NAVITUSLT

Controller with internal Quad-band GSM/GPRS/3G modem
MCL 5.10

User manual
Version 1.5

UAB NAVITUS LT, Lithuania 2018

Document revision history

Version	Date	Revision history	Controller Firmware version
1.0	2015-05-27	First Issue	1.0
1.3	2016-10-12	Updated power and connection information	3.0
1.4	2017-07-04	Added functionality	4.0
1.5	2017-11-13	Byte timeout explained	4.0

Disclaimer

The manufacturer guarantees that the following documentation is correct and intended for the device described. The manufacturer has no obligation for guarantee if the documentation is used for any other device not listed in this documentation. The manufacturer has the right to update or alter documentation without prior notice.

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Signs and Abbreviations

AC / DC	Alternating Current / Direct Current
APN	Access Point Name
CSD	Circuit Switched Data
EMC	Electromagnetic Compatibility
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
ISP	Internet Service Provider
IP	Internet Protocol address
IMEI	International Mobile Equipment Identity
LED	Light Emitting Diode
N/A	Not Available / Not Applicable
PC	Personal Computer
PIN	Personal Identification Number
Rx	Receiver connector
SIM	Subscriber Identity Module
SMA	SubMiniature version A connector
TCP/IP	Transmission Control Protocol/Internet Protocol
Tx	Transmitter connector
VPN	Virtual Private Network
URL	Uniform Resource Locator

2. Safety Instructions

⚠️	Please ensure you read and understand the installation instructions entirely before attempting to install and configure MCL 5.10.
⚡	Always disconnect the mains supply while installing or servicing the communication interfaces, antenna or changing SIM card.
⚠️	Only the authorized service persons with adequate qualifications can perform installation, uninstallation and parameterization of the GSM/GPRS controller MCL 5.10. National wiring rules should be followed while installing and using the controller.
⚠️	All equipment interconnected with this product should comply with the requirements of EN 60950-1:2006 (Personal computer, etc.) or other adequate safety standard applicable to the equipment (electricity meters).
⚠️	GSM/GPRS controller should be mounted in restricted access locations. Only authorised personnel should be able to access this location.
⚡	Some parts may remain energized even if the power is disconnected! Do not try to disassemble internal components. There are no serviceable parts inside.

3. Application and Functionality

General Information

MCL 5.10 controller (further referred to as a controller) is used in AMR systems for automated remote data reading of electricity, heat meters and other electronic devices and data transmission to remote offices. Device does not store, manipulate or alter meter information. The controller has an internal lithium-polymer battery for power failure notification to the remote data center.

GSM radio network with CSD/GPRS/2G/3G technology and TRANSPARENT DATA, TCP/IP protocols is used for data transmission to the management system.

Supported Communication Protocols

Controller supports two-direction data exchange with communication protocols IEC 62056-31, DLMS/COSEM and LST EN 62056-21:2001 (fixed baud rate 300 ...19 200 bauds, 8N1 or 7E1 bytes) (all security layers as well).

Configuration

RS485 electric communication interfaces are used for meter data read-out (fixed net baud rate of 300...115200 bauds, 8N1 or 7E1 bytes).
Depending on modification, device parameterization can be performed locally via RS232 or USB interfaces or remotely via SMS or GSM/GPRS.
Controller supports both TCP/IP server and client connection modes.

Mounting and power supply

Controller supports and is mounted (can be replaced) in the terminal covers of electricity meters provided by manufacturer or it's partners or on the DIN rail. When mounted properly, all of the modem indicators are visible. The controller is powered by the external power source from the meter using connection socket X2 of the controller MCL 5.10 or by external power source. **Note!** The controller might be powered on by USB cable, however, due to the lack of current the gsm modem will not function.

Firmware and settings update

The controller firmware can be updated locally (via RS232) and remotely (using GPRS connection). Aditionally, multiple controllers can be updated (updates involve managing controllers' parameters, reading values, firmware updates) using the software provided. There is possible to integrate new protocols and types of meters in new firmware versions. After power on, if the configuration is set to automatic update, the controller checks if there is the newer firmware version and automatically updates it's firmware.
Contact the manufacturer for the new firmware and tools for firmware upgrades.

Mobile network signal strength monitor

When controller powers on, if the controllers network parameters are set to "Auto", the device automatically tries to connect to the 3G network and measures signal strength. When the signal is weaker than the parameter described in the configuration, the controller changes connection to the 2G/GPRS. The signal strength measurement repeat time is described in the menu parameters. The controller automatically connects to the 3G network only after reboot. Alternatively, it can be set to connect to the 2G or 3G network only.

Automatic provider detection

When the SIM card is placed in the controller and controller is powered on, the system checks if the SIM card's prrovider's ID matches settings described in the configuration Providers' menu. If so, the controller automatically uses described providers settings. The providers ID and other options can be set using

controllers menu or via parametrization software in "provider settings".

Alarm system (Plug & Play)

When any event or alarm is received from the meter interface, the controller sends all the data received from the meter and the controllers information (IMEI, IP) using http protocol to the url address specified in the settings menu "Plug&Play server address".

