WIRELESS COMMUNICATION SYSTEM
Sigfox WS868

WS868-PLE-I

Revision 1.0

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1 Introduction

This document describes features, parameters and setting possibilities of the WS868-PLE-I module, which is used for reading of Elster BK-G series gas-meters and for radio-broadcasting of the data from the gas-meter to the superior remote reading system in form of Sigfox standard messages.

1.1 Sigfox communication network

Sigfox communication network is a global radio frequency (RF) communication system intended for collecting data from the huge number of terminal devices that transmit only a very limited amount of data. This kind of network services are commonly referred as „Internet of Things" ("IoT").

Sigfox technology (including communication protocol) is optimizing for **maximum radio range**, that enables building of country wide RF networks with a maximum cost effectivity. Unification of technology, global register of identification addresses as well as central registration and control system enable interconnection of national networks („roaming") into one global Sigfox network.

The module is designed for using in free **868 MHz frequency band** with maximum transmitting power of **25 mW** that is commonly used in European countries. Maximum reach of Sigfox services in this band for devices with maximum transmitting power in open terrain is in range of tens of kilometers. This extensive range is enabled by using of ultra-low modulation frequency (Ultra Narrow Band Modulation) where communication sub-channel bandwidth is just 100 - 600 bps (Baud). As the messages are transmitted with such extremely low speed, Sigfox message was invented as short as possible with maximum length of 26 Byte (maximum data content of 12 Byte). Optimized length of message has positive influence on the terminal device energy consumption during transmitting and receiving.

Sigfox network supports also **bi-directional communication**, if „Downlink" service for transfer of data in reverse direction is allowed, in earmarked time interval the Sigfox base station can deliver to terminal device a special downlink radio-message containing configuration commands.

National Sigfox RF network consists of number of base stations, that are connected by data channels into one central node („star" type topology). The messages from Sigfox RF network are transferred from Sigfox central network server to the application servers of authorized users through the **unified data interface** via public Internet.

1.2 Module usage

The WS868-PLE-I module can be used for remote reading of Elster BK-G series residential gas-meters that are equipped with special slot („lock") for external remote reading modules (e.g. IN-Z61) in the lower side of its counter. The module is equipped with one magnetic sensor for registration of gas-meter counter revolution and one magnetic sensor for detection of detachment from gas-meter („Tamper"). The module continuously registers revolving of gas-meter pivotal wheel into its internal counter and broadcasts info-messages with current status of gas-meter counter in form of Sigfox standard radio-messages (hereinafter „INFO-message"). The INFO-messages contain also service information about tamper status, battery voltage and processor temperature.

The INFO-messages are transferred through the Sigfox network to the central network server („Back-End"), from which there are forwarded to assigned IP-address of their addressee through the Internet. The addressee of the messages is an application server of remote reading service operator, where the messages are decoded and processed.

The WS868-PLE-I module supports **bi-directional communication** that can be used for remote setting of counter initial value and for change of broadcasting period. Required remote configuration values are delivered to the module by special radio-messages of „Downlink" service, that are assembled by „Back-End" server on the application server request and broadcasted by responsible base station.

1.3 Hardware features

The module is enclosed in plastic casing designed for mounting directly to the BK-G series gas-meter counter slot reserved for remote reading modules. The device is not suitable for using in exteriors without additional protection. The module is power supplied by internal battery with up to 10 years lifetime for frequency of 4 - 6 broadcastings per day. Battery lifetime can be negatively influenced by shorter broadcasting period, or by storing and operation in sites with the temperatures exceeding the recommended range. The module can be controlled and configured either by configuration cable, or wirelessly - by infra-red remote control with using of optical converter.

External appearance of the WS868-PLE-I module is shown in the figure 1. Position of infrared sensor for wireless configuration is marked by green arrow.

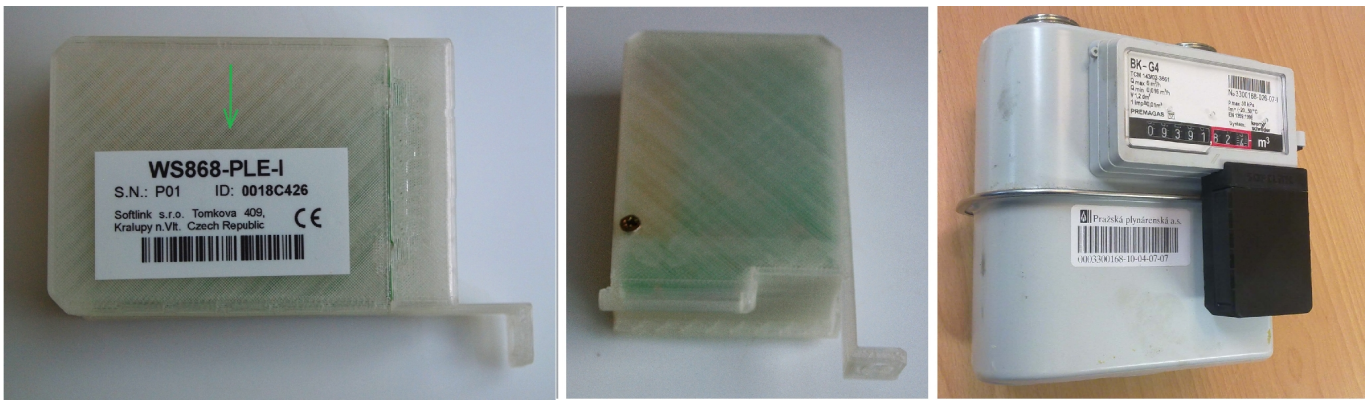

Figure 1: View of the WS868-PLE-I module

2 Technical parameters overview

Overview of WS868-PLE-I module technical parameters is shown in the Table1 below.

Table 1: Overview of WS868-PLE-I module technical parameters

RF subsystem parameters		
Frequency band	868,0 - 868,6	MHz
Modulation	DBPSK	
Sub-channel bandwidth	100	Hz
Transmitting power	15	mW
Receiver sensitivity	120	dBm
Communication protocol	Sigfox	
Transmission speed	100	Baud
Antenna	intergrated	
Configuration interface RS232		
Transmission speed	4800	Baud
Operation mode	asynchronous	
Transmission parameters	8 data bits, 1 stop bit, none parity	
Signal level	TTL/CMOS	
Optical configuration interface		
Transmission speed	115 200	Baud
Optical interface specification	IrPHY 1.4 standard	
Inputs		
Magnetic sensor of pivotal wheel revolving	index ”0”	
Mechanic „tamper” sensor	index ”1”	
Power supplying		
Lithium battery voltage	3,6	V
Lithium battery capacity	3,6	Ah
Weight and dimensions		
Length (w/o sealing protrusion)	90	mm
Width (w/o)	67	mm
Height	32	mm
Weight	cca 120	g
Storage and installation conditions		
Installation environment (by ČSN 33 2000-3)	normal AA6, AB4, A4	
Operation temperature range	(-20 ÷ 40)	°C
Storage temperature range	(0 ÷ 40)	°C
Relative humidity *	95	% (w/o condensation)
Degree of protection *	IP20	

3 Configuration of the WS868-PLE-I module

Configuration parameters of the WS868-PLE-I 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 WS868-PLE-I 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 WS868-PLE-I 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 WS868-PLE-I 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 a manufacturer's original configuration cable with „USB-CMOS" converter (see Figure 3). 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 2).

