

ENERGYSENS Power Measurement for Energy Data Management

3-349-974-03

1/12.17



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1 Outline

ENERGYSENS serves as detailed power measurement of single loads in 50 / 60 Hz low voltage systems. The data of such power measurement may then be used to carry out measures to e.g. improve the energy efficiency as part of an Energy Management System. The power measurement is done at the leads which exit the circuit breakers for the single devices within a low voltage distributor.

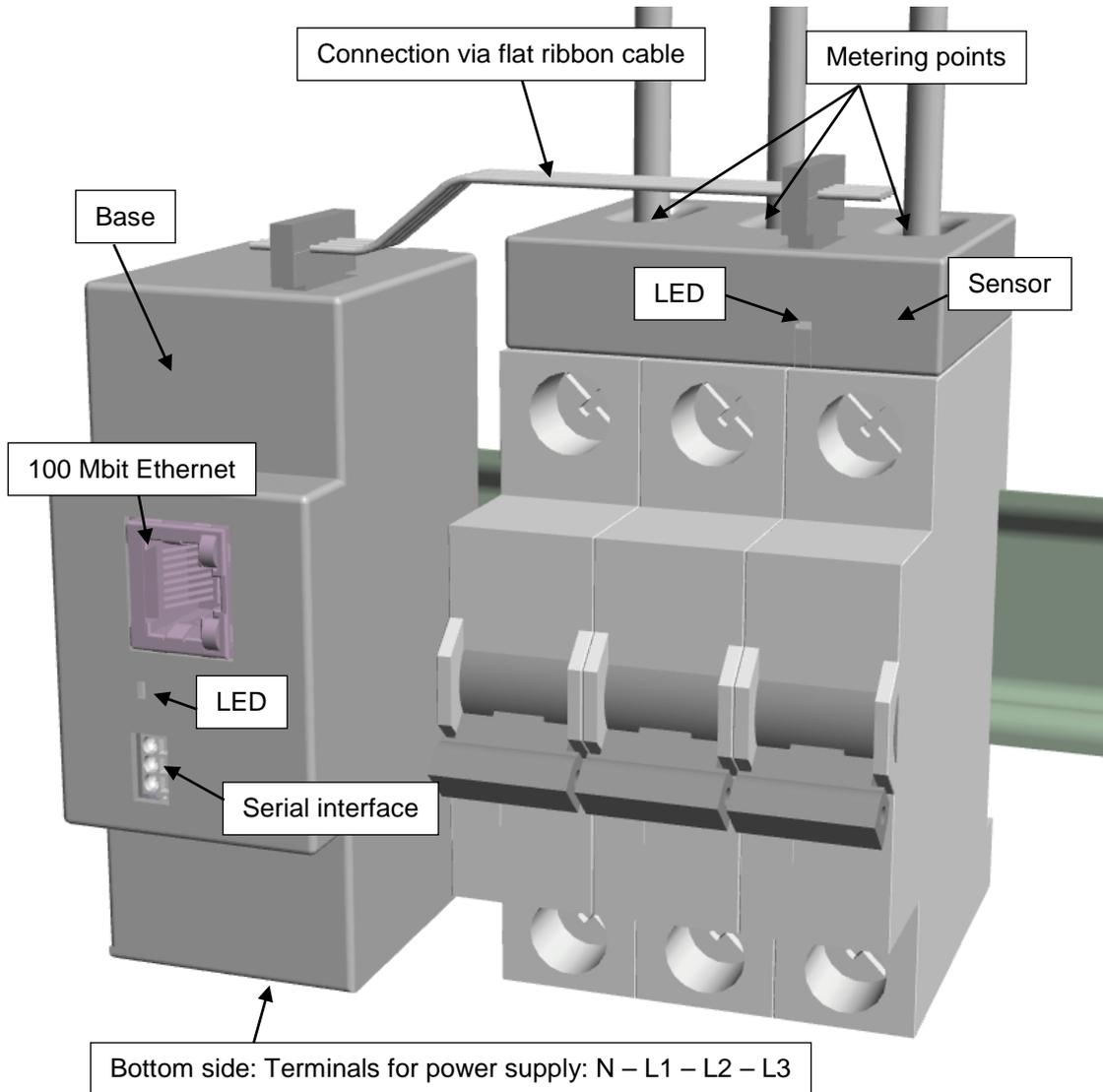
The modular system is composed of a base and one / more sensors. The sensors are equipped with several metering points to measure the power of multiple loads. The various versions of sensors differentiate with regard to the number of metering points and the respective nominal current.

The sensors are connected to the base via a flat ribbon cable (Sensorbus).

The measurements and the supply voltage required for the sensors are transferred via this flat ribbon cable. During installation, the flat ribbon cable is finished to fit the individual conditions of the respective facility.

The base and circuit breakers are mounted on a top hat rail (TS35). The sensors are mounted on the circuit breakers.

The Modbus Protocol works as interface to read the power values. ENERGYSENS supports the protocol versions Modbus-TCP and Modbus-RTU.



2 Installation

Please completely read this installation and operator's manual before you install and start the **ENERGYSENS**! This manual contains important safety information and is based on the technical stage of 13.09.2016. We reserve the right to update without prior announcement the information given in this manual.

General safety instructions:

The electrical installation and startup may only be carried out by a qualified licensed electrician respecting the following indications. An inappropriate execution of installation and startup may lead to damages and/or endanger people.

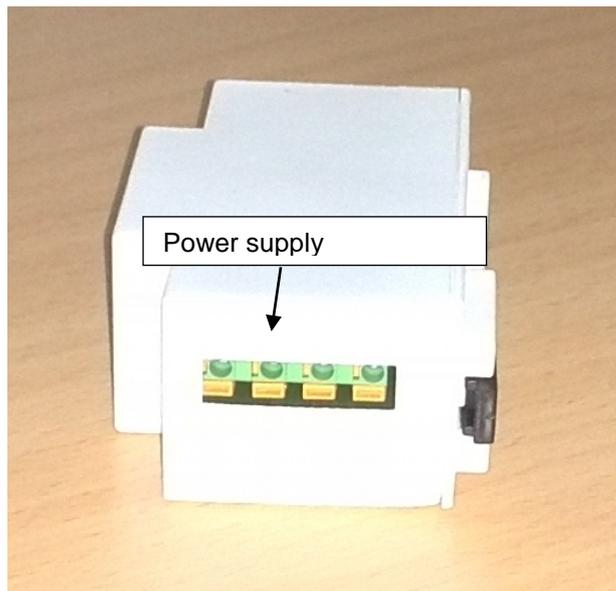
ENERGYSENS is only designed for usage in single and tri- phase low voltage systems with a nominal voltage of 230 / 400 V AC at 50 resp. 60 Hz.

Prior to installation all voltage carrying connections and measurement leads have to be disconnected from the mains.

The base is fixed by means of a slider on top-hat rail (TS35).



Power supply via terminals (voltage entries) on bottom side.



For fastening, slide the connection lead into the respective terminal. To disengage use the release key. Only L1 and N are connected in single phase systems. In tri-phase systems all phases and N are connected. The terminals are marked with their respective use.

