EN

TERA Radon Program

TSR4S – SIGFOX Wireless Radon Probe
Technical Specifications & Operation Manual

v.2 – 2020

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Manual also available on www.tesla.cz

1 Introduction

This document describes technical specifications and user operation of the TSR4S SIGFOX Wireless Radon Probe.

Product was developed and manufactured in the Czech Republic. All rights reserved TESLA. Offer or delivery of products or services related to the product does not include transfer of ownership rights.

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

Attention! This formatted text indicates the operating and safety instructions.

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

2 Description and Utilization
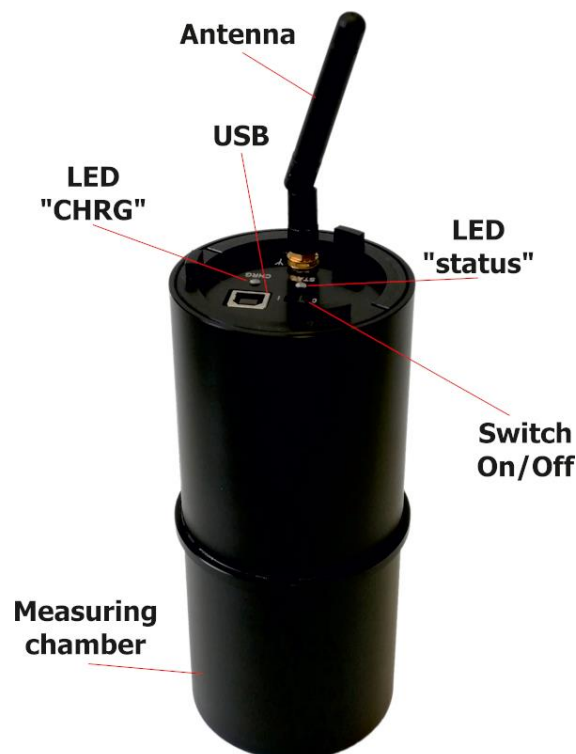
Portable radon measuring probe with rechargeble accumulator allows to watch radon results remotely over wireless mobile network of Internet of Things (IoT) SIGFOX. The probe can be placed anywhere in the world where this mobile network has coverage (https://www.sigfox.com/en/coverage). The probe autonomously sends in regular intervals measured current results (RVA - radon concentration (RaA+RaC), temperature, relavite humidity and accumulator voltage) over wireless network SIGFOX to web server where is possible to view and download results via internet and internet browser in web application TESLA - MONTES. In application is possible to set alarm messages which in case of crossing of radon concentration limit are sent by SMS, email or direct call.Coupled with delivery is charged wireless connectivity and web appplication regular service fee. Configuration of probe and setting regular interval of sending are made over USB port and application in PC. Probe includes GPS module for better localization in wider measurement networks.

It is similar like TSR4 probe only with another type of wireless communication SIGFOX. In case of need the TSR4S can be change to TSR4 or TSR4M and back by easy and quick way in product factory.

Probe is designed for continuous measuring of radon concentration. Portable probe basis is a measuring chamber with a semiconductor photodetector. Radon enters the chamber by diffusion through the input filter on the bottom of probe. The probe measures in autonomous and time continuous way. It processes results every 2 minute intervals and from this counts radon concentration (1 hour moving average - average of 30 2-minute process intervals). The probe sends results to server and saves time records in its internal memory (typically at an interval of 1 hour). Times of particular result records in internal memory and on server can be different in few second due to delay cause by radio transmission. Next saved value to internal memory is time record of measuring energy spectrum (typically at an interval of 12 hours). The probe can be switched on/off by switch. LEDs „STAT" a „CHRG" indicate current status of probe.

