



VF NUCLEAR

# HAND-FOOT CONTAMINATION MONITOR

## HF-4A, HF-4B, HF-4C, HF-4D, HF-4E

Type: K1175, K1176, K1177, K1178, K1179

Variants: K1175-02, K1176-02, K1177-02, K1178-02, K1179-02

## Instructions for Use



VF, a.s.  
Svitavská 588  
CZ 679 21 Černá Hora  
phone +420 516 428 611  
fax +420 516 428 610  
info@vfnuclear.com

[www.vfnuclear.com](http://www.vfnuclear.com)

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## Preface

Before using the hand-foot contamination monitor HF-4, please read the Instructions for Use carefully and follow them.

The information included in these Instructions for Use is the exclusive property of VF, a.s. and may not be modified, copied or disclosed to third parties in any way without the company's knowledge.

Failure to follow the instructions and safety information contained in these Instructions for Use may be considered a breach of warranty conditions and may lead to the termination of the warranty period.

The manufacturer reserves the right to make technical, visual and functional changes to the instrument without prior notice as part of the manufacturer's efforts for continuous development and improvement of its products.

The Instructions for Use form an integral part of the instrument.

## 1. Introduction

Hand-foot contamination monitors are intended for indicating contamination with alpha, beta or gamma radionuclides occurring on the surface of hands, feet or clothes.

### 1.1. Abbreviations

CRM	Certified reference material
LLMR	Lower limit of measurement range
LV1	Threshold of alarm level 1
LV2	Threshold of alarm level 2
PC	Personal computer
PCB	Printed circuit board
PLC	Programmable logic controller
PMT	Photomultiplier
R	Instrument response
RF	Response factor
SW	Software
TDCL	Threshold detector contamination level
ULMR	Upper limit of measurement range
USB	Universal Serial Bus
ZnS(Ag)	Silver-activated zinc sulphide (scintillation material for the detection of alpha particles)

## 1.2. Laws, regulations, standards

The specified laws, regulations and standards are valid in the European Union. The instrument meets and follows the directives and government regulations referred to in Tab. 1 as well as the harmonized technical standards referred to in Tab. 1.

Designation/year of publication	Name
Directive 2014/35/EU	Safety of Low-Voltage Electric Equipment
Directive 2014/30/EU	Electromagnetic Compatibility

Tab. 1 EU directives and government regulations

Designation	Name
ČSN EN 61098	Radiation protection instrumentation - Installed personnel surface contamination monitoring assemblies
ČSN EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
ČSN EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.
ČSN EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.
ČSN EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test.
ČSN EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.
ČSN EN 61000-4-8	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test
ČSN EN 61000-4-11	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests
ČSN EN 61000-6-3	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments


















Tab. 2 Technical standards

## 2. Occupational safety, fire protection and environmental impacts

### 2.1. Occupational safety

A summary of measures provided for in the legislation and recommended by the manufacturer, to prevent danger or damage to human health in the working process.

#### 2.1.1 Safety labels used in the company VF, a.s. and their meaning

	Prohibition		Warning		Caution; Hot surface
	Do not dispose of as common waste		Radioactive material or ionizing radiation		Grounding
	Do not extinguish with water		Caution; Electricity		Wear safety gloves
	No metal objects or watches		Caution; Toxic material		Wear eye protection
	No shoes with heels		Caution; Corrosive		Information
	Product compliance with EU legislation		Product compliance with UK legislation		

### 2.1.2 Obligations of the operator

- The operator is obliged to ensure compliance with general safety regulations when working with the instrument.
- To provide for the transport of the instrument, the operator is obliged to ensure training for the operating personnel in load lifting and slinging.
- Before instrument commissioning, the operator is obliged to define the competences of persons for the operation, service, cleaning, regular maintenance, setting and adjustment to provide for and maintain the proper functioning of the instrument and the safety of persons and property.

### 2.1.3 Qualification requirements for operators



The instrument may only be installed by a person familiar with the operational, safety and any other regulations relating to industrial safety in force in the place where the instrument is to be located or otherwise associated with the place of work. The instrument's electric system may only be installed and connected by a person qualified in compliance with the applicable legislation of the country of operation of the instrument.

The instrument may only be opened, adjusted and set up by persons who are physically and mentally fit, older than 18 years of age, demonstrably trained by their parent organization in the respective work and familiar with the Instructions for Use, which shall be kept in an accessible place.

### 2.1.4 Conditions for the safe operation of electrical equipment

- Keep the safety labels, symbols and notices on the instrument legible.
- Follow the relevant regulations for occupational health and safety and the valid local standards laying down the conditions for the wiring of electrical equipment and for its safe and reliable operation.
- Installation, operation and maintenance may only be provided by persons qualified for such activities in compliance with the valid legislation of the country of operation of the instrument. Perform inspections of electrical equipment on a regular basis as required by the internal rules of the organization or by applicable standards or guidelines of the manufacturer. Inspections may only be performed by persons qualified for carrying out such activities in compliance with the legislation of the country of operation of the instrument.
- All activities related to electrical equipment must be performed in compliance with the Instructions for Use.



Any intervention in the design of the instrument IS NOT ALLOWED.

Maintenance, cleaning and repairs of the instrument can only be performed with power supply disconnected and with the associated technological equipment turned off.

- If you detect a failure that you consider a threat to occupational health and safety, do not use the instrument and report the failure to the operator immediately.



The Instructions for Use must be available to all staff in charge of installation, operation, and maintenance of the electrical equipment at all times.

## 2.2. Fire protection

The instrument and its operation do not increase the fire risk.



CAUTION, electric equipment. Do not use water or foam extinguishers.

## 2.3. Declaration on environmental impacts

The instrument as such and its operation do not cause an environmental load.

## 2.4. Instrument disposal



It is necessary to proceed in accordance with the valid local legislation when disposing of the instrument after the end of its service life<sup>1</sup>.



VF, a.s. participates in the collective take-back system RETELA for the manufacturers of electrical equipment. For more information on RETELA please visit <http://www.retela.cz/> (<http://www.weee-forum.org/>).

<sup>1</sup> In the Czech Republic, proceed in accordance with Act No. 185/2001 Coll., on Waste, as amended, and the related decrees of the Ministry of the Environment.

### 3. Technical specifications

Instrument identification	
Trade name	Hand and Foot Contamination Monitor HF-4
Product designation	HF-4A, HF-4B, HF-4C, HF-4D, HF-4E
Type designation	K1175, K1176, K1177, K1178, K1179
Manufacturer	VF, a.s. Černá Hora, Czech Republic

Tab. 3 Instrument identification

General parameters	
Dimensions (W x H x D)	(600 x 1,434 x 825) mm – fixed detector design (633 x 1,434 x 825) mm – retractable detector design
Weight	Approx. 50 kg
Power supply	(100 ÷ 240) V AC / (45 ÷ 65) Hz
Input power	max. 50 W
Usual consumption (without peripheries)	approx. 20 W
Degree of protection	IP 20
Communication interface	RJ-45 (Ethernet)

Tab. 4 General parameters

Result indication	
Display	Backlit touch-screen 7" (WVGA, 800 x 480 pixels)
Optical signalization	1 x LED, 5 mm, indication of operation
Acoustic signalization	Voice output

Tab. 5 Result indication

Ambient conditions	
Operating temperature range	(0 ÷ 45) °C
Operating relative humidity	max. 90 %, non-condensing
Operating pressure	(86 ÷ 106) kPa

Tab. 6 Ambient conditions

Storage conditions	
Storage temperature range	(-25 ÷ 50) °C
Storage relative humidity	max. 90 %, non-condensing
Other storage conditions	The instrument should not be stored without switching on for more than 3 months.

Tab. 7 Storage conditions



Note relating to marks used in the tables hereunder:

- × the physical nature of the detector does not allow determination of the parameter
- the parameter has not been determined yet

### 3.1. Surface contamination detector SCD-286

Basic parameters	
Instrument type	SCD-286A: HF-4A, K1175
	SCD-286B: HF-4B, K1176
	SCD-286C: HF-4C, K1177
	SCD-286D: HF-4D, K1178
	SCD-286E: HF-4E, K1179
Radiation detected	SCD-286A: Alpha in one channel
	SCD-286B: Alpha + beta in one channel
	SCD-286C: Alpha / beta in two channels
	SCD-286D: Alpha + beta + gamma in one channel
	SCD-286E: Alpha / beta + gamma in two channels
Installed IR detector	SCD-286A: ZnS(Ag) on acrylic glass, thickness 1.5 mm Surface density of the scintillator (3.25 ± 0.25) mg/cm <sup>2</sup>
	SCD-286B: plastic scintillator, thickness 0.25 mm
	SCD-286C: ZnS(Ag) on plastic scintillator, thickness 0.25 mm Surface density of the scintillator (3.25 ± 0.25) mg/cm <sup>2</sup>
	SCD-286D: plastic scintillator, thickness 5 mm
	SCD-286E: ZnS(Ag) on plastic scintillator, thickness 5 mm Surface density of the scintillator (3.25 ± 0.25) mg/cm <sup>2</sup>
Photomultiplier	25 mm diameter with hemispheric window
High voltage source	(400 ÷ 1,000) V with sensitive current limitation
Sensitive area of the detector	(130 x 220) mm = 286 cm <sup>2</sup>
Window	Plated light-tight foil (3 x 0.29) mg/cm <sup>2</sup>
Protective grid	Hexagonal grid, transmittance 75%
Dead time	Automatically compensated; typically 4.6 µs

Tab. 8 Basic parameters of detector SCD-286



Radiometric parameters		
Instrument	Measurement range <sup>1</sup>	Background <sup>1</sup>
SCD-286A	4 cps to 100 kcps	< 0.01 cps, typically 0.04 cps
SCD-286B	6 cps to 100 kcps	< 20 cps, typically 10 cps
SCD-286C (alpha channel)	4 cps to 100 kcps	< 0.2 cps, typically 0.08 cps
SCD-286C (beta channel)	6 cps to 100 kcps	< 20 cps, typically 10 cps
SCD-286D	15 cps to 100 kcps	< 75 cps, typically 37 cps
SCD-286E (alpha channel)	4 cps to 100 kcps	< 0.3 cps, typically 0.14 cps
SCD-286E (beta + gamma channel)	15 cps to 100 kcps	< 75 cps, typically 37 cps
Displayed quantity	Count rate (cps), activity (Bq), surface activity (Bq/cm <sup>2</sup> ), source emission rate (pps/cm <sup>2</sup> )	
Relative intrinsic error	± 25%	
Reference radionuclide	241Am (alpha radiation), 36Cl (beta radiation)	
Time constant	Variable (3 ÷ 10) s	
Homogeneity	Minimum response must be greater than half the maximum response, measured across the detector's active surface, i.e. the deviation must be less than 50%, typically 25%.	
Crosstalk from alpha channel to beta channel (beta-gamma) for types SCD-286C, SCD-286E	< 30%, typically 6%	
Overload	Particle fluence corresponding to 120% of the maximum of the measurement range	

Tab. 9 Radiometric parameters of detector SCD-286

<sup>1</sup> Determined for background ~ 100 nGy/h. The lower limit of the measurement range corresponds to the detection limit specified under ISO 11929.

### 3.2. Surface contamination detector SCD-525

Basic parameters	
Instrument type	SCD-525A: HF-4A, K1175
	SCD-525B: HF-4B, K1176
	SCD-525C: HF-4C, K1177
	SCD-525D: HF-4D, K1178
	SCD-525E: HF-4E, K1179
Radiation detected	SCD-525A: Alpha in one channel
	SCD-525B: Alpha + beta in one channel
	SCD-525C: Alpha / beta in two channels
	SCD-525D: Alpha + beta + gamma in one channel
	SCD-525E: Alpha / beta + gamma in two channels
Installed IR detector	SCD-525A: ZnS(Ag) on acrylic glass, thickness 1.5 mm Surface density of the scintillator $(3.25 \pm 0.25) \text{ mg/cm}^2$
	SCD-525B: plastic scintillator, thickness 0.25 mm
	SCD-525C: ZnS(Ag) on plastic scintillator, thickness 0.25 mm Surface density of the scintillator $(3.25 \pm 0.25) \text{ mg/cm}^2$
	SCD-525D: plastic scintillator, thickness 5 mm
	SCD-525E: ZnS(Ag) on plastic scintillator, thickness 5 mm Surface density of the scintillator $(3.25 \pm 0.25) \text{ mg/cm}^2$
Photomultiplier	25 mm diameter with hemispheric window
High voltage source	(400 ÷ 1,000) V with sensitive current limitation
Sensitive area of the detector	$(150 \times 350) \text{ mm} = 525 \text{ cm}^2$
Window	Plated light-tight foil $(3 \times 0.29) \text{ mg/cm}^2$
Protective grid	Hexagonal grid, transmittance 70 %
Dead time	Automatically compensated; typically 4.5 $\mu\text{s}$

Tab. 10 Basic parameters of detector SCD-525

Radiometric parameters		
Instrument	Measurement range <sup>1</sup>	Background <sup>1</sup>
SCD-525A	4 cps to 100 kcps	< 0.25 cps, typically 0.12 cps
SCD-525B	6 cps to 100 kcps	< 40 cps, typically 20 cps
SCD-525C (alpha channel)	4 cps to 100 kcps	< 0.25 cps, typically 0.12 cps
SCD-525C (beta channel)	6 cps to 100 kcps	< 40 cps, typically 20 cps
SCD-525D	15 cps to 100 kcps	< 160 cps, typically 80 cps
SCD-525E (alpha channel)	4 cps to 100 kcps	< 0.30 cps, typically 0.15 cps
SCD-525E (beta + gamma channel)	15 cps to 100 kcps	< 160 cps, typically 80 cps
Displayed quantity	Count rate (cps), activity (Bq), surface activity (Bq/cm <sup>2</sup> ), source emission rate (pps/cm <sup>2</sup> )	
Relative intrinsic error	± 25%	
Reference radionuclide	<sup>241</sup> Am (alpha radiation), <sup>36</sup> Cl (beta radiation)	
Time constant	Variable (3 ÷ 10) s	
Homogeneity	Minimum response must be greater than half the maximum response, measured across the detector's active surface, i.e. the deviation must be less than 50%, typically 25%.	
Crosstalk from alpha channel to beta channel (beta-gamma) for types SCD-525C, SCD-525E	< 30%, typically 15%	
Overload	Particle fluence corresponding to 120% of the maximum of the measurement range	

Tab. 11 Radiometric parameters of detector SCD-525

### 3.3. Factory-set alarm levels

Alarm levels								
Channel	Nuclide		Hand detectors (SCD-286)		Foot detectors (SCD-525)		Frisker (SFP-100)	
	beta	alpha	beta	alpha	beta	alpha	beta	alpha
HF-4A	-	Am-241	-	11 Bq	-	24 Bq	-	80 Bq
HF-4B	Cl-36	-	110 Bq	-	240 Bq	-	200 Bq	-
HF-4C	Cl-36	Am-241	120 Bq	11 Bq	240 Bq	24 Bq	200 Bq	80 Bq
HF-4D	Cl-36	-	110 Bq	-	240 Bq	-	200 Bq	-
HF-4E	Cl-36	Am-241	120 Bq	11 Bq	240 Bq	24 Bq	200 Bq	80 Bq

Tab. 12 Alarm levels

<sup>1</sup> Determined for background ~ 100 nGy/h. The lower limit of the measurement range corresponds to the detection limit specified under ISO 11929.

## 4. General description

Hand-foot contamination monitors are intended for measuring contamination with alpha, beta or gamma radionuclides occurring on the surface of hands, feet or clothes.

Contamination measurement consists of two steps. The first step involves measurement of palms and feet and is followed by the second step, with the measurement of the back of the hand.

Optionally, the right hand detector can be fixed or retractable. A retractable detector is mostly used to monitor the contamination of clothes.

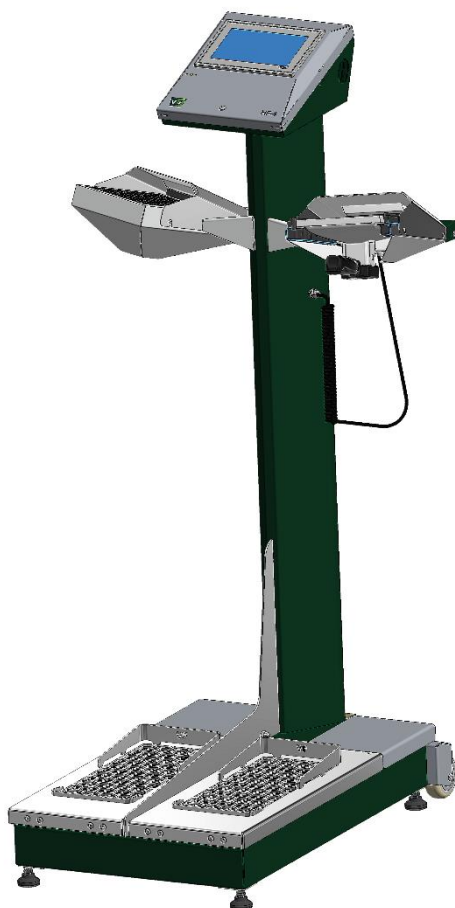


Fig. 1 HF-4 – variant with a retractable right hand detector

## 4.1. Design layout summary

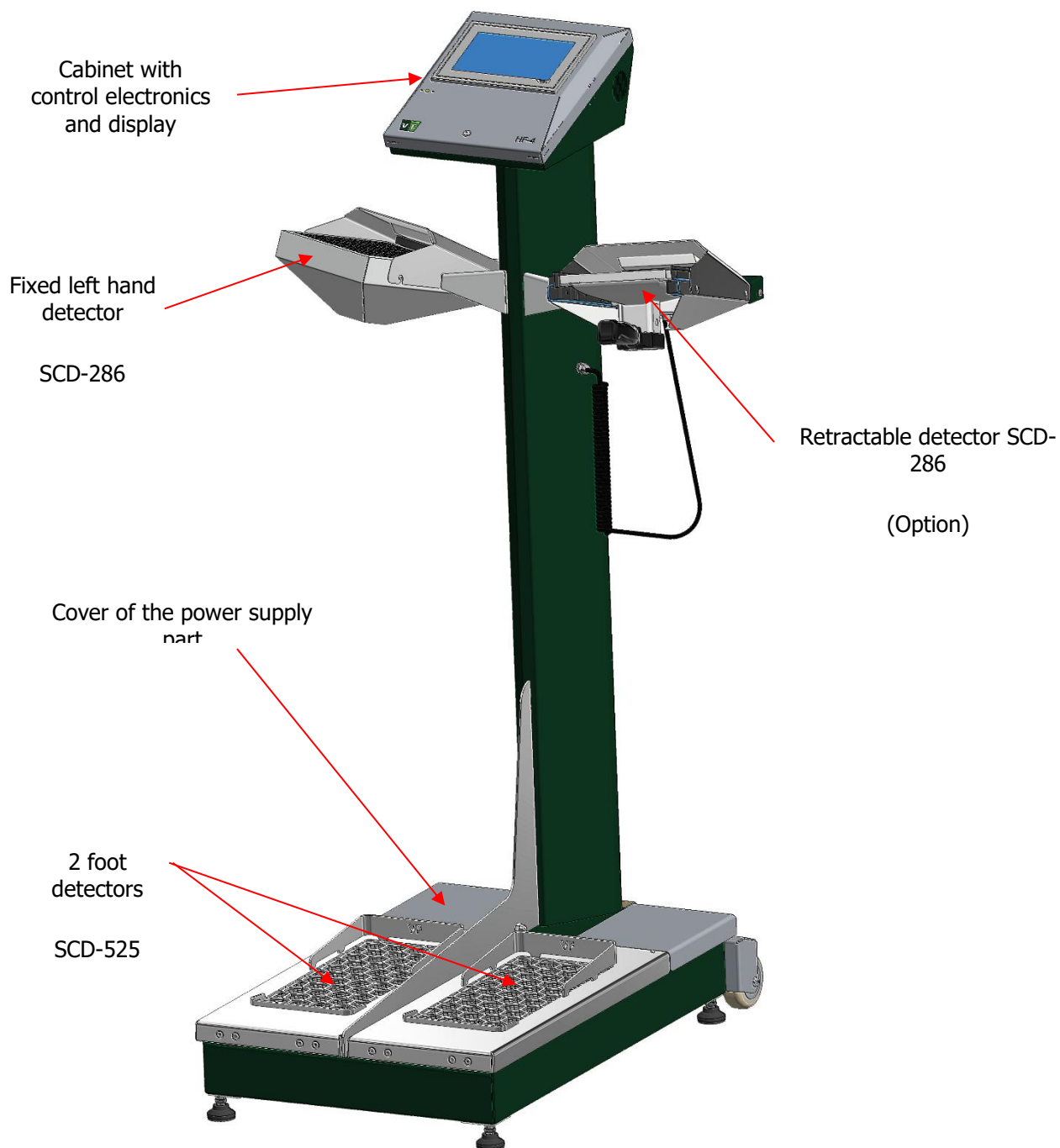


Fig. 2 HF-4 – design layout

## 4.2. Instrument dimensions

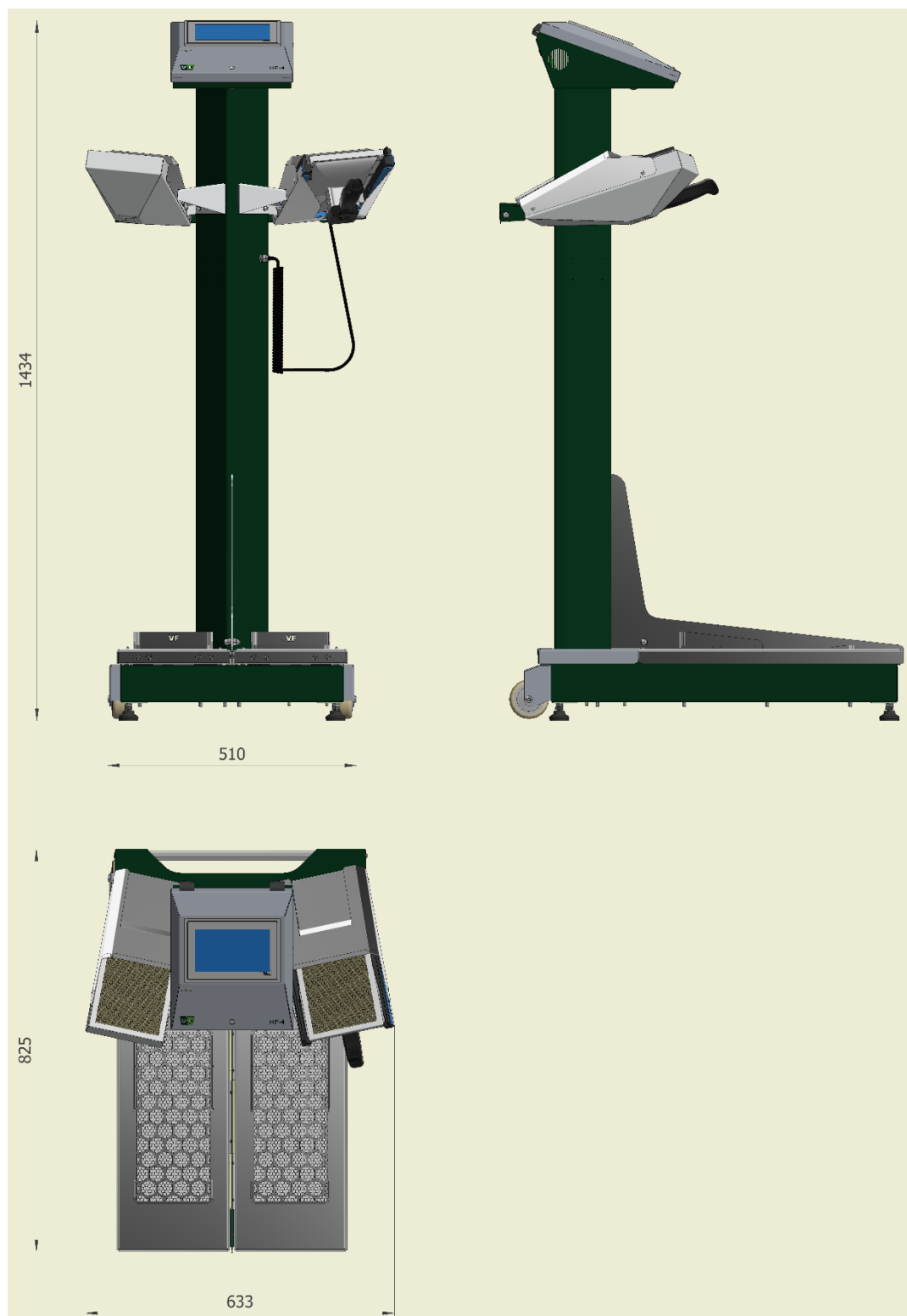


Fig. 3 HF-4 – dimensions – retractable detector

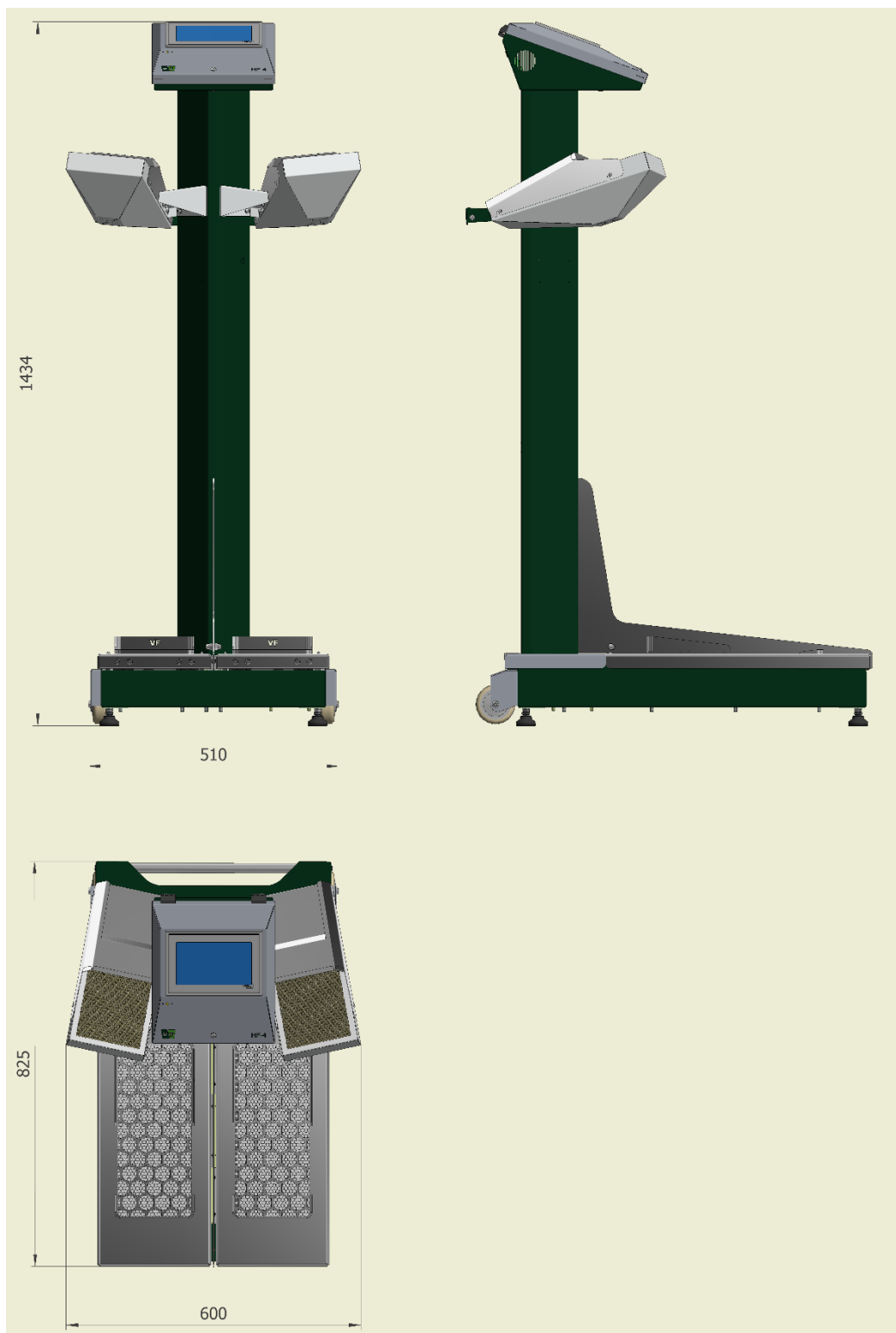


Fig. 4 HF-4 – dimensions – fixed detector

## 4.3. Electronic wiring

### 4.3.1 Block diagram

Fig. 5 shows the overall flow chart of instrument HF-4.

