SV 977D

SOUND & VIBRATION ANALYSER

Warsaw, 2022-11-23
Rev. 1.00

Note: *Because of continuous product improvement SVANTEK reserves the right to make changes to product specifications without notice. To download the most up to date User Manual please visit our web site at www.svantek.com. This User Manual presents the firmware revision named* **2.09.x.**

The succeeding software revisions (marked with the higher numbers) can change the view of some screens presented in the text of this manual.

WEEE Notice: *Do not throw the device away with the unsorted municipal waste at the end of its life. Instead, hand it in at an official collection point for recycling. By doing this you will help to preserve the environment.*

The software described in this manual is furnished under a license agreement and may be used only in accordance with the terms of that agreement.

Trademarks

Trademarks or registered marks in this manual belong to their respective manufacturers.

Microsoft and Windows are registered trademarks of Microsoft Corporation.

The *Bluetooth®* word mark and logos are registered trademarks owned by Bluetooth SIG, Inc.

Disclaimer

Information in this document is subject to change without notice and does not represent a commitment on the part of Svantek.

Svantek provides this document "as is", without warranty of any kind, either expressed or implied, including, but not limited to, its particular purpose. Svantek reserves the right to make improvements and/or changes to this manual, or to the products and/or the programs described in this manual, at any time.

Information provided in this manual is intended to be accurate and reliable. However, Svantek assumes no responsibility for its use, or for any infringements on the rights of third parties that may result from its use.

This product might include unintentional technical or typographical errors. Changes are periodically made to the information herein to correct such errors, and these changes are incorporated into new editions of the publication.

Technical Support Contact Information:

web: www.svantek.com

e-mail: support@svantek.com.pl

CONTENTS

INDEX

1   INTRODUCTION

SV 977D is an all-digital, Class 1 Sound & Vibration level meter designed for general acoustic and vibration, environmental noise, occupational health and building acoustic measurements.

Three acoustic or vibration user configurable profiles allow parallel measurements with independently defined frequency filters and RMS detector time constants. Each profile provides significant number of results (like **Spl**, **Leq, Sel**, **Lden**, **LEPd**, **Ltm3**, **LTeq**, **Peak**, **Max** and **Min** as well as ten statistics, two rolling Leq, expected Leq value, standard Leq deviation and noise criterium and noise ratio indexes in case of sound measurements or **RMS**, **Ovl**, **Peak**, **P-P** in case of vibration measurements). Advanced time history logging for each profile provides complete information about the measured signal. Data are stored on a micro SD memory card and can be easily downloaded to a PC over the USB interface. Optional RS 232 interface can be used for the connection of the instrument with the device that provides this type of connection (e.g. printers). Direct printing feature enables quick on-site printing with the use of optional portable printer.

All required weighting filters: **A**, **B**, **C**, **Z**, **U**, **AU** and **LF** for sound measurements and **HP1**, **HP3**, **HP10**, **Vel1**, **Vel3**, **Vel10**, **VelMF**, **Dil1**, **Dil3**, **Dil10** and **Wh** for general vibration measurements (like acceleration, velocity and displacement); are available with this instrument.

Using the computational power of its digital signal processor SV 977D can, simultaneously to the meter mode, perform the real time **1/1 Octave** or optionally **1/3 Octave** analysis including calculations of statistical levels or can optionally perform **FFT** analysis.

The built-in frequency analyser offers 1/1 octave and 1/3 octave real-time analysis as standard features and FFT as optional function. The frequency analysis is logged together with the time history of sound or vibration meter results.

Time domain waveform signal recording on the SD-card is available as an option and advanced trigger and alarm functions are available in the standard version of this instrument.

For building acoustic applications, SV 977D offers Reverberation Time measurements (RT60) option working with the *BA Assistant* application for smartphones.

SV 977D enables also STIPA calculations in accordance with IEC 60268-16:2011 as optional function.

A fast USB 2.0 interface creates a real-time link for the PC "front-end" application that allows to control the instrument with the use of *SvanPC++* software. Optional RS 232 interface allows the instrument to control the cellular modem when SV 977D is used with the **SV 277** monitoring station.

SV 977D is equipped with **Bluetooth®**[1] v.5.2 and can be remotely control by the *SvanMOBILE* and *BA Assistant* smartphone applications.

Working as a part of the SV 277 monitoring station, equipped with the cellular modem, SV 977D can transfer measured data via Internet to PC with the use of *SvanPC++_RC* option or via *SvanNET* web service. The instrument can be fully remotely controlled via these programs. The instrument has **advanced alarms** features, enables the user notification about exceeded threshold levels by SMS or mails.

The instrument is powered from four AA standard alkaline or rechargeable batteries (i.e. NiMH – a separate charger is required). Powering the instrument from the External DC power source or the USB interface is also possible.

---

[1] "The *Bluetooth®* word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by SVANTEK is under license. Other trademarks and trade names are those of their respective owners.

1.1   SV 977D as Sound Level Meter & Analyser

- Noise measurements (**Peak**, **Max**, **Min**, **Spl**, **Leq**, **SEL**, **Lden**, **LEPd**, **Ltm3**, **LTeq**, Leq statistics (**Ln**), expected Leq value (**EX**), standard Leq deviation (**SD**), two rolling Leq (**LR1** and **LR2**), measurement time and overload time % (**OVL**) as well as noise criterium (**NC**) and noise ratio (**NR**) in case of 1/1 Octave option) with Class 1 IEC 61672-1:2013 accuracy in the frequency range 20 Hz to 20 kHz with the MK 255 microphone.
- Parallel **Impulse**, **Fast** and **Slow** detectors for the measurements with **A**, **B**, **C**, **Z**, **U**, **UA** and **LF** frequency filters.
- Two measurement ranges 25 dB RMS(A) ÷ 123 dB Peak (**Low**) and 35 dB RMS(A) ÷ 140 dB Peak (**High**).
- **1/1 Octave** and optional **1/3 Octave** real time analysis - 10 filters with centre frequencies 31.5 Hz ÷ 16 kHz and 31 filters with centre frequencies 20 Hz ÷ 20 kHz, in accordance with Class 1 IEC 61260-1:2014.
- Optional reverberation time **RT60** analysis function for 1/1 octave bands or 1/3 octave bands and three total RMS levels (**A**, **C** and **Z** weighted) in accordance with the ISO 3382 standard.
- **STIPA** (speech transmission index for public address systems) measurements of electro-acoustic and acoustic environments effects that affect the speech intelligibility in the room acoustics and/or public address systems.
- Optional **Tonality** analysis function.

1.2   SV 977D as Vibration Level Meter & Analyser

- General Vibration measurements (acceleration, velocity and displacement) meeting ISO 20816-1:2016 standard in the frequency range depending on the parameters of the attached accelerometer, i.e. with the SV 80 general purpose transducer is equal to 0.5 Hz ÷ 14 kHz.
- Parallel **RMS**, **Max**, **Peak**, **Peak–Peak** measurements.
- **HP**, **HP1**, **HP3**, **HP10**, **Vel1**, **Vel3**, **Vel10**, **VelMF**, **Dil1**, **Dil3**, **Dil10** and **Wh** weighting filters.
- **1/1 Octave** and optional **1/3 Octave** real time analysis - 15 filters with centre frequencies 1 Hz ÷16 kHz, and 45 filters with centre frequencies 0.8 Hz ÷ 20 kHz, Class 1 IEC 61260-1: 2014.
- Optional **RPM** measurement with the use of RPM probe, connected to the **I/O** socket of SV 977D.
- Optional **FFT** analysis with the single **Total** overall value, performed with preselected frequency weighting filters and windows.

1.3   General features of SV 977D

- Advanced **Data Logger** function including spectrum logging on the micro **SD card**
- 1/1 and 1/3 octave and FFT analyser (1/3 octave and FFT – optionally)
- Time domain waveform signal recording (option)
- Advanced trigger and alarm functions
- **USB 2.0** interface (real time PC "front end" application supported)
- **RS 232** interface
- **Bluetooth**® v.5.2
- **GPS** module
- Integration time programmable up to **24 h**
- Power supply by **four AA** rechargeable or standard batteries
- Handheld, light weight and robust case
- Easy to use with menu driven user interface

1.4   ACCESSORIES INCLUDED

- **MK 255**   Microtech Gefell, 50 mV/Pa, prepolarised ½" condenser microphone
- **SV 12L**   microphone preamplifier with IEPE power supply
- **SA 22**   foam windscreen
- **SC 158**   USB type C to USB type A cable
- **memory**   32 GB SD card
- **batteries**   four AA alkaline batteries

1.5   ACCESSORIES AVAILABLE

- **SA 277D**   outdoor microphone kit (microphone, desiccator and cable not included)
- **SA 270D**   desiccator for the outdoor microphone kit
- **SC 26**   extension cable for SV 12L (TNC plug to TNC socket)
- **SV 36**   Class 1 sound calibrator: 94/114 dB@1000 Hz
- **SA 17A**   external battery pack using 6 x AA batteries
- **SA 143**   carrying case for SV 977D and accessories (lightweight)
- **SA 79**   carrying case for SV 977D and accessories (waterproof)
- **SA 47**   carrying bag for SV 977D and accessories (fabric material)
- **SP 75**   RS 232 interface for SV 977D
- **SV 80**   general purpose vibration accelerometer 100 mV/g (10 mV/ms^{-2})
- **SC 27**   coiled cable for accelerometer 2 m
- **SA 27/10-32**   mounting magnetic base for accelerometer
- **SA 15**   power supply
- **SA 31**   external charger for four AA rechargeable batteries

1.6   FIRMWARE OPTIONS AVAILABLE

The standard firmware of SV 977D includes 1/1 octave analysis. Other functions are optional:

- **SF 977_2**   1/3 octave analysis option
- **SF 977_4**   FFT analysis option
- **SF 977_5**   RT60 option
- **SF 977_6**   Tonality analysis option
- **SF 977_8**   RPM option (excluding Laser Tachometer)
- **SF 977_15**   Time domain waveform signal recording option
- **SF 977_20**   STIPA option

> **Note:** The software options for the instrument can be purchased at any time as only the introduction of a special unlock code is required for their activation in a specific instrument. Contact your local Svantek distributor for further information and costs for these options.

2   GENERAL INFORMATION

2.1   MEASUREMENT CONFIGURATIONS AS SOUND LEVEL METER (SLM)

The instrument's normal operating mode as SLM assumes operating with a preamplifier and a microphone attached to the instrument and without a windscreen. Optionally the instrument can be operated with the windscreen attached to the microphone or with the preamplifier and microphone fitted in the outdoor microphone kit and connected with the instrument by the extension cable (see Appendix C.7 for specification).

During sound measurements, to meet the requirements of the Class 1 accuracy, it is recommended to install the instrument on a tripod or in a holder to minimize the possibility of reflection and diffraction of acoustic waves. In particular, the instrument must not be held close to the body of the person performing the measurement. The instrument should be directed so that the microphone diaphragm plane is perpendicular to the direction of the measured sound source (the incidence angle of the sound wave is 0 degree). To control the instrument and readout results, it is recommended to use the *Assistant* smartphone application.

In the case of significant differences between the instrument's temperature and the ambient temperature at the measuring point, long enough acclimatization of the instrument is recommended so that its temperature is as close to the ambient temperature as possible.

In the case of measurements in the presence of wind, it is necessary to use a windscreen. The windscreen should be simply installed over the microphone with the preamplifier without any significant force.

To have measurements in accordance with the IEC 61672-1:2013 standard it is necessary to set the appropriate compensation in the **Compensation Filter** menu (see Chapter 4.5).

When measuring in the diffusion field (in small spaces) it is recommended to switch on the filter for the diffusion field.

The IEC 61672-1:2013 standard advises users to perform in-situ checks (System Check) of measuring instruments before starting measurements using the recommended sound calibrator. If the System Check gives negative result, then it is necessary to perform calibration of the instrument (see Chapter 3.3).

2.2   SOUND MEASUREMENTS IN SPECIAL CONDITIONS

While measuring a low-level acoustic pressure, the instrument should be placed on a tripod and the person measuring should be at least 1 meter from the microphone and do not touch the instrument. To control the instrument and readout results, it is recommended to use the *Assistant* smartphone application!

At locations where the static (ambient) pressure is from 65 kPa up to, but not including, 85 kPa, before the measurement, the device must be calibrated with a Class 1 calibrator (e.g. SV 36).

2.3   MEASUREMENT CONFIGURATIONS AS VIBRATION LEVEL METER (VLM)

The instrument can operate as VLM with the SV 80 general-purpose accelerometer 100 mV/g (10 mV/ms^{-2}) with the SC 27 coiled cable (see Appendix C for specification).

Chapter 17.3 presents the way of connecting the accelerometer to the instrument.

2.4   INPUT AND OUTPUT SOCKETS OF THE INSTRUMENT

SV 977D is supplied disassembled, so the user should mount the **MK 255** microphone and **SV 12L** preamplifier on his own.

It doesn't matter which elements will be assembled first: the microphone with the preamplifier or the instrument with the preamplifier.

