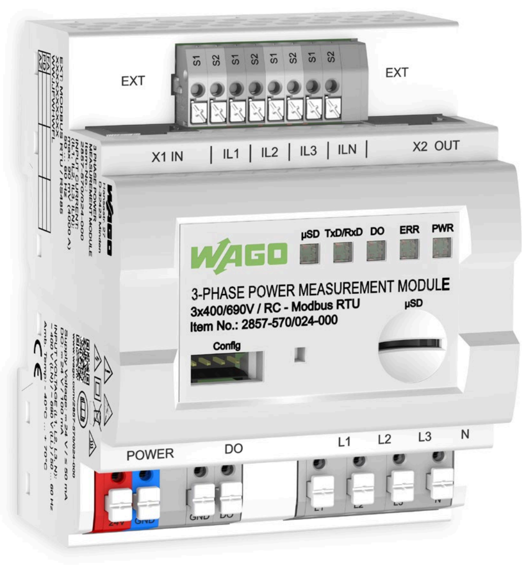
TECHDOCS

Manual



2857-0570(/xxxx-xxxx)

3-Phase Power Measurement Module

Version 1.0.0

WAGO Kontakttechnik GmbH & Co. KG

Hansastraße 27
D-32423 Minden

Phone: +49 (0) 571/8 87 – 0
Fax: +49 (0) 571/8 87 – 1 69

E-Mail: info@wago.com

Web: www.wago.com

Technical Support

Phone: +49 (0) 571/8 87 – 4 45 55
Fax: +49 (0) 571/8 87 – 84 45 55

E-Mail: support@wago.com

Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

E-Mail: documentation@wago.com

Table of Contents

1 Notes about this Documentation

Note

Always retain this documentation!
This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user. In addition, ensure that any supplement to this documentation is included, if necessary.

1.1 Validity of this Documentation

This documentation applies to the following 3-phase power measurement modules:

Table 1: Variants

Item number	Designation
2857-0570/0024-0000	3-Phase Power Measurement Module Rogowski
2857-0570/0024-0001	3-Phase Power Measurement Module 1 A (24 V)
2857-0570/0024-0005	3-Phase Power Measurement Module 5 A (24 V)

Note

Documentation Validity for Variants
Unless otherwise indicated, the information given in this documentation applies to listed variants.

The transducer 2857-0570 shall only be installed and operated according to the instructions in this manual.

1.2 Revision History

Table 2: Revision History

Document Version	Device Version		Description of Change
	Hardware	Software	
1.0.0	01	01	First issue

1.3 Copyright

1.4 Symbols

DANGER

Personal Injury!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

DANGER

Personal Injury Caused by Electric Current!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Personal Injury!
Indicates a moderate-risk, potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Personal Injury!
Indicates a low-risk, potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Damage to Property!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

NOTICE

Damage to Property Caused by Electrostatic Discharge (ESD)!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

Note

Important Note!
Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.

Information

Additional Information:
Refers to additional information which is not an integral part of this documentation (e.g., the Internet).

1.5 Number Notation

Table 3: Number Notation

Number Code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	In quotation marks, nibble separated with dots (.)

1.6 Font Conventions

Table 4: Font Conventions

Font Type	Indicates
italic	Names of paths and data files are marked in italic-type. e.g.: *C:\Program Files\WAGO Software*
Menu	Menu items are marked in bold letters. e.g.: **Save**
>	A greater-than sign between two names means the selection of a menu item from a menu. e.g.: **File** > **New**
Input	Designation of input or optional fields are marked in bold letters, e.g.: **Start of measurement range**
“Value”	Input or selective values are marked in inverted commas. e.g.: Enter the value “4 mA” under **Start of measurement range**.
[Button]	Pushbuttons in dialog boxes are marked with bold letters in square brackets. e.g.: **[Input]**
[Key]	Keys are marked with bold letters in square brackets. e.g.: **[F5]**

2 Important Notes

This section includes an overall summary of the most important safety requirements and notes that are mentioned in each individual section. To protect your health and prevent damage to devices as well, it is imperative to read and carefully follow the safety guidelines.

2.1 Legal Bases

2.1.1 Subject to Changes

WAGO Kontakttechnik GmbH & Co. KG reserves the right to provide for any alterations or modifications. WAGO Kontakttechnik GmbH & Co. KG owns all rights arising from the granting of patents or from the legal protection of utility patents. Third-party products are always mentioned without any reference to patent rights. Thus, the existence of such rights cannot be excluded.

2.1.2 Personnel Qualifications

The device described in these instructions shall only be installed by a qualified electrician according to both EN 50110-1/-2 and IEC 60364.

2.1.3 Intended Use of Signal Conditioners and Isolation Amplifiers of the 2857 Series

The devices have been developed for use in an environment that meets the IP20 protection class criteria. Protection against finger injury and solid impurities up to 12.5 mm diameter is assured; protection against water damage is not ensured. Unless otherwise specified, operation of the devices in wet and dusty environments is prohibited.

Operating the devices in home applications without further measures is only permitted if they meet the emission limits (emissions of interference) according to EN 61000-6-3. You will find the relevant information in the section “Device Description” > “Standards and Guidelines”.

Appropriate housing (per 2014/34/EU) is required when operating in hazardous environments. Please note that a prototype test certificate must be obtained that confirms the correct installation of the system in a housing or switch cabinet.

2.1.4 Technical Condition of Specified Devices

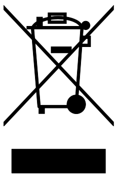
The devices to be supplied ex works are equipped with hardware and software configurations, which meet the individual application requirements. These modules contain no parts that can be serviced or repaired by the user. The following actions will result in the exclusion of liability on the part of WAGO Kontakttechnik GmbH & Co. KG:

- Repairs,
- Changes to the hardware or software that are not described in the operating instructions,
- Improper use of the components.

Further details are given in the contractual agreements. Please send your request for modified and new hardware or software configurations directly to WAGO Kontakttechnik GmbH & Co. KG.

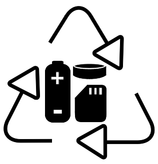
2.1.4.1 Disposal

2.1.4.1.1 Electrical and Electronic Equipment



Electrical and electronic equipment may not be disposed of with household waste. This also applies to products without this symbol.

Electrical and electronic equipment contain materials and substances that can be harmful to the environment and health. Electrical and electronic equipment must be disposed of properly after use.
WEEE 2012/19/EU applies throughout Europe. Directives and laws may vary nationally.



Environmentally friendly disposal benefits health and protects the environment from harmful substances in electrical and electronic equipment.

- Observe national and local regulations for the disposal of electrical and electronic equipment.
- Clear any data stored on the electrical and electronic equipment.
- Remove any added battery or memory card in the electrical and electronic equipment.
- Have the electrical and electronic equipment sent to your local collection point.

Improper disposal of electrical and electronic equipment can be harmful to the environment and human health.

2.1.4.1.2 Packaging

Packaging contains materials that can be reused.
PPWD 94/62/EU and 2004/12/EU packaging guidelines apply throughout Europe. Directives and laws may vary nationally.

Environmentally friendly disposal of the packaging protects the environment and allows sustainable and efficient use of resources.

- Observe national and local regulations for the disposal of packaging.
- Dispose of packaging of all types that allows a high level of recovery, reuse and recycling.

Improper disposal of packaging can be harmful to the environment and wastes valuable resources.

2.2 Safety Advice (Precautions)

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:

DANGER

Install protection against electric shock!
All wiring for the measurement system shall be provided with protection against shock hazard voltages along with the corresponding safety signs!

DANGER

Do not work on devices while energized!
All power sources to the device shall be switched off prior to performing any installation, repair or maintenance work.

DANGER

Install the device only in appropriate housings, cabinets or in electrical operation rooms!
The device is not closed. Therefore, install it exclusively in appropriate housings, cabinets or in electrical operation rooms. Allow access to authorized, qualified staff only by means of specific keys or tools.

DANGER

Dangerous Voltage!
If there is a fault, contacts may carry dangerous electrical voltage. This can cause electric shock or burns!

At a line conductor / neutral conductor of > 300 VAC, voltages can be measured directly. Ensure that the neutral conductor is not dangerously active in the existing network! Otherwise, additional protective measures must be used.

DANGER

Ensure a standard connection!
To minimize any hazardous situations resulting in personal injury or to avoid failures in your system, the data and power supply lines shall be installed according to standards, with careful attention given to ensuring the correct terminal assignment. Always adhere to the EMC directives applicable to your application.

CAUTION

Do not touch hot surfaces!
The surface of the housing can become hot during operation. If the device was operated at high ambient temperatures, allow it to cool off before touching it.

NOTICE

Note the max. continuous input current of 1 A resp. 5 A!
The max. continuous input current is 1 A resp. 5 A. If needed install additional current transformers with an appropriate transforming ratio!

NOTICE

Ensure proper contact with the DIN-rail!
Proper electrical contact between the DIN-rail and device is necessary to maintain the EMC characteristics and function of the device.

NOTICE

Replace defective or damaged devices!
Replace defective or damaged device/module (e.g., in the event of deformed contacts).

NOTICE

Protect the components against materials having seeping and insulating properties!
The components are not resistant to materials having seeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If you cannot exclude that such materials will appear in the component environment, then install the components in an enclosure being resistant to the above-mentioned materials. Clean tools and materials are imperative for handling devices/modules.

NOTICE

Clean only with permitted materials!
Clean housing and soiled contacts with propanol.

NOTICE

Do not use any contact spray!
Do not use any contact spray. The spray may impair contact area functionality in connection with contamination.

NOTICE

Do not reverse the polarity of connection lines!
Avoid reverse polarity of data and power supply lines, as this may damage the devices involved.

NOTICE

Avoid electrostatic discharge!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched. Please observe the safety precautions against electrostatic discharge per DIN EN 61340-5-1/-3. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly grounded.

3 Device Description

The 3-Phase Power Measurement Module (2857-0570) in rail-mount enclosures (also referred to by the short name “power measurement module”) enables measurement of electrical variables up to 400/690 V in a three-phase supply network.

When specific prerequisites are met, the voltages of the three phases can be directly measured – as can the currents – through Rogowski coils or current transformers (for more information, see Section “Connection Example: Power Measurement). On the basis of these input signals, the power measurement module determines the various AC measured quantities, such as voltage and current, reactive, apparent and active power, energy consumption, power factor, phase angle and frequency. Also, harmonic analysis is possible for a selectable phase up to the 41st harmonic.

The delivered measured values indicate the load type (inductive or capacitive) and whether it is an energy consumer or producer. This allows visualization as a four-quadrant display, as has been implemented with the Interface Configuration Software for display of the measured values in WAGO-I/O-CHECK.

The power measurement module provides the measured values via an RS-485/Modbus RTU. Thus, the measured values can also be transferred to a higher-level controller (e.g., WAGO EDM 2.0). This enables a comprehensive analysis of the three-phase network. These measured values allow the operator optimized control of the supply to a drive or machine, protecting the system from damage and failure. In addition, a line structure configuration (“Daisy Chain Configuration”) can be facilitated via a second RJ-45 interface.

- **2857-0570/0024-0000:** In this variant, the current measurement range depends on the output voltage of the Rogowski coil used.
- **2857-0570/0024-0001:** This variant measures currents through transformer ratios up to 1 A.
- **2857-0570/0024-0005:** This variant measures currents through transformer ratios up to 5 A.

The power measurement module can be used in the following network topologies:

- 3-wire three-phase network (3-L)
- 4-wire three-phase network (4-L)

3.1 Views

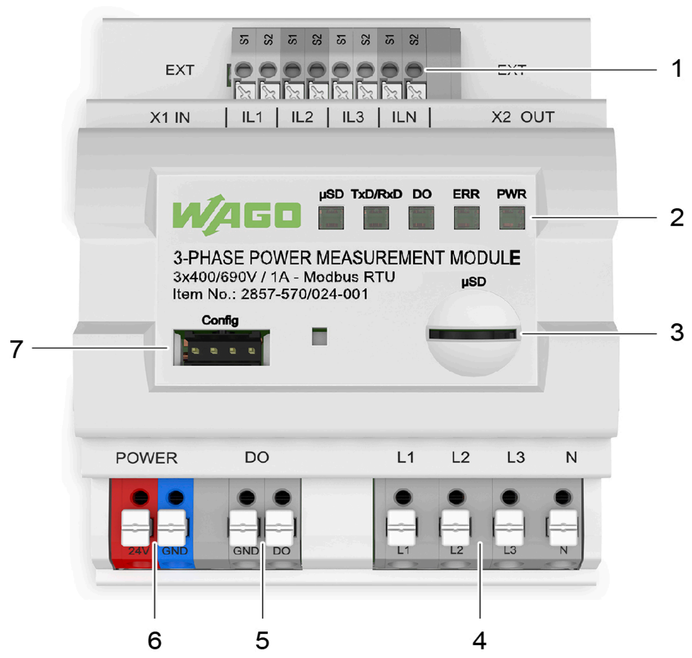


Figure 1: Front view 2857-0570/0024-0001

Table 5: Legend for figure “Front view” 2857-0570/0024-0001

No.	Name	For Details, See Section:
1	Current measurement inputs	“Device Description” > “Connections”
2	Status and error LEDs	
3	Memory card slot “µSD”	
4	Voltage measurement inputs	
5	Switch output “DO”	
6	Supply connection “POWER”	
7	Configuration interface “Config”	

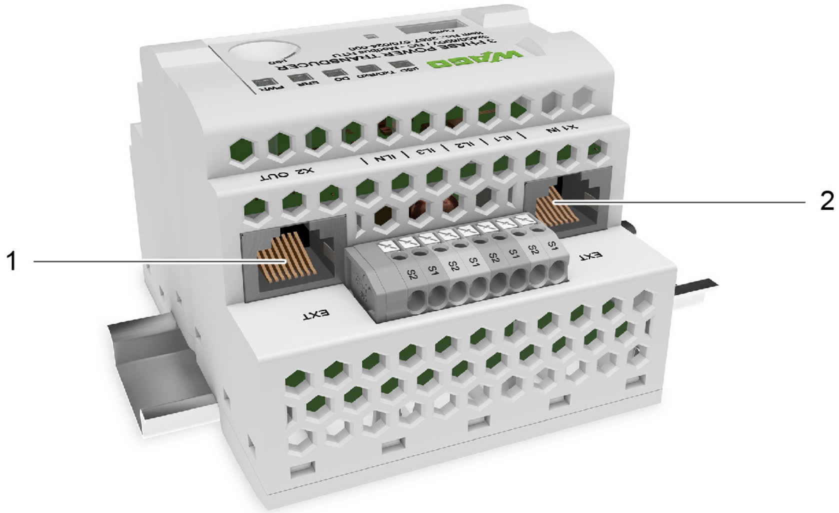


Figure 2: View from above

Table 6: Legend for figure “View from above”

No.	Name	For Details, See Section:
1	Modbus RTU interface “X2 OUT”	“Device Description” > “Connections”
2	Modbus RTU interface “X1 IN”	

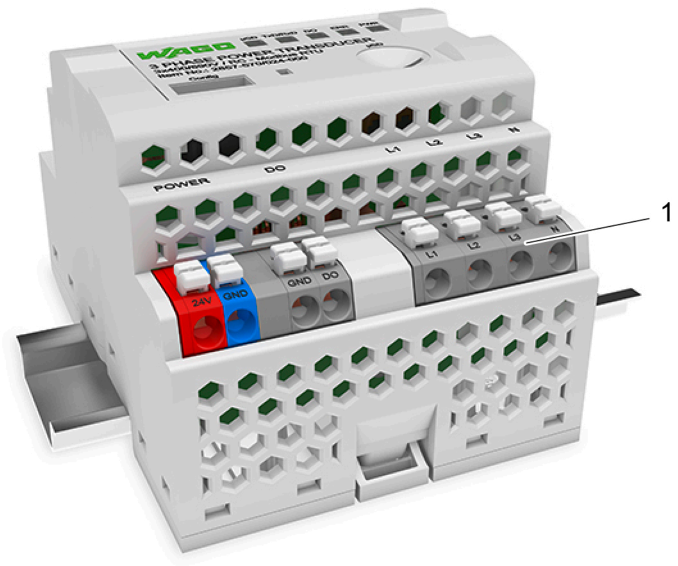


Figure 3: View from below

Table 7: Legend for figure “View from below”

No.	Name	For Details, See Section:
1	Supply connection “POWER,” switch output “DO” and voltage measurement inputs	“Device Description” > “Connections”

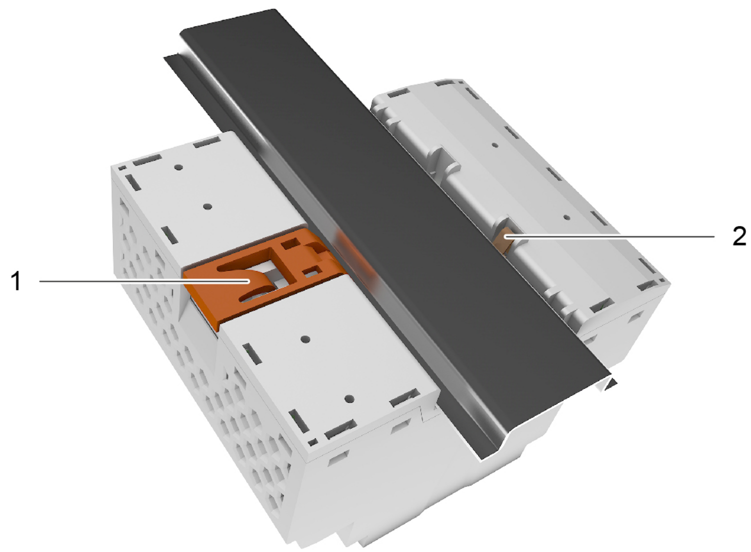


Figure 4: View from behind

Table 8: Legend for figure “View from behind”

No.	Name	For Details, See Section:
1	Snap-in mounting foot	Installation
2	Spring contact for functional ground	“Device Description” > “Schematic Diagram”

3.2 Dimensions

The power measurement module dimensions are:

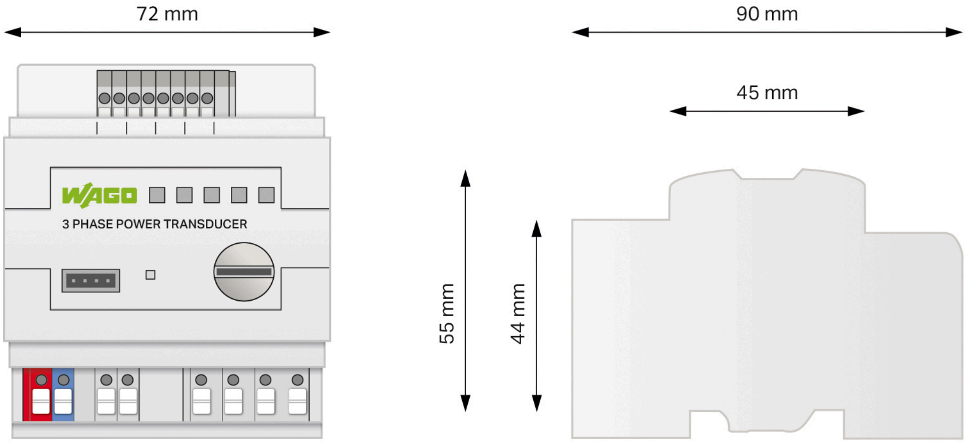


Figure 5: Dimensions

Table 9: Dimensions

Width	72 mm (2.8 inch)
Height (from upper edge of DIN-rail)	55 mm (2.2 inch)
Depth	90 mm (3.5 inch)

3.3 Connectors

3.3.1 Measurement Inputs

IL1 … ILN (terminals respectively marked with S1 and S2) are the current measurement inputs. The current transformers or Rogowski coils are connected here.
L1 … N (terminals marked accordingly) are the voltage measurement inputs. The four wires of the network to be measured are connected here.
See also Section “Conductor Termination.”

The terminals are the Push-in CAGE CLAMP® design with pushers and have a test port.

Table 10: Measurement Inputs

Designation	Connection	Function
IL1–S1 IL1–S2	Current transformer/Rogowski coil to L1	Differential input for current measurement at L1
IL2–S1 IL2–S2	Current transformer/Rogowski coil to L2	Differential input for current measurement at L2
IL3–S1 IL3–S2	Current transformer/Rogowski coil to L3	Differential input for current measurement at L3
ILN-S1 ILN-S2	Current transformer/Rogowski coil at N	Differential input for current measurement at N
L1	Conductor L1	Input for voltage measurement at L1
L2	Conductor L2	Input for voltage measurement at L2
L3	Conductor L3	Input for voltage measurement at L3
N	N-conductor N	Reference potential for voltage measurements

3.3.2 Switch Output "DO" and S0 Interface

With switch output "DO," whether the input signal exceeds or falls below the threshold values can be reported. If it does, the output is set to +24 VDC and delivers a maximum current of up to 100 mA. Then, e.g., an LED can be actuated.

More detailed information is presented in the following sections:

- "Threshold Over-/Underruns"
- "Energy Value Readout at the S0 Interface"

Table 11: Switch Output "DO" and S0 Interface

Designation	Connection	Function
DO	LEDs, relays, etc.	Dig. output, 24 VDC (switch output or S0 interface)
GND	Ground	Dig. output, ground (earth mass) or S0 interface)

To read out the energy values, switch output "DO" can be configured as an S0 interface (with the Interface Configuration Software). However, the same "DO" and "GND" connections are used.

Note

Either Switch Output or S0 Interface!
Please note, "DO" can be used as either as a switch output or an S0 interface! Both functions at the same time are not possible!

The terminals are the Push-in CAGE CLAMP® design with pushers and have a test port

3.3.3 Modbus® RTU Interfaces “X1 IN” and “X2 OUT” according to RS-485

The Modbus® RTU wires for registering communication with the subordinate controller (PLC) are connected to “X1 IN” und “X2 OUT.” This is an example of how the connections can be assigned:

- **Connection X1 IN:** PLC controller or up-circuit Modbus® device
- **Connection X2 OUT:** Down-circuit Modbus® device

The interfaces correspond to RJ-485 are equipped as RJ-45 ports. The shielding is directly connected to FE (functional ground).

Table 12: Pin Assignment for Modbus® Interfaces “X1 IN” and “X2 OUT”

Pin Contact	Assignment
-X1:1/-X2:1	N. C.
-X1:2/-X2:2	N. C.
-X1:3/-X2:3	N. C.
-X1:4/-X2:4	A (Data +)
-X1:5/-X2:5	B (Data -)
-X1:6/-X2:6	N. C.
-X1:7/-X2:7	N. C.
-X1:8/-X2:8	Common

To form a line structure, two interfaces are internally bridged. See the figure below:

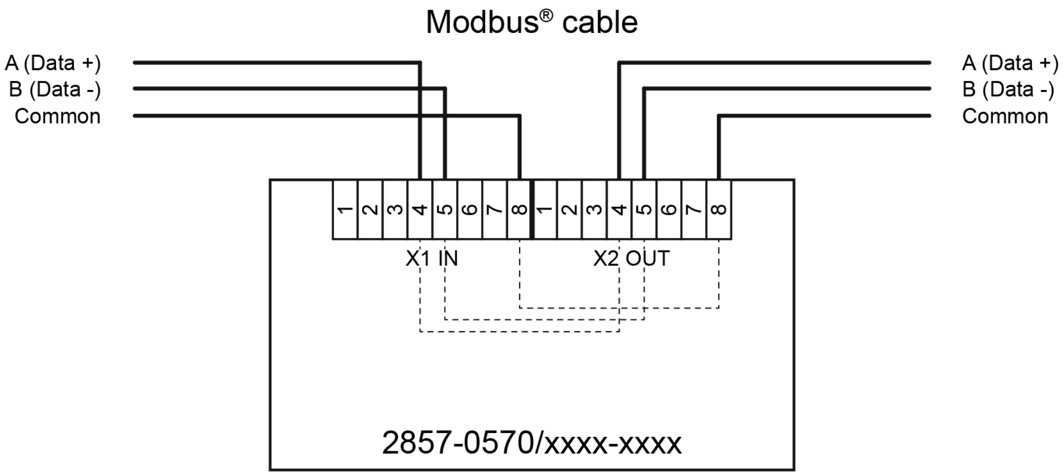


Figure 6: Power Measurement Module on Modbus®

Use a Category 5e patch cable (shielded twisted pair) to connect to the two adjacent bus devices. For more detailed information, see Section “Technical Data”.

3.3.4 Configuration Interface “Config”

To configure the power measurement module for visualizing measured values as the power is measured and for firmware updates, an engineering PC with the Interface Configuration Software is used.
Communication via the power measurement module and the PC is via the serial interface “Config” on the front side. It consists of a 4-pole male header.

A WAGO USB Communication Cable (750-923) is connected here. The operating system recognizes the communication cable as a virtual COM port.

Figure 7: Configuration Interface “Config”

3.3.5 Supply Connection “POWER”

An SELV with 24 VDC must be connected at the supply connection “POWER.” The terminals are the Push-in CAGE CLAMP® design with pushers and have a test port.

3.3.6 Memory Card Slot “µSD” for Micro SD Cards

There is a slot for micro SD cards on the front of the power measurement module.
Memory cards with 2 GB tested by WAGO can be used.

Note

Only use recommended memory cards!
Use only the microSD memory card available from WAGO (item No. 758-879/000-3102) as it is suitable for industrial applications subjected to environmental extremes and for use in this device.
Compatibility with other commercially available storage media cannot be guaranteed.

3.3.7 Functional Ground Connection

When the power measurement module is snapped to a DIN-rail, the contact spring automatically establishes a secure electrical contact with the DIN-rail and thus, to ground. This increases the immunity to electromagnetic interference.

3.4 Display Elements

Five LEDs in the front plate signal status and error messages.

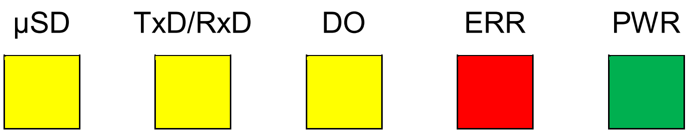


Figure 8: Indicators

The table below explains the meaning of the LED states.

Table 13: Legend for “Display Elements” Figure

LED	State	Meaning/Report
µSD	Off	No access to memory card
	Yellow flashing	The memory card is being written.
TxD/ RxD	Off	Modbus® is inactive.
	Yellow flashing	Modbus® is active.
DO	Off	The DO is inactive.
	Yellow	The DO is active.
PWR (Power)	Off	Not ready for operation.
	Green	Ready for operation.
ERR (error)	Off	No error
	Red	Group error message
	Red flashes at 8 Hz	Tamper Detect (fault current detection)
	Red flashes at 2 Hz	• Configured threshold values are exceeded or fallen below, or • the power measurement module is still stabilizing, so the measured values are not yet stable.
ERR and PWR	Alternate red and green flashing	The firmware is being updated.
ERR and PWR	Red steady and green flashing	Waiting for firmware update.

3.5 Schematic Diagram

The following figure shows the schematic circuit diagram.

