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USER MANUAL

Teco Enegy Optimizer (TEO)

MANUAL VERSION 1.2

TEO-01 for firmware version 1.0



Version: TEO v.1.01

1. Device Introduction

The Teco Enegy Optimizer (hereinafter referred **to as TEO)** is a Czech product of ELEBRO CZ s.r.o. and TECO a.s. The device was developed as a simple small device that can be connected via a serial communication line to photovoltaic power plant inverters, which can be easily placed in newly built electrical installations for PV plants.

The device is the size of 3 DIN modules, with a supply voltage of 230VAC. Communication with the PVPP inverter is via the MODBUS RTU protocol (RS-485 bus)

The TEO device is used for an overview of the current output of the PV plant, the consumption of the building and its outputs control the loads for the use of the electricity produced. All up-to-date data is stored directly on the device, so there is no delay caused by communication with remote servers.

The web application is also optimized for mobile devices, there is no need to install any additional applications or other software.

2. Connecting the device

2.1 Connecting TEO to the Object System

For its operation, TEO needs a 230V AC power supply with 2A protection, connection to the data network (LAN), connection of the RS-485 bus to the PVPP inverter and load switching elements.

2.2 Connecting to the communication line of the inverter

The TEO device communicates with inverters from various manufacturers using the MODBUS RTU protocol via the RS-485 bus. It communicates with only one inverter, multiple inverters for larger PV plants are not possible.

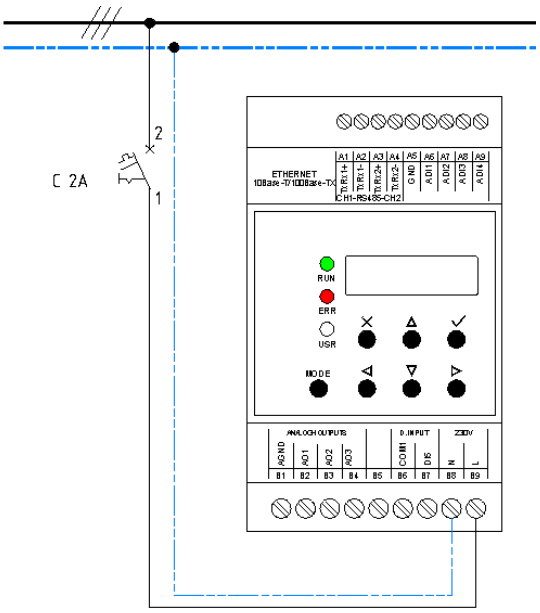
For the RS485 bus, it is best to use a shielded cable with a twisted pair of wires with a core cross-section of 0.35 – 0.8 mm2 with an impedance of approximately 120Ω and a capacitance of up to 65pF/m. A thicker conductor cross-section is preferable, it is not so prone to breakage when handling and fastening to the terminals.

If the line will be longer than a few meters, it is advisable to use 110 Ohm terminating resistors.

2.2.1 Connection to SOLAX inverters

The connection of the RS-485 communication line to the SOLAX inverters is made by connecting via an RJ-45 connector to the COM communication port, where the inverter pin 4:485+ is connected to terminal A1:485+ TEO **and the pin of inverter** 5:485- to **terminal** A2:485- TEO.

Figure 1 Wiring the TEO device



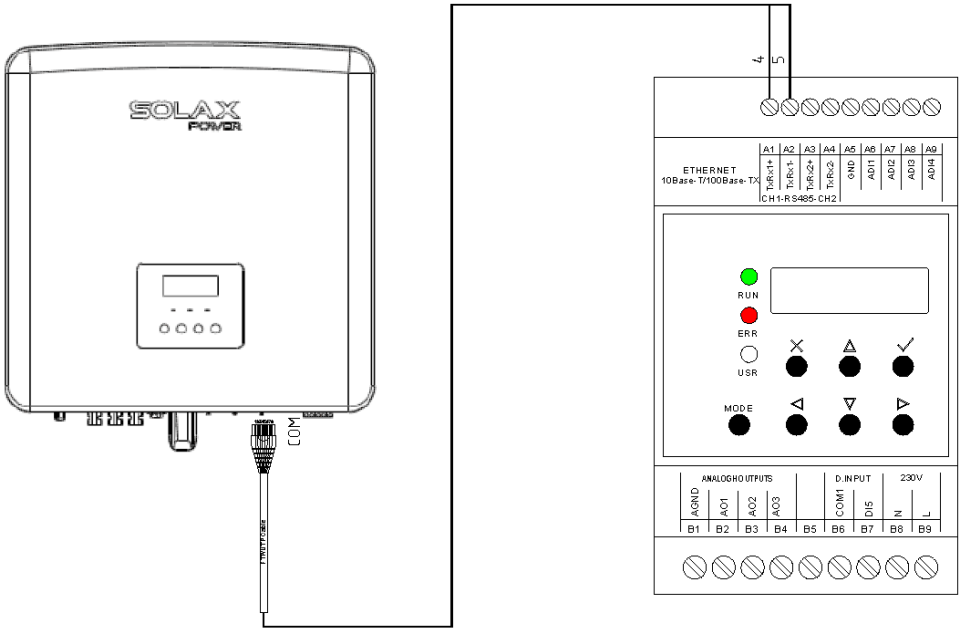


Figure 2 Connecting the communication line to the SOLAX inverter

2.2.2 Connecting to GoodWe Inverters

The connection of the RS-485 communication line to the GoodWe xxK-ET inverters is made to the communication port on the inverter, where the inverter **pin 1:485_A1** to terminal A1:485+ TEO and pin **of inverter 2:485_B1** to terminal **A2:485- TEO** are connected.

