EM211 type 900 - User Guide

v.1.4

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Preface

This User Guide is applicable for the basic single phase meter EM211 for use in 1 phase 2 wire networks. It contains all the relevant information for the operational use of the meters, in particular:

- Information about the design, function and main characteristics
- Advice on possible safety issues, consequences and ways of avoiding danger
- Explanations of all activities during the whole life of the meter, such as parameterization, installation, set up, operation, calibration, maintenance and finally putting the meter out of operation and disposal

The User Guide is aimed at technically qualified personnel of utility companies, dealing with the installation and set-up of electricity meters and also being responsible for putting the meters out of operation and disposal.

Technical staff working with this User Guide should have been trained in the field of electricity and should in particular be familiar with the specific circuits for energy measurement.

In general the single phase EM211 meters are easy to operate from installation through to operation. The following chapters will guide the user, step by step, through all the phases during the life of the meter.

The effective date of this user guide is 16/September/2013. Functions described refer to firmware version 1.12 checksum: #708A8487.

Table of Contents

1 Safety information

Meters must be installed only by suitably qualified personnel. Observe the following safety advice when installing meters.

- Adhere strictly to all relevant national regulations for the avoidance of electrical accidents
- Before installing or removing a meter, or removing the terminal cover for any reason, isolate the meter from the mains supply by removing the supply-side fuses or using alternative local arrangements. Take appropriate measures to ensure that the isolation cannot be overridden by another person. For example, keep physical possession of the supply fuses
- Clean meters only with a damp cloth or sponge. Do not use excessive or running water
- Install meters in accordance with the wire and environmental specifications given in the installation information.
- Use only tools that have been approved for electrical installations
- Do not install meters that are obviously damaged
- Do not install meters that have been dropped or otherwise subjected to significant impact even if no damage can be seen
- Following installation, ensure that the meter terminal covers are correctly fitted and sealed to prevent user access

2 Description

The EM211 - **I**tron **E**lectricity **M**eters are electronic metering devices incorporating state-of-the-art digital technology. They have been designed for accurate measurement of active and reactive energy specifically for residential and light commercial and industrial applications in a tamper proof design.

The meter is very simple to install, and uses extremely well-established and reliable technologies to ensure a long and maintenance-free certification life. It also has a range of both physical and electronic security measures to combat tampering and fraud.

The EM 211 meters have the following features:

- Full immunity against external magnetic field.
- Sealed for life meter case design.
- Large LCD display.
- Non-volatile meter memory.
- Optional terminal cover and meter cover opening detection.
- Maintenance free product.
- Communication through the optical port.
- Customer information through pulse output or databus output port.
- Multi rate operation
- Optional logbook
- Load profile
- Optional RS232 or RS485 communication
- Historical registers
- Relay upon request

2.1.1 Type convention

The members of the EM 211 meter family target different market needs therefore the following versions are available:

Product family	Type	Connection	Description
EM 211 type	710	Asymmetrical	Single rate version
	712	Symmetrical	
	720	Asymmetrical	Double rate version with external tariff control
	722	Symmetrical	
	900	Asymmetrical	Multi rate version, where the tariff switching is carried out based on the internal clock.
	902	Symmetrical	

This user guide introduces the EM211 type 900/902 meter.

3 Relevant standards, directives

IEC 62052-11 Electricity metering equipment (AC) - General requirements, tests and test conditions, part 11: Metering equipment (equivalent to EN 62052-11)

IEC 62052-21 Electricity metering equipment (AC) - General requirements, test and test conditions - part 21: Tariff and load control equipment

IEC 62053-21 Electricity metering equipment (AC) - Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)

IEC 62053-23 Electricity metering equipment (AC) - Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3)

MID 2004/22/EC - Measurement Instrument Directive

EN 50470-1 Electricity metering equipment (AC),part 1: General requirements Test & Test conditions, metering equipment class indexes A, B, C.

EN 50470-3 Electricity metering equipment (AC),part 3: Particular requirements static meters for active energy class indexes A, B, C.

IEC 62053-31 Electricity metering equipment (AC) - Particular requirements, part 31: Pulse output devices for electro-mechanical and electronic meters (equivalent to EN 62053-31)

IEC 62056-21 Electricity Metering – Data exchange for meter reading, tariff and load control - Direct local data exchange (replacing IEC61107)

IEC 62054-21 Electricity metering – Tariff and load control – Part 21: Particular requirements for time switches

EMC Directive 2004/108/EC as amended by 92/31/EEC, 93/68/EEC and 91/263/EEC. Compliance has been demonstrated by compliance with EN62052- 11, EN62053- 21, EN50470-1 and EN50470-3

CLC/TR50579: Electricity metering equipment – Severity levels, immunity requirements and test methods for conducted disturbances in the frequency range 2 – 150kHz: 2012

4 Product concept

4.1 Mechanical construction

The EM 211meters are constructed to ensure the safety of end users and of utility staff, and also to minimize unauthorized access and tampering.

The meter case comprises three main components - base, cover and terminal cover - which are all injection molded. All internal components are supported by the precision moldings without additional fixings. To protect the meter from tampering, the base and cover have ultrasonic welded features which help prevent them from being separated after assembly, maintaining the sealing possibility using a conventional type wire seal. In addition, the case and terminal cover fixings can be secured with conventional wire or plastic seals.

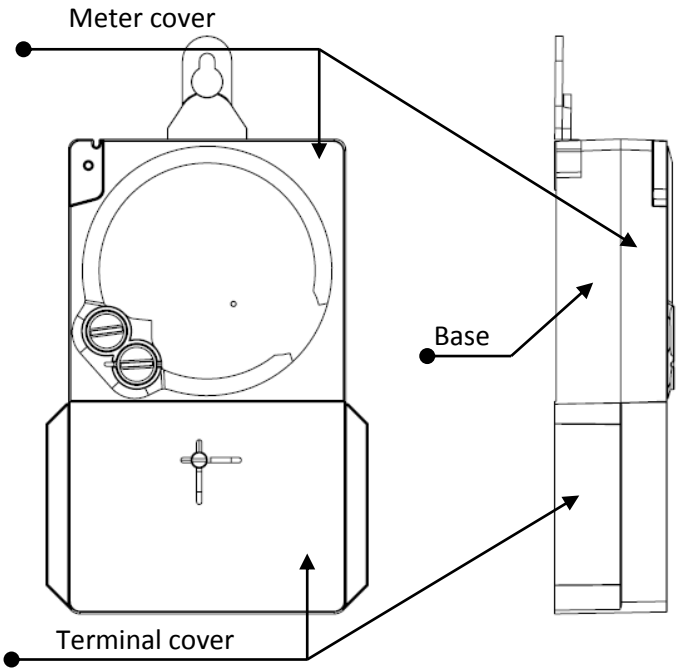


Figure 1 - The main parts of the EM214 meter

4.1.1 Base

The base is extended to the terminal block of the meter and integrates hidden upper and visible lower fixing points. It accommodates the main PCB with the power supply and the metrology circuits as well as the optional auxiliary terminals.

4.1.2 Cover

The meter cover is made of a single piece of a transparent thermoplast to provide visibility for the LCD display of the meter.

After the cover is placed on the meter base, it is secured to its position by ultrasonic welding.

The cover comprises the provision for the two push buttons, for the optical port, for the auxiliary terminals and for the voltage links.

4.1.3 Terminal cover

The optional terminal cover satisfies the requirements of the relevant DIN standard. It also protects the auxiliary terminals. The terminal cover is fixed and secured by two screws suitable for common sealing wires. The position of the sealing wire can be horizontal or even vertical.

The meter can also accept terminal covers, which are line with the DIN standard. If the meter is equipped with the optional terminal cover opening detection, then the original terminal cover must be used.

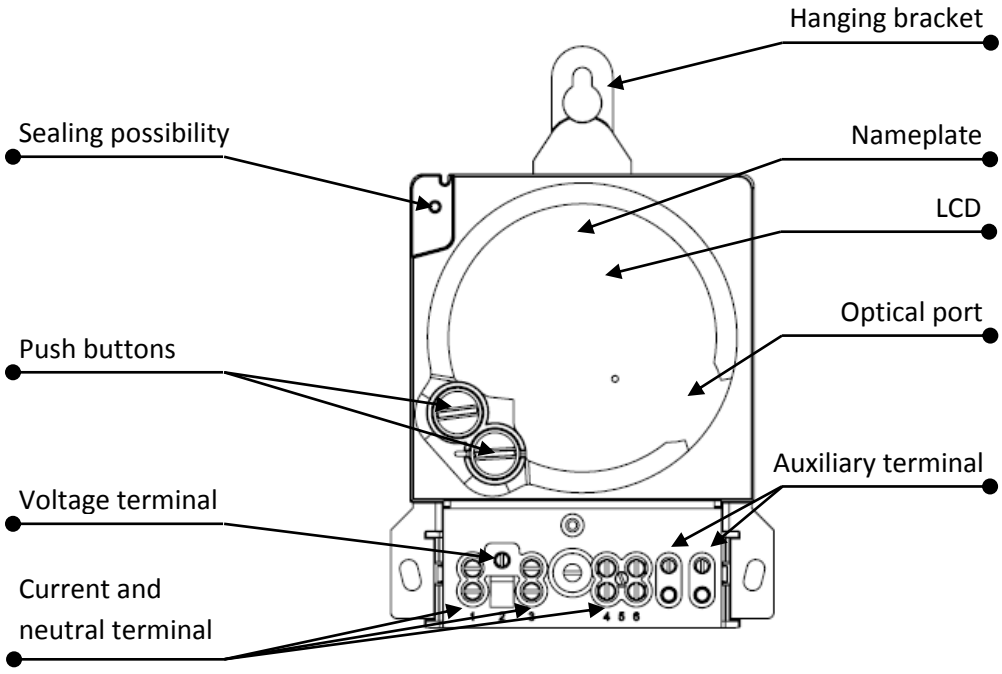


Figure 2 - Front view of the meter without terminal cover

4.1.4 Nameplate

The meter has a plastic nameplate, which shows all the relevant data and incorporates specific customer requirements, such as identification number, customer logo etc. Cut-out areas in the nameplate allow the LCD, the metrological LED, the optical interface to be seen.

