User 's Manual

EN

Series of single-phase meters IE14xx:

- ➢ **IE14-S**
- ➢ **IE14MS**
- ➢ **IE14MN**
- ➢ **IE14MM**
- ➢ **IE14MD**

Single-phase electrical energy meter

IE14xx

User's and Installation manual

Security Advices and Warnings

Please read this chapter carefully and examine the equipment carefully for potential damages that might arise during transport and to become familiar with it before continuing to install, energize ,and work with a single-phase energy meter IE14xx.

This chapter deals with important information and warnings that should be considered for safe installation and handling with a device to assure its correct use and continuous operation.

Everyone using the product should become familiar with the contents of chapter the »Security Advices and Warnings«.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

PLEASE NOTE

This booklet contains instructions for the installation and use of single-phase energy meter IE14xx. Installation and use of a device also include handling dangerous currents and voltages, therefore, should be installed, operated, serviced ,and maintained by qualified personnel only. ISKRA Company assumes no responsibility in connection with the installation and use of the product. If there is any doubt regarding the installation and use of the system in which the device is used for measuring or supervision, please contact a person who is responsible for the installation of such a system.

Before installing

Check the following before installing the device:

- Nominal voltage.
- Terminals integrity.
- Protection fuse for voltage inputs (recommended maximal external fuse size is 40 A).
- External switch or circuit breaker must be included in the installation for disconnection of the devices' power supply. It must be suitably located and properly marked for reliable disconnection of the device when needed.
- Proper connection and voltage level of I/O module.

Used symbols on devices' housing and labels

SYMBOL	EXPLANATION
	Single phase connection.
	Double insulation in compliance with the EN 61010−1: 2010 standard.
	WARNING Indicates situations where careful reading of this manual is required and following requested steps to avoid potential injury is advised.
NFC	NFC communication.
Modbus	Modbus communication.
M-Bus	M-Bus communication
	Compliance of the product with directive 2002/96/EC, as first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment.
CE	Compliance of the product with European CE directives.
UKCA	Compliance of the product with UK Conformity Assessed (UKCA) directives.

Disposal

It is strongly recommended that electrical and electronic equipment (WEEE) is not deposited as municipal waste. The manufacturer or provider shall take waste electrical and electronic equipment free of charge. The complete procedure after a lifetime should comply with the Directive 2002/96/EC about the restriction on the use of certain hazardous substances in electrical and electronic equipment.

Table of contents

1 BASIC DESCRIPTION AND OPERATION

The following chapter presents basic information about a IE14xx single-phase energy meter required to understand its purpose, applicability, and basic features connected to its operation.

In this chapter, you will find:

1.1 Description of the device

The IE14xx single-phase energy meters are intended for energy measurements in single-phase electrical power networks and can be used in residential, industrial, and utility applications. Meters measure energy directly in 2-wire networks according to the principle of fast sampling of voltage and current signals. A built-in microprocessor calculates active/reactive/apparent power and energy, current, voltage, frequency, power factor, power angle, and frequency from the measured signals. This smart meter can also perform basic harmonic analysis (THDU, THDI). This enables a quick overview of harmonic distortion either coming from a network or generated by the load.

The microprocessor also controls LCD, LED, IR communication, and optional extensions.

A capacitive touch button on the front of the energy meter enables access to switch between measurements and settings in the menu.

Connecting terminals can be sealed up against non-authorised access with protection covers. They are built to be fastened according to EN 60715 standard.

1.1.1 Appearance

Appearance of the IE14xx single-phase electric energy meter
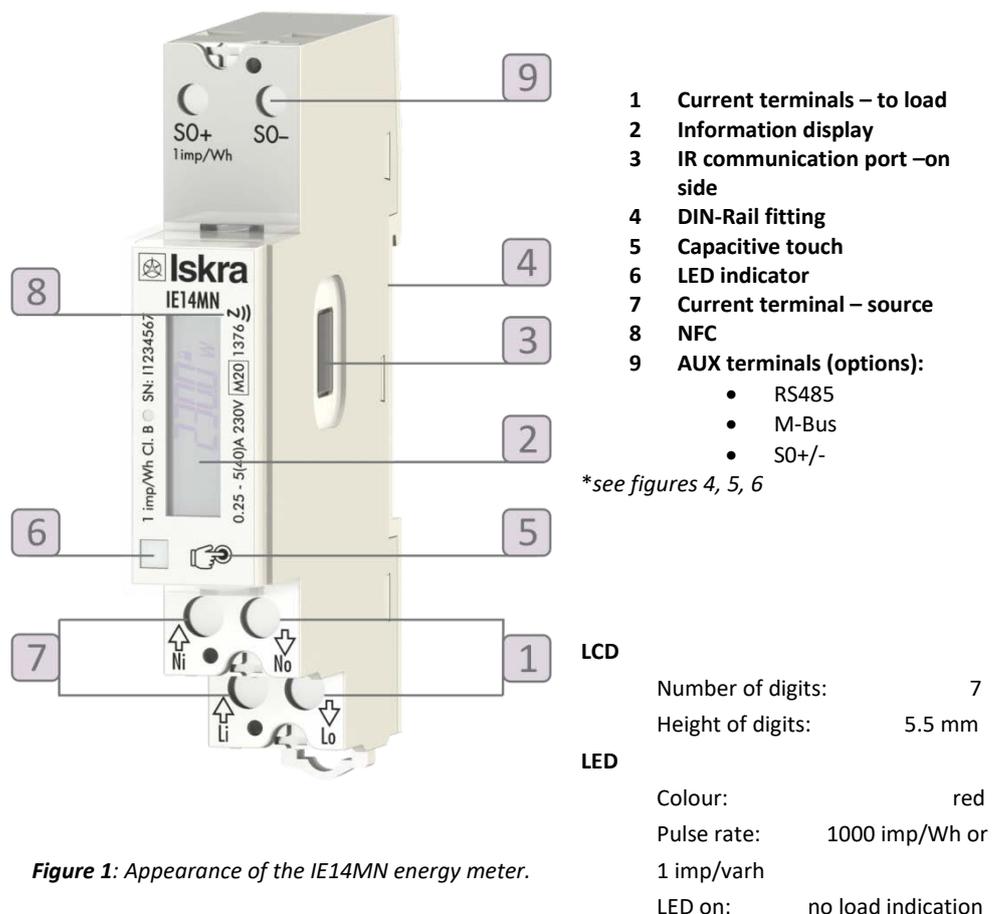
Figure 1: *Appearance of the IE14MN energy meter.*

1. Current terminals – to load
2. Information display
3. IR communication port –on side
4. DIN-Rail fitting
5. Capacitive touch
6. LED indicator
7. Current terminal – source
8. NFC
9. AUX terminals (options):
   - RS485
   - M-Bus
   - S0+/-

see figures 4, 5, 6

LCD

Number of digits:	7
Height of digits:	5.5 mm

LED

Colour:	red
Pulse rate:	1000 imp/Wh or 1 imp/varh
LED on:	no load indication

1.2 Single-phase energy meters application

Energy meters can be equipped with an optical (IR) communication port on the side as a standard. A special USB adapter (size 1 DIN module) can easily be attached to it. It can be used for direct communication with a PC to change settings of the device without any communication installed.

Meter has an optional built-in optical (IR) communication port on the side. It can be used for controlling Bistable switch – BICOM or in combination with SG smart gateway (more info about BICOM and SG can be found on https://www.iskra.eu/).

Meter can be equipped:

➢ **S0 output (pulse output)** is intended for connection to the devices that are checking and monitoring consumed energy.

➢ **RS485(Modbus)** serial communication with the Modbus protocol. Data is available in different formats prepared for easier integration into third party control and monitoring systems.

➢ **M-Bus** serial communication, which enables data transmission and thus the connection of the measuring places into the network for the control and management with energy.

➢ **NFC** communication for easy setting and downloading meter data via a mobile app.

Communication modules enable data transmission and thus the connection of the measuring places into the network for the control and management with energy.

On the housing there are only two terminals, thus only one functional extension is possible (serial communication, M-Bus).

NFC communication is implemented for parametrization as well as for reading data (e.g. counters, measurements, etc) from the smart meter.

PLEASE NOTE

Mobile application for NFC communication is not available at our company.

1.3 Main features

- Single-phase direct connected DIN-rail mounting meters.
- Active energy class B for MID approved types according to EN 62053-21 and class 1 for other types (non-MID version) according to EN 50470-3.
- Reactive energy Class 2 according to EN 62053-23.
- Bidirectional energy measurement (import/export).
- Basic current 5 A (I_b).
- Maximum current 40 A (I_{max}).
- 230 V rated system voltage input (U_n).
- Voltage operating range (-20%...+15%) U_n.
- Reference frequencies 50 Hz and 60 Hz (MID certified).
- Power consumption voltage circuit 10 VA at U_n.
- Power consumption current circuit < 0.1 VA at I_b.
- Temperature range climatic condition as indoor meter (-25 °C…+55 °C) according EN 62052-11.
- Custom LCD display with 7 digits (100 Wh resolution)
- Multifunctional front red LED.
- LED constant 1 imp/Wh or 1 imp/varh.
- IR(Modbus) serial communication (optional).
- Capacitive touch button for setting and control (optional).
- Backlight for better visibility (optional).
- Special functions added for easier integration into monitoring and control systems.

- Measurement of
  - power (active/reactive/apparent),
  - energy (active/reactive/apparent),
  - voltage,
  - current,
  - frequency,
  - power factor,
  - power angle,
  - active tariff (option),
  - THD of voltage,
  - THD of current.
- Pulse output according to EN 62053-31 (option).
- RS485 (Modbus) Serial communication (option).
- M-Bus Serial communication (option).
- NFC communication for easy setting and downloading meter data.
- Tariff management (up to 4 tariffs manageable via communication – option).
- DIN-rail mounting according to EN 60715.
- Secure data transfer (digital signature)
- 55°C ambient operation temperature (*for IE14MD; optional temperature range also -25 °C - +70 °C – upcoming version*)
- Sealable terminal cover.
- 1 DIN module width.

1.4 Types of IE14xx energy meters

Different type differ on functionality and equipment as shown in the following table.

General hardware features	IE14-S	IE14MS	IE14MN	IE14MM	IE14MD
MID approval	×	●	●	●	●
Pulse output S0	●	●	●	×	×
70°C display	×	×	×	×	●
Infrared (optical) communication - IR	×	×	●	●	●
Capacitive touch sensor	×	●	●	●	●
General software features	**IE14-S**	**IE14MS**	**IE14MN**	**IE14MM**	**IE14MD**
MODBUS comm. Protocol (IR)	×	×	×	×	●
M-bus serial comm.	×	×	×	●	×
NFC communication	×	×	●	●	●

● - supported

× - not supported

Table 1: *General hardware and software features of different types of meters*

2 CONNECTION

This chapter deals with the instructions for the IE14xx single-phase electrical energy meter connection. Both the use and connection of the device include handling dangerous currents and voltages. The connection shall therefore be performed ONLY by a qualified person using appropriate equipment. ISKRA, d.o.o. does not take any responsibility regarding the use and connection. If any doubt occurs regarding connection and uses in the system which device is intended for, please contact a person who is responsible for such installations.

In this chapter you will find:

2.1 Mounting

The IE14xx single-phase electrical energy meter is intended only for DIN-rail mounting. In the case of using the stranded wire, the ferrule must be attached before the mounting. The ferrule contact length should be 12 mm.

2.2 Electrical connection

WARNING

Wrong or incomplete connection of voltage or other terminals can cause non-operation or damage to the device.

- *To prevent electrical shock and/or equipment damage, disconnect electrical power at the main fuse or circuit breaker before installation or any servicing.*
- *Make sure, that no voltage is present in the installation.*
- *Prevent the disconnecting device from being switched on accidentally.*
- *Connect the module according to electrical diagram.*

WARNING

Security seal must be from plastic material.

Meter is used for direct connection into the two-wire networks. Meter can be equipped with different modules. The pictures below are showing equipped combinations.