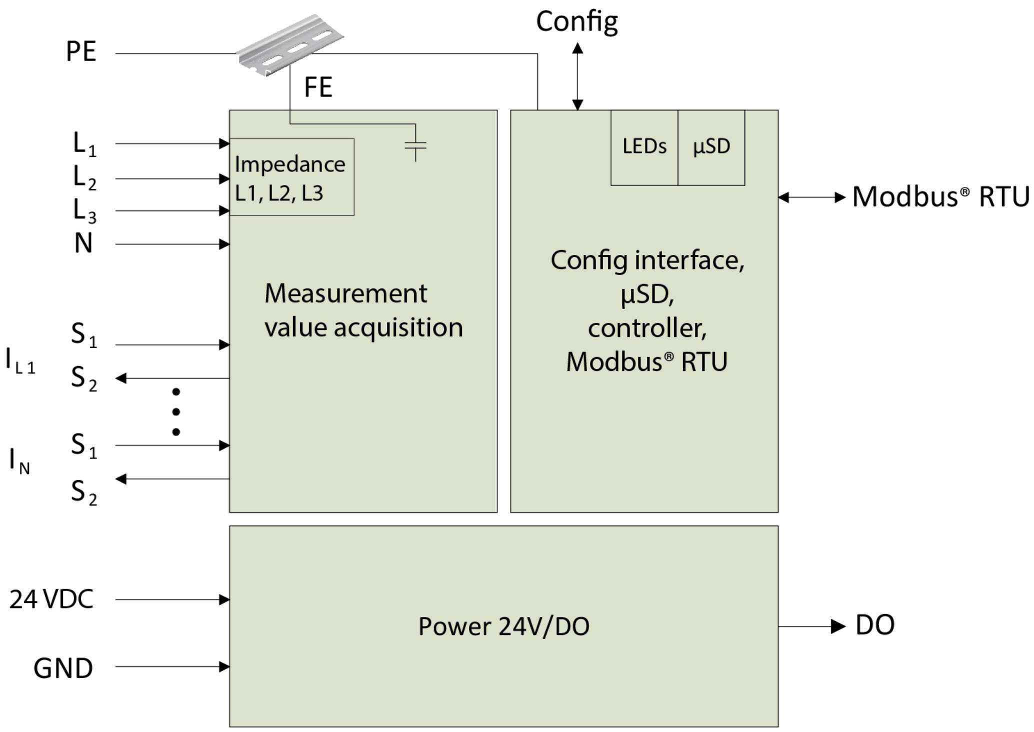


Figure 9: Schematic Circuit Diagram

Please note the following information:

- Measurement value acquisition,
- configuration interface, µSD, controller, Modbus RTU and
- Power 24 V/DO

are electrically isolated from each other.

To achieve functional grounding, the N connection must be connected to the DIN-rail via a 1nF capacitor and a spring contact. Connecting this to PE according to the instructions increases the immunity to electromagnetic interference.

3.6 Technical Data

3.6.1 Dimensions and Weight

Table 14: Technical Data – Dimensions and Weight

Width	72 mm
Height (from upper edge of DIN-rail)	55 mm
Depth	90 mm
Weight	118 g

3.6.2 Power Supply

Table 15: Technical Data – Power Supply

Supply voltage	SELV (Safety Extra Low Voltage) 24 VDC (± 30%)
Current consumption	< 50 mA + I_{DO}

3.6.3 Measurement Inputs

Table 16: Technical Data – Measurement Inputs

Number of inputs	3 voltage measurement inputs and 4 differential current measurement inputs
Voltage measurement range (rms) AC • Phase voltage Lx–N • Line-to-line voltage Lx–Ly	 70 … 300 VAC * 120 … 690 VAC
Resolution	100 mV
Typ. input resistance (voltage inputs)	1429 kΩ
Current measurement range (rms) AC • 2857-0570/0024-0000 • 2857-0570/0024-0001 • 2857-0570/0024-0005	 Depends on Rogowski coils used. Maximum 4000 A 0 … 1 A/AC × transformer ratio 0 … 5 A/AC × transformer ratio
Resolution	100 µA
Typ. input resistance (current inputs) • 2857-0570/0024-0000 • 2857-0570/0024-0001 • 2857-0570/0024-0005	 44 kΩ 22 mΩ 5 mΩ
Frequency range • Line frequency • Harmonic analysis	 45 … 65 Hz 0 … 3300 Hz
Limit frequency	15.9 kHz
Signal form	Arbitrary periodic signals (with threshold frequencies taken into account)
Test voltage	3.51 kVAC, 50 Hz, 1 min.

Safe isolation Input (supply/communication)	per EN 61010-1
Requirement (N input)	Not dangerously active
I_{LX} input requirement	Coils and transformers with basic insulation
Line/neutral conductor voltage	600 VAC/DC
Overvoltage category	III
Pollution degree	2

* 400 V when specific prerequisites are met; for more information, see Section “Connection Example: Power Measurement”.

3.6.4 Measured Variables

Table 17: Technical Data – Measured Variables

Measurement method	A/D input signal conversion with 8 Hz sampling rate and 24 bit quantization synchronized over all 7 measurement inputs; measurement value calculation with digital signal processor
Measured Variables:	
Voltage	• Voltage (rms) Lx–N • Min./max. voltage (rms) Lx–N • Arith. mean voltage Lx–N • Peak value voltage Lx–N • Line-to-line voltage (rms) Lx–Ly
Current	• Current (rms) Lx • Min./max. current (rms) Lx • Arith. mean current Lx • Peak value current Lx • Current (rms) N
Power	• Active power Lx • Min./max. active power Lx • Active power total • Reactive power Lx • Reactive power total • Apparent power Lx • Apparent power total

Table 17: Technical Data – Measured Variables

Energy	• Active energy LX • Active energy import Lx • Active energy export Lx • Active energy, total • Active energy import, total • Active energy export, total • Reactive energy Lx • Inductive active energy Lx • Capacitive active energy Lx • Reactive energy total • Reactive energy inductive total • Reactive energy capacitive total • Apparent energy Lx
Frequency	• Line frequency Lx • Min./max. line frequency Lx
Phase Angle	• phi Lx
Power Factor	• Cos phi Lx • Power factor, PF Lx • Power factor LF Lx
Harmonics analysis up to 41st harmonic	• Current (rms) • Voltage (rms) • HD/THD current • HD/THD voltage
Measuring Errors:	
Voltage	≤ 0.3% of measurement range final value (max. value)
Current	≤ 0.5% of measurement range final value (max. value)
Active power	≤ 0.5% of measurement range final value (max. value)
Phase Angle	± 0.3°
Frequency	± 0.01 Hz
Harmonic analysis measurement values	≤ 1 %

3.6.5 Communication

Table 18: Technical Data – Communication

Fieldbus protocol	Modbus RTU/RS-485
Communication interfaces “X1 IN” und “X2 OUT”	2 x RJ-45 ports for forming daisy chain configuration
Configuration interface “Config”	4-pole male terminal, serial, for configuring and visualizing the measurement value with PC via communication cable 750-923
S0 interface	For transmitting the energy values • 2857-0570/0024-0001/ 2857-0570/0024-0005: 1 … 10,000 pulses/kWh • 2857-0570/0024-0000: 1 … 10,000 pulses/MWh
Switch output “DO”	For signaling over-/underrun threshold values, 24 VDC, 100 mA max.
Data logging	With micro SD memory cards
Bus length	Maximum 1200 m (depending on transmission rate)
Baud rate	19200 baud 9600 baud
Terminating resistor [1]	150 Ω or 120 Ω/1 nF

[1] Can be configured via Service interface

3.6.6 Wiring

Note

Temperature at Connections May Be Hotter!
The temperature at the connectors can be up to 25 K higher than the expected environmental temperature. Take this into account when laying connecting cables!

Table 19: Technical Data, Wiring

Connection technology	Push-in CAGE CLAMP® with pusher
Solid “s”	0.25 … 2.5 mm² (AWG 20–12) [1] 0.2 … 1.5 mm² (AWG 24–16) [2]
Fine-stranded "f"	0.25 … 2.5 mm² (AWG 20–12) [1] 0.2 … 1.5 mm² (AWG 24–16) [2]
Strip length	10 … 11 mm / 0.39 … 0.43 inch [1] 9 … 10 mm / 0.35 … 0.39 inch [2]

[1] For supply connections, switch outputs and voltage measurement inputs
[2] For current measurement inputs

3.6.7 Mechanical Conditions

Table 20: Technical Data – Mechanical Conditions

Vibration resistance	Maximum 0.7 g [1]

[1] Follow the installation instructions.

3.6.8 Environmental Requirements

Table 21: Technical Data – Ambient Conditions

Surrounding air temperature, operation	−40 … +70 °C
Surrounding air temperature, storage	−40 … +85 °C
Protection Class	IP20

3.7 Approvals

The following approvals were granted for the 3-Phase Power Measurement Module (2857-0570):

CE Conformity Marking

3.8 Standards and Guidelines

The 3-Phase Power Measurement Module (2857-0570) complies with the Low Voltage Directive through application of the following standards:

Table 22: Low Voltage Directive

Electrical equipment for measurement, control, and laboratory use Part 1: General requirements	EN 61010-1

The 3-Phase Power Measurement Module (2857-0570) complies with the EMC Directive through application of the following standards:

Table 23: EMC Directive

EMC immunity to interference	EN 61000-6-2
EMC emission of interference	EN 61000-6-3

4 Function Description

4.1 Measuring Technique

The power measurement module uses seven A/D converters to capture the current and voltage values of all three phases and the current in the neutral conductor.
The three phases and the neutral conductor are differentially connected to the current measurement channels; i.e. two connections (S1 and S2) are available for connecting the current transformers or Rogowski coils.
Low-pass filters on the seven inputs have a cutoff frequency of 15.9 kHz.
Each input signal is sampled at 8 kHz, quantized with a depth of 24 bits and processed further digitally. Acquisition of the measured values of all three phases and the neutral conductor is performed time-synchronously in an identical manner.

4.2 Overview of Measured Values

The power measurement module provides the **measured AC values** of these measured variables **per phase** (Lx Ly = L1 L2 or L3).
However, depending on the network topology, not all measured values are always calculated. For more information, see Section 5, “Communication per Modbus RTU Protocol.”

Table 24: Measured Value Overview

Measured value	Measurement method	
	4-wire three-phase network	3-wire three-phase network
Voltage		
RMS voltage L1–N	X	-
RMS voltage L2–N	X	-
RMS voltage L3–N	X	-
Maximum RMS voltage L1–N	X	-
Maximum RMS voltage L2–N	X	-
Maximum RMS voltage L3–N	X	-
Minimum RMS voltage L1–N	X	-
Minimum RMS voltage L2–N	X	-
Minimum RMS voltage L3–N	X	-
RMS voltage L1–L2	X	X
RMS voltage L1–L3	X	X
RMS voltage L2–L3	X	X
Arithmetic mean voltage L1–N	X	-
Arithmetic mean voltage L2–N	X	-
Arithmetic mean voltage L3–N	X	-
Peak value voltage L1–N	X	-
Peak value voltage L2–N	X	-
Peak value voltage L3–N	X	-

Table 24: Measured Value Overview

Measured value	Measurement method	
	4-wire three-phase network	3-wire three-phase network
Current		
RMS current L1	X	X
RMS current L2	X	X
RMS current L3	X	X
Maximum RMS current L1	X	X
Maximum RMS current L2	X	X
Maximum RMS current L3	X	X
Minimum RMS current L1	X	X
Minimum RMS current L2	X	X
Minimum RMS current L3	X	X
Arithmetic mean current L1	X	X
Arithmetic mean current L2	X	X
Arithmetic mean current L3	X	X
Peak value current L1	X	X
Peak value current L2	X	X
Peak value current L3	X	X
RMS current N	X	-
Power		
Active power L1	X	-
Active power L2	X	-
Active power L3	X	-
Maximum active power L1	X	-
Maximum active power L2	X	-
Maximum active power L3	X	-
Minimum active power L1	X	-
Minimum active power L2	X	-
Minimum active power L3	X	-
Reactive power L1	X	-
Reactive power L2	X	-
Reactive power L3	X	-
Apparent power L1	X	-
Apparent power L2	X	-
Apparent power L3	X	-
Energy		
Active energy L1	X	-
Active energy L2	X	-
Active energy L3	X	-
Active energy import L1	X	-
Active energy import L2	X	-
Active energy import L3	X	-
Active energy export L1	X	-
Active energy export L2	X	-
Active energy export L3	X	-
Active energy total	X	X
Active energy import total	X	-
Active energy export total	X	-
Reactive energy L1	X	-
Reactive energy L2	X	-

Table 24: Measured Value Overview

Measured value	Measurement method	
	4-wire three-phase network	3-wire three-phase network
Reactive energy L3	X	-
Reactive energy inductive L1	X	-
Reactive energy inductive L2	X	-
Reactive energy inductive L3	X	-
Reactive energy capacitive L1	X	-
Reactive energy capacitive L2	X	-
Reactive energy capacitive L3	X	-
Reactive energy total	X	X
Reactive energy inductive total	X	-
Reactive energy capacitive total	X	-
Apparent energy L1	X	-
Apparent energy L2	X	-
Apparent energy L3	X	-
Fundamental Frequency		
Line frequency L1	X	X
Line frequency L2	-	-
Line frequency L3	-	-
Maximum line frequency L1	X	X
Maximum line frequency L2	-	-
Maximum line frequency L3	-	-
Minimum line frequency L1	X	X
Minimum line frequency L2	-	-
Minimum line frequency L3	-	-
Phase angle phi		
Phase angle phi L1	X	x
Phase angle phi L2	X	-
Phase angle phi L3	X	x
Power Factor		
cos phi L1	X	-
cos phi L2	X	-
cos phi L3	X	-
Power factor PF L1	X	-
Power factor PF L2	X	-
Power factor PF L3	X	-
Power factor LF L1	X	-
Power factor LF L2	X	-
Power factor LF L3	X	-
Upper Harmonic L1		
RMS current L1	X	X
Fundamental component current L1	X	X
Upper harmonic component current L1, 1st … 40th upper harmonic	X	X
Distortion current L1	X	X
RMS voltage L1	X	X
Fundamental component voltage L1	X	X
Upper harmonic component voltage L1, 1st … 40th upper harmonic	X	X
Distortion, voltage L1	X	X

Table 24: Measured Value Overview

Measured value	Measurement method	
	4-wire three-phase network	3-wire three-phase network
Upper harmonic L2		
RMS current L2	X	X
Fundamental component current L2	X	X
Upper harmonic component current L2, 1st … 40th upper harmonic	X	X
Distortion current L2	X	X
RMS voltage L2	X	-
Fundamental component voltage L2	X	-
Upper harmonic component voltage L2, 1st … 40th upper harmonic	X	-
Distortion, voltage L2	X	-
Upper harmonic L3		
RMS current L3	X	X
Fundamental component current L3	X	X
Upper harmonic component current L3, 1st … 40th upper harmonic	X	X
Distortion current L3	X	X
RMS voltage L3	X	X
Fundamental component voltage L3	X	X
Upper harmonic component voltage L3, 1st … 40th upper harmonic	X	X
Distortion, voltage L3	X	X
Active power total	X	X
Reactive power total	X	X
Apparent power total	X	-
Rotating field	X	X

Note

Relationship between Upper Harmonic and Harmonic

“First harmonic” refers to the vibration at the fundamental frequency (fundamental component), and “first **upper** harmonic” refers the vibration at twice the fundamental frequency. Therefore, in general, the *n*th harmonic corresponds to the (*n*−*1*)th upper harmonic.

4.3 Calculation of the Measured Values

Calculation for Current and Voltage

The power measurement module calculates the **true RMS value** for the voltage and current per period applied at the measurement inputs. See the figure below.

$$I_{eff} = \sqrt{\frac{1}{N}\sum_{k=0}^{N-1} i_k^{\,2}} \qquad U_{eff} = \sqrt{\frac{1}{N}\sum_{k=0}^{N-1} u_k^{\,2}}$$

i_k:	Current sampling values	I_{rms}:	RMS of current
u_k:	Voltage sampling values	U_{rms}:	RMS of voltage
N:	Number of sampling values		

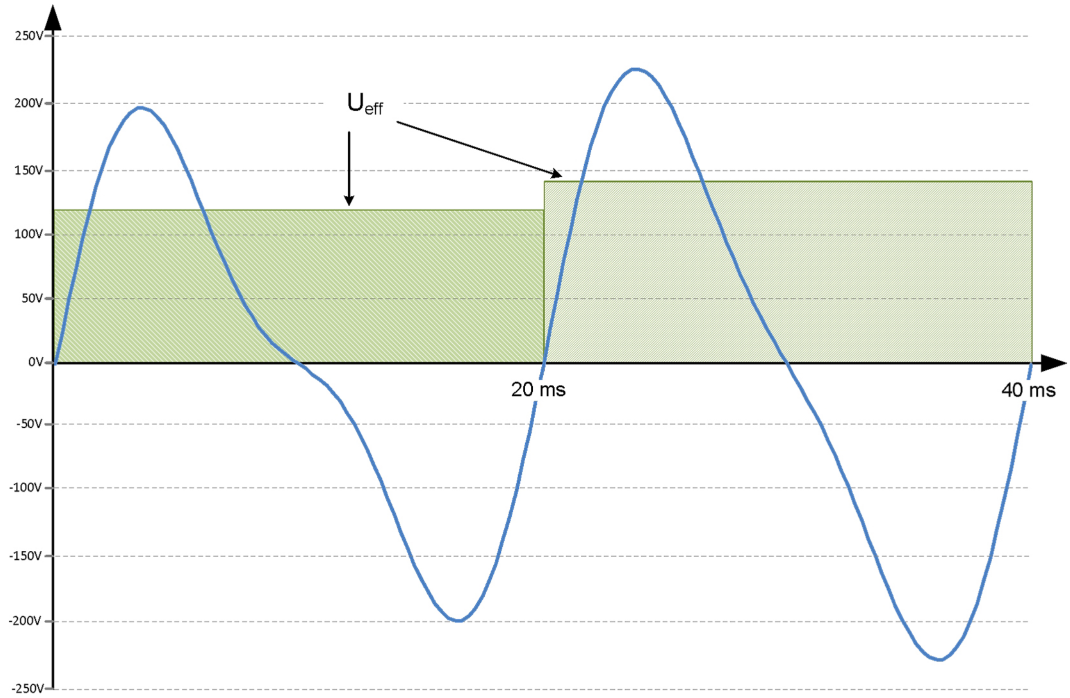


Figure 10: RMS Calculation (Example – Not to Scale)

The current and voltage RMS values are calculated for each period and refreshed every two periods (2T). In a 50 Hz power system, this corresponds to a refresh rate of 40 ms.

The power measurement module is designed for **measurements with current transformers**, so high currents (> 1 A or > 5 A) can be measured The transformation ratios are parameterized and then taken into account when the measured values are calculated.

The **arithmetic mean value** for the phase current and voltage is calculated on the basis of the RMS values. The observation interval for which the mean value should be calculated can be set with the Interface Configuration Software or parameters 21, 22 and 23.
For more detailed information, see Section “Parameters.”
The **minimum and maximum RMS values** for the current and voltage are also

determined over a configurable time interval.
A **reset interval** can be set with parameters 24, 25 and 26. This interval can be activated with parameter 2 (bits 8 to 10).

Peak current and voltage values can also be recorded, for one selectable phase (L1 or L2 or L3). The observation interval can be set according to number of half-waves (Interface Configuration Software or parameters 11, 12 and 13).

Arithmetic mean min./max. values and the peak value are not available for the neutral conductor current.

Calculation of line voltages Lx–Ly is performed on the basis of the phase voltages and the corresponding phase angles.

Calculation of Power

Individual, synchronous sampling values for current and voltage are used for calculating active power (P). Phase shifts between the currents and voltages are taken into account in the power calculation. Positive values occur when the power is “exhausted” by a load, i.e., the current has a phase shift of −90° to +90° relative to the voltage (operation under load, quadrants I and IV). Negative values occur when the power is “fed in” by a generator, i.e., the current has a phase shift of 90° … 270° relative to the voltage (generator operation, quadrants II and III).

Note

Negative Active Power!
Negative active power occurs if the two connections of up-circuit current transformers or Rogowski coils are swapped!

Active power minimum and maximum values are determined over a configurable time interval.

In real networks, not all loads are purely resistive. Thus, currents and voltages are phase-shifted. However, this does not affect the method for determining the RMS values for current and voltage previously described. The power measurement module calculates both the reactive power (Q) and the apparent power (S) for each phase.

Calculation of Energy

Time-based integration of power yields the level of energy for each phase. The power measurement module provides the values for active, reactive and apparent energy. Values for the individual phases and an overall value are provided both for active and reactive energy. A distinction can also be drawn between import and export of active energy and capacitive and inductive reactive energy (see figure below).

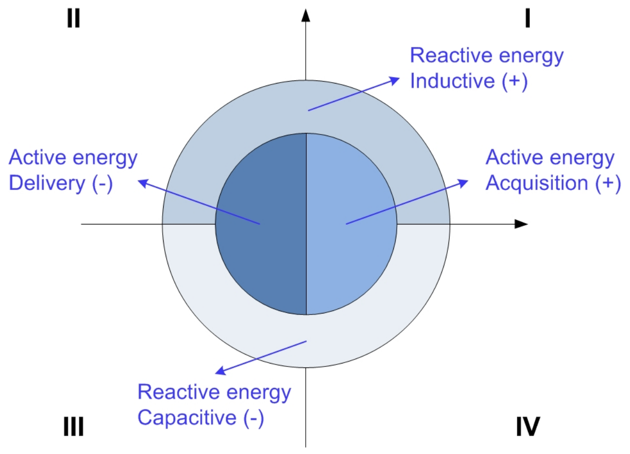


Figure 11: Assignment of Active and Reactive Energy in the Four Quadrants

The values of all energy meters are saved in the I/O module. They work internally in the resolutions Wh, VARh or VAh.
The values can be set via the Interface Configuration Software. For more information, see Section “Commissioning.”

The power measurement module also offers the option set **NOLOAD threshold values** (“response thresholds”) for the energy measurement; i.e., as soon as these values are underrun. This can be applied to keep creepage currents from flowing into the energy metering.Variables such as phase angle and active, apparent and reactive power are configurable via the Interface Configuration Software or parameters 27, 28 and 29.

Determining the frequency

The phase frequencies are calculated using zero crossing detection of the sampled signals for each phase. The minimum and maximum frequencies are determined over a configurable time period (Interface Configuration Software or parameters 24, 25, and 26).

Harmonic Analysis

The power measurement module calculates the frequency spectrum for the periodic input signals and analyzes the fundamental component and the first to the 40th upper harmonics for each phase, i.e. the first to the 41st harmonic of <u>one</u> phase. Then the other two phases can be analyzed.

The power measurement module always delivers the RMS values for current and voltage of the fundamental component for the selected phase. It also provides the total harmonic distortion (THD) for current and voltage.

From the 40 upper harmonics, three can be selected and analyzed at the same time. The RMS value for current and voltage is calculated for each selected upper harmonic, along with the harmonic distortion (HD). The three upper harmonics can be freely selected, e.g., 4, 12 and 19; or 2, 35 and 40. See also parameters 30 to 33.

Calculation of Power Factors

The power factor **cos phi** is the cosine of the phase angle between voltage and current for the specific phase. Calculation of the power factor only takes into account the phase shifting of the fundamental components of voltage and current. The sign of “cos phi” indicates the following:

- Positive (plus) sign: Import of active power from the network
- Negative (minus) sign: Export of active power to the network

The **PF power factor** is the quotient of the active power (P) and apparent power (S) and takes the entire spectrum into account, i.e., the fundamental component and the upper harmonics.

$$PF = P / S$$

- Positive (plus) sign: Import of active power from the network
- Negative (minus) sign: Export of active power to the network

The **LF power factor** is the quotient of the amount for active power (P) and apparent power (S), multiplied by the sign of the reactive power (Q), and takes the entire spectrum into account, i.e., the fundamental component and the upper harmonics:

$$LF = sign\ Q \cdot |P| / S$$

- Positive (plus) sign: Positive reactive power
- Negative (minus) sign: Negative reactive power

Note

Jump of LF Power Factor from +1 to −1
The LF value can jump between +1 and −1 when reactive power is very low. This behavior occurs as a result of digitization noise.

The four-quadrant display has the following form:

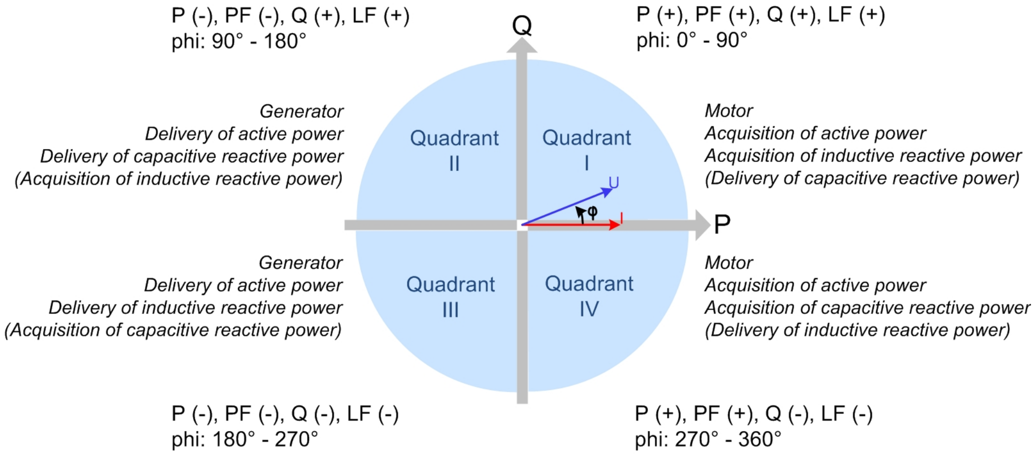


Figure 12: Four-Quadrant Display for Active and Reactive Power

The four-quadrant display is also presented in the Interface Configuration Software. For more information, see Section "Configuration with the Interface Configuration Software."

Phase Angle

The phase angle between voltage and current is calculated for each phase using time-synchronous sampling. The phase angle is indicated in degrees.

Rotating Field Detection

The zero crossings of the voltage characteristics for the three phases are monitored by rotating field detection. The direction of rotation of a motor or machine can only be determined when the phase sequence L1–L2–L3 at the power measurement module has been connected the same way as at the motor and when the motor corresponds to the guidelines of VDE 0530-8 or DIN EN 60034-8 with regard to "Terminal designations and direction of rotation" (L1 on U engine, L2 on V engine, L3 on W engine).
Phase sequence L1–L2–L3 signals clockwise rotation; a reversed phase sequence signals counterclockwise rotation. Caution: It is not possible to detect double reversing.

Tamper Detect (fault current detection)

The "Tamper Detect" function can be used to detect fault currents resulting from defective machines and equipment.
In a three-phase supply network, the following holds in the fault-free state: The sum of the instantaneous values of the line currents corresponds to the current in the neutral conductor. Therefore, the power measurement module calculates the sum of the instantaneous values of the line currents

$$i_{SUM\,Lx}(t) = i_{L1}(t) + i_{L2}(t) + i_{L3}(t)$$

and subtracts the instantaneous value $i_N(t)$ of the neutral conductor current from this sum in a time-synchronous manner. This yields the fault current:

$$i_{SUM\,Lx}(t) - i_N(t)$$

If this current is greater than the set threshold, (parameter 20), the overrun is signaled by the flashing **red LED "ERR"** and switch output **"DO."**

Note

Current converter with "Tamper Detect" function
For correct use of the "Tamper Detect" function, the current converters in all measurement paths must be of the same type.

4.4 Threshold Over-/Underruns

The power measurement module offers a threshold value monitoring function. For each phase, threshold values (limiting values) can be set for:

- Undervoltage
- Overvoltage
- Overcurrent
- Tamper Detect

(parameters 3, 4, 5 for undervoltage, 14, 15, 16 for overvoltage, 17, 18, 19 for overcurrent, 20 for Tamper Detect).

These states are signaled by the flashing **red "ERR" LED** and **switch output "DO"** as a group error message:

- **U_b alternating:** 24 VDC at switch output
- **GND alternating:** 0 VDC at switch output

4.5 Measuring Errors

The power measurement module measuring errors are listed in section "Device Description" > "Technical Data."

However, the values indicated only apply if the following conditions are met:

1. The measurement signals must be within the permitted limits specified in the technical data.
2. The line frequency must be between 45 and 65 Hz.
3. The surrounding air temperature must be +25 °C (+77 °F).

4.6 Measured Value Readout

The measured values are read out in various ways. For one, all measured values are filed in registers that can be read out via Modbus®.
For another, they can be sent to a PC via the Config interface. This requires the WAGO USB Communication Cable (750-923). The measured values are then configured and visualized on the PC with the Interface Configuration Software.
Also, the energy values for determining energy consumption can be read out at the S0 interface. This requires corresponding configuration of the “DO” switch output.
All measured values can also be saved as a CSV file (“data logging”) on a micro SD card.

5 Communication per “Modbus® RTU” Protocol

Register communication with the master (higher-level PLC) is per the “Modbus® RTU” protocol. Three Modbus® functions are implemented for this:

- 0x03 Read holding registers (read device parameters)
- 0x04 Read input registers (read measured values)
- 0x10 Write multiple registers (write device parameters)

The physical interfaces per RS-485 are the RJ-45 ports “X1 IN” and “X2 OUT.” In addition, a line structure configuration (“Daisy Chain Configuration”) can be facilitated via both interfaces.

