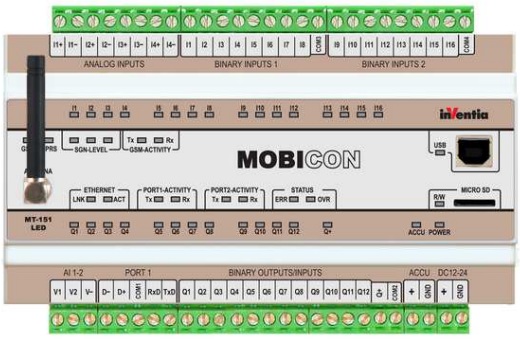
Professional Telemetry Module MOBICON MT-151 LED

User Manual



GSM/GPRS Telemetry Module for monitoring and control
Class 1 Telecommunications Terminal Equipment for GSM 850/900/1800/1900

CE

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1. Module destination

Telemetry Module MT-151 LED is a device which incorporates functions of industrial PLC, logger and protocol converter enriching it with robust wireless GSM/GPRS connectivity. Thanks to access to two independent GSM/GPRS networks Dual-SIM technology used in this device ensures continuity of data flow not achieved in other solutions.
Ethernet and two serial ports are powerful tools allowing communicating with other devices thus further expanding resources available to be used by user.
With compact, robust design, integral GSM modem, attractive technical features and easy to use configuration tools the MT-151 LED controller is an optimal solution for demanding wireless telemetry, control, diagnostic, surveillance and alarm systems.

General attributes of MT-151 LED:

- Dual-SIM technology (possibility of using 2 SIM card)
- Integral, quad-band 850/900/1800/1900 GSM modem
- 6 optoisolated binary inputs
- 12 optoisolated binary outputs with possibility of operation as binary inputs (selected independently for each output)
- 4 optoisolated 4 - 20mA analog inputs
- 2 optoisolated 0 -10V analog inputs
- Ethernet 10Base-T/100Base-TX port
- Optoisolated RS-232/485 serial port for communication with external devices
- Optoisolated RS-232 serial port with 5V power output dedicated for external control panels
- Diagnostic LEDs
- Backup power battery connector (build in battery charger)
- PLC functionality
- Standard industrial transmission protocols (Modbus RTU, Modbus TCP, Transparent) support and routing
- 3-year warranty

2. GSM requirements

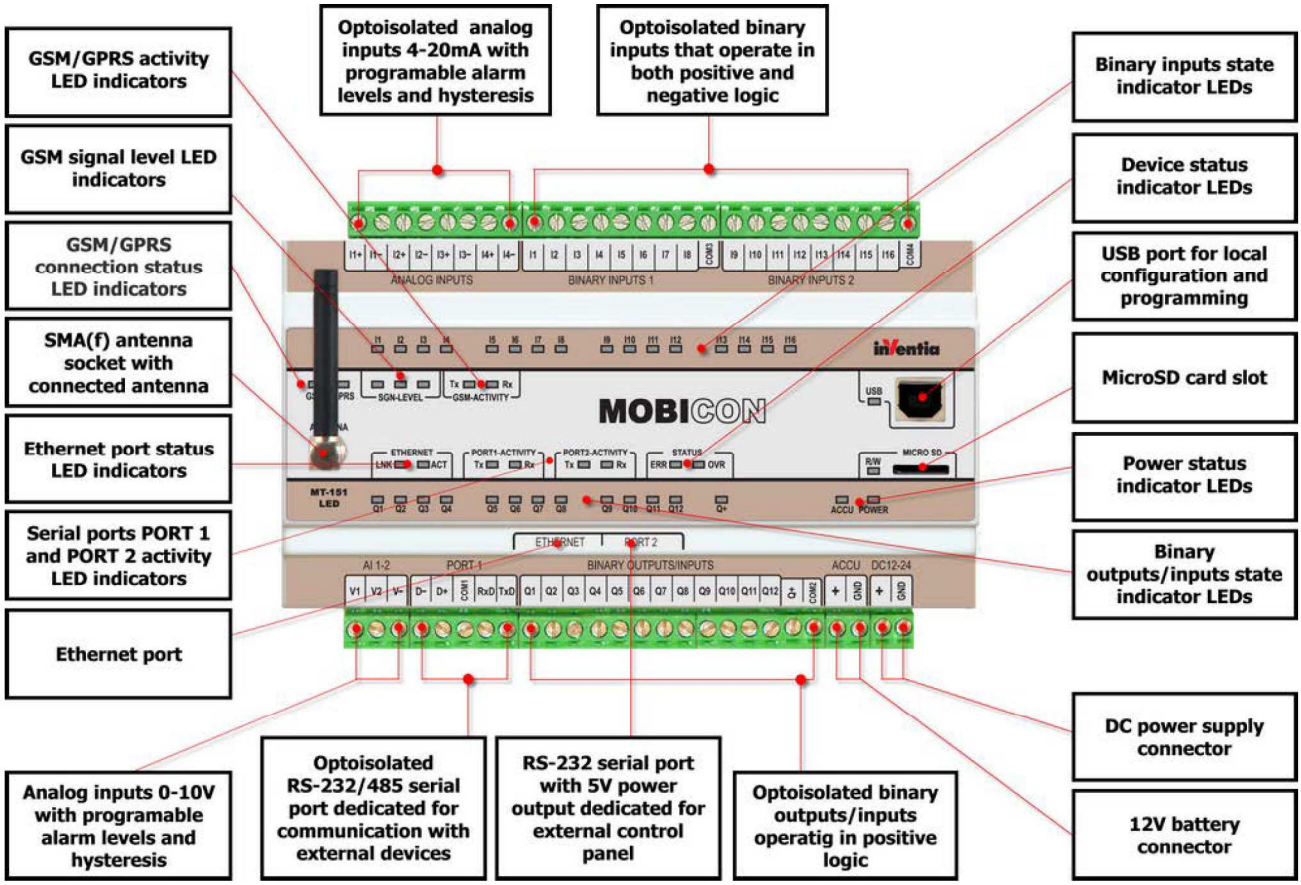
For proper operation, the module needs a SIM card supplied by a GSM operator providing GPRS and/or SMS services.

It is advised to use GPRS enabled SIM card with static IP addressing. The unique IP address of the SIM card is an identification for the module within the APN. This enables module-to-module and server-to-module communication within the APN structure. If SIM cards with dynamic addressing are used, then only module-to-server communication is possible.

A good and strong GSM signal in the place where the module's antenna is located is imperative for the proper function of the module. Using the module in places where the signal is weak may lead to interruptions in transmission and possible loss of transmitted data along with increased costs generated by transmission retries.

3. Module design

3.1. Topography



3.2. Hardware resources

Hardware resources of **MT-151 LED**

I1 - I16	binary inputs
Q1 -Q12	binary outputs that can operate as binary inputs
AI1 - AI4	4-20mA current analog inputs
AV1 - AV2	0-10V voltage analog inputs
PORT 1	RS-232/485 serial port
PORT 2	RS-232 serial port with 5V power output
Ethernet port	Ethernet 10Base-T/100Base-TX port
USB port	USB port used for configuration, programming and diagnostics
MicroSD card reader	Allows to install microSD memory card

3.2.1. Binary inputs

MT-151 LED telemetry module is equipped with 16 optoisolated binary inputs marked as **I1 - I16** which operate in both positive and negative logic. Binary inputs are divided into two groups (I1 - I8 and I9 - I16) with separate ground connector for each group. In addition binary outputs **Q1 - Q12** can be individually configured to operate as binary inputs, however they support only more common positive logic.

3.2.2. Binary outputs

MT-151 LED telemetry module is equipped with 12 optoisolated binary outputs marked as **Q1 - Q12**. Outputs state can be controlled locally by user written program or from remote via GPRS, SMS or using one of available communication ports.
In addition binary outputs **Q1 - Q12** can be individually configured to operate as binary inputs supporting positive logic.

3.2.3. Analog inputs 4-20mA

MT-151 LED telemetry module is equipped with 4 optoisolated analog inputs operating in 4-20mA range and marked as **AI1 - AI4**. Analog inputs measurement can be scaled in engineering units (e.g. in meters or percents). For each analog input user can define 4 alarm levels (2 high and 2 low) with hysteresis. It is also possible to define deadband parameter - each time measured value changes by value higher than defined by this parameter deadband bit assigned to this analog inputs rises for one program cycle. This bit can be used for tracking analog input value.

3.2.4. Analog inputs 0-10V

MT-151 LED telemetry module is equipped with 2 analog inputs operating in 0-10V range and marked as **AV1** and **AV2**. Analog inputs measurement can be scaled in engineering units (e.g. in meters or percents). For each analog input user can define 4 alarm levels (2 high and 2 low) with hysteresis. It is also possible to define deadband parameter - each time measured value changes by value higher than defined by this parameter deadband bit assigned to this analog inputs rises for one program cycle. This bit can be used for tracking analog input value.

3.2.5. Serial ports

MT-151 LED telemetry module is equipped with 2 serial ports:

- **PORT 1** - optoisolated RS-232/485 port designed for communication with external devices. Interface type and operating parameters are configurable using MTManager - program suite delivered for free with module.
- **PORT 2** - RS-232 port with 5V power output dedicated for communication with control panels and other devices.

3.2.6. Ethernet port

MT-151 LED telemetry module is equipped with Ethernet 10Base-T/100Base-TX port used for communication with external devices.

3.2.7. USB port

MT-151 LED telemetry module is equipped with USB B port which is used for device configuration (MTManager is required). Port is visible in system (driver only for Windows) as COM port. Device communicates at 115200 bps with 8 data bits, no parity bit and 1 stop bit. **Port is not optoisolated!**

3.2.8. MicroSD card reader

MT-151 LED telemetry module is equipped with microSD card reader supporting up to 2GB microSD cards. Cards should be formatted using FAT16 file system.

3.2.9. Real time clock

MT-151 LED module is equipped with Real Time Clock (**RTC**). This clock is a source for time measurement for the module timers and time stamping measurements stored in the logger and sent via GPRS.
It is recommended to manually synchronize modules real time clock during the first configuration performed using the **MTManager** program.

NOTICE!
The module RTC clock does not automatically adjust to summer/winter time. It is recommended to use UTC time to avoid loss of data during manual time adjustments.

NOTICE!
The RTC clock is powered from an internal battery and as long as it is operational there is no need to set the time again after power-off. Since the clock precision is not absolute, periodical time adjustment may be necessary.

3.3. Internal resources

3.3.1. Logger

MT-151 LED telemetry module is equipped with Logger capable of storing up to 12000 records, which allows to store measurements done every 10s for 30 hours or 40 days if measurement was saved every 5 minutes.
Records are saved asynchronously, meaning that the record writing is triggered by an event (defined by user in the Event table). The event may be e.g.: counting the time by the timer, GPRS logon, crossing one of defined alarm thresholds and other.
The logger records consists of up to 4 data blocks, 28 16-bit registers each. Each record in the logger has a time stamp of the module internal Real Time Clock (RTC).
The data written in the logger is transmitted to IP address assigned during configuration. Sending of the logger content is triggered by user defined events. Confirmation of reception marks records as sent. In case of overflowing logger the oldest records are overwritten.

3.3.2. Registers

MT-151 module provides access to measurements, and other data via 16-bit register divided into two groups according to Modbus device model - Input Registers (read only) and Holding Registers (read/write access). Remote access to registers is possible via SMS, GPRS (Modbus TCP and Standard Inventia protocol), serial ports (Modbus RTU) and Ethernet port (Modbus TCP).
Internal registers starting from address 1024 and Input register are zeroed after module restart (e.g. power off, module update).
Internal registers to address 1023 are nonvolatile.
There is possibility to access single bits of Input and Holding Registers - there is possibility to address them as Binary Inputs for Input Registers and Binary Outputs for Holding Registers. Detailed description of addressing method is described in Memory map chapter in Appendices.
Full list of register is available in Memory map chapter in Appendices.

3.3.3. Counters

MT-151 LED 16 general purpose counters. Their purpose is to count pulses understood as binary signal changes of any bit present in the memory map. Each counter has one incrementing and one decrementing input and assigned 32-bit register holding the difference of counted pulses.
Initial state of the counters may be defined by user activating MTManager menu item **Initial settings** (more info in **MTManager** manual).

3.3.4. Timers

MT-151 LED module is equipped with 16 general purpose programmable synchronous timers CT1 - CT16 synchronized with module RTC. Their function is counting constant user defined time intervals in range of 1 minute to 24 hours. The user may appoint months, days of month and days of week in which the timer is active.
In addition there are available 16 general purpose programmable asynchronous timers CK1 - CK16. These timers start counting when module is powered or reset and are not synchronized with RTC clock.

3.3.5. MT2MT buffer

MT2MT buffer enables creation of system where MT modules may exchange information (Holding Registers) with each other without any relaying instance.
Data transmission from one module to other is carried out by sending from one device group of Holding Registers with data to other device which has turned on MT2MT buffer functionality and defined MT2MT buffer which includes register addresses send from sending device. Data send by sender is saved to registers within buffer with same address. Each time new data arrives MT2MT_x bit is set, where x is position of sender IP address on receiver authorized IP list.

3.3.6. Constant parameters

In **MT-151 LED** module configuration user can define up to 128 constant parameters - 16-bit values in range from -32768 to 32767 that may be further used for control program parameterization. Values of constant parameters are nonvolatile.

3.3.7. System flags

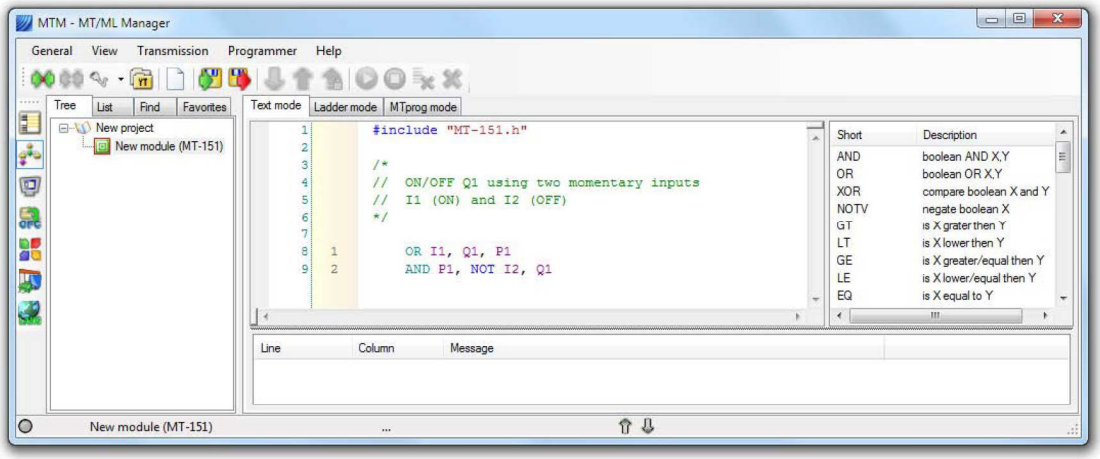
MT-151 LED provides various information about module status via system flags. Most important bits are:

- FS1_acu - when set to 1, then battery is connected to module;
- FS1_q+ - when set to 1, then there is no power provided for binary outputs;
- FS1_gprs - when set to 1, then module successfully logged into GPRS network;
- FS1_gsm - when set to 1, then module successfully logged into GSM network;

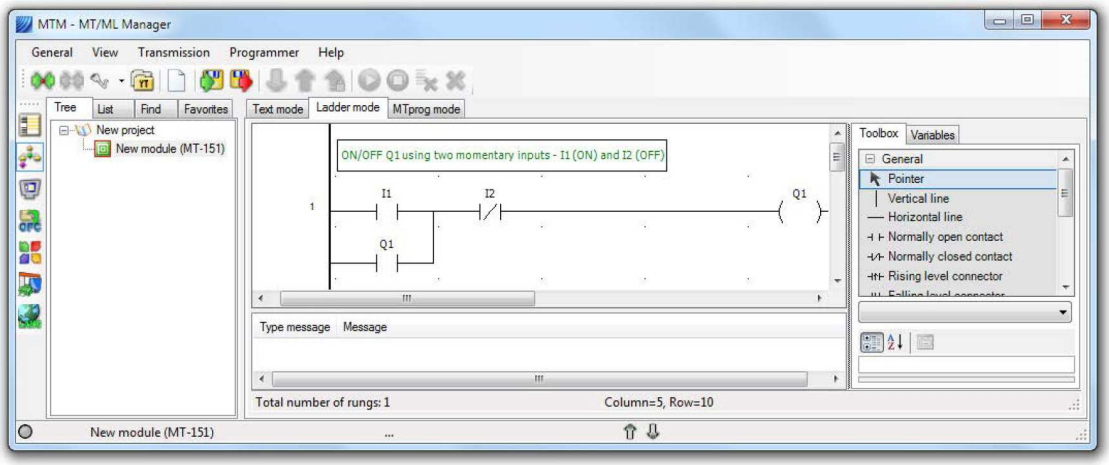
Full list of System flags is available in Memory map chapter in Appendices.

3.3.8. Control program

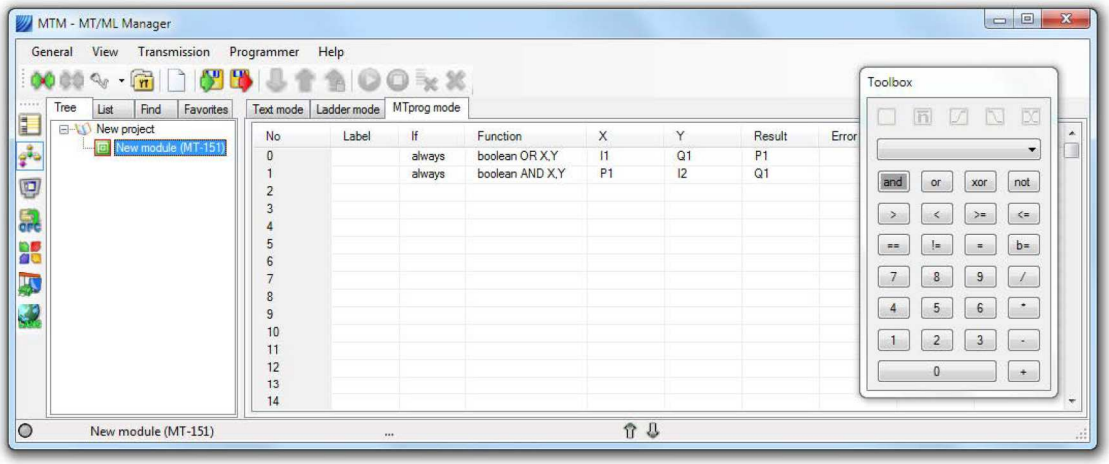
PLC functionality of MT-151 LED module allows user to define algorithm of control and data processing in form of control program. Program can be written in three languages available in MTManager.
Program is executed once a program cycle. There is 50ms delay between program cycles. Within this time module is capable of processing up to 10000 program lines. If program tries to execute more than 10000 lines it will be terminated in this program cycle. Maximum program length is 5000 lines.
Below is presented sample program which executes start/stop algorithm with two momentary inputs (I1 - start, I2 - stop) and one output (Q1).



MTManager - sample program in text mode



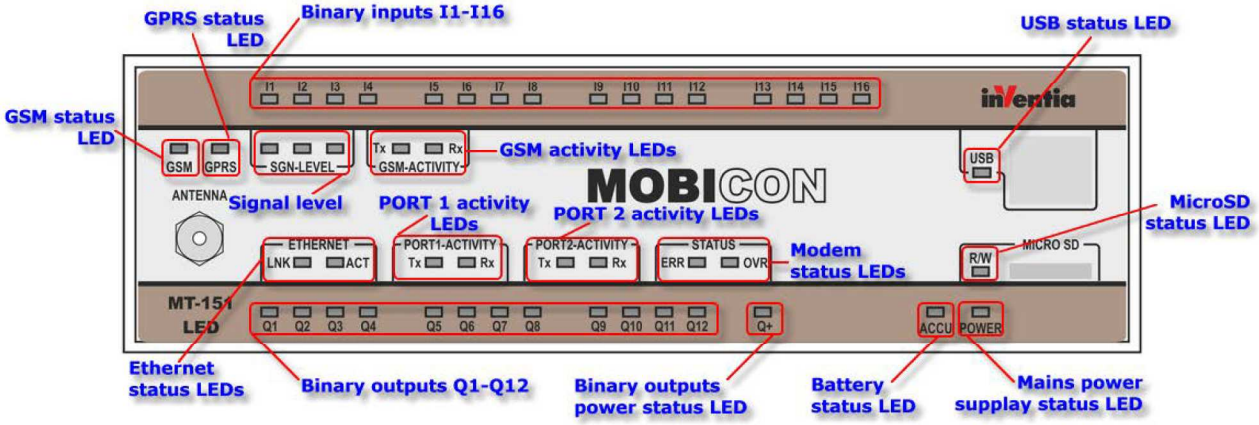
MTManager - sample program in ladder mode



MTManager - sample program in MTprog mode

3.4. LEDs

LED indicators placed on **MT-151 LED** front panel are a great help during module startup and troubleshooting.



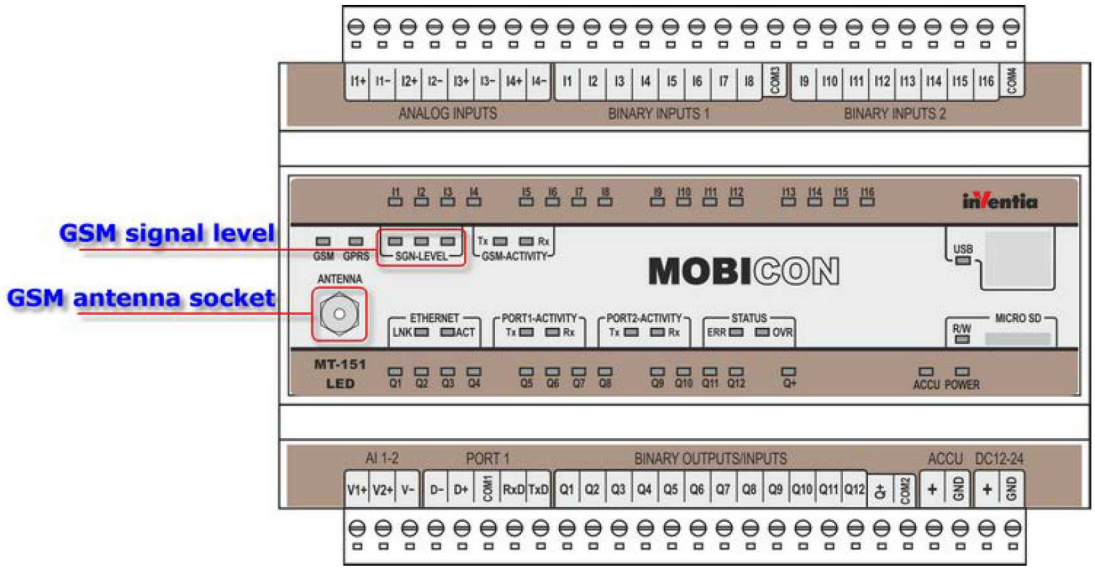
Detailed description of LED signaling can be found in LED signaling chapter.

