



WIRELESS COMMUNICATION SYSTEM

Sigfox WS868

WS868-Srmt

Revision 1.0

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1 Introduction

This document describes features, parameters and setting possibilities of the WS868-Srmt module, which is used for reading of either consumption meters with pulse output (water meters, electrometers, gas-meters...), or two-state sensors (e.g. door contacts, flood detectors, fire detectors, electronic seals...etc.) and for radio-broadcasting of the data from connected meters/sensors 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-Srmt module can be used either for remote reading of one or two consumption meters with pulse output, or for monitoring of up to two two-state sensors. It is possible to combine both type of usage.

When using for **remote reading of consumption meters** (water meters, gas meters, electro-meters...), up to two meters with standard pulse („SI”) output can be connected to the module. The meters can be of different kind, with different quantities and units and with different conversion rates. The module continuously registers incoming pulses (generated by meters) into its internal counters, with using of preconfigured multipliers/divisors converts current status of each counter into the required output value and broadcasts info-messages with current statuses of connected meters as Sigfox standard radio-messages (hereinafter „INFO-message”).

When using for **remote monitoring of sensor statuses** (door contacts, flood detectors, fire detectors, electronic seals...), up to two two-state sensors with „off/on” („0/1”) outputs can be connected to the module. The sensors can be of different kind, with different type of output and different logic of signaling. The module continuously monitors status of each sensor, records all its changes. and transmits information about the sensor status in INFO-messages.

INFO-messages with current statuses of meters/sensors contain also service information about battery voltage and processor temperature. These 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-Srmt module supports **bi-directional communication** that can be used for remote setting of initial values of input counters 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 humidity-proof plastic casing with IP65 degree of protection and can be used in interiors as well as in exteriors. The casing is designed for mounting on the wall or other construction element (beam, pipe...). Module can be treated with an additional sealing by high-adhesion silicon filling, that can ensure proof against inundation by water (IP68 grade). If this treatment is required from the manufacturer, it must be ordered separately.

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 wireless - by infra-red remote control with using of optical converter.

External appearance of the WS868-Srmt 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-Srmt module

2 Technical parameters overview

Overview of WS868-Srmt module technical parameters is shown in the Table 1 below.

Table 1: Overview of WS868-Srmt 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 connector	SMA female	
Antenna characteristic impedance	50	Ω
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	
Pulse/sensor inputs		
Resistance of released contact	more than 10	M Ω
Resistance of short-circuited contact	less than 10	k Ω
Maximum input voltage	0,25	V
Maximum frequency of input pulses	300	Hz
Minimum pulse length	20	ms
Power supplying		
Lithium battery voltage	3,6	V
Lithium battery capacity	3,6	Ah
Weight and dimensions		
Length	145	mm
Width	45	mm
Height	100	mm
Weight	cca 300	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 *	IP65 or IP68	

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

3 Configuration of the WS868-Srmt module

Configuration parameters of the WS868-Srmt 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-Srmt 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-Srmt 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-Srmt 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).

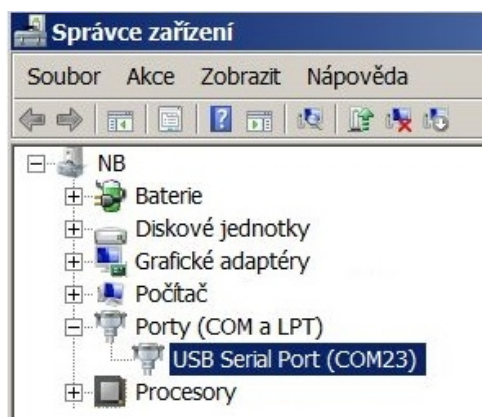


Figure 2: Appearance of the USB-CMOS converter in Windows „Device Manager”

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-Srmt 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.