To connect the preamplifier to the instrument, first insert the tip of the preamplifier into the socket and tighten the ring to the first screw thread. Then move the preamplifier outer sleeve in the direction to the instrument and tighten it to the screw thread.
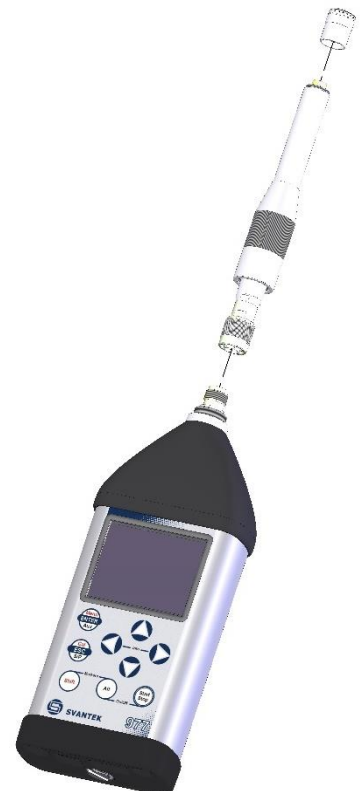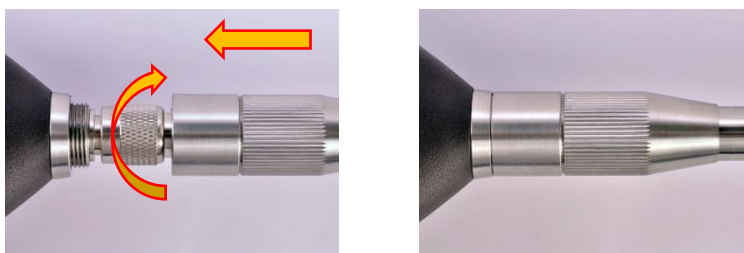
See also Chapter 17 for instrument Maintenance.

Top cover of the instrument

The measurement input is placed in the centre of the instrument's top cover. It is the TNC compatible socket. The SV 12L microphone preamplifier has a specially designed matching TNC plug and a locking screw to secure the preamplifier to the meter body. The accelerometers must be connected to the instrument also using the TNC connector. The full description of the signals connected to the socket is given in Appendix C.

Bottom cover of the instrument

In the bottom cover, there are three sockets: power (**7-16V**), C type USB (**USB**), and multi-purpose (**I/O**); and the SD card slot.

The USB-C Device 2.0 interface is the serial interface working with 12 MHz clock in the full speed mode and with 480 MHz in the high-speed mode, which is a default mode of the instrument.

The **Serial** socket is the Serial Port with RS232 data transfer format in TTL logic standard by means of the SP 75 interface. It conforms to the EIA Standard RS 232C and enables remote programming of all instrument functions and transmission to and from the instrument with speed from 300 bit/s to 115200 bit/s.

The additional multi-purpose input/output socket, called **I/O**, is a 3.5 mm jack socket. In case the Analogue Output functionality is selected, the signal from the input of the analogue/digital converter (before any frequency correction) is available on this socket. This signal can be recorded using a magnetic recorder or observed on an oscilloscope. The Digital Input as another functionality that serves as the external trigger to the instrument, while the Digital Output is used to generate the trigger pulse or alarm pulse from the instrument.

There is a micro-SD card memory slot located between sockets **7-16V** and **USB**. Under the bottom cover of the instrument there are spaces for the 4 x AA batteries.

All sockets are described in detail in Appendix C for this manual.

You can power the instrument from the external 6 x AA battery pack (SA 17A) or DC power source 7 V DC÷16 V DC, 1.5 W (SA 15) via the **7–16 V** socket or from the USB power source via the **USB** socket and SC 158 cable. The current consumption depends on the voltage of the power supplier.

> ⚠️ **Note:** *Use only high-quality USB-C cables, such as SC 158. Many poor-quality cables do not ensure low resistance of the cable, thus disabling proper operating of the instrument.*

> ⚠️ **Note:** *The originally supplied Kingston Industrial memory card has been tested by SVANTEK and cards of this type are strongly recommended for use when the original card is going to be replaced.*

> ⚠️ **Note:** *Switch the power off before connecting the instrument to any other device (e.g. a Personal Computer).*

2.5   POWER SUPPLY

SV 977D can be powered from one of the following sources:

- Four AA standard size internal batteries. In case of alkaline type, with a new fully charged set, the instrument can operate more than 12 h (6.0 V / 1.6 Ah). Instead of the ordinary alkaline cells, four AA rechargeable batteries can be used (a separate external charger is required for charging them). In this case, using the best NiMH type, the operation time can be increased up to 16 h (4.8 V / 2.6 Ah)
- External DC power source – 7 V DC÷16 V DC (1.5 W)
- SA 17A external battery pack – operation time > 24 h (option)
- **USB** interface – 500 mA HUB

When an external power source is connected, the instrument automatically switches powering from the internal batteries to the external source. After disconnection from the external power source, the instrument will automatically switch powering to the internal batteries.

> **Note:** *When the instrument is powering via USB, the internal batteries are slightly discharging. You should remember about this effect and remove the battery if discharging is undesirable.*

For each power source, the **Battery** screen (*path: Menu / Instrument / Battery*) has special view and special icon reflects the powering state.

When the instrument is powered from the internal batteries, the **"battery"** icon is displayed on the top of the screen and the **Battery** screen presents the battery capacity scale and voltage: **Voltage: x.xxV**. The colour of the icon and scale reflects the battery capacity: green (>75%), yellow (>25%), red (<25%).
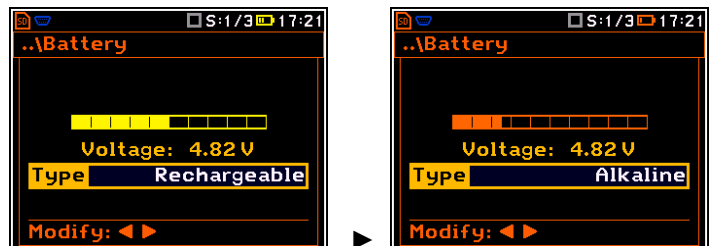
To have correct indication of the battery status, select the battery type in the **Type** position: **Alkaline** or **Rechargeable**.

When the voltage of the batteries is too low for reliable measurements, the icon is red or during attempt to switch the instrument on, the **Low Battery!** message is displayed for 2 seconds and the instrument switches itself off. A fully charged set of 4 batteries ensures more than 12 hours of continuous operation of the instrument (with display **Dim** switched on).

> **Note:** *When the "battery" icon is red, it is strongly recommended to use an external power adapter or USB interface as soon as possible to ensure reliable operation. If no suitable external power source is provided the instrument will be switched off automatically after a short time!*

Extension of the internal battery's life can be achieved by reducing the brightness of the screen when possible. The settings of **Brightness** and power saver function may be done in the **Screen Setup** screen (*path: <Menu> / Display / Screen Setup*).

When there is a connection to the USB interface, the „USB" icon appears, and the **Battery** screen displays the voltage of the **USB Power**.
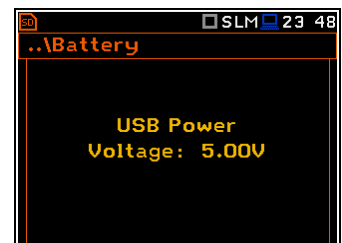
When there is a connection to the **7–16V** socket the "plug" icon appears, and the **Battery** screen displays the voltage of the **External Power**.
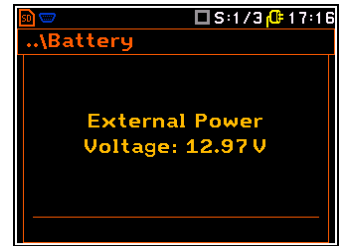
2.6   CONTROL KEYS

Control of the instrument has been developed in a fully interactive manner. Convenient and intuitive menu is used for device configuration Thanks to that, the number of keys has been reduced to nine for ease of use and convenience.

The following control keys are located on the front panel of the instrument:
- **<ENTER>**, **(<Menu>)**, **[<Save>]**,
- **<ESC>**, **(<Cal>)**, **[<S/P>]**,
- **<Shift>**,
- **<Alt>**,
- **▲**, **◄**, **►**, **▼**
- **<Start/Stop>**.

Functions of these keys are described below. The name given in (...) brackets denotes the second key function which is available after pressing it in conjunction (or in sequence) with the **<Shift>** key. For the first two keys, the name given in square brackets […] denotes also the third key function which is available after pressing it in conjunction (or in sequence) with the **<Alt>** key.

<Shift>   Enables the second function of some keys (for example, **<Menu>**).

<Alt>   Enables the third function of some keys (for example, **<S/P>**).

*Note: These keys can be used in two different modes, which are configured in the **Keyboard** screen (path: <Menu> / Instrument / Keyboard):*
- *like in a computer keyboard, when both the **<Shift>**/**<Alt>** key and the second key must be pressed simultaneously (**Direct** mode);*
- *like in a smartphone keyboard, when the first **<Shift>**/**<Alt>** key should be pressed and released and then the second key pressed (**2nd Function** mode).*

*Note: Simultaneous pressing of the **<Alt>** and **<Start/Stop>** keys turning the instrument on or off.*

<Start/Stop>   This key starts or stops the measurement. You can set the mode of this key so that to start or stop the measurements you should press **<Start/Stop>** simultaneously with **<Shift>**. This can prevent accidentally starting or stopping a measurement.

<ENTER>   This key opens the selected position in the list and confirms selected settings. Some additional functions of this key will be described in the following chapters of this manual.

(<Menu>)   This key (**<Shift> + <ENTER>**) opens the main **Menu** in the configuration mode. Double press of the **<Menu>** key opens the list containing last opened configuration screens. It gives faster access to the frequently used screens for easy navigation.

[<Save>]   This key (**<Alt> + <ENTER>**) enables saving of measurement results (see description in Chapter 2.11).

<ESC>   This key escapes from the lists of parameters, menu lists or other screens and return to the previous screen without saving changes. It acts in an opposite way to the **<ENTER>** key.

(<Cal.>)   This key (**<Shift> + <ESC>**) opens the **Calibration** menu.

[<S/P>]   This key (**<Alt> + <ESC>**) breaks the measurement process temporary or enables saving of the setup file if the instrument is not running the measurement**.**

◄, ►   These keys allow you to:
- change the cursor position to the left or right field;
- select column in a multi-column parameter list,
- select a parameter value in an active position (e.g. filter **Z**, **A**, **C** etc., **Start Delay** period: **1s**, **2s**, **3s**, … etc.). In case of numerical values, it speeds up selection after pressing and holding,
- control cursor in graph views (Logger, Spectrum etc.),
- activate/deactivate markers no. 2 and 3.

(◄, ►)   The ◄ / ► keys used in conjunction with **<Shift>** allow you to:
- change a parameter's value with double step (e.g. **Start Delay** period: form **1s** to **11s**, **21s**, … etc.);
- shift cursor to the first or to the last position on the plot.

[◄, ►]   The ◄ / ► keys used in conjunction with **<Alt>** allow you to:
- select a parameter's value in an active position (especially in the parameters table);
- insert or delete a character in the text editor screen.

▲, ▼   These keys allow you to:
- change a position in a list or a field in the result view;
- activate/deactivate markers no. 1 and 4.

(▲, ▼)   The ▲ / ▼ keys used in conjunction with **<Shift>** allow you to:
- change a position in a list to the first one or the last one;
- change relationship between Y-axis and X-axis in the Logger and Spectrum views.

[▲, ▼]   The ▲ / ▼ keys used in conjunction with **<Alt>** allow you to:
- change a result view;
- programme the Real-Time Clock (**RTC**) and **Timer**.

[Info]   The **<Info>** key (simultaneous pressing the ◄ and ► keys) opens the screen with the help information in the measurement display modes. Press **<ESC>** or **<ENTER>** to exit the Info screen.
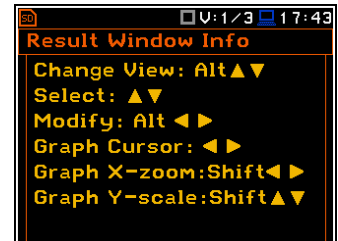
<Markers>   The <**Markers**> key (**<Shift> + <Alt>**) enables marking the special events, occurring during a measurement (for example, some sound or vibration disturbance). To activate markers, the logger should be switched on (*path: <Menu> / Measurement / Logging / Logger Setup*) and one or more logger results (**Peak**, **Max**, **Min**, **Leq**, **LXY**, **LR1** or **LR2** for sound measurements and **Peak**, **P–P**, **Max** or **RMS** for Vibration measurements) in profiles should be active (*path: <Menu> / Measurement / Logging / Logger Results).*

To enter the marker mode, press the **<Shift>** and **<Alt>** keys simultaneously during the measurement. Then four available markers will appear on the screen. To switch on marker no. 1, press the ▲ key (no. 2 - ◄, no. 3 - ► and no. 4 - ▼). Active marker number will be highlighted. To switch off the marker, press the appropriate arrow-key second time.

Markers disappear from the screen after pressing **<Shift>** and **<Alt>**, but their status doesn't change. To continue working with markers, press **<Shift>** and **<Alt>** again.

Markers are saved in the logger file (see Appendix B for details) and can be studied with the help of the SvanPC++ software.
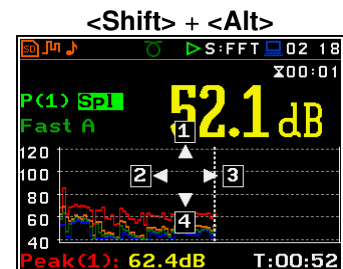
An example presentation of the markers on the time history plot is shown below.
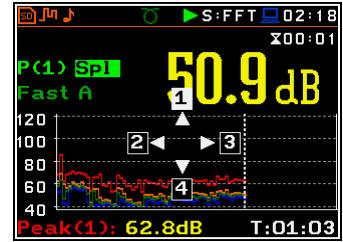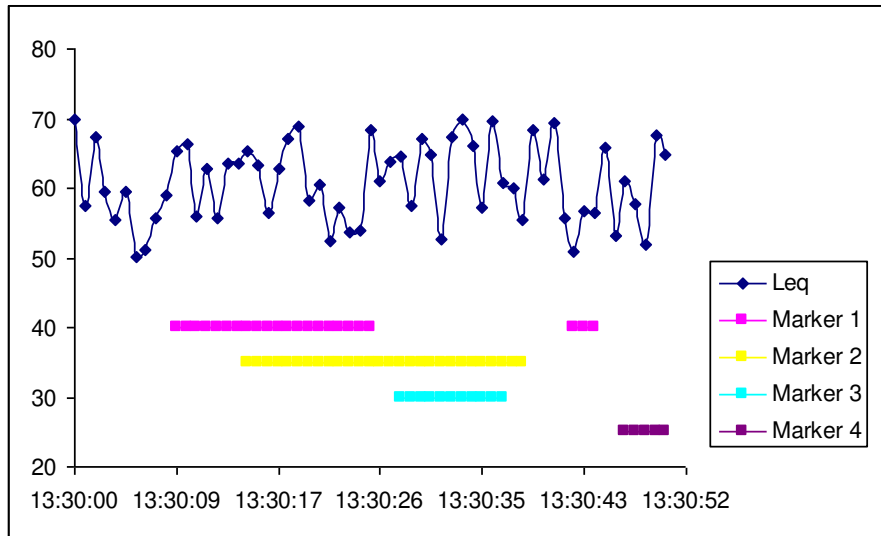
2.7   WORKING WITH THE INSTRUMENT

The instrument is controlled by means of nine keys on the keypad. Using these keys, one can access all available functions and change the value of all available parameters.

