ISKRAEMECO Energy Measurement and Management

MT830/MT831

Three-phase electronic multi-function meter for industry

Technical Description

Version 1.6

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MT830/MT831 – Three-phase electronic multi-function meter

MT830/MT831 three-phase electronic multi-function meter is intended for measuring active and apparent energy in two flow directions, reactive energy in four quadrants as well as imported and exported, maximal power of the above stated energies, registration of load curves and quality parameters of supplied electric energy in three-phase three- and four-wire networks. The meters can be connected directly, semi-directly or indirectly. They comply with the IEC 62052–11, IEC 62053-21, EN 50470-3, IEC 62053-22 and IEC 62053-23 standards, VDEW demands, and they are manufactured in compliance with the ISO 9001 standard. The meter consists of a polycarbonate housing, electronics for measuring and processing measuring data, input/output as well as communication electronics.

Two different meter versions are available:

- MT830 - a “closed” meter version with additional six terminals, which could be used for:
    - Communication interface
    - Functional or impulse inputs
    - Functional outputs
    - External power suplly

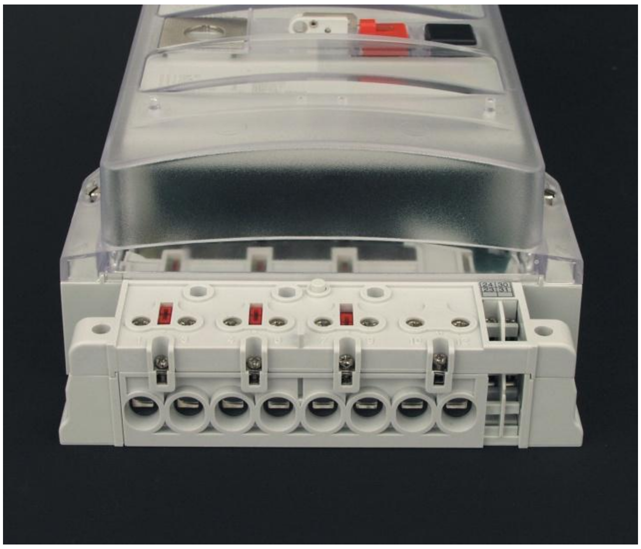

Figure 1: MT830 – a “closed” meter version

- MT831 – a modular meter version with communication (MK) and input/output (MIO) module which could be subsequently built into the meter and six additional terminals

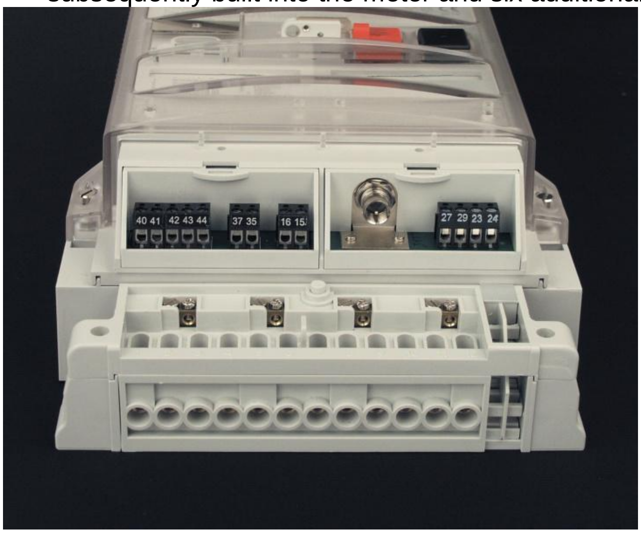

Figure 2: MT831 – a modular meter version

1. Meter characteristics

- Measuring active energy/power
- Measuring reactive energy/power in four quadrants and/or a sum of energies by individual quadrants (e.g. Q1+Q2 and Q3+Q4)
- Measuring apparent energy/power
- Calculating cumulative power
- Measuring and displaying parameters of energy quality:
  - rms voltage values by phases
  - Current by phases
  - Harmonic components in voltage and current (up to the 8^{th} harmonic)
  - Power factor per phase and total
  - Phase angle between phase voltage and current
  - Voltage failures
- Multi-tariff registration
- Load profiles (P.01, P.02)
- Log-books (P.98, P.99)
- Different display modes on LCD
- Meter reading in case of power down (“no power reading option with SONDA 6 (option)
- VDEW designed LCD → presence of phase voltages, energy flow direction, units and 11 statuses
- Communications

  IR interface for a local readout and meter programming (IEC 62056-21)
- Auxiliary terminals

  The main meter board (MT830 & MT831) could be equipped with up to six auxiliary terminals, which could be:
  - Communication on board port (MT830 only)

    MT830 meter could be equipped with
    - CS interface

    or
    - RS-485 interface

    or
    - RS-232 interface

Communication with the meter is performed in compliance with the IEC 62056-21 standard, mode C. The meter operation is not affected during communication.

Type of communication:

Serial asynchronous half-duplex ISO 1177

1 start bit

7 data bits

1 bit parity - even

1 stop bit

data transfer rate: 300, 600, 1200, 2400, 4800, 9600 Baud

Each communication port supports “fix” baud rate (for use of transparent telephone modems) or communication protocol according to IEC 62056-21 standard (communication sequence is started with 300 baud). Communication parameters in the meter are programmable.

The meter enables separate read out (different data) via IR and other communication interface at the same time.

The MT831 meter could be equipped with different communication modules (MK).

- Two inputs (3 terminals) are used
  - Functional or
  - Impulse inputs

Control voltage is from 100 V….240 V AC/DC.

Additional inputs & outputs could be implemented in input/output module (I/O module) – the MT831 meter only. Electrical characteristics:

- OFF state <= 30 V
- ON state >= 45 V
- Internal resistance 190 KOhm
- Switch on delay → typical 10 ms at 240V

- Four outputs in two functional groups (6 terminals)
- External power supply (2 terminals)

Terminal	Terminal designation	Additional explanation
30	50 – 240 V AC/DC	External power supply
31	50 – 240 V AC/DC	External power supply

- Modular construction – the MT831 meter only

MT831 could be upgraded with input/output (MIO) and communication (MK) module.

- Fraud detection
  - Detection of a meter cover and a terminal cover opening
- Connection to network**:** a three-phase meter can also be used as a single-phase or two-phase type
- Quality:
  - High accuracy as well as time stability of measurement
  - High reliability of operation and long life span (20 years)
- High immunity to EMC disturbances
- Simple and fast assembly
- A compact plastic housing is made of high quality self-extinguishable materials and is resistant to water and dust (IP53)
- Environment friendly: a meter is made of the materials that can be recycled or are not dangerous for the environment

2. Constituent parts

The meter consists of the following units:

- Measuring systems
- Microcontroller with external memory
- Real time clock
- LCD
- Optical interface
- Keys
- LEDs
- Power supply :
  - Internal three phase switcher
  - external power supply
  - power supply via optical probe (“no power” reading option with SONDA 6)

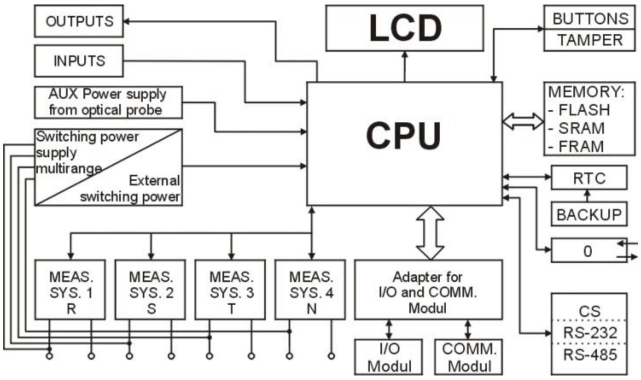

Figure 3 – A meter block diagram

2.1. Measuring system

The measuring systems are based on Rogowski coils that measure changes on the induced voltage. Current flows through a current coil. Voltage is induced inside the air coils due to alternate magnetic field. There are two Rogowski coils on each phase.

The measuring system is made of:

1. Current coil frame
2. Current coil
3. Two Rogowski coils
4. PCB

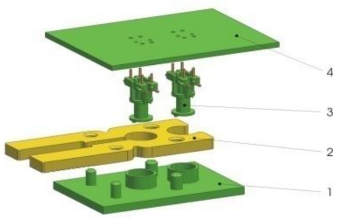

Figure 4 – Measuring system

A measuring system measures induced voltage on measuring coils which is proportional to the current on input. The first coil measures "load" energy and the second one is a compensation coil which measures outside disturbances. Compensation value is subtracted from a measuring element.
An output signal from Rogowsky coils is related to the input of the measuring integrated current. A signal is integrated, amplified and multiplied with measuring voltage and sent to the microprocessor.

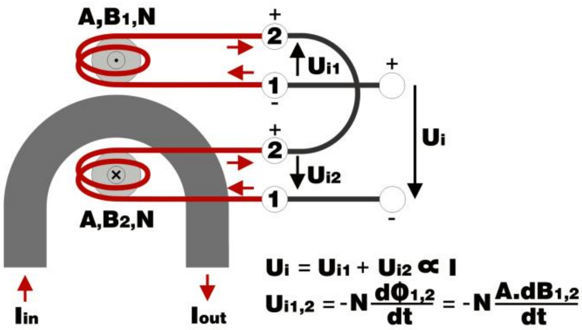

Figure 5 – Measuring principle

Sensors and circuits are protected from overvoltage. Influences of disturbance quantities are negligible, which assures high meter reliability.

2.2. Microcomputer

A microcomputer enables:

- Meter functions by customer's specification
- Storing measuring data and parameters
- Storing measuring data for previous billing periods (factory settings is 15 billing periods)
- Demand calculations
- Load Profile function
- Compensating measuring protocol of voltage and current transformers
- Logbook
- Display control
- Certain supervision and control meter functions for measuring phase voltages
- Measuring phase voltages
- Measuring harmonic components in current and voltage
- Measuring frequency

Operation of the microcomputer is controlled by a special Watch-dog circuit.

2.3. Real time clock

A real time clock is controlled by a 32 kHz quartz oscillator. The clock accuracy complies with the IEC 61038 standard requirements. Back up power supply source is built in the meter . It is usually a supercapactior and an Li battery which is directly soldered to the main printed circuit board. The supercapacitor assures energy for 250 hours of the clock operation in case of a complete power supply failure, while an Li battery assures 10 years of operation, with time life span of 20 years.
A real time clock generates:

- A measuring period for power and a registration period for load profile
- Tariff programs, season changeover, transition to day light saving period and vice-versa
- Time stamps of individual events. A time-stamp consists of a date, an hour, a minute and a second of the event.

2.4. LEDs

Two LEDs are built in the meter:

- Left → active (imp/kWh)
- Right → reactive (imp/kvarh) or apparent (imp/kVAh) (programmable)

They enable meter calibration. Impulse constants depend on nominal current and voltage and are programmable values.
Factory settings:

- Direct connected meter
  - 3x230/400 V, 5(60) A → 1.000 imp/kWh
  - 3x230/400 V, 5(120) A → 500 imp/kWh

- Transformer connected meter
  - 3x57.7/100 …. 3x240/415V, 5(6)A → 10.000 imp/kWh

To reduce the control time a special factory test mode is built in the meter, which increases LED constants 10 times higher, in comparison with a normal operating mode. After power down/up event, all constants take the original factory settings.

3. Multi-tariff registration

The meter enables registration of energy and power by separate tariff schemes. Up to 8 tariffs for energy and demand could be registered (factory settings → 4 tariffs). The meter is equipped with 160 tariff registers. Time of switching individual tariff is defined by hour and minute with a resolution of 1 minute. A number of periods in a day where one or several tariffs can be valid is defined with configuration. The same is valid for different daily tariff programs. Up to 32 various types of a day (a day in a week and a holiday) can be defined. A number of seasons in a year (factory settings → 4 seasons) is defined with configuration. Besides a current tariff program, the so-called slipping tariff programs can be defined. They are activated at previously defined dates. An optional number of holidays can be defined. A century-old callendar is built in the meter.

4. Maximum demand indicator

Maximum demand can be measured with a fixed or a sliding measuring period. A measuring period can be set from 1 minute to 60 minutes with a 1-minute resolution. It is possible to measure maximum demands for:

- Active energy in both flow directions
- Reactive energy in four quadrants as well as a sum of energies by individual quadrants (e.g. Q1+Q2 and Q3+Q4)
- Apparent energy in both energy-flow directions

Maximum demands are registered by individual tariffs and cummulatively.
Configuration of blocking the measurement of maximum demand for a certain time that follows a period of network voltage failure is also available.

5. Load Profile

A programmable data recorder enabling registration of a load profile is built in the meter:

- Active, apparent power and energy (cumulative or absolute values) → three-phase values in both energy flow directions
- Reactive power or energy (cumulative or absolute values) in four or combined quadrants (e.g. Q1+Q2 and Q3+Q4)
- Rms values of phase voltages
- Distortion factor
- Individual meter statuses (power supply failure, alarms)

A registration period or a load profile can be set within the range from 1 to 60 minutes. Two load profiles (P.01 and P.02) could be implemented in the meter. The first one (P.01) is normaly used for registering energy or demand, and the second one for registering the last average of voltage, current and power factor. Last average registration is related to the measuring period. Load profile periods and measurment period are independend from each other.

6. Registration of energy / power

The MT830/MT831 meter has three measuring systems and could be used in a three-phase three-wire or three-phase four-wire networks.

Registration types:

- Vector registration (∑ Li),
→ when the vector sum of energies is positive, the meter registers A+ energy; → when the vector sum of energies is negative, the meter registers A- energy

For example (phase load is the same)

Phase:	L1	L2	L3
Load:	+A	-A	+A

Total registration (1.8.0) → **(+A) + (-A) + (+A) = +A**
Total registration (2.8.0) → **0**

Meter registers +A (one phase load!!).

