Telemetry Module MT-723

CE

User Manual

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Telemetry Module
MT-723
User Manual

GSM/GPRS Telemetry Module
for monitoring and control

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

MT-723

INVENTIA Sp. z o.o

v0.90

MT-723

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1. Module's destination

The **MT-723** is a specialized telemetry module optimized for use within simple measuring and alarm systems where power lines are not available and environmental conditions are harsh (dust, high humidity, possibility of water flooding).

Compact design, low power consumption, a wide range of acceptable energy sources (alkaline or lithium battery packs, gel or car batteries, solar panels and other), 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 battery supply.

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-723 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

Maintenance and problem solving - here is described procedure of unblocking locked SIM card and LED signaling schemes

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 which is necessary for proper configuration of MTDataProvider and data collecting equipment.

3. GSM requirements

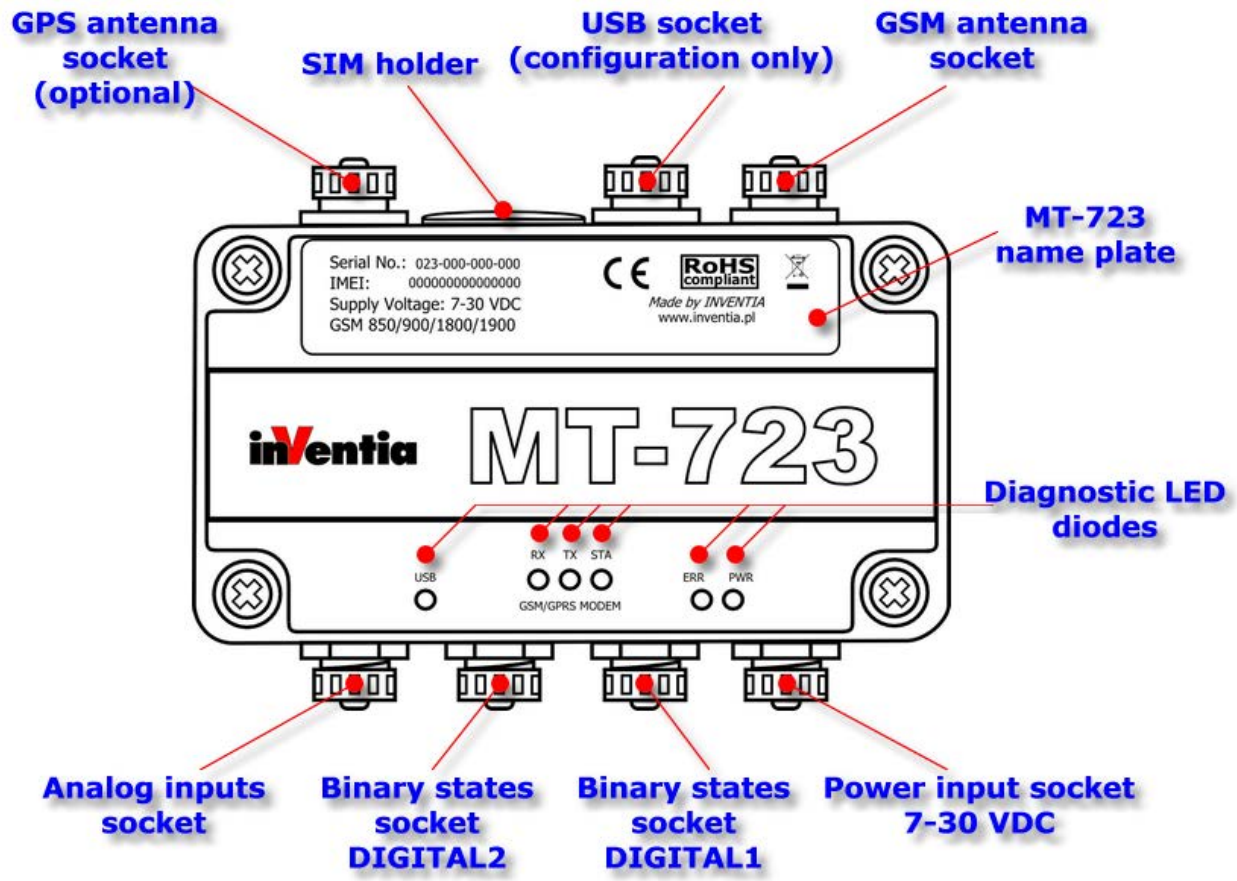
For proper operation of the module a SIM card provided by a GSM operator with GPRS and/or SMS option enabled is essential.

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



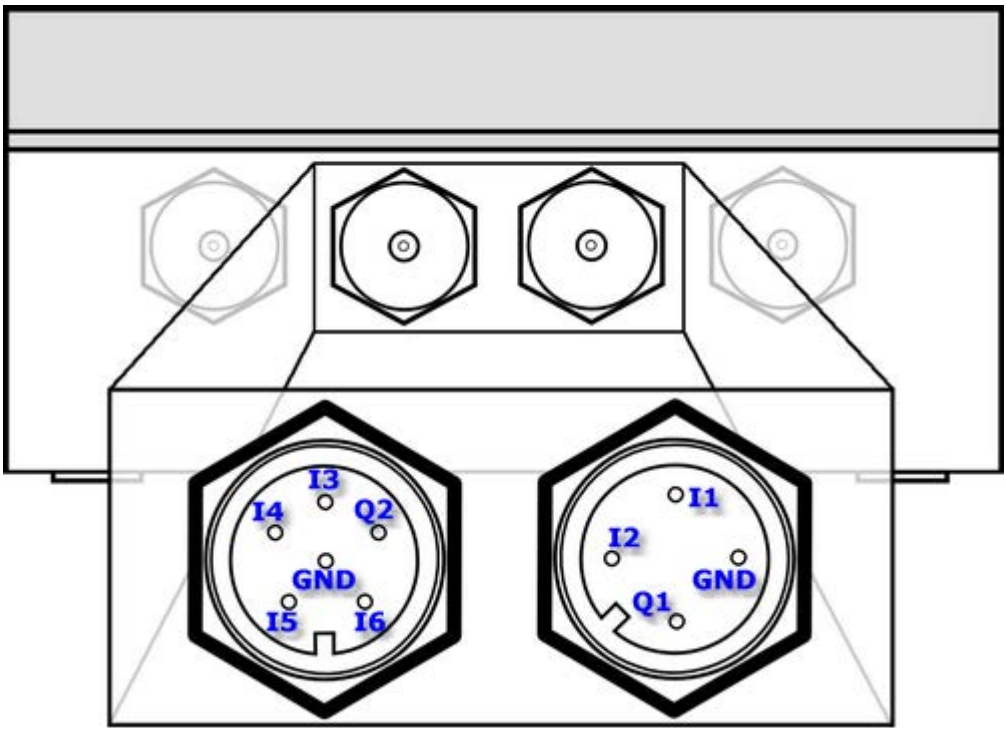
4.2. Resources

Hardware Resources of **MT-723:**

DI - binary inputs	5	binary inputs, pulse or potential free (the function is selected during configuration)
	1	potential free binary input I6 with possibility of setting its state using magnet (reed switch)
AI - analog inputs	2	0-5 V, with possibility of supplying power to the measuring circuit
DO – binary outputs	3	NMOS outputs ("open drain" type) 0…+30 VDC, mono- or bistable (the function is selected during configuration)
Temperature sensor	1	temperature sensor integrated in the microprocessor
Vibration sensor (binary input I5)	1	module has an integrated vibration sensor of contact, normally open, connected to digital input I5. It is used to detect movement of the device.
GPS Module (optional)	1	for calculating geographical position and time synchronization
Pressure sensor (optional)	1	special version of the module with an integrated pressure sensor
Module flooding sensor (optional)	1	in developing stage

4.2.1. Binary inputs

MT-723 module is equipped with 6 binary inputs (**DI**) marked as **I1...I6**.



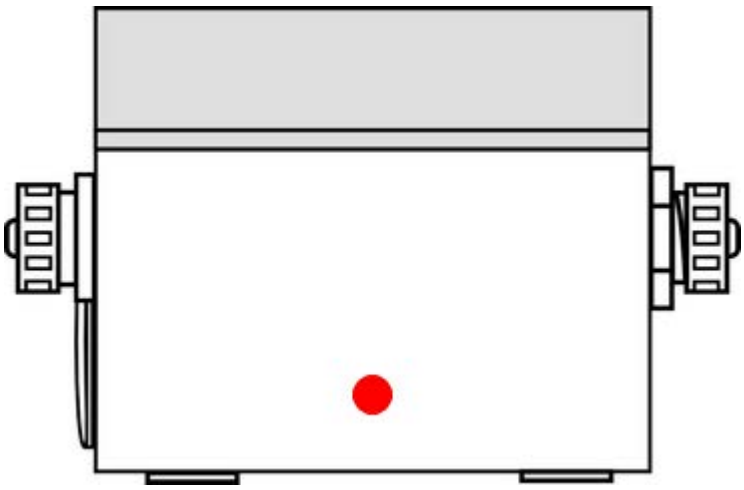
Inputs **I1…I6** are designed to cooperate with potential free contacts (contacts connecting the input and common for all inputs ground). The inputs operate in **negative logic**, meaning the input is high when connected to ground and low if the circuit is open. This solution allows energy saving, a 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 their state and cannot be used to trigger events except for counting inputs for counters CNT1…CNT5.

Binary input **I5** is connected with an integrated vibration sensor with normally open contacts. Therefore **it is not recommended** to use input I5 as binary input for fast-changing digital input signal or pulse input. It is not possible to simultaneously use the functionality of the vibration sensor and digital input, or pulse input I5. Additional parameters associated with vibration detection are gathered in Vibration sensor (optional) parameters group.

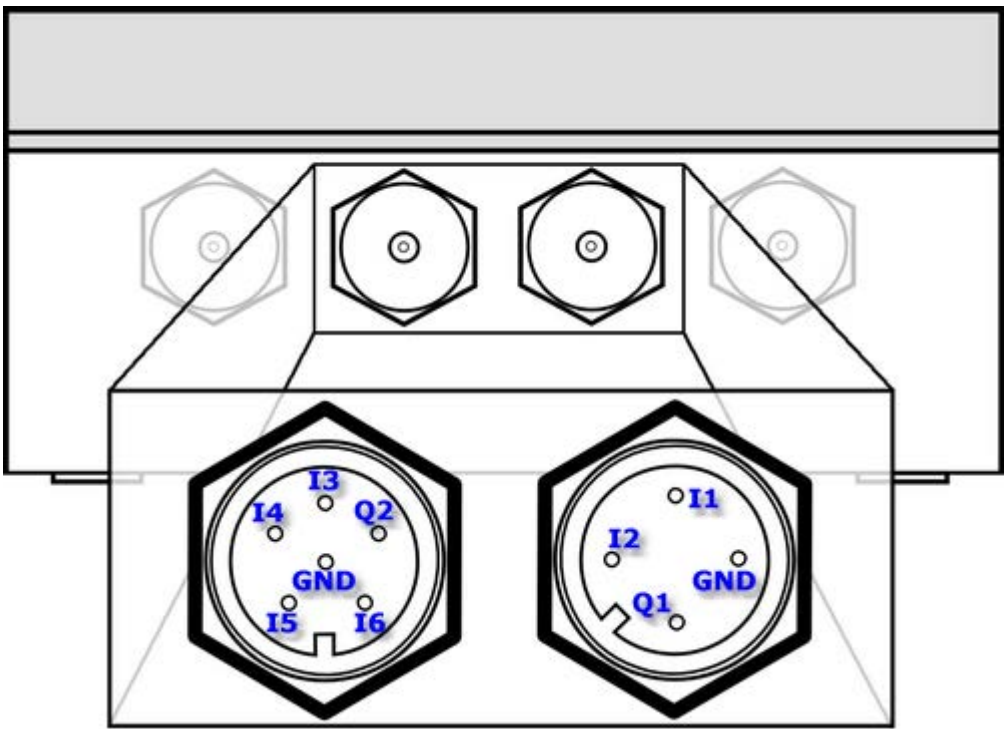
Binary input **I6** can operate **only as a binary input**. This input can be, in addition to short-circuiting its pin to GND pin, set in a high state by approximating the magnet to a point marked on the left side of the module.



Irrespectively to chosen mode of operation states of the binary inputs are monitored by the module in both **energy-consuming and sleep mode**.

4.2.2. Binary outputs

MT-723 module is equipped with 2 binary outputs (**DO**) marked as **Q1** i **Q2** .

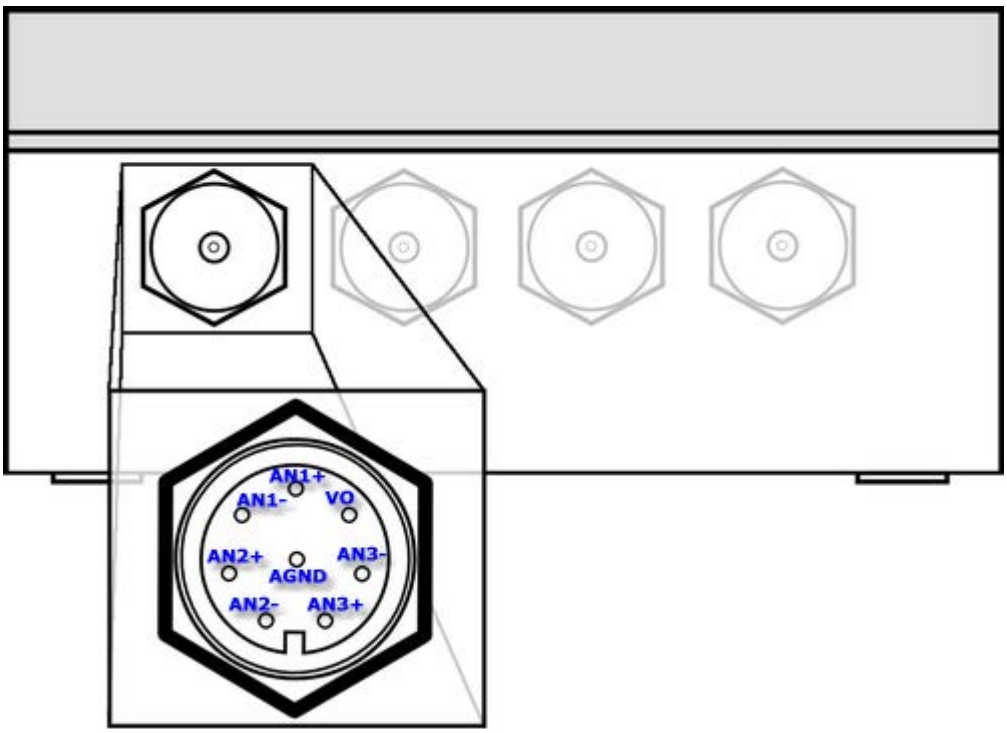


The outputs are designed to control loads powered by internal source (e.g. light signaling). The outputs are of "open drain" type controlled by NMOS transistors.
In High state the output is shorted to the ground by active NMOS transistor. In case of inductive type load connected (a relay) the circuit 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-723 module is equipped with 3 voltage analog inputs (**AI**) marked **AN1…AN3**.

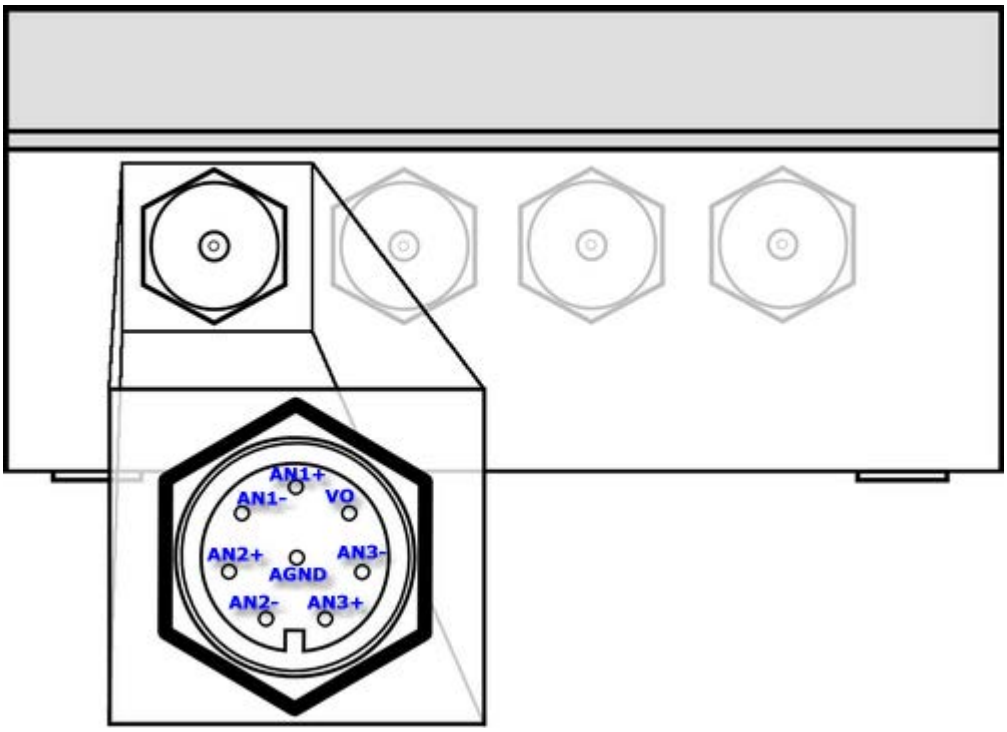


The inputs are designed to work with analog sensors generating signal in **0...5V** range. In order to minimize energy consumption the A/C converters are powered for the period necessary to conduct secure measurement.

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-723 module is equipped with the keyed power output Vo, which is destined to power sensors connected to analog inputs.



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. 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.

4.2.6. Vibration sensor

Binary input I5 is connected with an integrated vibration sensor with normally open contacts. This sensor can be used for detection of module movement. This allows user to detect intrusion into measurement system ,perform measurements of module's positions only when the device moves more.
Vibration sensor is always on.

4.2.7. Real Time Clock

MT-723 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.

NOTICE!!!
The clock setting has to be repeated if the module was in storage mode (details in Power supply chapter).

4.2.8. Timers

MT-723 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.

4.2.9. Counters

MT-723 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.

4.2.10. Logger

MT-723 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

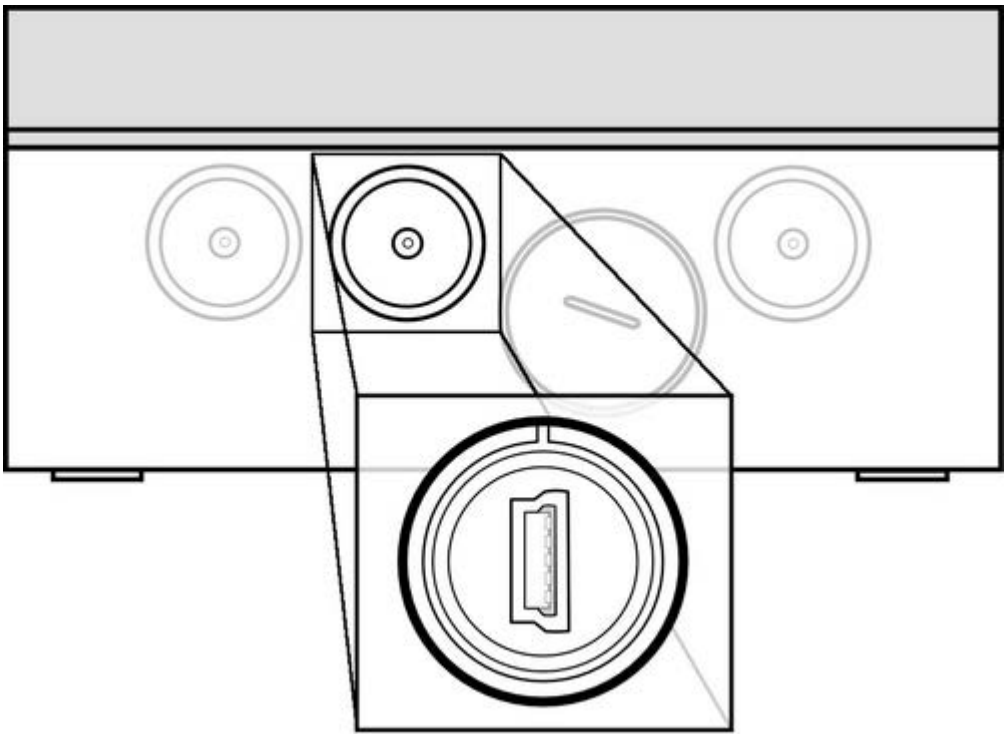
defined alarm thresholds and other. The logger records **all of the events defined in the table**. The user has an opportunity to define which ones have to be transmitted. The records are the copy of all module's registers. Each record in the logger has a time stamp of the module's internal Real Time 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.

4.2.11. GPS (optional)

MT-723 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

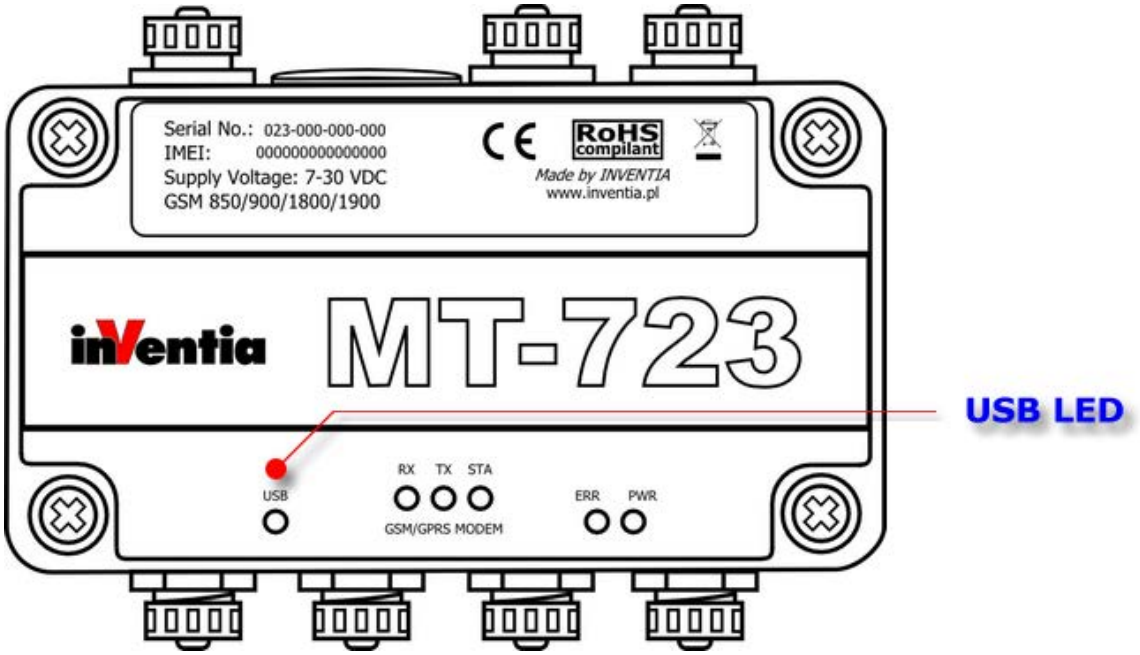
MT-723 provides **USB** socket used for local configuration by **MTManager2.0** program.



When module is connected via USB to a computer, it is powered via USB port. Thanks to that the module does not consume limited battery power during configuration and tests. During USB connection **VBAT** 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 AB type cable is used. See depicted plugs of the cable below.

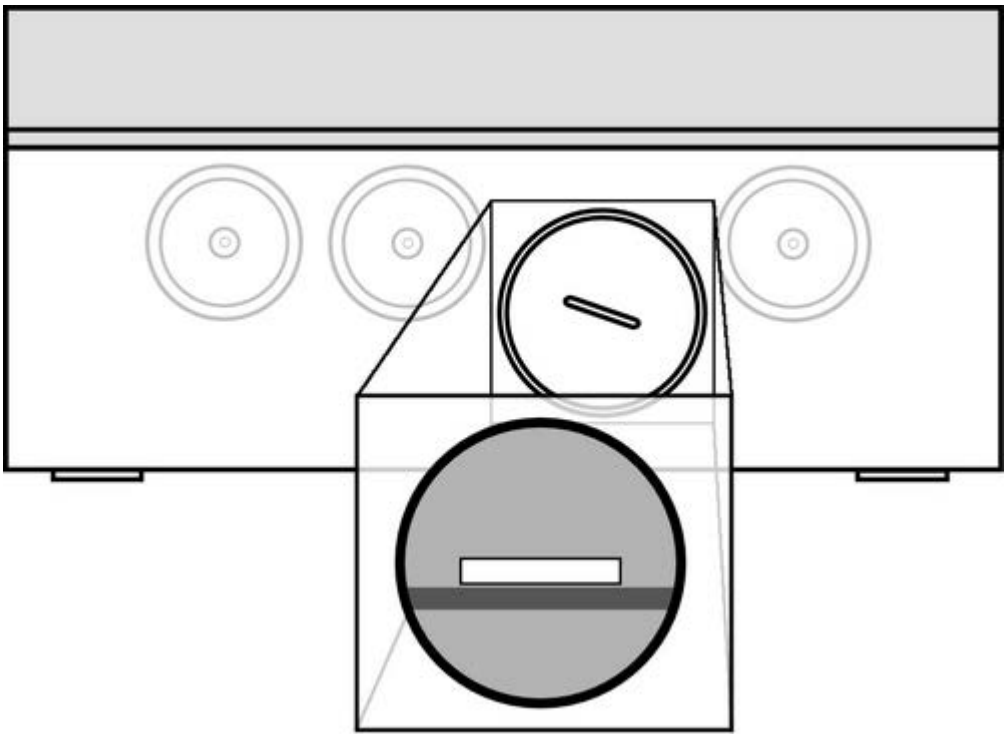
The proper USB connection is signaled by the **POWER LED** (the module is powered by USB) and the **USB LED** (USB port ready for transmission). Data transmission is signaled by shot flashes of USB LED.



Detailed information on using the **USB** port for module configuration can be found in the **MTManager2.0** manual.