	<p>Voltage entries L1, L2, L3 must be secured by circuit breakers 1A, release characteristic B.</p> <p>A method has to be provided allowing that the device may be powerless connected, e.g. a clearly marked interrupter or a fused cut-off switch.</p>
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Conductor cross sections for L1, L2, L3 and N:

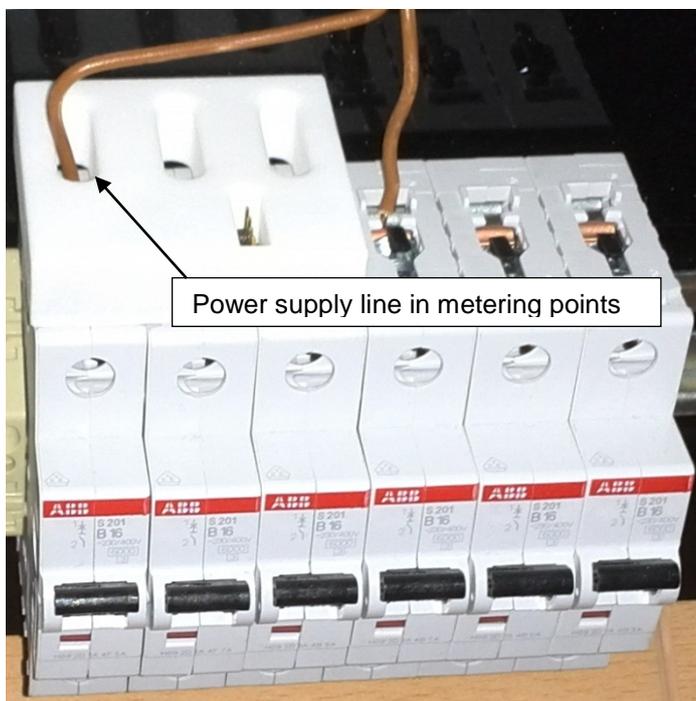
Solid core:	0.5 mm ² – 1.5 mm ²
Wire stripping length:	10 mm
Fine-wired with insulated ferrule:	0.5 mm ² – 1 mm ²

Important: The voltage connection of the base is installed in such a way that the stripped blank connection wire can be touched. The base must be installed respectively covered in such a way that the area of the voltage connection is covered.



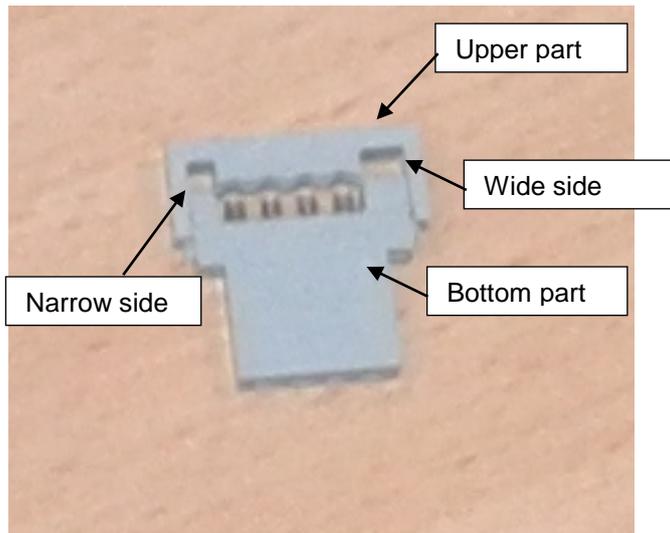
Detached power supply line

Detach possibly existing power supply lines prior to fastening the sensors. Before working on these lines, ensure that they are disconnected from the mains.



Power supply line in metering points

The power supply lines are lead through the openings of the metering points and are re-connected.



The plugs for the flat ribbon cable are assembled with upper and bottom part.
Note that the plugs are not symmetrical.



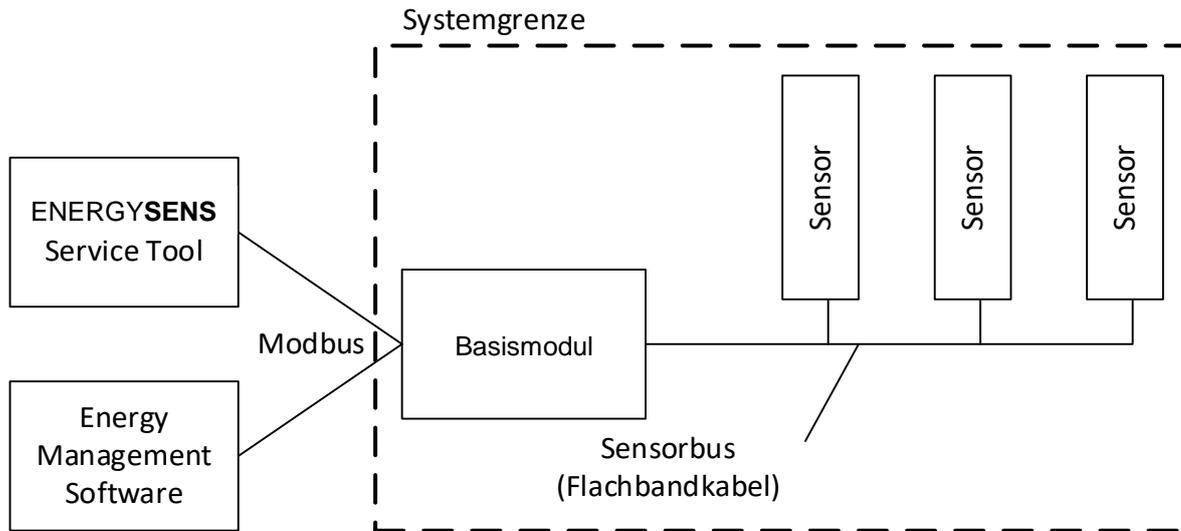
Use appropriate pliers to squeeze the plugs onto the cable.



The base and all sensors are connected with a flat ribbon cable. As shown in the picture, the plugs are put in the Sensorbus interfaces of the base and of the voltage sensors:

- The connectors are squeezed onto the cable at appropriate intervals.
- The sensors may be connected to both the left and the right side of the base.
- The order of the sensors on the cable is irrelevant.
- Only one central unit can be connected.
- **Important: Pin 1 of the cable must always be on the front of the base and all sensors.**
- **Important: The cut off cable end has no insulation. Keep the cable ends away from non-insulated low voltage cables. Maintain a minimum distance of 6 mm. Shrink-tube the open ends**

3 Software and Communication



ENERGYSENS has an internal interface via which the base communicates with the sensors. Communication to the outside takes place via the connections of the base.

ENERGYSENS has a Modbus interface as external interface. Both Modbus TCP (via Ethernet) and the Modbus RTU (via RS485) protocols are supported.

This document assumes a basic understanding of these protocols.

The communication can be carried out via one of the two interfaces, but it is also possible to use both interfaces alternatively.

All functions are available on both interfaces.

ENERGYSENS is supplied with a .net based configuration program (ENERGYSENS Service Tool). This program is used to configure the measuring system and it requires .net framework, version 4.0. The operation of this tool can be found in the chapters on configuration.

For operation, an energy management software is required, which is able to read Modbus registers and process the corresponding data. This software is not part of the delivery. The interface via which this software accesses the measured data can be found in the chapter "Operation".

The configuration possibilities for this software must be described by the manufacturer of the corresponding software.

Modbus TCP communication is via a 100 Mbit Ethernet interface with a RJ45 plug on the front of the device.

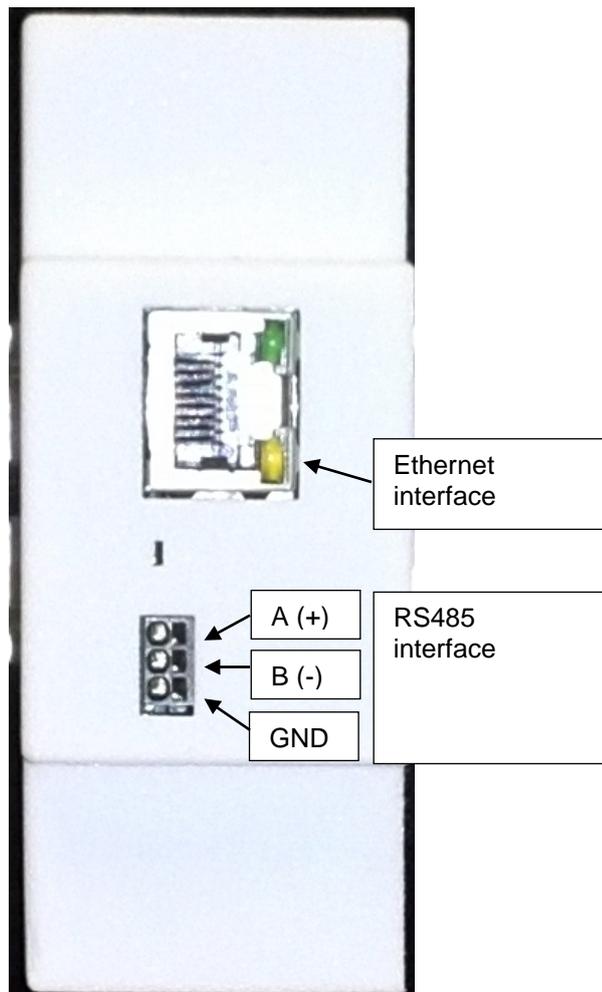
Modbus RTU communication is via a RS485 interface, which has three terminals on the front of the device.

