



Corinex User Manual

Corinex AMI Three Phase Meter
CLMS300 Series

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Published by:

Corinex Communications Corp.

900 - 1090 W Georgia Street
Vancouver, B.C. Canada V6E 3V7
Tel.: +1 604 692 0520
Fax: +1 604 694 0061
www.corinex.com

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 **NOTE:** This equipment has been tested and found to comply with the limits for Class B information technology equipment. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference, the end user is advised to take adequate measures.

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Acronyms

AMI	Advanced Metering Infrastructure
AMR	Automatic Meter Reading
AHE	AMI Head End
APN	Access Point Name
BPL	Broadband over power lines
DC	Data Concentrator
E	Electricity
EN	European Norm
EU	European Union
HHU	Hand Held Unit

IEC	International Electronical Commission
IEEE	The Institute of Electrical and Electronics Engineers
IP	Internet Protocol
MAC	Media Access Control
OBIS	Object Identification System
PQ	Power Quality
RF	Radio Frequency

1. Overview

The CLMS300 series is a new generation three phase electronic residential meter supporting smart grid infrastructure. The meter records the active and reactive power consumption measurement with robust performance of high accuracy, high reliability, wide measurement range, and low power consumption, etc. The CLMS300 is AMI industry's 1st fully optimized and BPL integrated meter to provide the high-speed two way communication over power lines with advance information and features. The meter is fully complied with metering standards, such as "EN50470-1", "EN50470-3", "IEC62052-11", "IEC62053-23", "IEC62056-21", "IEC62056-61", etc.

CLMS300 meter is applicable for both wide-range current measurement (Direct Connection) of AC active/reactive energy with frequency of 50/60Hz.

CLMS300 meter provides three-ways of communication with advanced information to the utility and end-customer, 1 uplink communication employs BPL technology, which makes it possible for remote data collection by utility. Optical port is used for crews on-site to communicate with meter. And the last one downlink communication option is RS485.

CLMS300 meter can be used as stand-alone unit with information visualized on the LCD display, or in a full AMI infrastructure, backed by head-end system for data collection and MDMS for metering data management.

CLMS300 is intended for Indoor use.

1.1 Features

1.1.1 Multi-energy measurement

- Bi-directional measurement of import/export active, reactive and apparent energy.
- Import/Export Energy as well as Absolute value of active energy measurement.
- Multi-channels of cumulative energy.
- Two kinds of measurement model, mode, Vector (V) and Magnitude (M), the possibility of setting parameters in production or in the laboratory.

1.1.2 Supply quality monitoring

Network quality information monitoring includes:

- Instantaneous voltage, current, power factor, and frequency data monitoring.
- Voltage quality data monitoring (over/under voltage, average voltage, and phase power failures).
- Instantaneous power quantity monitoring (active, reactive, apparent).

1.1.3 Time of use tariff

- 6 tariffs for active/reactive energy and record the elapsed time of them, tariff is always clearly indicated on LCD display.

1.1.4 Field replaceable battery

- Battery can be replaced.

1.1.5 Fraud detection

- Main cover, terminal cover opening detection is included as well as detection of strong magnetic field interference.

1.1.6 Firmware upgradability

- Local and remote upgradeability allowing the meter to be easily extensible and future-proof.

1.1.7 Real time calendar

- Accuracy: 0.5s/day @ 23°C, and 0.05s/°C/day.
- Remote clock synchronization by communication is supported.

1.1.8 Data security

- 4 levels of user clients access user credential and privilege which are configurable.
- Bidirectional authentications including CRC configurable.
- It is well structured with sealing.

1.1.9 Communication interface

- Optical Port according to IEC62056-21 C mode.
- RS485 port is used to pass-thru communication.
- Communication module supports, BPL communication compliant with IEC62056-21 protocol.

1.1.10 Interoperability

- Compliant with IEC 62056 standards, ensuring true communication technology interoperability and increased options for utilities.