Time synchronization

The controller synchronizes time with GSM network provider or NTP server. The device's time zone can be set and changed in the Device configuration menu. The current time is used for audit and event logging.

Passive Client (dynamic IP address)

This option is used when the client has dynamic IP SIM card or the SIM card cannot be accessed from the server, but the modem could connect to the server. It can work in report mode or in passive client mode. Report mode sends information about existing IP address to the server (UDP). Enabled passive client mode requires remote server address set in the settings. In this mode, the modem connects to the remote server and holds the open connection. This way the system should identify the connected modem and would be able to read data using live session. **Note!** In passive client mode the controller always has the connection open to the server so more mobile data can be used for upload than average.

Reports

Reports regarding signal strength , IMEI, IP address, events can be sent as an UDP message to multiple IP addresses or phone number via SMS depending on APN and their settings.
Report interval is a configurable value.
Report example: "SQ:-51dBm IMEI:355233050381548 IP:212.47.100.164 SN:170170170170

SMS control

Depending on APN a list of allowed numbers can be set to allow parameterization by SMS or to send periodic SMS reports with device status, SIM ID, signal strength, IP address.

SMS Parameterization

SMS parameterization command syntax is as follows below. **Important!** Command keys must be sent in lower case only. MAX sms size – 160 symbols.

SMS command syntax: **<keyword>:<parameters or commands key=value;><parameters or commands key=value;> !Important.** No signs (; =) must be used in parameters. For example: *smscfg:dev_userpassword=PA:SS;=WORD; is not allowed.*

Example: " *smscfg:dev_rebootperiod=1000;smscmd:sendreport;smscfg:dev_userpassword=asd;* "
Alternative: " **smscfg:dev_rebootperiod=1000;dev_userpassword=cccc;smscmd:sendreport;** "

If successful, the command will request the device to change the default automatic reboot value to 10 minutes and send report to data center.
Depending on the outcome the device will respond to each command in the following way:

      Ok;ok;ok;
OR
      Error;ok;error;

If device will not recognize the command the response will be "***No valid command***".

The entire command list is displayed in the Annex A. "Controller menu and configuration settings".

4. Principal Components of the controller MCL 5.10

The main controller components are listed below:

a) Comunication interfaces - RS232 or USB (for parametrization),CL and RS485 for data collection from meters
b) Internal 450mAh Li-polymer battery to ensure the notification of power failure or data transfer function support.
c) CSD/GSM/GPRS/3G modem is used for modem programming, firmware update, data reading and parameterization

GSM/GPRS Modem	
GSM/GPRS bands	850/900/1800/1900 Mhz
Class of power transmission	Multi-slot class 8, CS1-CS4, Class B
Data Speed	up to 85.6 kb/s
Uplink time slot	2
Antenna Connector type	SMA (50 Ohm)
3G modem	
UMTS / EDGE Bands	850/900/1800/1900/2100 Mhz
Class of power transmission	Multi-slot class 12, MCS1-9, Class B
Data Speed	HSUPA cat 6, up to 5.76 Mb/s UL
	HSDPA cat 8, up to 7.2 Mb/s DL
	WCDMA PS up to 384 kb/s DL/UL
	EDGE multi-slot class 12, up to 236.8 kb/s DL/UL

Table 3-1. Main characteristics of a GSM/GPRS modem module

5. Technical Characteristics

Power supply input voltage range (50/60Hz)	90 V – 264 V AC

Power consumption:
    a. maximum in transmission mode:
    b. average in duty mode:
	< 10 VA
	< 5 VA

Internal backup power supply	450mAh LiPo battery, mounted without soldering
Internal battery complete loading time	3 hours
PC to controller net baud rate via RS232 device interface, 8N1 bits, Baud	19200
PC to controller net baud rate via USB device interface, 8N1 bits, Baud	115200
Number of meters connected to RS485 interface	1 … 32
Number of meters connected to CL interface	1 … 3
Number of simultaneous communication sessions GSM/CSD/GPRS/3G	6
Work temperature range, °C	-20 … +55
Storage temperature range, °C	-40 … +70
Relative humidity, % without condensate	20 ... 75
Dimensions, mm	93 x 68 x 37
Plastic Materials, safety of flammability	ABS
Immunity to surge pulse	7 kV (1,2/50 μs)
RoHS	Compliant
Antenna	SMA
Protection degree based on IEC60529	IP51 under the cover of the meter

Table 4-1. MCL 5.10 controller technical characteristics

Table 4-2 MCL 5.10 controller indicators description

| Operation and received signal strength indication – RGB LED1:
   -   Not registered to GSM network / no SIM card
   -   Registered to GSM/GPRS network; |
R long pulse (0,4 Hz /1s)
G pulse |

- Registered to 3G network
Signal strength indication*:
   -113 to -82 dBm or less
   -81 to -70 dBm
   -69 to -51dBm or more
- GSM/GPRS data session active; (connection established)
	G double pulse
	
	R pulse (0,4 Hz)
	B pulse (0,4 Hz)
	G pulse (0,4 Hz)
	Same color more frequent pulse (2Hz)

Interface activity / battery charge indication – RGB LED 2: - Data transfer; active interface: RS485	 B- query / respond

Table 4-2. *Default values indicated. Signal strength is check every 20 seconds. Signal indication level can be changed in the Menu

Note! The controller is powered on if any of the indicator defining signal strength is on (pulse).

