

TERA Radon Program

TERAview application
User Manual

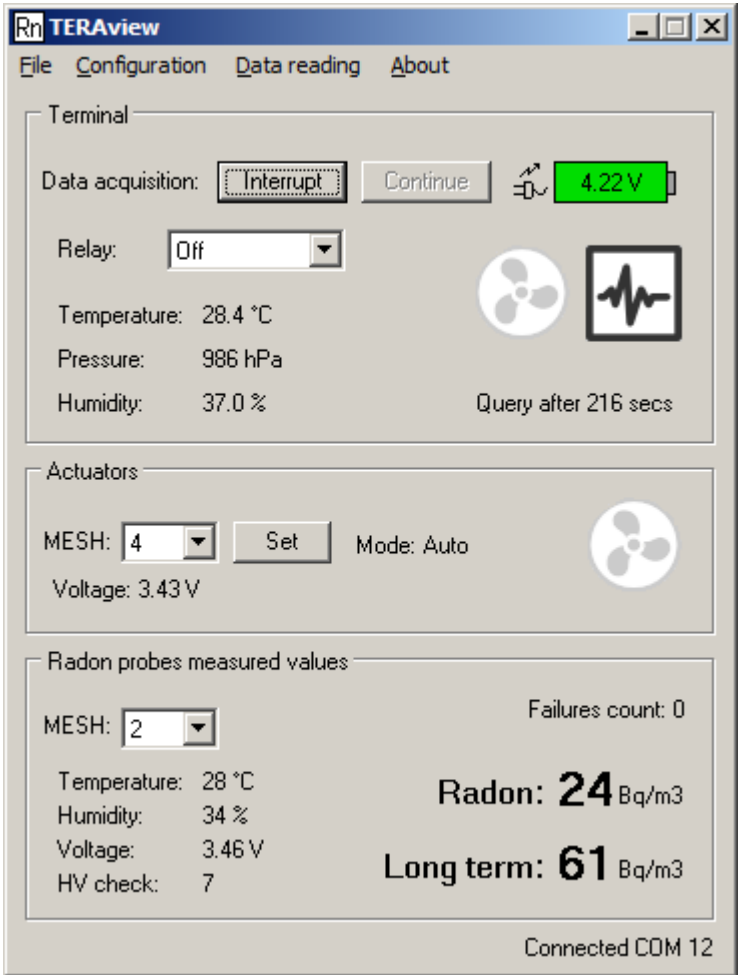


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1.1. Introduction

This document is a user instruction manual of the computer application TERAview.

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Before using the product, please read this manual carefully and understand all operating and safety precautions. Compliance with operational and safety precaution you can prevent from damage to equipment or injuries to personnel. Operating and safety instructions in the document are marked as follows:

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The product may only be used in the specified manner and for its intended purpose. The product may be provided to third persons with this documentation only.

1.2. Description and Utilization

TERAview program is designed for configuration and diagnostics of wireless radon measurement or control network TERA made by TESLA. Allows you to download, display and export measured data. TERAview communicates with wireless components in measurement network via a **Central Unit** connected to the computer via USB interface. Central unit is equipped with an antenna for radio communication with wireless components in the measurement network. For instructions and more information about Central Unit; see <http://www.tesla.cz/en/tera-centrala/>.

Before connecting the central unit to the PC you need to download and install drivers see paragraph "Installation".

TERAview can be used in these systems:

- A) TERA System for Radon Concentration Measurement (Figure 1)
- B) TERA System for Regulating Radon Concentrations (Figure 2)

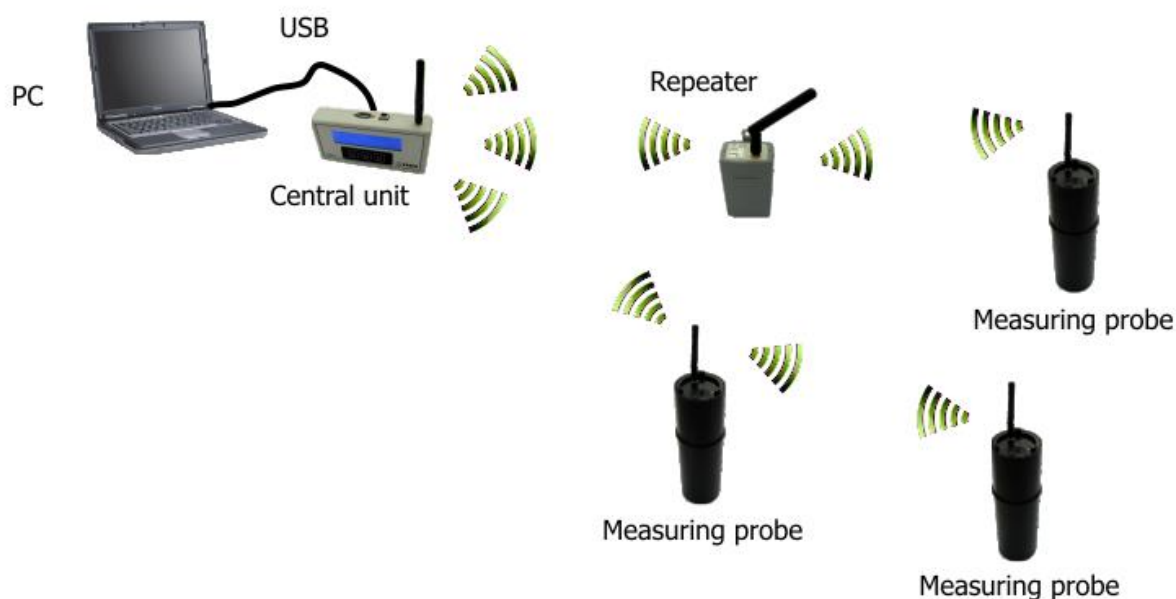


Figure 1 - TERA System for Radon Concentration Measurement

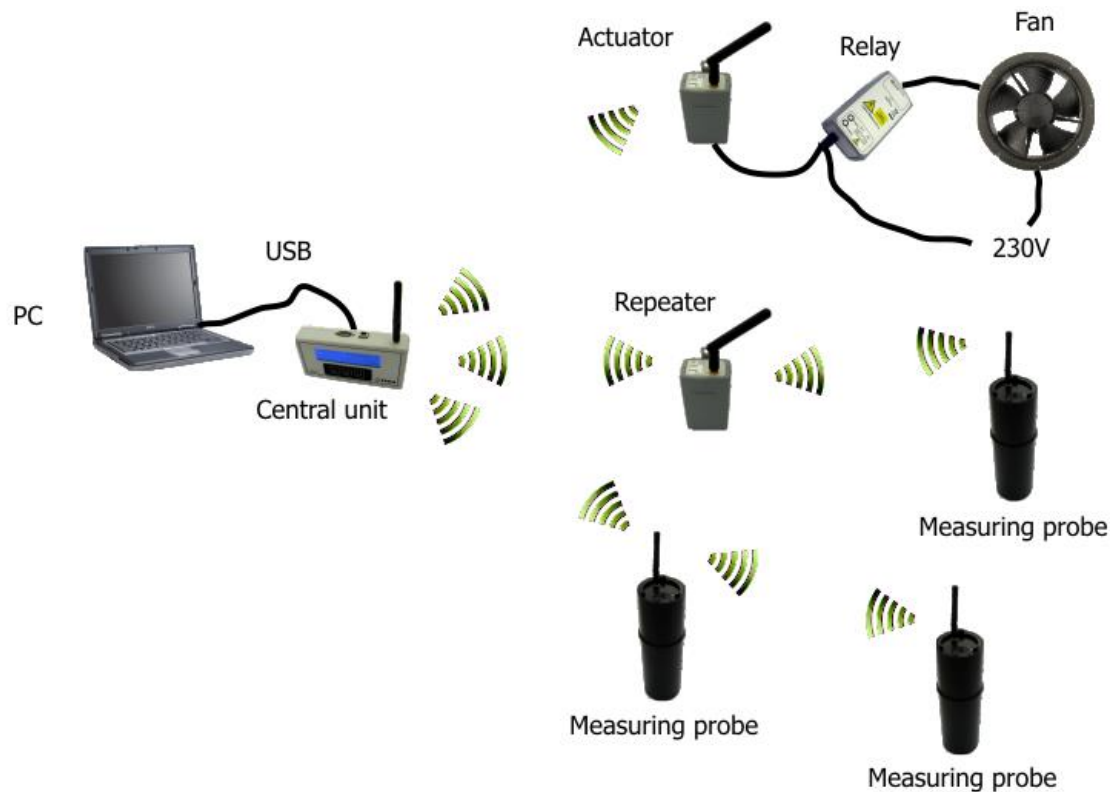


Figure 2 - TERA System for Regulating Radon Concentrations

Measuring system description - Thanks to its independent battery power, portable radon **measuring probe** supports flexible placing options within monitored structures. Battery will last for more than 1 year. The probe measures in autonomous and time continuous way. It processes results at given intervals (default 4-minute intervals) and it counts moving average of radon concentration value at an interval of 1 hour (default moving average of 15 4-minute process intervals). It also counts moving average of radon concentration value at an interval of 24 hours. The probe saves time records of these radon concentration values including values of humidity and temperature within internal memory (typically at an interval of 1 hour). Next saved value is time record of measuring energy spectrum (typically at an interval of 12 hours). The resulting values can be downloaded continuously during measurement or at once at the end of measurement. Central Unit supports simultaneous data downloads from up to 16 probes. All values are saved again into central unit memory.

Regulating system diagram description - Radon measuring probes located in a building transmit their current radon concentration values to central unit wirelessly. Central unit analyzes this information and on the basis of the measured (set) concentration level value it sends wireless command to **actuator** which is hardwired with **power relay**. Power relay switches on a fan which decreases radon concentration within an area. After decreasing of radon concentration, actuator receives command to switch off fan. This cycle repeats depending on increasing or decreasing volume activity of radon in building. Actuator also can switch low power load 30V/1A.

The probe is random for location in measured place, but generally it is put on the bottom of the probe. Bottom of the probe cannot be covered. In case of time continuous measurement of radon concentration or in case of setting in regulation system the probe must be placed in radio range of Central Unit. Distance (radio range) between the TSR2 and central unit is up to 600 m in open space. In the buildings it depends on number of walls, building material, etc. Strength of radio signals (RSSI) is monitored by Central Unit. If the radio signal strength between individual elements is insufficient, TSR2 radon probe must be inserted or **repeater** must be used to extend the signal.

Individual wireless network elements communicate with each other and transmit the data when elements are within radio range, it create so-called MESH wireless network, where each element communicates with everyone. For unambiguous determination of elements in the current network topology each element is assigned **MESH network address** (number) 1 to 16 during initial bonding (**bond**)

into the network. In various network topologies may be the one physical element always get different MESH address.

For successful various wireless elements configuration in measuring system it is essential to know element **radio channel number** (communication wireless channel) and **P2P address** (Peer-to Peer) (identification in wireless net). Both parameters are printed out on element serial number plate. Radio channel number is possible to change by the TERAview application and it must be identical to central unit radio channel number. P2P address is permanent and it can occur in one big wireless net only once. Central Unit P2P address can be identical to P2P address of other elements in network.



For instructions and more information about the individual elements of the wireless network TERA look at <http://www.tesla.cz/en/radonovy-program-tera/>.

