Iskra®

User 's Manual

EN

Energy meters WM1x6A

Single-phase electrical energy meter WM1-6A

Single-phase electrical energy meter WM1M6A

December 2021 • Version 1.01

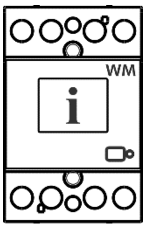
Single-phase electrical energy meter

WM1x6A

User and Installation manual

Security Advices and Warnings

Please read this chapter carefully and examine the equipment carefully for potential damages which might arise during transport and to become familiar with it before continue to install, energize and work with a single-phase energy meter WM1x6A.
This chapter deals with important information and warnings that should be considered for safe installation and handling with a device in order to assure its correct use and continuous operation.
Everyone using the product should become familiar with the contents of chapter »Security Advices and Warnings«.
If 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 installation and use of single-phase energy meter WM1x6A. Installation and use of a device also includes handling with dangerous currents and voltages therefore should be installed, operated, serviced and maintained by qualified personnel only. ISKRA Company assumes no responsibility in connection with installation and use of the product. If there is any doubt regarding installation and use of the system in which the device is used for measuring or supervision, please contact a person who is responsible for installation of such system.

Before switching the device ON

Check the following before switching on the device:

- Nominal voltage.
- Terminals integrity.
- Protection fuse for voltage inputs (recommended maximal external fuse size is 65 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
	**DANGER** Indicates proximity of hazardous high voltage, which might result in serious injury or death if not handled with care.
	**WARNING** Indicates situations where careful reading of this manual is required and following requested steps to avoid potential injury is advised.
	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.
	Compliance of the product with European CE directives.
	Compliance of the product with UK Conformity Assessed (UKCA) directives.

Disposal

It is strongly recommended that electrical and electronic equipment (WEEE) is not deposit as municipal waste. The manufacturer or provider shall take waste electrical and electronic equipment free of charge. The complete procedure after lifetime should comply with the Directive 2002/96/EC about 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 single-phase energy meter WM1x6A 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 single-phase energy meters **WM1-6A, WM1M6A (MID certified)** are intended for energy measurements in single-phase electrical power network 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 quick overview of harmonic distortion either coming from a network or generated by the load.
Microprocessor also controls LCD, LED, IR communication and optional extensions.
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

Figure 1: *Appearance of single-phase electric energy meter WM1x6A*

1 **Current terminals – to load**
2 **Information display**
3 **IR COMM PORT –ON SIDE**
4 **DIN-Rail fitting**
5 **User button and LED indicator (1000 imp/kWh)**
6 **Current terminal – source (max 65 A)**
7 **AUX terminals (options):**
- RS485
- M-BUS
- TARIFF INPUT

LCD

Number of digits:	8 (7+1)
Height of digits:	4.52 mm

LED

Colour:	red
Pulse rate:	1000 imp/kWh
LED on:	no load indication

1.2 Single-phase energy meters application

Energy meters have built-in optical (IR) communication port on the side as a standard. Special WM-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 devices without any communication installed. A built-in pulse output is designed for sending data to the devices for checking and monitoring consumed energy.
Energy meters could also be connected with iHUB-L1 or Bicom by optical communication (IR).
Optional the meter can be equipped with the following communications:

- **RS485** serial communication with the MODBUS protocol,
- **M-BUS** serial communication,

Communication modules enables data transmission and thus connection of the measuring places into the network for the control and management with energy.
Instead of communication modules, there can be also **tariff input** (option).
Tariff input provides measurement of two tariffs for selected energy registers.
On the housing there are only two terminals, thus only one functional extension is possible (serial communication, tariff input or M-bus).

1.3 Main features

- Single-phase direct connected DIN-rail mounting meters up to maximum current (**I_{max}**) **65 A.**
- Basic current (I_b) 5 A.
- **MID** approval (option for WM1M6A).
- **Class 1** for active energy according to EN 62053-21 and **B** according to EN 50470-3 .
- **Class 2** for reactive energy according to EN 62053-23.
- Reference frequency **50 Hz and 60 Hz.**
- **Bidirectional** energy measurement (import/export).
- Reference voltage 230 V (U_n).
- Voltage operating range (-20 % ... +15 %) U_n.
- **Pulse output** according to EN 62053-31.
- **Tariff input** (option).
- **RS485** serial communication (option).
- **M-BUS** serial communication (option).
- Display **LCD 7+1** digit (**100 Wh** resolution).
- Multifunctional front LED.
- LED constant 1000 imp/kWh.
- Built-in optical (**IR**) communication port.
- 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.
- **2-DIN rail** width mounting according to EN 60715.
- **Sealable** terminal cover.

2 CONNECTION

This chapter deals with the instructions for single-phase electrical energy meter WM1x6A connection. Both the use and connection of the device includes handling with dangerous currents and voltages. Connection shall therefore be performed ONLY by a qualified person using an appropriate equipment. ISKRA, d.o.o. does not take any responsibility regarding the use and connection. If any doubt occurs regarding connection and use 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

Singlee-phase electrical energy meter WM1x6A is intended only for DIN-rail mounting. In case of using the stranded wire, the ferrule must be attached before the mounting. Ferrule contact length should be 18 mm.

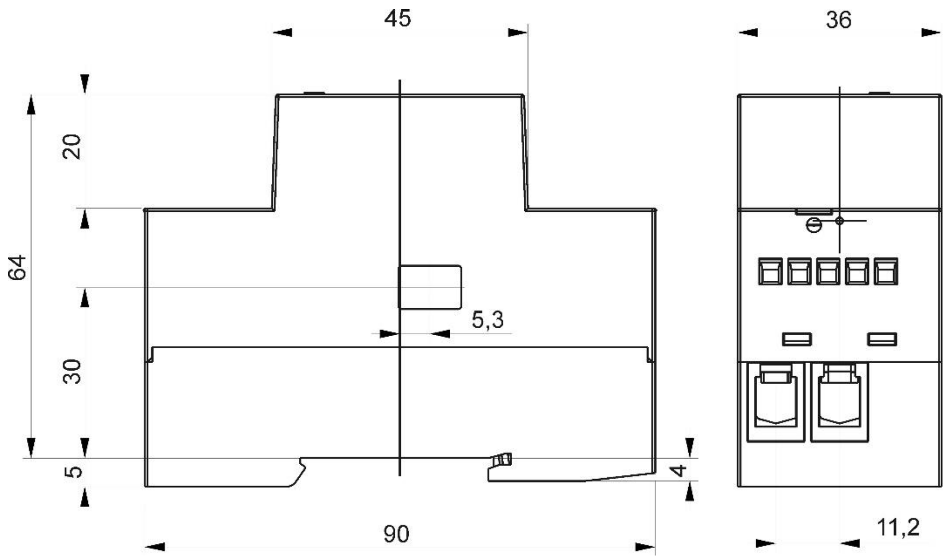
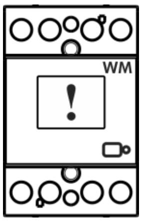


Figure 2: *Dimensional drawing and rear connection terminals position*

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.*

Meter is used for direct connection into the two-wire networks. Meter can be equipped with different modules. 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 mm^2 – 16* (25) mm^2 *(*Ferrule contact length should be 18 mm. Wire stripped to 20 mm.)*

  b. Connection screws M5

  c. Max torque 3.5 Nm

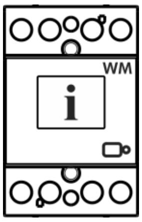
3 Auxiliary terminals:

  a. Auxiliary terminals contact capacity

  Flexible (Rigid) 0.05 mm^2 – 1 (2.5) mm^2

  b. Auxiliary terminals screws M3

  c. Max torque 0.6 Nm



PLEASE NOTE

Neutral wire must be connected to the meter.

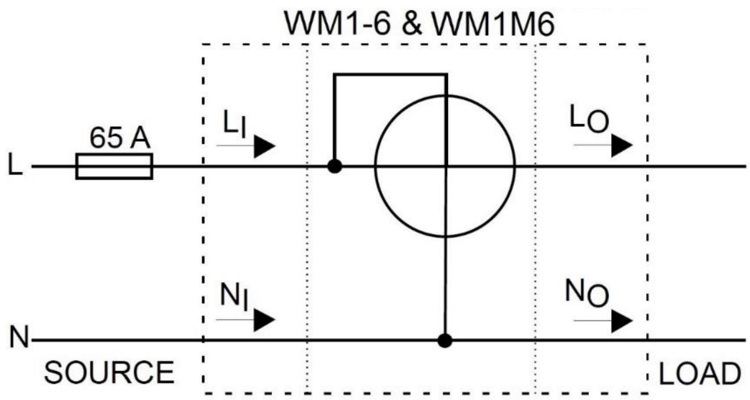


Figure 3: *Electrical diagram 230 V_{AC}*

Mark	*Meaning*
L_I	*Live input*
N_I	*Neutral input*
L_O	*Live output*
N_O	*Neutral output*

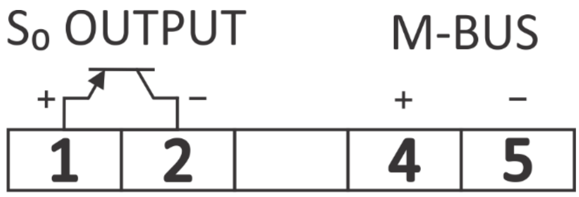


Figure 4: *Connection diagram for M-BUS option*

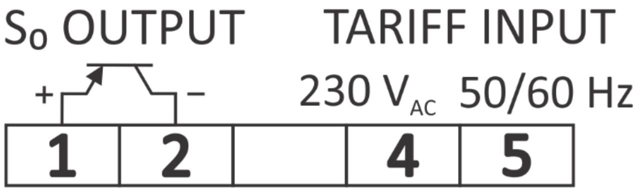


Figure 5: *Connection diagram for tariff input option*

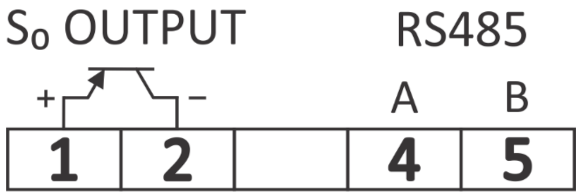


Figure 6: *Connection diagram for pulse output and RS485 communication*

Complete WM1x6A system is assembled with three units:

- Current and voltage capture unit.
- Measurement and processing unit (MAPU) with SMPS or capacitor power supply unit, IR communication, LED indicator, LCD support and EEPROM.
- Communication unit (MODBUS RS485, M-BUS, TARIFF) WITH Pulse output.

2.2.1 Communication connection

For communication with outside world multiple manners are used:

- **IR** communication module using MODBUS protocol is equipped on each meter. It can be used for setting and testing the meter using WM-USB adapter.
- **Pulse output (option)** module is used for counting number of pulses depending on consumed energy.
- **Tariff input (option)** module is used to set active tariff.
- **LED** diode is used for indication of no-load condition (I < 0,02A) and test output proportional to measured active energy (1000 imp/kWh). It can be also switched to reactive energy for test purpose using IR communication.
- **RS485 (option)** communication module is galvanic isolated form the meter. It enables setting the meter, data readout in the network and tariff setting.
- **M-BUS (option)** communication module is galvanic isolated form meter. It enables setting the bound rate and the address of the meter (for more informations see appendix 8.2).
- **Push button** is used to select display of desired measured or group of them.

Table 1: *Survey of communication connection*

Auxiliary terminal	**1**	**2**	**3**	**4**	**5**
M-Bus	SO+	SO-	NC	M+	M-
Tariff input	SO+	SO-	NC	AC1	AC2
RS485*	SO+	SO-	NC	A	B

**It is recommended to use ferrite bead on communication line RS485 (two turns) to reduce radiated emission.*

PLEASE NOTE

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

3 FIRST STEPS

Programming a single-phase electrical energy meter WM1x6A 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

On LCD measured data are presented. Display scrolls automatically. Displayed quantities and scroll time can be set via communication by MiQen software. Energy meters have LCD display with following layout.

