ISKRAEMECO

Energy Measurement and Management

MT372

Three-phase electronic meter with built-in modem or RS485 communication interface

Technical Description

Version 1, 09.06. 2005

Content:

ISKRAEMECO

Energy Measurement and Management

MT372 – Three-phase electronic meter

Three-phase electronic meters are intended for measuring and registration of electric energy in three-phase four-wire network for direct connection. Measuring and technical characteristics of the meter comply with the IEC 62052-11 and IEC 62053-21 (IEC 61036) international standards for electronic active energy meters, class 1 or 2.
The meters are designed and manufactured in compliance with the ISO 9001 standards as well as even more severe Iskraemeco internal standards.

Meter characteristics

- **Active energy meter**
  - accuracy class 1 or 2
- **Energy measuring and registration modes**
  - standard – as an induction meter
  - other options:
    bi-directional
    three-phase, two-phase, single-phase
- **Connection to network:** a three-phase meter can also function as a single-phase or a two-phase meter.
- **Additional functions:**
  - The forth measuring system, current measurement in neutral conductor. Neutral power-off detection, interruption of neutral conductor
  - Detection of voltage unbalance
  - Detection of phase unbalance
  - Measurement of under- and over-voltages, and their recoding
  - Generation of alarms and their transmission via communication interfaces
- **One or multi tariff registration (1...4T):**
  In compliance with real time clock
- **LCD display:**
  - In compliance with VDEW requirements
- **Display modes on LCD:**
  - automatic data circulation
  - manual (trigerred with a key)
- **Indications:**
  - LED:
    Imp / kWh
  - LCD:
    Presence of phase voltages. L1,L2, L3
    Phase currents direction
    Display of GSM/GPRS signal strength
- **Auxiliary inputs/outputs:**
  - Output for load control with a relay
  - Output for load control with Optomos relay
  - Alarm input (low voltage)
  - Up to two impulse inputs
- **Communication interface:**
  - IR interface for local readout and meter programming
  - Built-in GSM/GPRS modem with a bed for a SIM card
  - Built-in RS485 communication interface
- **Communication protocol:**
  - IR interface; IEC 62056 – 21, IEC 62056 – 46
  - GSM/GPRS modem; IEC 62056 – 46
  - Data organisation; IEC 62056 – 53
  - Identification system; IEC 62056 – 61
- **Detection of meter cover and terminal cover opening (option)**
- **Current terminals:** a universal clamping terminal enables the same quality of the contact for all types and cross-sections of connection wires

- **Voltage terminals:**
  - internal and external connection
  - a sliding bridge (for simple separation of a voltage part from a current part)

- **Quality:**
  - high accuracy as well as time stability of measurement
  - high reliability of operation
- **High immunity to EMC disturbances**
- **Simple and fast assembly**
- **A compact plastic casing,** made of high-quality self-extinguishable materials, and resistant to water and dust (IP54).

1. Constituent parts

1. A measuring chip (R phase)
2. A measuring chip (S phase)
3. A measuring chip (T phase)
4. A meter power supply unit
5. A microprocessor
6. LCD
7. An impulse diode
8. A »Call« and »Set« keys
9. IR optical interface
10. GSM/GPRS with a bed for a SIM card or RS485 communication interface
11. Inputs; impulse, alarm
12. Outputs; relay, circuit breaker switch off
13. Impulse inputs supply unit
14. Tariff inputs
15. Control circuits
16. Real time clock
17. FRAM memory

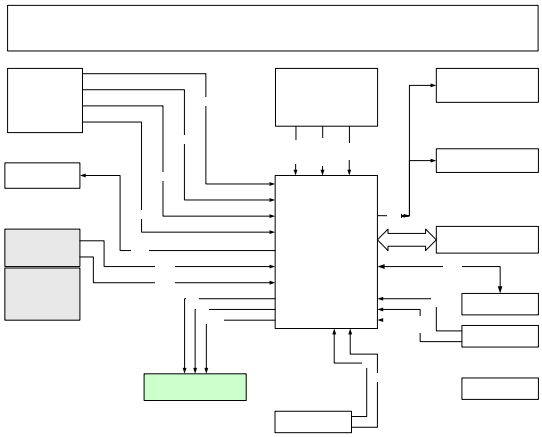


Fig.1 Meter block diagram

2. Microcomputer

A microcomputer collects impulses from measuring circuits, processes them at their inputs, forms values for measured energy, and saves results in energy registers depending on the tariff program or state at tariff inputs. The microcomputer task is formation of an output impulse for a calibration LED.

