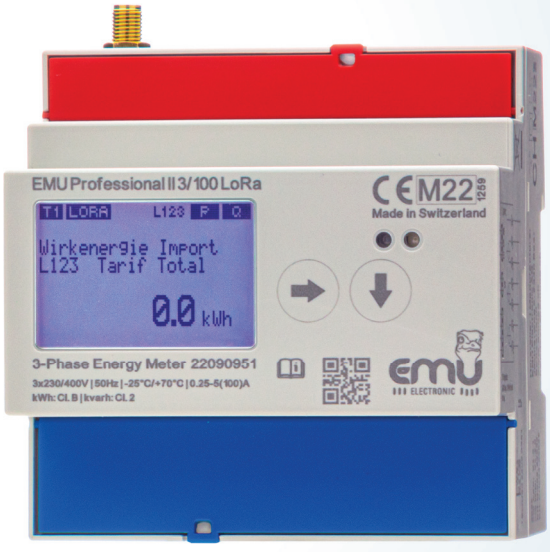
The worlds first power meter with blockchain technology



ENERGY METER

EMU PROFESSIONAL II

- Load profile PTB-A 50.7
- MID B + D Approval
- TCP/IP API
- LoRa
- M-Bus
- Modbus RTU + Modbus TCP

ABOUT EMU ELECTRONIC AG

Since its founding in 1989, EMU has been developing and producing energy meters for monitoring and billing purposes, data loggers and software solutions for energy management and billing. This allows users to manage and bill consumption in the era of IoT in a completely new way.

EMU uses leading edge technologies to provide future oriented products with innovative features and world-class customer service.

SMART FACTORY 2020

The new production line increases the annual output of 3-Phase Energy Meters in 2020 by 150’000 additional units.

IOT METERING - MADE IN SWITZERLAND

The energy industry is undergoing a massive change towards decentralized clean energy and smart network solutions. In the Internet of Things, machines trust each other and data integrity is essential. For this purpose, we developed **the world's first electricity meter with blockchain technology**[1] in the Crypto Valley Zug.

With the second generation of the EMU Professional we are setting new standards in the area of DIN rail energy meters.
A large number of measured values can be transmitted via a wide variety of readout interfaces such as TCP/IP and LoRa. In addition, the EMU Professional II has an internal memory to save the most important measured values every 15 minutes and store them for up to 3 years.

In order to ensure data integrity in the age of the Internet of Things and M2M communication, measured values can be saved in the IOTA Tangle. IOTA is a scalable and royalty-free communication and transaction protocol. The IOTA Foundation, based in Berlin, is developing the Tangle as a new standard for and with the industry.

[1] IOTA does not use Blockchain on the basis of a chained list. Transactions are recorded in a directed acyclical graph. This allows for better scaling. IOTA transaction will not incur direct transactional fees, but proof of work is required of the transaction originator.

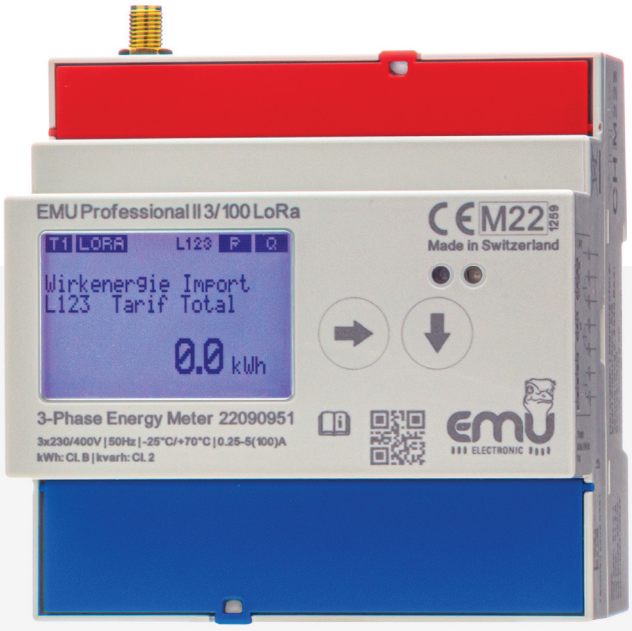
The EMU Professional II is ideal for use in modern decentralized energy solutions, industrial plants, for cost center accounting and sub-measurements, as well as for performance monitoring and energy management in accordance with ISO 50001.