Recommended installation:

1 Mounting to DIN rail according to DIN EN60715
2 Power contacts:
    a. Power contacts capacity:
       Flexible (Rigid) $1.5 \text{ mm}^2 - 10^* \text{ mm}^2$ *(*Ferrule contact length should be 12 mm. Wire stripped to 14 mm.)*
    b. Connection screws M3.5
    c. Max torque 0.8 Nm
3 Auxiliary terminals:
    a. Auxiliary terminals contact capacity
       Flexible (Rigid) $0.05 \text{ mm}^2 - 1 \text{ (2.5) mm}^2$
    b. Auxiliary terminals screws M3
    c. Max torque 0.6 Nm
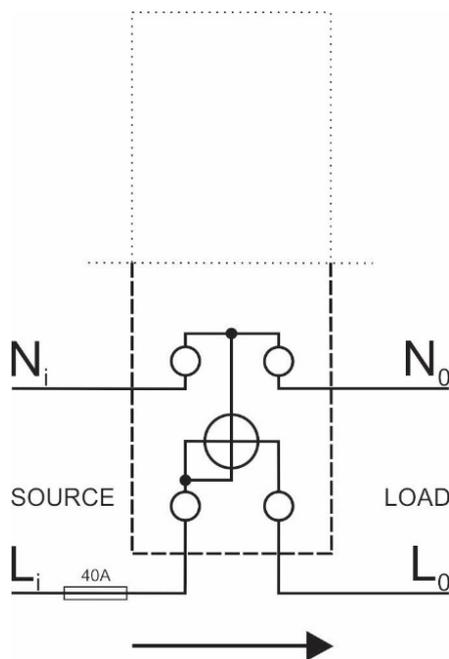
Figure 2: Electrical diagram 230 V_{AC}

Mark	Meaning
L_I	Line input
N_I	Neutral input
L_O	Line output
N_O	Neutral output

Table 2: Marks of inputs and outputs.
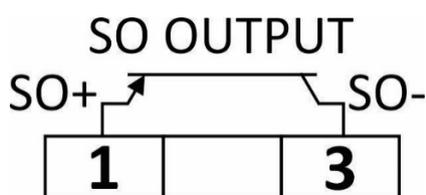
Figure 3: Connection diagram for pulse output
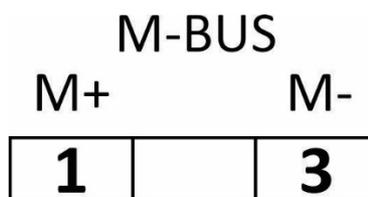
Figure 4: Connection diagram for M-Bus option

RS485

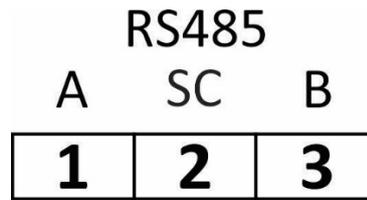| A	SC	B
1	**2**	**3**

Figure 5: Connection diagram for RS485 communication

2.2.1 Communication connection

There are multiple options for communication available for interaction with the outside world:

- **IR communication module (option)** using the MODBUS. It can be used for setting and testing the meter using a USB adapter.
- **The pulse output (option)** module is used for counting the number of pulses depending on consumed energy.
- **LED** is used for indication of no-load condition (I < 0,02A) and test output proportional to measured active energy (1 imp/Wh). It can be also switched to reactive energy for test purposes using communication.
- **RS485(Modbus) (option)** communication module is a galvanic isolated from the meter. It enables setting the meter and data readout in the network.
- **M-Bus (option)** communication module is a galvanic isolated from the meter. It enables setting the bound rate and the address of the meter (for more information see appendix 8.2).
- **NFC (option)** enables an easy setting and downloading meter data via a mobile app.
- **Capacitive touch** is used to select a display of desired measured or group of them.

Auxiliary terminal	1	2	3
Pulse output	S0+		S0-
M-Bus	M+		M-
RS485	A	*SC	B

*It is intended to be used for shielding for RS485.

Table 3: Survey of communication connection

PLEASE NOTE

Check connection diagram on the side of the meter to check what modules are built in.

3 FIRST STEPS

Programming an IE14xx single phase energy meter is very transparent and user friendly. Numerous settings are organized in groups according to their functionality.

In this chapter, you will find basic programming steps:

3.1 Display of device info

Measured data is presented on LCD. Display scrolls automatically. Displayed quantities and scroll time can be set via communication by MiQen software, or via mobile application using NFC.

PLEASE NOTE

Mobile application for NFC communication is not available at our company.

Energy meters have LCD display with the following layout:

1. Actual Value
2. Non resettable (MID) energy register. This sign indicates which energy counter permanently counts (it can not be reset to zero or any other value)
3. (→) Energy power import
   - (←) Energy power export
4. The sign indicates the specified counter is currently active (real-time data)
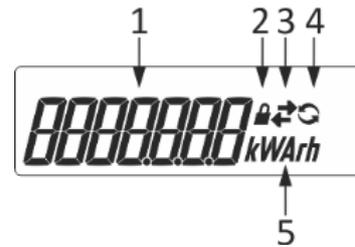5. Unit of measurement

Figure 6: Layout of LCD

Energy registers are displayed with resolution 6 + 1 (kWh, kvarh and kVAh).

PLEASE NOTE

When turning on IE14xx, the calibration of the capacitive touch sensor begins. Do not disturb the sensor at least for five seconds after turning on the device. If the sensor is disturbed during calibration, it will restart the calibration process.

PLEASE NOTE

The meter can be set to Test measuring mode which displays energy registers with better resolution. The test mode is used for test purposes during type testing and test of meter constant during initial verification. After power off meter automatically goes back to normal operation.

3.1.1 Welcome screens

Segment check: **Software version:** **Check sum:**

At power on the software version and check sum of MID approved measuring part of software is displayed.

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3.2 LCD User Interface

After the electrical connection, the display shows a segment check screen, software version screen, and check sum screen in a period of five seconds. The following is automatic cycling of measurements which consists of energy counters and actual measured values. The period is defined in settings. The cycling period and required measurement could be set via capacitive touch, MiQen software, or mobile app using NFC.

PLEASE NOTE

Mobile application for NFC communication is not available at our company.

Regarding the period that is defined in settings, measurement screen cycling is started until any key is pressed.

Besides the cycling of measurements, one can enter the display menu structure by using a long touch. If the capacitive touch is not pressed for more than 1 minute, the cycling of measurements automatically begins again. The hold page function is a function that locks a measurement screen. Therefore, even if the menu structure is entered and left for more than 1 minute, that specific measurement screen will be shown. This is also in case of a power-down.

The measured values can be scrolled automatically or can be selected by pressing the button. The LCD display has three types of actions:

- **short touch** (up to 1s): for scrolling through the menu or measured values.
- **long touch** (1-4s): after 1 second, the display starts blinking and after a touch release it enters the first level of the menu structure. Long touch is used also for every further sub-menu option or action confirmation,
- **extra long touch** (5s): if the touch is not released in 5 seconds, LCD returns in the initial cycling mode

The LCD display allows displaying the following measurement values:

1. **Energy registers**. Two different types (resettable and non-resettable). The resettable energy counter can be reset and the parameters can be modified, while the non-resettable has been measuring the quantity continuously. The energy counter you reset starts to re-measure the value from the zero value.

    I. **Non resettable energy counters**
        i. Energy counter E1
        ii. Energy counter E2
        iii. Energy counter E3
        iv. Energy counter E4

    II. **Resettable energy counters**
        i. Energy counter C1
        ii. Energy counter C2
        iii. Energy counter C3
        iv. Energy counter C4
        v. Energy counter C5
        vi. Energy counter C6
        vii. Energy counter C7
        viii. Energy counter C8

3   **Actual measured values**

I.	Active Power	VII.	Active Tariff
II.	Reactive Power	VIII.	Power Factor
III.	Apparent Power	IX.	Power Angle
IV.	Voltage	X.	THD of voltage
V.	Current	XI.	THD of current
VI.	Frequency		

3.2.1 Energy counters

There are two sets of energy registers – four non-resettable registers that can be assigned for active energy (MID approved), reactive energy (national approval), or apparent energy (no approval). The meter with MID approval should have at least one register with active energy measurement. There are additional 8 energy registers that can be parameterised by the user regarding type of energy, active quadrants, the direction of counting, and tariff and they can also be reset using MODBUS command or capacitive touch. Non-communication energy registers are displayed on the LCD display.

The indication of four non-resettable registers on the LCD is driven directly from the measuring part of SW.

On the LCD each energy counter is displayed with two screens. On the first screen, there is the counter designation and additional code. For the code, the user can choose between the OBIS code or letter description code. On the second screen there is the 7-digit numerical number which shows the value of the energy, the unit, lock sign for the fixed legally relevant non-resettable counters, energy direction sign, and the sign of currently active register. The decimal dot is fixed and resolution is fixed to 100 Wh. The first screen is displayed for three seconds and the second screen for the pre-set cyclic period. In the case of a manual scroll with capacitive touch, no additional touch is needed to switch between these two screens.

Legally relevant non-resettable registers are designated with letters E1 to E4, while legally non-relevant resettable registers are designated with C1 to C8. The code is specified in Table 1.

Register description E1 to E4	OBIS code	Letter description code
Active energy Q1+Q4 – all tariffs	1.8.0	A.I.0
Active energy Q2+Q3 – all tariffs	2.8.0	A.E.0
Active absolute energy– all tariffs (Abs(Q1+Q4) + abs(Q2+Q3))	15.8.0	A.A.0
Reactive energy – Q1+Q2 - all tariffs	3.8.0	r.I.0
Reactive energy – Q3+Q4 - all tariffs	4.8.0	r.E.0
Reactive absolute energy– all tariffs	95.8.0 (manufacturer specification)	r.A.0
Apparent absolute energy-all tariffs	9.8.0	S.A.0

Table 4: *Register description E1 to E4.*

Register description C1 to C8	OBIS code	Letter description code
Active energy Q1+Q4 – all tariffs	1.8.0	A.I.0
Active energy Q1+Q4 – tariff 1 to 4	1.8.1 to 1.8.4	A.I.1 to A.I.4
All energy types – tariff 1 to 4	x.x.1 to x.x.4	x.x.1.to x.x.4
All energy types – mixed tariffs (example tariff 1 and tariff 2)	x.x.9	x.x
Active energy Q2+Q3 – all tariffs	2.8.0	A.E.0
Active absolute energy– all tariffs (Abs(Q1+Q4) + abs(Q2+Q3))	15.8.0	A.A.0

Active energy (signed)– all tariffs (Abs(Q1+Q4) – abs(Q2+Q3))	16.8.0	A.b.0
Active energy Q1– all tariffs	17.8.0	A. .0
Active energy Q2– all tariffs	18.8.0	A. .0
Active energy Q3– all tariffs	19.8.0	A. .0
Active energy Q4– all tariffs	20.8.0	A. .0
Reactive energy – Q1+Q2 - all tariffs	3.8.0	r.I.0
Reactive energy – Q3+Q4 - all tariffs	4.8.0	r.E.0
Reactive energy – Q1 - all tariffs	5.8.0	r. .0
Reactive energy – Q2 - all tariffs	6.8.0	r. .0
Reactive energy – Q3 - all tariffs	7.8.0	r. .0
Reactive energy – Q4 - all tariffs	8.8.0	r. .0
Reactive absolute energy– all tariffs	95.8.0 (manufacturer specification)	r.A.0
Apparent absolute energy-all tariffs	9.8.0	S.A.0
Apparent energy –Q1+Q4 – all tariffs	9.8.0	S.I.0
Apparent energy – Q2+Q3 – all tariffs	10.8.0	S.E.0
Other unspecified custom setting regarding power, quadrants	0.0.y y (0,1,2,3,4,9)	x. .y x x (A,r,S), y (0,1,2,3,4,» «)

Table 5: *Register description C1 to C8.*

3.2.2 Actual measured quantities

The number on the screen shows the actual value of the measured quantity (P-W, Q-var, S, PF, U, f, and I). There is the direction of active energy flow (import/export = (/)) and reactance (inductive/capacitive = L/C) on the screen as well.

Active power:

$$0.0 \; \text{W} \; \rightleftarrows$$

Reactive power:

$$L \quad 0.0 \; \text{VAr} \; \rightleftarrows$$

Apparent power:

$$L \quad 0.0 \; \text{VA} \; \rightleftarrows$$

Voltage:

$$233.90 \; \text{V}$$

Current:

$$0.000 \; \text{A} \; \rightleftarrows$$

Frequency:

$$Hz \; 50.00$$

Active tariff:

$$tAriF \; 1$$

Power factor:

$$L \quad 0.0^{\circ} \; \rightleftarrows$$

Power angle:

| L | *1.000* ⇄ |

THD-U (%):

| th | 2.9 ᵥ |

THD-I (%):

| th | 0.0 ₐ |
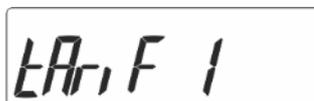
3.2.3 Initial display menu structure

The display menu is entered by touching the capacitive button for more than one second. The blinking of the screen indicates that. Short touches to move through the main menu. If the capacitive button is not used for more than one minute, the cycling mode starts automatically.

| MEASurE | →short touch→ | InFO | →short touch→ | SEt | →short touch→ | rESEt | →short touch→ | ESC |

By holding the cap button when positioned on certain screen (e.g. measure, set, info, etc.) the sub-menus are entered.

3.2.3.1 Measure menu

When in measure menu, short touches move user through it, allowing her/him to select a dedicated menu.

| MEASurE | →long touch→ | VALUE | →short touch→ | nrCnt | →short touch→ | Cnt | →short touch→ | ESC |

The screen COMM appears only in case the a ctual option is available on the meter.

3.2.3.2 Info menu

When in info menu, short touches move user through it, allowing her/him to select a dedicated menu.

| InFO | →long touch→ | run t | →short touch→ | VEr | →short touch→ | crc S | →short touch→ | crc d |

| Err crc | →short touch→ | ind cnt | →short touch→ | dG | →short touch→ | bACKCod | →short touch→ | ESC |

3.2.3.2.1 Info sub-menus

Run time (22 days, 0 hours, 16 minutes, 11 seconds):

| run t | →long touch→ | 22d | →short touch→ | 0h 16 11 | →short touch→ | ESC |

ESC (escape) screen is replaced by LCD segment test screen.

Software version:

| VEr | →long touch→ | 1 0.35 | →short touch→ | 2 0.35 | →short touch→ | ESC |

Screen 1: – Measurement module SW version

Screen 2: – Functional module SW version

Software Check sum:

A **checksum** is a small-sized datum derived from a block of digital data for the purpose of detecting errors that may have been introduced during its transmission or storage.

| crc 5 | long touch → | 1 9465 | short touch → | 2 36Ed | short touch → | ESC |

Screen 1: – Measurement module Check-sum

Screen 2: – Functional module Check-sum

Parameters Check sum:

| crc d | long touch → | 1 3211 | short touch → | 2 CdC1 | short touch → | 3 A615 | short touch → | ESC |

Screen 1: – MID setting data Check-sum

Screen 2: – Setting data Check-sum

Screen 3: – Calibration data Check sum

Error description:

A **cyclic redundancy check** (**CRC**) is an error-detecting code commonly used in digital networks and storage devices to detect accidental changes to raw data.

| Err crc | long touch → | Err 5 0 | short touch → | Err d 3 | short touch → | ESC |
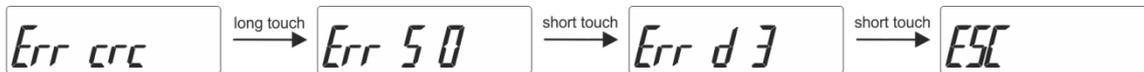
Screen 1 - Err s: – shows Firmware CRC details – decimal value (0…3) of Bit 6 and 7

Screen 2 - Err d: – shows Parameter CRC details – decimal value (0…7) of Bit 8, 9 and 10

Description of Check Sum Status register bits:

Code	Value	Description
30400	0	No Error (OK)
	Bit 0	Error Parameter CRC
	Bit 1	Error Firmware CRC
	Bit 2	Error MID-lock
	Bit 6	Error Measurement module Check Sum
	Bit 7	Error Functional Software Check Sum
	Bit 8	Error Calibration Data Check Sum
	Bit 9	Error MID Setting Data Check Sum
	Bit 10	Error Setting Data Check Sum

Table 6: Check Sum Status register bits.

