Automated data reading module

ESMB 3.0

User Manual

Version 1.4 (2018-10-09)

UAB NAVITUS LT, Lithuania 2018

This user manual serves as a description of ESMB 3.0 automated electricity meters reading module.Please read this document before starting the installation and operation of the controller. The manufacturer provides no warranties to the controllers if they are damaged as a result of failure to observe the requirements provided in this manual or technical certificate of the metering unit or due to the breach of occupational safety requirements.

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History of document and controller programme versions

Document version	**Date**	**Modifications, comments**	**Controller programme version**
1.0	01/10/2013	First revision	3.2.1.7
1.1	04/12/2013	Supplemented modbus addresses	3.3.0.8
1.2	12/12/2013	Fixed error in Tables 6.21 and 6.22 Data type not Integer, but Float	*
1.3	19/12/2013	Fixed reference to Table 6.44	*

Content

Notations and acronyms

CL	*Current Loop*
PC	*Personal Computer*
COM	*COMmunication port*
TCP/IP	*Transmission Control Protocol / Internet Protocol*
RTU	*Remote Terminal Unit*

1. Safety instructions

	Only the persons with adequate qualification can perform the installation, removal and configuration of the controller ESMB 3.0. When installing and operating the controller, it is necessary to observe the "Rules for the Installation of Electrical Equipment" (Vilnius, 2007).
	All equipment connected with the controller ESMB 3.0 must meet the requirements of EN 60950-1:2006 or other safety standards applicable to such equipment (electricity meters).
	Before connecting the controller to the power supply network, please read the installation manual provided in this document (Section 3).
	The controller ESMB 3.0 must be installed only in the places with limited access. It should be accessible only to the persons servicing this device.
	It is prohibited to open and disassemble the frame of the controller. There are no replaceable parts inside the controller. Electricity may be present in some parts even if the controller is disconnected from the power source!
	When replacing or connecting communication cables, the supply voltage must be disconnected at all times.

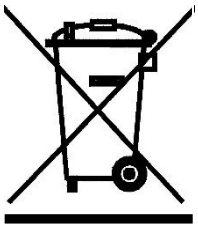
2. ESMB3.0 modifications

	EX.	UX.	CX.	LX
Example: Ethernet, 2 x 20mA Current loop (24V), RS232 + RS485	E1.	U0.	C2.	L1
Ethernet connection				
None	0			
Available	1			
(Reserved)				
Connection interfaces for metering units				
1 x 20mA Current loop (24V)			1	
2 x 20mA Current loop (24V)			2	
1 x RS485			3	
2 x RS485			4	
20mA Current loop (10V) + RS485			5	
1 x RS232			6	
Serial communication interface to read data from the controller (ModBus RTU/transparent protocol)				
RS232				1
RS232 + RS485				2

3. Technical specifications

Power supply	
Rated supply voltage	100 - 240 V, 50/60 Hz
Permissible range of supply voltage	90 - 264 V, 50/60 Hz 110 - 270 V, direct
Used power	No more than 5VA
Protection class	II.
Galvanic isolation: Power supply <-> Communication interfaces	3,000 V RMS, 1 minute
Communication interfaces	
20mA current loop (for connection of metering units)	Interface parameters according to LST EN 62056-21. Number of connected metering units - up to 5 (24V open current loop voltage) - up to 2 (10V open current loop voltage) Data transfer speed 300...19,200 baud
RS485 (for connection of metering units)	Number of connected metering units - up to 32 Data transfer speed 300...19,200 baud
RS232 (for connection/configuration of reading unit)	Data transfer speed 2,400 ... 19,200baud (factory setting 9,600 baud)
RS485 (for connection/configuration of reading unit)	Data transfer speed 300...19,200 baud
Ethernet (for data reading)	10/100 MBps, RJ45 connection
Galvanic isolation:	
Interfaces for connection of metering units <-> reading interfaces	500 V RMS, 1 minute
Environmental conditions, other	
Operating temperatures	-20 ...+50 ºC
Storage temperatures	-40 ...+70 ºC
Relative humidity	5 ... 95%, non-condensing
Dimensions	110 x 75 x 25 mm
Weight	115 g

As a matter of unilateral responsibility, UAB NAVITUS LT hereby declares that the product ESMB 3.0 is consistent with the requirements of the European Community Low Voltage Directive 2006/95/EC and Electromagnetic Compatibility Directive 2004/108/EC.



The crossed-out dustbin mark means that a product which is no longer usable must be recycled separately from other mixed waste in the EU. Do not utilise these products with mixed waste. ESMB 3.0 controller meets the norms of the European Community Directive 2002/96/EC.

4. Method of use

When reading data from the metering units, the LST EN 62056-31 (previously – IEC 1142) protocol is used. The controller converts LST EN 62056-31 to *Modbus RTU* or *Modbus TCP/IP* protocols (subject to the modification of the received query) hereinafter - *Modbus*.

The data transfer to the controlling unit can be performed transparently, via *Modbus* protocol or by mixed type. The parameters read by the controller depend on the type of the reader. The parameters supported by each type of controller is provided in Table 4.1.

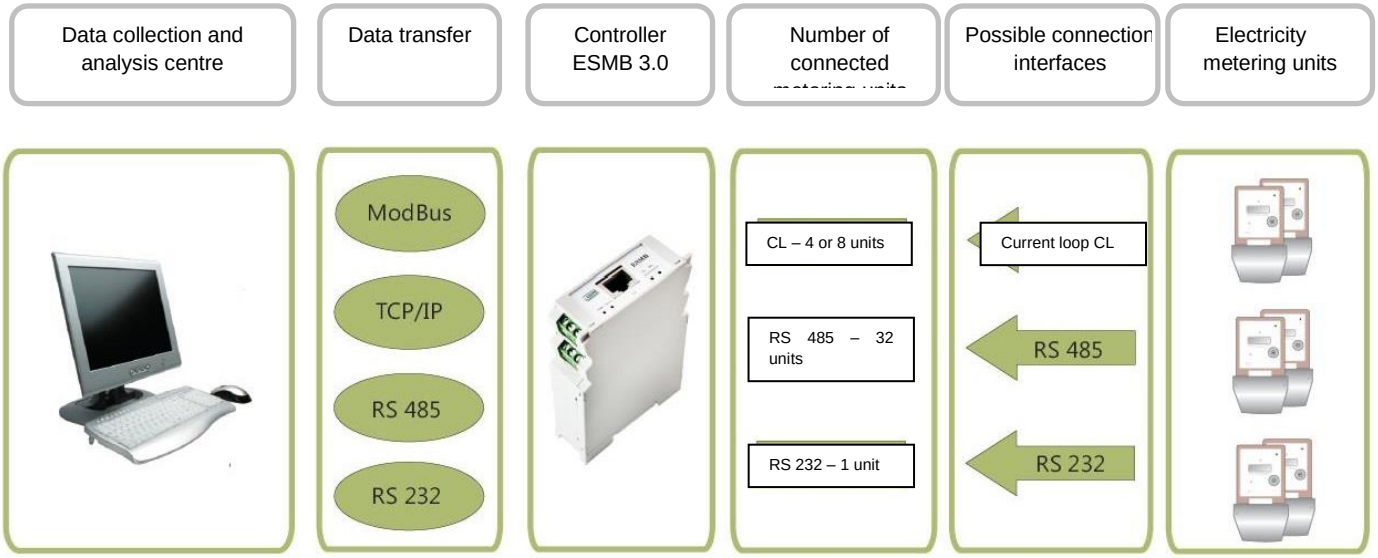


Fig. 4.1. Purpose of ESMB 3.0 controller

Table 4.1. List of controllers read by ESMB 3.0

No	Parameter Metering unit	GEM(f), GAMA 100	EMS, GAMA 300	EPQM, LZQM	EPQS
1.	Power of current integration period	x	x	x	x
2.	Power of previous integration period	x	x	x	x
3.	Total energy	x	x	x	x
4.	Table of power losses	x	x	x	x
5.	Table of switch of phases	-	x	x	x
6.	P15(30,60) previous day values	-	x	x	x
7.	Maximum power of integrated period of current and previous day	-	x	x	x
8.	Maximum period of integrated power of current and previous month	-	x	x	x
9.	Previous month energy	x	x	x	x
10.	Previous day energy	-	-	-	x
11.	Momentary data	x*	x*	x*	x
12.	Additional momentary data	x*	x*	x*	x
13.	Integration period	x	x	x	x
14.	Current day energy**	x*	x*	x	x
15.	Current month energy**	x	x	x	x

*Some metering units do not have all momentary, additional momentary and day energy parameters; specific parameters are provided in Section 6.4.

**Starting from 3.3.0.8 controller programme version

4.1 Meanings of contacts

The controller has twelve contact outputs the purpose of which is provided in Table 4.2, the numbers of contacts are provided in Fig. 4.2.

Fig. 4.2. ESMB 3.0 Contact outputs

Table 4.2. Purpose of ESMB 3.0 contact outputs

Purpose of connection	Contact number											
	1	2	3	4	5	6	7	8	9	10	11	12
Data (RS232)	Txd	Rxd	Gnd									
Power supply 230 V				L		N						
RS485 In							A(+)			B(-)		
CL2/RS485out								+/A(+)			-/B(-)	
CL1/RS485out									+/ A(+)			-/B(-)

4.2 Meanings of indicators

The controller ESMB 3.0 has three indication LEDs, two of them are used to indicate the status of metering unit interfaces (CL1, CL2), the remaining ones indicate the power supply and functioning of connection with the master device (PC). The meanings of indications are provided in Table 4.3.

Table 4.3. Meanings of ESMB 3.0 indications

Indicator	Indication	Meaning
PC	Periodically blinks in green	Connected power supply
	Non-periodically blinks in green	Data exchange via *RS232* interface
	Blinks in red	Data exchange via *RS485* interface
CL1, CL2	Glows red	Non-closed current loop circuit
	Blinks in green	Sending query to *slave* device via CL/RS485 interface
	Blinks in red	Receiving data from *slave* device via CL/RS485 interface
Ethernet	Glows in yellow	Ethernet 100 Mbps
	Does not glow in yellow	Ethernet 10 Mbps
	Blinks in green	Ethernet interface activity

4.3 Connection of power supply

The controller is connected to alternating voltage source with rated voltage from 100 to 240V. Wiring diagram is provided in Fig. 4.3.

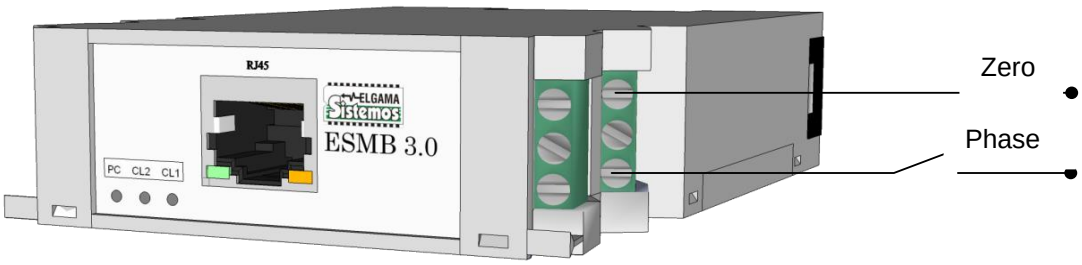


Fig. 4.3. Diagram of ESMB 3.0 connection to network

When connecting the controller to the supply voltage, it is particularly important to make sure if correct contacts are used. In case of connection of supply voltage to incorrect contact outputs, the controller is

The controller's power supply is connected via the automatic switch fitted near the device, which meets the following requirements:

- the rated voltage and current of the switch should meet the supply voltage and current of the controller;
- the switch must be installed near the controller and should be easily accessible to the operator;
- the switch should be labelled as the controlled disconnection device;
- the gap between the switch contacts should be at least 3 mm.

4.4 Connection of controller with computer

The controller is connected to the computer via *RS232* interface, the wiring diagram is provided in Fig. 4.4. It should be noted that controller *RS232* interface output *TX* (*Transmitter*) is sending data, whereas *RX* (*Receiver*) is accepting data. Controller *TX* output is connected to computer *COM* port with *RX*output, whereas controller *RX* output - with *COM* port *TX*. Controller's connection to computer is illustrated in Fig. 4.4.

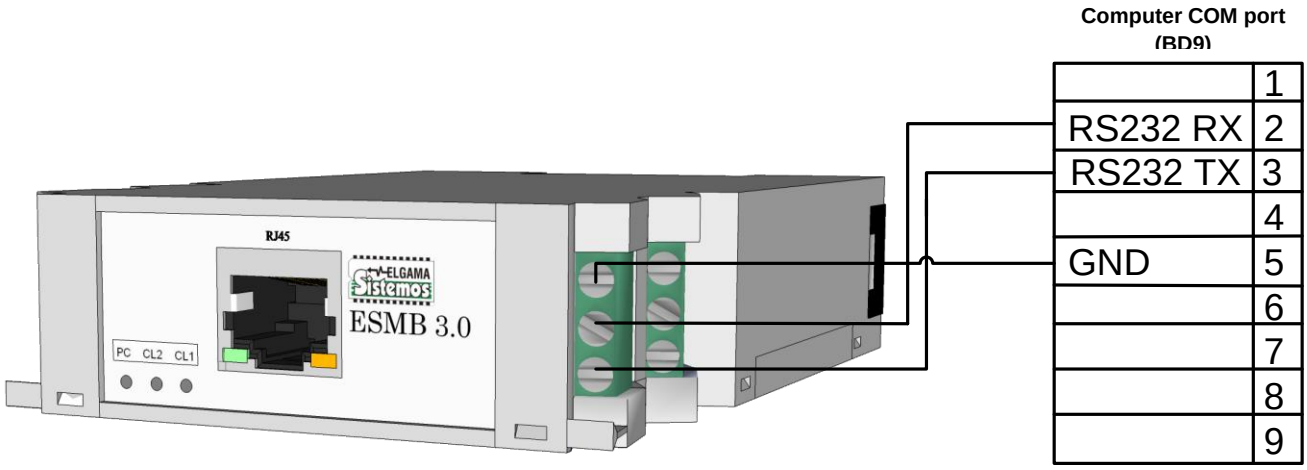


Fig. 4.4. ESMB 3.0 connection with computer by using RS232 interface

4.5 CL interfaces

Subject to modification, the controller ESMB 3.0 can have up to two 20mA current loop interfaces which can be used for connection with up to 8 metering units, i.e. 4 for each current loop. The metering units are connected to the controller's current loop in series and form a closed circuit. The connection of metering units to the current loop is provided in Fig. 4.5.