1.3. Installation

Software and hardware requirements for PC:

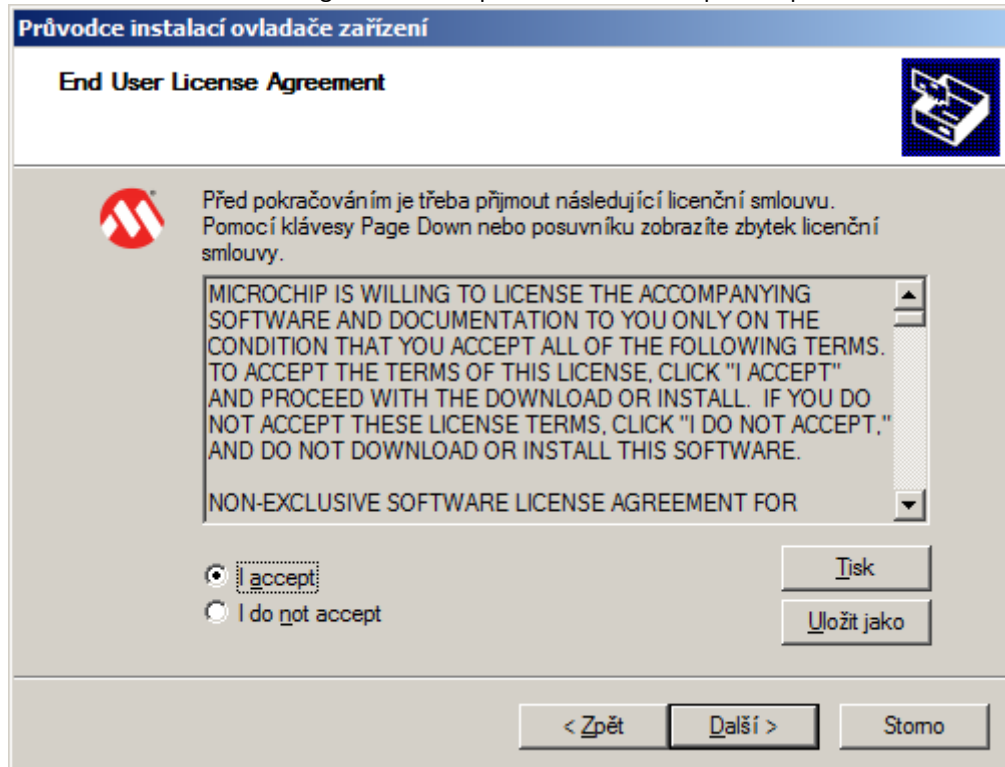
- Operating system (OS) Windows XP and later versions
- USB interface

For successful Central Unit drivers installation and TERAview program installation follow these instructions:

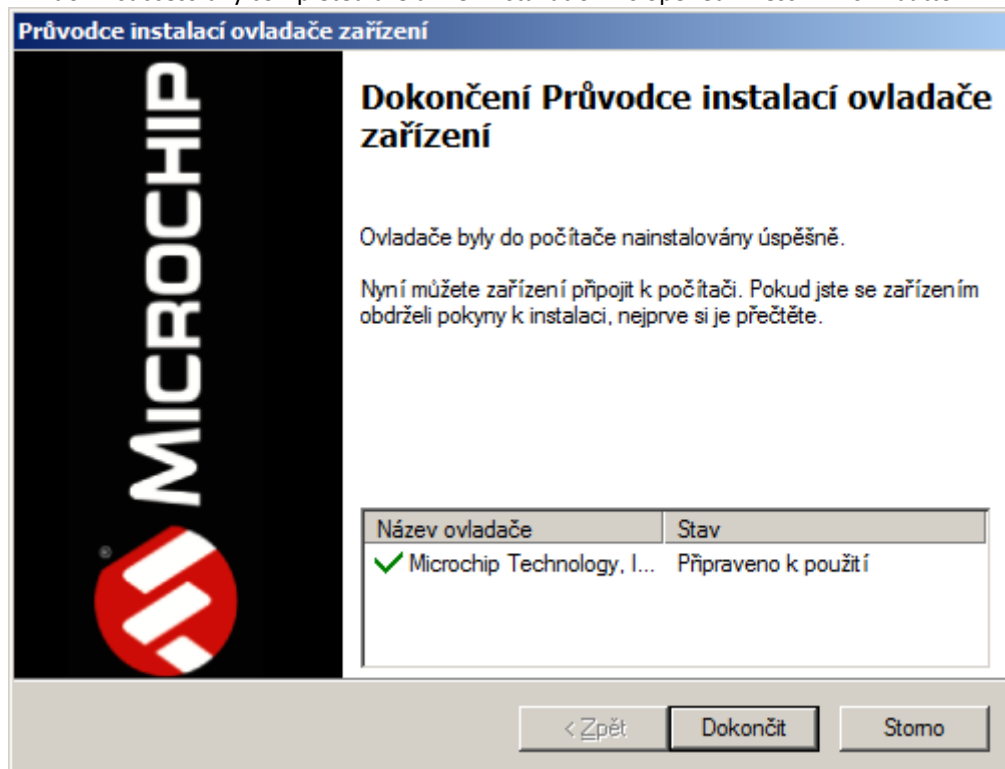
- 1) Do not connect Central Unit to PC.
- 2) Download from the website <http://www.tesla.cz/en/ke-stazeni/> current driver and program:
 TERA USB driver (32bit/64bit).zip
 TERAview_vXXX.zip
- 3) Extract compressed files to any directory on your PC.
- 4) Run USB driver installation according to the type of your operating system (OS):
64bit OS: ... \Driver Installation Tool\x64\McphCdcDriverInstallationTool.exe
32 bit OS: ... \Driver Installation Tool\x86\McphCdcDriverInstallationTool.exe
- 5) Installation wizard is opened in local language set. Press "Next" button.



- 6) Window "End User License Agreement" is opened. Check "I accept" and press "Next" button.

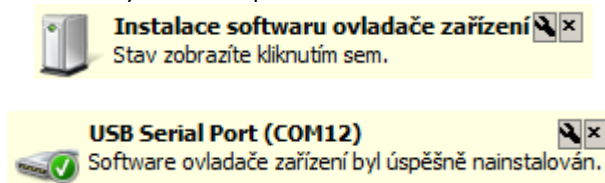


- 7) Window "successfully completed the driver installation" is opened. Press "Finish" button.

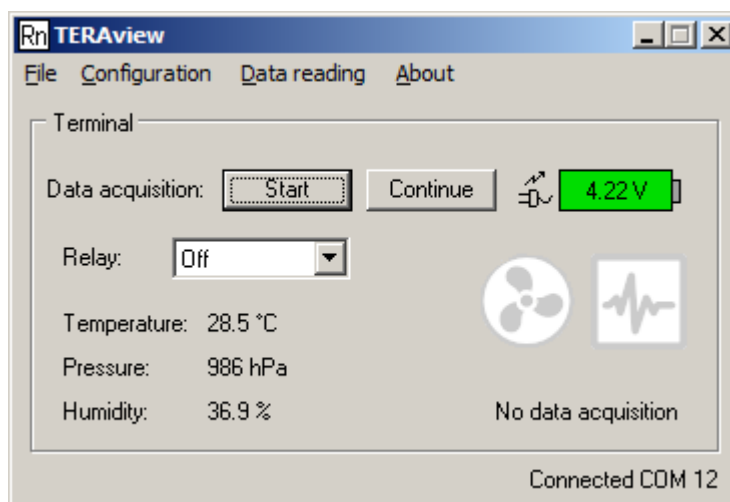
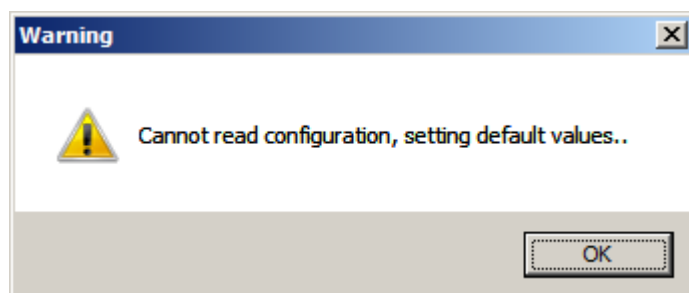


- 8) Connect Central Unit to PC via USB cable.

- 9) In bottom right corner of screen you will keep informed about the status of device installation.

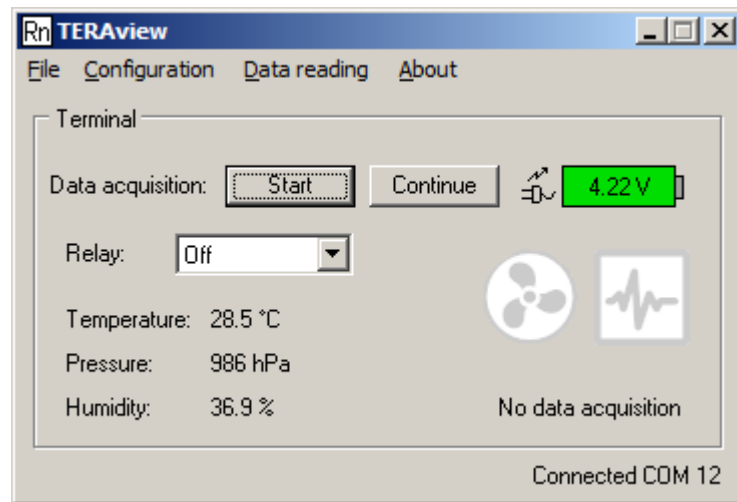


- 10) Run TERAview by opening extracted file **TERAview_vXXX.exe**. The program is self-running, requires no installation. First, the warning message is opened, which highlights the absence of auxiliary configuration file. Press "OK" button, auxiliary configuration file is created and will launch basic window of TERAview application. Next execution TERAview is already without display of warning message.



- 11) When a message "**Connected COM XX**" is displayed in bottom right corner of the application you have successfully connected Central Unit to PC and you have successfully installed the TERAview program. Now you can proceed to bonding and configuration of the wireless network (see 'Configuration of wireless measuring network TERA – "Configuration"').

1.4. Description of TERAview Basic Window



Basic window is divided into three parts:

- 1) **Menu bar** - Offers four pull-down menu:
 - 1) „**File**“ – Offering only "Exit" button to exit program.
 - 2) „**Configuration**“ – Used to configure the network and measuring (see 'Configuration of wireless measuring network TERA – “Configuration”').
 - 3) „**Data reading**“ – It allows to view and download measured results from memory of elements in a wireless network (see 'Measurement in wireless measuring network TERA – “Data reading”').
 - 4) „**About**“ – Opens a window with information about the program. The window is closed by pressing "OK".
- 2) **Display field** - Used to display the current set and current measured values.
- 3) **Bottom line** - Displays current status of USB connection of Central Unit "**Connected COM XX**" / "**No connection**" to serial COM port XX.

