Controller with an internal NB-IoT module

MCL 5.10 NB

User manual

Version 1.0

NAVITUS LT
Lithuania 2023

Document revision history

Version	Date	Revision history	Controller Firmware version
1.0	2023-02-21	First Issue	4.1

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.

Table of Contents

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
DI	Digital Input

2. Safety Instructions

	Please ensure you read and understand the installation instructions entirely before attempting to install and configure MCL 5.10 NB.
	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 controller MCL 5.10 NB. 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).
	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

The MCL 5.10 NB controller (hereinafter referred to as the Controller) is used for automated data collection after DI trigger occurs because of short or dry connection when very low energy consumption is required, or when the device operates from a battery or data must be sent from places characterized by poor communication conditions (underground car parks, wells, basements, thick reinforced concrete structures). Device sends information about the change of contact status (any of or all digtal input) in less than 30 seconds. The controller does not require access to global internet and sends the data to a remote server via MQTT.
NarrowBand (NB-IoT) Internet of Things technology is used for data transmission to remote centers.
The body of the controller is made of non-electrical material and ensures that there is no possibility to touch the internal components and parts of the controller during the installation or operation of the controller.
Attention! The functionality listed below depends on controller modification and additional customer requirements, so not all functions may be implemented in a specific product.

Connection to data center and NarrowBand-IoT technology

The controller supports two-way communication for data exchange (data reading and configuration) with the server (with some communication latency which depends on technology and provider). The controller can act both as a server (allow connection for data reading and configuration) and as a client (initiate connection, send data).
Due to the special NarrowBand-IoT technology of the modem, the controller is designed to work in difficult communication conditions with many communication disturbances.

Working from batteries and low power sleep mode

The controller conserves internal battery energy by being active only when it needs to send a message or receive requests from the data center. After sending the message, the controller switches to sleep mode and reduces power consumption to a minimum. The controller can be configured to sleep from an hour to a month* after the last message was sent (the default value is to wake up once per 24 hour). After the specified period, the controller wakes up by itself and sends a new message. Controllers battery is freely available on the EU market from several suppliers.

*recommended times vary and are coordinated with the operator

Digital input trigger

• For **digital input trigger monitoring**, the controller uses "dry" 0 (low signal) and 3-5V (high signal) 1 kHz control interfaces. The alarm generated from the DI chanel is stored in the controller's long-term non-volatile flash memory and sent to the remote server after it happens.

Mounting and power supply

Depending on the modification, the controller can have a housing with a dust and water resistance certificate to IP67 for work in rooms where there may be condensation, moisture or running water (for limited period of time). External mounting lugs are intended for mounting the controller on the wall.
The controller is powered by an internal battery.
Attention! The controller's battery capacity and battery life depend on the controller's intended use.

Firmware and settings update

The controller firmware can be updated locally (via USB) and remotely (using NB-IoT communication). Aditionally, multiple controllers can be configured (configuration involve managing controllers' parameters, reading values, firmware updates) using the software provided. Parameters are stored in the controller's non-volatile memory. 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.

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".

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.

4. Principal Components of the controller MCL 5.10 NB

The main controller components are listed below:

a) Communication interfaces - one or several - are selected according to the modification table. The purpose and parameters of the interfaces are specified in table;
b) Replacable internal battery working without external power source;
c) Mini-SIM (2FF) card holder.
d) SMA type connector for antenna. An external magnetic, insulated surface antenna with a 2 ... 5 m long cable is ordered together with the controller. The antenna can be from 3 dBi directional gain. The length and gain of the antenna cable is selected according to project decisions.
e) Integrated NB-IoT modem.

NarrowBand Modem	
4G LTE Cat NB2 Bands*	B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/B19/B20/B25/B28/B66/B70/B85
4G Class of power transmission	Power Class 3 (23 dBm)
4G Data Rate	Single-tone: Up to 25.5 Kb/s DL Up to 16.7 Kb/s UL Multi-tone: Up to 127 kb/s DL Up to 158.5 kb/s UL
Antenna Connector type	SMA (50 Ohm)

Additional Modem information	
Modem and TAC code	BC660K-GL
Power Supply	Supply voltage: 2.2V-4.3V Typical supply voltage: 3.3V
Transmitting Power	23dBm ±2 dB

Table 3-2. Additional modem characteristics

5. Technical Characteristics

Power consumption average in duty mode:	~150 uA sleep, ~60 mA communication
Internal battery (when no external power source is used)	Battery 3.6V Li-SOCl2, type D, 19Ah x 2pcs.
DI specifications	Dry contact, 0 – 3/5V Max resistor 1000 omh Max frequency 1* kHz
DI interfaces	4
Work temperature range, °C	-20 ... +50
Storage temperature range, °C	-40 ... +70 (without battery)
Operating time	5 years+ (once per day communication)
Relative humidity, %	0 ... 100% depending on modification
Local configuration	USB B socket
Dimensions, mm	227x118.5x55 mm**
Plastic Materials, safety of flammability	ABS
IP class	IP67
RoHS	Compliant
CE	Compliant (CE Mark on the Enclosure)
2014/53/EU directive	Compliant
Antenna	SMA

Table 4-1. MCL 5.10 NB controller technical characteristics

* The recommended signal frequency is adjusted depending on the specific project.
** Dimensions depend on body requirements and battery capacity
*** Weight depends on body requirements and battery capacity

6. Configuration

Main device functions are further described below. Device settings are stored in non-volatile flash memory. Configuration can be done locally (USB) or remotelly (via NB-IoT).

Security

Controller parameterization menus are protected with dedicated passwords to prevent from unauthorised access and configuration. All communication between the device and server can be encrypted.

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.

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 by directly connecting the controller direct connection using a PC. The manufacturer's proprietary firmware update tool or alternative software can be used in Latvenergo internal servers.

Grant menu interface

The controller menu can be reached using several interfaces: Wireless, 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".

MESSAGE

The controllers message is made of DI trigger channel, battery voltage and modem signal quality. Communication protocol can be chosen. The default is MQTT (client) protocol. Other communication protocols can be implemented upon request

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.

Annex B. Manufacturer's Guarantee

The manufacturer guarantees that materials used in controller manufacturing process, its parts and assembly are of a good quality. UAB NAVITUS LT (manufacturer) gives **24** months warranty service including free shipping of broken IoT modems and immediate registration of issues according to Latvian working time. 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. During guarantee period for defected IoT modems manufacturer ensures that repair time won't exceed proposed 1. order delivery time (including transportation). 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 NB 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.