6. Connecting interfaces

⚠️	**Important:** Before proceeding, please ensure the device will remain clean and dry during the installation and no liquid or other substance will remain inside as that could severely affect device performance and warranty.
⚠️	**Important:** PIN code of a SIM card must be disabled prior the installation
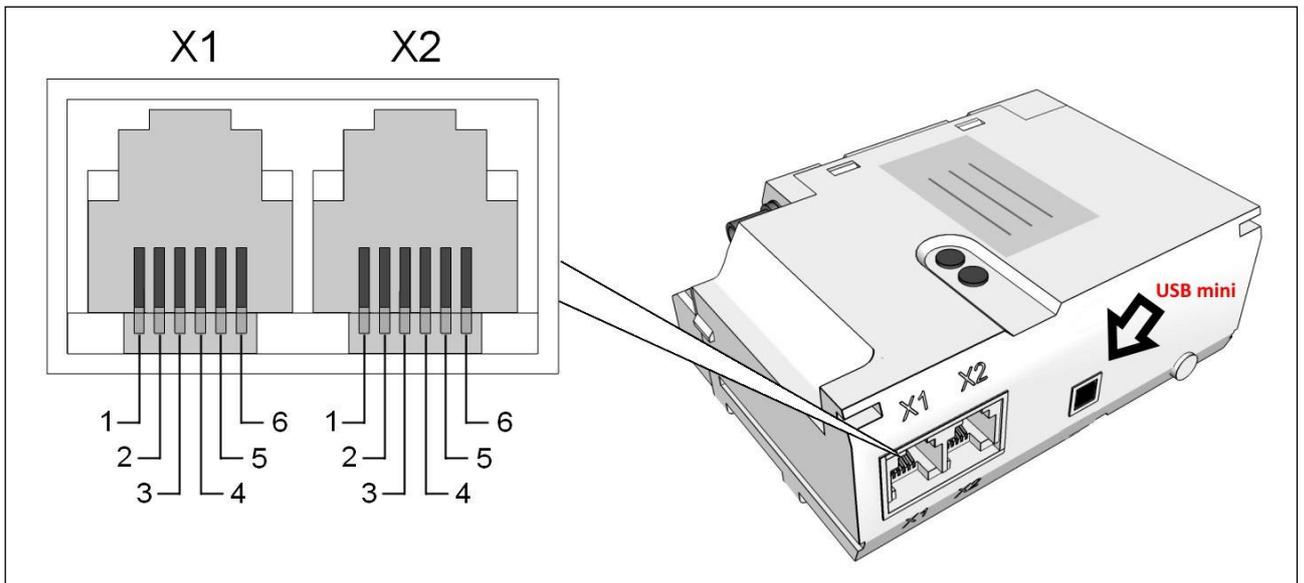
PIN	Signal	Source	Comment
- X1 -			
1	GND	-	Configuration interface (RS232)
2	RS232 TXd	Out	Configuration interface (RS232)
3	RS232 RXd	In	Configuration interface (RS232)
4	CL -	In/Out	Meter interface (CL)
5	CL +	In/Out	Meter interface (CL)
6	CLIN_BLOCK	In	Connect with GND to enter configuration mode for RS232

- X2 -			
1	*Reserved*	-	
2	*Reserved*		
3	RS485 B	In/Out	Meter interface (RS485)
4	RS485 A	In/Out	Meter interface (RS485)
5	CLIN +	In/Out	Client system connection interface (CLIN)
6	CLIN -	In/Out	Client system connection interface (CLIN)

6.1 Connecting a Meter

In order to connect a meter, please connect controller's X2 connector with a meter's "A" and "B" socket of the RS485 interface (see Figure 4.2-1). If there is more than one meter to be connected the parallel method must be used as indicated below:
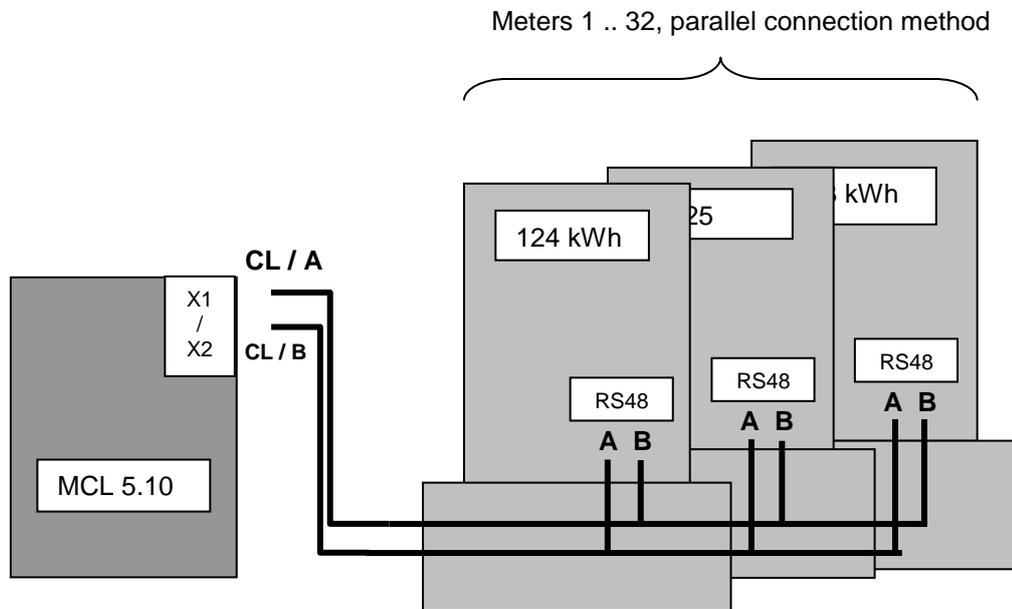
Figure 4.3.1-1. Meter connection to RS485 interface