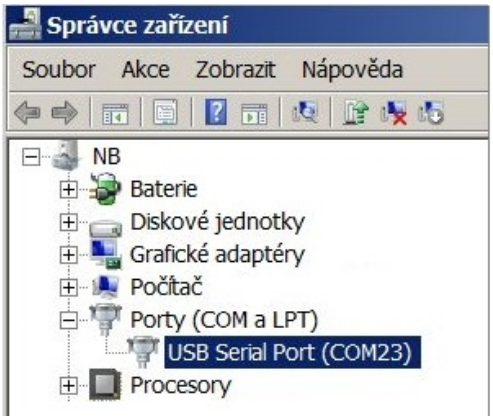

Figure 2: Appearance of the USB-CMOS converter in Windows „Device Manager"

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 WS868-PLE-I module printed circuit board as depicted in the figure 3 „Configuration via USB port of computer". Thus the computer is connected with the module and ready for performing any changes in configuration.

Figure 3: 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.

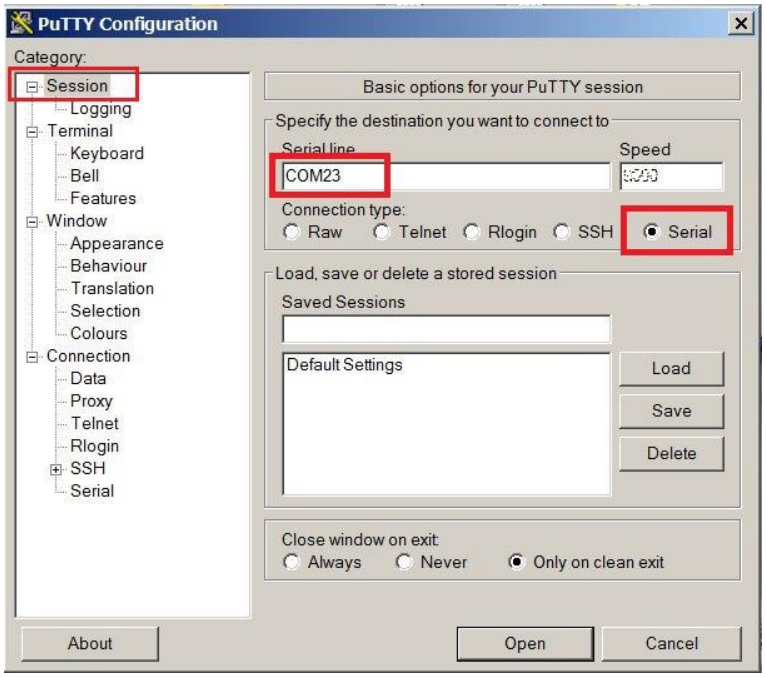

Figure 4: Terminal setting for serial line communication

„PuTTY" software runs after clicking on the downloaded file „putty.exe". There will open a window of the terminal communication (see Figure 4). 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 4800 bits/s and then enter into the „Serial line" tab the number of the serial port that the system automatically assigned to the virtual port at the moment of interconnection

module to the computer. The number of the serial port can be found in OS Windows by using of „Device Manager" (Control Panel/System and Maintenance/Device manager) by clicking on „Ports (COM a LPT)" where the numbers of ports appear (e.g. „COM23" - see figure 2).

Click on „Open" button in „PuTTY" program and open the terminal window. After pressing of „ENTER" key there will appear a command prompt **„sig50"** which announces that the module is ready to be configured (see figure 5).

Figure 5: 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 „sig50" or „mon" format (see figure 5);
- 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 6). 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

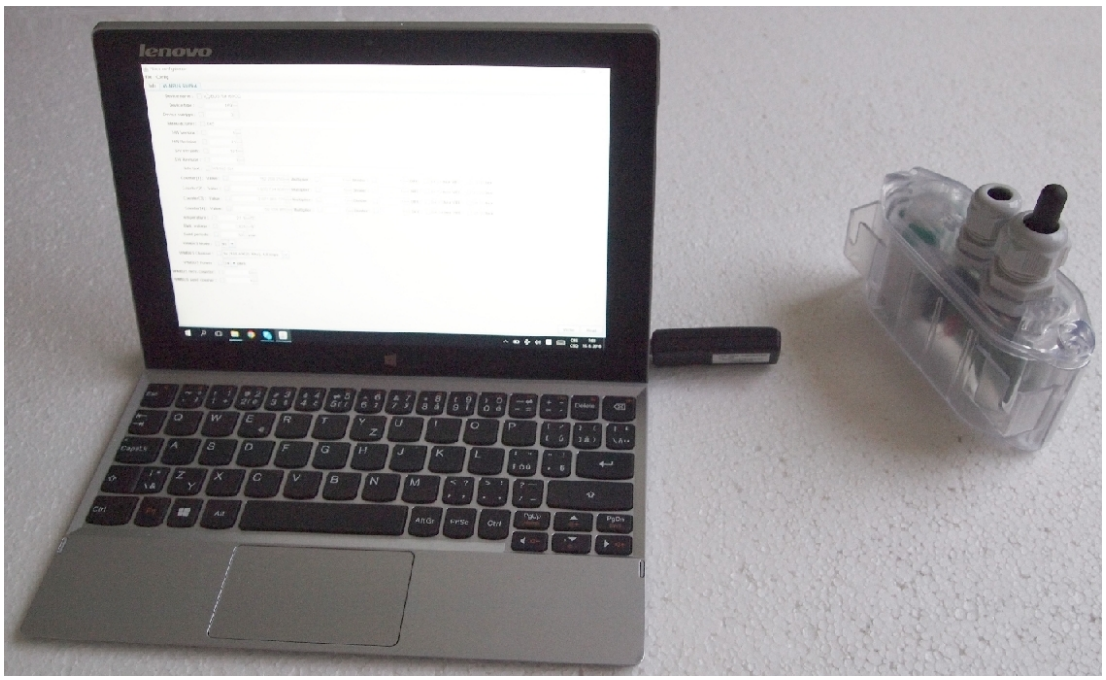

Figure 6: Configuration of the module with using of optical converter

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, 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 7).