3.5. SIM card slots

MT-151 LED module is equipped with two SIM card slots allowing to install two miniature (not micro!) SIM cards. For GPRS transmission it is advised to use static IP addressed SIM cards as it allows communication between devices and not only server and device.
Module support SIM cards using low voltage 3.3V technology.

3.6. Antenna

Connecting the antenna is necessary for reliable data transmission from **MT-151 LED** module. **SMA female** type antenna socket is placed on module front panel.



Proper antenna placement is important during the module installation. In case of low GSM signal level (all **SGN LEVEL** LED indicators are turned off) using the directional antenna with high gain may be necessary.

3.7. Power supply

MT-151 module can be powered from DC power supply providing voltage in range from 10.8 to 36 VDC.
In addition module supports using 12V SLA (Sealed Lead-Acid) battery as a backup power supply which provides power in case of loss of mains power supply.
Module has built in battery charger capable of servicing batteries with capacity up to 7Ah. Charger automatically charges battery if not fully charged. For proper operation charger demand that module is powered with voltage higher than 18V.
Module can be started only if mains power supply is present.

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

3.8. Enclosure

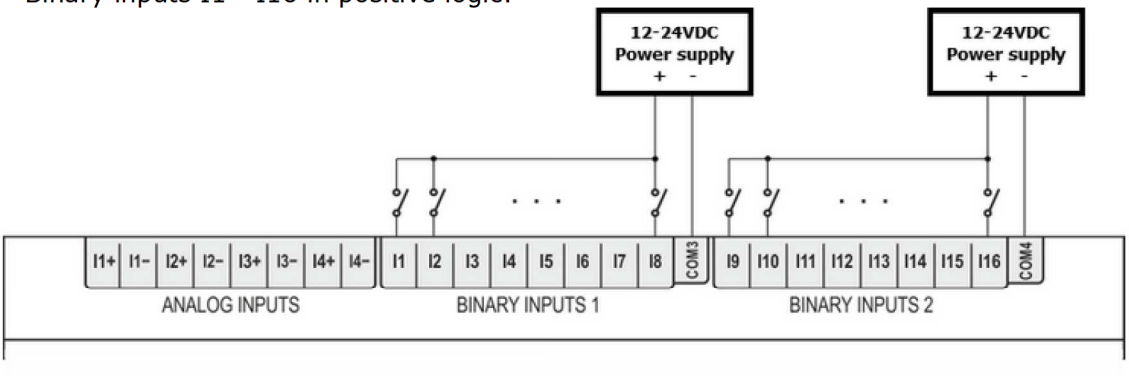
MT-151 LED module is encapsulated in standard IP40 housing made of plastic compliant with safety requirements and protecting the module in standard operating environment. The applied solution complies with standard industrial requirements for DIN rail mounting.

4. Connection diagrams

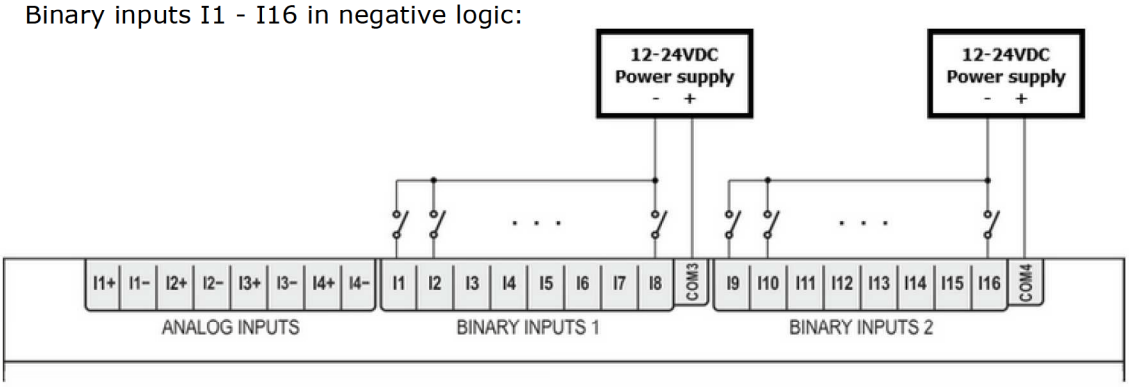
This chapter presents recommended wiring of external signals and installation of SIM card procedure.

4.1. Binary inputs

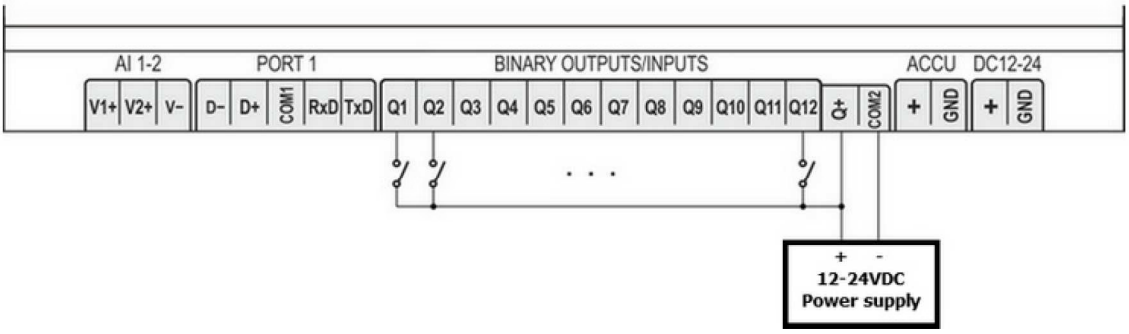
Binary inputs I1 - I16 in positive logic:



Binary inputs I1 - I16 in negative logic:



Binary inputs Q1 - Q12 in positive logic:

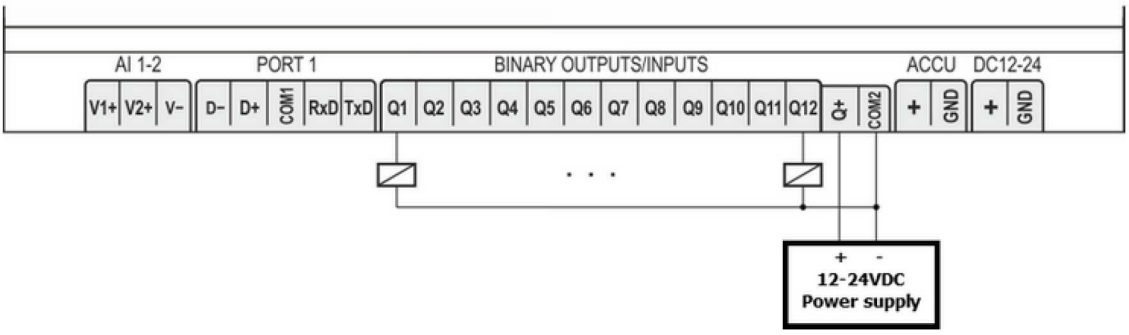


Attention!

- Power cables length should be < 10m
- Signal cables length should be < 30m
- For longer cables it is advised to use external overvoltage protection

4.2. Binary outputs

Binary outputs Q1 - Q12 in positive logic:

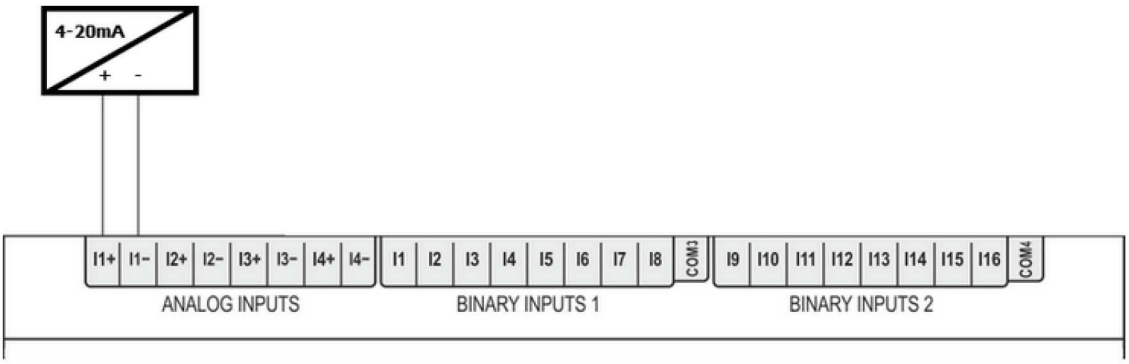


Attention!

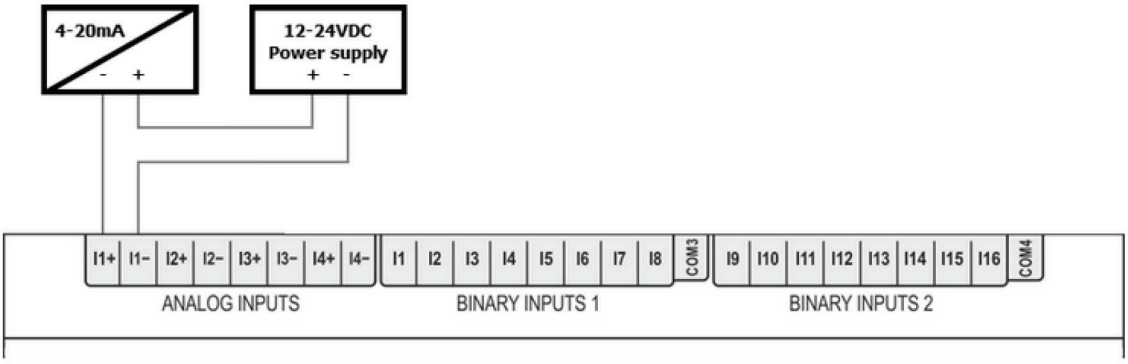
- Power cables length should be < 10m
- Signal cables length should be < 30m
- For longer cables it is advised to use external overvoltage protection

4.3. Analog inputs 4-20mA

Analog input AI1 - connection with active sensor:



Analog input AI1 - connection with passive sensor:

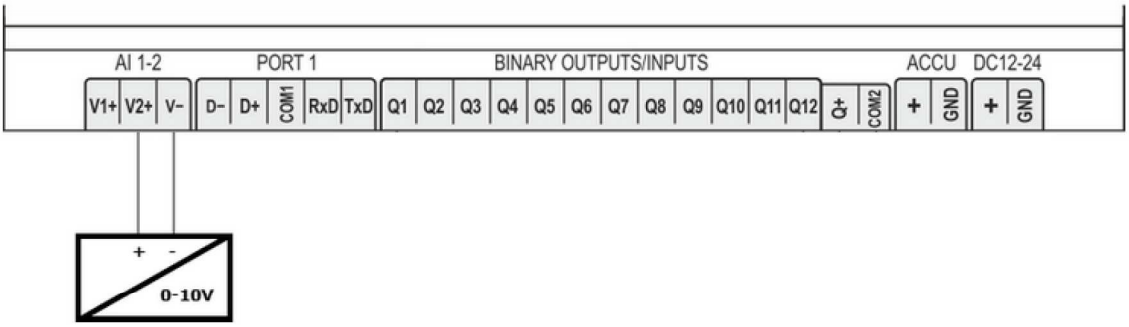


Attention!

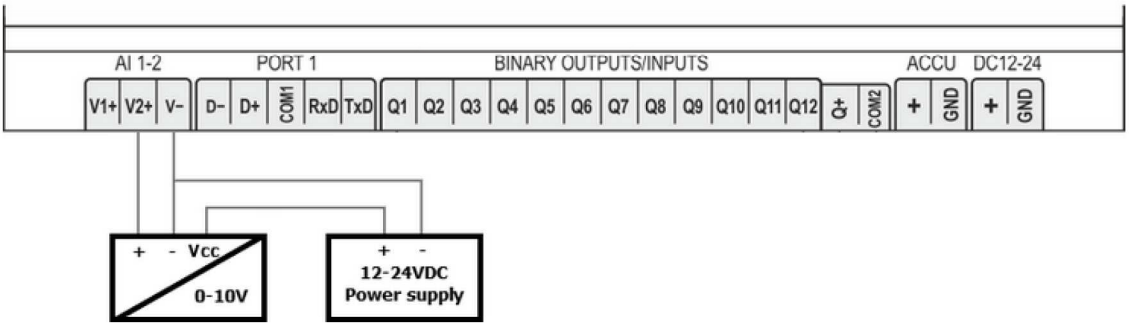
- Power cables length should be < 10m
- Signal cables length should be < 30m
- For longer cables it is advised to use external overvoltage protection

4.4. Analog inputs 0-10V

Analog input AV1 - connection with active sensor:



Analog input AI1 - connection with passive sensor:



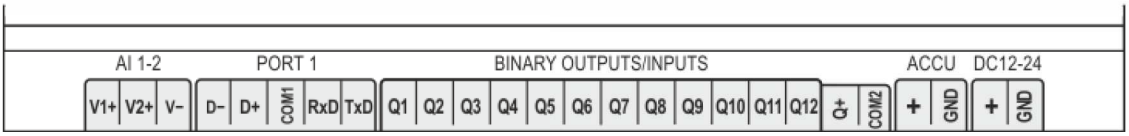
Attention!

- Power cables length should be < 10m
- Signal cables length should be < 30m

- For longer cables it is advised to use external overvoltage protection

4.5. Communication ports

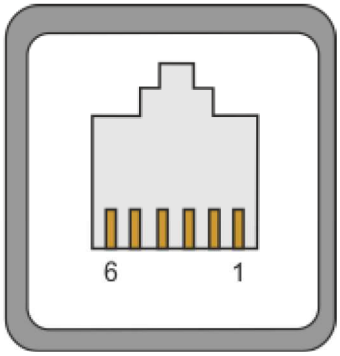
Port 1 - optoisolated RS-232/485 serial communication port. Port connector is located on terminal block as pictured below.



Connector name	Description
TXD	RS-232 - transceiver output
RXD	RS-232 - receiver input
COM1	Signal ground level for both modes
D+	RS-485 - transceiver output
D-	RS-485 - receiver input

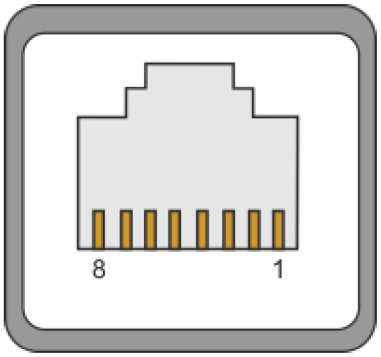
For operation in RS-232 mode cable length should not exceed 15m.

Port 2 - RS-232 serial communication port with 5V/500mA power output. No optoisolation. Port connector (RJ-12) is located on the front panel.



Pin	Description
1 - Vcc	+5V/500mA power output
2 – GND	Signal ground level
3 – TXD	Transceiver output
4 - RXD	Receiver input
5 – RTS	Handshake output (Ready To Send)
6 - CTS	Handshake input (Clear To Send)

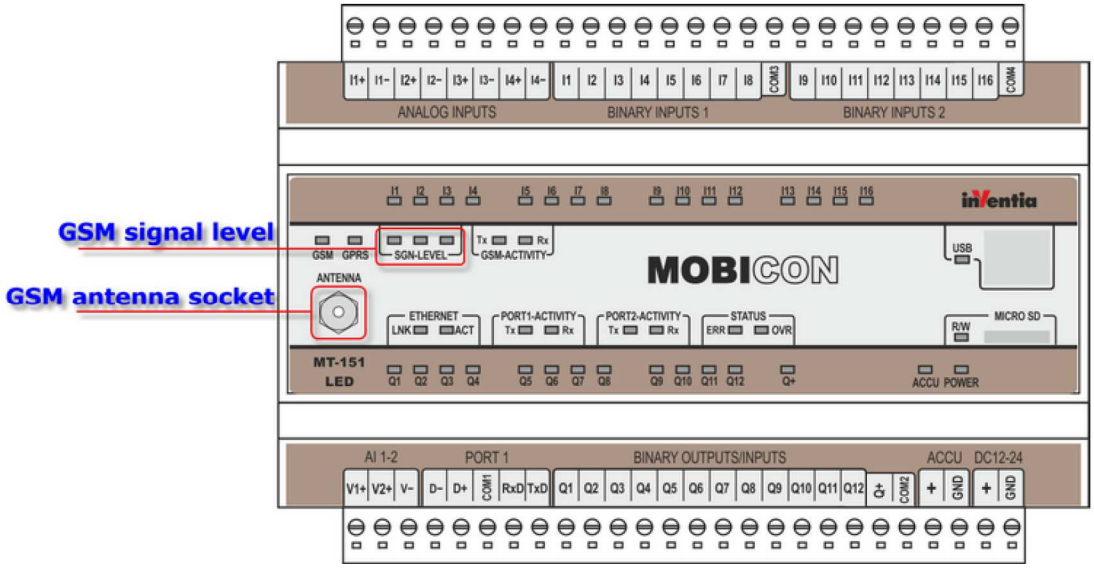
Ethernet port - optoisolated 10Base-T/100Base-TX communication port. Port connector (RJ-45) is located on the front panel.



Pin	Description
1 - TX+	Transceiver +
2 - TX-	Transceiver -
3 - RX+	Receiver +
4 - NC	Not connected
5 - NC	Not connected
6 - RX-	Receiver -
7 - NC	Not connected
8 - NC	Not connected

4.6. GSM antenna

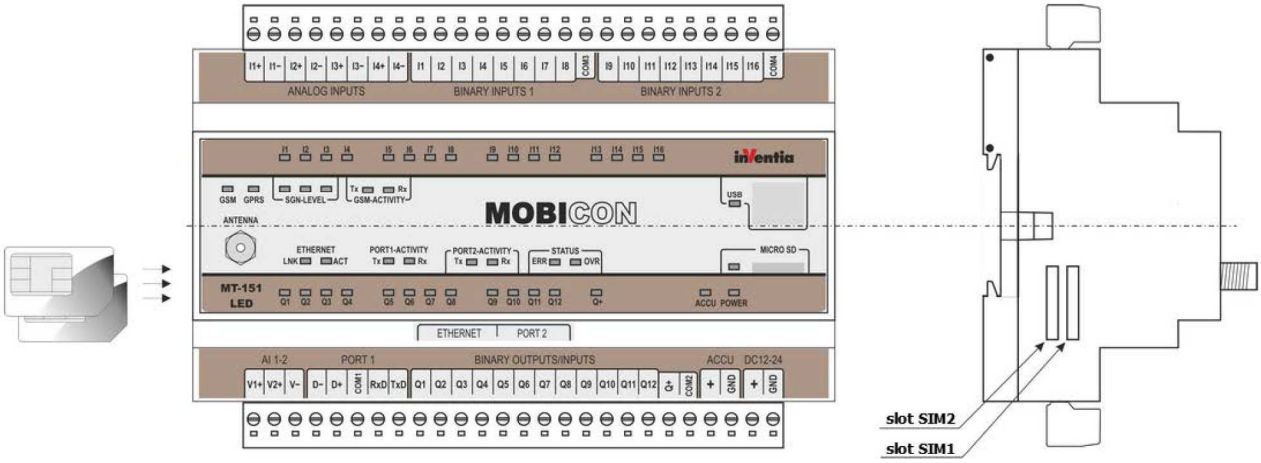
Connecting the antenna is necessary for reliable data transmission from **MT-151 LED** module. **SMA female** type antenna socket is placed on module front panel.



Proper antenna placement is important during the module installation. In case of low GSM signal level (all **SGN LEVEL** LED indicators are turned off) using the directional antenna with high gain may be necessary.

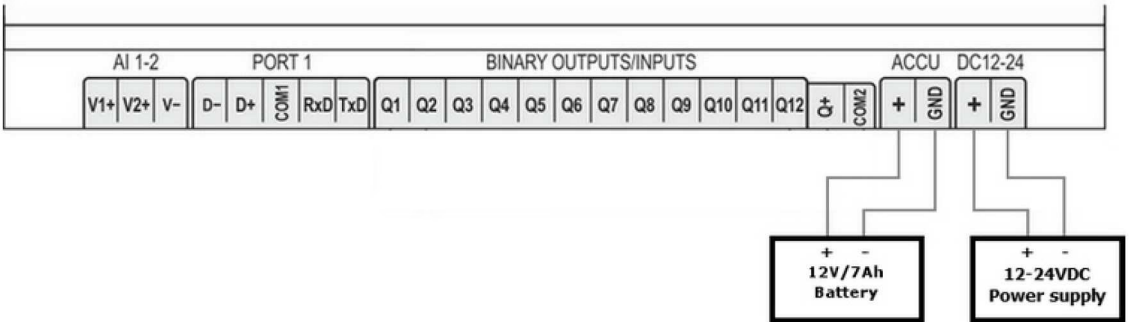
4.7. SIM card installation

MT-151 LED module is equipped with two SIM card slots allowing to install two miniature (not micro!) SIM cards. For GPRS transmission it is advised to use static IP addressed SIM cards as it allows communication between devices and not only server and device.
Module support SIM cards using low voltage 3.3V technology.
It is advised to install SIM card after configuration of module to prevent module from writing wrong PIN to SIM.



4.8. Power supply

Power supply and 12V/7Ah battery (backup power)



Pin	Group	Description
+	DC12-24	Positive pole of mains power supply connector
GND		Negative pole of mains power supply connector
+	ACCU	Positive pole of backup battery connector
GND		Negative pole of backup battery connector

Built-in battery charger requires power supply voltage higher than 18V.

