WIRELESS COMMUNICATION SYSTEM
Wireless M-BUS

WB169-TE

Revision 1.0

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1 Introduction

This document describes features, parameters and setting possibilities of the WB169-TE module, which is used for remote measurement of internal or external air temperature and for radio-broadcasting of the measured data in form of Wireless M-BUS standard messages. The WB169-TE module works either in unidirectional communication mode N1, or in the bidirectional N2 mode. In both modes the module regularly broadcasts information messages of „User Data" type intended for superior „master" device. In bidirectional N2 mode it is possible to use a back channel from master device, that can be used for transfer of „Request" type of messages with remote configuration demands.

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 back 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-TE module can be used for remote reading of instant, minimum, maximum and average air temperature in interiors as well as in exteriors, mainly in technological premises, halls, storages and (very frequently) for measurement of external temperature.

The module is equipped with the temperature sensor with recommended range of measured temperatures of (-30 ÷ 100) °C and with accuracy of ± 0,5 °C. The module measures a temperature every minute and broadcasts measured data as regular Wireless M-BUS „User Data" information messages. Each regular information message contains following entries:

- identification of the module
- instant, maximum, minimum and average temperature
- operational entries of the module (power, battery voltage, processor temperature, uptime)

Detailed information about the content and format of information messages can be found in paragraph 3.7.

Information messages are transmitted either in open mode (without encryption) or encrypted by AES-128 encryption key. The messages are transmitted on the 169.4 MHz frequency with data rate from 2.4 kbps to 19.2 kbps (according to used frequency channel). Messages can be received either by WB169-RFE communication gateway (WMBUS Ethernet GateWay produced by SOFTLINK), or by any other „Master" device that complies with the Wireless M-BUS EN 13757-3 / EN 13757-4 standard for 169 MHz frequency band. Principle of data transfer from the WB169-TE module for both kinds of solution is shown in the figure 1.

Bi-directional communication mode

If the WB169-TE module is preset for working in **bi-directional communication mode N2**, it could receive the **„Request" type of messages** according to the Wireless M-BUS standard. These messages can be originated by superior system or by superior „Master" device and can contain commands for remote configuration of following parameters:

- setting of transmitting power;
- setting of info-messages broadcasting period;

Receiving of „Request" type message take place always during the 500 ms long time window that starts immediately after transmitting of regular „User Data" info-message. During this interval the WB169-TE module opens its

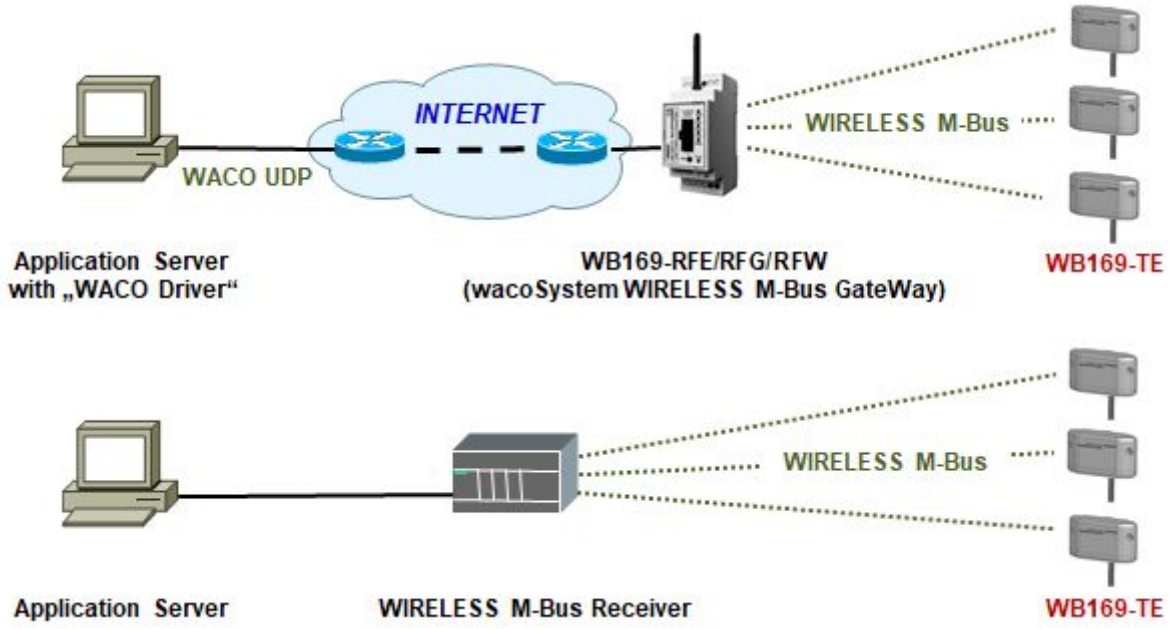


Figure 1: Principle of data transfer from WB169-TE module

receiver to be able to receive possible „Request" message. The module confirms receiving of „Request" by sending of „Acknowledgment" type of message.

Management of „Request" type of messages must be implemented into the central application software or into the superior „Master" device. The messages are coded by M-Bus standard principles with short Wireless M-BUS header with special indication of „Request" type messages (C-byte ="53", CI-byte = "5A"). The message contains one data block (with appropriate DIFE/VIFE code and required value) for each parameter, that should be remotely changed. More detailed description of „Request" type of message can be provided by producer of the WB169-TE module on request.

1.3 Hardware features and power supplying

The module is enclosed in humidity-proof plastic casing and can be used in interiors as well as in exteriors. Transparent casing enables wireless configuration with using of optical USB-IRDA converter. Modules can be equipped with additional sealing by high-adhesion silicon filling, that can ensure proof against inundation by water (IP68 grade). If this treatment is required from module producer, it must be ordered separately.

The module is equipped with an external temperature sensor that is placed in metal cover stick-out of the module casing. External appearance of the WB169-TE module is shown in the Figure 2.

Figure 2: View of the WB169-TE module

The module is power supplied by internal battery with 13 Ah capacity that enables operation with 30 minutes

broadcasting period for more than 5 years. Battery lifetime can be negatively influenced by shorter broadcasting period or by storing and operation in sites with the temperatures exceeding the recommended range for module storage and operation. Operation in bi-directional mode (N2) with using of back channel decreases the battery lifetime by 5 %.

2 Technical parameters overview

Overview of WB169-TE module technical parameters is shown in the Table1 below.

Table 1: Overview of WB169-TE module technical parameters

RF subsystem parameters		
Frequency band	169.40625 - 169.46875	MHz
Modulation *	2-GFSK, 4-GFSK	
Bandwidth *	12.5 or 50	kHz
Transmitting power	500	mW
Sensitivity of back-channel receiver	-109	dBm
Communication protocol	Wireless M-BUS	
Communication mode (by EN 13757-4)	N1 or N2	
Transmission speed *	2400, 4800, or 19200	Baud
Configuration interface RS232		
Transmission speed	9600	Baud
Operation mode	asynchronous	
Transmission parameters	8 data bits, 1 stop bit, none parity	
Signal level	TTL/CMOS	
Temperature sensor		
Range of measured temperatures	(-30 ÷ 100)	°C
Measurement resolution	0,1	°C
Measurement accuracy	± 0,5	°C
Power supplying		
3,6 V lithium battery capacity	13	Ah
Weight and dimensions		
Length	145	mm
Width	45	mm
Height (w/o antenna and sensor)	100	mm
Weight	cca 300	g
Storage and installation conditions		
Installation environment (by ČSN 33 2000-3)	normal AA6, AB4, A4	
Operation temperature range	(-30 ÷ 50)	°C
Storage temperature range	(0 ÷ 40)	°C
Relative humidity **	95	% (w/o condensation)
Degree of protection **	IP65 or IP68	

* in reliance on selected frequency channel - see EN 13757-4, Mode N, Physical link parameters (Table 18).

** modules with additional silicon filling are waterproof with IP68 degree of protection.

3 Configuration of the WB169-TE module

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

- with using of **„USB-CMOS"** converter and configuration cable connected to the module
- wireless, with using of **„USB-IRDA"** converter

Technique of interconnection of the module with configuration computer and general rules of configuration are described in detail in the section 3.1 „Configuration of the module with using of the configuration cable". The description and meaning of all configuration parameters that can be checked and changed by cable can be found in the section 3.5 „Setting of WB169-TE parameters via configuration cable".

Description of interconnection of the "USB-IRDA" converter with PC and general rules of configuration with using of this **optical converter** are described in the section 3.2 „Configuration of the WB169-TE module with using of optical converter". The description and meaning of the parameters that can be changed by optical converter can be found in the section 3.6 „Setting of parameters by using of optical „IRDA" converter".

3.1 Configuration of the module with using of the configuration cable

Configuration of the module can be performed by using of any PC with MS Windows or Linux operating systems interconnected by configuration data cable. The module's communication interface is of RS-232 (COM) type with CMOS signal level. The "CONFIG CMOS" configuration connector is placed on the module's printed circuit board.

3.1.1 Connecting of module to computer

Configuration can be performed by using of common USB port of the computer. For the interconnection with a USB port of computer it is necessary to use an manufacturer's original configuration cable with „USB-CMOS" converter (see Figure 4). This converter creates a virtual serial port through the USB interface and adapts voltage levels of the module's configuration port to the standard USB port of common PC. So as to be able to create a virtual serial connection via USB interface, there must be a relevant driver installed in the computer operation system. After the „USB-CMOS" converter is connected to 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 3).

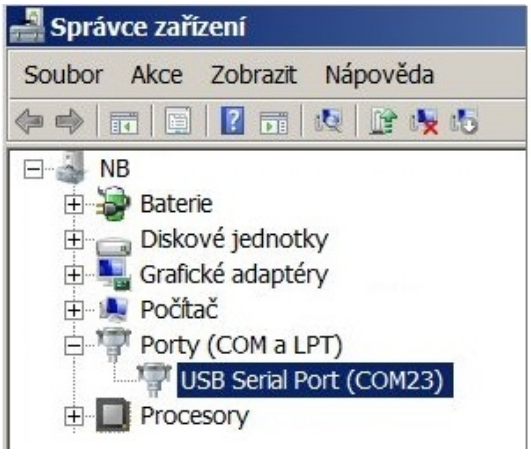


Figure 3: Appearance of the USB-CMOS converter in Windows „Device Manager"

As some of the older MS Windows versions do not support a generic driver for USB serial ports, the automatic installation of the driver could fail (system reports „Driver software installation failure", or „driver not found"). In this case there is necessary to install the driver manually, following the steps in paragraph 3.3 „Installation of USB-CMOS converter driver".

Insert USB-CMOS converter to the USB port of computer. Open module's casing to enable access to the configuration connector. Connect configuration cable to the „CONFIG CMOS" port on the module's printed circuit board. Thus the computer is connected with the module and ready for performing any changes in configuration (see figure 4 „Configuration via USB port of computer").

Figure 4: Configuration via USB port of computer

3.1.2 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.

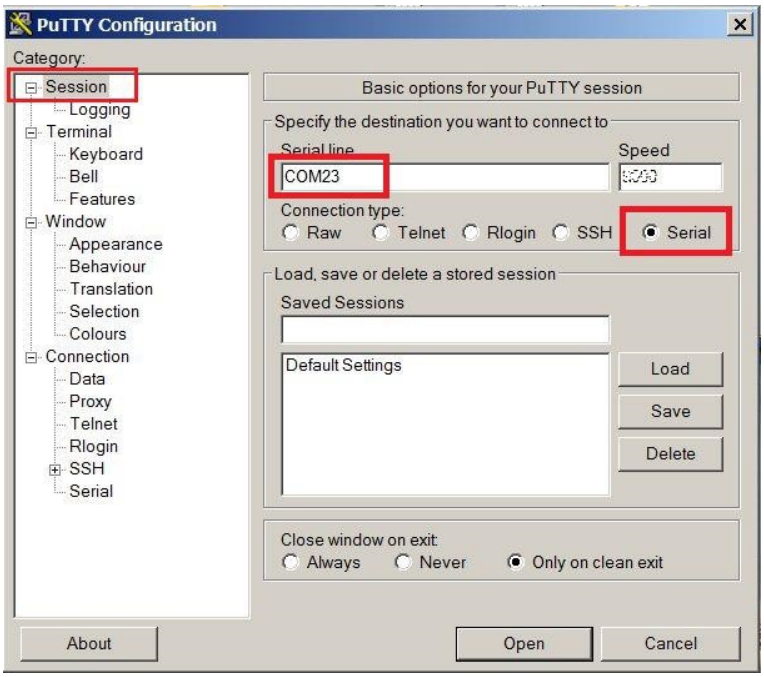


Figure 5: Terminal setting for serial line communication

„PuTTY" software runs after clicking on the downloaded file „putty.exe". There will open a window of the terminal communication (see Figure 5). 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 9600 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 3).

