

The worlds first energy meter  
with blockchain technology



# ENERGY METER

## EMU PROFESSIONAL II

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Load profile PTB-A 50.7

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MID B + D Approval

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TCP/IP API

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LoRa

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M-Bus

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Modbus RTU + Modbus TCP

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## 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 productionline 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<sup>1</sup> 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 OPC UA 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 over several 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. In order to store and retrieve the measured values for years, EMU operates its own IOTA Permanode.

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".

<sup>1</sup> 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.

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

## EMU PROFESSIONAL II

The EMU Professional II is a multifunctional bi-directional energy meter with exceptional flexibility and accuracy. All this fits in an only 90 mm (5module) wide device. Different parameters from sophisticated applications like residential, industrial and trade environments 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 a multimeter, a power and energy meter as well as a datalogger.

### FEATURES

- Modern Blockchain technology
- Bi-directional meter (export and consumption)
- Load profile storage
- MID B + D certified for billing purposes
- PTB-A 20.1 and PTB-A 50.7 certified
- Internal storage for a 15 min interval measurement for up to 3 years
- Environmental conditions mechanical: M2
- 1A and 5A current transformer connections for up to 20'000/5 or 4'000/1 A. The CT ratio can be adjusted multiple times on site
- Voltage transformer ratio is adjustable
- Direct connector for up to 100A
- 2 or 4 tariffs (Can be set on the meter itself)
- Highly robust Opto Power MOSFET S0 pulse output, 5–60V AC and V DC
- Graphic LC-Display (38x28 mm)
- 8-digits display with one decimal 1234567,8 kWh



### CUSTOMER BENEFIT

- Load profile conform to calibration law
- Buffered Clock capable of synchronization
- Safe against manipulations of energy data due to blockchain technology
- 15 minutes load profile storage with a storage depth of more than 3 years
- Internal logging of 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 Commission). Therefore it possesses the necessary declaration of conformity. The additional certification according to module D, QM-System for manufacturing and final testing, allows all EMU Professional II ex-factory to be used for billing purposes within the European Union and the European Economic Area (EEA).

EMU Electronic AG is certified according to ISO9001 and allows for conduction of annual external audits.

## OPERATION ON THE DISPLAY

A 38x28mm graphic LC-Display allows for effortless read-out of parameters and settings. The well-arranged and intuitive operation makes the adjustment of settings like Language, CT-ratio or date and time very easy and helps in the day to day work with the energy meter.

## SPECIAL ACCURACY FOR USES IN PHOTOVOLTAICS

The EMU Professional II is tested especially for uses in photovoltaics and its inverters. This additional testing guarantees a precise measurement in the non regulated frequency 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.

