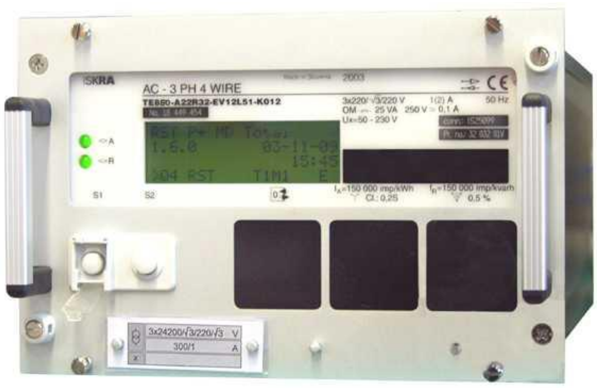
MT860

High Precision Multi-Function Meter 0.2S

Technical Description



V6.1 - English

Document code: EAD 020.615.660
Version 6.1
Date: 30.04.2014

Contents

DISCLAIMER AND LIMITATION OF LIABILITY
This manual was written for use of SEP2W software. This manual, including all documentation incorporated by reference herein such as documentation provided or made available at Iskrameco d.d. web site, is provided or made accessible "AS IS" and "AS AVAILABLE" and without condition, endorsement, guarantee, representation, or warranty of any kind by Iskraemeco d.d. and its affiliated companies (hereinafter collectively referred to as »Iskraemeco«). Iskraemeco assumes no responsibility for any typographical, technical, or other inaccuracies, errors, or omissions in this documentation, nor for any loss due to the use of this documentation. Iskraemeco reserves the right to periodically change information that is contained in this documentation; however, Iskraemeco makes no commitment to provide any such changes, updates, enhancements, or other additions to this documentation. Iskraemeco shall not be liable for any type of damages related to this documentation or its use, or performance or non-performance of any software, hardware, service, or any third party products and services.
SAVE AS EXPRESSLY PROVIDED IN YOUR CONTRACT WITH ISKRAEMECO, ISKRAEMECO EXPRESSLY DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTIBILITY OR FITNESS FOR A PARTICULARE PURPOSE AND AGAINST INFRINGEMENT. ISKRAEMECO DOES NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE PRODUCT WILL BE UNITERRUPTED OR ERROR-FREE, OR THAT DEFECTS IN THE PRODUCT OR ERRORS IN THE DATA WILL BE CORRECTED. FURTHERMORE, ISKRAEMECO DOES NOT WARRANT OR MAKE ANY REPRESENTATIONS REGARDING THE USE OR THE RESULTS OF THE USE OF THE PRODUCT OR ITS DOCUMENTATION IN TERMS OF THEIR CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE. NO ORAL OR WRITTEN INFORMATION OR ADVICE, GIVEN BY ISKRAEMECO OR AN ISKRAEMECO AUTHORIZED REPRESENTATIVE SHALL CREATE A WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF THIS WARRANTY. SOME JURISDICTIONS DO NOT ALLOW EXCLUSION OF THE IMPLIED WARRANTIES, SO THE ABOVE EXCLUSION MAY NOT APPLY. UNDER NO CIRCUMSTANCES INCLUDING NEGLIGENCE, SHALL ISKRAEMECO, THEIR DIRECTORS, OFFICERS, EMPLOYEES OR AGENTS BE LIABLE FOR ANY INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES (INCLUDING DAMAGES FOR LOSS OF BUSINESS, LOSS OF PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, ETC.) ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT OR ITS DOCUMENTATION, EVEN IF ISKRAEMECO OR AN ISKRAEMECO AUTHORIZED REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. SOME JURISDICTIONS DO NOT ALLOW LIMITATION OR EXCLUSION OF LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OR ALLOW EXCLUSION OR LIMITATION OF LIABILITY ONLY FOR NEGLIGENCE, BUT NOT FOR GROSS NEGLIGENCE OR ATTEMPT, SO THIS LIMITATION MAY NOT APPLY. IN NO EVENT SHALL ISKRAEMECO'S TOTAL LIABILITY FOR ALL DAMAGES, LOSSES AND CAUSES OF ACTION (WHETHER IN CONTRACT, TORT, INCLUDING NEGLIGENCE, OR OTHERWISE) EXCEED THE AMOUNT PAID FOR THE PRODUCT AND ITS DOCUMENTATION.

1. List of standards

1.1. IEC standards

IEC 60068-2-1	Environmental testing – Part 2-1: Tests – Test A: Cold
IEC 60068-2-2	Environmental testing – Part 2-2: Tests – Test B: Dry heat
IEC 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
IEC 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
IEC 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
IEC 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
IEC 61000-4-8	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test
IEC 61000-4-11	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests
IEC 62052-11	Electricity metering equipment (AC) – General requirements, tests and test conditions – Metering equipment
IEC 62053-21	Electricity metering equipment (a.c.) - static meters for active energy (classes 1 and 2)
IEC 62053-22	Electricity metering equipment (a.c.) – Particular Requirements – Part 22: Static meters for active energy (classes 0,2S and 0,5S) OK
IEC 62053-23	Electricity metering equipment (a.c.) - static meters for reactive energy (classes 2 and 3)
IEC 62054-21	Electricity metering (a.c.) – Tariff and load control – Particular requirements for time switches
IEC 62056-21	Electricity metering - Data exchange for meter reading, tariff and load control – Direct local data exchange
IEC 62059-41	Electricity metering equipment – Dependability – Reliability prediction
IEC 60695-2-10	Fire hazard testing part-2 test methods glow wire test and guidance,
EN 50470-3	Electricity metering equipment Static meters for active energy, classes A, B and C
CISPR 22	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
IEC 60695-2-11	Fire hazard testing-Glowing/hot wire based test methods - Glow-wire flammability test method for end-products
IEC 60068-2-75	Environmental testing - Tests-Test Eh: Hammer tests
IEC 60068-2-27	Basic environmental testing procedures - Tests - Tests Ea and guidance: Shock
IEC 60068-2-6	Basic environmental testing procedures - Tests - Tests Fc: Vibration (sinusoidal)
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 62053-23	Electricity metering equipment (AC.) - Particular requirements - Pulse output devices for electromechanical and electronic meters (two wires only)
IEC 60068-2-30	Environmental testing - Tests - Tests Db and guidance: Damp heat cyclic (12+12-hour cycle)
Draft:	
IEC 62053-24 Ed. 1.0	Electricity metering equipment (AC) - Particular requiremens - Part 24: Static meters for reactive energy (classes 0,5 S, 0,5, 1S and 1)

1.2. EU standards

2004/22/EC	Measuring instruments directive (MID)

1.3. CENELEC

EN 50470-1	Electricity metering equipment (a.c.) -- Part 1: General requirements, tests and test conditions - Metering equipment (class indexes A, B and C)
EN 50470-2	Electricity metering equipment (a.c.) -- Part 2: Particular requirements - Electromechanical meters for active energy (class indexes A and B)
EN 50470-3	Electricity metering equipment (a.c.) -- Part 3: Particular requirements - Static meters for active energy (class indexes A, B and C)
EN TR 50579	Electricity metering equipment - Severity levels, immunity requirements and test methods for conducted disturbances in the frequency range 2 -150 kHz
EN 62058-21	Electricity metering equipment (a.c.) - Acceptance inspection -- Part 21: Particular requirements for electromechanical meters for active energy (classes 0,5, 1 and 2 and class indexes A and B)
EN 62058-31	Electricity metering equipment (a.c.) - Acceptance inspection -- Part 31: Particular requirements for static meters for active energy (classes 0,2 S, 0,5 S, 1 and 2, and class indexes A, B and C)
EN 62059-32-1	Electricity metering equipment - Dependability -- Part 32-1: Durability - Testing of the stability of metrological characteristics by applying elevated temperature

1.4. Welmec guides

WELMEC guides	http://www.welmec.org/latest/guides.html
An Introduction to WELMEC	http://www.welmec.org/fileadmin/user_files/publications/WELMEC_1_-An_Introduction_issue_6.pdf
Guide 7.1	Software Requirements on the Basis of the Measuring Instruments Directive (MID)
Guide 7.2	Software Guide (Measuring Instruments Directive 2004/22/EC)
Guide 8	Measuring Instruments Directive 2004/22/EC, Generalities on the Assessment and Operationof Notified Bodies performing Conformity Assessment
Guide 8.2	Guide for Measuring Instruments Directive 2004/22/EC Application of Module H1
Guide 8.3	Measuring Instruments Directive 2004/22/EC, Application of Module B
Guide 8.4	Measuring Instruments Directive 2004/22/EC, Application of Module D
Guide 8.6	Measuring Instruments Directive 2004/22/EC, Presumption of Conformity of the Quality System of Manufacturers with Module D or H 1 when EN ISO 9001:2000 is applied
Guide 11.1	Guide for Measuring Instruments Directive 2004/22/EC, Common Application for utility meters
Guide 8.21	Guidance to the application of Measuring Instruments Directive 2004/22/EC (MID) on measuring instruments.
Guide 11.2	Guideline on time depending consumption measurements for billing purposes (interval metering)
Guide 11.3	Guide for sealing of Utility meters

2. Safety

Safety information used in this Installation and maintenance manual is described with the following symbols and pictograms:

DANGER: for a possibly dangerous situation, which could result in severe physical injury or fatality – attention to a high risk hazards.

WARNING: attention to a medium risk hazards.

CAUTION: for a possibly dangerous situation, which could result in minor physical injury or material damage - attention to a low risk hazards.

Operating instruction: for general details and other useful information.

All safety information in this Installation and maintenance manual describes the type and source of danger; it is possible consequences and measures to avoid the danger.

2.1. Responsibilities

The owner of the meter is responsible to assure that all authorized persons who work with the meter read and understand the parts of the User manual and Installation and maintenance manual that explains the safe handling with the meter.

The personnel must be sufficiently qualified for the work that will be performed. The installation personnel must possess the required electrical knowledge and skills, and must be authorised by the utility to perform the installation procedure.

The personnel must strictly follow the safety regulations and operating instructions, written in the individual chapters in this Installation and maintenance manual and the User Manual.

The owner of the meter responds specially for the protection of the persons, for prevention of material damage and for training of personnel.

.

2.2. Safety instructions

2.2.1 Handling and mounting

At the beginning of installation at the metering point, the meter should be carefully taken out of the box where it was packed. This should prevent the meter from falling as well as any other external or internal damage to the device and personal injuries. Should such an incident occur despite all precautions the meter may not be installed at the metering point as such damage may result in different hazards. In such case, the meter needs to be sent back to the manufacturer for examination and testing.

CAUTION: The edges of the seals, sealing wires as well as some edges under (removed) terminal cover are sharp!

CAUTION: The temperature of the terminal block of the connected and operating meter may rise, therefore the temperature of the terminal cover may rise as well.

DANGER: In case of any damage inside the meter (fire, explosion...) do not open the meter.

CAUTION: The meter may be used only for the purpose of measurement for which it was produced. Any misuse of the meter will lead to potential hazards.

WARNING: Safety measures should be observed at all times. Do not break the seals or open the meter at any time!

It must be consulted in all cases where symbol is marked in order to find out the nature of the potential hazards and any actions which have to be taken to avoid them.

The meter installation procedure is described in this Installation and maintenance manual. For safety reasons the following instructions should be followed.

See the complete User manual for detailed technical features of MT860 meter and its intended use.

Only a properly connected meter can measure correctly! Every connection error could result in a financial loss for the power company!

2.2.2 Meter installation procedure

DANGER: The MT860 electricity meter is a device connected into the electricity network. Any unauthorized manipulation of the device is dangerous for life and prohibited according to the applicable legislation. Any attempt to damage the seals as well as any unauthorized opening of the terminal or meter cover is strictly forbidden.

Installation companies shall implement a training policy that ensures that all installers are adequately trained, understand risk and safety issues and possess the relevant skills before they commence operational duties.

The installer will need to recognise and understand different metering installations, meter types and various equipments associated with those installations applicable to the successful installation of the electricity meter.

The installer must consult and comply with local regulations and read the installation instructions written in this Installation and maintenance manual before installation.

This Installation and maintenance manual provides the instructions for installing MT860 meters. The document provides a short overview of the meter, details of device installation and set-up, installation considerations, and health and safety considerations.

The installer will be considered as a public face by both the power company and its customers. The installer shall adopt the highest standards of behaviour and be respectful to clients and members of the public.

Before the beginning of the installation procedure, check if the metering point is correctly prepared for meter installation. The metering point must always be left clean and in order.

The work location shall be defined and clearly marked. Adequate working space as well as means of access and lighting shall be provided at all parts of an electrical installation on, with, or near which any work activity is to be carried out.

Where necessary, safe access to the work location shall be clearly marked.

The metering point must not be exposed to running water or fire.

Meter installation may not be performed by unauthorised and untrained personnel. Such persons are not allowed to cut the seals and open the terminal or meter cover as contact with the live parts of the meter is dangerous for life.

Opening the terminal or meter cover is dangerous for life because there are live parts inside.

Installation personnel must possess the required electrical knowledge and skills, and must be authorised by the utility to perform the installation procedure.

The installer is obligated to perform the installation procedure in accordance with the national legislation and internal norms of the utility.

National legislation can set out the minimum age and the competence criteria for installers. In case there are no national requirements defined, the following criteria shall be used by assessing the competence of installers: knowledge of electricity, experiences on electrical work, understanding of the installation procedures, practical experience of that work, understanding the hazards which can arise during the work and the precautions to be observed, ability to recognize at all times whether it is safe to continue working.

According to the basic principles, either the nominated person in control of the electrical installation or the nominated person in control of the work activity shall ensure that specific and detailed instructions are given to the personnel carrying out the work before starting and on completion of the work.

Before starting work, the nominated person in control of the work activity shall give notification to the nominated person in control of the electrical installation, of the nature, place and consequences to the electrical installation of the intended work.

CAUTION: The installer is expected to fully understand the risks and safety issues involved in electrical installations. The installer shall be aware at all times of the potential hazard of electrical shock and shall exercise due caution in completing the task!

Tools, equipment and devices shall comply with the requirements of relevant National or International Standards where these exist. Tools, equipment and devices shall be used in accordance with the instructions and/or guidance provided by the manufacturer or supplier.

Any tools, equipment and devices provided for the purpose of safe operation of, or work on, with, or near electrical installations shall be suitable for that use, be maintained and be properly used.

Personnel shall wear clothing suitable for the locations and conditions where they are working. This could include the use of close-fitting clothing or additional PPE (personal protective equipment).

CAUTION: The installer must be correctly equipped with personal protection equipment (PPE) and use the appropriate tools at all times during the installation.

Working procedures are divided into three different procedures: dead working, live working, and working in the vicinity of live parts. All these procedures are based on the use of protective measures against electric shock and/or the effects of short-circuits and arcing.

The installer must be informed if the national legislation permits the work on the installation under voltage – live work, and must follow the rules of legislation.

Depending on the kind of work, the personnel working in such conditions shall be instructed or skilled. Live working requires the use of specific procedures. Instructions shall be given how to maintain tools, equipment and devices in good working order and how to verify them before working.

This subclause deals with the essential requirements ("the five safety or golden rules") for ensuring that the electrical installation at the work location is dead and secure for the duration of the work.

This shall require clear identification of the work location. After the respective electrical installations have been identified, the following five essential requirements shall be undertaken in the specified order unless there are essential reasons for doing otherwise: disconnect completely (1.), secure against re-connection (2.), verify that the installation is dead (3.), carry out earthing and short-circuiting (4.) and provide protection against adjacent live parts (5.).

CAUTION: Do not attempt to install the meter before you have isolated the installation site from the network!

DANGER: The relevant preliminary fuses must be removed before making any modifications to the installation, and kept safe until completing the work to prevent the unnoticed reinsertion.

DANGER: Secondary circuit of current transformer must not be opened when current is flowing in the primary circuit. This would produce a dangerous voltage of several thousand volts at the terminals and the insulation of the transformer would be destroyed.

DANGER: Connecting the meter into the network under voltage is dangerous for life so the conductors at the metering point must not be connected to any voltage source during the connection procedure. The meter connection procedure may only be performed by well-trained and adequately authorized personnel.

CAUTION: Only one wire or ferrule may be connected in one terminal. Otherwise, the terminal could be damaged or the contact could not be made properly.

CAUTION: Do not use those types of cable, which are not prescribed for the installation site and the power requirements!

DANGER: The insulation of the connecting cable must extend over the whole visible part of the cable. There must be no further bare part of the cable visible above the terminal edge. Touching live parts is dangerous for life. The stripped part of the connecting wire should be shortened if necessary.

CAUTION: At the end of installation at the metering point no cable should stay unconnected or hanging freely from the metering point.

The meter has to be mounted on a smooth vertical surface and fixed at 2 or 3 points with screws using the proper torque (the meter has two attachment holes and, optionally, a top hanger).

The meter is intended to be mounted at an indoor metering point, in a meter cabinet, secured against the undesired access of unauthorized persons. Only scroll push button may be accessible from the outside. Do not expose meter surface to very high temperatures even though the surface is made of inflammable plastics to prevent fire.

Electrical connection: mounting cables must be properly dimensioned and of proper shape. They must be mounted using the proper torque. The meter should be connected according to the meter connection diagram that is attached to the inner side of the meter terminal cover. Screws on the current terminal must be tightened to proper torque.

CAUTION: If it is possible to install the meter without isolation from the network, i.e. on live network, then appropriate instructions and safety warnings shall be provided.

CAUTION: Specific aspects and safety hazards related to external voltage and current transformers, auxiliary supplies and local generation shall be covered.

DANGER: The preliminary fuses and/or voltage arresters must be re-inserted before commissioning and functional check of the meter.

Seals on the meter have to be checked at the end of the installation procedure so that the final customer cannot come into contact with live parts of the meter.

DANGER: If the terminal cover is not screwed tight, there exists a danger of contact with the connection terminals. Contact with live parts of the meter is dangerous for life.

CAUTION: For safety reasons, place the terminal cover immediately after the installation procedure and fix it with fixing screws!

DANGER: Switch on the power. Beware of the risk of electric shock at all times!

The functional check requires voltage to be applied and load applied to all phases. Determine first the energy flow direction.

If no main voltage is present, commissioning and functional check must be performed at a later date.

2.2.3 Meter maintenance

No maintenance is required during the meter's life-time. The implemented metering technique, built-in components and manufacturing procedures ensure high long-term stability of meters. Therefore no recalibration is required during entire meters life-time.

In case the service of the meter is needed, the requirements from the meter installation procedure must be observed and followed.

Cleaning of the meter is allowed only with a soft dry cloth. Cleaning is allowed only in upper part of the meter – in the region of the LCD. Cleaning is forbidden in the region of terminal cover, where cables are connected to the meter. Cleaning can be performed only bythe personnel responsible for meter maintenance.

CAUTION: Never clean soiled meters under running water or with high pressure devices. Penetrating water can cause short circuits. A damp cleaning cloth is sufficient to remove normal dirt such as dust. If the meter is more heavily soiled, it should be dismounted and sent to the responsible service or repair centre.

Visible signs of fraud attempt (mechanical damages, presence of a liquid, etc.) must be regularly checked.

The quality of seals and the state of the terminals and connecting cables must be regularly checked.