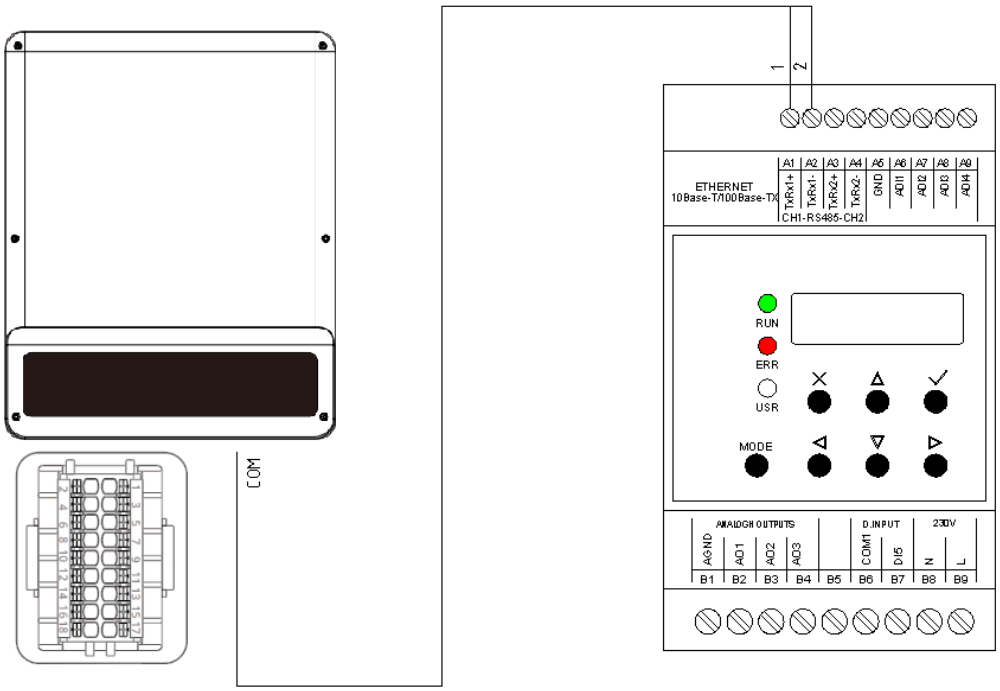


Figure 3 Connecting the communication line to the GoodWe inverter

2.3 Connecting to a data network

The TEO device connects to a computer network using a UTP cable with a standard RJ-45 connector.

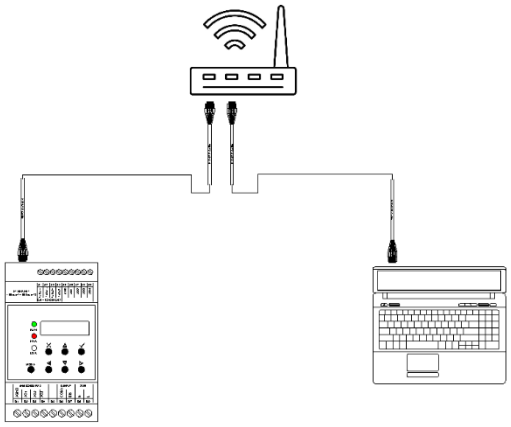


Figure 4 Connect TEO to the data network.

2.4 Connecting +Output Commands

Up to three analog outputs with a 0-10 V control signal can be connected to the ANALOG OUTPUTS terminals. 4. For switched, non-controllable loads, the outputs can be defined as two-state 0 and 10V. At the corresponding TEO output, the voltage level of the analog output is 0-10V corresponding to the logic "**0**" (0 V output) and logic "**1**" (10 V output).

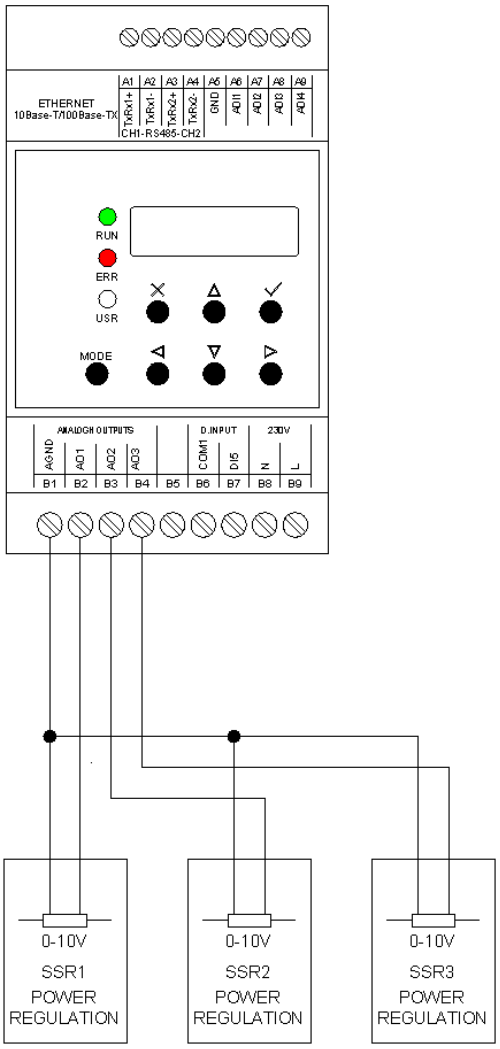


Figure 5 Connection of control signals 0 – 10 V to SSR

3. First start and configuration settings

3.1 Connecting and Starting the TEO

The device from which the configuration is performed must be connected in the same LAN as the TEO. After the TEO device is connected to the power supply network and the local data network, it is necessary to connect to its website by entering the TEO address from any browser (e.g. Google chrome, Firefox...):

http://smartfox.local

When set up correctly, the TEO application screen will be displayed, see Figure 7. For further activities, continue according to the instructions in the following chapters, i.e. the first step will be to configure the device.