4.4. SIM card

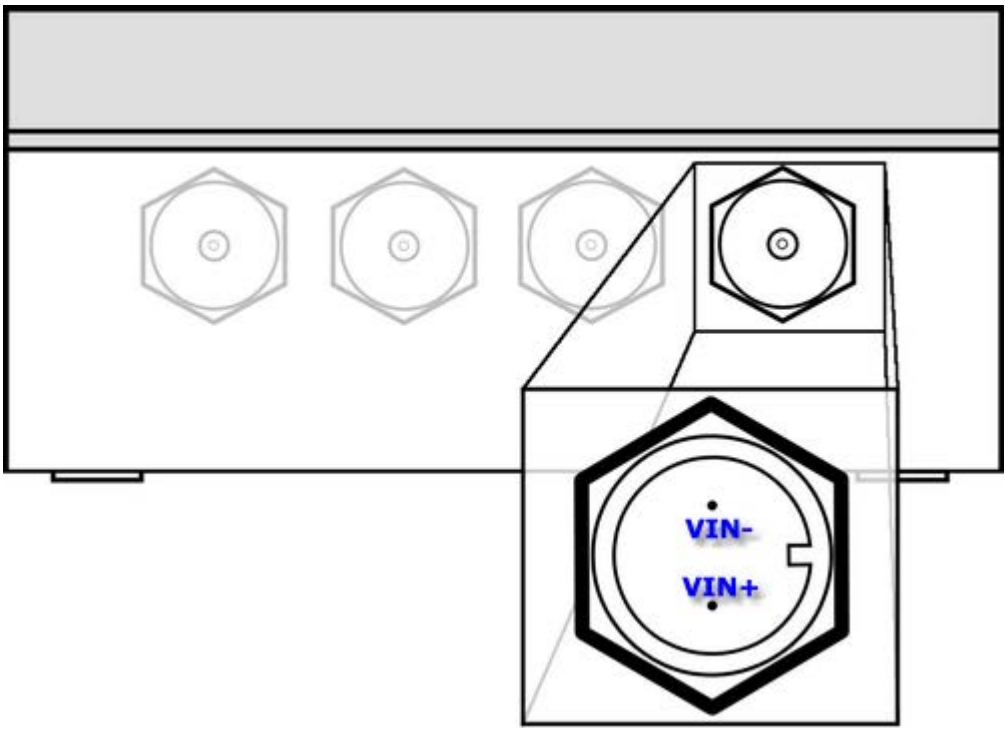
MT-723 module is equipped with a holder for miniature SIM card. The holder is placed horizontally on the PCB inside the enclosure.



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-723 module can be powered from **any DC power source** providing voltage within the range of 7-30 VDC, including a DC power supply, alkaline batteries, gel batteries, photovoltaic cells, and others.



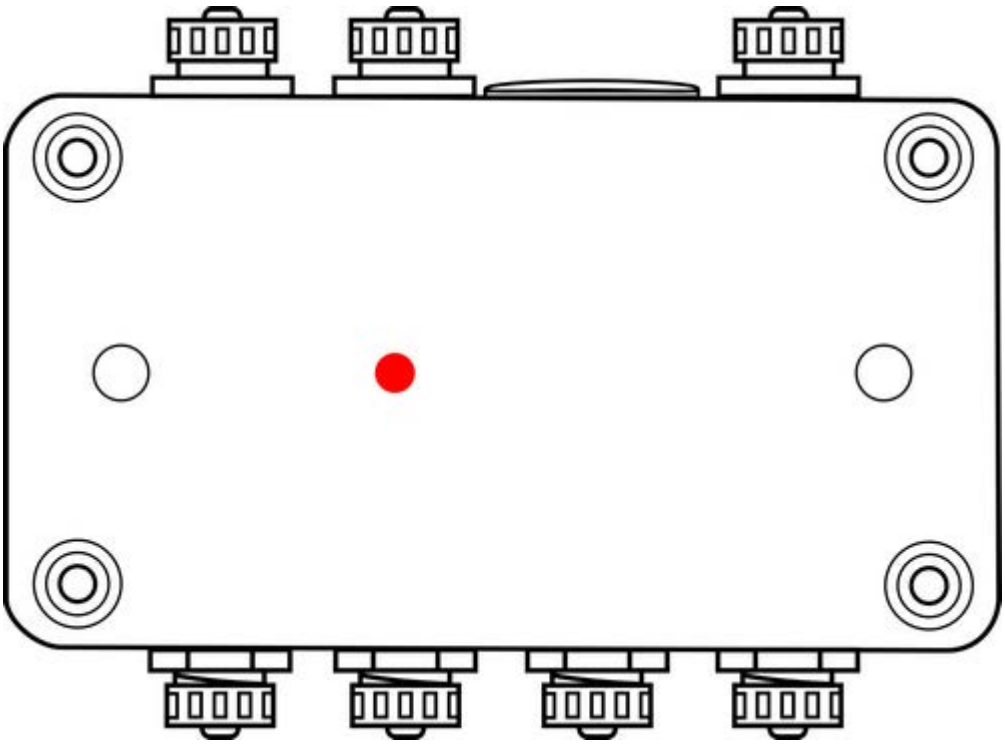
It is recommended to place the power supply in IP68 enclosure and ensure the connection with module is of the same class. Any power source housing or connectors leakage may allow water penetration and consequently damage electronic components of module. Proper power source connection is described in *Power supply* subchapter of *Connection diagrams* chapter.

When module is being configured via USB it is powered from a PC. This allows module to reduce battery consumption. Working with such supply is indicated by **PWR** and **USB** LEDs (details provided in *LED signaling* subchapter of *Maintenance and problem solving* chapter). Module connected to PC via USB is constantly in high energy consumption state (is awake and logged to GSM/GPRS network).

The module is equipped with an internal lithium **backup battery** that is designed to provide power to module after main power loss. This battery is **not replaceable nor rechargeable**.

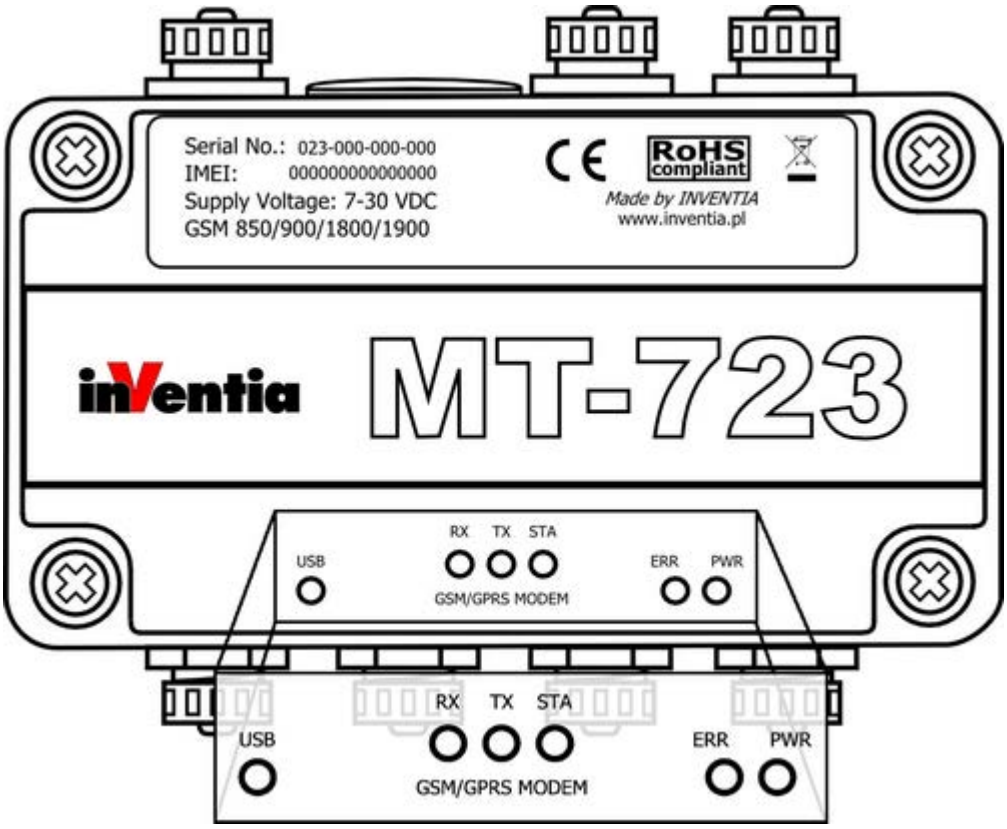
The module can be in three power supplying modes:

- **operational mode** - this is the default power supplying mode. In this mode modules is powered from external main power source or from USB cable. Module enters this state after connecting USB cable or connecting main power source. In this mode full functionality of module is available;
- **backup power mode** - in this mode module is powered from backup battery. Module enters this state three minutes after main power source loss. In this mode module is measuring binary inputs, counting pulses, measuring flows. Analog measurements and GSM/GPRS communication are not possible in this mode. Module is constantly in sleep mode to preserve power - it is signaled by PWR LED. It is advised to replace damaged/depleted power source as soon as possible;
- **storage mode** - in this mode is not connected to any power source and does not consume power from the internal lithium backup battery. To set module in this mode hold magnet for 1 minute at the point marked on the bottom of the device. The transition to this mode is indicated by lack of LED signaling (within 12 seconds there should be no **PWR** or other LED blink);



4.6. LED indicators

LED indicators placed on **MT-723** module's PCB are a great help during modules startup.



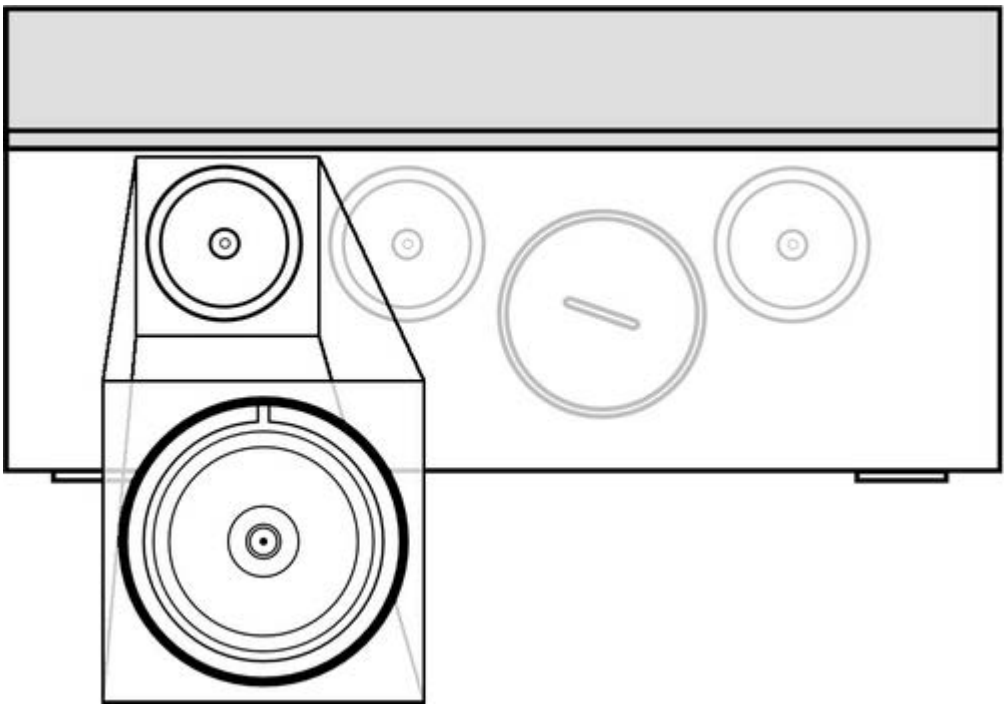
The LED's have assigned following significance:

- **PWR** 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 signaling* subchapter of *Maintenance and problem solving* chapter.

4.7. GSM antenna

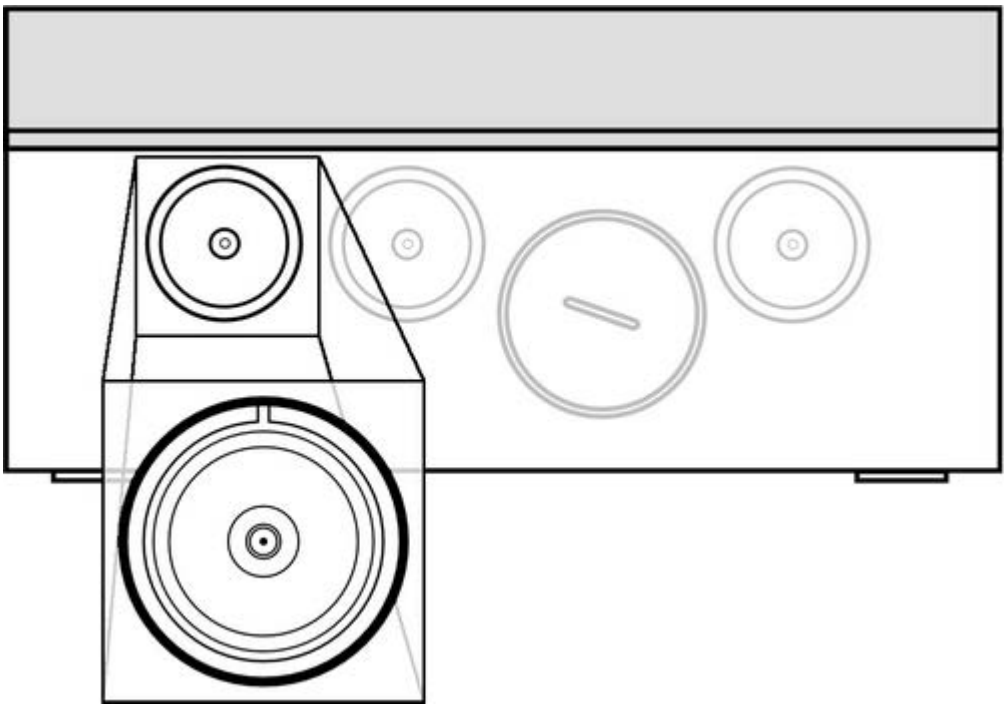
Connecting the antenna is necessary for reliable data transmission from **MT-723** module. **SMB IP68** type antenna socket is placed on module's panel.



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 or antenna high gain may be necessary.
It is essential to use IP68 connector to prevent moisture penetration which can cause module damage.

4.8. Pressure sensor

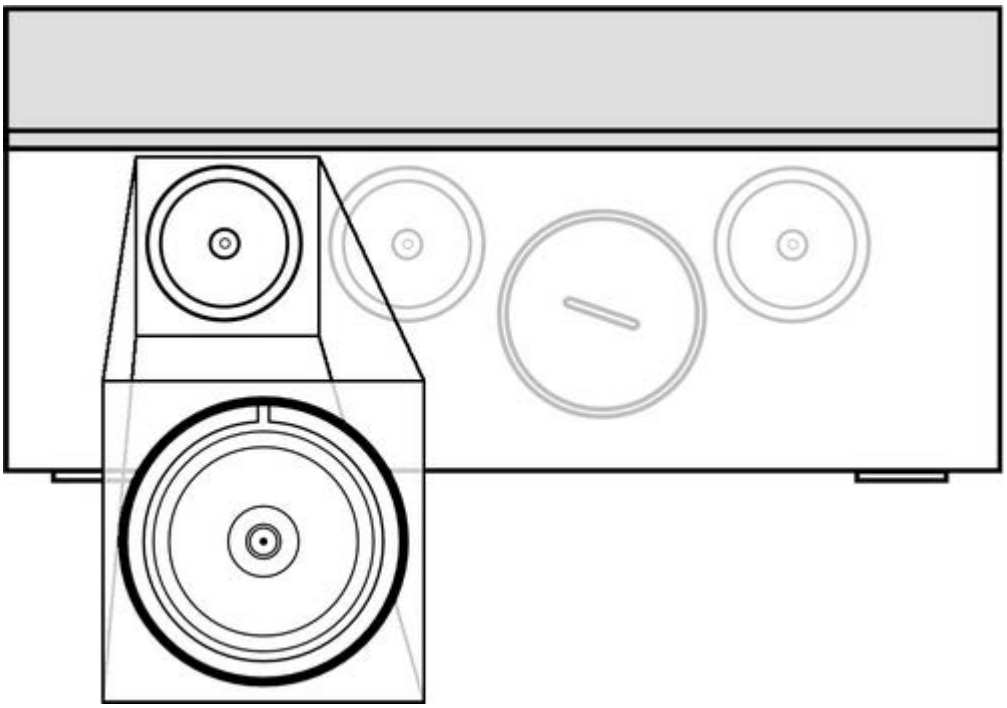
Connecting the antenna is necessary for reliable data transmission from **MT-723** module. **SMB IP68** type antenna socket is placed on module's panel.



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 or antenna high gain may be necessary.
It is essential to use IP68 connector to prevent moisture penetration which can cause module damage.

4.9. Module flooding sensor

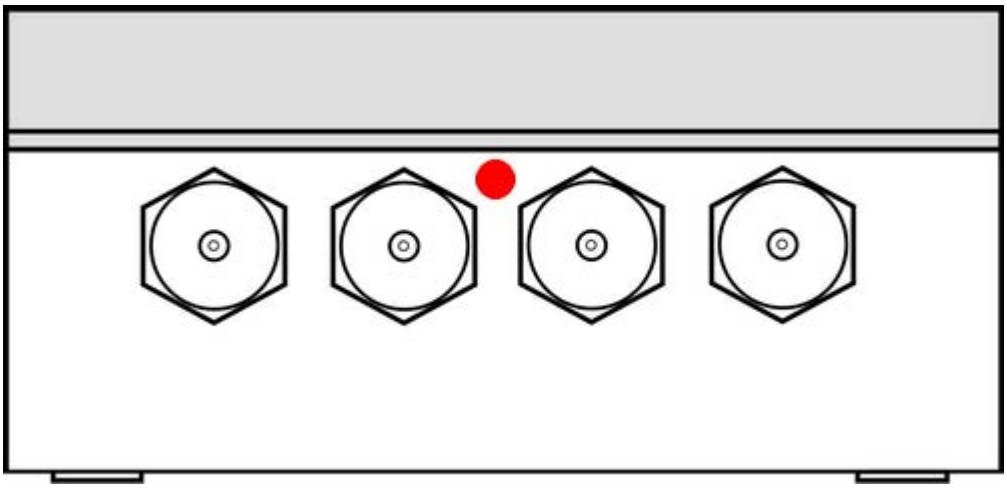
Connecting the antenna is necessary for reliable data transmission from **MT-723** module. **SMB IP68** type antenna socket is placed on module's panel.



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 or antenna high gain may be necessary.
It is essential to use IP68 connector to prevent moisture penetration which can cause module damage.

4.10. Reed switch input

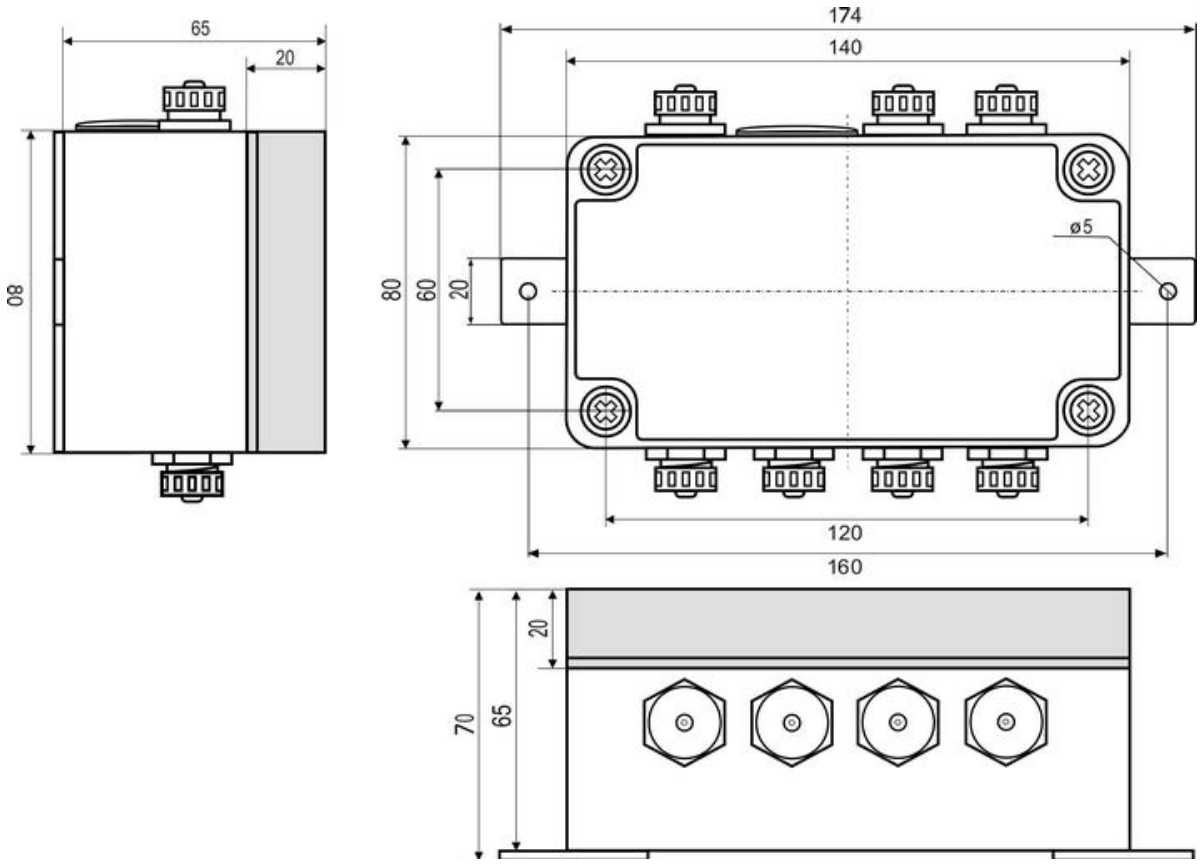
Between **DIGITAL1** and **DIGITAL2** sockets, in place marked on module housing there is spot which is used as reed switch test input. It is activated by putting a magnet on marked spot and then moving it away (negative logic).



Activation of this input causes setting **KEY_P** bit for one program cycle. This feature can be used to trigger events and/or measurements during telemetry system tests.

4.11. Enclosure

Enclosure of **MT-723** module is manufactured from high quality plastic securing highest environmental protection (**IP68**) for the electronics even in harsh environment. Housing is manufactured by FIBOX. All enclosure data including the parameters of used
material are available at manufacturer's web page www.fibox.com.



Please note that the degree of protection is highly dependent on used connectors. Connectors used in the construction ensure maintaining IP68 protection degree. **Using other connectors may result in water penetration and consequently cause device damage.**

5. Connection diagrams

This chapter presents recommended wiring configurations ensuring proper functioning of all **MT-723** module's resources.

Connections are presented for:

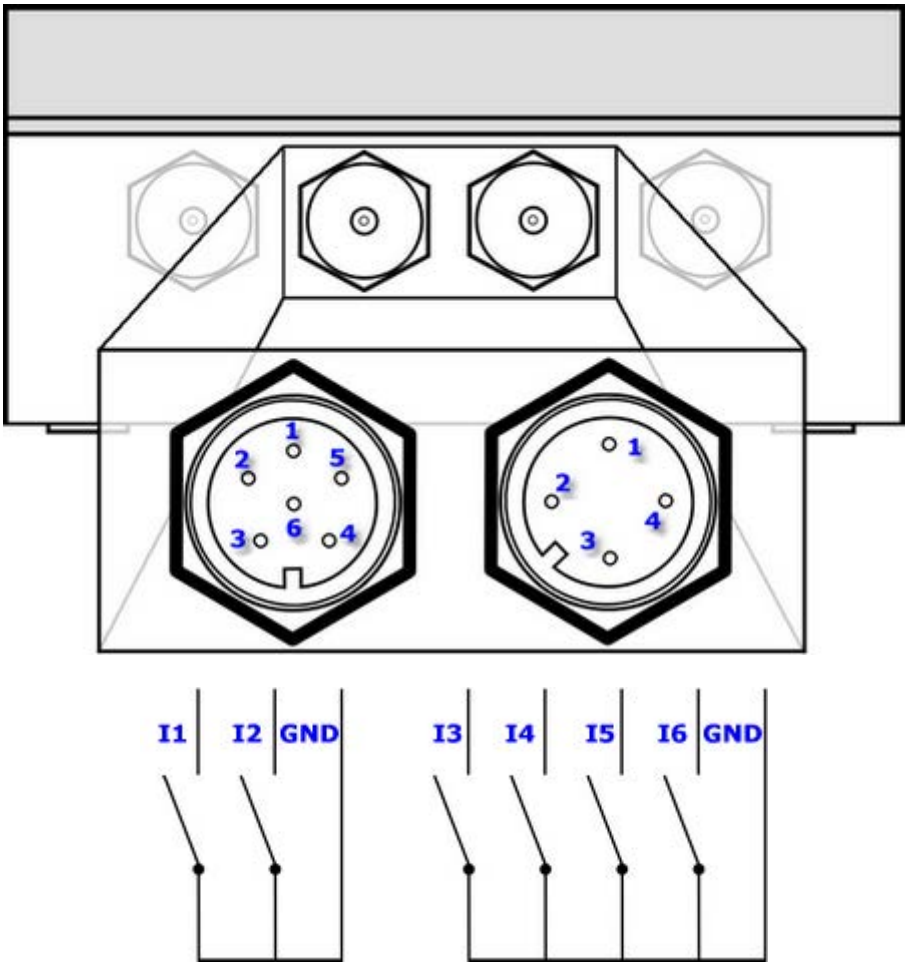
- Binary inputs I1...I5
- Binary outputs Q1...Q2
- Analog inputs AN1...AN3
- Power supply

and installation methods of:

- SIM card
- GSM antenna
- GPS antenna

5.1. Binary inputs

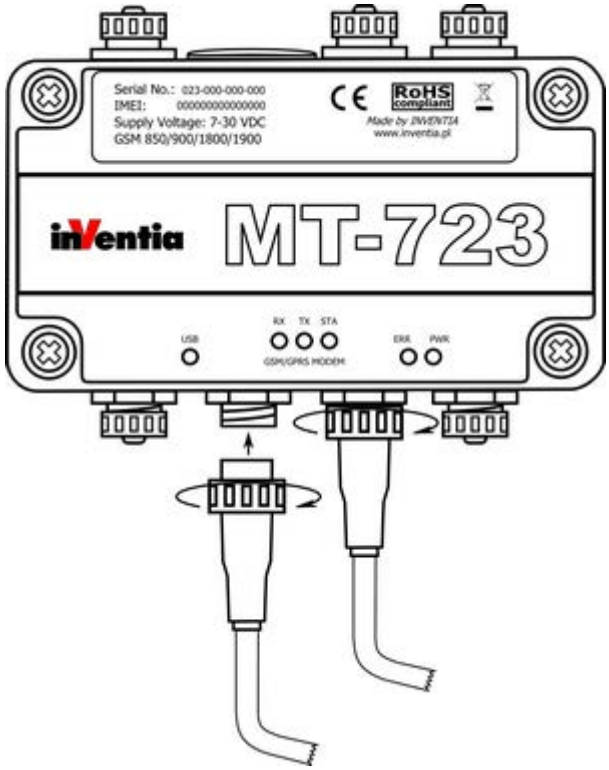
Binary inputs of MT-723 operate with **negative logic**, meaning that high state occurs only when the input is connected to ground. In open circuit the potential in reference to GND pin is not higher than **2,5 VDC**. Inputs work only with potential-free contacts like relay outputs, keyed transistor outputs. Below you can find recommended input connection diagram and sockets pinout description necessary for preparing plugs.



Resource	Connector	Pin number*
I1	Digital1 (4-pin)	1
I2	Digital1 (4-pin)	2
I3	Digital2 (6-pin)	1
I4	Digital2 (6-pin)	2
I5	Digital2 (6-pin)	3
I6	Digital2 (6-pin)	4
GND	Digital1 (4-pin)	4
GND	Digital2 (6-pin)	6

*pin in plug and pin in socket that create a contact have the same pin number

All binary inputs have same reference - module's electrical ground - negative pole of the power supply connected to **GND** pin.

