Telemetry Module
MT-713

CE 1471

User Manual

MT-713

inVentia

telemetria.pl
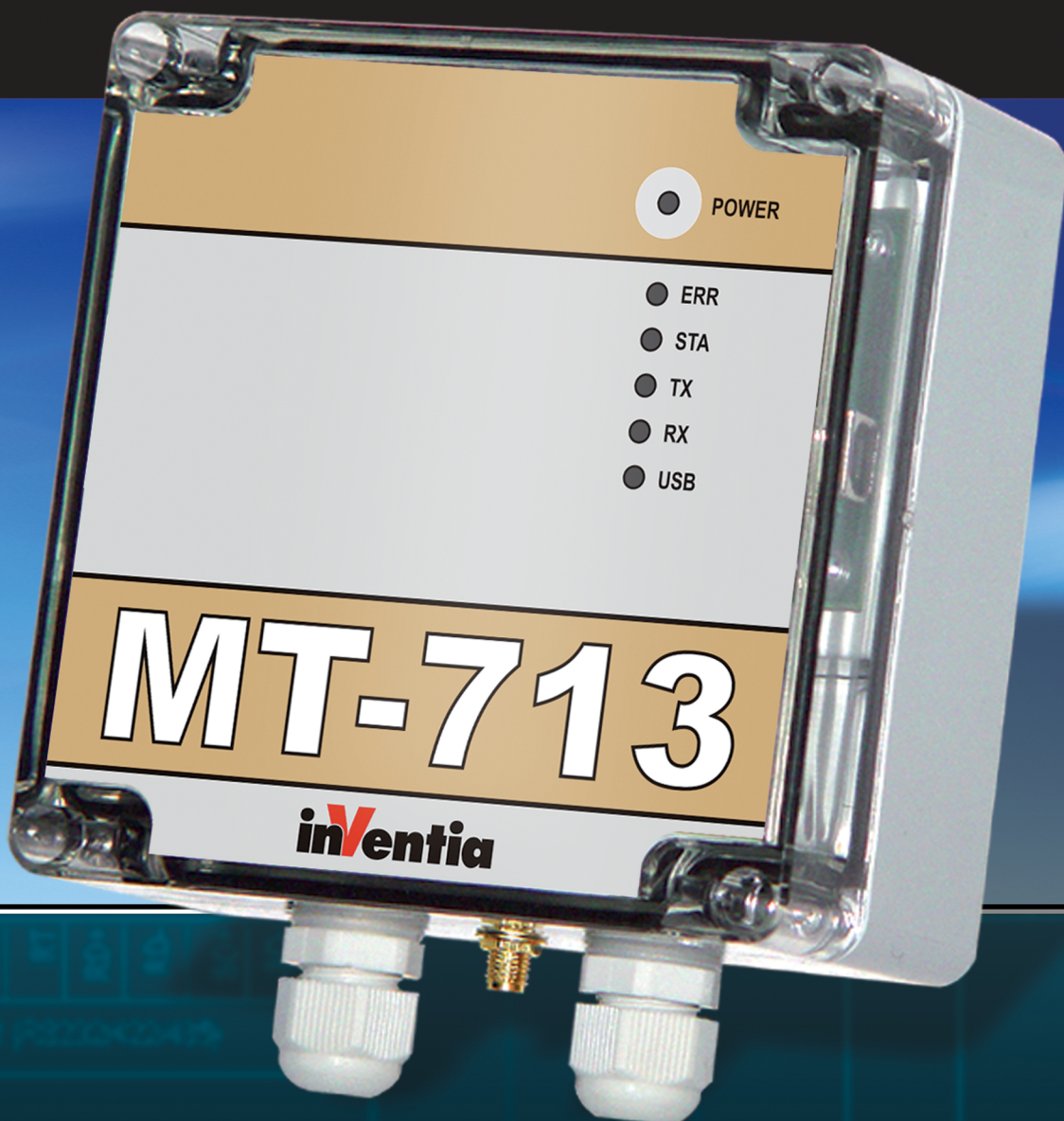
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Telemetry Module
MT-713
User Manual

GSM/GPRS Telemetry Module
for monitoring and control

Class 1 Telecommunications Terminal
Equipment for GSM 850/900/1800/1900

MT-713

INVENTIA Sp. z o.o

MT-713

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1. Module's destination

MT-713 Module is a specialized telemetry module optimized for application in simple measurement and alarming systems where power lines are unavailable.

Compact design, low power consumption from internal battery, continuous pulse counting on binary inputs, local logging of measurement results and spontaneous information sending upon predefined events makes the module ideal choice for applications requiring periodical supervision of parameters and long time operation on own battery supply. The module is delivered in two battery size versions (**MT-713 -** standard and **MT-713HC** - double capacity battery).

The typical application areas are water-sewerage, especially water flow measuring using potential-free contact meter and monitoring of water level in wells and vessels.

For better acquaintance with the module and optimizing the power consumption we recommend reading configuration guide and application examples in appendices.

2. How to use the manual

The manual was written for beginners as well as for advanced telemetry users. Each user will find useful information about:

Module's design - this chapter presents the basic information about module's resources and design elements. Her is the information about how does the module work and how and where it may be employed.

Module's connection diagrams - contains diagrams and procedures for connecting MT-713 with devices and external elements like sensors, antennas or the SIM card.

First start of the module - contains recommended first start procedure.

Configuration - this chapter presents information about all available configuration parameters. All parameters concern firmware version compliant with documentation version.

Problem solving - here all procedures for battery replacement and unblocking the SIM card along with LED indicators signaling.

Technical parameters - a revue of technical parameters and technical drawings.

Safety information - information concerning conditions of secure use of the module.

Appendices - contain a register of changes in consecutive firmware versions, syntax of SMS messages and the memory map of the module, necessary for proper configuration of MTDataProvider and data collecting equipment.

3. GSM requirements

For proper operation of the module a SIM card provided by a GSM operator with GPRS and/or SMS option enabled is essential.

The sim card has to be registered in the APN with static IP addressing. Assigned to SIM unique IP address will become a unique identifier of the module within the APN, enabling the communication with other units in the structure.

A paramount condition for operation is securing the adequate GSM signal level in the place where module's antenna is placed. Using the module in places where there is no adequate signal level may cause breaks in transmission and thereby data loss along with generating excessive transmission costs.

4. Module's design

4.1. Module's topography
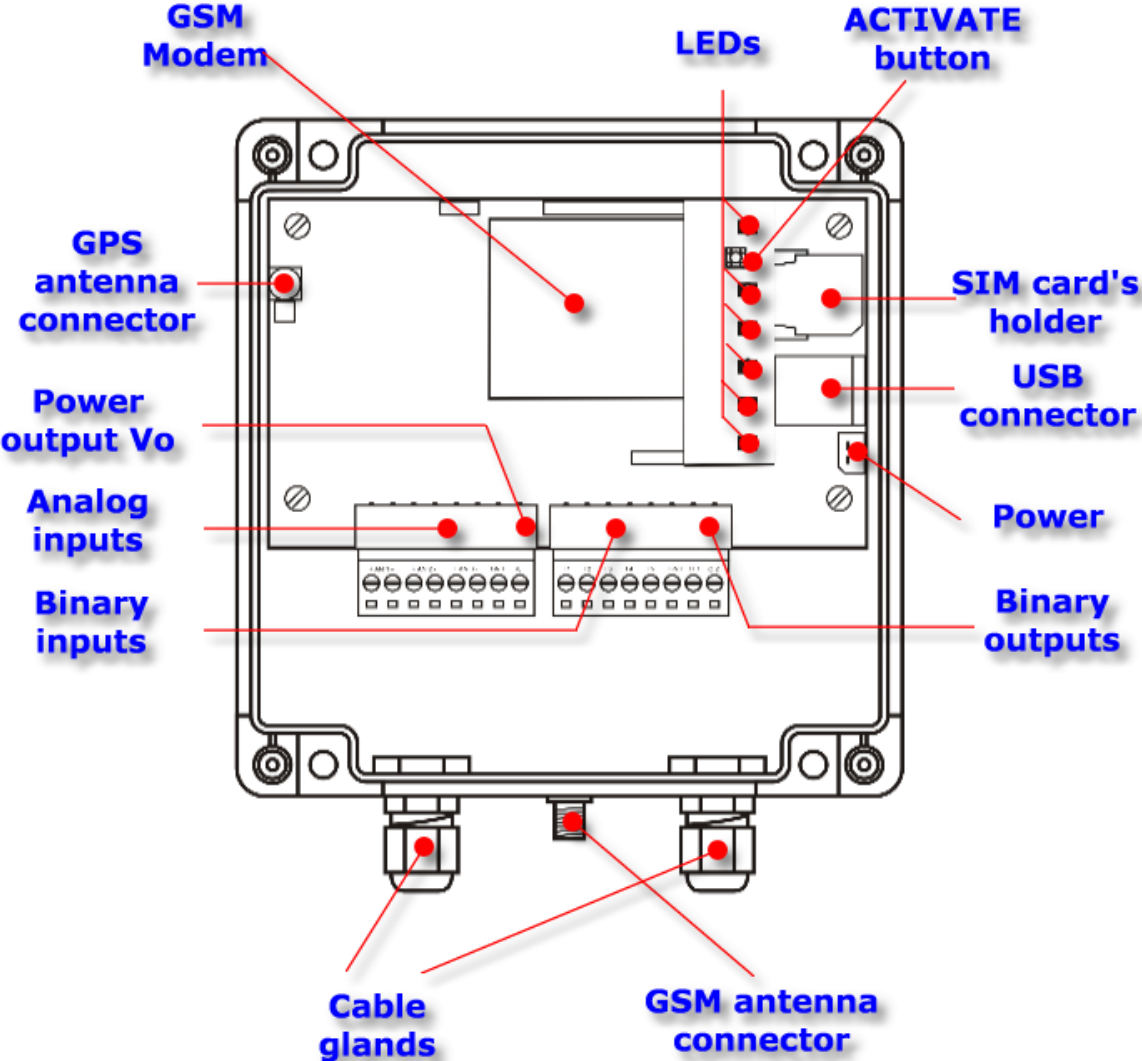
4.2. Resources

Hardware Resources of **MT-713:**

DI - binary inputs	5	binary inputs, pulse or potential free (the function is selected during configuration)
	1	enclosure opening sensor
AI - analog inputs	2	0-5 V, with possibility of supplying power to the measuring circuit
DO – binary outputs	3	NMOS type outputs ("open drain") 0...+30 VDC, mono- or bistable (the function is selected during configuration)
Temperature sensor	1	temperature sensor built in the microprocessor
Vibration sensor (binary input I5) (optional)	1	binary input I5 can be used for connecting vibration sensor (switch) with normally open contact (e.g. CM 4400-1)
GPS Module (optional)	1	for calculating geographical position and time synchronization
Temperature and humidity sensor (optional)	1	precise sensor of temperature and humidity inside the enclosure
communication interface RS-232, 485, M-BUS (optional)	1	in developing stage
LCD display with keyboard (optional)	1	in developing stage

4.2.1. Binary inputs

MT-713 module is equipped with 5 binary inputs (**DI**) marked as **I1...I5**.

**Binary inputs
I1...I5**
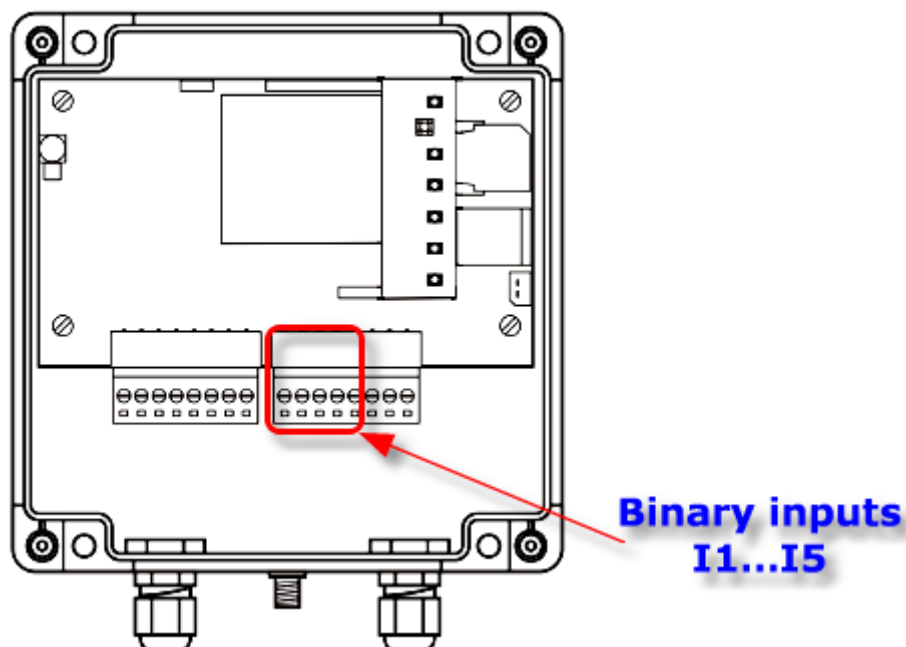
Inputs **I1...I5** are designed to cooperate with potential free contacts (contacts connecting the input and common for all inputs ground). The inputs operate in **Negative logic**, meaning the input is high when connected to ground and low if the circuit is open. This

solution allows energy saving, a crucial ability for battery driven devices. The contacts are polarized with potential of 3V in low state. Binary inputs **are not isolated.**

Each binary input, independently of other inputs configuration may operate as:
- Binary input - change of input's state after considering filtration coefficient results in change of bit assigned to it in memory (see the memory map). The bit's state change may be used to trigger data transmission, sms, analog signal measurement and other actions.
- Pulse input - allows calculating the flow based on counted flow-meter pulses. Aberrations may be filtered by setting signal's max. frequency, assuming the signal fill is 50%, (global setting) and max. pulse duration (individual for each input). The flow may be defined in engineering units per minute or hour. Each flow has assigned 4 alarm bits that may be used for event triggering.

   NOTICE! In this mode bits assigned to inputs (I1...I5) do not change the state and cannot be used to trigger events except for counting inputs for counters CNT1...CNT5.

In addition binary input I5 is prepared to operate as input of signal from vibration sensor with normally open contacts (e.g. CM 4400-1). Additional parameters are gathered in Vibration sensor (optional)

Independently of selected operating mode states of binary inputs are monitored by the module both in sleep mode and in wake mode.

4.2.2. Binary outputs

MT-713 module is equipped with 2 binary outputs (**DO**) marked as **Q1** and **Q2**.
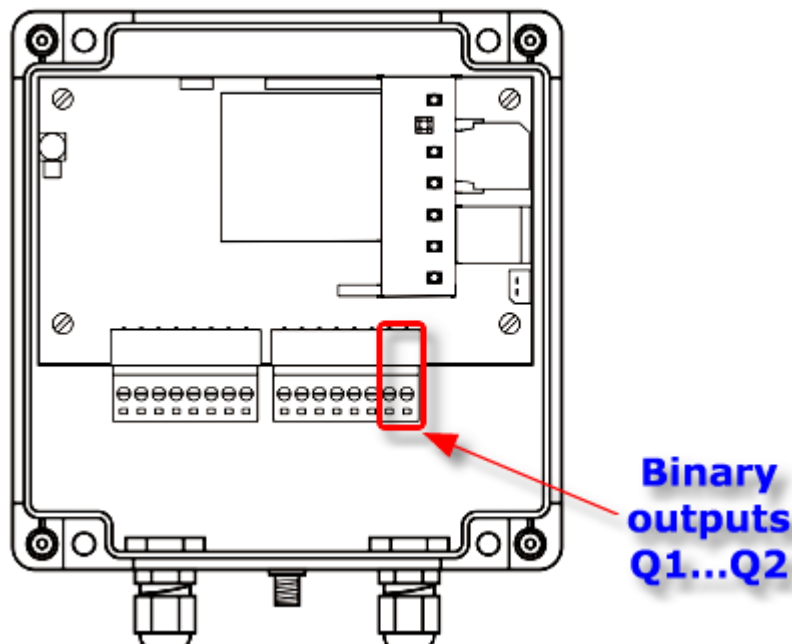
The outputs are designed to control loads powered by internal source (e.g. light signaling). The outputs are of "open drain" type controlled by NMOS transistors.
In High state the output is shorted to the ground by active NMOS transistor. In case of inductive type load connected (a relay) the circuit limiting voltage peaks to max. +30V is necessary.

Each binary output may be controlled remotely (SMS, GPRS) or locally. This means that the state may be altered by any device's bit change (e.g. analog input alert) [defined in output configuration](#).

The outputs may operate as mono- or bistable outputs. The operating mode as well as length of the pulse in monostable mode is individually defined for each output.

4.2.3. Analog inputs

MT-713 module is equipped with 3 voltage analog inputs (**AI**) marked **AN1**...**AN3**.
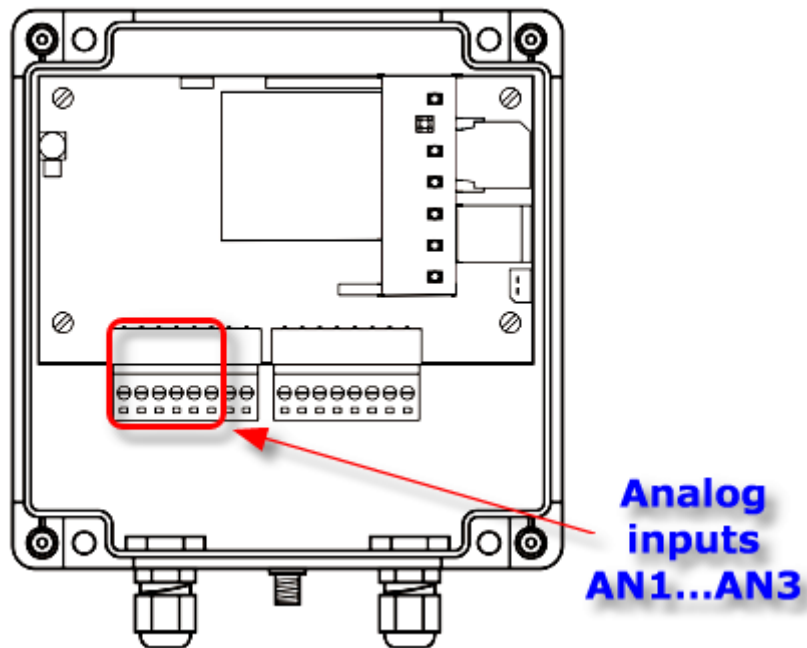
The inputs are designed to work with analog sensors generating signal in **0...5V** range. In order to minimize energy consumption the A/C converters are powered for the period necessary to conduct secure measurement.

The analog inputs are not isolated but due to floating, battery powering it does not influence modules resistance to disturbances.

The module measures values on all inputs simultaneously. Measurements may be triggered by any device bit (e.g. clock or binary input).

The result integration time for analog inputs is app. 0,5 sec. and minimum measure interval is 1 sec.

4.2.4. Power output Vo (analog sensors supply)

MT-713 module is equipped with the keyed power output Vo, which is destined to power sensors connected to analog inputs.

Power output and ground
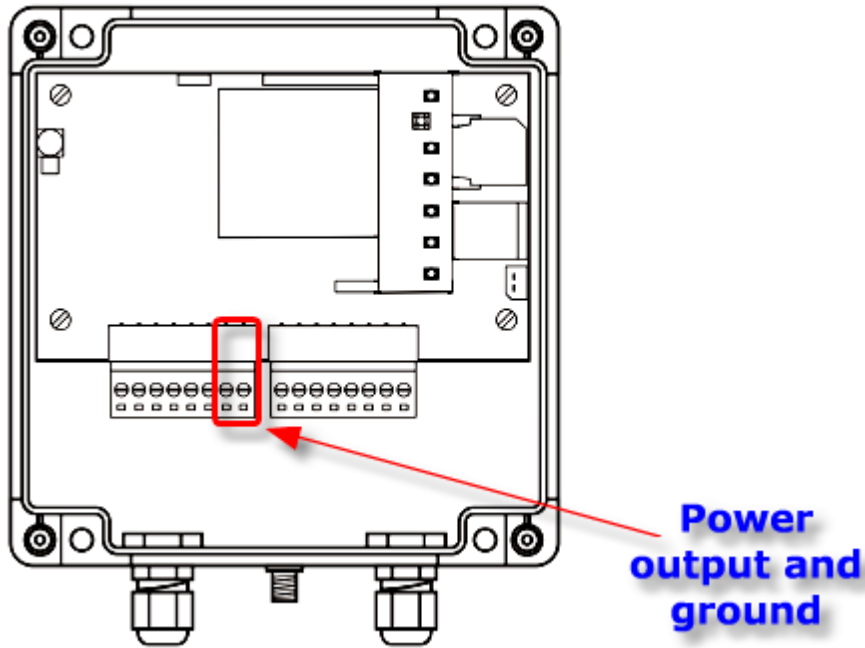
This output allows user to power sensors with voltage ranging from **0** to **5VDC** with step **0.1V**. Voltage is specified by the user parameter configuration.