If an error occurs during the transmission, an error message is sent to the sender. The error codes could be:

- 0x01 Illegal function (unsupported Modbus® function)
- 0x02 Illegal data address (data telegram too long or too short)
- 0x03 Illegal data value (checksum incorrect)

The following register identifies the power measurement module:

Table 25: Identification Register

Address	Byte	Name	Description	Access
0x0000	1	Node ID	Device identification number	R
0x0000	2	FW-Id	Firmware version	R
0x0001	1	HW-Id	Hardware version	R

Table 26: Device Identification Number

Item number	Name	Device identification number
2857-0570/0024-0000	3-phase power measurement module (24 V)	0x37
2857-0570/0024-0001	3-phase power measurement module 1 A (24 V)	0x35
2857-0570/0024-0005	3-phase power measurement module 5 A (24 V)	0x36

5.1 Function Block

A CODESYS function block (FB) is available for integrating the power measurement module into a PLC program. It is available for download on the website www.wago.com.

5.2 Modbus® Configurator

This section describes how the Modbus® configurator can be used to establish communication between the power measurement module and a PC. The Modbus® configurator can be called up through either WAGO-I/O-*PRO* or ***e!****COCKPIT*.

These hardware components are used for the following example:

Table 27: Hardware Components

Item Number	Hardware Component
2857-0570/0024-000x	3-phase power measurement module
289-175	Interface module for ETHERNET RJ-45
750-8206	PFC200
750-652	I/O module “serial interface”
750-600	End module

This results in the schematic hardware structure below:

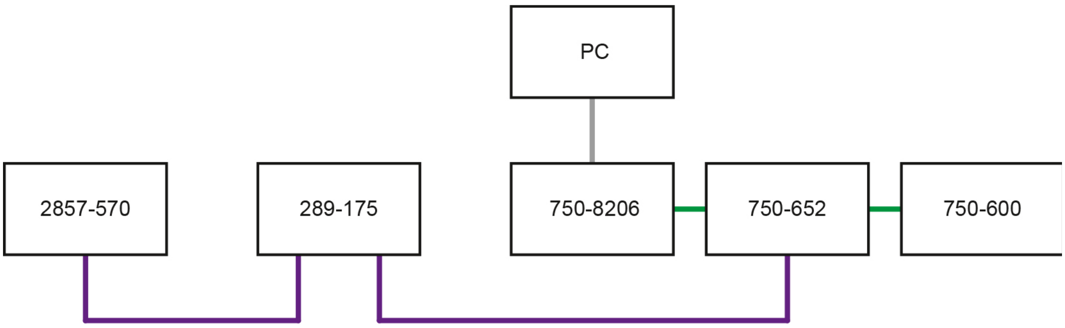


Figure 13: Hardware Components

The highlighted signal lines have the following meaning:

Table 28: Legend for Figure “Hardware Components”

Signal Line	Color Coding
RS-485 cable	Violet
Local bus	Green
ETHERNET cable	Gray

As prerequisite for the work steps listed below, the hardware components must be assembled and connected as shown in the schematic overview.

5.2.1 Modbus® Configurator in WAGO-I/O-*PRO*

1. Launch WAGO-I/O-*PRO*.

2. Create a new project. Click **File > New**.

The “Target System Settings” dialog appears.

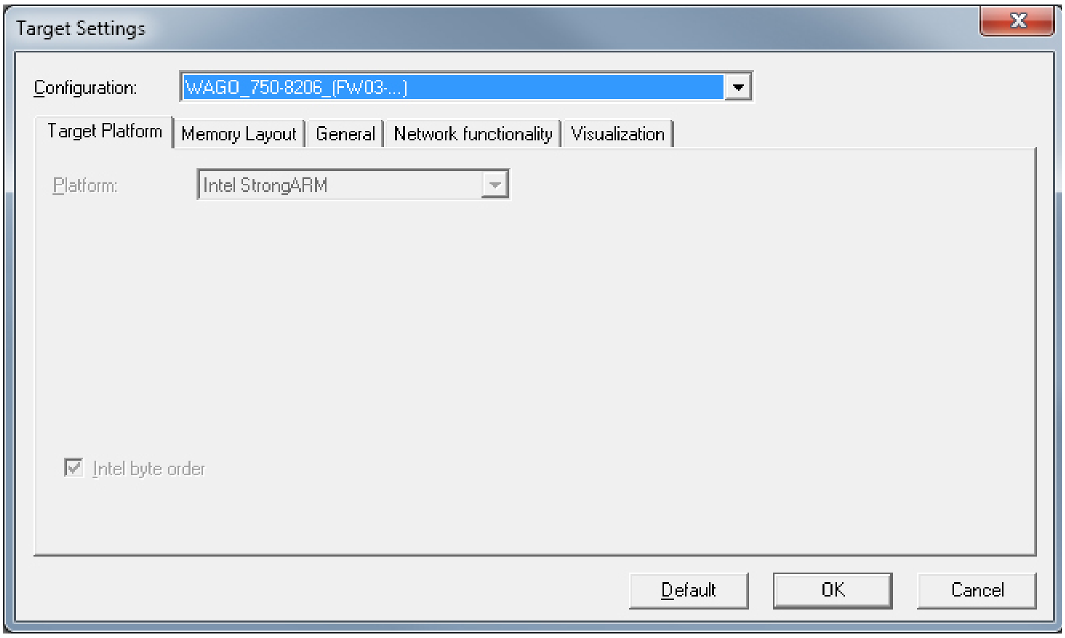


Figure 14: “Target System Settings” Dialog

3. Under **Configuration**, select the hardware you are using.

4. Click the **[OK]** button.

The “New POU” dialog appears.

5. Click the **[Cancel]** button because you do not want to create a new module.

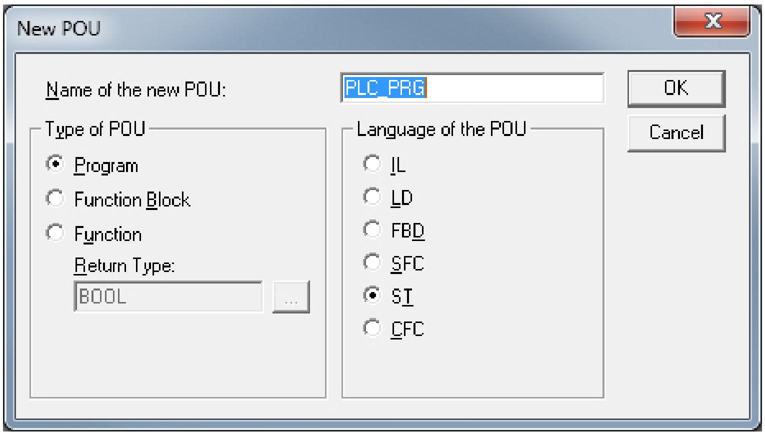


Figure 15: “New Module” Dialog

6. In the main menu, select the **Resources** tab.

Figure 16: “Resources” Tab

7. In the directory, select the **PLC Configuration** entry.

The “PLC Configuration” workspace appears.

8. Select the entry **Modbus-Master(FIX)** in the tree structure.

The tab “MODBUS Master configurator” opens.

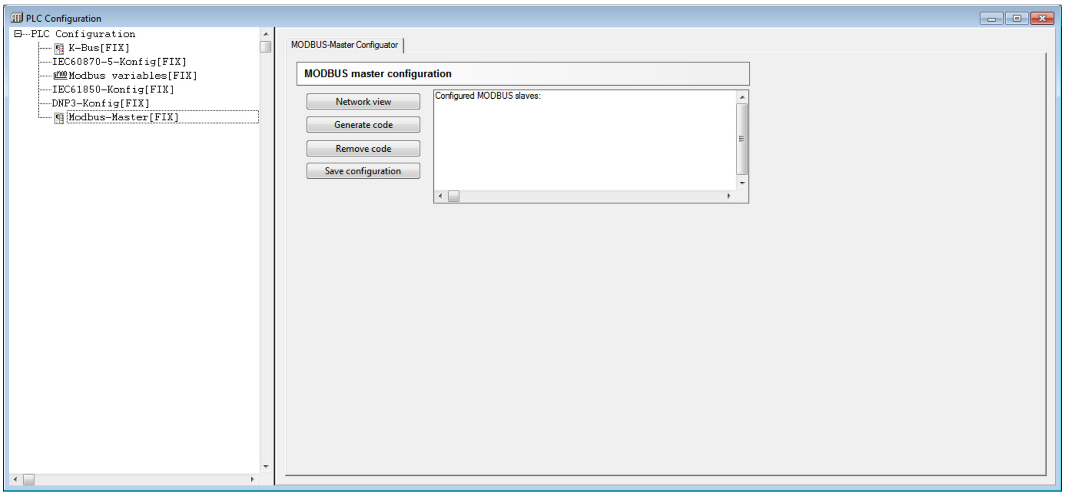


Figure 17: “Modbus-Master(FIX)” Dialog

9. Click the **[Network view]** button.

The dialog “MODBUS Master configurator” opens.

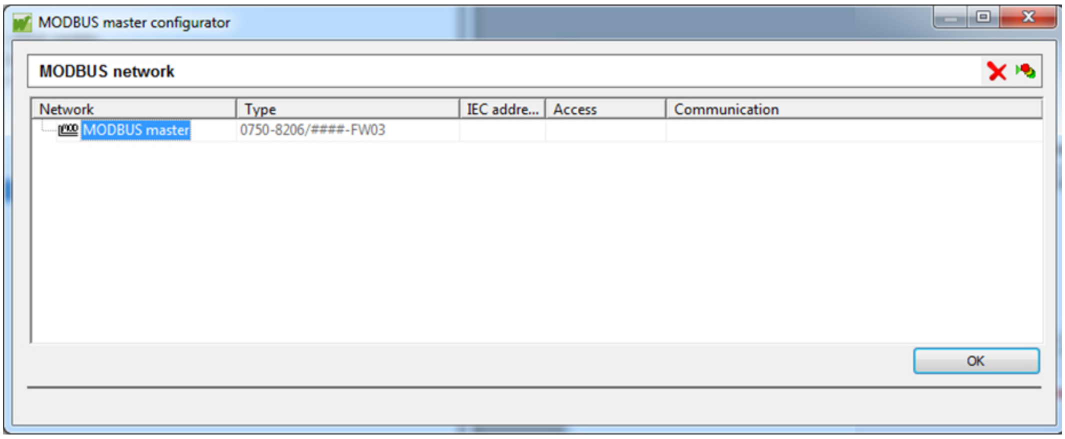


Figure 18: “MODBUS Master configurator” Dialog

10. Right-click the entry "MODBUS Master" and select **Add Serial Interface**.

The "Settings: Serial Interface" dialog opens.

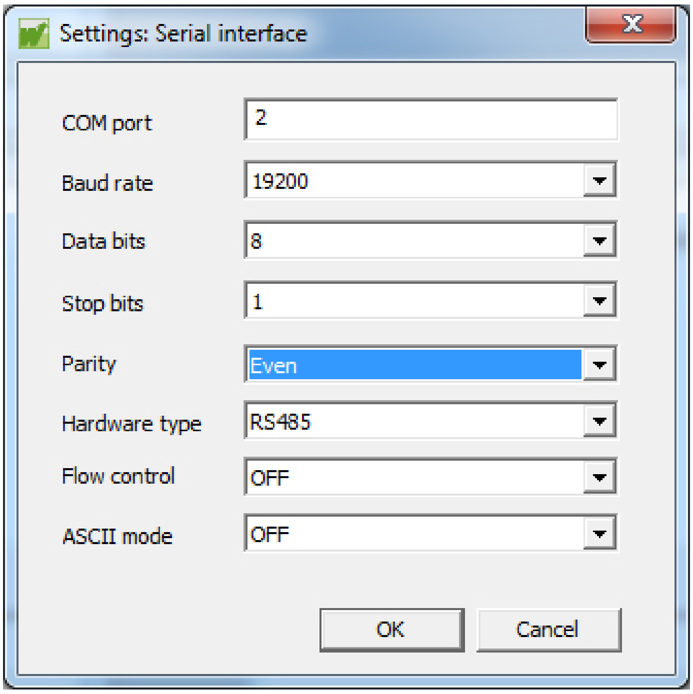


Figure 19: "Settings: Serial Interface" Dialog

11. Select the setting **19200** in the "Baud rate" selection box.

12. Select the setting **Even** in the "Parity" selection box.

13. Click the **[OK]** button.

The entry **Interface (COM2)** is created in the "MODBUS Master configurator" dialog.

14. Right-click the entry "Interface (COM2)" and select **Add Modbus Slave**.

The "MODBUS slave selection" dialog opens

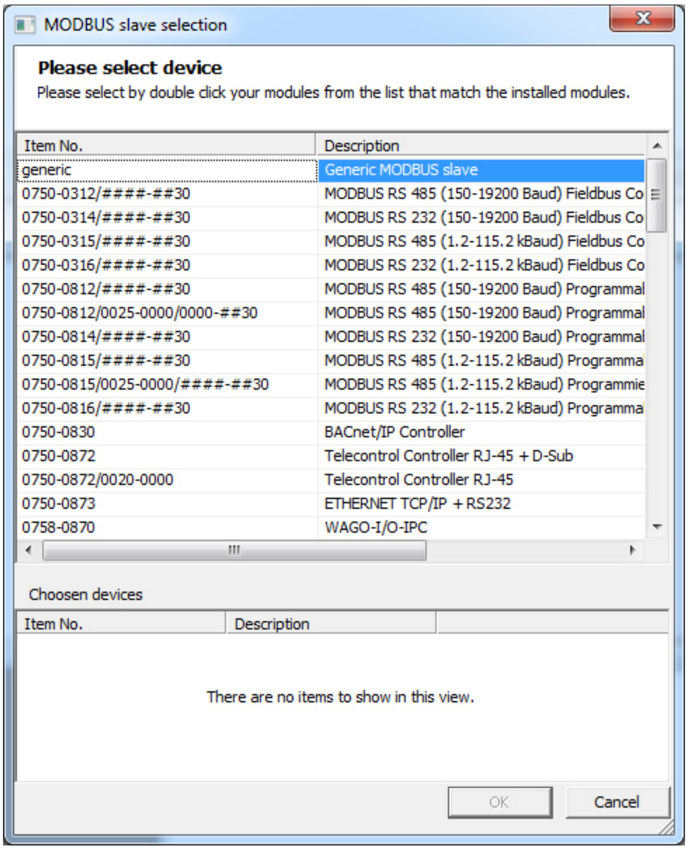


Figure 20: “MODBUS slave selection” Dialog

15. Double-click the entry **Generic MODBUS slave**.

The entry is displayed in the “Choosen devices” area.

16. Click the **[OK]** button.

The entry **Modbus slave** is created in the “MODBUS Master configurator” dialog.

17. Right-click the “Communication” input field; select **Edit**.

The “Communication settings” dialog opens.

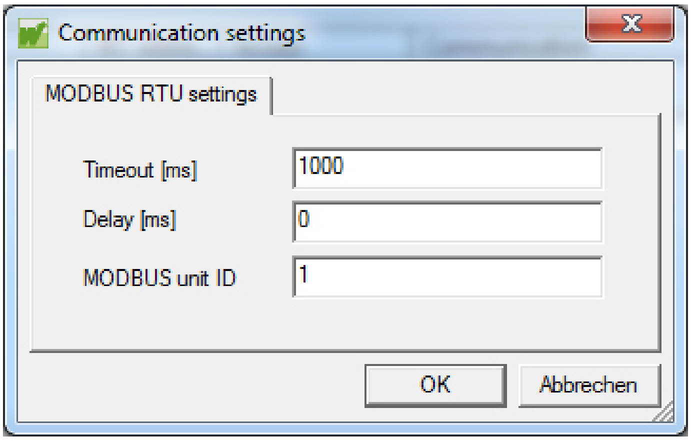


Figure 21: “Communication settings” Dialog

18. Enter the value **1** in the “Modbus unit ID” input field.

19. Click the **[OK]** button.

The entry **Generic Variables** is created in the “MODBUS Master configurator” dialog.

20. Right-click the entry “Generic Variables” and select **Add**.

A new variable is created in the “MODBUS Master configurator” dialog.

21. Right-click the entry “Generic Variables” and select **Add**.

The new variable **xNewVar** is created in the “Modbus®-Master-Configurator” dialog.

22. Double-click the variable **xNewVar**.

23. Rename the variable to **rVoltageL1**.

24. Click the input field “Type”; select **REAL**.

25. Click the input field “Access”; select **read only**.

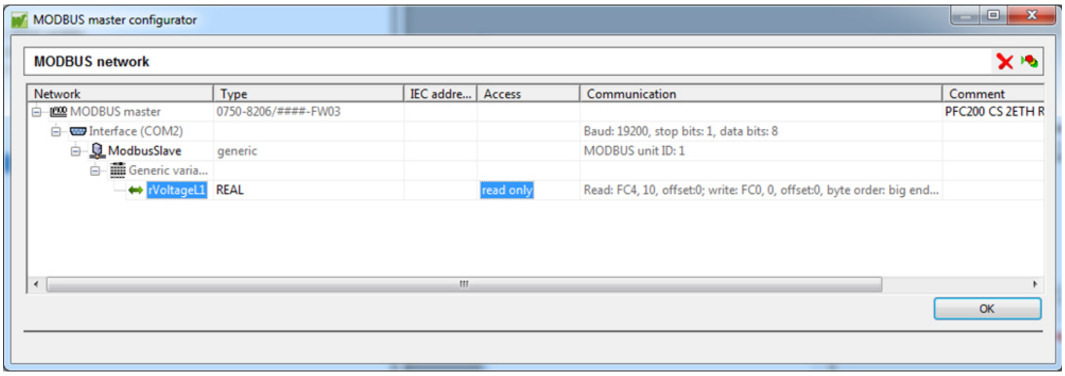


Figure 22: “Modbus®-Master-Configurator” Dialog

26. Right-click the “Communication” input field; select **Edit Addresses**.

The “MODBUS address” dialog opens

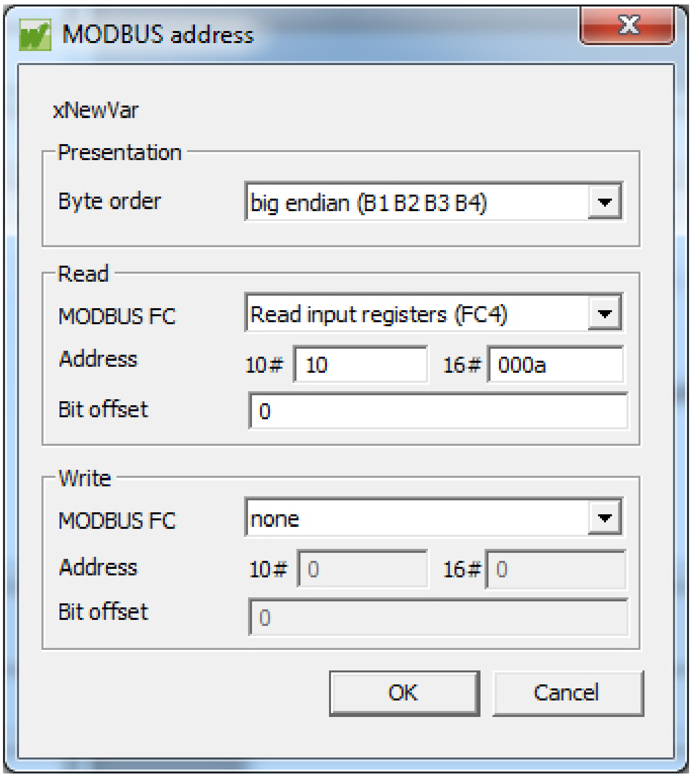


Figure 23: “MODBUS address” Dialog

27. In the selection box “MODBUS FC,” choose **Read input registers (FC4)**.

28. Enter the address **10** in the "Address" input field.

29. Click the **[OK]** button.

The changed settings are applied.
The values are displayed under “Communication” in the “MODBUS Master configurator” dialog.

30. Click the **[OK]** button.

The “MODBUS Master configurator” dialog is closed.

31. Click the **[Generate Code]** button.

The code is generated.

32. Click the **[Configuration]** button.

The configuration is saved.

33. In the main menu, click the **POUs** tab.

Figure 24: “Modules” Tab

34. Click **+** in front of the “**Generated Code**” entry in the tree structure.

35. Select the **MBCFG_ModbusSlave (PRG)** entry in the tree structure.

The program editor then opens.

36. Click **Online > Login**.

The solution is loaded into the controller.

37. Click **Online > Start**.

The controller is started.

The value of variable **rVoltageL1** is read out in the Program Editor.

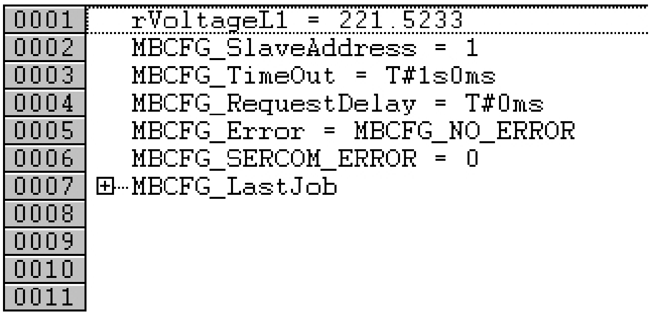


Figure 25: Program Editor

5.2.2 Modbus® Configurator in *e!COCKPIT*

For further information, please see the ***e!**COCKPIT* manual 2759-0101. The manual is available on www.wago.com.

5.3 Parameters

The configured parameters are saved in the power measurement module as “ID 1 … 40.” They are explained in the following tables.

Table 29: Parameter 1

<table>
<tr><th colspan="5">Parameter 1 – Command Interface “Request”</th></tr>
<tr><th colspan="2">Address</th><th>Data Type</th><th>Access</th><th>Factory Setting</th></tr>
<tr><td colspan="2">0x004D</td><td>UINT16</td><td>W</td><td>-none-</td></tr>
<tr><td>0x0004</td><td colspan="4">Reset registers, parameters and calibration data to factory settings.</td></tr>
<tr><td>0x0005</td><td colspan="4">Reset registers and parameters to factory settings.</td></tr>
<tr><td>0x0006</td><td colspan="4">Reset calibration data to factory settings.</td></tr>
<tr><td>0x0011</td><td colspan="4">Save energy consumption early.</td></tr>
<tr><td>0x0012</td><td colspan="4">Initialize all energy meters to 0.</td></tr>
<tr><td>0x0021</td><td colspan="4">Delete all minimum and maximum values.</td></tr>
<tr><td>0x0022</td><td colspan="4">Delete minimum current.</td></tr>
<tr><td>0x0023</td><td colspan="4">Delete maximum current.</td></tr>
<tr><td>0x0024</td><td colspan="4">Delete minimum voltage.</td></tr>
<tr><td>0x0025</td><td colspan="4">Delete maximum voltage.</td></tr>
<tr><td>0x0026</td><td colspan="4">Delete minimum power.</td></tr>
<tr><td>0x0027</td><td colspan="4">Delete maximum power.</td></tr>
<tr><td>0x0028</td><td colspan="4">Delete minimum frequency.</td></tr>
<tr><td>0x0029</td><td colspan="4">Delete maximum frequency.</td></tr>
</table>

Table 30: Parameter 2

Parameter 2 – Parameter Set 1				
Address		**Data Type**	**Access**	**Factory Setting**
0x004E		UINT16	R/W	0x0000
Bit 0 … 5: -reserved-				
Bit 6 + 7: Phase Selection for Peak Measurement				
0:	Peak measurement for phase 1 is active (factory setting).			
1:	Peak measurement for phase 2 is active.			
2:	Peak measurement for phase 3 is active.			
3:	-reserved-			
Bit 8: Min./Max. Value Automatic Reset Activation, Phase 1				
0:	Automatic deletion of minimum and maximum current, voltage and power values is not activated (factory settings).			
1:	Automatic deletion of minimum and maximum current, voltage and power values is activated.			
Bit 9: Min./Max. Value Automatic Reset Activation, Phase 2				
0:	Automatic deletion of minimum and maximum current, voltage and power values is not activated (factory settings).			
1:	Automatic deletion of minimum and maximum current, voltage and power values is activated.			
Bit 10: Min./Max. Value Automatic Reset Activation, Phase 3				
0:	Automatic deletion of minimum and maximum current, voltage and power values is not activated (factory settings).			
1:	Automatic deletion of minimum and maximum current, voltage and power values is activated.			
Bit 11: -reserved-				
Bit 12: User Scaling (current transformer ratio), Phase 1 (see also Par. 7)				
0:	User scaling is deactivated; the transformation ratio is 1:1 (factory setting).			
1:	User scaling is active; the transformation ratio is 1: (divisor for the current transformer ratio).			
Bit 13: User Scaling (current transformer ratio), Phase 2 (see also Par. 8)				
0:	User scaling is deactivated; the transformation ratio is 1:1 (factory setting).			
1:	User scaling is active; the transformation ratio is 1: (divisor for the current transformer ratio).			
Bit 14: User Scaling (current transformer ratio), Phase 3 (see also Par. 9)				
0:	User scaling is deactivated; the transformation ratio is 1:1 (factory setting).			
1:	User scaling is active; the transformation ratio is 1: (divisor for the current transformer ratio).			
Bit 15: User Scaling (current transformer ratio), Neutral Conductor (See also Par. 10)				
0:	User scaling is deactivated; the transformation ratio is 1:1 (factory setting).			
1:	User scaling is active; the transformation ratio is 1: (divisor for the current transformer ratio).			

Table 31: Parameter 3

Parameter 3 – Undervoltage Threshold, Phase 1				
Address		**Data Type**	**Access**	**Factory Setting**
0x0050		FLOAT	R/W	0 V
0:	Checking if undervoltage threshold is deactivated.			
≥1:	Value for undervoltage threshold (max. 440 V)			

Table 32: Parameter 4

Parameter 4 – Undervoltage Threshold, Phase 2				
Address		Data Type	Access	Factory Setting
0x0052		FLOAT	R/W	0 V
0:	Checking if undervoltage threshold is deactivated.			
≥1:	Value for undervoltage threshold (max. 440 V)			

Table 33: Parameter 5

Parameter 5 – Undervoltage Threshold, Phase 3				
Address		Data Type	Access	Factory Setting
0x0054		FLOAT	R/W	0 V
0:	Checking if undervoltage threshold is deactivated.			
≥1:	Value for undervoltage threshold (max. 440 V)			

Table 34: Parameter 6a

Parameter 6a – Rogowski Coil				
Address		Data Type	Access	Factory Setting
0x004F		UINT16	R/W	1
>0:	User-defined: Rogowski coil factor must be set.			
1	RC70: Rogowski coil factor = 0.07198 µH			
2	RC125: Rogowski coil factor = 0.07214 µH			
3	RC175: Rogowski coil factor = 0.07231 µH			

Table 35: Parameter 6b

Parameter 6b – Rogowski Coil Factor [µH]				
Address		Data Type	Access	Factory Setting
0x0056		FLOAT	R/W	0.07198 µH
>0:	Factor value in µF			

Table 36: Parameter 7

Parameter 7 – Current Transformer Ratio, Phase 1				
Address		Data Type	Access	Factory Setting
0x0058		UINT16	R/W	0x0001
Activation: Parameter 2, bit 12 recommended				
0:	-not permitted-			
≥1:	Value for the current transformer ratio divisor (maximum value = 2500)			

Table 37: Parameter 8

Parameter 8 – Current Transformer Ratio, Phase 2				
Address		Data Type	Access	Factory Setting
0x0059		UINT16	R/W	0x0001
Activation: Parameter 2, bit 13 recommended				
0:	-not permitted-			
≥1:	Value for the current transformer ratio divisor (maximum value = 2500)			

Table 38: Parameter 9

Parameter 9 – Current Transformer Ratio, Phase 3				
Address		**Data Type**	**Access**	**Factory Setting**
0x005A		UINT16	R/W	0x0001
Activation: Parameter 2, bit 14 recommended				
0:	-not permitted-			
≥1:	Value for the current transformer ratio divisor (maximum value = 2500)			

Table 39: Parameter 10

Parameter 10 – Current Transformer Ratio, Neutral Conductor				
Address		**Data Type**	**Access**	**Factory Setting**
0x005B		UINT16	R/W	0x0001
Activation: Parameter 2, bit 15 recommended				
0:	-not permitted-			
≥1:	Value for the current transformer ratio divisor.			