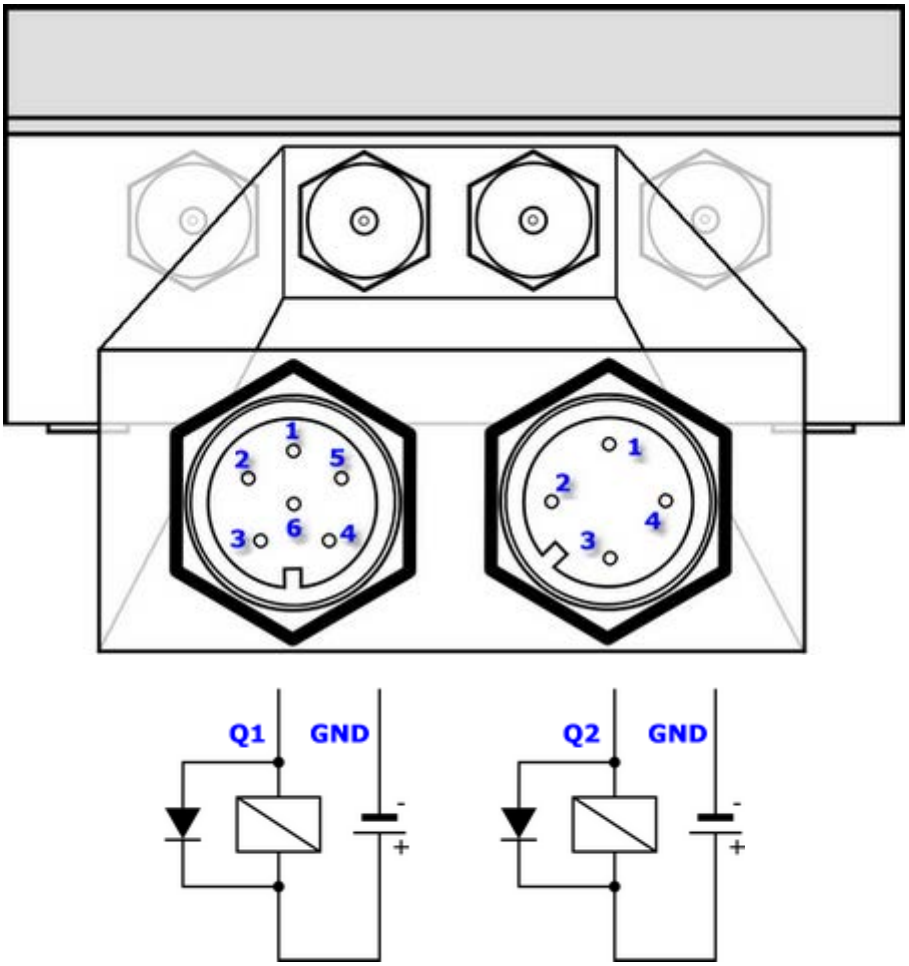


Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps. Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

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).

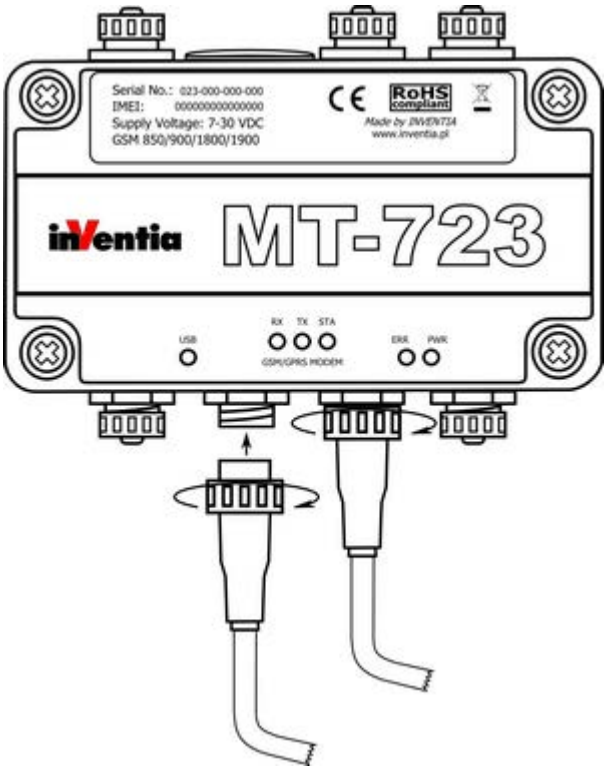
In case of inductive type load connected (a relay) a circuit limiting voltage peaks to max. +30V is necessary.
Below you can find recommended input connection diagram and sockets pinout description necessary for preparing plugs.



Resource	Connector	Pin number*
Q1	Digital1 (4-pin)	3
Q2	Digital2 (6-pin)	5
GND	Digital1 (4-pin)	4
GND	Digital2 (6-pin)	6

*pin in plug and pin in socket that create a contact have the same pin number

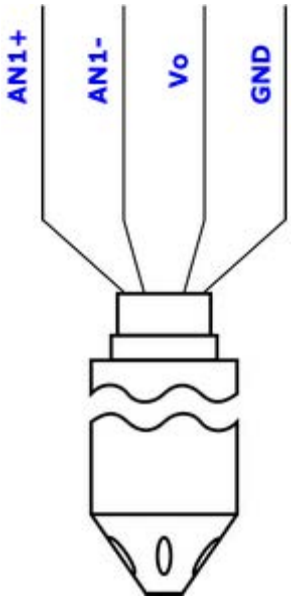
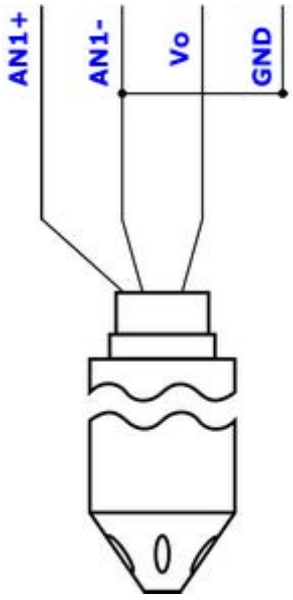
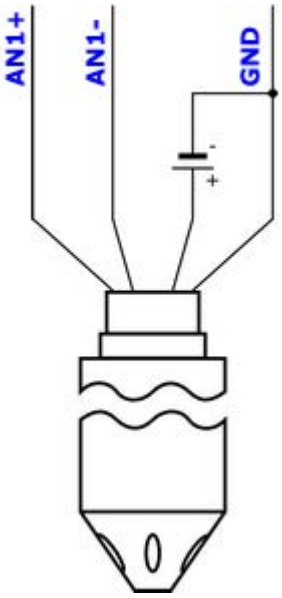
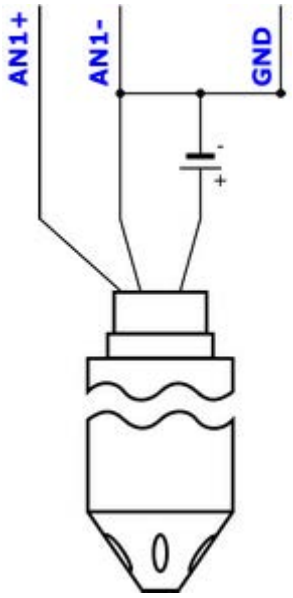
All binary outputs have same reference - module's electrical ground - negative pole of the power supply connected to **GND** pin.



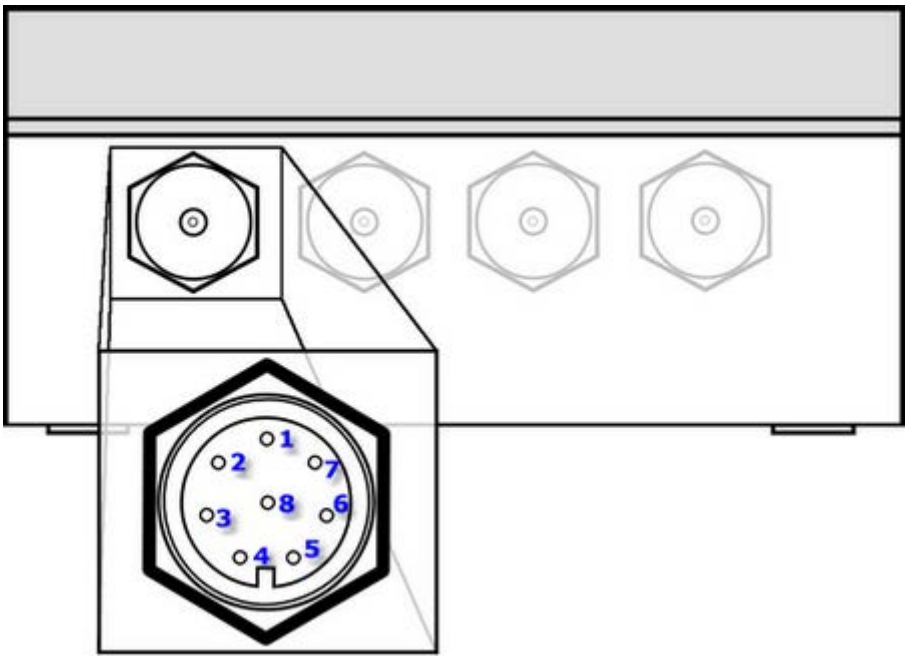
Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.
Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

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.

	4-wire sensor	3-wire sensor
powered from module		
powered from external power source		

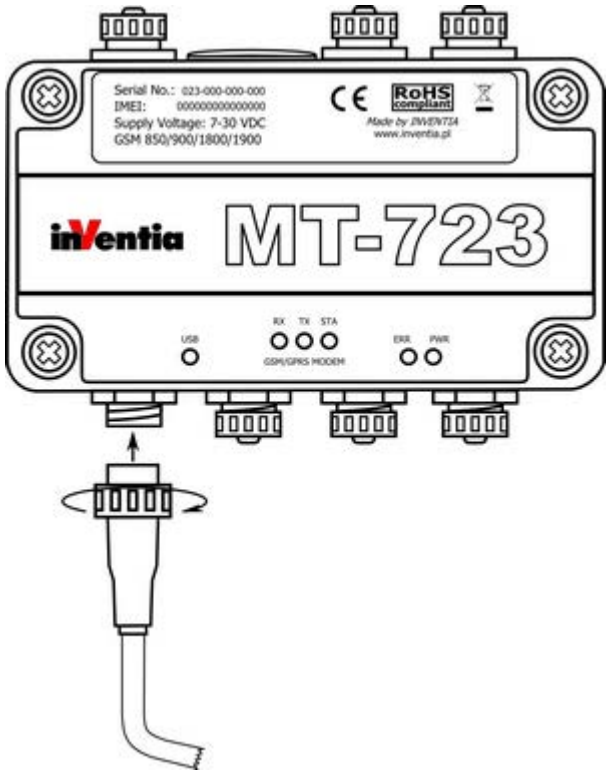
Sockets pinout description necessary for preparing plugs is described below:



Resourse	Pin number*
AN1+	1
AN1-	2
AN2+	3
AN2-	4
AN3+	5
AN3-	6
Vo	7
AGND	8

*pin in plug and pin in socket that create a contact have the same pin number

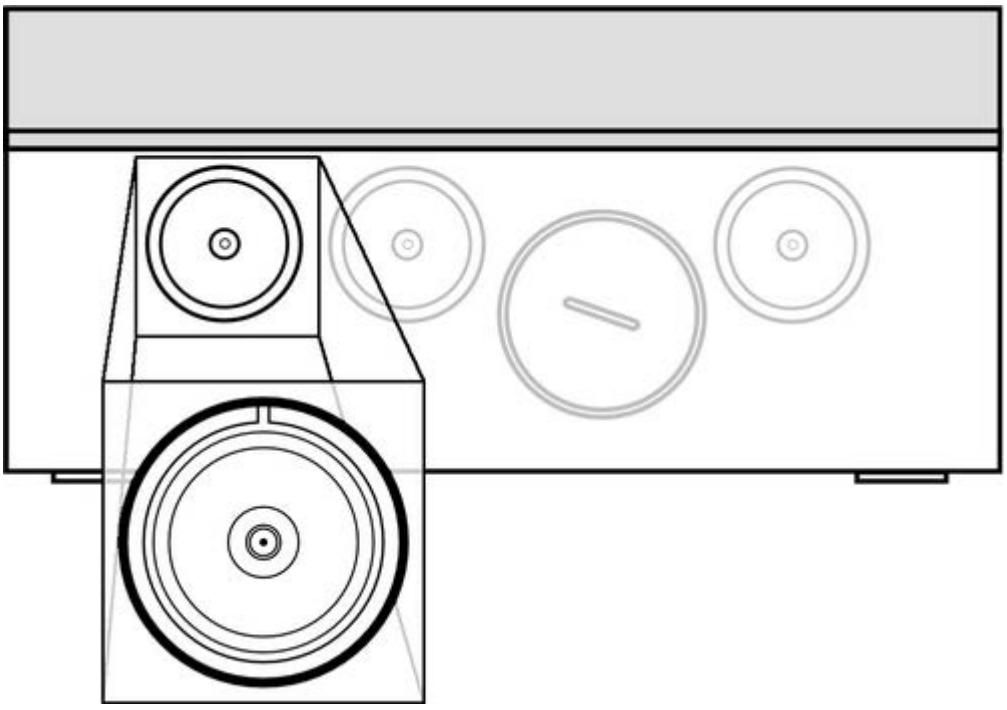
Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.



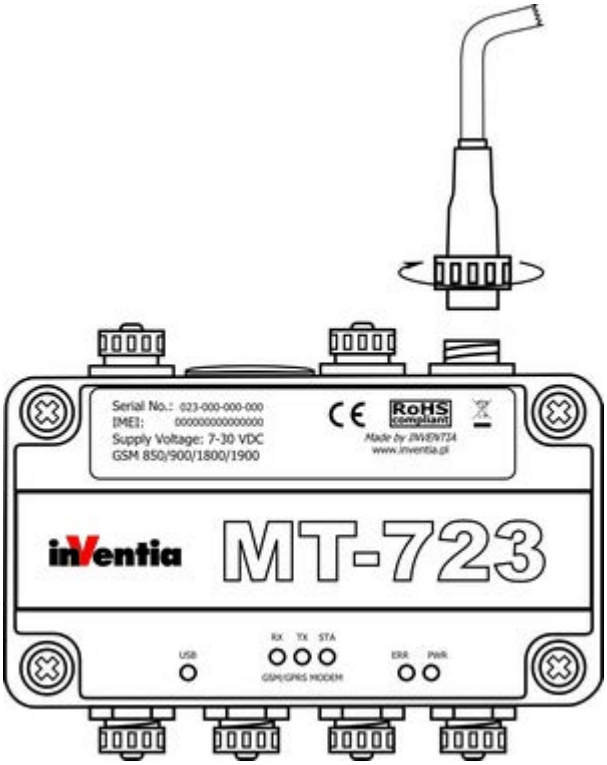
Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

5.4. GSM antenna

Antenna can be connected to **MT-723** module via SMB IP68 socket.



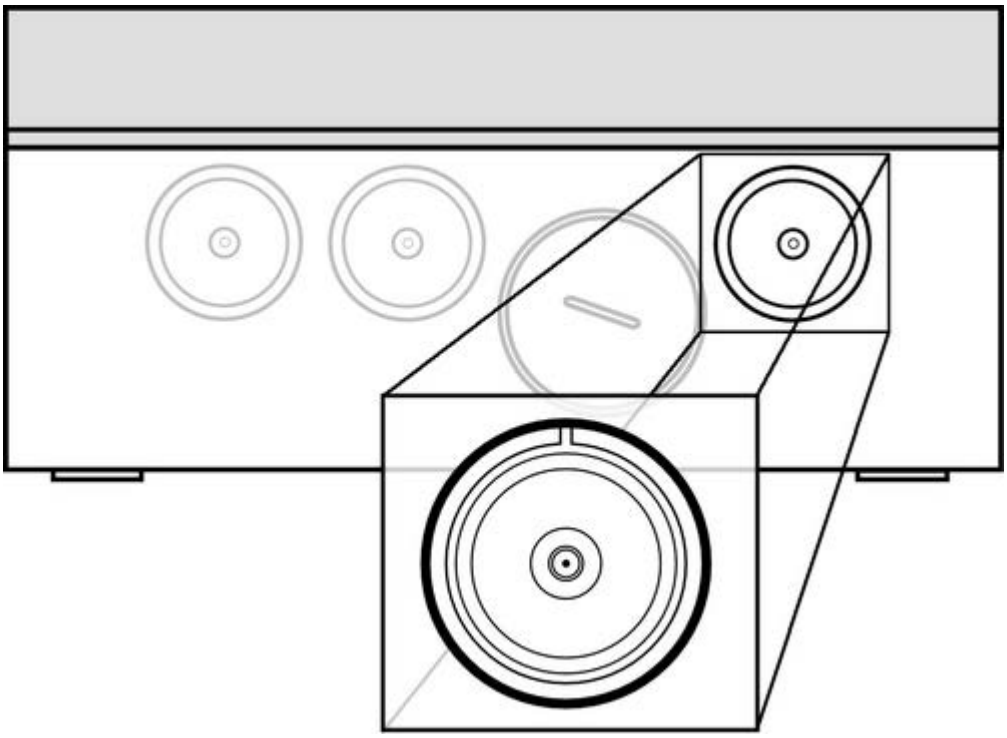
Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.



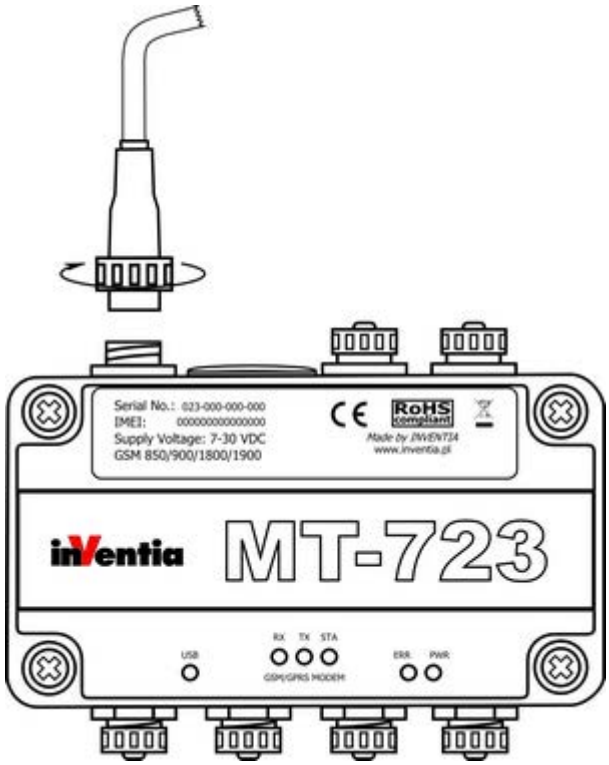
Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

5.5. GPS antenna

Antenna can be connected to **MT-723** module via SMB IP68 socket. This socket is available only in modules with integrated GPS receiver.



Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.



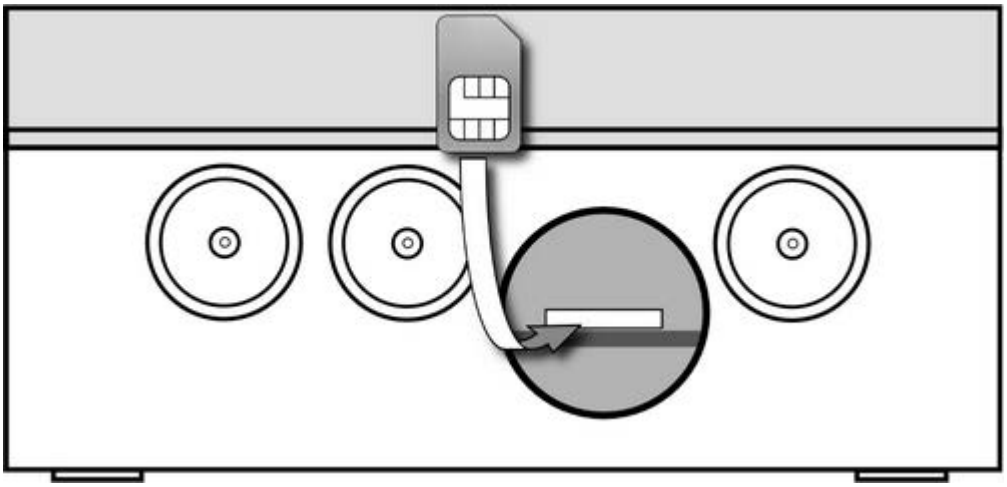
Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

5.6. 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 access to SMS services are impossible.

We recommend that inserting of **SIM** card is done with power disconnected, which means that both battery and USB cable are not connected.
We recommend inserting the SIM card after writing to module configuration including correct PIN code for that SIM card. Bear in mind that after three attempts of entering wrong PIN code the SIM card gets blocked. Inserting of wrong pin code is signaled by LED indicators. The blocked card may be unblocked. For details see procedure described in sub-chapter *Unblocking the SIM card* of *Maintenance and problem solving* chapter.

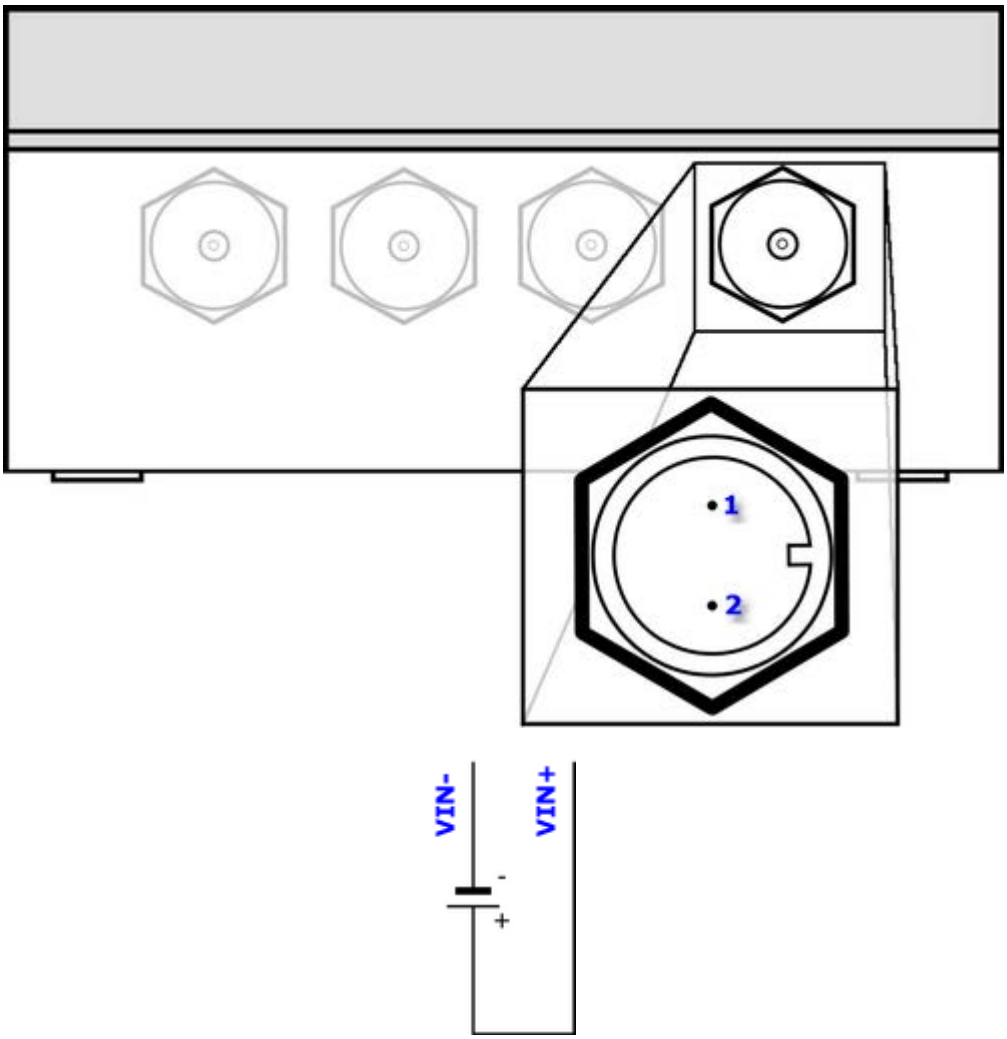
The SIM card should be inserted into SIM holder hidden behind large protective cap. SIM card contacts should face bottom of modules enclosure. The card should be pushed gently till slight resistance is felt. Properly installed SIM card should stick out slightly from the protective gel covering module's electronic parts.



Correctly installed **SIM** card secures connection between its contact fields and the holder contacts.

5.7. Power supply

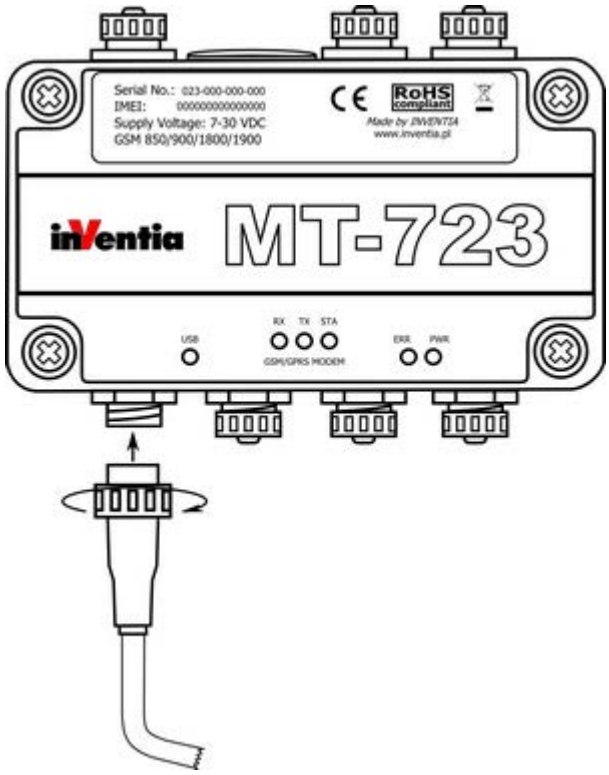
MT-723 module can be powered from **any DC power source** providing voltage within the range of 7-30 VDC, including a DC power supply, alkaline batteries, gel batteries, photovoltaic cells, and others.



Resource	Pin number*
VIN-	1
VIN+	2

*pin in plug and pin in socket that create a contact have the same pin number

Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.



Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

5.8. Installation

Telemetry module MT-723 must be secured to a stable substrate (e.g. to concrete wall), using two screws or bolts put through montage holes marked on the image below. Diameter of the holes is 5 mm and spacing between them is 160 mm.

Nie należy narażać obudowy na naprężenia bądź drgania mechaniczne, które mogą doprowadzić do jej rozhermetyzowania i w konsekwencji uszkodzenia urządzenia.
Do not expose the enclosure to tension or mechanical vibrations, which may lead to the dehermetization and as consequence to module damage.

6. First start of the module

First start of the module MT-723 requires a few simple activities. We recommend supplying the power via USB in order to save the battery. Please follow these steps:

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-723** 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 on the MTManager installation CD (MT-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)

These 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* Maintenance and 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.

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-723** 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-723** 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-723** 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.

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.

