

# Radioline + EMpro Modbus communication

## Wireless data transmission between EMpro and Radioline

Quick Reference Guide

QRG\_605\_EN\_00\_RAD-2400-IFS+EMpro-Modbus.docx



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Pos.	Quantity	Order-No.	Type	Description
01	5	2901541	RAD-2400-IFS	2400 MHz radio module with RS-232, RS-485 2-wire interface
02	1	2903447	RAD-CABLE-USB	Configuration cable for RAD-2400-IFS
03	2	2901363	EEM-MA250	Energy meter for measuring electrical parameters with RS-485 Modbus/RTU interface
04	2	2901364	EEM-MA400	Energy meter for measuring electrical parameters, extendable with communication module
05	2	2901365	EEM-RS485-MA400	Communication module, RS-485 Modbus, for EEM-MA400
06	1	2901366	EEM-MA600	Energy meter for measuring electrical parameters, extendable with communication module
07	1	2901374	EEM-ETH-RS485-MA600	Communication module, gateway RS-485 / Ethernet, for EEM-MA600

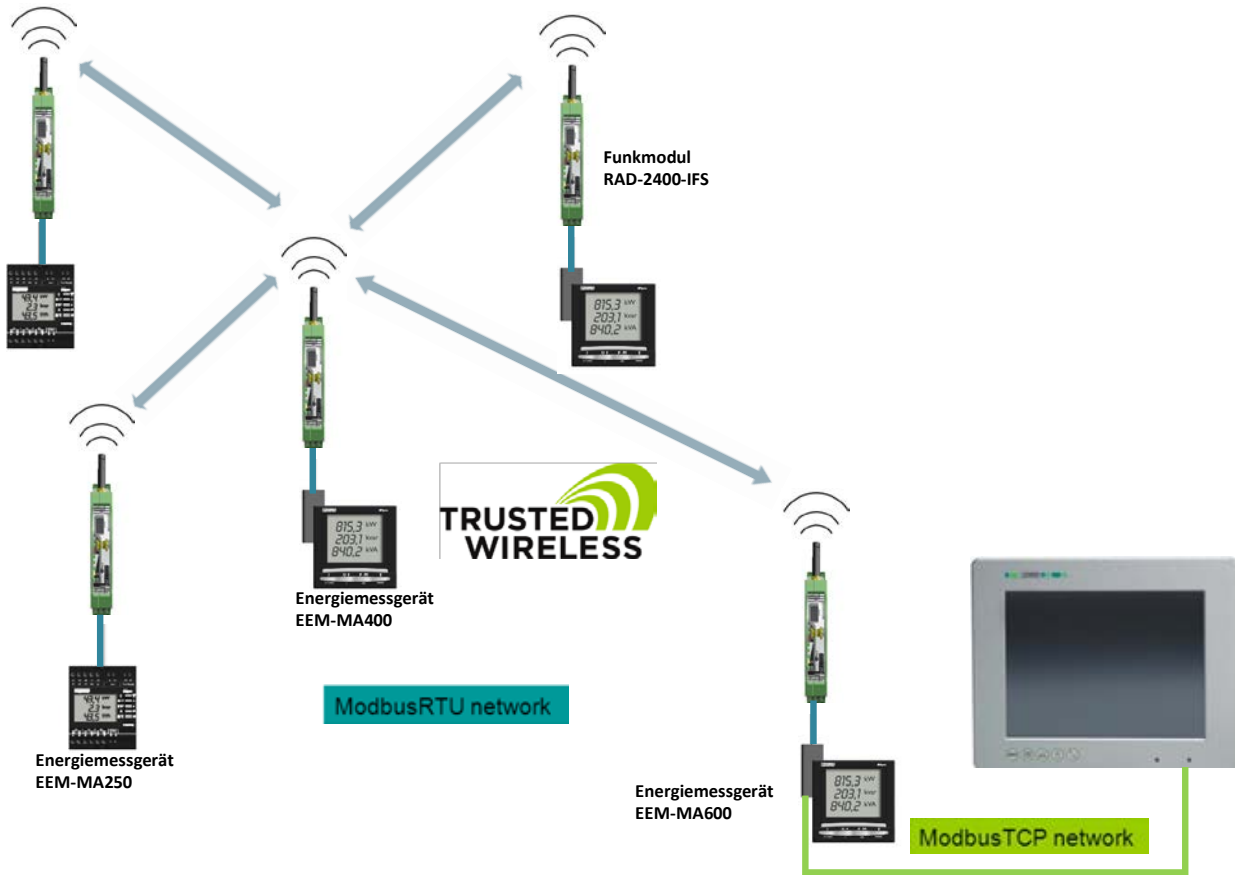


This document is only valid in association with the associated user manuals or package slips.  
Make sure that you always use the latest documentation.  
It can be downloaded at [www.phoenixcontact.net/catalog](http://www.phoenixcontact.net/catalog).

Contents

<b>1 Configuration and connection of EMpro .....</b>	<b>4</b>
1.1 Preparing EMpro EEM-MA250.....	4
1.2 Connecting the devices.....	5
1.3 Preparing EMpro EEM-MA400.....	6
1.4 Connecting the devices.....	7
1.5 Preparing EMpro EEM-MA400.....	8
1.6 Modbus/RTU configuration .....	8
1.7 Modbus/TCP configuration .....	9
1.8 Connecting the devices.....	10
<b>2 Configuration of Radioline.....</b>	<b>11</b>
2.1 System setup .....	11
2.2 Installation of the software.....	12
2.3 Configuration of a point-to-point/star connection .....	12
<b>3 Read out the measured values via Modbus Poll software.....</b>	<b>20</b>
<b>4 Reading the measured values (example: EMpro web server).....</b>	<b>25</b>
<b>5 Troubleshooting / FAQ.....</b>	<b>26</b>

The structure could look like this:



This document describes the basic operation of a Modbus network comprising EMpro energy meters and Radioline devices. The EEM-MA600 with communication module EEM-ETH-RS485-MA600 operates as a gateway between Modbus/RTU and Modbus/TCP.

The following chapters describe step-by-step the startup of EEM-MA250, EEM-MA400, EEM-MA600 and Radioline devices RAD-2400-IFS (Art. Nr. 2901541) with the Modbus Poll software on a Windows PC. The registers of each EMpro energy meter can be read out via Modbus Poll.

## 1 Configuration and connection of EMpro

The EMpro measuring devices can be configured via the pushbuttons on the front side. The configuration is described in the following sections.

Button	Description
PROG	Open configuration mode (hold down for 3 seconds)
▲ or ▼	Select the next menu item
▶	Open edit mode
◀ or ▶	In edit mode: Select parameters/values to be changed
▲ or ▼	In edit mode: change parameters/values
OK	Confirm setting

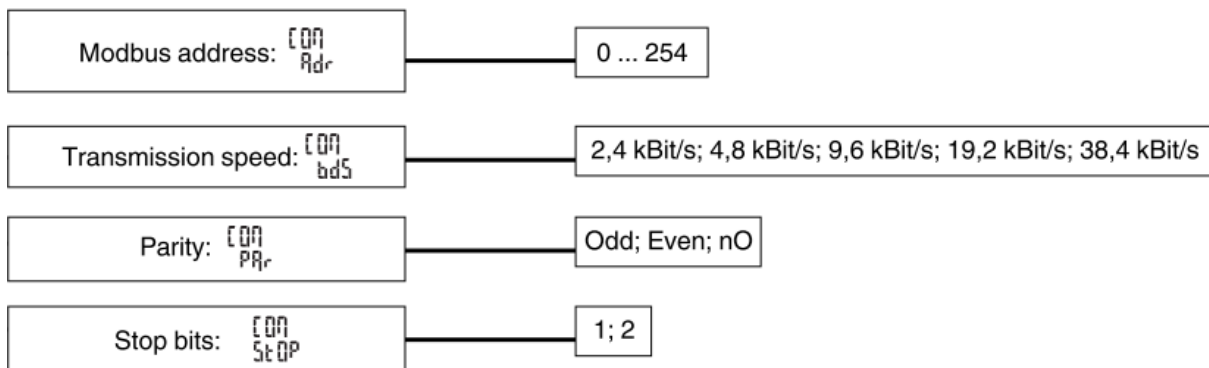
### 1.1 Preparing EMpro EEM-MA250

You will find the pin assignment of the power cable at [www.phoenixcontact.com](http://www.phoenixcontact.com). Please enter the article number of EEM-MA250 (2901363).