For Modbus RTU communication, the following communication parameters must be set:

Startbits	1
Stopbits	1
Parity	Even
Baudrate	115.2 KBaud

The ENERGYSENS Service Tool sets the required parameters for the serial interface itself.

The picture shows the communication interfaces of the base.



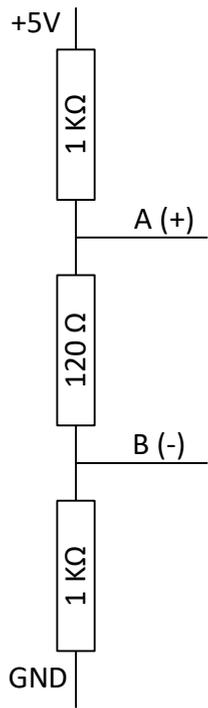
The Ethernet interface must be connected with an Ethernet cable CAT5 or better with a 100Mbit switch.

The RS485 interface is connected via the terminals. The picture shows the assignment of the signals to the base. The connection wire must only be pushed into the respective terminal for fixing. Release is done with the release button.

Conductor cross sections for A(+), B(-), GND:

Fine-wire with insulated wire end ferrule: 0.25 mm²

The termination of the RS485 interface in the device corresponds with this wiring:



3.1 System Configuration

ENERGYSENS is configured using the ENERGYSENS Service Tool.

This is used in particular for the following settings:

- Setting of base communication parameters (IP address or Modbus ID)
- Assignment of the sensors with their metering points to free sensor locations
- Assignment of the respective phases of the voltage measurement to the metering points of the sensors
- Definition of the logic devices and setting of the adjustable registers

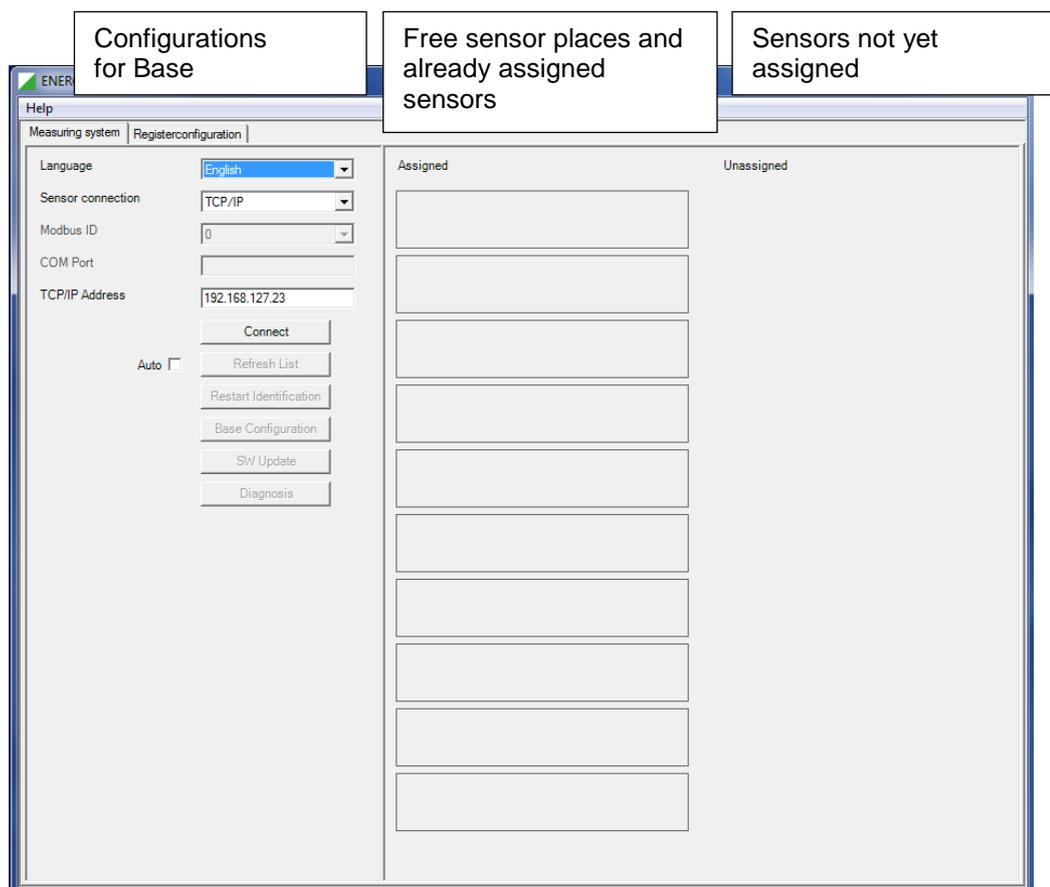
3.1.1 Installation of the ENERGYSENS Service Tool

The ENERGYSENS Service Tool must only be copied to a directory on the PC. The user must have write permission in the directory.

3.1.2 Program Start

To start, run the executable „ControlFramework.exe“

The program starts with its start screen. The system configuration is done via this screen. The screen is divided in three parts.



3.1.3 General configurations and communication with the base

3.1.3.1 Language Selection

The operating language of ENERGYSENS Tool is set via language selection.

3.1.3.2 Sensor Connection

The sensor connection is used to determine whether the ENERGYSENS service tool is to communicate with the base via TCP / IP or the serial interface. Depending on the selection, only the corresponding additional fields are available.

3.1.3.3 Modbus ID

This parameter is only used for communication via the serial interface.

This parameter sets the Modbus ID for communication with ENERGYSENSBase on the serial interface.

In the delivery condition, each base has Modbus ID 1. If the base is to be addressed via the serial interface after delivery, a Modbus must be used in which no other device uses the ID 1.

In case of communication via TCP/IP with the base, the Modbus ID is ignored in the telegrams. In this case, the addressing is exclusively carried out via the base IP address.

The selection is done via a list.

3.1.3.4 Serial Interface

This parameter is only used for communication via the serial interface.

The parameter is used to determine which serial interface of the PC (COM port, for example COM1) is to be used to communicate with the base.

The selection is done via a suitable entry in the text field.

3.1.3.5 TCP/IP Address

This parameter is only used for communication via TCP/IP.

The parameter is used to set the IP address for communication with the respective base in the network.

In the delivery state, each base has the IP address 192.168.127.20. If, after delivery, the base is to be addressed via TCP / IP, a subnet must be established in which this address can be addressed by the ENERGYSENS Service Tool. The selection is made by a suitable entry in the text field.

The setting procedure of ENERGYSENS base IP address is described in chapter „Base configuration“.

3.1.3.6 Connecting

After successful connection to the respective system, the user has access to the other options on the interface.

After disconnecting, they are deactivated again.

During connection, identification is made as to which sensors are connected to the base.

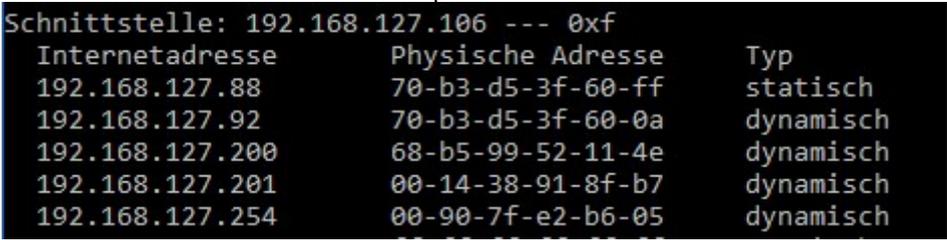
Alternatively, the TCP/IP address can also be set via a ping command:

The software of ENERGYSENS's central unit reacts to Ethernet ping messages as follows:

A ping message always contains a MAC address and an IP address. The MAC address may also be a broadcast address (0).

