User 's Manual

EN

Energy meters WM3x6

Three-phase electrical energy meter

WM3-6

Three-phase electrical energy meter

WM3M6

April 2019 • Version 1.02

Three-phase electrical energy meter

WM3x6

User and Installation manual

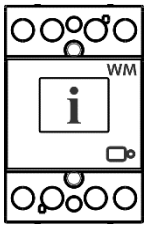
Security Advices and Warnings

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 three-phase energy meter WM3x6.

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 three-phase energy meter WM3x6. 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.

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 three-phase energy meter WM3x6 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 three-phase energy meters **WM3-6, WM3M6 (MID certified)** are intended for energy measurements in three-phase electrical power network and can be used in residential, industrial and utility applications. Meters measure energy directly in 4-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 (for each phase and total sum) 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 three-phase electric energy meter WM3x6*

1 Current terminals – to load
2 AUX terminals (options):
- RS485
- M-BUS
- PULSE OUTPUT
- TARIFF INPUT

3 IR COMM PORT –ON SIDE
4 Information display
5 DIN-Rail fitting
6 User button and LED indicator (1000 imp/kWh)
7 Current terminal – source (max 65 A)

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 Three-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.

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) or built-in **pulse output** (option).

Tariff input provides measurement of two tariffs for selected energy registers.

Pulse output is sending data to the devices for checking and monitoring consumed energy.

On the housing there are only two terminals, thus only one functional extension is possible (serial communication, tariff input, pulse output).

1.3 Main features

- Three-phase direct connected DIN-rail mounting meters up to maximum current ($\mathbf{I_{max}}$) **65 A.**
- Basic current (I_b) 5 A.
- **MID** approval (option for WM3M6).
- **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 3x230 V/400 V (U_n).
- Voltage operating range (-20 % ... +15 %) U_n.
- **Pulse output** according to EN 62053-31 (option).
- **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) and energy (each phase and total).
    - Voltage (each phase).
    - Current (each phase).
    - Phase to phase voltage.
    - Phase to phase angle.
    - Frequency.
    - Power factor (each phase and total).
    - Power angle (each phase and total).
    - Active tariff (option).
    - THD of voltage.
    - THD of current.
- **3-DIN rail** width mounting according to EN 60715.
- **Sealable** terminal cover.

2 CONNECTION

This chapter deals with the instructions for three-phase electrical energy meter WM3x6 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

Threee-phase electrical energy meter WM3x6 is intended for DIN-rail mounting. In case of using the stranded wire, the ferrule must be attached before the mounting.

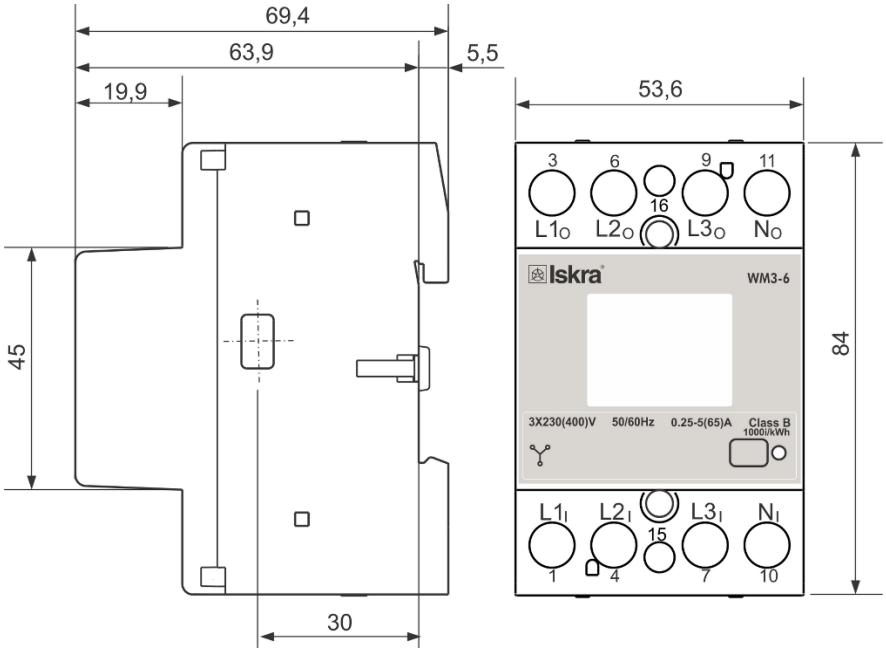
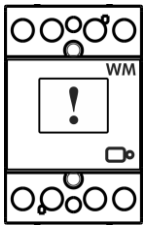


Figure 2: *Dimensional drawing and rear connection terminals position*

2.2 Electrical connection



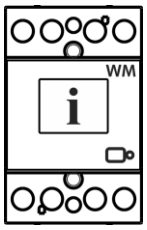
WARNING

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

Meter is used for direct connection into the four-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 2.5 mm^2 – 16 mm^2
   b. Connection screws M5
   c. Max torque 3.5 Nm
3. Auxiliary terminals:
   a. Auxiliary terminals contact capacity 1 mm^2 – 2.5 mm^2
   b. Auxiliary terminals screws M3
   c. Max torque 1.2 Nm



PLEASE NOTE

Neutral wire must be connected to the meter.

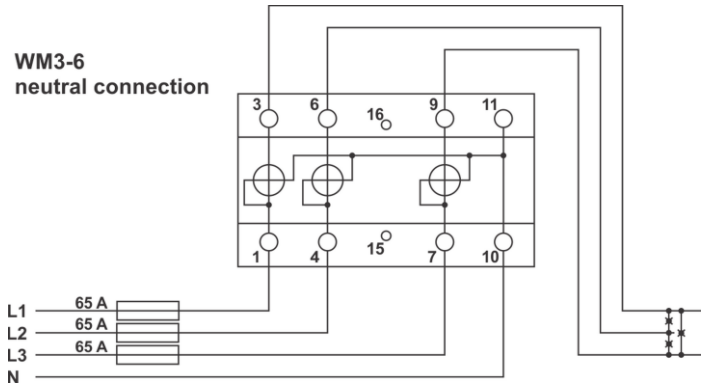


Figure 3: *Neutral connection of energy meters*

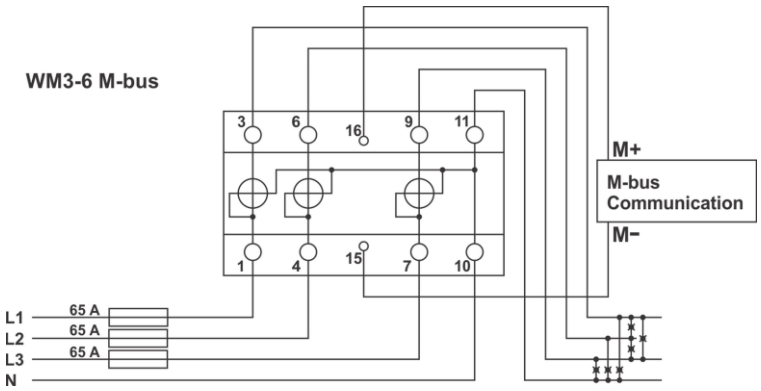


Figure 4: *Connection diagram for M-BUS option*

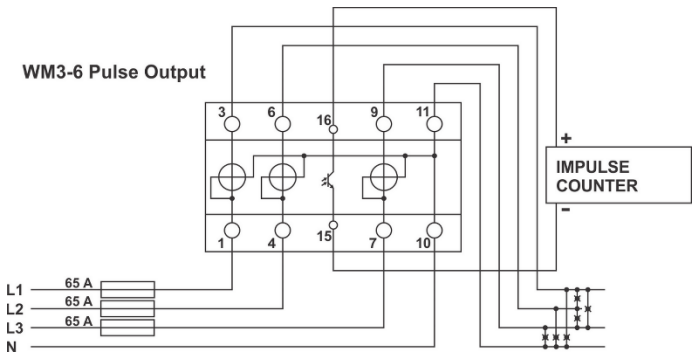


Figure 5: *Connection diagram for pulse output option*

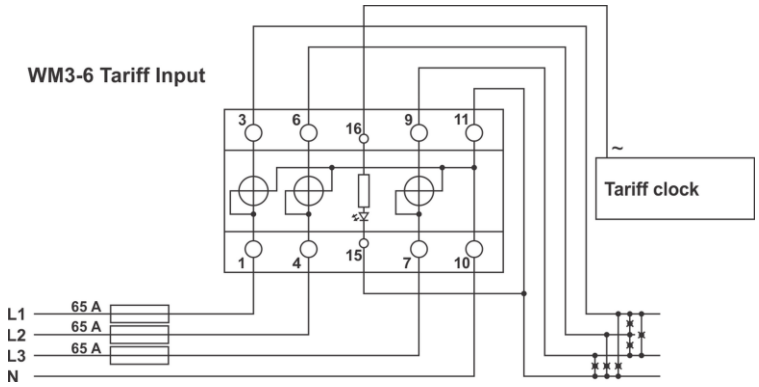


Figure 6: *Connection diagram for tariff input option*

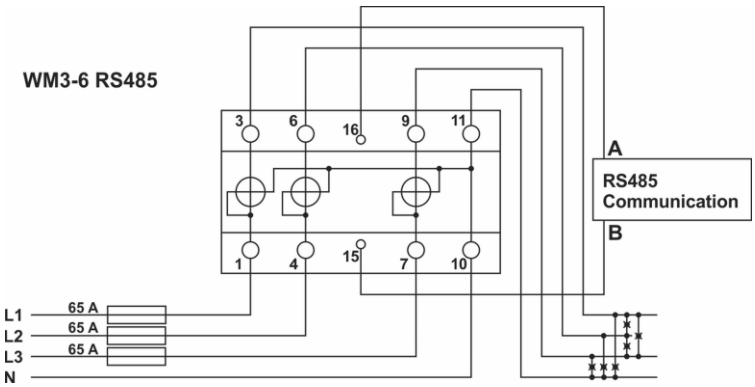


Figure 7: *Connection diagram for RS485*

Complete WM3x6 system is assembled with three main units and optionally communication unit:

- Individual phase measurement unit.
- Power supply unit (based on configuration).
- Processing unit (MCU) with IR communication, LED indicator, LCD support and EEPROM.
- Optionally available different communication units or extension modules (RS485, M-BUS, TARIFF, PULSE).

2.2.1 Communication connection

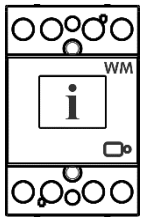
For communication with outside world multiple manners are used:

- **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 and test output proportional to measured active energy. It can be also switched to reactive energy for test purpose using IR communication.
- **RS485 (option)** communication module is galvanic isolated form 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 meter, data readout in the network and tariff setting.
- **Push button** is used to select display of desired measured or group of them.

Table 1: *Survey of communication connection*

Auxiliary terminal	**15**	**16**
M-Bus	M-	M+
Pulse output	SO-	SO+
Tariff input	AC2	AC1
RS485*	B	A

*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 three-phase electrical energy meter WM3x6 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

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
   – Four numbers - Code of MID approved energy counter.
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
10 Active phase display

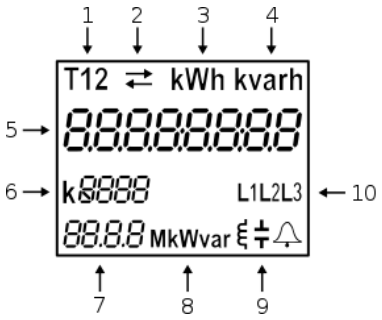


Figure 8: *Layout of LCD (welcome screen)*

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.

Test output is provided as LED with number of impulses proportional to active energy. Pulse constant is 1000 imp/kWh. Optionally the S0 impulse output with the same constant can be used for active energy. Pulse output is defined to be (32 ± 2) ms long according EN 62053-31.

Energy measurement is blocked for the currents less than 20 mA. The meter measures actual voltage and frequency. Current and power values are set to zero and there is no energy registration. No load condition is indicated with the LED on.

If the supply voltage is too low, the energy measurements are also blocked and communication is disabled. LCD stops to cycle and displays only value of voltage.

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:

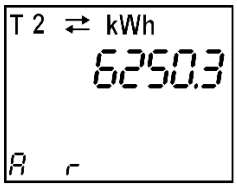
1. **Energy registers**. Two different types (resettable and non-resettable), both of them count the same quantity. The resettable energy counter can be reset, while the non-resettable has been measuring the quantity continuously. The energy counter you reset starts to re-measure the value from the zero.
    - **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, total, ph1, ph2, ph3
    - II. Reactive Power, total, ph1, ph2, ph3
    - III. Apparent Power total, ph1, ph2, ph3
    - IV. Power Factor, total, ph1, ph2, ph3
    - V. Voltages U1, U2, U3
    - VI. Phase to phase voltages U12, U13, U23
    - VII. Frequency
    - VIII. Current I1, I2, I3
    - IX. Power Angle total

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

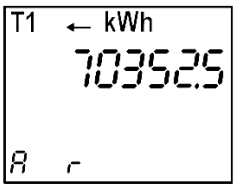
The button is used for navigating between measurement screens and for selecting/confirming the settings.