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 8). In **Config/Port** item of menu choose name of serial port assigned to USB-IRDA converter by operating system (see figure 7). 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.

By clicking to **„Walk device"** button the list of all variables that are used for module configuration can be displayed (see figure 9.

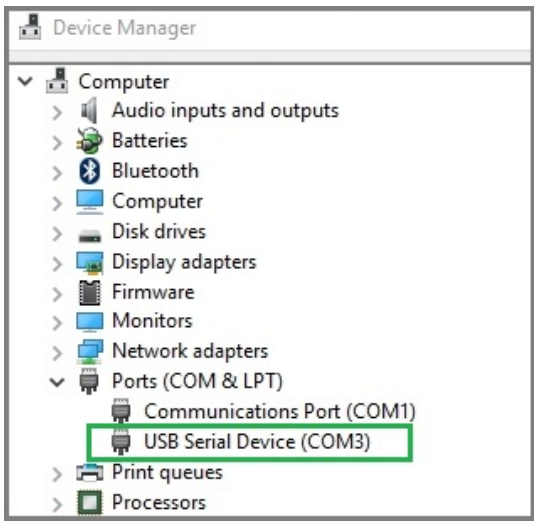

Figure 7: Displaying of the optical converter in the Windows' „Device Manager"

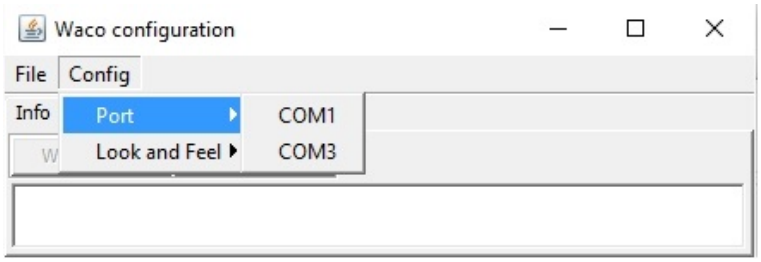

Figure 8: Displaying of „WACO OptoConf" configuration window"

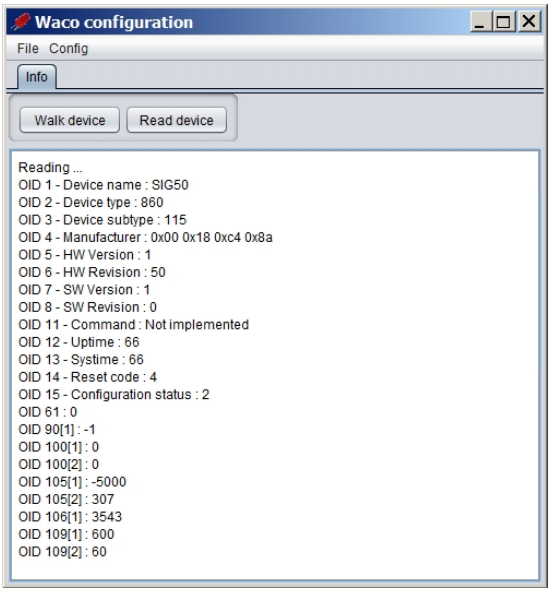

Figure 9: List of variables in the working window of „WACO OptoConf" program

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 10.

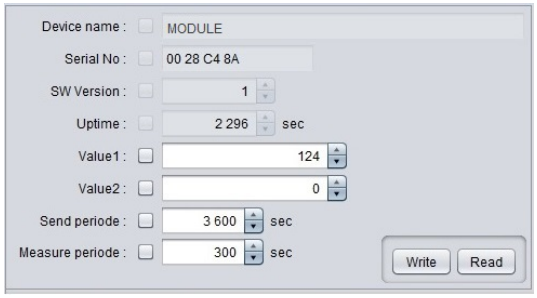

Figure 10: Example of module's configuration table in the „WACO OptoConf" window

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.

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 6). 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 1 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 WS868-PLE-I module as shown in the figure 11.

Figure 11: 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 1 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 ▵ a ▿ .

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 "√" 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 13 left).

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 13 right).

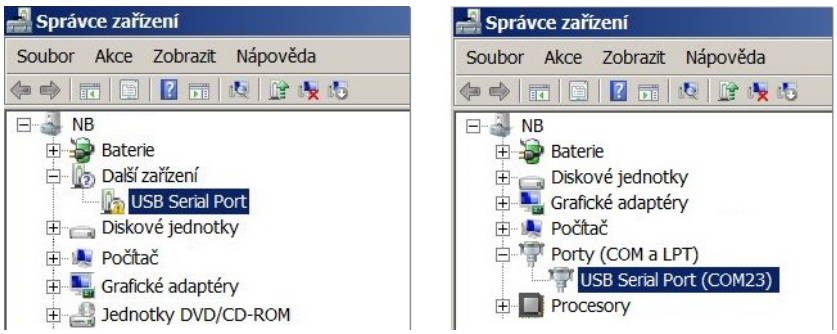

Figure 12: Appearance of converter without driver in the Windows „Device Manager" table

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 13 left).

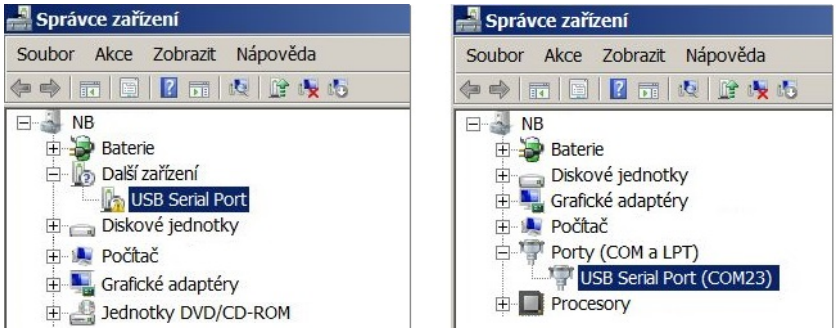

Figure 13: Displaying of the device without driver in "Device Manager" window

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 14 left). Choose „From disc" in the next „Choose driver which you want to install" window (figure 14 right).