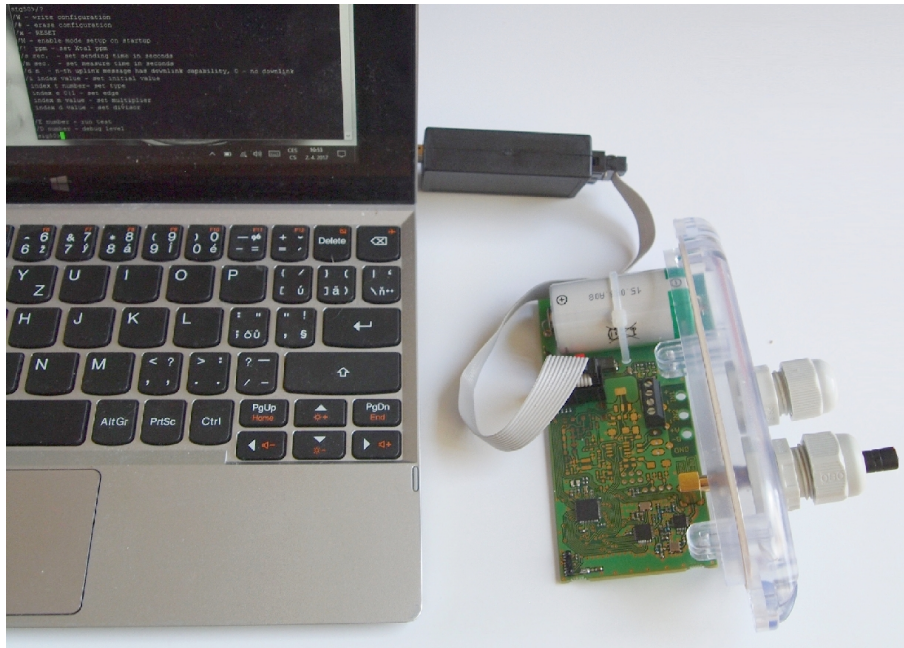


Figure 3: Configuration via USB port of computer

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.

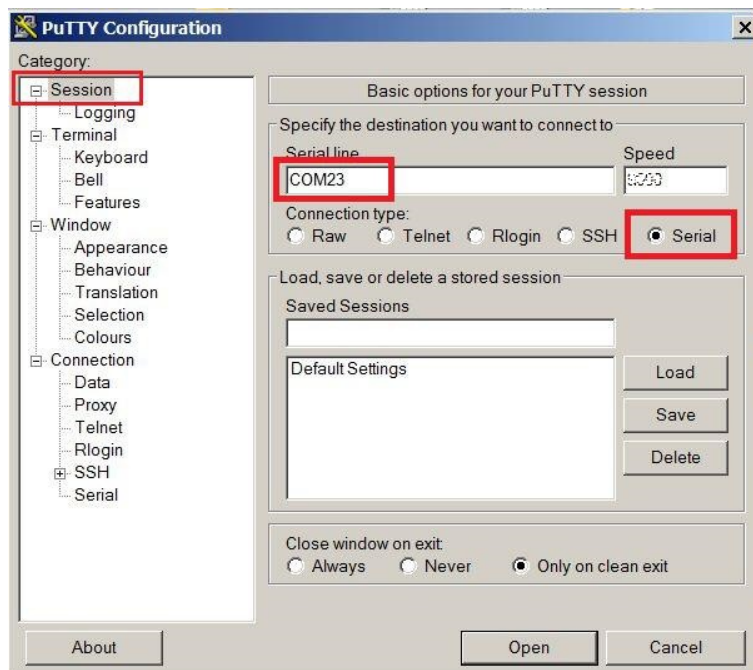


Figure 4: Terminal setting for serial line communication

„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

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).