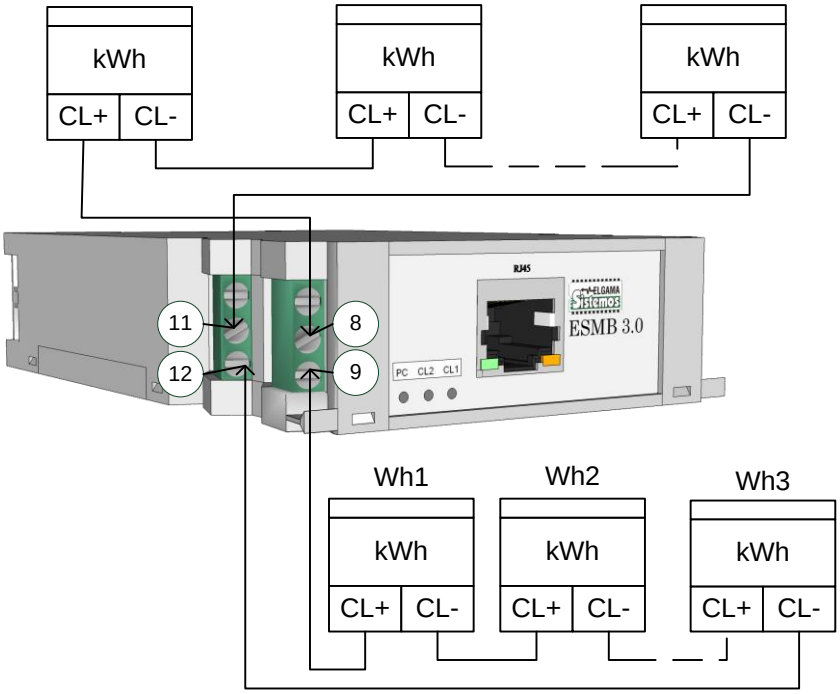


Fig. 4.5. Connection of metering units to ESMB 3.0 via current loop interfaces

Maximum length of conductors of current loop can be up to 1,000-2,000m. However, the longer the lines, the lower is the possible speed of data transfer. In case of long conductors (>100m), it is recommended to install additional surge protectors (PROTECT 10 type). It is recommended to use twisted pair cable 2 x 0.5mm or 2 x 0.64mm; a screen signal cable can also be used, for example, LIYCY 2 x 0, J-Y(St)Y 1 x 2 x 0.6. In case of correct connection of current loop interface, the voltage on the terminals of each metering unit current loop has to be 3.5 ... 4V (without data transfer), whereas the measured voltage on the controller CL leads (9-10 or 11-12 contacts) has to be 3.5... 4V, multiplied by the number of connected metering units. Accordingly, in case of connection of 2 metering units on controller CL outputs, the voltage will be 7-8V, in case of connection of 3 - 9-12V, etc.

4.6 Interface RS485

Subject to modification, the controller can have up to two RS485 interfaces. This interface can be physically connected with 32 metering units, therefore, in case of two RS485 interfaces in the controller, it is possible to connect up to 64 metering units to the controller. It should be noted that *Modbus* protocol can be used to read up to 32 metering units; if more meters are connected, the remaining ones should be read transparently. It is recommended to distribute an equal number of meters to these two interfaces, because they are functioning irrespective of each other and allow to increase the speed of the transfer of data read from the metering units. Interface conductors cannot be longer than 1,000m. It is recommended to use twisted pair cable 2 x 0.5 or 2 x 0.64; a screen signal cable can also be used, for example, LIYCY 2 x 0.5, J-Y(St)Y 1 x 2 x 0.6. In case of connection of more than one metering unit to RS485 interface, RS485 network should be of “line” and not “star” or other type, i.e. RS485 interface cable should stretch from one metering unit to another without long branching. The connection of metering units to RS485 is provided in Fig. 4.6.

IMPORTANT. Polarity should be observed! (“A” and “B”).

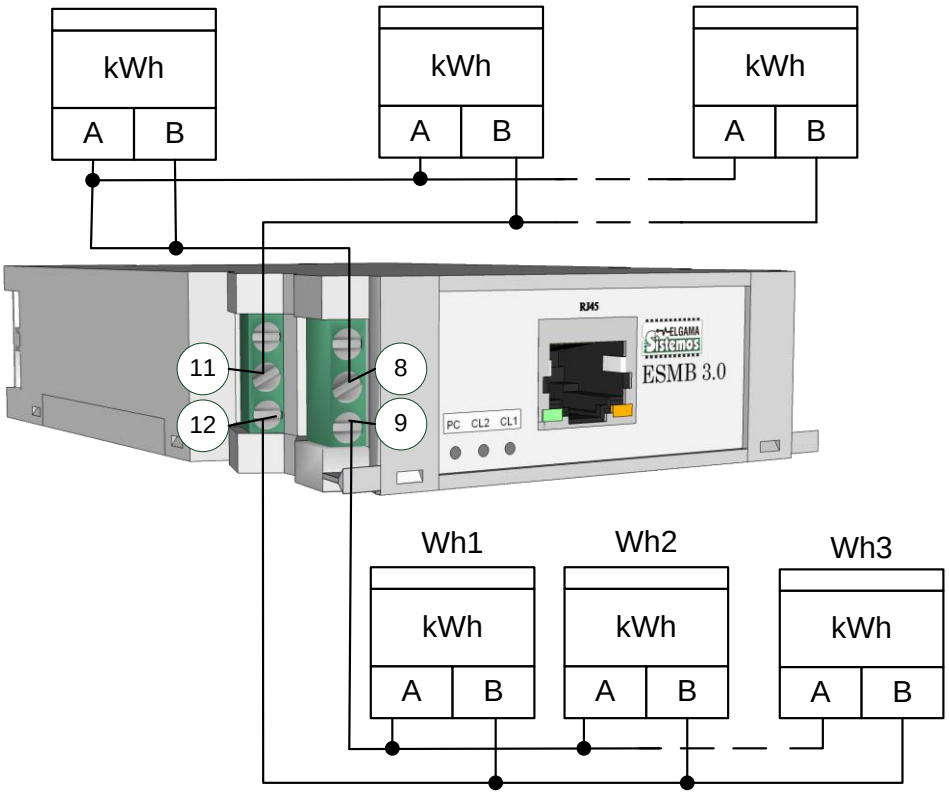


Fig. 4.6. Connection of metering units to ESMB 3.0 via RS485 interfaces.

5. *Modbus* settings configuration application *IECMaster*

Application *IECMaster* is used for the configuration of ESMB 3.0 Modbus protocol. It provides an opportunity to assign numbers and type of metering units to the controller, the speed of interface, to set buffering modes, to assign the interface to which the metering unit is connected and to change the number of controller (Modbus *Slave ID*). These parameters can also be changed by third party *Modbus* applications, by using register addresses provided in Subsection 6.3.*IECMaster* application can be downloaded from http://downloads.elgsis.com/files/ESMB3/IECMaster.zip. If *IECMaster* application which supports only ESMB 1.0 is already installed on the used computer, it should be uninstalled and replaced by installing the application version provided in the interface.

After launching *IECMaster*, the window provided in Fig. 5.1 is opened. After pressing the button "*Settings*", the computer COM port settings are opened. The settings menu is illustrated in Fig. 5.2a. In "*Connect using:*" field, it is necessary to choose computer COM port to which the controller is connected. By pressing "*Configure*" button, the window is opened which is provided in Fig. 5.2b. "*Bits per second:*" window sets the rate of data transfer which is used to communicate with the controller; this rate is set to 9,600 bps by default, however, it can be changed by using the terminal menu (see Section "7. ESMB 3.0 configuration menu"). The remaining settings should be left as referred to in the figure. After the discussed steps are completed, the settings tables are closed by pressing "*OK*".

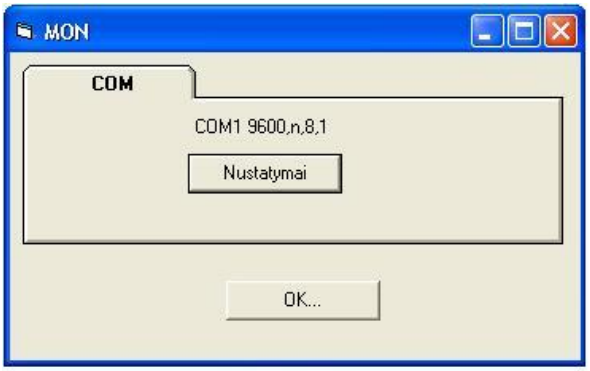
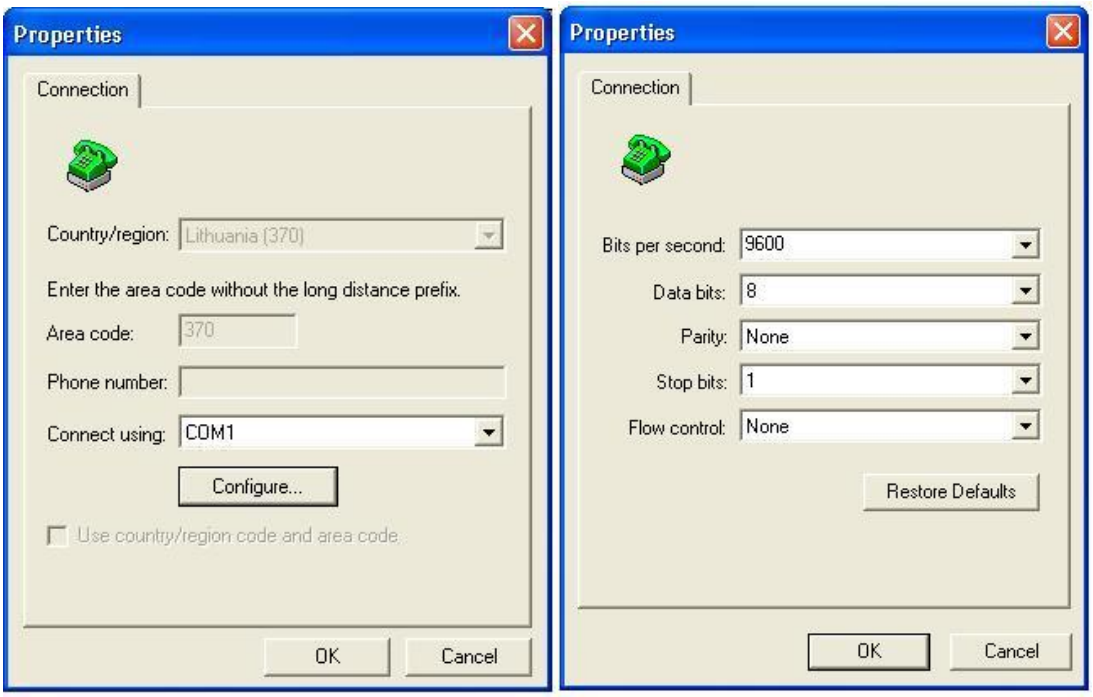


Fig. 5.1. *IECMaster* main window



a ***b***

Fig. 5.2. Computer COM interface configuration menu

After the main settings are performed, the ESMB version selection window provided in Fig. 5.3 is opened. In this window, it is necessary to provide controller number in "*Slave ID*" window (1 by default; the number is provided by going to the terminal menu as provided in Fig. 7.1). After the selection of ESMB2, the main application window is opened which is provided in Fig. 5.4:

1. Quick setup menu. Enables the attribution of the type and data transfer rate of the metering unit to all numbers.

2. Parameters window. It is divided into columns and by pressing the button "Send" under them it is possible to attribute the metering units and parameters to certain number indicated in each row. The list of performed functions with explanations of each column is provided in Table 5.1

3. Query and reply window. Shows all queries sent to the controller and the replies received from the controller.

3. Number of *Queries* and *Replies*. Shows the number of sent queries and the number of replies to these queries.

4. Manual sending of queries. Enables manual sending of queries (more information on queries is provided in Section "2. Protocol *Modbus* realisation").