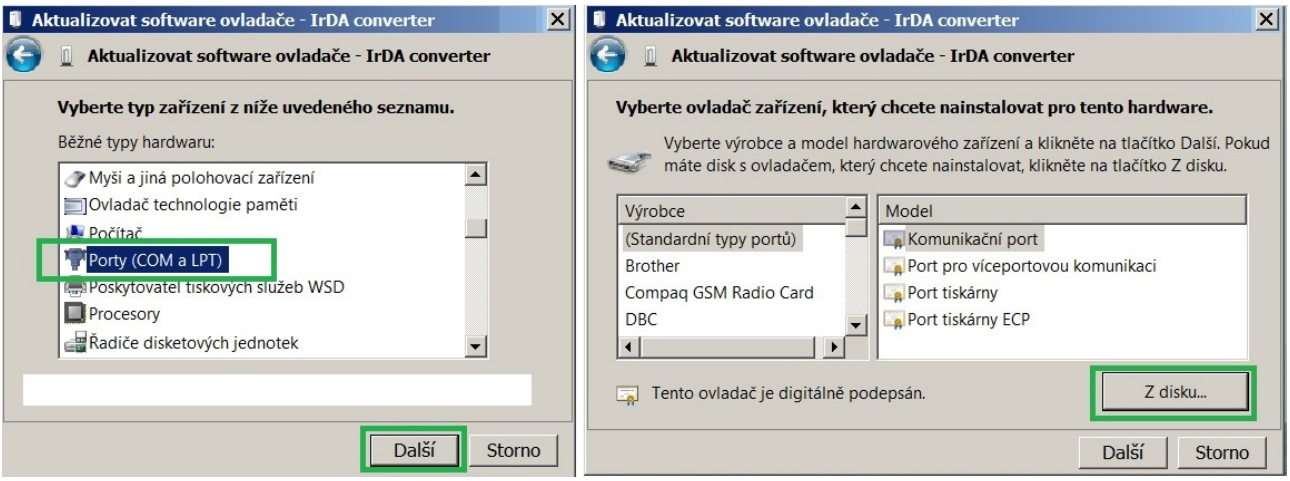

Figure 14: Manual selection of the driver file from a folder

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 15 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 15 right).

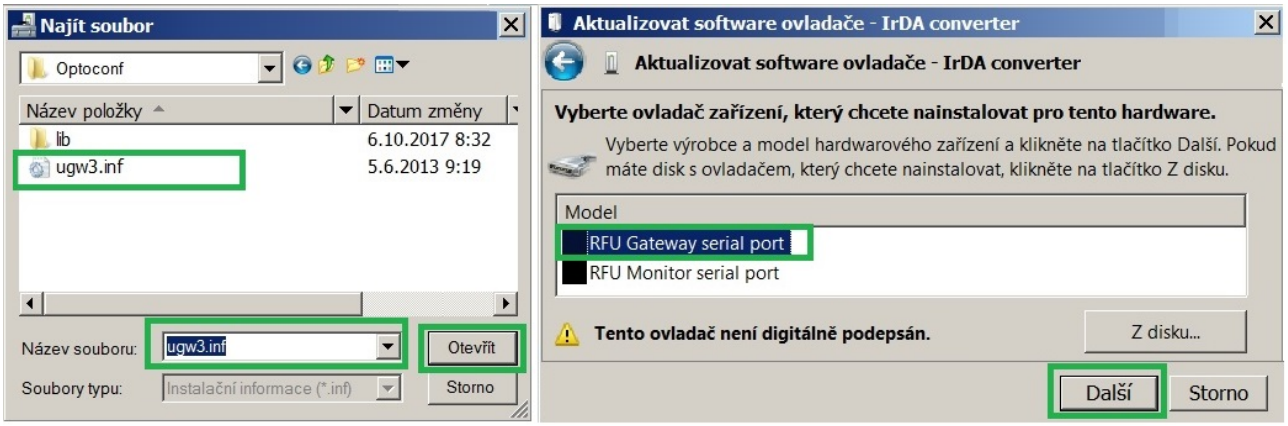

Figure 15: USB driver installation

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 13 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 WS868-PLE-I module parameters by configuration cable

In following part of the document there is a description of these parameters of the WS868-PLE-I module, that can be displayed and examined from PC connected to the module by configuration cable. Some of the parameters can be changed by configuration commands entered „from the console" as described in paragraph 3.1.

3.5.1 List of WS868-PLE-I module configuration parameters and commands

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

```
sig50>/
CONFIGURATION: OK
Mode Setup: 1
XTAL ppm: -21
sending time: 3600
measure time: 300
downlink : 0
i[0]  0 0 1 1 0
i[1]  0 0 1 1 0
Debug level: 0
sig50>
```

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

```
sig50>/?
/W - write configuration
/# - erase configuration
/x - RESET
/M - enable mode setup on startup
/!  ppm - set Xtal ppm
/s sec.  - set sending time in seconds
/m sec.  - set measure time in seconds
/d n  - n-th uplink message has downlink capability, 0 - no downlink
/i index value - set initial value
 index t number- set type
 index e 0|1 - set edge
 index m value - set multiplier
 index d value - set divisor

/D number - debug level
sig50>
```

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

The meaning of individual parameters and detailed description of their usage can be found in the following part of chapter 3.5.

3.5.2 Commands for saving of configuration parameters and reset

The module contains two sets of configurations: operating configuration and saved configuration. At the start of the system the module copies saved configuration into the operating configuration, with which continues to work. If user changes configuration parameters, it does so only in operating configuration.

Current status of storing of configuration parameters can be displayed in the list of all configuration parameters as „CONFIGURATION" item:

```
CONFIGURATION: OK
```

Information **„OK"** means, that the operating configuration is stored (it is identical with stored configuration)

Information **„NOT WRITTEN"** means, that the operating configuration is different from the configuration stored in Flash.

Configuration **can be saved** to Flash memory by using of **"/W"** command. Example:

```
sig50>/W
```

If the current operating configuration was not stored to FLASH memory, the module returns to the saved configuration after reset. If the parameter should be changed only temporarily (for example switch-on „test" function during diagnostics), it is not necessary to save operating configuration into FLASH memory (after diagnostics the function will be switched-off anyway). If the parameter should be changed permanently, there is necessary to save the configuration to FLASH memory.

Configuration can be **erased from the Flash memory** by using of **"/#"** command. Example:

```
sig50>#
```

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

The **module reset** can be performed by using of **"/x"** command. Example:

```
sig50>/x
```

After entering the command, the module goes to software restart.

