3 Phase Meter – Model EMP1

Basic Meter Versions (without communications)

User Manual

V1.0

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Revision History

Version number	Revisions
1.0	First release

Specification subject to change without notice

Contents

1 Introduction

This manual applies specifically to the non-communicating versions of the EM-Lite 3 phase meter, model type EMP1.

1.1 Purpose

This manual provides the necessary information required to operate the meter when used for its intended purpose:

- Construction, characteristics and functionality.
- Information about possible dangers, their consequences and measures on how to prevent them.
- Detailed description of the tasks to be performed during the life-cycle of the meter (configuration, installation, commissioning, operation and any maintenance).

1.2 Target Group

This manual is aimed at technically qualified electricians and personnel of meter operator companies for installation, commissioning, operation, maintenance, decommissioning and disposal of the meters.

2 Warnings

2.1 Intended Use and Installation

Meters are intended for installation in a in a class E2 electromagnetic environment and Class M1 Mechanical Environment, where shock and vibrations are of low significance, as per 2004/22/EC Directive. For this purpose they are either installed directly onto the distribution companies supply tails as a billing meter or fitted beyond the billing meter as a sub-meter of independent circuits. Meters must be installed in an indoor position either within a residential environment or in an external meter cabinet.

Meters must be fitted by qualified personnel and should be used in accordance with the technical specifications provided here and within associated data sheets. Meters must be installed away from sources of electromagnetic interference.
Meters have no user serviceable parts and must be returned to the manufacturer for repair or maintenance.
Meters must not be installed or used outside of the operation detailed within this manual. Applications of these meters outside of those described are considered as non-intended use.

Meters are classified as Cat III devices according to EN61010-1 2001

2.2 Safety Regulations

Warning - The following safety regulations must be observed at all times. Failure to observe precautions could result in severe physical injury or death:

- This equipment may contain a disconnection switch for interruption of supply. The switch does not provide supply isolation. Means of isolation from the supply must be provided as part of the building installation. Do not work on the equipment unless the supply is isolated. If isolation is made by removal of fuses or other cut-outs, the removed devices must be kept secure from replacement whilst work is performed. If isolation is provided by a switch, the switch shall conform to the requirements of IEC 947-1 and IEC 947-3 or equivalent.
- Overcurrent protection is not provided by the equipment and must be provided as part of the building installation. The maximum overcurrent device rating is 100 Amp at 415 Volts, conforming to the requirements of BS1361, or equivalent.
- Only suitably trained and qualified personnel shall be allowed to work on the equipment. Local safety standards shall be observed and shall take precedence over these regulations in points of conflict.
- The meters must be held securely during installation. They can cause injuries if dropped.
- Meters that have fallen must not be installed. Even if no damage is apparent, meters must be returned to the manufacturer for testing. Internal damage can result in functional disorders or short-circuits.
- The meters must only be cleaned whilst disconnected with a dry cloth without solvent and on no account be cleaned with running water or with high-pressure devices. Penetrating water can cause internal short-circuit.
- A terminal cover protects inadvertent exposure to the meter tail connections. The terminal cover must be fitted prior to energising the electrical supply.

2.3 Responsibilities

It is the responsibility of the meter asset owner to ensure that all persons engaged on meter related work:

- Have read and understood the relevant sections of the user manual.
- Are sufficiently qualified for the work to be performed.
- Strictly observe the safety regulations (according to section 2.2) and the operating information in the individual chapters.

In particular, the owner of the meter bears responsibility for the protection of persons, prevention of material damage and the training of personnel.

3 Meter Overview

This manual covers three models of the EM-Lite EMP1 Three Phase meter range -

EMP1.az	Basic single rate meter version, no outputs
EMP1.av	Basic single rate meter version including a single pulsed output
EMP1.at	Multi-rate version with time of use functionality, two pulsed outputs and auxiliary relay for control of off peak circuits

All models covered in this manual are direct connected and capable of 100A per phase current carrying capacity.

The models are not fitted with a supply disconnection switch.

4 Electrical Rating and General Description

4.1 Meter Ratings

Voltage	
Operating Voltage	230/400V
Operating voltage range	184V to 276V
Maximum operating voltage	276V
Frequency	50 Hz with an operating variation of ± 2%
Network system	Three phase, four wire supply
Current	
Reference Current	Optional reference currents (I_{ref}) of 5, 10 and 20 A
Starting current	Set automatically according to reference current
Max. Current	Rated maximum current (I_{max}) 100A per phase.
Accuracy	
Active energy	Class B according to BS EN 50470-3
Reactive energy	Class 2 according to BS EN 62053-23
Environmental	
Operating temperature	Operating temperature range -25 °C to +55°C, non-condensing humidity.
Ingress Protection	Protected against dust and water ingress to IP54 according to EN 60529
Protection Class	Protection class II according to BS EN 50470
Overload protection	
Voltage Overload	Capable of withstanding a phase to neutral over-voltage of 415V continuously
Current Overload	Capable of passing 145% of its maximum current rating in each line circuit without undue overheating or damage.
Clock (EMP1.at only)	
Type	Mains frequency locked with battery backed crystal cock
Accuracy	Within ±0.5 seconds/day at 23°C Accuracy deviation due to temperature variation from the reference: No more than ±0.15 seconds/per day for each 1°C.

4.2 Terminal configuration

4.2.1 Main meter connections

The terminal layout and lower meter fixings conform to the basic requirements of DIN 43857, excluding terminal spacing.
Main meter terminals are constructed from solid brass and provide an 8.2 mm diameter cable entry allowing meter tails of 25mm^2 cross sectional area to be fitted. Two steel slotted M6 terminal screws are provided in each terminal for cable fixing (optionally, brass screws may be requested).

4.2.1.1 Terminal numbering

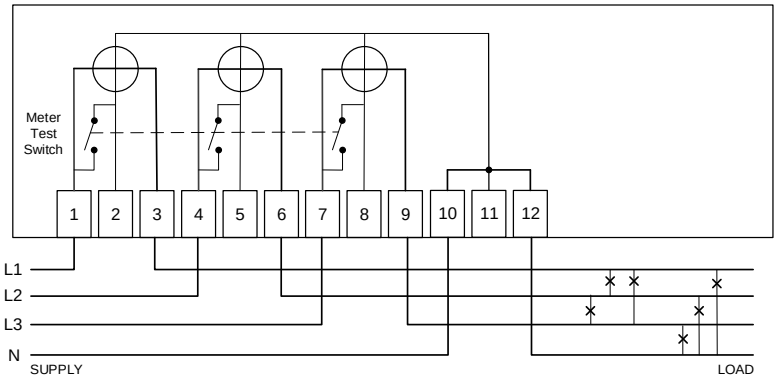
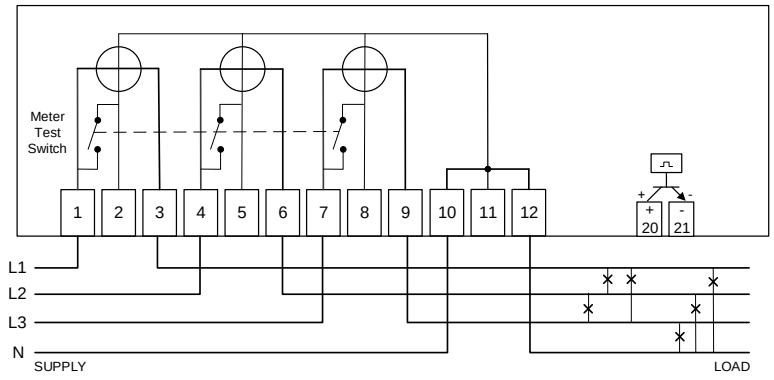
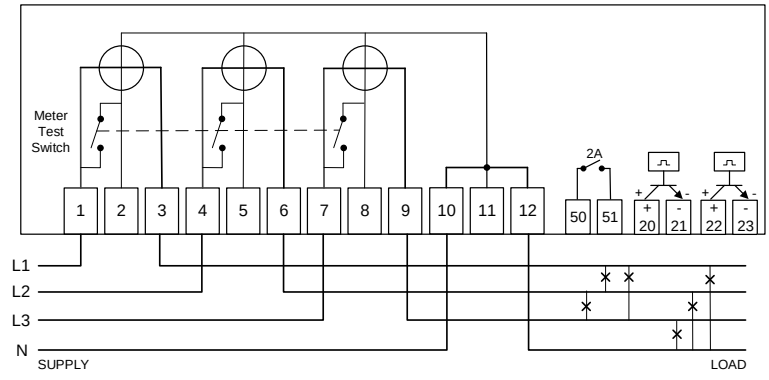
All meter terminals are numbered to aid identification as follows:

Main supply terminals are numbered 1, 3 (L1) 4, 6 (L2) 7, 9 (L3) 10 and 12 (N).

A set of test terminals are included, numbered 2, 5, 8 and 11.

Output terminals are numbered according to output type, see wiring diagrams.

4.2.1.2 Wiring Diagrams

EMP1.az	
EMP1.av	
EMP1.at	

4.2.2 **Pulsed outputs**

Pulsed outputs are available on the EMP1.av and EMP1.at versions of the meter. The outputs may be used to feed pulsed energy information into a building management system or similar.

The outputs are electrically isolated transistor type. The outputs conform to class A, IEC 62053-31. The polarity of each output must be observed when connecting equipment.

Maximum voltage 27Vdc

Maximum current 27mA

4.2.3 **Auxiliary relay**

The EMP1.at meter supports an auxiliary relay for the control off-peak loads. The relay is controlled by the internal time-of-use program.

The auxiliary relay is a normally open, single pole, voltage free contact.

The relay screw terminals allowing connection of up to 4mm^2 cable.

Relay is nominally rated at 230Vac, 2A max.

4.3 **Meter testing**

The reference voltage applied to each metering element may be separated from the current circuit for testing purposes.

A voltage test signal for each metering element may be applied to the test terminals 2 (L1), 5 (L2) and 8 (L3). An additional terminal, 11 is provided for neutral connection.

To isolate the voltage signals from the current circuits a single switch actuator is provided in the terminal block. The switch action isolates all three test terminals from their associated current circuits in one operation.

The switch is moved using a suitable flat bladed screwdriver. The positions are shown in figure 2.

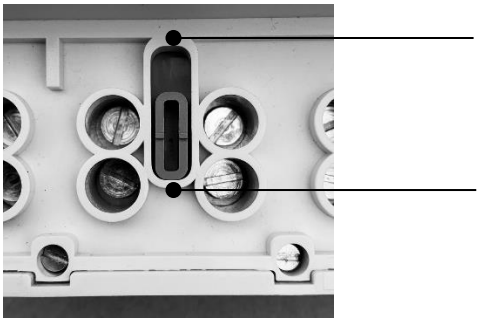


Figure 2 - Meter test switch position

NOTE: The meter test switch must be returned to the normal operating position after testing.

5 Meter installation

The meter is fitted using a hanging bracket situated uppermost on the rear side of the meter and two lower mounting screw points situated either side of the terminal block.

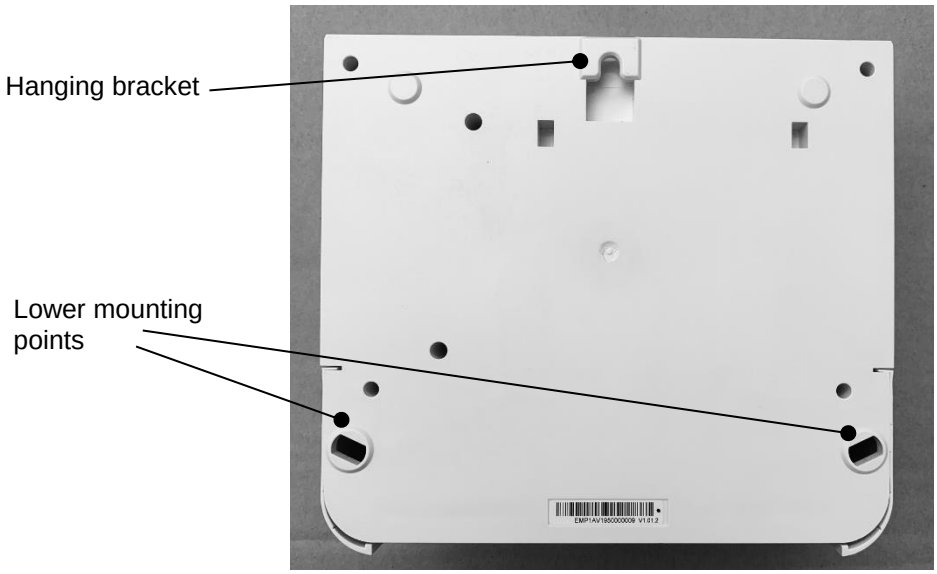


Figure 3 – Meter fixing points

When installing the meter, it should initially be hung from the rear hanging bracket using a suitable round headed screw. The screw depth should be adjusted so that the head fits snugly under the hanging point and the meter is held firmly against the meter board/wall. The meter should be mounted vertically and further secured using suitable screws into the two fixing points under the terminal cover.

5.1 Terminal covers and sealing

A choice of terminal covers are available, short cover and extended cover.

The short cover prevents access to the terminal block only, cables entries are exposed.

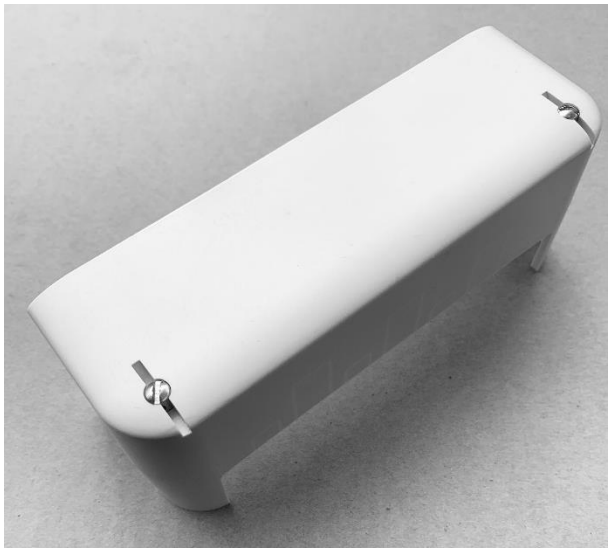


Figure 4 – Short Cover

The extended cover fits over the terminal block and extends 50mm past the cable entry face. The cover may be used to conceal cables entering the meter. A number of breakouts are fitted in the lower edge of the cover, these may be removed with snippers as required.

Figure 5 – Extended Cover

Once fitted, both terminal cover types should be sealed to prevent removal. The fixing screws carry a seal fixing hole allowing a Bowden cable and crimped ferrule seal type to be fitted.

5.1.1 **Finger guard**

As an additional option a finger guard may be installed over the terminal block. The finger guard allows the terminal cover to be removed while preventing access to the main meter terminals and may be used for safe access to the low voltage outputs such as the pulsed output terminals.