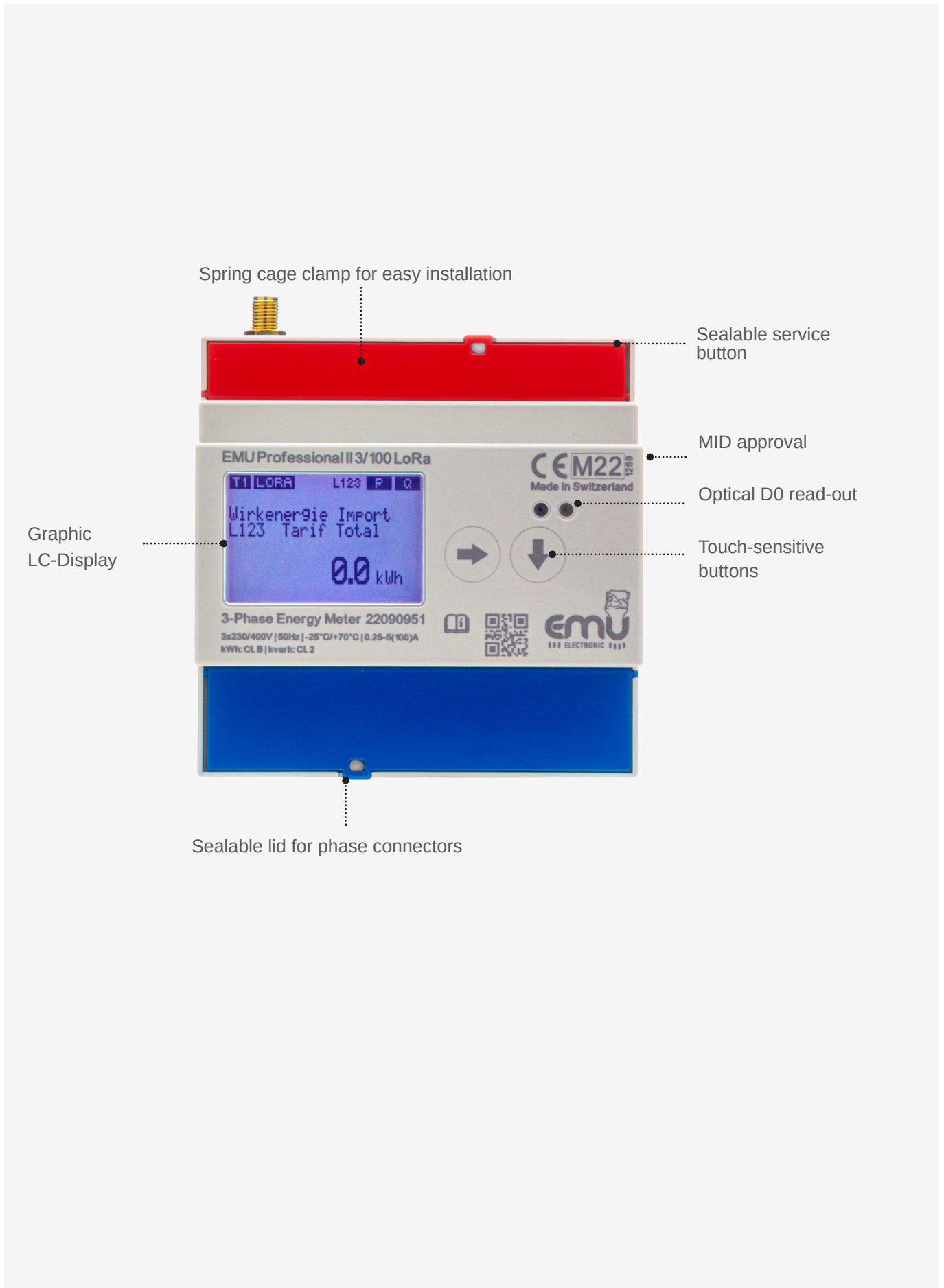
## CURRENT AND VOLTAGE TRANSFORMATION RATIO