2.1. Real time clock (RTC)

A real time clock involves an internal calendar that assures information on year, month, day, day in a week, hour, minute, second and leap year. The clock accuracy should comply with the IEC 62052-21 standard for time switches.

A super capacitor is used as an auxiliary power supply for surmounting longer power failures (up to 10 days). For a complete charging of the super capacitor the meter should be connected to network voltage for at least 35 minutes. The clock is driven by a crystal with 32.768 kHz frequency.

2.2. LED

The meter is provided with a LED on the front plate. It is intended for checking the meter accuracy. Impulse constant depends on the meter version.

2.3. Multi-tariff registration

The meter enables registration of energy and power. Max. four tariffs for power and energy can be registered. Tariff changeover is defined with hour and minute. Minimal resolution between changeovers is one minute.
Different combinations of the tariff program are avaliable:

- Up to 4 seasons
- Up to 8 daily definitions of the changeover program
- Up to 8 individual changeovers inside individual daily program
- Up to 32 holidays
- Support to lunar holidays in compliance with the Gregorian calendar.

2.4. Power measurement

Power is measured inside a measuring period. The measuring period is a meter parameter and can be set. Values that can be set are 15, 30 and 60 minutes. After termination of the measuring period, the measured meter value is transferred from current measuring period registers to registers for previous measuring period that can be later used for the formation of billing values.

2.5. Load profile

Load profile recorder can be provided up to two channels. In each channel up to four objects can be stored of which two are reserved for time and status. The remaining two objects are used for saving energy by tariffs.

- Values of energy registers by tariffs depending on the set saving period
- Meter status.

Record in a profile is equipped with a time flag and with the meter status in the last saving period and a check sum. The time flag indicates the end of a recording period. The saving period (a recording period) can be set. Possible values are 15, 30 and 60 minutes or a daily value.

3. Energy measurement and registration

The meter measures or registers electric energy:

- **In a three-phase three-wire,**
- **Single-phase two-wire,**
- **Three-phase four-wire network:**
  - by individual phases L1, L2, L3 (R, S, T) or
  - total (∑ Li)
  - only positive active energy
  - positive and negative active energy (A+, A-) separately
  - absolute active energy | A |

Measurement can be performed in max. four different tariffs.

4. Display

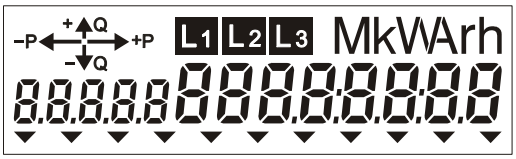


Fig.2 LCD

An LCD is a 7-segment display and complies with the VDEW requirements. Used OBIS identification codes of displayed data (IEC 62056 – 61) are 5-digit type with 6 mm high characters. Data are 8-digit with 8 mm character size. Additional designations indicate: energy flow direction, a physical unit of a momentary displayed data and failure of **L1**, **L2** and **L3** phase voltages. Eleven flags on the display bottom show the state of a valid tariff and data on the meter operation.

4.1. Data display on LCD

Data that are defined in auto scroll and manual scroll sequences are displayed.
Data are reviewed with a key or they are cyclically displayed.
Actual display can differ from a display of registers in a table and depends on actual meter configuration. Maximal set of registers that are available for a display is shown in a table.

CODE	DESCRIPTION
0.0.0	Device number
C.1.0	Device factory number
0.9.1	Time
0.9.2	Date
1.2.1.8.0	Register state of the first impulse input
1.3.1.8.0	Register state of the second impulse input
1.8.0	Total positive active energy (A+)
1.8.1	Positive active energy in first tariff (T1)
1.8.2	Positive active energy in second tariff (T2)
1.8.3	Positive active energy in third tariff (T3)
1.8.4	Positive active energy in forth tariff (T4)
2.8.0	Total negative active energy (A-)
2.8.1	Negative active energy in first tariff (T1)
2.8.2	Negative active energy in second tariff (T2)
2.8.3	Negative active energy in third tariff (T3)
2.8.4	Negative active energy in forth tariff (T4)
1.6.1	A+ max. billing demand in first tariff (T1)
1.6.2	A+ max. billing demand in second tariff (T2)
1.6.3	A+ max. billing demand in third tariff (T3)
1.6.4	A+ max. billing demand in forth tariff (T4)
2.6.1	A- max. billing demand in first tariff (T1)
2.6.2	A- max. billing demand in second tariff (T2)
2.6.3	A- max. billing demand in third tariff (T3)
2.6.4	A- max. billing demand in forth tariff (T4)
F.F	Fatal error

Table 1 - Display of register codes

4.2. Keys

Two keys are built on the cover:

- **RESET:** orange with possible sealing
- **CALL**: blue.