Attention!

- Power cables length should be < 10m
- Signal cables length should be < 30m
- For longer cables it is advised to use external overvoltage protection

NOTICE!
Due to high peak current of MT-151 power supply should be able to deliver current >= 2A.
Improper power supply may result in faulty operation and damage the module!

5. Starting the module

First start of the MT-151 LED module requires a few simple activities. Please follow steps listed below:

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

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

2. **First configuration of the module**

   The scope of first configuration of **MT-151 LED** is to enter parameters enabling login to GSM network and optionally GPRS network. A USB connection to the computer running **MTManager** program suite has to be established. Detailed information on how to install and use the **MTManager** program is attached in the installation CD.

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

   In **GSM** group:

   Use of GPRS
   Yes - if using GPRS packet transmission is intended
   No - if the module is not going to use GPRS packet transmission
   Use of SMS
   Yes - if using SMS messaging is intended
   No - if the module is not going to use SMS messaging

   In **GSM/SIM1** group:

   SIM card name PIN number
   provide PIN code for SIM card that is going to be placed in the module (unless the card is set in pin-less mode).
   APN name
   provide APN name for GPRS transmission. Visible when *Use of GPRS* parameter is set to ***Yes***.
   APN user name
   provide user name (if required by the operator). Visible when *Use of GPRS* parameter is set to ***Yes***.
   APN password
   provide the password (if required by the operator). Visible when *Use of GPRS* parameter is set to ***Yes***.

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

3. Inserting the SIM card

After downloading the first configuration disconnect the USB and power cables, insert the SIM card to SIM1 slot according to the instructions from previous chapter and reconnect power cable. The module should login to the GSM/GPRS network.
The status of the module may be verified by comparing LED indicators with the table provided in the LED signaling subchapter in Problem solving chapter.

Login sequence:

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

Verify the configuration if any errors are indicated.

4. Setting the module time

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

6. Interfaces and communication methods

6.1. Port 1

PORT 1 is a optoisolated RS-232/485 port designed for communication with external devices. Interface type and operating parameters are configurable using MTManager - program suite delivered for free with module.

6.1.1. Transparent mode

In this mode MT-151 LED communication from serial port Port 1 is channeled to other communication port or GPRS network according to rules defined in Transparent routing table. This allows to communicate two or more devices using protocol not implemented in MT-151 LED.
If module receives on port operating in that Modbus RTU command to ID which is matching ID for Port 1 it will respond to that command allowing user to get data from device.

6.1.2. Modbus RTU Master mode

In this mode MT-151 can poll for data from and write data to external Slave devices connected to that port using Data blocks. Each Data block defines number of addresses in Slave device and matching registers in Holding Registers address space in module. Module polls for data with given interval and saves it in module. If new data is saved to those registers by SMS, GPRS transmission, control program or any other method but from Port 1, this new data will be written to Slave device.
In this mode MT-151 is using Modbus RTU functions 1, 2, 3 and 4 for polls and 5, 6 for writes.
For each data block there is **SLx_ok** bit, where x is following number of data block, which informs about proper communication within this data block.
Also polls and writes from external devices communicating with MT-151 can be routed to Port 1 according to rules defined in Modbus routing table. All those commands are automatically translated to Modbus RTU protocol.

6.2. Modbus RTU Slave mode

In this mode MT-151 module acts on this port as Modbus RTU Slave device and awaits for incoming Modus RTU commands. It will react on command that are send to ID matching ID of MT-151 for that port.
Incoming Modbus RTU commands can be routed to other ports or GPRS according to routing rules defined in Modbus routing table thus allowing to communicate devices connected to different ports. If command is routed to Ethernet port it is automatically translated into Modbus TCP protocol. If it is routed to GPRS then it is automatically translated to chosen in GPRS parameter section protocol.

6.3. Port 2

PORT 2 is a RS-232 serial port with 5V power output dedicated for communication with control panels and other devices. It is not optoisolated.

6.3.1. Transparent mode

In this mode MT-151 LED communication from serial port Port 2 is channeled to other communication port or GPRS network according to rules defined in Transparent routing table. This allows to communicate two or more devices using protocol not implemented in MT-151 LED.
If module receives on port operating in that Modbus RTU command to ID which is matching ID for Port 2 it will respond to that command allowing user to get data from device.

6.3.2. Modbus RTU Slave mode

In this mode MT-151 module acts on this port as Modbus RTU Slave device and awaits for incoming Modus RTU commands. It will react on command that are send to ID matching ID of MT-151 for that port.
Incoming Modbus RTU commands can be routed to other ports or GPRS according to routing rules defined in Modbus routing table thus allowing to communicate devices connected to different ports. If command is routed to Ethernet port it is automatically translated into Modbus TCP protocol. If it is routed to GPRS then it is automatically translated to chosen in GPRS parameter section protocol.

6.4. Ethernet port

MT-151 LED telemetry module is equipped with Ethernet 10Base-T/100Base-TX port used for communication with external devices. MT-151 operates simultaneously as Master and Slave on this port.
Communication via this port is possible only with devices added to Authorized IP addresses list.

6.4.1. Modbus TCP Client

Modbus TCP Client functionality allows MT-151 to poll for data from and write data to external Modbus TCP Server devices connected to that port using Data blocks. Each Data block defines number of addresses in Server device and matching registers in Holding Registers address space in module. Module polls for data with given interval and saves it in module. If new data is saved to those registers by SMS, GPRS transmission, control program or any other method, this new data will be written to Server.
In this mode MT-151 is using Modbus TCP functions 1, 2, 3 and 4 for polls and 5, 6 for writes.
For each data block there is **TSLx_ok** bit, where x is following number of data block, which informs about proper communication within this data block.
Also polls and writes from external devices communicating with MT-151 can be routed to Ethernet device according to rules defined in Modbus routing table. All those commands are automatically translated to Modbus RTU protocol.
Modbus TCP Client connects to servers using port 502.

6.4.2. Modbus TCP Slave

MT-151 operates as a server listening on port 502 and awaits for Modbus TCP frames. It will react on command that are send to ID matching ID of MT-151 for that port.
Incoming Modbus TCP commands can be routed to other ports or GPRS according to routing rules defined in Modbus routing table thus allowing to communicate devices connected to different ports. If command is routed to serial port it is automatically translated into Modbus RTU protocol. If it is routed to GPRS then it is automatically translated to chosen in GPRS parameter section protocol.

6.5. GPRS

MT-151 LED module is equipped with build-in GSM/GPRS modem, which allows device to send and receive SMS messages and transmit data using GPRS network.
In sent SMS messages may be use special mnemonics which are dynamically changed to values from module memory. Same mnemonics in received messages can be used for polling and/or writing data to module. More details about SMS commands can be found in SMS commands syntax chapter in Appendices.
GPRS data transmission allows to communicate device with remote server or other device accessible from APN assigned to used SIM card. MT-151 is using two protocols for GPRS communication:

- *MT Standard* - module communicates using the protocol and transmission protection created by Inventia. This data frame is supported by all software tools provided with module.
- *UDP Standard* - data is send in form of Modbus RTU command encapsulated in standard UDP data frame. Data reception control is not available when using that data frame format. Detailed description of UDP Standard communication is available upon request from Inventia technical support team.

7. Configuration

MT-151 just like other MT devices is configured using **MTManager** (MTM) which is provided for free with all MT equipment.

MTManager is unified program environment allowing to set up and maintain over whole telemetric system or systems regardless of its scale. Possibility of arranging devices in groups of projects or putting them in folders makes effective managing of telemetry system easy.

All described on next pages parameters are available in MTManager configuration module after adding MT-151 to project. Detailed description of MTManager functionality is provided in MTManager User Manual.

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

7.1. Parameter groups

For clarity and ease of use module configuration parameters of MT-151 were 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 configuration parameters.
- GSM group - contains parameters responsible for GSM/GPRS networking.
- Resources group - defines parameters of hardware and software resources related with measurements.
- Communication ports group - contains parameters controlling both local and remote communication using serial and Ethernet as well as GPRS transactions. It is possible to set up routing rules for each port allowing to automatically pass data between communication ports.
- Communication group - contains lists of transmission tasks to be carried out upon occurrence of activating criteria.

There is also possibility to set up initial values for some of module resources (like counters) using MTManager Presets tool.

7.1.1. Header

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

7.1.1.1. Module name

Function - Displays name assigned to module during configuration
Data type - Text
Range - N/A, read-only parameter
Comments - N/A

7.1.1.2. Module type

Function - Displays the type of configured telemetry module
Data type - Text
Range - N/A, read-only parameter
Comments - N/A

7.1.1.3. Module serial number

Function - Displays serial number of telemetry module
Data type - Text
Range - N/A, Read-only parameter
Comments - This field displays serial number assigned to module during manufacturing. This number is static and unique identifier of the unit.

7.1.1.4. Modem firmware version

Function - Displays modem firmware version
Data type - Text
Range - N/A, read-only parameter
Comments - N/A

7.1.1.5. IMEI number

Function - Displays GSM modem IMEI number
Data type - Text
Range - N/A, read-only parameter
Comments - N/A

7.1.1.6. Firmware version

Function - Displays module firmware version
Data type - Text
Range - N/A, read-only parameter
Comments - N/A

7.1.1.7. Configuration file version

Function	- Displays version identification of configuration file used for actual configuration
Data type	- Text
Range	- N/A, read-only parameter
Comments	- Value depends on module firmware version. Auxiliary extension character defines the sub-version

7.1.1.8. Configuration identifier

Function	- Displays identification number of current configuration
Data type	- Hexadecimal number
Range	- N/A, read-only parameter
Comments	- The value of this parameter increases automatically by 1 after each successfully written configuration.

7.1.1.9. Last configuration date

Function	- Displays date and time of last successful configuration change
Data type	- Text
Range	- N/A, read-only parameter
Comments	- The value changes automatically after each successful configuration change. It is useful for tracing unauthorized configuration changes.

7.1.1.10. Last reading time

Function	- Displays internal module time recorded during last configuration reading or during last time setting
Data type	- Text
Range	- N/A, read-only parameter
Comments	- This field is useful in verifying last access time and checking internal module clock (RTC) settings

7.1.2. General

General group contains basic configuration and configuration protection parameters.

7.1.2.1. Device identifier

Function	- Selects device identifier used which is added to data frames sent by device and then to identify sender by server software (e.g. MTDataProvider)
Data type	- Selection list

Range - *IP address*
IP address assigned to device by GSM provider is used as identifier. Advantage of this solution is possibility of changing device on site to other of same type without need to reconfigure server. SIM card used with device should have static IP address.
Serial number
Serial number of device is used as identifier. Advantage of this solution is possibility of operation in APN with dynamic IP addressing.

Default value - *IP address*

Comments - N/A

7.1.2.2. Module IP

Function - Displays IP address assigned to module by GSM provider during last communication with module. It is used for remote configuration via GPRS.

Data type - IP address

Range - *0.0.0.0 - 255.255.255.255*

Default value - *0.0.0.0*

Comments - When this field is left at default value 0.0.0.0 remote communication with the module is impossible. IP address can be inserted manually to allow access to remote module via GPRS.

7.1.2.3. 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.

Data type - Text

Range - Letters and numbers, 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.

7.1.2.4. Configuration read disable

Function - Blocks reading of module configuration even when using valid password

Data type - Selection list

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

Default value - *No*

Comments - This parameter does not influence writing a new full configuration but prevents writing changes if configuration identifier in the module and in MTManager do not match

7.1.2.5. Error display time

Function - Defines (in seconds) time of displaying error code on Status GSM, SGN LEVEL and ERR LEDs

Data type - Number

Range - *1 - 250 [s]*

Default value - *30 [s]*

Comments - setting of too small value makes error code identification difficult while too long value extends the time span before module attempt to fix the problem.

7.1.3. GSM

GSM group contains parameters responsible for GSM/GPRS networking. Proper configuration of those parameters is essential for successful GSM and GPRS communication.

7.1.3.1. Number of SIM cards

Function - Defines number of SIM cards used by device. There are two slot for SIM cards - SIM1 (upper slot) and SIM2 (lower slot)

Data type - Selection list

Range - *1*
Only SIM1 slot is used by device
2
Both slots are used by device

Default value - *1*

Comments - N/A

7.1.3.2. Use of GPRS

Function - Enables GPRS communication

Data type - Selection list

Range - *Yes*
GPRS communication is allowed
No
GPRS communication is disabled

Default value - *Yes*

Comments - If set to *Yes* allows user to configure parameters essential for setting up GPRS communication. When set to *No* module will make no attempt to log into GPRS network.
If both GPRS and SMS are not used module disables all modem functionality.

7.1.3.3. Use of SMS

Function - Enables SMS communication

Data type - Selection list

Range - *Yes*
SMS communication is allowed
No
SMS communication is disabled

Default value - *Yes*

Comments - If set to *Yes* allows module to both receive and send SMS to Authorized phone numbers. When set to *No* module will not send not service received SMS messages. All received SMS will be deleted.
If both GPRS and SMS are not used module disables all modem functionality.

7.1.3.4. SIM1

SIM1 group contains parameters responsible for establishing GSM/GPRS communication using SIM card inserted into SIM1 slot (upper one).

7.1.3.4.1. 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 - Text

Range - Numerals, max 8 characters

Default value - N/A

Comments - Wrong pin can cause SIM card lock

NOTICE!
Caution is vital when setting the PIN code value. Entering incorrect PIN code may cause module start-up to be impossible and lock SIM card. For security reasons module makes attempt to enter PIN twice.

To unlock SIM card please follow procedure described in Problem solving chapter.

7.1.3.4.2. APN name

Function - Defines APN name which is used by module to carry out GPRS transmission using that SIM

Data type - Text

Range - Letters, numerals and special characters - max. 32 characters

Default value - N/A

Comments - Absence of APN name disables login into GPRS network

7.1.3.4.3. APN user name

Function	-	Defines APN user name, which will be used to log into APN
Data type	-	Text
Range	-	Letters, numerals and special characters - max. 32 characters
Default value	-	N/A
Comments	-	Optional parameter used only if required by GSM network operator

7.1.3.4.4. APN password

Function	-	Defines password, which will be used to log into APN
Data type	-	Text
Range	-	Letters, numerals and special characters - max. 32 characters
Default value	-	N/A
Comments	-	Optional parameter used only if required by GSM network operator

7.1.3.4.5. GPRS testing interval (ping)

Function	-	Defines in minutes interval of testing GPRS connection
Data type	-	Number
Range	-	*0 - 250 [min.]*
Default value	-	*40 [min.]*
Comments	-	Testing is performed by sending data frames to defined by the parameter GPRS testing address. Test frames are sent when the module is logged into APN and no communication is performed during the defined by this parameter period. If the test fails, that is the module does not receive confirmation within 12 seconds and after 3 retries - the connection to the APN is reset.

7.1.3.4.6. GPRS testing address (ping)

Function	-	Defines IP address used for sending GPRS transmission test frames.
Data type	-	IP address
Range	-	*0.0.0.0 - 255.255.255.255*
Default value	-	*0.0.0.0*
Comments	-	When this field is left at default value 0.0.0.0 test frames are sent to IP chosen by module from Authorized IP list. It is advised to set this parameter to IP address of device collecting data or other IP address always connected to APN.

7.1.3.4.7. Roaming

Function - Defines whether operation in foreign GSM network is allowed
Data type - Selection list
Range - *On*
In case of absence of home network, the module will attempt to login to other available network
Off
Login into foreign networks is not allowed
Default value - *Off*
Comments - This parameter decides whether module will try to login to available foreign networks in the absence of home network. This is possible only when the SIM card in module has roaming service enabled.

7.1.3.5. SIM2

SIM2 group contains parameters responsible for establishing GSM/GPRS communication using SIM card inserted into SIM2 slot (lower one).

7.1.3.5.1. 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 - Text
Range - Numerals, max 8 characters
Default value - N/A
Comments - Wrong pin can cause SIM card lock

NOTICE!
Caution is vital when setting the PIN code value. Entering incorrect PIN code may cause module start-up to be impossible and lock SIM card. For security reasons module makes attempt to enter PIN twice.

To unlock SIM card please follow procedure described in Problem solving chapter.

7.1.3.5.2. APN name

Function - Defines APN name which is used by module to carry out GPRS transmission using that SIM
Data type - Text
Range - Letters, numerals and special characters - max. 32 characters
Default value - N/A
Comments - Absence of APN name disables login into GPRS network

7.1.3.5.3. APN user name

Function	-	Defines APN user name, which will be used to log into APN
Data type	-	Text
Range	-	Letters, numerals and special characters - max. 32 characters
Default value	-	N/A
Comments	-	Optional parameter used only if required by GSM network operator

7.1.3.5.4. APN password

Function	-	Defines password, which will be used to log into APN
Data type	-	Text
Range	-	Letters, numerals and special characters - max. 32 characters
Default value	-	N/A
Comments	-	Optional parameter used only if required by GSM network operator

7.1.3.5.5. GPRS testing interval (ping)

Function	-	Defines in minutes interval of testing GPRS connection
Data type	-	Number
Range	-	*0 - 250 [min.]*
Default value	-	*40 [min.]*
Comments	-	Testing is performed by sending data frames to defined by the parameter GPRS testing address. Test frames are sent when the module is logged into APN and no communication is performed during the defined by this parameter period. If the test fails, that is the module does not receive confirmation within 12 seconds and after 3 retries - the connection to the APN is reset.

7.1.3.5.6. GPRS testing address (ping)

Function	-	Defines IP address used for sending GPRS transmission test frames.
Data type	-	IP address
Range	-	*0.0.0.0 - 255.255.255.255*
Default value	-	*0.0.0.0*
Comments	-	When this field is left at default value 0.0.0.0 test frames are sent to IP chosen by module from Authorized IP list. It is advised to set this parameter to IP address of device collecting data or other IP address always connected to APN.

7.1.3.5.7. Roaming

Function - Defines whether operation in foreign GSM network is allowed
Data type - Selection list
Range - *On*
In case of absence of home network, the module will attempt to login to other available network
Off
Login into foreign networks is not allowed
Default value - *Off*
Comments - This parameter decides whether module will try to login to available foreign networks in the absence of home network. This is possible only when the SIM card in module has roaming service enabled.

7.1.3.6. GPRS

GPRS contains parameters applying to GPRS communication handling valid for both SIM cards.

7.1.3.6.1. Sender IP address control

Function - Switches the control of sender IP address on/off
Data type - Selection list
Range - *Yes*
The module exchanges information only with IP addresses present on the Authorized IP list.
No
The module exchanges information (configuration, responses for queries) with any IP address sending qualified query or command. In this case the identification of the sender goes by its current identifier.
Default value - *Yes*
Comments - Switching the control off enables verification of the sender on the base of its currently assigned identifier other than IP address (e.g. serial number or virtual IP for MT-1XX series). This allows communication among units with dynamically assigned IP addresses (within same APN).
Sender's identifier must reside on Authorized IP list in order to establish the communication.

7.1.3.6.2. Wait time after disconnection

Function - Defines interval between GPRS connection attempts
Data type - Number
Range - *0.01 - 655.350 [s]*
Default value - *5.00 [s]*
Comments - N/A

7.1.3.6.3. UDP data frame format

Function - This parameter selects data frame type used by module for GPRS communication

Data type - Selection list

Range - *MT Standard*
Module communicates using the protocol and transmission protection created by Inventia. This data frame is supported by all software tools provided with module.
UDP Standard
Data is send in form of Modbus RTU command encapsulated in standard UDP data frame. Data reception control is not available when using that data frame format.

Default value - *MT Standard*

Comments - Detailed description of UDP Standard communication is available upon request from Inventia technical support team.

7.1.3.6.4. GPRS transmission retries number

Function - Defines number of attempts to send data through GPRS network if the reply to original transmission does not arrive in a timely manner specified by Transmission timeout parameter.

Data type - Number

Range - *0 - 9*

Default value - *2*

Comments - Setting the value to 0 results in sending data without waiting for reception confirmation.
In normal conditions the value should not exceed 3. This prevents loss of transmitted data without blocking of subsequent rules processing. Bear in mind that subsequent data will be sent after reception of confirmation for reception of previous frame.

7.1.3.6.5. Transmission timeout

Function - Defines the wait time for reception confirmation of sent data frame.

Data type - Number

Range - *1 - 60 [s]*

Default value - *8 [s]*

Comments - The value of this parameter along with number of transmission retries influences max. time of sending a data frame. For default values the time is (2 + 1) * 8 = 24s. After that time module drops data frame from queue.

7.1.3.7. SMS

SMS contains parameters related to sending and receiving of text messages by 151 LED module.

7.1.3.7.1. Daily SMS limit

Function	-	Defines maximum 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	-	*0 - 65535*
Default value	-	*0*
Comments	-	Setting this parameter to *0* removes daily SMS limit

NOTICE!
Reaching set by the parameter limit results with unconditional stop of SMS sending. One has to bear in mind that until 00:00 o'clock no messages will be sent even in alarm situations!
Unsent due to limitation SMS messages are queued (the queue holds up to 16 messages) and will be sent when it is possible (after midnight). If the number of queued messages is higher than the limit set by user, there is a risk of immediate consuming of the next day limit.

7.1.3.7.2. Number of SMS sending retries

Function	-	Defines maximum number of retries of unsuccessful SMS transmission
Data type	-	Number
Range	-	*0 - 255*
Default value	-	*3*
Comments	-	After reaching the defined value the SMS is deleted from sending queue.

7.1.3.7.3. SMS limit exceed information

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

7.1.3.7.4. Recipient of SMS limit exceed information

Function	-	Selects the SMS limit alert recipient
Data type	-	Selection list
Range	-	*None* and numbers defined in GSM -> Authorized numbers -> Phone list for SMS transmission
Default value	-	*None*
Comments	-	N/A

7.1.3.7.5. Answer for blank SMS

Function	-	Defines the text of reply for empty SMS to the sender.
Data type	-	Text
Range	-	Letters, numerals and special characters - max. 160 characters
Default value	-	*Hello, here MT-151*
Comments	-	In replay message text may be used symbolic names and macros following syntax rules defined in Appendices in the SMS commands syntax chapter.