There is also displayed a current list of errors occurring in the operation of the wireless system, "**Last errors view**". Typical errors may be, for example, elements that communicate "**Element Out of Range**" or low battery voltage elements "**Low battery!**"

1.5. Configuration of Wireless Measuring Network TERA - "Configuration"

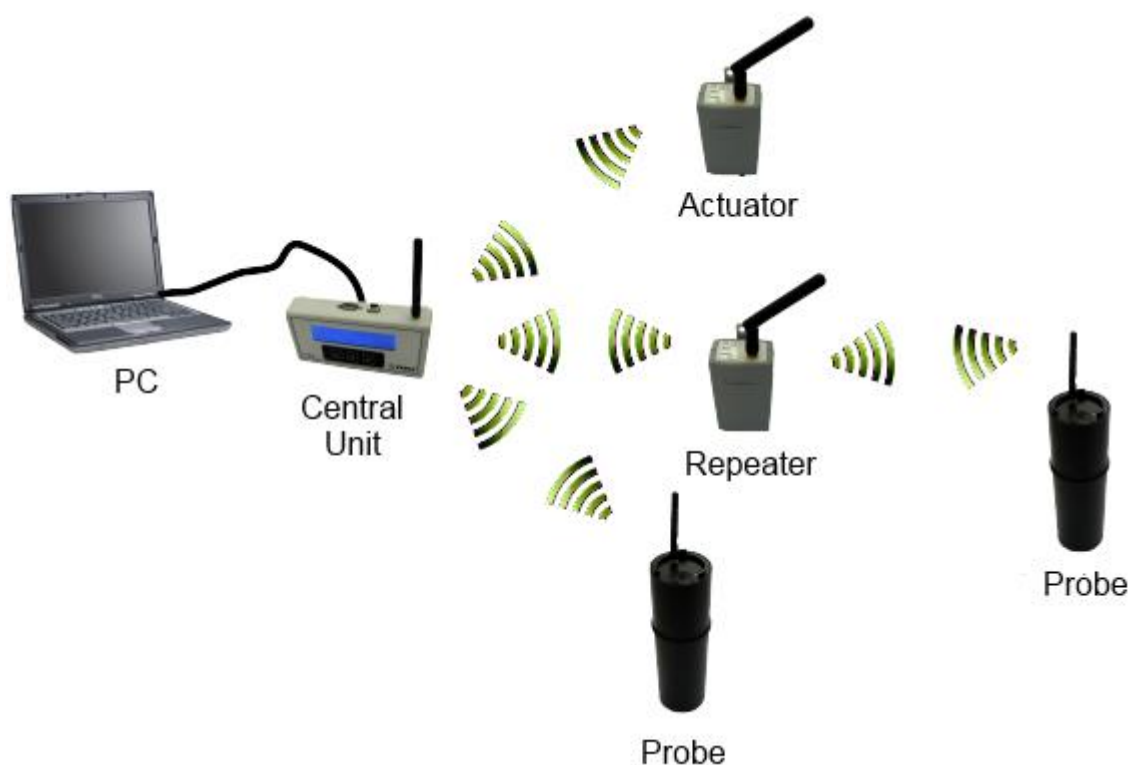
This chapter introduces you to the process of initial wireless network bonding and configuration.

For successful construction and wireless network bonding chronologically follow these instructions:

1.5.1 Preparation and Topology

Nearby PC connected with the central unit and installed program TERAview in it (see 'Installation') prepare particular wireless elements (elements) of which will consist expected wireless network (network). Assemble and run particular elements according to relevant instructions manual. Leave all elements except central unit without external antenna. Plan your topology (placement) of elements especially with regard to the planned number of radio signal repeaters to increase radio range. Retranslation is also automatic function of measuring probe.

Figure below shows model example of one network on which we will show whole process of bonding and network configuration. Particular elements are described in the section 'Description and Utilization'.



1.5.2 Radio Channel Selection

Operating radio channel (channel) of given network can be freely selected from 62 different predefined numbers of frequency channels which are determined by the following formula:

$$f_N = 863.15 + N * 0.1 \text{ [MHz]}, \text{ where } N \text{ is the number of radio channel.}$$

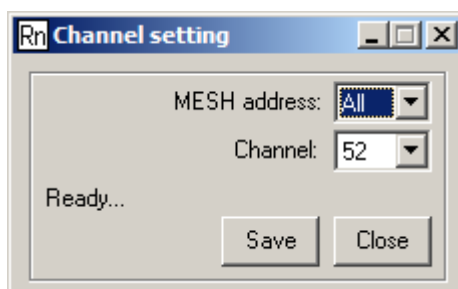
Selected operating frequency must be in accordance with authorizations to use spectrum in the region.

Default factory setting of all the elements is set to recommended channel number 52. It is seen on serial number plate of particular elements.

In case of more independent networks running in one location it is recommended to keep minimum spacing of 5 channel between operating channels of particular networks,. As the operating frequency band 863-869.2 MHz so called 'free' it means that it is free of charge band and in this band can work any other devices consequently there is possible that in selected channel

of your network may occur interference with other devices. For these above-mentioned cases it is possible to reconfigure number of radio channel:

Configuration -> Wireless -> Channel change -> Channel setting



<i>Item</i>	<i>Option</i>	<i>Description</i>
MESH address:	1-16	Radio channel reconfiguration only individual network elements
	Term	Radio channel reconfiguration only central unit
	All	Radio channel reconfiguration of the whole network
Channel:	0-61	Select of a new radio channel number
Save	-	It reconfigures radio channel number at new one for selected elements
Close	-	Window is closed

Attention! When using this function user must know exactly what he wants to do. In case of wrong process it can cause collapse of elements connection. The best way is change whole network at once. After changing radio channel of network or individual element we recommend this change to write on the element product label in "CH:" label.

Attention! The selected operating frequency must be in accordance with rules and privileges of frequency spectrum administrator in given territory.

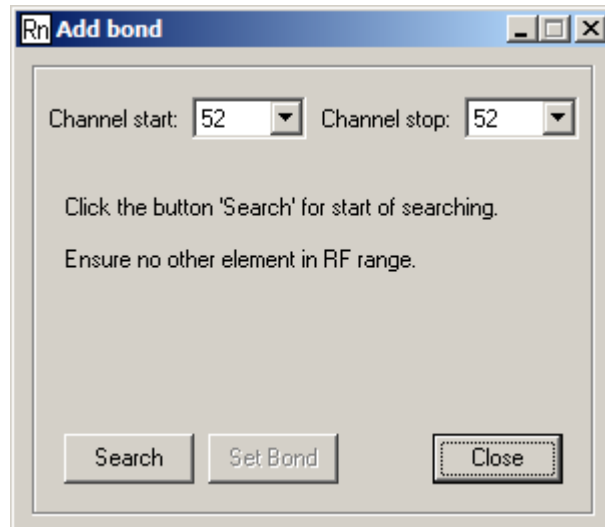
For next steps of the sample network we keep all network elements tuned to the channel recommended from the factory on the number 52, and thus the change of network channel do not need.

1.5.3 Connecting Wireless Elements to Network

Now we connect separately individual elements to the network in the following way:

3.1) We mount external antenna to connected element (on other elements besides the central unit antenna is not mounted).

3.2) **Configuration -> Wireless -> Add bond**

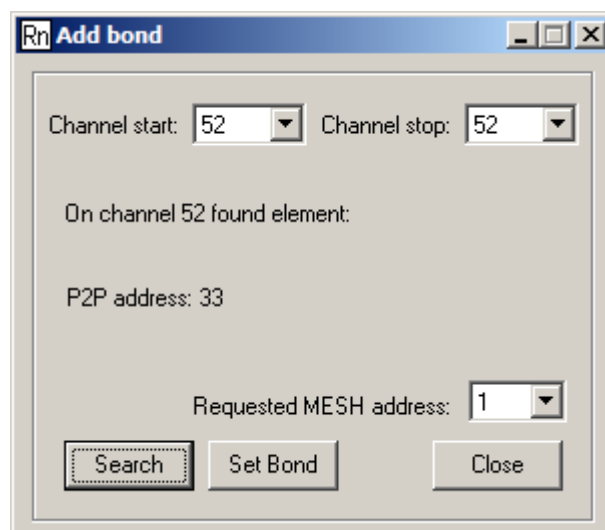


3.3) We set range radio channels „**Channel start:**“, „**Channel stop:**“ on which the central unit should search the connected element. If we know the number of radio channel connected element from the product label - position "CH:" we set this number into both range positions. For our example we set 52 to 52. If we don't know the radio channel of the connected element we must set whole range of radio channels from 0 to 61 and the searching will take longer time.

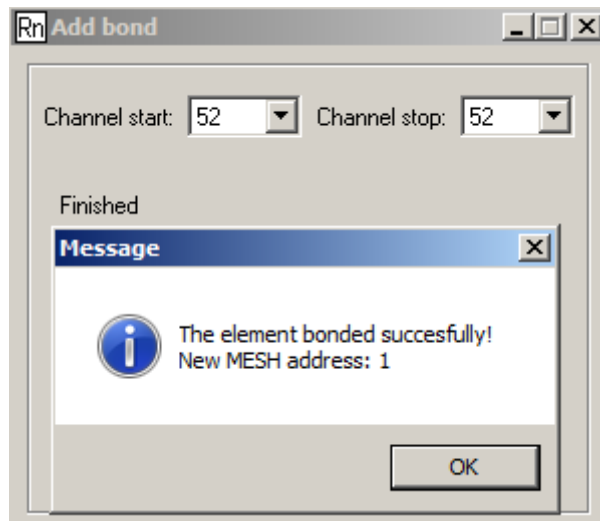
3.4) We press „**Search**“ button to searching new element.

3.5) The central unit find element with strongest radio signal, ie, the element with mounted external antenna and displays on the screen its unique P2P address „**P2P address:**“. Check if displayed P2P address is the same as the address of the connected element with mounted external antenna. P2P address element is written on a product label element - position "P2P".

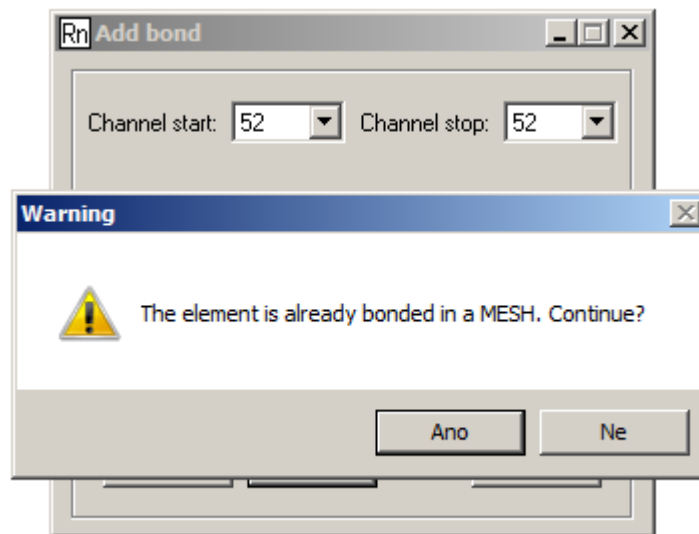
3.6) We select suitable network MESH address for element „**Requested MESH address:**“. The central unit can communicate with up to sixteen elements, ie, in the network can be allocated network MESH addresses from 1 to 16. Every element can be assigned basically any free network MESH address. But if in the network is used repeater or probe with relayed function those elements must be assigned the lowest possible network MESH address.



3.7) We press „**Set Bond**“ button for adding and saving element with the required MESH network address to the implemented net. Information window reports a successful addition to the network element, press „OK“ button. Radio channel of just added element is automatically change to radio channel of central unit (only in case of diferent radio channel of element).



If the connected element has previously been added in this or any other network it displays alert window with information about this status and offers a choice of whether really to add the element to new network, „YES“ or not to add the element „NO“.



3.8) We recommend assigned network MESH address and radio channel write on product label just connected element into „MESH:“ and „CH:“ position.

3.9) We dismount external antenna from the connected elements.

3.10) Now we can go back to item 3.1) and add another element to the network or close the window by pressing button „**Close**“.