If there exists a suspicion of incorrect operation of the meter, the local utility must be informed immediately.

DANGER: Breaking the seals and removing the terminal cover or meter cover will lead to potential hazards because there are live electrical parts inside.

After the end of the meter's lifetime, the meter should be treated according to the Waste Electric and Electronic (WEEE) Directive!

3. Overview

MT860 is an electronic multi-function transformer rated electricity meter, intended for measurement and registration of active, reactive and apparent energies, as well as demands.

High precision multifunction static meters are intended for large and medium size commercial and industrial customers.

Meters are manufactured in compliance with the ISO 9001 standard.

3.1. Main features

The MT860 meters support the new needs arising from deregulation and competition in the electricity market as well as classic metering.

The main meter features are:

- High-accuracy and long-term measurement stability,
- Modular design, communication modules and input/output modules,
- Connection via CT or CT/VT in three-phase three or four-wire networks,
- Multi-range.

Energy and demand measurement:

- active energy measurement (import, export) in compliance with the IEC 62053-22 standard, class 0.2S or 0.5S,
- reactive energy measurement (four quadrants and combined quadrants) in compliance with the IEC 62053-23 standard, class 2 or 3 (calibrated up to 0.5%),
- apparent energy in two flow directions
- current average, maximal and cumulative demand measurement.

Network quality monitoring:

- instantaneous and rms values of phase voltages, currents and frequency,
- THD,
- harmonic analysis,
- power factor,
- phase angle,
- power interruptions, etc.

Functions:

- time of use, on-line registration of energy and demand,
- two independent load profiles,
- two log books,
- possibility of three inputs and eight outputs,
- display of various data, alarms and statuses on LCD by IEC62056-61 (OBIS).

Advanced features:

- CT/VT error,
- security of the meter and meter data,
- internal or external supply with priorities.

Figure 1: Iskraemeco - metering tradition since 1945.

3.2. Benefits

New implemented innovative solutions enhance technical capabilities and expand meters functionality.

Furthermore, they bring cost benefits.

Thanks to the meter modularity, a wide multi-ranging measuring range and power supply, industrial and commercial users need only one Iskraemeco type of the meter for many different installations.

See Table 1: MT860 brings new practical and cost benefits.

3.3. 60 years of tradition

Meters are approved according to international standards and designed according to even more strict internal Iskraemeco standards, based on 60 years of meter manufacturing experience and 55 millions installed meters around the globe.

Feature	Practical benefits	Cost benefits
Multi-range	the same meter can be used at all nominal voltages	REDUCED INVENTORY COST Reducing the number of different meters that the utility should have on stock.
	easy connection	
	no damage to the meter at wrong connection or voltage	
	the same meter can be used for 3-wire or 4-wire networks	
	multi-ranging power supply allows the same meter to be used in a wide range of service	
Modularity	meet your needs both now and in the future	REDUCED COMMUNICATION COST No need for additional data loggers, communicators, etc.
	modules can be ordered or replaced when needed	
	modules can be used also with other Iskraemeco meters	
	IEC standards ensure easy integration into AMR systems	
USB optical magnetic probe	no power supply needed quick meter reading/writing without wiring the meter	No costs for batteries and time consumption for wiring.

Table 1: MT860 brings new practical and cost benefits.

4. Configuration

The meter is modular based. A communication and input/output modules can be built in the meter.

The meter consists of the following parts:

- central processing unit (CPU),
- measuring system with ADC and DSP,
- real time clock (RTC),
- display (LCD),
- optical-magnetic interface (O),
- RS 232 or RS485 interface,
- inputs/outputs,
- power supply.

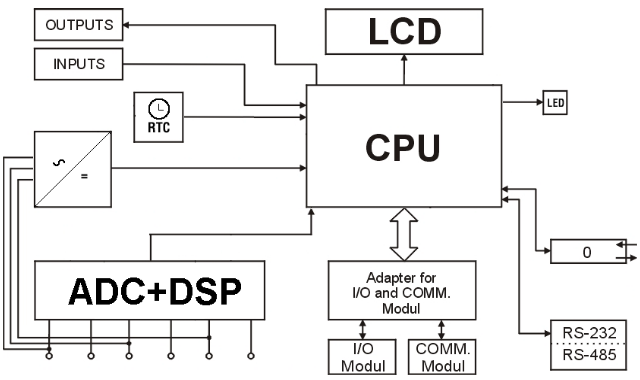


Figure 2: Meter block diagram

4.1. Watchdog

A separate integrated circuit is used to control power, reset and watchdog.

Micro controller program execution is controlled on the watchdog input. In case of malfuction, the watchdog output signal generates a reset to the micro controller.
Watchdog function is also used in a controlled manner when new parameters are written to the meter to start the application on the new set of parameters.

Power supply monitoring circuitry generates a reset output during power-up, power-down and brownout conditions.

4.2. Measuring system

A measuring system is based on three compensated current transformers with a linear characteristic and three voltage precise resistor dividers.

Current transformers with high permeability cores are compensated by electronic circuit. In that way, a non-linear magnetic curve (histeresis) is eliminated.

The metering elements are protected against over-voltage and high frequency disturbances.

Recalibration of the meter is thus not required during its life span.

4.2.1 Analogue to digital converter

A multi-channel analogue to digital converter has three ADC pairs. Each pair measures a single voltage and current signal.

ADC sampling frequency is 4 kHz with 16-bit resolution. ADCs have implemented anti-aliasing filters.

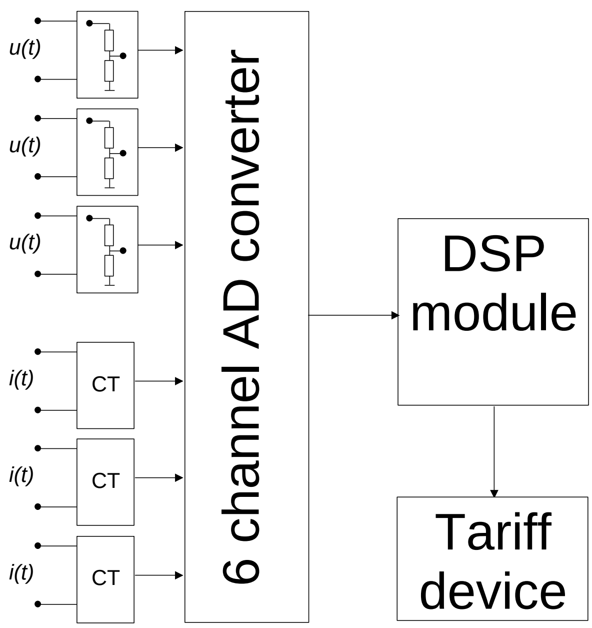


Figure 3: Measuring system

4.2.2 Digital signal processor

Digital data from ADC is sent by an SPI bus to a digital signal processor (DSP). DSP calculates energy, demand, frequency, network quality parameters, etc.

On one side DSP is connected with an SPI bus to ADC and on the other side it is connected to a tariff device micro-controller. DSP sends measured data through an SPI bus to a tariff device every second.

A DSP module controls also output LEDs.

4.2.3 Natural connection

Natural connection is used for reactive energy measurement.

With a natural connection for each phase the current and 90º-shifted voltage are multiplied. In this way the information about reactive energy is still correct for each phase.

4.3. Maintenance

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

The meter with the internal battery assures sufficient capacity for performing battery supported functions for the entire lifetime.

5. Meter parts

5.1. Surface-mounting housing

A compact plastic casing is made of high quality self-extinguishable materials and is resistant to water and dust (IP53). Meter and fixing dimensions comply with the DIN 43857 standard.

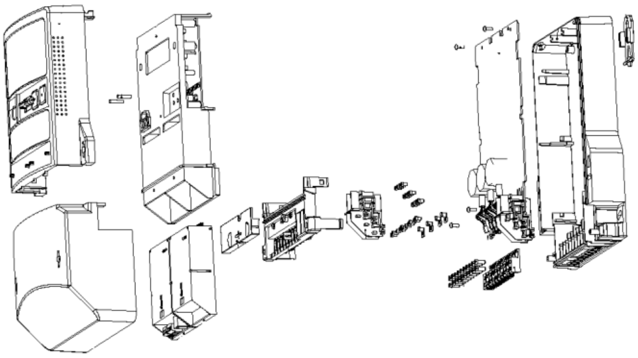


Figure 4: Surface-mounting housing

A sliding hanger enables installation for all fixing dimensions from 165 to 230 mm.

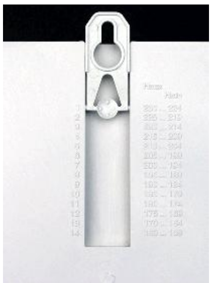


Figure 5: Adjustable hook at meter back

The meter is made of the materials that can be recycled and are environment-friendly.

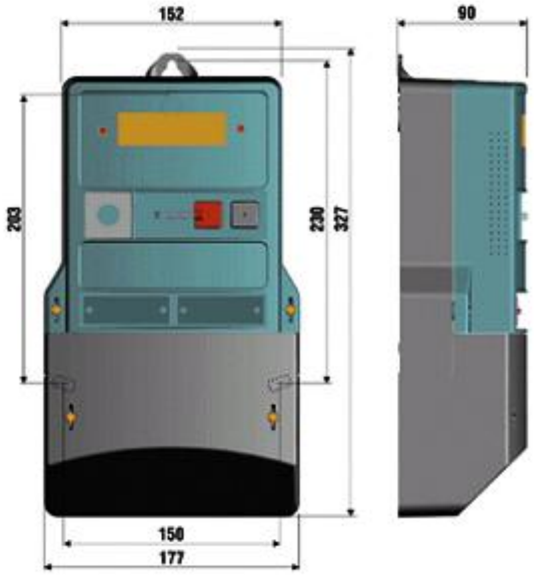
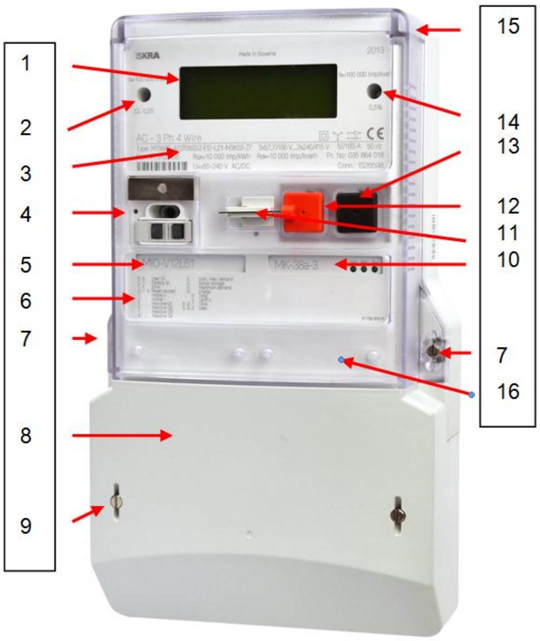


Figure 6: Surface-mounting housing dimensions



1. Display
2. Active energy metrological LED
3. Technical data
4. Optical-magnetic interface
5. Input/output module mark
6. Legend for register display
7. Meter cover sealing screw
8. Terminal cover
9. Terminal cover sealing screw
10. Communication module mark
11. Reset key blocking element
12. Reset key
13. Scroll key
14. Reactive energy metrological LED
15. Meter cover
16. Labels

Figure 7: Meter parts

5.1.1 Front plate

The following data are printed on the meter front plate:

- serial number,
- ownership number,
- type and version designation,
- accuracy,
- year of manufacturing,
- approval mark,
- rated voltage,
- rated and maximum currents,
- rated frequency,
- LED and output pulse constants,
- software version,
- owner's name or logo,
- bar code,
- code of connection diagram and program number.

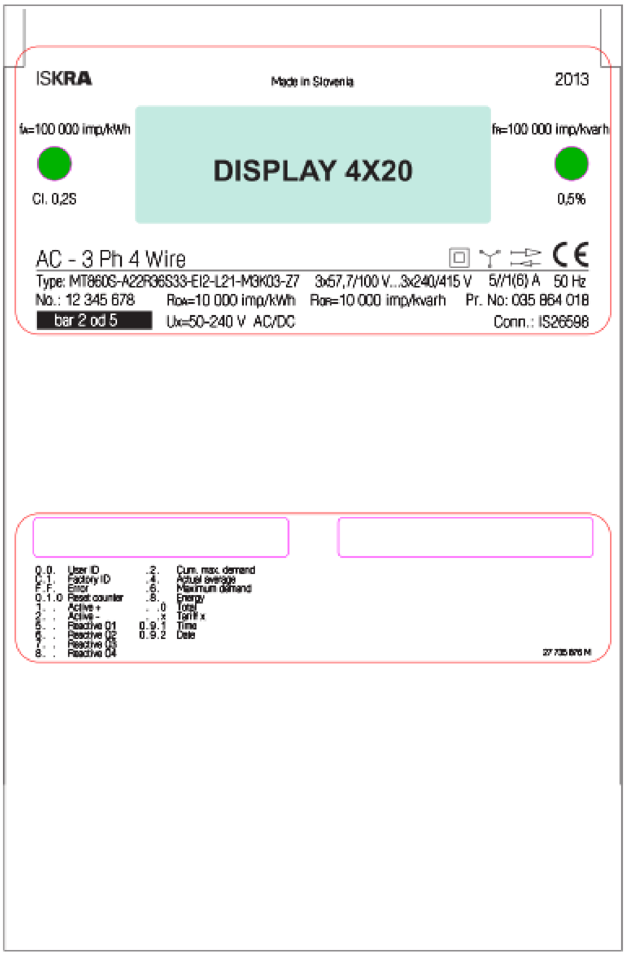
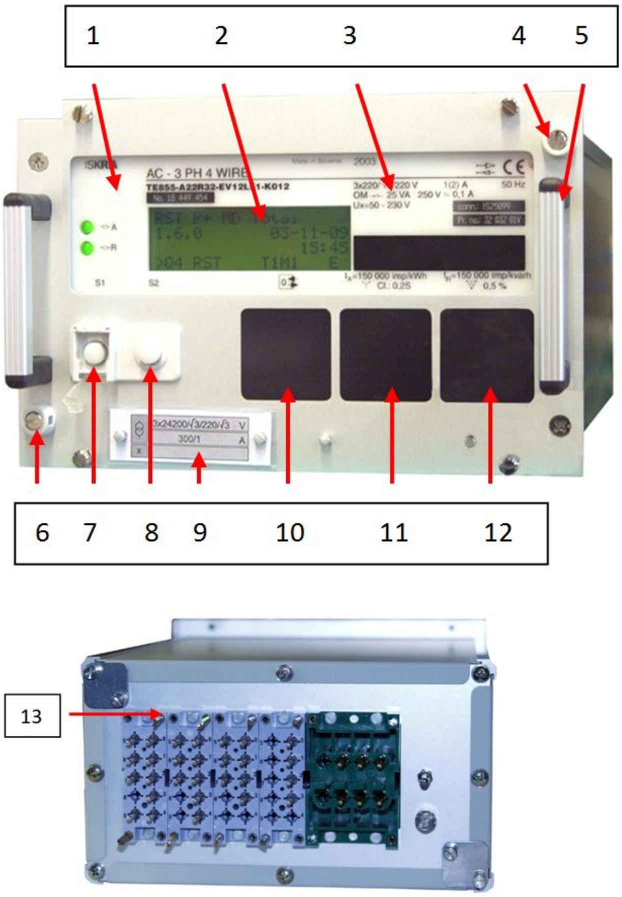


Figure 8: Front plate

5.2. Half 19'' rack mounting housing

Meter is built into a standard half 19" housing and can be thus mounted in a 19" cabinet by means of a carrying casing. The casing is made of metal. The meter fixing dimensions comply with the DIN 43862 standard.



1. Front plate
2. Display
3. Technical data
4. Meter cover sealing screw
5. Handle
6. Meter cover sealing screw
7. Reset key
8. Scroll key
9. Label
10. Optical interface
11. Active energy metrological LED
12. Reactive energy metrological LED
13. ESSAILEC connectors

Figure 9: Meter parts

Due to rack construction some options are not available for this version of the meter:

- tamper detection sensors,
- active probe,
- GSM module.

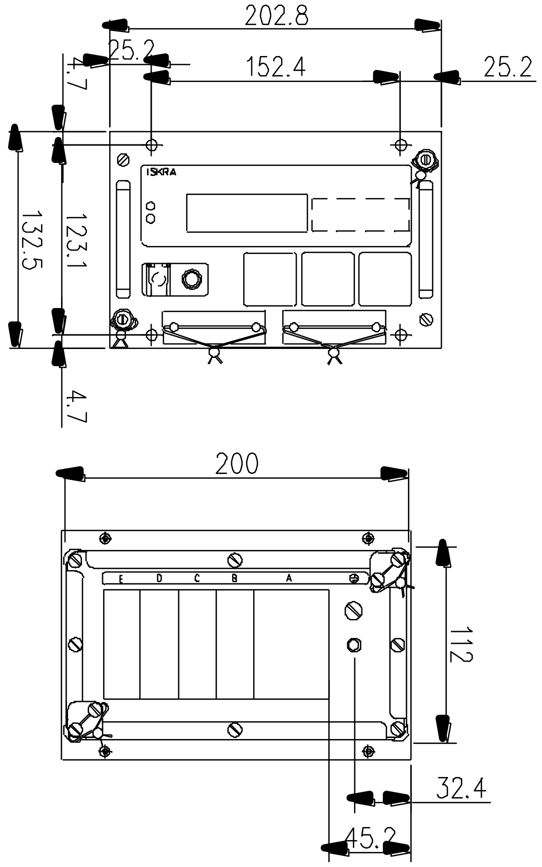


Figure 10: Half 19" rack mounting housing dimensions

5.2.1 ESSAILEC connector

ESSAILEC connector enables simple replacement of the meter on the measuring place. It automatically short circuits a secondary winding of the current transformer when the meter is removed from the measuring cabinet. The connectors are fixed to the meter with two screws that can also be sealed.

The meters are connected to the ESSAILEC connector (plug-in & plug-out) from the rear side. Measuring, input and output circuits as well as communication conductors are connected to ESSAILEC connectors according to the connection diagram that is stuck on the meter external side.

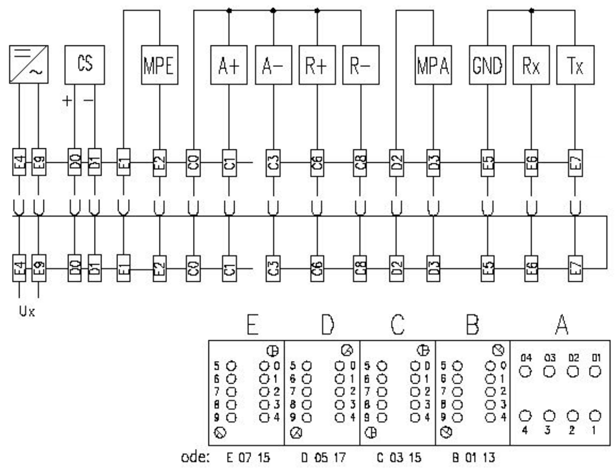


Figure 11: ESSAILEC connector scheme for half 19" rack

5.3. Wiring connections

The meters can be connected via current or current and voltage measuring transformer in three-phase, three or four-wire networks. They can also be connected by means of Aaron connection of both voltage and current transformers.