If the TEO is set up incorrectly by the factory, it is possible that the configuration screen will be displayed instead of the application screen, see **Appendix 1 Figure 15.** In this case, follow the instructions in **Annex No. 1, paragraph 2**.

For access from other networks (VPN, VLAN), it is necessary to replace the DNS name smartfox.local with the IP address of the device, which TEO received from the DHCP server of your router. To make specific settings, contact your computer network administrator.

3.2 Design Table

Once connected to the TEO, the wiring is configured.

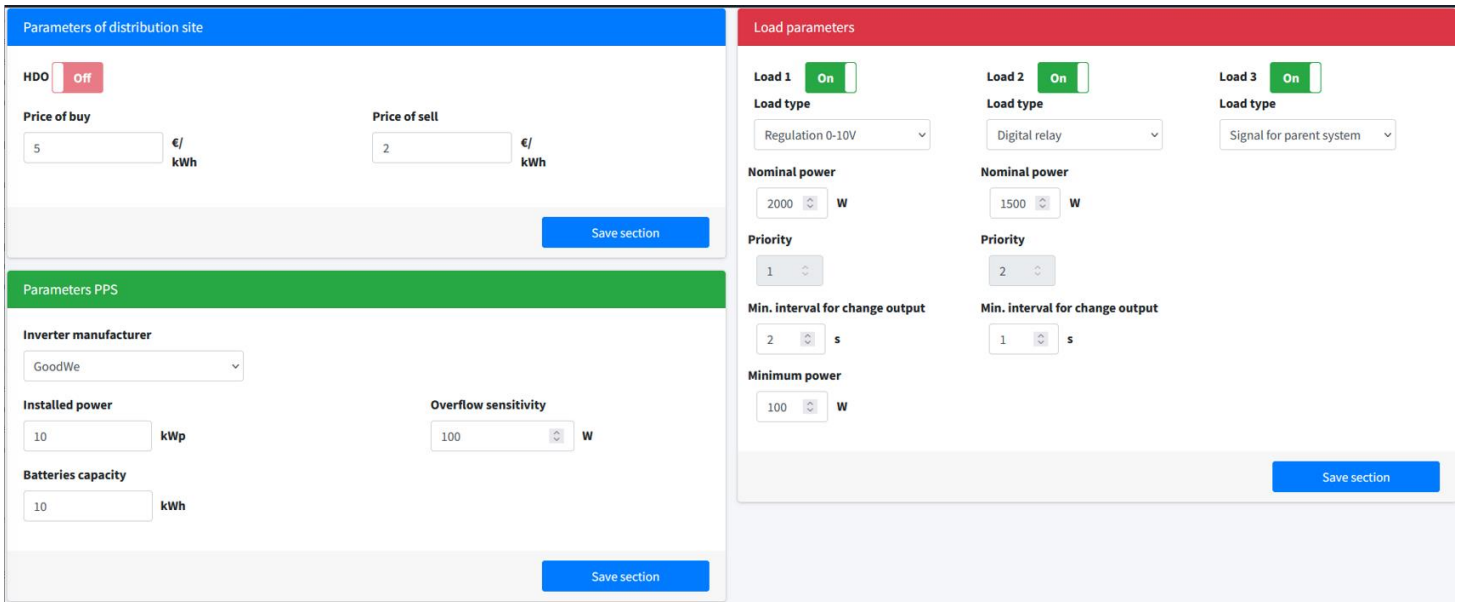


Figure 6 Design table

Distribution Network Parameters

1) HDO: ON – OFF (*in version 1.01 this input is not functional)*
2) Purchase price: purchase price of el. energy
3) Sale price: purchase price of el. energy.

PVPP parameters

1) Select inverter manufacturer from the drop-down menu: in the current firmware version, configuration is only available for GoodWe and SOLAX inverters
2) Installed capacity of the PV plant
3) Overflow sensitivity – a value indicating the minimum power in watts that will be considered as overflow. (Default 0 kW)
4) Battery Capacity

Load parameters

1) Load 1 (2, 3) – activation of the output of the connected load
2) Power rating – the power input value of the connected load
3) Load priority – in the current version, the priority is fixed, i.e. the load with priority 1 will be switched first, followed by the switching of loads with priority 2 and 3.
4) Minimum power – the lowest power of the PV plant at which the load will be started (default: 0 kW)
5) Minimum output change interval – the shortest time specified in seconds after which output can be changed (default: 0 sec)
6) Load type:
   a. **0-10V regulation** – proportional load control according to the set rated power with a voltage of 0-10 V
   b. **Digital relays** – switching the device (without power control), the load is switched on only when the full power is available
   c. **Signal for the master system** – signals the overflow rate of 0-10 V (0-100%) related to the defined installed power of the PVPP
   d. El. boiler – non-functional in version 1.01

The switching of the load depends on the available current power (production) of the PV plant.
Individual sections must be saved with the appropriate button. If the save is successful, the user is informed by the message "Settings have been saved" at the top right of the screen.