The device can be configured via the pushbuttons on the front side. For changing the serial parameters of the EEM-MA250, push the PROG button for 3 seconds. Enter the **code "100"** to access the device configuration. Use the arrow keys to scroll through the menu and change the serial parameters.

Note:

- All Modbus devices must be set to the same serial parameters (data rate, etc.).
- All Modbus devices must have different Modbus addresses.



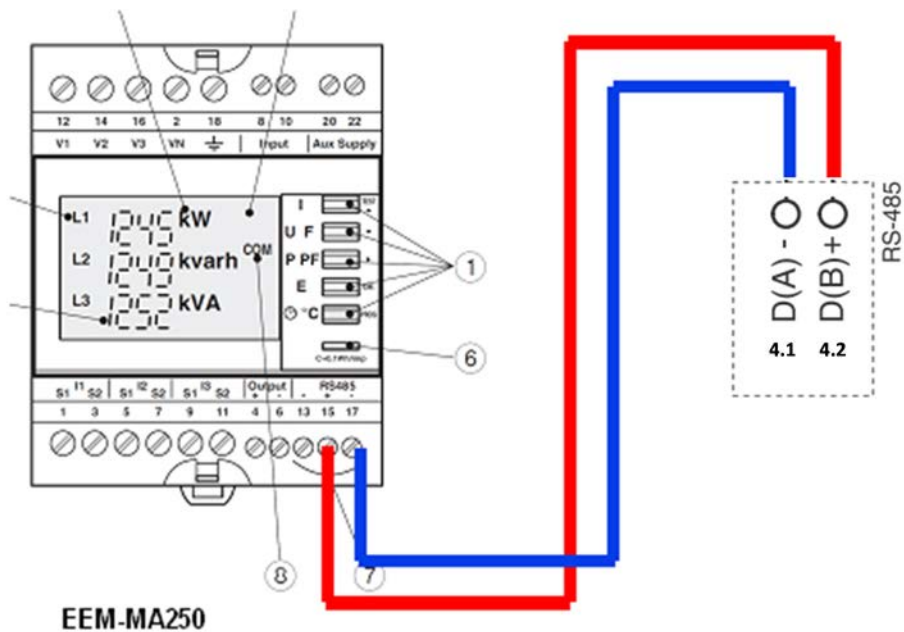
Configuration menu with adjustable serial parameters

## 1.2 Connecting the devices

The RS-485 interface must be connected as follows:

EEM-MA250 ↔ RAD-2400-IFS  
 Contact 15 ↔ 4.2 D(B)  
 Contact 17 ↔ 4.1 D(A).

The cable shield can be connected to an external cable shield ground clamp.



Note:

- EEM-MA250: The RS-485 cable must be terminated at both ends of the bus with a resistor. The resistor is supplied with the device.
- RAD-2400-IFS: The resistor can be activated via DIP switches.

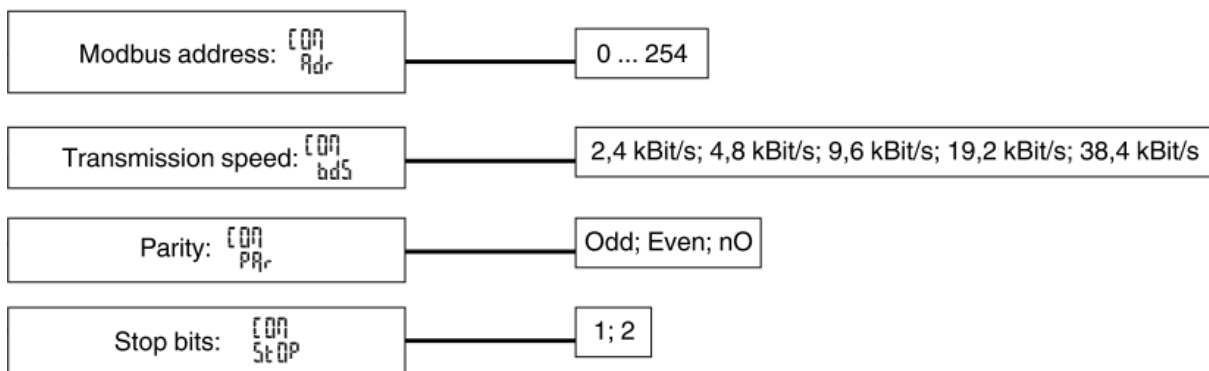
### 1.3 Preparing EMpro EEM-MA400

You will find the pin assignment of the power cable at [www.phoenixcontact.com](http://www.phoenixcontact.com). Please enter the article number of the EEM-MA400 (2901364).

The device can be configured via the pushbuttons on the front side. For changing the serial parameters of the EEM-MA400, push the PROG button for 3 seconds. Enter the **Code "100"** to access the device configuration. Use the arrow keys to scroll through the menu and change the serial parameters.

Note:

- All Modbus devices must be set to the same serial parameters (data rate, etc.).
- All Modbus devices must have different Modbus addresses.



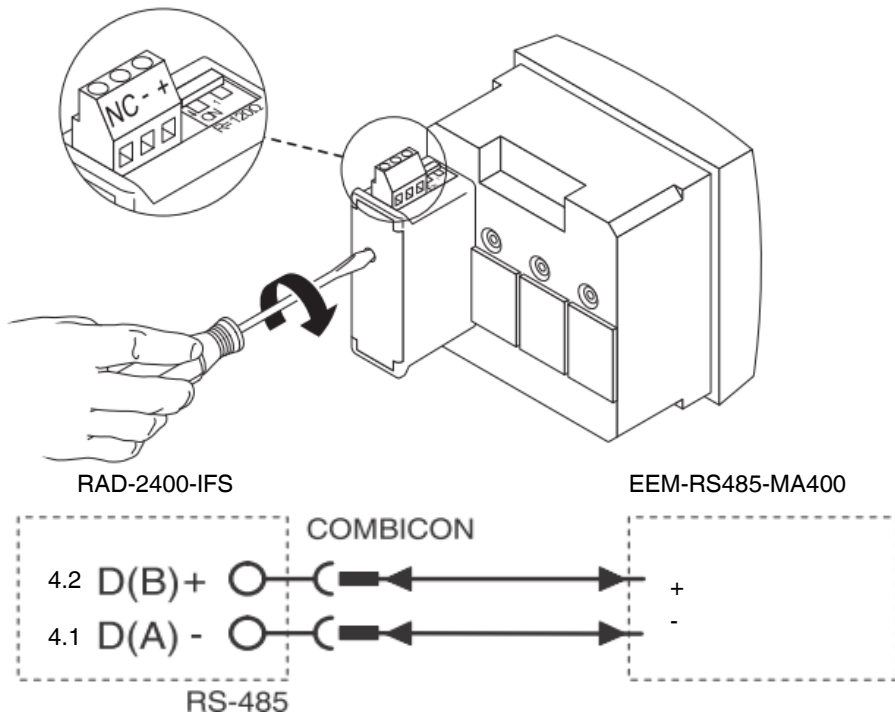
Configuration menu with adjustable serial parameters, if communication module EEM-RS485-MA400 is connected.

### 1.4 Connecting the devices

The RS-485 interface must be connected as follows:

EEM-MA400	↔	RAD-2400-IFS
Contact +	↔	4.2 D(B)
Contact -	↔	4.1 D(A)

The cable shield can be connected to an external cable shield ground clamp.



Note:

The RS-485 cable must be terminated at both ends of the bus with a resistor. The resistor can be activated via DIP switches.

