# WIRELESS COMMUNICATION SYSTEM
## Wireless M-BUS

# WB169-RFG

*Revision 1.0*

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# 1 Introduction

This document describes features, parameters and setting possibilities of the WB169-RFG communication gateway, which is used for receiving of radio messages from the devices for remote reading of consumption meters working in the communication system Wireless M-BUS (hereinafter referred as WMBUS) in the 169 MHz band and for transmitting of these messages over a standard IP network (Internet) to a central collecting system.

## 1.1 Wireless M-BUS Communication Protocol

Wireless M-BUS is the communications protocol described by international standards EN 13757-4 (physical and link layer) and EN 13757-3 (application layer), which is intended primarily for radio transmission of remote reading values from consumption meters and sensors. Protocol Wireless M-BUS (hereinafter „WMBUS") is based on a standard M-BUS definition (uses the same application layer as M-BUS standard), but is adapted for data transfer via radio signals.

Communications via WMBUS protocol works in Master-Slave mode, where „Master" is a collecting data device, „Slave" is a providing data device. Slave device could be integrated or external radio module transmitting data from the meter/sensor. The communications protocol WMBUS defines several communication modes (simplex or duplex). If working in simplex mode a „Slave" device only transmits messages to „Master" that these messages receives. If working in „bidirectional" mode, it is possible to use a reverse channel from „Master" device to „Slave" device for „Request" type of messages, that can contain e.g. request for the change of slave's configuration.

Wireless M-BUS communications protocol partially supports repeating of the messages. If receiving from some „Slave" device is not possible because of the low level of radio signal, the messages can be re-transmitted (repeated) by appointed element of the radio network (repeater or slave with such functionality). Each repeated message is marked as „repeated message" so as not to be repeated again.

## 1.2 Module usage

The WB169-RFG module is intended for data transfer from the RF modules of remote reading in 169 MHz radio band and a central computer application that receives and processes the data. The module receives radio messages coded according to the Wireless M-Bus EN 13757-3 and EN 13757-4 standard for the 169 MHz band, checks their correctness, encodes („repacks") them into IP/UDP frames and sends them to the configured IP address and a central application port number. Wireless M-Bus messages are packed to the IP/UDP frames with using of proprietary coding system "NEP" by SOFTLINK. As the Internet access is provided through the mobile data services, the module is equipped with the integrated GSM/LTE modem.

The WB169-RFG module works in **the N2 bidirectional communication mode**, where it can transmit Wireless M-BUS messages of **„Request" type** addressed to any subordinate module supporting N2 mode. These messages can be used for remote changing of parameters of the subordinate „Slave" device. Broadcasting of the reverse-channel message for a particular „Slave" device is under way during 500 ms long reverse-channel communication window that opens immediately after transmitting of „User Data" message from the device. During this time period the „Slave" activates its receiver so as to be able to receive a „Request" message (if transmitted). Receiving of the reverse-channel message is confirmed by „Acknowledgment" type of message.

Management of „Request" type of messages must be implemented into the central application software. These messages addressed to the particular „Slave" are transferred to the WB169-RFG module through the IP/UDP protocol with using of „NEP" coding. WB169-RFG module stores the „Request" messages (that contain also the lifetime period of each message) into its memory tables and after receiving of next „User Data" message from the „Slave" device transmits the reverse-channel message within the communication window. If the message is confirmed by receiving of „ACK" message from the „Slave", the message is removed from the WB169-RFG memory table. If „ACK" message does not come, „Request" is sent again during next window until its lifetime period is elapsed. WB169-RFG module can keep just one message in the memory table, so if the module receives another „Request" message from the central application, stored message is replaced by new one so that only the last message is transferred to the „Slave". „Request" messages are coded by using of common M-Bus principles and the coding system must be implemented in the central application as well as in the „Slave" device in a specular manner. The WB169-RFG module performs just transferring of the messages.

## 1.3 Module features

The basis of the module is a microcomputer with one **10/100 Mb/s Ethernet** communication port, one **mini USB** configuration port and an integrate GSM/LTE modem.

Communication ports are used for the following purposes:

- 10/100 Mb/s Ethernet port – this port is not used
- mini USB 2.0 port - the module configuration port;
- 169 MHz RF modem - RF communication with subordinate elements (terminal devices);
- GSM/LTE modem - communication with the central application.

The module is enclosed in a plastic casing adapted for mounting on a DIN-rail. The box has a standard „circuit breaker" profile and width of four standard DIN-modules. The module needs an external power supply 12V to 24V DC. For connecting of the power supply there is a screw terminal with marked voltage polarity.

The module RF transceiver is equipped with the **coaxial connector** of SMA (Female) type designated for interconnection of an external antenna (directly or via coaxial cable). The GSM modem is equipped in the same way. Both connectors are connected to the module front panel and are marked as "ANT 169 MHz" and "ANT GSM".

The module is equipped with a SIM card holder for using with a SIM card of the "Mini-SIM" format (2FF) with dimensions of 25 x 15 x 0.76 mm. The SIM holder is located on the module front panel, to the left of the LCD display.

On the right side of the front panel there is the 40x20 mm LCD display and control buttons. These elements are used for displaying the module basic parameters.

View of the WB169-RFG module is shown in Figure 1.

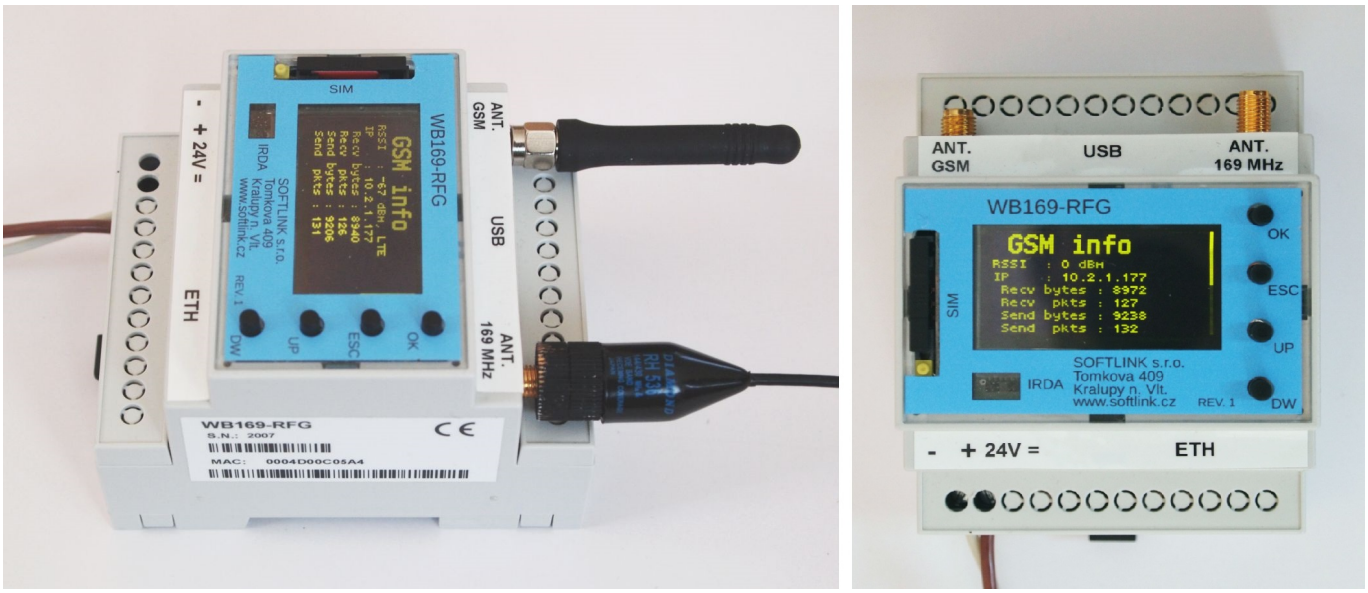



Figure 1: View of the WB169-RFG module

# 2 Technical parameters overview

Overview of all WB169-RFG module technical parameters is shown in the Table 1.

Table 1: Overview of WB169-RFG technical parameters

| | | |
|---|---|---|
| **Transmitter and receiver parameters** | | |
| Frequency band | 169,400 ÷ 169,475 | MHz |
| Modulation type | 2GFSK, 4GFSK | |
| No of channels in band | 10 | |
| Transmission rate | 2400, 4800, 19200 | Baud |
| Receiver sensitivity | -109 | dBm |
| Reverse channel transmitting power | 500 | mW |
| Antenna connector | SMA female | |
| Communication protocol | Wireless M-Bus | |
| Communication mode (by EN 13757-4) | N2 | |
| **Communication interface GSM** | | |
| Supported standards | LTE-TDD B38/B40/B41<br>LTE-FDD B1/B3/B5/B7/B8/B20<br>UMTS/HSPA+ B1/B5/B8<br>GSM/GPRS/EDGEB3/B8 | |
| Antenna characteristic impedance | 50 | Ω |
| Antenna connector | SMA female | |
| **Configuration interface USB** | | |
| Transmission speed | 115 200 | Baud |
| Operation mode | asynchronous | |
| Transmission rate | 8 data bits, 1 stop bit, none parity | |
| Connector | mini USB 2.0 | |
| **Optical configuration interface** | | |
| Transmission speed | 115 200 | Baud |
| Optical band | 870 | nm |
| Optical interface specification | IrPHY 1.4 standard | |
| **Power supplying** | | |
| External power supply | (12 ÷ 24) | V |
| Input power | 3 | W |
| **Weight and dimensions** | | |
| Width | 70 | mm |
| Height | 90 | mm |
| Depth | 58 | mm |
| Weight | cca 200 | g |
| DIN case | 4 modules | |
| SIM-card format | (15x12x0,76)mm) | „Micro-SIM” |
| **Storing and installation conditions** | | |
| Installation environment (CSN 33 2000-3) | normal AA6, AB4, A4 | |
| Operating temperatures range | (-10 ÷ 50) | °C |
| Storage temperatures range | (0 ÷ 70) | °C |
| Relative humidity | 90 | % (no condensation) |
| Degree of protection | IP20 | |

# 3 Configuration of the WB169-RFG module

Configuration parameters of the WB169-RFG module can be displayed and changed from the common computer (PC) by one of these methods:

- with using of common USB cable connected to the module configuration port;
- visually, with using of built-in LCD and control buttons;
- wirelessly, with using of **„USB-IRDA"** converter;
- **remotely** via Internet connection.

Technique of interconnection of the module with configuration computer and general rules of configuration are described in detail in paragraph 3.3. The description and meaning of all configuration parameters that can be checked and changed by cable can be found in the section 3.4 „Setting of WB169-RFG parameters via configuration cable".

The description of checking of basic parameters and operational statistics of the module by using of LCD display and control buttons can be found in the section 3.5 „Display of WB169-RFG module parameters on the LCD".

The description of checking of basic parameters and operational statistics of the module by using of optical converter can be found in the section 3.6 „Setting of parameters by using of optical converter".

The description of checking and setting of module parameters through the Internet connection can be found in the section 3.7 „Setting of parameters via the Internet data network".

## 3.1 Connection of the module to the computer

Configuration via USB cable can be performed by using of any PC with MS Windows or Linux operating systems. The module is equipped with the „mini USB" configuration interface and can be connected with the PC by common „USB 2.0 A Male - USB 2.0 mini B Male" interconnection cable.

After the module is connected to the computer for the first time, operating system will find and install appropriate generic driver of „USB Serial Device" category automatically. After driver installation is completed, the device will appear in the „Ports (COM and LPT)" section of the „Device Manger" window as „USB Serial Device (COMx)" (see figure 2).

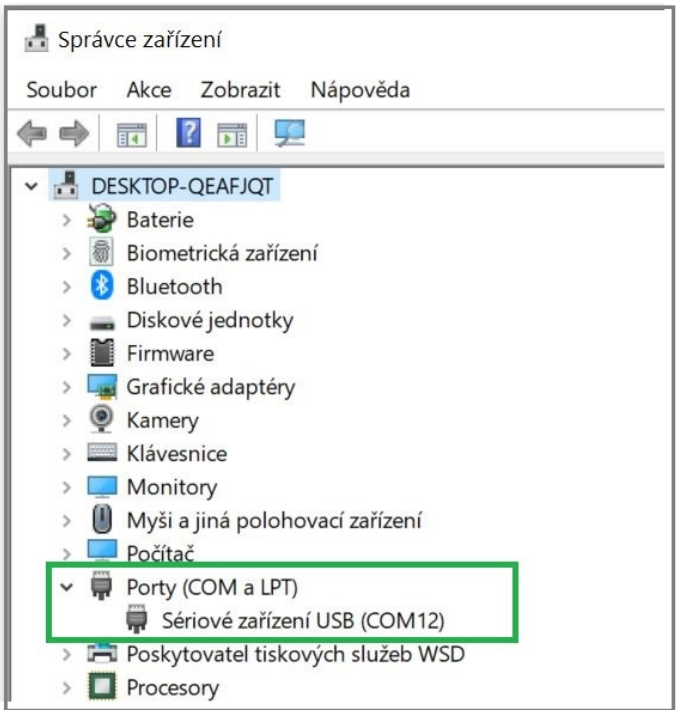



Figure 2: Appearance of the module in Windows „Device Manager"

Thus the computer is connected with the module and ready for performing any changes in configuration.