3.2.1 Energy counters

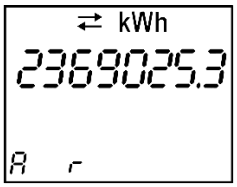
Energy counters are represented as shown on LCD examples bellow (up to 4 resetable counters, letter r representing it). At the top of the screen is settings of energy counter (tariff, import/export/total, active/reactive/apparent), the 8-digit numerical number shows the value of the energy and the letter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



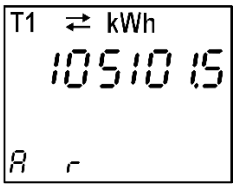
counter 1



counter 2

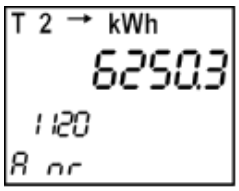


counter 3

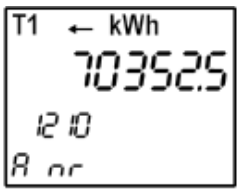


counter 4

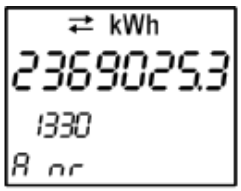
Non-MID meters show resettable counters (letter r representing it).



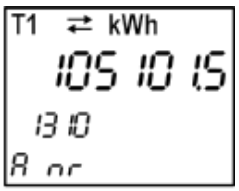
counter 1



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.

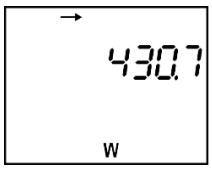
Counter 4 shows: Total Active Energy = 105101.5 kWh at Tarif 1.

3.2.2 Other measurements

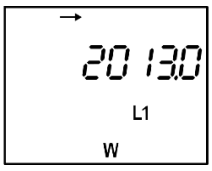
The number on the screen shows the actual value of the measured quantity (P-W, Q-var, S, PF, U, f and I). On the screen as well is the direction of active energy flow (import/export), reactance (inductive/capacitive) and active tariff (regarding tariff input).

Active power:

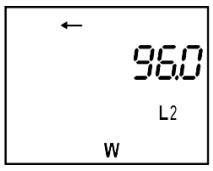
Active power total



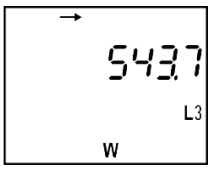
Active power phase 1



Active power phase 2

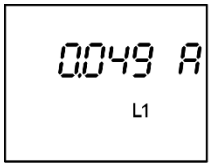


Active power phase 3

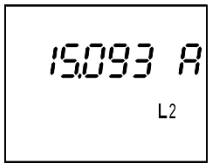


Phase currents:

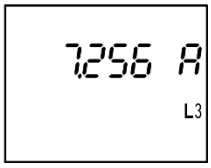
Current phase 1



Current phase 2

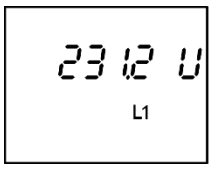


Current phase 3

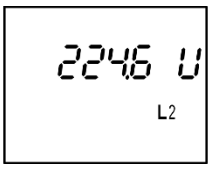


Phase Voltages:

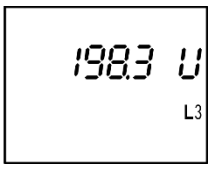
Voltage phase 1



Voltage phase 2

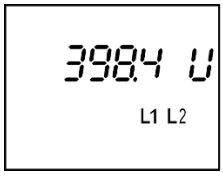


Voltage phase 3

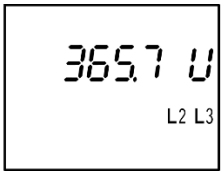


Phase to phase Voltages:

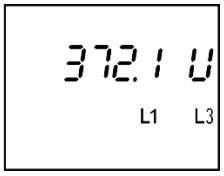
Phase to phase U_{12}



Phase to phase U_{23}

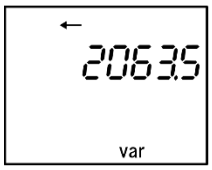


Phase to phase U_{13}

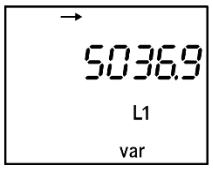


Reactive powers:

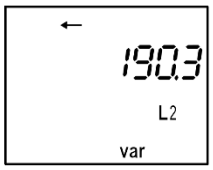
Reactive power total



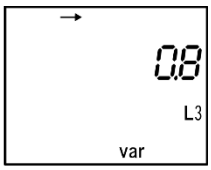
Reactive power phase 1



Reactive power phase 2

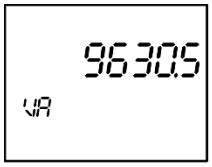


Reactive power phase 3

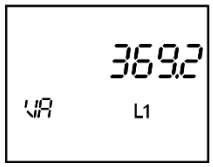


Apparent powers:

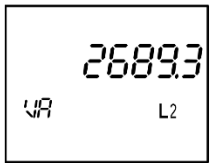
Apparent power total



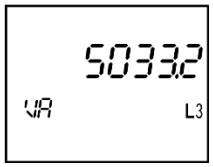
Apparent power phase 1



Apparent power phase 2

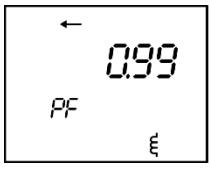


Apparent power phase 3

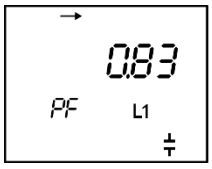


Power factors:

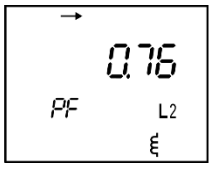
Power factor total



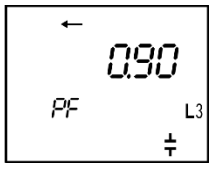
Power factor phase 1



Power factor phase 2

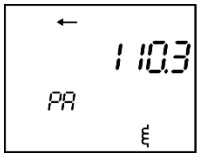


Power factor phase 3

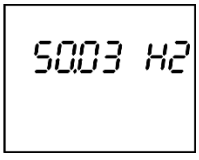


Power angle:

Power angle total

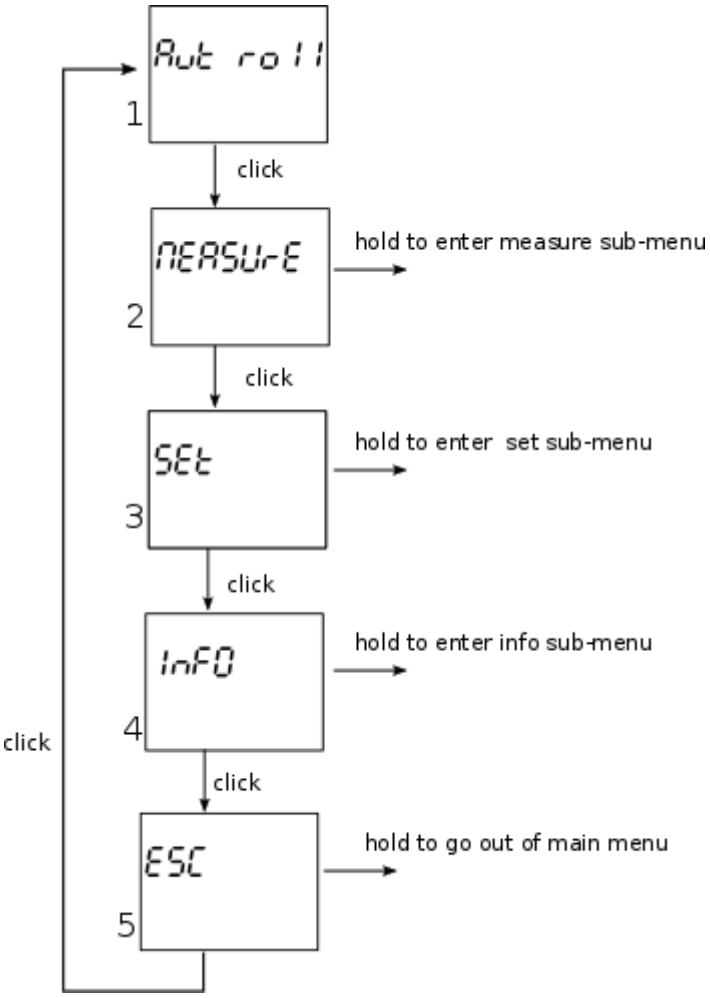


Frequency:



3.2.3 Display menu structure

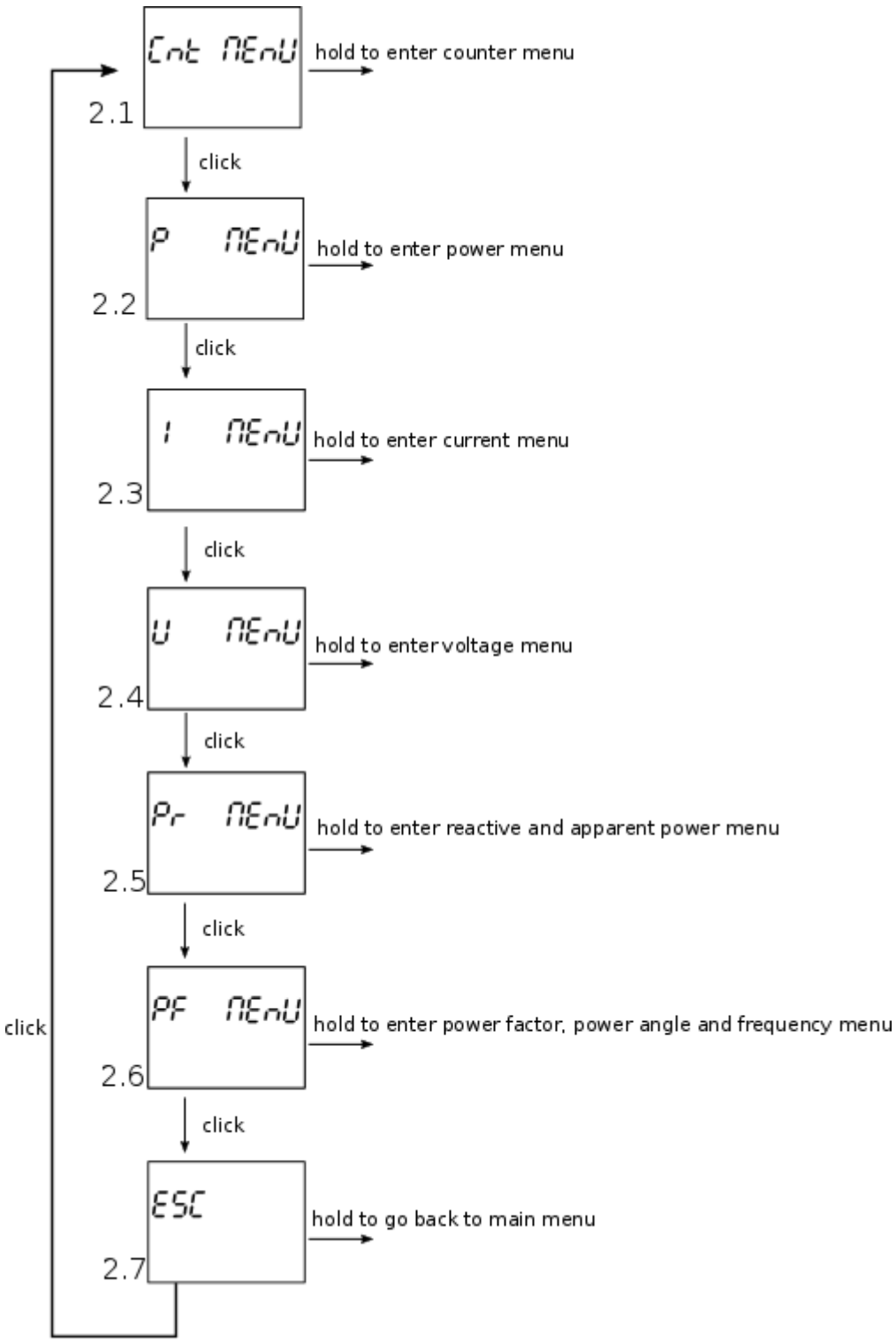
The display menu is entered by holding the push button for more than one second. Blinking of the screen indicates that.
Short clicks then move user through the main menu.



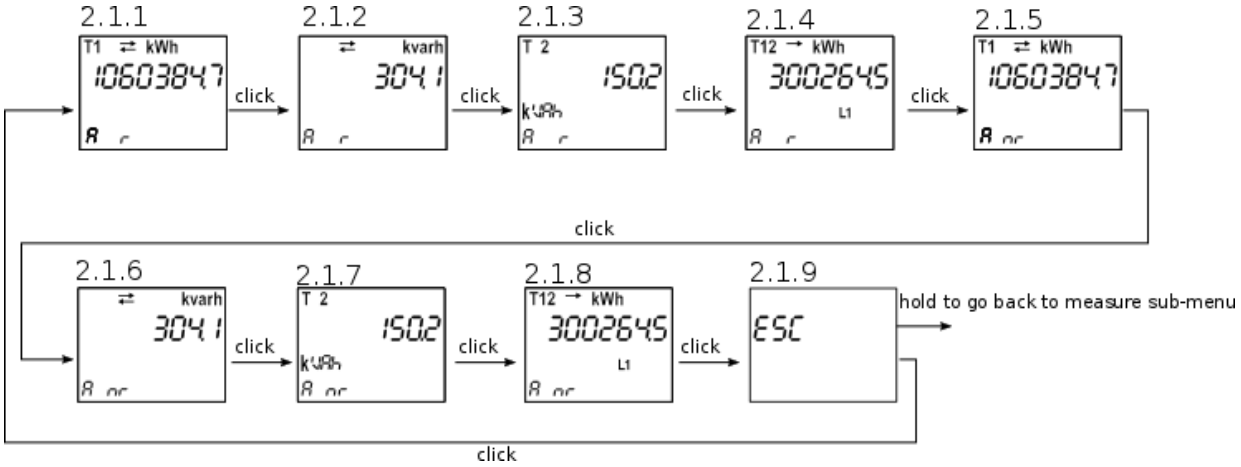
By holding the button when positioned on certain screen (e.g. measure, set, etc…) the sub-menu is entered.

