance of the device.

1.2 General Safety Instructions

- Avoid any unnecessary mechanical stress and inappropriate use.
- When replacing the filter cap make sure not to touch the sensing elements.
- For sensor cleaning and filter cap replacement please see “Cleaning instructions” at www.epluse.com.
- Installation, electrical connection, maintenance and commissioning shall be performed by qualified personnel only.

1.3 Specific Safety Instructions for Wireless System

Standards:

CE: Electromagnetic Compatibility according EN 61326-1 and EN 61326-2-3 / Industrial environment
FCC: Part 15 Class A
ICES: ICES-003 Class A

Transmission module:

EE242/EE244: Contains FCC ID: MCQ-S2CTH
EE245: Contains FCC ID: MCQ-XBS2C

This equipment complies with Part 15 of the FCC Rules.
Operation is subject to the following conditions:

- this device may not cause harmful interference
- under direct influence of EMC interference the device must continue to function, including interference that may cause an undesired operational situation.

	Regulatory conformity	EE242 / EE244	EE245
2.4 GHz	United States (FCC Part 15.247)	FCC ID: MCQ-S2CTH	FCC ID: MCQ-XBS2C
	Industry Canada (IC)	IC: 1846A-S2CTH	IC: 1846A-XBS2C
	Europe (RED)	CE Labeling	CE Labeling
	Australia	RCM	RCM

Tab. 1 Regulatory product conformity

Specific Instructions:

The transmission energy of the series EE240 is limited according to certain standards, alterations of the electronics with respect to the transmission license are therefore prohibited.

USA:

The antenna must be mounted more than 20 cm (8 inches) away from any human body.

1.4 Environmental Aspects

Products from E+E Elektronik® are developed and manufactured observing of all relevant requirements with respect to environment protection. Please observe local regulations for the device disposal.

For disposal, the individual components of the device must be separated according to local recycling regulations. The electronics shall be disposed of correctly as electronics waste. Batteries in particular shall be disposed of at the designated collection points in accordance with national or local regulations.

2 Scope of Supply

EE242 base station
1 piece per independent network, quantity and features according to order code.

EE244 transmitter/router
Quantity and features according to order code, each EE244 comes with 1 piece of HA010707 4 pole M12 connector for self assembly.

Sensing probes for EE244
Quantity and features according to order code.

EE245 room transmitter
Quantity and features according to order code.

3 Product Description

3.1 Wireless Network

3.1.1 General

An EE240 wireless sensor network consists of an EE242 base station, up to 500 EE244 and EE245 transmitters and up to 50 EE244 routers (EE244-AF7x).

The EE240 wireless sensor network uses the IEEE 802.15.4 radio standard. The RF modules operate on 2.4 GHz with a power of 8 dBm.

The transmission range depends greatly on the local conditions. Certain obstacles such as reinforced concrete walls, steel structures or metalised glas may attenuate the transmission signal and decrease the transmission range.

The transmission range can be optimized by selecting appropriate locations for the sensors or by one or more of the following measures:

- use of an antenna cable for placing the antenna at the optimal location
- use of probe extension cables for optimal location of the transmitter or router enclosure
- use of routers, which receive, amplify and re-transmit the signal.

Very important

- As a rule of the thumb, the signal strenghts during operation at any receiver (router or base station) shall be min. 50%. The signal strengths (%) can be seen on the web server of EE242, see chapter 6.2.2 Transmitters.

- For a stable wireless communication and an optimal network structure (with minimal number of components) it is neccessary to evaluate the site for defining the exact location of each transmitter, router and antenna. The site evaluation shall take place before ordering the EE240 network components. Please contact the E+E sales representative for details.

3.1.2 The Structure of the EE240 Wireless Sensor Network

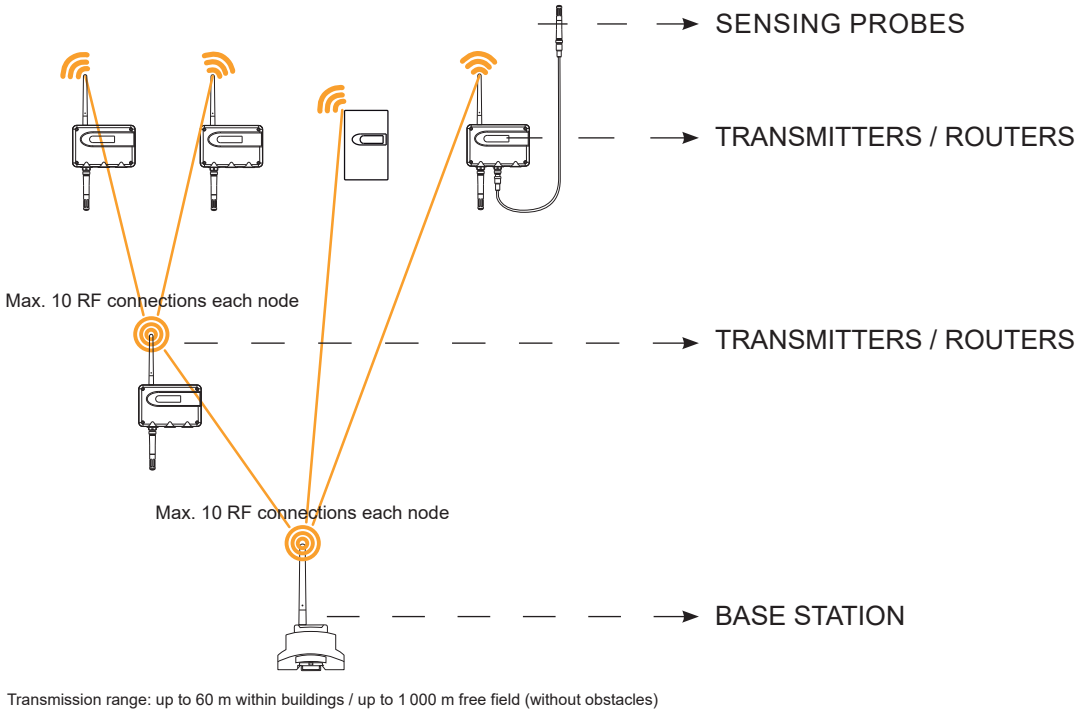


Fig. 1 Structure of EE240 wireless network

Each EE242 base station can communicate with max. 10 transmitters (EE244 or EE245) or routers (EE244-AF7x).

Each EE244 router can communicate with max. 10 transmitters (EE244 or EE245) or routers (EE244-AF7x).

The network is self-configuring and builds up in a star, tree, meshed or mixed topology.

3.2 Components of the EE240 Wireless Sensor Network

3.2.1 EE242 Base Station

The EE242 base station receives the measured data from all the transmitters and routers. It offers following data outputs and interfaces:

- Modbus (ASCII, RTU, TCP)
- JSON
- Four analogue outputs
- Display (optional)

The EE242 base station features a web server, which facilitates the setup of the entire EE240 wireless sensor network and the receving of the measured data.

For details see chapters 4.1 Base Station and 6 EE240 Network Configuration.

3.2.2 EE244 and EE245 Transmitter

Each EE244 and EE245 transmitter communicates with the base station either directly or indirectly via one or more routers. The transmitters can be powered ether by batteries or by an external supply unit, see accessories in the EE240 data sheet.

For details see chapter 4.2 EE244 Transmitter/Router, EE245 Transmitter, Sensing Probes.

3.2.3 EE244 Router (EE244-AF7x)

Each EE244 router can receive, amplify and re-transmit max. 10 signals from EE244 or EE245 transmitters or from other routers. Furthermore, an EE244 router can accommodate up to two sensing probes. The router requires extenal power supply, it cannot be battery powered.

For details see chapter 4.3 EE244 Router Additional Information.

3.2.4 Sensing probes for EE244

- T and RH / T measurement: EE07 Humidity and/or Temperature Probe with Digital Output
- CO_2 measurement: EE871 CO_2 Sensing Probe for the EE240 Wireless Sensor Network

For details please see the corresponding data sheets at www.epluse.com/EE240.

4 Mounting / Functional Description

4.1 Base Station

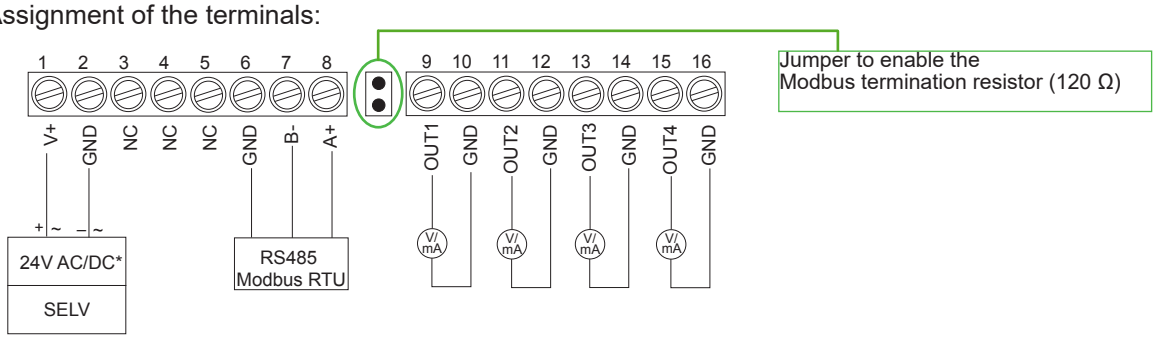
An EE240 wireless network consists of an EE242 base station and up to 500 transmitters and up to 50 routers. Up to 10 connections (from routers or transmitters) can be established to a base station. The Ethernet interface, RS485/Modbus and Webserver of EE240 allow for easy configuration of the entire network.

4.1.1 Mounting

The EE242 base station enclosure is suitable for DIN rail mounting. For dismounting, act with a screwdriver onto the orange snap locks. The antenna can be remotely installed using an optional cable, see accessories at www.epluse.com/EE240.

4.1.2 Electrical Connections

Assignment of the terminals:



*) The supply shall feature a ≤ 8A fuse.

Fig. 2 EE242 terminal assignment

4.1.3 Operating Components

The optional display shows the measurands selected for the four analogue outputs.

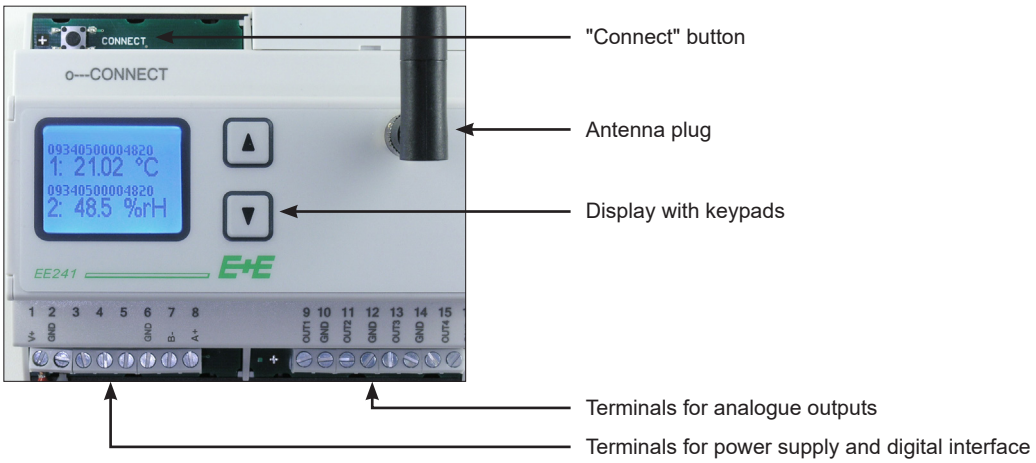


Fig. 3 EE242 base station features

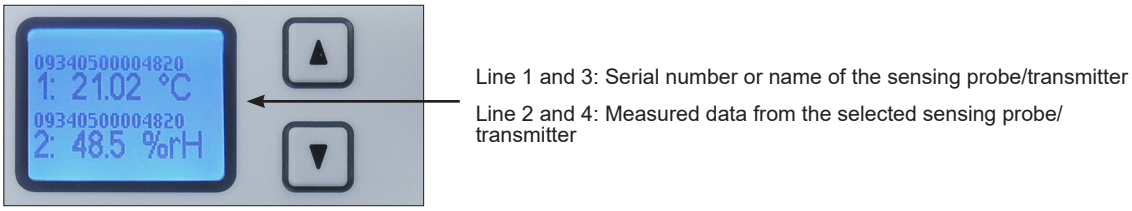


Fig. 4 EE242 base station display

4.2 EE244 Transmitter/Router, EE245 Transmitter, Sensing Probes

4.2.1 EE244 Mounting

Please note: The EE244 transmitters and the EE244 routers shall be mounted with the connectors and cable glands pointing downwards.

1. Mounting onto a wall: drill the mounting holes according to the drill template (see below). Fix the back cover of the transmitter / router onto the wall with four screws max 4.2 mm diameter (not in the scope of supply).

2. Mounting onto DIN rail: use the optional mounting kit (see accessories in the EE240 data sheet)

After wiring according to chapter 4.2.2 EE244 Electrical Connections, mount the front cover with four screws (in the scope of supply).

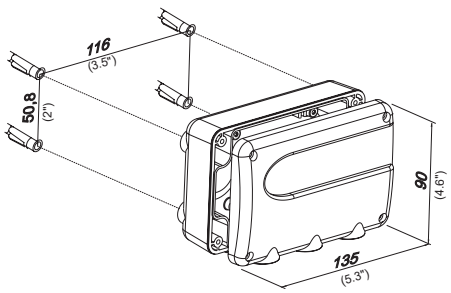


Fig. 5 EE244 wall mounting

4.2.2 EE244 Electrical Connections

Sensing probes

Depending on the type ordered, the EE244 can accommodate up to three sensing probes.

