ISKRAEMECO Energy Measurement and Management

ME172

Single-Phase Multifunction Meter

Technical Description

Version 1.7, 03.03. 2011

CE

Index:

ME172 - Electronic single-phase time-of-use kWh-meter

The ME172 electronic single-phase meters are designed for measurement and registration of active energy and demand in single-phase two-wire networks for direct connection. The metering and technical properties of the meters comply with the EN 50470-1 and -3 European standards classes A and B as well as with the IEC 62053-21 and IEC 62052-11 (former IEC 61036) international standards for electronic meters of active energy for classes 2 and 1.

A built-in time switch complies with the IEC 62054-21 and IEC 62052-21 standards. It enables energy registration in up to four tariffs.

The meters are designed and manufactured in compliance with the ISO 9001 standard.

ME172 meter properties:

- **Meter of active energy**
  - Accuracy class 1 or 2
  - Accuracy class A or B by EN 50470-1
  - Demand measurement
  - Maximum current measurement
- **Modes of energy measurement and registration**
  - For one-way energy flow direction (import), with an electronic reverse running stop
  - For two energy flow directions (import, export)
  - For one-way energy flow direction, with always positive registration, i.e. energy flowing in the export direction is registered as it flows in import direction too
- **Meter quality:**
  - Due to high accuracy and long term stability of the metering element no meter recalibration over its life-time is required
  - Long meter life-time and high meter reliability
  - High immunity to EMC
- **Time-of-use registration (up to 4 tariffs):**
  - Tariffs change-over by internal real-time clock
- **Load-profile recorder for up to more than 700 days, 1 channel and 1 hour (option)**
- **LCD:**
  - 7-segment, with 7 + 4 characters, indicators of active tariff - 4 signal flags of active tariff (T1, T2, T3, T4), 4 signal flags for indicating different meter state and alarms and two arrows for indication of energy flow-direction.
  - wide view angle and back-light
  - Optional no-power data display
- **Data display modes:**
  - Automatic cyclic data display with adjustable display time
  - Manual data display mode (by pressing the Scroll pushbutton)
- **Indicators:**
  - **LCD:**
    - Valid tariff at the moment
    - Meter status and alarms
    - Energy flow direction

- **LED**:
  - Imp / kWh

- **Communication channel:**
  - Infrared optical port in compliance with the IEC 62056-21 for local meter programming and data down-loading
  - RS485 interface (option)
  - IEC 62056 - 21, mode C protocol
- **Two pushbuttons:**
  - For data scrolling
  - For manual billing reset of the meter
  - For manual parameters setting
- **Pulse output:**
  - Class A by IEC 62053-31 (option)
  - Optomos relay with make contact (option)
- **Antifraud protection:**
  - Absolute energy measurement (option)
  - Metering element in neutral circuit (option)
  - Single-wire measurement
  - Reversed energy flow detector
  - Meter cover opening detector
  - Terminal cover opening detector
  - External magnet field detector
  - Hardware and software protection for programming
- **Plastic meter case:**
  - Made of high quality self-extinguishing UV stabilized material, that can be recycled
  - Double insulation
  - IP54 protection against dust and water penetration (by IEC 60529)

1. Meter appearance

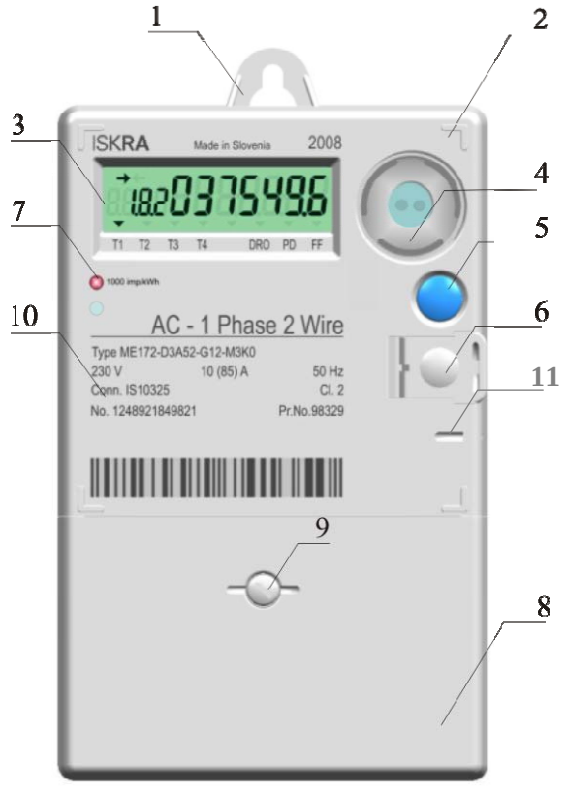
1.1. Meter case

A compact meter case consists of a meter base with a terminal block and two fixing elements for mounting the meter, a meter cover and a terminal block cover. The meter case is made of self-extinguishing UV stabilized polycarbonate which can be recycled. The meter case ensures double insulation and IP54 (IEC 60529) protection level against dust and water penetration.

The meter cover is made of polycarbonate. It is permanently stuck to the meter base so that access to the meter interior is not possible. Meter data are engraved in the meter cover.

An iron ring is positioned in the right top corner and is used for attaching an optical probe to the optical port. Two pushbuttons are positioned on the right side of the meter cover. The blue one (5) is always accessible and is used for data scrolling on the LCD. The covered blue pushbutton (6) can be sealed and is used for resetting the meter.

On request an element with a third fixing hole can be attached to the back side of the meter base.



(1) Hanger
(2) Meter cover (permanently stuck to the meter base)
(3) LCD display
(4) Optical port
(5) Scroll push-button
(6) Covered Reset push-button
(7) LED imp/kWh
(8) Terminal block cover
(9) Terminal cover plastic stopper
(10) Meter data
(11) Place for metrological seal

1.2. Terminal block

The meters are equipped with a terminal block that either complies with the DIN 43857 or the BS 5685 standard. The terminal block accommodates current terminals and optional auxiliary terminals. There is no potential link as the metering element is based on a shunt. Therefore, during the meters testing they should be connected via an isolation transformer.

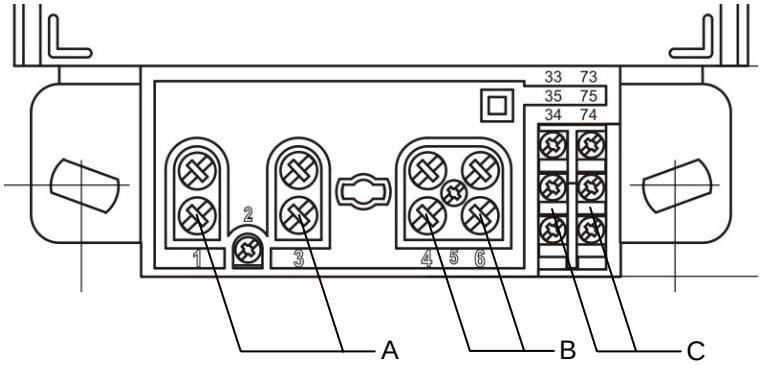
Current terminals are made of solid brass. At the DIN terminal block version the bore diameter is 8.5 mm and enables connection of conductors with cross sections up to 25 mm^2. At the BS terminal block version the bore diameter is 9.5 mm and enables connection of conductors with cross sections up to 35 mm^2. The conductors are fixed with two screws. The recommended torque for fixing the conductors is 2.5 Nm.