Click on „Open" button in „PuTTY" program and open the terminal window. After pressing of „ENTER" key there will appear a command prompt **„mon"** which announces that the module is ready to be configured (see figure 6).

Figure 6: Open terminal window for module configuration via serial line

3.1.3 General rules for configuration of the module by configuration cable

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 „mon" or „mon" format (see figure 6);
- 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;
- 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;
- 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.

3.2 „Configuration of the module with using of optical converter"

The module is equipped with an InfraRed interface that is intended for configuration with using of **„USB-IRDA"** converter. This converter serves for wireless transfer of configuration data (commands and values) between module and configuration computer via modulated beam of light in infrared band. By using of this kind of configuration there is possible to make all common settings through the transparent casing without necessity to open the module's cover (see figure 7). Optical beam goes through the transparent casing and it is decoded by the infrared modem placed on the module's printed board (PCB). A special software application program **„WACO OptoConf"** written in Java language can be used for required settings. This program can be installed to the computers with MS Windows as well as Linux operating systems.

3.2.1 Installation of the „WACO OptoConf" program

Installation of the **„WACO OptoConf"** program can be performed from the „Optoconf.zip" installation pack. Copy the pack to any folder of the computer and unpack it by any "unzip" program. The installation pack contains following files:

- „optoconf.jar" - executable file of the program
- „lib" - folder with „library" files
- „README.TXT" - "readme" file
- „SetupJSerial.msi" - serial port support for Java (installer)
- „ugw3.inf" - driver for USB-IRDA converter

The „WACO OptoConf" program can be started each time by launching of „optoconf.jar" file (clicking on the file name or to the created desktop shortcut to this file).

Check whether the "Java Runtime Environment" (Java Virtual Machine) program in the 8 or higher version is pre-installed in the computer. If after launching of the „optoconf.jar" file a Java-window of the configuration program does not open (or pop-up window „How do you want to open this file?" appears) then the Java support it is not installed (or installed in older version) and it is necessary to perform its installation (32-bit version for Windows,

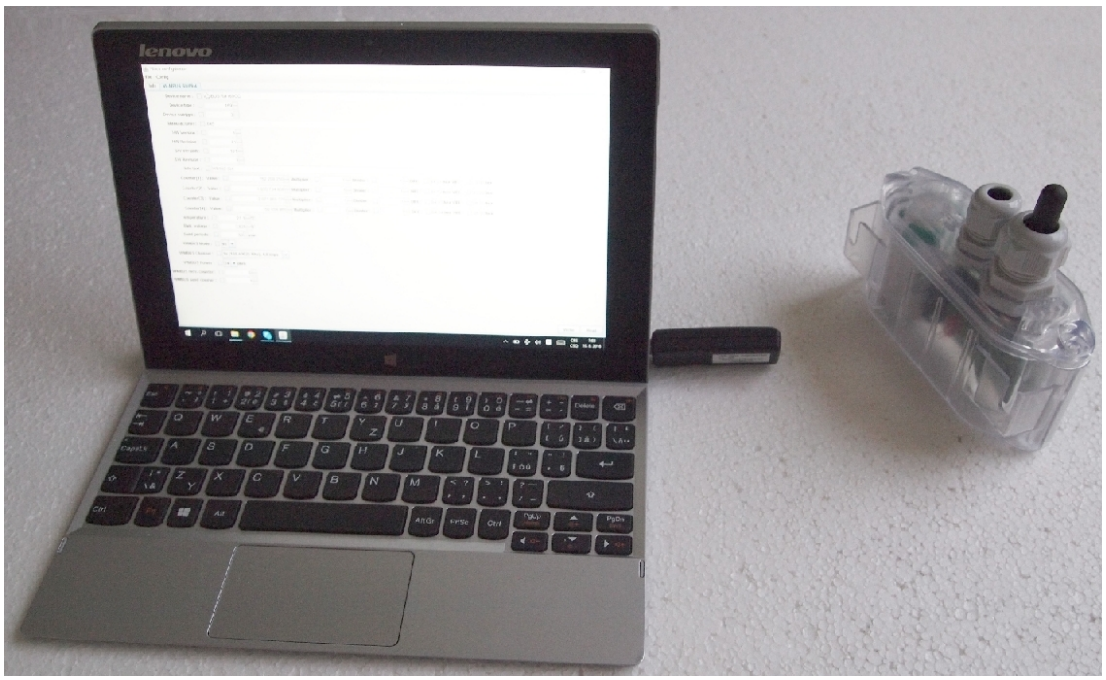


Figure 7: Configuration of the module with using of optical converter

64-bit version for Linux). The Java Runtime Environment program is available on the official Oracle WEB site for Java support here: Download Free Java Software

After installation of the Java Runtime Environment install the driver for a serial interface support in Java environment by clicking to **„SetupJSerial.msi"** file. The installer of driver starts running. The installation is very simple - it only requires confirmation of necessary changes in computer configuration („Do you want to allow this app to make changes to your PC?"). After the driver is installed try to start „WACO OptoConf' program again and if everything is all right the program window will be opened. Close the program window.

3.2.2 Connection of „USB-IRDA" optical converter to computer

Before starting of the **„WACO OptoConf"** program connect the **„USB-IRDA"** converter to USB port of the computer. When the converter is connected to computer for the first time an operating system will automatically find and install correct driver for the converter (i.e. generic driver for „USB Serial Device" category of device). After driver is successfully installed to MS Windows computer, the device should appear in the „Device Manager" in section „Ports (COM and LPT)" as „USB Serial Device (COMx)" (see figure 8).

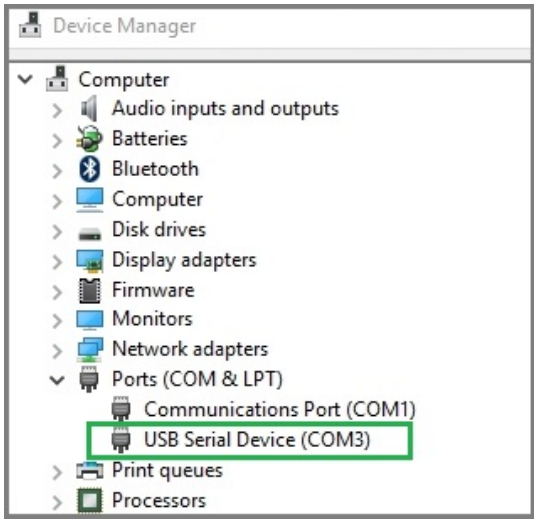


Figure 8: Displaying of the optical converter in the Windows' „Device Manager"

Older versions of MS Windows do not support generic driver for support of serial ports via USB. I this case install

the „ugw3.inf" driver from delivered installation pack according to the instructions mentioned in the paragraph 3.4 „USB GateWay" and „USB-IRDA" driver installation" below.

3.2.3 Using of „WACO OptoConf" program for configuration of modules

Start the **„WACO OptoConf"** program by clicking on the **„optoconf.jar"** file name or to the pre-created desktop shortcut to this file. Program window **„WACO configuration"** will open (see figure 9). In **Config/Port** item of menu choose name of serial port assigned to USB-IRDA converter by operating system (see figure 8). The program is thus fully functional and ready for configuring parameters. Menu item **„Config/Look and Feel"** serves only for choice of window color and design by clicking to one of pre-configured options.

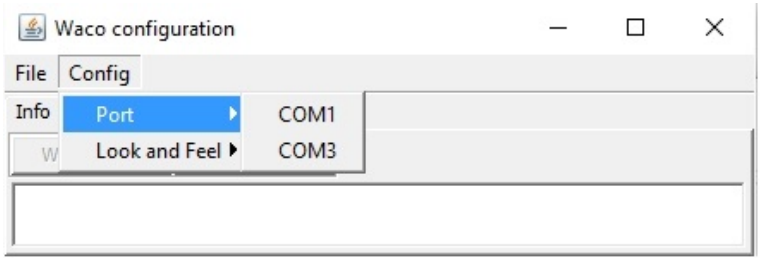


Figure 9: Displaying of „WACO OptoConf" configuration window"

By clicking to **„Walk device"** button the list of all variables that are used for module configuration can be displayed (see figure 10.

Figure 10: List of variables in the working window of „WACO OptoConf" program

Index and description of all variables of the NEP protocol, that is used for coding of data in Softlink's „wacoSystem" communication systems can be found on the producer's WEB site NEP Page.

By clicking to **„Read device"** button the textbfconfiguration table with all the relevant parameters of the module is displayed in the working window. Non-configurable (read only) parameters are displayed as "inactive" (with gray editing fields), while parameters that can be changed by „WACO OptoConf" program are displayed inside white editing fields ("active fields"). Example of configuration table of the module is depicted in the figure 11.

3.2.4 General rules for configuration of the module by optical converter

Connect **USB-IRDA** optical converter to the USB port of the computer. Flashing of green LED signalizes correct function of the converter. By clicking to „optoconf.jar" file (or its shortcut) launch **„WACO OptoConf"** program. If not chosen automatically by previous functioning, choose the name of serial port of the converter („COM XY") in the „Config/port" menu.

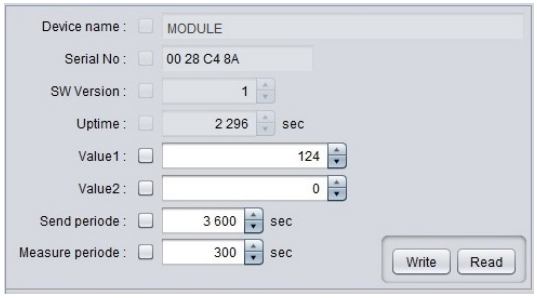


Figure 11: Example of module's configuration table in the „WACO OptoConf" window

Configuration can be performed either on the working desk or with using of a special holder for attaching of optical converter to the module.

Configuration on the **working desk** means that computer as well as the module are placed on the any convenient work surface (e.g. on the desk - see figure 7). In this case the module should be placed not more than 15 cm from the tip of converter, the module's printed board must be facing to converter by its element side, and module's optical sensor should be lying approximately in the converter's axis of symmetry (i.e. in the direction of the infrared beam). Approximate position of the optical sensor of the module is marked in the figure 2 by green arrow. Correctness of mutual position module/converter can be checked by displaying of the current configuration as described below. It is necessary to fix and keep such position in which the communication between module and converter is reliable.

When working directly at the installation site always use **a special holder** that is designed for attaching of converter to the module. Put the holder to the WB169-TE module as shown in the figure 12.

Figure 12: Attaching of optical converter to the holder

Put holder to the module from the element side and shift it to that side where the optical sensor is placed (approximate position of the optical sensor is marked in the figure 2 by green arrow). Connect the converter with laptop by using of extension USB cable and insert the converter to the slot in the holder as shown in the picture. Check correctness of converter's position by displaying of the current configuration as described below. If the connection is not reliable shift the holder along the module's cover. The best position is if the converter is right opposite to sensor.

By clicking to **„Read device"** open a configuration table with all the relevant parameters of the module. Parameters that can be changed are displayed in white colored editing fields. There are four types of editing fields:

- text fields, in which a text can be edited (e.g. "Info-text" field)
- numeric fields, in which a change of number can be done
- selection fields, in which a choice from pre-set options can be done
- hexadecimal fields (marked by "hex"), in which hexadecimal characters can be entered

Text fields can be changed by correcting, erasing, or rewriting of the text inside the field.