The keys enable:

- Changeover between meter operation modes,
- Listing of measuring results and settings,
- Billing generation,
- Alarms reset

5. Communication interface

5.1. IR communication interface

A built-in optical interface is intended for setting meter parameters and a local readout of measuring results. The protocol for transmitting data via an optical communication interface is IEC62056-46 (DLMS-HDLC).

Fig. 3 – Meter readout via an optical interface

A physical level of the interface complies with the IEC62056-21 standard. Communication mode is serial asynchronous. Available settings of data transfer rate are 300, 600, 1200, 2400, 4800, 9600, 19200 bit/s

5.2. RS485 communication interface - option

A built-in communication interface enables setting of meter parameters and a local readout of measuring results. The protocol for data transfer is IEC 62056 – 46.

5.3. Integrated GSM/GPRS communication interface with antenna - option

It enables data transmission via a communication interface towards the centre for management and billing or a data concentrator. Data transmission rate via network is 9600 baud/s, while actual data transmission rate depends on momentary conditions in network.

A GSM antenna is built in the meter. It enables operation in three frequency ranges

- 900 MHz
- 915 MHz
- 1800 MHz

If a built-in antenna does not meet the needs of covering the signal, an external antenna can be mounted. Coupling circuit is placed on the meter cover and enables a simple mounting of a coupling module.

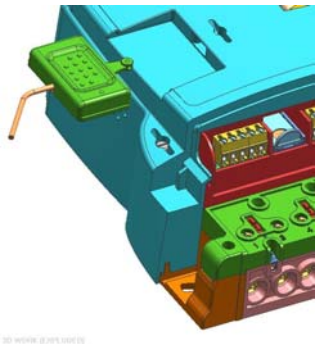


Fig. 4 – Coupling circuit

5.4. Readout via built-in communication interfaces

Built-in communication interfaces enable:

- Reading of registers
- Reading of load profile
- Reading of meter parameters
- Changing of meter parameters

Communication state is shown on a display, i.e.

RS485 and IR interface: during communication, a flag above a DRO mark is blinking
GSM/GPRS interface: at successful communication, several flags are displayed. The flag above the SQ mark indicates signal strength, the flag above the REG mark – if present - indicates that the meter is ready for telecommunication network, and the flag above the DRO mark indicates that communication is going on.

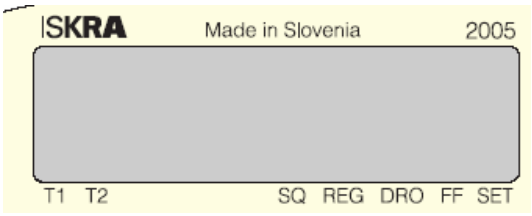


Fig. 5 – Display legend

6. Input and outputs

Input-output connection terminals are placed on the right side of the meter terminal block as well as on the upper additional plate. Eleven auxiliary connection terminals are used for

- Output for load control performed by a relay
- Output for load control performed by a optomos
- Output for circuit breaker control. On request outputs can be used as pulse outputs
- Up to two impulse inputs
- Input for an alarm (low voltage)
- A bed for a SIM card

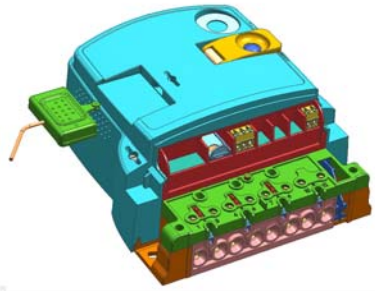


Fig. 5Input / output terminals

6.1. Inputs

The meter is equipped with three inputs that occupy five connection terminals.

Impulse inputs are active SO inputs that are supplied from the meter. Input for the alarm is a passive type and is controlled with voltage on terminals. Control voltage is from 3 V to 240 V AC/DC, and 230 V control voltage is available on request.