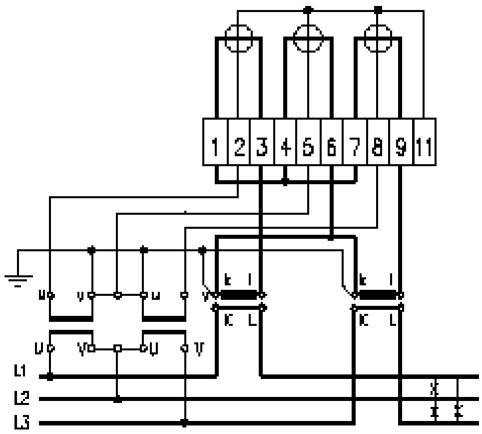


Figure 12: 3-wire connection

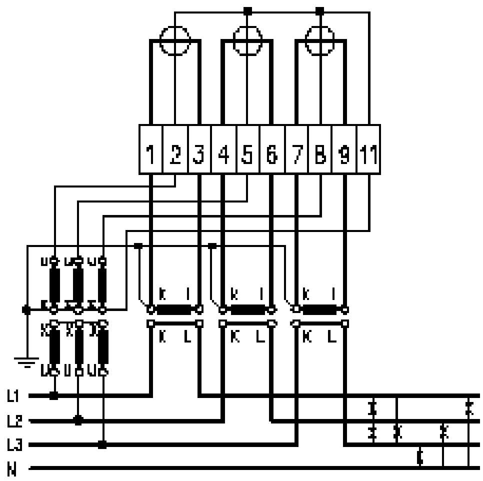
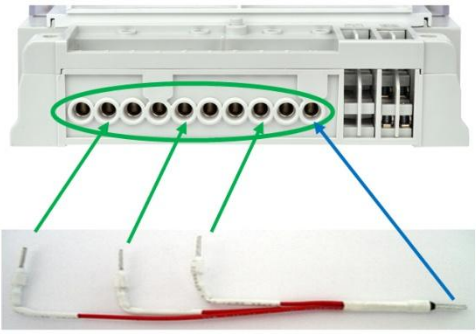


Figure 13: 4-wire connection

For 3P3W connection with connected external power supply (E1) we recommend to use external resistorsfor meter neutral stabilizing.
Iskraemeco d.d. can supply resistors kit if is necessary.

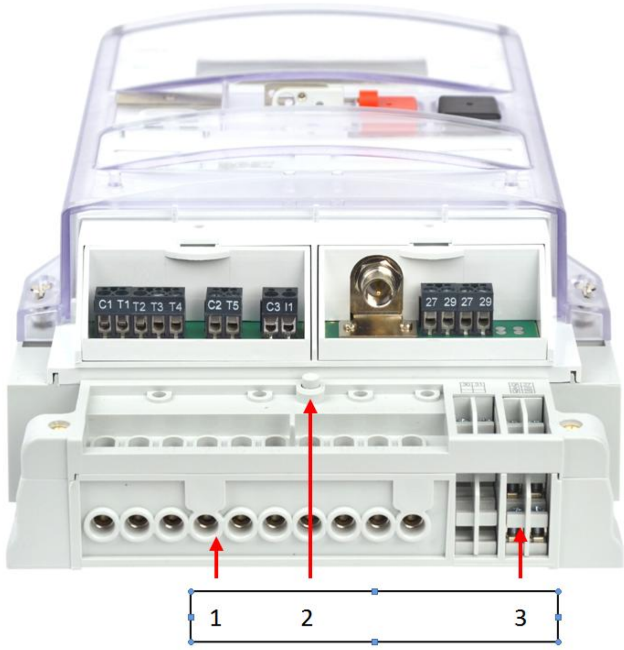
Reason: with 3P3W connection and connected external power supply to the meter the neutral line (terminal 11 on terminal block) is unstable. With using external resistors neutral is stable.

For more detailed information please contact Iskraemeco d.d. :info@iskraemeco.si.



L1L2 L3N

Figure 14: Connection of the meter



1 Voltage and current terminals
2 Sensor for terminal coveropening
3 Auxiliary terminals

Figure 15: Terminal block

5.4. Auxiliary terminals

There are 12 or 6 auxiliary terminals on the meter basic board. They are used for inputs, outputs, communication and external power supply.

The auxiliary terminals could be used for an RS232 or RS485 communication port, up to 2 programmable inputs, 2 programmable outputs and 2 dedicated energy LED outputs.
Optional modules expand basic input/output and communication meter capabilities.

Figure 16: Auxiliary terminals

5.5. LED pulse indicators

Two red LEDs on the front plate are used for meter testing and checking. Blinking rate of the LEDs depends on applied load and meter LED constant (imp./kWh or imp./kvarh). LED constants depend on rated voltage and current. Constants are secondary constants.

If load is lower than the meter threshold load or there is no load, the LEDs are constantly lit.

Un (V)	In (A)	LED (imp/kWh, imp/kvarh)	Output (imp/kWh, imp/kvarh)
Multi-range	1(2)	100,000	
3x57,7/100...	5(6)	100,000	Output=LED*M/N
...3x240/415	1(6)	100,000	

Table 2: LED and output constants

LED and output constants are software settable. The output constant is calculated from a LED constant via settable multiplication (M) and division (N) factors (0.0.128.11.4). Multiplication and division factors should be set so that the output constant is an integer number.

5.6. Optical-magnetic probe

An infra-red optical interface is a standard part of the meter enabling the meter setting and data reading. It is implemented on the meter front side where a probe is fixed. Communication is carried out in compliance with the IEC 62056-2 protocol.

An optional optical-magnetic probe with a USB interface enables "no-power" meter reading and setting. With this probe, by means of magnetic induction,communication and LCD display function is enabled also if the meter is not wired at all.
It is also possible to read meter data manually by means of the Scroll key.
Personal computer shall be capable to deliver maximum power specified by USB standard, that is 500 mA. Length of the USB cable is limited to 1,5 m. Extension is possible if it is additionally powered.

Figure 17: Optical-magnetic probe, Iskraemeco PROBE 6.

5.7. Power supply

The meter is supplied from multi-range internal power supply, external power supply or both.
Power supply is used by the meter and the I/O and communication modules.
Power supply priority is software settable.

5.7.1 Internal supply

Multi-range three-phase internal power supply allows the same meter to be used in a range from 3x57/100 V to 3x240/415 V (0.8 - 1.15 U_n) voltage, reducing the number of different meters that the utility should have on stock.

5.7.2 External supply

The meter is supplied from a single-phase switching supply unit that functions on the external source of voltage within the voltage range from 50 V to 240 V AC/DC.
It is electrically isolated from other circuits. If the meter is supplied from the external source, it is indicated on a display.

5.7.3 Internal and external supply

The meter has two main supply units: internal three-phase and external single-phase switching supply unit.

5.8. Power supply priority

Power supply priority is software settable. With MeterView software it is possible to set which supply is used first if both power supplies are present.

Until power supply with a priority is present, the meter is supplied from it. In case of power supply failure with a priority another supply is immediately activated.

To increase precision by unloading voltage transformers, choose external power supply priority. The meter is supplied from external power supply.

To avoid external supply (e.g. weak battery supply), set internal power supply priority to supply the meter from mains.

6. Modules

The meter is modular based. Different types of communication and I/O modules can be chosen. The same module can be used also for other Iskraemeco meter types: MT83x, MT86x.

Exchangeable modules are automatically recognised (plug & play). When the module is built in, it sends its identification code via a data bus. The module is automatically recognised by the meter and is correspondingly controlled.

The module can be exchanged without disconnecting power supply (hot-swap) or removing a calibration seal.
In case of module break-down, 100% safety of other functions is guaranteed.

Figure 18: Modules

6.1. Input/output module

An input/output module has 12 terminals

Available combinations are 1/5 or 4/8 inputs/outputs.
Input and output signals are programmable.
The inputs are performed as semiconductor resistor type inputs electrically isolated from the metering part. Outputs are programmable potential-free PHOTO-MOS relays.
I/O functions are defined in Table 6: Inputs and Table 7: Outputs.

Figure 19: Input/output module

6.2. Communication module

The modules cover the wide range of communication possibilities. Besides communication towards the centre, the modules also offer possibility of cascade connection.

Different combinations of the following types of communication interfaces are available in a single module.

Type	Interface
1	CS
2	RS232
3	RS485
7	PSTN
8	GSM
8a	GSM/GPRS
9	ISDN
e	Ethernet
MB	MODBUS

Table 3: Module communication types

Figure 20: Communication module

7. Display

The liquid crystal matrix-dot display with 4x20 characters enables a complex and clear display of different data, messages and events. Depending on the meter mode, different kind of information is shown.
Displayed data is identified with OBIS codes in compliance with IEC 62056-61.

Meters have back-light illumination for easy data reading at the metering place with bad light condition. The LCD is illuminated when any pushbutton is pressed, or tamper event is triggered. The illumination is switched-off after 3 minutes if no pushbutton was pressed at that time.

The LCD is mounted on a separate printed circuit board that is plugged in a corresponding connector.

7.1. Pushbuttons

A display is menu-driven and is handled by pressing one pushbutton at a time (one-hand handling) in compliance with the VDEW requirements.
Parameters are set by one hand, too.

Employed menu is controlled by two pushbuttons on the meter front side:

- scroll (black / right),
- reset, sealed (red / left).

Figure 21: Meter pushbuttons (surface / half 19" rack)

Each button has three activation times:

- short, up to 1 second,
- long, 1-3 seconds,
- extended, more than 3 seconds.

Pushbuttons perform the following actions:

Activation time	Scroll (black)	Reset (red)
Short	Move to next selection	Next value, Increase value
Long	Confirm selection	Confirm setting, Billing reset
Extended	Cancel	

Table 4: Pushbutton actions

7.2. Modes

The following modes are available:

- start-up logo (at power-up),
- LCD test,
- auto-scroll (auto-scroll sequence),
- manual (manual sequence)
  - registers (manual sequence),
  - load profile,
  - grid,
  - diagnostic
- settings,
  - settings (settings sequence),D
  - testing,
  - billing reset,
  - intrusion
- parameterisation lock.

In each mode, different data is shown on a display.
There are three modes with programmable data displaying sequences:

- auto-scroll mode: auto-scroll sequence,
- registers mode: manual sequence,
- settings mode: settings sequence.

Each sequence has a defined list of data items to be displayed or set. A display of sequences can be defined in the meter parameterisation mode.

7.3. Status indicators

In auto-scroll mode the following four lines are shown:

1. line: fatal status, date and time,
2. line: OBIS identification code,
3. line: value and unit,
4. line: meter status indicators.

Standard meter status indicators are:

- L123 Phase voltage detection. Blinking in case of incorrect phase sequence
- A+, A- Total active energy direction. Blinking if at least one phase energy direction is opposite.
- R+, R- Reactive energy direction. Blinking if reactive measurement is blocked.
- Tx Valid tariff for energy
- M Meter cover opened
- T Terminal cover opened
- C Communication
- P Parameterisation mode
- E External supply

In abnormal mode the first line on display is changed so that a blinking error message is displayed along with the date and time. Possible error messages are:

- F Error
- BadIO Bad input/output module
- BadCM Bad communication module

When entering special modes, the first line on the display is also changed. A non-blinking warning message is displayed together with date and time.

7.4. Phase voltages detection

The meter enables detection and alarming of the presence of phase voltages. Presence of voltage and phase sequence is marked by L123 characters in the bottom line of the LCD.

- If all three symbols L123 are displayed, it means that all three phase voltages are present.
- If characters L123 are blinking, phase sequence is not correct. In this case it is required to change the cables phase sequence, otherwise the reactive energy is registered in the wrong quadrant. The phase sequence does not impact on measurement and registration of the active energy.
- Any undisplayed symbol (1, 2 or 3) means that a certain phase voltage is lower than Un-25%.
- If a number is blinking, phase voltage is in the range from Un-25% to Un-10%.
- If a number is blinking on inverse background, phase voltage is higher than Un+10%.

The limits for under-voltage, over-voltage and voltage failures can be set.

7.5. Start-up logo mode

When the meter is switched on, start-up logo is displayed for up to 5 seconds until the meter is ready for measurement.
Then the meter is automatically switched to the auto-scroll mode.

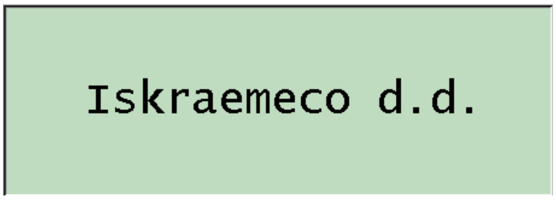


Figure 22: Start-up logo mode

7.6. Auto-scroll mode

Auto-scroll mode is a standard display mode. Data defined by auto-scroll sequence are scrolled automatically and displayed for 10 seconds each.

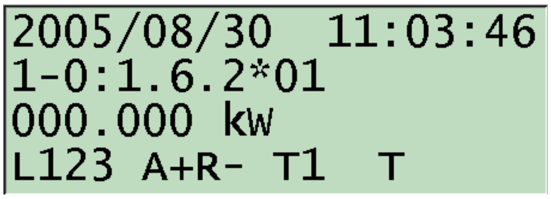


Figure 23: Auto-scroll and manual sequence display

The meter returns to auto-scroll mode from any mode automatically if no pushbutton has been depressed in a time span of 2 demand periods or if the scroll button is depressed for extended time.

7.7. LCD test mode

LCD test mode is used to check if all LCD dots are displayed. When a scroll button is pressed in auto-scroll mode, a display is illuminated and all LCD segments (dots) are blinking. LCD illumination time is set in register 0.0.128.0.5.

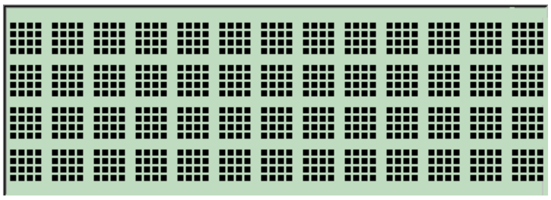


Figure 24: LCD test mode, all dots are displayed

7.8. Registers

In registers mode it is possible to list all registers from manual sequence with a scroll button.
The first data item displayed in the manual sequence list is usually the identification code and data on function errors. The next data item from the sequence is displayed when pressing the scroll button.

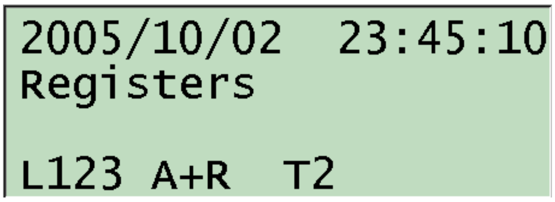


Figure 25: Press scroll pushbutton to enter manual sequence

By long pressing the scroll button the previous values are skipped, so that the next data is displayed. In this way manual sequence data items can be over-viewed faster.

7.9. Load profile

It is possible to view load profile by selecting date and time. To increase date or time a scroll button shall be pressed for a short time. To select date or time a scroll button shall be pressed for a long time.

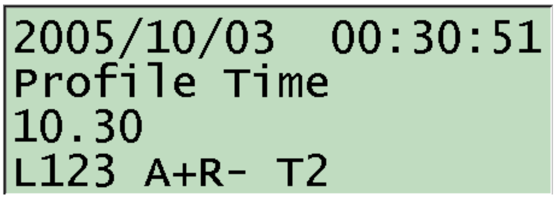


Figure 26:Time selection follows date selection

After defining desired date and time, the status value will be displayed.

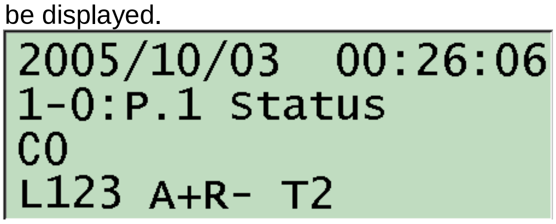


Figure 27: Load profile status value

Multiple status bits can be active simultaneously and indicate an event in a displayed period.

Bit	Character 1	Character 2
4	Power-down	Season change
3	Power-up	
2	Set time	
1	MD reset	

Example 1: Load profile bits. C0 (hex) = 1100 0000 (bin). Power-up and power-down event occurred

By pressing the scroll button for a short time, all load profile quantities will be shown. On customer request load profile values can be shown as:

- energy absolute x.8,
- energy delta value x.9,
- demand x.5,

where x is 1 (A+), 2 (A-), 3 (R+), 4 (R-), 5 (R1), 6 (R2), 7 (R3) or 8 (R4) respectively.

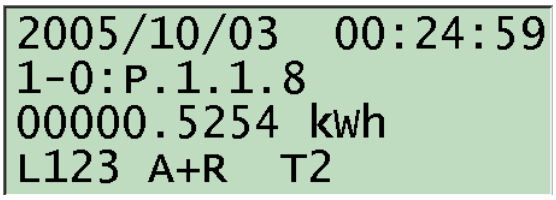


Figure 28: Load profile quantity

To move back to load profile initial screen select End for time setting.

7.10. Grid

The main network parameters are shown: phase currents, voltages, angles and frequency.

7.11. Settings

The setting sequence contains the list of parameters to be set in the setting mode manually by pushbuttons.
To enter settings mode the seal from the reset button shall be removed and the reset push-button pressed. Status P appears on LCD. Parameters defined in the setting sequence can be changed now. While parameters are set by buttons (digits are blinking), setting by communication interfaces is disabled.

To confirm data item selection press the scroll button for long time. To move between data item digits press the scroll button for a short time. To increase current digit value press the reset button.
To confirm data item setting press the scroll pushbutton for a long time. To reset the chosen value back to default push the reset button again.

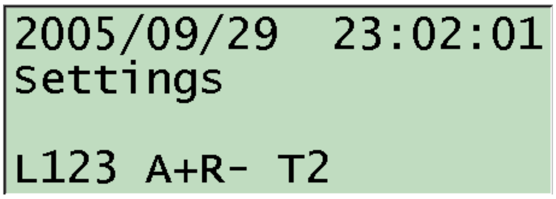


Figure 29: Settings mode

7.12. Testing

Test mode can be used when additional decimals are needed when observing the energy registers on LCD. Data sequence is as in registers mode.

7.13. Billing reset

By pressing the scroll pushbutton for a long time a billing reset is executed when billing reset is chosen.

The meter performs a billing reset also when the reset button is pressed in the auto-scroll mode. The “Billing reset” message indicates that the billing reset has been performed.
The “Billing reset locked” message indicates a billing reset blockade period when new billing reset can not be performed by pushbuttons.

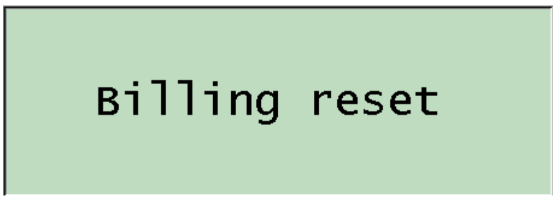


Figure 30: Billing reset message

7.14. Parameter setting

To enter parameter setting mode, the parameter setting pushbutton under the meter cover should be pressed. Seals on the meter cover shall be removed tohave the access to the parameter setting pushbutton under the meter cover.