Table 40: Parameter 11

Parameter 11 – Peak Value Measurement Observation Interval, Phase 1				
Address		**Data Type**	**Access**	**Factory Setting**
0x0060		UINT16	R/W	0x0014
0 … 19:	-not permitted-			
20 … 254:	Number of half waves for measuring peak values			
≥255:	-not permitted-			

Table 41: Parameter 12

Parameter 12 – Observation Interval, Peak Value Measurement, Phase 2				
Address		**Data Type**	**Access**	**Factory Setting**
0x0061		UINT16	R/W	0x0014
0 … 19:	-not permitted-			
20 … 254:	Number of half waves for measuring peak values			
≥255:	-not permitted-			

Table 42: Parameter 13

Parameter 13 – Peak Value Measurement Observation Interval, Phase 3				
Address		**Data Type**	**Access**	**Factory Setting**
0x0062		UINT16	R/W	0x0014
0 … 19:	-not permitted-			
20 … 254:	Number of half waves for measuring peak values			
≥255:	-not permitted-			

Table 43: Parameter 14

Parameter 14 – Overvoltage Threshold Value, Phase 1				
Address		**Data Type**	**Access**	**Factory Setting**
0x0064		FLOAT	R/W	410 V
0:	The overvoltage threshold check is deactivated.			
≥1:	Overvoltage threshold (maximum 440 V)			

Table 44: Parameter 15

Parameter 15 – Overvoltage Threshold Value, Phase 2				
Address		**Data Type**	**Access**	**Factory Setting**
0x0066		FLOAT	R/W	410 V
0:	The overvoltage threshold check is deactivated.			
≥1:	Overvoltage threshold (maximum 440 V)			

Table 45: Parameter 16

Parameter 16 – Overvoltage Threshold Value, Phase 3				
Address		**Data Type**	**Access**	**Factory Setting**
0x0068		FLOAT	R/W	410 V
0:	The overvoltage threshold check is deactivated.			
≥1:	Overvoltage threshold (maximum 440 V)			

Table 46: Parameter 17

Parameter 17 – Overcurrent Threshold Value, Phase 1				
Address		**Data Type**	**Access**	**Factory Setting**
0x006A		FLOAT	R/W	2857-0570/0024-0001: 1.1 A
				2857-0570/0024-0005: 5.5 A
				2857-0570/0024-0000: 550 A
0:	The overvoltage threshold check is deactivated.			
≥1:	Value of the overcurrent threshold check value (maximum 100000 A)			

Table 47: Parameter 18

Parameter 18 – Overcurrent Threshold Value, Phase 2				
Address		**Data Type**	**Access**	**Factory Setting**
0x006C		FLOAT	R/W	2857-0570/0024-0001: 1.1 A
				2857-0570/0024-0005: 5.5 A
				2857-0570/0024-0000: 550 A
0:	The overvoltage threshold check is deactivated.			
≥1:	Value of the overcurrent threshold check value (maximum 100000 A)			

Table 48: Parameter 19

Parameter 19 – Overcurrent Threshold Value, Phase 3				
Address		Data Type	Access	Factory Setting
0x006E		FLOAT	R/W	2857-0570/0024-0001: 1.1 A
				2857-0570/0024-0005: 5.5 A
				2857-0570/0024-0000: 550 A
0:	The overvoltage threshold check is deactivated.			
≥1:	Value of the overcurrent threshold check value (maximum 100000 A)			

Table 49: Parameter 20

Parameter 20 – Tamper Detect Current Threshold Value (fault current)				
Address		Data Type	Access	Factory Setting
0x0070		FLOAT	R/W	0 A
0:	The threshold value check is deactivated.			
≥1:	Current threshold value (maximum 100,000 A)			

Table 50: Parameter 21

Parameter 21 – Arithmetic Mean Observation Interval, Phase 1				
Address		Data Type	Access	Factory Setting
0x0072		UINT16	R/W	0x0004
0:	5 s			
1:	1 s			
2:	1 s			
3:	30 s			
4:	1 min			
5:	5 min			
6:	8 min			
7:	10 min			
8:	15 min			
≥9:	-reserved-			

Table 51: Parameter 22

Parameter 22 – Arithmetic Mean Observation Interval, Phase 2				
Address		Data Type	Access	Factory Setting
0x0073		UINT16	R/W	0x0004
0:	5 s			
1:	1 s			
2:	1 s			
3:	30 s			
4:	1 min			
5:	5 min			
6:	8 min			
7:	10 min			
8:	15 min			
≥9:	-reserved-			

Table 52: Parameter 23

Parameter 23 – Arithmetic Mean Observation Interval, Phase 3				
Address		Data Type	Access	Factory Setting
0x0074		UINT16	R/W	0x0004
0:	5 s			
1:	1 s			
2:	1 s			
3:	30 s			
4:	1 min			
5:	5 min			
6:	8 min			
7:	10 min			
8:	15 min			
≥9:	-reserved-			

Table 53: Parameter 24

Parameter 24 – Min/Max Value Automatic Reset Interval, Phase 1				
Address		Data Type	Access	Factory Setting
0x0075		UINT16	R/W	0x000A
Activation: Parameter 2, bit 8 recommended				
0 … 65535:	Interval in s			

Table 54: Parameter 25

Parameter 25 – Min/Max Value Automatic Reset Interval, Phase 2				
Address		Data Type	Access	Factory Setting
0x0076		UINT16	R/W	0x000A
Activation: Parameter 2, bit 9 recommended				
0 … 65535:	Interval in s			

Table 55: Parameter 26

Parameter 26 – Min/Max Value Automatic Reset Interval, Phase 3				
Address		Data Type	Access	Factory Setting
0x0077		UINT16	R/W	0x000A
Activation: Parameter 2, bit 10 recommended				
0 … 65535:	Interval in s			

Table 56: Parameter 27

Parameter 27 – Active Power NOLOAD Threshold (related to one phase)				
Address		Data Type	Access	Factory Setting
0x0078		FLOAT	R/W	0x0000 (disabled)
0:	The NOLOAD threshold is disabled.			
>0:	NOLOAD threshold value in W			

Table 57: Parameter 28

Parameter 28 – Reactive Power NOLOAD Threshold (related to one phase)				
Address		Data Type	Access	Factory Setting
0x007A		FLOAT	R/W	0x0000 (disabled)
0:	The NOLOAD threshold is disabled.			
>0:	NOLOAD threshold value in var			

Table 58: Parameter 29

Parameter 29 – Apparent Power NOLOAD Threshold (related to one phase)				
Address		Data Type	Access	Factory Setting
0x007C		FLOAT	R/W	0x0000 (disabled)
0:	The NOLOAD threshold is disabled.			
>0:	NOLOAD threshold value in VA			

Table 59: Parameter 30

Parameter 30 – Selection of Phase for Harmonic Analysis L_{sel}				
Address		Data Type	Access	Factory Setting
0x007E		UINT16	W	0x0000
0:	Harmonic analysis for phase 1 is active (factory setting).			
1:	Harmonic analysis for phase 2 is active.			
2:	Harmonic analysis for phase 3 is active.			

Table 60: Parameter 31

Parameter 31 – Selection of Upper Harmonic A				
Address		Data Type	Access	Factory Setting
0x007F		UINT16	W	0x0002
2 … 41:	Harmonic number (corresponds to first to 40th upper harmonic)			

Table 61: Parameter 32

Parameter 32 – Selection of Upper Harmonic B				
Address		**Data Type**	**Access**	**Factory Setting**
0x0080		UINT16	W	0x0003
2 … 41:	Harmonic number (corresponds to first to 40th upper harmonic)			

Table 62: Parameter 33

Parameter 33 – Selection of Upper Harmonic C				
Address		**Data Type**	**Access**	**Factory Setting**
0x0081		UINT16	W	0x0004
2 … 41:	Harmonic number (corresponds to first to 40th upper harmonic)			

Table 63: Parameter 34

Parameter 34 – Action of the Digital Output				
Address		**Data Type**	**Access**	**Factory Setting**
0x009A		UINT16	W	0x0000
0:	Start Date			
1:	U_b switching			
2:	GND switching			
3:	S0 interface			

Table 64: Parameter 35

Parameter 35 – Digital Output Pulse Rate; Mode: S0 Interface				
Address		**Data Type**	**Access**	**Factory Setting**
0x00A4		UINT16	W	400
1 … 10,000 pulses/kWh	2857-0570/0024-0001: 3-phase power measurement module 1 A (24 V) 2857-0570/0024-0005: 3-phase power measurement module 5 A (24 V)			
1 … 10000 pulse/MWh	2857-0570/0024-0000: 3-phase power measurement module (24 V)			

Table 65: Parameter 36

Parameter 36 – Pulse Width; Mode: S0 Interface				
Address		**Data Type**	**Access**	**Factory Setting**
0x00A5		UINT16	W	50
1 … 1000 ms	Pulse width value			

Table 66: Parameter 37

Parameter 37 – Overclocking Buffer; Mode: S0 Interface				
Address		**Data Type**	**Access**	**Factory Setting**
0x00A6		UINT16	W	10
1 … 600 s	Overclocking buffer value			

Table 67: Parameter 38

Parameter 38 – Voltage Transformer Ratio; Phases 1, 2, 3				
Address		**Data Type**	**Access**	**Factory Setting**
0x005C		UINT16	R/W	0x0001
0:	Not valid			
≥ 1:	Voltage transformer ratio divisor value Maximum value: 0xFFFF			

Table 68: Parameter 39

Parameter 39 – Topology				
Address		**Data Type**	**Access**	**Factory Setting**
0x005F		UINT16	R/W	0x0000
0:	4-wire three-phase network			
1:	3-wire three-phase network			

Table 69: Parameter 40

Parameter 40 – Modbus Terminating Resistor				
Address		**Data Type**	**Access**	**Factory Setting**
0x0091		UINT16	W	0
0:	No terminating resistor			
1:	150 Ω			
2	120 Ω + 1 nF			

5.4 Status Word

The higher-level controller reads out the power measurement module status messages via Modbus®. They are filed as “Status Word 1” in Register 0x0000.

The update interval is 40 ms.

Table 70: Status Word 1

Register 0x0000 – Status Word 1				
Function		**Data Type**	**Access**	**Factory Setting**
Power measurement module status information		UINT16	R	0x0000
Bit 0: Transient Response Period Warning				
0:	OK (transient response period elapsed)			
1:	Measured values not yet stable; waiting for transient response to end.			
Bit 1: -reserved-				
Bit 2: Threshold Value Undervoltage L1				
0:	Threshold value not reached			
1:	Threshold value underrun			
Bit 3: Threshold Value Overvoltage L1				
0:	Threshold value not reached			
1:	Threshold value reached or exceeded			
Bit 4: Threshold Value Overcurrent L1				
0:	Threshold value not reached			
1:	Threshold value reached or exceeded			

Table 70: Status Word 1

Register 0x0000 – Status Word 1			
Function	**Data Type**	**Access**	**Factory Setting**
Power measurement module status information	UINT16	R	0x0000
Bit 5: Threshold Value Undervoltage L2			
0:	Threshold value not reached		
1:	Threshold value underrun		
Bit 6: Threshold Value Overvoltage L2			
0:	Threshold value not reached		
1:	Threshold value reached or exceeded		
Bit 7: Threshold Value Overcurrent L2			
0:	Threshold value not reached		
1:	Threshold value reached or exceeded		
Bit 8: Threshold Value Undervoltage L3			
0:	Threshold value not reached		
1:	Threshold value underrun		
Bit 9: Threshold Value Overvoltage L3			
0:	Threshold value not reached		
1:	Threshold value reached or exceeded		
Bit 10: Threshold Value Overcurrent L3			
0:	Threshold value not reached		
1:	Threshold value reached or exceeded		
Bit 11: Tamper Detect			
0:	Fault current $i_{SUM\,Lx}(t) - i_N(t) \leq$ Tamper Detect threshold value		
1:	Fault current $i_{SUM\,Lx}(t) - i_N(t) >$ Tamper Detect threshold value		
Bit 12: Rotating Field Indicator			
0:	Rotating field correct L1–L2–L3 (clockwise)		
1:	Rotating field incorrect (counterclockwise)		
Bit 13: S0 Interface Overclocking Status			
0:	O.K.		
1:	S0 interface is overclocked.		
Bit 14, 15: -reserved-			

5.5 Measured Value Register

The higher-level controller has access to a number of measured value registers via Modbus®.

The measured values for the energies are in the data type INTEGER; all others are FLOAT. All registers have a size of four bytes (1 DWord). The byte sequence is as follows:

Table 71: Measured Value Register Structure

<table>
<tr><th colspan="16">Word 1 (high)</th><th colspan="16">Word 2 (low)</th></tr>
<tr><th colspan="8">Byte 1 (high)</th><th colspan="8">Byte 2 (low)</th><th colspan="8">Byte 3 (high)</th><th colspan="8">Byte 4 (low)</th></tr>
<tr><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
</table>

In the table below, all measured variables are listed with the corresponding register addresses and update intervals.

Note

The Measured Values are Dependent on the Network Topology!
All measured values are measured only in a 4-wire three-phase networks. In other networks, some values are not measured. See table below!

Table 72: Measured Value Register

Register Address	Measured Variable	Measurement Unit	Register Access	Update Rate [ms]	4-Wire 3-Phase Supply	3-Wire 3-Phase Supply
0x0000	Status	None	R	40	Yes	Yes
0x0002	RMS current L1	A	R	40	Yes	Yes
0x0004	RMS current L2	A	R	40	Yes	Yes
0x0006	RMS current L3	A	R	40	Yes	Yes
0x0008	RMS current N	A	R	40	Yes	No
0x000A	RMS voltage L1–N	V	R	40	Yes	No
0x000C	RMS voltage L2–N	V	R	40	Yes	No
0x000E	RMS voltage L3–N	V	R	40	Yes	No
0x0010	RMS voltage L1–L2	V	R	500	Yes	Yes
0x0012	RMS voltage L1–L3	V	R	500	Yes	Yes
0x0014	RMS voltage L2–L3	V	R	500	Yes	Yes
0x0016	Active power L1	W	R	40	Yes	Yes [1]
0x0018	Active power L2	W	R	40	Yes	No
0x001A	Active power L3	W	R	40	Yes	Yes [1]
0x001C	Apparent power L1	VA	R	40	Yes	Yes
0x001E	Apparent power L2	VA	R	40	Yes	No
0x0020	Apparent power L3	VA	R	40	Yes	Yes
0x0022	Reactive power L1	var	R	500	Yes	Yes [2]
0x0024	Reactive power L2	var	R	500	Yes	No
0x0026	Reactive power L3	var	R	500	Yes	Yes [2]
0x0028	Active power total	W	R	500	Yes	Yes [1]
0x002A	Reactive power total	var	R	500	Yes	Yes [2]
0x002C	Apparent power total	VA	R	500	Yes	No
0x002E	Line frequency L1	Hz	R	40	Yes	Yes
0x0030	Line frequency L2	Hz	R	40	Yes	No
0x0032	Line frequency L3	Hz	R	40	Yes	No
0x0034	Phase angle phi L1	°	R	500	Yes	Yes
0x0036	Phase angle phi L2	°	R	500	Yes	No
0x0038	Phase angle phi L3	°	R	500	Yes	Yes
0x003A	cos phi L1	None	R	500	Yes	No
0x003C	cos phi L2	None	R	500	Yes	No
0x003E	cos phi L3	None	R	500	Yes	No
0x0040	Power factor PF L1	None	R	40	Yes	No
0x0042	Power factor PF L2	None	R	40	Yes	No

Table 72: Measured Value Register

Register Address	Measured Variable	Measurement Unit	Register Access	Update Rate [ms]	4-Wire 3-Phase Supply	3-Wire 3-Phase Supply
0x0044	Power factor PF L3	None	R	40	Yes	No
0x0046	Power factor LF L1	None	R	40	Yes	No
0x0048	Power factor LF L2	None	R	40	Yes	No
0x004A	Power factor LF L3	None	R	40	Yes	No
0x004C	Maximum RMS current L1	A	R	40	Yes	Yes
0x004E	Maximum RMS current L2	A	R	40	Yes	Yes
0x0050	Maximum RMS current L3	A	R	40	Yes	Yes
0x0052	Minimum RMS current L1	A	R	40	Yes	Yes
0x0054	Minimum RMS current L2	A	R	40	Yes	Yes
0x0056	Minimum RMS current L3	A	R	40	Yes	Yes
0x0058	Arithmetic average value current L1	A	R	5,000 … 900,000 (per Para. 21)	Yes	Yes
0x005A	Arithmetic average value current L2	A	R	5,000 … 900,000 (per Para. 22)	Yes	Yes
0x005C	Arithmetic average value current L3	A	R	5,000 … 900,000 (per Para. 23)	Yes	Yes
0x005E	Maximum RMS voltage L1–N	V	R	40	Yes	No
0x0060	Maximum RMS voltage L2–N	V	R	40	Yes	No
0x0062	Maximum RMS voltage L3–N	V	R	40	Yes	No
0x0064	Minimum RMS voltage L1–N	V	R	40	Yes	No
0x0066	Minimum RMS voltage L2–N	V	R	40	Yes	No
0x0068	Minimum RMS voltage L3–N	V	R	40	Yes	No
0x006A	Arithmetic Average value voltage L1–N	V	R	5,000 … 900,000 (per Para. 21)	Yes	No
0x006C	Arithmetic Average value voltage L2–N	V	R	5,000 … 900,000 (per Para. 22)	Yes	No
0x006E	Arithmetic Average value voltage L3–N	V	R	5,000 … 900,000 (per Para. 23)	Yes	No
0x0070	Maximum active power L1	W	R	40	Yes	No
0x0072	Maximum active power L2	W	R	40	Yes	No
0x0074	Maximum active power L3	W	R	40	Yes	No
0x0076	Minimum active power L1	W	R	40	Yes	No
0x0078	Minimum active power L2	W	R	40	Yes	No
0x007A	Minimum active power L3	W	R	40	Yes	No
0x007C	Maximum line frequency L1	Hz	R	40	Yes	Yes
0x007E	Maximum line frequency L2	Hz	R	40	Yes	No
0x0080	Maximum line frequency L3	Hz	R	40	Yes	No
0x0082	Minimum line frequency L1	Hz	R	40	Yes	Yes
0x0084	Minimum line frequency L2	Hz	R	40	Yes	No
0x0086	Minimum line frequency L3	Hz	R	40	Yes	No
0x0088	Active energy L1	Wh	R	1100	Yes	No

Table 72: Measured Value Register

Register Address	Measured Variable	Measurement Unit	Register Access	Update Rate [ms]	4-Wire 3-Phase Supply	3-Wire 3-Phase Supply
0x0096	Active energy L2	Wh	R	1100	Yes	No
0x00A4	Active energy L3	Wh	R	1100	Yes	No
0x008A	Active energy import L1	Wh	R/W	1100	Yes	Yes [3]
0x0098	Active energy import L2	Wh	R/W	1100	Yes	No
0x00A6	Active energy import L3	Wh	R/W	1100	Yes	Yes [3]
0x008C	Active energy export L1	Wh	R/W	1100	Yes	Yes [3]
0x009A	Active energy export L2	Wh	R/W	1100	Yes	No
0x00A8	Active energy export L3	Wh	R/W	1100	Yes	Yes [3]
0x008E	Reactive energy L1	varh	R	1100	Yes	No
0x009C	Reactive energy L2	varh	R	1100	Yes	No
0x00AA	Reactive energy L3	varh	R	1100	Yes	No
0x0090	Reactive energy inductive L1	varh	R/W	1100	Yes	Yes [4]
0x009E	Reactive energy inductive L2	varh	R/W	1100	Yes	No
0x00AC	Reactive energy inductive L3	varh	R/W	1100	Yes	Yes [4]
0x0092	Reactive energy capacitive L1	varh	R/W	1100	Yes	Yes [4]
0x00A0	Reactive energy capacitive L2	varh	R/W	1100	Yes	No
0x00AE	Reactive energy capacitive L3	varh	R/W	1100	Yes	Yes [4]
0x0094	Apparent energy L1	VAh	R/W	1100	Yes	No
0x00A2	Apparent energy L2	VAh	R/W	1100	Yes	No
0x00B0	Apparent energy L3	VAh	R/W	1100	Yes	No
0x00B2	Active energy total	Wh	R	1100	Yes	Yes [3]
0x00B4	Active energy import total	Wh	R	1100	Yes	No
0x00B6	Active energy export total	Wh	R	1100	Yes	No
0x00B8	Reactive energy total	varh	R	1100	Yes	Yes [4]
0x00BA	Reactive energy inductive total	varh	R	1100	Yes	No
0x00BC	Reactive energy capacitive total	varh	R	1100	Yes	No
0x00BE	Peak value voltage Lx–N, for one phase	V	R	40	Yes	Yes
0x00C0	Peak value voltage Lx, for one phase	A	R	40	Yes	Yes
Harmonic Analysis for One Selected Phase L_{sel}:						
0x00C2	RMS current fundamental cmpt.	A	R	40	Yes	Yes
0x00C4	RMS voltage fundamental cmpt.	V	R	40	Yes	Yes
0x00C6	RMS current upper harmonic A	A	R	40	Yes	Yes
0x00C8	RMS current upper harmonic B	A	R	40	Yes	Yes
0x00CA	RMS current upper harmonic C	A	R	40	Yes	Yes
0x00CC	RMS voltage upper harmonic A	V	R	40	Yes	Yes
0x00CE	RMS voltage upper harmonic B	V	R	40	Yes	Yes
0x0D0	RMS voltage upper harmonic C	V	R	40	Yes	Yes
0x00D2	Distortion factor THD current	%	R	40	Yes	Yes
0x00D4	Distortion factor THD voltage	%	R	40	Yes	Yes
0x00D6	HD current upper harmonic A	%	R	40	Yes	Yes
0x00D8	HD current upper harmonic B	%	R	40	Yes	Yes
0x00DA	HD current upper harmonic C	%	R	40	Yes	Yes
0x00DC	HD voltage upper harmonic A	%	R	40	Yes	Yes
0x00DE	HD voltage upper harmonic B	%	R	40	Yes	Yes

Table 72: Measured Value Register

Register Address	Measured Variable	Measurement Unit	Register Access	Update Rate [ms]	4-Wire 3-Phase Supply	3-Wire 3-Phase Supply
0x00E0	HD voltage upper harmonic C	%	R	40	Yes	Yes

[1] Measurement topology "ARON":
Active power total = Summand X1 + Summand X3

[2] Measurement topology "ARON":
Reactive power total = Summand X1 + Summand X3

[3] Measurement topology "ARON":
Active power total = Active power import total − Active power export total = (Summand X1 + Summand X3) − (Summand X2 + Summand X4)

[4] Measurement topology "ARON":
Reactive power total = Reactive power import total − Reactive power export total = (Summand X1 + Summand X3) − (Summand X2 + Summand X4)

6 Mounting

The power measurement module has a DIN-rail-mount enclosure.

The device is installed and removed per EN 60715 by snapping it on to a DIN-35 rail without tools.

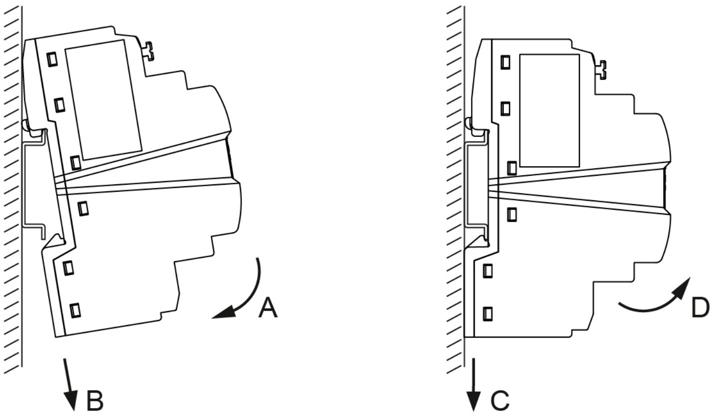


Figure 26: Installing and Removing the Signal Conditioner

6.1 Mounting on DIN Rail

1. Place the power measurement module with its snap-in mounting foot against the DIN-35 rail (A).

2. Push the power measurement module against the DIN-35 rail with a pivoting motion until it audibly locks (B).

6.2 Removal from the DIN Rail

1. Use an operating tool to lever the snap-in mounting away from the rail.

2. Pivot the power measurement module to remove it from the DIN-35 rail (D).

7 Connecting

DANGER

Install protection against electric shock!
All wiring for the measurement system shall be provided with protection against shock hazard voltages along with the corresponding safety signs!

7.1 Connecting Conductors

The **connection assignment** is shown in Section 3, “Device Description” > “Connectors” and > “Schematic Diagram.”

Several **examples for complete wiring** are in the following Sections “Connection Example: ...”.

The following conductors can be clamped at the terminals:

- The three phases of the supply network and the neutral conductor
- Up to four current transformers or Rogowski coils
- The 24 VDC supply voltage

Note

Only Clamp One Conductor per Terminal!
You must only clamp one conductor to each connection terminal. If several conductors must be connected, connect them using an up-circuit wiring assembly; e.g., WAGO Through Terminal Blocks.

Fine-stranded conductors (with or without ferrule) are connected as follows:

1. To open a connection terminal, press the pusher with the operating tool.
2. Insert the stripped conductor in the connection terminal.
3. To close the connection terminal, release the pusher. The conductor is now securely clamped.

Solid conductors can simply be pushed into the connection terminal without using the operating tool.

7.2 Disconnecting Conductors

If the wiring should be changed, a conductor is unclamped as follows:

1. To open a connection terminal, press the pusher with the operating tool.
2. Pull put the conductor.
3. To close the connection terminal, release the pusher.

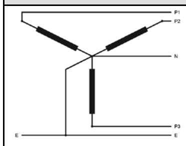
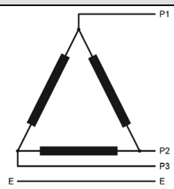
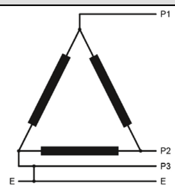
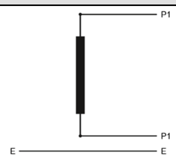
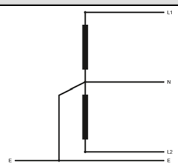
7.3 Connecting Modbus RTU

Connect the power measurement module with the two adjacent Modbus® devices (master or slave) at interfaces “X1 IN” und “X2 OUT.”

7.4 Overview: "Network Systems and Line Voltages"

The following network systems and line voltages are listed according to EN 61010-1.

Table 73: Network Systems and Line Voltages

Network Systems and Line Voltages					Voltage relevant to the type of network system between line conductor and neutral conductor, and rated voltage
4-wire three-phase systems with grounded neutral conductor [1)]	3-wire three-phase systems; not grounded	3-wire three-phase systems with grounded phase	Single-phase, single-wire systems, AC or DC	Split single-phase, single-wire systems, AC or DC [1]	
					
			12.5 V … 48 V	30 V/60 V	50 V
66 V/115 V	66 V	100 V	60 V	100 V/200 V	100 V
120 V/208 V 127 V/220 V	110 V, 115 V 120 V, 127 V		110 V, 115 V 120 V, 127 V	110 V/220 V 115 V/230 V 120 V/240 V	150 V
220 V/380 V 230 V/400 V 240 V/415 V 260 V/440 V 277 V/480 V	220 V, 230 V, 240 V 260 V, 277 V, 347 V 380 V, 400 V, 415 V 440 V, 480 V	200 V	220 V 230 V 240 V	220 V/440 V 240 V/480 V	300 V
347 V/600 V 380 V/660 V 400 V/690 V 417 V/720 V 480 V/830 V	500 V 577 V 600 V		480 V	480 V/690 V	600 V [2]

1 Voltage specifications with forward slash:
1. Voltage specifications: Voltage between line conductor and neutral conductor
2. Voltage specifications: Voltage between the line conductors

2 Please note the "Dangerous Voltage" safety advice in Section "Power Measurement in 4-Wire Three-Phase Networks." As stated therein, additional protective measures must be used!