1. Tariff setting for displayed counter/actual tariff
2. (→) Energy import/active power import
   - (←) Energy export/active power export
3. kWh display
4. kvarh display
5. Actual Value
6. Info:
   - VAh display
   - PF – power factor
   - VA – apparent power
   - PA – power angle
7. A – currently active counter, nr – non resettable counter or r – resettable counter
8. W – active power
   var – reactive power
9. Inductive or capacitive load

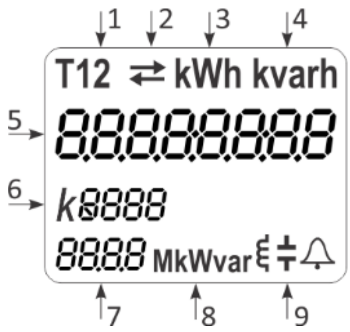
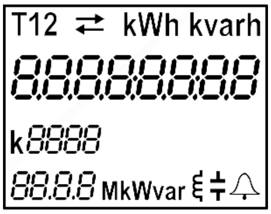


Figure 8: *Layout of LCD*

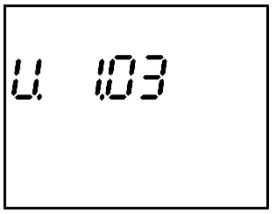
Energy registers are displayed with resolution 7 + 1 (kWh, kvarh and kVAh). The meter can be set to *Test measuring mode* which displays energy registers with better resolution. The test mode is used for test purposes during type testing and test of meter constant during initial verification. After power off meter automatically goes back to normal operation.

3.1.1 Welcome screens

Segment check



Built version



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3.2 LCD User Interface

After the electrical connection, the display shows a welcome screen for two seconds then the firmware version for the next two seconds. The following is a measurement screen automatically cycling on the screen, regarding the period that is defined in settings. The cycling period and required measurement could be set factory or in MiQen software.

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

The LCD display allows displaying the following measurement values:

1 **Energy registers**. Two different types (resettable and non-resettable), both of them count the same quantity. The resettable energy counter can be reset, 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. Resetable energy counters**
    - i. Energy counter 1 (default)
    - ii. Energy counter 2
    - iii. Energy counter 3
    - iv. Energy counter 4
- **II. Non resetable energy counters**
    - i. Energy counter 1
    - ii. Energy counter 2
    - iii. Energy counter 3
    - iv. Energy counter 4

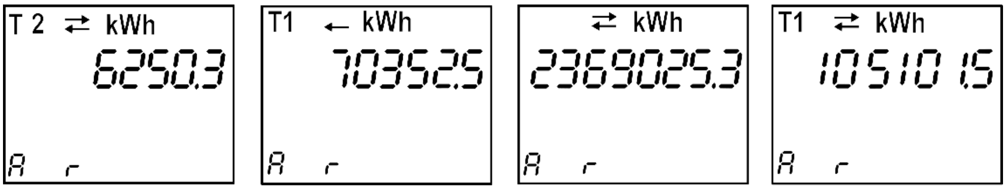
2 **Actual measured values**

- I. Active Power
- II. Reactive Power
- III. Apparent Power
- IV. Power Factor
- V. Voltage
- VI. Frequency
- VII. Current
- VIII. Power Angle

The measured values can be scrolled automatically or can be selected by pressing button.

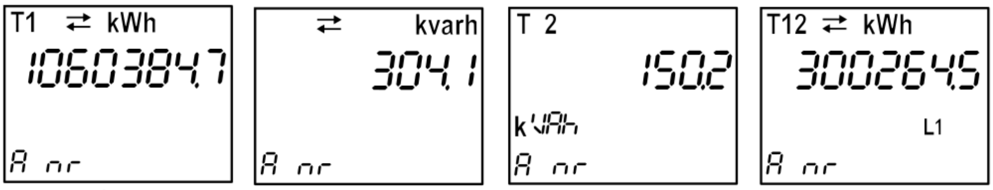
3.2.1 Energy counters

Energy counters are represented as shown on LCD examples bellow (up to 4 resetable counters, letter r representing it). At the top of the screen is settings of energy counter (tariff, import/export/total, active/reactive/apparent), the 8-digit numerical number shows the value of the energy and the letter at the bottom shows actual activity (counting (A)/not counting ( )).



counter 1 counter 2 counter 3 counter 4

Non-MID meters show resettable counters (letter r representing it).



counter 1 counter 2 counter 3 counter 4

MID meters show non resettable counters (letters nr representing it).

Counter 1 shows: Import Active Energy = 6250.3 kWh at Tarif 2.

Counter 2 shows: Export Active Energy = 70352.5 kWh at Tarif 1.

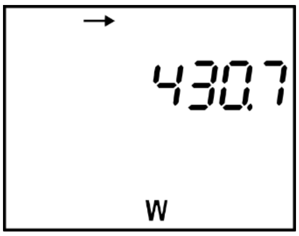
Counter 3 shows: Total Active Energy = 2369025.3 kWh at both Tarif 1 and 2.

Counter 4 shows: Total Active Energy = 105101.5 kWh at Tarif 1.

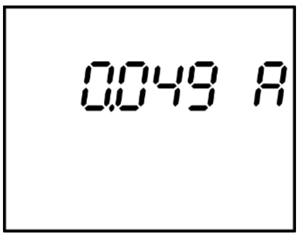
3.2.2 Other counters

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

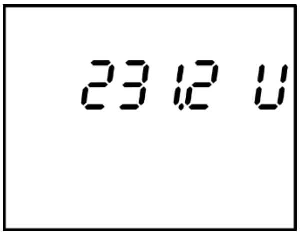
Active power:



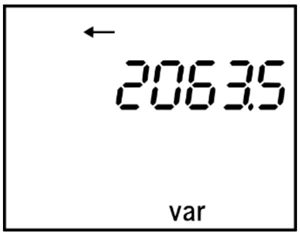
Current:



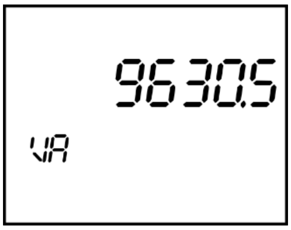
Voltage:



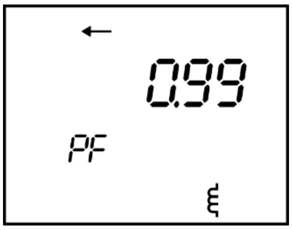
Reactive power:



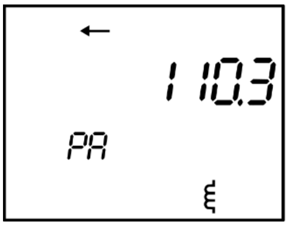
Apparent power:



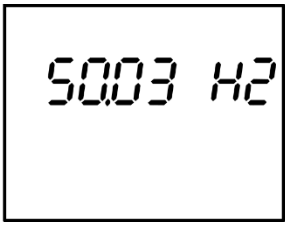
Power factor:



Power angle:

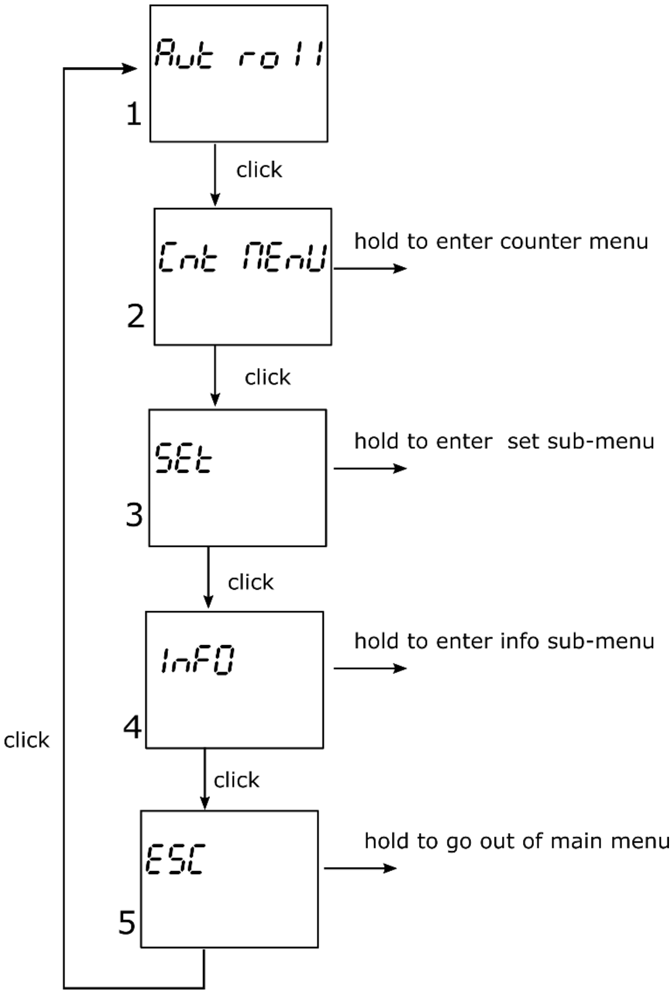


Frequency:



3.2.3 Display menu structure

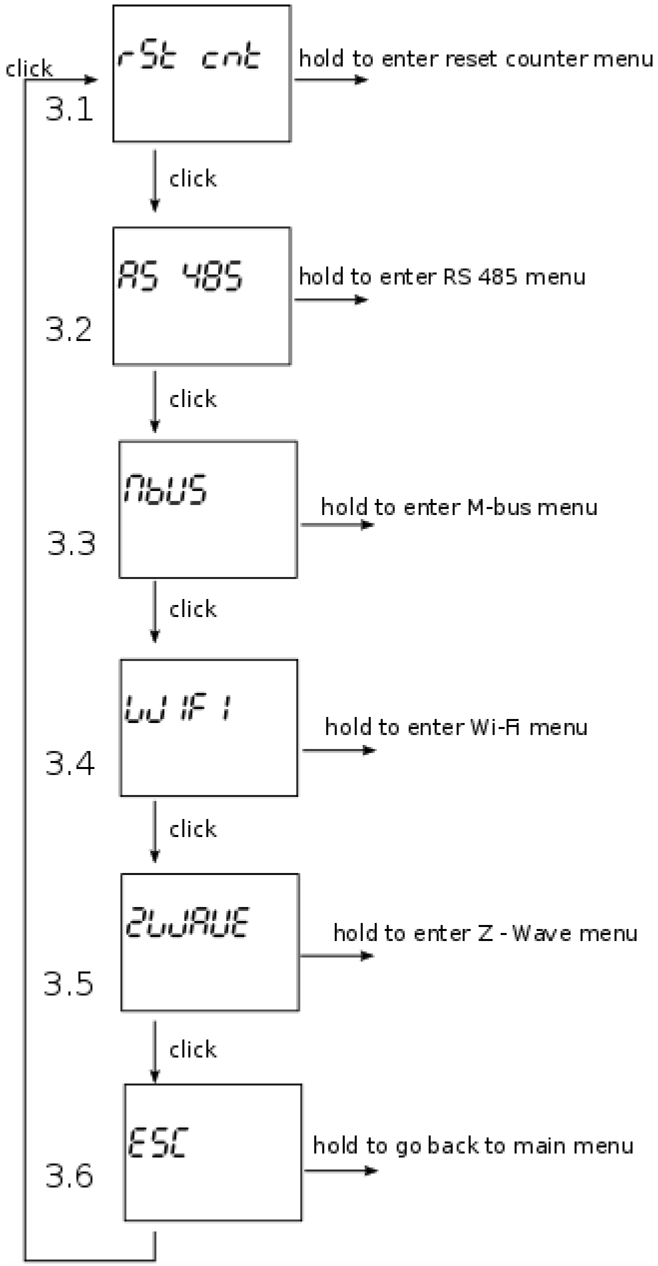
The display menu is entered by holding the push button for more than one second. Blinking of the screen indicates that. Short clicks then move user through the main menu.