In case of module signaling locked SIM card apply unblocking 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. Configuration read disable

Performed function	-	Allows blocking of configuration reading even when valid password is supplied.
Data type	-	Selection list
Range	-	*Yes* Configuration reading 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-723** 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 retries

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 Number of SMS sending retries.

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 Authorized numbers -> Phone. Selecting *None* disables sending daily SMS limit alert.

7.2.3.6. Response 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-723 here*
Comments	-	In replay message text symbolic names may be used following syntax rules defined in Appendices in the Syntax of read and write commands in SMS 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. APN name), optional (e.g. Spooler IP) and optimizing transmission (e.g. Transmission timeout [s]).

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 login to GPRS impossible.

7.2.4.2. APN user name

Performed function	-	Defines user name for APN access
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 its 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 its 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 its 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 control

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 Authorized IP addresses list.

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 its current identifier.

Default value	-	*Yes*
Comments	-	Switching the control off enables verification of the sender on the base of its 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 Authorized IP addresses list in order to establish the communication.

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

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!

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 numbers

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 Phone 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 Syntax for reading and writing commands using SMS 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 IP 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

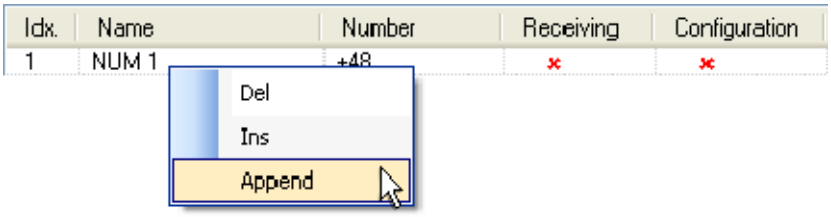
Name - Friendly name facilitating identification of the module while defining Rules. Max. length 16 characters

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.



7.2.5.4. IP

Ip. - Index number

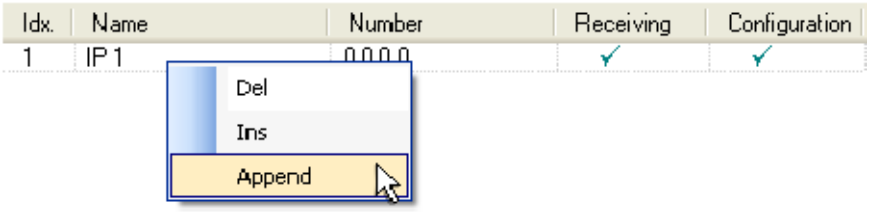
Name - Friendly name facilitating identification of the module's IP while defining Rules. Max. length 16 characters.

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.



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* (zero) 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 (I1…I6)/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). Mode available for inputs I1…I6.
- pulse input - configuration dedicated to counting pulses of external counters and calculating the flow. Mode available for inputs I1…I5.

7.2.6.2.1.1. Maximum pulse frequency

Performed function	-	Defines maximum 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 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.

7.2.6.2.1.3. Name

Performed function	-	Defines input's user friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 31 characters
Default value	-	Respective *I1*, *I2*, *I3*, *I4*, *I5*, *I6*
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 (option unavailable for input I6)
Default value	-	*Inactive*
Comments	-	According to selected mode MTManager displays additional configuration parameters for each input

7.2.6.2.1.5. Filtering constant

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 pulse input mode only. Parameter unavailable for input I6.

7.2.6.2.1.8. 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 input mode. Parameter unavailable for input I6.

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 input mode. Parameter unavailable for input I6.

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 input mode. Parameter unavailable for input I6.

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 input mode. Parameter unavailable for input I6.

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	-	Upon exceeding the preset value by calculated flow volume the HiHi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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	-	Upon exceeding the preset value by calculated flow volume the Hi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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	-	Upon exceeding the preset value by calculated flow volume the Lo alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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	-	Upon exceeding the preset value by calculated flow volume the LoLo alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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 input mode. Parameter unavailable for input I6.

7.2.6.2.1.17. Deadband - 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. Deadband flags are dedicated to continuous monitoring of flow changes. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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 user 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 bit list 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.

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.

7.2.6.2.2.3. 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 bistable (the output state is a true copy of the controlling bit's state).

7.2.6.2.3. Analog inputs (AN1...AN3)

MT-723 module is equipped with three analog inputs operating in 0 ... 5V standard and one controlled analog 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*
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 analog 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 user friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 31 characters
Default value	-	Respectively *AN1*, *AN2*, *AN3*
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 analog signal value in engineering units.
Data type	-	Number
Range	-	*-32767 ... 32767*
Default value	-	*32767*
Comments	-	Upon exceeding the preset value by analog 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 analog signal value in engineering units.
Data type	-	Number
Range	-	*-32767 ... 32767*
Default value	-	*32767*
Comments	-	Upon exceeding the preset value by analog signal the Hi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

7.2.6.2.3.12. Alarm Lo - engineering units

Performed function	-	Defines **Lo** alarm level for analog signal value in engineering units.
Data type	-	Number
Range	-	*-32767 ... 32767*
Default value	-	*-32767*

Comments	-	Upon exceeding the preset value by analog signal the Lo alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

7.2.6.2.3.13. Alarm LoLo - engineering units

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

7.2.6.2.3.14. Alarm hysteresis - engineering units

Performed function	-	Defines hysteresis value for analog 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. Deadband - engineering units

Performed function	-	This parameter defines a minimal change of registered analog signal to react on. Exceeding this value sets a flag (**AN1_DB**, **AN2_DB** and **AN3_DB**) respective to the analog 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. Deadband flags are dedicated to continuous monitoring of analog 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 bit list in Appendices) or *0 … 65535*
Default value	-	*None*
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.

7.2.6.3.2. 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

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.

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 bit list in Appendices) or *0 … 65535*
Default value	-	*None*
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.

7.2.6.3.4. Active edge of decrementing input

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

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.

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. Days of week

Performed function	-	Defines days of week 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 days of week and days of month. Selecting all week days will make the timer active all of the time. If no days of week are selected the activity of the timer will depend only on days of month selection.

7.2.6.4.1.4. Days of month

Performed function	-	Selects days of month 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 days of week and days of month. Selecting all month days will make the timer active all of the time. If no days of month are selected the activity of the timer will depend only on days of week selection.

7.2.6.5. Temperature sensor

MT-723 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 input)

Binary input **I5** is connected to an internal vibration sensor with contact normally open. This sensor can detect even slight movement of the device. This allows user to detect intrusion into the measurement installation, perform measurements of position only when the unit moves and much more.
Vibration sensor is always on.
Information about the detected vibration is signaled by the activation of **VIB** bit.
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 Filtering constant. 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. Power supply

Groups parameters defining method of monitoring power supply.

7.2.6.7.1. Low voltage alarm

Performed function	-	Defines alarm threshold level of power supply 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.

7.2.6.7.2. Alarm notifying period

Performed function	-	Defines the interval for generating low power supply 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 power supply 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 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.

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.

7.2.6.8.5. 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.

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 - Movement signaling threshold [km] 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 Movement signaling threshold [km] 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 Movement signaling threshold [km] parameter.
Parameter is available only if Movement signaling 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: Base position - latitude and Base position - longitude allowing user to set coordinates of geofencing circle centre and Radius [km] 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 Base position - longitude and Radius [km] 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*.

7.2.6.8.10. 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 Base position - latitude and Radius [km] 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*.

7.2.6.8.11. 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 Base position - latitude and Base position - longitude 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	-	*None*
Comments	-	If the Logger is not in use the parameter should have value of *None*.

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.

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.

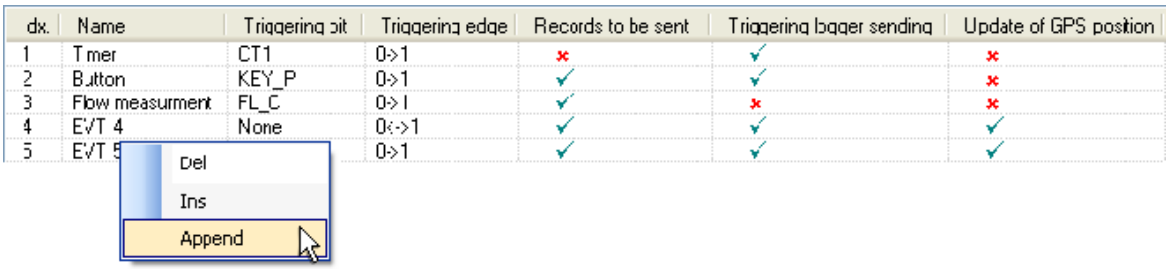
7.2.7.1. Number of events

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 edge	-	Event triggering edge Selection list *0->1* rising edge (default value) *1->0* falling edge *0<->1* any edge
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 than 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.



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.

7.2.8. 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 etc. 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 etc. 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

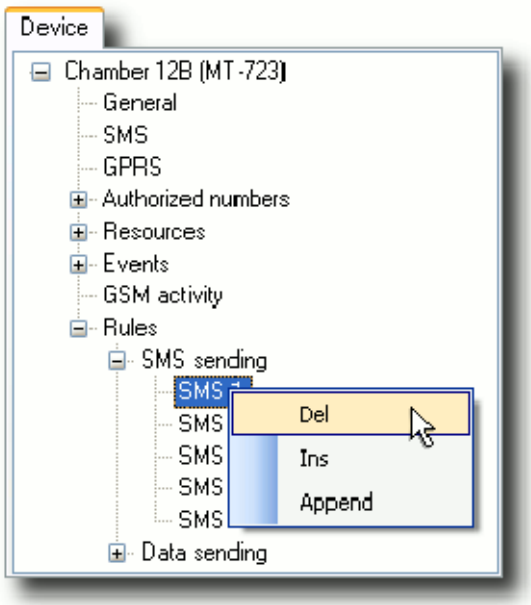
In both cases criteria are defined by employing previously defined Events.

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 Events table
Default value	-	*None*
Comments	-	To send the SMS message, Events table must have at least one event defined

7.2.9.1.3.2. Recipient

Performed function	-	Assigns a recipient of SMS from defined in Authorized numbers->Phone list.
Data type	-	Selection list
Range	-	*None* or the name from Phone list
Default value	-	*None*
Comments	-	To send the SMS message, the Authorized numbers->Phone 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 signs)
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 Syntax of commands for reading and writing data by SMS paragraph.

7.2.9.1.3.4. Activity period after login

Performed function	-	Defines how many minutes after login into 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

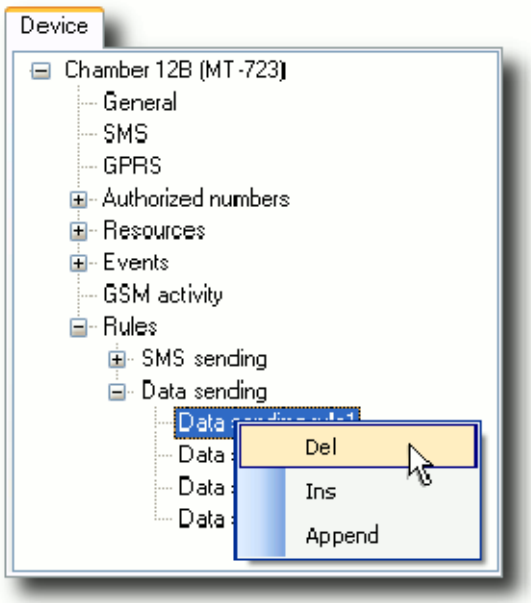
reception of SMS sent to the module. Leaving the *0* value makes the module to hibernate immediately after sending the SMS. Extending the activity period reduces battery life time.

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 Sooler IP located in GPRS group parameters.

7.2.9.2.4.4. Activity period after login

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 period shortens battery life time! Leaving it at *0* makes the module hibernate immediately after performing scheduled tasks.

7.2.9.2.4.5. Address space

Performed function - Defines module's memory space, where data prepared for transmission reside

Data type - Selection list

Range - *IREG*

Analog 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	-	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.

7.2.9.2.4.7. Buffer size

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

7.2.9.2.4.8. Receiver's buffer address in HREG address space

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	-	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.

7.3. 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-723 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.

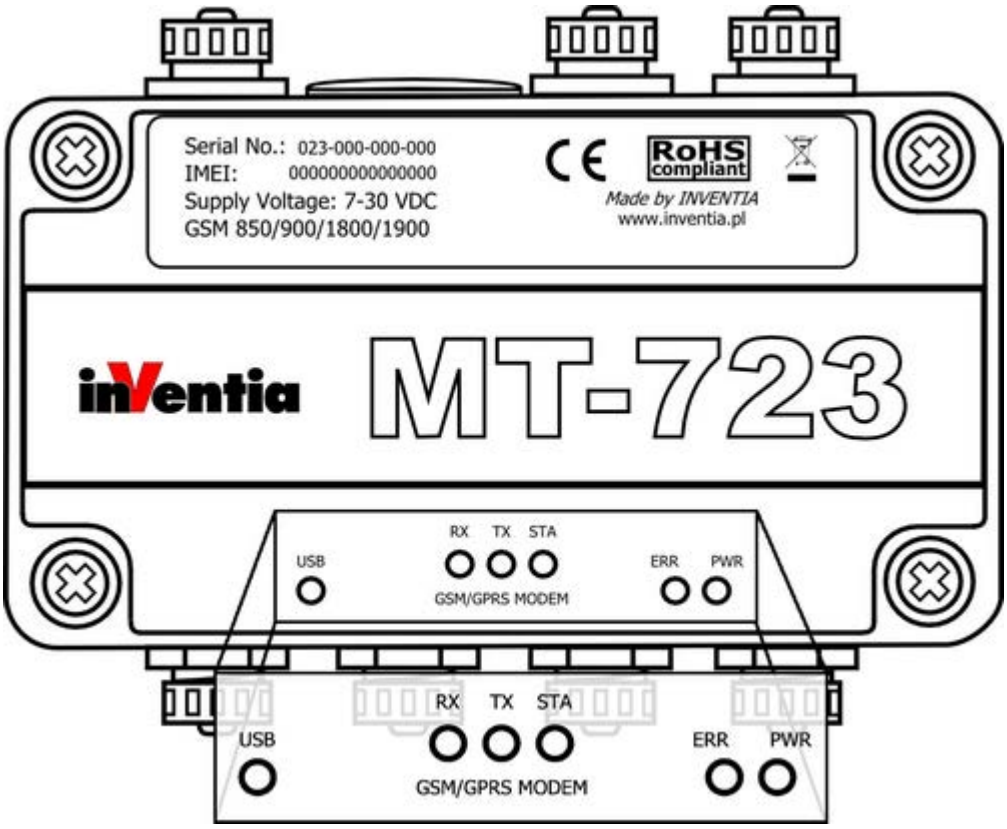
Parameter	Value
CN1	-12
CN2	2147483647
CN3	-2147483648
CN4	516
CN5	214
CN6	83647
CN7	-2183647
CN8	16

8. Maintenance and problem solving

8.1. LED signaling

MT-723 is equipped with six **LED** indicators reflecting the module state.

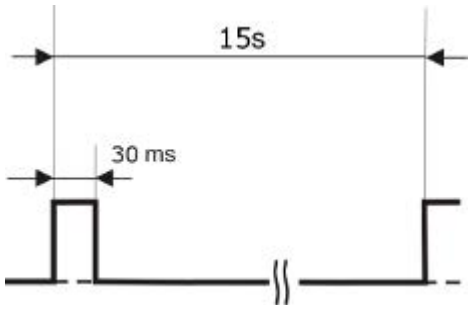
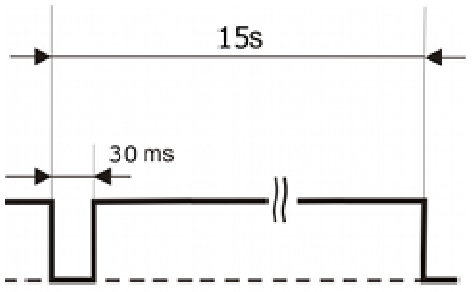
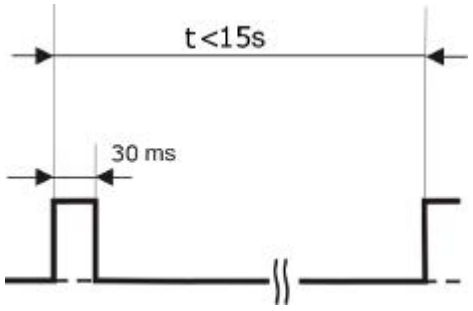
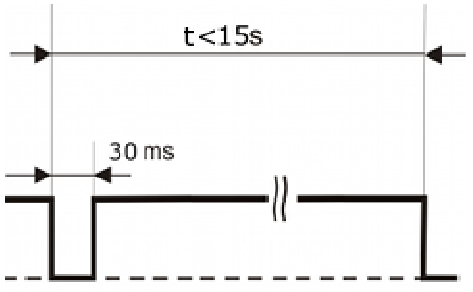
- **PWR** LED **-** indicates current Power supply and module's state (low and high energy consumption state called also sleep and activity state)
- **ERR** LED - indicates abnormal states
- **STA** LED - indicates GSM/GPRS status (GSM login as well as GPRS login, roaming, and signal level)
- **TX** LED - indicates Data or SMS transmission
- **RX** LED - indicates data or SMS reception
- **USB** LED - indicates USB port state

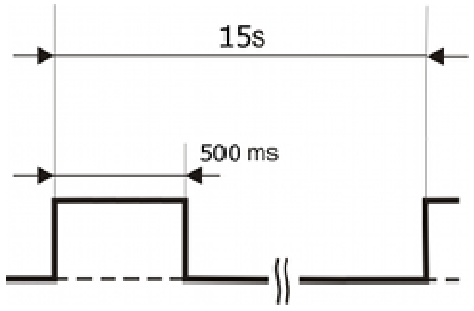
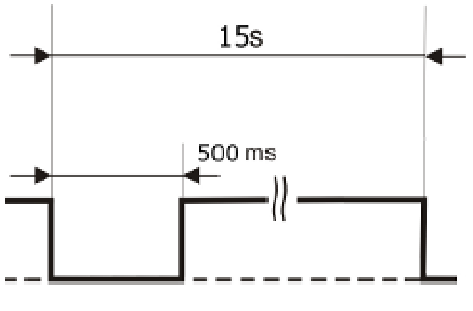
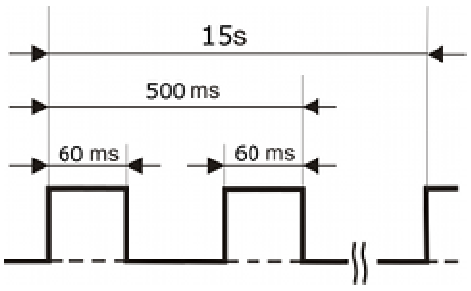


The current state is signaled by flashes varying in length and number.

8.1.1. PWR LED

Signals emitted by PWR 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 replace-ment 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 signaled.

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

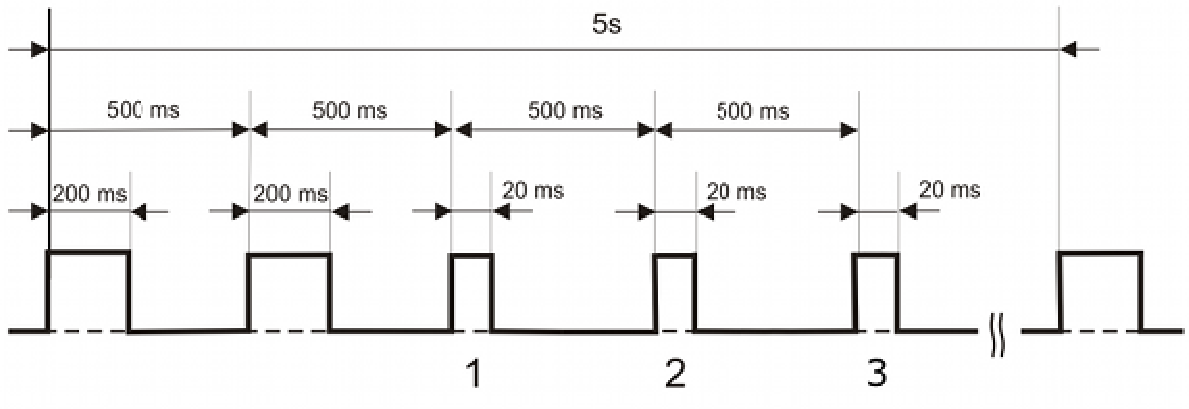
ERR LED	
○	critical error
◑	transmission error - SMS or GPRS transmission impossible
◐	missing, defective or blocked SIM card
◐ ◐	the card requires PIN code
◐ ◐ ◐	GSM error
◐ ◐ ◐ ◐	GPRS error
◐ ◐ ◐ ◐	APN login error
◐ ◐ ◐ ◐ ◐ ◐	wrong PIN

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 signaled 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.

9. Technical parameters

9.1. General

Dimensions (height x width x depth)	80 x 140 x 65 mm
Weight (with batteries)	680 g
Mounting method	2 ø5 mm holes
Operating temperatures	-20°C…+55°C
Protection class	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…I6

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	±0.1 %
Accuracy at full temperature range	±0.3 %

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

Acceptable power supply voltage range	7 - 30 V
Mean current consumption in sleep mode (at 12 V)	<250 µA
Mean current consumption with active GSM modem (at 12 V)	25 mA
Maksymalny chwilowy prąd w trybie aktywności modemu GSM (at 12 V)	500 mA
Internal battery type	lithium-thionyl chloride
Internal battery nominal voltage (at 2 mA, 20°C)	3.6 V
Internal lithium battery nominal capacity (at 15 mA, 20°C, 2.0 V cut off)	13 Ah

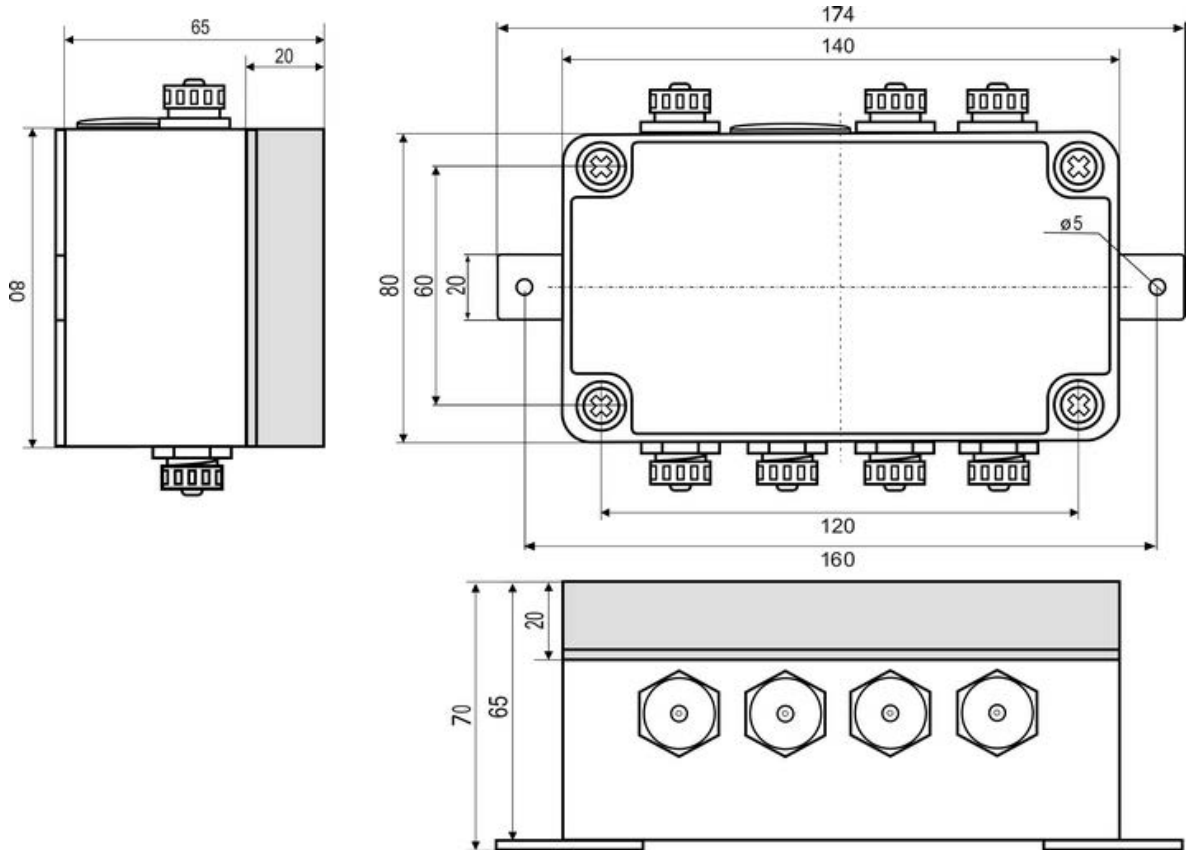
9.11. Enclosure

Mechanical endurance IK (EN 62262)	IK 08
Electrical isolation	Total isolation
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, 4X, 6, 6P, 12, 13
Material	Polycarbonate
Material of lid screws	Polyamide
Gasket material	Polyurethane

Dimensions without hanger	
Length	140 mm
Width	80 mm
Height	65 mm

Dimensions with hanger	
Length	174 mm
Width	80 mm
Height	70 mm

9.12. Drawings and dimensions



NOTICE!!!
All dimensions in millimeters!

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 its 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-723 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
#IR*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*]	extends 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 modules 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** [*el_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's (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 cannot interpret the command the response is *>ERR*.
If attempted write value is out of range the response is *>command=ERR* (eg. *>#CNT1=ERR*).
To pass the # sign in SMS type ##.

11.2. Memory map

All accessible from remote resources of MT-723 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 deactivation of reed switch input. 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

Analog inputs address space (read only), Modbus RTU functions (2,4)

Address		Bits																Name	Description
DEC	HEX	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
0	0x0000	---	---	---	---	---	---	---	---	---	---	---	---	RUN	FS	1	0	PRG_STATE	FS - first scan (first cycle) RUN - program running
1	0x0001	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}	RTC_FSEC	RTC (UTC time) - second fraction
2	0x0002	hour (0...23)					minute (0...59)						second / 2 (0...29)					RTC_HMS	RTC (UTC time) - RTC time second - youngest bit in RTC_FSEC (address 20)
3	0x0003	year - 2000 (0...127)							month - 1 (0...11)				day - 1 (0...30)					RTC_YMD	RTC (UTC time) - date
4	0x0004	int32(LoHi)																ON_TMR	Uptime [s] from connecting to power supply
5	0x0005																		
6	0x0006	**RTC_OK**	**RTC_C**	**ZONE_C**	**HREG_C**	**CFG_OK**	**GPS_C**	**AN_C**	**FL_C**	**KEY_P**	**PF**	**SLEEP**	**Vo**	**GPS**	**GSM**	**USB**	**BAT**	MT_BITS	**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 - reed switch input deactivated (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

7	0x0007	---	---	---	---	---	---	---	---	---	---	VIB	OPEN	TEMP_Hi	TEMP_Lo	---	LBAT_C	MT_ALM	**Alarm bits** LBAT_C = 1 - low battery voltage alarm (1 cycle) TEMP_Lo = 1 - low temperature alarm TEMP_Hi = 1 - high temperature alarm OPEN = 1 - open enclosure alarm VIB = 1 - vibrations alarm
8	0x0008	KEY	---	---	---	---	---	---	---	---	---	I6	I5	I4	I3	I2	I1	BIN	Ix - binary inputs states KEY - reed switch input 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	int16																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 [%] SIM_ERR = 1 - error or no SIM card PIN_ERR = 1 - wrong PIN APN = 1 - module logged into APN GPRS = 1 - GPRS available ROAMING = 1 - module in roaming GSM = 1 - module registered in GSM (range OK)
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	**FIX**	HDOP (0...99)	**MOV**	**GEOF_C**	**GEOF**	**-**	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 cycle) 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-723** 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	Activation of reed switch input. 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.
TEMP_Lo	Low temperature alarm
TEMP_Hi	High temperature alarm
OPEN	Open enclosure alarm (1 - enclosure open)
I1…I6	Binary inputs I1…I6
CT1…CT8	Binary outputs Q1…Q2
AN1_LoLo…AN3_LoLo	Analog inputs alarm bits - LoLo alarm level reached
AN1_Lo…AN3_Lo	Analog inputs alarm bits - Lo alarm level reached
AN1_Hi…AN3_Hi	Analog inputs alarm bits - Hi alarm level reached
AN1_HiHi…AN3_HiHi	Analog inputs alarm bits - HiHi alarm level reached
Q1…Q2	Binary outputs Q1…Q2

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

CE

Telemetry Module
MT-723
User Manual

GSM/GPRS Telemetry Module
for monitoring and control

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

MT-723

INVENTIA Sp. z o.o

v1.00

MT-723

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1. Module's destination

The **MT-723** is a specialized telemetry module optimized for use within simple measuring and alarm systems where power lines are not available and environmental conditions are harsh (dust, high humidity, possibility of water flooding).