The picture below shows the standard layout of the nameplate:

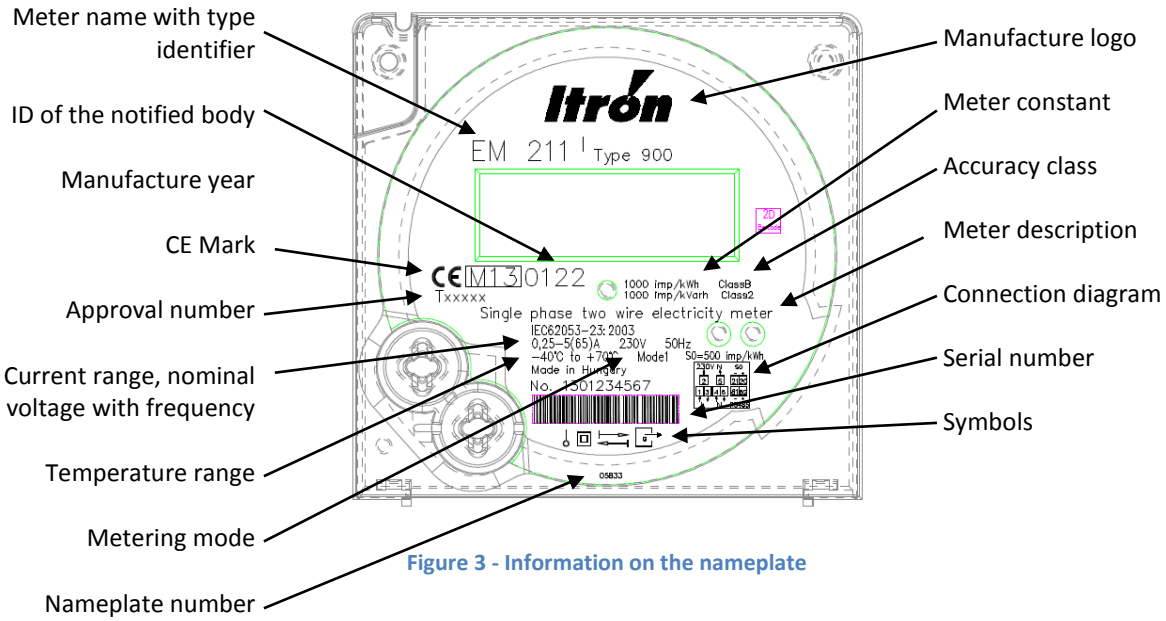


Figure 3 - Information on the nameplate

4.1.5 Current and neutral terminals

The current and neutral terminals of the meter are made off solid brass and allow connecting wires up to 9 mm diameter in case of symmetrical connection and up to 7.2mm in case of asymmetrical connection.

The standard current and neutral screws have cross-recessed (Pozidriv size n. 2 - PZ2) head. When connecting the wires the applied torque should be minimum2 Nm.

4.1.6 Auxiliary terminals

Optionally, for control and output circuits the meter provides up to 4 auxiliary terminals that are all accommodated in a terminal chamber above the neutral terminal block. The auxiliary terminals are suitable for wires with a maximum diameter of the wire of3mm.

4.1.7 Voltage links

Upon request, extra voltage output terminal can be provided located above the current terminal for powering external devices. The diameter is the same as for the auxiliary terminals.

4.1.8 Hanging bracket

Optionally a hanging bracket can be supplied with the meter; however it has a hidden, inbuilt, upper hanging point.

The hanging bracket is available upon request and it defines the position of the upper fixing point. (See installation section.).

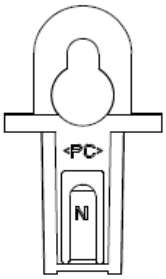


Figure 4 - Optional hanging bracket

During the meter delivery, this part can be stored in the terminal cover of the meter.

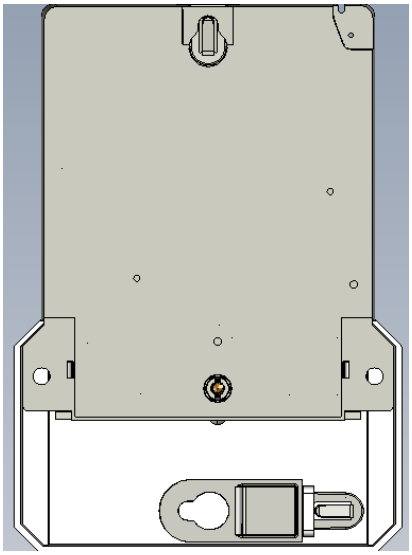


Figure 5 - Back side of the terminal cover with storage for the hanging bracket

4.2 Technical description

4.2.1 Functional block diagram of the meter

The EM 211meter is a single phase shunt based meter. This gives a very good linearity in the whole accuracy range.

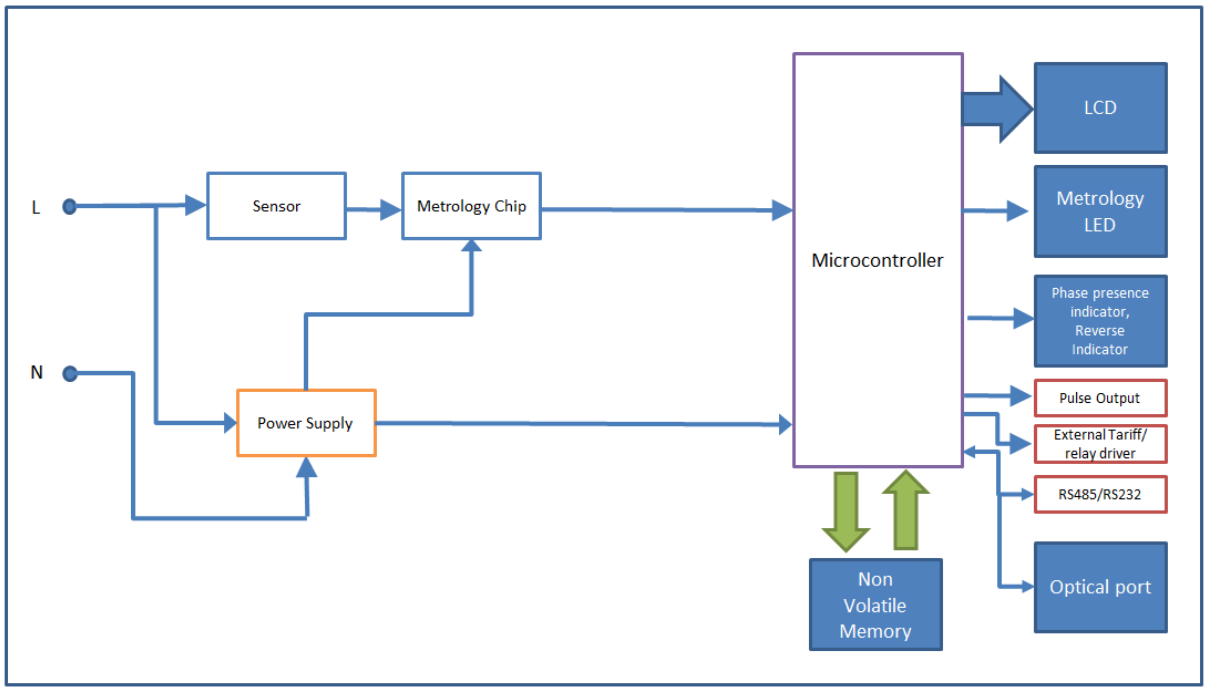


Figure 6 - Functional block diagram

4.2.2 Connections

The connections to the mains are shown on the left hand side of the block diagram. It consists of the phase connection (L) and the neutral (N) for the power supply of the meter. Optional voltage terminal can be specified for supplying auxiliary devices whose permanent load is less than 2A.

4.2.3 Inputs and Outputs

The input and output connections are shown on the right hand side of the block diagram. The LCD register is driven on a bus from the microcontroller. Visible metrological pulses proportional to energy consumption are provided via a visible red LED.A pulse output is optionally available for the transmission of energy pulses to external devices. An optional floating input can be assigned to change the active tariff by external signal.

4.2.4 Current Sensors

The current sensor is resistor (shunt). It is selected for its very good linearity on the whole metering range and immunity against external magnet field.

4.2.5 Power Supply

Capacitor dropper power supply is selected due to optimal self consumption and immunity against external perturbances.

4.2.6 Measuring System

The shunt generates a signal that is proportional to the instantaneous current whereas the line voltage is divided by capacitor divider. The system is completely self-contained and provides no facility for recalibration or access in the field.

4.2.7 Signal Processing

The microcontroller processes the digital signal of the phase and forms energy values. Then the values are weighted according to the selected energy measurement mode (which is configured in the factory) and they are transmitted to the microcontroller firmware. The microcontroller also controls the data transfer to the optional pulse outputs, visible metrological and infrared LED's, and secures meter operation in case of a voltage interruption.

4.2.8 Data Memory

The non-volatile memory (FRAM) contains the calibration and configuration data of the meter and secures the billing data against loss due to voltage interruptions. All internal calibration, configuration and energy consumption data are protected and not accessible or configurable in the field.

The data memory also stores historic information as instructed by the microcontroller.

4.2.9 Energy measurement modes

The EM211meter measures the active energy in two directions. The active energy measurement mode can be selected from the following 2 metering modes: Mode 1 –Bidirectional, Mode 3 – Unidirectional. The selection cannot be changed on the field.

The detailed description of the active energy measurement modes can be seen below:

Load	Mode 1 Bidirectional (Per phase)			Mode 3 Unidirectional		
L [kWh]	Import [kWh]	Export [kWh]	Met. LED*	Import [kWh]	Export [kWh]	Met. LED*
1	1	0	1000	1	0	1000
-1	0	1	1000	1	1	1000

Note (*): Assuming that the metrology constant is 1000 imp/kWh.