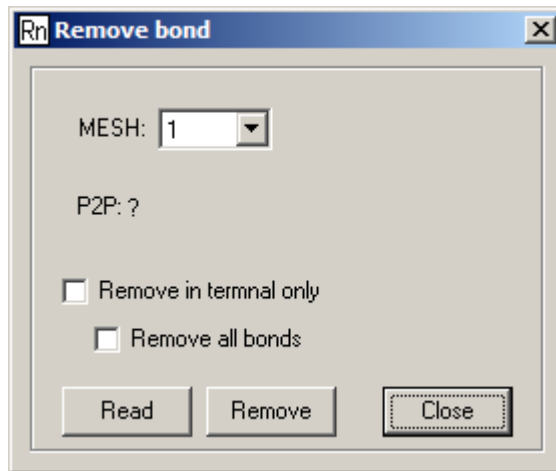
At this point in the case of exemplary network we added 4 elements on a radio channel 52. According to the rules in section 3.6) repeater is assigned the lowest MESH address 1. Overview of P2P addresses and MESH addresses network elements of the model is in the table below.

Element	P2P address	MESH address	Description
Element 1	2	1	Repeater
Element 2	66	2	Probe
Element 3	33	3	Probe
Element 4	126	4	Actuator

1.5.4 Removing the Wireless Element from Network

If it is needed to change the topology of configured network or the network cancel complete the elements can be removed from the network as follows:

4.1) Configuration -> Wireless -> Remove bond

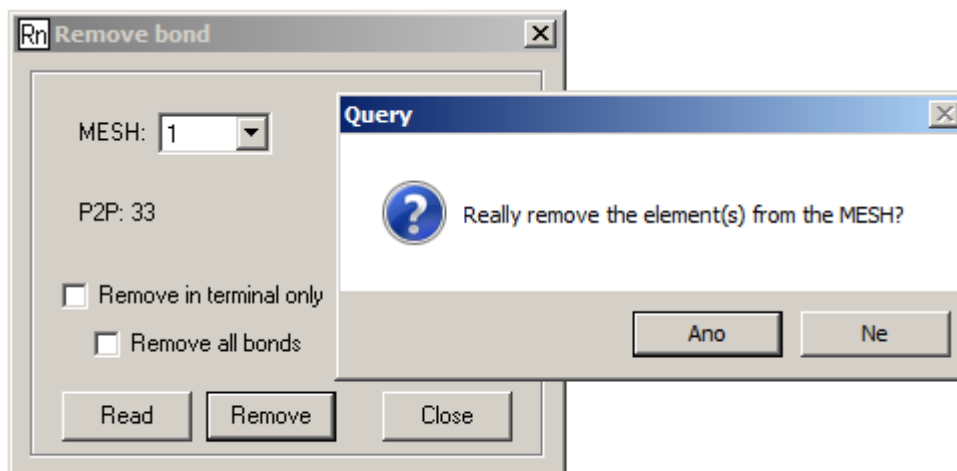


4.2) Choose MESH address „MESH:“ of element which you want to remove and press „Read“ button. Wait for searching of element and display its P2P address „P2P:“. Check if displayed P2P address is the same as the P2P address of the disconnected element. P2P element address is written on a product label - position „P2P:“. For example we are removing the element with MESH address 1.

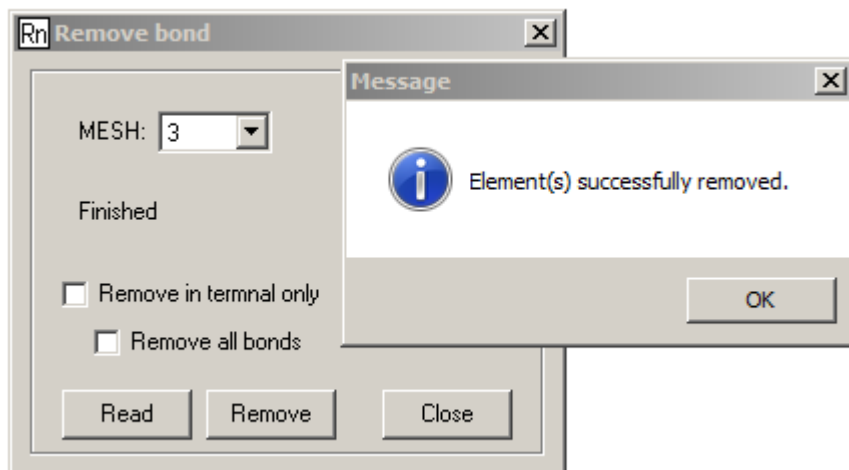
4.3) Before pressing „Remove“ to remove element from the network we can check advanced remove options:

„Remove in terminal only“	It removes one selected element from the network only in central unit. It is primarily used if network element is out of order or unavailable.
„Remove all bonds“	It removes all elements from the network only in the central unit. It is primarily us if network elements afe out of order or unavailable.
„Remove“	If not checked option above it removes the selected element from the network in the memory of the central unit and erases the record about connection in the memory element too.

4.4) Dialog window is displayed for confirmation of element removal. Press „Yes“ button.



4.5) Info window is appeared about successful removal of element from network. Press „OK“ button.

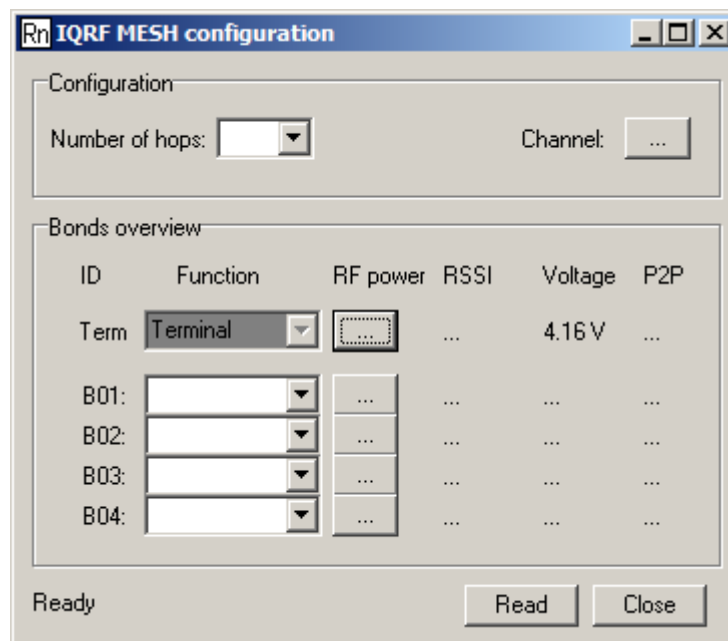


4.6) Do you want to remove another element start again at point 4.2) or press „Close“ button for closing a window. If you remove all elements of the network information window is displayed “No elements are bonded”.

1.5.5 MESH Network Configuration

We set and check remaining parameters of individual elements in the network as follows (for a example network):

5.1) Configuration -> Wireless -> MESH configuration



5.2) Press „Read“ button for loading all the information known about built radio network so far. Loading may take more time. During loading parameters you can press „Stop“ button for stop loading. If question mark „?“ is displayed at any position it means that the element or parameter is not available.

ID	Function	RF power	RSSI	Voltage	P2P
Term	Terminal	7		4.18 V	13
B01:	not assigned	7	77/84	3.42 V	2
B02:	not assigned	7	89/85	3.47 V	66
B03:	not assigned	7	92/94	3.40 V	33
B04:	not assigned	7	96/92	3.39 V	126

The parameters mean:

„Number of hops:“	Number of radio hops in the network 0-15. For network with no repeater element is entered the number 0. In the case of existence repeater elements in the network is necessary to set the number which is equal to the number of repeater elements in the network plus 1.
„Channel:“	Radio channel number of network. Press the button with channel number if you can change the network channel number, see 'Radio Channel Selecting'.
„ID“	MESH address of individual elements in the network.
„Function“	The function of individual elements in the network. „not assigned“ – function is not assigned, the element is not participating in the measurement „repeater“ – repeater „actuator“ – actuator „radon probe“ – radon probe
„RF power“	Radio output power of individual elements in the network. The value of power can be changed by pressing power value, see 'Output Power Setting'.
„RSSI“	Strength of the received radio signal of the individual elements in the network <i>element / the central unit</i> in the range from 40 to 100, higher number means a higher strength of received signal and a higher reliability of the connection.
„Voltage“	Battery voltage of the individual elements in the network.
„P2P“	P2P address of the individual elements in the network.

5.3) We set the parameters „Number of hops:“, „Channel:“, „Function“, „RF power“ according to the table above and according to requirements on network properties. We close window by pressing „Close“ button. In the case of our example network settings and parameters should look something like the following window:

Rn IQRF MESH configuration

Configuration

Number of hops: Channel:

Bonds overview

ID	Function	RF power	RSSI	Voltage	P2P
Term	<input type="text" value="Terminal"/>	<input type="text" value="7"/>		4.16 V	13
B01:	<input type="text" value="repeater"/>	<input type="text" value="7"/>	80/87	3.39 V	2
B02:	<input type="text" value="radon probe"/>	<input type="text" value="7"/>	67/63	3.46 V	66
B03:	<input type="text" value="radon probe"/>	<input type="text" value="7"/>	91/94	3.40 V	33
B04:	<input type="text" value="actuator"/>	<input type="text" value="7"/>	95/92	3.41 V	126

Read successfully

1.5.6 Location of Elements

Mount the external antenna to all network elements and arrange them on the planned places. Radio range of elements is in open space up to 600m but radio propagation is affected by many factors. Primarily depends on the composition of the wall, on the number of metal barrier in the monitored object and reflections of radio signal. It is necessary to find suitable location/position of the element so that it should be the least fixed obstacles between the central unit and the element or so that a radio signal way through obstacle as short as possible. Not to place elements near the wall.

After locating of all network elements run the MESH configuration window again:

Configuration -> Wireless -> MESH configuration

and press „Read“ button. For no error radio communication the loaded values strength of received radio signal „RSSI“ individual elements should not fall below the level of **50**. Received radio signal level affects the participation of man in the radio signal.

Rn IQRF MESH configuration

Configuration

Number of hops: Channel:

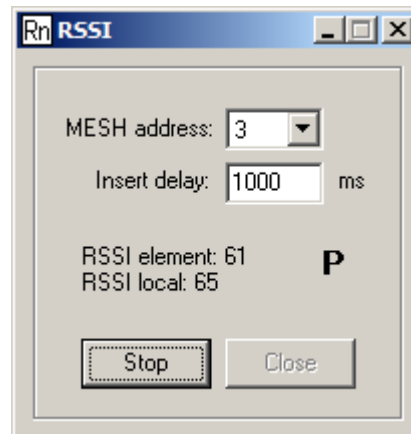
Bonds overview

ID	Function	RF power	RSSI	Voltage	P2P
Term	<input type="text" value="Terminal"/>	<input type="text" value="7"/>		4.20 V	13
B01:	<input type="text" value="repeater"/>	<input type="text" value="7"/>	71/75	3.41 V	2
B02:	<input type="text" value="radon probe"/>	<input type="text" value="7"/>	63/58	3.45 V	66
B03:	<input type="text" value="radon probe"/>	<input type="text" value="7"/>	62/66	3.41 V	33
B04:	<input type="text" value="actuator"/>	<input type="text" value="7"/>	66/63	3.33 V	126

Read successfully

If one of the elements has low RSSI level or you are just looking suitable location for elements, you can use special window for rapid measurement of RF signal strength of the selected element:

Configuration -> Wireless -> RSSI measuring

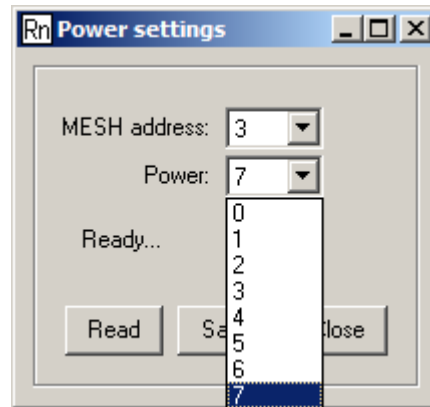


Here you set MESH address of element „**MESH address:**“, the time interval between the current RSSI readings „**Insert delay:**“ and press the „**Measure**“ button. Each showing of the letter „**P**“ indicates the current value of received radio signal strength of the element „**RSSI element:**“ and of the central unit „**RSSI local:**“. The measurement is stopped by pressing „**Stop**“ button. If the values is not measured or is too low, the message „Error FEh“ occurs. Recommended minimum time interval of RSSI measurement is 1000 ms.