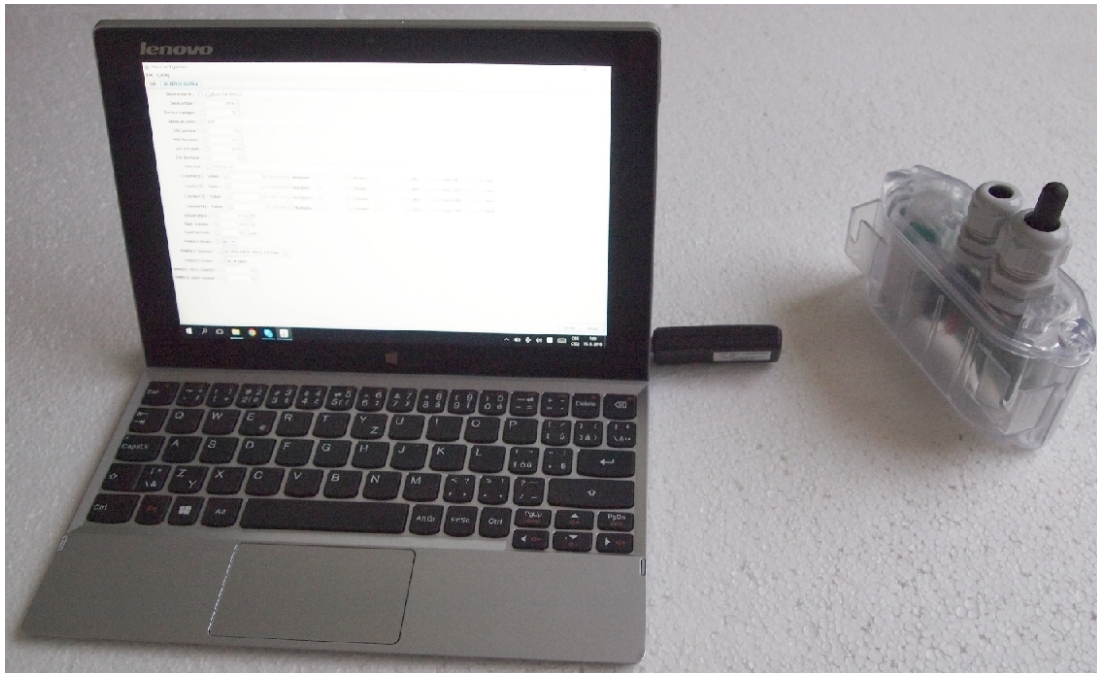


Figure 6: Configuration of the module with using of optical converter

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. In 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).

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](#).

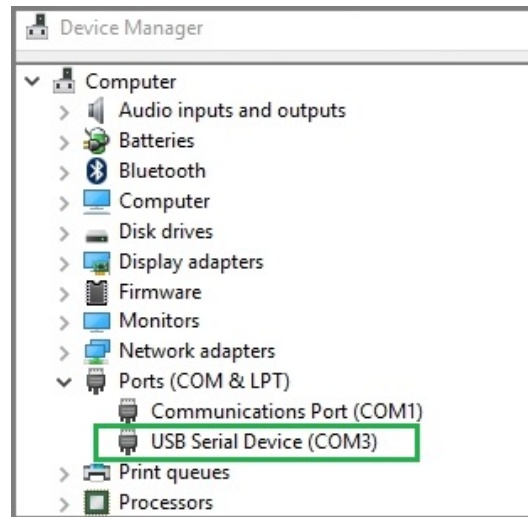


Figure 7: Displaying of the optical converter in the Windows' „Device Manager”

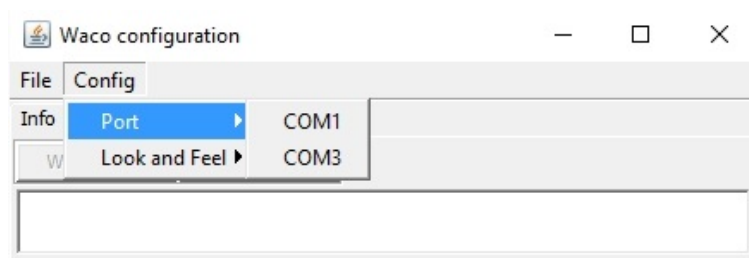


Figure 8: Displaying of „WACO OptoConf” configuration window”