The optional pulse output will be configured to follow one of the energy registers.

Optionally the EM211 meter can be set during the factory configuration for measuring reactive energy. The reactive energy measurement mode can be: Mode 1 – Per phase. The selection cannot be changed on the field.

The detailed description of the reactive energy measurement modes can be seen below:

Load	Mode 1 Bidirectional (Per phase)		
L [kVArh]	Import [kVArh]	Export [kVArh]	Met. LED*
1	1	0	1000
-1	0	1	1000

Note (*): Assuming that the metrology constant is 1000 imp/kVArh.

The optional pulse output will be configured to follow one of the energy registers.

5 Interfaces of the meter

The EM211 meter has a wide range of different interfaces to provide an easy and effective communication. Some of the interfaces are essential (e.g. display, metrology LED) and some of them are optional (e.g. pulse output, Data Bus Output).

This section gives a detailed description about the different interfaces.

5.1 Display

The main interface of the EM211meter is the large, crystal clear, simple structured liquid crystal display (LCD).

The following picture shows the full display, with every segment turned on:

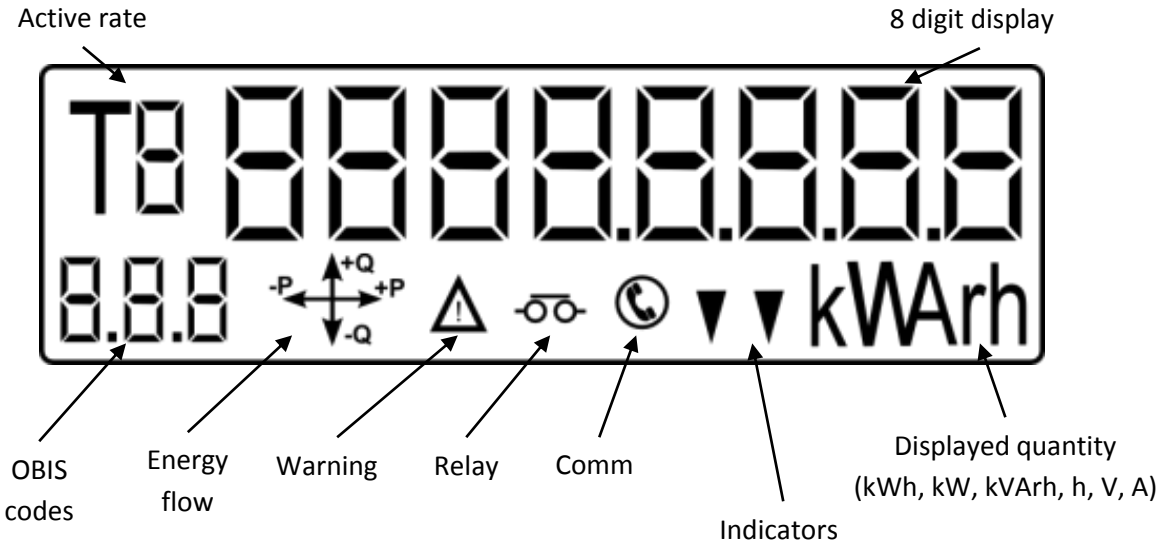
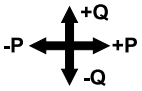


Figure 7- Display of the EM211 meter

Name	Image	Description
8 digit display	8.8.8.8.8.8.8.8	The displayed quantities can be seen on the 8 digit display in various resolutions.
OBIS code	8.8.8.8.8.8	The meter is able to display the standard OBIS code of each data on the LCD.
Displayed quantity	kWArh	This field defines the dimension of the displayed data. It can show kWh, kVArh, kW, h, V, A.
Indicators	▼ ▼	Upon the configuration, these annunciators can show, which the active rate in the meter is.
Communication		This symbol can be seen on the display, when there is ongoing communication with the meter.
Relay		If the meter is equipped with optional load control relay, then this symbol will be shown, when the relay is closed.

Name	Image	Description
Warning		Each time, when one of the bits in the error register or in the status word becomes '1' from '0', then the warning triangle gets active. It alerts the user to check the error register. (Please see the related section about the error register)
Energy flow		The energy direction is signaled based on the vectorial sum of the active and the reactive energy. That means maximum 2 arrows (one for active and one for reactive energy) can be seen at the same time.
Active rate		The meter shows the currently active rate. Depending on the configuration, it can be "T" + number of the active rate (e.g. "*T2*") or "TL"/"TH". L is for Low and H is for High.

5.1.1 Backlight

The display is equipped with backlight to provide good visibility in dark environment. The operation of the backlight is programmable and can be selected by the customer. The following operating modes are supported:

Mode	Description
Switched on	Permanently switched on, when the meter is connected to the mains.
Switched off	Permanently switched off.
Fractionally switched on	Switched on after user intervention (user pushes the button) and switched off after a predefined time period.

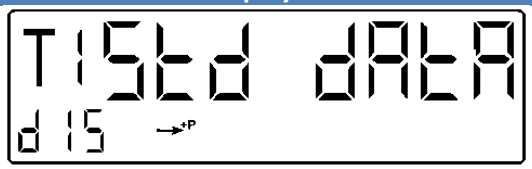
5.1.2 Display sequences

The meter supports up to 4 different, individual display sequences. The aim of the different sequences is to be able to easily separate between the different data and the correspondent registers could be found in the same section.

Each of the sequences can be configured individually. Maximum 20 items can be included in one display sequence. The resolution and the duration, how long the register is displayed on the LCD, can be set individually to each register.

Each display sequence can be identified with the following label on the LCD display, if it is required:

Name	Identified on the display	Description
"Installation data" display sequence		The aim of this sequence is to gather the data, which could be important during the installation. (e.g. Instantaneous power registers, instantaneous current registers.)

Name	Identified on the display	Description
"Standard data" display sequence		The standard consumption data could be put here. (e.g. Total import register, Rate registers)
"User data" display sequence		Registers, which are important for the user, can be put here. (e.g. Customer specific texts, Serial number of the meter)
"Read Without Power" display sequence	-	The data which can be seen when the meter is not connected to the mains can be seen here. (For more information, please see the "Read Without Power" section.)

During the normal operations, if the meter is programmed to "autoscrolling" mode, then it is scrolling through the data on the display, which is configured in the Standard data sequence. The data in the Installation data and User data display sequence is available by pushing the Button (No 1).

Once the button (No 1) is pushed, then the display is advanced and the autoscrolling function is stopped. After 5 minutes, the meter continues the normal operation.

If the "autoscrolling" mode is not enabled, then the LCD will show the first register in the Standard data display sequence after power up. The other configured registers can be seen by pushing the Button (No 1).

5.1.3 Available register resolution

Every register can be shown in its own, individual resolution. Based on the register type, the following resolutions are available:

Register type	Resolution	Number of integers	Number of decimals
Consumption registers	8+0	8	0
	7+1	7	1
	7+0	7	0
	6+2	6	2
	6+1	6	1
	6+0	6	0
	5+3	5	3
	5+2	5	2
	5+1	5	1
	5+0	5	0
Instantaneous registers	3+2	3	2
	3+1	3	1
	3+0	3	0
	2+2	2	2

Register type	Resolution	Number of integers	Number of decimals
	2+1	2	1
	2+0	2	0

5.2 Optical interface

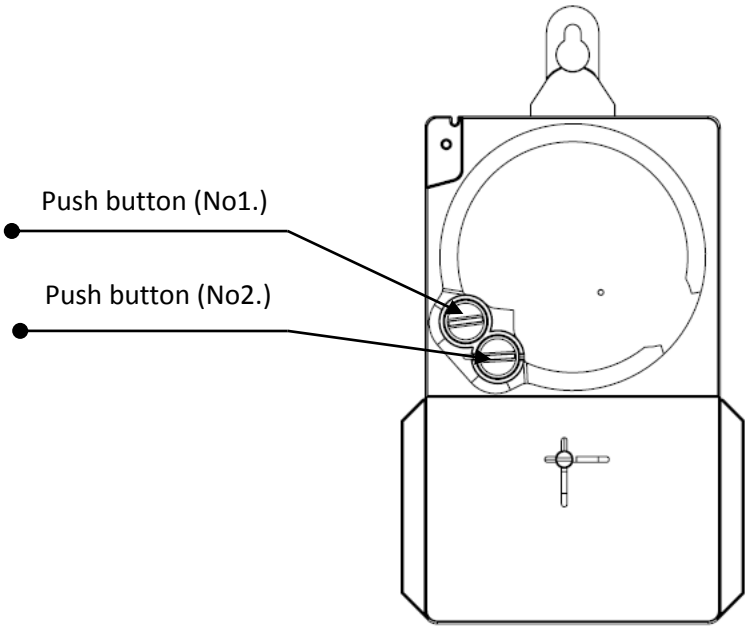
The EM 211 meter has an optical interface that complies with the requirements of IEC 62056 - 21.

The port is used for transmission of metering values from the meter to a Hand Held Unit (HHU) or personal computer running suitable software to enable communication. It is also possible to program the meter using this communications channel with knowing the meter password.

The optical port can be used by any optical probe which is in accordance with the requirements of the IEC 62065-21 standard.

5.3 Push buttons

The meter is equipped with two push buttons. The observation of the buttons is easy, because the color of them is blue to differ from the color of the nameplate.



The push button (No. 1) is primary button of the meter. It has two different statuses, one it the short push and the other is the long hold. The push function of it is to advance the display sequence each time it is pressed. The long hold is to exit from the test mode, if it is activated.

The push button (No. 2) is sealable and can have various functions depending on the configuration. It also has two different statuses, one it the short push and the other is the long hold. The push function can initiate two different actions: one is to step back in the display sequence and the other is to switch the metrology LED from active to reactive. The same is true for the long hold, it can perform and End-Of-Billing event or activate the test mode.