The instrument is equipped with the Blanview TFT-LCD 2.4" colour display (320 x 240 pixels), which displays the measurement results and the configuration menu.

The instrument has two general modes of operation: measurement performance and results preview mode and configuration mode with the use of Menu functionality.

Turning on the instrument

To turn the instrument on, press the **<Alt>** and **<Start/Stop>** keys at the same time.

The instrument goes through the self-test routine after turning on, displaying during this time the manufacturer logo, the name of the instrument and the firmware version.

Then it enters the screen with the list of settings from which you can select the required one and confirm the selection with the **<ENTER>** key or skip selecting with the **<ESC>** key.

The instrument will warm up for one minute, then it enters one of the results view mode:
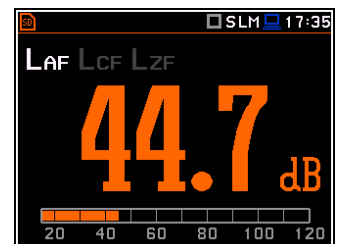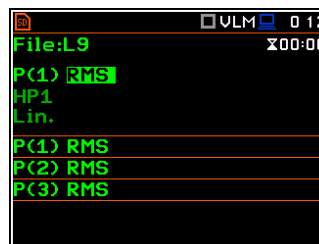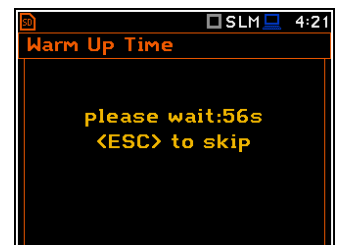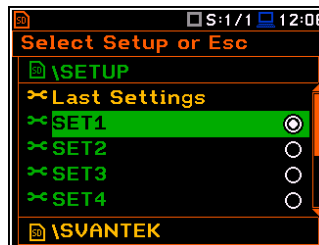
- in case of vibration measurement - the **Default** mode set in the **Display Modes** screen, or

- in case of sound measurement - the **Running SPL** mode, if it was enabled, or the **Default** mode set in the **Display Modes** screen, if the **Running SPL** mode was disabled.

2.7.1 Measurement mode

The measurement results can be viewed in different views or display modes, the set of which depend on the selected **Measurement Function** and which you can change and activate/deactivate.

Views present some measurement results as well as additional information in the way of icons regarding:

- instrument status: memory, power, real time, Bluetooth, GPS, connection with the modem etc.,

- measurement status: measurement function, measurement elapsed time, measurement start/stop/pause, trigger, logger etc.,

- measurement parameters: measured result, profile number, file name, detector type, filter etc.
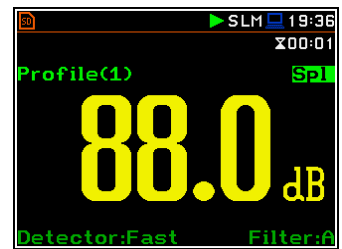
All icons are described in Chapter 2.9, other fields and view control functions - in Chapter 5.

Some views present numerical and some graphical results, like on the right-hand example: time-history plot and spectrum.
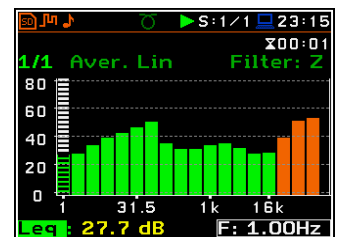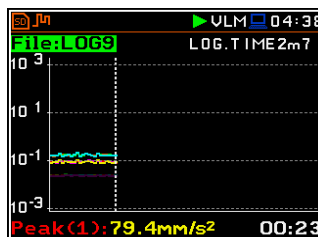
In some views the screen is divided into two parts to show more numerical results in different formats or both numerical and graphical results.

If you are in the measurement mode, you can switch between views using the ▲ / ▼ keys pressed together with **<Alt>**.
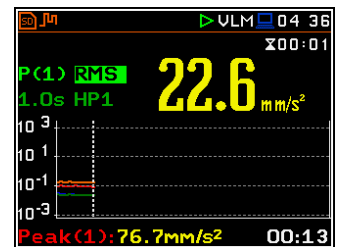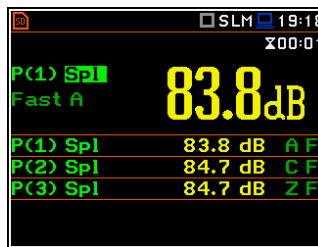
Starting measurement

To start the measurement, press the **<Start>** key. The [icon] icon will appear, and the measurement will be performed with the current settings, stored in the instrument's internal memory. During the measurement the shape of the [icon] icon will be changing from self to contoured.
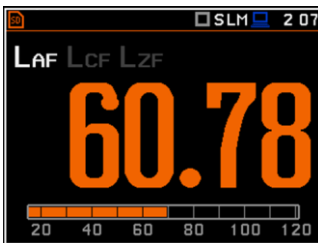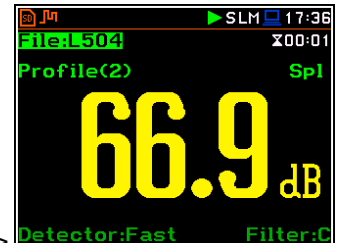
The time passed from the measurement start (elapsed time) is displayed in the right upper corner of the measurement screen in the format ⌛ **mm:ss** in the range from 00:00 to 59:59, or in the format ⌛ **hh:mm:ss** in the range from 01:00:00 to 99:59:59, or in the format ⌛ **xxxh** from 100h to 999h, and ⌛ **>999h** if the elapsed time exceeds 999 hours. Its maximum value is equal to the **Integration Period** and the elapsed time is zeroed when the new measurement cycle starts (see Chapter 4.1).
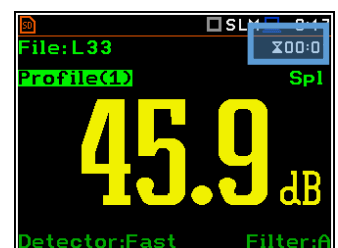
Pausing measurement

To pause a measurement, press the **<S/P>** key (**<Alt>+<ESC>**). The measurement will be paused and the [icon] icon will appear together with the **Pause** section at the bottom of the screen.
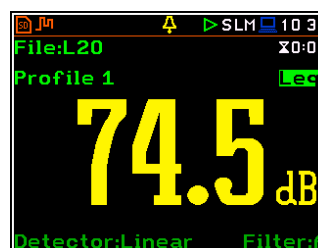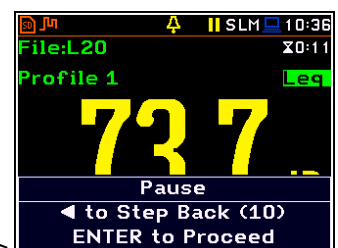
The Pause mode allows you to erase up to 16 last seconds of the measurement with the ◄ key. One press deletes one second of the measurement and this reduces also the elapsed time.

It may be useful if, for example, the measurement is temporarily disturbed by some event that should not normally occur.

To continue the measurement, press **<ENTER>**.
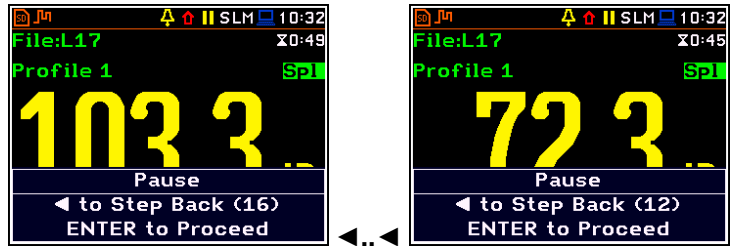
2.7.2   Configuration mode

To configure a measurement or the instrument, use the menu mode, which is switched with the **<Menu>** key. The menu consists of different type of screens, which include main menu, sub-menu, lists of options, lists of parameters, text editor screens, information screens etc.

Main menu

The main **Menu** contains the headers of six sections (sub-menu), which group configuration settings by feature. The main **Menu** is opened after pressing the **<Menu>** (**<Shift>** + **<ENTER>**) key. The main **Menu** list contains the following sections: **Function**, **Measurement**, **Display**, **File**, **Instrument**, **Auxiliary Setup** and **Report**.

Recent Items list

Double pressing of the **<Menu>** key opens the list of recently used menu items. This enables accessing most frequently used lists of parameters quickly, without the necessity of passing through the whole menu path.
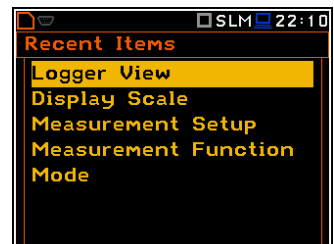
Selecting position

The desired position in the menu list is selected with the ▲ / ▼ key.
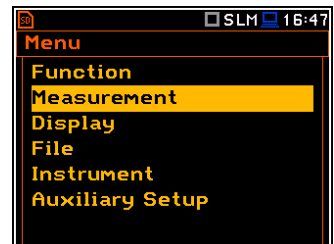
Opening position

After selecting the desired position in the menu list, press the **<ENTER>** key to open it. After this operation, a new sub-menu, option list, parameter list or information screen appears on the display.
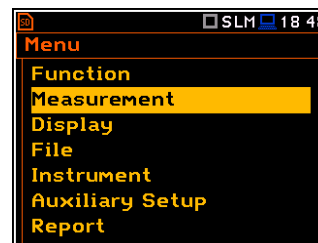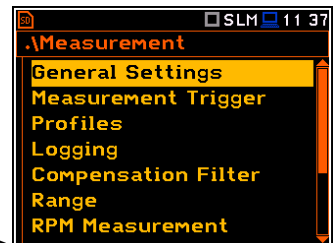
List of parameters

List of parameters contains parameters the value of which is selected from the available range or set.

- The desired position in a list is selected with the ▲ / ▼ key.

- Changing value in the selected position is performed with the ◄ / ► key.

- The **<ENTER>** key saves all performed changes in the list of parameters.
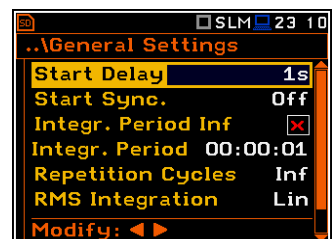
If the parameter has a numerical value, you can speed up a selection by pressing the ◄ / ► key and keeping it pressed by more than 2 seconds. In this case, the parameter value starts changing automatically until you release the pressed buttons.

You may change the numerical parameter value with a larger step (usually 10) with the ◄ / ► key pressed together with **<Shift>**.

List of options

The option list consists of different options, from which only one may be selected. The selection of the option is performed in the following way. Highlight the desired option with the ▲ / ▼ key and then press **<ENTER>**. This option becomes active and the list is closed. After re-entering this list again, the last selected option will be marked.
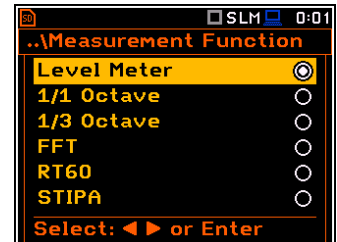
Matrix of parameters

When a list of parameters consists of more than one column you may change:

- column with the ◄ / ► key
- line in the same column with the ▲ / ▼ key
- value in a selected position with the ◄ / ► key pressed with **<Alt>**
- all values in the same column with the ▲ / ▼ key pressed with **<Shift>**
- all values in the same line with the ◄ / ► key pressed with **<Shift>**.
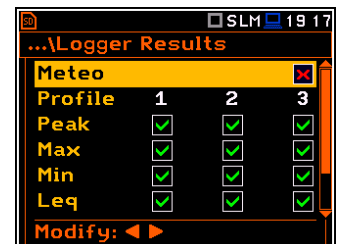
Complex parameters

For complex parameters, consisting of more than one value field like **Start Hour** or **Start Date**, you should first select the field and then change the value of this field in accordance with the help information on the bottom of the screen.
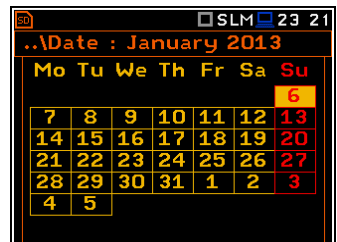
In all cases the **<ENTER>** key is used for confirmation of changes and for closing the opened list of parameters. The list of parameters is closed, ignoring any changes with the **<ESC>** key.