3.2.3.1 Measure sub-menu

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



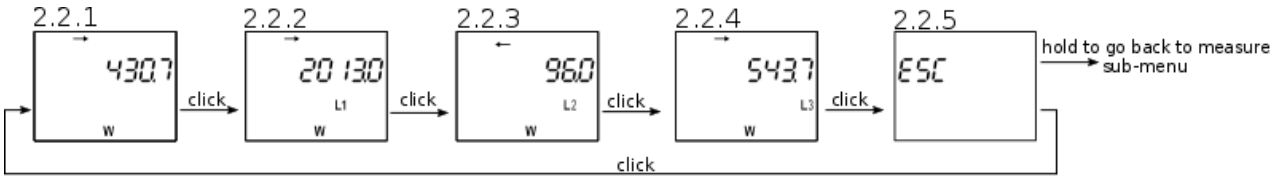
3.2.3.1.1 Counter menu



Holding button on any of screens 2.1.1 through 2.1.8 sets this screen as a meter screen.

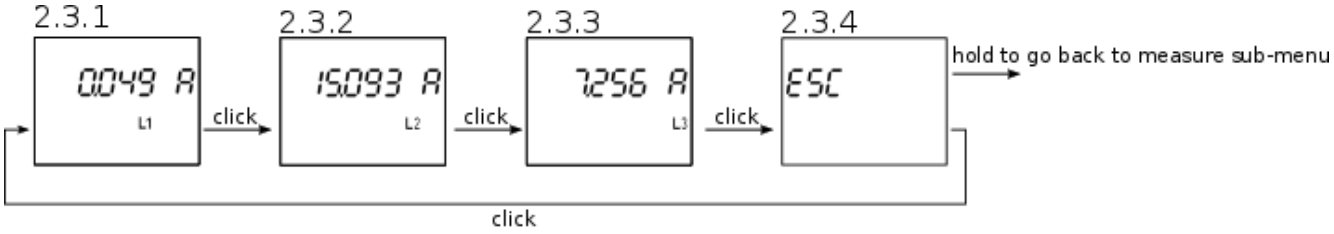
In the Counter menu all counters (resettable and non-resettable) are displayed for both – MID and non MID meters.

3.2.3.1.2 Power menu



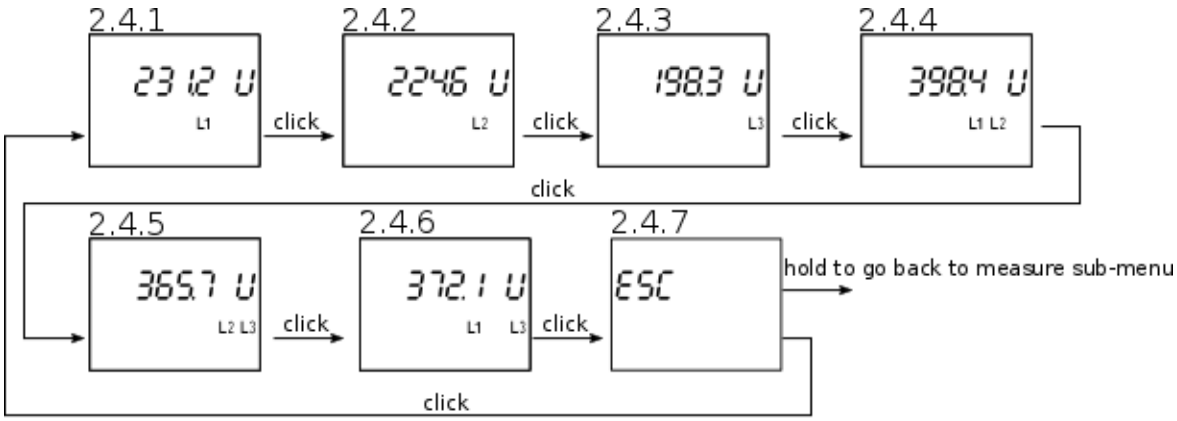
Holding button on any of screens 2.2.1 through 2.2.4 sets this screen as a meter screen.

3.2.3.1.3 Current menu



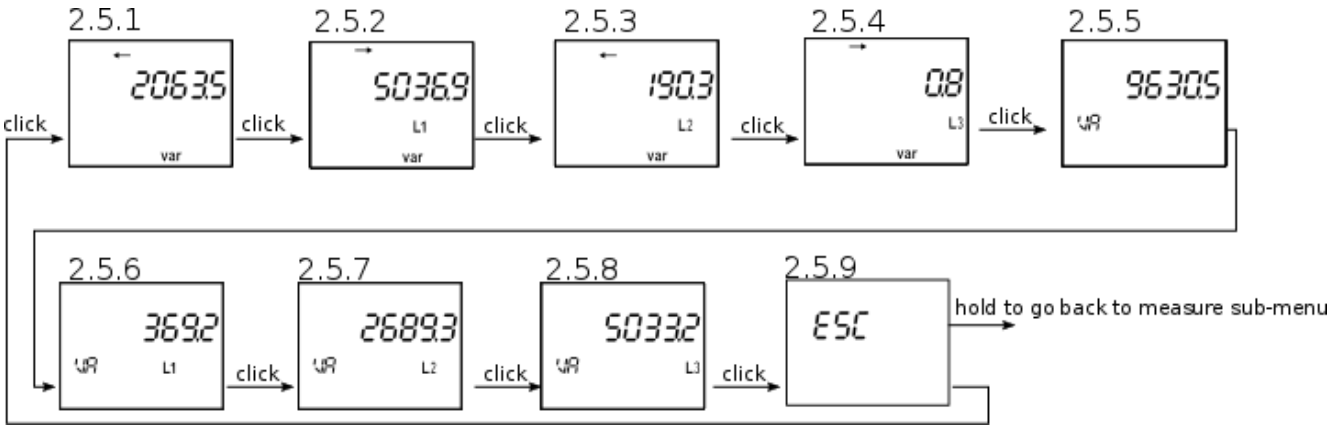
Holding button on any of screens 2.3.1 through 2.3.3 sets this screen as a meter screen.

3.2.3.1.4 Voltage menu



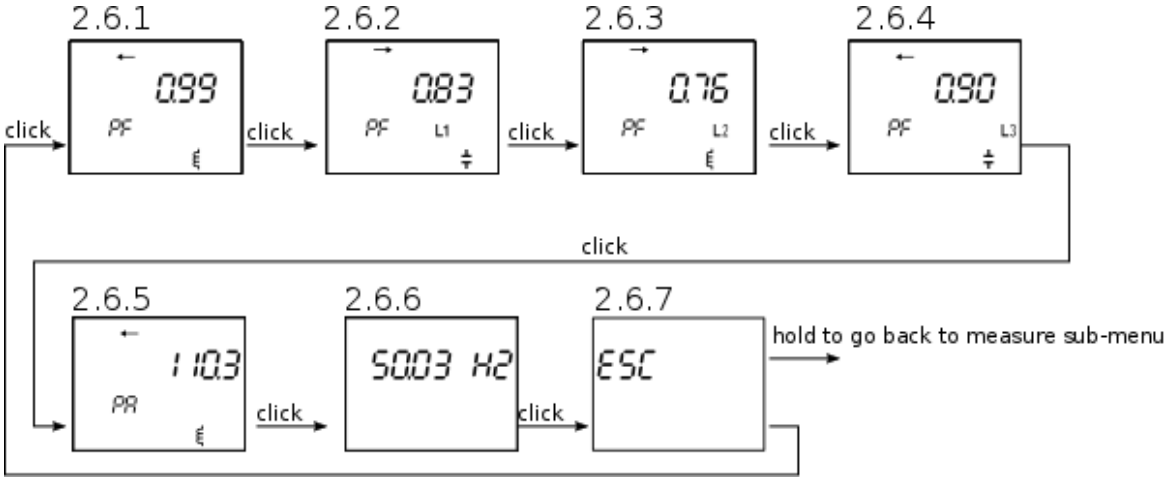
Holding button on any of screens 2.4.1 through 2.4.6 sets this screen as a meter screen.

3.2.3.1.5 Reactive and apparent power menu



Holding button on any of screens 2.5.1 through 2.5.8 sets this screen as a meter screen.

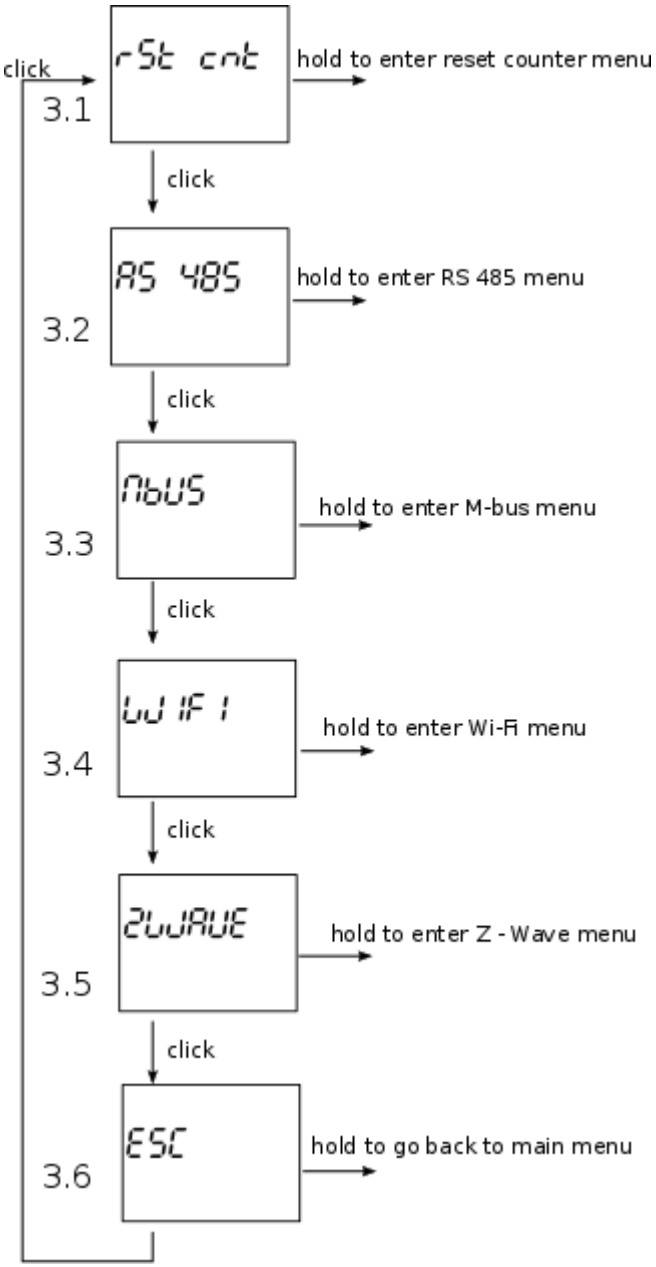
3.2.3.1.6 Power factor, power angle and frequency menu



Holding button on any of screens 2.6.1 through 2.6.6 sets this screen as a meter screen.

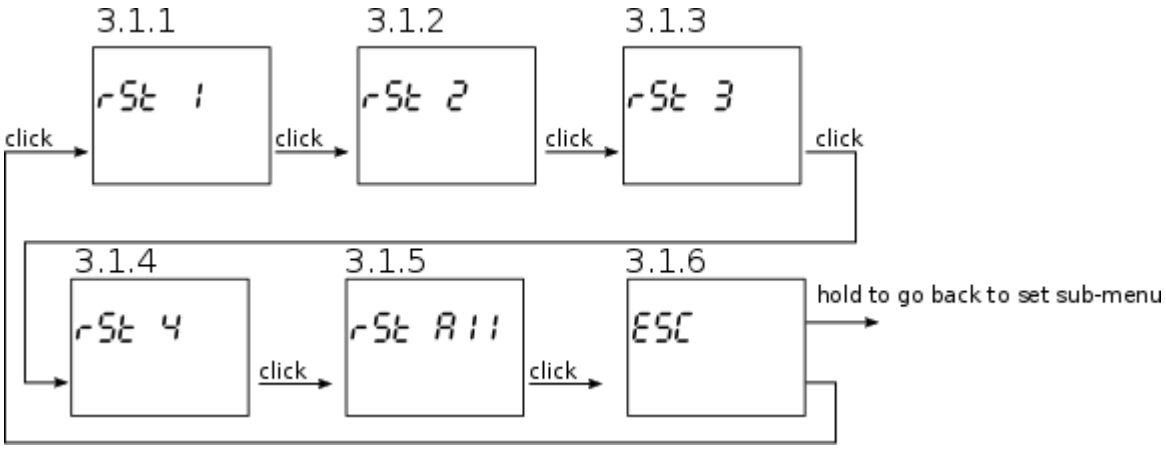
3.2.3.2 Set sub-menu

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



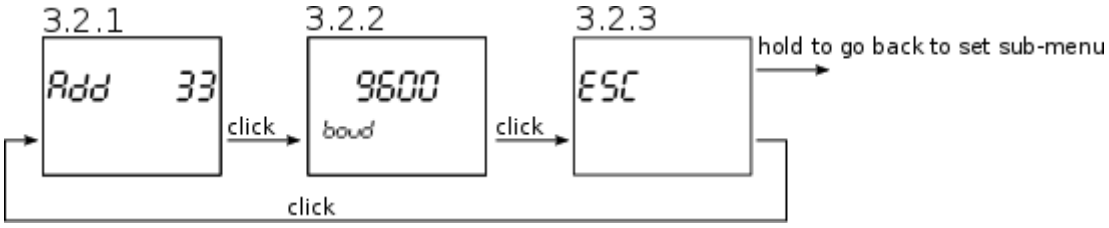
The screens 3.2 to 3.4 appear only in case the actual option is available on the meter.

