Telemetry Module MT-713 v3

CE 1471

User's Manual

inVentia

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Telemetry Module MT-713 v3

User's manual

2G/3G or 2G/LTE Cat-M1/NB-IoT Telemetry Module
for remote monitoring and control
Class 1 telecommunications terminal equipment

GSM 850/900/1800/1900
UMTS 800/850/900/1900/2100
Cat-M1/NB1 Band: 2,3,4,5,8,12,13,20,26,28

MT-713 v3

INVENTIA Sp. z o.o

v3.37

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Attention!
This User Manual applies to version **3.37** of the firmware of the Telemetry Module MT-713 v3. Versions older than the currently described version may not provide all the features.

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1. MODULE DESTINATION

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

Compact design, low power consumption from internal battery, continuous pulse counting on binary inputs, local logging of measurement results and spontaneous information sending upon predefined events makes the module ideal choice for applications requiring periodical supervision of parameters and longtime operation on own battery supply. The module is delivered in two battery size versions (**MT-713 -** standard and **MT-713/HC** - double capacity battery). There is available a few extensions on special wishes like high voltage power output (**MT-713/HV**), additional serial port with Modbus RTU communication protocol (**MT-713/RS485**) or internal GPS receiver (**MT-713/GPS**)

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. The housing of unit has got protection class **IP67**.

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 design - this chapter presents the basic information about Module resources and design elements. Her is the information about how does the module work and how and where it may be employed. Chapter contains signaling description of LED indicators which is necessary knowledge during module installation.

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

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

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

Problem solving - all procedures for battery replacement and unblocking the SIM card.

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

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

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

3. GSM REQUIREMENTS

For the telemetry module to work properly, it is necessary to insert a SIM card in the module that offers services in the field of packet transmission and/or SMS, depending on the use of the module.

Data from the module can be received on your own server or using the dataportal.pl/en cloud solution.

The server receiving the data should be reachable from the level of the network connection provided by the SIM card. Since the communication takes place in a protocol based on the UDP protocol, the ports used for transmission (by default, UDP ports 7110, 7111 and 7113) should be open. If address translation (NAT) occurs in the communication between the module (SIM card) and the server, care should be taken to redirect incoming traffic on these ports to the server. The application dedicated to receiving data is **MTDataProvider**.

An absolutely necessary condition for the correct operation of the module is to ensure sufficient signal strength in the place where the module antenna will be placed. Using the module in places that do not guarantee adequate signal strength may lead to breaking the transmission and generating excessive costs due to repeated sending of recorded data. We recommend using antennas with wires not longer than 10m.

4. REQUIRED PROGRAMS

For proper start of working with the module has to be install an additional software for configuration and communication with **MT-713**. In this manual we are often use a software names that is cooperating with module. Below is available the short description of the applications with information what is necessary to install on the computer on every stage work with a device.

MTManager (MTM) (absolutely required for module setup and diagnostic) - main application for MT\ML module management. Program allows a local and remote configuration of the modules, programing of control algorithms, firmwares upgrade and resources monitor. Application is available on MT-

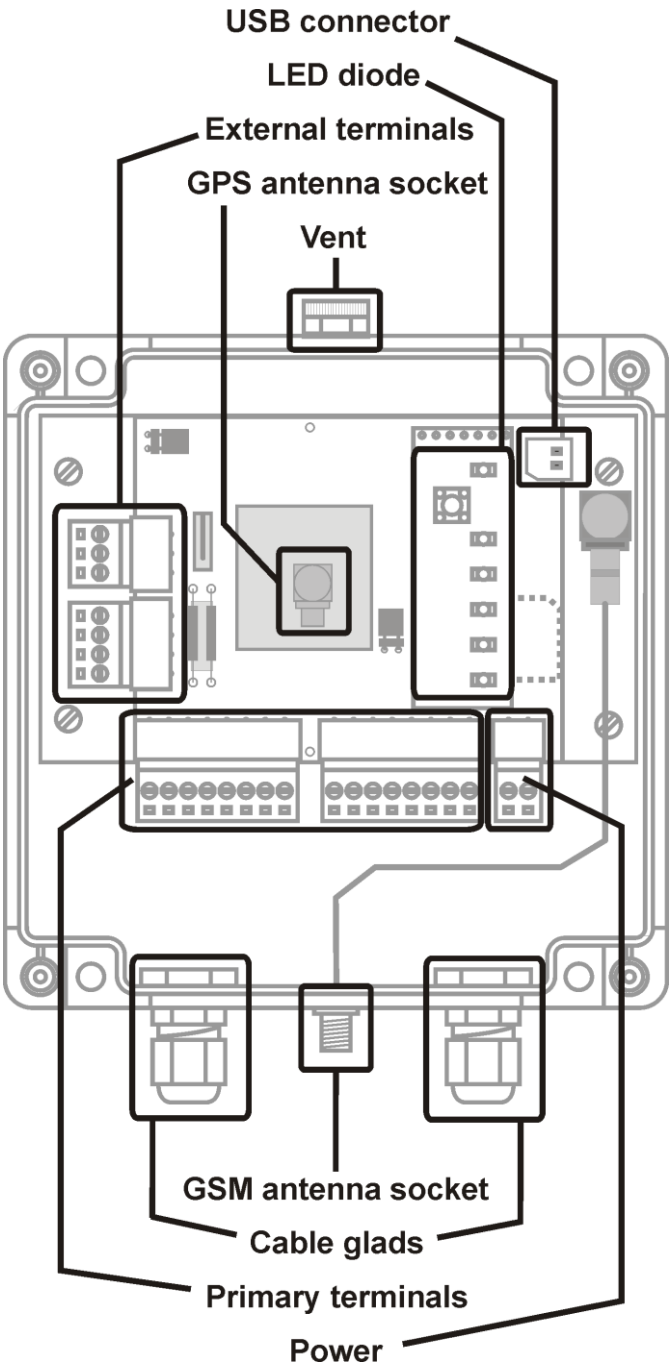
DISC, the USB key that is delivered with **MT-713** or can be downloaded after login on inventia.online web site.

MTData Provider (MTDP) (required for data transmission setup and diagnostic) - application for measurement data transmission in both ways, from and to the MT\ML modules. MT-Data Provider receive data from modules and share it in CSV files and write it to relational data base. The application supports OPC server functionality in two standards: DA\UA.

MTSpooler (MTS) (not required for module setup or diagnostic) - service that is designed for mass management of the MT modules configuration, especially for battery modules that working in sleep mode by most time is naturally behavior (the GSM modem is not logged to network). **MTSpooler** listens of module notification and after its receiving achieves tasks that was planned before.

XwaySYSTEM (not required for module setup or diagnostic) - in brief a GPS localization system with visualization of the moving objects on digital maps. Configured module **MT-713** can transmit the measurement results, which are registered with the precise date and time and exact location, directly to the location system. This feature can be launched after purchase the license for module to run in localization system.

5. MODULE DESIGN



Pic. Topography

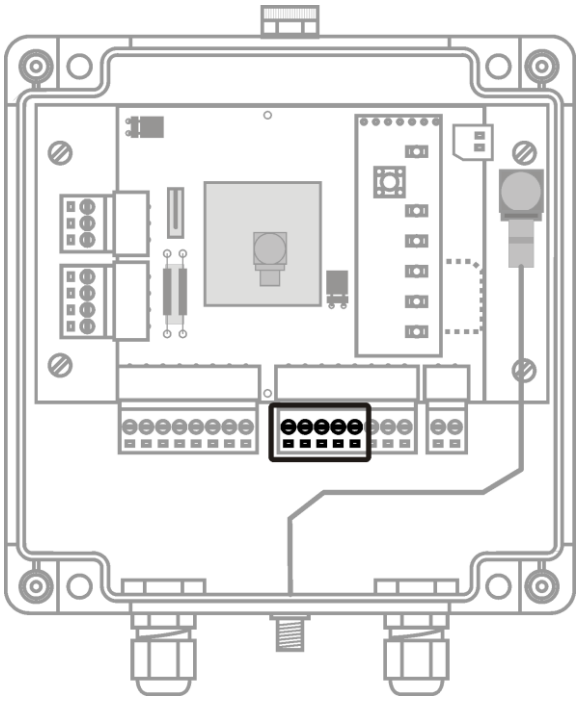
5.1. RESOURCES

Hardware Resources of **MT-713:**

Ix - binary inputs	5	binary inputs, pulse or potential free (the function is selected during configuration)
	1	enclosure opening sensor
ANx - analog inputs	2	**0 ÷ 5 V**, with possibility of supplying power to the measuring circuit
Qx – binary outputs	3	NMOS type outputs ("open drain") **0 ÷ +30 VDC**, mono- or bistable (the function is selected during configuration)
Temperature sensor	1	temperature sensor built in the microprocessor
Vibration sensor (binary input **I5**) (optional)	1	binary input **I5** can be used for connecting vibration sensor (switch) with normally open contact
GPS Module (optional)	1	for calculating geographical position and time synchronization
RS-485 communication interface (optional) symbol **/RS/HV**	1	low voltage serial interface with **Modbus RTU Slave** and **Mirror** master functionality (max. 4 Slave modules).
Power supply output (optional) symbol **/RS/HV**	1	power source for external sensors which can be use as converter of two signals **0 ÷ 20 mA (4 ÷ 20 mA)** from current loop to **0 ÷ 5 V (1 ÷ 5 V)** voltage and measurement them on 2 from 3 analog **AN1 ÷ AN3**

5.1.1. BINARY INPUTS

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



Pic. Binary input terminals I1 ¸ I5

Inputs **I1 ÷ I5** are designed to cooperate with potential free contacts (contacts connecting the input and common for all inputs ground **GND**). 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 **3 V** in low state.

Binary inputs **are not isolated.**

Each binary input, independently of other inputs configuration may operate as:

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

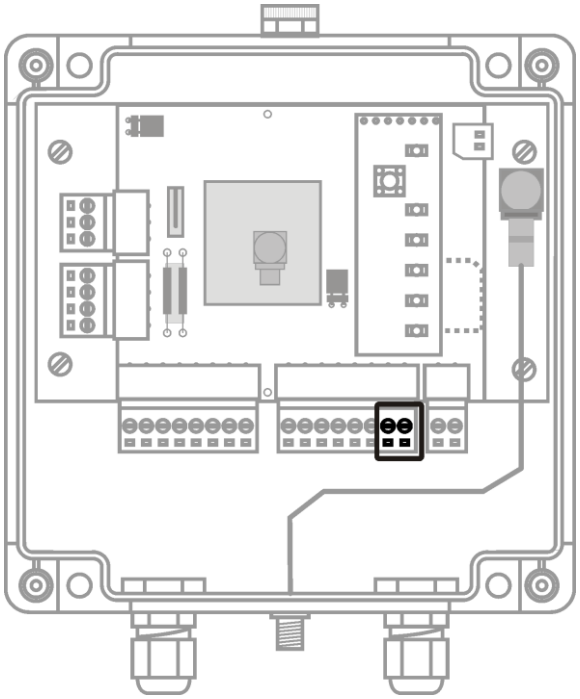
NOTICE!

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

In addition, binary input **I5** is prepared to operate as input of signal from vibration sensor with normally open contacts. Additional parameters are gathered in Vibration sensor (optional)
Independently of selected operating mode states the binary inputs are monitored by the module both in sleep mode and in wake mode.

5.1.2. BINARY OUTPUTS

MT-713 module is equipped with 2 binary outputs (**Qx**) marked as **Q1** and **Q2**. The outputs are designed to control loads powered by internal source (e.g. light signaling). The outputs are of "open drain" type controlled by **NMOS** transistors.



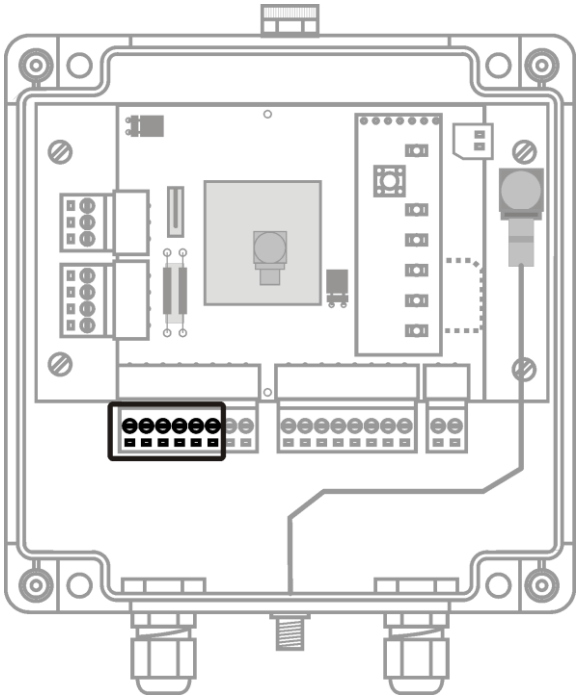
Pic. Binary output terminals Q1, Q2

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. **+30 V** 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.

5.1.3. ANALOG INPUTS

MT-713 module is equipped with 3 voltage analog inputs (**AN**) marked **AN1, AN2, AN3**. The inputs are designed to work with analog sensors generating signal in **0 ÷ 5 V** range (two 4 ÷ 20 mA inputs possible - more in the **/RS/HV** extension description). In order to minimize energy consumption and thus to extend the working time of the device on one set of batteries the A/C converters are powered for the period necessary to conduct secure measurement.

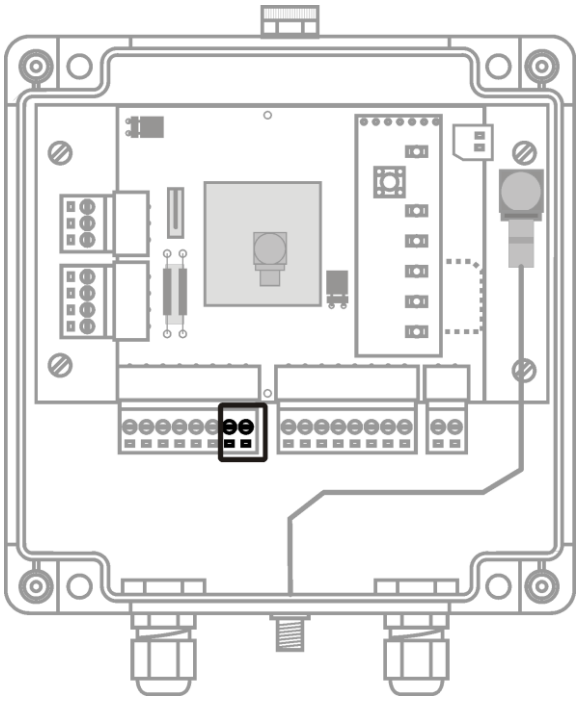


Pic. Analogue inputs terminals AN1, AN2, AN3

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.

5.1.4. POWER OUTPUT V0 (ANALOG SENSORS SUPPLY)

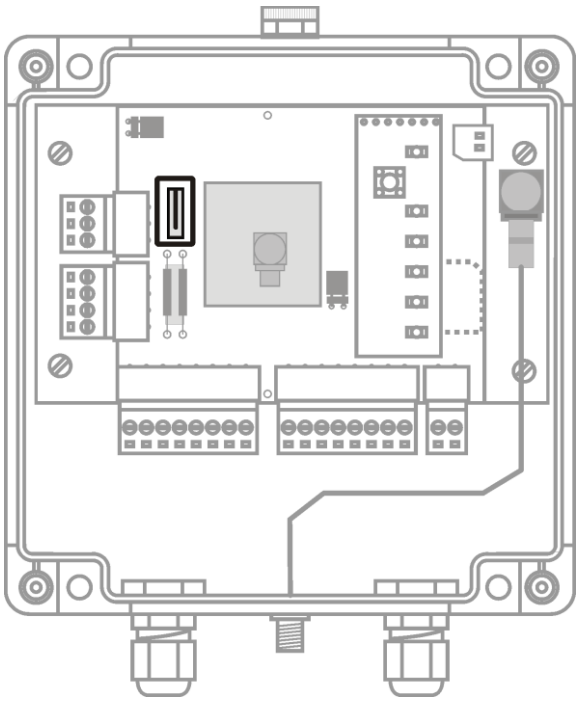
The **MT-713** module is equipped with the keyed power output **V0**, which is destined to power sensors connected to analog inputs. This output allows user to power sensors with voltage ranging from **0 ÷ 5 VDC** with step **0.1 V**. Voltage is specified by the user parameter configuration. In order 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 V0) is configurable.



Pic. Voltage output terminals V0 and GND

5.1.5. ENCLOSURE OPENING SENSOR

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



Pic. Enclosure opening sensor

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

5.1.6. TEMPERATURE SENSOR

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

5.1.7. VIBRATION SENSOR (OPTIONAL)

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

5.1.8. REAL TIME CLOCK

MT-713 module is equipped with Real Time Clock (**RTC**). This clock is a source for time measurement for the module timers and time stamping of measurements stored in the Logger, sent via GPRS and using SMS messages. 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 is required),
- 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 modules real time clock during the first configuration performed using the **MTManager** program.

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

5.1.9. TIMERS

MT-713 module is equipped with **8** general purpose programmable synchronous timers. Their function is counting constant user defined time intervals in range of **1 min.** to **24h**. The user may appoint months, month days and week days in which the timer is active. These clocks are synchronized once every 24 hours with the module's astronomical time clock (RTC).

In addition there are available 8 general purpose asynchronous timers which are capable of counting time in range from 1 to 1800 seconds (30 minutes). 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.

5.1.10. COUNTERS

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

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

5.1.11. LOGGER

MT-713 module has a programmable Logger that may hold up to **30720** data records. This equals either 24 hours measurements taken every 10 seconds or 1 month measurements taken with 5 minutes intervals, that gives 3,5 months.

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 APN, 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 modules registers. Each record in the logger has a time stamp of the module 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.