Plug the probes directly onto the M12 connector on the EE244 enclosure. Alternatively, install the probes remotely by using 2 m (6 ft), 5 m (16 ft), and 10 m (33 ft) optional M12 cables, see accessories in the EE240 data sheet.

Remotely installed probes shall point downwards.

Pluggable Antenna

Upon delivery the antenna ist mounted onto the EE244 enclosure. If needed, the antenna can be unplugged and remotely installed with an optional 2 m (6 ft) antenna cable, see accessories in the EE240 data sheet.

Power supply

- The EE244-AF6x transmitter can be powered with 4 x 1.5 V, AA / LR6 alkaline batteries (not in the scope of supply)
- The EE244-AF6E9x transmitter can be powered either by 4 x 1.5 V, AA / LR6 alkaline batteries (not in the scope of supply) or by external power unit. Select battery or external supply with the jumper J1, see Fig. 8.
  The external supply unit shall be connected to the EE244-AF6E9x and EE244-AF7E9x using a 4 pole M12 socket (included in the scope of supply, accessory no. HA010707). Pin assignment of the female socket, see Fig. 6.
- The EE244-AF7x router requires external power supply, it cannot be battery powered. The J1 jumper shall stay on the „EXT“ position, see Fig. 8.
  Important: Do not attempt to power the EE244 router with batteries. This would disable all EE244 routing functions.

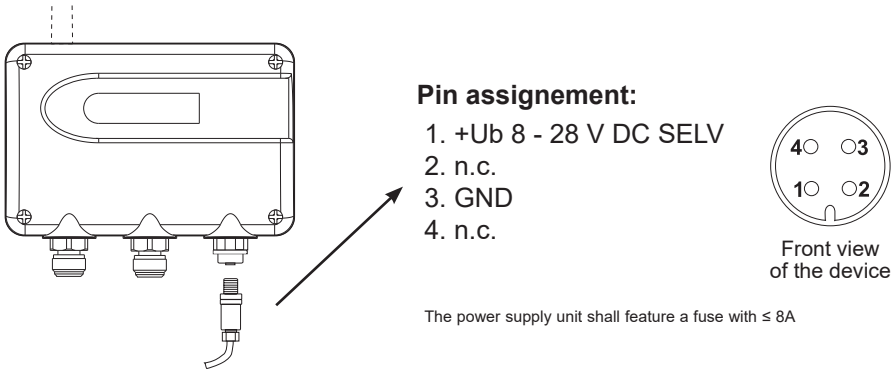


Fig. 6 EE244 external power supply

4.2.3 Operating Components of EE244 and EE245

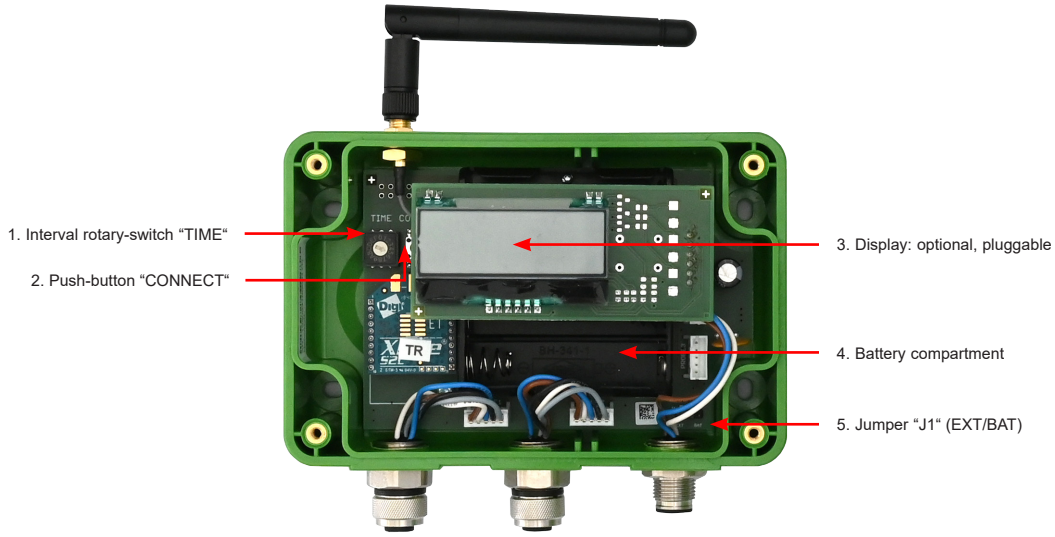


Fig. 7 EE244 components with optional display

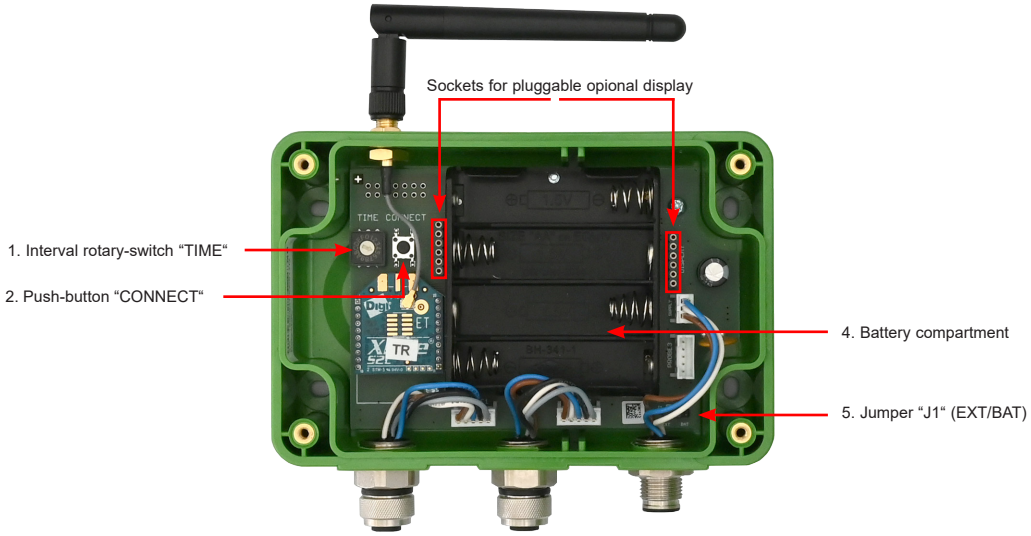


Fig. 8 EE244 components without optional display

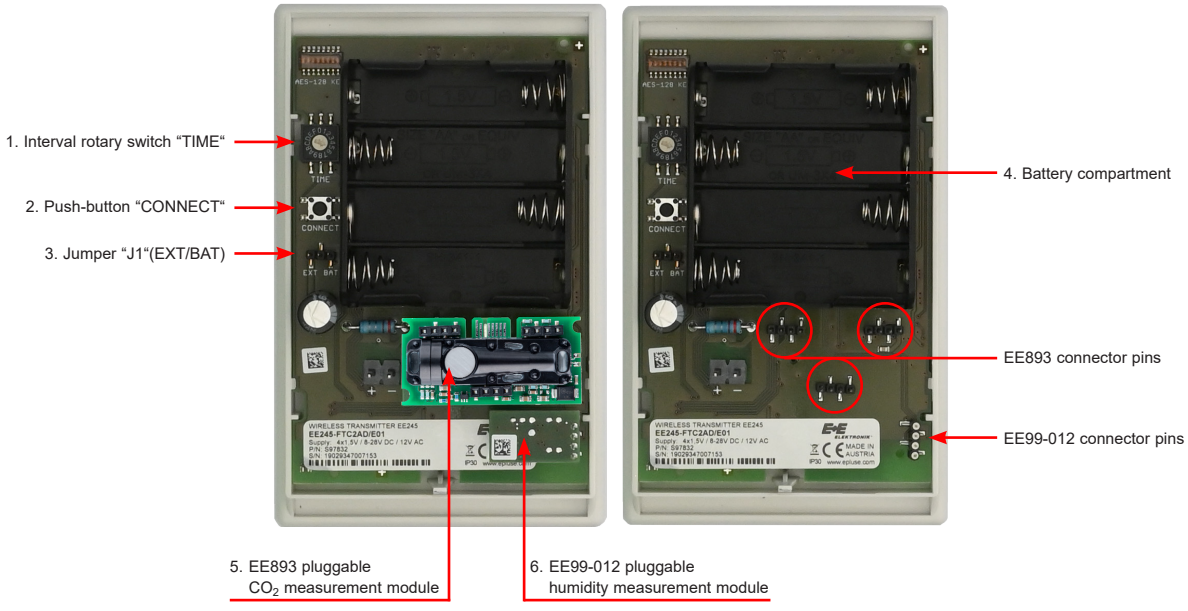


Fig. 9 EE245 components

1. Interval rotary switch "TIME":

Set the transmission interval. The transmission interval is equal to the measurement (sampling) interval:

Switch positon	Interval
0	20 s
1	30 s
2	45 s
3	1 min
4	2 min
5 = default	5 min
6	10 min
7	15 min
8	20 min
9	30 min
A	45 min
B	60 min (1 hr)
C	90 min (1.5 hrs)
D	120 min (2 hrs)
E	180 min (3 hrs)
F	240 min (4 hrs)

Tab. 2 Interval rotary switch position corresponding to sampling interval

Please note: The typical battery lifetime at 23 °C (73 °F) for a transmitter measuring T or RH/T with a transmission interval of 5 min is >1 year.

Very important:
- For extended battery life time, set the transmission interval of all transmitters to the maximum time meaningful for the applications. Please consider that in most applications the CO_2, RH, and T variations are rather slow.
- For CO_2 measurement as well as for short measuring intervals, it is strongly recommended to use external power supply.

2. Push-button "CONNECT":

Use the CONNECT button for
- establishing the connection between the transmitter or router and the base station while setting up the network, see chapter 5.1 Hardware Settings. Please note that for connecting the EE245, it has to be battery powered.
- showing the signal strength [%] on the optional display of the transmitter. Press the CONNECT button for min. 1 s while connecting the external supply unit or inserting the 4th battery. The display will return to normal operation layout after displaying the signal strength for 60 s.

3. Display:

The EE244 display alternately shows the latest reading for each measurand (RH, T, CO_2). The data is updated according to the selected transmission interval, see Tab. 2

The display can easily be replaced by the user. To do so, gently pull off the old (defect) display from the electronics board and carefully plug in the new display. Please mind the display orientation, see Fig. 7.

Furthermore, an EE244 originally without display can be fitted with display. Order number for a replacement display + front cover is D07W, see accessories in the EE240 data sheet as well as chapter 9 Spare Parts.

The pluggable display makes it possible to use successively one single display for several EE244 during the wireless network setup, see 5.1 Hardware Settings.

4. Battery compartment:

Use four 1.5V, AA / LR6 alkaline batteries (not in the scope of supply).

5. / 3. Jumper „J1" (EXT/BAT):

Select between 'battery power' and 'external power'.

4.2.4 EE245 Mounting

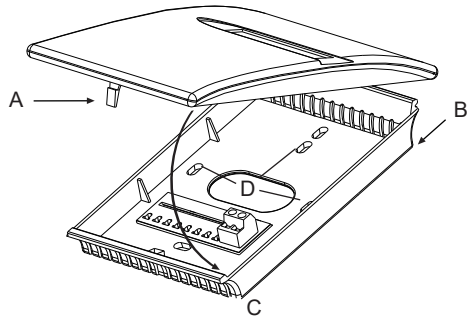


Fig. 10 EE245 enclosure

Opening the enclosure:

Release the front cover by pressing with a screw driver or a pen onto latch **A**.

Closing the enclosure:

Place the edge of the front cover into the **B** notch and rotate it (**C**) till latch **A** snaps in.

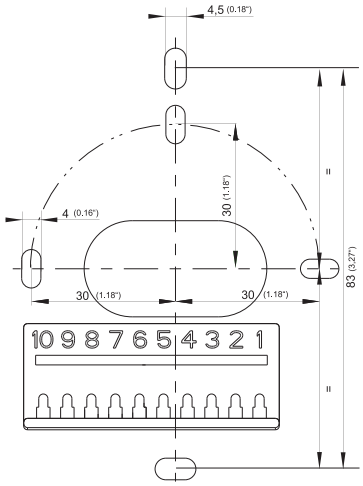


Fig. 11 EE245 wall mounting drill pattern

Installation:

Fix the back cover onto the wall by using the drill pattern (Fig. 11) and appropriate screws (not in the scope of supply).

4.2.5 EE245 Electrical Connctions

The EE245 transmitter can be powered either by 4 x 1.5V, AA / LR6 alkaline batteries (not in the scope of supply) or by external power unit. Select battery or external supply with jumper J1, see Fig. 9.
The external supply unit shall be connected to the screw terminals, see Fig. 12.

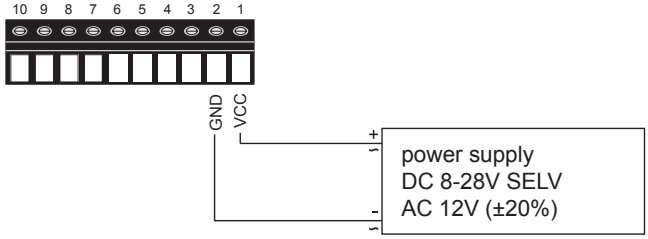


Fig. 12 EE245 screw terminals

4.3 EE244 Router Additional Information

The router is used for extending the transmission range and to bypass obstacles. It can receive and transmit a maximum of 10 signals from other transmitters or routers.