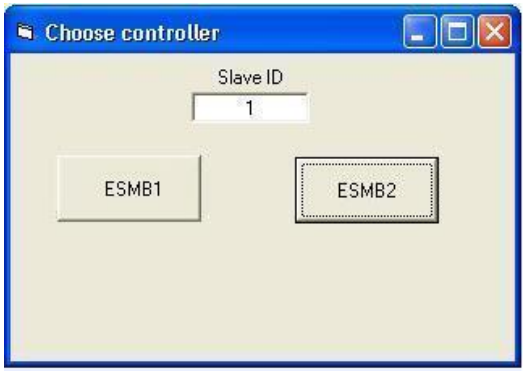


Fig. 5.3. Controller selection menu

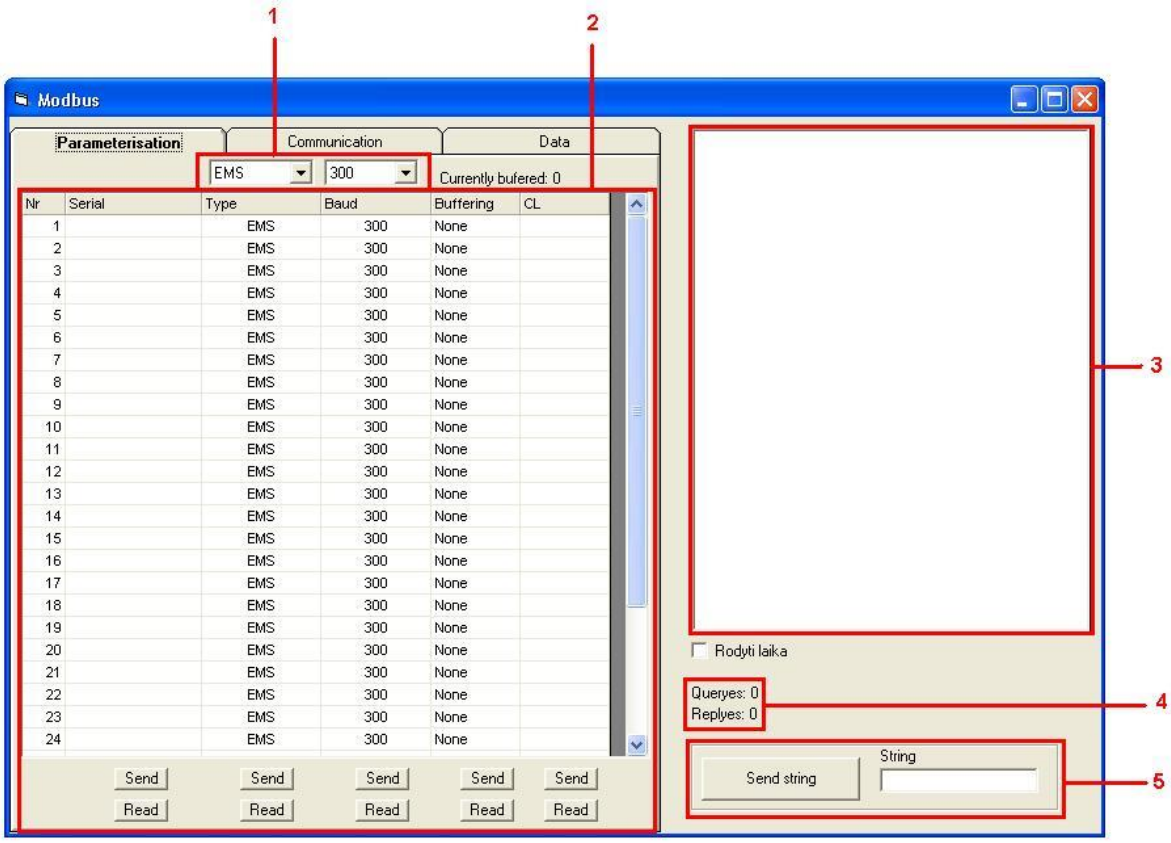


Fig. 5.4. Main programme *IECMaster* window

Table. 5.1. Explanations of options of parameters table

Name of column	**Explanation**
No	Number of attributed controller used when sending *Modbus* queries.
Serial	Serial number of the metering unit.
Type	Type of metering unit. Allows to choose from 6 possible: EMS (GAMA 300), EMSA, EPQM/LZQM, GEM(f) (GAMA 100), EMS, EPQS.
Baud	Data transfer rate Indicates the rate of controller query to the metering unit (bps).
Buffering	Buffering modes. It is possible to choose from 4 possible versions: "*None*" – buffering mode is disconnected, "*Total*" – only total data is buffered, "*Instant*" – only momentary data is buffered, "*Both*" – only momentary and total data is buffered.
CL	Selection of current loop Enables the attribution of the current loop to which the metering unit is connected.

6. Protocol *Modbus* realisation

The essential function of this protocol is to transfer data from different devices using different communication media and to transfer them to the master device in a single format. All data are stored by the controller in registers of the size of 2 bytes the address numbers of which depend on the type of data. The *Master* device can read this data or edit them by sending queries which indicate if there is a need to read from the selected address or to record to it. A reply or error report are sent by the controller to each *Modbus* query. To facilitate the calculation of Modbus register addresses, the Excel sample form is created, the information on how to receive it and how to use it is provided in Annex 1.

6.1 Reading of registers

A query must be sent for reading data from controller registers. The query consists of controller number, function code, address from which data is read, the number of registers to be read and *Cyclic Redundancy Check - CRC*. The format of query is illustrated in Table 6.1.

Table 6.1. Format of query for reading registers

Controller number	Function code	Initial address	Number of registers	*CRC*
1 B	1 B	2 B	2 B	2 B

The possible values of each reading query unit are indicated in Table 6.2. When sending the query, it is possible to address 255 controllers in total. Function code0x03 means that the reading query is sent. The address of the main registers consists of a word of two bytes that indicate the address of the main register from which the values are read. The amount of registers indicates how many registers need to be read in total.

Table 6.2. Meanings of reading query units

Name of unit	Number of bytes	Meaning
Controller number	1 B	1-255
Function code	1 B	0x03
Initial address	2 B	0x0000 - 0xFFFF
Number of words	2 B	1 - 125 (0x7D)
CRC	2 B	*CRC*

After each reading query, the controller sends a reply with data or with error code. The data reply consists of the number of controller which sends a reply, amount of data sent via function code in bytes, data and *CRC*. The format of positive reply to the reading query is illustrated in Table 6.3.

Table 6.3. Format of positive reply to register reading query

Controller number	Function code	Amount of bytes	Values of registers	*CRC*
1 B	1 B	1 B	N x 2 B	2 B

The possible value of each positive reply to reading query unit is provided in Table 6.4. Here, N shows how many registers had to be read during the query; since one register is of the size of two bytes, the received amount of data in bytes will be twice larger than the number of registers from which the reading is performed.

Table 6.4. Values of units of the positive reply to register reading query

Name of unit	Number of bytes	Value
Number of controller	1 B	1-255
Function code	1 B	0x03
Number of bytes	1 B	2 x N
Values of registers	N x 2 B	Information in registers

CRC	2 B	*CRC*

In case of receipt of incorrectly formed query, the controller sends the error report. The format of error report is illustrated in Table 6.5.

Table 6.5. Format of error report to register the reading query

Number of controller	Error report	Error code	*CRC*
1 B	1 B	1B	2 B

The value of each error report unit is provided in Table 6.6. The number of controller indicates which controller sends the error report. Error report 0x83 means that error reply is to the reading query. The values of error code are provided in Table 6.7**.**

Table 6.6. Values of units of error report to register reading query

Name of unit	Number of bytes	Value
Number of controller	1 B	1-255
Error report	1 B	0x83
Error code	1 B	01, 02, 03, 04
CRC	2 B	*CRC*

Table 6.7. *Modbus* query error codes

Error code	Value
01	False function code
02	False register address
03	False data
04	Error in execution of *Modbus* query

6.2 Recording to registers

In order to edit register values, it is necessary to send a recording query together with register data that need to be recorded. The form of register editing query is illustrated in Table 6.8.

Table 6.8. Format of register recording query

Number of controller	Function code	Initial address	Number of registers	Amount of bytes	Data	*CRC*
1 B	1 B	2 B	2 B	1 B	N x 2 B	2 B

The value of each recording query unit is provided in Table 6.9. Function code 0x10 shows that the query of recording to the registers is sent. The initial address indicates the address of register from which data is recorded. The number of registers shows the number of edited registers. The number of bytes indicates the amount of bytes to be recorded to registers since one register consists of two bytes, the amount of bytes should be twice greater than the number of recorded registers. The data unit indicates data to be recorded to the unit of selected registers.

Table 6.9. Values of recording query units

Name of unit	Amount of bytes	Value
Number of controller	1 B	1-255
Function code	1 B	0x10
Initial address	2 B	0x0000 - 0xFFFF
Number of registers	2 B	0x0001 - 0x0078
Amount of bytes	1 B	2 x N
Data	N x 2 B	Data
CRC	2 B	*CRC*

For each recording query the controller sends a reply which can indicate successful recording or error. The format of report on successful recording is illustrated in Table 6.10.

Table 6.10. Format of positive reply to register recording query

Number of controller	Function code	Initial address	Number of registers	*CRC*
1 B	1 B	2 B	2 B	2 B

The value of each successful recording function unit is provided in Table 6.11. Function code0x10 means the reply to recording query. The initial address indicates the address of register to which the information was recorded. The number of registers indicates how many registers were included in the unit of recorded data.

Table 6.11. Values of units of positive reply to register recording query

Name of unit	Amount of bytes	Value
Number of controller	1 B	1-255
Function code	1 B	0x10
Initial address	2 B	0x0000 - 0xFFFF
Number of registers	2 B	1 to 123 (0x7B)
CRC	2 B	*CRC*

The format of error report to recording query is identical to the format of error report to recording query provided in Table 6.6. The values of units error report to recording query is provided in Table 6.12. It is identical to the error report to data reading query, only the error report unit is different the value 0x90 of which means that the error took place after the acceptance of the recording query.

Table 6.12. Values of units of error report to register recording query

Name of unit	Amount of bytes	Value
Number of controller	1 B	1-255
Error report	1 B	0x90
Error code	1 B	01, 02, 03, 04
CRC	2 B	*CRC*

6.3 Registers of controller parameters

Registers of controller parameters can be edited by the controlling device and are used for the adjustment of the metering units with the controller. The master device can read these registers and rewrite them. The fields of configuration register addresses and their values are provided in Table 6.13.

Table 6.13. Fields of configuration register addresses

Parameter	Register addresses	Register addresses (hex)
Number of controller	65000	0xFDE8
Buffering settings	65001 - 65032	0xFDE9 - 0xFE08
Serial numbers of metering units	65033 - 65126	0xFE09 - 0xFE66
Rates of metering unit interfaces	65129 - 65160	0xFE69 - 0xFE88
Types of metering units	65161 - 65192	0xFE89 - 0xFEA8
Metering unit current loop interface	65193 - 65224	0xFEA9 - 0xFEC8

Detailed information on the fields of addresses of registers of each parameter is provided in Tables 6.14-4.19.

6.3.1 Register of controller number

Register of controller number is used to set the number of controller which can acquire values from 1 to 255.

Table 6.14. Register of controller number

Parameter	Value	data format	Register address	Register address (hex)
Number of controller	1-255	2 B integer	65000	0xFDE8

6.3.2 Buffering constant registers*

Buffering constants can be set in buffering constant register field for each metering unit. Each register indicates the buffering mode of data of the individual metering unit. Buffering constant can acquire four values: 0 – not buffered, 1 – buffering only total energy, 2 – buffering only momentary data, 3 - buffering only total energy and momentary data.

***ESMB 3.0 buffering function is not supported so far.**

Table 6.15. Buffering constant registers

Metering unit No	Parameter	Value	Data format	Register address	Register address (hex)
1	Buffering constant	0 - 3	2B integer	65001	0xFDE9
2	Buffering constant	0 - 3	2B integer	65002	0xFDEA
...	...				
32	Buffering constant	0 - 3	2B integer	65032	0xFE08

6.3.3 Registers of serial numbers of metering units

Registers of serial numbers of metering units indicate which serial numbers should be associated with the numbers of the metering unit, one number of the metering unit occupies the unit of three registers. Data format 2 B *bcd* means 2-byte decimal code expression in binary (*Binary to Decimal – BCD*).

Table 6.16. Registers of serial numbers of metering units

Metering unit No	Parameter	Value	data format	Register address	Register address (hex)
1	Serial No two youngest numbers	00 – 99, 00 – 99	2 B *bcd*	65033	0xFE09
1	Serial No two middle numbers	00 – 99, 00 – 99	2 B *bcd*	65034	0xFE0A
1	Serial No two oldest numbers	00 – 99, 00 – 99	2 B *bcd*	65035	0xFE0B
2	Serial No two youngest numbers	00 – 99, 00 – 99	2 B *bcd*	65036	0xFE0C
...	...				
32	Serial No two oldest numbers	00 – 99, 00 – 99	2 B *bcd*	65126	0xFE66

6.3.4 Registers of metering unit interface rate

In the field of registers of metering unit interface each register is responsible for the attribution of the connection rate to the interface of each metering unit number. Subject to the value of register, the data rate at which the controller sends queries by the metering unit and accepts responses will be different. The values of registers can acquire twelve values indicating the interface connection rate in bytes per second: 0 – 300 bps, 1 – 600 bps, 2 – 1,200 bps, 3 – 2,400 bps, 4 – 4,800 bps, 5 – 9,600 bps, 6 – 14,400 bps, 7 – 19,200 bps, 8 – 28,800 bps, 9 – 38,400 bps, 10 – 57,600 bps, 11 – 115,200 bps.