Ping messages where the MAC address corresponds with the MAC address of ENERGYSENS base (no broadcast), set the transferred IP address as new IP address in the ENERGYSENS base

To achieve this, follow these steps for a Windows PC:

- The PC must have an own IP address in the same subnet as the desired IP address of ENERGYSENS.
- For the MAC address of the ENERGYSENS base (this is located on the part number sticker on the back), a static entry must be generated in the ARP table of the PC.
- A shell in administrator mode is opened.
- The command `netsh interface show interface` is used to display the Ethernet interfaces
- The command `netsh interface ipv4 add neighbors "Name of the LAN-Verbindung" „IP“ „MAC“` is used to create a new ARP entry.
Example:
`netsh interface ipv4 add neighbors Ethernet 192.168.127.88 70-B3-D5-3F-60-FF`
- Mit Using the command `arp -a` the entries can be displayed. There must be a static entry for the new desired IP address at the interface, which is located in the same subnet. Example:


Internetadresse	Physische Adresse	Typ
192.168.127.88	70-b3-d5-3f-60-ff	statisch
192.168.127.92	70-b3-d5-3f-60-0a	dynamisch
192.168.127.200	68-b5-99-52-11-4e	dynamisch
192.168.127.201	00-14-38-91-8f-b7	dynamisch
192.168.127.254	00-90-7f-e2-b6-05	dynamisch
- Using the command `ping „IP“`
A ping message with the MAC address of the ENERGYSENS central unit and the new IP address is sent to the ENERGYSENS base. Example:
`ping 192.168.127.88`
The desired IP address is entered.
- The command `arp -d „IP“` deletes the static ARP entry. Example:
`ap -d 192.168.127.88`
- Afterwards the Service Tool can be used to communicate with ENERGYSENS via the new IP address.

3.1.4.1 Subnet Mask

This parameter is only used for communication via TCP/IP.

The parameter defines the subnet mask of the subnet in which the base is installed.

3.1.4.2 Standard Gateway

This parameter is only used for communication via TCP/IP. The parameter specifies the TCP / IP address of the default gateway in the subnet where the base is installed.

Ser. Delay:

The central unit answers the "Read Register" commands on the Modbus RTU interface with an adjustable delay. During this delay, the polling device must change the data flow direction on the interface from Send to Receive. Depending on the device, this can take a different time. The parameter can be used to set the delay in ms, thereby optimizing the scan speed.

MAC address:

MAC address of base for Ethernet communication.

Serial number:

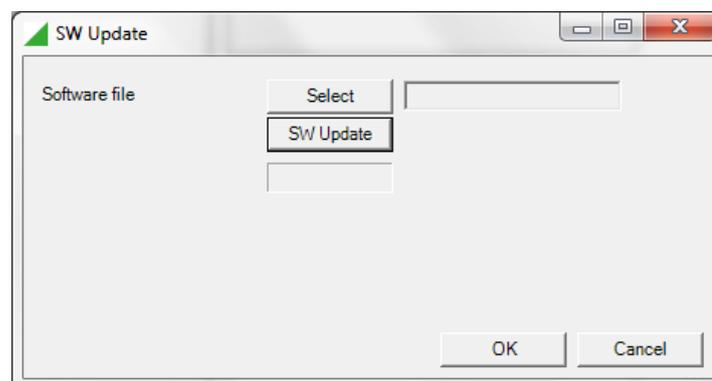
Serial number of base

Production date:

Production date of base

3.1.5 Update base

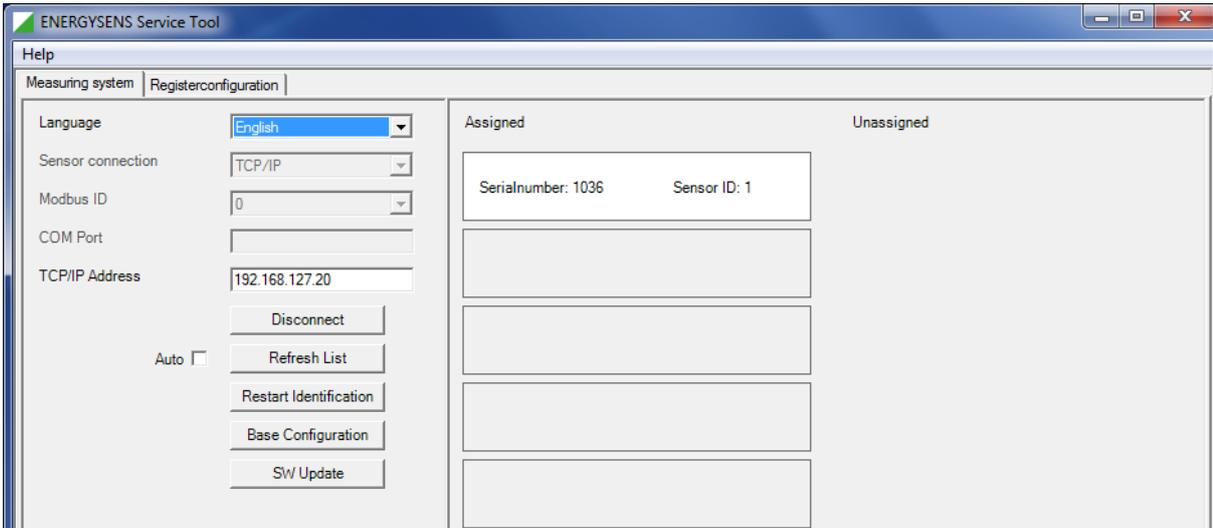
Use „SW Update“ to update the software. A dialog box opens for the update.



The corresponding ".ssu" file must be selected and the "Update SW" button must be pressed. The progress of the update is displayed on the progress bar.

3.1.6 Assigning the Sensors

A list of connected sensors is read out from the base by hitting the button „Connect“ or „Restart Identification“. Each sensor has a unique serial number.



When assigning the sensors, an individual ID is assigned to the individual sensors. The ID corresponds to a sensor location within the system and is later used to read out the registers of the respective sensor. In the respective box symbolizing a sensor, both the ID and the serial number can be seen.

After the read out, the non-assigned sensors are displayed, blinking in red-white, in the right column.

Sensors with an ID assigned, are displayed in white in the left column.

Errors of the assigned sensors are displayed as follows:

State	Description
Display blinks green	The sensor has not yet synchronized with the base. The blue LED on the sensor blinks rapidly.
Display blinks yellow	The sensor has not started the application because it is defective. A new application has to be loaded into the sensor
Display blinks red	The sensor no longer responds to the sensor bus

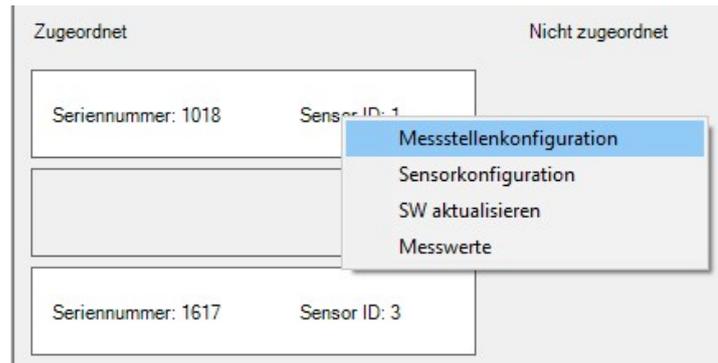
An update of the error conditions is scanned via the button „Refresh List“. With the auto checkbox activated, the status is automatically updated every 3 seconds.

When the mouse pointer is over a sensor, this sensor is displayed in blue on the PC surface. At the same time, the LED of the corresponding physical sensor is switched on. Via the illuminated LED, the sensor can easily be identified in the configuration view in the system.