By holding the button when positioned on certain screen (e.g. counter menu, set, info, etc…) the Set sub-menu is entered.

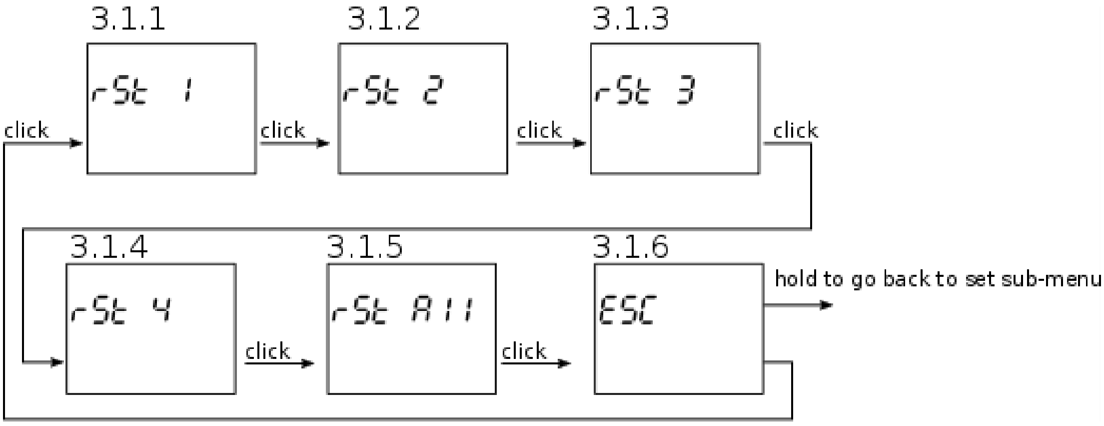
3.2.3.1 Set sub-menu

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



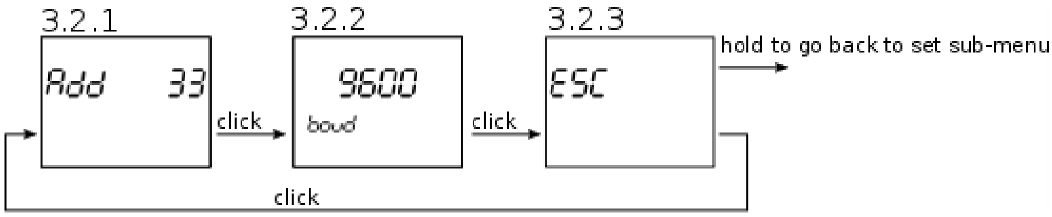
The screens 3.2 to 3.4 appear only in case the actual option is available on the meter.

3.2.3.1.1 Reset counters menu



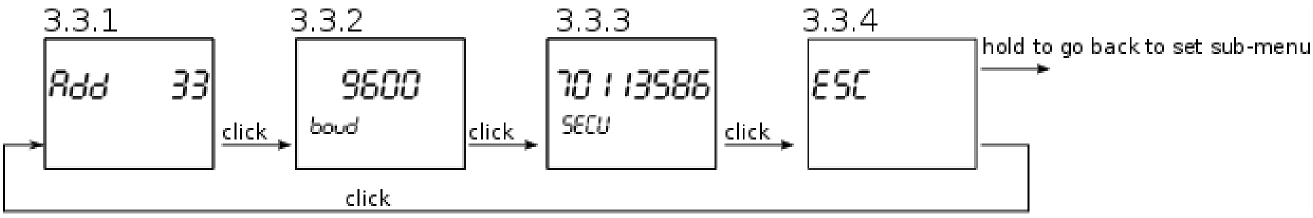
Holding button on any of screens 3.1.1 through 3.1.5 resets any of counters or all of them respectively.

3.2.3.1.2 RS485 menu



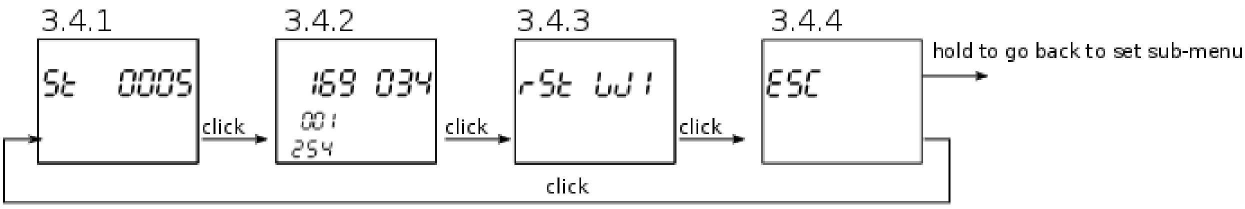
Screen 3.2.1 shows the address of RS485 communication and screen 3.2.2 shows the baud rate.

3.2.3.1.3 M-bus menu



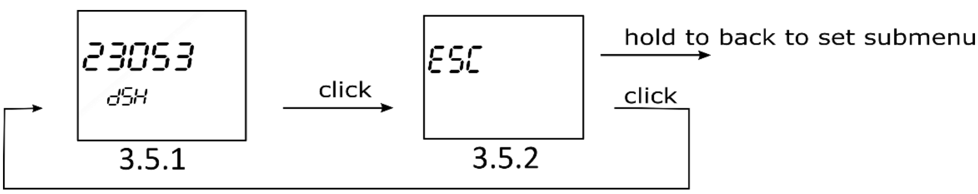
Screens 3.3.1 shows the primary address of M-bus communication, screen 3.3.2 shows baud rate and screen 3.3.3 shows the secondary address.

3.2.3.1.4 Wi-Fi menu



Screen 3.4.1 shows Wi-Fi status, screen 3.4.2 shows IP address of gateway module and screeen 3.4.3 resets the Wi-Fi.

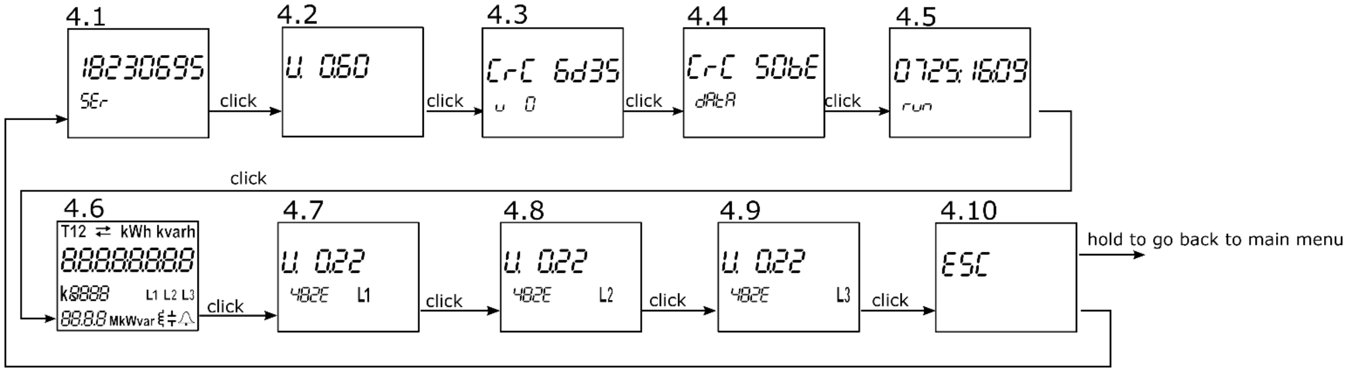
3.2.3.1.5 Z-Wave menu



Screen 3.5.1 shows S2 security inclusion PIN number.

3.2.3.2 Info sub-menu

When in info sub-menu, short clicks move user through it, allowing her/him to get required information about smart meter.



Screen 4.1 shows the serial number of the smart meter.

Screen 4.2 shows the software version present on smart meter.

Screen 4.3 shows CRC code and below the number of Firmware upgrades.

Screen 4.4 shows CRC of parameters and below the number of times the WM1M6A (MID version) was unlocked.

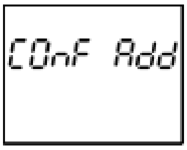
Screen 4.5 shows operating time (days:hour:minute) of WM1-6A.

Screen 4.6 shows initial LCD screen with all segments on.

Screens 4.7 through 4.9 show software versions of each of phase modules.

3.2.4 Set device ModBus address

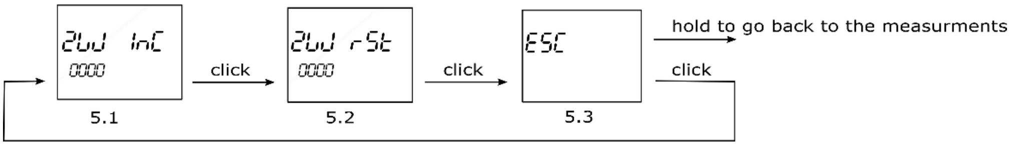
Non configured devices have the same factory Modbus address set to 33. One of the options for changing the Modbus address is the following. Holding the button for more than 6 seconds, the energy meter will switch to Modbus address configuration mode (you will see the screen below).



During this time, the WM1-6A responds to the 149 address via the ModBus. The device remains in configuration mode until the ModBus address is modified or when 3 minutes pass or with a long press of 1 second to 3 seconds.
The purpose of the procedure is to modify Modbus address in case if you want to connect more devices with the same address to the RS485 network.

3.2.5 ZWave inclusion

WM1-6A that has a built-in ZW module supports LCD menu that allows inclusion or exclusion into ZWave network. Holding the button for more than 6 seconds, the energy meter will switch to inclusion or exclusion ZWave mode and LCD shows the following menu:



Holding button on screen 5.1 include or exclude ZWave from network. Holding button on screen 5.2 resets ZWave module.

3.3 Limits

WM1-6A has a built-in limit function which can control the bistable relay using IR communication. The user can set one or two logically combined limits.

1 The following logic operations can be selected:
- Limit A
- Limit B
- Limit A AND Limit B
- Limit A OR Limit B

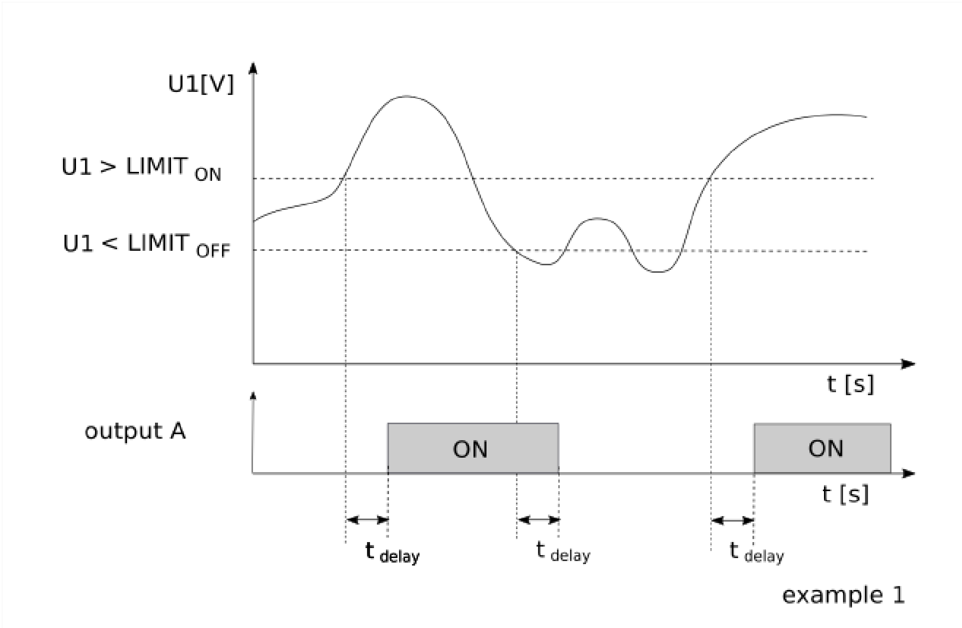
2 Limit function can monitor the following measured values:
- Voltages: U_1
- Currents: I_1
- Active power: P_1
- Reactive Power: Q_1
- Apparent Power: A_1
- Frequency
- Energy: Counter1, Counter2, Counter3, Counter4

Limits can be set by setting the correct Modbus registers.