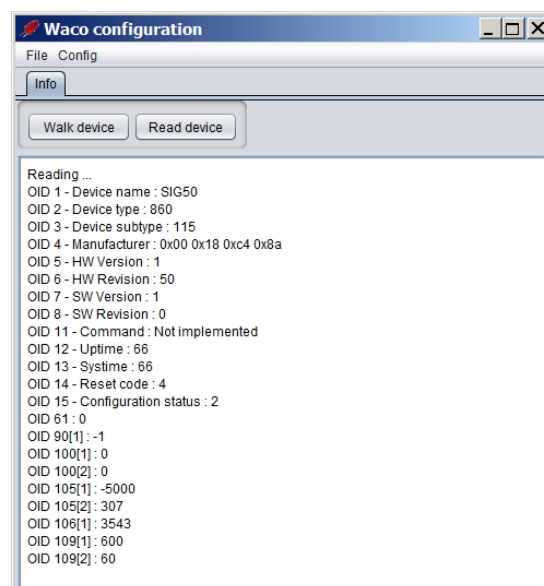


Figure 9: List of variables in the working window of „WACO OptoConf” program

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.

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”)

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

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-Srmt 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 Δ 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 signaled 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).

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

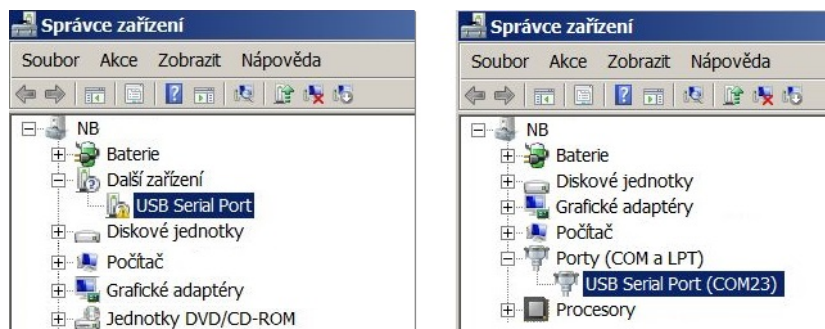


Figure 12: Appearance of converter without driver in the Windows „Device Manager” table

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).

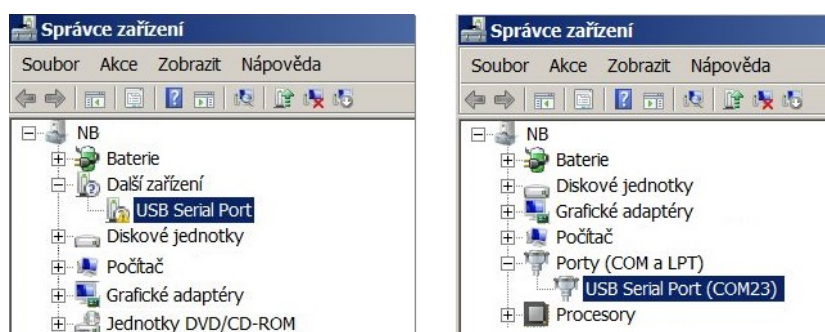


Figure 13: Displaying of the device without driver in "Device Manager" window

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).