The control unit is a PLC, which receives information from detection units and from position sensors. Based on this information, it controls and evaluates the contamination measurement. The main function of internal boards CAN2COMB and ROUTER is to provide communication between the detectors, the PLC and adjacent technology, if any (Ethernet and service port). Additional functions of the boards are inputs/outputs for sensors and signalization, voice module, connection of the identification reader, etc. Internal modules and signalization are supplied by voltage +24 V DC. The detectors are supplied through a router by voltage +5 V DC.

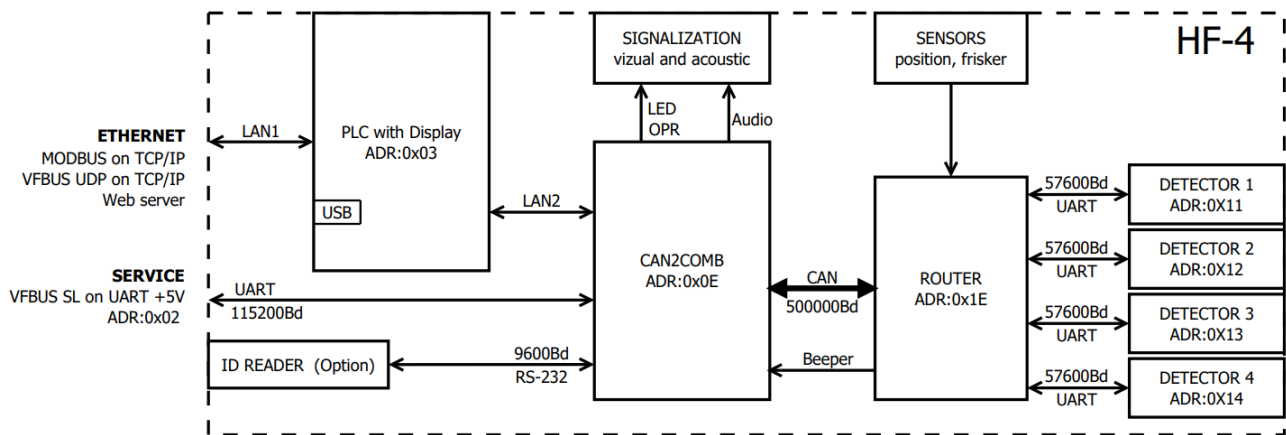


Fig. 5 HF-4 – flow chart



### 4.3.2 Display and PLC

A 7" display with an integrated PLC is used to show commands during measurement and measurement results. The resolution of the display is WVGA (800 x 480) and it is a colour TFT display with a resistive touch-screen (it can be operated e.g. in gloves). The button in the lower right corner is not used.

The expected half of the service life of the display is 50,000 hours (time until the backlight intensity decreases to 50%). The front section of the display provides IP65 coverage. The PLC with the display is maintenance-free (it does not contain batteries or fans).

### 4.3.3 Power supply

An AC/DC converter with a wide range of AC input power (85÷264) V AC with a frequency of 45 to 65 Hz and output voltage of 24 V DC is used to supply the instrument. The power source contains a slow overcurrent fuse of 3.15 A and varistor surge protection at the input.

The supply cable enters the instrument through a grommet M20 and is connected to a terminal block –XD1, which is intended for conductors with a diameter of (0.14 ÷ 4) mm<sup>2</sup>.

From there on, the L and N conductors pass through a main rocker switch, accessible from the rear of the instrument.

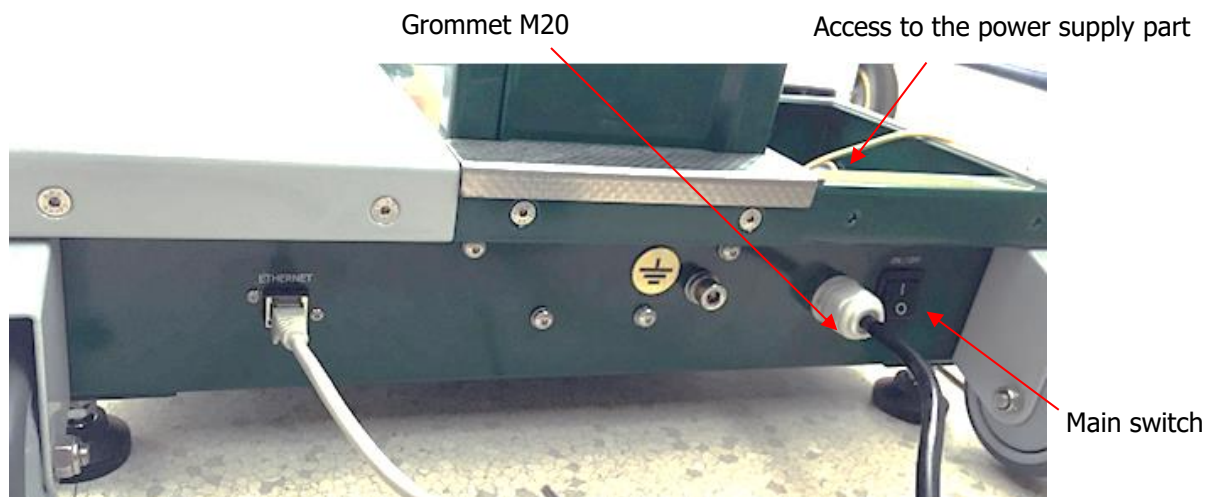


Fig. 6 HF-4 – power supply

#### 4.3.3.1. Connecting terminal block

The power supply cable is fed into the instrument, to terminal block XC1, through a grommet. The terminal block is accessible after removal of the cover of the power supply part.

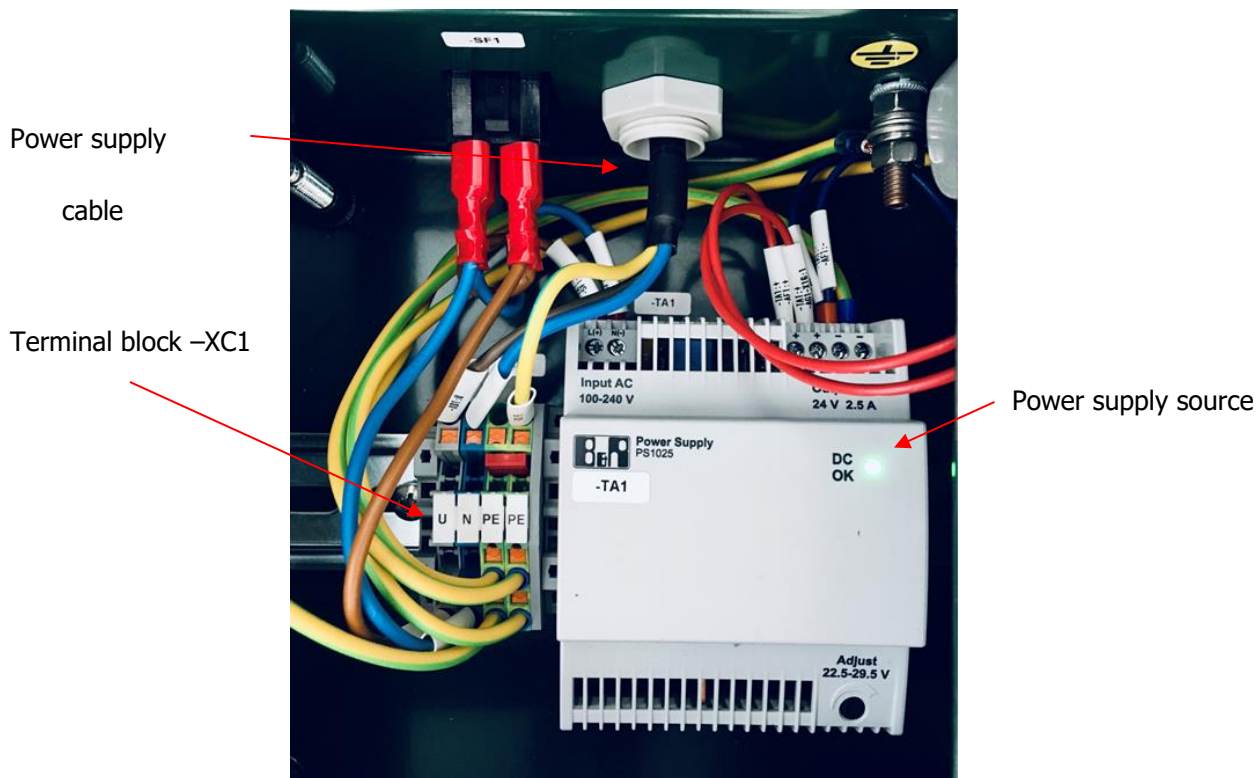


Fig. 7 HF-4 – Connecting terminal block

Designation	Terminal colour	Description
U	Grey	Phase conductor
N	Blue	Neutral conductor
PE	Green-yellow	Protective conductor
PE	Green-yellow	Protective conductor

Tab. 13 Connection of terminal board XC1

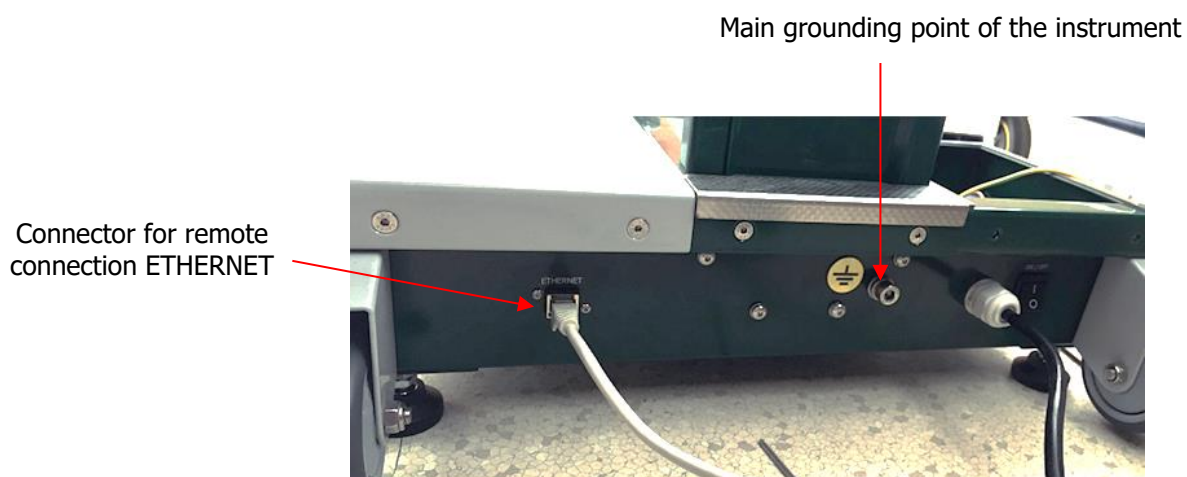
#### 4.3.4 Termination connectors

Designation	Connector type	Description
Ethernet	RJ-45	Instrument connection to the Ethernet
Service	Fischer 5.pin	Connection of the instrument to an external PC
Ground	Screw M6	Main grounding point of the instrument

Tab. 14 Termination connectors



Service connector SERVICE



Connector for remote connection ETHERNET

Main grounding point of the instrument

Fig. 8 HF-4 – Connectors

## 5. Before instrument commissioning



Avoid contact between sharp objects and the sensitive area of the detectors. The plated light-tight foil can be damaged through the protective grid of the detectors, with the possible damage to the photomultiplier.

### 5.1. Transport



When handling the instrument, follow the general safety regulations related to such activities.  
Pay special attention to the handling of heavy equipment.  
The instrument **MUST NOT** be exposed to mechanical shocks and vibrations harmful in particular to the photomultipliers used in the detectors.

The instrument is transported in an assembled state.

During transportation, secure the instrument against movement and damage.

Use only the frame to handle the instrument.

In addition, handling of the whole instrument should be carried out in a way to avoid mechanical damage to the connectors installed in the rear of the base.

### 5.2. Initial preparation

Remove the instrument from the transportation package.

Check the delivery for completeness as per Tab. 29.

Check all the delivered parts, including the control unit, display, connectors and detectors, for mechanical damage.



In case that defects are detected during the initial preparation, ensure that they are removed before the instrument is connected to power supply.

### 5.3. Power supply



The instrument is supplied by mains voltage 230 V AC / 50 Hz. The power source used enables power supply in the voltage range of (100 ÷ 240) V, (45 ÷ 65) Hz.

The instrument does not include standby power supply.

## 5.4. Storage



Store the instrument in vertical position.

Store the instrument in a suitable environment, see section 3.

The instrument should not be stored without switching on for more than 3 months.

Store under conditions which prevent any mechanical damage.

Avoid contact with water, chemicals and/or rain.

Protect the instrument against dust.

## 5.5. Installation



Installation shall be performed by the manufacturer, a trained service organization, or the user's staff trained by the manufacturer.

The electric part of the instrument may only be installed and connected by a person qualified in compliance with the applicable legislation of the country where the instrument is operated.

## 6. Operation of the instrument

### 6.1. General



When handling the instrument and during measurement, protect the detectors against mechanical damage.

Basic measurement control is only performed via position sensors. The measurement starts automatically when the measuring position is assumed, or when the frisker is extended.

A touch-screen is used to display detailed measurement results and for service activities.

### 6.2. Initial preparation

- The instrument is placed in the place of operation.
- The position of the instrument is adjusted to be stable using the adjustable feet.
- The instrument is connected to the AC mains and the main switch remains off at this time.
- The instrument can be connected to the Ethernet.

### 6.3. Checking operation

- Switch the instrument on using the main switch.
- When the operating system of the PLC boots up (if everything is in order), the green "Operation" indicator under the display is lit and the instrument switches, after initialization and background measurement, to the "Ready for measurement" state.

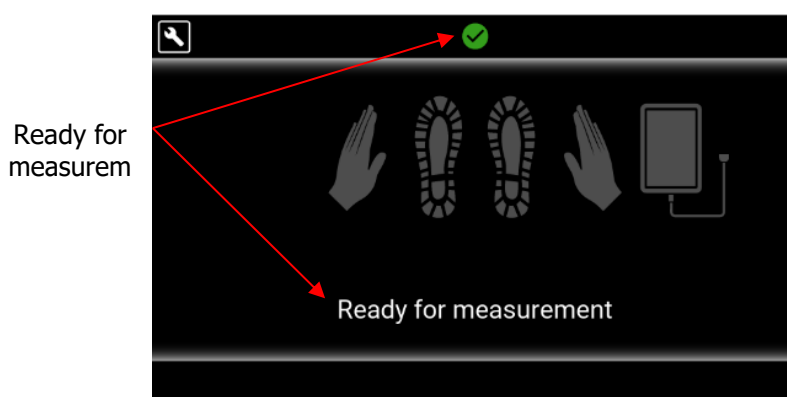
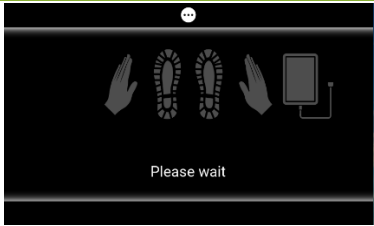
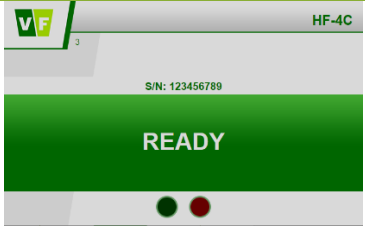
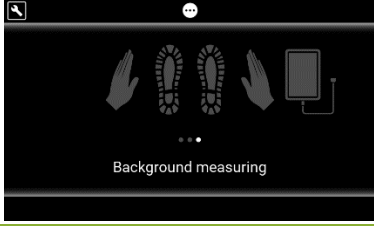
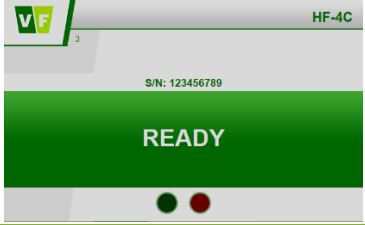
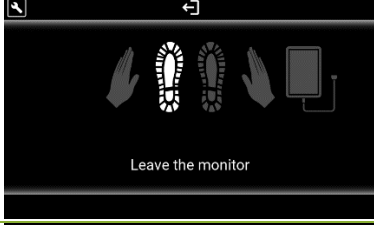
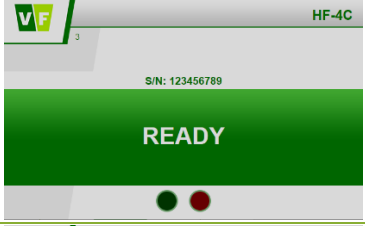
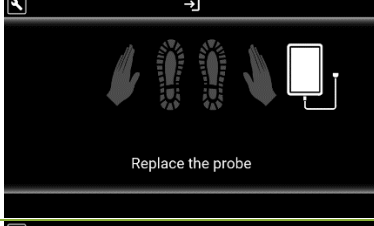
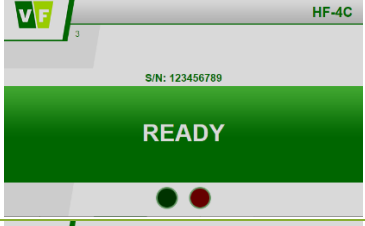
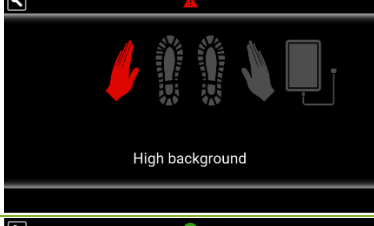
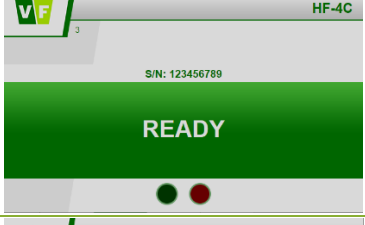
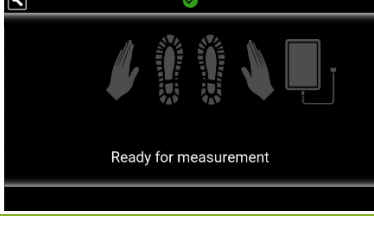
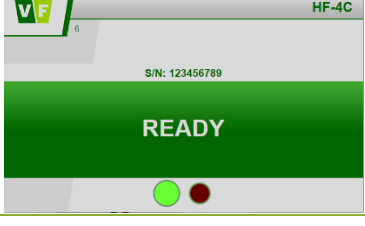


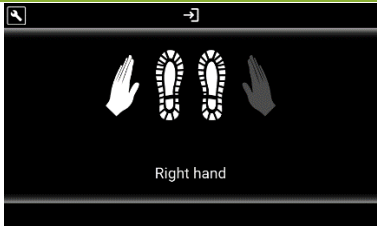
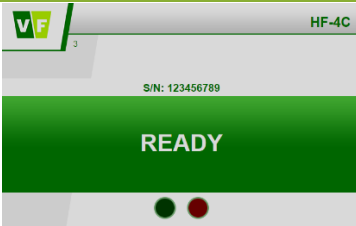
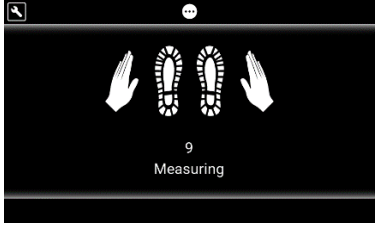
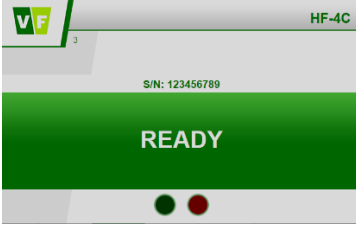
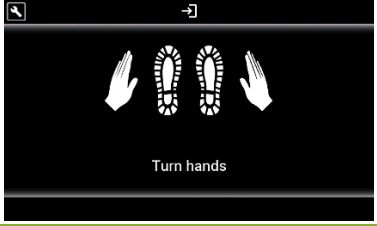
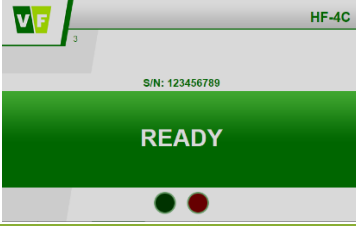
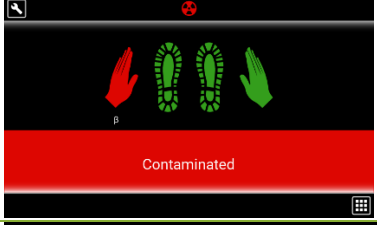
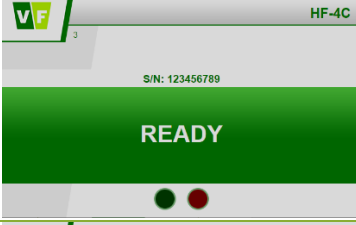
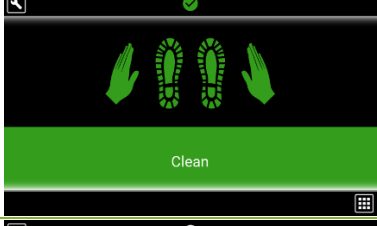
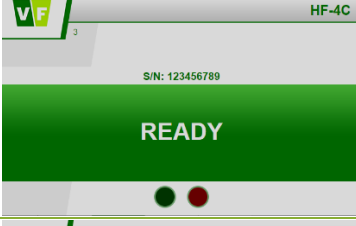
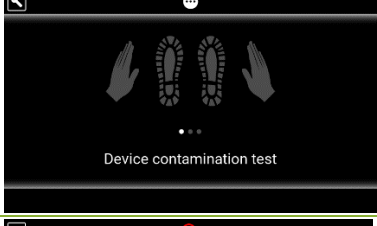
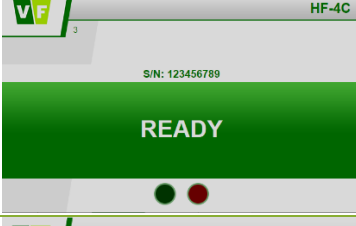
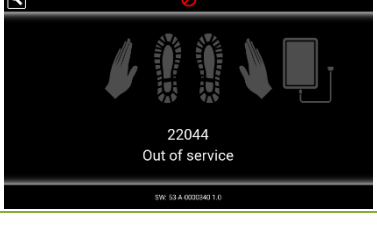
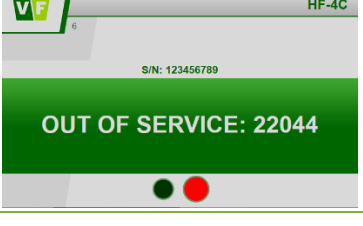
Fig. 9 Ready for measurement

## 6.4. Visual and acoustic signalization

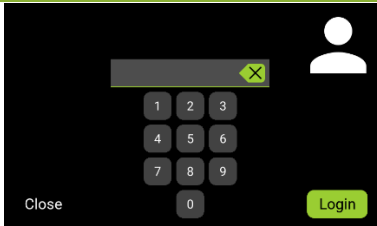
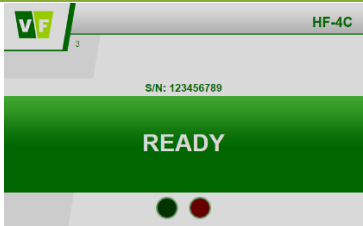
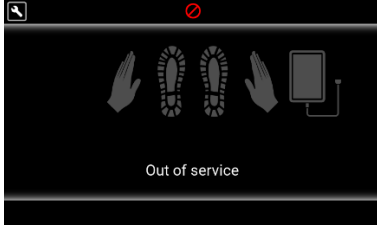
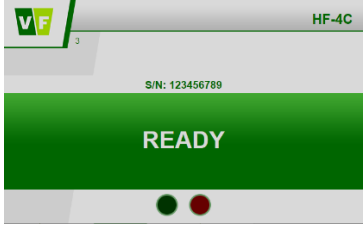
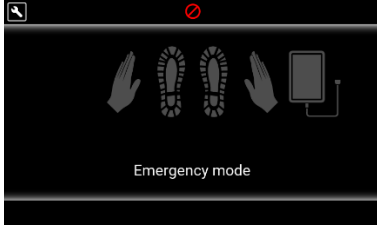
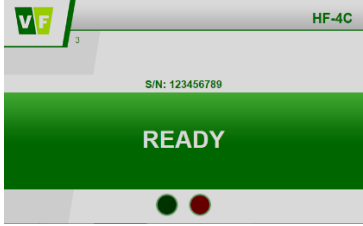

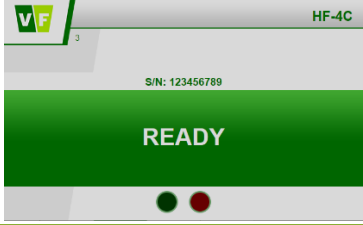

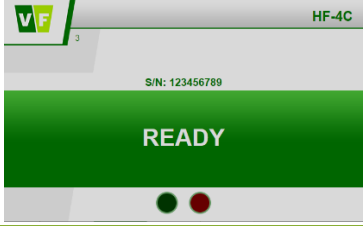
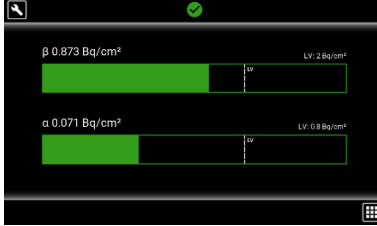
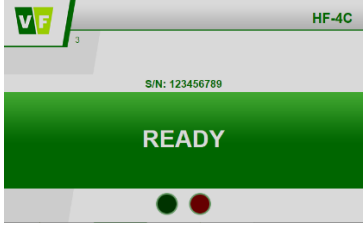

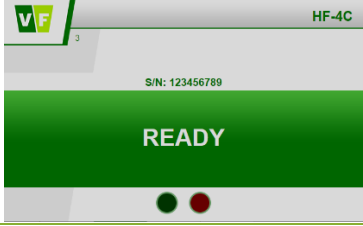
Visual signalization comprises the display showing main instrument states as well as the results and values of individual measurements. A small green LED located under the display provides additional visual signalization. If the LED is on, the instrument is not in error state.