3.3.1 Limit A

User can set the ON state of an output A, when the threshold is reached (any from the above specified measured values can be set as a threshold). Likewise the OFF state can be set, when the same measured value falls below the OFF state threshold. Optionally the delay time can be set (the time between reaching a threshold and setting output A).

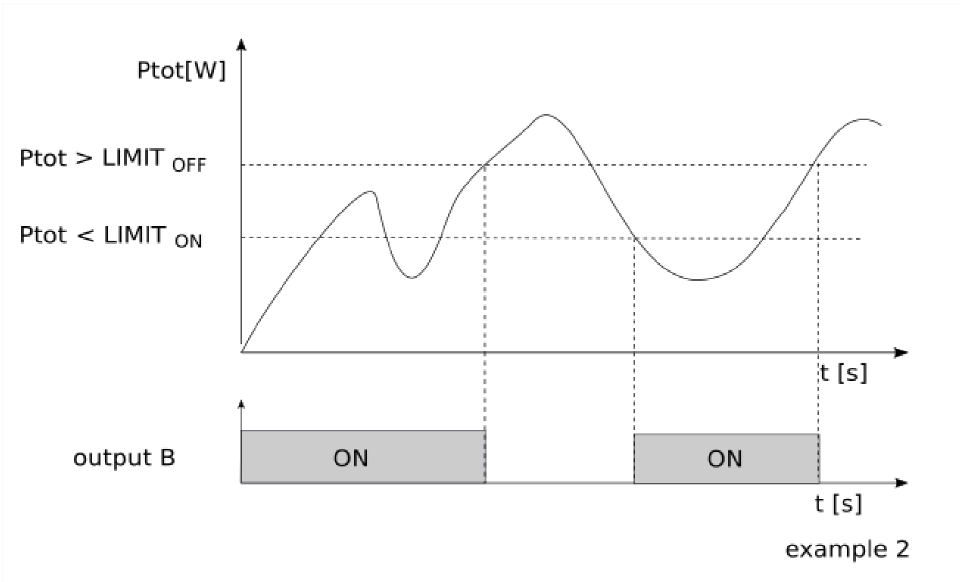
Figure below (example 1) shows the example using U1 as a limit A and delay time t_{delay}.



3.3.2 Limit B

User can set the OFF state of an output B, when the threshold is reached (any from the above specified measured values can be set as a threshold). Likewise the ON state can be set, when the same measured value falls below the ON state threshold. Optionally the delay time can be set (the time between reaching a threshold and setting output B).

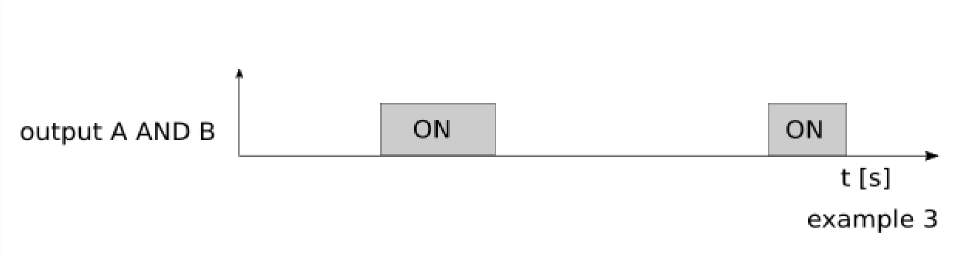
Figure below (example 2) shows the example using Ptot as a limit B and no delay time.



Limit A AND Limit B

Limit A AND Limit B is a logical operation, which sets the output A AND B ON, when both output A and output B are in ON.

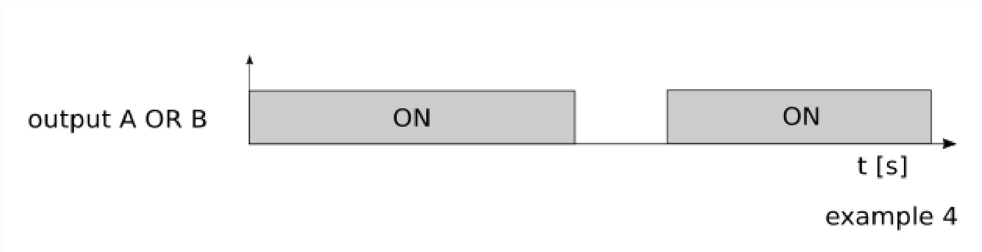
Figure below (example 3) shows the example of output A AND B being ON. For clearer picture refer also to output A (example 1) and output B (example 2) figures.



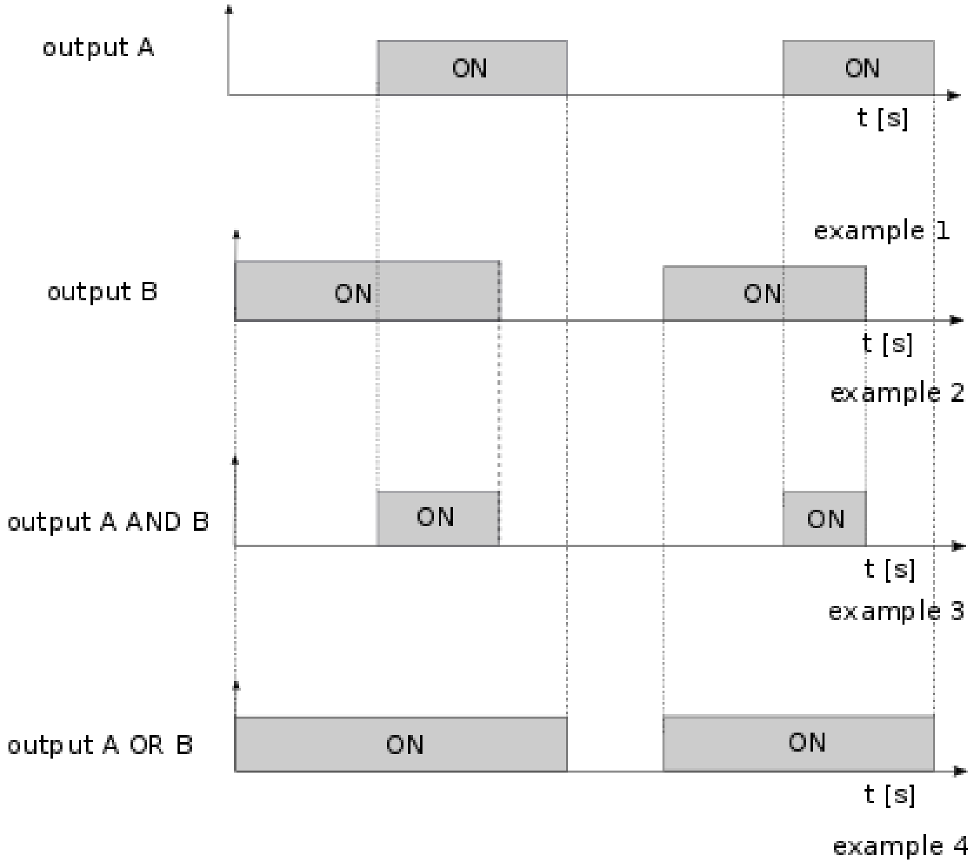
Limit A OR Limit B

Limit A OR Limit B is a logical operation, which sets the output A OR B ON, when any of output A or output B is ON.

Figure below (example 4) shows the example when output A OR B is ON. For clearer picture refer also to output A (example 1) and output B (example 2) figures.



Below graphical representation of both output A AND B as well as output A OR B.



Following Modbus registers define Limit function:

Address		Contents	Data	Ind	Values	min	max	P. Level
		LIMIT						
40187		**Limits enabled**	T1	0	None			
				1	Limit 1			
				2	Limit 2			
				3	Limit 1 OR Limit 2			
				4	Limit 1 AND Limit 2			
40188		**Display notification**	T1	0	None	0	2	2
				1	Relay ON			
				2	Relay OFF			
40189		**Limit 1: Parameter**	T1		See OutTypes			
40190		**Limit 1: Compare relation**	T1	0	measurement > limit	0	1	2
				1	measurement < limit			
40191		**Limit 1: ON level**	T17		% of parameter value	-300	300	2
40192		**Limit 1: OFF level**	T17		% of parameter value	-300	300	2
40193		**Limit 1: Compare time delay**	T1		seconds	0	600	2
40194	40198	**Limit 2**			see Limit 1			

OutTypes:

Code	Ident	Parameter		Limit	WM1-6	WM3-6	Value 100%
1	U	U	U	*	*		Un
9	I	I	I	*	*		In
16	P	P	Active Power P	*	*	*	Pn
20	Q	Q	Reactive Power Q	*	*	*	Pn
24	S	S	Apparent Power S	*	*	*	Pn
28	PF	PF	Power Factor PF	*	*	*	1
36	PA	PA	PA angle between U and I	*	*	*	100°
43	f	f	Frequency	*	*	*	100%=Fn+10Hz, 0%=Fn, -100%=Fn-10Hz
70	E1	E1	Energy Counter 1 (resetable)	*	*	*	(32-bit value) MOD 20000
71	E2	E2	Energy Counter 2 (resetable)	*	*	*	(32-bit value) MOD 20000
72	E3	E3	Energy Counter 3 (resetable)	*	*	*	(32-bit value) MOD 20000
73	E4	E4	Energy Counter 4 (resetable)	*	*	*	(32-bit value) MOD 20000

Un = Modbus register 30015

In = Modbus register 30017

Pn = Un * In

Fn = 55 Hz

3.4 Freeze counters

3.4.1 Meaning

Since WM1-6A energy meter does not support internaly synchronised real-time clock (RTC) for the purpose of simultaneous capture of measurements, the freeze function is implemented. Use is enabled only when the meter is on.

Freeze function enables using WM1x6A 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 WM1x6A 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.

3.4.2 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 WM1x6A enables several ways to activate freeze function:

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

3.4.3 Time to freeze register (41902)

The purpose of the time to freeze register is to freeze all energy meters simultaneously. Set the number of time 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 need 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.