4.0 Application Display

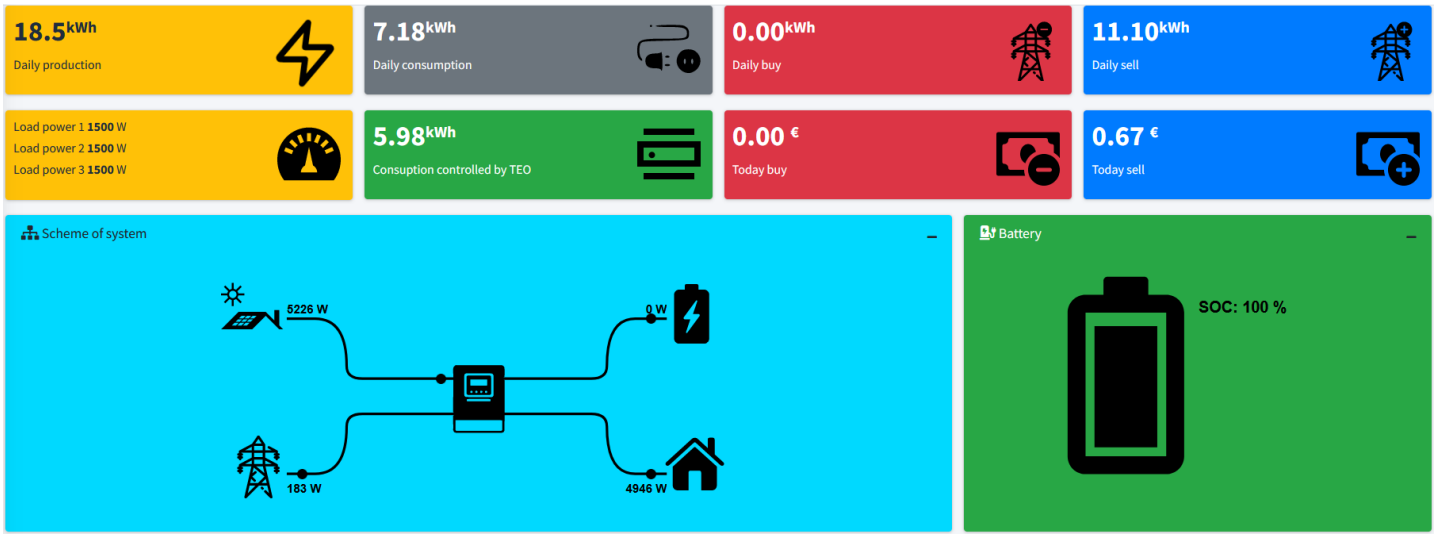


Figure 7 Visualization of the web application

Description of tiles

1) **Today's production** – current production on the current day
2) **Load power** – display the performance of currently connected loads on controlled outputs (the value is calculated, it may differ significantly from reality when connecting a load other than defined or not connected)
3) **Today's consumption** – own consumption of the object
4) **TEO-controlled consumption** – the electrical energy consumed by active triggering by TEO. If the defined load is not actually connected, it may show incorrect values.
5) **Today's Purchase** – Electricity Supplied from the Grid
6) **Purchased today** – electricity supplied from the grid converted to CZK (for a correct calculation, the price for the purchase of electricity must be entered correctly in the configuration table)
7) **Today's sale** - electricity supplied to the grid
8) **Sold today - electricity supplied to the** grid converted to CZK (for correct calculation, the price for the purchase of electricity must be correctly entered on the configuration table)
9) **System diagram** – graphical dynamic display of current energy production and consumption
10) **Battery** – current state of charge of the battery as a percentage of its capacity

4.1 Charts

On the main screen, in addition to the above, there are graphs of performance and battery charge status. We can find them at the bottom of the screen. The graph on the left shows the values of partial power in a given day, the second graph shows the battery charge rate. In both charts, it is possible to display data for the past 7 days. When you click on the date in the header of the chart card, a form for selecting the day will appear.