7. Labeling

Principal controller information is marked on a label.

Label explanation:
• LED indicator position
• Controller name
• Power supply input and consumption characteristics
• Unique identification number (ID)
• Unique identification number (Barcode), type: Interleaved 2/5

8. Parameterization Guide

⚠	**You need to have the proper cable to connect from the X1 port on the device to the RS232 port or the USB port of the computer**
⚠	**Important:** Parameterization may vary depending on connection interface type, device version, administrator's PC operating system region and version. Therefore figures and menus given below may differ from actual due to software updates and upgrades.
⚠	**Important:** It is required to disable PIN request on a SIM card, before inserting it in the controller's SIM socket
⚠	The settings of a COM port for parameterization are independent from the settings for the data readout and the default settings are set as follows: **19200 bps, parity - none, 8 data bits and flow control - none**.
⚠	**Important!** To load or re-load controller's menu press button **ESC** (on keyboard) **3 times**.

9. Initial Information

MCL 5.10 controller using GPRS technology transmits the data of measurement equipment (meters). There is an internal modem with a SIM card socket.

Connect the controller to the computer's COM or USB (depending on connection) port to start the setup. Connect the antenna before switching the controller on. It is not necessary to insert a SIM card for parameterization. If there is an ongoing data readout, it must be interrupted before parameterization.

9.1 Procedure of Local Parameterization

Access to the controller can be protected by a password. Several levels of users are possible: different admin logins and user login. Each login has separate menus and control functions. Parameterization can be handled using HyperTerminal (Figure 6.2-1, Figure 6.2-2) or other software allowing connecting MCL 5.10 via device's RS232 interface.
After parameterization user must restart the controller's using the reset function in the menu.

Enter a name for the new connection (Figure 6.2-1)

Figure 6.2-1

Select a port MCL is connected to (Figure 6.2-2)

Figure 6.2-2

After pressing *OK* in the *COM Properties* window (figure 6.2-3), the settings are set to *Auto detect* by default (figure 6.2-4).
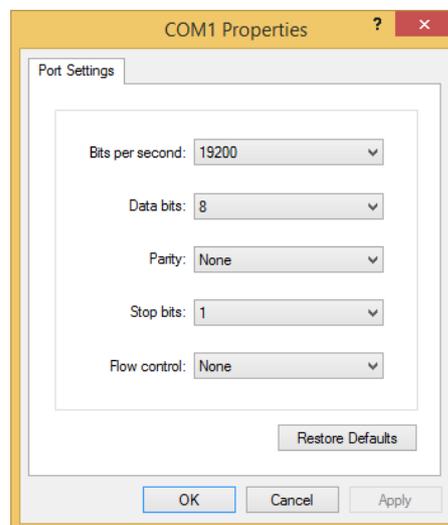
Figure 6.2-3 Select port settings
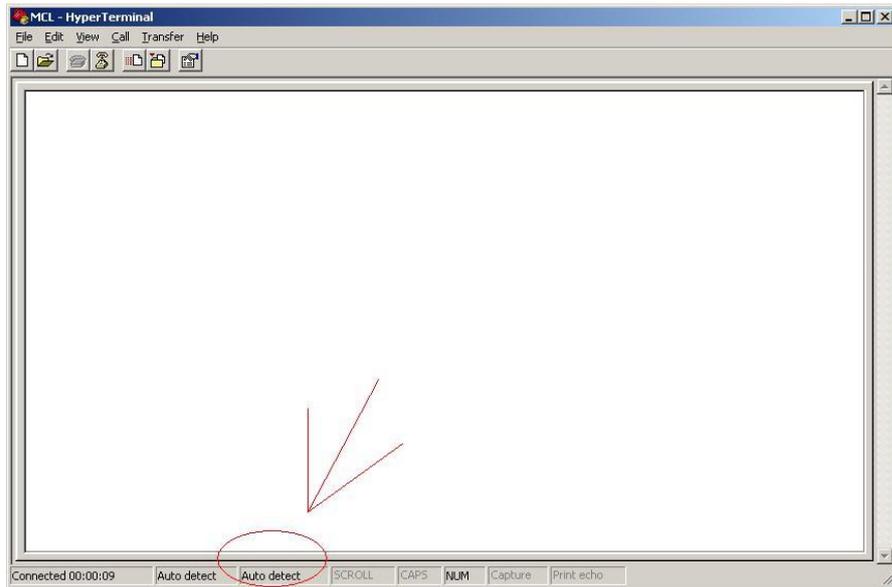
Figure 6.2-4