Information screen

Some screens inform about the state of the instrument, available memory, standards fulfilled by the instrument, etc. To scroll through the screen, use the ▲ / ▼ key. To close such a screen, press **<ENTER>** or **<ESC>**.
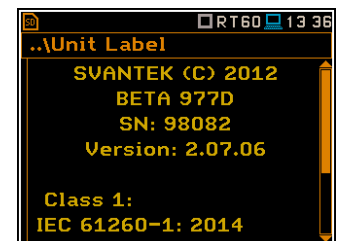
Text editor screen

In the text editor screens, you may edit text lines (file names, directory name etc.) The text editor screen is opened with the ◄ / ► key when the position with the text parameter is selected. These screens provide help information on how to edit text.
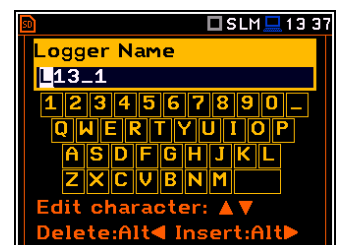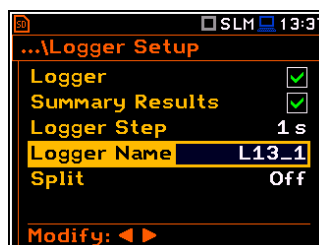
The edited text is displayed in the upper line and the character, which is displayed inversely may be changed, deleted or a space may be inserted before it.

- You can select the position of the character in the edited text with the ◄ / ► key.
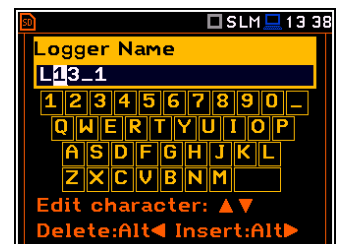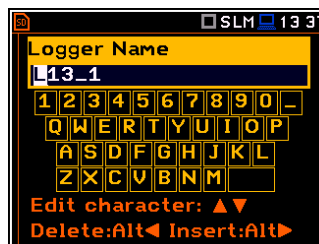
- You can insert or delete the position in the edited text with the ◄ / ► key pressed together with **<Alt>**.
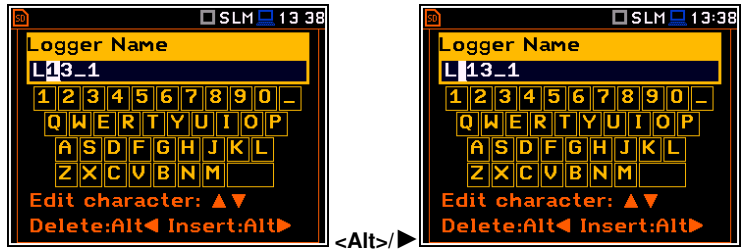
- You can change the character of the selected position using the virtual keyboard with available ASCII characters.

  To make a keyboard active, press the ▲ / ▼ key.

- To insert new character to the cursor position in the edited text, select the character of the virtual keyboard with ◄ / ► or ▲ / ▼ key and press **<ENTER>**.

  Cursor of the edited text will be shifted to the next right position.
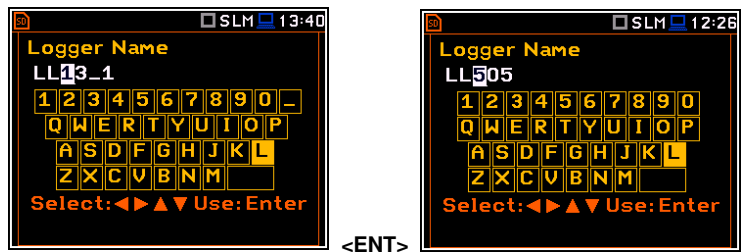
- Exit the virtual keyboard with the ▲ / ▼ key.
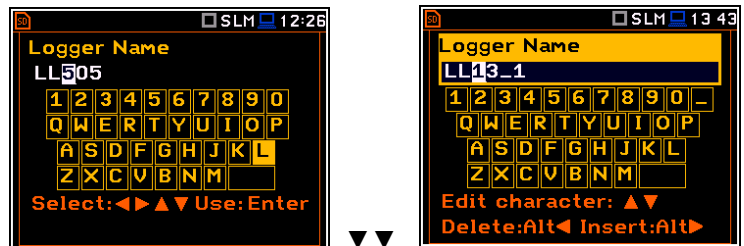
- To confirm changed text, press **<ENTER>**.
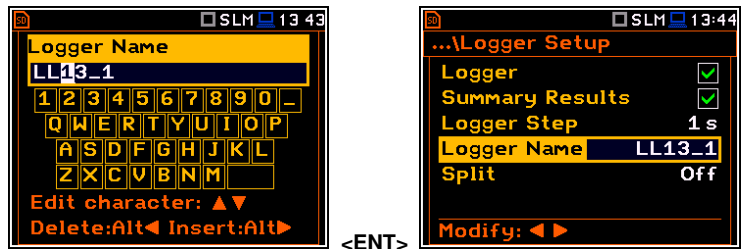
The above example shows the edition of the file name, which may consist only uppercase letters. Some texts can be written with the lowercase letters and use special characters. In such cases, the keyboard can be switched with the ▲ / ▼ key pressed together with **<Shift>**.
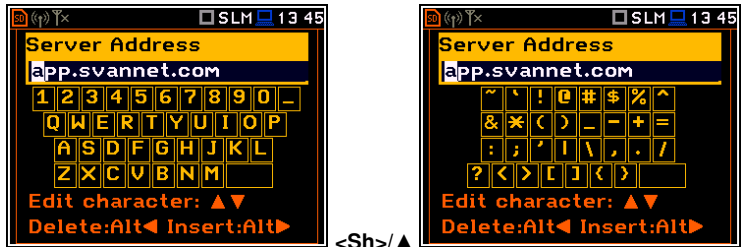
Inactive parameters

If some functions or parameters are not available, positions in the menu or lists of parameters linked with this function or parameter become inactive (their colour becomes grey). For example, if **Logger** (*path: <Menu> / Measurement / Logging / Logger Setup)* is switched off, the **Logger** view mode will be **not** active!
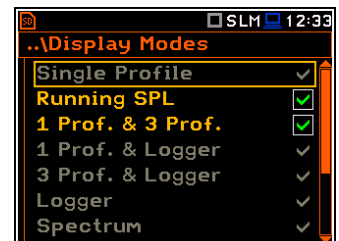
Help information

In most screens, the last line or several lines at the bottom of the screen contain help information. It informs how to select or modify the parameter's value, change the character in the text line etc.

2.8 DEFAULT SETTINGS

Factory settings

The instrument as sold has default settings which you may change, but always return to them with the use of **Factory Settings** option in the **Auxiliary Setup** menu.

Next chapters of the manual will describe in detail what each parameter means and how to change the instrument settings.

Main default settings

With the default settings, the instrument will measure sound pressure level by three virtual meters, so called profiles (Measurement **Mode: Sound**; **Measurement Function: Level Meter**) with 1 second delay from the **<Start>** key pressure (**Start Delay: 1 s**), 1 second integration time (**Integration Period: 00:00:01**), infinitive repetition till press the **<Stop>** key (**Repetition Cycle: Inf**), linear integration for the RMS base results (**RMS Integration: Lin**), linear integration for statistics (**Statistics: Lin**), daytime limits for Lden calculations (**Day Time Limits: 6-18 h**), time frames for two rolling Leq calculations (**Rolling Time(1): 30 m** and **Rolling Time2: 1 h**), free field compensation (**Compensation Filter: Free Field**), active logging of the selected results with 1 second step (**Logger: On**; **Logger Step: 1 s**; **Logger Results: Peak**, **Max**, **Min** and **Leq** for all profiles) and summary results saving including **Statistics**.

The logger and summary results will be automatically saved in the file with the name defined by the instrument and presented in the **Logger Setup** screen (**Logger Name: Lxxxx**).

Other functions are switched off, like:
- measurement trigger (**Measurement Trigger: Off**),
- logger trigger (**Logger Trigger: Off**),
- wave recording (**Wave Rec.: Off**),

timer (**Timer: Mode: Off**).

Default profile settings for Sound measurements:

Profile 1 - **A** weighting filter (**Filter(1)=A**), **Fast** RMS detector (**Detector(1)=Fast**);

Profile 2 - **C** weighting filter (**Filter(2)=C**), **Fast** RMS detector (**Detector(2)=Fast**);

Profile 3 - **Z** weighting filter (**Filter(3)=Z**), **Fast** RMS detector (**Detector(3)=Fast**).

Default profiles settings for Vibration measurements:

Profile 1 - **HP1** weighting filter (**Filter(1)=HP1**); **1.0s** RMS detector (**Detector(1)=1.0s**);

Profile 2 - **HP3** weighting filter (**Filter(2)=HP3**), **1.0s** RMS detector (**Detector(2)=1.0s**);

Profile 3 - **HP10** weighting filter (**Filter(3)=HP10**), **1.0s** RMS detector (**Detector(3)=1.0s**).
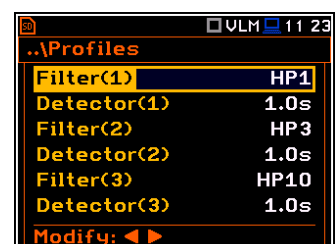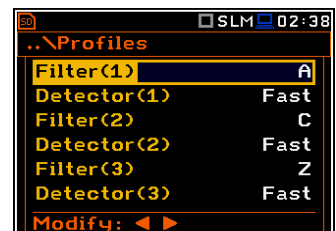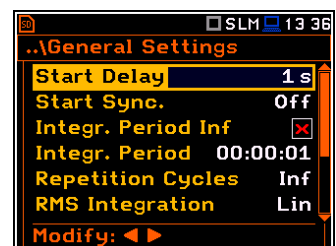
2.9 DESCRIPTION OF ICONS
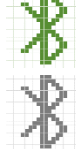
Additional information about the instrument's state is given by means of the row of icons visible in the top of the display.

The type of measurement function and the measurement mode (SLM, VLM, S:1/1 etc.) as well as real time clock (RTC) is also displayed in the same line together with icons.
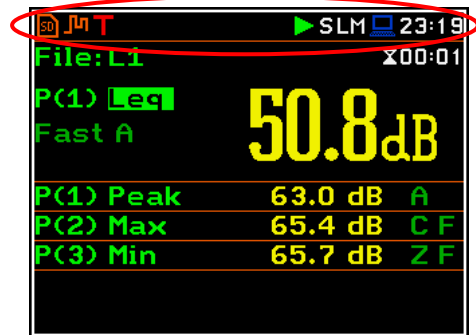
Meanings of the icons are as follows:

	"measurement" icon is displayed when the measurement is running, and the icon shape is changing from self to contoured.		**"memory warning"** icon is displayed when <u>there is no</u> inserted micro SD-card.
	"stop" icon is displayed when the measurement is stopped.		"**SD-card**" icon is displayed when the micro SD-card memory is inserted.
	"pause" icon is displayed when the measurement is paused.		**"RS232"** icon is displayed when the RS232 port is activated.
	„**USB**" icon is displayed when there is a successful USB connection with the PC.		„**logging**" icon is presented when current measurement results are logged into the logger file.
	„**level-**" icon is displayed when the "**Level-**" trigger is waiting for a condition fulfilment. The icon appears alternately with the „measurement", „logging" or „wave" icons.		**"level+"** icon is displayed when the "**Level+**" trigger is waiting for a condition fulfilment. The icon appears alternately with the „measurement", „logging" or „wave" icons.
	"slope–" icon is displayed when the "**Slope-**" trigger is waiting for a condition fulfilment. The icon appears alternately with the „measurement", „logging" or „wave" icons.		**"slope+"** icon is displayed when the "**Slope+**" trigger is waiting for a condition fulfilment. The icon appears alternately with the „measurement", „logging" or „wave" icons.
	"trigger" icon is displayed when other than Level or Slope trigger is waiting for a condition fulfilment. The icon appears alternately with the „measurement", „logging" or „wave" icons.		„**wave**" icon is displayed when the wave recording is active (wave files with extension WAV are saved automatically).
	„**overload**" icon is displayed when an overload appears.		„**underrange**" icon is displayed when an underrange appears.
	"alt" icon is displayed when the **<Alt>** key is pressed.		**"shift"** icon is displayed when the **<Shift>** key is pressed.
	"clock" icon is displayed when the timer is **On**. It is active when the instrument is waiting for the measurement start-up to occur. When the measurement start is close, the icon changes its colour to green and starts blinking.		**"battery"** icon is displayed when the instrument is powered from the internal batteries. The icon corresponds to the status of the batteries (three, two, one or none vertical bars inside the icon). When voltage of batteries is too low, the icon becomes red.

	"lightning" icon is displayed when polarisation voltage is 200V.		**"alarm"** icon is displayed when an alarm appears.
	"GPS" icon is displayed when GPS is active. Colours of the icon define the state of the GPS: green – active, blue – searching, grey – disconnected.		**"Bluetooth"** icon is displayed when the *Bluetooth®* is switched on. Color of the icon defines state of the connection: green – connected, grey – disconnected.
	"plug" icon is displayed if an external power is connected to the **7-16V** socket**.**		

Icons connected with modem functionality:

or	**"no wireless"** icon is displayed when the **GPRS** function is switched on and there is no cable connection with the modem	or	**"no range"** icon is displayed when the GPRS function is switched on and there is no cable connection with the modem and therefore no range
or	**"wireless"** icon is displayed when the wireless transmission (**GPRS** modem) is active, but there is no connection with Host or SvanNET	or	**"no range"** icon is displayed when the wireless transmission (**GPRS** modem) is active, but the modem is out of range
or	**"host"** icon is displayed if there is connection with Host		**"range"** icon is displayed if there is GPRS connection and shows the level of the GPRS signal and ways of data transmission.
	"SvanNET" icon is displayed if there is connection with SvanNET.		

2.10 OVERLOAD AND UNDERRANGE DETECTION

Overload detector

The instrument has the built-in overload detectors. Both A/D converter and input amplifier overload conditions are detected. The overload in the measurement channel (in its analogue part) and the overload of the analogue / digital converter are both detected. The "overload" indication appears when the input signal amplitude is 0.5 dB above the declared "Peak measurement range". This condition is checked once per second or with the Logger Step if it is less than 1 second.

An overload is indicating by the flashing icon which is displayed during the period from the overload detection till the end of the Integration Period. If the overload disappears to the Integration Period end, the overload icon will not be displayed from the start of the next measurement cycle.