3.5.3 Commands for setting of timers

This group of commands enables setting of measurement and broadcasting intervals and setting of receiving („downlink") mode. There are following commands:

/s sec	*spontaneous messages broadcasting period (sec)*
/m sec	*A/D converter measurement interval (sec)*
/d number	*setting of frequency of „downlink" activation*

The **„/s sec"** command can be used for setting of the module **broadcasting period**. The period is set in seconds and the module broadcasts its INFO-messages spontaneously with this period. Example of setting of broadcasting period to 1 hour (3600 seconds) and corresponding record in the module configuration summary:

```
sig50>/s 3600
...
sending time :  3600
```

***WARNING!**. Frequency of broadcasting in Sigfox network is under regulation. Each device working in Sigfox network has assigned its service profile that enables only limited number of broadcasted messages per day. Exceeding this limit can cause some restriction or sanction from the Sigfox service provider. When setting this parameter, check whether the setting complies with a service contract, that is valid for configured device.*

The **„/m sec"** command can be used for setting of the time interval for measurement of some operational parameters (temperature, voltage...). As the latest values of measured quantities are broadcasted in INFO-messages, measurement interval should be always shorter than broadcasting period. Example of setting of measurement interval of analogue quantities to 5 minutes (300 seconds) value and corresponding record in the module configuration summary:

```
sig50>/m 300
...
measure time :  300
```

By using of **„/d number"** command a frequency of activation of receiving („Downlink") channel can be set. The number "n" in this command determines frequency of receiving channel activation according to this principle:

- if **„0"** value is set, receiving channel is closed („Downlink" service disabled)
- if **„1"** value is set, receiving channel is opened after each INFO-message
- if **„2"** value is set, receiving channel is opened after every second INFO-message

- if **„n"** value is set, receiving channel is opened after each n-th INFO-message

Example of setting of receiving channel activation frequency to such mode, when the receiving channel opens after every fourth broadcasted message, and corresponding record in the module configuration summary:

```
sig50>/d 4
downlink:  4
```

Example: If the module broadcasts INFO messages eight times per day (sending time = 10800 second) and downlink channel will be opened after each fourth transmission, the module will be able to receiive dowlink message two times per day.

***WARNING!**. "Downlink" service of the Sigfox network is under regulation. This service is allowed only for some Sigfox service profiles and with limited frequency. When setting this parameter, check whether the setting complies with a service contract, that is valid for configured device.*

3.5.4 Commands for setting of input counters

The WS868-PLE-I module is equipped with two input pulse counters (index 0 - 1) optimized for working with specific series of gas-meters. The first sensor input is adapted for registration of gas-meter revolving, second input serves for for registration of tamper status (detection of module disconnection from the gas-meter). Each input counter can be set individually with using of following commands:

/i index value	*setting of initial value of the counter*
/i index t number	*setting of counter mode (not applicable)*
/i index e 0/1	*setting of trigger edge (not applicable)*
/i index m value	*setting of multiplier (output value = counter value * multiplier)*
/i index d value	*setting of divisor (output value = counter value / divisor)*

Important note:

*The first input (with **index "0"**), that **registers revolving** of gas-meter pivotal wheel, has factory preset counter mode and trigger edge parameters. Setting of these parameters has no relevance for this module and it is recommended not to use respective commands for their setting.*

*The second input (with **index "1"**), that **registers module disconnection from gas-meter**, has factory preset all counter parameters. Setting of these parameters has no efect for the module and it is recommended not to use respective commands for their setting.*

By using of the **„/i index value"** command setting of the **initial value** of the input counter can be performed. Initial value of the input should be entered as a natural number.

Example of setting of the first input (port "0") to the initial value „124":

```
sig50>/i0 124
sig50>
```

The **„/i index m value"** and **„/i index d value"** commands can be used for setting of multiplier and divisor constants for adjusting of output values to required output units. Default setting of both values is "1". If it is necessary to adjust the counter value by some coefficient, enter convenient combination of multiplier and divisor as shown in example below.

Multiplier setting example:

Gas-meter generates measuring pulses after each 0,01 m^3. To indicate gas consumption in 10^{-3} m^3 (litres), it is necessary to multiply counter value by "10".

Setting of multiplier to "10" value can be performed as follows:

```
sig50>/i0 m 10
sig50>
```

Setting of counter initial value to "124" and multiplier value to "10" will display in the module configuration status as follows:

```
i[0]  0 0 10 1 124
i[1]  0 0 1 1 0
```

Parameters of each input counter are displayed in one row of the statement in following order: mode - edge - multiplier - divisor - current value.

It is clear from the statement that current value of "0" input (124) will be presented in broadcast message as 1240 (litres).

Divisor setting example:

Gas-meter generates measuring pulses after each 0,1 m^3. To indicate gas consumption in m^3, it is necessary to divide counter value by "10".

Setting of divisor to "10" value can be performed as follows:

```
sig50>/i0 d 10
sig50>
```

Setting of counter initial value to "124" and divisor value to "10" will display in the module configuration status as follows:

```
i[0]  0 0 1 10 124
i[1]  0 0 1 1 0
```

It is clear from the statement, that current value of "0" input (124) will be presented in broadcast message as 12 (m^3.).

3.5.5 Commands for module activation and diagnostics

This group of commands is intended for the module initial setting during the manufacturing process, and for module diagnostics by manufacturer. **These commands are only for manufacturer use.**

There are following commands:

/M	*switching to module initialization mode "Mode setup" ((Do not use! Only for factory setting!)*
/! ppm	*enteering of "XTAL" correction constant ((Do not use! Only for factory setting!)*
/D number	*„debug" statement switch-on (Do not use! Only for factory setting!)*

WARNING *It is strongly recommended not to use these command during normal operation. Using of these commands can cause device malfunction!*

The **„T"** command (without „slash") can be used for immediate transmitting of standard INFO-message (out of scheduled time). This command can be used for example for checking of radio connection during the module installation. When using this command, it is necessary to realize that each device working in Sigfox network has assigned its service profile that enables only limited number of broadcasted messages per day. Exceeding this limit can cause some restriction or sanction from the Sigfox service provider.

3.5.6 Module current status statement

The**module current status statement** can be displayed by entering of **"i"** command (without „slash") into the command line and pressing of „ENTER" key. Following statement will appear in the terminal window:

```
sig50>i
SIG50   HW 1.50  SW: 1.0
0:54:29  1.1.1900  Reset cause=0 (0004)  Uptime=476
ID: 0018C48A
PAC: 853F16CCDC2FB9D7
temperature[1]: -500.0
temperature[2]: +32.3
humidity[1]: -1
voltage[1]: 3467
sig50>
```

In the first row there are displayed following device specifications: **manufacturer type** (Device name), **hardware version/revision** (HW version.revision) and **software version/revision** (SW vesion.revision). These specifications are factory set and cannot be changed.

In the second row there are values of module **system time** in common time format, **reset cause** of module last reset and value of module **"Uptime"**.

The **„Systime"** parameter value shows setting of module real time. System time is kept in the same format as in computer operating systems, i.e. in seconds, starting from 1.1.1970 („UNIX Epoch time"). In default status (after battery switch-on) there is zero value in the counter and it increases by one every second. As setting of this parameter is not required for any common application of the module, command for its setting is not included in the set of configuration commands.

The **„Uptime"** parameter value shows the time interval passed from the last device reset in seconds so that the exact moment of the last module reset can be recognized by this parameter. The parameter cannot be changed by user („read only" type).