Table 6.17. Registers of metering unit interface rate

Metering unit No	Parameter	Value	data format	Register address	Register address (hex)
1	interface rate constant	0-11	2B integer	65129	0xFE69
2	interface rate constant	0-11	2B integer	65130	0xFE6A
...	...				0x0000
32	interface rate constant	0-11	2B integer	65160	0xFE88

6.3.5 Registers of metering unit type

The constants of the type of metering unit are stored in the field of metering unit type. Each register attributes the type of metering unit to the number of the metering unit. Register type constant can acquire six values: 0 – EMS(GAMA300), 1 – EMSA, 2 – EPQM, 4 – GEM(GAMA100), 5 – EPQS.

Table 6.18. Registers of metering unit type

Metering unit No	Parameter	Value	data format	Register address	Register address (hex)
1	Metering unit type constant*	0 - 5	2B integer	65161	0xFE89
2	Metering unit type constant*	0 - 5	2B integer	65162	0xFE8A
...	...				0x0000
32	Metering unit type constant*	0 - 5	2B integer	65192	0xFEA8

6.3.6 Registers of metering unit current loop interface

The registers of metering unit current loop interface indicate which current loop interface of the controller should be attributed to the metering unit number. Current loop number should coincide with the controller current loop to which the addressed metering unit is connected.

Table 6.19. Registers of metering unit current loop interface

Metering unit No	Parameter	Value	data format	Register address	Register address (hex)
1	Current loop (CL) number	1, 2	2B integer	65193	0xFEA9
2	Current loop (CL) number	1, 2	2B integer	65194	0xFEAA
...	...				
32	Current loop (CL) number	1, 2	2B integer	65224	0xFEC8

6.4 Registers of metering unit data

The registers of metering unit data store data received from metering units and are used to read data from the master device. Metering data register address fields and their values are provided in Table 6.20.

Table 6.20. Fields of metering unit data register addresses

Parameter	Parameter addresses	Parameter addresses (hex)	
Capacity of previous integration period	0 – 254	0x0000 – 0x00FE	Table 6.21
Capacity of current integration period	256 – 510	0x0100 – 0x01FE	Table 6.22
Time of power loss	512 – 4243	0x0200 – 0x1093	Table 6.23
Time of switch of phases	4366 – 5457	0x110E –0x1551	Table 6.24
Previous day load profile (capacities of integrated periods)	5472 – 30046	0x1560 – 0x755E	Table 6.25 Table 6.26 Table 6.27
Maximum capacity of the integration period of the previous day	30048 – 32095	0x7560 –0x7D5F	Table 6.28
Maximum capacity of the integration period of the current day	32096 – 34143	0x7D60 – 0x855F	0 6.29
Maximum capacity of the integration period of the previous month	34144 – 6703	0x8560 – 0x8F5F	Table 6.30
Maximum capacity of the integration period of the current month	36704 – 39263	0x8F60 – 0x995F	Table 6.31
Previous day energy	39264 – 40286	0x9960 –0x9D5E	Table 6.32
Previous month energy	40288 – 41310	0x9D60 – 0xA15E	Table 6.33

Total energy	41312 – 42334	0xA160 – 0xA55E	Table 6.36
Momentary data	42336 – 43422	0xA560 – 0xA99E	Table 6.37
Additional momentary data	43424 – 44159	0xA9A0 – 0xAC7F	Table 6.38
Integration period	44160 – 44191	0xAC80 – 0xAC9F	Table 6.39
Current day energy	44192 – 45215	0xACA0 – 0xB09F	Table 6.34
Current month energy	45216 – 46239	0xB0A0 – 0xB49F	Table 6.35

Detailed information on the fields of addresses of each parameter is provided in Tables 6.21-6.39.

6.4.1 Registers of capacity of previous integration period

Data of capacity of previous integration period are stored for each metering unit in four register units. Each element of the unit meets a separate capacity parameter of previous integration period (P+, P-, Q+, Q-). All this data is returned in these registers in watts (W), is of the size of 4 bytes, *float* type and occupy four registers.

Table 6.21. Registers of capacity of previous integration period

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	P+	0	0x0000	Float (4 B)
	P-	2	0x0002	Float (4 B)
	Q+	4	0x0004	Float (4 B)
	Q-	6	0x0006	Float (4 B)
2	P+	8	0x0008	Float (4 B)
	...	...	...	...
32	Q-	254	0x00FE	Float (4 B)

6.4.2 Registers of capacity of current integration period

Data of capacity of current integration period are stored for each metering unit in four register units. Each element of the unit meets a separate capacity parameter of current integration period (P+, P-, Q+, Q-). All this data in these registers is measured in watts (W), is of the size of 4 bytes and *float* type.

Table 6.22. Capacity of current integration period

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	P+	256	0x0100	Float (4 B)
	P-	258	0x0102	Float (4 B)
	Q+	260	0x0104	Float (4 B)
	Q-	262	0x0106	Float (4 B)
2	P+	264	0x0108	Float (4 B)
	...	...	...	Float (4 B)
32	...	...	...	Float (4 B)
	Q-	510	0x01FE	Float (4 B)

6.4.3 Registers of power losses and switch of phases

A unit of 12 registers is provided for each metering unit for data of the power losses and restoration the first six of which indicate the time of loss, the others - the time of restoration. Each parameter is of the size of 2 bytes, *integer* type and indicates the respective numerical values of the year, month, day, hour, minute and second.

Table 6.23. Registers of the time of power losses and restoration

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	lost, year	512	0x0200	Integer (2 B)
	lost, month	513	0x0201	Integer (2 B)
	lost, day	514	0x0202	Integer (2 B)
	lost, hour	515	0x0203	Integer (2 B)
	lost, minute	516	0x0204	Integer (2 B)
	lost, second	517	0x0205	Integer (2 B)
	restored, year	518	0x0206	Integer (2 B)
	restored, month	519	0x0207	Integer (2 B)
	restored, day	520	0x0208	Integer (2 B)
	restored, hour	521	0x0209	Integer (2 B)
	restored, minute	522	0x020A	Integer (2 B)
	restored, second	523	0x020B	Integer (2 B)
2	lost, year	632	0x0278	Integer (2 B)
	...	...	...	...
32	...	...	...	...
	restored, second	4243	0x1093	Integer (2 B)

A unit of seven registers is provided for each metering unit to store the time and status of the switch of phases. Each register reflects a separate parameter of the switch of phases. All stored parameters are of *integer* type and of the size of two bytes.

Table 6.24. Registers of the switch of phases

Number of the metering unit	Parameter	Register address	Register address HEX	Type of data
1	switch, year	4366	0x110E	Integer (2 B)
	switch, month	4367	0x110F	Integer (2 B)
	switch, day	4368	0x1110	Integer (2 B)
	switch, hour	4369	0x1111	Integer (2 B)
	switch, minute	4370	0x1112	Integer (2 B)
	switch, second	4371	0x1113	Integer (2 B)
	phase statuses	4372	0x1114	Integer (2 B)
2	switch, year	4401	0x1131	Integer (2 B)
	...	...	...	...
32	...	...	...	...
	statuses of phases	5457	0x1551	Integer (2 B)

6.4.4 Registers of load profiles

192 registers are provided to store each parameter of previous day profile (+p, -p, +q, -q), each parameter is of *float* type and each occupies two registers. It depends on the integration period if all registers used to store data of the previous day profile will be used.

Table 6.25. Previous day load profile (capacities of integrated periods, when integration period is 15 min.)

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	+p 00:15	5472	0x1560	Float
	+p 00:30	5474	0x1562	Float
	...	...	...	...
	+p 00:00	5662	0x161E	Float
	-p 00:15	5664	0x1620	Float
	...	...	...	...
	-p 00:00	5854	0x16DE	Float
	+p 00:15	5856	0x16E0	Float
	...	...	...	...
	+p 00:00	6046	0x179E	Float
	-q 00:15	6048	0x17A0	Float
	...	...	...	...
	-q 00:00	6238	0x185E	Float
2	+p 00:15	6240	0x1860	Float
...	...	...	...	...
32	...	...	...	...
	-q 00:00	30046	0x755E	Float

Table 6.27. Previous day load profile (capacities of integrated periods, when integration period is 60 min.)

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	+p 01:00	5472	0x1560	Float
	+p 02:00	5474	0x1562	Float
	...	...	...	...
	+p 00:00	5518	0x158E	Float
	-p 01:00	5664	0x1620	Float
	...	...	...	...
	-p 00:00	5710	0x164E	Float
	+p 01:00	5856	0x16E0	Float
	...	...	...	...
	+p 00:00	5902	0x170E	Float
	-q 01:00	6048	0x17A0	Float
	...	...	...	...
	-q 00:00	6094	0x17CE	Float
2	+p 01:00	6240	0x1860	Float
...	...	...	...	...
32	...	...	...	...
	-q 00:00	29902	0x74CE	Float

Table 6.26. Previous day load profile (capacities of integrated periods, when integration period is 30 min.)

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	+p 00:30	5472	0x1560	Float
	+p 01:00	5474	0x1562	Float
	...	...	...	...
	+p 00:00	5566	0x15BE	Float
	-p 00:30	5664	0x1620	Float
	...	...	...	...
	-p 00:00	5758	0x167E	Float
	+p 00:30	5856	0x16E0	Float
	...	...	...	...
	+p 00:00	5950	0x173E	Float
	-q 00:30	6048	0x17A0	Float
	...	...	...	...
	-q 00:00	6142	0x17FE	Float
2	+p 00:30	6240	0x1860	Float
...	...	...	...	...
32	...	...	...	...
	-q 00:00	29950	0x74FE	Float

6.4.5 Registers of the maximum capacity of integration period

The maximum capacities of integration period are of *float* type and each occupies 2 registers (4 B). All time parameters occupy 2 bytes each and are of *integer* type.

Table 6.28. Maximum capacity of the integration period of the previous day

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	+p, T1	30048	0x7560	Float
	hour	30050	0x7562	Integer (2 B)
	minute	30051	0x7563	Integer (2 B)
	+p, T2	30052	0x7564	Float
	hour	30054	0x7566	Integer (2 B)
	minute	30055	0x7567	Integer (2 B)
	+p T3	30056	0x7568	Float
	hour	30058	0x756A	Integer (2 B)
	minute	30059	0x756B	Integer (2 B)
	+p, T4	30060	0x756C	Float
	hour	30062	0x756E	Integer (2 B)
	minute	30063	0x756F	Integer (2 B)
	-p, T1	30064	0x7570	Float
	...	...	...	...
	+q, T1	30080	0x7580	Float
	...	...	...	...

Table 6.29. Maximum capacity of the integration period of the current day

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	+p, T1	32096	0x7D60	Float
	hour	32098	0x7D62	Integer (2 B)
	minute	32099	0x7D63	Integer (2 B)
	+p, T2	32100	0x7D64	Float
	hour	32102	0x7D66	Integer (2 B)
	minute	32103	0x7D67	Integer (2 B)
	+p, T3	32104	0x7D68	Float
	hour	32106	0x7D6A	Integer (2 B)
	minute	32107	0x7D6B	Integer (2 B)
	+p, T4	32108	0x7D6C	Float
	hour	32110	0x7D6E	Integer (2 B)
	minute	32111	0x7D6F	Integer (2 B)
	-p, T1	32112	0x7D70	Float
	...	...	...	...
	+q, T1	32128	0x7D80	Float
	...	...	...	...
	-q, T1	32144	0x7D90	Float
	...	...	...	...
2	+p, T1	32160	0x7DA0	Float
	...	...	...	...
32	...	...	...	...
	minute	34143	0x855F	Integer (2 B)

	-q, T1	30096	0x7590	Float
	...	...	...	...
2	+p, T1	30112	0x75A0	Float
	...	...	...	...
32	...	...	...	...
	minute	32095	0x7D5F	Integer (2 B)

Table 6.30. Maximum capacity of previous month integration period

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	+p, T1	34144	0x8560	Float
	day	34146	0x8562	Integer (2 B)
	hour	34147	0x8563	Integer (2 B)
	minute	34148	0x8564	Integer (2 B)
	+p, T2	34149	0x8565	Float
	day	34151	0x8567	Integer (2 B)
	hour	34152	0x8568	Integer (2 B)
	minute	34153	0x8569	Integer (2 B)
	+p, T3	34154	0x856A	Float
	day	34156	0x856C	Integer (2 B)
	hour	34157	0x856D	Integer (2 B)
	minute	34158	0x856E	Integer (2 B)
	+p, T4	34159	0x856F	Float
	day	34161	0x8571	Integer (2 B)
	hour	34162	0x8572	Integer (2 B)
	minute	34163	0x8573	Integer (2 B)
	-p, T1	34164	0x8574	Float
	...	...	...	...
	+q, T1	34184	0x8588	Float
	...	...	...	...
	-q, T1	34204	0x859C	Float
	...	...	...	...
2	+p, T1	34224	0x85B0	Float
	...	...	...	...
32	...	...	...	...
	minute	36703	0x8F5F	Integer (2 B)

Table 6.31. Maximum capacity of the integration period of the current month

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	+p, T1	36704	0x8F60	Float
	day	36706	0x8F62	Integer (2 B)
	hour	36707	0x8F63	Integer (2 B)
	minute	36708	0x8F64	Integer (2 B)
	+p, T2	36709	0x8F65	Float
	day	36711	0x8F67	Integer (2 B)
	hour	36712	0x8F68	Integer (2 B)
	minute	36713	0x8F69	Integer (2 B)
	+p, T3	36714	0x8F6A	Float
	day	36716	0x8F6C	Integer (2 B)
	hour	36717	0x8F6D	Integer (2 B)
	minute	36718	0x8F6E	Integer (2 B)
	+p, T4	36719	0x8F6F	Float
	day	36721	0x8F71	Integer (2 B)
	hour	36722	0x8F72	Integer (2 B)
	minute	36723	0x8F73	Integer (2 B)
	-p, T1	36724	0x8F74	Float
	...	...	...	...
	+q, T1	36744	0x8F88	Float
	...	...	...	...
	-q, T1	36764	0x8F9C	Float
	...	...	...	...
2	+p, T1	36784	0x8FB0	Float
	...	...	...	...
32	...	...	...	...
	minute	39263	0x995F	Integer (2 B)

6.4.6 Registers of previous day and previous month energy

Previous day and previous month energy takes four bytes and is of *float* type.