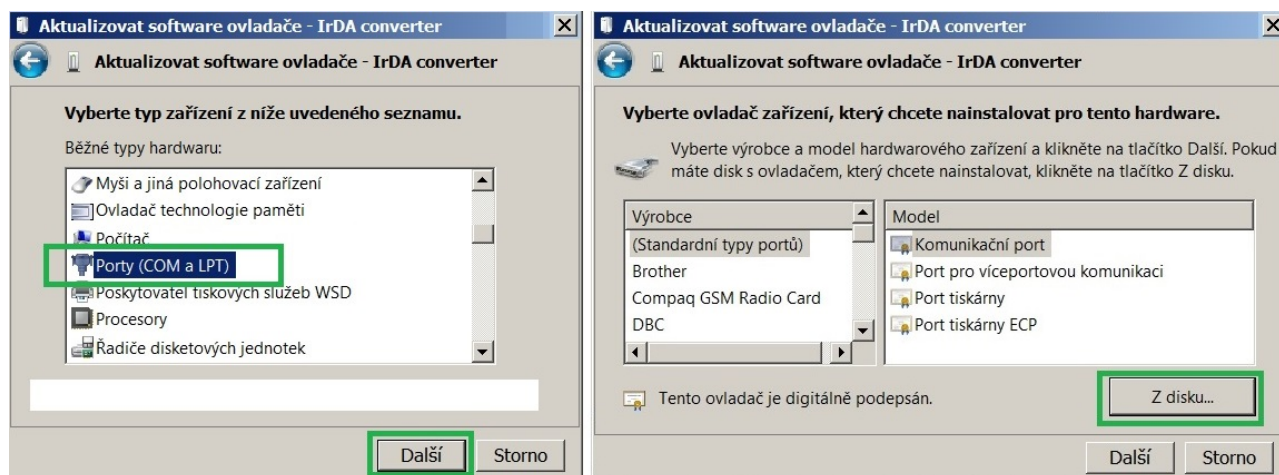


Figure 14: Manual selection of the driver file from a folder

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).

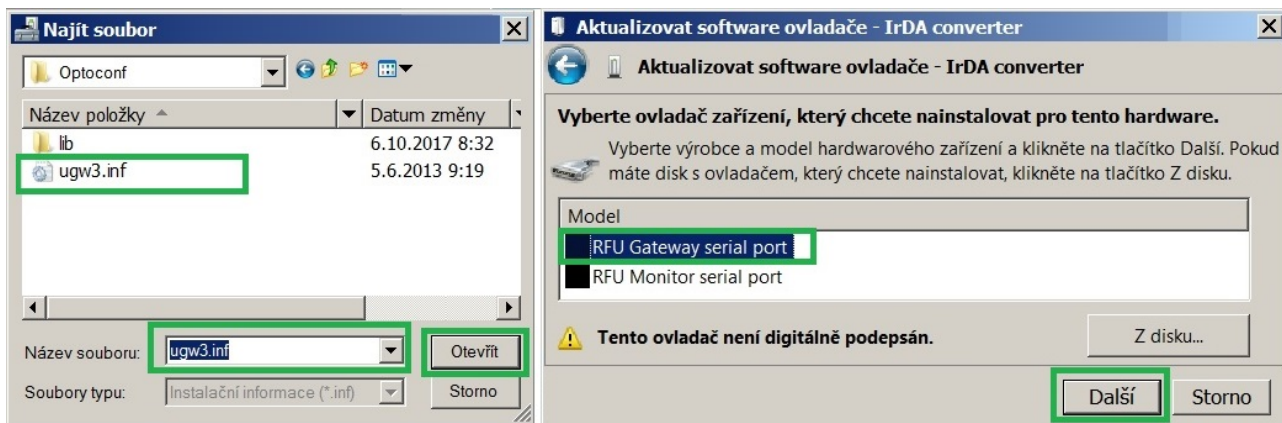


Figure 15: USB driver installation

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-Srmt module parameters by configuration cable

In following part of the document there is a description of these parameters of the WS868-Srmt 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-Srmt 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
```

Overview of configuration parameters with short description of their meaning can be also found in table 2 on the page 19.

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 receive downlink 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-Srmt module is equipped with two input pulse counters (index 0 - 1) and enables reading of two consumption meters with pulse output or sensors. As each input counter can be set individually, different types of devices (meters or sensors) can be connected (with different kind, initial status, multiplier or divisor).

Setting of pulse inputs can be performed with using of following commands:

/i index value	setting of initial value of the counter
/i index t number	setting of counter mode: 0-quick pulses, 1-edges, 2-slow pulses
/i index e 0/1	setting of trigger edge (only for „edges” mode)
/i index m value	setting of multiplier (output value = counter value * multiplier)
/i index d value	setting of divisor (output value = counter value / divisor)

By using of the „/i index value” command setting of the **initial values** of individual input counters 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>
```