MID relevant counters:

| mid cnt | long touch → | L 0 | short touch → | UP 3 | short touch → | ESC |

Screen 1 – MID unlock counter

Screen 2 – FW upgrade counter (measuring mode)

Digits check menu:

All segments are displayed in this window, which can be used to check the correct operation of the display.

| dIG | long touch → | 8888888 kWArh | short touch → | ESC |

Backup code menu

Backup code is intended for acquiring a backup password, if password at level 2 has been forgotten. More information on chapter 4.4.1.1.1.
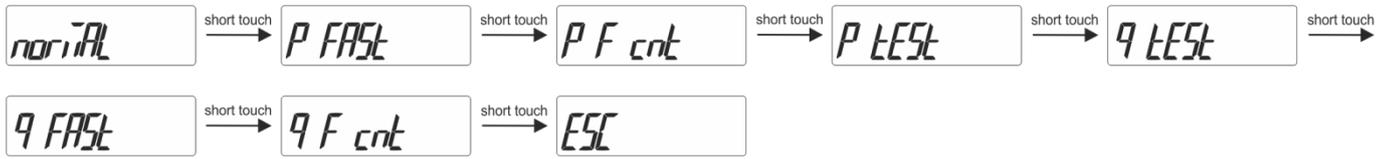
| bACKCod | long touch → | 5235498 | short touch → | ESC |

3.2.3.3 Set menu

When in set menu, short touches move user through it, allowing her/him to select a dedicated menu.

3.2.3.3.1 Set sub-menus

Led test mode (Led tSt):

This function shall be used only for testing purposes during type testing and metrological verification of the meters.

Test modes:

Normal – 1000 imp/kWh, counter resolution 100 Wh/100 varh

P fast (Test mode P Fast) – 100000 imp/kWh, counter resolution 1 Wh/1 varh

P F cnt (Test mode P Fast – counter only) – 1000 imp/kWh, counter resolution 1 Wh/1 varh

P test (Test mode P) – 1000 imp/kWh, counter resolution 100 Wh/100 varh

Q test (Test mode Q)– 1000 imp/kvarh, counter resolution 100 Wh/100 varh

Q fast (Test mode Q fast) – 100000 imp/kvarh, counter resolution 1 Wh/1 varh

Q F cnt (Test mode Q fast - counter only) – 1000 imp/kvarh, counter resolution 1 Wh/1 varh

Password mode (when in PASS menu, short touches move user through it):

If you stop using short touches on a certain screen, further menus start cycling automatically:

Unlock – shows the accessible level. With long touch password can be entered and the acces is unlocked.

Lock – shows the accessible level. With long touch the acces is locked. In case no manual locking is done, the acces is locked automatically 5 minutes after last touch.

With long touch one can enter the menu for setting Password Level 1.

With long touch one can enter the menu for setting Password Level 2.

Screen for entering the password for unlocking or setting the password:

When the character is blinking, one can scroll through different characters using short touches:

The character can be confirmed by using the long touch. These characters are used (from A to Z):

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	b	C	d	E	F	G	h	I	J	h	L	ii	N	O	P	q	r	S	t	U	u	"	H	y	Z

Communication menu: (when in COMM menu, short touches move user through it):

Communication menu is available at M-bus and RS485 option (IE14MM and IE14MD) and can be used for setting communication parameters (communication addresses, baud rate, parity and stop bits)

M-bus setting menu:

| PriiAdr | → short touch | SEcAdr | → short touch | bAud | → short touch | ESC |

If one stops using short touches on a certain screen, the screen with the parameter value is shown and it starts cycling automatically. With a long touch you can enter the setting mode:

Primary address:

| PriiAdr | ⟶ | 000 |

Secondary address:

When the character is blinking, one can scroll through numbers using short touches. The number can be confirmed by using the long touch

| SEcAdr |

Two types of parameter values are scrolling automatically. Example:

| 1234567 | ⟶ | 2345678 |

Baud rate:

| bAud | ⟶ | 0000 |

RS485 (Modbus) setting menu:

| AdrESS | → short touch | bAud | → short touch | PArity | → short touch | StoP | → short touch | ESC |

If one stops using short touches on a certain screen, the screen with the parameter value is shown and it starts cycling automatically. With the long touch you can enter the setting mode.

Address:

When the character is blinking, one can scroll through numbers using short touches. The number can be confirmed by using the long touch.

Example:

| AdrESS | ⟶ | 357 |

Baud rate:

You can choose between different values: 2400, 4800, 9600, 19200, 38400, 57600, 115200.

Example:

| bAud | ⟶ | 2400 |

Parity:

You can choose between **even**, **odd,** and **none**.

Example:

| PArity | ⟶ | NonE |

Stop bits:

You can choose between values: 1, 2.

Example:

| StoP | ⟶ | 2 |

3.2.3.4   Reset menu

When in the reset menu, short touches move the user through it, allowing her/him to select a dedicated menu. With the long touch, all counters or a single counter can be chosen.

| rESEt | long touch → | ESC | short touch → | Cnt ALL | short touch → | Cnt C1 | short touch → | Cnt C2 | short touch → | Cnt C3 | short touch → |

| Cnt C4 | short touch → | Cnt C5 | short touch → | Cnt C6 | short touch → | Cnt C7 | short touch → | Cnt C8 |

Reset counter E05:
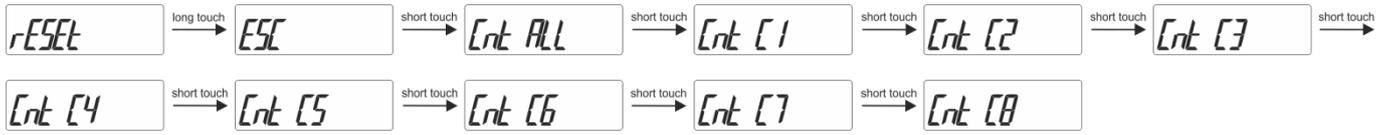
| rESEt | short touch → | Cnt C5 | long touch → | ESC | short touch → | rESEt | long touch → | Cnt C5 |

For final execution, additional confirmation of reset is necessary.

3.2.3.5   Error display

In case the meter detects an error in firmware or parameter check sum, the Error screen with the decimal value of the first three bits is displayed after each cycle of the displayed quantities. The details of the error are shown in the Info menu. In case of the error, the manufacturer should be consulted or the meter replaced.

| Error 1 |

3.3   Freeze counters

3.3.1   Meaning

Since IE14xx single phase energy meter does not support internaly synchronised real-time clock (RTC) for simultaneous capture of measurements, the freeze function is implemented. Use is enabled only when the meter is on.

Freeze function enables using IE14xx smart meters for billing or sub-billing purposes and to compare sub-metering data with main energy meter. Reading several hundred serially connected counters can last more than 10 minutes. That is why IE14xx supports command Freeze counters. Its purpose is to freeze data simultaneously on all devices in the network.

The freeze function operation is also performed in case of device power supply failure or device reset.

3.3.2   Set up

To perform the freeze function, the energy meters should be connected to the serial communication RS485 and belonging software which use Modbus registers.

The energy meter IE14xx enables several ways to activate the freeze function:

- Freeze status register,
- time to freeze register,
- auto freeze interval register.

3.3.3 Time to freeze register (41902)

The purpose of the time to freeze register is to freeze all energy meters simultaneously. Set the number of times to freeze register (41902), the value of appropriate time (in seconds) before the time of the freeze, and time of the freeze. After an expired time, the freeze command is executed automatically. Due to unreliability in communication, it is recommended that the desired time is sent more than ones, to ensure that freeze is simultaneous on all instruments. The desired time needs to be sent in the interval of one minute.

For example, if you want that freeze function is executed at 10 am, run the command seven times, starting 7 s before 10 am and repeat it with a one-second interval (see the picture below).

All instruments that received one of the commands will freeze at the same time. This is the advantage of the described register, so it is recommended to use it.

It is also possible to individually enter the appropriate time in register 41902 of each instrument.

3.3.4 Auto freeze interval register (41901)

The purpose of the auto freeze interval register is to freeze energy meters in the same time interval, for example, every day. Set a certain auto freeze interval (in minutes). The maximum allowed value is 65535 minutes. Periodic synchronization is activated automatically after the entered interval. If the interval is set to 0, the auto freeze interval function is turned off.

The disadvantage of this register is that the time is not appropriate if the meters reset or in case of another failure.

Status register of freeze (41905)

The purpose of the status register is to test the reliability of RS485 communication. Enter the broadcast command of different identification codes between 1 to FFFD in the freeze status register (41905). Repeatedly send a different identification code to the freeze status register (41905) in order to increase the reliability of receiving commands. The reliability of reading different numbers of identification code enables analysis of communication reliability. In the case of 100% reliability of communication, all instruments have the value of the first sent identification code, when reading the status register.

After the instrument receives the identification code, it ignores all entries in the status register in the interval of one minute. Send as many different identification codes in a short time interval. For example, send the different identification codes ten times within one second. Use numbers from 1 to FFFD (1 - 65533). For example, first, use value 1, then D, AAA, and at the end FFFD (see picture below). Please note that you never know if all the meters will freeze, so send as many commands as possible within one minute.
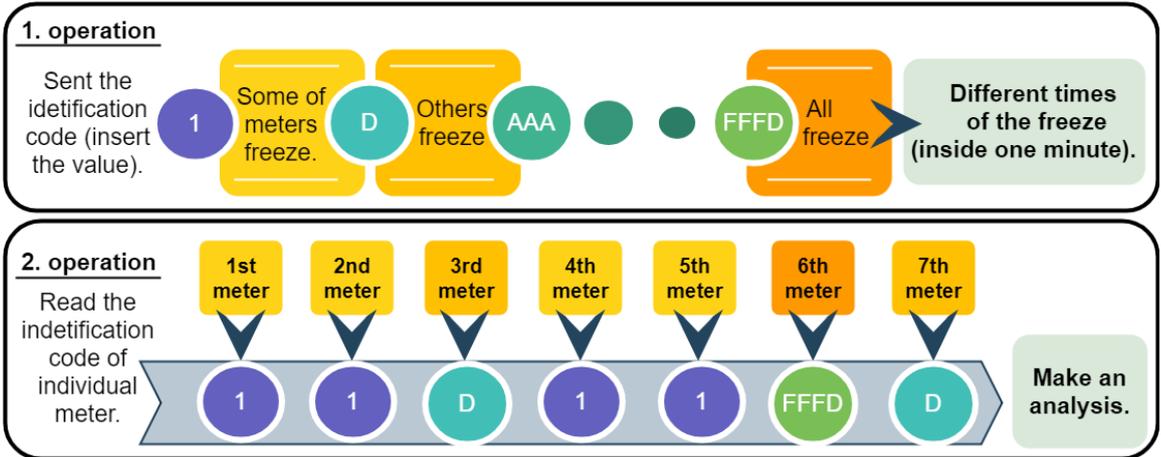
PLEASE NOTE

Please do not use the values 0000, FFFF, or FFFE. The 0000 is reserved to start the meter when connected to the power supply. The freeze function is performed. The FFFF is reserved to trigger the freezing function automatically (same as the time to freeze register 41902). The FFFE is reserved for the auto interval freeze.

Send the command for reading the register, so you can see which identification code has been accepted by the individual instrument. The server calculates time from a freeze of the device.

3.3.5 Access and interpretation of data

After the execution of the freeze command, the counters are stored into registers 41906 to 41930, which can be read by the master. Registers 41907 to 41930 display frozen energy counters (1 - 12). The data we read on all devices can this way be compared. Encoded information should be read with the Modbus table (see Appendix A).

In addition, the time since the last freeze can be checked with time from the freeze register (41903, 41904). The purpose of this register is to control if displayed measurements are relevant. The register contains the time (in seconds) from the last freeze counters' execution.

4 SETTINGS

A setting structure, which is similar to a file structure in an explorer is displayed in the left part of the MiQen setting window. Available settings of that segment are displayed in the right part by clicking any of the stated parameters.

In this chapter, you will find a detailed description of all IE14xx features and settings. The chapter is organized in a way to follow settings organisation as in setting software MiQen.

4.1 Introduction

Parameterization can be modified by serial communication (RS485 or Mbus) or by a special USB adapter (size 1 DIN module) and MiQen software version 2.0 or higher.