Table 6.32. Previous day energy

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	W+, T1	39264	0x9960	Float
	W+, T2	39266	0x9962	Float
	W+, T3	39268	0x9964	Float
	W+, T4	39270	0x9966	Float
	W-, T1	39272	0x9968	Float
	W-, T2	39274	0x996A	Float
	W-, T3	39276	0x996C	Float
	W-, T4	39278	0x996E	Float
	Q+, T1	39280	0x9970	Float
	Q+, T2	39282	0x9972	Float
	Q+, T3	39284	0x9974	Float
	Q+, T4	39286	0x9976	Float
	Q-, T1	39288	0x9978	Float
	Q-, T2	39290	0x997A	Float
	Q-, T3	39292	0x997C	Float
	Q-, T4	39294	0x997E	Float
2	W+, T1	39296	0x9980	Float
	...	...	...	...
	Q-, T4	39326	0x999E	Float
32	...	...	...	...
	Q-, T4	40286	0x9D5E	Float

Table 6.33. Previous month energy

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	W+, T1	40288	0x9D60	Float
	W+, T2	40290	0x9D62	Float
	W+, T3	40292	0x9D64	Float
	W+, T4	40294	0x9D66	Float
	W-, T1	40296	0x9D68	Float
	W-, T2	40298	0x9D6A	Float
	W-, T3	40300	0x9D6C	Float
	W-, T4	40302	0x9D6E	Float
	Q+, T1	40304	0x9D70	Float
	Q+, T2	40306	0x9D72	Float
	Q+, T3	40308	0x9D74	Float
	Q+, T4	40310	0x9D76	Float
	Q-, T1	40312	0x9D78	Float
	Q-, T2	40314	0x9D7A	Float
	Q-, T3	40316	0x9D7C	Float
	Q-, T4	40318	0x9D7E	Float
2	W+, T1	40320	0x9D80	Float
	...	...	...	...
	Q-, T4	40350	0x9D9E	Float
32	...	...	...	...
	Q-, T4	41310	0xA15E	Float

6.4.7 Registers of current day and current month energy

Current day and current month energy takes four bytes and is of *float* type.

Table 6.34. Current day energy

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	W+, T1	44192	0xACA0	Float
	W+, T2	44194	0xACA2	Float
	W+, T3	44196	0xACA4	Float
	W+, T4	44198	0xACA6	Float
	W-, T1	44200	0xACA8	Float
	W-, T2	44202	0xACAA	Float
	W-, T3	44204	0xACAC	Float
	W-, T4	44206	0xACAE	Float
	Q+, T1	44208	0xACB0	Float
	Q+, T2	44210	0xACB2	Float
	Q+, T3	44212	0xACB4	Float
	Q+, T4	44214	0xACB6	Float
	Q-, T1	44216	0xACB8	Float
	Q-, T2	44218	0xACBA	Float
	Q-, T3	44220	0xACBC	Float
	Q-, T4	44222	0xACBE	Float
2	W+, T1	44224	0xACC0	Float
	...	...	...	...
	Q-, T4	44254	0xACDE	Float
32	...	...	...	...
	Q-, T4	45214	0xB09E	Float

Table 6.35. Current month energy

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	W+, T1	45216	0xB0A0	Float
	W+, T2	45218	0xB0A2	Float
	W+, T3	45220	0xB0A4	Float
	W+, T4	45222	0xB0A6	Float
	W-, T1	45224	0xB0A8	Float
	W-, T2	45226	0xB0AA	Float
	W-, T3	45228	0xB0AC	Float
	W-, T4	45230	0xB0AE	Float
	Q+, T1	45232	0xB0B0	Float
	Q+, T2	45234	0xB0B2	Float
	Q+, T3	45236	0xB0B4	Float
	Q+, T4	45238	0xB0B6	Float
	Q-, T1	45240	0xB0B8	Float
	Q-, T2	45242	0xB0BA	Float
	Q-, T3	45244	0xB0BC	Float
	Q-, T4	45246	0xB0BE	Float
2	W+, T1	45248	0xB0A0	Float
	...	...	...	...
	Q-, T4	45278	0xB0DE	Float
32	...	...	...	...
	Q-, T4	46238	0xB49E	Float

6.4.8 Total energy registers

Data of total energy are of *float* type and take four bytes.

Table 6.36. Total energy

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data
1	W+, T1	41312	0xA160	Float
	W+, T2	41314	0xA162	Float
	W+, T3	41316	0xA164	Float
	W+, T4	41318	0xA166	Float
	W-, T1	41320	0xA168	Float
	W-, T2	41322	0xA16A	Float
	W-, T3	41324	0xA16C	Float
	W-, T4	41326	0xA16E	Float
	Q+, T1	41328	0xA170	Float
	Q+, T2	41330	0xA172	Float
	Q+, T3	41332	0xA174	Float
	Q+, T4	41334	0xA176	Float
	Q-, T1	41336	0xA178	Float
	Q-, T2	41338	0xA17A	Float
	Q-, T3	41340	0xA17C	Float
	Q-, T4	41342	0xA17E	Float
2	W+, T1	41344	0xA180	Float
	...	...	...	...
	Q-, T4	41374	0xA19E	Float
32	...	...	...	...
	Q-, T4	42334	0xA55E	Float

6.4.9 Momentary data

Table 6.37. Momentary data

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data	EMS/EMSA	EPQM/LZQM	GEM(f)	EPQS
1	P+ L1, [W]	42336	0xA560	Float	x	x	x	x
	P+ L2, [W]	42338	0xA562	Float	x	x	-	x
	P+ L3, [W]	42340	0xA564	Float	x	x	-	x
	Q+ L1, [ver]	42342	0xA566	Float	x	x	-	x
	Q+ L2, [ver]	42344	0xA568	Float	x	x	-	x
	Q+ L3, [ver]	42346	0xA56A	Float	x	x	-	x
	U L1, [V]	42348	0xA56C	Float	x^1	x	x	x
	U L2, [V]	42350	0xA56E	Float	x^1	x	-	x
	U L3, [V]	42352	0xA570	Float	x^1	x	-	x
	I L1, [A]	42354	0xA572	Float	x^1	x	x	x
	I L2, [A]	42356	0xA574	Float	x^1	x	-	x
	I L3, [A]	42358	0xA576	Float	x^1	x	-	x
	U L1 L2, [V]	42360	0xA578	Float	-	-	-	x
	U L1 L3, [V]	42362	0xA57A	Float	-	-	-	x
	U L2 L3, [V]	42364	0xA57C	Float	-	-	-	x
	f, [Hz]	42366	0xA57E	Float	x^1	x	x	x
	cosφ	42368	0xA580	Float	x^2	x^2	`x	x
2	P+ L1, [W]	42370	0xA582	Float	x	x	x	x
	...	...	...	...				
	cosφ	42402	0xA5A2	Float	x^2	x^2	`x	x
32	...	...	...	...				
	cosφ	43422	0xA99E	Float	x^2	x^2	`x	x

X^1 – from 60 EMS metering unit software version and from 50 EMSA metering unit software version.

X^2 – EPQM/LZQM/EMS/GAMA 300 metering unit do not provide cosφ value. ESMB controller estimates cosφ according to formula cosφ = P/(√(P2 + Q2)) (P = P1 + P2 + P3; Q = Q1 + Q2 + Q3).

All momentary data are of *float* type and take four bytes each.

6.4.10 Registers of additional momentary data

Table 6.38. Additional momentary data

Number of the metering unit	Parameter	Register address	Register addr. HEX	Type of data	EMS / EMSA	EPQM/ LZQM	GEM(f)	EPQS
1	S+ L1	43424	0xA9A0	float	-	-	-	x
	S+ L2	43426	0xA9A2	float	-	-	-	x
	S+ L3	43428	0xA9A4	float	-	-	-	x
	GF L1 (cosφ)	43430	0xA9A6	float	-	-	-	x
	GF L2 (cosφ)	43432	0xA9A8	float	-	-	-	x
	GF L3 (cosφ)	43434	0xA9AA	float	-	-	-	x
	Quadrant L1	43436	0xA9AC	2B uint	-	n	-	x
	Quadrant L2	43437	0xA9AD	2B uint	-	n	-	x
	Quadrant L3	43438	0xA9AE	2B uint	-	n	-	x
	Sequence of phases	43439	0xA9AF	2B uint	n	-	-	x
	Temperature	43440	0xA9B0	2B int	-	-	-	x
	years	43441	0xA9B1	2B uint	x	x	x	x
	month	43442	0xA9B2	2B uint	x	x	x	x
	day	43443	0xA9B3	2B uint	x	x	x	x
	hour	43444	0xA9B4	2B uint	x	x	x	x
	minute	43445	0xA9B5	2B uint	x	x	x	x
	second	43446	0xA9B6	2B uint	x	x	x	x
2	S+ L1	43447	0xA9B7	float	-	-	-	x
	...	...	...	...				
	second	43469	0xA9CD	2B uint	x	x	x	x
32	...	...	...	...				
	second	44159	0xAC7F	2B uint	x	x	x	x

6.4.11 Registers of integration period

All data of integration period take two bytes each and are of *integer* type.

Table 6.39. Integration period

Number of the metering unit	Parameter	Register address	Register addr. HEX
1	int. period	44160	0xAC80
2	int. period	44161	0xAC81
3	int. period	44162	0xAC82
...	...	...	...
32	int. period	44191	0xAC9F

6.5 Maximum size of data per one query

Modbus protocol integrated in ESMB 3.0 controllers allows to read a group of registers by one query. The tables below show the parameters all values of which can be read by one query. For example, from EMS metering unit one query can be used to read the total energy of all tariffs +A, whereas from LZQM (EPQM) metering units, the energy of all tariffs and all types (+A, -A, +R, -R). If the user equipment tries to read more values than indicated in the table by one query, the performance of query will take longer because more than one metering unit is queried. Furthermore, it is necessary to

consider that if the limits of the field of read addresses are larger than of the group of parameters, the same group of parameters of the next metering unit is read.

6.5.1 EMS / EMSA / GAMA 300

The table below provides the groups of parameters which can be read from EMS / EMSA / GAMA 300 metering units by one query.

Table 6.40. EMS / EMSA / GAMA 300

Group of parameters read by one query	Type of value	Number of bytes/registers	Number of queries per metering unit
Capacity of current int. period (Hex, Float)	+p, -p*, +q*, -q*	16 / 8	1
Capacity of previous int. period (Float)	+p, -p*, +q*, -q*	16 / 8	1
Total energy (Hex, Float)	+A (T1-T4)	16 / 8	4
	-A (T1-T4)	16 / 8	
	+R (T1-T4)	16 / 8	
	-R (T1-T4)	16 / 8	
Table of power losses	Entry No 1	24 / 12	10
	Entry No 2	24 / 12	
	...	24 / 12	
	Entry No 10	24 / 12	
Table of switch of phases	Entry No 1	14 / 7	5
	Entry No 2	14 / 7	
	...	14 / 7	
	Entry No 5	14 / 7	
P15(30,60) capacities of integration period of the previous day (Float)**	1-8 values	32 / 16	$\frac{180}{T}$, T – integration period in minutes
	9-16 values	32 / 16	
	...	32 / 16	
	…-N (N - number of values per day)	32 / 16	
Maximum capacity of int. period of current and previous day (Float)	+p (T1-T4) with time stamp	32 / 16	4
	-p (T1-T4) with time stamp	32 / 16	
	+q (T1-T4) with time stamp	32 / 16	
	-q (T1-T4) with time stamp	32 / 16	
Maximum capacity of int. period of current and previous month (Float)	+p (T1-T4) with time stamp	40 / 20	4
	-p (T1-T4) with time stamp	40 / 20	
	+q (T1-T4) with time stamp	40 / 20	
	-q (T1-T4) with time stamp	40 / 20	
Previous month energy (Float)	+A (T1-T4)	16 / 8	4
	-A (T1-T4)	16 / 8	
	+R (T1-T4)	16 / 8	
	-R (T1-T4)	16 / 8	
Previous day energy (Float)	-****	-****	-****
Momentary data	P, Q*	12 / 6	3
	U***, I***	24 / 12	
	f***	4 / 2	
Additional momentary data	-****	-****	2
	Sequence of phases	n	
	Date	12 / 6	

* - the number of measured energies depends on the type of the metering unit. If the metering unit does not measure the value, it is replaced with 0 in the register.

** - Due to *Modbus* standard restrictions, it is possible to read only up to 253 bytes at the same time, thus, if the integration period is 15 minutes, the capacities of integration periods of one day will be read only by two queries.