5.4 Metrology LED

The metrology LED of the meter can be found under the LCD display. It emits visible metrology pulses proportional to energy consumption. It is configurable that the LED operates in line with the active or reactive energy and the metrology constant. The following table shows the selectable options:

Energy	Constant
Active	500, 1000, 2000 impulses/kWh
Reactive	500, 1000, 2000 impulses/kVArh

If no energy is flowing through the meter, then the metrology LED is constantly turned on showing that the meter is in no load state.

5.5 Pulse output

Upon request the meter can be supplied with an optically-isolated pulse output in accordance with IEC 62053-31 Class A. It is configurable that the pulse output operates in line with the active or reactive energy, the import or export energy register and the metrology constant. The following table shows the selectable options:

Energy	Register	Constant
Active	Total kWh import	250, 500, 1000 impulses/kWh
	Total kWh export	
Reactive	Total kVArh import	250, 500, 1000 impulses/kVArh
	Total kVArh export	

5.6 Data bus output

The pulse output of the meter used as a Data Bus Output (DBO) port upon request on the order.

This is a one way communication, where 2 wires are used. By connecting an external device to this port, the meter can be read out remotely. The data is coming from the meter to the external device. On the device side, it can be used as an RS232 serial port.

The meter periodically puts data on the DBO port. Speed of the communication is 4800 Baud. The content of the dataset is configurable by selecting the available registers of the meter. (For more information about the available registers, please see the relevant section.). Maximum 40 register can be transmitted on this port.

The structure of the sent data can be seen below:

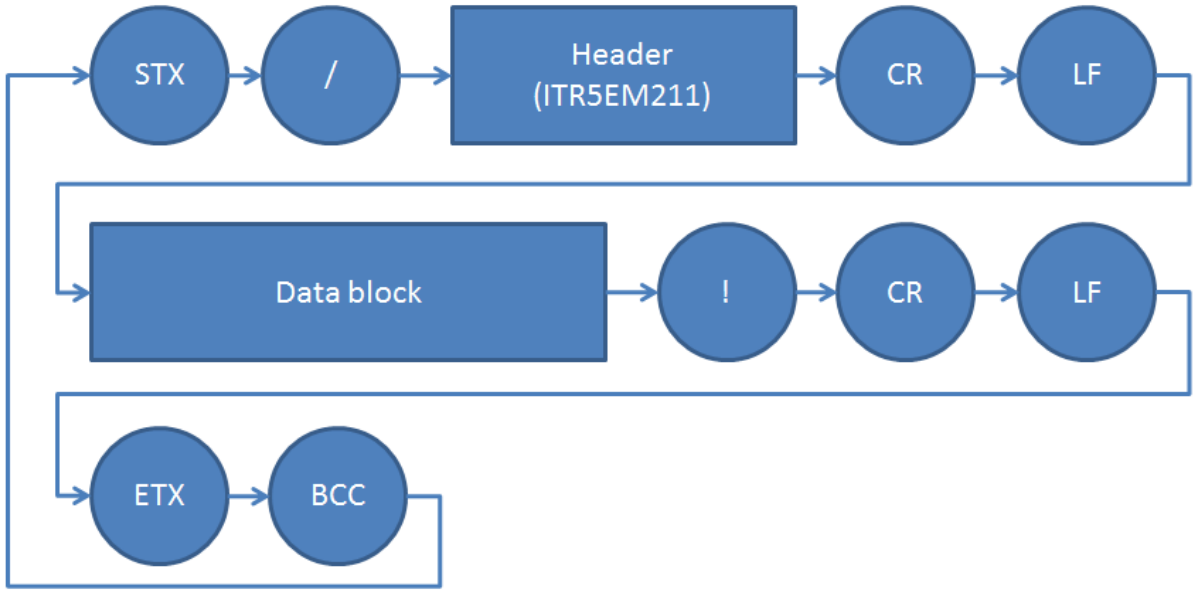


Figure 8 – Data structure

The Data block consists of Data lines:

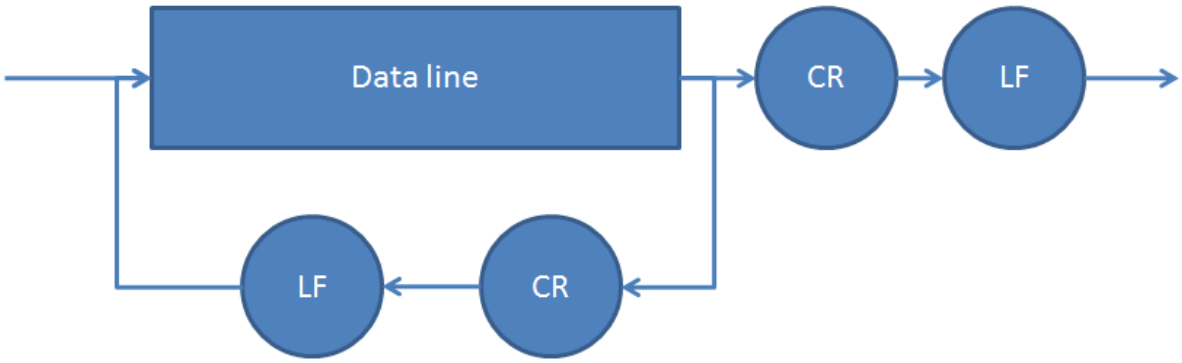


Figure 9 – Structure of a data block

Each Data line contains the data address, followed by the data value between brackets. The data address is a standard OBIS code. The data value includes the numerical value and corresponding unit:

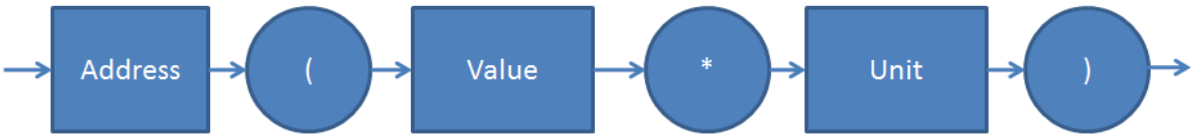


Figure 10 –Structure of a data line

Below a sample read out can be seen:

```
<STX>/ITR5EM211<CR><LF>
1.7.0(000011.4*kW)<CR><LF>
1.8.0(000120.3*kWh)<CR><LF>
1.8.1(000055.0*kWh)<CR><LF>
1.8.2(000065.3*kWh)<CR><LF>
2.7.0(000000.0*kW)<CR><LF>
2.8.0(000002.4*kWh)<CR><LF>
2.8.1(000002.0*kWh)<CR><LF>
2.8.2(000000.4*kWh)<CR><LF>
!<CR><LF>
<ETX><BCC>
```

5.7 RS232/RS485 interface

Upon request the meter can be equipped with a two-way RS232 or RS485 port. These ports provide the same functionality what the optical port can deliver.

The RS232 port uses 3 wires and the RS485 port uses 2 wires for the communication. (Detailed wiring drawing can be found in the Annex D).

The RS485 port can be used in a master-slave, bus architecture. This way several (up to 100) meters can be connected to the same RS485 bus. The communication device plays the role of the master and the meters operate as slaves. The master should use the last 6 digits of the serial number of the selected slave meter to establish the communication. (Serial numbers less than 16 digits will be filled up with leading zeros.)

5.8 Relay

The meter can be equipped with a load control relay.

The relay can operate in line with programmed tariff profile of the meter. It means that the relay is closed when the selected rate is active. Otherwise it is opened.

Furthermore the relay can follow its own preprogrammed daily profile. In this profile maximum 16 switching times can be defined to achieve the desired operation.

It can be loaded up to 5A.

6 Functions

The EM211 meter provides a wide range of different useful functions, which are designed for easier meter installation, readout when the mains is not present, operation and easier tamper detection. This section introduces these functions and gives detailed description about them.

6.1 Test mode

The installation of the meter at the customer site can be carried out simpler by using the test mode function.

When the test mode is activated, then the active rate register can be seen on the LCD display in a higher resolution (5+3) and for a predefined time period. With this higher energy resolution, smaller increments in the energy register can be observed.

When this mode is active then advancing the display is only allowed by pushing the button (No 1.) if previously this button was long hold.

Depending on the customer's preference test mode can be activated automatically after each power up for a predefined duration or switch on and off directly by IEC command via the IR port. Furthermore upon request the constant of the metrology LED can be changed to 10 000 pulses/kWh or 10 000 pulses/kVArh during the test mode.

6.2 Read Without Power

The meter can be ordered with read without power (RWP) function. This means, that the content of some registers can be read out from the LCD display, even when the main is not present.

This function can be used in two different ways: manual and automatic. If manual mode is selected, then to activate this function, the user should push the button (No. 1) of the meter when it is powered down and the display will be activated. During this function, the meter shows the content of the preconfigured read without power display sequence. (For more information, see the relevant sections about the display sequences.) Pressing again the button will put the next register on the display.

After a predefined time period (max. 30 seconds), if there is no further button push action the meter exits from this state and switches off the display. This function can be used for maximum 10 times within a voltage absence period.

If the push button is not accessible, then the automatic mode can be selected. This means, that the display switches on periodically and scrolls through the content of the preconfigured display sequence for this operation. After reaching the end of the data list, the display switches off.

6.3 Error register

The detection of the critical error in the EM211 meter is simple by observing the error register.

The error register comprises the most important indicator bits, which show any deviation in the normal operation.

It can be configured that when it changes from its default value, the warning triangle (⚠) on the LCD will be turned on, showing that the meter should be checked.