The transmission interval selected with the TIME switch applies only for the transmission of the status information and the measured data of the EE244 router and the probes connected to it. For details refer to chapter 4.2.3.

The receiving and re-transmitting of information from the transmitters and routers connected to it is continuously active.

5 EE240 Network Setup

Please note: A thorough site evaluation at the very start of the project is highly recommended for trouble free setup and commissioning.

The stable and failure free function of the EE240 network, as well as its smooth setup and putting into operation, depends on the topology of the network, which includes the type and the hardware setup (remote probes, remote antennas) of the transmitters and routers, their exact locations and the wireless signal strength at each network component.

A thorough site evaluation is of paramount importance for a performant network design and it shall be done at the very beginning of the project. The site evaluation includes choosing the exact place of each component based on testing the actual strength of the wireless signal (min. 50% strength required for safe operation!) at each location.

Please contact your local E+E representative for assistance with your wireless project, with the site evaluation and the design of the network.

5.1 Hardware Settings

After mounting and wiring the base station as well all the EE244 / 245 transmitters, EE244 routers, EE07 and EE871 sensing probes and antennas, proceed as follows:

1. Power up the base station, the routers and the transmitters. During the initializing time, the display (where available) will shortly show “Init”
2. Establish the wireless connection for each of the transmitters and routers as follows. Please consider that a base station can communicate directly with max. 10 devices. For more devices in the network it is necessary to add routers. Please observe the network topology example in Fig. 1.
   - For operation as *Closed System*: Press and hold for 3 seconds the “CONNECT” button of the EE242 base station. The base station switches to connect mode for 30 seconds, which is indicated by the LED next to the “CONNECT” button.
     For operation as *Open System*: There is no need to press the connect button. The EE242 base station is always in connect mode.
   - If the base station is already connected to a PC and the webserver is open, a count-down is available on the web server.
   - Within the 30 seconds press and hold for 3 seconds “CONNECT” button of the transmitter or router. For a device with display press and hold the “CONNECT” button till the display shows “Conn”.
   - An active wireless connection is indicated on the transmitter / router display by the symbol >< which continuously shows on the optional display.
   - All active wireless connections can be seen on the webserver in the “Transmitters” section, see chapter 6.2.2 Transmitters.
     Please note: For an EE244 transmitter without display, it is highly recommended to use a spare display (or a display from another EE244) just for the setup, see chapter 4.2.3 Operating Components of EE244 and EE245. Beside the indication of the active connection, one can also see if the sensing probes have been recognized by the EE244 and easily check the actual wireless signal strength, see push-button “CONNECT”, chapter 4.2.3.
   - The blinking >< symbol on a transmitter display indicates a poor or fluctuating wireless connection.
   - An active wireless connection is indicated at the base station by the presence of measured data at the analogue outputs or on the optional display.
   - Set the desired transmission interval of each transmitter (default: 5 minutes) using its TIME switch, see chapter 4.2.3 Operating Components of EE244 and EE245.
   - Repeat above procedure for the other transmitter and routers in the network.
3. For a network with more than 10 transmitters: after connecting first 9 transmitters to the base station as described above, establish the wireless connection to a router. Then continue with connecting up to 9 further transmitters as above; these transmitters will connect automatically to the base station through the router. Then connect a second router, and so on.

5.2 Operation of Parallel EE240 Sensor Networks with Overlapping Radio Ranges

Each EE240 wireless network is built around one EE242 base station. Depending on the required transmission range and on the number of transmitters, it may include one or more EE244 routers. All devices are linked directly or indirectly to one dedicated EE242 base station. There may be applications with two or more networks with overlapping radio ranges.

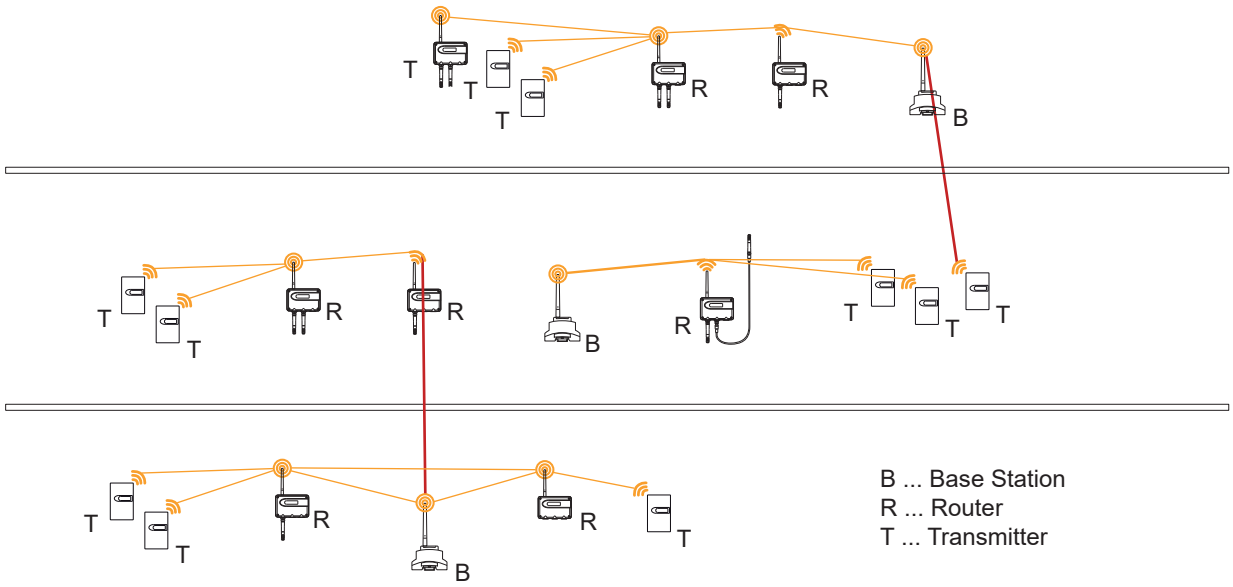


Fig. 13 Unwanted behaviour in parallel networks

Fig. 13 shows three parallel networks divided horizontally which show some unwanted effects within spacially close networks. Each transmitter and router automatically establishes a connection with the most favorable neighbouring node, as it is usual in self-organizing networks. This may lead to an undesired way of establishing a network, where transmitters and routers connect to a base station it should not connect to. This behaviour is indicated by the red connections in Fig. 13. In order to assure logical network separation and assignment of transmitters and routers to one dedicated base station, the network elements must be encoded before shipment.

A site evaluation at the very beginning of the project is therefore highly recommended to clarifiy the details.
Please contact your local E+E representative for assistance.

5.3 Network Reset

To reset the network to the default factory settings, press the push-button “Connect” at the EE242 base station for 10 seconds.

All settings will return to the default factory settings:
IP address of the base station, password of the web server, etc.
All wireless connections with transmitters and routers will be cancelled as well.

6 EE240 Network Configuration

The EE242 base station features a web server with the corresponding options for configuration and setting of network and transmitter parameters. An Ethernet network connection from any personal computer to the EE242 is sufficient for access. There is no need to install any software on the PC. There are also no hard disk space requirements. Administrator rights are required

1. Use the “crossover cable” (PC ⇔ EE242: accessory HA010333) for connecting the PC directly to the EE242. Alternatively, use a switch and two network cables.
2. Connect the EE242 base station with the PC using an Ethernet cable.
3. Set the IP address of the PC for matching the IP address range of the base station.
4. Start any internet browser such as Google Chrome, Internet Explorer or Firefox.
5. Enter the default IP address of the EE242 base station (192.168.0.64) in the browser address line.

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E+E Elektronik® is not liable for any direct or consequential damages (for example, but not restricted to loss of earnings, interruption of business, loss of information and data or any other financial losses), which result from the installation, usage and also impossibility of usage of a software product from E+E Elektronik® and any associated support or non-performance of support.

6.1 Creating an Ethernet Connection between PC and EE242

In order to establish communication between the PC and EE242, the IP address of the personal computer has to be altered to fit the IP address range of the EE242 base station.

IP address default factory settings of the base station:

IP address of EE242 base station:	**192.168.0.64**
Subnet mask:	**255.255.255.0**

IP address setup procedure:

1. STEP:

For example Windows 10: Go to Windows control panel ► Network and Sharing Center ► Change adapter settings ► double-click “Ethernet” (Fig. 14)

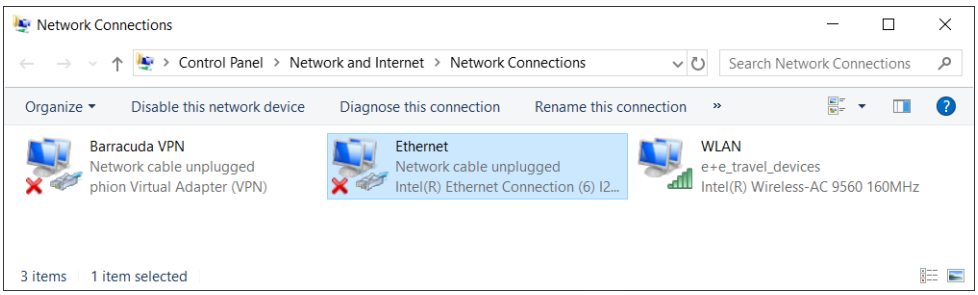
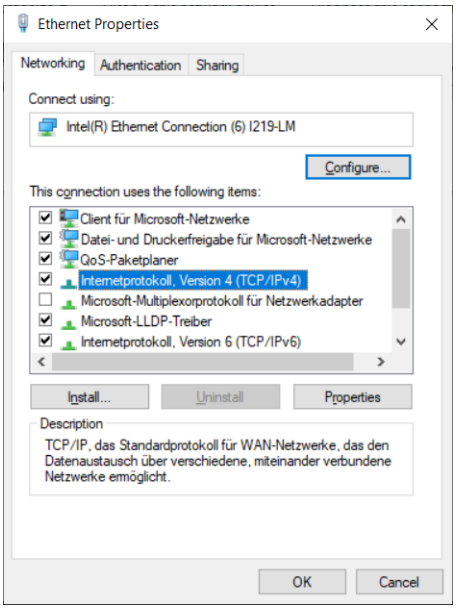
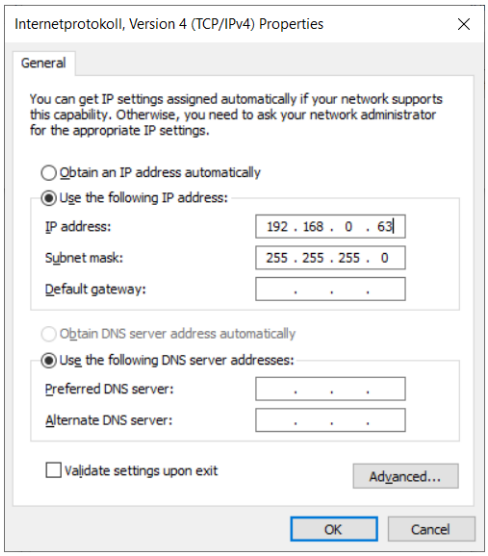


Fig. 14 Windows control panel



In the dialog box “Ethernet Properties” double-click “Internet Protocol, Version 4 (TCP/IP)”.



Check “Use the following IP address” and change the computer IP address to 192.168.0.X (choose X between 33 and 63).

Please note: 192.168.0.64 is already used by EE242!

Enter in the “Subnet Mask” field ‘255.255.255.0’ and click the “OK” button to save the setup.

Fig. 15 Changing the PC‘s IP address

2. STEP:

- Connect the personal computer and EE242 with the “crossover cable” (PC ↔ EE242: accessory HA010333) or connect both EE242 and PC to the same LAN.
- Power up the EE242.
- Start the internet browser and enter the IP address of the base station: http://192.168.0.64
- Enter username and password - the following profiles are set by default:

- Reader:	**username**	**= reader**
	password	**= reader**
- Administrator:	**username**	**= admin**
	password	**= admin**

For security reasons, it is strongly recommended to change the default passwords.

- As soon as the password is entered, the web server platform will start automatically. The network configuration can be set under the menu item “Management”, e.g. the IP address of the EE242 base station or the password for Username “Reader” and “Admin” (for details see chapter 6.2.5 Management).

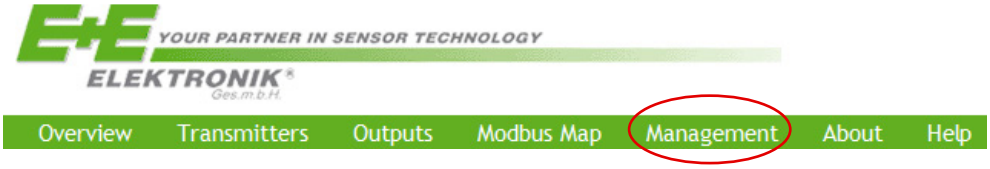


Fig. 16 EE242 web service menu items

6.2 Menu Items

6.2.1 Overview

Shows the overview of the wireless network and its components.