7.1.3.7.6. Formats

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

7.1.3.7.6.1. Date format

Function	-	Defines date format used by #date predefined symbolic name
Data type	-	Text
Range	-	Letters, numerals and special characters - max. 31 characters
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. 2013), *YY* - if placed in this format text automatically changed for year in two digit notation (e.g. 13), *MM* - if placed in this format text automatically changed for month (e.g. 07 for January), *DD* - if placed in this format text automatically changed for day of month (e.g. 26). Example: Parameter is set to: *Date of measurement: YYYY-MM-DD* Macro result is (providing today is 26th of July 2013): *Date of measurement: 2013-07-26*

7.1.3.7.6.2. Time format

Function - Defines date format used by *#time* predefined symbolic name
Data type - Text
Range - Letters, numerals and special characters - max. 31 characters
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. 23),
SS - if placed in this format text automatically changed for current seconds (e.g. 45).
Example:
Parameter is set to:
Time of measurement: HH:MN:SS
Macro result is (providing the time is 01:23:45):
Time of measurement: 01:23:45

7.1.3.7.7. Symbolic names

Symbolic names group contains names assigned by the user referring to bits or registers. There can be defined up to 32 symbolic names.
In order to use a symbolic name in SMS put it name preceded by '#' sign in SMS text and send it from module - it will be automatically changed to value of corresponding register or bit. Symbolic names can be used in macros and to poll module for data using SMS. More about SMS messaging can be found in SMS commands syntax chapter in Appendices.

7.1.3.7.7.1. Number of symbolic names

Function - Defines number of user defined symbolic names.
Data type - Number
Range - *1 - 32*
Default value - *1*
Comments - N/A

7.1.3.7.7.2. Symbolic name table

Idx. - Index number
Symbolic name - Friendly name facilitating identification of module resource. Letters, numerals and special characters - max. 50 characters. Default value is *IREG0*.
Address space - *Binary Inputs*
Binary inputs (address 1XXX), read only
Binary Outputs
Binary outputs (address 0XXX), read/write
Input Registers
Input registers (address 3XXX) also known as analog inputs address space, read only

Holding Registers
Holding registers (address 4XXX) also known as internal registers and analog outputs address space, read/write

Register/bit address - Address of bit or register to which symbolic name is assigned.
0 - 65535
Default value is *0*.

7.1.3.7.8. Macros

Macros group contains up to 16 user-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 macro in SMS put it name preceded by '*' sign in SMS text send from mobile phone to module or in SMS text sent from module or other macro.
Using macros makes composing complex SMS texts and queries much more convenient and user friendly.
More about SMS messaging can be found in SMS commands syntax chapter in Appendices.

7.1.3.7.8.1. Number of macros

Function - Defines number of user defined macros.
Data type - Number
Range - *1 - 16*
Default value - *1*
Comments - N/A

7.1.3.7.8.2. Macro table

Idx. - Index number
Macro name - Friendly name facilitating identification of macro.
Letters, numerals and special characters - max. 20 characters.
Default value is *M0*.
Macro content - Text to which macro is decoded. May use other macros with lower index, symbolic names and SMS commands as described in SMS commands syntax chapter in Appendices.
Letters, numerals, special characters - max. 160 characters
Default value is *#date #time*.

7.1.3.8. Authorized numbers

Authorized numbers comprises lists of phone numbers and IP addresses the module can communicate with. The list of IP addresses serves to granting access to configuration and data reception privileges. Numbers and addresses saved in this group are then used as receivers in Rules.

7.1.3.8.1. Number of phone numbers

Function - Defines the length of phone numbers list authorized to exchange SMS messages.
Data type - Number
Range - *0 - 32*
Default value - *0*
Comments - The value of this parameter may vary as the result of adding/deleting when using the context menu operating directly on Phone list.

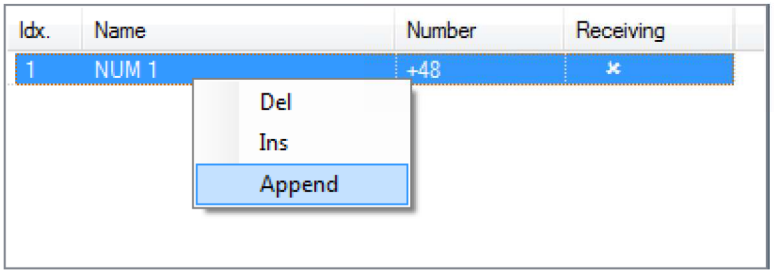
7.1.3.8.2. Number of IP addresses

Function - Defines the length of the IP addresses list
Data type - Number
Range - *0 - 32*
Default value - *0*
Comments - The value of this parameter may vary as the result of adding/deleting when using the context menu operating directly on IP list.

7.1.3.8.3. Phone

Idx. - Index number
Name - Friendly name facilitating identification of the receiver while defining Rules. Max. length is 16 characters.
Number - Phone number assigned to list index. Max. 23 characters
Receiving - The module receives and analyzes SMS messages depending on selected setting. When receiving is not allowed, all SMS messages will be deleted
Default value: ✗ (not allowed)

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



7.1.3.8.4. IP

Idx. - Index number
Name - Friendly name facilitating identification of the receiver while defining Rules. Max. length is 16 characters.

SIM1 address - IP address assigned to list index used when SIM card installed in SIM1 slot is used

SIM2 address - IP address assigned to list index used when SIM card installed in SIM2 slot is used. Parameter is available only when two SIM cards are used.

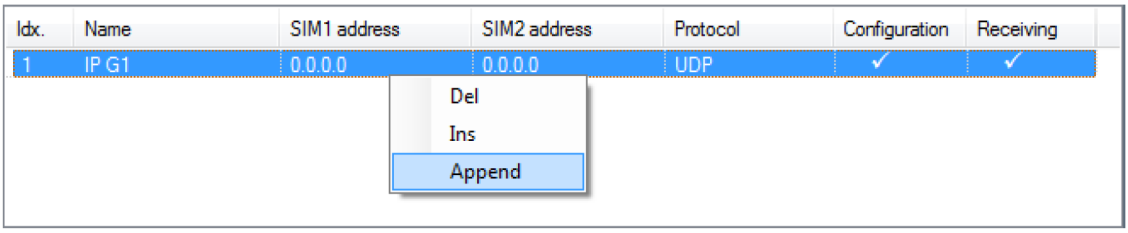
Protocol *UDP*

Communication is carried out using UDP protocol

Configuration - Value of this parameter determines whether remote configuration data arriving from selected IP will be ignored or accepted
Default value: ✓ (allowed)

Receiving - Value of this parameter determines whether data arriving from selected IP will be accepted or ignored
Default value: ✓ (allowed)

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



7.1.4. Resources

Group **Resources** encompasses a list of hardware and software resources available to users.

7.1.4.1. Binary inputs (I1 - I16)

All parameters listed in this group are set individually for each binary input. Binary inputs operate in both positive and negative logic at the same time.

7.1.4.1.1. Name

Function - Friendly name facilitating identification of the binary input task
Data type - Text
Range - Letters and numerals - max. 31 characters
Default value - Respectively from *I1* to *I16*
Comments - N/A

7.1.4.1.2. Input type

Function - Defines binary input operating mode
Data type - Selection list

Range - *Binary input*
Selected terminal operates as binary input

Default value - *Binary input*

Comments - N/A

7.1.4.1.3. Filtering

Function - Defines (in seconds) minimum duration of electrical state on the input to be considered stable, thereby defining maximum time duration of electrical signal considered as noise

Data type - Number

Range - *0.01 - 600.00 [s]*

Default value - *0.10 [s]*

Comments - Increasing the value increases noise immunity but delays change detection.
This parameter is available in binary input mode only.

7.1.4.2. Binary outputs (Q1 - Q12)

All parameters listed in this group are set individually for each binary output.

7.1.4.2.1. Name

Function - Friendly name facilitating identification of the binary output task

Data type - Text

Range - Letters and numerals - max. 31 characters

Default value - Respectively from *Q1* to *Q12*

Comments - N/A

7.1.4.2.2. Input type

Function - Defines binary output operating mode

Data type - Selection list

Range - *Binary input*
Selected terminal operates as binary input
Binary output
Selected terminal operates as binary output

Default value - *Binary output*

Comments - N/A

7.1.4.2.3. Filtering

Function - Defines (in seconds) minimum duration of electrical state on the input to be considered stable, thereby defining maximum time duration of electrical signal considered as noise

Data type - Number
Range - *0.01 - 600.00 [s]*
Default value - *0.10 [s]*
Comments - Increasing the value increases noise immunity but delays change detection.
This parameter is available in binary input mode only.

7.1.4.3. Analog inputs 4-20mA (AI1 - AI4)

MT-151 is equipped with four current analog inputs operating in 4-20mA range. All parameters but sampling frequency are set individually for each input.

7.1.4.3.1. Sampling frequency

Function - Defines analog input sampling frequency and measurement resolution
Data type - Selection list
Range - *1Hz*
New measurement is available every second. Measurement is slower but more precise - resolution is nearly 20000 units (above 14 bits). This setting is advised for low-dynamics signals.
10Hz
New measurement is available every 100 milliseconds. Measurement is faster but less accurate - resolution is above 2000 units (11 bits). This setting is advised for low-dynamics signals.
Default value - *1Hz*
Comments - N/A

7.1.4.3.2. Name

Function - Friendly name facilitating identification of the analog input task
Data type - Text
Range - Letters and numerals - max. 31 characters
Default value - Respectively from *AI1* to *AI4*
Comments - N/A

7.1.4.3.3. Engineering units

Function - Allows user to enter unit name for information purpose
Data type - Text
Range - Letters and numerals - max. 15 characters
Default value - *µA*
Comments - N/A

7.1.4.3.4. Low reference - internal units

Function - Defines number of µA corresponding to number of engineering units defined by Low reference - engineering units parameter
Data type - Number
Range - *4000 - 20000 [µA]*
Default value - *4000 [µA]*
Comments - Used along with other reference parameters for rescaling input signal to engineering units.

7.1.4.3.5. Low reference - engineering units

Function - Defines number of engineering units corresponding to number of µA defined by Low reference - internal units parameter
Data type - Number
Range - *-32768 - 32767*
Default value - *4000*
Comments - Used along with other reference parameters for rescaling input signal to engineering units.

7.1.4.3.6. High reference - internal units

Function - Defines number of µA corresponding to number of engineering units defined by High reference - engineering units parameter
Data type - Number
Range - *4000 - 20000 [µA]*
Default value - *20000 [µA]*
Comments - Used along with other reference parameters for rescaling input signal to engineering units.

7.1.4.3.7. High reference - engineering units

Function - Defines number of engineering units corresponding to number of µA defined by High reference - internal units parameter
Data type - Number
Range - *-32768 - 32767*
Default value - *20000*
Comments - Used along with other reference parameters for rescaling input signal to engineering units.

7.1.4.3.8. HiHi alarm - engineering units

Function - Defines **HiHi** alarm level for analog signal value in engineering units.
Data type - Number
Range - *-32768 - 32767*

Default value - *32767*

Comments - If value of analog signal is higher than value of this parameter, then the **HiHi** alarm flag is risen. The resetting level of this flag depends on Alarm hysteresis - engineering units setting.

7.1.4.3.9. Hi alarm - engineering units

Function - Defines **Hi** alarm level for analog signal value in engineering units.

Data type - Number

Range - *-32768 - 32767*

Default value - *32767*

Comments - If value of analog signal is higher than value of this parameter, then the **Hi** alarm flag is risen. The resetting level of this flag depends on Alarm hysteresis - engineering units setting.

7.1.4.3.10. Lo alarm - engineering units

Function - Defines **Lo** alarm level for analog signal value in engineering units.

Data type - Number

Range - *-32768 - 32767*

Default value - *-32768*

Comments - If value of analog signal is lower than value of this parameter, then the **Lo** alarm flag is risen. The resetting level of this flag depends on Alarm hysteresis - engineering units setting.

7.1.4.3.11. LoLo alarm - engineering units

Function - Defines **LoLo** alarm level for analog signal value in engineering units.

Data type - Number

Range - *-32768 - 32767*

Default value - *-32768*

Comments - If value of analog signal is lower than value of this parameter, then the **LoLo** alarm flag is risen. The resetting level of this flag depends on Alarm hysteresis - engineering units setting.

7.1.4.3.12. Alarm hysteresis - engineering units

Function - Defines in engineering units hysteresis for analog inputs alarms.

Data type - Number

Range - *0 - 65535*

Default value - *100*

Comments - Setting proper value prevents from too often turning on and off alarms when measured value is oscillating around alarm value.

7.1.4.3.13. Deadband - engineering units

Function	-	Defines a minimum change of registered analog signal which should set to high state deadband flag corresponding to analog input where the change was detected (AI1_DB - AI4_DB). This flag is reset to 0 after one program cycle.
Data type	-	Number
Range	-	*0 - 65535*
Default value	-	*100*
Comments	-	Deadband is very useful for tracking analog signal on server - data is send only when analog input changes.

7.1.4.4. Analog inputs 0-10V (AV1 - AV2)

MT-151 is equipped with two voltage analog inputs operating in 0-10V range. All parameters are set individually for each input.

7.1.4.4.1. Name

Function	-	Friendly name facilitating identification of the analog input task
Data type	-	Text
Range	-	Letters and numerals - max. 31 characters
Default value	-	Respectively *AV1* and *AV2*
Comments	-	N/A

7.1.4.4.2. Engineering units

Function	-	Allows user to enter unit name for information purpose
Data type	-	Text
Range	-	Letters and numerals - max. 15 characters
Default value	-	*mV*
Comments	-	N/A

7.1.4.4.3. Low reference - internal units

Function	-	Defines number of mV corresponding to number of engineering units defined by Low reference - engineering units parameter
Data type	-	Number
Range	-	*0 - 10000 [mV]*
Default value	-	*0 [mV]*
Comments	-	Used along with other reference parameters for rescaling input signal to engineering units.

7.1.4.4.4. Low reference - engineering units

Function - Defines number of engineering units corresponding to number of mV defined by Low reference - internal units parameter
Data type - Number
Range - *-32768 - 32767*
Default value - *0*
Comments - Used along with other reference parameters for rescaling input signal to engineering units.

7.1.4.4.5. High reference - internal units

Function - Defines number of mV corresponding to number of engineering units defined by High reference - engineering units parameter
Data type - Number
Range - *0 - 10000 [mV]*
Default value - *10000 [mV]*
Comments - Used along with other reference parameters for rescaling input signal to engineering units.

7.1.4.4.6. High reference - engineering units

Function - Defines number of engineering units corresponding to number of mV defined by High reference - internal units parameter
Data type - Number
Range - *-32768 - 32767*
Default value - *10000*
Comments - Used along with other reference parameters for rescaling input signal to engineering units.

7.1.4.4.7. HiHi alarm - engineering units

Function - Defines **HiHi** alarm level for analog signal value in engineering units.
Data type - Number
Range - *-32768 - 32767*
Default value - *32767*
Comments - If value of analog signal is higher than value of this parameter, then the **HiHi** alarm flag is risen. The resetting level of this flag depends on Alarm hysteresis - engineering units setting.

7.1.4.4.8. Hi alarm - engineering units

Function - Defines **Hi** alarm level for analog signal value in engineering units.
Data type - Number

Range - *-32768 - 32767*
Default value - *32767*
Comments - If value of analog signal is higher than value of this parameter, then the **Hi** alarm flag is risen. The resetting level of this flag depends on Alarm hysteresis - engineering units setting.

7.1.4.4.9. Lo alarm - engineering units

Function - Defines **Lo** alarm level for analog signal value in engineering units.
Data type - Number
Range - *-32768 - 32767*
Default value - *-32768*
Comments - If value of analog signal is lower than value of this parameter, then the **Lo** alarm flag is risen. The resetting level of this flag depends on Alarm hysteresis - engineering units setting.

7.1.4.4.10. LoLo alarm - engineering units

Function - Defines **LoLo** alarm level for analog signal value in engineering units.
Data type - Number
Range - *-32768 - 32767*
Default value - *-32768*
Comments - If value of analog signal is lower than value of this parameter, then the **LoLo** alarm flag is risen. The resetting level of this flag depends on Alarm hysteresis - engineering units setting.

7.1.4.4.11. Alarm hysteresis - engineering units

Function - Defines in engineering units hysteresis for analog inputs alarms.
Data type - Number
Range - *0 - 65535*
Default value - *100*
Comments - Setting proper value prevents from too often turning on and off alarms when measured value is oscillating around alarm value.

7.1.4.4.12. Deadband - engineering units

Function - Defines a minimum change of registered analog signal which should set to high state deadband flag corresponding to analog input where the change was detected (AV1_DB and AV2_DB). This flag is reset to 0 after one program cycle.
Data type - Number
Range - *0 - 65535*
Default value - *100*

Comments - Deadband is very useful for tracking analog signal on server - data is send only when analog input changes.

7.1.4.5. Counters (CNT1 - CNT16)

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

7.1.4.5.1. Incrementing input

Function - Defines the bit which state change increments counter value by 1

Data type - Number or Selection list

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

Default value - N/A

Comments - Bit addresses *0 - 9999* point to analog inputs/binary inputs address space while addresses *10000 - 65535* point to Internal registers/binary outputs address space.
More information on calculating bit addresses can be found in Memory map chapter in Appendices.

7.1.4.5.2. Active edge of incrementing input

Function - Defines edge of incrementing bit which increments counter value by 1

Data type - Selection list

Range - *0->1*
logical state change from 0 to 1
1->0
logical state change from 1 to 0

Default value - *0->1*

Comments - N/A

7.1.4.5.3. Decrementing input

Function - Defines the bit which state change decrements counter value by 1

Data type - Number

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

Default value - N/A

Comments - Bit addresses *0 - 9999* point to analog inputs/binary inputs address space while addresses *10000 - 65535* point to Internal registers/binary outputs address space.
More information on calculating bit addresses can be found in Memory map chapter in Appendices.

7.1.4.5.4. Active edge of decrementing input

Function	-	Defines edge of decrementing bit which decrements counter value by 1
Data type	-	Selection list
Range	-	*0->1* logical state change from 0 to 1 *1->0* logical state change from 1 to 0
Default value	-	*0->1*
Comments	-	N/A

7.1.4.5.5. Counting range (32 bits)

Function	-	Defines the bit which state change increments counter value by 1
Data type	-	Number
Range	-	*0 - 2147483647*
Default value	-	*0*
Comments	-	When counting up the counter is zeroed by next appearing pulse upon reaching declared value. When counting down, next pulse writes declared value into the counter upon reaching 0. Setting this parameter to *0* turns off counter.

7.1.4.6. Timers

Timers group contains configuration parameters of module timers.

7.1.4.6.1. Synchronous timers (CT1 - CT16)

Synchronous timers measure cyclically defined time intervals. They are synchronized with module real time clock (RTC). Each time is counted CT flag corresponding to timer is set to high level for one program cycle.

7.1.4.6.1.1. Start [HH:MM]

Function	-	Defines the synchronization point of timer with RTC
Data type	-	Time
Range	-	*00:00 - 23:59*
Default value	-	*00:00*
Comments	-	At the time defined by this parameter the module will always set timer flag high.

7.1.4.6.1.2. Period

Function	-	Defines time period counted by timer
Data type	-	Selection list

Range - *None*, *1 min.*, *2 min.*, *3 min.*, *5 min.*, *10 min.*, *15 min.*, *30 min.*, *1 hour*, *2 hours*, *3 hours*, *4 hours*, *6 hours*, *8 hours*, *12 hours*, *24 hours*

Default value - *None*

Comments - Choosing *None* disables the timer.

7.1.4.6.1.3. Days of week

Function - Defines days of week when 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 are selected)

Comments - Timer is active when date and time of module RTC matching following equation:

(X **OR** Y)**AND** Z = 1,

where X=1, when current RTC day of week is selected on Days of week parameter; if it is not then X = 0,
Y=1, when current RTC day of month is selected on Days of month parameter; if it is not then Y = 0,
Z=1, when current RTC month is selected on Months parameter; if it is not then Z = 0.
E.g. if selected day of week is Friday, day of month is 13 and all months are selected timer will operate on all Fridays and on 13th day of each month.

7.1.4.6.1.4. Days of month

Function - Defines days of month when timer is active

Data type - Multiple choice field

Range - *1 - 31*, *Last*

Default value - *No day selected* (no month day is selected)

Comments - Timer is active when date and time of module RTC matching following equation:

(X **OR** Y)**AND** Z = 1,

where X=1, when current RTC day of week is selected on Days of week parameter; if it is not then X = 0,
Y=1, when current RTC day of month is selected on Days of month parameter; if it is not then Y = 0,
Z=1, when current RTC month is selected on Months parameter; if it is not then Z = 0.
E.g. if selected day of week is Friday, day of month is 13 and all months are selected timer will operate on all Fridays and on 13th day of each month.

7.1.4.6.1.5. Months

Function - Defines months when timer is active

Data type - Multiple choice field

Range - *Jan.*, *Feb.*, *Mar.*, *Apr.*, *May*, *Jun.*, *Jul.*, *Aug.*, *Sep.*, *Oct.*, *Nov.*, *Dec.*

Default value - *Jan.*, *Feb.*, *Mar.*, *Apr.*, *May*, *Jun.*, *Jul.*, *Aug.*, *Sep.*, *Oct.*, *Nov.*, *Dec.* (all months are selected)

Comments - Timer is active when date and time of module RTC matching following equation:

(X **OR** Y)**AND** Z = 1,

where X=1, when current RTC day of week is selected on Days of week parameter; if it is not then X = 0,
Y=1, when current RTC day of month is selected on Days of month parameter; if it is not then Y = 0,
Z=1, when current RTC month is selected on Months parameter; if it is not then Z = 0.
E.g. if selected day of week is Friday, day of month is 13 and all months are selected timer will operate on all Fridays and on 13th day of each month.

7.1.4.6.2. Asynchronous timers (CK1 - CK16)

Synchronous timers measure cyclically defined time intervals. They are not synchronized with module real time clock (RTC) - they start counting time when module is powered on or reset. Each time is counted CK flag corresponding to timer is set to high level for one program cycle.

7.1.4.6.2.1. Activating input

Function - Defines the bit which state turns on (bit set to logical 1) or off (bit set to logical 0) timer

Data type - Number or Selection list

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

Default value - *None*

Comments - Bit addresses *0 - 9999* point to analog inputs/binary inputs address space while addresses *10000 - 65535* point to Internal registers/binary outputs address space.
More information on calculating bit addresses can be found in Memory map chapter in Appendices.