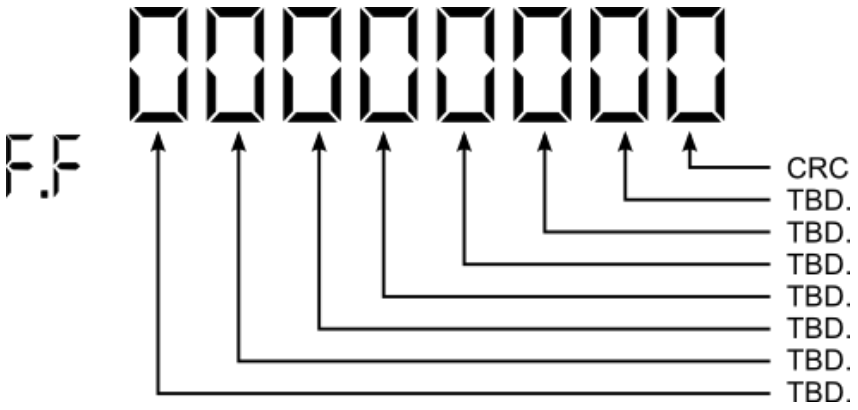


Figure 11 - Content of the F.F register

Digit	ID	Value	Description
8th (LSB)	CRC error	0/1	CRC error. The Cyclic Redundancy Check is a method to maintain the data validity by calculating a checksum on the data. 0 – The calculated checksum is the same as the stored one. 1 – The calculated checksum of the data is not the same as the stored one in the memory
7th	TBD	0/1	Reserved for future usage
6th	TBD	0/1	
5th	TBD	0/1	
4th	TBD	0/1	
3rd	TBD	0/1	
2nd	TBD	0/1	
1st (MSB)	TBD	0/1	

6.4 Instantaneous voltage, current and power measurement

The EM211 meter is able to measure and display the instantaneous voltage, current and power values.

These values can be showed on the LCD display or can be transmitted through the optical port or the optional DBO port.

The currents which flow from the customer to the network (export currents) have a negative (“-“) sing helping the easier identification.

For more information, please see the related (Available registers) section.

6.5 Real time clock

The EM211 type 900 meter can be equipped with real time clock.

In case of voltage absence, an inbuilt battery supports to maintain the current date and time.

The format of it can be configured during the manufacturing. It supports the following date and time formats:

- DD/MM/YYYY HH:MM:SS
- YYYY/MM/DD HH:MM:SS
- MM/DD/YYYY HH:MM:SS

The RTC uses temperature compensation therefore the accuracy of it is better than 5ppm.(±0.5s/day).

6.5.1 DTS management

The EM211 meter supports the widely used Daylight Saving Time.

It can follow the European algorithm, where the time is set forward on the last Sunday of March and backward on the last Sunday of October. The hour and the direction of the change are configurable.

Any other specific DST algorithm can be implemented, because the DST dates can be manually programmed for 20 year in advance.

6.5.2 Maximum demand

The meter can measure and store the Maximum Demand with date and timestamp.

The maximum demand register contains the highest average power value, which average power is calculated over the integration period.

The Maximum Demand register is available for the rate and for the total registers. The integration period is configurable from the following values: 10, 15, 20, 30 and 60 minutes.

Depending on the configuration, the maximum demand registers can be reset manually, by command or scheduled. If it is scheduled, then it can be configured to occur on the selected day of everyone, every 3, every 6 or every 12 months.

This reset is also called as End-Of-Billing event. After this event a timeout period is activated. Within this period, further reset cannot be carried out.

Every End-Of-Billing event increments the reset counter register by one.

On top of that the cumulative maximum demand register is available, which is the sum of the total maximum demand values.

6.5.3 Historical register

The EM211 meter supports the accurate billing by the historical registers.

The historical registers are the snapshot of the current energy, maximum demand and operational time registers.

Depending on the configuration of the meter, it can store maximum the latest 15 sets of historical registers. Each set can consist of the following registers:

Register	OBIS
Date and time of the historical saving	0.1.2
Total import active register	1.8.0
Total export active register	2.8.0
Total import reactive register	3.8.0
Total export reactive register	4.8.0
Rate n import active register (*)	1.8.n
Rate n export active register (*)	2.8.n
Total maximum demand	1.6.0
Rate n maximum demand (*)	1.6.n
Cumulative maximum demand	1.2.0
Total operational time	C.8.0
Rate n operational time (*)	C.8.n

Note (*): The maximum value of n is 6.

The saving of a new historical register set coincides with the End-Of-Billing event. Therefore it can be on demand or scheduled.

6.6 Multi rate operation

The EM211 meter supports the multi rate operation based on the internal real time clock.

The following concept is used: every day profile contains a time based switching pattern between different rate registers. The week profile consists of maximum 7 different day profiles. The season is based on a week profile.

The tariff engine of the meter is able to support up to 6 rates.

Based on the tariff configuration, maximum 24 day profiles can be defined. Each day profile can have 16 switching times.

Up to 6 week profiles and 6 seasons are supported. A single week profile can contain up to 7 day profiles.

The seasons can operate in line with the DST or configured individually. If they are operate with the DST then 2 seasons exists. One is active in the DTS season and the other is when out of the DST season. In case of individually configured then the starting month and day can define when the selected season is activated.

On top of that maximum 64 special days can be defined. Two types of special day exist: fixed special day and flexible special day. The total number (64) is split between these two types. The special days have a separate special day profile.

6.7 Load profile

The EM211 meter has load monitoring feature, which can be provided by the load profile.

The load profile has 2 independent channels. Each channel can contain the one of the following registers:

Register	OBIS
Total import active register	1.8.0
Total export active register	2.8.0
Total import reactive register	3.8.0
Total export reactive register	4.8.0
Rate n import register (*)	1.8.n
Rate n export register(*)	2.8.n

Note (*): The maximum value of n is 6.

The method of the register recording can be selected from the followings:

- Register saving: The current value of the selected register is being stored.
- Consumption saving: Only the increment compared to the previously saved value is being stored.

The integration period can be configured to 1, 5, 10, 15, 20, 30 and 60 minutes. The load profile can contain maximum 6048 records.

Furthermore the following events are also included in it: power down, power up and time setting.

6.8 Anti-tamper features

6.8.1 Logbook

The EM211 meter provide logbook for more effective and easier tamper detection and registration.

Logbook is a circular type memory where different types of events are recorded in the same format. The most recent entry overwrites the first entry after filling up the memory designated to this task.

The meter retains three event logs: General, Fraud and Power event logs. Each of the three logs maintains the last 50 events.

The following events are included in the logbooks:

Event log	Events
General event log	• Programming event (C.2.0) • Reading event (C.12.1) • Mode C reading event (C.50.2) • Clearing of the logbook (C.60.0)
Fraud event log	• Main cover open detection (C.13.2) • Terminal cover open detection (C.13.10) • Magnetic field detection (C.13.20) • Reverse energy (C.14.0) • Invalid communication password (C.14.1)
Power event log	• Power loss / Power restore (C.7.0)

Following information is stored in the logbook, in the following structure:

Information	Description
SRN of the event	Serial number of the event. Maximum number is 99999
SRN of the same type	Serial number of the event of the same type. (The maximum number is 6660.)
Logbook ID	Defines logbook: GE – General Event FE – Fraud Event PE – Power Event
Start date and time	Starting date and time of the event with a resolution of 1 second.
ID	Identifier of the event
Ending date and time	Ending date and time of the event with a resolution of 1 second.

Below a sample logbook can be seen:

SRN of the event	SRN of the same type	Logbook ID	Start date & time	ID	Finish date & time
7	2	FE	15-09-10 13:12:10	C.13.10	Ongoing
6	1	FE	15-09-10 11:48:53	C.13.20	15-09-10 11:50:05
5	3	PE	14-09-10 18:01:02	C.7.0	14-09-10 18:31:02
4	1	GE	14-09-10 14:12:21	C.12.1	14-09-10 14:13:00
3	2	PE	14-09-10 13:20:20	C.7.0	14-09-10 13:45:20
2	1	FE	14-09-10 13:15:02	C.14.0	14-09-10 13:57:21
1	1	PE	14-09-10 11:42:05	C.7.0	14-09-10 11:59:34

Reading of logbook is can be carried out by separate commands.

The logbook data can only be deleted by separate command under security control. The serial number of the events cannot be reset. (i.e. if erasure of the logbook data has been done after the 2354 event, the serial number a new event afterwards will be recorded with serial number 2355. The type serial number is managed in the same way.)

6.8.2 Status word

The monitoring of the tampered state of the EM 211 meter is very easy and effective by using the status word.

The status word comprises the most important tamper indicator bits.

It can be configured that when one of the bits changes from its default value, the warning triangle (⚠) on the LCD will be turned on, showing that the meter should be checked.

The detailed description of the bits can be seen below:

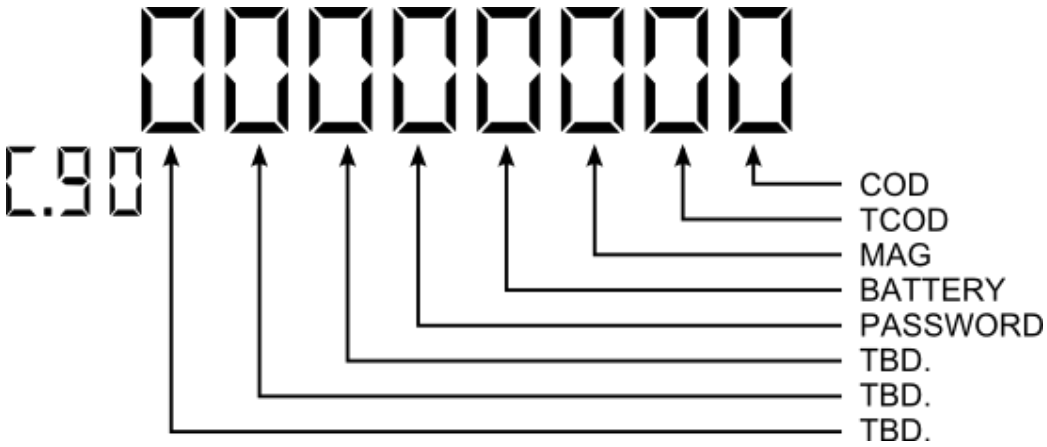


Figure 12- Content of the C.90 register

Digit	ID	Value	Description
8th (LSB)	COD	0/1	0 – If no meter cover opening detection event 1 – If there was at least 1 meter cover opening event
7th	TCOD	0/1	0 – If no terminal cover opening detection event 1 – If there was at least 1 terminal cover opening event
6th	MAG	0/1	0 – If no external magnetic field detection event 1 – If there was at least 1 external magnetic field event
5th	BATTERY	0/1	0 – If the battery is operating 1 – If the battery goes down
4th	PASSWORD	0/1	Password lockout event: when the meter gets 4 times wrong password and locks out the optical communication for 24 hours. 0 – If there was no password lockout event 1 – If there was at least 1 password lockout event
3rd	TBD	0/1	Reserved for future usage
2nd	TBD	0/1	
1st (MSB)	TBD	0/1	

The status word can be reset to the default value through the optical port only by having the appropriate access rights.