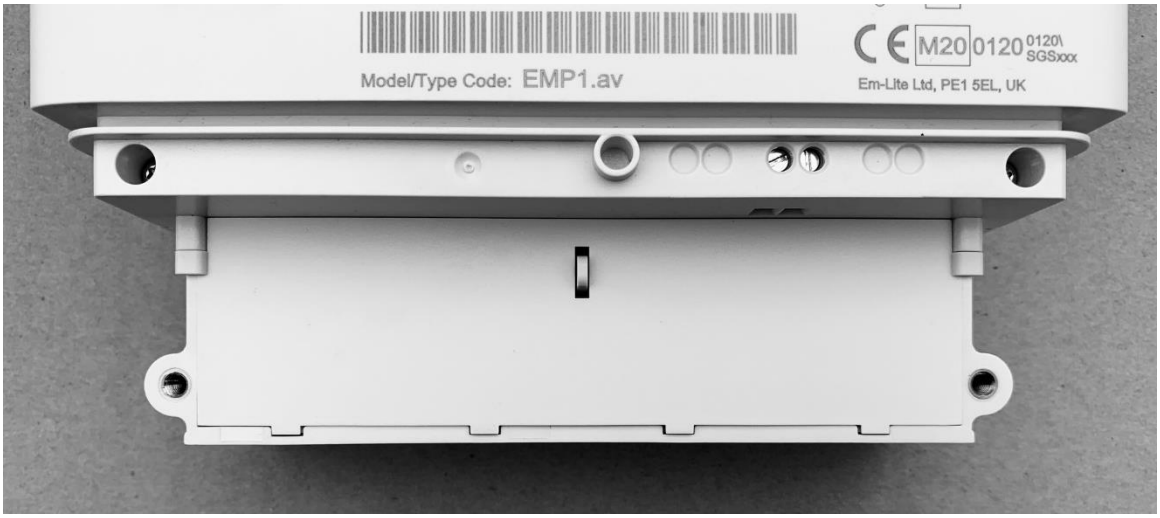


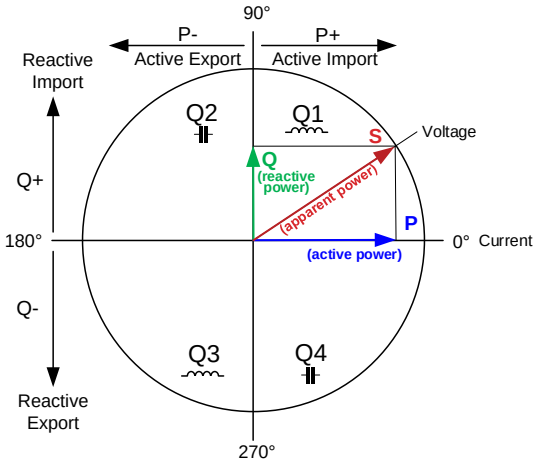
Figure 6 – Finger guard installation

The finger guard should be sealed using the centre fixing by Bowden cable and crimped ferrule.

6 Measured Quantities

6.1 Measured Quantities

The meter measures Active (P) and Reactive (Q) energy over four quadrants. Apparent energy (S) is calculated from these values. Individual phase voltages, currents and quality of supply values are also measured.



The overall energy direction is indicated on the display via an energy direction indicator showing the quadrant of the energy flow.

Energy is recorded in separate registers for each phase and per quadrant. Depending on the meter version, energy may also be recorded across set time periods (time-of-use). Registers may be read though the meter's optical data port or via the display.

6.1.1 Accuracy

For Active energy (kWh), the meter meets the accuracy requirements of class B as defined in BS EN 505470. The meter is approved in accordance to the Metering Instruments Directive (MID).

For Reactive energy (kvarh), the meter meets class 2 as defined in IEC 62053-23.

6.1.2 Metrology Indicator operation

Two separate visible red LED's pulse to indicate energy registration. The LED's indicate as follows:

Active energy (upper LED) - pulses at 1000 impulses/kWh (1Wh/pulse).
Reactive energy (lower LED) - pulses at 1000 impulses/kvarh (1Wh/varh).

Pulse on time is 10ms.

The energy indicated by the metrology LED's is the result of the energy registered across all three phases according to the Measuring Mode.

When no energy is recorded or the recorded energy is of a very low value the meter will enter an anti-creep mode. While in anti-creep mode the metrology indicators are continuously lit and no energy is recorded in the energy registers. An anti-creep threshold value is factory set according to the reference current rating of the meter. The meter will exit anti-creep mode when 1 Wh of energy is recorded.

6.1.3 Test Modes

6.1.3.1 Metrology indication

A set of test modes are available to change the operation of the test Indicators. The test mode is set via the optical port.

When set into a test mode, the operation is automatically cancelled when the supply voltage is removed. The meter reverts to normal operation when the supply voltage is reconnected.

The following test modes may be set by programming the associated test key:

Test Key		Upper indicator	Lower indicator
1	L1 active energy	Pulses for active energy registered on L1 element only	off
2	L2 active energy	Pulses for active energy registered on L2 element only	off
3	L3 active energy	Pulses for active energy registered on L3 element only	off
4	L1 reactive energy	Pulses for reactive energy registered on L1 element only	off
5	L2 reactive energy	Pulses for reactive energy registered on L2 element only	off
6	L3 reactive energy	Pulses for reactive energy registered on L3 element only	off
7	Total active energy	Pulses for total active energy summated on L1, L2 and L3 elements.	off
8	Total reactive energy	Pulses for total reactive energy summated on L1, L2 and L3 elements.	off
9	Revert to normal operation	Pulses for total active energy summated on L1, L2 and L3 elements.	Pulses for total reactive energy summated on L1, L2 and L3 elements.

6.1.3.2 **3 decimal place display mode**

The meter may be programmed to temporarily show energy registration to 3 decimal places (Wh resolution).

The following test displays may be set by programming the associated test key:

Test Key		Display
1	Active energy import	Overrides display list and shows Total Active Import Display to 3 decimal places (Wh resolution)
2	Active energy export	Overrides display list and shows Total Active Export Display to 3 decimal places (Wh resolution)
3	Reactive energy import	Overrides display list and shows Total Reactive Import Display to 3 decimal places (varh resolution)
4	Reactive energy import	Overrides display list and shows Total Reactive Export Display to 3 decimal places (varh resolution)
5	Revert to normal operation	Reverts to configured display list

When the meter is in a 3dp test mode the most significant digit of the register is not shown.

When the supply voltage is removed the test operation is cancelled, the meter reverts to normal operation when the supply voltage is reconnected.

6.2 Total energy registers

The meter records and stores the following total energy registers:

Energy type	Registers	Unit
Active energy	Total active import energy	Internal storage to 1 Wh. Displayed with leading zeros to 999999 kWh
	Total active export energy	
Reactive energy	Total reactive import energy	Internal storage to 1 varh. Displayed with leading zeros to 999999 kvarh
	Total reactive export energy	
Apparent energy	Total apparent import energy	Internal storage to 1 Vah. Displayed with leading zeros to 999999 kVAh
	Total apparent export energy	

Rollover of an energy register to zero occurs when the register increments past its maximum value.

Total registers are summated from the energy measured in each of the 3 phases according to the configured measuring mode

6.2.1 Measuring Modes

The meter operates in one of three measuring modes, defining how the total energy registers are calculated from the energy recorded per phase.

The measuring mode is configured as a factory setting. As a default, a meter will be programmed to the Vector Summation mode otherwise requested.