To assign an ID to a sensor, simply drag the corresponding sensor to a sensor location while holding down the left mouse button. If the sensor location is already occupied, the existing sensor is automatically pushed to the next higher position.

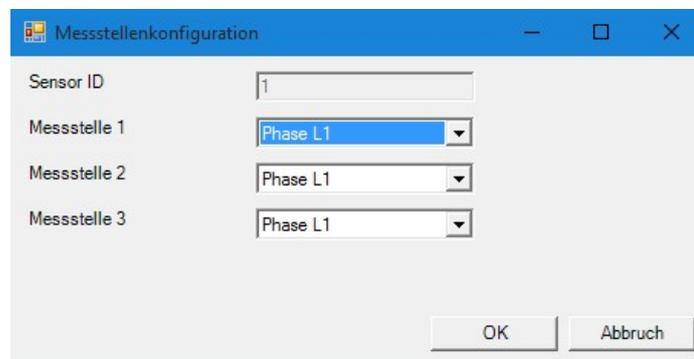
3.1.7 Phase assignment for the individual metering points in the sensors

Open the context menu “Metering point configuration” with a right mouse click on the sensor to open the window for the metering point configuration.



In this window, the corresponding voltage phase for each metering point is set up. By hitting OK, the regulated values for each sensor are saved for the respective sensor.

When using adjustable Modbus registers, the phase assignment has to be carried out when creating the register configuration. This process is described in chapter "Sensor configuration".

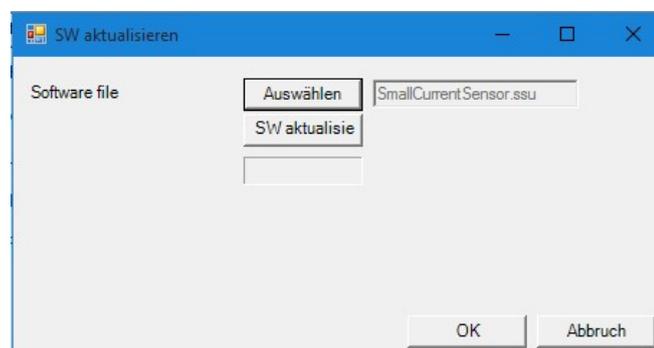


3.1.8 Reading the settings of the sensors

Via the context menu "Sensorconfiguration", which is opened by right-clicking on a sensor, the window for configuring the sensors is opened. Various configuration values of the sensors can be read in the window. The display is for information only, the user cannot change the settings

3.1.9 Sensor update

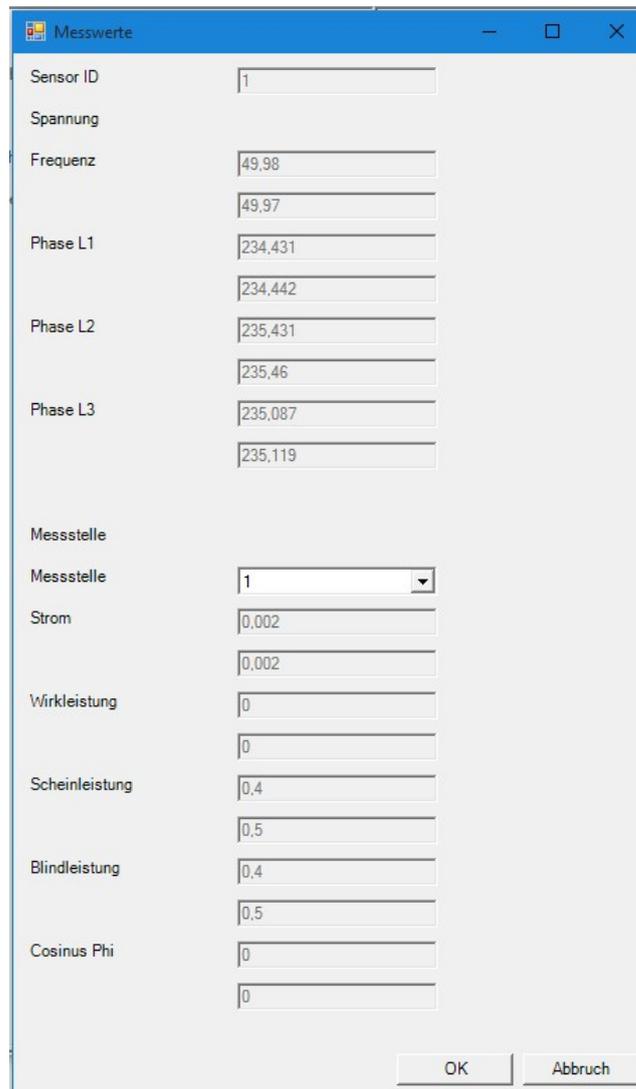
A software update is done via the context menu „SW Update“. A dialog box for updates opens.



Select the corresponding .ssu file and hit the button „SW Update“. The update progress is displayed in a progress bar.

3.1.10 Read out of sensor measurements

Via a context menu which is opened by right-clicking on a sensor, the window for reading the current measured values is opened.



The screenshot shows a software window titled "Messwerte" with a blue header bar. The window contains a list of electrical measurement parameters, each with a corresponding input field. The parameters and their values are as follows:

Parameter	Value
Sensor ID	1
Spannung	
Frequenz	49,98
	49,97
Phase L1	234,431
	234,442
Phase L2	235,431
	235,46
Phase L3	235,087
	235,119
Messstelle	
Messstelle	1
Strom	0,002
	0,002
Wirkleistung	0
	0
Scheinleistung	0,4
	0,5
Blindleistung	0,4
	0,5
Cosinus Phi	0
	0

At the bottom right of the window, there are two buttons: "OK" and "Abbruch".

This window contains a general section in which the measured voltage values are displayed for all phases.

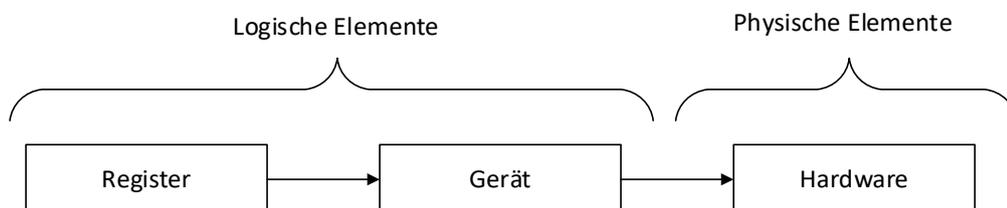
The metering point is selected in the metering point specific part. The current and power values are displayed for this selected metering point.

The upper line includes the value by second, the lower line the mean value during the past minute.