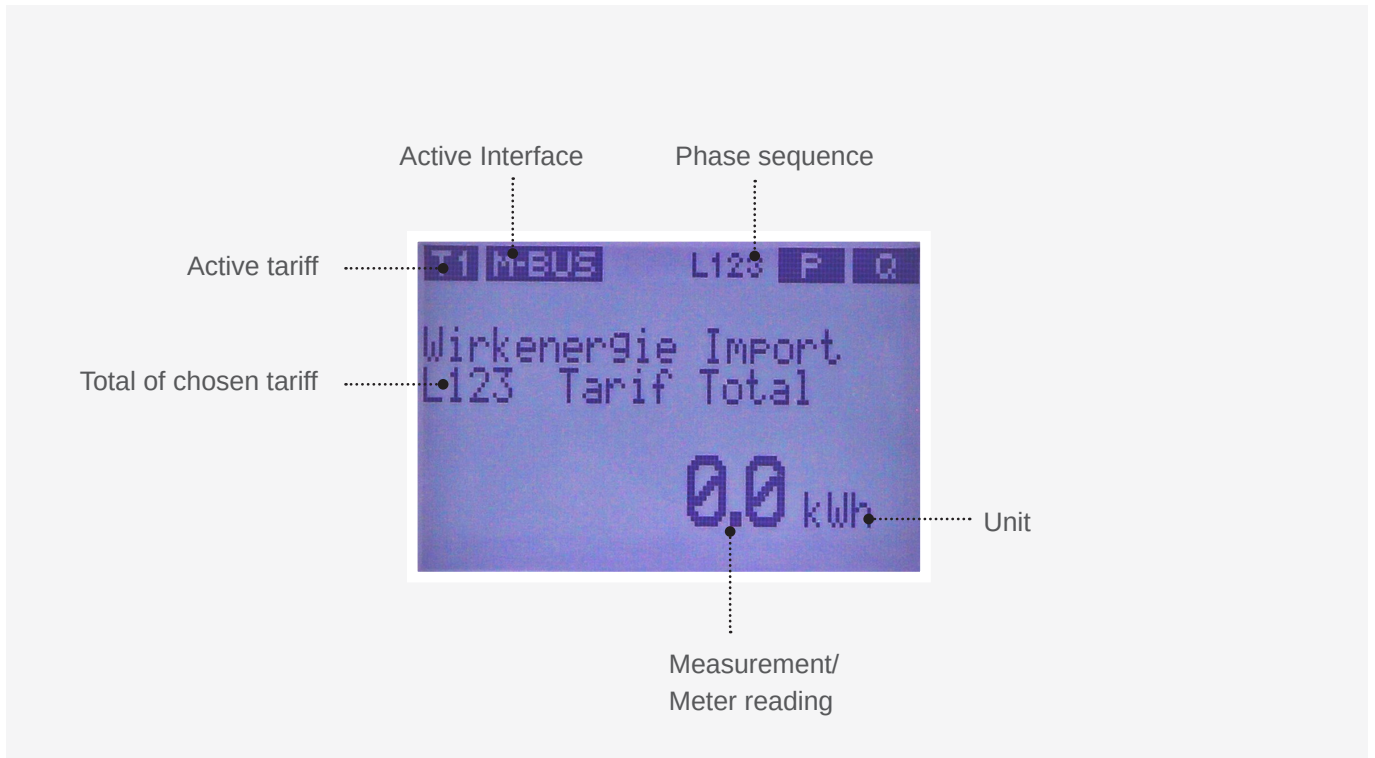
The current transformer ratio can be adjusted **several times** on the EMU Professional II with MID-Certification via the touch buttons. Adjustable settings go from 5/5A up to 20'000/5 A or 1/1A up to 4'000/1 A.

The service button is sealable and critical settings therefore cannot be manipulated. Additionally **all changes** to the transformer ratio 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 and pulse output
- MID B, PTB-A 20.1 and PTB-A 50.7 approval
- Bidirectional meter (export and consumption)
- Proof of frequency-independent measuring mechanism in the range of 2 kHz to 150 kHz according to CLC / FprTR 50579: 2012
- Integrated manipulation detection





	Total / Sum 3-phase	Per phase	Per tariff
Active Energy Consumption (kWh)	•	•	•
Active Energy Export (kWh)	•	•	•
Reactive Energy Consumption (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	-	-	•
Settings	•	-	-

## MEASUREMENT ON DISPLAY

This table is not complete. Until wide market release new measurements can be added or deleted.



## PTB-A 20.1 AND PTB-A 50.7 CERTIFIED

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 cut off of generated energy against third party intervention.

The internal storage can hold over 110'000 load profiles. For a load profile save interval of 15 minutes this means that even 3 year old load profiles are still stored on the Professional II.

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## THIRD-PARTY-DIFFERENTIATION

Starting on January 1st 2022 corporations located in Germany that export energy are obligated to record their self-produced and self-consumed energy according to paragraph 62b of the Erneuerbare-Energien-Gesetz (EEG). This recording must happen every 15 minutes on a officially calibrated measurement system.