To change the values:

1. Press *Disconnect* button as shown on figure 6.2-5 (arrow 1);
2. Press *Properties* button as shown on figure 6.2-5 (arrow 2);
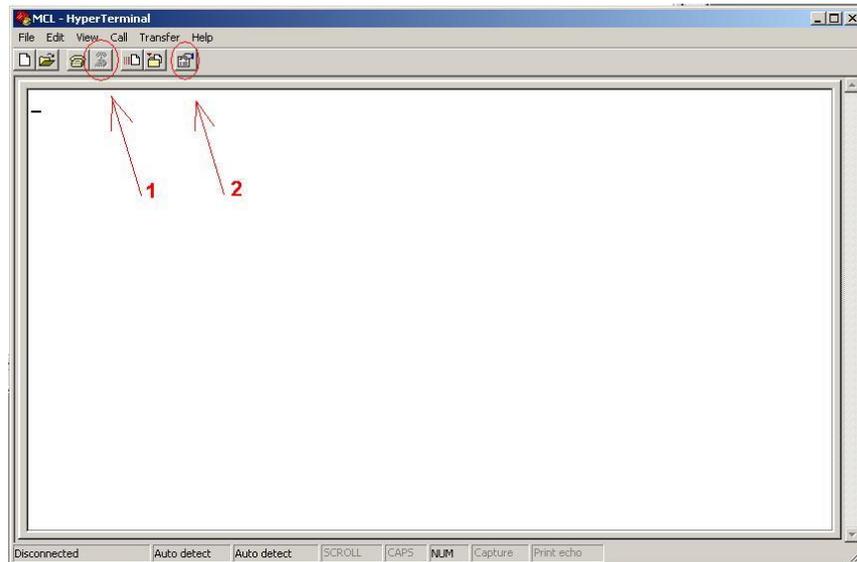
Figure 6.2-5