## 3.2 Using of „PuTTy" freeware program for configuration

The module configuration can be done with using of any suitable program for the serial line communication. The description bellow is relevant for the open-source software „PuTTY" that is available for free on www.putty.org.

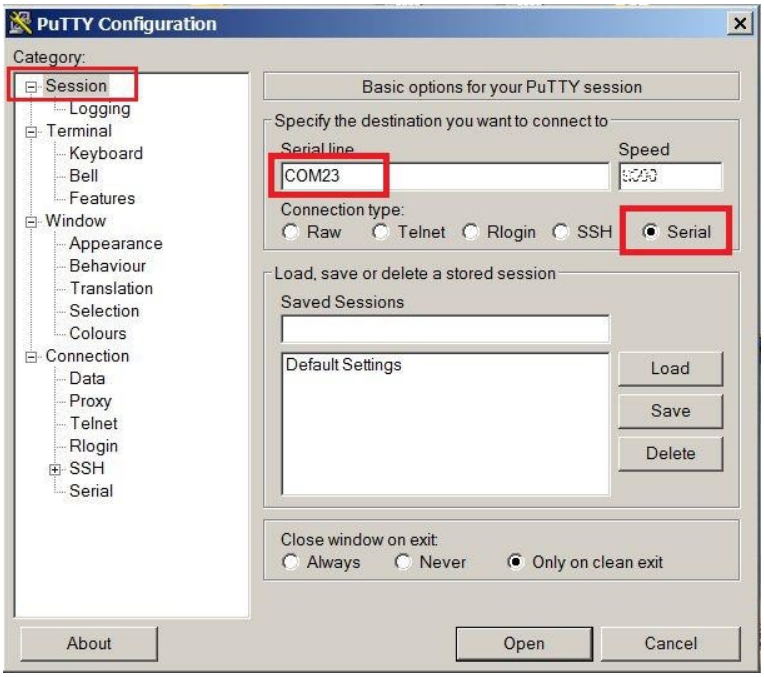



Figure 3: Terminal setting for serial line communication

„PuTTY" software runs after clicking on the downloaded file „putty.exe". There will open a window of the terminal communication (see Figure 3). For switching the program into the serial line communication, choose „Serial" option of the connection type in the „Session" tab.

Check (or set up) the communication speed („Speed") to 115200 bits/s and then enter into the „Serial line" tab the number of the serial port that the system automatically assigned to the virtual port at the moment of interconnection module to the computer. The number of the serial port can be found in OS Windows by using of „Device Manager" (Control Panel/System and Maintenance/Device manager) by clicking on „Ports (COM a LPT)" where the numbers of ports appear (e.g. „COM23" - see figure 2).

Click on „Open" button in „PuTTY" program and open the terminal window. After pressing of "ENTER" key there will appear a request for login and (after entering login) password. Factory preset login/pasword couple is „*admin/admin*", it is recommended to change it after installation. After login procedure there will appear a sequence with an information about last reset ended by system command line marked by "GW33H7-0#" prompt, which announces that the module is ready to be configured (see figure 4).

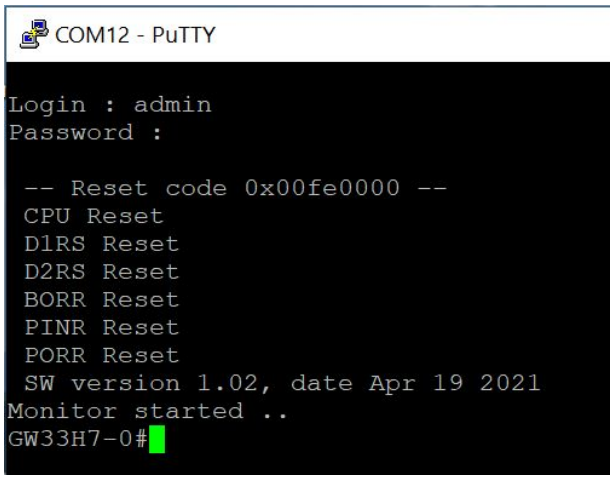



Figure 4: Open terminal window for module configuration via serial line

## 3.3 General rules for entering of configuration commands

Activate the terminal window for the configuration via the configuration cable according to the instructions above. These general rules are valid for entering commands in the command line:

- the command must be entered only when a prompt for command appears in front of the cursor mark (colored or flashing little square); the prompt is either „GW33H7-0#" or „mon" format (see figure 4);
- it is possible to enter only one command each time;
- the command could be entered in an alphanumeric character (or several characters);
- the command is sent to device by clicking on „ENTER" key. After the command being carried out, the prompt will appear again and it is ready for a new command to be entered. In case the command fails to execute, there will appear an error report;
- if it takes longer from the last command, due to a loss of communication on the serial line the module may respond to the command with the error message "command not found" even if the command is correct. In that case, just enter the command again. Before entering each command (especially for longer and more complex commands) it is recommended to "refresh" the serial line by pressing of "ENTER" key.
- check the execution of the command by displaying of the list of configuration parameters which appears by entering "show" or "/" and pressing on „ENTER" key;
- to display a summary of configuration commands and their parameters („HELP"), enter "?" (question mark), or "/?" and press „ENTER" key;
- some subsystems have their own command set. To view a summary (set) of commands for a given subsystem, enter the set name and the "?" (question mark). For example, to display a set of commands for the GSM subsystem, enter the command "gsm?". The individual commands for a given subsystem can be entered by writing of "distinguishing" command for the given subsystem followed by the command itself (after the space). For example, setting the APN for GSM communication is done with the command "gsm apn", where "gsm" is the distinguishing command for the GSM subsystem and "apn" is the command for configuring the APN. The distinguishing commands for each set are listed at the end of the "HELP" configuration command summary;
- when entering characters, distinguish strictly the capital and small letters (according to the documentation or „HELP");
- Do not enter other characters than those listed in „HELP" or in the documentation, otherwise you would be risking the unwanted command enter that might be the same as the ones used for manufacturer settings, diagnostics or service and repair.

## 3.4 Configuration of the module individual parameters via cable

In following part of the document there is a description of these parameters of the WB169-RFG module, that can be displayed and examined from PC connected to the module by configuration cable. Some of the parameters can be changed by configuration commands entered „from the console" of the serial line communication program as described in paragraph 3.3 of this document.

### 3.4.1 List of WB169-RFG module configuration parameters

List of all configuration parameters of the module can be displayed by entering of **"show"** command and pressing of „ENTER" key. The following list of parameters will display in the terminal window:

```
GW33H7-0#show

-- CPU info --
CPUID : 411fc271
FPU Type : 00000002
 Flash size 2048 kB
 Flash bank size 1048576 B, 0x00100000
 Flash base addr 0x08000000
 CPU UID 3339510a001c0036

 SW version 1.02, date Apr 19 2021

-- HW configuration --
 Active bank : 2
 Name : GW33H7
 Type : 2, version 1
 Vendor ID : 0000000000
 Mac addr : 0004d0ffffff
 x32 0.00 ppm
 In slot P card : 'RF169, cc1120, LNA', type 122, version 1
 In slot L card : 'GSM LTE, SIM7600E', type 140, version 1
GW33H7-0#
```

As can be seen from the example, the report contains the identification data of the module as well as data on its hardware configuration and software version.

### 3.4.2 Displaying a summary of configuration commands ("HELP")

List of all configuration commands ("HELP") can be displayed by entering of **"?"** command into the command line and pressing of „ENTER" key. The following list of commands will display in the terminal window:

```
GW33H7-0#?
 Help :
 --- System commands ---
ta                : Show tasks
mb                : Show mail boxes
du addr           : Dump memory
rb addr           : Read byte from addr
rw addr           : Read word from addr
rd addr           : Read dword from addr
sb addr val       : Set byte on addr
sw addr val       : Set word on addr
sd addr val       : Set dword on addr
port              : Show port [a,b,..]
usb               : Show usb registers
rng               : Show rng number
show              : show info
time              : Show or set rtc time, set as BCD : 0x102033 is 10:20:33
date              : Show or set rtc date, set as BCD : 0x171231 is 2017-12-31
uptime            : Show uptime
reset             : Reset device
te                : Test tsSend
fs                : Test FS
ppm               : Set RTC ppm
free              : Show free memory
users             : Show users
useradd           : create users passwd
userdel           : delete users
userpass          : change user's password
cfgserver         : Config server IP
cfgport           : Config server port
usecfgserver      : Use config server, 0 - no, 1 - yes
nepserver         : Default NEP server IP
nepport           : Default NEP server port
 --- Utils ---
loca              : location (0-63 chars)
ekey              : Set encrypt key, point '.' no encrypt
serialkey         : Set index for serial key, 0 - disabled
nepkey            : Set index for nep key, 0 - disabled
write             : Write configuration to flash
cread             : Read configuration from flash
clear             : Clear configation and load defaults
ping              : Send ICMP ping to address
sens              : show sensors values
deb               : set debug
ls                : show all config file names
rm                : delete file
mkdir             : create dir
cat file          : show config file
mount             : mount sd
unmount           : unmount sd
deb               : set debug
?                 : Show this help

sys               : System commands
disp              : Display command
ip                : IP commands
gsm               : GSM command
gw                : gateway command
cc                : cc1120 commands
hist              : history table command
ntp               : NTP command
GW33H7-0#
```

In the upper part of the list (up to the "?" command) there are the main commands for setting of module basic functions. They are always entered directly after the prompt.

In the bottom part of the list (after the space, starting with "sys") there is a list of module subsystems, that have their own commands. These commands can be displayed by entering the name of the subsystem followed by the "?" character (no space). Example of displaying commands for the "ntp" subsystem:

```
GW33H7-0#ntp?
 Help :
rest              : restart
info              : NTP info
ena               : NTP enable
srv1              : NTP server 1
srv2              : NTP server 2
srv3              : NTP server 3
write             : save configuration
deb               : NTP info
?                 : show help
```

The listed ntp-subsystem commands can be used only for NTP subsystem by first entering the subsystem name, and then the command itself after the space. Example for entering the "info" command for the "ntp" subsystem:

```
GW33H7-0#ntp info
NTP info :
  172.16.17.1, status : wait, stratum : 0, reach : 0, delay 0, timeout 1671
* 172.16.16.1, status : wait, stratum : 2, reach : 3, delay 143, timeout 1681
```

The meaning of individual commands (including subsystem commands) is described below.

### 3.4.3 Commands of „System commands" group for control of module basic functions and diagnostics

This group of commands serves for control and diagnostics of module basic functions. There are following commands:

```
 --- System commands ---
ta                : Show tasks
mb                : Show mail boxes
du addr           : Dump memmory
rb addr           : Read byte from addr
rw addr           : Read word from addr
rd addr           : Read dword from addr
sb addr val       : Set byte on addr
sw addr val       : Set word on addr
sd addr val       : Set dword on addr
port              : Show port [a,b,..]
usb               : Show usb registers
rng               : Show rng number  ov+řit
show              : show info
time              : Show or set rtc time, set as BCD : 0x102033 is 10:20:33
date              : Show or set rtc date, set as BCD : 0x171231 is 2017-12-31
uptime            : Show uptime
reset             : Reset device
te                : Test tsSend
fs                : Test FS
ppm               : Set RTC ppm
free              : Show free memmory
users             : Show users
useradd           : create users passwd
userdel           : delete users
userpass          : change user's password
nepserver         : Default NEP server IP
nepport           : Default NEP server port
```

Commands **"ta", "mb", "du addr", "rw addr", "rb addr", "rd addr", "sw addr val", "sb addr val", "sd addr val", "tshort", "tlong", "port", "usb", "te", "fs", "ppm",** and **"free"** are used for troubleshooting and repair of the device in a factory. **Manufacturer strongly recommends not to use these commands during common operation.**

With using of **"show"** command the module current configuration statement can be displayed (see paragraph 3.4.1):

```
cfg#show
```

By using of **time** or **date** command the current setting of RTC (Real Time Clock) can be displayed. Current RTC value will appear after entering of any of these commands without parameter:

```
GW33H7-0#time
Time : RTC 11:11:56, systime 2021-05-05, 11:11:56
GW33H7-0#date
Date is 2021-05-05
GW33H7-0#
```

The module can use time synchronization from the GSM network (see GSM subsystem commands), or by periodic query to preset NTP servers (Network Time Protocol - see NTP subsystem commands). By using of the **time** and **date** commands the current RTC (Real-Time Clock) values can be displayed, and if necessary (if the above-mentioned resources are not available) manually entered:

```
GW33H7-0#date 0x210505
Date is 2021-05-05
GW33H7-0#time 0x111533
Time : RTC 11:15:33, systime 2021-05-05, 11:15:33
GW33H7-0#
```

As can be seen from the example, the „time" value is entered in the "0x**hhmmss**" format, the „date" value is entered in the format of "0x**YYMMDD**". The manually entered value is automatically corrected when the entries from external synchronization sources (GSM or NTP) are available.