### 1.5 Preparing EMpro EEM-MA400

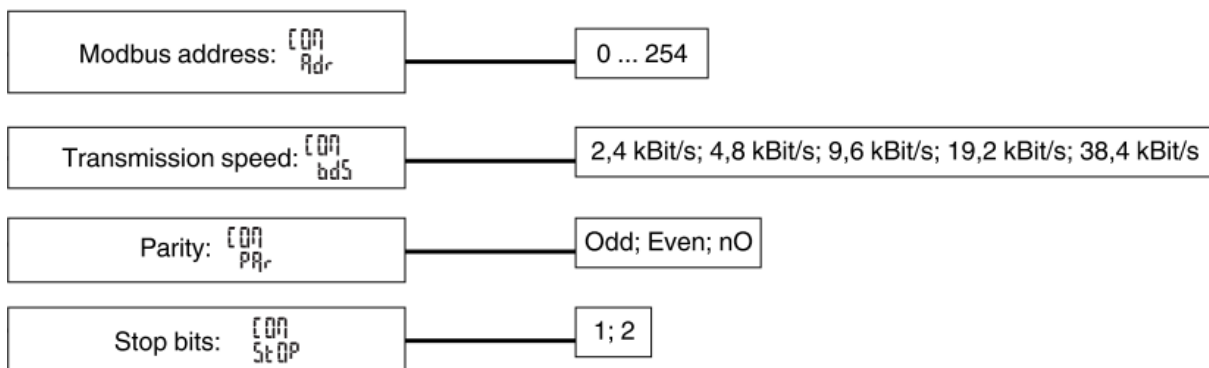
You will find the pin assignment of the power cable at [www.phoenixcontact.com](http://www.phoenixcontact.com). Please enter the article number of the EEM-MA400 (2901364).

The device can be configured via the pushbuttons on the front side. For changing the serial parameters of the EEM-MA400, push the PROG button for 3 seconds. Enter the **code "100"** to access the device configuration. Use the arrow keys to scroll through the menu and change the serial parameters and Ethernet parameters.

### 1.6 Modbus/RTU configuration

Note:

- All Modbus devices must be set to the same serial parameters (data rate, etc.).
- All Modbus devices must have different Modbus addresses.



Configuration menu with adjustable serial parameters, if communication module EEM-ETH-RS485-MA600 is connected

### 1.7 Modbus/TCP configuration

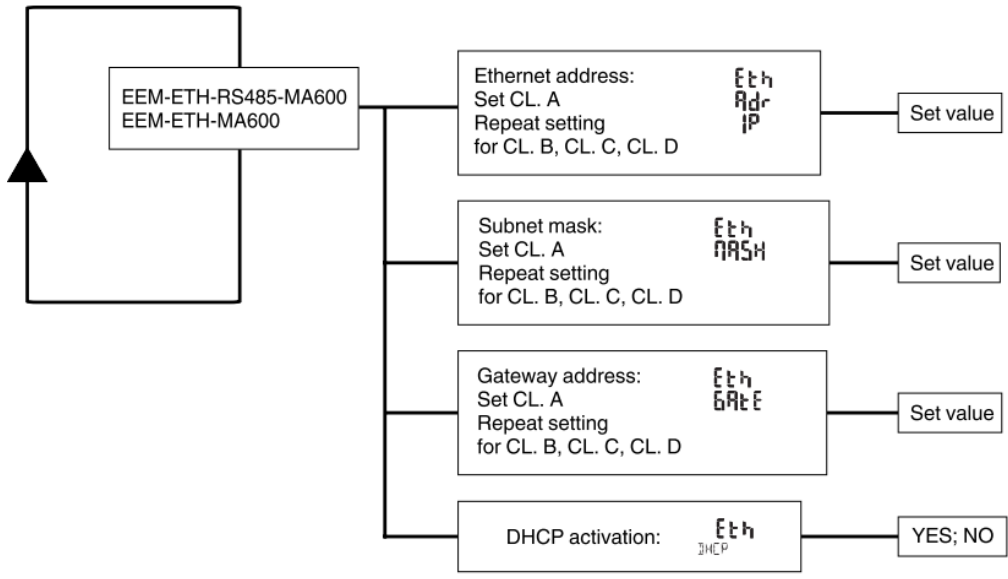
Default settings:

**IP address:** 192.168.1.1

**Subnet mask:** 255.255.255.0

**Gateway:** 0.0.0.0

DHCP activation: No

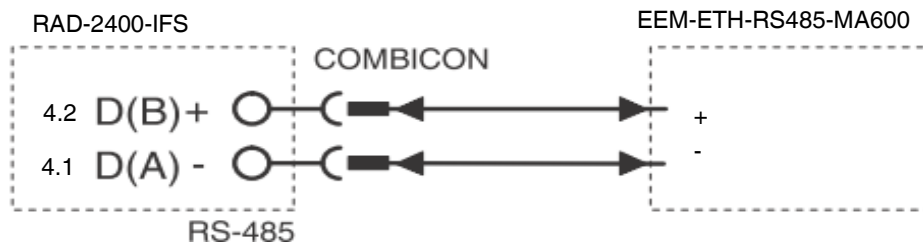
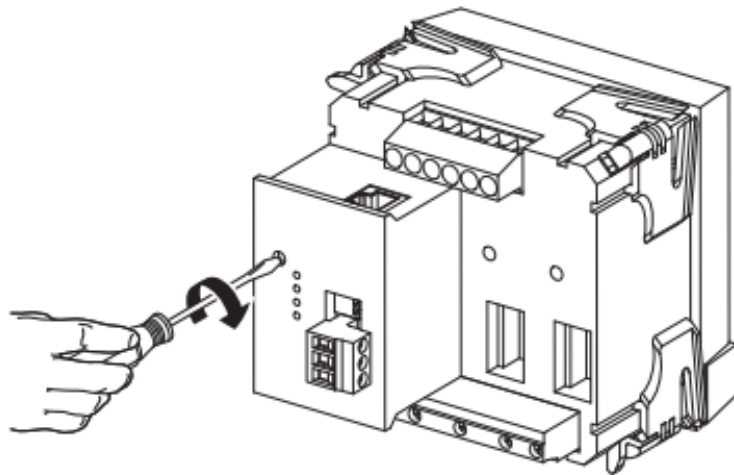


### 1.8 Connecting the devices

The RS-485 interface must be connected as follows:

EEM-MA600	↔	RAD-2400-IFS
Contact +	↔	4.2 D(B)
Contact -	↔	4.1 D(A)

The cable shield can be connected to an external cable shield ground clamp.



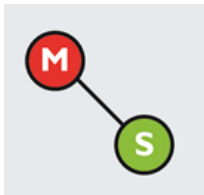
Note:

- The RS-485 cable must be terminated at both ends of the bus with a resistor. The resistor can be activated via DIP switches.
- The EEM-ETH-MA600 allows for an Ethernet connection to 10BaseT or 100BaseT networks. Connect a twisted pair cable to the RJ45 connector of the communication module EEM-ETH-RS485-MA600 and connect it to your Ethernet network.

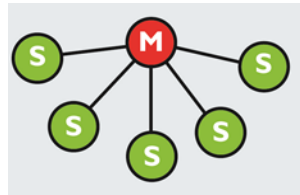
## 2 Configuration of Radioline

### 2.1 System setup

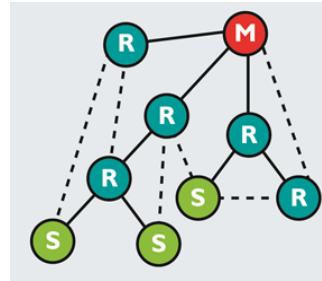
Point-to-Point



Star



Line/Mesh



M = Master      S = Slave      R = Repeater

#### Point-to-Point/Star

A point-to-point/star network may consist of only one master and up to 249 slaves. In this network structure, each slave is directly connected to the master. The data exchange in this structure can be very fast. The more slaves are in the network, the higher is the delay time of the radio network.

#### Line/Mesh

A mesh network may consist of only one master and up to 249 slaves. A mesh network supports repeater functionality, it is able to heal itself. If a connection is lost, the device can establish an alternative communication path. This construction of an alternative communication path is done automatically within a very short time. This time depends on the data rate of the radio interface. The network type "line/mesh" results in a longer delay, because in this setting each wireless module works as a repeater/slave. The delay time depends on the number of repeaters/slaves in the network and of the selected data rate of the radio interface (16/125/250 kbaud).

The Radioline devices support the following functions:

**Master:** The master wireless module is the central point in the network. Initializations and network-specific functions are coordinated by the master. Without a master, there is no wireless connection in the network. The master of a wireless network is usually located at a central point, for example in the control room. The master PLC, which is connected to the master wireless module, manages the serial data transmission. There can only be one master in the network. The master always has the RAD-ID = 01.