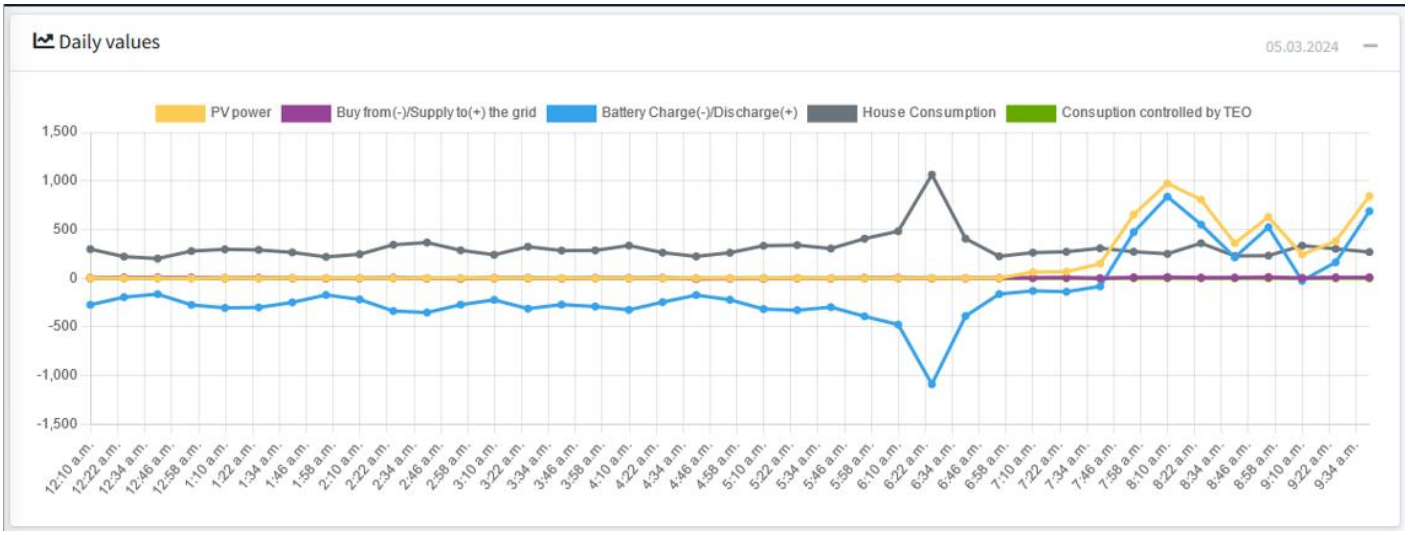


Figure 8 Performance Graph

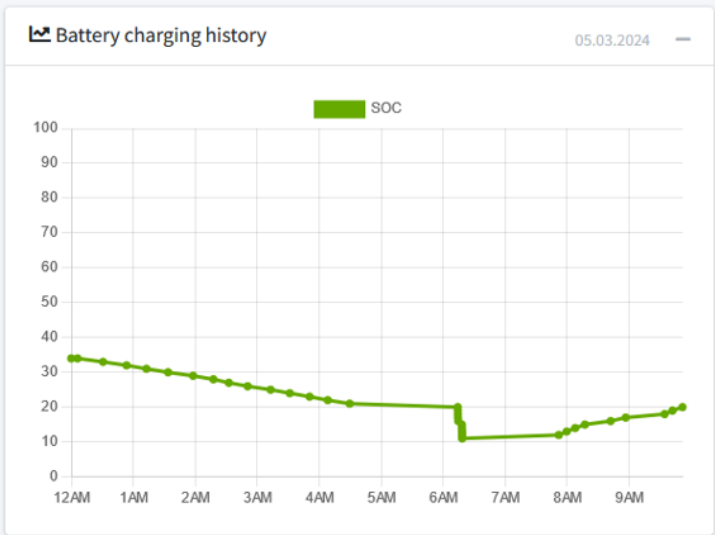


Figure 9 Battery Charge Graph

5. Wiring example

The TEO device is particularly suitable for continuous control of heating coils in a DHW accumulation tank. TEO is designed to make efficient use of electricity produced by a local photovoltaic power plant so that there are no electricity overflows. energy to the distribution network.

Example of connection with a photovoltaic power plant, inverter and single-phase boiler.

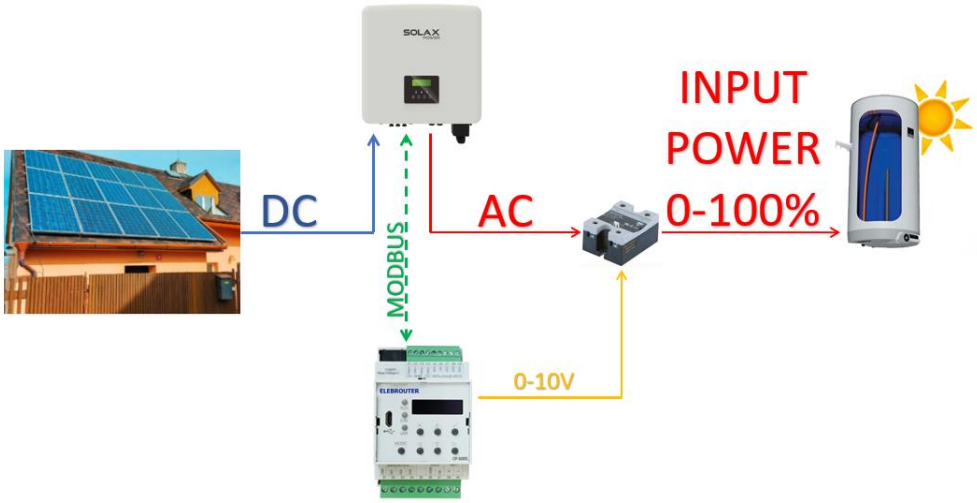


Figure 10 Connection diagram for controlling a single device

Example of connection with a photovoltaic power plant, an inverter and a three-phase boiler, or three single-phase boilers.