Acoustic signalization is provided by one speaker with a power of up to 15 W, located in the upper case of the instrument. In different states, the instrument therefore plays audio commands and signals as per the table below.

State	Screen	LED	Audio command number	Web interface
Initialization		OFF	-	
Background measurement		ON	-	
Leave the instrument		ON	38	
Insert the frisker		ON	4	
High background		ON	-	
Ready for measurement		ON	-	

Positioning before measurement		ON	5 to 14, 75 to 78	
Contamination measurement		ON	72 to 74	
Positioning during measurement		ON	33	
Result of CONTAMINATION measurement		ON	16 to 21, 36, 38, 56 to 61	
Measurement result CLEAN		ON	2, 38	
Detector contamination test		ON	-	
Instrument out of service		OFF	-	



Forced state Service mode		ON	-	
Forced state Out of service		ON	-	
Forced state Emergency mode		ON	-	
Forced state Calibration mode		ON	-	
Measurement with frisker		ON	Pulse arrival signalization	
Measurement result with frisker CLEAN		ON	-	
Measurement result with frisker CONTAMINATION		ON	Continuous tone	

Tab. 15 Visual and acoustic signalization

### 6.4.1 Language of text and audio commands

The language of user screens and audio commands is adjustable using the service application VF-Setup. The language can be either fixed without the option to choose on the main screen, or configured with the option to switch languages on the main screen. If the option to choose on the main screen is on, it is also possible to set:

- The default language when the instrument is switched on.
- The number of flags on the main screen (four at the maximum) and their positions
- The option whether the default language is restored or the last selected language remains on after measurement



Fig. 10 Choice of language on the screen

The language of the text is fixed to the respective directory of audio commands (see Tab. 16). It is saved on the microSD memory card. The card is inserted in the board CAN2COMB (see Fig. 11).

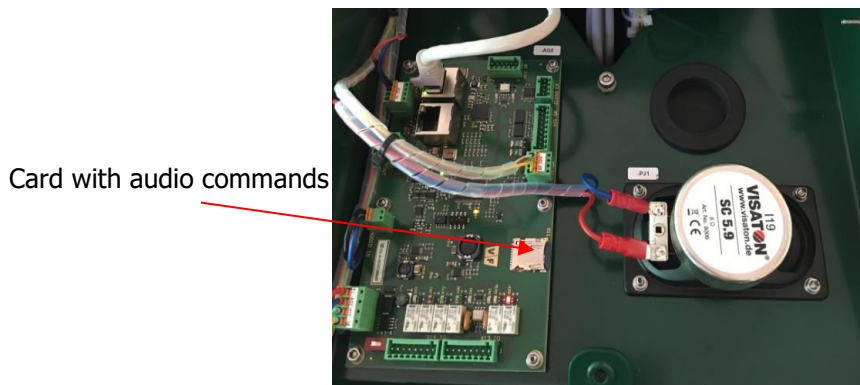


Fig. 11 Choice of language on the screen

The name of the audio files is in the "XXXXY.wav" format where XX is a designation of the directory in which the files are stored (see Tab. 16) and YYY is the number of the audio command. The list of audio commands and their numbering are specified in Tab. 32. The permitted format of the audio command is WAV, Mono, 22050Hz, 32Bit Float (Tab. 31).

	EN	CZ	RU	FR
Directory number:	00	01	02	05

Tab. 16 Directories of audio commands

The only language of service screens is EN.

## 6.5. Operation of the instrument

### 6.5.1 Initialization

When the instrument is switched on (or when the PLC is restarted), initialization is first performed to check:

- configuration of parameters – critical parameters are checked to ensure that they are set within the permitted range
- configuration of electric modules (detectors and PCB) – check of identification parameters of HW and SW

If the parameters are in order and the connected HW corresponds to expectations, other checks are performed – these are, however, performed all the time, i.e. in all other states (except for the service state).

- check of communication – check of receipt of automatic replies from detectors and the PCB
- check of the state of modules – these conditions are specific to each module type (e.g. detector time-out, overload, etc.). For more details on errors see section 45.

### 6.5.2 Leaving the instrument

Before the background measurement starts, the instrument is checked to determine whether it is not occupied and, if applicable, whether the frisker is not extended. Background buffers are also cleaned in this state. The instrument also switches to this state e.g. when the service menu is left.

### 6.5.3 Background measurement

Background measurement is performed continuously, unless the instrument is occupied or the frisker is retracted and contamination measurement is under way. Background update takes place every second. The values of the measuring channels are saved in the circular buffer (each measuring channel has its own buffer) whose length is set by default to 120 seconds (parameters HFTBG and FSTBG). The current values of the background buffers of individual channels can be viewed in the "Response" table in the service menu on the instrument's display (see section 6.6.4).

Each new incoming value entering the background buffer is tested at first for compliance with the specified chi-squared probability distribution (parameters HFX2CRIT1 and FSX2CRIT1). If the new value exceeds the critical value of distribution, then the background buffer is "frozen" and new values are stored in the change buffer. With these new values, the chi-squared distribution test is performed again (parameters HFX2CRIT2 and FSX2CRIT2). If the new values are stable for 20 seconds (parameters HFTTEST and FSTTEST), the frozen background buffer is cleared and the values from the change buffer are moved to it. The new background is thus accepted. If the background changes are shorter than 20 seconds mentioned above, the values in the background buffer are not affected.

The current background, the alarm levels set and the required measurement parameters are used to calculate the contamination measurement time. It is calculated separately for contamination measurement of people and for contamination measurement of detectors. Background measurement can therefore have the following states:

- **Wait** – The state in which it is not yet possible to perform the contamination measurement but there is a prediction that if you wait until the background buffers are full, the instrument will switch to the Ready for measurement state. In this state it is not permitted to step on the instrument or extend the frisker.

- **Ready for measurement** – The background level is such that the contamination measurement of people can start, considering the set measurement parameters.
- **High background** – The background level is too high to start the measurement. In this state it is not permitted to step on the instrument or extend the frisker. As soon as the background drops, the instrument will automatically switch to the Ready for measurement state (this is not a final error state as in case of Failure).

*Note:* In this state the calculated contamination measurement time is higher than the maximum permitted time (parameters HFTGMAX and FSTGMAX).

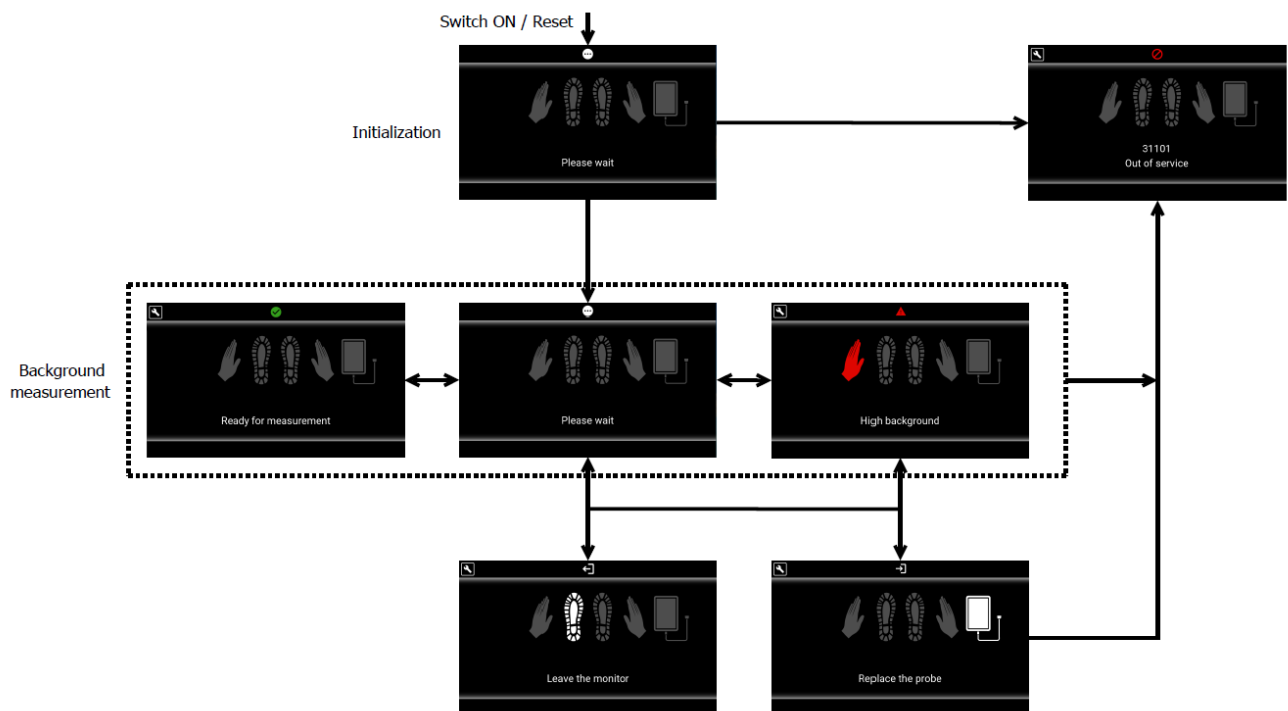


Fig. 12 State indication panel – background measurement

### 6.5.4 Selecting presets

Work with presets is described in section 6.6.11.

The instrument allows to select presets directly from the main screen without the need of logging into the service menu and restarting the instrument. This selection function can be enabled (or disabled) in the user settings using the service application VF-Setup, see section 8. If the selection function is enabled, a button for selection from the user list of presets is available on the main screen. The name of the currently selected preset is shown on the bottom line of the main screen. Selection is only possible before the start of contamination measurement.

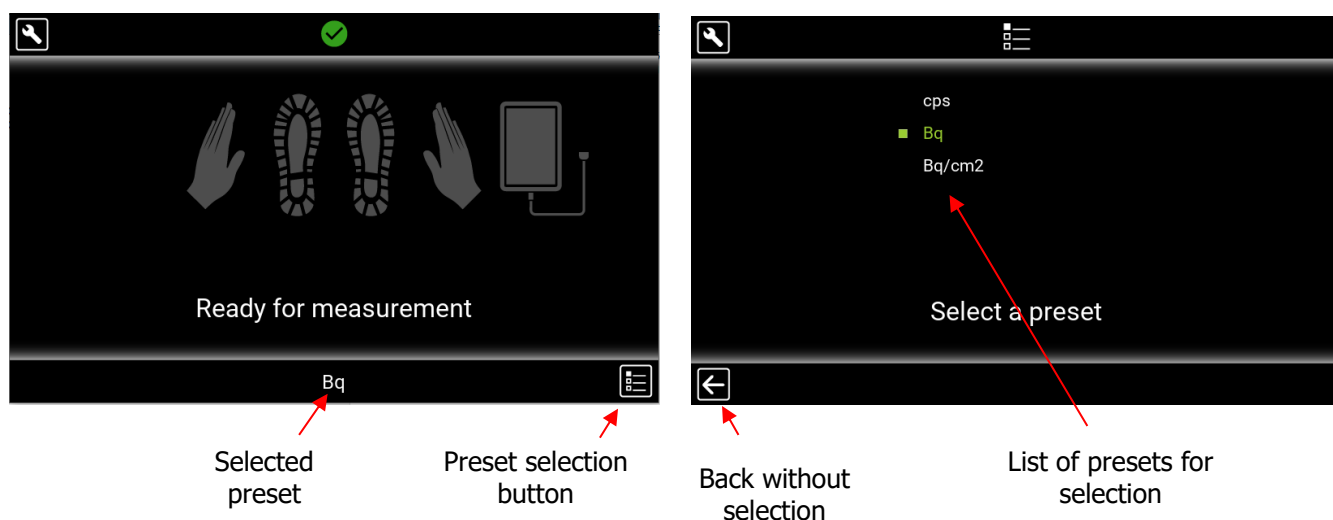


Fig. 13 Selection of preset from the main screen

### 6.5.5 Measurement of contamination of hands and feet

If the instrument is in the "Ready for measurement" state, it is possible to step on the instrument. This automatically starts the positioning and measurement process. Depending on the instrument settings, we distinguish two methods of hand and foot contamination measurement – single-phase and double-phase.

#### 6.5.5.1. Single-phase measurement

In case of single-phase measurement, the contamination measurement is only performed in one step using all detectors (2 hand, 2 foot). The presentation and voice guidance do not distinguish between the palm and the back of the hand, they generally refer to hands (e.g. "Contamination of right hand detected" etc.).

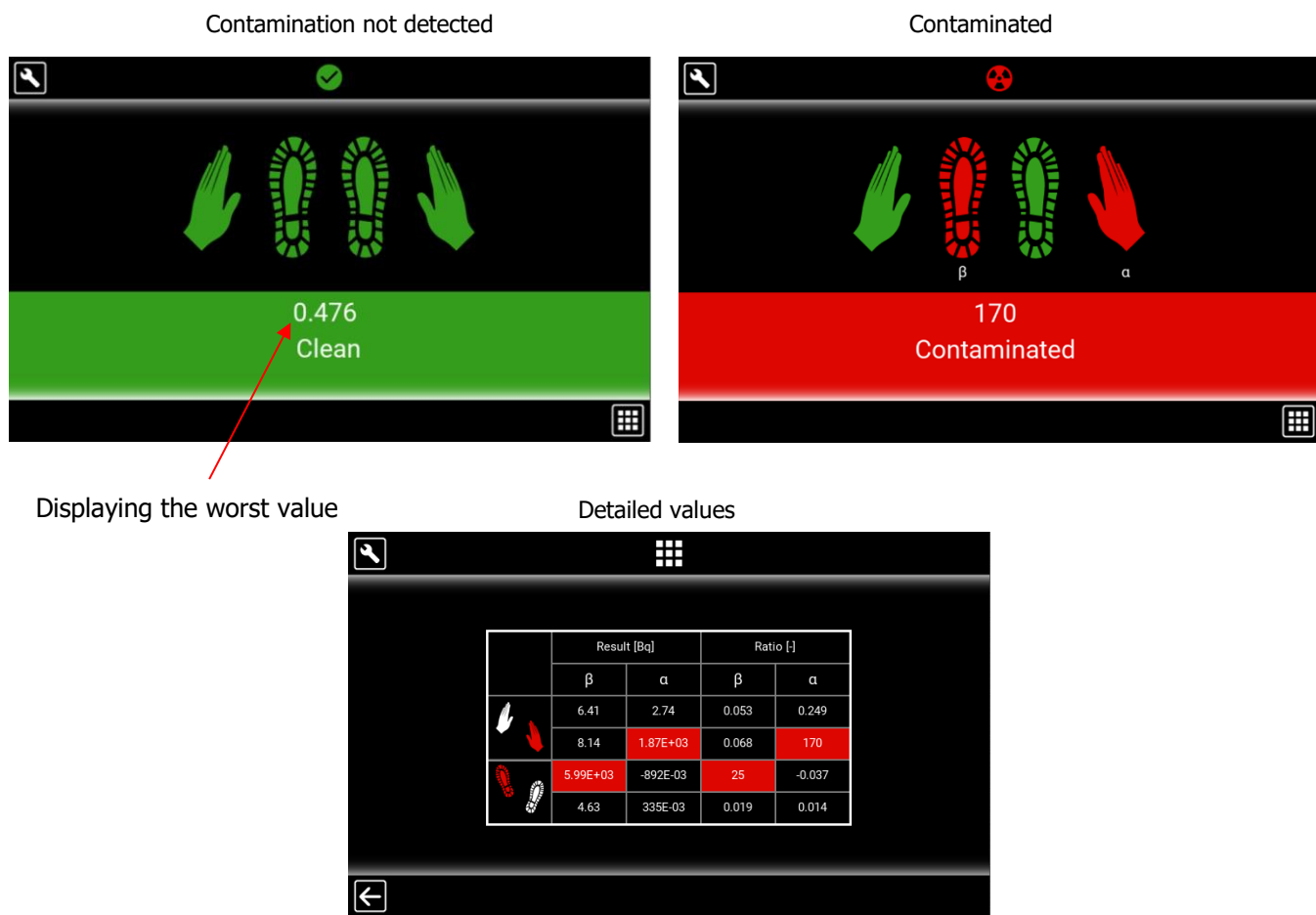


Fig. 14 Measurement with frisker – Presentation of results

On the results screen it is also possible to show the worst measured value, in addition to the overall result. The worst value is the value with the highest ratio to the set alarm level. This value can be displayed as:

- ratio to the alarm level (see the printscreen)
- set unit (cps, Bq, Bq/cm2,...)
- in percentage of the alarm level (100% = the value equals the alarm level)

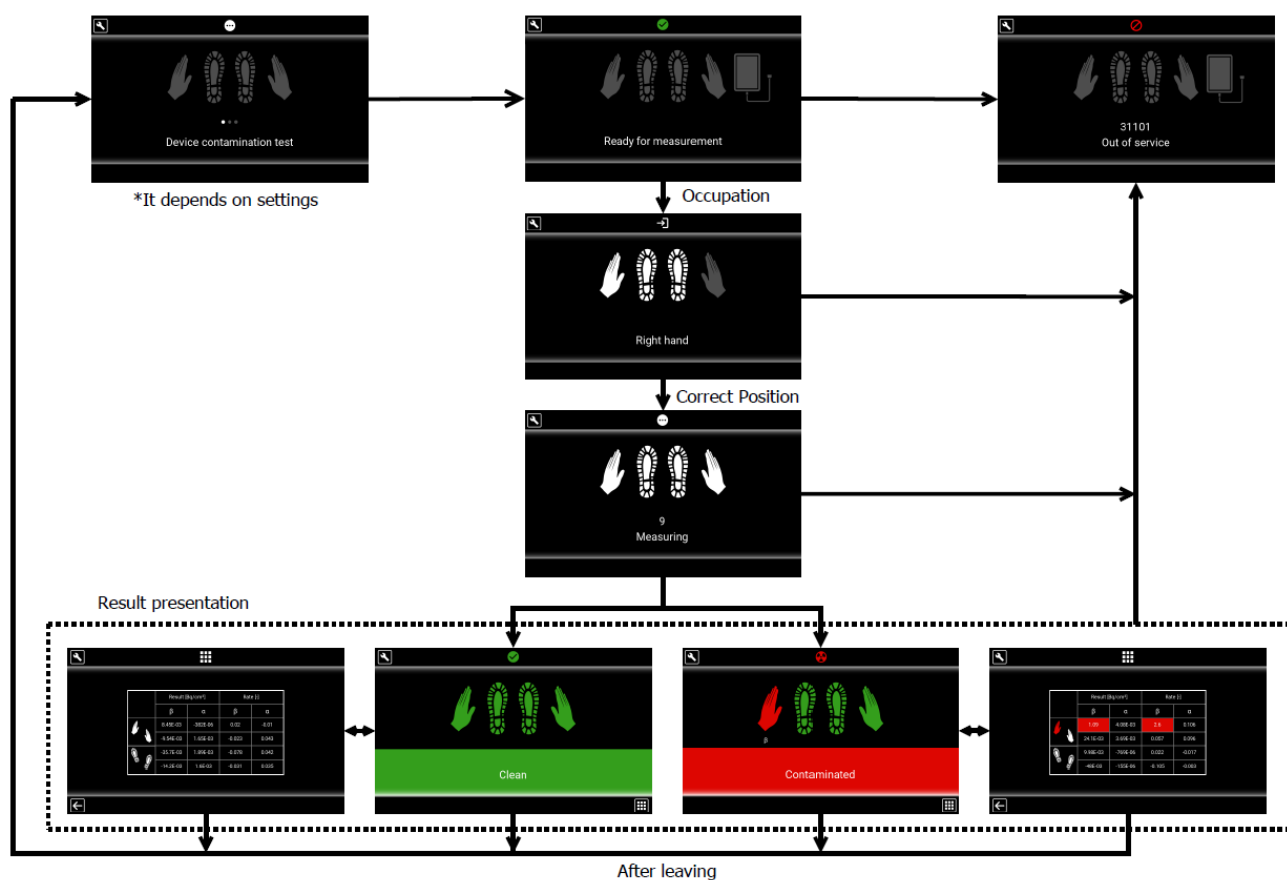


Fig. 15 State indication panel – single-phase measurement of contamination

### 6.5.5.2. Double-phase measurement

The instrument can be set to double-phase measurement of contamination. In case of double-phase measurement, the first step measures the feet and the palms of hands. The second step only measures the backs of hands.

The presentation of results and the voice guidance distinguish between palms and backs of hands (e.g. "Contamination of the palm of the right hand detected" etc.). After the first phase the user is prompted to turn the hands. The check of turning is conditional on the disconnection of the hand sensors.

If a part of the hand is contaminated, the results screen shows the whole hand pictogram coloured red.



Fig. 16 Measurement with frisker – Presentation of results



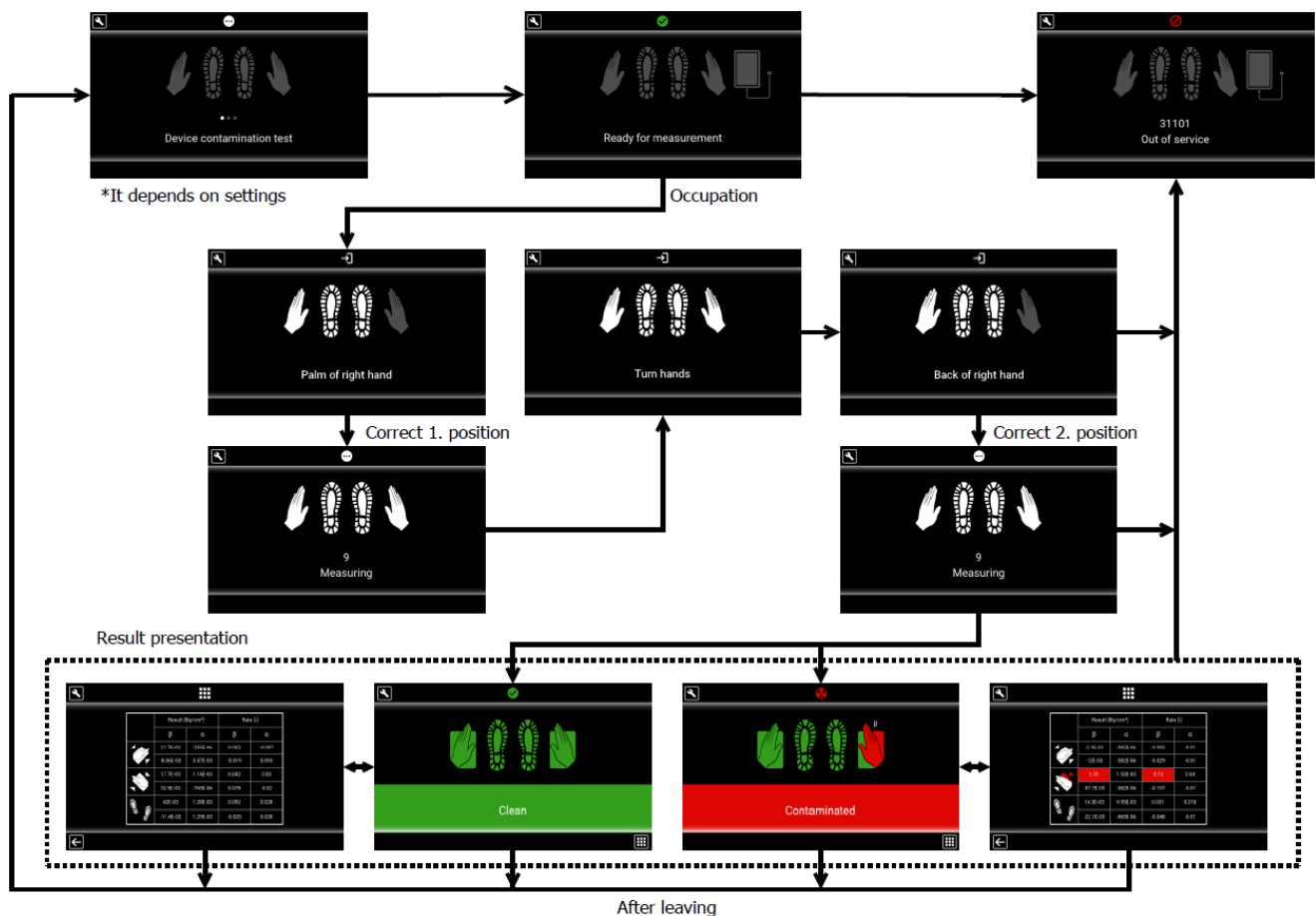


Fig. 17 State indication panel – double-phase measurement of contamination

## 6.5.6 Contamination measurement using the frisker

The option of a retractable right hand detector is an optional design of the HF-4 monitor. This detector can be used for regular contamination measurement of the right hand and as a frisker for checking the contamination of clothes, tools, etc.

Measurement with the frisker starts automatically when the detector is extended from the holder. At the same time, however, the instrument must not be stepped on before the frisker is extended as the instrument being occupied would automatically start regular hand and foot measurement.

### 6.5.6.1. Measurement process

A bar graph is shown for each measuring channel during the measurement. The bar graph scale is logarithmic. The alarm level LV is fixed at 2/3 of the scale. The minimum of the scale is 0.01 times the alarm level and the maximum is ten times the alarm level.

In addition, acoustic signalization of the arrival of pulses is on during the measurement. A higher, longer tone is used for the alpha channel, a lower, shorter tone is used for the beta / beta + gamma channel. In case of single-channel detectors, only a shorter, lower tone is used for acoustic signalization. By default, the acoustic signalization is divided by 5 for beta pulses and by 1 for alpha pulses (i.e. every fifth beta pulse and even alpha pulse are signalized).

If the alarm level LV is exceeded on any channel during the measurement, then:

- the contour of the bar graph changes permanently from green to red colour
- the "MAX" line is red

- the bar with the Current level is red
  - pulse arrival signalization is interrupted by a continuous acoustic tone (tone as per the channel).
- Continuous tone can be switched off by the ACK button and it is possible to return to pulse arrival signalization. If the alarm level is undershot and subsequently exceeded again, the continuous tone is again actuated automatically.