Up to six auxiliary terminals for optional outputs can be built into the meter on request. The bore diameter of the auxiliary terminals is 3.5 mm. Wires are fixed with a screw. In addition, two auxiliary voltage terminals for power supply of an external device can be built-in on request too.

Both current and auxiliary terminals are nickel-plated at a tropical meter version.

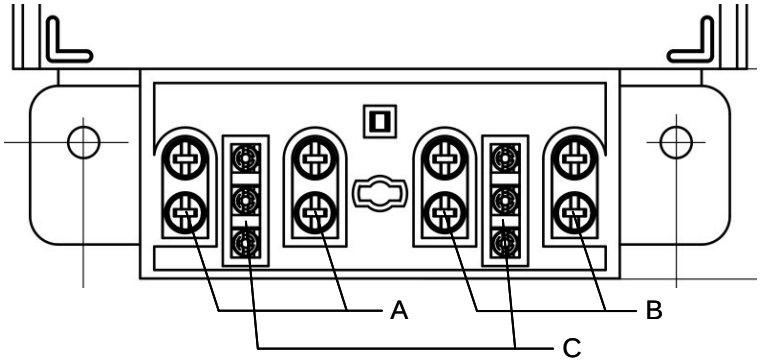
The terminal cover can be long or short and is fixed with a plastic stopper. A meter connection diagram is stuck on the inner side of the terminal cover.

Terminal block in compliance with the DIN 43857 standard



A. Current terminals – phase
B. Current terminals – neutral
C. Auxiliary terminals

Terminal block in compliance with the BS 5685 standard

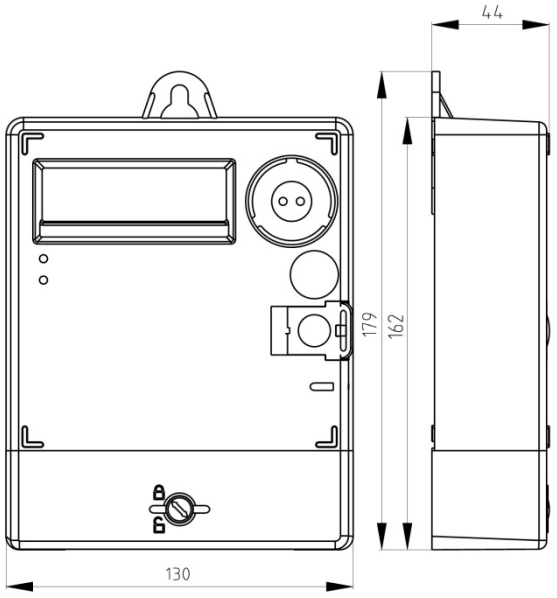


A. Current terminals – mains
B. Current terminals – load
C. Auxiliary terminals

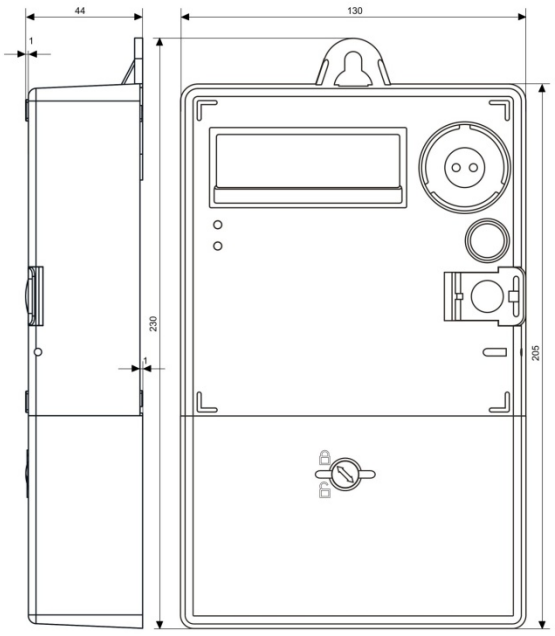
1.3. Over-all dimensions

Meter fixing dimensions comply with the DIN 43857.

Meter version with short terminal cover



Meter version with long terminal cover



2. Meter configuration

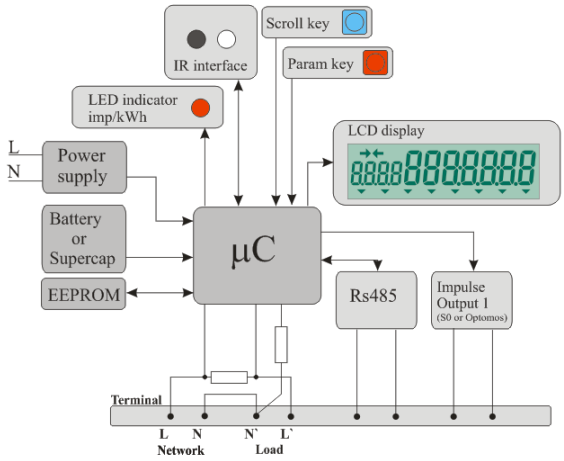


Fig.: Meter block-diagram

The meter consists of:

1. Measuring element
2. Meter power supply stage
3. Microprocessor with EEPROM
4. RTC with a Li-battery
5. LCD
6. Impulse LED
7. Scroll pushbutton
8. Reset pushbutton with a cover
9. IR optical port
10. Pulse or tariff output (option)

2.1. Metering element

The metering element enables precise measurement of active energy in a wide metering and a temperature range.

The metering element consists of a current and a voltage sensor. The current sensor is a shunt, while the voltage sensor is a resistive voltage divider. Signals of currents and voltages are fed to the A/D converters. They are digitally multiplied so that instantaneous power is calculated. The instantaneous power is integrated in a microcontroller, where it is further processed.

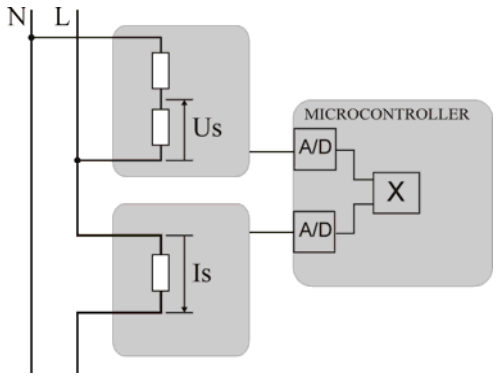


Fig.: Metering element

The metering element ensures excellent metering properties:

1. Negligible effect of electromagnetic disturbances and influence quantities
2. High long-term stability so that meter recalibration is not required over its lifetime
3. Long meter lifetime and high reliability in use

2.2. Power supply stage

The power supply stage is a capacitor type, which enables a meter to operate accurately in a voltage range from 80% to 120% of the rated voltage.