When an overload is detected the special marker will be recorded to the logger file with the data logging step.

The overload time is measured by the **OVL** result during the Integration Period and is saved in the logger file as part of Summary Results.

Underrange detector

The instrument has the built-in underrange detector. The "underrange" indication appears when the RMS value for the elapsed time is below the lower linear operating range. This condition is checked once per second.

An underrange is indicating by the flashing [icon] icon which is displayed during the period of the underrange detection. When an underrange is detected till the Integration Period, the special marker will be recorded to the logger file with the Integration Period step. If during the Integration Period the signal level increases and the total RMS is greater than the minimum, the icon stops displaying and the underrange marker is not recording.

2.11 SAVING DATA

Memory type

All available measurement results and settings can be stored in the instrument's memory (micro **SD Card**) as files in the predefined or assigned directories. The measurement files are stored by default in the predefined SVANTEK directory. The predefined SVANTEK directory can be reassigned by the user. The setup files are stored in the predefined directory SETUP. Other special files (logs, advanced alarms settings) are stored in the predefined SYSTEM directory.

The **SD Card** memory is activated automatically after insertion of the card into the instrument' card slot.

The instrument current settings are stored in the instrument internal RAM. This file can be downloaded to the PC as **Settings.svt** with the use of SvanPC++ software. It can be edited with the special **Setup file editor** tool of SvanPC++ and uploaded to the instrument's internal RAM (see *SvanPC++ User Manual*).

The "SD-card" icon is displayed when the micro SD-card is inserted in the memory slot.

If the SD-card is removed from the memory slot the "memory warning" icon appears instead of "SD-card" icon.

The **SD Card** memory is organised as a standard memory with directories and sub-directories (FAT32 file system). It is possible to create and delete the directories from the instrument level.

The content of the instrument's memory can be controlled with the help of the **File Manager** or **Setup Manager** function of the **File** menu.

In the **File Manager** or **Setup Manager** screens, data files are described by their file name with an extension (**SVL**, **SVT** or **WAV**) as well as additional icon and size (**2KB** etc.).

Directory

New file or directory

Logger file .SVL

Setup file .SVT

Wave file .WAV

Managing directories and files

You can manage files saved on the SD card with the help of the **File Manager** or **Setup Manager** in the **File** section (see Chapter 6).

<ENT>
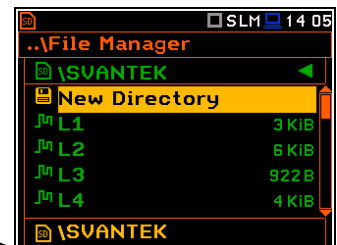
Files are saved in the directory, which was assigned as a working directory. The working directory is displayed in the bottom line of the **File Manager** screen together with the memory icon.

Directories are created manually with the use of **<New Directory>** position.

In more details, **File** menu is described in Chapter 6.
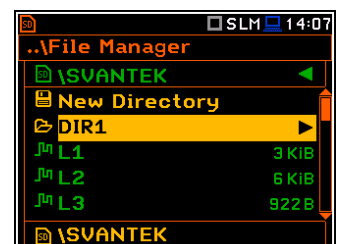
Automatic saving of logger files

Files which contain the logger data are saved automatically in the **SD Card** memory with an extension .SVL. To enable automatic saving next conditions should be fulfilled:

- SD-card should be inserted and there should be enough space on it.

- The **Logger** (*path: <Menu> / Measurement / Logging / Logger Setup*) should be switched on.
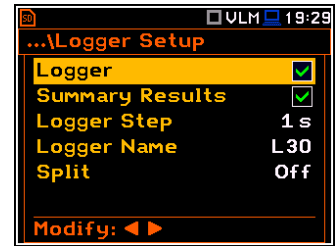
The logger file name is defined automatically using a pattern **LLdd**, where **LL** is the string of letters (so called prefix) and **dd** is a string of digits that forms a number. Up to 8 characters can be used to name a file. The default prefix for the logger files is "**L**".

The instrument assigns an individual counter to every prefix of files the instrument has already created and saved in the working directory. This counter is equal to the maximum number in the set of files with the same prefix. For example, if there are files with names: **L0**, **L16** and **L29**, the counter value is 29.

The number of the new automatically created file will have the value of the counter plus one. So, for the above example, new file name will be **L30**.
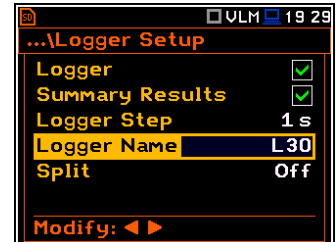
You can change the automatically generated file name in the special screen, which is opened after pressing the ◄ / ► key.

After changing the file name number without changing the prefix and pressing **<ENTER>**, the counter will be adjusted to the new number.
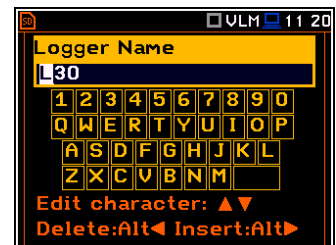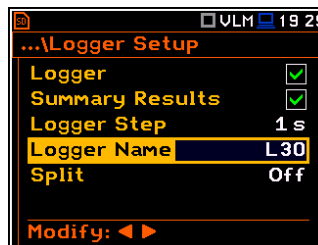
The instrument accepts only that name which number is higher than the counter, assigned to the file's prefix.

You can change the automatically proposed prefix. In such case the instrument assigns the new counter to the new prefix.

The screens below show the automatic file saving during two subsequent measurements. Before and during the first measurement the file name **L30** is displayed. This file is saved automatically in the SD-card memory after the measurement stop. After start of second measurement the instrument automatically changes the file name to **L31** and this file is saved after stop of the second measurement and so on.
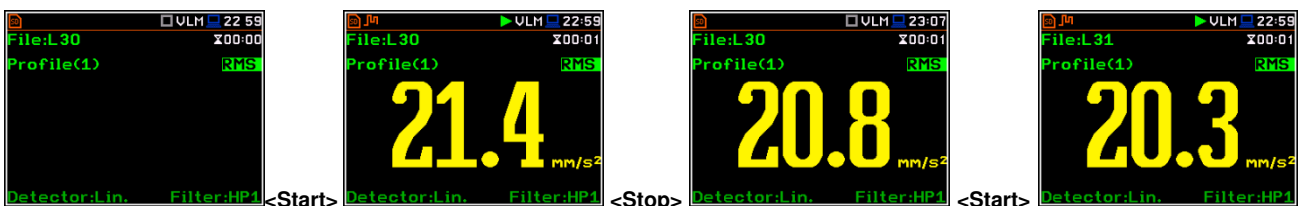
Note: During the measurement run with data logging to a logger file, the „logging" icon is displayed.

You can quickly jump to the directory where files were saved. To do this, make the field with file name active by means of ▲ / ▼ key and press **<ENTER>**.
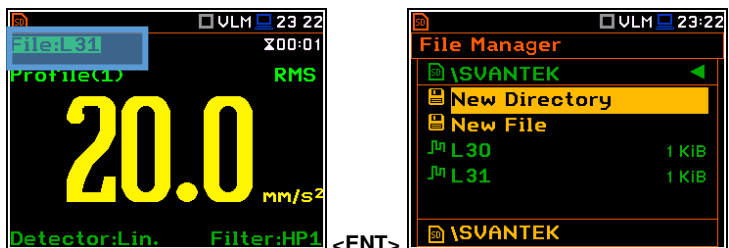
If you press **<Save>** (**<Alt>+<ENTER>**) after the measurement, the instrument opens the **Logger Setup** screen (*path: <Menu> / Measurement / Logging / Logger Setup*) with the selected **Logger Name** position and the file

name with the increased number. Pressing **<ENTER>** will return the instrument to the measurement screen with no results of the previous measurement and new file name in the file field.

<Save>   **<ENT>**
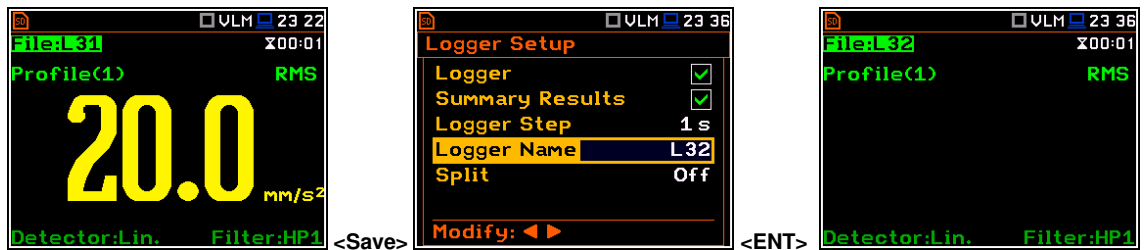
Manual saving of Summary Results

If the **Logger** or the **Summary Results** option is switched off in the **Logger Setup** list (*path: <Menu> / Measurement / Logging / Logger Setup*) the automatic saving of the measurement data (so called Summary Results) is switched off too. In such a case **Summary Results** for the last cycle can be saved only manually.

or

Note: If ***Logger*** *is Off, the field with file name in the result view screen will be empty!*
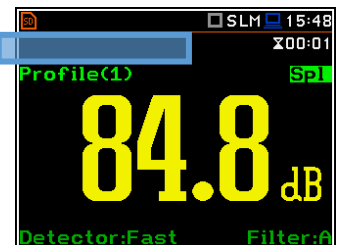
There are two options for saving manually the **Summary Results** data. One option is to press **<Save>** key (**<Alt>+<ENTER>**) right after the measurement stop.

After pressing **<Save>** the **New File** screen appears with the predefined name which has a number increased by one regarding the latest saved with the prefix "**L**". In the **New File** screen, you can enter a new name for the file.
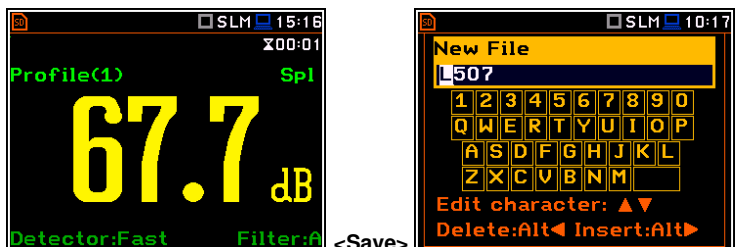
After editing of the automatically proposed name, press **<ENTER>** to confirm.

<Save>

File with the proposed or created by you name will be saved in the working directory on the SD-card.
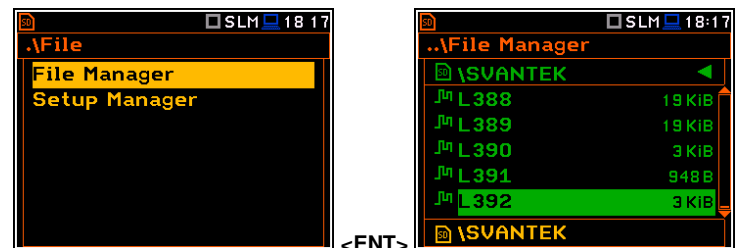
In case of conflict of names, the instrument will save the file with the proposed name.

<ENT>

Another option is to open the **File Manager** screen (*path: <Menu> / File / File Manger*), select **New File** and press **<ENTER>**.
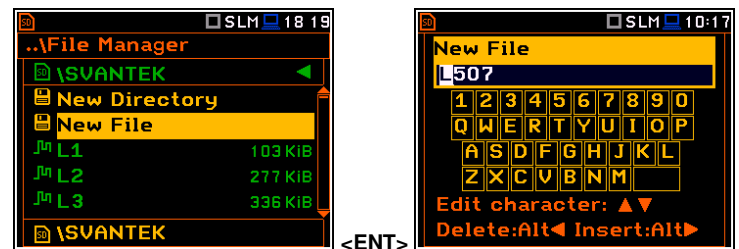
After edition of the automatically proposed name, press **<ENTER>** to confirm.

<ENT>   **<ENT>**

If **Logger** and **Summary Results** are both switched on in the **Logger Setup** list (*path: <Menu> / Measurement / Logging / Logger Setup*) the Logger results and Summary results will be saved automatically in the file with their

steps. At the same time, you can manually save only the Summary Results for the last cycle with the use of the **File Manager** described above.

> **Note:** *Manual saving is not possible when the instrument is measuring. If you attempt to save results, the message "***Measurement in progress!***" will be displayed for about 3 seconds.*

> **Note:** *When no measurements were performed and there are no results to save, all the save functions are disabled.*

Automatic saving of Wave files

Wave files with an extension .WAV containing signal recording data are also saved automatically in the **SD Card** memory. To enable automatic saving next conditions should be fulfilled:

1. SD-card should be inserted and there should be enough space on it.

2. The wave recording should be switched on (*path: <Menu> / Measurement / Logging / Wave Recording / Wave Rec.: Continuous or On Trigger*).

The wave file name is defined automatically using the same rules as for the logger files. The default prefix for the wave files is **R**.
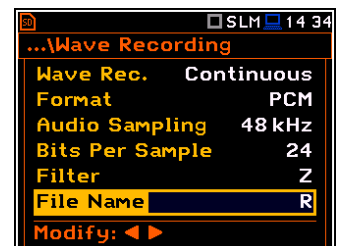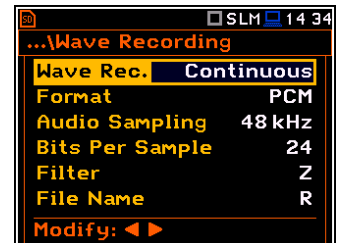
> **Note:** *During the measurement run with recording of the time-domain signal to the wave file the „wave" icon is displayed.*

> **Note:** *The wave files usually are big in size and may use enormous memory space. Since the wave-file name is not displayed on the result view screen, you should remember that wave recording function is active and switch it off always when wave recording is not required.*

Saving of setup files

The measurement configuration setup files can be stored in the **SD Card** memory with an extension .SVT manually either by means of **<S/P>** key or by creating the **<New File>** in the **Setup Manager** list.

