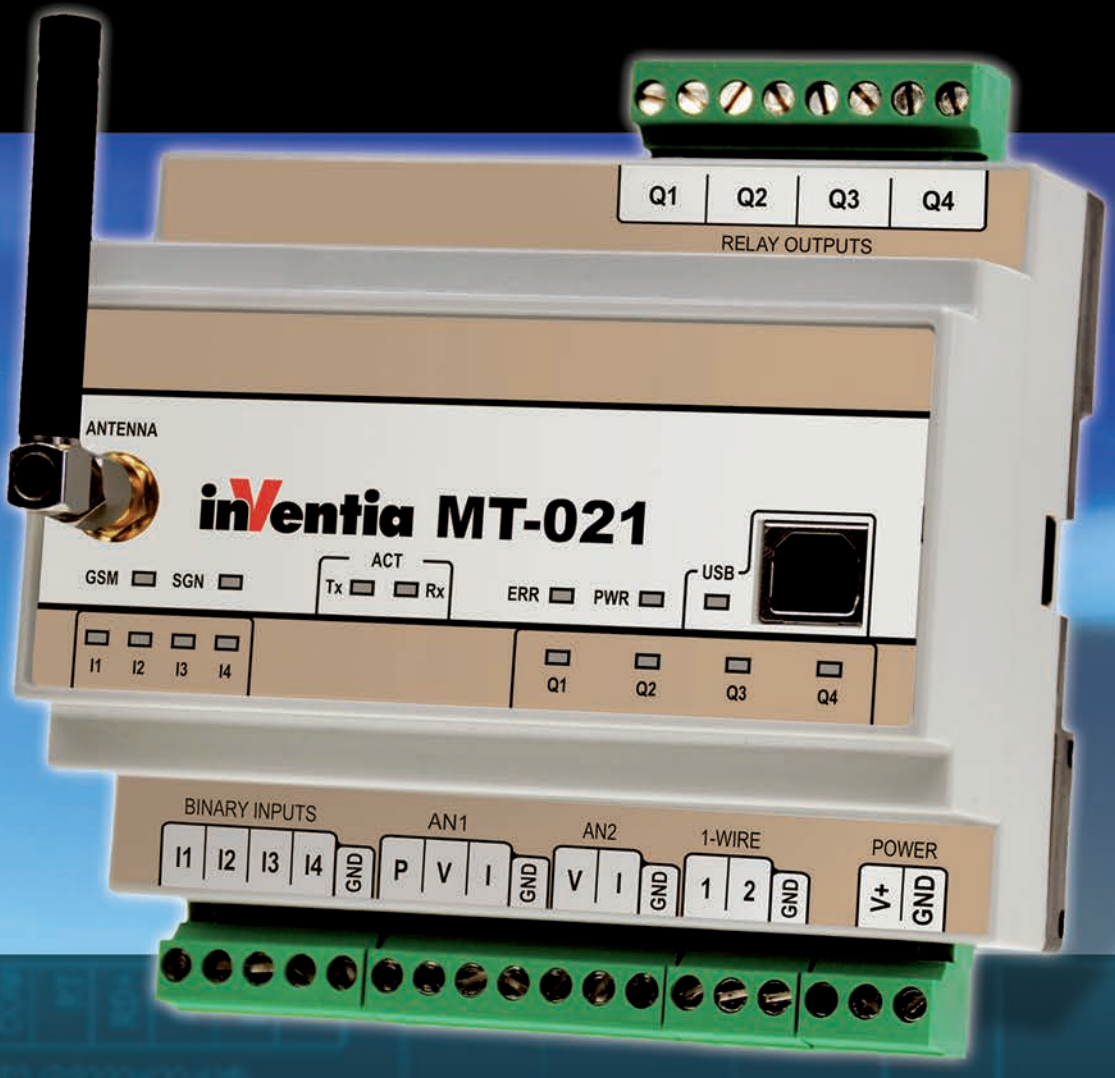
Telemetry Module MT-021

CE

User Manual



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Telemetry Module
MT-021
User Manual

GSM/GPRS Telemetry Module
for monitoring and control

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

MT-021

INVENTIA Sp. z o.o

v1.51

MT-021

Publisher:

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MTC Compatibility:

1.51

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1. Module's destination

Telemetry Module **MT-021** with built-in GSM modem is a device dedicated for remote monitoring, diagnostics and control of objects via short text messages (SMS), CLIP calls or e-mail. Configurable messages send from device with static (text) or dynamic (text and measured values) content are a convenient way of passing important information to the monitoring center, or directly to the defined phone numbers. SMS messages sending can be triggered by change of binary input state, reaching alarm thresholds, marker state change, counters and clocks. Industrial design, practical set of I/O resources, easy to use software tools as well as the ability to configure the module from remote via SMS commands are significant advantages of MT-021 in the wireless telemetry systems. Direct connection of temperature sensors lowers the cost of building system. 1-Wire inputs can be used for reading typical Dallas pellets for the purpose of identification and authentication. The module can work with humidity sensors, water level sensor, pressure transducers, flow sensors, smoke, gas, motion, shock and noise detectors, etc.

Typical applications:
• Alarm systems • Access control • Preventive diagnostic • Remote meter reading (AMR) • Remote control of various devices by CLIP call or SMS (gates, pumps, heating, lighting, etc.)

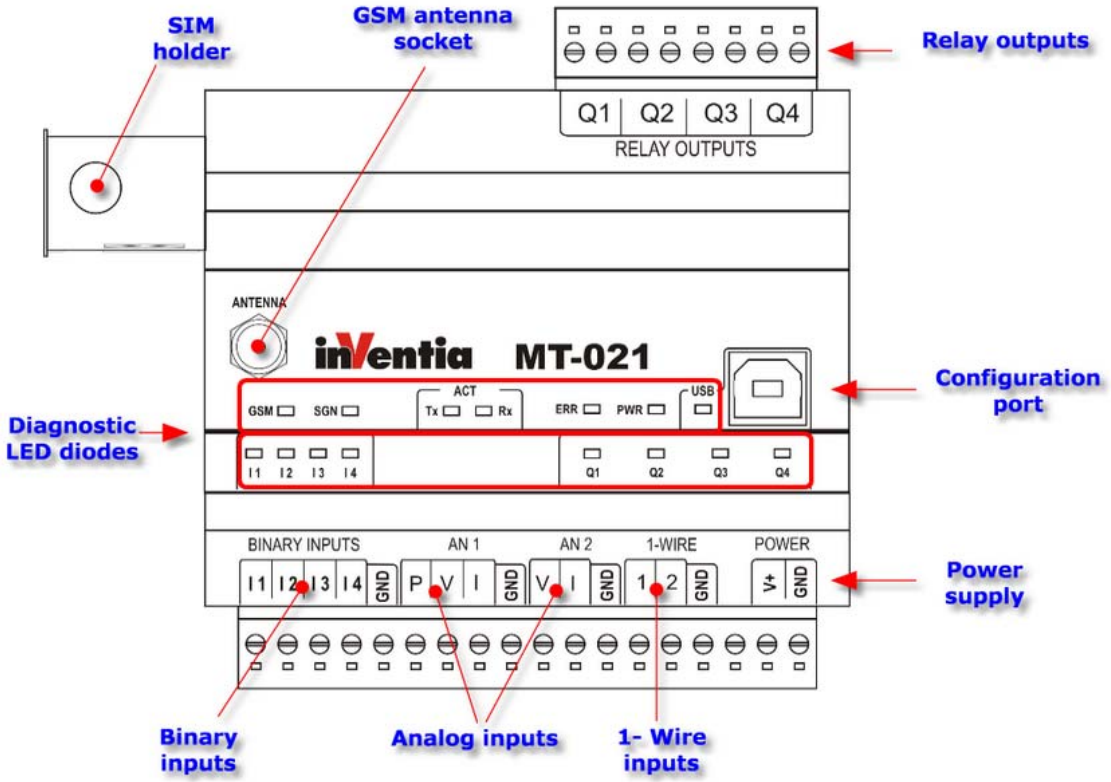
2. GSM requirements

For proper operation of the module a SIM card provided by a GSM operator with SMS/CLIP option enabled is essential. Enabled GPRS communication allows device to send e-mails.

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

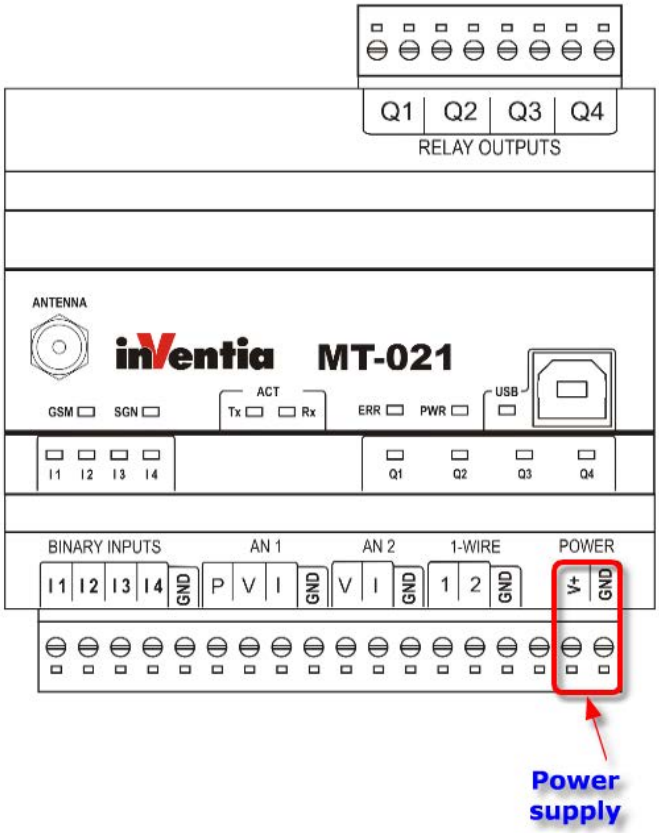
3. Module's design

3.1. Module's topography



3.2. Power supply

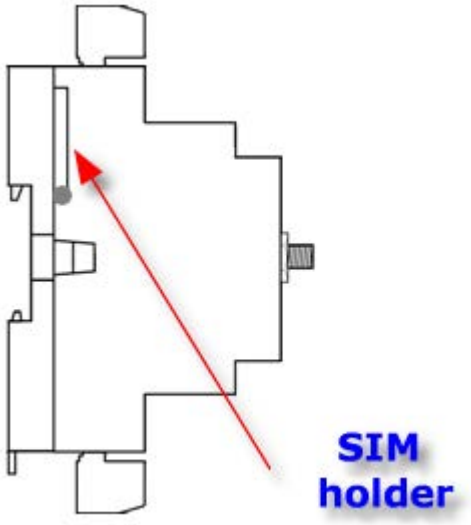
MT-021 may be powered by 9...30 V (DC).



NOTICE!
Exceeding the range of accepted power supply voltage may cause faulty operation or damage to the module!

3.3. SIM card

MT-021 telemetry module is equipped with standard miniature SIM card holder for connecting card to GSM modem.



Proper placement of the SIM card is imperative for module's operation. The module accepts only SIM cards operating in low potential technology 3,3V.

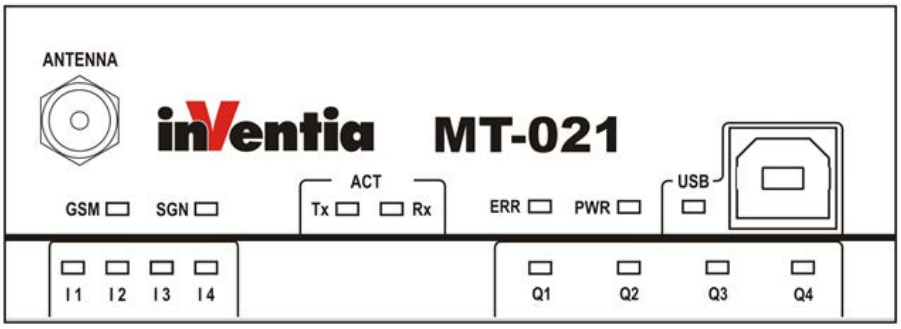
3.4. LED diodes

LED indicators placed on **MT-021** front panel are convenient during module start up phase.

The LED's have assigned following significance:

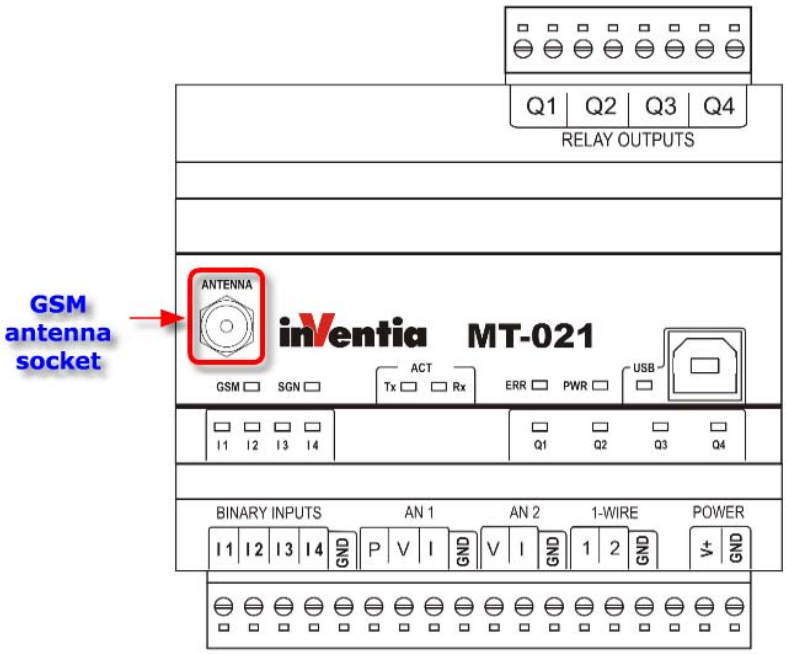
- **PWR** LED indicates module's activity,
- **I1 ... I4** LED indicates state of binary inputs,
- **Q1 ... Q4** LED indicates state of binary outputs,
- **ERR** LED indicates an error,
- **GSM** LED reflects current login to GSM network state,
- **SGN** LED reflects GSM signal strength,
- **ACT** (**Tx** i **Rx)** LEDs indicate GSM communication (TX - data transmission, RX - data reception),
- **USB** LED indicates USB port state.

Detailed description can be found in LED signaling subchapter of Problem solving chapter.



3.5. Antenna

Attachment of antenna is essential for proper operation of MT-101 telemetry module. SMA socket is placed on module's front panel. The attached antenna has to secure appropriate radio signal level enabling login to GSM network.



The type and placement of antenna has significant influence on module's sender/receiver circuits. GSM signal level is reflected by **SGN** led on module's front panel. Please use a directional antenna system when GSM signal level is not sufficient. Refer chapter Problem solving/LED signaling.

3.6. Housing

MT-021 module is encapsulated in standard housing made of plastic compliant with safety requirements and protecting the module in standard operating environment.
The applied solution complies with standard industrial requirements for DIN rail mounting.

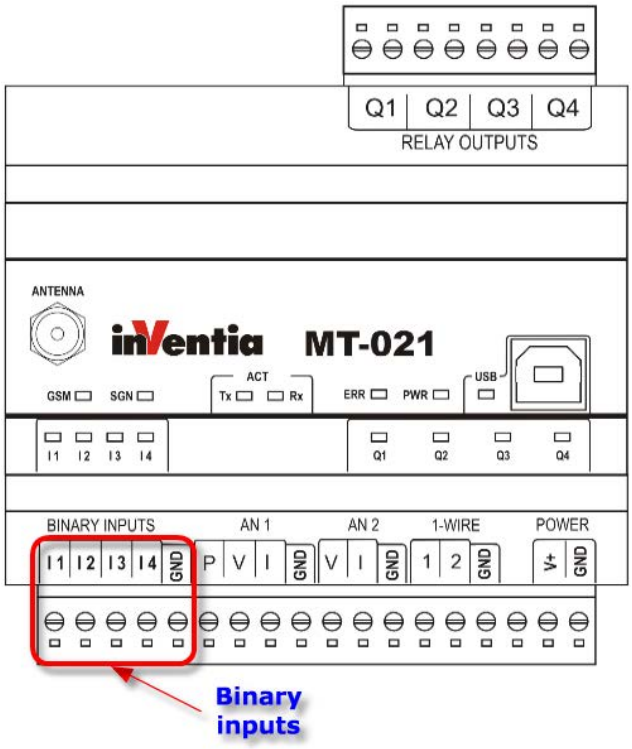
3.7. Resources

MT-021 module's resources:

I1...I4 - binary inputs	4	Optoisolated binary inputs
Q1...Q4 - Relay outputs	4	Relay outputs can operate in one of two functional modes: • monostable • bistable
CNT - Counters	0 (max. 4)	Each input can work as a counter input
AN1, AN2 - Analog inputs	2	• PT100 • NTC • 0..10V/0..5V • 4-20mA
1-Wire - Inputs	2	Standard Dallas I-Button, Temperature measurement
USB Port	1	Standard RS232 - configuration

3.7.1. Binary inputs

MT-021 module is equipped with 4 optoisolated binary inputs marked as I1...I4. They may work only in positive logic. All binary inputs have same reference - module's electrical ground - negative pole of the power supply connected to GND pin.



The change of the input signal sets the alarm flag, connected with the corresponding binary input respectively as Bi 0->1, Bi 1->0 or Bi 0->1|Bi 1->0.

Any of binary inputs I1...I4 may operate as counter input. This requires a change in the operating mode of input, which is made during its configuration. The counter can count „up" or „down", and the range can be freely defined in range of 1 to 2 147 483 647. Counting "up" means that the counter value is increased by 1 for each detected pulse and after reaching the value set as "counter length-1" is reset to "0". Counting "down" diminishes the counter value by 1 for each detected pulse and after reaching the value set as "counter length-1" is reset to "0" to resume the value of defined maximum. Crossing the value of counter length sets counter flag for respective input.

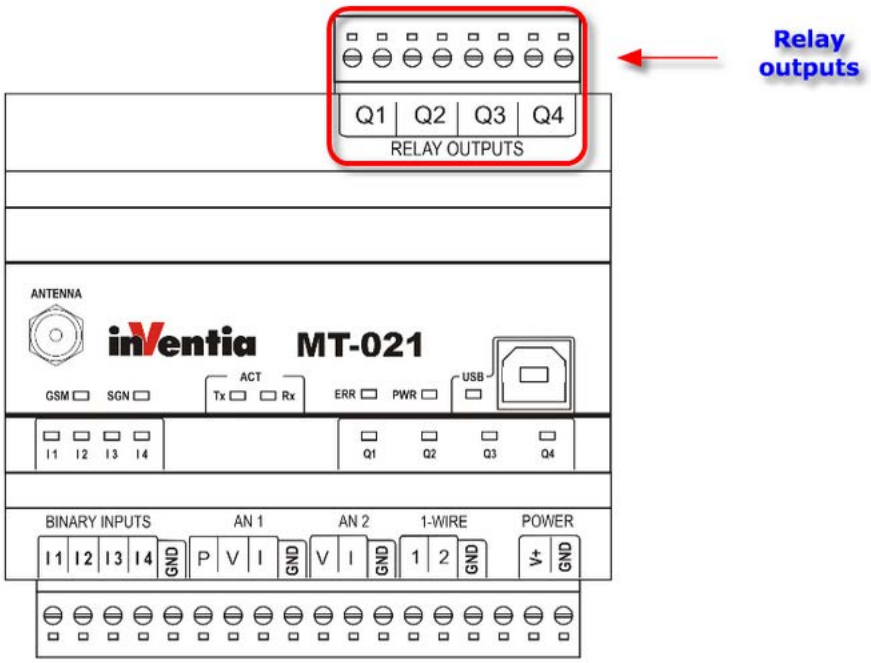
These flags may be used in events table to trigger rules.