4.2 MiQen software

MiQen software is a tool for complete programming and monitoring of ISKRA measuring instruments, connected to a PC via serial communication or by a special IR-USB adapter (only for devices with IR communication). A user-friendly interface consists of five segments: devices' management (Connection), instrument settings (Settings), real-time measurements (Measurements), data analysis (Analysis), and software upgrading (Upgrades). These segments are easily accessed by means of five icons on the left side.
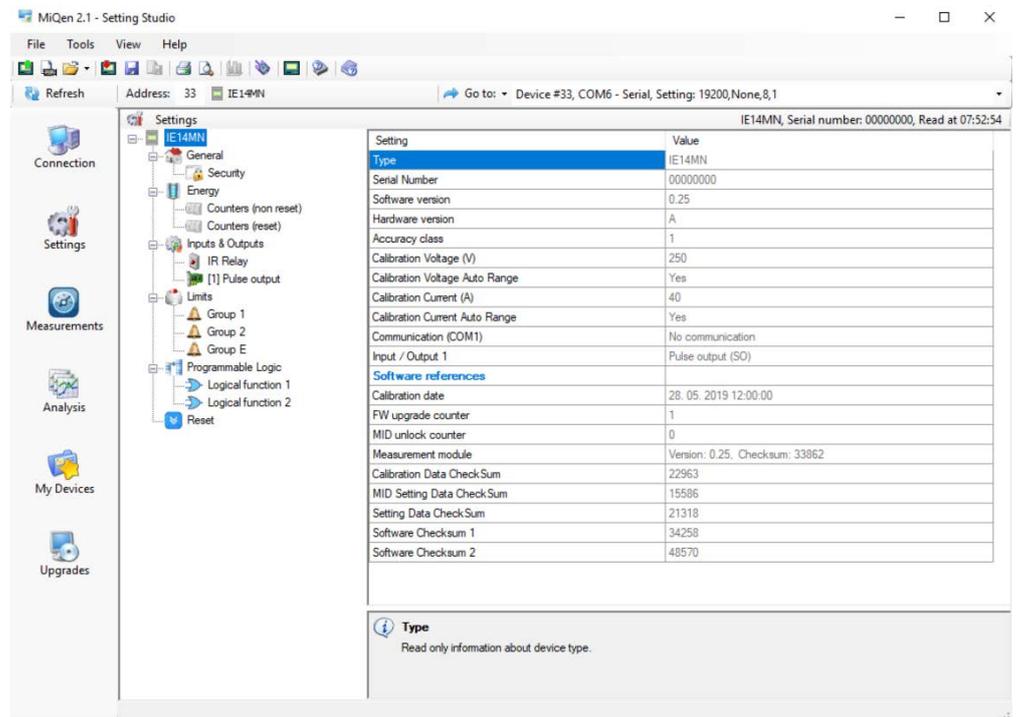
Figure 7: *MiQen programming and monitoring software*

MiQen version 2.1 or higher is required for programming and monitoring IE14xx. Software installation can be downloaded from https://www.iskra.eu/en/Iskra-Software/MiQen-Settings-Studio/

PLEASE NOTE

MiQen has very intuitive help system. All functions and settings are described in Info window on the bottom of MiQen window.

4.3 Devices management
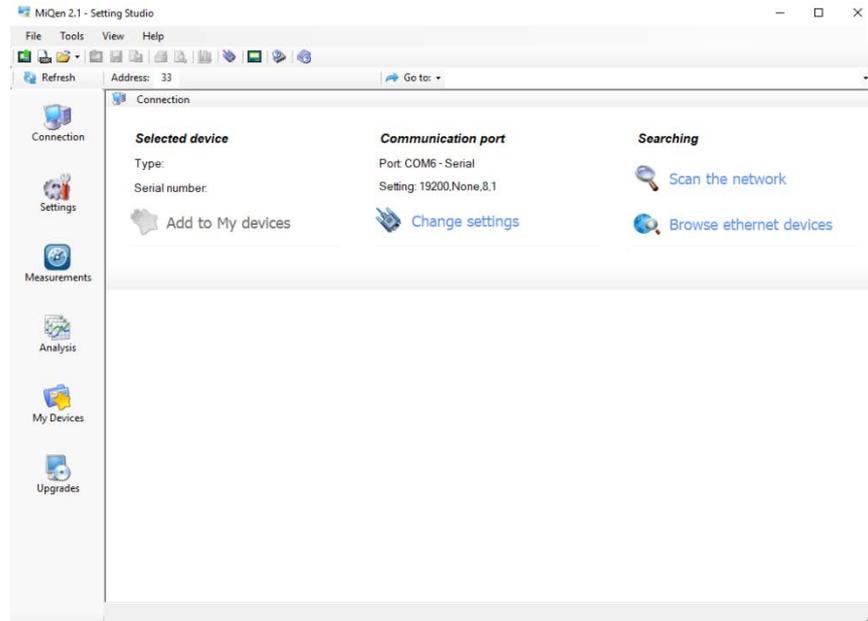
Figure 8: MiQen Device Management window

Use Scan the network explorer to set and explore the network of the device. Communication parameters of all devices and their addresses in a network can be easily set. Selected devices can be added to the list of My devices.

Set Communication port parameters

Under *Communication port,* current communication parameters are displayed. To change those parameters click on *Change settings* button. A Communication port window opens with different communication interfaces.
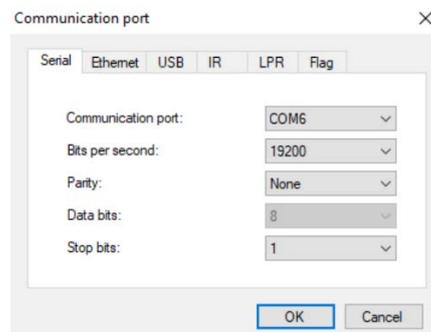
Figure 9: Communication port window

IE14xx supports only serial communication, so only serial communication parameters can be set.

Set device Modbus address number

Each device connected to a network has its unique Modbus address number. In order to communicate with that device an appropriate address number should be set.
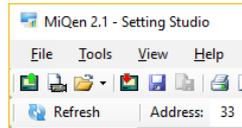
Figure 10: Address number

The factory default the Modbus address for all devices is 33. Therefore it is required to change Modbus address number of devices if they are connected in the network so each device will have its unique address number.

Start communicating with a device

Click on the REFRESH button and devices information will be displayed.

When devices are connected to a network and a certain device is required it is possible to browse a network for devices. For this purpose choose **Scan the network**.

Figure 11: Scan the network button.

4.4 Device settings

Multi Register Edit technology assures a simple modification of settings that are organized in a tree structure. Besides transferring settings into the instrument, storing and reading from the setting files is also available.

4.4.1 General settings

General settings set LCD properties and Security settings (passwords).

Description and location segment is intended for easier recognition of a certain unit. They are specially used for identification of the device or location on which measurements are performed.

Figure 12: Description window

Average interval for measurements (sec): the averaging interval defines a refresh rate of measurements on display or communication. It is also used for actual alarm value calculation for alarm triggering.

Setting	Value
Description	
Location	
Average interval for measurements (sec)	1
Display	
Mode	Cycling
Cycling period (sec)	5
Displayed measurements - Counters	n.E1, n.E2, n.E3, n.E4, E1, E2, E3, E4, E5, E6, E7, E8
Displayed measurements - Others	P, Q, S, U, I, f, AT, PF, PA, THD-U, THD-I
Back light intensity	10
Saving mode (min)	Disabled

Figure 13: Average interval for measurements window

Mode defines whether displayed values automatically cycle between different measurands or display only one measurement. Hold page function – in more detail, chapter 0.

Setting	Value
Description	
Location	
Average interval for measurements (sec)	1
Display	
Mode	Cycling ∨
Cycling period (sec)	Cycling
Displayed measurements - Counters	Counter n1
	Hold page
Displayed measurements - Others	P, Q, S, U, I, f, AT, PF, PA, THD-U, THD-I
Back light intensity	10
Saving mode (min)	Disabled

Figure 14: Mode window

Cycling period (sec) sets the period of cycling, valid values from 5 s to 60 s .

Setting	Value
Description	
Location	
Average interval for measurements (sec)	1
Display	
Mode	Cycling
Cycling period (sec)	5
Displayed measurements - Counters	n.E1, n.E2, n.E3, n.E4, E1, E2, E3, E4, E5, E6, E7, E8
Displayed measurements - Others	P, Q, S, U, I, f, AT, PF, PA, THD-U, THD-I
Back light intensity	10
Saving mode (min)	Disabled

Figure 15: Cycling period window

Displayed measurements – Counters: sets the counters displayed at the display. A user can select them on the drop-down menu (low-cost version (IE14-S) only shows counter 1):

Figure 16: Set of displayed measurements

Displayed measurements – Others: sets the measurements at the startup display.
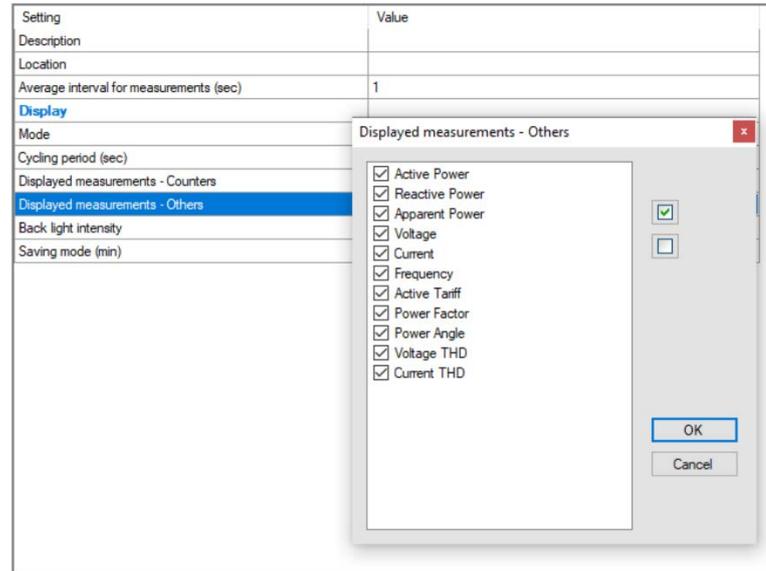
Figure 17: Displayed measurements window

Backlight intensity: defines the visibility and legibility of a display. Display settings shall be defined in compliance with the conditions in which they will be monitored. Economizing mode switches off backlight according to the set time of inactivity.
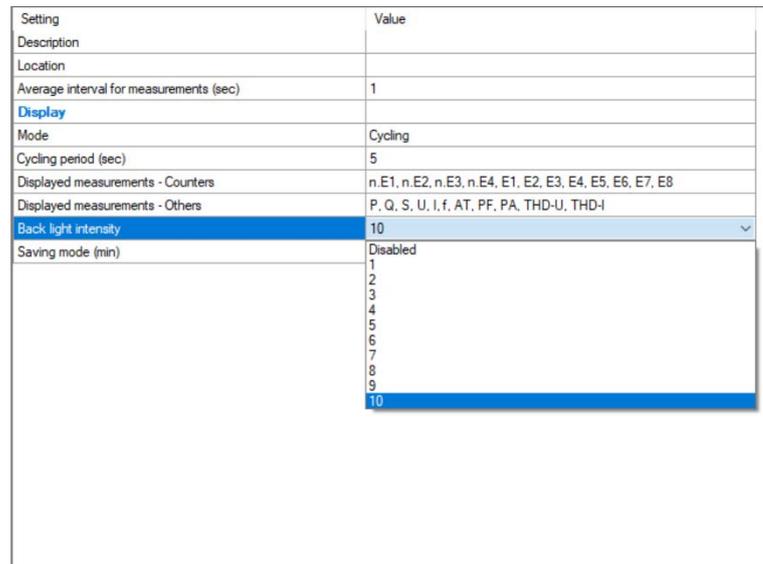
Figure 18: Backlight intensity window

Saving mode (min): defines the time in minutes for the instrument to get into energy-saving mode (backlight off). Enter value 0 if you don't want to use energy-saving mode.

Setting	Value
Description	
Location	
Average interval for measurements (sec)	1
Display	
Mode	Cycling
Cycling period (sec)	5
Displayed measurements - Counters	n.E1, n.E2, n.E3, n.E4, E1, E2, E3, E4, E5, E6, E7, E8
Displayed measurements - Others	P, Q, S, U, I, f, AT, PF, PA, THD-U, THD-I
Back light intensity	10
Saving mode (min)	Disabled
	Disabled
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12
	13
	14
	15
	16
	17
	18
	19
	20

Figure 19: Saving mode window

4.4.1.1 Security

A password consists of four letters taken from the British alphabet from A to Z. When setting a password, only the letter being set is visible while the others are covered with •.

Settings parameters are divided into single groups regarding security level: PL1 >password level 1, PL2 >password level 2 and BP >a backup password.

PLEASE NOTE

A serial number of device is stated on the label and is also accessible with MiQen software. It can be found on the LCD under info sub-menu as well.

4.4.1.1.1 Password levels

Password-Level 1 >PL1

Password for first level is required. It can be used only if Password – Level 2 is also applied.

Available settings that require password level 1:

General	Reset
Date and Time	Reset energy counters
Auto Summer/Winter time	Reset limit control IR relay

Table 7: Password Level 1 parameters.

Password-Level 2 >PL2

Password for second level is required. Available settings that require password level 2:

General	Communication	Display	Security
Description	Primary address	Backlight intensity	Password Level 1
Location	Secondary address	Saving mode	Password Level 2
Average interval for measurements	Baud rate	Mode	
	Communication parameters	Cycling period	
		Displayed measurement-counters	
		Counter description mode	
Energy	**IR Relay**	**Limits**	**Logical function 1**
Counters (Reset)	Operating mode	Group 1	Gate 1
	Enabled groups	Group 2	Gate 2
	Output signal	Group E	Gate 3
Logical function 2			
Gate 1			
Gate 2			
Gate 3			

Table 8: Password Level 2 parameters.

Password-Level 0>PL0

Password for level 0 is only used for reading settings.

Backup Password->BP

A backup password >BP is used if passwords at level 2 >PL2 has been forgotten, and it is different for each device. For meters without communication (IE14-S), the backup password code (which you can access in the backup code menu; 3.2.3.2.1) is enough. For other meters, there is a serial number that has to be stated to the user support department in Iskra d.o.o. (https://www.iskra.eu/). The personnel reports back the backup password for your device.