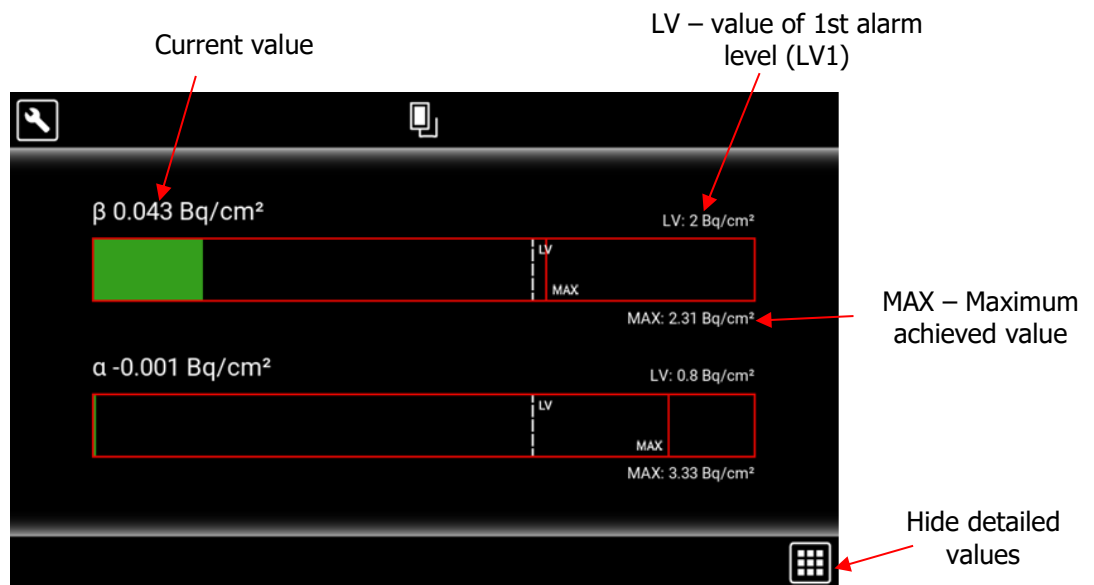
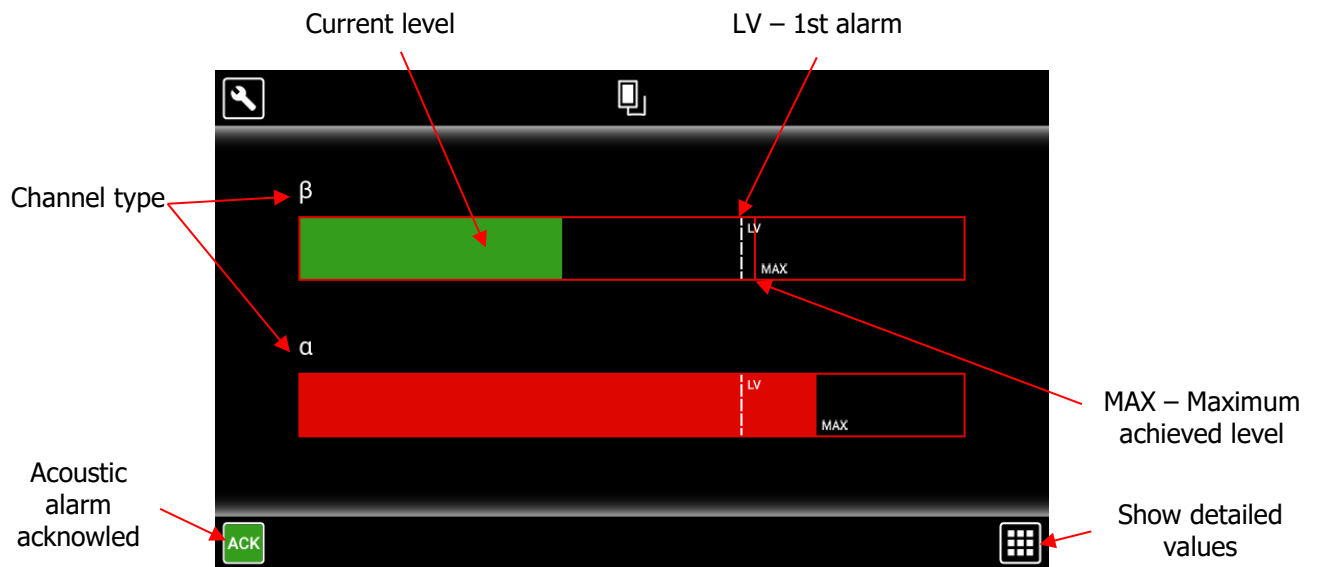


Fig. 18 Measurement with frisker – Progress

### 6.5.6.2. Measurement completion

The measurement is finished when the frisker is returned in the holder. If the alarm level was exceeded during the measurement, the overall result is "Contaminated". Otherwise the overall result is "Contamination not detected".

The presentation of the result is shown in Fig. 19. If detailed values were on during the measurement, the result details are also shown after completion. The screens are displayed for a period of time adjustable separately for each result. The display can be fully cancelled by setting the time to 0 s. The screen is also displayed until the instrument is left (e.g. a person standing on the instrument). A continuous acoustic tone is played during the display of the results of a contaminated measurement; this tone can be muted by pressing the ACK button.

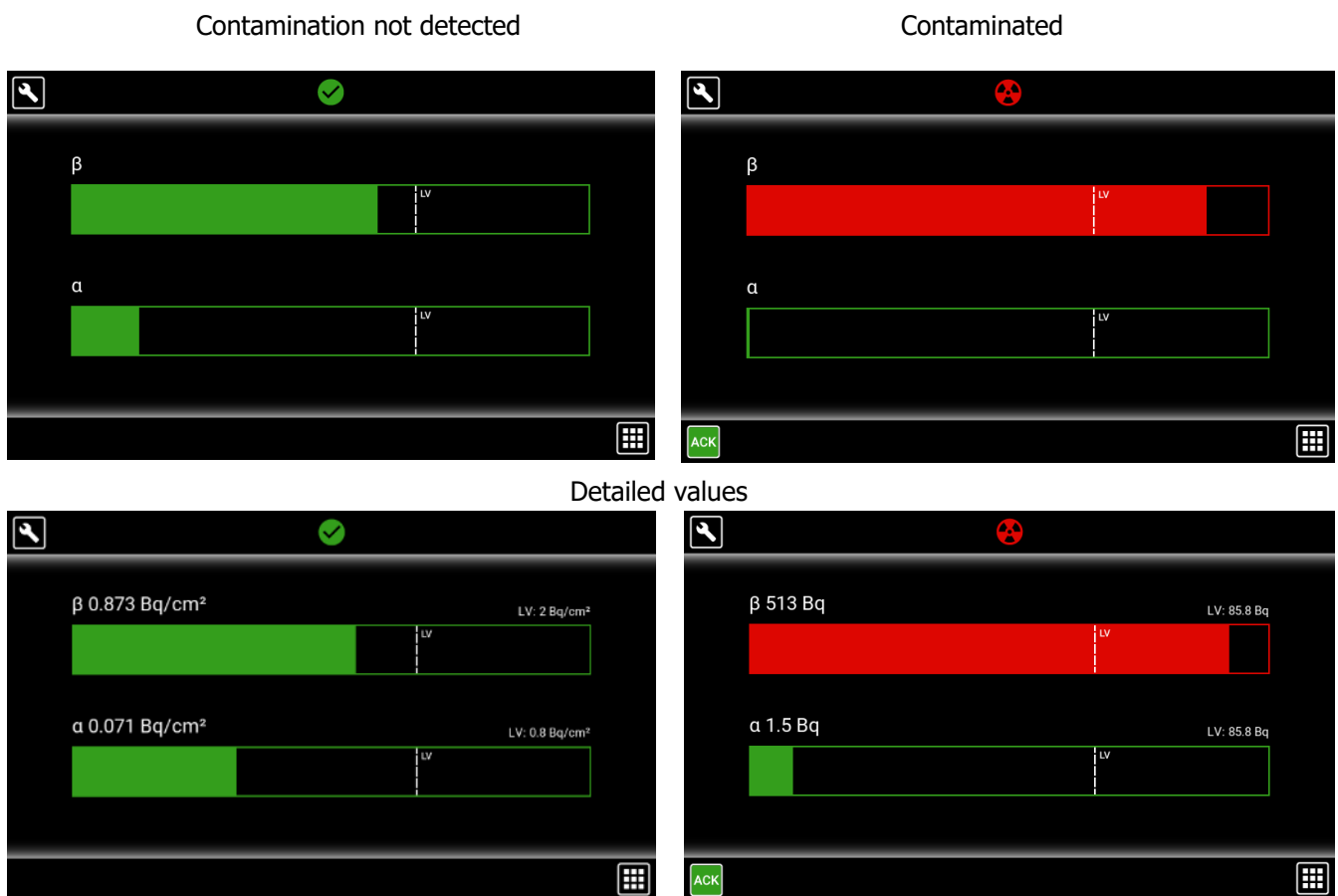


Fig. 19 Measurement with frisker – Presentation of results

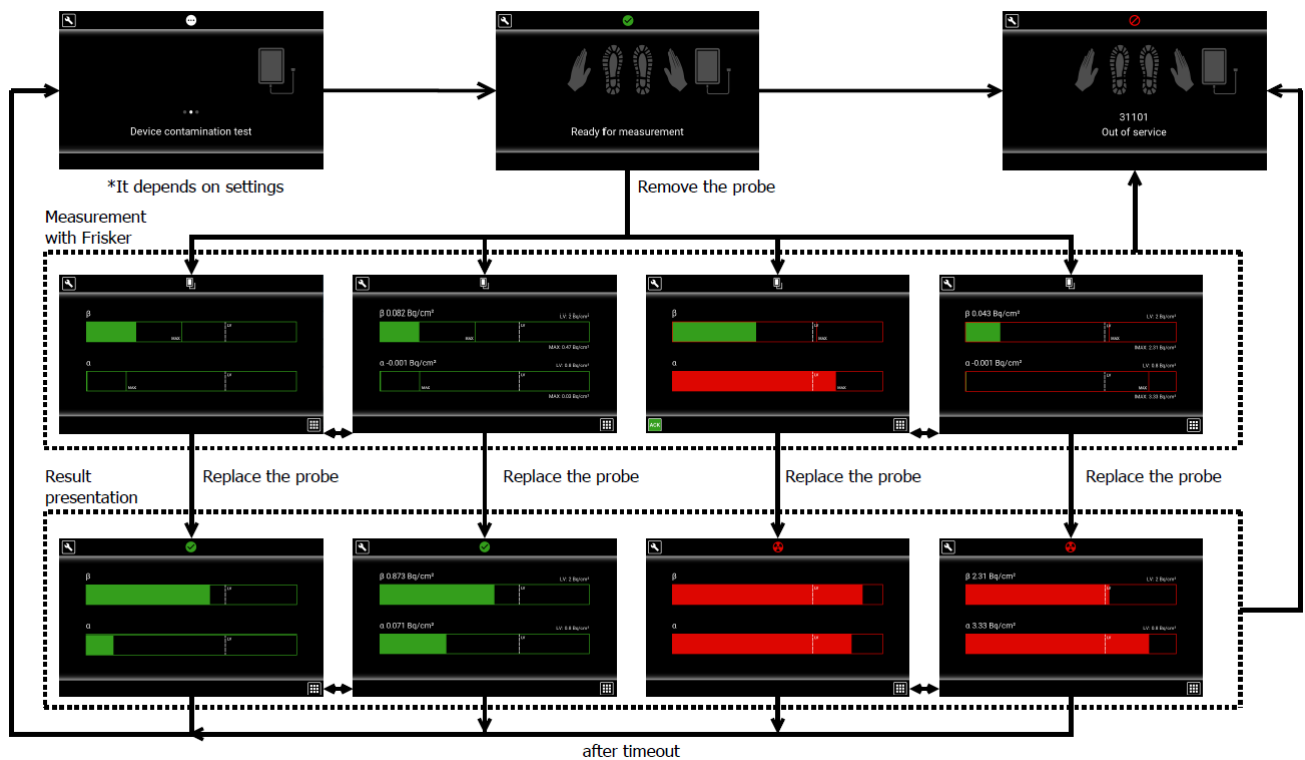


Fig. 20 State indication panel – measurement with frisker

### 6.5.7 Instrument contamination test

The test serves to check the instrument for any contamination, i.e. for the risk of possible spreading of contamination (e.g. due to abrasion), after the instrument has been used. The time performance of the test can be set through SW configuration.

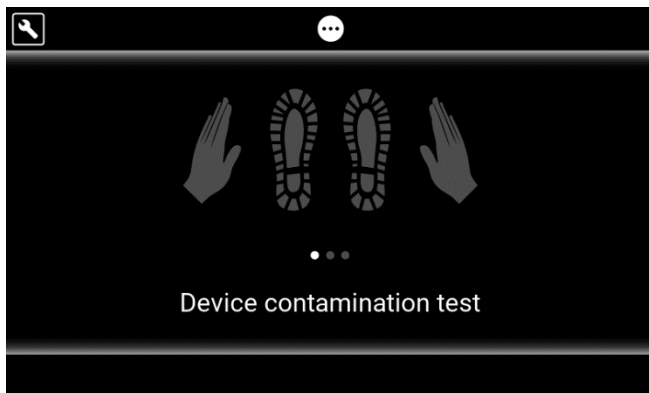
Situations when the test can be performed:

- **after contaminated measurement** (actual risk of detector contamination due to a contaminated person)
- **after unfinished measurement** (theoretical risk – a person comes into contact with the instrument and is not known to be clean or contaminated)
- **after clean measurement** (very low risk, not used in practice)
- **after contact with the instrument** (this includes cases when e.g. the frisker is handled during hand and foot measurement or conversely a person steps on the foot detectors during frisker measurement (theoretical risk, person comes into contact with the instrument and is not known to be clean or contaminated)

The contamination test is performed in the same way as a standard contamination measurement, but without a person present. The contamination test has its own, separately adjustable alarm level – TDCL. It is usually set in the same way as the 1st alarm level. In some situations (e.g. in case of accidents), however, the level may be required to be less strict.

If the contamination test ends up with the Contamination result, the instrument passes into the **Out of service** state and operator intervention is required. Operators perform a check and, as applicable, decontamination. Instrument contamination is often caused "only" by slight damage to the detector foil, which results in a pulse increase. The error code shown on the screen indicates the measuring channel on which the contamination was measured first. The detailed test results are saved in the measurement archive, where it is also possible to determine if only one detector or multiple detectors are contaminated.

Test on hand and foot detectors



Test on the frisker

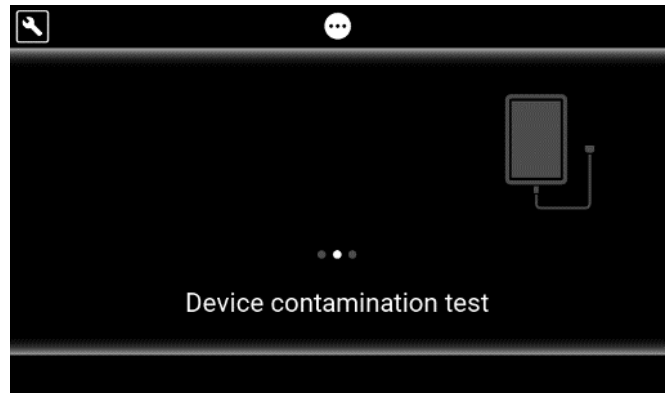


Fig. 21 Instrument contamination test

During the contamination test, the screen shows on which detectors the test is being carried out. During the test it is not permitted to step on the instrument or extend the frisker.

### 6.5.8 Out of service

This is an error state of the instrument when operator intervention is required. The error is specified on the screen with a numerical code which can be decoded using Tab. 33. There may be multiple errors on the instrument at the same time but the screen only shows the code of the first captured error. More detailed diagnostics can be performed using the service application VF-Setup.

SW identification is indicated on the main screen.

To recover the instrument after removing the cause of the error, it is necessary to restart the PLC.




Fig. 22 Out of service

## 6.6. Service menu

The menu is accessible from the display of the instrument and serves for basic diagnostics and settings of the instrument. The only language of the service menu is English. Two menu levels are distinguished, Manager and Administrator. The levels are determined by the log-in password. The passwords are four-digit numbers and can be changed by the user using the service application.

Log-in level	Initial password	Description
Manager	"0000"	Option to perform basic diagnostics and reset the instrument. It is not possible to change instrument settings.
Administrator	"8888"	Option to perform basic diagnostics and instrument reset and settings.

Tab. 17 Initial log-in passwords for the service menu

The log-in screen is shown when the  button is pressed and it can be opened in any instrument state.

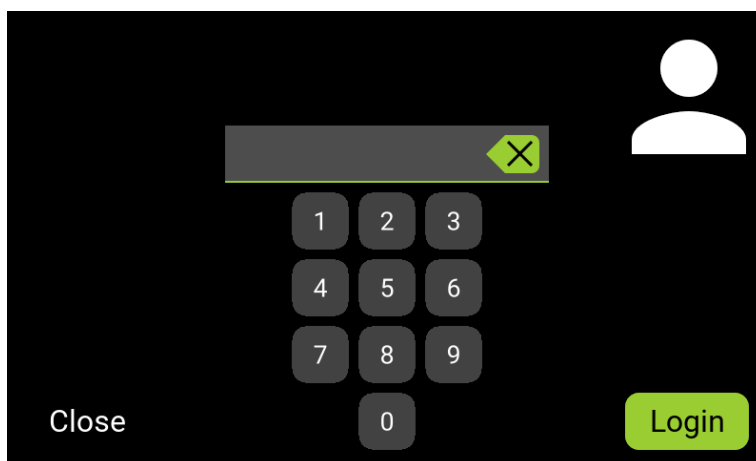


Fig. 23 Log-in to the Service menu

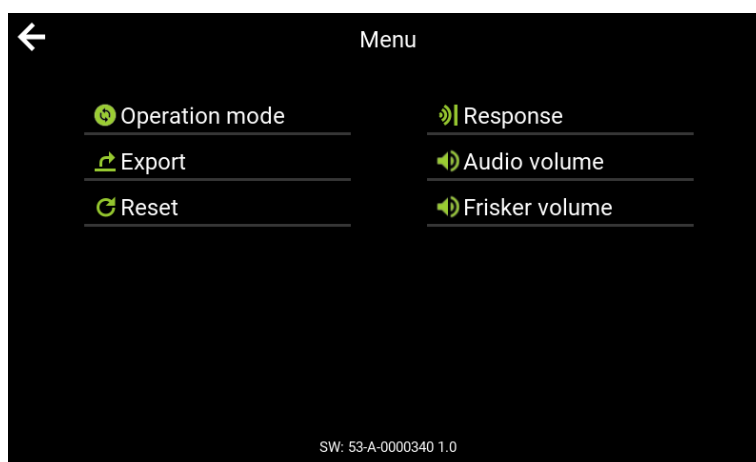


Fig. 24 Menu – Manager

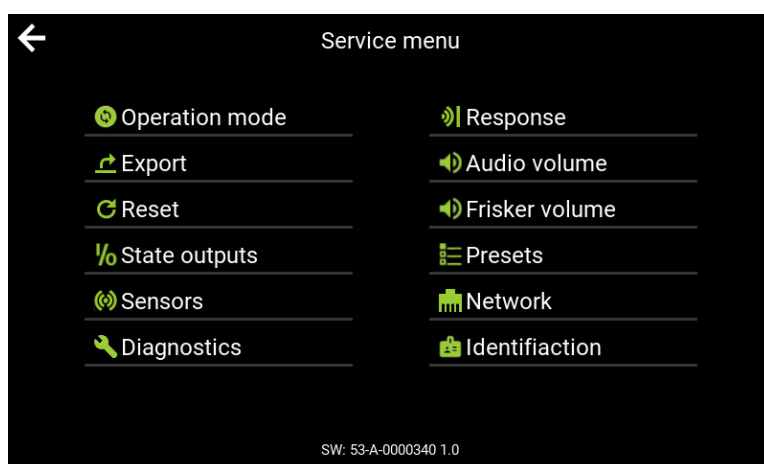



Fig. 25 Service menu – Administrator

Available menus:

Menu item	Manager	Administrator	Description
Operation mode	yes	yes	Switching between Normal mode / Emergency mode / Out of service
Export	yes	yes	Export of the measurement archive to an external USB flash drive
Reset	yes	yes	System restart of the PLC
Response	yes	yes	Response of all measuring channels
Audio volume	yes	yes	Volume control of audio commands
Frisker volume	yes	yes	Volume control of frisker beeping
Presets	no	yes	Setting the default preset
State outputs	no	yes	Control of state relay outputs
Network	no	yes	Ethernet network settings
Sensors	no	yes	State of sensors
Diagnostics	no	yes	Check of visual and acoustic signalization

Tab. 18 Service menu

The  button is used to leave the service menu. If the "SAVE" button is used in the service menu, the instrument is automatically reset when the menu is left (see section 6.6.3). In other cases the instrument returns to the main screen background buffers are erased and the instrument is required to be unoccupied. The instrument starts new background measurement. If the instrument was in the Out of service state before the service menu was entered, it will remain in the error state when the menu is left.

### 6.6.1 Operation Mode

The menu is intended to switch the instrument to non-measuring modes temporarily. For example during maintenance, it is possible to shut down the instrument manually into the out of service state, or in case of emergencies, when no check is required, it is possible to make the instrument passable (applies if the instrument is equipped with a barrier).

Switching between modes takes effect immediately and does not require the instrument to be reset. Non-measuring modes are only issued temporarily (until instrument restart or until switching to the Normal mode).

Menu item	Description
Normal mode	Regular contamination measurement mode for people
Emergency mode	Passage without measurement permitted
Out of service	Use of the instrument is disabled. The numeric error code is not displayed against the actual error.

Tab. 19 Instrument modes

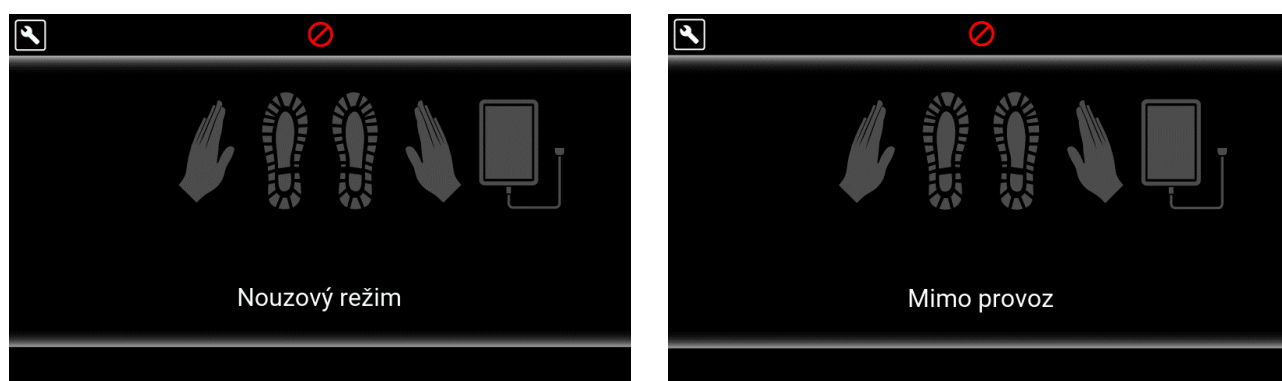


Fig. 26 Non-measuring modes



## 6.6.2 Export (measurement archive)

The instrument saves the results of individual measurements and error states in its internal permanent memory. The maximum number of records in the memory is 10,000. At least the latest 1,000 records also contain detailed resulting values on individual measuring channels, see Tab. 21. The maximum number of detailed values depends on the measurement type and the number of measuring channels. The remaining records only contain the record header, see Tab. 20. If the archive memory is full, the oldest record is automatically erased with each new record.

Archive export is possible to a USB storage drive (e.g. FLASH drive), which needs to be inserted directly in the connector of the PLC when the upper lid of the instrument is opened. Using the Export service menu and after pressing the button, the internal archive exported to an external storage drive. Successful completion of the export is signaled by the message "Done", unsuccessful by "Error".

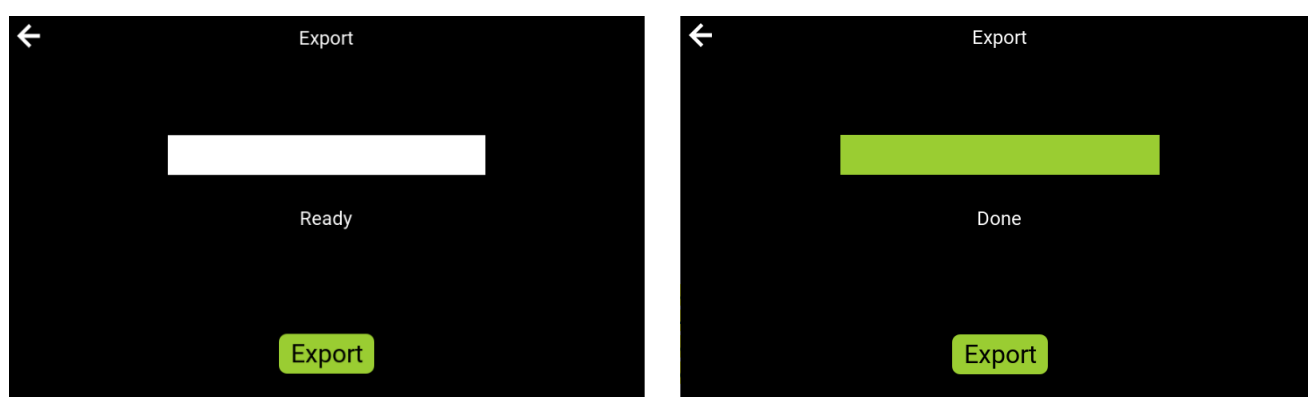


Fig. 27 Export of the measurement archive

The format of the exported file is *hfm\_XXXXXXXX.csv*, where xxx... is the serial number of the given instrument. The values in the text file are separated by a semicolon and for example Microsoft Excel is suitable for tabular processing. A sample of the exported file is shown in Fig. 28, the meanings of individual columns are shown in Tab. 20. and Tab. 21.