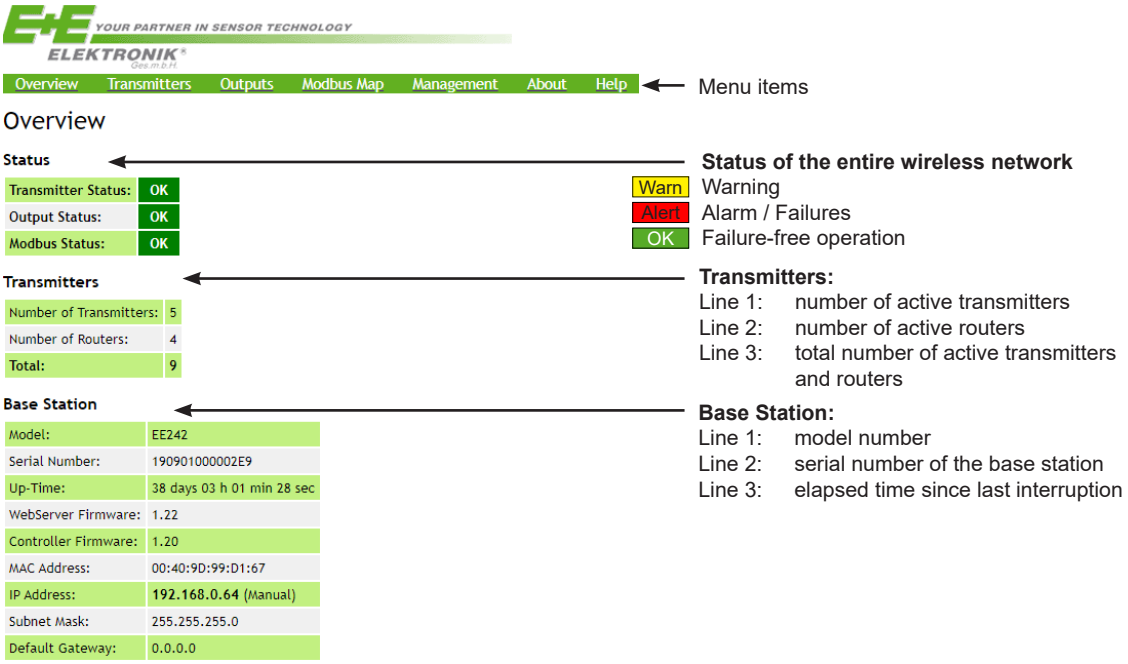


Fig. 17 Menu item “Overview”

The webserver data refresh interval is 5 seconds.

6.2.2 Transmitters

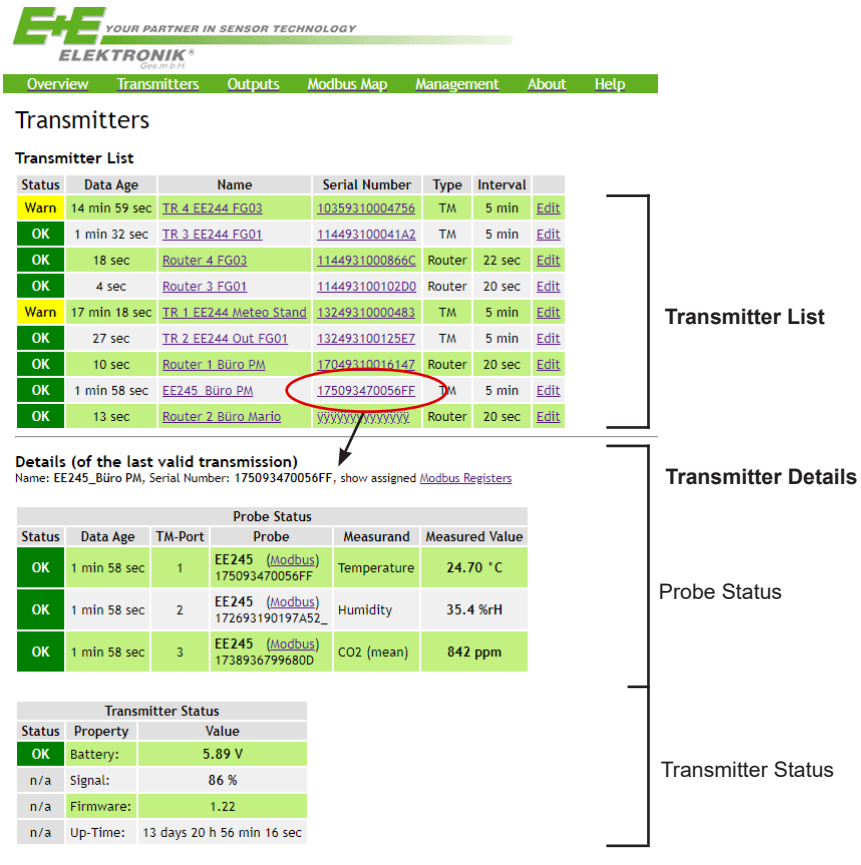


Fig. 18 Menu item “Transmitters” and transmitter details

Transmitter List

Status:

OK / WARNING / ALERT

Meaning of the status information:

OK	The wireless connection works without failures
Warn	The last two data transmissions failed
Alert	Several data transmissions failed

Data Age:

Indicates the time elapsed since the transmission of the last measured data.

Name:

Transmitter name, editable by the user [admin].

Serial Number:

Serial number of the transmitter (factory set).

Type:

- TM = transmitter
- Router = router

Interval:

Indicates the transmission interval.

The transmission interval can be setup with the rotary switch "TIME" (chapter 4.2.3 Operating Components of EE244 and EE245, under 1. Interval rotary switch "TIME") or direct from the web server. The web server overrules the rotary switch.

A newly set transmission interval becomes active after the next data transmission. Example (below): current interval = 30 s, new interval = 10 min.

Transmitter List

Status	Data Age	Name	Serial Number	Type	Interval	
OK	23 sec	EE244_Room31	Test_1004_00003	TM	30 sec (10 min)	Edit

Fig. 19 Transmitter after changed transmission interval

Edit:

Click „Edit" for changing the name and the interval. Save the changes with "Save Changes". To leave the edit menu, click on "Back to Transmitters"

Probe Status

Click the name or the serial number for a pop-up showing the details of the last valid data transmission form that transmitter.

Status:

OK / WARNING / ALERT

TM-Port:

Indicates the port where the sensing probe is connected (see Fig. 20).

Probe:

Type of sensing probe and serial number.

Measurand:

Indicates the active measurand of the sensing probe (Temperature, Humidity, CO_2, ..).

Measured Value:

Latest transmitted measured value.

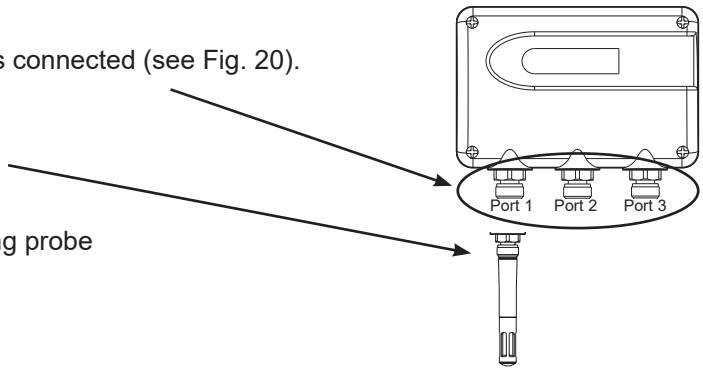


Fig. 20 Transmitter ports

Replacing the RH and / or the CO_2 sensing module of EE245

After replacing the module (see chapter 7.2), the new module is recognized automatically and shows up with its serial number in the „Transmitter Details“. The removed module is removed automatically from „Transmitter Details“.

Replacing the sensing probes of EE244

Procedure:

1. Disconnect the old sensing probe.
2. Connected the new sensing probe.
3. Remove the old sensing probe from the system by clicking “Delete Probe”.

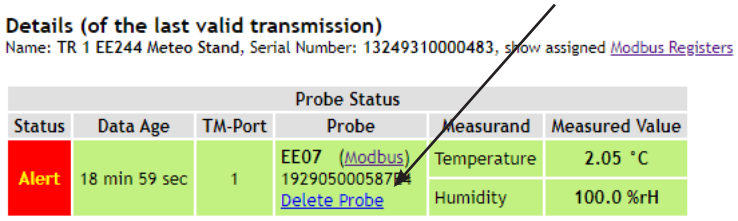


Fig. 21 Probe to be deleted

Transmitter Status

Battery:

Indication of the battery status, resp. “Ext. Power” if power supply is external.

Threshold voltage: > 4.6V OK
4.3 - 4.6V WARNING
< 4.3V ALERT ► failure of the data transmission

Signal:

Indication of the wireless signal strength.

Firmware:

Software version of the transmitter.

Up-Time:

Elapsed time since the last interruption.

6.2.3 Outputs

Outputs

Analog Outputs

Status	Data Age	#	Current Value	Assigned To	Serial Number	Port	Measurand	Unit	Phys. Range	Type	Range	Failsafe Value	
OK	1 sec	1	24.03 °C	Transmitter	gh1003_0001_2346	any	Temperature	°C	0..100 °C	Voltage	0..10 V	0.00 V	Edit
OK	1 sec	2	49.2 %rH	Probe	--- any ---	n/a	Humidity	%rH	0..100 %rH	Voltage	0..10 V	0.00 V	Edit
OK	infinite	3	n/a	Probe	--- any ---	n/a	--- No Measurand ---	n/a	0..10000 n/a	Voltage	0..10 V	0.00 V	Edit

Fig. 22 List of analogue outputs

Each analogue output can be configured by clicking on “Edit”

In general there are two methods to map a measurement signal to an analogue output:

(a) Mapping a certain port ‘X’ of a transmitter ‘Y’ to an analogue output: This configuration always maps the measured data of port ‘X’ to the output. In addition, it does not matter if the sensing probe is replaced by another one of the same type (e.g. calibration cycle or replacement of probe).

(b) Mapping a specific sensing probe (with a defined serial number) to an analogue output: This configuration maps ONLY this specific sensing probe to the analogue output. It does not matter to which transmitter the sensing probe is a connected.

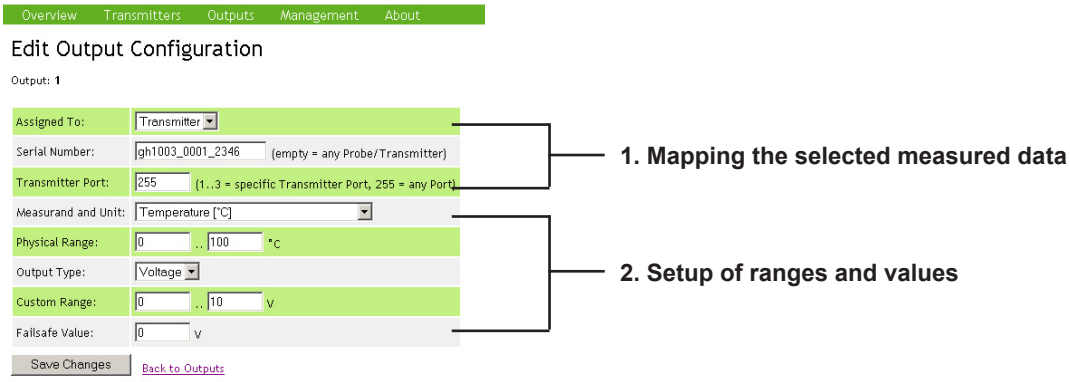


Fig. 23 Options for editing the output configuration

1. Mapping the selected measurement signal:

Example (a): "Mapping an EE07 sensing probe at port 2 of the transmitter '10045689788'
Assigned to: Select "Transmitter".
Serial Number: Enter the serial number of the desired transmitter or copy and paste it from the transmitter list (see section "Transmitter List" in chapter 6.2.2).
Transmitter Port: Select the transmitter port (see section "Probe Status" in chapter 6.2.2, under "TM-Port") to which the sensing probe is connected (Port 1, 2 or 3, resp. 255, if only one port is occupied, but the port number is unknown).

Example (b): "*Mapping an EE07 sensing probe with serial number 0909500001055D*"
Assigned to: Select "Probe".
Serial Number: Enter the serial number of the sensing probeor copy and paste it from the "Transmitter Details" of the transmitter list see chapter 6.2.2 Transmitters.
Transmitter Port: Enter "255".

2. Setup of ranges and values:

Measurand and Unit: Selected desired measurand (T, RH …).

Physical Range: Enter desired range and unit of the measurand (e.g. 0 ...100 °C).

Output Type: Indicates the physical output quantity (factory setting according to order code).

Custom Range: Analogue output value, to represent the "Physical Range" as indicated above.

Failsafe Value: Analogue output value in case of failure / alarm.

6.2.4 Modbus Map

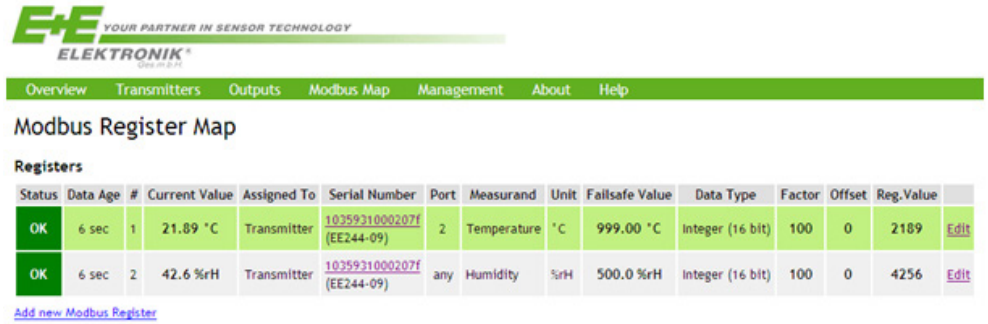


Fig. 24 List of Modbus registers

Click on the link "Add new Modbus Register" to create new registers / variables. The Edit Modbus Register Configuration dialogue will open.