6.2. Outputs

The meter is equipped with three outputs occupying six connection terminals.

There are two outputs for load control. One with a relay that is capable of switching 250 V, 6 A, and another one that is performed with an Optomos element and is capable of switching 250 V, 100 mA. It is possible to control each control output separately, depending on the written tariff program or on received command.

Three connection terminals are intended for breaking module control. The central terminal is common, the left one is used for breaking module switch-on, and the right one for switch-off. On request outputs can be used as SO pulse outputs.

7. Circuit-breaker - option

On request, the meters can be equipped with an external plug-in unit – a circuit breaker. The circuit breaker is equipped with a terminal cover, and can be sealed.

Assembly is simple since one part is inserted into the meter terminal block, and another part is extension of the terminal block. The meter with the circuit-breaker as a whole complies with the DIN 43857 standard or the stated fixing dimensions.

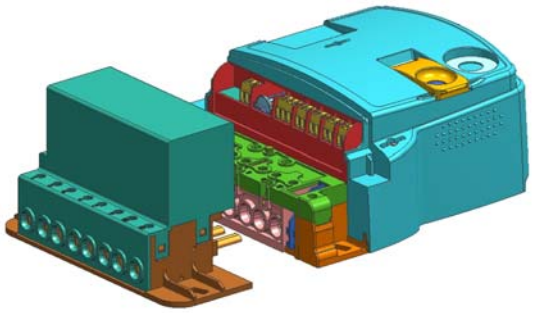


Fig. 6 – A circuit-breaker

8. Handling with the meter

Two sets of tools are available:

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

The tool is intended for the operators who service or re-programme the meters in the laboratory or in a field.

- **For billing readout:**
  - The SEP2W program package with Collect, Data Base and Report modules.
  - A central station – a server with a corresponding software and hardware
- **For billing readout and programming:**
  - MeterRead (Iskraemeco software) for all types of Palm-top PCs operating in the WinCE environment
  - An optical probe

The tool is intended for readers in the field.

9. Maintenance:

The meter is designed and manufactured in such a way that it does not need any maintenance interventions in the entire lifetime. Measuring stability assures that no recalibration is required.

10. Lifetime:

The meter is designed for an 18-year lifetime at normal operating conditions.

11. Connection procedure

1. Place the meter to a connection place.

2. Connect the meter to network; conductors fixing torque is 2.5 Nm.

3. Check connection indication:
   - LED is lit (load current is less than inverse current)
   - LED is blinking (proportional to load current strength)

4. Check connection – see LCD indications:
   - Presence of all three phases - **L1 L2 L3** all symbols displayed,
   - Phase failure – a symbol for a failed phase is not lit
   - Wrong phase sequence - **L1 L2 L3** symbols of wrongly connected phases are blinking

11.1. Connection procedure of GSM/GPRS communication interface

Checking of the presence of a SIM card

1. Remove a terminal block cover.
2. Check if a SIM card is inserted as shown on a figure below
3. If a SIM card is not inserted, insert it into the shown place

Fig. 8 – SIM card bed

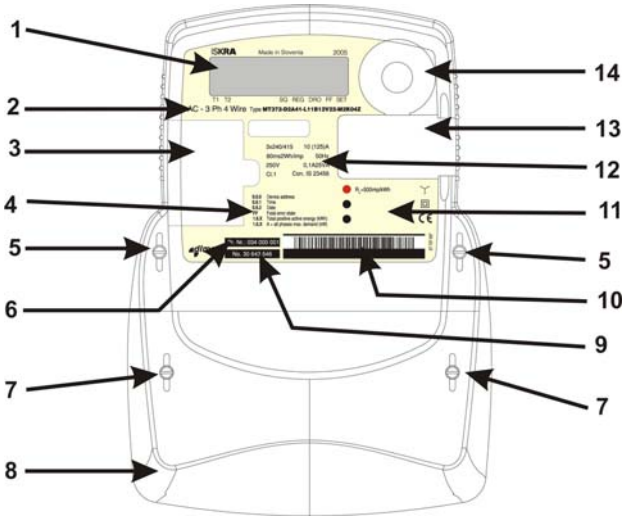
Check the GSM/GPRS signal strength on LCD:

a. **The flag is permanently lit**; good covering with a GSM/GPRS signal.
b. **The flag is blinking**; bad covering with the GSM/GPRS signal. It is recommended to find a better location for meter installation.
c. **The flag is not lit;** it is recommended to find a better location for installation. If the flag is not lit even on a new place, an external antenna is required.