Compact design, low power consumption, a wide range of acceptable energy sources (alkaline or lithium battery packs, gel or car batteries, solar panels and other), 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 battery supply.

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-723 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

Maintenance and problem solving - here is described procedure of unblocking locked SIM card and LED signaling schemes

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 which is necessary for proper configuration of MTDataProvider and data collecting equipment.

3. GSM requirements

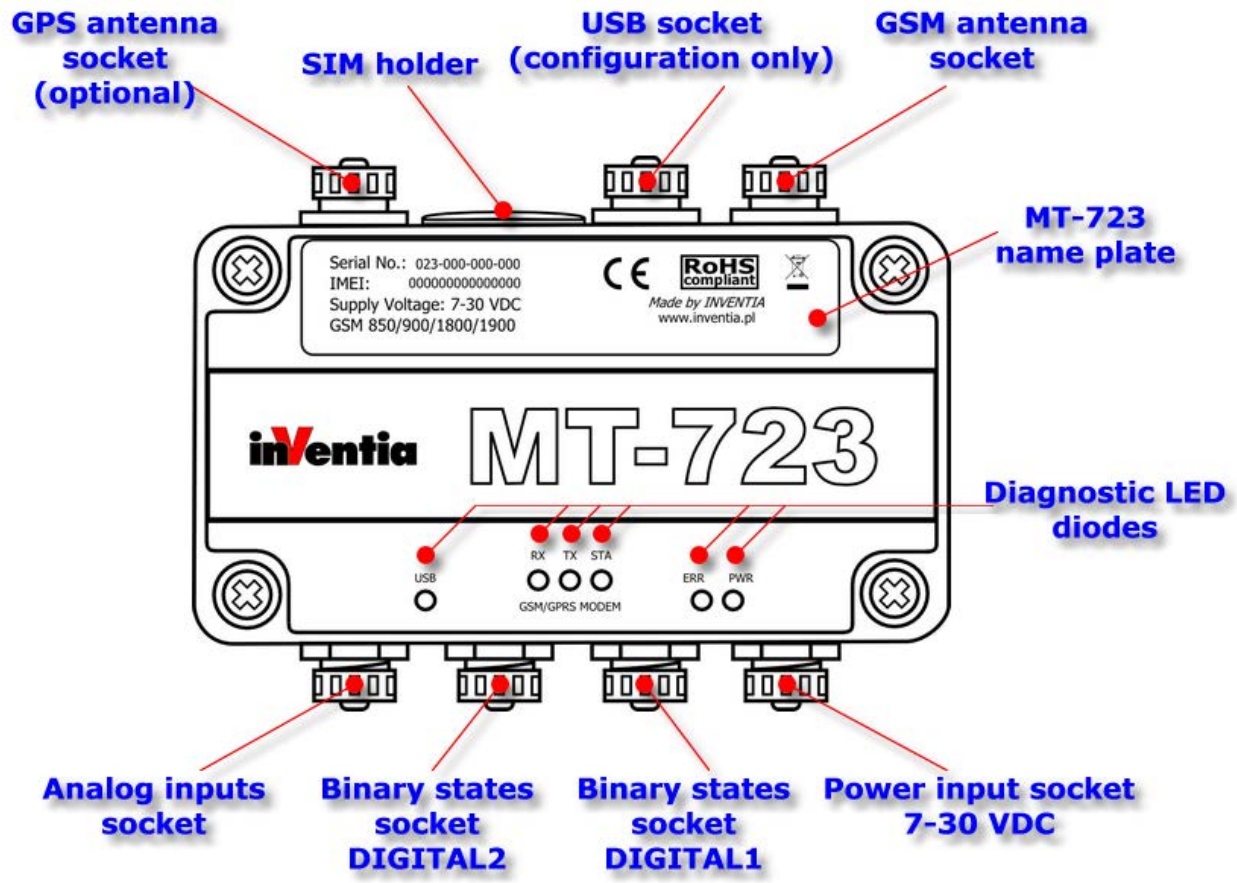
For proper operation of the module a SIM card provided by a GSM operator with GPRS and/or SMS option enabled is essential.

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



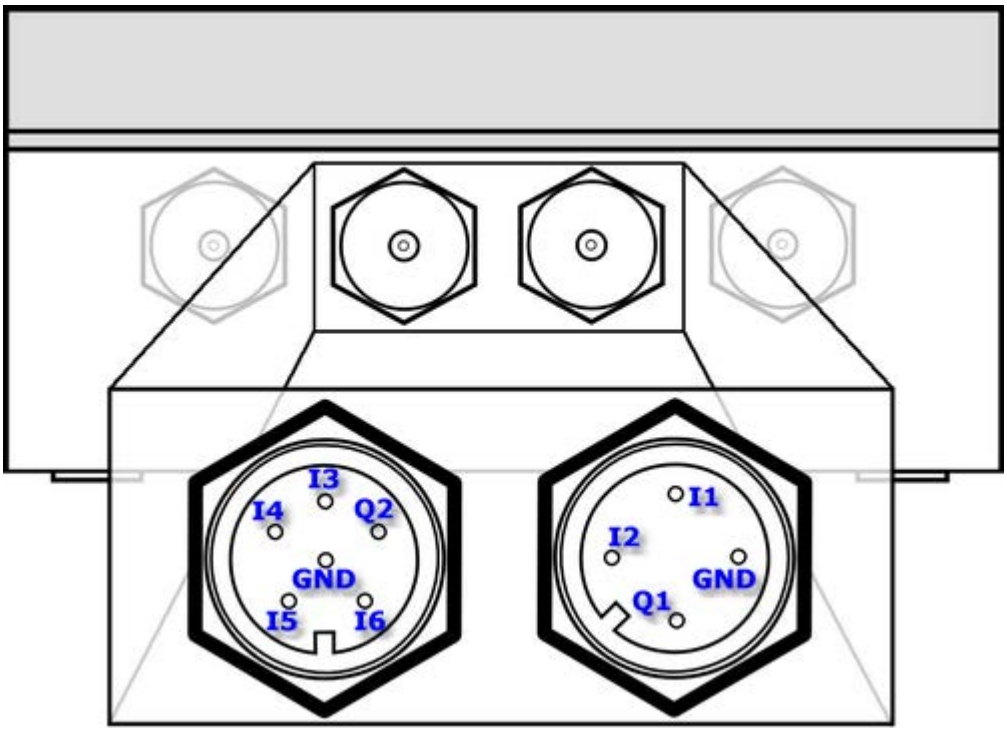
4.2. Resources

Hardware Resources of **MT-723:**

DI - binary inputs	5	binary inputs, pulse or potential free (the function is selected during configuration)
	1	potential free binary input I6 with possibility of setting its state using magnet (reed switch)
AI - analog inputs	2	0-5 V, with possibility of supplying power to the measuring circuit
DO – binary outputs	3	NMOS outputs ("open drain" type) 0…+30 VDC, mono- or bistable (the function is selected during configuration)
Temperature sensor	1	temperature sensor integrated in the microprocessor
Vibration sensor (binary input I5)	1	module has an integrated vibration sensor of contact, normally open, connected to digital input I5. It is used to detect movement of the device.
GPS Module (optional)	1	for calculating geographical position and time synchronization
Pressure sensor (optional)	1	**MT-723/PT** version of the module with an integrated pressure sensor
Module flooding sensor (optional)	1	in developing stage

4.2.1. Binary inputs

MT-723 module is equipped with 6 binary inputs (**DI**) marked as **I1...I6**.



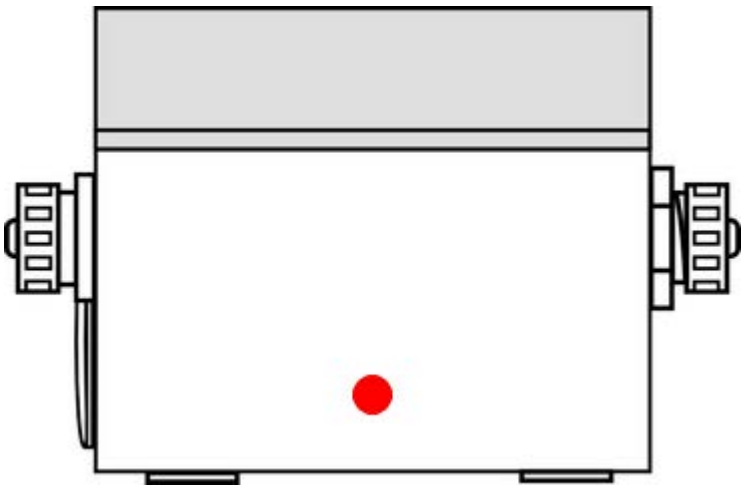
Inputs **I1…I6** are designed to cooperate with potential free contacts (contacts connecting the input and common for all inputs ground). The inputs operate in **negative logic**, meaning the input is high when connected to ground and low if the circuit is open. This solution allows energy saving, a 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 their state and cannot be used to trigger events except for counting inputs for counters CNT1…CNT5.

Binary input **I5** is connected with an integrated vibration sensor with normally open contacts. Therefore **it is not recommended** to use input I5 as binary input for fast-changing digital input signal or pulse input. It is not possible to simultaneously use the functionality of the vibration sensor and digital input, or pulse input I5. Additional parameters associated with vibration detection are gathered in Vibration sensor (optional) parameters group.

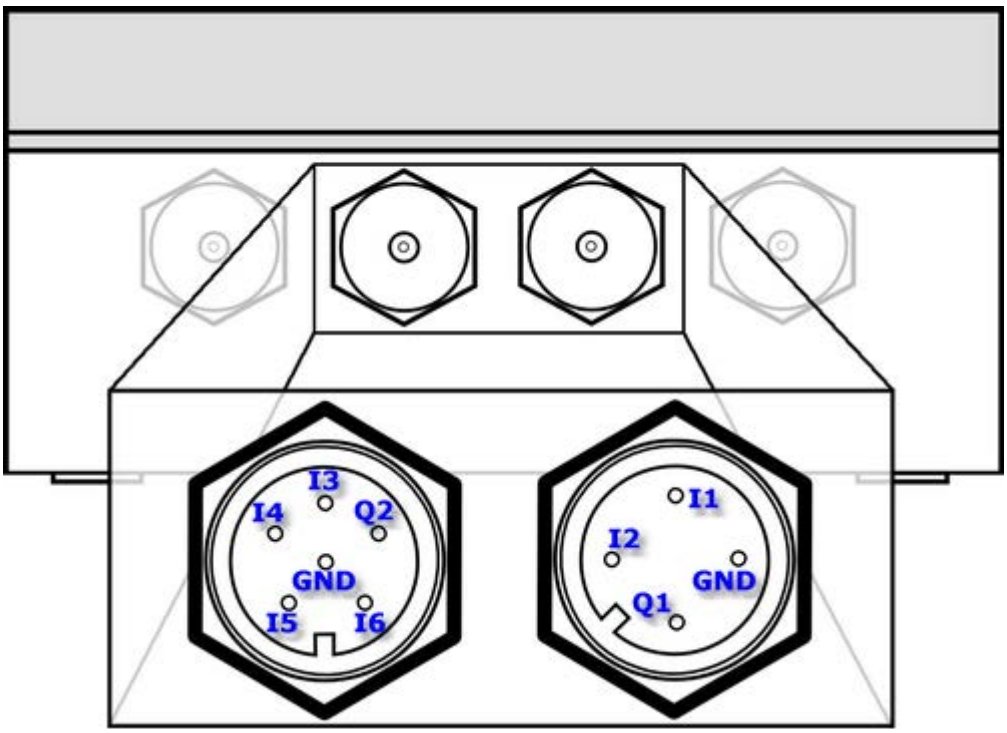
Binary input **I6** can operate **only as a binary input**. This input can be, in addition to short-circuiting its pin to GND pin, set in a high state by approximating the magnet to a point marked on the left side of the module.



Irrespectively to chosen mode of operation states of the binary inputs are monitored by the module in both **energy-consuming and sleep mode**.

4.2.2. Binary outputs

MT-723 module is equipped with 2 binary outputs (**DO**) marked as **Q1** i **Q2** .

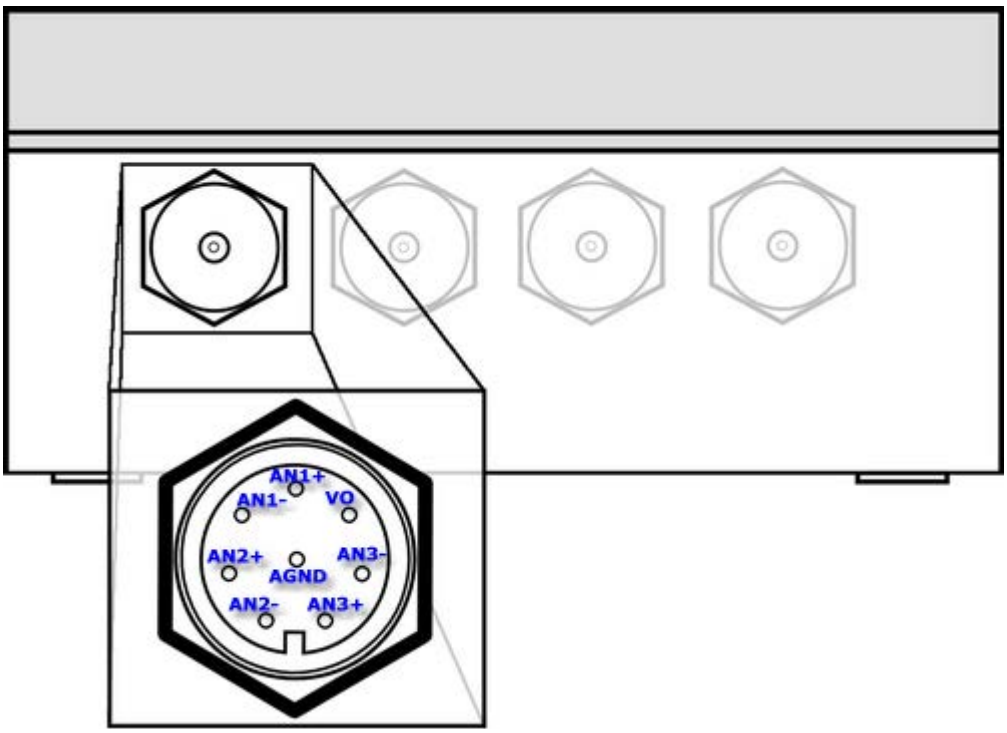


The outputs are designed to control loads powered by internal source (e.g. light signaling). The outputs are of "open drain" type controlled by NMOS transistors.
In High state the output is shorted to the ground by active NMOS transistor. In case of inductive type load connected (a relay) the circuit 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-723 module is equipped with 3 voltage analog inputs (**AI**) marked **AN1…AN3**.

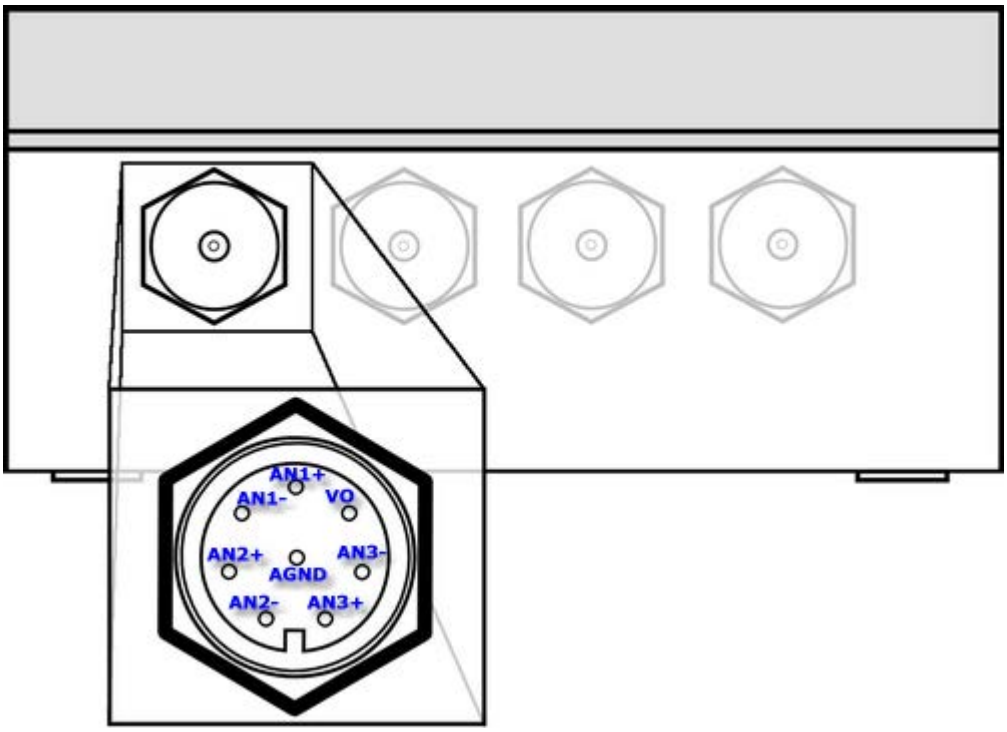


The inputs are designed to work with analog sensors generating signal in **0...5V** range. In order to minimize energy consumption the A/C converters are powered for the period necessary to conduct secure measurement.

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-723 module is equipped with the keyed power output Vo, which is destined to power sensors connected to analog inputs.



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. 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.

4.2.6. Vibration sensor

Binary input I5 is connected with an integrated vibration sensor with normally open contacts. This sensor can be used for detection of module movement. This allows user to detect intrusion into measurement system ,perform measurements of module's positions only when the device moves more.
Vibration sensor is always on.

4.2.7. Real Time Clock

MT-723 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.

NOTICE!!!
The clock setting has to be repeated if the module was in storage mode (details in Power supply chapter).

4.2.8. Timers

MT-723 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.

In addition there are available 8 general purpose asynchronous timers which are capable of counting time in range from 1 to 240 seconds. These timers start counting when module is powered or reset and are not synchronized with RTC clock.

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

4.2.9. Counters

MT-723 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.

4.2.10. Logger

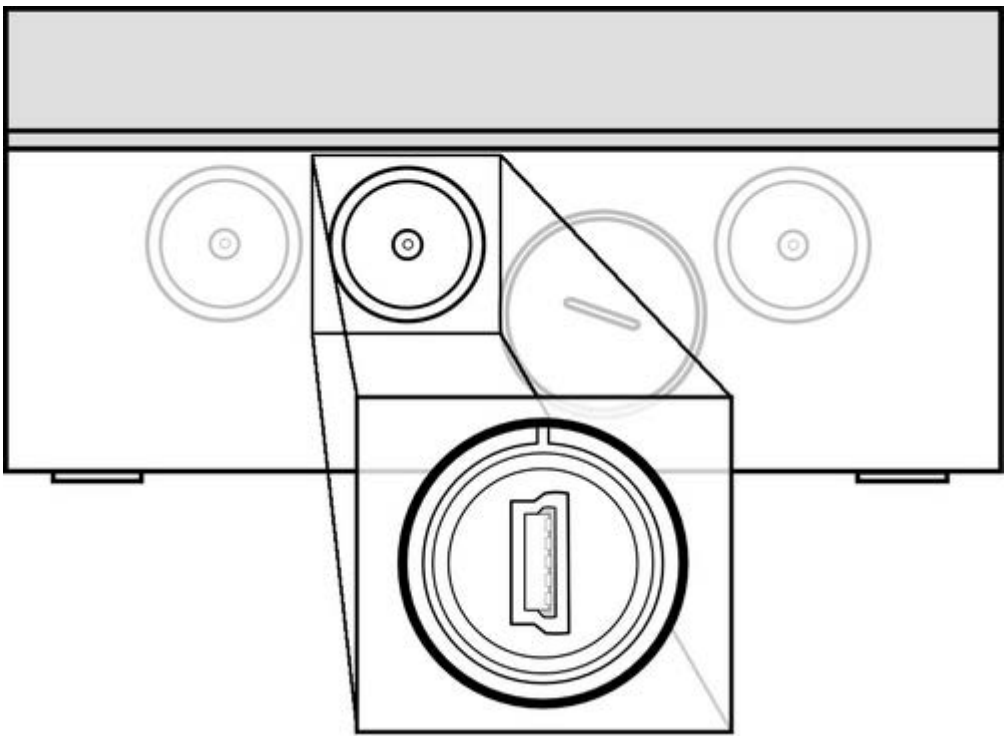
MT-723 module has a programmable logger that may hold up to 10240 data records. This equals either 24 hours measurements taken every 10 seconds or 1 month measurements taken with 5 minutes intervals.
The logger logs asynchronous data, meaning that the record writing is triggered by an event (defined 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.

4.2.11. GPS (optional)

MT-723 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

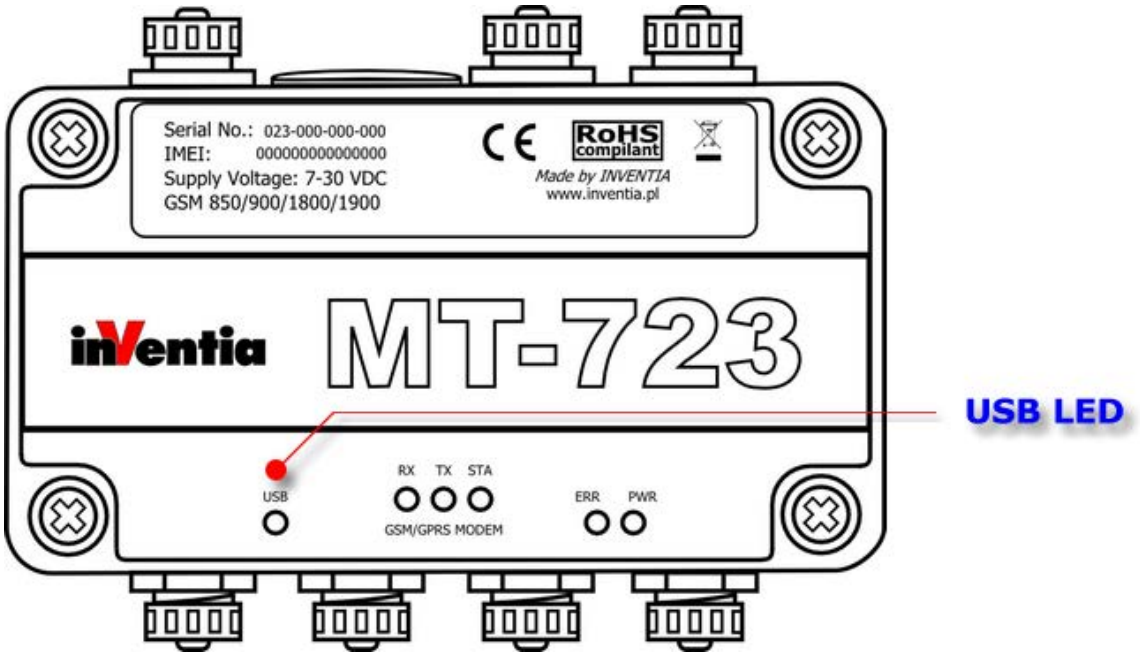
MT-723 provides **USB** socket used for local configuration by **MTManager2.0** program.



When module is connected via USB to a computer, it is powered via USB port. Thanks to that the module does not consume limited battery power during configuration and tests. During USB connection **VBAT** 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 AB type cable is used. See depicted plugs of the cable below.

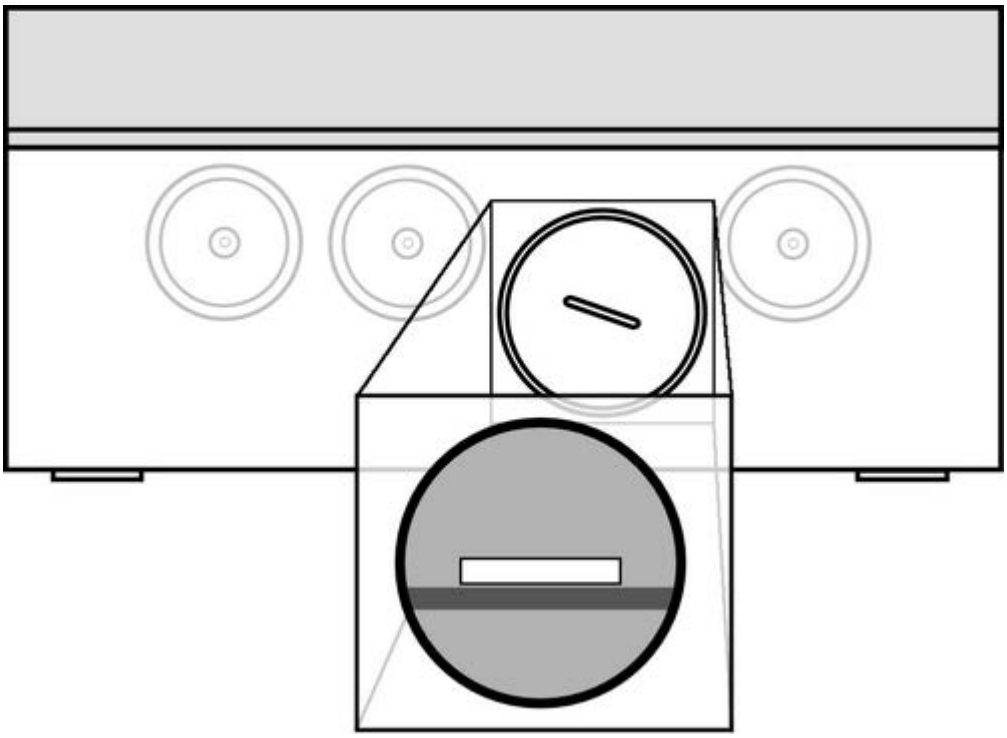
The proper USB connection is signaled by the **POWER LED** (the module is powered by USB) and the **USB LED** (USB port ready for transmission). Data transmission is signaled by shot flashes of USB LED.