2.3. Microcontroller

The microcontroller acquires signals from the metering elements, processes them and calculates values of measured energy and demand. The results are stored in energy registers for particular tariffs and stores energy data in previous billing periods. The microcontroller also generates pulses for the LED and pulse output, drives the LCD and enables two-way communication via the optical port.

All measured data are stored in a non-volatile memory (EEPROM) and are kept for more than 10 years period without external power supply.

2.3.1. Billing results keeping

The meter keeps billing results (energy values registered by tariffs and total) for up to last 15 billing periods (months). A number of billing periods (months) for which billing results are kept is set in the factory and can not be changed subsequently. The billing results are stored in a FIFO memory, so that they are always available for the last n (n = 1, 2, …15) billing periods (months), regardless if the meter billing reset was performed by means of the RTC, the Reset pushbutton or via the optical port. The metering results of the past billing periods (months) can be displayed (9) or down-loaded (15) via the optical port.

The billing reset can be set to be executed by the RTC:

- Single on a specified date and time
- Once a year on a specified date and time
- Every month on specified day in a month and time
- Every month on a specified day in a week after specified day in a month and specified time
- Every week on a specified day in a week and time
- Every day on a specified time

Billing reset blockade:

- the billing reset blockade timeout is minimal time between two billing resets
- blockade timeout can be set from 1 to 1092 min
- blockade timeout is reset if meter is disconnected from main supply voltage
- billing reset blockade is valid only for push-button reset and reset via communication port

2.3.2. Log-book

The microcontroller registers 128 events and meter statuses in a log-book. It is organized as a FIFO memory, which means that the last 128 events are always available. The following events and meter statuses can be registered in a log-book:

- Fatal meter error
- Meter billing reset
- Changing the value of set parameters
- Internal clock setting
- Network voltage failure
- Restoration of network voltage
- Deleting log-book registers

2.4. Real-time clock

A real-time clock is controlled with a 32.768 kHz quartz crystal which is digitally trimmed. Its accuracy is better than requested in the IEC 62054-21 standard for time switches. The RTC involves an internal calendar that assures information on year, month, day, day in a week, hour, minute, second and leap year.

The RTC enables:

- Time-of-use registration (in max. 4 tariffs),
- Generation of demand periods
- Generation of time stamp (date and time) for demand and events
- Automatic meter billing reset at the end of the billing period (month)
- Automatic change-over to daylight saving period and back (winter – summer time).

2.4.1. RTC back-up power supply

An Li-battery is used as the RTC back-up power supply. It assures 5 years of the RTC operation reserve and has 15-year lifetime. The lithium battery is positioned on the meter printed circuit board under the meter cover.

On request the Li-battery enables data display when the meter is in a no-power state. If this function is built in the meter, a blue pushbutton should be pressed when the meter is not connected to the network or there is no voltage in order to display data on the LCD. The blue pushbutton should be pressed again and again for displaying next data. If the blue key is not pressed in the time to manual display timeout (set in the factory to 60 sec.), the LCD is automatically switched off.

2.4.2. Testing RTC accuracy

The RTC accuracy can be tested via the imp/kWh LED, when the meter is in the RTC test mode. The meter is set in the RTC test mode via the optical port by means of the Iskraemeco Meter-View software so that a command Clock control is sent to the meter. When the meter is in the RTC test mode, the RTC 4096 Hz test frequency is fed to the imp/kWh LED. The meter will stay in the RTC test mode approximately 18 hours. Then it will return back into the meter mode automatically. Other ways to exit from the RTC test mode are:

- By sending a command to exit RTC test mode by means of the MeterView software
- By disconnecting a meter from the voltage supply

2.4.3. Time-of-use registration

The meter is designed as a multi-tariff with maximum four tariffs. A tariff change-over time is defined with hour and minute. Minimal time period between change-over is five minute. The real-time clock enables complex daily and weekly tariff structures, as well as a couple of seasons in a year:

- Up to 10 seasons in a year, resolution for season is 1 hour
- up to 10 weekly tariff programs
- Up to 10 daily definitions of the tariff change-over program
- Up to 10 tariff change-over inside individual daily tariff programs
- up to 4 tariff
- Up to 46 holidays (including those based on a lunar calendar) in which a special tariff program is defined.
- tariff program can be set up with the MeterView software package

2.4.4. Meter billing reset

A meter billing reset is usually done by RTC once a month. However, any other period of a meter billing reset can also be set (see Item “Billing results keeping”). Day and time of the meter billing reset can be set for any day in a month and any time during a day. At a meter billing reset the billing data for a current month are transferred from the registers for a current month (a billing period) to the registers of a previous month (a billing period, while the registers of a current month (a billing period) are deleted in order to be ready for measurement in the next month (a billing period). At the same time a counter of billing resets is incremented.

The meter billing reset can be also performed by pressing the Reset pushbutton, via the IR optical port.

2.4.5. Maximum demand

The internal clock generates a measuring period for demand calculation. Demand is calculated as a mean value in the measuring period. In the ME172 meters the following measuring periods can be set: 5, 15, 30 or 60

minutes. At the end of a measuring period, the calculated demand is transferred from the current measuring period register to the register of the measuring period that was just terminated. It is compared with the value stored in the maximum demand in the billing period. If the new calculated demand is greater than the value in the maximum demand register, a new demand value is stored, otherwise the old value is kept. In this way, a maximum demand is also registered at a meter billing reset.

- Measuring period is synchronized with the real time clock
- up to 4 tariff, equal tariff program for MD and time-of-use registration
- at power-down the measuring period is finished
- at power-up the new measuring period is started, the end of new period is synchronized with the real time clock
- tariff change over - tariff changeover for MD is delayed, the end of measuring period is synchronized with the real time clock
- billing reset - measuring period is finished, new measuring period is started
- real time clock setup - measuring period is finished, new measuring period is started

2.4.6. Load-profile recorder (option)

A load-profile recorder enables saving total energy registers (1.8.0, 2.8.0 or 15.8.0) on a time interval basis, which is set by registering period (RP). Status value and measured energy are recorded at the end of each RP according to VDEW 2.0. If there is a power down and power up event in the same RP, then the period won't reset but events will be saved in status. If power up occurs in one of the later periods, then current energy registers and status will be saved and RP will reset. Same goes for RTC event - if it is set forward or backward and stays in the same RP, the reset won't happen. If it is set forward or backward to other RP, the RP will reset.