- Arithmetical registration → the meter could register A+ and A- energy in the same time

For example (phase load is the same)

Phase:	L1	L2	L3
Load:	+A	-A	+A

Total registration
Positive direction (1.8.0) → (**+A) + (+A) = 2*(+A)**
Negative direction (2.8.0) → -**A**
If the second phase is wrongly connected, the meter also registers this energy with such registration type.

- Absolute active energy │A│

For example (phase load is the same)

Phase:	L1	L2	L3
Load:	+A	-A	+A

Total registration
Positive direction (1.8.0) → **|+A| + |-A|** + **|+A| =3*(+A)**

With such registration the meter registers only “imported” energy, also in case of “wrong” connection.

For measuring reactive energy a natural connection is used. Internal register provides for a corresponding voltage and current phase shift.

MT830/MT831 meters could be provided with:

- three measuring systems (MT830 – T1 /MT831 – T1) – transformer connected

7. Display

LCD is designed according to the VDEW requirements.

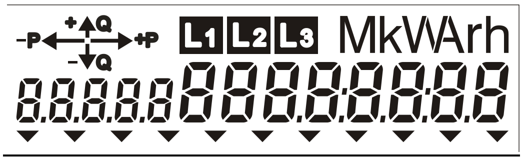

Figure 6 - LCD

The measuring data on LCD are displayed with eight 7-segment 8 mm x 4 mm high numbers. Displayed data are identified with five-digit OBIS identification codes (IEC 62056 – 61), 6 mm x 3 mm high numbers. Dimension of LCD (visible area) is 69 mm x 20 mm.

Meters have back-light illumination for easy data reading at metering place with bad light condition. The LCD is illuminated when any pushbutton is pressed. The illumination is switched-off after 3 minutes if no pushbutton was pressed at that time.
A meter operates in different display modes

- Automatic data circulation → **Autoscrool**
  (Time between two register presentations in LCD is programmable). Because only 5 digits are used for identification, 9 previous register values are presented on the LCD.

Additional modes are accessible with a black and a red button.
Displaying modes accessible with the black one:

- Manual data display – registers → **Std dAtA**
- Manual data display – network parameters (voltage, current, phase angle, etc.) → **Grid**
- Manual data display– **Load Profile** (P.01 and/or P.02 (programmable))
- Presentation of the GSM modem parameters → **DiAg** (C.C.3 → signal level (should be higher than 17), C.C.4 → GSM provider (1 – home provider, 5 – roaming), C.C.5 → error code (should be 0))

Displaying modes accessible with the red button:

- Manual setting of time, date, etc. → **SET** mode
- Registers presented in Autoscool mode with enhanced energy registers presentation → **TEST** mode
- Resetting the LCD statuses of meter and terminal cover opening → **Intrusion restart** mode

Format and data units are programmed. At transformer connected meters, displayed measuring data can be primary, or secondary.
Besides measuring data, the energy flow direction, presence of phase voltages, display of individual events, meter statuses and alarms can be displayed.

7.1. Keys

The meter is equipped with three keys.
Black → dislay key is used for transition from a basic to an extended data display mode.

Red → reset key is used for billing meter reset or, in combination with the DISPLAY key, for setting certain meter parameters (SET, TEST or Intrusion restart meter operation mode). The RESET key is sealed separately or it can be locked.

Param key is under the meter cover and is used for setting meter parameters in the laboratory.

8. Communication interfaces

An optical communication interface is located on the meter basic board. One of communication interfaces that are intended for remote meter readout (CS or RS-232 or RS-485) can be mounted on customer demand. The meter is provided with two independent communication channels.

8.1. IR communication interface

The optical communication interface enables a user to set the meter parameters and read the measuring results (registers reading, a logbook, a load profile, reading individual registers, sending individual commands).

8.1.1. Meter reading in absence of measuring voltages (option)

On customer's request, the meter can be equipped with additional electronics, which enables communication via an optical interface also in case of measuring voltages failure. This is enabled with a special probe (SONDA 6). It is also possible to read meter data manually by means of the DISPLAY key.

Figure 7 – "No power" meter reading option with SONDA 6 (option for MT830/MT831)

8.2. RS-485 interface

The RS-485 serial interface enables communication with maximum transmission rate 9600 bauds. The MT830 meters with a built-in RS 485 interface are equipped with two auxiliary terminals. Up to 31 meters can be connected to the RS-485 interface with maximum distance of 1200 m. In such configuration, the meter readout is obligatory with device address! For longer distances (more than few hundred meters), the use of termination resistor of 120 Ohm on each edge is recommended.

Terminal	Terminal designation	Additional explanation
27	A	A terminal
29	B	B terminal

Table1 – RS-485 terminals designation

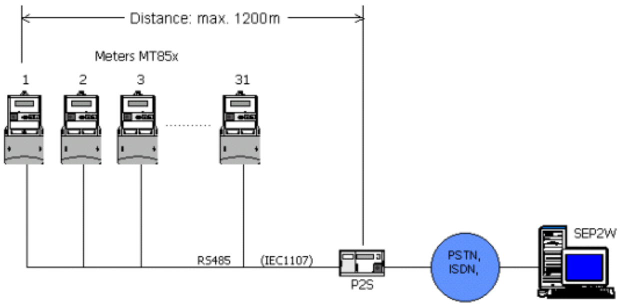

Figure 8 – Meters connected to the modem via RS-485 interface

8.3. RS-232 interface

The RS 232 serial interface enables communication with maximum transmission rate 9600 bauds. The MT830 meters with built-in RS 232 interface are equipped with three auxiliary terminals

Terminal	Terminal designation	Additional explanation
27	RxD	Rx terminal
28	GND	Common terminal
29	TxD	Tx terminal

Table 2 – RS-232 terminals designation

or RJ11 connector.

Pin Nr.	RS-232
3	Rx
4	Tx
5	GND

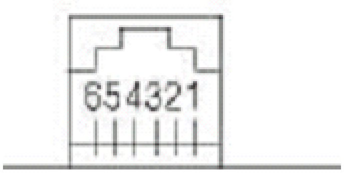

Figure 9 – RS-232 RJ11 terminal designation

8.4. CS-communication interface

The CS interface (20-mA current loop) complies with the DIN 66348 standard and is two-wire communication. It enables communication with maximum transmission rate 9600 bauds. The MT830 meters with built-in CS interface are equipped with two auxiliary terminals. Up to four meters can be connected to the CS interface with maximum distance of 1500m. In such configuration, the meter readout is obligatory with a device address!

Terminal	Terminal designation	Additional explanation
23	CS+	CS+ terminal
24	CS-	CS- terminal

Table 3 – CS interface terminals designation

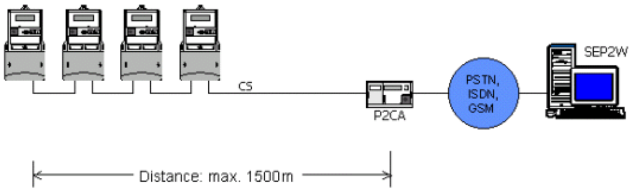

Figure 10 – Meters connected to the modem via CS interface

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9. Input /output module (MT831 meter only)

I/O modules are plug & play. Two versions regarding the internal programming are available:

- **Input – output module function is predefined in module EEROM**
  The module is pre-programmed in the factory. After inserting the module into the meter, the meter automatically accepts the module parameters (plug and play module). Terminals are marked according to the VDEW requirements. The module can be re- programmed only in the factory

- **Input – output module function is not predefined in module EEROM**
  The function of input-output module terminals is defined when setting meter parameters which are specified in the group “Input/output pins” → MeterView 4 program. Terminal designations:
  - Cx for common terminals
  - Tx for output terminals
  - TEx for input terminals

  where x is from 1 to n (a terminal number).

  Standard versions are:
  - MIO-V12L51 → 4 outputs + 1 output + 1 input
  - MIO-V42L81 → 4 outputs + 4 outputs + 4 inputs
  - MIO-V12L41B11 → 4 outputs + 1 output 5A bistable rele + 1 input

  Error on an input/output module does not influence in the meter operation.

Figure 11 - Input/output module (MT831 only)

Definition of input terminals:

Terminal	Terminal designation	Additional explanation
15	COM	Common terminal for functional inputs
13, 33	TE1/2, TE3/4	Energy tariff input T1 – T4
14, 34	ME1/2, ME3/4	Demand tariff input M1 – M4
16	MPE	External time/measurement period synchronization input
17	MZE	External input for disabling of demand measurement
18	MREa	Input a for external billing reset
19	MREb	Input b for external billing reset
21	MKE1	Alarm input 1
22	MKE2	Alarm input 2
90	COM	Common terminal for impulse inputs
91	IME1	Impulse input 1
92	IME2	Impulse input 2

Table 4 – Input terminals designation

Impulse inputs are realized as passive inputs. An impulse constant is programmable and could be different for each impulse input. Maximum impulse frequency is 25 imp/sec.

Definition of output terminals:

Terminal	Terminal designation	Additional explanation
35	COM	Common terminal
36	MKA	Alarm output
37	MPA	Measurement period output
38	ERA+A	Energy flow direction +A
39	ERA+R	Energy flow direction +R
40	COM	Common terminal
41	+AA	Pulse output for +A
42	-AA	Pulse output for -A
43	+RA	Pulse output for +R
44	-RA	Pulse output for -R
45	RA1	Pulse output for RA1
46	RA2	Pulse output for RA2
47	RA3	Pulse output for RA3
48	RA4	Pulse output for RA4

52	COM	Common terminal for 41 and 42 terminals
54	COM	Common terminal for 43 and 44 terminals
56	COM	Common terminal for 45 and 46 terminals
58	COM	Common terminal for 47 and 48 terminals
59	COM	Common terminal for terminals from 45 up to 48
65	COM	Common terminal
61, 63	TA1/2, TA3/4	Demand tariff outputs T1 – T4
62, 64	MA1/2, MA3/4	Demand tariff outputs M1 – M4
68	MRAa	Output for external billing reset a
69	MRAb	Output for external billing reset b
75	COM	Common terminal
71	LA1	Load control output 1
72	LA2	Load control output 2

Table 6 – Output terminals designation

10. Communication module (MT831 meter only)

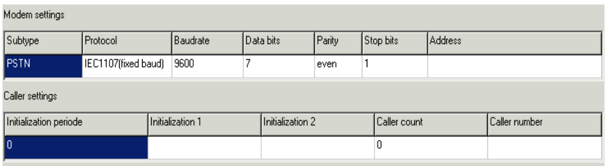
Communication modules are plug & play. Two versions regarding the internal programming available:

- **Communication module parameters setting is predefined in the module EEROM**

  The module is pre-programmed in the factory (baud rate, parity, stop bit, some special modem settings). After inserting the module in the meter, the meter automatically accepts the module parameters (a plug and play module).

- **Communication module parameters setting is not predefined in the module EEROM**

  All settings regarding the communication modem accept from the meter parameters. The modem is automatically initialized after predefined period or meters internal initializations.


Modem settings

Subtype	Protocol	Baudrate	Data bits	Parity	Stop bits	Address
PSTN	IEC1107(fixed baud)	9600	7	even	1	

Caller settings

Initialization periode	Initialization 1	Initialization 2	Caller count	Caller number
0			0	

Each module, except the RS-232 module with a 25-pin DB connector, has two independent communication interfaces, which enables simultaneous meter reading. Communication interfaces are isolated from each other.

Additional special programming (for example: PSTN modem) is possible with the MeterView 4 program.

Communication module designation:

MK – the 1st comm. Inter. – the 2nd comm. Inter.

For example:

MK – f38 – 3

First communication interface (**MK** – **f38** – 3):

8 → GSM modem

+

3 → RS-485 interface
+
f → active CS interface
(it is possible to establish multi drop communication via RS-485 and CS communication interface)

Second communication interface (**MK** – f38 – **3**):
3 → RS-485
Second (independent) RS-485 communication interface.

Besides communication towards the centre, the modules also offer possibility of cascade connection (a CS interface and an RS-485 interface). The module enables hot swap installation (modules can be changed or built into the meter during the meter operation). The modules are located under the terminal cover and are not sealed with a metrological seal. On costumer's request, modules could be sealed with an unremovable sticker.
The same communication module can be built into different meter types: MT831 and MT860. All modules are »plug & play« type. When the module is built in, it sends its identification code via a data bus. The module is automatically recognized by the meter and is correspondingly controlled.
The error on the communication module does not influence in the meter operation.

Figure 12 - Communication module (MT831 only)

11. Fraud protection

The meter is protected against fraud in several ways.

- The meter cover and the terminal cover are sealed separately
- The RESET key is sealed or locked with a lock
- Commands and accesses to individual registers are protected with three password levels
- All interventions into the meter are recorded in a logbook
- Measuring data are stored in a nonvolatile memory on two places (a primary and a secondary copy)

11.1. Detection of meter cover and terminal cover opening

MT830/MT831 meter detects the meter cover (MCO) and terminal cover (TCO) opening. Time and date of such occurrence are written in the meter logbook. The state of the MCO and TCO opening could also be presented in the status flags on the LCD.

When the meter is powered via measuring voltages or auxiliary power supply, the opening time stamp present the real (actual) time.

Example:

(a terminal and a meter cover were opened during "normal" meter operation → meter was powered by measuring voltages)

(060317115820)(0080) → power down

(060317125820)(0040) → power up

(060317132820)(0020) → time setting

(060317134520)(0020) → time setting

(060317135940)(811B) → terminal cover opened

(060317140015)(811D) → meter cover opened

The meter also detects the TCO and MCO in case of **power down** but without the real time of such event. Meter electronics detects only opening event, while date and time in such case are related to the first power up.

Example:

A terminal and a meter cover were opened during power down.