The **„Reset cause"** parameter value gives an information about the last reset circumstances. Following reset codes are relevant for this type of device:

- **„0"** means „Cold start" (caused by user „RESET" command)
- **„1"** means „Warm start" (based on „suspension" cause
- **„2"** means „Watchdog reset" (reset by „watchdog" system)
- **„3"** means „Error reset" (incorrect instruction or inconsistent data)
- **„4"** means „Power reset" (caused by low power voltage)

The parameter has „read only" character and it is used mainly for the diagnostics.

In the third row there is a value of module Sigfox **ID**, that is an **unique identifier of the device** in the Sigfox global network. This ID is permanently assigned to the given module and cannot be changed.

In the fourth row there is a value of module Sigfox **"PAC" code** (Personal Authentication Code), that is an unique identifier of **assigning** of the given device to **concrete customer** - service contractor. Initial PAC-code is assigned to the module in factory and can be changed only with co-operation with Sigfox network provider (with possible change of service contractor). Initial PAC-code is written in module configuration as an information for user. Setting of this parameter has no influence on the module functionality. After possible change of service contractor, the new contractor could decide to register change of PAC-code in the module configuration or not.

In next rows there are values of **current temperature** measured by sensor (temperature [1]), **current processor temperature** (temperature [2]), **current humidity** measured by sensor (humidity[1]), and **current voltage of internal battery** (voltage [1]). As the module is not equipped by temperature/humidity sensors, the "temperature [1]" and "humidity[1]" values are random numbers with no practical meaning.

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

All parameters that is necessary to set-up during common operation can be configured by optical interface. The settings can be performed through the translucent casing without necessity to open the module's cover. This is the significant advantage especially if the module is already mounted to gas-meter and sealed by antifraud seal, because it is not possible to remove cover without breaking seal.

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 WS868-PLE-I 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 16.

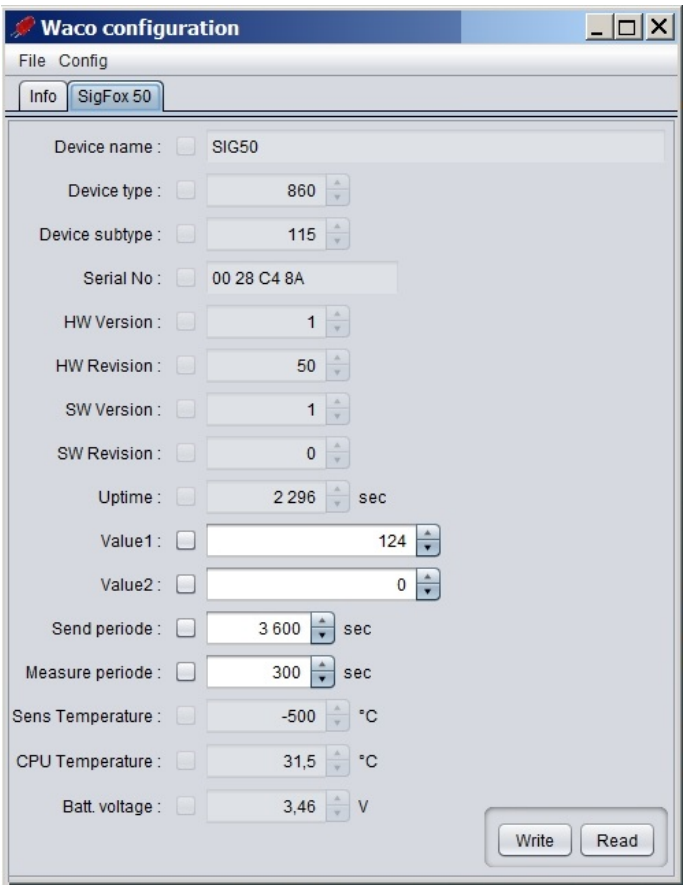

Figure 16: The WS868-PLE-I module configuration table

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*
Uptime	*elapsed time from last reset in seconds*

All the parameters (except „Uptime") contain information about device identification, series and hardware/software version 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 WS868-PLE-I module. There are following parameters:

Value1	*setting of initial value of the first port counter (index "0")*
Value2	*setting of initial value of the second port counter (index "1")*
Send periode	*setting of broadcasting period*
Measure periode	*setting of A/D measurement interval*

The **„Value1"** parameter is used for setting of the initial (or current) value of internal counter for registration of gas-meter revolving. After this setting the initial value increases by one unit with each turn of gas-meter mechanical counter.

The **„Value2"** parameter is used for registration of tamper status. Current value of this variable (0/1) shows, whether the tamper reed-contact is connected or released. Setting of this value has no practical meaning.

The **„Send periode"** parameter is used for setting of broadcasting period of regular information messages. Value of the period should be set in seconds. More detailed description of this parameter and its setting can be found in paragraph 3.5.3 „Commands for setting of timers".

WARNING!. *Frequency of broadcasting in Sigfox network is under regulation. Each device working in Sigfox network has assigned its service profile that enables only limited number of broadcasted messages per day. Exceeding this limit can cause some restriction or sanction from the Sigfox service provider. When setting this parameter, check whether the setting complies with a service contract, that is valid for configured device.*

The **„Measure periode"** parameter is used for setting of analog quantities (temperature, voltage..) measurement interval in seconds. More detailed description of this variable and possibilities of its setting are explained in details in paragraph 3.5.3 „Commands for setting of timers".

Setting of „Value1" and „Send periode" variable can be performed by editing (rewriting) of current value to required number and clicking to „Write" button. The process can be observed by flashing of green LED on the converter and yellow LED on the module. After each writing of new values „WACO OptoConf" program automatically re-read actual data from the module, so that if required values will display in the configuration window at the end (after yellow LED on the module ceases flashing), the process was completed successfully.

In the **lower section of the table** there are current values of external and internal sensors (temperature, voltage...). There are following parameters:

Sens. Temperature	*current sensor temperature (not applicable)*
CPU Temperature	*current processor temperature (read only)*
Batt. voltage	*current battery voltage (read only)*

In the non-editable fields **„Sens. Temperature"**, **„CPU Temperature"** and **„Batt. voltage"** there are displayed current values of module sensor temperature (not used), processor temperature and battery voltage. CPU temperature and battery voltage values are transmitted in each info-message (see description of information message in section 3.7 „Structure of WS868-PLE-I module data message").

3.6.1 Overview of module configuration parameters

Overview of configuration parameters that can be used for user settings of the WS868-PLE-I module is shown in the Table 2 below. The parameters are presented in the same order as they appear in the List of all configuration parameters (see paragraph 3.5.1).