3.7.2. Relay outputs

MT-021 telemetry module has 4 relay outputs **Q1 ... Q4**. Outputs can operate in one of two functional modes:

- monostable
- bistable

The outputs operate independently and are isolated from each other.
Outputs are control by writing value to the internal register (No. 8 - OUT_CTRL flag).
This can be made remotely via SMS or CLIP.



3.7.3. Analog inputs

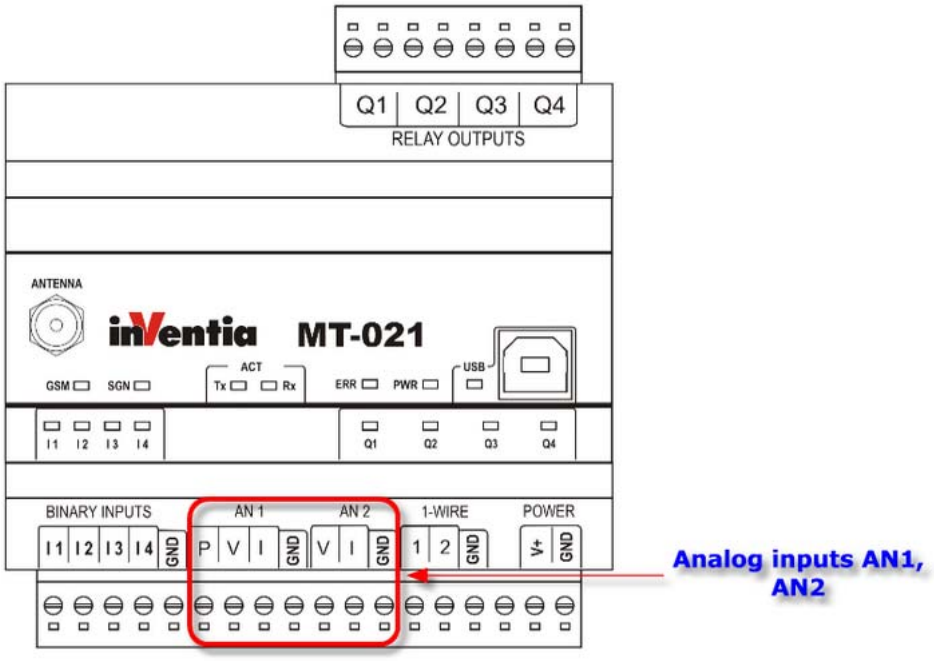
MT-021 provides two analog inputs marked as **AN1, AN2** which can operate in following modes:

AN1:

- PT100 sensor temperature readout
- voltage input - 0...5V/0...10V
- current input - 4...20mA

AN1:

- NTC sensor temperature readout
- voltage input - 0...5V/0...10V
- current input - 4...20mA



3.7.4. Real time clock (RTC)

MT-021 Module is equipped with **astronomical time clock (RTC).**

The clock is a base for defining working cycles of module, timers and time stamps for measurement results recorded in registers. Imprecise clock setting results in faulty time stamping and subsequent loss of vital information. For that reason, it is recommended to set the clock to UTC time instead of the local time zone of the module's placement.

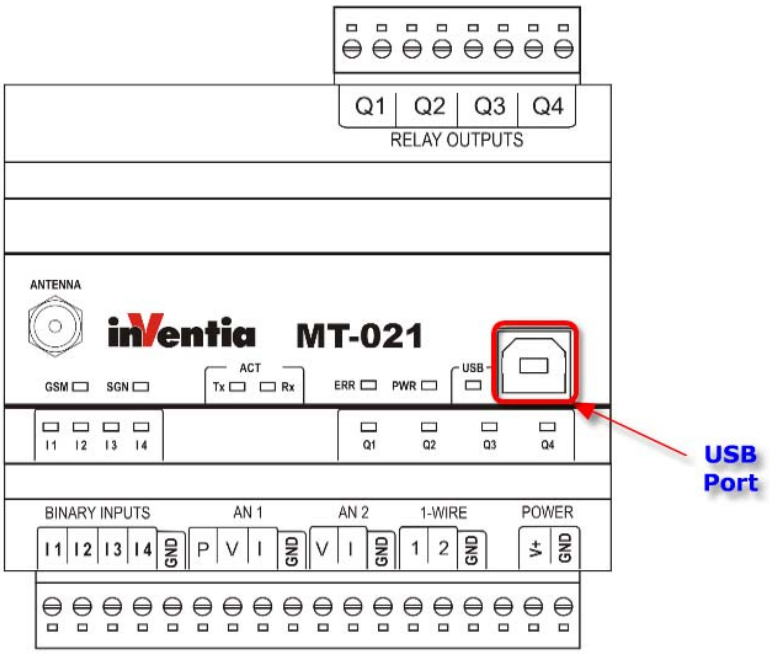
CAUTION!
The clock setting has to be repeated if the module was turned off for long time.

Setting the time is described in configuring mode documentation for the MTManager program. There is also a method for setting the RTC remotely using SMS configuration commands described in chapter Starting the module/Remote configuration via SMS.

3.7.5. USB port

MT-021 module is equipped with one USB port.

This port is intended for the local configuration of the module's parameters and readout event logger. The port should be connected to an external PC computer with the configuration program running (MTManager) or software for reading event logger (MT Log Reader).



3.7.6. Event logger

MT-021 automatically registers events like analog inputs measurement, time interval being counted by timer, GSM logon, making an outgoing call, one of analog values exceeding an alarm thresholds value, module power on and other. Logger can store up to 48000 records. This allows to reconstruct the history of module operations.

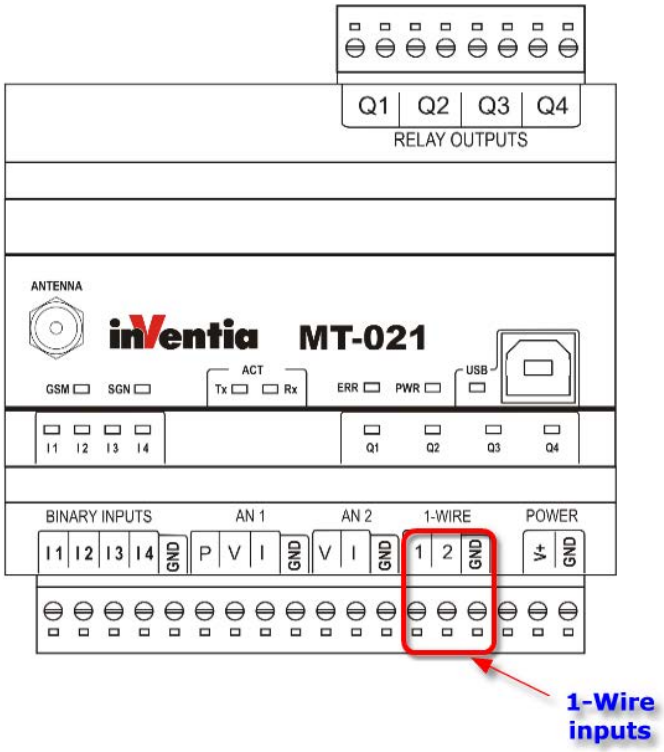
Logger records can be read via USB using MT Log Reader application.

3.7.7. Timers

MT-021 provides four synchronous timers TMR1...TMR4 that enable cyclical time measuring from 1 min to 1 month with synchronization with module z RTC clock. Timers can be used for triggering various actions like establishing clip calls, setting binary outputs and other.

3.7.8. 1-Wire inputs

Telemetry Module **MT-021** is equipped with two 1-Wire inputs for connection sensors using this interface for transmission of measured temperature value and Dallas I-button used for identification.
There is possibility of creating individual 1-Wire solutions to suit special application needs. For more information please contact your local distributor.


Q1 Q2 Q3 Q4
RELAY OUTPUTS
ANTENNA
inVentia
MT-021
GSM
SGN
ACT
Tx
Rx
ERR
PWR
USB
I1 I2 I3 I4
Q1 Q2 Q3 Q4
BINARY INPUTS
AN 1
AN 2
1-WIRE
POWER
I1 I2 I3 I4 GND
P V I GND
V I GND
1 2 GND
V+ GND
1-Wire inputs

4. Starting the module

Starting **MT-021** module requires few basic activities.

There are two methods of configuring module:

- locally - using MTManager
- remotely - via SMS

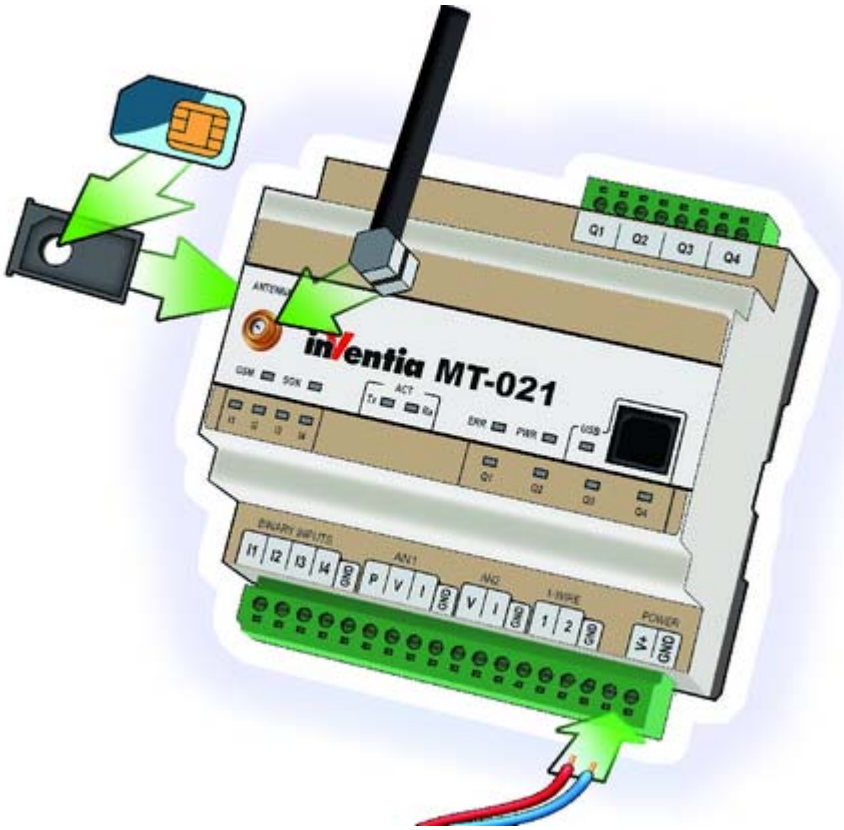
Using one method does not exclude using of the second as the can be used interchangeably.

Starting MT-021

1. Connect GSM antenna,
2. Install SIM card. If plan to make first configuration of module via SMS turn off PIN code request,

> **Notice!**
> **The details of the procedure unlock the SIM card is described in the chapter** How do I disable a SIM PIN number.

3. Connect power to module ('POWER' terminal block; 9...30 VDC).



Correct power connection is signaled by PWR LED (green light). After connecting power the module starts process of registration in the GSM network. If you use a SIM card with PIN code request option turned off, module should log on to the GSM network. Successful GSM network logon is indicated by three blinks of GSM LED and signal strength presented on SGN LEDs.

In next steps you will see how to create basic configuration, which can be described by following points:

- Entering PIN code,
- Adding telephone number to authorized phone list,
- Defining event for binary input I1 when it is changing its state from 0 to 1 (rising edge),
- Defining SMS sending rule which will send SMS that reads “ALARM” to a predefined phone number when previously configured event is triggered,
- Setting RTC clock of the device.

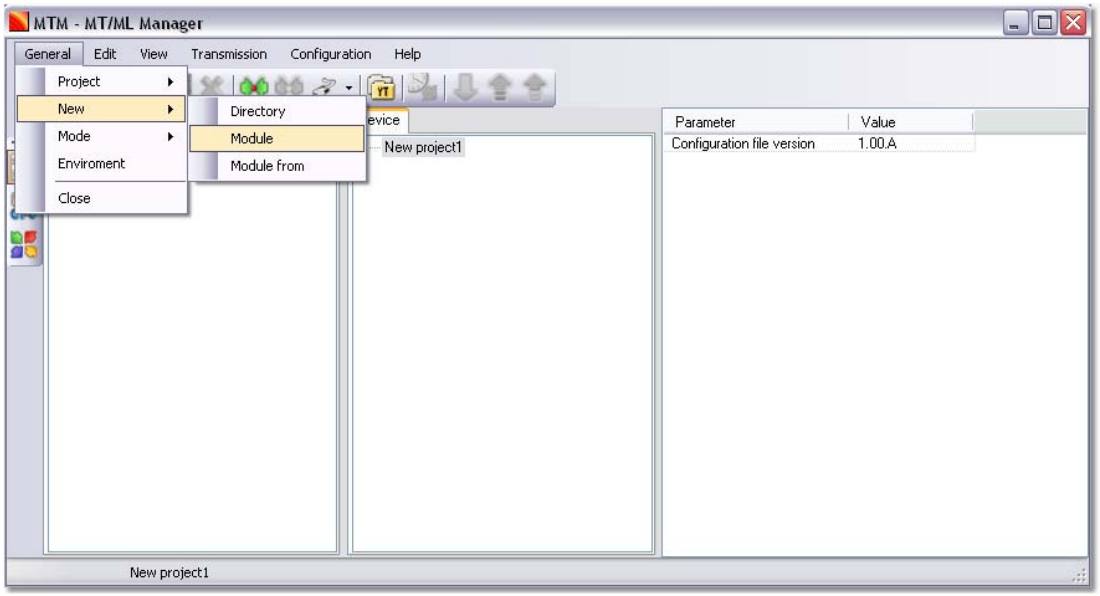
4.1. Configuring MT-021 using MTManager

Install MTManager on your PC from CD provided with module.

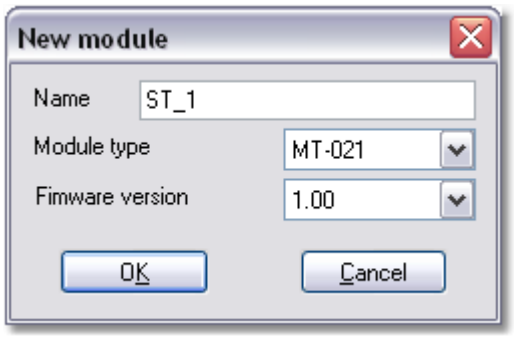
When installed with default setting MTManager creates shortcuts on Desktop and in Start menu.
Please proceed to next step.

Start MTManager by double-click on shortcut icon:

In newly created MTManager project add new module using main menu option **General->New->Module.**

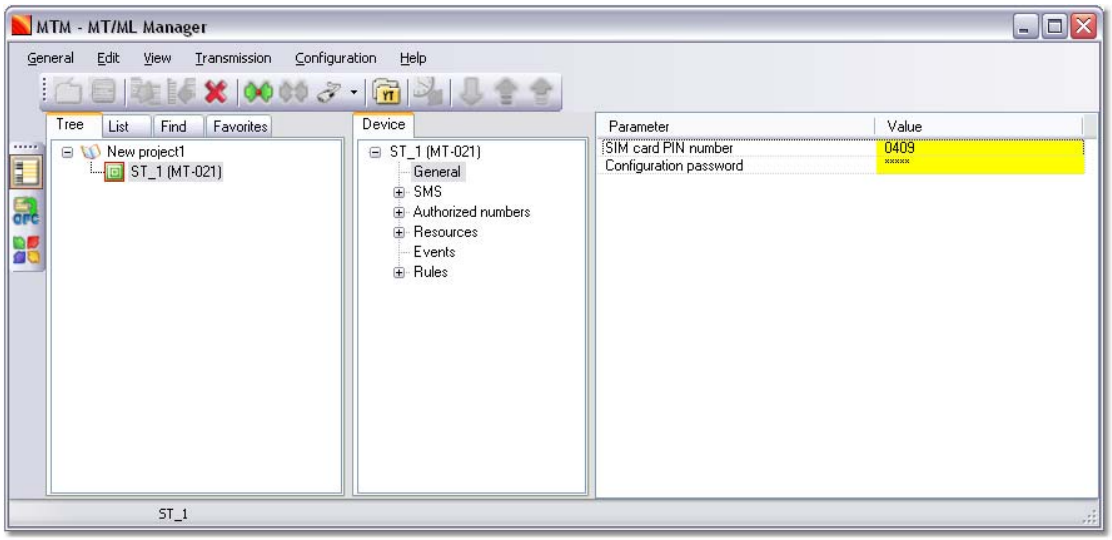


Choose **MT-021** as type, type module name (e.g. ST_1) in name field and select firmware version (firmware version is marked on the box).

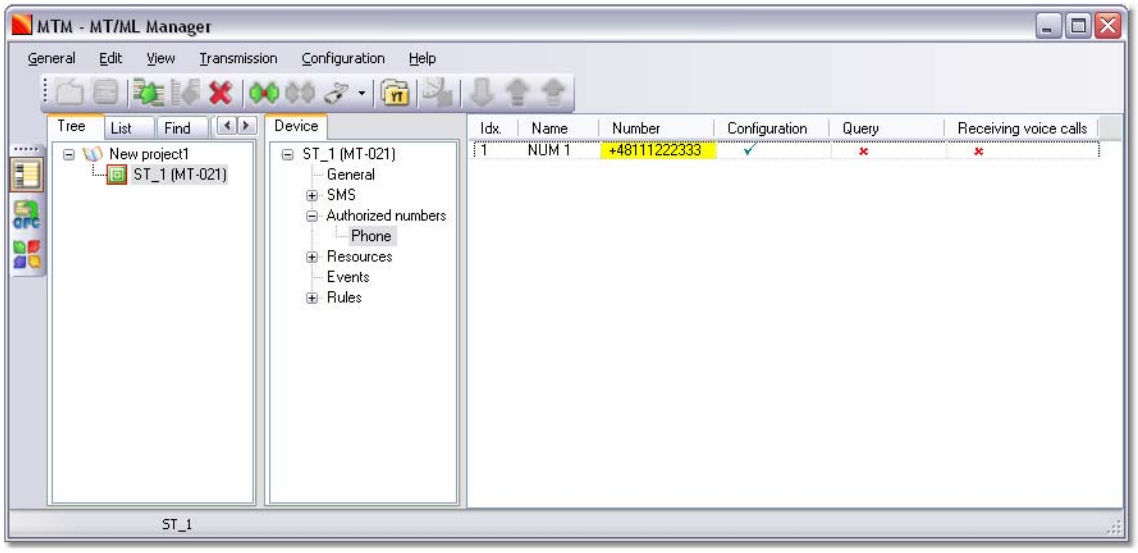


In the next step set parameters essential for establishing GSM connection:

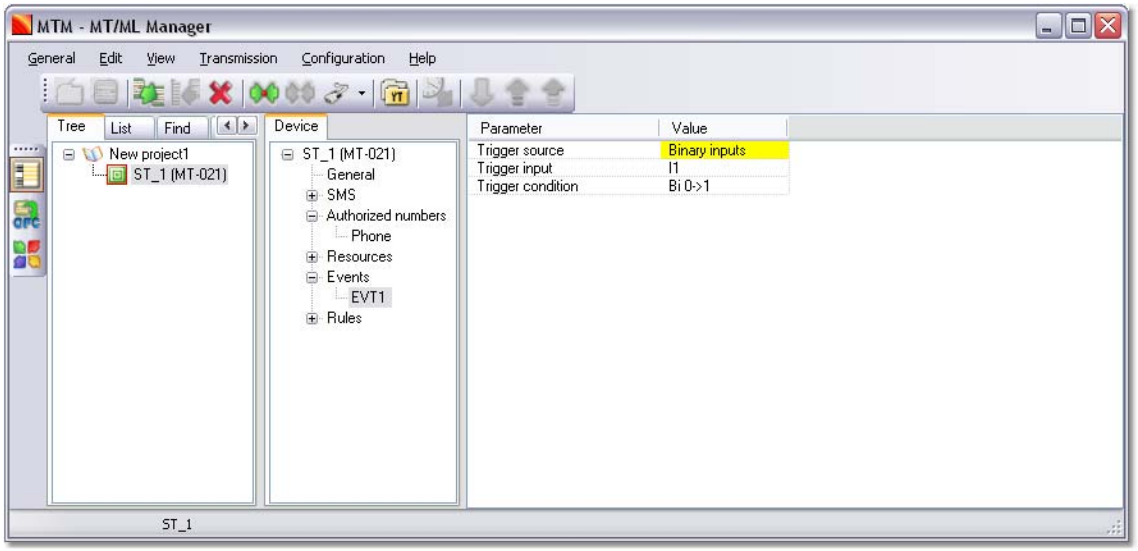
- SIM card PIN number (required if PIN code request is on
- Configuration password to protect module from unauthorized access.