(060317115820)(0080) → power down

→ meter and terminal cover were opened during this time

(060317145820)(0040) → power up

(060317145821)(811B) → terminal cover opened

(060317145821)(811D) → meter cover opened

After installing the meter, at least MCO event is registered in the meter Log Book or in the status flag on the LCD. To restart the TCO and MCO registering “Intrusion Restart” function must be implemented. This function is accessible by using the black and the red button or remotely by sending a special command into the meter. Intrusion Restart function is automatically done after power up event, parameter changing (when meter goes through the “Standby”).

After “Intrusion Restart”, the meter detects only one TCO and MCO opening.

Note: to detect the opening of the meter and the terminal cover, “Intrusion Restart” must be implemented!

12. Handling with the meter

Two sets of tools are available:

- For service programming and readout:
  - MeterView 4 (Iskraemeco software)
  - An optical probe
  - A PC, a table or a portable one (PC - desk-top, PC – laptop).

The tool is intended for the operators who service or reprogramme the meters in the laboratory or in the field.

- For billing readout and programming:
  - MeterRead (Iskraemeco software), for all types of palmtop PCs operating in the WinCE environment
  - An optical probe

The tool is intended for readers in the field.

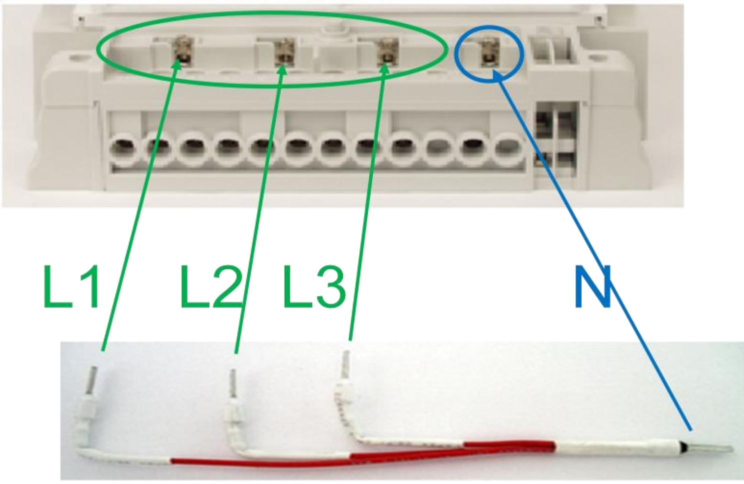
13. Connection procedure

1. Meter assembly
2. Meter connection to network
3. Checking connection indication – a LED is lit
4. Checking correct connection – see LCD indications:
   - Presence of all three phases - **L1 L2 L3** all symbols are displayed
   - At least 1 phase is absent - **L1 L3** absent phase is marked
   - Wrong phase sequence - **L1 L2 L3** symbols of wrongly connected phases are blinking

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

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

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



14. Housing

The meter housing is made of self-extinguishable polycarbonate that can be recycled. The housing assures double isolation and IP53 protection degree against dust and water penetration. Meter dimensions and fixing dimensions comply with the DIN 43857 standard. A hook fixing is adapted by height. In case of a simple version, the mask does not have any bed for modules and the meter cover is extended

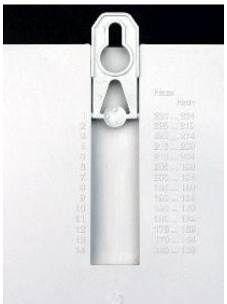


Figure 13 - A hook adjustable by height (MT830/MT831)

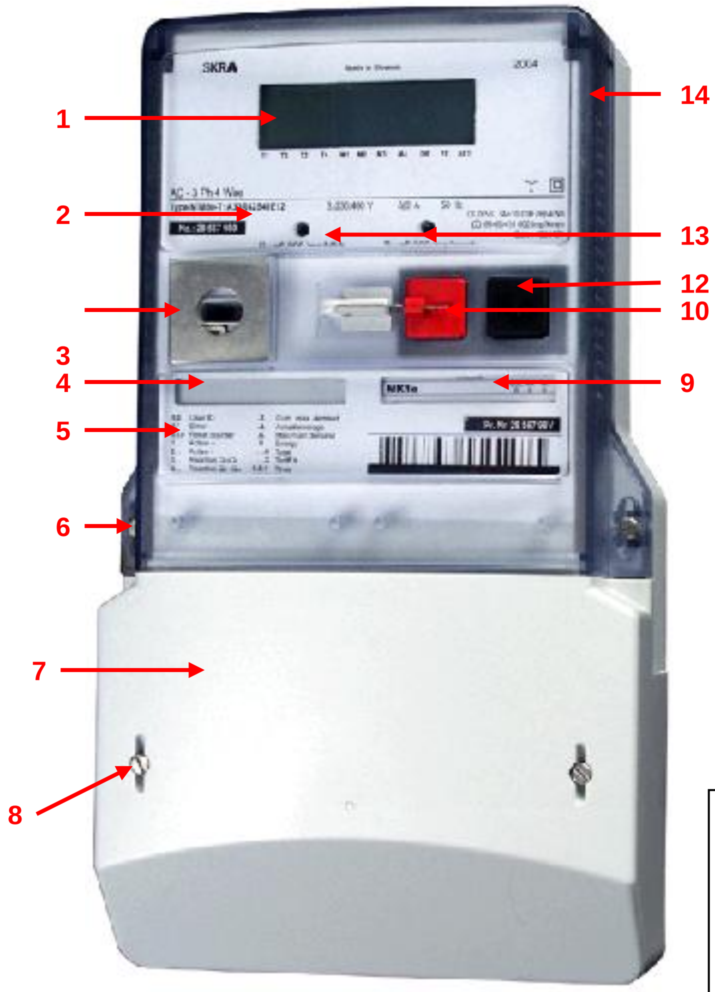
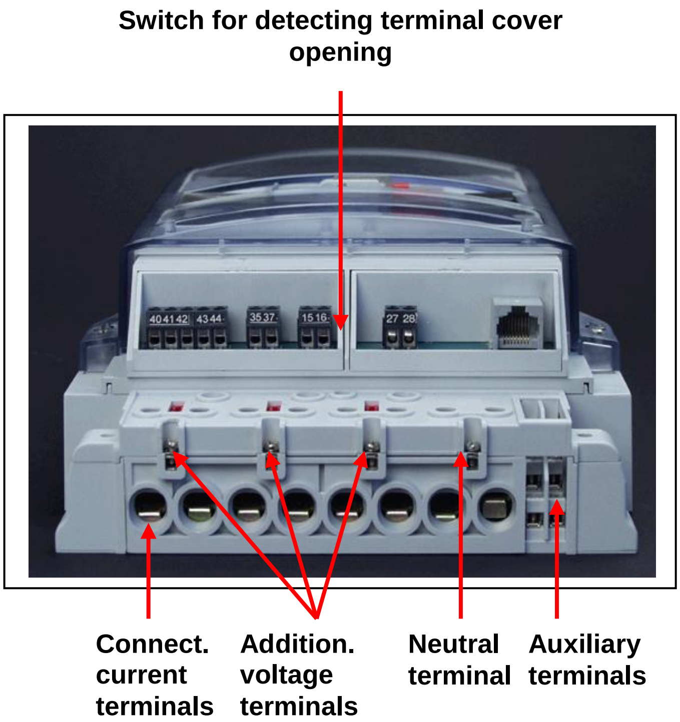


Figure 14 - Meter constituent parts

1. LCD
2. Meter technical data
3. IR optical interface
4. Input/output module mark
5. Legend of displaying registers on LCD
6. Meter cover sealing screw
7. Terminal cover
8. Terminal cover sealing screw
9. Communication module mark
10. RESET key blocking element
11. RESET key
12. DISPLAY key
13. Impulse diode – active and reactive energy
14. Meter cover



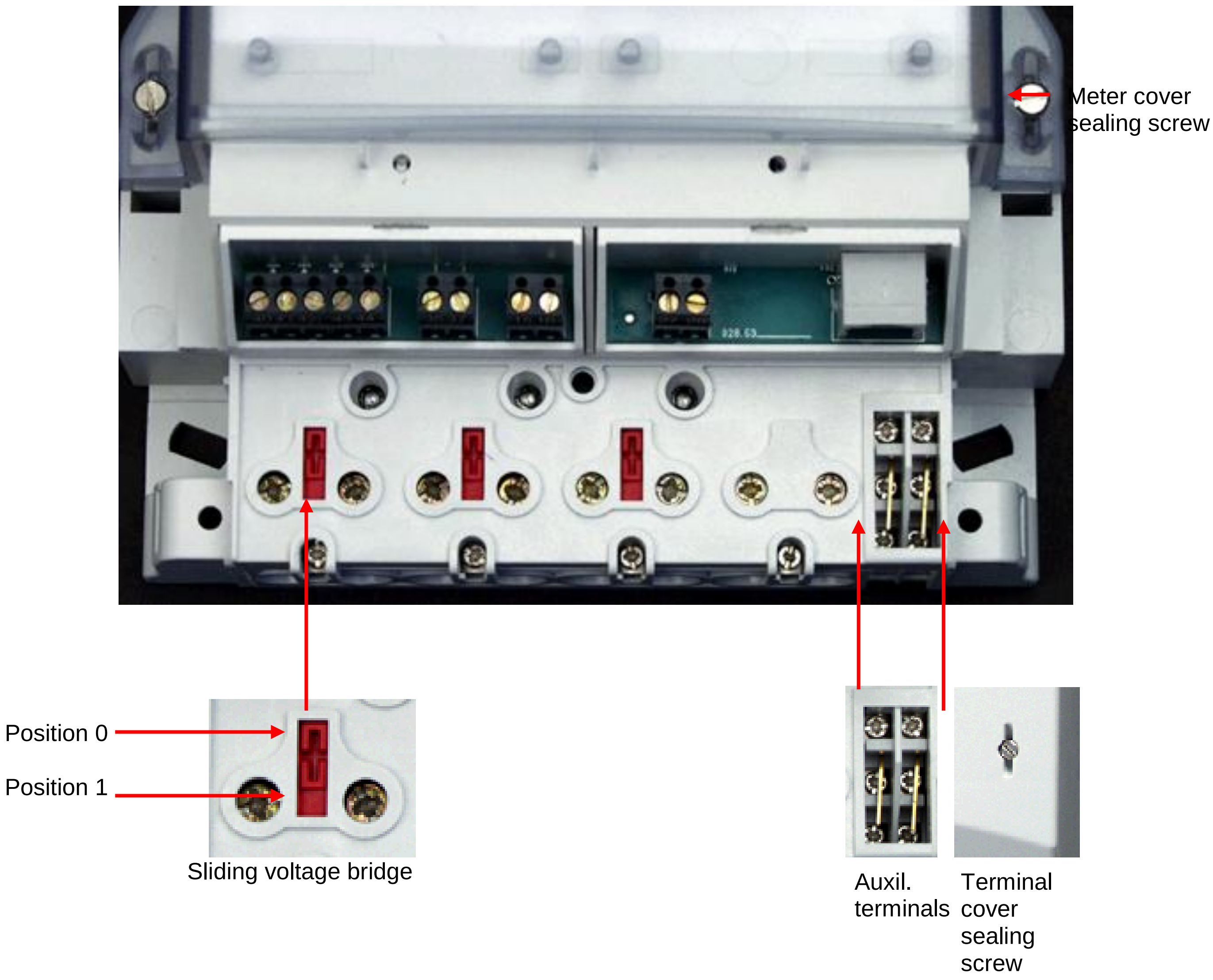


Figure 15 - Terminal block constituent parts for direct connected meter

15. Terminal block

15.1. Terminal block

A terminal block complies with the standard. It is made of high quality polycarbonate that assures: resistance to high temperatures, voltage breakdown and mechanical strength.

15.2. Current terminals

Direct connected meter:
Connection terminals are made of nickel plated steels and have only one screw per terminal. A universal clamping terminal assures the same quality of the contact irrespective of the shape of the connection conductor (a compact wire, a stranded wire, greater or smaller cross-section). It is made of brass and has only one screw. It also assures faster meter assembly.

Figure 16: Current terminals for direct connected meter version

15.3. Auxiliary voltage terminals:

A direct connected meter:
The meter can be equipped with max. four auxiliary voltage terminals (L1, L2, L3, N). They enable simple connection of additional external devices.

15.4. Sliding voltage bridge

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

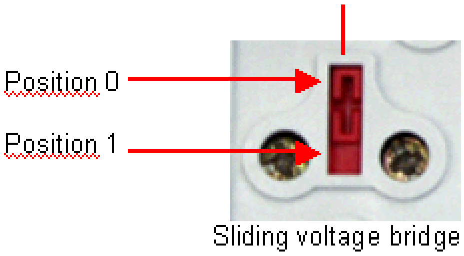


Figure 17: Sliding voltage bridge

Position 0: Voltage bridge is disconnected
Position 1: Voltage bridge is connected

Different versions of sliding bridges exist:

- External connection

Figure 18: External version of voltage bridges

- Internal connection (voltages bridges are accessible only by opening the meter cover)

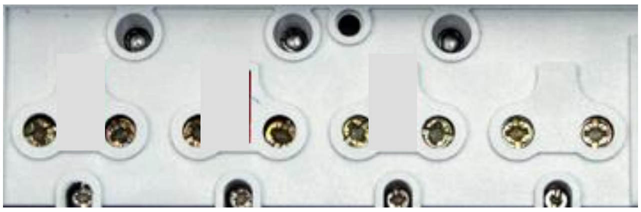


Figure 19: Internal version of voltage bridges

- Cop5 terminal (voltage terminals are covered) – also for transformer connected meter

Figure 20: Meter terminals are covered with special Cop5 cover

15.5. Dimensions

Meter fixing dimensions comply with the DIN 43857 standard.