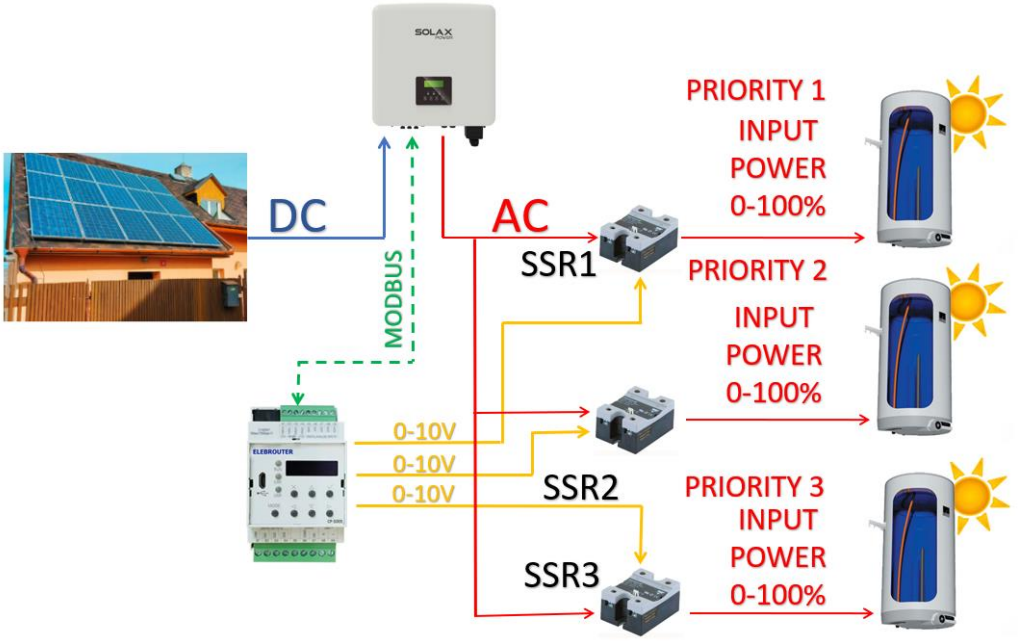


Figure 11 Connection diagram for controlling three devices

6. Link to download the manual

http://elebro.cz/nasereseni/teo

7. Access to the device from the Internet environment

Access from the cloud

Unfortunately, it is not yet possible to access your device via the cloud. However, our teams are working intensively to develop this feature, and we expect it to be available soon. It is now in the testing process. Keep an eye on our official TECO website and app updates for the latest information.

Public IP address

If you have a public IP address and want to access outside of your home network, you may want to consider setting up ports on your router. For proper operation, it is necessary to forward port 80 for http and 61690 for the transmission of process data. It is important to mention that this method does not provide any security. A safer alternative is to use a VPN that provides a built-in security layer. This will allow you to create a secure channel for remote access.

8. Update of SW TEO

You can contact your installer or the manufacturer directly for an update.
The TEO SW update is performed from the browser by entering the address:

http://smartfox.local/upload

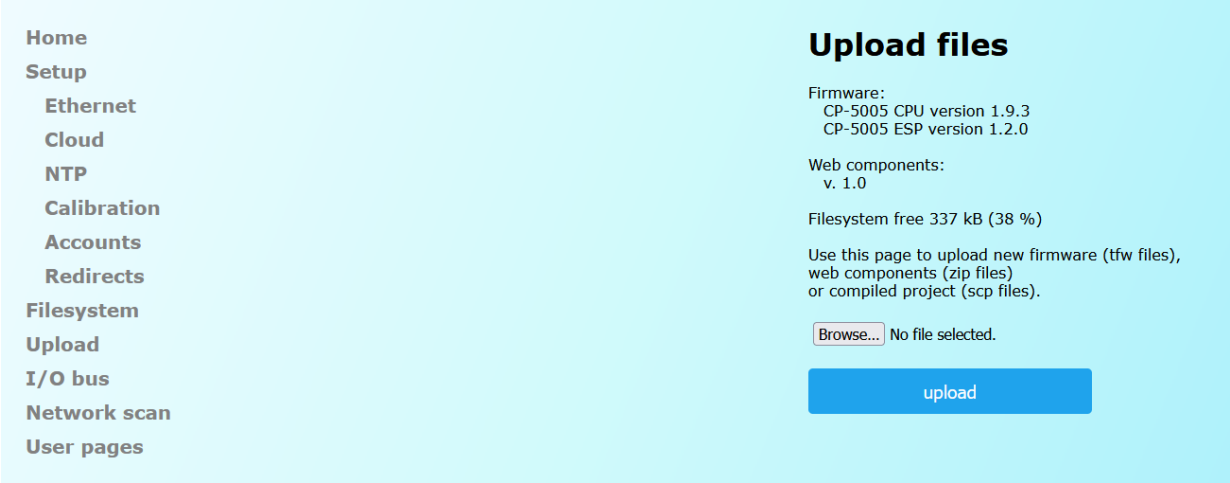


Figure 12 Upload configuration screen

During the TEO life cycle, new versions of firmware will be released with bug fixes or new features. The TEO firmware consists of a total of four parts:

1. TEO Firmware CPU (*.tlf)
2. TEO Firmware CPU (*.tlf)
3. TEO Software Control (*.scp)
4. TEO Software WEB always www.zip.

For the best possible function, we recommend that you always have the latest firmware.

When installing TEO for the first time, always check if your smartfox device has the latest firmware versions installed!
All firmware version files are available for download at the manufacturer's distribution address:
https://fw.tecoenergyoptimizer.com/

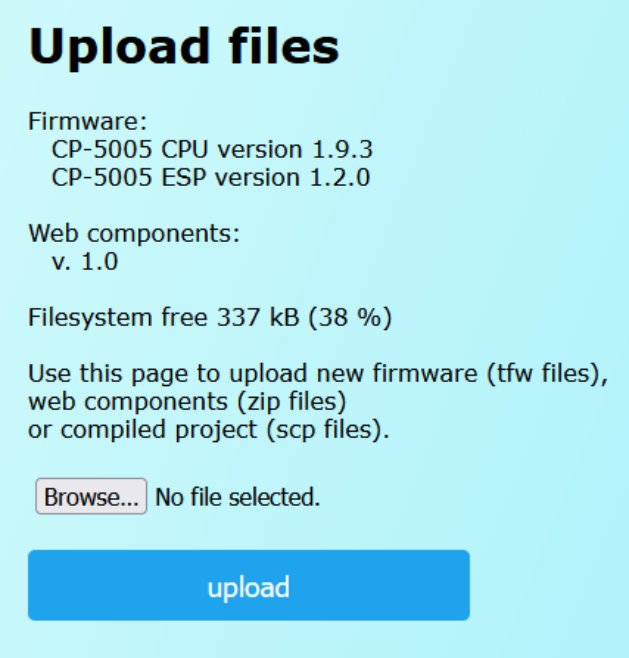


Figure 13 Firmware check and upload page

First of all, you need to update the CPU and ESP firmware (both with the *.tfw extension). If the firmware is not up to date, we can also upload it on this page using the "upload" button.