1.5.7 Output Power Setting

We recommend not to change the output power from the factory-set maximum value **7** (5 dBm). If you have high levels of RSSI in operate system you can decrease the values of output power and so reduce consumption of elements during transmitting and so extend battery life. Decrease by one degree means a reduction about 2.5 dB.

Configuration -> Wireless -> RF power change

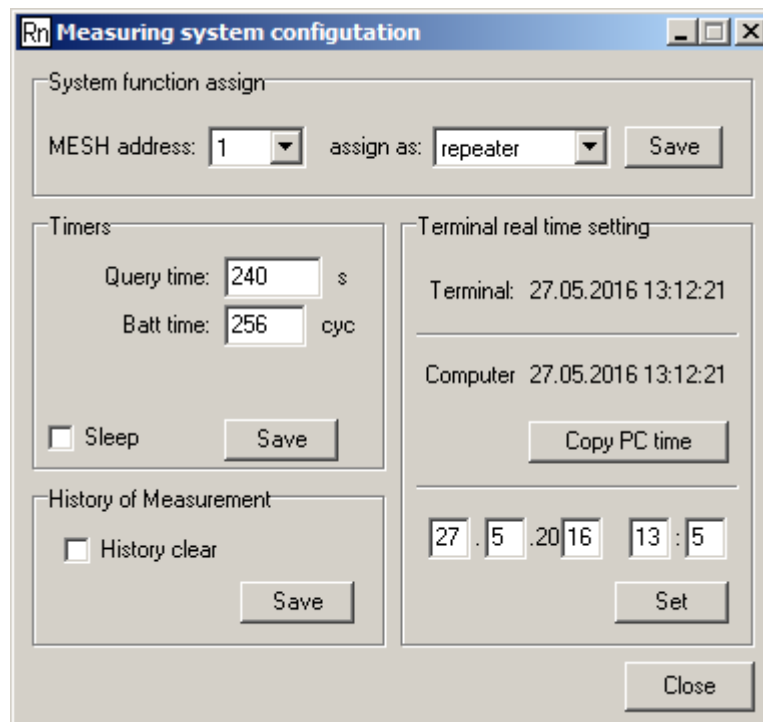


Choose MESH address of element „**MESH address:**“ which you want to change the output power. By pressing „**Read**“ button you can read current power setting of the selected element. In the „**Power:**“ you can enter the new value of power between 0 - 7 . For writing the new value into element memory press „**Save**“. Close window you can click to „**Close**“ button. For new setting of output power check RSSI see previous paragraph.

1.5.8 Measurement Setup - Central Unit

Here you can set the basic parameters of the measuring system concerning the central unit.

Configuration -> Measuring system -> System configuration



Description of setting is in the following table:

„System function assign“	There is possibility to assign functions to individual elements. The same setting as in 'Mesh Network Configuration'. Saving this parameter to the central unit is done by pressing the „Save“ button. Info window about a successful completion is shown, press „OK“.
„Timers – Query time:“	The time interval after which the central unit always regularly download the latest data from the wireless elements in whole network. The interval is set in seconds within the range 240 – 32400 (i.e. 4 minutes to 9 hours). Prolongation of the interval can reduce consumption of element and extend battery life. Saving this parameter to the central unit is done by pressing the „Save“ button. Info window about a successful completion is shown, press „OK“.
„Timers – Batt time“	The time interval after which the actual battery voltage of repeater is measured. The time interval is set in multiples of interval „Query time“ in range 1x – 256x. Prolongation of the interval can reduce consumption of repeaters and extend battery life. If the battery voltage drops below 3.0V the application opens a warning message. In this case the battery in repeater must be replaced with new one. Saving this parameter to the central unit is done by pressing the „Save“ button. Info window about a successful completion is shown, press „OK“.
„Timers – Sleep“	By checking this box you enable to go to sleep mode of elements in networks during the communication gap. Do not use! Only for service purposes.
„Terminal real time setting“	Setting current real time into the central unit. This can be done by setting the current time in the computer „Copy PC time“ or by manual typing in boxes and pressing „Set“ button. The central unit can not automatically change the real time during the change between winter and summer time.
„History of Measurement“	By checking the box „History clear“ and press „Save“ button is erased all older data stored in the main memory of central unit. Info window about a successful completion is shown, press „OK“.

Attention! If you are going to erase old data from the central unit „History clear“ you must be absolutely sure that the previous records and the value you will not need in the future.

For our example network we keep time intervals at the default settings as is shown in the picture above. We set the actual time and we can erase the memory of the central unit because we know that the prepared measurement will be completely new and previous results definitely we do not need. We close the window by pressing the „Close“.

1.5.9 Measurement Setup - Radon Probe

Here you can read and set the basic parameters of the measuring system concerning radon probes.

Configuration -> Measuring system -> Radon probes configuration -> Parameters

Rn Radon probes setting

MESH address: 2

Parameters

Discrimination: 40 65 95

Calibration: 635

Limit: 200

Gain: 102

Record time: 60 min

Read

Info

Real time: 17.01.2000 06:55:13

Total counts: 12987

Read

Finished..

Initialise Close

Select gradually individual radon probes according to MESH address „**MESH address:**“. Press „**Read**“ for reading of the currently set probes parameters in the table „**Parameters**“. If you need to rewrite the parameters please contact TESLA www.tesla.cz. Changes of these parameters is mainly provided for service engineers or expert. Description of parameters is in the following table:

Parameters

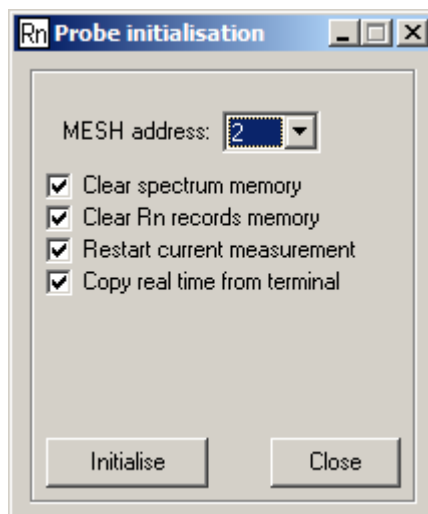
„ Discrimination: “	The whole measured energy spectrum is divided into 96 channels and three adjustable discriminatory layers divides the whole area into four parts. The value of radon concentration is determined from the sum of the second and third areas, i.e. the area lying between the first (left) and the third (right) value of the discriminating layer. Energy impulses generated due to decay of radon is precisely known so that the appropriate settings discriminating layers is separated from the useful pulses artifacts generated noise like. (Service value)
„ Calibration: “	The constant value for the calculation of the concentration of radon from the number of pulses. It is determined individually during probe calibration.
„ Limit: “	Is the value of radon concentration at which switches on/switches off relays in case of regulating system realization. Value has introduced a hysteresis of about 10%, when limit values to avoid frequent switching on/switching off. The default value is 200 Bq/m ³ . (Service value)
„ Gain: “	Value of movement of the energy spectrum to left or right. It is determined individually during probe calibration. (Service value)
„ Record time: “	Time interval in minutes between two records of radon concentration. The default value is 60 (minutes), ie. record is created every hour. (Service value)

After pressing a button „Read“ in table „Info“ you can see current value of the real-time in the probe „Real time:“ and the value of the internal probe counter for service use „Total counts:“.

Pressing „Initialise“ button or choosing menu option

Configuration -> Measuring system -> Radon probes configuration ->Initialisation

you can open a initialization window of radon probes where you can start a resetting and setting operations according to the following table for the probe with a particular MESH address „MESH address: X“ or for all probes in the network at once „MESH address: All“. Selected operation is done by pressing „Initialise“.



„Clear spectrum memory“	It erases all previous spectrum records in the probe memory
„Clear Rn records memory“	It erases all previous measured data records in the probe memory
„Restart current measurement“	It resets current calculated average values of radon concentration in probe
„Copy real time from terminal“	It sets real time to probe from a central unit

The initialization process is recommended before each completely new measurement.

Attention! When you initialize the probe you must be absolutely sure that the previous records and the value you will not need in the future.

In our sample network we will not change any of the parameters and we leave it in the factory setting. We only make initialization of radon probe so that we erase all records in memory and we set real time from a central unit. Info window about a successful completion is shown, press „OK“. Then close the window by pressing „Close“.

1.5.10 Measurement Setup - Actuators

Here you can set the basic parameters of the measuring system concerning actuators.

Configuration -> Measuring system -> Actuators configuration -> Parameters

If actuator is not connected in system an information message is shown: „No actuators are bonded”.



Pressing „Read” button is read the current state of the switching contacts „State:” and adjusted operation mode of actuators switch with MESH address „MESH address:”. The „Off” state means that the switch contacts are currently switched off and state „On” means that the switch contacts are currently switched on. The actuators switch can be adjusted to three modes of operation according to the following table. Selected mode of operation is saved into the actuator by pressing button „Save”.

„Off”	The actuators switch is permanently switched off.
„On”	The actuators switch is permanently switched on.
„Auto”	The actuators switch is controlled wirelessly from a central unit according to the current concentration of radon and according to the adjusted switching limits in radon probes.

Attention! If the actuator is connected to the system for regulating radon concentration is necessary to have set the mode of operation to „Auto”.

In our sample network we set mode of operation of the actuator with MESH address 4 to “Auto” and we press „Save”. Then close the window by pressing the „Close”.

1.5.11 Measurement Setup - Repeaters

Repeaters operate autonomously and no configuration is needed.

1.5.12 IQRF Mode Setting

Configuration -> Wireless -> IQRF mode

This setting is intended for service purposes only. Changing the setting may cause disfunction of the system.

1.6. Measurement in Wireless Measuring Network TERA – „Data reading“

This chapter introduces you how to start measuring, displaying current results and reading data records from the probe and the central unit.

Radon probes continuously measures the radon concentrations and associated parameters. Continuous measurement and evaluation of all parameters in the probe can be stopped only by removing the battery. Measured results are automatically saved into the probe memory. The central unit only provides data acquisition from these probes and other wireless network elements.