3. Press *Configure* button as shown on figure 6.2-6 (arrow 3);

4. Press *OK* button as shown on figure 6.2-6 (arrow 4);
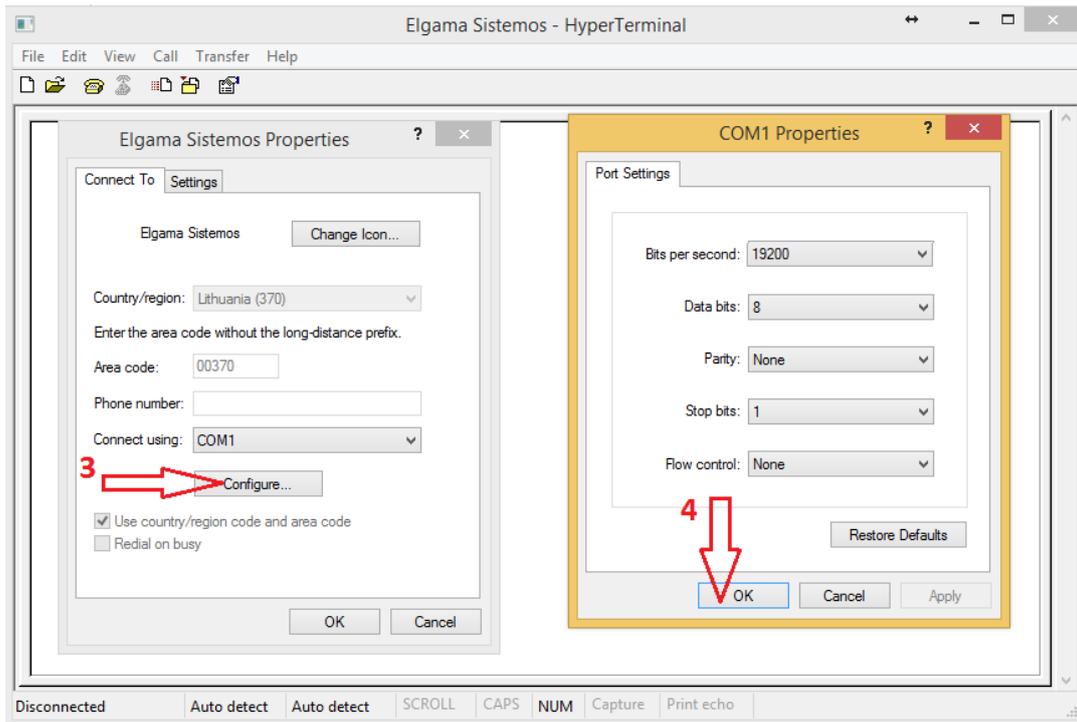
Figure 6.2-6

5. **Important.** Ensure that other settings of the connection are set as shown on figures 6.2-7;
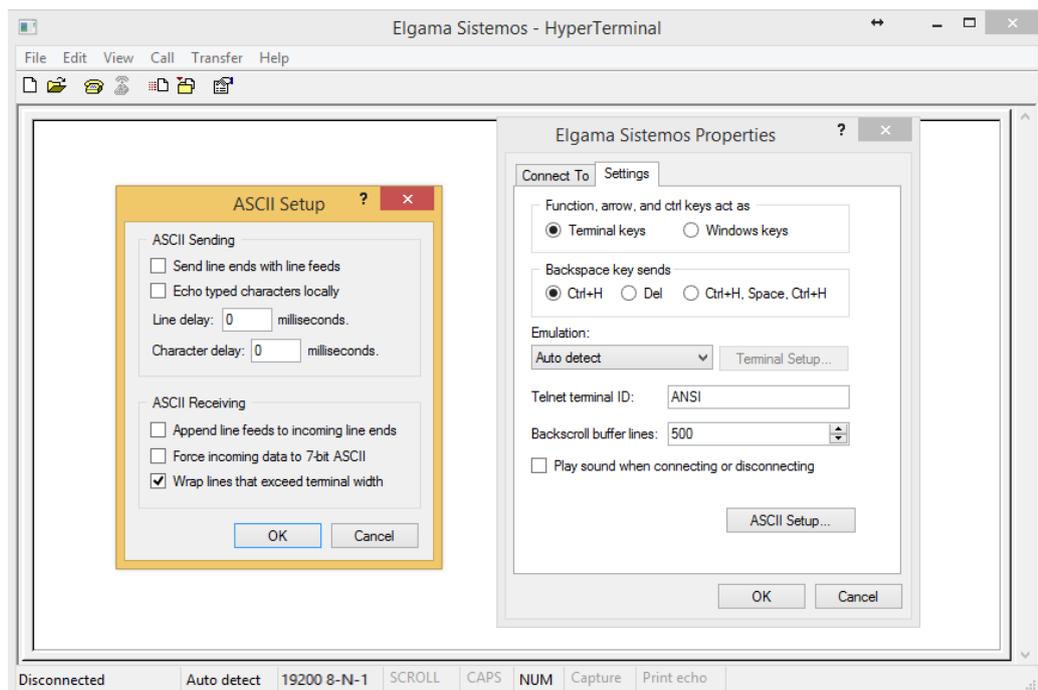
Figure 6.2-7

6. The settings should change to 19200 8-N-1 as shown on figure 6.2-8
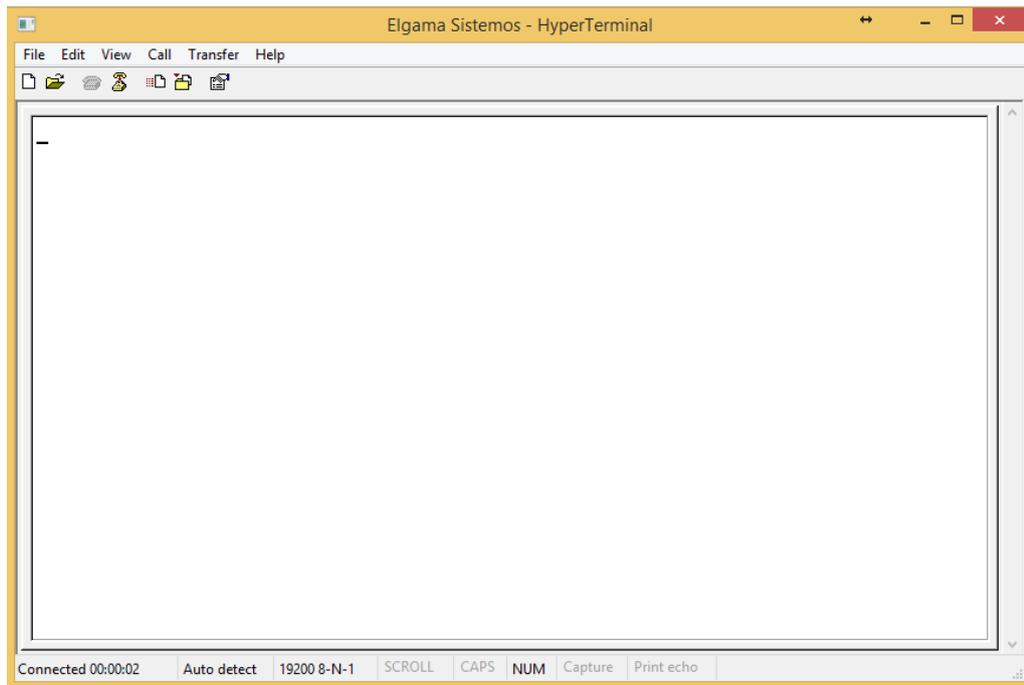
Figure 6.2-8

Important! To load or re-load controller's menu press button ESC (on keyboard) 3 times.

10. Parameterization

The entire MCL 5.10 menu hierarchy is described in an Annex A. "Controller menu and configuration settings". Main device functions are further described below.

Security

Controller parameterization menus are protected with dedicated passwords to prevent from unauthorised access and configuration.

Default Password

There are two user levels: **admin** and **user** where admin is superior.
Default admin password is "**admin**". Default **user** password is "**user**".

Each login has separate menus and control functions. If required, a different default passwords can be set automatically during the manufacturing process. Alternatively, default passwords can be changed manually or automatically.