The **"uptime"** command can be used to display the time since the module startup or reset. This command can be useful for module diagnostics. The „Uptime" value indicates the exact time of module last reset. The variable is of the „read only" type. Example:

```
GW33H7-0#uptime
Uptime 304 sec - 0 day(s), 0:05:04
TSC 304589310 usec.
GW33H7-0#
```

Reset of the module can be performed by using of the **"reset"** command. After each reset the saved set of configuration parameters is read from the FLASH memory. Tu keep the newly created configuration, it is necessary to copy (write) it from working set into the FLASH memory before performing a reset (see paragraph 3.4.7). At the time of reset the serial line connection with the module is usually interrupted and the connection must be re-established with the "Restart Session" command (for PuTTY in the main program menu, accessible by right-clicking on the top bar). Example of using the module reset command:

```
GW33H7-0#reset
Reseting ...
 -- Remote Monitor --
Login :
```

The module supports access of multiple users with different logins. By using of the **"users"** command a current list of all users can be displayed:

```
GW33H7-0#users
System users :
 'admin'
GW33H7-0#
```

A new login can be added by **"useradd [login] [password]"** command:

```
GW33H7-0#useradd servis servis654
User 'servis' created
GW33H7-0#
```

This setting should be saved into the Flash memory so that it is not lost when the module is reset or switched off. Introduction of a new user can be checked again with the "users" command:

```
GW33H7-0#write
Write config ... 0
GW33H7-0#users
System users :
 'admin'
 'servis'
GW33H7-0#
```

The user can be deleted (disabled) by using of **"userdel [login]"** command. This change must be saved as well. Example:

```
GW33H7-0#userdel servis
User 'servis' was deleted
GW33H7-0#
```

If all logins are unintentionally deleted, the module will automatically generate the default admin/admin during restart.

Change of password of any user can be performed by using of **"userpass [login] [oldpassword] [newpassword]"** command:

```
GW33H7-0#userpass admin admin admin223
Password changed
GW33H7-0#write
Write config ... 0
GW33H7-0#
```

By using of the **"nepserver"** and **"nepport"** commands the default IP address and port number of the superior server can be entered. The module will forward messages from its RF-network to that server in case the gateway has not received a „setup packet" or the setup packet has expired (see the description of the gateway functionality in chapter 4 „Structure of forwarded messages").

Example of setting the IP address and port number of the default server for sending messages:

```
GW33H7-0#nepserver
Config server IP : 0.0.0.0
GW33H7-0#nepserver 10.0.0.8
Config server IP : 10.0.0.8
GW33H7-0#
GW33H7-0#nepport
Config server port : 1141
GW33H7-0#nepport 1142
Config server port : 1142
GW33H7-0#
```

### 3.4.4 Commands of "ip" subsystem for setting of IP communication

This group of commands can be used for setting of subsystem for control of communication via IP network. There are following commands:

```
GW33H7-0#ip?
 Help :
arp              : show arp table
addr             : show interfaces
route            : show routing table
conn             : show connection table
phy              : show ethernet PHY registers
ethaddr          : set static address mask
ethroute         : set static default router
ethdhcp          : enable / disable DHCP
ethena           : enable / disable ethernet
write            : save configuration
deb              : debug lebel
reg              : show eth registers
?                : show help
```

The **"ip arp"** command can be used for checking of ARP table of the module. The WB169-RFG module has no other active local port, so that its ARP table is typically empty. The **"ip addr"** command can be used for browsing of addresses and statistics of module individual communication ports. Example of the dump:

```
GW33H7-0#ip addr

Interface lo, status Up, half duplex, MTU 1500
 IP Address : 127.0.0.1, mask : 255.0.0.0
 Rx packets 0, bytes 0, errors 0
 Tx packets 0, bytes 0, errors 0

Interface eth0, status Down
 MAC : 00:04:d0:ff:ff:ff
 Rx packets 0, bytes 0, errors 0
 Tx packets 0, bytes 0, errors 0

Interface ppp0, status Up, full duplex, MTU 1500
 IP Address : 10.2.1.177, mask : 255.255.255.255
 Rx packets 123, bytes 8940, errors 0
 Tx packets 126, bytes 9168, errors 0
GW33H7-0#
```

The *lo* (loopback) port has standard loopback address. As the WB169-RFG module uses GSM uplink, the *ethernet* port is not active. As the connection with superior server is closed through the *PPP connection*, the module IP address is preset at PPP interface.

The **"ip route"** command can be used for browsing of module routing table. Example of routing table dump:

```
GW33H7-0#ip addr
GW33H7-0#ip route

Routing table :
 IP : 10.2.1.177/32 (255.255.255.255) dev ppp0
 IP : 127.0.0.1/8 (255.0.0.0) dev lo
 IP : 0.0.0.0/0 (0.0.0.0) gw : 10.2.1.177
GW33H7-0#
```

In the first row there is a route to the superior network via PPP interface, where the module IP address is linked with the virtual PPP interface. In the second row there is a loopback route defined. In the third row there is a route to the default gateway, that is also accessible through the PPP connection.

The **"ip conn"** command can be used for browsing of statistics on the communication protocol layers. This information can be used for module diagnostics.

The **"ip ethaddr", "ip ethroute", "ethdhcp** and **"ip ethena"** commands can be used for setting of communication through the Ethernet port. This setting has no importance for this type of module. The **"ip reg"** command can be used for Ethernet port diagnostics (dump of registers), this has also no meaning for the WB169-RFG module.

By using of **"ip write"** command all possible changes in the "ip" subsystem can be saved.

By using of **"ip deb"** command the required level of debug statements of the subsystem can be set.

### 3.4.5 Commands of "gsm" subsystem for setting of communication via GSM network

This group of commands can be used for setting of subsystem for control of communication via GSM network.

There are following commands:

```
GW33H7-0#gsm?
 Help :
apn              : APN
pingip           : IP for icmp connection test
pingper          : Periode in min. for icmp connection test
pingreq          : Req. count for icmp connection test
pingtim          : Timeout for icmp connection test
pin              : SIM pin
useip            : IP on/off
usegps           : GPS on/off
usetime          : Sync time on/off
info             : show GSM info
gps              : show GPS info
cmux             : show CMUX info
lcp              : show LCP info
deb              : GSM debug
write            : save current configuration
cread            : read configuration
at               : modem command
sms              : phone msg
restart          : Restart GSM modem
?                : show help
GW33H7-0#
```

The **"gsm apn"** command can be used for setting of APN (Access Point Name) that is a gateway between GSM network and adjacent IP-network. Example of setting the APN name to "gr.softlink":

```
GW33H7-0#gsm apn gr.softlink
APN : 'gr.softlink'
GW33H7-0#
```

By using of **"gsm pin"** command a PIN for GSM modem SIM-card can be entered. Example of setting a PIN to "2583":

```
GW33H7-0#gsm pin 2583
SIM pin : '2583'
GW33H7-0#
```

The **"gsm pingip", "gsm pingper", "gsm pingreq"** and **"gsm pingtim"** command can be used for setting of parameters for ICMP-ping testing function:

- "gsm pingip" command serves for setting of tested computer IP-address (where the ping will be sent)
- "gsm pingper" command serves for setting of testing period in minutes
- "gsm pingreq" command serves for setting of number of pings in each test sequence
- "gsm pingti" command serves for setting of maximum response time for each ping

Example of setting of ICMP-ping testing parameters:

```
GW33H7-0#gsm pingip
Ping IP : 172.16.16.2
GW33H7-0#gsm pingper
Ping periode : 60 min.
GW33H7-0#gsm pingreq
Ping req. count : 3
GW33H7-0#gsm pingtim
Ping timeout : 10 sec.
```

In case of this setting the module will send three "ping" tests every 60 minutes to the "172.16.16.2" computer. If the response to at least one ping will not be received until 10 seconds, the module will restart GSM connection.

*Testing of GSM connection is a preventive measure against the situation when the PPP connection is terminated by the GSM network server (for example due to the restart of the GSM network server). This situation results in the loss of the connection between the module and the superior data collection system, while the module does not "know" about the connection breakdown, and the connection cannot be restored by the activity of superior system.*

Check of setting can be performed by "ping" command (see explanation of this command in paragraph 3.4.7 „Commands of "Utils" group for checking and settings of communication").

By using of **"gsm useip", "gsm usegps"** and **"gsm usetime"** commands with "0/1" parameter the individual services of "gsm" subsystem can be activated/deactivated:

- by "gsm useip" command the PPP-connection to IP network can be activated
- by "gsm usegps" command an integrated GPS receiver can be activated
- by "gsm usetime" command a time synchronization from GSM network can be activated

Current setting can be learned by using the command without parameter. Example of checking of services activation status and follow-up activation of time synchronization from GSM:

```
GW33H7-0#gsm useip
Use GSM IP : 1
GW33H7-0#gsm usegps
Use GPS : 1
GW33H7-0#gsm usetime
Sync GPS/GSM time : 0
GW33H7-0#gsm usetime 1
Sync GPS/GSM time : 1
```

The **"gsm info"** command can be used for displaying of basic information about setting of "gsm" subsystem, including statistics of GSM interface communication. Example:

```
GW33H7-0#gsm info
 GSM info :
  IMEI : 867584035706790
  CCID : 8942031020012105157
  IMSI : 230030092110515

  RSSI  : -51 dBm
  Data mode : LTE
  ppp connections : 1
  IP : 10.2.1.177
 Recv bytes : 16864
 Recv  pkts : 232
 Send bytes : 17092
 Send  pkts : 235
 Ping test : 172.16.17.1
  periode : 60 min.
  next : 9:16 sec.
  sent : 5
  recv : 5
  timeouts : 0
  restarts : 0
GW33H7-0#
```

The **"gsm gps", "gsm cmux"** and **"gsm lcp"** commands can be used for displaying of status information of GPS receiver and statistics of CMUX and LCP internal interfaces. The **"gsm restart"** command can be used for restart of "gsm" subsystem, by using of **"gsm deb"** command required level of debug statements of the subsystem can be set. These commands serve only for module diagnostics.

The **"gsm sms"** command can be used for sending of test SMS for verification of SIM card functionality (e.g. to make sure the card is activated within GSM operator systems). Example:

```
GW33H7-0#gsm sms 603659910 test
Sending to '603659910' message 'test'
GW33H7-0#
```

### 3.4.6 Commands of "gw" subsystem for setting of RF network communication

This group of commands can be used for setting and diagnostics of "gw" subsystem for control of communication between 169 MHz RF network and a superior server for data collection. There are following commands:

```
GW33H7-0#gw?
 Help :
info              : show radio info
squeue            : show send queue
reload            : reload filters
filter            : show filters
send              : send wmbus message
proto1            : Set protocol
chan1             : Set channel
power1            : Set power
proto2            : Set protocol
chan2             : Set channel
power2            : Set power
deb               : Set debug level
write             : save current configuration
cread             : read configuration
?                 : show help
```

By using of **"gw info"** command basic information about the setting of "gw" subsystem can be browsed. This also include data transfer statistics on the RF network and data uplink interfaces. Example:

```
GW33H7-0#gw info
Radio info, CC1120 :
  Last RSSI  : -50 dbm
  Recv  pkts : 128479
  Send  pkts : 9
  Recv error : 376
  Radio err  : 0
  Send queue size : 0
  Nep receive : 128479
  Nep send to server : 128479
  Nep filter drop : 0
  Nep servers timeout 300 :
172.16.17.25 : 1142, msgs 128467, timeout 261
```

In upper part of the dump there is a basic operational information about the RF subsystem (RSSI of last received message, number of received and transmitted RF messages, number of error messages).