3.2.3.2.1 Reset counters menu



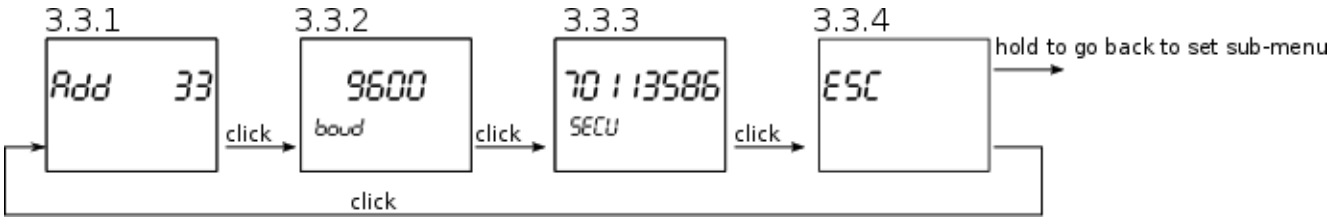
Holding button on any of screens 3.1.1 through 3.1.5 resets any of counters or all of them respectively.

3.2.3.2.2 RS485 menu



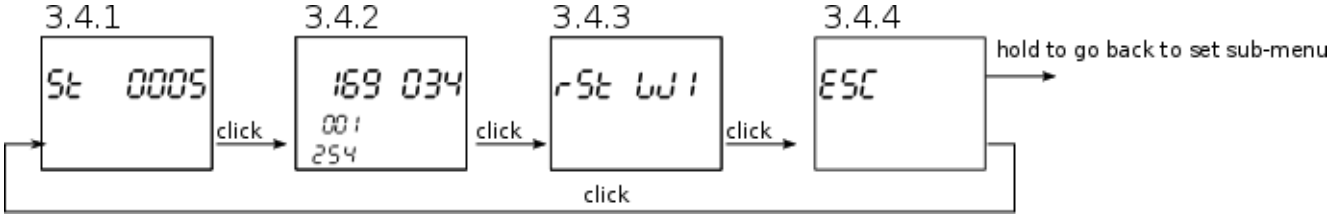
Screen 3.2.1 shows the address of RS 485 communication and screen 3.2.2 shows the baud rate.

3.2.3.2.3 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.

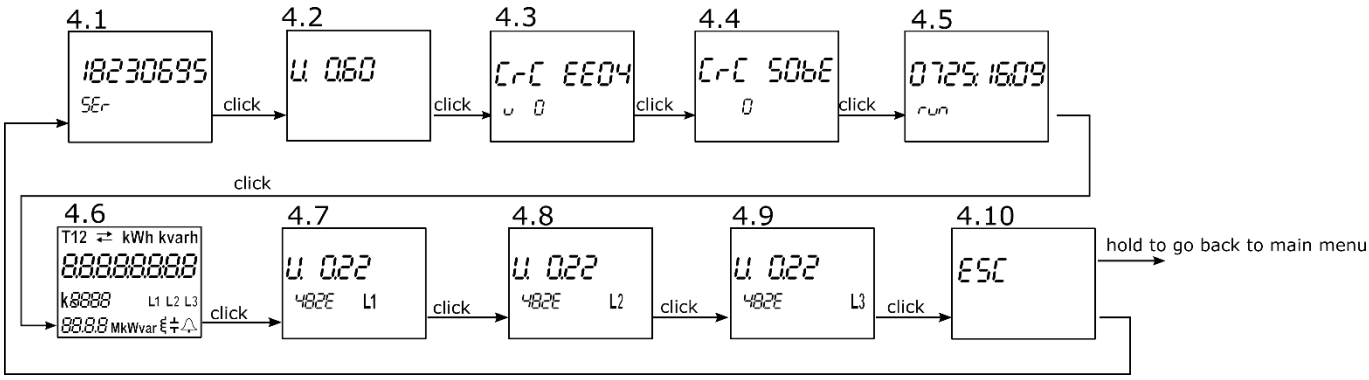
3.2.3.2.4 Wi-Fi menu



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.

3.2.3.4 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 WM3M6 (MID version) was unlocked.

Screen 4.5 shows operating time (days:hour:minute) of WM3-6.

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 WM3-6 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.

3.3 Limits

WM3-6 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

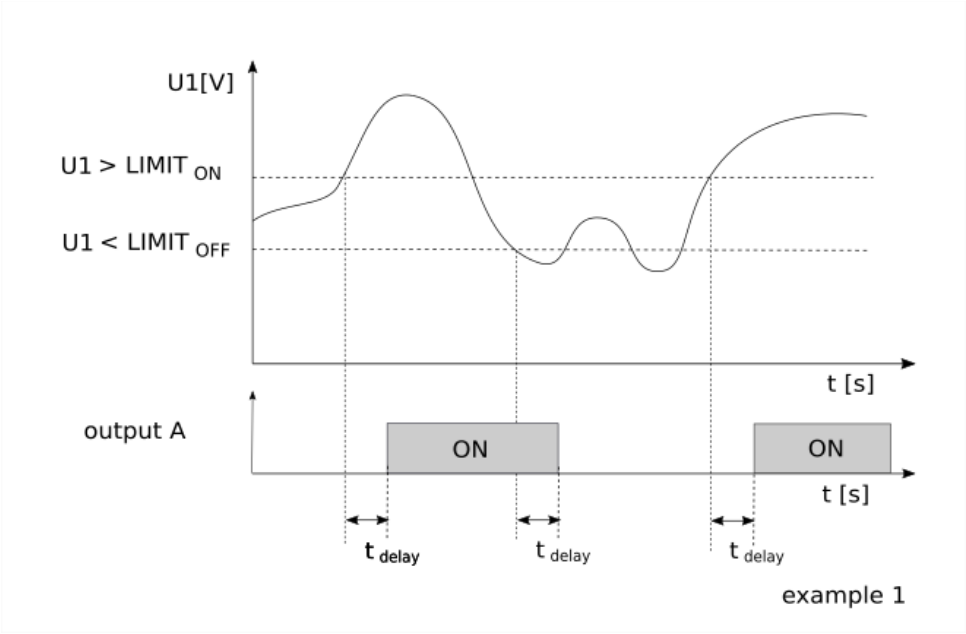
2 Limit function can monitor the following measured values:
- Voltages: U_1, U_2, U_3, U_{12}, U_{23}, U_{13}
- Currents: I_1, I_2, I_3
- Active power: P_{tot}, P_1, P_2, P_3
- Reactive Power: Q_{tot}, Q_1, Q_2, Q_3
- Apparent Power: A_{tot}, A_1, A_2, A_3
- Power Factor: PF_{tot}, PF_1, PF_2, PF_3
- 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).

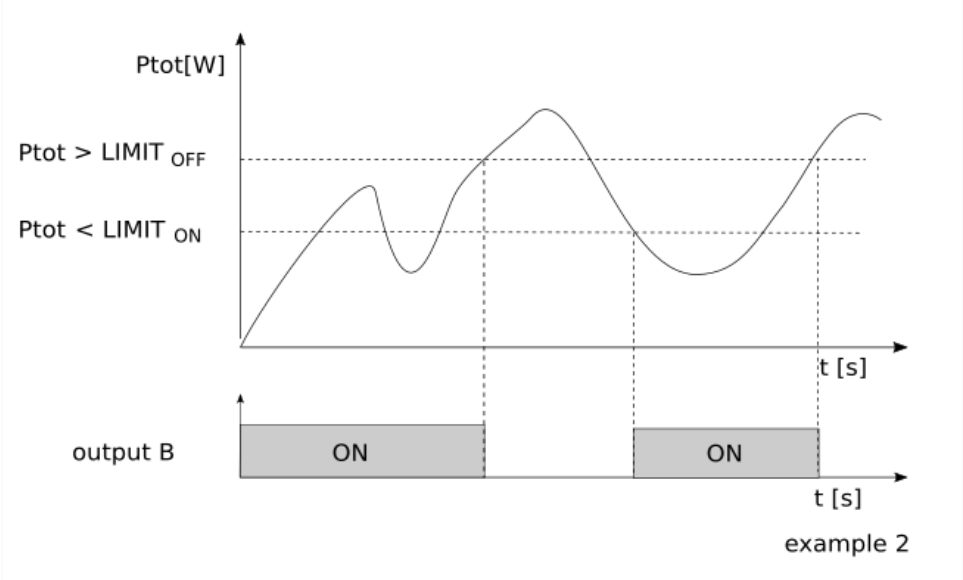
Figure below (example 1) shows the example using U1 as a limit A and delay time t_{delay}.



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).

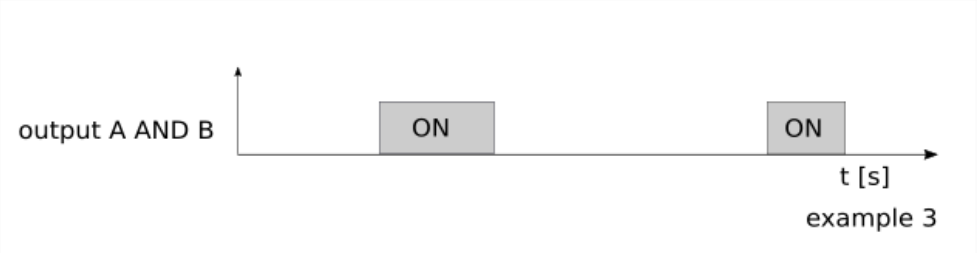
Figure below (example 2) shows the example using Ptot as a limit B and no delay time.



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.

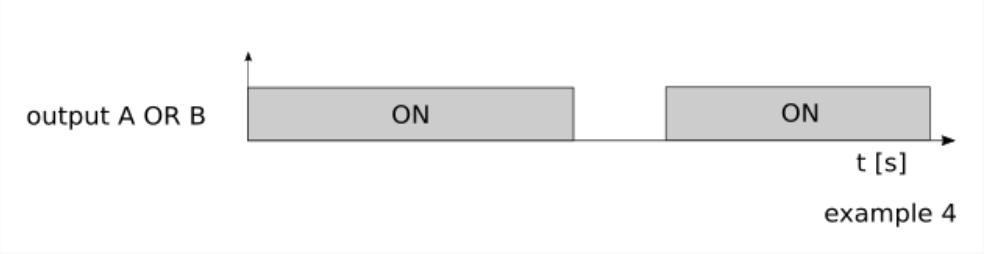
Figure below (example 3) shows the example of output A AND B being ON. For clearer picture refer also to output A (example 1) and output B (example 2) figures.