Like all EMU products, the latest generation of energy meters has been designed for maximum performance, durability, functionality and demanding measurement tasks. "Quality that counts - Made in Switzerland".

3-phasen multi-measurement device with MID and PTB approval

EMU PROFESSIONAL II

The EMU Professional II is a multifunctional bi-directional energy meter with exceptional flexiblity and accuracy. All this fits in an only 90 mm (5 module) wide device. Different parameters from sophisticated applications like residential, industrial and trade environnements can be analysed and supervised via a range of different connection protocols. All that is needed is a direct or current transformer connection. It combines the function of an energy meter, a datalogger and supplies additional measurements such as current, voltage, power etc.



FEATURES

- Bi-directional meter (export and import)
- Load profile storage
- MID B + D certified for billing purposes
- PTB-A 20.1 and PTB-A 50.7 certified
- Environmental conditions mechanical: M2
- 1 and 5 A current transformer connections for up to 20’000/5 or 4’000/1 A. The CT ratio can be adjusted multiple times via a sealable button
- Direct connector for up to 100A
- 2 or 4 tariffs (Can be set on the meter itself)
- Graphic LC-Display (38x28 mm) with backgroundligh-ting
- Dynamic 8-digit display with up to three decimal places

CUSTOMER BENEFIT

- Load profile conform to calibration law
- Buffered Clock
- Safe against manipulations of energy data due to blockchain technology
- 15 minutes load profile storage with a storage depth of more than 3 years
- Logbook for configuration adjustments relevant to calibration

MID CERTIFIED FOR BILLING PURPOSES

The EMU Professional II is tested and certified according to MID-Modul B + D (Measurement Instrument Directive 2004/22/EG of the european comission). Therefore it posesses the neccessary declaration of conformity. The additional certification according to module D, QM-System for manufacturing and final testing, allows all EMU Professional II ex-factorio to be used for billing purposes within the European Union and the European Economic Area (EEA).

EMU Electronic AG is certified according to ISO 9001 and allows for conduction of annual external audits.

ACCURACY FOR USES IN PHOTOVOLTAICS

The EMU Professional II is tested especially for uses in photovoltaics and its invertors. This additional testing guarantees a precise measurement in the non regulated frequenzy range between 2 kHz and 150 kHz.

The problem of inaccurate measurements in this range is known and renowned trade journals have reported of errors in measurement of up to 18%. With an EMU Professional II you will not have to worry about this problem.

OPERATION ON THE DISPLAY

A 38x28mm graphic LC-Display with background lighting allows for effortless read-out in difficult lighting conditions. The desired language can be chosen via the two touch buttons. The clear and intuitive buttons make the initial operation and the day to day work with the energy meter very easy.