Detailed information on using the **USB** port for module configuration can be found in the **MTManager2.0** manual.

4.4. SIM card

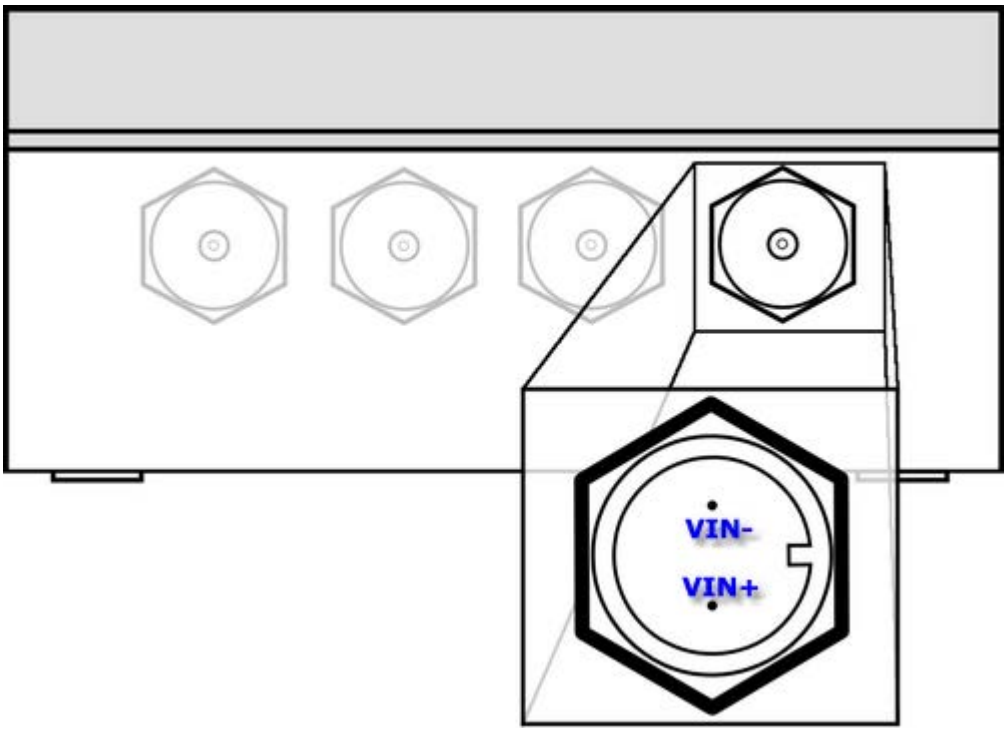
MT-723 module is equipped with a holder for miniature SIM card. The holder is placed horizontally on the PCB inside the enclosure.



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-723 module can be powered from **any DC power source** providing voltage within the range of 7-30 VDC, including a DC power supply, alkaline batteries, gel batteries, photovoltaic cells, and others.



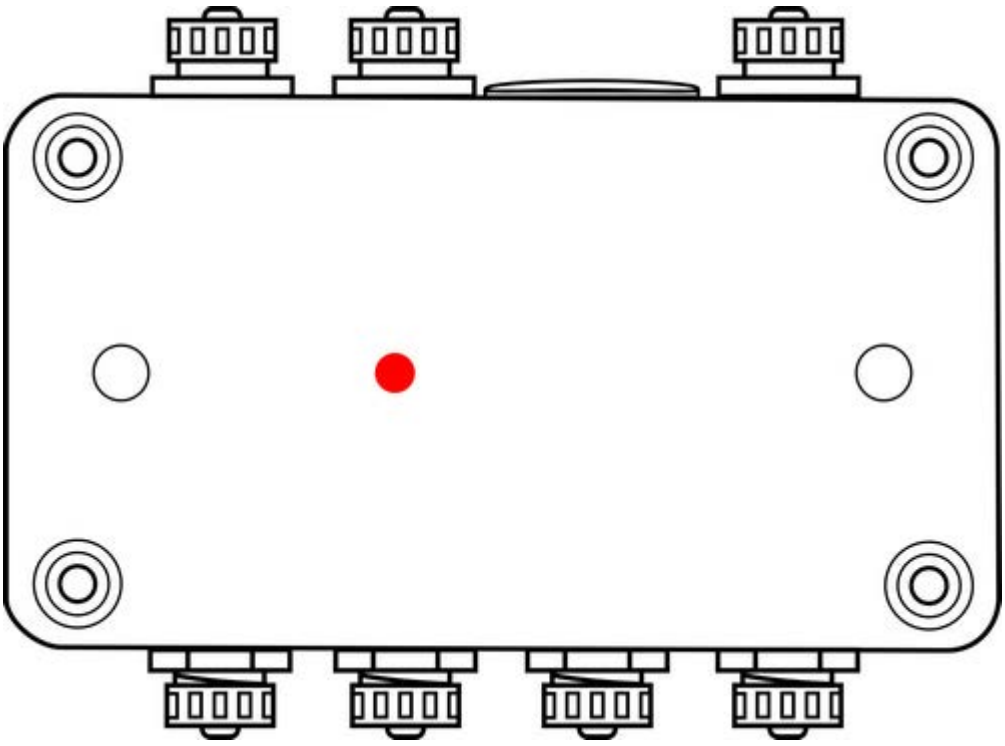
It is recommended to place the power supply in IP68 enclosure and ensure the connection with module is of the same class. Any power source housing or connectors leakage may allow water penetration and consequently damage electronic components of module. Proper power source connection is described in *Power supply* subchapter of *Connection diagrams* chapter.

When module is being configured via USB it is powered from a PC. This allows module to reduce battery consumption. Working with such supply is indicated by **PWR** and **USB** LEDs (details provided in *LED signaling* subchapter of *Maintenance and problem solving* chapter). Module connected to PC via USB is constantly in high energy consumption state (is awake and logged to GSM/GPRS network).

The module is equipped with an internal lithium **backup battery** that is designed to provide power to module after main power loss. This battery is **not replaceable nor rechargeable**.

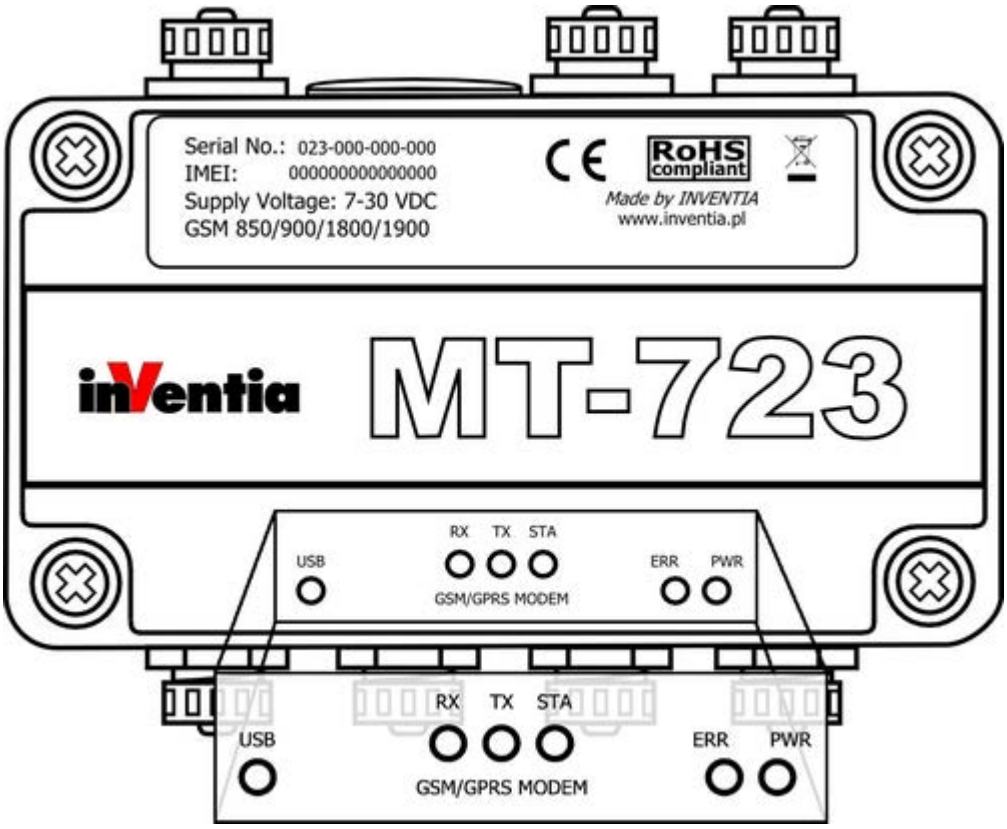
The module can be in three power supplying modes:

- **operational mode** - this is the default power supplying mode. In this mode modules is powered from external main power source or from USB cable. Module enters this state after connecting USB cable or connecting main power source. In this mode full functionality of module is available;
- **backup power mode** - in this mode module is powered from backup battery. Module enters this state three minutes after main power source loss. In this mode module is measuring binary inputs, counting pulses, measuring flows. Analog measurements and GSM/GPRS communication are not possible in this mode. Module is constantly in sleep mode to preserve power - it is signaled by PWR LED. It is advised to replace damaged/depleted power source as soon as possible;
- **storage mode** - in this mode is not connected to any power source and does not consume power from the internal lithium backup battery. To set module in this mode hold magnet for 1 minute at the point marked on the bottom of the device. The transition to this mode is indicated by lack of LED signaling (within 12 seconds there should be no **PWR** or other LED blink);



4.6. LED indicators

LED indicators placed on **MT-723** module's PCB are a great help during modules startup.



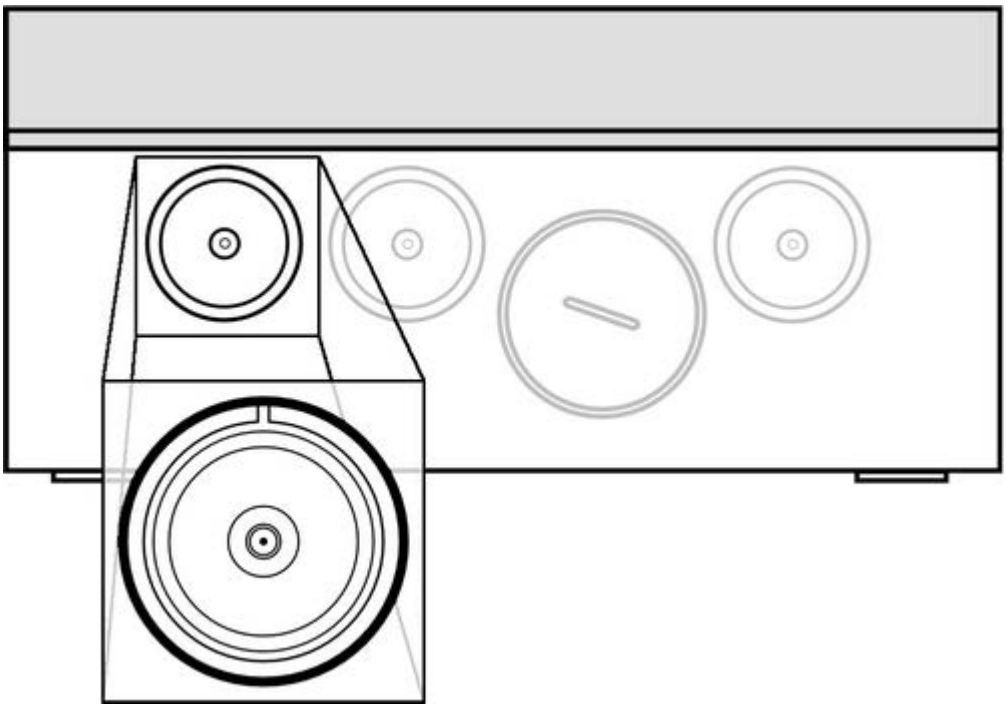
The LED's have assigned following significance:

- **PWR** 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 signaling* subchapter of *Maintenance and problem solving* chapter.

4.7. GSM antenna

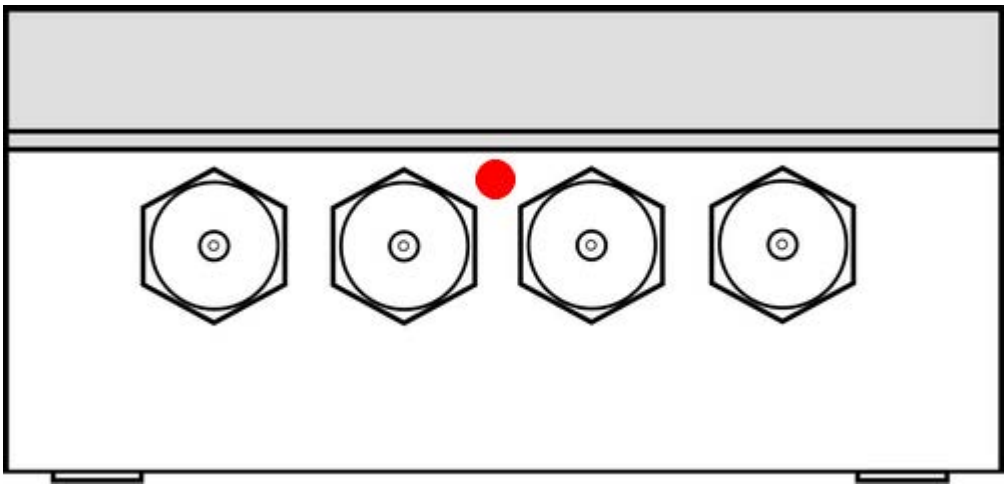
Connecting the antenna is necessary for reliable data transmission from **MT-723** module. **SMB IP68** type antenna socket is placed on module's panel.



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 or antenna high gain may be necessary.
It is essential to use IP68 connector to prevent moisture penetration which can cause module damage.

4.8. Reed switch input

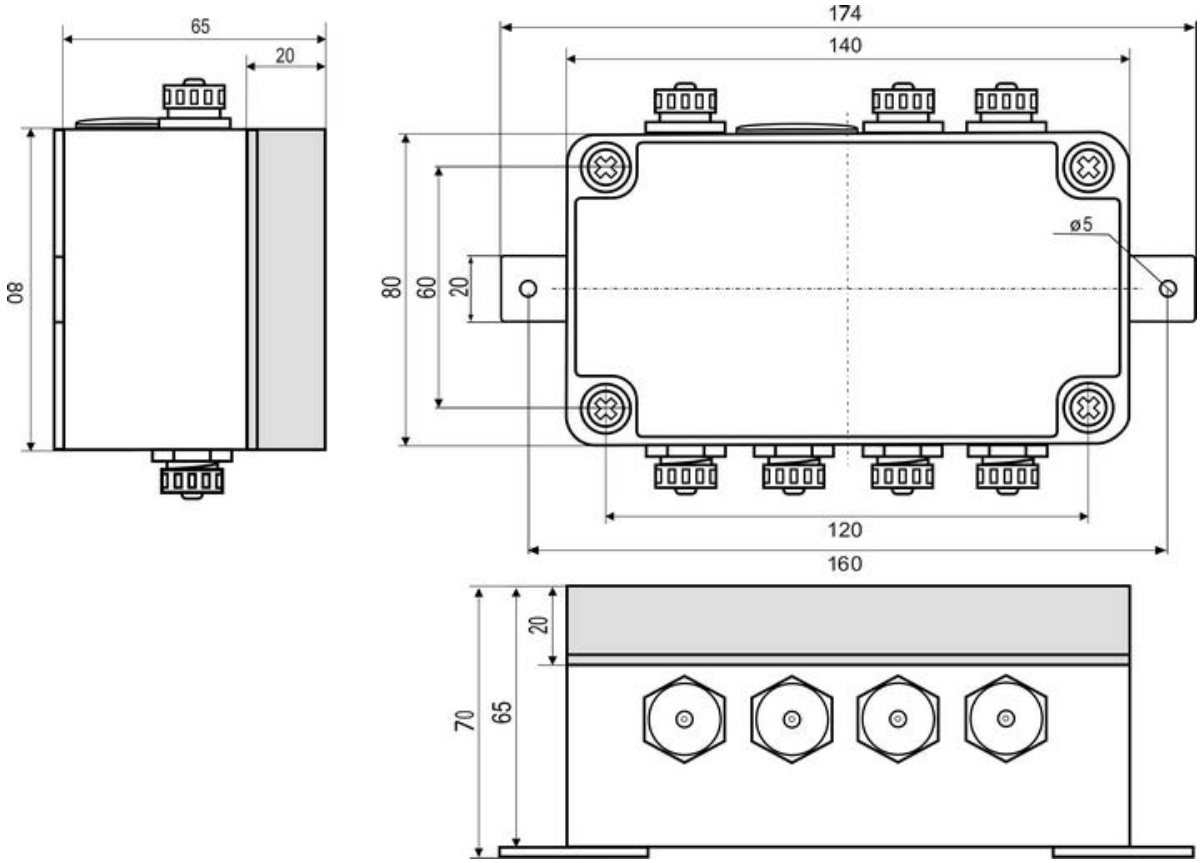
Between **DIGITAL1** and **DIGITAL2** sockets, in place marked on module housing there is spot which is used as reed switch test input. It is activated by putting a magnet on marked spot and then moving it away (negative logic).



Activation of this input causes setting **KEY_P** bit for one program cycle. This feature can be used to trigger events and/or measurements during telemetry system tests.

4.9. Enclosure

Enclosure of **MT-723** module is manufactured from high quality plastic securing highest environmental protection (**IP68**) for the electronics even in harsh environment. Housing is manufactured by FIBOX. All enclosure data including the parameters of used material are available at manufacturer's web page www.fibox.com.



Please note that the degree of protection is highly dependent on used connectors. Connectors used in the construction ensure maintaining IP68 protection degree. **Using other connectors may result in water penetration and consequently cause device damage.**

5. Connection diagrams

This chapter presents recommended wiring configurations ensuring proper functioning of all **MT-723** module's resources.

Connections are presented for:

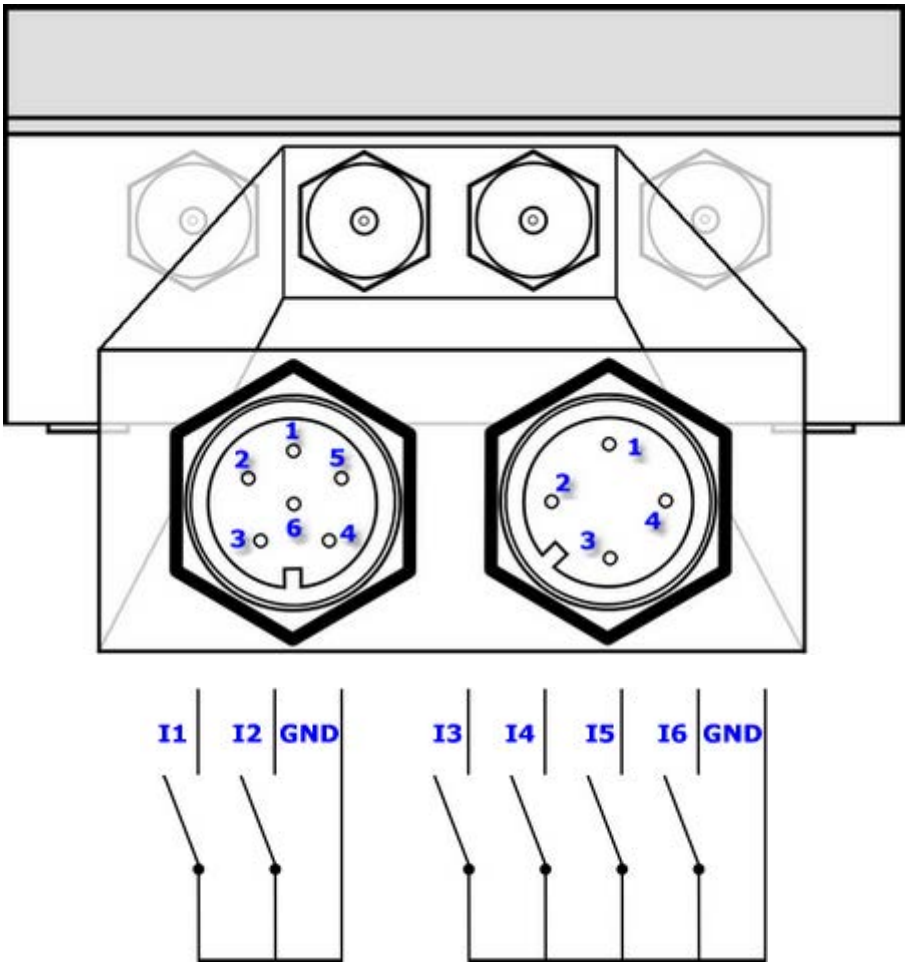
- Binary inputs I1...I5
- Binary outputs Q1...Q2
- Analog inputs AN1...AN3
- Power supply

and installation methods of:

- SIM card
- GSM antenna
- GPS antenna

5.1. Binary inputs

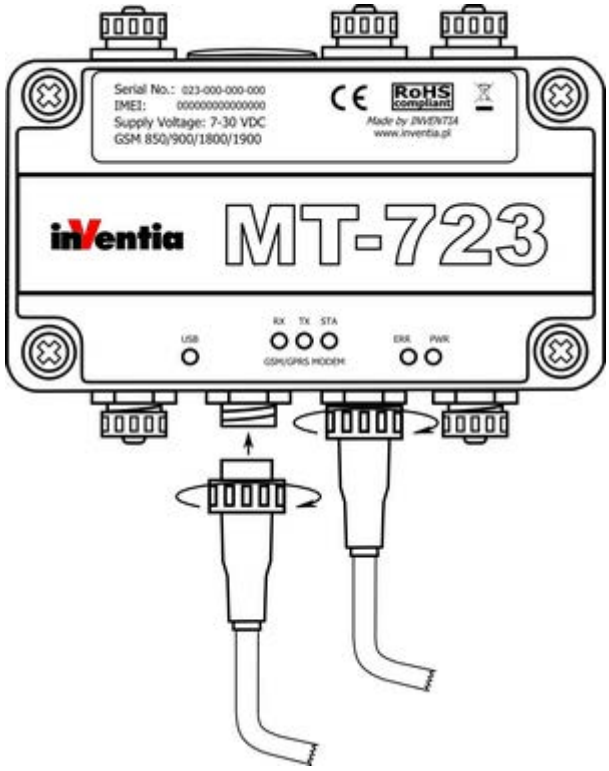
Binary inputs of MT-723 operate with **negative logic**, meaning that high state occurs only when the input is connected to ground. In open circuit the potential in reference to GND pin is not higher than **2,5 VDC**. Inputs work only with potential-free contacts like relay outputs, keyed transistor outputs. Below you can find recommended input connection diagram and sockets pinout description necessary for preparing plugs.



Resource	Connector	Pin number*
I1	Digital1 (4-pin)	1
I2	Digital1 (4-pin)	2
I3	Digital2 (6-pin)	1
I4	Digital2 (6-pin)	2
I5	Digital2 (6-pin)	3
I6	Digital2 (6-pin)	4
GND	Digital1 (4-pin)	4
GND	Digital2 (6-pin)	6

*pin in plug and pin in socket that create a contact have the same pin number

All binary inputs have same reference - module's electrical ground - negative pole of the power supply connected to **GND** pin.

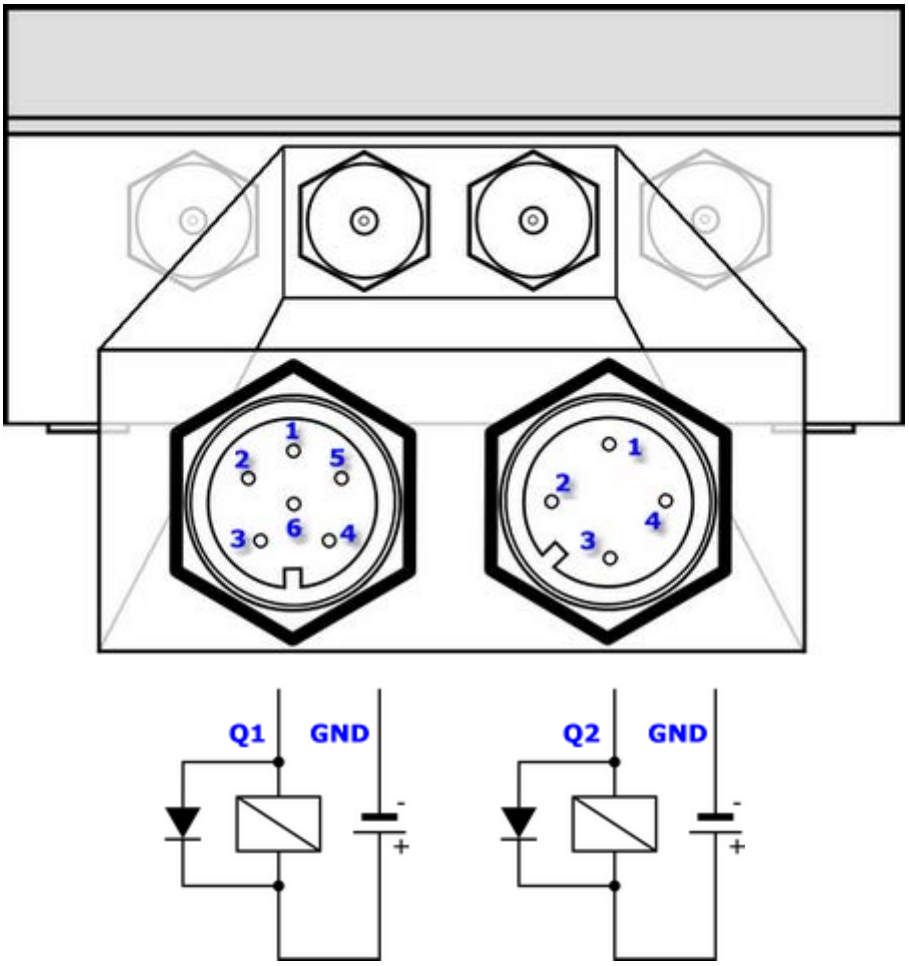


Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps. Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

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).

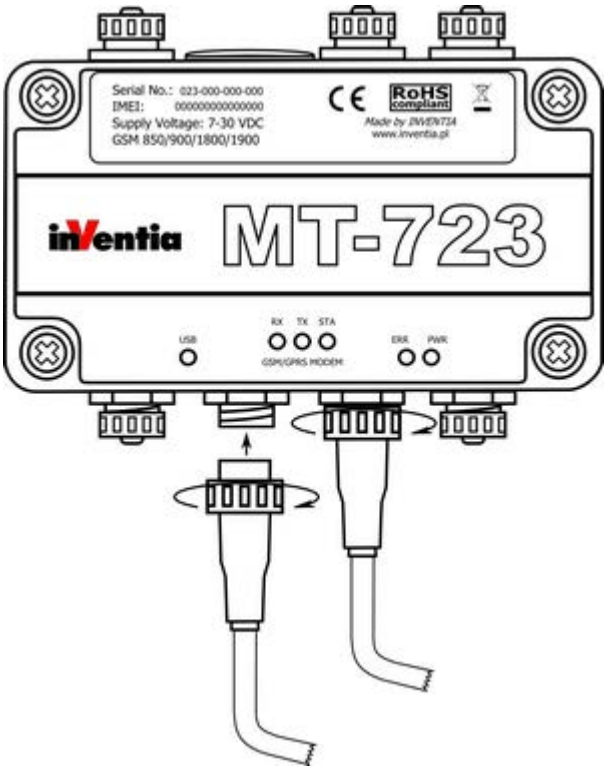
In case of inductive type load connected (a relay) a circuit limiting voltage peaks to max. +30V is necessary.
Below you can find recommended input connection diagram and sockets pinout description necessary for preparing plugs.