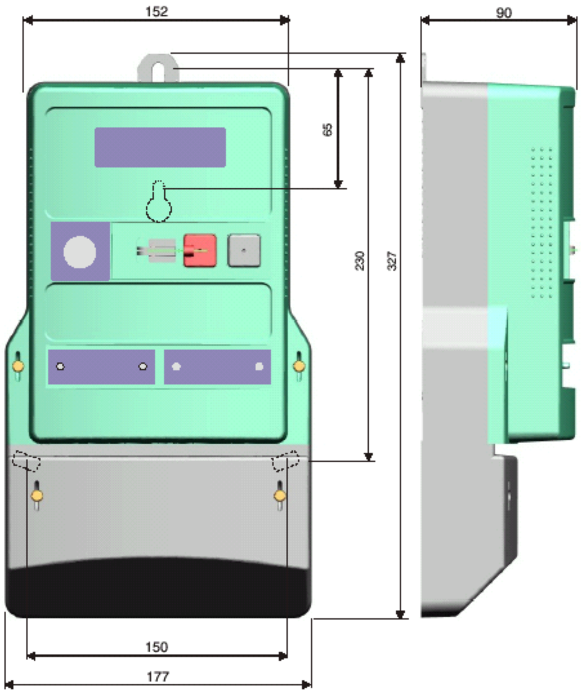


Figure 21- Meter fixing dimensions (MT830)

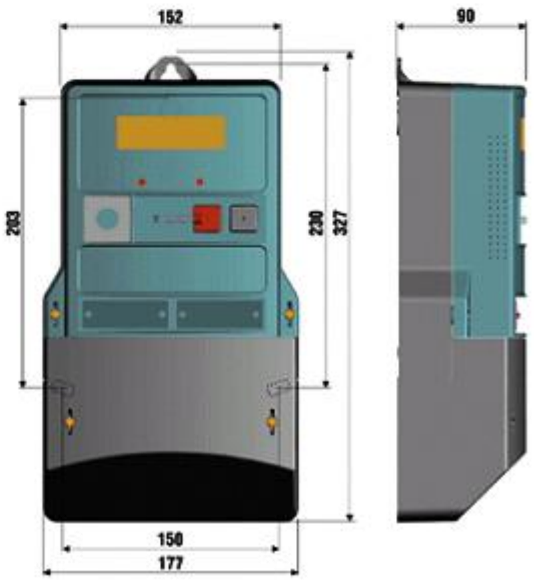


Figure 22- Meter fixing dimensions (MT831)

16. Maintenance:

The meter is designed and manufactured in such a way that it does not need any maintenance interventions in the entire lifetime. Measuring stability assures that no recalibration is required. The meter with the internal battery assures sufficient capacity for performing battery-supported functions for the entire lifetime

17. Lifetime:

The meter is designed for 20-year lifetime at normal operating conditions.

18. Technical data

Accuracy class	
Active energy	A or B or C (EN 50470 - 3)
	Class 2 or 1 (IEC 62053-21) Class 0.5S (IEC 62053-22)
Reactive energy	Classes 2, 3 (IEC 62053-23), calibrated up to 1%
Apparent energy	Class 2 or 3, calibrated up to 1%
Voltages (V)	
Voltage range	3 x 57.7/100V ... 3 x 240/415V 3x100V … 3x415V (3P3W - external Aaron connection) 3x100V … 3x230V (3P3W connection) 0.8 - 1.15 U_n
Reference frequency	50 Hz ±5 % or 60Hz ±5 %

Currents (A)	
Direct connection	0.25 – 5(120)A, (Class A or B)
Indirect connection	0.01 – 1(6)A, (Class A or B or C) 0.01 – 1(10)A, (Class A or B or C) 0.05 – 5(6)A, (Class A or B or C) 0.01 – 5(10)A, (Class A or B or C) 0.05 – 5(20)A, (Class A or B or C)
Start up current	0.002In for class A or B (EN 50470 - 3) 0.002In for class 2 or 1 (EN 62053 - 21) 0.001In for class C (EN 50470 - 3) 0.001In for class 0.5S (EN 62053 - 21)
Short-circuit	30 Imax for direct connected 20 Imax for indirect connected
Outputs	
Type	PHOTO-MOS voltage-free relay
Contact	Make or break contact
Permitted load	25 VA (100 mA, 275 V AC)
Pulse length	From 20 ms to 240 ms (adjustable in steps by 20 ms)
Transmission distance	Up to 1 km
Inputs	
Voltage level	100 – 240 V AC ON: U ≥ 80 V OFF: U < 20 V
Current consumption	< 2 mA @ 50V < 10 mA @ 240V
Self consumption of circuit	< 0,1 VA / phase
Self consumption of voltage circuits	0.5 W / 1.1 VA (self consumption of voltage circuits, when meter is supplied from the measuring voltages) 0.2 W / 0.4 VA (self consumption of voltage circuits, when meter is supplied from the external voltage) 1.1 W / 3.7 VA (self consumption of the external power supply, when meter is supplied from the external voltage) max. 2.5 W / 3 VA (GSM module)
Communication	
IR	Max. 9600 Baud IEC62056-21
CS	Max. 9600 Baud, passive, CL0 in compliance with DIN 66348, Part 1.
RS232	Max. 9600 Baud
RS485	Max. 9600 Baud
Protocols	62056-21 mode C with or without a password.
LED output	Impulse frequency ≤ 40 Hz Impulse length approx. 8 ms

Real time clock Accuracy Back-up power supply	 Crystal: 6 ppm = ≤ ±3 min./year (at T_{op}= +25°C) Super-Cap: 0.1F and Li-battery
External power supply	50 - 240 V AC/DC
EMC Electrostatic discharge VF magnetic field Transient test Insulation strength Impulse voltage Glow wire test Spring hammer test	 15 kV (IEC 60801-2) 10 V/m (IEC 60801-3) 4 kV (IEC 60801-4) 4 kV_{rms}, 50 Hz, 1 min 6 kV, 1.2/50 μs IEC 695-2-1 IEC 60068-2-75
Temperature ranges Operation Storing	 -40°C ... +70°C -40°C ... +80°C
Humidity	> 95%
Terminals (diameter)	CT connection: 5 mm (2 screws per terminal) Direct connection: 9.5 mm (one screw per terminal)
Dimensions	327 x 177 x 90 mm
Mass	Approx. 1.4 kg

Table 7 Technical data

19. Type designation

19.1. Meter marking

M T 83x – D2 (T1) AnmRnmSnm – EnVn2Lnm – M3 K0xZ4

MT83x			three-phase multi-function four-quadrant electronic meter with three measuring systems
0			closed (basis) version of the meter
1			modular version of the meter
D2			a meter for direct connection and max. current 120 A
T1			transformer rated meter and max. current 20 A
A			Active energy
	n = 3		class 0.5S, C (IEC 62053-22, EN 50470-3)
	n = 4		class 1, B (IEC 62053-21, EN 50470-3)
	n = 5		class 2, A (IEC 62053-21, EN 50470-3)
		m = 1	one energy flow direction
		m = 2	two energy flow directions
R			**Reactive energy**
	n = 4		class 2 (IEC 62053 – 23), calibrated to 1%
	n = 5		class 2 (IEC 62053 – 23)
	n = 6		class 3 (IEC 62053 – 23)
		m = 1	reactive energy flow in one direction (Q+ = Q1 + Q2)
		m = 2	reactive energy flow in two directions (Q+ = Q1 + Q2 and Q-=Q3 + Q4)
		m = 3	inductive reactive energy - reception, capacitive reactive energy transmission (Q1 and Q4)
		m = 4	inductive reactive energy in two directions (Q1 in Q3)
		m = 5	measurement of reactive energy in four quadrants (Q1, Q2, Q3 and Q4)
		m = 6	measurement of reactive energy in four quadrants, reception and transmission (Q1, Q2, Q3, Q4 Q+ and Q-)
S			**Apparent energy**
	n = 4		adjusted to 1%
	n = 5		adjusted to 2%
	n = 6		adjusted to 3%
		m = 3	apparent energy → $P^{2+} Q^2$
E			**External power supply**
	n = 1		power supply of the whole meter
	n = 2		power supply via the optical probe (reading if measuring voltages are absent)
V			**Control inputs**
	n = 1..2		a number of inputs
		2	control voltage is phase voltage
L			**OptoMOS relay outputs**
	n=1..4		a number of outputs
		m = 1	make contact
		m = 2	optoMOS relay
M			**Additional device**
	3		real time clock + Li battery
K			**Communication interface**
	0		first interface: IR – optical interface
	1		second interface: CS-interface (20 mA current loop) (MT830 only)
	2		second interface: RS-232 (MT830 only)
	3		second interface: RS-485 (MT830 only)
Z			**Load profile recorder**
	4		memory capacity for load profile 512k FLASH ROM

20. Input-output module marking (for MT831 meter only)

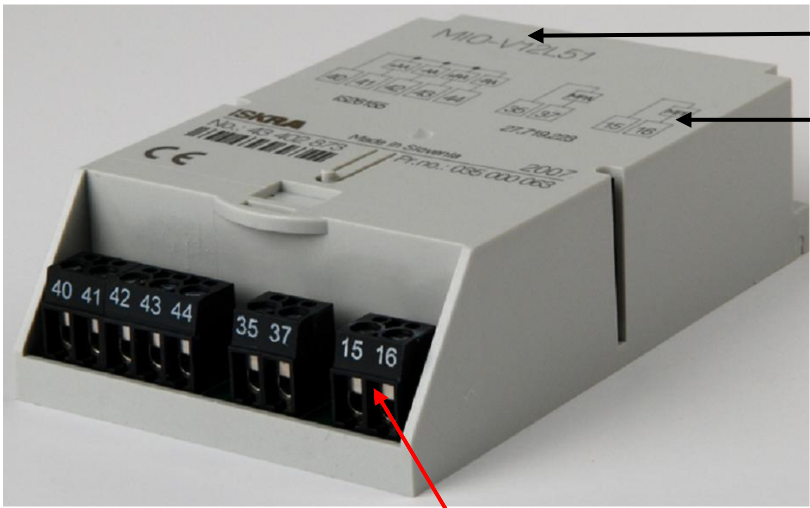
MIO - Vn2 Ln1 B11

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

<u>Input/output module options:</u>

MIO – V12L51
MIO – V42L81
MIO – V12L41B11

Input/output module MIO – V12L51

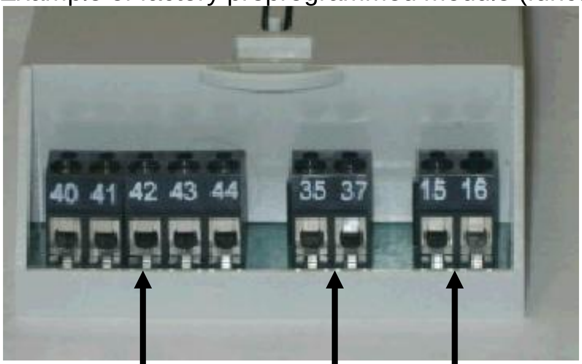


Module marking:

Connection diagram

Input/output module terminals

Example of factory preprogrammed module (function of the terminals are defined in the module) :



Common		G	15
External synchronization (for clock/demand period)	Active	MPE	16

Common		G	35
Measuring period	make contact	MPA	37

Common		G	40
Pulse output for active energy +A	make contact	+AA	41
Pulse output for active energy -A	make contact	+AA	42
Pulse output for reactive energy +R	make contact	+RA	43
Pulse output for reactive energy -R	make contact	-AA	44

21. Communication module marking (for MT831 meters only)

MK – f3n - m

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

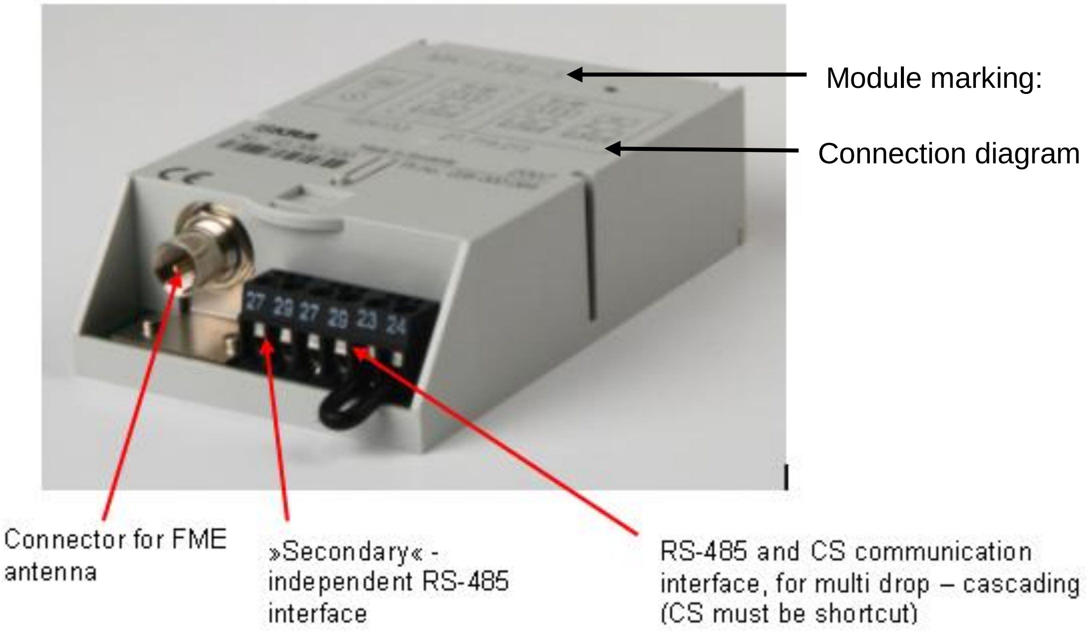
<u>**Communication module options:**</u>