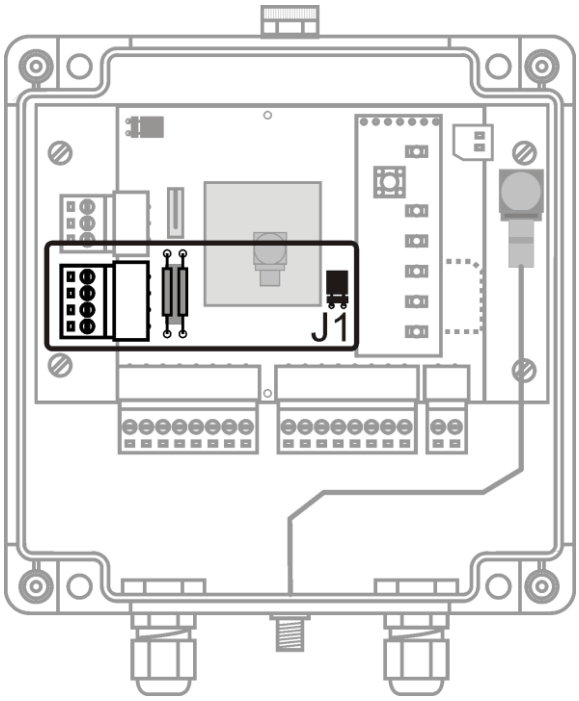
5.1.12. /GPS (OPTIONAL VERSION)

MT-713 module nay be equipped with a GPS receiver. This allows defining 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. In standard version module is equipped with GPS with SMA antenna socket for external active antennas. On special user order module can be equipped in passive internal antenna. Module with passive antenna is available as **MT-713/GPS**. Extension **/GPS** is available only when RS-485 serial port is not mounted.

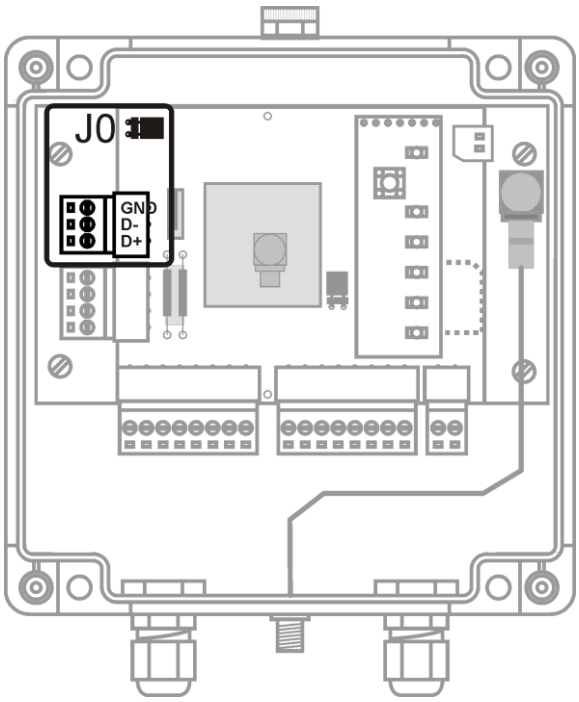
5.1.13. /RS/HV (OPTIONAL VERSION)

The **MT-713** module can be equipped with an additional output of the keyed supply voltage **VOUT**, which operates in the range of **15 ÷ 24 V** and is intended for supplying external sensors requiring a voltage higher than 5 V. The value of the output voltage is selected by jumper **J1** located on the PCB of the module (jumper closed - output voltage 15 V, jumper open - output voltage 24 V). The output voltage is supplied at the same time as the voltage at the V0 output of the MT-713 module.

The extension also adds two precision **250 Ω** resistors, which are designed to convert the current loop current **0 ÷ 20 mA (4 ÷ 20 mA)** to the voltage **0 ÷ 5 V (1 ÷ 5 V).** The circuit allows the conversion of two current signals to the voltage input standard (**AN1 ÷ AN3**) in the MT-713 module with **15 V** power supply and one with **24 V** power supply.



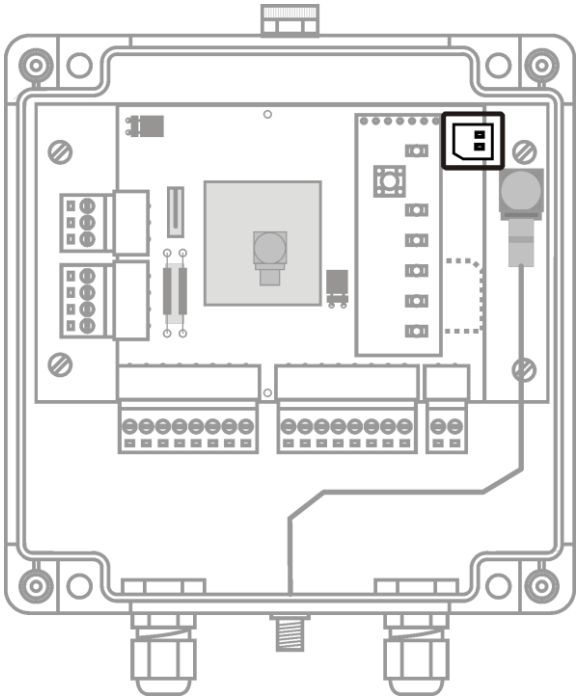
The **MT-713** Telemetry Module can be equipped with an RS-485 serial port. MT-713 acts as a "Master" of the serial bus, which can communicate via the Modbus RTU protocol with up to four "Slave" devices. Connecting the wires to the port is done by means of screw connectors located on the left side of the PCB. By default, the port is terminated with a terminator (resistor 100 Ω, capacitor 100 nF), which can be disconnected by removing the jumper J0. The **/RS/HV** extension is available interchangeably with the optional GPS receiver.



Pic. Terminals and jumper of /RS/HV extension

5.2. USB

Inside the enclosure of **MT-713** there is a **USB** socket used for local configuration by **MTManager** program.

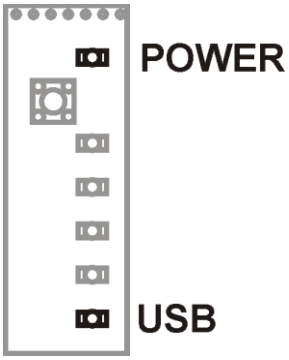


Pic. USB connector for configuration

During USB connection between the module and the computer, the module is powered via USB port. Thanks to that the module does not consume precious battery power during configuration and tests. During USB connection the register holding data of battery voltage is **frozen on the last recorded value** (at first configuration the value is 0).

For **USB** connection a standard cable of type A and micro B.

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



Pic. POWER and USB LEDs

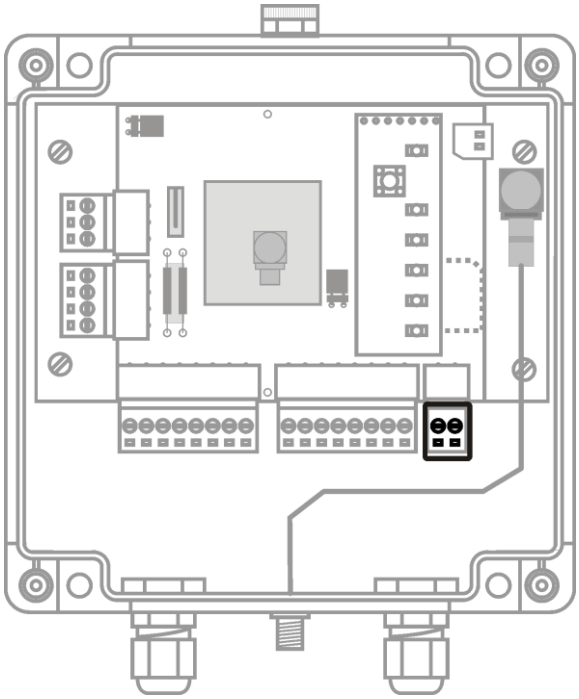
Detailed information on using the **USB** port for module configuration are to be found in the **MTManager** program manual.

5.3. SIM CARD HOLDER

MT-713 module is equipped with a holder for **SIM** card (mini-SIM size) for GSM modem. The holder is placed horizontally on the PCB inside the enclosure. Proper insertion of the **SIM** card is essential for modules operation in GSM network. The installation diagram is available in the Connection Diagrams chapter. The module accepts only **SIM** cards in **3.3 V** low voltage technology.

5.4. POWER SUPPLY

MT-713 module may be powered **exclusively** from battery the pack with nominal voltage **4.5 VDC**. The battery pack is placed in the cradle below the PCB and connects to the module by a special plug. The plug and the socket are asymmetrical thus preventing reverse polarization. This way secures easy and safe battery replacement.



Pic. Power terminals

The module in standard edition is powered by 3 industrial standard serially connected alkali R20 batteries. The nominal capacity of the battery pack is 16Ah allowing up to **5 years** of operation (depending on usage pattern). Factory connected batteries eliminate the problem of contact oxidation

during the long time of operation. We recommend replacing the batteries with same type or the type with similar parameters.

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

Third version with R20 Lithium batteries with nominal voltage of 3.6VDC and **39Ah** capacity in standard housing and with **78Ah** capacity in extended housing is also available. Max. operating time for lithium batteries powered modules is up to **10 years**. More information about available power supplies may be obtained by contacting the module supplier or directly with Inventia.

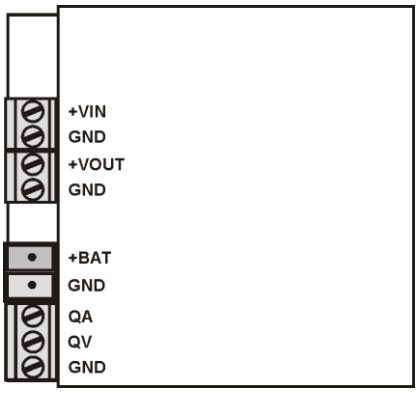
During local configuration via USB connection the module is powered from the computer. The external supply is indicated by **POWER** LED (details are to be found in LED indicators sub-chapter of Module design. The module powered from USB is in the state of high energy consumption.

As an alternative power source can be used specialized power supply module called **MT-CPV** which is available as optional accessories for **MT-713**.

5.4.1. MT-CPV - OPTIONAL EQUIPMENT

MT-CPV is a power supply unit with **3.6 VDC** nominal output voltage designed for powering battery powered telemetry modules. It can operate with 12 V solar panels (17 VDC output at max power point). Energy drawn from solar panel is storage in Li-Ion battery used then to power module.
Power unit and battery should be installed inside telemetry module. The voltage from the battery is supplied to the module's power supply input through a fuse. To increase the efficiency of energy acquisition, a processor-controlled maximum power point tracking system of the solar battery (MPPT - Maximum Power Point Tracking) was used in the power supply.

MT-CPV is using processor controlled maximum power tracking (MPPT) system increasing efficiency of energy drawing from solar panel.
MT-CPV can also use different energy sources to power telemetry module. Those can be wind turbine generator, mains power supply, car battery, alkaline battery pack and other providing that they provide voltage within **7.5** ÷ **30 VDC** range.



Pic. Power unit MT-CPV

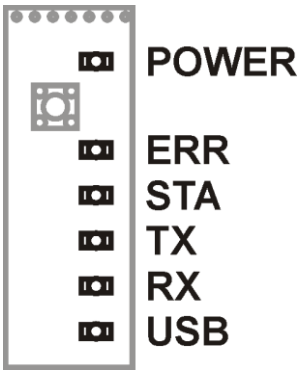
Power unit is providing information about energy drawn from **+VIN** terminal (battery) using pulses on **QA** output (1 pulse = 1mAh) and information about voltage between terminals **+VIN** and **–VIN** (battery voltage) using pulses on **QV** output (voltage = pulse frequency * 6).

Terminals	Description
+VIN	The positive terminal of solar panel (fuse protected).
-VIN	The negative terminal of solar panel (internally connected to GND ground).
+VOUT	The positive terminal of output voltage. Should be connected to positive battery pin in module.
-VOUT	The negative terminal of output voltage (internally connected to GND ground). Should be connected to negative battery pin in module.
+VBAT	The positive battery terminal (fuse protected).
-VBAT	The negative battery terminal (internally connected to GND ground).
QA	The binary output informing about energy drawn from +VIN input (battery). 1 pulse corresponds to 1 mAh.
QV	The binary output informing about voltage between +VIN and -VIN terminals (battery voltage). Voltage = pulse frequency * 6
GND	Ground

Detailed wiring schema of connecting an additional supply unit is in Connection diagrams chapter.

5.5. LED INDICATORS

LED indicators placed on **MT-713** modules PCB are a great help during modules startup.



Pic. Signaling diodes

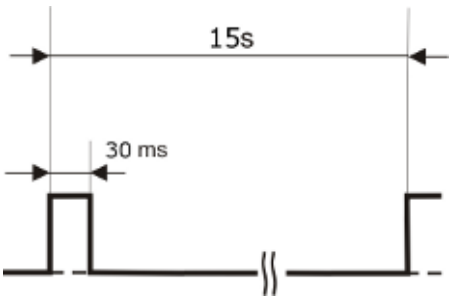
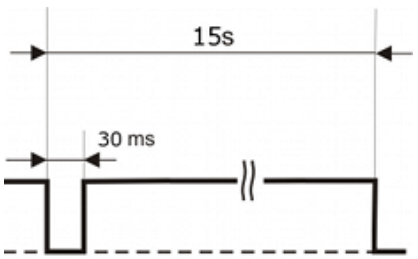
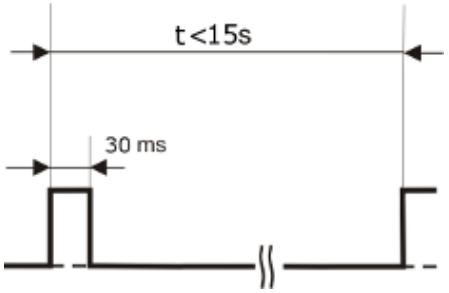
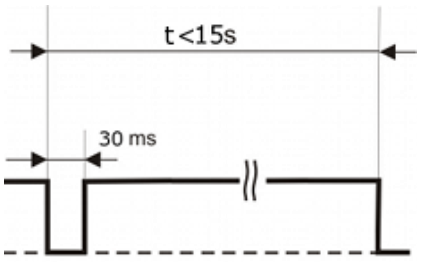
The LED's have assigned following significance:

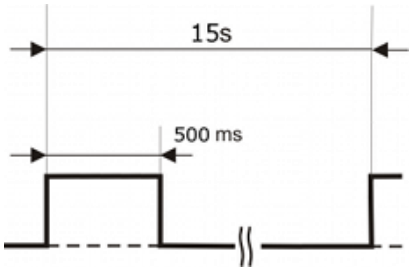
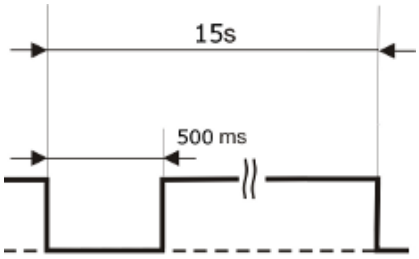
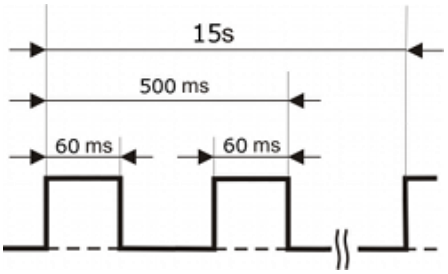
- **POWER** indicates current Power supply and module state (low and high energy consumption state called also sleep and activity state)
- **ERR** LED indicates abnormal states
- **STA** LED indicates GSM/GPRS status (GSM login as well as GPRS login, roaming, and signal level)
- **TX** LED indicates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

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

5.5.1. POWER LED

Signals emitted by POWER LED identify current Power supply and module state. See the table below.

	Battery supply	**USB port supply**
Sleep state		
Measurement in progress (flashes when measuring)		

GPS position calculation		
Battery replacement mode		

5.5.2. 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

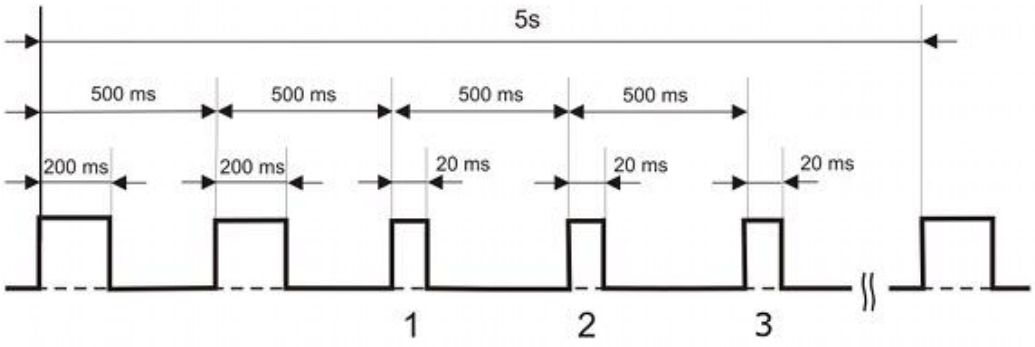
ERR LED	
○	critical error
◐	transmission error - SMS or GPRS transmission impossible
◔	missing, defective or blocked SIM card
◔ ◔	the card requires PIN code
◔ ◔ ◔	GSM error
◔ ◔ ◔ ◔	GPRS error
◔ ◔ ◔ ◔ ◔	APN login error
◔ ◔ ◔ ◔ ◔ ◔	wrong PIN

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)

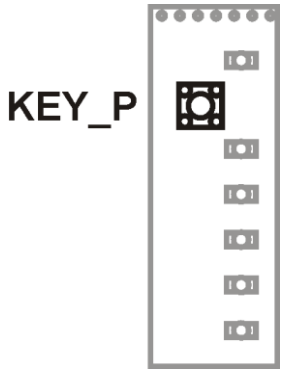
TX and RX LEDs	
◑	sending (TX)/receiving (RX) SMS messages
◔	sending (TX)/receiving (RX) GPRS data frame

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.



5.6. KEY_P BUTTON



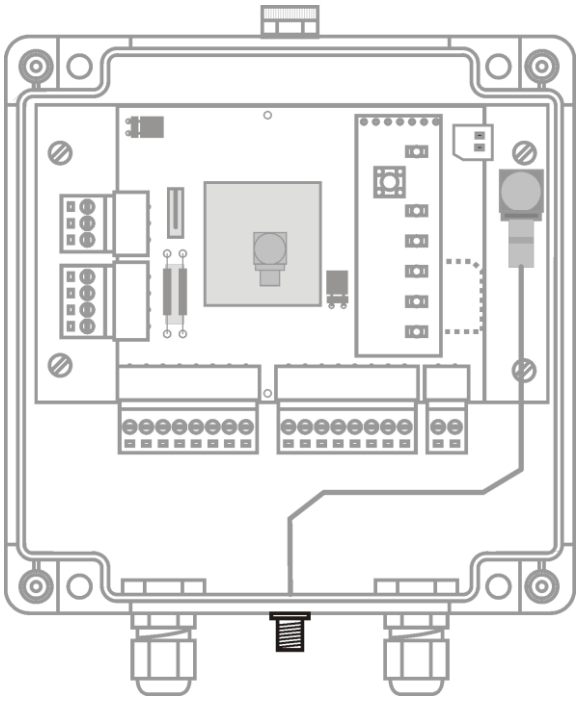
Pic. KEY_P button

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

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

5.7. GSM ANTENNA

Connecting the antenna is necessary for reliable data transmission from **MT-713** module. **SMA** type antenna socket is placed on module down wall between two cable glands.