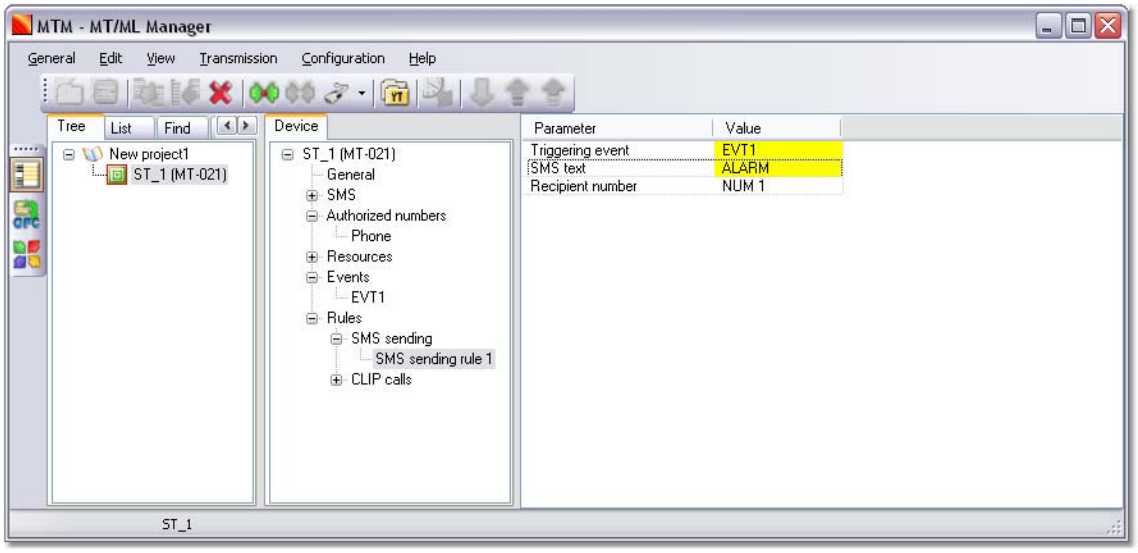
Open Authorized numbers -> Phone and add to the list new telephone number which will be receiving SMS messages from device (e.g. +48111222333).



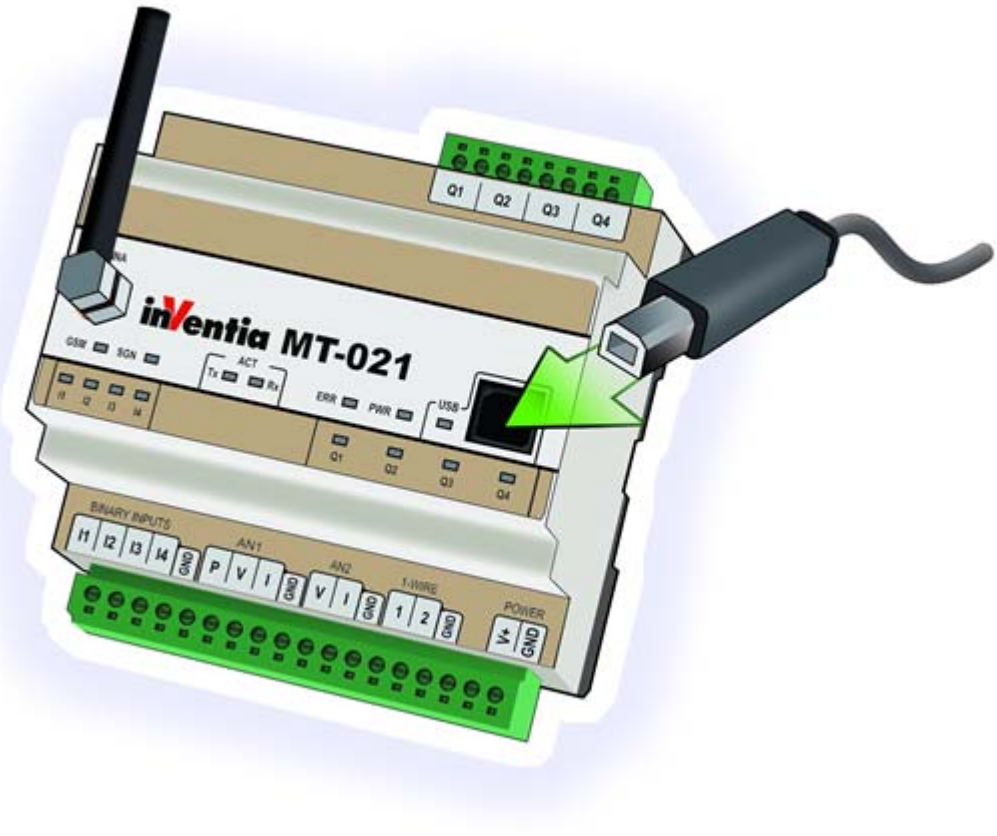
Create Event EVT1 (in this example event will be triggered by binary input I1 when changing it will change logical state 0->1).



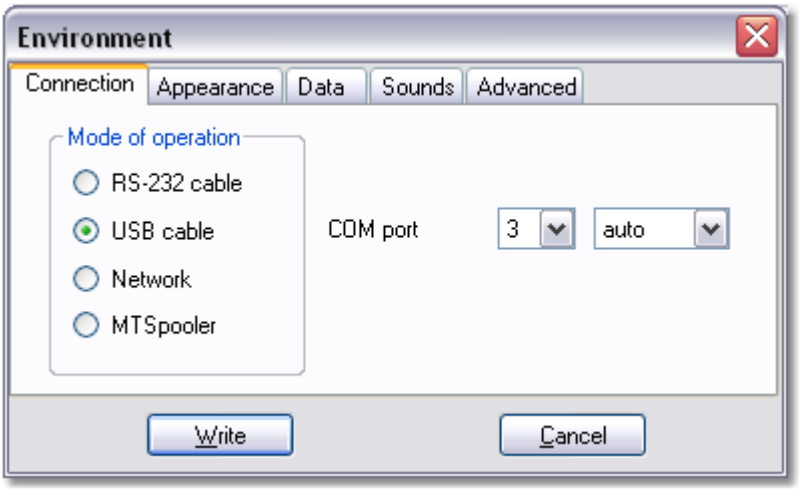
As last step of configuration please set SMS sending rule 1. Choose EVT1 as Triggering event, type *ALARM* in SMS text. NUM1 corresponds to telephone number added in previous step.



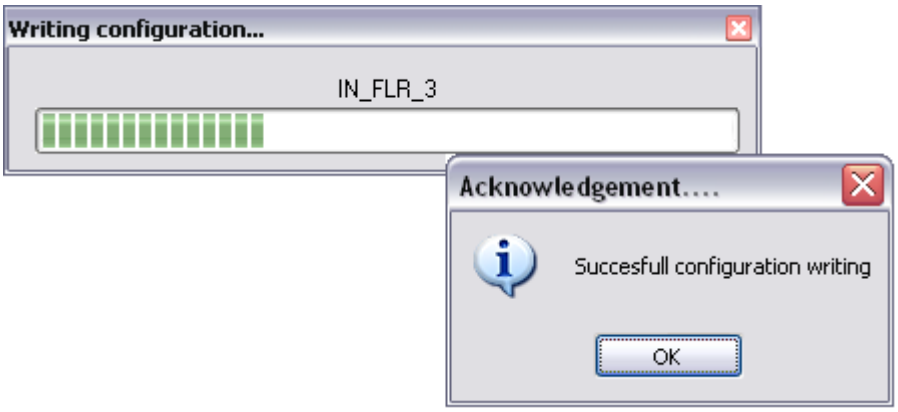
To write into module configuration prepared in previous steps connect MT-021 with PC using USB cable provided with module. Proper USB connection is signaled by USB LED. Operating system should automatically install driver for MT-021 - it will be seen in Device Manager as additional COM port called **Silicon Labs CP210x USB to UART Bridge (COMX)**, where **X** is COM port number.



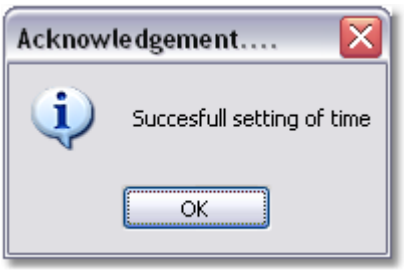
Please open **Environment** in MTManager (General->Environment), set correct COM port in **USB cable** option and press **Write** to save setting.



Next press **Connect** button (Transmission->Connect) then **Write** button (Transmission->Write).



At the end synchronize device RT using **Set time** button (Configuration->Set time).



Now setting binary input in high logical state, e.g. by connecting V+ cable with terminal I1 and power GND with binary inputs GND, will result in sending SMS that reads 'ALARM ' to +48111222333.

4.2. Remote configuration via SMS

Configuration described in chapter Configurating MT-021 using MTManager can be also written to module using SMS commands. Those commands, their default values and allowed value ranges are described in chapter Appendices/Module configuration via SMS. Below you can find sample configuration SMS:

&#SPIN="2323"#CONF_PSW="PASS"#SMSN_1="+48111222333"#EVNO=1 #EV_TRIG_1=2#EV_FLAG_1=0#EV_EDGE_1=1#TRNO=1#TR_TRIG_1=1 #TR_TCH_1=1#TR_T_1="ALARM"#TR_N_1=1

That SMS sets:
- SIM card PIN number (2323)
- Configuration password (PASS)
- First telephone on Authorized->Phone list (+48111222333)
- Event EVT1 triggered when binary input I1 changes its logical state 0->1
- SMS sending rule 1 which will send SMS saying *ALARM* to previously defined telephone number each time event EVT1 is triggered.

As an answer to this SMS module will send back the same text preceding it with '>' sign. After first configuration it is good to adjust module RTC. SMS below sets time to last second of 2010:

&PASS#CRTC="2010-12-31 23:59:59"

SMS begins new password set by previous configuration SMS preceded by '&' sign.

First configuration can be done from any phone number. Any following SMS configuration commands will be accepted only from numbers placed on Authorized list. Therefore it is vital to enter at least one phone number to that list during first configuration. Maximum length of SMS configuration command should not exceed 160 signs.

Now setting binary input in high logical state, e.g. by connecting V+ cable with terminal I1 and power GND with binary inputs GND, will result in sending SMS that reads ‘ALARM ‘ to +48111222333.

4.3. How do I disable a SIM PIN number

The procedure for setting the SIM mode to allow its use without requiring a PIN (e.g. Nokia, model 6210):

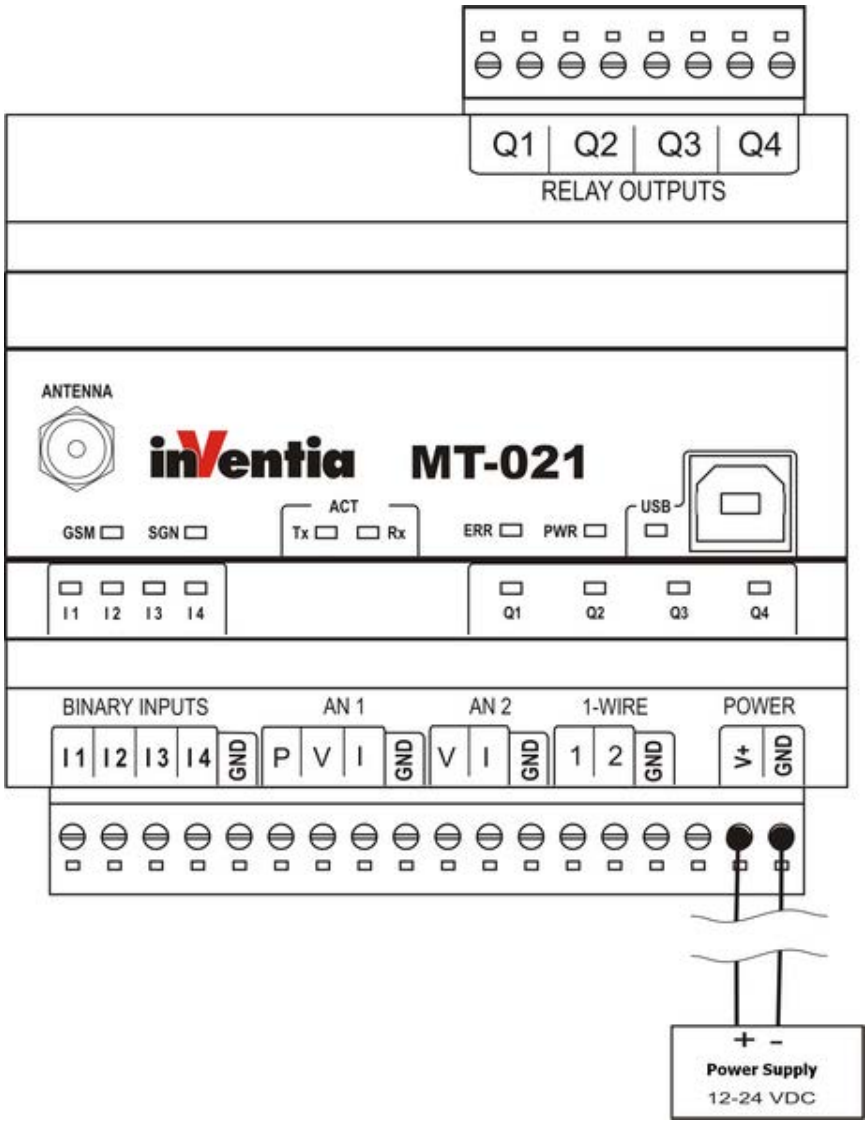
- Place the SIM card into the appropriate slot on the phone.
- Turn on the phone, and enter the correct PIN number for your SIM card.
- From the available commands, select **Menu\Settings\Security Settings.**
- Choose menu **PIN code request** then press Select, you will be prompted for a PIN number.
- Then select **OFF** response to a question **PIN code request**
- At the end appears a message **PIN code request is not active**.

5. Connections scheme

The chapter shows standard configurations securing proper operation of MT-021 module's integral inputs/outputs in all available operating modes.

5.1. Power supply

MT-021 module can be powered from **any DC power source** providing voltage within the range 9-30 VDC.



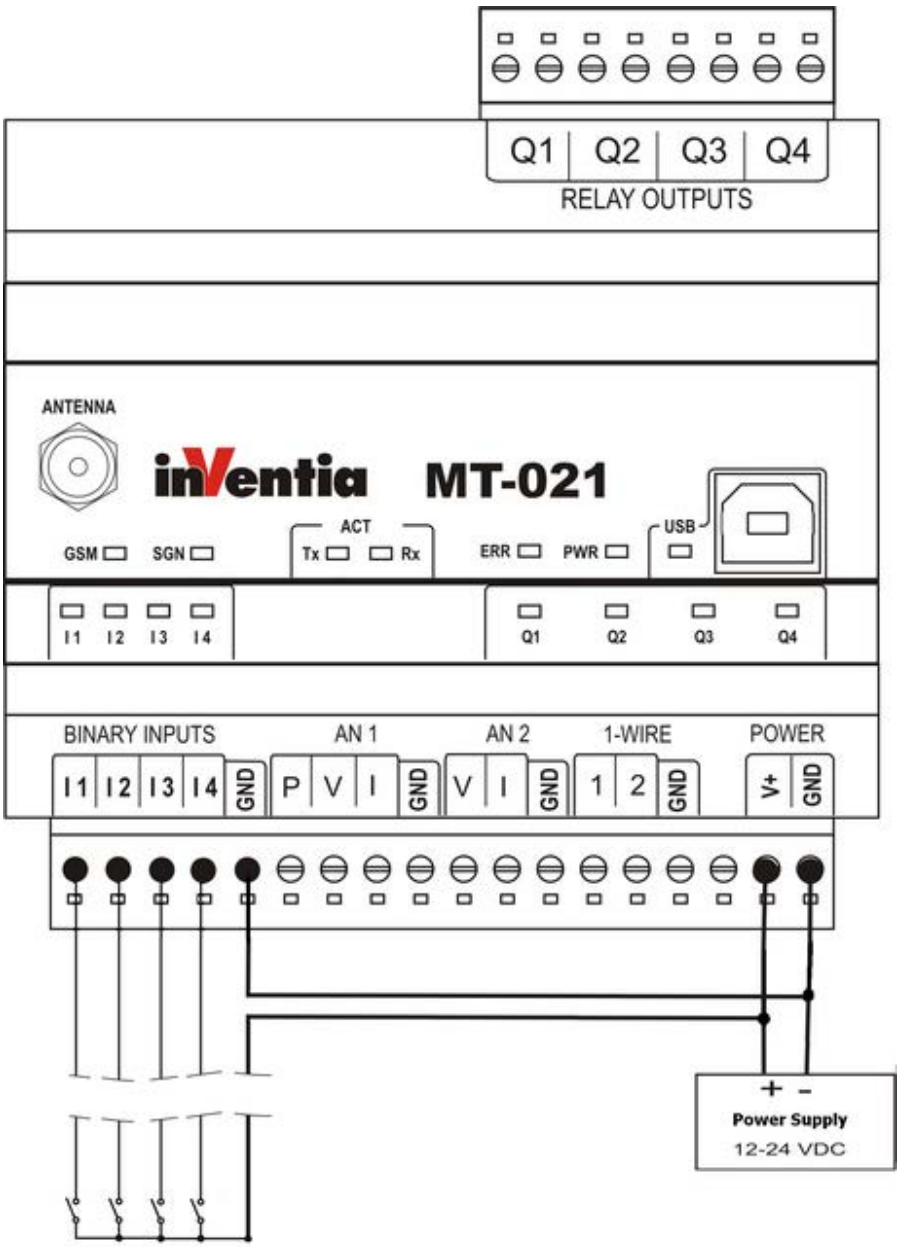
Notice!
Exceeding the range of power supply may cause faulty operation or damage the module!

Notice!
Supply cables length < 10m. Signal cables length < 30m. For longer cables it is recommended to use external overvoltage protection.

5.2. Binary inputs I1 ... I4

Internal optoisolated binary inputs marked as I1...I4 may work only in positive logic. All binary inputs have same reference - module's electrical ground - negative pole of the power supply connected to GND pin.