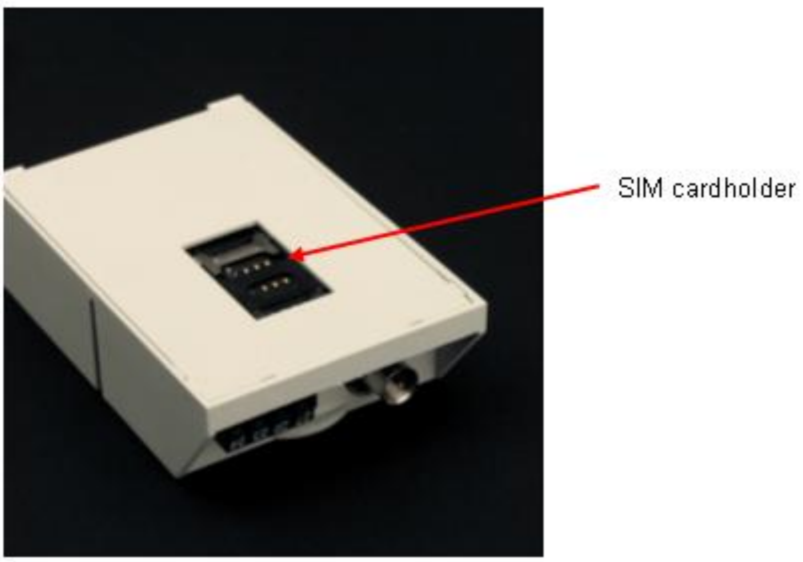
MK – 2 – 3 (RS-232 & RS-485 interface)
MK – 1 – 3 (CS interface & RS-485 interface)
MK – 3 – 3 (RS-485 interface & RS-485 interface)
MK – f37 – 3 (PSTN modem+CS+RS-485 interface & RS-485 interface) → module enables multidrop communication
MK – f38 – 3 (GSM modem+CS+RS-485 interface & RS-485 interface) → module enables multidrop communication
MK – f39 – 3 (ISDN modem+CS+RS-485 interface & RS-485 interface) → module enables multidrop communication

MK – f38a – 3 (GSM/GPRS modem +RS-485 interface & RS-485 interface) → module enables multidrop communication
MK – 3e – 3 (Ethernet+RS-485 & RS-485 interface) → module enables multidrop communication

MK-MB-3-e-3 (MODBUS; Etherne interface+ RS-485 & RS-485 interface) → module enables multidrop communication

GSM communication module MK – f38 – 3



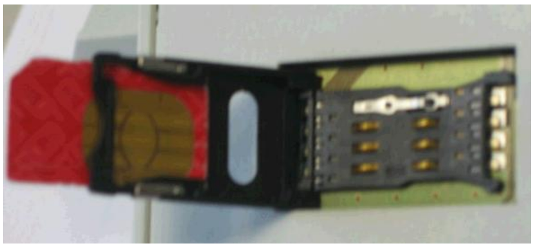


Installation of the SIM card (SIM card must be enabled for data transfer)

1. Remove the GSM or GSM/GPRS modem from the meter

2. SIM card must be without PIN code
3. Insert the SIM card into the SIM cardholder

Move lock to the left,
to enable opening
the SIM cardholder!



4. Insert the GSM modem back into the meter

5. Connect the antenna with the modem

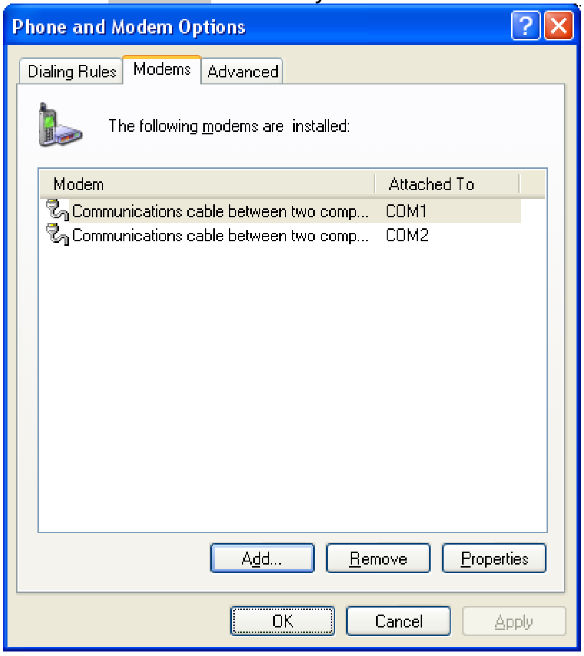
6. With the **DIAG** menu on the meter (accessible with the black button), the following can be checked:
   - C.C.3 → a signal level (should be higher than 17)
   - C.C.4 → GSM provider (1 – home provider, 5 – roaming)

- C.C.5 → error code (should be 0)

22. Configuring a PC modem

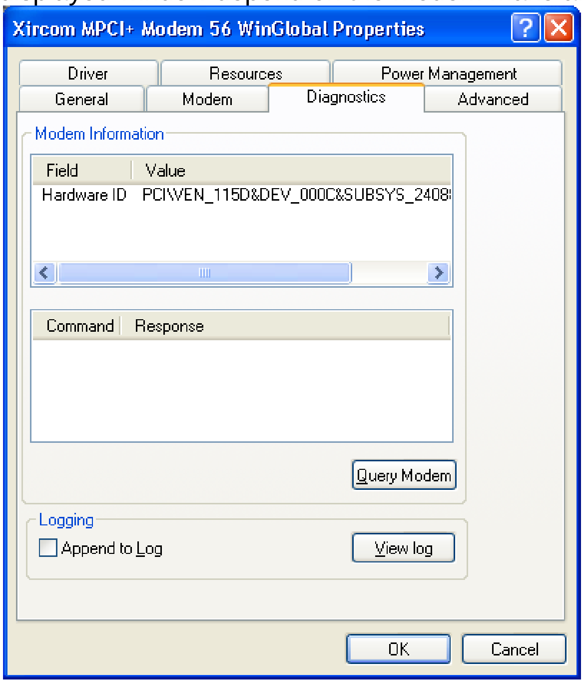
What is described below is the general method of installing a modem. You should follow the instructions given by your modem's manufacturer if different from any information given here.

The most effective way to use a modem with Meter View is to properly install it in Windows. To do this, launch Windows Control Panel (click the Windows Start button, click Settings if you see this option, then click Control Panel) and start the Phone and Modem Settings applet.
Click the Modems tab and you should see the following window.



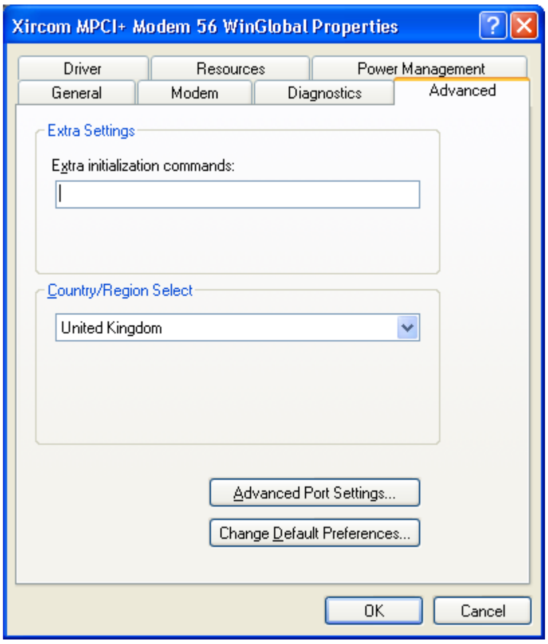
The Windows Control Panel Phone and Modem Options window.

The contents of the list of modems will depend on your system current configuration.
To add a modem, click Add... to see the Windows Add Hardware Wizard and follow the on-screen instructions.
If your modem is connected to your computer, it is a good idea to do a diagnostic check when you return to the Windows Phone and Modem Options window. To do this, select the newly added device and click Properties. Click the Diagnostics tab in the window and a window that closely resembles the following is displayed. The specific details of the displayed window depend on the modem make and model.



Windows Modem Properties window

Click the Query Modem button to see that the Command and Response list is populated and that no error messages are displayed.
If your modem requires additional commands to select the correct mode of operation, click the Advanced tab to see the following window.

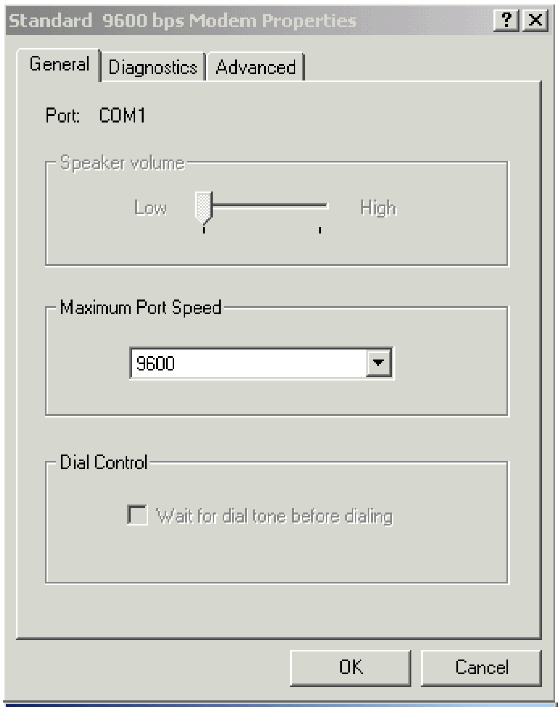


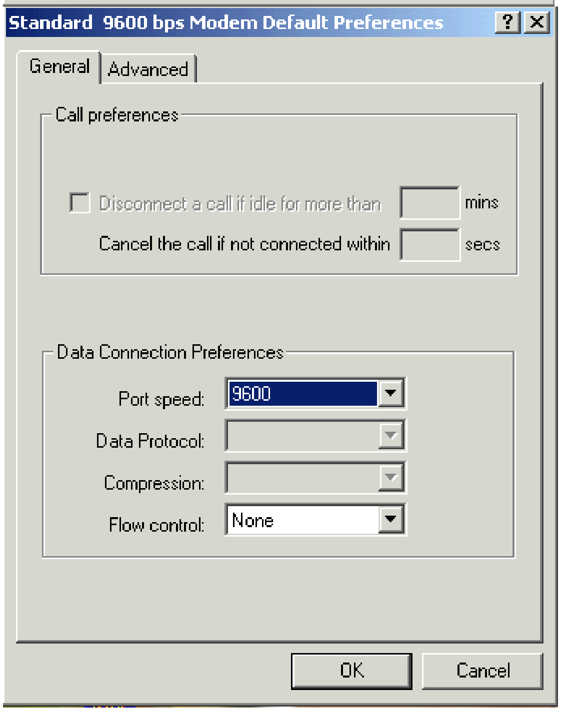
Consult your modem documentation on the commands available to you.

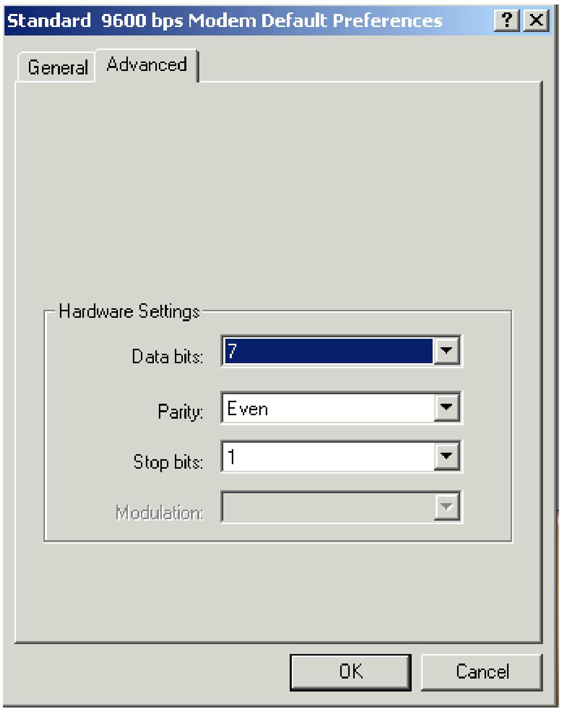
Communication with the MT8xx meters is performed in compliance with the **IEC 1107** standard with **Mode C protocol**.