**Slave:** Slaves always build the endpoint of the network and cannot forward data to other slaves. Slaves of a PLC can be connected to a slave wireless module. Slave wireless modules only have subordinate rights.

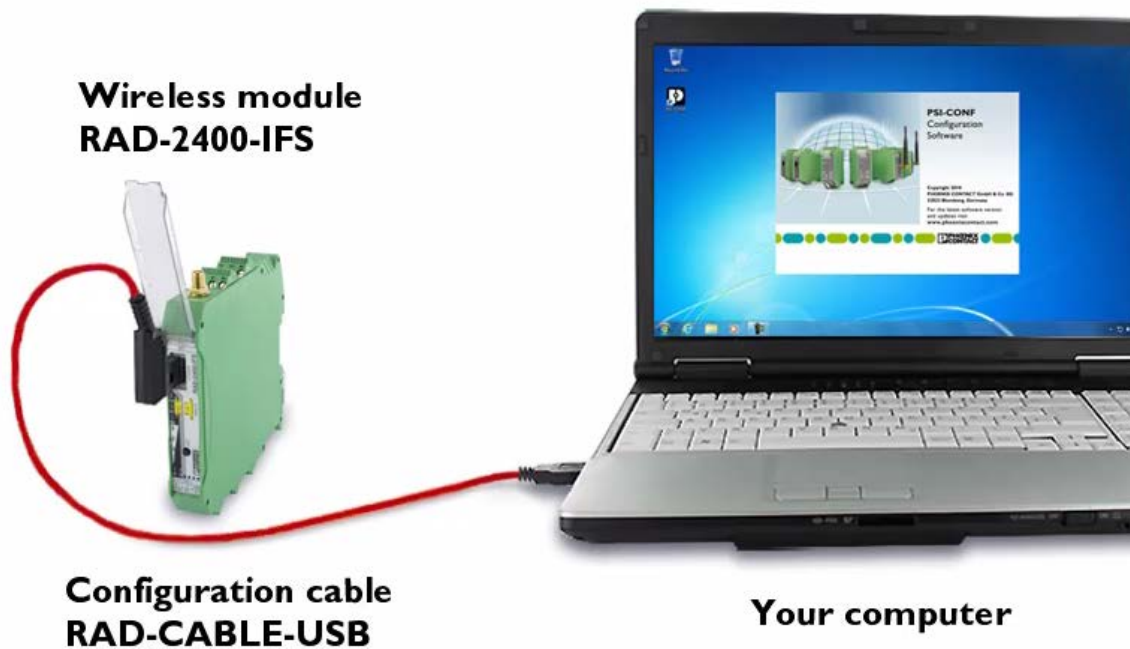
**Repeater/Slave:** A repeater/slave can communicate data to other wireless modules in the network. It is possible to build line/mesh structures. A repeater/slave supports two functions: The wireless module works as a repeater by receiving and forwarding data and as a slave by sending the data to its serial interface. A slave PLC can be connected to each repeater/slave wireless module.

## 2.2 Installation of the software

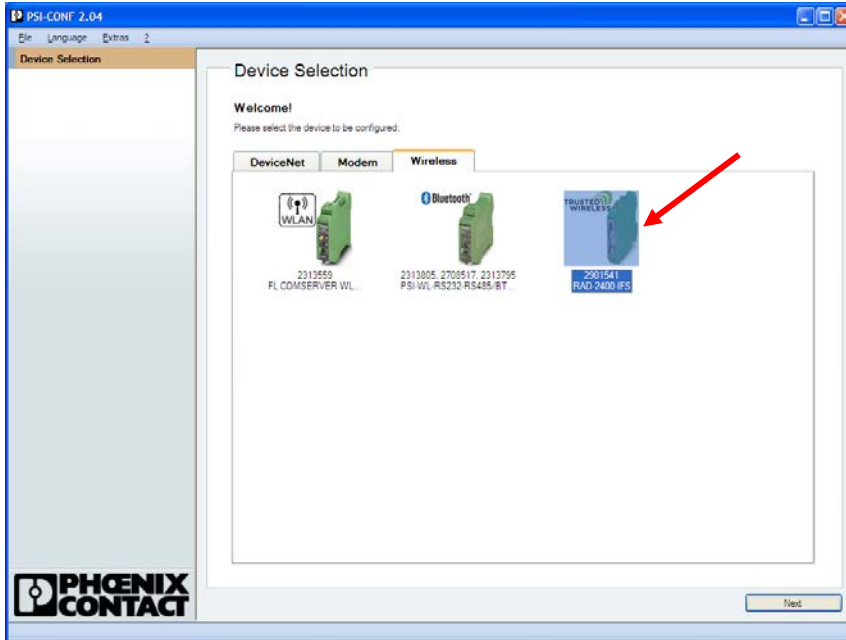
Please download the current PSI-CONF software at [www.phoenixcontact.com](http://www.phoenixcontact.com). Install it on your computer and follow the instructions.

## 2.3 Configuration of a point-to-point/star connection

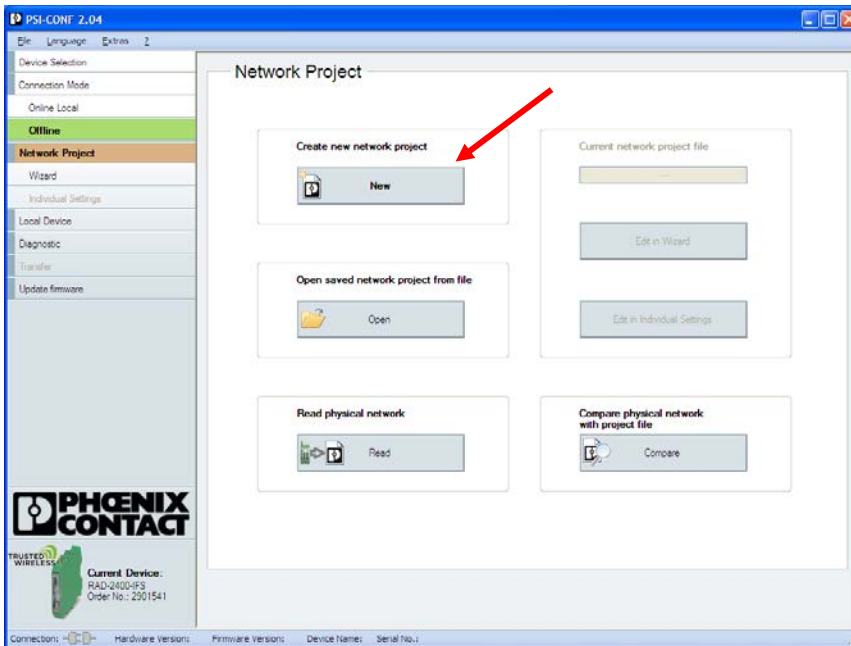
1. Start the PSI-CONF software on the PC. Connect the wireless module to the PC using the configuration cable.



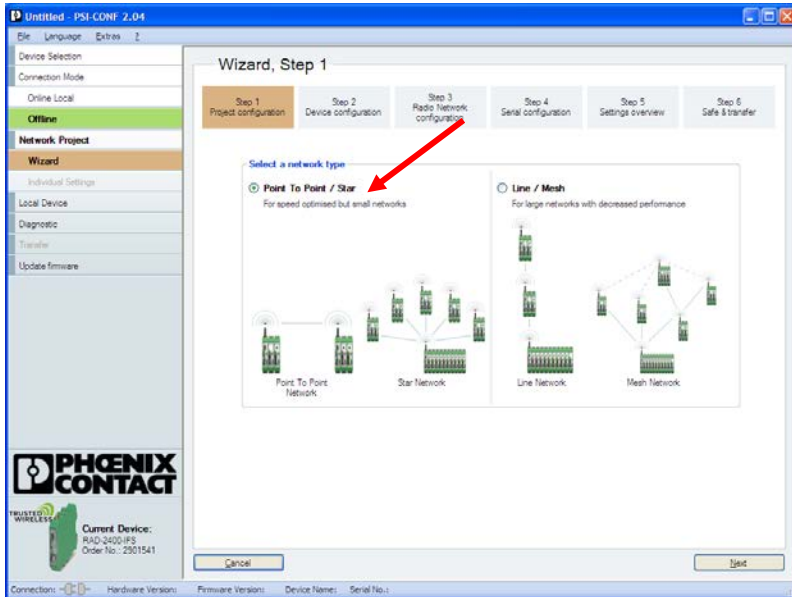
2. Select the device in the folder "Wireless".