1.2 Working principle

When the meter works, the meter circuits for measuring voltage and current sample and collect the respective voltage and current over phase A, B and C. The collected data is sent to the measurement chip to process, and then the microprocessor will distribute the processed data to various output interfaces according to the demand of applications, for instance the data for display will be sent to the LCD, the remote collection data will be sent to the communication module.

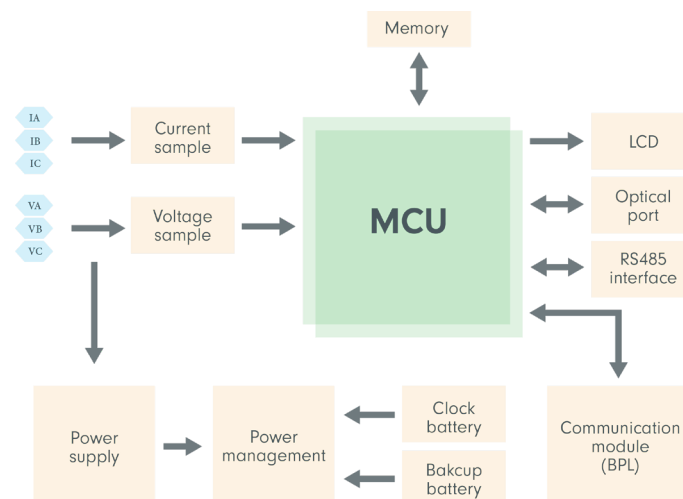


Figure 1. Meter architecture

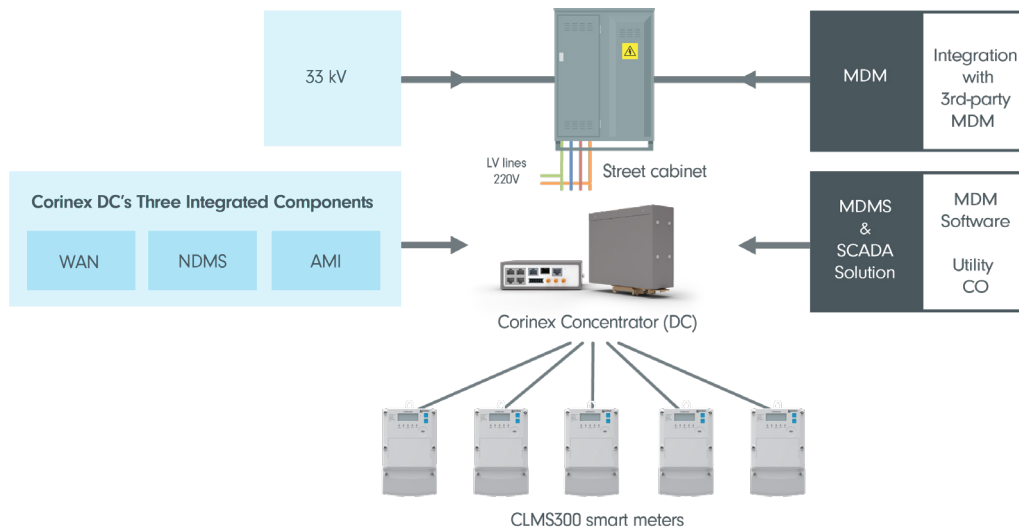


Figure 2. System architecture

2. Applicable Standards

The smart meters are manufactured and tested in accordance with the latest edition of the following standards:

IEC 62052-11: Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 11: Metering equipment

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

EN 50470-1: Electricity metering equipment (a.c.) - Part 1: General requirements, tests and test conditions - Metering equipment (class indexes A, B, C)

EN 50470-3: Electricity metering equipment Static meters for active energy, classes A, B and C