Type of communication: Serial asynchronous half-duplex ISO 1177
1 start bit
7 data bits
1 bit parity - even
1 stop bit
Data transfer rate: 300, 600, 1200, 2400, 4800, 9600 Baud

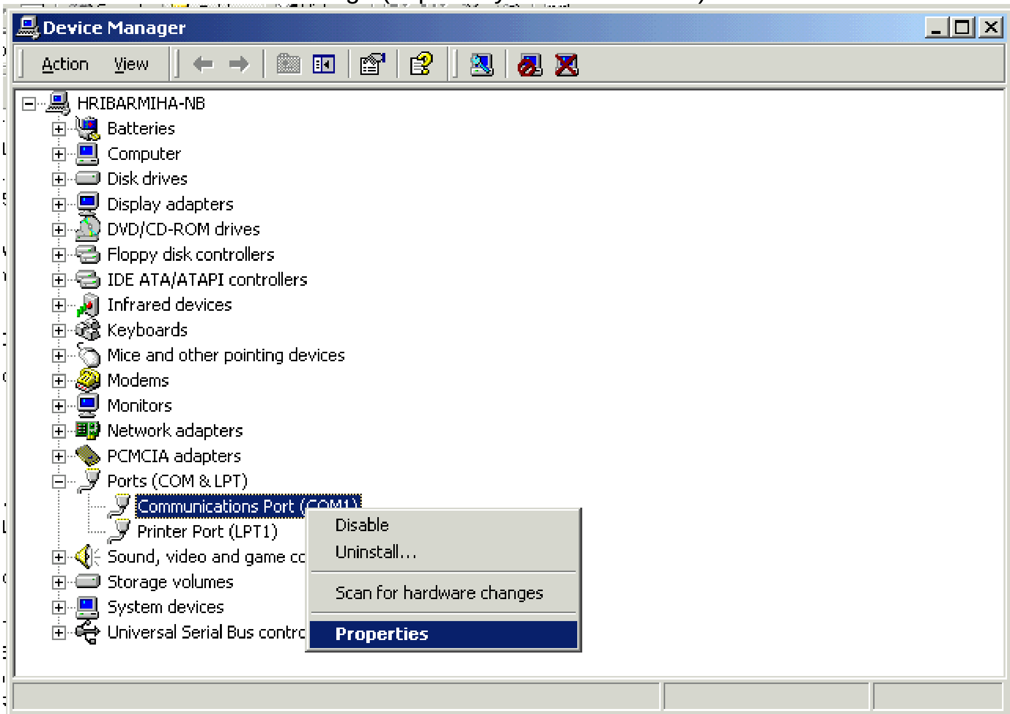
Appropriate modem settings:

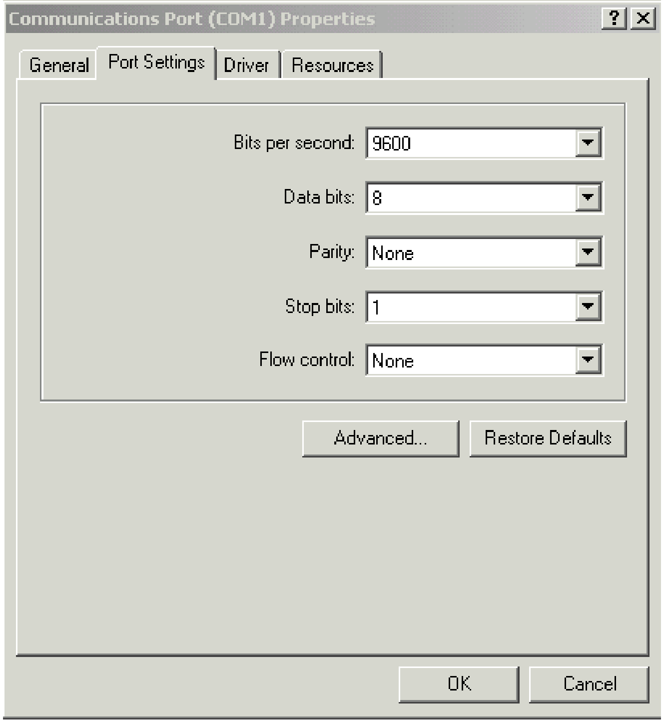

Standard 9600 bps Modem Properties
General
Diagnostics
Advanced
Port: COM1
Speaker volume
Low
High
Maximum Port Speed
9600
Dial Control
Wait for dial tone before dialing
OK
Cancel


Standard 9600 bps Modem Default Preferences
General
Advanced
Call preferences
Disconnect a call if idle for more than
mins
Cancel the call if not connected within
secs
Data Connection Preferences
Port speed:
9600
Data Protocol:
Compression:
Flow control:
None
OK
Cancel

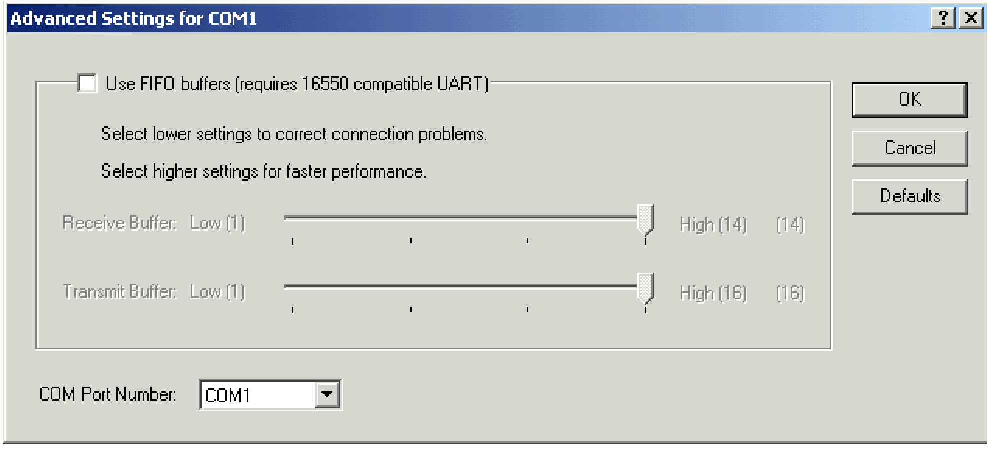

Standard 9600 bps Modem Default Preferences
General
Advanced
Hardware Settings
Data bits:
7
Parity:
Even
Stop bits:
1
Modulation:
OK
Cancel

Check also FIFO buffer settings (especially for XP windows):

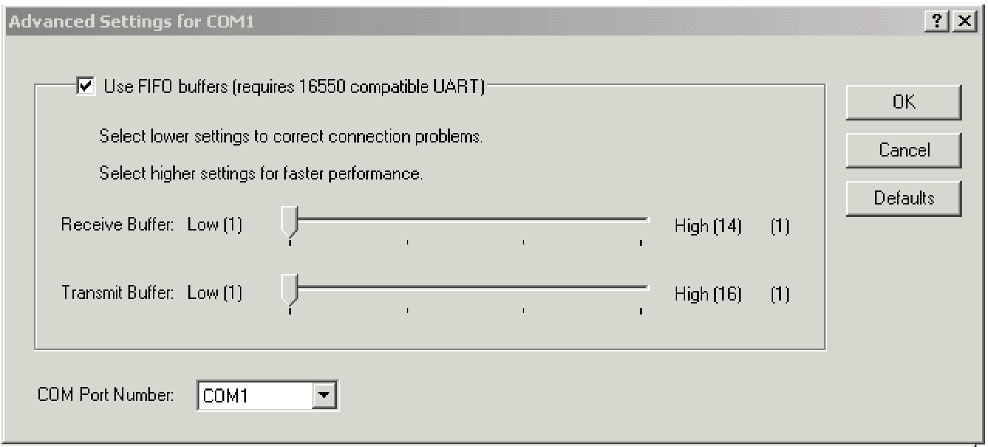


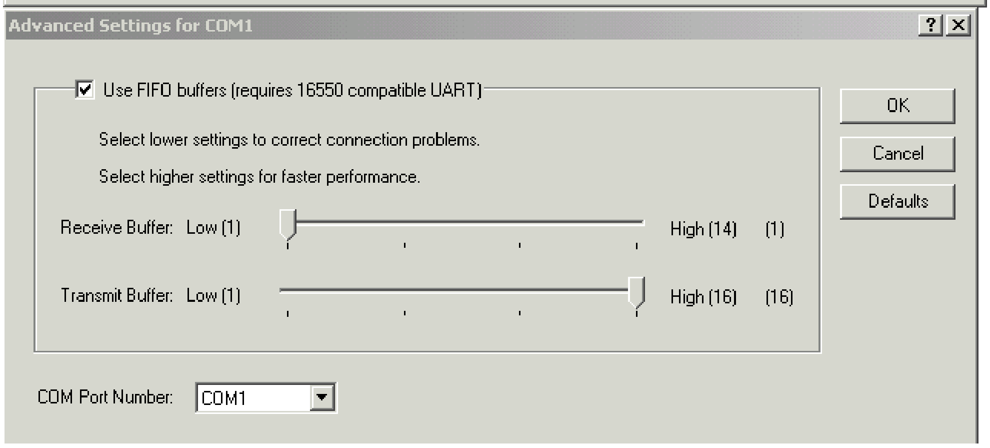


Advanced →


Advanced Settings for COM1
Use FIFO buffers (requires 16550 compatible UART)
Select lower settings to correct connection problems.
Select higher settings for faster performance.
Receive Buffer: Low (1)
High (14) (14)
Transmit Buffer: Low (1)
High (16) (16)
COM Port Number: COM1
OK
Cancel
Defaults

or


Advanced Settings for COM1
Use FIFO buffers (requires 16550 compatible UART)
Select lower settings to correct connection problems.
Select higher settings for faster performance.
Receive Buffer: Low (1)
High (14) (1)
Transmit Buffer: Low (1)
High (16) (1)
COM Port Number: COM1
OK
Cancel
Defaults


Advanced Settings for COM1
Use FIFO buffers (requires 16550 compatible UART)
Select lower settings to correct connection problems.
Select higher settings for faster performance.
Receive Buffer: Low (1)
High (14) (1)
Transmit Buffer: Low (1)
High (16) (16)
COM Port Number: COM1
OK
Cancel
Defaults

Appendix A: OBIS codes and data names

OBIS code	Data name
Three phases energy registers, t = TOU registers (1,..n)	
1-0:1.8.0	A+, Active energy import, total register
1-0:1.8.t	A+, Active energy import, TOU register
1-0:1.9.0	A+, Active energy import in the billing period, total register
1-0:1.9.t	A+, Active energy import in the billing period, TOU register
1-0:2.8.0	A-, Active energy export, total register
1-0:2.8.t	A-, Active energy export, TOU register
1-0:2.9.0	A-, Active energy export in the billing period, total register
1-0:2.9.t	A-, Active energy export in the billing period, TOU register
1-0:3.8.0	Q+=Q1+ Q2, Reactive energy import, total register
1-0:3.8.t	Q+=Q1+ Q2, Reactive energy import, TOU register
1-0:3.9.0	Q+=Q1+ Q2, Reactive energy import in the billing period, total register
1-0:3.9.t	Q+=Q1+ Q2, Reactive energy import in the billing period, TOU register
1-0:4.8.0	Q-=Q3+ Q4, Reactive energy export, total register
1-0:4.8.t	Q-=Q3+ Q4, Reactive energy export, TOU register
1-0:4.9.0	Q-=Q3+ Q4, Reactive energy export in the billing period, total register
1-0:4.9.t	Q-=Q3+ Q4, Reactive energy export in the billing period, TOU register
1-0:5.8.0	Q1, Reactive energy, inductive import, total register
1-0:5.8.t	Q1, Reactive energy, inductive import, TOU register
1-0:5.9.0	Q1, Reactive energy, inductive import in the billing period, total register
1-0:5.9.t	Q1, Reactive energy, inductive import in the billing period, TOU register
1-0:6.8.0	Q2, Reactive energy, capacitive import, total register
1-0:6.8.t	Q2, Reactive energy, capacitive import, TOU register
1-0:6.9.0	Q2, Reactive energy, capacitive import in the billing period, total register
1-0:6.9.t	Q2, Reactive energy, capacitive import in the billing period, TOU register
1-0:7.8.0	Q3, Reactive energy, inductive export, total register
1-0:7.8.t	Q3, Reactive energy, inductive export, TOU register
1-0:7.9.0	Q3, Reactive energy, inductive export in the billing period, total register
1-0:7.9.t	Q3, Reactive energy, inductive export in the billing period, TOU register
1-0:8.8.0	Q4, Reactive energy, capacitive export, total register
1-0:8.8.t	Q4, Reactive energy, capacitive export, TOU register
1-0:8.9.0	Q4, Reactive energy, capacitive export in the billing period, total register
1-0:8.9.t	Q4, Reactive energy, capacitive export in the billing period, TOU register
1-0:9.8.0	S+, Apparent energy import, total register
1-0:9.8.t	S+, Apparent energy import, TOU register
1-0:9.9.0	S+, Apparent energy import in the billing period, total register
1-0:9.9.t	S+, Apparent energy import in the billing period, TOU register
1-0:10.8.0	S-, Apparent energy export, total register
1-0:10.8.t	S-, Apparent energy export, TOU register
1-0:10.9.0	S-, Apparent energy export in the billing period, total register
1-0:10.9.t	S-, Apparent energy export in the billing period, TOU register
Three phases cumulative demand registers, t = TOU registers (1,..n)	
1-0:1.2.0	P+ cumulative demand total register
1-0:1.2.t	P+ cumulative demand TOU register
1-0:2.2.0	P- cumulative demand total register
1-0:2.2.t	P- cumulative demand TOU register
1-0:3.2.0	Q+ cumulative demand total register
1-0:3.2.t	Q+ cumulative demand TOU register
1-0:4.2.0	Q- cumulative demand total register
1-0:4.2.t	Q- cumulative demand TOU register

1-0:5.2.0	Q1 cumulative demand total register
1-0:5.2.t	Q1 cumulative demand TOU register
1-0:6.2.0	Q2 cumulative demand total register
1-0:6.2.t	Q2 cumulative demand TOU register
1-0:7.2.0	Q3 cumulative demand total register
1-0:7.2.t	Q3 cumulative demand TOU register
1-0:8.2.0	Q4 cumulative demand total register
1-0:8.2.t	Q4 cumulative demand TOU register
1-0:9.2.0	S+ cumulative demand total register
1-0:9.2.t	S+ cumulative demand TOU register
1-0:10.2.0	S- cumulative demand total register
1-0:10.2.t	S- cumulative demand TOU register
Three phases momentary demand registers	
1-0:1.4.0	P+ momentary demand register
1-0:2.4.0	P- momentary demand register
1-0:3.4.0	Q+ momentary demand register
1-0:4.4.0	Q- momentary demand register
1-0:5.4.0	Q1 momentary demand register
1-0:6.4.0	Q2 momentary demand register
1-0:7.4.0	Q3 momentary demand register
1-0:8.4.0	Q4 momentary demand register
1-0:9.4.0	S+ momentary demand register
1-0:10.4.0	S- momentary demand register
Three phases last ended measurement period demand register	
1-0:1.5.0	P+ last ended measurement period demand register
1-0:2.5.0	P- last ended measurement period demand register
1-0:3.5.0	Q+ last ended measurement period demand register
1-0:4.5.0	Q- last ended measurement period demand register
1-0:5.5.0	Q1 last ended measurement period demand register
1-0:6.5.0	Q2 last ended measurement period demand register
1-0:7.5.0	Q3 last ended measurement period demand register
1-0:8.5.0	Q4 last ended measurement period demand register
1-0:9.5.0	S+ last ended measurement period demand register
1-0:10.5.0	S- last ended measurement period demand register
Three phases maximum demand registers, t = TOU registers (1,..n)	
1-0:1.6.0	P+ maximum demand total register
1-0:1.6.t	P+ maximum demand TOU register
1-0:2.6.0	P- maximum demand total register
1-0:2.6.t	P- maximum demand TOU register
1-0:3.6.0	Q+ maximum demand total register
1-0:3.6.t	Q+ maximum demand TOU register
1-0:4.6.0	Q- maximum demand total register
1-0:4.6.t	Q- maximum demand TOU register
1-0:5.6.0	Q1 maximum demand total register
1-0:5.6.t	Q1 maximum demand TOU register
1-0:6.6.0	Q2 maximum demand total register
1-0:6.6.t	Q2 maximum demand TOU register
1-0:7.6.0	Q3 maximum demand total register
1-0:7.6.t	Q3 maximum demand TOU register
1-0:8.6.0	Q4 maximum demand total register
1-0:8.6.t	Q4 maximum demand TOU register
1-0:9.6.0	S+ maximum demand total register
1-0:9.6.t	S+ maximum demand TOU register
1-0:10.6.0	S- maximum demand total register