By using of the „/i index t number” command an **operation mode** of the individual input counter can be chosen. Standard („quick”) mode can be preset by value „0”, „slow” mode with equalizing filter can be preset by value „2”. Value „1” can be used for switching to the „edge detection” mode, in which the counter changes its binary status after each change of input value (goes from „0” to „1” with rising edge, and from „1” to „0” with falling edge). By using of („/i index e”) command this logic can be inverted.

Example of command for setting of the first input counter to the „slow” mode:

```
sig50>/i0 t2
```

The „/i index e 0/1” command is intended for closer specification of the „edge detection” mode. This setting can be used for counter in „edges” mode for specification of 0/1 meaning (e.g. to specify if low input signal will be registered as „1”, or as „0”).

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:

Watermeter generates measuring pulses after each 0,01 m³ (10 litres). To indicate water consumption in 10⁻³ m³ (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:

Watermeter generates measuring pulses after each 0,1 m³ (100 litres). To indicate water consumption in m³, 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 (m³).

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	entering 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 version.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 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 WS868-Srmt 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.

The screenshot shows a window titled "Waco configuration" with a menu bar containing "File" and "Config". Below the menu bar are two tabs: "Info" and "SigFox 50". The "Info" tab is selected. The main area of the window contains a list of parameters, each with a checkbox and a value field. The parameters and their values are: Device name: ☐ SIG50; Device type: ☐ 860; Device subtype: ☐ 115; Serial No.: ☐ 00 28 C4 8A; HW Version: ☐ 1; HW Revision: ☐ 50; SW Version: ☐ 1; SW Revision: ☐ 0; Uptime: ☐ 2 296 sec; Value1: ☐ 124; Value2: ☐ 0; Send periode: ☐ 3 600 sec; Measure periode: ☐ 300 sec; Sens Temperature: ☐ -500 °C; CPU Temperature: ☐ 31,5 °C; Batt. voltage: ☐ 3,46 V. At the bottom right of the window are two buttons: "Write" and "Read".

Figure 16: WS868-Srmt 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	<i>device name by manufacturer</i>
Device type	<i>device type by manufacturer</i>
Device subtype	<i>device subtype by manufacturer</i>
Serial No.	<i>device serial number (as well MBUS-ID in M-Bus address)</i>
HW Version	<i>hardware version by manufacturer</i>
HW Revision	<i>hardware revision by manufacturer</i>
SW Version	<i>software version by manufacturer</i>
SW Revision	<i>software revision by manufacturer</i>
Uptime	<i>time from last module reset in seconds</i>

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-Srmt module. There are following parameters:

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

The „**Value1**” parameter is used for setting of the initial (or current) value of the first port counter. After this setting the initial value increases by one unit with each incoming measuring pulse.

The „**Value2**” parameter is used for setting of the initial (or current) value of the second port counter. After this setting the initial value increases by one unit with each incoming measuring pulse.

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 variable and possibilities of its setting are explained in details in paragraph 3.5.3 „Commands for setting of timers”.

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”.

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

Sens. Temperature	<i>current sensor temperature (not used)</i>
CPU Temperature	<i>current processor temperature (read only)</i>
Batt. voltage	<i>current battery voltage (read only)</i>

In the non-editable fields „**Sens. Temperature**”, „**CPU Temperature**” and „**Batt. voltage**” there are displayed current values of ambient air temperature measured by sensor (in this model not used), processor temperature and battery voltage of the module. These values are transmitted in each info-message (see description of information message in section 3.7 „Structure of WS868-Srmt 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-Srmt 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-Srmt 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-Srmt module is intended for reading of connected meters/sensors with pulse interface and broadcasting of current statuses („readings”) of the meters through the Sigfox IoT network. The module regularly transmits standardized Sigfox INFO-messages with maximum length of 26 Byte, and with maximum length of data payload 12 Byte.