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

3. Technical specification

3.1 General specification

Meter name	CLMS300
General meter specification	Single phase direct connected meter 4-Quadrant measurement (+P, -P, Q1, Q2, Q3, Q4) 8 digit LCD Integrated BPL module
Normal voltage	3×220(380)V, 3×230 (400)V, 3×240(415)V
Normal (maximum current)	5(80)A , 5(100)A
Starting current	20mA
Minimum current	250mA
Normal frequency	50 / 60 Hz, +/-2%
Operation voltage	80% to 115% of normal voltage
Accuracy class	Class B for active energy and power Class 2 for reactive energy and power
Power consumption (Voltage Circuit)	< 1.05W and < 2VA (without BPL module installed) <4W and <8VA (with BPL module installed)
Power consumption (Current Circuit)	< 2VA (without BPL module installed)
Tariffs	6 tariffs
Real time clock	< 5ppm clock accuracy
Impulse constant (imp/kWh, imp/kvarh)	1000/10,000

Relay output	<ul style="list-style-type: none"> • Control load: 10A 250VAC • Maximum switching voltage: 277VAC/30VDC • Maximum switching current: 10A • Maximum switching capacitance: 2500VA/150W • Minimum load: 5VDC, 100mA • Operation temperature: -40° to 70° C • Mechanical lifetime: above 10000K cycles • Electrical lifetime: above 50K at 10A 250VAC • 1.5 to 2.5 mm² cable section areas in each connector
System interface	<ul style="list-style-type: none"> • BPL bi-direction communication, • Standard G.hn (ITU-T-G9960) • Frequency range: 2-50MHz • Maximum transmission power: -50dBm/Hz • Up to 200Mbps (max) on physical layer
Wireless interface	W-Mbus (Optional)
Local interface	RS485 Optical port Relay (for ripple control) (Optional)
Optical test outputs	PDA access via optical port
Meter protocol	COSEM/DLMS
Temperature, conditions	Operation: -40° to 70° C Storage: -40° to 80° C Humidity: 0% to 90% non-condensing
Lifetime	16.3 years
Housing	Dimension: 278 × 170 × 81 (mm) Protection class: IP54 Material: polycarbonate, non-inflammable, recyclable Triple points fixation 150 x 210 (230) (mm)

3.2 Functional specification

Description	Technical Parameters
RTC	Yes
Battery	Yes
Push button (Scroll display)	Yes
Metrology	
• Active	Yes
• Reactive	Yes
• 4 Quadrants	Yes
• Instantaneous	Yes
Instantaneous measurement	
• Voltage, Current, Frequency, power factor,Power	Yes
Tariff	Yes
Anti-tampering	
• Meter cover open	Yes
• Terminal cover open	Yes
• Reverse tamper detection	Yes
• Magnetic field	Yes
Communication	
• RS485	Yes
• Optical Port	Yes
• Communication module (BPL)	Yes
Firmware upgrade	

• Local via Optical port	Yes
• BPL	Yes
Event & Alarm	
• Recording	Yes
• Report	Yes
Internal Relay	
• Local disconnect/reconnect	Yes
• Remote disconnect/reconnect	Yes
Data Security	
• Access levels via password	Yes
Configuration software	Yes
Detection of reverse phase	Yes
Average voltages	Yes

4. Display and Outlook

4.1 LCD and description

When the meter is powered on, the LCD will start with a full screen mode that displays all the icons and indicators as below:

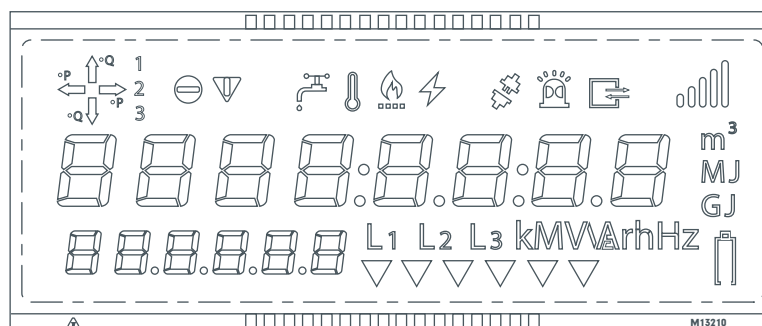





Figure 3. LCD full screen display

4.2 Description of LCD icons and indicators

LCD icon or indicator	Description
	Energy flow (quadrant) and phase indicator
	Active anti-creep indication and Reactive anti-creep indication
	Data Display
	OBIS code Display
	From left to right : Water meter, Heat meter, Gas meter, and sub-electric meter
	Instantaneous load current
	Alarm
	Disconnect
	Communication over optical port
	Battery level
L1 L2 L3	Phase presence indications
kMVA r hHz	Units
	Tariff rate indication

4.3 Outlook and layout

The meter base, meter cover and terminal cover are made of non-flammable and high grade polycarbonate with fiber glass. The meter cover and meter base have a good performance against the solar radiation. The meter is designed and made with solid mechanical structure for easy installation. Refer to Figure 4 for its outlook, layout the display elements.

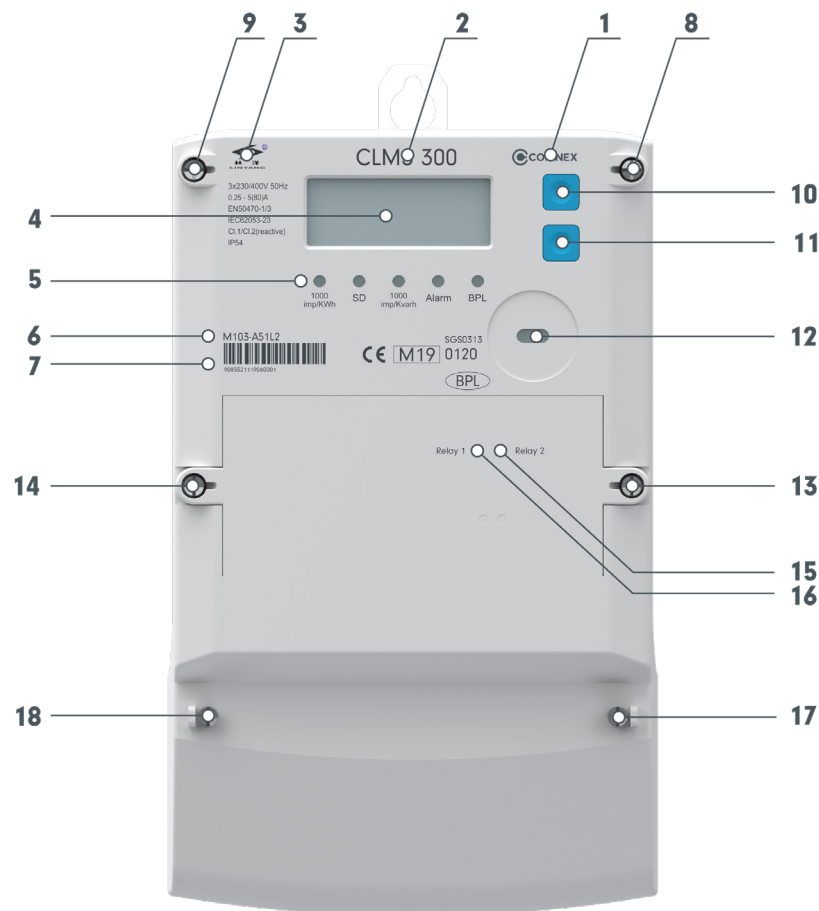


Figure 4. Outlooks and layout

Number	Name
1	Distributor of meter
2	Name of meter

3	Manufacturer of meter
4	Display
5	LED indicators
6	Type of meter
7	Bar code
8	Screw of main meter cover
9	Screw of main meter cover
10	Display button
11	Connection/Disconnection button
12	Optical port
13	Screw of middle cover
14	Screw of middle cover
15	LED indicator of Relay 2 LED is ON > Relay 2 is closed LED is OFF > Relay 2 is open
16	LED indicator of Relay 1 LED is ON > Relay 1 is closed LED is OFF > Relay 1 is open
17	Screw of terminal cover
18	Screw of terminal cover