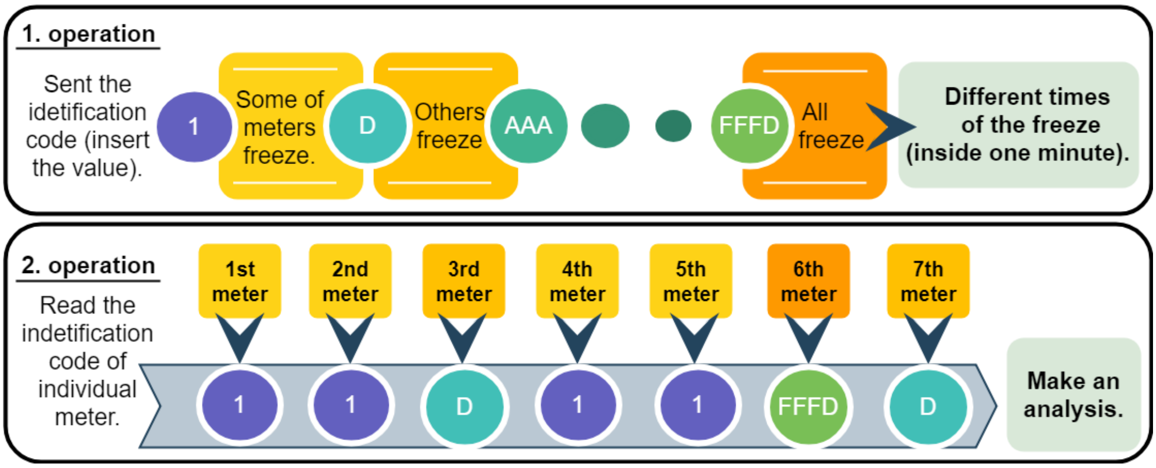
3.4.4 Auto freeze interval register (41901)

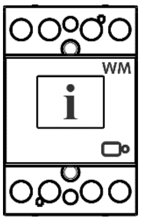
The purpose of the auto freeze interval register is to freeze energy meters in the same time interval, for example, every day. Set the certain auto freeze interval (in minutes). Maximum allowed value is 65535 minutes. Periodic synchronization is activated automatically after the entered interval. If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

3.4.5 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. Freeze function is performed. The FFFF is reserved to trigger freezing function automatically (same as 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.

3.4.6 Access and interpretation of data

After the execution of the freeze command, the counters are stored into registers 41906 to 41938, which can be read by the master. Register 41906 displays frozen tariff counter and registers 41907 to 41938 display frozen energy counters (1 - 16). The data we read on all devices can this way be compared. Encoded information should be read with Modbus table (see Appendix A).
In addition, the time since the last freeze can be checked with time from freeze register (41903, 41904). The purpose of these register is to control if displayed measurements are relevant. The register contains 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 detailed description of all ***WM1x6A*** features and settings. 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 WM-USB adapter (size 1 DIN module) and MiQen software version 2.0 or higher.

4.2 MiQen software

MiQen software is a tool for a complete programming and monitoring of ISKRA measuring instruments, connected to a PC via serial communication or by a special WM-USB adapter. 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.

Two editions of MiQen software are available:

- Professional edition with full functionality and supports all software functionality. CDKey is required for the installation.
- Standard edition, freeware edition which supports all software functionality except data analysis.

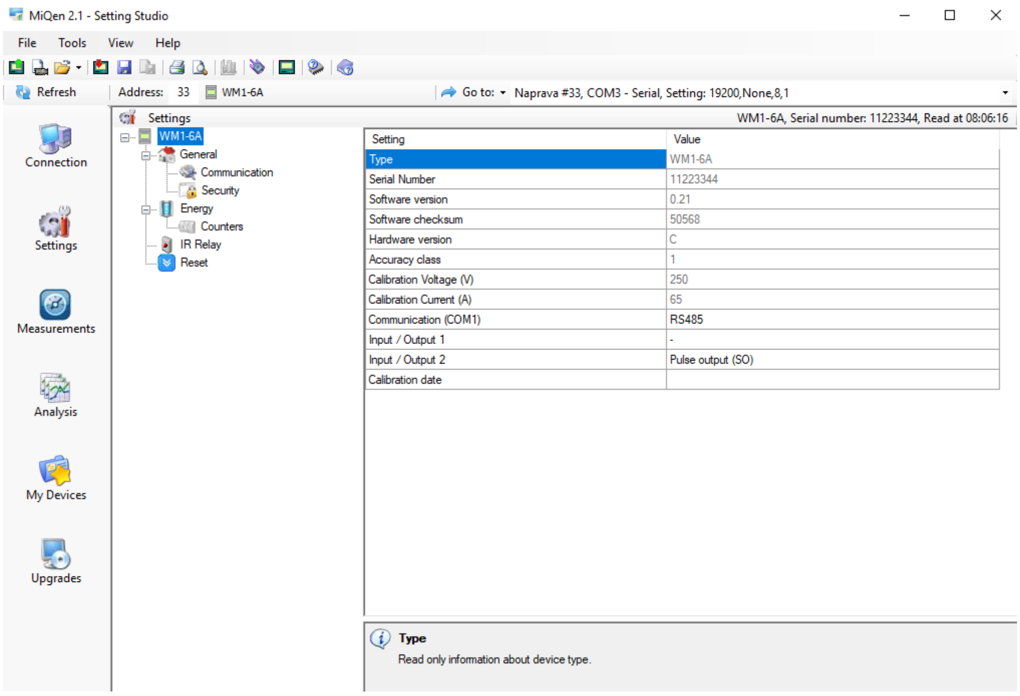
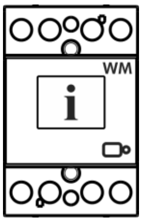


Figure 9: *MiQen programming and monitoring software*



MiQen version 2.1 or higher is required for programming and monitoring ***WM1x6A***. Software installation is stored on a CD as a part of consignment or it 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

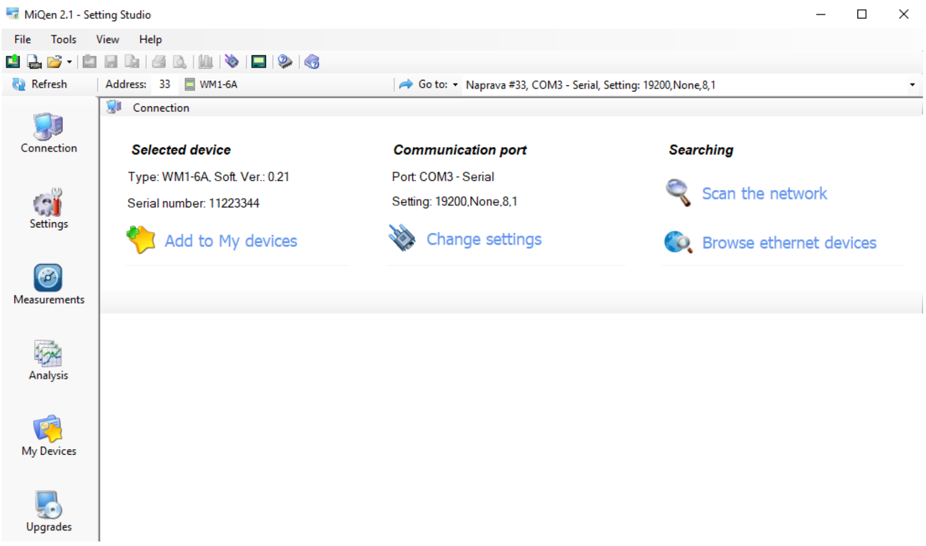


Figure 10: *MiQen Device Management window*

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.

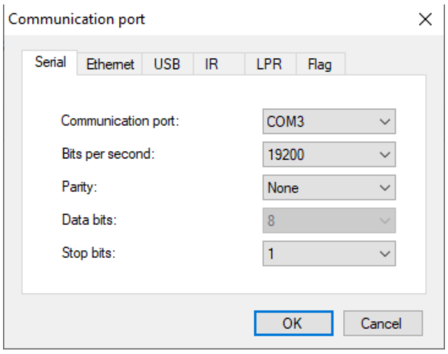
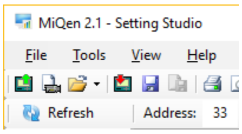


Figure 11: *Communication port window*

WM1x6A supports only serial communication, so only serial communication parameters can be set.

Set device Modbus address number

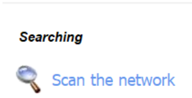
Each device connected to a network has its unique Modbus address number. In order co communicate with that device an appropriate address number should be set.



Factory default 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 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***.

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 the LCD properties and Security settings (passwords).

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

LCD Mode defines whether displayed values automatically cycle between different measurands or display only one measurement.

LCD Cycling period sets the period of cycling, valid values from 5 s to 60 s .

LCD measurements sets the measurements displayed on the LCD. A user can select them on the drop-down menu (Counter1 is Preset and is mandatory selected):

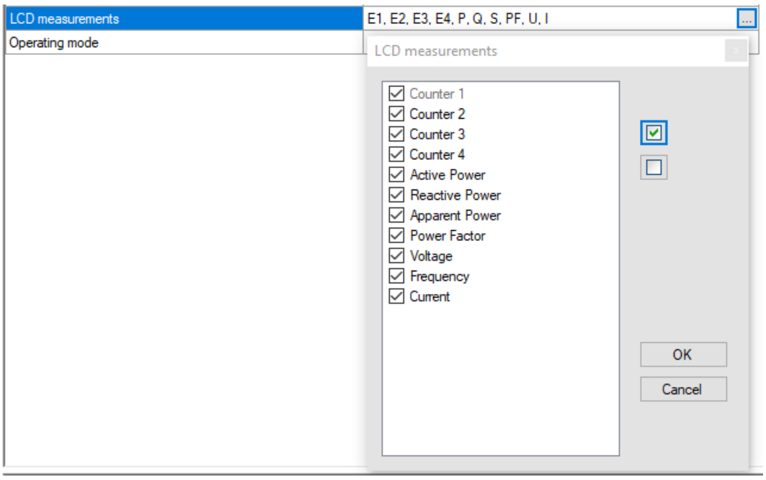


Figure 12: *Set of optional measurements*

***Operating Mode** segment is intended for selection between Normal Mode and various test modes. After reset or power cycle meter starts in Normal Mode.*

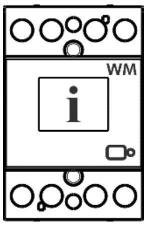
4.4.1.1 Communication

Communication segment is intended for setting the serial communication parameters (M-Bus or RS485).

4.4.1.2 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.

Password-Level 1 >PL1

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

Available settings:

- Energy meters reset (locked on communication port and pushbutton)
- Active tariff settings

Password-Level 2 >PL2

Password for second level is required. All settings are available.

A 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, depending on a serial number of the device. The BP password is available in the user support department in ISKRA d.o.o., and is entered instead of the password PL1 or/and PL2. Do not forget to state the device serial number when contacting the personnel in ISKRA, d.o.o..

Password locks time >min

Password lock time is fixed – 1 minute.

Password setting

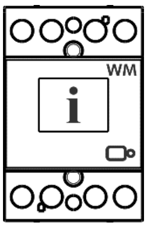
A password consists of four letters taken from the British alphabet from A to Z.

Password modification

A password is optionally modified; however, PL1 and PL2 password can be modified with access level of password PL2.

Password disabling

A password is disabled by setting the "AAAA" password.



PLEASE NOTE

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

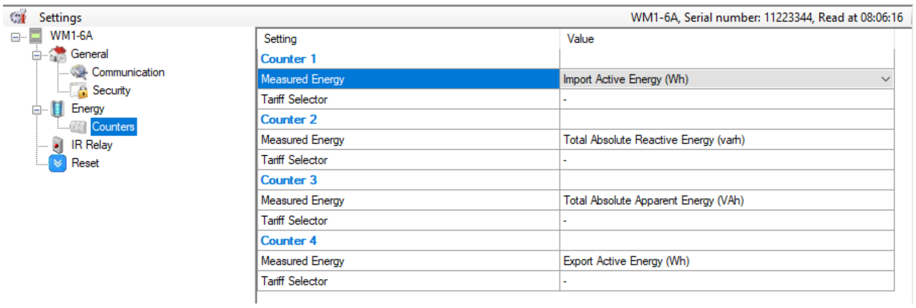
4.4.2 ENERGY

Active tariff

Switching between tariffs is done with a tariff input or by selecting values in a drop-down menu.