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 to the current transformer ratio
- A real-time clock with synchronization via a NTP time server. In case of a power outage a super capacitor sustains this clock for numerous days.
- The load profile is saved every 15 minutes. The stored data can be easily reviewed on the Professional II and possesses a storage depth of over 3 years.

### The load profile can be reviewed via the following interfaces:

- TCP/IP Interface with integrated webserver, Modbus TCP and API.
- M-Bus
- RS485 Modbus RTU



## 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 read-out of many different measurements like: active and reactive energy and power, current, voltage, apparent power, power factor, net frequency and more.

The following interfaces are already available or in development (d):

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

## S0 PULSE OUTPUT

The EMU Professional II possesses a S0 pulse output (Opto Power MOSFET, 5–60V AC / V DC).

The pulse length 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.

### Adjustable pulse rate and length:

Pulse rate per kWh / kvarh:	1, 10, 100, 1'000 oder 10'000
Pulse length in millisecc:	Adjustable: 2ms, 10ms, 30ms, 40ms, 120ms

### Configuration ex-factory:

S0 pulse output:	Active energy consumption
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 and voltage.
- Configuration of the M-Bus can be done manually via the buttons on the device
- Or via our own EMU MB-Connect software. This software allows for specific arrangements of the M-Bus protocols. With these available systems one can adjust the primary and secondary addresses as well as the Baud rate. The strain put on the EMU Professional II by the M-Bus amounts to an average of only 1.5 mA.

### Bus-connector and type of cable

- The M-Bus line is connected to a 2-pin spring clamp for both flexible and rigid conductors. This cable must be chosen for each Project individually depending on the project's requirements.
- 2x2 M-Bus Pins for easy serial connectivity
- Generally the cabling should be as short as possible and situates a short distance away from the power network.
- Our recommendation: Telephone cable, twisted pair, shielded, Type: JY(St)Y 2x0.5 up to 1.5 mm<sup>2</sup>

### 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 21081234
Baud rate:	2400

## LORA COMMUNICATION INTERFACE

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

## 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
- Logging of various measurements
- Access protection through password
- Remote read-out via Modbus TCP
- HTTP-GET API
- 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. TCP-Port 502 is reserved for Modbus TCP.

### 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 Consumption
- Active Energy Export
- Active Power per phase L1 / L2 / L3
- Current per phase L1 / L2 / L3
- Voltage per phase L1 / L2 L3

### Default Settings Ex-Factory

Network configuration: DHCP

### Bus-Anschluss und Kabeltyp

RJ45 Twisted-Pair

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## 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.

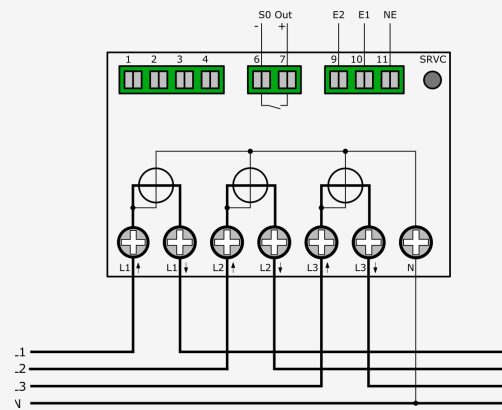
## ORDER INFORMATION

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 ext. Ant	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 ext. Ant.	Indirect, CT /5 and /1A	P21A000LE

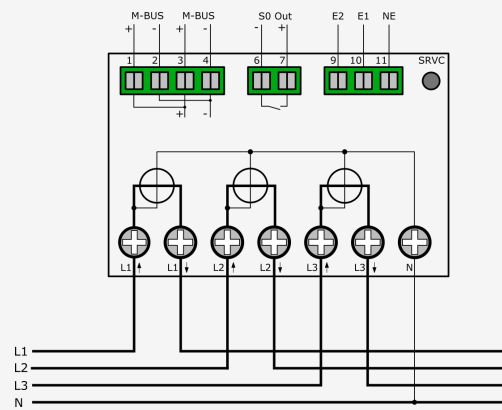
ORDER INFORMATION PTB-A 50.7 APPROVED

Type incl. PTB-A 50.7 approval		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 3/100 Modbus LP	Direct	P20A030MO
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
EMU Professional II 3/5 Modbus LP	Indirect, CT /5 and /1A	P21A030MO

