econ SOLUTIONS

# Manual

# econ sens +
# econ sens+ pro

## 3-phase Power Meter

## with

## Logging Function

**Version 1.40**

# Content

# Content

# Safety Instructions and Warranty Terms

## *Safety Instructions*

### Intended use

The econ sens+ energy consumption meter is intended solely for the measurement of electrical parameters such as voltage, current, power, electrical energy, etc.. Installation and initial operation may only be performed by electrically qualified persons.

### Hazard warnings

The warnings denote the following:

**Danger**:
Means that there is an immediate risk to the health of the user if the appropriate safety measures are not taken.

**Warning**:
Risk of potential damage to property or damage to the device if the appropriate safety measures are not taken.

### Information on disposal

The econ sens+ energy consumption meter contains a small lithium battery. Never dispose of used batteries with normal household waste. They should be handed in at a collection point for used batteries.

## *Warranty Terms*

econ solutions GmbH assumes no liability and furnishes no warranty for any consequences of improper use, in particular if the user and installation instructions have not been observed. The user must ensure that the device is not operated outside the specified technical parameters.
In the event of changes or modifications to the device and of unauthorized repairs by the user, the warranty becomes void.

All information contained in this manual was prepared to the best of our knowledge and checked with care. Nevertheless, errors cannot be completely ruled out. For this reason, the information contained in this manual is not associated with any obligation or guarantee of any kind. The authors, companies and the publisher assume therefore no legal responsibility and will not assume any consequential or other liability, that might arise in any way from the use of this information or parts of such, also not for any breach of patent rights or other rights of third parties that could result therefrom.



## Description

econ sens + is a compact, versatile energy consumption meter with a web interface and memory function.
It measures the voltage and the current of the individual phases and the voltage between PE and the neutral conductor.
When calculating the power, econ sens+ is able to differentiate between the generated and consumed power. The energy consumption values calculated from the power data are displayed to the user via the web interface and made available for any energy monitoring systems or similar that may be connected via:

1. 2 x S0 pulse outputs to DIN EN 62053-31 (for consumed and generated active energy)
2. Modbus TCP
3. Modbus RTU (RS-485)

Allowed the detection of active, reactive and apparent power, current and voltage, each per line and further readings on the Modbus interface (see Chapter Modbus).

The econ sens+ samples the input voltages and currents at 32 samples/signal period. To do this, it tracks the frequency of the inputs and continuously updates its sampling rate accordingly. At the same time, the econ sens+ resamples the input voltages at 1kHz. These samples give a picture of the waveform. These waveforms are stored for several types of events.

The econ sens + has a size of 16MB memory to store values, logs and events. It holds power logs per second for the last 2 days. It logs all measurements per minute for the last 39 days, per interval (10 or 15

minutes) for the last 13 months and per day for the last 10 years. No logging is performed if the time is not valid.

Logs are stored after every interval. Average, minimum and maximum values are determined over the interval. The interval is expressed in seconds and can be either 600s (10min) or 900s (15min).

## *Special features*

- For 2, 3, and 4-wire power systems with arbitrary load
- Modbus TCP
- 2 x S0 pulse outputs for consumed and generated active energy or alternatively, Modbus RTU (RS 485)
- Acquisition of instantaneous values for U, I, P, Q and power factor per phase, together with mean and cumulative values
- Current range up to 3200 A / phase
- No additional current transformer needed
- Integrated web interface for configuration and fast and simple data acquisition
- Quick installation, even during operation*

***Please note!**

In order to log the current strength, it is not necessary to switch off the consumer load that is to be measured, as the Rogowski coils can be opened and wrapped round the conductor. When connecting the voltage path, the relevant safety regulations for work on electrical systems must be observed!

# Connections

## *Overview S0 model*

Figure 1 shows the layout of the econ sens+ connections (S0 model)

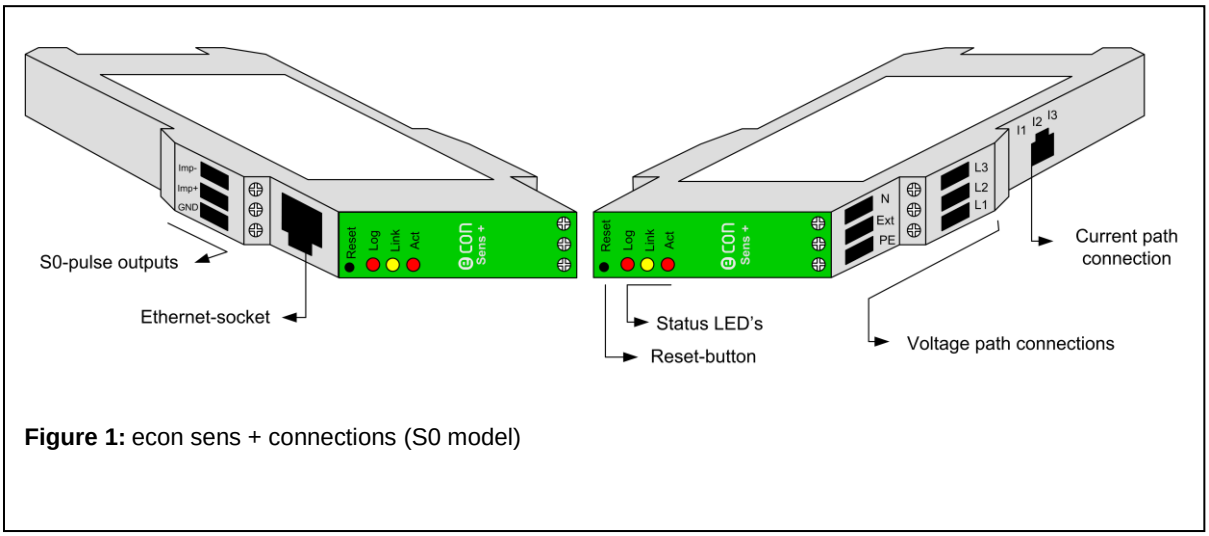



**Figure 1:** econ sens + connections (S0 model)

**S0-pulse outputs**

**Imp - :** Pulse output (Open Collector, NPN) for generated energy

**Imp + :** Pulse output (Open Collector, NPN) for consumed energy

**GND :** Common ground for Imp – und Imp +

## *Overview RS485 model*

Figure 2 shows the layout of the econ sens+ connections (RS485)

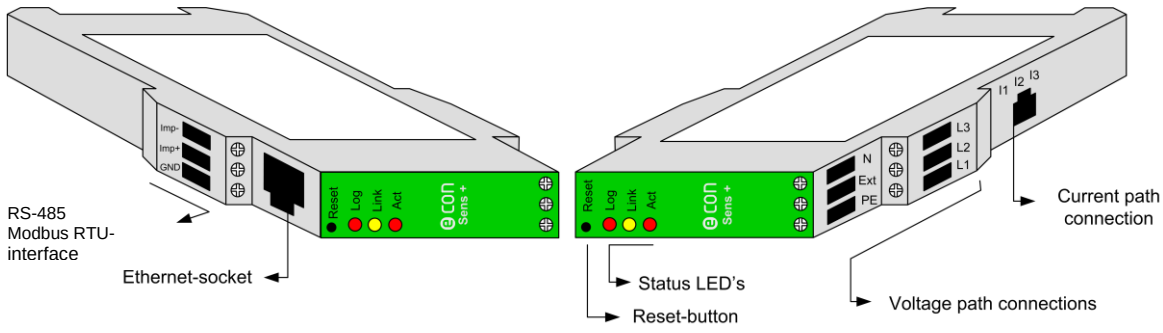



**Figure 2:** econ sens + connections (RS485)

**RS485 model (Modbus RTU):**

**A :** data line B Modbus RTU

**B :** data line A Modbus RTU

**GND :** Common ground for data line A and B.

## *Voltage path connections*

**L1, L2, L3:** Terminals for phases L1, L2 and L3

**PE:** Terminals for the PE conductor

**Ext:** "Extension" terminal. Is bridged with terminal L2

**To avoid damage to the econ sens+, the maximum torque for tightening the terminals is ≤ 2.5 Nm.**

## *Current path connections*

**I1, I2, I3:** Connection socket (RJ11) of the econ sens+ coils for current measurement

## *Ethernet connection*

**Ethernet:** Ethernet connection (RJ45) / 100 Mbit (fixed speed)

## *Indicators and operating controls*

## *S0 model*

Figure 3 shows the layout of the indicators and operating controls of the econ sens+.


**Figure 3:** econ sens+ indicators and operating controls (S0 model)

**“Log” LED:** Lights up as soon as the econ sens+ records measured data

**“Link” LED:** Lights up when there is an active connection to the network

**“Activity” LED**: Lights up or flashes as soon as data is sent or received via the Ethernet port

**Reset**: Reset button to perform “Factory Reset”.

## RS485 model

The RS485 model of the econ sens + differs in its external appearance only by the absence of the lower right corner of the front panel (see Figure 4). All operating and display elements are identical to those of S0 model.

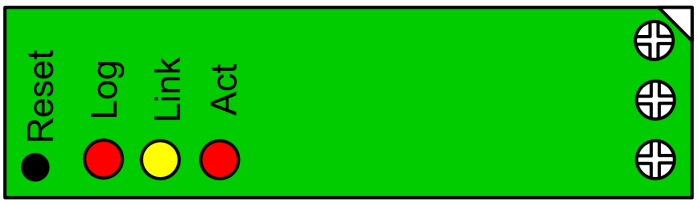



**Figure 2:** econ sens+ indicators and operating controls (RS485 model)

Further details on the connections can be found in the "*Technical Data*" chapter; examples of connections can be found in the *"Installation Instructions"*.

# Installation Instructions

## *Mounting the device on the top hat rail*

The econ sens + energy consumption meter was designed for mounting on a top hat rail. The device is attached at an angle to the top hat rail with the upper retaining lug and locked into place with light downward pressure (see Fig. 5).

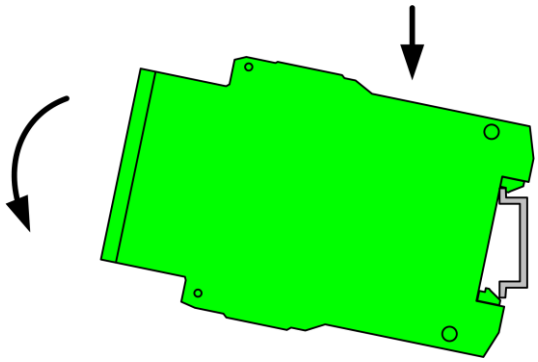


**Figure 3:** Mounting the econ sens+

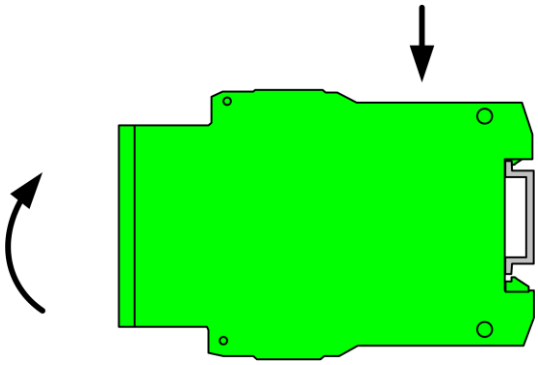


**Figure 4:** Dismounting the econ sens+

The device is dismounted as shown in Fig. 6. Press the device downwards using light pressure and then pivot it upwards.

## *Connecting the voltage path*

**Installation of the econ sens + may only be performed by specially trained staff (e.g qualified electricians).**
**Safety regulations for working with electrical power systems must be observed under all circumstances!**

The econ sens+ energy consumption meter can be used with various public power supplies:

**3-phase four-wire power system (with neutral conductor)**

**3-phase three-wire power system (without neutral conductor)**

**Single-phase power system**

Fig. 7 shows the integration of the econ sens + into a 3-phase 4-wire power system.