ID	TS	TYPE	CNT	PARAM1	PARAM2	PID	VAL1	ERR1	STA1	ASI1	QUAN1	UNIT1	NUKL1	VAL2	ERR2	STA2	ASI2	QUAN2	UNIT2	NUKL2	VAL3	ERR3
58	07.12.2021 12:25	300	2	0			-0,31414	1,50796	0	0	1	1	0	0,241672	0,334481	0	0	1	1	0		
57	07.12.2021 12:25	200	2	32			407,721	11,7595	32	0	1	1	0	423,719	11,8857	0	0	1	1	0		
56	07.12.2021 12:04	300	8	0			-2,79871	0,974103	0	0	1	1	0	-0,0333341	0,0333337	0	0	1	1	0	-2,53351	1,0
55	07.12.2021 12:04	100	8	32			-0,798615	1,27105	0	0	1	1	0	-0,0333341	0,0333337	0	0	1	1	0	0	
54	07.12.2021 12:04	100	8	0			-2,61372	1,04274	0	0	1	1	0	0,294878	0,335549	0	0	1	1	0	11,0534	2,5
53	07.12.2021 12:04	100	8	0			-0,14287	1,37294	0	0	1	1	0	0,289862	0,336161	0	0	1	1	0	4,58019	2,0
52	07.12.2021 12:03	2	0	1																		
51	07.12.2021 10:37	2	0	1																		
50	07.12.2021 10:37	0	0	31103																		
49	07.12.2021 10:37	300	8	32			-0,49622	1,21851	0	0	1	1	0	-0,133336	0,0333337	0	0	1	1	0	0	
48	07.12.2021 10:37	101	4	0			-2,51071	0,901814	0	0	1	1	0	1,20003	0,667507	0	0	1	1	0	-0,649086	1,5
47	07.12.2021 10:37	110	8	32			1,15614	1,42673	0	0	1	1	0	0,200005	0,335	0	0	1	1	0	-3,25163	1,0
46	07.12.2021 10:36	100	0	1																		
45	07.12.2021 10:36	300	8	0			0,52879	1,34829	0	0	1	1	0	-0,116669	0,0311808	0	0	1	1	0	-2,24861	1,3
44	07.12.2021 10:36	101	4	0			2,51797	1,5751	0	0	1	1	0	0,550012	0,47244	0	0	1	1	0	0,751663	1,0
43	07.12.2021 10:36	110	8	32			0	0	32	0	1	1	0	0,550012	0,47244	0	0	1	1	0	-5,42904	0,81
42	07.12.2021 10:34	400	10	0			2,17058	1,54069	0	0	1	1	0	-0,116669	0,0311808	0	0	1	1	0	0,566862	1,6
41	07.12.2021 10:34	400	10	0			1,50388	1,4668	0	0	1	1	0	0,216672	0,334792	0	0	1	1	0	0,900277	1,6
40	07.12.2021 10:34	400	10	0			-0,842356	1,17022	0	0	1	1	0	0,216672	0,334792	0	0	1	1	0	-1,76655	1,3

Fig. 28 Archive export sample

Designation in the archive	Description
ID	Record number. Acquires values of 1 to 4294967295. If ID = 0, such a record does not exist.
TS	Record creation time. Format "dd.mm.yyyy_hh:mm:ss"
TYPE	Record type: 0 – Failure 2 – Information 100 – Single-step contamination measurement 110 – Two-step contamination measurement – 1st position 101 – Two-step contamination measurement – 2nd position 200 – Measurement with frisker 300 – Instrument contamination test 400 – Calibration
CNT	Number of channel values for the given record. If CNT=0, the values are not available for the given record
PARAM1	Meaning depending on the record type: when TYPE=0, then: Error number, as per Tab. 33 when TYPE=1, then: 1 – information on instrument actuation when TYPE=xxx, then: Measurement status (worst result of all channels) 0 – no contamination detected 1 – not measured 32 – overload 256 – contamination - alarm level 1 exceeded 512 – contamination - alarm level 2 exceeded
PARAM2	<i>not used</i>
PID	Person identification (number of identification card read before measurement) – optional accessories

Tab. 20 Record header structure

Designation in the archive	Description
VAL	Measured value of channel "i" in the set units. Channel numbering is specified in Tab. 34 and Tab. 35.
ERR	Uncertainty of measured value of channel "i"
STA	Channel status "i" 0 – No contamination detected 1 – Not measured 32 – Overload 256 – Contamination - alarm level 1 exceeded 512 – Contamination - alarm level 2 exceeded
ASI	<i>Not used</i>
QUAN	Physical quantity of channel "i" 1 – Count rate 2 – Activity 3 – Surface activity 14 – Emissions 16 – Particle fluence
UNIT	Unit of channel "i" 1 – cps      3 – Bq      9 – dpm      29 – Ci/cm <sup>2</sup> 33 – 1/(cm <sup>2</sup> .s) 2 – cpm      4 – Bq/cm <sup>2</sup> 22 – Ci      32 – 1/s      34 – 1/(cm <sup>2</sup> .min)
NUCL	Nuclide of channel "i" 1 – <sup>11</sup> C      12 – <sup>42</sup> K      23 – <sup>67</sup> Ga      34 – <sup>113</sup> Sn      45 – <sup>198</sup> Au 2 – <sup>13</sup> N      13 – <sup>45</sup> Ca      24 – <sup>75</sup> Se      35 – <sup>114m</sup> In      46 – <sup>201</sup> Tl 3 – <sup>14</sup> C      14 – <sup>46</sup> Sc      25 – <sup>85</sup> Sr      36 – <sup>123</sup> I      47 – <sup>204</sup> Tl 4 – <sup>15</sup> O      16 – <sup>47</sup> Ca      26 – <sup>86</sup> Rb      37 – <sup>131</sup> I      48 – <sup>238</sup> Pu

Designation in the archive	Description				
	5 – <sup>18</sup> F	17 – <sup>51</sup> Cr	27 – <sup>89</sup> Sr	38 – <sup>137</sup> Cs	49 – <sup>241</sup> Am
	6 – <sup>22</sup> Na	15 – <sup>54</sup> Mn	28 – <sup>90</sup> (Sr/Y)	39 – <sup>147</sup> Pm	50 – <sup>239</sup> Pu
	7 – <sup>32</sup> P	18 – <sup>57</sup> Co	29 – <sup>90</sup> Y	40 – <sup>153</sup> Sm	51 – <sup>210</sup> Po
	8 – <sup>33</sup> P	19 – <sup>58</sup> Co	30 – <sup>99</sup> Tc	41 – <sup>169</sup> Er	52 – <sup>238</sup> U
	9 – <sup>35</sup> S	20 – <sup>59</sup> Fe	31 – <sup>99m</sup> Tc	42 – <sup>223</sup> Ra	53 – <sup>108</sup> Ag
	10 – <sup>36</sup> Cl	21 – <sup>60</sup> Co	32 – <sup>106</sup> Ru	43 – <sup>186</sup> Re	54 – <sup>133</sup> Ba
	11 – <sup>40</sup> K	22 – <sup>63</sup> Ni	33 – <sup>111</sup> In	44 – <sup>188</sup> Re	55 – <sup>152</sup> Eu

Tab. 21 Structure of channel values of the record

The records archive is also accessible using VF-Setup: the application makes it possible to create a csv file (the same as in case of an export to a flash drive, see section 8.7).

Register of the archive are accessible for remote machine reading using the protocol Modbus TCP/IP. A description of the registers is given in document VF2107090088; please contact the manufacturer of the instrument, VF, a.s., to obtain the description).

### 6.6.3 Reset

The menu performs a hard system restart of the running programme in the PLC, during which the following takes place:

- initialization of SW variables (the required of instrument settings are loaded from the permanent memory)
- check of HW (check of detectors and other internal PCBs, display, reading of detector sensitivity,...)
- check of preparedness of the instrument for the start of measurement (check of occupancy of the instrument, clearing of background buffers)
- start of new background measurement

Reset is especially used for the purposes of restoration of the instrument's operation if it enters error states. These states are always final. Instrument operators must evaluate the errors and, as applicable, remove them and restart the system again using this menu. Another use for reset is to apply new settings. The new settings are always applied after system restart, even when saved in the instrument. Until then the instrument works with the original settings. The reset is therefore applied automatically when the service menu is left in case that setting was performed.

Instrument reset takes about 20 seconds and during that time the instrument is unable to communicate with the higher-level system.

Temporary lack of function is signaled by the status LED on the front panel being turned off.

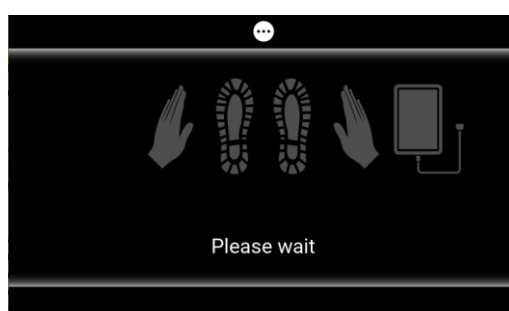
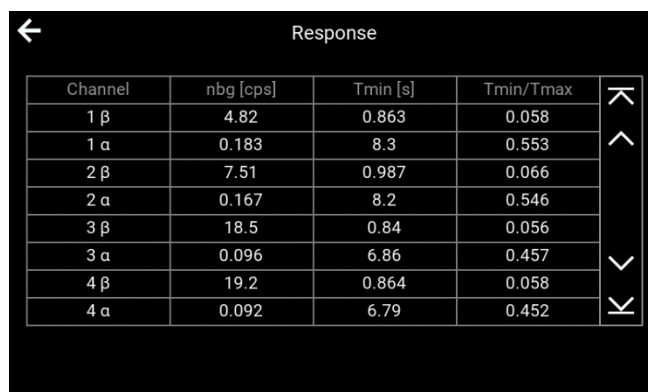


Fig. 29 Screen in case of instrument restart

### 6.6.4 Detector (detector response)

The Response table shows the response of all active measuring channels of the instrument. Depending on the design, it can be 4 to 10 measuring channels. The numbering of individual channels is shown in Tab. 34 and, as applicable, in Tab. 35.



Channel	nbg [cps]	Tmin [s]	Tmin/Tmax
1 $\beta$	4.82	0.863	0.058
1 $\alpha$	0.183	8.3	0.553
2 $\beta$	7.51	0.987	0.066
2 $\alpha$	0.167	8.2	0.546
3 $\beta$	18.5	0.84	0.056
3 $\alpha$	0.096	6.86	0.457
4 $\beta$	19.2	0.864	0.058
4 $\alpha$	0.092	6.79	0.452

Fig. 30 Detector response

For each channel, the following data are available:

Name	Description
Channel	Channel of respective detector
nbg [cps]	Pulses count rate from the background. This is the average value in the background buffer. The buffer length is set to 120 seconds by default.
Tmin [s]	Calculated contamination measurement time in seconds. The time depends on the current background, on the set 1st alarm level and also on measurement accuracy.
Tmin/Tmax	Ratio of the calculated measurement time to the maximum required measurement time. The value must be < 1 in order to allow the instrument to measure. When the value 1 is exceeded (for a specific detector or channel), the monitor is not principally able to decide whether or not the tested person is contaminated. An increased value indicates an increased background outside the monitor or possible contamination of the detector.

Tab. 22 Response - table of detector response

### 6.6.5 Audio volume (volume of audio commands)

Using this menu it is possible to adjust the volume of audio commands played in the process of contamination measurement. The current volume level is signalized by a green bar graph. It can be changed using the buttons - and +, and as applicable directly by pressing the level in the graph. A test audio command is played upon pressing. The volume is set immediately without the need to reset the instrument.

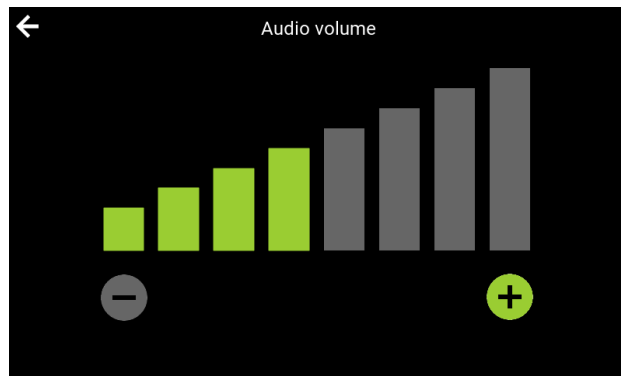


Fig. 31 Audio volume – volume of audio commands

### 6.6.6 Frisker volume

If the instrument is equipped with a removable frisker, this menu can be used to adjust the volume of acoustic signalization of pulse arrival, which is on during measurement using the frisker. When the menu is opened, acoustic signalization switches on automatically as in case of regular measurement. The current volume level is signalized by a green bar graph. It can be changed using the buttons - and +, and as applicable directly by pressing the level in the graph. The volume is set immediately without the need to reset the instrument.

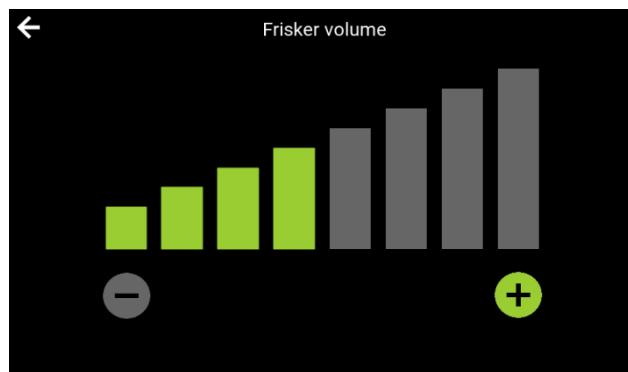


Fig. 32 Frisker volume

### 6.6.7 Sensors

In the menu it is possible to monitor the functionality of all sensors of the instrument. If the instrument is not occupied by a person and the frisker is not extended, all sensors must be inactive. The screen then immediately responds to the action of individual sensors by the respective actuation.

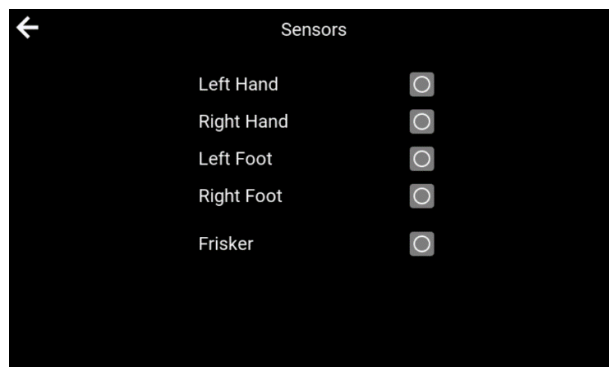


Fig. 33 Sensors – sensor diagnostics

### 6.6.8 Diagnostics (signalization control)

The menu serves for manual control of visual and acoustic signalization on the instrument. Instrument HF-4 is equipped with only one means of visual signalization, a green status LED under the display. In addition, the instrument is equipped with acoustic signalization, when a test audio command is played during the test at the set instrument volume.

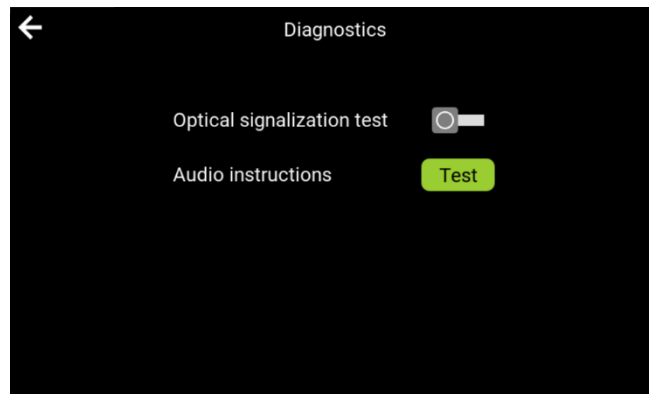


Fig. 34 Diagnostics – signalization control

### 6.6.9 Network (network settings)

The menu is intended for the purposes of setting the network connection. If automatic address allocation from the DHCP server is used, the allocated IP address can be determined in the menu. If a change in the settings is made, it is necessary to save the new settings using the Save button. The changes are applied after instrument restart, which is performed automatically when the service menu is left.

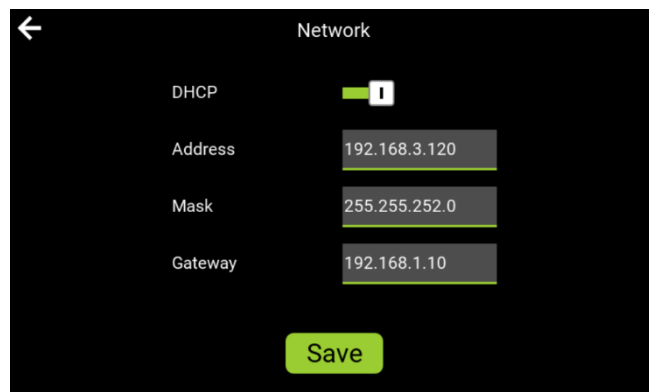


Fig. 35 Network - network settings

### 6.6.10 Identification (identification before measurement)

If the instrument is equipped with a reader (it is an optional design), it is possible to switch on or off the requirement for identification of people before the start of contamination measurement in this menu. If a change in the settings is made, it is necessary to save the new settings using the Save button. The changes are applied after instrument restart, which is performed automatically when the service menu is left.

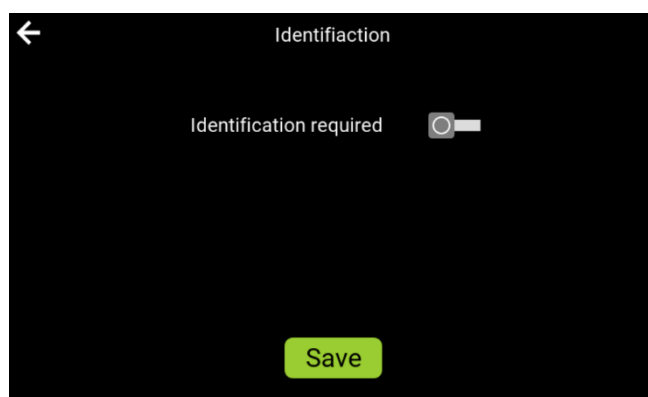


Fig. 36 Identification – identification before measurement

### 6.6.11 Presets (starting preset)

The installation works with presets. The presets keep the radiometric parameters of individual measuring channels. The instrument allows to set up to ten presets and it is always necessary to define at least one preset.

If at least two presets are defined, it is possible to select from a list of presets in the Preset menu. The list shows all active presets, i.e. presets with a defined name. If only one preset is active, the service menu does not show the "Preset" menu. If a change in the settings is made, it is necessary to save the new settings using the "Save" button. The changes are applied after instrument restart, which is performed automatically when the service menu is left.

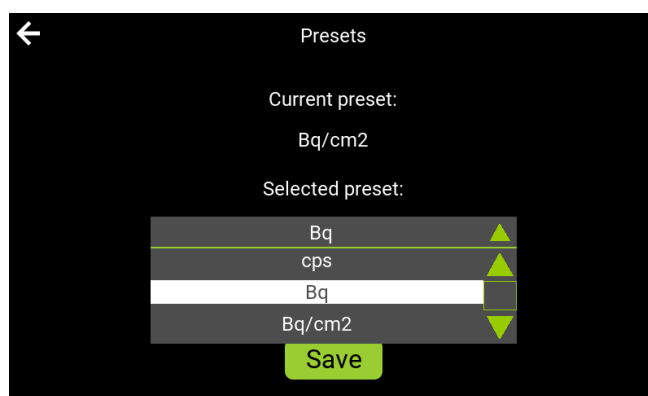


Fig. 37 Presets – Selection of starting preset

Name	Description
Current preset	The current preset whose parameters are used for the current contamination measurement.
Selected preset	The selected preset. The preset saved as the default starting preset after pressing the Save button and set as "Current preset" after instrument restart.

Tab. 23 Presets – Selection of starting preset

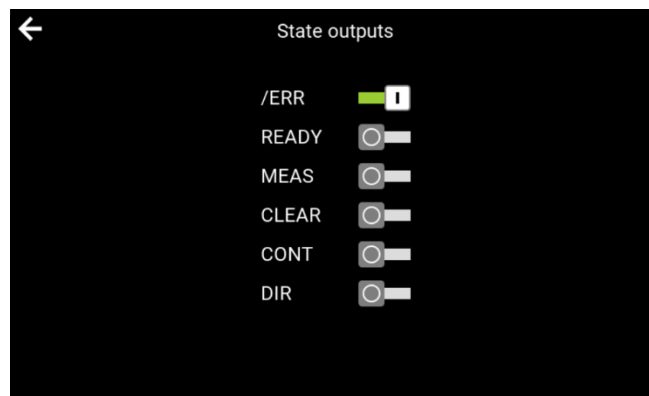


Fig. 38 Relay outputs



## 7. Web interface

If the instrument is connected to the network and has a properly set IP address, it is possible to connect to it remotely via the web interface. The instrument cannot be set using the web interface. It only serves to display the current state of the instrument in terms of its functionality. For a detailed description of signalization see section 6.4.

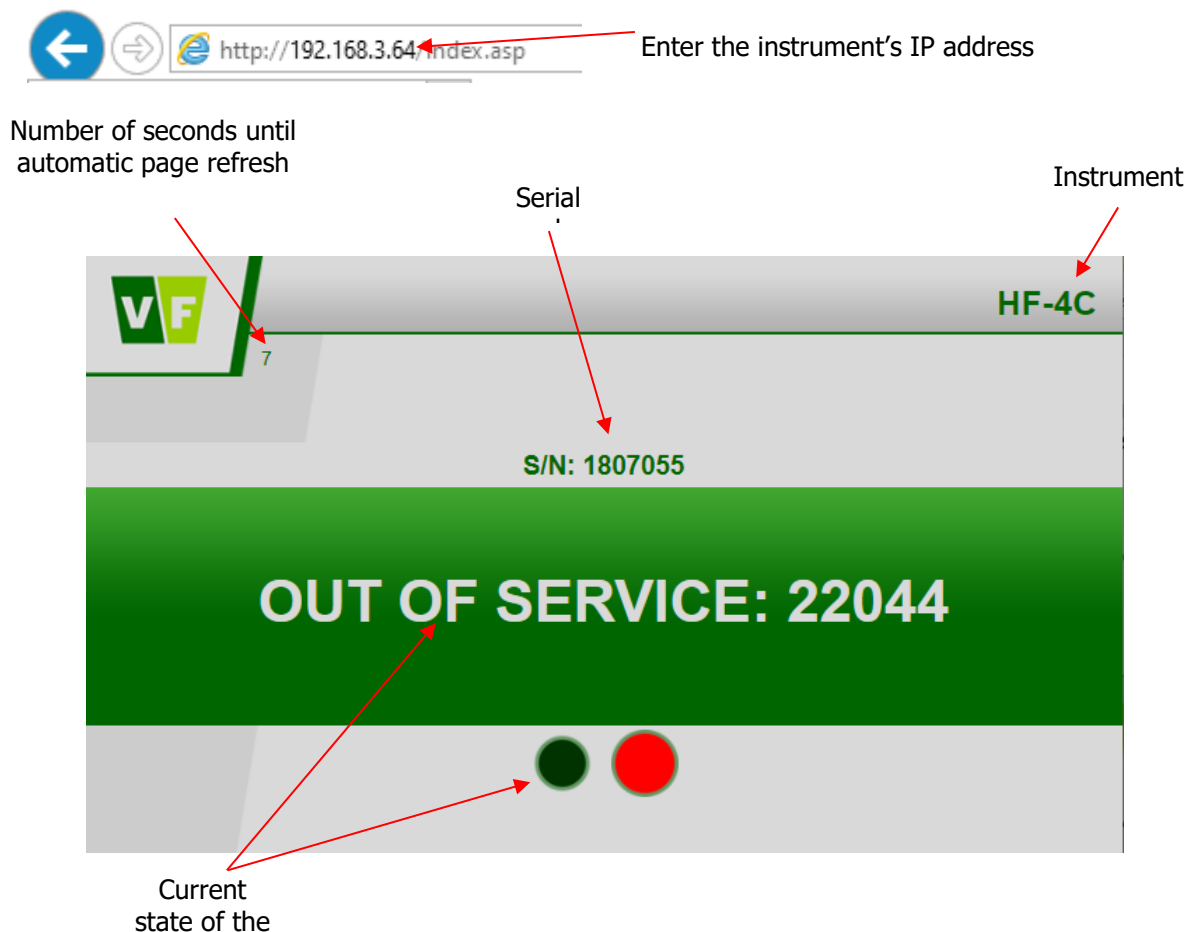


Fig. 39 Web interface

	Instrument in the "Ready for measurement" state
	Instrument in the Out of service" state
	Instrument in other states, e.g. measurement in progress, high background, etc.

Tab. 24 Web interface – signalization

## 8. Instrument settings

The instrument can be set using the service programme VF-Setup. It is possible to connect to the instrument either locally via the SERVICE interface or remotely via the ETHERNET line. All programme functions are described in the separate document Software for Setting the Parameters of Detectors VF-Setup (document number VF1611040217). Below you will only find instructions related to instrument-specific settings.



The VF-Setup programme is intended for complex service management of the instrument. It allows two log-in levels, specifically USER and SERVICE. Some specialized tasks, such as detector settings, can only be performed after the required training either by the manufacturer or a service organization. The service log-in details are provided after that.

The application allows for example the following tasks to be performed:

- setting of the working voltage of detectors and measurement of detector response – only locally via the SERVICE port and only with SERVICE rights
- setting of parameters of measuring channels (such as alarm levels, presets, units, measurement errors etc.)
- setting of parameters of the entire instrument (such as instrument language, measurement time, measurement position, identification and many others)
- service setting and diagnostics of all internal modules, including detectors – only locally via the SERVICE port and only with SERVICE rights

The service application VF-Setup is executable on an external PC under OS Windows (note: launching the application requires Microsoft.NET Framework to be installed).

### 8.1. Instrument connection

Connect the instrument to the external PC either using a service USB cable (Fig. 40), which is included in the supply, or connection of the instrument to the Ethernet network. The SERVICE connector is accessible in the rear of the upper case, the ETHERNET connector in the rear of the base (Fig. 8).

Upon first connection via USB the installation of USB port driver will automatically start up. The driver is a part of the application scope of delivery.



Fig. 40 Service cable with a converter

## 8.2. Reading XML root file

Several text files of XML format are defined for each instrument. These files are delivered as a standard on a USB flash drive HA-123 (NM 1-0203-00046) together with the service SW.

The xml root file is the main file defining the service programme's behaviour for the specific instrument. The name of this file always contains the word "root". This file defines which detectors and which auxiliary units are installed in the instrument, their internal addresses, the files containing the definition of their parameters, the number of channels of the detectors, the number of photomultipliers, which detectors can be controlled by which rules, etc. The xml root configuration file also defines the number or appearance and content of the tabs that are displayed on the main screen of VF-Setup.

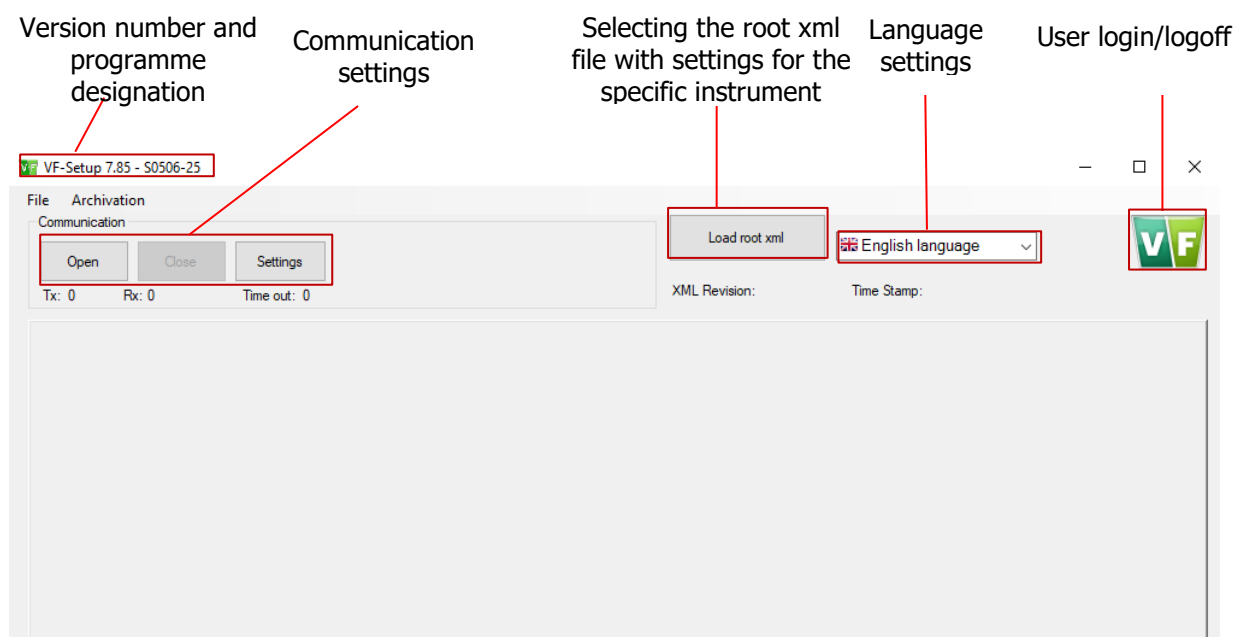


Fig. 41 Appearance of the screen after the first start of the programme VF-Setup

Procedure of reading the XML root file:

1. Press the "Load root xml" button.
2. Open the directory where the files for HF-4 are saved.
3. Select the file having the word "root" in its name and confirm by pressing "Open".
4. The main screen of VF-Setup is set according to the configuration in the XML file.