5. Key Features

5.1 Electric Power Measurement

- **Measuring & recording load profile** of import/export active & reactive energy, four-quadrant reactive energy, and apparent energy.
- **Measuring, storing profile** of voltage, current, power, power factor, etc.
- **Remote on-demand retrieval** of instantaneous metering data.
- Configure multi-channel energy and recording.
- **Multi-tariff measurement function**, energy registers are stored in HEX format as 6 byte variables. LCD can display maximum 8 digits. Number (0-3) of measurement display decimals on LCD can be configured by manufacturer with respect to meter type. The maximum display and roll-over value is 99999999 kWh.
- The device is designed so that electric circuitry and insulation won't reach temperatures that would negatively affect the device operation under normal conditions of its use.

Summation methods by quantity Σ^+A / Σ^-A :

Summation by quantity separates the positive from the negative values of the individual phases. Measured quantity Σ^+A therefore only includes the positive values, measured quantity Σ^-A only the negative values, provided any are present. In case of a connection error the meter measures correctly the real energy consumption. It also measures a real export in the correct way.

Summation methods by vectors $+A$ / $-A$:

As in Ferraris meters the meter summates the values of the individual phases taking account to the sign. With differing signs (energy directions) the sum corresponds to the difference between the positive and negative values.

5.2 Display

LCD display contents include the main part and auxiliary part. The auxiliary part of display indicates the **category of measuring value** and the **unit of corresponding measurement value**.

CLMS300 can display all measured parameters and other recorded data. Display contents can be configured, at the end of user manual, a **Configurable Display** list is provided.

5.2.1 User modes

The meter has **two types of user modes**, the **Service Mode** and the **Normal Mode** that will display different sets of data on LCD for the end user to navigate. Usually service mode is configured with **extended data for utility field agent to record data or investigates issues** while normal mode provides **basic information for the residence of household**. Service Mode can be **configured whether to be entered at meter's power-up or skipped**, i.e. meter enters Normal Mode directly when power-up. Furthermore the entering of service mode can be protected by whether to associate with terminal cover removal required.

With the Service Mode, user can configure the meter by specifying what parameter should be displayed once the meter is powered on. With the Normal Mode, user can configure the meter by specifying what parameters should be displayed and define the time interval of displayed items.

User can also switch Normal Mode to Service Mode by long press the Display Button for 8 seconds. The display duration for service mode is configurable. Once service mode finishes sequentially displaying all of the configured items or the duration has expired, the meter will exit Service Mode then enter Normal Mode automatically.

5.2.2 Display modes

There are two display modes, the **Auto scroll display mode** and **Manual scroll display mode**. In Auto scroll display mode, when the meter is powered up, full screen displays for 3 seconds, then meter enters the Auto scroll display mode.

LCD sequentially displays the data and scrolls every 10 seconds (configurable, default 10s) and when Auto-scrolling completes scrolling all the items, it will automatically rotate back to the beginning.

The default auto scroll time interval is 3 seconds for showing the screen of categorized measuring items, but user can set up this time period to be 1~100 seconds time range. During meter in auto-scroll display mode, Manual scroll mode can be activated by pressing **Display button from the upper right corner of the meter**, and the next item in the configuration list can be manually scrolled as per button press. When there is no key pressed for more than 3s (default), the meter will resume auto-scroll mode.

The meter can enter test mode with a command, the test mode have features as below:

- Display the value of energy register at the current rate, the energy is the first channel which is configured.
- Displaying registers in 3 decimal format.
- Activation test mode with a command via optical port. Deactivation of test mode may come after either power-cycle or through a command.
- The communication interface is not interrupted when the meter is in test mode.