4.4.1.1.2   Generating passwords
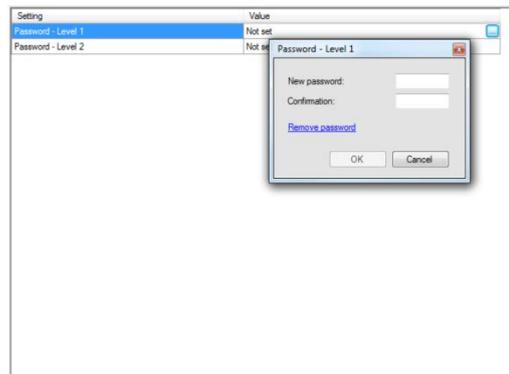
Enter L1 password. Example: BBBB

Figure 20: *Password Level 1 window*
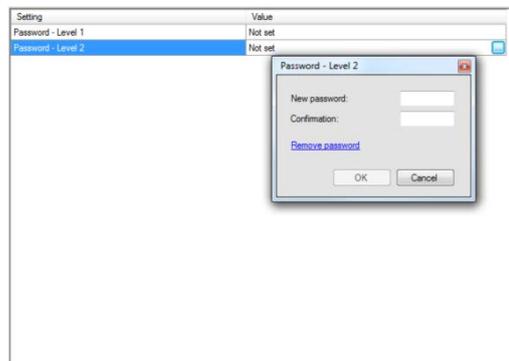
Enter L2 password. Example: CCCC

Figure 21: *Password Level 2 window*
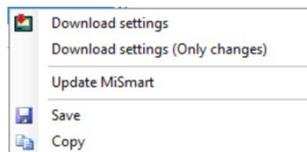
Right click on the mouse and execute "Download settings".

Figure 22: *Download settings window*

After the execution, the passwords are entered.

PLEASE NOTE

L1 password can only be used if L2 is also entered, because of its higher priority.

4.4.1.1.3 Operation test for passwords (example for L1)

Go to the "Reset window". Choose the option "Reset energy counters".
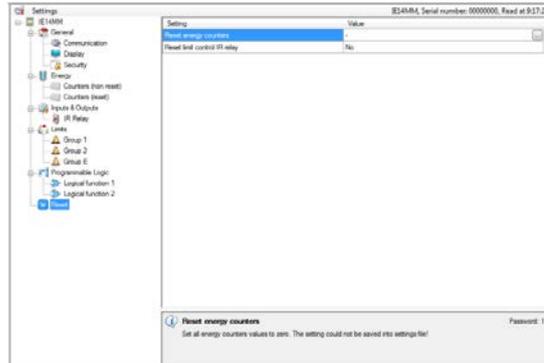
Figure 23: *Reset window*

Mark the counter you want to reset.
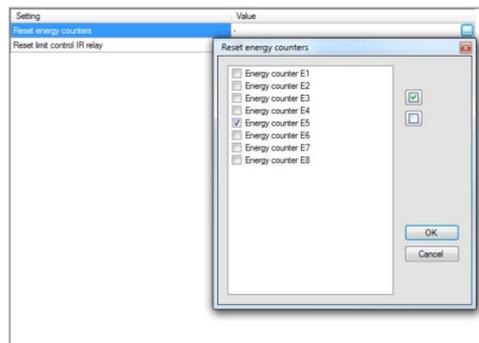
Figure 24: *Reset energy counters window*

Click "OK". Right click on the mouse and execute "Download settings".
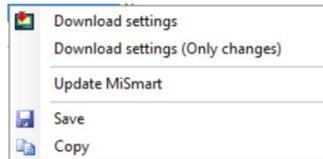
Figure 25: *Download settings window*

Then L1 password is required.

Figure 26: *Password entry window*

After the password entry, the meter resets. The state is maintained even if the meter is disconnected from the power supply.

4.4.1.1.4   Wrong password entry

In the case of a wrong L1 or L2 password entry, a note appears stating that the password is incorrect.

Figure 27: *Wrong password entry window*

Another entry can be carried out after 5 s. if you enter the L2 password in this field where the L1 password is required, the action will run without disruption. That is because the L2 password is stronger and is the condition for L1 password execution at the same time (User/Admin relation).

4.4.1.1.5   Removing or changing password

In the case of a changing or removing L1 password, MiQen demands the L2 password. With the L2 password entry, L1 changes or is removed. L2 password remains and is active for the settings change, when it is demanded. The changes that demand L1 or L0 passwords are executed without a password request. The user with an assigned L1 password is prevented from changing the password without knowing (L2)-Admin.

The procedure of removing both passwords is:

Choose "Settings window" and Security section.
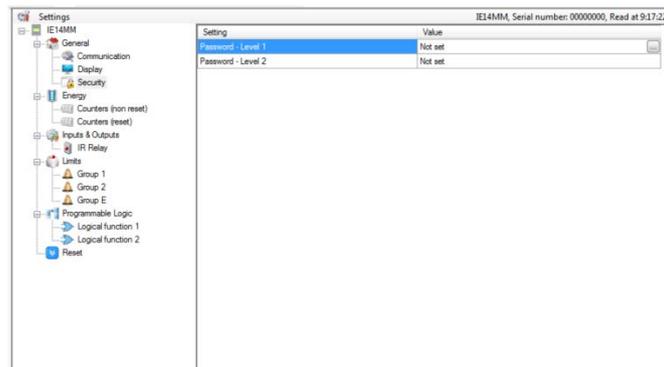
Figure 28: *Security window*

Under L2 password chose the "Remove password option".

Figure 29: *New password window*

And go to "Download settings".

Figure 30: *Download window*
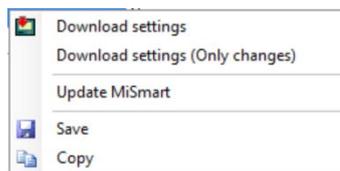
Then type the CCCC password (for example).

***Figure 31:** Password 2 entry window*

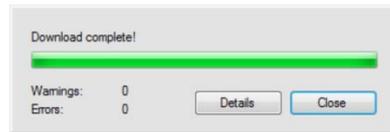L2 password is removed, and L1 also after that.

***Figure 32:** Download complete window*

Both password positions are now set to not set.

PLEASE NOTE

A factory set password is "AAAA" at both access levels >PL1 and PL2. This password does not limit access.

4.4.2 Energy

Active Tariff setting is not applicable as no tariff input is available at IE14xx meter. For meters with RS485 communication the resettable non-MID counters C1 to C8 can be parametrised for tariffs T1 to T4 and the tariff can be changed by writing the tariff value to the MODBUS register 40030 using system software (not supported in MiQen software). The value can not be stored, so after power down the meter restarts in the default tariff T1. Test output LED can be set in test modes for type testing and verification purposes. Test mode setting cannot be saved and after power down the meter is always started in normal operation mode. Test mode description: see item *3.2.3.3.1*. Pulse output constant, pulse length and measured energy cannot be permanently changed at MID approved meters.
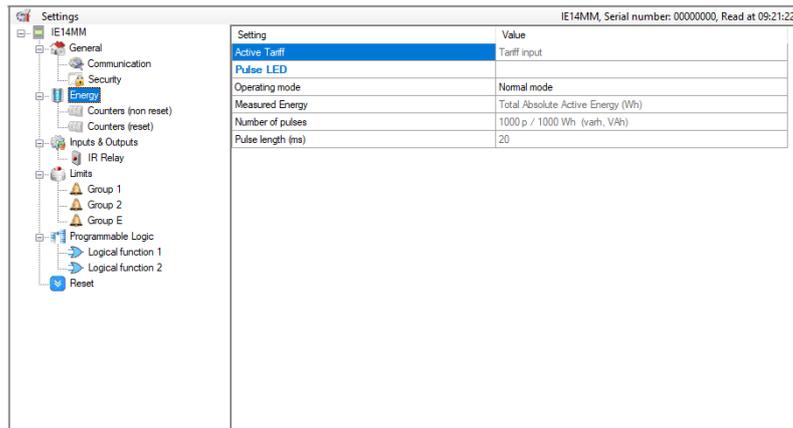

Figure 33: Energy window

4.4.2.1 Counters

The meter has four unresettable counters for which MID approval is valid. The setting of these counters is fixed in the production and the setting parameters can not be modified during use and the counters can not be reset. Additionally the meter has 8 counters which are user-configurable. Users can set Active, Reactive, Apparent Energy, energy flow direction, and tariff. In the Custom setting, there are additional options for measurement in individual quadrants and setting for absolute and inverse counting.
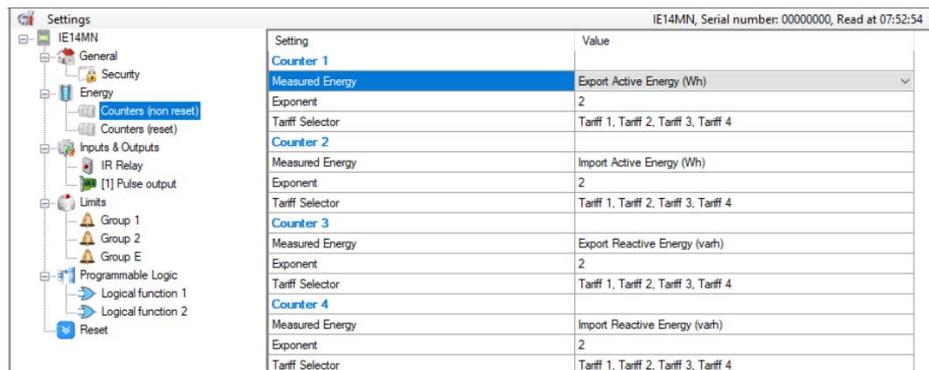

Figure 34: MiQen energy counters

WARNING!

In the case of a modification of energy parameters during operation, the values of energy counters must be recorded to avoid wrong interpretation of readings.

The resetting counters' function is applicable only for eight resettable counters. MID approval applies only to four non-resettable counters, which can not be reset.
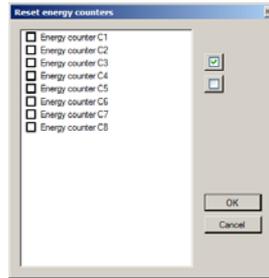

Figure 35: MiQen reset counters

4.4.3 Inputs & outputs

I/O functionality is a powerful tool of IE14xx using various I/O modules. The device can be used not only for monitoring main electrical quantities but also for monitoring process quantities (temp., pressure, wind speed, etc.) and for various control purposes. IE14xx can be equipped with different I/O modules with different functionality.

4.4.3.1 IR relay

IR Relay module supports control of ISKRA bistable switch BICOMxxx-WM1 via IR port. IR Relay operating mode defines how IE14xx controls external bistable switch BICOM via propriety IR communication. Available modes are: Not connected, Manual, and Limit control. The Preset is Not connected. Manual mode enables control of BICOM via RS485 communication. Limit Control enables IE14xx internal set limits for switching BICOM. For a more precise description of Limits please see chapter 4.4.4.
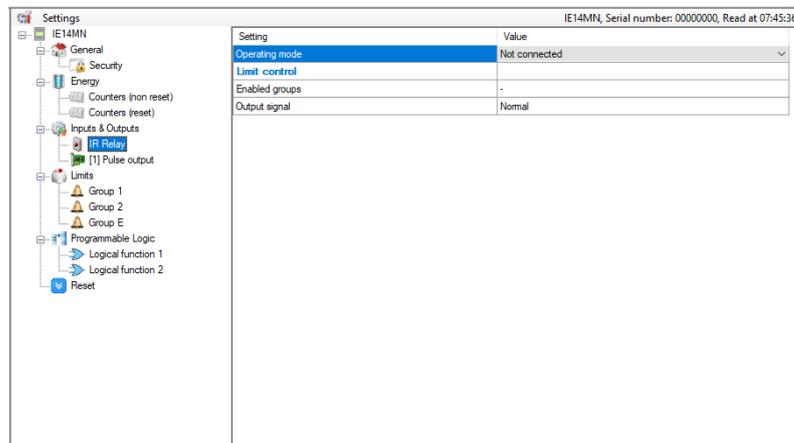

Figure 36: IR relay window

4.4.3.2 Pulse output

The pulse output is a solid-state, optocoupler, open collector switch. Its main purpose is pulse output for selected energy counter, but can also be used as an alarm or general-purpose digital output.

In the case of MID approved meter pulse output is fixed to absolute active energy with the fixed constant of 1000 imp/kWh.
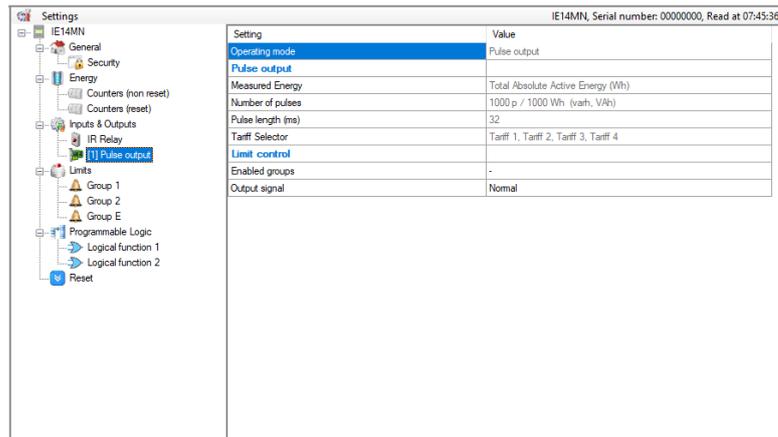
Figure 37: Pulse output window

4.4.4 Limits

IE14xx has a built-in limit function which can control the bistable relay using IR communication or optional S0 output. They are divided into 3 groups (1, 2, E), each having 4 limits. Each group of limits has some common settings applicable to all limits within this group.
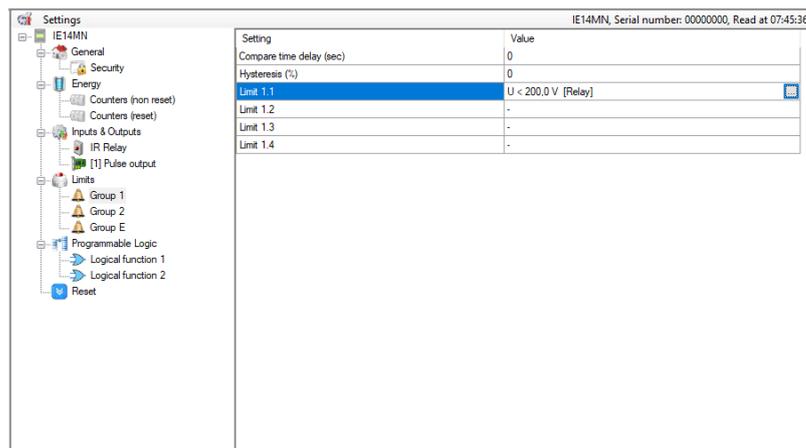

Figure 38: Limits window

Compare time delay (sec): This setting defines delay time (if required) between satisfying the alarm condition and alarm activation. If the alarm condition is shorter then this setting alarm will not be triggered. This setting is used to rule out sporadic and very short duration triggers.