In the lower part of the dump (below space) there are basic uplink traffic statistics: length of sending queue, numbers of transmitted and received messages, number of dropped messages that not complied with filter, list of active servers, that are registered as "target server" for the module. Within the **"gw.cfg"** configuration file there is a possibility to set a **filter** for limitation of forwarding messages to target servers. In the same file there is also a parameter **timeout**, that determines validity of target server registration. Example of "gw.cfg" file preview displayed by "cat" command:

```
GW33H7-0#cat /etc/gw.cfg
Show file '/etc/gw.cfg' :
[gw]
address = 0
server = 0.0.0.0
port = 0
[radio]
channel = 2
proto = 0
power = 4
[radio2]
channel = 0
proto = 0
power = 0
[gw]
gwtimeout = 300
[filter]
allow = *,SFT,*,*
deny = *,CEN,*,*
```

In the second part of the file there is a "gwtimeout" record with setting of **time interval in which a registration of each target server to the module is valid**. In order to be able to flexibly redirect data transfer to target applications, message forwarding is controlled from the target servers. Setting of the target server IP address into the gateway configuration iis dynamic, using a "zero" packet mechanism. The mechanism is following: the target application sends at regular intervals (for example 30 seconds) an UDP packet with zero data content to each "its" gateway (i.e. the gateway from which collects data). After receiving such a packet, the gateway saves the IP address of the sender as IP address of the target application and sends all messages to the address. This IP address is valid for a timeout period (in this case 300 seconds), until then the validity of the address must be "extended" by another zero packet. If the information transmission is not extended, the gateway will stop forwarding data to the given server.

This system allows simple redirection of communication to another target server, easy change of given server IP address, or temporary redirection of communication, for example for diagnostic purposes. The communication gateway can simultaneously send data to 4 different servers, currently "logged in" servers are displayed in the last lines of the "gw info" report, including the time until the timeout expires.

In the third part of the file there are records of **gateway traffic filters**, which can be used to restrict data forwarding. Filters work by comparing each packet sequentially first with the "allow" setting and then with the "deny" setting. The "allow" filter contains conditions that the WMBUS address of the packet must meet to be forwarded. The "deny" filter sets the conditions under which the packet is dropped.

Each filter consists of four parts, separated by comma. Each part represents one component of WMBUS address:

- WMBUS ID (typically serial number) - it could be a number or one asterisk
- Manufacturer - either 3 characters of manufacturer code, or one asterisk ("all")
- Version - either number from 0-255 range, or one asterisk ("all")
- Medium - either number from 0-255 range, or one asterisk ("all")

Example of filter:

```
82*,SFT,*,*
```

Only packets whose ID starts with "82" and whose address contains "SFT" in the manufacturer code field will pass through this filter.

If this filter is used as "allow", packets with the *82xxxx* address from *SFT* manufacturer will pass through and will be forwarded to the destination servers (unless restricted by the "deny" setting).

If this filter were used as "deny", packets with the *82xxxx* address from *SFT* manufacturer would not be forwarded by the module.

Settings of filters can be browsed by using of **gw filter** command. The "gw.cfg" file cannot be edited locally, it must be uploaded to the WB169-RFG module from external computer via TFTP protocol (locally or remotely). After uploading the new "gw.cfg" file, it is necessary to load the new settings into the "gw" subsystem using the **"gw reload"** command.

The hardware platform of the WB169-RFG communication gateway is modular, where the required functionality is achieved by installing of different HW sub-modules (internal boards) into the HW frame. Software of the device is also modular in some manner. As the slot marked "1" of the WB169-RFG module is equipped by the 169 MHz radio transceiver, set of commands for 169 MHz transceiver is always marked with a number "1".

There are following commands:

- **"proto1** command for setting of communication protocol
- **"chan1** command for setting of frequency channel
- **"power1** command for setting of transmitting power

The **"proto1"** command can be used for setting of the gateway communication protocol. As the WB169-RFG module acts as a Wireless M-Bus gateway, the **communication protocol "WMBUS N2"** must always be set. Example of correct module setting:

```
GW33H7-0#gw proto1
Protocol :
* 0 - WMBUS N2
  1 - WACO
GW33H7-0#
```

The command **"chan1"** is used for selecting of the module's radio frequency channel. Frequency channels for the particular frequency bands are defined by the Wireless M-Bus standard. The setting can be performed by using of "chan1" command followed by the required channel number. Current setting can be displayed by using of the command without parameter, where the current setting is marked with an asterisk.

An example of setting of "2a" channel and follow up check of the setting:

```
GW33H7-0#gw chan1 2
channel is 2 2a
GW33H7-0#gw chan1
Channel :
  0 - 1a
  1 - 1b
* 2 - 2a
  3 - 2b
  4 - 3a
  5 - 3b
  6 - 3g
GW33H7-0#
```

The command **„power1"** is used for adjusting of the module transmitting power. There are five levels of transmitting power, marked by numbers "0", "1", "2", "3" and "4", where lower level "0" means 4 dBm (2,5 mW) and higher level ("4") means 27 dBm (500 mW). Transmitting power can be set-up by entering of the number of power level after "power1" command. Current setting can be displayed by using of the command without parameter, where the current setting is marked with an asterisk.

An example of setting of transmitting power to the highest level and re-checking of the setting:

```
GW33H7-0#gw power1 4
power is 4 - 27
GW33H7-0#gw power1
Power :
  0 - 4
  1 - 17
  2 - 20
  3 - 24
* 4 - 27
GW33H7-0#
```

Setting of RF-subsystem parameters of the module is stored at "gw.etc" configuration file, under section [radio].

The **"squeue"** command can be used for display of queue of messages, that are waiting for transmission to the terminal devices through the "reverse channel". The reverse channel works in such principle that the central application sends a message to the gateway for a specific terminal, and this message waits in the queue for sending until the device "rings". Immediately after receiving the message from the terminal device, the gateway sends back a reverse channel message. Each terminal that supports the reverse channel waits immediately after sending its message with the receiver open for a possible return message.

Reverse channel queue can be checked following way:

```
GW33H7-0#gw squeue
 GW send queue table, size 0 :
```

By using of **"send"** command a test radio-message in Wireless M-Bus format can be transmitted. Its header address contains gateway ID (according to settings, default "12345678"), manufacturer's code "SFT", medium "15" and version "1". The data content of the message contains processor temperature and supply voltage values. The test message can be used to verify the range of the reverse channel, or for transmission power measurement.

By using of **"gw write"** command all possible changes in the "gw" subsystem can be saved.

By using of **"gw deb"** command the required level of debug statements of the subsystem can be set.

### 3.4.7 Commands of „Utils" group for setting of communication

This group of commands is intended for checking and setting of the basic functions of module operating system, as well as the basic communication functions of the module. There are following commands:

```
  --- Utils ---
loca             : location (0-63 chars)
ekey             : Set encrypt key, point '.' no encrypt
serialkey        : Set index for serial key, 0 - disabled
nepkey           : Set index for nep key, 0 - disabled
write            : Write configuration to flash
cread            : Read configuration from flash
clear            : Clear configuration and load defaults
ping             : Send ICMP ping to address
sens             : show sensors values
deb              : set debug
ls               : show all config file names
rm               : delete file
mkdir            : create dir
cat file         : show config file
mount            : mount sd
unmount          : unmount sd
?                : Show this help
```

By using of the **"loca"** command the individual designation of the module (e.g. its location) can be preset. Up to 63 alphanumeric characters can be entered. Example of setting an individual module designation:

```
GW33H7-0#loca unhost
Change location from : '' to : 'unhost'
GW33H7-0#
```

The parameter **„Encryption key"** is used for setting of the encryption key for an encryption of transmitted messages by using of AES-128 key. Up to 4 encryption keys can be added to the table and by using of other commands (as "serialkey", "nepkey") assigned to individual communication channels. The encryption key of 16 bytes length is entered by using of **„ekey"** command, followed by the string of 16 bytes that can be entered in a decimal or hexadecimal format (see examples).

An example of insertion of the encryption key in hexadecimal format:

```
GW33H7-0#ekey 3 0x2a 0x35 0x9f 0xbc 0xff 0x8a 0xf1 0xca 0x88 0x15 0x62 0x93 0xeb 0x0f 0x91 0x88
New key[3] :2a359fbcff8af1ca88156293eb0f9188
GW33H7-0#
```

An example of insertion of the encryption key in decimal format:

```
GW33H7-0#ekey 4 42 53 159 188 255 138 241 202 136 21 98 147 235 15 145 136
New key[4] :2a359fbcff8af1ca88156293eb0f9188
GW33H7-0#
```

List of all stored encryption keys can be displayed by using of "ekey" command without parameter:

```
GW33H7-0#ekey
Key[1] : a61e8d65d04df7270b7722c2ea89f72a
Key[2] : a61e8d65d04df7270b7722c2ea89f72a
Key[3] : 2a359fbcff8af1ca88156293eb0f9188
Key[4] : 2a359fbcff8af1ca88156293eb0f9188
GW33H7-0#
```

Encryption can be switched off by setting of "." (dot) parameter after the „ekey" command:

```
GW33H7-0#ekey 4 .
Key[4] disabled
GW33H7-0#
```

Any of stored encryption keys can be assigned for encryption of data traffic between the gateway and superior server (with NEP-coding) by using of **"nepkey"** command. Thus the communication between the module and the superior application will be encrypted in both directions. Example of assignation a key with index "3" for NEP-coded uplink:

```
GW33H7-0#nepkey 3
NEP key index : 3
GW33H7-0#
```

Similarly, by using of **"serialkey"** command the selected key can be assigned for communication through the serial line, if the module is equipped with a serial line. Since the serial line is not used for the gateway function, using of this command is irrelevant for the WB169-RFG module.

The **"write", "cread"** and **"clear"** commands serve for management of saving data in the module memory. The module contains two sets of configuration: operating configuration and saved configuration. At the start of the system the module copies saved configuration to operating configuration, with which continues to work. If the user changes configuration parameters, it does so only in operating configuration.

If the current operating configuration was not stored to FLASH memory, the module returns to the saved configuration after reset. If the parameter should be changed only temporarily (for example switch-on debug information), it is not necessary to save operating configuration in FLASH memory (after the work is completed, the debug dumps can be switched-off by module reset). If the parameter should be changed permanently, there is necessary to save configuration to FLASH memory.

Current operating configuration can be rewritten to the FLASH memory by using of **"write"** command:

```
GW33H7-0#write
Write config ... 0
GW33H7-0#
```

Reading of the configuration from FLASH memory can be done by using of **"cread"** command:

```
GW33H7-0#cread
Read config ... 39
GW33H7-0#
```

The configuration can be erased in Flash memory by using of **"clear"** command:

```
cfg#clear
Clearing configuration ... OK, version
```

This command deletes all configuration parameters from the FLASH memory, so it is necessary to set them again.

If after erasing all parameters in FLASH memory the module goes to reset, default set of parameters (configured in the program of the device) is duplicated to FLASH memory.