In order to lower power consumption of the device, output is switched on only for the time necessary for the measurement. The delay between switching the input on and the measurement (and therefore turning off of output Vo) is configurable.

4.2.5. Enclosure opening sensor

Enclosure opening sensor detects opening of enclosure thus allowing gathering of information about maintenance work (battery replacement) and unauthorized access.

Enclosure opening sensor
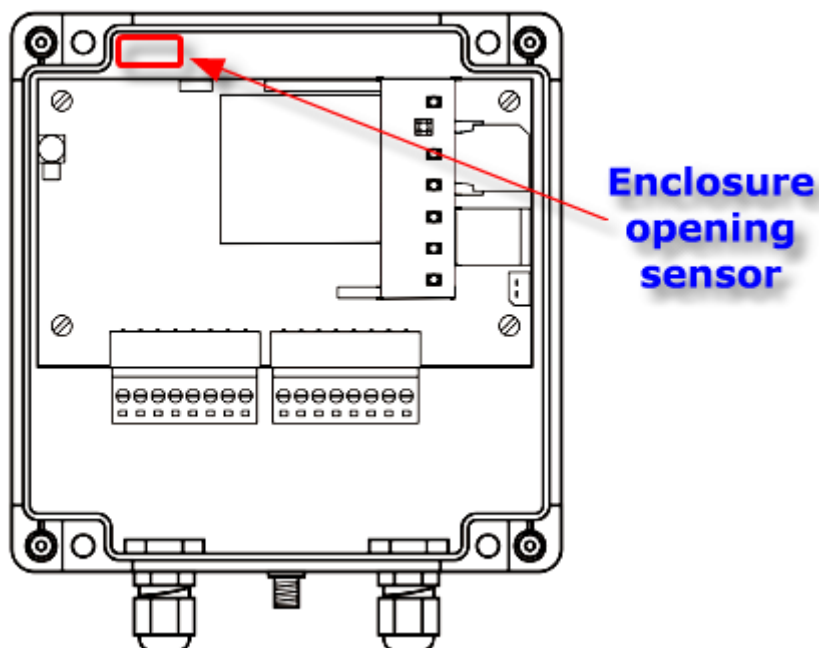
The information about enclosure opening is represented by the **OPEN** bit. This bit changes it's state to high 0.1 second after enclosure opening and shifts to low state 60 seconds after closing the enclosure. The 60 second delay prevents false alarms caused by multiple activations of the sensor during closing of the enclosure.

4.2.6. Temperature sensor

Integrated in the modem temperature sensor measures the temperature inside the enclosure and - after configuration- sends alerts about too high respective too low temperature.
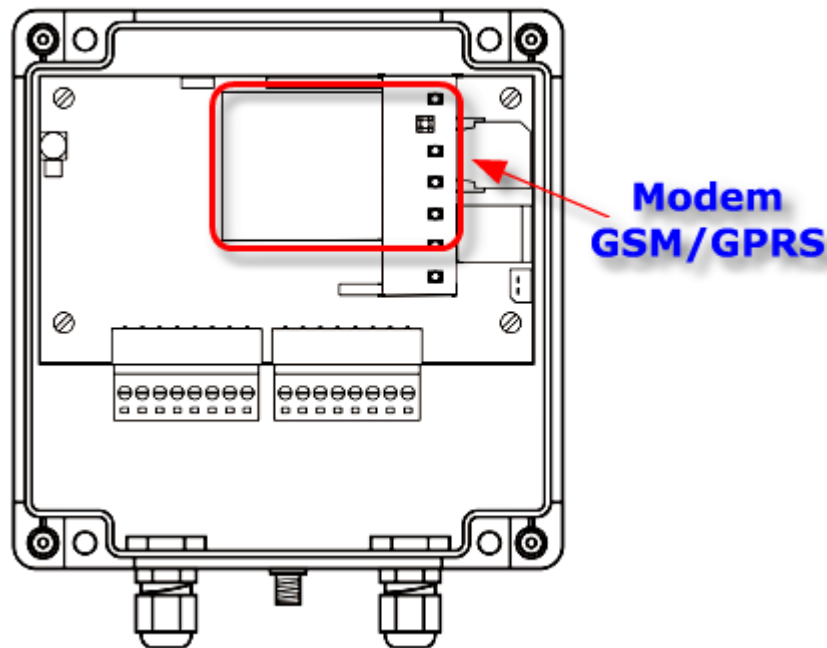
Employing the sensor allows detection of operating on the border of Allowed operating temperature.
Operating in conditions close to dew point may be dangerous for electronic circuits. Therefore it is recommended to use optional sensor for humidity and temperature.

4.2.7. Vibration sensor (optional)

Binary input I5 is prepared to operate as signal input from external vibration sensor (switch) with normally open contact (e.g. CM 4400-1). This sensor can be used for detection of module movement. This allows user to perform measurements of module's positions only when the device moves thus reducing power consumption.
Vibration sensor should be connected to binary input I5 according to connection diagram of binary inputs.

4.2.8. Real Time Clock

MT-713 module is equipped with Real Time Clock (**RTC**). This clock is a source for time measurement for the module's timers and time stamping of measurements stored in the Logger. The data transmitted by GPRS and data recorded in the logger are stamped with **UTC** time without taking the time zone into consideration. The timer used by SMS services and Timers respects the time zone settings.

Real Time Clock may be synchronized with :
- Network operator time (the service provided by some GSM operators),
- automatically with the **MTSpooler** (at every reporting to the server. Previous assignment of Spooler's IP),
- manually, using the **MTManager** (the clock synchronizing is described in the program documentation),
- automatically with **GPS** localization- available in modules with installed GPS receiver.

It is recommended to manually synchronize module's real time clock during the first configuration performed using the **MTManager** program.

<div style="border: 1px solid black; background-color: #ffffcc; text-align: center; color: red; font-weight: bold;">

NOTICE!!!
The clock setting has to be repeated if the module is disconnected from power source for more than 10 minutes.

</div>

4.2.9. Timers

MT-713 module is equipped with 8 general purpose programmable synchronous timers. Their function is counting constant user defined time intervals in range of 1 min to 24 hours. The user may appoint month and week days when the timer is active.

The timer may be used to trigger periodical events like measuring analog values, flow, data transmission, logger recordings and other functions.

4.2.10. Counters

MT-713 is equipped with 8 general purpose counters. Their duty is to count pulses understood as binary signal changes of any bit present in the memory map. Each counter has one incrementing and one decrementing input and assigned 32-bit register holding the difference of counted pulses.
Initial state of the counters may be defined by user activating MTManager2.0 menu item **Initial settings** (more info in **MTManager2.0** manual).

Counters may be used for e.g. flow meter's pulse counting, counting of enclosure openings, GPRS logins and many others.

4.2.11. Logger

MT-713 module has a programmable Logger that may hold up to 10240 data records. This equals either 24 hours measurements taken every 10 seconds or 1 month measurements taken with 5 minutes intervals.
The logger logs asynchronous data, meaning that the record writing is triggered by an event (defined by user in the Event table). The event may be e.g.: analog value measuring completion, counting the time by the timer, login to GPRS, crossing one of defined alarm thresholds and other. The logger records **all of the events defined in the table**. The user has an opportunity to define which ones have to be transmitted.
The records are the copy of all module's registers. Each record in the logger has a time stamp of the module's internal Real Time Clock (RTC) .
The data written in the logger is transmitted to IP address assigned during configuration. Sending of the logger content is triggered by user defined events. Confirmation of reception marks records as sent. In case of overflowing the oldest records are overwritten.

4.2.12. GPS (optional)

MT-713 module may be equipped with a GPS receiver. This allows defining the exact geographical position of the module. This feature may be employed to identify units in a mass deployment or to define actual position of the mobile measuring point. It is possible to use a GPS receiver to report movements of the module.

4.3. USB

Inside the enclosure of **MT-713** there is a **USB** socket used for local configuration by **MTManager** program.
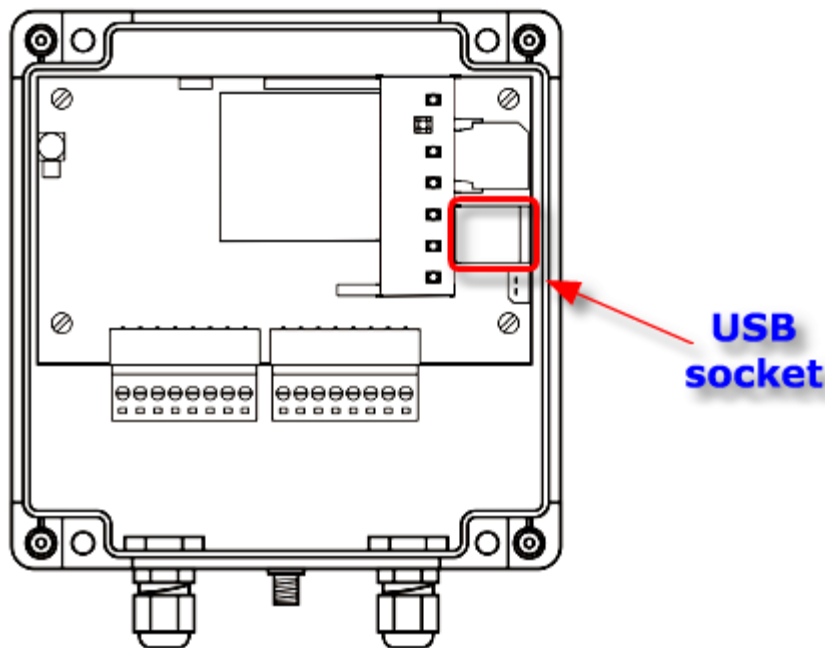
During USB connection between the module and the computer, the module is powered via USB port. Thanks to that the module does not consume precious battery power during configuration and tests. During USB connection the register holding data of battery voltage is **frozen on the last recorded value** (at first configuration the value is 0).

For **USB** connection a standard cable of type AB is used. See depicted plugs of the cable below.

The proper USB connection is signaled by the **POWER LED**. (the module is powered by USB) and the **USB LED.** (USB port ready for transmission). Data transmission is signaled by shot flashes of USB LED.
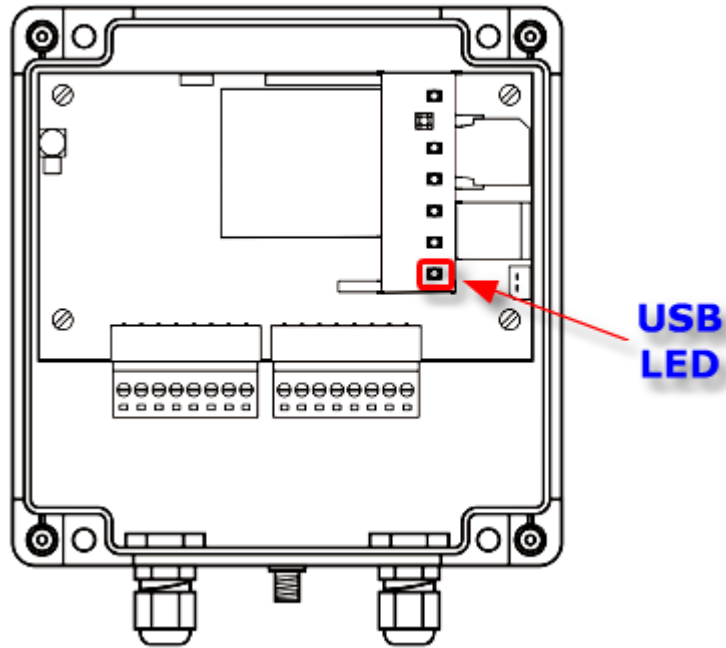
Detailed information on using the **USB** port for module configuration is to be found in the **MTManager2.0**. program manual.

4.4. SIM card's holder

MT-713 module is equipped with a holder for miniature **SIM** card for GSM modem. The holder is placed horizontally on the PCB inside the enclosure.
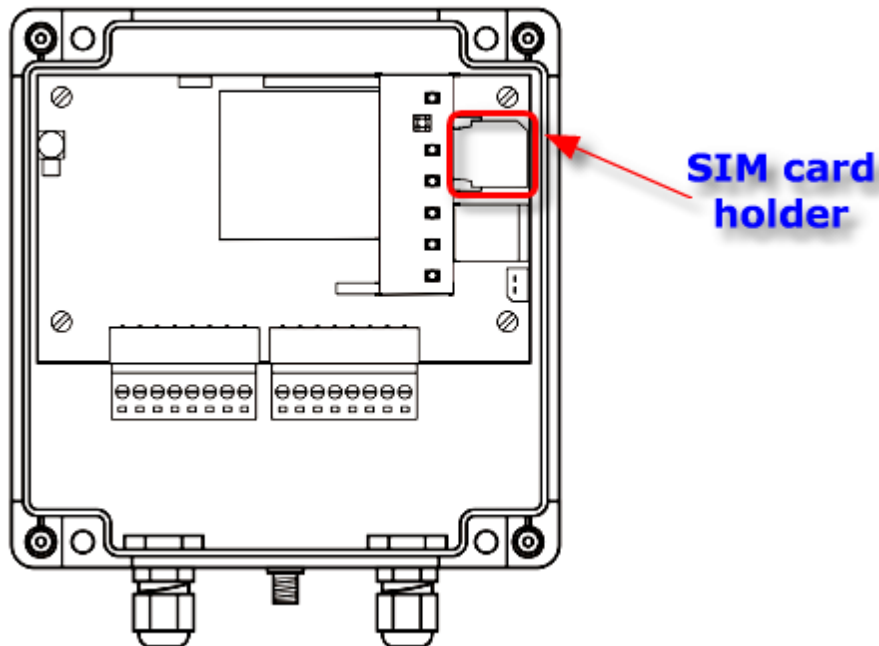
Proper insertion of the **SIM** card is essential for module's operation in GSM network. The module accepts only **SIM** cards in **3,3V** low voltage technology.

4.5. Power supply

MT-713 module may be powered **exclusively** from battery the pack with nominal voltage 4,5VDC. The battery pack is placed in the cradle below the PCB and connects to the module by a special plug. The plug and the socket are asymmetrical thus preventing reverse polarization. This way secures easy and safe battery replacement.

**Battery connector
(power supply socket)**
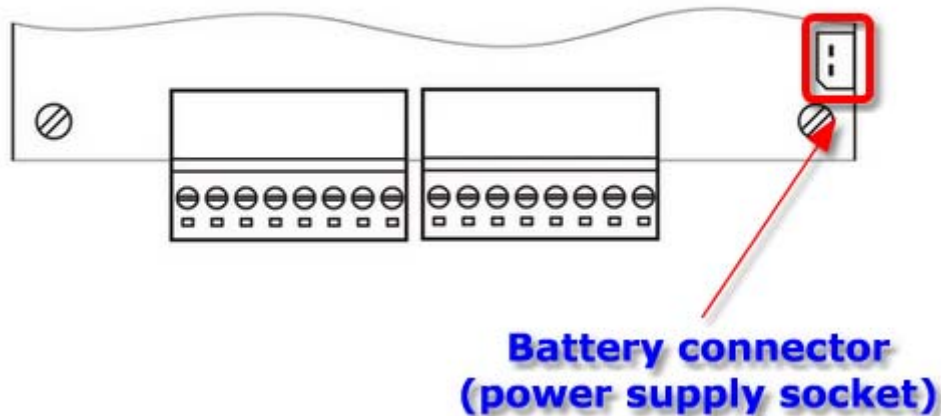
The module in standard edition is powered by 3 industrial standard serially connected alkali R20 batteries. The nominal capacity of the battery pack is 16Ah allowing up to **5 years** of operation (depending on usage pattern). Factory connected batteries eliminate the problem of contact oxidation during the long time of operation. We recommend replacing the batteries with same type or the type with similar parameters.

The module is also available in HC version with **double capacity battery** (32Ah) in order to prolong the operation on one battery pack. The module is delivered in extended cabinet with 6 R20 alkali batteries securing longer operation time even with frequent measurements.

Third version with R20 Lithium batteries with nominal voltage of 3,6VDC and 39Ah capacity in standard housing and with 78Ah capacity in extended housing is also available. Max. operating time for lithium batteries powered modules is up to **10 years**. More information about available power supplies may be obtained by contacting the module supplier or directly with Inventia.

During local configuration via USB connection the module is powered from the computer. The external supply is indicated by **POWER** LED (details are to be found in *LED* sub-chapter of Problem solving chapter). The module powered from USB is in the state of high energy consumption.

4.6. LED indicators

LED indicators placed on **MT-713** module's PCB are a great help during modules startup.
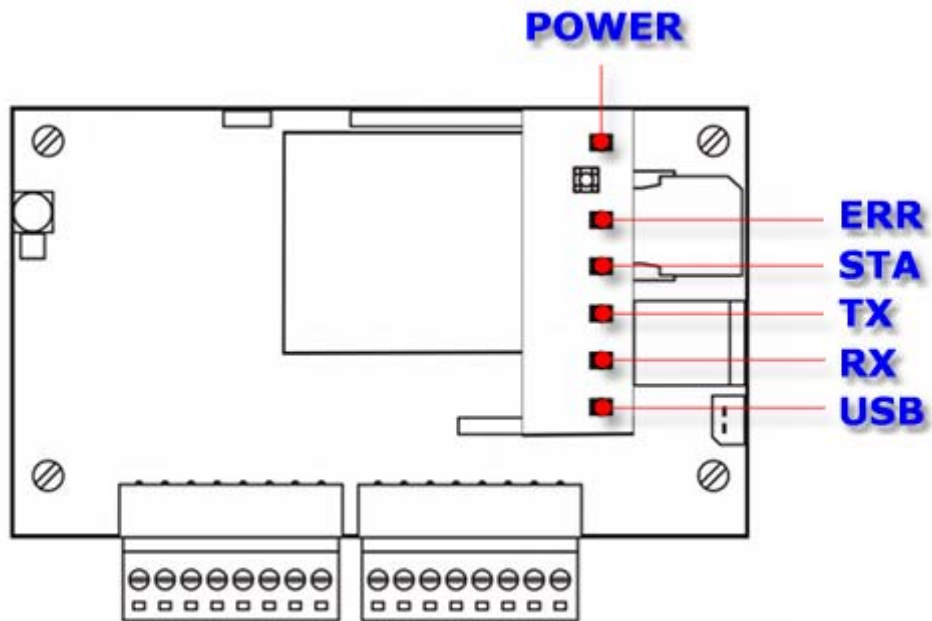
The LED's have assigned following significance:

- **POWER** LED indicates module's activity and mode
- **ERR** LED indicates an error
- **STA** LED indicates GSM status
- **TX** LED indicates GSM data transmission
- **RX** LED indicates GSM data reception
- **USB** LED indicates USB communication on USB port

Detailed description can be found in *LED sub-chapter of Problem solving chapter*.