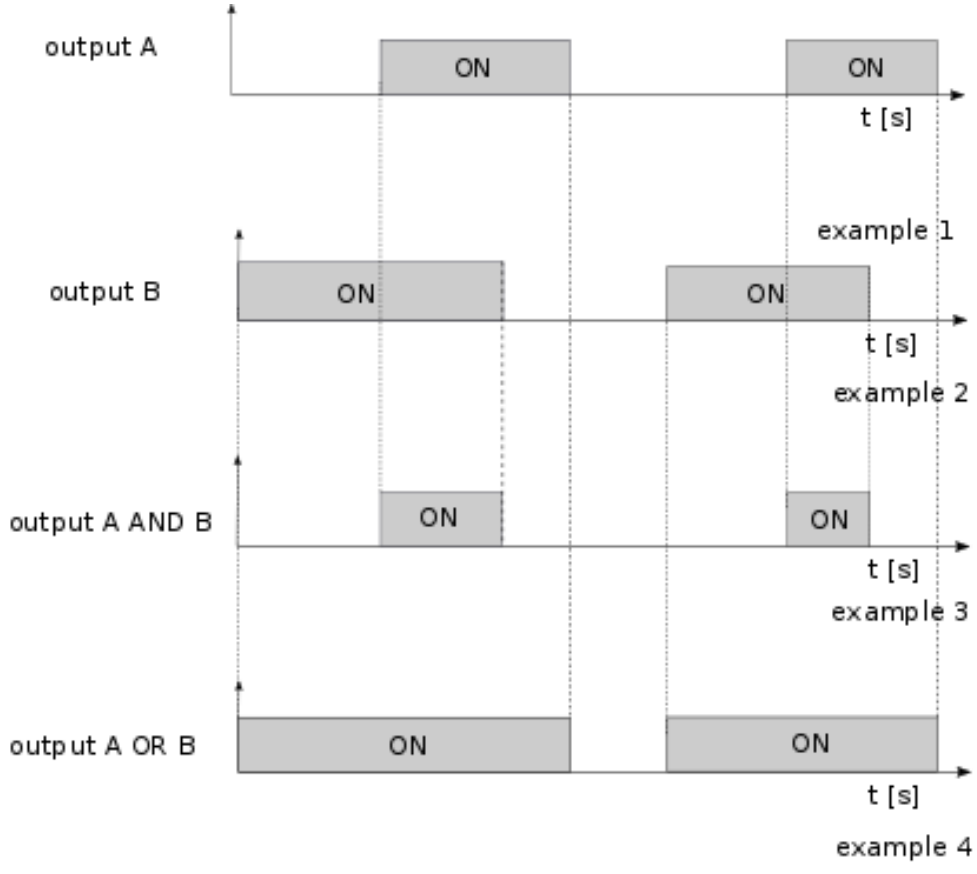
Limit A OR Limit B

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
2	U1	U1	U1	*		*	Un
3	U2	U2	U2	*		*	Un
4	U3	U3	U3	*		*	Un
5	U12	U12	U12	*		*	Un
6	U23	U23	U23	*		*	Un
7	U31	U31	U31	*		*	Un
9	I	I	I	*	*		In
10	I1	I1	I1	*		*	In
11	I2	I2	I2	*		*	In
12	I3	I3	I3	*		*	In
16	P	P	Active Power P	*	*	*	Pn
17	P1	P1	Active Power Phase L1 (P1)	*		*	Pn
18	P2	P2	Active Power Phase L2 (P2)	*		*	Pn
19	P3	P3	Active Power Phase L3 (P3)	*		*	Pn
20	Q	Q	Reactive Power Q	*	*	*	Pn
21	Q1	Q1	Reactive Power Phase L1 (Q1)	*		*	Pn
22	Q2	Q2	Reactive Power Phase L2 (Q2)	*		*	Pn
23	Q3	Q3	Reactive Power Phase L3 (Q3)	*		*	Pn
24	S	S	Apparent Power S	*	*	*	Pn
25	S1	S1	Apparent Power Phase L1 (S1)	*		*	Pn
26	S2	S2	Apparent Power Phase L2 (S2)	*		*	Pn
27	S3	S3	Apparent Power Phase L3 (S3)	*		*	Pn
28	PF	PF	Power Factor PF	*	*	*	1
29	PF1	PF1	Power Factor Phase 1 (PF1)	*		*	Pn
30	PF2	PF2	Power Factor Phase 2 (PF2)	*		*	Pn

Code	Ident	Parameter		Limit	WM1-6	WM3-6	Value 100%
31	PF3	PF3	Power Factor Phase 3 (PF3)	*		*	Pn
36	PA	PA	PA angle between U and I	*	*	*	100°
37	PA1	PA1	j1 (angle between U1 and I1)	*		*	1
38	PA2	PA2	j2 (angle between U2 and I2)	*		*	1
39	PA3	PA3	j3 (angle between U3 and I3)	*		*	1
40	A12	fi U12	j12 (angle between U1 and U2)	*		*	100°
41	A23	fi U23	j23 (angle between U2 and U3)	*		*	100°
42	A31	fi U31	j31 (angle between U3 and U1)	*		*	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 WM3-6 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 WM3x6 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 WM3x6 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 WM3x6 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)

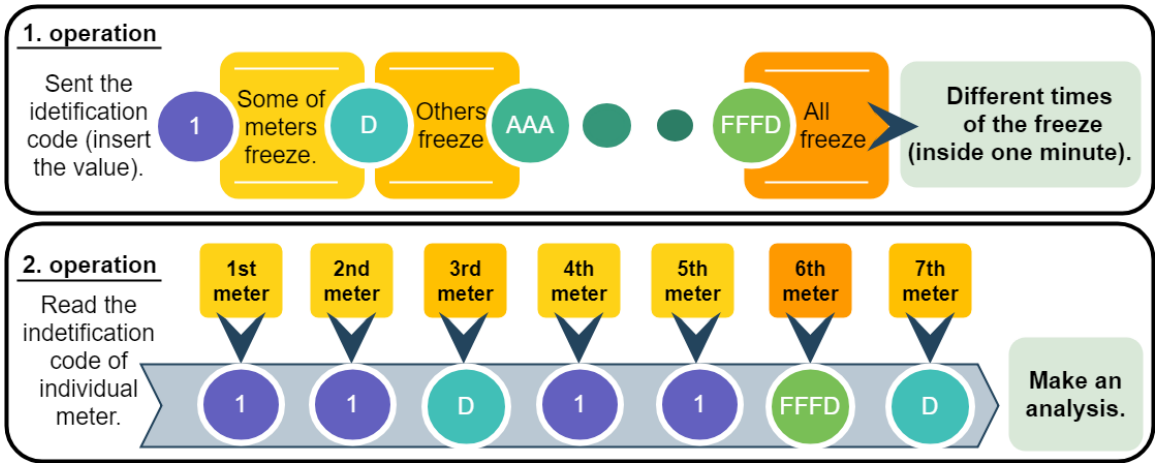
The purpose of the auto freeze interval register is to freeze energy meters in the same time interval, for example, every day. Set the certain auto freeze interval (in minutes). Maximum allowed value is 65535 minutes. Periodic synchronization is activated automatically after the entered interval. If 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 ***WM3x6*** 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.

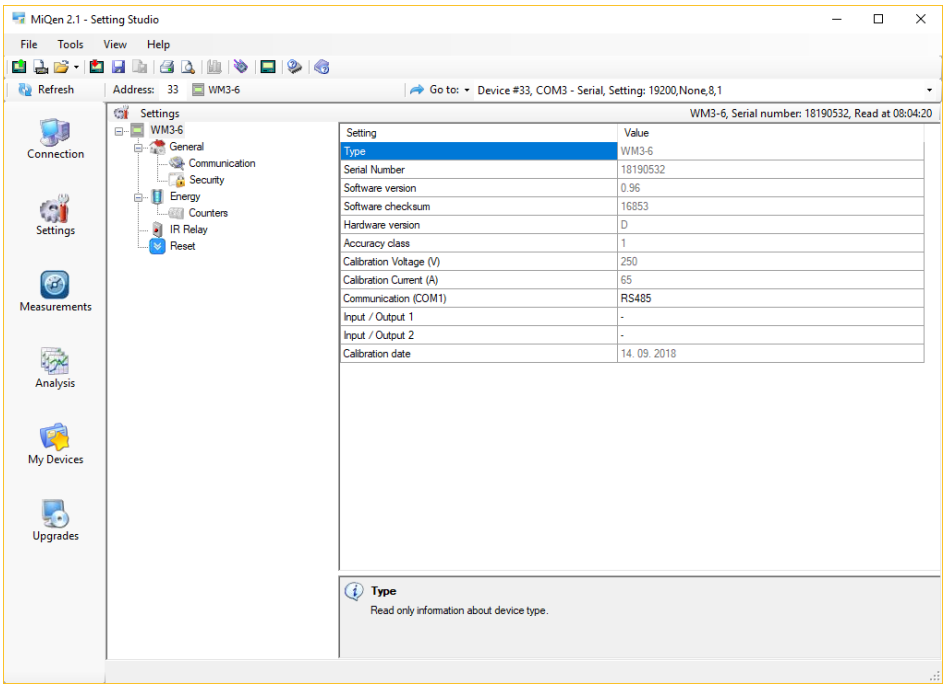


Figure 9: *MiQen programming and monitoring software*

MiQen version 2.1 or higher is required for programming and monitoring ***WM3x6***. 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

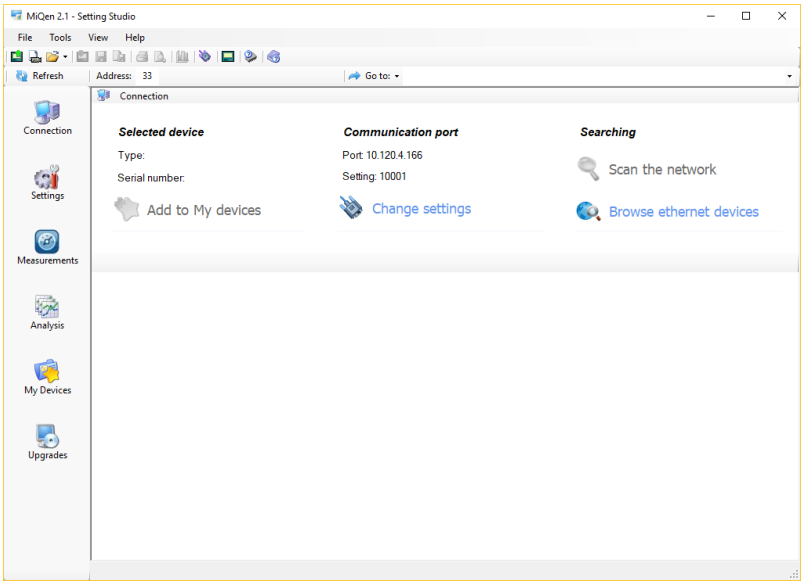


Figure 10: *MiQen Device Management window*

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.

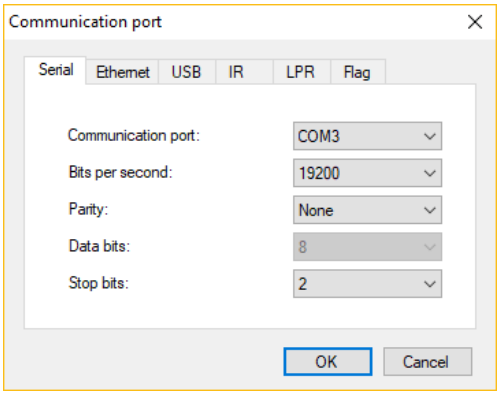
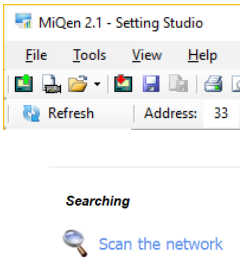


Figure 11: *Communication port window*

WM3x6 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):

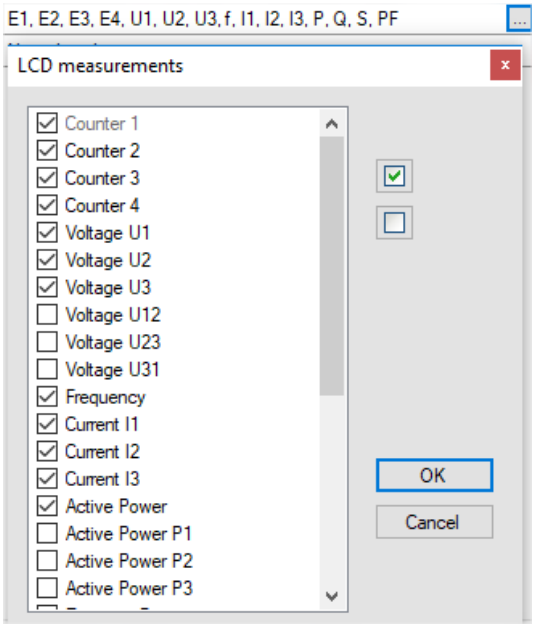


Figure 12: *Set of optional measurements*

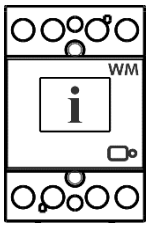
Operating Mode *segment is intended for selection between Normal Mode and various test modes. After reset or power cycle meter starts in Normal Mode.*

4.4.2 Communication

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

4.4.2.1 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 three groups regarding security level: PL1 >password level 1, PL2 >password level 2 and BP >a backup password.



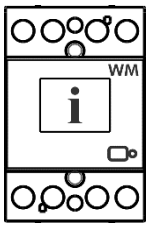
PLEASE NOTE

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.

4.4.3 ENERGY

Active tariff
Changing tariff settings is allowed only on non MID meters.
Switching between tariffs is done with a tariff input or by selecting values in a drop-down menu.

4.4.3.1 Counters

Changing counter settings is allowed only on non MID meters.

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.

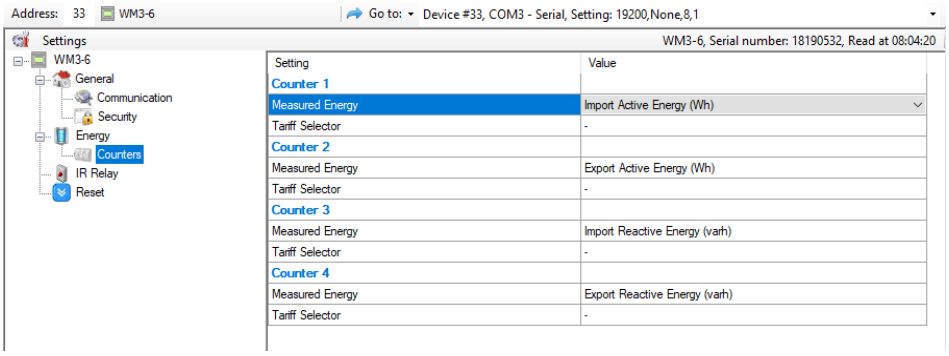
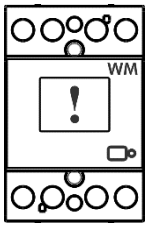


Figure 14: *MiQen energy counters*



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 WM3x6 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 WM3x6 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 onlyfor 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 or graphical form. All data can be exported to an Access database, Excel worksheets or as a text file.