There is no automatic option for the setup files saving, but the instrument always generates new setup name automatically with default prefix **SET**.

<S/P>

<ENT>
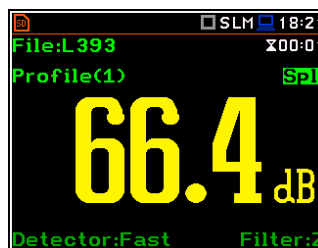
2.12 DOWNLOADING AND UPLOADING FILES

Downloading files

All files stored in the instrument's memory (micro SD-card) can be downloaded to the PC. There are two ways to download files.

Since the file structure of the SD-card is the same as on most PC, you may extract the micro SD-card and use it directly in the PC. But it is not recommended.

It is recommended to use the SvanPC++ software, which provides download and upload functions as well as data viewing and data processing options. In this case, the instrument should be connected to the PC via the SC 158 USB cable.

Note: *Description of SvanPC++ is given in the "SvanPC++ User Manual".*

Uploading files

Same approach is used for uploading files to the instrument (usually setup files). Files can be upload via the SD-card or via the SvanPC++ software.

2.13 ACTIVATING OPTIONAL FUNCTIONS

Standard instrument firmware contains all basic functions to perform measurements in accordance with most international standards and methods. For more complex tasks you have the possibility of expanding the basic functions of the instrument with additional functions. These features include 1/1, 1/3 octave, FFT analysis, signal recording and others.

If additional functions were not supplied in the instrument kit and were not unblocked by the supplier, such a task is in responsibility of the user who decides to buy additional functions later.

The optional function should be activated in the moment of the first attempt to use it. For example, if a signal recording (Wave) was blocked, but you purchased this option later, then during the first attempt to switch it on, the instrument requires entering the special code that will unlock this function. Once unlocked, option will be available permanently.

Pressing simultaneously **<Shift>** and ◄ keys right after turning on the instrument allows you to check and lock back early unlocked options.

To select other options, press the **<ENTER>** key, which opens another page of the **Active Functions** list.

3   MEASUREMENT FUNCTIONS AND CALIBRATION – Function

In the **Function** section, you can select a measurement mode (**Mode**) which relates to the transducer type, a measurement function (**Measurement Function**) and perform the instrument check or calibration (**Calibration**).

<ENT>
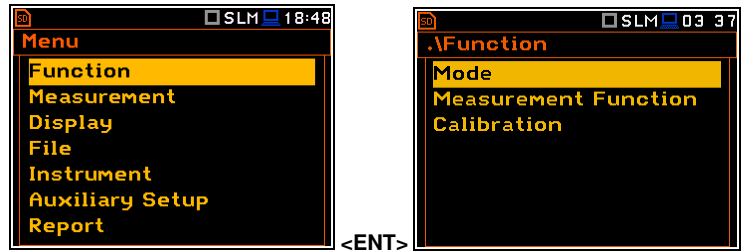
3.1   SELECTING THE INSTRUMENT MODE – MODE

The instrument can work in two modes: **Sound Meter** and **Vibration Meter**.

The **Mode** relates to the type of transducer connected to the instrument: microphone with preamplifier or accelerometer.

<ENT>
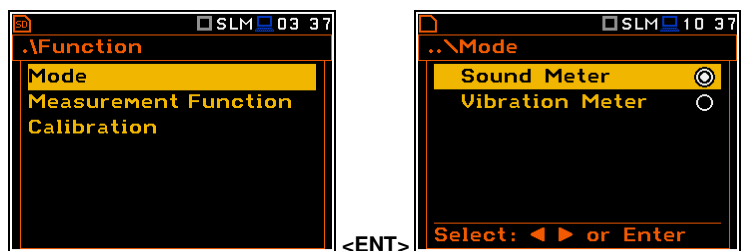
Note: The instrument doesn't recognize the type of transducer, connected to its input socket. Remember to switch the **Mode** all the time you change the transducer.

Note: In the manual text the Sound mode (or Sound measurements) refers to the **Sound Meter** modes and the appropriate functions dedicated to the measurement and analysis of the acoustic signal: **Level Meter**, **1/1 Octave**, **1/3 Octave**, **FFT** etc.; the Vibration mode (or Vibration measurements) refers to the **Vibration Meter** modes and the appropriate functions dedicated for the measurement and analysis of the vibration signal: **Level Meter**, **1/1 Octave**, **1/3 Octave**, **FFT** etc.

3.2   ACTIVATING MEASUREMENT FUNCTIONS – MEASUREMENT FUNCTION

The main function of the instrument is the measurement of Sound pressure or Vibration acceleration broad band levels (**Level Meter**). The Sound Level Meter (SLM) meets the standard IEC 61672-1:2013 for Class 1 accuracy and the Vibration Level Meter (VLM) meets the ISO 8041-1:2017 standard.

You may also use 1/1 and 1/3 real time octave band or FFT frequency analysis functions. These functions extend the main Level Meter functionality of the instrument, because the selected 1/1 and 1/3 octave or FFT analysis is performed along with all calculations of the broadband Level Meter results.

The instrument offers also the specialized functions dedicated for the reverberation time (**RT60**), tonality (**Tonality**) and speech transmission index (**STIPA**) assessments.

To activate a function, open the **Measurement Function** list, select the required function and press **<ENTER>** to confirm selection.

The type of measurement function and the measurement mode is displayed in the upper line of the screen in the form of abbreviation as presented below:

<ENT>
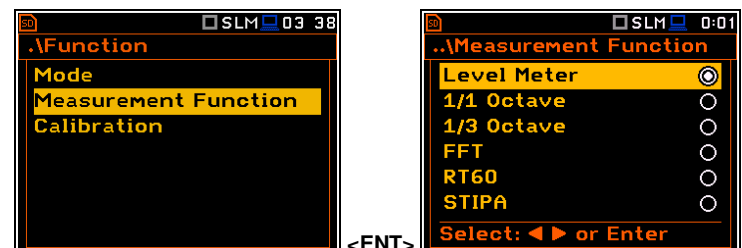
Mode: Sound Meter

SLM	**Sound Level Meter**,
S:1/1	**Sound 1/1 Octave**,
S:1/3	**Sound 1/3 Octave**,
S:FFT	**Sound FFT**,
RT60	**RT60**,
TON	**Tonality**
STI	**STIPA**.

Mode: Vibration Meter

VLM	**Vibration Level Meter**,
V:1/1	**Vibration 1/1 Octave**,
V:1/3	**Vibration 1/3 Octave**,
V:FFT	**Vibration FFT**.

Note: It is not possible to change the measurement function during a measurement run. In this case, the instrument displays for about 3 seconds the message: "Measurement in Progress". To change the function of the instrument the current measurement must be stopped!

*Note: The **1/3 Octave**, **FFT**, **RT60** and **STIPA** functions are optional and should be unlocked by entering the activation code in the text editor screen, which is opened after first attempt to select it. Once unlocked, this option will be ready to use permanently.*

Optional measurement functions that broaden the application of the instrument can be initially supplied and activated by the manufacturer or purchased later and activated by the user.

3.3 CALIBRATING THE INSTRUMENT – CALIBRATION

The instrument is factory calibrated with the supplied microphone and accelerometer for the reference environmental conditions. Because the 'accuracy' of the electronic components can drift so equipment should be calibrated periodically by a competent laboratory. Because the sensitivity of the microphone and accelerometer is a function of the temperature, ambient pressure and humidity and when the absolute sound pressure level value is important, the absolute calibration of the measurement channel should be performed before the measurement. It is also good practice to check the instrument measurement channel before and after measurements.

Due to implemented automatic calibration the instrument can perform the sound calibration automatically, when the calibrator is placed over the microphone (switched on or with the auto run function). The calibrator level is automatically detected, and the calibration measurement is started automatically. Just press **<ENTER>** to confirm the calibration results. A sound measurement cannot be in progress while the automatic calibration is being performed.

The **Calibration** list comprises positions enabling in-situ system checking and calibration (**System Check**, **Calibr. by Sensitivity**, **Calibr. by Measurement**), checking and erasing calibration records (**Calibration History**, **Clear Calibr. History**), switching on the automatic calibration (**Auto Calibration**) as well as adding the current calibration results to the data files (**Post Calibration**).

<ENT>
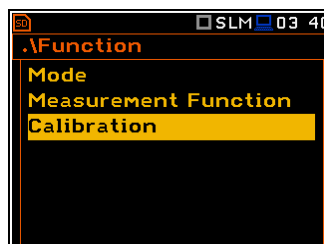
*Note: The calibration factor is always added to measurement results and measurement range limits of the **Level Meter**, **1/1 Octave**, **1/3 Octave** and **FFT** functions.*

*Note: The calibration level and the calibration result are expressed in different units depending on the settings of the instrument. The metric or non-metric Vibration units are set in the **Vibration Units** screen (path: <Menu> / Auxiliary Setup / Vibration Units). Additionally, the linear or logarithmic units are set in the **Display Scale** screen (path: <Menu> / Display / Display Scale).*

Note: To check or calibrate the instrument, the current measurement in progress must be finished!

3.3.1 System Check

The IEC 61672-1:2013 standard advises users to perform in-situ checks of measuring instruments. Checking should be carried out immediately before and after the measurement.

1. Open the **System Check** position.

2. Set the reference calibration level (**Cal. Level**).

3. Attach the sound calibrator to the instrument's microphone or accelerometer to the vibration calibrator.

4. Switch on the calibrator and wait approximately 30 seconds before starting the system check measurement.

5. Start the calibration measurement with the **<Start>** key.

The measurement starts without delay. If maximal difference between three 1-second consecutive results (Leq(C) or RMS) is less than **0.05dB**, the measurement will be stopped. Otherwise, the user should stop it manually.

During the system check measurement, the **<ESC>** and **<Pause>** keys do not operate but it is possible to stop the measurement using the **<Stop>** key.

System check is considered as successful if its result (**Cal. Result**) does not differ from the calibration level by more than 0.5 dB.

If the system check measurement shows bigger difference than 0.5 dB, you should perform **Calibration by Measurement**.

6. Press **<ENTER>** to exit **System Check**.

Note: *It is advised to perform the system check of the instrument each time before the measurements begin. If system check gives negative result, then it is necessary to perform calibration.*

3.3.2 Calibration by Sensitivity (Acoustic signal)

Calibration on the base of the microphone's published sensitivity information can be performed the following way:

1. Open the **Calibr. by Sensitivity** position in the **Calibration** list.

2. Set the **Sensitivity** of the microphone taken from its calibration certificate using the ◄ / ► key and then press **<ENTER>.** The calibration factor (**Cal. Factor**) is calculated every time after pressing the ◄ / ► key, in relation to the nominal value of 50.00 mV/Pa.
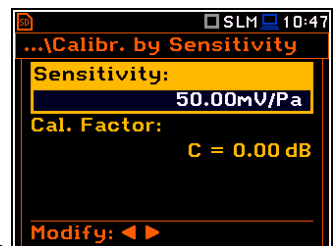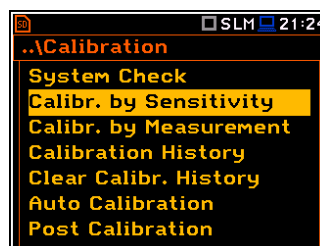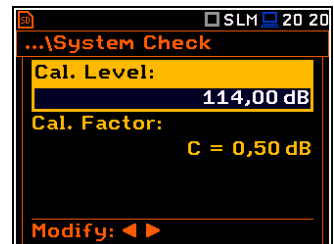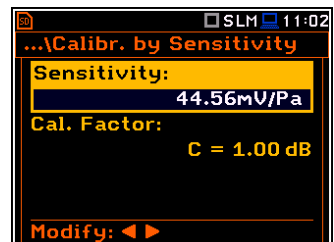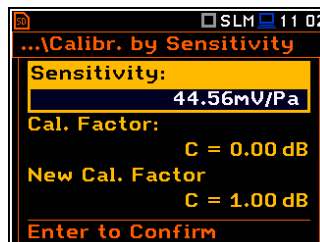
For microphones with sensitivity over 35.0 mV/Pa, the calibration factor will be negative. For microphones with sensitivity less than 35.0 mV/Pa, the calibration factor will be positive.

The lowest available value of the sensitivity that can be introduced is equal to 35.0 µV/Pa (it conforms to the calibration factor equal to 60.0 dB) and the highest value is equal to 35.0 V/Pa (calibration factor is equal to -60.0 dB).

To confirm the new calibration factor, press **<ENTER>**, or press **<ESC>** to return to the **Calibration** list without changes.

3.3.3   Calibration by Sensitivity (Vibration signal)

The calibration by using the accelerometer's published sensitivity information can be performed in the following way:

1. Open the **Calibr. by Sensitivity** position in the **Calibration** list.

2. Set the **Sensitivity** of the accelerometer taken from its calibration certificate using the ◄ / ► key.

The calibration factor (**Cal. Factor**) is calculated every time after pressing the ◄ / ► key, in relation to the nominal value of 10.0 mV/ms^{-2}.

For accelerometers with sensitivity less than 10.0 mV/ms^{-2}, the calibration factor will be positive. For accelerometers with sensitivity over 10.0 mV/ms^{-2}, the calibration factor will be negative.

The lowest applicable value of the accelerometer sensitivity is equal to **10.0µV/ms^{-2}** (**60.0dB** calibration factor) and the highest one is equal to **10.0V/ms^{-2}** (**-60.0dB** calibration factor).

3. To confirm the new calibration factor, press **<ENTER>**, or press **<ESC>** to return to the **Calibration** list without changes.