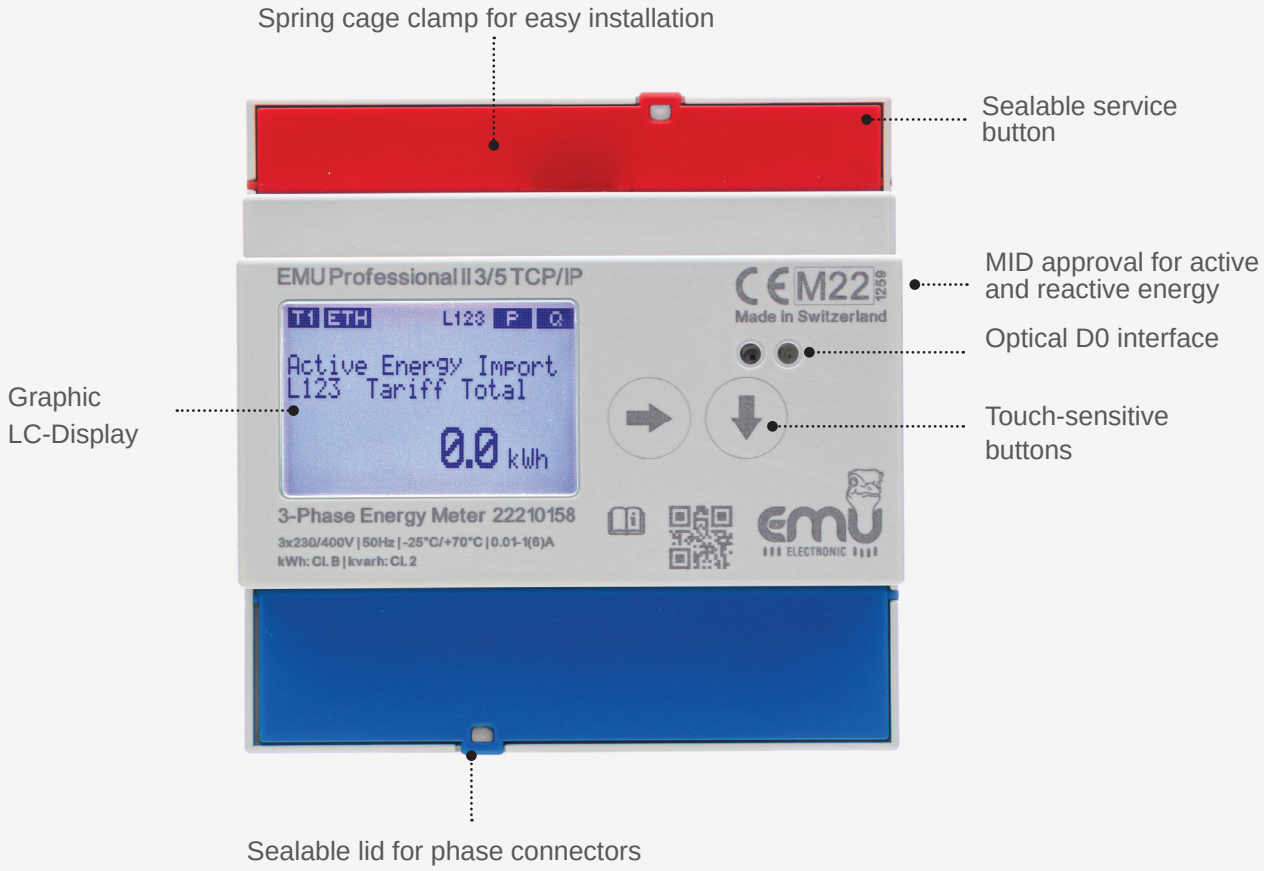
CURRENT TRANSFORMATION RATIO

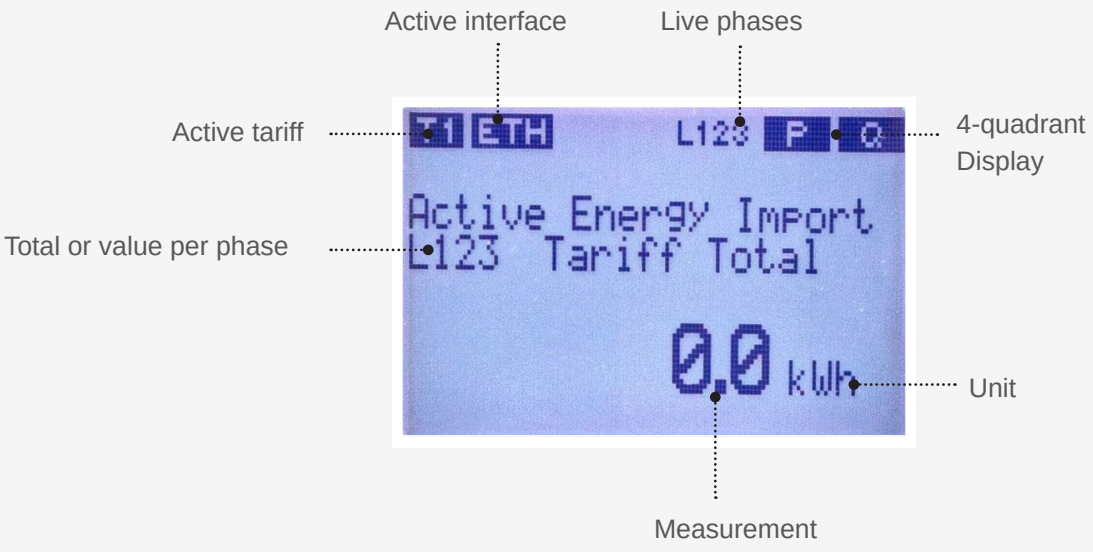
The current transformer ratio can be adjusted **several times** on the EMU Professional II with MID-Certification via the touch buttons. Adjustable settings go from 5/5 A up to 20’000/5 A or 1/1 A up to 4’000/1 A.