7.5 Connection Example: Voltage Measurement

DANGER

Dangerous Voltage!
If there is a fault, contacts may carry dangerous electrical voltage. This can cause electric shock or burns!

Systems with line conductor/neutral conductor voltages > 300 VAC and a neutral conductor considered as “dangerously live” must have an additional safety measure!
Use suitable current transformers to realize these additional safety measures.

The power measurement module can be used to measure voltage. The measured values are provided serially via the RS-485 interface.

To measure the voltages of a 4-wire three-phase network, connect the four wires with connection terminals L1, L2, L3 and N.

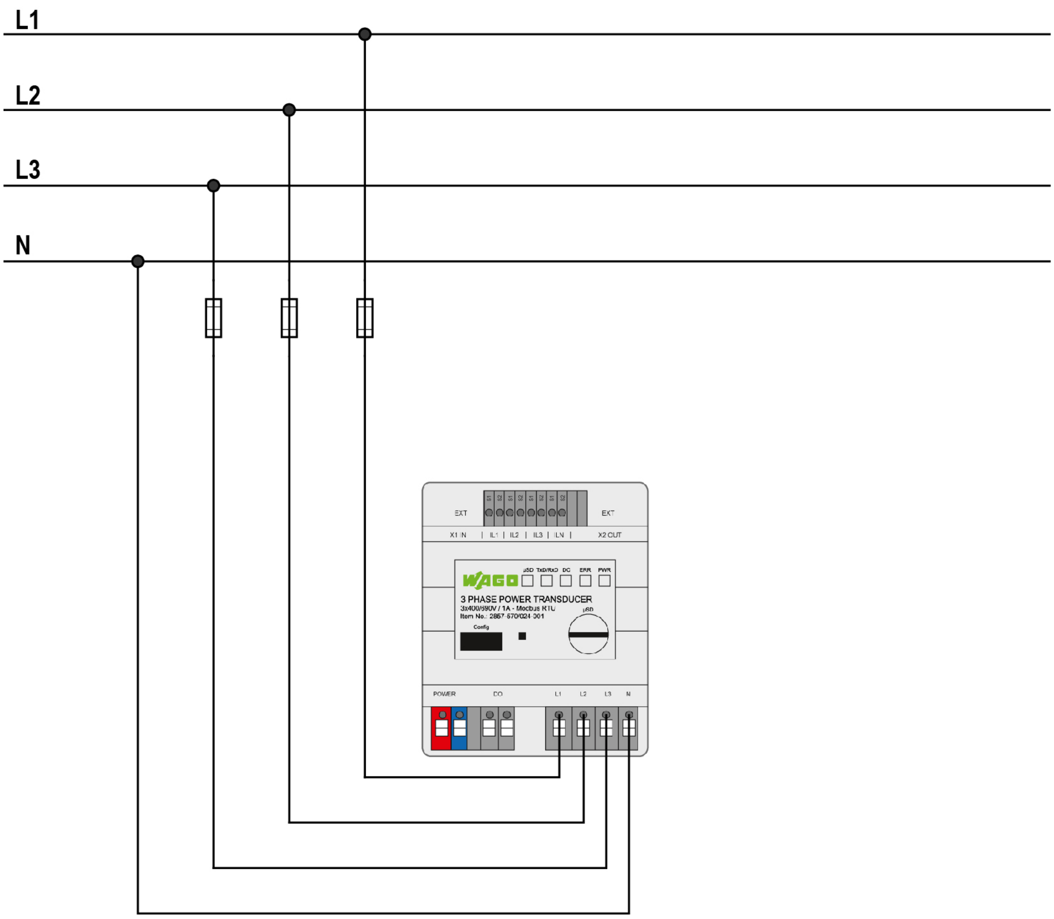


Figure 27: Voltage Measurement with Power Measurement Module

7.6 Connection Example: Measuring Current

The power measurement module can be used to measure current and can handle up to four currents simultaneously. The measured values are provided serially via the RS-485 interface.

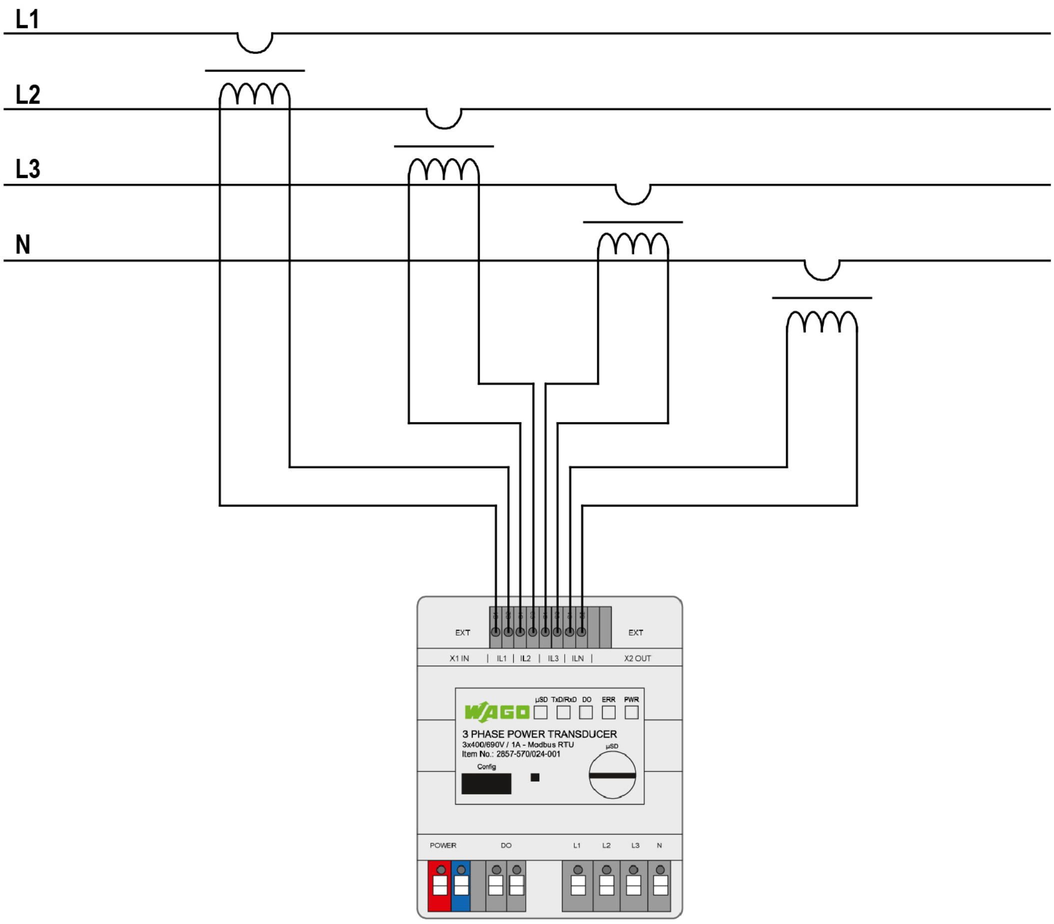


Figure 28: Current Measurement with Power Measurement Module

7.7 Connection Example: Measuring Power

DANGER

Electrical Shock due to Components with No Contact Protection!
You may suffer an electrical shock if current/voltage transformers or Rogowski coils with no contact protection are used!

Only use current/voltage transformers and Rogowski coils with basic insulation!

DANGER

No Open Operation Permitted!
For a secondary circuit of the current transformer that is not under load, high voltages are induced on its secondary terminals. The occurring voltage values pose a danger to people as well as the reliability of the converter. "Open operation", i.e., operation of the current transformer without secondary circuit is prohibited!

NOTICE

Do Not Confuse the Current and Voltage Connections!
When connecting, be sure not to confuse the current and voltage paths, since direct connection of the line voltages to the low-impedance current inputs will destroy the device.

Note

Negative Power Values!
If power measurements yield negative power values, check whether you have connected the corresponding current transformer or Rogowski coil with the correct orientation.

7.7.1 Power Measurement in 4-Wire Three-Phase Networks

To measure the voltages and currents of a 4-wire three-phase network, connect the four wires with connection terminals L1, L2, L3, N and the current transformers or Rogowski coils with the current measurement inputs.
For devices 2857-0570/0024-0001 and -0005, current transformers are used for power measurement; for device 2857-0570/0024-0000, Rogowski coils are used.

7.7.1.1 3-Phase Power Measurement with N-Conductor ≤ 300 V

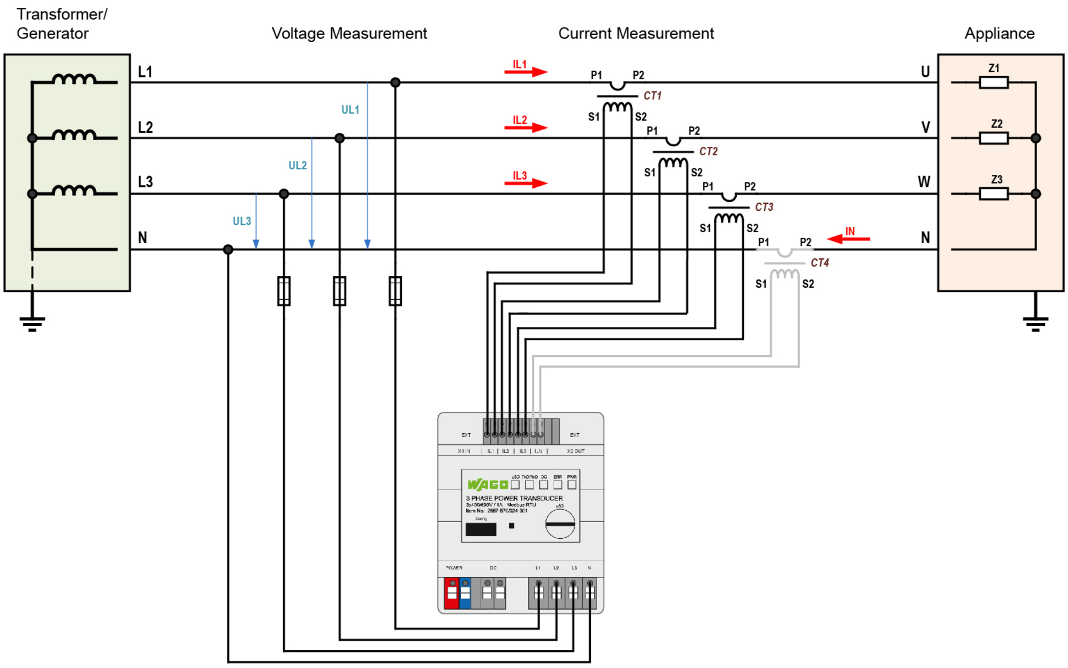


Figure 29: 3-Phase Power Measurement with N-Conductor ≤ 300 V

Please Observe the Following:

- $U_{LX} \rightarrow U_N \leq 300\ V_{RMS}$
- Connection terminal N on the device is reference potential for all voltage and current inputs.
- If it can be insured that the neutral conductor is not dangerously live, direct voltage measurements up to U_{LxN} (rms) ≤ 400 V may be performed.
- The current transformer in the N-conductor is optional.

7.7.1.2 3-Phase Power Measurement with N-Conductor ≥ 300 V

⚠ DANGER

Dangerous Voltage!
If there is a fault, contacts may carry dangerous electrical voltage. This can cause electric shock or burns!

Systems with line conductor/neutral conductor voltages > 300 VAC and a neutral conductor considered as “dangerously live” must have an additional safety measure!
Use suitable current transformers to realize these additional safety measures.

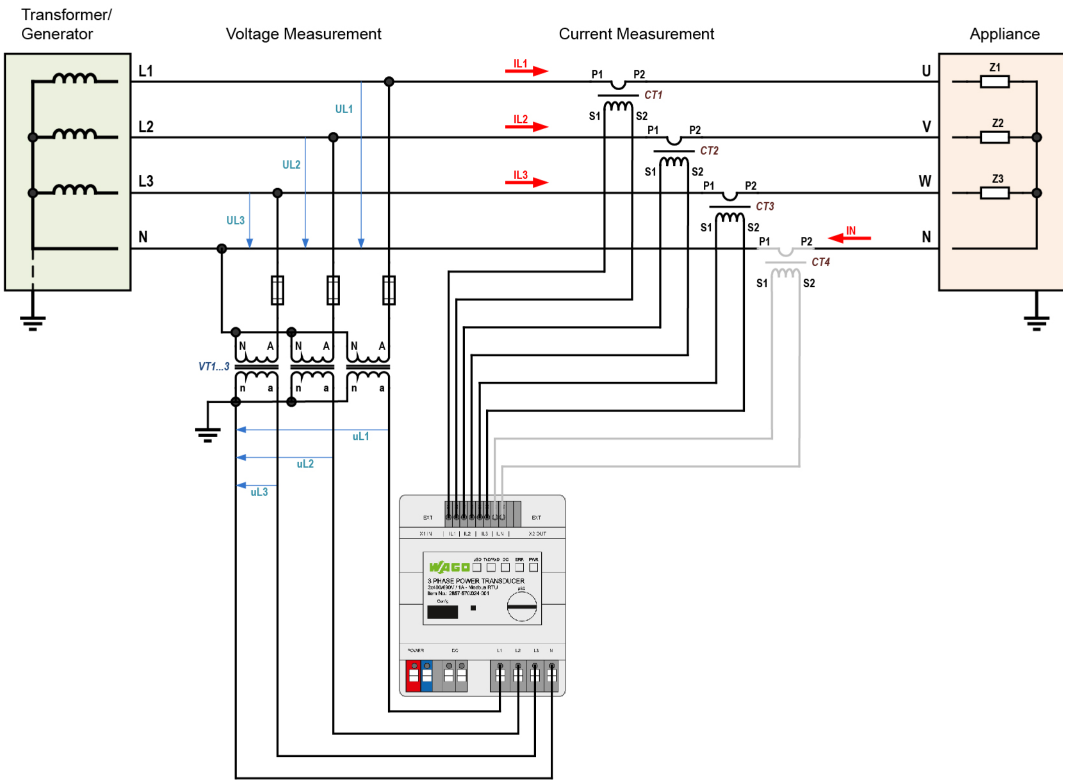


Figure 30: 3-Phase Power Measurement with N-Conductor ≥ 300 V

Please Observe the Following:

- $U_{LX} \rightarrow U_N \geq 300\ V_{RMS}$
- Connection terminal N on the device is reference potential for all voltage and current inputs.
- The neutral conductor is dangerously active per IEC 61010-1.
- The current transformer in the N-conductor is optional.

7.7.1.3 1-Phase Power Measurement with N-Conductor ≤ 300 V

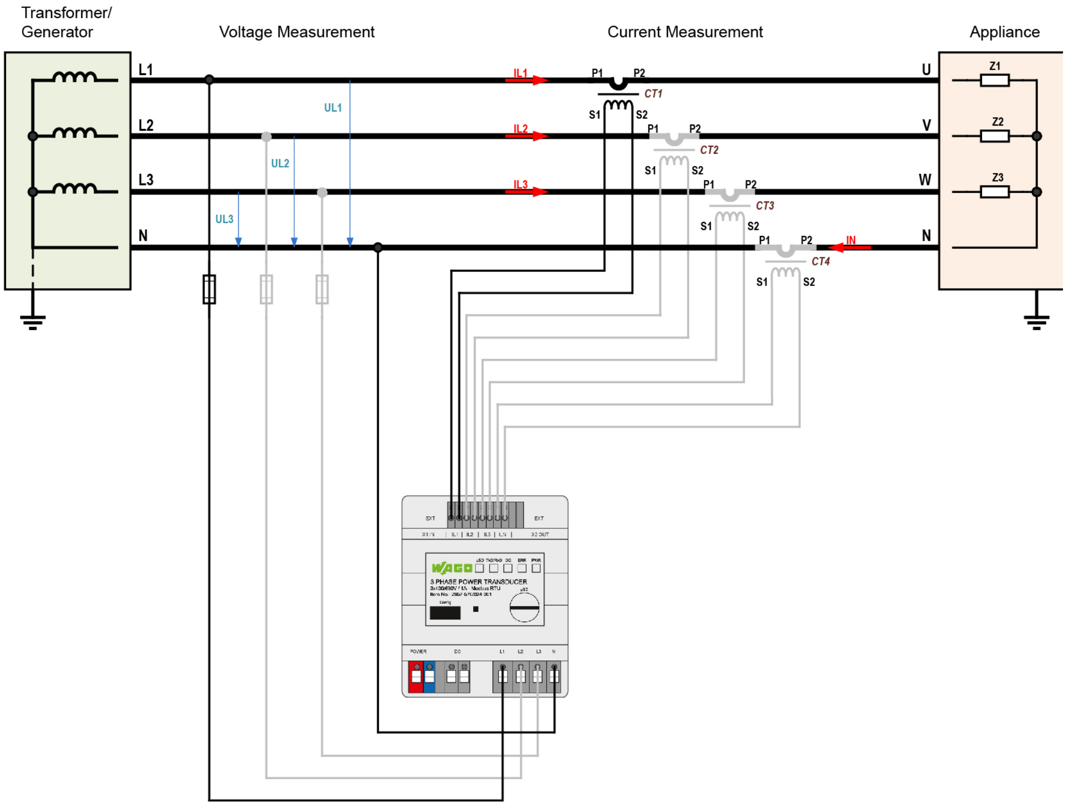


Figure 31: 1-Phase Power Measurement with N-Conductor ≤ 300 V

Please Observe the Following:

- $U_{LX} \rightarrow U_N \leq 300\ V_{RMS}$
- Connection terminal N on the device is reference potential for all voltage and current inputs.
- If it can be insured that the neutral conductor is not dangerously live, direct voltage measurements up to U_{LxN} (rms) ≤ 400 V may be performed.
- The current transformer in the N-conductor is optional.

7.7.1.4 1-Phase Power Measurement with N-Conductor ≥ 300 V

DANGER

Dangerous Voltage!
If there is a fault, contacts may carry dangerous electrical voltage. This can cause electric shock or burns!

Systems with line conductor/neutral conductor voltages > 300 VAC and a neutral conductor considered as “dangerously live” must have an additional safety measure!
Use suitable current transformers to realize these additional safety measures.

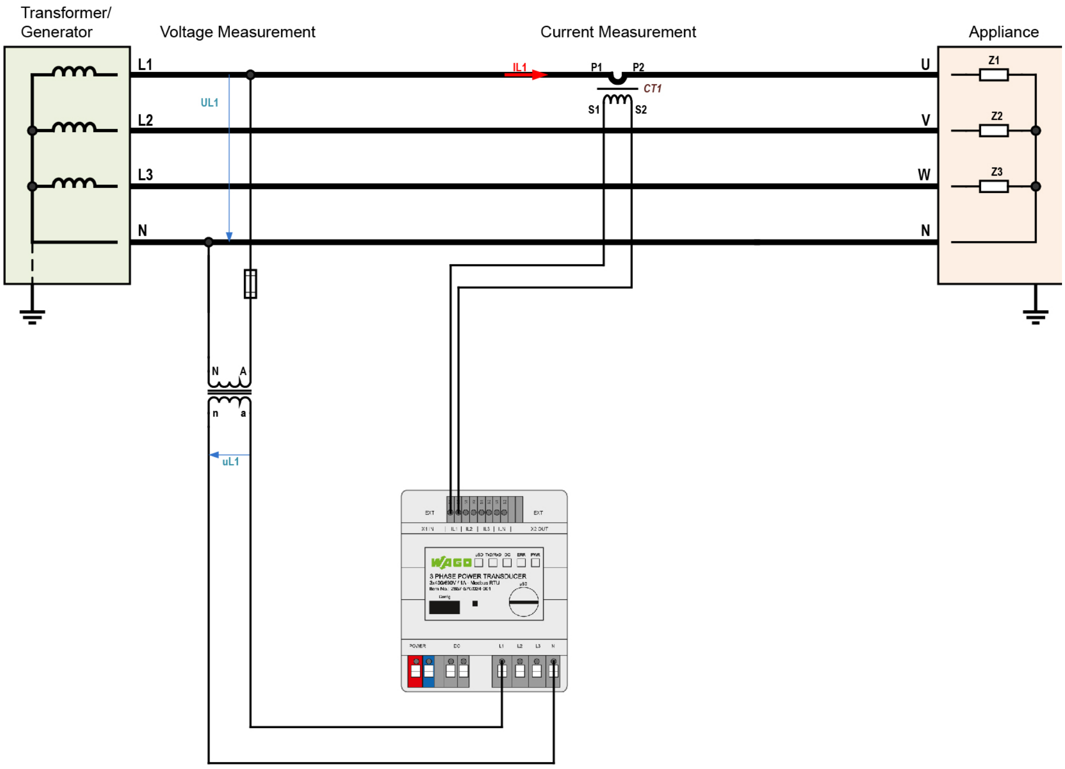


Figure 32: 1-Phase Power Measurement with N-Conductor ≥ 300 V

Please Observe the Following:

- $U_{LX} \rightarrow U_N \geq 300\ V_{RMS}$
- Connection terminal N on the device is reference potential for all voltage and current inputs.
- The neutral conductor is dangerously active per IEC 61010-1.
- The current transformer in the N-conductor is optional.

7.7.2 Power Measurement in 3-Wire Three-Phase Networks

To measure the voltages and currents of a 3-wire three-phase network, connect the four wires with connection terminals L1, L2, L3 and the current transformers or Rogowski coils with the current measurement inputs.
For devices 2857-0570/0024-0001 and -0005, current transformers are used for power measurement; for device 2857-0570/0024-0000, Rogowski coils are used.

7.7.2.1 3-Phase Power Measurement without N-Conductor ≤ 300 V

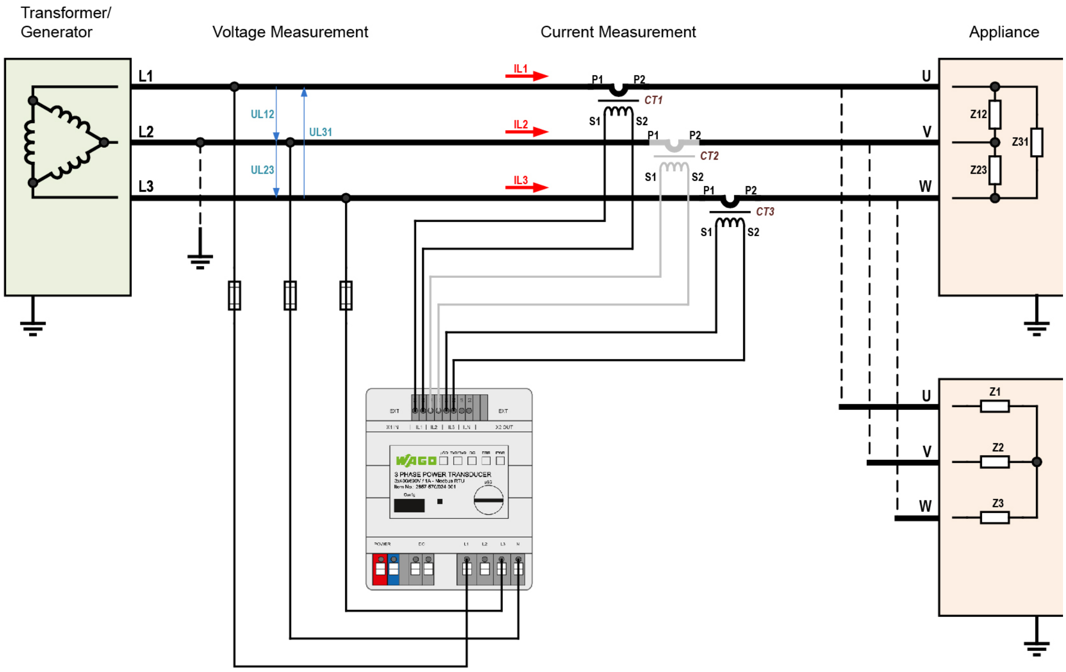


Figure 33: 3-Phase Power Measurement without N-Conductor ≤ 300 V

Please Observe the Following:

- 3-wire three-phase systems with grounded phase:
  $U_{L12} = U_{L23} = U_{L31} \leq 300\ V_{RMS}$
- 3-wire three-phase systems; not grounded:
  $U_{L12} = U_{L23} = U_{L31} \leq 480\ V_{RMS}$
- Connection terminal N on the device is reference potential for all voltage and current inputs.
- The current transformer connected to the reference conductor (L2) is not absolutely necessary and is only included as an option. Thus, the transformer is drawn in gray in the connection example.
- Grounding (PE) of L2 for networks with one grounded phase.

7.7.2.2 3-Phase Power Measurement without N-Conductor ≥ 300 V

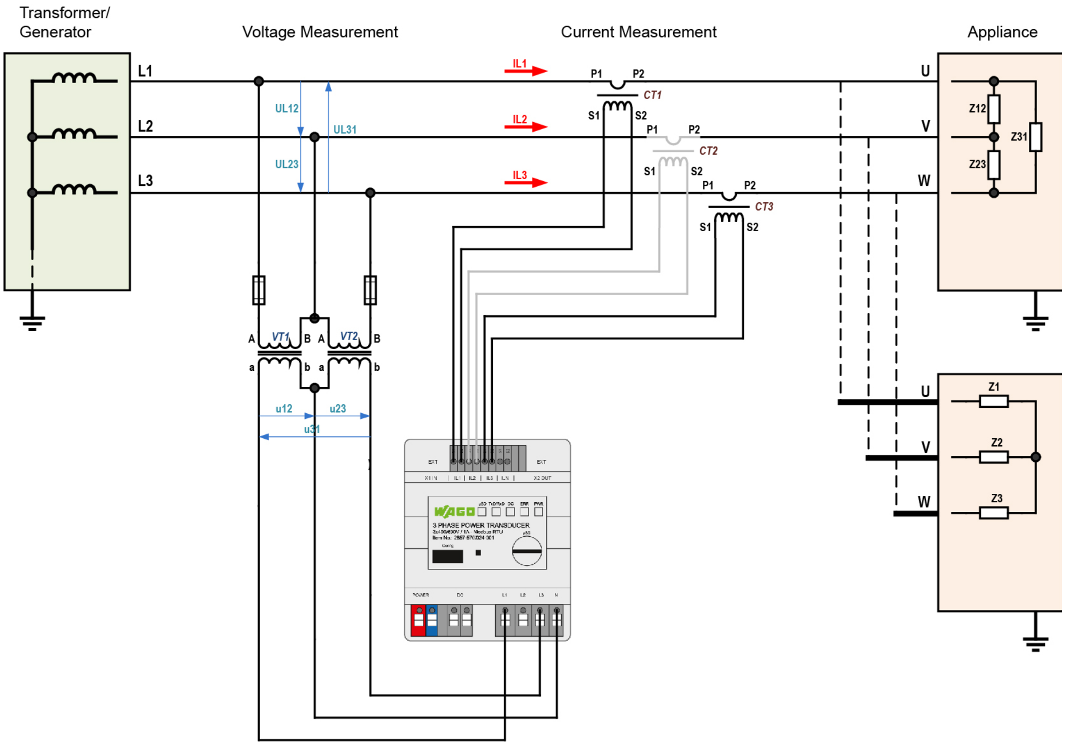


Figure 34: 3-Phase Power Measurement without N-Conductor ≥ 300 V

Please Observe the Following:

- $U_{L12} = U_{L23} = U_{L31} \geq 300\ V_{RMS}$
- Connection terminal N on the device is reference potential for all voltage and current inputs.
- The current transformer connected to the reference conductor (L2) is not absolutely necessary and is only included as an option. Thus, the transformer is drawn in gray in the connection example.