Numeric fields can be changed by rewriting number inside the field or by its increasing/decreasing with using of arrows $\triangle$ a $\triangledown$.

Selection fields can be changed by clicking to symbol ∇ and choosing required option from the list-box.

Hexadecimal number fields (e.g. "8B 01") can be changed by clicking on the character and rewriting its value to another hexadecimal character (0 to F).

For editing of individual items keep following rules:

- after making any change in editing field there appears symbol "$\surd$" before the field that is an indication of

active change request that will be sent to the module;

- by clicking to **„Write"** button in the lower part of the configuration table the program sends configuration commands through the USB-IRDA converter. During the process of establishing connection converter's LED light stops flashing for approximately 2 seconds and then lights-up;
- after sending data to module the program automatically requests a new status of configuration. Displaying of the new current status of configuration parameters (after requested changes) is signalized by disappearance of symbol "√" before editing field;
- if requested change of some parameter is out of its range, the change is not accomplished and after disappearance of symbol "√" there appears an original value in the editing field;
- the program enables making multiple configuration changes at one time. If there are changes in several editing fields of the table, each of them is marked by symbol "√" and after clicking to „Write" button all the changes are requested/performed;
- if some of the fields was edited unintentionally (by mistake) and the change of this field is not really requested, by clicking to symbol "√" the field can be „unchecked" and the change request of the parameter is not sent to module;
- current status of all configuration parameters of the module can be requested anytime by clicking to **„Read"** button in lower part of the table;
- ongoing communication between module and USB-IRDA converter may be signaled by flashing of LED on the configured device;
- if the connection between USB-IRDA and the module was not established until several seconds, error window "Error: Read timeout" will appear in the program window;
- the most common reason of connection failure is either bad position of the module (long distance, wrong orientation, dirty cover, obstacle in the beam), or the module's battery was switched off.

NOTE! „WACO OptoConf" program contains specific data and settings for interworking with certain types of modules. Each version of the program thus supports only the relevant versions of the wacoSystem modules (i.e. actual versions of the modules up to date of the software release). If after reading of data from the module the error window "Error: Unknown device" will appear, the current version of the program does not support configuration of this version of the module. In this case it is necessary to download a new version of the „WACO OptoConf" program from the product WEB site www.wacosystem.com/podpora, or contact manufacturer's technical support by e-mail: support@softlink.cz.

3.3 USB-CMOS converter driver installation

If the computer operation system failed in automatic installing of the driver for the „USB-CMOS", it is necessary to install the driver manually. The relevant current driver can be found on a chip manufacturer's (FTDI) webpages, namely in the „VCP Drivers" (Virtual COM Ports) section.

www.ftdichip.com/Drivers/VCP.htm

In the „Currently Supported VCP Drivers" table find a link to a driver relevant to your operating system. To download the file, click on a link in the table. After downloading the file (in .ZIP format) into any directory in your computer, unzip the file. It will create a new folder (directory) with a set of files (e.g. „CDM 2.08.24 WHQL Certified").

Connect the converter „USB-CMOS" to your computer and open a „Device Manager" tool. The converter with the disabled driver will be displayed in the top right corner of the window as „Other Devices" (see figure 14 left).

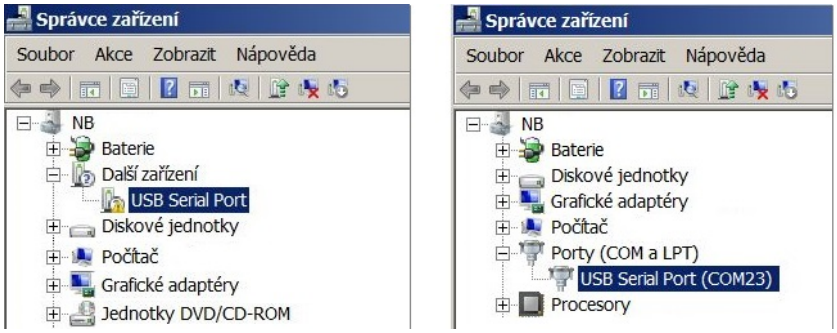


Figure 13: Appearance of converter without driver in the Windows „Device Manager" table

Click by right mouse button on „USB Serial Port" and choose „Update Driver Software" option in the context menu. Choose „Find Driver in this computer" option in the „Update Driver Software" window. Use „Browse" button to set up the path to the driver's folder (directory) and then click on the „Next" button. The driver installation process will launch. After the driver installation is completed, the standard „Installation Completed" message will appear. After the installation the converter will appear in the „Ports (COM and LPT)" section of the „Device Manager" window (see figure 14 right).

3.4 „USB GateWay" and „USB-IRDA" driver installation

The driver „ugw3.inf" intended for support of multiple virtual serial ports through the USB interface of a computer is a part of delivered installation pack. If your version of MS Windows operating system failed in automatic installation of a driver for connected „USB GateWay" or „USB-IRDA" device, make an installation of „ugw3.inf" driver manually.

Connect the device to computer and open a window of „Device Manager" tool. The device appears in the „Other device" section in upper part of the window as „USB Serial port" device (see figure 14 left).

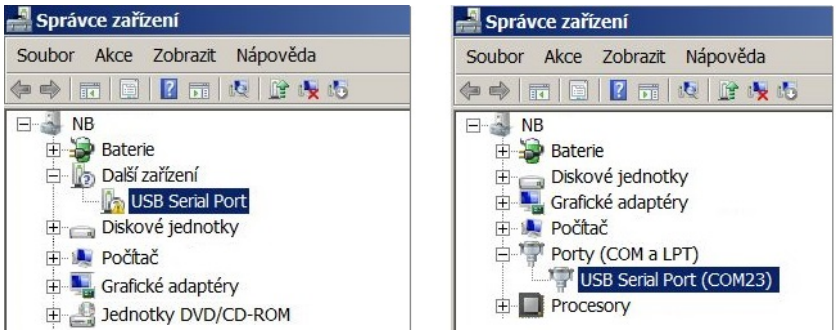


Figure 14: Displaying of the device without driver in "Device Manager" window

By right-clicking to „USB Serial port" open the context menu and choose „Update driver software" item. Click on „Find driver in this computer" in the opened window. Click to „Select driver from the list" and „Next" in next window. After a new „Select device type from the following list" window appears, select „Ports (CPM & LPT)" in the window and click to „Next" button (see figure 15 left). Choose „From disc" in the next „Choose driver which you want to install" window (figure 15 right).

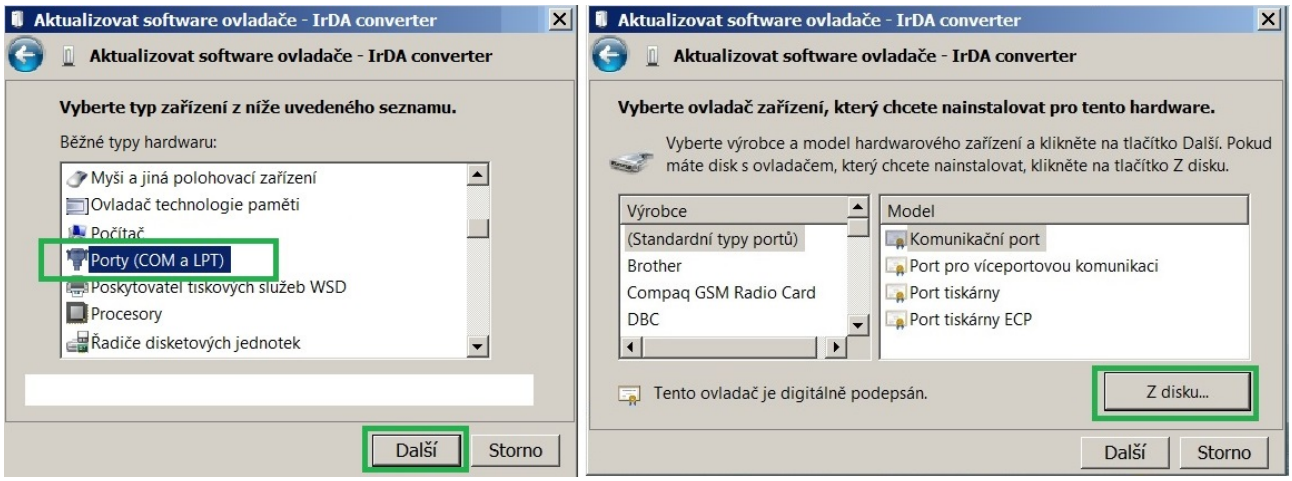


Figure 15: Manual selection of the driver file from a folder

After that a new „Find file" window appears. Set the folder with driver file in the „Browse" tool, select „ugw3.inf" file name that will appear in the window and click to „Open" button (see figure 16 left). A new „Choose driver to be installed for the hardware" window will appear, select „RFU Gateway Serial port" item and click to „Next" button (see figure 16 right).

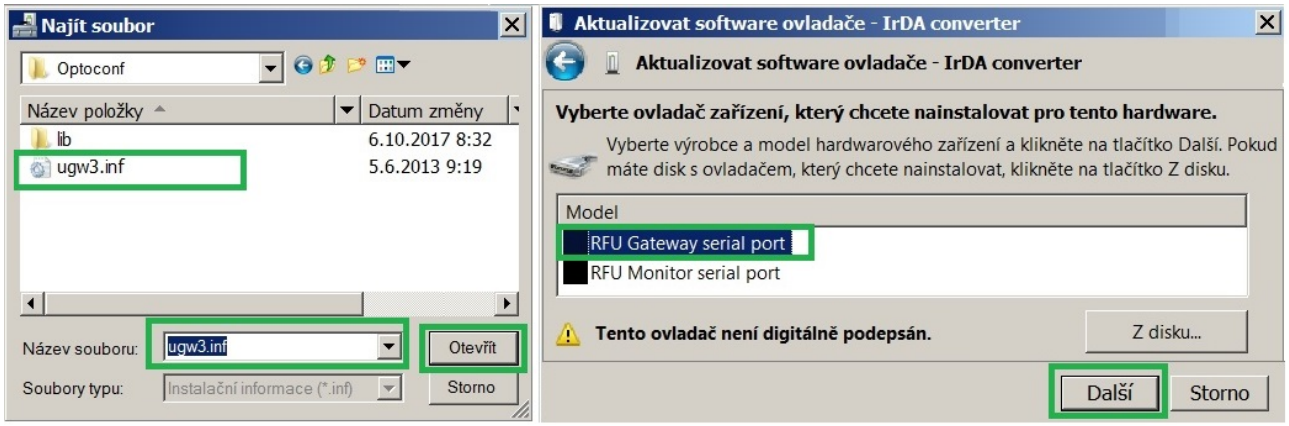


Figure 16: USB driver installation

A new „Driver software installation" window will appear with standard red „unknown driver producer" Windows system warning. Click to „Install the software anyway" option and the installation process will launch (*). After the process is completed the system shows positive message „The driver was successfully installed" (or similar). The device will move to the „Ports (COM & LPT)" section of the „Device Manager" window (see figure 14 right).

(*) If installing the driver into the Windows 8 or Windows 10 OS computer, it could be a security problem with the installation because the driver doesn't have a digital signature („unsigned driver"). In this case follow the instructions below.

3.4.1 How to disable driver signature enforcement in Windows 8 system

Enforcement of signed driver installation in Windows 8 can be disabled by following procedure:

- by pressing the „Windows + R" keys open the „Run" window;
- write a restart command "shutdown.exe /r /o /f /t 00" into the „Open" editable field;
- choose „Troubleshoot" option in the „Choose an option" window that will pop-up;
- choose „Advanced options" in opened „Troubleshoot" window;
- choose „Windows Startup Settings" in opened „Advanced options" window and run „Restart";
- during the system restart process a window „Advanced Boot Options" appears, choose „Disable Driver Signature Enforcement" option in this window;
- after launching the system install the driver according the above mentioned instructions.

Deactivation of the enforcement of signed driver function of the Windows 8 operating system is functional only until the next restart of the system.