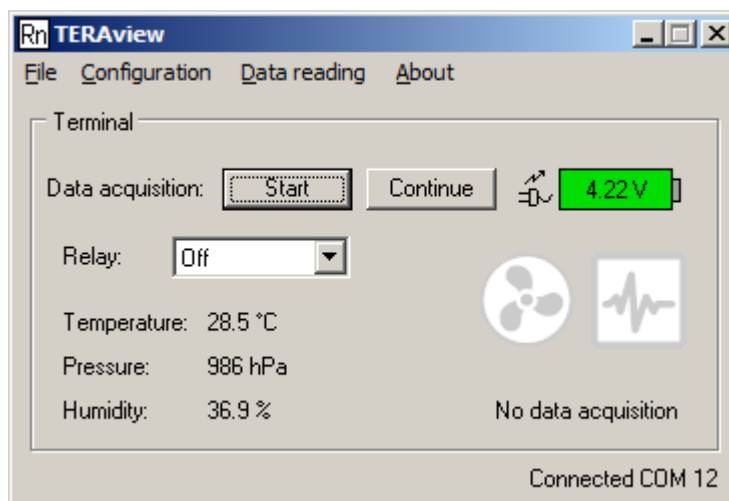
There are two possibilities how to download data to a central unit from radon probes and the whole network:

- a) **Continuous data download** – The central unit is present during the measurement and it periodically downloads the current data and the records from radon probes and other elements. This principle is necessary in a system for regulating radon concentration in buildings where central unit continuously evaluates the limit concentration in the measured area. The advantage of this principle to use in systems for radon concentration measurement is that the measured results in probe memory are transmitted to the central unit continuously and after the end of measurement data is immediately available and it can be downloaded quickly from the central unit to the PC.
- b) **Downloading data after the measurement** – The central unit is not present in the wireless network during the measurement. Radon probes after configuring measure autonomously. The central unit is connected wirelessly to radon probes after the end of measurement and downloading runs additionally. The advantage of this principle is that during the measurement it does not need the central unit. The disadvantage of this principle is that the additional download more data may take some time because the wireless communication channel between the probe and the central unit has a very limited transmission speed.

In the following summary are described procedures for starting of measuring, displaying of current results and reading of data records from a central unit and a probes for only principle of continuous data download. The procedure for principle of downloading data from the probe after the measurement is at point 1.6.4).

1.6.1 Starting and Stopping of Measurement

Starting and stopping of measurement in the central unit only mean the start and the end of data acquisition from elements of the wireless network. The measurement is started and stopped in the basic window of application in table „Terminal“ in item „Data acquisition:“ by pressing the buttons which are detailed in the following table:



„Start“	Start acquisition of completely new measurement data from the moment of pressing „Start“ button. Measured data before the time you press the „Start“ will not be downloaded.
„Continue“	Continuation of data acquisition after interrupt of downloading (press „Interrupt“) so that downloaded data was complete from the first pressing „Start“. It will be downloaded even the data (records) which wasn't download during the interruption. When the interrupt is longer the data records will be downloaded only up to a depth of 256 records items (with the 1 hour records interval the interrupt can take about 11 days ago) and only up to a depth of 32 items of energy spectra (with the 12 hour record interval the interrupt can take about 16 days ago).
„Interrupt“	Interruption of data acquisition into the central unit (of course radon probes measure continuously on)

Attention! When you need to change the network configuration during the measurement (data acquisition) you should always interrupt the data acquisition by pressing the "Interrupt". For continuation of data acquisition to press the "Continue" button is needed.

Attention !: If you interrupt (stop) data acquisition into a central unit by pressing the „Interrupt“, you always carefully consider what you expect from a measuring system in the next step:

- a) You ended the measurement and you are going to make completely new measurement -> press „Start“ button
- b) You only interrupted the measurement due to network configuration etc., and then you are going to continue the measurement -> press „Continue“ button

Attention! If you want to start quite new measurement (press „Start“ button) it is recommended to initialize (reset) radon probes, see „Measurement Setup - radon probe “ and to delete older recordings in a central unit, see „ Measurement Setup - central unit“. In these operations you must be aware of the losses measured data from previous periods or before deleting data download into the PC.

1.6.2 Displaying Current Values

When the data acquisition is ran basic window displays the current values of the wireless network elements. Names of the tables in the basic window corresponding to the elements from which the current values and parameters are downloaded:

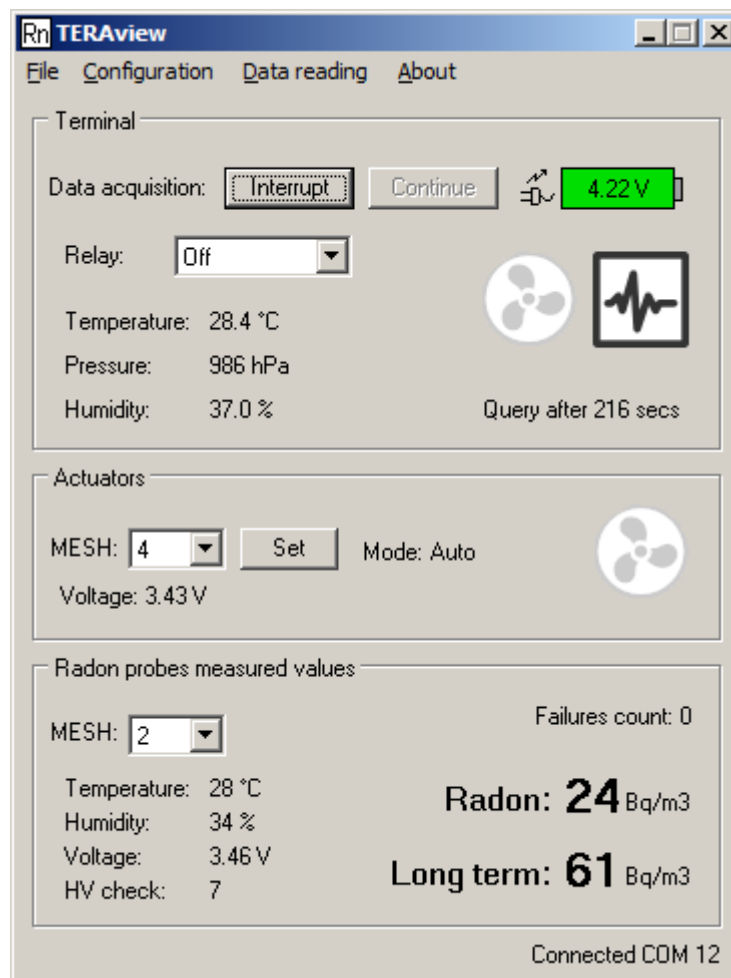
„Terminal“ – Central Unit

„Actuators“ – Actuators

„Radon probes measured values“ – Radon probes



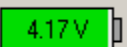





The actual values of the elements are repeatedly read after a specific period of time „Query time“, which is set during configuration of wireless network see „Measurement Setup - central unit“. The actual value of the central unit are read regularly after 1 second.

The basic window for our sample network with "Query time" 240 seconds is on the following image:





Descriptions of items from basic window are in the following tables:

„Terminal“

 ; 	Accumulator in the central unit is being charged; Accumulator in the central unit is not being charged
	Actual accumulator voltage of the central unit over 3.5V – green color – OK below 3.5V – yellow color – need to charge below 3.3 V – red color – necessarily charge below 3.1 V – Central unit is automatically turned off
„Relay:“	The currently set mode switching relay located in the central unit. You can resize: „Off“ Relay is permanently clapsed „On“ Relay is permanently not clapsed „Auto“ The relay is controlled by the central unit of the actual concentration of radon and according to the set switching limits radon probes.
 ; 	Current status of the relay contacts in the central unit: Contacts are off; Contacts are on
 ;  ; 	Current status of data acquisition in the central unit: Data acquisition is off; Data acquisition is on; Data acquisition is on and just a new current values are downloaded
„Temperature:“	Temperature in degrees of Celsius (°C) measured in the central unit.
„Pressure:“	Atmospheric pressure in kilopascals (kPa) measured in the central unit.
„Humidity:“	Relative humidity in percentage (%) measured in the central unit.
„Query after xxx secs“; „No data acquisition“	The time remaining to the next data acquisition in seconds; Data acquisition is off

„Actuators“

„MESH:“	Selecting of displayed actuator by MESH address.
„Set“	Button for configuration of actuator see „ Measurement Setup - Actuators“. During configuration the data acquisition must be off „Interrupt“.
„Mode:“	Currently set mode of actuator operation: „Off“ The actuators switch is permanently switched off. „On“ The actuators switch is permanently switched on. „Auto“ The actuators switch is controlled wirelessly from a central unit according to the current concentration of radon and according to the adjusted switching limits in radon probes.
 ; 	Current status of the relay contacts in the actuator: Contacts are off; Contacts are on
„Voltage:“	Actual actuator battery voltage. Under voltage 3.0 V the value turns red and warning window of low battery voltage is opened. In this case the battery must be replaced.

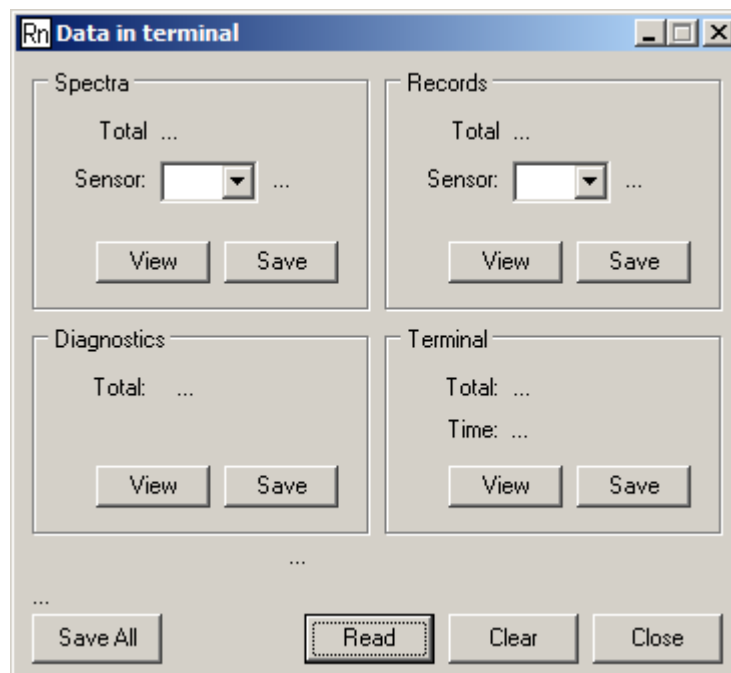
„Radon probes measured values“

„MESH:“	Selecting displayed radon probe by MESH address.
„Radon:“	Hour moving average of radon concentration in Bq / m3.
„Long term:“	Day moving average of radon concentration in Bq / m3.
„Temperature:“	Temperature in degrees of Celsius (°C) measured in radon probe.
„Humidity:“	Relative humidity in percentage (%) measured in radon probe.
„Voltage:“	Actual radon probe battery voltage Under voltage 3.0 V the value turns red and warning window of low battery voltage is opened. In this case the battery must be replaced.
„HV check:“	Status of high voltage in radon probe (for service purposes).
„Failures count:“	Number of failed communications between the radon probe and the central unit. During the first correct communication to zeroise this number. History of unsuccessful communications can be found in the diagnostic data of the central unit see „ Records Readings from Central Unit “ (for service purposes).

1.6.3 Records Readings from Central Unit

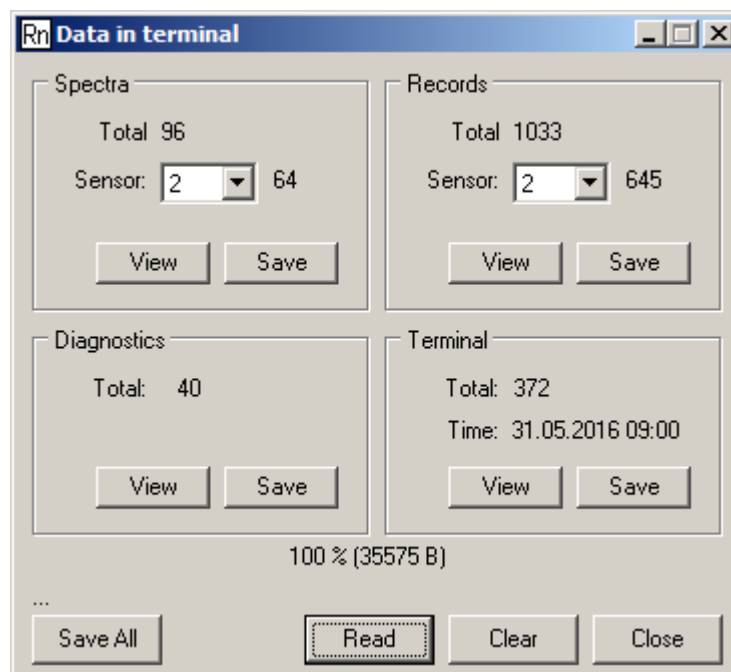
These time records of measured values and diagnostic data can be downloaded from the central unit only in continuous data download mode when the central unit is connected to the measuring system during the measurement.