When the parameter setting button is been pressed, the cursor P is displayed indicating that the meter is in the parameter setting mode.

The meter is now ready to be programmed via optical communication interface. Setting of all parameters with this protection degree is enabled.

The parameter setting mode is terminated:

- at the end of communication,
- after communication time out,
- after power-down.

7.15. Flowcharts

Legend: see Table 4: Pushbutton actions.

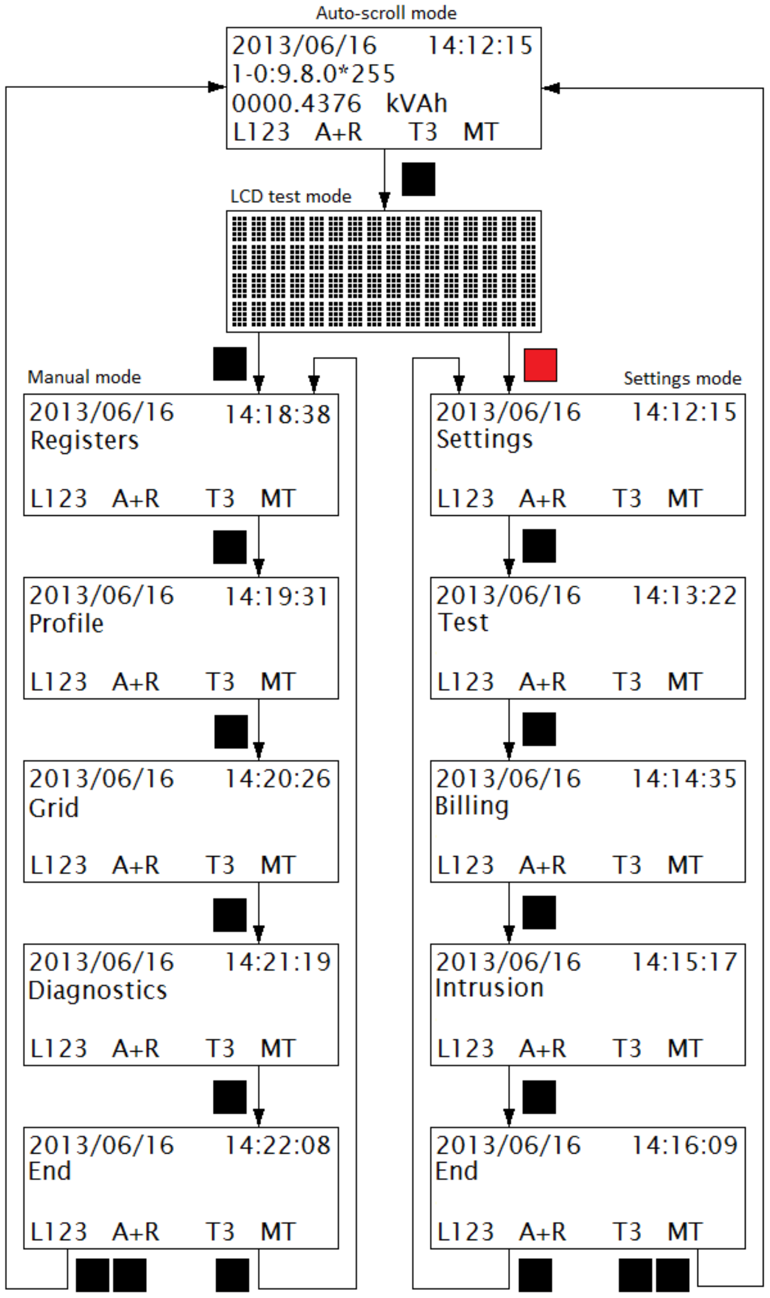


Figure 31: Display modes

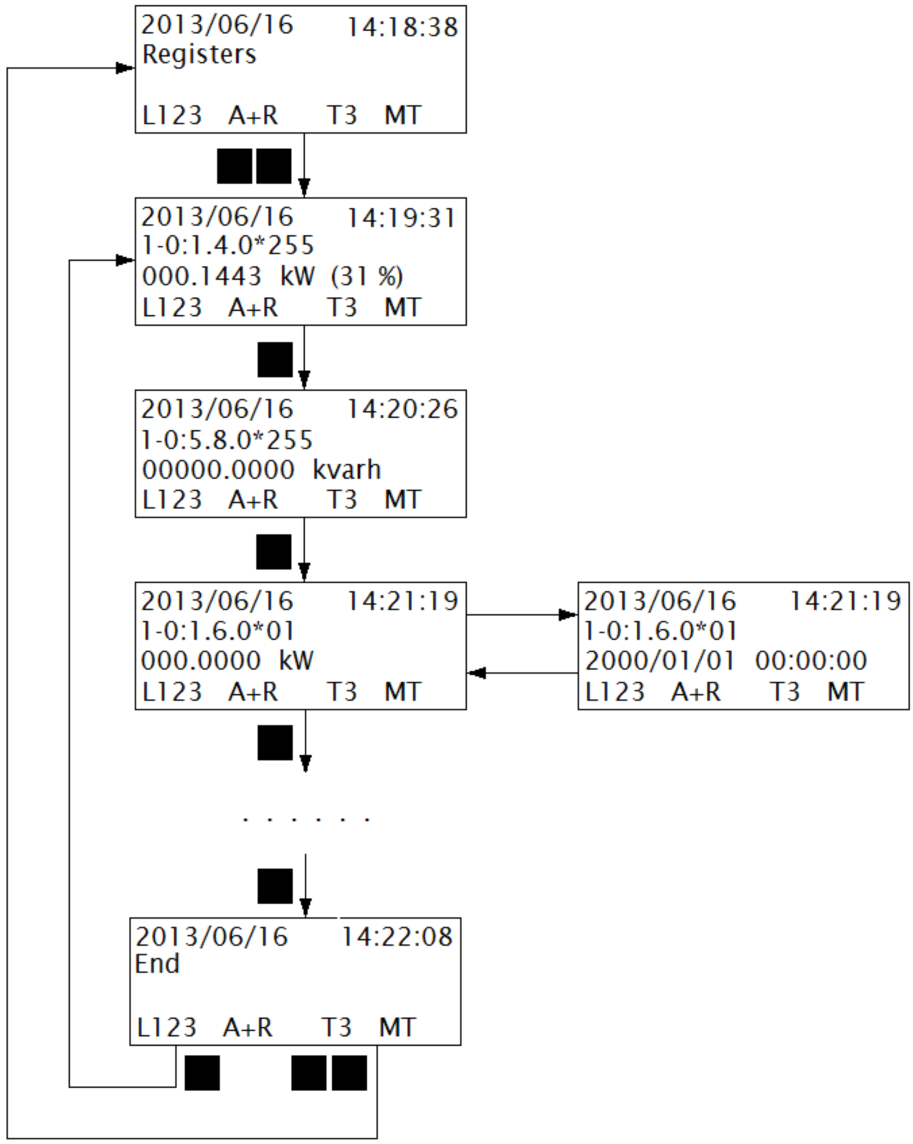


Figure 32: Register flowchart, scrolling through manual sequence

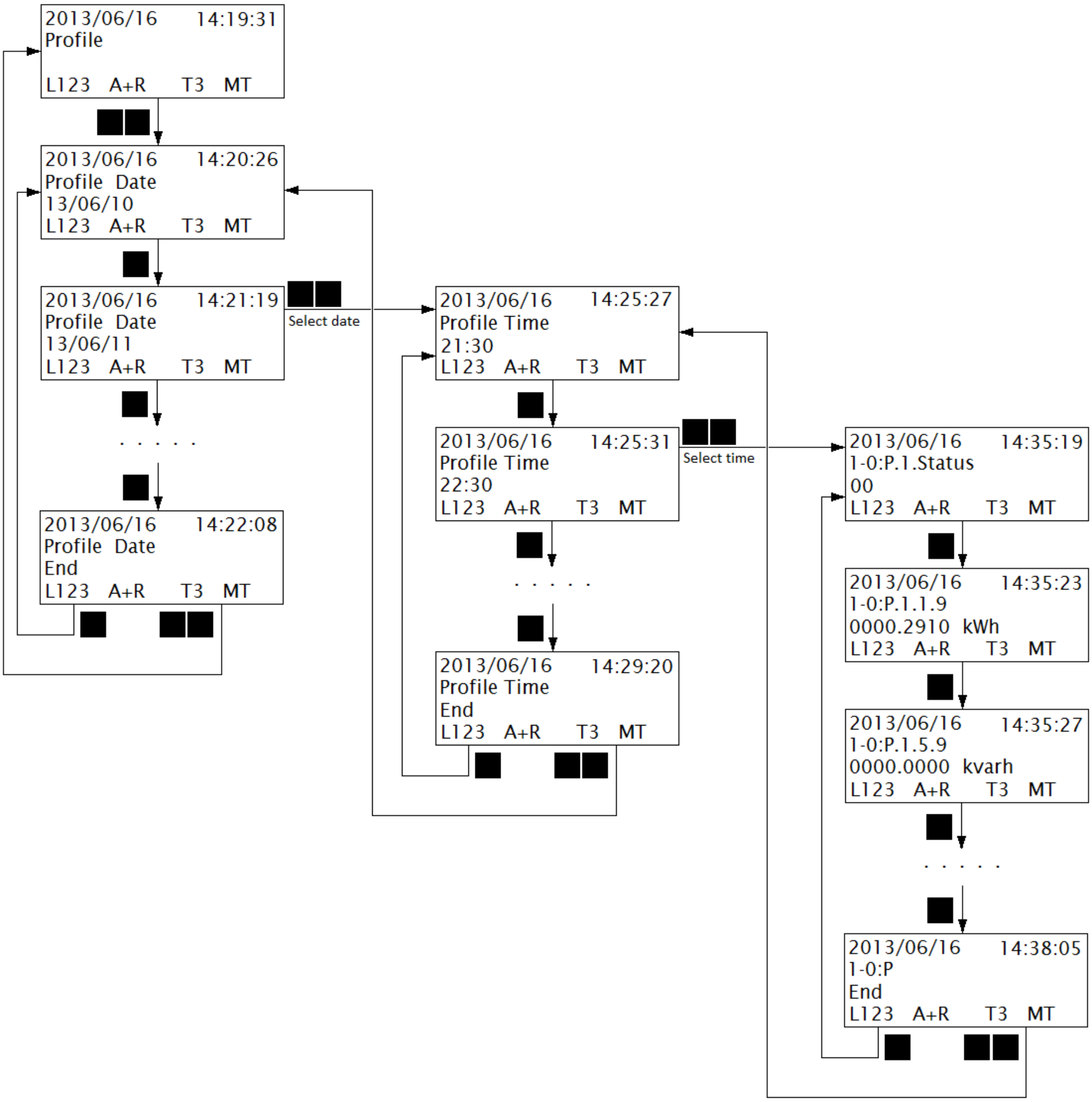


Figure 33: Load profile flowchart. Select date, select time, scroll load profile data

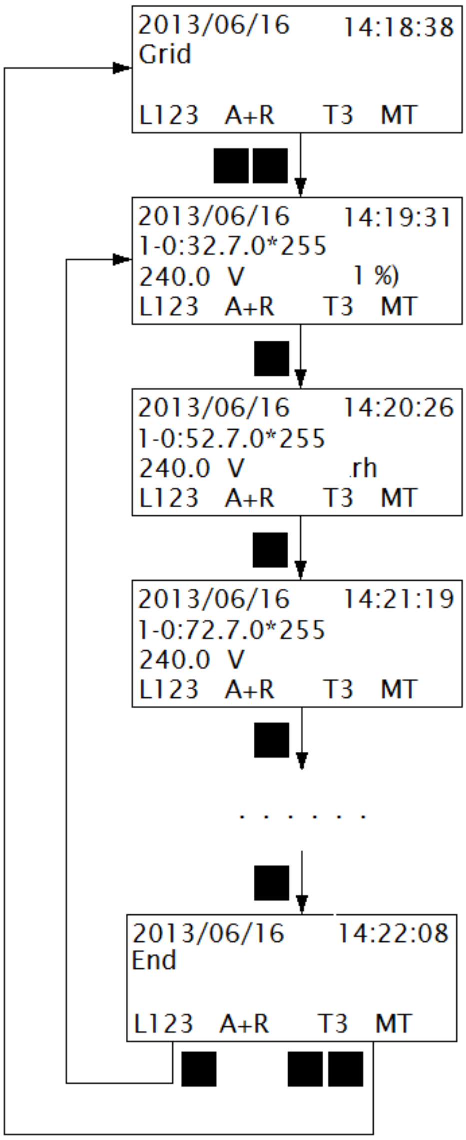


Figure 34: Grid flowchart

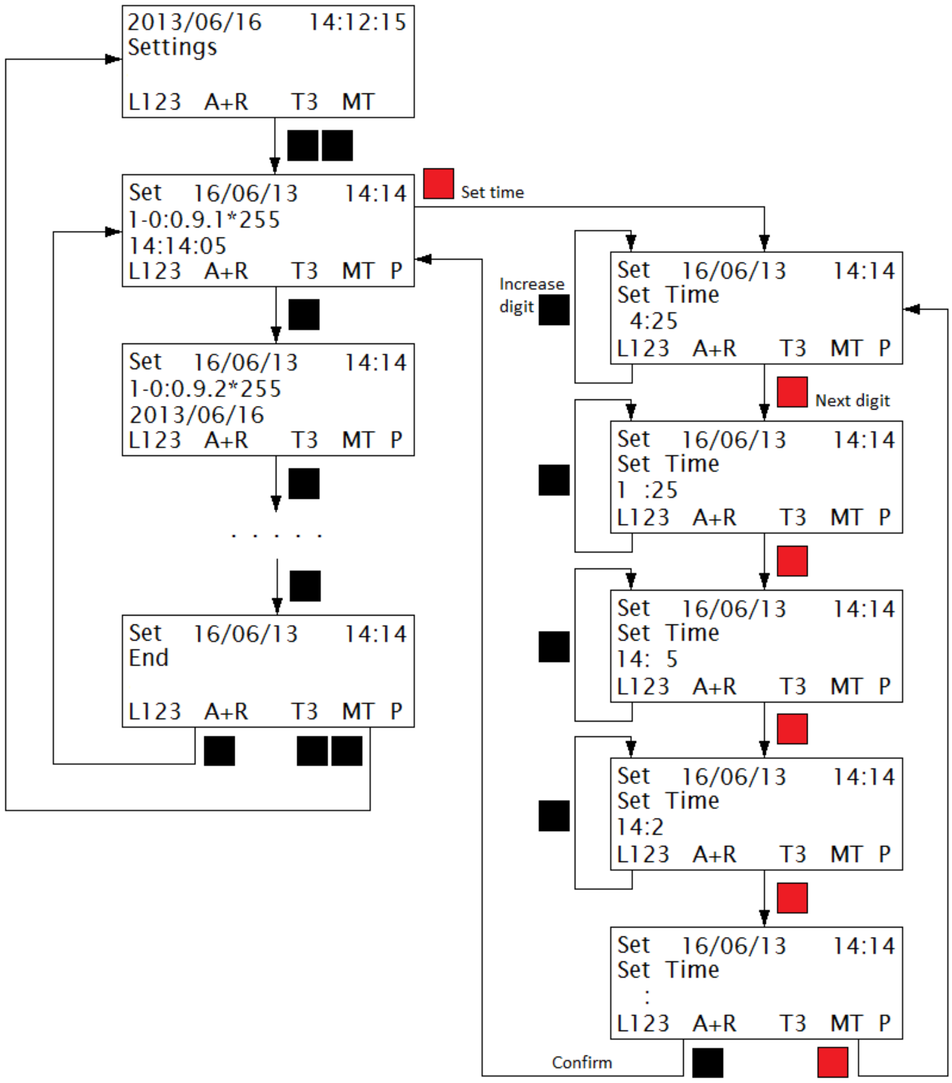


Figure 35: Time setting flowchart

8. Real time clock

Real time clock performs all time related meter functions:

- an annual calendar programmed till 2090,
- lunar calendar,
- daylight saving time (DST).

The following registers contain time and date:

	Format	Register
Time	hhmmss	1-0:0.9.1
Date	YYMMDD	1-0:0.9.2
Date and time	YYMMDDhhmmss	1-0:0.9.4

Table 5: Format of date and time. hh- hour 0-23, mm-minute 0-59, ss- second 0-59, YY- year 00-99, MM- month 1-12, DD- day 1-31.

A day of week is set automatically from 1 to 7 regarding the entered date. Each day in a week can be defined as the first one.

RTC can be controlled by a 32 kHz oscillator or corrected by an MPE input signal.
The RTC power supply is backed-up with a super capacitor and a Li-battery.

8.1. Quartz crystal

The quartz crystal is digitally trimmed in the factory. A value of the trimming constant in ppms is stored in register 1.0.96.50.1.
The crystal controlled RTC complies with the IEC 61038 standard. Its accuracy is ±3 min/year at room temperature. The error is cumulative.

8.2. MPE correction

Besides a quartz crystal an MPE input could be built in the meter. When applied, the MPE signal rounds current RTC time to the nearest minute, and seconds are set to zero.

Current time	10:50:31	10:50:29
After MPE correction	10:51:00	10:50:00

Example 2: MPE time correction

8.3. Back-up power supply

The RTC is backed-up with a super capacitor and a Li-battery.

The Li-battery enables 10 years operation of the RTC. Its shelf life is 20 years. The Li-battery condition is displayed with two registers: 0-0:96.6.0 - elapsed time of the RTC backed up with the Li-battery (expressed in days), and 0-0:96.6.1 – the remaining capacity of the LI battery (expressed in percentage). The "Battery low" message on the LCD indicates that the battery was discharged and has to be replaced. As an option, also the output can be set for remote alarming.

8.4. Setting

The RTC can be set to current time and date by the user by means of buttons (see Figure 35: Time setting flowchart) or a communication interface.
Default setting is performed automatically by the microcomputer when an RTC error occurs. From that moment onwards the RTC date and time are not correct anymore.

Regular setting is performed when date and time are entered manually with the pushbuttons or via a communication interface. In this way exact time and date are set.

8.5. Daylight saving time

RTC enables automatic change to daylight saving time and back to the standard time, also known as a summer and winter time.
DST switching can be done by:

- an algorithm, switching DST each year on the last Sunday of the selected month and hour stated in register 0.0.128.7.3,
- a fixed date stated in a form of a table in 0.0.128.7.3 register.

DST switching type is set in the 0.0.128.7.5 register.

In case of power shortage at transition from a winter to a summer time or vice versa, the meter will correct the time automatically when the power supply is restored.

9. Inputs and outputs

The meter can be equipped with up to 4 programmable inputs with a common ground, up to 8 programmable outputs and 2 dedicated energy LED outputs.