Connection scheme:

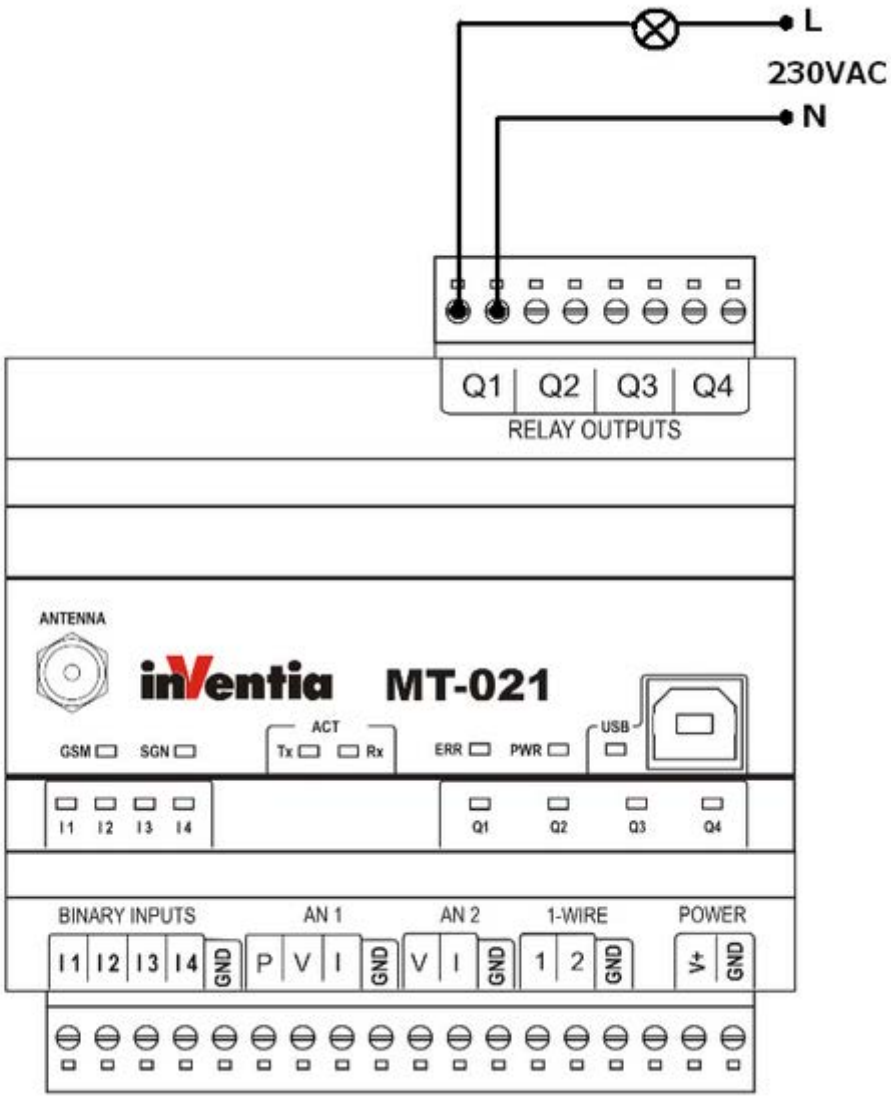


Notice!
Supply cables length < 10m.
Signal cables length < 30m.
For longer cables it is recommended to use external overvoltage protection.

5.3. Relay outputs Q1...Q4

Telemetry module has 4 normally open (NO) relay outputs marked as **Q1 ... Q4**. The outputs operate independently and are isolated from each other.

Connection scheme:

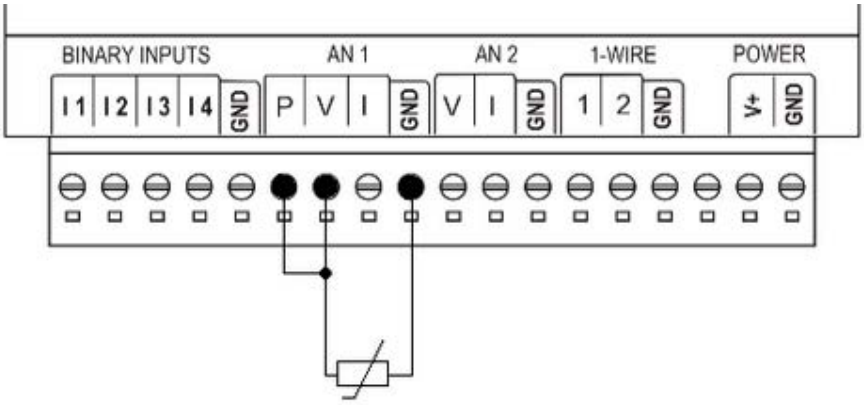


Notice!
Maximum voltage between contacts is 230V AC
Maximum switching current is 6A.

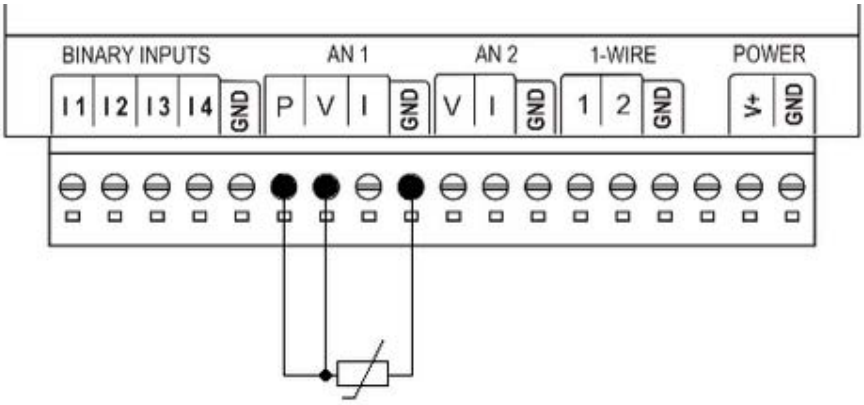
5.4. Analog inputs AN1, AN2

Analog inputs **AN1** and **AN2** can be used for measuring temperature using Pt-100 and NTC sensors or collecting measurements via current (4-20mA) or voltage signal (0-5V/0-10V). Mode of operation is user-configurable. Below are shown proper connection schematics:

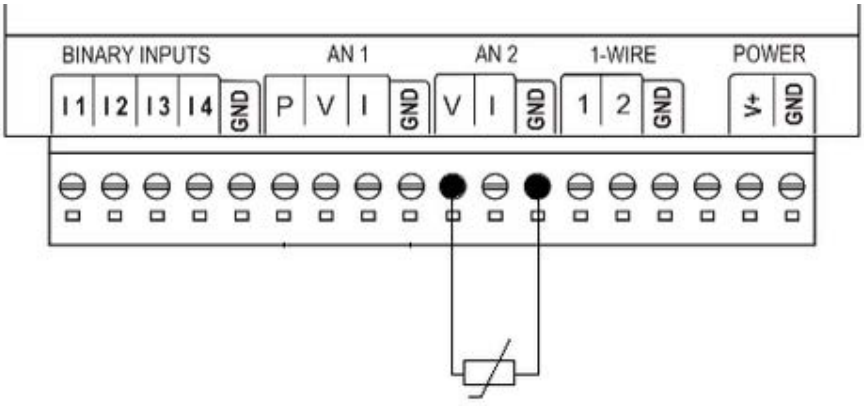
Pt-100 - 2 wire (AN1 only)



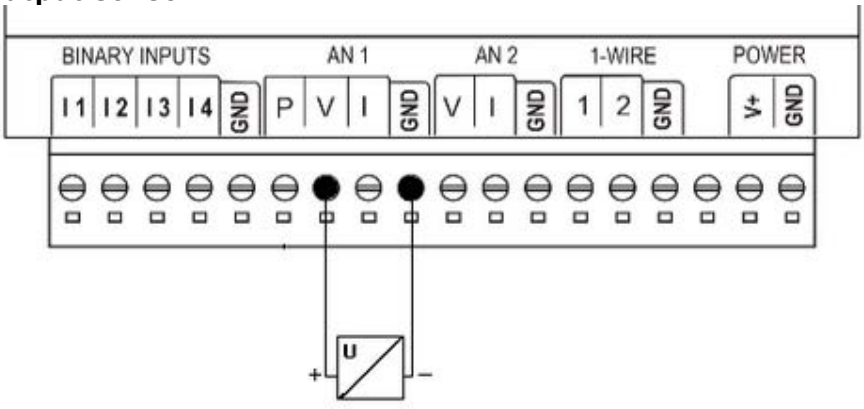
Pt-100 - 3 wire (AN1 only)



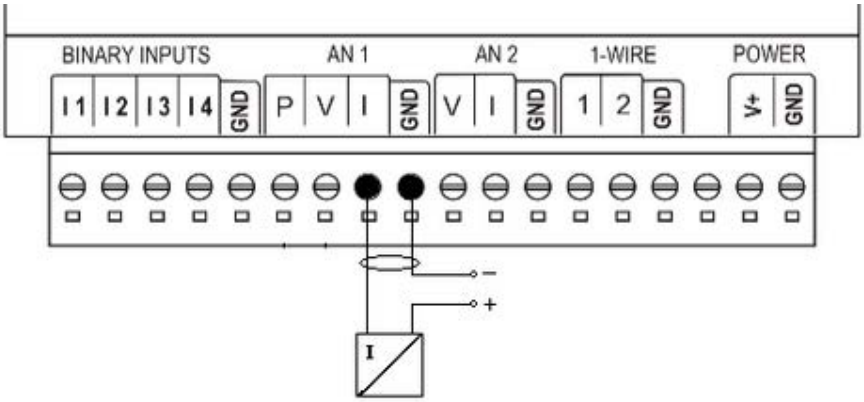
NTC (AN2 only)



Voltage output sensor



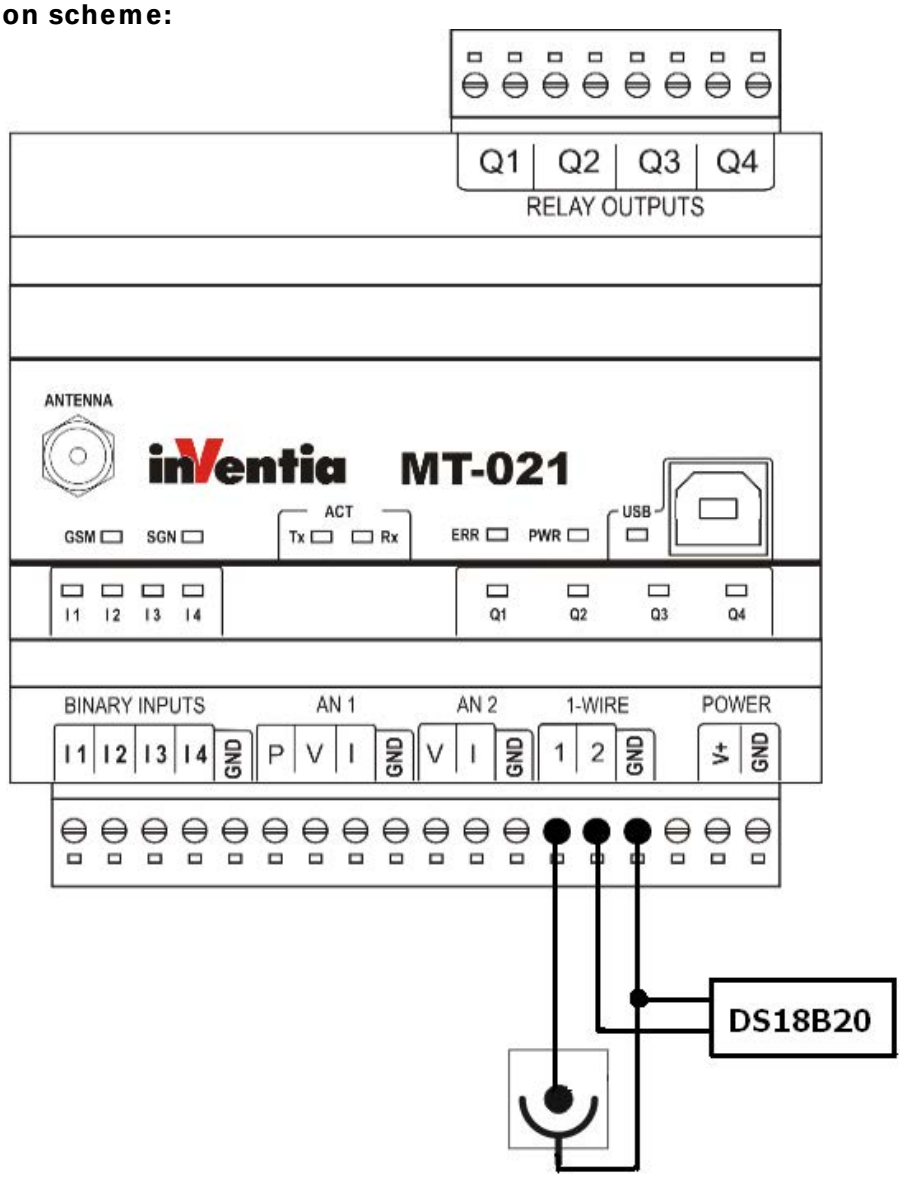
Current output sensor



5.5. 1-Wire inputs

For the **1-Wire** communication is used one line for data and GND line. The **MT-021** has two 1-Wire bus inputs marked as 1 and 2 with a common reference point (GND).

Connection scheme:



6. Configuration

6.1. General information

The configuration of **MT-021** module, as is the case for other modules in the MT series, is carried out using the MTM (MT Manager) program portal, delivered free of charge to users of our telemetry solutions.

The portal is a specialized environment providing full control of the entire telemetry system regardless of the system's size. The possibility of dividing hardware resources into Projects and Folders facilitates efficient management of very complex telemetry systems.
After adding a new module to the environment and selecting it, all module parameters are available for editing. Detailed description of functions and their applications are to be found in MTM user manual.

Each of the configuration parameters is also possible to set by SMS. SMS schemes have been presented in Chapter Appendices/Module configuration via SMS

NOTICE!
Availability of different functions and parameters depends on module's firmware version and the settings of parameters they may be dependent on.

6.2. Parameter groups

For clarity and ease of use, the operating parameters of **MT-021** module are divided into logically or functionally connected groups in the following order:

Header group - contains unmodifiable parameters describing the module, its 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 for GPRS logging

Authorized numbers group - contains lists of phone numbers of other terminals authorized for communication with configured module.

Resources group - defines parameters for hardware and software resources related to reading and processing measurement data.

Events group - contains list of defined events (e.g. binary input state change), used to trigger module's actions (e.g.: sending SMS or trigger CLIP)

Rules group - contains lists of transmission tasks to be carried out upon occurrence of activating criteria

6.2.1. Header

Header of parameter structure describes **MT-021** telemetry module. It holds basic information unique to the module, the configuration contained by module and configuration file version. Information displayed is not user editable and solely used for verification and information purpose.

6.2.1.1. Module name

Function	-	displays name assigned to module during configuration
Data type	-	text
Range	-	n/a, read-only parameter
Default value	-	New module
Comments	-	n/a

6.2.1.2. Module type

Function	-	displays the type of configured telemetry module
Data type	-	text
Range	-	n/a, read-only parameter
Default value	-	MT-021
Comments	-	n/a

6.2.1.3. Module serial number

Function	-	displays serial number configured telemetry module
Data type	-	text
Range	-	n/a, Read-only parameter
Default value	-	n/a
Comments	-	this field displays module serial number assigned during manufacturing. This number is static and unique identifier of the unit.

6.2.1.4. IMEI number

Function	-	displays GSM modem's IMEI number
Data type	-	text
Range	-	n/a, read-only parameter
Comments	-	n/a

6.2.1.5. SIM card number

Function	-	displays SIM card's serial number
Data type	-	Number
Range	-	n/a, read-only parameter
Comments	-	n/a

6.2.1.6. Modem's firmware version

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.

6.2.1.7. Firmware version

Function	-	displays the identifier of current firmware version
Data type	-	text
Range	-	n/a, read-only parameter
Default value	-	e.g. 1.00
Comments	-	the field updates automatically after downloading the firmware.

6.2.1.8. Configuration file version

Function	-	displays version identification of configuration file used for actual configuration
Data type	-	text
Range	-	n/a, Read-only parameter
Default value	-	e.g. 1.00 C
Comments	-	value depends on module's firmware version chosen during creation of module definition. Auxiliary extension character defines the sub-version

6.2.1.9. Configuration identifier

Function	-	displays identification of current configuration
Data type	-	hexadecimal
Range	-	n/a, read-only parameter
Comments	-	the value of this parameter increases automatically by 1 after each successfully stored configuration.

6.2.1.10. Last configuration date

Function	-	displays time and date of last successful configuration change
Data type	-	text
Range	-	n/a, read-only parameter
Comments	-	the value changes automatically with successful configuration change. Useful in tracing unauthorized configuration changes.

6.2.1.11. Last reading time

Function	-	displays internal module time recorded during last configuration reading or during last time setting
Data type	-	text
Range	-	compliant with Date and Time format
Comments	-	this field is useful in verifying last access time and checking internal module clock settings (RTC)

6.2.2. General

General group encompasses parameters vital for whole module.
Contains data necessary for successful login to GSM network and password-protection module configuration.
Note: values set here have impact on module's behavior and in worst case, when chosen improperly may even lock the module.

6.2.2.1. SIM card PIN number

Function	-	defines PIN access code for SIM module delivered by GSM operator. For SIM modules not protected by PIN code, the value is insignificant.
Data type	-	Number
Range	-	numerals, from 4 to 8 characters
Default value	-	empty
Comments	-	wrong pin can cause locking of SIM module

CAUTION!
Caution is vital when setting the PIN code value. Entering faulty PIN code may cause module start-up to be impossible and lock SIM card. In latest versions of the module, attempting to enter wrong PIN code twice renders a third attempt impossible.

Procedure in case of blocked module as the result of the wrong PIN value

6.2.2.2. Configuration password

Function	-	defines the password protecting access to configuration of the module. The password will be required for both local and remote access, thus protecting against unauthorized configuration alterations. The password does not protect against reading current configuration or the module status.
Data type	-	text string
Range	-	letters and numerals, max. 32 characters
Default value	-	n/a
Comments	-	since the only way of unlocking the module is resetting it to factory settings, it is vital that the password is stored in a safe way and available when needed.

6.2.2.3. Use of GPRS

Function	-	enables GPRS usage required for e-mail sending.
Data type	-	Selection list
Range	-	*No* GPRS is disabled. *Yes* GPRS is enabled.
Default value	-	*No*
Comments	-	When GPRS is enabled new group of parameters called GPRS is visible.

6.2.3. SMS

Group **SMS** contains parameters related to sending and receiving of text messages by **MT-021** module.

6.2.3.1. Daily SMS limit

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…65 535*
Default value	-	*0 = unlimited*
Comments	-	N/A

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

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

6.2.3.2. Roaming for SMS

Function	-	Decides whether the module may send SMS when roaming in foreign network.
Data type	-	Selection list
Range	-	*No* When roaming in foreign GSM network no SMS are sent. *Answer* The module can only respond to queries from authorized numbers

Yes
All SMS messages are sent regardless of the GSM roaming

Default value - *Answer*

Comments - In order to be able to sent SMS in roaming the SIM card in the module has to have roaming option active.

6.2.3.3. Number of SMS sending retries

Function - Defines max number of retries of failed SMS transmission

Data type - Number

Range - *0...255*

Default value - *10*

Comments - After reaching the defined value the SMS is deleted from sending queue.

6.2.3.4. Answer for blank SMS

Function - defines the text of reply for empty SMS to the sender.

Data type - Text

Range - max. 160 characters

Default value - *M0

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.

6.2.3.5. SMS limit exceed information text

Function - Decides whether the module may send alert that SMS limit was exceeded.

Data type - Selection list

Range - *On*
module send SMS limit alert to defined phone number of info recipient
Off
disabled sending SMS limit alert

Default value - *Off*

Comments - This information is sent beyond standard messages queue and only **once a day**. This message does not increment sent messages counter.

6.2.3.5.1. Phone number of info recipient

Function - Selects the SMS limit alert recipient

Data type - Selection list

Range - Authorized numbers list

Default value - *NUM 1*

Comments	-	The recipient must be previously defined in Authorized numbers -> Phone.

6.2.3.5.2. SMS limit exceed information

Function	-	Contains the text of the SMS message sent upon reaching Daily SMS limit.
Data type	-	Text
Range	-	max 160 characters
Default value	-	empty
Comments	-	This information is sent beyond standard messages queue and only **once a day**. This message does not increment sent messages counter.

6.2.3.6. Formats

Group **Formats** contains parameters allowing user to define formats of date and time presented in SMS messages.