Critical settings ar protected agains manipulation by third parties with the sealable service button. Additionally **all critical configuration changes** are recorded and stored on the EMU Professional II.

HIGHLIGHTS

- Data storage with blockchain technology
- Integrated storage for load profiles with a depth of 3 years
- Spring cage clamp for M-Bus, Modbus, pulse output and tariff input
- MID B, PTB-A 20.1 and PTB-A 50.7 Certification
- Bidirectional meter (import and export)
- Proof of frequency-independent measuring mechanism in the range of 2 kHz to 150 kHz according to CLC / FprTR 50579: 2012
- Integrated manipulation detection


Spring cage clamp for easy installation
Sealable service button
MID approval for active and reactive energy
Optical D0 interface
Touch-sensitive buttons
Graphic LC-Display
Sealable lid for phase connectors
EMU Professional II 3/5 TCP/IP
M22
Made in Switzerland
T1 ETH
L123 P Q
Active Energy Import
L123 Tariff Total
0.0 kWh
3-Phase Energy Meter 22210158
3x230/400V | 50Hz | -25°C/+70°C | 0.01-1(6)A
kWh: Cl. B | kvarh: Cl. 2
ELECTRONIC



	Total / Sum 3-phase	Per phase	Per tariff
Active Energy Import (kWh)	•	•	•
Active Energy Export (kWh)	•	•	•
Reactive Energy Import(kvarh)	•	•	•
Reactive Energy Export (kvarh)	•	•	•
Active Power (kW)	•	•	-
Reactive Power (kvar)	•	•	-
Apparent Power (kVA)	•	•	-
Current (A)	•	•	-
Voltage (V) L-N	-	•	-
Voltage (V) L-L	-	•	-
Power factor (Cos Phi)	-	•	-
Frequency (Hz)	•	-	-
Number of power failures	•	-	-
Load profile storage	-	-	•
Logbook	•	-	-

MEASUREMENT ON DISPLAY

This table is not complete. New measurements may be added or deleted.

PTB-A 20.1 AND PTB-A 50.7

Supplementary to its MID certification the LP version of the EMU Professional II is certified according to PTB-A 50.7 and therefore fulfills regulation regarding differentiation of generated energy with third party involvement.
The internal memory allows for archivation of load profiles (and other measurements) for up to 3 years in a 15 minutes interval.

THIRD-PARTY-DIFFERENTIATION

The EMU Professional II LP possesses the following necessary features for the national certificate PTB-A 50.7.

Features

- Internal, easily reviewed logbook for recording the following calibration-law relevant events and changes in configuration
  - Adjustments of date or time
  - Adjustments of the current transformer ratio
  - Adjustments of the pulse ratio and pulse duration
  - Adjustments of the voltage transformer ratio
- Load-profile memory with a depth of up to 3 years
- Buffered internal clock

The internal clock is buffered in case of power failure. Load profiles are saved every 15 minutes. The memory can be read-out via optional interfaces or the display.

The load profile can be reviewed via the following interfaces:

- TCP/IP Interface with integrated webserver, Modbus TCP and API.
- M-Bus

OPTIONAL READ-OUT INTERFACES

The EMU Professional II can be outfitted with different read-out modules. These Modules are all integrated into the EMU Professional II to prevent manipulation and keep them protected from grime and water according to an IP51 standard. These interfaces enable the red-out of many different measurements like: active and reactive energy, current, voltage, active/reactive/apparent power, power factor and net frequency.

- M-Bus
- RS 485 Modbus RTU
- TCP/IP: Web-Server, Modbus TCP, API
- LoRa

S0 PULSE OUTPUT

The EMU Professional II comes with a S0 pulse output for active or reactive energy (Opto Power MOSFET, 5–60V AC / V DC).