Features:
- On-line monitoring of measured results on WEB (radon concentration, temperature, humidity)
- Alarms over SMS, email and call if radon cross the limit
- Internal memory for backup of measured results (downloading over USB)
- Monitoring of GPS position on map
- Accumulator life up to 1 year after full charging or using permanent power adapter 230V
- User friendly web application, graphs, data export
- Unique web access for management of probes

Radon Probe can be operated by these ways:

A) **SIGFOX** - Thanks to its independent battery power, portable radon measuring probe supports flexible placing options within monitored structures. Accumulator will last for more than 1 year after full charging. After switching on probe immediately starts measuring and sending in simplex mode results over wireless mobile network SIGFOX to server and the same time the results are saved to internal memory of probe (every hour default). On server it is possible to view or download results over internet connection and web page of application MONTES in internet browse of your PC (https://montes.tesla.cz).
Pozor!: The probes aren´t possible to configure over network sigfox only over USB point B).
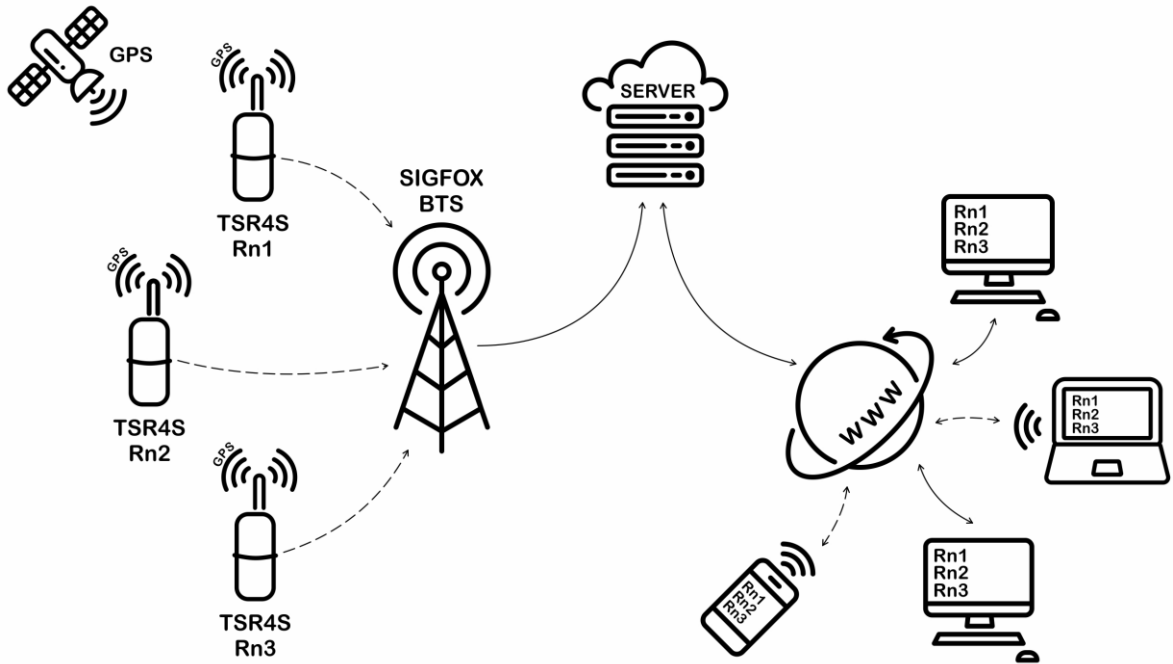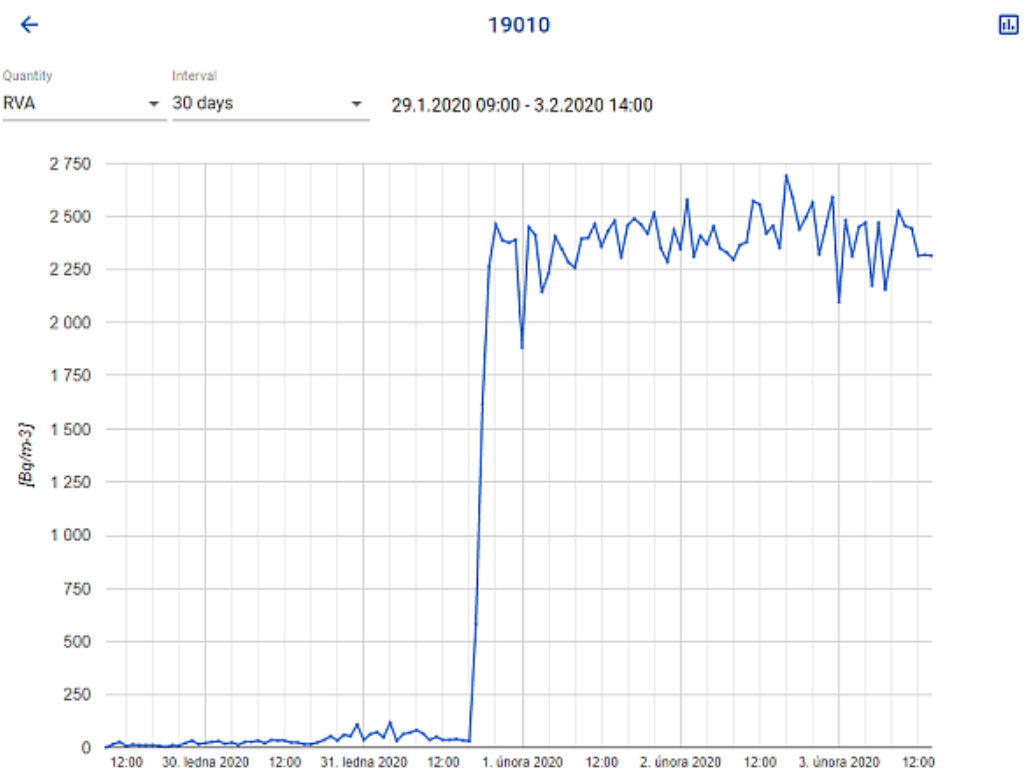
B) **USB** – After switching on the probe immediately starts measuring and saving results into internal memory too. Using usbRADONview app and USB cable is possible to download results to PC continuously during measurement or at once at the end of measurement from internal memory of probe. usbRADONview application, drivers and user manual is free downloaded on website: http://www.tesla.cz/ .
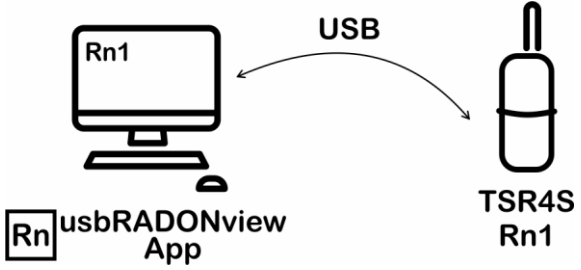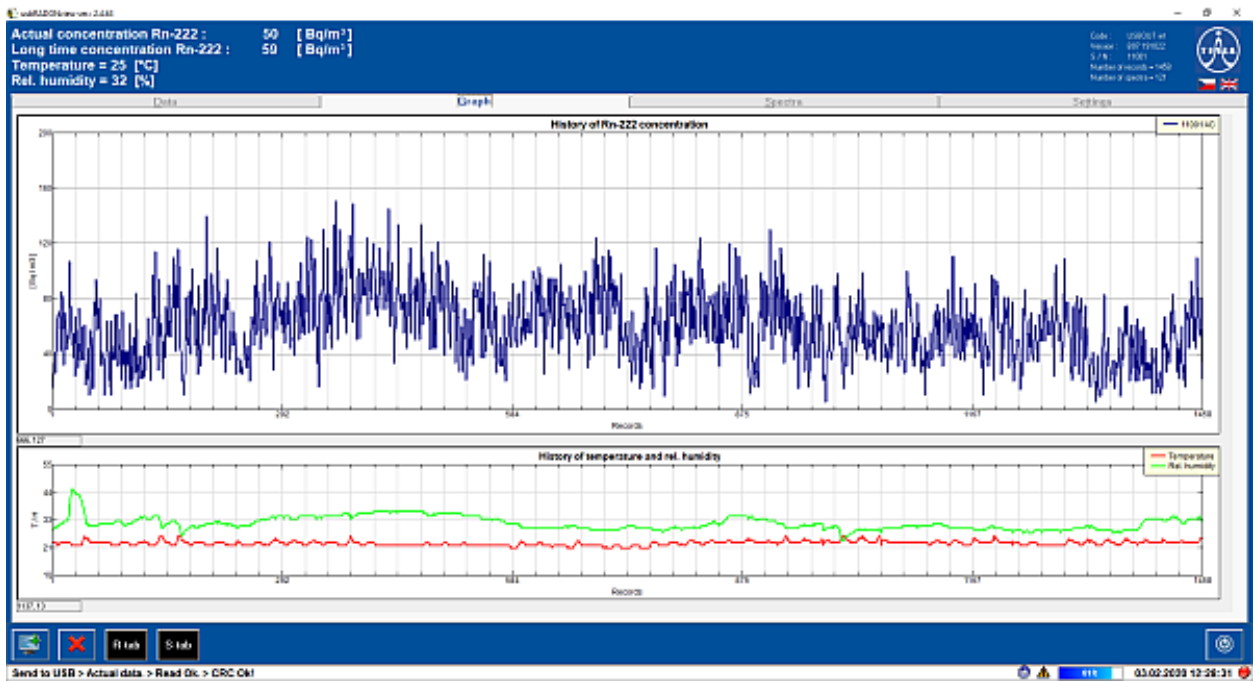
3 Scope of Delivery