4.4.2.1 Counters

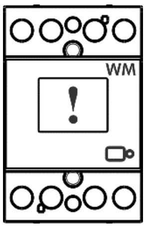
There are four pairs of counters, which are user configurable. Each counter setting applies to one resetable and one non-resetable counter. User can set Active, Reactive, Apparent Energy, energy flow direction and tariff. In Custom setting there are additional options for measurment in individual quadrants and energy measurement for individual phases.



Setting	Value
Counter 1	
Measured Energy	Import Active Energy (Wh)
Tariff Selector	-
Counter 2	
Measured Energy	Total Absolute Reactive Energy (varh)
Tariff Selector	-
Counter 3	
Measured Energy	Total Absolute Apparent Energy (VAh)
Tariff Selector	-
Counter 4	
Measured Energy	Export Active Energy (Wh)
Tariff Selector	-

Figure 14: *MiQen energy counters*

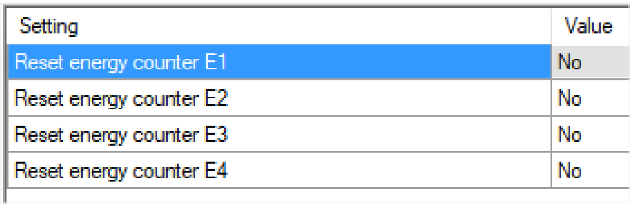
WARNING!



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

IR Relay operating mode defines how WM1x6A controls external bistable switch BI432 via proprietery IR communication. Available modes are: Not Connected, Manual and Limit control. Preset is Not connected, Manual mode enables control of BI432 via RS485 communication, Limit Control enables WM1x6A internal set limits for switching BI432. For a more precise description of Limits please see chapter Limits on page 46.

Resetting counters function is applicable only for four resettable counters. MID approval applies only to parallel non-resettable counters, which can not be reset.



Setting	Value
Reset energy counter E1	No
Reset energy counter E2	No
Reset energy counter E3	No
Reset energy counter E4	No

Figure 13: *MiQen reset counters*

4.5 Real-time measurements

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

In ONLINE mode all supported measurements and alarms can be seen in real time in a tabelaric form. All data can be exported to an Access database, Excel worksheets or as a text file.

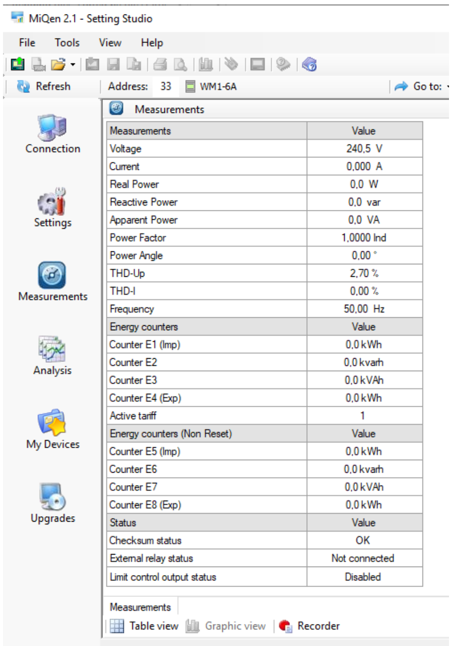


***Figure 15:** Measurements in tabular form*

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

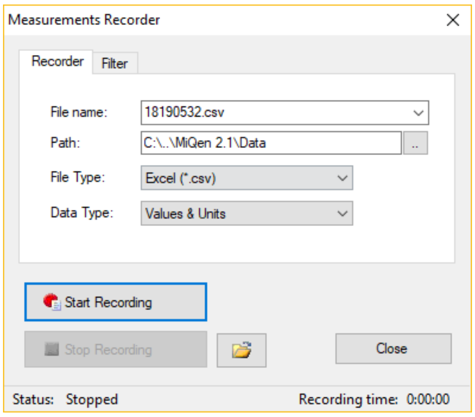


***Figure 17:** Measurements Recorder*

4.6 Data analysis

PLEASE NOTE

The energy meter WM1x6A do not support data analysis.

4.7 My devices

My devices section enables the personal selection of devices.

4.8 Software upgrading

MID version does not support software upgrade.

Always use the latest version of 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 execution of firmware upgrades of devices. It only informs that new version is available and offers link to download it from the server. Software for execution of firmware upgrades is included in downloaded zip file together with upgrade file, upgrade procedure description and revision history.

PLEASE NOTE

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

In order 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.

5 MEASUREMENTS

The ***WM1-6A*** is bidirectional energy meter measures voltage and current. From which it is able to calculate two quantities, imported and exported energy. The ***WM1-6A*** 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 rate of readings monitored with MiQen is fixed and refreshed approx. each second.

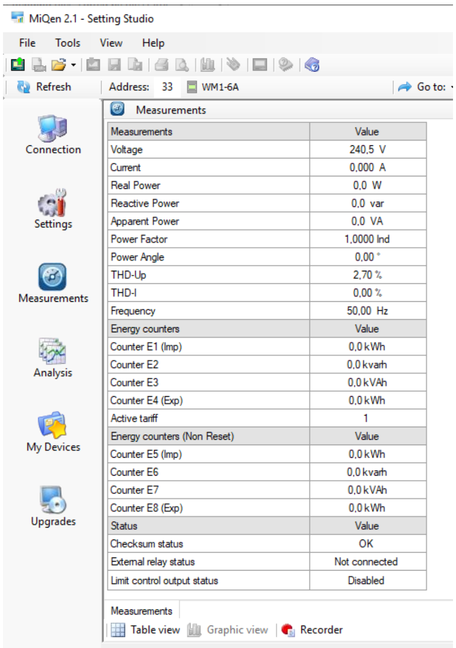


Figure 27: *Online measurements in tabelaric form*

5.2 Selection of available quantities

Microprocesor calculates the RMS voltage, RMS 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. 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_RMS}	☑1ph	
	Q_{1_RMS}	☑1ph🕮	*reactive power can be calculated as a squared difference between S and P or as delayed sample*
	S_{1_RMS}	☑1ph	
	PF_{1_RMS}	☑1ph	
	φ_{1_RMS}	☑1ph	*PA – Power angle*
	Harmonic analysis		
	THD-U_1	☑1ph	
	THD-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). Total energy is a sum of one counter for all tariffs. Tariffs can be fixed, date/time dependent or tariff input dependent*
	$E_{TOT\_1\text{-}8}$	☑	
	Active tariff	☑	
Other measurements	Miscellaneous		
	Frequency		
Status	Checksum status		
	External relay status		
	Limit control status		

🕮 Further description is available in following subchapters

Table 2: *Selection of available measurement quantities*

5.3 Calculation and display of measurements

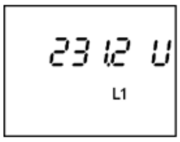
This chapter deals with capture, calculation and display of all supported measurement quantities. For more information about display presentation see chapter 3.2 LCD User Interface. Only the most important equations are described; however, all of them are shown in a chapter APPENDIX C: EQUATIONS with 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 standard or customized displays.

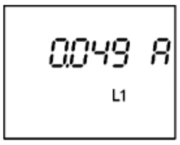


5.3.2 Current

Real effective (RMS) value of current.

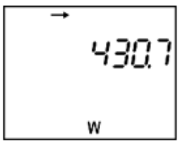
$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}.$$

All current measurements are available on communication as well as standard and customized displays on LCD.



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.



5.3.4 Power factor and power angle

PF or distortion power factor is calculated as the quotient of active and apparent power for each phase separately and total power angle. It is called distortion power factor since true (distorted) signals are using in equation (all equations are presented in chapter APPENDIX C: EQUATIONS). A symbol for a coil (positive sign) represents inductive load and a symbol for a capacitor (negative sign) represents capacitive load.

5.3.5 Frequency

Network frequency is calculated from time periods of measured voltage. Instrument uses synchronization method, which is highly immune to harmonic disturbances.

5.3.6 Energy counters

Three different variants of displaying Energy counters are available:

- by individual counter,
- by tariffs for each counter separately and,
- energy cost by counter.

At a display of measured counter by tariffs, the sum in the upper line depends on the tariffs set in the instrument.

Additional information, how to set and define a counter quantity is explained in chapter Settings – Energy.

5.3.7 Harmonic distortion

WM1-6 energy meter calculates THD for current and voltage and is expressed as percent of high harmonic components regarding to 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
	±1.5% from I_{min} to I_{tr}
	±1% from I_{tr} to I_{max}
Reactive energy:	*class 2 EN 62053-23*
	±2.5% from I_{min} to I_{tr}
	±2% from I_{tr} to I_{max}
Voltage:	*±1% of measured value*
Current:	*±1% of I_{ref} from I_{st} to I_{ref}*
	±1% of measured value from I_{ref} to I_{max}
Active Power:	*±1% of nominal power ($U_n * I_{ref}$) from I_{st} to I_{ref}*
	±1% of measured value from I_{ref} to I_{max}
Reactive, Apparent power:	*±2% of nominal power from I_{st} to I_{ref}*
	±2% of measured value from I_{ref} to I_{max}
Frequency:	*±0.5% 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 18 mm.

Terminals		Max. conductor cross-sections
Main inputs	*Contacts capacity flexible (rigit):*	*1.5 mm^2 ... 16* (25) mm^2* **Ferrule contact length should be 18 mm. Wire stripped to 20 mm.*
	Connection screws:	*M5*
	Max torque:	*3.5 Nm (PZ2)*
	Length of removed isolation:	*10 mm*
Optional modules	*Contacts capacity:*	0.05 mm^2...1 (2.5) mm^2
	Connection screws:	*M3*
	Max torque:	*0.6 Nm*
	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}):	*65 A*
	Minimum current (I_{min}):	*0.25 A*
	Transitional current (I_{tr}):	*0.5 A*
	Starting current:	*20 mA*
	Power consumption at I_{ref}	*0.1 VA*
	Nominal voltage (U_n):	*230 V (-20 - +15)%*
	Power consumption at U_n:	*< 8 VA*
	Nominal frequency (f_n):	*50 Hz and 60 Hz*

	Minimum measuring time:	*10 s*

Pulse output (option)	*Pulse rate:*	*1000 imp/kWh*
	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 (default 2400 bit/s)*
	Protocol:	*M-BUS*
	Primary address:	*0 – (default)*
RS485 Serial communication (option)	*Type:*	*RS485*
	Speed:	*1200 bit/s to 19200 bit/s (default 19200 bit/s)*
	Frame:	*8, N, 2*
	Protocol:	*MODBUS RTU*
	Address:	*33 – (default)*
Optical communication	*Type:*	*IR*
	Connection:	*via WM-USB adapter*
	Speed:	*19200 bit/s*
	Frame:	*8, N, 2*
	Protocol:	*MODBUS RTU*
	Address:	*33*
	Remark:	*All settings are fixed*
Tariff input (option)	*Rated voltage:*	*230 V (+15 %- 20 %)*
	Input resistance:	*450 kOhm*
	Rated voltage:	*230 V (+15 %- 20 %)*
	Maximum load current:	*50 mA*

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.)*
Operating temperature:	*-25 °C - +55 °C (non-condensig humudity)*
Storage temperature:	*-40 °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 36 mm*
Dimensions (W x H x D):	*36 mm x 90 mm x 64 mm*
Package dimensions (W x H x D):	*37 mm x 91 mm x 78 mm*
Colour:	*RAL 7035*