4.7. ACTIVATE button
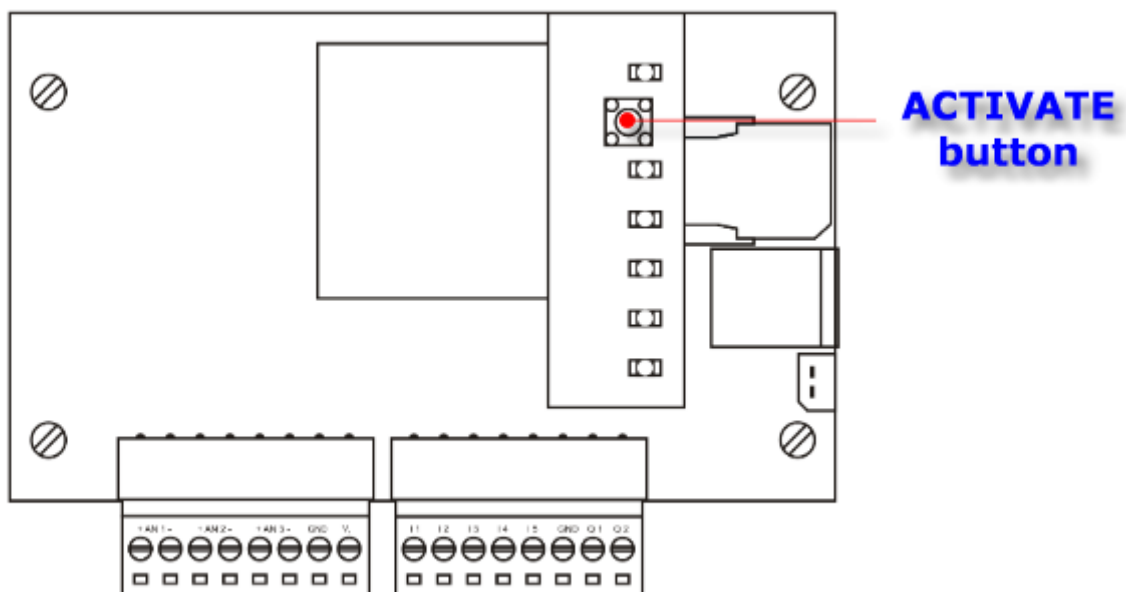
ACTIVATE button placed on PCB plays different roles depending on activation time:

- 0-2s - the **KEY P** bit is set High and can be used for triggering events/measurements during system tests.
- 2-8s - the module enters into **battery replacement mode** and does not send events neither measurements nor GPS position. In this mode the module can operate without the battery for 10 minutes. Leaving battery replacement mode occurs after connecting the new battery or after pressing the **ACTIVATE** button for 2 to 8 seconds, or closing the enclosure lid. Entering battery replacement mode is signaled by 2 flashes of POWER LED (more details are to be found in _LED sub-chapter of Problem solving chapter_).

4.8. GSM antenna

Connecting the antenna is necessary for reliable data transmission from **MT-713** module. **SMA** type antenna socket is placed on module's front wall.
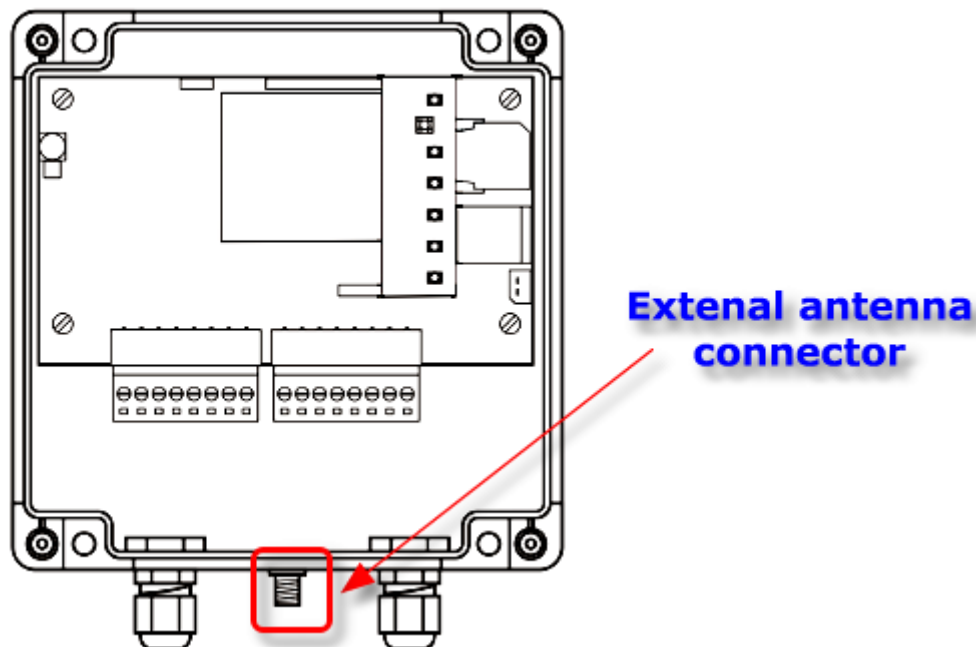
Depending on local signal propagation and user's needs different antenna types may be used. Proper antenna placement is important during the module installation. In case of low GSM signal level using the directional antenna with high gain.

Where GSM signal is good internal antenna may be used. In that case the antenna socket shall be moved to inside the enclosure to the hole in module's metal frame. The empty hole in the enclosure should be sealed.

4.9. Condensation sensor

On the modules circuit board module condensation sensor is implemented. If water is condensing on the MT-713 PCB, this sensor sets DEW alarm bit.

4.10. Enclosure

Enclosure of **MT-713** module is manufactured by FIBOX of high quality plastic securing sufficient environmental protection (**IP67**) for the electronics even in harsh environment. The catalog number is PCT121207. All enclosure data, including the parameters of used Material, are available at manufacturer's web page www.fibox.com. The **IP68** version of enclosure is available upon request.
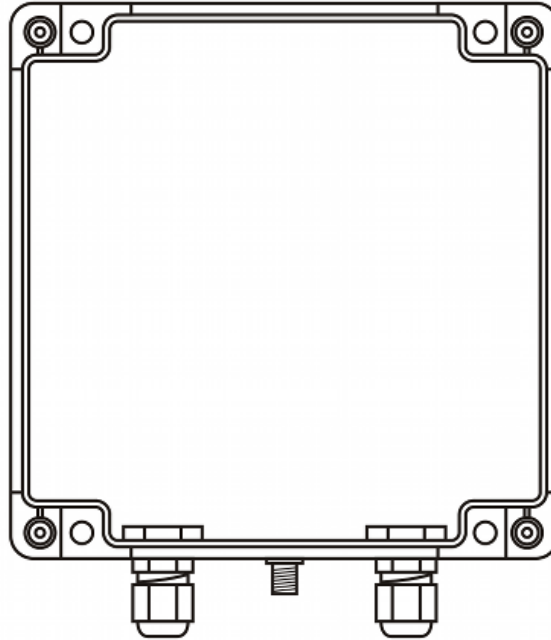
Bear in mind that protection grade is highly dependent on proper lid assembly and sealing cable glands. Improperly closed (leaking) cabinet leaves the electronics and the battery unprotected.

5. Connection diagrams

This chapter presents recommended configurations of connections for proper functioning of all **MT-713** module's resources.
Connections are presented for:

- Binary inputs I1…I5
- Binary outputs Q1…Q2
- Analog inputs AN1…AN3
- Power supply

5.1. Binary inputs

Binary inputs of MT-713 operate with **negative logic**, meaning that high state occurs only when the input is connected to ground. In open circuit the potential in reference to GND pin is not higher than **2,5 VDC**. Inputs work only with potential-free contacts like relay outputs, keyed transistor outputs. Recommended input connection diagram.
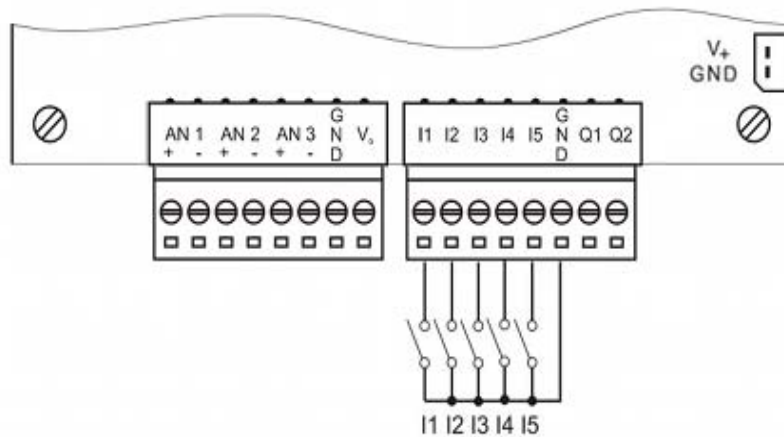
All binary inputs have same reference - module's electrical ground - negative pole of the power supply connected to **GND** pin.
Vibration sensor should be connected between **I5** and **GND**.

5.2. Binary outputs

Binary outputs are **transistor outputs of NMOS** type (QI). They are designed to control loads powered from **external, positive potential source**. In the High state the output is shorted to ground via NMOS transistor in ON state ("open drain" circuit). In case of inductive type load connected (a relay) the circuit limiting voltage peaks to max. +30V is necessary.

The recommended connection diagram.
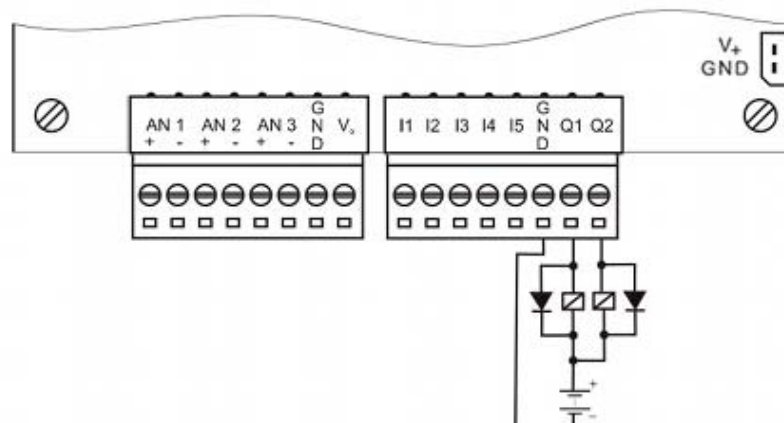
Negative pole of the external load's power supply **has to be connected to module's GND** terminal.

5.3. Analog inputs

Analog inputs convert input voltage in 0-5V range. This means that the potential between analog input terminals shall not be higher than 5V. The potential of analog input terminals towards module's ground (applies for connection with the symmetrical sensor, four leaded) has to be within -0,5V to 9V for positive terminal and from -5,5V to 9V for negative terminal.

Power output Vo used to supply the sensors allows generating potential in 0-5V range with 0,1V accuracy. Max. drawn current should not exceed 50mA.

Diagrams illustrating recommended connections of sensors in various configurations.

Sensor with asymmetric output (three leads version) powered from Vo output:
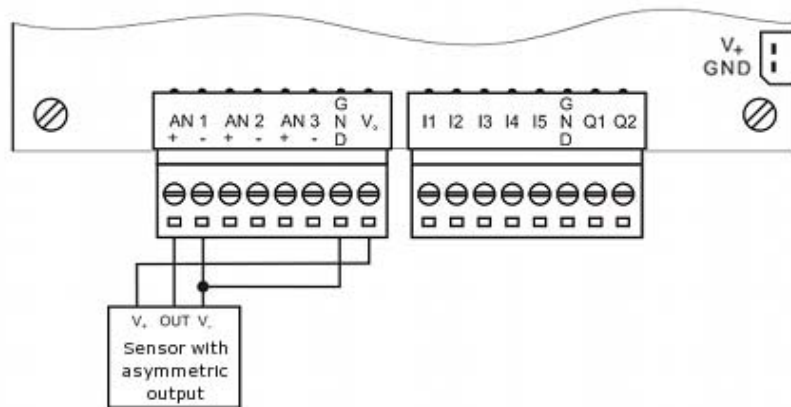
Sensor with asymmetric output (three leads version) powered from external power source:
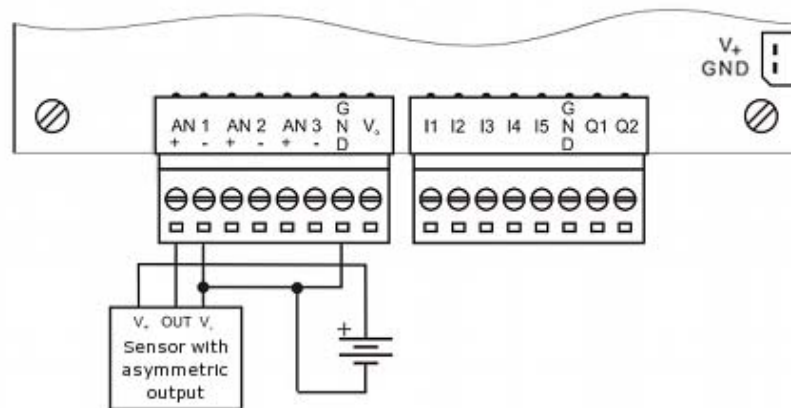
Sensor with symmetric output (four leads version) powered form Vo output:
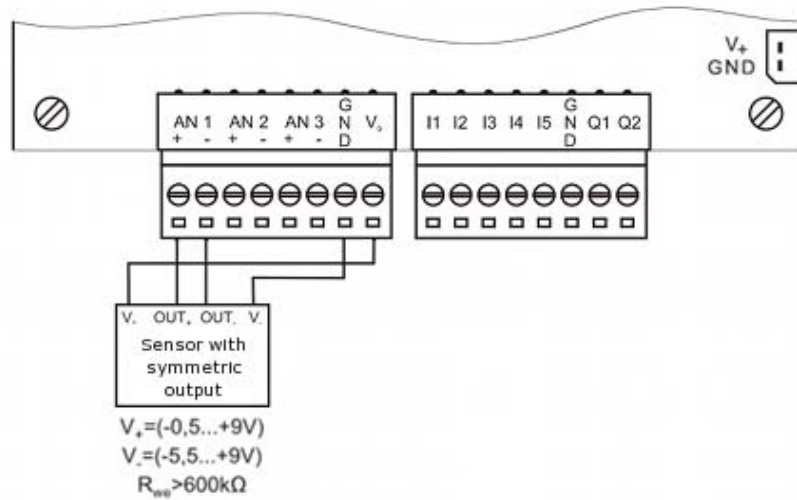
V+=(-0,5...+9V)
V-=(-5,5...+9V)
$R_{we}>600k\Omega$

Sensor with symmetric output (four leads version) powered from external power source:

V+=(-0,5...+9V)
V-=(-5,5...+9V)
$R_{we}>600k\Omega$
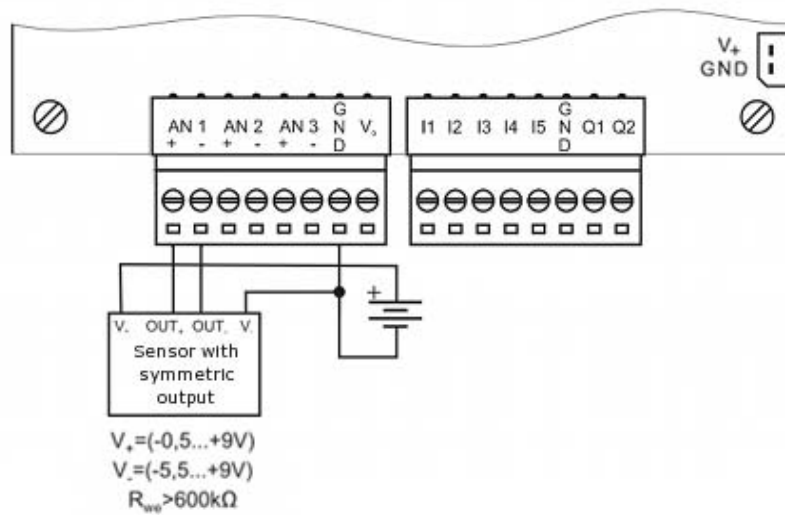
5.4. GSM antenna

Antenna is connected to **MT-713** module via SMA socket placed on bottom wall of the enclosure.
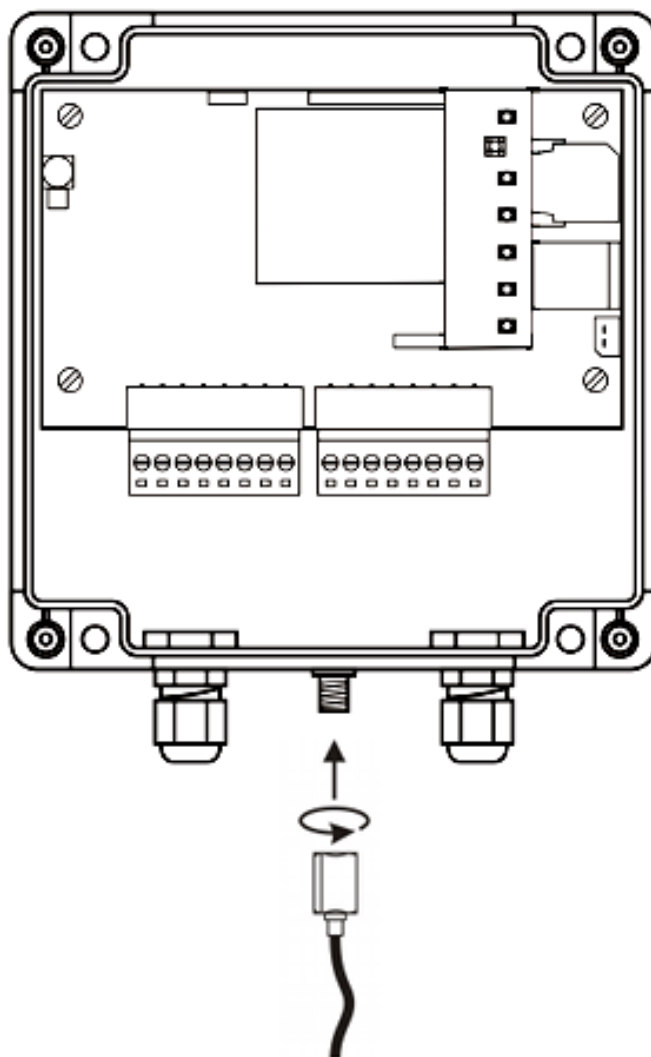
Alternatively, the antenna may be placed inside the module's enclosure.

5.5. SIM card installation

Proper insertion of the **SIM** card is one of fundamental conditions of module's correct operation. Without it the data transmission and SMS services are impossible.

We recommend that inserting of **SIM** card is done without power on which for the **MT-713** module means that both battery cable and USB cable are not attached.
We recommend inserting the SIM in the holder after the configuration holding the PIN code for the SIM card has been successfully performed. Bear in mind that 3 failed attempts of using faulty PIN code the SIM card gets blocked. Inserting of wrong pin code is signaled by LED indicators. The blocked card may be unblocked using the procedure described in sub-chapter "unblocking the SIM card" of Problem solving chapter.

SIM card shall be placed with contact fields down in the holder placed on PCB so that the cut off corner points outwards the holder.
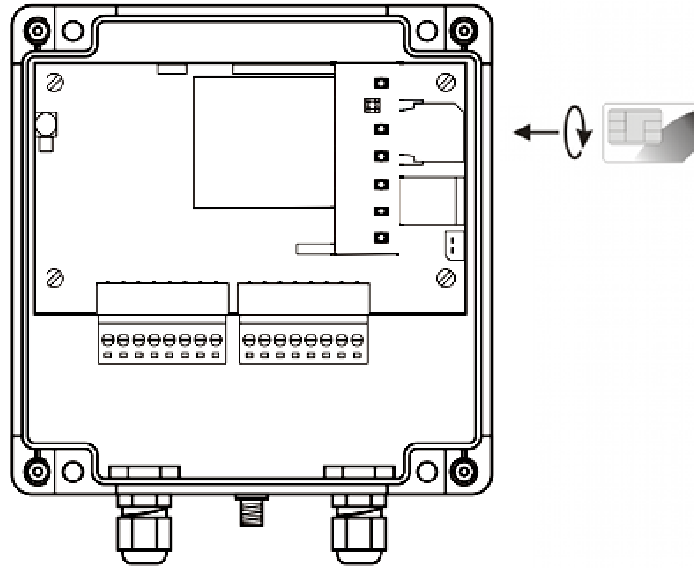
Correctly installed **SIM** card secures connection between its contact fields and the holder contacts.

5.6. Power supply

MT-713 module is powered by replaceable internal battery pack with 4,5 VDC (3,6 VDC for lithium batteries) nominal voltage. Total capacity of new alkaline battery pack is 16 Ah (32 Ah in HC version) and 39 Ah for lithium pack (78 Ah in HC version). Depending on frequency of data transmission/SMS messaging the module may operate for up to 5 years on alkaline batteries or up to 10 years on lithium batteries.
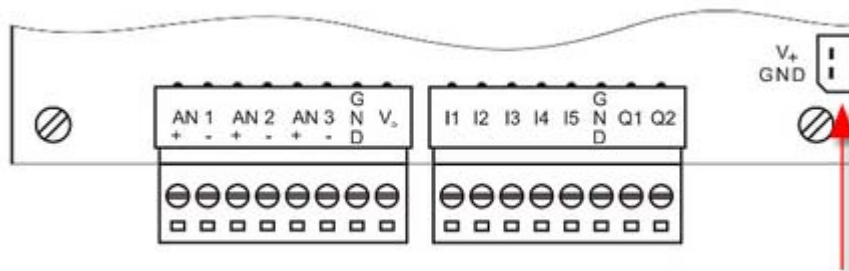
The battery plug and the socket are asymmetrical to prevent reverse polarization and secure easy and safe battery replacement.