**This command is recommended to use only by users with good knowledge of the system or after consultation with the manufacturer.**

Availability of IP-connection between the WB169-RFG module and any computer on the Internet can be checked by using the ICMP "ping" function. By entering of **"ping [address]"** command the system sends a control ping to the specified IP address and displays the result. Example:

```
GW32-2007#ping 172.16.15.1
PING ip 172.16.15.1 ..
 resp. time 131 ms
 resp. time 33 ms
 resp. time 60 ms
GW32-2007#
```

The **"sens"** command can be used for displaying of current values of A/D converters measuring power voltage and processor temperature. This command is intended only for module checking and diagnostics.

```
GW33H7-0#sens
 -- Sensors --
CPU  :  34.6 $^\circ$C
VDA  : 3.342 V
GW33H7-0#
```

By using of **"gw deb"** command the required level (1, 2 or 3) of debug statements of the "monitor" subsystem can be set. This command is intended only for module checking and diagnostics. By using of "deb" command without parameter setting of debug-statements of all subsystems can be displayed. Example of setting of debug-statements to "1" level and follow-up check of the setting:

```
GW33H7-0#deb 1
Change mondebug level from 0 to 1
GW33H7-0#deb
Debug level :
 monitor - 1
 eth - 0
 display - 0
 gsm - 0
 wmbus - 0
GW33H7-0#
```

The **"ls", "rm", "mkdir", "cat", "mount"** and **"unmount"** commands allow manual interventions in the filesystem of the module. These commands are not needed for normal operation of the module, they can be used in case of module upgrade (addition of HW / SW components), or when restoring module functionality, for example after unintentional deletion of the directory with saved configurations by unprofessional operator intervention. The individual commands have this purpose:

| | |
|---|---|
| **ls [/dir]** | *dump of assigned directory* |
| **rm [/dir/file]** | *delete of directory or file* |
| **mkdir** | *create a new directory* |
| **cat [/dir/file]** | *browse assigned configuration file* |
| **mount** | *mount external drive* |
| **unmount** | *unmount external drive* |

Example of listing the contents of a directory and viewing the configuration file (which must always be in the "/etc" directory):

```
GW33H7-0#ls
Readdir '/'
  256 2020-01-01, 0:00:00 /.
  256 2020-01-01, 0:00:00 /..
  256 2020-01-01, 0:00:00 /etc
GW33H7-0#ls /etc
Readdir '/etc'
  256 2020-01-01, 0:00:00 /etc/.
  256 2020-01-01, 0:00:00 /etc/..
  124 2020-01-01, 0:02:38 /etc/gw.cfg
  165 2021-05-06, 11:47:59 /etc/network.cfg
  157 2021-05-05, 12:11:39 /etc/gsm.cfg
  254 2021-05-06, 11:47:59 /etc/system.cfg
GW33H7-0#
```

```
GW33H7-0#cat /etc/gsm.cfg
Show file '/etc/gsm.cfg' :
[gsm]
apn = gprsa.softlink
pin = 1234
useip = true
usegps = true
synctime = false
pingip = 172.16.17.1
pingperiode = 60
pingreqcount = 2
pingreqtimeout = 10
GW33H7-0#
```

Commands for controlling the filesystem are intended mainly for manufacturer and it is **strongly recommended not to use them** without detailed knowledge of the module function. Only using of the "cat" command to check the current module configuration can be useful in normal operation.

### 3.4.8 Commands of "sys", "disp" and "cc" subsystems for module initial setting and diagnostics

The commands of these three subsystems are used for the initial setting of the module during the production of its motherboard ("sys"), display ("dis") and radio chip ("cc").

**It is strongly recommended not to use these commands during common operation.**

### 3.4.9 Command of "ntp" subsystem for setting of time synchronization

This group of commands can be used for setting of time synchronization subsystem (RTC) from network servers of the NTP (Network Time Protocol) system. There are following commands:

```
GW33H7-0#ntp?
 Help :
rest             : restart
info             : NTP info
ena              : NTP enable
srv1             : NTP server 1
srv2             : NTP server 2
srv3             : NTP server 3
write            : save configuration
deb              : NTP info
?                : show help
GW33H7-0#ntp info
```

Time synchronization from NTP servers can be enabled/disabled by using of **"ntp ena [0/1]"** command.

By using of **"ntp srv1", "ntp srv2"** and **"ntp srv3"** commands up to three NTP servers can be preset for module synchronization. The command parameter is server IP-address.

Current setting of the subsystem can be displayed by using of **ntp info** command.

Examples of using commands for setting of RTC synchronization:

```
GW33H7-0#ntp ena 1
Ntp is enable
GW33H7-0#ntp srv1 172.16.17.1
Server[1] : 172.16.17.1
GW33H7-0#ntp info
NTP info :
+ 172.16.17.1, status : wait, stratum : 2, reach : 48, delay 39, timeout 1758
* 172.16.16.1, status : wait, stratum : 2, reach : 51, delay 54, timeout 1768
GW33H7-0#
```

As it is evident form the example, synchronization was enabled by "ntp ena" command, the IP address of NTP server was preset by "ntp srv1" command and the setting was checked by "ntp info" command.

The settings should be saved by using of **"ntp write"** command.

The **"ntp restart"** command can be used for restart of the subsystem, by using of **"ntp deb"** command the required level of debug statements of the subsystem can be set.

### 3.4.10 Command of "hist" subsystem for examination of „History" table records

**The "History" subsystem** is used to support gateway operation. It contains a table with records of the last received messages from all terminals within the last 150 minutes. Each terminal always has only one record in the table, regardless of the number of its messages received during last 150 minutes. The maximum capacity of the table is 960 records, if the gateway receives more messages in a given interval, the oldest messages are always deleted. The "History" record table is used to monitor the gateway function, its records can help to learn which terminals are within the gateway radio range and how strong their signal is. The content of "History" table can be transmitted via the NEP protocol to the remote reading system, or to another application that serves for the operational support of the remote measurement network.

A group of **"hist"** commands is intended for checking of the "History" subsystem. There are folowing commands:

```
GW33H7-0#hist?
 Help :
info             : show table info
hash             : show hash detail
rec              : show table records
?                : hashtable help
GW33H7-0#
```

Number of records in the "hist" table can be displayed by **"hist info"** command. The **"hist hash"** command can be used for display of hash table for saving of records. These outputs can help with the subsystem diagnostics.

The content of „History" table with the records of last received messages can be browsed by using of **"hist rec"** command. Example:

```
GW33H7-0#hist rec
Hash record list :
WMBUS : 00006166-SFT-5-7, RSSI -101, time : 2021-05-06, 13:08:54
WMBUS : 00900010-SFT-6-7, RSSI -98, time : 2021-05-06, 13:05:10
WMBUS : 00800044-SFT-51-8, RSSI -107, time : 2021-05-06, 13:00:31
WMBUS : 00000103-SFT-3-3, RSSI -104, time : 2021-05-06, 12:55:52
WMBUS : 00003411-SFT-5-7, RSSI -88, time : 2021-05-06, 12:42:36
WMBUS : 00004663-SFT-5-7, RSSI -111, time : 2021-05-06, 12:33:13
WMBUS : 00003095-SFT-3-7, RSSI -86, time : 2021-05-06, 12:25:26
WMBUS : 00002417-SFT-2-7, RSSI -110, time : 2021-05-06, 12:22:06
WMBUS : 00005491-SFT-5-7, RSSI -104, time : 2021-05-06, 12:20:06
Hash records : 9
```

It is clear from the example, that in the last 150 minutes the gateway has received messages from 9 terminals. Each record contains the identification of the terminal device according to the Wireless M-Bus addressing system (ID, Manufacturer, Version, Medium), the RSSI (Received Signal Strength Indicator) value, expressing the strength of the received signal of the last message, and the time of receiving the last message from the device.

The command can be used (as an example) during gateway installation to examine signal strength from all devices that the gateway is expected to operate. The information can be obtained even in initial time of installation when the uplink connection to external servers is not available yet.

## 3.5 Display of WB169-RFG module parameters on the LCD screen

The WB169-RFG module is equipped on the front panel with a multi-line **LCD display** and **control buttons**, which are used to display selected identification, configuration and operating data of the module.

After switching on the module, the basic information about the module will be displayed on the LCD display (see figure 5 on the left.


Figure 5: Display the main screen, main menu and system information

In addition to the manufacturer's name, the text information includes the device type and version, the device ID (serial number), and the system time. In the right part of the display there is a set of symbols that indicate the status of module main communication channels:

- on top there is a standard image of "signal strength" symbolizing **GSM communication** with a graphical representation of GSM signal strength. Below the symbol there are up and down arrows that flash each time a message is received (down) and sent (up);
- in the middle there is an antenna pictogram, symbolizing **communication over the 169 MHz radio network**. Below the symbol there are also up and down arrows, which flash each time a Wireless M-Bus message is received and sent;
- at the bottom there is a data network pictogram symbolizing **communication via Ethernet port**. Below the pictogram there is the "X" symbol, which indicates that the system is not active.

By pressing the "OK" button the main menu is displayed on the screen (see image 5 in the middle).

Selection of individual menu items can be performed by using of four control buttons at the right from the display, which have the following functions:

- use **"OK"** button for displaying the selected (marked) item from the menu;
- use **"ESC"** button for return from the actual screen back to the menu;
- use **"UP"** and **"DOWN"** buttons for moving in the menu or scrolling through the displayed records.

In the current version of the module, the basic information can be browsed via five menu items:

- configuration of hardware, sensor statuses and uptime ("System info")
- Ethernet interface settings and statistics
- GSM interface settings and statistics
- 169 MHz RF-interface statistics ("CC1120")
- list of current records of "History" table

Appearance of individual screens can be seen in the figure 6.


Figure 6: Appearance of Ethernet, GSM, CC1120 and History menu items

## 3.6 Setting of parameters by using of optical converter

The module i equipped with the „IRDA" infrared optical interface, that can be used for configuration through the **„USB-IRDA"** converter. Module parameters, for which the NEP-protocol has been implemented, can be configured by using an optical converter and a suitable program with NEP-protocol support (for example, „WACO OptoConf"). Because the set of these parameters expands over time, this document shows only the principle of their display, not their complete description.

The description of the connection of the optical converter to the computer („USB-IRDA") and the general rules for configuring the module using the **optical converter** are described in chapter 3 of the manual **„Configuration of wacoSystem product family devices"**, available at download from the module manufacturer's website.

The list of parameters that can currently be read from the module can be displayed using the "Walk device" button in the „WACO OptoConf" program window. A preview of the list is shown in figure 7.

In the current version of the WB169-RFG module no parameters can be changed via the optical interface, only their values can be checked. The description of the parameters is given in the „NEP Coding Table", which is maintained centrally by SOFTLINK and is available at the public WEB address NEP Page. A more detailed description of the NEP-protocol coding principle is given in chapter 4 "Structure of forwarded messages".

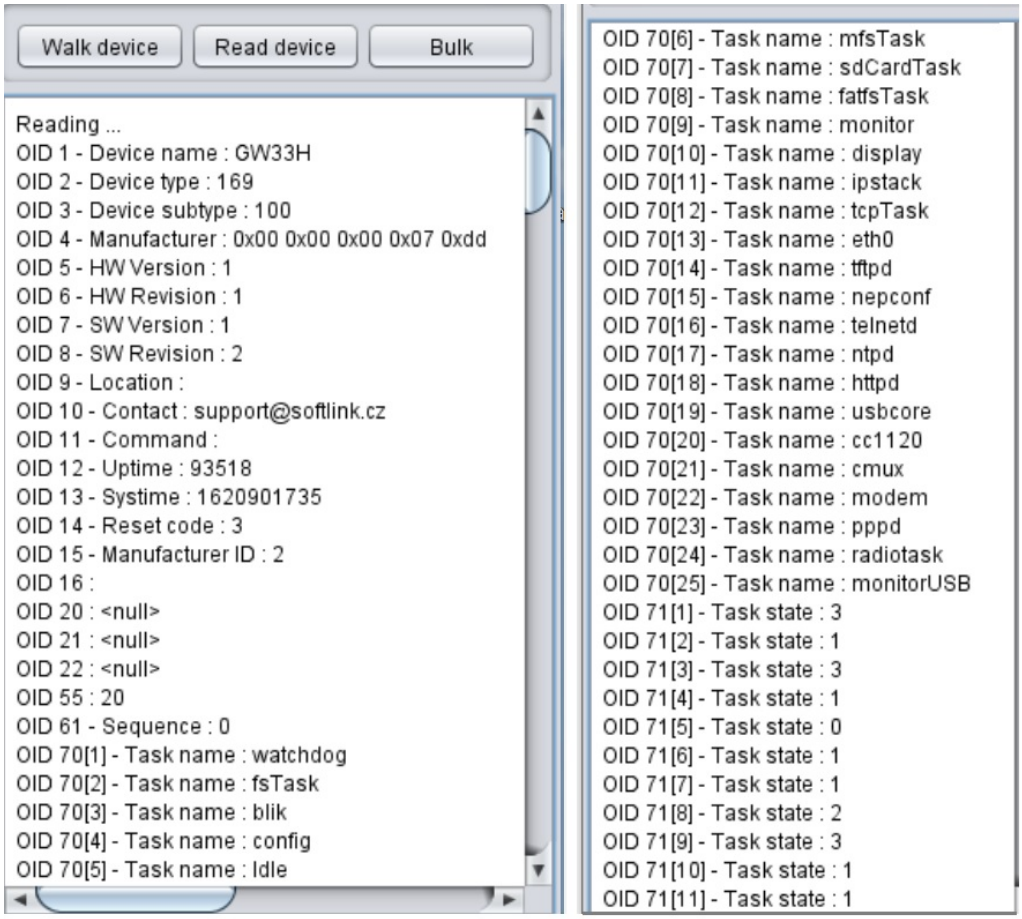



Figure 7: Table of parameters of the WB169-RFG module. that are readable via the optical interface

## 3.7 Setting the module parameters via Internet

Since the WB169-RFG module is always connected to the Internet from the principle of its function, following standard tools commonly used in IP networks can also be used for its remote management:

"ICMP" for module availability check
- "Telnet" for remote access to the module configuration console
- "TFTP" for downloading and uploading of configuration files
- "HTTP" for displaying some data via module WEB interface

The module also supports checking and setting of some of its parameters by using the IP/UDP datagrams with the NEP-encoded data content (see paragraph 3.6 „Checking module parameters using the optical converter".