3.3.4   Calibration by Measurement (Acoustic signal)

Calibration by measurement of the acoustic signal can be done in the following way:

1. Open the **Calibr. by Measurement** position in the **Calibration** list.

2. Set the reference calibration level (**Cal. Level**).

3. Attach the acoustic calibrator SV 36 (or equivalent 114 dB@1000 Hz) carefully over the microphone of the instrument.
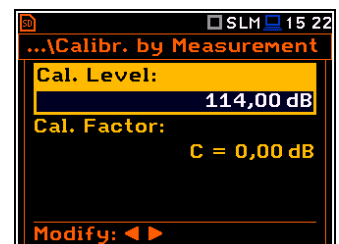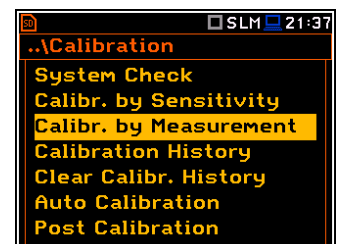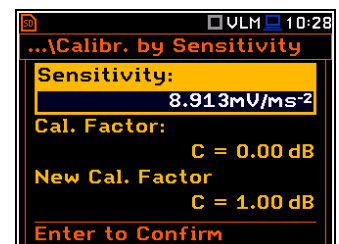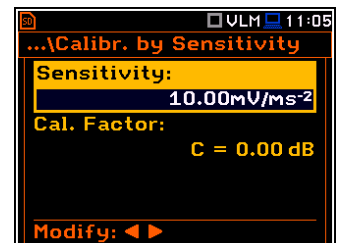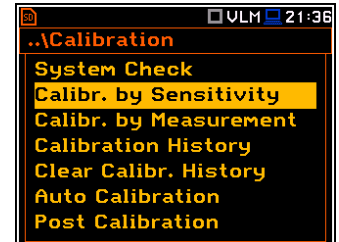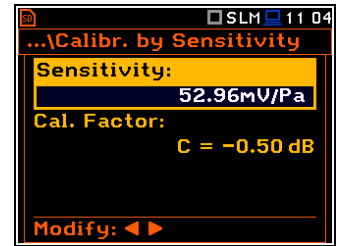
Note: *It is also possible to use an electro-mechanical pistonphone, which generates a signal (ca 124 dB) or different type of acoustic calibrator dedicated for ½" microphones. It is also necessary to switch the instrument* **Range** *to the* **High** *level.*

4. Switch on the calibrator (if the used calibrator doesn't have auto run function) and wait approximately 30 seconds for the tone to stabilise before starting the calibration measurement.

5. Start the calibration measurement by pressing the **<Start>** key.

The instrument performs series of 1-second consecutive measurements displaying levels of the measured calibration signal.

If maximal difference between three 1-second consecutive results (Leq(C)) is less than **0.05dB**, the calibration measurement will be stopped, and the calibration factor calculated. The measurement can be always stopped by the **<Stop>** key.

After calibration measurement stop, **Calibration Result** (measured reference signal without calibration factor correction) and **New Calibration Factor** (difference between the Calibration Level and the Calibration Result, calculated in dB) are displayed.

6. Press **<ENTER>** to save the new calibration factor (**Enter to Confirm**), or press **<ESC>** to reject it. In both cases the instrument exits the **Calibration by Measurement** screen.

It is recommended to repeat the calibration measurement few times. Obtained results should be almost the same (with ±0.1 dB difference). Reasons for unstable results are as follows:
- the calibrator is not properly attached to the instrument,
- there are external acoustic disturbances such as high noise levels close by,
- the calibrator or the measurement channel (the microphone, the preamplifier or the instrument itself) are damaged.

7. Detach the calibrator from the microphone.

Note: *During the calibration measurement, any external disturbances (acoustic noise or vibrations) should not exceed a value of 100 dB (when using a calibrator that generates a level of 114 dB).*

Note: *Maximum deviation of the calibration factor cannot exceed +/-1.5 dB.* **In other case please contact Svantek service.**

3.3.5 Calibration by Measurement (Vibration signal)

Calibration by measurement of the vibration signal can be done in the following way:

1. Open the **Calibr. by Measurement** position in the **Calibration** list.

2. Set the calibration level (**Cal. Level**) appropriate to the used calibrator. The default level for calibration in the vibration mode is 10 m/s² at 159.2 Hz. Remember to change this level if using an alternative vibration calibration signal source.

3. Attach the instrument's accelerometer to the vibration calibrator using an appropriate or recommended fixing method.

4. Switch on the calibrator and wait approximately 30 seconds before starting the calibration measurement.

5. Start the calibration measurement by pressing the **<Start>** key.
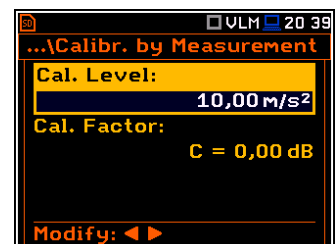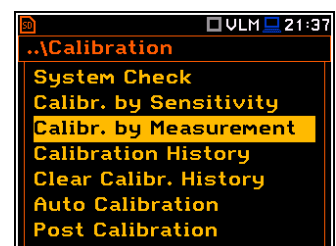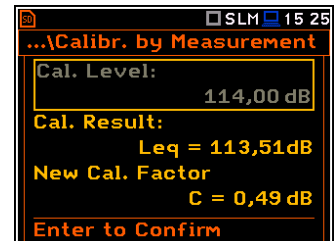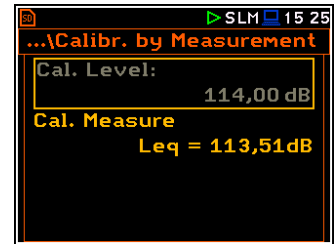
During the calibration measurement, the level of the measured calibration signal is displayed. If the maximal difference between three 1-second consecutive results (RMS(HP10)) is less than **0.05dB**, the calibration measurement will be stopped, and the calibration factor calculated. The measurement can be always stopped by the **<Stop>** key.

After calibration measurement stop, **Calibration Result** (the measured reference signal without calibration factor correction) and **New Calibration Factor** (difference between the Calibration Level and the Calibration Result, calculated in dB) are displayed.

6.   Press **<ENTER>** to save the new calibration factor (**Enter to Confirm**), or press **<ESC>** to reject it. In both cases the instrument exits the **Calibration by Measurement** screen.

It is recommended to repeat the calibration measurement few times. Obtained results should be almost the same (with ±0.1 dB difference). Reasons for unstable results are as follows:

- the accelerometer is not properly attached to the calibrator,
- there are external disturbances,
- the calibrator or the measurement channel (the accelerometer or the instrument itself) are damaged.

7.   Detach the accelerometer from the calibrator.

Note: *During the calibration measurement, the external disturbances (vibrations or acoustic noise) should not exceed a value of 1/10 of the calibration signal level.*

3.3.6   History of performed calibrations – Calibration History

The **Calibration History** screen displays records of performed calibrations.
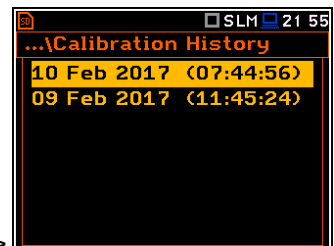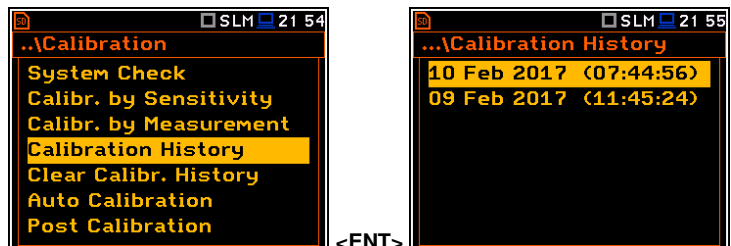
To review the calibration records, select the required line in the **Calibration History** screen and press **<ENTER>**.

The calibration record screen contains the information regarding the performed calibration: date and time of calibration, used calibration method, obtained calibration factor etc.
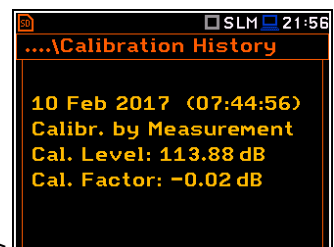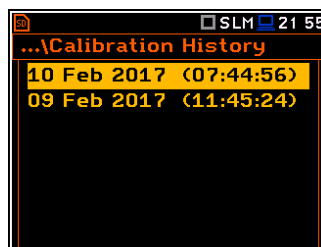
3.3.7   Erasing calibration records – Clear Calibr. History

You can erase all calibration records. To do this, choose the **Clear Calibr. History** position in the **Calibration** list and press **<ENTER>** to perform this operation.

The instrument will request the confirmation of this operation.

After erasing calibration records, the **Calibration History** screen will not contain any previous calibration records. The content of this screen is also cleared after the **Factory Settings** operation (*path: <Menu> / Auxiliary Setup*).
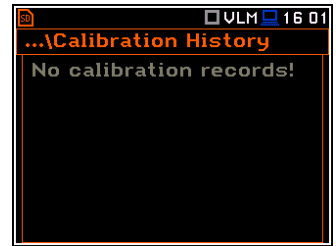
> **Note:** *Acoustic and vibration calibration histories are independent files in the internal instrument's memory and erasing the calibration history in one mode does not erase it in another mode.*

3.3.8   Automatic calibration – Auto Calibration

Automatic calibration feature enables calibration of the instrument input as easy as possible with minimum steps.

If the automatic calibration is switched on, the instrument, when it doesn't perform the measurement, periodically compares the measured signal level with the reference calibration level and starts the calibration measurement if the stable result is within ±5dB of the calibration level.

To perform the automatic microphone calibration, follow next steps:

1.   Switch on the instrument.
2.   Attach the SV 36 calibrator (or equivalent 114 dB@1000 Hz) to the microphone and switch it on (if the used calibrator doesn't have automatic switch-on feature).

Generated by the calibrator sound pressure level starts the Automatic Calibration process if the difference between the **Calibration Level** value set up in the **Calibration By Measurement** screen and the measured calibrator SPL level is in the range **±5dB**.

During the calibration measurement, the level of the measured calibration signal will be displayed. If the maximal difference between three consecutive 1-second Leq results is less than **0.05dB**, the calibration measurement will be finished. The measurement can be always stopped by the **<Stop>** key.

After calibration measurement stop, the **Calibration Result** (the measured reference signal without calibration factor correction) and the **New Calibration Factor** (difference between the Calibration Level and the Calibration Result, calculated in dB) are displayed.

3.   Press **<ENTER>** to save the new calibration factor (**Enter to Confirm**), press **<ESC>** to reject it. In both cases the instrument exits the **Calibration by Measurement** screen.
4.   Detach the calibrator from the microphone.
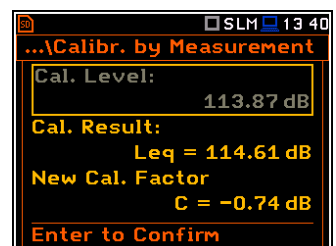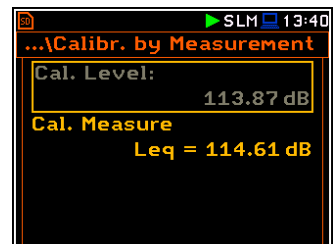
3.3.9   Post measurement calibration – Post Calibration

Some regulations require post-measurement calibration information to be added to measurement files created before such calibration. The last calibration factor is for informational purposes only, as it was not considered during the measurement.
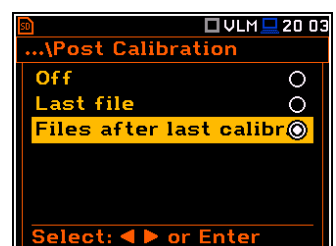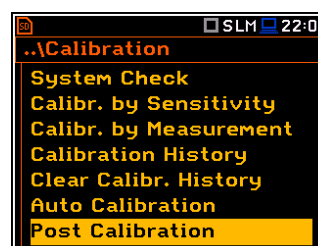
The **Post Calibration** screen allows three options: not to save (**Off**), save in the last created file (**Last file**) or save in the files which were created after the previous calibration (**Files after last calibr**).

4   CONFIGURING MEASUREMENT PARAMETERS – Measurement

The **Measurement** section groups items of the menu related to configuration of measurement parameters.

<ENT>
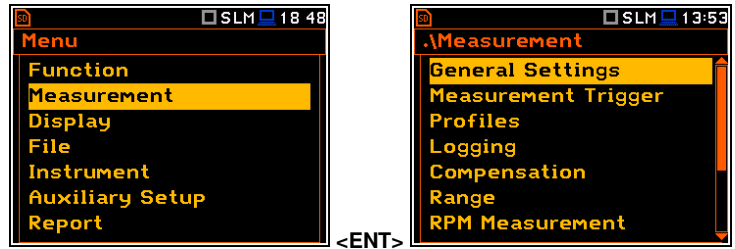
The **Measurement** list contains the following positions:

General Settings	allowing you to set general measurement parameters,
Measurement Trigger	allowing you to set the measurement trigger,
Profiles	allowing you to program the profile parameters,
Logging	allowing you to program the logging function,
Spectrum	allowing you to set the spectrum parameters; this position appears for the 1/1 or 1/3 octave functions,
FFT	allowing you to set the FFT parameters; this position appears for the FFT function,
RT60	allowing you to set the RT60 parameters; this position appears for the RT60 function,
Tonality	allowing you to set up the Tonality parameters; this position appears for the Tonality function,
STIPA Settings	allowing you to set the STIPA parameters; this position appears for the STIPA function,
Ambient noise	allowing you to set the ambient noise levels; this position appears for the STIPA function,
Compensation	allowing you to switch on the required compensation filter,
Range	allowing you to select the correct measurement range,
RPM Measurement	allowing you to set the RPM measurements parameters,
Exposure Time	allowing you to set the daily exposure time for dose measurements,
Statistical Levels	allowing you to define 10 statistical levels,
Timer	allowing you to programme the delayed start timer,
Alarms	allowing you to check the status of the advanced alarm function; this position appears if the ALARM.SVA file is uploaded to the predefined SYSTEM catalogue.