The measuring mode are described in the following sections.

6.2.1.1 Measuring mode 1: Vector Summation

This mode simulates the operation of a Ferraris disk meter and assumes one or more of the phases are capable of reverse running e.g. due to local generation.

The total import or export registers are advanced by the vector addition of the energy in the three phases. When the vector sum of the three vectors L1, L2 and L3 is positive the energy is added to the import energy register. If the vector sum of the three phases is negative the energy is added to the export register. Only one of the import or export total registers will therefore advance at any time.

6.2.1.2 Measuring mode 2: Magnitude summation

Mode 2 advances the total registers according to the sign of each phase's energy value. Phases recording positive (import) energy are summed and added to the total import register.

Phases with negative signs (export) are also summed and added to the total export register.

Both import and export total registers may advance at any one time and assumes the reverse running is capable due to local generation. The metrology LED will only indicate import energy.

6.2.1.3 Measuring Mode 3: Unidirectional

This mode may be used to detect and deter energy fraud (fraud attempts to turn meter backwards) where no export energy is possible. The export register may be used to determine the amount of fraud attempted.

Mode 3 adds all energy into the total import register irrespective of the energy sign. Phases with positive signs are added to import register, phases with negative signs are also added to the import register. Phases with –signs are independently added into the export register.

6.3 Energy registers per quantity

The meter stores the following additional energy registers.

Registers are stored internally to 9 digits for Wh and varh (to 999999.999 kWh, kvarh). Rollover to zero occurs when the register increments past this value.

6.3.1 Total energy per phase

Energy type	Registers	Unit
Active energy, import	Active import energy, phase L1	Internal storage to 1 Wh Displayed with leading zeros in kWh units
	Active import energy, phase L2	
	Active import energy, phase L3	
Active energy, export	Active export energy, phase L1	
	Active export energy, phase L2	
	Active export energy, phase L3	
Reactive energy, import	Reactive import energy, phase L1	Internal storage to 1 varh Displayed with leading zeros in kvarh units
	Reactive import energy, phase L2	
	Reactive import energy, phase L3	
Reactive energy, export	Reactive export energy, phase L1	
	Reactive export energy, phase L2	
	Reactive export energy, phase L3	

6.3.2 Total energy per quadrant

Energy type	Registers	Unit
Active energy	L1 Active energy, Quadrant 1	Internal storage to 1 Wh (not a displayed value)
	L1 Active energy, Quadrant 2	
	L1 Active energy, Quadrant 3	
	L1 Active energy, Quadrant 4	
	L2 Active energy, Quadrant 1	
	L2 Active energy, Quadrant 2	
	L2 Active energy, Quadrant 3	
	L2 Active energy, Quadrant 4	
	L3 Active energy, Quadrant 1	
	L3 Active energy, Quadrant 2	
	L3 Active energy, Quadrant 3	
	L3 Active energy, Quadrant 4	
Reactive energy	L1 Reactive energy, Quadrant 1	Internal storage to 1 varh (not a displayed value)
	L1 Reactive energy, Quadrant 2	
	L1 Reactive energy, Quadrant 3	
	L1 Reactive energy, Quadrant 4	
	L2 Reactive energy, Quadrant 1	
	L2 Reactive energy, Quadrant 2	
	L2 Reactive energy, Quadrant 3	
	L2 Reactive energy, Quadrant 4	
	L3 Reactive energy, Quadrant 1	
	L3 Reactive energy, Quadrant 2	
	L3 Reactive energy, Quadrant 3	
	L3 Reactive energy, Quadrant 4	

6.3.3 **Time-of-Use Registers**

EMP1.at model version only. The meter records and stores active and reactive energy across set time periods.

Energy type	Registers	Unit
Rated active import energy	Rate 1 Active import energy	Internal storage to 1 Wh Displayed with leading zeros in kWh units
	Rate 2 Active import energy	
	Rate 3 Active import energy	
	Rate 4 Active import energy	
	Rate 5 Active import energy	
	Rate 6 Active import energy	
	Rate 7 Active import energy	
	Rate 8 Active import energy	
Rated active export energy	Rate 1 Active export energy	
	Rate 2 Active export energy	
	Rate 3 Active export energy	
	Rate 4 Active export energy	
	Rate 5 Active export energy	
	Rate 6 Active export energy	
	Rate 7 Active export energy	
	Rate 8 Active export energy	
Rated reactive import energy	Rate 1 Reactive import energy	Internal storage to 1 varh Displayed with leading zeros in kvarh units
	Rate 2 Reactive import energy	
	Rate 3 Reactive import energy	
	Rate 4 Reactive import energy	
	Rate 5 Reactive import energy	
	Rate 6 Reactive import energy	
	Rate 7 Reactive import energy	
	Rate 8 Reactive import energy	
Rated reactive export energy	Rate 1 Reactive export energy	
	Rate 2 Reactive export energy	
	Rate 3 Reactive export energy	
	Rate 4 Reactive export energy	
	Rate 5 Reactive export energy	
	Rate 6 Reactive export energy	
	Rate 7 Reactive export energy	
	Rate 8 Reactive export energy	

6.4 **Power**

Parameter	Registers	Unit
Active power (instantaneous value)	System active import power	Internal storage as W Displayed in kW units
	Active import power, phase L1	
	Active import power, phase L2	
	Active import power, phase L3	
	System active export power	
	Active export power phase L1	
	Active export power phase L2	
	Active export power phase L3	

Values are averaged and refreshed every one second.

System active power is the summation of the power values in the 3 phases.

7 Power Quality

The following power qualities are measured.

Item	Register objects	Unit
Voltage (instantaneous value, phase to neutral)	Voltage, phase L1	Internal recording to 0.1V Displayed to xxx.x V
	Voltage, phase L2	
	Voltage, phase L3	
Current (instantaneous value)	Current phase L1	Internal recording to 0.1A Displayed to xxx.x A
	Current phase L2	
	Current phase L3	
Frequency	Network frequency	Internal recording to 0.1Hz Displayed to xx.x Hz

All values are recorded into separate registers and may be read through the optical port.

Values are averaged and refreshed every one second.

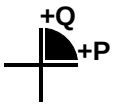
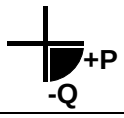
RMS voltage is measured phase to neutral.

8 Functional

8.1 Display operation

8.1.1 Energy direction indicator

An energy direction indicator provides an instantaneous indication of the direction of the energy measured by the meter. The indicator shows the direction of energy as a summation across the three phases. When current is flowing, the indicator shows the resulting quadrant, see Measured Quantities section.

Energy direction	Indicator
Quadrant 1 (active import, reactive import)	
Quadrant 2 (active export, reactive import)	
Quadrant 3 (active export, reactive export)	
Quadrant 4 (active import, reactive export)	
No current flowing (or in anti-creep)	

8.1.2 Phase supply indicators

Phase indicators are shown when a supply voltage (above 100V) is connected to the corresponding phase. When all phases are below 100V the meter remains in a low power mode and displays ‘Lo’. If one or more phases are above 100V but a phase is supplied with voltage below this value the indicator is not shown for that phase, denoting a phase outage.

Phase	Indicator
Supply voltage supplied to L1	
Supply voltage supplied to L2	
Supply voltage supplied to L3	

8.1.3 Display list configuration and display advance

All meter versions may be configured with display list which may be manually our automatically cycled depending on the meter version. The EMP1.at meter is fitted with a push button to allow the user to manually cycle through the display list. The EMP1.az and .av versions are not fitted with a push button. Meter versions without push button are typically configured without a display list and only the Total Import energy display shown.