Inputs	Marking
Energy tariff change-over	TE1, TE2, TE3
Demand tariff change-over	ME1, ME2, ME3
Billing reset	MRE (MRa, MRb)
Time synchronisation or demand period triggering	MPE
Demand measurement disabling	MZE

Table 6: Inputs

Outputs	Marking
Energy active tariff	TA1, TA2, TA3
Demand active tariff	MA1, MA2, MA3
Demand period start	MPA
Billing reset	MRA (MRAa, MRAb)
Energy reading pulses	+AA, -AA, +RA, -RA, RA1, RA2, RA3, RA4
Alarm	MKA

Table 7: Outputs

9.1. Inputs

9.1.1 Tariff change-over

The inputs are used for external change-over of tariffs for energy or demand registration. There are inputs for demand tariff change-over (ME1, ME2, ME3) and inputs for energy tariff change-over (TE1, TE2, TE3).

The following rules are valid for both demand and energy tariff change-over. There are two possibilities:

- Each input represents one tariff. A combination of tariffs can be activated at the same time. In this case a maximum number of tariffs are 3.
- Only one tariff is active at the moment. In this case the number of tariffs is increased to $2^3 = 8$.

No. of tariff inputs	Max. no. of tariffs
1	2
2	4
3	8

Table 8: Number of tariff inputs and number of tariffs

9.1.2 Billing reset

Inputs MRa and MRb enable remote resetting of the meter at the end of billing periods. See chapter 17Billing reset.

9.1.3 Demand measurement disabling

MZE input enables triggering of demand forgiveness period. As long as a signal is applied, demand is not measured.

9.1.4 Time synchronisation and demand period triggering

MPE input is used for either:

- external triggering of demand periods,
- RTC synchronisation.

MPE input has the highest priority. It starts a new demand period irrespectively of elapsed demand period or internal tariff device command.
When the MPE signal is applied for RTC synchronisation, seconds are set to zero and time is shifted to the nearest minute.

9.2. Programmable outputs

9.2.1 Energy reading

The meters can be equipped with up to six pulse outputs for remote reading of active energy in two energy flow directions and reactive energy in four quadrants or in combined quadrants.

Output pulse constants (imp./kWh or imp./kvarh) depend on rated current of the meter. Output constants are settable, see Table 2: LED and output constants.

9.2.2 Energy flow direction

Can be performed through MKA (Alarm) output.

9.2.3 Tariff change-over

Depending on a number of tariffs for energy or demand, the meter can be equipped with up to 3 tariff outputs for energy (TA1, TA2, TA3) and up to 3 tariff outputs for demand (MA1, MA2, MA3).

A make contact is closed at the corresponding tariff output or outputs for remote indication of the tariff that is valid for energy registration at the moment.

9.2.4 Billing reset

MRAa and MRAb outputs indicate a billing reset. At the moment of a billing reset the contact on the first output closes and the other output contact opens. Only simultaneous change of both MRAa and MRAb outputs indicates that the billing reset was performed.

In case of a power failure the contacts are open on both outputs. When power supply is restored the contact of the first output is closed and the other remains open. The next simultaneous change indicates the first billing reset after the meter initialisation.

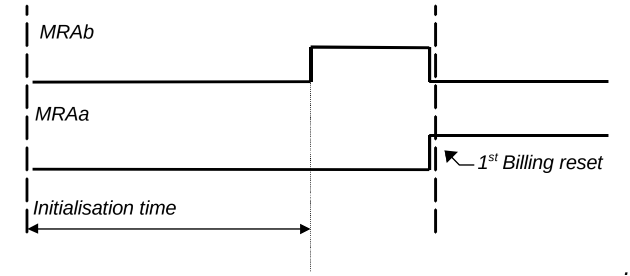


Figure 36: MRAa MRAb outputs at restart and first billing reset

The billing reset can also be done by a single MRsignal that is actually a combination of MRAa and MRAb signals. The length of the impulse is settable in the limits between 2 ms and 250 s, with 0,001 s, 0,01 s, 0,1 s or 1 s resolution.

9.2.5 Demand period start

The MPA output indicates the start of a new demand period. At the beginning of each demand period, a make contact is closed for a short period of time. A standard MPA output version defines 1% time span of the demand period. Register 0.0.128.11.3 defines duration of MPA output activity. If set to 0, it means 1% of MP. Values from 1 to 60 represent the number of seconds.

9.2.6 Alarm

The meter can be equipped with up to 8 status outputs for remote alarming. Particular status indicating a fatal error, phase failure, current without voltage, etc. or status combination can be used.

9.3. Energy LED outputs

The meter can be equipped with 2 dedicated energy LED outputs, when higher resolution of remote energy reading is required. The length of an impulse is fixed to 2 ms. Therefore, reading is possible with the highest impulse constant:100,000 (imp/kWh, imp/kvarh) at the highest nominal load applied, independent of the division/multiplication factors (table 2).

10. Communication

As a standard, the meter is equipped with an optical interface. On the meter board one RS232 or RS485 communication port for remote meter readout can be implemented. The IEC 62056-21 communication protocol is implemented.

Communication activities of the meter do not interrupt the meter operation.

Meter communication capabilities can be extended with the additional communication module. On communication modules different communication interfaces are implemented. Interfaces are completely independent on the protocol, rate and data.

It is possible to read data from up to three communication interfaces. If there are more requests to write data to a meter, the priority is given to the communication interface where the first request occurred.
The following registers define communication rates:

- C.57.0, COM 0, IR interface,
- C.57.1, COM 1,
- C.57.2, COM 2.

C.57.0, C.57.1, C.57.2	Rate (Baud)
0	disabled
1	300
2	600
3	1200
4	2400
5	4800
6	9600
7	19200

Table 9: Communication settings

10.1. RS 232 interface

Three-wire RS 232 interface is used for point-to-point communication in compliance with the IEC 62056-21 standard. An external device can be connected to the RS 232 terminals. Maximum transmission rate is 19200 Baud.

10.2. RS 485 interface

Two-wire RS 485 interface is used for multi-drop (daisy chain / multi-drop) communication in accordance with standard IEC 62056-21. Maximum transmission rate 19200 Baud.

10.3. IEC 62056-21

The IEC 62056-21 protocol is based on a serial asynchronous half-duplex communication in compliance with the ISO 1177 standard.

Communication settings are as follows:

Start bit	1
Data bits	7
Parity	even
Stop bit	1
Reply timeout (ms)	1500 (default)

Table 10: IEC 62056-21 communication settings

A protocol diagram flow is shown in Figure. The following steps of communication are shown:

- login,
- setting of communication rate,
- data reading/writing,
- interruption.

10.3.1 Login

In the first step, a message for login to the meter to which communication is required is sent. Each meter has its address consisting of 10 characters (register 0.0.0). It defines a device in a network.

If there is only one meter on a serial channel, login is possible without a meter address.

10.3.2 Rate setting

According to the standard, the initial transmission rate is set to 300 Baud and is then changed. The "Z" parameter in a message represents the communication rate after the initial rate of 300 Baud.

Since the request stated in the IEC 62056-21 standard is quite inconvenient, the Iskraemeco meters enable a non-standard additional possibility of communication with only one specified rate (fixed baud rate).

10.3.3 Commands R1 and W1

After setting the rate, the meter data can be read or written. Data reading and writing can be protected with a password.

R1 command enables data reading from meter registers:

SOH	R1	STX	Address	Data	ETX	BCC

W1 command enables data writing into registers:

SOH	W1	STX	Address	Data	ETX	BCC

Address is defined by the data in the register:

- address; access to individual register,
- address, offset; access to the register with an index (offset) from Address,
- address (number of elements); access to a number of elements from Address onwards,
- address, offset (number of elements); access to a number of elements from the Address with index onwards.

There is only one data or a sequence of several data:

(data1)	(data 2)	...	(data N)

Data can consist of both a value and a unit:

value (* unit)

Each data has its own type and is therefore formatted by itself. You can therefore always refer only to the name and get the value in the right format.

The meter answers to the received message:

- ACK, a command has been performed correctly,
- NACK, a command has not been performed correctly,
- a message is sent back with requested data,
- a message about the error is sent back.

A meter message with data:

STX	Data	ETX	BCC

A meter message in case of error:

STX	Error	ETX	BCC

A complete message should not be longer than 256 characters.

10.3.4 Command R5

For logbook or load profile reading the R5 command is used:

SOH	R5	STX	Address	ETX	BCC

where address is P.01 (load profile), P.98 (log book), 0.9.1 (time) and 0.9.2 (date). All data are stated in one block.

10.3.5 Data readout

At data readout (DRO), the meter relays all data that are defined in DRO sequence together with their previous values if they are selected.

ACK	0	Z	0	CR	LF

10.3.6 Interruption

If there is no message at a certain time, communication is interrupted automatically after timeout of 60 seconds. Communication can be interrupted also with a message:

SOH	B0	ETX	BCC

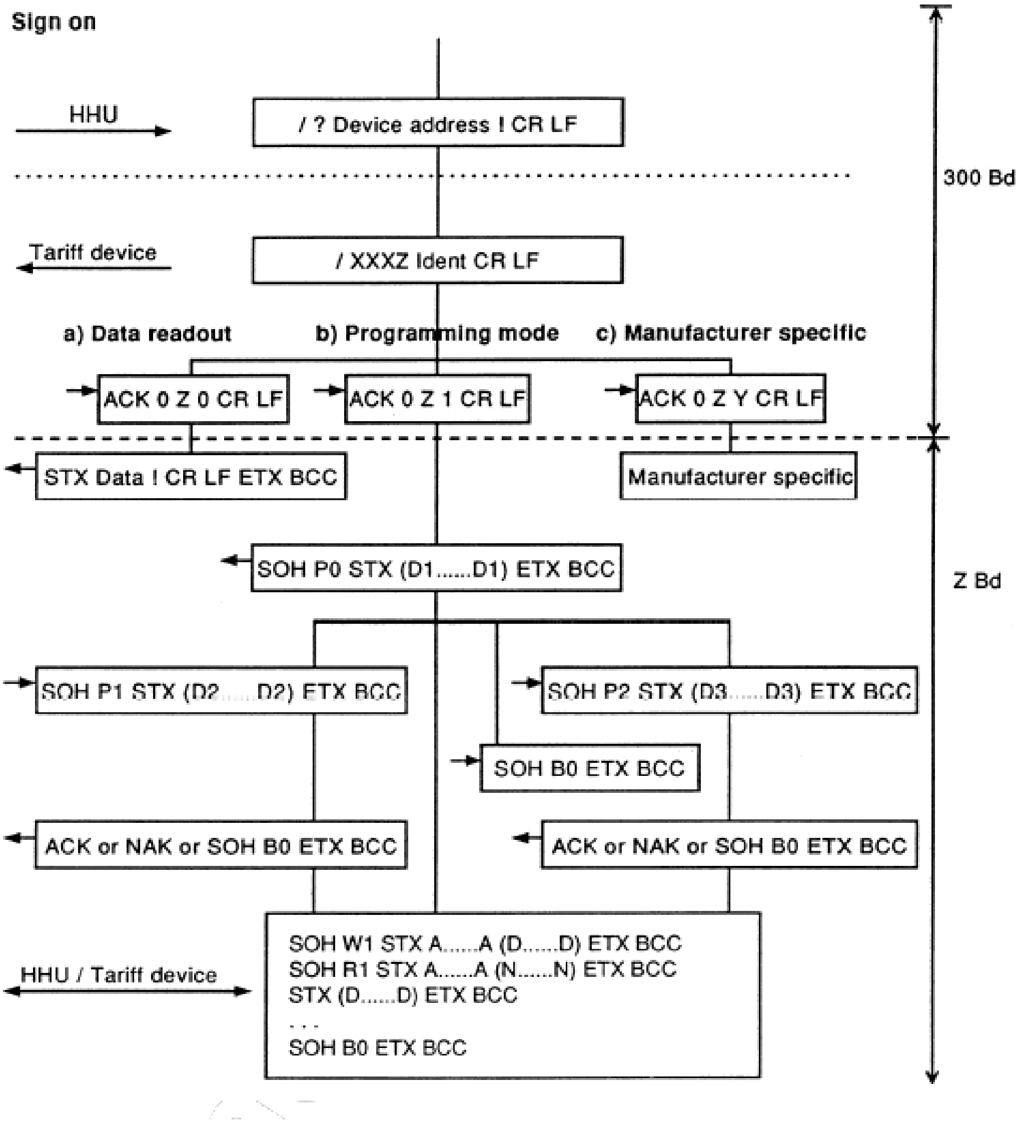


Figure 37: IEC 62056-21 protocol diagram

10.3.7 Error messages

The table below shows a list of communication error codes and description.

ERxy	Explanation
01	OBIS Code not found
02	OBIS Code not implemented
03	Unknown parameter
04	Unknown index
05	Unknown value
06	Unknown command
07	Access denied
08	No data
09	No resource
10	Device error
11	Unknown address

Table 11: A list of error messages on communication

11. Energy measurement

The following types of energy are measured:

Active energy according to the IEC 62053-22 standard, class 0.2S or 0.5S:

- imported +A,
- exported -A.

Reactive energy according to the IEC 62053-23 standard, class 2 or 3, calibrated down to 0.2% in:

- four quadrants: R1, R2 , R3 and R4,
- combined quadrants e.g. +R = R1 + R4 and -R = R2 + R3.

Apparent energy according to the IEC 62053-22 standard.

- imported +S,
- exported -S.

All energies are measured per each phase separately and three-phase.

Meters that are connected via current or current and voltage transformers enable the metering data to be displayed in semi-primary or secondary value.

11.1. Previous billing periods

For a current billing period, energies measured by the meter are registered in the corresponding registers. At the meter reset at the end of a billing period, metered data from registers for a current metering period are transferred into the corresponding registers of the previous billing period. Metering values stored in registers of previous billing periods are called previous values.

Up to 50 previous billing periods can be registered. Default is 15 billing periods.

Energy can be registered as:

- Differential value, a difference between cumulative values in two successive billing periods,
- Cumulative value, a cumulative value from the beginning of the energy measurement.

11.2. Voltage transformer compensation

All metering values are stored in a raw binary form in the microprocessor. Therefore it is necessary to multiply the raw binary data with a metering output constant k_{out}.

The meters connected by a voltage transformer enable compensation of the voltage transformer error. To get an energy value, raw data must be multiplied by the constant k_{mc}:

$$k_{mc} = \frac{k_{out}}{(k_{ct} * k_{vt} * T_{corr})}$$

where:

k_{ct} - a current transformer ratio,
k_{vt} - a product of a voltage transformer ratio and voltage transformer error compensation.
T_{corr} - a transformer correction factor in ppms (0.0.128.0.12)

A current transformer ratio k_{ct} is an integer in a range from 1 to 30,000 (0.0.128.0.10). A product of voltage transformer ratio and error compensation of voltage transformer k_{vt} is a floating point number (0.0.128.0.11). If no voltage transformer error compensation is required, the k_{vt} is equal to voltage transformer ratio.

11.3. Current without voltage

Meter detects current without voltage. The threshold I_{th} is fixed to approximately 2% of I_n.

If the meter detects current in a phase without voltage, »a current without voltage »signal is generated for each phase separately.

Also status in event Logbook is generated when this situation appears and also when it disappears.

12. Demand measurement

The demand is calculated as a quotient of energy integrated over a period of time and the time period. It is an average value. The period of energy integration is called a demand period. The meter calculates:

- cumulative maximum demands (x.2.y),
- actual average demand values in a current demand period (x.4.y),
- demands registered in the last ended demand period (x.5.y),
- maximum demand values in a billing period (x.6.y).

12.1. Previous billing periods

The meters enable registration of all maximum demands up to 50 billing periods. Previous billing periods data can be displayed on the LCD or transferred via the communication interfaces.

12.2. Maximum demand

The maximum demand is the largest demand in a billing period. A maximum demand can be calculated for all energies that are measured or calculated, like:

- demand of imported and exported active energy +P and -P,
- demand of imported and exported apparent energy +S and -S,
- demand of reactive energy in four quadrants Q1, Q2, Q3 and Q4,
- demand of reactive energy in combined quadrants +Q=Q1+Q2 and -Q=Q3+Q4,

Maximum demand could be registered like:

- tariff rated (x.4.y; x.5.y, x.6.y),
- cumulative (x.2.y).

Date and time of the end of maximum demand are stated by each maximum demand.
At the billing reset a maximum demand for a current billing period is transferred into the corresponding register for a previous billing period.

12.3. Tariff rated demand

The number of tariff rated maximum demand quantities depends on the number of tariff registers.
Note that tariff changeover schedule for demands can differ from the one for energies.

12.4. Cumulative demand

Cumulative tariff rated maximum demands are checking values and are sums of the corresponding maximum demands registered in all completed billing periods since the beginning of the measurement. Therefore there are no registers for previous billing periods.

12.5. Modes

The modes of demand measurement differ regarding:

- demand period type,
- triggering of demand period start.

12.5.1 Fixed demand period

At fixed demand measurement a new demand period is started when the previous one is ended.

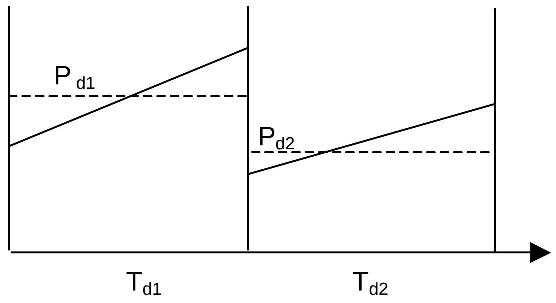


Figure 38: Fixed demand period mode

12.5.2 Demand period type settings

A demand period type is set by defining length of a demand period in a register 0.0.128.0.23 expressed in a range from 1 to 60 minutes, with step of 1 minute.

12.5.3 Synchronous mode

In a synchronous mode only a fixed demand period type is possible.

If there is no load profile, a demand period start is synchronised with a day. It means that a demand period starts at 00:00 hours and during a day there will be an integer number of demand periods completed.

If there is a load profile, the registration period is a multiple of demand periods and a demand period starts synchronously with the registration period. Both the registration period and demand period are synchronised with a day.
In the synchronous mode the demand measurement and load profile can start at any time during a day, but the first demand period may not be complete.

The demand measurement in a synchronous mode differs from the demand measurement in asynchronous mode in cases when the demand period is interrupted due to power shortage.

The main difference is that the demand measurements continue if the power supply is restored in the same demand period; otherwise it is ended for that demand period and the demand measurement is started again at the point of a new demand period when the power supply is restored.

12.5.4 Triggering with MPE input

The external triggering of demand period is enabled when a parameter in the register C.59.2 has value 3, 4 or 5. When a parameter in the register C.59.2 has value 0, 1 or 2, the MPE input can be used for synchronisation of the real-time clock only.
The demand period starts on the rising edge of a control signal on the MPE input.

Besides the demand period, subinterval and demand mode triggered by MPE, also a tolerance (a time span in seconds, register C.55.11, within which a control pulse should appear at the MPE input after the end of the previous demand period) should be defined.

When the demand period is triggered with an MPE input, demand is calculated by dividing measured energy integrated between two successive control pulses with the demand period set in the register 0.8.0 (even if the time between the two pulses is shorter than the demand period).

If the next pulse does not appear on the MPE input within the time span defined in the register C.55.11 after the end of the previous demand period, this is considered as that the external triggering of demand period has failed and the meter automatically turns on the corresponding mode of demand measurement with internal triggering of demand periods.