Pic. GSM external socket antenna

Depending on local signal propagation and user's needs different antenna types may be used. Proper antenna placement is important during the module installation. In case of low GSM signal level using the directional antenna with high gain may be necessary.

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

5.8. CONDENSATION SENSOR

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

5.9. ENCLOSURE

Enclosure of **MT-713** module is manufactured by FIBOX of high quality plastic securing sufficient environmental protection (**IP67**) for the electronics even in harsh environment. The catalog number is PCT121207. All enclosure data including the parameters of used material are available at manufacturer's web page www.fibox.com. Bear in mind that protection grade is highly dependent on proper lid assembly and sealing cable glands. Improperly closed (leaking) cabinet leaves the electronics and the battery unprotected. Due to the technology of the cover gasket (spray gasket), we recommend replacing the cover when replacing the battery. The gasket deforms over time and does not provide a proper seal when the cover is reinstalled.

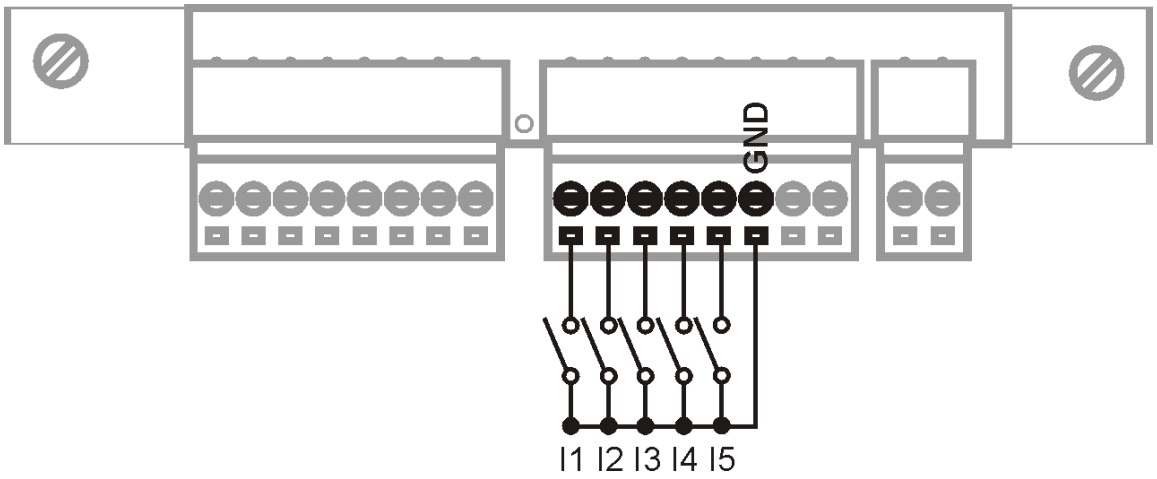
6. CONNECTION DIAGRAMS

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

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

6.1. BINARY INPUTS

Binary inputs of **MT-713** operate with **negative logic**, meaning that high state occurs only when the input is connected to ground. In open circuit the potential in reference to GND pin is not higher than **2.5 VDC**. Inputs work only with potential-free contacts like relay outputs, keyed transistor outputs. Recommended input connection diagram.



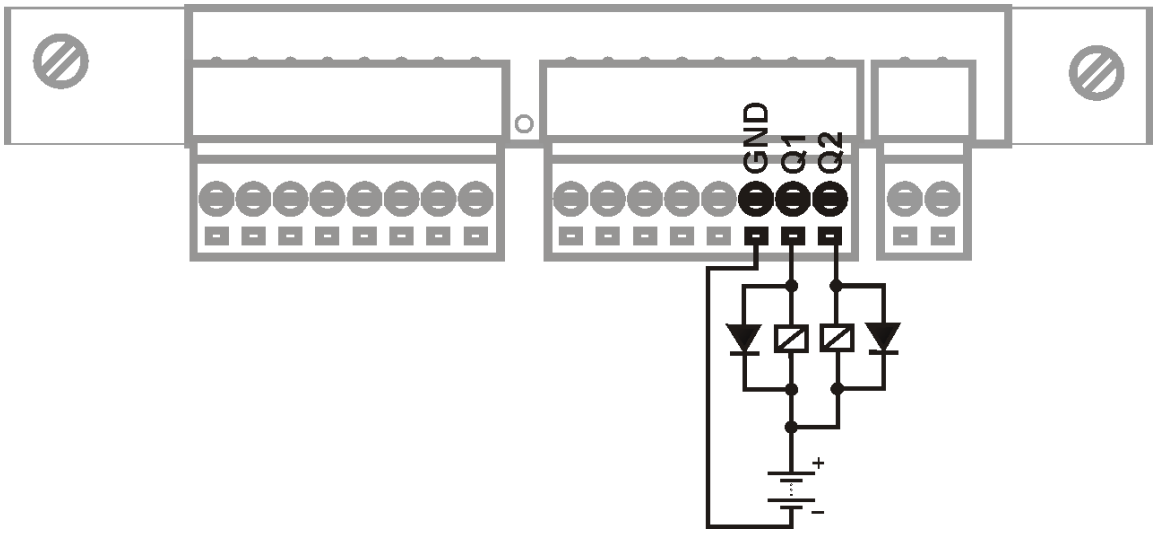
Pic. Wiring schema of the binary inputs

All binary inputs have same reference - modules electrical ground - negative pole of the power supply connected to **GND** pin.
Vibration sensor should be connected between **I5** and **GND**.

6.2. BINARY OUTPUTS

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

The recommended connection diagram.

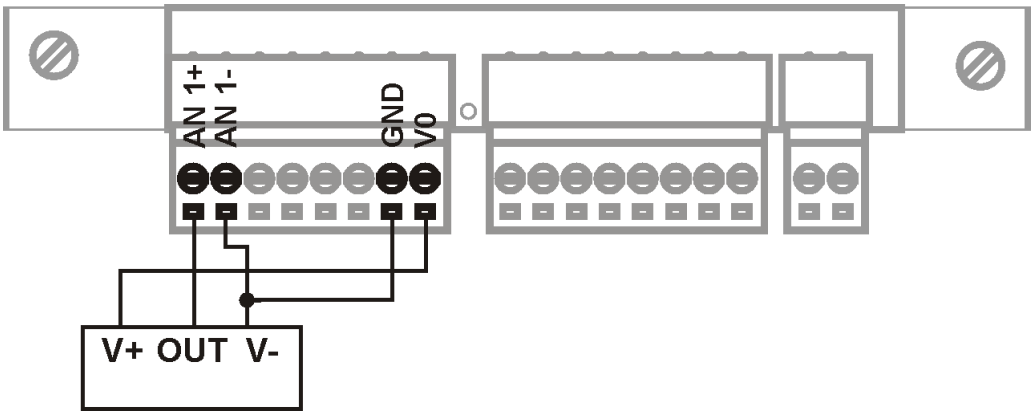


Pic. Wiring schema of the binary outputs

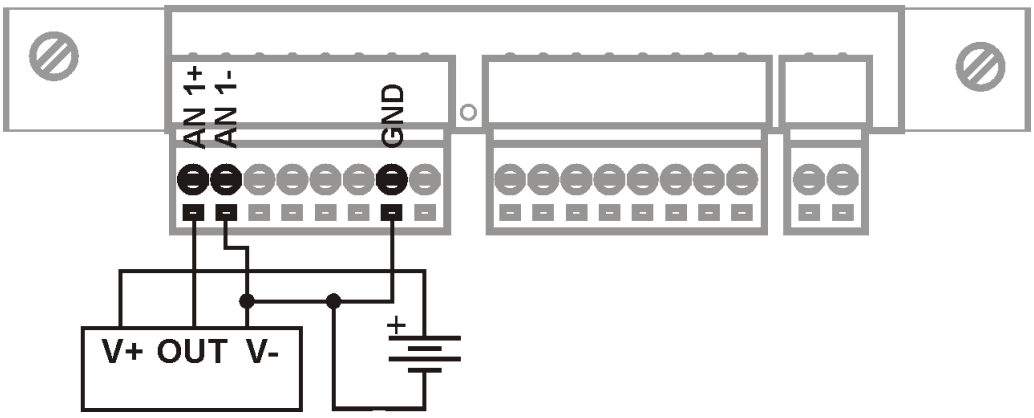
Negative pole of the external load's power supply **has to be connected to modules GND** terminal.

6.3. ANALOG INPUTS

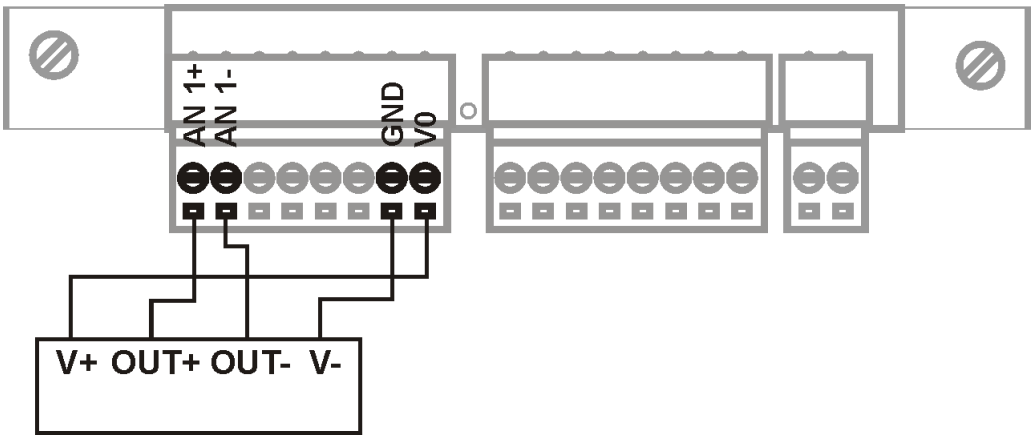
Analog inputs convert input voltage in **0 ÷ 5 V** range. This means that the potential between analog input terminals shall not be higher than 5V. The potential of analog input terminals towards modules ground (applies for connection with the symmetrical sensor, four leaded) has to be within **-0.5 V to 9 V** for positive terminal and from **-5.5 V to 9 V** for negative terminal.
Power output **V0** used to supply the sensors allows generating potential in **0 ÷ 5 V** range with **0.1 V** accuracy. Max. drawn current should not exceed 50 mA.
Diagrams illustrating recommended connections of sensors in various configurations.



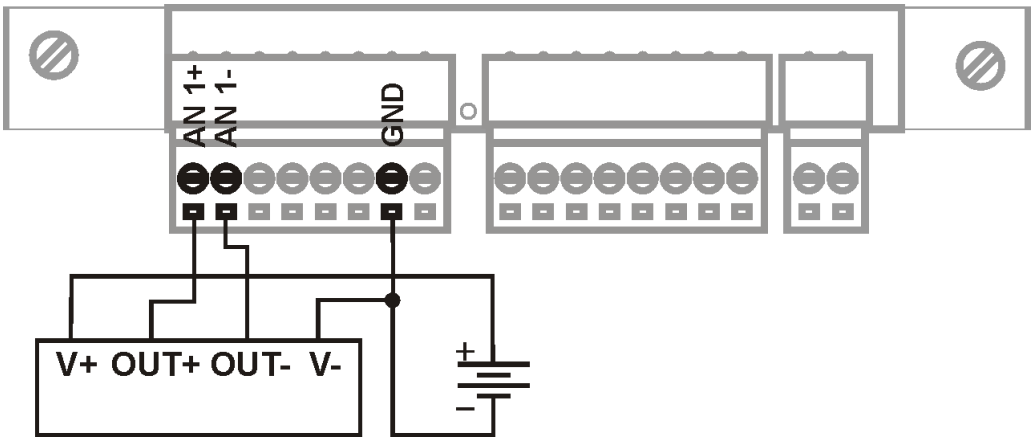
*Pic. Sensor with asymmetric output (three leads version) powered from **V0** output*



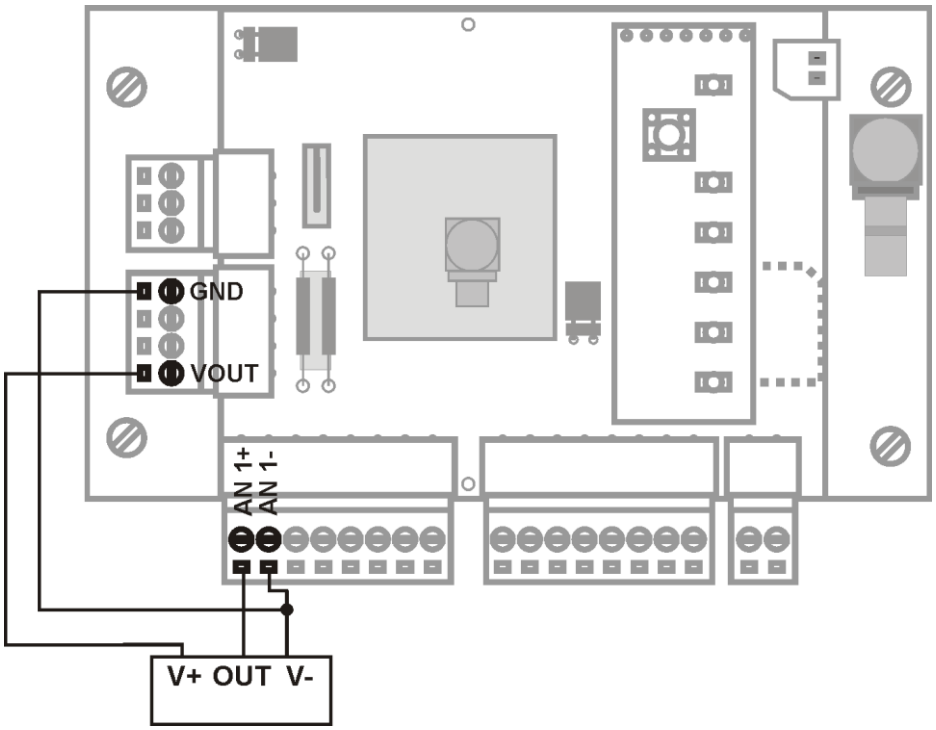
Pic. Sensor with asymmetric output (three leads version) powered from external power source



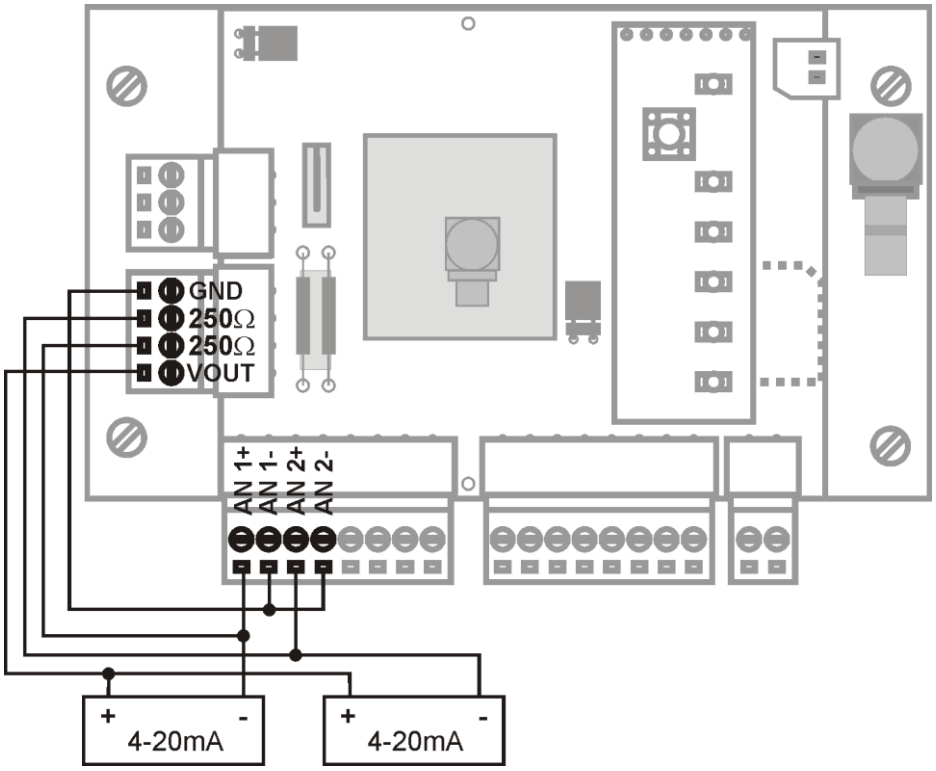
*Pic. Sensor with symmetric output (four leads version) powered form **V0** output*



Pic. Sensor with symmetric output (four leads version) powered form external power source



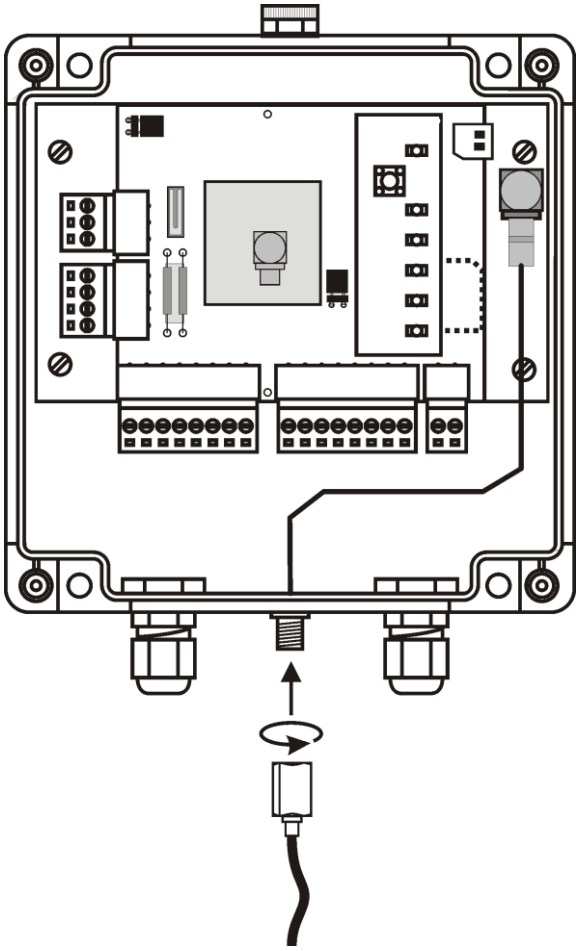
Pic. Sensor with asymmetric output 0 ÷ 5 VDC (three leads version) powered form voltage output VOUT (15 ÷ 24 V)



Pic. Wiring scheme for two sensors with output 4 ÷ 20mA powered form voltage output VOUT (for VOUT = 24 V only one sensor is supported)

6.4. GSM ANTENNA

Antenna is connected to **MT-713** module via SMA socket placed on bottom wall of the enclosure.