Hysteresis (%): This setting defines alarm deactivation hysteresis. When monitored quantity is close to a set limit line its slight variation can trigger numerous alarms. Hysteresis should be set according to the estimated variation of monitored quantity.

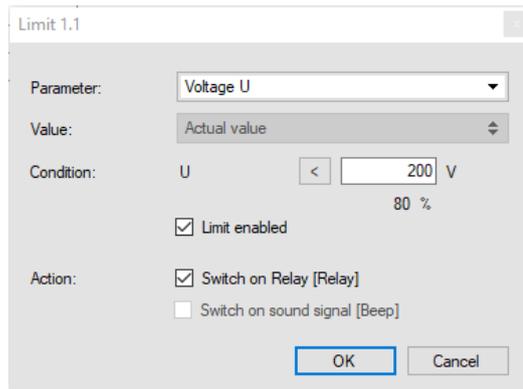**Individual limit settings:** For each individual alarm different settings are possible.

***Figure 39:** Limit settings window*
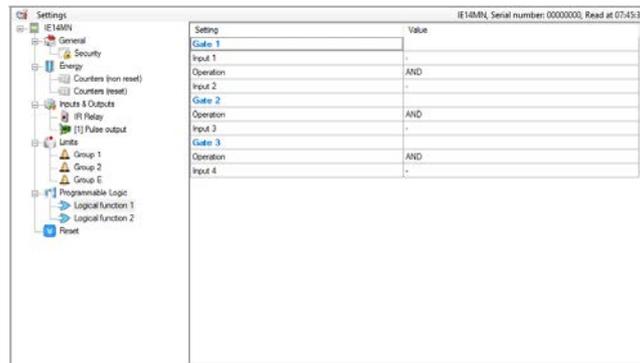
4.4.5 Programmable logic

***Figure 40:** Programmable logic window*

4.4.5.1 Logical function 1 & Logical function 2

Basic logical functions are: AND, OR, XOR, NOT, NAND, NOR and XNOR. IE14xx supports AND/OR logical functions.
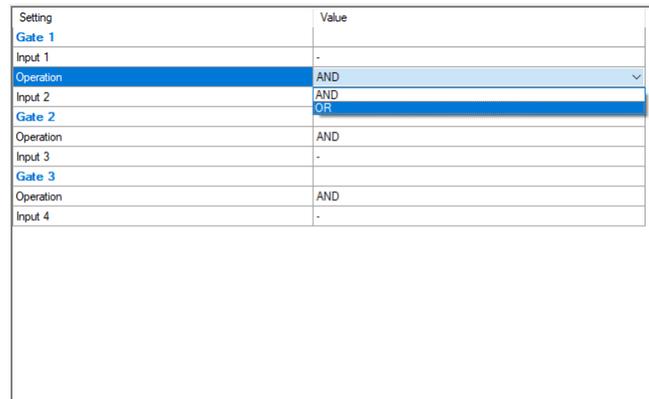

***Figure 41:** Logical function window*

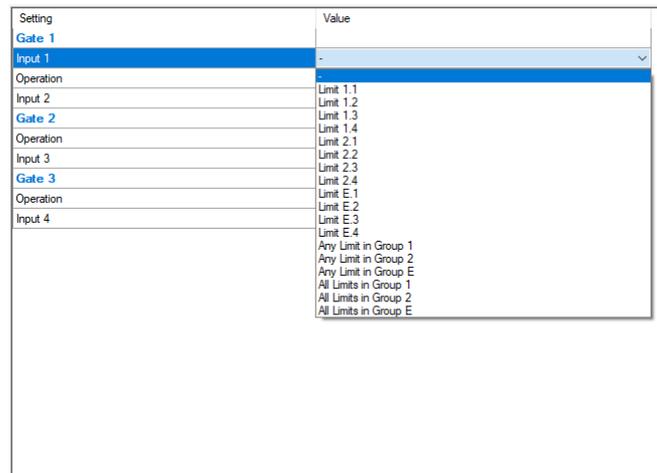Logical function - Select logical function over existing logical inputs:

Figure 42: *Logical function selection window*

4.5 Real-time measurements

Measurements can be seen ONLINE when the device is connected to aux. power supply and is communicating with MiQen. When the device is not connected it is possible to see OFFLINE measurement simulation. The latter is useful for presentations and visualisation of measurements without the presence of actual device.

In ONLINE mode all supported measurements and alarms can be seen in real time in a tabular form.

All data can be exported to an Access database, Excel worksheets or as a text file.
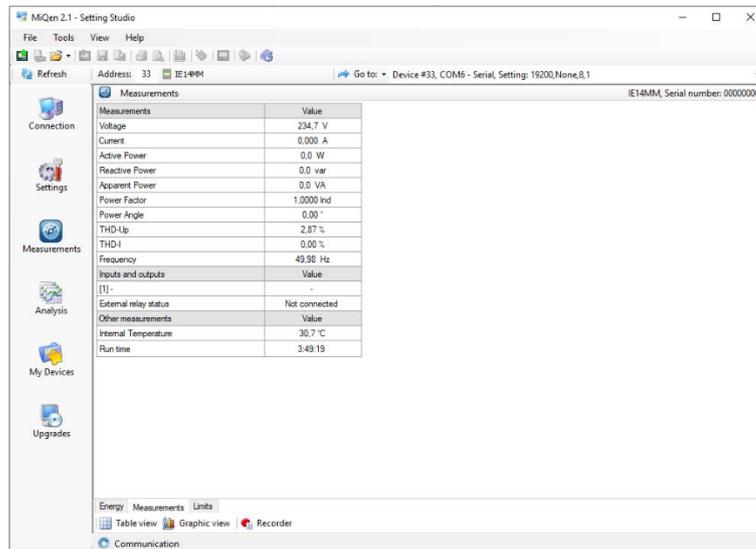
Figure 43: *Measurements in tabular form*

Figure 44: Energy in tabular form

MiQen shows Check Sum Status in the scope of Energy measurement display as a binary value of Check Sum Status register 30400. For more information, see chapter *3.2.3.2.1.*

Figure 45: Limits in tabular form
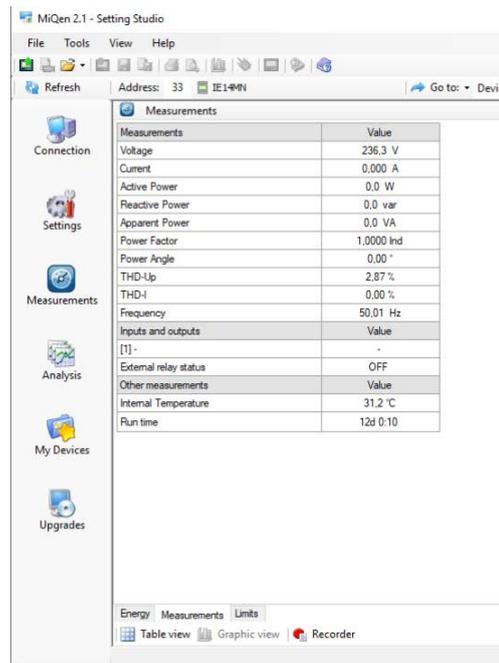
Figure 46: *Measurements in tabular form*

For further processing of the results of measurements, it is possible to set a recorder (Recorder button) on an active device that will record and save selected measurements to MS Excel .csv file format.
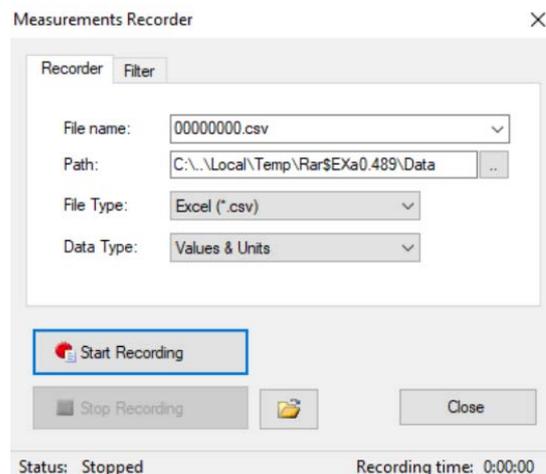
Figure 47: *Measurements Recorder*

RAM logger

Actual measurements in the Graphic view show a vector diagram and a graph of 96 average 15 minutes values of active power, which represents the values for one day. The values are taken from the set of 128 average active power values of the RAM logger. It is not stored in the non-volatile memory, so it is lost at power down.
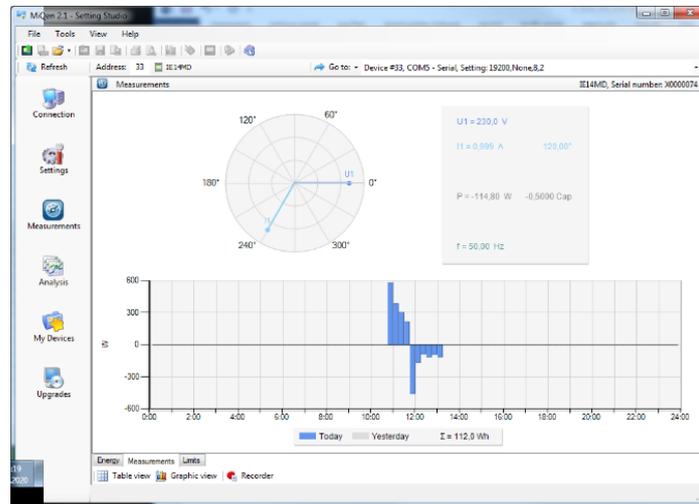
Figure 48: RAM logger window

4.6 Data analysis

PLEASE NOTE

The energy meter IE14xx does not support data analysis.

4.7 My devices

My devices section enables the personal selection of devices.

4.8 Software upgrading

The software in the meter is divided into two parts. The basic measuring part of the software is MID approved and it cannot be upgraded on the field during use. The other part of the software supports all other additional functions (communication, NFC, limits, and alarms, bistable switch support) and this part can be upgraded during use, using IR communication with a USB adapter or RS485 communication.

Always use the latest version of the software, both MiQen, and software in the device. The program automatically informs you about available upgrades (device firmware upgrades and MiQen software upgrades) that can be transferred from the web site and used for upgrading.

PLEASE NOTE

MiQen cannot be used for the execution of firmware upgrades of devices. It only informs that a new version is available and offers a link to download it from the server. Software for the execution of firmware upgrades is included in the downloaded zip file together with the upgrade file, upgrade procedure, description and revision history.

PLEASE NOTE

More information about MiQen software can be found in MiQen Help system!

To modify instrument settings with MiQen, current parameters must be loaded first. Instrument settings can be acquired via a communication link (serial or USB to IR adapter) or can be loaded off-line from a file on a local disk. Settings are displayed in the MiQen Setting Window - the left part displays a hierarchical tree structure of settings, the right part displays parameter values of the chosen setting group.

PLEASE NOTE

Supported settings and functions depend on the type of device.

4.9 NFC settings

NFC allows the reading of the energy registers and different meter parameters. On meters that are not MID certified (energy registers can be reset) the parameters of the resetable energy registres can also be changed. The advantage of NFC implemented functionality on Iskra d.o.o. electricity meters is that in the event of a power down, it remembers all the last measured values, which can be read via NFC.