6.5 EU DIRECTIVES CONFORMITY

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

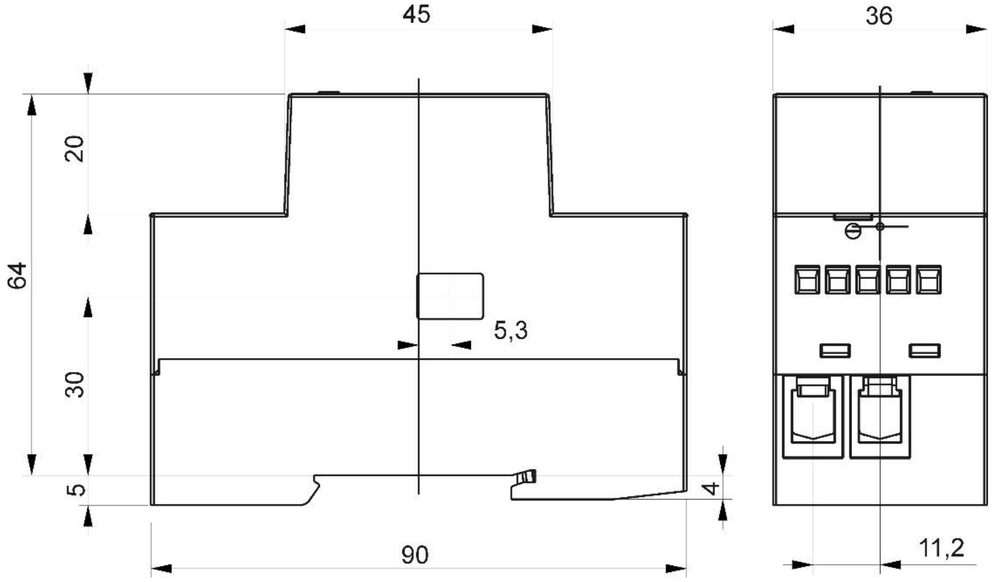
EU Directive on EMC **2014/30/EU**

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

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

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 quantity*
IR	*Infrared (optical) communication*
Pt1000	*Temperature sensor*
RMS	*Root Mean Square*
PO	*Pulse output*
PA	*Power angle (between current and voltage)*
PF	*Power factor*
THD	*Total harmonic distortion*
NC	*Not connected*

List of common abbreviations and expressions

8 APPENDICES

8.1 APPENDIX A: MODBUS communication protocol

Modbus protocol enables operation of device on Modbus networks. For WM1-6A\WM1M6A 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

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

Response Frame

			Register Data	CRC
Slave Address	Function Code	Byte Count	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**

REGISTER TABLE FOR THE ACTUAL MEASUREMENTS

The tables below represent the complete set of MODBUS register map.

SETTINGS

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
		READ ONLY INFO			
30000		Device group	T1	4	WM
30001	30008	Model Number	T_Str16		WM1-6A Energy
30009	30012	Serial Number	T_Str8		WM######
30013		Software Reference	T1		100=1.00
30014		Hardware Reference	T_Str2		A (B,C,D…)
30015		Calibration voltage	T4		230 V
30017		Calibration current	T4		65 A
30019		Accuracy class	T17		100=1.0
30020		MiNet Flag	T1	0	
30024		COM1: Communication Type	T1	2	RS485
				9	Infra-red
				13	M-BUS
30029		I/O 1	T1	0	No I/O
				5	Tariff Input
				10	Digital input
30030		I/O 2	T1	0	No I/O
				12	Pulse Output (SO)
				26	Load control Output
30047	30048	Calibration Time Stamp	T10		
30079		MID unlock counter	T1		

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
30080		FW upgrade counter	T1		
30096		CheckSum Parameters	T1		
30097		CheckSum Firmware	T1		
30098		Active Communication Port	T1	0	IR
				1	COM1
30099		Modbus Max. Register Read at Once	T1		
30101		Phase valid measurement	T1	Bit 0	Invalid measurement phase 1
				Bit 1	Invalid measurement phase 2
				Bit 2	Invalid measurement phase 3

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
		ACTUAL MEASUREMENTS			
30105	30106	Frequency	T5		
30107	30108	U1	T5		
30126	30127	I1	T5		
30140	30141	Active Power Total (Pt)	T6		
30148	30149	Reactive Power Total (Qt)	T6		
30156	30157	Apparent Power Total (St)	T5		
30164	30165	Power Factor Total (PFt)	T7		
30172		Power Angle Total(atan2(Pt,Qt))	T17		
30182		U1 THD%	T16		
30188		I1 THD%	T16		
30197		External relay status	T1	0	Off
				1	On
				250	Comm. Error
				255	Not connected
30198		Load control output status	T1	0	Off
				1	On
30199		Digital input status	T1	0	Off
				1	On
30200		Limit control output status	T1	0	Off
				1	On
				255	Disabled
30201		Button status	T1	0	Not pressed
				1	pressed

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
		ENERGY			
30400		Error register	T1	0	No Error
				Bit 0	Error Parameter CRC
				Bit 1	Error Firmware CRC
				Bit 2	MID version is not locked
30401		Energy Counter 1 Exponent (resettable)	T2		
30402		Energy Counter 2 Exponent (resettable)	T2		
30403		Energy Counter 3 Exponent (resettable)	T2		
30404		Energy Counter 4 Exponent (resettable)	T2		
30405		Current Active Tariff	T1		
30406	30407	Energy Counter 1 (resettable)	T3		
30408	30409	Energy Counter 2 (resettable)	T3		
30410	30411	Energy Counter 3 (resettable)	T3		
30412	30413	Energy Counter 4 (resettable)	T3		
30414		Energy Counter 1 Exponent (Non-reset)	T2		
30415		Energy Counter 2 Exponent (Non-reset)	T2		
30416		Energy Counter 3 Exponent (Non-reset)	T2		
30417		Energy Counter 4 Exponent (Non-reset)	T2		
30418	30419	Energy Counter 1 (Non-reset)	T3		
30420	30421	Energy Counter 2 (Non-reset)	T3		
30422	30423	Energy Counter 3 (Non-reset)	T3		
30424	30425	Energy Counter 4 (Non-reset)	T3		
30426	30427	1000 x Energy Counter 1 (res.)	T3		
30428	30429	1000 x Energy Counter 2 (res.)	T3		
30430	30431	1000 x Energy Counter 3 (res.)	T3		
30432	30433	1000 x Energy Counter 4 (res.)	T3		
30434	30435	1000 x Energy Counter 1 (Non -res.)	T3		
30436	30437	1000 x Energy Counter 1 (Non -res.)	T3		
30438	30439	1000 x Energy Counter 1 (Non -res.)	T3		
30440	30441	1000 x Energy Counter 1 (Non -res.)	T3		
34999	35000	Run time	T3		seconds

Address		Contents	Data	Ind	Values	min	max	P. Level
		RAM logger						
36000		Measurement parameter	T1		See OutTypes			
36001		Time interval	T1		minutes			
36002		Number of valid results	T1					
36003		Time stamp of last result	T2		minutes since midnight (<0 if no time)			
36004	36131	Logger table (newest to oldest)	T17		Normalised values			

ACTUAL MEASUREMENTS

		SYSTEM COMMANDS						
40001	40002	User Password (L1, L2)	T_Str4	A…Z	Password to attempt user access level upgrade			0
40003	40005	Factory Password (FAC)	T_Str6	A…Z	Password to attempt factory access level upgrade			0
40006	40007	Level 1 - User password	T_Str4	A…Z				2
40008	40009	Level 2 - User password	T_Str4	A…Z				2
40010		Active Access Level	T1	0	Full protection	0	0	0
				1	Access up to level 1 user password			
				2	Access up to level 2 user password			
				3	Access up to level 2 (backup pass.)			
				4	Factory access level			
40011		Manual password activation	T1	1	Lock instrument			0
40012		Operator Command Register	T1	1	Save Settings			1
				2	Abort Settings			
				3	Restart Instrument			

Address		Contents	Data	Ind	Values	min	max	P. Level
40013		Reset command register 1	T1	Bit-0	Reset counter 1			1
				Bit-1	Reset counter 2			
				Bit-2	Reset counter 3			
				Bit-3	Reset counter 4			
				Bit-4	Reset alarm output relay 2			
40015		IR external relay command action	T1	0	Off	0	1	0
				1	On			
40016		Load control Output state		0	Off	0	1	0
				1	On			
40017		Digital input function		0				
				1	Tariff input			
				2	IR relay push button			
				3	IR relay switch			
				4	External relay push button			
				5	External relay switch			
40101	40120	Description	T_Str16					2
40121	40140	Location	T_Str16					2

Address		Contents	Data	Ind	Values	min	max	P. Level
40151		CT connection	T1	2	Reverse Energy flow direction (Fixed)	2	2	2
40173		LCD Mode	T1	0	Manual	0	1	2
				1	Cycling			
40174		LCD cycling period	T1		Seconds	5	60	2
40184		LCD parameters	T1	Bit 0	Counter 1 (Always)	1	65535	2
				Bit 1	Counter 2			
				Bit 2	Counter 3			
				Bit 3	Counter 4			
				Bit 4	Active Power Total (Pt)			
				Bit 5	Reactive Power Total (Qt)			
				Bit 6	Apparent Power Total (St)			
				Bit 7	Power Factor Total (PFt)			
				Bit 8	Power Angle total(atan2(Pt,Qt))			
				Bit 12	Frequency			
40185		Operation mode		0	Normal mode	0	1	0
				1	Test mode P-Fast			
				2	Test mode P –Fast (Counter only)			
				4	Test mode Q			
				5	Test mode Q - Fast			
				6	Test mode Q – Fast (Counter only)			
40186		External relay operating mode	T1	0	Not connected	0	1	2
				1	Manual			
40187		Limits enabled		0	None	0	4	2
				1	Limit 1			
				2	Limit 2			
				3	Limit 1 OR Limit 2			
				4	Limit 1 AND Limit 2			
40188		Display notification		0	None	0	2	2
				1	Relay ON			
				2	Relay OFF			

Address		Contents	Data	Ind	Values	min	max	P. Level
		LIMIT						
40189		Limit 1: Parameter	T1		See OutTypes			
40190		Limit 1: Compare relation	T1	0	measurement > limit	0	1	2
				1	measurement < limit			
40191		Limit 1: ON level	T17		% of parameter value	-300	300	2
40192		Limit 1: OFF level	T17		% of parameter value	-300	300	2
40193		Limit 1: Compare time delay	T1		seconds	0	600	2
40194	40198	Limit 2			see Limit 1			

		COMMUNICATION						
40202		Port 1: Device Address (Modbus)	T1			1	247	2
40203		Port 1: Baud Rate	T1	0	Baud rate 1200	1	7	2
				1	Baud rate 2400			
				2	Baud rate 4800			
				3	Baud rate 9600			
				4	Baud rate 19200			
40204		Port 1: Stop Bit	T1	0	1 Stop bit	0	1	2
				1	2 Stop bits			
40205		Port 1: Parity	T1	0	No parity	0	2	2
				1	Odd parity			
				2	Even parity			
40206		Port 1: Data Bits	T1	0	8 bits	0	0	2
		WIFI adapter						
42750		WIFI LCD menu time enabled	T1		Seconds			
42751		WIFI status	T1		WIFI status			
42752	42753	WIFI IP	T3		example: 129.168.001.255			
42754		WIFI command	T1		reset WIFI			
42755	42760	Reserved for WIFI numbers	T1					
42761	42770	WIFI status text 1	T_Str20					
42771	42780	WIFI status text 2	T_Str20					