The pulse duration and rate can be configured via the buttons on the device. This allows for an optimal resolution of measurements. What information the output sends can be switched via the same buttons. Choose between active and reactive energy. Changes to this configuration are logged on an internal storage (LP version only).

Adjustable pulse rate and duration:

Pulse rate per kWh / kvarh:	1, 10, 100, 1’000 or 10’000
Pulse duration in millisec:	2ms, 10ms, 30ms, 40ms, 120ms

Configuration ex-factory:

S0 pulse output:	Active energy differential
Direct connector:	1’000 pulse/kWh, 40ms
Converter counter:	10 pulse/kWh, 120ms

M-BUS INTERFACE

The M-Bus interface according to EN13757-2, -3 (was EN1434-3) is directly integrated into the meter to avoid manipulation and contamination.

Read-out data and configuration

- Many measurements can be read-out over the M-Bus interface. Examples are active and reactive energy, current, voltage, power factor and frequency.
- Configuration of the primary and secondary address as well as the baud rate can be done manually via the buttons on the device. The load put on the M-Bus amounts to an average of only 1.5 mA which is one standard load.
- The read-out data may also be configured via our own **free EMU MB-Connect software**. The software allows for specific arrangements of the M-Bus protocols.

Bus-connector and type of cable

- The M-Bus line is connected to a 2-pin spring clamp for both flexible and rigid conductors.
- 2x2 M-Bus Pins for easy serial connectivity
- Generally the cabling should be as short as possible and situated away from any power conducting cables.
- Our recommendation: Telephone cable, twisted pair, shielded, Type: JY(St)Y 2x0.5 up to 1.5 mm^2

Data transfer rate

The communication via M-Bus takes place at 300, 600, 1’200, 2’400, 4’800 and 9’600 Baud on the EMU Professional II.

Configuration ex-factory:

M-Bus primary address:	000
M-Bus secondary address:	Corresponds to the serial number, e.g 22350632
Baud rate:	2400

LORA COMMUNICATION INTERFACE

LoRa radio technology allows for communication between energy meters, sensors and actuators on free radiofrequencies. Developed especially for Internet of Things applications, LoRa is construed for long range communication while meeting current security demands.

The EMU Professional II posesses an optional integrated LoRa communication interface. The device is conceived as Class-C and therefore always ready to receive LoRa commands. Measurements can be configured and can be adjusted to the local situation flexibly.

Operation of LoRa networks:

The EMU Professional can be:

- incorporated into existing LoRa networks (LORIOT, The Things Network)
- incorporated into privately operated LoRa networks

This allows for a cheap operation of private LoRa networks.

Features:

- Internal antenna, optimized for frequency band 863-870 MHz
- Version with optional SMA-connector for an external antenna
- Both antenna have an attenuation of 14dBm
- Class C Device, can also operate as a Class A Device
- Automatic clock synchronization through LoRa network
- Supports both OTAA and ABP for joining a network
- Interval and content of uplink messages can be configured flexibly
- De- and encoders are already deposited on The Things Network
- For integration into other systems, de- and encoders are freely available
- LoRa status display on the LCD.

TCP/ IP INTERFACE

The TCP/IP interface is directly integrated into the meter to avoid manipulation and contamination. This interface lends itself for third-party-differentiation of energy export.

Overview of Functions

- Display up-to-date measurements
- Access protection through password
- Remote read-out via Modbus TCP
- HTTP-GET API
- Real Time Clock synchronization via NTP Time server
- Export of saved data

Modbus TCP

Modbus TCP is closely related to Modbus RTU with the difference in the use of TCP/IP packages for transmission. The TCP-Port for Modbus may be adjusted individually.

Storage

Integrated load profile storage with a memory depth of over 3 years for 15 minutes intervals.

The following measurements can be logged:

- Active Energy Import
- Active Energy Export
- Active Power per phase L1 / L2 / L3
- Current per phase L1 / L2 / L3
- Voltage per phase L1 / L2 / L3
- Power factor per phase L1 / L2 / L3
- Frequency

Default Settings Ex-Factory

Network configuration via DHCP

Bus-Anschluss und Kabeltyp

RJ45 Twisted-Pair with 100Mbit full-duplex

MODBUS RTU RS485

The ModBus RTU and ASCII interface is directly integrated into the meter to avoid manipulation and contamination. ModBus RTU (Remote Terminal Unit) sends data in binary format.