The INFO-message broadcasted by WS868-Srmt 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 first pulse input counter.

„Counter 2” value represents current status of second pulse input counter.

„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 battery 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-Srmt 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.: "WS868-Srmt/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 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 $(0 \div 30) ^\circ\text{C}$. 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-Srmt 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-Srmt module installation

WS868-Srmt 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. Input clamps, 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 and with both cables 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”

In the figure 17 right there is displayed the detail of WS868-Srmt module printed circuit board with configuration connector marked by yellow colour, battery switch marked by red colour, input clamps marked by blue colour and antenna connector marked by green colour. Appearance of the module PCB could slightly vary in dependence on the module modification.

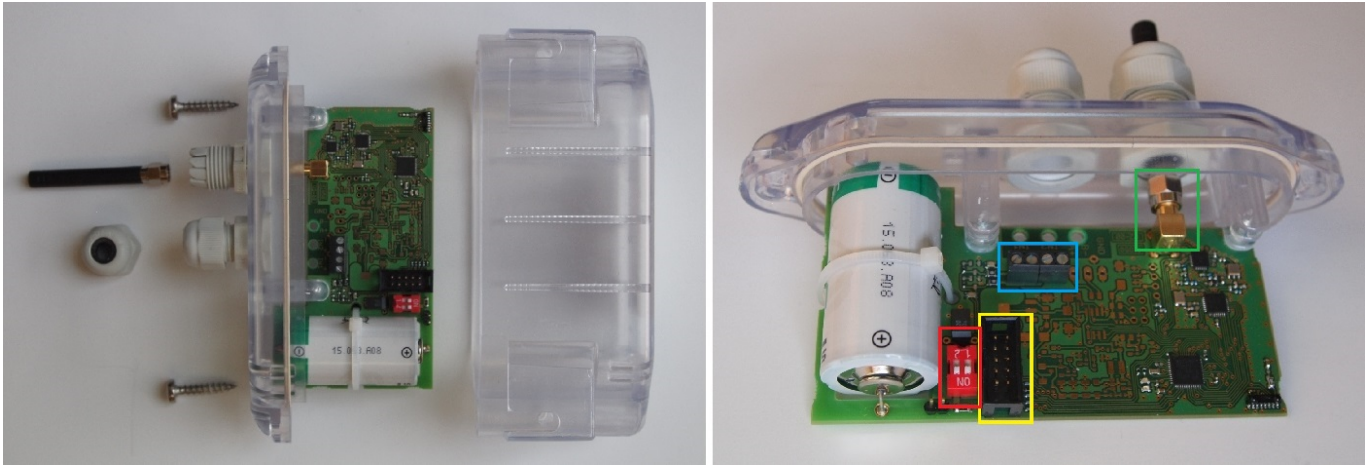


Figure 17: Detailed view of WS868-Srmt module

The case of WS868-Srmt 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 outputs from the consumption meters or sensors through the cable bushing (**) 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 its basic functionality:

- check setting of basic module parameters, especially broadcasting period, measurement interval and "Down-link" mode as described in paragraph 3.5.3;
- after connection of input cables from connected meters/sensors check correctness of reading input pulses by repetitive inspection of counter current values in the list of configuration parameters (reading of "i[0]" and "i[1]" values by configuration cable or reading of "Value1" and "Value2" values by using of optical converter). If there is a real consumption in progress on the measured volume or energy, counter values should change in correspondence with changing of values on mechanical counters. Values of physical quantities (temperature, voltage..) should correspond with reality;
- examine coverage of the site with Sigfox 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;
- 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, use test broadcasting function described in previous item.

4.10 Operation of the WS868-Srmt module

The WS868-Srmt module performs 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 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 module mechanical damage. 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.