Data reading -> Terminal -> Data



Pressing by button **„Read“** to download all time records from the central unit (from a measuring network) into TERAview application from the time of the last memory erasing in the central unit, see 'Measurement Setup - Central Unit'. Downloading can be interrupted by pressing the **„Interrupt“**.

Records are continously download in the central unit only when acquisition data running **„Data acquisition“**.

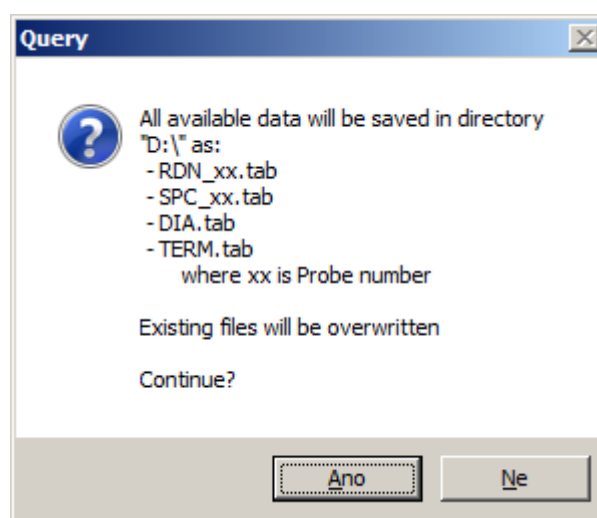


From wireless measuring network can be downloaded four kinds of records:

„Records“	Time record of measured values in the individual probes (radon concentration, temperature, humidity, battery voltage, etc.)
„Spectra“	Time record of the energy spectrum in the individual probes after 12 hours
„Diagnostics“	Time record of events in the measurement network
„Terminal“	Time record of the measured values in the central unit (pressure, temperature, humidity, the battery voltage)

All records downloaded in TERAview application can be deleted by pressing „Clear“ button. Pressing this button will not be deleted records from the central unit!

All records can be saved at once to a file in the PC by pressing „Save All“ button. After pressing this button is needed in the next window choose a destination folder on the PC where you want to save the all records. Confirmation of target directory the control window is opened whether really want to create these files in selecting location and whether you want to rewrite the older records by new one in case of existence records in selecting location.



Confirming this window the set of files with spreadsheets prescription is created.

The file names of individual records are firmly defined as follows:

RDN_XX.tab	Time records of measured values in probes where XX is MESH address of individual probes
SPC_XX.tab	Time records of energy spectra in probes where XX is MESH address of individual probes
DIA.tab	Time record of events in the measurement network
TERM.tab	Time record of the measured values in the central unit (pressure, temperature, humidity, the battery voltage)

Files with extension .tab are text files with spreadsheets prescription and can be opened in any text editor (Notepad, Word, etc.) and in any spreadsheets (Excel, etc.) for further processing. For easy graphical display of file .tab can also use the program Radonview see „Accessories“.

Records can be also viewed and downloaded individually by pressing „**View**“ or „**Save**“ buttons in tables „**Records**“, „**Spectra**“, „**Diagnostics**“, „**Terminal**“. In tables are also displayed numbers of records „**Total**“. In table „**Records**“ can be chosen MESH address of displayed radon probe „**Sensor**“. In table „**Terminal**“ is also seen the time of first record in the terminal „**Time**“.

The following windows and tables illustrate options of display and setting for individual record types.

„Records“ – Time records of measured values in radon probes

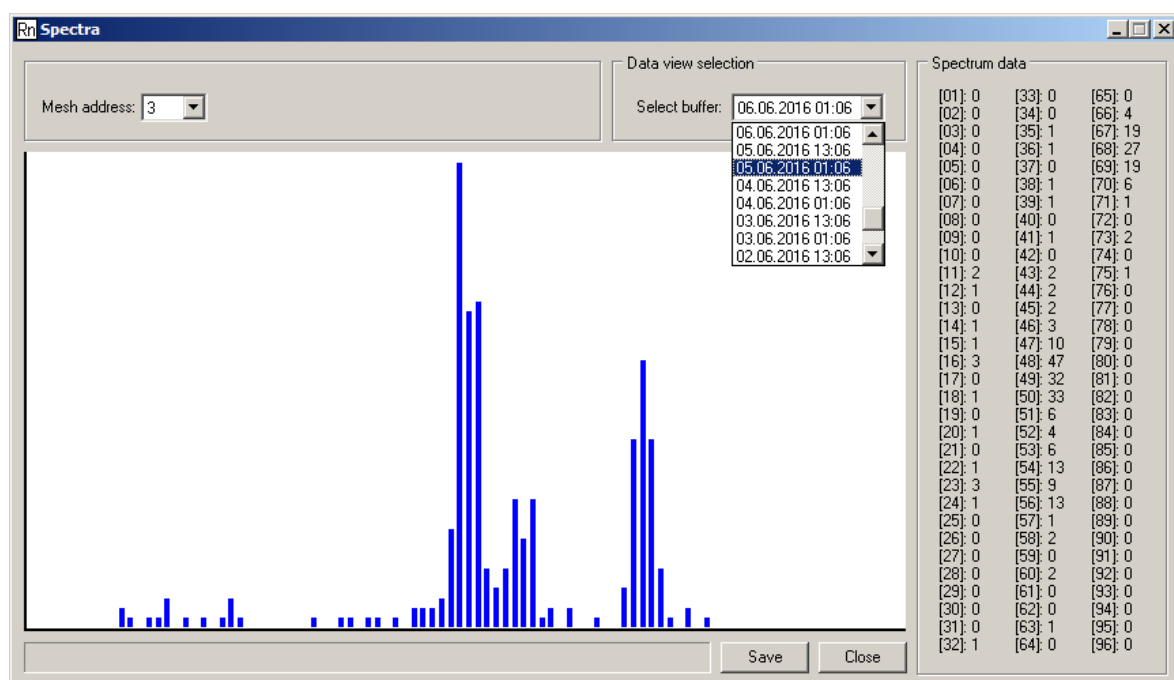
Rn Radon records

MESH address: Find record No:

Records	time	radon [Bq/m3]	sum1	sum2	sum3	sum4	temperature [°C]	humidity [%]	HV
1	16.06.2016 12:05	25	0	3	0	0	27	41	7
2	16.06.2016 11:05	60	1	7	0	0	27	42	7
3	16.06.2016 10:05	41	1	5	0	0	25	43	7
4	16.06.2016 09:05	41	2	5	0	0	25	43	7
5	16.06.2016 08:05	58	1	6	1	0	25	43	7
6	16.06.2016 07:05	81	2	9	1	0	24	43	7
7	16.06.2016 06:05	24	2	3	0	0	24	44	7
8	16.06.2016 05:05	82	0	10	0	0	24	44	7
9	16.06.2016 04:05	48	0	6	0	0	24	43	7
10	16.06.2016 03:05	48	1	6	0	0	24	43	7
11	16.06.2016 02:05	24	1	3	0	0	24	43	7
12	16.06.2016 01:05	40	0	5	0	0	24	43	7
13	16.06.2016 00:05	40	0	5	0	0	24	43	7
14	15.06.2016 23:05	25	1	2	1	0	25	43	7
15	15.06.2016 22:05	16	0	2	0	0	25	42	7
16	15.06.2016 21:05	0	0	0	0	0	25	42	7
17	15.06.2016 20:05	24	0	3	0	0	25	42	7

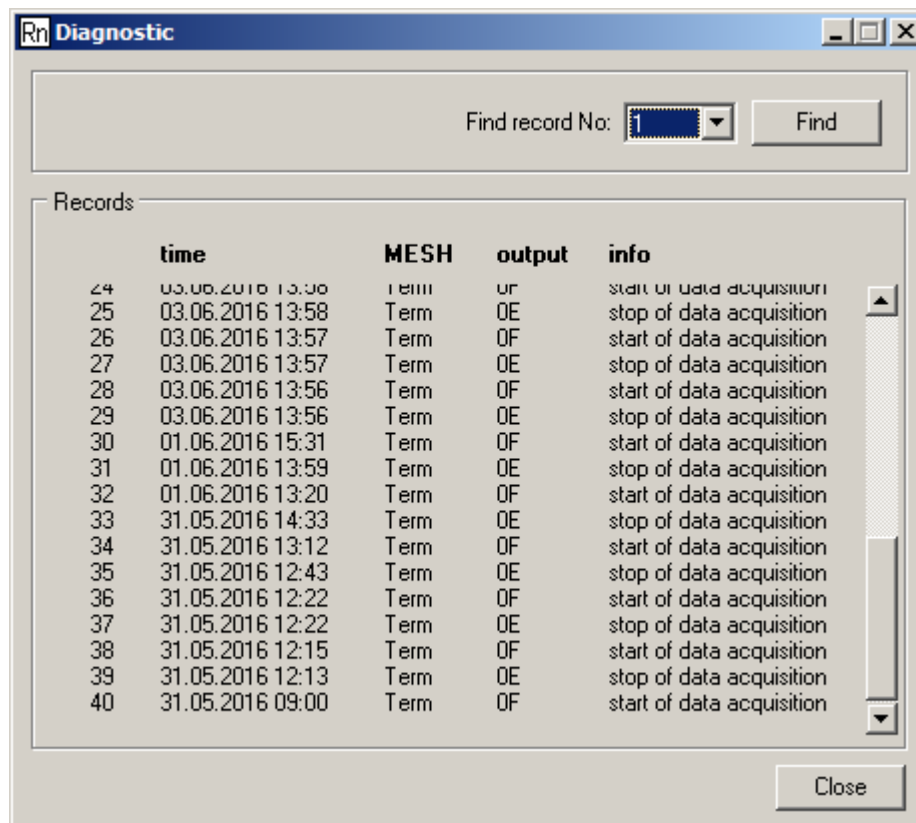
MESH address:	Selecting of displayed radon probe by MESH address
1..X	Number of individual record
time	Time of individual record
radon [Bq/m3]	Hour moving average of radon concentration
sum1,sum2,sum3,sum4	The number of impulses in the energy window (expert, services)
temperature [°C]	Temperature measured in the chamber of radon probe
humidity [%]	Relative humidity measured in the chamber of radon probe
HV	Number excitation of high voltage generator (for service purposes)
Save	Pressing the button saves the records to the file.tab in PC
Close	Pressing the button closes window viewing records

„Spectra“ – Time record of the energy spectrum in radon probes after 12 hours



MESH address:	Selecting of displayed radon probe by MESH address
Select buffer:	Selecting of displayed energy spectrum by date and time
Spectrum data	Data for the selected energy spectrum
Save	Pressing the button saves the records to the file.tab in PC
Close	Pressing the button closes window viewing records