1-0:10.6.t	S- maximum demand TOU register
Three phases quality instantaneous registers	
1-0:11.7.0	Average current RMS
1-0:12.7.0	Average voltage RMS
1-0:13.7.0	Average power factor
1-0:14.7.0	Average frequency
1-0:11.7.h	Average harmonics component in current, h – harmonics component (1, ..,8)
1-0:12.7.h	Average harmonics component in voltage, h – harmonics component (1, ..,8)
1-0: 15.7.0	ΣLi Active power (abs(QI+QIV)+(abs(QII+QIII))
Phase R energy registers, t = TOU registers (1,..n)	
1-0:21.8.0	A+, Active energy import in phase R, total register
1-0:21.8.t	A+, Active energy import in phase R, TOU register
1-0:21.9.0	A+, Active energy import in the billing period, phase R
1-0:21.9.t	A+, Active energy import in the billing period TOU register, phase R
1-0:22.8.0	A-, Active energy export in phase R, total register
1-0:22.8.t	A-, Active energy export in phase R, TOU register
1-0:22.9.0	A-, Active energy export in the billing period, phase R
1-0:22.9.t	A-, Active energy export in the billing period TOU register, phase R
1-0:23.8.0	Q+=Q1+ Q2, Reactive energy import in phase R, total register
1-0:23.8.t	Q+=Q1+ Q2, Reactive energy import in phase R, TOU register
1-0:23.9.0	Q+=Q1+ Q2, Reactive energy import in the billing period, phase R
1-0:23.9.t	Q+=Q1+ Q2, Reactive energy import in the billing period TOU register, phase R
1-0:24.8.0	Q-=Q3+ Q4, Reactive energy export in phase R, total register
1-0:24.8.t	Q-=Q3+ Q4, Reactive energy export in phase R, TOU register
1-0:24.9.0	Q-=Q3+ Q4, Reactive energy export in the billing period, phase R
1-0:24.9.t	Q-=Q3+ Q4, Reactive energy export in the billing period TOU register, phase R
1-0:25.8.0	Q1, Reactive energy, inductive import in phase R, total register
1-0:25.8.t	Q1, Reactive energy, inductive import in phase R, TOU register
1-0:25.9.0	Q1, Reactive energy, inductive import in the billing period, phase R
1-0:25.9.t	Q1, Reactive energy, inductive import in the billing period TOU register, phase R
1-0:26.8.0	Q2, Reactive energy, capacitive import in phase R, total register
1-0:26.8.t	Q2, Reactive energy, capacitive import in phase R, TOU register
1-0:26.9.0	Q2, Reactive energy, capacitive import in the billing period, phase R
1-0:26.9.t	Q2, Reactive energy, capacitive import in the billing period TOU register, phase
1-0:27.8.0	Q3, Reactive energy, inductive export in phase R, total register
1-0:27.8.t	Q3, Reactive energy, inductive export in phase R, TOU register
1-0:27.9.0	Q3, Reactive energy, inductive export in the billing period, phase R
1-0:27.9.t	Q3, Reactive energy, inductive export in the billing period TOU register, phase R
1-0:28.8.0	Q4, Reactive energy, capacitive export in phase R, total register
1-0:28.8.t	Q4, Reactive energy, capacitive export in phase R, TOU register
1-0:28.9.0	Q4, Reactive energy, capacitive export in the billing period, phase R
1-0:28.9.t	Q4, Reactive energy, capacitive export in the billing period TOU register, phase
1-0:29.8.0	S+, Apparent energy import in phase R, total register
1-0:29.8.t	S+, Apparent energy import in phase R, TOU register
1-0:29.9.0	S+, Apparent energy import in the billing period, phase R
1-0:29.9.t	S+, Apparent energy import in the billing period TOU register, phase R
1-0:30.8.0	S- Apparent energy export in phase R, total register
1-0:30.8.t	S- Apparent energy export in phase R, TOU register
1-0:30.9.0	S-, Apparent energy export in the billing period, phase R
1-0:30.9.t	S-, Apparent energy export in the billing period TOU register, phase R
Phase R cumulative demand register, t = TOU registers (1,..n)	
1-0:21.2.0	P+ cumulative demand in phase R total register
1-0:21.2.t	P+ cumulative demand in phase R TOU register
1-0:22.2.0	P- cumulative demand in phase R total register

1-0:22.2.t	P- cumulative demand in phase R TOU register
1-0:23.2.0	Q+ cumulative demand in phase R total register
1-0:23.2.t	Q+ cumulative demand in phase R TOU register
1-0:24.2.0	Q- cumulative demand in phase R total register
1-0:24.2.t	Q- cumulative demand in phase R TOU register
1-0:25.2.0	Q1 cumulative demand in phase R total register
1-0:25.2.t	Q1 cumulative demand in phase R TOU register
1-0:26.2.0	Q2 cumulative demand in phase R total register
1-0:26.2.t	Q2 cumulative demand in phase R TOU register
1-0:27.2.0	Q3 cumulative demand in phase R total register
1-0:2.2.t	Q3 cumulative demand in phase R TOU register
1-0:28.2.0	Q4 cumulative demand in phase R total register
1-0:28.2.t	Q4 cumulative demand in phase R TOU register
1-0:29.2.0	S+ cumulative demand in phase R total register
1-0:29.2.t	S+ cumulative demand in phase R TOU register
1-0:30.2.0	S- cumulative demand in phase R total register
1-0:30.2.t	S- cumulative demand in phase R TOU register
Phase R momentary demand register	
1-0:21.4.0	P+ momentary demand in phase R register
1-0:22.4.0	P- momentary demand in phase R register
1-0:23.4.0	Q+ momentary demand in phase R register
1-0:24.4.0	Q- momentary demand in phase R register
1-0:25.4.0	Q1 momentary demand in phase R register
1-0:26.4.0	Q2 momentary demand in phase R register
1-0:27.4.0	Q3 momentary demand in phase R register
1-0:28.4.0	Q4 momentary demand in phase R register
1-0:29.4.0	S+ momentary demand in phase R register
1-0:30.4.0	S- momentary demand in phase R register
Phase R last ended measurement period demand register	
1-0:21.5.0	P+ last ended measurement period in phase R demand register
1-0:22.5.0	P- last ended measurement period in phase R demand register
1-0:23.5.0	Q+ last ended measurement period in phase R demand register
1-0:24.5.0	Q- last ended measurement period in phase R demand register
1-0:25.5.0	Q1 last ended measurement period in phase R demand register
1-0:26.5.0	Q2 last ended measurement period in phase R demand register
1-0:27.5.0	Q3 last ended measurement period in phase R demand register
1-0:28.5.0	Q4 last ended measurement period in phase R demand register
1-0:29.5.0	S+ last ended measurement period in phase R demand register
1-0:30.5.0	S- last ended measurement period in phase R demand register
Phase R maximum demand registers, t = TOU registers (1,..n)	
1-0:21.6.0	P+ maximum demand in phase R register
1-0:21.6.t	P+ maximum demand in phase R TOU register
1-0:22.6.0	P- maximum demand in phase R register
1-0:22.6.t	P- maximum demand in phase R TOU register
1-0:23.6.0	Q+ maximum demand in phase R register
1-0:23.6.t	Q+ maximum demand in phase R TOU register
1-0:24.6.0	Q- maximum demand in phase R register
1-0:24.6.t	Q- maximum demand in phase R TOU register
1-0:25.6.0	Q1 maximum demand in phase R register
1-0:25.6.t	Q1 maximum demand in phase R TOU register
1-0:26.6.0	Q2 maximum demand in phase R register
1-0:26.6.t	Q2 maximum demand in phase R TOU register
1-0:27.6.0	Q3 maximum demand in phase R register
1-0:27.6.t	Q3 maximum demand in phase R TOU register

1-0:28.6.0	Q4 maximum demand in phase R register
1-0:28.6.t	Q4 maximum demand in phase R TOU register
1-0:29.6.0	S+ maximum demand in phase R register
1-0:29.6.t	S+ maximum demand in phase R TOU register
1-0:30.6.0	S- maximum demand in phase R register
1-0:30.6.t	S- maximum demand in phase R TOU register
Phase R quality instantaneous registers	
1-0:31.7.0	Average current RMS in phase R
1-0:32.7.0	Average voltage RMS in phase R
1-0:33.7.0	Average power factor in phase R
1-0:34.7.0	Average frequency in phase R
1-0:31.7.h	Average harmonics component in current, h – harmonics component (1, ..,8) in phase R
1-0:32.7.h	Average harmonics component in voltage, h – harmonics component (1, ..,8) in phase R
1-0:81.7.40	Phase angle in phase R
Phase S energy registers, t = TOU registers (1,..n)	
1-0:41.8.0	A+, Active energy import in phase S, total register
1-0:41.8.t	A+, Active energy import in phase S, total register
1-0:41.9.0	A+, Active energy import in the billing period, phase S
1-0:41.9.t	A+, Active energy import in the billing period, phase S
1-0:42.8.0	A-, Active energy export in phase S, total register
1-0:42.8.t	A-, Active energy export in phase S, total register
1-0:42.9.0	A-, Active energy export in the billing period, phase S
1-0:42.9.t	A-, Active energy export in the billing period, phase S
1-0:43.8.0	Q+=Q1+ Q2, Reactive energy import in phase S, total register
1-0:43.8.t	Q+=Q1+ Q2, Reactive energy import in phase S, total register
1-0:43.9.0	Q+=Q1+ Q2, Reactive energy import in the billing period, phase S
1-0:43.9.t	Q+=Q1+ Q2, Reactive energy import in the billing period, phase S
1-0:44.8.0	Q-=Q3+ Q4, Reactive energy export in phase S, total register
1-0:44.8.t	Q-=Q3+ Q4, Reactive energy export in phase S, total register
1-0:44.9.0	Q-=Q3+ Q4, Reactive energy export in the billing period, phase S
1-0:44.9.t	Q-=Q3+ Q4, Reactive energy export in the billing period, phase S
1-0:45.8.0	Q1, Reactive energy, inductive import in phase S, total register
1-0:45.8.t	Q1, Reactive energy, inductive import in phase S, total register
1-0:45.9.0	Q1, Reactive energy, inductive import in the billing period, phase S
1-0:45.9.t	Q1, Reactive energy, inductive import in the billing period, phase S
1-0:46.8.0	Q2, Reactive energy, capacitive import in phase S, total register
1-0:46.8.t	Q2, Reactive energy, capacitive import in phase S, total register
1-0:46.9.0	Q2, Reactive energy, capacitive import in the billing period, phase S
1-0:46.9.t	Q2, Reactive energy, capacitive import in the billing period, phase S
1-0:47.8.0	Q3, Reactive energy, inductive export in phase S, total register
1-0:47.8.t	Q3, Reactive energy, inductive export in phase S, total register
1-0:47.9.0	Q3, Reactive energy, inductive export in the billing period, phase S
1-0:47.9.t	Q3, Reactive energy, inductive export in the billing period, phase S
1-0:48.8.0	Q4, Reactive energy, capacitive export in phase S, total register
1-0:48.8.t	Q4, Reactive energy, capacitive export in phase S, total register
1-0:48.9.0	Q4, Reactive energy, capacitive export in the billing period, phase S
1-0:48.9.t	Q4, Reactive energy, capacitive export in the billing period, phase S
1-0:49.8.0	S+, Apparent energy import in phase S, total register
1-0:49.8.t	S+, Apparent energy import in phase S, total register
1-0:49.9.0	S+, Apparent energy import in the billing period, phase S
1-0:49.9.t	S+, Apparent energy import in the billing period, phase S
1-0:50.8.0	S-, Apparent energy export in phase S, total register