6.8.3 Meter cover opening detection

The EM 211 meter can be optionally equipped with meter cover opening detection on top of the meter case is sealed for life.

The meter registers the cumulative duration and the cumulative number of this type of event.

If the meter is equipped with battery, then this function is operational even if the meter is not connected to the mains.

6.8.4 Terminal cover opening detection

The EM 211 meter can be optionally equipped with terminal cover opening detection.

The meter registers the cumulative duration being without terminal cover and the cumulative number this type of event.

If the meter is equipped with battery, then this function is operational even if the meter is not connected to the mains.

6.8.5 External magnetic tamper registration

However the EM 211 meter is fully immune against the external magnetic fields, optionally it can be equipped with magnetic field sensor to detect external magnetic fields.

External magnetic field, which strength is greater than 250mT can be sensed. The meter registers the cumulative duration, the cumulative number this type of event. Also the energy, which was consumed during the magnetic tamper, is measured and stored separately in a register.

6.8.6 Sealed for life meter case

The meter was designed into a sealed for life meter case. This means, that after the meter has left the factory, it is not possible to open the meter case without obvious physical damage.

The cover is permanently fixed to the base by ultrasonic welding technology.

7 Available registers

List and OBIS code of the available registers can be seen below:

Group	Data	Display	Data list	Example
Billing registers	Active total import register	Y	Y	1.8.0(012345.67*kWh)
	Active total export register	Y	Y	2.8.0(012345.67*kWh)
	Active rate 1 import register	Y	Y	1.8.1(012345.67*kWh)
	Active rate n import register (*)	Y	Y	1.8.n(012345.67*kWh)
	Active rate 1 export register	Y	Y	2.8.1(012345.67*kWh)
	Active rate n export register(*)	Y	Y	2.8.n(012345.67*kWh)
	Reactive total import register	Y	Y	3.8.0(012345.67*kVArh)
	Reactive total export register	Y	Y	4.8.0(012345.67*kVArh)
	Active total import MD	Y	Y	1.6.0(12.2*kW)(23-03-11 10:00)
	Active rate 1 import MD	Y	Y	1.6.1(12.2*kW)(23-03-11 10:00)
	Active rate n import MD (*)	Y	Y	1.6.n(00.0*kW)(01-01-70 00:00)
	Cumulative MD register	Y	Y	1.2.0(00.0*kW)(23-03-11 10:00)
Instantaneous registers	Current time	Y	Y	0.9.1(12:12)
	Current date	Y	Y	0.9.1(31-12-11)
	Instantaneous current	Y	Y	31.7(000.0*A)
	Instantaneous voltage	Y	Y	32.7(000*V)
	Instantaneous import active power on phase	Y	Y	21.7(00.00kW)
Informational registers	Status word	Y	Y	C.90(00000000)
	Error register	Y	Y	F.F(00000000)
	Firmware number with checksum	Y	Y	0.2.0(V4.03#51AF7EA3)
	Reset counter	Y	Y	0.1.0(15)
	Meter serial number	Y	Y	C.1(0123456789 0123456789)
	Meter serial number	Y	Y	0.0.0(0123456789 0123456789)
	Customer specific text 1	Y	Y	0.2.1(Itron1)
	Customer specific text 2	Y	Y	0.2.2(Itron2)
	Total operational time	Y	Y	C.8.0(012345.67*h)
	Operational time in rate 1	Y	Y	C.8.1(010000.00*h)
	Operational time in rate n (*)	Y	Y	C.8.n(002345.67*h)
	Battery usage counter (**)	Y	Y	C.6.0.(000018.12*h)
	Battery voltage (**)	Y	Y	C.6.3(4.35*V)
	Total number of mains	Y	Y	C.7.0(0013)

Group	Data	Display	Data list	Example
	outages			
	Timestamp of last mains outage	Y	Y	C.7.1(25-10-09 02:14)
	Total duration of mains outages	N	Y	C.7.15(00000018*h)
	Total duration of low load	Y	Y	C.50(0000001210*secs)
	Segment test	Y	N	-
Tamper registers	Number of meter cover opening actions (**)	N	Y	C.13.2(4)
	Total duration of meter cover opening(**)	N	Y	C.13.1(00000012*secs)
	Number of terminal cover opening actions (**)	N	Y	C.13.12(5)
	Total duration of terminal cover opening(**)	N	Y	C.13.11(00000025*secs)
	Number of ext. magnetic field detection(**)	N	Y	C.13.22(3)
	Total duration of ext. magnetic field det. (**)	N	Y	C.13.21(00000124*secs)
	Import energy consumed during ext. mag. field(**)	N	Y	1.8.81(012345.67*kWh)
	Export energy consumed during ext. mag. field(**)	N	Y	2.8.81(012345.67*kWh)
Historical registers	Date of hist. saving	Y (***)	Y	0.1.2*XX(01-04-11 00:00)
	Time of hist. saving	Y (***)	Y	0.1.2*XX(01-04-11 00:00)
	Active total import register	Y (***)	Y	1.8.0*XX(012345.67*kWh)
	Active total export register	Y (***)	Y	2.8.0*XX(012345.67*kWh)
	Active rate 1 import register	Y (***)	Y	1.8.1*XX(012345.67*kWh)
	Active rate n import register(*)	Y (***)	Y	1.8.n*XX(012345.67*kWh)
	Active rate 1 export register	Y (***)	Y	2.8.1*XX(012345.67*kWh)
	Active rate n export register (*)	Y (***)	Y	2.8.n*XX(012345.67*kWh)
	Reactive total import register	Y (***)	Y	3.8.0*XX(012345.67*kVArh)
	Reactive total export register	Y (***)	Y	4.8.0*XX(012345.67*kVArh)
	Total active import MD	Y (***)	Y	1.6.0*XX(12.2*kW)(23-03-11 10:00)
	Rate 1 active import MD	Y (***)	Y	1.6.1*XX(12.2*kW)(23-03-11 10:00)
	Rate n active import MD (*)	Y (***)	Y	1.6.n*XX(00.0*kW)(01-01-70 00:00)
	Cumulative MD register	Y (***)	Y	1.2.0*XX(00.0*kW) 01-01-70 00:00)
	Total operational time	Y (***)	Y	C.8.0*XX(125*h)
	Rate 1 operational time	Y (***)	Y	C.8.1*XX(125*h)
	Rate n operational time (*)	Y (***)	Y	C.8.n*XX(125*h)

Remarks:

- (*) The maximum value of the n is 6.
- (**) The availability of these register are depending on the actual hardware of the meter.
- (***) The most recent historical registers are available on the display

8 Main meter parameters

Measurement parameters	
Meter type	Static, single phase active/reactive energy meter
Network	1-phase, 2 wire
Metrology sensor	Shunt
Metering modes for active energy	Mode 1 – Bidirectional(Per phase), Mode 3 – Unidirectional
Metering modes for reactive energy	Mode 1 – Per phase
Connection type	Asymmetrical, Symmetrical
Accuracy Class	A or B for active energy
	Class 1 or 2 for active energy
	Class 2 or 3 for reactive energy
Reference current	5A
Maximum current	Asymmetrical: 65A Symmetrical: 100A
Starting current	Below 15mA
Reference voltage	230 V
Reference frequency	50 Hz / 60Hz
Instantaneous voltage and current measurement	Accuracy is better than 1%.
Operational temperature range	-40°C / +70°C (LCD: -25°C / +70°C)
Storage temperature range	-40°C / +85°C

Electrical parameters	
Impulse voltage resistance	12kV
Fast transient burst	4kV
Surge immunity	4kV
Magnetic immunity	Full immunity against external DC magnetic field.
Immunity against disturbing current in 2-150kHz frequency range	Fully immune
Self consumption	Voltage circuit: below 1W, 8VA
	Current circuit: below 0.5VA
Pulse output parameter	Maximum voltage: 27V DC
	Maximum current in ON state: 27mA
	Minimum current in ON state: 10mA
	Maximum current in OFF state: 2mA
Tariff control input parameters	Control voltage: Nominal voltage
	Voltage range: -20% to +15% Un
	Logical voltage “OFF”: below 0.5 Un
	Logical voltage “ON”: above 0.8 Un
Data bus output parameter	Communication speed: 4800 Baud

Electrical parameters	
	Databits: 7
	Parity: Even
	Stopbit: 1
RS232 port	3 wires (RX, TX, GND)
	Point to point communication
RS485 port	2 wires (+, -)
	Bus connection, up to 100 meters

Configurable parameters	
Outputs	Optional pulse output
	Optional data bus output
	Optional relay
Input	Optional external tariff control
Input & Output	RS232
	RS485
Tariffication	Multirate
Antifraud feature	Meter cover open detection
	Terminal cover open detection
	External magnetic field detection
	Logbook
RTC	Accuracy is better than 5ppm.
	Backup by an inbuilt battery
Load profile	2 channel load profile

Mechanical parameters	
Environment classes	M2 / E2
IP protection	IP54
Main dimensions	Without terminal cover 138X122X45mm
Main dimensions	With terminal cover: 180X122X45mm
Current and neutral terminals	Symmetrical: 9mm, solid brass Asymmetrical: 7.2 mm, solid brass
Current and neutral screws	Cross-recessed (PZ2) head, 2Nm torque
Terminal cover	DIN compliant
Auxiliary terminals	Solid terminal, screw type, 2.5mm wire can be connected
Display	Size of the digits is 10x5mm
	Size of the LCD display 65.5x19.5mm
	Number of digits, max 8.
Buttons	2 push buttons, diameter 14mm
Fixing triangle	Lower fixing point: 105mm
	Upper hanging point: 110mm / 153mm

Mechanical parameters	
Weight	0.36 kg

9 Installation

This section provides information and instructions to store, unpack and install correctly all versions of the EM 211 meters.