Pic. GSM antenna connection

Alternatively, the antenna may be placed inside the modules enclosure straight on connector placed on PCB board.
That kind of version is marked as **MT-713/IA** and is extra paid.

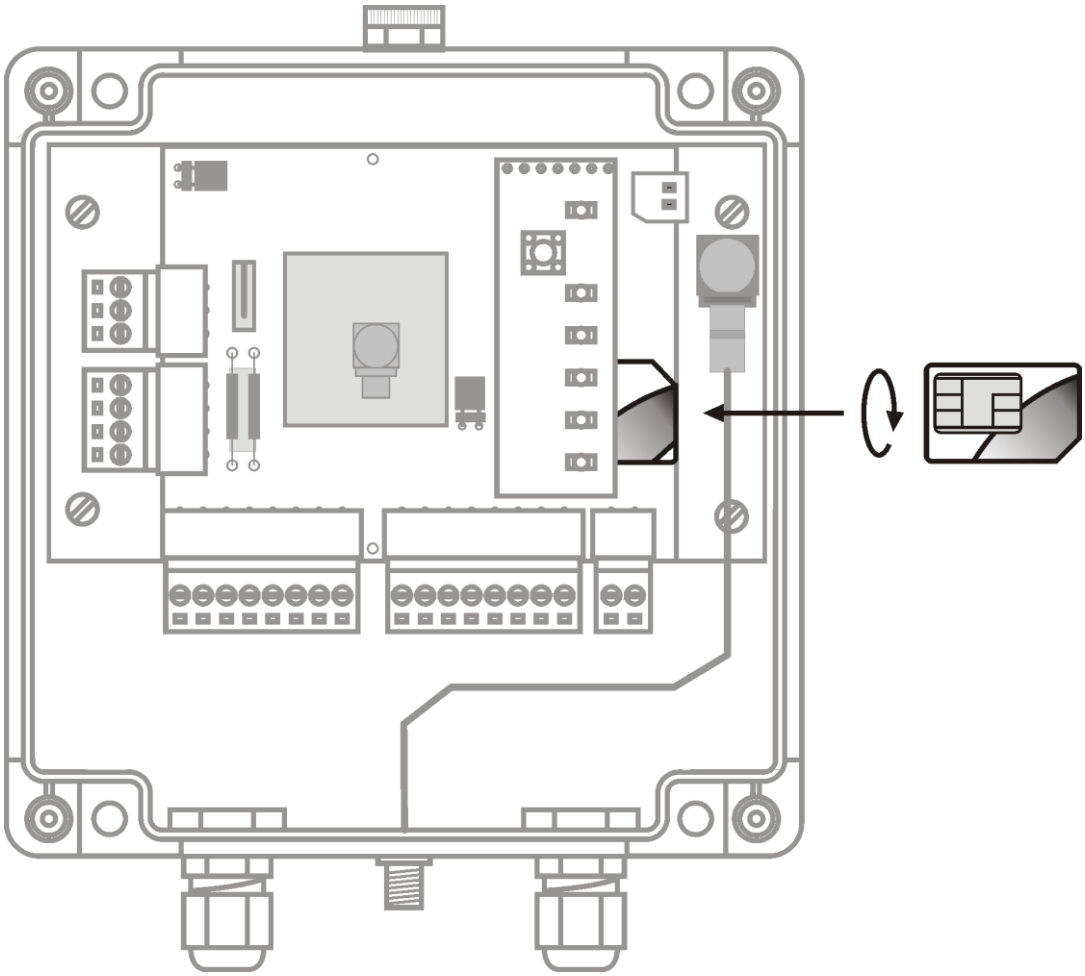
6.5. SIM CARD INSTALLATION

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

We recommend that inserting of **SIM** card is done without power on which for the **MT-713** module means that both battery cable and USB cable are not attached.

We recommend inserting the SIM in the holder after the configuration holding the PIN code for the SIM card has been successfully performed. Bear in mind that 3 failed attempts of using faulty PIN code the SIM card gets blocked. Inserting of wrong pin code is signaled by LED indicators. The blocked card may be unblocked using the procedure described in sub-chapter "Unblocking the SIM card" of Problem solving chapter.

SIM card shall be placed with contact fields down in the holder placed on PCB so that the cut off corner points outwards the holder.



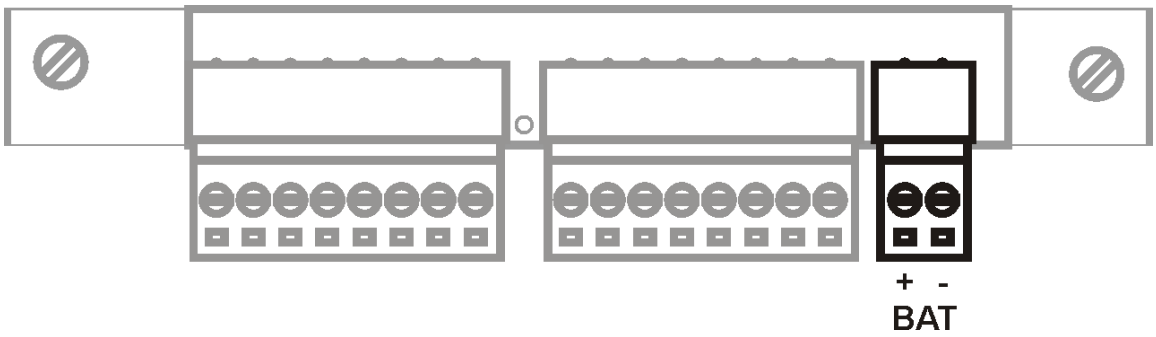
Pic. Properly SIM card installation

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

6.6. POWER SUPPLY

MT-713 module is powered by replaceable internal battery pack with **4.5 VDC** (**3.6 VDC** for lithium batteries) nominal voltage. Total capacity of new alkaline battery pack is **16 Ah** (**32 Ah** in **/HC** version) and **39 Ah** for lithium pack (**78 Ah** in **/HC** version). Depending on frequency of data transmis-

sion/SMS messaging the module may operate for up to **5 years** on alkaline batteries or up to **10 years** on lithium batteries.

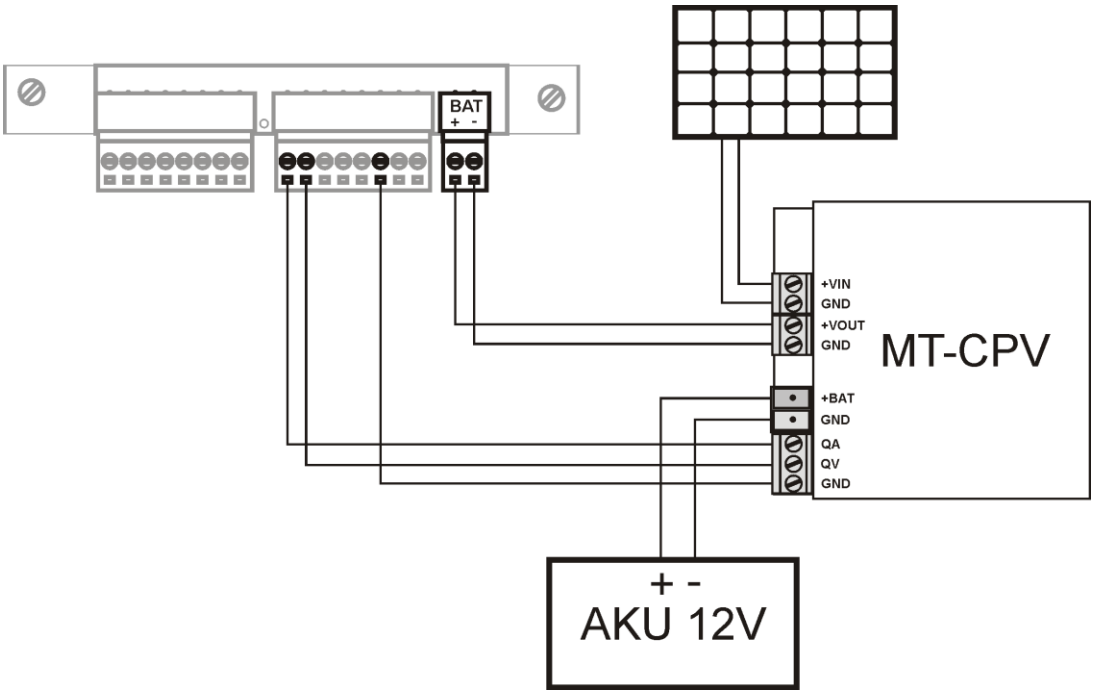


Pic. Power supply terminals

The voltage from the battery is supplied with a cable terminated with a standard screw connector. The battery plug and the socket are asymmetrical to prevent reverse polarization and secure easy and safe battery replacement.

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

Because design of the module is characterizing a low-energy consumption, as a power supply we recommend only alkaline (or lithium) packages of batteries. For external supply can be used dedicated for **MT-713**, only **MT-CPV** power supply with battery backup. Powering from improper external supply without using **MT-CPV** could damage the module.



Pic. MT-CPV supply application example

7. FIRST START OF THE MODULE

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

1. Connect signal wires and GSM antenna

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

2. First configuration of the module

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

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

In **General** group:

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

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

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

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

3. Inserting the SIM card

After downloading the first configuration disconnect the USB connection, insert the SIM card according to the previous chapter's

instructions and reconnect the USB cable. The module should login to the GSM/GPRS network.
A correctly logged-in module to the GSM network is signaled on the STA LED by one long flash followed by several short ones (maximum 3), which indicate the strength of the GSM signal. No short flashes indicates a very weak GSM signal.
The status of the module may be verified by comparing LED indicators with the table provided in the sub-chapter LED signaling of Problem solving chapter.

Login sequence:
1. Module start
2. Verification of SIM card's PIN code
3. Registration of modem in GSM network
4. Login to selected APN in GPRS network

Verify the configuration if any errors are indicated.

4. Setting the module time

The last, but very important element of modules 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.

8. CONFIGURATION

8.1. GENERAL INFORMATION

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

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

8.2. PARAMETER GROUPS

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

Header group	- contains unmodifiable parameters describing the module, firmware and configuration.
General group	- contains basic parameters defining module's operating mode
SMS group	- contains parameters for SMS services handling
GPRS group	- contains parameters necessary for log in GPRS network and defining vital parameters for reliable transmission
Authorized numbers group	- contains lists of phone numbers and IP addresses of other terminals authorized to communicate with the module
Resources group	- contains parameters for programmatic and hardware resources related to reading and processing measurement data
Events group	- contains a list of defined events (e.g. binary input state change), used to trigger module's actions (e.g.: sending SMS, measurement data, logger data)
Internal program group	- contains a list of predefined module operation algorithms
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.

8.2.1. 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.

8.2.1.1. MODULE NAME

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

8.2.1.2. 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

8.2.1.3. IMEI NUMBER

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

8.2.1.4. SIM CARD'S NUMBER

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

8.2.1.5. 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.

8.2.1.6. 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.

8.2.1.7. 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

8.2.1.8. 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.

8.2.1.9. 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

8.2.1.10. LAST CONFIGURATION DATE (UTC)

Performed function	-	Displays UTC 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 tracking unauthorized configuration changes.

8.2.1.11. LAST READ DEVICE TIME (UTC)

Performed function	-	Displays internal clock UTC 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

8.2.1.12. HARDWARE VERSION

Performed function	-	Displays the type of configured module
Data type	-	Text
Range	-	0 - Standard version of **MT-713** module 1 – **MT-713** with serial port **RS-485**
Default value	-	depends form version
Comments	-	N/A

8.2.1.13. LOGGER SIZE [RECORDS]

Performed function	-	Internal logger capacity (records count)
Data type	-	Text
Range	-	N/A
Default value	-	depends from version
Comments	-	N/A

8.2.2. 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 SIM card PIN number).

8.2.2.1. SIM CARD PIN NUMBER

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 unlocking procedure described in **Problem solving** chapter**.**

8.2.2.2. 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.

8.2.2.3. SELECTION OF NETWORK TYPE

Performed function - It allows you to choose the technology of the network used

Data type - Selection list

Range - ***2G***

The module will only use the second generation network (GSM, GPRS, EDGE)

Auto

The module will automatically select the type of network, preferring the network with better signal strength

3G/4G

The module will only use the third or fourth generation network (depending on the soldered modem)

Default value - ***2G***

Comments - *None*

8.2.2.4. NETWORK 4G TYPE

Performed function - It allows you to choose the technology of the 4G network used

Data type - Selection list

Range - ***CatM1***

The module will use the LTE CatM1 network

NBIoT

LTE NBIot

Default value - ***CatM1***

Comments - The parameter is relevant only for modules with 4G uBlox SARA-R412M modem

8.2.2.5. BAND 4G MASK

Performed function - It allows you to select the bands used by the module in 4G networks

Data type - Number

Range - 0-999999999

Default value - ***524420***

Comments - The parameter is relevant only for modules with 4G uBlox SARA-R412M modem

8.2.2.6. CONFIGURATION READ DISABLE

Performed function - Allows blocking of configuration reading even when valid password is supplied.

Data type - Selection list

Range - ***Yes***
Reading of configuration is impossible.
No
The module is not protected against reading of configuration

Default value - ***No***

Comments - This parameter does not influence writing of full configuration while it prevents writing changes if configuration identifiers are not identical in the module and in MTManager program.

8.2.2.7. GSM NETWORK

Performed function - Allows to enter the prefer (coercion) operator code (CCN number - Country Code Network) to log on GSM modem.

Data type - Selection list with ability to insert numeric value

Range - ***Auto***
Module will automatically choose the GSM provider and login without preferences.
Plus PL
T-Mobile PL
Orange PL
Play PL
Module will automatically login to selected provider.

Default value - ***Auto***

Comments - The parameter is useful especially on border area for protection against logon of modem to foreign network or for coercion in selection of indicated provider when the modem is working in roaming.

8.2.2.8. 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.

Spooler
time synchronization with MTspooler service. This option need to additional software have to be installed and running.

Additional spooler
time synchronization with MTSpooler backup service. This option need to additional software have to be installed and running.

Default value - ***None***

Comments - If the module is furnished 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.

8.2.2.9. USE OF 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

8.2.3. SMS

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

8.2.3.1. 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

NOTICE!
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.

8.2.3.2. 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.

8.2.3.3. 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 send 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.

8.2.3.4. SMS LIMIT EXCEED INFORMATION

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.

8.2.3.5. RECIPIENT OF SMS LIMIT EXCEED INFORMATION

Performed function	-	Selects the SMS limit exceed information 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.

8.2.3.6. REPLY TO EMPTY SMS

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

8.2.4. 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 (eg. Transmission timeout [s]).

8.2.4.1. DEVICE IP

Performed function - Inserts IP address for a newly created module and presents this address read from the module when reading the configuration and assigned during the last GPRS login.

Data type - IP address

Range - ***0.0.0.0 - 255.255.255.255***

Default value - ***0.0.0.0***

Comments - If, after the local configuration and logging of the module to the GPRS network, the IP number is not read from the module or entered manually, remote configuration of the module via GPRS will not be possible.

8.2.4.2. APN NAME

Performed function - Defines the name of APN in which GPRS transmission will be carried out

Data type - Text

Range - Letters, numerals, special characters - max. 63 characters

Default value - Empty

Comments - Not defined APN name renders log-in to GPRS impossible.

8.2.4.3. APN AUTHORIZATION

Performed function - Specifies the type of protocol used to pass the username and password.

Data type - Selection list

Range - ***No***

no username or password will be provided when logging into the APN.

PAP

The password and username will be communicated via PAP.

CHAP

The password and username will be communicated using the CHAP protocol.

Default value - ***None***

Comments - None

8.2.4.4. APN USER NAME

Performed function - Defines user name for access to APN

Data type - Text

Range - Letters, numerals, special characters - max. 31 characters

Default value - Empty

Comments - This parameter is optional, supplied only if GSM operator requires it.

8.2.4.5. 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.

8.2.4.6. 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 (MTData Provider) 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 (MTData Provider) 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 MTData Provider'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.

8.2.4.7. SENDER IP ADDRESS CHECK

Performed function - Switches the control of sender's IP address on/off

Data type - Selection list

Range - ***Yes***

The module exchanges information only with IP addresses present on the 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.

8.2.4.8. 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 - 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.

8.2.4.9. SPOOLER'S 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.

8.2.4.10. ADDITIONAL SPOOLER'S IP

Performed function	-	Defines IP address of the computer running additional instance of 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.

ATTENTION!
The module notify independently in both IP numbers if entered.
In a situation where both instances of MTSpooler have a new configurations for the module, one of them will not be saved to the device.

8.2.4.11. ACTIVE AFTER SENDING NOTIFICATION TO THE SPOOLER [MIN]

Performed function	-	Defines an activity time duration (in minutes) of the module (online mode) counted from the moment of sending the spooler's frame to IP address of MTSpooler instance (or additional MTSpooler)
Data type	-	Number
Range	-	***0*** … ***1080***
Default value	-	***1***
Comments	-	N/A

8.2.4.12. 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.

8.2.4.13. 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.

8.2.4.14. GPRS TESTING ADDRESS (PING)

Performed function - Defines IP address for GPRS transmission test frames.