APN

APN names and settings (GSM Provider/Network ID, DNS etc) for each APN are entered by administrator or imported via sms and can be accessed via configuration menu. Each separate APN has different numbers and IP address lists and every other APN can be configured manually.

Automatic Reboot

The device configuration allows to set an interval in minutes to enable automatic device reboot (restart) when idle, without having an engineer to interfere. The reboot command may also be sent manualy using SMS or parametrization menu.

CSD operation mode

The device has a list of phone numbers that can call to device. If call is made and the number is allowed, the device switches to the CSD mode. There is an option to allow all calling from any number. When the call is finished or the session is disconnected, the device returns to GPRS mode. More connection settings in the menu item **Wireless in configuration.**

2G/3G mode

The device can work select the 2G or the 3G mode automatically depending on the best quality or it can be done remotely in menu item **Provider settings, Provider network mode.**

Firmware update

The firmware can be set to be updated automatically or manually.

Automatic Firmware Update

If set to automatic, after restart controller will attempt automatic firmware download and update from the IP (IP of a FTP server) address indicated in the APN setting for a specific APN used.

Manual Firmware update

Depending on the client's end system configuration, controller modification and settings, controller can support manual firmware update via GSM/GPRS or via USB, RS485 by directly connecting the controller direct connection using a PC. The manufacturer's proprietary firmware update tool or alternative software can be used when required.

Byte w. timeout

Timeout value defined (it depends on baud rate) in miliseconds. Timeout is set after each received byte in frame. If timeout expires after the last received byte, the frame is adopted.
This parameter depends on the meter attached to the controller. Older meters takes time to answer to the queries, so the meters might pause between answer packets. For the new meters, this parameter should be 1 .. 5 ms, for older meters it is recommended to use 30 .. 200 ms.

Grant menu interface

The controller menu can be reached using several interfaces: Wireless, RS485, RS232, USB (depending on the modification). Each menu interface can be enabled (granted) or disabled. To enable interface for controller configuration, set the menu option for the interface value "Grant interface – false". For example, to disable RS485 menu interface, go to the RS485 out configuration and set the value "Grant menu interface" to false.

Event Log

Event Log Record Format

Each event log record will register the following information:

Date and time of the event (if known)
Type of the event
Subject identity and/or source of the event
Outcome of the event

Logging Events

Controller logs the following events:

- Failed authorization or authentication
- Requests or commands received
- Firmware update/information
- High number of malformed or unexpected messages and errors
- Power supply recovery events
- Unauthenticated communication

All events logs can be enabled/disabled if required. If event log is disabled, event alert is disabled as well.

11. Annex A. Controller menu and configuration settings

Important: Menu item availability depends on the user rights and device modification. User rights can be managed only from the **admin** account secured by the admin password.

Menu Item		Description	SMS command (smscfg:)
0. EXIT		Exit terminal mode	
1. Device configuration	0. RETURN	Back to the main menu	
	1. **Password/Keys**		
	0. RETURN		
	1. User password	Set user password	
	2. Admin password	Set admin password	
	3. User encryption key	User encryption key	
	4. Admin encryption key	Admin encryption key	
	2. **Messaging**		
	0. RETURN		
	1. AC Fault report address	Network address of web service processing alarm messages generated by meters	
	2. AC Fault fix timeout	Timeout	
	3. AC Fault message send retry	Times to retry sending the message	
	4. AC Fault message send timeout	Timeout period of acknowledgment reception of alarm message	
	5. Plug&Play server address	Plug & Play function alarm url address	
	6. Plug&Play message send retry	Times to retry sending the plug&play message	
	7. Plug&Play message send timeout	Message timeout	
	3. Menu language of [Public]	Menu language	
	4. Menu language of [User]	Menu language	
	5. Menu language of [Admin]	Menu language	
	6. Menu language of [SuperAdmin]	Menu language	
	7. Device reboot period	Reboot time value in minutes. If there are no queries coming via GPRS or CSD during specified time, controller will automatically reboot. After each GPRS or CSD query by reboot time is set to initial value	
	8. Time zone	Device time zone	
	9. Firmware update mode	Auto / Manual firmware download and update	
	10. Modbus slave ID	Modbus Slave ID	
	11. Run firmware update	Manually run firmware update	
	12. Notes	Notes about the device can be added here	
	13. Restore factory defaults	Restore system settings to factory defaults without loosing user data (provider settings, baud rate data is not affected)	
	14. Reboot	Restarts the controller immediately after pressing <Enter> key	