8.1.3.1 Push button advance

Two display cycles are available in the meter, a normal (consumer) display cycle and an extended (engineering) display cycle. Each display list holds references for up to 32 displays and defines the content and the sequence of each display cycle.

The first position in the normal display cycle defines the normal operating display (shown when no push button advances have been made). The normal display cycle is advanced by a short press of the display cycle button or may be set to auto-cycle, advancing automatically.

The extended display is gained by a long press (3 seconds) of the display button. Once selected, the extended cycle is advanced by further short presses of the display cycle button. The meter returns to the normal operating display either by a further long press or a display timeout.

Upon reaching the end of either display list the ‘Display End’ message is shown. The meter will return to the beginning of the list.

If there are no button presses for 30 seconds a display timeout will occur and the display will return to the normal operating display

8.1.3.2 **Auto-cycling display**

An auto-cycling feature automatically advances through the normal display cycle with a set time period between each advance. The duration before advancing is configurable, between 1 and 30 seconds. When the display is configured to auto-cycle only the display list is shown, the ‘End’ message is omitted at the end of the cycle.

The auto-cycling feature may also be used in conjunction with a push button (if fitted). A short press of the display button during auto-cycling will advance the cycle one position; a long press will enter the extended display cycle.

When entering the extended cycle, the extended display list will be auto cycled at the set duration until the final display is shown, after this the ‘End’ message is shown and the display returns to the normal operating display. While in the extended display, a short press of the display button will advance the cycle one position.

A value of 0 set into the auto-cycling time value disables the auto-cycling function and push button cycling is used.

8.1.4 **Display resolution**

For normal operation, the energy registers may be configured to one of the following resolutions:

a) 6 whole numbers + 2 decimal places;
b) 6 whole numbers + 1 decimal place; or
c) 6 whole numbers only.

The meter may be configured to 3 decimal places by special test key - for testing purposes only.

8.1.5 **Backlight operation**

The EMP1.at meter version is fitted with a display backlight.

The backlight may be configured to operate according in one of the following modes:

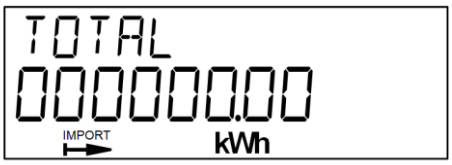
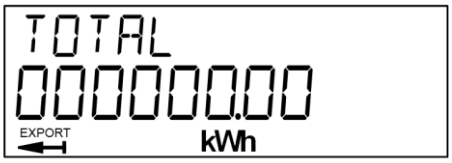
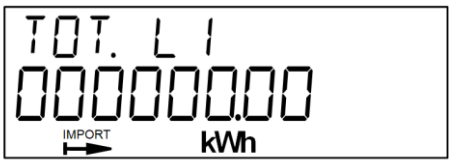
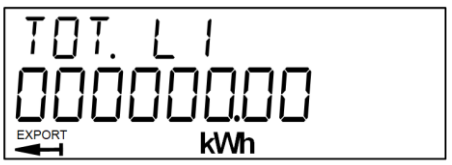
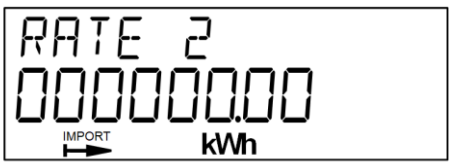
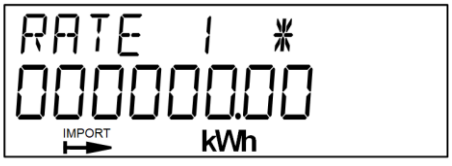
a) Automatic - When the display button is pressed the backlight illuminates. The display will advance one position on the button press as normal. The backlight remains on between 1-30 seconds (configurable) after the last button press;
b) Always on (backlight time set to 255); or
c) Always off (backlight time set to 0).

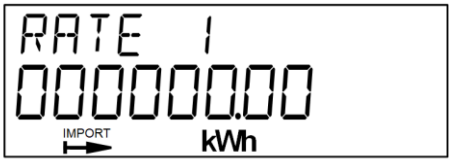
8.1.6 **Displayed items**

A description and the format of all available display types is provided in this section.

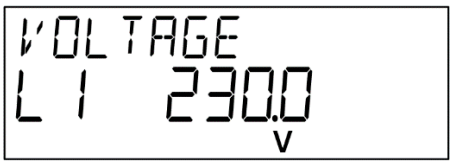
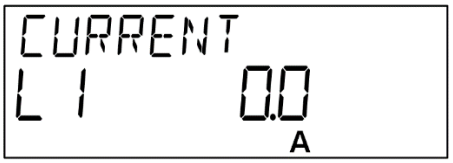
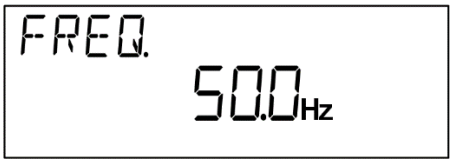
Instantaneous values are updated every second, energy registers are updated as the energy value changes by the least significant digit displayed.

8.1.6.1 Energy register display formats

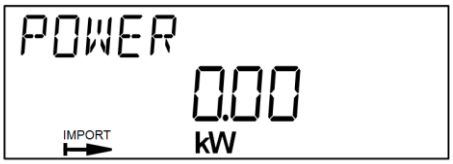
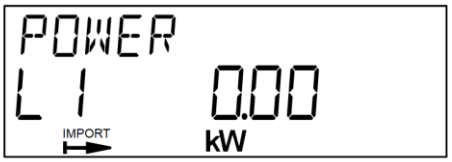
Total active import Register shown to 6 whole numbers with leading zeros. Decimal places as configured	
Total active export Register shown to 6 whole numbers with leading zeros. Decimal places as configured	
Active import per phase Separate displays for L1, L2, L3 values. Register shown to 6 whole numbers with leading zeros. Decimal places as configured.	
Active export per phase Separate displays for L1, L2, L3 values. Register shown to 6 whole numbers with leading zeros. Decimal places as configured.	
Total reactive import Register shown to 6 whole numbers with leading zeros. Decimal places as configured.	
Total reactive export Register shown to 6 whole numbers with leading zeros. Decimal places as configured.	
Reactive import per phase Separate displays for L1, L2, L3. Register shown to 6 whole numbers with leading zeros. Decimal places as configured.	
Reactive export per phase Separate displays for L1, L2, L3 values Register shown to 6 whole numbers with leading zeros Decimal places as configured	
Time-of-use rate Separate rate registers for eight TOU rates are configurable into the display cycle. Register shown to 6 whole numbers with leading zeros. Decimal places as configured. When the rate is active, an additional asterisk is shown against the rate identifier.	 

Active rate display The active rate display can be configured as the default display. The register shows the active TOU rate and the register value for the rate. An asterisk is not shown.	