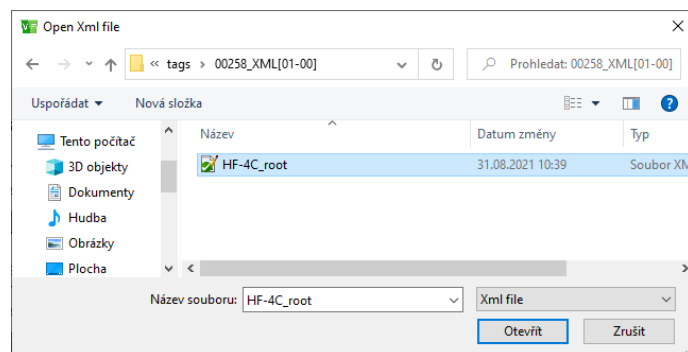


Fig. 42 Selection of the XML file



The content of configuration xml files is protected by a CRC sum. An error message stating “CRC Xml File missing” is displayed when reading of the manually modified file is attempted. If a wrong file is read, there is nothing shown under the button.

The programme VF-Setup remembers which file was last read, so if you work with one type of instrument only, you do not need to read the root file each time you run the programme.

### 8.3. Communication settings

Press the “Settings” button in the “Communication” section.

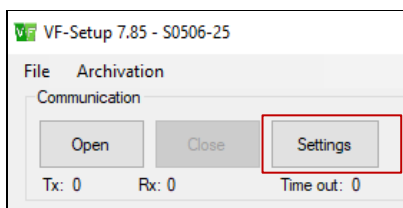


Fig. 43 Section “Communication”

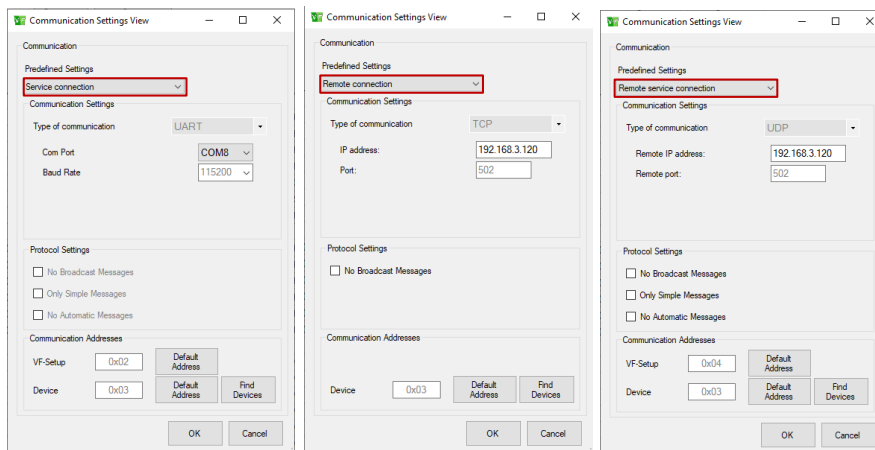


Fig. 44 “Communication Settings” section

The "Predefined Settings" item is used to select one of the predefined ways of setting communication based on the connected instrument. For local connection using a service cable use the "Service connection" option. In case of connection via Ethernet use the "Remote connection" option. Use the "Remote service connection" option if it is necessary to communicate remotely with internal modules. This option, however, requires service log-in rights and then actuation of the forwarding of internal communication to the Ethernet line.

When the predefined connection option is selected, it is necessary to select the assigned COMx port, or as applicable to fill in the set IP address of the instrument.

Press the "Open" button now and the instrument HF-4 is successfully paired with the programme VF-Setup.

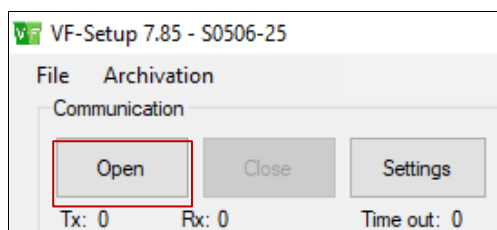


Fig. 45 "Open" button



The options in the "Protocol Settings" section are predefined in the XML set and their user modification is not recommended. Any changes require detailed knowledge of the instrument, communication protocols and VF-Setup software beyond the scope of this document. Leave the "Protocol Settings" and "Communication Addresses" sections at the default values.

## 8.4. Parameters

Button for one-time reading of parameters from the instrument

Button for reading the parameters from the instrument repeatedly, setting the period and the reading cycle counter

Drop-down menu of the parameter tables

Reading and saving of the table of parameters

Button for saving the changed only or all parameters to the instrument

Button for rewriting with the values from the "Default" column

Button for rewriting with the values from the "Value" column

Button for work with commands

Log	Parameter	Value	Default	Unit	Rights	Description
<input type="checkbox"/>	HW_ID	50-A-0015871	50-A-0015871	-	RO	HW identification
<input type="checkbox"/>	SW_ID	53-A-0000340	53-A-0000340	-	RO	FW identification
<input type="checkbox"/>	SW_VER	1.00	1.00	-	RO	FW version
<input type="checkbox"/>	SER_NO	123456789		-	RO	Serial number of the device
<input type="checkbox"/>	PR_ID	K1177-02	K1177-02	-	RO	Product ID
<input type="checkbox"/>	PR_NAME	HF-4C	HF-4C	-	RO	Product name

Fig. 46 Parameters tab – overview

The „Group Reading/Writing of Parameters“ option switches between the modes of reading (writing) one parameter at a time or reading (writing) parameters in blocks. In the case of block reading, the application groups the parameters into as large complete blocks as possible. This allows the application to reduce the amount of communication required to read all parameters.

In the case of block writing of parameters, only those parameters that are adjacent to each other are grouped, so that the order of their writing does not change. This is because the order of writing can be critical to the proper functioning of the instrument.

All parameters are always read from the instrument to the "Value" column. Press the "Read from Device" button to carry out single reading. Reading can be repeated. The period of repetition is defined in the "Period [s]" menu.

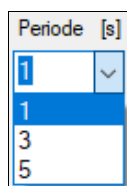


Fig. 47 Setting the parameter reading period

The times of 1 s, 3 s and 5 s are offered automatically; however, the value can be manually rewritten in any way. The repeated reading is turned on and off by pressing the "Start repeated reading" button. During the automatic reading process, you can only view the parameters; anything else is blocked. Successful reading is indicated by green colour in the appropriate cell and unsuccessful reading is indicated by red colour in the appropriate cell. During the automatic reading process, you can save the selected parameters in the file by checking the appropriate cell in the "Log" column. The file name is in the format "yymmdd\_xxx\_Log\_param.txt", where "yy" is the year, "mm" is the month, "dd" is the day and "xxx" is the order of measurement.

Right-clicking at any point in the parameter table can display a menu for turning off and on the display of individual parameter types in the table. It is also possible to display all parameters and to display only different parameter values with one click.

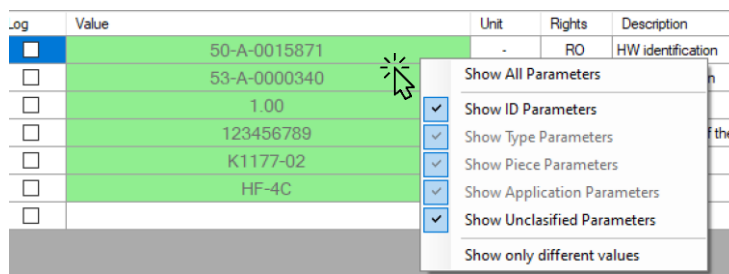


Fig. 48 Selection of parameter type

When reading the parameter table, a check is carried out whether the table contains at least one parameter of the given type. If this is not the case, the option to select the display of this parameter is inactive.

Right-clicking the parameter table displays a menu for turning off and on the individual columns in the table. Clicking the appropriate item enables or disables the display of the appropriate column in the table. The programme remembers the settings of the display of columns even after closing.

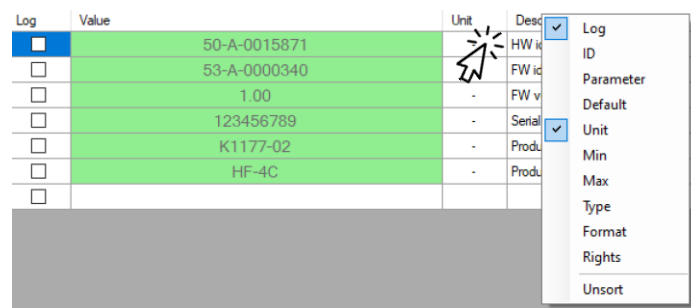


Fig. 49 Selection of displayed columns

You can write the parameters from the "Value" column to the instrument by pressing the "Write to device" button with the additional option "Write all". If the "Write all" option is not checked, only the parameters changed manually will be written. If checked, the "Write Settings" dialogue window will show up. If the filter type concerned has been filtered by the user or if the parameter type does not exist in the loaded xml, the option to select the write Settings for this parameter is unavailable. The window also contains the "All" option that automatically selects all available parameters.

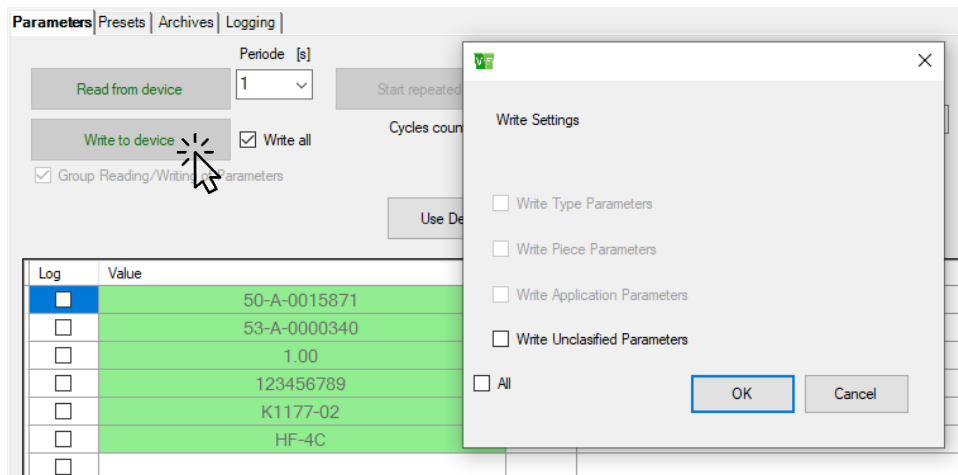


Fig. 50 "Write Settings" window

If the value in the column "Value" is changed by the user, this change will be indicated by yellow colour. Successful writing is indicated by green colour in the appropriate cell and unsuccessful writing is indicated by red colour in the appropriate cell.

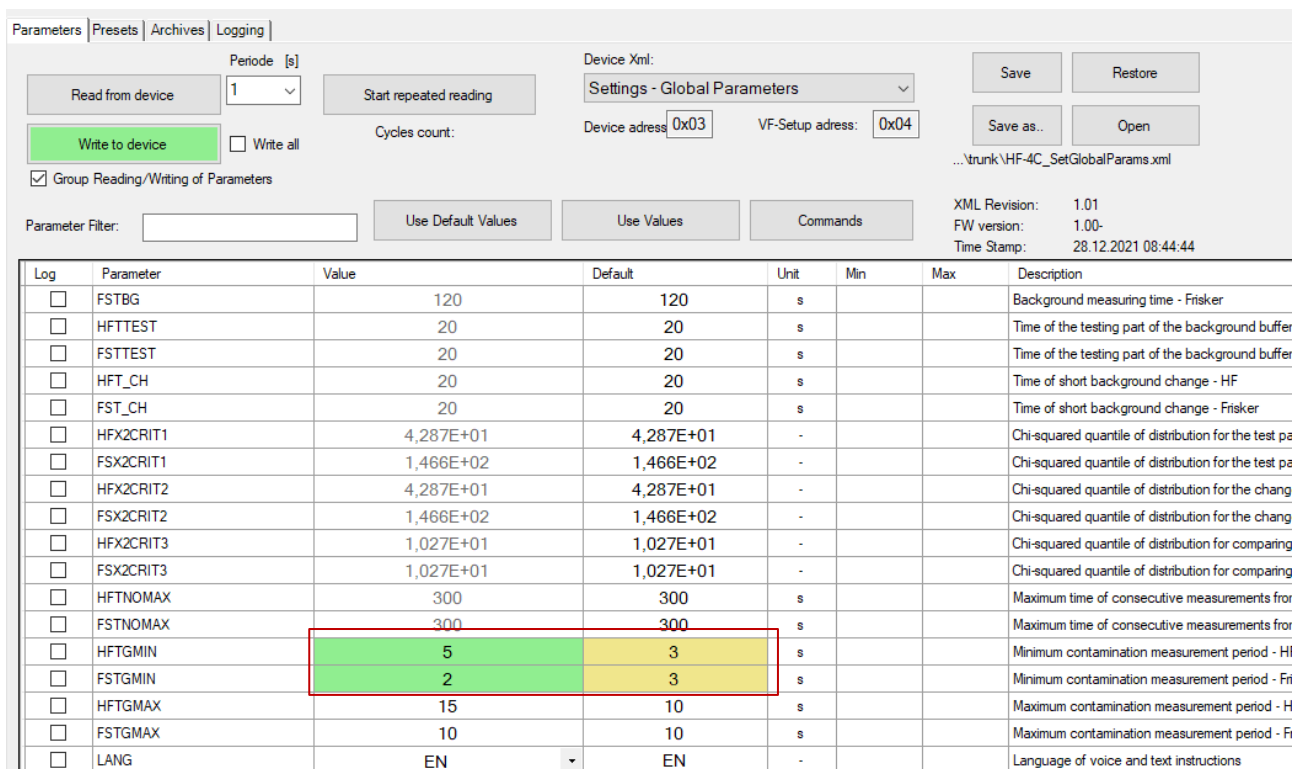


Fig. 51 Successful writing of values to the instrument

Buttons for work with the file containing the definition of the table content are located in the right section of the tab. You can use the "Save" button to rewrite the content of the original file. Thus the current values in the "Value" column become the new default values in the "Default" column. Use the button "Restore" to restore the state of the table according to the content of the file. This will rewrite the values to the default values.



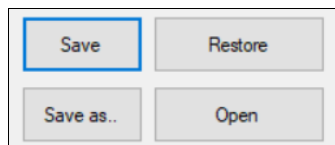


Fig. 52 Buttons for work with the file

The button "Use Default Values" rewrites all the values in the column "Value" with the values from the column "Default". The button "Use Values" rewrites all the values in the column "Default" with the values from the column "Values".

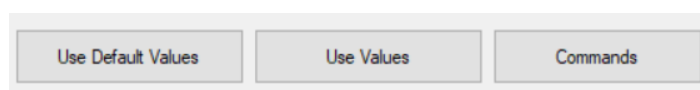


Fig. 53 „Use Default Values“, „Use Values“ and „Commands“ buttons

The "Commands" button allows to send predefined commands to the instrument. Pressing the button opens a new window. Window elements are arranged into a table.

The left column consists of command buttons. The right column is always reserved for a description of the command function. After pressing the command button, the application displays a screen prompt to enter the command.

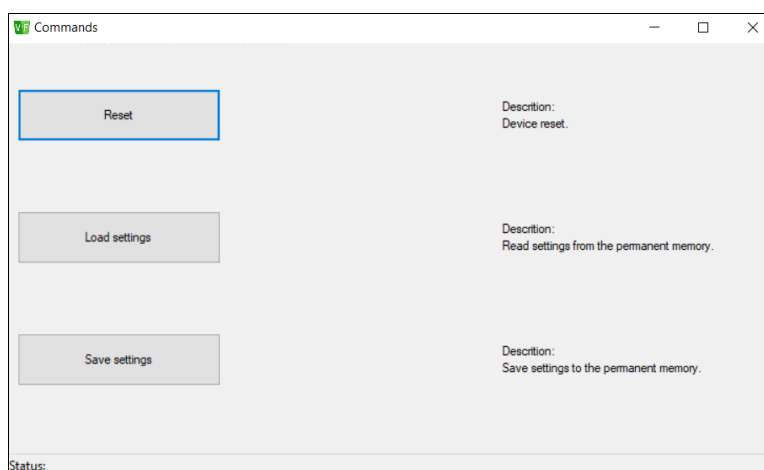


Fig. 54 "Commands" window

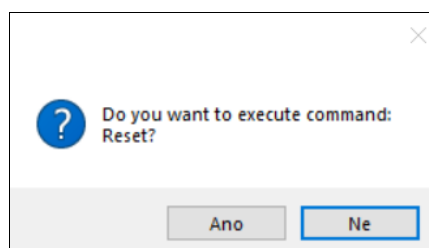


Fig. 55 Screen prompt for entering the command

Confirming the action launches the command input process. In case of success the button becomes green for 5 seconds. If the process fails, the button turns red for 5 seconds. After completion, the result of the operation is written in the status line.



Fig. 56 Successful execution of the command

All the functions described above can be applied to the respective xml sheet (selected in the drop-down menu). Depending on the log-in level, instrument HF-4 contains the following sheets:

Instrument XML	Description	Rights
Identification	Information on instrument type, serial number, SW version and other	User
Module identification	Information on internal modules	Service
Settings – modules	Settings of internal modules	Service
Settings – global parameters	Settings of basic instrument parameters	User
Settings – channels	Settings of parameters of measuring channels	User
Calibration mode	Control of the instrument during calibration	User
Archive	Reading of records from the archive of measurements and errors	User
State – instrument	Current state of the instrument and its measuring channels	User
State – detectors	Current state of detectors	Service

Tab. 25 Drop-down menu of instrument XML

## 8.5. Work with presets

The table with presets contains a set of unified parameters that are used by various instruments to process and present the measured values. Instrument HF-4 offers the possibility to define up to 10 presets. Each preset contains up to 10 measuring channels depending on the design variant. For easier setting, these measuring channels are firmly divided into groups for which the same settings are expected.

The screenshot shows the 'Presets' tab of the HF-4C interface. The 'Device' dropdown is set to 'HF-4C'. On the left, a tree list shows the preset hierarchy: '1. cps' (expanded) containing '1 HANDS\_BetaChannel' (with sub-items '1. Channel' and '3. Channel'), '2 HANDS\_AlphaChannel', '3 FEET\_BetaChannel', '4 FEET\_AlphaChannel', '5 FRISKER\_BetaChannel', '6 FRISKER\_AlphaChannel', '2. Bq', and '3. Bq/cm2'. The '1. Channel' is selected. On the right, a table displays parameters for the selected channel. Above the table are 'Read', 'Write', and 'Write All' buttons. To the right of the table are 'Save', 'Restore', 'Save as..', and 'Open' buttons. A file name 'HF-4C\_ContamatPresets.xml' is shown below these buttons.

**Annotations:**

- Presets tab:** Points to the 'Presets' tab at the top.
- Preset number:** Points to the '1. cps' label next to the tree list.
- Parameters:** Points to the table header 'Name', 'Device Value', 'Working value', 'Xml File Value'.
- Buttons for reading and writing presets:** Points to the 'Read', 'Write', and 'Write All' buttons.
- Tree list of presets and their channels:** Points to the left-hand tree view.
- Selected channel of the given preset:** Points to the '1. Channel' label.
- Parameters of channel:** Points to the parameter table for the selected channel.
- Working with an XML file:** Points to the 'Save', 'Restore', 'Save as..', and 'Open' buttons.

Name	Device Value	Working value	Xml File Value
NAME		cps	cps

Name	Device Value	Working value	Xml File Value
CFG		1: Valid	1: Valid
PQ		Count Rate	Count Rate
UNIT		cps	cps
NUCLIDE		Ndef	Ndef
RF		1,000E+00	1,000E+00
TUL1		2,810E+01	2,810E+01
TDCL		2,810E+01	2,810E+01

Fig. 57 Main screen of presets

### 8.5.1 Handling presets

The "Read" button always reads all available presets from the instrument. If the read values from the instrument differ from the default values saved in XML, these differences are shown in yellow.

The "Write" button only writes to the instrument those presets for which the user has changed the parameters. These presets are highlighted in bold and yellow in the window on the left side of the screen. When the "Write all" field is checked, all available presets will be written. When writing is complete, it will be saved to the permanent memory of the instrument.

The buttons on the right side of the screen are used to save or read from the XML file. The "Restore" and "Save" buttons work with the already downloaded XML file. When selecting the "Open" or "Save as.." button, the user is asked for the path to the XML file to be read or saved.

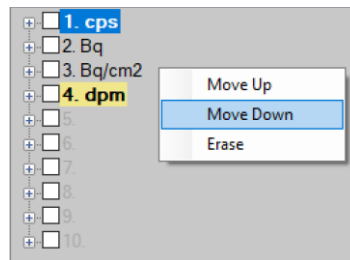


Fig. 58 Handling presets

By right clicking one of the presets, we open a window to handle the presets. We can freely move them up, down or delete them completely. Any shift of a preset is highlighted in yellow in the list.

### 8.5.2 Settings of presets

A preset is considered as valid if its Name is filled in. If the name of a preset is not filled in, the instrument does not work with the preset and this preset cannot be selected in the list of the service menu (Fig. 37) or on the main screen (Fig. 13).

To set the name it is necessary to mark the specific preset in the tree list and fill in the required name in the table.

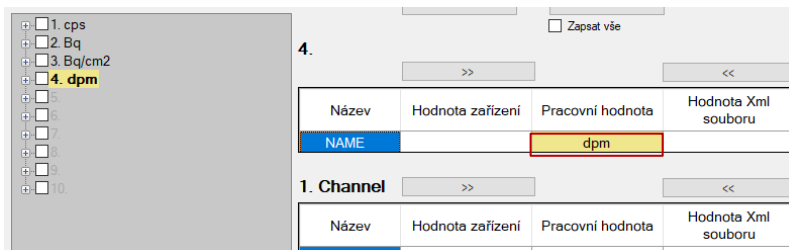


Fig. 59 Setting the preset name

After that it is possible to set the parameters of individual channels of the given preset. In the tree list it is first necessary to expand the respective menu down to the level of individual channels. The setting wizard as described in the following section is then launched by double clicking the required channel. If other channels in the given group were marked using the check boxes before launching the wizard, the guide also automatically sets these channels in the same way (applies only to channels in the same group).

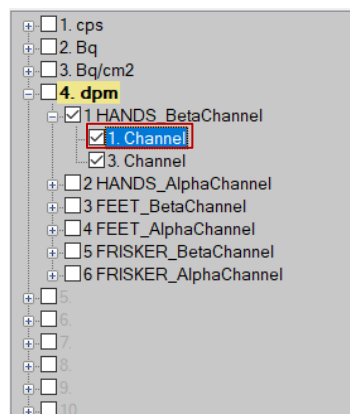


Fig. 60 Opening the Preset Wizard

### 8.5.2.1. Quantity and unit settings

The screenshot shows a window titled "1. Preset Wizard". Inside, there are three rows of settings:

- Measured Quantity:** A dropdown menu with "Surface Activity" selected.
- Unit:** A dropdown menu with "Bq/cm2" selected.
- Reference Surface:** A text input field containing "286" followed by a unit label "[cm2]".

At the bottom of the window, there are three buttons: "Back", "Next", and "Cancel".

Fig. 61 Preset Wizard – quantity and unit settings

The quantity and unit settings serve as definitions for displaying the preset in the instrument and for calculating the range factors in the preset.

Quantity	Unit
count rate	cps (count per second), cpm (count per minute)
activity	Bq, dpm (disintegration per minute), Ci (Curie; $Ci=3,7 \times 10^{10}$ Bq)
surface activity	Bq/cm <sup>2</sup> , Ci/cm <sup>2</sup>
emissions	1/s (parts per second)
particle fluence rate	1/(cm <sup>2</sup> .s), 1/(cm <sup>2</sup> .min)

Tab. 26 Quantities and units

### 8.5.2.2. Nuclide settings

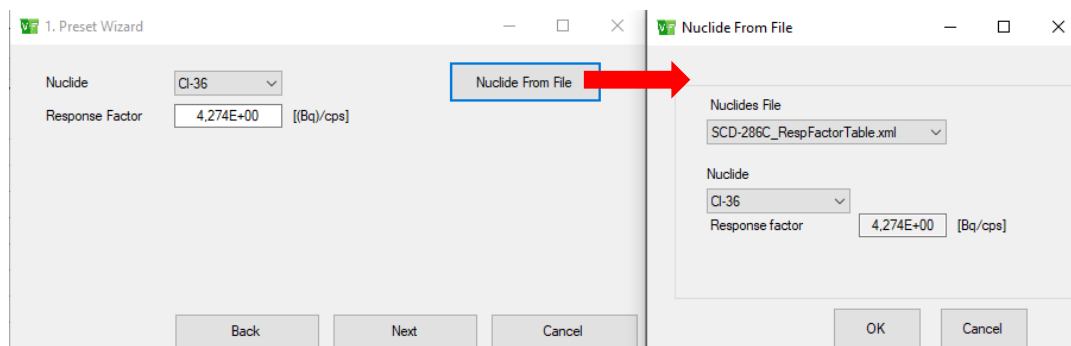


Fig. 62 Preset Wizard – nuclide settings

The user can choose the nuclide and response factor. The user selects the nuclide from a set of nuclides that is read from the XML set used. If there are several nuclide files in the given XML set, the user can choose between them in the drop-down menu that can be accessed by clicking the „Nuclide From File“ button.

The response factor serves to convert the count rate measured by the detector to the value shown on the display. By default, it is specified according to the selected unit, radionuclide, and detector area as follows:

Unit	Response factor RF
cps	1
cpm	1 / 60
Bq, pps	1 / R
dpm	1 / (60 * R)
Bq/cm2, pps/cm2	1 / (S * R)
Note: R is the instrument response in cps to unit activity or emission	
Note: S is the reference area pursuant to local legislation, usually the area of the detector	

Tab. 27 Determination of the response factor for different units

### 8.5.2.3. Setting measurement ranges and threshold levels

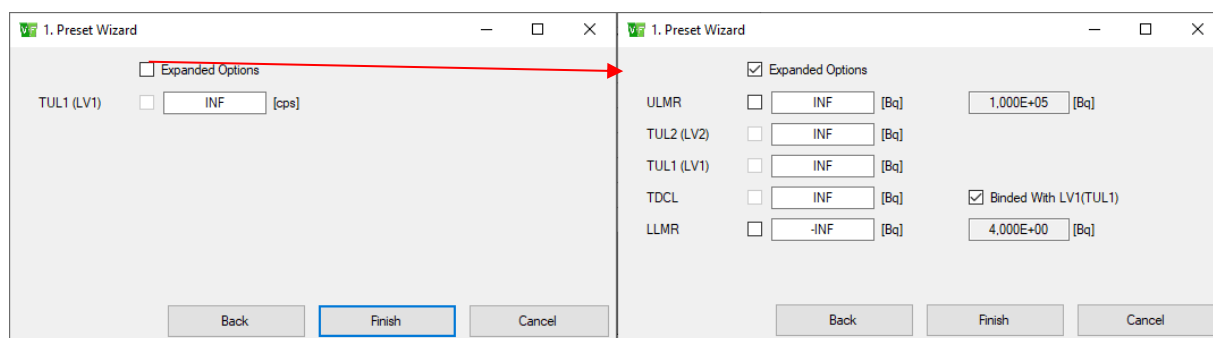


Fig. 63 Preset Wizard – setting of measurement ranges and threshold levels

Parameter	Description
ULMR	Upper limit of the measurement range
LV2	Alarm level 2
LV1	Alarm level 1
TDCL	Alarm level for the contamination test
LLMR	Lower limit of the measurement range

Tab. 28 Description of parameters of measurement ranges

The basic window layout only contains Alarm level 1 – LV1. By default, this value is tied to the value of TDCL, i.e. if I set LV1, TDCL is automatically set, too.