- TSR4S Radon probe
- Power adapter 230VAC/5VDC
- USB cable A-B
- Antenna
- Probe holder
- Operation Manual
- ID and password for web access

4 Product Specification

Product	TSR4S - SIGFOX Wireless Radon Probe
Type symbol	042 127 216 000
Average measurement sensitivity	0,25 count/hour/Bq.m-3 (method RaA+RaC; 15°C ÷ 30°C; rel. hum. 20% ÷ 40%)
Measuring range	MDA – 100 000 Bq/m^3; MDA = 100 Bq/m^3 per 1 hour or 20 Bq/m^3 per 24 hours
Measurement uncertainty	< 13% at 300 Bq/m^3 per 1 hour; < 3% at 300 Bq/m^3 per 24 hour
Measuring chamber capacity	0,176 dm3
Response rate	< 30 minutes (RaA); < 3 hours (RaA + RaC)
Radon records	calculated from RaA (quicker, less sensitive), (recorded only in internal memory) calculated form RaA + RaC (slower, more sensitive), (sended to server and recorded in internal memory)
Measuring relative humidity range	10 – 90 % (WEB and recorded in internal memory)
Measuring temperature range	-20 to + 60 °C (WEB and recorded in internal memory)
Results sending and saving interval	15 - 255 minutes, default 1 hour
Results memory capacity	4096
Powering	internal rechargeble accumulator; charging via USB
Accu life after full charging	>1 year
Dimension	Ø 80 x 175 mm
Radio technology	SIGFOX RC1 868 MHz

5 Operating Instructions

Switching on and off:

The probe measures radon concentration autonomously and sends messages to server only if the switch is in position „I"(switch on). The switching on is signalized by LED diode „STAT" according chart below.

If the switch is in position „0" (switch off) the probe doesn´t measure radon concentration and doesn´t send messages to server. In switching off mode the probe only keeps running real time for correct date and time of records in case of switch it on again. By switching off the probe doesn´t lose previous records of measurement. The switching on is signalized by LED diode „STAT" according chart below.

Download data from probe over USB is possible only if switch is in position „I" (switch on).

LED diode „STAT":

It signalizes status radon probe according to following chart:

Color	Description
Green blink 3x	Radon probe has just been turned on.
Green blink after 5s	Radon probe measures and works correctly
Yellow blink 4x	Radon probe has just been turned off.
Green / Yellow blink after 5s	Radon probe measures but troubles are occur. – especially low capacity of accumulator. Warnings and errors are shown in PC application.
No light, No blinking	Radon probe doesn´t measure or accumulator is empty or device is damaged. Charging process of accumulator is described in chapter „Basic Maintenance/ Accumulator charging"

Power supply:

According to operation method the radon probe can be supplied:

1) <u>By internal accumulator for portable use</u> – Radon probe includes internal accumulator which is able to ensure autonomous operation of probe for more than 12 months without charging. Depends on climatic condition of probe use. Accumulator is charged with USB port and provided USB cable. The USB cable is possible to connect to PC or to delivered power adapter. Status of accumulator and charging process are described in paragraph ´Basic Maintenance/Accumulator charging´

2) <u>By mains power supply 230V/50Hz for stationary use</u> – Radon probe is permanently supplied by delivered power adapter. Power adapter is connected to probe via provided USB cable. In case of blackout internal accumulator ensures UPS function.