7.1.4.6.2.2. Reset input

Function - Defines the bit which state resets timer. When bit is set to logical 1 - timer it stopped and zeroed. When bit is set to logical 0 – timer is counting.

Data type - Number or Selection list

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

Default value - *None*

Comments - Bit addresses *0 - 9999* point to analog inputs/binary inputs address space while addresses *10000 - 65535* point to Internal registers/binary outputs address space.
More information on calculating bit addresses can be found in Memory map chapter in Appendices.

7.1.4.6.2.3. Timer time unit

Function	-	Defines timer time unit and therefore precision
Data type	-	Selection list
Range	-	*1s*, *0.01s*
Default value	-	*1s*
Comments	-	N/A

7.1.4.6.2.4. Counting range in timer units

Function	-	Defines timer counting range
Data type	-	Number
Range	-	*0 - 2147483647*
Default value	-	*0*
Comments	-	N/A

7.1.4.7. Constant parameters

Constant parameters are constant values entered in configuration which then can be used within MT-151 program. This allows to parameterize universal program for application needs.

7.1.4.7.1. Number of constant parameters

Function	-	Defines number of constant parameters on list
Data type	-	Number
Range	-	*0 - 128*
Default value	-	*0*
Comments	-	N/A

7.1.4.7.2. Parameter 1 - 128

Function	-	Defines value of constant parameter
Data type	-	Number
Range	-	*-32768 - 32767*
Default value	-	*0*
Comments	-	N/A

7.1.5. Communication ports

Communication ports group contain parameters configuring operation of serial ports, Ethernet and routing data between communication interfaces of device.

7.1.5.1. Modbus ID - Port 1

Function - Defines Modbus ID for internal resources of device on Port 1 (Modbus RTU)
Data type - Number
Range - *0 - 255*
Default value - *1*
Comments - setting this value to *0* disables access to device resources from serial port Port 1

7.1.5.2. Modbus ID - Port 2

Function - Defines Modbus ID for internal resources of device on Port 2 (Modbus RTU)
Data type - Number
Range - *0 - 255*
Default value - *1*
Comments - setting this value to *0* disables access to device resources from serial port Port 2

7.1.5.3. Modbus ID - Ethernet

Function - Defines Modbus ID for internal resources of device on Ethernet port (Modbus TCP)
Data type - Number
Range - *0 - 255*
Default value - *1*
Comments - setting this value to *0* disables access to device resources from Ethernet port

7.1.5.4. Modbus ID - GPRS

Function - Defines Modbus ID for internal resources of device for polls incoming via GPRS network
Data type - Number
Range - *0 - 255*
Default value - *1*
Comments - setting this value to *0* disables access to device resources from GPRS network

7.1.5.5. Port 1

Subgroup **Port 1** contain parameters configuring operation of RS-232/485 serial port Port 1.

7.1.5.5.1. Operating mode

Function - Defines operating mode of serial port Port 1

Data type - Selection list

Range - *Inactive*
Serial port Port 1 is disabled
Transparent
Serial port communication is channeled to other communication port or GPRS network according to rules defined in Transparent routing table. Additional configuration parameters are available in Transparent mode group.
Modbus RTU Slave
MT-151 operates as Modbus RTU Slave on Port 1 serial port. External Master device can poll for data from and write data to module.
Modbus RTU Master
MT-151 operates as Modbus RTU Master on Port 1 serial port. It can poll for data from and write data to external Slave devices connected to that port using Data blocks. Also polls and writes from external devices communicating with MT-151 can be routed to Port 1 according to rules defined in Modbus routing table. Additional configuration parameters are available in Modbus RTU Master mode group.

Default value - *Inactive*

Comments - N/A

7.1.5.5.2. Interface type

Function - Defines electrical serial port standard used for communication

Data type - Selection list

Range - *RS-232*
Half-duplex, 3-wire, ±12 VDC voltage interface. Only one device can be connected to port in this mode.
RS-485
Half-duplex, 2-wire differential interface. Many device can be connected to port in this mode.

Default value - *RS-232*

Comments - N/A

7.1.5.5.3. Transmission speed

Function - Defines transmission speed in bits per second

Data type - Selection list

Range - *1200*, *2400*, *4800*, *9600*, *19200*, *38400*, *57600*, *115200 [bps]*

Default value - *9600 [bps]*

Comments - N/A

7.1.5.5.4. Stop bits

Function - Defines number of stop bits used during communication
Data type - Selection list
Range - *1*, *2*
Default value - *1*
Comments - When one of Modbus operating modes is selected this parameter value does not influence communication - number of stop bits is automatically chosen according to Parity setting.

7.1.5.5.5. Parity

Function - Defines parity control of transmitted byte
Data type - Selection list
Range - *None*, *Even*, *Odd*
Default value - *None*
Comments - When one of Modbus operating modes is selected this parameter **overrides** Stop bits parameter setting as follows:
None
1 stop bit
Even or *Odd*
2 stop bits

7.1.5.5.6. Transparent mode

In this mode communication on serial port Port 1 is channeled to other communication port or GPRS network according to rules defined in Transparent routing table. This group lists additional communication parameters for this mode.

7.1.5.5.6.1. Max. data packet size

Function - Defines maximum size of data packet in bytes
Data type - Number
Range - *1 - 1408*
Default value - *256*
Comments - If number of data bytes in receiving buffer reaches declared value, data packet is sent according to rules defined in Transparent routing table.

7.1.5.5.6.2. Data frame delimiter

Function - Defines in seconds minimum interval between receiving data packets
Data type - Number
Range - *0.00 - 655.35 [s]*
Default value - *1.00 [s]*
Comments - If no new data arrives to receiving buffer within declared time, data already saved in that buffer is sent according to rules defined in Transparent routing table.

7.1.5.5.7. Modbus RTU Master mode

In this mode MT-151 can poll for data from and write data to external Slave devices connected to that port using Data blocks. Also polls and writes from external devices communicating with MT-151 can be routed to Port 1 according to rules defined in Modbus routing table. This group provides additional configuration parameters for this mode.

7.1.5.5.7.1. Delay after error in communication with Slave

Function	-	Defines in seconds delay between error in communication and next communication for current Data block
Data type	-	Number
Range	-	*0 - 65535 [s]*
Default value	-	*15 [s]*
Comments	-	This time is measured separately for each Data block - error in communication on one block does not influence communication carried out using other Data blocks.

7.1.5.5.7.2. Number of read/write data blocks

Function	-	Defines number of data blocks to define
Data type	-	Number
Range	-	*0 - 16*
Default value	-	*0*
Comments	-	N/A

7.1.5.5.7.3. Data blocks (read/write)

Data blocks defined in this group allow to read from and write data to external Modbus RTU Slave devices. Each block is matching group of addresses from one slave device with group of registers in Internal registers address space in device. Data from external devices is polled from external device and written into those registers. Saving new data to those registers either by program or from remote via GPRS or other communication port or method automatically saves this data into Modbus RTU Slave device.

7.1.5.5.7.3.1. Data block (read /write)

7.1.5.5.7.3.1.1. Modbus Slave ID

Function	-	Defines Modbus ID of Slave, which should be polled under this data block
Data type	-	Number
Range	-	*0 - 255*
Default value	-	*1*
Comments	-	setting this value to *0* disables data block

7.1.5.5.7.3.1.2. Address space in Slave

Function - Defines address space of Slave device where from data will be polled

Data type - Selection list

Range - *Binary Inputs*
Binary inputs (address 1XXX), read only
Binary Outputs
Binary outputs (address 0XXX), read/write
Input Registers
Input registers (address 3XXX) also known as analog inputs address space, read only
Holding Registers
Holding registers (address 4XXX) also known as internal registers and analog outputs address space, read/write

Default value - *Binary Inputs*

Comments - N/A

7.1.5.5.7.3.1.3. Mapped space address - Slave

Function - Defines address of first resource (bit or register depending on address space) of data block mapped from Slave to module

Data type - Number

Range - *0 - 65535*

Default value - *0*

Comments - setting this value to *0* disables data block

7.1.5.5.7.3.1.4. Mapped space size

Function - Defines number of Slave device addresses (bit or register depending on address space) to be mapped to registers of module

Data type - Number

Range - *1 - 2040*

Default value - *1*

Comments - N/A

7.1.5.5.7.3.1.5. Mapped space address - Module

Function - Defines address of register in Internal registers address space of module which is mapped to Slave resources defined in data block. If data does not fit within one register (e.g. 17 bits or 2 registers), next register is used as well.

Data type - Number

Range - *0 - 8191*

Default value - *1160*

Comments - N/A

7.1.5.5.7.3.1.6. Mapped space refresh interval

Function - Defines in seconds interval between polls of Slave resources within data block. Data writes are also executed with this interval

Data type - Number

Range - *0 - 65535 [s]*

Default value - *1*

Comments - Entering *0* forces communication with maximum possible speed. This speed depends on port communication speed and number of data blocks

7.1.5.6. Port 2

Subgroup **Port 2** contain parameters configuring operation of RS-232 serial port Port 2.

7.1.5.6.1. Operating mode

Function - Defines operating mode of serial port Port 2

Data type - Selection list

Range - *Inactive*
Serial port Port 2 is disabled
Transparent
Serial port communication is channeled to other communication port or GPRS network according to rules defined in Transparent routing table. Additional configuration parameters are available in Transparent mode group.
Modbus RTU Slave
MT-151 operates as Modbus RTU Slave on Port 2 serial port. External Master device can poll for data from and write data to module.

Default value - *Inactive*

Comments - N/A

7.1.5.6.2. Transmission speed

Function - Defines transmission speed in bits per second

Data type - Selection list

Range - *1200*, *2400*, *4800*, *9600*, *19200*, *38400*, *57600*, *115200 [bps]*

Default value - *9600 [bps]*

Comments - N/A

7.1.5.6.3. Stop bits

Function - Defines number of stop bits used during communication

Data type - Selection list

Range - *1*, *2*

Default value - *1*

Comments - When one of Modbus operating modes is selected this parameter value does not influence communication - number of stop bits is automatically chosen according to Parity setting.

7.1.5.6.4. Parity

Function - Defines parity control of transmitted byte

Data type - Selection list

Range - *None*, *Even*, *Odd*

Default value - *None*

Comments - When one of Modbus operating modes is selected this parameter **overrides** Stop bits parameter setting as follows:
None
1 stop bit
Even or *Odd*
2 stop bits

7.1.5.6.5. Transparent mode

In this mode communication on serial port Port 2 is channeled to other communication port or GPRS network according to rules defined in Transparent routing table. This group lists additional communication parameters for this mode.

7.1.5.6.5.1. Max. data packet size

Function - Defines maximum size of data packet in bytes

Data type - Number

Range - *1 - 1408*

Default value - *256*

Comments - If number of data bytes in receiving buffer reaches declared value, data packet is sent according to rules defined in Transparent routing table.

7.1.5.6.5.2. Data frame delimiter

Function - Defines in seconds minimum interval between receiving data packets

Data type - Number

Range - *0.00 - 655.35 [s]*

Default value - *1.00 [s]*

Comments - If no new data arrives to receiving buffer within declared time, data already saved in that buffer is sent according to rules defined in Transparent routing table.

7.1.5.7. Ethernet

Subgroup **Ethernet** contains parameters configuring operation of Ethernet port.

7.1.5.7.1. Use of Ethernet

Function - Enables communication via Ethernet port
Data type - Selection list
Range - *No*
Ethernet port is disabled
Yes
Ethernet port is enabled.
Default value - *No*
Comments - MT-151 operates on Ethernet port as Server - it allows remote connection from clients which then can poll for data or write to device. When needed module connects as client to servers to poll for data according to Modbus TCP Client data blocks or when transmitting incoming data according to routing tables.

7.1.5.7.2. IP address

Function - Enables configuration of IP address of module used on Ethernet
Data type - IP address
Range - *0.0.0.0 - 255.255.255.255*
Default value - *0.0.0.0*
Comments - N/A

7.1.5.7.3. Subnet mask

Function - Allows to enter IP mask defining subnet used by module
Data type - IP mask
Range - *0.0.0.0 - 255.255.255.255*
Default value - *0.0.0.0*
Comments - N/A

7.1.5.7.4. Default gateway

Function - Enables configuration of IP address of default Ethernet gateway
Data type - IP address
Range - *0.0.0.0 - 255.255.255.255*
Default value - *0.0.0.0*
Comments - N/A

7.1.5.7.5. Authorized IP addresses

Authorized numbers comprises lists of Ethernet IP addresses the module can communicate with.

7.1.5.7.5.1. Number of IP addresses

Function - Defines the length of the IP addresses list allowed to communicate with device via Ethernet
Data type - Number
Range - *0 - 16*
Default value - *0*
Comments - N/A

7.1.5.7.5.2. IP

Idx. - Index number
Name - Friendly name facilitating identification of device. Max. length is 16 characters.
IP address - IP address assigned to Ethernet Device
Protocol *TCP*
Communication is carried out using TCP protocol

7.1.5.7.6. Modbus TCP Client

In this group MT-151 can poll for data from and write data to external Modbus TCP Slave devices connected to Ethernet port using Data blocks. Also polls and writes from external devices communicating with MT-151 can be routed to Ethernet according to rules defined in Modbus routing table.

7.1.5.7.6.1. Delay after error in communication with Server

Function - Defines in seconds delay between error in communication and next communication for current Data block
Data type - Number
Range - *0 - 65535 [s]*
Default value - *15 [s]*
Comments - This time is measured separately for each Data block - error in communication on one block does not influence communication carried out using other Data blocks.

7.1.5.7.6.2. Number of read/write data blocks

Function - Defines number of data blocks to define
Data type - Number
Range - *0 - 16*
Default value - *0*
Comments - N/A

7.1.5.7.6.3. Data block (read/write)

7.1.5.7.6.3.1. Ethernet IP

Function - Allows to choose IP address of Modbus TCP Server device
Data type - Selection list
Range - *None* or one of Names defined on Authorized IP list for Ethernet
Default value - *None*
Comments - N/A

7.1.5.7.6.3.2. Address space in Server

Function - Defines address space of Modbus TCP Slave device where from data will be polled
Data type - Selection list
Range - *Binary Inputs*
Binary inputs (address 1XXX), read only
Binary Outputs
Binary outputs (address 0XXX), read/write
Input Registers
Input registers (address 3XXX) also known as analog inputs address space, read only
Holding Registers
Holding registers (address 4XXX) also known as internal registers and analog outputs address space, read/write
Default value - *Binary Inputs*
Comments - N/A

7.1.5.7.6.3.3. Mapped space address - Server

Function - Defines address of first resource (bit or register depending on address space) of data block mapped from Modbus TCP Server to module
Data type - Number
Range - *0 - 65535*
Default value - *0*
Comments - setting this value to *0* disables data block

7.1.5.7.6.3.4. Mapped space size

Function - Defines number of Modbus TCP Server device addresses (bit or register depending on address space) to be mapped to registers of module
Data type - Number
Range - *1 - 2040*
Default value - *1*
Comments - N/A

7.1.5.7.6.3.5. Mapped space address - Module

Function	-	Defines address of register in Internal registers address space of module which is mapped to Modbus TCP Server resources defined in data block. If data does not fit within one register (e.g. 17 bits or 2 registers), next register is used as well.
Data type	-	Number
Range	-	*0 - 8191*
Default value	-	*116*
Comments	-	N/A

7.1.5.7.6.3.6. Mapped space refresh interval

Function	-	Defines in seconds interval between polls of Server resources within data block. Data writes are also executed with this interval
Data type	-	Number
Range	-	*0 - 65535 [s]*
Default value	-	*10*
Comments	-	Entering *0* forces communication with maximum possible speed.

7.1.5.8. Routing tables

Routing tables group consists of tables defining data routing rules between Port 1, Port 2, Ethernet and GPRS. There are different tables for different protocols.

7.1.5.8.1. Number of Modbus routing table rules

Function	-	Defines the length of the Modbus routing table
Data type	-	Number
Range	-	*0 - 16*
Default value	-	*0*
Comments	-	N/A

7.1.5.8.2. Number of Transparent routing table rules

Function	-	Defines the length of the Transparent routing table
Data type	-	Number
Range	-	*0 - 4*
Default value	-	*0*
Comments	-	N/A

7.1.5.8.3. Modbus routing table

Idx. - Index number

Name - Friendly name facilitating identification of routing rule purpose. Max. length is 31 characters.

Interface - *None*
Routing rule is disabled.
Port 1
Modbus RTU Slave device is connected to Port 1. Option available only when Port 1 operate in Modbus RTU Master mode.
Port 2
Modbus RTU Slave device is connected to Port 2. Option available only when Port 2 operate in Modbus RTU Master mode.
Ethernet
Modbus TCP Server device is connected to Ethernet port. Option available only when Ethernet is turned on.
GPRS
Modbus TCP Server/RTU Slave device is connected to MT telemetry module logged into GPRS. Option available only when GPRS is turned on.

Port1 ID - ID of Modbus RTU Slave device as seen from Port 1
1 - 255

Port2 ID - ID of Modbus RTU Slave device as seen from Port 2
1 - 255

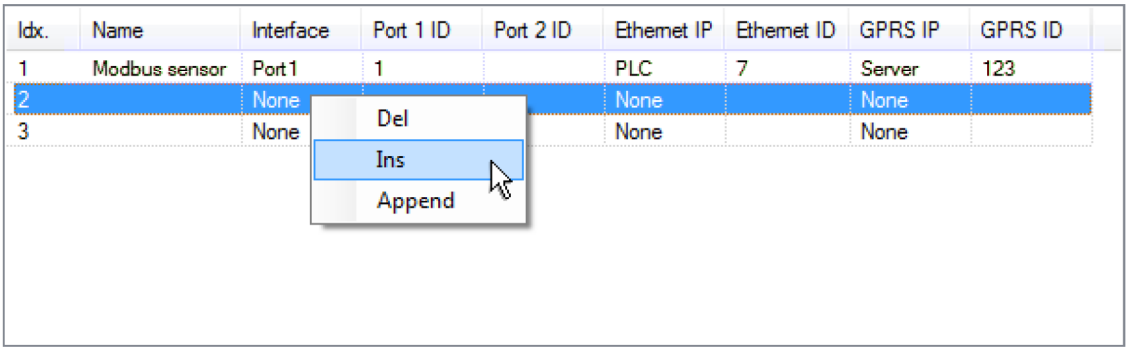
Ethernet IP - IP of Modbus TCP Server device as seen from Ethernet
0.0.0.0 - 255.255.255.255

Ethernet ID ID of Modbus TCP Server device as seen from Ethernet
1 - 255

GPRS IP IP of MT telemetry module as seen from GPRS
0.0.0.0 - 255.255.255.255

GPRS ID ID of MT telemetry module or device connected to it as seen from GPRS
1 - 255

Entries on this 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.



Modbus sensor from picture above is connected to Port 1 serial port and its Modbus ID is 1. It can be accessed from Ethernet by PLC - it should poll MT-151 using Modbus TCP

protocol for ID 7. This poll will be automatically translated to Modbus RTU and send to Port 1 with ID 1. This sensor can also be accessed from GPRS by Server. It should poll for ID 123 to get access to Modbus sensor.

7.1.5.8.4. Transparent routing table

Idx. - Index number

Name - Friendly name facilitating identification of routing rule purpose. Max. length is 31 characters.

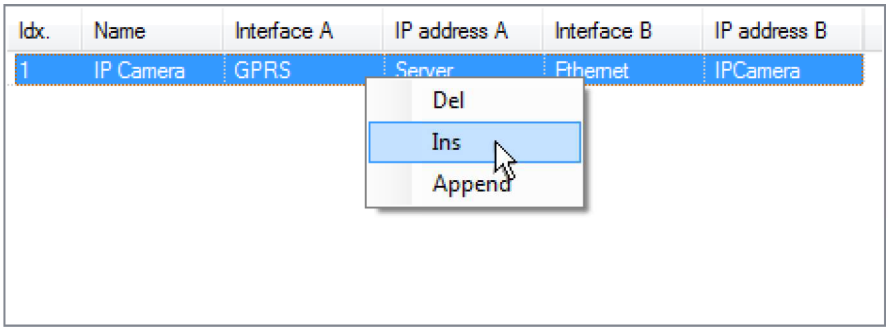
Interface A - *None*
Routing rule is disabled.
Port 1
All communication from Port 1 is routed to Interface B. Option visible only when Port 1 operating mode is set to Transparent.
Port 2
All communication from Port 2 is routed to Interface B. Option visible only when Port 2 operating mode is set to Transparent.
Ethernet
All communication from Ethernet IP given in next column is routed to Interface B.
GPRS
All communication from GPRS IP given in next column is routed to Interface B.

IP address A - IP address for Interface A. Parameter valid only for GPRS and Ethernet interfaces.

Interface B - *None*
Routing rule is disabled.
Port 1
All communication from Port 1 is routed to Interface A. Option visible only when Port 1 operating mode is set to Transparent.
Port 2
All communication from Port 2 is routed to Interface A. Option visible only when Port 2 operating mode is set to Transparent.
Ethernet
All communication from Ethernet IP given in next column is routed to Interface A.
GPRS
All communication from GPRS IP given in next column is routed to Interface A.

IP address B - IP address for Interface B. Parameter valid only for GPRS and Ethernet interfaces.

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



7.1.6. Communication

Communication group contains parameters managing SMS and spontaneous data transmission. Here you can configure when transmission will be triggered, what data or message it will send and where it shall be send.

7.1.6.1. MT2MT buffer

MT2MT buffer enables creation of system where MT modules may exchange information (Holding Registers) with each other without any relaying instance.
Data transmission from one module to other is carried out by sending from one device group of Holding Registers with data to other device which has turned on MT2MT buffer functionality and defined MT2MT buffer which includes register addresses send from sending device. Data send by sender is saved to registers within buffer with same address. Each time new data arrives MT2MT_x bit is set, where x is position of sender IP address on receiver authorized IP list.

7.1.6.1.1. Active

Function - Enables receiving GPRS frames to MT2MT buffer
Data type - Selection list
Range - *No*
MT2MT buffer functionality is disabled
Yes
MT2MT buffer functionality is enabled
Default value - *No*
Comments - When set to *No* module cannot receive GPRS frames to buffer, however it still can send data to other buffers.
GPRS is required for MT2MT communication.