6.2.3.6.1. Date format

Function	-	Defines date format used by #date predefined symbolic name and by *ld* and *ud* macro prefixes
Data type	-	Text
Range	-	0...31 signs
Default value	-	*YYYY-DD-MM*
Comments	-	In the text user can put any sign combination but predefined with special meaning listed below: YYYY - if placed in this format text automatically changed for year in four digit notation (e.g. 2011), YY - if placed in this format text automatically changed for year in two digit notation (e.g. 11), MM - if placed in this format text automatically changed for month (e.g. 01 for January), DD - if placed in this format text automatically changed for day of month (e.g. 31). Example: Parameter is set to: *Date of measurement: YYYY-MM-DD* Macro result is (providing today is 31st of January 2011): *Date of measurement: 2011-01-31*

6.2.3.6.2. Time format

Function	-	Defines date format used by *#time* predefined symbolic name and by *lt* and *ut* macro prefixes
Data type	-	Text
Range	-	0...31 signs
Default value	-	*HH:MN:SS*
Comments	-	In the text user can put any sign combination but predefined with special meaning listed below:

HH - if placed in this format text automatically changed for current hour in 24h format (e.g. 01),
MN - if placed in this format text automatically changed for current minutes (e.g. 01),
SS - if placed in this format text automatically changed for current seconds (e.g. 59).

Example:
Parameter is set to:
Time of measurement: HH:MN:SS
Macro result is (providing the time is 01:01:59):
Time of measurement: 01:01:59

6.2.3.6.3. General format 1

Function	-	Defines date format used by *#RTC* predefined symbolic name and by *T1* macro prefix
Data type	-	Text
Range	-	0...31 signs
Default value	-	*YYYY/MM/DD, HH:MN:SS*
Comments	-	In the text user can use symbols available for parameters Date format i Time format.

6.2.3.6.4. General format 2

Function	-	Defines date format used by *T2* macro prefix
Data type	-	Text
Range	-	0...31 signs
Default value	-	*YYYY/MM/DD, HH:MN:SS*
Comments	-	In the text user can use symbols available for parameters Date format i Time format.

6.2.3.7. Symbolic names

Symbolic names group contains names assigned by the user referring to the internal and input registers. There can be defined up to 16 symbolic names.
In order to use a symbolic name in SMS put it name preceded by '#' sign in SMS text send from mobile phone or defined in *Rules/SMS sending* or as a component of user-defined macros. Using symbolic names makes composing SMS text much more convenient and user friendly.

6.2.3.7.1. Number of symbolic names

Function	-	declares number of user defined symbolic names.
Data type	-	number
Range	-	1..16
Default value	-	1
Comments	-	N/A

6.2.3.7.2. Symbolic name

Function	-	Defines user friendly name
Data type	-	Text
Range	-	0..50 characters
Default value	-	*IREG0...IREG15*
Comments	-	N/A

6.2.3.7.3. Space

Function	-	Selection of register address space assigned to symbolic name.
Data type	-	selection list
Range	-	*HReg* Internal registers address space (registers readout) *IReg* Analog input address space (registers readout) *HB* Internal register address space (bits readout) *IB* Analog register address space (bits readout)
Default value	-	IReg
Comments	-	N/A

6.2.3.7.4. Register/bit number

Function	-	This parameter, together with the parameter Space defines the register address or bit assigned to symbolic name.
Data type	-	number
Range	-	0...65535
Default value	-	0...15
Comments	-	N/A

6.2.3.8. Macros

Macros group contains up to 16 use-defined macros. Macro may contain ASCII signs, symbolic names, SMS commands and other macros that will be put in SMS text.
In order to use a symbolic name in SMS put it name preceded by '*' sign in SMS text send from mobile phone or defined in *Rules/SMS sending* or other macro.
Using macros makes composing complex SMS texts and queries much more convenient and user friendly.

6.2.3.8.1. Number of macros

Function	-	declares number of user defined macros.
Data type	-	number
Range	-	1..16

Default value	-	1
Comments	-	N/A

6.2.3.8.2. Macro name

Function	-	Defines macro's user friendly name
Data type	-	Text
Range	-	0..20 characters
Default value	-	*M0*
Comments	-	N/A

6.2.3.8.3. Macro's content

Function	-	The content that is inserted into the SMS message, instead of macro name.
Data type	-	text
Range	-	0..160 characters
Default value	-	#lt.ir0 #ld.ir0
Comments	-	N/A

6.2.4. GPRS

GPRS group contains parameters related to GPRS transmission an logging.

6.2.4.1. APN name

Function	-	defines APN name selected for GPRS transmission
Data type	-	text
Range	-	letters, numerals, special characters - max. 63 characters
Default value	-	empty
Comments	-	absence of APN name disables login to GPRS network

6.2.4.2. APN user name

Function	-	defines APN user name
Data type	-	text
Range	-	letters, numerals, special characters - max. 31 characters
Default value	-	empty
Comments	-	Optional parameter used only if required by GSM network operator

6.2.4.3. APN password

Function	-	defines password for APN user account
Data type	-	text
Range	-	letters, numerals, special characters - max. 31 characters

Default value - empty
Comments - Optional parameter used only if required by GSM network operator

6.2.4.4. Module IP

Function - allows user to define IP number for newly created module definition and displays IP number read from the module configuration that was assigned to the module during last login to GPRS network
Data type - IP number field
Range - 0.0.0.0 - 255.255.255.255
Default value - 0.0.0.0
Comments - If after reading the configuration or setting device time this parameter value is different from 0.0.0.0, it means that module is logged into GPRS network with this particular IP address assigned to it.

6.2.4.5. GPRS login retry interval [s]

Function - Defines interval (in seconds) between retries of GPRS logon attempts after GPRS login failure.
Data type - number
Range - 10...3600 [s]
Default value - 10 [s]
Comments -

6.2.4.6. GPRS testing address (ping)

Function - sets IP address which is used to test GPRS network connection in case it is lost
Data type - IP address field
Range - 0.0.0.0 - 255.255.255.255
Default value - 0.0.0.0
Comments - This parameter sets recipient address for ping data frames testing GPRS transmission channel.
Leaving recipient address at *0.0.0.0* turns off GPRS testing functionality which is not advised.

6.2.4.7. Idle time [s]

Function - Defines interval (in seconds) for sending data frame (ping) testing GPRS network in case it is lost
Data type - number
Range - 0...21600 [s] (6h)
Default value - 0 [s]
Comments - in case of inactivity longer than the value defined in this parameter the module sends a control frame in order to check

whether transmission is still possible. The frame is sent to the address specified by parameter GPRS testing IP address, if different than 0.0.0.0.
Lack of reply to sent ping frame after exercising defined timeout and number of retries is considered as GPRS connection loss and resets modem.

6.2.5. Authorized numbers

Group **Authorized numbers** comprises lists of phone numbers the module is going to communicate with.

6.2.5.1. Number of phone numbers

Function	-	Defines the length of phone numbers list authorized to exchange SMS messages.
Data type	-	Number
Range	-	*1...32*
Default value	-	*1*
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. Read more in Syntax for reading and writing data in SMS mode chapter of Appendices.

6.2.5.2. Update phone numbers from SIM card

Function	-	Enables synchronization of Authorized numbers\Phone list with phone book saved on Defines the length of phone numbers list authorized to exchange SMS messages.
Data type	-	selection list
Range	-	*Yes* synchronization is on *No* synchronization is off
Default value	-	*No*
Comments	-	Synchronization is done after every reboot of the module, after inserting the SIM card or when configuration is written to the module. The module browses SIM card phone book and if it finds entries of the same name as defined in the Authorized numbers\Phone it overrides the numbers from configuration with the numbers from the SIM card. Those numbers are remembered till module restart.

6.2.5.3. Phone number from SIM card always authorized

Function	-	Enables receiving voice calls authorization for all phone numbers stored in SIM card phone book.

Data type - selection list

Range - *Yes*
authorization is on
No
authorization is off

Default value - *No*

Comments - If set to *Yes*, all mobile phones stored on SIM card are treated as if they were placed on Authorized numbers\Phone list with tick next to *Receiving voice calls* option.
The name assigned to him on the SIM card cannot be empty. Phone book entries with empty name won't be analysed.

6.2.5.4. Phone

lp. - Index number

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

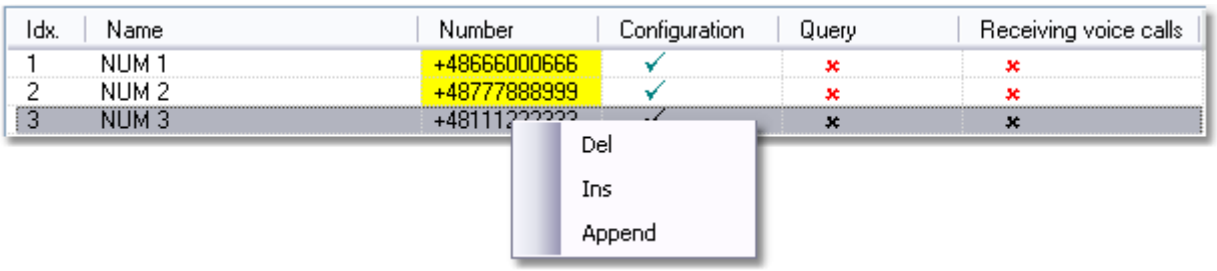
Number - Phone number assigned to list index. Max. 14 characters

Configuration - Depending on configuration settings incoming configuration SMS will be processed or ignored.
Default value: ✓ (Allowed)

Query - The module receives and analyzes SMS query messages depending on selected setting. When Query is not allowed, all SMS query messages from that phone number will be ignored
Default value: ✗ (not allowed)

Receiving voice calls - The module receives calls and can use these signals for trigger event depending on selected setting. When Receiving is not allowed, all calls from that phone number will be ignored
Default value: ✗ (not allowed)

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



6.2.6. Resources

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

6.2.6.1. Terminals

Sub-group **Terminals** gathers all inputs and outputs. Depending on type of accepted input, they are binary and analogue. Final functionality of each input depends on settings and configuration parameters connected.

6.2.6.1.1. Inputs I1 ... I4

Module **MT-021** has four identical binary inputs. Inputs can operate in one of two functional modes:
- standard binary input
- counter input

Each mode has a set of specific configuration parameters.

6.2.6.1.1.1. Name

Function	-	Defines input's user friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 16 characters
Default value	-	Respective *I1*, *I2*, *I3*, *I4*
Comments	-	Assigning friendly names facilitates discrimination of inputs destination and required settings.

6.2.6.1.1.2. Input type

Function	-	Defines binary input's operating mode.
Data type	-	Selection list
Range	-	*Binary input* Operates as binary input *Counter input* Operates as counter input
Default value	-	*Binary input*
Comments	-	According to selected mode MTManager displays additional configuration parameters for each input

6.2.6.1.1.2.1. Counter input

6.2.6.1.1.2.1.1. Counting direction

Function	-	defines counting direction
Data type	-	selection list
Range	-	*Up* A pulse on input increases value of counter register *Down* A pulse on input decreases value of counter register
Default value	-	*Up*
Comments	-	N/A

6.2.6.1.1.2.1.2. Counting range (32bits)

Function	-	defines max. value assumed by the counter
Data type	-	number
Range	-	0....2 147 483 647
Default value	-	0
Comments	-	N/A

6.2.6.1.1.2.1.3. Triggering slope

Function	-	selects counting direction
Data type	-	selection list
Range	-	*Bi 0->1* The change of counter state occurs upon signal change from 0 > 1 *Bi 1->0* The change of counter state occurs upon signal change from 1 > 0 *Bi 0->1 | 1->0* The change of counter state occurs upon any change of signal
Default value	-	*Bi 0->1*
Comments	-	N/A

6.2.6.1.1.3. Filtering constant [s]

Function	-	Defines (in seconds) value of minimum duration of altered state on input in order to consider state to be stable.
Data type	-	number
Range	-	0....163,83 [s]
Default value	-	0,10 [s]
Comments	-	Setting value appropriate to contact characteristics eliminates disturbance caused by contact bounce thus preventing multiple registration of what is in reality one pulse.

6.2.6.1.2. Outputs Q1 ... Q4

The **MT-021** module is equipped in four relay outputs Q1...Q4. Outputs can operate in one of two functional modes:

- monostable
- bistable

Each mode has a set of specific configuration parameters.

6.2.6.1.2.1. Name

Function	-	Defines output's user friendly name
Data type	-	Text
Range	-	Letters and numerals, max 16 characters
Default value	-	Respectively (*Q1…Q4*)
Comments	-	Assigning friendly names facilitates discrimination of outputs destination and required settings.

6.2.6.1.2.2. Output mode

Function	-	selection of binary output mode
Data type	-	selection list
Range	-	*Monostable* binary output is set for time given by Pulse duration parameter *Bistable* state of output is defined by user
Default value	-	*Monostable*
Comments	-	N/A

6.2.6.1.2.3. Pulse duration [s]

Function	-	defines length (in seconds) of impulse on binary output in monostable output mode
Data type	-	number
Range	-	0.1 ... 214748364.7
Default value	-	0.1
Comments	-	N/A

6.2.6.1.2.4. On event

Function	-	Allows selection of predefined event from the event list, which is to be used to turn on output.
Data type	-	selection list
Range	-	*None* or names of event from the Events table
Default value	-	*None*
Comments	-	N/A

6.2.6.1.2.5. Off event

Function	-	Allows selection of predefined event from the event list, which is to be used to turn off output.
Data type	-	selection list
Range	-	*None* or names of event from the Events table
Default value	-	*None*
Comments	-	Parameter is only available when Output mode is set to *Bistable.*

6.2.6.1.3. Analog inputs AN1...AN2

MT-021 module is equipped with two analog inputs operating in 4...20mA or 0...5V/0...10V standard and direct measurement of the temperature sensor PT100 (AN1) or NTC (AN2).

Each mode has a set of specific configuration parameters.

6.2.6.1.3.1. Name

Function	-	Defines input's user friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 16 characters
Default value	-	Respectively (*AN1, AN2*)
Comments	-	Assigning friendly names facilitates discrimination of inputs destination and required settings.

6.2.6.1.3.2. Input type

Function	-	selection of analog input mode
Data type	-	selection list
Range	-	*Voltage input* signal measurement 0..10V or 0..5V depending on selected setting *Current input* signal measurement 4..20mA *Pt100* temperature measurement by PT100 sensor (available for AN1) *NTC* temperature measurement by NTC sensor (available for AN2)
Default value	-	*Voltage input*
Comments	-	N/A

6.2.6.1.3.3. Filtering constant [s]

Function	-	defines (in seconds) the value of the measurement averaging time of analog input
Data type	-	selection list
Range	-	0, 0.05, 0.1, 0.25, 0.5, 1, 2, 4, 8
Default value	-	0
Comments	-	N/A

6.2.6.1.3.4. Signal range

Function	-	selection of voltage analog input range
Data type	-	selection list

Range - 0...10V or 0...5V
Default value - 0...10V
Comments - N/A

6.2.6.1.3.5. Low reference - internal units

Function - used along with other reference parameters for rescaling input signal range to engineering units range
Data type - number
Range - *0...500* for voltage input *(range 0...5V)*
0...1 000 for voltage input *(range 0...10V)*
0...2 000 for current input
Default value - 0 for voltage input
400 for current input
Comments - low reference point for internal units

6.2.6.1.3.6. High reference - internal units

Function - used along with other reference parameters for rescaling input signal range to engineering units range
Data type - number
Range - *0...500* for voltage input (range 0...5V)
0...1 000 for voltage input (range 0...10V)
0...2 000 for current input
Default value - 500 - for voltage input (range 0...5V)
1 000 - for voltage input (range 0...10V)
2 000 - for current input
Comments - high reference point for internal units

6.2.6.1.3.7. Low reference - engineering units

Function - used along with other reference parameters for rescaling input signal range to engineering units range
Data type - number
Range - *-32767...32767*
Default value - 0
Comments - Low reference for engineering units

6.2.6.1.3.8. High reference - engineering units

Function - used along with other reference parameters for rescaling input signal range to engineering units range
Data type - number
Range - *-32767...32767*
Default value - 1 000
Comments - High reference for engineering units

6.2.6.1.3.9. Alarm HiHi - engineering units

Function	-	Defines **HiHi** alarm level for analog signal value in engineering units.
Data type	-	number
Range	-	*-32767...32767*
Default value	-	32 767
Comments	-	Upon exceeding the preset value by analog signal the HiHi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

6.2.6.1.3.10. Alarm Hi - engineering units

Function	-	Defines **Hi** alarm level for analog signal value in engineering units.
Data type	-	number
Range	-	*-32767...32767*
Default value	-	32 767
Comments	-	Upon exceeding the preset value by analog signal the Hi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

6.2.6.1.3.11. Alarm Lo - engineering units

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

6.2.6.1.3.12. Alarm LoLo - engineering units

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

6.2.6.1.3.13. Alarm hysteresis - engineering units

Function	-	Defines hysteresis value for analog signal thresholds. 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.

6.2.6.1.3.14. Deadband - engineering units

Function	-	This parameter defines a minimal change of registered analog signal to react on.
Data type	-	number
Range	-	*0....32767*
Default value	-	100
Comments	-	When set to value *0*, the flag will rise upon every detected signal change by minimum 1 engineering unit. Deadband flags are dedicated to continuous monitoring of analog signal changes.

6.2.6.1.4. Inputs 1-WIRE1, 1-WIRE2

MT-021 module is equipped with two 1-WIRE inputs which allow connection of external transducers (e.g. temperature sensors).

6.2.6.1.4.1. Name

Function	-	Defines input's user friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 16 characters
Default value	-	Respectively (*1-WIRE1, 1-WIRE2*)
Comments	-	Assigning friendly names facilitates discrimination of inputs destination and required settings.

6.2.6.1.4.2. Input type

Function	-	selection of 1-WIRE input mode
Data type	-	selection list
Range	-	*Temperature measurement* Temperature measurement by **DS18B20** sensor *Inactive* Input switched off
Default value	-	*Inactive*
Comments	-	N/A

6.2.6.1.4.2.1. Temperature measurement

In this mode, the input module performs temperature reading from the DS18B20 sensor connected to a 1-Wire bus. Configuration parameters associated with that operation mode allows to set alarm thresholds, hysteresis and deadband.

6.2.6.1.4.2.1.1. Alarm HiHi

Function - Defines **HiHi** alarm level for 1-wire value.
Data type - number
Range - *-25...125*
Default value - 125
Comments - Upon exceeding the preset value by 1-wire signal the HiHi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

6.2.6.1.4.2.1.2. Alarm Hi

Function - Defines **Hi** alarm level for 1-wire signal value.
Data type - number
Range - *-25...125*
Default value - 125
Comments - Upon exceeding the preset value by 1-wire signal the Hi alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

6.2.6.1.4.2.1.3. Alarm Lo

Function - Defines **Lo** alarm level for 1-wire signal value.
Data type - number
Range - *-25...125*
Default value - -25
Comments - Upon exceeding the preset value by 1-wire signal the Lo alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

6.2.6.1.4.2.1.4. Alarm LoLo

Function - Defines **LoLo** alarm level for 1-wire signal value.
Data type - number
Range - *-25...125*
Default value - -25
Comments - Upon exceeding the preset value by 1-wire signal the LoLo alarm flag is risen. The resetting level of the flag depends on Alarm hysteresis setting.

6.2.6.1.4.2.1.5. Alarm hysteresis

Function - Defines hysteresis value for 1-wire signal thresholds.
Data type - number
Range - *0...50*
Default value - 2
Comments - Setting hysteresis relevant for signal fluctuations prevents excessive activations of alarm flags.

6.2.6.1.4.2.1.6. Deadband

Function - This parameter defines a minimal change of registered 1-wire signal to react on.
Data type - number
Range - *0....50*
Default value - *2*
Comments - When set to value *0*, the flag will rise upon every detected signal change by minimum 1 unit. Deadband flags are dedicated to continuous monitoring of 1-wire signal changes.

6.2.6.2. Synchronous timers TMR1...TMR4

Synchronous timers group contains parameters set for four timers capable of cooperating with module real time (RTC) clock thus enabling triggering of events synchronized with defined time.

6.2.6.2.1. Active

Function - selection timer activity
Data type - selection list
Range - *Yes*
Inactive timer
No
Active timer
Default value - *No*
Comments - N/A

6.2.6.2.1.1. Start [HH:MM]

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*)

6.2.6.2.1.2. Period

Function - Defines the interval module's clock should measure.
Data type - selection list
Range - 1 min., 2 min., 3min., 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 - 12 hours
Comments - N/A

6.2.6.2.1.3. Days of week

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

6.2.6.2.1.4. Days of month

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

6.2.6.3. State logging

Save status Subgroup contains parameters for defining messages (which may include the current states of inputs and outputs) periodically saved in the event logger of MT-021 module. This allows to periodically record measured values.