Note, limits are adjustable

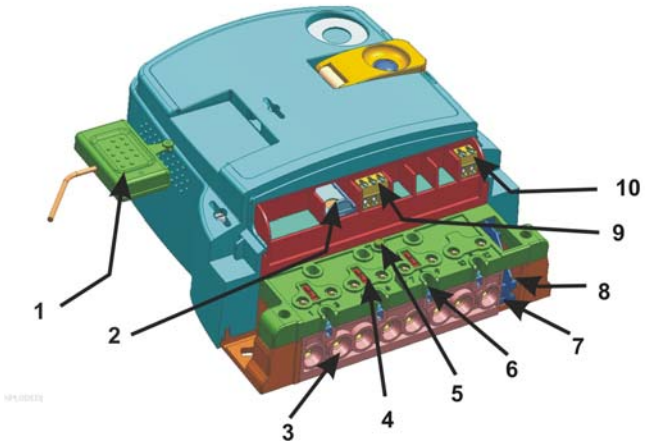
12. Casing

The meter casing is made of self-extinguishable polycarbonate that can be recycled.



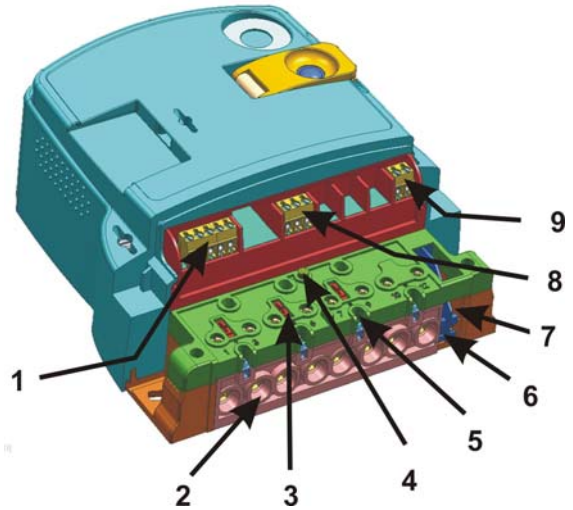
1. LCD
2. Technical data
3. Coupling circuit
4. A legend of registers display on LCD
5. A meter cover sealing screw
6. A meter serial number
7. A terminal cover sealing screw
8. A terminal cover
9. Project number
10. A meter BAR code
11. Impulse LED
12. Meter technical data
13. CALL and RESET keys
14. IR optical interface

Fig. 9 – Meter constituent parts



1. Coupling circuit
2. SIM card bed
3. Current terminals
4. A sliding voltage bridge
5. A switch for detection of terminal cover opening
6. Additional voltage terminals
7. Outputs for load control
8. Impulse inputs
9. Output for circuit breaker control
10. Alarm input (low voltage)

Fig. 10 – Details of a terminal block for GSM/GPRS meter version



1. RS485 communication interface
2. Current terminal
3. Sliding voltage bridge
4. Switch for selection of terminal cover opening
5. Additional voltage terminals
6. Outputs for load control
7. Impulse inputs
8. Output for circuit breaker control
9. Alarm input (low voltage)