A load-profile (stored in P.01) is supported with same search function as logbook. Readout consist of header and measured values. Header is sent only when the status changes and for the first record in a day, otherwise just values are sent. It can be erased by write command (W1 or W5) to register P.01. It will also be erased each time whether one of LP parameters is changed. If the registration period is changed, the data stored in the load profile will be lost. Before changing load-profile registration period the load-profile data must be down-loaded first in order not to be lost. Load-profile data can’t be displayed on the LCD.

A load-profile recorder is provided with maximum two channels. For each channel it can be selected one of the energy type - total energy register (1.8.0, 2.8.0 or 15.8.0). The recording (registering) period can be set to 15, 30, 45 or 60 minutes. Data in the load-profile recorder are provided with a time stamp (date and time of the end of a registration period), a meter status in the last registration period and a check sum.

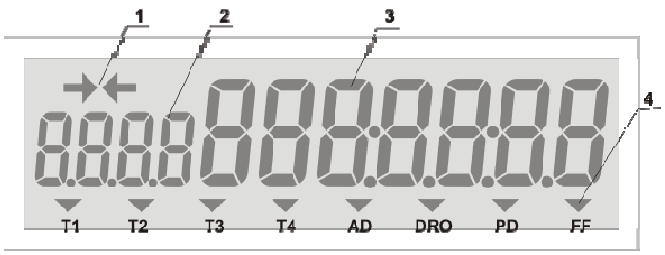
A capacity of the load-profile recorder depends on the registration period and a number of registered quantities (channels) and is given in the table below.

Registering period (min)	1 channel (days)	2 channels (days)
15	194	116
30	389	233
60	779	467

2.5. LCD

The 7-segment LCD has 7 characters for data display, 4 characters for data identification codes, 4 signal flags of active tariff (T1, T2, T3, T4), 4 signal flags for indicating different meter state and alarms and two arrows for indication of energy flow-direction. Large characters and a wide angle of view, as well as optional LCD back-light, enable easy data reading.

LCD display:



1. Energy flow-direction
2. Data identification code
3. Data display
4. Signal flags for indicating different meter state and alarms

The data characters are 12.5 mm high. For data identification four characters are employed, they are 8.5 mm high. The standard data identification codes are EDIS. The meaning of signal flags are engraved on the meter name plate below them.

Two arrows in the left upper corner indicate energy flow direction. Only one of them is displayed at the time indicating import direction (🡐) or export direction (🡒) of energy flow.

Data defined in Auto scroll sequence and in Manual scroll sequence are displayed on the LCD. Data from Auto scroll sequence are displayed in a circle, and each data is displayed for 8 sec. as a standard display time. On request, longer or shorter data display time can be set via the meter optical port by means of Iskraemeco MeterView software. At Manual scroll sequence the blue push-button should be pressed for displaying the next piece of data. Data in Manual scroll sequence remains displayed until the push-button is pressed again or until time for automatic return into the Auto scroll sequence is elapsed.

Max. number of register in sequence:

- Auto-scroll: 34
- Manual-scroll: 50

Optionally, data can be displayed on the LCD in a no-power meter state by pressing the Data scroll push-button.

2.5.1. LCD modes

The LCD is menu-driven and is handled by pressing one pushbutton at a time. The LCD has the following modes of data display:

- Starting mode
- Auto scroll mode
- Manual scroll mode
- Parameters setting mode
- Meter testing mode

2.5.2. LCD testing

The LCD can be tested automatically so that all LCD segments are displayed for 3 seconds to check if they are in order. The LCD test can be performed either in:

- the Starting mode (after voltage is applied to the meter)
- the Auto scroll mode or
- Manual scroll mode
- with command through communication interface

2.5.3. No-power reading option

Optionally, data can be displayed on the LCD in a no-power meter state by pressing the Scroll push-button. Data from the Manual scroll sequence (with exception of previous values if they are included in this sequence) are displayed on the LCD in the no-power reading mode. For displaying each data on the LCD the Scroll pushbutton is to be pressed again. If the Scroll pushbutton has not been pressed for a time longer than the time of scrolling data in the Auto display mode, the LCD automatically turns-off in order to save the Li-battery.

2.6. LED

The meter is provided with a LED on the front plate. The imp/kWh LED has two functions depending on the meter mode. In the meter mode it is used for testing the meter accuracy and blinks with a pulse rate 1,000 imp/kWh, the pulses width is 40 ms.

LED	STATUS	INDICATION
Imp/kWh	Blinks	Energy is registered. The pulse rate is proportional to demand
	Lit	Voltage applied to the meter, but load current is lower than the meter starting current.
	OFF	No voltage is applied to the meter.

In the RTC testing mode the LED is used for testing the RTC accuracy and blinks with 4096 Hz test frequency.

2.7. Communication channels

The meters can be equipped with the following communication channels:

- Optical interface (low priority) - if RS485 interface is active, optical communication is interrupted
- RS485 interface (high priority)

Communication with the meter in progress is indicated on the LCD by the DRO signal flag.

2.7.1. IR optical port

The optical port is in the right top corner. On the meter cover there is an iron plate that enables attaching an optical probe to the optical port. An optical probe should be so attached that its cable is perpendicular to the meter bottom edge.

The optical port complies with the IEC 62056-21 and is used for local meter programming and data down-loading. It is located in the right top corner of the meter. The communication protocol complies with IEC 62056-21, mode C. The communication is serial asynchronous with data transmission rate from 300 bit/sec to 19,200 bit/sec. If data transmission rate of the used optical probe is lower than 19,200 bit/sec, the maximum permissible data transmission rate is equal to that value. If higher data transmission rate is set, communication via optical port will not be possible.

The optical port wavelength is 660 nm and luminous intensity is min. 1 mW/sr for the ON state.

2.7.2. RS485 interface

On request, an RS485 interface can be built into the ME172 meters. It enables remote readout and setting of the meter parameters. The RS485 interface enables connection of 31 meters to one communicator with a built-in RS485 interface, e.g. Iskraemeco P2CC. Master-slave architecture is used. The communicator is a master device and the ME172 meters are slave devices. Max. distance among the meters and the communicator is 1.200 meters. At two-way communication via the RS485 interface the IEC 62056-21, mode C protocol is used. The data transmission rate is fixed and default set to 9.600 bit/s. Anyhow, any other data transmission rate in the range from 300 bit/s to 19.200 bit/s can be set depending on the data transmission rate of the master to which the meter is connected. The RS485 interface is connected to the auxiliary terminals in the terminal block.

Terminal	Description
27	RS485 A
29	RS485 B

Note: The meter address could be long up to 20 characters and is stored in the register 0.0.0. It is not allowed that two meters connected to one master device have the same address. If the meter address is not specified by a customer at the meter ordering, the default meter address is the meter serial number.