3. Select "New" by clicking on the button "Create new network project".



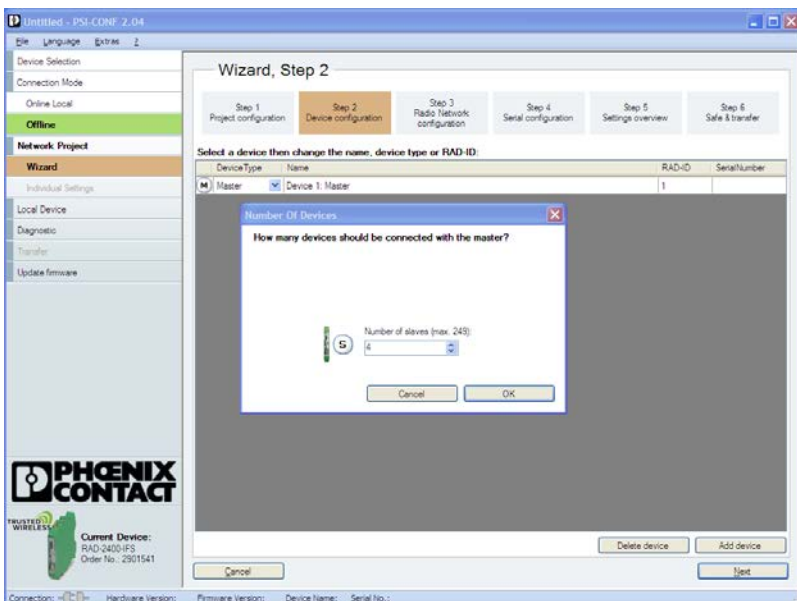
4. Step 1: Select the network type "Point to Point / Star" and confirm with "Next".



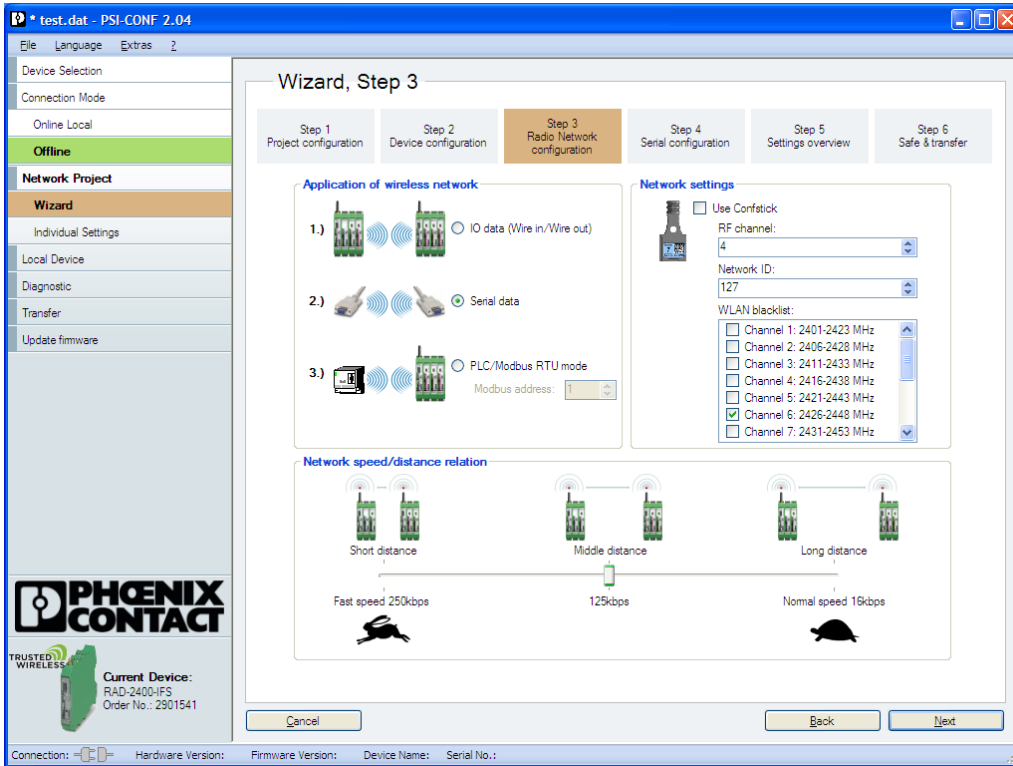
Note:

Selecting the network type "Line/Mesh" results in a longer delay, as in this setting each wireless module works as a repeater/slave. The delay time depends on the number of repeaters/slaves in the network, the data package size and the selected data rate (16 / 125 / 250 kbaud).

5. Step 2: Follow the Wizard and select the number of network devices. Confirm with "OK" and "Next".



6. Step 3: Choose "Serial data". Under "Network settings", you can choose the RF channel, the network ID and the blacklisting of WLAN channels. Under "Network speed/distance relation", you can choose the necessary data rate. The data rate depends on the distance. Confirm with "Next".



The **Trusted Wireless 2.0** technology supports the following receiver sensitivity:

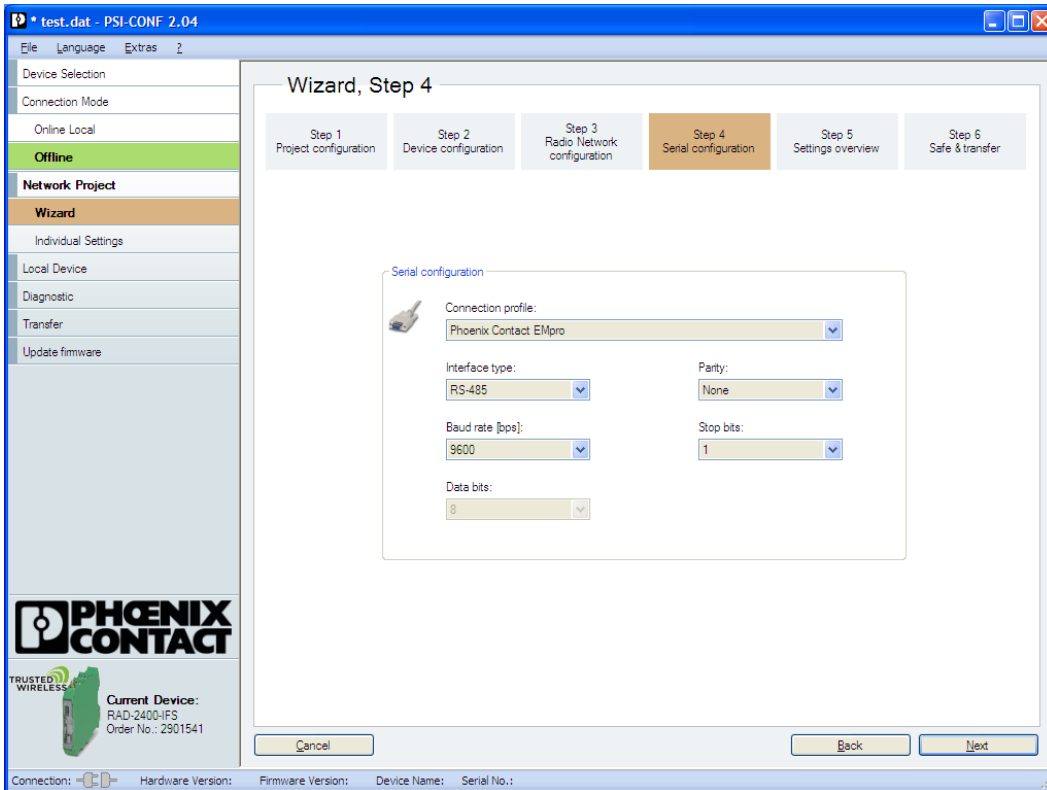
Data transmission speed [kbps]	Typical receiver sensitivity [dBm]	Typical link budget [dBm]	Potential distance that can be covered with LOS* and a system reserve of 12 dB
250	- 93	-112	1000m
125	-96	-115	1500m
16	-106	-125	5000m