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-Srmt 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 Failures of communication with meters

Failures of pulse signal transfer from the consumption meters to the correspond module inputs typically appear as „zero consumption” of the meter even though the consumption of the meter is evident, or generally, meter status from remote reading is different than meter status shown in meter’s mechanical counter. In this case try to proceed with troubleshooting of the connection with meters in following steps:

- Visually check the meter and connecting cable between meter and radio-module, especially whether the meter’s pulse generator is correctly mounted on the meter (if it is removable) and whether the meter or cable are not damaged;
- in case of any doubt check the functionality of cable connection by ohm-meter. If there is a problem with reliability of the connection, or the cable is evidently damaged, replace the cable immediately;
- check whether the cable is correctly associated with the module input (correct port number, correctness of polarity - if required by meter producer);
- Visually check if there are not placed any objects or devices radiating a magnetic field (for example a device for water treatment with magnet, electrical installation. . .) around the consumption meter. The pulse generators of some types of the consumption meters are very sensitive to the magnetic field presence. If such device is detected, it must be removed or there must be taken necessary measures to eliminate the magnetic field influence on the pulse generator of the consumption meter. To find more about the influence of the magnetic field on a particular consumption meter, you must follow its manufacturer instructions;

- if there is some possibility of measuring metering pulses, make sure that the meter generates the pulses properly and that these pulses lead up entirely to the radio module input;
- correctness of generating and transfer of metering pulses can be alternatively checked by short-circuiting of the cable on the meter side. If after each short-circuit the status value of the module's counter goes up, the module and cable are probably correct, and the trouble is probable caused by meter or by its pulse generator;
- if the module doesn't read the data even the metering pulses are provably brought to the correct radio module input, check the pulse counter parameter settings (counter mode, trigger edge) according to the paragraph 3.5.4 „Internal Counter Setting Commands”. In case the setting is correct, the problem is the most probably in the malfunction of the radio module. Replace the module following the instructions in the paragraph 4.7.

If the module register „false” pulses (consumption registered by remote reading is significantly higher than consumption registered by mechanical counter) and setting of the counter to „slow” mode has not solved the problem, the failure could be caused either by too long or poor-quality cable or strong local disturbance (or combining of these two circumstances). In this case replace the cable for high-quality shielded one or make changes in the installation to shorten the cable.

In case of unstable data transfer from connected sensors the signs of failure are very similar to the troubles with pulse meters - the wrong indication of measured data from sensors. Troubleshooting of this failure is similar with troubleshooting of pulse meters:

- visually check the sensor and connecting cable between sensor and radio-module for any damage;
- check whether the cable is correctly associated with the module input (correct port number, correctness of polarity - if required by sensor producer);
- visually check if there are not placed any objects or devices around the sensor that can influence its functioning;
- check correctness of the sensor input by short-circuiting of the cable on the sensor side. If after each short-circuit the value of the module's counter changes, the module and cable are probably correct, and the trouble is with high probability caused by sensor;
- if the module doesn't register the changes of sensor status even though the changes are provably brought to the correct radio module input, check the counter parameter settings (counter mode, trigger edge) according to the paragraph 3.5.4 „Command for setting of internal counters”. In case the setting is correct, the problem is the most probably in the malfunction of the radio module. Replace the module following the instructions in the paragraph 4.7.

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, readings from connected meters/sensors are available, but data from some meters/sensors 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 meter/sensor, especially correctness of its ID, address and association of the meter/sensor with right port of reading module. Check correctness of counter initial value, multiplier and divisor;
 - check functionality of receiving pulse signals on the module's input as described in paragraph 5.1.3 „Failures of communication with meters”.
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 the transmitting and receiving of the radio-signal 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-Srmt 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 and receiving of the radio-signal as described in the paragraph 5.1.4 „Transmitter and receiver failures”.

NOTE: WS868-Srmt 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, discharging of internal battery, or voltage pulses induced to the input cables. 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-Srmt RF-modules, designed for operation in Sigfox IoT network in 868 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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