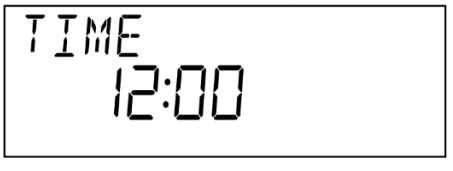
8.1.6.2 Power quality displays

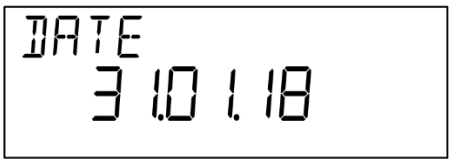
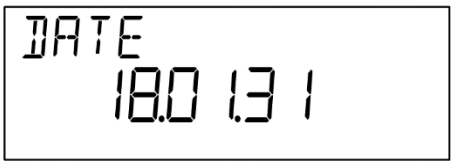
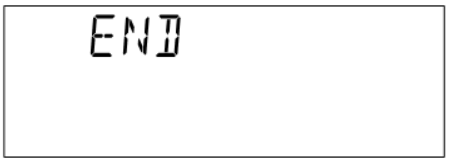
Voltage per phase Separate displays for L1, L2 and L3 values. Voltage displayed to 1 decimal place. No leading zeros.	
Current per phase Separate displays for L1, L2 and L3 values. Current displayed to 1 decimal place. No leading zeros.	
Frequency Network frequency value. Frequency displayed to 1 decimal place. No leading zeros.	

8.1.6.3 Power

Overall active power Power shown to 2 decimal places. Import/export indicator changes dynamically as overall direction changes.	
Active power per phase Separate displays for L1, L2, L3 values. Import/export indicator changes dynamically as direction changes. Power shown to 2 decimal places.	
Overall reactive power Power shown to 2 decimal places. Import/export indicator changes dynamically as overall direction changes.	
Reactive power per phase Separate displays for L1, L2, L3 values. Import/export indicator changes dynamically as direction changes. Power shown to 2 decimal places.	

8.1.6.4 Other displays

Time Present time in meter (with automatic correction for daylight saving if set).	

Date Present date in meter. Two separate displays to allow the date to be available in two formats: DD-MM-YY YY-MM-DD	 
User configurable message (Tariff name) Configurable message content, see 8.1.7	
All segments on Test display with all segments shown.	
Display End Denotes the end of the display cycle	

8.1.7 **User configurable message**

A user configurable message for purposes such as describing the meter tariff configuration may be added to either the normal or extended display list.

Both lines of the display may be configured, the upper line may be configured with alpha numeric characters, the lower line numeric characters. Both lines hold up to eight characters each.

For the upper line the message may be constructed from the following character set:

A B C D E F G H I J K L M N O P Q R 5 T U V W X Y Z 1 2 3 4 5 6 7 8 9 0 -

For the lower line a message can be generated from the character set;

1 2 3 4 5 6 7 8 9 0 -

In both lines a space character is supported.

When the message display is entered into a display list but the message content is not configured a blank display will be shown.

8.2 Pulsed output operation

Up to two pulsed outputs may be supported depending on meter version:

EMP1.av supports one pulsed outputs terminating at terminals 20 and 21

EMP1.at supports two pulsed outputs terminating at terminals 20, 21 and 22, 23

The pulsed outputs may be configured as follows:

Pulsed output (terminals)	20, 21	22, 23
Energy type	Active Import only	Reactive Import or Active Export (configurable)
Number of pulses per kWh/kvarh unit	1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 100, 125, 200, 250, 500 or 1000 (configurable)	
Duration	1 – 255 20ms steps (configurable 20ms to 5.1seconds per pulse)	

8.3 Time-of-use

The EMP1.at meter supports a seasonal time-of-use tariff structure with the following features:

a) 8 Time-of-use (ToU) rate registers
b) 4 user defined seasons
c) Summer/Winter seasonal switching
d) Day-of-week switching
e) 40 switching times
f) Daylight saving correction

8.3.1 Rate registers

The meter supports 8 ToU rates, each rate is independently time controlled. When a particular ToU rate becomes active, the meter records energy (active import, active export, reactive import and reactive export) into separate ToU registers relating to the active rate.

8.3.2 Time switches

ToU rate switching is controlled by a time switching plan holding 40 time switches. Each programmed time switch defines the time at which a particular rate or settings will become active. The time switches also control the state of the auxiliary relay.

Time switches may be configured to operate during particular seasonal periods or on particular days of the week.

Each Time Switch may be configured with the following information:

Item	Description
Start Time	Time in HH:MM 24hr clock format at which the time switch becomes active.
ToU active rate (1 to 8)	Defines the ToU rate that will become active at the start time.
Active season (Summer, Winter, or user defined seasons 1, 2, 3 or 4)	Defines the period of the year when the time switch should operate. Selecting both summer and winter seasons defines all year operation. Seasons may be defined as summer/winter or with specific start dates, see Season 8.3.3
Active day of the week	Defines the day(s) of the week the time switch should operate (Mon-Sun, true or false). Any combination of days are allowed (provides flexibility for separate Weekday/Weekend switching regimes)
Relay Operation	Controls the operation of the auxiliary relay which may be closed for the duration of the time switch. (The switching plan allows for the operation of two auxiliary relays available in other EMP1 meter versions)

Where no Time switch settings are made, ToU rate 1 will be always be active, any energy measured being recorded in the rate 1 registers.

8.3.2.1 Examples of TOU operation

Standard 7 hour off peak time switch plan

Time switch	Start	Active Rate	Seasons	Operational days of week (true 1, false 0)							Relay operation (on 1, off 0)	
				M	T	W	T	F	S	S	RLY1	RLY2
1	00:00	1	S,W	1	1	1	1	1	1	1	1	N/A
2	07:00	2	S,W	1	1	1	1	1	1	1	0	N/A

Off peak rate (1) from midnight to 07:00, standard rate (2) for remainder of day. Operates every day, all year.

The auxiliary relay closes during off peak time.

Weekend/Weekday Time Switch plan

Time switch	Start	Active Rate	Seasons	Operational days of week (true 1, false 0)							Relay operation (on 1, off 0)	
				M	T	W	T	F	S	S	RLY1	RLY2
1	00:00	1	S,W	1	1	1	1	1	0	0	1	N/A
2	07:00	2	S,W	1	1	1	1	1	0	0	0	N/A
3	00:00	3	S,W	0	0	0	0	0	1	1	0	N/A

Off peak rate (1) from midnight to 07:00, standard rate (2) for remainder of day, operating on weekdays only, all year. Weekend tariff rate (3) from Sat 00:00 all weekend until 00:00 Mon. Auxiliary relay closes during off peak night time.

Summer/ Winter Seasonal switching plan

Time switch	Start	Active Rate	Seasons	Operational days of week (true 1, false 0)							Relay operation (on 1, off 0)	
				M	T	W	T	F	S	S	RLY1	RLY2
1	00:00	1	W*	1	1	1	1	1	1	1	1	N/A
2	09:00	2	W*	1	1	1	1	1	1	1	0	N/A
3	00:00	1	S*	1	1	1	1	1	1	1	1	N/A
4	07:00	2	S*	1	1	1	1	1	1	1	0	N/A

* Season settings – set to change as per European daylight savings dates

Winter season provides additional two hours off peak during winter season.

Seasonal Switching plan

Time switch	Start	Active Rate	Seasons	Operational days of week (true 1, false 0)							Relay operation (on 1, off 0)	
				M	T	W	T	F	S	S	RLY1	RLY2
1	00:00	1	Season 1*	1	1	1	1	1	1	1	1	N/A
3	01:00	1	Season 2*	1	1	1	1	1	1	1	1	N/A
4	09:00	2	Season 2*	1	1	1	1	1	1	1	0	N/A

* Season settings - season 1 – starts 1st November, Season 2 – Starts 1st February

Off peak winter tariff. Off peak rate (1) is active all winter season 1st Nov- 1st Feb. During summer season off peak rate (1) every day from 01:00 to 09:00, standard rate (2) for remainder of day. Auxiliary relay closed during off peak rate.