Read-out Data and Configuration

Read-out various measurements like Active and Reactive Energy, Current and Voltage incl. Min/Max Values, Power Factor and Frequency.

Data Transfer Rate

On Modbus the EMU Professional communicates at 9’600, 19’200, 38’400, 57’600 and 115’200 Baud.

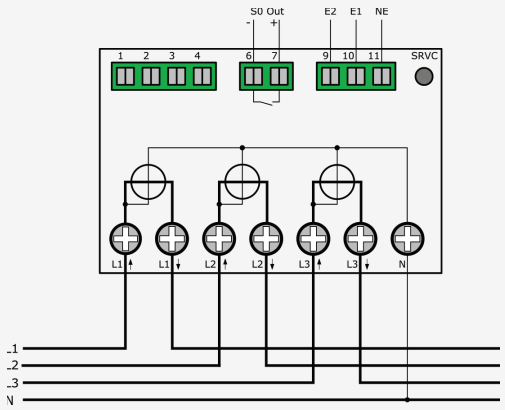
ORDER INFORMATION

Version	Type	Part.No.
EMU Professional II 3/100	Direct	P20A0000
EMU Professional II 3/100 M-Bus	Direct	P20A000M
EMU Professional II 3/100 TCP/IP	Direct	P20A000T
EMU Professional II 3/100 Modbus	Direct	P20A000MO
EMU Professional II 3/100 LoRa	Direct	P20A000LO
EMU Professional II 3/100 LoRa external antenna (SMA-Connector)	Direct	P20A000LE
EMU Professional II 3/5	Indirect, CT /5 and /1A	P21A0000
EMU Professional II 3/5 M-Bus	Indirect, CT /5 and /1A	P21A000M
EMU Professional II 3/5 TCP/IP	Indirect, CT /5 and /1A	P21A000T
EMU Professional II 3/5 Modbus	Indirect, CT /5 and /1A	P21A000MO
EMU Professional II 3/5 LoRa	Indirect, CT /5 and /1A	P21A000LO
EMU Professional II 3/5 LoRa external antenna (SMA-Connector)	Indirect, CT /5 and /1A	P21A000LE

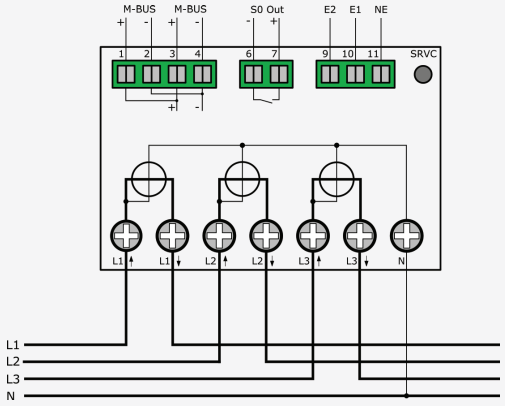
ORDER INFORMATION PTB-A 50.7 APPROVED

PTB-A 50.7 Certification	Type	Part.No.
EMU Professional II 3/100 M-Bus LP	Direct	P20A030M
EMU Professional II 3/100 TCP/IP LP	Direct	P20A030T
EMU Professional II 3/5 M-Bus LP	Indirect, CT /5 and /1A	P21A030M
EMU Professional II 3/5 TCP/IP LP	Indirect, CT /5 and /1A	P21A030T