**Checking of module availability** by using the "ICMP ping" application can be performed by entering the command "ping" and the IP address of the module from the command line of any computer. Example of performing a "ping" availability check from the Windows Command Prompt:

```
C:\Users\99hon>ping 172.1.16.24

Pinging 172.1.16.24 with 32 bytes of data:
Reply from 172.1.16.24: bytes=32 time=1ms TTL=64
Reply from 172.1.16.24: bytes=32 time=1ms TTL=64
Reply from 172.1.16.24: bytes=32 time=3ms TTL=64
Reply from 172.1.16.24: bytes=32 time=1ms TTL=64

Ping statistics for 172.1.16.24:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 3ms, Average = 1ms

C:\Users\99hon>
```

Configuration of the module parameters can be performed via remote access using the "Telnet" application. An example of remote connection to the module via Telnet from PuTTY program is shown in the figure 8:

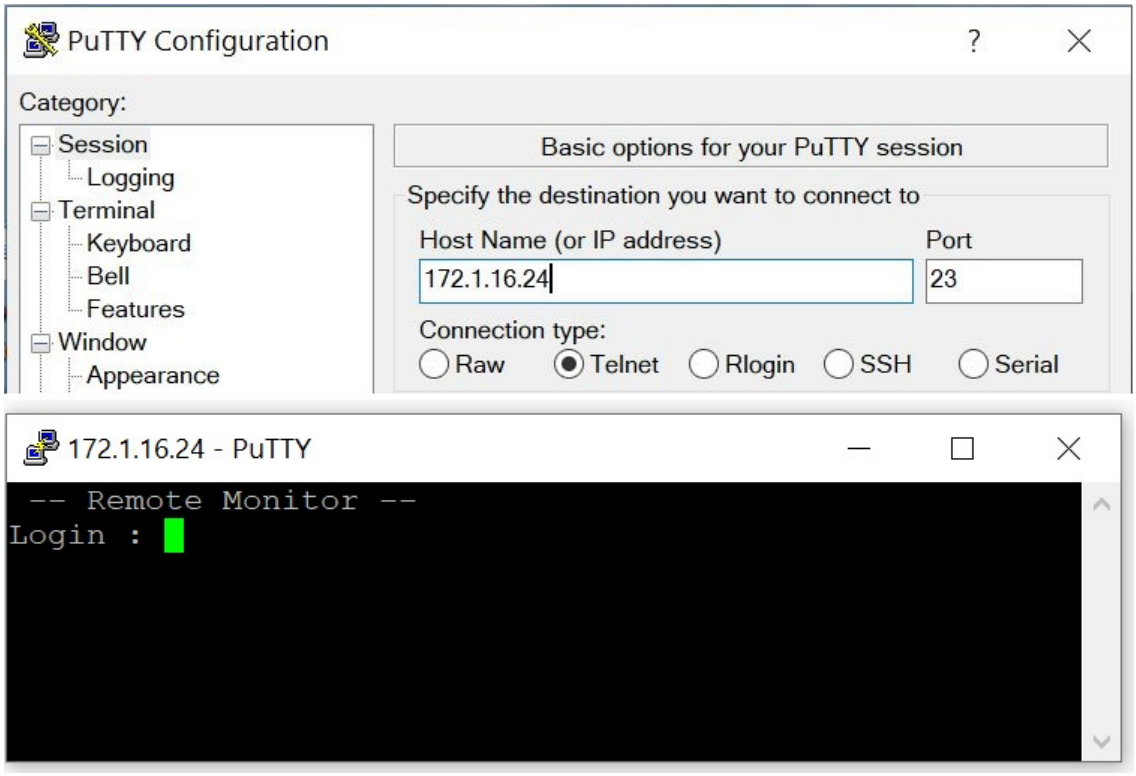



Figure 8: Telnet connection to the WB169-RFG module

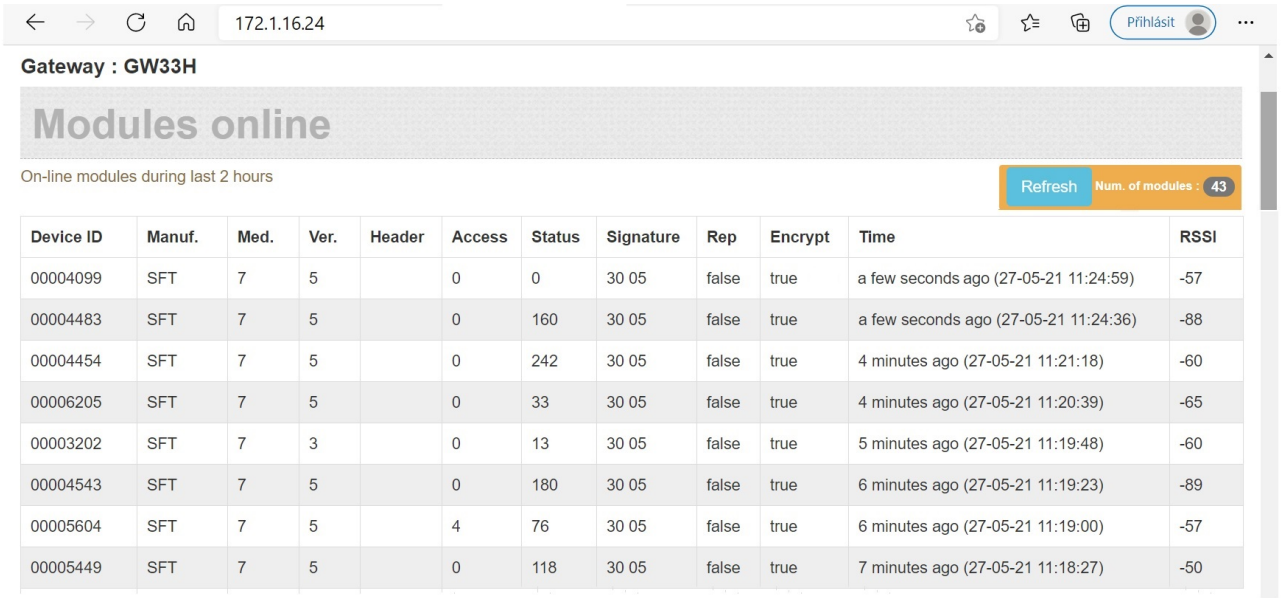
At the top of the image there is an example of settings of the PuTTY program for Telnet communication, at the bottom of the image there is a preview of the remote access configuration window.

**The procedure for configuring the module via the Telnet remote access application is the same as for locally connected computer through the USB cable.**

All important configuration parameters of the module are stored in configuration files. An effective way to configure the module remotely is to make the required changes **by changing the appropriate configuration file with using of TFTP tool**. The change can be performed by downloading the required file, editing it and uploading the modified file back to the module. This method of configuration allows storing of configuration files of all operated WB169-RFG modules in backup server, preparing and testing the required changes locally, in the testing environment, and then replacing the files very quickly, with minimal disruption to the module operation.

Configuration files can be listed using the "ls" command and viewed using the "cat" command. An example of listing the configuration files and viewing the contents of the "gw.cfg" configuration file is given in section 3.4.7 „Commands of „Utils" group for setting of communication".

The module is also equipped with a WEB server, which enables **display of some module parameters with using the HTTP protocol**. Currently it is possible to use WEB browser to display **the content of the "History" table** with a list of all terminal devices, whose messages the module has received in the last 150 minutes (see figure 9).




| Device ID | Manuf. | Med. | Ver. | Header | Access | Status | Signature | Rep | Encrypt | Time | RSSI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 00004099 | SFT | 7 | 5 | | 0 | 0 | 30 05 | false | true | a few seconds ago (27-05-21 11:24:59) | -57 |
| 00004483 | SFT | 7 | 5 | | 0 | 160 | 30 05 | false | true | a few seconds ago (27-05-21 11:24:36) | -88 |
| 00004454 | SFT | 7 | 5 | | 0 | 242 | 30 05 | false | true | 4 minutes ago (27-05-21 11:21:18) | -60 |
| 00006205 | SFT | 7 | 5 | | 0 | 33 | 30 05 | false | true | 4 minutes ago (27-05-21 11:20:39) | -65 |
| 00003202 | SFT | 7 | 3 | | 0 | 13 | 30 05 | false | true | 5 minutes ago (27-05-21 11:19:48) | -60 |
| 00004543 | SFT | 7 | 5 | | 0 | 180 | 30 05 | false | true | 6 minutes ago (27-05-21 11:19:23) | -89 |
| 00005604 | SFT | 7 | 5 | | 4 | 76 | 30 05 | false | true | 6 minutes ago (27-05-21 11:19:00) | -57 |
| 00005449 | SFT | 7 | 5 | | 0 | 118 | 30 05 | false | true | 7 minutes ago (27-05-21 11:18:27) | -50 |

Figure 9: Display of the "History" table of the WB169-RFG module via HTTP

There are following information displayed in the "History" table:

- "Device ID" - serial number of the module (ID according to M-Bus standard)
- "Manufacturer" - manufacturer code according to M-Bus standard
- "Medium" - medium code according to M-Bus standard
- "Version" - generation/version number according to M-Bus standard
- "Access" - message transaction ID according to M-Bus standard
- "Status" - error status of the device according to M-Bus standard
- "Signature" - type and parameter of encryption according to M-Bus standard
- "Rep" - message repeating flag ("true" = message was repeated)
- "Encrypt" - message encryption flag ("true" = message was encrypted)
- "Time" - message reception time
- "RSSI" - signal strength with which the message was received

The first seven items are entries from the Wireless M-Bus message header (WMBUS Header + M-Bus Header). The table can be used to verify the possibility of receiving messages from a specified set of devices, for example when there were some changes in the gateway installation (replacement, relocation, new antenna ...), or to verify whether the gateway receives data from a newly installed device.

# 4 Structure of forwarded messages

The WB169-RFG communication gateway receives radio messages from the WB169 series modules (terminal devices), which are in the Wireless M-Bus communication protocol format (hereinafter WMBUS) and forwards them via the Internet to a remote data collection application server (AMR) in IP/UDP data packets.

In the reverse direction, the gateway receives IP/UDP data packets via the Internet with setting messages for individual terminal devices, stores them in a "queue" for sending, and when establishing communication with the individual device, the message is sent to the device in the return channel time window.

The gateway receives RF-messages in WMBUS format, checks their checksum (WMBUS CRC), and if the CRC is OK, deletes the CRC and sends it wrapped in a UDP packet to the address of the target application. The message is decoded only by the target application. Similarly, in the opposite direction, the gateway receives completed setup messages in WMBUS format from AMR, adds WMBUS CRCs to them and takes care of sending them via the RF-interface at the right time (ie at the time of opening the message recipient's return channel).

## 4.1 Structure of UDP-packet

The structure of a message sent over the Internet is shown in figure 10. It is a standard IP/UDP packet, containing the IP header, UDP header and the transmitted data itself. The UDP header is described at the bottom of the figure. The packet is addressed to the target application (see the description of the IP address settings of the target application below).

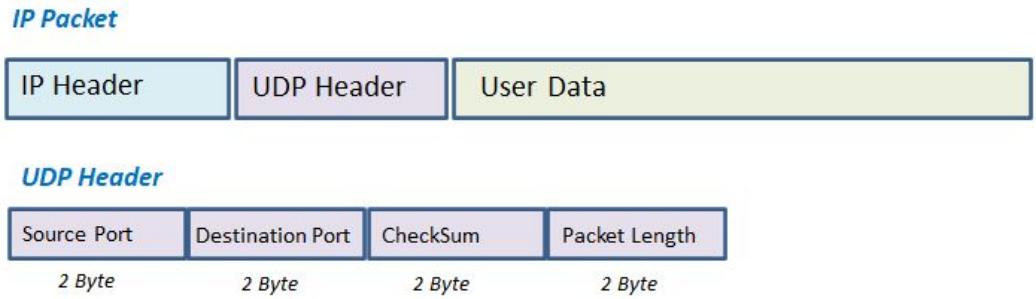



Figure 10: UDP packet structure

### 4.1.1 Setting of target application IP-address

The target application is the application that the gateway should send data. The setting of target application IP address is dynamic, using a mechanism of "zero" packets. The target application sends a packet with zero length of its data content to each subordinate gateway at regular intervals (for example, every 30 seconds). After receiving such a packet, the gateway stores the source IP address of that packet as the IP address of the target application, to which it then sends all messages. This IP address is valid for three minutes, until then the information must be restored with another zero packet. If no valid IP address is set by using the zero packet mechanism, the module forwards the messages to the "default" IP address preset by using the "nepserver" and "nepport" commands (see paragraph 3.4.3).