Fig. 11 – Details of a terminal block for RS485 meter version

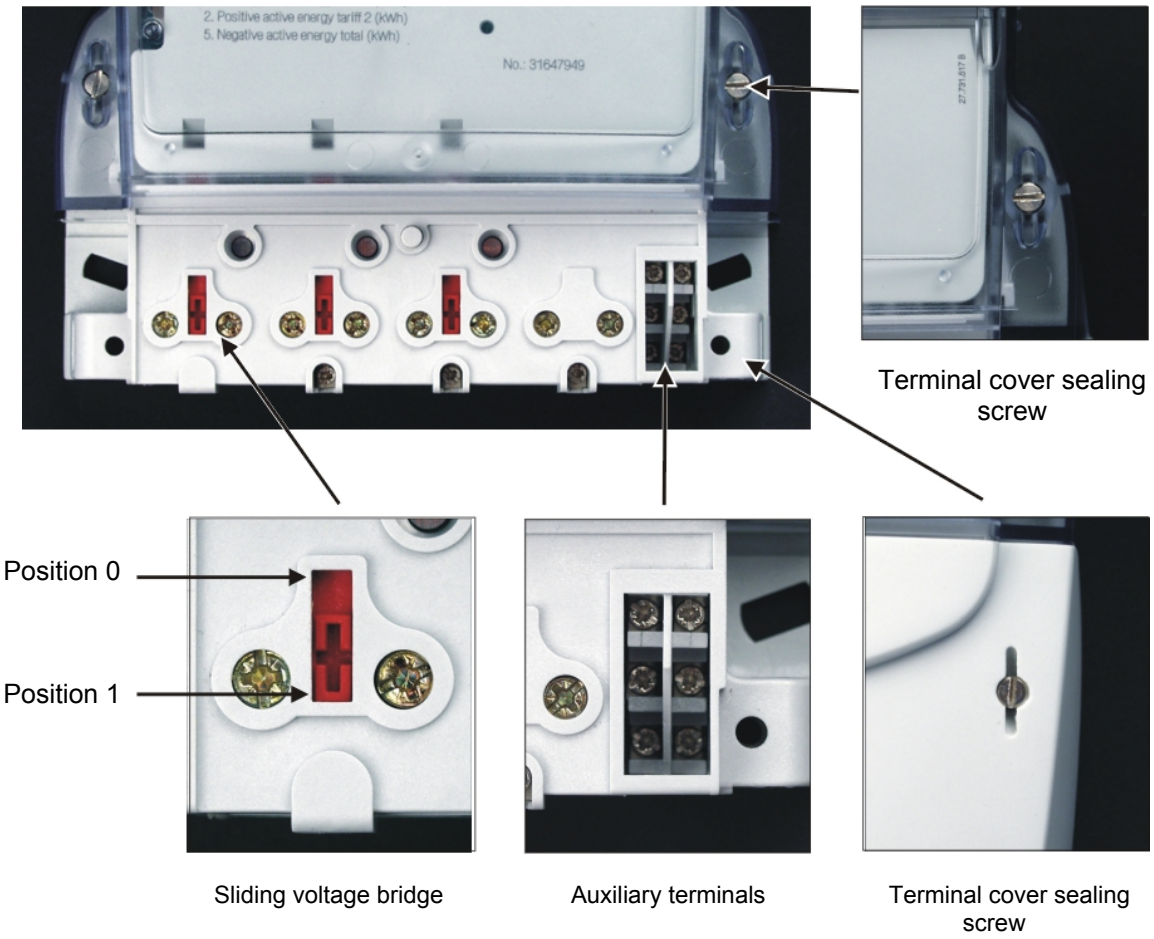


Fig. 12 – Terminal block constituent parts

12.1. Dimensions

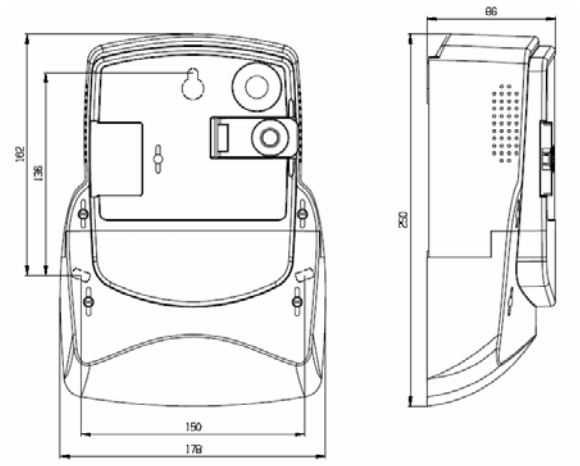


Fig. 13 – Meter fixing dimensions.