Data type - IP address

Range - ***0.0.0.0 - 255.255.255.255***

Default value - ***0.0.0.0***

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

8.2.4.15. 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.

8.2.4.16. 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!

8.2.4.17. DATA FRAME FORMAT

Performed function - GPRS communication with the module will be realized according to selected protocol.

Data type - Selection list

Range - ***Standard***

Communication frame format which are sending and receiving by the module complies with **MT-Data Provider.** This format is not available for user.

Open

Communication frame format which are sending and receiving by the module complies with **OPEN** specification. This format is open for user (see details in Appendices).

Open2

Communication frame format which are sending and receiving by the module complies with **OPEN2** specification. This format is open for user (see details in Appendices).

Default value - ***Standard***

Comments - N/A

8.2.5. 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.

8.2.5.1. NUMBER OF PHONE BOOK ENTRIES

Performed function - Defines the length of phone numbers list authorized to exchange SMS messages.

Data type - Number

Range - ***0*** … ***32***

Default value - ***0***

Comments - The value of this parameter may vary as the result of adding/deleting when using the context menu operating directly on 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.

8.2.5.2. 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.

8.2.5.3. 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)

8.2.5.4. 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)

8.2.6. 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).

8.2.6.1. 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.

8.2.6.2. 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.

8.2.6.2.1. BINARY/PULSE INPUTS (I1…I5)

Binary inputs of the module operate in two modes:

- binary input - the input operates as negative logic input (logical true equals GND potential)
- pulse input - configuration dedicated to counting pulses of external counters and calculating the flow.

8.2.6.2.1.1. 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.

8.2.6.2.1.2. FLOW MEASUREMENT MODE

Performed function	-	Allows to expand number of alarms bits that can trigger events sending
Data type	-	Selection list
Range	-	***Standard*** Measurement triggering is independent of the last measured values. ***Expanded*** There are independent measurement trigger bits for the value exceeding the HiHi or LoLo alarm threshold, for the value exceeding the Hi or Lo warning threshold and for the normal value (no alarm or warning threshold has been exceeded)

Default value	-	***Standard***
Comments	-	***None***

8.2.6.2.1.3. 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. The parameter is visible if the Flow measurement trigger type parameter is set to Standard.

ATTENTION!
Bit states and register values marked with bold in memory map are refreshed at every program cycle (including execution of the μProg program). 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.

8.2.6.2.1.4. BIT TRIGGERING FLOW CALCULATION WHEN NO ALARMS PRESSENT

Performed function	-	Selects any bit from the address space of the module, which will initiate the flow calculation process when it goes high. The indicated Bit will activate flow calculations only when the last measured flow did not trigger any alarm.
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. The parameter is visible if the Flow measurement trigger type parameter is set to Extended.

ATTENTION!
Bit states and register values marked with bold in memory map are refreshed at every program cycle (including execution of the μProg program).

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.

8.2.6.2.1.5. BIT TRIGGERING FLOW CALCULATION WHEN LO OR HI ALARM PRESENT

Performed function	-	Selects any bit from module's address space. Change of bit's state to high initiates flow calculation process only when there's Lo or Hi alarm state on the input.
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 (including execution of the μProg program). 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.

8.2.6.2.1.6. BIT TRIGGERING FLOW CALCULATION WHEN LOLO OR HIHI ALARM PRESENT

Performed function	-	Selects any bit from module's address space. Change of bit's state to high initiates flow calculation process only when there's LoLo or HiHi alarm state on the input.
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. The parameter is visible if the Flow measurement trigger type parameter is set to Extended.

ATTENTION!
Bit states and register values marked with bold in memory map are refreshed at every program cycle (including execution of the μProg program). 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.

8.2.6.2.1.7. EXTRA TRIGGERING BIT 1

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 (including execution of the μProg program). 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.

8.2.6.2.1.8. EXTRA TRIGGERING BIT 2

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 (including execution of the μProg program). 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.

8.2.6.2.1.9. EXTRA TRIGGERING BIT 3

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 (including execution of the μProg program). 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.

8.2.6.2.1.10. ALARM FREQUENCY ON COUNTING INPUTS [HZ]

Performed function	-	Allows to detect the incorrect behavior of the flow meter signal involving on pulse frequency detection which is repeated at a specified time. Signalization of the alarm is realized on binary inputs bits **I1 … I5** for the time that is defined by Frequency alarm duration parameter.
Data type	-	Number
Range	-	***0 … 250***
Default value	-	***0***
Comments	-	Value ***0*** means that the functionality is turned off.

8.2.6.2.1.11. FREQUENCY ALARM DURATION [MIN]

Performed function	-	Allows to define time for maintain of the binary inputs bit which is alarming.
Data type	-	Number
Range	-	***0 … 1080***
Default value	-	***61***
Comments	-	N/A

8.2.6.2.1.12. NAME

Performed function	-	Defines input's friendly name

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

8.2.6.2.1.13. INPUT TYPE

Performed function	-	Defines binary input's operating mode.
Data type	-	Selection list
Range	-	***Inactive*** Input switched off ***Binary input*** Operates as binary input ***Counting input*** Operates as pulse input ***Gated counting input (I1 - not active)*** Operates as pulse input ***Gated counting input (I1 - active)*** Operates as pulse input
Default value	-	***Inactive***
Comments	-	According to selected mode MTManager displays additional configuration parameters for each input

8.2.6.2.1.14. FILTRATION

Performed function	-	Defines (in seconds) minimum duration of electrical state on the input to be considered stable, thereby indirectly defining maximum time duration of electrical noise.
Data type	-	Number
Range	-	***0.1 … 60.0***
Default value	-	***0.1***
Comments	-	Increasing the value increases noise immunity but delays change detection reaction. This parameter is available in binary input mode only.

8.2.6.2.1.15. 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 cleanup is required

8.2.6.2.1.16. MINIMUM PULSE LENGTH

Performed function - Defines approximated minimal pulse length

Data type - Selection list

Range - ***2ms … 12.8s***

Default value - ***64ms***

Comments - This parameter filters high frequency signal noise. Available values of the parameter depend on previously defined Max pulse frequency.
NOTICE! Do not select higher value than actual pulse duration, because it will make the module reject received pulses as too short (noise). This parameter is available in binary input mode only.

8.2.6.2.1.17. ACTIVE SLOPE

Performed function - Defines which slope of incrementing bit activates the counter incrementing function

Data type - Selection list

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

Default value - ***Pulse start***

Comments - This parameter is available only in pulse counting mode.

8.2.6.2.1.18. FLOW UNIT

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

8.2.6.2.1.19. FLOW SCALING

Performed function - Selects time reference units for flow scaling.
Data type - Selection list
Range - ***None***
Indicates the value increment for the period between successive flow calculation triggers
Minute (eng. units/min)
Indicates the increment of the value for the period between successive flow calculation triggers in engineering units per minute
Hour (eng. units/h)
Indicates the increment of the value for the period between successive flow calculation triggers in engineering units per hour
THF-01 temperature
Reads the temperature from the THF-01 sensor (temperature frequency output)
Humidity THF-01
Reads the relative humidity from the THF-01 sensor (humidity frequency output)
THF-01 barometer
Reads the atmospheric pressure from the THF-01 sensor (atmospheric pressure frequency output)
Default value - ***None***
Comments - This parameter is available only in pulse counting mode.

8.2.6.2.1.20. PULSE WEIGHT - ENGINEERING UNITS

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

8.2.6.2.1.21. 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 counting mode.

8.2.6.2.1.22. 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 counting mode.

8.2.6.2.1.23. 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 counting mode.

8.2.6.2.1.24. 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 counting mode.

8.2.6.2.1.25. ALARM HYSTERESIS - ENGINEERING UNITS

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

8.2.6.2.1.26. TRACKING MODE

Performed function - Allows to select the operation mode for bits informing about exceeding the tracking range of flow calculations.
Data type - Selection list
Range - ***Bidirectional***
FL1_DB ... FL5_DB bits will be actualize when trace resolution excess in both ways.
Increase only
FL1_DB ... FL5_DB bits will be actualize when trace resolution excess only upwards.
Decrease only
FL1_DB ... FL5_DB bits will be actualized when resolution trace excess only downwards.
Default value - ***Bidirectional***
Comments - This parameter is available only in pulse counting mode.

8.2.6.2.1.27. 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 counting mode.

8.2.6.2.2. 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.

8.2.6.2.2.1. NAME

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

8.2.6.2.2.2. 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.

8.2.6.2.2.3. 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).

8.2.6.2.3. ANALOGUE INPUTS (AN1…AN3)

MT-713 module is equipped with three analogue inputs operating in **0 … 5 V** standard and one controlled analogue output **V0** designed to power connected sensors.

8.2.6.2.3.1. SENSOR POWERING VOLTAGE V0

Performed function	-	Defines the value of voltage generated at power output V0 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.

8.2.6.2.3.2. MEASUREMENT DELAY AFTER ACTIVATING V0

Performed function	-	Defines the time interval in seconds from the moment of supplying the power at the V0 output to the measurement carried out on the analog inputs.
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.

8.2.6.2.3.3. INPUT TYPE

Performed function	-	Allows to choose additional arithmetic operations on analog measurements results.
Data type	-	Selection list

Range - ***AN1, AN2, AN3***
Subtraction is not executed.
AN1-AN3, AN2, AN3
AN3 values is subtracted from **AN1** value. Result is presented on **AN1** register. Operations on **AN2** and **AN3** are not executed.
AN1, AN2-AN3, AN3
AN3 values is subtracted from **AN2** value. Result is presented on **AN2** register. Operations on **AN1** and **AN3** are not executed.

AN1-AN3, AN2-AN3, AN3
AN3 values is subtracted from **AN1** value. Result is presented on **AN1** register.
AN3 values is subtracted from **AN2** value. Result is presented on **AN2** register.
Operations on **AN3** are not executed.

Default value - ***AN1, AN2, AN3***

Comments - N/A

8.2.6.2.3.4. MEASUREMENT MODE

Performed function - Allows to expand number of analogue alarms bits that can trigger events sending

Data type - Selection list

Range - ***Standard***
Flow calculation triggering bits list is limited to 4 positions.
Expanded
Flow calculation triggering bits list is expanded for 2 additional positions.

Default value - ***Standard***

Comments - Bit addresses **0 ... 9999** point to input space while addresses **10000 ... 65535** point to internal registers space.

8.2.6.2.3.5. TRIGGERING BIT

Performed function - Selects any bit from module's address space. Change of bit's state to high initiates analogue inputs reading.

Data type - Selection list or Number

Range - Name from bit list (see bit list in Appendices) or ***0 ... 65535***

Default value	-	***N/A***
Comments	-	Bit addresses **0 … 9999** point to input space while addresses **10000 … 65535** point to internal registers space.

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

8.2.6.2.3.6. TRIGGERING BIT WHEN NO ALARMS PRESENT

Performed function	-	Selects any bit from module's address space. Change of bit's state to high initiates analogue inputs reading only when there's no alarm on the input.
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. The parameter is visible if the Measurement triggering type parameter is set to Extended.

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.

8.2.6.2.3.7. TRIGGERING BIT WHEN LO OR HI ALARM PRESENT

Performed function	-	Selects any bit from module's address space. Change of bit's state to high initiates analogue inputs reading only when there's **Lo** or **Hi** alarm state on the input.
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. The parameter is visible if the Measurement triggering type parameter is set to Extended.

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.

8.2.6.2.3.8. TRIGGERING BIT WHEN LOLO OR HIHI ALARM PRESENT

Performed function	-	Selects any bit from module's address space. Change of bit's state to high initiates analogue inputs reading only when there's **LoLo** or **HiHi** alarm state on the input.
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. The parameter is visible if the Measurement triggering type parameter is set to Extended.

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.

8.2.6.2.3.9. EXTRA TRIGGERING BIT 1

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

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

8.2.6.2.3.10. EXTRA TRIGGERING BIT 2

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

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

8.2.6.2.3.11. EXTRA TRIGGERING BIT 3

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

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

8.2.6.2.3.12. NAME

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

8.2.6.2.3.13. 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.

8.2.6.2.3.14. 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

8.2.6.2.3.15. 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

8.2.6.2.3.16. 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

8.2.6.2.3.17. 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

8.2.6.2.3.18. ALARM HIHI - ENGINEERING UNITS

Performed function	-	Defines **HiHi** alarm level for analogue signal value in engineering units.
Data type	-	Number
Range	-	***-32767 … 32767***
Default value	-	***32767***
Comments	-	If value of analogue signal is higher than value of this parameter, the HiHi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

8.2.6.2.3.19. ALARM HI - ENGINEERING UNITS

Performed function	-	Defines **Hi** alarm level for analogue signal value in engineering units.
Data type	-	Number
Range	-	***-32767 … 32767***
Default value	-	***32767***
Comments	-	If value of analogue signal is higher than value of this parameter, the Hi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

8.2.6.2.3.20. ALARM LO - ENGINEERING UNITS

Performed function	-	Defines **Lo** alarm level for analogue signal value in engineering units.
Data type	-	Number
Range	-	***-32767 … 32767***
Default value	-	***-32767***
Comments	-	If value of analogue signal is lower than value of this parameter, the Lo alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

8.2.6.2.3.21. ALARM LOLO - ENGINEERING UNITS

Performed function	-	Defines **LoLo** alarm level for analogue signal value in engineering units.
Data type	-	Number
Range	-	***-32767 … 32767***
Default value	-	***-32767***
Comments	-	If value of analogue signal is lower than value of this parameter, the LoLo alarm flag is risen.

The resetting level of the flag depends on Alarm hysteresis setting.

8.2.6.2.3.22. ALARM HYSTERESIS - ENGINEERING UNITS

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

8.2.6.2.3.23. TRACKING MODE

Performed function	-	Allows to select the operation mode for bits informing about exceeding the tracking range of analog inputs.
Data type	-	Selection list
Range	-	***Bidirectional*** **AN1_DB … AN3_DB** bits will be actualize when trace resolution excess in both ways. ***Increase only*** **AN1_DB … AN3_DB** bits will be actualize when trace resolution excess only upwards. ***Decrease only*** **AN1_DB … AN3_DB** bits will be actualized when resolution trace excess only downwards.
Default value	-	***Bidirectional***
Comments	-	N/A

8.2.6.2.3.24. DAEDBAND - ENGINEERING UNITS

Performed function	-	This parameter defines a minimal change of registered analogue signal to react on. Exceeding this value sets a flag (**AN1_DB**, **AN2_DB** and **AN3_DB**) respective to the analogue input where the change has been detected high. The flag is reset after one program cycle to low state (0).
Data type	-	Number
Range	-	***0 … 65535***
Default value	-	***100***
Comments	-	When set to value ***0***, the flag will rise upon every detected signal change by minimum ***1*** engineering unit. Deadband flags are dedicated to continuous monitoring of analogue signal changes.

8.2.6.3. COUNTERS (CNT1…CNT8)

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.

8.2.6.3.1. 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	-	***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.

8.2.6.3.2. ACTIVE EDGE OF INCREMENTING INPUT

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 ***1<->0*** any change of the logical state
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.

8.2.6.3.3. PULSE WEIGHT FOR INCREMENTING INPUT

Performed function - Defines incrementing bit's weight for activating counter incrementing function
Data type - Number
Range - ***1 … 1000***
Default value - ***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.

8.2.6.3.4. 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 - ***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.

8.2.6.3.5. 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
1<->0
any change of the logical state
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.

8.2.6.3.6. PULSE WEIGHT FOR DECREMENTING INPUT

Performed function	-	Defines incrementing bit's weight for activating counter decrementing function
Data type	-	Number
Range	-	***1 … 1000***
Default value	-	***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.

8.2.6.3.7. UPPER LIMIT

Performed function	-	Specifies the upper limit of the number of counted pulses. After it is exceeded, the counter is reset and the bit CNT1_UP, CNT2_UP, CNT3_UP, CNT4_UP, CNT5_UP, CNT6_UP, CNT7_UP or CNT8_UP is issued for one cycle, respectively.
Data type	-	Number
Range	-	***2147483647 … -2147483648***
Default value	-	***2147483647***
Comments	-	N/A

8.2.6.3.8. LOWER LIMIT

Performed function	-	Defines the lower limit of the number of counted pulses. After it is exceeded, the counter is reset and the bit CNT1_DN, CNT2_DN, CNT3_DN, CNT4_DN, CNT5_DN, CNT6_DN, CNT7_DN or CNT8_DN is issued for one cycle, respectively.
Data type	-	Number
Range	-	***2147483647 … -2147483648***
Default value	-	***-2147483648***
Comments	-	N/A

8.2.6.4. TIMERS

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

8.2.6.4.1. SYNCHRONOUS TIMERS (CT1...CT8)

Synchronous timers measure cyclically defined time intervals. They are synchronized with module's real time clock (RTC). The countdown of the set interval is signaled by setting a high state for one program cycle on the CT flag corresponding to the clock.

8.2.6.4.1.1. START [HH:MM]

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***)

8.2.6.4.1.2. 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

8.2.6.4.1.3. ACTIVITY BIT

Performed function	-	Selects a Bit whose state 1 means that the timer is active.
Data type	-	Selection list
Range	-	Name from bit list (see Bit list in Appendices), None or bit indicator 0 … 65535
Default value	-	***1***
Comments	-	Value 1 means that the clock works continuously and, according to the period, activates the appropriate Bit CT1 ... CT8 for one program cycle.

8.2.6.4.1.4. WEEK DAYS

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

8.2.6.4.1.5. MONTH DAYS

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

8.2.6.4.1.6. MONTH

Performed function	-	Allows you to select the months in which the timer is active
Data type	-	Multiple choice box
Range	-	***Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec***
Default value	-	***Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec*** (all months are selectable)
Comments	-	Timer is active in those months, which are selected. IF none of the months is selected, then the timer is inactive.

8.2.6.4.2. ASYNCHRONOUS TIMERS (CK1...CK8)

Asynchronous timers measure cyclically defined time intervals. They are not synchronized with module's real time clock (RTC). The countdown of the set interval is signaled by setting a high state for one program cycle on the CK flag corresponding to the clock.