Resource	Connector	Pin number*
Q1	Digital1 (4-pin)	3
Q2	Digital2 (6-pin)	5
GND	Digital1 (4-pin)	4
GND	Digital2 (6-pin)	6

*pin in plug and pin in socket that create a contact have the same pin number

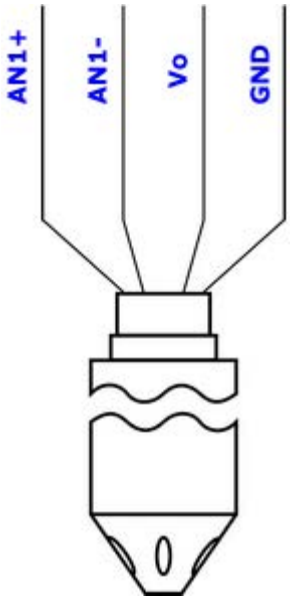
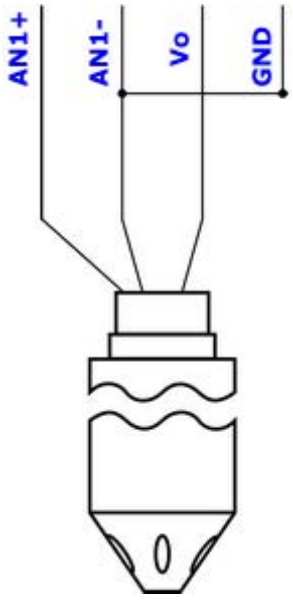
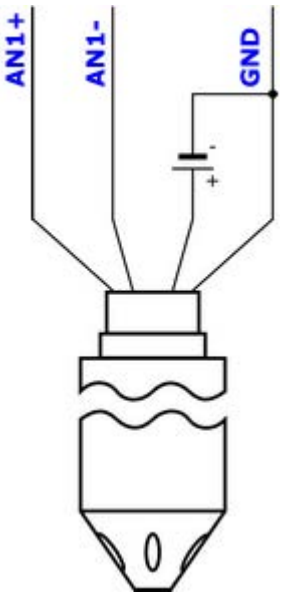
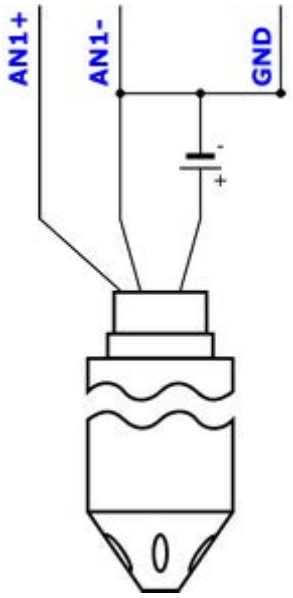
All binary outputs have same reference - module's electrical ground - negative pole of the power supply connected to **GND** pin.



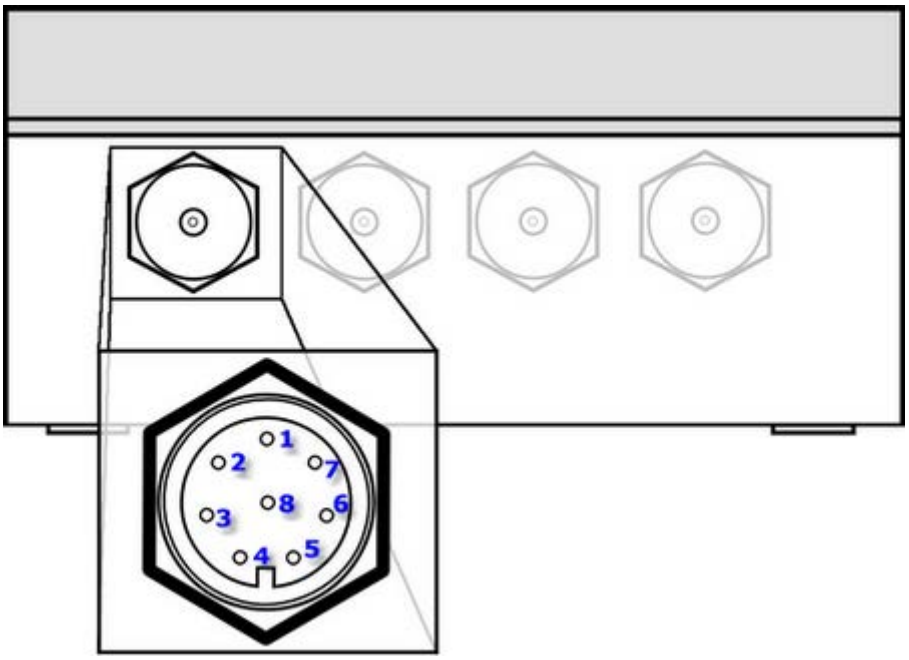
Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.
Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

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.

	4-wire sensor	3-wire sensor
powered from module		
powered from external power source		

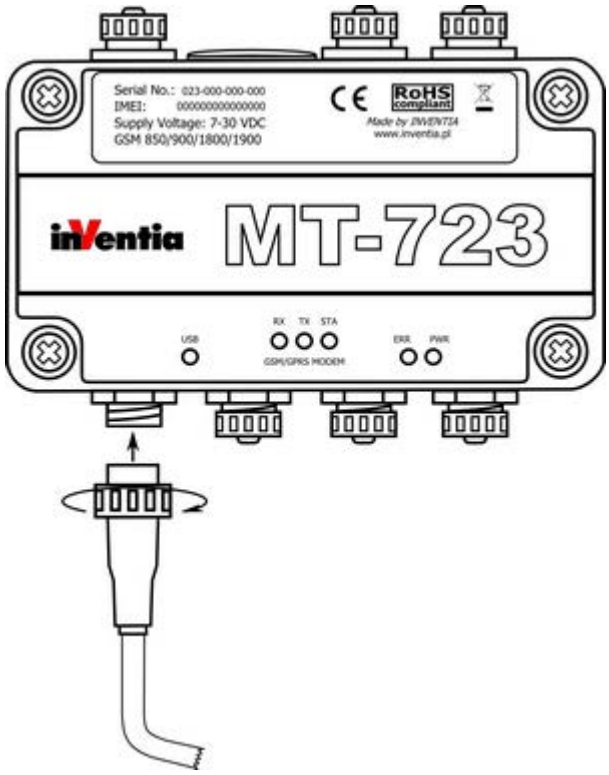
Sockets pinout description necessary for preparing plugs is described below:



Resourse	Pin number*
AN1+	1
AN1-	2
AN2+	3
AN2-	4
AN3+	5
AN3-	6
Vo	7
AGND	8

*pin in plug and pin in socket that create a contact have the same pin number

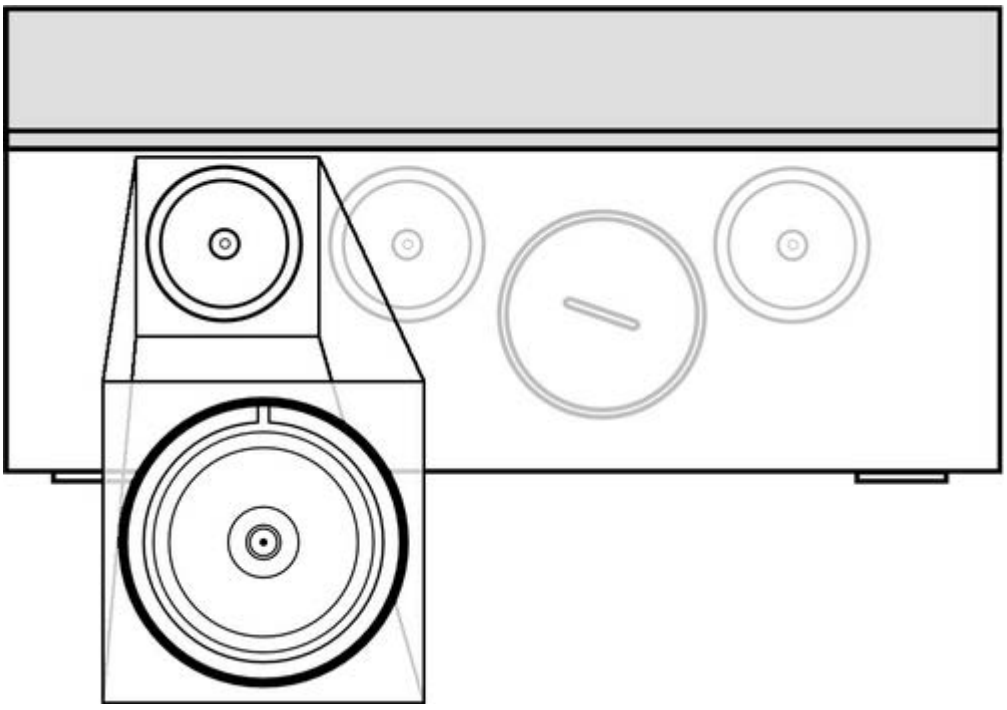
Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.



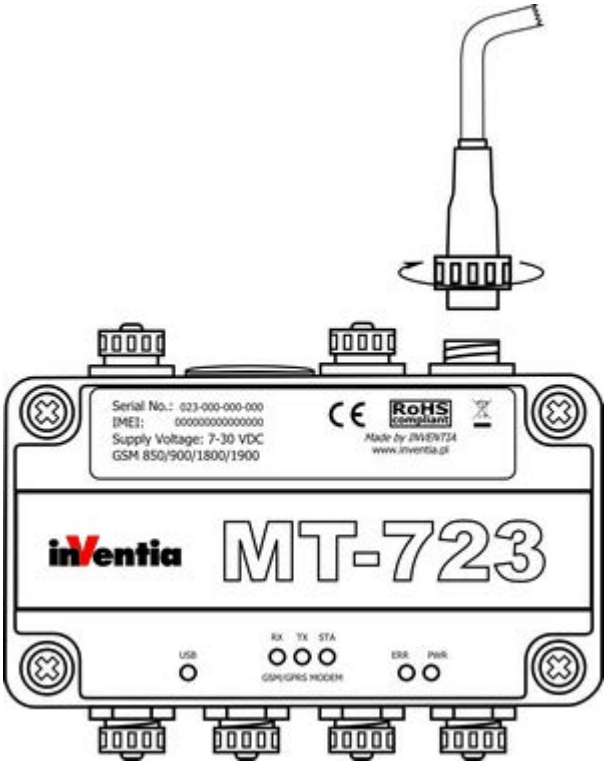
Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

5.4. GSM antenna

Antenna can be connected to **MT-723** module via SMB IP68 socket.



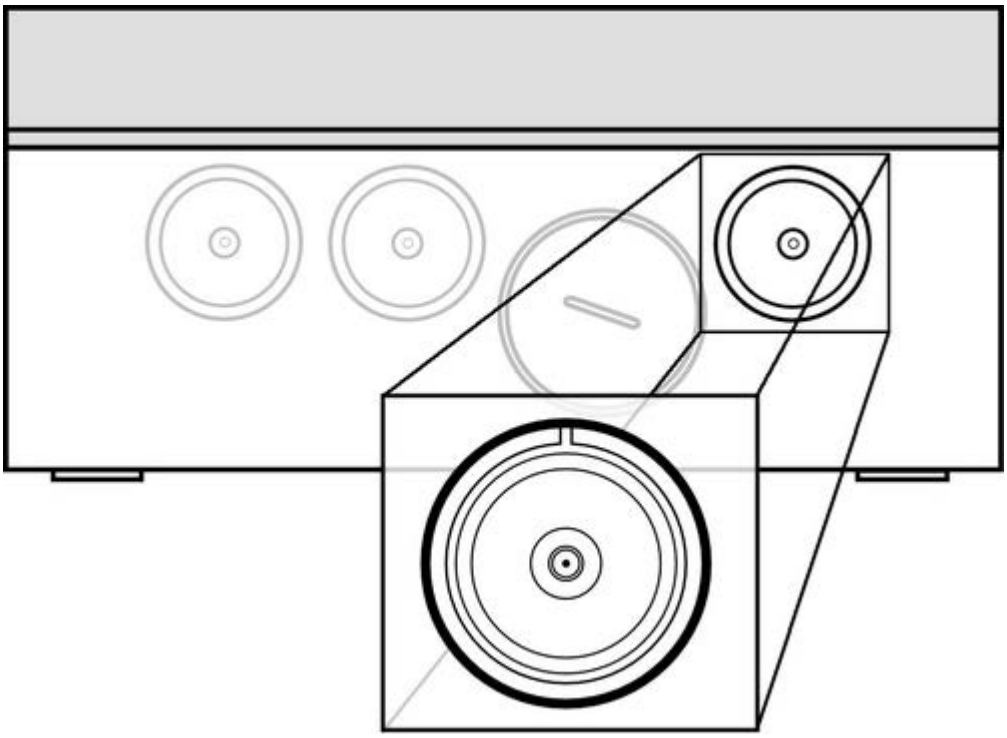
Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.



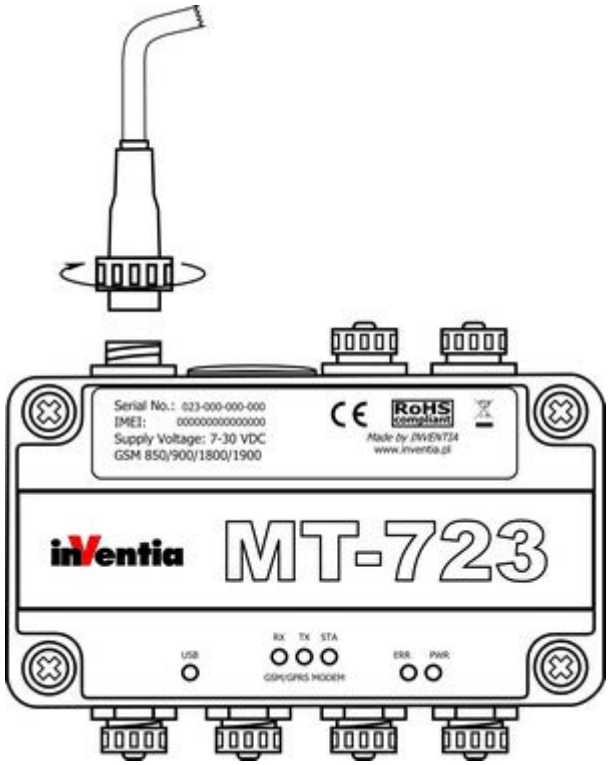
Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

5.5. GPS antenna

Antenna can be connected to **MT-723** module via SMB IP68 socket. This socket is available only in modules with integrated GPS receiver.



Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.



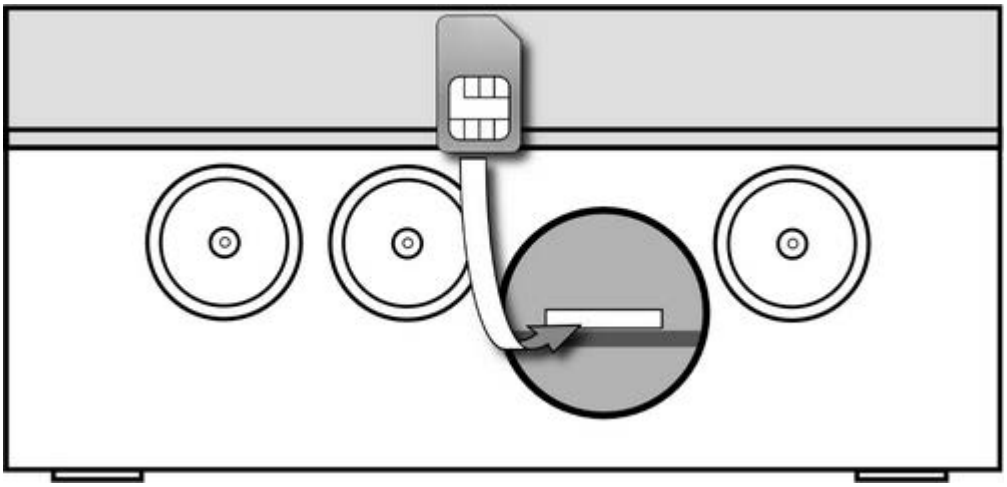
Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

5.6. 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 access to SMS services are impossible.

We recommend that inserting of **SIM** card is done with power disconnected, which means that both battery and USB cable are not connected.
We recommend inserting the SIM card after writing to module configuration including correct PIN code for that SIM card. Bear in mind that after three attempts of entering wrong PIN code the SIM card gets blocked. Inserting of wrong pin code is signaled by LED indicators. The blocked card may be unblocked. For details see procedure described in sub-chapter *Unblocking the SIM card* of *Maintenance and problem solving* chapter.

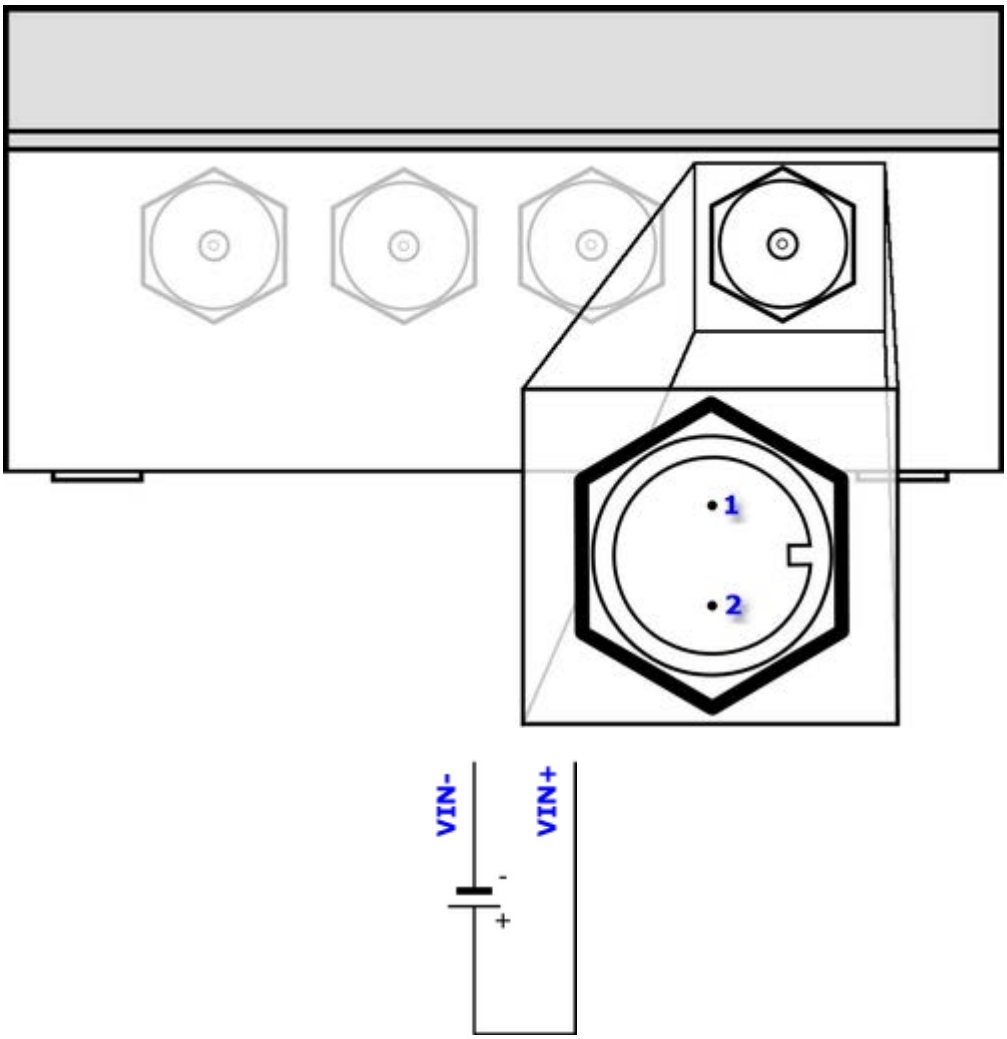
The SIM card should be inserted into SIM holder hidden behind large protective cap. SIM card contacts should face bottom of modules enclosure. The card should be pushed gently till slight resistance is felt. Properly installed SIM card should stick out slightly from the protective gel covering module's electronic parts.



Correctly installed **SIM** card secures connection between its contact fields and the holder contacts.

5.7. Power supply

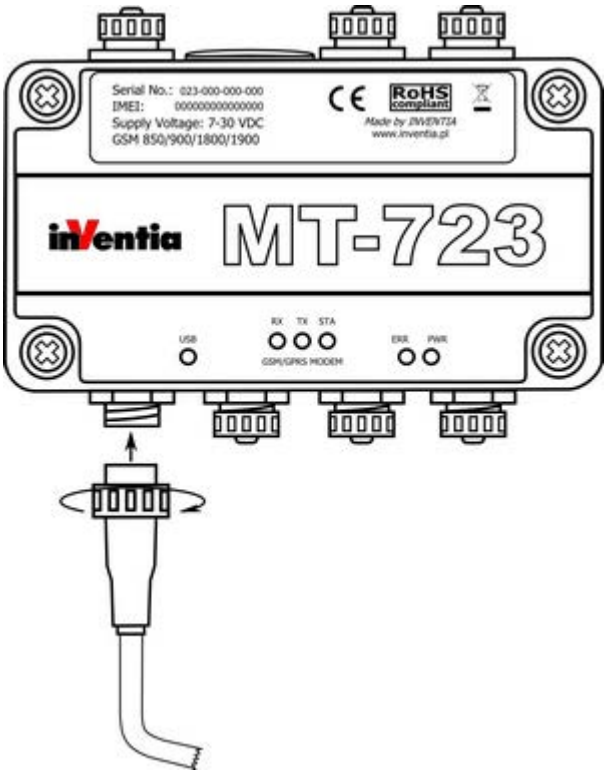
MT-723 module can be powered from **any DC power source** providing voltage within the range of 7-30 VDC, including a DC power supply, alkaline batteries, gel batteries, photovoltaic cells, and others.



Resource	Pin number*
VIN-	1
VIN+	2

*pin in plug and pin in socket that create a contact have the same pin number

Connection between plug and socket should be secured with locking ring to ensure certainty of the connection. Unused slots should be secured with protective caps.



Assembly of IP68 plug is described in the instruction attached to the elements of the plug. It is recommended to use cables with a circular cross-section. Usage of cables with different cross-section does not warrant maintaining tightness of the system.

5.8. Installation

Telemetry module MT-723 must be secured to a stable substrate (e.g. to concrete wall), using two screws or bolts put through montage holes marked on the image below. Diameter of the holes is 5 mm and spacing between them is 160 mm.

Do not expose the enclosure to tension or mechanical vibrations, which may lead to the dehermetization and as consequence to module damage.

6. First start of the module

First start of the module MT-723 requires a few simple activities. We recommend supplying the power via USB in order to save the battery. Please follow these steps:

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-723** 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 on the MTManager installation CD (MT-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)

These 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* Maintenance and 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.

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-723** 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-723** 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-723** 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.

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.

In case of module signaling locked SIM card apply unblocking 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. Configuration read disable

Performed function	-	Allows blocking of configuration reading even when valid password is supplied.
Data type	-	Selection list
Range	-	*Yes* Configuration reading 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-723** 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 retries

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 Number of SMS sending retries.

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 Authorized numbers -> Phone. Selecting *None* disables sending daily SMS limit alert.

7.2.3.6. Response 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-723 here*
Comments	-	In replay message text symbolic names may be used following syntax rules defined in Appendices in the Syntax of read and write commands in SMS 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. APN name), optional (e.g. Spooler IP) and optimizing transmission (e.g. Transmission timeout [s]).

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 login to GPRS impossible.

7.2.4.2. APN user name

Performed function	-	Defines user name for APN access
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 its 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 its 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 its 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 control

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 Authorized IP addresses list.

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 its current identifier.

Default value	-	*Yes*
Comments	-	Switching the control off enables verification of the sender on the base of its 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 Authorized IP addresses list in order to establish the communication.

7.2.4.6. Module 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. Parameter - Force IP (0.0.0.0 – DHCP)

Performed function	-	Allows to force user given IP address within APN
Data type	-	IP address
Range	-	0.0.0.0 - 255.255.255.255
Default value	-	*0.0.0.0*
Comments	-	Comments - If value is 0.0.0.0 then IP is given by DHCP. If this functionality is not supported by APN then IP is given by DHCP.

7.2.4.8. 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.

7.2.4.9. 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.

7.2.4.10. 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.

7.2.4.11. 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 putting here central node's (data collector) IP address.

7.2.4.12. 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.

7.2.4.13. 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.
Default value	-	*No*
Comments	-	In order to log-in to other networks the SIM card present in the module must have roaming option enabled.

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!

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 numbers

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 Phone 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 Syntax for reading and writing commands using SMS chapter of Appendices.

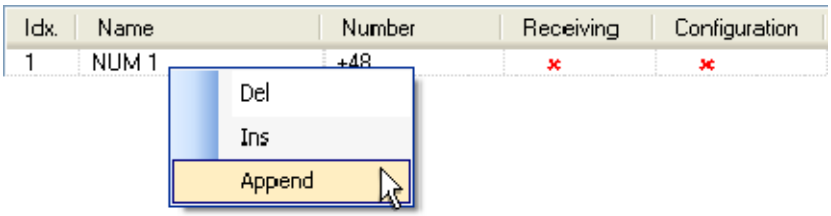
7.2.5.2. Number of IP addresses

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 IP 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)

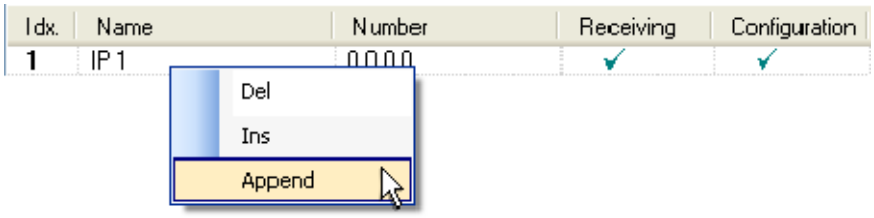
Entries on phone list may be easily added and deleted by using context menu activated by right mouse button click on any position of the list in parameters window.



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.



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* (zero) 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 (I1...I6)/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). Mode available for inputs I1...I6.
- pulse input - configuration dedicated to counting pulses of external counters and calculating the flow. Mode available for inputs I1...I5.

7.2.6.2.1.1. Maximum pulse frequency

Performed function	-	Defines maximum 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 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.