8.3.3 **Seasonal Switching**

Two types of seasonal switching are available:

a) User defined seasons
b) Summer/Winter Seasons.

8.3.3.1 **User Defined Seasons**

User defined seasons allow up to four seasons to be specified by start date and month.

Season	Start day and month
1	DD/MM
2	DD/MM
3	DD/MM
4	DD/MM

A season becomes active at 00:00 of the specified start date:

Start Month is represented by a value 1 to 12, January = 1, December =12. Start dates use a value 1 to 31.
A season setting shall be invalid if a non-legal month or date value is used.

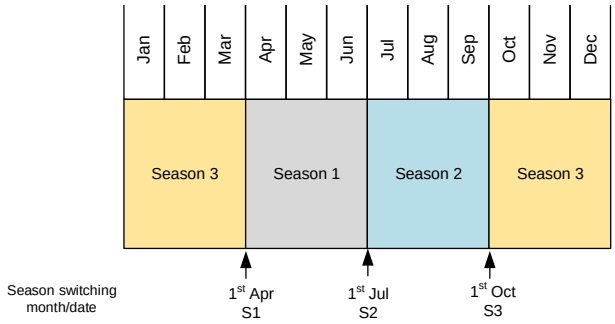
Time switch settings may be applied to any of the user defined seasons. A season will be active until a new season begins. The settings will be applied every year.

A separate ‘Enable Programmable Seasons’ setting is used to enable user defined season operation. The setting is part of the Options setting. User defined seasonal switching may also be disabled by using a default date setting.

8.3.3.2 **Example of user defined seasons**

The diagram below shows the configuration of three seasons:

Season 1: begins starts 1st April (operational from April – end June);
Season 2: begins 1st July (operational from July – end September);
Season 3: begins 1st October (0operational October - end March).



Season numbers 1 to 3 are applied to the time switch settings to apply the time switch to a season.

8.3.3.3 **Summer/Winter seasons**

Summer/Winter season start dates follow the dates set for Daylight Saving Time correction, see 8.4.2.

Daylight Saving settings may be configured without enabling time correction allowing seasonal switching only when time correction is not required.

Summer/winter seasons are applied to a time switch by setting the required summer or winter season in the time switch to true.

8.4 Clock

8.4.1 Mains locked clock

The meter is standardly configured (unless otherwise requested) to run a mains locked clock on 50 Hz networks. When running the mains locked clock, it should be ensured that the network frequency is maintained to an average 50Hz over a long term period

The mains locked clock function counts the cycles of the mains frequency to derive a one second time signal. On power up (or when the mains locked clock is first enabled) the meter retrieves the time from the battery backed crystal clock and advances the mains locked clock by one second each time 50 mains cycles is counted. Once every 24 hour period, or on power down, the meter will write the calculated time to the battery backed clock.

8.4.2 Daylight saving

The meter may be configured to support daylight saving time (DST) correction.

The start and end date for DST correction is configured through the Summer/Winter season settings, see 8.3.3.3.

DST time correction has a separate enabling option to allow the Summer/winter seasonal settings to operate independently, with or without DST time correction.

When DST time correction settings are applied, the displayed time will automatically correct for DST correction.

ToU time switches follow local time and therefore will operate with DST correction when applied.

DST settings may be programmed with the following settings:

	Date (Day of Month)	Month	Day of Week	Hour	Minute
Summer Start	1-254	1-12	1-7 & 255	0-23	00-59
Summer End	1-254	1-12	1-7 & 255	0-23	00-59

Item	Description
Date (day of month)	Used to specify a particular or the last day of the month the daylight saving starts or ends: A value of 1 to 31 specifies the exact date within the month the season starts/ends. Selecting the last day of the month - A value of 254 specifies the season starts/ends on a last day of the month. The setting is used in conjunction with the Day of Week setting: Setting Date to 254 and the Day of Week between 1 and 7 results in the season starting/ending on the last Monday to Sunday in the month. Setting Date to 254 and Day of Week to 255 corresponds to the season starting/ending on the last day of the month. A Date value of 253 corresponds to the second last day of the month if Day of Week is set to 255 or second last day type of the month (Mon-Sun) if Day of week is set 1 to 7, etc.

Month	The month that daylight saving starts / ends. January is represented by a value of 1, December a value of 12.
Day of Week	Specifies the day of week where Monday is 1 and Sunday is 7. A value of 255 specifies last day of month when used in conjunction with Date setting 254, see above.
Hour/Minute	Specifies time in hour/minutes.

Time is advanced during summer season by a DST deviation value. The Deviation value is a signed value of ±120 minutes. Default value is +60 minutes (advance clock 1hour).

A separate DST correction setting is used to enable the DST correction of the meter clock time. The setting is part of the 'Options' setting.

8.4.2.1 **DST setting example**

To set standard European DST settings:

Summer Start: Last Sunday in March, time move forwards 1 hr at 01:00

Summer End: Last Sunday in October, time moves backwards 1 hr at 01:00

	Date (Day of Month)	Month	Day of Week	Hour	Minute
Summer Start	254	3	7	01	00
Summer End	254	10	7	01	00

9 Decommissioning and disposal of meters

At the end of the meter's usable life, the product should be sent to a professional electronic waste treatment company for processing and recycling. The product can be easily dismantled into its major components to aid recycling. Major plastic parts are stamped with the plastic material used.

9.1 Materials

The materials used in the product breakdown into the following categories:

Component part	Material	Percentage of product (by weight)
Outer plastic casework	Polycarbonate plastic	37%
Electrical terminals and associated metalwork	Brass/copper	46%
PCB assembly	Mixed electronic components	16%
Battery	Lithium coin cell	<1%

The EMP1.at meter contains a lithium battery (coin cell) which should be removed from the main printed circuit board assembly. Lithium cells must be handled carefully to avoid the risk of short circuit, overheating and fire.

9.2 Component disposal

The following disposal advice is for general guidelines only; Local environmental laws and policies must always take precedence, the recycling of component parts should always be carried out in accordance with local regulations. Waste treatment plants should always be approved by local authorities.

Wherever possible, component parts should be treated as follows:

Component part	Disposal advice
Outer plastic casework	Material should be sorted and re-granulated
Electrical terminals and associated metalwork	Sorted and sent to a metals recycling facility.
PCB assembly	Sent for recycling at specialist electronic waste plants
Battery	Removed from the PCB assembly and delivered to a specialist recycling plant. Note handling caution above.

The product should not be disposed of in landfill or with other regular waste.