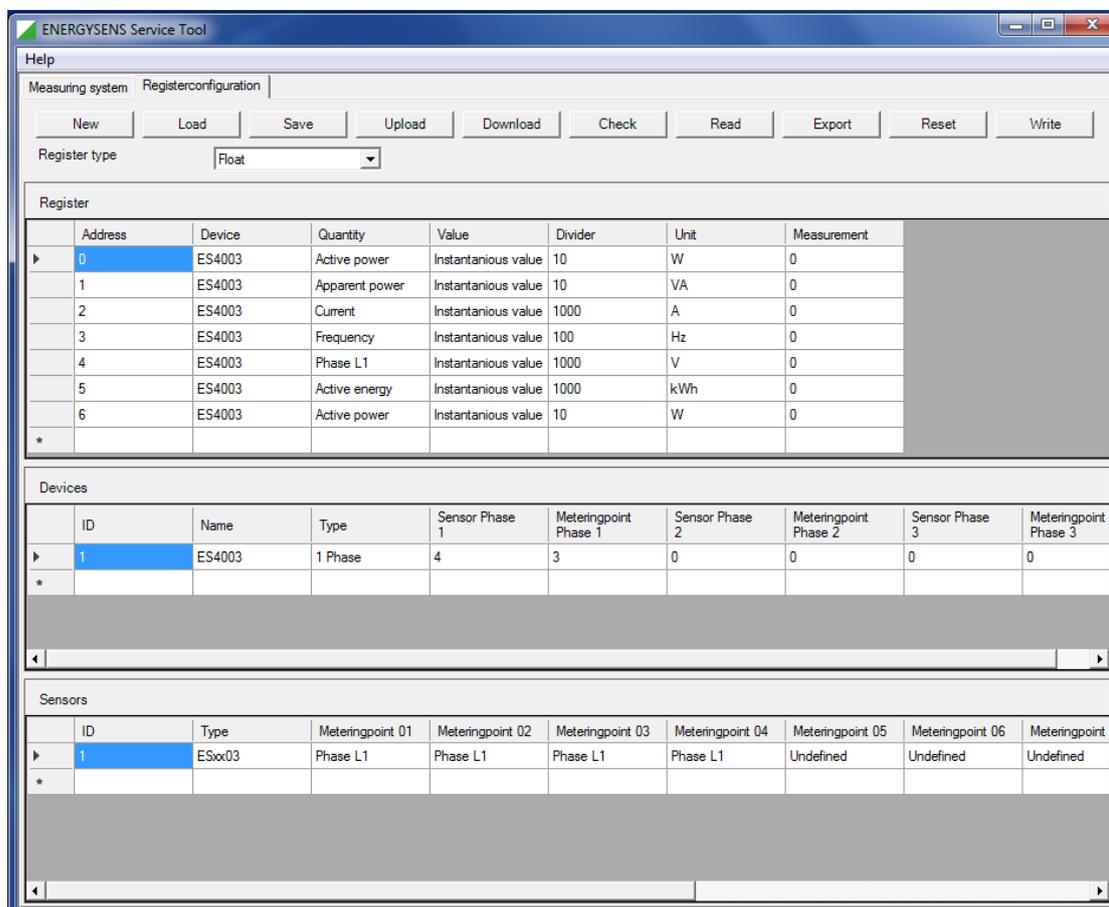
The measurements are updated by the second.

3.2 Configuration of the adjustable Modbus registers

ENERGYSENS offers an outwards logical register interface via the register configuration. The user defines devices to access the metering system ENERGYSENS. A device may have one or three phases and may use the according number of metering points. The user may create registers for the single devices which supply the quantities of the complete device, e.g. active power or Cos Phi.



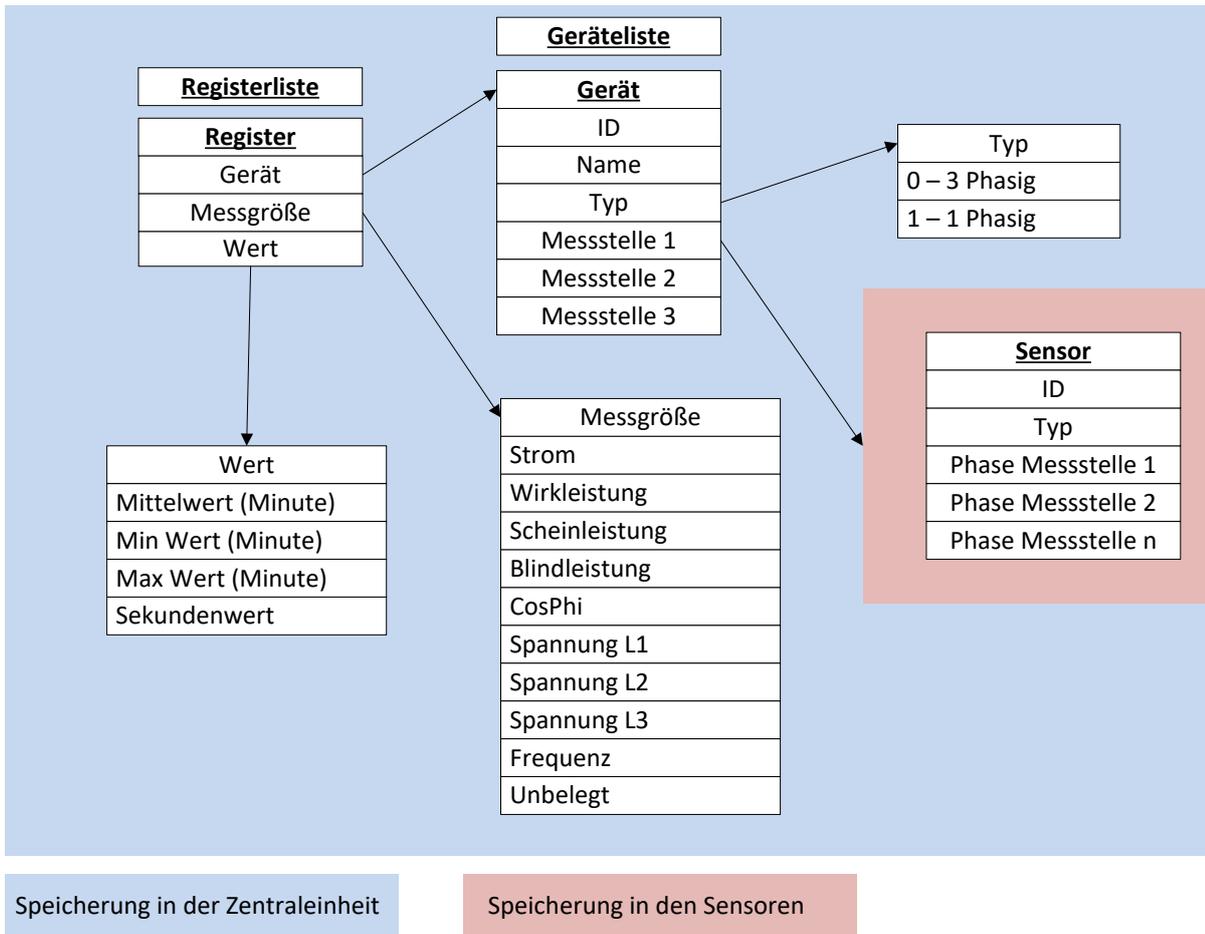
With ENERGYSENS Service Tool, the user may configure the area of the adjustable registers.



3.2.1 Configuration process

Use tab „Registerconfiguration“ on ENERGYSENS Service Tool to configure the adjustable registers. The configuration may be saved in a file and loaded from the file. In order to process the configuration, no connection of the service tool to an ENERGYSENS measuring system is necessary. The configuration can be checked offline for logic errors.

Once created, the configuration can be uploaded in the metering system. Prior to uploading, the configuration has to be tested for logical errors and compatibility with the hardware. The configuration may also be downloaded from the hardware.



The configuration consists of the elements with their respective attributes shown in the diagram. When saving in file, all elements are stored in a configuration file. Storing in ENERGYSENS hardware means that the registers, devices and texts are saved in the base. The available sensors store the assignment of the phase to each metering point. The configuration may also be downloaded from the measurement system.

3.2.2 Sensor configuration

The sensors must match the available sensors of the device. The phase of the corresponding conductor has to be set for each metering point.

3.2.3 Configuration of the devices

Up to 120 devices may be created. The devices receive a name for identification during the configuration process and an ID from 0 to 255. The ID is given by the user and must be unique. Gaps are permitted and the order is arbitrary. Each device is either single phase or three-phase configured. Corresponding with the number of phases, one or 3 metering points have to be assigned. In the case of three-phase devices, no defined order for the three phases L1, L2 and L3 must be maintained.

3.2.4 Register configuration

Up to 2,032 32 Bit registers can be created. Each register represents a quantity for the device. This value corresponds to a distinct combination of device, quantity and value. The registers must have a distinct internal address between 0 and 2,031. Gaps are permissible and the order is arbitrary. During readout from the Modbus, an offset of 0xC000 is added to the internal register address.

Due to the fact that the registers in question are 32 Bit registers,

- always two 16 Bit Modbus registers must be readout. Bit 0 of the address differentiates the high and the low register.
- for the Modbus' address calculation, the internal register address has to be multiplied by 2.

The measurements are transferred as big Endian data. The messages of the data in the "read holding register" have the following meaning

Register N		Register N+1	
Byte 3 (MSB)	Byte 2	Byte 1	Byte 0 (LSB)

3.2.5 Register functions

The registers represent a physical address. Each address has an SI unit.