Configuration:

Setting and configuration are realized by usbRADONview application. UsbRADONview application, drivers and user manual with detail configuration description are free downloaded on website: http://www.tesla.cz.

Attention!: Values and interval of sent SIGFOX data message to server are same as values and interval of saved data into internal memory of probe. The interval of sent SIGFOX message is set by interval of saved data into internal memory of probe „Concentration Record" in usbRADONview application.

Type of SIGFOX messages:

During of probe operation is sent various type of SIGFOX messages to server. Description of particular types of messages is below:

Value - Regular message with measured data (RVA - radon concentration (RaA+RaC), temperature, relavite humidity,accumulator voltage (battery), status of high voltage). Time interval is adjustable (default 1 hour).

Start – Extra message is sent immediately when probe is switched on

Keepalive1 – Extra message is sent regularly every midnight with information about configuration and status of probe.

Keepalive2 - Extra message is sent regularly every midnight with information about configuration and status of probe.

GPS - Extra message is sent regularly every midnight with information about GPS position of probe. If probe „see" less than 2 GPS satellites the message isnt sent.

Data from Extra messages are shown on server under „Service details" and it means following current information about the probe:

Battery [mV] – Voltage of probe internal accumulator. Voltage should not fall below 3.5 V, in limit conditions falls below 3.3V. In MONTES web application you can configure your alarm message to SMS, email or call if voltage of accumulator is too low.

HV voltage [-] – Status of high voltage in measuring chamber (frequency of charging). Number should not raise over 40 (service information).

Impulses [tis.] – Number of impulses catch by detector from beginning (service information).

HW [-] – Serial number of probe.

SW [-] – Version of probe software.

Period [min] – Time interval of measured data saving to internal memory and time interval of measured data sending to server.

Channel Max. [-] – Description of last energy spectrum - Channel (Energy) in maximum of whole spectrum [x 0,1 MeV]. Expected energy peak for Po-218 is in 60-61 channel as 6,00MeV. Expected energy peak for Po-214 is in 77-78 channel as 7,69MeV. (expert information).

Pulses at Max. [-] – Description of last energy spectrum – Number of catched impulses with energy in Channel Max.

Ch. Max. d2 [-] - Description of last energy spectrum – Channel (Energy) in maximum of spectrum area Po-218 [x 0,1 MeV] (expert information). Expected energy peak for Po-218 is in 60-61 channel as 6,00MeV

Ch. Max. d3 [-] - Description of last energy spectrum – Channel (Energy)in maximum of spectrum area Po-214 [x 0,1 MeV] (expert information). maximum of whole spectrum [x 0,1 MeV]. Expected energy peak for Po-214 is in 77-78 channel as 7,69MeV.

Discrimination 1 [-] – Discriminating energy channel for beginning of area d2 (Po-218)(expert information).

Discrimination 2 [-] - Discriminating energy channel for dividing line between area d2 (Po-218) and area d3 (Po-214)(expert information).

Discrimination 3 [-] - Discriminating energy channel for ending of area d3 (Po-214)(expert information).

Calibr. C.. A [-] – Calibration constant for radon concentration from Po-218(RaA)(service information).

Calibr. C. AC [-] - Calibration constant for radon concentration from Po-218(RaA)+ Po-214(RaC)(service information).

Gain [-] – Offset of energy spectrum (service information)

GPS Position [-] – GPS position of probe.

Satellites [-] – Number of visible satellites during last position measuring. If probe „see" less than 2 GPS satellites the message „GPS" isnt sent..

Altitude [m] – Altitude of probe location.

Start [-] – Time of last probe switching on and the „Start" message was sent to server.