*** - momentary voltages, currents and frequency emerged in EMS metering units starting from version 60. In EMSA metering units - from version 50. The number of version of the metering unit is shown on its panel. These are the two last numbers in the string of symbols under the serial number.

**** - The metering unit does not have these parameters

6.5.2 GEM(f) / GAMA 100

The table below provides the groups of parameters which can be read from GEM(f) / GAMA 100 metering units by one query.

Table 6.41. GEM(f) / GAMA 100

Group of parameters read by one query	Type of value	Number of bytes/registers	Number of queries per metering unit
Capacity of current int. period (Hex, Float)	+p	16 / 8	1
Capacity of previous int. period (Float)	+p	16 / 8	1
Total energy (Hex, Float)	+A	16 / 8	1
Table of power losses	Entry No 1	24 / 12	10
	Entry No 2	24 / 12	
	...	24 / 12	
	Entry No 10	24 / 12	
Table of switch of phases	-**	-**	-**
P15(30,60) capacities of integration period of the previous day (Float)**	-**	-**	-**
Maximum capacity of int. period of current and previous day (Float)	-**	-**	-**
Maximum capacity of int. period power of current and previous month (Float)	-**	-**	-**
Previous month energy (Float)	+A (T1-T4)	16 / 8	1
Previous day energy (Float)	-**	-**	-**
Momentary data	P (L1), U (L1), I (L1), f, cosφ	68 / 17*	1
Additional momentary data	Date	12 / 6	1

* P (L2, L3), Q (L1-L3), U (L2, L3), I (L2, L3) – returned zero values.

** - The metering unit does not have these parameters

6.5.3 LZQM, EPQM

The table below provides the groups of parameters which can be read by one query from LZQM, EPQM metering units.

Table 6.42. LZQM, EPQM

Group of parameters read by one query	Type of value	Number of bytes/registers	Number of queries per metering unit
Capacity of current int. period (Hex, Float)	+p, -p, +q, -q	16 / 8	1
Capacity of previous int. period (Float)	+p, -p, +q, -q	16 / 8	1
Total energy (Hex, Float)	+A, -A, +R, -R (T1-T4)	64 / 32	1
Table of power losses	Entry No 1	24 / 12	10
	Entry No 2	24 / 12	
	...	24 / 12	
	Entry No 10	24 / 12	
Table of switch of phases	Entry No 1	14 / 7	5
	Entry No 2	14 / 7	
	...	14 / 7	
	Entry No 5	14 / 7	
P15(30,60) capacities of integration periods of previous day (Float)*	1-24 values (P60)	96 / 48	2 (P15), 1 (P30,60)
	1-48 values (P30, P15)	192 / 96	
	49-96 values (P15)	192 / 96	
Maximum capacity of int. period of current and previous day (Float)	+p, -p, +q, -q (T1-T4)	128 / 64	1
Maximum capacity of int. period of current and previous month (Float)	+p, -p, +q, -q (T1-T4)	160 / 80	1
Previous month energy (Float)	+A, -A, +R, -R (T1-T4)	64 / 32	1
Previous day energy (Float)	+A, -A, +R, -R (T1-T4)	16 / 32	1
Momentary data	P, Q, U, I, f, cosφ**	68 / 34	1
Additional momentary data	Quadrant	6 / 3	2
	Date	12 / 6	

* - Due to *Modbus* standard restrictions, it is possible to read only up to 253 bytes at the same time, thus, if the integration period is 15 minutes, the capacities of integration periods of one day will be read only by two queries.
** - EPQM, LZQM do not support cosφ. This value is estimated by the controller according to formula $\cos\varphi = P/(\sqrt{(P^2 + Q^2)})$.

6.5.4 EPQS

The table below provides the groups of parameters which can be read by one query from LZQM, EPQM metering units.

Table 6.43. EPQS

Group of parameters read by one query	Type of value	Number of bytes/registers	Number of queries per metering unit
Capacity of current int. period (Hex, Float)	+p	4 / 2	4
	-p	4 / 2	
	+q	4 / 2	
	-q	4 / 2	
Capacity of previous int. period (Float)	+p	4 / 2	4
	-p	4 / 2	
	+q	4 / 2	
	-q	4 / 2	
Total energy (Hex, Float)	+A (T1-T4)	16 / 8	4
	-A (T1-T4)	16 / 8	
	+R (T1-T4)	16 / 8	
	-R (T1-T4)	16 / 8	
Table of power losses	Entry No 1 - Entry No 5	70 / 35	1
Table of switch of phases	Entry No 1 - Entry No 10	240 / 120	1
P15(30,60) capacities of integration period of previous day (Float)*	1-24 values (P60)	96 / 48	1 (P30,60), 2 (P15)
	1-48 values (P30, P15)	192 / 96	
	49-96 values (P15)	192 / 96	
Maximum capacity of int. period of current and previous day (Float)	+p (T1-T4) with time stamp	32 / 16	4
	-p (T1-T4) with time stamp	32 / 16	
	+q (T1-T4) with time stamp	32 / 16	
	-q (T1-T4) with time stamp	32 / 16	
Maximum capacity of int. period of current and previous month (Float)	+p (T1-T4) with time stamp	40 / 20	4
	-p (T1-T4) with time stamp	40 / 20	
	+q (T1-T4) with time stamp	40 / 20	
	-q (T1-T4) with time stamp	40 / 20	
Previous month energy (Float)	+A (T1-T4)	16 / 8	4
	-A (T1-T4)	16 / 8	
	+R (T1-T4)	16 / 8	
	-R (T1-T4)	16 / 8	
Previous day energy (Float)	+A (T1-T4)	16 / 8	4
	-A (T1-T4)	16 / 8	
	+R (T1-T4)	16 / 8	
	-R (T1-T4)	16 / 8	
Momentary data	P, Q, U, I, UL, f, cosφ	68 / 34	1
Additional momentary data	S, GF, Quadrant, Sequence of phases, Temperature, Date	46 / 23	1

* - Due to *Modbus* standard restrictions, it is possible to read only up to 253 bytes at the same time, thus, if the integration period is 15 minutes, the capacities of integration periods of one day will be read only by two queries.

6.6 Query execution time

When reading several parameters at the same time, it is necessary to consider the query execution time. The preliminary time depending on the speed of communication interface with the metering unit and read data in bytes is provided in Table 0 .

Table 6.44. The dependence of query execution time on the speed on connection and the amount of read data

Connection rate, b/s	Number of queries per metering unit	Time, ms
300	1	2,250
	2	4,230
	4	8,200
	6	16,110
	8	32,000
600	1	1,170
	2	2,200
	4	4,260
	6	8,380
	8	16,620
1,200	1	622
	2	1,180
	4	2,290
	6	4,510
	8	8,950
2,400	1	351
	2	670
	4	1,310
	6	2,580
	8	5,120
4,800	1	216
	2	415
	4	812
	6	1,610
	8	3,200
9,600	1	150
	2	290
	4	570
	6	1,130
	8	2,240
19,200	1	120
	2	230
	4	450
	6	890
	8	1,760

6.7 Data buffering

The controller needs to have an opportunity to accumulate (buffer) the readings of metering units. It is possible to collect momentary (register addresses 42336 – 43422) or total readings (register addresses 41312 - 42334) of metering units EMS, GAMA 300, EPQM, LZQM, EPQS. The controller memory can collect the readings of 32 metering units at maximum. In case of collection of momentary and total data of all metering units, it is possible to buffer up to 16 metering units in total. The advantage of data collection is the speed of reading of data and a possibility to read the data of several metering units by one query of *Modbus* protocol. The amount of data to be red is restricted by the length of *Modbus* protocol package, the maximum amount of data in one package – 253 bytes. If the metering unit does not support a certain buffered parameter, it acquires zero value in the controller memory. All other non-buffered parameters are read through the controller directly from the metering unit. If non-buffered data is inserted between non-buffered parameters when reading data, they are also successfully read from the metering unit.

For optimum use of the buffering possibility, it is recommended to attribute the numbers of all buffered metering unit in sequence and not to insert non-buffered metering unit to the list. In this way, it is possible to query a maximum number of metering units with a minimum number of queries.

If the priority of transparent or Modbus queries is normal, the controller, having received the query, does not execute it until the completion of the cycle of all data buffered by a single metering unit. If a priority of transparent or Modbus queries is high, the controller, having received a query, terminates the buffering cycle and executes it. The method of determination of priorities is explained in Section 5 "ESMB 3.0 configuration menu".

7. ESMB 3.0 configuration menu

ESMB 3.0 can be configured by using computer terminal through all input interfaces. Information on how to configure "HyperTerminal" software is provided in Annex 2. When "HyperTerminal" (hereinafter referred to as terminal) is prepared, the settings menu will be opened to the terminal by pressing button <Esc> three times or entering text "ESMB20" (in capital or small letters). In some modifications, before opening menu, it is requested to enter the password of device. In such case, only if correct password is entered, menu is opened to configure the settings of the device. Menu illustration is provided in Fig. 7.1.

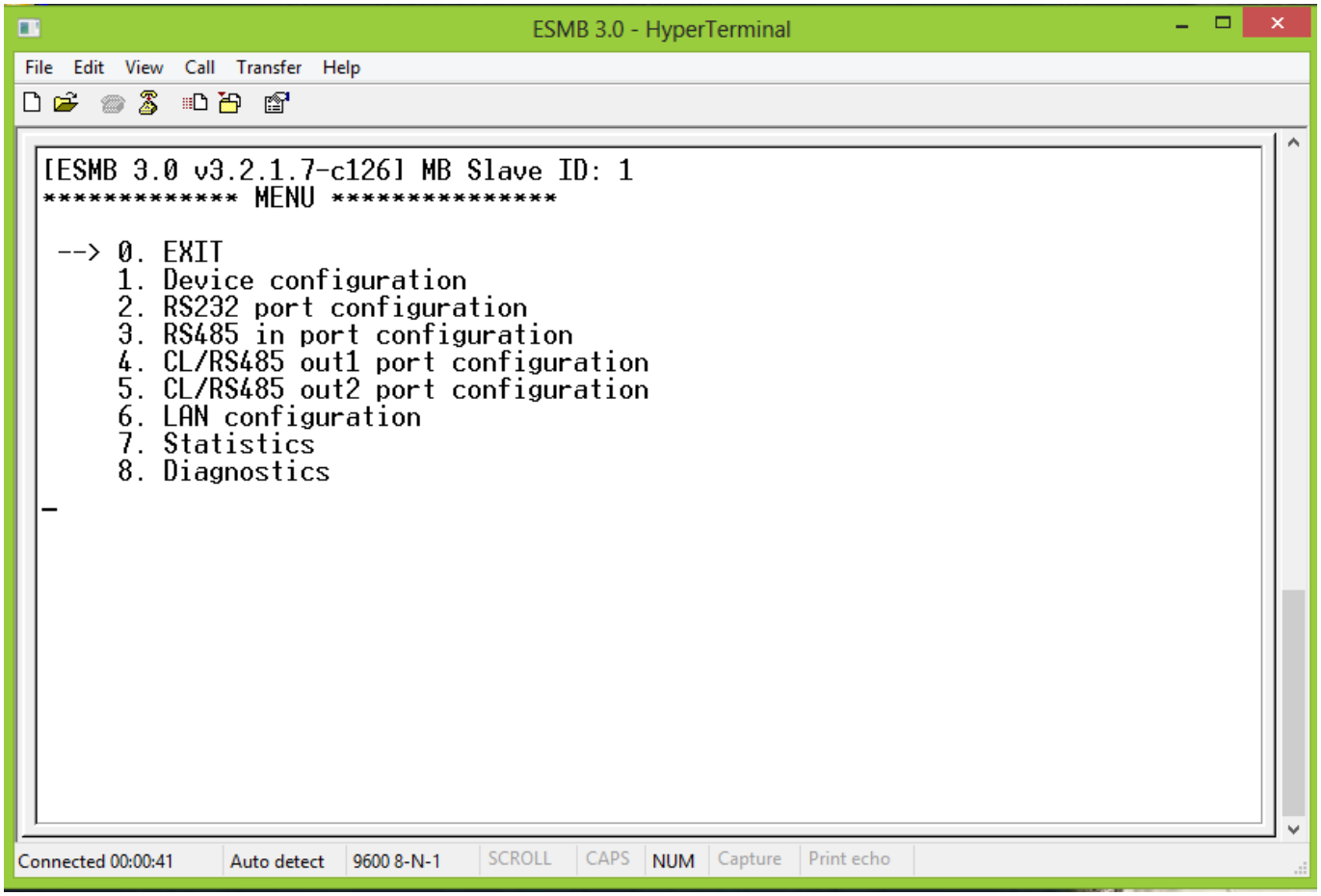


Fig. 7.1. Illustration of ESMB 3.0 main menu window

Symbol indicates the selection of menu item; by pressing <ENTER> button the selected menu item is activated. The options of menu item are changed by pressing <↓> and <↑> buttons. If the user enters the configuration mode and performs no settings for 60 seconds, the message “Exit terminal mode” will be shown and menu will be closed. In order to leave the menu mode, it is necessary to select item “EXIT”. Controller menu hierarchy is provided in Fig. 7.2. More detailed explanation of each menu is provided in the Table 7.1.