2.7.3. Data downloaded via communication channel(s)

Data downloaded via IR optical port are identified with EDIS codes. Besides data for a current billing period, if requested, the historical data of previous billing periods can be down-loaded via the IR optical port too. Historical data can be downloaded for the maximum 15 last billing periods.

Built-in communication channels enable:

- Billing data readout
- Load-profiles readout
- Log book registers readout
- Meter parameters readout
- Meter parameters setting

2.7.4. Communication protocol

The communication protocol is IEC 62056-21 (former IEC 61107), mode C. The communication is asyn-chronous half-duplex.

Data format:

1 start bit, 7 data bits, 1 parity bit, 1 stop bit

The entire data block is protected by a control mark in compliance with the DIN 66219 standard. After receiving the calling telegram at a 300 baud data transmission rate,

/ ? Device address ! CR LF or / ? ! CR LF

the meter reveals its identification at a 300 baud data transmission rate:

/ISK5ME172-*Program Version*

The meter address refers to the contents of the 0.0.0 or 0.0.1 registers. Then the meter waits for 2 sec. so that the proposed data transmission rate is confirmed:

ACK 0 5 0 CR LF

If the proposed baud rate is confirmed, communication at a 9,600 baud rate follows; if it is not confirmed, communication at 300 baud continues. The meter transmits the data telegram:

STX Data ! CR LF ETX BCC

where

STX: stands for the start of a text
Data: refers to codes and data
! CR LF: stands for the end of data
ETX: stands for the end of a text
BCC: stands for Block Check Character parity check

2.8. Output

The ME172 meters can be equipped either with pulse or tariff output.

2.8.1. Pulse output

Optionally the meter can be equipped with one pulse output. Impulse output is passive and complies with the requirements stated in the IEC 62053-32 standard, class A (S0 in compliance with DIN 43864). Impulse constant is equal to the half of the meter constant, impulse width is 30 ms. However, a smaller impulse constant or a larger impulse length can be set on request. If different impulse length and impulse constants are required, it is necessary to select such their values that prevents lapping of impulses at maximum load.

On request, the impulse output can be performed as an optomos relay with a make contact that can switch 25W (100 mA, 250 V).

2.8.2. Tariff output

Optionally the meter can be equipped with one tariff output. The tariff output is an optomos relay with a make contact with switching capability 25 VA (100 mA at 250 V). It can be set as *active* or *not active* for each tariff.

3. Antifraud protection

Special attention is paid to a system of meter data protection in order to prevent meter tampering by use of hardware and software counter measures as well as a meter design itself.

- **Absolute energy measurement (option)**
- **Metering element in neutral circuit (option)**
- **Single-wire measurement**
- **Reversed energy flow detector**
- **Meter cover opening detector**
- **Terminal cover opening detector**
- **External magnet field detector**
- **Hardware and software protection for programming**

- **Log-book**
- **Events counters and time stamps**
- **Signal flags on LCD for fraud attempts**
- **Meter cover stuck to meter base**
- **Tamper energy registers and time stamps**

3.1. Absolute energy measurement

The option of absolute energy measurement (always positive energy registration) at the meters regardless in which direction energy flows through the metering element prevents meter misuse by wrong connection of the conductors into the terminal block. In this way registered energy is equal to the one actually consumed regardless of the meter connection. In addition, an alarm flag (AD or REV) is displayed on the LCD when energy flows in reversed direction. Reversed energy can be registered into a separate register on request too. Besides, the following registers can be implemented into the meter:

- Events counter of reversed energy flow
- Time-stamps of the last reversed energy events

3.2. Metering element in neutral circuit

The meter ME172 can be optionally equipped with two mutually independent measuring elements. This system allows proper registration of energy at any unauthorized tampering with the meter or an attempt to thieve energy. A secondary metering element measures current flowing through the neutral circuit. The microcontroller compares it with a current flowing through the line circuit.

With a normal meter connection into the electricity network, the measured values of both measuring elements are identical or similar. If the values are the same, the meter takes into account for registration the measured value of the primary measuring element. If the difference between the measured values is higher than 1%, the meter takes into account for the registration higher measured value of the energy. The limit for the triggering event for theft (earth fault) is determined by the maximum permissible difference between the values measured quantities of both measuring elements, that is defined by measuring configuration and meter values: Earth Fault Relative Delta (12%) and Earth Fault Absolute Delta (6W). This event for theft (earth fault) is registered into the log-book together with its time stamp (date and time) and the corresponding flag can be displayed in the LCD. Besides, the following registers can be implemented into the ME172 meters:

- Fraud energy register (see item 3.6 Tamper registers)
- Events counter of the meter tampering via its neutral circuit
- Time-stamps of the last meter tampering via its neutral circuit

In addition the option of a single wire mode enables energy measurement and registration when only a line or neutral conductor is connected to the meter and thus there is no voltage applied to the metering voltage circuitry. Energy is calculated as U_{rated} * $I_{measured}$ * time. Single wire energy is added to register 1.8.4.

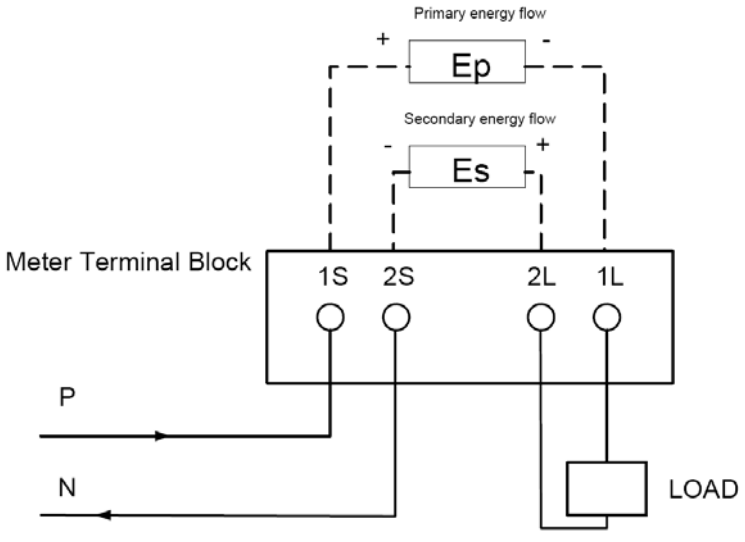


Fig.: Single-phase two measurement system

3.3. Single-wire measurement

The option of a single wire mode enables energy measurement and registration when only a line conductor is connected to the meter and thus there is no voltage applied to the metering voltage circuitry. This happens in the case, when someone cut a neutral conductor. The meter loses power (for its power supply and measurement), but the meter with this Single-wire measurement function turns on alarm for Single-wire measurement. The meter is in this case powered via Li-battery backup and it continues to measure, although the meter's LCD is off.

The current will be measured in a line conductor and its value will be multiplied by voltage constant (220V or 230V ...), which is valid at that place. This multiplied value represents energy consumption during that time period.