8.2.6.4.2.1. PERIOD [S] (0 – INACTIVE)

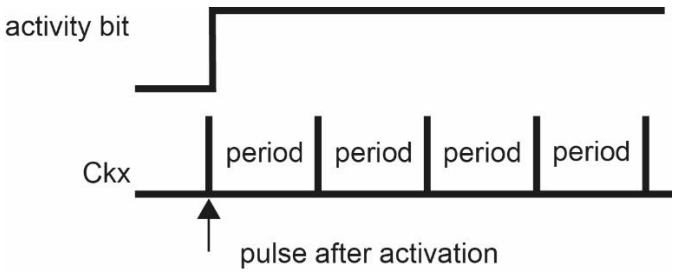
Performed function	-	Defines in seconds the interval module's clock should measure.
Data type	-	Number
Range	-	***0 … 240***
Default value	-	***0***
Comments	-	Selecting ***0*** deactivates the timer

8.2.6.4.2.2. ACTIVITY BIT

Performed function	-	Allows you to select a Bit whose state 1 means that the timer has started counting down.
Data type	-	Selection list
Range	-	Name from bit list (see Bit list in Appendices) ***None*** or bit indicator ***0 … 65535***
Default value	-	***1***
Comments	-	Value ***1*** means that the clock works continuously and, according to the period, activates the appropriate Bit **CK1 … CK8** for one program cycle.

8.2.6.4.2.3. PULSE AFTER ACTIVATION

Performed function	-	Allows you to specify whether the bits **(CK1 … CK8)** are to be set in the first cycle after the activity bit is triggered.
Data type	-	Selection list
Range	-	***Yes*** Triggering the activity bit automatically causes a pulse on the bit **CK1 … CK8** appropriate for a given clock. ***No*** Triggering the activity bit does not cause a pulse on bits **CK1 … CK8**. The bits will be activated after the first period has been counted. The calculation of the period starts with the activation of the Activity Bit.
Default value	-	***No***
Comments	-	The figure explains what a pulse is when activated



8.2.6.5. TEMPERATURE SENSOR

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

8.2.6.5.1. ALARM HI [°C]

Performed function	-	Defines the high temperature (°C) 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.

8.2.6.5.2. ALARM LO [°C]

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.

8.2.6.6. VIBRATION SENSOR (I5)

Binary input **I5** can operate as a input of signal from external vibration sensor with normally open contact. Notification about detected vibration is done by setting **VIB** bit high.
To use this feature binary input **I5** Operating mode parameter should be set to any setting but ***Inactive***. Full functionality of the binary input is maintained while the state of binary input **I5** is analyzed on the presence of vibration. This analysis is done without taking into account limitations imposed by parameters: Minimum pulse length and Filtration. Effect on analysis however has setting of Maximum pulse frequency parameter.

8.2.6.6.1. 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***.

8.2.6.6.2. 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***.

8.2.6.7. BATTERY

Groups parameters defining the battery state monitoring method.

8.2.6.7.1. LOW VOLTAGE ALARM

Performed function - Defines threshold level of battery voltage. When the voltage drops to the threshold value, a **LBAT_C** flag is raised. The alarm is generated for the voltage lower than threshold value. The alarm flag is raised for one program cycle.
Data type - Number
Range - ***2.0 … 4.0***
Default value - ***3.3***
Comments - The **LBAT_C** alarm flag is recommended to dispatch the information about necessity of battery replacement.
For lithium batteries it is advised to set this parameter to ***3,3***.

8.2.6.7.2. ALARM GENERATING INTERVAL

Performed function - Defines the interval for generating battery low voltage alarm
Data type - Selection list
Range - ***1 hour, 2 hours, 3 hours, 4 hours, 6 hours, 8 hours, 12 hours, 24 hours***

Default value	-	***24 hours***
Comments	-	When the battery voltage is lower than the one defined by Low voltage alarm parameter the module will rise alarm flag with frequency defined by this parameter. When the voltage returns to value above threshold (battery replaced) the module will stop generating alarms.

8.2.6.8. GPS

Contains parameters controlling optional GPS receiver, available in a special version of the module, i.e. MT-713/GPS.

8.2.6.8.1. 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.

8.2.6.8.2. 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.

8.2.6.8.3. 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.

8.2.6.8.4. 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.

8.2.6.8.5. 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.

8.2.6.8.6. 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.

8.2.6.8.7. 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***.

8.2.6.8.8. 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 center 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.

8.2.6.8.9. BASE POSITION - LATITUDE

Performed function - Allows user to set latitude of geofencing circle center
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***.

8.2.6.8.10. BASE POSITION - LONGITUDE

Performed function - Allows user to set longitude of geofencing circle center

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***.

8.2.6.8.11. RADIUS [KM]

Performed function - Allows user to set radius (in km) of geofencing circle center

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***.

8.2.6.9. LOGGER

Contains parameter controlling logger's operation. Events triggering saving of records and triggering sending of data stored in logger can be set in the Events subgroup.

8.2.6.9.1. 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.

8.2.6.9.2. 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***.

8.2.6.9.3. ALTERNATIVE RECIPIENT

Performed function	-	Defines IP address to send Logger's content to.
Data type	-	Selection list
Range	-	List of authorized IP addresses
Default value	-	***N/A***
Comments	-	If the Logger is not in use the parameter should have value of ***None***.

8.2.6.9.4. RECIPIENT'S UDP PORT

Performed function	-	Defines UDP port to which logger contents 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.

8.2.6.9.5. SENDING IN ONLINE MODE [MIN]

Performed function	-	Defines the logger sending interval if the module is on-line mode. After emptying the entire content of the logger, an attempt to send newly recorded records must be initiated on a new event with the Triggering logger sending option selected.
Data type	-	Number
Range	-	***1 … 250***
Default value	-	***1***
Comments	-	N/A

8.2.6.9.6. DATA FRAME FORMAT

Performed function	-	Defines, which registers will be added to data frames and send to recipient number.

Data type - Selection list

Range - ***All***

All available registers will be send to recipient number.

Selected resources

Only selected groups of registers will be send to recipient number.

Default value - ***All***

Comments - N/A

8.2.6.9.6.1. SELECTED REGISTERS

Register's calm includes the same names of registers like in memory map. Round brackets includes space name and address of each register.

Parameter	Registers	Description
Real-Time Clock	**RTC_FSEC(IR1)** **RTC_HSM(IR2)** **RTC_YMD(IR3)**	Registers contain time from RTC clock that is countered by module.
Status	**PRG_STATE (IR0)** **MT_BITS(IR6)** **MT_ALM(IR7)** **VBAT(IR21)** **TEMP(IR22)** **GSM_STATE(IR24)** **LAC(IR44)** **LCID(IR45)** **SL_BITS(IR23)**	Registers group that contain a status of the module.
Binary inputs/outputs	**BIN(IR8)** **BOUT(HR0)**	Registers that contains all bits from binary inputs, outputs states.
Timers	**CLOCK(IR9)** **Z_BITS(HR1)**	Registers that contains all bits from counters states.
Analog and counting inputs	**FL1(IR10)** **FL2(IR11)** **FL3(IR12)** **FL4(IR13)** **FL5(IR14)** **AN1(IR15)** **AN2(IR16)** **AN3(IR17)** **ALM_L(IR18)** **ALM_H(IR19)** **ALM_DB(IR20)**	Registers that contains measures of analog inputs and results of a flow calculations.
GPS Receiver	**GPS_FESC(IR25)** **GPS_HMS(IR26)** **GPS_YMD(IR27)** **GPS_LAT(IR28)** **GPS_LONG(IR30)**	Registers that contains geographical coordinates coming from internal GPS receiver.

Parameter	Registers	Description
	GPS_COG(IR32) **GPS_SPD(IR34)** **GPS_STATE(IR34)**	
Counters	**CNT1(HR2)** **CNT2(HR4)** **CNT3(HR6)** **CNT4(HR8)** **CNT5(HR10)** **CNT6(HR12)** **CNT7(HR14)** **CNT8(HR16)**	Registers that contains sum of pulse countered by pulse counters.
Modbus Mirror	**SL_R0(HR18)** **...** **SL_R15(HR33)** **SL2_R0(HR44)** **...** **SL2_R15(HR59)**	Registers that contains values from external devices which are connected to RS-485 serial port.
Internal program	**P_BITS(HR34)** **AUX0(HR35)** **...** **AUX8(HR43)**	Registers assigned to internal program execution.
Diagnostic registers	**ON_TMR(IR4)** **BAT_ACT(IR35)** **BAT_PWR(IR36)** **V0_ACT(IR37)** **GPS_ACT(IR38)** **GSM_ACT(IR39)** **GSM_PWR_UP (IR40)** **DIAG_REG(IR41)** **LOG_ERR(IR42)** **SND_ERR(IR43)**	Registers that contains a diagnostics information.

8.2.6.10. PORT RS-485 (MODBUS MIRROR)

Parameters of this subgroup are associated with serial communication that is available in special version of **MT-713/RS485** which is equipped to **RS-485** port with **Modbus RTU Mirror** protocol. It this mode the module works as a "Master" is serial network. Four data blocks are available for reading and writing up to 16 bits or registers in maximum. The protocol tasks are also realized during a sleep mode of the module. All parameters that has been necessary to set for correct communication with external device are described below.

8.2.6.10.1. NUMBER OF RETRIES

Performed function	-	Defines number of retries of serial port transmission in case of not receiving confirmation in time defined by Poll timeout parameter.
Data type	-	Number
Range	-	***1 … 7***
Default value	-	***3***
Comments	-	N/A

8.2.6.10.2. POLL TIMEOUT [S]

Performed function	-	Defines waiting time (in seconds) for confirmation of reception of sent data frame in every poll trigger events
Data type	-	Number
Range	-	***0.1 … 25.0***
Default value	-	***0.2***
Comments	-	N/A

8.2.6.10.3. PORT SPEED [B\S]

Performed function	-	Defines transmission speed (b\s) for serial port
Data type	-	Selection list
Range	-	***1200, 2400, 4800 -*** List of supported speed
Default value	-	***4800***
Comments	-	N/A

8.2.6.10.4. PARITY

Performed function	-	Defines control of transmitted byte
Data type	-	Selection list
Range	-	***None, Even, Odd -*** List of available options
Default value	-	***None***
Comments	-	N/A

8.2.6.10.5. SLAVE

Slave1 … Slave4 data blocks available to run communication with maximum 4 external devices. Each blocks has got independent configuration and required to enter ID Modbus for external device to activate the reading.

8.2.6.10.5.1. MODBUS SLAVE ID

Performed function	-	Defines Modbus ID of Slave device from which configured data block is to be read or write.
Data type	-	Selection list or number
Range	-	***None, 0 … 255***
Default value	-	***None***
Comments	-	Setting Modbus ID 0 (zero) switches the mapping off

8.2.6.10.5.2. MAPPED DATA BLOCK ADDRESS SPACE

Performed function	-	Selects Modbus space mapped from peripheral Slave device attached to RS-485 port.
Data type	-	Selection list
Range	-	***Binary inputs*** *(read only)* ***Binary outputs*** *(read and write)* ***Analog inputs*** *(read only)* ***Holding registers*** *(read and write)*
Default value	-	***Holding registers***
Comments	-	N/A

8.2.6.10.5.3. MODE

Performed function	-	Allows to choose which function use to mapping each Slave block.
Data type	-	Selection list
Range	-	***Read only*** Only reading functions are used in the queries appropriate for the selected area of the mapped space. ***Read/Write auto*** Writing and reading functions are used in the queries appropriate for the selected area of the mapped space. Writing functions are selected automatically. ***Read/Write single*** Writing and reading functions are used in the queries appropriate for the selected area of the mapped space. Writing is realized by a single-write function of the bit or register. In case of settings where the mapped space is highest than value 1, each write will be realized using single write function. ***Read/Write the whole block*** Writing and reading functions are used in the queries appropriate for the selected area

of the mapped space. Writing is realized by a multi-write function of the bits or registers. In case of settings where the mapped space is set to value 1, the write will be realized using single write function.

Default value - ***Read only***
Comments - N/A

8.2.6.10.5.4. MAPPED DATA BLOCK ADDRESS IN SLAVE

Performed function - Defines start address (in dec) bit or register of mapped block from peripheral Slave.
Data type - Number
Range - ***0 … 65535***
Default value - ***0***
Comments - N/A

8.2.6.10.5.5. MAPPED DATA BLOCK SIZE

Performed function - Defines the size of registers necessary for reading or writing mapped space from peripheral Slave device
Data type - Number
Range - ***1 … 16***
Default value - ***16***
Comments - N/A

8.2.6.10.5.6. POLL TRIGGERING

Performed function - Allows to choose a bit, that will control the data block reading of the slave. The reading is triggered only for status changes from 0 to 1.
Data type - Selection list or number
Range - Name from bit list (see bit list in Appendices), ***None*** or bit marker ***0 … 65535***
Default value - ***None***
Comments - Value ***1*** does not implements continuous reading of Slave's data block. Changes of the value in data blocks are detected automatically, triggering write function in every cycle of the program. Write functions are not depend from the reading.

8.2.6.10.5.7. BLOCK ADDRESS IN MODULE

Performed function	-	Address (dec) of the first register in module, that is prepare to store data that are reading from Slave device. Mapped data block size determines the number of consecutive registers.
Data type	-	Number
Range	-	***2 … 59***
Default value	-	***18***
Comments	-	Registers **2 ... 17** and **34** can be used to store data values reading form Slave device only when default features are not used: counters **CNT1 ... CNT8** and flags **P1 ... P16** it means register **P_BITS**.

8.2.6.11. CONSTANT PARAMETERS

The triggering bit	-	Address of the bit whose rising edge triggers the writing of the value **Expected value [unit]** to the register **HREG register** Name from bit list (see Bit list in Appendices) or ***0 … 65535***
Expected value [unit]	-	Value written to the register HREG register after detecting a rising edge on a bit. Bit that triggers writing Number ***10000 … 65535*** rising slope (default) ***1->0*** falling slope ***0<->1*** any slope
HREG register	-	The address of the register to which the value is written Name from register list or ***10000 … 65535***
Comments	-	Bit indicators in the range **0 ... 9999** indicate the space of inputs, and addresses **10000 ... 65535** binary outputs. Register indicators in the range **0 ... 9999** indicate the space of analog inputs, and addresses **10000 ... 65535** internal registers.

The list consists of 32 items.

ATTENTION!!!
The states of bits and values of registers whose names have been bolded in the memory map are refreshed every program cycle. Other resources are refreshed only when the module is in a high power (wake up) state. It is recommended that bits controlling outputs and triggering events belong to the first group of resources.

8.2.6.12. µPROG

µProg programing feature is available in **MT-713** form 1.29 firmware version. This add-on allows to configure own control algorithm that are not in standard or a data distribution additional method. Programing mode used to logical operation on internal resources as bits and flags. User can use up to 32 instructions that are realized every cycle of system program. Instruction are executed in sequence starting from the first. The function arguments are chosen from the list or can be entered from the keyboard. Each Function execute an operation as was described below and return a result as output value of selected bit.

Idx. - List indexing number

Function - **END** - program exit, next lines is not executed
AND - logical product
OR - logical sum
XOR - compare boolean X and Y
NOP - no operation, skip line
NAND - X and Y disjunction
NOR - binegation of X and Y
XNOR - equivalence of X and Y
JK_LATCH - performs the function of the JK relay, where Parameter1 is the SET input, Parameter2 is the RESET input, and the Result is Q - non-inverting relay output
IF1_BCPY - copies the state of the Parameter2 bit to the Output bit if the Parameter1 bit is "1"
IF0_BCPY - copies the state of the Parameter2 bit to the bit Output if the Parameter1 bit is "0"
IF1_MOVE - copies the value of the register from Parameter2 to the Output register if the Parameter1 bit is "1"
IF0_MOVE - copies the value of the register from Parameter2 to the Output register if the Parameter1 bit is "0"
IF1_CONST - writes the value from Parameter2 to the Output register if the Parameter1 bit is "1"
IF0_CONST - writes the value from Parameter2 to the Output register if the Parameter1 bit is "0"
IF1_RRA - shifts the bits in the Parameter2 register one position to the right and writes to the Output register if the Parameter1 bit is "1". The value in the most significant bit is saved
IF0_RRA - shifts the bits in the Parameter2 register one position to the right and writes to the Output register if the Parameter1 bit is "0". The value in the most significant bit is saved
IF1_RLA - shifts the bits in the Parameter2 register one position to the left and writes to the Output register if the Parameter1 bit is "1". The value in

the least significant bit is set to zero
IF0_RLA - shifts the bits in the Parameter2 register one position to the left and writes to the Output register if the Parameter1 bit is "0". The value in the least significant bit is set to zero
CMP_EQ - if the value in the Paramert1 register is equal to the value in the Parameter2 register, the Result bit is set to "1". Otherwise, it is set to "0".
CMP_NE - if the value in the Paramert1 register is different from the value in the Parameter2 register, the Result bit is set to "1". Otherwise, it is set to "0".
CMP_LO - if the value in the Paramert1 register is lower than the value in the Parameter2 register, the Result bit is set to "1". Otherwise, it is set to "0".
CMP_LE - if the value in the Paramert1 register is less than or equal to the value in the Parameter2 register, the Result bit is set to "1". Otherwise, it is set to "0".
CMP_GT - if the value in the Paramert1 register is greater than the value in the Parameter2 register, the Result bit is set to "1". Otherwise, it is set to "0".
CMP_GE - if the value in the Paramert1 register is greater than or equal to the value in the Parameter2 register, the Result bit is set to "1". Otherwise, it is set to "0".
NOP - no operation, skip instruction

Parameter1 - Name from bit list (see bit list in Appendices) or ***0 …65535***

Parameter2 - Name from bit list (see bit list in Appendices) or ***0 …65535***

Return - Q1,Q2,P1 ... P16 or registers address number from internal space (**10000 … 65535)**.

Comments - Bit addresses **0 … 9999** point to analog inputs space while addresses **10000 … 65535** point to internal registers space.
Last program instruction not required **END** function.

Table presenting the status of Outputs for logical functions with different combinations of Parameter1 and Parameter2 states

Parameter1	Parameter2	AND	OR	XOR	NAND	NOR	XNOR	JK_LATCH
0	0	0	0	0	1	1	1	previous state
0	1	0	1	1	1	0	0	0
1	0	0	1	1	1	0	0	1
1	1	1	1	0	0	0	1	toggles the state

8.2.7. 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.

8.2.7.1. 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

8.2.7.2. EVENTS TABLE

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

Items in the list of events can be freely added and removed using the context menu, available under the right mouse button when the cursor is over one of the items in the list or in the area of the 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.