Meniu	
0. Exit	
1. Device configure	0. RETURN
	1. Device ID-SerialNumber
	2. Reboot time
	3. Data protocol
	4. Send query in transp. mode
	5. Transp. queries priority
	6. ModBus queries priority
	7. Reboot
2. RS232 port configure	0. RETURN
	1. PC port data rate
	2. Byte w. timeout in X bytes
	3. Request proceed timeout
3. RS485 in port configure	0. RETURN
	1. RS485 in port data rate
	2. Byte w. timeout in X bytes
	3. Request proceed timeout
4. CL/RS485 out1 port configure	0. RETURN
	1. CL/RS485 out1 data rate
	2. Byte w. timeout in X bytes
	3. Data wait timeout
	4. Pause before next req.
5. CL/RS485 out2 port configure	0. RETURN
	1. CL/RS485 out2 data rate
	2. Byte w. timeout in X bytes
	3. Data wait timeout
	4. Pause before next req.
6. LAN configuration	0. RETURN
	1. Dynamic IP (DHCP)
	2. Static IP address
	3. Current IP address
	4. Data port
	5. Subnet mask
	6. Default gateway
	7. DNS IP address
	8. TCP/IP session timeout
	9. Request proceed timeout
	10. External loop IP address
	11. Ext. loop check period
	12. MAC address
7. Statistics	0. RETURN
	1. Tr. Out1 Q. QC/QR/QT/AF/R
	2. Tr. Out2 Q. QC/QR/QT/AF/R
	3. ModBus Quer. QC/QR/QT/AF/R
	4. Buffering Q. QC/AF/R
	5. Buff. cycle time Out1/Out2
	6. Clear all stat. counters
8. Diagnostics	0. RETURN
	1. CL out1 state
	2. CL out2 state
	3. LAN IP address

Fig. 7.2. ESMB 3.0 menu hierarchy

Table 7.1. Values of ESMB 3.0 menu items

Menu item		**Explanation**
0. EXIT		Exits menu mode
1. Device configure	0. RETURN	Return to main menu
	1. Device ID-Serial Number	Controller unique serial number
	2. Reboot time	Controller reboot period. Indicates the intervals of reboot of controller; it is possible to select time interval from 10 to 255 minutes.
	3. Data protocol	Data protocol enables the selection between three options: 0 – Transparent, 1 – Modbus, 2 – Modbus + Transparent. In case of setting of transparent mode, the controller sends all data without processing them. In Modbus mode, the controller processes data according to Modbus protocol and rejects data that do not meet this protocol. In third mode, the controller processes Modbus data and all other queries not recognised as Modbus are transferred to the transparent one.
	4. Send query in transp. mode	Indicates the interface through which the transparent queries should be sent; it is possible to choose from three options: both, the first or the second. In case of activation of one interface only, the transparent queries are sent only through one of the interfaces without loading the other communication interface.
	5. Transp. Queries priority	Indicates the priority of transparent queries in view of buffering of metering unit data. Two priorities are possible - high or normal. In case of selection of high priority, in case of query the buffering of the metering unit is terminated and continued only after the execution of the query. If the priority is normal, the controller will first allow the completion of buffering of metering unit data and only then it executes the received query.
	6. Modbus queries priority	Indicates the priority of Modbus queries in view of buffering of metering unit data. Two priorities are possible - high or normal. In case of selection of high priority, in case of receipt of query the buffering of the metering unit is terminated and continued only after the execution of the query. If the priority is normal, the controller will first allow the completion of buffering of metering unit data and only then it executes the received query.
	7. Reboot	Reboots the controller
2. RS232 port configure	0. RETURN	Return to main menu
	1. PC port data rate	Indicates the rate of connection of RS232 interface with the master device.
	2. Byte w. timeout in X bytes	Time interval after the receipt of the last package byte after the deadline of which the package is forwarded and processed. This setting is applied to packages received via RS232 interface.
	3. Request proceed time out	Indicates the time of expectation of response to the query if the controller or the system is loaded and the execution of encrypted query does not start within the indicated period of time, the encrypted query will be automatically rejected.
3. RS485 in port configure	0. RETURN	Return to main menu
	1. PC port data rate	Indicates the rate of connection of RS485 interface with the master device.
	2. Byte w. timeout in X bytes	Time interval after the receipt of the last package byte after the deadline of which the package is forwarded and processed. This setting is applied to packages received via RS485 interface.
	3. Request proceed time out	Indicates the time of expectation of response to the query if the controller or the system is loaded and the execution of encrypted query does not start within the indicated period of time, the encrypted query will be automatically rejected.
4. CL/RS485 out1 port configure	0. RETURN	Return to main menu
	1. CL/RS485 out1 data rate	Indicates the rate of first communication interface with the metering unit.
	2. Byte w. timeout in X bytes	Time interval after the receipt of the last package byte after the deadline of which the package is forwarded and processed. This setting is applied to packages received via first interface with the metering unit.
	3. Data wait timeout	Time interval for the expectation of the response from the device connected to CL/RS485 interfaces after sending of the query via CL/RS485 interfaces.

	4. Pause before next req.	Indicates the time interval between the execution of old query and sending of the new one. It is set in view of the technical parameters of the queried metering unit.
5. CL/RS485 out2 port configure	0. RETURN	Return to main menu
	1. CL/RS485 out2 datarate	Indicates the rate of second communication interface with the metering unit.
	2. Byte w. timeout in X bytes	Time interval after the receipt of the last package byte after the deadline of which the package is forwarded and processed. This setting is applied to packages received via second interface with the metering unit.
	3. Data wait timeout	Time interval for the expectation of the response from the device connected to CL/RS485 interfaces after sending of the query via CL/RS485 interfaces.
	4. Pause before next req.	Indicates the time interval between the execution of old query and sending of the new one. It is set in view of the technical parameters of the queried metering unit.
6. LAN configuration	0. RETURN	Return to main menu
	1. Dynamic IP (DHCP)	Setting of the dynamic IP address to the controller. Allows to choose from two possible: 1 - ON, 0 - OFF. If DHCP is set as ON, the controller should receive IP address automatically from the network. If DHCP mode is off, the static IP address is set for the controller.
	2. Static IP address	Static controller IP address. Active in case of disconnection of dynamic IP function.
	3. Current IP address	Current controller IP address.
	4. Data port	Data port. In case of indication of this port when connecting to the controller, the controller understands that it should be used for transfer to controller outputs or Modbus query is processed.
	5. Subnet mask	Subnet mask address.
	6. Default gateway	Standard lock.
	7. DNS IP address	DNS IP address
	8. TCP/IP session timeout	TCP/IP session period of validity in seconds. It is the time after the last data exchange or session update when the controller initiated session closing.
	9. Request proceed timeout	Maximum query execution period in the controller. It is a period from the moment when the controller accepted the query from the client until the start of sending of the response to the client. If this time expired earlier, the query processing is terminated.
	10. External loop IP address	External IP address for diagnosis of the controller to check if Ethernet interface is functioning. If the controller does not receive any packaged within the indicated period of time, it sends ping query via external IP address. If it receives the response, the period starts running afresh, if the reply is not received, Ethernet interface is reloaded.
	11. Ext. loop check period	Ethernet functioning inspection period in seconds.
	12. MAC address	Controller MAC address
6. Statistics*	0. RETURN	Return to main menu
	1. Tr. Out1 Q. QC/QR/QT/AF/R	Statistics of the first connection interface queries.
	2. Tr. Out2 Q. QC/QR/QT/AF/R	Statistics of the second connection interface queries.
	3. ModBus Quer. QC/QR/QT/AF/R	Statistics of Modbus queries.
	4. Buffering Q. QC/AF/R	Statistics of data buffering of the metering unit.
	5. Buff. cycle time Out1/Out2	The period of buffering cycle for the first/second connection interface. Shows the period of buffering of all data of buffered metering units.
	6. Clear all stat. counters	Sets meters of query responses to zero.
7. Diagnostics	0. RETURN	Returns to main menu
	1. CL out1 state	Indicates the status of the first current loop chain (open or closed).
	2. CL out2 state	Indicates the status of the second current loop chain (open or closed).
	3. LAN IP address	Network IP address

*ESMB 3.0 collects statistical data about execution of queries. Used abbreviations:

- QC (*Queries count*) – number of queries received from the master device.
- QR (*Queries refused*) – number of queries that were refused by the controller. The queries are refused when the controller is unable to keep in pace with their processing, i.e. they are sent too densely).
- QT (*Query timed out*) – Number of non-executed queries due to exceeded query processing time (*Request proceed time out*).

- AF (*Answer failed*) – Number of queries that were not replied from the metering units.
- R (*Rate*) – the percentage rate of queries that were not fully executed with all queries. Shows the percentage of successfully executed queries.

8. Manufacturer's warranties

UAB NAVITUS LT ("the Manufacturer") warrants that the materials and components used in the production of the controller as well as performed assembly, tuning works are free of defects and the production employees performed their duties with due quality.

The guarantee is also applied to the technical specifications of the product. The manufacturer hereby warrants that in case of disconnection of its produced controllers or other equipment of the same purpose of use and their reconnection, the entire information contained in the meters will remain unchanged and will be available for acceptance and analysis.

The period of warranty service of controller – 12 months. Warranty obligations are only valid if the user observes the following rules:

- the installation of controller is performed by the Manufacturer or his authorised representative or the Manufacturer provides a written consent to the legal person to perform installation works by providing him with complete technical documentation for the installation;

- avoids termination and short circuit in the communication lines connecting the controller with the metering units or other controllers, also avoids their short-term and long-term connection with telephone, electricity and other communication lines that do not belong to the system;

- when changing the electricity meters in the system, their configuration or layout in the system, it is necessary to inform system producer hereof and to receive his consent as well as mandatory software updates/modifications (in case of change of metering units connected to the system);

- avoids damage to the controller box seals and stickers.

9. Contact information

In case of any problems related to the installation or use of our equipment and in case of lack of necessary information in this document, please contact us by e-mail - support@navitus.lt.

Manufacturer:

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TECHNICAL CERTIFICATE OF THE PRODUCT

Performed inspection of Controller ESMB 3.0 S/N _____.

Controller modification number: _____

L. S.

Date of sale: _____ Sold by:_____

Name and address of the company where the controller is installed:

_____

Date of installation: _____

Works performed by _____

(First name, last name, signature)

Maintenance records

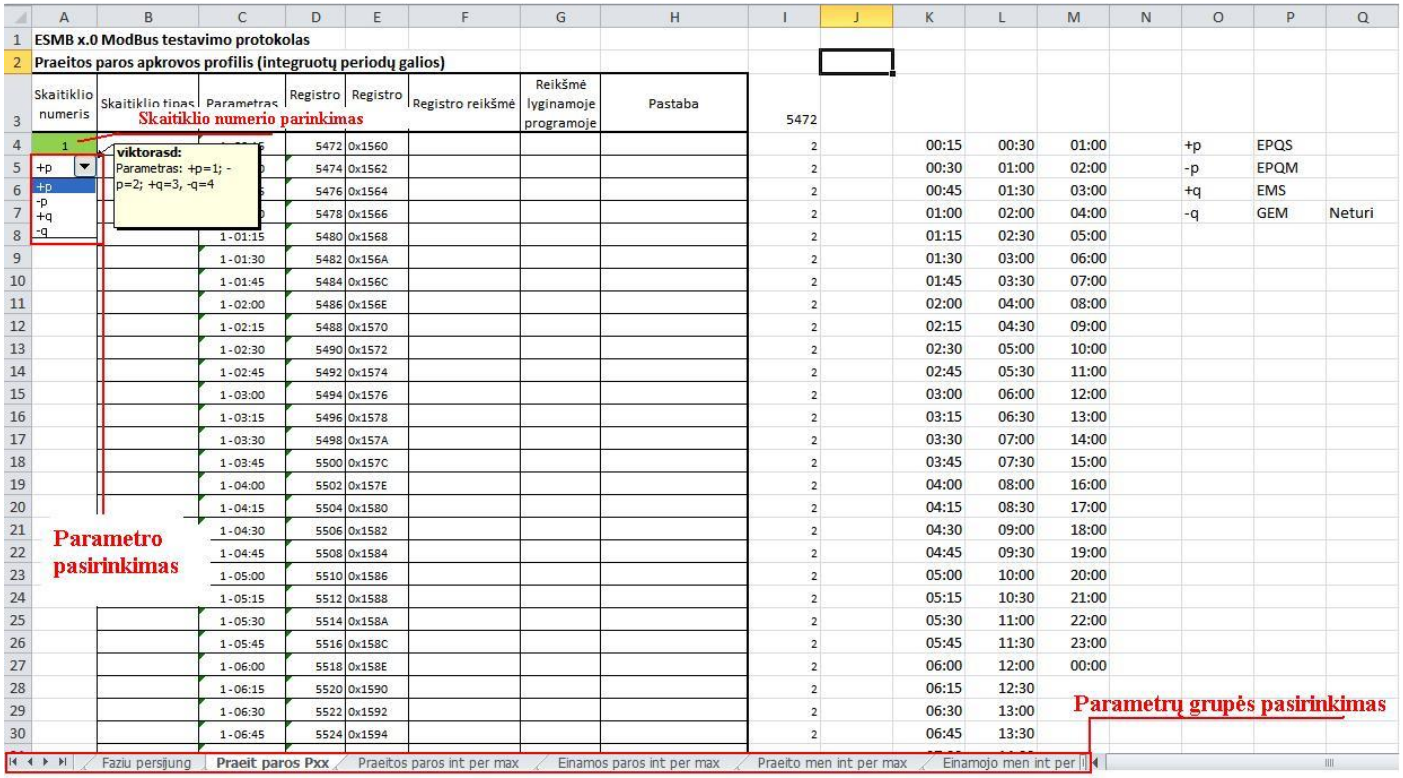
Date	Performed works, last name, signature

Annex 1

Calculation of addresses according to Excel sample form

The Excel sample form was prepared to facilitate the work when looking for specific parameter register addresses and can be downloaded from: http://local.elgsis.lt/files/ESMB3/ESMB_20_MB_AdresuSkaiciuote.xlsx .