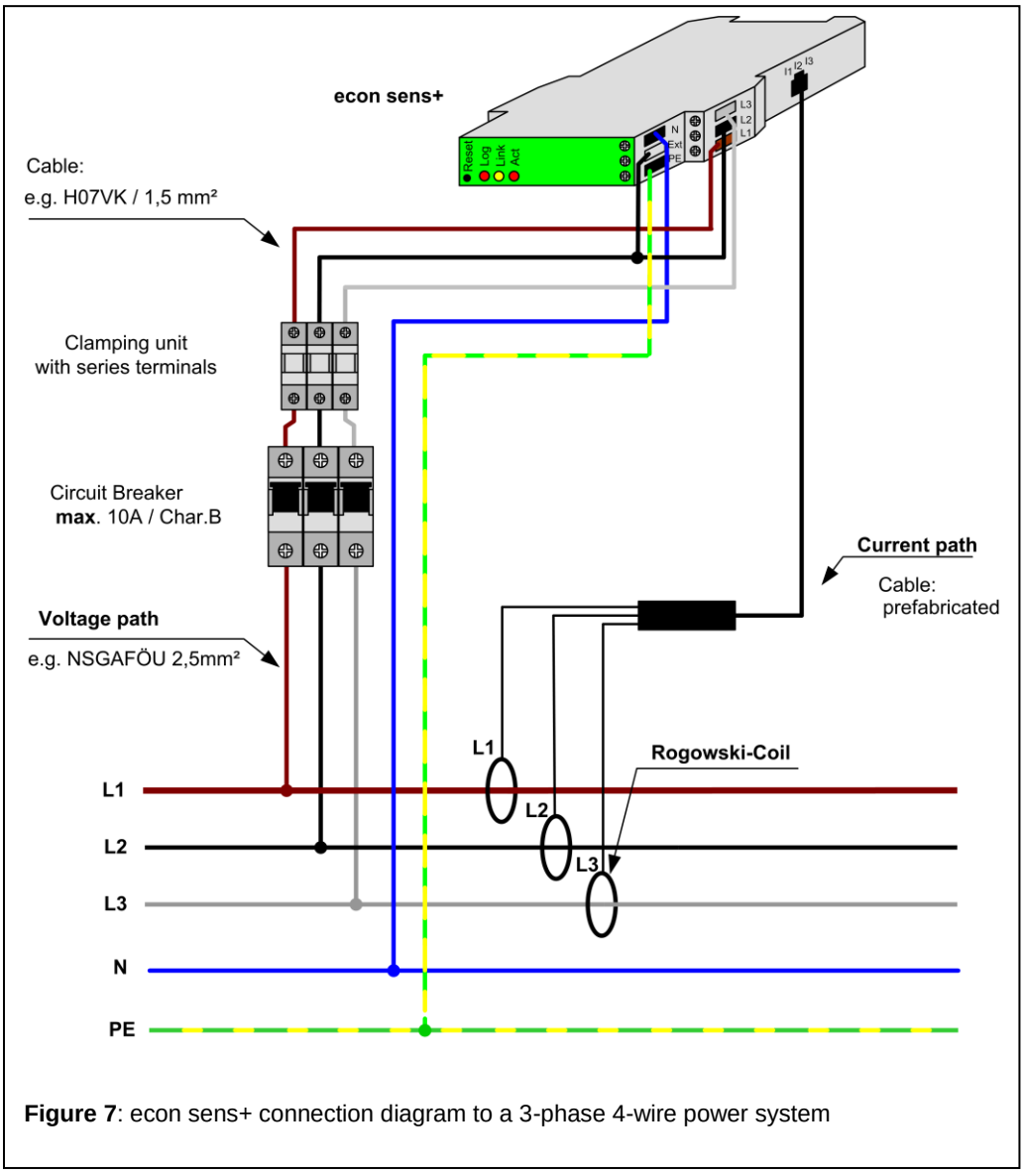



**Figure 7**: econ sens+ connection diagram to a 3-phase 4-wire power system

The phases L1, L2 and L3 of the voltage path must be protected by means of automatic circuit breakers to prevent the system from being damaged in the event of a short circuit. A B6 (max. B10) automatic circuit breaker is recommended. For safety reasons it is preferable to use a short-circuit-proof conductor (NSGAFÖU) in front of the circuit breakers.

If several econ sens+ devices are installed next to one another it is recommended that you use a clamping unit with series terminals. As a result it is easier to direct the fused voltage path in parallel to all devices.

Table 1 shows the terminal assignment of the voltage path terminals for the various types of power system.

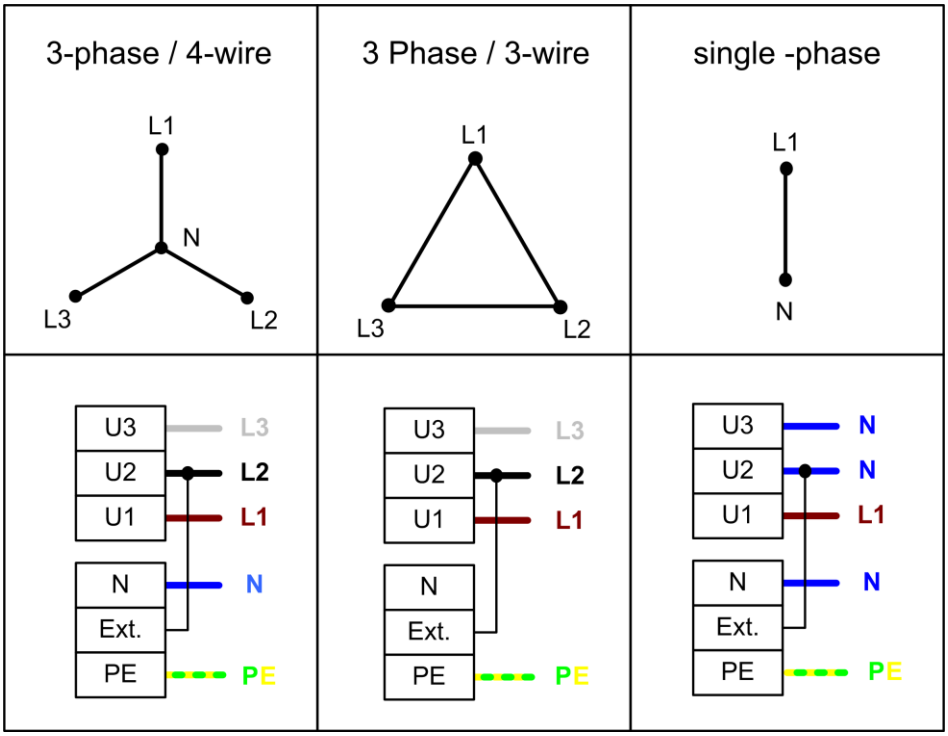



**Table 1:** Connection diagrams of various power system topologies

## *Installing the econ sens + in a 690V grid*

The econ sens + can also be used in a 690 V grid (IT-System). It should be noted that a neutral conductor is required. This is because the power supply of this device is itself designed for voltages on the primary side to 440Vrms. When connected to a 690 V power connection so the image has to be used according to Fig. 8.

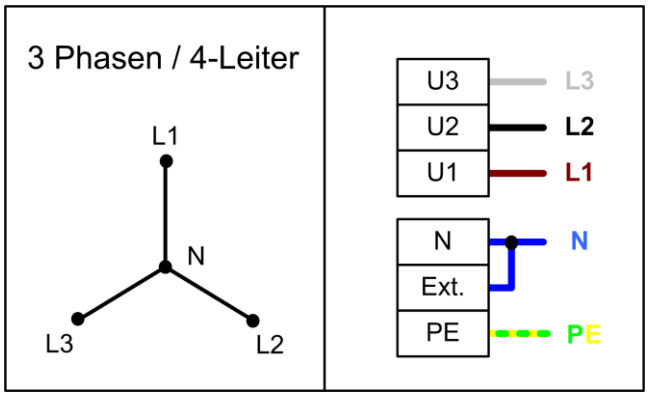



**Abbildung 8:** Anschlussschema 690 V-Netz

## *Installing the current sensors*

To install the current sensors (Rogowski coils), wrap these around the conductor that is to be measured, as shown in Fig. 9. This can be a cable or also a conductor rail.
Insert the free end of the cable into the end piece of the coil until it latches into place. The coil must form a closed loop around the conductor.

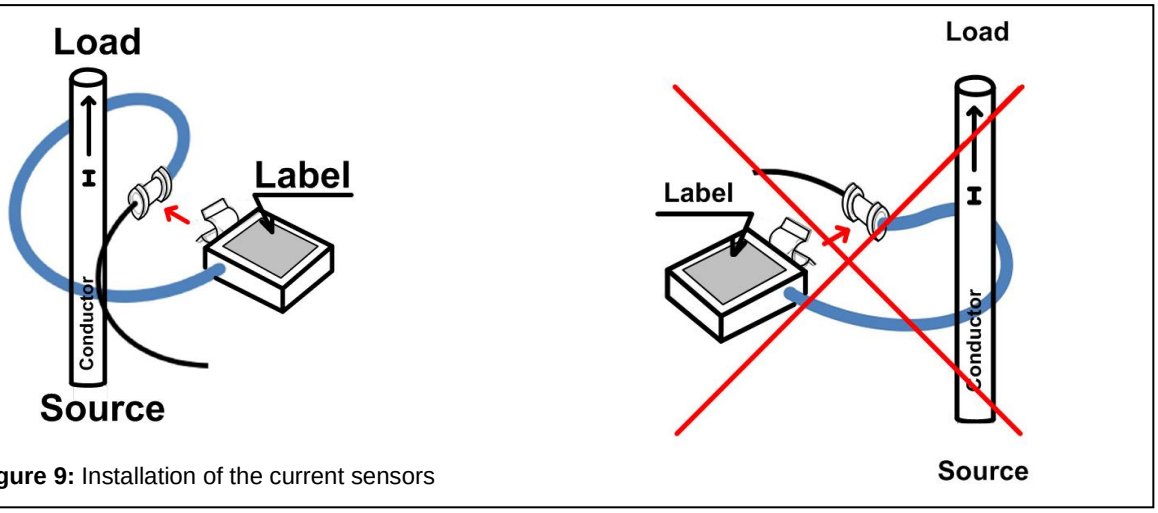



**Figure 9:** Installation of the current sensors

The label on the coil must be aligned in such a way that it points towards the consumer. This ensures the correct direction of current flow through the coil.
Please also ensure that each sensor matches the corresponding phase of the voltage path (coil L1 to phase L1, etc.)

**Alignment of the coil with the current flow**

If possible, secure the coil round the conductor (cable, conductor rail, etc.) with a tie wrap. Make sure that the loss angle of the coil is not too large (see Fig. 10).

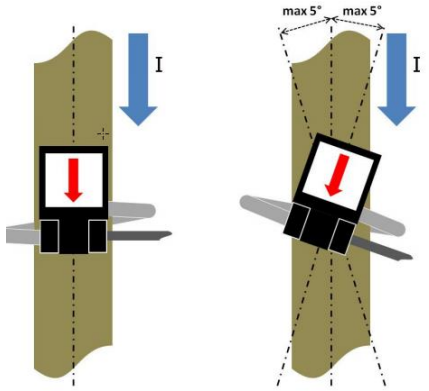



**Figure 10:** Loss angle of the current sensors

In the case of loss angles > +/-5°, the relative error of measurement is also greater and consequently also the relative deviation of the measured current and the calculated parameters (e.g. power).

# Connecting the data outputs

## *S0-Interface*

The consumption data measured by the econ sens+ is outputted via the pulse outputs Imp+ and Imp- (open-collector NPN outputs) as a pulse sequence. Each output pulse is 50 ms long and corresponds to a defined amount of energy in Wh. This can be configured via the web interface. (For details see “Web Interface” chapter). The default value for this pulse weighting is 10 Wh/pulse, which corresponds to an output of 100 pulses/kWh.
The pulse outputs are used for the automated capture of the energy consumption values by means of a data logger, e.g. the Econ Unit. Fig. 11 shows the layout of the pulse interface.

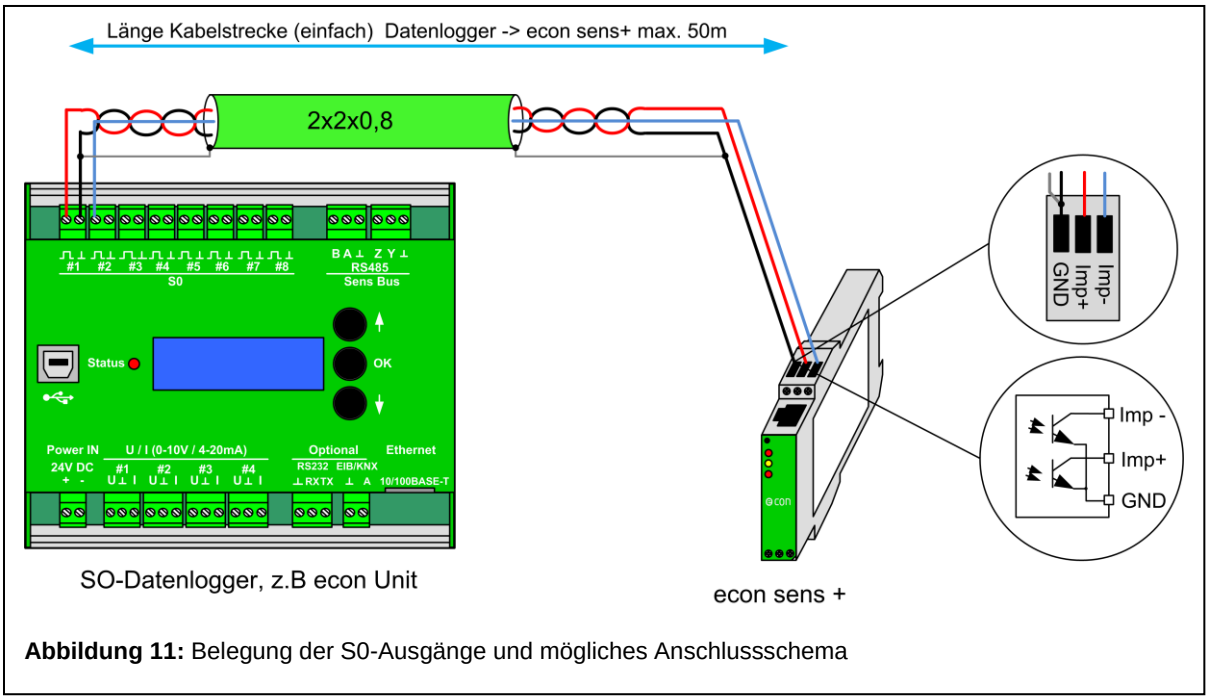



**Abbildung 11:** Belegung der S0-Ausgänge und mögliches Anschlussschema

The distance between the data logger and the econ sens + may be amount to max. 50 meter. When connecting a cable, a shielded cable is recommended *, as Belden YE00820. For shorter distances an unshielded cable can be used.