3.4. Meter cover and terminal cover opening detectors

On request, a detector of the meter and/or the terminal cover opening can be built into the meter. They are two switches with a pushbutton that trigger a signal in case of opening the cover. The event is registered in the log-book together with its time-stamp (date and time) and the corresponding flag (AD or MC, TC) is displayed in the LCD. Besides, the following registers can be implemented into the meter:

- Tamper energy register (see item 3.6 Tamper registers)
- Events counter of a cover opening
- Time-stamps of the last reversed cover opening events

3.5. External magnet field detector

On request, a detector of an external magnetic field can be built into the meter. If an external magnetic field is detected, this event is registered in the log-book together with its time-stamp (date and time) and the corresponding flag (AD or MD) is displayed in the LCD. Consumed energy during meter tampering with a permanent magnet can be registered into a separate register on request too. Besides, the following registers can be implemented into the meter:

- Tamper energy register (see item 3.6 Tamper registers)
- Elapsed time during which the meter was exposed to a permanent magnet field (if an external magnet field detector is built-in)
- Events counter of a meter tampering with a permanent magnet
- Time-stamps of the last meter tampering with a permanent magnet events

3.6. Tamper registers

In these registers it will be registered energy that was consumed during the time of fraud. Tamper (fraud) events/states that can trigger tamper register are:

- magnetic field detection
- meter cover opened
- terminal cover opened
- negative (reverse) energy flow direction
- earth fault (ETF fault) - only in the meter with two measuring elements
- exceeded reverse energy flow (REV fault) - only in the meter with two measuring elements

All these fraud events don't have influence on registration of energy in registers 1.8.x, 2.8.x or 15.8.x. Tamper energy registers can register positive and/or negative energy. They are active only at mains supply voltage.

There are two additional tamper registers that are active at power down:

- C.6.0 - power down time counter
- C.53.8 - single wire tamper time counter

Format and resolution of displaying tamper energy registers are the same as format and resolution of displaying other energy registers.

EDIS CODE	DESCRIPTION
C.53.1	Tamper energy register 1
C.53.2	Tamper energy register 2
C.53.3	Tamper energy register 3
C.53.4	Tamper time counter 1
C.53.5	Tamper time counter 2
C.53.6	Tamper time counter 3

4. Handling with the meter

Two sets of tools are available for personal which will manage the meters:

- **For service programming and readout:**
  - MeterView (Iskraemeco software)
  - An optical probe
  - PC: a desktop, a laptop

The tool is intended for the staff that service or reprogram the meters in the laboratory or in the field.

- **For billing readout and programming:**
  - MeterRead (Iskraemeco software) for all types of handheld units operating in the Windows CE environment
  - An optical probe

The tool is intended for meter readers in the field.

5. Meter maintenance

The meter is designed and manufactured in such a way that no maintenance is required in the entire meter lifetime. Measuring stability assures that no recalibration is required. If a battery is built into the meter, its capacity is sufficient to backup all functions for the entire meter lifetime.

6. Meter connection diagrams

The meter connection diagrams in compliance with DIN 43857 and BS 5685 standards respectively are shown in the figure:

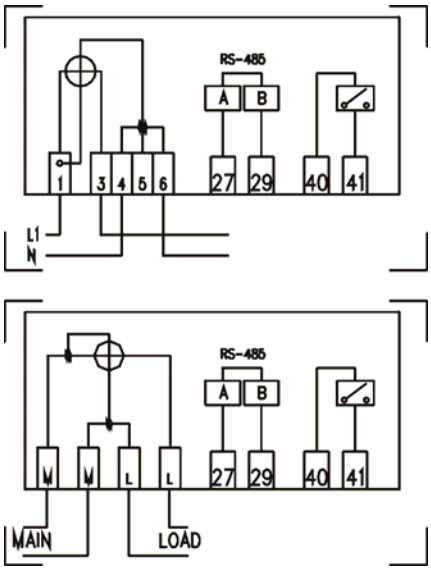


Fig.: Meter connection diagrams (a meter with one measuring element)

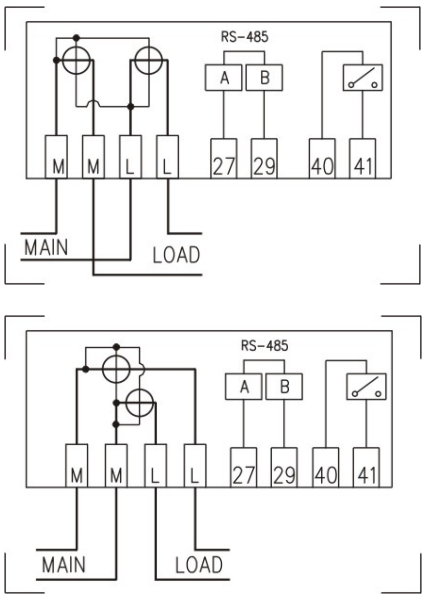


Fig.: Meter connection diagrams (a meter with two measuring elements)

7. Meter type designation

ME172-D1A52-G12-M3K03Z

M	Electronic meter
E	Single-phase meter
172	Multirate meter with internal time-switch
D1	Terminal block for direct connection up to 85 A by DIN 43857
D3	Terminal block for direct connection up to 100 A by BS 5685
D31	Terminal block for Imax = 100 A with two metering systems - DIN connection
D32	Terminal block for Imax = 100 A with two metering systems - BS connection
A4	Active energy measurement, accuracy class 1 (class B by EN 50470-3)
A5	Active energy measurement, accuracy class 2 (class A by EN 50470-3)
1	One energy flow direction
2	Two energy flow directions
4	Absolute registration
G12	S0 pulse output (option)
L11	Pulse output optomos relay with make contact (option)
M3	Internal time switch with Li-battery
K	Communication interface
0	Optical port by IEC 62056-21 (IEC 61107)
3	RS485 interface (option)
Z	Load-profile recorder (option)