The illustration below shows the example of the use of the sample form. The example shows the fields that can be used by the user; when changing the value of indicated cells, the table fills up automatically.



Annex 2

Configuration of “Hyperterminal” software

Configuration is performed by using software “HyperTerminal” (Fig. 1, Fig. 2) or any other analogous software enabling the connection to the controller via RS232 interface. If the computer operates on Windows 7 Operating system, “HyperTerminal” software can be downloaded from: http://downloads.elgsis.com/files/hyperterm_win7.zip, the files in the downloaded archive have to be opened to the general directory and it is necessary to launch “hyperterm.exe”.COM interface settings for configuration are **independent from settings for data reading** and shall be set as follows: **4800 (2400, 9600, 19200, etc. subject to the speed of controller interface) bits per second, parity - none, 8 data bits, 1 stop bit, flow control - none.**

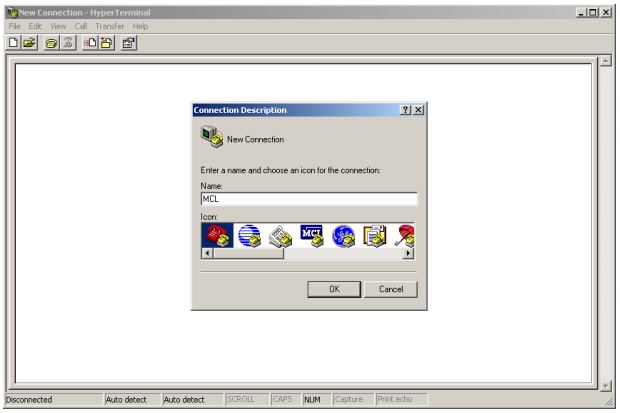


Fig. 1. Enter new connection name

Fig. 2. Choose the interface to which MCL is connected

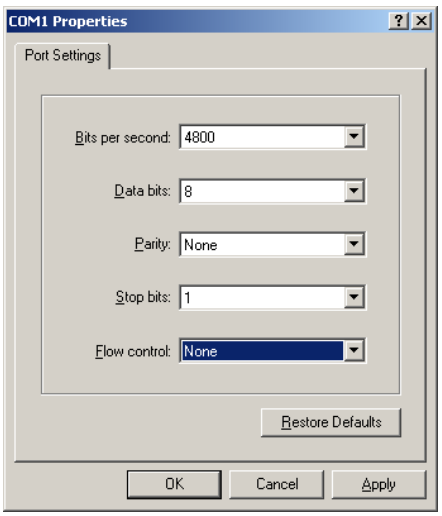


Fig. 3. Choose interface settings

After pressing "OK" in dialogue window "*COM Properties*" (Fig. 3), the settings are set on "*Auto detect*" by default (Fig. 4). Replace them with respective values:

1. Press button "*Disconnect*" as shown in Fig. 5;
2. Press button "*Properties*" as shown in Fig. 5;
3. Press button "*Configure*" as shown in Fig. 6;
4. Press button "*OK*" as shown in Fig. 7;
5. Make sure that other connection settings are set as shown in Fig. 6 and Fig. 7;
6. Press button "*OK*" as shown in Fig. 8;
7. The settings should change to 4,800 (9,600) 8-N-1 as shown in Fig. 9;

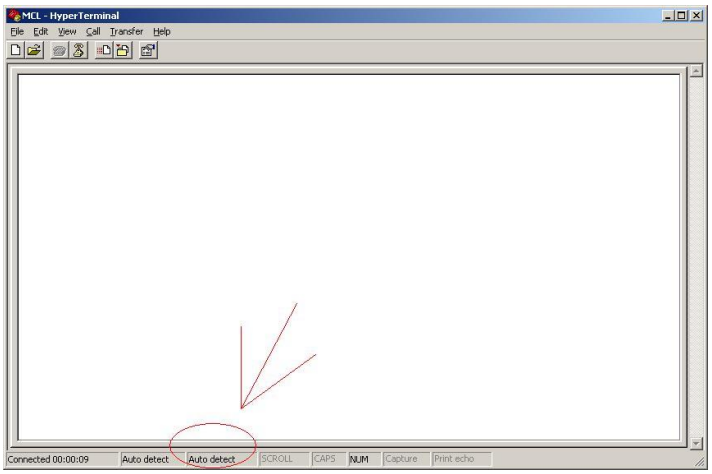


Fig. 4.

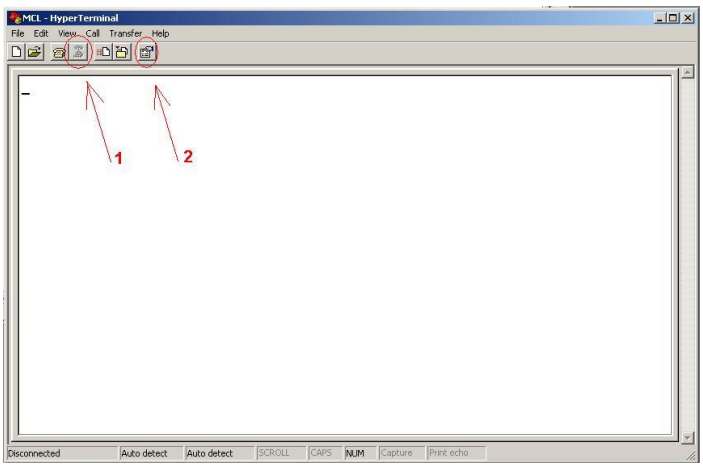


Fig. 5.

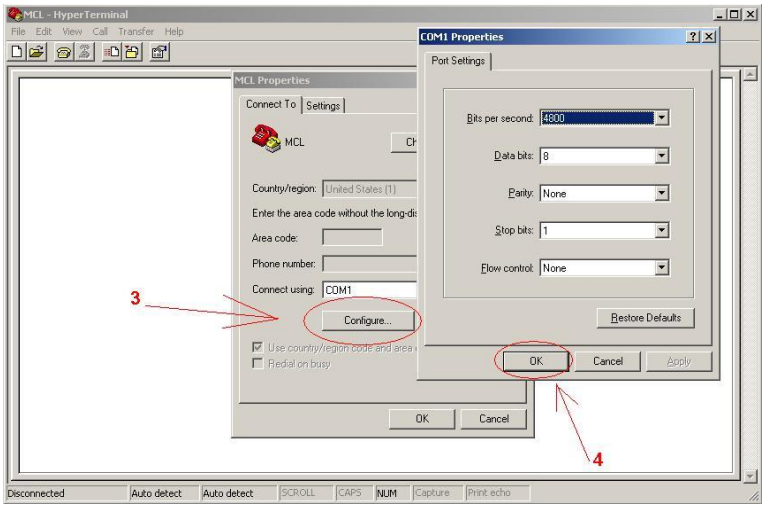


Fig. 6.

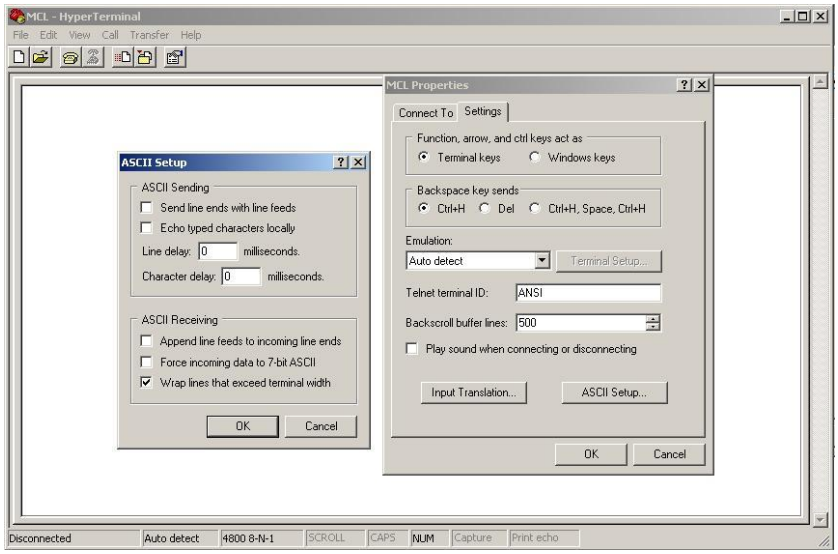


Fig. 7.

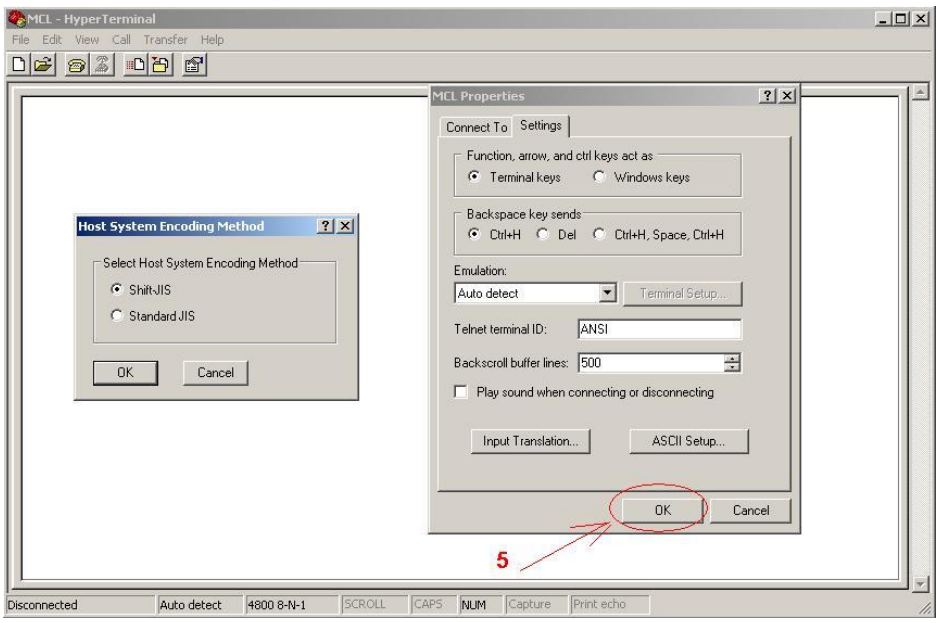

MCL - HyperTerminal
File Edit View Call Transfer Help
MCL Properties
Connect To
Settings
Function, arrow, and ctrl keys act as
Terminal keys
Windows keys
Backspace key sends
Ctrl+H
Del
Ctrl+H, Space, Ctrl+H
Emulation:
Auto detect
Terminal Setup...
Telnet terminal ID:
ANSI
Backscroll buffer lines:
500
Play sound when connecting or disconnecting
Input Translation...
ASCII Setup...
OK
Cancel
Host System Encoding Method
Select Host System Encoding Method
Shift-JIS
Standard JIS
OK
Cancel
5
Disconnected
Auto detect
4800 8-N-1
SCROLL
CAPS
NUM
Capture
Print echo

Fig. 8.

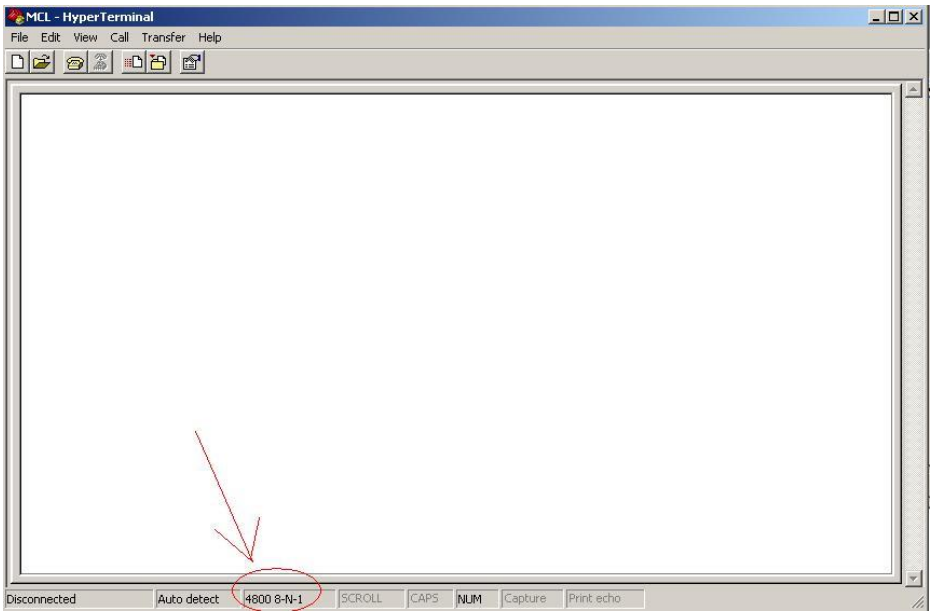

MCL - HyperTerminal
File Edit View Call Transfer Help
Disconnected
Auto detect
4800 8-N-1
SCROLL
CAPS
NUM
Capture
Print echo

Fig. 9.