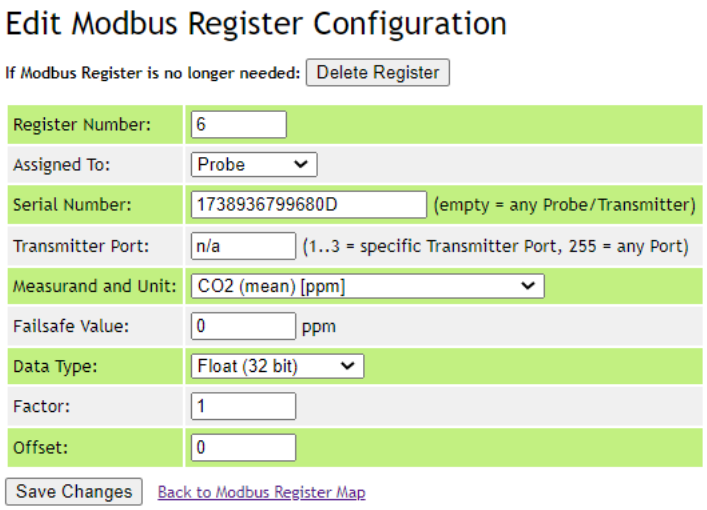


Fig. 25 Options for creating a new Modbus register

Register Number: Is incremented automatically and can be changed manually.

Assigned to: Select whether a sensing probe or a transmitter will be mapped to the register. (Details see 6.2.3 Outputs → Mapping the selected measurand)

Serial Number: Type in the serial number of the probe or transmitter or copy and paste from the transmitter list (see chapter 6.2.2)

Transmitter Port: Type in transmitter port (see chapter 6.2.2)

Measurand / Unit: Select measurand and unit.

Failsafe Value: Set the output value in case of (transmission) error/alarm.

Data Type: Select data type (Float, Integer,..)

Factor: Set the multiplication factor for the register value (Reg.Value = Current Value * Factor)

Offset: Set the offset for the register value (Reg.Value = Current Value * Factor + Offset)

Create Register: The register will be created with the selected configuration.

Deleting registers:
Click the “Edit“ link in the “Modbus Register Map“ list to change the configuration of any register.
Click the button “Delete Register“ to delete the selected register.

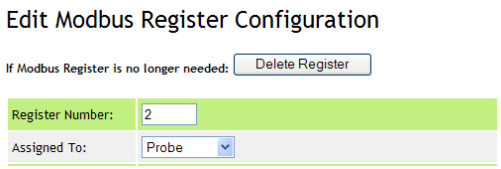


Fig. 26 Deleting a register

Basic Modbus settings:

Main menu ► Management ► Modbus:

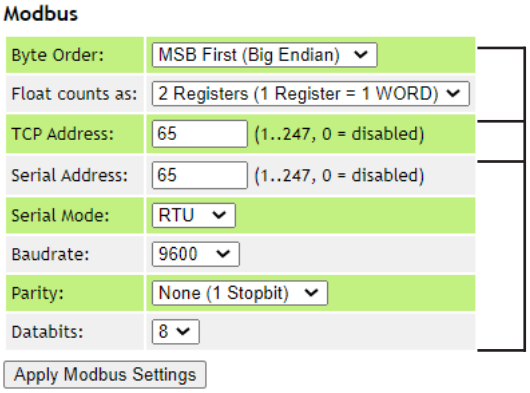


Fig. 27 Basic Modbus settings

Byte Order: MSB First (Big Endian)
LSB First (Little Endian)

Float counts as: 1 Register used for Integer 16 bit and Unsigned Integer 16 bit
2 Registers used for Float 32 bit

TCP Address: Slave ID for Modbus TCP communication; set to 0 to disable the protocol

Serial Address: Slave ID for Modbus RTU communication; set to 0 to disable the protocol

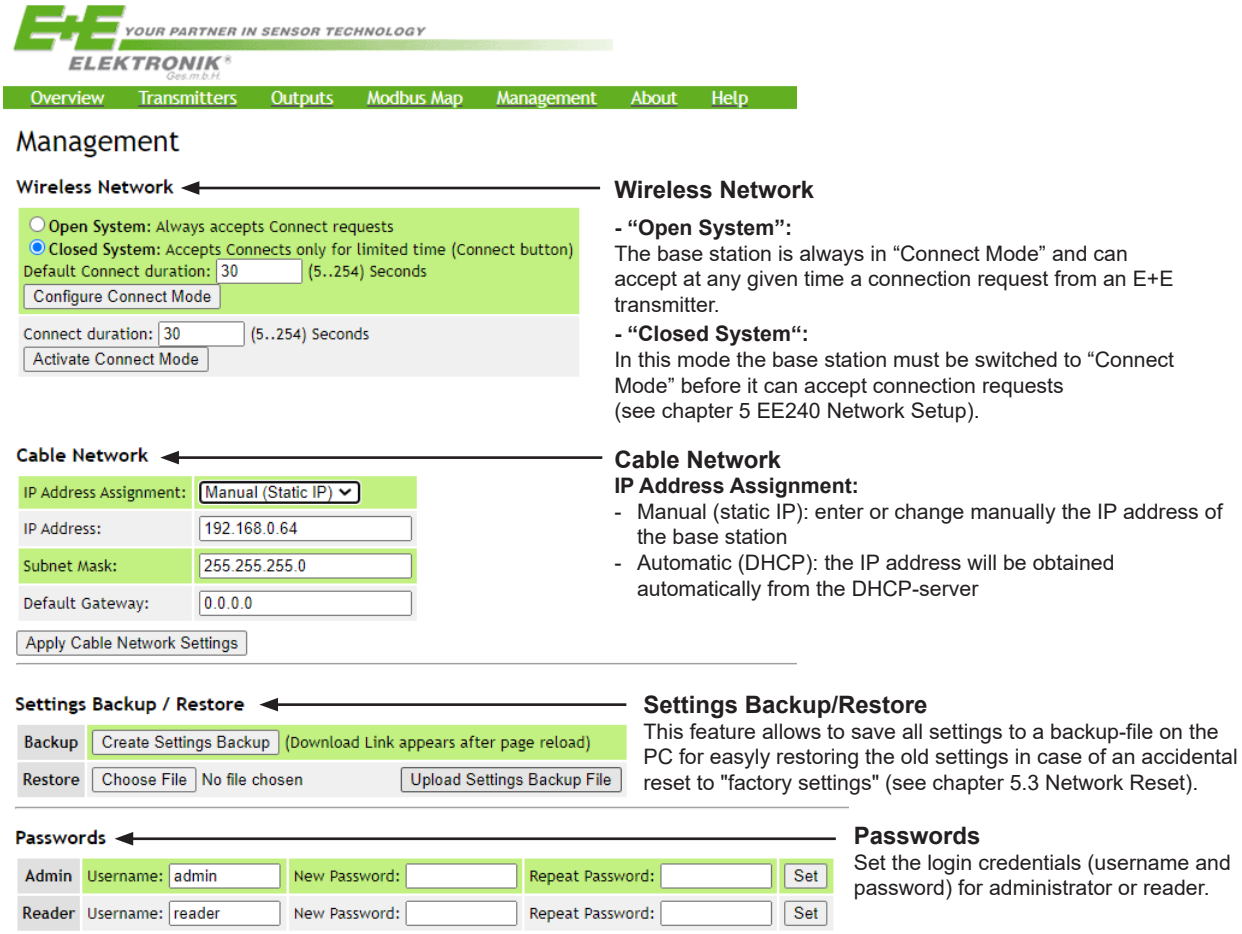
Serial Mode: RTU or ASCII

Baudrate: 9 600, 19 200, 38 400 or 57 600

Parity: Even, Odd, None (1 Stopbit) or None (1 Stopbits)

Databits: 7 or 8

6.2.5 Management



Wireless Network

- "Open System":
The base station is always in "Connect Mode" and can accept at any given time a connection request from an E+E transmitter.

- "Closed System":
In this mode the base station must be switched to "Connect Mode" before it can accept connection requests (see chapter 5 EE240 Network Setup).

Cable Network

IP Address Assignment:
- Manual (static IP): enter or change manually the IP address of the base station
- Automatic (DHCP): the IP address will be obtained automatically from the DHCP-server

Settings Backup/Restore

This feature allows to save all settings to a backup-file on the PC for easyly restoring the old settings in case of an accidental reset to "factory settings" (see chapter 5.3 Network Reset).

Passwords

Set the login credentials (username and password) for administrator or reader.

Fig. 28 Network management

6.2.6 About

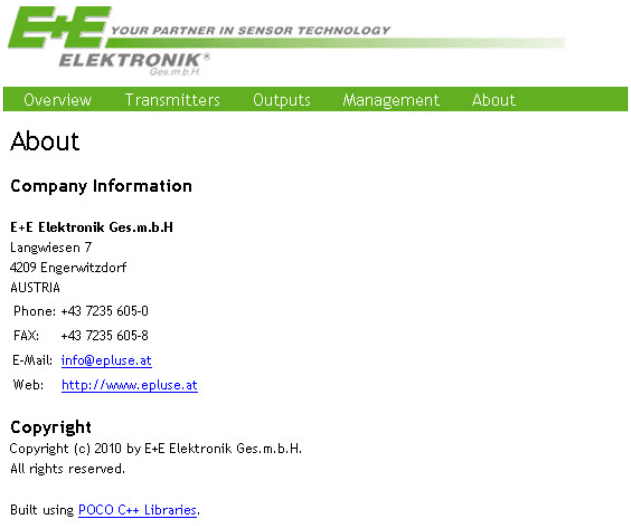


Fig. 29 About E+E Elektronik

7 Adjustment and Calibration

Definitions

Adjustment:
The specimen is brought in line with the reference.

Calibration:
The specimen is compared with a reference and its deviation from the reference is documented.

7.1 Calibration and Adjustment of the Sensing Probes

Depending on the application and the requirements of certain industries, there might arise the need for periodical probe calibration or adjustment.

7.1.1 Calibration and Adjustment at E+E

Calibration and/or adjustment can be performed in the E+E Elektronik calibration laboratory. Return the sensing probes for adjustment and calibration at E+E. Please see www.kalibrierdienst.at for information on the scope of calibration and contact your E+E local sales representative for advice.

7.1.2 User Adjustment and Calibration

E+E Elektronik provides qualified references for RH, T, and CO_2 probe calibration:

- E+E Humidity Calibrator Humor 20, please see the data sheet at www.epluse.com/humor20
- Humidity Calibration Kit, please see data sheet at www.epluse.com/EE07
- Calibrated salt solutions, please see “Calibration Kit - User Guide“ at www.epluse.com/EE07
- Hand-held instrument for various measurands, please find details at www.epluse.com/omniport30

Please contact your E+E local sales representative for further information.

7.2 Replacement and Maintenance of the Sensing Probes for EE244

Replacement:
For replacement probes see the EE07 and EE871 data sheets at www.epluse.com/EE240.

Maintenance:
The filter cap of EE07 RH/T and of EE871 shall be replaced as needed with an E+E original one. A polluted filter cap causes longer response time.

7.3 Cleaning of the Sensing Head of the EE07 RH/T Probe

Use in polluted environment might arise the need for cleaning the sensing head and replacing the filter cap. In such a case please see “Cleaning Instructions” at www.epluse.com/EE240.

7.4 Replacement of the RH and of the CO_2 Measuring Module of EE245

The RH and the CO_2 modules of the EE245 are pluggable and can be easily replaced if needed, such as in case of drift caused by polluted and aggressive environment.

Replacement procedure:

- Open the EE245 enclosure, see chapter 4.2.4 EE245 Mounting
- Power off the EE245 by removing one battery, if battery powered.
- Carefully remove the module by pulling it straight upward off the main electronics board, see Fig. 9.
- Plug in the replacement module. Take good care to not bend or break the connecting pins.
- Power on the EE245 and close the enclosure, see chapter 4.2.4

7.5 Functional Test for the EE244 and the entire EE240 Wireless Sensor Network

A test of correct function and accuracy of the wireless network can be easily performed with the optional reference probes, see accessories in the EE240 data sheet. The reference probes supply fix values for RH and T. Simply plug the reference probe instead of any sensing probe of EE244 and check the indication on the transmitter display or / and the data received by the base station.

7.6 Loop Calibration

The RH and T loop calibration as recommended by the FDA for the pharmaceutical, biotech, food and beverage industries, can be easily performed with separate EE07 RH and T sensing probes. For information on the high accuracy E+E humidity calibrator Humor 20 please see the data sheet at www.epluse.com/humor20.

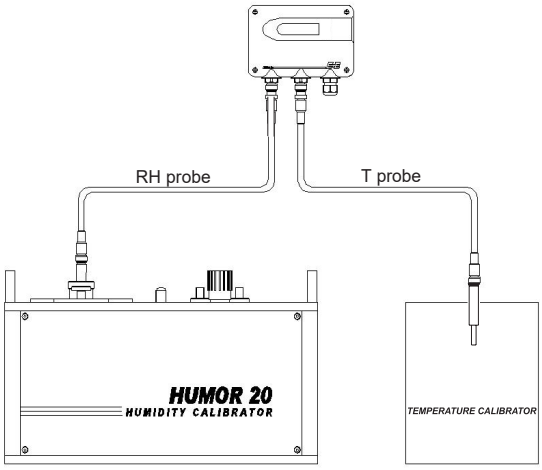


Fig. 30 Loop calibration with Humor 20

8 Troubleshooting

Error	Possible cause → Action / Correction
Transmitter failure	• Supply failure → Check the external supply or the batteries. If the batteries are replaced within 7 days after the failure, the communication will be automatically reestablished. If the batteries are replaced after more than 7 days, it is sufficient to press the push-button “Connect” at the base station to restore the connection.
Failure of the wireless connection	• Supply failure → Check the external supply or the batteries. • Newly erected obstacles (metal structures …) attenuate the wireless signal → Bypass the obstacles utilizing additional router(s).
Forgot password	• Reset the base station E242 to the default factory settings (IP address, password) see chapter 5.3 Network Reset

9 Spare Parts

For replacement sensing probes and their accessories see the data sheets EE07 and EE871 at www.epluse.com/EE240.