*** When the incorrect order of meter line phase is detected, the related icon (phase indication) will be flashing as a sign of alarm for such abnormal event.**

*** When the remaining of backup battery is below configured low voltage threshold, the icon of battery indication will be flashing.**

*** The meter supports the backlight function for LCD. When the meter is in the normal operation, pressing the Display Button once can switch ON LCD backlight for 5 seconds.**

5.3 Real Time Clock and Tariff Rate

The meter is equipped with **internal RTC circuit** supported by temperature compensation function. The frequency of RTC is **1Hz** and its accuracy is kept as **0.5s per day with 23°C**.

The switching between the summer and winter time performs automatically and it is possible to define by user. This functionality is possible to switch off. A switch occurs within one minute between the times. The time failure will not change the device's behaviour (resetting, a change of metrological properties, change of tariff, etc.)

RTC is possible to synchronise via the **IR** and **BPL interface**. The RTC is synchronised by **NTP server each 4 hours** and also it is possible to set any time defined by the user using the relevant software.

5.3.1 Tariff rate indication

There are 6 reversed triangle icons to indicate the 6 tariff rate. The active icon shows which tariff rate is selected at at present time of use. The VT and NT assignment on label is as follows: **1.8.2=VT**, **1.8.3=NT**. The remaining two tariffs are **1.8.1** and **1.8.4**.

Planned tariff control is provided using a TOU table recorded in the electricity meter. Any TOU table settings (including seasons, special days, etc.) is included in a single parameterisation file of this TOU. The TOU table can be changed remotely. The TOU table is possible to record

onto the device through parameterisation software and it performs independently of other electricity meter parameterisation.

The tariff is possible to switch at least **12 times** in 24 hours. And it is possible for the user to define at least four seasons in any time interval. It is possible as well to specify switching tariffs for weekends/week days and user-selected special days.

After restoring voltage the switching element (relay) will switch to currently valid state according to the TOU table.

5.4 Program

- Meter's parameter can be re-configured over the BPL power line interface or PC software via **Optical port**.
- Different level password will be required for various group of user to perform above set up.

5.5 Measuring and Monitoring

- Meter can measure, record and display the following measurements for the individual of single phase, such as the voltage, current, power, power factor etc. The measuring accuracy for active power is within $\pm 1\%$.
- Meter can monitor power quality **in real time**, such as Voltage, Power etc. User can pre-set up the limit value for the specific parameter, when the measured value exceed the limit value, the meter report the situation as an Event.

5.6 Record of Event

The events are generated and recoded helping remote monitoring and diagnostic. There are several alarms recorded by the meter as follows:

- Removal of meter housing cover, backup battery/ripple relay cover, and terminal cover.
- Detection of low battery for backup battery.
- Detection of the strong magnetic field around meter.
- Detection of individual phase failure and main power outage.
- Reverse tamper detection.
- Over/under voltage threshold tier and actual voltage recorded when those events occur. Over power threshold notification for contracted operation failure of performing disconnect.

These are extended by the events:

- TOU table change
- Permission to restore supply
- Restoration of supply
- Voltage failure and restoration of voltage
- Removal of terminal cover, phase failure and magnetic field detection

The firmware change and attempts at logging into the device are addressed as follows:

- Meter and SCU firmware/software upgrade have record stored in Data Concentrator database. Once the upgrade process is done, Data Concentrator will generate a report and send to MDM, but the upgrade report is not designed as a metering event.
- Meter login attempts are designed as metering events and stored in Module, later will be retrieved by SCU and then MDM.
- The memory capacity of the event log is 200 events/alarms including timestamp.

5.7 Communication functions

The meter is equipped with **1 Optical port**, **1 RS485 port** and **1 BPL module** with the communication interface over power line. Each port is designed independently so the damage to one port will not impact to other ports' function.

For Optical port, the default Baud rate is **300bit/s**. User can switch to different baud rate. The transmission and reception diode of an optical interface are placed on a common horizontal axis.