7.7.2.3 2-Phase Power Measurement – Split-Phase ≤ 300 V

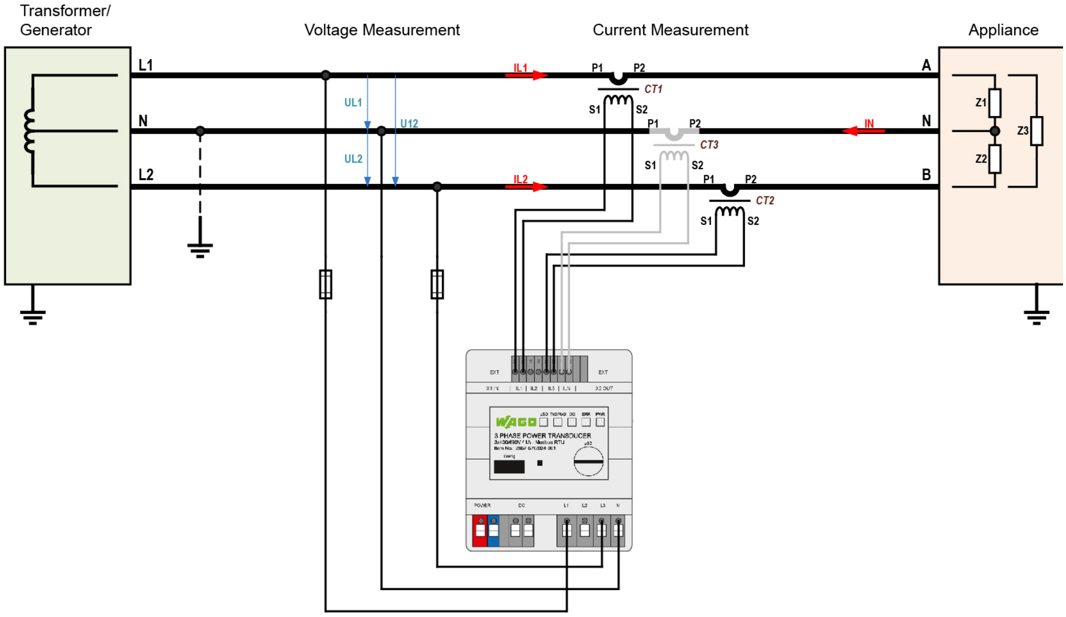


Figure 35: 2-Phase Power Measurement – Split-Phase ≤ 300 V

Please Observe the Following:

- Connection terminal N on the device is reference potential for all voltage and current inputs.
- The current transformer connected to the neutral conductor is not absolutely necessary and is only included as an option. Thus, the transformer is drawn in gray in the connection example.
- Grounding (PE) of the split phase for networks with grounded N-conductor.

7.7.3 Current Transformers

DANGER

No Open Operation Permitted!
For a secondary circuit of the current transformer that is not under load, high voltages are induced on its secondary terminals. The occurring voltage values pose a danger to people as well as the reliability of the converter. “Open operation”, i.e., operation of the current transformer without secondary circuit is prohibited!

Normally, selection of the current transformers is not a critical factor. The internal resistance in the current path for the signal conditioner is so low that it can be disregarded when considering the overall resistances of the current loop.
The transformers must be able to delivery secondary current of 1 A or 5 A. The rated primary current I_{pn} must be at least as large as the currents that are to be measured.
The normal permissible overload level of 1.2 x I_{pn} presents no problems for the signal conditioner but may lead to minor measurement errors.

For more detailed information, see Section “Accessories.”

7.7.3.1 Accuracy Class

Please note that the overall accuracy of the setup consisting of the signal conditioners and current transformers essentially depends on the accuracy class of the transformers.

Note

Do Not Use 3-Phase Power Measurement Modules for Billing Purposes!
The 3-phase power measurement module is not an approved utility billing meter as defined in the standard for electricity meters (DIN 43 856).

7.7.3.2 Types of Current

The signal conditioner can measure any alternating currents with harmonic content up to a frequency of 3.3 kHz.

7.7.3.3 Overcurrent Limiting Factor FS

A current transformer’s overcurrent limiting factor (FS) indicates at which multiple of the rated primary current saturation occurs with the current transformer for protecting connected measuring instruments. The overcurrent limiting factor is printed on the corresponding type plate.

7.7.3.4 Line Length Calculation

Line calculation of copper conductors between measurement device and current transformer.

$$P_V = \frac{I_S^2 \times 2 \times l}{A_{CU} \times 56}$$

I_S	= Secondary rated measuring current strength (A)
l	= Simple cable length (m)
A_{CU}	Cable cross section (mm^2)
P_V	= Power loss of connection cables (VA)

7.7.3.5 Protection against Hazardous Touch Voltages

No hazardous voltage is produced when the signal conditioner is used with appropriate current transformers according to the specifications. Secondary voltage is a low voltage level. The following fault cases can result in high voltage levels:

- Open current path for one or more transformers
- Disconnected neutral conductor at the voltage measuring end of the signal conditioner
- General insulation fault

DANGER

Provide Touch-Proof Protection!
Provide all the wiring of the measurement setup with touch-proof protection and corresponding warning signs!

The signal conditioner allows a maximum line-to-line voltage of 690 V for normal operating conditions. The voltages between the connections of voltage inputs L1, L2 and L3 must not exceed 690 V! Use an interposing transformer stage for higher voltages. However, it must not cause any phase shifting (Yy0)!

The signal conditioner is equipped with an impedance of 1429 kΩ at the voltage measurement end (see Section "Schematic Diagram."). If the neutral conductor is not connected and only one connection at the voltage-measuring end is under power, a voltage of 690 VAC to ground is yielded in a 3-phase alternating current system with a line-to-line voltage of 400 VAC. This must be measured using a multimeter at the current measuring end with 10 MΩ internal resistance. This does not represent an insulation fault, since the N connection of the voltage measurement is also the internal reference potential for the voltage measurement.

7.7.4 Rogowski Coils

The signal conditioner supports type RC70/125/175 Rogowski coils.

Like current transformers, Rogowski coils are for electrically isolated measurement of high currents. They consist of a special coil arrangement that is removable, so it can be easily wrapped around a conductor or current bar, even after installation.
The AC current flowing through the conductor induces a magnetic field; in accordance with the law of induction, this induces a frequency-dependent voltage in the coil, which is proportional to the current. It is also possible to individually set the transformation factor.

When connecting Rogowski coils, pay attention to the direction of current, since otherwise incorrect signs may be output (see Figure below).

The primary winding is identified with “P1” and “P2.” The connections of the secondary winding are identified with “S1” and “S2” accordingly.

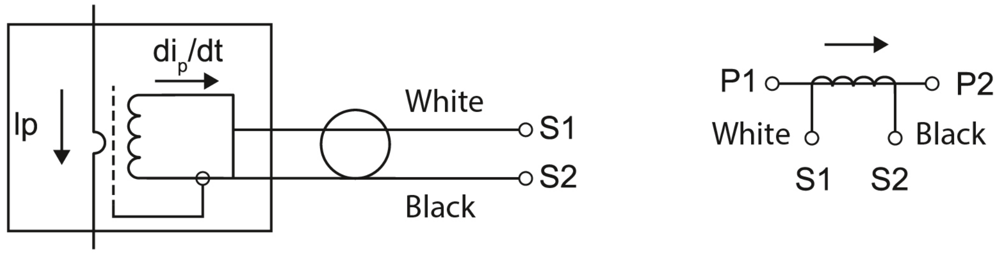


Figure 36: Connection of Rogowski Coils

For more detailed information, see Section “Accessories”.

7.7.5 Additional Measuring Instruments in the Current Circuit

Please note that incorporating additional measuring instruments (such as ammeters) to the current circuit can substantially increase the overall apparent power.
Therefore, additional measuring equipment must be potential-free and wired accordingly.

8 Commissioning

After you have connected the 3-phase supply network, the consumers or producers (via current transformers or Rogowski coils), the Modbus® cable and the power supply, the power measurement module is ready to operate.

Now use the Interface Configuration Software to make all settings.

9 Configuration with the Interface Configuration Software

The power measurement module is configured with the Interface Configuration Software.

This software offers the following functions:

- Graphical representation of the power measurement module
- Visualizing, recording and exporting measured values as CSV files
- Settings for the application
- Settings for measurements of the individual phases
- Power measurement module settings
- Energy value saving settings
- Saving all settings
- Modbus® communication settings
- Data logging settings

Information

Interface Configuration Software
The Interface Configuration Software is available for download at the WAGO website www.wago.com.

Load the software to your PC. Then connect the configuration interface (see front view) with a USB input on the PC via a WAGO USB Communication Cable (750-923) and start the Interface Configuration Software.

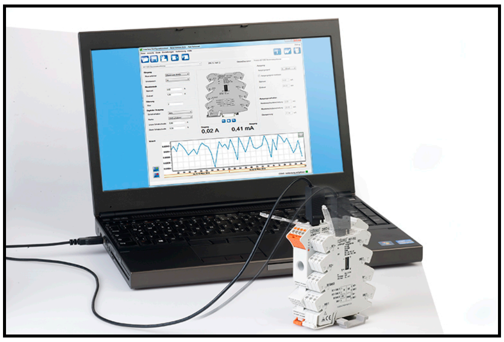


Figure 37: Configuration with the Interface Configuration Software (example)

9.1 Establishing a Communication Connection

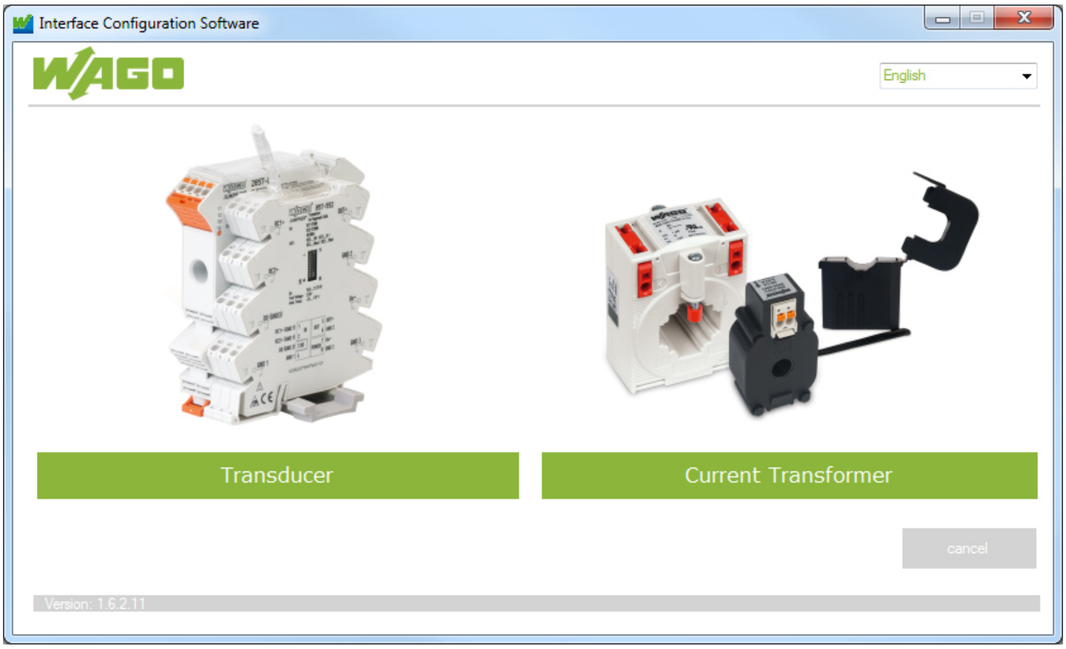


Figure 38: Start Screen

1. Click the **[Transducer]** button.

2. Select the communication connection.

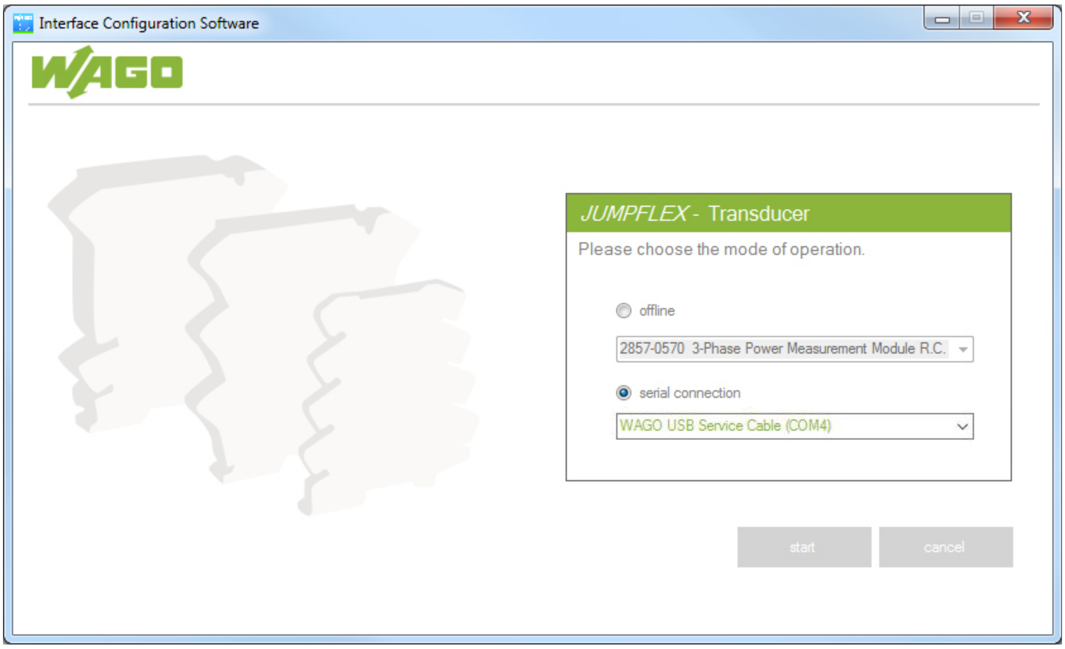


Figure 39: Selecting the Communication Connection

3. Click the **[Start]** button.

The graphical user interface opens. This is described in the next section.

9.2 Graphical User Interface

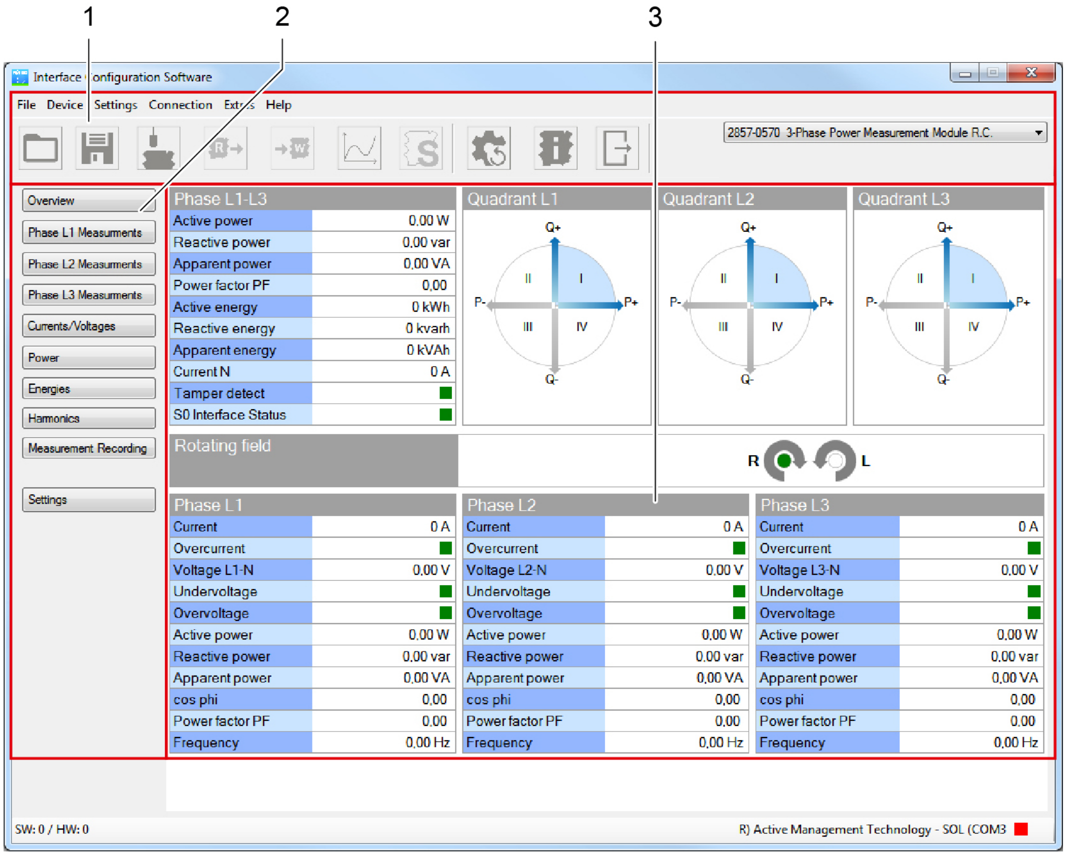


Figure 40: “Graphical User Interface” Overview

The graphical user interface is structured in three partial areas.

Table 74: Legend for the “Graphical User Interface” Overview

Number	Area	Description
1	**Menu Bar**	The individual menu items and buttons for the general parameters are arranged here.
2	**Selection Area**	The individual buttons for the corresponding measured value views are located here.
3	**Measured Value Views**	Depending on the view chosen from the selection area, the specific measured values are displayed here. In addition, specific parameters can be activated, deactivated or adapted.

The individual areas are explained in more detail in the following subsections.

9.2.1 Menu Bar

Figure 41: Menu Bar

9.2.1.1 "File" Menu

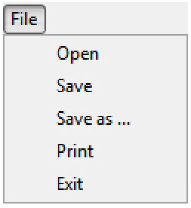


Figure 42: "File" Menu

Table 75: "File" Menu

Menu Item	Description
Open	Opens an existing configuration file.
Save	Saves the existing configuration.
Save as	Saves the current configuration and creates a configuration file from it.
Print	Prints the current configuration.
Exit	Accepts all parameters in the configuration file and closes the graphical user interface.

9.2.1.2 "Device" Menu

Figure 43: "Device" Menu

Table 76: "Device" Menu

Menu Item	Description
Read from device	Reads all parameters from the connected power measurement module.
Write to device	Writes all parameters in the connected power measurement module.
Connect	Makes a connection to a connected power measurement module.
Disconnect	Interrupts an existing connection to the power measurement module.
Simulation	This function is not supported.

9.2.1.3 “Settings” Menu

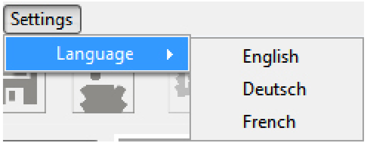


Figure 44: “Settings” Menu

Table 77: “Settings” Menu

Menu Item	Description
Language	Sets the language for the graphical user interface. The following options are available: • **English** • **Deutsch** • **French**

9.2.1.4 “Connection” Menu

Figure 45: “Connection” Menu

Table 78: “COM Port” Menu

Menu Item	Description
COM-Port	Opens the “COM Port” dialog The dialog is described below.

“COM Port” Dialog

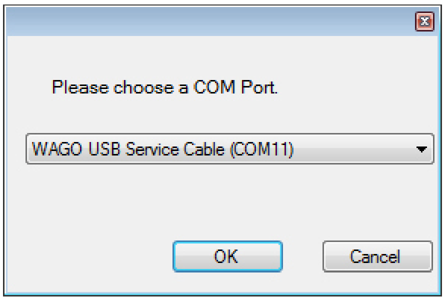


Figure 46: “COM Port” Dialog

An existing communication connection can be changed in the “COM Port” dialog.

Table 79: “COM Port” Menu

Menu Item	Description
WAGO USB Service Cable	Makes a connection to the power measurement module.
WAGO *Bluetooth*® Connection	Optional; when a Bluetooth adapter is used: Makes a connection to the power measurement module.
[OK] button	Copies all parameters to the configuration and closes the dialog.
[Cancel] button	Discards the created configuration and closes the dialog.

9.2.1.5 “Extras” Menu

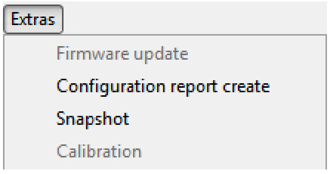


Figure 47: “Extras” Menu

Table 80: “Extras” Menu

Menu Item	Description
Firmware update	Performs a firmware update.
Configuration report create	Create a configuration report in .xlsx format.
Snapshot	Creates a snapshot in .csv format.
Calibration	Calibrates the measurement module.

9.2.1.6 “Help” Menu

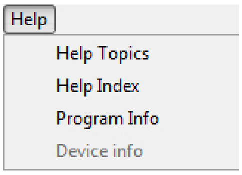


Figure 48: “Help” Menu

Table 81: “Help” Menu

Menu Item	Description
Help Topics	This function is not supported at this time.
Help Index	This function is not supported at this time.
Program Info	Displays version information for the graphical user interface.
Device Info	Displays specific information about the connected device.

9.2.1.7 Buttons

Table 82: Buttons

Symbol	Designation	Description
	**[Open]**	Opens an existing configuration file.
	**[Save]**	Saves the existing configuration.
	**[Connect]**	Connects or disconnects a connection with the connected PC.
	**[Reading from Device]**	Reads all parameters from the connected power measurement module.
	**[Writing to Device]**	Writes all parameters in the connected power measurement module.
	**[Trend]**	Creates a trend.
	**[Simulation]**	This function is not supported at this time.
	**[Factory Settings]**	Resets the power measurement module to factory settings.
	**[Help]**	This function is not supported at this time.
	**[Exit]**	Accepts all parameters in the configuration file and closes the graphical user interface.

9.2.2 Selection Area

The individual buttons for the corresponding measured value views are located here.

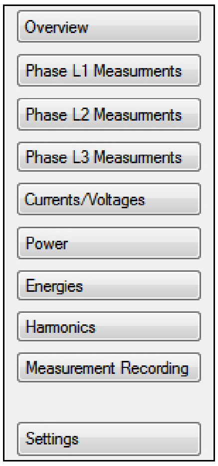


Figure 49: Selection Area

The selection area consists of ten different buttons:

- “Overview” button
- “Phase L1 Measurements” button
- “Phase L2 Measurements” button
- “Phase L3 Measurements” button
- “Currents/Voltages” button
- “Power” button
- “Energies” button
- “Harmonics” button
- “Measurement Recording” button
- “Settings” button

The measured value corresponding to the selected button opens. The specific measured values are displayed in the individual views. In addition, specific parameters can be activated, deactivated or adapted here. All the views are described in the Section “Measured Value Views” below.

9.2.3 Measured Value Views

The specific measured values are displayed here. In addition, specific parameters can be activated, deactivated or adapted.

9.2.3.1 "Overview" Measured Value View

In this view, the measured values of the three phases are displayed next to each other.

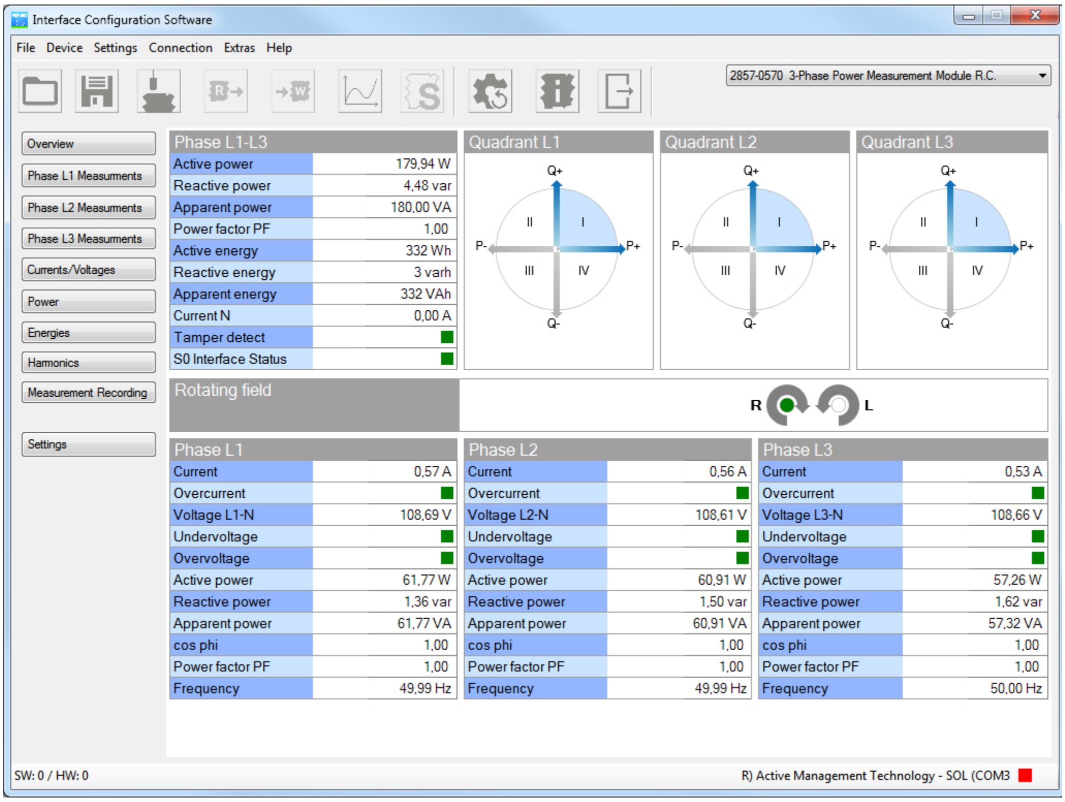


Figure 50: "Overview" Measured Value View – Connection Separated

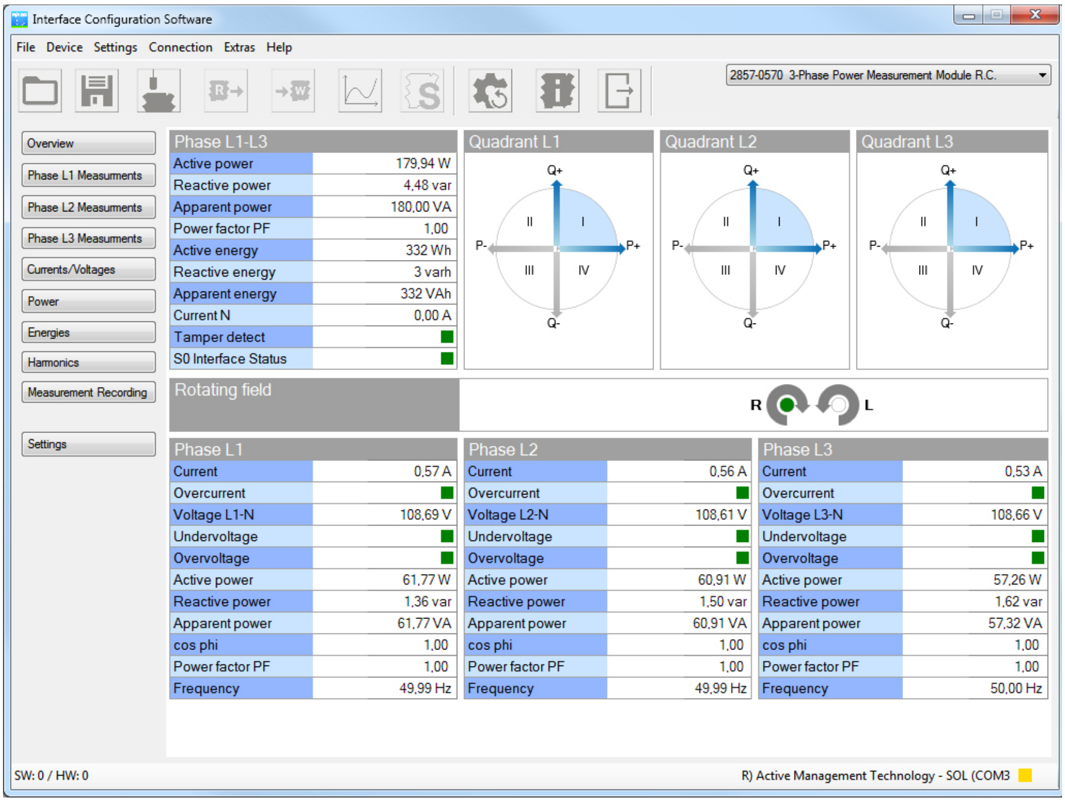


Figure 51: “Overview” Measured Value View – Connection Active

9.2.3.2 “Phase L1–L3 Measurements” Measured Value Views

There is a specific view for the measured values for each phase L1–L3.