For replacement filer caps for the probes please also see data sheet accessories at www.epluse.com/EE240.

RH measurement module for EE245		EE99-012
CO_2 replacement module for EE245	0...2000 ppm	EE893-02C2
	0...5000 ppm	EE893-05C2
Display and front cover for EE244		D07W

10 Technical Data

EE242 Base Station

Digital interface / protocol	Ethernet / Modbus TCP or JSON RS485 / Modbus RTU / ASCII
Analogue outputs	0 - 5 V -0 < I_L < 0.5 mA 0 - 10 V -0 < I_L < 1 mA 0 - 20 mA / 4 - 20 mA R_L < 500 Ω
Number of analogue outputs	4
Accuracy of analogue outputs	±5 mV resp. ±10 µA
Temperature dependence of analogue outputs, max.	0.1 $\frac{mV}{°C}$ resp. 1 $\frac{\mu A}{°C}$
Resolution of analogue outputs	0.7 mV resp. 1.5 µA
Working and storage temperature range	-30...+50 °C (-22...122°F) -20...+50 °C (-4...122°F) with display
Power supply class III	24 V AC/DC ±20%, USA & Canada: class 2 supply required
Electrical connection	Screw terminals max. 2.5 mm²
Current consumption, typ. max.	I_L = 150 mA at 24V DC; I_L = 180 mA at 24V DC
Enclosure material	Polycarbonate (PC)
Protection rating enclosure	IP20

EE244 Transmitter and Router

Max. number of measurands	6 (battery powered) 4 (external supply)
Max. number of sensing probes	3 (battery powered) 2 (external supply)
Working and storage temperature range	-40...+50 °C (-40...122 °F) -20...+50 °C (-4...122 °F) with display
Working temperature range of probes	Refer to data sheet of respective probe
Battery supply with EE244-AF6x	4x1.5 V AA[1] (not in the scope of supply)
External supply with EE244-AFxE9x[2] class III	8 - 28 V DC, USA & Canada: class 2 supply required
Current consumption with external supply, typ. max.	I_L = 20 mA at 24 V DC I_L = 35 mA at 24 V DC
Enclosure material	Polycarbonate (PC)
Protection rating enclosure	IP65 / NEMA 4X

EE245 Room Transmitter

Accuracy		
	T:	±0.3 °C (at 20 °C) / ±0.4 °C (20...55 °C)
at 23 °C (73 °F)	RH:	±3 % (30...70 %) / ±5 % (70...90 %)
at 25 °C (77 °F) and 1013 mbar	CO_2:	2000 ppm (< ±50 ppm + 2 % of m.v.) 5000 ppm (< ±50 ppm + 3 % of m.v.) m.v. = measured value
Antenna		Internal
Working and storage conditions		-5...+55 °C (23...131 °F) / 0...90 %RH (non-condensing)
Battery supply		4x1.5 V AA[2] (not in the scope of supply)
External power supply class III		8 - 28 V DC / 12 V AC (±20%), USA & Canada: class 2 supply required
Electrical connection		Screw terminals 1.5 mm²
Enclosure material		Polycarbonate (PC)
Protection rating		IP30

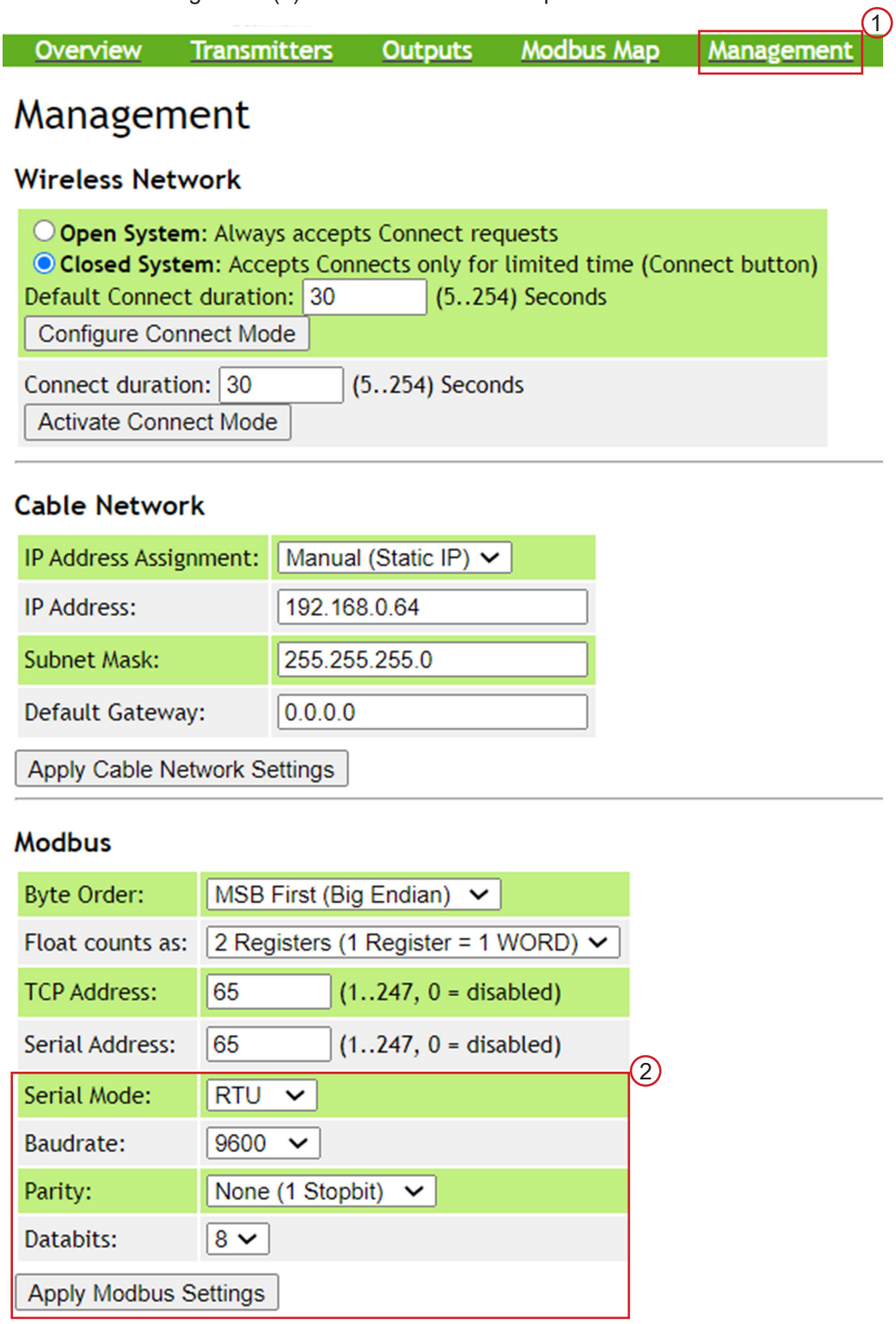
General

Transmission frequency	2.4 GHz
Transmission standard	IEEE 802.15.4
Transmission power	8 dBm
Transmission range	Up to 60 m (197 ft) indoors, up to 1000 m (3300 ft) in open field
Approval	ETSI / FCC Part 15.247 / IC
Electromagnetic compatibility	EN 61326-1 Industry FCC Part 15 Class A EN 61326-2-3 Industry ICES-003 Class A

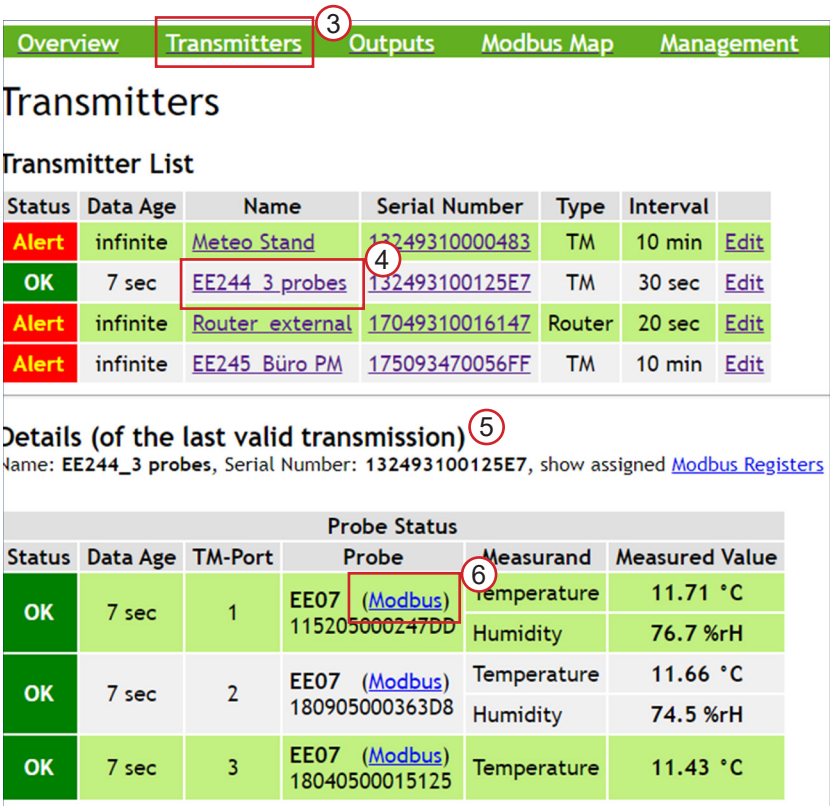
1) Battery lifetime > 1 year with a measuring data transmission every 5 min. (for T / RH)
2) Choice between batteries and external power supply via jumper on the electronics board for EE244-AF6E9x possible

11 Annex A: Setting the Modbus Communication in an EE240 Wireless Sensor Network

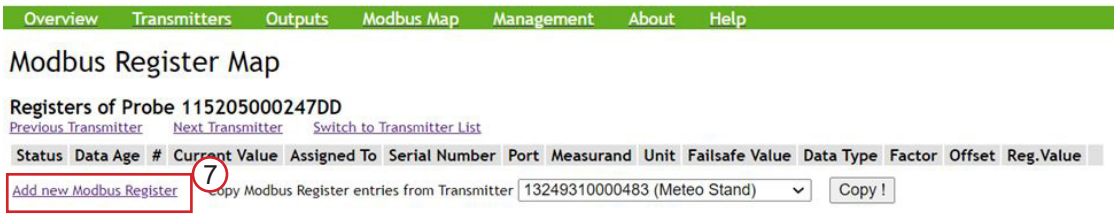
In the menu Management (1) set the communication parameters for the serial RS485 interface (2)



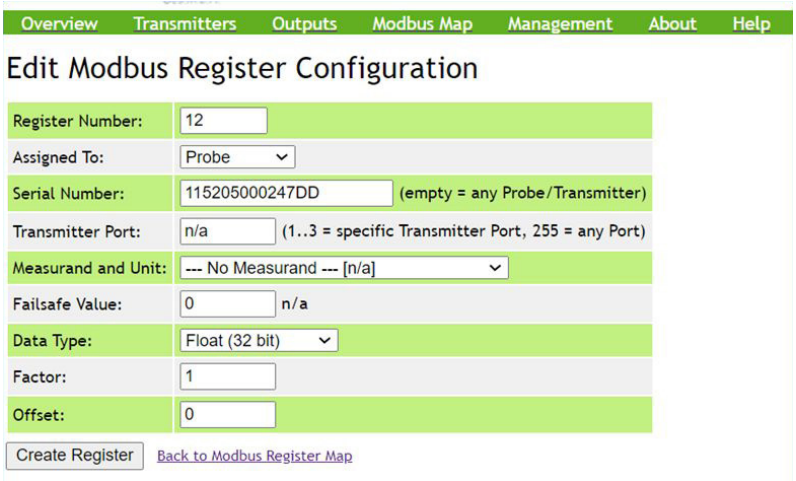
The Transmitters menu (3) shows all the transmitters connected to the base station.
In the example shown below, the green one is active. The others in red are offline at the moment of screen capture.
By clicking on the transmitter name (4), the available sensors in the transmitter (5) appear.