NFC reading is possible with every type that has the following label:
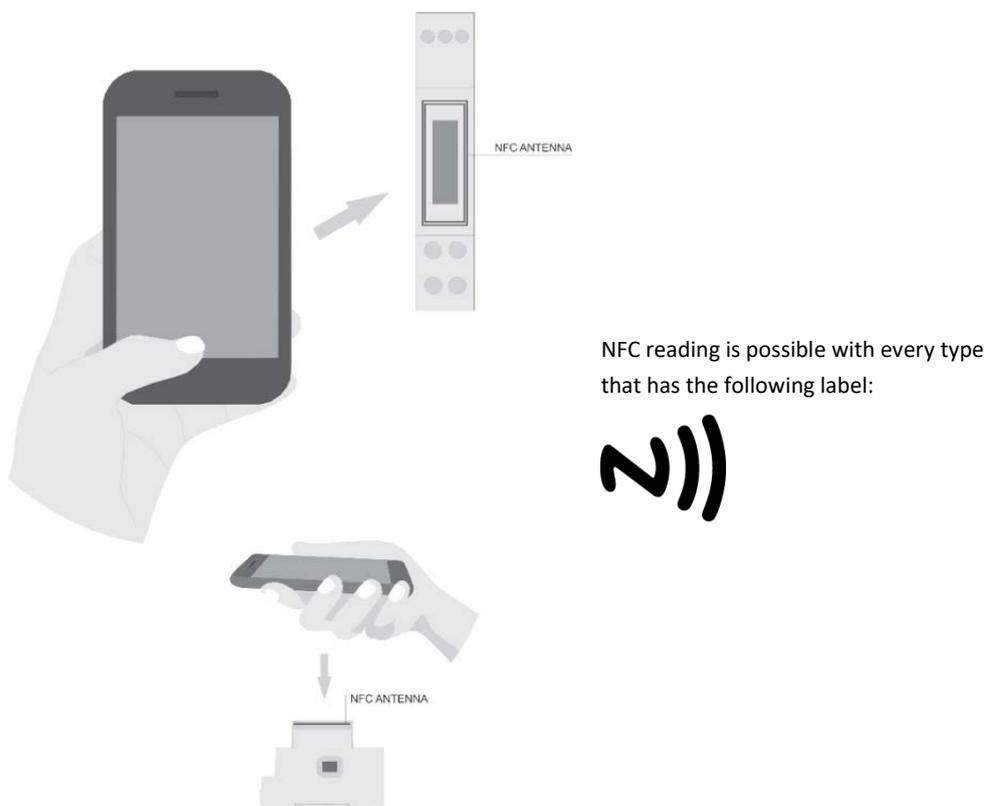
Figure 49: *Utilization of NFC*

PLEASE NOTE

Mobile application for NFC communication is not available at our company.

5 MEASUREMENTS

The IE14xx is a bidirectional energy meter that samples voltage and current. From that, it can calculate all measuring quantities. The IE14xx energy meter performs measurements with a sampling frequency equal to 3906.25 Hz.

5.1 Introduction

5.1.1 Online measurements

Online measurements are available on display or can be monitored with setting and monitoring software MiQen.

Readings on display are performed continuously with refresh time dependent on set average interval whereas the rate of readings monitored with MiQen is fixed and refreshed approximately every second.

Figure 50: *Online measurements in tabular form*

5.2 Selection of available quantities

Microprocessor calculates the TRMS voltage, TRMS current, active, reactive, and apparent power, power factor, power angle, first harmonic of voltage, first harmonic of current, THD of voltage, and THD of current. A complete selection of available online measuring quantities is shown in a table below.

Meas. type	Measurement	1-phase	comments
Phase measurements	*Voltage*		
	U_{1_RMS}	☑1ph	
	Current		
	I_{1_RMS}	☑1ph	
	Power		
	P_1	☑1ph	
	Q_1	☑1ph 📖	*reactive power is calculated with 90° delayed samples*
	S_1	☑1ph	
	PF_1	☑1ph	
	φ_1	☑1ph	*PA – Power angle*
	Harmonic analysis		
	$THD\text{-}U_1$	☑1ph	*%*
	$THD\text{-}I_1$	☑1ph	*%*
Metering	Energy	☑	
	Counter $E_{1\text{-}8}$	☑	*Each counter can be dedicated to any of four quadrants (P-Q, import-export, L-C).*
	$E_{TOT\_1\text{-}8}$	☑	

Other measurements	Miscellaneous		
	Frequency		
Status	Checksum status		
	External relay status		
	Limit control status		

📖 Further description is available in following subchapters

Table 9: *Selection of available measurement quantities*

5.3 Calculation and display of measurements

This chapter deals with capture, calculation, and display of all supported measurement quantities. For more information about display presentation see chapter 3.2. Only the most important equations are described; however, all of them are shown in chapter APPENDIX C: EQUATIONS with additional descriptions and explanations.

5.3.1 Voltage

Voltage related measurements are listed below:

$$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}}.$$

All voltage measurements are available through communication as well as on LCD displays.

Figure 51: *Voltage display*

5.3.2 Current

Real effective (true RMS) value of current.

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}.$$

All current measurements are available on communication as well as LCD display.

5.3.3 Active, reactive and apparent power

Active power is calculated from instantaneous phase voltages and currents. All measurements are seen on communication or are displayed on LCD. For more detailed information about calculation see chapter APPENDIX C: EQUATIONS*.*

Figure 52: *Active power*

Figure 53: *Reactive power*

Figure 54: *Apparent power*

5.3.4 Power factor and power angle

The power factor is calculated as the quotient of active and apparent power. The power angle is the angle between the active and reactive power.

5.3.5 Frequency

Network frequency is calculated from periods of the measured voltage. The instrument uses a synchronization method, which is highly immune to harmonic disturbances.

5.3.6 Energy counters

Energy counters are displaying by individual counter.

5.3.7 Harmonic distortion

IE14xx energy meter calculates THD for current and voltage and is expressed as a percent of high harmonic components regarding fundamental harmonic.

6 TECHNICAL DATA

In following chapter all technical data regarding operation of a single-phase electrical energy meter is presented.

6.1 Accuracy

Measured values	Accuracy class
Active energy:	class 1 EN 62053-21
	class B EN 50470-3
	$\pm1.5\%$ from I_{min} to I_{tr}
	$\pm1\%$ from I_{tr} to I_{max}
Reactive energy:	class 2 EN 62053-23
	$\pm2.5\%$ from I_{min} to I_{tr}
	$\pm2\%$ from I_{tr} to I_{max}
Voltage:	$\pm1\%$ of measured value
Current:	$\pm1\%$ of I_{ref} from I_{st} to I_{ref}
	$\pm1\%$ of measured value from I_{ref} to I_{max}
Active Power:	$\pm1\%$ of nominal power ($U_n * I_{ref}$) from I_{st} to I_{ref}
	$\pm1\%$ of measured value from I_{ref} to I_{max}
Reactive, Apparent power:	$\pm2\%$ of nominal power from I_{st} to I_{ref}
	$\pm2\%$ of measured value from I_{ref} to I_{max}
Frequency:	$\pm0.1\%$ of measured value

6.2 Mechanical characteristics of input

Rail mounting according DIN EN 60715. In case of using the stranded wire, the ferrule must be attached before the mounting. Ferrule contact length should be 12 mm.

Terminals		Max. conductor cross-sections
Main inputs	Contacts capacity flexible (rigit):	$1.5\ mm^2\ ...\ 10\ mm^2$
		*Ferrule contact length should be 12 mm. Wire stripped to 14 mm.
	Connection screws:	M3.5
	Recommended/Max torque:	0.8/0.9 Nm (PH1)
	Length of removed isolation:	10 mm
Optional modules	Contacts capacity:	$0.25\ mm^2...1\ (2.5)\ mm^2$
	Connection screws:	M3
	Recommended/Max torque:	0.5/0.6 Nm (PZ2)
	Length or removed isolation:	8 mm

6.3 Electrical characteristics of input

Inputs and outputs		
Measuring input	Type (connection):	single-phase (1b)
	Reference current (I_{ref})	5 A
	Maximum current (I_{max}):	40 A
	Minimum current (I_{min}):	0.25 A
	Transitional current (I_{tr}):	0.5 A
	Starting current (I_{st}):	20 mA
	Power consumption at I_{ref}	< 0.1 VA
	Nominal voltage (U_n):	230 V (-20 - +15)%
	Power consumption at U_n:	10 VA
	Nominal frequency (f_n):	50 Hz and 60 Hz
	Minimum measuring time:	10 s
	Maximum peak current	1200 A/10 ms
	Power consumption	0,5 W

Pulse output (option)	Type:	Optocoupler open collector switch	
	Pulse rate:	1000 imp/kWh (test mode only)	
	Pulse duration:	32 ms ± 2 ms	
	Rated voltage DC:	27 V max	
	Switched current	27 mA max	
	Standard:	EN 62053-31 (A&B)	
M-Bus Serial communication (option)	Type:	M-Bus	
	Speed:	300 bit/s to 9600 bit/s	
	Protocol:	M-Bus	
	Primary address:	0 – (default)	
RS485 Serial communication (option)	Type:	RS485	
	Speed:	1200 bit/s to 115200 bit/s	
	Frame:	8, N, 2	
	Protocol:	MODBUS RTU	
	Address:	33 – (default)	
Optical communication (option)	Type:	IR	
	Connection:	via USB adapter	
	Speed:	19200 bit/s	
	Frame:	8, N, 2	
	Protocol:	MODBUS RTU	
	Address:	33	
NFC (option)	Protocol:	ISO/IEC 14443 Part 2 and 3 compliant	
	Frequency range:	13.56 Mhz	
	Baudrate:	106 kbps	
	Operating distance:	up to 15 mm from LCD (depending on the used reader)	

6.4 Safety and ambient conditions

According to standards for indoor active energy meters.

Temperature and climatic condition according to EN 62052-11.

Dust/water protection:	*IP50 (For IP51 it should be installed in appropriate cabinet.)*
Touch by fingers protection	*IP20*
Operating temperature:	*-25 °C - +55 °C /70 °C (only for IE14MD)*
Storage temperature:	*-30 °C...+ 70 °C*
Enclosure:	*self extinguish, complying UL94-V*
Indoor meter:	*Yes*
Degree of pollution:	*2*
Protection class:	*II*
Installation category	*300 Vrms cat.III*
Standard:	*IEC 62052-31*
Mechanical environment:	*M1*
Electromagnetic environment:	*E2*
Humidity:	*non condensing*
Weight (with packaging):	*150 g (170 g)*
Installation:	*DIN Rail 35 mm*
Dimensions (W x H x D):	*17,5 mm x 90,7 mm x 68,2 mm*
Package dimensions (W x H x D):	*37 mm x 91 mm x 78 mm*
Colour:	*RAL 7035*
Security seals:	*must be from plastic material*

6.5 EU Directives Conformity

EU Directive on Measuring Instruments **2014/32/EU**

EU Directive on EMC **2014/30/EU**

EU Directive on Low Voltage **2014/35/EU**

EC Directive WEEE **2002/96/EC**

EU Directive RED **2014/53/EU**

6.6 Dimensions

6.6.1 Dimensional drawing

Construction	Appearance
Dimensions	All dimensions are in mm
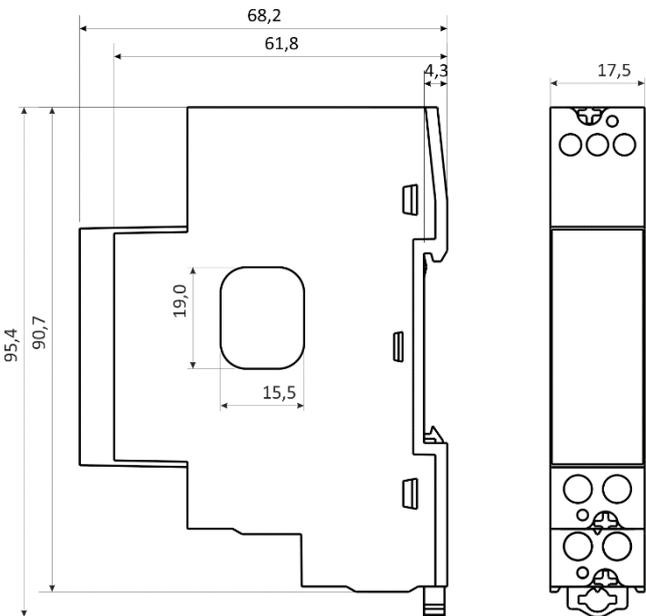
7 ABBREVIATION/GLOSSARY

Abbreviations are explained within the text where they appear the first time. Most common abbreviations and expressions are explained in the following table:

Term	Explanation
MODBUS / DNP3	Industrial protocol for data transmission
MiQen	Setting Software for ISKRA instruments
PI	Pulse input module
AC	Alternating current
IR	Infrared (optical) communication
RMS	Root Mean Square
PO	Pulse output
PA	Power angle (between current and voltage)
PF	Power factor
THD	Total harmonic distortion
NC	Not connected
SC	Shield

List of common abbreviations and expressions

8 APPENDICES

PLEASE NOTE

This chapter is a subject of change.

8.1 Advanced Encryption Standard

8.2 APPENDIX A: MODBUS communication protocol

Modbus protocol enables operation of device on Modbus networks. For IE14(M)\IE14x(M) with serial communication the Modbus protocol enables multi drop communication via RS485 communication. Modbus protocol is a widely supported open interconnect originally designed by Modicon.

The memory reference for input and holding registers is 30000 and 40000 respectively.

Communication operates on a master-slave basis where only one device (the master) can initiate transactions called 'Requests'. The other devices (slaves) respond by supplying the requested data to the master. This is called the 'Request - Response Cycle'.

The master could send the MODBUS request to the slaves in two modes:

- **Unicast mode**, where the master sends the request to an individual slave. It returns a replay to the master after the request is received and processed. A MODBUS transaction consists of two messages. Each slave should have an unique address.
- **Broadcast mode**, where the master sends a request to all slaves and an answer is never followed. All devices should accept the broadcast request function. The Modbus address 0 is reserved to identify the broadcast request.

Master to Slave Request

Device address	Function Code	nx8 bit data bytes	Error check

Slave to Master Response

Device address	Function Code	nx8 bit data bytes	Error check

Request

This Master to Slave transaction takes the form:

- **Device address**: master addressing a slave (Address 0 is used for the broadcast address, which all slave devices recognize.)
- **Function code** e.g. 03 asks the slave to read its registers and respond with their contents.
- **Data bytes**: tells the slave which register to start at and how many registers to read.

Response

This Slave to Master transaction takes the form:

- **Device address**: to let the master know which slave is responding.
- **Function code**: this is an echo of the request function code.
- **Data bytes**: contains the data collected from the slave.