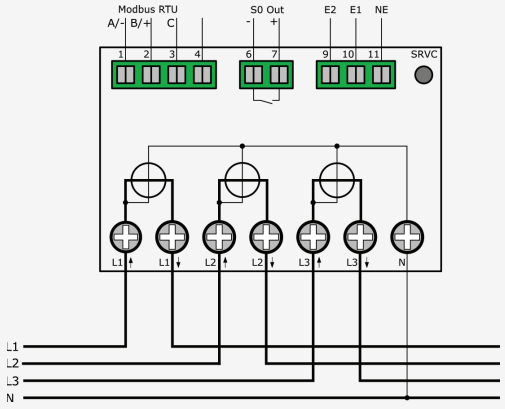
Professional II 3/100



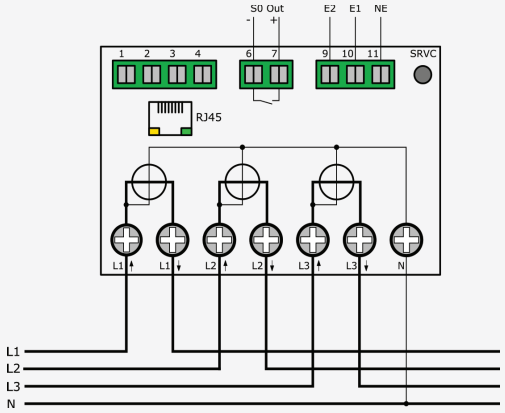
Professional 3/100
M-Bus



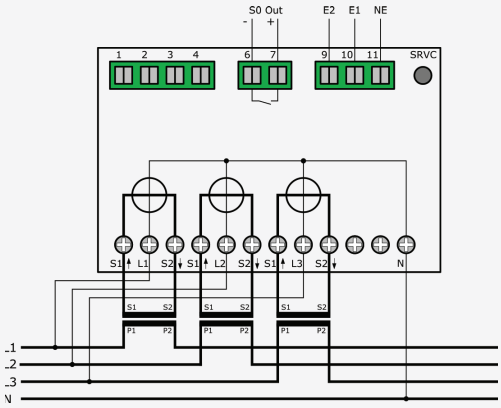
Professional II 3/100
Modbus RTU



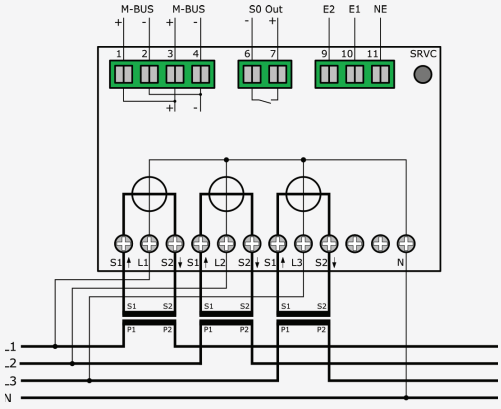
Professional II 3/100 TCP/IP



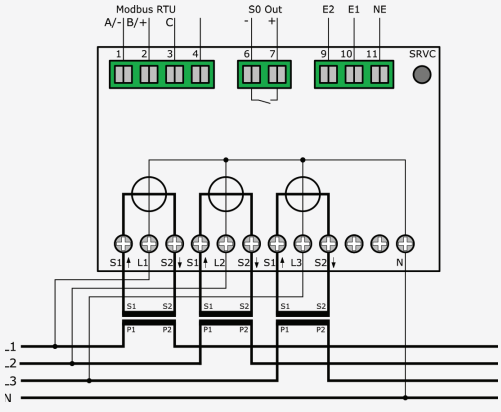
Professional II 3/5



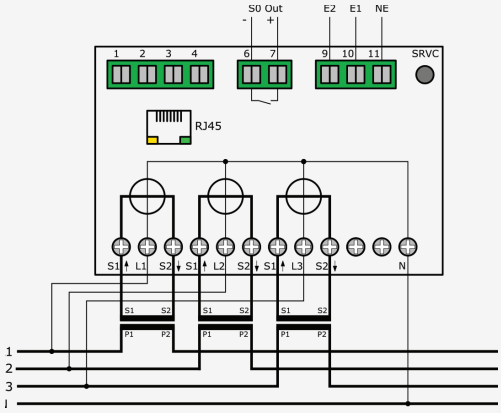
Professional II 3/5 M-Bus



Professional II 3/5 Modbus RTU



Professional II 3/5 TCP/IP



PRODUKT INFORMATION

Active Energy	Class B (1%) according to EN50470-3 Direct meter Class B (1%) according to EN50470-3 Converter counter
Reactive Energy	Class 2 (2%) according to EN62053
Supply Voltage	L-L: 400VAC +/- 20% L-N: 230VAC +/- 20%
Max Current	Direct meter: 100A Converter counter: 6A
Initial Current	Direct meter 20mA at power factor 1 Converter counter 1mA at power factor 1
Frequency	Nominal frequency: 50Hz, 60Hz on request Critical frequency: 40 - 65 Hz
Internal Consumption	Voltage route 0.8 VA / 0.8W per phase Current route of Converter counter 0.075 VA per phase
Current and Voltage connector	Direct meter: 1.5-35 mm^2, Torque: 2 Nm, max. 3 Nm Converter counter: 1-6 mm^2, Torque: 0.8 Nm, max. 1 Nm
Tariff Change	2 or 4 tariff configurable on the Professional II, Tariffchange: 230VAC
Current transformer ratio	The current transformer ratio can be adjusted multiple times on the converter counter EMU Professional II 3/5 Current transformer /5 A 5/5 A up to 20’000/5 A in 5 A-steps Current transformer /1 A 1/1 A up to 4’000/1 A in 1 A-steps
Display	Dynamic 8-digit display with up to three decimal places Graphical LC-Display mit background lighting (LxW) 38x28 mm
S0 Pulse Output	Norm EN62053-31 Output is potential free Pulse rate per kWh/kvarh: 1, 10, 100, 1’000 or 10’000 pulses Puls duration: 2ms, 10ms, 30ms, 40ms or 120ms Pulse rate and duration adjustable on the meter
M-Bus	Norm EN13757-2, -3 Current consumption 1.5 mA (one standard load) Connector diameter 1.5 mm^2 Secondary address 8-digit 00000000-99999999 Primary address 0 to 250 Baud rate: 300, 600, 1’200, 2’400, 4’800 and 9’600 Baud Configuration via buttons or the EMU MB-Connect Software Read-out data configurable via EMU MB-Connect Software
Modbus RTU RS485	Connector diameter 1.5 mm^2 Configuration via buttons Baud rate 9600, 19200, 38400, 57600, 115200 1/8 standard load

PRODUKT INFORMATION