> **NOTICE!!!**
> **Due to use of high capacity capacitor disconnecting the battery does not immediately switch the module off. Depending on state of the module when disconnected it may vary from 20-30 seconds to over half of an hour.**

Under no circumstances an external power supply should be used. Powering from improper sources may damage the module permanently.

6. First start of the module

First start of the module MT-713 requires a few simple activities. We recommend supplying the power via USB in order to save the battery. Please follow

1. **Connect signal wires and GSM antenna**

   Recommended connections diagrams for signal wires and the antenna are in **Module connections diagrams** chapter.

2. **First configuration of the module**

   The scope of first configuration of **MT-713** is to enter parameters enabling login to GSM network and optionally GPRS network. A USB connection to the computer running **MTManager** program suite has to be established.
   Detailed information on how to install and use the **MTManager** program is attached in the installation CD.

   In order to login to GSM/GPRS network the basic information about the SIM card and APN have to be provided to the module:

   In **General** group:

   > *PIN code for the SIM card*
   > provide PIN code for SIM card that is going to be placed in the module (unless the card is set in pin-less mode).
   > *Using GPRS*
   > *Yes* - if using SMS and GPRS packet transmission is intended
   > *No* - if the module is going to use SMS mode only.

   In **GPRS** group - visible when *Using GPRS* parameter is set to *Yes*:

   > *APN name*
   > provide APN name for GPRS transmission.
   > *APN user name*
   > provide user name (if required by the operator)
   > *APN password*
   > provide the password (if required by the operator)

   This parameters are the only parameters required to login to GSM/GPRS network. Bear in mind that the module with only the basic configuration does not have ability to send data. After checking the ability to login the full configuration of parameters has to be performed in order to use the module in intended extent.

3. **Inserting the SIM card**

   After downloading the first configuration disconnect the USB connection, insert the SIM card according to the previous chapter's instructions and reconnect the USB cable. The module should login to the GSM/GPRS network.
   The status of the module may be verified by comparing LED indicators with the table provided in the sub-chapter *LED signaling of* Problem solving chapter .
   Login sequence:

   1. Module start
   2. Verification of SIM card's PIN code
   3. Registration of modem in GSM network
   4. Login to selected APN in GPRS network
   Verify the configuration if any errors are indicated.

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4.Setting the module time

The last, but very important element of module's startup is synchronizing the Real Time Clock of the module with the computer clock. It is crucial since lack of synchronization may result with faulty time stamping of the data in Logger and may lead to data loss. More information about time synchronization is in MTManager user manual.

7. Configuration

7.1. General information

Configuration of **MT-713** module is performed by MTManager (MTM) program delivered free of charge to all users of our telemetry solutions.
The program objective is creating a coherent program environment for management and configuration of MT/ML module series.
The program is a specialized environment enabling full control of the telemetry system regardless its size.
The opportunity of dividing all resources into Projects and Folders facilitates management of very large systems.

All parameters described below are available after adding a **MT-713** module to MTM environment. Detailed description of functionality and use of MTM program is to be found in MTManager User Manual.

7.2. Parameter Groups

For the ease of use, **MT-713** parameters are divided into logically or functionally related groups.

Header group	– contains unmodifiable parameters describing the module, firmware and configuration.
General group	– contains basic parameters defining module's operating mode
SMS group	– contains parameters for SMS services handling
GPRS group	– contains parameters necessary for log in GPRS network and defining vital parameters for reliable transmission
Authorized numbers group	– contains lists of phone numbers and IP addresses of other terminals authorized to communicate with the module
Resources group	– contains parameters for programmatic and hardware resources related to reading and processing measurement data
Events group	– contains a list of defined events (e.g. binary input state change), used to trigger module's actions (e.g.: sending SMS, measurement data, logger data)
GSM activity group	– contains parameters extending GSM/GPRS log in time after reception of SMS or incoming data
Rules group	– contains lists of transmission tasks to perform when defining criteria are met

Beyond above mentioned configuration parameter groups there are Initial settings, enabling presetting of module's resources.

7.2.1. Header group

The header group contains basic information describing the module, along with configuration and version of configuration file stored by the program. Information displayed is for verification purposes only and thus not available for user configuration.

7.2.1.1. Module name

Performed function	-	Presents the name assigned to the module during configuration
Data type	-	Text
Range	-	None, read only parameter
Comments	-	N/A

7.2.1.2. Module type

Performed function	-	Displays the type of configured module
Data type	-	Text
Range	-	N/A, read-only parameter
Default value	-	N/A
Comments	-	N/A

7.2.1.3. IMEI number

Performed function	-	Displays GSM modem's IMEI number
Data type	-	Number
Range	-	N/A, read-only parameter
Comments	-	N/A

7.2.1.4. SIM card's number

Performed function	-	Displays SIM card's serial number
Data type	-	Number
Range	-	N/A, read-only parameter
Comments	-	N/A

7.2.1.5. Module's serial number

Performed function	-	Displays the serial number of configured module
Data type	-	Text
Range	-	N/A, read-only parameter
Default value	-	N/A
Comments	-	This field displays a serial number assigned during manufacturing process. This is a device's unique identifier.

7.2.1.6. Modem firmware version

Performed function	-	Displays GSM modem's firmware version
Data type	-	Text
Range	-	N/A, read-only parameter
Default value	-	N/A
Comments	-	The field updates automatically after downloading the firmware.

7.2.1.7. Module's firmware version

Performed function	-	Displays the identifier of current firmware version
Data type	-	Text
Range	-	N/A, read-only parameter
Default value	-	N/A
Comments	-	The field updates automatically after downloading the firmware

7.2.1.8. Configuration file version

Performed function	-	Displays the version of configuration file used to configure the module
Data type	-	Text
Range	-	N/A, read-only parameter
Default value	-	N/A
Comments	-	The value depends on firmware version chosen during creation of module definition. Additional literal extension enables creation of sub-versions within same general functionality.

7.2.1.9. Configuration identifier

Performed function	-	Displays the identifier of current device configuration
Data type	-	Hexadecimal
Range	-	N/A, read-only parameter
Default value	-	N/A
Comments	-	The value is increased automatically by 1 after each successful configuration downloaded to the module

7.2.1.10. Last configuration date

Performed function	-	Displays the date and time of last successful configuration change
Data type	-	Text
Range	-	N/A, read-only parameter
Default value	-	N/A
Comments	-	The value of this field updates automatically after successful configuration change. This parameter helps tracing unauthorized configuration changes.

7.2.1.11. Last read device time

Performed function	-	Displays internal clock time read upon change of time or during last configuration reading.
Data type	-	Text
Range	-	Compliant with Time and Date format
Default value	-	N/A
Comments	-	This field's value may be used for verifying last access time and setting real time clock (RTC) of the module

7.2.2. General

Group **General** consists of parameters vital for module's operation regardless of employed resources and functionality. Data inserted here is paramount for proper log-in to GSM and GPRS network. One has to be aware of the fact that values inserted here influence module's operation. Inserting invalid parameter values may render the module dysfunctional (e.g. inserting of invalid PIN code for the SIM card)

7.2.2.1. PIN code of the SIM card

Performed function	-	Allows passing of the PIN code supplied along with the SIM card inserted into the module. For SIM cards not protected by the code the value is insignificant.
Data type	-	Number
Range	-	Max 8 digits
Default value	-	N/A
Comments	-	Inserting of wrong value may cause blocking of the module.

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NOTICE!!!
Pay attention when inserting the PIN code. Inserting of wrong code will not only render starting of the module impossible but may lock the SIM card! To prevent locking the card the module makes only 2 attempts of inserting the PIN code.

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In case of module signaling locked SIM card apply unlocking procedure described in **Problem solving** chapter**.**

7.2.2.2. Configuration password

Performed function	-	Allows protecting the configuration with a password. The password will be required in order to read and write configuration both for local and remote operations. The password protects against unauthorized attempts of changing the configuration. The password does not protect against reading of module's resources.
Data type	-	Alphanumeric
Range	-	Letters, digits and special characters; max 31 characters
Default value	-	N/A
Comments	-	Since the only way of unlocking the module without the

password is returning to factory settings it is strongly recommended to store passwords at safe location.

7.2.2.3. Blocking of configuration reading

Performed function	-	Allows blocking of configuration reading even when valid password is supplied.
Data type	-	Selection list
Range	-	*Yes*
		Reading of configuration is impossible.
		No
		The module is not protected against reading of configuration
Default value	-	*No*
Comments	-	This parameter does not influence writing of full configuration while it prevents writing changes if configuration identifiers are not identical in the module and in MTManager program.

7.2.2.4. Time synchronization

Performed function	-	Selects the source and synchronizes module's real time clock (RTC)
Data type	-	Selection list
Range	-	*None*
		time synchronization off
		Operator GSM
		time synchronization with GSM operator's network. This option works only in networks supporting time synchronization.
Default value	-	*None*
Comments	-	If the module is furbished with GPS module, the clock will be synchronized with GPS time each time the geographical position is set. This synchronization is independent of Time synchronization parameter settings.

7.2.2.5. Using GPRS

Performed function	-	The parameter selects module's operating mode.
Data type	-	Selection list
Range	-	*Yes*
		The Module operates in GPRS mode and attempts to log in to appointed APN at power on. This mode requires SIM card with GPRS enabled.
		No
		The Module operates in GSM mode. The only way of remote operation is sending SMS messages. This operating mode does not require GPRS thus allowing use of a pre-paid SIM
Default value	-	*Yes*
Comments	-	N/A

7.2.3. SMS

Group **SMS** contains parameters related to sending and receiving of text messages by **MT-713** module.

7.2.3.1. Daily SMS limit

Performed function	-	Defines max number of SMS, the module may send during one day. The parameter protects against uncontrolled sending of SMS messages and consequent high running expenses.
Data type	-	Number
Range	-	*1…60 000*
Default value	-	*100*
Comments	-	N/A

ATTENTION!
Reaching set by the parameter limit results with unconditional stop of SMS sending. One has to bear in mind that until 00:00 o'clock no messages will be sent even in alarm situations!

Unsent due to limitation SMS messages are queued (the queue holds 16 messages) and will be sent when it is possible (after 00:00). If the number of queued messages is higher than the limit set by user, there is a risk of immediate consuming of the next days limit.

7.2.3.2. Number of SMS sending attempts

Performed function	-	Defines max number of retries of failed SMS transmission
Data type	-	Number
Range	-	*1…16*
Default value	-	*3*
Comments	-	After reaching the defined value the SMS is deleted from sending queue.

7.2.3.3. SMS in roaming

Performed function	-	Decides whether the module may send SMS when roaming in foreign network.
Data type	-	Selection list
Range	-	*Yes*
		All SMS messages are sent regardless of the GSM roaming
		No
		When roaming in foreign GSM network no SMS are sent. Messages are queued and will be sent upon return to home network.
Default value	-	*No*
Comments	-	In order to be able to sent SMS in roaming the SIM card in the module has to have roaming option active. When roaming option

of the SIM is not active, the messages will be lost after reaching the <u>Number of SMS sending attempts</u>.

7.2.3.4. SMS limit alert

Performed function	-	Contains the text of the SMS message sent upon reaching Daily SMS limit.
Data type	-	Text
Range	-	Letters, numerals and special characters; max 255 characters
Default value	-	*SMS limit was exceeded!*
Comments	-	This information is sent beyond standard messages queue and only **once a day**. This message does not increment sent messages counter.

7.2.3.5. SMS limit alert recipient

Performed function	-	Selects the SMS limit alert recipient
Data type	-	Selection list
Range	-	Authorized numbers list and *None*
Default value	-	*None*
Comments	-	The recipient must be previously defined in <u>Authorized numbers -> Phone</u>. Selecting *None* disables sending daily SMS limit alert.

7.2.3.6. Reply to empty SMS

Performed function	-	defines the text of reply for empty SMS to the sender.
Data type	-	Text
Range	-	Letters, numerals and special characters; max. 255 characters
Default value	-	*Hello! MT-713 here*
Comments	-	In replay message text symbolic names may be used following syntax rules defined in Appendices in the <u>Syntax of read and write commands in SMS</u> chapter.

7.2.4. GPRS

GPRS Group contains parameters related to log-in and data transmission functions in GPRS system. They can be divided into mandatory (e.g. <u>APN name</u>), optional (e.g. <u>Spooler IP</u>) and optimizing transmission (e.g <u>Transmission timeout [s]</u>).

7.2.4.1. APN name

Performed function	-	Defines the name of APN in which GPRS transmission will be carried out
Data type	-	Text
Range	-	Letters, numerals, special characters - max. 63 characters
Default value	-	Empty
Comments	-	Not defined APN name renders log-in to GPRS impossible.

7.2.4.2. APN user name

Performed function	-	Defines user name for access to APN
Data type	-	Text
Range	-	Letters, numerals, special characters - max. 31 characters
Default value	-	Empty
Comments	-	This parameter is optional, supplied only if GSM operator requires it.

7.2.4.3. APN password

Performed function	-	Defines a password for the particular APN user.
Data type	-	Text
Range	-	Letters, numerals, special characters - max. 31 characters
Default value	-	Empty
Comments	-	This parameter is optional, supplied only if GSM operator requires it.

7.2.4.4. Device identifier

Performed function	-	Selects device identifier type to be set in data frame header sent from the module.
Data type	-	Selection list
Range	-	*IP address*
		The header of data frame contains IP address of sending device. The device is recognized by the data collecting service (MTDataProvider) on the base of it's IP address.
		Serial Number
		The header of data frame contains a serial number of sending device. The device is recognized by the data collecting service (MTDataProvider) on the base of it's serial number. The advantage of this solution is the possibility of changing module's IP address (exchange of SIM card or dynamically assigned IP address) without changing MTDataProvider's configuration or giving up a part of it's abilities (writing into data base)
Default value	-	*IP address*
Comments	-	When operating in dynamic IP assignment mode the identification goes by serial number and allows only reception of data from the module.

7.2.4.5. Sender IP address check

Performed function	-	Switches the control of sender's IP address on/off
Data type	-	Selection list
Range	-	*Yes*
		The module exchanges information only with IP addresses present on the <u>Authorized IP addresses list</u>.

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No

> The module exchanges information (configuration, responses for queries) with any IP address sending qualified query or command. In this case the identification of the sender goes by it's current identifier.

Default value	-	*Yes*
Comments	-	Switching the control off enables verification of the sender on the base of it's currently assigned identifier other than IP address (e.g. serial number or (virtual IP for MT-1xx series)). This allows communication among units with dynamically assigned IP addresses (within same APN). Sender's identifier must reside on <u>Authorized IP addresses list</u> in order to establish the communication.

7.2.4.6. Device IP

Performed function	-	Inserts IP address for newly created module definition. The address assigned upon last GPRS login and read in along with the configuration is displayed
Data type	-	IP address
Range	-	*0.0.0.0 - 255.255.255.255*
Default value	-	*0.0.0.0*
Comments	-	When this field is left at default value 0.0.0.0 the remote communication with the module will be impossible.

7.2.4.7. Spooler IP

Performed function	-	Defines IP address of the computer running MTSpooler, the program performing delayed remote configuration of battery powered modules.
Data type	-	Selection list
Range	-	Authorized IP list
Default value	-	*None*
Comments	-	If MTSpooler is not employed, the parameter should have value *None*. This will avoid obsolete reporting to the spooler and pointless retries due to missing replies.

7.2.4.8. GPRS transmission retries number

Performed function	-	Defines number of attempts to send data through GPRS network if the reply to original transmission does not arrive in a timely manner specified by Transmission timeout parameter
Data type	-	Number
Range	-	*0…9*
Default value	-	*2*
Comments	-	Setting the value to *0* results in sending data without waiting for reception confirmation. In normal conditions the value should not exceed *3*. This prevents loss of transmitted data without blocking of subsequent rules processing. Bear in mind that subsequent data will be sent after reception of confirmation for reception of previous frame. Every transmission prolongs high energy consumption state and influences battery life time.

7.2.4.9. Transmission timeout

Performed function	-	Defines the wait time for reception confirmation of sent data frame . (in seconds)
Data type	-	Number
Range	-	*1...60*
Default value	-	*8*
Comments	-	The value of this parameter along with number of transmission retries influences max. time of sending a data frame. For default values the time is (3 + 1) * 6 = 24s. One has to bear in mind that long waiting time consumes the energy and shortens battery life time.

7.2.4.10. GPRS testing address (ping)

Performed function	-	Defines IP address for GPRS transmission test frames.
Data type	-	IP address
Range	-	*0.0.0.0 - 255.255.255.255*
Default value	-	*0.0.0.0*
Comments	-	This parameter defines IP address to send data frames testing GPRS transmission channel. Default value *0.0.0.0* deactivates testing process. Any inserted IP address is assumed to be valid. We recommend using here the central node's (data collector) IP address.

7.2.4.11. GPRS testing time

Performed function	-	Defines the interval of testing GPRS connection (in minutes)
Data type	-	Number
Range	-	*0 ... 250*
Default value	-	*4*
Comments	-	Testing is performed by sending data frames to defined by the parameter GPRS testing address. Test frames are sent when the module is logged in APN and no communication is performed during the defined by this parameter period. If the test fails, that is the module does not receive confirmation during the time defined by the Transmission timeout parameter and after defined number of retries - the connection to the APN is reset.

7.2.4.12. GPRS roaming

Performed function	-	Defines whether the module is to use GPRS transmission when roaming in foreign GSM network.
Data type	-	Selection list
Range	-	*Yes* In absence of home network availability the module will try to log in to available foreign GPRS network. *No* Using of GPRS networks other than home network disabled.

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Default value	-	*No*
Comments	-	In order to log-in to other networks the SIM card present in the module must have roaming option enabled.

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ATTENTION!
Using GPRS roaming may cause considerable expenses! It is strongly recommended to investigate the cost of GPRS transmission of countries one plans to use roaming services in!

</div>

7.2.5. Authorized numbers

Group **Authorized numbers** comprises lists of phone numbers and IP addresses the module is going to communicate with. The List of IP addresses serves to granting access to configuration and data reception privileges.

7.2.5.1. Number of phone book entries

Performed function	-	Defines the length of phone numbers list authorized to exchange SMS messages.
Data type	-	Number
Range	-	*0…32*
Default value	-	*0*
Comments	-	The value of this parameter may vary as the result of adding/deleting when using the context menu operating directly on <u>Phone</u> number. The module will communicate only with units with the phone number present on the list. The only exception is a special SMS activating the module. Read more in <u>Syntax for reading and writing commands using SMS</u> chapter of Appendices.

7.2.5.2. Number of IP addresses

Performed function	-	Defines the length of the IP addresses list
Data type	-	Number
Range	-	*0…32*
Default value	-	*0*
Comments	-	The value of this parameter may vary as the result of adding/deleting when using the context menu operating directly <u>IP</u> addresses list. The module will communicate only with units with the IP address present on the list.

7.2.5.3. Phone

Ip.	-	Index number
Name	-	Friendly name facilitating identification of the module while defining Rules. Max. length 16 characters
Number	-	Phone number assigned to list index. Max. 14 characters
Receiving	-	The module receives and analyzes SMS messages depending on

selected setting. When Receiving is not allowed, all SMS messages will be deleted
Default value: ✖ (not allowed)
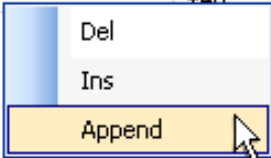
Configuration - Depending on configuration settings incoming configuration SMS will be processed or ignored.
Default value: ✖ (not allowed)

Entries on phone list may be easily added and deleted by using context menu activated by right mouse button click on any position of the list in parameters window.

Idx.	Name	Number	Receiving	Configuration
1	NUM 1	+48	✖	✖

Del
Ins
Append

7.2.5.4. IP

Ip. - Index number

Name - Friendly name facilitating identification of the module's IP while defining Rules. Max. length 16 characters.