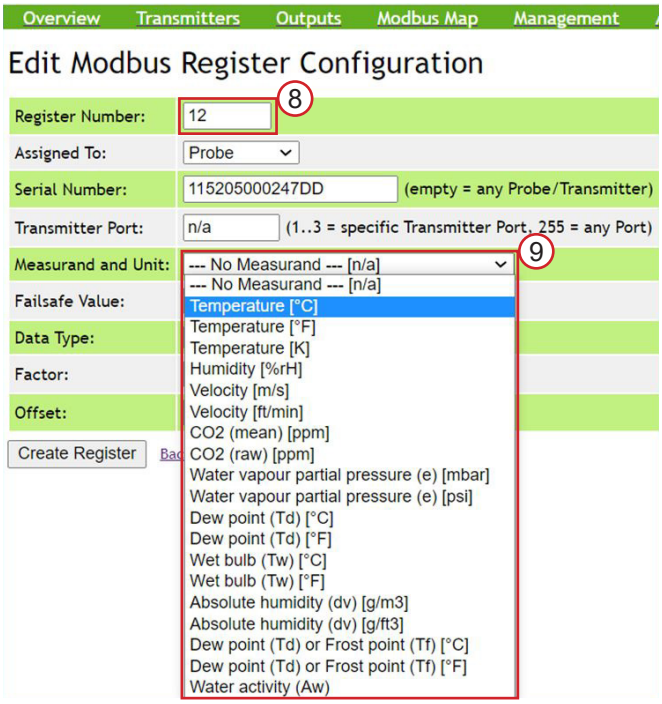
By clicking on the Modbus link of the desired sensor (6), the Modbus Register Map page appears. Click on the link Add new Modbus Register (7)



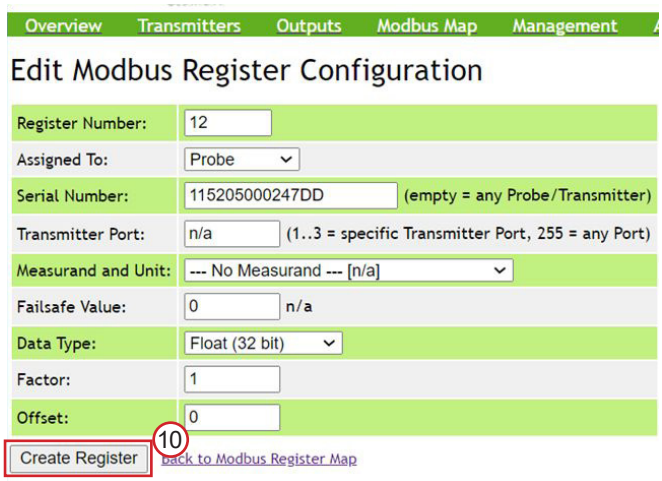
The Edit Modbus Register Configuration dialogue appears and the parameters of the register can be set. The system automatically assigns the Register Number and other default parameters, all these values can be changed according to user preferences as described below.

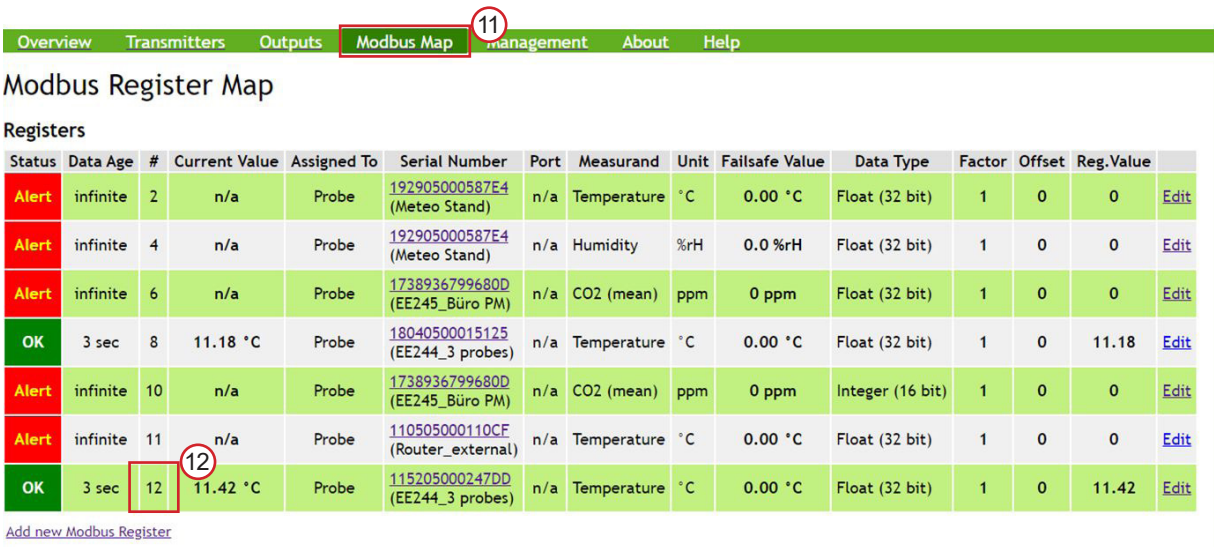


Assign to the register (8), in this case the Register number #12, the desired measureand. Choose the parameter (9), e.g. temperature in °C.

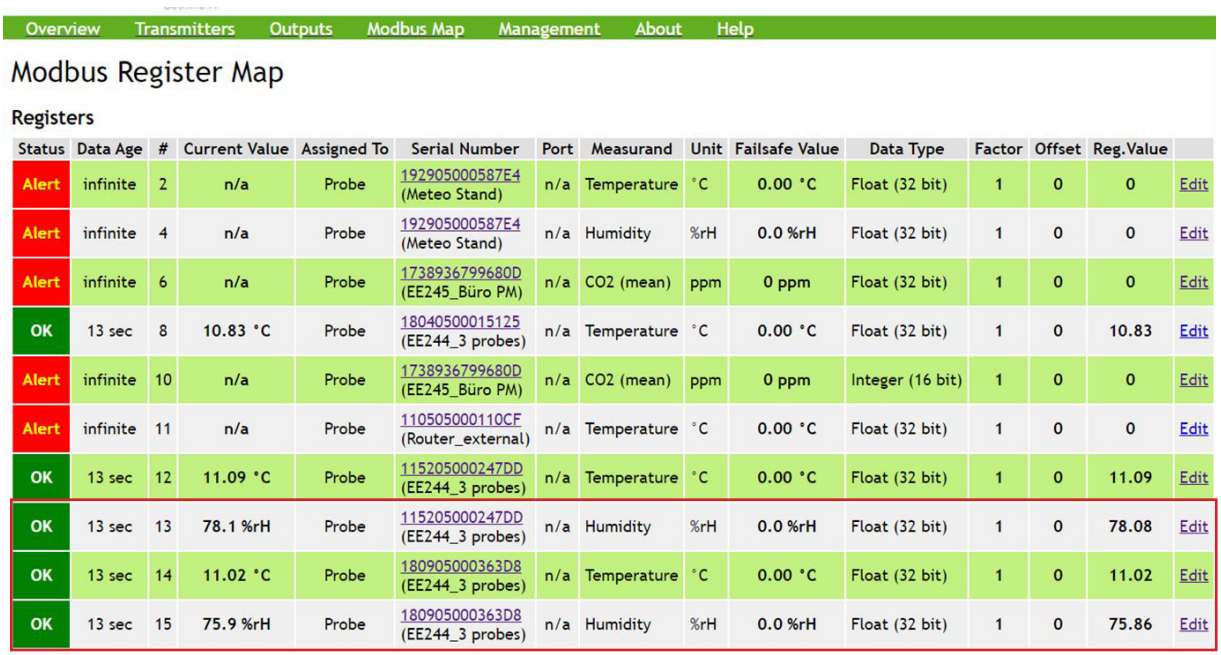


By clicking on Create Register (10), the register setup is saved and available for reading.
The newly created register appears in the Modbus Map page (11) (12).

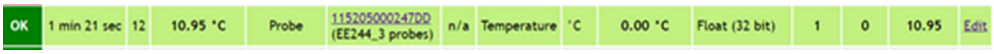




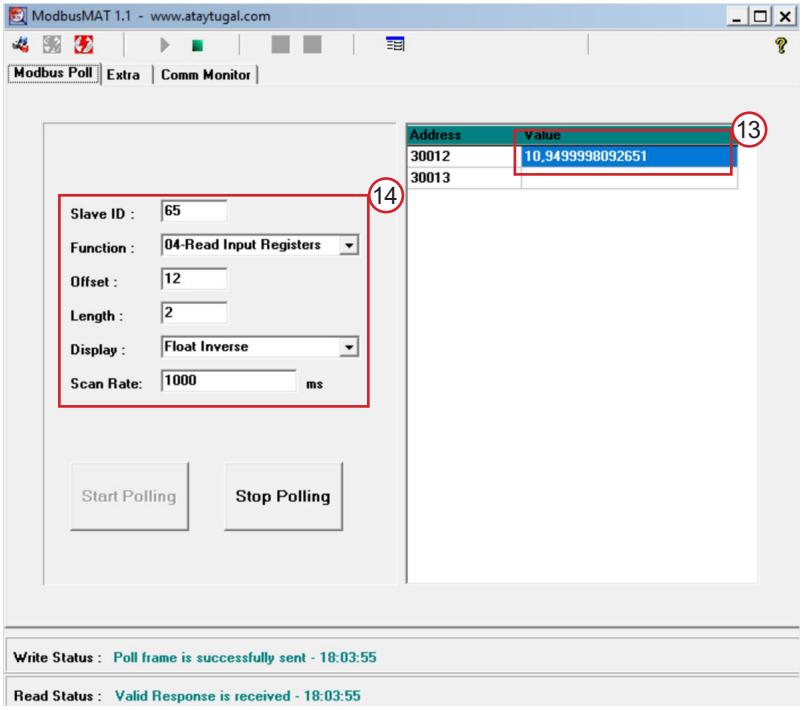
Repeat the procedure described above to create further registers (e.g. # 13, 14, 15) with other measurands from other transmitters/probes:



Example of data reading from register #12:

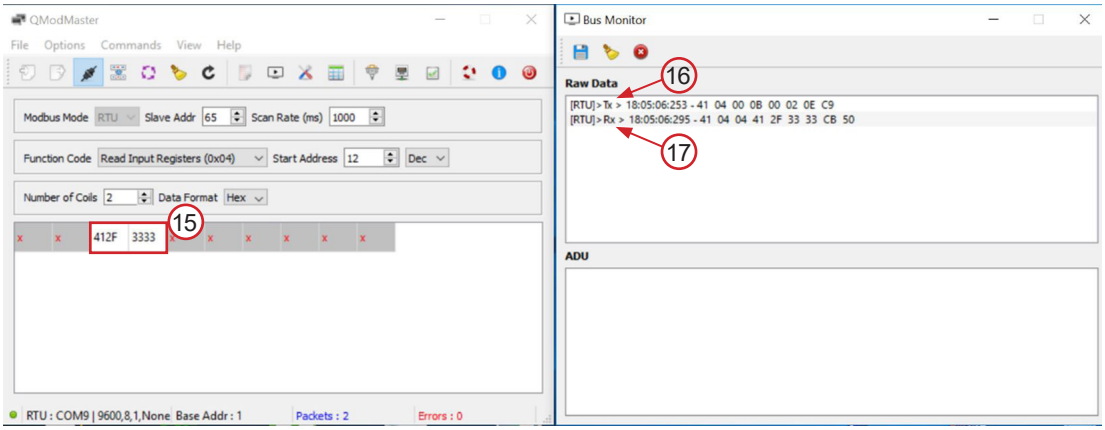


A common Modbus program (e.g. “ModbusMAT”, free download from https://modbus-rtu-server.software.informer.com/1.1/) shows the decoded value (13).
The following screenshot shows the settings (14).

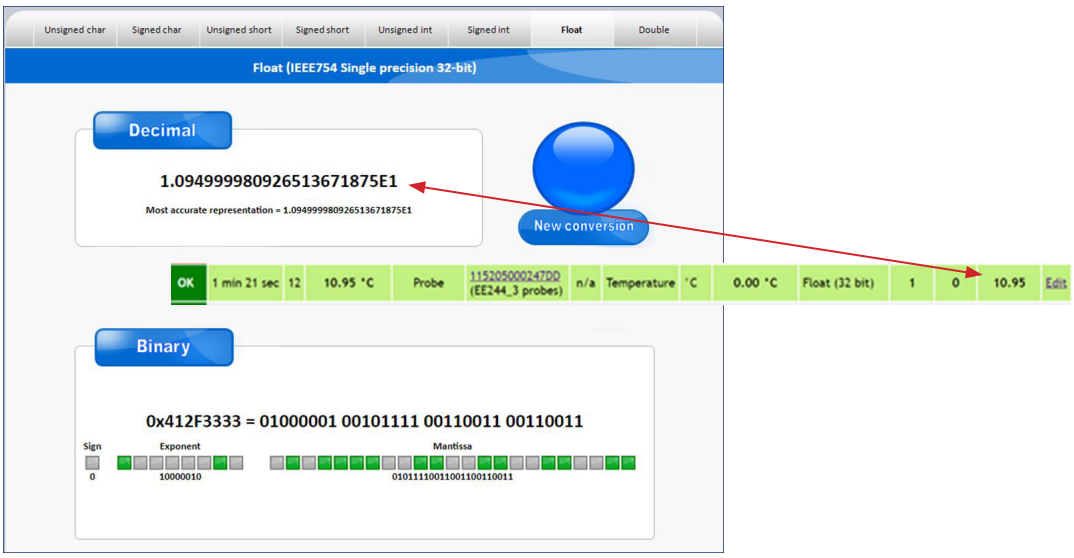


With this software, in the menu “Comm Monitor” it is possible to monitor the activity on the serial communication (the string sent and received).

Other freely available software programs allow for reading the registers in raw hex format (e.g. QModMaster, free download from: https://sourceforge.net/projects/qmodmaster/)
The bus monitor shows the commands sent (Tx, 16) and received (Rx, 17):



The byte order is set in the Management menu: MSB first (Big Endian).
The register has been set as Data Type: Float (32 bit), menu Edit Modbus Register Configuration (page 2).
The received bytes 412F 3333 are decoded according the IEEE754 standard which results in a value of 10.949998.
An online converter can be found at http://www.binaryconvert.com/convert_float.html.