8.2.8. INTERNAL PROGRAM

This module has got implemented additional works algorithm prepared especially for our partners companies. Algorithms realized measurements and control according to input parameters and measures. Properly operation is associated with correct configuration of others available parameters and correct connection of the measured signals. More information about parameters and internal program functionality are not available in this manual. Please contact directly with us for more info if you plan to use this option.

8.2.8.1. TYPE OF ALGORITHM

Performed function - Selection and automatic activation of additional work algorithms in **MT-713**

Data type - Selection list

Range - ***None***

Algorithm of Internal program is not realized.

PRV time

Implementation of control valves algorithm in time function for pressure adjustment in water supply network (Depends from time of the day).

PRV flow

Implementation of control valves algorithm in flow function for pressure adjustment in water supply network.

Geonor M-600

Implementation of the algorithm of cooperation with piezo-electric pressure sensor.

Variable hourly alarms

Allows to set the normal level for four selected variables (e.g. analog input) depending on the hour of the day. A deviation from the normal level by a given percentage causes the alarm bit to be issued.

Default value - ***None***

Comments - More information about parameters and internal program functionality are not available in this manual. Please contact directly with us for more info if you plan to use this option.

8.2.9. GSM ACTIVITIES

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

8.2.9.1. ACTIVE AFTER SMS RECEPTION [MIN.]

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!

8.2.9.2. ACTIVE AFTER GPRS FRAME RECEPTION [MIN.]

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!

8.2.10. 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.

8.2.10.1. SENDING SMS

Sub-group Sending SMS consists of two parts:

- list of SMS sending rules
- general parameters of all rules

The list of SMS sending rules includes up to 32 rules to trigger the sending of a short text message. List items can be added from the context menu available under the right mouse button when the cursor is in the Device window of the MTManager program over one of the defined rules.

It is also possible to set the number of rules by setting the value of the Number of SMS sending rules parameter.

8.2.10.1.1. SMS VALIDITY TIME [H]

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.

8.2.10.1.2. 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.

8.2.10.1.3. 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.

8.2.10.1.3.1. 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

8.2.10.1.3.2. 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

8.2.10.1.3.3. TEMPLATE

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

8.2.10.1.3.4. ACTIVITY TIME AFTER LOG-IN

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

8.2.10.2. SENDING DATA

Sub-group Sending consists of two parts:

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

The list of Data sending rules includes up to 32 rules that trigger the sending of data defined by the User to the indicated IP address. List items can be added from the context menu available under the right mouse button when the cursor is in the Device window of the MTManager program over one of the defined rules.

It is also possible to set the number of rules by setting the value of the Number of SMS sending rules parameter

8.2.10.2.1. 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.

8.2.10.2.2. DATA VALIDITY TIME [H]

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.

8.2.10.2.3. 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.

8.2.10.2.4. 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.

8.2.10.2.4.1. 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

8.2.10.2.4.2. 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

Write command

Frame for saving data from the MT-713 module to internal registers of another MT module

Default value - ***Status***

Comments - Depending on selected frame type some parameters may become unavailable

8.2.10.2.4.3. 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 **MTSpooler**. In this particular case the recipient is defined by MTSooler IP in GPRS group's parameters

8.2.10.2.4.4. ACTIVITY TIME AFTER LOG-IN [MIN.]

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

8.2.10.2.4.5. SPACE

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

Data type - Selection list

Range - ***IREG***
Analogue inputs space (input registers)
HREG
Internal registers space (holding registers)

Default value - ***IREG***

Comments - This parameter is accessible only when Buffer data format has been selected. Addresses of module's resources may be found in Memory map in Appendices.

8.2.10.2.4.6. BUFFER START ADDRESS

Performed function - Points out the address of the first register of the array to be sent.

Data type - Number

Range - ***0 … 31***

Default value - ***0***

Comments - N/A

8.2.10.2.4.7. BUFFER SIZE

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

8.2.10.2.4.8. HREG SPACE TARGET ADDRESS

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

8.2.10.2.4.9. RECIPIENT ID ADDRESS

Performed function	-	Indicates the recipient's Modbus ID to which the sent buffer will be written.
Data type	-	Number
Range	-	***0 … 9999***
Default value	-	***96***
Comments	-	N/A

8.3. PRESETS

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

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

 - Presets

The **Presets** icon is active only when the module is connected and selected transmission channel is not the Spooler. Sending data in **Presets** mode is possible only as sending changes. Bear in mind that sending configuration changes result in immediate and irrevocable updating of the resource.
When **Presets** mode is selected all configuration groups disappear from the panel and only parameters that may have initial value set are displayed. For **MT-713** module the parameters are Counters **CNT1…CNT8**.

8.3.1. COUNTERS (CNT1…CNT8)

Resource's name - 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.

9. PROBLEM SOLVING

9.1. 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 modules proper operation.

9.2. BATTERY REPLACEMENT

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

- prepare the necessary tools and products, i.e. a Phillips screwdriver, a new battery with parameters (voltage, dimensions) compatible with the previous one, a new cover for the module
- disassemble the enclosure lid
- press the **KEY_P** button for 2 to 8 seconds - this will force the module to go into battery replacement mode signaled by double flashes of POWER LED. In this mode the module does not perform analog inputs measurements, neither GPS measurements nor log into GSM network nor send data and SMS messages.
- disconnect the power cable from the PCB
- tilt the metal shelf with PCB
- remove the battery pack and replace it with the new one
- put the shelf back in place
- connect the battery to the socket on PCB
- assemble ~~back~~ and tighten properly the **new** cover

The device operating in the battery replacement mode does not perform analog input measurements, GPS measurements, does not log into the GSM network and does not send data and SMS messages. This allows you to extend the working time of the module without power. The module exits this operating mode when the **KEY_P** button is pressed for 2 to 8 seconds or the battery is connected or the housing is closed.

We recommend using original battery packs available at manufacturers stores.

Due to the technology of the cover gasket (spray gasket), it is recommended to replace the cover when replacing the battery periodically. The gasket deforms over time and does not provide a proper seal when the cover is re-installed.

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

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

10. TECHNICAL PARAMETERS

10.1. GENERAL

Dimensions (height x width x depth)	120 x 120 x 65 mm (122 x 120 x 95 mm for HC version)
Weight (with batteries)	1030 g (1430 g for HC version)
Mounting method	4 holes
Operating temperatures (alkaline batteries)	-20°C ÷+55°C
Operating temperatures (lithium batteries)	-30°C…+65°C
Protection class	IP67

10.2. MODEM GSM/GPRS

Modem type	uBlox SARA-U201	uBlox SARA-R12M
GSM	quad-band (850/900/1800/1900 MHz)	
UMTS	Five band (800/850/900/1900/2100 MHz)	
LTE		Cat M1/NB1 Band: 2, 3, 4, 5, 8, 12, 13, 20, 26, 28
Data transmission:		
GSM	GPRS Class 12 DL: 85.6 kbps UL: 85.6 kbps	GPRS Class 33 DL: 107 kbps UL: 85.6 kbps
UMTS	HSPA DL: 7.2 Mbps (HSDPA Cat. 8) UL: 5.7 Mbps (HSUPA Cat. 6)	-
LTE	-	CATM1 / NB1 DL: 300 kbps / 27.2 kbps UL: 357 kbps / 62.5 kbps
Transmitter Peak Power:		
GSM 850 MHz/EGSM 900 MHz	+33 dBm (2W)	+33 dBm (2W)
DCS 1800 MHz/PCS 1900 MHz	+30 dBm (1W)	+30 dBm (1W)
UMTS	+24 dBm (0,25W)	-
LTE Cat M1/NB1	-	+23 dBm
Channel spacing	200 kHz	200 kHz
Antenna	50 Ω	50 Ω
SIM card	Mini SIM (25x15 mm)	Mini SIM (25x15 mm)

10.3. BINARY/PULSE INPUTS I1…I5

Contacts polarization	3.0 V
Counting frequency (fill 50%)	250 Hz max.
Minimal pulse length - operating in pulse input mode	2 ms
Minimal pulse length - operating in binary input mode	100 ms

10.4. NMOS OUTPUTS Q1, Q2

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

10.5. ANALOG INPUTS AN1…AN3

Type	voltage, differential
Measuring range	0 - 5.0 V
Input resistance	>600 kΩ typically
Resolution	12 bits
Accuracy at 25°C temperature	±0.2 %
Accuracy at full temperature range	±0.5 %

10.6. POWER OUTPUT V0

Voltage range	0 - 5.0 V
Resolution	0.1 V
Accuracy	2 %
Maximum current	50 mA

VOUT output

	Min	Typ	Max
Output voltage			
15V(J1 close)	14.1V	14.8V	15.6V
24V(J1 open)	22.4V	23.6V	24.8V

Output current 15V(J1 close) 24V(J1 open)	 40mA 25mA
Noise level	0.3 Vp-p

Resistors

Nominal resistance	250W
Accuracy	0.1 %
Temperature coefficient	10ppm/K
Maximum current	20 mA

10.7. LOGGER

Memory type	FLASH
Max. records number	30 720
Min. recording time	30 ms

10.8. GPS RECEIVER

Type	NEO-7 (GALILEO supported)
Frequency	L1
Encoding	C/A
Number of channels	56
Accuracy	2.5 m CEP
Sensitivity	- 162 dBm

10.9. TEMPERATURE SENSOR

Type	Integrated sensor
Accuracy	±3°C

10.10. POWER SUPPLY

Battery pack: 3 alkaline batteries 3 lithium batteries 6 alkaline batteries 6 lithium batteries	 4.5 V / 16 Ah 3.6 V / 39 Ah 4.5 V / 32 Ah 3.6 V / 78 Ah

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

MT-CPV

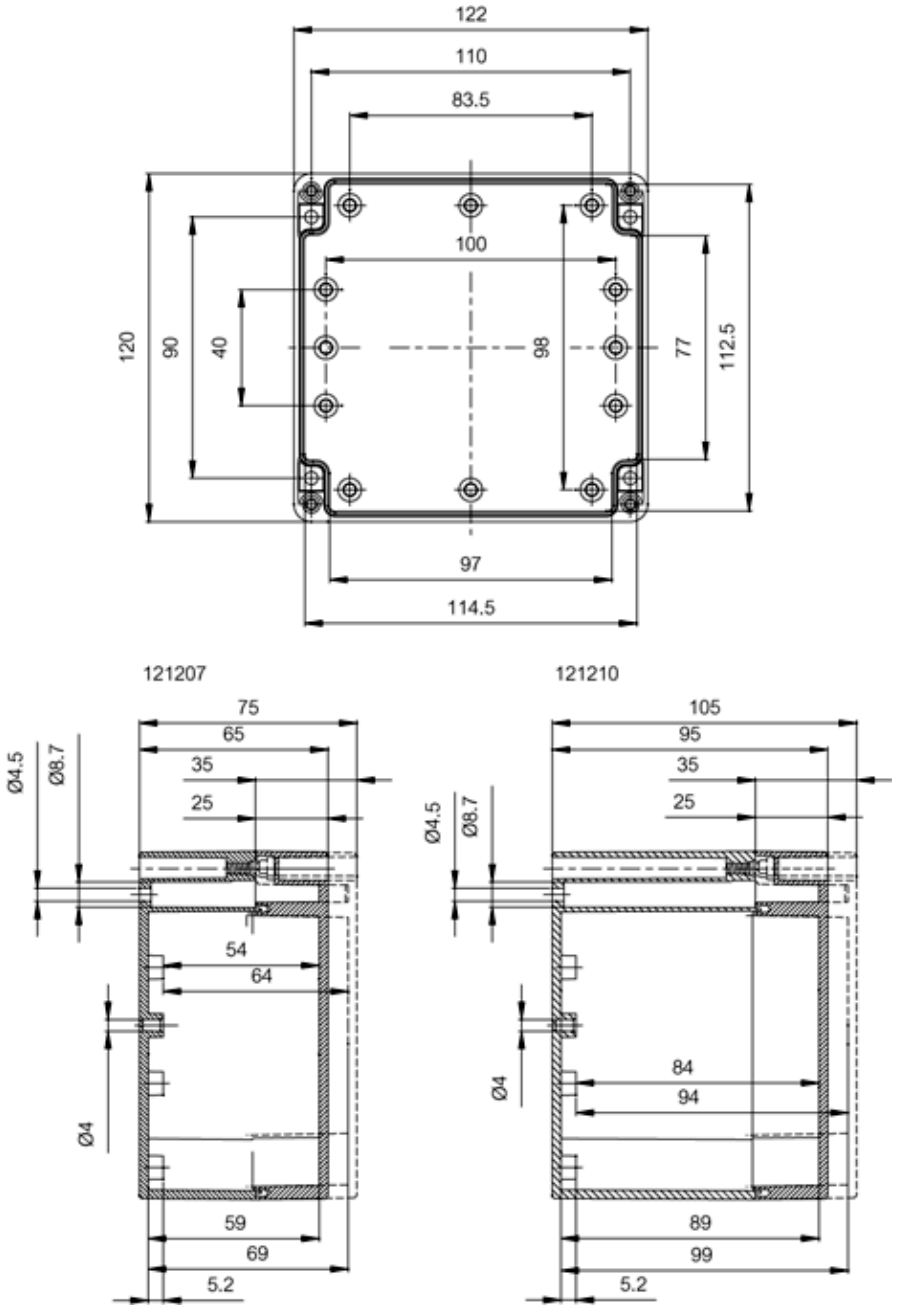
Dimension	60x56x15 mm
Installation	inside module
Input voltage VIN	7.5 – 30 VDC
PU efficiency	~ 70 %
Supported battery type	Li-Ion 3.6 V
Max charging current	0.7 A
Full charge voltage	4.15 V
Current drawn by MT-CPV from battery when mains power supply is not available	<100 µA

10.11. ENCLOSURE

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

Standard version dimensions (121207)	
Length	122 mm
Width	120 mm
Height	65 mm
HC version dimensions (121210)	
Length	122 mm
Width	120 mm
Height	95 mm

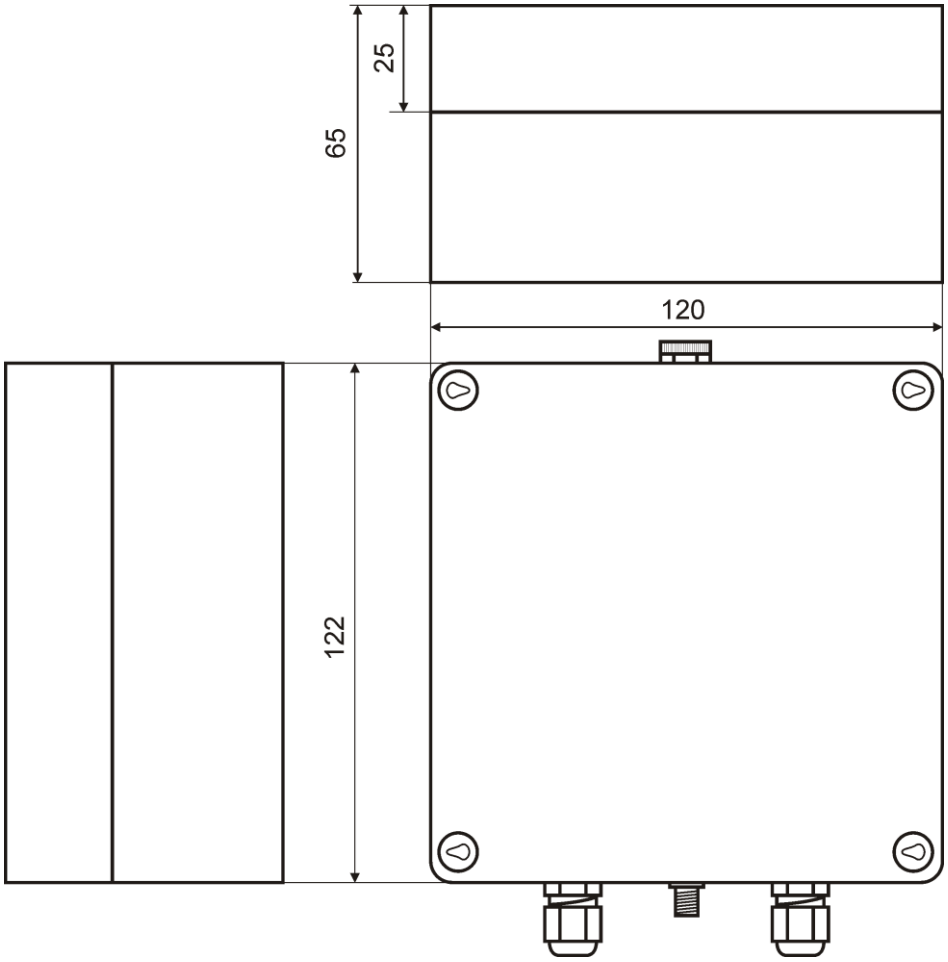
10.11.1. MONUTING HOLES DIMENSIONS



Enclosure and mounting holes dimensions

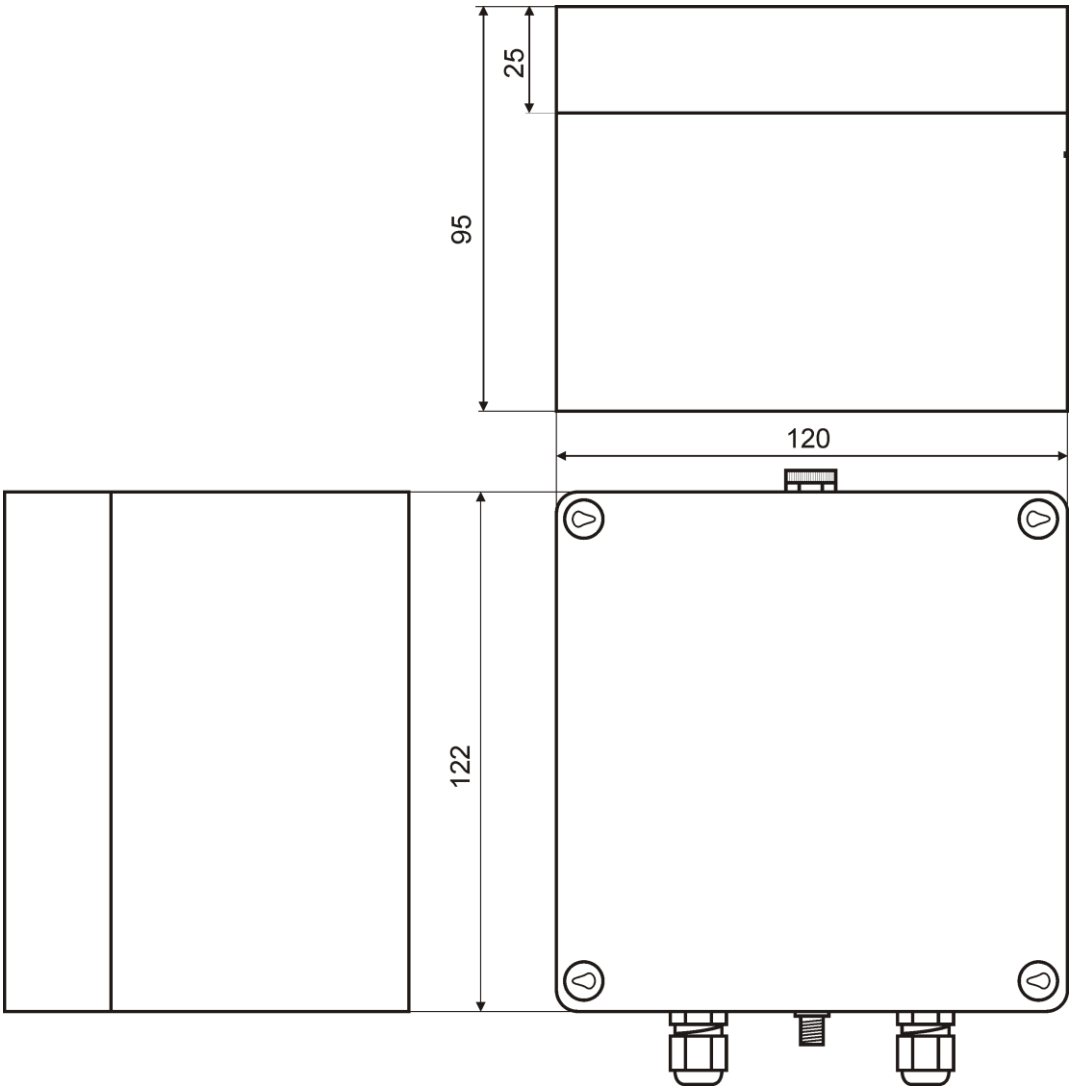
NOTICE!!!
All dimensions in millimeters!