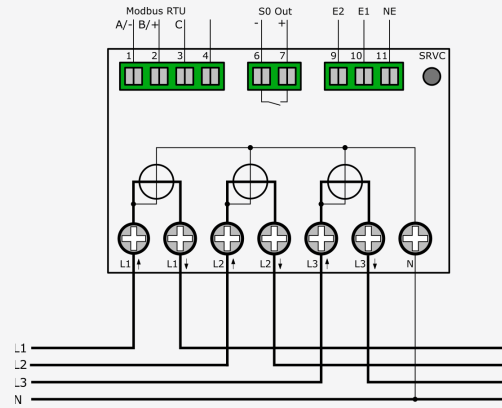
## Professional II 3/100



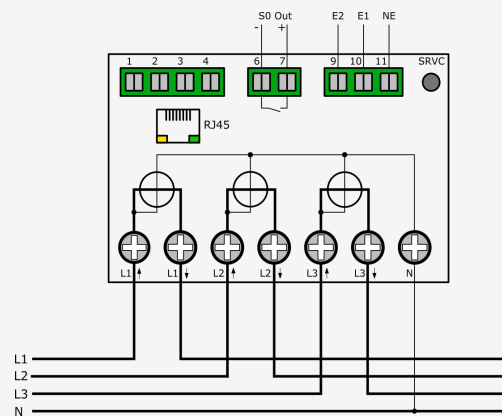
## Professional 3/100 M-Bus



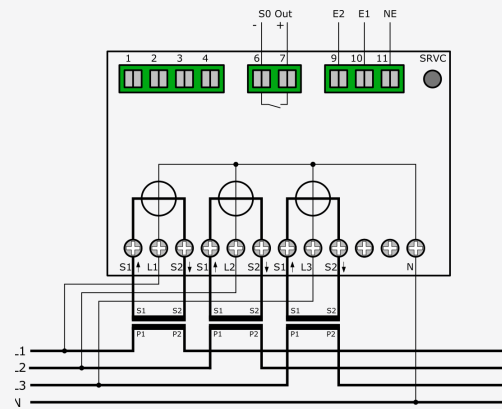
## Professional II 3/100 Modbus RTU



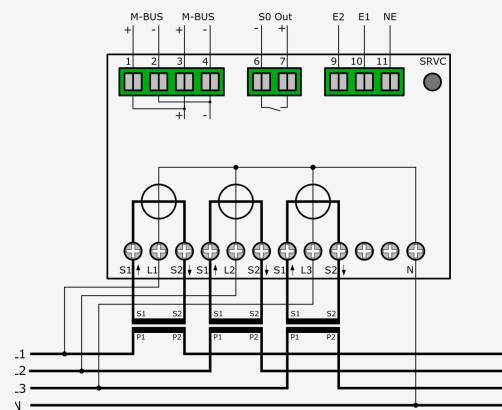
## Professional II 3/100 TCP/IP



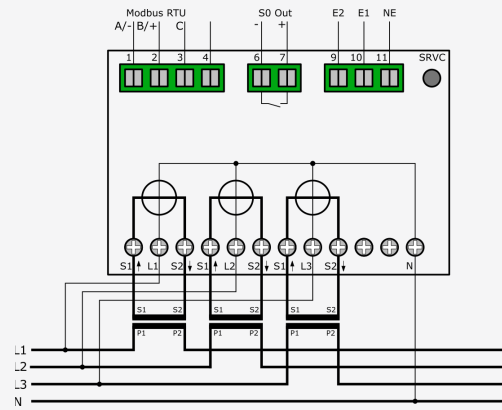
Professional II 3/5



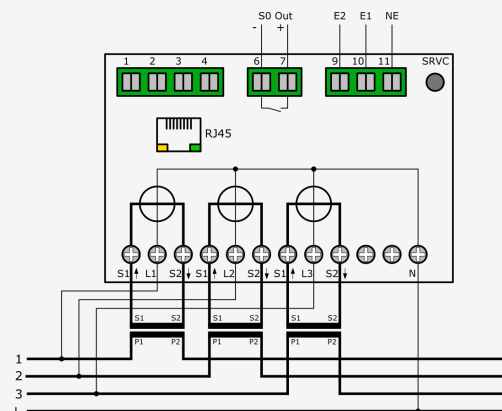
Professional II 3/5 M-Bus



Professional II 3/5 Modbus RTU



Professional II 3/5 TCP/IP



## PRODUKT INFORMATION

Active Energy	Class B (1%) according to EN50470-3 Direct connection meter Class B (1%) according to EN50470-3 Indirect meter
Reactive Energy	Class 2 (2%) according to EN62053
Supply Voltage	L-L: 400VAC +/- 20% L-N: 230VAC +/- 20%
Max Current	Direct connection meter: 100A Indirect (Current transformer) meter: 5A
Initial Current	Direct connection meter <9 mA at cosphi 1 Converter counter <1 mA at cosphi 1
Frequency	Nominal frequency: 50Hz, 60Hz on demand Critical frequency: 40 - 65 Hz
Internal Consumption	Voltage route 0.8 VA / 0.8W per phase Current route of Converter counter 0.03 VA per phase
Current and Voltage connectors	Direct connection meter: 1.5-25 mm <sup>2</sup> , Torque: 2 Nm, max. 3 Nm Converter counter: 1-16 mm <sup>2</sup> , Torque: 1 Nm, max. 3 Nm
Tariff Change	2 or 4 tariff configurable on the Professional II, Tariffchange: 230VAC
Repeated adjustments of current transformer	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 These changes are recorded on the internal logbook.
Voltage Transformer	On the transformer-connected meter EMU Professional II 3/5 the voltage transformation can be configured multiple times. These changes are recorded on the internal logbook.