* A shielded cable should come in all applications where massive electromagnetic disturbances from the environment is expected.

## *RS485-Interface*

The econ sens + supported on this interface the following protocols:

- Modbus RTU

## *Modbus RTU*

Via the RS485 Modbus RTU protocol, the values "Modbus / pulses / s submenu " p.17 ff) can be retrieved according to section.

To use Modbus RTU a Modbus master is required. In a segment of up to 32 devices can be connected together. For more than 32 devices in a segment repeaters are required. The wiring of components is a “linear structure”, as shown in Fig 13. Other bus topologies, such as Star shape is not possible. At the beginning and end of a segment, the cable is terminated with resistors (bus termination). Put between lines A and B a 120 Ω termination resistor. As a connecting line between the devices we recommend a shielded cable 2x2x0, 8, for example, Belden YE00820 or a Cat 5 network cable. The maximum length is 1200 meters.

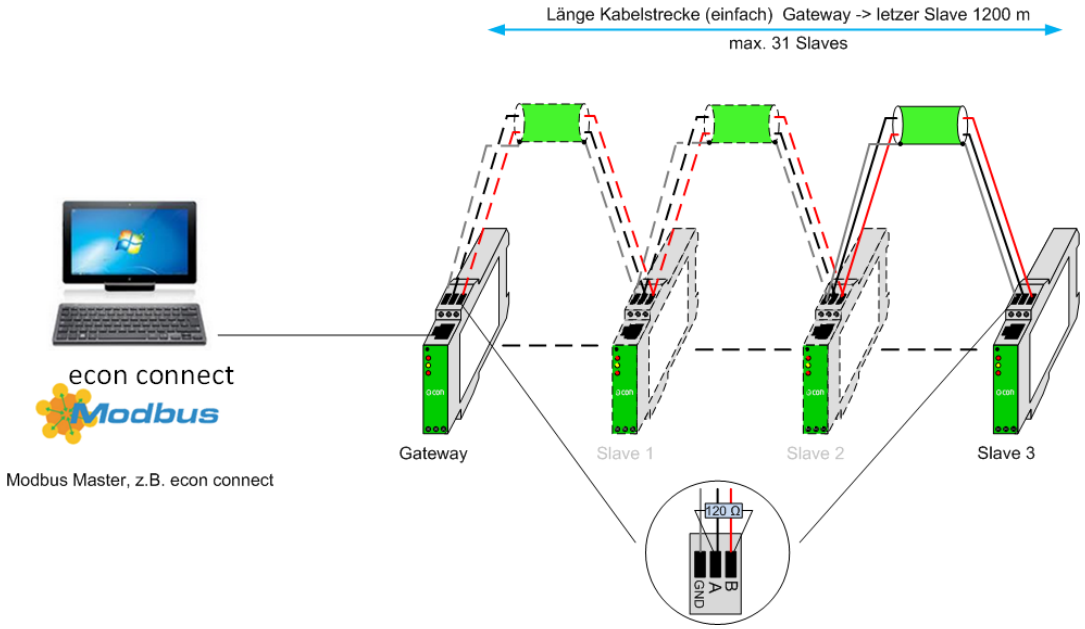



**Figure 13:** Assignment of the RS485 outputs (here with one econ sens+ as gateway)

## *Connecting the network*

The econ sens+ energy consumption meter has a 100BASE-T network connection for web interface access. This can be connected to a PC either directly or via a node such as a hub or switch. Connect the econ sens+ to your hub/switch using a patch cable (1:1) or directly to your PC (using a crossover cable).

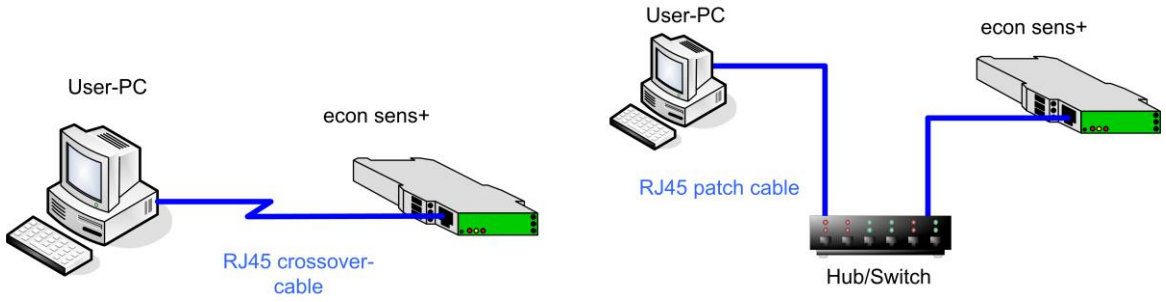



**Figure 14:** econ sens+ network connection

Further information on the IP address settings, etc. can be found in the “Initial operation” chapter.

## *Modbus TCP*

Via the network connection measured values and events (Pro variant) can be accessed via the Modbus protocol for both versions (S0/RS485). The parameter settings are performed in the Modbus / pulses / s submenu. The corresponding register addresses can be found in the manual on page 34 ff.

# Web Interface of the econ sens+

## *Accessing the web interface*

The web interface is accessed by entering the IP address of the econ sens+ in the address bar of the web browser (Firefox, IExplorer, GoogleChrome, etc.). The network default settings of the econ sens+ are as follows:

| | |
|---|---|
| **IP address:** | **192.168.0.1** |
| **Subnet mask:** | **255.255.255.0** |
| **Standard gateway:** | **192.168.0.254** |

For the web interface to be accessed, ensure that the user PC is in the same network as the econ sens+. Configure as follows (e.g. under WinXP):

**1.** Under *"Start / Control Panel / Network and Internet Connections / Network Connections"* double-click the LAN connection of the network interface card connected to the network.

**2.** Click the "*Properties"* button.

**3**. Select *"Internet protocol (TCP/IP)"* from the list and click on *"Properties".*

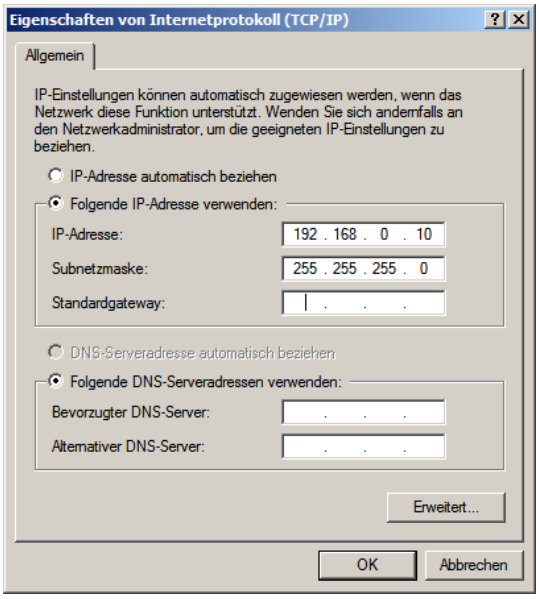



**Figure 15:** Internet protocol properties

**4**. Activate the options "Use the following IP address" and "Use the following DNS server addresses".

**5**. Enter the parameters shown in Fig. 10 and confirm with "*OK*".

When the above IP address is entered in the web browser, the econ-sens+ homepage should appear.

The settings for Windows 7 are performed in the *Network and Sharing Center.*

**Accessing the web interface in a network with a DHCP server**

If the econ sens+ is located in a network in which there is a DHCP server available for automatic address assignment, it automatically adopts the address assigned to it by this server. You can identify which address the econ sens+ has been given in the DHCP Server.

## *Home menu*

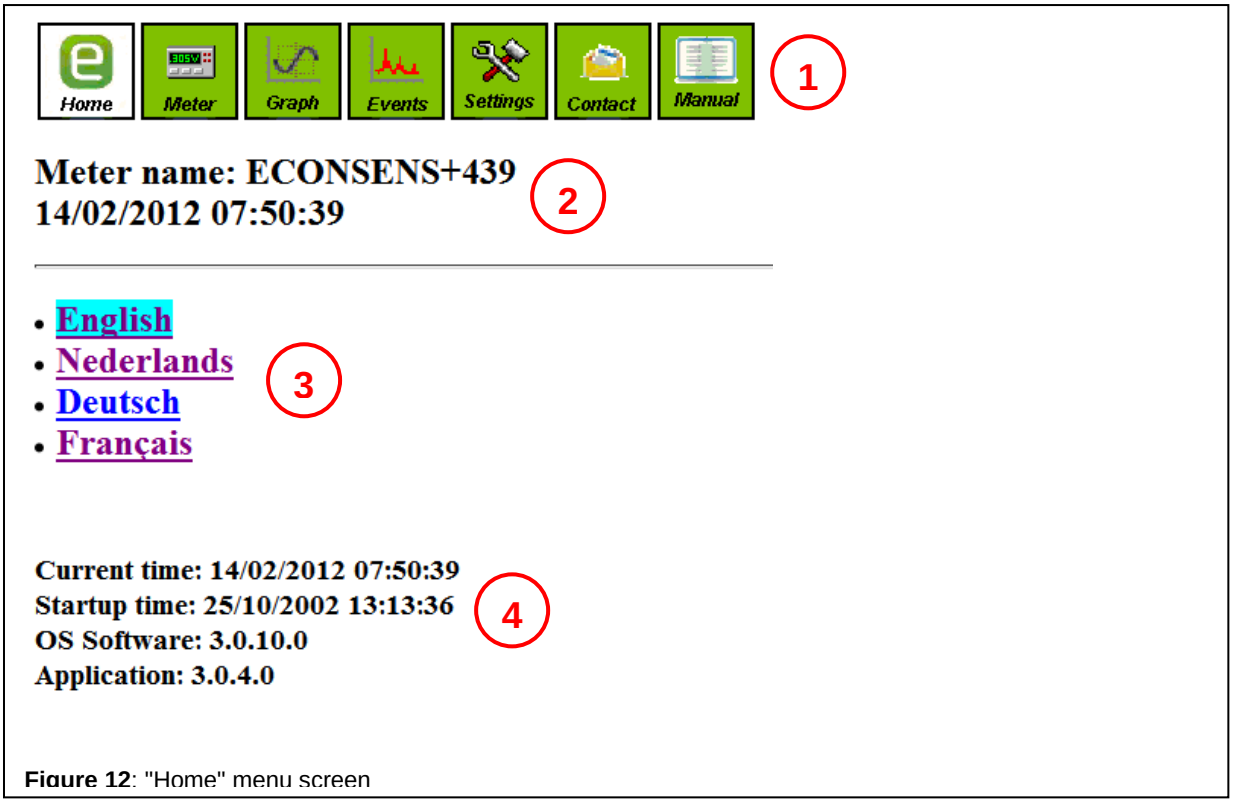



**Figure 12**: "Home" menu screen

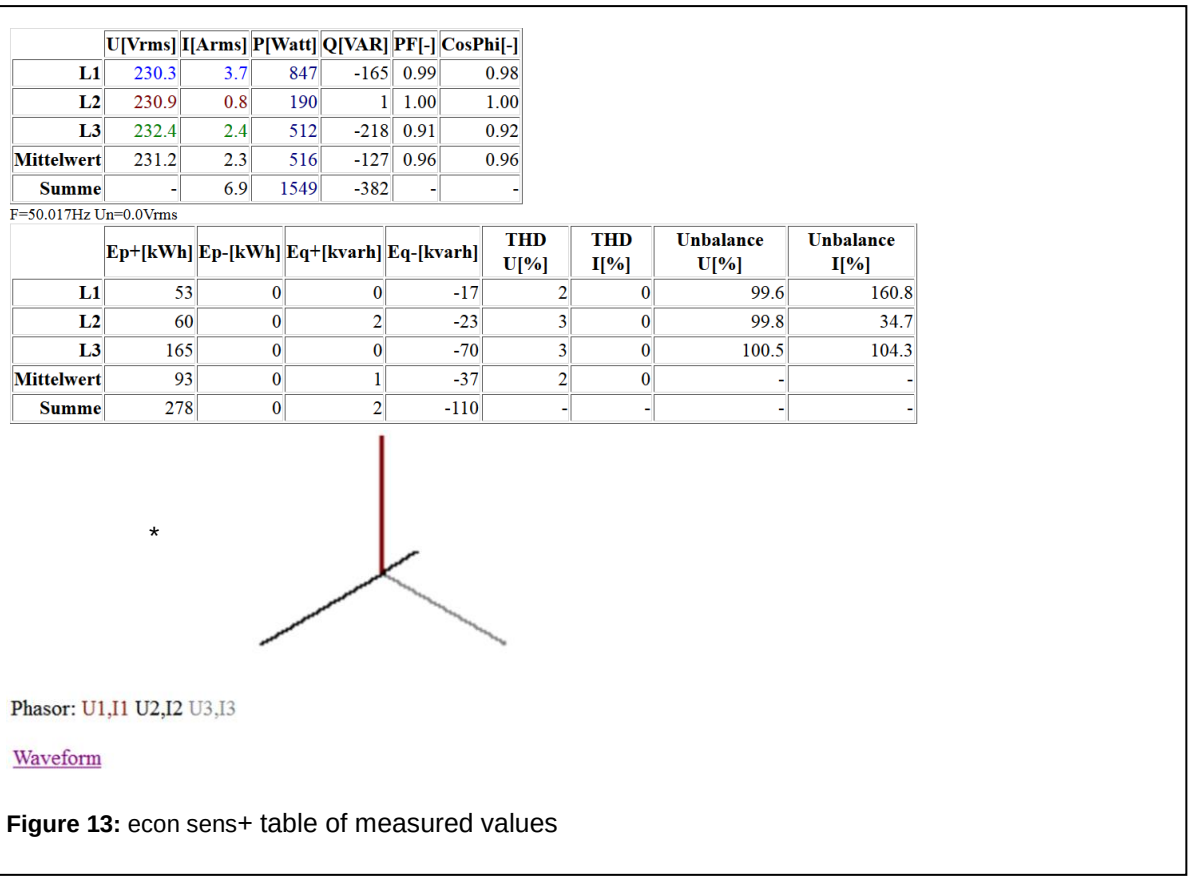
On the home screen of the econ sens + you find the following information:

1. Menu bar to navigate the individual menus of the econ sens+
2. Device name and current time/date
3. Language selection menu
4. Information bar
    - Time/date settings
    - Start-up time
    - Operating system version
    - Application software version

## *Meter menu*

Econ sens+ displays the measured values in tabular form in the *Meter* menu.