By selecting the “Expanded Options” option, we get to the remaining alarm level thresholds TDCL and LV2 and measurement range limits.

Definition of the origin (ULMR) and end (LLMR) of the measurement range is not obligatory and the instrument does not work with these values. However, it provides approximate information on the measurement range. By default, the upper measurement range and upper threshold levels are set to infinity (INF) and the lower measurement range is set to negative infinity (-INF). The values of the Upper Limit of Measurement Range (ULMR) and Lower Limit of Measurement Range (LLMR) calculated according to the type of instrument are in the right part of the window.

The set values are checked according to the following conditions:

$LLMR \leq LV1 \leq LV2 \leq ULMR$ ,

$LLMR \leq TDCL \leq ULMR$ ,

$LLMR < ULMR$ ,

$LLMR = \text{calculated LLMR} \pm 20\%$ ,

$ULMR = \text{calculated ULMR} \pm 20\%$ .

If these conditions are not met, the user is prompted to correct the entered parameters.

The Preset Wizard is finished by pressing the “Finish” button. The preset is processed and written to the preset parameters, which are written to the instrument. After correction, the preset is highlighted in bold and in yellow. The changed preset parameters are also highlighted in yellow in the table of parameters.

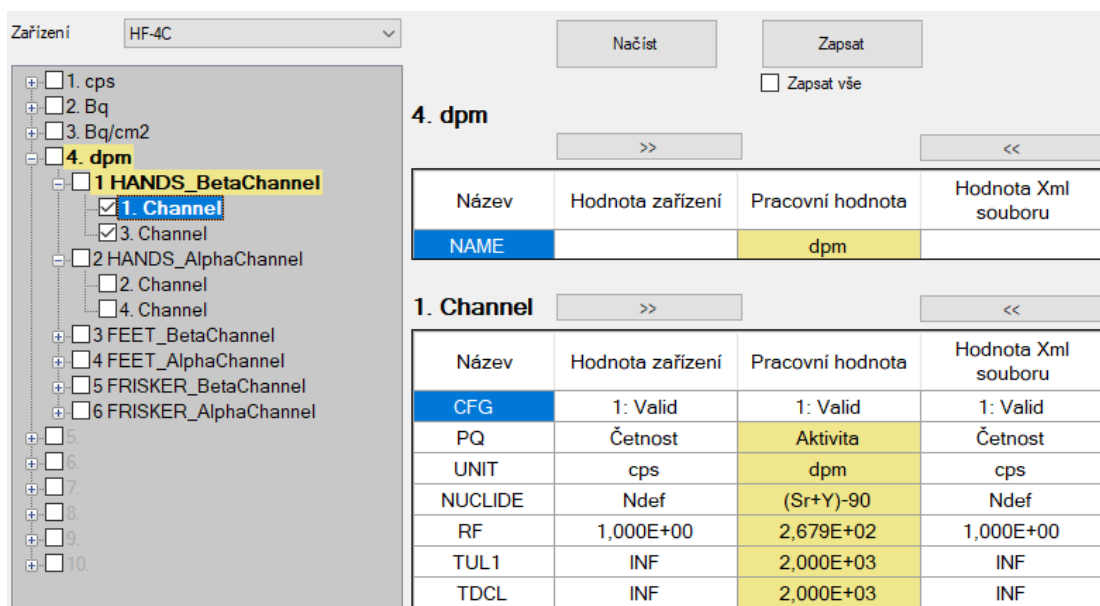


Fig. 64 Change of parameters

## 8.6. Archiving

### 8.6.1 Archiving parameters

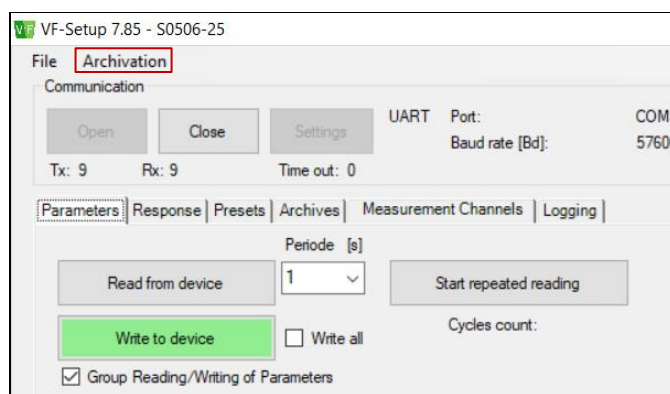


Fig. 65 "Archivation" menu

The "Archive" button will be made accessible in the "Archivation" menu once the communication channel has been opened. After the "Archive" option is pressed, archiving the parameters defined in the XML set loaded in the application will start. A window with an indicator of the parameter archiving progress is displayed. If necessary, the application will prompt the entry of the serial number for the currently archived instrument. Archived data are saved in the "Archivation" directory in the application path. The data in the "Archivation" directory are in .zip format with the file name in this format:

1700700\_20211007\_085835\_HF-4C.zip

Serial number      Date of archiving      Time of archiving      Instrument name



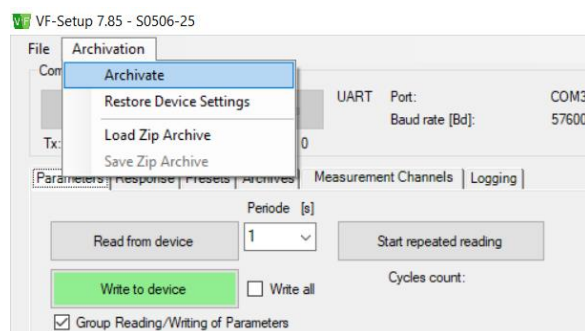


Fig. 66 "Archive" menu

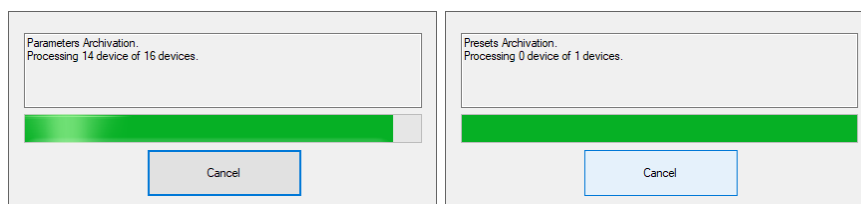


Fig. 67 Progress of parameters archiving

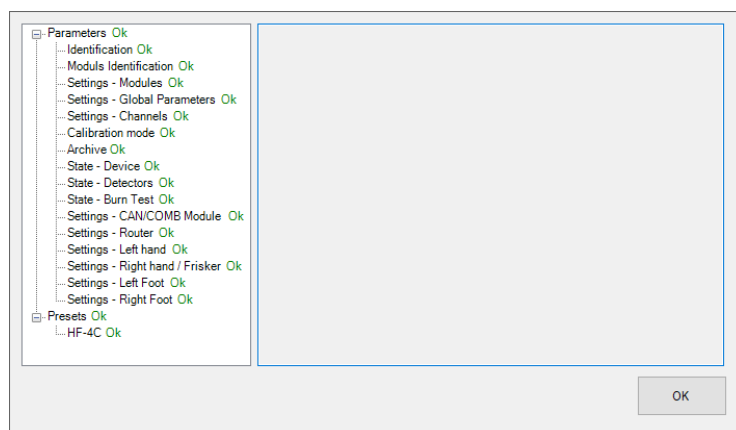


Fig. 68 Report on successful completion of archiving

## 8.6.2 Restoring instrument settings

The "Restore Device Settings" item is used to restore the original instrument settings from the archived zip file. The window will appear by pressing the button where we select the path to the already archived zip file. When writing, the programme asks which parameters to write in the instrument.

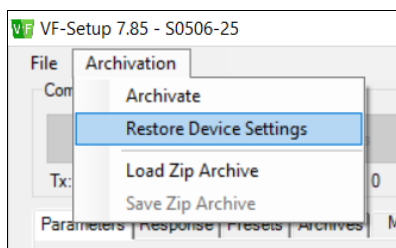


Fig. 69 Restoring instrument settings

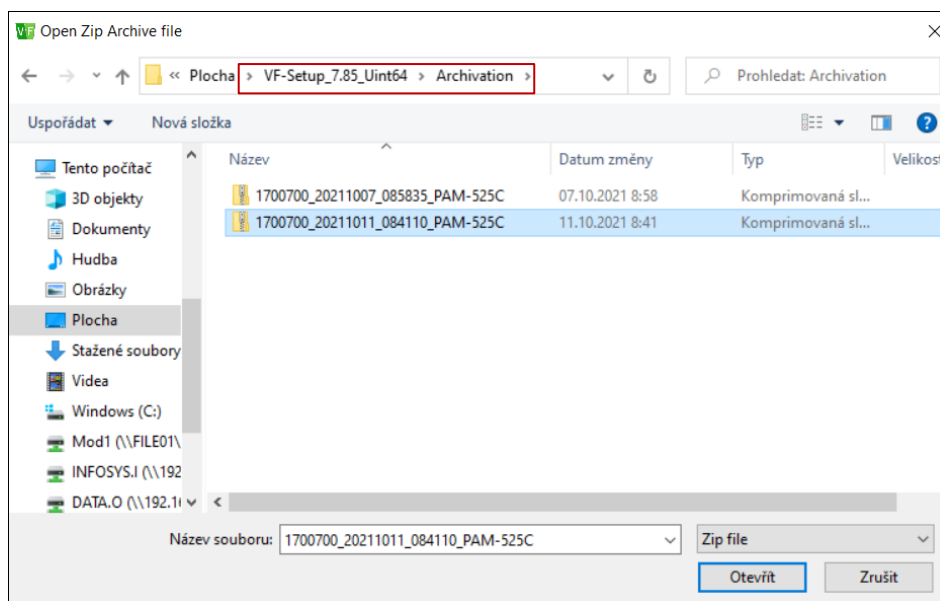


Fig. 70 Restoring instrument settings from zip file

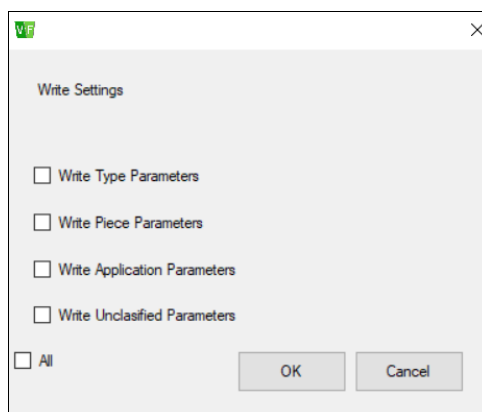


Fig. 71 Selection of parameters to write in the instrument

### 8.6.3 Load/save ZIP archive

The “Load/Save Zip Archive” items are used for temporary work with the configuration file. Using the “Load Zip Archive” item, we select the XML file for instrument HF-4 in zip format.

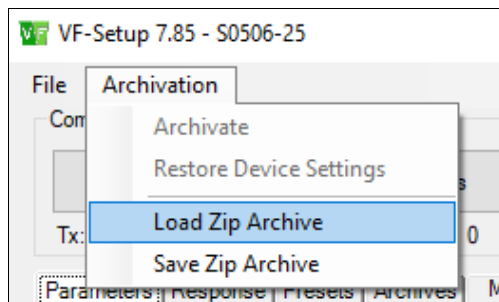


Fig. 72 “Load/Save Zip Archive” items

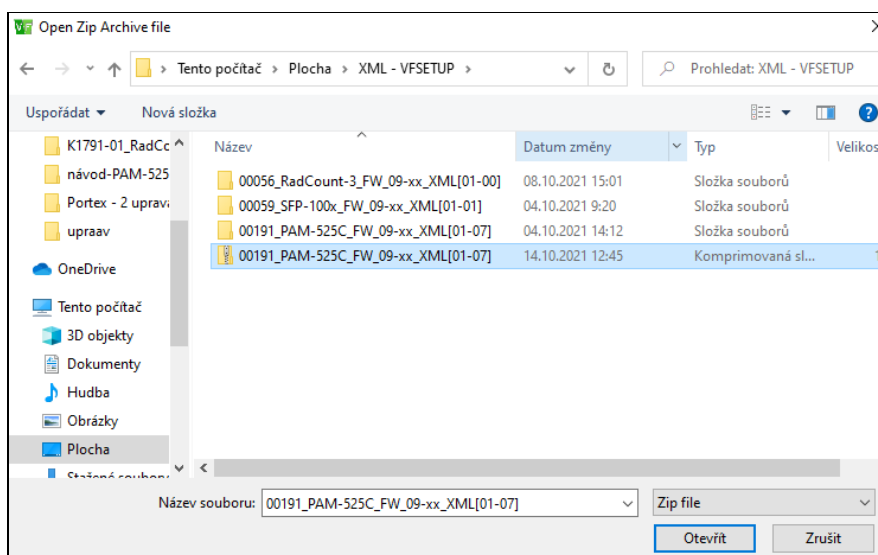


Fig. 73 XML set in zip format

Unlike conventional loading using the “Load root xml” button, the programme works with the configuration file only in temporary state – i.e. the programme no longer remembers it after switching off. Therefore, if we want to save the changes, we press the “Save Zip Archive” button. After that we can return to this file at any time using the “Load Zip Archive” button.

## 8.7. Archivation tab

The tab is intended to export the measurement archive saved in the instrument in a CSV file. Before the export it is possible to select the number of the required records in a drop-down menu. The choice includes 10, 100, 1,000, all and remaining. The format of the exported file is CSV. The user chooses the location and name of the file. The resulting file contains identification data of the instrument from which the export was acquired (HW\_ID, SW\_ID, SW\_VER, SN). The values in the text file are separated by a semicolon and for example Microsoft Excel is suitable for tabular processing. The meanings of individual columns are shown Tab. 20 and Tab. 21.

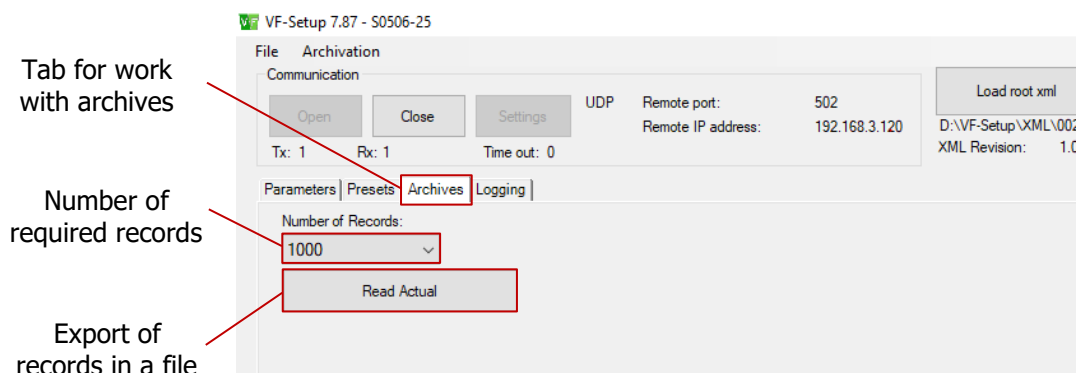


Fig. 74 XML set of in zip format for instrument PAM-525

## 9. Maintenance and care



When performing maintenance and care of the instrument, follow the requirements and principles of occupational safety.

### 9.1. Daily maintenance

- Inspect the instrument visually. If you discover any visible damage to the instrument or its peripheries, inform the instrument administrator.
- Clean the detectors (section 8).
- Check the measured background using the service menu on the instrument display. If an increased number of background pulses is measured, the detector's light-tight foil is probably damaged or the detector is contaminated.

### 9.2. Three-month maintenance

- Check the switches of foot detector grates, including lubrication (section 9.8). Movable parts in hand detector holders are self-lubricating.

### 9.3. Annual maintenance



MANUFACTURER'S RECOMMENDATION – Check the stability of the detector using CRM (Am-241 and Cl-36). Check the metal-coated light-tight aluminium foil using a source of light. If the detector is exposed to sharp light, e.g. halogen or LED lamp, the response must not increase by more than 40%.

### 9.4. Metrological traceability

- The primary settings and calibration are carried out by the manufacturer.
- Setting is performed by the manufacturer, an authorized service organization or the user's staff trained by the manufacturer.
- The working regulations for metrological settings and calibration of the instrument are specified in separate document VF2112300018.



MANUFACTURER'S RECOMMENDATION – Carry out calibration at least once in 2 years.



To maintain the quality of the set metrological parameters in the course of time, do not leave the instrument switched off for longer than 3 months<sup>1</sup>.



If the user modifies parameter settings using the programme VF-Setup in the configuration for service organizations, the manufacturer cannot guarantee the accuracy and precision of the displayed values of quantities – activity or surface activity. In such a situation, we recommend to provide for the calibration of instrument in a laboratory authorized or accredited in accordance with ČSN EN ISO / IEC 17025.

## 9.5. Service life of the photomultiplier

The photomultiplier is an electrical component that can detect very weak light signals, usually in the range of (295 ÷ 630) nm.

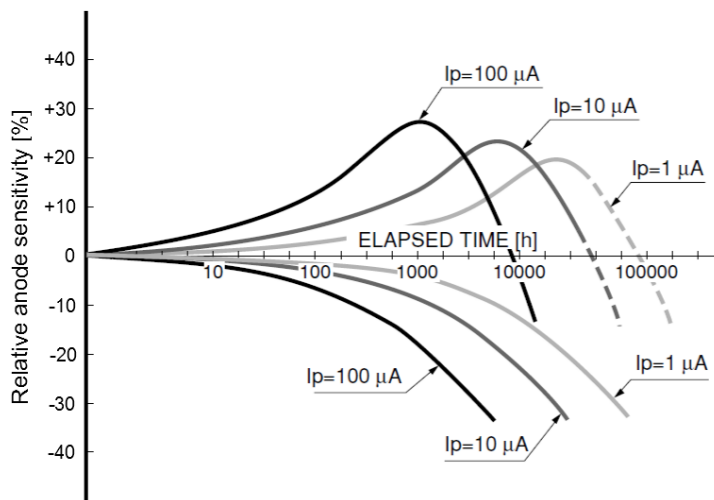


Fig. 75 Photomultiplier

When a photon hits a sensitive photo cathode, the photoelectric effect results in the emission of electrons, which are gradually accelerated by the electric voltage between the individual electrodes (dynodes). The impact of accelerated electrons on the dynodes gives rise to the emission of a larger quantity of electrons (secondary emission), resulting in an amplification of the electron current colliding with the anode.

PMT stability in time depends both on the anode current as well as on the material of the photo cathode and the dynodes. Time dependence is specific, i.e. the photomultipliers should be sorted for selected applications. Each PMT is tested in VF and it is assessed whether or not its parameters meet the expected requirements. PMT testing and stabilization take usually 48 hours. The chart shows typical dependence of anode current in time. The detectors manufactured by our company have anode current < 1 micro ampere, i.e. very long time stability. When the photomultiplier is not used for several months, its properties can return into the state before stabilization.

<sup>1</sup> If the period of inactivity is longer, it is necessary to keep the instrument switched on for several hours and monitor the stability of the measured quantity response. When stability is achieved, the response to CRM needs to be checked (241Am for alpha channel and 36Cl for beta channel). If the deviation is more than  $\pm 25\%$  compared to the reference sensitivities specified in the document Radiometric Parameters, it is necessary to have new instrument settings performed by the manufacturer or an authorized service organization.



The photomultiplier is a very sensitive component composed of a large amount of small components. These are connected by soldering. If the PMT is exposed to shocks, they can impair the integrity of mechanical parts, thus changing the parameters of the photomultiplier. Mechanical failures of the PMT are manifested mostly by sparking, i.e. increase in the count rate, which occurs after the apparatus is switched on. An opposite effect, i.e. decrease in PMT response, can occur as a result of loss of vacuum.

Fig. 76 Typical dependence of anode current of the photomultiplier in time



**MANUFACTURER'S RECOMMENDATION** – In case of a drift or response instability of measured quantity, contact the authorized service organization.

## 9.6. Care for detectors

The most common cause of problems is the introduction of rough dirt into the instrument and its adhesion (especially on foot detectors). It is recommended to clean the floor of the instrument, the step-on detector grids and the protective grids of foot detectors every day. For cleaning it is possible to use a suitable lint-free damp cloth.

Gross dirt around foot detectors can be removed using a vacuum cleaner.



When using a vacuum cleaner, it is necessary to proceed very carefully, as vacuum cleaners can damage the very thin protective foil of the detectors. The suction power must be adjusted (reduced).

It is also recommended to clean the cover grids of detector displays with a mildly damp cloth every day.

## 9.7. Protective foils of foot detectors

Special, very thin foils in cardboard frames, serving as additional mechanical protection of foot detectors, can be supplied as optional accessories (Fig. 77). The frames with the foil are placed inside the base between the detectors and the tilting protective grids. Each foot detector has a separate foil.



Using different protective foils may disable the measurement of alpha contamination or influence the measurement of beta radiation. Please consult the manufacturer for their use.



Fig. 77 Cardboard frame with foil for alpha radiation

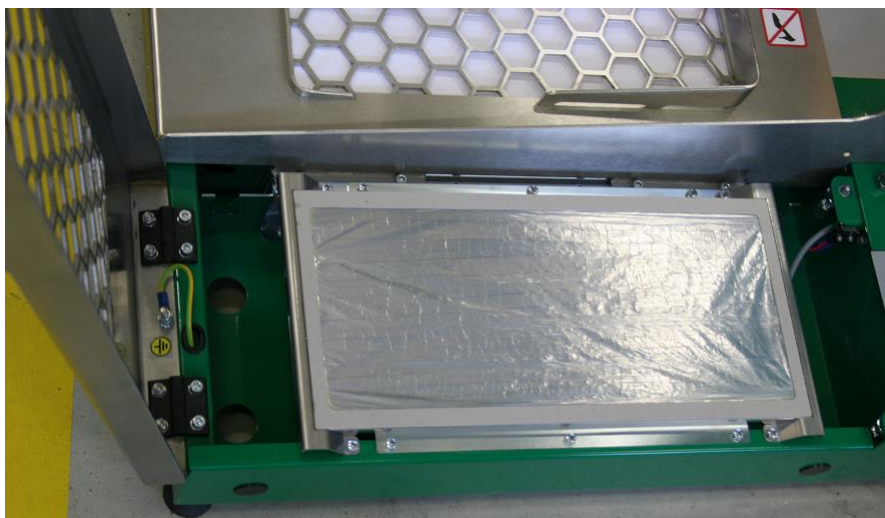


Fig. 78 Protective foil in a frame on the foot detector (with an open protective grid)



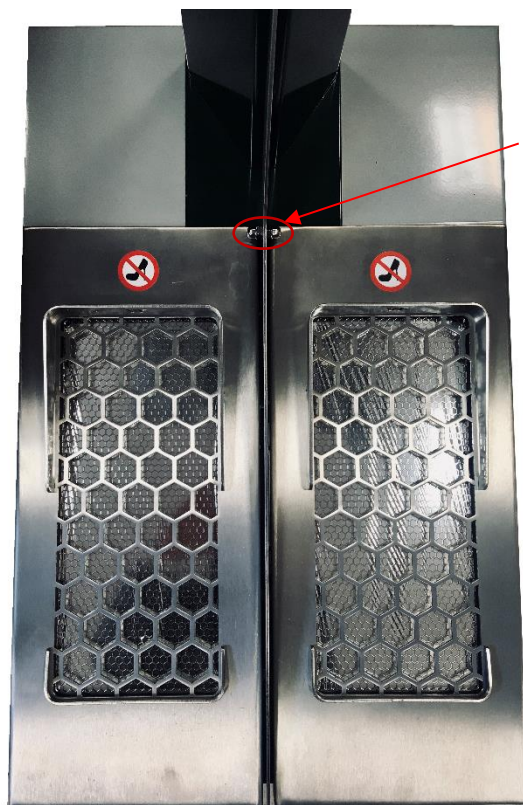
## 9.8. Checking the switches for foot detector grates

1. Use a wrench (M13) to loosen the nut in the middle of the pillar of the instrument and lift the grids above the detectors.
2. If used, remove the frames with the protective foil.
3. Clean the interior around the detectors.



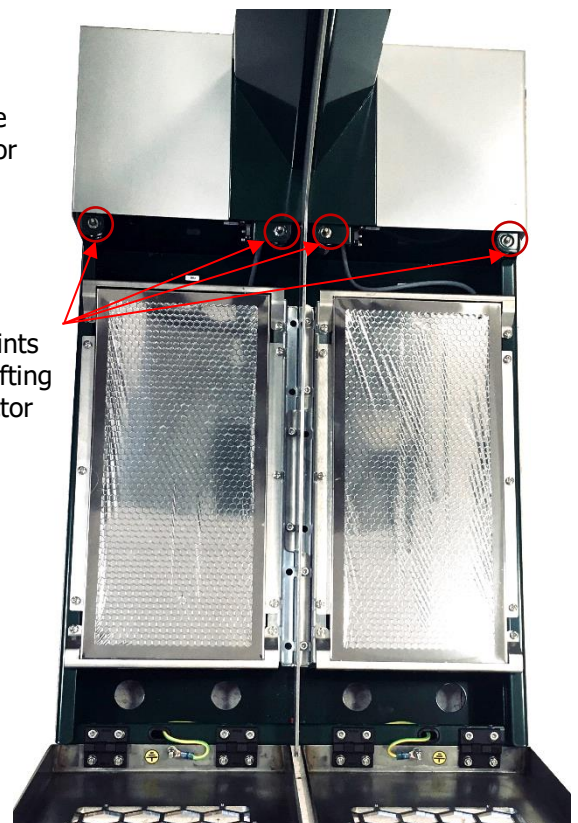
Use the vacuum cleaner very carefully to prevent rupture of the light-tight aluminium foil of the detector!

4. Use silicone oil to lubricate the moving part of the activation switch for foot detectors.
5. Check the tightening and functioning of the switch for foot detectors.
6. If used, put the frames with the protective foil back.
7. Close the foot detector grates and secure with a screw with a nut.



Nuts to release  
the foot detector  
grids

Lubrication points  
on springs for lifting  
the foot detector  
grids



Travel (bump stop) of the  
foot detector

Foot detector  
switch

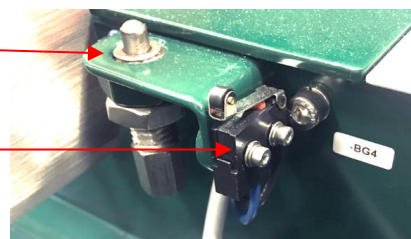


Fig. 79 Foot detectors – basic maintenance

## 9.9. Service



The service interventions described below may only be performed by the manufacturer, an authorized service organization or the user's staff trained for this purpose!