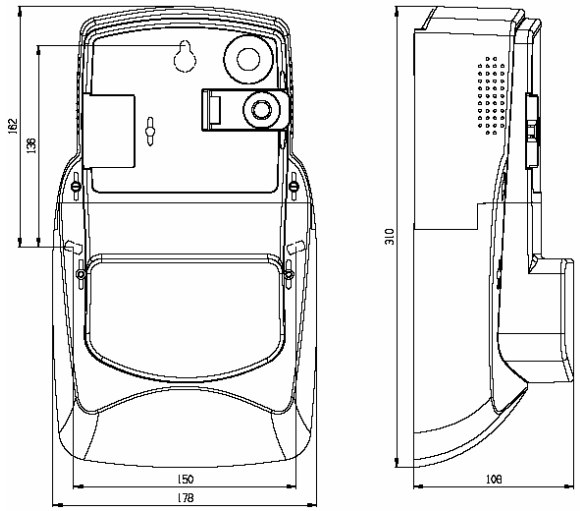


Fig. 14 – Fixing dimensions of meters with a mounted breaking module

13. Terminal block

13.1. Terminal block

A terminal block complies with the DIN 43857 standard. It is made of high quality polycarbonate assuring resistance to high temperatures, voltage-breakdown and mechanical strength.

13.2. Current terminals

Current terminals are made of zinc-plated iron and have only one screw. A universal clamping terminal assures the same quality of the contact irrespective of the shape of the connection conductor (a compact wire, a stranded wire, greater or smaller cross-sections). It also assures faster meter assembly. Available current terminals are:

- Current terminal according DIN standard for currents up to 85A with hole diameter is 8.5 mm,
- Current terminal for currents up to 120A with hole diameter is 9.5 mm,
- Current terminal for current up to 6A with hole diameter is 5.5 mm,

13.3. Auxiliary voltage terminals

The meter can be equipped with max. four auxiliary voltage terminals 2 (L1), 5 (L2), 8 (L3), 11 (N). They enable simple connection of additional external devices.

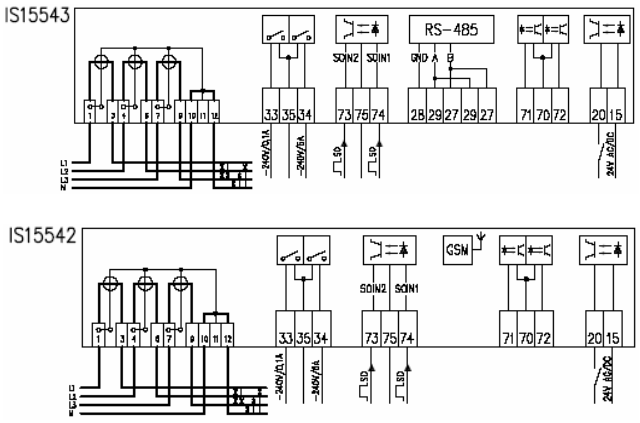
13.4. Sliding voltage bridge

A sliding voltage bridge is intended for fast and simple separation of meter current and voltage circuit used for calibration or accuracy testing. A special slider is built in each phase of the connection terminal. It can be shifted up and down with a screwdriver. When a voltage bridge is in »0« position, it means that the voltage part is separated from the current part, while in position »1« it is closed.

Mounting and fixing meter dimensions comply with the DIN 43857 standard.

14. Connection

The meter can be connected to network as a single-phase, two-phase or three-phase meter.



CLAMP	MAX VOLTAGE	MAX CURRENT	DIAMETER
71	27 V	27 mA	2,5 mm
70	Common clamp		2,5 mm
72	27 V	27 mA	2,5 mm
15	Common clamp		2,5 mm
20	27 V	24 mA	2,5 mm
33	250 V	100 mA	2,5 mm
35	Common clamp		2,5 mm
34	250 V	6 A	2,5 mm
73	27 V	20 mA	2,5 mm
75	Common clamp		2,5 mm
74	27 V	20 mA	2,5 mm
28,29,27 ,29,27	Communication interface		2,5 mm