Number - IP address assigned to list index.

Receiving - Value of this parameter determines whether data arriving from selected IP will be accepted or ignored
Default value: ✓ (Allowed)
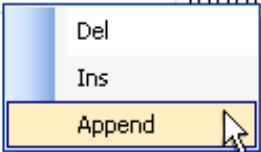
Configuration - Value of this parameter determines whether remote configuration data arriving from selected IP will be ignored or accepted. Notice that both sender's and receiver's addresses must reside in the same network (APN).
Default value: ✓ (Allowed)

Entries on the list may be easily added and deleted by using context menu activated by right mouse button click on any position of the list in parameters window.

Idx.	Name	Number	Receiving	Configuration
1	IP 1	0.0.0.0	✓	✓

Del
Ins
Append

7.2.6. Resources

Resources group contains user defined hardware configuration and hardware programs parameters. Particular sub-groups contain fields allowing fast and intuitive preparation of the module to perform measurements and evaluations of external parameters (binary states, pulse counters, temperature and air humidity) as well as internal (timers, flags).

7.2.6.1. Internal resources Modbus ID

Performed function	-	Defines Modbus ID of module's Internal resources in Modbus Slave operating mode
Data type	-	Number
Range	-	*0 ... 255*
Default value	-	*1*
Comments	-	Value of ID Modbus *0* (zer0) renders remote reading of internal resources impossible.

7.2.6.2. Terminals

Sub-group **Terminals** comprises all hardware resources of the module that can be described as inputs or outputs.
Every resource has a group of parameters assigned. Proper configuration of parameters influences the quality of measurements and module's battery life-time.

7.2.6.2.1. Binary/pulse inputs (I1...I5)

Binary inputs of the module operate in two modes:
- binary input - the input operates as negative logic input (logical true equals GND potential)
- pulse input - configuration dedicated to counting pulses of external counters and calculating the flow.

7.2.6.2.1.1. Max.pulse frequency

Performed function	-	Defines max. frequency of counted pulses
Data type	-	Selection list
Range	-	*8Hz, 16Hz, 32Hz, 64Hz, 128Hz, 256Hz*
Default value	-	*8Hz*
Comments	-	For energy savings select lowest frequency required by application.

7.2.6.2.1.2. Bit triggering flow calculation

Performed function	-	Selects any bit from module's address space. Change of bit's state to high initiates flow calculation process.
Data type	-	Selection list or Number
Range	-	Name from bit list (see <u>bit list</u> in Appendices) or *0 ...65535*
Default value	-	*N/A*
Comments	-	Bit addresses 0...9999 point to input space while addresses 10000...65535 point to internal registers space.

> **ATTENTION!**
> **Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.**

7.2.6.2.1.3. Name

Performed function	-	Defines input's friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 31 characters
Default value	-	Respective *I1*, *I2*, *I3*, *I4*, *I5*
Comments	-	Assigning friendly names facilitates discrimination of inputs destination and required settings.

7.2.6.2.1.4. Operating mode

Performed function	-	Defines binary input's operating mode.
Data type	-	Selection list

Range	-	*Inactive*
		    Input switched off
		Binary input
		    Operates as binary input
		Pulse input
		    Operates as pulse input

Default value	-	*Inactive*
Comments	-	According to selected mode MTManager displays additional configuration parameters for each input

7.2.6.2.1.5. Filtration

Performed function	-	Defines (in seconds) minimum duration of electrical state on the input to be considered stable, thereby indirectly defining maximum time duration of electrical noise
Data type	-	Number
Range	-	*0,1 … 60,0*
Default value	-	*0,1*
Comments	-	Increasing the value increases noise immunity but delays change detection reaction. This parameter is available in binary input mode only.

7.2.6.2.1.6. Dynamic pull-up

Performed function	-	Defines dynamic pull-up function
Data type	-	Selection list

Range	-	*Yes*
		    Dynamic pull-up on
		No
		    Dynamic pull-up off

Default value	-	*Yes*
Comments	-	Activating of dynamic pull-up reduces binary inputs energy consumption - the current is sent through internal resistors to the input only during input state sampling time. When dynamic pull-up is off the current is flowing constantly thus increasing power consumption, especially for inputs working

in high state mainly.
We recommend to keep dynamic pull-up on, except situations where:
- connected circuit has the capacity higher than 1 nF
- direct current contact clean up is required

7.2.6.2.1.7. Minimum pulse length

Performed function	-	Defines approximated minimal pulse length
Data type	-	Selection list
Range	-	*2ms … 12,8s*
Default value	-	*64ms*
Comments	-	This parameter filters high frequency signal noise. Available values of the parameter depend on previously defined Max pulse frequency. NOTICE! Do not select higher value than actual pulse duration, because it will make the module reject received pulses as too short (noise). This parameter is available in binary input mode only.

7.2.6.2.1.8. Active slope

Performed function	-	Defines which slope of incrementing bit activates the counter incrementing function
Data type	-	Selection list

Range	-	*Pulse start*
		      pulse start is considered a new pulse
		Pulse end
		      pulse end is considered a new pulse

Default value	-	*Pulse start*
Comments	-	This parameter is available only in pulse counting mode.

7.2.6.2.1.9. Flow unit

Performed function	-	Defines the flow unit
Data type	-	Text
Range	-	Letters and numerals, max. 15 characters
Default value	-	*mV*
Comments	-	The unit name has solely informative value with no influence on measured and transmitted information. This parameter is available only in pulse counting mode.

7.2.6.2.1.10. Flow scaling

Performed function	-	Selects time reference units for flow scaling.
Data type	-	Selection list
Range	-	*None*

Minute (eng. units/min)
       Defines value increase per minute
Hour (eng. units/h)
       Defines value increase per hour

Default value	-	*None*
Comments	-	This parameter is available only in pulse counting mode.

7.2.6.2.1.11. Pulse weight - engineering units

Performed function	-	Defines pulse weight
Data type	-	Number
Range	-	*1 … 1000*
Default value	-	*1*
Comments	-	The value of the parameter is multiplied by counted pulses in order to calculate flow rate. This parameter is available only in pulse counting mode.

7.2.6.2.1.12. Alarm HiHi - engineering units

Performed function	-	Defines **HiHi** alarm level for flow value in engineering units
Data type	-	Number
Range	-	*0 … 32767*
Default value	-	*32767*
Comments	-	If value of analog signal is higher than value of this parameter, the HiHi alarm flag is risen. The resetting level of the flag depends on <u>Alarm hysteresis</u> setting. This parameter is available only in pulse counting mode.

7.2.6.2.1.13. Alarm Hi - engineering units

Performed function	-	Defines **Hi** alarm level for flow value in engineering units
Data type	-	Number
Range	-	*0 … 32767*
Default value	-	*32767*
Comments	-	If value of analog signal is higher than value of this parameter, the Hi alarm flag is risen. The resetting level of the flag depends on <u>Alarm hysteresis</u> setting. This parameter is available only in pulse counting mode.

7.2.6.2.1.14. Alarm Lo - engineering units

Performed function	-	Defines **Lo** alarm level for flow value in engineering units
Data type	-	Number
Range	-	*0 … 32767*
Default value	-	*0*
Comments	-	If value of analog signal is lower than value of this parameter,

the Lo alarm flag is risen. The resetting level of the flag depends on [Alarm hysteresis](#) setting.
This parameter is available only in pulse counting mode.

7.2.6.2.1.15. Alarm LoLo - engineering units

Performed function	-	Defines **LoLo** alarm level for flow value in engineering units
Data type	-	Number
Range	-	*0 ... 32767*
Default value	-	*0*
Comments	-	If value of analog signal is lower than value of this parameter, the LoLo alarm flag is risen. The resetting level of the flag depends on [Alarm hysteresis](#) setting. This parameter is available only in pulse counting mode.

7.2.6.2.1.16. Alarm hysteresis - engineering units

Performed function	-	Defines the hysteresis value for flow alarm threshold. The value is set in engineering units.
Data type	-	Number
Range	-	*0...32767*
Default value	-	*100*
Comments	-	Setting hysteresis relevant for signal fluctuations prevents excessive activations of alarm flags. This parameter is available only in pulse counting mode.

7.2.6.2.1.17. Tracing reslolution - engineering units

Performed function	-	This parameter defines a minimal change of calculated flow value to react on. Exceeding this value sets a flag (**FL1_DB** to **FL5_DB**) respective to the pulse input where the change has been detected high. The flag is reset after one program cycle to low state (0).
Data type	-	Number
Range	-	*0...32767*
Default value	-	*100*
Comments	-	When set to value *0*, the flag will rise upon every detected flow change by minimum 1 engineering unit. Tracing resolution flags are dedicated to continuous monitoring of flow changes. This parameter is available only in pulse counting mode.

7.2.6.2.2. Binary outputs (Q1...Q2)

The module has two latching binary outputs that may operate as mono or bi-stable. In the high state output connects to GND.

7.2.6.2.2.1. Name

Performed function	-	Defines output's friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 31 characters
Default value	-	Respectively *Q1* and *Q2*
Comments	-	Assigning friendly names facilitates discrimination of outputs destination and required settings.

7.2.6.2.2.2. Controlling bit

Performed function	-	Selects any bit from module's address space. Change of bit's state to high triggers the output high.
Data type	-	Selection list or Number
Range	-	Name from the bit list (see <u>bit list</u> in Appendices) or *0 ...65535*
Default value	-	Respectively *Q1* (address *10000*), *Q2* (address *10001*)
Comments	-	Bit addresses 0...9999 point to input space while addresses 10000...65535 point to internal registers space.

<div style="border:2px solid black; background:#ffff99; text-align:center; color:red;">

ATTENTION!
Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.

</div>

7.2.6.2.2.3. Pulse length

Performed function	-	Defines the length of pulse generated on binary output in seconds.
Data type	-	Number
Range	-	*0,0...1800,0* with *0,1* step
Default value	-	*0*
Comments	-	Setting the value to *0* changes operating mode of the output from monostable to bi-stable (the output state is a true copy of the controlling bit's state).

7.2.6.2.3. Analogue inputs (AN1...AN3)

MT-713 module is equipped with three analogue inputs operating in 0 ... 5V standard and one controlled analogue output Vo designed to power connected sensors.

7.2.6.2.3.1. Sensor powering voltage Vo

Performed function	-	Defines the value of voltage generated at power output Vo dedicated to power analog sensors connected to the module.
Data type	-	Number
Range	-	*0,0 ... 5,0*
Default value	-	*0,0*

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| Comments | - | Voltage adjusting step is 0,1 V. Max. current may not exceed 50 mA. |

7.2.6.2.3.2. Measurement delay after activating Vo

Performed function	-	Defines delay between delivering voltage to sensors and registering the readings.
Data type	-	Number
Range	-	*0 … 60*
Default value	-	*1*
Comments	-	Delay time is defined with 1 second accuracy. When set to 0, readings are performed with 62,5 ms delay.

7.2.6.2.3.3. Triggering bit

Performed function	-	Selects any bit from module's address space. Change of bit's state to high initiates analogue inputs reading.
Data type	-	Selection list or Number
Range	-	Name from bit list (see bit list in Appendices) or *0 …65535*
Default value	-	*N/A*
Comments	-	Bit addresses 0…9999 point to input space while addresses 10000…65535 point to internal registers space.

> **ATTENTION!**
> **Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.**

7.2.6.2.3.4. Name

Performed function	-	Defines input's friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 31 characters
Default value	-	Respectively *AN1*, *AN2*, *AN3*, *AN4*, *AN5*
Comments	-	Assigning friendly names facilitates discrimination of inputs destination and required settings.

7.2.6.2.3.5. Engineering units

Performed function	-	Defines engineering units for measured values
Data type	-	Text
Range	-	Letters and numerals, max. 15 characters
Default value	-	*mV*
Comments	-	Applied unit name has purely informative value and has no influence neither upon measured nor transmitted values.

7.2.6.2.3.6. Low reference

Performed function	-	Sets internal units low reference for rescaling of input signal to engineering units.
Data type	-	Number
Range	-	*0 ...5000*
Default value	-	*0*
Comments	-	Low reference for internal units

7.2.6.2.3.7. Low reference - engineering units

Performed function	-	Sets engineering units low reference for rescaling of input signal to engineering units.
Data type	-	Number
Range	-	*-32767...32767*
Default value	-	*0*
Comments	-	Low reference for Engineering units

7.2.6.2.3.8. High reference

Performed function	-	Sets internal units high reference for rescaling of input signal to engineering units.
Data type	-	Number
Range	-	*0 ... 5000*
Default value	-	*5000*
Comments	-	High reference for internal units

7.2.6.2.3.9. High reference - engineering units

Performed function	-	Sets engineering units high reference for rescaling of input signal to engineering units.
Data type	-	Number
Range	-	*-32767 ... 32767*
Default value	-	*5000*
Comments	-	High reference for Engineering units

7.2.6.2.3.10. Alarm HiHi - engineering units

Performed function	-	Defines **HiHi** alarm level for analogue signal value in engineering units.
Data type	-	Number
Range	-	*-32767 ... 32767*
Default value	-	*32767*
Comments	-	Upon exceeding the preset value by analogue signal the HiHi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

7.2.6.2.3.11. Alarm Hi - engineering units

Performed function	-	Defines **Hi** alarm level for analogue signal value in engineering units.
Data type	-	Number
Range	-	*-32767 … 32767*
Default value	-	*32767*
Comments	-	Upon exceeding the preset value by analogue signal the Hi alarm flag is risen. The resetting level of the flag depends on <u>Alarm hysteresis</u> setting.

7.2.6.2.3.12. Alarm Lo - engineering units

Performed function	-	Defines **Lo** alarm level for analogue signal value in engineering units.
Data type	-	Number
Range	-	*-32767 … 32767*
Default value	-	*-32767*
Comments	-	Upon exceeding the preset value by analogue signal the Lo alarm flag is risen. The resetting level of the flag depends on <u>Alarm hysteresis</u> setting.

7.2.6.2.3.13. Alarm LoLo - engineering units

Performed function	-	Defines **LoLo** alarm level for analogue signal value in engineering units.
Data type	-	Number
Range	-	*-32767 … 32767*
Default value	-	*-32767*
Comments	-	Upon exceeding the preset value by analogue signal the LoLo alarm flag is risen. The resetting level of the flag depends on <u>Alarm hysteresis</u> setting.

7.2.6.2.3.14. Alarm hysteresis - engineering units

Performed function	-	Defines hysteresis value for analogue signal thresholds. The value is set in engineering units.
Data type	-	Number
Range	-	*0...65535*
Default value	-	*100*
Comments	-	Setting hysteresis relevant for signal fluctuations prevents excessive activations of alarm flags.

7.2.6.2.3.15. Tracing reslolution - engineering units

Performed function	-	This parameter defines a minimal change of registered analogue signal to react on. Exceeding this value sets a flag (**AN1_DB**, **AN2_DB** and **AN3_DB**) respective to the analogue input where the change has been detected high. The flag is reset after one program cycle to low state (0).

Data type	-	Number
Range	-	*0...65535*
Default value	-	*100*
Comments	-	When set to value *0*, the flag will rise upon every detected signal change by minimum 1 engineering unit. Tracing resolution flags are dedicated to continuous monitoring of analogue signal changes.

7.2.6.3. Counters (CN1...CN8)

Module's Counters may be used to count any pulses (interpreted as bit or binary input state changes). Counters are equipped with two inputs each. One incrementing and one decrementing the counter's register value.

7.2.6.3.1. Incrementing input

Performed function	-	Defines the bit which state change increments counter value by 1
Data type	-	Selection list or Number
Range	-	Name from bit list (see <u>bit list</u> in Appendices) or *0 ...65535*
Default value	-	*N/A*
Comments	-	Bit addresses 0...9999 point to input space while addresses 10000...65535 point to internal registers space.

<div style="border: 1px solid black; background-color: yellow; text-align: center; color: red; font-weight: bold;">

ATTENTION!
Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.

</div>

7.2.6.3.2. Incrementing input's active slope

Performed function	-	Defines incrementing bit's slope activating counter incrementing function
Data type	-	Selection list
Range	-	*0->1*
		logical state change from 0 to 1
		1->0
		logical state change from 1 to 0
Default value	-	*0->1*
Comments	-	N/A

<div style="border: 1px solid black; background-color: yellow; text-align: center; color: red; font-weight: bold;">

ATTENTION!
If bits set for one program cycle are counted (e.g. clock flags) or pulses on binary input set as pulse counter, the right parameter setting is 0->1.
With any other selected value measurements will not be performed.

</div>

7.2.6.3.3. Decrementing input

Performed function	-	Defines the bit which state change decrements counter value by 1
Data type	-	Selection list or Number
Range	-	Name from bit list (see <u>bit list</u> in Appendices) or *0 ...65535*
Default value	-	*N/A*
Comments	-	Bit addresses 0...9999 point to input space while addresses 10000...65535 point to internal registers space.

<div style="border:1px solid; background:#ffffcc; color:red; text-align:center">

ATTENTION!
Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.

</div>

7.2.6.3.4. Decrementing input's active slope

Performed function	-	Defines decrementing bit's slope activating counter decrementing function
Data type	-	Selection list
Range	-	*0->1*
		logical state change from 0 to 1
		1->0
		logical state change from 1 to 0
Default value	-	*0->1*
Comments	-	N/A

<div style="border:1px solid; background:#ffffcc; color:red; text-align:center">

ATTENTION!
If bits set for one program cycle are counted (e.g. clock flags) or pulses on binary input set as pulse counter, the right parameter setting is 0->1. With any other selected value measurements will not be performed.

</div>

7.2.6.4. Timers

Group **Timers** contains configuration parameters of module's timers.

7.2.6.4.1. Synchronous timers (CT1...CT8)

Synchronous timers measure cyclically defined time intervals. They are synchronized with module's real time clock. RTC

7.2.6.4.1.1. Start

Performed function	-	Defines the synchronization point with RTC
Data type	-	Time
Range	-	*00:00 - 23:59*
Default value	-	*00:00*

| **Comments** | - | At time defined by this parameter the module will always generate a pulse. One can make it generate pulse every hour, 15 minutes after the hour elapses (in that case the parameter **Start** should have value *00:15*) |

7.2.6.4.1.2. Interval

Performed function	-	Defines the interval module's clock should measure.
Data type	-	Selection list
Range	-	*Never*, *1 min.*, *2 min.*, *3 min.*, *5 min.*, *10 min.*, *15 min.*, *30 min.*, *1 hour*, *2 hours*, *3 hours*, *4 hours*, *6 hours*, *8 hours*, *12 hours*, *24 hours*
Default value	-	*Never*
Comments	-	Selecting *Never* deactivates the timer

7.2.6.4.1.3. Week days

Performed function	-	Defines week days when the timer is active
Data type	-	Multiple choice field
Range	-	*Mo.,Tu.,We.,Th.,Fr.,Sa.,Su.*
Default value	-	*Mo.,Tu.,We.,Th.,Fr.,Sa.,Su.* (all week days selected)
Comments	-	The timer's activity is depending on logical sum of week days and month days. Selecting all week days will make the timer active all of the time. If no week days are selected the activity of the timer will depend on month days selection.

7.2.6.4.1.4. Month days

Performed function	-	Selects month days when the timer is active.
Data type	-	Multiple choice field
Range	-	*1*, *2*, *... 30*, *31*, *Last*
Default value	-	*No day selected* (none of month days is selected)
Comments	-	The timer's activity is depending on logical sum of week days and month days. Selecting all month days will make the timer active all of the time. If no month days are selected the activity of the timer will depend on week days selection.

7.2.6.5. Temperature sensor

MT-713 module is equipped with an integrated temperature sensor, or with optional precise temperature and humidity sensor.

7.2.6.5.1. Alarm Hi

| **Performed function** | - | Defines the high temperature threshold value. When exceeded the module rises a **TEMP_Hi** flag. |
| **Data type** | - | Number |

Range	-	*-20 ... 50*
Default value	-	*50*
Comments	-	Resetting of the **TEMP_Hi** flag occurs when the temperature drops more than half degree below the threshold value.

7.2.6.5.2. Alarm Lo

Performed function	-	Defines the low temperature threshold value. When crossed, the module rises a **TEMP_Lo** flag.
Data type	-	Number
Range	-	*-20 ... 50*
Default value	-	*-20*
Comments	-	Resetting of the **TEMP_Lo** flag occurs when the temperature rises more than half degree above the threshold value.