7.2.6.2.1.3. Name

Performed function	-	Defines input's user friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 31 characters
Default value	-	Respective *I1*, *I2*, *I3*, *I4*, *I5*, *I6*
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 (option unavailable for input I6)
Default value	-	*Inactive*
Comments	-	According to selected mode MTManager displays additional configuration parameters for each input

7.2.6.2.1.5. Filtering constant

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 pulse input mode only. Parameter unavailable for input I6.

7.2.6.2.1.8. 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 input mode. Parameter unavailable for input I6.

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 input mode. Parameter unavailable for input I6.

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 input mode. Parameter unavailable for input I6.

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 input mode. Parameter unavailable for input I6.

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	-	Upon exceeding the preset value by calculated flow volume the HiHi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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	-	Upon exceeding the preset value by calculated flow volume the Hi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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	-	Upon exceeding the preset value by calculated flow volume the Lo alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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	-	Upon exceeding the preset value by calculated flow volume the LoLo alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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 input mode. Parameter unavailable for input I6.

7.2.6.2.1.17. Deadband - 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. Deadband flags are dedicated to continuous monitoring of flow changes. This parameter is available only in pulse input mode. Parameter unavailable for input I6.

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 user 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 bit list 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.

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.

7.2.6.2.2.3. 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 bistable (the output state is a true copy of the controlling bit's state).

7.2.6.2.3. Analog inputs (AN1...AN3)

MT-723 module is equipped with three analog inputs operating in 0 ... 5V standard and one controlled analog 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*
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 analog 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 user friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 31 characters
Default value	-	Respectively *AN1*, *AN2*, *AN3*
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 analog signal value in engineering units.
Data type	-	Number
Range	-	*-32767 ... 32767*
Default value	-	*32767*
Comments	-	Upon exceeding the preset value by analog 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 analog signal value in engineering units.
Data type	-	Number
Range	-	*-32767 ... 32767*
Default value	-	*32767*
Comments	-	Upon exceeding the preset value by analog signal the Hi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

7.2.6.2.3.12. Alarm Lo - engineering units

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

7.2.6.2.3.13. Alarm LoLo - engineering units

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

7.2.6.2.3.14. Alarm hysteresis - engineering units

Performed function	-	Defines hysteresis value for analog 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. Deadband - engineering units

Performed function	-	This parameter defines a minimal change of registered analog signal to react on. Exceeding this value sets a flag (**AN1_DB**, **AN2_DB** and **AN3_DB**) respective to the analog 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. Deadband flags are dedicated to continuous monitoring of analog signal changes.

7.2.6.3. Counters (CNT1…CNT)

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 bit list in Appendices) or *0 … 65535*
Default value	-	*None*
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.

7.2.6.3.2. 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

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.

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 bit list in Appendices) or *0 … 65535*
Default value	-	*None*

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.

7.2.6.3.4. Active edge of decrementing input

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

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.

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. Days of week

Performed function	-	Defines days of week 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 days of week and days of month. Selecting all week days will make the timer active all of the time. If no days of week are selected the activity of the timer will depend only on days of month selection.

7.2.6.4.1.4. Days of month

Performed function	-	Selects days of month 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 days of week and days of month. Selecting all month days will make the timer active all of the time. If no days of month are selected the activity of the timer will depend only on days of week selection.

7.2.6.4.2. Asynchronous timers (CK1...CK8)

Asynchronous timers measure cyclically defined time intervals. They are not synchronized with module's real time clock (RTC).

7.2.6.4.2.1. Period [s] (0 – inactive)

Performed function	-	Defines the interval module's clock should measure.
Data type	-	Number
Range	-	*0 ... 240*
Default value	-	*0*
Comments	-	Selecting *0* deactivates the timer

7.2.6.5. Temperature sensor

MT-723 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 input)

Binary input **I5** is connected to an internal vibration sensor with contact normally open. This sensor can detect even slight movement of the device. This allows user to detect intrusion into the measurement installation, perform measurements of position only when the unit moves and much more.
Vibration sensor is always on.
Information about the detected vibration is signaled by the activation of **VIB** bit.
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 Filtering constant. 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. Power supply

Groups parameters defining method of monitoring power supply.

7.2.6.7.1. Low voltage alarm

Performed function	-	Defines alarm threshold level of power supply 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 … 99,0*
Default value	-	*10,5*
Comments	-	The **LBAT_C** alarm flag is recommended to dispatch the information about necessity of battery replacement.

7.2.6.7.2. Alarm notifying period

Performed function	-	Defines the interval for generating low power supply 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 power supply 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 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.

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.

7.2.6.8.5. 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.

2.6.8.6. Movement signalling

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 - Movement signaling threshold [km] 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 Movement signaling threshold [km] 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 Movement signaling threshold [km] parameter. Parameter is available only if Movement signaling 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: Base position - latitude and Base position - longitude allowing user to set coordinates of geofencing circle centre and Radius [km] 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 Base position - longitude and Radius [km] 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*.

7.2.6.8.10. 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 Base position - latitude and Radius [km] 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*.

7.2.6.8.11. 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 Base position - latitude and Base position - longitude 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	-	*None*
Comments	-	If the Logger is not in use the parameter should have value of *None*.

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.

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.

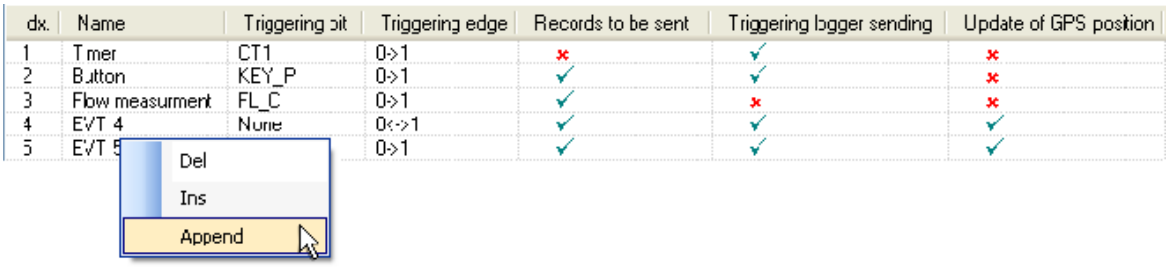
7.2.7.1. Number of events

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 edge	-	Event triggering edge Selection list *0->1* rising edge (default value) *1->0* falling edge *0<->1* any edge
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 than 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.



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.

7.2.8. 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 etc. 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 etc. 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

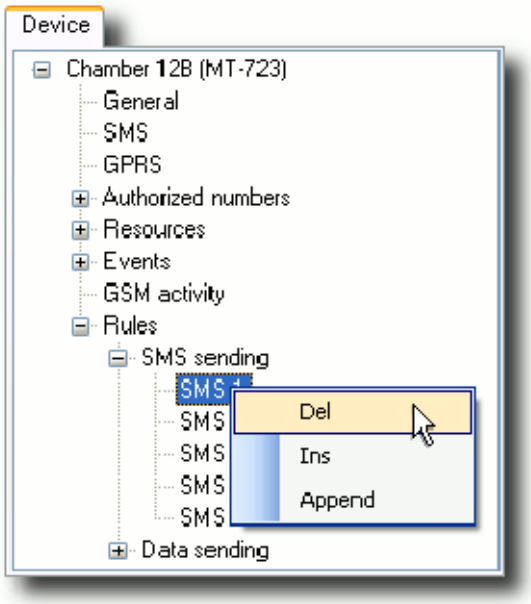
In both cases criteria are defined by employing previously defined Events.

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 Events table
Default value	-	*None*
Comments	-	To send the SMS message, Events table must have at least one event defined

7.2.9.1.3.2. Recipient

Performed function	-	Assigns a recipient of SMS from defined in Authorized numbers->Phone list.
Data type	-	Selection list
Range	-	*None* or the name from Phone list
Default value	-	*None*
Comments	-	To send the SMS message, the Authorized numbers->Phone 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 signs)
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 Syntax of commands for reading and writing data by SMS paragraph.

7.2.9.1.3.4. Activity period after login

Performed function	-	Defines how many minutes after login into GSM network in order to send SMS the module remains active.
Data type	-	Number

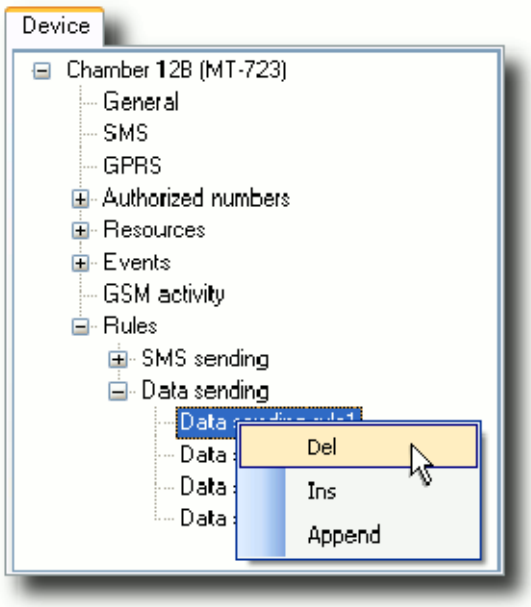
Range	-	*0 ... 1080*
Default value	-	*0*
Comments	-	Any value different than *0* ensures prolonged time for remote access to the module after sending the SMS or for reception of SMS sent to the module. Leaving the *0* value makes the module to hibernate immediately after sending the SMS. Extending the activity period 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 Sooler IP located in GPRS group parameters.

7.2.9.2.4.4. Activity period after login

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 etc. Increasing activity period shortens battery life time! Leaving it at *0* makes the module hibernate immediately after performing scheduled tasks.

7.2.9.2.4.5. Address space

Performed function - Defines module's memory space, where data prepared for transmission reside

Data type - Selection list

Range - *IREG*

Analog 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	-	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.

7.2.9.2.4.7. Buffer size

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

7.2.9.2.4.8. Receiver's buffer address in HREG address space

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	-	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.

7.3. 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-723 module the parameters are Counters CNT1...CNT8.

7.3.1. Counters (CNT1...CNT8)

Name of the resource	-	Counter CNT1...CNT8
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.

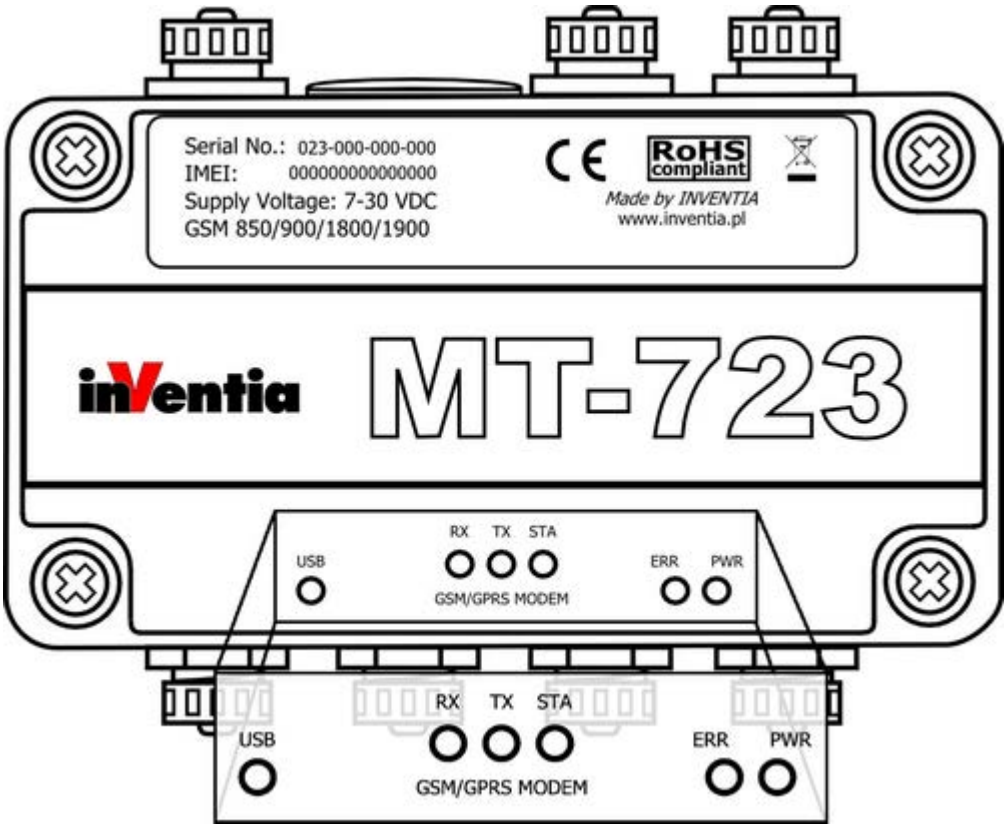
Parameter	Value
CNT1	-12
CNT2	2147483647
CNT3	-2147483648
CNT4	516
CNT5	214
CNT6	83647
CNT7	-2183647
CNT8	16

8. Maintenance and problem solving

8.1. LED signaling

MT-723 is equipped with six **LED** indicators reflecting the module state.

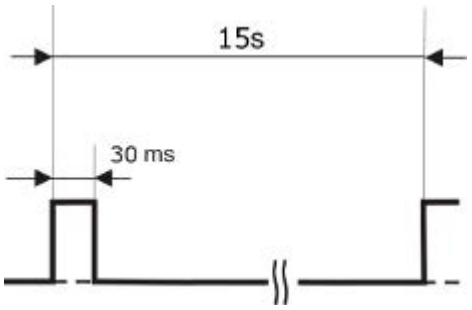
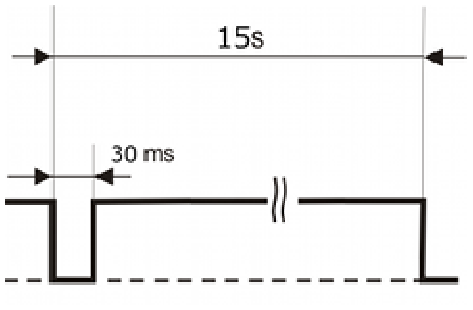
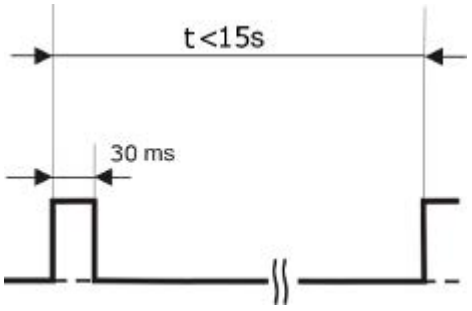
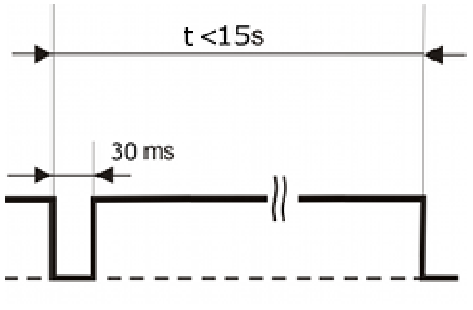
- **PWR** LED **-** indicates current Power supply and module's state (low and high energy consumption state called also sleep and activity state)
- **ERR** LED - indicates abnormal states
- **STA** LED - indicates GSM/GPRS status (GSM login as well as GPRS login, roaming, and signal level)
- **TX** LED - indicates Data or SMS transmission
- **RX** LED - indicates data or SMS reception
- **USB** LED - indicates USB port state

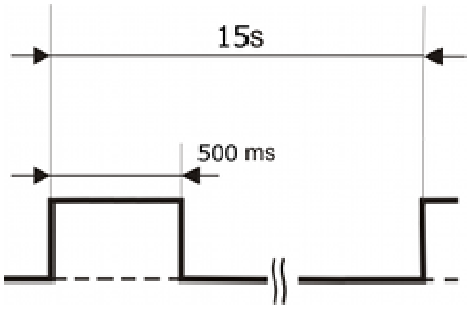
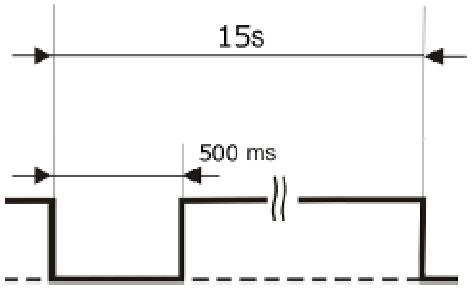
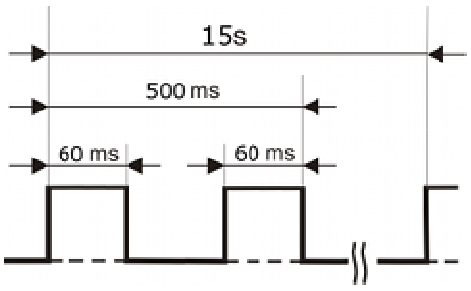


The current state is signaled by flashes varying in length and number.

8.1.1. PWR LED

Signals emitted by PWR 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 replace-ment 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 signaled.

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

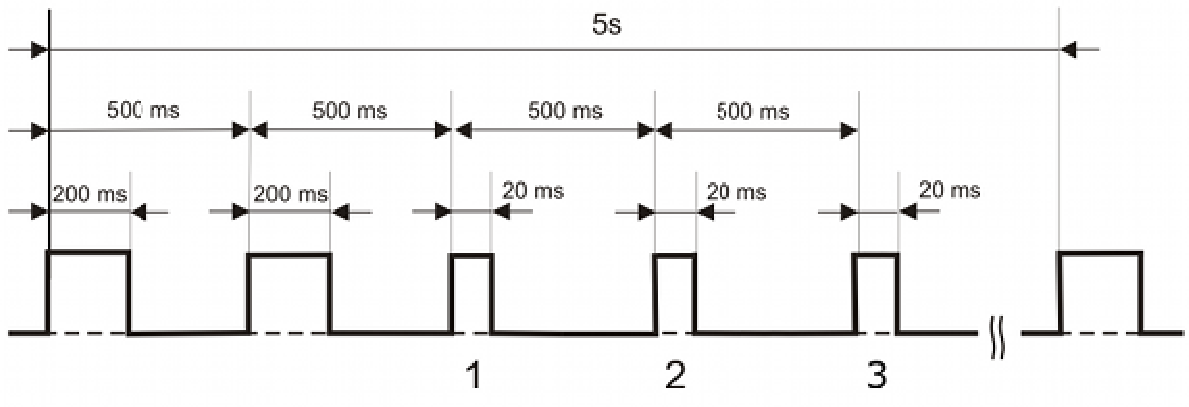
ERR LED	
○	critical error
◑	transmission error - SMS or GPRS transmission impossible
◐	missing, defective or blocked SIM card
◐ ◐	the card requires PIN code
◐ ◐ ◐	GSM error
◐ ◐ ◐ ◐	GPRS error
◐ ◐ ◐ ◐	APN login error
◐ ◐ ◐ ◐ ◐ ◐	wrong PIN

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 signaled 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.

9. Technical parameters

9.1. General

Dimensions (height x width x depth)	80 x 140 x 65 mm
Weight (with batteries)	680 g
Mounting method	2 ø5 mm holes
Operating temperatures	-20°C…+55°C
Protection class	IP68

9.2. Modem GSM/GPRS

Modem type	Sierra Wireless AirPrime
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

For modules with serial number lower than 023-011-020-000 manufactured before 2011-05-16:

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…I6

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	±0.1 %
Accuracy at full temperature range	±0.3 %

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

Acceptable power supply voltage range	7 - 30 V
Mean current consumption in sleep mode (at 12 V)	<250 µA
Mean current consumption with active GSM modem (at 12 V)	25 mA
Maximum peak current when GSM modem is active (at 12 V)	500 mA
Internal battery type	lithium-thionyl chloride
Internal battery nominal voltage (at 2 mA, 20°C)	3.6 V
Internal lithium battery nominal capacity (at 15 mA, 20°C, 2.0 V cut off)	13 Ah

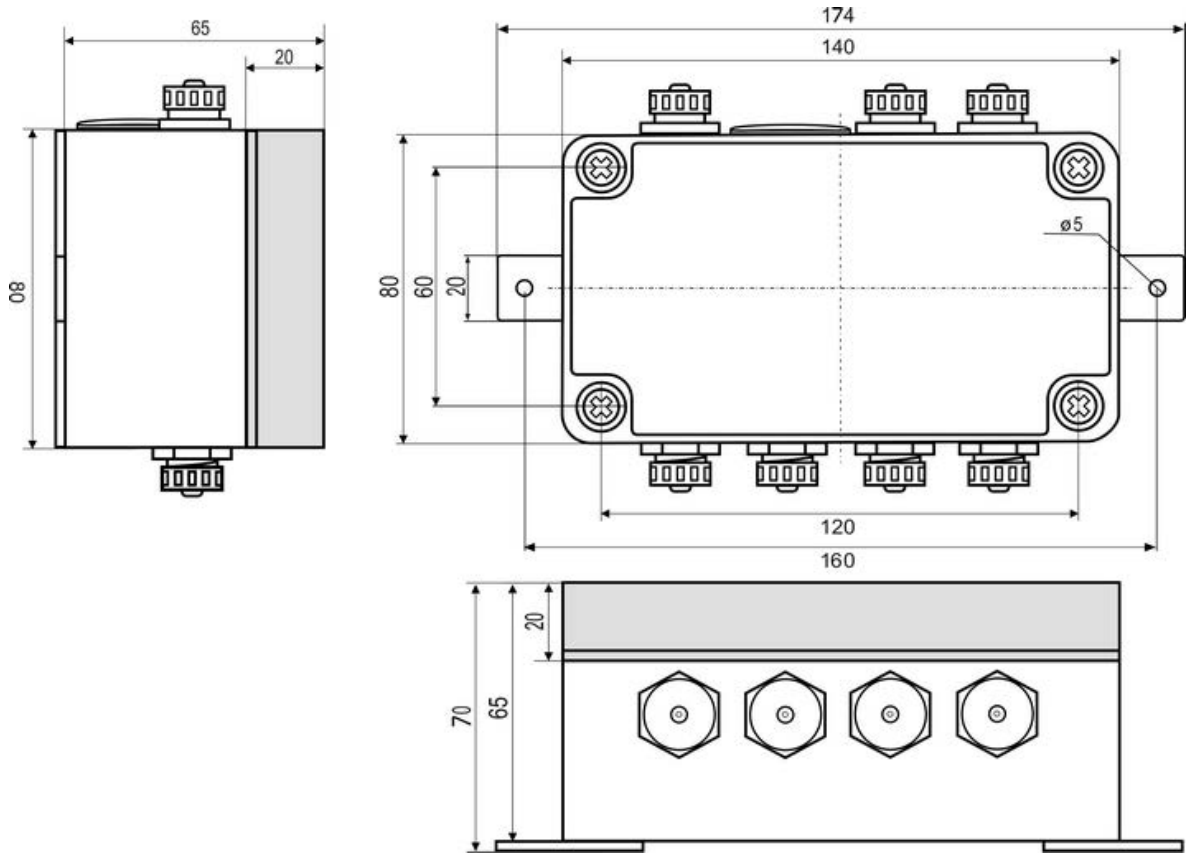
9.11. Enclosure

Mechanical endurance IK (EN 62262)	IK 08
Electrical isolation	Total isolation
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, 4X, 6, 6P, 12, 13
Material	Polycarbonate
Material of lid screws	Polyamide
Gasket material	Polyurethane

Dimensions without hanger	
Length	140 mm
Width	80 mm
Height	65 mm

Dimensions with hanger	
Length	174 mm
Width	80 mm
Height	70 mm

9.12. Drawings and dimensions



NOTICE!!!
All dimensions in millimeters!

10. Safety information

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 its 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-723 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
#BTV	battery voltage in format x.xxV
#CNT*counter_number*	read counter status
#IR*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
#SAT	read number satellites
#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)
#TEMP	read temperature from temperature indicator build-in modem in form [-]xx.xC

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*]	extends 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 modules 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's (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 cannot interpret the command the response is *>ERR*.
If attempted write value is out of range the response is *>command=ERR* (eg. *>#CNT1=ERR*).
To pass the # sign in SMS type ##.

11.2. Memory map

All accessible from remote resources of MT-723 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 deactivation of reed switch input. 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

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**HEX**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
0	0x0000	---	---	---	---	---	---	---	---	---	---	---	---	RUN	FS	1	0	PRG_STATE	FS - first scan RUN - program running
1	0x0001	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}	RTC_FSEC	RTC (UTC time) - second fraction
2	0x0002	hour (0...23)					minute (0...59)						second / 2 (0...29)					RTC_HMS	RTC (UTC time) - RTC time second - youngest bit in RTC_FSEC (address 20)
3	0x0003	year - 2000 (0...127)							month - 1 (0...11)				day - 1 (0...30)					RTC_YMD	RTC (UTC time) - date
4	0x0004	int32(LoHi)																ON_TMR	Uptime [s] from connecting to power supply
5	0x0005																		
6	0x0006	**RTC_OK**	**RTC_C**	**ZONE_C**	**HREG_C**	**CFG_OK**	**GPS_C**	**AN_C**	**FL_C**	**KEY_P**	**PF**	**SLEEP**	**Vo**	**GPS**	**GSM**	**USB**	**BAT**	MT_BITS	**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 - reed switch input deactivated (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

7	0x0007	---	---	---	---	---	---	---	---	---	---	VIB	OPEN	TEMP_Hi	TEMP_Lo	---	LBAT_C	MT_ALM	**Alarm bits** LBAT_C = 1 - low battery voltage alarm (1 cycle) TEMP_Lo = 1 - low temperature alarm TEMP_Hi = 1 - high temperature alarm OPEN = 1 - open enclosure alarm VIB = 1 - vibrations alarm
8	0x0008	KEY	---	---	---	---	---	---	---	---	---	I6	I5	I4	I3	I2	I1	BIN	Ix - binary inputs states KEY - reed switch input state
9	0x0009	CT8	CT7	CT6	CT5	CT4	CT3	CT2	CT1	CK8	CK7	CK6	CK5	CK4	CK3	CK2	CK1	CLOCK	Timer flags (1 cycle)
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	int16																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 [%] SIM_ERR = 1 - error or no SIM card PIN_ERR = 1 - wrong PIN APN = 1 - module logged into APN GPRS = 1 - GPRS available ROAMING = 1 - module in roaming GSM = 1 - module registered in GSM (range OK)
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	**FIX**	HDOP (0...99)	**MOV**	**GEOF_C**	**GEOF**	**-**	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 cycle) 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	int16							BAT_PWR	Counter of consumed energy [mAh]
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-723** 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	Activation of reed switch input. 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.
TEMP_Lo	Low temperature alarm
TEMP_Hi	High temperature alarm
OPEN	Open enclosure alarm (1 - enclosure open)
I1…I6	Binary inputs I1…I6
CT1…CT8	Flags of CT1…CT8 timers. Bit set for one program cycle - events only on rising edge.
CK1…CK8	Flags of CK1…CK8 timers. Bit set for one program cycle - events only on rising edge.
AN1_LoLo…AN3_LoLo	Analog inputs alarm bits - LoLo alarm level reached
AN1_Lo…AN3_Lo	Analog inputs alarm bits - Lo alarm level reached
AN1_Hi…AN3_Hi	Analog inputs alarm bits - Hi alarm level reached
AN1_HiHi…AN3_HiHi	Analog inputs alarm bits - HiHi alarm level reached
Q1…Q2	Binary outputs Q1…Q2

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