1-0:50.8.t	S-, Apparent energy export in phase S, total register
1-0:50.9.0	S-, Apparent energy export in the billing period, phase S
1-0:50.9.t	S-, Apparent energy export in the billing period, phase S
Phase S momentary demand register	
1-0:41.4.0	P+ momentary demand in phase S register
1-0:42.4.0	P- momentary demand in phase S register
1-0:43.4.0	Q+ momentary demand in phase S register
1-0:44.4.0	Q- momentary demand in phase S register
1-0:45.4.0	Q1 momentary demand in phase S register
1-0:46.4.0	Q2 momentary demand in phase S register
1-0:47.4.0	Q3 momentary demand in phase S register
1-0:48.4.0	Q4 momentary demand in phase S register
1-0:49.4.0	S+ momentary demand in phase S register
1-0:50.4.0	S- momentary demand in phase S register
Phase S last ended measurement period demand register	
1-0:41.5.0	P+ last ended measurement period in phase S demand register
1-0:42.5.0	P- last ended measurement period in phase S demand register
1-0:43.5.0	Q+ last ended measurement period in phase S demand register
1-0:44.5.0	Q- last ended measurement period in phase S demand register
1-0:45.5.0	Q1 last ended measurement period in phase S demand register
1-0:46.5.0	Q2 last ended measurement period in phase S demand register
1-0:47.5.0	Q3 last ended measurement period in phase S demand register
1-0:48.5.0	Q4 last ended measurement period in phase S demand register
1-0:49.5.0	S+ last ended measurement period in phase S demand register
1-0:50.5.0	S- last ended measurement period in phase S demand register
Phase S maximum demand registers, t = TOU registers (1,..n)	
1-0:41.6.0	P+ maximum demand in phase S register
1-0:41.6.t	P+ maximum demand in phase S TOU register
1-0:42.6.0	P- maximum demand in phase S register
1-0:42.6.t	P- maximum demand in phase S TOU register
1-0:43.6.0	Q+ maximum demand in phase S register
1-0:43.6.t	Q+ maximum demand in phase S TOU register
1-0:44.6.0	Q- maximum demand in phase S register
1-0:44.6.t	Q- maximum demand in phase S TOU register
1-0:45.6.0	Q1 maximum demand in phase S register
1-0:45.6.t	Q1 maximum demand in phase S TOU register
1-0:46.6.0	Q2 maximum demand in phase S register
1-0:46.6.t	Q2 maximum demand in phase S TOU register
1-0:47.6.0	Q3 maximum demand in phase S register
1-0:47.6.t	Q3 maximum demand in phase S TOU register
1-0:48.6.0	Q4 maximum demand in phase S register
1-0:48.6.t	Q4 maximum demand in phase S TOU register
1-0:49.6.0	S+ maximum demand in phase S register
1-0:49.6.t	S+ maximum demand in phase S TOU register
1-0:50.6.0	S- maximum demand in phase S register
1-0:50.6.t	S- maximum demand in phase S TOU register
Phase S quality instantaneous registers	
1-0:51.7.0	Average current RMS in phase S
1-0:52.7.0	Average voltage RMS in phase S
1-0:53.7.0	Average power factor in phase S
1-0:54.7.0	Average frequency in phase S
1-0:51.7.h	Average harmonics component in current, h – harmonics component (1, ..,8) in phase S

1-0:52.7.h	Average harmonics component in voltage, h – harmonics component (1, ..,8) in phase S
1-0:81.7.51	Phase angle in phase S
Phase T energy registers, t = TOU registers (1,..n)	
1-0:61.8.0	A+, Active energy import in phase T, total register
1-0:61.8.t	A+, Active energy import in phase T, total register
1-0:61.9.0	A+, Active energy import in the billing period, phase T
1-0:61.9.t	A+, Active energy import in the billing period, phase T
1-0:62.8.0	A-, Active energy export in phase T, total register
1-0:62.8.t	A-, Active energy export in phase T, total register
1-0:62.9.0	A-, Active energy export in the billing period, phase T
1-0:62.9.t	A-, Active energy export in the billing period, phase T
1-0:63.8.0	Q+=Q1+ Q2, Reactive energy import in phase T, total register
1-0:63.8.t	Q+=Q1+ Q2, Reactive energy import in phase T, total register
1-0:63.9.0	Q+=Q1+ Q2, Reactive energy import in the billing period, phase T
1-0:63.9.t	Q+=Q1+ Q2, Reactive energy import in the billing period, phase T
1-0:64.8.0	Q-=Q3+ Q4, Reactive energy export in phase T, total register
1-0:64.8.t	Q-=Q3+ Q4, Reactive energy export in phase T, total register
1-0:64.9.0	Q-=Q3+ Q4, Reactive energy export in the billing period, phase T
1-0:64.9.t	Q-=Q3+ Q4, Reactive energy export in the billing period, phase T
1-0:65.8.0	Q1, Reactive energy, inductive import in phase T, total register
1-0:65.8.t	Q1, Reactive energy, inductive import in phase T, total register
1-0:65.9.0	Q1, Reactive energy, inductive import in the billing period, phase T
1-0:65.9.t	Q1, Reactive energy, inductive import in the billing period, phase T
1-0:66.8.0	Q2, Reactive energy, capacitive import in phase T, total register
1-0:66.8.t	Q2, Reactive energy, capacitive import in phase T, total register
1-0:66.9.0	Q2, Reactive energy, capacitive import in the billing period, phase T
1-0:66.9.t	Q2, Reactive energy, capacitive import in the billing period, phase T
1-0:67.8.0	Q3, Reactive energy, inductive export in phase T, total register
1-0:67.8.t	Q3, Reactive energy, inductive export in phase T, total register
1-0:67.9.0	Q3, Reactive energy, inductive export in the billing period, phase T
1-0:67.9.t	Q3, Reactive energy, inductive export in the billing period, phase T
1-0:68.8.0	Q4, Reactive energy, capacitive export in phase T, total register
1-0:68.8.t	Q4, Reactive energy, capacitive export in phase T, total register
1-0:68.9.0	Q4, Reactive energy, capacitive export in the billing period, phase T
1-0:68.9.t	Q4, Reactive energy, capacitive export in the billing period, phase T
1-0:69.8.0	S+, Apparent energy import in phase T, total register
1-0:69.8.t	S+, Apparent energy import in phase T, total register
1-0:69.9.0	S+, Apparent energy import in the billing period, phase T
1-0:69.9.t	S+, Apparent energy import in the billing period, phase T
1-0:70.8.0	S-, Apparent energy export in phase T, total register
1-0:70.8.t	S-, Apparent energy export in phase T, total register
1-0:70.9.0	S-, Apparent energy export in the billing period, phase T
1-0:70.9.t	S-, Apparent energy export in the billing period, phase T
Phase T momentary demand register	
1-0:61.4.0	P+ momentary demand in phase T register
1-0:62.4.0	P- momentary demand in phase T register
1-0:63.4.0	Q+ momentary demand in phase T register
1-0:64.4.0	Q- momentary demand in phase T register
1-0:65.4.0	Q1 momentary demand in phase T register
1-0:66.4.0	Q2 momentary demand in phase T register
1-0:67.4.0	Q3 momentary demand in phase T register
1-0:68.4.0	Q4 momentary demand in phase T register
1-0:69.4.0	S+ momentary demand in phase T register

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

Appendix B: Log book events

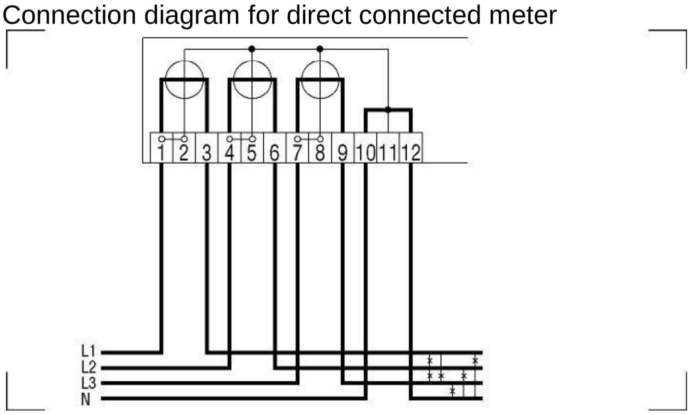
LB code	Data name
LB.0080	Power down
LB.0040	Power up
LB.8102	Voltage down phase L1
LB.8103	Voltage down phase L2
LB.8104	Voltage down phase L3
LB.8105	Under-voltage phase L1
LB.8106	Under-voltage phase L2

LB.8107	Under-voltage phase L3
LB.8108	Voltage normal phase L1
LB.8109	Voltage normal phase L2
LB.810A	Voltage normal phase L3
LB.810B	Over-voltage phase L1
LB.810C	Over-voltage phase L2
LB.810D	Over-voltage phase L3
LB.810E	Billing reset
LB.810F	RTC sync start
LB.8110	RTC sync end
LB.0020	RTC Set
LB.0008	DST
LB.2000	Log-Book erased
LB.4000	Load-Profile erased
LB.0001	Device disturbance
LB.8117	Parameters changed
LB.8118	Watch dog
LB.8119	Fraud start
LB.811A	Fraud end
LB.811B	Terminal cover opened
LB.811C	Terminal cover closed
LB.811D	Main cover opened
LB.811E	Main cover closed
LB.811F	Master reset
LB.8120	Parameter changed via remote comm.
LB.8121	Scheduled parameter change
LB.814E	Full Technical Log Book
LB.814F	Unable to send SMS alarm
LB.8150	Intrusion reset
LB.8151	Previous values reset
LB.8152	Current without Voltage phase L1 - start
LB.8153	Current without Voltage phase L2 – start
LB.8154	Current without Voltage phase L3 - start
LB.8155	Current without Voltage phase L1 - end
LB.8156	Current without Voltage phase L2 – end
LB.8157	Current without Voltage phase L3 – end
LB.815E	Wrong password login
LB.815F	Password changed
LB.8158	COM module inserted - bad
LB.8159	COM module inserted - OK
LB.815A	COM module out
LB.815B	IO module inserted - bad
LB.815C	IO module inserted - OK
LB.815D	IO module out
LB.8160	Start DST changed
LB.8161	End DST changed
LB.8162	Low battery
LB.8163	Inverted current start phase L1
LB.8164	Inverted current end phase L1
LB.8165	Inverted current start phase L2
LB.8166	Inverted current end phase L2
LB.8167	Inverted current start phase L3
LB.8168	Inverted current end phase L3
LB.8169	Unbalanced by current start
LB.816A	Unbalanced by current end
LB.816B	Unbalanced by voltage start

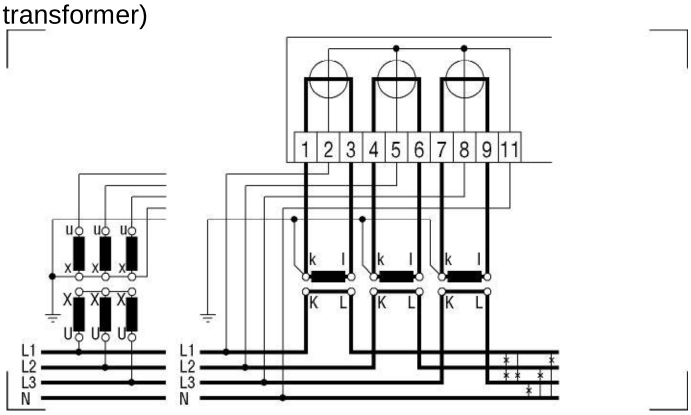
LB.816C	Unbalanced by voltage end
LB.816D	External alarm
LB.816E	Alarm output set
LB.8171	External alarm 2
LB.8172	External alarm 3
LB.8173	External alarm 4

Appendix C: Connection diagrams

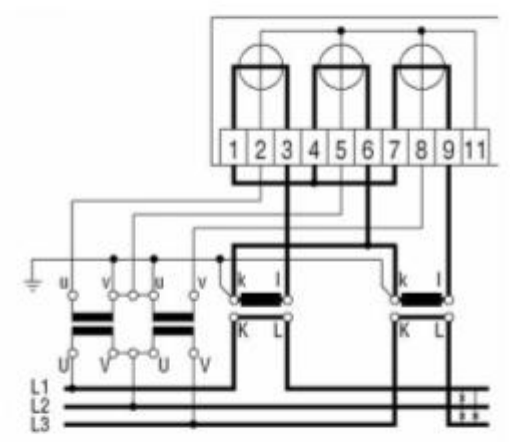
Connection diagram for direct connected meter



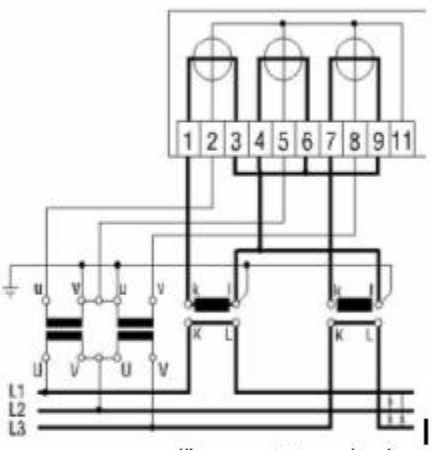
Connection diagram for indirect connected meter (4-wire connection, connection via current and (or) voltage transformer)



Connection diagram for indirect connected meter (3-wire connection, connection via current and voltage transformer)

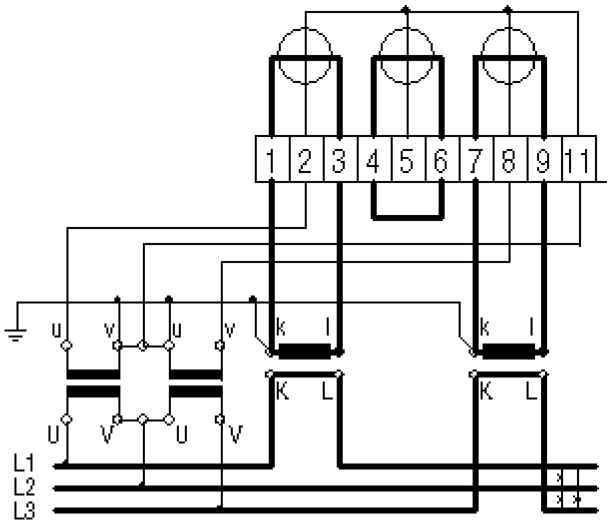


„k" current terminals are grounded



„l" current terminals are grounded

Connection diagram for indirect connected meter (3P3W connection, connection via current and voltage transformer)



Note: Such connection could be used only for maximal nominal voltage 3x230V and with vector registration only!