User scaling, min./max. values and general parameters can be configured on tabs “Phase L1,” “Phase L2” and “Phase L3.” These are saved in the power measurement module.

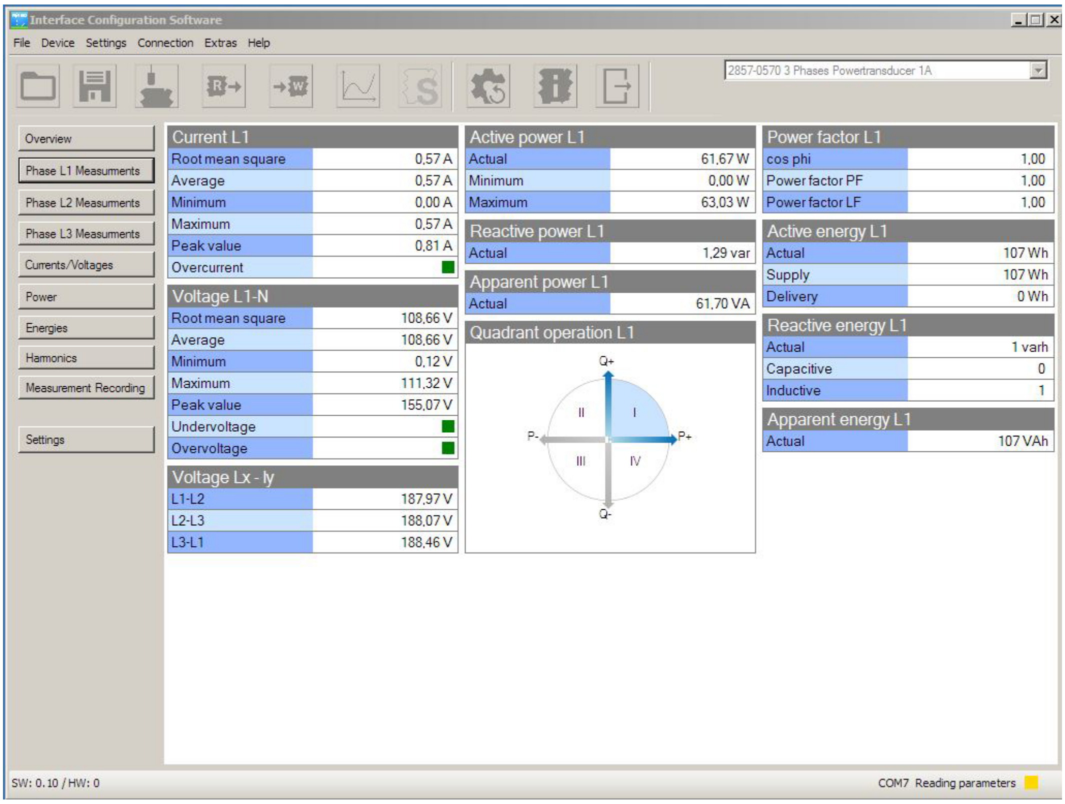


Figure 52: “Phase L1 Measurements” Measured Value View

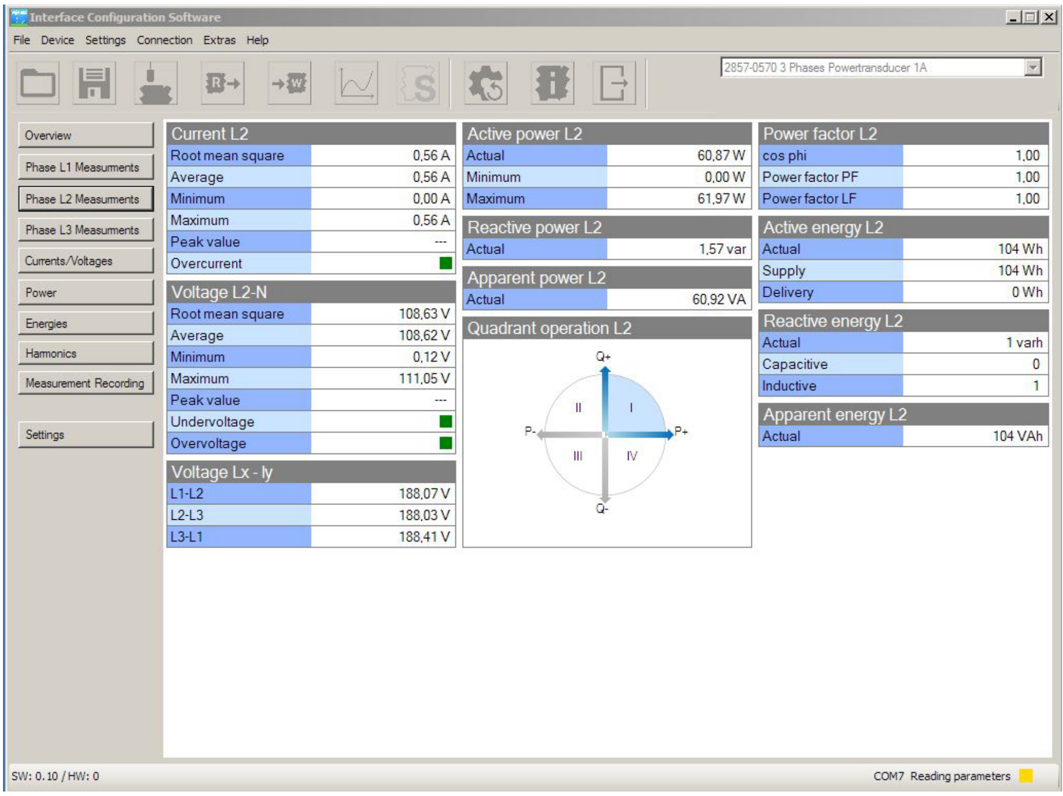


Figure 53: “Phase L2 Measurements” Measured Value View

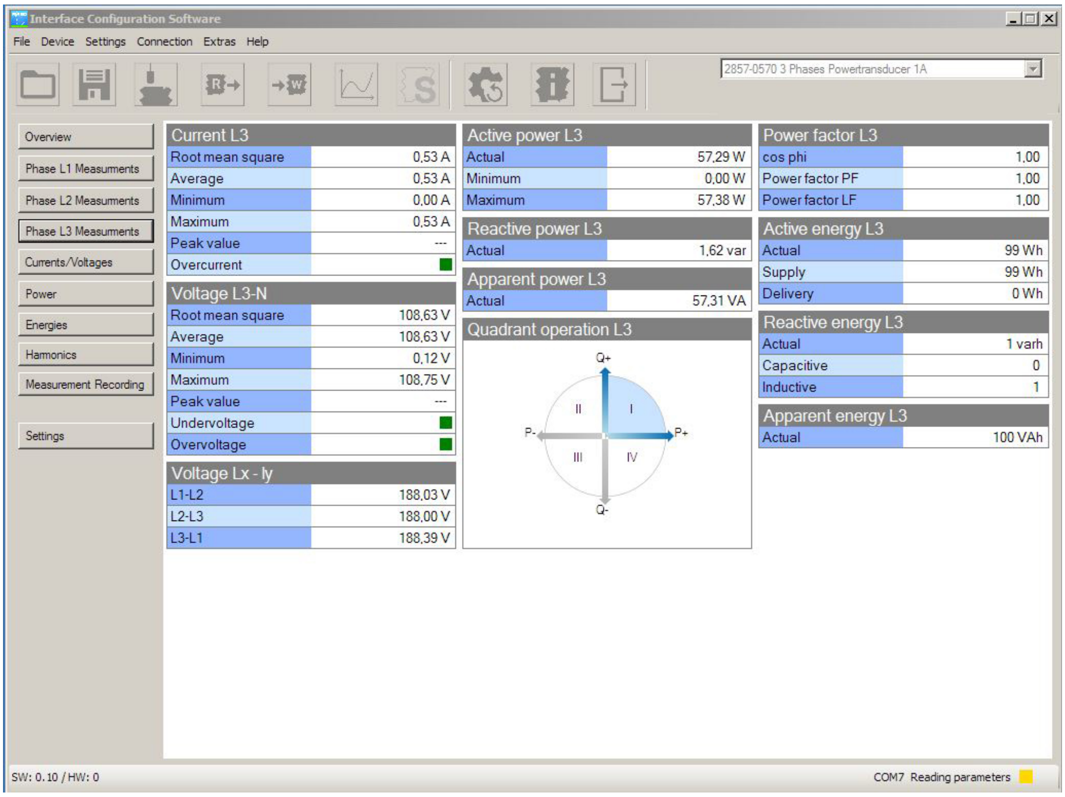


Figure 54: “Phase L3 Measurements” Measured Value View

9.2.3.3 “Currents/Voltages” Measured Value View

The specific currents and voltages are displayed in this view.

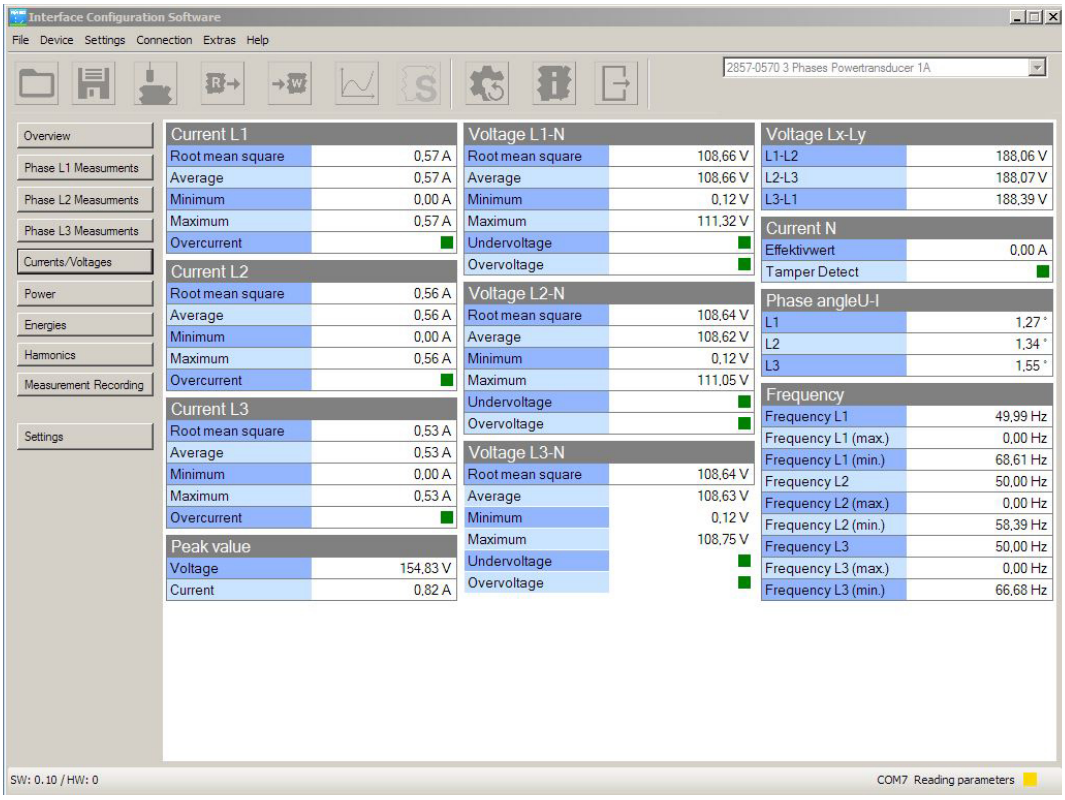


Figure 55: “Currents/Voltages” Measured Value View

9.2.3.4 “Power” Measured Value View

The specific powers are displayed in this view.

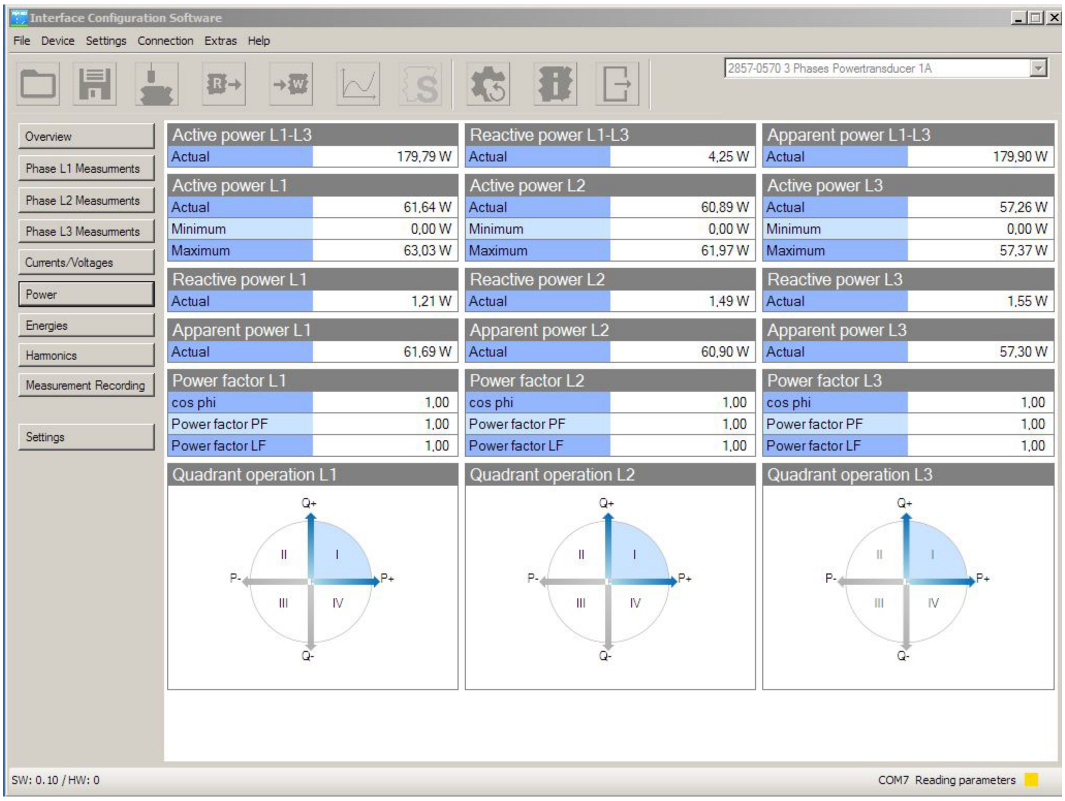


Figure 56: “Power” Measured Value View

9.2.3.5 “Energies” Measured Value View

In this view, the different energies are displayed.

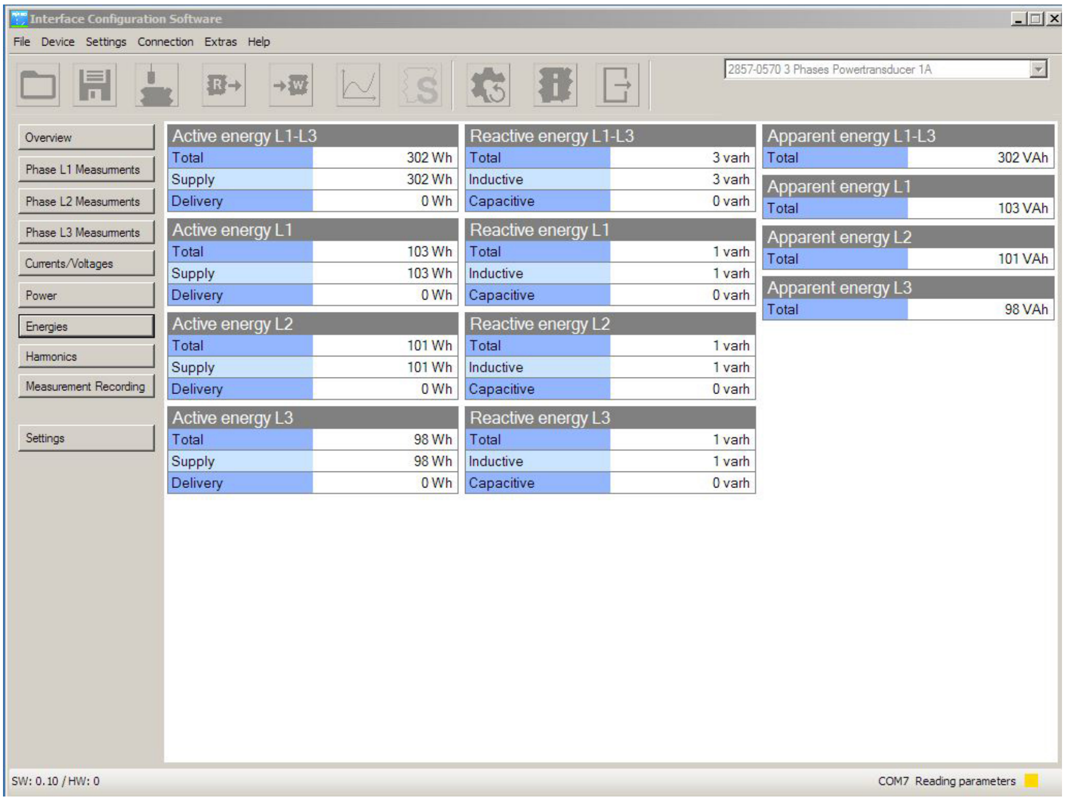


Figure 57: “Energies” Measured Value View

9.2.3.6 "Harmonics" Measured Value View

The 40 harmonics of all three phases are displayed in this view.

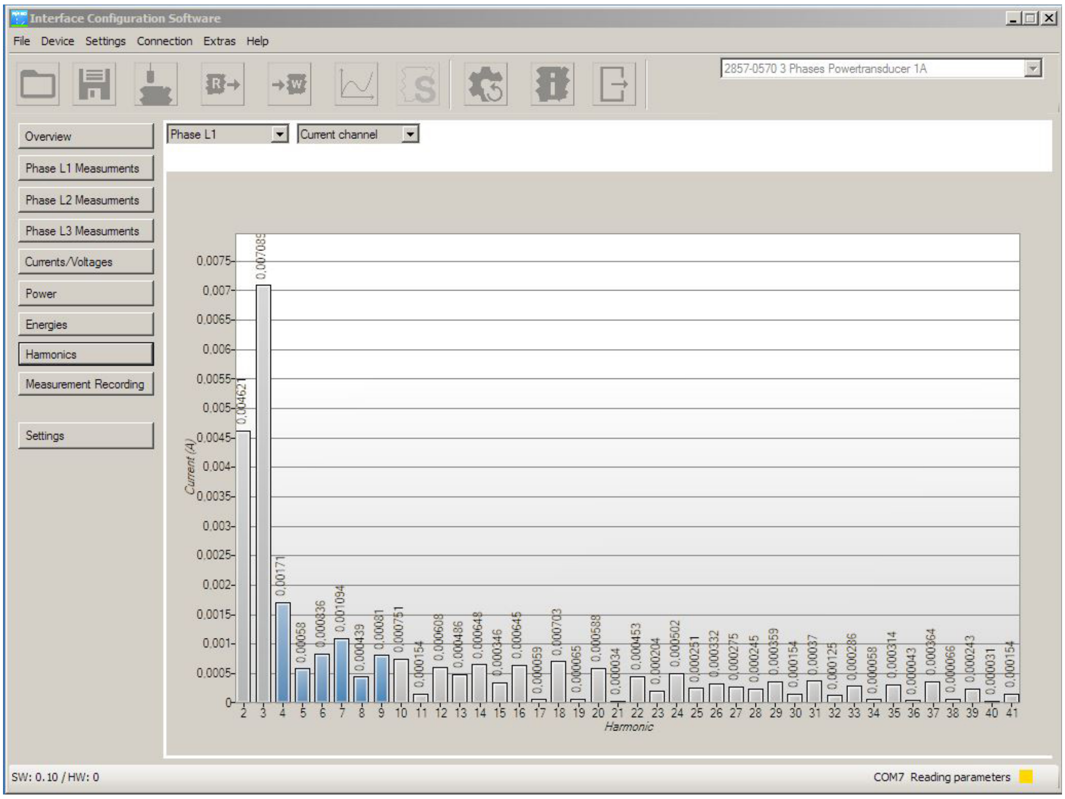


Figure 58: "Harmonics" Measured Value View

Table 83: "Harmonics" Measured Value View

Settings Option	Description
Selection box for the phases	The phase to be analyzed can be selected here.
Selection box for the voltage channel/current channel	Whether the the voltage channel or current channel should be observed can be selected here.

9.2.3.7 “Measurement Recording” Measured Value View

In this view, the three measured variables are shown in their temporal trends.

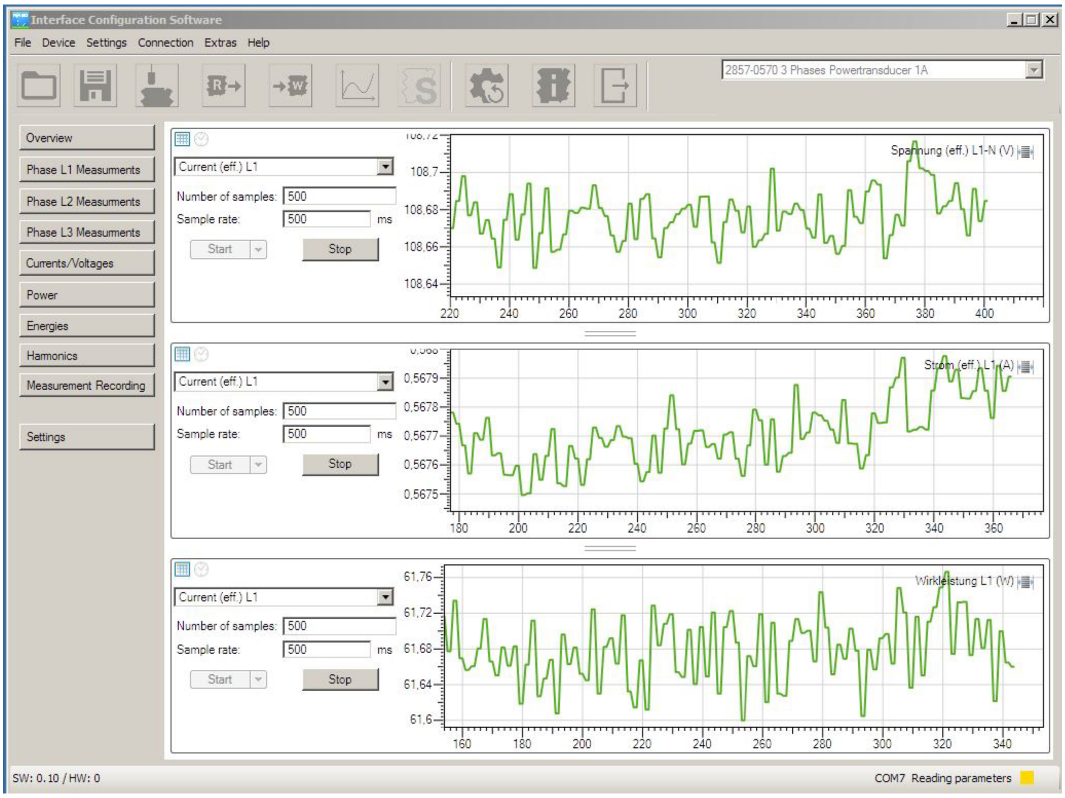


Figure 59: “Measurement Recording” Measured Value View

Table 84: “Measurement Recording” Measured Value View

Settings Option	Description
Selection box	The measured variable to be analyzed can be selected here.
Number of samples	The number of measuring points can be entered here.
Sample rate	The duration during which the measuring points are displayed can be entered here.
[Start]/[▼]	**[Start]:** Opens the “Save under” dialog, where the saving location for a CSV file can be entered. Then the measurement starts. **[▼]:** Opens a submenu with the entry **Without Export**. **[Without Export]:** Starts the measurement without creating a CSV file.
[Stop]	Stops the measurement prematurely.

Within the three graphical charts, you can zoom in and out using the mouse wheel and shift the displayed region by holding down the left mouse button. You can then return to following the current chart by clicking “Next.”

9.2.3.8 “Settings” Measured Value View

This view is divided into five tabs, wherein specific parameters can be set:

- “Phase” tab
- “Device” tab
- “Energy” tab
- “Modbus” tab
- “SD Card” tab

“Phase” Tab

On this tab, the user scaling for phases L1–L3 can be parameterized.

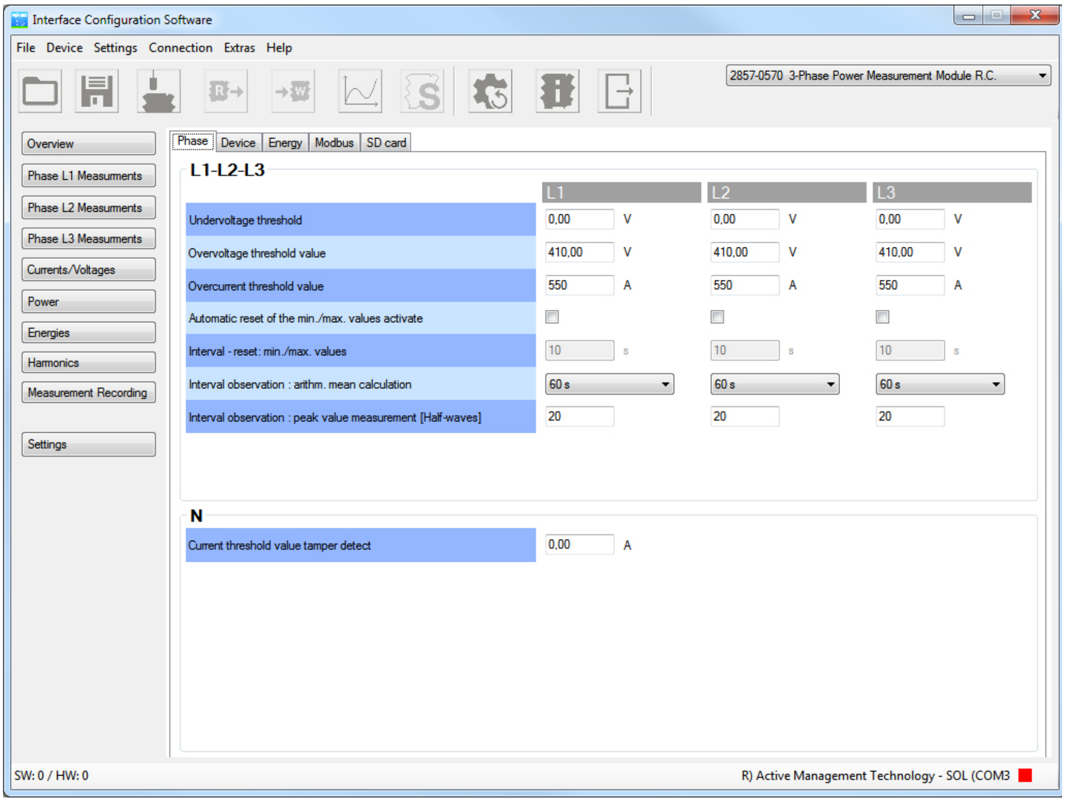


Figure 60: “Phase” Tab

Table 85: “Phase” Tab

Settings Option	Description
Phases L1–L2–L3	
Undervoltage threshold	The undervoltage threshold value can be entered here. Values from 0 V … 440 V are possible.
Overvoltage threshold value	The overvoltage threshold value can be entered here. Values from 0 V … 440 V are possible.
Overcurrent threshold value	The overcurrent threshold value can be entered here. Values from 1 A … 65535 A are possible.
Automatic reset of the min./max. values activate	If this control box is activated, the minimum and maximum current, voltage and power values are automatically reset after a specified time.
Interval reset: min./max. values	The time interval after which the values are automatically reset can be entered here.
Interval observation: arithm. mean calculation	The interval for the arithmetic mean calculation can be entered here.
Interval observation: peak value measurement (half-waves)	The setting for the interval for the peak value measurement can be entered here.
N-conductor	
Current threshold value tamper detect	The threshold value for the fault current detection (Tamper Detect) can be entered here.

"Device" Tab

Device-specific settings can be parameterized here.