When time between two successive control pulses at the MPE input is longer than the set demand period in the register 0.8.0, energy is integrated over the set demand period only. The demand is not measured in a tolerance time.

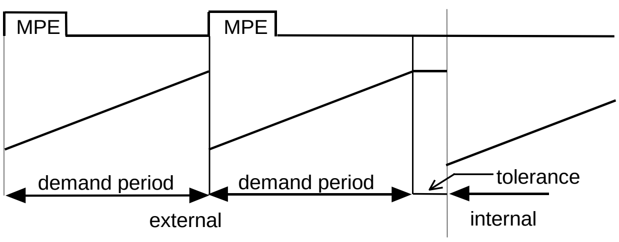


Figure 39: Demand not measured in a tolerance time

12.6. Billing reset and tariff changeover

Neither a billing reset and demand period nor tariff changeover and demand period are synchronised. This means that in most cases a billing reset and/or tariff changeover are performed during a current demand period and not at its end.

On the other hand, both a billing reset and a tariff changeover start demand measurement in a new demand period. Due to this fact, the following maximum demand measurement modes regarding a billing reset and tariff changeover are possible:

- billing reset does not interrupt the demand period,
- tariff changeover does not interrupt the demand period,
- billing reset is delayed up to the end of the demand period.

12.6.1 Billing reset does not interrupt demand period

Billing reset at the end of a billing period is performed during a current demand period but does not interrupt it. Demand registered in the demand period in which the billing reset was performed is considered in the next billing period although a part of energy was integrated in just ended billing period.

If it is the largest demand in the new billing period, it will be registered as its maximum demand.

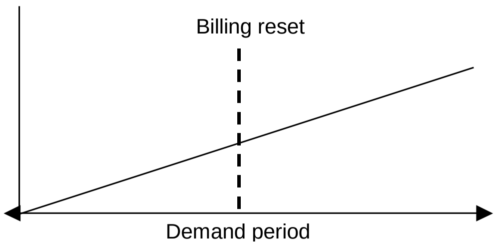


Figure 40: Billing reset does not interrupt demand period

12.6.2 Delayed billing reset

In this mode, the meter does not execute a command for a billing reset immediately. It delays the billing reset up to the end of the current demand period instead. Consequently the current demand period is not interrupted and the billing period is extended up to its end.
The demand of demand period in which the billing reset was requested is considered in the extended billing period. If the demand is the largest one in the

extended billing period, it is registered as the maximum demand.

A billing period timestamp is set at the moment when it was actually performed.

13. Network quality

Network parameters are monitored and displayed:

- rms instantaneous values of phase voltages, currents and frequency,
- calculation of the neutral line current and phase symmetry,
- power factor and phase angle by phases,
- harmonic analysis up to 30 harmonic,
- power outages (optional),
- voltage dips/sags (optional).

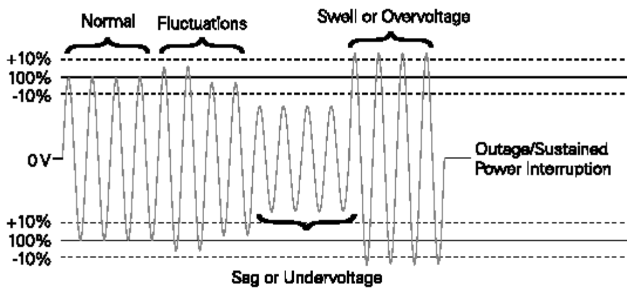


Figure 41: Voltage waveform example

ADC sampling frequency is 4 kHz. ADC resolution is 16-bit. ADC has implemented anti-aliasing filters.

Network quality events like short power outages, voltage dips/sags are recorded in a logbook with a timestamp and a parameter value.

An alarm can be generated on output in case of power shortage.

Quantity	Avr.	R	S	T
Current rms		31.7.0	51.7.0	71.7.0
Current harm. rms		31.7.h	51.7.h	71.7.h
Voltage rms		32.7.0	52.7.0	72.7.0
Voltage harm. rms		32.7.h	52.7.h	72.7.h
Power factor (cos φ)	13.7.0	33.7.0	53.7.0	73.7.0
Frequency	14.7.0			
Phase angle		81.7.40	81.7.51	81.7.62

Table 12: Network quality codes (h - h^{th} harmonic)

14. Multi-rate revenue metering

Meters enable multi-rate registration separately for energy and demand (Time of use - TOU).
The considerable amount of tariffs and 64 tariff registers enable flexible and complex tariff systems. Default value for a number of tariffs is 4.
Time of switching individual tariff is defined by hour and minute with a resolution of 1 minute.

A number of periods in a day where one or several tariffs can be valid is defined with configuration. The same is valid for different daily tariff programs. Up to 8 various types of a day (a day in a week and a holiday) can be defined.
A number of seasons in a year is defined with configuration. Besides a current tariff program, the so-called slipping tariff programs can be defined. They are activated at previously defined dates.

An optional number of holidays can be defined. A century-based calendar is built in the meter.

The tariff changeover can be simultaneously controlled by several tariff control sources, which have different or same priorities. Tariff changeover is performed by tariff control source that has the highest priority. Tariff change-over can be controlled by:

- internal tariff device,
- externally by tariff inputs.

14.1. Tariff device

Powerful memory and an adaptive tariff device enable performing various tariff programs. A number of tariff registers, tariffs, programs, seasons, holidays, weekly and daily programs can be adapted to specific customers' requirements.

	Max. no.
Tariff programs	10
Seasons	30
Weekly programs	64
Daily programs	30
Daily schedules	96
Holidays	100

Table 13: Tariff device capabilities

14.1.1 Program

Tariff changeover programs for energy and demand are independent and programmed separately. The changeover program is defined with:

- seasons,
- weekly programs,
- daily programs.

A valid tariff program is specified for each season, and daily programs are defined for each weekly program. A weekly program can have several periods. Time of switching individual tariffs is defined with an hour and a minute.
You can define not only a current tariff program but also the so-called sleeping tariff programs that are activated at previously defined dates.

14.1.2 Season

A year is divided into seasons in which one of the weekly programs is active. The season is defined with a weekly program and with a date of the end of the season and time.

Season	Season end		Weekly program
1	03.01.	12:00	2
2	05.15.	00:00	4
3	10.01.	00:00	3
4	11.20.	02:30	1
5	12.31.	24:00	2

Table 14: Annual season schedule

The first season starts on 1.1. at 00:00 and is valid till the first defined season end, when the second season starts. The last season is terminated at the end of the year, i.e. on 31.1. at 24:00.

14.1.3 Weekly program

A weekly program defines which daily program is active on each day in a week. In a weekly program 8 different day types can be defined: 7 for days in a week plus 1 for holidays.

Day in a week	Daily program
Sunday	7
Monday	2
Tuesday	2
Wednesday	2
Thursday	2
Friday	2
Saturday	5
Holiday	19

Table 15: Weekly program

14.1.4 Daily program

A daily program defines daily schedules of tariff changeover. It consists of time spans in which a certain tariff or their combination is valid. Each time span is defined with its start time. The first time span always starts at 00:00.
Daily programs for energy are independent from daily programs for demand.

Time	Tariffs
00:00	1
06:00	2
09:15	3
11:30	5
15:45	3
18:30	6
21:00	1

Table 16: Daily program

14.1.5 Holidays

Holidays can relate to a lunar calendar (e.g. Easter) or any other periodical algorithm. Holidays can be programmed using the following algorithms:

- unique holiday,
- every year on selected date (MM.DD.),
- lunar holidays.

14.2. Tariff control via inputs

There are three external tariff change-over inputs separated for energy or demand. With three inputs it is possible to control up to 8 tariffs. See also chapter 9.1.1Tariff change-over.

15. Load profiles

Two independent load profiles recorders are implemented in the meter. Each load profile is defined with:

- number of channels,
- registration period,
- quantities to register,
- capacity in days (e.g. 15 min. period, 10 channels, 60 days).

Each load profile has up to 8 channels. A registration period or a load profile can be set within the range from 1 to 60 minutes. A load profile recorder records the following:

- active, apparent power and energy (cumulative or absolute values), three-phase values in both energy flow directions,
- reactive power or energy (cumulative or absolute values) in four or combined quadrants (e.g. Q1+Q2 and Q3+Q4),
- phase voltage and current rms values,
- average values of phase voltage and current registered during the last measurement period,
- network quality parameters (harmonics, power factor, frequency, etc.),
- individual meter statuses (power supply failure, alarms, etc.).

Each record is accompanied with a date and time of the end of a registration period to which it relates.
In a load profile mode on the console only the first load profile (i.e. P.01) is displayed.

15.1. Channels

Each load profile has up to 8 channels and 8 status bits. A channel represents one measured quantity.

15.2. Registration period

A registration period is set in the range from 1 minute to 60 minutes with 1 minute resolution. However, such a time period should be selected that it is concluded in a day without a residuum. Suggested registration periods are multiples of measurement period.
Default value for the first load profile period is 15 minutes and for the second period 1 minute.

15.3. Quantities

The load profile recorder can record two basic types of quantities:

- measured quantities,
- device statuses and measuring situations.

Measured quantities are energy absolute values, delta values or demands of active and reactive energy or last average values of network quality measurements.

Common statuses recorded are: power up/down, RTC set, season change, fatal error, etc. Status bits are associated into bytes of eight. Status arrays with 0, 8, 16, 24, 32 status bits are available in load profile.

15.4. Capacity

Capacity of both load profiles is limited to 20,000 records. This amount of records is divided between two load profiles.
A capacity of each load profile stated in days for which data are stored in the load profile depends on:

- number of channels,
- registration period.

Period	Minutes	No. of ch.	Capacity (day)
LP1	1	1	10
LP2	15	1	156
LP1	1	4	5
LP2	15	4	74
LP1	1	8	3
LP2	15	8	43

Table 17: Load profile capacity examples

The capacity if all records are dedicated to a single load profile is shown in the table bellow:

Period (min.)	No. of channels	Capacity (day)
15	4	182
15	8	91
30	4	364
30	8	182

Table 18: Maximum load profile capacity

15.5. Format

A load profile format as it is sent via communication and also represented on a display can be as:

- energy absolute x.8,
- energy delta value x.9,
- demand x.5,
- network quality,

where x is 1 (+A), 2 (-A), 3 (+R), 4 (-R), 5 (R1), 6 (R2), 7 (R3), 8 (R4), 9 (+S) or 10 (-S) respectively.

16. Logbooks

The event logbook is a recorder organised as a FIFO buffer. It holds the information of all important events that occurred in the meter.

Each event has a timestamp in the TST12 format:

YYMMDDhhmmss

where YY - year, MM - month, DD-day, hh-hour, mm - minute, ss - second.

The meter could have two logbooks:

- A standard logbook records events like MD reset, master reset, time setting, parameters setting, load profile and logbook initialisation, etc.
- A special network quality events logbook is used for voltage network analysis like power shortage periods, dips/sags, etc.

Due to security reasons data recorded in the logbook can not be deleted without opening the meter.

Exy	Event
0	Power down
1	Power up
2	R voltage down
3	S voltage down
4	T voltage down
5	R voltage low
6	S voltage low
7	T voltage low
8	R voltage normal
9	S voltage normal
10	T voltage normal
11	R voltage high
12	S voltage high
13	T voltage high
14	RR done
15	RTC start synchronization
16	RTC end synchronization
17	RTC start setting
18	RTC end setting
19	DST season change
22	Fatal error
23	Param. change manually/module insertion
24	Watchdog
25	Fraud start
26	Fraud stop
27	Terminal cover opened
29	Meter cover opened
31	Mater reset
32	Parameters change by communication
33	Parameters change scheduled

Table 19: Logbook events identification

17. Billing reset

A billing period is a period over which energy is integrated and in which maximum demand is calculated with a purpose to charge consumed energy to the consumer. At the end of a billing period the billing reset is performed in order to:

- transfer metering data from registers for a current billing period into the corresponding registers of a previous billing period,
- transfer data from registers for previous billing periods into corresponding registers for one billing period back,
- clear registers of demands in a current demand period,
- clear registers of maximum demands,
- sum up maximum demands of the just ended billing period with corresponding values in the cumulative demand registers.

The meters are provided with two counters for previous billing periods:

- a counter in the register 0.1.0 counts how many billing resets have been performed. This counter is incremented with each billing reset.
- a constant in the register 0.1.1 indicates a number of billing periods for which metering data are available in the meter.

17.1. Types of billing resets

The following billing resets can be executed:

- automatically by the internal tariff device,
- by communication interfaces,
- by inputs,
- manually by the reset button.

17.1.1 Internal tariff device

A billing reset is performed automatically with the internal real-time clock.

A variety of billing reset can be programmed with a MeterView software. Up to 20 billing dates can be entered. On a special request this number can be increased.

The following billing reset options are available:

Type	Description	Date
0	unique date	YY-MM-DD hh:mm
1	every year on the same month and day	MM-DD hh:mm
10	once a month on a date	DD hh:mm

Table 20: Billing reset options

17.1.2 Manual

The manual billing reset can be performed by pressing the reset button any time when the meter is in the automatic data display mode.

The manual billing reset is disabled when the meter communicates via a communication interface.

17.1.3 Communication interfaces

A billing reset can be performed by optical interface or other communication interface.

17.1.4 MRa and MRb inputs

The meters can be equipped with inputs MRa and MRb for remote billing reset.

In a normal state a signal at the first input is high and on the other input it is low. In order to perform the billing reset, signals on both inputs should be changed from high to low and from low to high in an optional long time span.

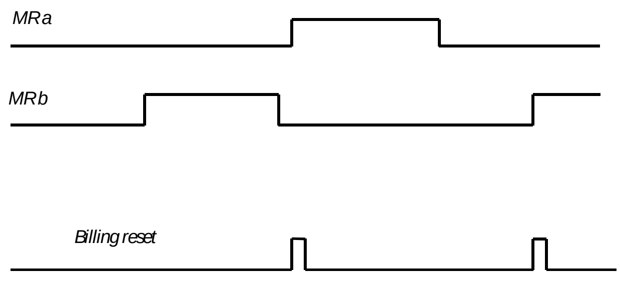


Figure 42: MRa and MRb signals perform billing reset.

17.2. Billing reset blockade

When a billing reset is performed by pressing the reset button or via a communication interface, a new billing reset is disabled by the same means for a certain time.
This time can be programmed in a range from 0 to 65535 minutes (45 days) in a register 0.0.128.0.18 for

a billing reset by a reset button and 0.0.128.0.19 by communication. When this time elapses, the billing reset can be repeated by the same means.

A billing reset is not temporally disabled for inputs MRa and MRb or internal tariff device.

17.3. MRAa and MRAb outputs

The meters can be equipped with MRAa and MRAb outputs for a billing reset of an external meter.
See also chapter 9.2.4: Billing reset.

17.4. Billing data

The following data is stored at billing reset:

- data on measured quantities,
- data on billing period completion.

Each billing period involves data on:

- cumulative energies,
- cumulative tariff energies,
- tariff maximum demands,
- cumulative tariff maximum demands.

All data, except cumulative maximum demands, are indexed with an index of previous values. The previous values are values registered in corresponding previous billing periods.

Cumulative maximum demands are unique data to which billing tariff maximum demands are added at every billing reset while values of previous billing periods are not stored.

Billing data on measured energy can be stored and listed as:

- cumulative value - values of cumulative energy registers of individual energies are stored at the end of a billing period.
- delta value - differences of cumulative energy registers of individual energies of two successive billing periods are stored.

Every billing period contains date and time when the billing occurred (timestamp).

17.4.1 Index of previous values

In case of linear indexing, data of the last billing period always have number 01, data of a billing period before that have a number 02, etc.

1.8.2(000004.28*kWh)	data of a current billing period
1.8.2*01(000003.93*kWh)	data of the last billing period
1.8.2*02(000003.18*kWh)	etc.

Example 3: Linear billing reset

When a billing period obtains indexes of a maximum set value - e.g. 100 (=00), the next billing period gets index 01 again. With the next billing reset the index is incremented by 1 and the whole cycle of incrementing index at each reset is repeated. Therefore indexes of previous billing periods circulate permanently.

In register 0.1.2 the timestamps of billing resets can be seen.

18. Protection

Meters are well protected against attempts to tamper the measuring results and unauthorised access to the registers containing parameters that influence in the results of measurements. Protection measures are implemented as:

- hardware protection,
- software protection.

Hardware protection includes sealing of:

- a meter cover and therefore also a parameter setting button,
- a reset button,
- detection of meter cover opening (option),
- detection of terminal cover opening (option).

Software protection includes:

- software locks of registers and passwords,
- temporary meter programming blockade if more wrong passwords were entered,
- billing resets counting,
- logbook records parameter changes,
- meter status registration,
- calculation of the neutral line current and phase symmetry.

18.1. Hardware protection

The reset button can not be pressed without breaking its seal. Therefore it is not possible to perform a billing reset or to set meter parameters via the pushbuttons.

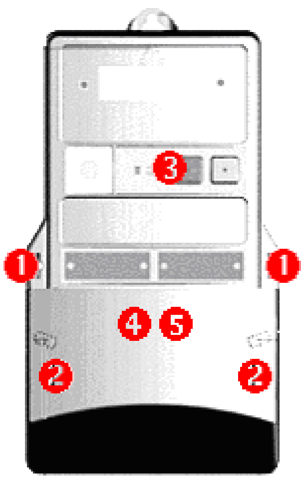


Figure 43: Hardware protection. Places of sealing: 1-meter cover, 2-terminal cover, 3-reset button. Optional detection of: 4- meter cover opening, 5- terminal cover opening.

The parameter setting button can not be pressed without breaking the seals on the meter cover and removing it. Therefore parameters can not be changed in the meter parameter setting mode.

Access to the meter terminals and module terminals is not possible without breaking terminal cover seals.

18.1.1 Tamper protection

For tamper protection, the meter cover and the terminal cover opening sensors are implemented. Statuses M (meter cover opened) and T (terminal cover opened) will be displayed for 10 min. or until the reset button is pressed and held for time longer than 2 sec.

18.2. Software protection

18.2.1 Locks

All registers containing parameters that influence or contain results of measurement, meter statuses or different counters of events are protected with up to 4 software locks. These locks should be unlocked first if the content of the register is to be changed.

18.2.2 Passwords

There are four passwords in the registers from 0.0.128.4.8 to 0.0.128.4.11 as well as a password with an encryption algorithm. These registers are protected with a password both against changing and reading.

Register	Function
0.0.128.4.8.255	reading (READ)
0.0.128.4.9.255	setting (SET)
0.0.128.4.10.255	parameter setting (PARAM)
0.0.128.4.11.255	for command W5 (SET)

Table 21: List of passwords

18.2.3 Communication blockade

In case three wrong passwords have been entered into the meter via a communication interface, the meter programming via communication interfaces is temporary disabled for a certain time. Besides, every wrong password is counted by the wrong passwords counter. In this way the meter is protected against attempts to break the meter passwords.

18.2.4 Billing resets counting

When a billing reset is performed, date and time as well as way of reset are recorded in the logbook. The counter of billing resets is incremented by one with each billing reset. In this way non-authorised billing resets are recorded.

18.2.5 Logbook

All significant events due to failures, interventions into the meter, settings, etc. are recorded into the logbook with a time stamp. The logbook can not be deleted except if the meter is re-configured. Therefore eventual unauthorised interventions into the meter are registered permanently.