2. Wireless "in" configuration	0. RETURN	Back to the main menu	
	1. Request to proceed timeout	During the specified time the received request has to be send to a meter (through RS485/RS232 out), if it times out the request will be discarded	
	2. Byte w. timeout in X bytes	Timeout value defined in byte transfer time (it depends on baud rate) multiplied by this setting value. Timeout is set after each received byte in frame. If timeout expires after last received byte, the frame is accepted. This setting is for RS485 out interfaces	
	3. Idle timeout	Idle timeout period in seconds	
	4. Connection check period	Time after which the controller tries to communicate with GSM network to test conectivity	
	5. Signal indication level 1-2	LED signal level indication settings	
	6. Signal indication level 2-3	LED signal level indication settings	
	7. Enable time sync with provider	Enable time sync with provider	
	8. Minimum tolerated signal level	Tolerated signal level. If the signal level is weaker than the minimum level, the controller will change the connection to 2G	
	9. Grant menu interface	This option allows to enable or disable the menu through the interface specified	
3. RS232 IN configuration	0. RETURN	Back to the main menu	
	1. Request to proceed timeout	During the specified time the received request has to be send to a meter (through RS485/RS232 out), if it times out the request will be discarded	
	2. Data rate	RS232 IN baud rate configuration	
	3. Data bits	Define data bit quantity	
	4. Stop bits	Define stop bit	
	5. Parity	Define parity	
	6. Byte wait timeout	Timeout value defined in byte transfer time (it depends on baud rate) multiplied by this setting value. Timeout is set after each received byte in frame. If timeout expires after last received byte, the frame is accepted. This setting is for RS485 out interfaces	
	7. Answer wait timeout	Time for waiting data (answer) in RS485 out, after the request has been sent	
	8. Grant menu interface	This option allows to enable or disable the menu through the interface specified	
4. RS485 OUT configuration	0. RETURN	Back to the main menu	
	1. Request to proceed timeout	During the specified time the received request has to be send to a meter (through RS485/RS232 out), if it times out the request will be discarded	
	2. Data rate	RS485S out baud rate configuration	
	3. Data bits	Define data bit quantity	
	4. Stop bits	Define stop bit	
	5. Parity	Define parity	
	6. Byte wait timeout	Timeout value defined in byte transfer time (it depends on baud rate) multiplied by this setting value. Timeout is set after each received byte in frame. If timeout expires after last received byte, the frame is	

		accepted. This setting is for RS485 out interfaces	
	7. Answer wait timeout	Time for waiting data (answer) in RS485 out, after the request has been sent	
	8. Next request pause	Time for waiting for the next frame in RS485 out, after one frame has been received	
	9. Answer buffer size	Answer buffer size	
	10. Service answer delay	Service answer delay	
	11. Grant menu interface	This option allows to enable or disable the menu through the interface specified	
5. SIM card configuration	0. RETURN	Back to the main menu	
	1. PIN for SIM card	Enter SIM card PIN number	
	2. Change SIM pin	Change the pin code of the SIM card	
6. Provider settings	0. RETURN	Back to the main menu	
	1. **Provider identification**		
	0. RETURN	Back to the main menu	
	1. Provider Code	GSM Provider/Network ID	
	2. Provider Name	GSM Provider/Network name	
	2. **Provider FTP configuration**		
	0. Return		
	1. FTP server URL	FTP server address	
	2. FTP username	FTP login username for firmware download	
	3. FTP password	FTP login password for firmware download	
	3. **Provider GPRS configuration**		
	0. Return		
	1. User name	GPRS network username	
	2. Password	GPRS network password	
	3. APN	Access point name	
	4. TCP/IP listen port	TCP/IP port	
	5. Authentication protocol	Authentication protocol	
	6. DNS server	DNS server address	
	4. **Provider network mode**		
	0. Return		
	1. Network radio mode	Network mode: 2G or 3G	
12. Diagnostics	0. RETURN	Back to the main menu.	
	1. SIM card IP	The physical device address on the GPRS TCP / IP network = Device SIM card IP address (if the card has a static IP address)	
	2. Active provider	Indicates which Provider's (1….6) SIM card is present	
	3. Signal quality	GSM signal quality	
	4. IMEI	IMEI is displayed only when SIM card is present	

	5. GSM registration status	GSM registration status	
	6. Modem GPRS status	Modem GPRS status	
	7. Network mode	Network mode	
	8. SIM Status	Status of the SIM card	
	9. Battery voltage	Battery voltage	
	10. Battery charging	Battery charging	
	11. Start battery test	Start battery test	
	12. Battery test status	Battery test status	
	13. Read log	Read log	

Table A-1. MCL 5.10 menu item values

12. Annex B. Manufacturer's Guarantee

The manufacturer guarantees that materials used in controller manufacturing process, its parts and assembly are of a good quality. During the guarantee period, manufacturer ensures uninterrupted performance of the device only if it was installed and serviced by the authorized manufacturer's representative or licenced engineer if they are strictly following the installation and configuration procedures described in the manual. Firmware updates and patches will be provided for agreed years after signing acceptance certificate.

In case of a power cut, manufacturer ensures, that AMR (Automatic Meter Reading) system equipment will not have any influence on the electricity meter's data. MCL 5.10 system will restart automatically and will start operating as normal as soon as the voltage is restored.

The manufacturer has no obligation to service under the guarantee and provide free service in the following cases:

- If communication lines were cut off or were shortened, if they were connected to telephone lines or any other lines or wires that do not belong to the relevant AMR system;
- If the producer of the system was not informed about the change of structure or AMR scheme, the change of electricity meters, their installation spot or parameterization data. Consent for structure or AMR scheme change has to be given. The manufacturer has no obligation for guarantee and to provide free service if any damage to the AMR system is produced.
- If the informational stickers and seals, attached to its containing parts or case, were broken.