7.2.6.6. Vibration sensor (I5)

Binary input I5 can operate as a input of signal from external vibration sensor with normally open contact such as CM 4400-1. Notification about detected vibration is done by setting **VIB** bit high.

To use this feature binary input I5 Operating mode parameter should be set to any setting but *Inactive*. Full functionality of the binary input is maintained while the state of binary input I5 is analyzed on the presence of vibration. This analysis is done without taking into account limitations imposed by parameters: Minimum pulse length and Filtration. Effect on analysis however has setting of Maximum pulse frequency parameter.

7.2.6.6.1. Activity delay [s]

Performed function	-	Defines minimum time of vibrations causing setting **VIB** bit high. **VIB** is bit informing about vibrations.
Data type	-	Number
Range	-	*0 ... 60*
Default value	-	*1*
Comments	-	Setting this parameter to *0* causes setting **VIB** high on every single pulse on I5 binary input. This parameter is available only when Operating mode of I5 binary input is set to any setting but *Inactive*.

7.2.6.6.2. Activity time [min]

Performed function	-	Defines minimum time (in minutes) of lack vibrations causing zeroing of **VIB** bit. **VIB** is bit informing about vibrations.
Data type	-	Number
Range	-	*0 ... 30*
Default value	-	*1*
Comments	-	This parameter is available only when Operating mode of I5 binary input is set to any setting but *Inactive*.

7.2.6.7. Battery

Groups parameters defining the battery state monitoring method.

7.2.6.7.1. Low voltage alarm

Performed function	-	Defines threshold level of battery voltage. When the voltage drops to the threshold value, a **LBAT_C** flag is raised. The alarm is generated for the voltage lower than threshold value. The alarm flag is raised for one program cycle.
Data type	-	Number
Range	-	*2,0 … 4,0*
Default value	-	*3,0*
Comments	-	The LBAT_C alarm flag is recommended to dispatch the information about necessity of battery replacement. For lithium batteries it is advised to set this parameter to 3,0.

7.2.6.7.2. Alarm generating interval

Performed function	-	Defines the interval for generating battery low voltage alarm
Data type	-	Selection list
Range	-	*1 hour, 2 hours, 3 hours, 4 hours, 6 hours, 8 hours, 12 hours, 24 hours*
Default value	-	*24 hours*
Comments	-	When the battery voltage is lower than the one defined by Low voltage alarm parameter the module will rise alarm flag with frequency defined by this parameter. When the voltage returns to value above threshold (battery replaced) the module will stop generating alarms.

7.2.6.8. GPS

Contains parameters controlling the optional GPS receiver

7.2.6.8.1. SEL selection bit

Performed function	-	Defines bit used for choosing one from two position measurement triggering sources
Data type	-	Selection list or Number
Range	-	Name from bit list (see bit list in Appendices) or *0 … 65535*
Default value	-	*None*
Comments	-	If parameter is set to *None* here is only one Bit triggering position measurement. In any other case there are two such parameters: Bit triggering position measurement, when SEL=0 and Bit triggering position measurement, when SEL=1. As a SEL bit you can set e.g. vibration sensor bit (**VIB**), to measure position more often when device is moving. Bit addresses 0…9999 point to input space while addresses 10000…65535 point to internal registers space.

ATTENTION!
Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.

7.2.6.8.2. Bit triggering position measurement

Performed function	-	Defines bit triggering position measurement
Data type	-	Selection list or Number
Range	-	Name from bit list (see bit list in Appendices) or *0 ... 65535*
Default value	-	*None*
Comments	-	Parameter is visible only when parameter SEL selection bit is set to *None*. Bit addresses 0...9999 point to input space while addresses 10000...65535 point to internal registers space.

> **ATTENTION!**
> **Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.**

7.2.6.8.3. Bit triggering position measurement, when SEL=0

Performed function	-	Defines bit triggering position measurement, when SEL bit is zeroed.
Data type	-	Selection list or Number
Range	-	Name from bit list (see bit list in Appendices) or *0 ... 65535*
Default value	-	*None*
Comments	-	Parameter is visible only when parameter SEL selection bit is set to any value but *None*. Bit addresses 0...9999 point to input space while addresses 10000...65535 point to internal registers space.

> **ATTENTION!**
> **Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.**

7.2.6.8.4. Bit triggering position measurement, when SEL=1

Performed function	-	Defines bit triggering position measurement, when SEL bit is in high state.
Data type	-	Selection list or Number
Range	-	Name from bit list (see bit list in Appendices) or *0 ... 65535*
Default value	-	*None*
Comments	-	Parameter is visible only when parameter SEL selection bit is set to any value but *None*. Bit addresses 0...9999 point to input space while addresses 10000...65535 point to internal registers space.

> **ATENTION!**
> **Bit states and register values marked with bold in memory map are refreshed at every program cycle. All remaining resources are refreshed only when the module is in high energy consumption state (awake). It is recommended to employ bits marked bold for triggering purposes.**

7.2.6.8.5. Accuracy of position measurement (HDOP)

Performed function	-	Defines border value of HDOP parameter
Data type	-	Number
Range	-	*1 ... 99*
Default value	-	*25*
Comments	-	GPS receiver will stop position measurement when it will reach set HDOP value or after 4 minutes from beginning of GPS measurement. After completion of position measurement **GPS_C** bit is set. If module was able to measure position, it sets **FIX** bit, and writes new GPS data to registers.

7.2.6.8.6. Movement signaling

Performed function	-	Enables/disables movement detection mechanism
Data type	-	Selection list

Range	-	*Yes*
		    Signaling enabled
		No
		    Signaling disabled

Default value	-	*No*
Comments	-	Setting this parameter to *Yes* makes available additional parameter - <u>Movement signaling threshold [km]</u> used for determining minimum distance causing movement signaling. Signaling is done by setting **MOV** bit high for one cycle after detecting movement for distance greater than given by <u>Movement signaling threshold [km]</u> parameter.

7.2.6.8.7. Movement signaling threshold [km]

Performed function	-	Defines minimum movement distance (in km) causing movement signaling
Data type	-	Number
Range	-	*0,1 ... 65,0*
Default value	-	*1,0*
Comments	-	Signaling is done by setting **MOV** bit high for one cycle after detecting movement for distance greater than given by <u>Movement signaling threshold [km]</u> parameter. Parameter is available only if <u>Movement signaling</u> parameter is set to *Yes*.

7.2.6.8.8. Geofencing

Performed function	-	Enables/disables geofencing mechanism
Data type	-	Selection list

Range	-	*Yes*
		    Geofencing enabled
		No
		    Geofencing disabled

Default value	-	*No*
Comments	-	Setting this parameter to *Yes* makes available additional parameters: <u>Base position - latitude</u> and <u>Base position - longitude</u> allowing user to set coordinates of geofencing circle centre and <u>Radius [km]</u> parameter defining geofencing circle radius.
		If measured position of module is located outside geofencing circle, module sets **GEOFC** bit high and **GEOF_C** bit high for one cycle. **GEOFC** bit is zeroed when measured position is within geofencing circle.

7.2.6.8.9. Base position - latitude

Performed function	-	Allows user to set latitude of geofencing circle centre
Data type	-	Number
Range	-	*-90,00000° (90,00000° N) … 90,00000° (90,00000° S)*
Default value	-	*0,00000° (0,00000° N)*
Comments	-	Along with <u>Base position - longitude</u> and <u>Radius [km]</u> parameters allows user to define geofencing circle.
		If measured position of module is located outside geofencing circle, module sets **GEOFC** bit high and **GEOF_C** bit high for one cycle. **GEOFC** bit is zeroed when measured position is within geofencing circle.
		Parameter is available if <u>Geofencing</u> parameter is set to *Yes*.

7.2.6.8.10. Base position - longitude

Performed function	-	Allows user to set longitude of geofencing circle centre
Data type	-	Number
Range	-	*-90,00000° (90,00000° W) … 90,00000° (90,00000° E)*
Default value	-	*0,00000° (0,00000° E)*
Comments	-	Along with <u>Base position - latitude</u> and <u>Radius [km]</u> parameters allows user to define geofencing circle.
		If measured position of module is located outside geofencing circle, module sets **GEOFC** bit high and **GEOF_C** bit high for one cycle. **GEOFC** bit is zeroed when measured position is within geofencing circle.
		Parameter is available if <u>Geofencing</u> parameter is set to *Yes*.

7.2.6.8.11. Radius [km]

Performed function	-	Allows user to set radius (in km) of geofencing circle centre
Data type	-	Number
Range	-	*0,1 … 65,0*
Default value	-	*1,0*
Comments	-	Along with <u>Base position - latitude</u> and <u>Base position - longitude</u> parameters allows user to define geofencing circle.
		If measured position of module is located outside geofencing circle, module sets **GEOFC** bit high and **GEOF_C** bit high for one

cycle. **GEOFC** bit is zeroed when measured position is within geofencing circle.

Parameter is available if Geofencing parameter is set to *Yes*.

7.2.6.9. Logger

Contains parameter controlling logger's operation.

7.2.6.9.1. Record validity time

Performed function	-	Defines period of collected records validity. All records collected before are considered invalid and will not be transmitted.
Data type	-	Number
Range	-	*Unlimited* or *1 … 240*
Default value	-	*Unlimited*
Comments	-	After validity period elapsed the records are not deleted. There is a possibility of reading them on demand.

7.2.6.9.2. Recipient

Performed function	-	Defines IP address to send Logger's content to.
Data type	-	Selection list
Range	-	List of authorized IP addresses
Default value	-	*N/A*
Comments	-	If the Logger is not in use the parameter should have value of *N/A*.

7.2.6.9.3. Recipient's UDP port

Performed function	-	Defines UDP port to which logger contens will be sent.
Data type	-	Number
Range	-	*1024 …65535*
Default value	-	*7110*
Comments	-	One has to remember to configure the receiving side's port driver **MTDataProvider** to receive on the same port as set by this parameter.

7.2.6.9.4. Sending in online mode

Performed function	-	Defines the logger sending interval if the module is on line mode. The sending must be in advance triggered by a relevant event. If the module goes into hibernation the triggering has to be reactivated.
Data type	-	Number
Range	-	*1 …250*
Default value	-	*1*
Comments	-	If the module is non-stop on line it will send the logger content after first triggering event and will keep on sending logger at intervals defined by this parameter.

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7.2.7. Events

Group **Events** defines status change of binary inputs(flags, inputs, outputs, bits) as events. Events are used to trigger recording and flushing the logger along with reporting to **MTSpooler** and sending data and SMS messages.
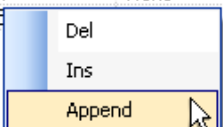
7.2.7.1. Number of events

Performed function	-	Defines the number of events in Events Table
Data type	-	Number
Range	-	*0 ... 64*
Default value	-	*0*
Comments	-	If the value is 0, Events table is not displayed

7.2.7.2. Events table

Idx.	-	List indexing number
Name	-	Friendly name of event used in Rules to define the event triggering the rule processing Max. length 16 characters.
Triggering bit	-	Address of bit triggering the event Name from bit list (see bit list in Appendices) or *0 ...65535*
Triggering slope	-	Event triggering slope Selection list *0->1* rising slope(default value) *1->0* falling slope *0<->1* any slope
Records to be sent	-	Toggles on/off sending records written to logger on occurring event **Default value:** ✖ (OFF)
Triggering logger transmission	-	Toggles sending the logger content on/off on occurring event **Default value:** ✖ (OFF)
Update of GPS position	-	Toggles GPS positioning on/off on occurring event **Default value:** ✖ (OFF)
Comments	-	The event table appears when defined number of events is greater then zero. The number of positions on the list equals defined events number.

Entries on the list may be easily added and deleted by using context menu activated by right mouse button click on any position of the list in parameters window.

Idx.	Name	Triggering bit	Triggering slope	Records to be sent	Triggering logger sending	Update of GPS position
1	Timer	CT1	0->1	✖	✔	✖
2	Button	KEY_P	0->1	✔	✔	✖
3	Flow measurment	FL_C	0->1	✔	✖	✖
4	EVT 4	None	0<->1	✔	✔	✔
5	EVT 5		0->1	✔	✔	✔

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7.2.8. GSM activities

The group contains parameters defining minimum log-in time in GPRS network after receiving data or SMS message.

7.2.8.1. Active after SMS reception

Performed function	-	Defines GSM activity time after receiving of SMS (in minutes)
Data type	-	Number
Range	-	*0 … 1080*
Default value	-	*0*
Comments	-	Value other than *0* grants extra time for remote access to the module for e.g. configuration, data read-out e.t.c. Increasing activity time shortens battery life time!

7.2.8.2. Active after GPRS frame reception

Performed function	-	Defines GSM activity time after receiving of GPRS frame (in minutes)
Data type	-	Number
Range	-	*0 … 1080*
Default value	-	*0*
Comments	-	Value other than *0* grants extra time for remote access to the module for e.g. configuration, data read-out e.t.c. Increasing activity time shortens battery life time!

7.2.9. Rules

Group Rules contains list of transmission tasks performed in case of fulfillment of defined criteria by internal program . Tasks are divided in two groups:
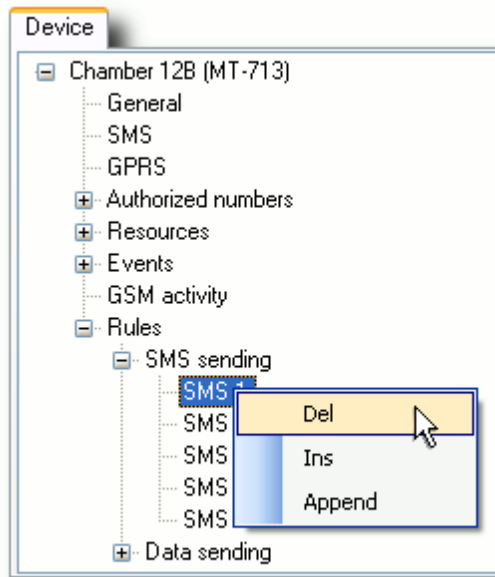- SMS sending rules
- Data sending rules

In both cases criteria are defined by employing previously defined Events.

7.2.9.1. Sending SMS

Sub-group Sending SMS consists of two parts:
- list of SMS sending rules
- general parameters of all rules

List of SMS sending rules allows max. 32 rules triggering SMS transmission. Entries on the list may be easily added and deleted by using context menu activated by right mouse button click on any position of the list in defined rules window.

The number of rules may be defined by setting Number of SMS sending rules

7.2.9.1.1. SMS validity time

Performed function	-	Defines validity time of SMS messages
Data type	-	Number
Range	-	*Unlimited or 1...240*
Default value	-	*Unlimited*
Comments	-	If the module cannot send SMS messages (no coverage, no roaming, exceeded SMS limit) they are kept in the memory and will be dispatched at first convenience. This parameter defines maximum time the message waits for the opportunity to be sent. After defined time the messages are deleted.

7.2.9.1.2. Number of SMS sending rules

Performed function	-	Defines the number SMS sending rules
Data type	-	Number
Range	-	*0...32*
Default value	-	*0*
Comments	-	Reducing the rules number does not delete settings of rules until writing the configuration to the module.

7.2.9.1.3. SMS 1...32

Each SMS sending rule on the list is defined by mandatory parameters like recipient, triggering event and the message text. The maximum number of rules is 32.

7.2.9.1.3.1. Triggering event

Performed function	-	Assigns which one of previously defined event will trigger sending of a particular text message.
Data type	-	Selection list
Range	-	*None* or names of events from the <u>Events table</u>
Default value	-	*None*
Comments	-	To send the SMS message, <u>Events table</u> must have at least one event defined

7.2.9.1.3.2. Recipient

Performed function	-	Assigns a recipient of SMS from defined in <u>Authorized numbers->Phone</u> list.
Data type	-	Selection list
Range	-	*None* or the name from <u>Phone</u> list
Default value	-	*None*
Comments	-	To send the SMS message, the <u>Authorized numbers->Phone</u> must have at least one phone number defined

7.2.9.1.3.3. Template

|		
Performed function	-	Defines a template of SMS message
Data type	-	Alphanumeric array
Range	-	*0...255* alphanumeric characters (no diacritical)
Default value	-	*0*
Comments	-	SMS messages Template may contain any string of characters, except diacritical. It may contain mnemonics dynamically replaced at run-time by values drawn from the module e.g.: time, register or logical state of the bit. The syntax of commands is described in detail in <u>Syntax of commands for reading and writing data by SMS</u> paragraph.

7.2.9.1.3.4. Activity time after log-in

Performed function	-	Defines how many minutes after log-in to GSM network in order to send SMS the module remains active.
Data type	-	Number
Range	-	*0 ... 1080*
Default value	-	*0*
Comments	-	Any value different than *0* ensures prolonged time for remote access to the module after sending the SMS or for reception of SMS sent to the module. Leaving the *0* value makes the module to hibernate immediately after sending the SMS. Extending the activity time reduces battery life time.

7.2.9.2. Sending data

Sub-group Sending consists of two parts:

- list of data sending rules
- general parameters common to all rules on the list

List of data sending rules contains max. 32 rules allowing sending user defined data to appointed IP address. Entries on the list may be easily added by using context menu activated by right mouse button click on any position of the list of rules.
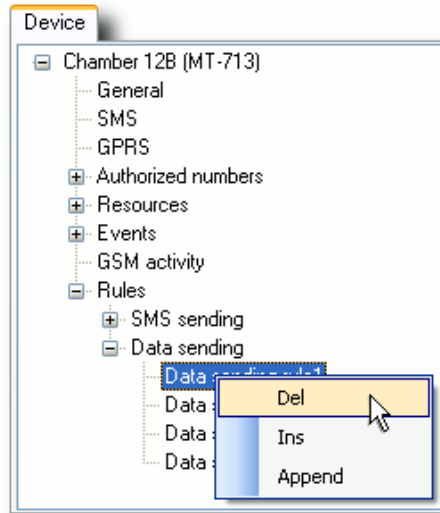
The number of rules may be defined by setting Number of data sending rules parameter.

7.2.9.2.1. Recipient's UDP port

Performed function	-	Assigns UDP port number for transmitted data frames
Data type	-	Number
Range	-	*1024 … 65535*
Default value	-	*7110*
Comments	-	One has to remember to configure receiving side's driver to listen to the same port number.

7.2.9.2.2. Data validity time

Performed function	-	Defines validity time of data, in hours
Data type	-	Number
Range	-	*Unlimited* or *1…240*
Default value	-	*Unlimited*
Comments	-	If the module cannot send GPRS data frame (no coverage, no roaming, no GPRS services) the data is stored in module's memory and will be sent at first convenience. This parameter defines max. storage time until deleting the data. This parameter does not influence the logger.

7.2.9.2.3. Number of data sending rules

Performed function	-	Defines the n umber of data sending rules

Data type	-	Number
Range	-	*0 ...32*
Default value	-	*0*
Comments	-	Reducing the rules number does not delete settings of rules until writing the configuration to the module.

7.2.9.2.4. Data 1...32

Each of rules is defined by mandatory parameters as recipient, triggering event and data format. The maximum number of rules is 32.

7.2.9.2.4.1. Triggering event

Performed function	-	Assigns which one of previously defined events will trigger data frame transmission.
Data type	-	Selection list
Range	-	*None* or a name selected from the Event table
Default value	-	*None*
Comments	-	In order to send data there must be at least one event defined in the Event table

7.2.9.2.4.2. Data format

Performed function	-	Defines type of transmitted data
Data type	-	Selection list

Range	-	*Status*
		    Frame containing complete information on module's state
		Xway
		    Frame containing GPS position data for Xway vehicle localization system
		Spooler
		    Frame reporting to MTSpooler program that is used for remote configuration of battery powered modules.
		Buffer
		    Frame containing selected registers of the module. This type of frame may be used to communicate with other MT modules.

Default value	-	*Status*
Comments	-	Depending on selected frame type some parameters may become unavailable

7.2.9.2.4.3. Recipient

Performed function	-	Defines a particular recipient of data previously defined on Authorized numbers->IP list
Data type	-	Selection list
Range	-	*None* or the name from IP list
Default value	-	*None*
Comments	-	In order to send data there must be at least one address defined

on the Authorized numbers->IP list.
This parameter is unavailable when selected Data Format is Spooler. In this particular case the recipient is defined by Spooler IP in GPRS group's parameters

7.2.9.2.4.4. Activity time after log-in

Performed function	-	Defines how long time after GPRS log-in the module remains active.
Data type	-	Number
Range	-	*0...1080*
Default value	-	*0*
Comments	-	Value other than *0* grants extra time for remote access to the module for e.g. configuration, data read-out, SMS reception e.t.c. Increasing activity time shortens battery life time! Leaving it at *0* makes the module hibernate immediately after performing scheduled tasks.