10.12. DRAWINGS AND DIMENSIONS



Standard version

NOTICE!!!
All dimensions in millimeters!



/HC version

NOTICE!!!
All dimensions in millimeters!

11. SAFETY INFORMATION

11.1. 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.

11.2. 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.

11.2.1. 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.

11.2.2. 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.

11.2.3. 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).

11.2.4. RF MARKED EQUIPMENT

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

11.3. 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.

12. APPENDICES

12.1. SMS COMMANDS SYNTAX

MT-713 can send SMS messages including mnemonics replaced with numerical values at the moment of dispatch. It can respond to queries sent via SMS. Bear in mind that the module receives SMS messages only when it is logged in the network.
In the table you will find all available commands and mnemonics for SMS. Bold types represent mandatory commands while italics represent parameters added by user. Square brackets embrace optional elements.

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

#BAT	battery voltage
#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 of satellites used to calculate GPS position
#HDOP	read HDOP of 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 time
#DATE	read module date
#IP	read module 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**
#CR	new line in text of SMS message
#Fn.*variable*	value from register is presented as flow number (n=1 ¸ 3) Example: Notation #F3.HR10 when value HR10=1234 will be presented in SMS content as 1.234

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 timestamp. This activation does not make module to report to MTSpooler. *password* is password protecting module configuration. If there is no password protecting modules configuration just omit *password* parameter and space just after it.
![*password*]**GETIP**	read modules current IP address (if not logged to GPRS answer is *0.0.0.0*). *password* is password protecting modules configuration. If there is no password protecting modules 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 modules configuration. If there is no password protecting modules 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 modules configuration. If there is no password protecting modules 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 modules configuration. If there is no password protecting modules 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 modules configuration. If there is no password protecting modules 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 modules configuration. If there is no password protecting modules configuration just omit *password* parameter and space just after it.

NOTICE!!!

Special commands are received and processed form telephone number when:

1. module is password protected - then phone number is not required on authorization number list.
2. module is NOT password protected - then phone number has to be required on authorization number list.

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 modules 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*** (np. ***>#CNT1=ERR***).
To pass the ***#*** sign in SMS type ***##***.

12.2. MEMORY MAP

All accessible from remote resources of **MT-713** module were collected in four address spaces: binary inputs, analog inputs, binary outputs and internal registers. Spaces of binary inputs and analog inputs and spaces of binary outputs and internal registers are connected in pairs and contain the same resources. The difference between spaces is in the way of accessing the resources - for binary inputs and outputs are used for accessing individual bits and groups of bits while analog inputs and internal registers address spaces allow access to the full registers.
This difference results in a different way addressing. In the internal registers and analog input address spaces each address is assigned to the each register while the for binary inputs and outputs address spaces are each address corresponds to individual bit. The memory map tables are arranged by their addresses for addressing registers. To calculate the addresses of the individual bits in the binary spaces, use the following equation:

register_address * 16 + bit_position = bit_address

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

6 * 16 +7 = 103.

In the module configuration, to distinguish the bit spaces, the calculated bit address of the binary output space should be supplemented with the value 10000. For example, for the P1 flag, we have the trigger bit value equal to 10544 (P1 bit = 544 dec + 10000).

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.

12.2.1. ANALOG INPUTS/BINARY INPUTS ADDRESS SPACE

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
0	0	---	---	---	---	---	---	---	---	---	---	---	---	RUN	FS	1	0	PRG_STATE	FS - first scan (first cycle) RUN - program running
1	16	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	32	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	48	year - 2000 (0…127)						month - 1 (0…11)					day - 1 (0…30)					RTC_YMD	RTC (UTC time) - date
4	64	int32(LoHi)																ON_TMR	Uptime [s] from connecting to power supply
5	80																		
6	96	**RTC_OK**	**RTC_C**	**ZONE_C**	**HREG_C**	**CFG_OK**	**GPS_C**	**AN_C**	**FL_C**	**KEY_P**	**PF**	**SLEEP**	**V0**	**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 V0 = 1 - Vo output on SLEEP = 1 - set for 1 cycle after awaking (1 cycle) PF = 1 - set for one cycle after power restore (1 cycle) KEY_P = 1 - ACTIVATE button released (1 cycle)

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
																			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	112	**PWR_F**	**RES_F**	**---**	**---**	**---**	**---**	**---**	**FAIL**	**SL_E**	**SL_C**	**VIB**	**OPEN**	**TEMP_Hi**	**TEMP_Lo**	**DEW**	**LBAT_C**	MT_ALM	**Alarm bits** LBAT_C = 1 - low battery voltage alarm (1 cycle) DEW = 1 - condensation alarm TEMP_Lo = 1 - low temperature alarm TEMP_Hi = 1 - high temperature alarm OPEN = 1 - open enclosure

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
																			alarm VIB = 1 - vibrations alarm SL_C = 1 new data (read) Modbus Mirror (1cycle) SL_E = 1 read error Modbus Mirror (1 cycle) FAIL = 1 modem damage info flag
8	128	KEY	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**I5**	**I4**	**I3**	**I2**	**I1**	BIN	Ix - binary inputs states KEY - ACTIVATE button state
9	144	**CT8**	**CT7**	**CT6**	**CT5**	**CT4**	**CT3**	**CT2**	**CT1**	**CK8**	**CK7**	**CK6**	**CK5**	**CK4**	**CK3**	**CK2**	**CK1**	CLOCK	Timer flags (1 cycle)
10	160	int16																FL1	Flow I1
11	176	int16																FL2	Flow I2
12	192	int16																FL3	Flow I3
13	208	int16																FL4	Flow I4
14	224	int16																FL5	Flow I5
15	240	int16																AN1	Analog input AN1
16	256	int16																AN2	Analog input AN2
17	272	int16																AN3	Analog input AN3
18	288	**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

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
19	304	**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	320	**---**	**---**	**---**	**---**	**AN_HHLL**	**AN_HL**	**FL_HHLL**	**FL_HL**	**AN3_DB**	**AN2_DB**	**AN1_DB**	**FL5_DB**	**FL4_DB**	**FL3_DB**	**FL2_DB**	**FL1_DB**	ALM_DB	Deadband bits (1 cycle) FL_HL - flow alarm threshold Lo or Hi FL_HHLL - flow alarm threshold LoLo or HiHi AN_HL - analogue alarm threshold Lo or Hi AN_HHLL - analogue alarm threshold LoLo or HiHi
21	336	Battery voltage (0…5000)																VBAT	Battery voltage [mV]
22	352	Temperature																TEMP	Temperature x 0,1 [°C]
23	368	**SL4_W_ER**	**SL3_W_ER**	**SL2_W_ER**	**SL1_W_ER**	**SL4_R_ER**	**SL3_R_ER**	**SL2_R_ER**	**SL1_R_ER**	**SL4_W_OK**	**SL3_W_OK**	**SL2_W_OK**	**SL1_W_OK**	**SL4_R_OK**	**SL3_R_OK**	**SL2_R_OK**	**SL1_R_OK**	SL_BITS	MODBUS MIRROR mode information bits (1cycle) SLx_R_OK =1 - info about reading data SLx_R_ER =1 - data reading error SLx_W_OK =1 - correct data writing to Slave SLx_W_ER =1 - data writing error

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
24	384	SYG_LEV (0…100)								SIM_ERR	PIN_ERR	-	-	APN	GPRS	ROAMING	GSM	GSM_STATE	**GSM status bits** GSM = 1 - module registered in GSM (range OK) ROAMING = 1 - module in roaming GPRS = 1 - GPRS available APN = 1 - module logged into APN PIN_ERR = 1 - wrong PIN SIM_ERR = 1 - error or no SIM card SYG_LEV = GSM signal strength [%]
25	400	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	416	hour (0…23)					minute (0…59)						second / 2 (0…29)					GPS_HMS	
27	432	year - 2000 (0…127)							month - 1 (0…11)				day - 1 (0…30)					GPS_YMD	
28	448	Geographical latitude																GPS_LAT	Latitude in degrees
29	464																		
30	480	Geographical longitude																GPS_LONG	Longitude in degrees
31	496																		
32	512	Course (0…359)																GPS_COG	Course in degrees (0° -N, 90° - E, 180° -S, 270° -W)

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
33	528	Speed																GPS_SPD	Speed [km/h]
34	544	**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 cykl) HDOP - accuracy of position measurement (0…99) FIX = 1 - position found (1 cycle)
35	560	uint16																BAT_ACT	Time on battery [h] (rested after battery disconnection)
36	576	-																-	Reserved
37	592	uint16																VO_ACT	Time on battery [h] (rested after battery disconnection)

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
38	608	uint16																GPS_ACT	Timer of GPS receiver activity [m] (rested after battery disconnection)
39	624	uint16																GSM_ACT	Timer of GSM modem activity [m] (rested after battery disconnection)
40	640	uint16																GSM_CNT	GSM modem starts counter (rested after battery disconnection)
41	656	uint16																DIAG_REG	Diagnostic register
42	672	uint16																LOG_REG	GPRS login failed attempt counter
43	688	uint16																SND_ERR	Not sent frames counter (events+logger frames)
44	704	uint16																LAC	GSM Local Area Code
45	720	uint32																LCID	GSM Cell ID
46	736																		
47	752	CNT_8_UP	CNT_7_UP	CNT_6_UP	CNT_5_UP	CNT_4_UP	CNT_3_UP	CNT_2_UP	CNT_1_UP	CNT_8_DN	CNT_7_DN	CNT_6_DN	CNT_5_DN	CNT_4_DN	CNT_3_DN	CNT_2_DN	CNT_1_DN	CNT_BITS	CNTx_UP - counter overflow (>2147483647) (1 cycle) CNTx_DN - counter underflow (<-2147483648) (1 cycle)

Analog inputs address space (read only), Modbus RTU functions (2,4)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
48	768	SL8_W_ER	SL7_W_ER	SL6_W_ER	SL5_W_ER	SL8_R_ER	SL7_R_ER	SL6_R_ER	SL5_R_ER	SL8_W_OK	SL7_W_OK	SL6_W_OK	SL5_W_OK	SL8_R_OK	SL7_R_OK	SL6_R_OK	SL5_R_OK	SL_BITS2	Information about communication in MODBUS MIRROR mode (1 cycle) SLx_R_OK =1 - information about reading data in block x SLx_R_ER =1 - data reading error in the x side SLx_W_OK =1 - correct saving of changes to the Slave in block x SLx_W_ER =1 - data writing error in block x
49	784	SL12_W_ER	SL11_W_ER	SL10_W_ER	SL9_W_ER	SL12_R_ER	SL11_R_ER	SL10_R_ER	SL9_R_ER	SL12_W_OK	SL11_W_OK	SL10_W_OK	SL9_W_OK	SL12_R_OK	SL11_R_OK	SL10_R_OK	SL9_R_OK	SL_BITS3	
50	800	SL16_W_ER	SL15_W_ER	SL14_W_ER	SL13_W_ER	SL16_R_ER	SL15_R_ER	SL14_R_ER	SL13_R_ER	SL16_W_OK	SL15_W_OK	SL14_W_OK	SL13_W_OK	SL16_R_OK	SL15_R_OK	SL14_R_OK	SL13_R_OK	SL_BITS4	

12.2.2. 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	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
0	0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Q2	Q1	BOUT	Qx - outputs steering bits. If set to 1 output is set high. When read show current output state.
1	16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Reserved
2	32	int32(LoHi)																CNT1	32-bit general purpose counter
3	48																		
4	64	int32(LoHi)																CNT2	32-bit general purpose counter
5	80																		
6	96	int32(LoHi)																CNT3	32-bit general purpose counter
7	112																		
8	128	int32(LoHi)																CNT4	32-bit general purpose counter
9	144																		
10	160	int32(LoHi)																CNT5	32-bit general purpose counter
11	176																		
12	192	int32(LoHi)																CNT6	32-bit general purpose counter
13	208																		

Internal registers address space (read/write), Modbus RTU functions (read - 1, 4; write - 5, 6, 15, 16)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
14	224	int32(LoHi)																CNT7	32-bit general purpose counter
15	240																		
16	256	int32(LoHi)																CNT8	32-bit general purpose counter
17	272																		
18	288	int16																SL_R0	Modbus Mirror data blocks
19	304	int16																SL_R1	
20	320	int16																SL_R2	
21	336	int16																SL_R3	
22	352	int16																SL_R4	
23	368	int16																SL_R5	
24	384	int16																SL_R6	
25	400	int16																SL_R7	
26	416	int16																SL_R8	
27	432	int16																SL_R9	
28	448	int16																SL_R10	
29	464	int16																SL_R11	
30	480	int16																SL_R12	

Internal registers address space (read/write), Modbus RTU functions (read - 1, 4; write - 5, 6, 15, 16)																			
Address		**Bits**																**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
31	496	int16																SL_R13	
32	512	int16																SL_R14	
33	528	int16																SL_R15	
34	544	P16	P15	P14	P13	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1	P_BITS	Internal algorithm bits
35	560	int16																AUX0	Internal algorithm additional registers
36	576	int16																AUX1	
37	592	int16																AUX2	
38	608	int16																AUX3	
39	624	int16																AUX4	
40	640	int16																AUX5	
41	656	int16																AUX6	
42	672	int16																AUX7	
43	688	int16																AUX8	
44	704	int16																SL2_R0	Modbus Mirror data blocks
45	720	int16																SL2_R1	
46	736	int16																SL2_R2	
47	752	int16																SL2_R3	

Internal registers address space (read/write), Modbus RTU functions (read - 1, 4; write - 5, 6, 15, 16)																		
Address		**Bits**															**Name**	**Description**
DEC	**BIT**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
48	768	int16																SL2_R4	
49	784	int16																SL2_R4	
50	800	int16																SL2_R5	
51	816	int16																SL2_R6	
52	832	int16																SL2_R7	
53	848	int16																SL2_R8	
54	864	int16																SL2_R9	
55	880	int16																SL2_R10	
56	896	int16																SL2_R11	
57	912	int16																SL2_R12	
58	928	int16																SL2_R13	
59	944	int16																SL2_R14	

12.3. BIT LIST

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

Bit name	Description
KEY_P	ACTIVATE button presses and released. Bit set for one program cycle - events only on rising edge.
FL_C	New flow value computed. Bit set for one program cycle - events only on rising edge.
AN_C	Analog inputs measurement finished. Bit set for one program cycle - events only on rising edge.
GPS_C	New data from GPS. Bit set for one program cycle - events only on rising edge.
LBAT_C	Low battery voltage alarm. Bit set for one program cycle - events only on rising edge.
DEW	Condensation alarm
TEMP_Lo	Low temperature alarm
TEMP_Hi	High temperature alarm
OPEN	Open enclosure alarm (1 - enclosure open)
VIB	Detects vibrations from external sensor connected to input I5 (1 - vibrations detected)
SL_C	Successful data reading from any Slave (Modbus Mirror)
SL_E	Error data reading from any Slave (Modbus Mirror)
I1…I5	Binary inputs I1…I5
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. Measured value lower than LoLo alarm threshold.

Bit name	Description
AN1_Lo…AN3_Lo	Analog inputs alarm bits - Lo alarm. Measured value lower than Lo alarm threshold.
AN1_Hi…AN3_Hi	Analog inputs alarm bits - Hi alarm. Measured value higher than Hi alarm threshold.
AN1_HiHi…AN3_HiHi	Analog inputs alarm bits - HiHi alarm. Measured value higher than HiHi alarm threshold.
GEOF	GPS Flag, informing about exceeding the allowable radius of the circle. Center of the circle is determined as geographical coordinates. Bit goes to 0 value when the module position will back into the circle.
GEOF_C	GPS Flag, informing about exceeding the allowable radius of the circle. Center of the circle is determined as geographical coordinates. Bit is set only for one program cycle.
MOV	GPS Flag, informing about moving detection according to Movement signaling threshold. Bit is set only on one program cycle - events only on rising edge. Bit records the coordinates of new position which will used to next move detection.
FIX	GPS Flag, The proper position is set. Bit is set only on one program cycle - events only on rising edge.
CNT1_UP…CNT8_UP	Flags of CNT counters, scrolling counter on upper limit in accordance with a predetermined limit
Q1…Q2	Binary outputs Q1…Q2
P1…P16	Internal Flags used in **µProg** feature.

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