For the RS485 port, the baud rate for communications can be configured flexibly, the standard Baud rate is **300bit/s, 600 bit/s, 1200bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s**. The **RS485** only supports passive mode communication.

The communication over optical port and BPL interface will follow "**IEC62056-21**" and other associated standards.

5.8 Output Interface

- Two LEDs (Imp/kWh, Imp/kvarh) output impulses for measuring active power Import/Export and reactive power.
- One LED to indicate the Alarm for critical/fraud event.
- One LED to indicate the status of Relay connection/disconnection.
- One LED to indicate the status of BPL communication.

5.9 Remote control to relay function

The utility can send the command from MDM system remotely to disconnect and reconnect the relay in order of controlling the power supply to end user. The relay is possible to control by meter's button as well while it can be activated or deactivated remotely. Remote control switch from AMM center in accordance with **EN 62056-46 OBIS** code using the object **0.0.24.4.0.255 ic:70** (Disconnect control). Factory set command mode (control mode attribute) 5th.

5.10 Metrological LED

The 'at rest' and 'pulse output proportionate to energy' functions is indicated on this LED. For the 'at rest' state (current lower than build-up current) the diode is permanently off.

Metrological LED and Impulse output

Active energy metering constant Import / Export (optical output - red LED)	1000 imp./kWh	EN 62052-11
Reactive energy metering constant (optical output - red LED)	1000 imp./kWh	EN 62052-11

5.11 Battery backup

The meter is equipped with two backup batteries, the coin battery for RTC and backup battery for backing up. The lifetime of both batteries is at least 10 years. Both batteries are replaceable without breaching the manufacturer's security labels or the necessity to detach the electricity meter from the supply source. The batteries cover is possible to seal.

6. Parametrization

Parametrization is the configuration process of **BPL module to be able to communicate with meter and create meter profiles correctly**. Parametrization is realized by sending the parametrization string (consists of all necessary parameters) to BPL module locally or remotely.

6.1 Local parametrization

The local parametrization is performed through the optical interface and the software that contains the parametrization strings.

6.2 Remote parametrization

For remote parametrization is used software with the remote connection to the meter (BPL module) and the parametrization string is sent to device via telnet/ssh command.

The parametrization string contains the following parameters – meter type, number of phases, complete list of registers, limiter value, daylight saving time, passwords for changing the tariffs/rates and disconnecter control, etc.

7. Profiles

Meter has possibility to record at least **3 profiles** of metering or registered values. Each profile supports the recording of **95 values** (channels). The sampling period inside of load profile can be set from 1 to 60 minutes. The parameters of profiles are statically defined for all. Meters records the following profiles: load profiles, profile of daily register, profile of monthly register. The profiles are archived 90 days for all six channels.

7.1 List of profiles

Type of Profiles	Type	OBIS code
Load	LP15	1.0.99.1.0.255
Daily	LP1440	1.0.99.2.0.255
Monthly	LP43200	1.0.99.3.0.255
Voltage	LP10	1.0.99.4.0.255
Standard Event	EVN1	0.0.99.98.1.255

TOU	LP302	0.0.99.98.2.255
Fraud Detection	EVN3	0.0.99.98.3.255
Power Quality	LP304	0.0.99.98.4.255

8. Firmware upgrade

Meter supports remote firmware upgrade via BPL.

- Customer can monitor the image transfer status in real time.
- Meter supports resuming image transfer from breakpoint.

9. User configuration Software – PC tool

Please refer to the attached extra document – **MeterSoftwarePCGuide.pdf**

10. User Software – Optotool

Please refer to the attached extra document – **OptoTool_5_0_User_manual_SK2.pdf**

11. Installation and Wiring

11.1 Installation

Meter is installed along the wall vertically. The meter is design following **DIN 43857-2 standard** for standardized installation.

The meter is intended to be installed in a Mechanical Environment 'M1', with **Shock and Vibrations** of low significance, as per **2014/32/EU Directive**.