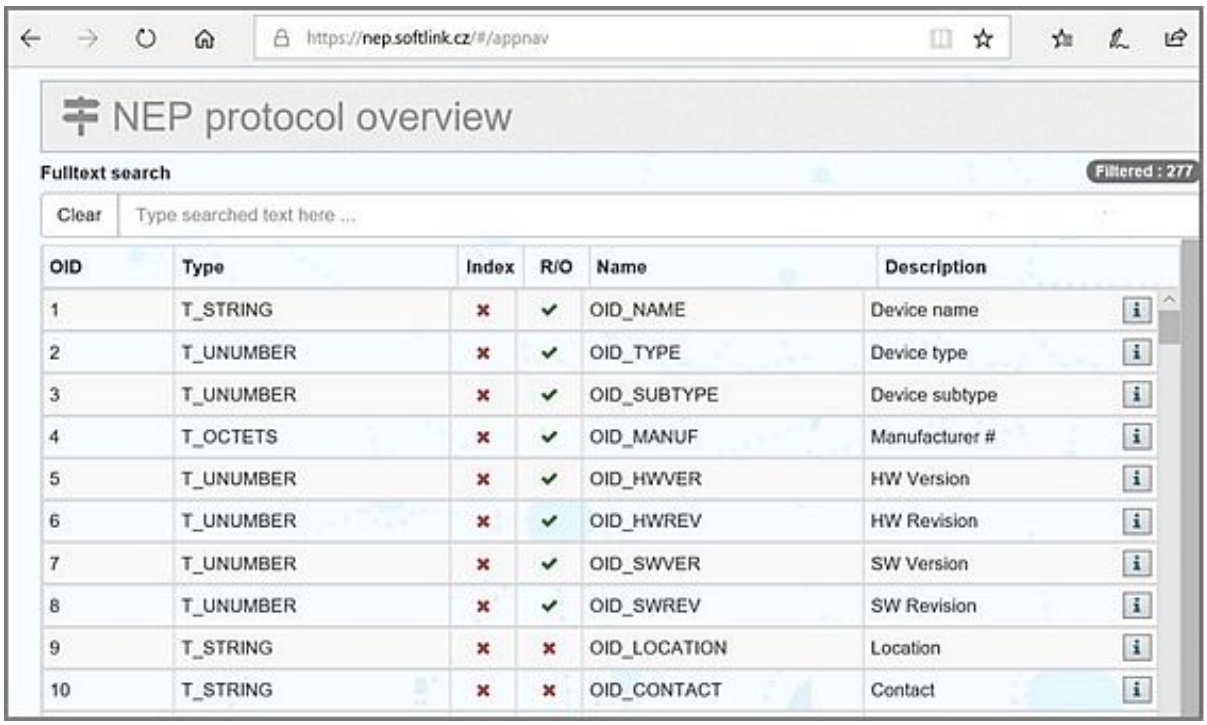
This system allows easy redirection of traffic to another server, easy change of IP address, or temporary redirection of traffic from the gateway to the analyzer (or other diagnostic tool) for diagnostic purposes.

The communication gateway can simultaneously send data to 4 different servers. Communication with servers can be encrypted.

## 4.2 UDP message data content

The data content of the message is encoded using SOFTLINK's proprietary "NEP" encoding system, where each type of variable has its own designation "OID" (Object ID), which determines the meaning, character, and data type of the variable. For variables that can be used multiple times (several inputs, temperatures, voltages ...), the order number of the variable („Index") is also mandatory. The "NEP" coding table is maintained centrally by SOFTLINK and is available at the public WEB address NEP Page.

A preview of the "NEP" table for encoding variables within the wacoSystem product family is shown in figure 11.




| OID | Type | Index | R/O | Name | Description |
|---|---|---|---|---|---|
| 1 | T_STRING | ✖ | ✔ | OID_NAME | Device name |
| 2 | T_UNUMBER | ✖ | ✔ | OID_TYPE | Device type |
| 3 | T_UNUMBER | ✖ | ✔ | OID_SUBTYPE | Device subtype |
| 4 | T_OCTETS | ✖ | ✔ | OID_MANUF | Manufacturer # |
| 5 | T_UNUMBER | ✖ | ✔ | OID_HWVER | HW Version |
| 6 | T_UNUMBER | ✖ | ✔ | OID_HWREV | HW Revision |
| 7 | T_UNUMBER | ✖ | ✔ | OID_SWVER | SW Version |
| 8 | T_UNUMBER | ✖ | ✔ | OID_SWREV | SW Revision |
| 9 | T_STRING | ✖ | ✖ | OID_LOCATION | Location |
| 10 | T_STRING | ✖ | ✖ | OID_CONTACT | Contact |

Figure 11: NEP Table of variables

To enable decoding of individual variables, there are two decoding information („Type" and „Length") that are transferred with each variable. This way the receiving system can correctly find out OID, index and value of the variable even without knowing its meaning. The general format of the data content of the message is shown in figure 12.

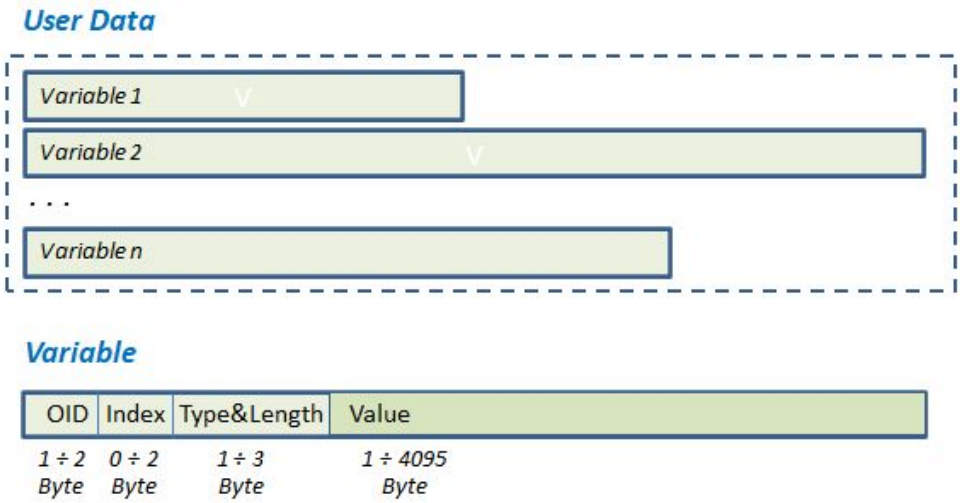



Figure 12: General structure of NEP variable

As it is clear from the figure, the UDP packet payload of one or more NEP variables, arranged in series. The general structure of the NEP variable is shown at the bottom of the figure 12.

Each Wireless M-Bus radio message is transported through the IP/UDP uplink in following three NEP-variables:

- The first variable is **„Message type"** (OID 63). It is a mandatory NEP protocol variable that indicates what type of message it is. The value of the variable carrying WMBUS data is always "6", which means " DATA ". This variable always takes the same length in the UDP payload and is always the same.
- The second variable is **„RSSI"** (OID 216/1). It is a number expressing the received signal strength (Received Signal Strength Indication) with which the radio packet was received by the gateway. This variable is attached to the Wireless M-Bus packet by gateway as potentially useful information for target application.
- The third variable is the **Wireless M-Bus radio packet** (OID 215/1) itself. Its length depends on the number and type of transmitted M-Bus variables.

The structure of a message containing WMBUS packet is shown in figure 13

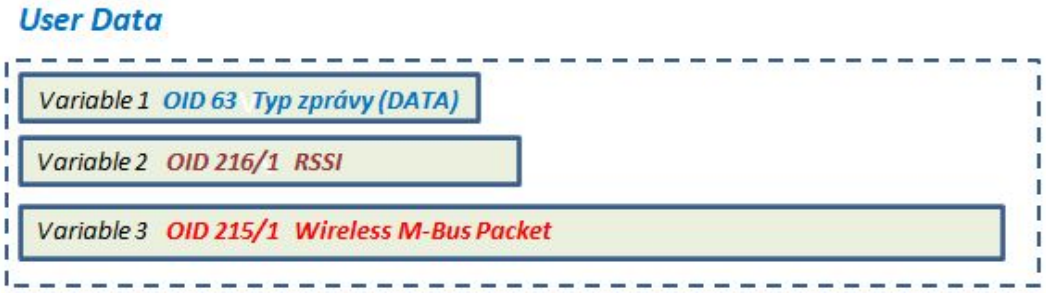



Figure 13: Structure of the message from the WB169-RFG GateWay containing the WMBUS packet

An example of a specific message is shown in figure 14.

3f2106c0d80131cac0d70181212044d44c020000000507740300000027a0000427a050031fd3a0004
13a1fff6fd

Kde:

| | | |
|---|---|---|
| 3f2106 | OID 63 unsigned, délka 1, hodnota 6 - MSG_DATA | (Typ zprávy) |
| c0d80131ca | OID 216, index 1 signed, délka 1, hodnota -54 | (RSSI dBm) |
| c0d70181212044d44c... | OID 215, index 1, bytes, délka 33, hodnota - 2044d44c.... | (paket WMBUS) |

Figure 14: Example of a message with the WMBUS-packet

As it is clear from the figure, the WMBUS packet itself starts from the string "xxxxx2044d44c. . . ."

## 4.3 Filtering of the GateWay traffic

The GateWay allows to incorporate a traffic filter into the data forwarding mechanism, that can restrict the traffic according to individual components of the M-Bus address (ID, Manufacturer, Version, Medium). If, for example, some specific „Medium" or „Manufacturer" codes are entered into the filter, only messages with these codes are cleared for forwarding (or vice-versa their forwarding is forbidden). By entering some characters of the M-Bus ID into the filter the traffic will be limited only to the series of M-Bus addresses containing the characters. The filter can be incorporated only through the "gw.cfg" configuration file (by uploading the file with the filter). A more detailed description of the filter's functionality and its settings is given in paragraph 3.4.6 „Commands of "gw" subsystem for setting of RF network communication".

# 5 Operational conditions

This section of the document describes basic recommendations for transportation, storing, installation and operation of WB169-RFG radio modules.

## 5.1 General operational risks

Radio modules WB169-RFG are electronic devices powered from the external power source that receive radio messages from surrounding terminals and forward these messages to the superior server over the Internet. They are connected to the Internet via GSM data services (GPRS, UMTS, LTE). During the operation of the modules there are following potential risks:

### 5.1.1 Risk of mechanical damage

The devices are covered in plastic boxes, so electronic components are not accessible for a direct mechanical damage. When installing it is necessary to ensure a sufficient space for connecting cables (including the configuration cable) and also that the cables are as short as possible (especially power and antenna cables). It is necessary to ensure the proper fastening of the module to DIN-rail with a plastic lock. In normal operation no special precautions are needed, besides avoiding of the mechanical damage from strong pressure or shocks.

Special attention is required for power, communication/signaling and antenna cables. In operation it is necessary to ensure that the cables are not stressed by mechanical tension or bending. In the case of damage of any cable isolation it is recommended to replace the cable immediately. If the module is equipped with a remote antenna on a coaxial cable, much attention should be paid for the antenna and the antenna cable as well. The minimum bending radius of the antenna cable with 6 mm diameter is 4 cm, for the antenna cable with the 2,5 mm diameter the bending radius is 2 cm. Violation of these bending parameters can lead to breach of homogeneity of the coaxial cable that could cause reducing of radio range of the device. Further it is necessary to ensure that the connected antenna cable will not stress the antenna connector of the device by tension or twist. Excessive loads can damage or destroy antenna connectors.

The module is specified for installation in normal internal premises with the temperature range of (-10 ÷ +50)°C, with humidity up to 90% without condensation. Direct installation of the equipment in outdoor areas is not possible.

### 5.1.2 Risk of electrical damage

Electrical installation of the module can be performed only by a person with necessary qualification in electrical engineering and at the same time trained for this device installation. The device is powered by DC power with safe voltage up to 24 V and current consumption up to 200 mA.