6.2.6.3.1. Start [HH:MM]

Function	-	Defines the synchronization point of period of logging device state to event logger with RTC clock
Data type	-	time
Range	-	00:00 - 23:59
Default value	-	00:00
Comments	-	

6.2.6.3.2. Period

Function	-	Defines interval of saving user-defined message in the event logger of MT-021 module
Data type	-	selection list
Range	-	10 min., 20 min., 30 min., 45 min., 1 hour, 2 hours, 3 hours, 4 hours, 6 hours, 8 hours, 12 hours, 24 hours
Default value	-	6 hours
Comments	-	

6.2.6.3.3. Logged information

Function	-	Defines text of message periodically put in event logger
Data type	-	text
Range	-	0..160 characters
Default value	-	
Comments	-	text 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 states of bits. The syntax of commands is described in detail in Syntax of commands for reading and writing data by SMS paragraph.

6.2.7. Events

Group **Events** defines status change of binary inputs (flags, inputs, outputs, bits) as events. Events are used to trigger recording events logger and sending SMS messages/CLIP calls or to control relay outputs.

6.2.7.1. Number of events

Function	-	Defines the number of events in events table.
Data type	-	number
Range	-	*0...32*
Default value	-	*0*
Comments	-	If the value is 0, events table is not displayed

6.2.7.2. Name

Function	-	Defines events user friendly name
Data type	-	Text
Range	-	Letters and numerals, max. 15 characters
Default value	-	**EVT1...EVT32**
Comments	-	Entering user-friendly names makes it much easier to distinguish events source and therefore choosing the correct event to trigger specific rule or action of module.

6.2.7.3. Trigger source (binary inputs)

Function	-	defines resource to trigger event
Data type	-	selection list
Range	-	*None* Inactive event ***Binary inputs*** Events associated with binary inputs I1 ... I4 *Analog inputs* Events associated with analog inputs AN1, AN2 *Inputs 1-WIRE* Events associated with 1-WIRE inputs

Clocks
Events associated with TMR1...TMR4 timer flags
Flags
Events generated by the system/internal processor
Counters
Events associated with counter's flags
Connections
Events associated with incoming telephone calls

Default value - None
Comments - N/A

6.2.7.3.1. Trigger input

Function - select flag of binary input which can trigger an event
Data type - selection list
Range - I1...I4
Default value - I1
Comments - N/A

6.2.7.3.2. Trigger condition

Function - Defines the flag associated with the selected binary input and used to trigger an event
Data type - selection list
Range - Bi 0->1, Bi 1->0, Bi 0->1|1->0
Default value - Bi 0->1
Comments - N/A

6.2.7.4. Trigger source (analog inputs)

Function - defines resource to trigger event
Data type - selection list
Range - *None*
Inactive event
Binary inputs
Events associated with binary inputs I1 ... I4

Analog inputs
Events associated with analog inputs AN1, AN2
Inputs 1-WIRE
Events associated with 1-WIRE inputs
Clocks
Events associated with TMR1...TMR4 timer flags
Flags
Events generated by the system/internal processor
Counters
Events associated with counter's flags
Connections
Events associated with incoming telephone calls

Default value - None
Comments - N/A

6.2.7.4.1. Trigger input

Function - select flag of analog input which can trigger event
Data type - selection list
Range - AN1, AN2
Default value - AN1
Comments - N/A

6.2.7.4.2. Trigger condition

Function - Defines the alarm flag associated with the selected analog input and used to trigger an event
Data type - selection list
Range - Alarm HiHi, Alarm Hi, Alarm Lo, Alarm LoLo
Default value - Alarm HiHi
Comments - N/A

6.2.7.5. Trigger source (inputs 1-WIRE)

Function - defines resource to trigger event
Data type - selection list
Range - *None*
Inactive event
Binary inputs
Events associated with binary inputs I1 ... I4
Analog inputs
Events associated with analog inputs AN1, AN2
Inputs 1-WIRE
Events associated with 1-WIRE inputs
Clocks
Events associated with TMR1...TMR4 timer flags
Flags
Events generated by the system/internal processor
Counters
Events associated with counter's flags
Connections
Events associated with incoming telephone calls
Default value - None
Comments - N/A

6.2.7.5.1. Trigger input

Function - select flag of 1-WIRE input which can trigger event
Data type - selection list

Range	-	1-WIRE1...1-WIRE2
Default value	-	1-WIRE1
Comments	-	N/A

6.2.7.5.2. Trigger condition

Function	-	Defines the alarm flag associated with the selected 1-WIRE input and used to trigger an event
Data type	-	selection list
Range	-	Alarm HiHi, Alarm Hi, Alarm Lo, Alarm LoLo
Default value	-	Alarm HiHi
Comments	-	N/A

6.2.7.6. Trigger source (Clocks)

Function	-	defines resource to trigger event
Data type	-	selection list
Range	-	*None* Inactive event Binary inputs Events associated with binary inputs I1 ... I4 *Analog inputs* Events associated with analog inputs AN1, AN2 *Inputs 1-WIRE* Events associated with 1-WIRE inputs ***Clocks*** Events associated with TMR1...TMR4 timer flags *Flags* Events generated by the system/internal processor *Counters* Events associated with counter's flags *Connections* Events associated with incoming telephone calls
Default value	-	None
Comments	-	N/A

6.2.7.6.1. Triggering clock

Function	-	Defines the flag associated with the selected Clock and used to trigger an event
Data type	-	selection list
Range	-	TMR1...TMR4
Default value	-	TMR1
Comments	-	N/A

6.2.7.7. Trigger source (Flags)

Function - defines resource to trigger event
Data type - selection list
Range - *None*
Inactive event
Binary inputs
Events associated with binary inputs I1 ... I4
Analog inputs
Events associated with analog inputs AN1, AN2
Inputs 1-WIRE
Events associated with 1-WIRE inputs
Clocks
Events associated with TMR1...TMR4 timer flags
Flags
Events generated by the system/internal processor
Counters
Events associated with counter's flags
Connections
Events associated with incoming telephone calls
Default value - None
Comments - N/A

6.2.7.7.1. Triggering flag

Function - Defines the system flag and used to trigger an event
Data type - selection list
Range - Module power on reset - module restart
Default value - Module power on reset
Comments - N/A

6.2.7.8. Trigger source (Counters)

Function - defines resource to trigger event
Data type - selection list
Range - *None*
Inactive event
Binary inputs
Events associated with binary inputs I1 ... I4
Analog inputs
Events associated with analog inputs AN1, AN2
Inputs 1-WIRE
Events associated with 1-WIRE inputs
Clocks
Events associated with TMR1...TMR4 timer flags
Flags
Events generated by the system/internal processor
Counters
Events associated with counter's flags

Connections
Events associated with incoming telephone calls

Default value - None

Comments - N/A

6.2.7.8.1. Triggering counter

Function - Defines the flag associated with the configured counter input and used to trigger an event

Data type - selection list

Range - I1...I4

Default value - I1

Comments - N/A

6.2.7.9. Trigger source (Connections)

Function - defines resource to trigger event

Data type - selection list

Range - *None*
Inactive event
Binary inputs
Events associated with binary inputs I1 ... I4
Analog inputs
Events associated with analog inputs AN1, AN2
Inputs 1-WIRE
Events associated with 1-WIRE inputs
Clocks
Events associated with TMR1...TMR4 timer flags
Flags
Events generated by the system/internal processor
Counters
Events associated with counter's flags
Connections
Events associated with incoming telephone calls

Default value - None

Comments - N/A

6.2.7.9.1. Connection from any authorized

Function - Determines whether the event it to be triggered by an incoming call from particular number or with a group of numbers from authorized number list.

Data type - selection list

Range - Yes
Event will trigger by any connection from authorized numbers and selected permission for Receiving voice calls parameter.
No
Event will trigger by connection from selected phone number defined Dial-in from number parameter.

Default value	-	Yes
Comments	-	N/A

6.2.7.9.1.1. Dial-in from number

Function	-	select phone number name from authorized list which can trigger event
Data type	-	selection list
Range	-	friendly names of recipients associated with phone numbers in Authorized number list
Default value	-	NUM 1 - first number on the list
Comments	-	N/A

6.2.8. Rules

Rules group contains lists of transmission tasks performed by internal program when criteria defined in rules are met. Tasks are divided into two groups:

- rules concerning transmission of SMS messages
- rules concerning transmission of CLIP calls
- rules concerning transmission of e-mail messages

In both cases, the criteria are defined by using same resources and conditions of application of the rule.

6.2.8.1. Massage sending

List of SMS sending rules can hold max. 32 entries defining short text message transmission conditions. Adding a new position is done in the context menu by right-clicking mouse while one of positions on the list is highlighted.

Adding more rules is done by setting the parameter Number of SMS sending rules.

6.2.8.1.1. Number of message sending rules

Function	-	declares number of SMS or e-mail sending rules.
Data type	-	number
Range	-	1..32
Default value	-	1
Comments	-	diminishing the number of rules does not delete settings until the configuration is written to the module.

6.2.8.1.2. Sender e-mail address

Function	-	Allows to enter sender e-mail address, e.g. john.smith@company.com
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.1.3. SMTP server name

Function	-	Allows to enter name of SMTP server which will be used for e-mail sending, e.g. smtp.company.com
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.1.4. SMTP server port

Function	-	declares port number which is used for communication with SMTP server
Data type	-	number
Range	-	1..65535
Default value	-	25
Comments	-	

6.2.8.1.5. SMTP authentication

Function	-	enables SMTP authentication if required by SMTP server.
Data type	-	Selection list
Range	-	*No* SMTP authentication is disabled. *Yes* SMTP authentication is enabled. In configuration two new parameters appear: SMTP user name and SMTP password which are used to authenticate module on SMTP server.
Default value	-	*No*
Comments	-	

6.2.8.1.6. SMTP user name

Function	-	Allows to enter user name which will be used during authentication process on SMTP server, e.g. john.smith
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.1.7. SMTP password

Function	-	Allows to enter password which will be used during authentication process on SMTP server, e.g. j0h2ny$m1th
Data type	-	text
Range	-	0..31 characters

Default value	-	
Comments	-	

6.2.8.1.8. Message sending rules 1...32

Each of rules residing on the list is defined by following parameters:

Triggering event
Transmission type
Recipient number
Receiver e-mail address
E-mail title
Message text

6.2.8.1.8.1. Triggering event

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	-	N/A

6.2.8.1.8.2. Transmission type

Function	-	selection of method of textual message delivery
Data type	-	selection list
Range	-	*SMS* message is delivered as SMS *E-mail* message is delivered as e-mail *E-mail or SMS* message is delivered as e-mail and if it is not possible (e.g. no GPRS available) - as SMS
Default value	-	*SMS*
Comments	-	Value o which this parameter is set affects availability of other parameters within the same group.

6.2.8.1.8.3. Recipient number

Function	-	Assigns a recipient of SMS from list defined in Authorized numbers->Phone
Data type	-	selection list
Range	-	friendly names of recipients associated with phone numbers in Authorized number list
Default value	-	NUM 1 - first number on the list
Comments	-	since recipient's phone number is selected from the list of friendly names, it is important to enter unique, unambiguous names facilitating identification.

6.2.8.1.8.4. Receiver e-mail address

Function	-	Allows to enter receiver e-mail address, e.g. jane.brown@other_company.com
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.1.8.5. E-mail title

Function	-	Defines an e-mail title
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.1.8.6. Message text

Function	-	Defines text which will be send as an e-mail or SMS message
Data type	-	text
Range	-	0..160 characters
Default value	-	
Comments	-	Messages text may contain any string of characters, except diacritical signs. It may contain mnemonics dynamically replaced at run-time by values drawn from the module e.g.: time, register values or logical state of bits. Syntax of commands is described in Syntax of commands for reading and writing data by SMS paragraph.

6.2.8.2. CLIP calls

The term „CLIP call" describes attempts to establish a phone connection to a defined number. This connection is not supposed to be picked up by the recipient. Identification of sending module's phone number is enough to convey the alert. The meaning of alert should be agreed upon. Notice that recipient does not have to be a GSM network subscriber but must have a phone able to identify and display caller ID. The function corresponds to sending 1 bit of information triggered by event occurrence free of charge. The list of rules holds max. 16 rules allowing to establish a connection with selected phone number. Adding a new position is done in the context menu by right-clicking mouse while one of positions on the list is highlighted.

Adding more rules is done by setting the parameter Number of CLIP calls rules to desired value.

6.2.8.2.1. Number of CLIP calls rules

Function	-	declares number of CLIP calls rules.
Data type	-	number
Range	-	1..16
Default value	-	1
Comments	-	diminishing the number of rules does not delete settings until the configuration is written to the module.

6.2.8.2.2. CLIP call rules 1...16

Each of rules residing on the list is defined by following parameters:
Triggering event
Recipient number

6.2.8.2.2.1. Triggering event

Function	-	Assigns which one of previously defined event will trigger CLIP call rule.
Data type	-	selection list
Range	-	*None* or names of events from the Events table
Default value	-	*None*
Comments	-	N/A

6.2.8.2.2.2. Recipient number

Function	-	Selects CLIP call recipient number
Data type	-	selection list
Range	-	friendly names of recipients associated with phone numbers in Authorized number list
Default value	-	NUM 1 - first number on the list
Comments	-	since recipient's phone number is selected from the list of friendly names, it is important to enter unique, unambiguous names facilitating identification.

6.2.8.3. E-mail sending

List of e-mail sending rules can hold max. 16 entries defining e-mail message transmission conditions. Adding a new position is done in the context menu by right-clicking mouse while one of positions on the list is highlighted.

Adding more rules is done by setting the parameter Number of e-mail sending rules.

6.2.8.3.1. Number of e-mail sending rules

Function	-	declares number of e-mail sending rules.
Data type	-	number
Range	-	1..16

Default value	-	1
Comments	-	diminishing the number of rules does not delete settings until the configuration is written to the module.

6.2.8.3.2. Sender e-mail address

Function	-	Allows to enter sender e-mail address, e.g. john.smith@company.com
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.3.3. SMTP server name

Function	-	Allows to enter name of SMTP server which will be used for e-mail sending, e.g. smtp.company.com
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.3.4. SMTP server port

Function	-	declares port number which is used for communication with SMTP server
Data type	-	number
Range	-	1..65535
Default value	-	25
Comments	-	

6.2.8.3.5. SMTP authentication

Function	-	enables SMTP authentication if required by SMTP server.
Data type	-	Selection list
Range	-	*No* SMTP authentication is disabled. *Yes* SMTP authentication is enabled. In configuration two new parameters appear: SMTP user name and SMTP password which are used to authenticate module on SMTP server.
Default value	-	*No*
Comments	-	

6.2.8.3.6. SMTP user name

Function	-	Allows to enter user name which will be used during authentication process on SMTP server, e.g. john.smith
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.3.7. SMTP password

Function	-	Allows to enter password which will be used during authentication process on SMTP server, e.g. j0h2ny$m1th
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.3.8. E-mail sending rules 1...16

Each of rules residing on the list is defined by following parameters:

Triggering event
Receiver e-mail address
E-mail title
E-mail text

6.2.8.3.8.1. Triggering event

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	-	N/A

6.2.8.3.8.2. Receiver e-mail address

Function	-	Allows to enter receiver e-mail address, e.g. jane.brown@other_company.com
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.3.8.3. E-mail title

Function	-	Defines an e-mail title
Data type	-	text
Range	-	0..31 characters
Default value	-	
Comments	-	

6.2.8.3.8.4. E-mail text

Function	-	Defines text of an message
Data type	-	text
Range	-	0..160 characters
Default value	-	
Comments	-	Text may contain any string of characters, except diacritical signs. 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.

6.3. Configuration writing

After required modifications and parameter settings, the configuration is stored on the configuring PC's hard disk only. In order to write it to the module memory, it has to be transmitted to the module. For local configuration, it is enough to secure a connection via RS232 cable. Detailed description of local configuration is to be found in the MTM user manual.

Remote configuration can be realized via SMS commands. It is necessary to enter the phone number on an authorized list, except for the first configuration of the module. Detailed description of remote configuration is to be found in the chapter Module configuration via SMS.

6.4. Verification of configuration

Despite high reliability of both local and remote module configuration, verify of it is important. It is relevant if the module's behavior does not comply in accordance with the performed configuration. For verification, please read the configuration from the module and check parameters settings.

Reading of module configuration is described in details in MTM user manual and chapter Module configuration via SMS.

7. Technical Data

7.1. General

Dimensions (height x width x length)	105x86x58 mm
Weight	300 g
Mounting method	DIN Rail 35mm
Operating temperature	0 ... +55°C
Protection class	IP40

7.2. GSM Modem

Modem type	Cinterion TC63i
GSM	Quad Band (850/900/1800/1900)
Frequency range (GSM 850)	Transmitter: from 824 MHz to 849 MHz Receiver: from 869 MHz to 894 MHz
Frequency range (EGSM 900)	Transmitter: from 880 MHz to 915 MHz Receiver: from 925 MHz to 960 MHz
Frequency range (DCS 1800)	Transmitter: from 1710 MHz to 1785 MHz Receiver: from 1805 MHz to 1880 MHz
Frequency range (PCS 1900)	Transmitter: from 1850 MHz to 1910 MHz Receiver: from 1930 MHz to 1990 MHz
Transmitter peak power (GSM850 / EGSM900 MHz)	33 dBm (2W) – class 4 station
Transmitter peak power (DCS1800 / PCS1900 MHz)	30 dBm (1W) – class 1 station
Modulation	0,3 GMSK
Channel spacing	200 kHz
Antenna	50Ω

7.3. Power supply

Power voltage range	9 ... 30VDC
Current for 12 VDC	Idle 0,05 Max 1,00
Current for 24 VDC	Idle 0,03 Max 0,70

CAUTION!
Due to high momentary current consumption the power supply must be capable of delivering >= 1A of current.
Inappropriate power supply may result in faulty operation or cause damage to MT-021 module!