Fig. 15 – Connection diagrams

15. Technical data

GENERAL METER MEASURING CHARACTERISTICS	
Accuracy class	2 or 1 (IEC 1036)
Nominal current	5 A
Max. current – direct connected meter	85 A
Max. current – direct connected meter	120 A
Max. current – transformer connected meter	6 A
Thermal current	1.2 I_{max} –direct connection
Starting current	<0.005 I_b at cos φ = 1, for class 2 <0.004 I_b at cos φ = 1, for class 1
Short-circuit current	30 I_{max}
Nominal voltage	3x230/400 V, 3x400 V other voltages on request
Voltage range	0.8 U_n ... 1.15 U_n
Nominal frequency	50 Hz or 60 Hz
Meter constant (impulse LED)	1000 imp/kWh at Imax = 85 A 500 imp/kWh at Imax = 120 A 10000 imp/kWh at Imax = 6 A
Temperature range of operation	-25 °C ... +60 °C
Extended temperature range	-40 °C ... +70 °C
Storing temperature	-40 °C ... +80 °C
Voltage circuit self-consumption	< 2W / 10VA
Current circuit self-consumption	< 0.16 VA irrespective of nominal current I_n
INTERNAL CLOCK	
Accuracy (at 25°C)	≤ 6 ppm or ≤ ±3 min / year
Reserve power supply	> 150 hours, supercapacitor
Clock signal	Quartz crystal 32 kHz
Optical communication interface	
Interface	IEC62056-21 (IEC61107) Mode E,
Protocol	IEC62056-46, Registers marking in compliance with OBIS (IEC62056-61)
Transmission rate	19200 bit/sec
RS485 communication interface	
Protocol	IEC62056-46, Marking of registers in compliance with OBIS (IEC62056-61)
Data transmission rate	19200 bit/sec
GSM/GPRS communication interface	
Protocol	IEC62056-46,
Data transmission rate	GSM: 9600 bit/sec GPRS: 28000 bit/sec Actual rate depends on network configuration!

LOAD PROFILE	
Number of channels	1 or 2
OUTPUTS	
High voltage output	Hardware type; bistable relay Output type; Load control Switching voltage: 250 V Switching current: 6 A
High voltage output	Hardware type; Optomoss Output type; Servis control Switching voltage: 250 V Switching current: 100mA
Low voltage output	Hardware type; transistor Output type; circuit breaker control or pulse output Switching voltage: 27 V Switching current: 27 mA
INPUTS	
Low voltage input	Hardware type: Active transistor input Inputs type; SO impulse inputs Switching voltage: 27 V Switching current: 27 mA
Low voltage input	Hardware type: Passive transistor input Inputs type; Alarm input Switching voltage: 3 – 24 V AC/DC
CIRCUIT BREAKER	
Circuit breaker	Input type:; 3 x bistable relay Switching voltage: 3 x 44 0V Switching current: 3 x 100 A
METER RESISTANCE TO ELECTROMAGNETIC DISTURBANCES	
Insulation strength	4 kV, 50 Hz, 1 min
Electrostatic discharges	15 kV (IEC 1000 - 4 - 2)
Electroma-gnetic field	10 V/m (IEC 1000 - 4 - 3)
Burst test – high-frequency disturbances	4 kV (IEC 1000 - 4 - 4)
Shock voltage	12 kV, 1,2/50 μs (IEC 61036) –to meter main circuit
DIMENSIONS	
W xH xL Mass	Meter with terminal cover and breaking module 86 x 250 x 178 1300 g
W xH xL Mass Breaking module	Meter with terminal cover and breaking module 86 x 250 x 178 1300 g 650 g

Table 2 – Technical data

16. Type designation

M														Electronic meter
T														Three-phase three-system meter
372														With built-in communication module
	-													
		D1												Terminal block up to 85 A (DIN standard)
		D2												Terminal block up to 120 A
		T1												Terminal block up to 6 A
			A4											Active energy measurement, accuracy class 1
			A5											Active energy measurement, accuracy class 2
				1										Energy measurement in one direction
				2										Energy measurement in two directions
					-									
						V								Low voltage passive transistor input
							1							No. of inputs
							2							Control voltage is phase voltage
						W								Low voltage active transistor input
							n							Number of inputs (n = 1, 2)
							2							Resistive impulse input
						B								High voltage output – relay type
							1							One relay contact
							1							Make contact
						G								Low voltage output
							N							Number of outputs (n=1, 2)
							2							Transistor output
						L								High voltage output – Optomoss type
							1							One control output
							1							Make contact
								-						
									M					Internal clock
										2				Back-up power supply – super capacitor
											K			Communication interface
												0		Optical interface in compliance with IEC 62056 - 21
												3		RS485 communication interface (on request)
												8		GSM modem (on request)
													a	GPRS modem (on request)
													Z	Load profile (option)

Table 3 – Type designation

Iskraemeco d.d., Energy Measurement and Management
4000 Kranj, Savska loka 4, Slovenia
Telephone (+386 4) 206 40 00, Fax: (+386 4) 206 43 76
http://www.iskraemeco.si, E-mail: info@iskraemeco.si
Published: Iskraemeco, Marketing, Data subjected to alteration without notice. MT372_Technical_Description.doc