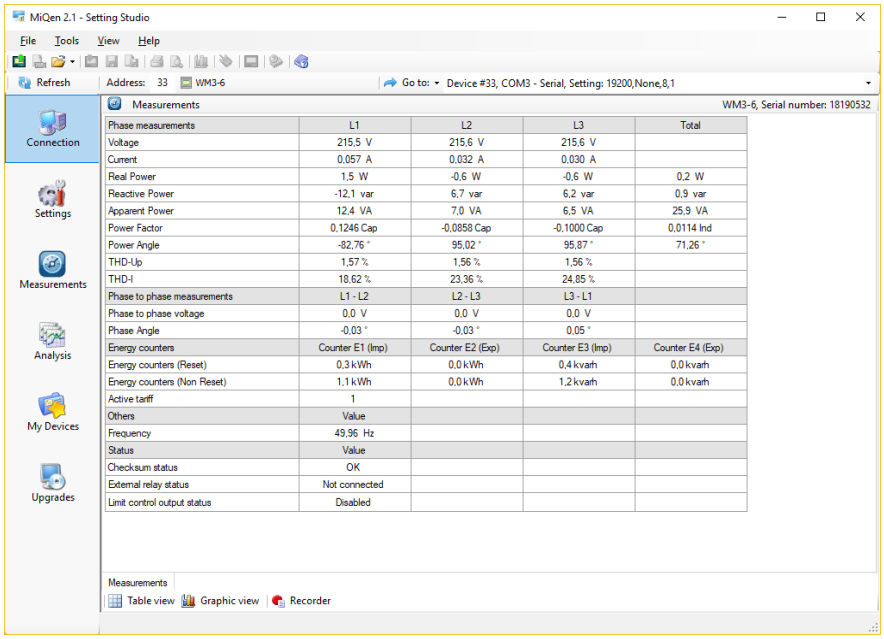


Figure 15: *Measurements in tabular form*

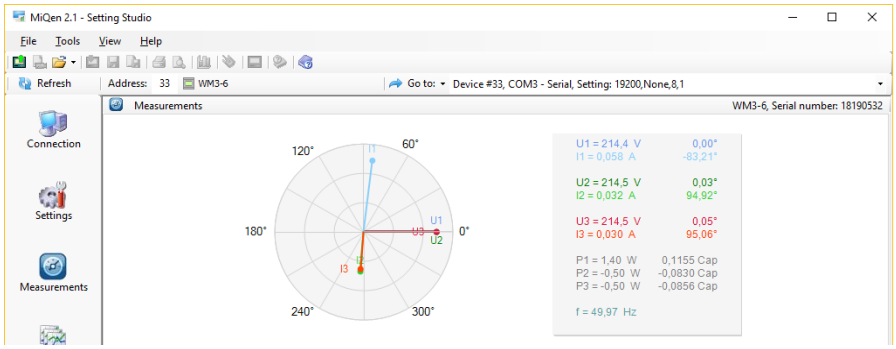


Figure 16: *Measurements in graphical form*

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.

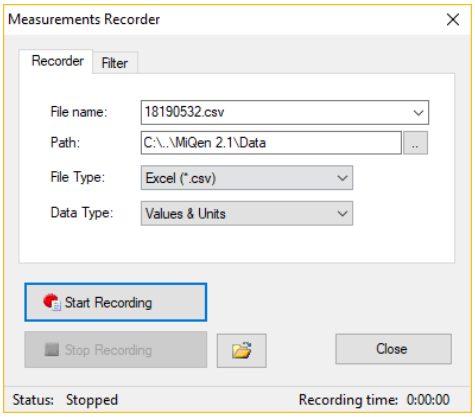
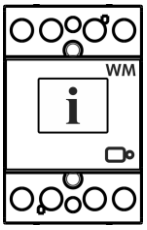


Figure 17: *Measurements Recorder*

4.6 DATA ANALYSIS



PLEASE NOTE

The energy meter WM3x6 do not support data analysis.

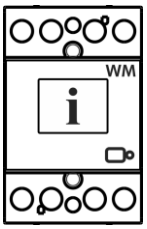
4.7 MY DEVICES

My devices section enables the personal selection of devices.

4.8 Software upgrading

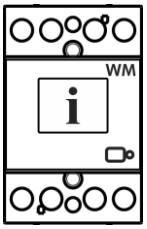
MID version does not support software upgrade.

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

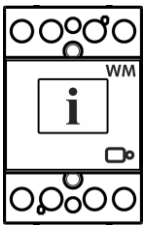
MiQen cannot be used for execution of firmware upgrades of devices. It only informs that new version is available and offers link to download it from the server. Software for execution of firmware upgrades is included in downloaded zip file together with upgrade file, upgrade procedure description and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

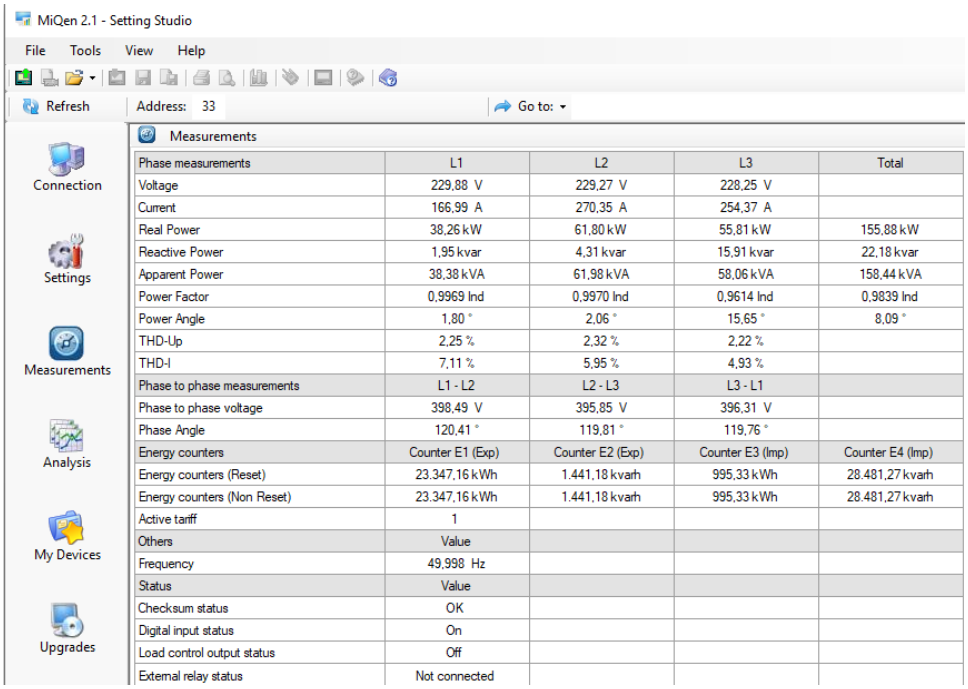
Supported settings and functions depend on the type of device.

5 MEASUREMENTS

The ***WM3-6*** is bidirectional energy meter measures voltage and current. From which it is able to calculate two quantities, imported and exported energy. The ***WM3-6*** energy meter performs measurements with a sampling frequency equal to 3906,25 Hz.

5.1 Online measurements

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



Phase measurements	L1	L2	L3	Total
Voltage	229,88 V	229,27 V	228,25 V	
Current	166,99 A	270,35 A	254,37 A	
Real Power	38,26 kW	61,80 kW	55,81 kW	155,88 kW
Reactive Power	1,95 kvar	4,31 kvar	15,91 kvar	22,18 kvar
Apparent Power	38,38 kVA	61,98 kVA	58,06 kVA	158,44 kVA
Power Factor	0,9969 Ind	0,9970 Ind	0,9614 Ind	0,9839 Ind
Power Angle	1,80 °	2,06 °	15,65 °	8,09 °
THD-Up	2,25 %	2,32 %	2,22 %	
THD-I	7,11 %	5,95 %	4,93 %	
Phase to phase measurements	L1 - L2	L2 - L3	L3 - L1	
Phase to phase voltage	398,49 V	395,85 V	396,31 V	
Phase Angle	120,41 °	119,81 °	119,76 °	
Energy counters	Counter E1 (Exp)	Counter E2 (Exp)	Counter E3 (Imp)	Counter E4 (Imp)
Energy counters (Reset)	23.347,16 kWh	1.441,18 kvarh	995,33 kWh	28.481,27 kvarh
Energy counters (Non Reset)	23.347,16 kWh	1.441,18 kvarh	995,33 kWh	28.481,27 kvarh
Active tariff	1			
Others	Value			
Frequency	49,998 Hz			
Status	Value			
Checksum status	OK			
Digital input status	On			
Load control output status	Off			
External relay status	Not connected			

Figure 9: *Online measurements in tabelaric form*

5.2 Selection of available quantities

Microprocesor calculates the RMS voltage, RMS current, active, reactive and apparent power, U-I phase angle, first harmonic of voltage, first harmonic of current, peak to peak voltage, THD of voltage and THD of current. Complete selection of available online measuring quantities is shown in a table below.

Meas. type	Measurement	3-phase	comments
Phase measurements	Voltage		
	U_{1-3_RMS}	☑	
	Current		
	I_{1-3_RMS}	☑	
	Power		
	P_{1-3_RMS}	☑	
	P_{TOT_RMS}	☑	
	Q_{1-3_RMS}	☑📖	Reactive power can be calculated as a squared difference between S and P or as sample delayed
	Q_{TOT_RMS}	☑	
	S_{1-3_RMS}	☑	
	S_{TOT_RMS}	☑	
	PF_{1-3_RMS}	☑	
	PF_{TOT}	☑	
	φ_{1-3_RMS}	☑	
	φ_{TOT_RMS}	☑	
	Harmonic analysis		
	THD-U_{1-3}	☑	
	THD-I_{1-3}	☑	
Phase to phase measurements	Voltage		
	Upp_{1-3_RMS}	☑	
	φ_{x-y_RMS}	☑	Phase-to-phase angle
Metering	Energy	☑	
	Counter E_{1-8}	☑	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
	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

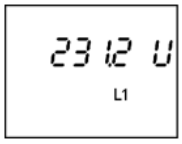
Voltage related measurements are listed below:

- Real effective (RMS) value of all phase voltages (U_1, U_2, U_3) and phase-to-phase voltages (U_{12}, U_{23}, U_{31}).
- Phase and phase-to-phase voltage angles (φ_{12}, φ_{23}, φ_{31})

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

$$U_{xy} = \sqrt{\frac{\sum_{n=1}^{N} (u_{xn} - u_{yn})^2}{N}}$$

All voltage measurements are available through communication as well as on standard or customized displays.



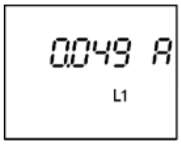
5.3.2 Current

WM3-6 energy meter measures:

- real effective (RMS) value of phase currents

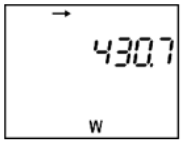
$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$$

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

Two different variants of displaying Energy counters are available:

- by individual counter,
- by tariffs for each counter separately.

5.3.7 Harmonic distortion

WM3-6 energy meter calculates THD for phase currents and phase voltages 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 three-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.

Terminals		***Max. conductor cross-sections***
Main inputs	*Contacts capacity:*	*2.5 mm^2 ... 25 (16) mm^2*
	Connection screws:	*M5*
	Max torque:	*3.5 Nm (PZ2)*
	Length of removed isolation:	*10 mm*
Optional modules	*Contacts capacity:*	1 mm^2... 2.5 mm^2
	Connection screws:	*M3*
	Max torque:	*1.2 Nm*
	Length or removed isolation:	*8 mm*

6.3 Electrical characteristics of input

Inputs and outputs		
Measuring input	*Type (connection):*	*three-phase (4u)*
	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 per phase 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 38400 bit/s (default 38400 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):	*216 g (230 g)*
Installation:	*DIN Rail 41 mm*
Dimensions (W x H x D):	*53,6 mm x 84 mm x 64 mm (69 mm)*
Package dimensions (W x H x D):	*57 mm x 93 mm x 85 mm*
Colour:	*RAL 7035*

6.5 EU DIRECTIVES CONFORMITY

6.5.1 WM3M6 MID certified meters

MID approval applies to non-resettable active energy counters.