10 Dimensions

10.1 Short terminal cover

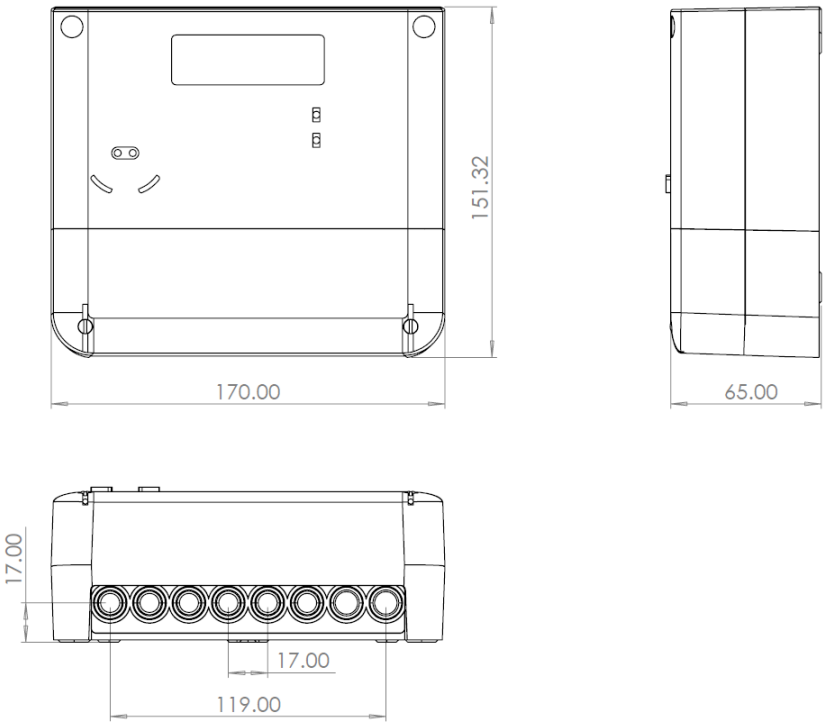


Fig. 7 - EMP1.az and EMP1.av dimensions when fitted with short terminal cover

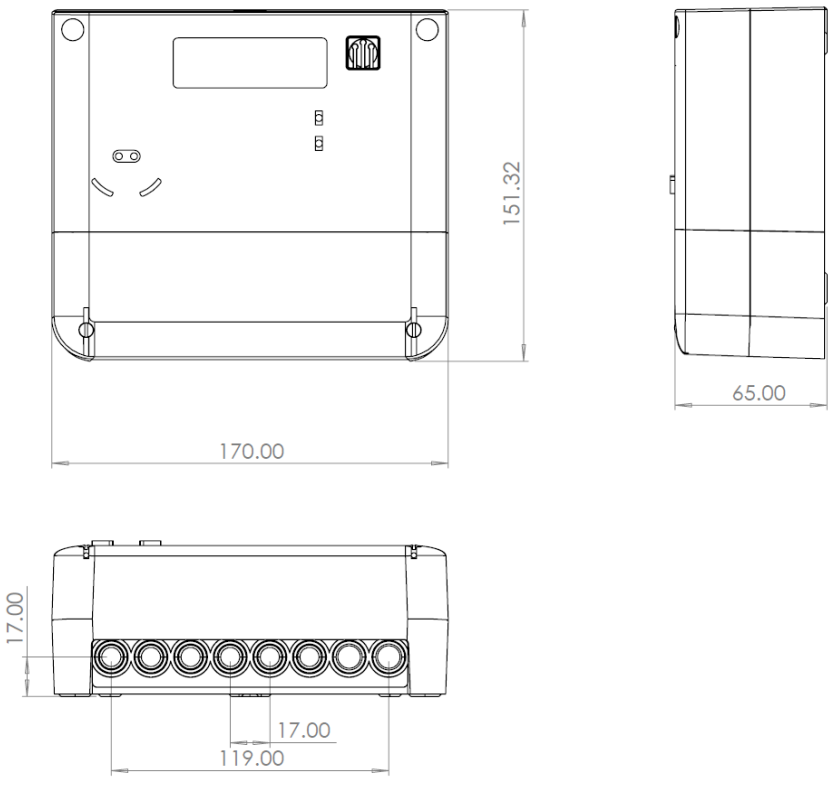


Fig. 8 - EMP1.at dimensions, short cover

10.2 **Extended terminal cover**

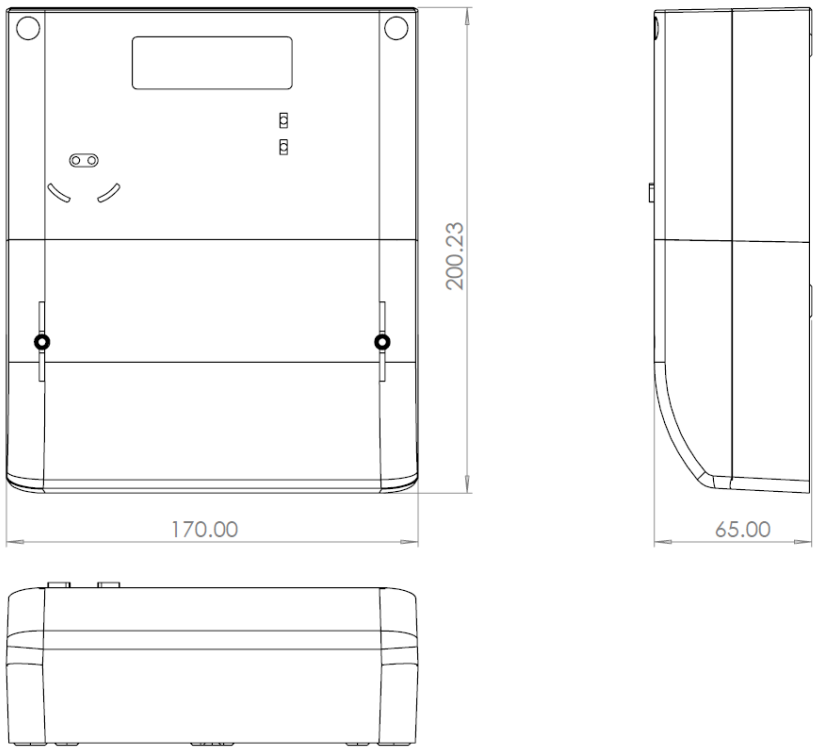


Fig. 9 - EMP1.az and EMP1.av dimensions when fitted with extended terminal cover

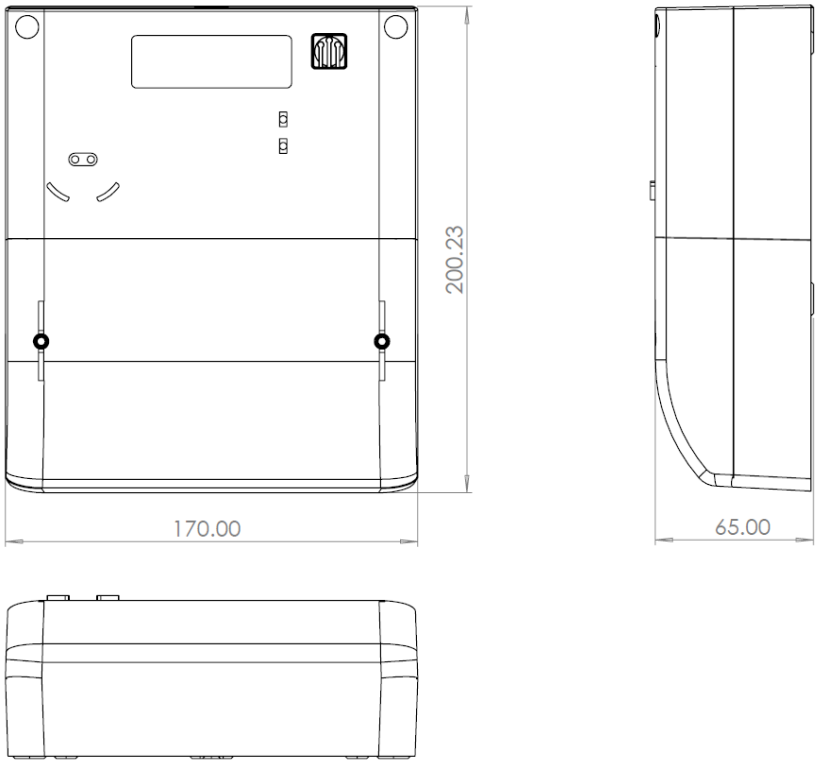


Fig. 10 - EMP1.at dimensions, extended cover