7.2.9.2.4.5. Space

Performed function	-	Defines module's memory space, where data prepared for transmission reside
Data type	-	Selection list
Range	-	*IREG*
		Analogue inputs space (input registers)
		HREG
		Internal registers space (holding registers)
Default value	-	*IREG*
Comments	-	This parameter is accessible only when Buffer data format has been selected. Addresses of module's resources may be found in Memory map in Appendices.

7.2.9.2.4.6. Buffer start address

Performed function	-	Points out the address of the first register of the array to be sent.
Data type	-	Number
Range	-	*0 ... 31*
Default value	-	*0*
Comments	-	N/A

7.2.9.2.4.7. Buffer size

Performed function	-	Defines the number of consecutive register to be sent.
Data type	-	Number
Range	-	*1...32*
Default value	-	*1*
Comments	-	N/A

7.2.9.2.4.8. HREG space target address

Performed function	-	Defines the address in receiving unit's internal registers(holding registers), where the buffer is going to be written.
Data type	-	Number
Range	-	*0...9999*
Default value	-	*96*
Comments	-	N/A

7.3. Presets

In order to expand module's application areas it is furbished with initial settings for some resources. It is necessary when the module is operating as a pulse counter for measuring devices (e.g. water consumption meter with pulse output), having initial count other than zero. Due to **Presets**, the actual value of (totalizer) register may be equalized with mechanical counter of the device, thus not disturbing the functionality of the system.

In order to set **Presets**, go to menu *Configuration* and select the *Initial settings* option or click the icon on the toolbar.

 - Presets

The **Presets** icon is active only when the module is connected and selected transmission channel is not the Spooler. Sending data in **Presets** mode is possible only as sending changes. Bear in mind that sending configuration changes result in immediate and irrevocable updating of the resource.

When **Presets** mode is selected all configuration groups disappear from the panel and only parameters that may have initial value set are displayed. For MT-713 module the parameters are Counters CN1...CN8.

7.3.1. Counters (CN1...CN8)

Name of the resource	-	Counter CN1...CN8
Data type	-	Number
Range	-	*-2 147 483 647...2 147 483 647*

After inserting new values of the resource the background becomes highlighted yellow. This means that the value has been changed and is selected to be sent to the module.

Parameter	Value
CN1	-12
CN2	2147483647
CN3	-2147483648
CN4	516
CN5	214
CN6	83647
CN7	-2183647
CN8	16

8. Problem solving

8.1. LED signaling

MT-713 is equipped with six **LED** indicators reflecting the module state.

- **POWER** LED **-** indicates current Power supply and module's state (low and high energy consumption state called also sleep and activity state)
- **ERR** LED - indicates abnormal states
- **STA** LED - indicates GSM/GPRS status (GSM login as well as GPRS login, roaming, and signal level)
- **TX** LED - indicates Data or SMS transmission
- **RX** LED - indicates data or SMS reception
- **USB** LED - indicates USB port state
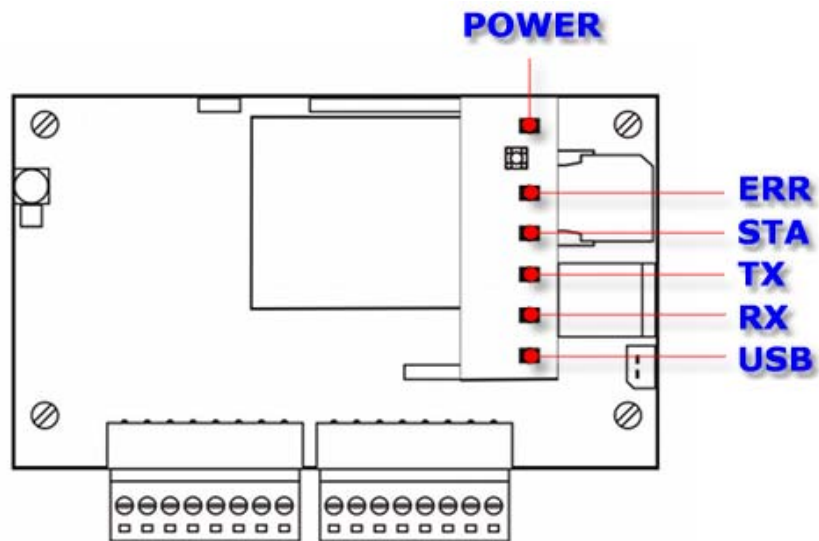
The current state is signaled by flashes varying in length and number.
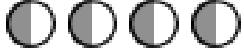
8.1.1. POWER LED

Signals emitted by POWER LED identify current Power supply and module's state. See the table below.
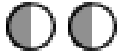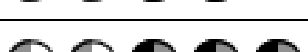
	Battery supply	USB port supply
Sleep state		
Measurement in progress (flashes when measuring)		
GPS position calculation		
Battery replacement mode		

8.1.2. LED indicators

LED signaling consists of five-second "messages" comprising four basic signals differing by lit time of LED indicators. Tables below display all states signalled.

Legend	
○	LED lit stable
◐	long flash (200ms)
◖	short flash (20ms)
●	LED off

ERR LED	
○	critical error
◑ (black left)	transmission error - SMS or GPRS transmission impossible
◐ (grey)	missing, defective or blocked SIM card
◐ ◐	the card requires PIN code
◐ ◐ ◐	GSM error
◐ ◐ ◐ ◐	GPRS error
◐ ◐ ◐ ◐ ◐	APN login error
◐ ◐ ◐ ◐ ◐ ◐	wrong PIN

STA LED	
●	PIN missing in configuration (does not apply for pin-less cards)
○	PIN received, module not logged in GSM network
◐	logged in GSM network, very weak signal (< -99 dBi)
◐ ◑	logged in GSM network, very weak signal (-97…-83 dBi)
◐ ◑ ◑	logged in GSM network, good signal (-81…-67 dBi)
◐ ◑ ◑ ◑	logged in GSM network, very good signal (> -65 dBi)
◐ ◐	logged in foreign GSM network (roaming), very weak signal (< -99 dBi)
◐ ◐ ◑	logged in foreign GSM network (roaming), very weak signal (-97…-83 dBi)
◐ ◐ ◑ ◑	logged in foreign GSM network (roaming), good signal (-81…-67 dBi)
◐ ◐ ◑ ◑ ◑	logged in foreign GSM network (roaming), very good signal (> -65 dBi)

TX and RX LEDs	
◑	sending (TX)/receiving (RX) SMS messages
◐	sending (TX)/receiving (RX) GPRS data frame

USB LED	
◑	data packet sent via USB port
○	port in offline state

See the example of **STA LED** signaling logging in GSM/GPRS in roaming with very good signal.
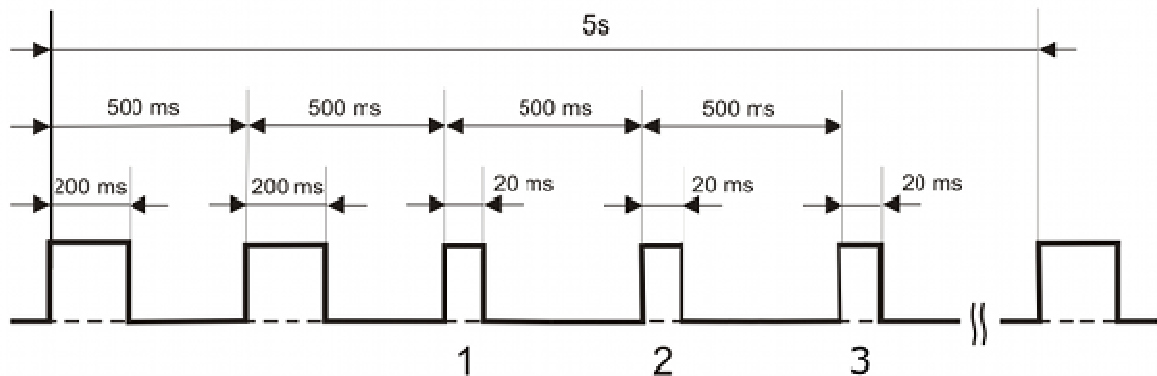
8.2. Unblocking the SIM card

Triple insertion of wrong PIN code results in blocking the SIM card. Blocked card renders SMS and data transmission impossible. Blocked sim card is signalled by **ERR LED**.
In order to unblock the SIM card do the following:

- power the module off
- take the SIM card off
- insert the SIM card to the mobile phone that accepts the SIM issued by your operator
- start the phone and insert the PUK code followed by PIN code
- power the module on
- insert proper PIN into configuration
- power the module off
- place the SIM card in the module
- power the module on

Executing the procedure unblocks the SIM card and enables module's proper operation.

8.3. Battery replacement

In order to replace the battery in **MT-713** do following:

- disassemble the enclosure lid
- press the ACTIVATE button for 2 to 8 seconds - this will force the module to go into battery replacement mode signaled by double flashes of POWER LED. In this mode the module does not perform analog inputs measurements, neither GPS measurements nor log into GSM network nor send data and SMS messages.
- disconnect the power cable from the PCB
- tilt the metal shelf with PCB

- remove the battery pack and replace it with the new one
- put the shelf back in place
- connect the battery to the socket on PCB
- assemble back and tighten the lid

The battery replacement mode extends the operating without power supply time. Deactivating the battery replacement mode is performed by pressing the **ACTIVATE** button for 2 to 8 seconds or connecting the battery or placing the enclosure lid at it's place.
We recommend using original battery packs available at manufacturers stores.

> **NOTICE!!!**
> **Battery replacement must be performed in less than 10 minutes. Not fulfilling this requirement leads to loss of current measurement data and RTC synchronization.**

> **NOTICE!!!**
> **Due to high environmental protection class (IP67) it is imperative to close the enclosure lid accurately. Precise alignment and tightening all screws is crucial for obtaining the required protection.**

9. Technical parameters

9.1. General

Dimensions (height x width x depth)	120 x 120 x 65 mm (122 x 120 x 95 mm for HC version)
Weight (with batteries)	1030 g (1430 g for HC version)
Mounting method	4 holes
Operating temperatures	-20°C…+55°C
Protection class	IP67 (optionally IP68)

9.2. Modem GSM/GPRS

Modem type	WAVECOM WIRELESS CPU
GSM	quad-band (850/900/1800/1900)
GPRS	Class 10
Frequency range:	
GSM 850 MHz	Transmitter: from 824 MHz do 849 MHz Receiver: from 869 MHz do 894 MHz
EGSM 900 MHz	Transmitter: from 880 MHz do 915 MHz Receiver: from 925 MHz do 960 MHz
DCS 1800 MHz	Transmitter: from 1710 MHz do 1785 MHz Receiver: from 1805 MHz do 1880 MHz
PCS 1900 MHz	Transmitter: 1850 MHz - 1910 MHz Receiver: 1930 MHz - 1990 MHz

Transmitter peak power	
GSM 850 MHz/EGSM900 MHz)	33 dBm (2W) – station of class 4
DCS 1800 MHz/PCS1900 MHz)	30 dBm (1W) – station of class 1
Modulation	0,3 GMSK
Channel spacing	200 kHz
Antenna	50 Ω

9.3. Binary/pulse inputs I1...I5

Contacts polarization	3,0 V
Counting frequency (fill 50%)	250 Hz max.
Minimal pulse length - operating in pulse input mode	0,5 ms
Minimal pulse length - operating in binary input mode	100 ms

9.4. NMOS outputs Q1, Q2

Maximum voltage	30 V
Maximum current	250 mA
Switch off current	<50 µA
Resistance	1 Ω

9.5. Analog inputs AN1...AN3

Type	voltage, differential
Measuring range	0 - 5,0 V
Input resistance	>600 kΩ typically
Resolution	12 bits
Accuracy at 25°C temperature	±0,2 %
Accuracy at full temperature range	±0,5 %

9.6. Power output Vo

Voltage range	0...5,0V
Resolution	0,1V
Accuracy	2 %
Maximum current	50 mA

9.7. Logger

Memory type	FLASH
Max. records number	10 240
Min. recording time	30 ms

9.8. GPS receiver

Type	ANTARIS 4
Frequency	L1
Encoding	C/A
Number of channels	16
Accuracy	2,5 m CEP (3,0 m SEP)
Sensitivity	- 148 dBm

9.9. Temperature sensor

Type	Integrated sensor
Accuracy	±3°C

9.10. Power supply

Battery pack:
    3 alkaline batteries
    3 lithium batteries
    6 alkaline batteries
    6 lithium batteries
	4,5 V / 16 Ah
	3,6 V / 39 Ah
	4,5 V / 32 Ah
	3,6 V / 78 Ah

Mean current consumption in sleep mode	<250 µA
Mean current consumption with active GSM modem	50 mA

9.11. Enclosure

Mechanical endurance IK (EN 62262)	IK 08/07
Electrical isolation	Total isolation (II)
Halogen-less (DIN/VDE 0472, Part 815)	Yes
UV resistance	UL 508
Flammability Class (UL 746 C 5):	UL 94 5V
Glowing rod test (IEC 695-2-1) °C	960
NEMA Standard	NEMA 1, 4, 4X, 12, 13
Material	Polycarbonate
Material of lid screws	Stainless steel
Gasket material	Polyurethane

Standard version dimensions (121207)	
Length	122 mm
Width	120 mm
Height	65 mm

HC version dimensions (121210)	
Length	122 mm
Width	120 mm
Height	95 mm

121207

121210

9.12. Drawings and dimensions

MT-713 standard version:
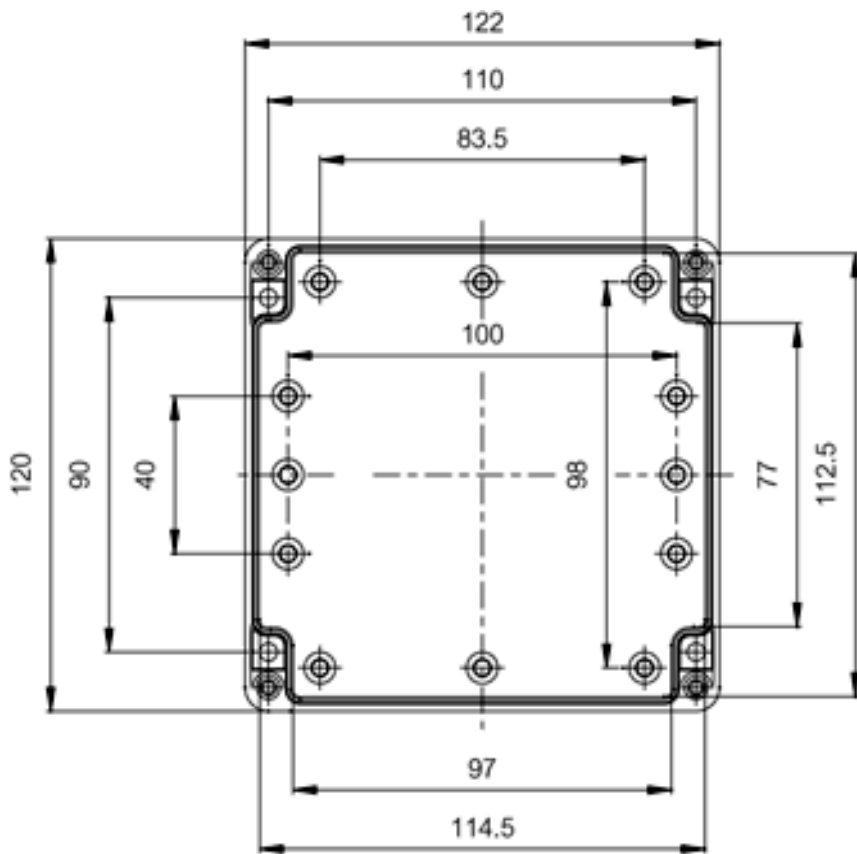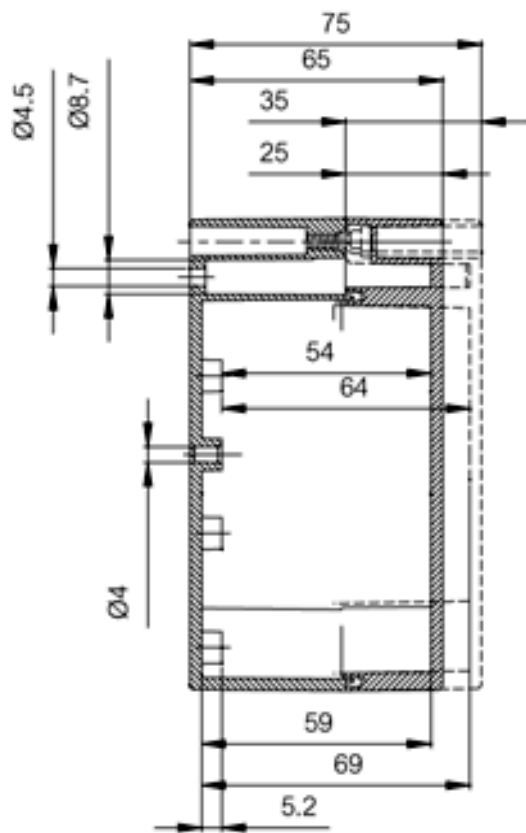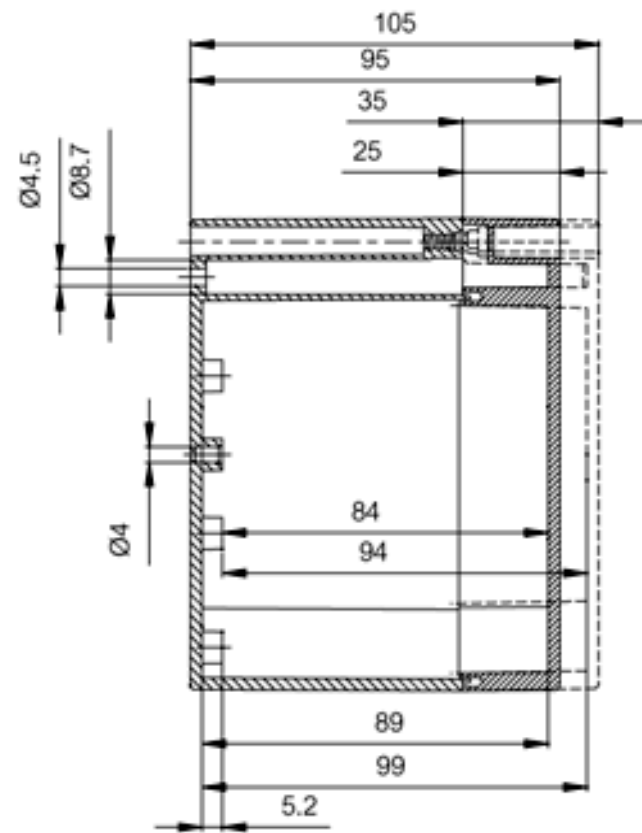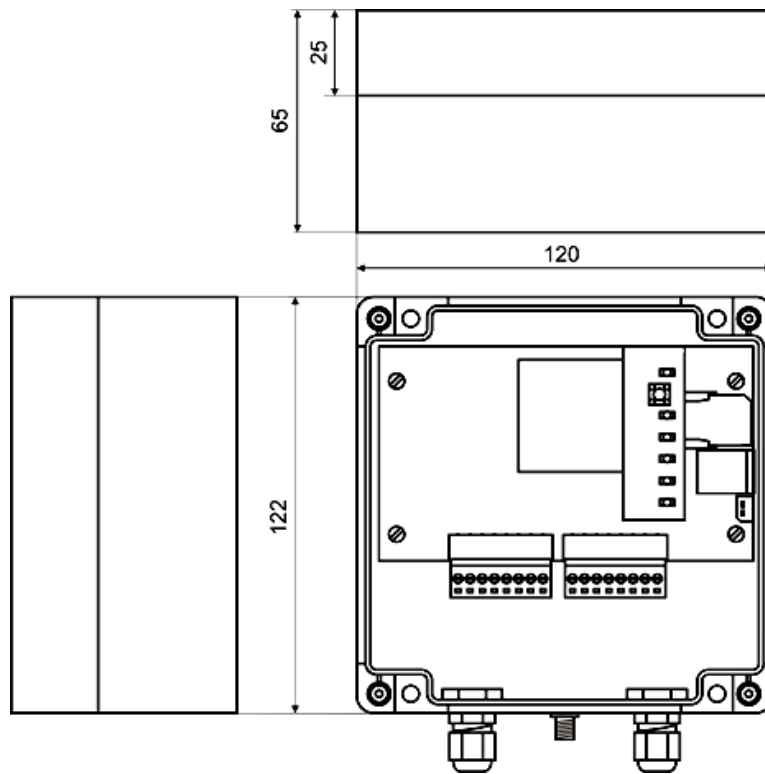
MT-713 HC version:
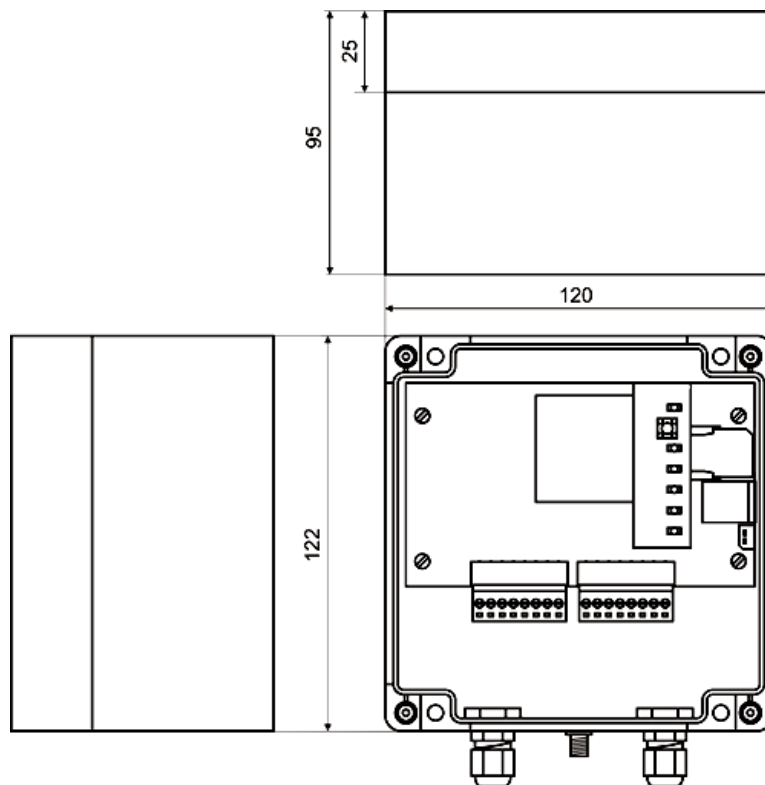
<div style="background:yellow; color:red; text-align:center; font-weight:bold;">
NOTICE!!!
All dimensions in millimetres!
</div>

10. Safety informations

10.1. Working environment

When deploying telemetry modules one has to observe and comply to local legislation and regulations. Using the telemetry module in places where it can cause radio noise or other disturbances is strictly prohibited.