7.4. Binary inputs I1....I4

Signal voltage range	0 ... 30VDC
Input resistance	5,4 kΩ
Input ON (1) voltage	> 9V
Input OFF (0) voltage	0 ... 3V

7.5. Relay outputs Q1...Q4

Output type	Relay, optoisolated, NO
Maximum voltage between contacts	250VAC/300VDC
Load current	6A/230VAC, 6A/24VDC
Maximum switching current	15A/20ms
Resistance	<100mΩ

7.6. Analogue inputs AN1, AN2

Analog/Pt100 input AN1 - temperature measurement

Sensor type	PT100, 2- or 3-wired
Wires resistance compensation	yes (applies only to 3-wire sensor)
Measurement range	-40...+200°C
Accuracy	+/-1°C

Analog/NTC input AN2 - temperature measurement

Sensor type	NTC 10k
Measurement range	-25...+55°C
Accuracy	+/-1°C (depending on used sensor)

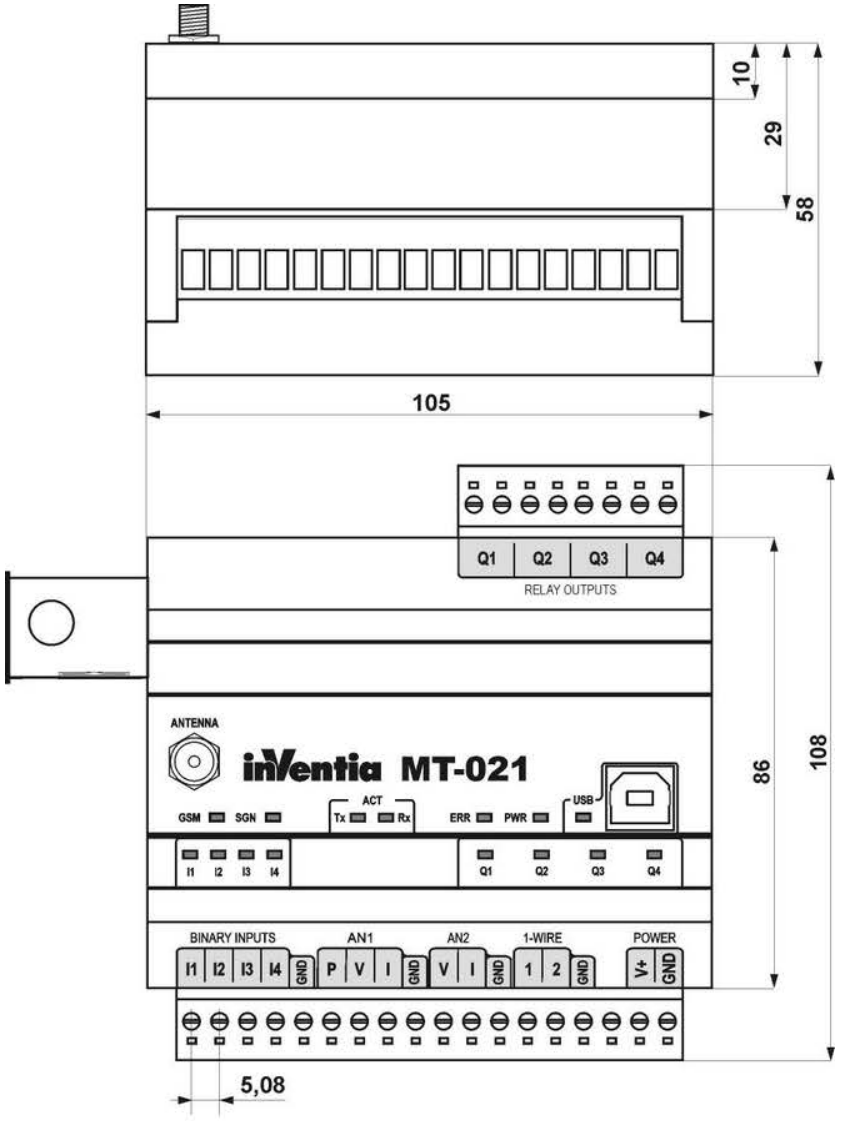
Analog inputs AN1, AN2 - voltage measurement

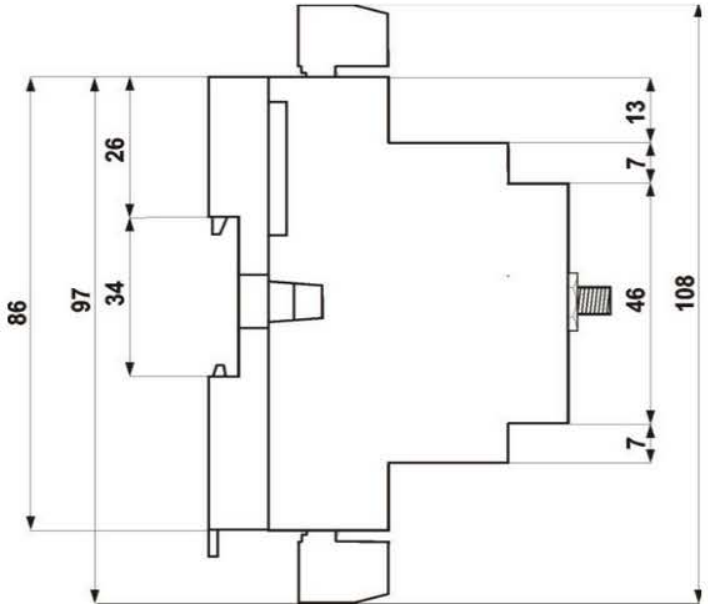
Measurement range	0...5V/0...10V
Maximum input voltage	18V
Input dynamic impedance	150kΩ typ.
Accuracy	+/-1,5% max.
Nonlinearity	+/-1% max.

Analog inputs AN1, AN2 - current measurement

Measurement range	4...20mA
Maximum input current	50 mA max.
Input dynamic impedance	100Ω typ.
Voltage drop at 20mA	2V max.
Accuracy	+/-1,5% max.
Nonlinearity	+/-1% max.

7.7. Drawings and dimensions (All dimensions in millimeters)

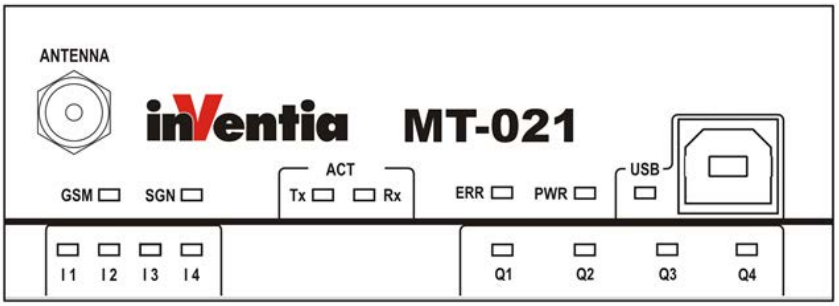




8. Problem solving

8.1. LED signaling

LED indicators placed on **MT-021** panel are a great diagnostic tool.



In table below are described all states signaled by LED diodes.

LED	Signaling	Description
PWR	on	Module powered V+ and GND terminals
USB	on	USB connected - module powered from USB
I1...I4	on	Input activated
	off	Input deactivated
Q1...Q4	on	Output activated
	off	Output deactivated
GSM	blinking quickly	Module initialization
	1 blink	Modem initialization
	2 blinks	GSM network searching
	3 blinks	Module logged in GSM network
	1 long i 3 short blinks	Module logged in GPRS network
SGN	1-4 blinks	GSM signal strength
ACT Tx	on	Sending SMS
	blinking	Outgoing call
ACT Rx	on	Receiving SMS
	blinking	Incoming call
ERR	blinking quickly	Updating module firmware
	1 blink	Unsuccessful SMS sending attempt
	2 blinks	No SIM card or SIM card improperly inserted
	3 blinks	Wrong PIN
	4 blinks	Wrong PIN. No more PIN entering attempts or PUK needed.
	5 blinks	Unsuccessful GSM log in attempt

8.2. Unblocking of SIM card

Three failed attempts of entering PIN code locks the SIM card and requires entering the PUK code. The fact that the SIM card locked is indicated by the ERR LED. An attempt to unlock the module may be performed only when the right PIN code is known.
Necessary procedure:

- turn the power supply off,
- remove SIM card from the module,
- insert SIM to ordinary mobile phone accepting cards from the operator that issued actual SIM,
- start the phone and enter proper PUK code and correct PIN code,
- if not accomplished before...
  - start the module,
  - insert appropriate PIN into configuration,
  - power the module off,
- remove the SIM from the phone and place it in the module,
- start the module

Entering correct PUK-code unblocks the card and resets PIN fault counter making the card operational.

9. Safety information

9.1. 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.

9.2. 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.

9.2.1. 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.

9.2.2. 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.

9.2.3. 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).

9.2.4. RF Marked equipment

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

9.3. 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.

10. Appendices

10.1. Register of changes

Current version - **v1.51.02**

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v1.51.02 - 2012-08-01

- added new prefix #Fx (x-number of digits after dot) to the SMS commands allowing to present values from 16-bit registers as numbers with decimal fraction
- SMS and E-mail sending rules are merged into one block of Messages sending rules. This allow to choose channel of communication from: "SMS", "e-mail", "e-mail or SMS" where last option sends SMS where unable to send e-mail for some reason (e.g. no GPRS available)
- added three new predefined symbolic names for use in SMS and e-mail commands: #NAME (gives name of device defined during configuration)), #SERIAL (gives serial number of device) i #IPADDR (gives current IP address of module).
- added GPRS testing address and Idle time parameters used for GPRS connection check
- added possibility to write to multiple registers at once using Monitoring - software module of MTM

v1.50.01 - 2012-04-16

- added email sending functionality (via SMTP server and GPRS service)

v1.00.12 - 2011-03-31

• improvement in access to read/write resources from memory map via USB port

v1.00.11 - 2011-03-03

• improvement in answer for blank SMS
• improvement in procedure of sending SMS with '$' sign (without answer)
• improvement in roaming procedure
• added access to read/write resources from memory map via USB port

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v1.00 - First official version

10.2. Module configuration via SMS

MT-021 can be configured locally using **MTManager** (software tool for telemetry modules management) and remotely via SMS commands. However, you should note that the first SMS message with configuration commands is processed without sender authorization verification - number of sender does not have to figure on Authorized numbers->Phone list (this allows to make first configuration via SMS). Therefore it is strongly recommended to add at least one phone number to this list in first SMS command with allowed configuration changing. Otherwise remote configuration will be disabled.
For system demanding high security configuration can be additionally protected by password (parameter General->Configuration password). It will be needed for both local and remote configuration of the module.

Format of SMS configuration commands:

&password#parameter=value#parameter=value#parameter...

where:
password - password protecting module given by General->Configuration password parameter (if module is not password protected this parameter should be omitted - SMS should begin only with '&')
parameter - predefined configuration parameter mnemonic
value - parameter value. It may be number or text depending on parameter type. Text values should be put in quotes, e.g. "+48123456789" or "Anna". If equals sign and **value** are omitted module will treat command as an inquiry.

If in sent SMS command parameters were given values than module will make attempt to write them into configuration. Result of this action will be send in response SMS.

If SMS was send with correct syntax and values within allowed range or SMS was an inquiry (no values) than response is built from list of parameters with corresponding values.

>#parameter=value#parameter=value#parameter...

If there was at least one wrong parameter name module will not change any configuration parameter and will send following response:

>#parameter?#parameter?...

If there was at least one of parameter values will not be within accepted range or will be of wrong type change any configuration parameter and will send following response:

>#parameter=Err#parameter=Err...

The following tables list all available configuration parameter mnemonics, their allowed parameter value range and default value. Please note that some of the parameters and parameter values are depending on other parameter values, e.g. number entered on sixth position on Authorized numbers->Phone list is active only if Authorized numbers->Number of phone numbers parameter is set to six or more.

Parameters in bold accept only text values.

General group:

Parameter	MTManager description	Default value	Range	Definition
SPIN	SIM card PIN number	empty	from 4 to 8 characters or empty	
CONF_PSW	Configuration password	empty	max. 32 characters	
CRTC	RTC time	2000-01-01 00:00:01	YYYY-MM-DD HH:MN:SS	
GPRS_EN	Use of GPRS	1	1 2	No Yes

SMS group:

*** - index from 1 to 16**

Parameter	MTManager description	Default value	Range	Definition
MAXS	Daily SMS limit	0	0...65535	
RSMS	Roaming for SMS	2	1 2 3	No Answer All
SREP	Number of SMS sending retries	10	0...255	
SPAT	Answer for blank SMS	*M0	max. 160 characters	
SLII	SMS limit exceed information text	1	1 2	Off On
SLIN	Phone number of info recipient	1	1...32	SMST_* (* - index from 1 to 32)
SLIT	SMS limit exceed information	empty	max. 160 characters	
SFOD	Date format	YYYY-DD-MM	max. 31 characters	
SFOT	Time format	HH:MN:SS	max. 31 characters	
SFOO1	General format 1	YYYY/MM/DD , HH:MN:SS	max. 31 characters	
SFOO2	General format 2	YY/DD/MM, HH:MN:SS	max. 31 characters	
SREB	Number of symbolic names	1	0...16	
SREA_*	Symbolic name	IREG0	max. 50 characters	
SRES_*	Space	2	1 2 3 4	Hreg Ireg HB IB
SREN_*	Register/bit number	0	0...65535	
SMAS	Number of macros	1	0...16	
SMAN_*	Macro name	M0	max. 20 characters	
SMAC_*	Macro's content	#lt.ir0 #ld.ir0	max. 160 characters	

GPRS group:

Parameter	MTManager description	Default value	Range	Definition
APN_NAME	APN name	empty	max. 63 characters	
APN_USR	APN user name	empty	max. 31 characters	
APN_PSW	APN password	empty	max. 31 characters	
GLBR	GPRS login retry interval [s]	10	10...3600	

Authorized numbers group:

*** - index from 1 to 32**

Parameter	MTManager description	Default value	Range	Definition
LPHN	Number of phone numbers	1	1...32	
SPBS	Update phone numbers from SIM card	1	1 2	No Yes
SALS	Phone number from SIM card always authorized	1	1 2	No Yes
SMST_*	Name	NUM *	max. 16 characters	
SMSN_*	Number	+48	max. 14 characters	
SCFG	Configuration	FFFFFFFF	from 00000000 to FFFFFFFF	Bits defining configuration access authorization. Bit=1 - authorization granted. Representation - see reference 1.
SINQ	Query	00000000	from 00000000 to FFFFFFFF	Bits defining data polling authorization. Bit=1 - authorization granted. Representation - see reference 1.
SMS_AUT	Receiving voice calls	00000000	from 00000000 to FFFFFFFF	Bits defining receiving calls authorization. Bit=1 - authorization granted. Representation - see reference 1.

Resources group:

Parameter	MTManager description	Default value	Range	Definition
Binary inputs I1...I4 (counter inputs) * -index from 1 to 4				
IN_NAME_*	Name	I*	max. 16 characters	
IN_MODE_*	Input type	1	1 3	Binary input Counter input
IN_DIR_*	Counting direction	1	1 2	Up Down
IN_RANGE_*	Counting range (32bits)	0	0...2147483647	
IN_EDGE_*	Triggering slope	1	1 2 3	Bi 0->1 Bi 1->0 Bi 0->1|1->0
IN_FLR_*	Filtering constant [s]	10	10...16383	unit is value/100 [s]
Relay outputs Q1...Q4 * - index from 1 to 4				
OUT_NAME_*	Name	Q*	max. 16 characters	
OUT_IMP_*	Output mode	1	1 2	Monostable Bistable
OUT_IMPLEN_*	Pulse duration [s]	1	1...3600	unit is value/10 [s]
OUT_ONEVT_*	On event	0	0 1 ... 16	None EVT1 ... EVT16 (* - index from 1 to 16)

Parameter	MTManager description		Default value	Range	Definition
OUT_OFFEVT_*	Off event	0		0 1 ... 16	None EVT1 ... EVT16 (* - index from 1 to 16)
Analog inputs AN1, AN2 * - index from 1 to 2					
AN_NAME_*	Name	AN*	max. 16 characters		
AN_MODE_*	Input type	1		1 2 3	Voltage input Current input PT100 (AN1) or NTC (AN2)
AN_FLR_*	Filtering constant [s]	0		0 1 2 3 4 5 6 7 8	0 0,05 0,1 0,25 0,5 1 2 4 8
AN_RANGE_*	Signal range	1		0 1	0...5V 0...10V
AN_LREF_*	Low reference - internal units {0...5V}	0	0...500		
AN_LREF_*	Low reference - internal units {0...10V}	0	0...1000		
AN_LREF_*	Low reference - internal units	0	0...2000		
AN_HREF_*	High reference - internal units {0...5V}	1000	0...500		
AN_HREF_*	High reference - internal units {0...10V}	1000	0...1000		
AN_HREF_*	High reference - internal units	1000	0...2000		
AN_LENG_*	Low reference - engineering units	0	-32757...32767		
AN_HENG_*	High reference - engineering units	1000	-32757...32767		
AN_ALM_HH_*	Alarm HiHi - engineering units	32767	-32757...32767		
AN_NAME_*	Name	AN*	max. 16 characters		
AN_ALM_HI_*	Alarm Hi - engineering units	32767	-32757...32767		
AN_ALM_LO_*	Alarm Lo - engineering units	-32767	-32757...32767		
AN_ALM_LL_*	Alarm LoLo - engineering units	-32767	-32757...32767		
AN_ALM_HIST_*	Alarm hysteresis - engineering units	100	0...65535		
AN_DBD_*	Deadband - engineering units	100	0...65535		
1-Wire inputs (1, 2) * - index from 1 to 2					
OW_NAME_*	Name	1-WIRE*	max. 16 characters		
OW_ACT_*	Input mode	1		1 2	Inactive Temperature measurement
OW_ALM_HH_*	Alarm HiHi	125	-25...125		
OW_ALM_HI_*	Alarm Hi	125	-25...125		
OW_ALM_LO_*	Alarm Lo	-25	-25...125		
OW_ALM_LL_*	Alarm LoLo	-25	-25...125		
OW_ALM_HIST_*	Alarm hysteresis	2	0...50		
OW_DBD_*	Deadband	2	0...50		

Synchronous timers TMR1...TMR4 group:

*** - index from 1 to 4**

Parameter	MTManager description	Default value	Range	Definition
TMR_ON_*	Active	2	1 2	Yes No
TMR_START_*	Start [HH:MM]	00:00	00:00...23:59	
TMR_PERIOD_*	Period	14	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	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.
TMR_DOFW_*	Days of week	7F	from 00 to 7F	Days of week when timer is active. 1 - Monday 2 - Tuesday 4 - Wednesday 8 - Thursday 10 - Friday 20 - Saturday 40 - Sunday e.g. Wednesday, Thursday and Friday is 1C.
TMR_DOFM_*	Days of month	00000000	from 00000000 to FFFFFFFF	Days of month when timer is active. Bit=1 - day is selected. Representation - see reference 2.

State logging group:

Parameter	MTManager description	Default value	Range	Definition
STWS	Start [HH:MM]	00:00	00:00...23:59	
STWP	Period	9	1 2 3 4 5 6 7 8 9 10 11 12	10 min. 20 min. 30 min. 45 min. 1 h 2 h 3 h 4 h 6 h 8 h 12 h 24 h
STWI	Logged information	empty	max. 160 characters	

Events group:

† - index from 1 to 16

Parameter	MTManager description	Default value	Range	Definition
EVNO	Number of events	0	0...32	
EV_TRIG_†	Trigger source	1	1 2 3 4 5 6 7 8	None Binary inputs Analog inputs Inputs 1-wire Clocks Flags Counters Connections
Binary inputs I1...I4 (counter inputs)				
EV_FLAG_†	Trigger input	0	0 1 2 3	I1 I2 I3 I4
EV_EDGE_†	Trigger condition	1	1 2 3	Bi 0->1 Bi 1->0 Bi 0->1|1->0
Analog input AN1, AN2				
EV_FLAG_†	Trigger input	63	63 71	AN1 AN2
EV_EDGE_†	Trigger condition	1	1 2 3 4	Alarm HiHi Alarm Hi Alarm Lo Alarm LoLo
1-Wire inputs (1, 2)				
EV_FLAG_†	Trigger input	79	79 87	1-Wire1 1-Wire2
EV_EDGE_†	Trigger condition	1	1 2 3 4	Alarm HiHi Alarm Hi Alarm Lo Alarm LoLo
Clocks				
EV_FLAG_†	Triggering clock	32	32 33 34 35	TMR1 TMR2 TMR3 TMR4
Flags				
EV_FLAG_†	Triggering flag	48	48	Module power on reset
Counters				
EV_FLAG_†	Triggering counter	16	16 17 18 19	I1 I2 I3 I4
Connections				
EV_FLAG_†	Connection from any authorized	1	1 2	Yes No
EV_NUM_†	Dial-in from number	1	1...32	1...32 - number index from Authorized phone numbers list

Rules group:

*** - index from 1 to 16**
† - index from 1 to 32

Parameter	MTManager description	Default value	Range	Definition
Message sending				
TRNO	Number of message sending rules	1	1...32	
TR_SMF	Sender e-mail address	empty	max. 63 characters	
TR_SMA	SMTP server name	empty	max. 63 characters	
TR_SMP	SMTP server port	25	1...65535	
TR_SML				
TR_AU	SMTP user name	empty	max. 31 characters	
TR_AP	SMTP password	empty	max. 31 characters	
TR_TRIG_†	Triggering event	0	0...32	0-None 1...32 - event index from event list
TR_TCH_†				
TR_N_†	SMS recipient number	1	1...32	1...32 - number index from Authorized phone numbers list
TR_A_†	E-mail receiver address	empty	max. 48 characters	
TR_S_†	E-mail title	empty	max. 31 characters	
TR_T_†	Message text	empty	max. 160 characters	
CLIP calls				
CRNO	Number of CLIP calls rules	1	1...16	
CR_TRIG_*	Triggering event	0	0...32	0-None 1...32 - event index from event list
CR_N_*	Recipient number	1	1...32	1...32 - number index from Authorized phone numbers list
Parameter	**MTManager description**	**Default value**	**Range**	**Definition**
Message sending				
TRNO	Number of message sending rules	1	1...32	

References:

1.) Information about configuration authorization, query authorization and receiving calls authorization is stored in one 32-bit digit, in which each single bit corresponds to position on Phone list according to table below:

Bit position	31 (MSB)	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Position on Phone list	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9
Bit position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0 (LSB)
Position on Phone list	24	23	22	21	20	19	18	17	32	31	30	29	28	27	26	25

For example to enable authorization for eighth and ninth phone on the list you need to set parameter to 80010000 (10000000 00000001 00000000 00000000 in binary notation).