8. Technical data

GENERAL METER PROPERTIES	
Reference voltage U_n	230 V (other voltage on request)
Voltage range	0,8 U_n... 1,15 U_n (from 0,2 U_n to 1,3 U_n error of the meter in class)
Reference frequency f_n	50 Hz or 60 Hz
IEC SPECIFIC DATA (IEC 62052-11, IEC 62053-21, IEC 62053-23)	
Accuracy class for active energy	2 or 1 (IEC 62053-21)
Basic current I_b	5A
Maximum current I_{max}	DIN terminal: **85 A** BS terminal: **100 A**
Starting current I_{st}	<0,004 I_b for class 1 (active energy IEC 62053-21) <0,005 I_b for class 2 (active energy IEC 62053-21)
MID SPECIFIC DATA (EN 50470-1, EN 50470-3)	
Class index	A or B (EN 50470-3)
Climatic environments	-40 °C … 70 °C, non-condensing humidity, closed location
Mechanical environments	M1
Electromagnetic environments	E2
Reference current I_{ref}	5 A
Transitional current I_{tr}	0,5 A
Maximum current I_{max}	DIN terminal: **85 A** BS terminal: **100 A**
Minimum current I_{min}	0,25 A
Starting current I_{st}	<0,04 I_{tr} for class B <0,05 I_{tr} for class A
GENERAL	
Meter constant (per LED)	1.000 imp/kWh, (can be changed - FW parameter)
Meter constant (per imp. output)	1.000 imp/kWh, (can be changed - FW parameter)
Operating temp. range	-30 °C … 70 °C
Extended temp. range	-40 °C … 80 °C
Storing temperature	-40 °C … 85 °C
Power consumption in voltage circuit	<2W/10VA - typical 1,4 W/8,8 VA (ME172 with RS485)
Power consumption in current circuit	At basic/reference current <2,5 VA - typical 0,01 VA (5A)
Short-circuit current	30 × I_{max}
Protection against penetration of dust and water (IEC 60529)	IP 54
Insulation properties	Protective class II Impulse voltage 1,2/50 μs in voltage and current circuit 12 kV (higher than standard requirements) between circuits 6 kV AC voltage between circuits and earth 4 kV between circuits 2 kV
Electromagnetic compatibility	Electrostatic discharges (IEC 61000-4-2) contact discharges 8 kV air discharges 15 kV Radiated RF electromagnetic fields (IEC 61000-4-3) from 80 MHz to 2 GHz 15 V/m - active (higher than standard requirements) 30 V/m - passive Electrical fast transients/burst (IEC 61000-4-4) In voltage and current circuits (main lines): Active (IEC 62053-21/EN 50470-3) 6kV (higher than standard requirements) Passive 6 kV In auxiliary circuits with reference voltage over 40 V: 2 kV

	Surge (IEC 61000-4-5) In voltage and current circuits (main lines): 6 kV In auxiliary circuits with reference voltage over 40 V: 1 kV Conducted disturbances, inducted by RF fields (IEC 61000-4-6) from 150 kHz to 80 MHz voltage level 20 V (higher then standard requirements) Power frequency magnetic fields of external origin (IEC 61000-4-8) Field strength 0,5 mT error deviation (IEC 62053-21/EN50470-3) <2 % typical error deviation 1 % Radio interference suppression (EN 55022) Class B equipment
RTC	
Time base	Quartz crystal 32 kHz
Time-keeping accuracy of RTC (EN 62054-21)	< 0,5 s/day at reference condition
Variation of time-keeping accuracy with temperature (EN 62054-21)	< 0,15 s/°C/day
Back-up power supply	Min. 5 years Li-battery power supply source
OPTICAL INTERFACE	
Optical interface	IEC 62056-21 (IEC 61107)
Protocol	IEC 62056-21 (IEC 61107) Mode C
Data ident. Code.	EDIS (option OBIS) IEC 62056-61
Data transmission rate	9.600 bit/s (limited data transmission rate of optical probe)

RS485 INTERFACE (option)	
Protocol	IEC 62056-21 (IEC 61107) Mode C
Ident. data code.	EDIS (option OBIS) IEC 62056-61
Data transmission rate	9.600 bit/s
Loop length	1.200 m
OUTPUTS (option)	
Impulse output	Only 1 IEC 62053-31 class A (S0 in compl. With DIN 43864) or Optomos relay with make contact.
Tariff output	Optomos relay with make contact. (max 25VA) (option instead of impulse output)
DIMENSIONS AND MASS	
Meters with long terminal cover:	
Dimensions (w × h × d) in mm	130 × 222 × 44
Meters with short terminal cover:	
Dimensions (w × h × d) in mm	130 × 179 × 44
Mass	0,5 kg
COMBUSTIBILITY OF HOUSING	
Class	V0 (Standard UL 94)
TORQUE FOR TERMINAL SCREWS	
Direct-connected meters	2.5 Nm

9. Appendix: EDIS codes, data stored in registers, sequences, previous values

EDIS CODE	DESCRIPTION	LCD	DRO	PV
	Energy registers:			
1.8.0	Positive active energy total (A+)	x	x	x
1.8.1	Positive active energy in first tariff (T1)	x	x	x
1.8.2	Positive active energy in second tariff (T2)	x	x	x
1.8.3	Positive active energy in third tariff (T3)	x	x	x
1.8.4	Positive active energy in fourth tariff (T4)	x	x	x
2.8.0	Negative active energy total (A-)	x	x	x
2.8.1	Negative active energy in first tariff (T1)	x	x	x
2.8.2	Negative active energy in second tariff (T2)	x	x	x
2.8.3	Negative active energy in third tariff (T3)	x	x	x
2.8.4	Negative active energy in fourth tariff (T4)	x	x	x
15.8.0	Absolute active energy total (|A|)	x	x	x
15.8.1	Absolute active energy in first tariff (T1)	x	x	x
15.8.2	Absolute active energy in second tariff (T2)	x	x	x
15.8.3	Absolute active energy in third tariff (T3)	x	x	x
15.8.4	Absolute active energy in fourth tariff (T4)	x	x	x
	Maximum demand registers:			
1.6.0	Positive active maximum demand total	x	x	x
1.6.1	Positive active maximum demand in tariff (T1)	x	x	x
1.6.2	Positive active maximum demand in tariff (T2)	x	x	x
1.6.3	Positive active maximum demand in tariff (T3)	x	x	x
1.6.4	Positive active maximum demand in tariff (T4)	x	x	x
2.6.0	Negative active maximum demand total	x	x	x
2.6.1	Negative active maximum demand in tariff (T1)	x	x	x
2.6.2	Negative active maximum demand in tariff (T2)	x	x	x
2.6.3	Negative active maximum demand in tariff (T3)	x	x	x
2.6.4	Negative active maximum demand in tariff (T4)	x	x	x
15.6.0	Absolute active maximum demand total	x	x	x
15.6.1	Absolute active maximum demand in tariff (T1)	x	x	x
15.6.2	Absolute active maximum demand in tariff (T2)	x	x	x
15.6.3	Absolute active maximum demand in tariff (T3)	x	x	x
15.6.4	Absolute active maximum demand in tariff (T4)	x	x	x
	Cumulative maximum demand registers:			
1.2.0	Positive active cumulative maximum demand total	x	x	/
1.2.1	Positive active cumulative maximum demand in tariff (T1)	x	x	/
1.2.2	Positive active cumulative maximum demand in tariff (T2)	x	x	/
1.2.3	Positive active cumulative maximum demand in tariff (T3)	x	x	/
1.2.4	Positive active cumulative maximum demand in tariff (T4)	x	x	/
2.2.0	Negative active cumulative maximum demand total	x	x	/
2.2.1	Negative active cumulative maximum demand in tariff (T1)	x	x	/
2.2.2	Negative active cumulative maximum demand in tariff (T2)	x	x	/