Address		Contents	Data	Ind	Values	min	max	P. Level
		ENERGY						
40401		Active Tariff	T1	0	Tariff input	0	2	1
				1..2	Tariff 1..2			
40421		Energy Counter 1 Parameter	T1	1	Active Power	1	15	2
				2	Reactive Power			
				3	Apparent Power			
40422		Energy Counter 1 Configuration	T1	Bit-0	Quadrant I Enabled	0	63	2
				Bit-1	Quadrant II Enabled			
				Bit-2	Quadrant III Enabled			
				Bit-3	Quadrant IIII Enabled			
				Bit-4	Absolute Value			
				Bit-5	Invert Value			
40424		Energy Counter 1 Tarif Selector	T1	Bit-0	Tarif 1 Enabled	0	15	2
				Bit-1	Tarif 2 Enabled			
40425	40430	Reserved						
40431		Energy Cnt 2 Parameter	T1		See Energy Counter 1 Parameter			
40432		Energy Cnt 2 Configuration	T1		see Energy Counter 1 Configuration	0	63*	2
40434		Energy Cnt 2 Tarif Selector	T1		see Energy Counter 1 Tarif Selector	0	3	2
40441		Energy Cnt 3 Parameter	T1		see Energy Counter 2 Parameter	0	3*	2
40442		Energy Cnt 3 Configuration	T1		see Energy Counter 1 Configuration	0	63*	2
40444		Energy Cnt 3 Tarif Selector	T1		see Energy Counter 1 Tarif Selector	0	3	2
40451		Energy Cnt 4 Parameter	T1		see Energy Counter 2 Parameter	0	3*	2
40452		Energy Cnt 4 Configuration	T1		see Energy Counter 1 Configuration	0	63*	2
40454		Energy Counter 4 Tarif Selector	T1		see Energy Counter 1 Tarif Selector	0	3	2

		Counter freeze						
41901		Auto freeze interval [minutes]	T1					
41902		time to freeze [s]	T1					
41903	41904	time from freeze [s]	T3u					
41905		Freeze status	T1					
41906		Current Active Tariff	T1					
41907	41908	Energy Counter 1 (resetable)	T3					
41909	41910	Energy Counter 2 (resetable)	T3					
41911	41912	Energy Counter 3 (resetable)	T3					
41913	41914	Energy Counter 4 (resetable)	T3					
41915	41916	Energy Counter 1 (Non-reset)	T3					
41917	41918	Energy Counter 2 (Non-reset)	T3					
41919	41920	Energy Counter 3 (Non-reset)	T3					
41921	41922	Energy Counter 4 (Non-reset)	T3					
41923	41924	1000x Energy Counter 1 (resetable)	T3					
41925	41926	1000x Energy Counter 2 (resetable)	T3					
41927	41928	1000x Energy Counter 3 (resetable)	T3					
41929	41930	1000x Energy Counter 4 (resetable)	T3					
41931	41932	1000x Energy Counter 1 (Non-reset)	T3					
41933	41934	1000x Energy Counter 2 (Non-reset)	T3					
41935	41936	1000x Energy Counter 3 (Non-reset)	T3					
41937	41938	1000x Energy Counter 4 (Non-reset)	T3					

SUPPORTED FUNCTIONS AND USAGE

Code DEC	Code HEX	Function	References
3	03	to read from holding registers	(4XXXX memory references)
4	04	to read from input registers	(3XXXX memory references)
6	06	to write to a single holding register	(4XXXX memory references)
16	10	to write to one or more holding register	(4XXXX memory references)

DATATYPES DECODING

Registers defined in the Modbus database will define data as one of the data types described in the following table:

Type	Value / Bit Mask	Description
T1		Unsigned Value (16 bit) Example: 12345 stored as 12345 = $3039_{(16)}$
T2		Signed Value (16 bit) Example: -12345 stored as -12345 = $CFC7_{(16)}$
T3		Signed Long Value (32 bit) Example: 123456789 stored as 123456789 = 075B CD $15_{(16)}$
T4	 bits # 15..14 bits # 13..00	Short Unsigned float (16 bit) Decade Exponent(Unsigned 2 bit) Binary Unsigned Value (14 bit) Example: $10000*10^2$ stored as $A710_{(16)}$

Type	Value / Bit Mask	Description
T5	 bits # 31..24 bits # 23..00	Unsigned Measurement (32 bit) Decade Exponent(Signed 8 bit) Binary Unsigned Value (24 bit) Example: 123456*10^{-3} stored as FD01 $E240_{(16)}$
T6	 bits # 31..24 bits # 23..00	Signed Measurement (32 bit) Decade Exponent (Signed 8 bit) Binary Signed value (24 bit) Example: - 123456*10^{-3} stored as FDFE $1DC0_{(16)}$
T7	 bits # 31..24 bits # 23..16 bits # 15..00	Power Factor (32 bit) Sign: Import/Export (00/FF) Sign: Inductive/Capacitive (00/FF) Unsigned Value (16 bit), 4 decimal places Example: 0.9876 CAP stored as 00FF $2694_{(16)}$
T8	 bits # 31..24 bits # 23..16 bits # 15..08 bits # 07..00	Time stamp (32 bit) Minutes 00 - 59 (BCD) Hours 00 - 23 (BCD) Day of month 01 - 31 (BCD) Month of year 01 - 12 (BCD) Example: 15:42, 1. SEP stored as 4215 $0109_{(16)}$
T9	 bits # 31..24 bits # 23..16 bits # 15..08 bits # 07..00	Time (32 bit) 1/100s 00 - 99 (BCD) Seconds 00 - 59 (BCD) Minutes 00 - 59 (BCD) Hours 00 - 24 (BCD) Example: 15:42:03.75 stored as 7503 $4215_{(16)}$
T10	 bits # 31..24 bits # 23..16 bits # 15..00	Date (32 bit) Day of month 01 - 31 (BCD) Month of year 01 - 12 (BCD) Year (unsigned integer) 1998..4095 Example: 10, SEP 2000 stored as 1009 $07D0_{(16)}$
T_Str4 (T11)		Text String 4 characters Two characters per 16 bit register
T_Str6 (T12)		Text String 6 characters Two charcters per 16 bit register
T_Str8		Text String 8 characters Two characters per 16 bit register.
T_Str16		Text String 16 characters Two characters per 16 bit register.
T_Str20		Text String 20 characters Two characters per 16 bit register.
T16		Unsigned Value (16 bit), 2 decimal places Example: 123.45 stored as 123.45 = $3039_{(16)}$
T17		Signed Value (16 bit), 2 decimal places Example: -123.45 stored as -123.45 = $CFC7_{(16)}$

Type	Value / Bit Mask	Description
T_Time	 bits # 63..56 bits # 55..48 bits # 47..40 bits # 39..32 bits # 31..24 bits # 23..16 bits # 15..00	Time and Date (64 bit) 1/100s 00 - 99 (BCD) Seconds 00 - 59 (BCD) Minutes 00 - 59 (BCD) Hours 00 - 24 (BCD) Day of month 01 - 31 (BCD) Month of year 01 - 12 (BCD) Year (unsigned integer) 1998..4095 Example: 15:42:03.75, 10. SEP 2000 stored as 7503 4215 1009 $07D0_{(16)}$
T_TimeIEC	 bits # 63..55 bits # 54..48 bits # 47..44 bits # 43..40 bits # 39..37 bits # 36..32 bit # 31 bits # 30..29 bits # 28..24 bit # 23 bit # 22 bits # 21..16 bits # 15..00	Time and Date (64 bit) = IEC870-5-4 "Binary Time 2a" Reserved Years (0 .. 99) Reserved Months (1 .. 12) Day of Week (1 .. 7) Day of Month (1 .. 31) Summer Time (0 .. 1): Summer time (1), Standard time (0) Reserved Hours (0 .. 23) Invalid (0 .. 1): Invalid (1), Valid (0) Reserved Minutes (0 .. 59) Miliseconds (0 .. 59999) Example: 15:42, 1. SEP stored as 4215 $0109_{(16)}$
T_Data		Record Data Size and SubTypes depends on the Actual Memory Part
T_Str40		Text String 40 characters Two characters per 16 bit register.
T_float	 bits # 31 bits # 30..23 bits # 22..0	IEEE 754 Floating-Point Single Precision Value (32 bit) Sign Bit (1 bit) Exponent Field (8 bit) Significand (23 bit) Example: 123.45 stored as 123.45000 = 42F6 $E666_{(16)}$
T9A	 bits # 15..08 bits # 07..00	Time (16 bit) Minutes 00 - 59 (BCD) Hours 00 - 24 (BCD) Example: 15:42 stored as $4215_{(16)}$
T10A	 bits # 15..08 bits # 07..00	Date (16 bit) Day of month 00 - 31 (BCD) Month of year 00 - 12 (BCD) Example: 30, SEP stored as $3009_{(16)}$
T18		Signed Value (16 bit), 4 decimal places Example: -0.2345 stored as -2345 = $F6D7_{(16)}$
T_DSK		HEX value 16 bytes

8.2 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 WM1-6A. The M-BUS WM1-6A confirms correct receipt by Single Character Acknowledgement (ACK = E5). If the telegram was not correctly received the WM1-6A will not send an acknowledgement.

Select M-BUS WM3-6 Using Secondary Address (SND_UD)

This Telegram enables to select M-BUS WM3-6. The M-BUS WM3-6 confirms the correct receipt by ACK. If the telegram has not been correctly received the M-BUS WM1-6A will not send an Acknowledgement. After issue of the Single Character Acknowledgement the M-BUS WM1-6A 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 WM1-6A 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 WM1-6A and to command it to transmit the Read-out Data parameterized. The M-BUS WM1-6A 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 WM1-6A. 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 WM1-6A confirms the correct receipt by ACK. If the telegram was not received correctly the M-BUS WM1-6A does not send an Acknowledgement. The (ACK) is sent by the M-BUS WM1-6A in the Old Baud Rate. As soon as ACK is transmitted the M-BUS Meter switches to the baud rate newly parameterized. If the WM1-6A 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 WM1-6A confirms the correct receipt by ACK. If the telegram has not been correctly received the M-BUS WM1-6A 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 WM1-6A confirms the correct receipt by ACK. If the telegram has not been correctly received the M-BUS WM1-6A 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 MC350 via Primary/Secondary Address (SND_UD)

This Telegram reset/restarts M-BUS MC350. The M-BUS WM1-6A confirms correct receipt by ACK. If the telegram was not correctly received the M-BUS WM1-6A will not send an acknowledgement.

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	

8.3 APPENDIX C: 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

$$P_f = \frac{1}{N} \cdot \sum_{n=1}^{N} \left(u_{fn} \cdot i_{fn}\right)$$

Active power

N – a number of periods

n – index of sample in a period

f – phase designation (f = 1)

$$\mathrm{SignQ}_f(\varphi)$$
$$\varphi \in [0° - 180°] \Rightarrow \mathrm{SignQ}_f(\varphi) = +1$$
$$\varphi \in [180° - 360°] \Rightarrow \mathrm{SignQ}_f(\varphi) = -1$$

Reactive power sign

Q_f – reactive power

φ – power angle

$S_f = U_f \cdot I_f$	**Apparent power** U_f – phase voltage I_f – phase current
$Q_f = \mathrm{SignQ}_f(\varphi) \cdot \sqrt{S_f^2 - P_f^2}$	**Reactive power** S_f – apparent power P_f – active power
$Q_f = \frac{1}{N} \cdot \sum_{n=1}^{N} \left(u_{f\,n} \times i_{f\,[n+N/4]} \right)$	**Reactive power by phases (displacement method)** N – a number of samples in a period n – sample number (0 ≤ n ≤ N) f – phase designation
$\varphi_s = \arctan 2(P_t, Q_t)$ $\varphi_s = [-180°, 179{,}99°]$	**Total power angle** P_t – total active power Q_t – total reactive power
$PF = \frac{\lvert P \rvert}{S}$	**Distortion power factor** P – active power S –apparent power

THD

$I_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} I_n^{\ 2}}}{I_1} \cdot 100$	**Current THD** I_1 – value of first harmonic n – number of harmonic
$U_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} U_{fn}^{\ 2}}}{U_{f1}} \cdot 100$	**Phase voltage THD** U_1 – value of first harmonic n – number of harmonic

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Published by Iskra, d.o.o. • Subject to change without notice • Version 1.01 December 2021 • EN K22.433.913