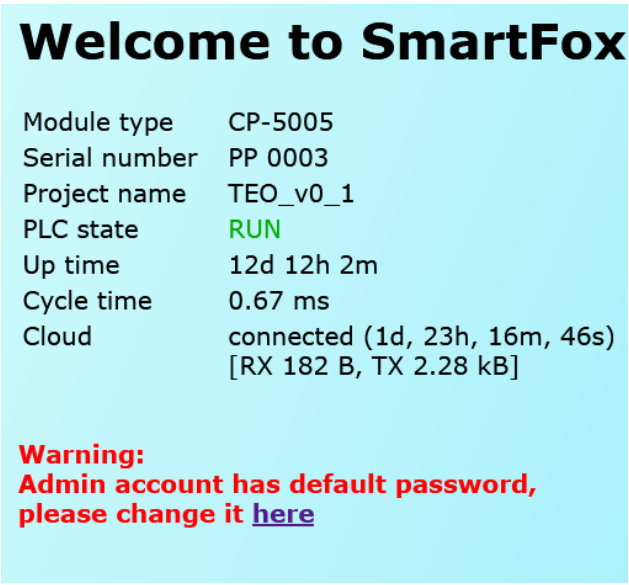


Figure 14 TEO version information page

Another firmware that can be updated on this page is the TEO (Control) program itself. It is a file with the scp extension. The current installed version of the TEO control program can be viewed at smartfox.local/plc The version of TEO Control can be found in **the Project name**.
From the example to Figure 14 *it is noticeable that the TEO unit contains SW in the version* ***TEO_v0_1***.

After updating the mentioned firmware, the configuration will be lost!

The last SW part of the application, which can be updated, is the TEO WEB web application. Information about the currently uploaded version of TEO WEB is available in the footer of the web application on the right side or on the upload page in the Web components section, see Figure 13. To upload a new version of the web application, upload the archive www.zip similar to the previous components.
Updating this component will not cause the configuration to be lost, unlike the previous ones.

9. Supported inverters and firmware versions

Teo currently supports or will soon support the inverters mentioned in the table 1.

1 Supported inverters

Producer	Series	Tested FW of the inverter
GoodWe	ET	816, 827, 1127
Solax	X3-Hybrid-G4	
Huawei (in development)	SUN2000	

It is likely that TEO will also be compatible with other versions of the FW inverter, or even with other model series than those listed.

10. Technical parameters

TEO-01

Type	DI	UNTIL	AI	AO	Comm
TEO-01	1x 120V/230V		4x AI/DI	3x 0-10V	Ethernet 2x RS-485

Connection

- Removable screw terminals.
- Compact shape for DIN rail mounting (3 modules wide) for standard control cabinets.

CPU Features	
CPU	32-bit RISC processor
Real Time Clock (RTC)	Yes
Remanent memory backup time	Unlimited
Back-up time	Type. 6 days
User Program Memory	64 KB Flash 64 kB RAM4 kB permanent

Universal inputs (ADI1 – ADI4)	
Number of inputs	4
Configurable inputs	Voltage/Resistance/RTD measurement, Current (ADI3, ADI4 only), Binary input 24V, Binary contact
Common Conductor	minus (GND)
Galvanic isolation of inputs from internal circuits	no

Function: Binary Input Contact (ADI1-ADI4)	
Input Type	Potential free contact
Min. input circuit impedance for log. 0 (UL)	50 kΩ
Max. input circuit impedance for log. 1 (UH)	100 Ω
Input current for log. 1 (IH)	1.8 mA
Delay 0 –> 1/ 1 –> 0 ADI1 ÷ ADI2 ADI3 ÷ ADI4	 10 µs 1 ms

Measuring ranges	
Current (ADI3, ADI4 only)	
Input impedance	100 Ω
Input Range	0 ÷ 20 mA, 4 ÷ 20 mA
Maximum error at 25 °C	±0.4% full scale
Permissible overload	+50 mA (between AI and AGND)
Tension	
Input Range	0 ÷ 2 V, 0 ÷ 10 V
Input impedance 0 ÷ 2 V 0 ÷ 10 V	 50 kΩ 24 kΩ
Maximum error at 25 °C	±1.5% of full scale
Resistance Temperature Detectors (RTDs)	
Input impedance	Type. 5 kΩ
Input Range Pt1000 1.385 Pt1000 1.391 Ni1000 1.500 Ni1000 1.618 KTY81-121 NTC10k 3435 NTC10k 3977 NTC12k 3740	 -90 ÷ + 320 °C -90 ÷ + 320 °C -60 ÷ + 200 °C -60 ÷ + 200 °C -55 ÷ + 125 °C -40 ÷ + 130 °C -40 ÷ + 130 °C -30 ÷ + 130 °C
Abhorrence	
Input Range	0 ÷ 2.5 kΩ, 0 ÷ 100 kΩ
Maximum error at 25 °C 0 ÷ 2.5 kΩ 0 ÷ 100 kΩ	 ±0.4% full scale ±2% full scale

Analog Inputs (ADI1-ADI4)	
Resolution	12 bit
Transfer time	32 µs per input
Type of protection	Integrated surge protection