3.4.2 How to disable driver signature enforcement in Windows 10 system

Enforcement of signed driver installation in Windows 10 can be switched-off by following procedure:

- click to „Windows" icon in left the bottom left corner of the screen and choose „Settings" icon;
- select „Update and security" in „Settings" window;
- select „Recovery" in next window';
- select „Advanced startup" section in „Recovery" window and click to „Restart" button in the section;
- in a few seconds the new „Choose an option" screen appears; select „Troubleshoot" option;
- in next steps select „Advanced options" and „Startup repair" options and click to „Restart" button;
- in this step an instruction for entering of „BitLocker" recovery key could appear (depends on the system settings). This is a 64-character access key for data section of the user that can be used in case of loss of OS Windows password. The key can be found in the „Microsoft Account Settings" page, that can be displayed by clicking to „Windows" icon and „User" item of main Windows menu. To get to the account it is necessary to click to „Change account setting" and „Manage my Microsoft account" and log into the account by using of Microsoft user login/password. Select „Device" in main menu of the user account page and click to „Obtain BitLocker recovery key" in „Desktop" section and „Bitlocker" subsection. The new screen with recovery keys will open. Copy down the key that is valid for the required unit (according to the required unit identifier);

- after entering of the key the new screen with startup options will appear, select „Disable Driver Signature Enforcement" option from the list. The selection can be done with using of F1 - F10 keys, for selected option with order number „7" press key „F7";
- after OS Windows restart perform the driver installation according to the above described procedure.

Deactivation of the enforcement of signed driver function of the Windows 10 operating system is functional only until the next restart of the system.

3.4.3 Support of older OS Windows versions and OS Linux support

Earlier MS Windows versions (Vista, Windows XP and older ones) do not support sufficiently the installation of multiple virtual serial ports onto one physical USB port and the current versions of „USB GateWay" and „USB-IRDA" devices cannot be connected to the computers with these operating systems.

There is no need to install any drivers with serial port support to the computer with Linux OS as the Linux system will automatically use its own generic drivers.

3.5 Setting of WB169-TE module parameters by configuration cable

In this section of the manual there are described these parameters of the WB169-TE module, that can be browsed, checked and changed from the computer connected with the module through the configuration cable („console configuration") as described in paragraph 3.1.

Table of all configuration parameters, as displayed in the list of configuration parameters viewed from the console, can be found in the paragraph 4.1.2, together with a short description of their meaning.

3.5.1 List of module configuration parameters

List of 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:

```
mon#show
Show configuration :
 MBUS ID : 00000019
 MBUS version : 51
 MBUS manufacturer : SFT
 MBUS medium : 8
 MBUS manuf info : TE
 Data will be encrypted by AES
  Send periode : 0
 WMBUS power   : 3 (20 dBm)
  mode    : N2
  channel : 3 (chan 2a (169.43125 Mhz), 2.4 kbps Mhz, 2,4 bps)
  send 5, recv 0 pkts

 Configuration version : 4
 SW version 1.06 TS, date Sep 13 2018
mon#
```

The **„MBUS ID"**, **„MBUS version"**, **„MBUS manufacturer"** and **„MBUS medium"** parameters are components of the WB169-TE module own address within Wireless MBUS system that is used in all its information messages. The **„MBUS manuf info"** parameter is designation of module type that is a part of the information message. All these parameters can be changed only by console configuration and it is strongly recommended not to change their values.

The **„Data will be encrypted by AES"** record indicates setting of data encryption system. In this example the encryption is enabled (see description and using of "ekey" command in paragraph 3.5.6).

The **„Send periode"** parameter is a broadcasting period of information messages. The **„WMBUS power"**, **„WMBUS mode"** and **„WMBUS channel"** parameters indicate setting of radio-frequency subsystem of the module. As necessary, these parameters can be changed by user as described in paragraph 3.5.6 „Parameters of „Modem commands" group".

The **„send"** and **„recv"** records show number of broadcasted and received messages from the last reset.

The **„Configuration version"** and **„SW version"** are intended only for factory diagnostics.

Overview of configuration parameters with short description of their meaning can be found in table 2 on the page 20.

3.5.2 Displaying the List of configuration commands („HELP")

List of all configuration commands can be displayed by entering of **„?"** command. The following list of commands will display in the terminal window:

```
mon#?
 Help :
 ---  System commands --- ---
deb               : Show or set debug level
ta                : Show tasks
mb                : Show mail boxes
du addr           : Dump memory
rb addr           : Read byte from addr
rw addr           : Read word from addr
sw addr val       : Set word on addr
sb addr val       : Set byte on addr
uptime            : Show uptime
reset             : Reset device
sens              : Show ADC, vcc and temperature values
?                 : Show this help

 ---  WMBUS commands --- ---
mid               : Show or set WMBUS ID (0 - 99999999)
power             : Show or set WMBUS power (1 - 5)
manuf             : Show or set MBUS manufacturer code (AAA)
info              : Show or set MBUS info string (0-30 chars)
vers              : Show or set MBUS version (0 - 255)
medium            : Show or set MBUS medium (0 - 255)
periode           : Change periode of send
mode              : Set WMBUS mode 1 - N1, 2 - N2
chan              : Set WMBUS channel, type ? for help
ekey              : Set encrypt key, point '.' no encrypt
 ---  Configuration --- ---
show              : Show all configuration
write             : Write configuration to flash
read              : Read configuration from flash
clear             : Clear configation and load defaults
 ---  Modem commands --- ---
mr                : Modem receive mode
mt test time      : Set test on modem, 1 - TX carrier, 2 - TX PN9, 0 - off, time is in second, default 10
ms                : Get modem state
mi                : Get modem info
mfreq             : Set or get radio frequency correction
cfreq             : Set +- frequency correction, 1 = 1Hz
send              : Send WMBUS message
mon#
```

The meaning and usage of individual commands are described in the following part of chapter 3.5.

3.5.3 „System commands" group for general diagnostics

Commands „**"deb", "ta", "mb", "du addr", "rw addr", "rb addr", "rd addr", "sw addr", "sb addr", "sd addr"** and **"uptime"** are used for troubleshooting and repair of the device in a factory. **Manufacturer strongly recommends not to use these commands during common operation.**

The command **"reset"** performs the equipment reset. Its meaning and using are described in the paragraph 3.5.5.

The command **„?'** can be used to display a list (summary) of configuration commands and their parameters (so called „Help"). Its meaning and using are described in the paragraph 3.5.2.

„sens" command can be used for displaying of current values of A/D converters measuring physical quantities (battery voltage, internal voltage, CPU temperature and external sensor temperature). This command is intended only for module checking and diagnostics. Example:

```
mon#sens
 VBAT 929 -> 3.628 V
 VCPU 715 -> 2.792 V
 CPU Temp. -> 26.9 $^\circ$C
 Ext.Temp. -> 27.81 $^\circ$C
mon#
```

3.5.4 „WMBUS" group commands for setting of messages

This group of commands serves for setting of Wireless M-BUS addressing of the WB169-TE module and for setting of broadcasting parameters. There are following command:

mid	*setting of device fabrication number („M-BUS ID" – range 0 to 99999999)*
manuf	*setting of manufacturer code („Manufacturer" - supplement of M-BUS address)*
vers	*setting of „addressing version" („Version" - supplement of M-BUS address)*
medium	*setting of media code („Medium" - supplement of M-BUS address)*
info	*setting device name*
periode	*setting of regular messages broadcasting period*
power	*setting of transmitting power (mW)*
mode	*setting of communication mode (1 - N1 mode, 2 - N2 mode)*
chan	*setting of frequency channel (choice from 7 options)*
ekey	*setting of encryption key ("." - encryption disabled)*

*Parameters and commands **„power"** (transmitting power), **„chan"** (frequency channel), **„mode"** (communication mode) and **„ekey"** (encryption key) serve for setting of radio-frequency subsystem of the module. These parameters and commands are described in detail in paragraph 3.5.6 „Modem commands group for radio-frequency settings" together with other commands for setting and checking of WB169-TE module transmitter and receiver.*

Variable **„M-BUS ID"** is a serial number of the device in M-Bus standard identification system. The address is editable for the WB169-TE module and cannot be changed. Assigned serial number of the module can be displayed by**„mid"** command (without parameter):

```
cfg#mid
MBUS ID : 00112233
cfg#
```

Variable **„Manufacturer"** is an international code of device producer according to the M-Bus standard. The code is editable for the WB169-TE module, its value is „SFT" (Softlink) and it cannot be changed. Assigned manufacturer code can be displayed by**„manuf"** command (without parameter):

```
cfg#manuf
MBUS manufacturer : SFT
cfg#
```

Variable **„Version"** is number of addressing version according to the M-Bus standard (each type and modification of the device could have its own line of serial numbers). The code is editable for the WB169-TE module and cannot be changed. Assigned version number can be displayed by **„vers"** command (without parameter):

```
cfg#vers
MBUS version : 101
cfg#
```

Variable **„Medium"** is an international code of measured medium (water, energy, physical quantity..) according to the M-Bus standard. The variable is editable and it is factory preset to 02 ("Heat Cost Allocator"). Current setting of the medium value can be displayed by **„medium"** command (without parameter). Medium parameter can be changed by entering of required code of medium according to M-Bus standard (range: 0 to 255).

Example of medium code setting to "02" value (electricity):

```
cfg#medium
MBUS medium : 7
cfg#medium2
MBUS medium changed from 7 to 2
cfg#
```

***Note**: The full identification of the device in M-Bus standard systems is done by combination of four ID components: „M-BUS ID", „Manufacturer", „Version" and „Medium". This combination must be unambiguous that means there cannot exist two M-Bus devices worldwide, that have the same combination of all these parameters. If there are fixed configuration of the address components used, producer of the device is responsible for unique setting of „read only" address components for each device. If M-Bus address components are configurable, operator of the M-Bus system can use serial number of connected meter in combining with its type, subtype and manufacturer. Using of „independent" addressing line is possible only in that case, if the operator of the system owns its M-Bus manufacturer code and can assure that the identification of all operated devices under his code will be unique*

„Info" command can be used for setting of device name that is a part of each broadcasted message (see paragraph 3.7). The parameter is preset from the factory to „TE" value. By using of **„info"** command (without parameter) an actual value of the name can be displayed. The device name can be set by entering of any string of characters after „info" command.

Example of displaying, setting and follow-up checking of the device name:

```
cfg#info
MBUS manuf info  : 'ABC'
cfg#info XYZ
Change MBUS manuf info from : 'ABC' to : 'XYZ'
cfg#info
MBUS manuf info  : 'XYZ'
cfg#
```

Maximum length of the string is 29 characters. The only basic set of characters can be used (without diacritics). It is not recommended to change this parameter.

„Periode" command serves for setting of broadcasting period of regular info messages. The value of the parameter is factory preset to 60 minutes. Current value can be checked by **„periode"** command (without parameter). Broadcasting period can be changed by entering of required number of minutes after „periode" command.

Example of displaying, setting and follow-up checking of broadcasting period:

```
cfg#periode
Periode is 60 min.
cfg#periode 30
Periode changed from 60 to 30 min.
cfg#periode
Periode is 30 min.
cfg#
```

3.5.5 „Configuration" group of commands for writing of configuration and reset

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 shorten of the broadcasting period during installation), it is not necessary to save operating configuration in FLASH memory (after the work finishing module can be returned to normal configuration by its reset). If the parameter should be changed permanently, there is necessary to save configuration to FLASH memory.

If operating configuration corresponds to the saved set (ie. there are no differences between commands in FLASH and in the operating set), the module will „report“ prompt in the format "mon#“. If operating configuration was changed so that it no longer matches to the saved set, the module will report prompt in the format „cfg#".

Every time the current configuration is saved into FLASH memory the value of the „Configuration version" parameter increases by one and the prompt changes to „mon#". The parameter resets to zero by erasing of the FLASH memory.