In the **„Type"** column there is a data type of the parameter. In the **„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 set in reliance on the specific usage
- red colour - parameters that are not recommended to change
- grey colour - values that cannot be changed („read only")

Table 2: Overview of WS868-PLE-I module configuration parameters

Item	Name	Type	Description	Default.
1	Config.	text	Configuration status	read only
2	Mode Setup	0/1	Module initialization status	read only
3	XTAL	number	RF subsystem correction constant	
4	Sending Time	number	Broadcasting period in seconds	3600
5	Measure time	number	A/D measurement interval	300
6	Downlink	number	Downlink activation frequency	0
7	Value	number	Internal counter value	0
8	Mode	number	Internal counter mode	0
9	Edge	0/1	Internal counter trigger edge	0
10	Multiplier	number	Internal counter multiplier	1
11	Divider	number	Internal counter divisor	1
12	Debug level	number	Debug level	0

3.7 Structure of module data messages

The WS868-PLE-I module is intended for reading of data from Elster gas-meters of BK-G series and broadcasting of measured data through the Sigfox RF network. Maximum length of standardized Sigfox INFO-messages is 26 Byte, maximum length of data payload is 12 Byte.

The INFO-message broadcasted by WS868-PLE-I module is 26 Byte long and contains 12 Byte long payload with following information:

P.č.	Byte	Format	Description
1	0 ÷ 3	32-bit integer, LSB first	current status of counter 1
2	4 ÷ 7	32-bit integer, LSB first	current status of counter 2
3	8 ÷ 9	16-bit integer LSB first	temperature in tenth of Celsius
4	10	8-bit unsigned integer	voltage battery in mV / 20
5	11	8-bit signed integer	relative humidity in per-cent (0 - 100)

„Counter 1" value represents current status of gas-meter input counter.

„Counter 2" value represents current status of tamper (0=not mounted, 1=mounted).

„Temperature" value represents current status of module processor temperature. It indirectly indicates ambient temperature in installation site.

„Voltage" value represents current status of module battery voltage. It indirectly indicates status of batery lifetime. The value is indicated in „mV/20" units, what means that to get the real voltage value in mV, indicated value must be multiplied by 20.

*Example: If there is a "181" value in the message, real value of battery voltage is: 181 * 20 = 3620 mV.*

„Humidity" value represent status of humidity sensor. As this model of device is not equipped with humidity sensor, „humidity" value has no practical meaning.

4 Operational conditions

This section of the document describes basic recommendations for transportation, storing, installation and operation of WS868-PLE-I radio modules.

4.1 General Operation Risks

The radio modules are electronic devices power-supplied by internal batteries that register rotation of gas-meter into the internal counter and broadcast radio-messages with actual gas-meter status.

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.

The device is intended for using in normal internal environment. The device is designed for mounting directly to the mechanical counter slot of the gas-meter reserved for remote reading modules. In normal operation no special precautions are needed, besides avoiding of the mechanical damage from strong pressure or shocks and protection against excessive humidity.

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.

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 broadcasting.

4.2 The condition of modules on delivery

Modules are delivered in standard cardboard boxes. The modules are commonly delivered in fully operating status with battery switched on and completed registration in Sigfox Network. For saving battery energy reasons the long transmitting period (e.g. 1 day) is pre-set in the factory.

4.3 Modules storage

As the modules are already registered in the Sigfox Network on delivery and the subscription period is already passing, it is strongly recommended to store modules only as short time as necessary. If necessary, store the modules in dry rooms or halls, in the temperature interval $(0 \div 30)$ °C. To prevent the unwanted discharging of internal battery it is recommended to keep the long transmitting period configured until the module's installation.

IMPORTANT WARNING *Sigfox Network services are charged on the base of prepaid subscription, when each individual device can be operated only until the end of subscription period and then it is automatically deactivated. Operation of the module is the most economical in case the module was put into operation immediately after delivery and it is kept in operation for all the subscription period.*

4.4 Safety precautions

Warning! Mechanical and electrical installation of the WS868-PLE-I 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 WS868-PLE-I module installation

WS868-PLE-I radio modules are enclosed in plastic casings with IP20 degree of protection. The case consists of two parts:

- back cover with printed circuit board („base")
- front lid with production tag

Both parts are screwed together and there is no reason to dismantle the casing during normal operation. View of assembled module and view of module printed circuit board are displayed in the figure 17. View of WS868-PLE-I module mounted to gas-meter is displayed in the figure 1.

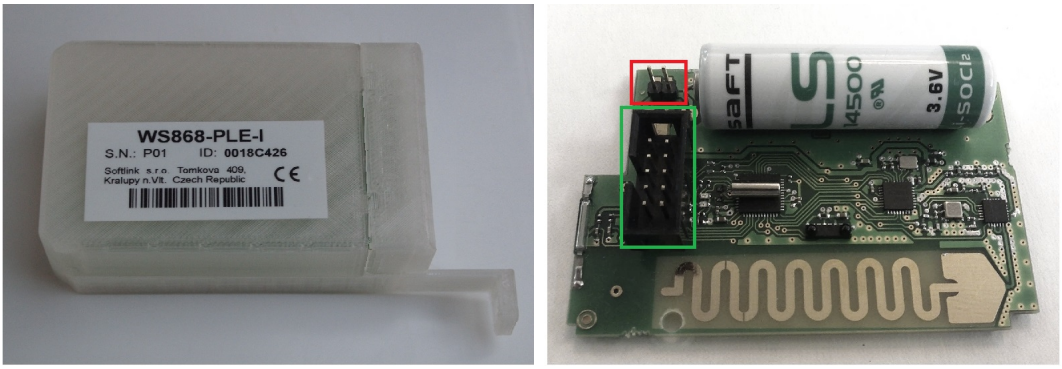

Figure 17: Detailed view of WS868-PLE-I module

The module is delivered fully assembled and activated in the Sigfox network. When mounting the device follow these instructions:

1. If the battery was already switched on in preliminary phase of installation, the module was already pre-configured and there is a possibility to perform setting of initial counter value by optical converter, it is not necessary to open the casing before installation. In this case perform the module setting and installation this way:
   - insert the module into the slot under gas-meter counter. L-shaped sealing protrusion should be oriented to the right and must fit in the protrusion on the right side of the counter. Short plastic protrusion on the upper left side of the module should be locked inside the gas-meter lock;
   - connect module sealing protrusion with matching protrusion on the gas-meter by sealing screw or sealing wire (or other prescribed way) and seal the connection by antifraud seal;
   - check setting of broadcasting period and set initial counter value by using of optical converter as described in paragraph 3.6.