This table is shown in Fig. 17.



| | U[Vrms] | I[Arms] | P[Watt] | Q[VAR] | PF[-] | CosPhi[-] |
|---|---|---|---|---|---|---|
| L1 | 230.3 | 3.7 | 847 | -165 | 0.99 | 0.98 |
| L2 | 230.9 | 0.8 | 190 | 1 | 1.00 | 1.00 |
| L3 | 232.4 | 2.4 | 512 | -218 | 0.91 | 0.92 |
| Mittelwert | 231.2 | 2.3 | 516 | -127 | 0.96 | 0.96 |
| Summe | - | 6.9 | 1549 | -382 | - | - |

F=50.017Hz Un=0.0Vrms

| | Ep+[kWh] | Ep-[kWh] | Eq+[kvarh] | Eq-[kvarh] | THD U[%] | THD I[%] | Unbalance U[%] | Unbalance I[%] |
|---|---|---|---|---|---|---|---|---|
| L1 | 53 | 0 | 0 | -17 | 2 | 0 | 99.6 | 160.8 |
| L2 | 60 | 0 | 2 | -23 | 3 | 0 | 99.8 | 34.7 |
| L3 | 165 | 0 | 0 | -70 | 3 | 0 | 100.5 | 104.3 |
| Mittelwert | 93 | 0 | 1 | -37 | 2 | 0 | - | - |
| Summe | 278 | 0 | 2 | -110 | - | - | - | - |



**Figure 13:** econ sens+ table of measured values

The following are displayed: the voltages of the phases L1, L2, L3, the corresponding currents, as well as the active and the reactive power per phase and the “power factor” (for pure sinusoidal alternating currents, this is synonymous with the familiar cos phi).

You can refresh the display by pressing the *F5 key* on your keyboard as required or you can activate the arrow button next to the word “*Actual power”.* Then the display will be updated every second.

The *vector* diagram below the table serves to visualize the phase shift between the voltages L1, L2 L3 and the corresponding currents.

*The “Un” specification below the table indicates the so-called neutral conductor voltage (voltage difference between the neutral conductor and the protective earth). This is needed for the Events menu, which deals with network analysis. This menu is however disabled in this software version.

You can also have the voltage and the current on the three phases displayed as a curve by selecting the *Curve* option at the bottom left of the screen. (see Fig.18)

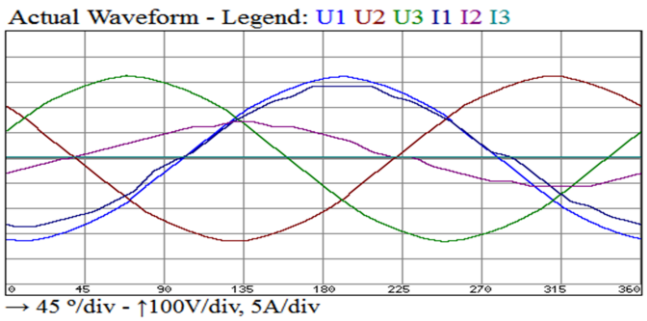



**Figure 18:** Current and voltage curves

Econ sens+ is able to measure and display both the generated and the consumed active power. This is illustrated in Fig.12.

The consumed active power is shown in the table in blue, while the generated active power with a negative sign is shown in red. In the above example this means that on phase L1 power is only consumed and on phase L2 power is only generated.

If power is both consumed and generated at the same time on one phase, econ sens+ shows the **sum** of the two.

An example:

With your photovoltaic power system with downstream inverter you generate 1 kW on each of the three phases L1, L2, L3, at the same time consuming 500 Watt on phase L2 for various household appliances. Then your table of measured values would look like the table in Fig. 19.

**Actual Power**

| | U[Vrms] | I[Arms] | P[Watt] | Q[VAR] | PF[-] |
|---|---|---|---|---|---|
| **L1** | 227.8 | 4.4 | -1000 | 36 | 1.00 |
| **L2** | 228.3 | 2.2 | -500 | 7 | 1.00 |
| **L3** | 228.9 | 4.3 | -1000 | - | - |
| **Mean** | 228.3 | 3.6 | -833 | 21 | 1.00 |
| **Sum** | - | 10.9 | -2500 | 43 | - |

Un=0.1Vrms

**Figure 19:** Table of measured values for the example

## Installation check routine „Installation check“

The econ sens + has a small installation check routine, called "installation check".

**Messwerte**

| | U[Vrms] | I[Arms] | P[Watt] | Q[VAR] | PF[-] |
|---|---|---|---|---|---|
| **L1** | 226,2 | 27,9 | 6311 | 27 | 1,00 |
| **L2** | 228,6 | 0,1 | - | - | - |
| **L3** | 227,9 | 0,1 | - | - | - |
| **Mittelwert** | 227,5 | 27,9 | 6311 | 27 | 1,00 |
| **Summe** | - | 27,9 | 6311 | 27 | - |

Un=0,2Vrms

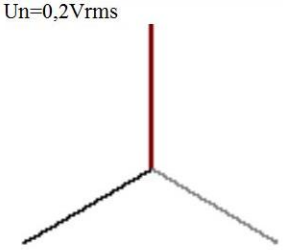


**Figure 20: Table of measured values without error message**

General, it is assumed that all measurement coils were installed correctly, and the measured load has a power factor of >0.71 (phase shift between U and I <45 °). Then the table of measurements in Figure 20 is shown. In this example, a load of about 6 kW measured at L1, L2 and L3 are unloaded.

Is an installation error, for example, the coil L2 is placed around the voltage circuit from L1, the power factor falls below 0,71 and it appears in the table of measurements the following error message:

**Messwerte**

| | U[Vrms] | I[Arms] | P[Watt] | Q[VAR] | PF[-] |
|---|---|---|---|---|---|
| **L1** | 226,2 | 0,0 | - | - | - |
| **L2** | 228,4 | 27,4 | -3187 | 5376 | 0,50(*) |
| **L3** | 227,9 | 0,1 | - | - | - |
| **Mittelwert** | 227,5 | 27,4 | -3187 | 5376 | 0,50 |
| **Summe** | - | 27,4 | -3187 | 5376 | - |

(*) Fehler: Power factor zu niedrig. Weitere Informationen finden Sie im Handbuch ! 2

Un=0,2Vrms

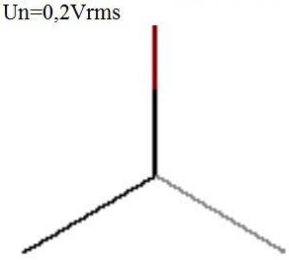


**Figure 21: Error message**

In the table of measured values it can be seen that the power factor of phase 2 has dropped below 0,71 and the phase shift between U2 and I2 in the graphic "Phasor" has 120°. This is a typical error pattern for the above-named Installation errors.

**Note:**

Due to the simplicity of the installation check routine, there are also cases where there are no installation errors, the routine but still displays an error message such as:

a) The measured power is exclusively produced and there is a little or no consumed power

b) The power factor of the connected load is actually <0,71

Therefore, always be careful to correct installation of the measuring coils and their assignment to the voltage path to avoid misunderstandings.

## *Graph menu*

In the Graph menu, the measurement results are represented as a measuring curve. Fig. 22 shows an example of such a curve.

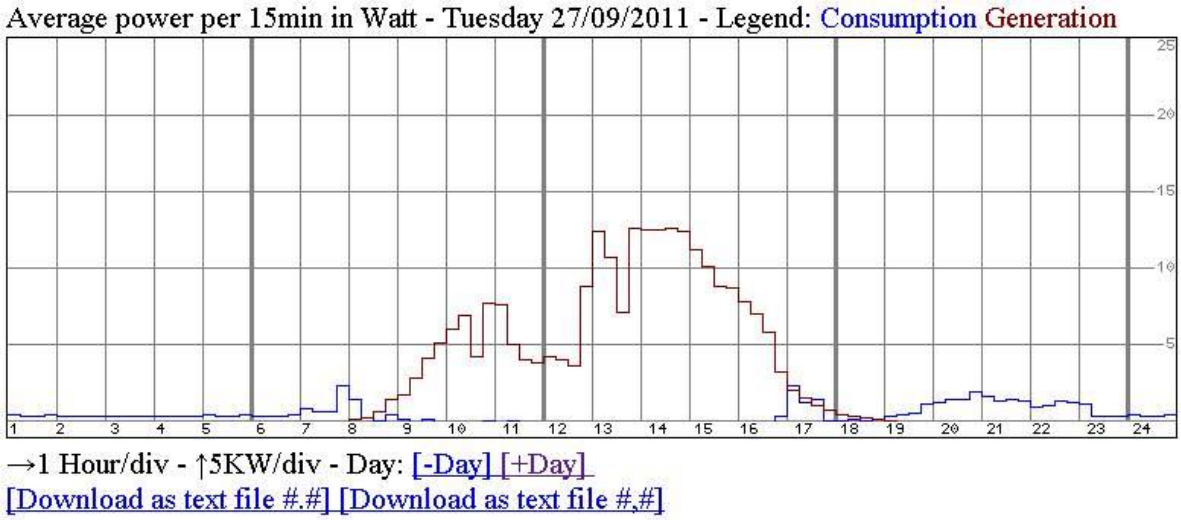



**Figure 14:** Measuring curve in Graph menu

The sum of the power/energy from the three phases is shown over a certain period of time. Using the – *period* and + *period* buttons next to the X-axis label you can toggle through the measuring curves step by step (e.g. every day of a month).

The following views are available:

| | |
|---|---|
| Month view: | Consumed and generated energy (kWh) in 15-min steps |
| Day view: | Consumed and generated energy (W) in 15-min steps |
| Hour view: | Consumed and generated energy (W) in 1-min steps |
| 15-min view: | Consumed and generated energy (W) in 1-s steps |

The measured values associated with the curves can be downloaded as a text file using the Download function

Using *File-> Save page as…* in your browser you can transfer the text file to your PC.
There are two Download options to choose from; the only difference between them is the use of different separators (comma or point) in decimal numbers

## *Events menu*

The Events menu is used to configure the recording of network events. These are needed for network analysis in accordance with EN 50160. This function is optional available (Pro-version).

## *Settings menu*

The Settings menu is used for the parameterization of the econ sens+. All settings required for the operation of the device can be performed in the corresponding submenus. The main page of the menu shows status information.

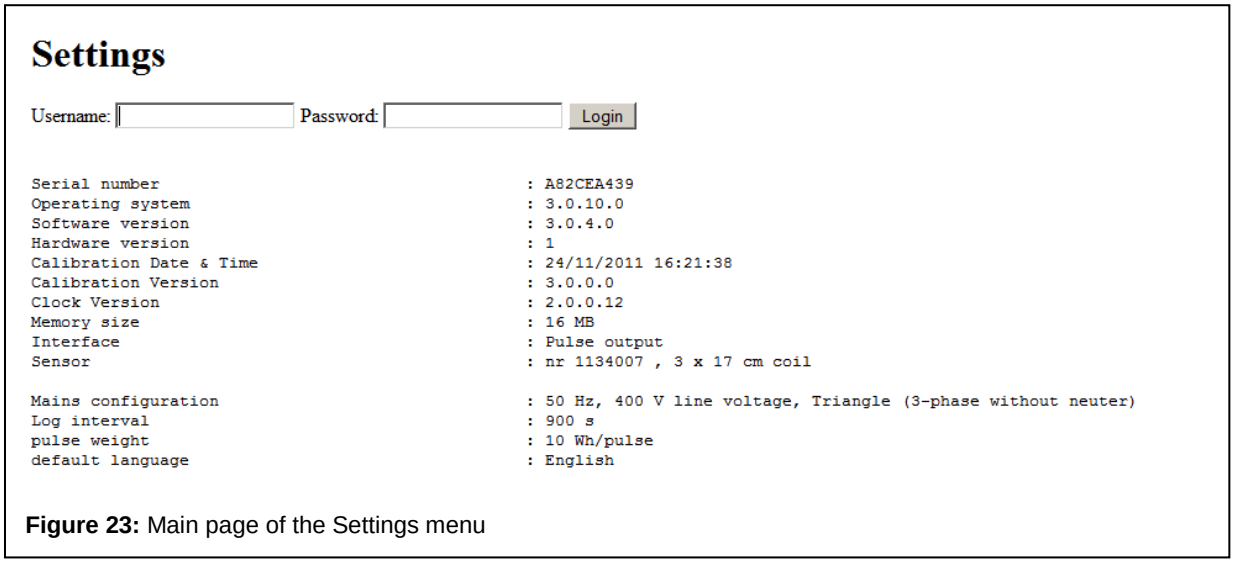



**Figure 23:** Main page of the Settings menu

You can access the submenus by entering your user name and password. The default settings are as follows:

**User name: user** **Password: pass**

Via the login you will be redirected to the submenus and will automatically land in the *Time/Date* submenu.