Current operating configuration can be displayed by using of **„show“** command (see paragraph 3.5.1):

```
cfg#show
```

Current operating configuration can be rewrite the to FLASH memory by using of **„write“** command:

```
cfg#write
Writing config ... OK, version 3
```

Reading of the configuration from FLASH memory can be done by by using of **„read“** command (for some modifications the command is **„cread“**):

```
cfg#read
Reading config ... OK, version 3
```

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. There is only one exception - frequency constant keeps the actual value also after cleaning of FLASH memory by "clean" command.

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

The module reset can be performed by using of **„reset“** command:

```
cfg#reset
cfg#
Reset code 22 : WDT time out (PUC)
RF module started, sw version 1.02, date Aug 15 2014
mon#
```

3.5.6 „Modem commands" group for radio-frequency settings

This group of commands enables setting of transmitting system and setting of radio-frequency modem parameters.

The first part comprises commands for setting of Wireless M-Bus messages transmitting system. These parameters are relevant for all messages of the module. There are following commands:

power	*setting of transmitting power (5 options)*
mode	*setting of communication mode (N1 or N2)*
chan	*setting of transmitting channel (7 options)*
ekey	*setting of necryption key (”.” - no encryption)*

The command **„Power"** is used for adjusting of the module broadcasting power. Factory setting is 100 mW (average power). Actual value of the power can be displayed by using of the **"power"** command without parameter. Transmitting power can be set-up by entering of the number of power level. There are five levels available:

- value "1" for transmitting power 14 dBm (25 mW)
- value "2" for transmitting power 17 dBm (50 mW)
- value "3" for transmitting power 20 dBm (100 mW)
- value "4" for transmitting power 24 dBm (250 mW)
- value "5" for transmitting power 27 dBm (500 mW)

An example of checking, setting and re-checking of transmitting power:

```
cfg#power
MBUS power : 3 (20 dBm)
cfg#power 5
MBUS power changed from 3 to 5 (27 dbm)
cfg#power
MBUS power : 5 (27 dBm)
cfg#
```

The command **„Communication mode"** is used for selecting of the module's communication mode. Factory setting is N1, N2, actual setting can be checked by using of **„mode"** command without parameter. Change of mode can be done by entering of desired option as a parameter of the command. Communication modes are defined by the Wireless M-BUS standard, accurate choice of relevant communication modes of the module is stated in the line "mode" of "Help" summary (see the paragraph 3.5.2).

An example of checking, setting and re-checking of communication mode:

```
cfg#mode
Mode N1
cfg#mode 2
CC1120 state 0x0f, marcstate 65, fifo tx 0, rx 0
Mode changed from 1 to 2
cfg#mode
Mode N2
cfg#
```

The command **„Frequency channel"** 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. Actual setting can be checked by using of **„chan"** command without parameter. Change of channel can be done by entering of desired option as a parameter of the command. Accurate choice of relevant broacasting communication modes of the module is stated in a line "mode" in "Help" summary (see the paragraph 3.5.2).

An example of checking, setting, saving and re-checking of frequency channel:

```
cfg#chan
Help :
  1 - chan 1a (169.40625 Mhz), 4.8 kbps
  2 - chan 1b (169.41875 Mhz), 4.8 kbps
* 3 - chan 2a (169.43125 Mhz), 2.4 kbps
  4 - chan 2b (169.44375 Mhz), 2.4 kbps
  5 - chan 3a (169.45625 Mhz), 4.8 kbps
  6 - chan 3b (169.46875 Mhz), 4.8 kbps
  7 - chan 3g (169.43750 Mhz), 19.2 kbps
cfg#chan 1
Channel changed from 3 to 1 : chan 1a (169.40625 Mhz), 4.8 kbps
CC1120 state 0x0f, marcstate 65, fifo tx 0, rx 0
cfg#chan
Help :
* 1 - chan 1a (169.40625 Mhz), 4.8 kbps
  2 - chan 1b (169.41875 Mhz), 4.8 kbps
  3 - chan 2a (169.43125 Mhz), 2.4 kbps
...
  7 - chan 3g (169.43750 Mhz), 19.2 kbps
cfg#
```

The command **„Encryption key"** is used for setting of the encryption key for an encryption of transmitted messages by using of AES-128 key. 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:

```
cfg#ekey 0x1a 0x2b 0x3c 0x4d 0x5e 0x6f 0xa1 0xb2 0xc3 0xd4 0xe5 0xf6 0x77 0x88 0x99 0xaf
Setting encyption key : 1a 2b 3c 4d 5e 6f a1 b2 c3 d4 e5 f6 77 88 99 af
cfg#
```

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

```
cfg#ekey42 53 159 188 255 138 241 202 136 21 98 147 235 15 145 136
Setting encyption key : 2a 35 9f bc ff 8a f1 ca 88 15 62 93 eb 0f 91 88
cfg#
```

If the encryption key is set to the module's configuration, an information ***„Data will be encrypted by AES"*** displays in the list of configuration parameters (see chapter 3.5.1)

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

```
cfg#ekey.
Encyption disabling
cfg#
```

In this case an information ***„Data will be unencrypted"*** *appers in the list of configuration parameters* .

The second part comprises commands for setting of radio-frequency sub-system of the module. These commands are used primarily for the initial setting of the module in factory. There are following commands:

mr	*receiving mode switch-on (diagnostics)*
mt test	*testing broadcasting switch-on (set-up and diagnostics)*
ms	*internal status of RF-modem (diagnostics)*
mi	*dump of modem internal registers (diagnostics)*
mfreq	*frequency constant setting (frequency setting)*
cfreq	*frequency constant correction (frequency tunnig)*
send	*immediate sending of radio message*

The command **„send"** can be used for immediate („out od turn") transmitting of the standard Wireless M-Bus information message that contents information about temperature, voltage and other measured parameters (see

paragraph 3.7) relevant to the connected device (meter) specified by index. This command can be used for example for checking of radio signal availability during the system installation, or for any adjustments and testing of the module, connected meter, or receiving device. The command makes possible to send the information message anytime without necessity to change the transmission period or without waiting until the message will be sent spontaneously within the pre-set period.

An example of the command for immediate sending of the information message with the information from the device (attached meter) with index "2":

```
mon#send 2
Send [2] ...
 send [2] msg 255
mon#
```

Similar command **„sendp [number]"** can be used for transmitting of series of several message when the first message is transmitted immediately. Number of messages in the series is done by "number" parameter after command, where maximum number of messages in series is 30. This command can be used during installation and testing of the module. The command is implemented only in newer modifications of the module (only if it appears in "HELP").

An example of the command for sending of series of 5 messages:

```
mon#sendp 5
 send 5 msgs
mon#
```

Commands **„mr", „mt test", „ms" „mi", „mfreq"** and **„cfreq"** are used for radio-frequency subsystem diagnostics and initial adjustment of the nominal frequency during the manufacturing process and outgoing inspection in factory.

Manufacturer strongly recommends not to use these commands during the common operation. Using of these commands can cause inoperability of the device.

3.5.7 Overview of module configuration parameters

Overview of configuration parameters that can be used for user settings of the WB169-TE module is shown in the Table 2 below. The parameters are presented in the same order as they appear in the List of configuration parameters (see paragraph 3.5.1).

Table 2: Overview of WB169-TE module configuration parameters

Item	Name	Value	Description	Default.
1	MBUS ID	0 - 99999999	Serial number (M-Bus address)	
2	MBUS Version	0 - 255	Generation or version (M-Bus address suppl.)	
3	MBUS Manufacturer	code	Device producer (M-Bus address suppl.)	SFT
4	MBUS Medium	code	Medium (M-Bus address suppl.)	08
5	MBUS Manuf. info	0 - 29 char.	Device name	TE
6	Encryption	code	Encryption key	individuální
7	Periode	1 - 65535	Broadcasting period in minutes	60
8	WMBUS Power	1 - 5	Transmitting power	3
9	Mode	1 - 2	Communication mode	1 (N1)
10	Channel	1 - 7	Frequency channel	1
11	No of sent msgs	curr. status	Sent messages since last reset	read only
12	No of recv msgs	curr. status	Received messages since last reset	read only
13	Config. Version	curr. status	No of stored images since last FLASH erasure	read only
14	SW Version	curr. status	Software version and date of issue	read only

In **„Value"** column there are allowable ranges of parameter values. If there is a „code" indication in the „Value" column, it means that the value is displayed in hexadecimal code (where couple of hexadecimal characters represents one Byte).

In **„Default"** column there are default (factory) settings of the parameter. Colour marking of this field has following meaning:

- green colour - commonly used parameters that should be setup in reliance on the specific usage
- red colour - parameters that are not recommended to change
- grey colour - values that cannot be changed („read only")

Yellow colouring of the „Item" number highlights the parameters, that can be configured by using of **USB-IRDA optical converter** as described in details in chapter 3.6 „Setting of parameters by using of optical „USB-IRDA" converter".

3.6 Setting of parameters by using of optical „USB-IRDA" converter

All WB169-TE module parameters that is necessary to set-up during common operation can be configured by optical interface. The settings can be performed through the transparent casing without necessity to open the module's cover. This is the significant advantage especially if the module is used in humid environment and has been sealed by additional silicon filling (additional adaptation for IP-68 proofing).

Principles of the optical configuration, technique of connection to computer and working procedure with using of the **„WACO OptoConf"** program are explained in detail in the section 3.2 „Configuration of the WB169-TE module with using of optical converter".

Any changes in module's settings can be performed in **Module configuration table** that opens by click on the „Read device" button in "WACO OptoConf" program window. View of configuration table is depicted in figure 17.

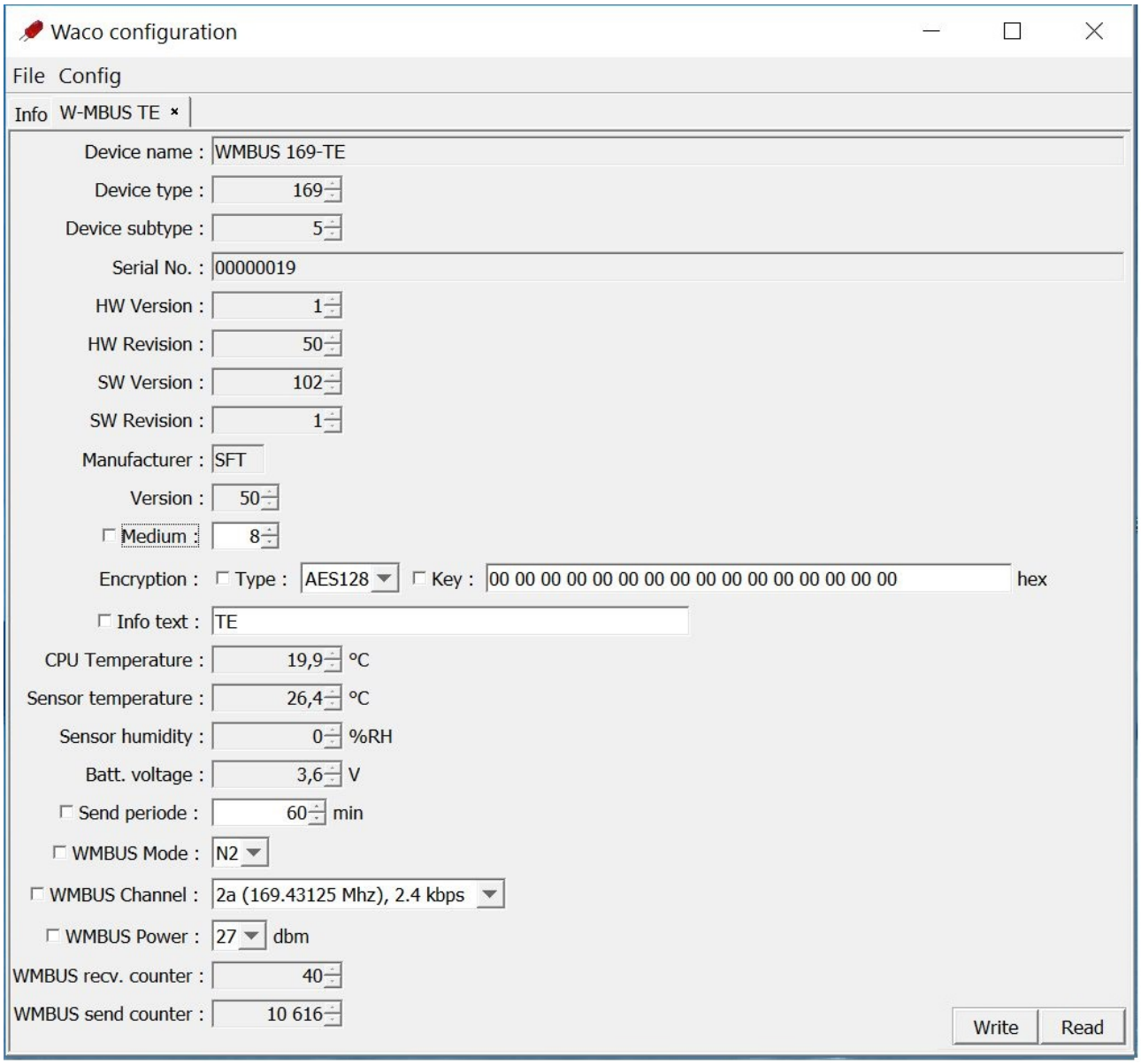


Figure 17: WB169-TE module configuration table

In the **upper section of the table** there are „read only" type of parameters (factory settings) that refer to the identification of the module and its components. There are following parameters:

Device name	*device name by manufacturer*
Device type	*device type by manufacturer*
Device subtype	*device subtype by manufacturer*
Serial No.	*device serial number (as well MBUS-ID in M-Bus address)*
HW Version	*hardware version by manufacturer*
HW Revision	*hardware revision by manufacturer*
SW Version	*software version by manufacturer*
SW Revision	*software revision by manufacturer*
Manufacturer	*MBUS Manufacturer code*
Version	*MBUS-Version in M-Bus address*

Meaning of **„Serial No."** (MBUS-ID), **„SW Version"** (MBUS Version) and **„Manufacturer"** (MBUS Manufacturer) parameters is more precisely described in section 3.5.4 **„Commands for WMBUS messages settings"**. The rest of parameters contain information about specific identification of production series and software version of the device and are intended only for manufacturer's use.

In the **middle section of the table** there is a group of commonly used configurable parameters of the WB169-TE module. There are following parameters:

Medium	*MBUS-Medium code in M-Bus address*
Encryption	*encryption key setting*
Info text	*device type information*

The **„Medium"** parameter is an international code of measured energy, water or other medium according to the M-Bus coding system. The value of the parameter is editable for the WB169-TE (it is an editable part of full meter/sensor M-Bus identification), the default value of the "Medium" parameter is 02 ("Heat Cost Allocator"). More detailed description of the variable and possibilities of its setting are explained in details in section 3.5.4 „Commands for WMBUS messages settings".

The **„Encryption"** parameter is used for entering of the encryption key for AES-128 encryption of transmitted messages. If there is "AES-128" selected in the "Type" field then the encryption key of 16 bytes length should be entered to the „Key" field (always in hexadecimal format). If there is "none" selected in the "Type" field then the encryption is switched off.

The **„Info text"** parameter is used for setting of the device name. Entered device name is thus a part of each information message (see paragraph 3.7). Default setting of this variable is „TE". More detailed description of the variable and possibilities of its setting are explained in details in section 3.5.4 „Commands for WMBUS messages settings".

In the **lower section of the table** there are current values of temperature, humidity and voltage sensors and variables for setting of transmitting parameters.

There are following parameters:

CPU Temperature	*current processor temperature (read only)*
Sensor Temperature	*current measured temperature (read only)*
Sensor humidity	*current measured humidity (read only)*
Batt. voltage	*current battery voltage (read only)*
Send periode	*setting of info-messages transmitting period*
WMBUS Mode	*setting of WMBUS communication mode*
WMBUS Channel	*setting of WMBUS RF channel*
WMBUS Power	*setting of transmitting power*
WMBUS recv. counter	*current number of received messages (read only)*
WMBUS send counter	*current number of transmitted messages (read only)*

In the non-editable fields **„CPU Temperature"**, **„Sensor Temperature"**, **„Sensor humidity"** and **„Batt. voltage"** there are displayed current values of temperature/humidity sensors, as well as values of internal sensors

of processor temperature and battery voltage. These values are transmitted in each info-message (see description of information message in section 3.7 "Structure of WB169-TE module data message").

The **„Send periode"** parameter is used for setting of broadcasting period of regular information messages. Value of the period should be set in minutes, default setting is 60 minutes. More detailed description of this variable and possibilities of its setting are explained in details in section 3.5.4 "Commands for WMBUS messages settings".

Editable variables **„WMBUS Mode"**, **„WMBUS Channel"** and **„WMBUS Power"** are used for settings of radio-frequency subsystem of the module. More detailed description of these variables and possibilities of their setting are explained in details in section 3.5.6 „Modem group commands".

The **„WMBUS Mode"** parameter can be used for selection of the module's WMBUS communication mode. Factory setting is "N1" mode, variable is entered by choosing from pre-set relevant options.

The **„WMBUS Channel"** parameter can be used for selection of the module's frequency channel. Frequency channels within particular frequency bands are defined by the M-Bus standard. Variable is entered by choosing from pre-set relevant options (there are 7 options for WB169-TE module).

The **„WMBUS Power"** parameter can be used for selection of the module's transmitting power. Factory setting is 100 mW (moderate power), variable is entered by choosing from pre-set relevant options.

In the non-editable fields **„WMBUS recv. counter"** and **„WMBUS send counter"** there are displayed current numbers of received and transmitted messages from the last reset of the module. These data can be used for module's diagnostics.

3.7 Structure of module data messages

The information message with the temperature readings and some additional information, broadcasted by WB169-TE module in regular intervals, consists of the Wireless M-BUS header and the M-Bus application layer with length of 49 Bytes.

The application layer of the message consists of the short (4 Byte) M-Bus header and a data block with ten data segments (45 Byte).

Structure of Wireless M-BUS message header of the WB169-TE module is described in the Table 3.

Table 3: Structure of Wireless M-BUS message header of the WB169-TE module

Name	Length (Byte)	Description/meaning
Length (L)	1	Message length in Byte
Type (C)	1	"Spontaneous User Data"
Manufacturer ID (M)	2	"SFT" (manufacturer code of Softlink)
Address (A)	4	M-BUS Device ID (configurable)
Version (V)	1	M-BUS Version/Generation (configurable)
Medium (T)	1	M-BUS type of medium (configurable)
Application type (Cl)	1	"Slave to Master, 4-Byte header, variable data format"

Wireless M-BUS header contains full identification of the device according to the M-Bus specification (manufacturer/medium/version/serial number) and also message type and format of content.

Short 4-Byte M-Bus header of the message application layer contains following data:

- item "Access No" that increases by one with each sent message;
- item „Status" that is normally "00", value "04" („Low Power") signalizes low battery volatge;
- item „Signature" contains encryption type and parameter ("00 00" means no encryption).

If the message has been re-transmitted (repeated), item „Signature" is modified by Wireless M-Bus repeater to "01 XX" (low bit of the first Byte changes from "0" to "1").

Data block of "OPTO" coding meter consists of 10 data segments, each of them carries data to one variable. Overview of variables, that are sent in the WB169-TE of the message can be seen in the Table 4.

* Value „No of measurements" means number of temperature measurements since last broadcasting of information message. The temperature is measured with one-minute interval. Minimum, maximum and average values are calculated from all measured values of broadcasting period.

View of WB169-TE module information message, as received and decoded by *WMBUS RFAN1*Wireless M-BUS analyzer, can be seen in the Figure 18.

Table 4: Overview of variables in the data block of WB169-TE module

textbfOrder	**Variable (description)**	**Unit**	**Type**	**Data format**
1	Device name („Info”)	Fabric. No.	Inst.	Variable (ASCII)
2	Current temperature	°C	Inst.	16 bit Integer
3	Minimum temperature	°C	Min.	16 bit Integer
4	Maximum temperature	°C	Max.	16 bit Integer
5	Average temperature	°C	Avg.	16 bit Integer
6	No of measurements *	counter	Inst.	16 bit Integer
7	Internal voltage	V (10^{-3})	Inst.	16 bit Integer
8	Transmitting power	mW	Inst.	16 bit Integer
9	Processor temperature	°C (1)	Inst.	16 bit Integer
10	”Uptime” from last reset	seconds	Inst.	32 bit Integer

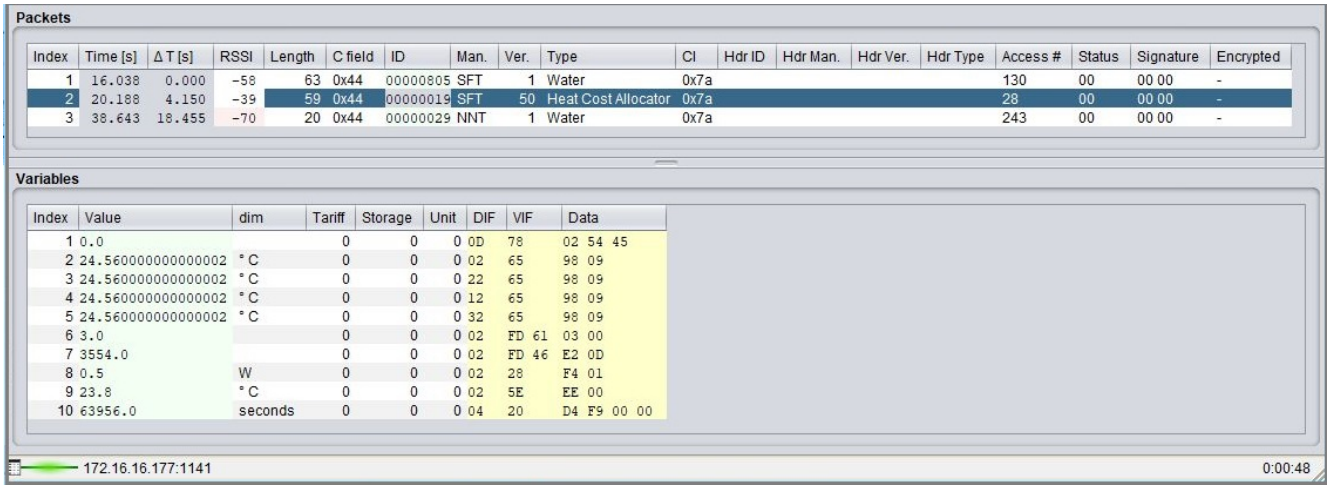


Figure 18: View of WB169-TE module info message received by *WMBUS RFAN1* analyzer

4 Operational conditions

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

4.1 General Operation Risks

The radio modules are electronic devices power-supplied by internal batteries. The modules read counters or registers of the connected consumption meters or sensors. During their operation be aware mainly of the following risks:

4.1.1 Risk of mechanical and/or electric damage

The devices are enclosed in plastic boxes, so that the electrical components are protected from the direct damage by human touch, tools or static electricity. In normal operation no special precautions are needed, besides avoiding of the mechanical damage from strong pressure or shocks.

Special attention is required for signal cables that connect the radio modules with the meters or sensors. In operation it is necessary to ensure that the cables are not stressed by mechanical tension or bending. In 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 can 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.

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. It is recommended to lead antenna and signal cables as far from 230/50 Hz power cables as possible.

4.1.2 Risk of premature battery discharge

The devices are equipped with the long duration batteries. Battery life can be influenced by these factors:

- storage and operation temperature – in high temperatures the spontaneous discharging current increases, in low temperature the battery capacity reduces;
- frequency of radio-transmitting.

Modules are delivered with preset period of regular transmitting of info-messages as stated in the configuration table in section of this document and the battery life cycle is quoted for this period. If the transmitting period is significantly reduced, battery life will be proportionally shortened.

4.1.3 Risk of damage by excessive humidity

Radio modules could be (as any other electronic devices) damaged by water, that could cause a short-circuit among some electronic elements or corrosion of the elements. Correctly assembled plastic box protects the module's printed circuit board against direct penetration of water, but the damage could be caused also by gradual penetration of humid air which can cause corrosion or other damage by condensed water inside the box.