Function: Binary Inputs 24V (ADI1-ADI4)	
Input Type	Digital 24V
Input voltage for log. 0 (UL)	0 V DC; (-5 ÷ +3 V DC)
Input voltage for log.1 (UH)	+24 V DC; (+7 ÷ +30 V DC)
Input current for log. 1 (IH)	1.2 mA @ 24 V

Analog outputs (AO1-AO3)	
Number of outputs	3
Galvanic isolation	No
Resolution	12 bit
Output range	0 - 10V
Output current	max. 10mA

Operating conditions	
Operating Temperature	-20 ÷ +55 °C
Storage Temperature	-25 ÷ + 70 °C
IP protection (IEC EN 60 529)	IP 20
Surge Category	II
Degree of pollution (IEC EN 61131-2)	2
Working position	Vertical
Installation	DIN rail mounted
Connection	Screw terminals
Cross-section of conductors	max. 2.5 mm2

Feed	
Supply voltage	230V AC / 120V AC
Range	85 ÷ 264 V AC
Maximum power consumption	3 W
Galvanic isolation	Yes
Communication	
RS-485	
Ethernet	

Annex: 1

1.1 TEO Configuration Screen

By default, this screen is available at:

http://smartfox.local/plc

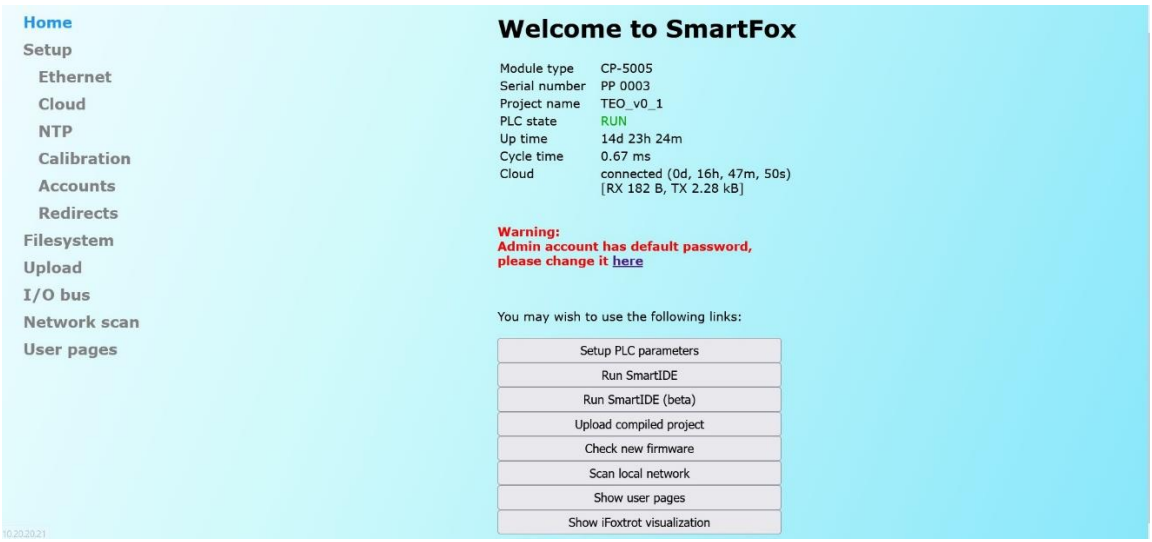


Figure 15 SmartFox device configuration screen

1.2 Set up redirection TEO application screen.

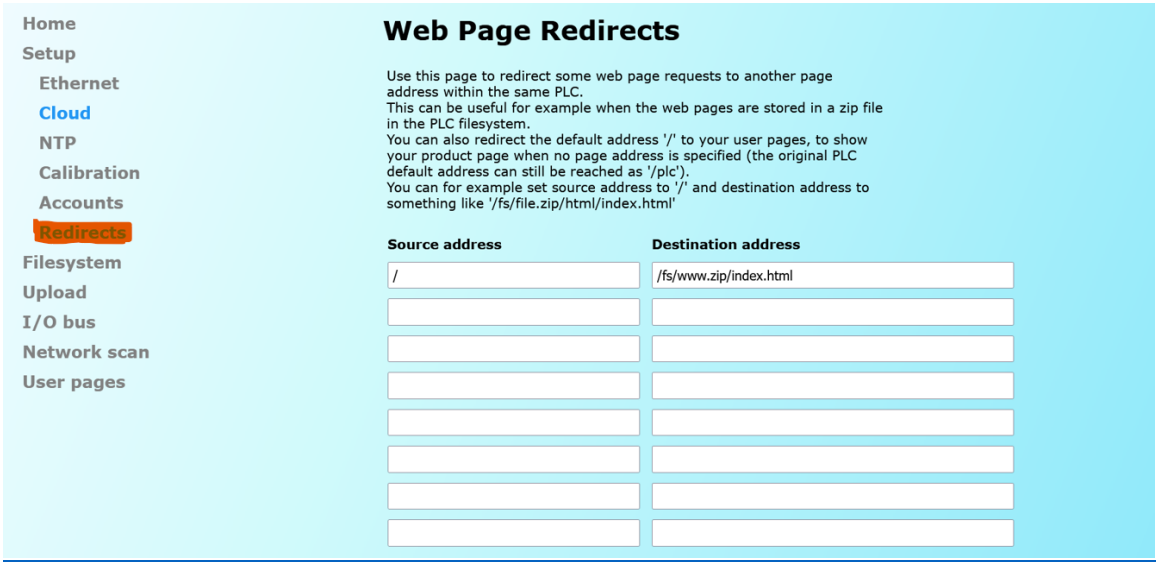


Figure 16 Setting up TEO application screen redirection