10.2. Electronic equipment

Thou most of modern electrical equipment is well RF (Radio Frequency) shielded there is no certainty that radio waves emitted by the telemetry module's antenna may have negative influence on it's function.

10.2.1. Heart pacemakers

It is recommended that the distance between the antenna of telemetry module and the Heart Pacemaker is greater than 20 cm.
This distance is recommended by manufacturers of Pacemakers and in full harmony with results of studies conducted independently by Wireless Technology Research.

10.2.2. Hearing aids

In rare cases the signal emitted by the telemetry module's antenna may disturb hearing aids functions. Should that occur, one has to study detailed operating instructions and recommendations for that particular product.

10.2.3. Other medical equipment

Any radio device including the telemetry module may disturb the work of electronic medical equipment.
When there is a need of installing telemetry module in vicinity of medical equipment one has to contact the manufacturer of this equipment in order to make sure that the equipment is adequately protected against interference of radio frequency waves (RF).

10.2.4. RF Marked equipment

The restriction against installing telemetry modules in areas marked as radio frequency (RF) prohibition zones must be unconditionally observed.

10.3. Explosive environment

Installation of telemetry modules in the environment where explosion hazard is present is not permitted. Usually, but not always, these places are marked with warning signs. Where there is no marking do not install telemetry modules at liquid or gas fuels stores, inflammable materials stores, nor places contaminated with metal or wheat dust.

11. Appendices

11.1. SMS commands syntax

MT-713 can send SMS messages including mnemonics replaced with numerical values at the moment of dispatch. It can respond to queries sent via SMS. Bear in mind that the module receives SMS messages only when it is logged in the network.

In the table you will find all available commands and mnemonics for SMS. Bold types represent mandatory commands while italics represent parameters added by user. Square brackets embrace optional elements.

Read commands:

Commands may be used as mnemonics in SMS messages sent as a result of Rules processing.

#BAT	battery voltage
#CNT*counter number*	read counter status
#IRB*decimal register address*	read analog register value (input registers)
#HR*decimal register address*	read internal register value (holding registers)
#IB*decimal bit address*	read bit from analog registers space (input registers)
#HB*decimal bit address*	read bit from internal registers space (holding registers)
#GPST	read GPS position time stamp (UTC)
#GPSD	read GPS position date stamp (UTC)
#GPSP	read GPS position
#I*binary input number*	read binary input state
#Q*binary output number*	read binary output state
#AN*analog input number*	read analog input register value (does not perform the measurement)
#FL*binary input number*	read flow register value (does not perform the flow calculation)
#GSM	read signal level
#SN	read serial number
#MOD	read module type
#NAME	read module name
#VER	read module firmware version
#TIME	read module's time
#DATE	read module's date
#IP	read module's current IP address (if not logged to GPRS answer is 0.0.0.0)

Write commands:

#CNT*counter number*=	write new value to counter register (calibration)
#HR*decimal register address*=	write new value to internal register (holding registers)
#HB*decimal bit address*=	write bit value to internal register space (holding registers)
#Q*binary output number*=	set binary output (does not work if the output is controlled by other bit than Q1 or Q2)

Special commands:

![*password* **]ACTIVATE** *HH:MM mm*	this command makes module activate and log into GPRS at *HH:MM* for *mm* minutes (zeroes at the beginning of hour and/or minutes can be omitted). The module sends confirmation with date and time of activation and module's timestamp. This activation does not make module to report to MTSpooler. *password* is password protecting module's configuration. If there is no password protecting module's configuration just omit *password* parameter and space just after it.
![*password* **]GETIP**	read module's current IP address (if not logged to GPRS answer is *0.0.0.0*). *password* is password protecting module's configuration. If there is no password protecting module's configuration just omit *password* parameter and space just after it.
![*password* **]ONLINE[** *mmmm*]	extend module activity time by *mmmm* minutes in range 1...1092. If this parameter is omitted activity is prolonged by 3 minutes. In response module sends time remaining to go asleep. *password* is password protecting module's configuration. If there is no password protecting module's configuration just omit *password* parameter and space just after it.
![*password* **]CLRLOG**	delete all stored in FLASH memory events and logger records. *password* is password protecting module's configuration. If there is no password protecting module's configuration just omit *password* parameter and space just after it.
![*password* **]CLRCFG**	clear module configuration. All but parameters essential to log module to GSM/GPRS network and for remote configuration are set to default values. *password* is password protecting module's configuration. If there is no password protecting module's configuration just omit *password* parameter and space just after it.
![*password* **]ENPHONE[** *tel_number*]	add telephone number to authorized telephone numbers. Authorization expires when module enters sleep mode. *password* is password protecting module's configuration. If there is no password protecting module's configuration just omit *password* parameter and space just after it.
![*password* **]ENIP[** *IP_address*]	add *IP_address* to authorized IP (configuration only). Authorization expires when module enters sleep mode. *password* is password protecting module's configuration. If there is no password protecting module's configuration just omit *password* parameter and space just after it.

Comments:
Each special SMS command (except for **![***password* **]ONLINE[** *mmmm*<3]) prolongates activity of module by 3 minutes.
All SMS commands, including the incorrect commands, are answered by SMS.
To prevent module from sending a reply to the command put *$* sign on beginning of SMS (not applicable to special SMS commands).
All module's responses are preceded by *>* sign.
If the module can not interpret the command the response is *>ERR*.
If attempted write value is out of range the response is *>command=ERR* (e.g. *>#CNT1=ERR*).
To pass the *#* sign in SMS type *##*.

11.2. Memory map

All accessible from remote resources of MT-713 module were collected in four address spaces: binary inputs, analog inputs, binary outputs and internal registers. Spaces of binary inputs and analog inputs and spaces of binary outputs and internal registers are connected in pairs and contain the same resources. The difference between spaces is in the way of accessing the resources - for binary inputs and outputs are used for accessing individual bits and groups of bits while analog inputs and internal registers address spaces allow access to the full registers.

This difference results in a different way addressing. In the internal registers and analog input address spaces each address is assigned to the each register while the for binary inputs and outputs address spaces are each address corresponds to individual bit. The memory map tables are arranged by their addresses for addressing registers. To calculate the addresses of the individual bits in the binary spaces, use the following equation:

$$register\_address * 16 + bit\_position = bit\_address$$

For example, in the MT_BITS register from analog inputs address space (address 6) on position 7 is the KEY_P bit indicating pressing ACTIVATE button. Using that formula, you can specify the address of KEY_P bit in binary inputs address space as follows:

$$6 * 16 + 7 = 103.$$

Bits that are typed in bold in the memory map tables are refreshed in each program cycle, irrespective of fact if modem is on or off. It is recommended to use only those bits for generating events that trigger a measurement or data/SMS sending rule. In case of using those bits for such purposes, expected action of module will be executed only after GSM modem start triggered by other event.

11.2.1. Analog inputs/binary inputs address space

<table>
<tr><th colspan="21">Analog inputs address space (read only), Modbus RTU functions (2,4)</th></tr>
<tr><th colspan="2">Address</th><th colspan="16">Bits</th><th rowspan="2">Name</th><th rowspan="2">Description</th></tr>
<tr><th>DEC</th><th>HEX</th><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td>0x0000</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>RUN</td><td>FS</td><td>1</td><td>0</td><td>PRG_STATE</td><td>FS - first scan (pierwszy cykl)
RUN - program running</td></tr>
<tr><td>1</td><td>0x0001</td><td>2^0</td><td>2^{-1}</td><td>2^{-2}</td><td>2^{-3}</td><td>2^{-4}</td><td>2^{-5}</td><td>2^{-6}</td><td>2^{-7}</td><td>2^{-8}</td><td>2^{-9}</td><td>2^{-10}</td><td>2^{-11}</td><td>2^{-12}</td><td>2^{-13}</td><td>2^{-14}</td><td>2^{-15}</td><td>RTC_FSEC</td><td>RTC (UTC time) - second fraction</td></tr>
<tr><td>2</td><td>0x0002</td><td colspan="5">hour (0...23)</td><td colspan="6">minute (0...59)</td><td colspan="5">second / 2 (0...29)</td><td>RTC_HMS</td><td>RTC (UTC time) - RTC time second - youngest bit in RTC_FSEC (address 20)</td></tr>
<tr><td>3</td><td>0x0003</td><td colspan="5">year - 2000 (0...127)</td><td colspan="5">month - 1 (0...11)</td><td colspan="6">day - 1 (0...30)</td><td>RTC_YMD</td><td>RTC (UTC time) - date</td></tr>
<tr><td>4</td><td>0x0004</td><td colspan="16" rowspan="2">int32(LoHi)</td><td rowspan="2">ON_TMR</td><td rowspan="2">Uptime [s] from connecting to power supply</td></tr>
<tr><td>5</td><td>0x0005</td></tr>
<tr><td>6</td><td>0x0006</td><td>RTC_OK</td><td>RTC_C</td><td>ZONE_C</td><td>HREG_C</td><td>CFG_OK</td><td>GPS_C</td><td>AN_C</td><td>FL_C</td><td>KEY_P</td><td>PF</td><td>SLEEP</td><td>Vo</td><td>GPS</td><td>GSM</td><td>USB</td><td>BAT</td><td>MT_BITS</td><td>**Module status bits**
BAT = 1 - battery OK
USB = 1 - powered from USB
GSM = 1 - GSM modem on
GPS = 1 - GPS on
Vo = 1 - Vo output on
SLEEP = 1 - set for 1 cycle after awaking (1 cycle)
PF = 1 - set for one cycle after power restore (1 cycle)
KEY_P = 1 - ACTIVATE button released (1 cycle)
FL_C = 1 - new flow value computed (1 cycle)
AN_C = 1 - analog inputs measurement finished (1 cycle)
GPS_C = 1 - new data from GPS (1 cycle)
CFG_OK = 1 - module configuration OK
HREG_C = 1 - remote HREG registers change (1 cycle)
ZONE_C = 1 - timezone change (1 cycle)
RTC_C = 1 - RTC clock change (1 cycle)
RTC_OK = 1 - RTC clock set</td></tr>
</table>

No.	Addr																	Name	Description
7	0x0007	---	---	---	---	---	---	---	---	---	---	VIB	OPEN	TEMP_Hi	TEMP_Lo	DEW	LBAT_C	MT_ALM	**Alarm bits** LBAT_C = 1 - low battery voltage alarm (1 cycle) DEW = 1 - condensation alarm TEMP_Lo = 1 - low temperature alarm TEMP_Hi = 1 - high temperature alarm OPEN = 1 - open enclosure alarm VIB = 1 - vibrations alarm
8	0x0008	KEY	---	---	---	---	---	---	---	---	---	---	I5	I4	I3	I2	I1	BIN	Ix - binary inputs states KEY - ACTIVATE button state
9	0x0009	CT8	CT7	CT6	CT5	CT4	CT3	CT2	CT1	CK8	CK7	CK6	CK5	CK4	CK3	CK2	CK1	CLOCK	Timer flags (1 cykl)
10	0x000A	int16																FL1	Flow I1
11	0x000B	int16																FL2	Flow I2
12	0x000C	int16																FL3	Flow I3
13	0x000D	int16																FL4	Flow I4
14	0x000E	int16																FL5	Flow I5
15	0x000F	int16																AN1	Analog input AN1
16	0x0010	int16																AN2	Analog input AN2
17	0x0011	int16																AN3	Analog input AN3
18	0x0012	AN3_LoLo	AN2_LoLo	AN1_LoLo	FL5_LoLo	FL4_LoLo	FL3_LoLo	FL2_LoLo	FL1_LoLo	AN3_Lo	AN2_Lo	AN1_Lo	FL5_Lo	FL4_Lo	FL3_Lo	FL2_Lo	FL1_Lo	ALM_L	Low alarm bits
19	0x0013	AN3_HiHi	AN2_HiHi	AN1_HiHi	FL5_HiHi	FL4_HiHi	FL3_HiHi	FL2_HiHi	FL1_HiHi	AN3_Hi	AN2_Hi	AN1_Hi	FL5_Hi	FL4_Hi	FL3_Hi	FL2_Hi	FL1_Hi	ALM_H	High alarm bits
20	0x0014	---	---	---	---	---	---	---	---	AN3_DB	AN2_DB	AN1_DB	FL5_DB	FL4_DB	FL3_DB	FL2_DB	FL1_DB	ALM_DB	Deadband bits (1 cycle)
21	0x0015	0...5000																VBAT	Battery voltage [mV]
22	0x0016	int16																TEMP	Temperature x 0,1 [°C]
23	0x0017																		
24	0x0018	SYG_LEV (0...100)								SIM_ERR	PIN_ERR	-	-	APN	GPRS	ROAMING	GSM	GSM_STATE	**GSM status bits** SYG_LEV = GSM signal strength [%] GSM = 1 - module registered in GSM (range OK) ROAMING = 1 - module in roaming GPRS = 1 - GPRS available APN = 1 - module logged into APN SIM_ERR = 1 - error or no SIM card PIN_ERR = 1 - wrong PIN
25	0x0019	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	GPS_FSEC	GPS timestamp (format same as RTC)
26	0x001A	hour (0...23)					minute (0...59)						second / 2 (0...29)					GPS_HMS	
27	0x001B	year - 2000 (0...127)						month - 1 (0...11)				day - 1 (0...30)						GPS_YMD	

28	0x001C	Latitude (LoHi)						GPS_LAT	Latitude in degrees
29	0x001D								
30	0x001E	Longitude (LoHi)						GPS_LONG	Longitude in degrees
31	0x001F								
32	0x0020	Course over ground (0...359)						GPS_COG	Course in degrees (0° - N, 90° - E, 180° - S, 270° - W)
33	0x0021	Speed						GPS_SPD	Speed [km/h]
34	0x0022	F I X	HDOP (0...99)	M O V	G E O F _ C	G E O F	-	SAT (0...15)	GPS_STATE	**GPS status** SAT - number of satellites (max 15) GEOF = 1 - position outside geofencing border GEOF_C = 1 - position outside geofencing border (1 cycle) MOV = 1 - movement detected (1 cykl) HDOP - accuracy of position measurement (0...99) FIX = 1 - position found (1 cycle)
35	0x0023	int16						BAT_ACT	Time on battery [h] (rested after battery disconnection)
36	0x0024	-						-	Reserved
37	0x0025	int16						VO_ACT	Timer of Vo activity [m] (rested after battery disconnection)
38	0x0026	int16						GPS_ACT	Timer of GPS receiver activity [m] (rested after battery disconnection)
39	0x0027	int16						GSM_ACT	Timer of GSM modem activity [m] (rested after battery disconnection)
40	0x0028	int16						GSM_CNT	GSM modem starts counter (rested after battery disconnection)

11.2.2. Internal registers/binary outputs address space

Internal registers address space (read/write), Modbus RTU functions (read - 1, 4; write - 5, 6, 15, 16)																			
Address		Bits																Name	Description
DEC	HEX	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
0	0x0000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Q1	Q2	BOUT	Qx - outputs steering bits. If set to 1 output is set high. When read show current output state.
1	0x0001	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Reserved
2	0x0002	int32(LoHi)																CNT1	32-bit general purpose counter
3	0x0003																		
4	0x0004	int32(LoHi)																CNT2	32-bit general purpose counter
5	0x0005																		
6	0x0006	int32(LoHi)																CNT3	32-bit general purpose counter
7	0x0007																		
8	0x0008	int32(LoHi)																CNT4	32-bit general purpose counter
9	0x0009																		
10	0x000A	int32(LoHi)																CNT5	32-bit general purpose counter
11	0x000B																		
12	0x000C	int32(LoHi)																CNT6	32-bit general purpose counter
13	0x000D																		
14	0x000E	int32(LoHi)																CNT7	32-bit general purpose counter
15	0x000F																		
16	0x0010	int32(LoHi)																CNT8	32-bit general purpose counter
17	0x0011																		

11.3. Bit list

During its operation **MT-713** is setting a series of binary variables associated with the I/O and module diagnostics. They can be used for trigger events and measurements. **MTManager2.0**, for user convince, have implemented list of predefined bits.

Bit name	Description
KEY_P	ACTIVATE button presses and released. Bit set for one program cycle - events only on rising edge.
FL_C	New flow value computed. Bit set for one program cycle - events only on rising edge.
AN_C	Analog inputs measurement finished. Bit set for one program cycle - events only on rising edge.
GPS_C	New data from GPS. Bit set for one program cycle - events only on rising edge.
LBAT_C	Low battery voltage alarm. Bit set for one program cycle - events only on rising edge.
DEW	Condensation alarm
TEMP_Lo	Low temperature alarm
TEMP_Hi	High temperature alarm
OPEN	Open enclosure alarm (1 - enclosure open)
I1...I5	Binary inputs I1...I5
CT1...CT8	Binary outputs Q1...Q2
AN1_LoLo...AN3_LoLo	Analog inputs alarm bits - LoLo alarm. Measured value lower than LoLo alarm threshold.
AN1_Lo...AN3_Lo	Analog inputs alarm bits - Lo alarm. Measured value lower than Lo alarm threshold.
AN1_Hi...AN3_Hi	Analog inputs alarm bits - Hi alarm. Measured value higher than Hi alarm threshold.
AN1_HiHi...AN3_HiHi	Analog inputs alarm bits - HiHi alarm. Measured value higher than HiHi alarm threshold.
Q1...Q2	Binary outputs Q1...Q2

More information about all available bits can be found in Memory map.