The power supply must meet the requirements for the safety protective transformer ČSN-EN61558-2-6. The module has an integrated protection against reversing the polarity of the supply voltage. Reversing the polarity is indicated so that after switching on the supply voltage to the module a green LED „PWR" on the front panel does not shine. Unwanted reversing the polarity of the supply voltage does not lead to damage or destruction of the device. In addition, the module is on the supply inlet equipped with a irreversible fuse (polyswitch) with the actuating current of 300 mA and over-voltage protection with 30 V switching level.

The module is not equipped by any disconnecting component – switch. It is suitable to place in installation a disconnecting component, for example a circuit breaker, which can be inserted into 24V/DC lateral of the supply or into the 230V/AC side of the supply. The primary side of the power source must be protected by automatically irreversible fuse.

To connect external antennas, it is necessary to use standardized good quality coaxial cables and lead them as far from the 230V/50Hz power lines as possible.

## 5.2 The condition of modules on delivery

Modules are delivered in standard cardboard boxes. At standard term of delivery the module does not include the antenna, the power supply and cables, if required these components must be ordered separately.

## 5.3 Modules storage

Modules should be stored in dry rooms with a temperature range (0 ÷ 30) °C.

## 5.4 Safety precautions

**Warning!** Mechanical and electrical installation of the WB169-RFG module can be provided only by a person with necessary qualification in electrical engineering.

## 5.5 Environmental protection and recycling

The equipment does not contain exchangeable components, which require compliance with specific rules in terms of environmental protection for their replacing, storage and disposal. Damaged, destroyed or discarded devices cannot be disposed as household waste. Equipment must be disposed of in the waste collection yards, which dispose electronic waste. Information about the nearest collection yard can be provided by the relevant local (municipal) authority.

## 5.6 WB169-RFG module installation

WB169-RFG radio modules are enclosed in plastic casings with an IP20 degree of protection equipped by plastic locks for mounting on the DIN-rail. Casings should not be open under mounting, dismantling and normal operation. A view of the WB169-RFG module mounted on the DIN-rail in the distribution cabinet is shown in Figure 15.


Figure 15: View of installed WB169-RFG module

Installation of the module should be performed by the following procedure:

- installation of the module can be performed only by a person with necessary qualification in electrical engineering and at the same time trained for this device installation;
- when selecting an installation site pay attention to secure sufficient space for connection of antenna, power and signaling cables to the module (see paragraph 5.1.1 „Risk of mechanical damage"). It is necessary to keep the sufficient space for the connecting of configuration cable as well;
- when selecting a site for the module installation it is necessary to choose a place with availability of power supply. The power supply should be placed close to the module so that the feed of 24 voltage is as short as possible. Further it is necessary to consider the method of the module switching off and location of an appropriate disconnecting element (see paragraph 5.1.2 „Risk of electrical damage").
- mount the module to the selected place on the DIN-rail. Pull down black plastic lock in the bottom side of the module (outward of the module), attach the module to the DIN-rail so that the rail fits into the slot on the rear side of the module and push the black plastic lock up (inward the module);

- connect the antenna and signal cables to the module;
- make sure that the power supply is turned off and connect the power cable to the module. Verify that the polarity of power supply corresponds with the marking on the module terminals;
- check whether everything is properly connected and fasted and turn on the power supply. Green LED „Power" will shine on the module and the operation system will start up;
- perform the basic diagnostic of the module in compliance with the procedure mentioned in the paragraph 5.9 „Functional check of the module" and possibly (if the module was not pre-configured during the preparatory stage of installation) its configuration with using of the configuration cable according to the procedure described in the paragraph 3 „Configuration of the module individual parameters";
- record information about the module installation (serial number, position, picture of installation...) to the operational documentation under internal rules.

When locating installation site, selecting antenna type and antenna position it is necessary to take into account conditions for radio signal propagation in the area of installation. The conditions is possible either estimate empirically on the base of previous experience, or accomplish a measurement of the signal strength by the signal analyzer.

## 5.7 Module replacement

When there is necessary to replace the module due to the module failure follow this procedure:

- switch off the power supply and disconnect the power cable wires from the module;
- disconnect the signal cable and the antenna cable;
- release the module from DIN-rail by pulling down of the black plastic lock on the bottom side of the module down (outward of the module) and remove the module from the rail;
- attach the new module at the place of the original module and proceed further according to the procedure mentioned in the paragraph 5.6. Especially pay attention to the correct connection of the power cable;
- after switching power on perform the diagnostics and set-up parameters;
- label the original module as „defective" and fill in the appropriate documentation prescribed by internal rules for this case.

## 5.8 The module dismantling

When dismantling module turn the power supply off and disconnect the power supply cables from the module. Disconnect the signal cable and the antenna cable from the module. Release the module from DIN-rail by pulling down of the black plastic lock on the bottom side of the module (outward of the module). If there is no further use for the antenna, remove the antenna cable and the antenna. If there is no further use for the power supply, remove the power supply and the power cable. If the power supply is used for other purposes, secure power cables against short circuit (by insulation of live ends of wires or by removal of useless power branches) and connect the power supply again. After dismantling label the module properly as „dismounted" and fill in the appropriate documentation prescribed by internal rules for this case.

## 5.9 Functional check of the module

After putting the module into operation (or after each repair and replacing of the module) it is recommended to check Internet connection via GSM-modem and testing of the receiver functionality in the „Radar" mode.

**A quick check of the functionality of the Internet connection** can be performed immediately after switching on the module using the data on the LCD display. Check the connection to the GSM network in the „GSM Info" display, check the functionality of the 169 MHz receiver in the „CC1120" display, and go through the group of terminals within the reception area in the „History" display.

The „History" table is filled in gradually as the individual terminal devices „ring" one after the other. When installing a local Wireless M-Bus collecting network, it is advantageous to put the gateway into operation first, and just then the individual terminal devices. This way it is possible to check continuously the success of the installation of individual terminals from the laptop with the „Modules online" („Radar") table opened in the WEB browser (see the description in paragraph 3.7 „Setting the module parameters via the Internet data network". This way the quality of the connection between the transmitting devices and the communication gateway can be also checked.

A detailed check of the settings of all parameters can be performed using a laptop and a program for communication over the serial line (for example „PuTTY") as described in paragraph 3.4 „Configuration of the WB169-RFG module by using the configuration cable ".

## 5.10 Operation of the WB169-RFG module

Receiving radio messages from surrounding radio modules and forwarding of the messages to the superior system via Internet the WB169-RFG module performs fully automatically. Take into consideration that the broadcasting systems according to the Wireless M-BUS standard has no protection against interference during transmission (a signal collision, which occurs when two modules broadcast at the same time), so that temporary loss of data from some modules can commonly occur in case of operating of a large number of modules in one radio network. These losses can last for several hours or days.

The greatest risks of the signal losses from surrounding radio modules are commonly caused by human activities within the installation. It is mainly about the following risks:

- turning off the module power (e.g. circuit breaker failure or unintentional shutdown);
- malfunction of the Internet connection caused by a local failure of the GSM network, or failure of the PPP connection caused by incorrect functioning of the authorization servers or other devices of the GSM operator;
- temporary or permanent shading of the antenna (e.g. due to building operations);
- mechanical damage of the module, the antenna cable or the antenna when handling things at the installation site.

To eliminate these risks, it is recommended to pay close attention to selection of the installation site and choice of antenna and antenna location so that to find appropriate compromise between qualities of signal and the level of risk of mechanical damage of the module or antenna. It is necessary to carry out the installation carefully with using of high-quality cables and mounting components.

In case of loss of income data from large number (or all) reading modules, it is recommended to contact the installation site caretaker and ask for the potential cause of the anomaly or perform the physical check on the installation site.

# 6 Troubleshooting

If during installation or operation anomaly or malfunctions are detected, the probable cause of the failure can be found in the following manner:

1. No data come from the gateway; no data are available from the devices which communicate via the gateway (hereinafter as „reading modules"). In this case try to find the cause of the failure as follows:
   - Find out whether there is an IP-connection between the gateway and the superior system by using of the standard "ping" test commonly used in the IP-network:
     - if the gateway is connected directly to the public network (it has a public IP-address), it should respond to "ping" test from any computer with an access to the public Internet;
     - if the gateway is connected to a private network (it has a private IP-address) and there is an access to the edge router of the private network available, try to use "ping" test from the edge router;
     - if the gateway is connected through a VPN/APN, "ping" test can be performed from the computer which has access to the VPN/APN.
     - Availability of the gateway and its functionality can be verified by using the WEB-application „Modules Online" („Radar") as described in paragraph 3.7.
   - If the gateway is accessible and functional, try to find out the reason why the gateway does not receive the signals from reading modules under the proceeding described in the paragraph 2;
   - If the gateway is not accessible examine its power supplying, especially:
     - whether there has been a power failure in the object,
     - whether the power supply is on,
     - whether the gateway is really under power supplying (the „Power" LED should be shining).
   - If the power supplying of the gateway is not working, repair wiring, power supply or A/C power input.
   - If the power supplying is correct and the gateway is not accessible, search for any circumstances which may affect the IP-connectivity, especially if the local Internet access in the installation site is currently available, if there are any changes in routing or in IP-addressing, or whether the **PIN-control of the SIM is turned off**.
   - If the IP-connectivity is most likely available and the power supply is correct (LED „Power" on the module shines), perform a quick check of connection to the local network according to the paragraph 5.9. In case that the gateway has no IP-address assigned, check functionality of the local IP network and reset the module by disconnecting and connecting of the power supply (the source off/on). If this intervention does not restore communication, replace the gateway according to the paragraph 5.7. If after replacing the new module works correctly, label the dismantled module as "defective". If there is no apparent physical damage on the module and it is still under warranty, follow the warranty claim procedure;
   - If the neither restart nor replacing of the module do not lead to restoration of the connection between the gate and the superior system, solve the problem of IP-connectivity with experts in routing within IP-network.
2. The module evidently communicates, answers to "ping", the result of the quick test of the gateway availability is „OK", but data does not come from all (or most) reading modules which communicate via the gateway. In this case try to find the cause of trouble following way:
   - Check receiving functionality of the module in „Modules online" („Radar") mode as described in the paragraph 5.9. If there is no device in the „Radar" table even after a long time, the module probably does not receive any messages;
   - Ensure that there are no changes in the object, which could have the fatal effect on receiving quality;
   - Check the module visually for any damage of the antenna, antenna cable or connector. If there are any doubts about functionality of any of these components, replace it;
   - Check the module settings according to the paragraph 3.4.6 (Commands of "gw" subsystem for setting of RF network communication), particularly settings of the communication mode and frequency channel parameters;
   - If the module is configured correctly perform measuring of the signal strength from reading modules by using of the analyzer (or other receiving device);

- If the signal from reading modules in the place of the WB169-RFG module installation is sufficiently strong and the module is set correctly, replace the module according to paragraph 5.7. If after the replacing a new module works correctly, label the dismantled module as "defective". If there is no apparent physical damage on the module and it is still under warranty, follow the warranty claim procedure;
- If even after replacing the new module does not work correctly, the possible cause of trouble could be the local radio interference or wrong settings that has not been discovered by examination. Check functionality of the exchanged module in different location (in area where other gateway is evidently working) and if the module works properly in another location, search for a source of interference or request a company with an expertise in the radio signal transmission to determine the cause of trouble.
- If the module does not work even at another location, go through its configuration again or try to set-up the spare module to the same configuration. If even spare module with the same configuration does not work, the trouble is probably in configuration details related to given purpose. Ask for support the manufacturer or other knowledgeable person.

3. The module evidently communicates, responds to "ping" tests, result of „Modules online" („Radar") test is positive, but the data from some reading modules are not received. In this case the problem may be caused by weakening of the signal in the area of the gateway antenna position, failure of the gateway receiver or radio interference at the installation site. Execute the similar examination as described in the point 2:
   - check the antenna, the antenna cable and the connector,
   - inspection of the gateway installation site,
   - inspection of reading modules installation sites.

   If all the results are correct and signals from reading modules measured by signal analyzer or referential receiver are sufficiently strong, replace gateway and proceed further as described in the point 2.

# 7 Additional information

This manual is focused on description, parameters and configuration options of radio modules WB169-RFG, operating according to the Wireless M-BUS standard (EN 13757-3 / EN 13757-4 recommendation) for the 169 MHz band, that are a part of the Softlink's **wacoSystem** product family. More information about all WB169 (Wireless M-BUS), WM868 (WACO), WS868 (Sigfox) or NB (NB-IoT) series of the modules can be found on the manufacturer website:

www.wacosystem.com
www.softlink.cz

If interested in any additional information related to application of radio modules of WB169, WM868, WS868, NB series or other manufacturer's equipment for telemetry and remote reading of consumption meters, feel free to contact the manufacturer:

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