2.) Information about days of month is stored in one 32-bit digit, in which each single bit corresponds to one day of month according to table below:

Bit position	31 (MSB)	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Day of month	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9
Bit position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0 (LSB)
Day of month	24	23	22	21	20	19	18	17	All	31	30	29	28	27	26	25

For example to enable timer for first and last day of month (30th and 31st) you need to set parameter to 1000060 (00000001 00000000 00000000 01100000 in binary notation).

Examples:

- Setting new value of SIM card PIN number (0101) and new Configuration password (ADMIN):

  &#SPIN="0101"#SMSP="ADMIN"
  Module response:

  >#SPIN="0101"#SMSP="ADMIN"

  Attention!!! All changes to SIM card PIN number and Configuration password parameters are taking effect after module restart.

- Reading telephone number stored on second position on Authorized numbers->Phone list:

  &ADMIN#SMSN_2

  Module response:

  >#SMSN_2="+48111222333"

  Number on this position is *+48 111 222 333*.

- Setting new phone number (*+48 123 456 789*) on second position on Authorized numbers->Phone list:

  &ADMIN#SMSN_2="+48123456789"

  Module response:

  >#SMSN_2="+48123456789"

- Setting new phone number on sixth position on Authorized numbers->Phone list. Name parameter is *Mark* and Number parameter is *+48 987 654 321*:

&ADMIN#LPHN=6#SMST_6="Mark"#SMSN_6="+48987654321"

Module response:

>#LPHN=6#SMST_6="Mark"#SMSN_6="+48987654321"

- Setting HiHi alarm threshold of 1-Wire 2 input to *115*:

  &ADMIN#OW_ACT_2=2#OW_ALM_HH_2=115

  Module response:

  >#OW_ACT_2=2#OW_ALM_HH_2=115

- Setting new event on seventh position on event list. Event is triggered by crossing LoLo alarm threshold on analog input AN2:

  &ADMIN#EVNO=7#EV_TRIG_7=3#EV_FLAG_7=71#EV_EDGE_7=4

  Module response:

  >#EVNO=7#EV_TRIG_7=3#EV_FLAG_7=71#EV_EDGE_7=4

- Setting module RTC clock to *2010-12-31 23:59:59*:

  &ADMIN#CRTC="2010-12-31 23:59:59"

  Module response:

  >#CRTC="2010-06-17 08:27:40"

10.3. Syntax for reading and writing data in SMS mode

Description of SMS command

Internal application of a module is able to receive, process and send short text messages (SMS). There is a set of command which can be put in SMS message, allowing the user to read from and write to internal registers placed in module's memory.

Characters with special meaning:

Character	Description
#	starts a command ATTENTION! putting two hash signs one after another will prevent module from processing command following it. However after sending one of hash signs will be deleted - this allows to control resources of one module from another, e.g. set binary output Q1 to '1' (##HB128=1)
*****	starts a macro
>	used as first character in SMS text inhibits parsing of SMS
$	used as first character in SMS text inhibits answering to this SMS

After reception of SMS message, internal application tries to parse SMS text and execute command enclosed in it. Parsing process generates new message text, which is send back to user (if module is allowed to, either by configuration or by presence/absence of '$' sign).

Commands are formatted as follows:

#[prefix.]symbol[=value]

where:

prefix defines data representation and register count

symbol defines register address and register space being accessed

value defines data to be written to register (s)

Prefix is optional; when not present, data is interpreted according to preset defaults.

Basic read command:

#HR0

When module receives and parses the SMS message containing this command, command string will be replaced with value of register 0 read from holding registers space, noted in decimal format, and this value will be put in SMS sent back to user. Answer to this command sent back will be:

>10

where 10 is value read from holding register 0.

If received SMS contains any other characters than correctly formatted commands, these characters will be copied unaltered to message being sent back. This allows user to freely compose text of return message and include register values together with some informational text. For example, if user sends containing:

Voice call was #IR12 seconds long

then module will answer with:

>Voice call was 15 seconds long

where 15 is a value read from input register 12.

It should be noted that answer from module begins with '>' sign - it means that this SMS was generated by module. If module receives SMS beginning with '>', such message will be ignored (not parsed). This prevents endless "looping" of messages in case they are being exchanged between modules

Writing to register is archived by expanding basic command with '=' sign and value that should be written:

#HR20=2

User should be aware that writing is allowed only to holding register space.

When module receives SMS with write command, it executes the command and sends back value written. For example, sending to module SMS with text:

#HR1=1234

causes module to write value 1234 to holding register 10 and send back SMS with text:

>1234

Both read and write commands can be expanded by adding a prefix, which defines data format (notation). Prefix should be placed between '#' mark (command start) and register symbol, and should contain one (or more) characters ended with a dot. For example, to read an input register 4 in hexadecimal format, one should use a command:

#H.IR4

and module's answer will be:

>1FC8

Prefixes can also be used with write commands.

Command can operate on more than one register. Register count can be included in prefix, after character denoting data format (which is then mandatory). For example, command:

#D2.HR2=123456

causes write 123456 to two registers, HR2 and HR3 (32-bit variable).

Full list of available prefixes is enclosed below.

User can define in MTManager own symbolic names in module's config and assign them to registers. Then, such names can be used instead of register symbols. It allows user to define "friendly" names for registers and to erase access to bit values. For example, if user has defined symbolic name "output" and assigned it to bit 321 of internal registers space (which is equal to bit of HR20 register), then sending a command:

#output=1

causes module to write 1 to bit 1 of HR20 register. There are several predefined (internal) symbolic names.

Apart from symbolic names, user can define macros. A macro is defined as a name and a text assigned to this name. Parsing of received message begins with macro expansion. Parser looks for words beginning with '*' sign and replaces such names with assigned strings. Once macro expansions ends, new message text is being interpreted and commands executed. It allows user to place both commands and symbolic names in macro text. Furthermore, macros can contain another macro names ("nested" macros), but only those defined higher in macro list. For example, if configuration contains following macros (in order shown):

No.	Macro name	Macro text
1	counter	*mtime: input 0 counter: #D2.HR0
2	mtime	#date #time
3	state	*mtime: inputs - #B8.IB64, #IR19 SMS sent

then macro *mtime used in macro number 3 (*state) will be correctly expanded and SMS text:

***state**

after macro expansion (before executing commands) will be changed to:

#date #time: inputs - #B8.IB64, #IR19 SMS sent

but expansion of macro 1 will not contain text assigned to macro name *mtime, therefore text being executed after macro 1 was used will look like:

***mtime: input 0 counter: #D2.HR0**

which in turn causes module to send back SMS containing:

>*mtime: input 0 counter: 123

Register spaces

Module's firmware distinguishes two register spaces: input registers and holding registers. Access to register space can be made by calls to 16-bit registers or by calls to individual bits.

Symbol	Description
HR{0..n}	Holding registers space. Read/write access. 16-bit registers.
IR{0..n}	Input registers space. Read only. 16 bit registers.
HB{0..16*n}	Bit access to holding registers space. One can access individual bits (or groups of bits). Read/Write. Bit mapping is as follows: bits 0..15 correspond to holding register 0, bits 16...31 - to holding register 1 and so on.
IB{0..16*n}	Bit access to input registers space. One can access individual bits (or groups of bits). Read only. Bit mapping is as follows: bits 0..15 correspond to input register 0, bits 16..31 - to input register 1 and so on.

Register symbols can be preceded by prefixes, which can define amount of data being processed and data format.

Available prefixes:

Register space HR, IR (16-bit registers)

Prefix	Description
B[1..4]	Binary format, 16 characters (bits) default, bits from most to least significant. Prefix can contain register count (1..4) being processed (register symbol defines lowest register) - in resulting string, rightmost character corresponds to bit with lowest number.
D[1..4]	Decimal format, 1..5 characters, unsigned. Prefix can contain register count (1..4) being processed (register symbol defines lowest register) - number returned is decimal notation of n*16 bit value where most significant bit is placed in register with lowest address (big endian).
H[1..4]	Hexadecimal format, 4 characters. Prefix can contain register count (1..4) being processed - returned string contains n*4-character groups, leftmost group corresponds to register with lowest address (big endian).
LT	Local time fetched from three consecutive registers Rn:Rn+1:Rn+2, where n corresponds to register symbol used. Time format according to "Time format" string in configuration.

UT	UTC time fetched from three consecutive registers R*n:Rn+1:Rn+2*, where *n* corresponds to register symbol used. Time format according to „Time format" string in configuration.
LD	Local date fetched from three consecutive registers R*n:Rn+1:Rn+2*, where *n* corresponds to register symbol used. Date format according to „Date format" string in configuration.
UD	UTC date fetched from three consecutive registers R*n:Rn+1:Rn+2*, where *n* corresponds to register symbol used. Date format according to „Date format" string in configuration.
T{1..2}	UTC timestamp fetched from three consecutive registers R*n:Rn+1:Rn+2*, where *n* corresponds to register symbol used. Timestamp format according to „General format 1" or „General format 2" strings in configuration.
S	Decimal format, 1..5 characters (with '-' sign when needed), signed. Access to single register treated as 16-bit signed value.
F[1..3]	Converts decimal value to floating point number. Number next to prefix defines number of digits after dot.

Bit access to register spaces - HB, IB

Prefix	Description
B[1..64]	Binary format. Amount of bits being displayed provided in prefix. Bits are presented in order from least to most significant (opposite to binary representation of whole register).
D[1..64]	Decimal format. Value presented is calculated from amount of bits provided in prefix, with bit with lowest address being least significant (*little endian*)
H[1..64]	Hexadecimal format. Value presented is calculated from amount of bits provided in prefix, with bit with lowest address being least significant (*little endian*)

It is worth noting that use of D prefix to display more than 16 bits of data will return different results when combined with different access modes (registers, bits). Such behavior is result of storage model used for multi-register (32- or 64-bit) data. Most significant word is stored in register with lowest address (big endian) and, consequently, on bits with lowest addresses. Register access obeys this storage model, but bit access does not, treating bits as linear space from bit with lowest address to bit with highest address.

So, if one tries to read two registers using "register access":

#D2.IR0

then such a command can return:

134749453

but "bit access" to 32 bits from two registers:

#D32.IB0

will return:

487393288

The same applies to **H** prefix and to write access.

Predefined symbolic names

Name	Description
TIME	Returns local time read from RTC registers – the same as **#LT.IR0** command
DATE	Returns local date read from RTC registers – the same as **#LD.IR0** command
RTC	Returns UTC time and date read from RTC registers – the same as **#T1.IR0** command
NAME	Returns module name
SERIAL	Returns module serial number
IPADDR	Returns module current IP address

Date and time formats

User is allowed to specify date and time formats which will be used in SMS messages when timestamp processing commands are used. Module's configuration contains four format strings:

Date format is used by date processing commands (prefixes LD, UD)
Time format is used by time processing commands (prefixes LT, UT)
General format 1 and **2** are used by timestamp processing commands (prefixes T1 and T2, respectively)

Format strings can contain specific character combinations, related to date/time information, which will then be replaced with corresponding values during parsing. Apart from this, format strings can contain additional characters – they will be copied to resulting timestamp string unchanged.

Available specifiers are:

Specifier	Replaced with
YYYY	year, four digits (e.g. 2010)
YY	year, two digits (e.g. 10)
MM	month, two digits (01..12)
DD	day in month, two digits (01..31)
HH	hour, two digits (00..23)
MN	minute, two digits (00..59)
SS	second, two digits (00..59)

For example, if user defines "General format 1" as:

DD/MM/YYYY, HH:MN:SS

and when it will be applied to RTC registers by a SMS command:

#T1.IR0

returned string will look like:
>25/02/2010, 08:51:33

User should define at least **Date format** and **Time format** strings – this will ensure that use of LT, UT, LD and UD prefixes return expected data.

Other examples:

Read input registers 20:

#IR20

Write value 1 to holding register 0:

#HR0=1

Binary representation of input register 4 (readout):

#B.IR4

Read flag (bit) 4:

#B.IB4

Write hexadecimal value **01AC** to holding register 0:

#H.HR0=01AC

10.4. Memory map

All accessible from remote resources of MT-021 module were collected in two address spaces: analog inputs and internal registers.

10.4.1. Analog inputs address space

Address Dec	Bit address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Description
0	0	Month								Year								RTC
1	16	Hour								Day of month								
2	32	Seconds								Minutes								
3	48	Event source								Number of event in a second								
4	64	I1	I2	I3	I4					Q1	Q2	Q3	Q4	--	--	--	--	digital I/Os
5	80	Modem OK	GSM SEARCH	GSM OK	GSM ERROR					SMS ERR	NO SIM	PIN ERROR	PIN CNT					GSM status
6	96	GSM signal																GSM signal [0...31]
7	112																	Number of SMS messages sent since power on
8	128																	Number of SMS messages sent today
9	144																	Number of SMS messages which could not been sent
10	160	Lower 16-bits																Module on timer [s]
11	176	Higher 16-bits																
12	192	Time zone															Sign	Time zone [quarters]
13	208																	Analog input AN1 - internal units
14	224																	Analog input AN2 - internal units
15	240																	Analog input AN1 - engineering units (signed)
16	256																	Analog input AN2 - engineering units (signed)
17	272	Wire 1 OK	Wire 1 SHORT	Wire 1 No dev.	Wire 1 CRC					Wire 2 OK	Wire 2 SHORT	Wire 2 No dev.	Wire 2 CRC					1-Wire status
18	288																	Temperature - 1-Wire 1 (signed)
19	304																	Temperature - 1-Wire 2 (signed)
20	320	LAC																GSM LAC (Location Area Code) code
21	336	CID																GSM CID (Cell ID)
22	352																	Module restart code

Address Dec	Bit address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Description
23	368	I1 CNT	I2 CNT	I3 CNT	I4 CNT													Pulse counters flags
24	384	TMR 1	TMR2	TMR3	TMR4													Timer flags
25	400	RES ET	CALL AUTH ORIZE D															General flags: * RESET - set to '1' after reset * CALL AUTHORIZED - set to '1' on incoming authorized call
26	416	AN1 HiHi	AN1 Hi	AN1 Lo	AN1 LoLo					AN2 HiHi	AN2 Hi	AN2 Lo	AN2 LoLo					Analog inputs alarm flags
27	432	1-WI RE1 HiHi	1-WIR E1 Hi	1-WI RE1 Lo	1-WIR E1 LoLo					1-WIR E2 HiHi	1-WI RE2 Hi	1-WI RE2 Lo	1-WI RE2 LoLo					1-WIRE inputs alarm flags
28	448	CALL 1	CALL2	CALL 3	CALL4	CA LL 5	CA LL 6	CA LL 7	CA LL 8	CALL9	CALL 10	CALL 11	CALL 12	CA LL 13	CALL 14	CA LL 15	CALL1 6	Incoming calls flags
29	464	CALL 17	CALL 18	CALL 19	CALL 20	CA LL 21	CA LL 22	CA LL 23	CA LL 24	CALL2 5	CALL 26	CALL 27	CALL 28	CA LL 29	CALL 30	CA LL 31	CALL3 2	
30	480	EVT1	EVT2	EVT3	EVT4	EV T5	EV T6	EV T7	EV T8	EVT9	EVT1 0	EVT1 1	EVT1 2	EV T1 3	EVT1 4	EV T1 5	EVT16	Event flags
31	496	EVT 17	EVT18	EVT 19	EVT20	EV T2 1	EV T2 2	EV T2 3	EV T2 4	EVT25	EVT2 6	EVT2 7	EVT2 8	EV T2 9	EVT3 0	EV T3 1	EVT32	
32	512																	Power voltage [mV]
33	528	Lower 16-bits																IP address
34	544	Higher 16-bits																
35	560	Reserved																Reserved
36	576	Reserved																Reserved
37	592	Reserved																Reserved
38	608	Reserved																Reserved
39	624																	Number of failed GPRS logins (zeroed on reset)
40	640																	Number of successful GPRS logins (zeroed on reset)
41	656	Reserved																Reserved
42	672																	Number of sent e-mails (zeroed on reset)

Address Dec	Bit address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Description
43	688																	Number of e-mail sending errors (zeroed on reset)
44	576																	Number of e-mail sending retries (zeroed on reset)

"**GSM Status**" register flags description

Flag	Description
Modem OK	Successful modem initialization
GSM SEARCH	GSM network searching
GSM OK	Module registered in GSM network
GSM ERROR	Unsuccessful GSM registration attempt
SMS ERR	Unsuccessful SMS sending attempt
NO SIM	No SIM card, or SIM card inserted improperly
PIN ERROR	Wrong PIN
PIN CNT	Wrong PIN. Two attempts made. No more attempts will be made.

"1-Wire line status" register flags description

Flag	Description
Wire 1 OK	Successful communication with device on 1-Wire 1 line
Wire 1 SHORT	1-Wire 1 line short
Wire 1 No dev.	No device connected to 1-Wire 1 line
Wire 1 CRC	CRC error on 1-Wire 1 line
Wire 2 OK	Successful communication with device on 1-Wire 2 line
Wire 2 SHORT	1-Wire 2 line short
Wire 2 No dev.	No device connected to 1-Wire 2 line
Wire 2 CRC	CRC error on 1-Wire 2 line

10.4.2. Internal registers address space

Internal registers address space (read 03H/write 06H or 10) - Not zeroed at reset

Address Dec (Hex)	Bit address	Description	Symbol	LOW byte										HIGH byte					
				0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0 (0x00)	0	32 bit counter - input I1	CNT_I1	(Low 16 bits)															
1 (0x01)	16			(High 16 bits)															
2 (0x02)	32	32 bit counter - input I2	CNT_I2	(Low 16 bits)															
3 (0x03)	48			(High 16 bits)															
4 (0x04)	64	32 bit counter - input I3	CNT_I3	(Low 16 bits)															
5 (0x05)	80			(High 16 bits)															
6 (0x06)	96	32 bit counter - input I4	CNT_I4	(Low 16 bits)															
7 (0x07)	112			(High 16 bits)															
8 (0x08)	128	bits controlling outputs	OUT_CTRL	Q1	Q2	Q3	Q4												
9 (0x09)	144	special function code	SPEC_FUN_C																

10.5. Flags

During operation **MT-021** module governs a number of binary flags (assuming value True or False) that trigger rules processing and remote diagnostics.

The User has access to following flags:

Bit name	Description
I1…I4	State of binary inputs I1...I4
Alarm HiHi	Flag assuming value True if value of analogue or 1-wire input is higher than value set as Alarm HiHi (preserving relation to hysteresis)
Alarm Hi	Flag assuming value True if value if value of analogue or 1-wire input is higher than value set as Alarm Hi (preserving relation to hysteresis)
Alarm LoLo	Flag assuming value True if value of analogue or 1-wire input is lower than value set as Alarm LoLo (preserving relation to hysteresis)
Alarm Lo	Flag assuming value True if value of analogue or 1-wire input is lower than value set as Alarm Lo (preserving relation to hysteresis)
TMR1...TMR4	Synchronous timer flags
Module power on (reset)	Flag informs about power on (reset) unit