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

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

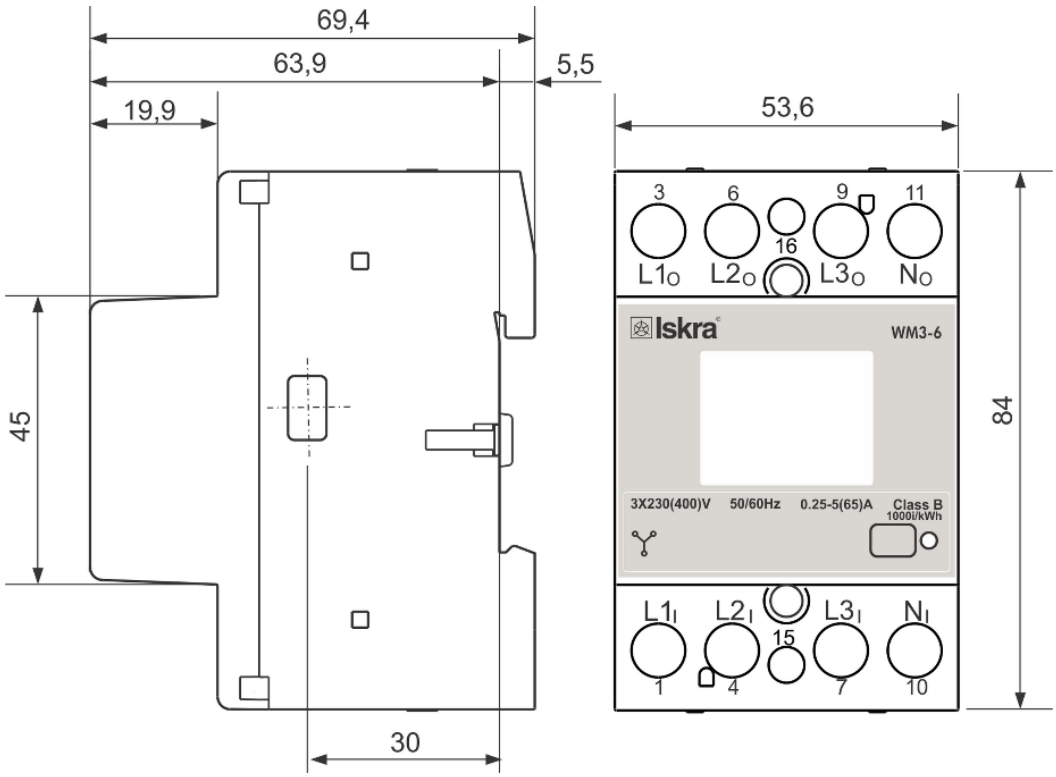
EU Directive on Low Voltage **2014/35/EU**

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

EU RED Directive **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:

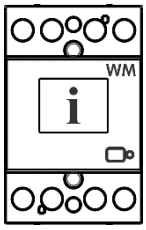
Term	*Explanation*
MODBUS	*Industrial protocol for data transmission*
MiQen	*Setting Software for ISKRA instruments*
AC	*Alternating quantity*
IR	*Infrared (optical) communication*
RMS	*Root Mean Square*
PO	*Pulse output*
PA	*Power angle (between current and voltage)*
PF	*Power factor*
THD	*Total harmonic distortion*

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 WM3-6\WM3M6 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.



PLEASE NOTE

The Modbus table is subject to change without notice. For the latest and complete Modbus table please visit ISKRA web page.

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	Function	HI LO	HI LO	LO
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. Register refresh frequency for actual measurement from register 30105 to register 30190 is one second. Register refresh frequency for energy counters (from 30406 to 30441) is 40 ms. The registers from 30426 to 30441 (1000 x Energy Counter from 30406 to 30413 and from 30418 to 30425) represent the same energy counters at 1000-times higher resolution. This registers cam be read to calculate the energy difference in the time interval more accurate.

ACTUAL MEASUREMENTS

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
		READ ONLY INFO			
30000		Device group	T1	4	WM
30001	30008	Model Number	T_Str16		WM3-6 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

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
				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		
30080		FW upgrade counter	T1		
30090		phase module 0 CheckSum	T1		
30091		phase module 1 CheckSum	T1		
30092		phase module 2 CheckSum	T1		
30093		phase module 0 SW reference	T1		100=1,0
30094		phase module 1 SW reference	T1		100=1,0
30095		phase module 2 SW reference	T1		100=1,0
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		
30109	30110	U2	T5		
30111	30112	U3	T5		
30113	30114	Uavg (phase to neutral)	T5		
30115		j12 (angle between U1 and U2)	T17		
30116		j23 (angle between U2 and U3)	T17		
30117		j31 (angle between U3 and U1)	T17		
30118	30119	U12	T5		
30120	30121	U23	T5		
30122	30123	U31	T5		
30124	30125	Uavg (phase to phase)	T5		
30126	30127	I1	T5		
30128	30129	I2	T5		
30130	30131	I3	T5		
30132	30133	INc	T5		
30134	30135	INm - reserved	T5		
30136	30137	Iavg	T5		
30138	30139	S I	T5		
30140	30141	Active Power Total (Pt)	T6		
30142	30143	Active Power Phase L1 (P1)	T6		
30144	30145	Active Power Phase L2 (P2)	T6		
30146	30147	Active Power Phase L3 (P3)	T6		
30148	30149	Reactive Power Total (Qt)	T6		
30150	30151	Reactive Power Phase L1 (Q1)	T6		
30152	30153	Reactive Power Phase L2 (Q2)	T6		
30154	30155	Reactive Power Phase L3 (Q3)	T6		
30156	30157	Apparent Power Total (St)	T5		
30158	30159	Apparent Power Phase L1 (S1)	T5	30158	30159
30160	30161	Apparent Power Phase L2 (S2)	T5	30160	30161
30162	30163	Apparent Power Phase L3 (S3)	T5	30162	30163
30164	30165	Power Factor Total (PFt)	T7	30164	30165
30166	30167	Power Factor Phase 1 (PF1)	T7	30166	30167
30168	30169	Power Factor Phase 2 (PF2)	T7	30168	30169
30170	30171	Power Factor Phase 3 (PF3)	T7	30170	30171

30174		angle between U2 and I2	T17		
30175		angle between U3 and I3	T17		
30182		U1 THD%	T16		
30183		U2 THD%	T16		
30184		U3 THD%	T16		
30188		I1 THD%	T16		
30189		I2 THD%	T16		
30190		I3 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		CheckSum Status	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			

INTERVAL MEASUREMENTS

Interval measurements are intended for data collection and synchronization of the time for data reading, trough the communication. The time interval of data reading is programmable, by default is one minute. The minimum and maximum measurements could be read within a given time interval.

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
		AVERAGE MEASUREMENTS			
35500		The last Average interval duration	T1		Seconds/10
35501		Time since the last average meaurements	T1		Seconds/10
35502		Average measurements counter	T1		
35503	35504	Timestamp (Run time)	T3		'= 0 after reset
35505	35506	Frequency	T5		
35507	35508	U1	T5		
35509	35510	U2	T5		
35511	35512	U3	T5		
35513	35514	Uavg (phase to neutral)	T5		
35515		j12 (angle between U1 and U2)	T17		
35516		j23 (angle between U2 and U3)	T17		
35517		j31 (angle between U3 and U1)	T17		
35518	35519	U12	T5		
35520	35521	U23	T5		
35522	35523	U31	T5		
35524	35525	Uavg (phase to phase)	T5		
35526	35527	I1	T5		
35528	35529	I2	T5		
35530	35531	I3	T5		
35536	35537	Iavg	T5		
35540	35541	Active Power Total (Pt)	T6		
35542	35543	Active Power Phase L1 (P1)	T6		
35544	35545	Active Power Phase L2 (P2)	T6		
35546	35547	Active Power Phase L3 (P3)	T6		
35548	35549	Reactive Power Total (Qt)	T6		
35550	35551	Reactive Power Phase L1 (Q1)	T6		
35552	35553	Reactive Power Phase L2 (Q2)	T6		
35554	35555	Reactive Power Phase L3 (Q3)	T6		
35556	35557	Apparent Power Total (St)	T5		
35558	35559	Apparent Power Phase L1 (S1)	T5		
35560	35561	Apparent Power Phase L2 (S2)	T5		
35562	35563	Apparent Power Phase L3 (S3)	T5		
35564	35565	Power Factor Total (PFt)	T7		
35566	35567	Power Factor Phase 1 (PF1)	T7		
35568	35569	Power Factor Phase 2 (PF2)	T7		

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
		AVERAGE MEASUREMENTS			
35570	35571	Power Factor Phase 3 (PF3)	T7		
35572		Power Angle Total (atan2(Pt,Qt))	T17		
35573		j1 (angle between U1 and I1)	T17		
35574		j2 (angle between U2 and I2)	T17		
35575		j3 (angle between U3 and I3)	T17		
35581		Internal Temperature	T17		
		THD HARMONIC DATA			
35582		U1 THD%	T16		
35583		U2 THD%	T16		
35584		U3 THD%	T16		
35588		I1 THD%	T16		
35589		I2 THD%	T16		
35590		I3 THD%	T16		
		MAXIMUM MEASUREMENTS			
35600	35604	Reserved			
35605	35606	Frequency	T5		
35607	35608	U1	T5		
35609	35610	U2	T5		
35611	35612	U3	T5		
35613	35614	Uavg (phase to neutral)	T5		
35615		j12 (angle between U1 and U2)	T17		
35616		j23 (angle between U2 and U3)	T17		
35617		j31 (angle between U3 and U1)	T17		
35618	35619	U12	T5		
35620	35621	U23	T5		
35622	35623	U31	T5		
35624	35625	Uavg (phase to phase)	T5		
35626	35627	I1	T5		
35628	35629	I2	T5		
35630	35631	I3	T5		
35636	35637	Iavg	T5		
35640	35641	Active Power Total (Pt)	T6		
35642	35643	Active Power Phase L1 (P1)	T6		
35644	35645	Active Power Phase L2 (P2)	T6		
35646	35647	Active Power Phase L3 (P3)	T6		
35648	35649	Reactive Power Total (Qt)	T6		
35650	35651	Reactive Power Phase L1 (Q1)	T6		
35652	35653	Reactive Power Phase L2 (Q2)	T6		
35654	35655	Reactive Power Phase L3 (Q3)	T6		
35656	35657	Apparent Power Total (St)	T5		
35658	35659	Apparent Power Phase L1 (S1)	T5		
35660	35661	Apparent Power Phase L2 (S2)	T5		
35662	35663	Apparent Power Phase L3 (S3)	T5		
35664	35665	Power Factor Total (PFt)	T7		
35666	35667	Power Factor Phase 1 (PF1)	T7		
35668	35669	Power Factor Phase 2 (PF2)	T7		
35670	35671	Power Factor Phase 3 (PF3)	T7		

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
		AVERAGE MEASUREMENTS			
35672		Power Angle Total (atan2(Pt,Qt))	T17		
35673		j1 (angle between U1 and I1)	T17		
35674		j2 (angle between U2 and I2)	T17		
35675		j3 (angle between U3 and I3)	T17		
35681		Internal Temperature	T17		
		THD HARMONIC DATA			
35682		U1 THD%	T16		
35683		U2 THD%	T16		
35684		U3 THD%	T16		
35688		I1 THD%	T16		
35689		I2 THD%	T16		
35690		I3 THD%	T16		
		MINIMUM MEASUREMENTS			
35700	35704	Reserved			
35705	35706	Frequency	T5		
35707	35708	U1	T5		
35709	35710	U2	T5		
35711	35712	U3	T5		
35713	35714	Uavg (phase to neutral)	T5		
35715		j12 (angle between U1 and U2)	T17		
35716		j23 (angle between U2 and U3)	T17		
35717		j31 (angle between U3 and U1)	T17		
35718	35719	U12	T5		
35720	35721	U23	T5		
35722	35723	U31	T5		
35724	35725	Uavg (phase to phase)	T5		
35726	35727	I1	T5		
35728	35729	I2	T5		
35730	35731	I3	T5		
35736	35737	Iavg	T5		
35740	35741	Active Power Total (Pt)	T6		
35742	35743	Active Power Phase L1 (P1)	T6		
35744	35745	Active Power Phase L2 (P2)	T6		
35746	35747	Active Power Phase L3 (P3)	T6		
35748	35749	Reactive Power Total (Qt)	T6		
35750	35751	Reactive Power Phase L1 (Q1)	T6		
35752	35753	Reactive Power Phase L2 (Q2)	T6		
35754	35755	Reactive Power Phase L3 (Q3)	T6		
35756	35757	Apparent Power Total (St)	T5		
35758	35759	Apparent Power Phase L1 (S1)	T5		
35760	35761	Apparent Power Phase L2 (S2)	T5		
35762	35763	Apparent Power Phase L3 (S3)	T5		
35764	35765	Power Factor Total (PFt)	T7		
35766	35767	Power Factor Phase 1 (PF1)	T7		
35768	35769	Power Factor Phase 2 (PF2)	T7		
35770	35771	Power Factor Phase 3 (PF3)	T7		
35772		Power Angle Total (atan2(Pt,Qt))	T17		

Address		Contents	Data	Ind	Values / Dependencies
		Input Registers			
		AVERAGE MEASUREMENTS			
35773		j1 (angle between U1 and I1)	T17		
35774		j2 (angle between U2 and I2)	T17		
35775		j3 (angle between U3 and I3)	T17		
35781		Internal Temperature	T17		
		THD HARMONIC DATA			
35782		U1 THD%	T16		
35783		U2 THD%	T16		
35784		U3 THD%	T16		
35788		I1 THD%	T16		
35789		I2 THD%	T16		
35790		I3 THD%	T16		

LIMIT'S MEASUREMENTS (option)

35900		Limit S Value	T1		VA
35901		Limits Status	T1	Bit 0	Limit Output State
				Bit 1	Average S > Limit S
				Bit 2	Predicted S > Limit S
				Bit 3	Actual S > Limit S
35902	35903	Average Total Export Apparent Power	T5		
35904	35905	Predicted Total Export Apparent Power	T5		
35906	35907	Actual Total Export Apparent Power	T5		