## General information on saving settings

The overall configuration procedure for the econ sens+ is spread over several menus and various input windows.
On every menu page there is an *Accept* button. This is used to save your inputs on the respective menu page, i.e. if you change the menu page and forget to press *Accept*, your inputs will revert to the default values.
In order to permanently save your settings at the end of the overall configuration procedure, select *Store changes in permanent memory* in the *Save* menu and confirm with *Accept*.

On every menu page you will be reminded to permanently save your settings with the message "*Remember to save your changes permanently"*.

## Time/Date submenu

Time/Date submenu is used to configure the time and date settings of the econ sens+.

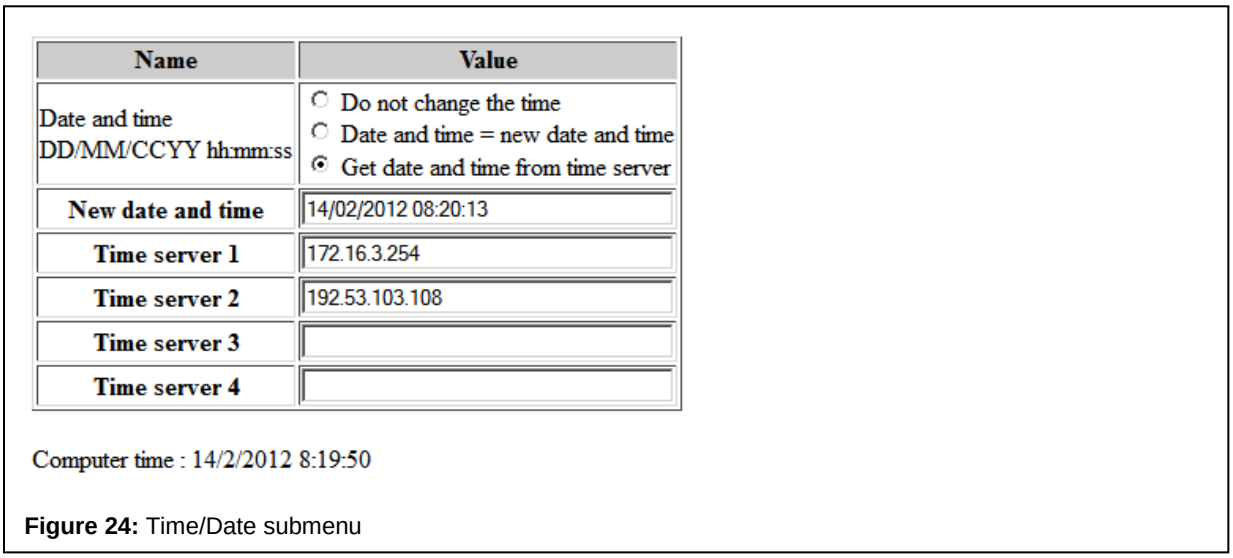



**Figure 24:** Time/Date submenu

The following options are available:

**1. Time setting using NTP time server**

If the econ sens+ is in a network in which a time server with NTP protocol is available, the device can adopt the time and date from this server. To do this, activate the *Adopt time and date from time server* select box.
You can define up to four ntp time servers. To do this enter the IP addresses or names of the respective servers in the fields adjoining ntp time servers 1..4, e.g.

ptbtime1.ptb.de or 192.53.103.108

When you click on *Accept, the* econ sens+ first of all checks the connection to the specified server. If there are several servers available, the device automatically selects the one with the shortest response time.

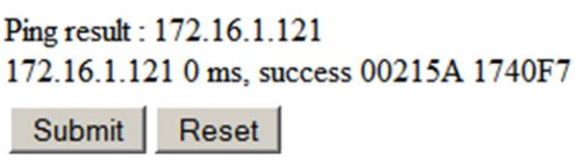



**Figure 25:** Connection to time server was successful

**2. Manual time settings:**

If there is no ntp time server available, the device time settings can be set manually.

Activate select box *Date and time = set time manually*. When you click on *Accept,* the system time and date of the econ sens+ are compared with the values in the *Set time manually* field. Copy e.g. the time settings of your PC into this field.

Click on *Reset* to reset your entries to the default values.

## Network submenu

In the *Network* menu you can perform the basic network settings of the econ sens+.

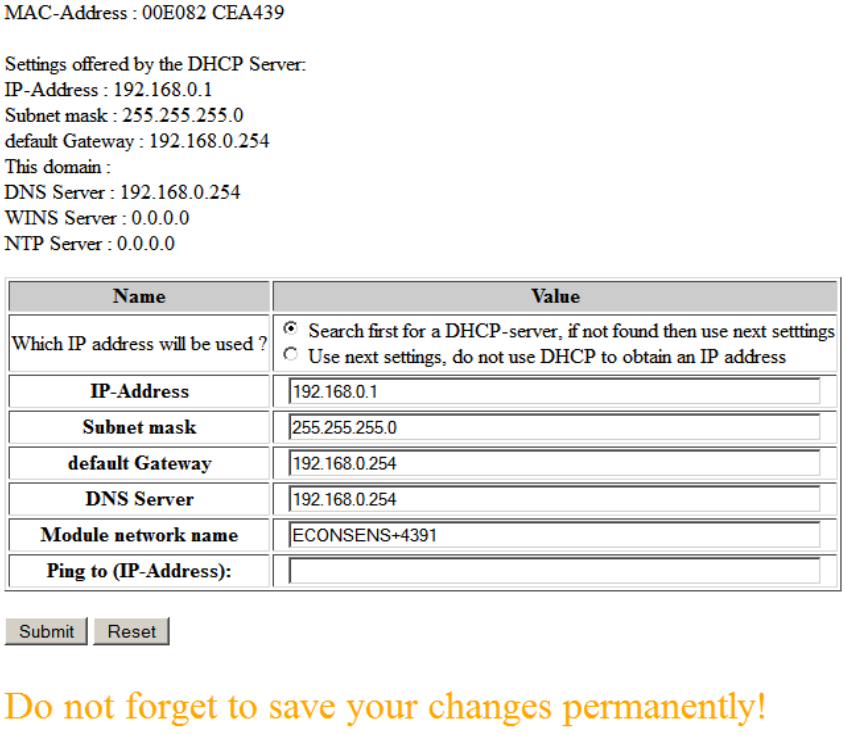



**Figure 26:** Main page of the Network menu

In the info area, the MAC address of the device is shown at the top. Under this is listed all of the information provided by the DHCP server, which may exist in the system. If there is no DHCP server in the system, these info fields remain empty.

In the table below this the following settings can be made:

**Which IP address should be used?**

You have the choice between manual assignment of the IP address or assignment of the address by DHCP server. The default setting is the function: *If possible obtain IP address per DHCP*.

If the device does not find a DHCP server, the data from the IP address, subnet mask, default gateway, DNS server and network device name fields are automatically used. The data shown in Fig. 20 represents the device default settings.

The *ping IP address* field is used to send a ping command to a defined IP address, as you may be familiar with from DOS. This function is used to test the network connection.

## Electrical submenu

The Electrical submenu is used for configuration

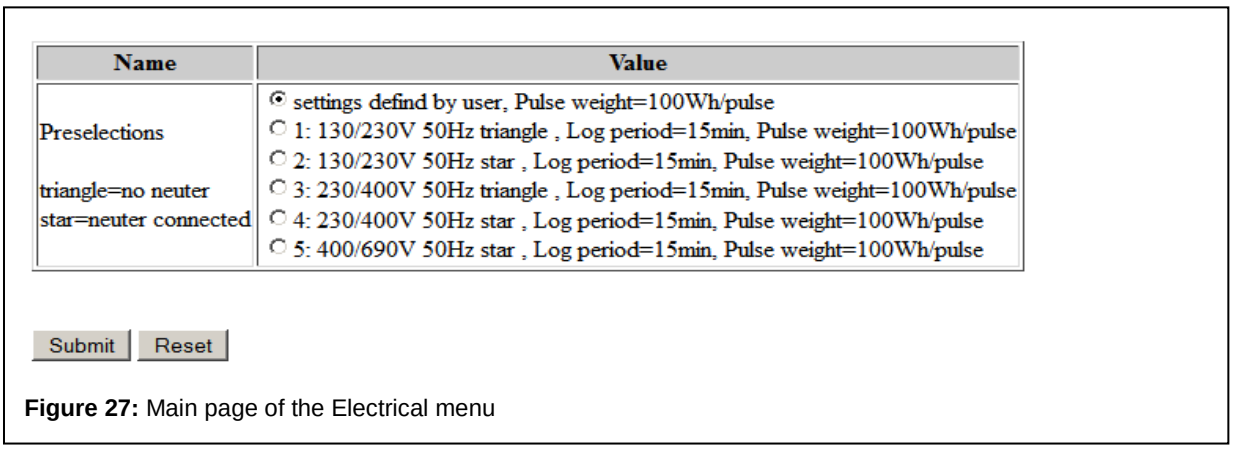



**Figure 27:** Main page of the Electrical menu

Econ sens+ can be used in various different power systems, e.g. in 2, 3 and 4-wire power systems with any load. The device can be operated in power systems with a nominal voltage starting at 120V (e.g. USA), as well as in power systems with 230/400 V and 400/690 V. Different power frequencies (50 und 60 Hz) can also be represented.

For the configuration of the power system, in which econ sens + will be used, there are only a few settings to be made.

You can either use one of the predefined settings or compile all of the parameters yourself using the user-defined settings.

Explanation of the settings:

The European region generally has 230/400 V power systems. The 130/230 V setting must be used for power systems in the USA; 400/690V power systems are found in large manufacturing plants or wind power plants. In Europe the supply frequency is 50 Hz in the USA it is 60 Hz. Before you change any of these parameters, you should find out which setting needs to be selected.
As a general rule, you will use the econ sens+ in a power system or measure the power consumption of a consumer that is supplied with 3 phases and a neutral conductor. Symmetrical consumers, e.g. large electric motors are the exception; these are connected via only three phases.
Therefore you can still choose between the triangle option (three-phase three-wire power system without neutral conductor) and the star option (three-phase four-wire power system with neutral conductor) or a single-phase power system.

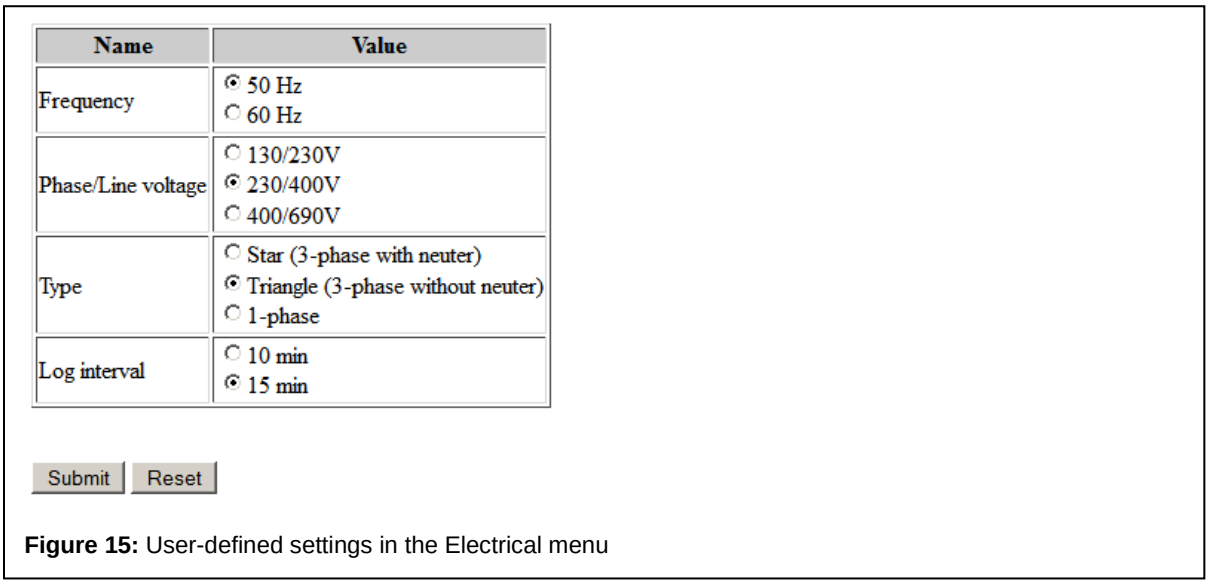



**Figure 15:** User-defined settings in the Electrical menu

The *Recording interval* setting determines whether you obtain 10-min mean values or 15-min mean values when you export the energy consumption data, as described in the chapter on the Graph menu. The default setting is 15-min mean values.