2.2.3	Negative active cumulative maximum demand in tariff (T3)	x	x	/
2.2.4	Negative active cumulative maximum demand in tariff (T4)	x	x	/
15.2.0	Absolute active cumulative maximum demand total	x	x	/
15.2.1	Absolute active cumulative maximum demand in tariff (T1)	x	x	/
15.2.2	Absolute active cumulative maximum demand in tariff (T2)	x	x	/
15.2.3	Absolute active cumulative maximum demand in tariff (T3)	x	x	/
15.2.4	Absolute active cumulative maximum demand in tariff (T4)	x	x	/
Interval demand registers:				
1.4.0	Positive active current interval demand	x	x	/
2.4.0	Negative active current interval demand	x	x	/
15.4.0	Absolute active current interval demand	x	x	/
1.5.0	Positive active last interval demand	x	x	/
2.5.0	Negative active last interval demand	x	x	/
15.5.0	Absolute active last interval demand	x	x	/
Event registers:				
C.2.0	Event param change - count	x	x	/
C.2.1	Event param change - timestamp	/	x	*
C.51.1	Event terminal cover opened - count	x	x	/
C.51.2	Event terminal cover opened - timestamp	/	x	*
C.51.3	Event main cover opened - count	x	x	/
C.51.4	Event main cover opened - timestamp	/	x	*
C.51.5	Event magnetic field detection start - count	x	x	/
C.51.6	Event magnetic field detection start - timestamp	/	x	*
C.51.7	Event reverse power flow - count	x	x	/
C.51.8	Event reverse power flow - timestamp	/	x	*
C.7.0	Event power down - count	x	x	/
C.7.10	Event power down - timestamp	/	x	*
C.51.13	Event power up - count	x	x	/
C.51.14	Event power up - timestamp	/	x	*
C.51.15	Event rtc set - count	x	x	/
C.51.16	Event rtc set - timestamp	/	x	*
C.51.17	Event battery discharged - count	x	x	/
C.51.18	Event battery discharged - timestamp	/	x	*
C.51.19	Event dst change - count	x	x	/
C.51.20	Event dst change - timestamp	x	/	*
C.51.21	Event terminal cover closed - count	x	x	/
C.51.22	Event terminal cover closed - timestamp	/	x	*
C.51.23	Event main cover closed - count	x	x	/
C.51.24	Event main cover closed - timestamp	/	x	*
C.51.25	Event logbook 1 erased - count	x	x	/
C.51.26	Event logbook 1 erased - timestamp	/	x	*
C.51.27	Event fraud start - count	x	x	/
C.51.28	Event fraud start - timestamp	/	x	*
C.51.29	Event fraud stop - count	x	x	/
C.51.30	Event fraud stop - timestamp	/	x	*

C.51.31	Event wdog reset - count	x	x	/
C.51.32	Event wdog reset - timestamp	/	x	*
C.51.33	Event wrong password login - count	x	x	/
C.51.34	Event wrong password login - timestamp	/	x	*
C.51.35	Event logbook 0 erased - count	x	x	/
C.51.36	Event logbook 0 erased - timestamp	/	x	*
C.51.37	Event magnetic field detection end - count	x	x	/
C.51.38	Event magnetic field detection end - timestamp	/	x	*
C.51.39	Event energy loss detection end - count	x	x	/
C.51.40	Event energy loss detection end - timestamp	/	x	*
Other registers:				
0.1.2	MD reset times	/	x	x
0.1.0	MD reset count	x	x	/
0.8.0	Measurement period [min]	x	x	/
0.9.1	Time of day	x	x	/
0.9.2	Date	x	x	/
0.0.0	Device address 1	x	x	/
0.0.1	Device address 2	x	x	/
C.1.0	Manufacturing number	x	x	/
12.7.0	Instanteous voltage	x	x	/
11.7.0	Instanteous current	x	x	/
31.7.0	Instanteous L1 current	x	x	/
91.7.0	Instanteous L0 current	x	x	/
16.7.0	Instanteous active power	x	x	/
9.7.0	Instanteous apparent power	x	x	/
13.7.0	Power factor	x	x	/
14.7.0	Supply frequency	x	x	/
11.6.0	Maximum current	x	x	/
F.F.0	Status register	x	x	/
255.255.0	LCD display test	x	/	/
P.98.0	Event log 1	/	x	x
P.98.1	Event log 2	/	x	x
C.87.0	Active tariff	x	x	/
C.1.6	Firmware check sum	x	x	/
0.2.0	Firmware version	x	x	/
0.9.4	Date and Time	/	x	/
C.6.0	Power down time counter	x	x	/
C.6.1	Battery remaining capacity	x	x	/
C.53.1	Tamper energy register 1	x	x	/
C.53.2	Tamper energy register 2	x	x	/
C.53.3	Tamper energy register 3	x	x	/
C.53.5	Tamper time counter 1	x	x	/
C.53.6	Tamper time counter 2	x	x	/
C.53.7	Tamper time counter 3	x	x	/
C.53.8	Single wire tamper time counter	x	x	/

C.1.2	Param file code	/	x	/
C.1.4	Param check sum	x	x	/
C.1.5	Firmware built date	x	x	/
255.255.1	End of sequence	x	x	/
0.2.2	Tariff program id	x	x	/
C.52.6	Input states	/	/	/
C.60.9	Fraud flag	/	/	/
0.2.1	Param scheme id	/	/	/
C.1.1	IEC1107 Ident	/	/	/
C.58.01	Password READ	/	/	/
C.58.02	Password SET	/	/	/
C.58.03	Pasword PARAM	/	/	/
C.50.10	PFile Hollidays	/	/	/
C.50.01	PFile Tariff_1	/	/	/
C.50.02	PFile Tariff_2	/	/	/
C.50.40	PFile Meter Setup	/	/	/
C.50.20	PFile Sequence LCD	/	/	/
C.50.21	PFile Meter Format	/	/	/
C.50.22	PFile Sequence DRO	/	/	/
C.50.23	PFile Meter LCD Ident	/	/	/
C.50.50	PFile BIlling	/	/	/
C.50.81	PFile Meter Config	/	/	/
C.50.80	PFile Meter Calibration	/	/	/
C.50.30	PFile Meter ID	/	/	/
C.60.00	LCD Test mode Command	/	/	/
C.60.10	Fast LED mode Command	/	/	/
C.60.30	Auto Calibration Command	/	/	/
C.60.40	Reset Energy Registers Command	/	/	/
C.99.99	Billing Reset Command	/	/	/
C.60.50	Fraud Flag Reset Command	/	/	/
C.60.5	Set Time Stamp Command	/	/	/
C.60.11	Set Impulse Outputs Command	/	/	/
C.60.41	Meter Initialization Command	/	/	/

* for up to 6 events the previous values time stamp can be configured

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