7.1.6.1.2. Buffer address

Function - Defines address of register from Holding Registers address space where buffer begins
Data type - Number
Range - *0 - 8191*
Default value - *116*
Comments - Received data which does not fit within defined buffer is not saved in module.

7.1.6.1.3. Buffer size

Function - Defines number of registers from Holding Registers from which MT2MT buffer consist
Data type - Number
Range - *1 - 700*
Default value - *16*
Comments - Received data which does not fit within defined buffer is not saved in module.

7.1.6.2. Logger

Events subgroup contains parameters controlling logger functionality.

7.1.6.2.1. Recipient

Function - Defines IP address which shall receive logger data frames
Data type - Selection list
Range - *None* and addresses defined in GSM -> Authorized numbers -> IP list for GPRS transmission
Default value - *None*
Comments - N/A

7.1.6.2.2. Recipient UDP port

Function - Defines UDP port to which the logger shall be sent
Data type - Number
Range - *1024 - 65535*
Default value - *7110*
Comments - N/A

7.1.6.2.3. Number of logger data blocks

Function - Defines the length of the Logger data block table
Data type - Number
Range - *0 - 4*
Default value - *0*
Comments - N/A

7.1.6.2.4. Logger data block table

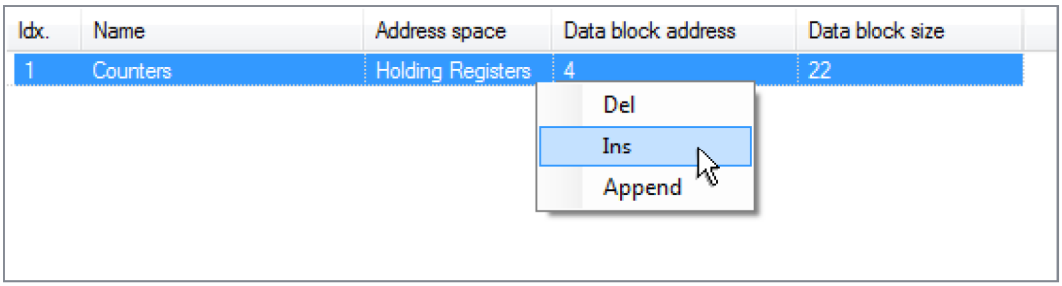
Idx. - Index number
Name - Friendly name facilitating identification of data block purpose. Max. length is 16 characters.

Address space - Defines address space of data block
Input Registers
Input registers (address 3XXX) also known as analog inputs address space, read only
Holding Registers
Holding registers (address 4XXX) also known as internal registers and analog outputs address space, read/write

Data block address - Defines address of register from which data block begins
0 - 8191

Data block size Defines number of registers which are in data block
1 - 28

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



7.1.6.3. Events

Events subgroup contains definitions of changes of binary resources states (flags, inputs, outputs, bits) which then can be used for triggering SMS and data sending in Rules and also trigger record saving and logger transmission.

7.1.6.3.1. Number of events

Function - Defines the length of the Event table
Data type - Number
Range - *0 - 32*
Default value - *0*
Comments - N/A

7.1.6.3.2. Event table

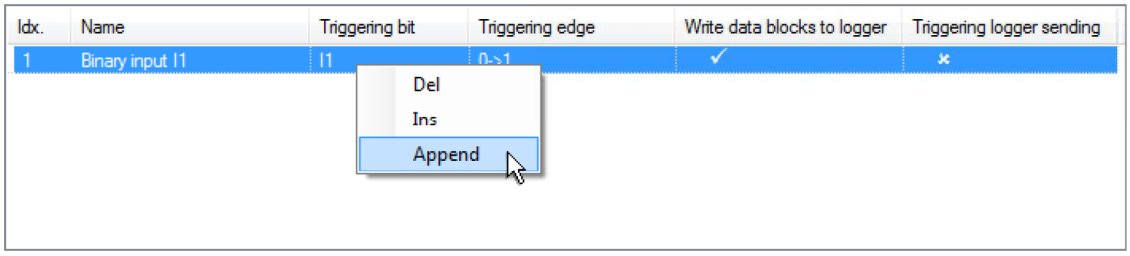
Idx. - Index number
Name - Friendly name facilitating identification of event purpose. Max. length is 16 characters.
Triggering bit - Defines the bit which state change will trigger event
0 - 65535 or name from bit list (see bit list in Appendices)
Triggering edge - *0->1*
Trigger event on rising edge.
1->0
Trigger event on falling edge.

0<->1
Trigger event on any edge.

Write data blocks to logger - Toggles saving logger data blocks to logger as new record on/off on occurring event.
Default value is ✗ (off).

Trigger logger sending - Toggles sending the logger content on/off on occurring event.
Default value is ✗ (off).

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



7.1.6.4. Data blocks

Data blocks subgroup contains definitions of data which then can be used send using Rules.

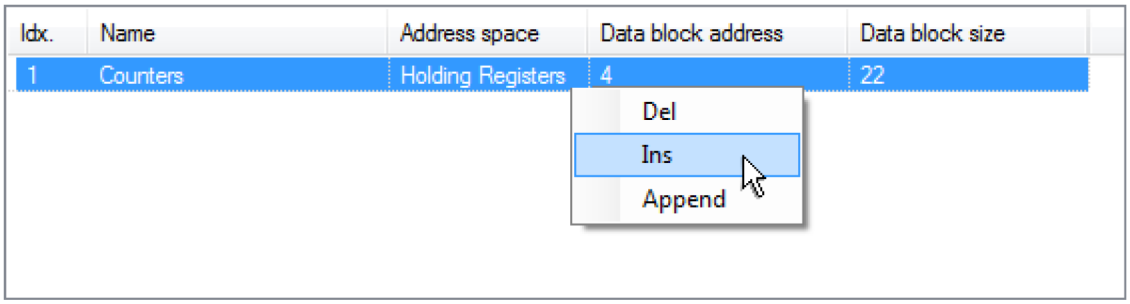
7.1.6.4.1. Number of data blocks

Function - Defines the length of the Data block table
Data type - Number
Range - *0 - 32*
Default value - *0*
Comments - N/A

7.1.6.4.2. Data block table

Idx. - Index number
Name - Friendly name facilitating identification of data block purpose. Max. length is 16 characters.
Address space - Defines address space of data block
Input Registers
Input registers (address 3XXX) also known as analog inputs address space, read only
Holding Registers
Holding registers (address 4XXX) also known as internal registers and analog outputs address space, read/write
Data block address - Defines address of register from which data block begins
0 - 8191
Data block size Defines number of registers which are in data block
1 - 256

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



7.1.6.5. Rules

Rules subgroup consists of list of communication rules allowing to send SMS messages or send selected Data blocks via GPRS when selected event occurs.

7.1.6.5.1. Number of rules

Function - Defines number of Rules to define
Data type - Number
Range - *0 - 32*
Default value - *0*
Comments - N/A

7.1.6.5.2. Rule

7.1.6.5.2.1. Name

Function - Friendly name facilitating identification of the rule
Data type - Text
Range - Letters and numerals - max. 31 characters
Default value - Respectively from *RULE1* to *RULE32*
Comments - N/A

7.1.6.5.2.2. Triggering event

Function - Defines event which triggers transmission
Data type - Selection list
Range - *None* and events defined in Event table
Default value - *None*
Comments - N/A

7.1.6.5.2.3. Transmission type

Function - Defines transmission type

Data type - Selection list

Range - *None*
Rule is disabled
SMS
Rule triggers sending SMS message
GPRS
Rule triggers sending data using GPRS

Default value - *None*

Comments - SMS and GPRS options are visible only when those methods of communication are enabled

7.1.6.5.2.4. Receiver

Function - Defines receiver of SMS or data package (depends on Transmission typesetting)

Data type - Selection list

Range - *None* and numbers defined in GSM -> Authorized numbers -> Phone list for SMS transmission
None and addresses defined in GSM -> Authorized numbers -> IP list for GPRS transmission

Default value - *None*

Comments - N/A

7.1.6.5.2.5. SMS text

Function - Allows to enter text which will be send as SMS

Data type - Text

Range - Letters, numerals and special characters - max. 160 characters

Default value - N/A

Comments - It is possible to add to SMS text macros, symbolic names and special mnemonics dynamically changed for values from module, e.g. analog input value or binary input state.
Description of this mnemonics can be found in SMS commands syntax chapter in Appendices.
Parameter is visible only when Transmission type parameter is set to SMS.

7.1.6.5.2.6. Data block

Function - Defines data block which is sent via GPRS by rule

Data type - Selection list

Range - *None* and events defined in Data block table

Default value - *None*

Comments - Parameter is visible only when Transmission type parameter is set to GPRS.

7.2. Presets

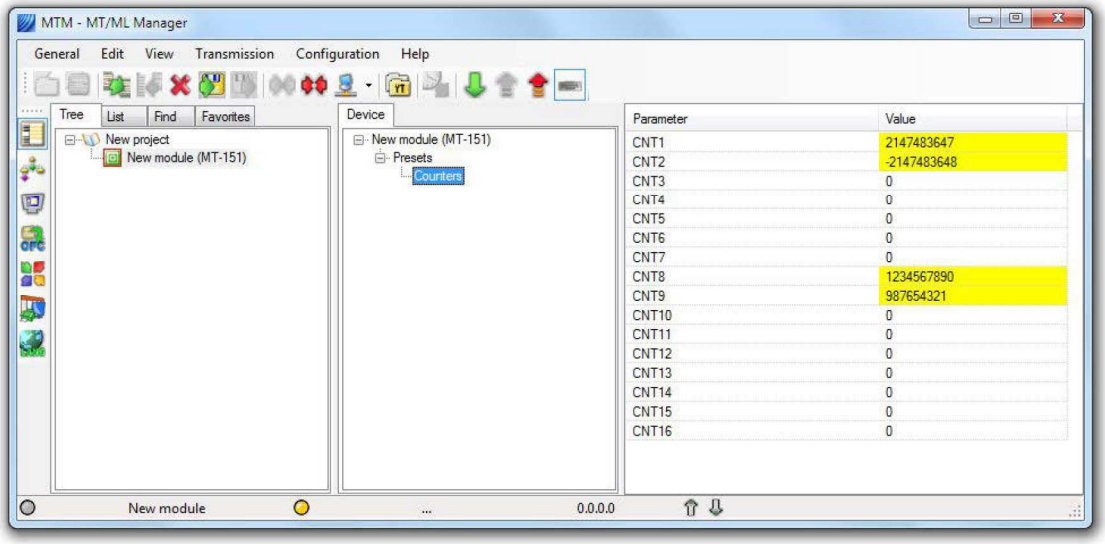
In order to expand module application area it is furbished with initial settings for some resources. It is necessary when the module is operating as a pulse counter for measuring devices (e.g. water consumption meter with pulse output) having initial count other than zero. Due to **Presets** the actual value of counter register may be equalized with mechanical counter of the device thus not disturbing the functionality of the system.
In order to set **Presets** go to Configuration menu and select the Initial settings option or click following icon on the toolbar.

The **Presets** icon is active only when the module is connected and selected transmission channel is not set to Spooler. Sending data in **Presets** mode is possible only as sending changes. Bear in mind that sending configuration changes result in immediate and irrevocable updating of the resource.
When **Presets** mode is selected all configuration groups disappear from the panel and only parameters that may have initial value set are displayed. For MT-151 module those parameters are **counters CNT1 - CNT16**.

7.2.1. Counters (CNT1 - CNT16)

Name of resource	-	counters CNT1 - CNT16
Data type	-	number
Range	-	*-2147483648 ... 2147483647*
Default value	-	*0*
Comments	-	N/A

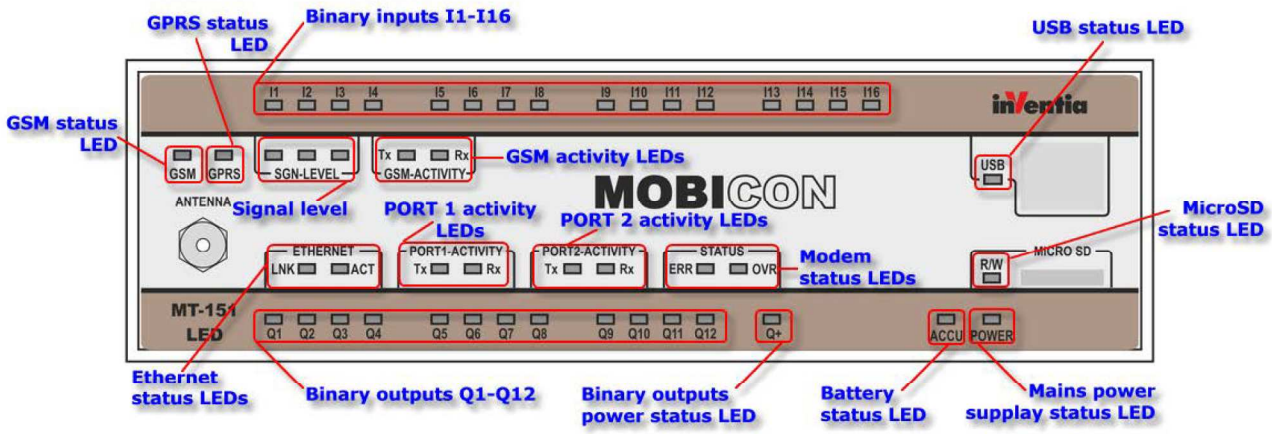
After entering new value counter field turns yellow. It means that value visible in MTManager is not written to device. To send new values to device press **Write changes** button (second from the right on toolbar).



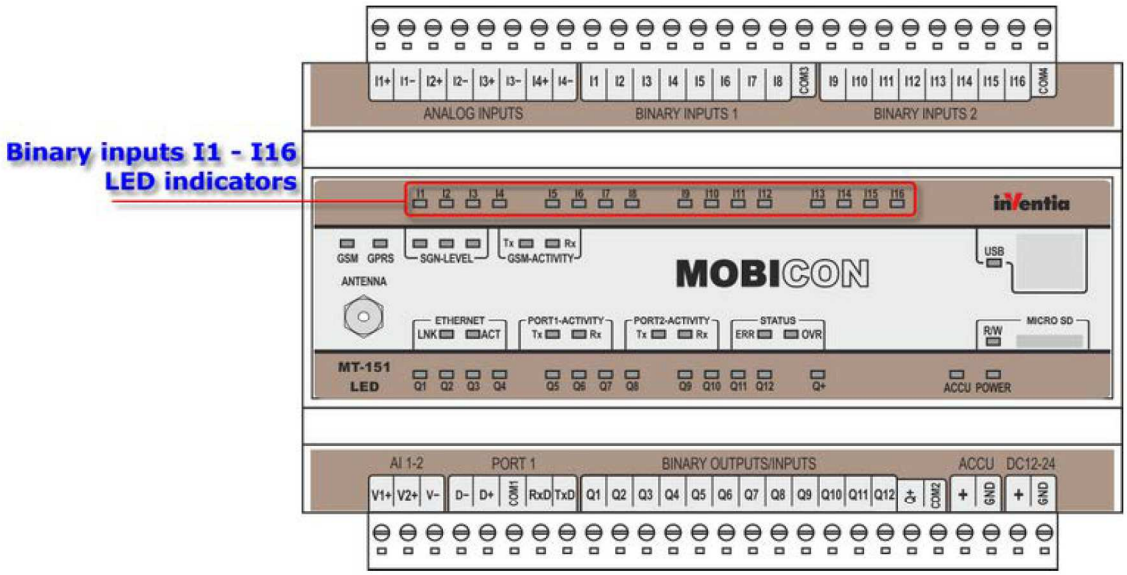
8. Problem solving

8.1. LED signaling

LED indicators placed on **MT-151 LED** front panel are a great help during module startup and troubleshooting.

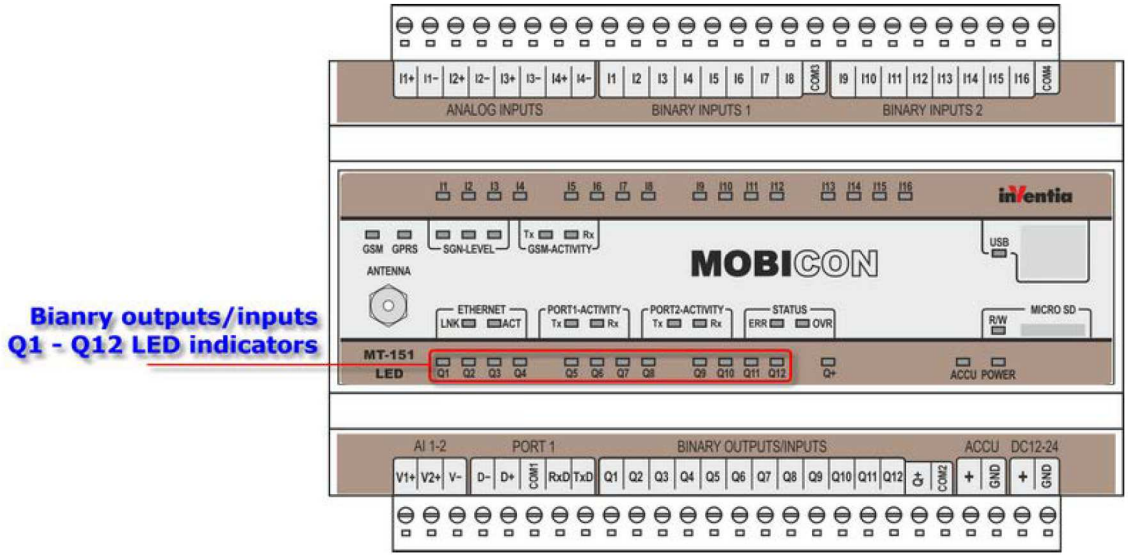


8.1.1. Binary inputs I1 - I16



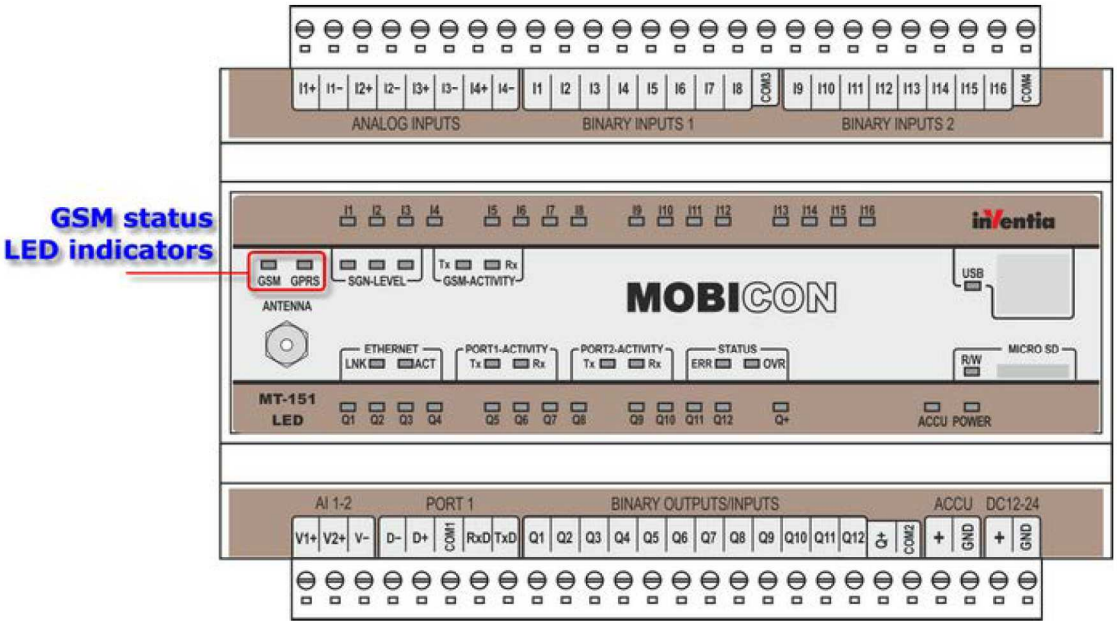
LED indicators of I1 - I16 LED indicators are signaling logical state of I1 - I16 pins (on - high state, off - low state).

8.1.2. Binary outputs/inputs Q1 - Q12



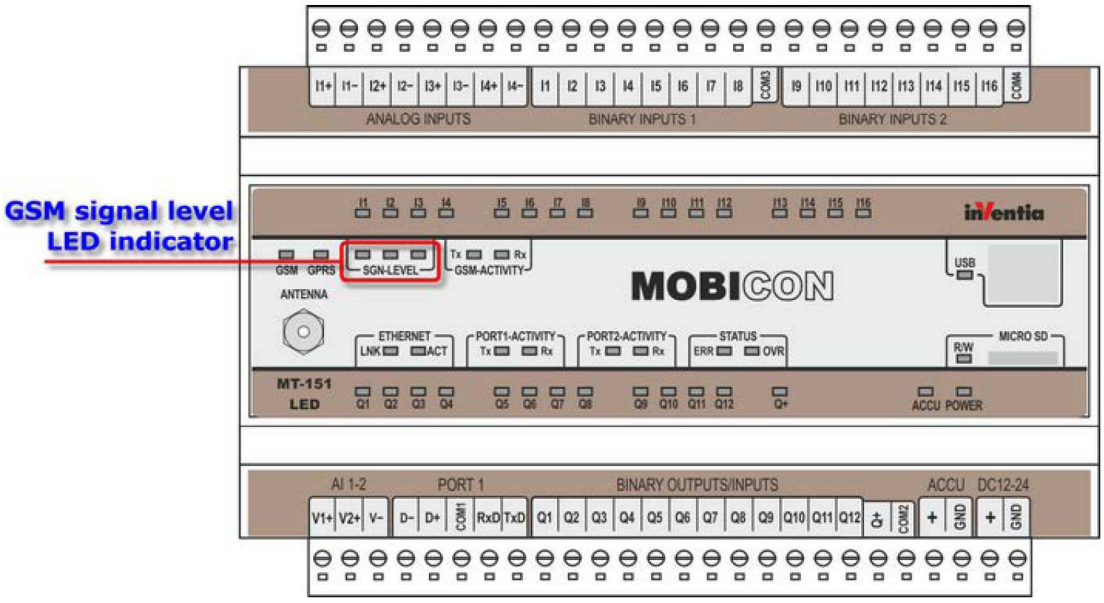
LED indicators of Q1 - Q12 LED indicators are signaling logical state of Q1 - Q12 pins (on - high state, off - low state) in both binary output and binary input mode.
If any of LEDs from this group is blinking with 2Hz frequency, then module detected difference between state of corresponding output bit and actual state of pin. It may happen when outputs arte not powered (Q+ LED is off) or are connected directly to ground.