12 Annex B: Modbus Reading Examples

12.1 Modbus RTU, Reading a Temperature of 18.87 °C (Float 32 bit) from Register #2

Modbus Register Map

Registers

Status	Data Age	#	Current Value	Assigned To	Serial Number	Port	Measurand	Unit	Failsafe Value	Data Type	Factor	Offset	Reg.Value	
OK	2 min 40 sec	2	18.87 °C	Probe	192905000587E4 (Meteo Stand)	n/a	Temperature	°C	0.00 °C	Float (32 bit)	1	0	18.87	Edit
OK	2 min 40 sec	4	77.4 %rH	Probe	192905000587E4 (Meteo Stand)	n/a	Humidity	%rH	0.0 %rH	Float (32 bit)	1	0	77.37	Edit

The data is encapsulated according the Modbus standard described in the Modbus Application Note AN0103 (available at www.epluse.com/EE240), with the command line listed below to be sent for reading the temperature at register #2 of slave ID 65 (hex 41).

3 Packet format for read function codes 0x03 and 0x04

Request:

Modbus Address	Function Code	Communication Address HB	Communication Address LB	Quantity of Registers HB	Quantity of Registers LB	CRC LB	CRC HB
YY	03, 04	YY	YY	YY	YY	CC	CC

41	04	00	01	00	02	2E	CB

Register 01, counted from 0, means register #2 (number set in the EE240 webserver)

Response if byte order is MSB first:

Modbus

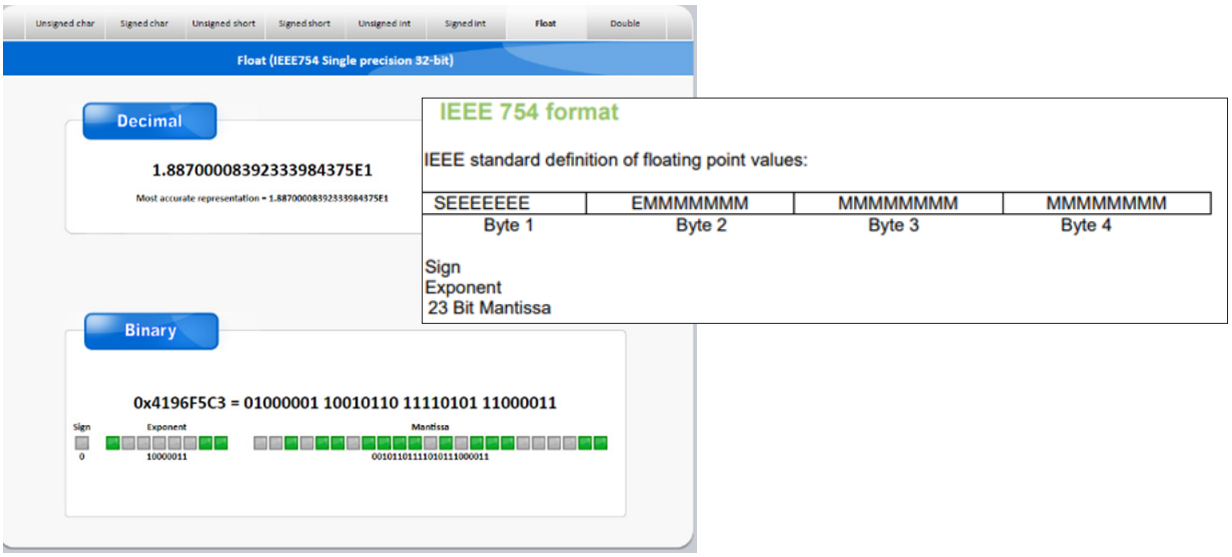
Byte Order:	MSB First (Big Endian)
Float counts as:	2 Registers (1 Register = 1 WORD)
TCP Address:	65 (1..247, 0 = disabled)
Serial Address:	65 (1..247, 0 = disabled)

Response from the E+E Modbus device:

Modbus Address	Function Code	Byte Count	2 Registers (4 Byte)				CRC LB	CRC HB
YY	03	04	YY	YY	YY	YY	CC	CC

41	04	04	41	96	F5	C3	49	51

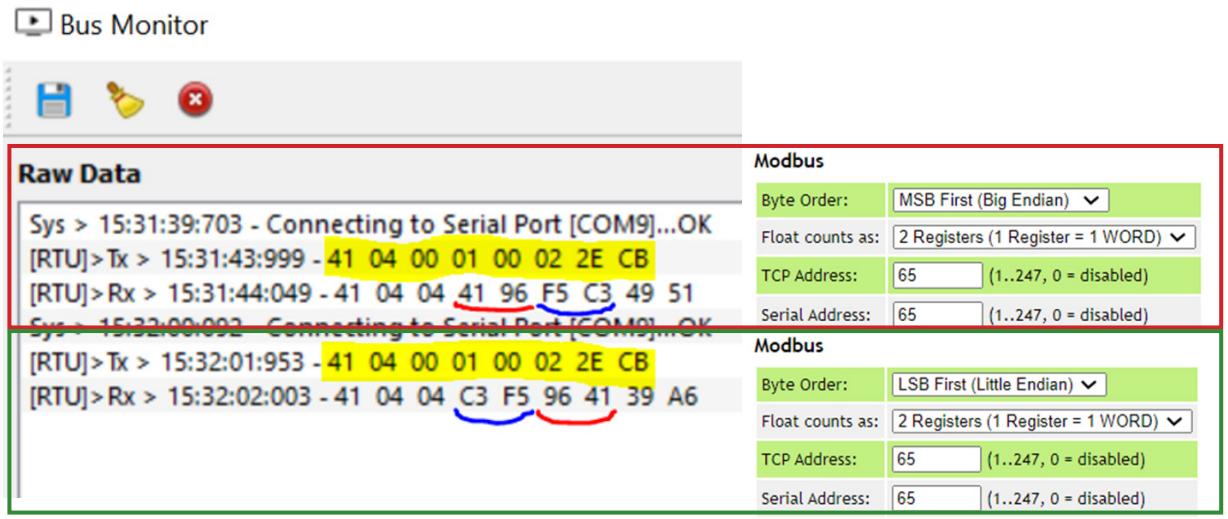
Decoding the 4 bytes (41 96 F5 C3) according the IEEE754 format results in 18.870000 °C



Please note: In the EE240, the Byte pairs 3 and 4 are not inverted with the byte pairs 1 and 2. So for decoding, the sentence in chapter 7.2 of AN0103 is not valid!

Effect of byte order change (Main menu ► Management ► Modbus):
The request is the same (marked yellow, see below), but the response is different according the selection of the Modbus byte order: MSB first (Big Endian) is the normal way. For decoding, the inversion of bytes pair is not necessary (41 96 F5 C3)

If LSB first (Little Endian) is selected, not only the byte pairs 1,2 /3,4 are inverted, but also the position of byte 1,2 and 3,4 are swapped. So inversion of byte order and position is required for correct decoding (41 96 F5 C3).



12.2 Modbus TCP, Reading a Temperature of 18.97 °C (Float 32 bit) from Register #2

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Overview | Transmitters | Outputs | Modbus Map | Management | About | Help

Modbus Register Map

Registers

Status	Data Age	#	Current Value	Assigned To	Serial Number	Port	Measurand	Unit	Failsafe Value	Data Type	Factor	Offset	Reg.Value	
OK	0 sec	2	18.97 °C	Probe	192905000587E4 (Meteo Stand)	n/a	Temperature	°C	0.00 °C	Float (32 bit)	1	0	18.97	Edit
OK	0 sec	4	74.5 %rH	Probe	192905000587E4 (Meteo Stand)	n/a	Humidity	%rH	0.0 %rH	Float (32 bit)	1	0	74.5	Edit

The data is encapsulated according the Modbus standard described in AN0103, with the command line listed below to be sent for reading the temperature from register #2 of slave ID 65 (hex 41).

3 Packet format for read function codes 0x03 and 0x04

Request:

Modbus Address	Function Code	Communication Address HB	Communication Address LB	Quantity of Registers HB	Quantity of Registers LB
YY	03, 04	YY	YY	YY	YY

41	04	00	01	00	02

Register 01, counted from 0, means register #2 (number set in the EE240 webserver)

Response if byte order is MSB first (there is no CRC):

Modbus

Byte Order:	MSB First (Big Endian)
Float counts as:	2 Registers (1 Register = 1 WORD)
TCP Address:	65 (1..247, 0 = disabled)
Serial Address:	65 (1..247, 0 = disabled)

Response from the E+E Modbus device:

Modbus Address	Function Code	Byte Count	2 Registers (4 Byte)			
YY	03	04	YY	YY	YY	YY

41	04	00	41	97	C2	8F

Decoding the 4 bytes (41 97 C2 8F) according the IEEE754 format results in 18.969999 °C

Unsigned char | Signed char | Unsigned short | Signed short | Unsigned int | Signed int | Float | Double

Float (IEEE754 Single precision 32-bit)

Decimal

1.896999931335449218 75E1

Most accurate representation – 1.896999931335449218 75E1

Binary

0x4197C28F = 01000001 10010111 11000010 10001111

Sign | Exponent | Mantissa

0 | 10000011 | 00101111100001010001111

7.1 IEEE 754 format

The IEEE standard definition of floating point values:

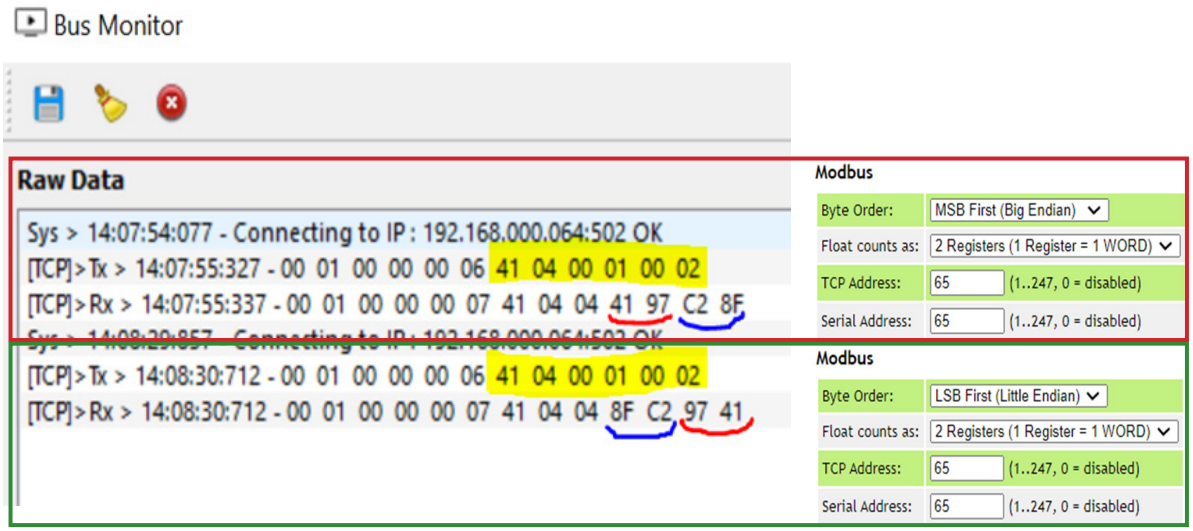
SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM
Byte 1	Byte 2	Byte 3	Byte 4

S ... Sign
E ... Exponent
M ... 23 Bit Mantissa

Please note: In the EE240, the Byte pairs 3 and 4 are not inverted with the byte pairs 1 and 2.
So for decoding, the sentence in chapter 7.2 of AN0103 is not valid!

Effect of byte order change (Main menu ► Management ► Modbus):
The Tx is the same (marked yellow, see below), but the response is different according the selection of the Modbus byte order: MSB first (Big Endian) is the normal way. For decoding, the inversion of bytes pair is not necessary (41 97 C2 8F)

If LSB (Little Endian) is selected, not only the byte pairs 1,2 /3,4 are inverted, but also the position of byte 1,2 and 3,4 are swapped. So inversion of byte order and position is required for correct decoding (41 97 C2 8F).



Important note for communication via Modbus TCP:
After reading a value, the connection must be closed before reading the next one.

HEADQUARTERS

E+E Elektronik Ges.m.b.H.
Langwiesen 7
4209 Engerwitzdorf
Austria
Tel.: +43 7235 605-0
E-mail: info@epluse.com
Web: www.epluse.com

SUBSIDIARIES

E+E Elektronik China
18F, Kaidi Financial Building,
No.1088 XiangYin Road
200433 Shanghai
Tel.: +86 21 6117 6129
E-mail: info@epluse.cn

E+E Elektronik France
47 Avenue de l'Europe
92310 Sèvres
Tel.: +33 4 74 72 35 82
E-mail: info@epluse.fr

E+E Elektronik Germany
Obere Zeil 2
61440 Oberursel
Tel.: +49 6171 69411-0
E-mail: info@epluse.de

E+E Elektronik Italy
Via Alghero 17/19
20128 Milano (MI)
Tel.: +39 02 2707 86 36
E-mail: info@epluse.it

E+E Elektronik Korea
Suite 2001, Heungdeok IT
Valley Towerdong, 13,
Heungdeok 1-ro, Giheung-gu
16954 Yongin-si, Gyeonggi-do
Tel.: +82 31 732 6050
E-mail: info@epluse.co.kr

E+E Elektronik USA
333 East State Parkway
Schaumburg, IL 60173
Tel.: +1 847 490 0520
E-mail: office@epluse.com