„Diagnostic“ – Time record of events in the measurement network



1..X	Number of individual record
time	Time of individual record
MESH	MESH address of the element which triggered the event (Term - Central Unit)
output	Event code
info	Event description
Close	Pressing the button closes window viewing records

„Terminal“– Time record of measured values in the central unit

The screenshot shows a window titled "Records in terminal". At the top, there is a search bar labeled "Find record No:" with a dropdown menu showing "1" and a "Find" button. Below this is a table with the following columns: "time", "pressure [hPa]", "temperature [°C]", "humidity [%]", and "accu [V]". The table contains 17 rows of data, with the first row being the most recent (16.06.2016 12:37) and the last row being the oldest (15.06.2016 22:34). A vertical scrollbar is on the right side of the table. At the bottom right of the window is a "Close" button.

	time	pressure [hPa]	temperature [°C]	humidity [%]	accu [V]
1	16.06.2016 12:37	975	28.3	43.3	4.19
2	16.06.2016 11:37	975	27.7	44.1	4.20
3	16.06.2016 11:29	975	27.5	44.2	4.20
4	16.06.2016 11:25	975	27.3	44.3	4.20
5	16.06.2016 10:34	976	26.1	44.9	4.11
6	16.06.2016 09:34	976	25.4	45.2	4.11
7	16.06.2016 08:34	977	24.8	45.4	4.11
8	16.06.2016 07:34	977	24.8	45.5	4.11
9	16.06.2016 06:34	977	24.5	45.5	4.11
10	16.06.2016 05:34	977	24.4	45.7	4.11
11	16.06.2016 04:34	977	24.4	45.6	4.11
12	16.06.2016 03:34	977	24.4	45.5	4.11
13	16.06.2016 02:34	977	24.5	45.4	4.11
14	16.06.2016 01:34	977	24.6	45.2	4.11
15	16.06.2016 00:34	977	24.6	45.1	4.12
16	15.06.2016 23:34	977	24.7	44.9	4.11
17	15.06.2016 22:34	976	24.8	44.6	4.12

1..X	Number of individual record
time	Time of individual record
pressure [hPa]	Air pressure measured in the central unit
temperature [°C]	Temperature measured in the central unit
humidity [%]	The relative humidity measured in the central unit
accu [V]	Battery voltage in the central unit
Close	Pressing the button closes window viewing records

1.6.4 Records Readings from Radon Probes

If the central unit has not been connected in the measuring system during measurement and it is utilized only for one time records downloading from radon probes after the end of measurement, then you select the described process below for downloading records of measured values and downloading records of energy spectra from the individual probes. This principle of downloading is due to the very limited transmission speed of wireless connection more time consuming especially for larger volumes of downloaded records.

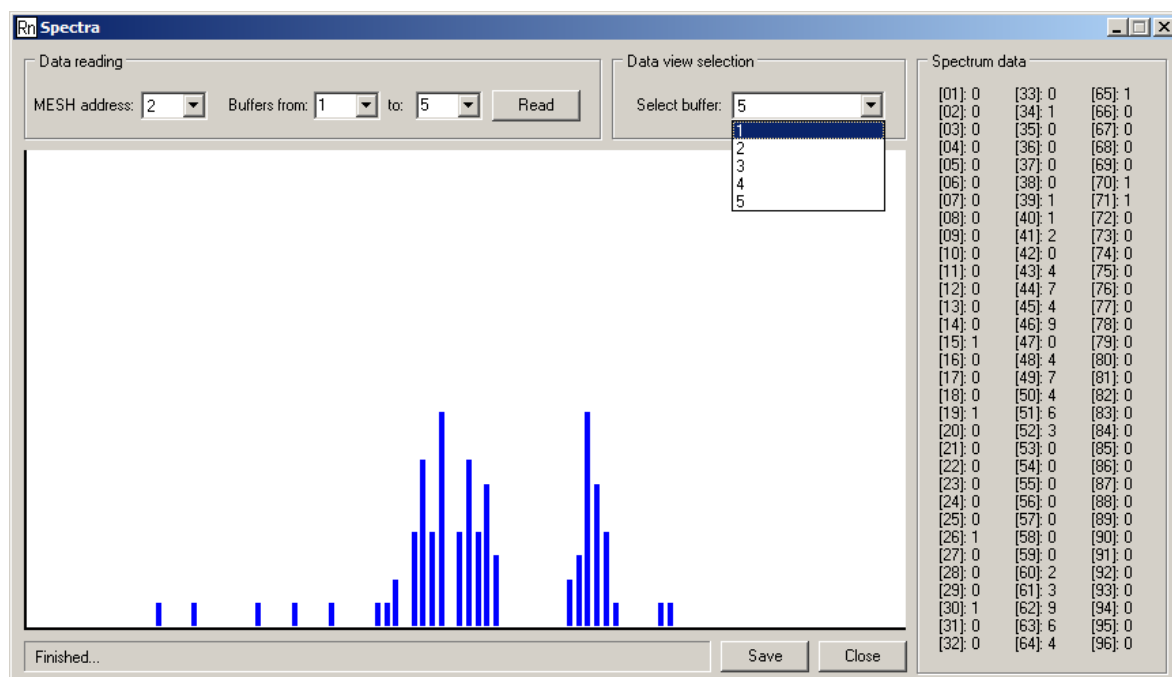
Time records of measured values in radon probes

Data reading -> Radon probes -> Records

	time	radon [Bq/m3]	sum1	sum2	sum3	sum4	temperature [°C]	humidity [%]	HV
1	17.06.2016 08:05	69	0	8	0	0	25	47	7
2	17.06.2016 07:05	34	1	4	0	0	25	47	7
3	17.06.2016 06:05	77	0	9	0	0	25	46	7
4	17.06.2016 05:05	102	1	12	0	0	25	45	7
5	17.06.2016 04:05	102	1	12	0	0	25	45	7
6	17.06.2016 03:05	102	0	12	0	0	25	45	7
7	17.06.2016 02:05	92	0	10	1	0	25	44	7
8	17.06.2016 01:05	75	1	9	0	0	25	44	7
9	17.06.2016 00:05	117	1	14	0	0	25	44	7
10	16.06.2016 23:05	60	0	7	0	0	26	44	7
11	16.06.2016 22:05	153	0	18	0	0	26	43	7
12	16.06.2016 21:05	119	0	14	0	0	26	43	7
13	16.06.2016 20:05	94	0	11	0	0	26	43	7
14	16.06.2016 19:05	42	1	5	0	0	26	42	7
15	16.06.2016 18:05	43	0	5	0	0	27	42	7
16	16.06.2016 17:05	8	0	1	0	0	27	41	7
17	16.06.2016 16:05	61	0	7	0	0	28	41	7

MESH address:	Selecting of displayed radon probe by MESH address
Records from to	Selecting of range of downloaded records items from - to (default values can also be overwritten by desired number). Item number 1 is always the most recent record.
Read	Pressing the button is started downloading of records from radon probe (Downloading can be interrupted by pressing the „Stop“)
1..X	Number of individual record
time	Time of individual record
radon [Bq/m3]	Hour moving average of radon concentration
sum1,sum2,sum3,sum4	The number of impulses in the energy window (expert, services)
temperature [°C]	Temperature measured in the chamber of radon probe
humidity [%]	Relative humidity measured in the chamber of radon probe
HV	Number excitation of high voltage generator (for service purposes)
Save	Pressing the button saves the records to the file.tab in PC
Close	Pressing the button closes window viewing records

Time record of the energy spectrum of radon probes after 12h
Data reading -> Radon probes -> Spectra



MESH address:	Selecting of displayed radon probe by MESH address
Buffers from to	Selecting of range of downloaded records items from - to (default values can also be overwritten by desired number). Item number 1 is always the most recent record.
Read	Pressing the button is started downloading of records from radon probe (Downloading can be interrupted by pressing the „Stop“)
Select buffer:	Selecting of displayed energy spectrum by date and time
Spectrum data	Data for the selected energy spectrum
Save	Pressing the button saves the records to the file.tab in PC
Close	Pressing the button closes window viewing records

1.7. Warranty and Licensing

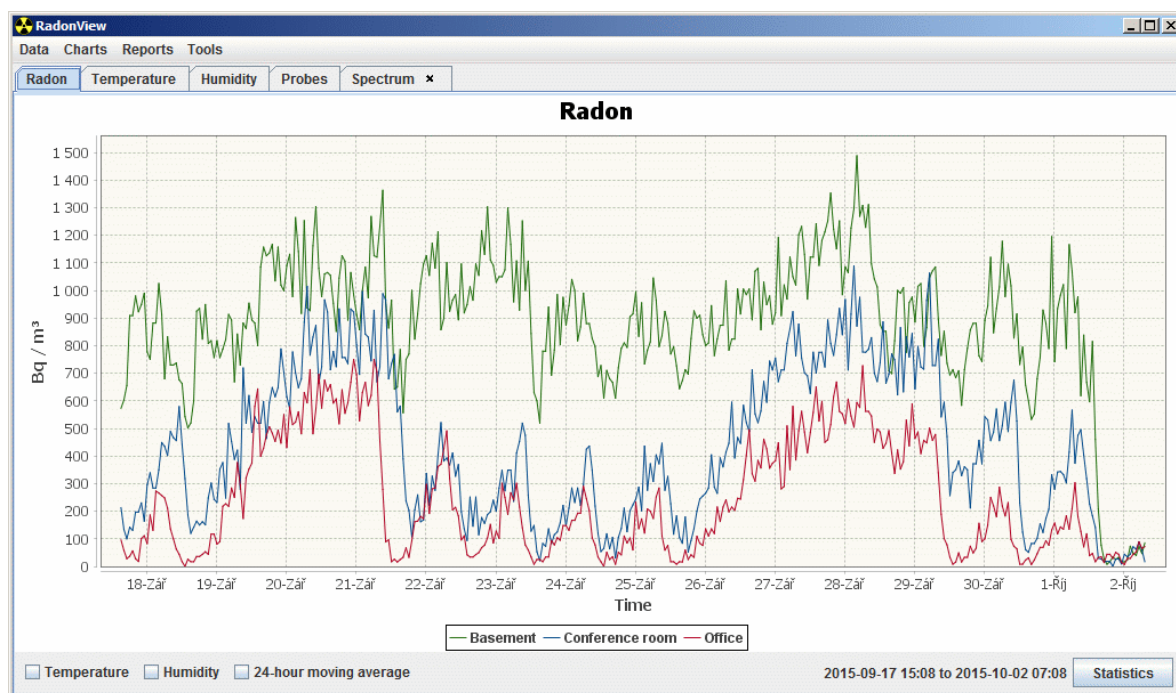
TERAview application can be freely downloaded from the manufacturer's website TESLA www.tesla.cz. TERAview downloading of an application from the website and then running it you agree with the conditions of the end user license agreement which is included in the download package TERAview. You agree that you will not give permission, copy, sell, rent, transfer, distribute, publish, offer to third parties or otherwise commercially exploit application TERAview without the prior written consent of TESLA.

TESLA assumes no responsibility for errors, omissions and damages resulting from the use of applications TERAview.

Other versions and modifications can be created without prior notice to users of the current version.

1.8. Accessories

[RadonView](http://www.suro.cz) - Computer application for easy viewing records and spectra measurement of radon concentration (files .tab) to download on the website of the SÚRO (National Radiation Protection Institute) (<https://www.suro.cz/en/prirodnioz/suro-software-data-processing-from-continuous-rn-monitors>)



1.9. Revision History

Revision	Date	Comment
Rev.1:	22. 7. 2015	Initial release
Rev.2:	30. 4. 2016	Extended release
Rev.3:	20. 8. 2016	Corrected release