Please read this installation manual carefully before meter installation. EM 211 meters must always be installed by qualified personnel, in compliance with local safety regulation.

Please note that due to the shunt based metrology, the current and voltage circuits are permanently connected, therefore it is mandatory to use a test bench with insulated current and voltage circuits for each position, in case of metrology test before installation.

9.1 Security Advice

9.1.1 Responsibilities

It is the responsibility of the meter owner (in the normal case the utility) to ensure that all his staff dealing with the meter:

- have read and fully understood the relevant clauses of the User Guide
- have been sufficiently qualified for the work
- follow the security advice and the related work instruction as described in the relevant clauses.

In general, the owner of the meter is responsible for the safety protection of persons, avoidance of damages to property and training of the staff.

9.1.2 Security Advice

The following security advice should be followed when installing meters:

- National regulations for the avoidance of electrical accidents shall be strictly followed.
- Meters must be installed only by competent and well-trained staff.
- Use only suitable tools that have been approved for electrical installations. Please see the Installation Manual for the recommended size of screw drivers.
- Caution! It is dangerous to touch live electrical components. Therefore, line voltage must be switched off before meter installation. Remove all fuses upstream of the meter and closely guard them until the installation is finished.
- Do not install meters that are obviously damaged or have been dropped, even if no damage can be seen. Possible internal failures could cause short circuits. Send these meters to the local Itron representative for inspection and repair.
- Do not clean the meter with running water or high pressured spray water. The water might penetrate into the meter and cause a short circuit.

9.1.3 Storage

Store the meters in a clean, dry environment at temperatures between – 40°C and + 85°C. Any prolonged storage (more than one year) at temperatures above + 70°C should be avoided.

9.1.4 Unpacking

As with all precision electronic instruments, the EM211 meters should be handled carefully. For more efficient work during multiple installations, the EM211 meters are delivered fully adjusted and ready

for use. The meter cover is closed by ultrasonic welding in the factory, so no separate hanging seal is foreseen for warranty purposes. On customer request or according to national regulations a traditional seal can be used, stamped with Itron or national certification mark.

9.1.5 Preliminary Inspection

After unpacking, please inspect the meters as follows:

- Inspect for obvious shipping damage to the meter. If there is any, notification should be given immediately to the relevant freight forwarder.
- Check if the seals are intact. Do not install a meter if the seals are not in place or if they are damaged.
- From the meter name plate, please verify the following information, as specified in the original order:
- Meter type
  - Accuracy class
  - Nominal voltage
  - Nominal frequency
  - Nominal and maximum current
  - Meter constant
  - Serial number
  - Bar code data

9.2 Meter Installation

9.2.1 Materials and Tools for the Installation

The following material has to be available before the installation:

- Electricity meter as per specification on the nameplate.
- Circuit diagram, normally printed on the nameplate of the meter or optionally it can be found under the terminal cover.
- Fixing screws for mounting the meter into the meter cabinet or on the meter panel.
- Customer seals for sealing the terminal cover after installation.
- Stamping tong for customer seals.
- Screw drivers suitable for the mains connections. (The head of the default current and neutral screws is cross-recessed (PZ2))
- Drilling machine for the fixing holes.
- Phase sequence tester or multi-function measuring instrument.

9.2.2 Mounting of the Meter

Install meters on a meter panel or in a meter cabinet according to usual practice.

Make sure that the connection wires at the installation location do not have voltage when mounting the meter. Touching live parts is dangerous. Therefore, the relevant fuses have to be removed and kept under control so that nobody else can put them in place unnoticed.

9.3 Mains Circuit Connections

Connect the meter according to the circuit diagram on the nameplate or on the inside of the terminal cover.

Before electrical connection make sure that there is no voltage in the connection wires. Touching of life parts is dangerous. Therefore, the relevant fuses have to be removed and kept under control so that nobody else can put them in place unnoticed.

The dimensions of the terminals and the connection wires are shown in the table below. The cables can be copper or aluminum.

	Connection	Diameter	Recommended wire diameter	Recommended torque
Current and neutral terminal	Asymmetrical	∅ 7.2 mm	Up to 60A: 25 mm^2 cable	2 Nm
	Symmetrical	∅ 9 mm	Up to 60A: 25 mm^2 cable Up to 80A: 35 mm^2 cable Up to 100A 50 mm^2cable	

To ensure that the right connection wire is connected at the corresponding terminal, it is recommended to select the wires by means of a buzzer.

The wires can be easily introduced into the terminals by cone-shaped guiding holes in the terminal block.

The terminal screws of the EM211 meter have a combined slot and crossed slot. Therefore, screw drivers with a blade for simple slots or a blade suitable for cross recesses size Z2 according to ISO 4757 can be used.

9.3.1 Auxiliary Circuit Connections

For external power supply up to one auxiliary terminal can be provided. This device can be an external tariff control equipment or a unit for collecting the pulses from the pulse output.

All auxiliary terminals are single screw terminals. Therefore the connection of auxiliary circuits can be easily handled with the EM 211 meter.

	Diameter	Recommended torque
Power supply	∅ 3 mm	0.5Nm
I/O terminals	∅ 3 mm	0.5Nm

The auxiliary terminals of the signal inputs and outputs are numbered according to the connection diagram printed on the name plate. The auxiliary circuits have to be connected at the terminals as demonstrated with the figure below:

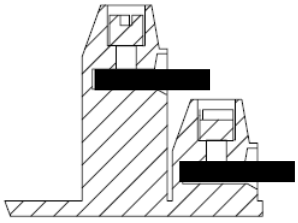


Figure 13 - Connecting the auxiliary wires

Do not try to withdraw the wire when the terminal is closed. The terminal might be damaged.

9.3.2 Check for Correct Installation

Before starting up the installed meter the following points have to be re-checked and corrected if necessary. In particular make sure that:

- The meter type with the right identification number has been installed for this client at this metering point.
- All connection screws of the mains wires and the neutral wires have been tightened with the recommended torque.
- Incoming wires are connected to the In-terminals 1, 4 and 7 and wires to the consumer are connected at the Out-terminals 3, 6 and 9.
- The neutral wire is connected to the terminals 10 and 12

Changing the wires between live and neutral can damage the meter.

Put the terminal cover in place before starting up of the meter.

9.4 Sealing

The EM211 meter is closed for life so traditional hanging sealing is not required to prove that the meter has been certified according to the MID directive. However on special request and for shipments outside the European Union, the meter can be delivered with hanging seal normally, requested for country specific local regulations. For this purpose one single sealing position is available on the cover that can be used for metrology sealing.

The figure below shows the position of the seals.

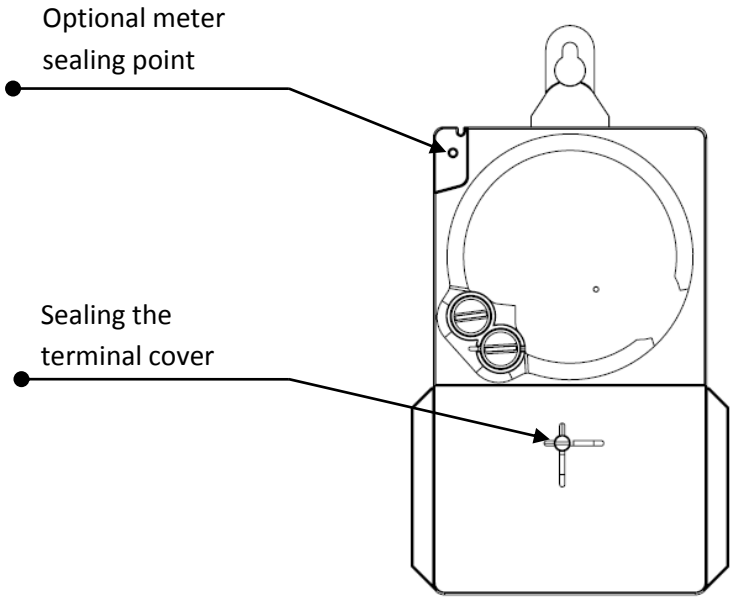


Figure 14 - Sealing points of the meters

10 Annexes

10.1 Annex A - Dimensions

Front and side view of the meter:

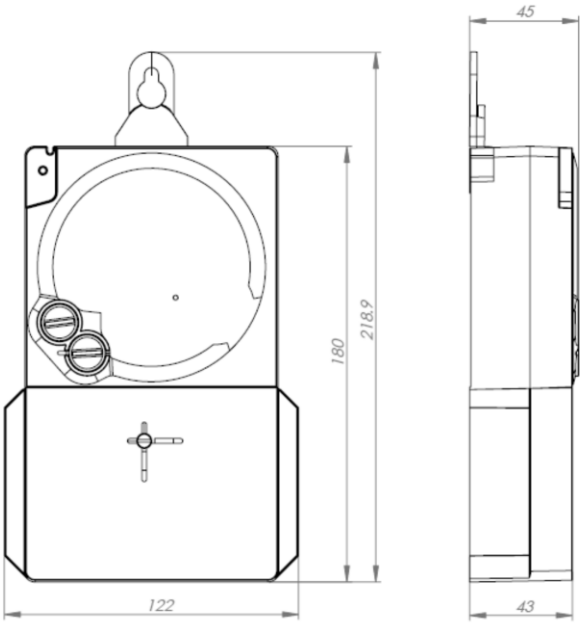


Figure 15 - Main dimensions

Arrangement of the current and neutral terminals:

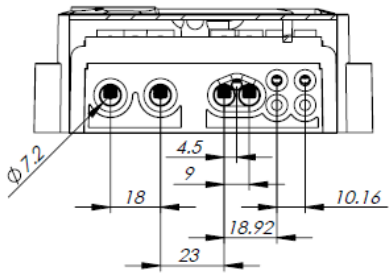


Figure 16 Wiring dimensions at asymmetrical connection

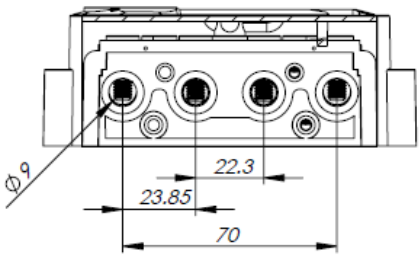


Figure 17 - Wiring dimensions at symmetrical connection

10.2 Annex B–Position of the fixing points

The picture below shows the different upper hanging points:

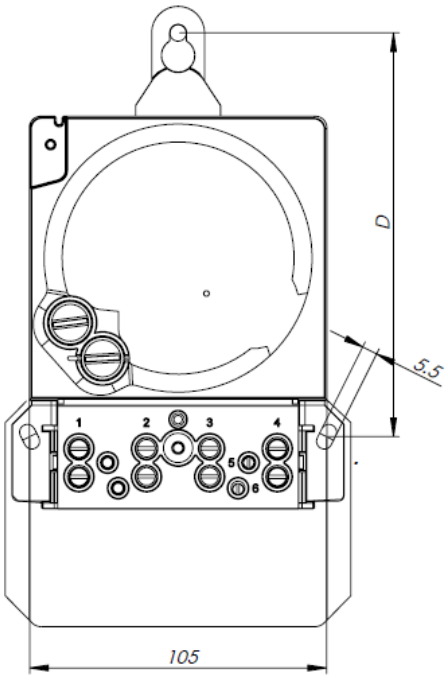


Figure 18 - Fixing points

Hanging bracket	Distance from the lower hanging points
A203343	D= 153 mm
without	D= 110 mm

10.3 Annex B -wiring specification

The picture below shows, how the phases and the neutral should be connected to the meter:

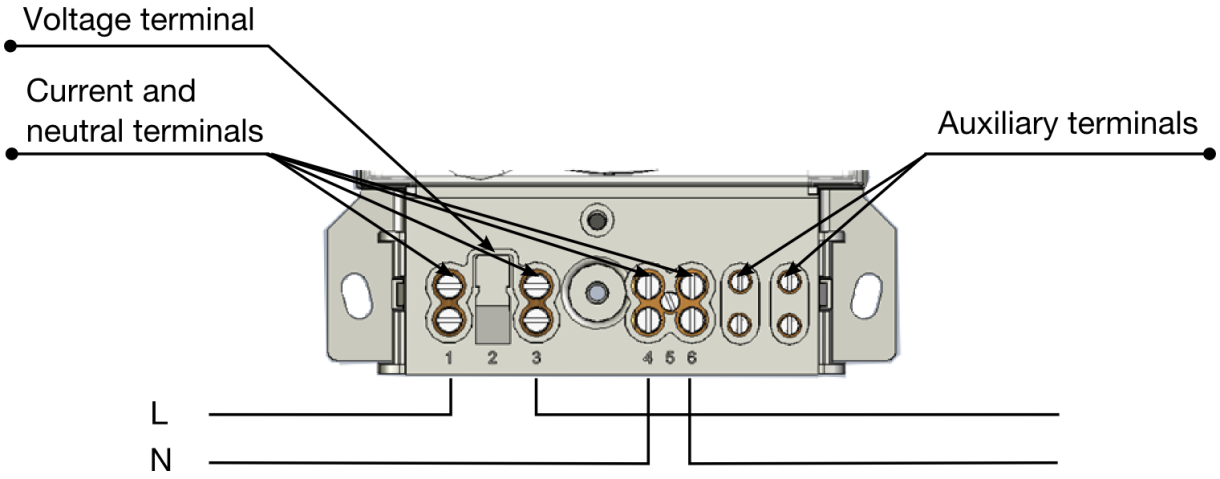


Figure 19 - Asymmetrical connection

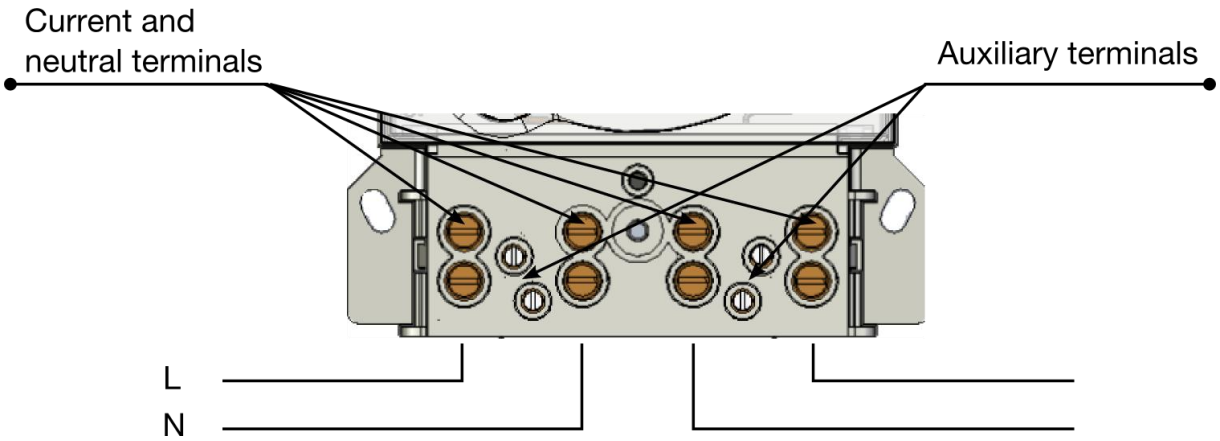


Figure 20 – Symmetrical connection

The connection diagram (*) can be seen below:

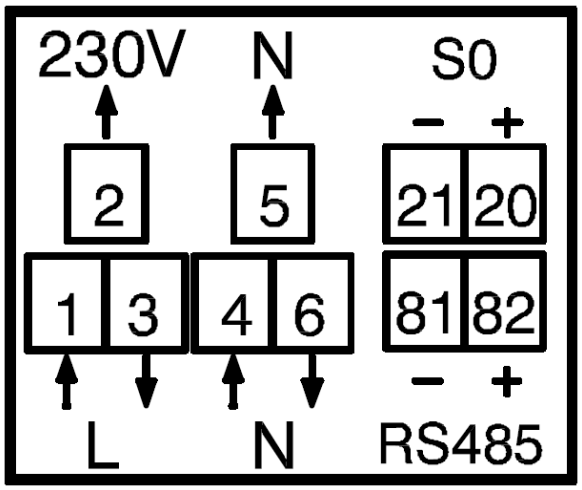


Figure 21 - Connection diagram on the nameplate

The explanation of the connection diagram (*) can be found below:

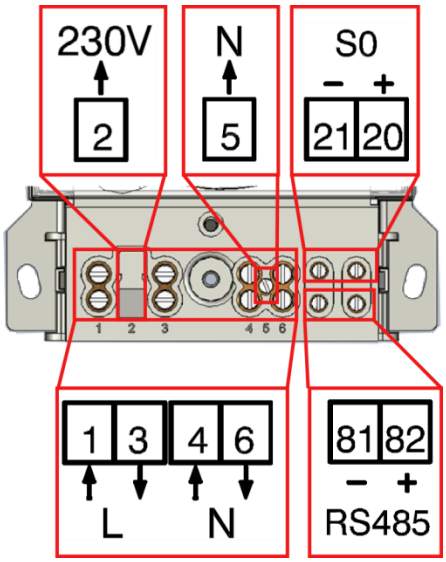


Figure 22 - Explanation of the connection diagram

Note: (*) Please note that the pictures show a fully equipped meter version. The actual one can be different.

10.4 Annex C–Auxiliary terminal arrangement

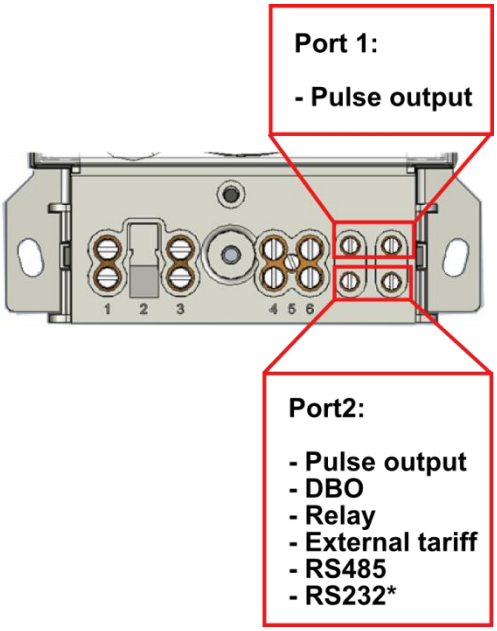


Figure 23 - Allocation of the auxiliary ports in the asymmetrical connected version

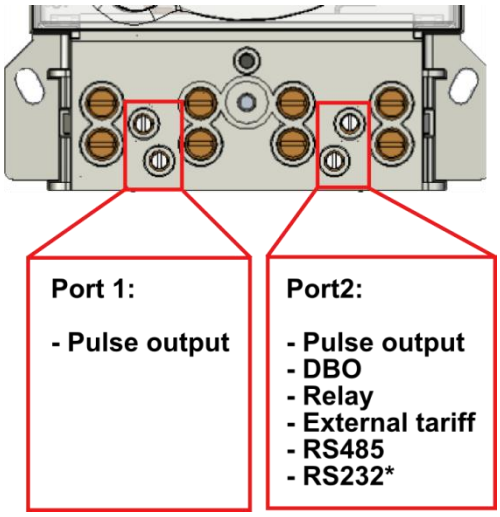


Figure 24 - Allocation of the auxiliary ports in the symmetrical connected version

Note: (*) Please note that in case of the RS232 auxiliary port is selected, then the Port 1 should be disabled.

11 Further support

The EM 214 meter does not require further maintenance during the product lifetime.

For further support, please contact your local Itron distributor.