| Name | Ereignisse aufzeichnen | Einstellungen | Wert |
|---|---|---|---|
| Frequenzschwankungen | ☑ | Frequenzschwankungen Integrationsintervall [s] | 10 |
| | | Frequenzschwankungen Untergrenze [%] | 99 |
| | | Frequenzschwankungen Obergrenze [%] | 101 |
| Langsame Spannungsänderungen | ☑ | Langsame Spannungsänderungen Integrationsintervall [s] | 600 |
| | | Langsame Spannungsänderungen Untergrenze [%] | 90 |
| | | Langsame Spannungsänderungen Obergrenze [%] | 110 |
| Schnelle Spannungsänderungen | ☑ | Schnelle Spannungsänderungen Grenze [%] | 5 |
| Flicker Schärfegrad | ☑ | Schärfegrad Beobachtugnsinterval [s] | 600 |
| | | Schärfegrad-Obergrenze [x10] | 10 |
| Spannungseinbruch | ☑ | Grenze für Spannungseinbrüche (> 1min) [%] | 90 |
| Spannungsunterbrechung | ☑ | Grenze für Spannungunterbrechungen [%] | 10 |
| Zeitweilige netzfrequente Überspannungen | ☑ | Zeitweilige netzfrequente Überspannungen [%] | 110 |
| Transiente Überspannungen | ☑ | Transiente Überspannungen [%] | 150 |
| Spannungsunsymetrie | ☑ | Spannungsunsymetrie [%] | 2 |
| Oberschwingungsspannung | ☑ | Oberschwingungsspannung [%] | 8 |
| Stromlevel | ☑ | Überschreitung des Strom-Messbereichs [Arms] | 3000 |
| Frequenzverschiebung | ☑ | Grenze Frequenzverschiebung [mHz] | 1000 |
| Vektorsprung | ☑ | Vektorsprung [Grad] | 30 |
| Neutralleiter-PE-Spannungsabfal | ☑ | Neutralleiter -> PE-Spannung Obergrenze [%] | 10 |
| Leistung | ☑ | - | - |
| Oberschwingungsstrom | ☑ | Harmonic Strom grenze [%] | 100 |
| Time Change | ☑ | - | - |
| - | - | Event-Halbwertszeit [Tag] | 30 |

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Einstellungen nach EN50160 anwenden ☐

**Figure 29:** Custom Settings menu “Electrical” (Pro version)

With an optional activation key the econ sens + can be extended to the Pro version. The limits for event recording are carried out in this table (Figure 29). "Apply settings to EN501060" by selecting the limits are set to default values according to the above standard. The event log and the waveforms are called on the menu: ***Events***

**Event description:**

**Frequency variations**

The average supply frequency is checked every 10 seconds. Deviations of more than 1% from the nominal frequency are detected. This is the slow frequency deviation event.

**Magnitude variations**

The average supply voltage is checked every 10 minutes. Deviations of more than 10% from the nominal supply voltage are detected. This is the slow voltage deviation event.
Default Value: low limit 90% /high limit 110%

**Rapid voltage changes**

The 3 supply phases are checked. Sudden voltage changes of more than 5% of the nominal supply voltage are detected. Default Value: 5%

**Flicker severity**

The 3 supply phases are checked. The method used to calculate the flicker is an approximation of the standard method. Default Value: limit x10

**Voltage dips**

The 3 supply phases are checked. Voltage drops below 90% of the nominal supply voltage and less than 1 minute in duration are detected.
A waveform is stored for this event. Default Value: 90%

**Voltage interruptions**

The 3 supply phases are checked. Voltage drops below 10% of the nominal supply voltage and less than 3 minutes in duration are detected.
A waveform is stored for this event.

**Temporary overvoltage**

The 3 supply phases are checked. Overvoltage above 110% of the nominal supply voltage and less than 3 minutes in duration are detected.
A waveform is stored for this event. Default Value: 110%

**Transient overvoltage**

The 3 supply phases are checked. Overvoltage above 150% of the nominal supply voltage and less than 1 minute in duration are detected.
A waveform is stored for this event. Default Value: 150%

**Voltage unbalance**

The 3 supply phases are checked. Unbalance above 2% is detected.
A waveform is stored for this event. Default Value: 2%

**Harmonic voltage**

The 3 supply phases are checked. Total harmonic distortions of a voltage above 8% are detected. Harmonics are detected up to the 15th harmonic.
A waveform is stored for this event. Default Value: 8%

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**Current limit**

The 3 supply phases are checked. Currents above maximum current range are detected.
A waveform is stored for this event. Default Value: 3000Arms

**Frequency drift**

The supply frequency is checked. Sudden frequency changes of more than 1Hz of the nominal supply voltage are detected.
A waveform is stored for this event. Default Value 100%

**Vector jump**

The 3 supply phases are checked. Jumps of the voltage angle of more than 30° are detected.
A waveform is stored for this event. Default Value 30%

**Neutral overvoltage**

The neutral voltage is checked. A voltage above 10% of the nominal supply voltage is detected. Default Value 10%

**Power on/off**

The last power on and off times are logged.

**Harmonic current**

The 3 supply phases are checked. Total harmonic distortions of a current above 2% are detected. A waveform is is stored for this event. Default Value 100%

**Time change**

Changes to the internal clock time are logged.

## Events (Proversion) submenu

For each event up to 6 parameters are logged when the event occurs. Unused parameters are 0.

| Event | Parameter 1 | Parameter 2 | Parameter 3 | Parameter 4 | Parameter 5 | Parameter 6 |
|---|---|---|---|---|---|---|
| **Frequency variations** | measured frequency [mHz] | ratio of measured to nominal frequency [%] | 0 | 0 | 0 | 0 |
| **Magnitude variations** | measured voltage on line 1 [dVrms] | measured voltage on line 2 [dVrms] | measured voltage on line 3 [dVrms] | ratio of maximum measured voltage to nominal voltage[%] | 0 | 0 |
| **Rapid voltage changes** | voltage change on line 1 [dVrms] | voltage change on line 2 [dVrms] | voltage change on line 3 [dVrms] | 0 | 0 | 0 |
| **Flicker severity** | long-term flicker on line 1 [-/10] | long-term flicker on line 2 [-/10] | long-term flicker on line 3 [-/10] | 0 | 0 | 0 |
| **Voltage dips** | lowest ratio measured to nominal voltage for line 1 [%] | lowest ratio measured to nominal voltage for line 1 [%] | lowest ratio measured to nominal voltage for line 1 [%] | duration [ms] | 0 | 0 |
| **Voltage interruptions** | lowest voltage on line 1 [dVrms] | lowest voltage on line 2 [dVrms] | lowest voltage on line 3 [dVrms] | duration [ms] | 0 | 0 |
| **Temporary overvoltage** | highest ratio measured to nominal voltage for line 1 [%] | highest ratio measured to nominal voltage for line 1 [%] | highest ratio measured to nominal voltage for line 1 [%] | duration [ms] | 0 | 0 |
| **Transient overvoltage** | integral of overvoltage for line 1 [dVrms*s] | integral of overvoltage for line 2 [dVrms*s] | integral of overvoltage for line 3 [dVrms*s] | duration [ms] | 0 | 0 |
| **Voltage unbalance** | maximum unbalance for line 1 [%] | maximum unbalance for line 2 [%] | maximum unbalance for line 3 [%] | duration [ms] | 0 | 0 |
| **Harmonic voltage** | maximum total | maximum total | maximum total | duration [ms] | 0 | 0 |
| | distortion for line 1 [%] | distortion for line 2 [%] | distortion for line 3 [%] | | | |
| **Current limit** | integral of current above limit for line 1 [dArms*s] | integral of current above limit for line 2 [dArms*s] | integral of current above limit for line 3 [dArms*s] | duration [ms] | 0 | 0 |
| **Frequency drift** | frequency before change [mHz] | frequency after change [mHz] | 0 | 0 | 0 | 0 |
| **Vector jump** | vector jump for line 1 [°] | vector jump for line 2 [°] | vector jump for line 3 [°] | 0 | 0 | 0 |
| **Neutral overvoltage** | highest neutral voltage [dVrms] | duration [ms] | 0 | 0 | 0 | 0 |
| **Power on/off** | 1=On, 0=off | 0 | 0 | 0 | 0 | 0 |
| **Harmonic current** | maximum total distortion for line 1 [%] | maximum total distortion for line 2 [%] | maximum total distortion for line 3 [%] | duration [ms] | 0 | 0 |
| **Time change** | time difference [s] | 0 | 0 | 0 | 0 | 0 |

## Pulses / s submenu

Every pulse that is outputted via the two pulse outputs corresponds to an amount of energy in Wh. This “pulse weight” can be set in the *Pulses/s* menu.

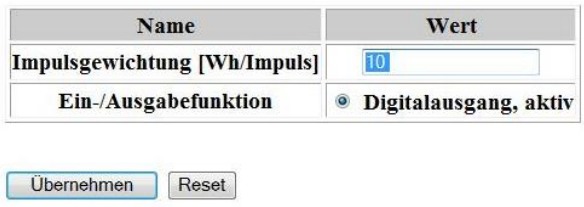



**Figure 30:** pulse weighting S0-Interface

This is necessary, as the pulse output can supply a maximum pulse frequency of 10 Hz; this corresponds to 36000 pulses/h.

The maximum admissible pulse weighting factor can be calculated with the following equation:

$$X = \frac{(P * 1h)}{36000}$$

P = max. connected load in Watt

X = pulse weighting factor in Wh/pulse

*Example*: If the consumer to be measured is a machine with $P_{ges}$ = *100 KW*

$$X = \frac{100.000 * 1h}{36000} \approx 2.8 \frac{Wh}{pulse}$$

In practice, electric meters often have a pulse constant (here K) in pulses/kWh. To convert X into this constant K:

$$K = \frac{1}{X} * 1000$$

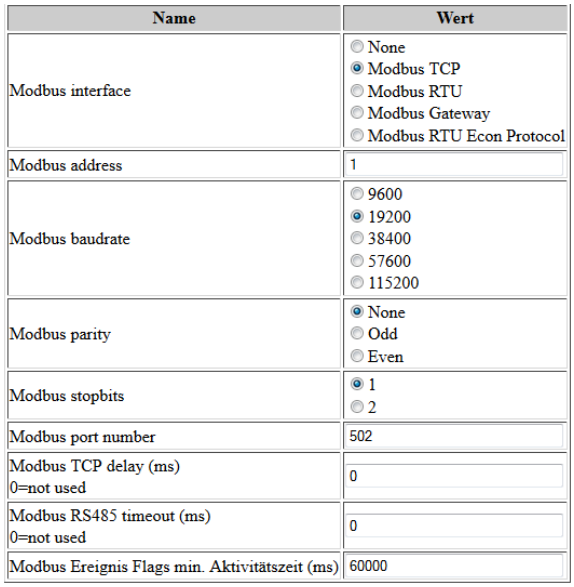
In our example, this means:

$$K = \frac{1}{2{,}8} * 1000 = 357 \frac{pulses}{kWh}$$

Practice has shown that a pulse rate of **100 pulses/kWh (= 10 Wh/pulse)** is entirely sufficient.

## Modbus Pulses / s (S0/RS 485-Variante) submenu

The settings for the Modbus communication is carried out in this section.



| Name | Wert |
|---|---|
| Modbus interface | ○ None<br>◉ Modbus TCP<br>○ Modbus RTU<br>○ Modbus Gateway<br>○ Modbus RTU Econ Protocol |
| Modbus address | 1 |
| Modbus baudrate | ○ 9600<br>◉ 19200<br>○ 38400<br>○ 57600<br>○ 115200 |
| Modbus parity | ◉ None<br>○ Odd<br>○ Even |
| Modbus stopbits | ◉ 1<br>○ 2 |
| Modbus port number | 502 |
| Modbus TCP delay (ms)<br>0=not used | 0 |
| Modbus RS485 timeout (ms)<br>0=not used | 0 |
| Modbus Ereignis Flags min. Aktivitätszeit (ms) | 60000 |

**Figure 31:** Custom Modbus settings in the menu pulse / s (Example: Modbus TCP)

### Modbus Settings

The setup has to be performed via HTML.

| Parameter | Description |
|---|---|
| Modbus Interface | This selects which modbus protocol is used:<br>- none<br>- Modbus TCP<br>- Modbus RTU (over RS485 line)<br>- Modbus Gateway |
| Modbus address | This single byte value selects the bus address.<br>Allowed values are 0..255. |
| Modbus baudrate | This selects the RS485 baudrate. Allowed values are 9600, 19200, 38400, 57600 and 115200. |
| Modbus paritiy | This selects the RS485 parity: none, odd, even. |
| Modbus stopbits | Stopbits: 1 or 2. |
| Modbus port number | This selects the port number for modbus over TCP/IP.<br>The default value is 502. Other values are allowed |
| Modbus TCP delay | This parameter is only used when the sesn+ is used as a modbus gateway. This is a time in milliseconds, allowed values are 0..3600000. |
| Modbus RS 485 timeout | This parameter is only used when the sens+ is used as a modbus gateway. This is a time in milliseconds, allowed values are 0..3600000. |
| Modbus Events Flag minimum activity time (ms) | minimum activity time for modbus event flags, can be set via HTML modbus settings. This is a time in milliseconds, allowed values are 0..3600000. |

**Modbus register address ranges**

| Range | Contents | Data size & type |
|---|---|---|
| 2…110 | Measurements - Present value | 32 bit, Float |
| 120…126 | Measurements - Present value | 32 bit, Float |
| 200...216 | Event flags | 1 bit |
| 300...340 | Event settings | 32 bit, Integer |
| 400...406 | System | 16 bit, Integer |
| 500...510 | Event values | 32 bit, Float |
| 1002...1110 | Measurements - Present value | 32 bit, Float, gedreht |
| 1120...1126 | Measurements - Present value | 32 bit, Float, gedreht |
| 1300…1340 | Event settings | 32 bit, Integer, gedreht |
| 1500…1510 | Event values | 32 bit, Integer, gedreht |

The following is a list of all the measurement registers that can be read through modbus. All data is expressed in floating point and uses 2 registers for 4 bytes in total. The data is available from registers 2..110 and 1002..1110. The values in both ranges are the same, but the order of the registers is switched.