\* LOS = line of sight and adherence to the Fresnel zone

You can achieve transmission within the kilometer range using the wireless module if the following conditions are fulfilled:

- Suitable gain antennae are used
- Line of sight
- Adherence to the Fresnel zone

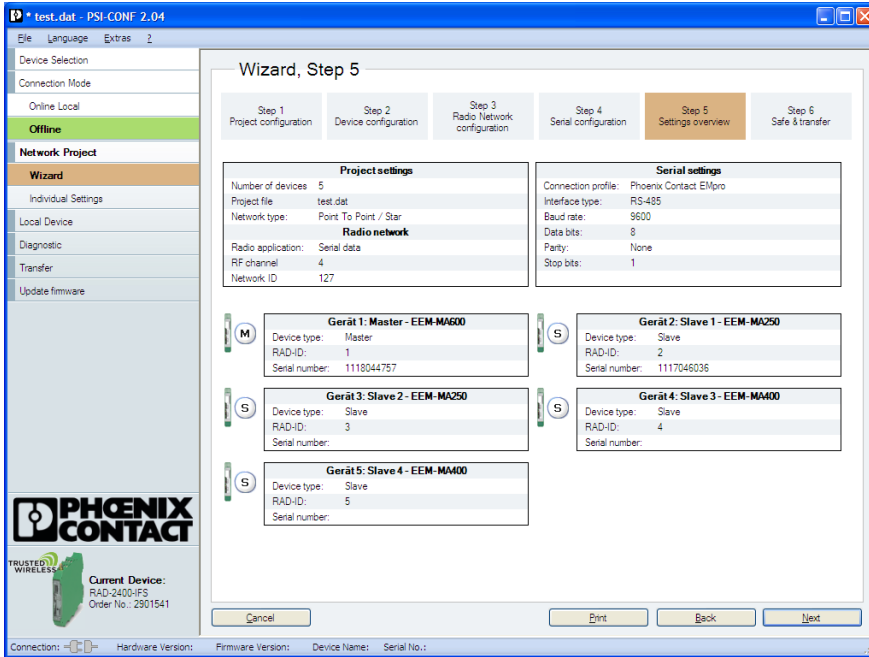
7. Step 4: Choose the connection profile PROFIBUS and select the required data rate. Confirm with “Next”.



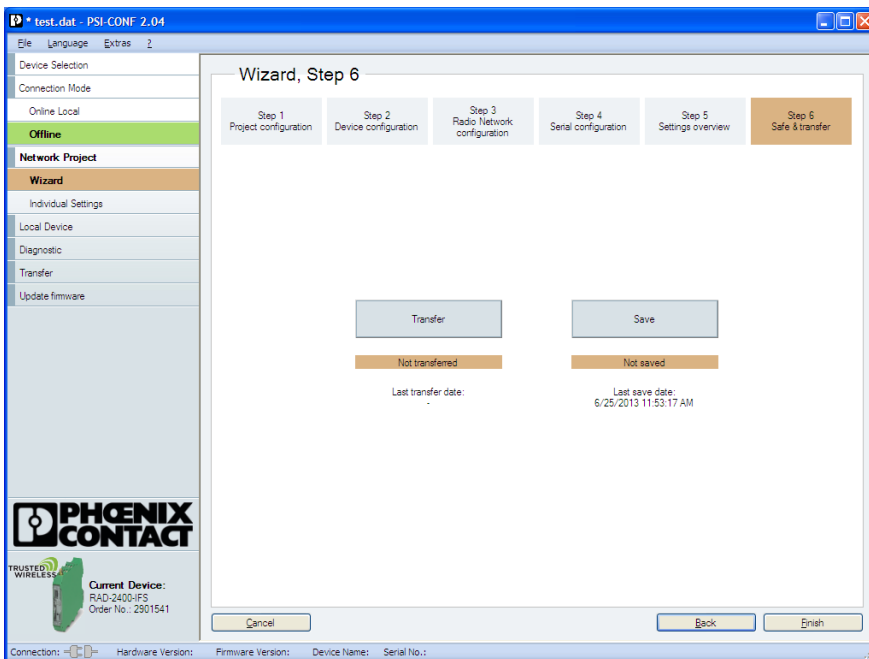
**Note:**

- The serial data rate must be reduced depending on the distance to be covered (data rate of the radio interface 16/125/250 kbaud).
- Set the same serial interface parameters as for the EMpro devices.

8. Step 5: The configuration is finished. Confirm with "Next".

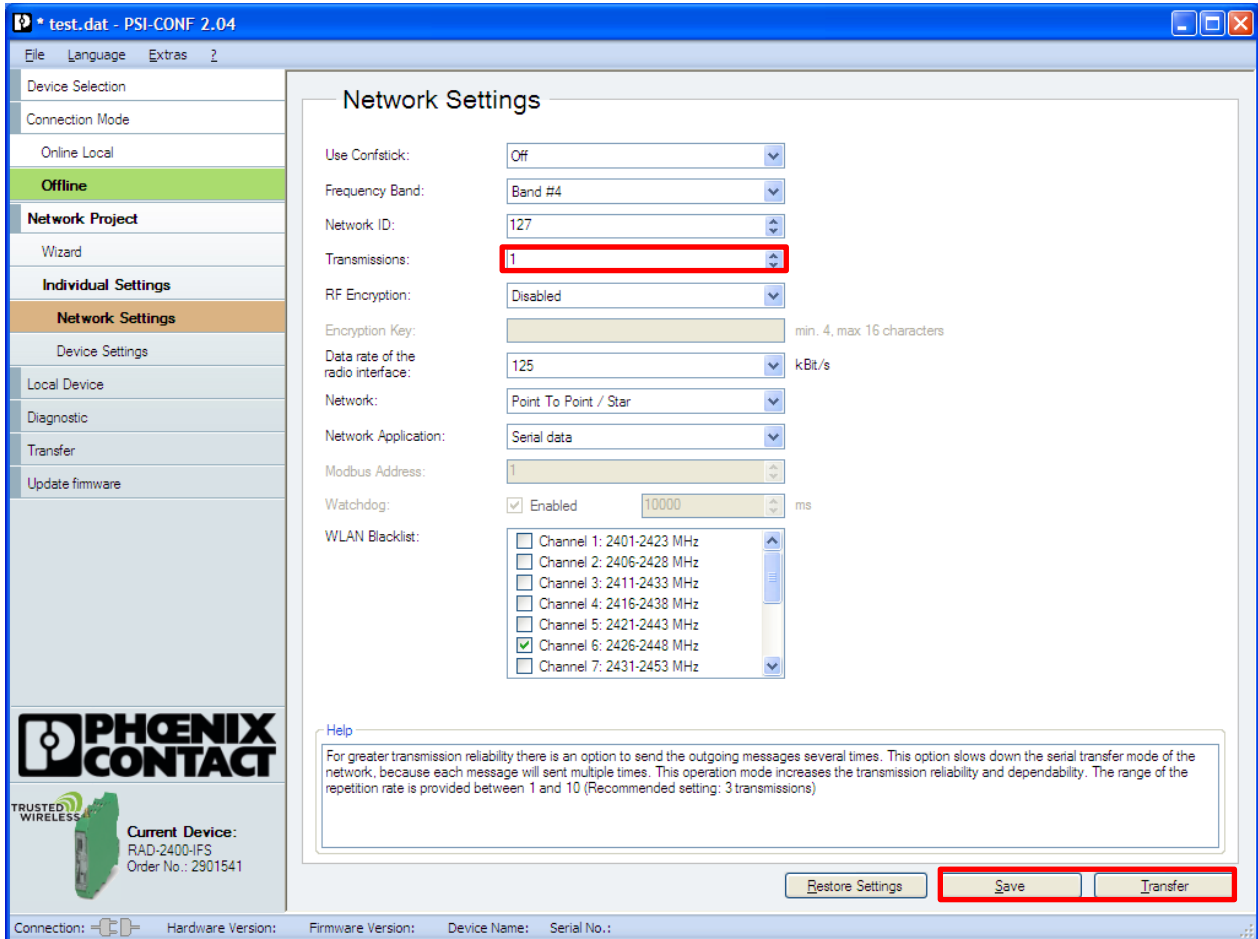


9. Step 6: Save the project.



**Optimization for faster data transfer:**

1. After saving, open "Individual settings" and change the value "Transmissions" to "1". Save the settings again and transfer the settings to the wireless devices.