18.2.6 Revenue protection

Different meter statuses or event counters are registered by the load profile recorder:

- reversed phase sequence,
- absence of phase voltages,
- voltage failures,
- detection of different incorrect operations of a meter, etc.

This enables registration of uncommon meter operation conditions, which might be caused by non-authorised intervention into the meter connection.

18.3. Settings and parameter setting

A customer can change meter settings, and can thus influence in its operation. As certain changes of settings can essentially influence in the results of measurement and meter operation defined in a corresponding authorisation level, each parameter should be corresponding set.

The meter settings are protected with three levels:

- password,
- reset button,
- parameter setting button.

The lowest protection level is protection with a password. In the MeterView program it is necessary to enter only the password for the access to settings that can be modified in this way.

At protection with the reset button, the reset button seal should be removed. Go to the settings mode and change settings with buttons or by means of the MeterView program. Settings that can be changed are found in the setting sequence.

The highest level is the protection with a parameter setting button.
Remove the meter cover seals. Open the cover and press the parameter setting button for parameter setting in the meter internal part.

Settings are changed only with a dedicated program and with software protection measures:

- password,
- encryption algorithm.

18.4. Software MeterView and MeterRead

The meters are supported by software MeterView for Microsoft Windows or MeterRead for Windows CE for palmtops (PDAs).

MeterView software has been designed specifically for meter specialists and technicians who need to configure meters. It offers intuitive graphical interface for meter setting, parameter setting, programming and data readout.

See details in MeterView and MeterRead Iskraemeco documents.

19. Technical data

Accuracy class Active energy Reactive energy Apparent energy	 0.2S or 0.5S (IEC 62053-22) class 2, 3 (IEC 62053-23), calibrated up to 0.5% according to the IEC 62053-22 standard.
Measuring voltage (V) Voltage range Rated frequency	Multirange, 3x240/415 V (0.8 - 1.15 U_n) 3 x 57.7/100 3 x 100 3 x 63/110 3 x 110 3 x 115/200 3 x 200 3 x 127/220 3 x 220 3 x 220/380 3 x 380 3 x 230/400 3 x 400 3 x 240/415 3 x 415 0.8 - 1.15 U_n 45-65 Hz
Measuring current (A) Short-circuit current Starting current	1(1.2), 1(2), 1(6), 5(6), 5(10) 30 I_{max} 0.001 I_n
Programmable outputs Type Permitted load Isolation dielectric strength Impulse length Impulse frequency	 PHOTO-MOS potential-free relay 25 VA (100 mA, 250 V AC) make contact: 5000 V_{rms} from 10 to 2500 ms (programmable in steps of 10 ms) max. 5 imp/s at impulse length 80 ms (shorter length, larger frequency is possible)
Energy LED outputs Type Permitted load Isolation dielectric strength Impulse length	 PHOTO-MOS potential-free relay 25 VA (100 mA, 250 V AC) make contact: 5000 V_{rms} 2 ms
Inputs Voltage threshold Current consumption	100 – 240 V AC ON: $U \geq 50$ V OFF: $U < 20$ V < 2 mA @ 57.7V < 10 mA @ 240V
Communication IR RS232 RS485 Protocols	 max. 19200 Baud max. 19200 Baud max. 19200 Baud IEC 62056-21, MODBUS
Optical reading LED Impulse frequency Impulse length	 ≤ 40 Hz approx. 6 or 30 ms
Real time clock Accuracy Super-Cap Li-battery	 crystal 6 ppm = ≤±3 min./year (at Top= +25°C) 1F for minimal 250 h of back-up. operation reserve 10 years, life span 20 years
External power supply	50 - 240 V AC/DC

EMC testing	**In compliance with**
Immunity to voltage dips and short interruptions	EN 50470-1 item 7.4.2, item 7.4.3. item 7.4.4, IEC 62052-11 item 7.1.2
Immunity to electrostatic discharges	EN 50470-1 item 7.4.5, IEC 62052-11 item 7.5.2
Immunity to electrical fast transients/bursts	EN 50470-1 item 7.4.7, EN 50470-3 item 8.5, item 8.7.7.14, IEC 62052-11 item 7.5.4, IEC 62053-21 item 8.2, IEC 62053-22 item 8.2, IEC 62053-23 item 8.2
Immunity to surges	EN50470-1 item 7.4.9, IEC 62052-11 item 7.5.6
Immunity to oscillatory waves	EN 50470-1 item 7.4.10, EN 50470-3 item 8.5, item 8.7.7.16, IEC 62052-11 item 7.5.7, IEC 62053-21 item 8.2, IEC 62053-22 item 8.2, IEC 62053-23 item 8.2
Immunity to continous magnetic fields of external origin	EN 50470-1 item 7.4.11, EN50470-3 item 8.5; 8.7.7.10, IEC 62053-21 item 8.2;8.2.4, IEC 62053-22 item 8.2;8.2.3, IEC 62053-23 item 8.2;8.2.2
Immunity to power frequency magnetic fields of external origin	EN 50470-1 item 7.4.12, EN 50470-3 item 8.5; 8.7.7.11, IEC 62053-21 item 8.2, IEC 62053-22 item 8.2, IEC62053-23 item 8.2
Photovoltaics - Conducted, differential mode	EN 33429, IEC pr 61000-4-19 Ed.1.0, FNN 3.6
Radio interference supression - radiated	EN50470-1 item 7.4.13, IEC 62052-11 item 7.5.8
Radio interference suppression - conducted	EN50470-1 item 7.4.13, IEC 62052-11 item 7.5.8
Immunity to conducted disturbances induced by RF fields	EN 50470-1 item 7.4.8, EN 50470-3 item 8.5, item 8.7.7.15, IEC 62052-11 item 7.5.5, IEC 62053-21 item 8.2, IEC 62053-22 item 8.2, IEC 62053-23 item 8.2
Immunity to radiated RF electromagnetic fields	EN 50470-1 item 7.4.6, IEC 62052-11 item 7.5.3, EN 50470-3 item 8.5, item 8.7.7.12, IEC 62053-21 item 8.2, IEC 62053-22 item 8.2, IEC 62053-23 item 8.2
Electrical requirements	
AC voltage test	EN 50470-1 item 7.3.4, IEC 62052-11 item 7.3.3, EN 50470-3 item 7.2, IEC 62053-21 item 7.4, IEC 62053-22 item 7.4, IEC 62053-23 item 7.4
Impulse voltage test	EN 50470-1 item7.3.2, item 7.3.3.2, item 7.3.3.3, IEC 62052-11 item 7.3.1, item 7.3.2.1, item 7.3.2.2
Temperature range	In compliance with IEC62053-22
Operation	-20°C ... +60°C
Storage	-30°C ... +70°C
Housing	
Half 19" for rack mounting	DIN 43862, ESSAILEC connector. app. 3.1 kg.
Surface-mounting	DIN 43857, 327 x 177 x 90 mm, 1.4 kg, UL94 (94V0), IP53
Self consumption	
Current circuits	<0,1 VA / phase
Voltage circuits	<3 W / 10 VA

Table 22: Technical data

20. Type designation

M T 8 6 0 S - A n m R n m S n m - E I V n 2 L n 1 - M n K 0 - Z n

MT860	3-element meter
S	Surface-mounted version
A	**Active energy**
n = 2	class 0.2S (IEC 62053-22)
n = 3	class 0.5S (IEC 62053-22)
m = 1	one energy-flow direction
m = 2	two energy-flow directions
R	**Reactive energy**
n = 3	0.5 %
n = 4	1 %
n = 5	class 2 (IEC 62053-23)
n = 6	class 3 (IEC 62053-23)
m = 1	one energy-flow dir. (Q+)
m = 6	4-quadr. (Q+,Q-,Q1,Q2,Q3,Q4)
S	**Apparent energy**
n = 5	2 %
m = 2	product U_{RMS} x I_{RMS}
-	
E	**External supply**
n=1	power supply of the whole meter
n=2	power supply via the optical probe (reading if measuring voltages are absent)
V	Control **Inputs**
n = 1...2	a number of inputs
2	inputs – resistor type (control voltage is phase voltage)
L	OptoMOS relay **outputs**
n = 1...4	a number of outputs
1	PHOTO-MOS make contact
-	
M	**Additional device**
n = 3	Super-Cap + Li-battery
K	**Communication interface**
n = 0	first interface: IR optical port
m = 3	second interface: RS-485
-	
Z	**Load profile recorder**
n = 7	memory capacity: 4096K FLASH ROM

Appendix A: Communication module type designation

MK – f3n - m

MK	**Communication module**
f	active CS- interface (20 mA current loop) – for multidrop communication
1	passive CS- interface (20 mA current loop)
2	RS-232 interface
3	RS-485 interface–for multidrop communication (module with modem)
n = 7..9,a,e	**the first communication interface (type of modem)**
n=7	PSTN modem
n=8	GSM modem
n=9	ISDN modem
n=a	GSM/GPRS modem
n=e	Ethernet
m	**the second communication interface**
m=1	passive CS - interface (20 mA current loop)
m=2	RS-232 interface
m=3	RS-485 interface

Communication modules	Type designation
RS232&RS485	MK - 2-3
CS & RS485	MK - 1-3
RS485 & RS485	MK - 3-3
PSTN+CS+RS485& RS485	MK - f37-3
GSM+CS+RS485 & RS485	MK - f38-3
GSM/GPRS+RS485 & RS485	MK - 38a-3
ISDN+CS+RS485 & RS485	MK - f39-3
Ethernet+RS485 & RS485	MK - 3e-3
MODBUS (Eth.Int.+RS485 & RS485)	MK - MB-3-e-3

Table 23: Communication modules

Appendix B: Input/output module type designation

MIO - Vn2 Ln1 B11

MIO	**Input/output module**
V	**Control inputs**
n = 1...4	a number of inputs
2	control voltage is phase voltage
L	**OptoMOS relay outputs**
n = 1...8	a number of outputs
1	make contact
B	Relay outputs
n = 1	5A bistable relay

Appendix C: OBIS code

OBIS code	Data name
Three phases energy registers, t = TOU registers (1,..n)	
1-0:1.8.0	A+, Active energy import, total register
1-0:1.8.t	A+, Active energy import, TOU register
1-0:1.9.0	A+, Active energy import in the billing period, total register
1-0:1.9.t	A+, Active energy import in the billing period, TOU register
1-0:2.8.0	A-, Active energy export, total register
1-0:2.8.t	A-, Active energy export, TOU register
1-0:2.9.0	A-, Active energy export in the billing period, total register
1-0:2.9.t	A-, Active energy export in the billing period, TOU register
1-0:3.8.0	Q+=Q1+ Q2, Reactive energy import, total register
1-0:3.8.t	Q+=Q1+ Q2, Reactive energy import, TOU register
1-0:3.9.0	Q+=Q1+ Q2, Reactive energy import in the billing period, total register
1-0:3.9.t	Q+=Q1+ Q2, Reactive energy import in the billing period, TOU register
1-0:4.8.0	Q-=Q3+ Q4, Reactive energy export, total register
1-0:4.8.t	Q-=Q3+ Q4, Reactive energy export, TOU register
1-0:4.9.0	Q-=Q3+ Q4, Reactive energy export in the billing period, total register
1-0:4.9.t	Q-=Q3+ Q4, Reactive energy export in the billing period, TOU register
1-0:5.8.0	Q1, Reactive energy, inductive import, total register
1-0:5.8.t	Q1, Reactive energy, inductive import, TOU register
1-0:5.9.0	Q1, Reactive energy, inductive import in the billing period, total register
1-0:5.9.t	Q1, Reactive energy, inductive import in the billing period, TOU register
1-0:6.8.0	Q2, Reactive energy, capacitive import, total register
1-0:6.8.t	Q2, Reactive energy, capacitive import, TOU register
1-0:6.9.0	Q2, Reactive energy, capacitive import in the billing period, total register
1-0:6.9.t	Q2, Reactive energy, capacitive import in the billing period, TOU register
1-0:7.8.0	Q3, Reactive energy, inductive export, total register
1-0:7.8.t	Q3, Reactive energy, inductive export, TOU register
1-0:7.9.0	Q3, Reactive energy, inductive export in the billing period, total register
1-0:7.9.t	Q3, Reactive energy, inductive export in the billing period, TOU register
1-0:8.8.0	Q4, Reactive energy, capacitive export, total register
1-0:8.8.t	Q4, Reactive energy, capacitive export, TOU register
1-0:8.9.0	Q4, Reactive energy, capacitive export in the billing period, total register
1-0:8.9.t	Q4, Reactive energy, capacitive export in the billing period, TOU register
1-0:9.8.0	S+, Apparent energy import, total register
1-0:9.8.t	S+, Apparent energy import, TOU register
1-0:9.9.0	S+, Apparent energy import in the billing period, total register
1-0:9.9.t	S+, Apparent energy import in the billing period, TOU register
1-0:10.8.0	S-, Apparent energy export, total register
1-0:10.8.t	S-, Apparent energy export, TOU register
1-0:10.9.0	S-, Apparent energy export in the billing period, total register
1-0:10.9.t	S-, Apparent energy export in the billing period, TOU register
Three phases cumulative demand registers, t = TOU registers (1,..n)	
1-0:1.2.0	P+ cumulative demand total register
1-0:1.2.t	P+ cumulative demand TOU register
1-0:2.2.0	P- cumulative demand total register
1-0:2.2.t	P- cumulative demand TOU register
1-0:3.2.0	Q+ cumulative demand total register
1-0:3.2.t	Q+ cumulative demand TOU register
1-0:4.2.0	Q- cumulative demand total register

1-0:4.2.t	Q- cumulative demand TOU register
1-0:5.2.0	Q1 cumulative demand total register
1-0:5.2.t	Q1 cumulative demand TOU register
1-0:6.2.0	Q2 cumulative demand total register
1-0:6.2.t	Q2 cumulative demand TOU register
1-0:7.2.0	Q3 cumulative demand total register
1-0:7.2.t	Q3 cumulative demand TOU register
1-0:8.2.0	Q4 cumulative demand total register
1-0:8.2.t	Q4 cumulative demand TOU register
1-0:9.2.0	S+ cumulative demand total register
1-0:9.2.t	S+ cumulative demand TOU register
1-0:10.2.0	S- cumulative demand total register
1-0:10.2.t	S- cumulative demand TOU register
Three phases momentary demand registers	
1-0:1.4.0	P+ momentary demand register
1-0:2.4.0	P- momentary demand register
1-0:3.4.0	Q+ momentary demand register
1-0:4.4.0	Q- momentary demand register
1-0:5.4.0	Q1 momentary demand register
1-0:6.4.0	Q2 momentary demand register
1-0:7.4.0	Q3 momentary demand register
1-0:8.4.0	Q4 momentary demand register
1-0:9.4.0	S+ momentary demand register
1-0:10.4.0	S- momentary demand register
Three phases last ended measurement period demand register	
1-0:1.5.0	P+ last ended measurement period demand register
1-0:2.5.0	P- last ended measurement period demand register
1-0:3.5.0	Q+ last ended measurement period demand register
1-0:4.5.0	Q- last ended measurement period demand register
1-0:5.5.0	Q1 last ended measurement period demand register
1-0:6.5.0	Q2 last ended measurement period demand register
1-0:7.5.0	Q3 last ended measurement period demand register
1-0:8.5.0	Q4 last ended measurement period demand register
1-0:9.5.0	S+ last ended measurement period demand register
1-0:10.5.0	S- last ended measurement period demand register
Three phases maximum demand registers, t = TOU registers (1,..n)	
1-0:1.6.0	P+ maximum demand total register
1-0:1.6.t	P+ maximum demand TOU register
1-0:2.6.0	P- maximum demand total register
1-0:2.6.t	P- maximum demand TOU register
1-0:3.6.0	Q+ maximum demand total register
1-0:3.6.t	Q+ maximum demand TOU register
1-0:4.6.0	Q- maximum demand total register
1-0:4.6.t	Q- maximum demand TOU register
1-0:5.6.0	Q1 maximum demand total register
1-0:5.6.t	Q1 maximum demand TOU register
1-0:6.6.0	Q2 maximum demand total register
1-0:6.6.t	Q2 maximum demand TOU register
1-0:7.6.0	Q3 maximum demand total register
1-0:7.6.t	Q3 maximum demand TOU register
1-0:8.6.0	Q4 maximum demand total register
1-0:8.6.t	Q4 maximum demand TOU register
1-0:9.6.0	S+ maximum demand total register

1-0:9.6.t	S+ maximum demand TOU register
1-0:10.6.0	S- maximum demand total register
1-0:10.6.t	S- maximum demand TOU register
Three phases quality instantaneous registers	
1-0:11.7.0	Average current RMS
1-0:12.7.0	Average voltage RMS
1-0:13.7.0	Average power factor
1-0:14.7.0	Average frequency
1-0:11.7.h	Average harmonics component in current, h – harmonics component (1, ..,8)
1-0:12.7.h	Average harmonics component in voltage, h – harmonics component (1, ..,8)
Phase R energy registers, t = TOU registers (1,..n)	
1-0:21.8.0	A+, Active energy import in phase R, total register
1-0:21.8.t	A+, Active energy import in phase R, TOU register
1-0:21.9.0	A+, Active energy import in the billing period, phase R
1-0:21.9.t	A+, Active energy import in the billing period TOU register, phase R
1-0:22.8.0	A-, Active energy export in phase R, total register
1-0:22.8.t	A-, Active energy export in phase R, TOU register
1-0:22.9.0	A-, Active energy export in the billing period, phase R
1-0:22.9.t	A-, Active energy export in the billing period TOU register, phase R
1-0:23.8.0	Q+=Q1+ Q2, Reactive energy import in phase R, total register
1-0:23.8.t	Q+=Q1+ Q2, Reactive energy import in phase R, TOU register
1-0:23.9.0	Q+=Q1+ Q2, Reactive energy import in the billing period, phase R
1-0:23.9.t	Q+=Q1+ Q2, Reactive energy import in the billing period TOU register, phase R
1-0:24.8.0	Q-=Q3+ Q4, Reactive energy export in phase R, total register
1-0:24.8.t	Q-=Q3+ Q4, Reactive energy export in phase R, TOU register
1-0:24.9.0	Q-=Q3+ Q4, Reactive energy export in the billing period, phase R
1-0:24.9.t	Q-=Q3+ Q4, Reactive energy export in the billing period TOU register, phase R
1-0:25.8.0	Q1, Reactive energy, inductive import in phase R, total register
1-0:25.8.t	Q1, Reactive energy, inductive import in phase R, TOU register
1-0:25.9.0	Q1, Reactive energy, inductive import in the billing period, phase R
1-0:25.9.t	Q1, Reactive energy, inductive import in the billing period TOU register, phase R
1-0:26.8.0	Q2, Reactive energy, capacitive import in phase R, total register
1-0:26.8.t	Q2, Reactive energy, capacitive import in phase R, TOU register
1-0:26.9.0	Q2, Reactive energy, capacitive import in the billing period, phase R
1-0:26.9.t	Q2, Reactive energy, capacitive import in the billing period TOU register, phase R
1-0:27.8.0	Q3, Reactive energy, inductive export in phase R, total register
1-0:27.8.t	Q3, Reactive energy, inductive export in phase R, TOU register
1-0:27.9.0	Q3, Reactive energy, inductive export in the billing period, phase R
1-0:27.9.t	Q3, Reactive energy, inductive export in the billing period TOU register, phase R
1-0:28.8.0	Q4, Reactive energy, capacitive export in phase R, total register
1-0:28.8.t	Q4, Reactive energy, capacitive export in phase R, TOU register
1-0:28.9.0	Q4, Reactive energy, capacitive export in the billing period, phase R
1-0:28.9.t	Q4, Reactive energy, capacitive export in the billing period TOU register, phase R
1-0:29.8.0	S+, Apparent energy import in phase R, total register
1-0:29.8.t	S+, Apparent energy import in phase R, TOU register
1-0:29.9.0	S+, Apparent energy import in the billing period, phase R
1-0:29.9.t	S+, Apparent energy import in the billing period TOU register, phase R
1-0:30.8.0	S- Apparent energy export in phase R, total register
1-0:30.8.t	S- Apparent energy export in phase R, TOU register
1-0:30.9.0	S-, Apparent energy export in the billing period, phase R
1-0:30.9.t	S-, Apparent energy export in the billing period TOU register, phase R
Phase R cumulative demand register, t = TOU registers (1,..n)	
1-0:21.2.0	P+ cumulative demand in phase R total register