Modules are enclosed in IP65 grade plastic boxes (proof against short-time squirted water) or with additional sealing by high-adhesion silicon filling, that can ensure proof against inundation by water (IP68 grade). Modules, that are delivered with IP68 sealing from factory are clearly assigned by IP68 degree of protection on the manufacturer's production label (e.g.: "WB169-TE/B13/IP68").

Risks of damage of the device in basic **"IP65"** design caused by penetration of excessive humidity can be eliminated by these precautions:

- install only modules that are correctly assembled, with undamaged box and undamaged rubber seal;
- in case of any doubt perform additional sealing of connection of both parts of the box and both cable bushings by silicon sealant;
- install modules only to the sites where relative humidity exceed value of 95% only occasionally;

- install modules only to the sites where they can be squirted or sprayed by water only occasionally and only for a short time;
- do not install modules to the sites where they can be dipped into the water.

Risks of damage of the device in waterproof **"IP68"** design caused by penetration of excessive humidity can be eliminated by these precautions:

- do not open the module with silicon filling without serious reason;
- if (from some reason) the module was already opened, manipulate with it very carefully or renew its silicon filling by pouring of a few milliliters of special silicon (same as original - consult the technique with manufacturer). **In case the module has been opened, there is no manufacturer's guarantee of IP68 degree of protection.**;
- install modules only to the sites where they can be dipped into the water only occasionally and only for a short time;
- do not install modules to the sites where their antenna could be submerged under water. Antenna must be installed to such place, where there is no possibility to be flooded. **Operating of the module with antenna submerged under water could cause irretrievable damage of the device!**

4.2 The condition of modules on delivery

Modules are delivered in standard cardboard boxes. The modules are commonly delivered with battery switched off. There is an exception in case the modules are delivered with additional sealing by silicon filling - in this case the modules are switched on.

4.3 Modules storage

It is strongly recommended to store the modules in dry rooms or halls, in the temperature interval (0 ÷ 30) °C. To prevent the unwanted discharging of internal battery it is recommended storing the modules with batteries disconnected and activate the battery during mounting (with exception of modules with additional sealing by silicon filling - see paragraph 4.2).

4.4 Safety precautions

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

4.5 Environmental protection and recycling

The equipment contains non-rechargeable lithium battery. It is necessary to remove battery before module disposal and dispose battery separately in compliance with the dangerous waste disposal rules. 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.

4.6 WB169-TE module installation

WB169-TE radio modules are enclosed in plastic casings with an IP65 degree of protection equipped with mounts for mounting on the wall, pipe or any other construction element. Module battery switch, configuration connector as well as antenna connector are placed on the module's printed circuit board, so that it is necessary to open the casing to access these elements.

Modules with additional silicon filling (IP68 degree of protection) are delivered with battery switched on, with completed configuration and with antenna connected before silicon filling. **It is recommended do not open the casing during operation until it is really necessary, and if so, do it very carefully**. Configuration of the modules should be performed by USB-IRDA optical converter as described in section 3.6 „Setting of parameters by using of optical „IRDA" converter"

Detail of fully assembled WB169-TE module equipped with rod antenna is shown in the figure 19 left. In the right part of the figure there is displayed the WB169-TE module in IP68 design with open casing.

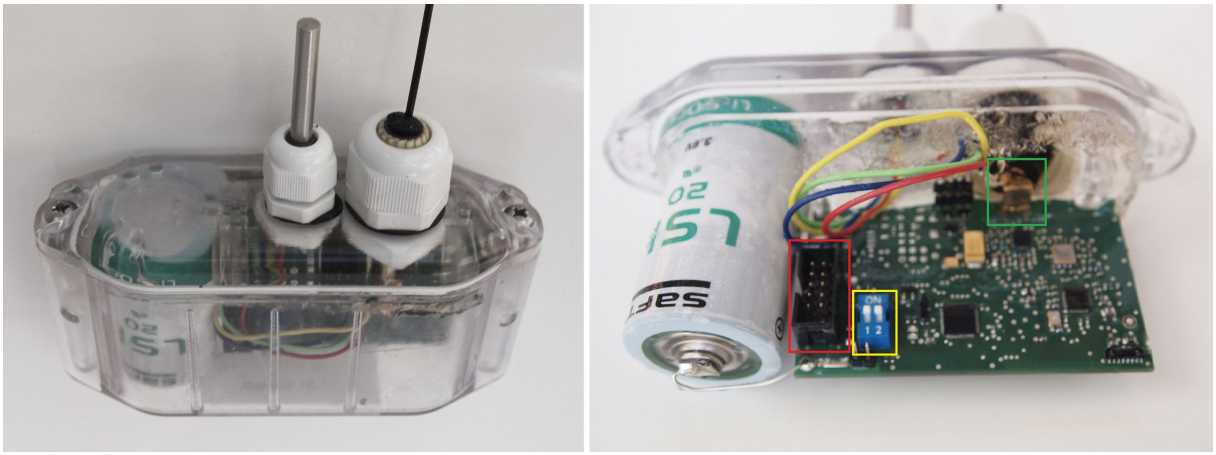


Figure 19: Detail of WB169-TE module with marked position of basic elements

In the figure 19 right there is displayed the layout of WB169-TE module elements on the printed circuit board, where there are marked its basic elements: battery switch (red colour), configuration connector (yellow colour) and antenna connector (green colour). Appearance of the module PCB could slightly vary in dependence on the module modification.

The case of WB169-TE module consists of two parts:

- module base with the printed circuit board attached. It is the where the cable bushings are placed;
- box cap that covers the printed circuit board, with mounts for attaching of the module to the wall or other construction element

When mounting the device follow these instructions:

- attach the module to a suitable firm object (wall, pipe) by two screws or by a clamping tape. There are mounts by the box sides for the attachment. The recommended position of the mounted module is in the way that the base is down, cable bushings are facing to the floor;
- unscrew the screws on the sides of the module base (right beside the cable bushings), loosen the cap of the module and slide the base out of the cap;
- pull the cables with the pulse outputs from the consumption meters through the cable bushings (**) and connect the individual conductors to the input clamps of the module. The scheme of deployment and polarity of individual clamps is glued inside on the cap of the box. Make sure that the meters are connected to the relevant inputs according to the project materials or write down the diagram of individual connections;
- connect the local antenna (stick or rod type) or an antenna cable from a remote antenna into the antenna connector (coaxial connector on the printed circuit board beside the input clamps). Pull the antenna or the antenna cable through the cable bushings that is just right opposite to the antenna connector;
- switch-on battery by switching of both of the micro-switches („jumpers") placed on the PCB beside the configuration connector into the „ON" position. Some modifications of the module could be equipped with a pair of simple shortening pins, that should be short-circuited by shortening connector;
- perform an elementary module diagnostics and alternatively go through the module configuration (setting of parameters) with using of configuration cable as described in chapter 3 „Module configuration". In case the module has been fully pre-configured in the preparatory phase of installation, at least check and set-up input/output values to ensure that the information sent in the radio-messages will be correct;
- tighten the nuts on the cable bushings to seal them and protect the cables from unwanted pulling out of the clamps;
- insert the base back into the cap and fix with screws. For the mounting in a humid environment it is recommended to apply silicone sealant on the outer perimeter of the seating edge of the base before screwing the box back together;
- if the internal rules or the mounting process needs the antifraud seal to be installed (as the protection from the unwanted influencing), stick the antifraud seal across the joint between the two parts of the box.

(*) ATTENTION! *If the module is sealed by additional silicon filling with IP68 degree of protection do not open its casing during the installation! Meter outputs can be connected to appropriate wires of the input cable (that had been connected to the module before silicon filling) and configuration could be performed by radio or by using of an optical converter USB-IRDA.*

If the module is rated in IP65 or IP68 degree of protection, this declaration is valid only under condition of the proper mounting and sealing. When assembling the modules with IP68 degree of protection that will be placed in the humid environment, it is necessary to follow these rules:

- both cable bushings must be properly sealed;
- the joint of both parts of the box must be properly sealed by original rubber sealing).

After the mounting, write down the counter values of all consumption meters connected to the module into the mounting sheet and alternatively once again check out the module's functionality and the correctness of output values (which must correspond to consumption meter mechanical counters). Test the module functionality by „end-to-end" method, that means by checking of the readings directly in the central system of remote reading.

Follow the consumption meter manufacturer's instructions for determination of the length of the connection cables between the consumption meters and the radio modules.

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 as well as protection of the device against possible mechanical damage. The radio-signal conditions can be estimated empirically on the base of previous experience, or examined by measuring of the signal strength by the reference transmitter/receiver.

4.7 Module and Meter Replacement

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

- check the antifraud seal before dismantling – the antifraud seal damage must be solved according to the internal rules of the customer/project;
- unscrew two screws on the sides of the module base (beside the cable bushings), loosen the cap of the module and slide out the base from the cap;
- disconnect the cables from the consumption meters from the input clamps, alternatively disconnect the cable of the external antenna from the antenna connector;
- by switching of both of the micro-switches („jumpers") placed on the PCB beside the configuration connector into the „OFF" position (or replacing of shortening connector from shortening pins) disconnect the module from the battery power supply;
- loosen the fixing screws (or clamping tape) that hold the module on the wall, pipe or other pad and dismantle the cap;
- put both parts of the module back together by screwing the cap together with base (*). Mark the module visibly as „defective", alternatively you can fill in the form (mounting report) about the module replacement;
- install a new module in the same way as described in paragraph 4.6 above. Pay attention to the correct connection of the input cables (must be the same inputs as they were on the original module) and set up the relevant configuration parameters, namely broadcasting period and input/output values.
- write down the serial number and seal number of the module, alternatively also actual statuses of counters of connected meters;
- if possible, arrange making of all appropriate changes in the database of the remote reading system immediately.

***(*) CAUTION!** The type label with RF-address and serial number of the module is always on the cap of the module so the base and the cap of the module must always be one whole unchangeable unit. Always pay attention to the completing of the correct cap with the correct base of the module, that is the reason why it is always necessary to replace the whole module – the base and the cap together. The correct module completion can be checked out according to the auxiliary label with the RF-address glued on the PCB (RF-address on the PCB must correspond with the RF-address on the cap of the module).*

When there is necessary to replace a consumption meter connected to the module due to the meter failure, expired metrology period or for any other reason, follow this procedure:

- check the antifraud seal before dismantling – the antifraud seal damage must be solved according to the internal rules of each customer/project;
- if the module is sealed by additional silicon filling with IP68 degree of protection do not open its casing! Disconnect replaced meter from the input cable and connect new meter to the same wires;
- if the module is in common IP-68 design, unscrew two screws on the sides of the box (beside the cable bushings), loosen the cap of the module and slide out the base from the cap;

- disconnect the cables from replaced consumption meter from the input clamps, replace the consumption meter and connect its cable back into the input clamps;
- perform setting of input/output values of the relevant input according to the instruction in the chapter 3 „Module configuration". Check out the correctness of output values (which must correspond to consumption meter mechanical counters) by checking of the readings directly in the remote reading system.
- fill in the required documentation for the meter replacement (mounting sheet), precisely write down the value of the mechanical counter of the new meter;
- cover the module and, if needed, apply the sealant according to the instructions in paragraph 4.6. Alternatively wait for the first reading and cover the module afterwards.