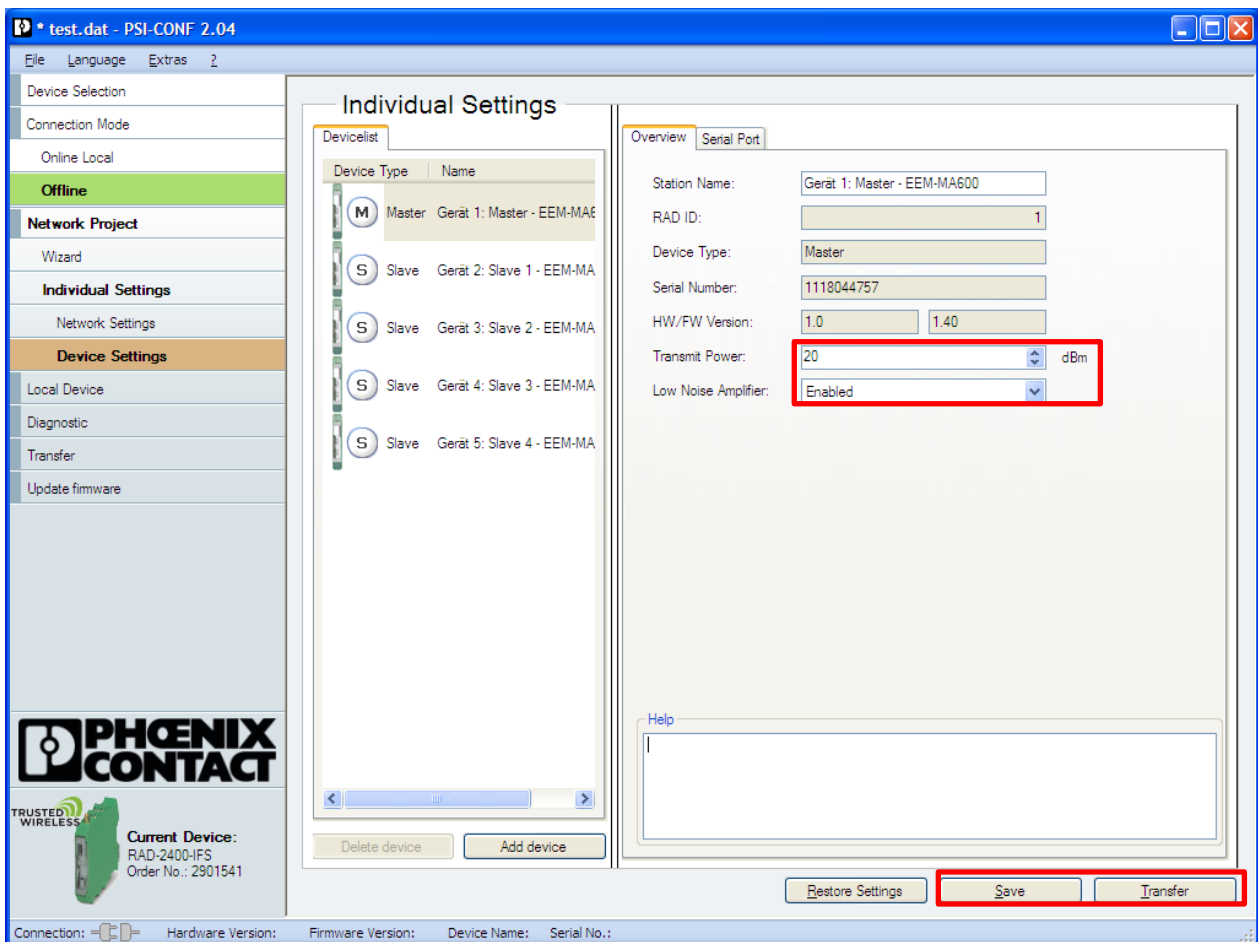


## Setting the transmit power

2. Open "Individual Settings, Device Settings". Here you can set the transmit power and activate or deactivate the low noise amplifier.

The **Transmit Power** can be set between 0 dBm (1 mW) and 20 dBm (100 mW). Depending on the place of installation and the antenna used, you may have to reduce the transmit power. Therefore, please note the restrictions of use according to your country and reduce the maximum power output of the device, if required.

The **Low Noise Amplifier** can be enabled and disabled. It will change the sensitivity of the wireless module. For larger distances, the low noise amplifier must be activated. When wireless modules are operated in close proximity to each other (less than 1 meter), it is recommended to disable the low noise amplifier, so that the module is not overloaded.

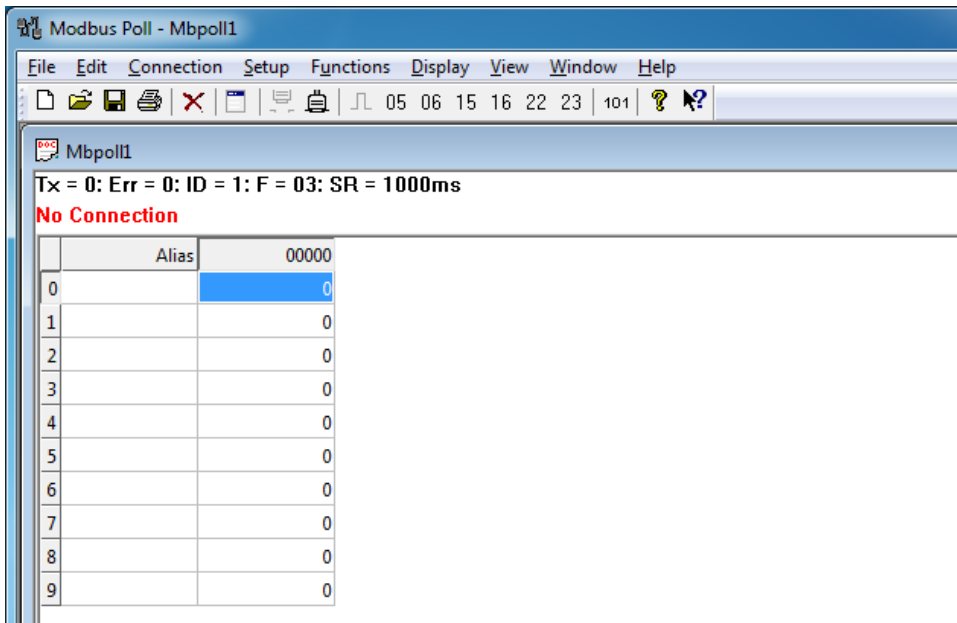


### 3 Read out the measured values via Modbus Poll software

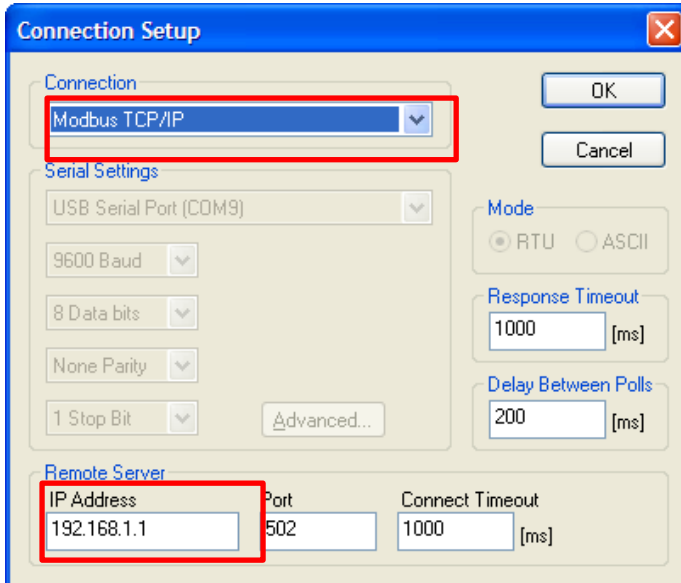
Modbus Poll is available as a free 30 day trial version on the following website: [www.modbustools.com](http://www.modbustools.com)

The software can read Modbus registers via different interfaces.