To support the access of different types of management software, these addresses may be readout as single precision float in the usual IEEE 754 bit display or as 32 Bit Integer. The change is made via "register type" setting.

Since the requirements for the accuracy of the values also requires digits after the comma, the value read out must be divided by a divider when using the integer interface in order to obtain the correct value.

Quantity	Unit	Divisor
Amperage	A	1000
Active power	W	10
Apparent power	VA	10
Reactive power	Var	10
CosPhi	-	1000
Voltage	V	1000
Frequency	Hz	100
Active energy	kWh	10

The following values are offered for each quantity:

Value	Description
Average value	Created during one minute The measurement is updated once per minute.
Minimum	Created during one minute The measurement is updated once per minute.
Maximum	Created during one minute The measurement is updated once per minute.
Instantaneous value	Created during one second The measurement is updated once per second.

The register for the active power is a special feature:

It is a counter accumulating the value of the active power and may be read out via the register. For this reason, the distinction between minimum, maximum, average and active value is meaningless. The same meter count is read out for these settings.

3.2.6 Read-out of register values

The configured register values can be readout with the „Read“ button. The current measurements are displayed in the column „measurement“. The display in the column already considers the divider for the respective quantity.

3.2.7 Writing of register values in a file

The configured register values can be regularly read out and written into a Microsoft excel file with the „Write“ button. The prerequisite is that Microsoft Excel is installed on the PC on which the Service Tool is installed.

3.2.8 Saving of register configuration

The register configuration can be written into a file with the „Export“ button. A dialog box opens where the file format can be selected. In case of the generic format, the columns contain this information:

Function	Comment
Register address	Decimal digit Address on Modbus
Register quantity as index	0 amperage 1 active power 2 apparent power 3 reactive power 4 CosPhi 5 voltage L1 6 voltage L2 7 voltage L3 8 frequency 9 active energy
Register quantity as text	
Device ID	Given by user
Device name as text	Given by user
Divisor	Decimal digit Depending on the quantity
Value as index	0 average value 1 minimum 2 maximum 3 value by second
Value as text	
Unit as text	Depending on the quantity

For the easy integration of ENERGYSENS into other software environments, customized, specialized export files can be created. These can then be imported into the respective software in order to obtain easy access to the configured registers. The export differs according to the use of float or integer registers. For each register a name is created from the name of the device used, the respective quantity and the value.

When using umlauts, make sure that the respective software can also import files with umlauts.

3.2.9 Reset of active energy counter

The „Reset“ button allows to reset all or individual counters for the active energy.

3.2.10 Possible conflicts and errors

The configuration is tested for errors against the installed hardware and for logical errors within the configuration.

The user gets a prompt with a description of the conflict. The loading process in the system is terminated.

In case of warnings, the configuration may be uploaded in the system.

Logical conflicts can be detected without a system.

At first, the configuration is tested for logical errors. When the configuration is free from logical errors, it is tested for compatibility with the hardware.

Conflict	Type of conflict	Type of error
A sensor ID is included in the configuration but not in the system	hardware	error
A sensor ID is included in the system but not in the configuration	hardware	warning
The configuration includes a sensor with more metering points than the respective sensor in the system	hardware	error
The configuration includes a sensor with less metering points than the respective sensor in the system	hardware	warning
The phase of a metering point in use in the configuration is differently allocated than in the system	hardware	Message The configuration value is written in the system
Two devices use the same ID	logic	error
The number of devices is bigger than admitted	logic	error
A three-phase device was not assigned three metering points	logic	error
No metering point was assigned to a one-phase device	logic	error
No phase was assigned to a metering point in use	logic	error
A device was assigned a metering point without sensor	logic	error
A three-phase device was not assigned with three metering points with all phases	logic	error

A register accesses a device not included in the configuration	logic	error
The internal address of a register is bigger than the max. admitted	logic	error
Two registers use the same internal address	logic	error
The memory demand is too big due to long texts	logic	error

3.3 Operation

During operation, the data are continuously measured and offered as Modbus register contents. The corresponding energy management software accesses the registers and uses the read data.

All measurements are saved as 32 Bit values. 2 16 Bit Modbus registers must always be read out for a complete measurement. The command "03 Read Holding Register" is used for reading.

The measurements are always integer values.

The measurements are transferred as big Endian data. The data in the "read holding register" messages have the following meaning:

Register N		Register N+1	
Byte 3 (MSB)	Byte 2	Byte 1	Byte 0 (LSB)

For the individual quantities there is a value with the data of the last second.

In addition there is minimum, maximum and mean value over one minute. These values are updated every 15 seconds.

The registers display physical quantities as integers. Each quantity has a SI unit.

Since the requirements for the accuracy of the value points are required by the comma, the integer value must still be divided by a divisor in order to obtain the correct value.

The following quantities are offered:

Metering	Indication	Unit	Divisor
Effective voltage value	for L1, L2, L3	V	1000
Frequency	only calculated using L1	Hz	100
Effective current value	For each metering point	A	1000
Active power	For each metering point	W	10
Apparent power	For each metering point	VA	10
Reactive power	For each metering point	VA	10
Cosinus Phi	For each metering point		1000
Active energy	For configured devices	kWh	10

3.3.1 Addresses of adjustable Modbus registers

In der Konfiguration können bis zu 2032 32 Bit Register angelegt werden. Jedes Register stellt eine Messgröße für ein Gerät dar. Dieser Wert entspricht der eindeutigen Kombination aus Messgröße, Wert und Gerät.

Up to 2,032 32 Bit registers may be created in the configuration. Each register represents a measured value of one device. This value corresponds with the unique combination of quantity, value and device.

The registers have a unique internal address between 0 and 2,031.

During read out on the Modbus, an offset of 0xC000 is added to the internal register address.

Due to the fact that the registers in question are 32 Bit registers,

- always two 16 Bit Modbus registers must be read out. The address's Bit 0 differentiates the high and the low register.
- the internal register address has to be multiplied by 2 for the calculation of the Modbus' address.

The configuration of the adjustable register is described in the chapter "Configuration of the adjustable Modbus registers".

These registers can be configured either for integer or for floating point figures.

3.3.2 Addresses of fixedly defined Modbus registers

The measurements of a sensor can be directly, without configuration, readout via the fixedly defined Modbus registers.

Due to the very large number of metering points, quantities and values, the number of Modbus registers is too large to display all registers in a table.

A scheme is used to calculate Modbus register addresses. There is a scheme for frequency and voltage values and another scheme for the remaining values. This scheme simplifies the calculation of the desired register address.

The following indices are used for the scheme:

Index	Function / quantity
0	Current
1	Active power
2	Apparent power
3	Reactive power
4	COS Phi
5	Voltages
6	Adjustable registers
7	Blank

Scheme for functions 0-4

Bit 15 - 13	Bit 12 - 7	Bit 6 - 3	Bit 2 - 1	Bit 0
Function (0-4)	Sensor - 1	Metering point - 1	Average: 0 Min:1 Max:2 Value by second:3	H/L Register

The sensors and metering points are indexed. This means that for the register calculation, 1 has to be subtracted from the value of the sensor or of the metering point, respectively.