*(*) **CAUTION!** The new meter might require a different setting of module's input/output even if the meter is the same type and manufacturer. Conversion constants can differ from each other even in various modifications of the same type of the meter.*

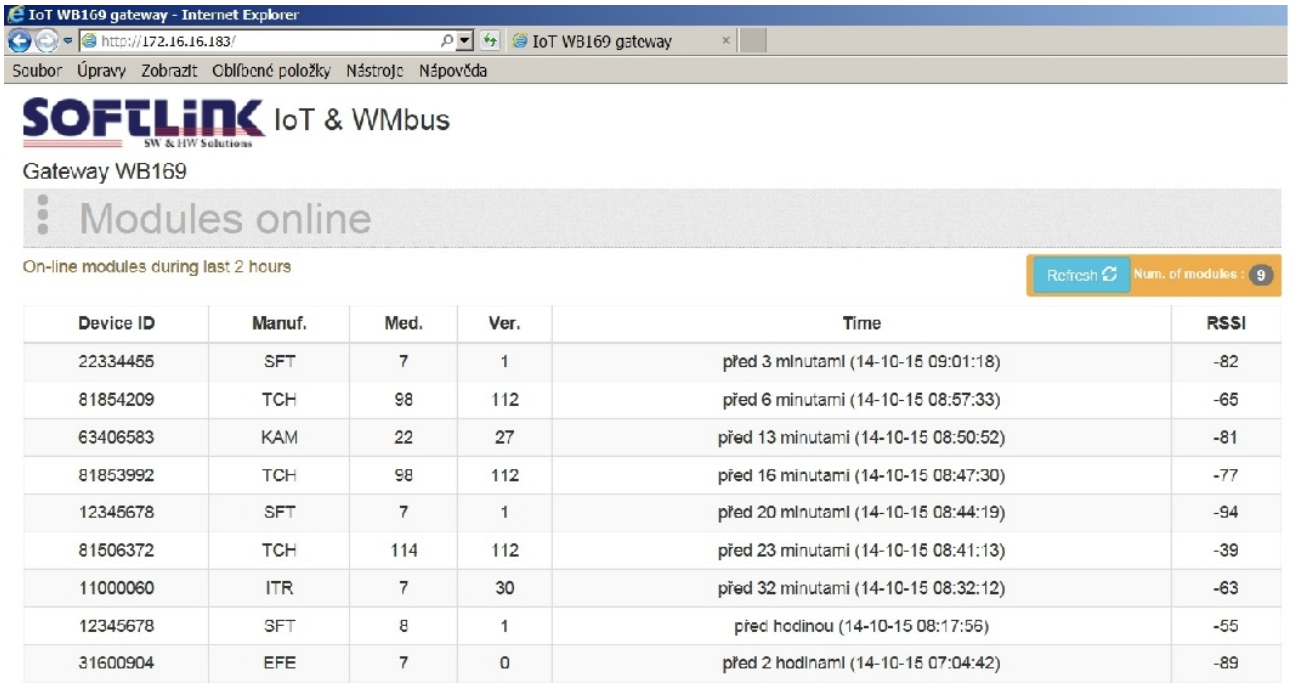
4.8 Module Dismantling

When dismantling, open the module, disconnect cables and dismantle the cap from the wall, pad or pipe. Switch the battery off and put the module parts back together (put the cap on the base of the module). After the dismantling mark the module as „dismantled" and fill in the relevant documentation, prescribed for this situation by the internal rules. If possible, arrange deactivation of the module in the database of remote reading system immediately.

4.9 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 functionality of its broadcasting with using of common „Master" receiver, testing (reference) receiver, signal analyzer or any other convenient device.

If the WB169-TE module is connected to remote data collecting system with using of WB169-RFE gateway, functionality of its broadcasting could be checked from any computer in **„Radar" mode** by presence of module's signal in the „Radar" application. Open any WEB browser in the computer and enter IP-address of the module's superior WB169-RFE gateway. URL address of the gateway should be entered in „**http://ip_adresa/**" form and search should be started after that. If an IP-connectivity between the computer and gateway is available, the website of „Radar" application opens (see figure 20), where there is a table with last reports from all devices broadcasting in the area of the gateway radio receiving (that work on the same frequency and with same communication mode).



Device ID	Manuf.	Med.	Ver.	Time	RSSI
22334455	SFT	7	1	před 3 minutami (14-10-15 09:01:18)	-82
81854209	TCH	98	112	před 6 minutami (14-10-15 08:57:33)	-65
63406583	KAM	22	27	před 13 minutami (14-10-15 08:50:52)	-81
81853992	TCH	98	112	před 16 minutami (14-10-15 08:47:30)	-77
12345678	SFT	7	1	před 20 minutami (14-10-15 08:44:19)	-94
81506372	TCH	114	112	před 23 minutami (14-10-15 08:41:13)	-39
11000060	ITR	7	30	před 32 minutami (14-10-15 08:32:12)	-63
12345678	SFT	8	1	před hodinou (14-10-15 08:17:56)	-55
31600904	EFE	7	0	před 2 hodinami (14-10-15 07:04:42)	-89

Figure 20: Example of „Radar" application table

The record of each device registered by gateway is displayed in a separate line where the following data can be seen:

- equipment identification
- receiving time of the last report from the equipment
- indication of radio signal quality of received message (RSSI = Received Signal Strength Indicator)

If the „Radar" table is displayed in a sufficiently long time since the WB169-TE module was putting into operation (or since its rebooting), the table should contain reports of temperature values measured by the module, including the evaluation of the receiving quality. The „Radar" table displays only records received during last 2 hours.

4.10 Operation of the WB169-TE module

The WB169-TE module performs broadcasting of radio messages 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 permanent breakdown of module broadcasting are commonly caused by human activities within the installation. It is mainly about the following risks:

- 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.

To prevent an unexpected breakdown, it is recommended to perform regular monitoring of all broadcasting data, i.e. readings, processor temperature and battery voltage. If some of the parameters goes beyond the common steady value, 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.

5 Troubleshooting

5.1 Possible causes of module failures

If during operation of WB169-TE module some anomaly, malfunctions or other troubles are recognized, the possible causes of the failures can be classified by following categories:

5.1.1 Power supplying failures

The module is supplied by electrical power from the long-life internal battery. Approximate battery life is specified in paragraph 1.2 „Modul usage". Battery life can be negatively influenced ba circumstances that are described in detail in paragarph 4.1.2 „Risk of premature battery discharge".

Low battery power becomes evident as irregular drop-outs of signal reception from the module, finally the radio connection with the module completely failes.

Battery is soldered into the printed circuit board of the module and the module has to be disassembled for its replacement. Battery replacement can be performed only by qualified and experienced person. Soldering of battery by unskilled person can cause irretrievable damage of the module. There are only top-quality batteries used in the wacoSystem modules, that have been carefully selected and properly tested. In case of battery replacement by user the new battery parameters should meet same technical requirements (type, capacity, voltage, current load, auto-discharging current...) as the original battery. It is strongly recommended to use for replacement same type of battery as used in production.

5.1.2 System failures

As „system failure" are considered mainly failures of module's processor, memory, internal supplying or any other failures that cause a complete breakdown of the device. If module's battery has correct voltage with no signs

of discharging and the device still does not communicate through its configuration port and does not respond to any commands and this status will not change even after module's restart (by switching off and switching on its battery),the system failure probably occur. Perform the replacement of the module according to the instructions in paragraph 4.7 and check functionality of the new module. If the new device works properly, label the original module as „defective" and fill in the appropriate documentation prescribed by internal rules for this case.

5.1.3 Transmitter and receiver failures

Transmission of RF messages is signaled by flashing of red "TX" LED on the module front panel in time the message is transmitted.

If the module is powered by correct voltage, the module communicates through the configuration port, responds to the configuration commands but the radio-messages from the module are still not received steadily, the possible reason of the trouble can be a failure of transmitting or receiving of radio signal. The typical indication of transmitting or receiving failures is state of „partial" functionality, when there are repetitive breakdowns in reception data from the module or occasional malfunctions of back channel (if implemented).

The ground of all above described troubles with communication could be unreliable radio-communication caused by one of these reasons:

- incorrect setting of transmitter parameters, mainly frequency channel, mode, or transmitting power;
- permanent or occasional blocking of radio signal caused by construction works or any construction changes within the premises, or by operation around the installation site (moving of machines, cars, etc.);
- permanent, periodical or occasional interference (jamming) of radio signal from externel source (another radio system in the same frequency band, or industrial disturbance);
- low level of transmitting power caused by wrong setting or by failure of transmitter;
- failure of receiver that causes malfunction of back channel;
- damage of antenna or antenna cable (if external antenna used).

If above described indications of unreliable radio-communication become evident, proceed with troubleshooting of the malfunctioning in following steps:

- visually check surrounding of the installation site to find out if there are any changes that can influence radio signal (e.g. new objects, things, machines...). If there are such negative circumstances, solve the trouble by reorganization of the object or by redesign of radio network;
- visually check an external antenna and antenna cable (if used), possibly replace these elements for the spare ones with proven functionality;
- check correctness of module settings, especially setting of radio parameters as described in paragraph 3.5.6 and perform the check of module overall functionality as described in paragraph 4.9;
- replace the module according to the paragraph 4.7 and perform the setting and check of overall functionality off the new module after that;
- if the module is not properly working even after its replacement for proven device and equipment, the trouble can be caused by local interference (jamming) from external source. Another possible reason could be an unsuitable setting of some configuration parameter that has not been discovered. In this case ask for your supplier, producer, or other experienced person for some form of assistance.

Appropriate level of transmitting power can be checked by comparing of its signal strength with the reference signal from another module (modules) under comparable circumstances, for example with using of signal analyzer or testing receiver placed to the suitable spot. If the signal strength is similar to the signal of reference transmitter, then the module's transmitting power is adequate, and the reason of troubles could be in insufficient signal strength on the receiving side. Attenuation of the signal can be caused by making of some change in module installation site (e.g. turning of antenna or placing of some object nearby, installation of iron bars, rack or shelfs...) or similar changes in the installation site of receiver (GateWay). This kind of troubles can be solved by redesign of the radio network in order to secure sufficient signal reception (that means changing of antenna for better type, moving of antenna or whole device etc.).

5.1.4 Sensor failures

Typical sign of temperature sensor failure is reading of incorrect temperature values. The data from the module are received regularly, but the values differ from reality or are totally senseless. In this case visually check whether there are any significant changes in the installation circumstances (e.g. relocation of the module, installation/deinstallation of a heater nearby..). If the deviation of the temperature values has no natural explanation,

check correctness of the module identification within the remote reading system (ID confusion possibility). If the module is implemented in the system correctly, then the most probable reason of the trouble is failure of the module temperature sensor. In this case replace the module according to the paragraph 4.7.

5.2 Troubleshooting procedure

To identify a reason of device failure or any anomaly in its operation follow this procedure:

1. The module communicates normally, messages are coming regularly. The temperature readings are available, but their values are incorrect (under certain circumstances, or permanently). In this case it is recommended to check functionality of temperature sensor as described in the paragraph 5.1.4 „Sensor failures".
2. Reading data are coming irregularly from the module, there are periodical drop-outs in the readings. In this case it is recommended to check functionality of the module subsystems in following order:
   - check functionality of the transmitting and receiving of the radio-signal as described in the paragraph 5.1.3 „Transmitter and receiver failures"
   - check functionality of power supplying as described in the paragraph 5.1.1 „Power supplying failures"
   - check functionality of the device that is receiving data from the module (Wireless M-BUS network local master, or gateway) according to the respective documentation.
3. No data are available from the WB169-TE module. In this case it is recommended to check functionality of the module subsystems in following order:
   - check correctness of central application configuration related to the module, especially correctness of its ID and address;
   - check functionality of power supplying as described in the paragraph 5.1.1 „Power supplying failures";
   - check functionality of the system as described in the paragraph 5.1.2 „System failures";
   - check functionality of the transmitting and receiving of the radio-signal as described in the paragraph 5.1.3 „Transmitter and receiver failures".

NOTE: WB169-TE module is a reliable device with relatively simple and resilient construction, so that any possible failure of the device is very likely caused by external circumstances, especially installation environment, mechanical damage, excessive humidity, or discharging of internal battery. After each replacement of the module caused by its failure it is recommended to check the root cause of the failure and take necessary measures to eliminate any persisting troubles.

6 Additional information

This manual is focused on description, parameters and configuration options of radio modules WB169-TE, 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, WB868 (Wireless M-BUS), WM169, WM868 (WACO) or WS868 (Sigfox) 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, WB868, WM169, WM868, WB868, WS868 series or other manufacturer's equipment for telemetry and remote reading of consumption meters, feel free to contact the manufacturer:

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