Optional Interfaces	M-Bus TCP/IP: Web-server, Modbus TCP, API Modbus RTU LoRa (optional SMA-Connector for external antenna)
Optical (IR) D0-Interface	EN 62056-21
Security of Data	Dead-voltage in the EEPROM, Miniumum 10 years Optional: IOTA Tangle (Blockchain technology)
Clock	Buffered Clock (up to 18 days) Time synchronization via interface possible
Installation	Not dependent on location and position On 35mm DIN-rails or with front installation frame Weight ca. 350g
Housing	Housing material Polycarbonat, halogen free, recyclable Connectors safety class IP20, Housing safety class IP 51 Protection class II Physical dimensions (LxWxD) 90x91x72mm 5 module width
Certificates	CE and MID B + D PTB-A 20.1 PTB-A 50.7 Suitable for energy management according to ISO 50001
Environnemental Conditions	Mechanical: M2 Electromagnetic: E2 Temperature operation: -25 °C to + 70 °C Temperatur storage: -40 °C to + 70 °C Relative humidity: yearly avg. 75%, short term 90%, noncondensing
Safety Instructions	The meters may only be installed by electrically skilled personal. Current transformers must not be operated in open loop due to high voltages. These Voltages may lead to damage to persons or property.
Choice of device	To ensure most efficient installation and service of the EMU Professional II meter we recommend using indirect metering such as EMU Professional II 3/5 in conjunction with current transformers for installations where a quick and inexpensive shut down of the installation is not possible.

Disclaimer

This Brochure contains, when indicated, statements of future possibilities that are based on current assumptions and assessments of the EMU Electronic AG. Such statements are clearly marked with appropriate wording. These statements must not be taken as guarantee for these assumptions to be correct. The future development as well as the actual achievements of EMU Electronic AG and her linked companies depends on a series of risks and uncertainties and can therefore deviate from stated possibilities. Various of these factors are not within control of the company and can therefore not be predicted accurately. Such factors include, but are not limited to, the future economic setting or the behavior of competitors, other market participants and legislators. An update of these statements is not planned, nor does this company take any liability on this.

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