Request Frame

Slave Address	Function Code	Starting Register		Register Count		CRC	
		HI	LO	HI	LO	LO	HI
21	04	00	6B	00	02	07	77

Response Frame

Slave Address	Function Code	Byte Count	Register Data				CRC	
			HI LO		HI LO		LO	HI
21	04	04	FE 00		59 96			

Request- response cycle example

Address number of slave: 21

Function code: 04 → 30000

Starting register HI...LO: 00...6B$_{(16)}$ → 107$_{(10)}$ +30000$_{(10)}$ = **30107$_{(10)}$** (Meaning that actual measurement is U1. For further informations *see REGISTER TABLE FOR THE ACTUAL MEASUREMENTS*.)

Register count HI...LO: 00...02$_{(16)}$ → 2$_{(10)}$ (Two registers: 30107 and 30108)

Data type: T5 (Unsigned Measurement (32 bit) – *see table of DATA types decoding*)

Register data: FE 00 59 74$_{(16)}$ → $22934 * 10^{-2}$ V = **229,34 V**

8.3 APPENDIX B: M-Bus

The M-Bus interface fully complies with M-Bus European standard EN13757-2. The entire communication is ensured with 8 Data Bits, Even Parity, 1 Stop Bit and a Baud Rate from 300 to 9600 Bauds.

Communication settings

Default communication settings are: 2400, 8, E, 1 primary address 0 and secondary address is set to serial number of device.

Initialize M-Bus (SNK_NKE)

This Short Telegram initializes the M-Bus IE14xx. The M-Bus IE14xx confirms correct receipt by Single Character Acknowledgement (ACK = E5). If the telegram was not correctly received the IE14xx will not send an acknowledgement.

Select M-BUS IE14xx Using Secondary Address (SND_UD)

This Telegram enables to select M-Bus IE14xx. The M-Bus IE14xx confirms the correct receipt by ACK. If the telegram has not been correctly received the M-Bus IE14xx will not send an Acknowledgement. After issue of the Single Character Acknowledgement the M-Bus IE14xx is ready to transmit the entire Read-out Data within 3 seconds from receiving the Telegram „Transmit Read-out Data". At the end of 3 seconds the M-Bus IE14xx will switch back to normal mode.

Transmit Read-out Data via Primary/Secondary Address (REQ_UD2)

This Short Telegram enables to select the M-Bus IE14xx and to command it to transmit the Read-out Data parameterized. The M-Bus IE14xx confirms correct receipt by transmitting of the Read-out Data. If the Short Telegram has not been received correctly; no Data will be transmitted by the M-Bus IE14xx. The Read-out Data are sent within 35 ms – 75 ms from receipt of the Short Telegram by the M-Bus Meter (fom more infomations see section M-Bus telegrams).

Set Baud Rate via Primary/Secondary Address (SND_UD)

This telegram enables to set the desired Baud Rate. The M-Bus IE14xx confirms the correct receipt by ACK. If the telegram was not received correctly the M-Bus **IE14xx** does not send an Acknowledgement. The (ACK) is sent by the M-Bus IE14xx in the Old Baud Rate. As soon as ACK is transmitted the M-Bus Meter switches to the baud rate newly parameterized. If the IE14xx now does not receive a new Telegram under the new baud rate within a period of 30 seconds – 40 seconds, it automatically switches back to the old baud rate. This is apt to prevent that a faulty setting of the baud rate may interrupt communication.

Set Primary Address via Primary/Secondary Address (SND_UD)

This Telegram enables to set a new Primary Address. The M-Bus IE14xx confirms the correct receipt by ACK. If the telegram has not been correctly received the M-Bus IE14xx will not send an Acknowledgement.

Set Secondary Address via Primary/Secondary Address (SND_UD)

This Telegram enables to set a new Secondary Address. The M-Bus IE14xx(M) confirms the correct receipt by ACK. If the telegram has not been correctly received the M-Bus IE14xx will not send an Acknowledgement.

Secondary Address (UD) consists of:

Identification Number:	00000000 – 99999999	8-digit Secondary Address number
Manufacturer's Code:	73 26	2 Byte Company Constant (Iskra = "73 26")
Version Number:	01 – FF	1 Byte
Medium: 02	1 Byte Constant Electricit	

Reset, Restart M-Bus IE14xx via Primary/Secondary Address (SND_UD)

This Telegram reset/restarts M-Bus IE14xx. The M-Bus IE14xx confirms correct receipt by ACK. If the telegram was not correctly received the M-Bus IE14xx will not send an acknowledgement.

8.3.1 M-Bus Telegram

Total Energy counters 0, 1, 2, 3

Energy counters could represent: +/- active energy, +/-reactive energy or apparent energy and one of 4-th tariff.

	DIF	DIFE	DIFE	VIF	VIFE	VIFE	VIFE	DATA
								xx.xx.xx.xx
T0:	04	none	none					
T1:	84	10	none					
T2:	84	20	none					
A+:				05	None	none	none	$*10^{5-3}$ Wh
A-:				85	3C	none	none	$*10^{5-3}$ Wh
R+:				FB	82	75	none	$*10^{5-3}$ varh
R-:				FB	82	F5	3C	$*10^{5-3}$ varh
App:				FB	84	75	none	$*10^{5-3}$ VAh

Active Tariff number

Tariff number in progress (1 to 4)

	DIF	DIFE	DIFE	VIF	VIFE	VIFE	VIFE	DATA
	01			FF	01			xx

DATA: value represent as 8-bit integer

Active Power Total Pt (W)

Active power total in 32 bit x $10^{(2-3)}$ W

	DIF	DIFE	DIFE	VIF	VIFE	DATA
	04			2A		xx.xx.xx.xx

Rective Power Total (kvar)

Reactive power total in 32bit x$10^{(2-3)}$ var

	DIF	DIFE	VIF	VIFE	VIFE	VIFE	DATA
	04		FB	97	72		xx.xx.xx.xx

Instant Apparent Power Total (VA)

Apparent power total in 32 bit x $10^{(5-6)}$ VA

	DIF	DIFE	VIF	VIFE	VIFE	VIFE	DATA
	04		FB	B4	75		xx.xx.xx.xx

n - 0…7

Power Factor: -: leading et +: lagging: PF

Power factor as 32-bit integer * 10^{-3}

	DIF	DIFE	DIFE	VIF	VIFE	VIFE	VIFE	DATA
	04			A8	B4	35		xx.xx.xx.xx

Unit : W/V/A

Current Total (A)

Total current as 32 bit x $10^{(9-12)}$ A

	DIF	DIFE	VIF	VIFE	VIFE	DATA
	04		FD	59		xx.xx.xx.xx

System frequency (Hz/1000)

Contains the line frequency 32-bit integer in mHz.

	DIF	DIFE	DIFE	VIF	VIFE	VIFE	VIFE	DATA
	04			FB	2C			xx.xx.xx.xx

Voltages (V)

Voltage as 32 bit x $10^{(7-9)}$ V

	DIF	DIFE	VIF	VIFE	VIFE	VIFE	DATA
	04						xx.xx.xx.xx
U1:			FD	C7	FC	01	

8.4 APPENDIX C: OBIS CODE

OBIS code	Description
Active energy registers:	
1.8.0	Positive active energy (A+) total [kWh]
1.8.1	Positive active energy (A+) in tariff T1 [kWh]
1.8.2	Positive active energy (A+) in tariff T2 [kWh]
1.8.3	Positive active energy (A+) in tariff T3 [kWh]
1.8.4	Positive active energy (A+) in tariff T4 [kWh]
2.8.0	Negative active energy (A-) total [kWh]
2.8.1	Negative active energy (A-) in tariff T1 [kWh]
2.8.2	Negative active energy (A-) in tariff T2 [kWh]
2.8.3	Negative active energy (A-) in tariff T3 [kWh]
2.8.4	Negative active energy (A-) in tariff T4 [kWh]
15.8.0	Absolute active energy (A+) total [kWh]
15.8.1	Absolute active energy (A+) in tariff T1 [kWh]
15.8.2	Absolute active energy (A+) in tariff T2 [kWh]
15.8.3	Absolute active energy (A+) in tariff T3 [kWh]
15.8.4	Absolute active energy (A+) in tariff T4 [kWh]
16.8.1	Sum active energy without reverse blockade (A+ - A-) in tariff T1 [kWh]
16.8.2	Sum active energy without reverse blockade (A+ - A-) in tariff T2 [kWh]
16.8.3	Sum active energy without reverse blockade (A+ - A-) in tariff T3 [kWh]
16.8.4	Sum active energy without reverse blockade (A+ - A-) in tariff T4 [kWh]
2. Reactive energy registers	
3.8.0	Positive reactive energy (Q+) total [kvarh]
3.8.1	Positive reactive energy (Q+) in tariff T1 [kvarh]
3.8.2	Positive reactive energy (Q+) in tariff T2 [kvarh]
3.8.3	Positive reactive energy (Q+) in tariff T3 [kvarh]
3.8.4	Positive reactive energy (Q+) in tariff T4 [kvarh]
4.8.0	Negative reactive energy (Q-) total [kvarh]
4.8.1	Negative reactive energy (Q-) in tariff T1 [kvarh]
4.8.2	Negative reactive energy (Q-) in tariff T2 [kvarh]
4.8.3	Negative reactive energy (Q-) in tariff T3 [kvarh]
4.8.4	Negative reactive energy (Q-) in tariff T4 [kvarh]
5.8.0	Imported inductive reactive energy in 1-st quadrant (Q1) total [kvarh]
5.8.1	Imported inductive reactive energy in 1-st quadrant (Q1) in tariff T1 [kvarh]
5.8.2	Imported inductive reactive energy in 1-st quadrant (Q1) in tariff T2 [kvarh]
5.8.3	Imported inductive reactive energy in 1-st quadrant (Q1) in tariff T3 [kvarh]
5.8.4	Imported inductive reactive energy in 1-st quadrant (Q1) in tariff T4 [kvarh]
6.8.0	Imported capacitive reactive energy in 2-nd quadrant (Q2) total [kvarh]
6.8.1	Imported capacitive reactive energy in 2-nd quadr. (Q2) in tariff T1 [kvarh]
6.8.2	Imported capacitive reactive energy in 2-nd quadr. (Q2) in tariff T2 [kvarh]
6.8.3	Imported capacitive reactive energy in 2-nd quadr. (Q2) in tariff T3 [kvarh]
6.8.4	Imported capacitive reactive energy in 2-nd quadr. (Q2) in tariff T4 [kvarh]
7.8.0	Exported inductive reactive energy in 3-rd quadrant (Q3) total [kvarh]
7.8.1	Exported inductive reactive energy in 3-rd quadrant (Q3) in tariff T1 [kvarh]
7.8.2	Exported inductive reactive energy in 3-rd quadrant (Q3) in tariff T2 [kvarh]

7.8.3	Exported inductive reactive energy in 3-rd quadrant (Q3) in tariff T3 [kvarh]
7.8.4	Exported inductive reactive energy in 3-rd quadrant (Q3) in tariff T4 [kvarh]
8.8.0	Exported capacitive reactive energy in 4-th quadrant (Q4) total [kvarh]
8.8.1	Exported capacitive reactive energy in 4-th quadr. (Q4) in tariff T1 [kvarh]
8.8.2	Exported capacitive reactive energy in 4-th quadr. (Q4) in tariff T2 [kvarh]
8.8.3	Exported capacitive reactive energy in 4-th quadr. (Q4) in tariff T3 [kvarh]
8.8.4	Exported capacitive reactive energy in 4-th quadr. (Q4) in tariff T4 [kvarh]
3. Apparent energy registers	
9.8.0	Apparent energy (S+) total [kVAh]
9.8.1	Apparent energy (S+) in tariff T1 [kVAh]
9.8.2	Apparent energy (S+) in tariff T2 [kVAh]
9.8.3	Apparent energy (S+) in tariff T3 [kVAh]
9.8.4	Apparent energy (S+) in tariff T4 [kVAh]

8.5 APPENDIX D: Equations

Definitions of symbols

Symbol	Definition
f	Phase, f is allways equal 1.
U_f	Phase voltage (U_1)
N	Total number of samples in a period
n	Sample number ($0 \le n \le N$)
i_n	Current sample n
φ_f	Power angle between current and phase voltage f (φ_1)

Voltage

$$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}}$$

N – samples in averaging interval (up to 65 Hz)

Current

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$$

N – samples in averaging interval (up to 65 Hz)

Power

$$P = \frac{1}{N}\sum_{n=1}^{N}(u_n \times i_n)$$

Active power

N – samples in averaging interval

n – index of sample in a period

f – phase designation (f = 1)

SignQ (φ) — **Reactive power sign**

$\varphi \in [0° - 180°] \rightarrow \text{SignQ}(\varphi) = +1$
$\varphi \in [180° - 360°] \rightarrow \text{SignQ}(\varphi) = -1$

Q – reactive power

φ – power angle

$S = U_f \cdot I_f$

Apparent power

U_f – phase voltage

I_f – phase current

$$Q_f = \frac{1}{N} \cdot \sum_{n=1}^{N} \left(u_{f_n} \times i_{f_{[n+N/4]}} \right)$$

Reactive power Q_f (displacement method)

N – a number of samples in a period

n – sample number (0 ≤ n ≤ N)

$\varphi = a\,tan2\,(P, Q)$
$\varphi = [-180°, 179,99°]$

Total power angle

P_t – total active power

Q_t – total reactive power

$PF = \dfrac{P}{S}$

Power factor

P – active power

S –apparent power

THD

$I_f\,THD(\%) = \dfrac{\sqrt{\sum_{n=2}^{N} I_n^2}}{I_1} 100$

Current THD

I_1 – value of first harmonic

n – number of harmonic

$U_f\,THD(\%) = \dfrac{\sqrt{\sum_{n=2}^{N} U_n^2}}{U_1} 100$

Phase voltage THD

U_1 – value of first harmonic

n – number of harmonic

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