- Big-Endian (High-Byte vor Low-Byte) - Register 2…110
- Little-Endian (Low-Byte vor High-Byte) - Register 1002...1110

Modbus supports the commands “Read Holding Registers” (0x03) and “Read Input Registers” (0x04). Registers 2..110 are addressed as 1..109. Only requests with a odd register address and a quantity of registers that is a multiple of 2 are valid. Other request will return an “Illegal Data Address” (0x02) exception code.

| Name | Register | Description | Phase | Units |
|---|---|---|---|---|
| Ptot | 2 | Real Energy (Actual count) | L1,L2,L3 | kWh |
| P L1 | 4 | Real Energy (Actual count) | L1 | kWh |
| P L2 | 6 | Real Energy (Actual count) | L2 | kWh |
| P L3 | 8 | Real Energy (Actual count) | L3 | kWh |
| Qtot | 10 | Reactive Energy (Actual count) | L1,L2,L3 | kvarh |
| Q L1 | 12 | Reactive Energy (Actual count) | L1 | kvarh |
| Q L2 | 14 | Reactive Energy (Actual count) | L2 | kvarh |
| Q L3 | 16 | Reactive Energy (Actual count) | L3 | kvarh |
| u(L1) | 18 | Voltage (Present value) | L1-L2 | V |
| u(L2) | 20 | Voltage (Present value) | L2-L3 | V |
| u(L3) | 22 | Voltage (Present value) | L3-L1 | V |
| un(L1) | 24 | Voltage (Present value) | L1-N | V |
| un(L2) | 26 | Voltage (Present value) | L2-N | V |
| un(L3) | 28 | Voltage (Present value) | L3-N | V |
| i(L1) | 30 | Current (Present value) | L1 | A |
| i(L2) | 32 | Current (Present value) | L2 | A |

| | | | | |
|---|---|---|---|---|
| i(L3) | 34 | Current (Present value) | L3 | A |
| p(L1) | 36 | Real Power (Present value) | L1 | kW |
| p(L2) | 38 | Real Power (Present value) | L2 | kW |
| p(L3) | 40 | Real Power (Present value) | L3 | kW |
| q(L1) | 42 | Reactive Power (Present value) | L1 | kvar |
| q(L2) | 44 | Reactive Power (Present value) | L2 | kvar |
| q(L3) | 46 | Reactive Power (Present value) | L3 | kvar |
| s(L1) | 48 | Apparent Power (Present value) | L1 | kVA |
| s(L2) | 50 | Apparent Power (Present value) | L2 | kVA |
| s(L3) | 52 | Apparent Power (Present value) | L3 | kVA |
| PF tot | 54 | Power Factor (Present value) | L1,L2,L3 | |
| PF(L1) | 56 | Power Factor (Present value) | L1 | |
| PF(L2) | 58 | Power Factor (Present value) | L2 | |
| PF(L3) | 60 | Power Factor (Present value) | L3 | |
| Hdu(L1) | 62 | Voltage Distortion (Present value) | L1-N; THD | % |
| Hdu(L2) | 64 | Voltage Distortion (Present value) | L2-N; THD | % |
| Hdu(L3) | 66 | Voltage Distortion (Present value) | L3-N; THD | % |
| Hdi(L1) | 68 | Current Distortion (Present value) | L1; THD | % |
| Hdi(L2) | 70 | Current Distortion (Present value) | L2; THD | % |
| Hdi(L3) | 72 | Current Distortion (Present value) | L3; THD | % |
| Temp | 74 | Temperature (Present value) | | °C |
| Freq | 76 | Frequency (Present value) | | Hz |
| P+tot | 78 | Real Energy, verbraucht (Actual count) | L1,L2,L3 | kWh |
| P+ L1 | 80 | Real Energy, verbraucht (Actual count) | L1 | kWh |
| P+ L2 | 82 | Real Energy, verbraucht (Actual count) | L2 | kWh |
| P+ L3 | 84 | Real Energy, verbraucht (Actual count) | L3 | kWh |
| P-tot | 86 | Real Energy, Rückspeisung (Actual count) | L1,L2,L3 | kWh |
| P- L1 | 88 | Real Energy, Rückspeisung (Actual count) | L1 | kWh |
| P- L2 | 90 | Real Energy, Rückspeisung (Actual count) | L2 | kWh |
| P- L3 | 92 | Real Energy, Rückspeisung (Actual count) | L3 | kWh |
| Q+tot | 94 | Reactive Energy, verbraucht (Actual count) | L1,L2,L3 | kvarh |
| Q+ L1 | 96 | Reactive Energy, verbraucht (Actual count) | L1 | kvarh |
| Q+ L2 | 98 | Reactive Energy, verbraucht (Actual count) | L2 | kvarh |
| Q+ L3 | 100 | Reactive Energy, verbraucht (Actual count) | L3 | kvarh |
| Q-tot | 102 | Reactive Energy, Rückspeisung (Actual count) | L1,L2,L3 | kvarh |
| Q- L1 | 104 | Reactive Energy, Rückspeisung (Actual count) | L1 | kvarh |
| Q- L2 | 106 | Reactive Energy, Rückspeisung (Actual count) | L2 | kvarh |
| Q- L3 | 108 | Reactive Energy, Rückspeisung (Actual count) | L3 | kvarh |
| U (N) | 110 | Voltage (Present value) | N | V |

**Modbus Register – Present value/actual count part 1**

| Name | Register | Description | Phase | Units |
|---|---|---|---|---|
| i tot | 120 | Current, total (Present value) | L1,L2,L3 | A |
| p tot | 122 | Real Power, total (Present value) | L1,L2,L3 | kW |
| q tot | 124 | Reactive Power, total (Present value) | L1,L2,L3 | kvar |
| s tot | 126 | Apparent Power, total (Present value) | L1,L2,L3 | kVA |

**Modbus Register – Present value/ actual count part 2**

### Modbus Events

The following is a list of all the coils that can be read through modbus. Every event has a single flag. When the event starts, the VIPtrak3 sets the flag. The flag is cleared when the event ends. The user can set a minimum activity time, the flag will remain high for at least this time. A setup register for this value is included after the event settings. Its value is expressed in milliseconds. Modbus supports the commands “Read Coils” (0x01) and “Read Discrete Inputs” (0x02). Coils 200..216 are addressed as 199..215.

| Name | Register |
|---|---|
| Frequency Variation | 200 |
| Magnitude Variation | 201 |
| Rapid Voltage Change | 202 |
| Flicker Severity | 203 |
| Voltage Dip | 204 |
| Voltage Interruption | 205 |
| Temporary Overvoltage | 206 |
| Transient Overvoltage | 207 |
| Voltage Unbalance | 208 |
| Harmonic Voltage | 209 |
| Current Trigger | 210 |
| Frequency Drift | 211 |
| Vector Surge | 212 |
| Neutral Overvoltage | 213 |
| Power | 214 |
| Harmonic Current | 215 |
| Time Change | 216 |

**Table Modbus – Events**

### Modbus Event Setting Registers

The event settings are also available. These are included in registers 300..340 or 1300..1340.

| Name | Register |
|---|---|
| Frequency Variation Intervall | 300 |
| Frequency Variation low limit | 302 |
| Frequency Variation high limit | 304 |
| Magnitude Variation Period | 306 |
| Magnitude Variation low limit | 308 |
| Magnitude Variation high limit | 310 |
| Rapid Voltage Change limit | 312 |
| Flicker Severity Period | 314 |
| Flicker Severity limit | 316 |
| Voltage Dip limit | 318 |
| Voltage Interruption limit | 320 |
| Temporary Overvoltage limit | 322 |
| Transient Overvoltage limit | 324 |
| Voltage Unbalance limit | 326 |
| Harmonic Voltage limit | 328 |
| Current Trigger | 330 |
| Frequency Drift limit | 332 |
| Vector Surge limit | 334 |
| Neutral Overvoltage limit | 336 |
| Harmonic Current limit | 338 |
| Event halflife time | 340 |

### Modbus System Register

| Name | Register |
|---|---|
| Serial number | 400 |
| Year | 401 |
| Month | 402 |
| Day | 403 |
| Hour | 404 |
| Minute | 405 |
| Second | 406 |

**Table Modbus general registers**

**Modbus Event Value Registers**

Pst is the short term flicker value for the last flicker period. Plt is the long term flicker value, this is the cubic mean value over the last 12 periods.

| Name | Register |
|---|---|
| Short term flicker Pst L1 | 500 |
| Short term flicker Pst L2 | 502 |
| Short term flicker Pst L3 | 504 |
| Long term flicker Plt L1 | 506 |
| Long term flicker Plt L2 | 508 |
| Long term flicker PltL3 | 510 |

**Table - Modbus event value registers**

**Modbus TCP**

When the econ sens+ is used as a Modbus server over TCP/IP, the modbus TCP specification suggests to use address 255 and port number 502. Other values are possible. This modbus interface can be used on devices that do not have an RS485 connection.

**Modbus RTU**

When the econ sens+ is used as a Modbus server over RS485, only the serial line parameters are required.

**Modbus-Gateway**

When the econ sens+ is used as a Modbus Gateway, all parameters are required. The modbus TCP specification suggests to use port number 502. Other values are possible. If the modbus gateway receives a request over TCP/IP with an address byte that matches its own bus address, it will act as modbus server. This way, a device can be both gateway and server at the same time. All requests with a different address byte are sent to the RS485 bus. This modbus interface can be used on devices that do not have an RS485 connection. Since it cannot pass on request to the RS485 bus, it will respond with an exception code 0xA “Gateway path unavailable”. The TCP delay is a time in milliseconds. After the gateway sends a request to the RS485 bus, it will check the RS485 line for a response. During the TCP delay, it will not check for new requests on the TCP/IP input. After the delay is over, the gateway is ready to receive new request via the TCP/IP input. It will keep checking the RS485 line.

## Pass submenu

In the *Pass* submenu you can change your password and user name.

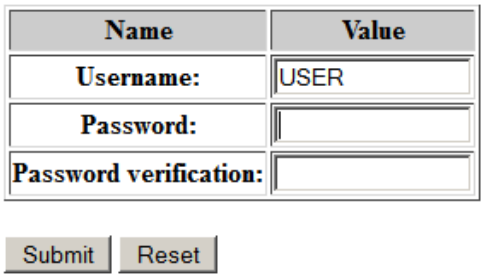



**Figure 32:** Main page of the Pass submenu

When this menu is accessed, the user name that is currently used is displayed in the User Name field.
To change the password or user name proceed as follows:
Enter the new name and new password in the User Name and Password fields and repeat in the *Verify password* field. When you click on *Accept* the following screen appears:

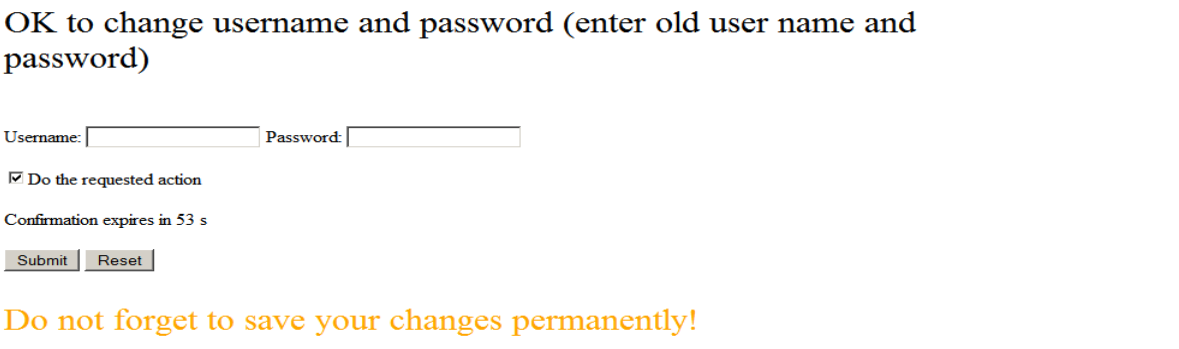



**Figure 33:** Confirming password change

Within 60 s, enter the old user name and the old password. Ensure that there is a tick in the "*Accept requested changes*" box.
Click on *Accept* to save the new password and, if applicable, the new user name.