2. if the battery was not switched on yet, proceed in module setting and installation this way:
   - unscrew a screw on the module back cover and remove front lid;
   - switch-on battery by putting of shortening connector onto shortening pins. The pins are placed on the PCB beside the battery lead (in the figure 17 marked by red rectangle);
   - connect the cable of USB-CMOS converter to the module configuration connector (in the figure 17 marked by green rectangle) and perform setting of module as described in section 3 „Module configuration". Alternatively, the configuration can be performed after mounting to gas-meter by using of optical converter (see paragraph 3.6).
   - save the configuration;
   - place front lid to the module base (the locks on the lid should be fastened in the base) and affix it by screw. The module should be assembled before mounting to gas-meter;
   - insert the assembled module into the slot under gas-meter counter. L-shaped sealing protrusion should be oriented to the right and must fit in the protrusion on the right side of the counter. Short plastic protrusion on the upper left side of the module should be locked inside the gas-meter lock;
   - connect module sealing protrusion with matching protrusion on the gas-meter by sealing screw or sealing wire (or other prescribed way) and seal the connection by antifraud seal;

All manipulation with the WS868-PLE-I module during installation is in principle the same, as handling with any other type of authorized remote reading module for Elster BK-G series gas-meter (e.g. IN-Z61). View of WS868-PLE-I module installed to gas-meter is displayed in the figure 1.

After module installation make sure the right module is mounted to right gas-meter and fill in the prescribed documentation.

4.7 Module 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;
- remove connecting element (screw, wire...) between the module sealing protrusion and matching protrusion on the gas-meter;
- cautiously pull the module out of gas-meter slot;
- unscrew a screw on the module back cover and remove front lid;
- switch-off battery by removing of shortening connector from shortening pins and mark the module visibly as „defective". Alternatively, just mark the module as defective, it can be opened and switched off later in the workshop;
- prepare a new module in the same way as described in paragraph 4.6 above. Switch on battery, perform diagnostics and setting as described in pargraph 4.9 „Functional check of the module". Especially check and set counter initial value as descrobed in paragraph **??** „Commands for setting of input counters" and broadcasting period as described in paragraph 3.5.3 „Commands for setting of timers". Alternatively, alls these settings (excepting „downlink" mode) can be performed via optical converter after mounting to gas-meter;
- place front lid to the module base and affix it by screw. Mount the assembled module onto the gas-meter and seal by antifraud seal;
- write down the new module ID, gas-meter counter status and seal number. Fill in the prescribed service documentation. If possible, arrange making of all appropriate changes in the database of the remote reading system immediately.

4.8 Module dismantle

When dismantling from gas-meter, remove sealing connection and detach the module from gas-meter. Remove front lid from the base and switch the battery off (alternatively, this could be done later in the workshop). 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. Take off an external antenna (if used).

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 its basic functionality:

- before installation check setting of module and examine availability of Sigfox network radio-signal by sending of several messages with using of "T" command as described in paragraph 3.5.5 „Commands for module activation and diagnostics" and receiving them in the central system. Alternatively, examination of the network signal can be performed by using of Sigfox signal tester;
- after installation to the gas-meter check correctness of reading system by repetitive inspection of counter current value ("Value1") by using of optical converter. If there is a real gas consumption in progress, counter value should change in correspondence with changing of mechanical counter value. Values of physical quantities (temperature, voltage..) should correspond with reality;
- check setting of broadcasting period;
- perform complex (end-to-end) check of implementation of the module into the remote reading system by inspection of data rendered by module in reading system database. If the module broadcasting period is quite long, set shorter period for testing. **After testing don't forget to set correct value of broadcasting period (in accordance with service contract!**.

4.10 Operation of the WS868-PLE-I module

The WS868-PLE-I module performs reading of gas-meter and broadcasting of radio messages fully automatically. The greatest risks of permanent breakdown of module broadcasting are commonly caused by human activities within the installation site, especially mechanical damage of the module, excessive humidity or water inundation, or shading the RF signal by metallic object due to building operations.

To prevent an unexpected breakdown, it is recommended to perform regular monitoring of 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 or perform the physical check on the installation site.

The risk of **premature battery discharge** could be eliminated by respecting the instructions described in paragraph 4.1.2.

5 Troubleshooting

5.1 Possible causes of module failures

If during operation of WS868-PLE-I 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 1.3 „Hardware features". Battery life can be negatively influenced by circumstances that are described in detail in paragraph 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 fails.

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 voltage is correct, 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 Reading system failures

Reading system failures typically appear as „zero consumption" of the gas-meter even though the consumption of the meter is evident, or generally, meter status from remote reading is considerably different than meter status shown in meter's mechanical counter. In this case try to proceed with troubleshooting in following steps:

- visually check whether the module is correctly mounted to gas-meter and whether there are any signs of gas-meter or module damage;
- if the module is correctly mounted to appropriate gas-meter type and there are no signs of damage or unauthorized manipulation, dismantle module from gas-meter and visually check the module and gas-meter again. If everything looks well, without any signs of damage, replace the module according to the paragraph 4.7;
- if the new module (after replacement) does not work properly as well, the trouble is probably caused by defective gas-meter.

5.1.4 Transmitter and receiver failures

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 with frequent breakdowns in the receiving data from the module.

All above described troubles could have on common ground, which is unreliability of radio-communication caused by one of these reasons:

- weak radio-signal of Sigfox network in installation site. RF signal availability can be influenced by weather conditions (rain, fog..), or by some changes in the transmitting or receiving side (around module installation site as well as around Sigfox base station).
- permanent or occasional shading 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 external source (another radio system in the same frequency band, or industrial disturbance);
- low level of transmitting signal caused by transmitter failure;
- low level of receiving signal caused by receiver failure;
- low level of transmitting and receiving signal caused by 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 relocation of the module or its antenna (if external antenna used);
- 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 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 of the new module as described in paragraph 4.9 after that;
- if the module is not properly working even after its replacement for proven device and equipment, the trouble can be caused by weak signal of Sigfox network or interference (jamming) from external source in the installation site. In this case consult actual status of Sigfox coverage and its future development with your Sigfox network provider.

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, gas-meter readings are available, but the data are apparently incorrect. 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 gas-meter, especially correctness of its ID, and correctness of initial value, multiplier and divisor;
   - check functionality of gas-meter revolving registration system (module input system) as described in paragraph 5.1.3 „Reading system failures".

2. Data from the module are coming irregularly, with periodical breakdowns. In this case it is recommended to check functionality of the module subsystems in following order:
   - check functionality of transmitting as described in the paragraph 5.1.4 „Transmitter and receiver failures".
   - check functionality of internal battery as described in the paragraph 5.1.1 „Power supplying failures";

3. No data are available from the WS868-PLE-I module. In this case it is recommended to check functionality of the module subsystems in following order:
   - check correctness of setting of the module in the central system database;
   - 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 transmitting as described in the paragraph 5.1.4 „Transmitter and receiver failures".

NOTE: WS868-PLE-I 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 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 WS868-PLE-I RF-modules, designed for operation in Sigfox IoT network in868 MHz frequency band, that are a part of the Softlink's **wacoSystem** product family. More information about all WS868 (Sigfox), WM868 (WACO), or WB169 (Wireless M-BUS) series of 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 WS868, WM868, WB169 series or other manufacturer's equipment for telemetry and remote reading of consumption meters, feel free to contact manufacturer:

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