Installation:

The probe is delivered with simple holder for wall mounting but the probe can operate in random position or probe is possible to stand to the bottom. The probe is mainly design for indoor operation. For outdoor installation is necessary to insert probe to some cover so that the part with electronics will be prevent from water and the bottom of probe will be free. For outdoor installation the producer offers on request the special cover with solar panel for long time operation.

During installation is necessary to test strength of radio signal SIGFOX on the measuring spot. For this case is possible to use test extra message „Start". This message is sent immediately when probe switch is switched on to position „I". Whether the message was delivered to server correctly you can make sure in your account on https://montes.tesla.cz in menu Overviews -> Messages.

If the „Start" messages repeatedly didnt come to server the radio network hasnt good coverage on this spot and probe is neccesary to shift or removeto another place where will be better radio signal and smaller radio shadow. Generally this radio sevice use the towers of mobile operators for spreading.

If the „Start" message came to server it is possible to find out probable quality of radio signal on the spot according parameter RSSI or according colors of radio icon at this message on server. Strength of radio signal is affected by all sorts of effects therefore relevant radio quality on the spot is possible to find out after longer operation and from more incoming messages to server.

Green icon - RSSI under 122 dB – very good quality of radio signal

Orange icon – RSSI from 122 to 135 dB – worse quality of radio signal

Red icon - RSSI 135 dB – limit quality of radio signal

6 Basic Maintenance

Accumulator charging:

During portable use of radon probe is essential to monitor state of internal accumulator and recharge it if necessary. If accumulator is discharged the probe automatically turns off. The probe is switched on again powering USB port.

Current state of accumulator can be determined in two ways:

1) By LED diode ´STAT´ - If LED starts blinking in green-yellow color it indicates that system is working incorrectly and one of main case is low voltage of accumulator (see paragraph "Operation Manual / LED diode "STAT"").

2) In usbRADONview application - where you can check current accumulator voltage. Voltage should not fall below 3.5 V, in limit conditions falls below 3.3V.

3) In MONTES application on server - where you can check current accumulator voltage. Voltage should not fall below 3.5 V, in limit conditions falls below 3.3V. In MONTES web application you can configure your alarm message to SMS, email or call if voltage of accumulator is too low.

Accumulator is charged via USB port using supplied USB cable. USB cable can be connected to PC or to supplied power adapter. Connect USB cable with power to USB port of probe. LED diode ´CHRG´ next to USB port of probe indicates charging status according to following chart:

LED diode ´CHRG´

Color	Description
Green	Accumulator is fully charged
Yellow	Accumulator is being charged
Green - Yellow alternate blinking	Accumulator is damaged, contact Service Center
No light, No blinking	It is not connected to an external power supply or device is damaged.

Accumulator is fully charged when LED diode ´CHRG´ is green. You can disconnect USB cable.

7 EC Declaration of Conformity

EC Declaration of Conformity will be delivered by Tesla producer on request. If interested, please use contacts on the web www.tesla.cz .

8 Repairs

Any repairs and non basic maintenance must be performed exclusively by TESLA manufacturer.

TESLA
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9 Warranty

- This product is covered by warranty of 24 months from purchase date.
- In case of buying MONTES service the warranty is extend for term of use the service.
- In case of warranty claim, please contact our Service Department.
- Warranty covers any defects in materials or workmanship and excludes any damage resulting from or caused by transport or handling or by any misuse.
- Warranty ceases if product has been used improperly or its seal is broken.
- In case of warranty claim, warranty period is prolonged by number of days product was undergoing warranty repairs.
- After the end of its life, product must be handled as e-waste.

10 Accessories

Radon Probe accessories are available at producer www.tesla.cz or at distributor.

Probe holder (is included in package)   **Reserve antenna**

11 Alternatives

TSR4S probe is easy and quick to change in manufacturer to new type of these probes:

TSR4 – WLAN Wireless and USB Radon Probe
TSR4M - USB Radon Probe with big memory

12 Revision History

Revision	Date	Comments
Rev.1:	20.4.2019	Initial release
Rev.2:	13.3.2019	SIGFOX Message Type