## 9.10. Detector replacement procedure

### 9.10.1 Fixed hand detector

- Switch off the instrument and disconnect the power supply.
- Loosed the four screws attaching the upper and lower covers of the detector using socket wrench No. 2.5.

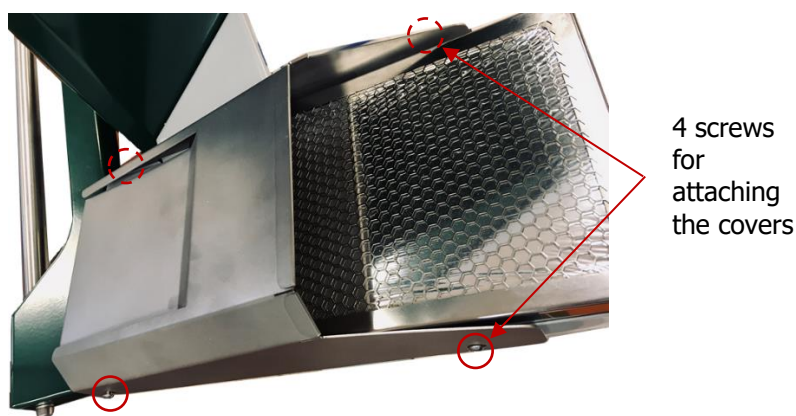


Fig. 80 Hand detector attachment

- Remove the upper cover and then the lower cover. Detach the green-yellow conductor of equipotential bonding from the bottom cover. On the cover side the conductor is connected using a Fast-on connector, which can be disconnected by pulling.
- Disconnect the connector of the detector's supply cable. The connectors are equipped with a securing mechanism against accidental disconnection. To disconnect the supply cable, pull the outer jacket of the connector away from the output connector of the detector.

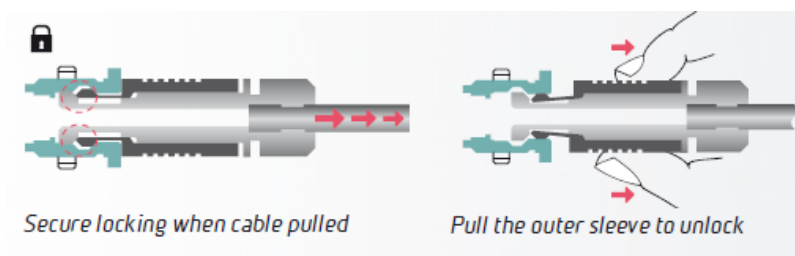


Fig. 81 Disconnection of the connector of the SCD detector

- Loosen the six screws attaching the detectors to the instrument using socket wrench No. 2.5.



Fig. 82 Hand detector attachment

- Carefully remove the detector and place a new detector with the same orientation (active surface up, connector back).
- Fix the detector using six socket-head screws M 4 x 6 and tighten the screws properly (see Fig. 84). The screws are equipped with spring washers and one of the screws with a fan washer.
- Connect the connector of the detector's supply cable. When inserting the connector it is necessary to turn the cable connector to the correct position, see the red marks.



Fig. 83 Connector orientation during connection

- Connect the PE protective conductor to the bottom cover.
- Replace the bottom cover and the upper cover of the detector and tighten the screws.
- Attach the instrument to power supply and switch it on.
- Set the new detector using the service application VF-Setup. It is especially necessary to set communication of the new detector with the PLC and perform metrological setting of the detector.

### 9.10.2 Foot detector

- Switch off the instrument and disconnect the power supply.
- Use a wrench (M13) to loosen the nut in the middle of the pillar of the instrument and lift the grids above the detectors (see Fig. 89).
- Disconnect the connector of the supply cable from the detector (see Fig. 81).

- Using a socket wrench No. 2.5, loosen the six screws attaching the foot detector (see Fig. 84) and remove it carefully.

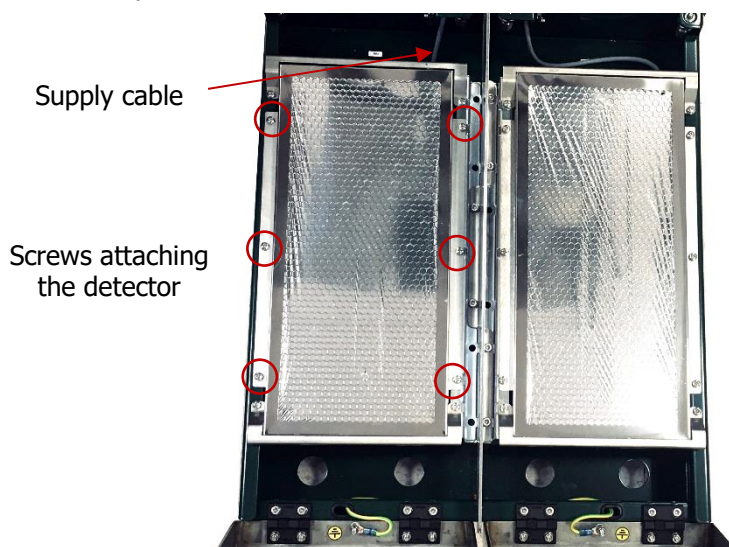


Fig. 84 Attaching the foot detector

- Using a socket wrench No. 2.5, loosen the six screws attaching the two support plates of the detector and remove the plates (see Fig. 85)

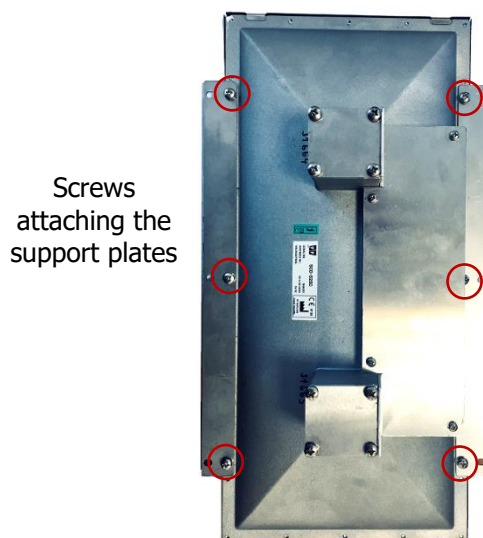


Fig. 85 Attaching the support plates of the foot detector

- Install the support plates on the new detector using six socket-head screws M 4 x 6 and tighten the screws properly (see Fig. 85). The screws are equipped with spring washers and one of the screws with a fan washer.
- Install the detector with support plates in position and connect the supply cable connector. Secure the detector using six socket-head screws M 4 x 6 and tighten the screws properly (see Fig. 84). The screws are equipped with spring washers and one of the screws with a fan washer.
- Close the step-on grid and secure with a screw and nut.
- Attach the instrument to power supply and switch it on.
- Set the new detector using the service application VF-Setup. It is especially necessary to set communication of the new detector with the PLC and perform metrological setting of the detector.



### 9.10.3 Retractable hand detector

- Switch off the instrument and disconnect the power supply.
- Disconnect the connector of the spiral supply cable of the detector (see Fig. 81).
- Remove the detector from the holder.
- Loosen the 6 screws attaching the two guide plates using a socket wrench No. 2.5 (see Fig. 86).
- Loosen the 2 screws attaching the handle to the detector using a socket wrench No. 2.5 (see Fig. 86).

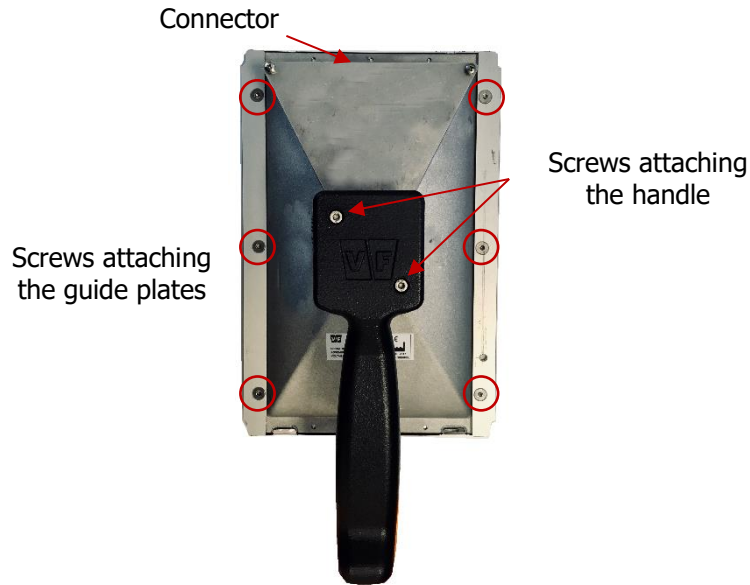


Fig. 86 Attaching the handle and guide plates of the retractable detector

- Attach the handle to the new detector using two socket wrenches with cylindrical head M 4 x 6. Comply with the orientation of the handle with respect to the connector, see Fig. 86.
- Attach the guide plates using six countersunk socket screws M 4 x 6. The orientation of guide bars is determined by the recess for countersunk socket screws M 4 x 6, which must be countersunk after tightening.
- Connect the connector of the spiral cable to the detector. When inserting the connector it is necessary to turn the cable connector to the correct position, see the red marks in Fig. 83.
- Attach the instrument to power supply and switch it on.
- Set the new detector using the service application VF-Setup. It is especially necessary to set communication of the new detector with the PLC and perform metrological setting of the detector.

### 9.11. Procedure for replacement of the light-tight foil

- The foil is replaced on a disassembled detector outside the instrument. The detector removal procedure is given in previous section 9.10.
- Loosen the two screws attaching the detector's cover grid and remove the grid carefully.
- Position the screw jig that prevents unintentional damage to the light-tight foil.
- Loosen all the screws attaching the grid with the foil to the detector body.
- Remove the screwing tool.
- Carefully remove the grid with the foil. Part of the grid with a foil is also a seal that is glued to the grid.
- Install a new grid with foil and seal. The grid must be installed with the seal against the detector body.
- Mount the service tool against damaging the light-tight foil.
- Screw all the screws around the grid perimeter. The recommended tightening torque is 0.3 Nm.
- Remove the screwing tool.
- Install the cover grid and secure with two screws.

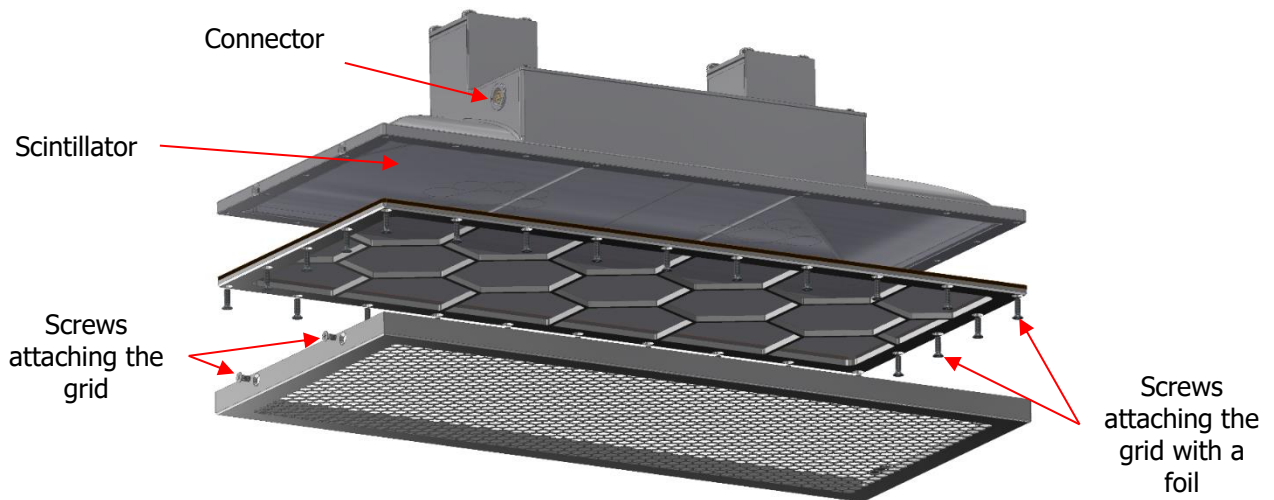


Fig. 87 Design layout of SCD detectors

## 9.12. Instrument decontamination

In the first step, it is important to localize the contaminated detector and the extent of possible contamination spreading within the instrument. The instrument is only capable of detecting contamination on its detectors. But there is a risk that other parts of the instrument which the contaminated person came into contact with have also been contaminated (e.g. handle of the retractable detector, touch screen of the display, etc.).

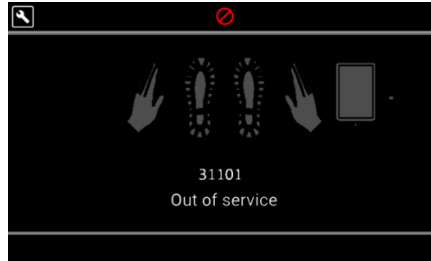


Fig. 88 "Out of service" screen – instrument contamination detected

The contaminated detector can be localized via the "Response" service screen (section 6.6.4) where the current response in cps units from all detectors or measuring channels is visible. It is necessary to focus on detectors that show an increased response compared to other detectors.

The very common reason of increased detector response is damage to the light-tight foil. In case of damage to the light-tight foil it is possible to see response decline when the detector is covered. Light-tightness must be checked slowly because in case of a rapid response increase the suppression algorithms described in section 6.5.3 will be triggered. If the foil is damaged, replace it as per section 9.9.

If damage to the light-tight foil of the detector is excluded, try to remove the contamination



**ATTENTION** – The light-tight foil is very prone to mechanical damage, therefore do not touch it with your hand or any other objects.

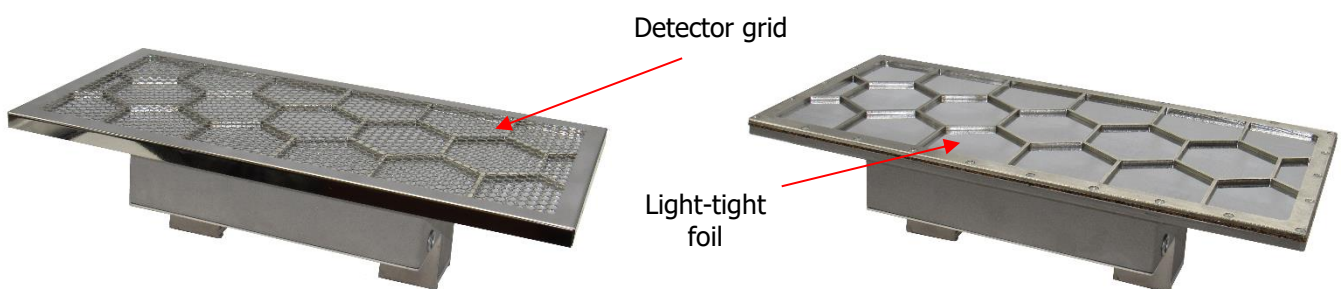


Fig. 89 Detector grid and light-tight foil

Detector grids are made of polished stainless steel. Other external surfaces are treated with powder paint – komaxit. The plastic elements are made of acetal resin (polyoxymethylene).

For decontamination, the standard solutions for decontamination can be used, such as:

- alcohol
- solutions containing citric acid with tensides
- Neodekont



Decontaminate only a switched-off instrument with the supply cable unplugged.  
Avoid any liquid getting into the instrument.

In case of contamination of the light-tight foil of the detector replace the entire frame with the foil.

Wipe the instrument after the decontamination and have it assessed in the laboratory. Repeat the decontamination in case of adverse results.

In case of contamination of the instrument, follow the internal guidelines of the organization in which the instrument is operated.



## 10. Part of delivery, accessories and consumables

### 10.1. Standard parts of the scope of supply

Item specification		Identification (VF stock number)	Quantity
1.	POWER CABLE 3m	1-0216-00023	1 pc
2.	VF-Setup	53-A-0000006	1 pc

Tab. 29 Scope of supply

### 10.2. Optional accessories

Item specification		Identification (VF stock number)	Quantity
1.	Supply cable UK fork/free ends, length 2m, incl. fuse 5A	1-0216-00254	1 pc
2.	Supply cable USA 3x1.5mm black, 3.5m, PVC, fork for socket NEMA 5-15/free ends	1-0216-00408	1 pc
3.	SCD-525: Paper frame with protective foil	50-A-0011369	1 pc
4.	Service cable USB/5pin	51-A-0000259	1 pc

Tab. 30 Optional accessories

### 10.3. Consumables

Item specification		Designation (VF stock number)	Quantity
1.	-		

Tab. 31 Consumables

## 11. Warranty conditions

The warranty applies to all defects caused by material defects or by instrument malfunction. The warranty is conditional upon adherence to the Instructions for Use and to the performance of maintenance and care of the instrument under these Instructions for Use without making any changes in the design of the instrument. During the warranty period the manufacturer guarantees free-of-charge repairs under the following conditions:

- the complaint is filed for faults occurring during the warranty period and within 15 days of expiry of the warranty period at the latest
- the product was used in accordance with the manufacturer's recommendations
- the product is complete, including the confirmed warranty certificate
- warranty inspections have been performed by a service organization in accordance with the conditions agreed in the order (purchase contract)

The user must not fix product faults occurring during the warranty period but must report them to the supplier, who will provide for their remedy within the agreed period of time. The warranty does not apply to the natural wear of parts and to faults resulting from mechanical damage, overloading, unprofessional installation, handling, or use of the instrument other than as intended, or from natural disasters.

The supplier is not responsible for damage caused to persons, animals or things as a direct consequence of non-observance of the recommendations stated in the Instructions for Use.

### **The product cannot be fixed free of charge under the warranty:**

- if the method of use and maintenance of the product stated in the Instructions for Use is not observed
- in case of damage and faults resulting from unprofessional and inappropriate installation of the product, use of inappropriate sources and installations not conforming to technical standards
- in case of any repairs, product modifications, changes or settings not authorized by the manufacturer in advance
- in case of faults caused by natural disasters
- in case of any use other than as intended
- in case of damage obviously resulting from the use of incorrect voltage, short circuits or instability of the supply network
- after a previous repair performed by an unauthorized service partner
- upon damage to components such as handles, glass, control switches, etc., resulting from their functional wear
- in case of changes of colour of plastic components (it is a common physical and chemical phenomenon occurring after some time of use)
- in case of faults resulting from improper handling or treatment
- in case that an unauthorized person interferes with the product

Other warranty conditions are individually agreed in the delivery terms and conditions. Submit any claims under the warranty by post to the manufacturer's address or by email to the address **service@vfnuclear.com**, and give a description of the defect.

### 11.1. Contact details

The instrument is supplied and post-warranty services are provided by:

The instrument is supplied and post-warranty service is provided by:		Contact details of the service partner:
	<b>Czech Republic:</b> VF, a.s. Svitavská 588 679 21 Černá Hora Phone: +420 516 42 86 11, Fax: +420 516 42 86 10 e-mail: info@vfnuclear.com, www.vfnuclear.com	
	<b>Slovak Republic:</b> VF, s.r.o. M.R. Štefánika 9 010 02 Žilina Phone: +421 (41) 507 2411, Fax: +421 (41) 507 2410 e-mail: info.sk@vfnuclear.com, www.vfnuclear.com	

## 12. Annexes

### Пříloha A. HF-4, List of audio commands

1	Contaminated	Byla zjištěna kontaminace	Обнаружено загрязнение	Contaminé
2	Not contaminated, please leave the monitor	Kontaminace nebyla zjištěna, opusťte zařízení	Загрязнение не обнаружено, покиньте устройство	Non contaminé, veuillez quitter le moniteur
4	Please replace the probe in the holder	Zasuňte ruční sondu	Вставьте ручной зонд	Replacer le détecteur sur son support
5	Please insert left hand	Vložte levou ruku	Вставьте левую руку	Insérez main gauche
6	Please place left hand	Přiložte levou ruku	Приложите левую руку	Placez main gauche
9	Please insert right hand	Vložte pravou ruku	Вставьте правую руку	Insérez main droite
10	Please place right hand	Přiložte pravou ruku	Приложите правую руку	Placez main droite
13	Please insert left foot	Vložte levou nohu	Вставьте левую ногу	Insérez pied gauche
14	Please insert right foot	Vložte pravou nohu	Вставьте правую ногу	Insérez pied droit
33	Turn hands, backs to detectors	Otočte ruce, hřbety k detektorům	Поверните руки тыльными сторонами к детекторам	Tournez vos mains, dos aux détecteurs
34	Please enter your identification	Proveďte identifikaci	Выполните идентификацию	Veuillez vous identifier
36	Please leave the monitor and carry out decontamination	Opusťte přístroj a proveďte dekontaminaci	Покиньте прибор и проведите обеззараживание	Veuillez quitter le moniteur et réaliser une décontamination
37	The measurement is not complete, please repeat the measurement	Měření nebylo kompletní, prosím opakujte měření	Измерение не было завершено, повторите измерение	La mesure n'est pas complète, veuillez répéter la mesure svp
38	Please leave the monitor	Opusťte zařízení	Покиньте монитор	Veuillez quitter le moniteur svp
56	Back of left hand	Hřbetu levé ruky	Тыльной стороны кисти левой руки	Dos de la main gauche
57	Palm of left hand	Dlaně levé ruky	Ладони левой руки	Paume de la main gauche
58	Back of right hand	Hřbetu pravé ruky	Тыльной стороны кисти правой руки	Dos de la main droite
59	Palm of right hand	Dlaně pravé ruky	Ладони правой руки	Paume de la main droite
60	Left foot	Levé nohy	Левой ноги	Pied gauche
61	Right foot	Pravé nohy	Правой ноги	Pied droit
72	Short Beep	Short Beep	Short Beep	Short Beep
73	Long Beep	Long Beep	Long Beep	Long Beep
74	Error Beep	Error Beep	Error Beep	Error Beep

75	Please place palm of left hand	Přiložte dlaň levé ruky	Прислоните ладонь левой руки	Placez paume de la main gauche
76	Please place back of left hand	Přiložte hřbet levé ruky	Прислоните тыльную сторону кисти левой руки	Placez dos de la main gauche
77	Please place palm of right hand	Přiložte dlaň pravé ruky	Прислоните ладонь правой руки	Placez paume de la main droite
78	Please place back of right hand	Přiložte hřbet pravé ruky	Прислоните тыльную сторону кисти правой руки	Placez dos de la main droite
79	Left hand	Levé ruky	Левой руки	Main gauche
80	Right hand	Pravé ruky	Правой руки	Main droite
999	Test sound	Test sound	Test sound	Test sound

Tab. 32 List of audio commands

## Příloha B. HF-4, Error code table

Error code	Description																																																						
0	- No errors																																																						
2xyyz	<p>- Module error</p> <p><b>x</b> ... 1 - error occurred during initialization, 2 - error occurred during operation</p> <p><b>yy</b>... module identification, see the table below.</p> <p><b>z</b> ... depending on module type, see the tables below.</p> <table> <tr> <th>yy</th><th>Module</th></tr> <tr> <td>01</td><td>CAN2COMB</td></tr> <tr> <td>02</td><td>Router</td></tr> <tr> <td>03</td><td>Detector 1</td></tr> <tr> <td>04</td><td>Detector 2</td></tr> <tr> <td>05</td><td>Detector 3</td></tr> <tr> <td>06</td><td>Detector 4</td></tr> </table> <table> <tr> <th>z</th><th>Description for yy=01 (CAN2COMB)</th></tr> <tr> <td>01</td><td>Missing response when reading module identification</td></tr> <tr> <td>02</td><td>Invalid identification</td></tr> <tr> <td>03</td><td>Automatic data (inputs) not received</td></tr> <tr> <td>04</td><td>Reply receipt time-out on reading</td></tr> <tr> <td>05</td><td>Status reports an instrument failure</td></tr> <tr> <td>06</td><td>Main command error</td></tr> </table> <table> <tr> <th>z</th><th>Description for yy=02 (CAN2UART)</th></tr> <tr> <td>01</td><td>Missing response when reading module identification</td></tr> <tr> <td>02</td><td>Invalid identification</td></tr> <tr> <td>03</td><td>Automatic data (inputs) not received</td></tr> <tr> <td>04</td><td>Reply receipt time-out on reading</td></tr> <tr> <td>05</td><td>Reply receipt time-out on output writing</td></tr> <tr> <td>06</td><td>Status reports an instrument failure</td></tr> </table> <table> <tr> <th>z</th><th>Description for yy=03 to 06 (Detectors)</th></tr> <tr> <td>01</td><td>Missing response when reading detector identification</td></tr> <tr> <td>02</td><td>Invalid identification</td></tr> <tr> <td>03</td><td>Unfinished reading of parameters from detector</td></tr> <tr> <td>04</td><td>Automatic data (values) not received</td></tr> <tr> <td>05</td><td>Forced values are not set</td></tr> </table>	yy	Module	01	CAN2COMB	02	Router	03	Detector 1	04	Detector 2	05	Detector 3	06	Detector 4	z	Description for yy=01 (CAN2COMB)	01	Missing response when reading module identification	02	Invalid identification	03	Automatic data (inputs) not received	04	Reply receipt time-out on reading	05	Status reports an instrument failure	06	Main command error	z	Description for yy=02 (CAN2UART)	01	Missing response when reading module identification	02	Invalid identification	03	Automatic data (inputs) not received	04	Reply receipt time-out on reading	05	Reply receipt time-out on output writing	06	Status reports an instrument failure	z	Description for yy=03 to 06 (Detectors)	01	Missing response when reading detector identification	02	Invalid identification	03	Unfinished reading of parameters from detector	04	Automatic data (values) not received	05	Forced values are not set
yy	Module																																																						
01	CAN2COMB																																																						
02	Router																																																						
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06	Detector 4																																																						
z	Description for yy=01 (CAN2COMB)																																																						
01	Missing response when reading module identification																																																						
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05	Status reports an instrument failure																																																						
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04	Automatic data (values) not received																																																						
05	Forced values are not set																																																						
301xx	- Measuring channel xx is set as inactive																																																						
302xx	- Measuring channel xx reports an error																																																						
303xx	- Measuring channel xx reports pulses time-out																																																						
304xx	- Measuring channel xx reports overload of VN source																																																						
305xx	- Measuring channel xx reports disconnection of detector (PMT)																																																						
306xx	- Error of elementary period of measurement channel xx																																																						
311xx	- Contamination of instrument on measuring channel xx detected																																																						

Tab. 33 Error coding

Measuring channel XX	Detector	Channel type
01	left hand	beta / beta+gamma
02	left hand	alpha
03	right hand	beta / beta+gamma
04	right hand	alpha
05	left foot	beta / beta+gamma
06	left foot	alpha
07	right foot	beta / beta+gamma
08	right foot	alpha
09	frisker	beta / beta+gamma
10	frisker	alpha

Tab. 34 Channel coding – two-channel design (HF-4C / HF-4E)

Measuring channel XX	Detector	Channel type
01	left hand	alpha / alpha+beta / alpha+beta+gamma
02	right hand	alpha / alpha+beta / alpha+beta+gamma
03	left foot	alpha / alpha+beta / alpha+beta+gamma
04	right foot	alpha / alpha+beta / alpha+beta+gamma
05	frisker	alpha / alpha+beta / alpha+beta+gamma

Tab. 35 Channel numbering – single-channel design (HF-4A / HF-4B / HF-4D)

## 13. Notes