SETTINGS

		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
40183		WM3 - LCD parameters	T1	Bit 0	Active Power P1	1	65535	2
				Bit 1	Active Power P2			
				Bit 2	Active Power P3			
				Bit 3	Reactive Power Q1			
				Bit 4	Reactive Power Q2			
				Bit 5	Reactive Power Q3			
				Bit 6	Apparent Power S1			
				Bit 7	Apparent Power S2			
				Bit 8	Apparent Power S3			
				Bit 9	Power Factor PF1			
				Bit 10	Power Factor PF2			
				Bit 11	Power Factor PF3			
				Bit 12	Voltage U12			
				Bit 13	Voltage U23			
				Bit 14	Voltage U31			
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 9	Voltage ph.1			
				Bit 10	Voltage ph.2			
				Bit 11	Voltage ph.3			
				Bit 12	Frequency			
40184		LCD parameters	T1	Bit 13	Current ph.1			
				Bit 14	Current ph.2			
				Bit 15	Current ph.3			
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			
				5	Active Power Phase 1			
				6	Reactive pover Phase 1			
				7	Apparent Power Phase 1			
				9	Active Power Phase 2			
				10	Reactive pover Phase 2			
				11	Apparent Power Phase 2			
				13	Active Power Phase 3			
				14	Reactive pover Phase 3			
				15	Apparent Power Phase 3			
				33	Active Power individual phases			
				34	Reactive Power individual phases			
				35	Apparent Power individual phases			
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

Address		Contents	Data	Ind	Values	min	max	P. Level
		LIMIT S						
41201		Limit S Value	T1		VA	0	65535	2
41202		Predicted Time	T1		s	1	30	2
41203	41900	Reserved						
		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					
		INTERVAL MEASUREMENTS						
41990		Interval duration [s/10]	T1		600=60,0 sec	0,1	3600	0
41991		Time to calculate interval meas. [s/10]	T1			0,1	3600	0
		Wifi status						
42750		Wifi LCD menu time enabled	T1		Seconds			0
42751		Wifi status	T1		Wifi status			0
42752	42753	WIFI IP	T3		example : 129.168.001.255			0
42754		WIFI command	T1	1	reset WIFI			0
42755	42760	Reserved for WIFI numbers	T1					0
42761	42770	Wifi status text 1	T_Str20					0
42771	42780	Wifi status text 2	T_Str20					0
42781		I-Hub status	T1	0	BICom Off			
				1	BICom On			
				255	disconect I-Hub			

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)

DATA TYPES 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		Time and Date (64 bit)
	bits # 63..56	1/100s 00 - 99 (BCD)
	bits # 55..48	Seconds 00 - 59 (BCD)
	bits # 47..40	Minutes 00 - 59 (BCD)
	bits # 39..32	Hours 00 - 24 (BCD)
	bits # 31..24	Day of month 01 - 31 (BCD)
	bits # 23..16	Month of year 01 - 12 (BCD)
	bits # 15..00	Year (unsigned integer) 1998..4095
		Example: 15:42:03.75, 10. SEP 2000 stored as 7503 4215 1009 $07D0_{(16)}$
T_TimeIEC		Time and Date (64 bit) = IEC870-5-4 "Binary Time 2a"
	bits # 63..55	Reserved
	bits # 54..48	Years (0 .. 99)
	bits # 47..44	Reserved
	bits # 43..40	Months (1 .. 12)
	bits # 39..37	Day of Week (1 .. 7)
	bits # 36..32	Day of Month (1 .. 31)
	bit # 31	Summer Time (0 .. 1): Summer time (1), Standard time (0)
	bits # 30..29	Reserved
	bits # 28..24	Hours (0 .. 23)
	bit # 23	Invalid (0 .. 1): Invalid (1), Valid (0)
	bit # 22	Reserved
	bits # 21..16	Minutes (0 .. 59)
	bits # 15..00	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		IEEE 754 Floating-Point Single Precision Value (32 bit)
	bits # 31	Sign Bit (1 bit)
	bits # 30..23	Exponent Field (8 bit)
	bits # 22..0	Significand (23 bit)
		Example: 123.45 stored as 123.45000 = 42F6 $E666_{(16)}$
T9A		Time (16 bit)
	bits # 15..08	Minutes 00 - 59 (BCD)
	bits # 07..00	Hours 00 - 24 (BCD)
		Example: 15:42 stored as $4215_{(16)}$
T10A		Date (16 bit)
	bits # 15..08	Day of month 00 - 31 (BCD)
	bits # 07..00	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 WM3-6. The M-BUS WM3-6 confirms correct receipt by Single Character Acknowledgement (ACK = E5). If the telegram was not correctly received the WM3-6 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 WM3-6 will not send an Acknowledgement. After issue of the Single Character Acknowledgement the M-BUS WM3-6 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 WM3-6 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 WM3-6 and to command it to transmit the Read-out Data parameterized. The M-BUS WM3-6 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 WM3-6. 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 WM3-6 confirms the correct receipt by ACK. If the telegram was not received correctly the M-BUS WM3-6 does not send an Acknowledgement. The (ACK) is sent by the M-BUS WM3-6 in the Old Baud Rate. As soon as ACK is transmitted the M-BUS Meter switches to the baud rate newly parameterized. If the WM3-6 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 WM3-6 confirms the correct receipt by ACK. If the telegram has not been correctly received the M-BUS WM3-6 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 WM3-6 confirms the correct receipt by ACK. If the telegram has not been correctly received the M-BUS WM3-6 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 WM3-6 confirms correct receipt by ACK. If the telegram was not correctly received the M-BUS WM3-6 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

Active 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

Active Power in Phase 1, 2, 3 (W)

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

	DIF	DIFE	DIFE	VIF	VIFE	VIFE	DATA
	04						xx.xx.xx.xx
P1:				AA	FC	01	
P2:				AA	FC	02	
P3:				AA	FC	03	

Current in Phase 1, 2, 3, Neutral (A)

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

	DIF	DIFE	VIF	VIFE	VIFE	VIFE	DATA
	04						xx.xx.xx.xx
I1:			FD	D9	FC	01	
I2:			FD	D9	FC	02	
I3:			FD	D9	FC	03	

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	
U2:			FD	C7	FC	02	
U3:			FD	C7	FC	03	
U12:			FD	C7	FC	05	
U23:			FD	C7	FC	06	
U31:			FD	C7	FC	07	

8.4 APPENDIX C: Equations

Definitions of symbols

No	Symbol	Definition
1	MP	Average interval
2	U_f	Phase voltage (U_1, U_2 or U_3)
3	U_{ff}	Phase-to-phase voltage (U_{12}, U_{23} or U_{31})
4	N	Total number of samples in a period
5	n	Sample number ($0 \leq n \leq N$)
6	x, y	Phase number (1, 2 or 3)
7	i_n	Current sample n
8	u_{fn}	Phase voltage sample n
9	u_{ffn}	Phase-to-phase voltage sample n
10	φ_f	Power angle between current and phase voltage f (φ_1, φ_2 or φ_3)

Voltage

$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}}$	**Phase voltage** N – samples in averaging interval (up to 65 Hz)
$U_{xy} = \sqrt{\frac{\sum_{n=1}^{N}(u_{xn} - u_{yn})^2}{N}}$	**Phase-to-phase voltage** u_x, u_y – phase voltages (U_f) N – a number of samples in averaging interval

Current

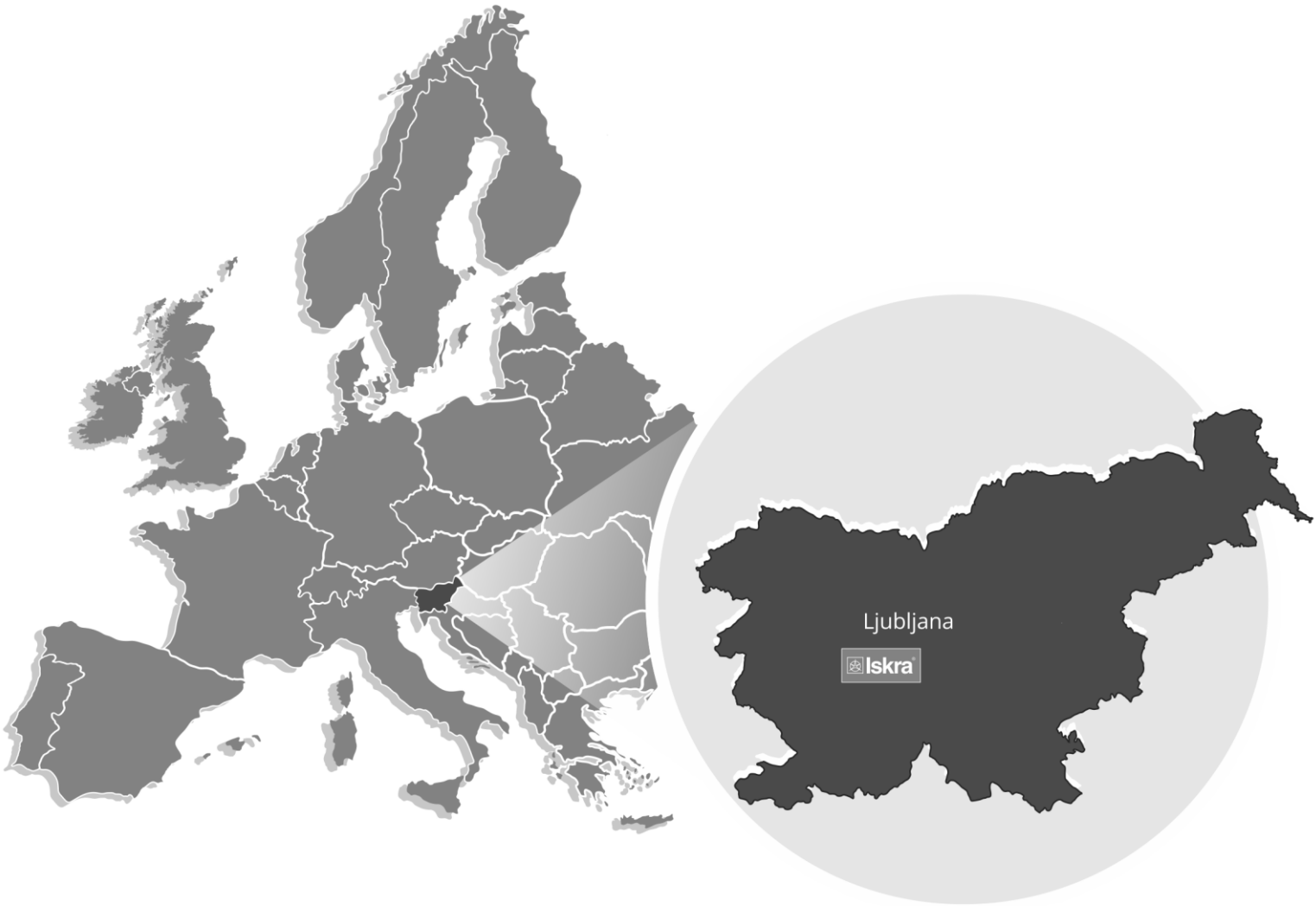
$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$	**Phase current** N – samples in averaging interval (up to 65 Hz)

Power

$\mathrm{P}_f = \frac{1}{\mathrm{N}} \sum_{\mathrm{n}=1}^{\mathrm{N}} (u_{fn} \times \mathrm{i}_{fn})$	**Active power by phases** N – a number of periods n – index of sample in a period f – phase designation
$P_t = P_1 + P_2 + P_3$	**Total active power** t – total power 1, 2, 3 – phase designation
$\mathrm{SignQ_f}(\varphi)$ $\varphi \in [0° - 180°] \rightarrow \mathrm{SignQ}_f(\varphi) = +1$ $\varphi \in [180° - 360°] \rightarrow \mathrm{SignQ}_f(\varphi) = -1$	**Reactive power sign** Q_f – reactive power (by phases) φ – power angle
$S = U_f \cdot I_f$	**Apparent power by phases** U_f – phase voltage I_f – phase current
$S_t = S_1 + S_2 + S_3$	**Total apparent power** S_t – apparent power by phases
$Q_f = SignQ(\varphi) \times \sqrt{{S_f}^2 - {P_f}^2}$	**Reactive power by phases** S_f – apparent power by phases P_f – active power by phases
$Q_f = \frac{1}{N} \cdot \sum_{n=1}^{N} (u_{fn} \times i_{f[n+N/4]})$	**Reactive power by phases (displacement method)** N – a number of samples in a period n – sample number (0 ≤ n ≤ N) f – phase designation
$Q_t = Q_1 + Q_2 + Q_3$	**Total reactive power** Q_t – reactive power by phases
$\varphi_s = a\ tan2\ (P_f, Q_f)$ $\varphi_s = [-180°, 179{,}99°]$	**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

$I_f\ THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} I_{fn}^2}}{I_{f1}} 100$	**Current THD** I_1 – value of first harmonic n – number of harmonic
$U_f\ THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} U_{fn}^2}}{U_{f1}} 100$	**Phase voltage THD** U_1 – value of first harmonic n – number of harmonic
$U_{ff}\ THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} U_{ffn}^2}}{U_{ff1}} 100$	**Phase-to-phase voltage THD** U_1 – value of first harmonic n – number of harmonic



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