Scheme for function 5

Bit 15 - 13	Bit 12 - 5	Bit 4 - 3	Bit 2 - 1	Bit 0
Function (5)	0: voltage value 1: frequency value	Phase: L1: 0, L2: 1, L3: 2	Average: 0 Min:1 Max:2 Value by second:3	H/L Register

Scheme for function 6 (adjustable register)

Bit 15 - 13	Bit 12 - 1	Bit 0
Function (6)	Internal register address of adjustable registers Admitted values: 0 - 2031	H/L Register

Examples of pre-defined register addresses:

Function	Value
Frequency, value by second	0xA026 = 40998
Effective value of voltage L1, value by second	0xA006 = 40966
Effective value of current Average value by minute Sensor ID 1 Metering point 1	0x0000 = 0
Effective value of current Minimum value by minute Sensor ID 2 Metering point 3	0x0092 = 146

4 Glossary

Term	Definition
Quantity	The quantity is that physical quantity to be measured, e.g. current, voltage, frequency
Value	The value defines on which base the quantity is calculated: min., max., average value, value by second
Measurement	The last read value of a quantity
Metering point	The part of a sensor which calculates the measurement of a conductor with current flow.
Phase	<ol style="list-style-type: none"> 1. The voltage phase assigned to a metering point. 2. The terminal on the base where the conductor is connected.
Base	The central device with its software.
Sensor	The devices connected to the base for acquisition of the currents of several conductors with current flow.
Sensor ID	Logical address (ID) to address a sensor on the Sensorbus.
Sensor place	ENERGYSENS provides 10 logical sensor places. By setting an ID within the sensor, the sensor is assigned a place.
Current transformer	<ol style="list-style-type: none"> 1. Torodoil core for conversion of a primary current into a secondary current. One current transformer is used per metering point. 2. External device for conversion of a primary current into a secondary current. These current transformers will be used in a future derivate of ENERGYSENS.
Sensorbus	The cable connecting the base and the sensors with the signals and power supply.
Firmware	Base, resp. sensor loader. This software part cannot be updated in the field.
Software	Base, resp. sensor application. This part of the software can be updated in the field.
Configuration	Data controlling the firmware and the software. These are in part set during production, in part during the user and saved in nonvolatile memories of the base resp. of the sensors.
Register configuration	<p>The configuration part describing the configurable registers. The register configuration can be saved in the metering system and in a file.</p> <p>When saving in the metering system, parts are saved in the sensors and other parts are saved in the base.</p>
Device	This component of the register configuration describes an external device for which defined quantities must be gathered. There are single phase and tri-phase devices.
Register	<ol style="list-style-type: none"> 1. This component of the register configuration describes a certain quantity to be gathered by the device and the corresponding address for readout of the quantity. 2. Registers with fix addresses serve to readout defined quantities of individual metering points.
Service Tool	PC software of ENERGYSENS to set parameters.
Metering system	All hardware and embedded software components e.g. Error message: No connection with the metering system possible.

ENERGY SENS	Brand name for all components.
ENERGY SENS Base	Brand name of the base
ENERGY SENS 3/12	Brand name for all sensors with 3 / 12 metering points

5 Technical data

Electrical connections	
Voltage (L1)	230 V, 50/60 Hz
Power (max. value for base and 10 sensors)	5 W
Amperage (min. connection value for the fuse)	1 A

Configuration	
ENERGYSENSBase	Up to 10 sensors
Sensors	Versions with 3 and 12 metering points Different amperage
Length of connection via flat ribbon cable (max. value)	5 m

Dimensions ENERGYSENSBase	
Height	91 mm
Width	35 mm (2 modules)
Depth	59 mm

Dimensions sensors	
Height	13 mm
Width	17.5 mm (1 module) / metering point
Depth	47 mm

Communication interface	
1 x RS485	Modbus RTU, 115,2 kBaud
1 x Ethernet	Modbus TCP, 100 MBit

Measuring technique	Nominal value	Precision
Voltage measuring	3~230/400 V	Class 1 according to DIN EN 60688
Current measuring	40 A 80 A	Class 1 according to DIN EN 60688
Frequency measuring	50 / 60 Hz	Class 1 according to DIN EN 60688
Power measuring active power	9.2 kW 18.4 kW	Class 1 according to DIN EN 62053-21 (applied ¹)

¹ The accuracy of the power measuring active power is according to DIN EN 62053-21.
The impact of the relevant influencing variables on the measurement accuracy is according to DIN EN 62053-21

6 Safety instructions

The safety and warning instructions here and in further chapters of the manual must be respected to avoid health endangerments, dangerous situations and system damages.

GMC-I Messtechnik GmbH, is not liable for damages and results due to:

- Connection and / or installation errors.
- Use of violence, damages of the device and / or of the connection leads.
- Damages of the devices due to mechanical influences and / or excess voltage.
- Each and any modification of the device and / or the connection leads.
- Use for other purposes than those described in this manual.
- Exposure to liquids and / or insufficient ventilation.
- Unauthorized opening of the device. This, amongst others, results in warranty loss.
- Consequential damages resulting from non-intended use.

The metering system is laid out for operation under voltages bigger than 50V. These voltages mean life danger due to dangerous body strikes / electric shock.

These safety instructions must be respected:

- Only qualified licensed electricians can carry out works on the electric device.
- Immediate life danger, when touching current leading parts.
- Damages of the insulation or of single components can be life-endangering.
- In case of damaged insulation (housing), the currency supply has to be immediately turned off and the damaged part must be replaced.
- Prior to working on electric devices, switch to not energized and check that there is no current.
- Prior to maintenance, cleaning and repair works, turn off the power supply and secure it against newly turning on.
- Do not override and set out of order any fuse / circuit breaker.
- Protect **ENERGYSENS** from water.

Conductor cross section for L1, L2, L3 and N	
Solid core	0.5 mm ² – 1.5 mm ²
Insulation length	10 mm
Fine-wired with insulated wire end ferrule	0.5 mm ² – 1 mm ²

Conductor cross section for A(+), B(-), GND	
Fine-wired with insulated wire end ferrule	0.25 mm ²

Environment conditions	
Storage temperature	-20°C - +65°C
Operation temperature	-20°C - +55°C
Height	max. 2000m over MSL
Humidity	max. 90% non-condensing
Place of operation	Only internal spaces

Safety	
Protection class	II
Installation category	300V CAT III
Contamination level	2

Max. work conditions of voltage input for N entry	
Supply voltage (L1)	230V +/- 10%
Metering voltage (L2, L3)	0 – 230V + 10%

Max. work conditions of voltage inputs	
Current measurement	0 – $I_{nom} + 10\%$

Max. work conditions of RS485 interface	
Put down under standard ANSI/TIA/EIA-485-A-98	

Max. work conditions for Ethernet interface	
Put down under standard IEEE 802.3 Clause 25 und TIA-568A/B	

Max. work conditions for Sensorbus interface	
This proprietary interface must only be used to connect with sensors in the ENERGY SENS metering system.	

	<p>The voltage entries L1, L2, L3 must be secured by 1A, release characteristic B circuit breakers.</p> <p>A method has to be provided, to switch the device volt-free, e.g. a distinctly marked interrupter.</p>
	<p>The installation of the sensors, the flat ribbon cable and the base has to be done behind a cover panel and in such a way to ensure that only qualified licensed electricians can access the sensors, the flat ribbon cable and the connecting terminals without removing the cover panel. The cover panel has to be clearly marked that open, dangerous, current leading parts are behind the panel.</p> <p>Alternatively, all components of ENERGYSENS can be installed in such a way that only qualified licensed electricians can access them (e.g. electric control cabinet).</p>
	<p>A minimum distance of the flat ribbon cable to the current leading parts of the device must be respected. The blank ends of the flat ribbon cable must be closed by a shrink hose.</p>
	<p>Protection class II Touch protection is guaranteed by a protective insulation.</p>

**Repair and Replacement Parts Service
Calibration Center and Rental Instrument Service**

If required, please contact:

GMC-I Service GmbH
Service-Center
Thomas-Mann-Strasse 20
90471 Nürnberg • Germany
Phone +49 911 817718-0
Fax +49 911 817718-253
E-Mail service@gossenmetrawatt.com
www.gmci-service.com

This address is only valid in Germany.
Please contact our representatives or subsidiaries for service in other countries.

Product Support

If required, please contact:

GMC-I Messtechnik GmbH
Product Support Hotline
Phone +49 911 8602-0
Fax +49 911 8602-709
E-Mail support@gossenmetrawatt.com

*** DAkkS Calibration Laboratory for Electrical Quantities D-K-15080-01-01
accredited per DIN EN ISO/IEC 17025**

Accredited measured quantities: direct voltage, direct current values, DC resistance, alternating voltage, alternating current values, AC active power, AC apparent power, DC power, capacitance, frequency and temperature