8.1.3. GSM status



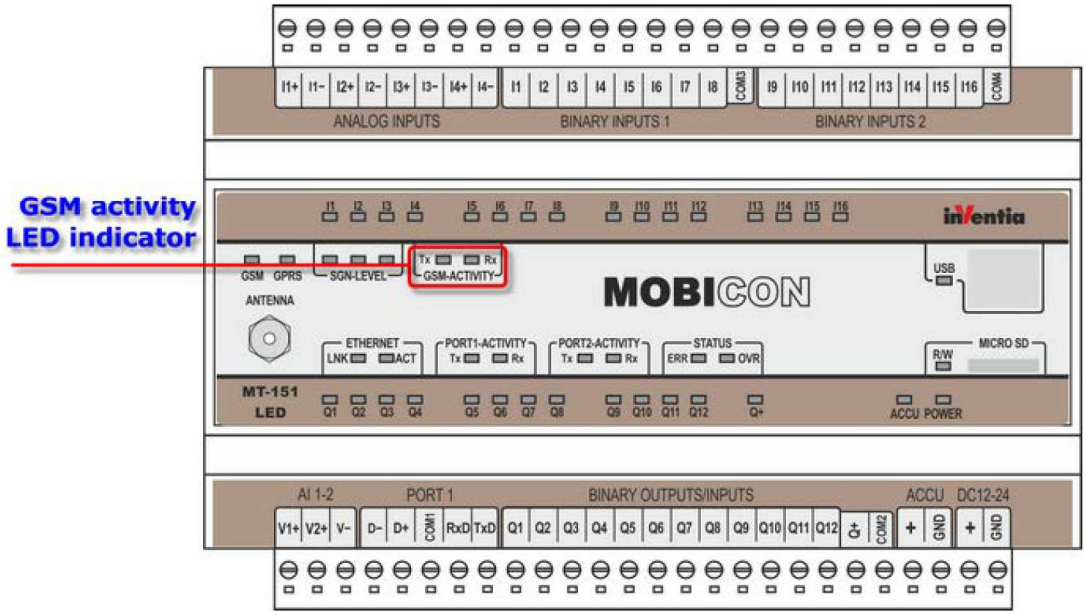
GSM and GPRS LED indicators are signaling connection to GSM and GPRS network (GSM LED on - module logged into GSM network, GPRS LED on - module logged into GPRS network).

8.1.4. Signal level



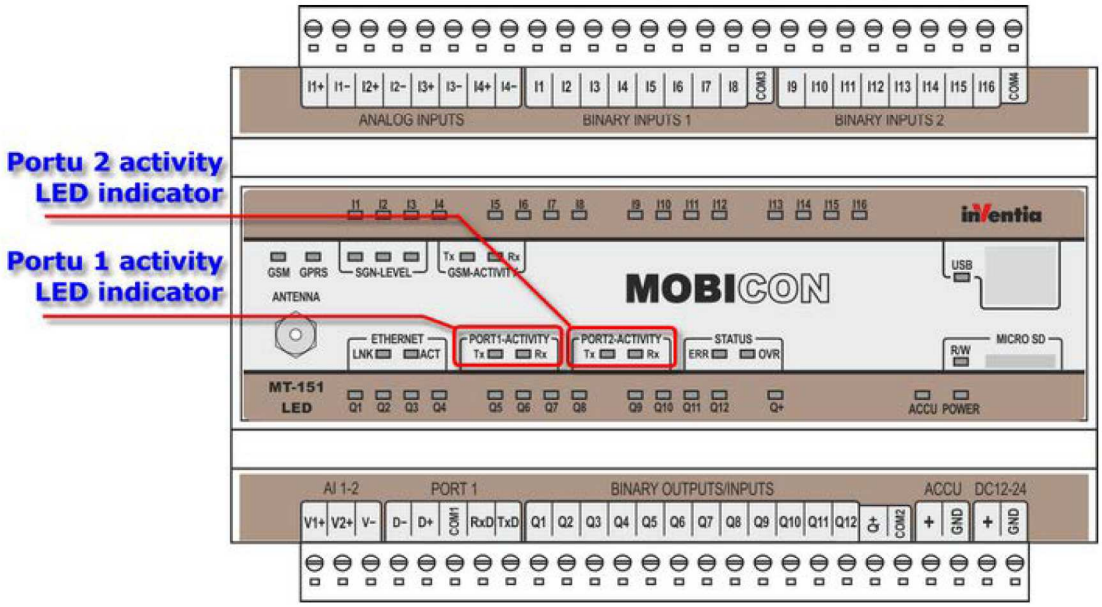
GSM signal level LED indicator provides information about GSM signal strength. Signal level signaled by one LED on is enough for stable GPRS communication. More LEDs are on, better the signal.

8.1.5. GSM activity



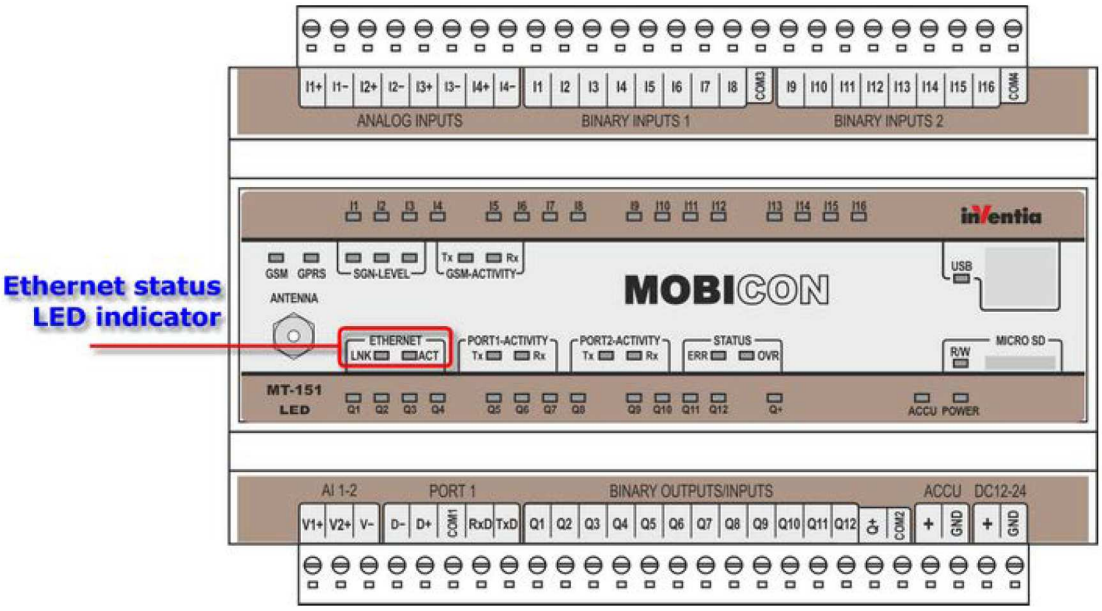
Short blinks of **Tx** LED indicate data packet or SMS sending while **Rx** LED blink indicate reception of data packet or SMS.

8.1.6. Serial ports activity



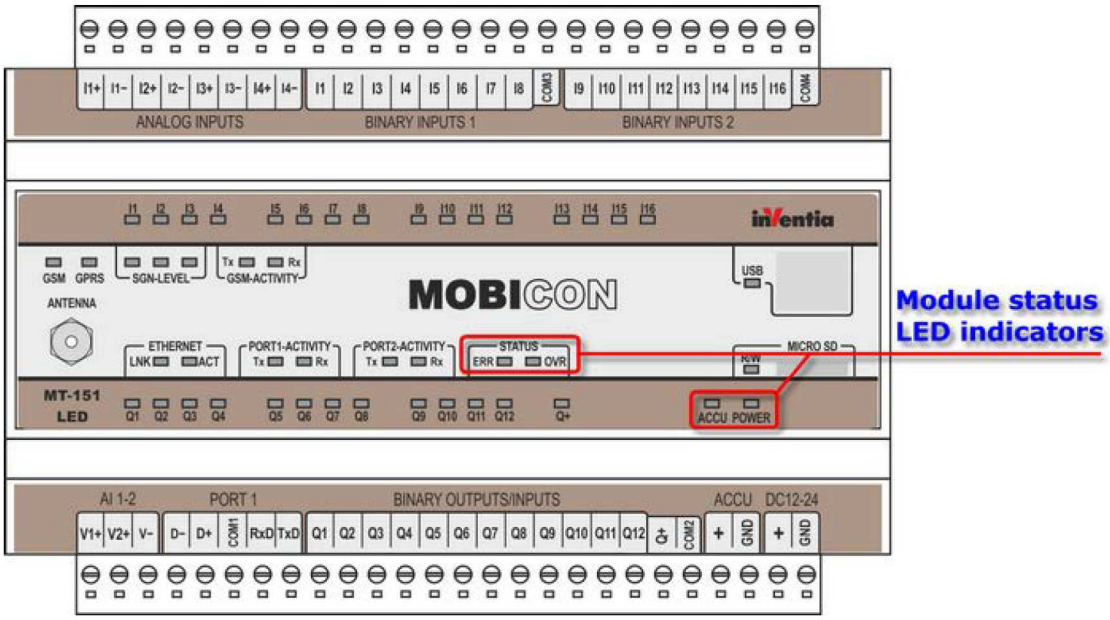
Short blinks of **Tx** LED indicate data sending while **Rx** LED blink indicate data reception on serial port corresponding to LED indicator.

8.1.7. Ethernet status



LNK LED is signaling connection of proper Ethernet cable while **ACT** LED is signaling data transmission.

8.1.8. Module status



LEDs from this groups provide information about power and control program status.

Meaning of LED indicators:

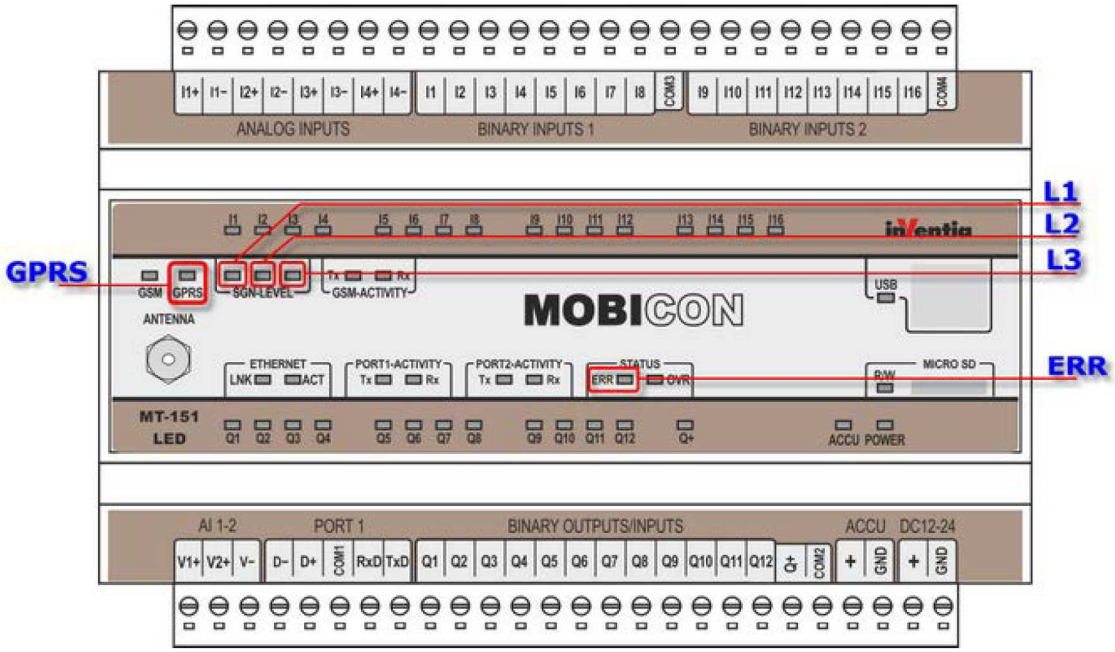
- **ERR** LED - when lit, the **ERR** LED indicates an error forcing automatic reboot. The reason may be lack of GPRS communication. Triple flash of ERR LED indicates that current firmware does not support the function used in the program. In this situation please update module firmware to most recent.
- **OVR** LED - when lit, the **OVR** LED indicates that control program is stopped. It is also lit for few seconds after writing new firmware or configuration to module indicating that module should not be powered off.
- **ACCU** LED - when lit, battery charger is operating.
- **PWR** LED - is lit all the time the module is powered from mains power supply.

Indicators of Module status group are the main sources of visual information about correct operation of the module.

8.2. Error signaling

Despite the efforts of module designers and users errors in function do occur. It is often imperative to diagnose and remove the cause of error. Error signaling is a tool for solving problems. Following LED indicators on module front panel display error code:

- **ERR**
- **GPRS**
- **L1**, **L2**, **L3** of **SGN LEVEL** group



8.2.1. Standard errors

A sign of **Standard error** occurrence is lit **ERR** LED. Error code numbers are displayed on signal level and **GPRS** LEDs.

ERR	State
○	lit

GPRS	L1	L2	L3	Error number	Description
●	○	●	●	1	Modem error
●	●	○	●	2	GSM network error - check antenna connection and SIM card activation in GSM network
●	○	○	●	3	GPRS network error - check SIM card activation in GPRS network
●	●	●	○	4	Wrong user name or password for GPRS network
●	○	●	○	5	Error during GPRS login
●	●	○	○	6	Connection interrupted
●	○	○	○	7	Other error
○	●	●	●	8	
○	○	●	●	9	SIM card error (locked or missing)
○	●	○	●	10	
○	○	○	●	11	
○	●	●	○	12	
○	○	●	○	13	
○	●	○	○	14	
○	○	○	○	15	Wrong PIN for SIM card

○	LED flashing (0.5Hz)
●	LED off

When GPRS LED is off the module will automatically try to reinitiate transmission.
When GPRS LED is flashing user intervention is required. Remove the reason for error and reconnect power.

8.3. Unlocking the SIM card

Triple insertion of wrong PIN code results in locking the SIM card. Locked card renders SMS and data transmission impossible. Locked SIM card is signaled by **ERR LED**.
In order to unlock the SIM card do the following:

- Power off the module
- Remove the SIM card from device
- Insert the SIM card to a mobile phone that accepts the SIM issued by your operator
- Start the phone and insert the PUK code followed by PIN code
- Power the module on
- Insert proper PIN into configuration

- Power the module off
- Install the SIM card in the module
- Power the module on

Executing the procedure unlocks the SIM card and enables modules proper operation.

9. Technical parameters

9.1. General

Dimensions (height x width x depth)	157mm x 86mm x 58mm
Weight	450g
Mounting method	35mm DIN rail
Operating temperature	-20°C +65°C
Ingress protection class	IP40
Humidity	up to 95%, non-condensing

9.2. GSM/GPRS modem

Modem type	Cinterion TC63i
GSM band	QuadBand (GSM 850/EGSM 900/ DCS 1800/PCS 1900)
Transmitter peak power (GSM 850/EGSM 900)	33 dBm (2W) – station of class 4
Transmitter peak power (DCS 1800/PCS 1900 MHz)	30 dBm (1W) – station of class 1
GPRS	Class 10
Modulation	0.3 GMSK
Channel spacing	200kHz
Antenna	50Ω

9.3. Power supply

Direct current DC (12VDC, 24VDC) Direct current DC required for battery charger (24VDC)	10.8 - 36V 18 - 36V
Input current for 12VDC	Idle 0.12A Active 0.50A Max 2.00A
Input current for 24VDC	Idle 0.06A Active 0.25A Max 1.00A
External battery nominal voltage	12V
External battery nominal capacity	7Ah
Maximum external battery charging current	50mA

NOTICE!
Due to high momentary current consumption the power supply must be capable of delivering > 2A of current.
Inappropriate power supply may result in faulty operation or cause damage to the module!

9.4. Binary inputs

For binary inputs I1-I16	
Input voltage range	-36 - 36V
Input voltage range resistance	5.4 kΩ
Input voltage for high state (1)	> 9V or < -9V
Input voltage for low state (0)	-3V to 3V
For binary outputs Q1-Q12 operating in binary input mode	
Maximum input voltage	36V
Input voltage range resistance	5.4 kΩ
Input voltage for high state (1)	> 9V
Input voltage for low state (0)	< 3V

9.5. Binary outputs

Maximum output current	160mA
Voltage drop for 100mA	< 0.5V
Current in low state (0)	< 0.2μA

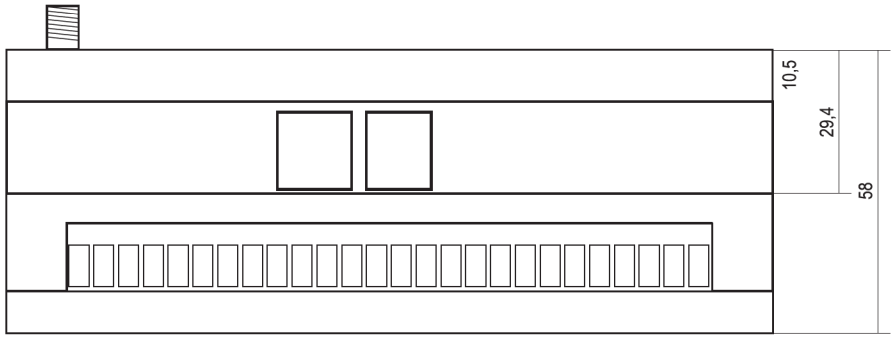
9.6. Analog inputs 4-20mA

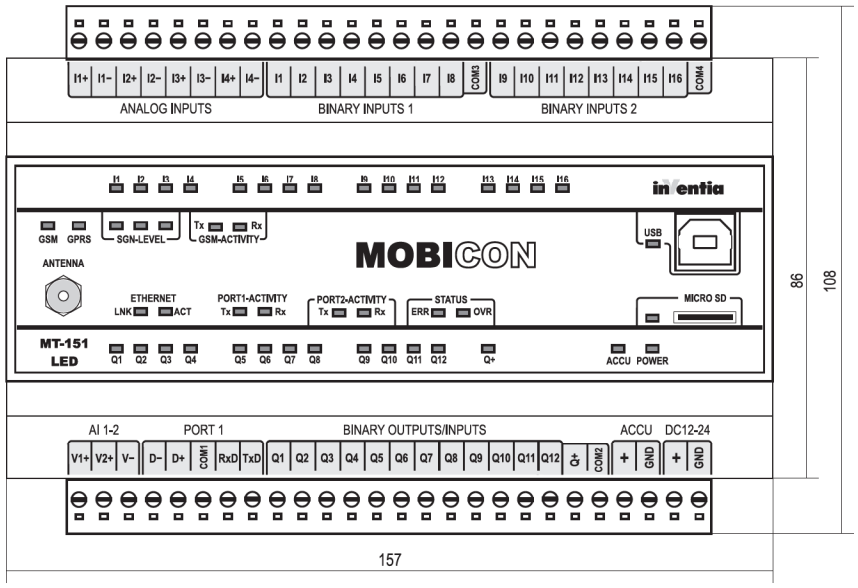
Measuring range	4 - 20mA
Maximum input current	50mA
Dynamic impedance	typically 55 Ω
Voltage drop at 20mA	< 5V
A/D converter resolution	14 bits
Accuracy @ 25°C	±0.2%

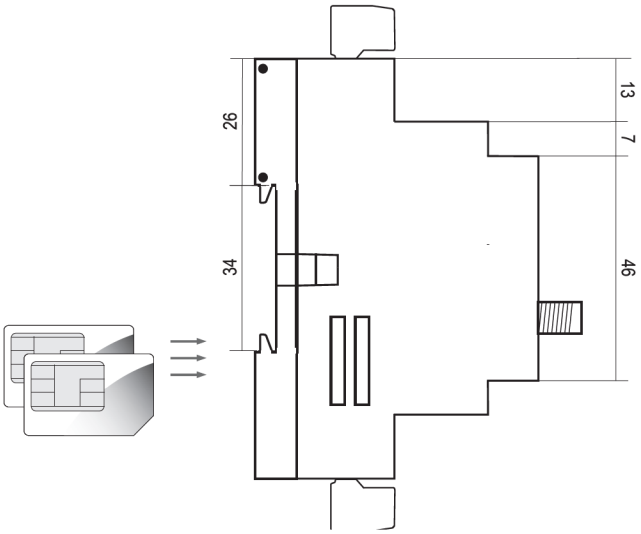
9.7. Analog inputs 0-10V

Measuring range	0 - 10V
Maximum input voltage	20V
Dynamic impedance	typically 197kΩ
A/D converter resolution	12 bits
Accuracy @ 25°C	±0.5%

9.8. Drawings and dimensions







NOTICE!
All dimension in millimeters.

10. Safety information

10.1. Working environment

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

10.2. Electronic equipment

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

10.2.1. Heart pacemakers

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

10.2.2. Hearing aids

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

10.2.3. Other medical equipment

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

10.2.4. RF Marked equipment

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

10.3. Explosive environment

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

11. Appendices

11.1. SMS commands syntax

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 and e-mail message, allowing the user to read from and write (SMS only) 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:

GSM signal level is #IR132%

then module will answer with:

>GSM signal level is 96%

where 96 is a value read from input register 132.