#### 1. Install and run the software



2. Choose "Connection" → "Connect" to open the connection settings



3. Choose **Modbus TCP/IP** and enter the **IP-Adresse** of the EEM-MA600 / EEM-ETH-RS485-MA600 device. The standard Modbus port is preconfigured to 502.
4. Confirm with "OK". The connection between EEM-MA600/EEM-ETH-RS485-MA600 and PC is established. The measured values of EEM-MA250 are displayed.

5. Open "Setup" → "Read/Write Definition"

The screenshot shows the 'Read/Write Definition' dialog box with the following settings:

- Slave ID: 1
- Function: 03 Read Holding Registers (4x)
- Address: 50512
- Quantity: 10
- Scan Rate: 1000 ms
- Read/Write Enabled
- Buttons: OK, Cancel, Apply, Read/Write Once
- View section:
  - Rows: 10 (selected), 20, 50, 100
  - Hide Alias Columns
  - Address in Cell
  - PLC Addresses (Base 1)
- Display: Signed

6. Choose the **Slave ID 1** (serial Modbus/RTU address of EEM-MA250) and register address **50512**.

The following spreadsheet (Manual EEM-MA250) shows the register addresses of the main measured values.

Decimal address	Hexa-decimal address	Number of data words	Designation	Unit	Register access
50512	C550	2	Hour: Operating hours counter	h/100	R
50514	C552	2	U12: Conductor voltage (1-2)	V/100	R
50516	C554	2	U23: Conductor voltage (2-3)	V/100	R
50518	C556	2	U31: Conductor voltage (3-1)	V/100	R
50520	C558	2	V1: Conductor voltage to N	V/100	R
50522	C55A	2	V2: Conductor voltage to N	V/100	R
50524	C55C	2	V3: Conductor voltage to N	V/100	R
50526	C55E	2	F: Frequency	Hz/100	R
50528	C560	2	I1: Current	mA	R
50530	C562	2	I2: Current	mA	R
50532	C564	2	I3: Current	mA	R
50534	C566	2	In: Neutral conductor current	mA	R
50536	C568	2	$\Sigma P$ : Total real power +/-	kW/100	R
50538	C56A	2	$\Sigma Q$ : Total reactive power +/-	kvar/100	R
50540	C56C	2	$\Sigma S$ : Total apparent power	kVA/100	R
50542	C56E	2	$\Sigma PF$ : Total power factor -: Capacitive, +: Inductive	0.001	R
50544	C570	2	P1: Real power phase 1 +/-	kW/100	R
50546	C572	2	P2: Real power phase 2 +/-	kW/100	R
50548	C574	2	P3: Real power phase 3 +/-	kW/100	R
50550	C576	2	Q1: Reactive power phase 1 +/-	kvar/100	R
50552	C578	2	Q2: Reactive power phase 2 +/-	kvar/100	R
50554	C57A	2	Q3: Reactive power phase 3 +/-	kvar/100	R
50556	C57C	2	S1: Apparent power phase 1	kVA/100	R
50558	C57E	2	S2: Apparent power phase 2	kVA/100	R
50560	C580	2	S3: Apparent power phase 3	kVA/100	R

The screenshot shows the Modbus Poll software interface. The title bar reads "Modbus Poll @ - [Mbpoll1]". The menu bar includes "File", "Edit", "Connection", "Setup", "Functions", "Display", "View", and "Window". The status bar at the top indicates "Tx = 151: Err = 0: ID = 1: F = 03: SR = 1000ms". Below this is a table with 10 rows and 5 columns. The columns are labeled "Alias", "50510", "Alias", and "50520". The values in the "50510" column are 0, 0, 0, 7698, 0, 0, 0, 0, 0, 0. The values in the "50520" column are 0, 0, and 0. The status bar at the bottom left says "For Help, press F1." and the bottom right shows the IP address "192.168.1.1: 502".

	Alias	50510	Alias	50520
0				0
1				0
2		0		
3		7698		
4		0		
5		0		
6		0		
7		0		
8		0		
9		0		

## 4 Reading the measured values (example: EMpro web server)

Up to 10 slaves can be connected and evaluated via the web server interface.

The integrated web server of the communication module connected to EEM-MA600 serves to configure, visualize and diagnose the devices in the network.

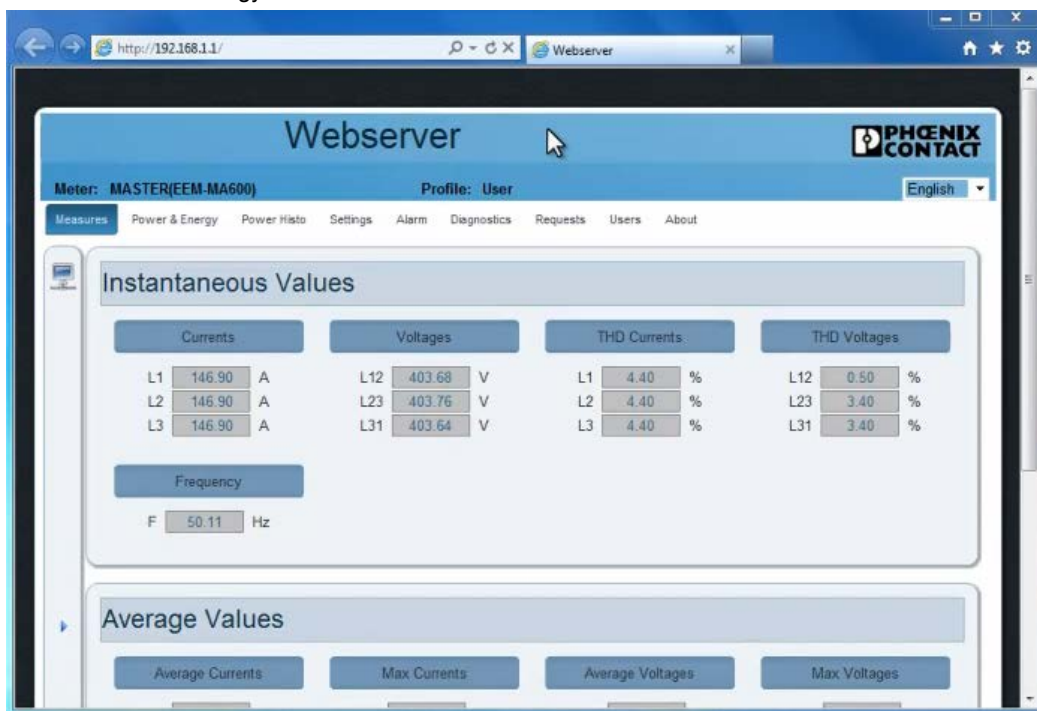
The following functions are available via web server:

- Displaying the most important basic parameters of the EEM-MA600
- Displaying the most important current and average measured values and counters
- Configuration, visualization and diagnostics of devices connected to the network

To access the web server, you need to enter the IP address of the EEM-MA600 in the internet browser.

Example:

IP address of the energy meter EEM-MA600: 192.168.1.1



You will find further information on the EMpro web server at [www.phoenixcontact.com](http://www.phoenixcontact.com).

## 5 Troubleshooting / FAQ

**Error:**

No network connection to EEM-MA600.

("Modbus Connection Failed. Connect Timeout" im Modbus Poll)

**Reason:**

- EEM-MA600 cannot be reached.

**Correction:**

- Access the configuration menu and check the settings of the EEM-MA600.
  - Check the IP address and subnet address of your PC
- 

**Error:**

"Gateway target device failed to respond" im Modbus Poll (Tx and Err error counter count up)

**Reason:**

- Serial parameters of the RS-485 connection are wrong.
- RS-485 interface not selected
- Wiring inverted
- Slave ID in Modbus Poll not correct

**Correction:**

- Check the serial settings and wiring on RAD-2400-IFS and EEM-MA250
  - Check the slave ID in Modbus Poll
- 

**Error:**

"Illegal Data Value" in Modbus Poll (Tx and Err error counter count up)

**Reason:**

Wrong main measurement value address in Modbus Poll

**Correction:**

Set the right register address via "Read/Write Definition" (see Modbus register tables of the EMpro device on page 23).