## Save submenu

The *Save* submenu is used to save or restore settings from the non-volatile memory of the econ sens+. Settings that have been made in the menus are lost when the supply voltage is switched off, if they have not been saved by selecting *Store changes in permanent memory*.

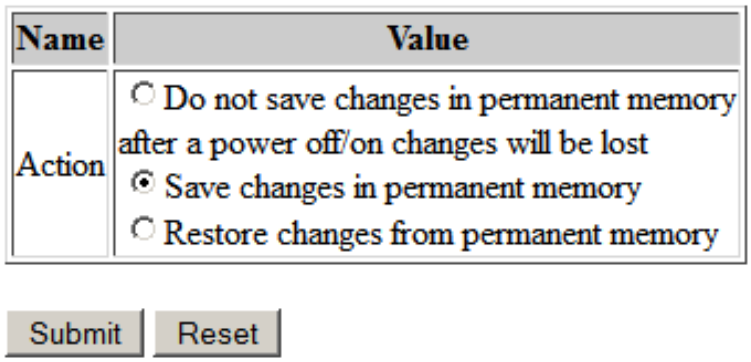
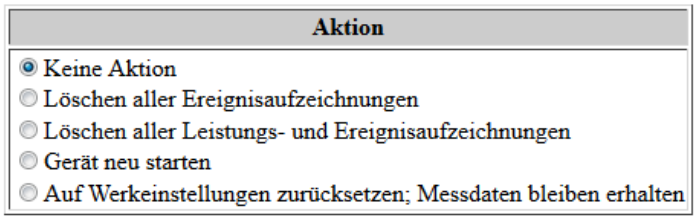



**Figure 16:** Main screen of the Save submenu

## System submenu

The following functions are available in the System submenu:




**Besondere Aktionen:**
komplettes Speicher-Backup für Leistungs- und Eventaufzeichnungen (für technischen support)

Programmupdate, aktuelle Version wird gesucht

Programmupdate aus der Datei

Options

**Figure 35:** Main screen of system menu

**Deletion of all event recordings:**

Deletes all data from the device resulting from event recordings (during network analysis). The network analysis is however disabled in this software version.

**Deletion of all output and event recordings:**

Deletes all measured output and event recordings from the device.

**Restart device**

Restarts the econ sens+ (not a reset)

**Restore default settings; measured data is retained**

Resets the econ sens+ back to its default settings (incl. user name and password). Measured data is not deleted from the memory.

**Complete memory backup for power and event recordings**

With this function, the entire memory content of the device (except user name and password) is written into a text file. This text file is encrypted and cannot be read by the user. It is intended for the manufacturer for error analysis.

**Programupdate, current version is searched**

With this function, the current firmware is located and installed from the econ update server.

**Programupdate aus Datei**

With this function, the current firmware will be uploaded from a text file to the device.

**Options**

With this function, the network analysis and event recording (Pro version) are activated by key.

## *Contact menu*

By clicking on the *Contact* menu item, you will automatically be routed to the official website of econ solutions GmbH, http://www.econ-solutions.de, where you will find information on further econ-solutions products and also of course on the econ sens+.

## *Manual menu*

By clicking on the Manual menu item, the user is automatically transferred to the website http://www.econ-sens.com, where this manual is available online.

## Initial Operation

For initial operation of the econ sens+ proceed as follows:

**1.)** Before you switch the device on, check that all cable connections to the econ sens + are in place as described in the previous chapters.

**2.)** Switch on the circuit breakers in the voltage path; all three indicator LEDs should then light up.
Check that the voltages are applied to the device and that the phases L1, L2 and L3 are correctly connected.

**3.)** Access the web interface of the device and check first of all the time settings and the display in the *Meter* menu.
If there is no load connected you should at least see the voltage values. If there is a load connected, verify the measurement result, if possible.
If you do not see any measured values even though there is a load connected, proceed as described in Chapter 7 *Troubleshooting*.

# Troubleshooting

### 1.) The S0 outputs of the Econ Sens + supply no pulses

Possible causes:

a.) **The pulse weighting in the Pulses/s menu is set to 0 Wh/pulse**

-> Set the pulse weighting to > 0 Wh/pulse

b.) **The pulse weighting in the Pulses/s menu is set too high**

-> The pulse outputs of the econ sens+ allow for a maximum pulse rate of 10 Hz. Lower the pulse rate to a lower value. How to calculate the maximum admissible pulse rate is explained in the chapter *Pulses/s*.

c.) **Wrong allocation of L1, L2 and L3 between the voltage path and the current path**

-> Ensure that the coil L1 of the current path is wrapped round the conductor L1 of the voltage path at the consumer. Do the same for phases L2 and L3. If necessary, check the rotating field in the voltage path.

In the Meter menu, check whether the measured power ratings are non-zero.

d.) **The coils on the econ sens + are not plugged in properly**

-> If the coils on the econ sens+ are not plugged in properly, the current path is missing, i.e. the individual power measured = 0.

If the coils are missing, the following error message will be displayed in the Home menu:


**Fig. 36:** Missing coils error message

e.) **The coils for current measurement are wrongly aligned (label does not point in direction of load)**

-> econ sens + is able to measure both generated and consumed power/energy.

The econ sens + has one pulse output for consumed power and one for generated energy.

Imp+ = consumed power
Imp- = generated power

Only the Imp+ output is of significance for the measurement of pure energy consumption.
In the web interface, consumed power is shown in the Meter menu as a positive value and generated power as a negative value and the sum of the two is calculated.
If the sum of the individual power values is positive, i.e. the consumed portion predominates, the pulses are outputted to the Imp+ output.
If the sum of the individual power values is negative, i.e. the generated portion predominates, the pulses are outputted to the Imp- output.
If all three coils are wrongly aligned, the individual power values are for the econ sens+ generated values and are negative. Therefore the pulses are outputted to the Imp- output and not to the Imp+.

**3.) econ sens+ can no longer be reached via the browser**

Possible causes:

a**.) The network connection to the econ sens + is interrupted**

-> Ensure that there is a network connection to the econ sens+ and that the conductor is not interrupted.

b.) **The voltage path to the econ sens+ was interrupted**

-> Ensure that the circuit breakers in the voltage path of the econ sens+ are switched on and that a voltage is applied to the terminals.

c. ) **econ sens+ has a new IP address**

-> If you are operating the econ sens+ in a network with a DCHP server, ensure in the DHCP server that the device always received the same IP address (IP reservation). Otherwise, if the operating voltage is missing for a longer period of time (power failure,

maintenance work, etc.), it may be that the sens+ has received a new IP address without you noticing.

# Technical data

## *econ sens+ basic unit*

**mechanical**

| | | |
|---|---|---|
| Dimensions (W x H x D) | [mm] | 94 x 23 x 121 |
| Equipment class | | IP 20 |

**electrical**

| | | |
|---|---|---|
| Operating voltage range[1] | [$V_{AC}$] | 70..350 (betw. U1,U2,U3 and N) |
| Terminal cross-section Voltage inputs | mm² | 0.15 - 4 mm² |
| Max. clamping torque | Nm | 2,5 |
| Total internal consumption | [W] | max. 1.5 Watt with |
| | | Ethernet operation |
| Frequency range | Hz | 45…65 Hz |
| Temperature range | °C | 0..55°C, max. 80% rel H, non-condensing 2000m NN |
| Rel. error Voltage measurement | % | +/- 1 |

[1] The supply voltage is generated from phases L1 and L2 (with connection to 3-phasen power system)

**S0 pulse outputs**

| | | |
|---|---|---|
| Description | | S0 pulse outputs in accordance with DIN 43864 |
| Voltage range | [$V_{DC}$] | 5..30 |
| Max. load / Output | A | 0.1 |
| Max. pulse rate | Hz | 10 |
| Terminal cross-section | mm² | 0.15 - 4 mm² |
| Max. clamping torque | Nm | 2,5 |

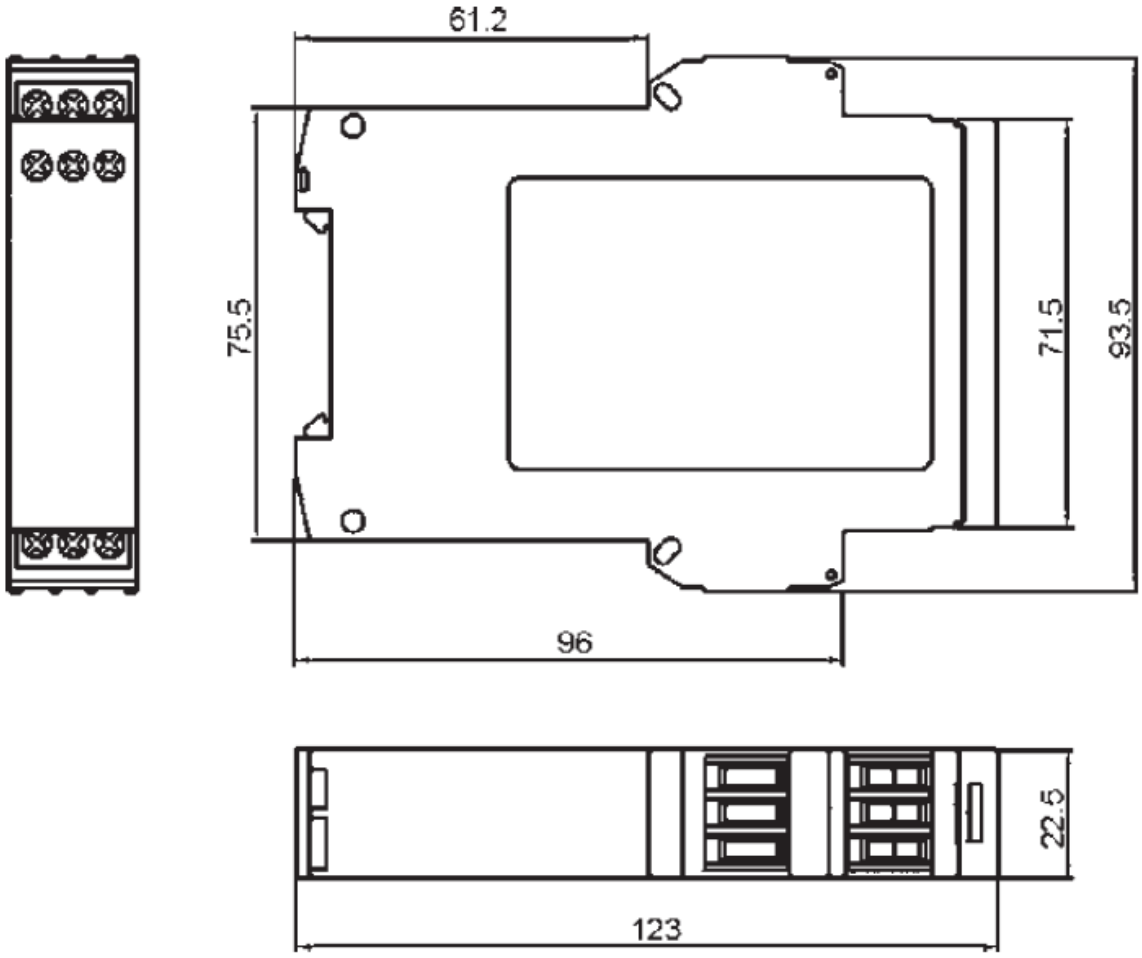
**Ethernet Interface**

| | | |
|---|---|---|
| 100Mbit fix via RJ-45 socket | | |
| Communications interface Modbus TCP | | |

**RS-485-Interface**

| | | |
|---|---|---|
| Description | | RS-485 based Bussystem. 1 Master and max. 31 Slaves (Modbus RTU) |
| Max. cable length Master -> last Slave | m | 1200 (Modbus) |
| Baudrate | Bd | 9600, 19200, 38400, 57600, 115200 (Modbus) |
| Terminal cross-section | mm² | 0,15 - 4 mm² |
| Max. clamping torque | Nm | 2,5 |

**Dimensions / mm**



## *econ sens+ measuring coils:*

| | | Coil 170 | Coil 250 | Coil 350 |
|---|---|---|---|---|
| **mechanical** | | | | |
| Overall length of coils | [mm] | 170 | 250 | 350 |
| Max.diameter of measured cable | [mm] | 35 | 65 | 95 |
| Max. bending radius | [mm] | 35 | | |
| Length of connecting cable | [m] | 2 | | |

| **electrical** | | | | |
|---|---|---|---|---|
| Measurement range | [$A_{rms}$] | 0...400 | 0...1600 | 0..3200 |
| Resolution | [$A_{rms}$] | 0.1 | | |
| Rel. error | % | +/- 1 | | |

## *Default settings*

**Network**

By default the econ sens+ searches for a DHCP server; if there is no DCHP server in the network, the following applies:

**IP address:** **192.168.0.1**

**Subnet mask:** **255.255.255.0**

**Standard gateway** **192.168.0.254**

**Date/Time settings**

Time / Date: **Adopt time and date from time server**

**Power settings**

Network topology: T**hree-phase 4-wire power system (230/400V, 50 Hz)**

**Pulse weighting**

Pulse weighting [Wh/pulse]: **10 Wh/pulse = 100 pulses/kWh**

**User name:** **user**

**Password:** **pass**