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.HR4=123456

causes write 123456 to two registers, HR4 and HR5 (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 48 of internal registers space (which is equal to 0 bit of HR3 register), then sending a command:

#output=1

causes module to write 1 to bit 0 of HR3 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	*mttime: counter of I1: #D2.HR4
2	mttime	#date #time
3	state	*mttime: GSM - #IR132%

then macro *mttime 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: GSM - #IR132%

but expansion of macro 1 will not contain text assigned to macro name *mttime, therefore text being executed after macro 1 was used will look like:
***mttime: counter of I1: #D2.HR4**

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).
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
DATE	Returns local date read from RTC registers
NAME	Returns module name
SERIAL	Returns module serial number
IPADDR	Returns module current IP address
CR	Enters new line in SMS text

Other examples:

Read Input Registers address 23:
#IR23

Write value 1 to Holding Register 3:
#HR0=3

Binary representation of Input Register 17 (readout):
#B.IR17

Read flag (bit) 4:
#B.IB17

Write hexadecimal value **01AC** to holding register 4:
#H.HR4=01AC

Read 8 bits starting from address 16 (Input Registers 1):
#B8.IB16

Read decimal number consisting from 6 bits starting from address 64 (Input Register 4):
#D6.IB64

Write single bit to register (Bit 0 to Holding Register 3):
#HB48=1

Read signed number from register:
#S.IR18

11.2. Bit list

During its operation **MT-151** is setting a series of binary variables associated with the I/O and module diagnostics. **MTManager**, for user convince, has implemented list of predefined bits.

Name of bit	Description
I1 - I16	Binary inputs I1 - I16
IQ1 - IQ12	Binary inputs IQ1 - IQ12 (outputs Q1 -Q12 operating in binary input mode)
Q1 - Q12	Binary outputs Q1 -Q12
CT1 - CT16	Synchronous timer flags CT1 - CT16
CK1 - CK16	Asynchronous timer flags CK1 - CK16
AI1_LoLo - AI4_LoLo	Analog inputs 4-20mA alarm bits - LoLo alarm. Measured value lower than LoLo alarm threshold.
AI1_Lo -AI4_Lo	Analog inputs 4-20mA alarm bits - Lo alarm. Measured value lower than Lo alarm threshold.
AI1_Hi - AI4_Hi	Analog inputs 4-20mA alarm bits - Hi alarm. Measured value higher than Hi alarm threshold.
AI1_HiHi - AI4_HiHi	Analog inputs 4-20mA alarm bits - HiHi alarm. Measured value higher than HiHi alarm threshold.
AV1_LoLo, AV2_LoLo	Analog inputs 0-10V alarm bits - LoLo alarm. Measured value lower than LoLo alarm threshold.
AV1_Lo, AV2_Lo	Analog inputs 0-10V alarm bits - Lo alarm. Measured value lower than Lo alarm threshold.
AV1_Hi, AV2_Hi	Analog inputs 0-10V alarm bits - Hi alarm. Measured value higher than Hi alarm threshold.
AV1_HiHi, AV2_HiHi	Analog inputs 0-10V alarm bits - HiHi alarm. Measured value higher than HiHi alarm threshold.
AI1_ABOVE - AI4_ABOVE	Analog inputs 4-20mA alarm bits - out of measurement range. Measured value lower than 3.5mA.
AI1_BELOW - AI4_BELOW	Analog inputs 4-20mA alarm bits - out of measurement range. Measured value higher than 20.5mA.
AV1_ABOVE, AV2_ABOVE	Analog inputs 0-10V alarm bits - out of measurement range. Measured value lower than 0V.
AV1_BELOW, AV2_BELOW	Analog inputs 0-10V alarm bits - out of measurement range. Measured value higher than 10V.
P1 - P256	General purpose program flags P1 - P256

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

11.3. Memory map

All accessible from remote and by program resources of MT-151 module were collected in four address spaces: Binary Inputs, Input Register, Binary Outputs and Holding Registers. Spaces of Binary
Inputs and Input Register and spaces of Binary Outputs and Holding Registers are connected in pairs and contain the same resources. The difference between spaces is in the way of accessing the resources - Binary Inputs and Outputs are used for accessing individual bits and groups of bits while Input and Holding Registers address spaces allow access to the full registers and register groups.
This difference results in a different way of addressing. In the Input Registers and Holding Registers address spaces each address is assigned to the each register while the for Binary Inputs and Outputs address spaces each address corresponds to individual bit. The memory map tables are arranged by their addresses for addressing registers. To calculate the addresses of the individual bits in the Binary Inputs, use the following equation:

register_address * 16 + bit_position = bit_address

To calculate the addresses of the individual bits in the Binary Outputs, use the following equation:

register_address * 16 + bit_position +10000 = bit_address

For example, in the PRG_FLG1 register from Input Registers address space (address 2) on position 7 is located FS1_gprs bit indicating GPRS logon. Using that formula, you can specify the address of FS1_gprs bit in Binary Inputs address space as follows:

2 * 16 +7 = 39.

11.3.1. Input registers/binary inputs address space

Input registers/binary inputs address space (read only), access using Modbus RTU and TCP functions 2 and 4																				
Address		**Bit**																	**Name**	**Description**
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**			
0	0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Reserved
1	16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Reserved
2	32	---	---	---	---	---	FS1_acu	FS1_sd	FS1_usb	FS1_gprs	FS1_gsm	FS1_q+	FS1_prog	---	FS1_stop	FS1_new	FS1_fs		PRG_FLG1	Status flags: FS1_fs - first program scan FS1_new - informs about loading new program FS1_stop = 1 when program is stopped FS1_prog = 1 when error in user program FS1_q+ = 1 when binary outputs are not powered FS1_gsm = 1 when module is logged into GSM network FS1_gprs = 1 when module is logged into GPRS network FS1_usb = 1 when USB cable is connected FS1_sd = 1 when microSD card is installed in slot FS1_acu = 1 when battery is connected
3	48	---	---	---	---	---	---	---	---	---	---	---	---	---	---	FS2_rtc_min	FS2_rtc_sec		PRG_FLG2	System flags: FS2_rtc_sec - 1Hz impulsator (1 second) FS2_rtc_min - 1/60Hz impulsator (1 minute)
4	64	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}		RTC_FSEC	RTC - fraction of second
5	80	int16(LoHi)																	RTC_Sec	RTC - second (0 - 59)
6	96	int16(LoHi)																	RTC_Min	RTC - minute (0 - 59)
7	112	int16(LoHi)																	RTC_Hour	RTC - hour (0 - 23)
8	128	int16(LoHi)																	RTC_DofW	RTC - day of week (1 - Sunday, 7 - Saturday)
9	144	int16(LoHi)																	RTC_Day	RTC - day of month (1-31)
10	160	int16(LoHi)																	RTC_Mon	RTC - month (1-12)

Input registers/binary inputs address space (read only), access using Modbus RTU and TCP functions 2 and 4																				
Address		**Bit**																	**Name**	**Description**
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**			
11	176	int16(LoHi)																	RTC_Year	RTC - year (2000-2099)
12	192	int32(LoHi)																	RTC	Timestamp
13	208																			
14	224	int32(LoHi)																	ON_TMR	Time in seconds since power on
15	240																			
16	256	CT16	CT15	CT14	CT13	CT12	CT11	CT10	CT9	CT8	CT7	CT6	CT5	CT4	CT3	CT2	CT1		CLOCK	Synchronous timers flags (set for 1 program cycle)
17	272	I16	I15	I14	I13	I12	I11	I10	I9	I8	I7	I6	I5	I4	I3	I2	I1		BIN	Binary inputs
18	288	---	---	---	---	IQ12	IQ11	IQ10	IQ9	IQ8	IQ7	IQ6	IQ5	IQ4	IQ3	IQ2	IQ1		BFB	Binary outputs/inputs pin state
19	304	int16(LoHi)																	AI1_raw	Analog input AI1 measurement [mA]
20	320	int16(LoHi)																	AI2_raw	Analog input AI2 measurement [mA]
21	336	int16(LoHi)																	AI3_raw	Analog input AI3 measurement [mA]
22	352	int16(LoHi)																	AI4_raw	Analog input AI4 measurement [mA]
23	368	int16(LoHi)																	AI1	Analog input AI1 measurement [engineering units]
24	384	int16(LoHi)																	AI2	Analog input AI2 measurement [engineering units]
25	400	int16(LoHi)																	AI3	Analog input AI3 measurement [engineering units]
26	416	int16(LoHi)																	AI4	Analog input AI4 measurement [engineering units]
27	432	---	AI2_ABOVE	AI2_BELOW	AI2_DBD	AI2_HiHi	AI2_Hi	AI2_LoLo	AI2_Lo	---	AI1_ABOVE	AI1_BELOW	AI1_DBD	AI1_HiHi	AI1_Hi	AI1_LoLo	AI1_Lo		ALM_I12	Alarm bits for AI1 - AI4 analog inputs: AIx_ABOVE - measurement above 20.5mA AIx_BELOW - measurement below 3.5mA AIx_DBD - measurement change higher than deadband AIx_LoLo - LoLo alarm flag AIx_Lo - Lo alarm flag AIx_Hi - Hi alarm flag AIx_HiHi - HiHi alarm flag
28	448	---	AI4_ABOVE	AI4_BELOW	AI4_DBD	AI4_HiHi	AI4_Hi	AI4_LoLo	AI4_Lo	---	AI3_ABOVE	AI3_BELOW	AI3_DBD	AI3_HiHi	AI3_Hi	AI3_LoLo	AI3_Lo		ALM_I34	
29	464	int16(LoHi)																	AV1_raw	Analog input AV1 measurement [mV]

Input registers/binary inputs address space (read only), access using Modbus RTU and TCP functions 2 and 4																				
Address		**Bit**																	**Name**	**Description**
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**			
30	480	int16(LoHi)																	AV2_raw	Analog input AV2 measurement [mV]
31	496	int16(LoHi)																	AV1	Analog input AV1 measurement [engineering units]
32	512	int16(LoHi)																	AV2	Analog input AV2 measurement [engineering units]
33	528	---	AV2_ ABOVE	AV2_ BELOW	AV2_ DBD	AV2_ HiHi	AV2_ Hi	AV2_ LoLo	AV2_ Lo	---	AV1_ ABOVE	AV1_ BELOW	AV1_ DBD	AV1_ HiHi	AV1_ Hi	AV1_ LoLo	AV1_ Lo		ALM_V12	Alarm bits for AV1 - AV2 analog inputs: AVx_ABOVE - measurement above 10V AVx_BELOW - measurement below 0V AVx_DBD - measurement change higher than deadband AVx_LoLo - LoLo alarm flag AVx_Lo - Lo alarm flag AVx_Hi - Hi alarm flag AVx_HiHi - HiHi alarm flag
34	544	int16(LoHi)																	AVAKU	Battery voltage [mV]
35	560	int16(LoHi)																	AVZ	Power supply voltage [mV]
36	576	CNT16_OVFL	CNT15_OVFL	CNT14_OVFL	CNT13_OVFL	CNT12_OVFL	CNT11_OVFL	CNT10_OVFL	CNT9_OVFL	CNT8_OVFL	CNT7_OVFL	CNT6_OVFL	CNT5_OVFL	CNT4_OVFL	CNT3_OVFL	CNT2_OVFL	CNT1_OVFL		CNT_OVFL	Counter overflow bits (set for 1 program cycle)
37	592	CK16	CK15	CK14	CK13	CK12	CK11	CK10	CK9	CK8	CK7	CK6	CK5	CK4	CK3	CK2	CK1		CKx	Asynchronous timers flags (set for 1 program cycle)
38	608	SL16_ok	SL15_ok	SL14_ok	SL13_ok	SL12_ok	SL11_ok	SL10_ok	SL9_ok	SL8_ok	SL7_ok	SL6_ok	SL5_ok	SL4_ok	SL3_ok	SL2_ok	SL1_ok			SLx_ok=1 when data block x communication on serial port is OK

Input registers/binary inputs address space (read only), access using Modbus RTU and TCP functions 2 and 4																			
Address		**Bit**																**Name**	**Description**
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
39	624									C8	C7	C6	C5	C4	C3	C2	C1		Program counters Cx overflow flags
40	640									T8	T7	T6	T5	T4	T3	T2	T1		Program timers Tx flags
41	656	TSL16_ok	TSL15_ok	TSL14_ok	TSL13_ok	TSL12_ok	TSL11_ok	TSL10_ok	TSL9_ok	TSL8_ok	TSL7_ok	TSL6_ok	TSL5_ok	TSL4_ok	TSL3_ok	TSL2_ok	TSL1_ok		TSLx_ok=1 - when data block x communication on Ethernet port is OK
42	672	MT2MT_16	MT2MT_15	MT2MT_14	MT2MT_13	MT2MT_12	MT2MT_11	MT2MT_10	MT2MT_9	MT2MT_8	MT2MT_7	MT2MT_6	MT2MT_5	MT2MT_4	MT2MT_3	MT2MT_2	MT2MT_1		MTx bit informs about receiving data to MT2MT buffer from device, which IP number is saved on x position on Authorized -> IP list
43	688	MT2MT_32	MT2MT_31	MT2MT_30	MT2MT_29	MT2MT_28	MT2MT_27	MT2MT_26	MT2MT_25	MT2MT_24	MT2MT_23	MT2MT_22	MT2MT_21	MT2MT_20	MT2MT_19	MT2MT_18	MT2MT_17		
...	...	...																...	...
127	2032	int16(LoHi)																	Last restart code: 32 - restart after new configuration 64 - restart after firmware update 128 - restarted by system
...	...	...																...	...
132	2112	int16(LoHi)																SYG_LEV	GSM signal level [%]
133	2128	int32(LoHi)																FIRMWARE_VER	Firmware version y.xx.zz (encoded in HEX)
134	2144																		
135	2160	int16(LoHi)																PRG_CLINE	Number of program lines executed in previous program cycle
136	2176	int16(LoHi)																PRG_CTIME	Time of execution of previous program cycle [ms]

Input registers/binary inputs address space (read only), access using Modbus RTU and TCP functions 2 and 4																		
Address		**Bit**															**Name**	**Description**
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
...	...	...															...	...
138	2208	int16(LoHi)															PAR_1	Parameter 1
...	...	...															...	...
256	4096	int16(LoHi)															PAR_128	Parameter 128

11.3.2. Holding registers/binary outputs address space

Holding registers/binary outputs address space (read/write), access using Modbus RTU and TCP functions: read - 1, 3; write - 5, 6, 15, 16)																				
Address		**Bit**											**Name**		**Description**					
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**			
0	0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Reserved
1	16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Reserved
2	32	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	PS1_STOP	SYS_FLG1	PS1_STOP - writing 1 stops program, 0 - starts program	
3	48			---	---	Q12	Q11	Q10	Q9	Q8	Q7	Q6	Q5	Q4	Q3	Q2	Q1	BOUT	Bits controlling binary outputs 1 - output set to high level, 0 - low level	
4	64	int32(LoHi)																CNT1	32-bit counter register	
5	80																			
6	96	int32(LoHi)																CNT2	32-bit counter register	
7	112																			
8	128	int32(LoHi)																CNT3	32-bit counter register	
9	144																			
10	160	int32(LoHi)																CNT4	32-bit counter register	
11	176																			
12	192	int32(LoHi)																CNT5	32-bit counter register	
13	208																			
14	224	int32(LoHi)																CNT6	32-bit counter register	
15	240																			
16	256	int32(LoHi)																CNT7	32-bit counter register	
17	272																			

Holding registers/binary outputs address space (read/write), access using Modbus RTU and TCP functions: read - 1, 3; write - 5, 6, 15, 16)																			
Address		**Bit**											**Name**		**Description**				
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
18	288	int32(LoHi)																CNT8	32-bit counter register
19	304																		
20	320	int32(LoHi)																CNT9	32 bit counter register
21	336																		
22	352	int32(LoHi)																CNT10	32-bit counter register
23	368																		
24	384	int32(LoHi)																CNT11	32-bit counter register
25	400																		
26	416	int32(LoHi)																CNT12	32-bit counter register
27	432																		
28	448	int32(LoHi)																CNT13	32-bit counter register
29	464																		
30	480	int32(LoHi)																CNT14	32-bit counter register
31	496																		
32	512	int32(LoHi)																CNT15	32-bit counter register
33	528																		
34	544	int32(LoHi)																CNT16	32-bit counter register
35	560																		
36	576	int32(LoHi)																REG_CK1	CK1 asynchronous timer - current value
37	592																		
38	608	int32(LoHi)																REG_CK2	CK2 asynchronous timer - current value
39	624																		

Holding registers/binary outputs address space (read/write), access using Modbus RTU and TCP functions: read - 1, 3; write - 5, 6, 15, 16)																			
Address		**Bit**											**Name**		**Description**				
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
40	640	int32(LoHi)																REG_CK3	CK3 asynchronous timer - current value
41	656																		
42	672	int32(LoHi)																REG_CK4	CK4 asynchronous timer - current value
43	688																		
44	704	int32(LoHi)																REG_CK5	CK5 asynchronous timer - current value
45	720																		
46	736	int32(LoHi)																REG_CK6	CK6 asynchronous timer - current value
47	752																		
48	768	int32(LoHi)																REG_CK7	CK7 asynchronous timer - current value
49	784																		
50	800	int32(LoHi)																REG_CK8	CK8 asynchronous timer - current value
51	816																		
52	832	int32(LoHi)																REG_CK9	CK9 asynchronous timer - current value
53	848																		
54	864	int32(LoHi)																REG_CK10	CK10 asynchronous timer - current value
55	880																		
56	896	int32(LoHi)																REG_CK11	CK11 asynchronous timer - current value
57	912																		
58	928	int32(LoHi)																REG_CK12	CK12 asynchronous timer - current value
59	944																		
60	960	int32(LoHi)																REG_CK13	CK13 asynchronous timer - current value
61	976																		

Holding registers/binary outputs address space (read/write), access using Modbus RTU and TCP functions: read - 1, 3; write - 5, 6, 15, 16)																			
Address		**Bit**											**Name**		**Description**				
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
62	992	int32(LoHi)																REG_CK14	CK14 asynchronous timer - current value
63	1008																		
64	1024	int32(LoHi)																REG_CK15	CK15 asynchronous timer - current value
65	1040																		
66	1056	int32(LoHi)																REG_CK16	CK16 asynchronous timer - current value
67	1072																		
68	1088	int16(LoHi)																RESTART	Module restart counter
69	1104									CLK_C8	CLK_C7	CLK_C6	CLK_C5	CLK_C4	CLK_C3	CLK_C2	CLK_C1		C1 - C8 program counters counting inputs (active on rising edge)
70	1120									RST_C8	RST_C7	RST_C6	RST_C5	RST_C4	RST_C3	RST_C2	RST_C1		C1 - C8 program counters resetting inputs (active on 1)
71	1136									EN_T8	EN_T7	EN_T6	EN_T5	EN_T4	EN_T3	EN_T2	EN_T1		T1 - T8 program timers enable bits (active on 1)
72	1152									RST_T8	RST_T7	RST_T6	RST_T5	RST_T4	RST_T3	RST_T2	RST_T1		T1 - T8 program timers resetting bits (active on 1)
...	...	...																...	...
100	1600	P16	P15	P14	P13	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1	PFLG	General purpose program flags
...	...	...																	

Holding registers/binary outputs address space (read/write), access using Modbus RTU and TCP functions: read - 1, 3; write - 5, 6, 15, 16)																			
Address		**Bit**											**Name**	**Description**					
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
115	1840	P256	P255	P254	P253	P252	P251	P250	P249	P248	P247	P246	P245	P244	P243	P242	P241		
116	1856	int16(LoHi)																REG1	General purpose 16-bit register
...	...	...																...	...
371	5936	int16(LoHi)																REG256	General purpose 16-bit register
372	5952	int32(LoHi)																DREG1	General purpose 32-bit register (signed value)
373	5968																		
...	...	...																...	...
628	10048	int32(LoHi)																DREG128	General purpose 32-bit register (signed value)
629	10064																		
630	10080	int16(LoHi)																PV_C1	C1 program counter threshold value
631	10096	int16(LoHi)																PV_C2	C2 program counter threshold value
632	10112	int16(LoHi)																PV_C3	C3 program counter threshold value
633	10128	int16(LoHi)																PV_C4	C4 program counter threshold value
634	10144	int16(LoHi)																PV_C5	C5 program counter threshold value
635	10160	int16(LoHi)																PV_C6	C6 program counter threshold value
636	10176	int16(LoHi)																PV_C7	C7 program counter threshold value
637	10192	int16(LoHi)																PV_C8	C8 program counter threshold value
638	10208	int16(LoHi)																PV_T1	T1 program timer threshold value
639	10224	int16(LoHi)																PV_T2	T2 program timer threshold value
640	10240	int16(LoHi)																PV_T3	T3 program timer threshold value
641	10256	int16(LoHi)																PV_T4	T4 program timer threshold value
642	10272	int16(LoHi)																PV_T5	T5 program timer threshold value
643	10288	int16(LoHi)																PV_T6	T6 program timer threshold value
644	10304	int16(LoHi)																PV_T7	T7 program timer threshold value
645	10320	int16(LoHi)																PV_T8	T8 program timer threshold value
646	10336	int16(LoHi)																REG_C1	C1 program counter current value

Holding registers/binary outputs address space (read/write), access using Modbus RTU and TCP functions: read - 1, 3; write - 5, 6, 15, 16)																			
Address		**Bit**											**Name**	**Description**					
Reg	**Bit**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**		
647	10352	int16(LoHi)																REG_C2	C2 program counter current value
648	10368	int16(LoHi)																REG_C3	C3 program counter current value
649	10384	int16(LoHi)																REG_C4	C4 program counter current value
650	10400	int16(LoHi)																REG_C5	C5 program counter current value
651	10416	int16(LoHi)																REG_C6	C6 program counter current value
652	10432	int16(LoHi)																REG_C7	C7 program counter current value
653	10448	int16(LoHi)																REG_C8	C8 program counter current value
654	10464	int16(LoHi)																REG_T1	T1 program timer current value
655	10480	int16(LoHi)																REG_T2	T2 program timer current value
656	10496	int16(LoHi)																REG_T3	T3 program timer current value
657	10512	int16(LoHi)																REG_T4	T4 program timer current value
658	10528	int16(LoHi)																REG_T5	T5 program timer current value
659	10544	int16(LoHi)																REG_T6	T6 program timer current value
660	10560	int16(LoHi)																REG_T7	T7 program timer current value
661	10576	int16(LoHi)																REG_T8	T8 program timer current value
...	...	...																...	...
1024	16384	int16(LoHi)																HR1024	General purpose 16-bit register zeroed at reset
...	...	...																...	...
8191	131056	int16(LoHi)																HR8191	General purpose 16-bit register zeroed at reset