The meter is intended to be installed in Electromagnetic Environment 'E2', as per **2014/32/EU Directive**.

See meter's dimension for installation from **Figure 5** below:

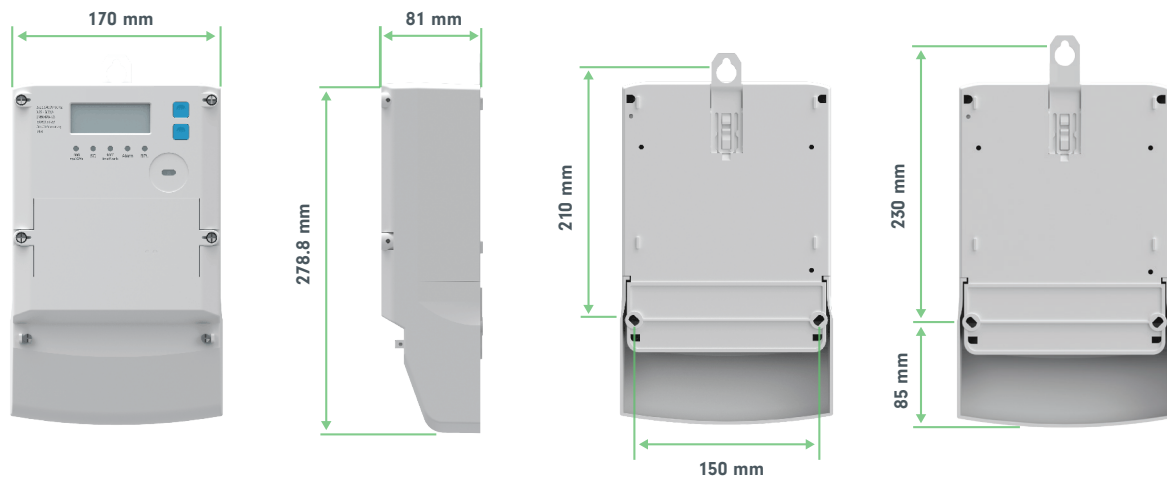


Figure 5. Product dimensions

11.2 Wiring Diagram

In case there are differences, please use the wiring diagram under terminal cover for your reference.

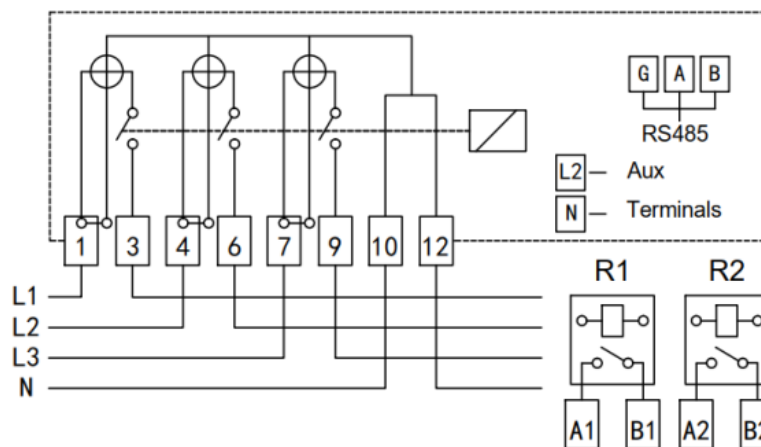


Figure 6. Wiring diagram

12. Transportation and Storage

The meters should be transported only in closed vehicles (carriage, container, hold). Shake acceleration is to be up to **30m/s², 80-120 strikes per minute**.

The meters shall be stored on the shelves with the original package. The highest packaged carton box should less than 5 layers. Storage place shall be clean and tidy without harmful gas or stream, and ambient temperature shall range from -40°C to 80°C and average humidity must not exceed 95%. The meters must be kept and exploited in premises protected from dust, aggressive vapors and gas.