Display	LC-Display 8-digit with one decimal place 1234567,8 kWh Graphical LCD (LxW) 38x28 mm
S0 Pulse Output	Norm EN62053-31 Output is potential free Pulse rate per kWh or kvarh: 1, 10, 100, 1'000, 10'000 pulses Puls length: Adjustable 2ms, 10ms, 30ms, 40ms, 120ms Puls rate- and length adjustable on the meter
M-Bus	Norm EN13757-2, -3 Current consumption 1.5 mA, one standard load Connector diameter 0.5–2.5 mm <sup>2</sup> 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 0.5–2.5 mm <sup>2</sup> Configuration via buttons



## PRODUKT INFORMATION

Optional Data Interfaces	M-Bus TCP/IP: Web-server, Modbus TCP, API Modbus RTU LoRa
Optical (IR) D0-Interface	EN 62056-21
Security of Data	Dead-voltage on the Up Flash or Eeprom, Minimum 10 years Optional: IOTA Tangle (Blockchain technology)
Clock	Integrated clock with options to synchronize via NTP, Modbus, M-Bus, LoRa (according to the interface)
Installation	Not dependent on location and position On 35mm DIN-rails or with front installation frame Weight ca. 400g
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
Environmental Conditions	Mechanical: M2 Electromechanical: 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.

**Disclaimer**

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EMU Metering GmbH  
Friemar Str. 38  
99867 Gotha  
Germany

Tel.: +49 (0)3621 510 40 70  
Mail: [hello@emu-metering.de](mailto:hello@emu-metering.de)  
Web: [www.emu-metering.de](http://www.emu-metering.de)

EMU Electronic AG  
Jöchlerweg 2  
6340 Baar  
Switzerland

Tel.: +41 (0)41 545 03 00  
Mail: [info@emuag.ch](mailto:info@emuag.ch)  
Web: [www.emuag.ch](http://www.emuag.ch)