1-0:21.2.t	P+ cumulative demand in phase R TOU register
1-0:22.2.0	P- cumulative demand in phase R total register
1-0:22.2.t	P- cumulative demand in phase R TOU register
1-0:23.2.0	Q+ cumulative demand in phase R total register
1-0:23.2.t	Q+ cumulative demand in phase R TOU register
1-0:24.2.0	Q- cumulative demand in phase R total register
1-0:24.2.t	Q- cumulative demand in phase R TOU register
1-0:25.2.0	Q1 cumulative demand in phase R total register
1-0:25.2.t	Q1 cumulative demand in phase R TOU register
1-0:26.2.0	Q2 cumulative demand in phase R total register
1-0:26.2.t	Q2 cumulative demand in phase R TOU register
1-0:27.2.0	Q3 cumulative demand in phase R total register
1-0:2.2.t	Q3 cumulative demand in phase R TOU register
1-0:28.2.0	Q4 cumulative demand in phase R total register
1-0:28.2.t	Q4 cumulative demand in phase R TOU register
1-0:29.2.0	S+ cumulative demand in phase R total register
1-0:29.2.t	S+ cumulative demand in phase R TOU register
1-0:30.2.0	S- cumulative demand in phase R total register
1-0:30.2.t	S- cumulative demand in phase R TOU register
Phase R momentary demand register	
1-0:21.4.0	P+ momentary demand in phase R register
1-0:22.4.0	P- momentary demand in phase R register
1-0:23.4.0	Q+ momentary demand in phase R register
1-0:24.4.0	Q- momentary demand in phase R register
1-0:25.4.0	Q1 momentary demand in phase R register
1-0:26.4.0	Q2 momentary demand in phase R register
1-0:27.4.0	Q3 momentary demand in phase R register
1-0:28.4.0	Q4 momentary demand in phase R register
1-0:29.4.0	S+ momentary demand in phase R register
1-0:30.4.0	S- momentary demand in phase R register
Phase R last ended measurement period demand register	
1-0:21.5.0	P+ last ended measurement period in phase R demand register
1-0:22.5.0	P- last ended measurement period in phase R demand register
1-0:23.5.0	Q+ last ended measurement period in phase R demand register
1-0:24.5.0	Q- last ended measurement period in phase R demand register
1-0:25.5.0	Q1 last ended measurement period in phase R demand register
1-0:26.5.0	Q2 last ended measurement period in phase R demand register
1-0:27.5.0	Q3 last ended measurement period in phase R demand register
1-0:28.5.0	Q4 last ended measurement period in phase R demand register
1-0:29.5.0	S+ last ended measurement period in phase R demand register
1-0:30.5.0	S- last ended measurement period in phase R demand register
Phase R maximum demand registers, t = TOU registers (1,..n)	
1-0:21.6.0	P+ maximum demand in phase R register
1-0:21.6.t	P+ maximum demand in phase R TOU register
1-0:22.6.0	P- maximum demand in phase R register
1-0:22.6.t	P- maximum demand in phase R TOU register
1-0:23.6.0	Q+ maximum demand in phase R register
1-0:23.6.t	Q+ maximum demand in phase R TOU register
1-0:24.6.0	Q- maximum demand in phase R register
1-0:24.6.t	Q- maximum demand in phase R TOU register
1-0:25.6.0	Q1 maximum demand in phase R register
1-0:25.6.t	Q1 maximum demand in phase R TOU register
1-0:26.6.0	Q2 maximum demand in phase R register

1-0:26.6.t	Q2 maximum demand in phase R TOU register
1-0:27.6.0	Q3 maximum demand in phase R register
1-0:27.6.t	Q3 maximum demand in phase R TOU register
1-0:28.6.0	Q4 maximum demand in phase R register
1-0:28.6.t	Q4 maximum demand in phase R TOU register
1-0:29.6.0	S+ maximum demand in phase R register
1-0:29.6.t	S+ maximum demand in phase R TOU register
1-0:30.6.0	S- maximum demand in phase R register
1-0:30.6.t	S- maximum demand in phase R TOU register
Phase R quality instantaneous registers	
1-0:31.7.0	Average current RMS in phase R
1-0:32.7.0	Average voltage RMS in phase R
1-0:33.7.0	Average power factor in phase R
1-0:34.7.0	Average frequency in phase R
1-0:31.7.h	Average harmonics component in current, h – harmonics component (1, ..,8) in phase R
1-0:32.7.h	Average harmonics component in voltage, h – harmonics component (1, ..,8) in phase R
1-0:81.7.40	Phase angle in phase R
Phase S energy registers, t = TOU registers (1,..n)	
1-0:41.8.0	A+, Active energy import in phase S, total register
1-0:41.8.t	A+, Active energy import in phase S, total register
1-0:41.9.0	A+, Active energy import in the billing period, phase S
1-0:41.9.t	A+, Active energy import in the billing period, phase S
1-0:42.8.0	A-, Active energy export in phase S, total register
1-0:42.8.t	A-, Active energy export in phase S, total register
1-0:42.9.0	A-, Active energy export in the billing period, phase S
1-0:42.9.t	A-, Active energy export in the billing period, phase S
1-0:43.8.0	Q+=Q1+ Q2, Reactive energy import in phase S, total register
1-0:43.8.t	Q+=Q1+ Q2, Reactive energy import in phase S, total register
1-0:43.9.0	Q+=Q1+ Q2, Reactive energy import in the billing period, phase S
1-0:43.9.t	Q+=Q1+ Q2, Reactive energy import in the billing period, phase S
1-0:44.8.0	Q-=Q3+ Q4, Reactive energy export in phase S, total register
1-0:44.8.t	Q-=Q3+ Q4, Reactive energy export in phase S, total register
1-0:44.9.0	Q-=Q3+ Q4, Reactive energy export in the billing period, phase S
1-0:44.9.t	Q-=Q3+ Q4, Reactive energy export in the billing period, phase S
1-0:45.8.0	Q1, Reactive energy, inductive import in phase S, total register
1-0:45.8.t	Q1, Reactive energy, inductive import in phase S, total register
1-0:45.9.0	Q1, Reactive energy, inductive import in the billing period, phase S
1-0:45.9.t	Q1, Reactive energy, inductive import in the billing period, phase S
1-0:46.8.0	Q2, Reactive energy, capacitive import in phase S, total register
1-0:46.8.t	Q2, Reactive energy, capacitive import in phase S, total register
1-0:46.9.0	Q2, Reactive energy, capacitive import in the billing period, phase S
1-0:46.9.t	Q2, Reactive energy, capacitive import in the billing period, phase S
1-0:47.8.0	Q3, Reactive energy, inductive export in phase S, total register
1-0:47.8.t	Q3, Reactive energy, inductive export in phase S, total register
1-0:47.9.0	Q3, Reactive energy, inductive export in the billing period, phase S
1-0:47.9.t	Q3, Reactive energy, inductive export in the billing period, phase S
1-0:48.8.0	Q4, Reactive energy, capacitive export in phase S, total register
1-0:48.8.t	Q4, Reactive energy, capacitive export in phase S, total register
1-0:48.9.0	Q4, Reactive energy, capacitive export in the billing period, phase S
1-0:48.9.t	Q4, Reactive energy, capacitive export in the billing period, phase S
1-0:49.8.0	S+, Apparent energy import in phase S, total register
1-0:49.8.t	S+, Apparent energy import in phase S, total register
1-0:49.9.0	S+, Apparent energy import in the billing period, phase S

1-0:49.9.t	S+, Apparent energy import in the billing period, phase S
1-0:50.8.0	S-, Apparent energy export in phase S, total register
1-0:50.8.t	S-, Apparent energy export in phase S, total register
1-0:50.9.0	S-, Apparent energy export in the billing period, phase S
1-0:50.9.t	S-, Apparent energy export in the billing period, phase S
Phase S momentary demand register	
1-0:41.4.0	P+ momentary demand in phase S register
1-0:42.4.0	P- momentary demand in phase S register
1-0:43.4.0	Q+ momentary demand in phase S register
1-0:44.4.0	Q- momentary demand in phase S register
1-0:45.4.0	Q1 momentary demand in phase S register
1-0:46.4.0	Q2 momentary demand in phase S register
1-0:47.4.0	Q3 momentary demand in phase S register
1-0:48.4.0	Q4 momentary demand in phase S register
1-0:49.4.0	S+ momentary demand in phase S register
1-0:50.4.0	S- momentary demand in phase S register
Phase S last ended measurement period demand register	
1-0:41.5.0	P+ last ended measurement period in phase S demand register
1-0:42.5.0	P- last ended measurement period in phase S demand register
1-0:43.5.0	Q+ last ended measurement period in phase S demand register
1-0:44.5.0	Q- last ended measurement period in phase S demand register
1-0:45.5.0	Q1 last ended measurement period in phase S demand register
1-0:46.5.0	Q2 last ended measurement period in phase S demand register
1-0:47.5.0	Q3 last ended measurement period in phase S demand register
1-0:48.5.0	Q4 last ended measurement period in phase S demand register
1-0:49.5.0	S+ last ended measurement period in phase S demand register
1-0:50.5.0	S- last ended measurement period in phase S demand register
Phase S maximum demand registers, t = TOU registers (1,..n)	
1-0:41.6.0	P+ maximum demand in phase S register
1-0:41.6.t	P+ maximum demand in phase S TOU register
1-0:42.6.0	P- maximum demand in phase S register
1-0:42.6.t	P- maximum demand in phase S TOU register
1-0:43.6.0	Q+ maximum demand in phase S register
1-0:43.6.t	Q+ maximum demand in phase S TOU register
1-0:44.6.0	Q- maximum demand in phase S register
1-0:44.6.t	Q- maximum demand in phase S TOU register
1-0:45.6.0	Q1 maximum demand in phase S register
1-0:45.6.t	Q1 maximum demand in phase S TOU register
1-0:46.6.0	Q2 maximum demand in phase S register
1-0:46.6.t	Q2 maximum demand in phase S TOU register
1-0:47.6.0	Q3 maximum demand in phase S register
1-0:47.6.t	Q3 maximum demand in phase S TOU register
1-0:48.6.0	Q4 maximum demand in phase S register
1-0:48.6.t	Q4 maximum demand in phase S TOU register
1-0:49.6.0	S+ maximum demand in phase S register
1-0:49.6.t	S+ maximum demand in phase S TOU register
1-0:50.6.0	S- maximum demand in phase S register
1-0:50.6.t	S- maximum demand in phase S TOU register
Phase S quality instantaneous registers	
1-0:51.7.0	Average current RMS in phase S
1-0:52.7.0	Average voltage RMS in phase S
1-0:53.7.0	Average power factor in phase S
1-0:54.7.0	Average frequency in phase S

1-0:51.7.h	Average harmonics component in current, h – harmonics component (1, ..,8) in phase S
1-0:52.7.h	Average harmonics component in voltage, h – harmonics component (1, ..,8) in phase S
1-0:81.7.51	Phase angle in phase S
Phase T energy registers, t = TOU registers (1,..n)	
1-0:61.8.0	A+, Active energy import in phase T, total register
1-0:61.8.t	A+, Active energy import in phase T, total register
1-0:61.9.0	A+, Active energy import in the billing period, phase T
1-0:61.9.t	A+, Active energy import in the billing period, phase T
1-0:62.8.0	A-, Active energy export in phase T, total register
1-0:62.8.t	A-, Active energy export in phase T, total register
1-0:62.9.0	A-, Active energy export in the billing period, phase T
1-0:62.9.t	A-, Active energy export in the billing period, phase T
1-0:63.8.0	Q+=Q1+ Q2, Reactive energy import in phase T, total register
1-0:63.8.t	Q+=Q1+ Q2, Reactive energy import in phase T, total register
1-0:63.9.0	Q+=Q1+ Q2, Reactive energy import in the billing period, phase T
1-0:63.9.t	Q+=Q1+ Q2, Reactive energy import in the billing period, phase T
1-0:64.8.0	Q-=Q3+ Q4, Reactive energy export in phase T, total register
1-0:64.8.t	Q-=Q3+ Q4, Reactive energy export in phase T, total register
1-0:64.9.0	Q-=Q3+ Q4, Reactive energy export in the billing period, phase T
1-0:64.9.t	Q-=Q3+ Q4, Reactive energy export in the billing period, phase T
1-0:65.8.0	Q1, Reactive energy, inductive import in phase T, total register
1-0:65.8.t	Q1, Reactive energy, inductive import in phase T, total register
1-0:65.9.0	Q1, Reactive energy, inductive import in the billing period, phase T
1-0:65.9.t	Q1, Reactive energy, inductive import in the billing period, phase T
1-0:66.8.0	Q2, Reactive energy, capacitive import in phase T, total register
1-0:66.8.t	Q2, Reactive energy, capacitive import in phase T, total register
1-0:66.9.0	Q2, Reactive energy, capacitive import in the billing period, phase T
1-0:66.9.t	Q2, Reactive energy, capacitive import in the billing period, phase T
1-0:67.8.0	Q3, Reactive energy, inductive export in phase T, total register
1-0:67.8.t	Q3, Reactive energy, inductive export in phase T, total register
1-0:67.9.0	Q3, Reactive energy, inductive export in the billing period, phase T
1-0:67.9.t	Q3, Reactive energy, inductive export in the billing period, phase T
1-0:68.8.0	Q4, Reactive energy, capacitive export in phase T, total register
1-0:68.8.t	Q4, Reactive energy, capacitive export in phase T, total register
1-0:68.9.0	Q4, Reactive energy, capacitive export in the billing period, phase T
1-0:68.9.t	Q4, Reactive energy, capacitive export in the billing period, phase T
1-0:69.8.0	S+, Apparent energy import in phase T, total register
1-0:69.8.t	S+, Apparent energy import in phase T, total register
1-0:69.9.0	S+, Apparent energy import in the billing period, phase T
1-0:69.9.t	S+, Apparent energy import in the billing period, phase T
1-0:70.8.0	S-, Apparent energy export in phase T, total register
1-0:70.8.t	S-, Apparent energy export in phase T, total register
1-0:70.9.0	S-, Apparent energy export in the billing period, phase T
1-0:70.9.t	S-, Apparent energy export in the billing period, phase T
Phase T momentary demand register	
1-0:61.4.0	P+ momentary demand in phase T register
1-0:62.4.0	P- momentary demand in phase T register
1-0:63.4.0	Q+ momentary demand in phase T register
1-0:64.4.0	Q- momentary demand in phase T register
1-0:65.4.0	Q1 momentary demand in phase T register
1-0:66.4.0	Q2 momentary demand in phase T register
1-0:67.4.0	Q3 momentary demand in phase T register
1-0:68.4.0	Q4 momentary demand in phase T register

1-0:69.4.0	S+ momentary demand in phase T register
1-0:70.4.0	S- momentary demand in phase T register
Phase T last ended measurement period demand register	
1-0:61.5.0	P+ last ended measurement period in phase T demand register
1-0:62.5.0	P- last ended measurement period in phase T demand register
1-0:63.5.0	Q+ last ended measurement period in phase T demand register
1-0:64.5.0	Q- last ended measurement period in phase T demand register
1-0:65.5.0	Q1 last ended measurement period in phase T demand register
1-0:66.5.0	Q2 last ended measurement period in phase T demand register
1-0:67.5.0	Q3 last ended measurement period in phase T demand register
1-0:68.5.0	Q4 last ended measurement period in phase T demand register
1-0:69.5.0	S+ last ended measurement period in phase T demand register
1-0:70.5.0	S- last ended measurement period in phase T demand register
Phase T maximum demand registers, t = TOU registers (1,..n)	
1-0:61.6.0	P+ maximum demand in phase T register
1-0:61.6.t	P+ maximum demand in phase T TOU register
1-0:62.6.0	P+ maximum demand in phase T register
1-0:62.6.t	P- maximum demand in phase T TOU register
1-0:63.6.0	Q+ maximum demand in phase T register
1-0:63.6.t	Q+ maximum demand in phase T TOU register
1-0:64.6.0	Q- maximum demand in phase T register
1-0:64.6.t	Q- maximum demand in phase T TOU register
1-0:65.6.0	Q1 maximum demand in phase T register
1-0:65.6.t	Q1 maximum demand in phase T TOU register
1-0:66.6.0	Q2 maximum demand in phase T register
1-0:66.6.t	Q2 maximum demand in phase T TOU register
1-0:67.6.0	Q3 maximum demand in phase T register
1-0:67.6.t	Q3 maximum demand in phase T TOU register
1-0:68.6.0	Q4 maximum demand in phase T register
1-0:68.6.t	Q4 maximum demand in phase T TOU register
1-0:69.6.0	S+ maximum demand in phase T register
1-0:69.6.t	S+ maximum demand in phase T TOU register
1-0:70.6.0	S- maximum demand in phase T register
1-0:70.6.t	S- maximum demand in phase T TOU register
Phase T quality instantaneous registers	
1-0:71.7.0	Average current RMS in phase T
1-0:72.7.0	Average voltage RMS in phase T
1-0:73.7.0	Average power factor in phase T
1-0:74.7.0	Average frequency in phase T
1-0:71.7.h	Average harmonics component in current, h – harmonics component (1, ..,8) in phase T
1-0:72.7.h	Average harmonics component in voltage, h – harmonics component (1, ..,8) in phase T
1-0:81.7.62	Phase angle in phase T

UNITED KINGDOM - DISTRIBUTOR:

SMS Metering Ltd
41 London Road, Castle Court, Reigate RH2 9RJ TEL: 0845 604 7244
E-mail: sales@smsmetering.co.uk
Web: www.smsmetering.co.uk

Owing to periodical improvements of our products the supplied products can differ in some details from the data stated in the Technical description.

Iskraemeco d.d., Energy Measurement and Management
4000 Kranj, Savska loka 4, Slovenia

Published: Iskraemeco, Data subjected to alteration without notice MT860_TD_eng_V6.1.doc