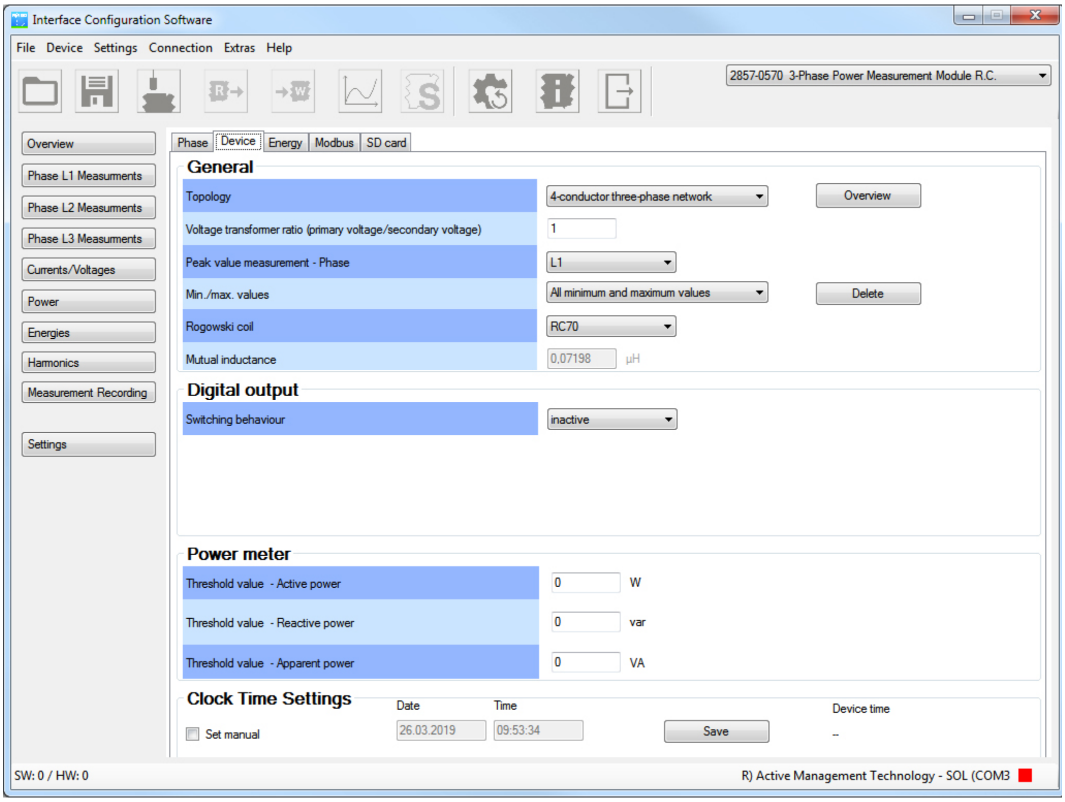


Figure 61: "Device" Tab

Table 86: "Device" Tab

Settings Option	Description
General	
Topology	The topology can be selected here. The following options are available: • 4-conductor three-phase network • 3-conductor three-phase network (ARON)
Voltage transformer ratio (primary voltage/ secondary voltage)	The relationship between primary and secondary voltage can be set here.
Peak value measurement - phase	The line conductor for which the peak value should be measured can be selected here. The following options are available: • L1 • L2 • L3
Min./max. values [Delete]	A minimum or maximum value that should be deleted can be selected here. It is also possible to delete all measured values. **[Delete]:** Deletes the selection.
Rogowski coil	The connected Rogowski coil type can be selected here.
Mutual inductance	The mutual inductance is displayed here.

Table 86: “Device” Tab

Settings Option	Description
General	
Digital Output	
Switching behavior	The digital output switching behavior can be selected here. The following options are available: • Inactive • S0 interface • U_S switching • GND switching
Power meter	
Threshold value, Active power	Corresponding threshold values for active power, apparent power and reactive power can be selected here. Systemic leakage currents are not included in the energy measurement. The energy measurement is interrupted as soon as there is an underrun of one of the set values.
Threshold value, Reactive power	
Threshold value, Apparent power	
Clock Time Setting	
Set manual	If this control field is activated, the corresponding calendar date and internal system time can be manually set in the input fields “Date” and “Time.”
[Save]	Saves the new settings.

“Energy” Tab

The energy values for each phase can be adapted or reset here. This view is password-protected. The initial password is: *wago*.

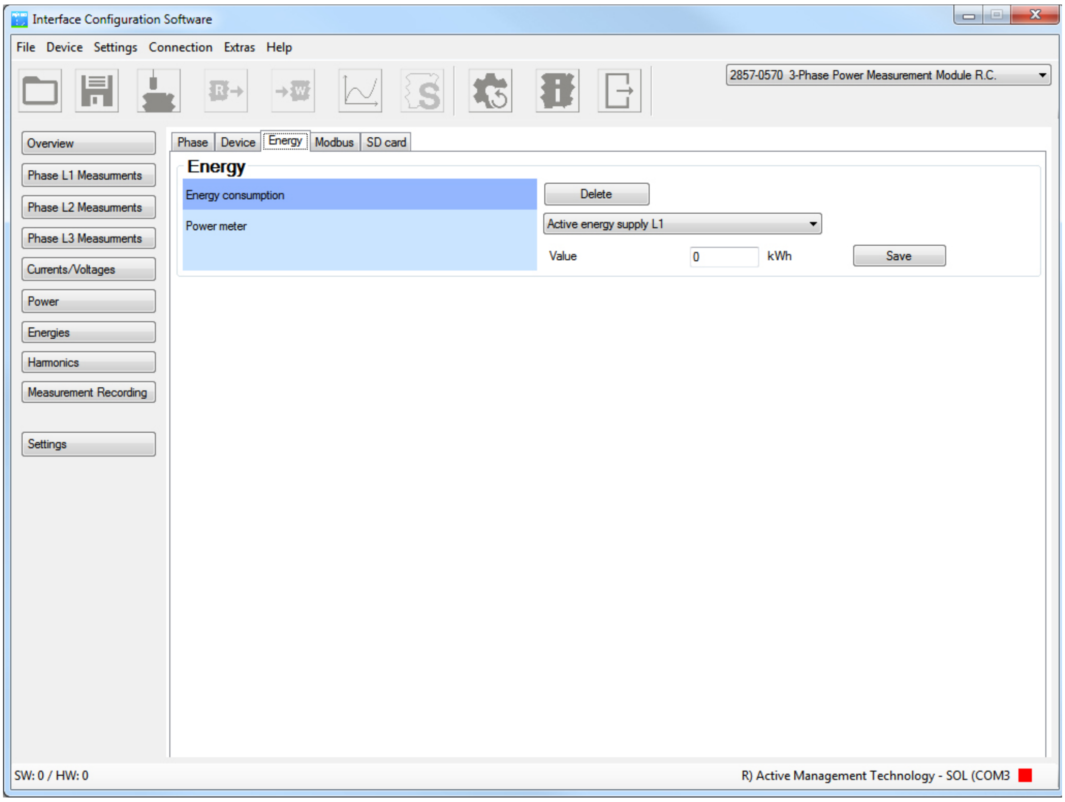


Figure 62: “Energy” Tab

Table 87: “Energy” Tab

Settings Option	Description
Energy	
Energy consumption	**[Delete]:** Deletes the recorded energy range.
Power meter	**Selection box:** Here, the energy meter can be selected: • Active energy supply L1 • Active energy supply L2 • Active energy supply L3 • Active energy delivery L1 • Active energy delivery L2 • Active energy delivery L3 • Reactive energy inductive L1 • Reactive energy inductive L2 • Reactive energy inductive L3 • Reactive energy capacitive L1 • Reactive energy capacitive L2 • Reactive energy capacitive L3 • Apparent energy L1 • Apparent energy L2 • Apparent energy L3 **Value:** The value the energy meter should be set to can be selected here. **[Save]:** Saves the new settings.

“Modbus” Tab

Settings that apply specifically to Modbus® can be made here.

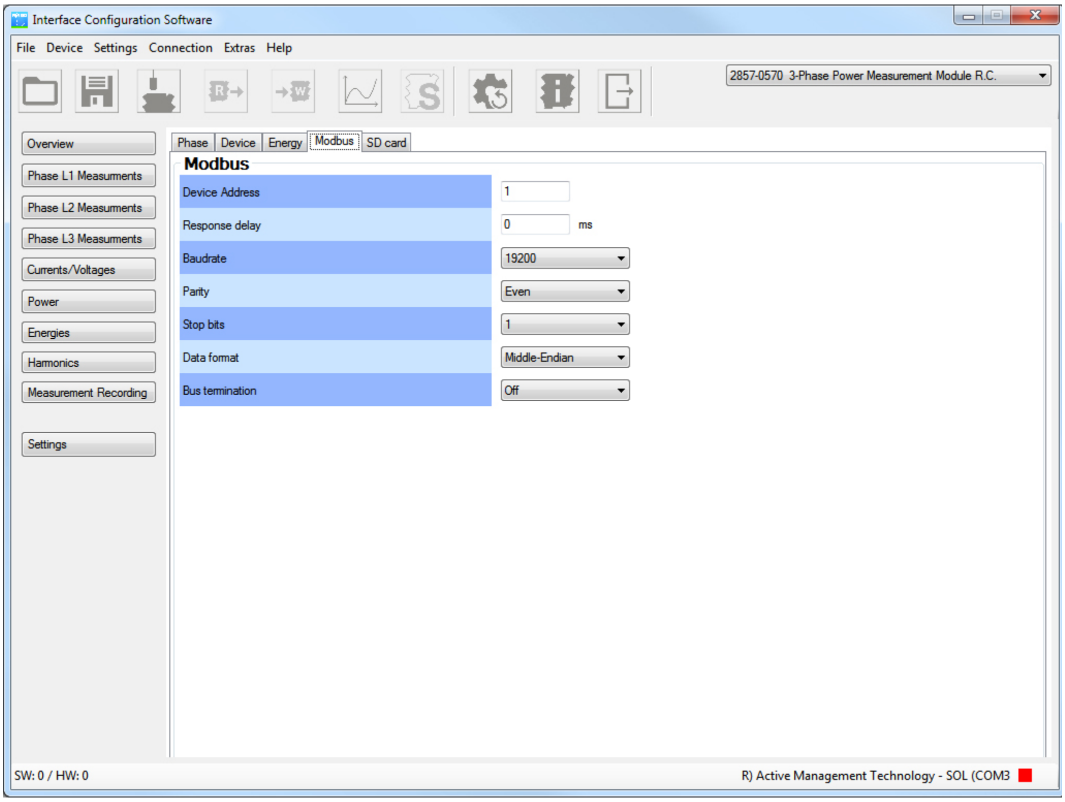


Figure 63: “Modbus” Tab

Note

Set the Correct Device Address, Baud Rate and Parity!
Each device on the bus must have a different address. But: The baud rate and parity must always be the same!

Table 88: “Modbus” Tab

Settings Option	**Description**
Modbus	
Device Address	The device address can be entered here.
Response delay	The response delay can be entered here.
Baudrate	The baud rate can be selected here. The following options are available: • **19200 baud** • **9600 baud**
Parity	The parity can be selected here. The following options are available: • **Even** • **None** • **Odd**

Table 88: “Modbus” Tab

Settings Option	Description
Modbus	
Stop bits	The selection of stopbits can be selected here. The following options are available: • **0.5** • **1** • **2** • **2.5**
Data format	The data format can be selected here: The following options are available: • **Big-Endian** • **Middle-Endian** • **Little-Endian**
Bus termination	The bus termination can be selected here. The following options are available: • **Off** • **150 Ω** • **120 Ω 1nF**

“SD Card” Tab

The values to be saved on the SD card can be selected here. The time points or event values that should be written can also be set.

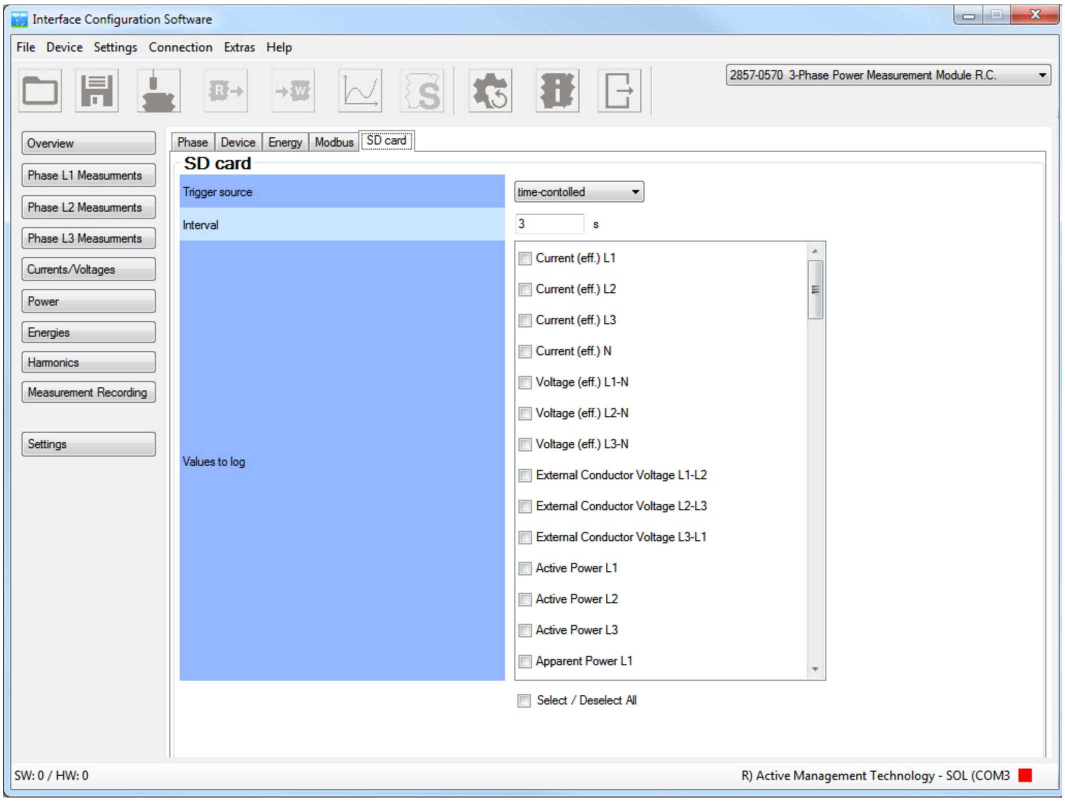


Figure 64: “SD Card” Tab

Table 89: “SD Card” Tab

Settings Option	Description
SD Card	
Trigger source	The trigger source can be selected here. The following options are available: • **Off** • **Time-controlled** • **Event-controlled**
Interval	The trigger interval can be entered here.
Values to log	The measured values that should be logged can be selected here.
Select/deselect All	Activates or deactivates all parameters.

10 Performing Measurements

The measured values can be processed in several ways as the measurement runs.

10.1 Reading Out the Measured Value Register

In the default procedure, since the measured value register is read out (register communication), the higher-level controller polls the measured values via Modbus.

See also Section “Communication per Modbus RTU Protocol”.

10.2 Energy Value Readout at the S0 Interface

To determine the energy consumption, the energy values can be read out at the S0 interface. This requires configuration of the “DO” as an S0 interface. Ultimately, the same connection terminals are used.
The values are transmitted in the form of pulses. Pulse rates from 1 ... 10,000 pulses per kWh can be set.

Note

Do Not Use 3-Phase Power Measurement Modules for Billing Purposes!
The 3-phase power measurement module is not an approved utility billing meter as defined in the standard for electricity meters (DIN 43 856).

10.3 Data Logging with a Micro SD Memory Card

With the data logging function, the measured values can be cyclically saved on a micro SD card as a CSV file. All measured and calculated measurement values can be saved. Once the micro SD card is inserted, the measured values are automatically saved with the default settings.

The saving interval can be configured within a range of 1 s ... 3600 s in increments of 1 s.

Date and time are specified for each measured value. This information is provided by a real-time clock, which has an energy reserve of about eight hours. Note that to ensure accurate time recording, this clock must be regularly synchronized with the system clock of a connected PC.

For more information about data logging, see Section “Configuration with the Interface Configuration Software”.

These parameters support the data logging function:

Table 90: Data Logging – Supported Parameters

Parameters	Validity
RMS value current	L1
	L2
	L3
	N
RMS value voltage	L1–N
	L2–N
	L3–N
	L1–L2
	L1–L3
	L2–L3
Active power	L1
	L2
	L3
Apparent power	L1
	L2
	L3
Reactive power	L1
	L2
	L3
Line frequency	L1
	L2
	L3
Phase angle phi	L1
	L2
	L3
cos phi	L1
	L2
	L3
Power factor PF	L1
	L2
	L3
Power factor LF	L1
	L2
	L3
Maximum RMS current	L1
	L2
	L3

Table 90: Data Logging – Supported Parameters

Parameters	Validity
Minimum RMS current	L1
	L2
	L3
Arithmetic mean current	L1
	L2
	L3
Maximum RMS voltage	L1–N
	L2–N
	L3–N
Minimum RMS voltage	L1–N
	L2–N
	L3–N
Arithmetic mean voltage	L1–N
	L2–N
	L3–N
Maximum active power	L1
	L2
	L3
Minimum active power	L1
	L2
	L3
Maximum line frequency	L1
	L2
	L3
Minimum line frequency	L1
	L2
	L3
Active energy	L1
Active energy import	
Active energy export	
Reactive energy	
Reactive energy inductive	
Reactive energy capacitive	
Apparent energy	
Active energy	L2
Active energy import	
Active energy export	
Reactive energy	
Reactive energy inductive	
Reactive energy capacitive	
Apparent energy	

Table 90: Data Logging – Supported Parameters

Parameters	Validity
Active energy	L3
Active energy import	
Active energy export	
Reactive energy	
Reactive energy inductive	
Reactive energy capacitive	
Apparent energy	
Active energy total	-
Active energy import total	
Active energy export total	
Reactive energy total	
Reactive energy inductive total	
Reactive energy capacitive total	
Peak value voltage	
Peak value current	

The parameter default values are:

- Data logging inactive
- Saving interval: 10 s
- Measured variables: Currents (rms); L1, L2, L3, N. Voltages (rms); L1–N, L2-N, L3–N. Active power; L2, L3.

11 Service

Firmware Update

In addition to configuration and visualization, firmware updates can also be performed with the Interface Configuration Software.

12 Appendix

12.1 Accessories

The following accessories are available for the power measurement module:

Table 91: Accessories

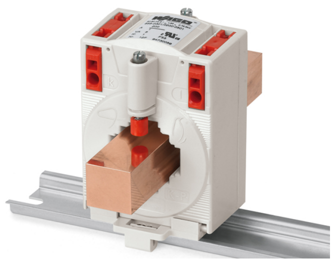
Accessory	**Item Number**	**Figure**
Configuration and Display		
Interface Configuration Software	Download under www.wago.com	-
WAGO USB Communication Cable, length 2.5 m	750-923	
WAGO USB Communication Cable, length 5 m	750-923/000-001	
Current Transformers and Rogowski Coils		
Rogowski Coil RC70, for measuring currents up to 4000 A AC, Ø 70 mm • Cable length: 1.5 m • Cable length: 4.5 m	 855-9150/2000-0701 855-9450/2000-0701	
Rogowski Coil RC125, for measuring currents up to 4000 A AC, Ø 125 mm • Cable length: 1.5 m • Cable length: 4.5 m	 855-9150/2000-1251 855-9450/2000-1251	
Rogowski Coil RC175, for measuring currents up to 4000 A AC, Ø 175 mm • Cable length: 1.5 m • Cable length: 4.5 m	 855-9150/2000-1751 855-9450/2000-1751	
Plug-In Current Transformers with CAGE CLAMP® Connection Technology	For example, 855-301/050-103 *	
Plug-in Current Transformers with a *picoMAX®* Pluggable Connector	855-1700/032-000 855-2701/035-001 855-2701/064-001	

Table 91: Accessories

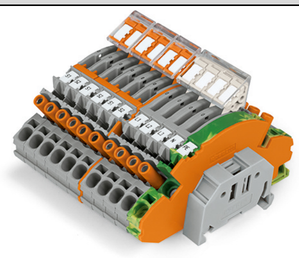
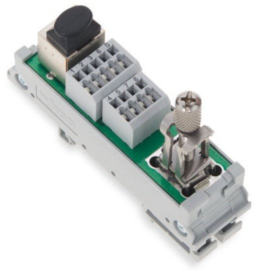
Accessory	**Item Number**	**Figure**
Split-Core Current Transformers	For example, 855-3001/060-003 *	
Current and Voltage Taps		
• … up to 50 mm² (AWG 1/0) • … up to 95 mm² (AWG 4/0) • … up to 185 mm² (AWG 350 kcmil)	855-0501/150-000 855-0951/250-000 855-1851/350-0000	
Voltage Taps		
• … with M6 mount • … with M8 mount • … with clamp mount	855-8006 855-8008 855-8015	
Voltage Taps		
2.5 mm² … 6 mm², (AWG 12–10) ∅ 3 mm … 5 mm 10 mm² … 16 mm², (AWG 8–6) ∅ 5 mm … 7 mm	855-8001 (black) 855-8002 (blue) 855-8003 (black) 855-8004 (blue)	
Terminal Block Assemblies		
Terminal block assembly for current transformer circuit (connections for current and voltage)	2007-8873 2007-8874	
Terminal block assembly for current transformer circuit (connection for current)	2007-8875 2007-8877	

Table 91: Accessories

Accessory	Item Number	Figure
Interface Modules		
Interface module for ETHERNET RJ-45	289-175/790-108	
Interface module for ETHERNET Y-ConJack-22	289-176	
ETHERNET connector, RJ-45	750-978/000-011	
DC Power Supplies		
DC Power Supply	787-2850	
Tools		
Operating tool, type 2	210-720	-
T-wrench (for 855-8015)	855-8000	
Memory Cards		
Micro SD memory card, 2 GB	758-879/000-3102	-

* You will find additional current transformers under www.wago.com.

12.2 Examples of CSV Data Files

12.2.1 Snapshot

The following table presents an example of a CSV file that was created with the Interface Configuration Software. Click **Snapshot** in the “Tools” menu. It lists the current measured values, the error messages and the parameter settings.

Table 92: CSV File “Snapshot”

2018-10-04 14:40	**WAGO Kontakttechnik GmbH & Co. KG**	**2857-0570 3-Phase Power Measurement Module, 5 A**
Measured values		
Current (rms) L1	1.979612231	A
Current (rms) L2	0.062213849	A
Current (rms) L3	0.063112609	A
Current (rms) N	0.008522959	A
Voltage (rms) L1–N	269.1612244	V
Voltage (rms) L2–N	281.8621521	V
Voltage (rms) L3–N	270.8454285	V
Line-to-line voltage L1–L2	12.70088577	V
Line-to-line voltage L2–L3	1.713913679	V
Line-to-line voltage L3–L1	11.01490498	V
Active power L1	1.097641587	W
Active power L2	17.06621552	W
Active power L3	16.63612938	W
Apparent power L1	532.8337402	VA
Apparent power L2	17.53324127	VA
Apparent power L3	17.09260178	VA
Reactive power L1	-532.8253784	var
Reactive power L2	-4.050521851	var
Reactive power L3	-3.846014977	var
Frequency L1	49.99999619	Hz
Frequency L2	49.99999619	Hz
Frequency L3	49.99999619	Hz
Phase angle U-I L1	0	°
Phase angle U-I L2	0	°
Phase angle U-I L3	0	°
cos phi L1	0.001286041	
cos phi L2	0.972957373	
cos phi L3	0.974356353	
Power factor PF L1	0.002060008	
Power factor PF L2	0.9733634	
Power factor PF L3	0.973294139	
Power factor LF L1	-0.002136296	
Power factor LF L2	-0.973326802	
Power factor LF L3	-0.973326802	
Maximum current (rms) L1	1.980008841	A
Maximum current (rms) L2	0.079724401	A
Maximum current (rms) L3	0.080853127	A
Minimum current (rms) L1	1.97918272	A
Minimum current (rms) L2	0.059897725	A
Minimum current (rms) L3	0.060773019	A
Average value current (rms) L1	1.980110526	A
Average value current (rms) L2	0.062145382	A
Average value current (rms) L3	0.063039444	A
Maximum voltage (rms) L1–N	360.8012085	V

Table 92: CSV File “Snapshot”

2018-10-04 14:40	**WAGO Kontakttechnik GmbH & Co. KG**	**2857-0570 3-Phase Power Measurement Module, 5 A**
Maximum voltage (rms) L2–N	377.819397	V
Maximum voltage (rms) L3–N	363.0617981	V
Minimum voltage (rms) L1–N	199.0415497	V
Minimum voltage (rms) L2–N	281.8067932	V
Minimum voltage (rms) L3–N	270.7977295	V
Average value voltage (rms) L1–N	269.1274109	V
Average value voltage (rms) L2–N	281.8670654	V
Average value voltage (rms) L3–N	270.853302	V
Maximum active power L1	4.253361225	W
Maximum active power L2	29.67589951	W
Maximum active power L3	28.926548	W
Minimum active power L1	0.564652145	W
Minimum active power L2	16.42240715	W
Minimum active power L3	16.01078987	W
Maximum frequency L1	0	Hz
Maximum frequency L2	0	Hz
Maximum frequency L3	0	Hz
Minimum frequency L1	0	Hz
Minimum frequency L2	0	Hz
Minimum frequency L3	0	Hz
Active energy L1	10	Wh
Active energy import L1	10	Wh
Active energy export L1	0	Wh
Reactive energy L1	-4237	varh
Reactive energy inductive L1	0	varh
Reactive energy capacitive L1	4237	varh
Apparent energy L1	4237	Wh
Active energy L2	31	Wh
Active energy import L2	31	Wh
Active energy export L2	0	Wh
Reactive energy L2	-5	varh
Reactive energy inductive L2	0	varh
Reactive energy capacitive L2	5	varh
Apparent energy L2	32	Wh
Active energy L3	30	Wh
Active energy import L3	30	Wh
Active energy export L3	0	Wh
Reactive energy L3	-5	varh
Reactive energy inductive L3	0	varh
Reactive energy capacitive L3	5	varh
Apparent energy L3	31	Wh
Active power total	71	Wh
Active power import total	71	Wh
Active power export total	0	Wh
Reactive energy total	-4247	varh
Reactive energy inductive total	0	varh
Reactive energy capacitive total	4247	varh
Peak value voltage	380.794281	V
Peak value current	2.801195383	A
Quadrant L1	4	
Quadrant L2	4	

Table 92: CSV File “Snapshot”

2018-10-04 14:40	**WAGO Kontakttechnik GmbH & Co. KG**	**2857-0570 3-Phase Power Measurement Module, 5 A**
Quadrant L3	4	
Tamper Detect	Inactive	
Rotating field	Left	

12.2.2 Measured Value Trend

The following table presents an example of a CSV file that was created with the Interface Configuration Software. To do so, click **[Start]** in the “Measured Value Trend” measured value view. In this case, the measured variable “Current (rms) L1–N” was selected as a measurement sequence with 20 measured values.

Table 93: “Measured Value Trend” CSV File

2018-10-04 14:46	**WAGO Kontakttechnik GmbH & Co. KG**	**Interface Configuration Software (1.6.2.5)**	**3-Phase Power Measurement Module, 5 A, 2857-0570**	**Current (rms) L1**	**A**
02:46:46	1.979541779				
02:46:47	1.979541779				
02:46:47	1.979534745				
02:46:48	1.979534745				
02:46:48	1.979506612				
02:46:49	1.979506612				
02:46:49	1.979384542				
02:46:50	1.979384542				
02:46:50	1.979393959				
02:46:51	1.979393959				
02:46:51	1.979466677				
02:46:52	1.979466677				
02:46:52	1.979516029				
02:46:53	1.979516029				
02:46:53	1.979492545				
02:46:54	1.979492545				
02:46:54	1.97945261				
02:46:55	1.97945261				
02:46:55	1.979429126				
02:46:56	1.979429126				

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WAGO Kontakttechnik GmbH & Co. KG
Postfach 2880 • D - 32385 Minden
Hansastraße 27 • D - 32423 Minden
Phone: +49 571 887 – 0
Fax: +49 571 887 – 844169
E-Mail: info@wago.com
Internet: www.wago.com