The content of the **Measurement** list depends on settings of **Mode** and **Measurement Function**. Examples for two different modes and measurement functions are attached.
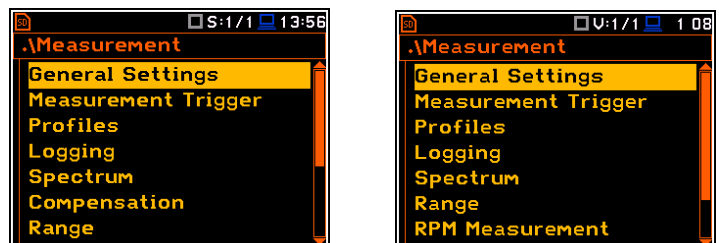
Any parameter in the **Measurement** list can be changed only when the instrument is not currently executing a measurement. The parameters are displayed with grey colour. The blinking „measurement" icon indicates that the instrument is performing a measurement.
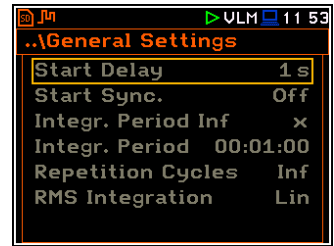
4.1   SETTING GENERAL MEASUREMENT PARAMETERS – GENERAL SETTINGS

The **General Settings** screen allows you to configure general measurement parameters: delay of the measurement start (**Start Delay**), synchronisation with the instrument's RTC (**Start Sync.**), integration period/measurement run time (**Integration Period**), repetition of measurement cycles (**Repetition Cycles**), RMS detector type (**RMS Integration**), day time hours (**Day Time Limits**) and time window for the **LRm** results (**Rolling Time**).
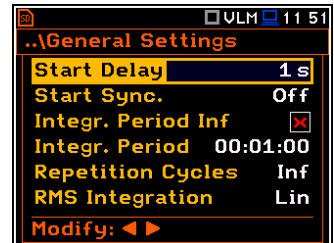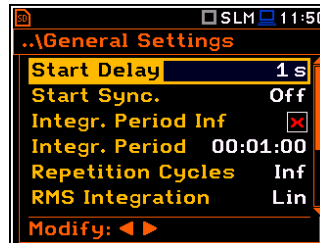
Delay of measurement start

The **Start Delay** parameter defines the delay period from the **<Start>** keystroke to the real start of the measurement (digital filters of the instrument constantly analyses the input signal even when the measurement is stopped). This delay period can be set from **0 second** to **60 seconds**. Default value:**1s**.
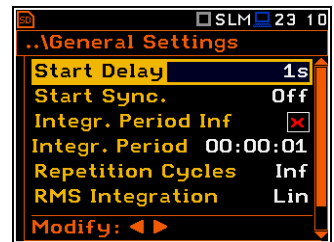
Synchronisation of measurement cycles

The **Start Sync.** parameter defines synchronisation points with the instrument's RTC and can be set as: **Off**, **1m**, **15m**, **30m** and **1h**. For example, if **1h** is selected, the measurement will start from the beginning of the first second of next hour after the **<Start>** keystroke, and then will be repeated also from the first second of the following hour after elapsing the integration period if the number of cycles is greater than one. Default value: **Off**.
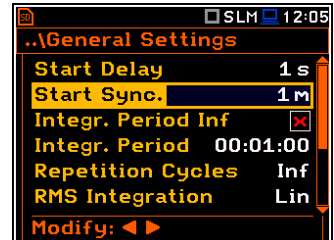
Infinite integration period

The **Integr. Period Inf** parameter activates the infinite integration period. In this case the additional **Split Cycles** parameter appears which define the maximum number of splits of the data registration in separate files – see Chapter 4.4.1.

If the **Split** parameter (*path: <Menu> / Measurement / Logging / Logger Setup*) if **Off**, the signal will be averaged all the time until the **<Stop>** keystroke.

If the **Split** parameter <u>not</u> **Off**, the signal will be averaged from the measurement start till the split. After the split new measurement will start with averaging until the next split. Such measurements will be performed as many times as is set by the **Split Cycles** parameter.
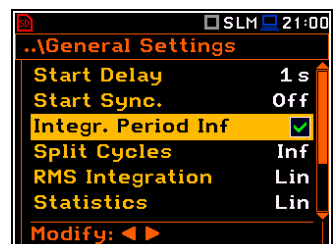
If the **Integr. Period Inf** parameter is disabled, then two positions (**Integration Period** and **Repetition Cycles**) become active.

Integration period

The **Integr. Period** parameter defines a period during which the signal is being measured (and for some results averaged/integrated) and a step with which measured results are logged in the logger file as **Summary Results** (see description of the **Logger Setup**). The integration period can be set in the special screen, which is opened with the ◄ / ► key.
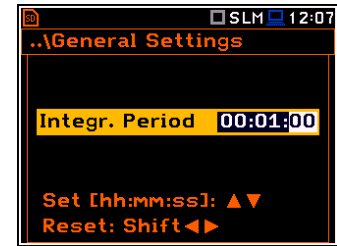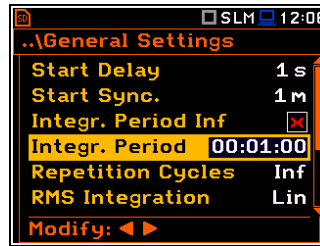
During the Integration period, the instrument performs series of 1-second measurements/integrations, and every second averages 1-second results with the results averaged for n-1 seconds. Averaged results are displayed and renewed every second for the elapsed measurement time (n seconds). In the end of the Integration period averaged measurement results are saved in the logger file providing that such saving is enabled.

The measurement will stop automatically after this period and start again if the number of **Repetition Cycles** is greater than one.

The definitions of the measurement results in which the integration period is used are given in Appendix D.

To set the integration period you should define the required hours, minutes and seconds fields.

- The appropriate field may be selected with the ◄ / ► key.

- Value of hour, minute and second is changing with the ▲ / ▼ key.
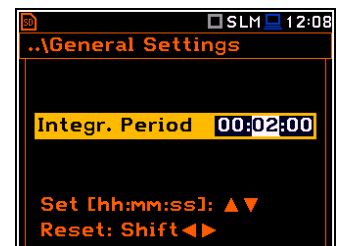
Number of measurement cycles

The **Repetition Cycles** parameter defines the number of measurements (with the measurement period defined by the **Integration Period**) to be performed by the instrument after the **<Start>** keystroke. The **Repetition Cycles** number values are within the limits [Inf, 1÷1000].

This enables you to make a series of measurements without pressing the **<Start>** key and save this series in the file.
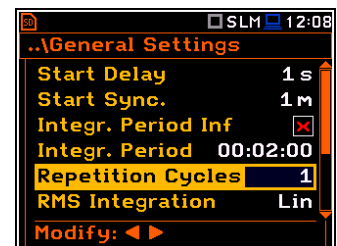
For example, if **Integration Period** is equal to 8 hours and **Repetition Cycles** is equal to 2, the instrument performs first integration for the 8-hour period from the measurement start and second integration for the 8-hours period from the end of the first integration. At the end of each cycle the 8-hours LEQ and other results will be saved in the file.

Note: In case of the infinite integration period or infinite repetition cycles the measurement must be stopped manually.

Detector type

The **RMS Integration** parameter defines the detector type for the integration of the RMS based results. Two options are available: linear (**Lin**) and exponential (**Exp**). Default value: **Lin**.

For sound measurements, **Leq**, **SEL**, **LEPd**, **Lden** and **Ln** results can be calculated with both detectors, and **Lmax**, **Lmin**, **Spl**, **Ltm3**, **LTeq** results – only with the exponential detector.

For vibration measurements, **RMS** result can be calculated with both detectors, and **Max** results – only with the exponential detector.

Results definitions are given in Appendix D.
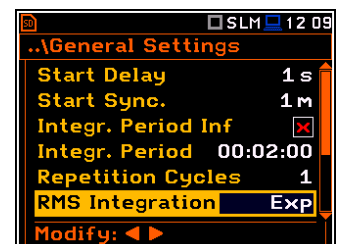
Selecting **Lin** is required for obtaining the true RMS value of the measured signal (according to IEC 61672-1:2013 for sound measurements). When this option is selected the RMS based results do not depend on the detector time constant, defined in the **Profiles** screen (*path: <Menu> / Measurement / Profiles*). In this case, the indicator **Linear** (or **L**) is displayed during the result presentation.

Selecting **Exp** enables fulfilling the requirements of other standards for time averaging of **Leq**. When this option is selected, the RMS based results depend on the detector time constant, defined in the **Profiles** screen (*path: <Menu> / Measurement / Profiles*): **Slow**, **Fast**, **Impulse** for sound measurements and **100ms**, **125ms**, **200ms**, **500ms**, **1.0s**, **2.0s**, **5.0s**, **10.0s** for vibration measurements. Results are displayed with the indicator of the detector type selected for the profiles.

Detector for statistics

The **Statistics** parameter defines the method for calculation of statistical results **Ln**. Statistics for profiles will be calculated based on RMS results with linear detector (**Lin**) or exponential detector (**Exp**), e.g. **Impulse**, **Fast** or **Slow**, defined in the **Profiles** list, regardless of how main results are measured. Default value: **Lin**.
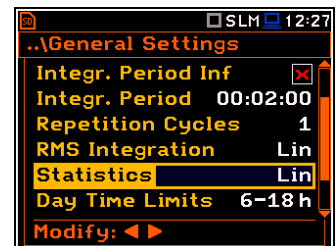
Day time limits

The **Day Time Limits** parameter defines the day and night-time limits required by the local standards. These limits are used for the calculation of the **Lden** function (see Appendix D for definition). Two options are available: **6h-18h** and **7h-19h**. Default value: **6h-18h**.
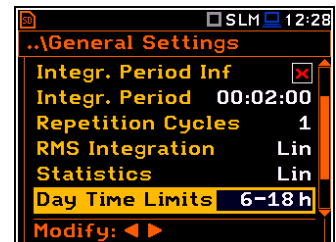
Rolling Leq

The **Rolling Time(x)** parameter defines „time window" for the "Rolling RMS" calculation. The Rolling Leq are presented as LR+<time window>. For example, if the **Rolling Time** is equal to 30 minutes, the appropriate result will be named as **LR30** and will be calculated each second as Leq of last 30 minutes. If the **Rolling Time** is in seconds, for example is equal to 50s, the result name will have letter "s" (**LR50s**), to make it different from 50 minutes LR result (**LR50**). Default values: **30 m** and **1 h**.
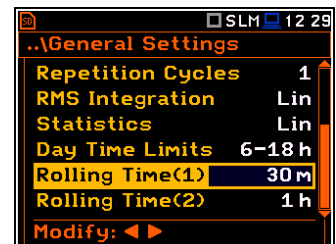
> ⚠ **Note:** *In case of vibration measurements, positions* **Statistics**, **Day Time Limits** *and* **Rolling Time(x)** *are not presented in the* **General Settings** *list.*

You can easily access the **General Settings** screen during the measurement performance from the result view. It is necessary to enter some result field (for example, **RMS**) with the ▲ / ▼ or ◄ / ► key and press **<ENTER>**.
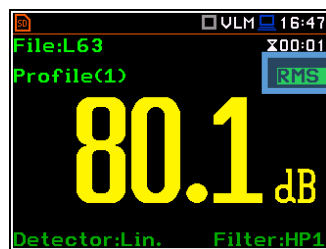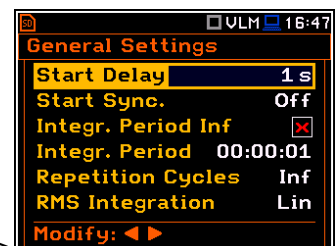
4.2 SETTING THE MEASUREMENT TRIGGER – MEASUREMENT TRIGGER

The **Measurement Trigger** list allows you to set parameters of the measurement trigger, that switches the measurement process in case the trigger condition is met.

The **Measurement Trigger** can be switched **Off** or On by selecting its type in the **Trigger** position. Default value: **Off**.
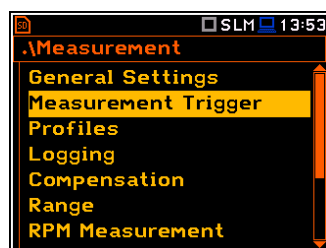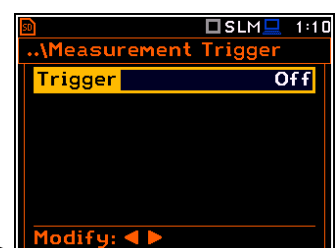
The triggering is switched on if any trigger type is chosen in the **Trigger** position: **Slope +**, **Slope –**, **Level +**, **Level –**, **Grad +** or **External**. When the trigger is selected, additional parameters can be defined: the measurement result that is checked for a trigger condition (**Source**), its threshold value (**Level**) and the rate of its changing (**Gradient**).

Slope trigger

The **Slope +** / **Slope -** trigger starts the measurement/integration with the duration of the **Integration Period** on condition: rising value of the measured result (**Source**) integrated during 0.5 ms passes above/below the threshold value (**Level**).
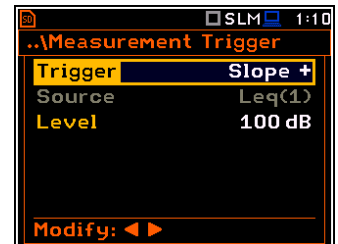
When a new measurement cycle begins (after pressing the **<Start>** key or automatically after previous measurement cycle stop) the instrument checks a trigger condition every 0.5 ms and if condition is met the instrument starts a <u>continuous series</u> of 1-second integrations, the number of which is equal to the number of seconds in the **Integration Period**.

After ending the **Integration Period**, the new measurement cycle can start with above logic.

The measurement can be stopped manually at any moment with the **<Stop>** key.
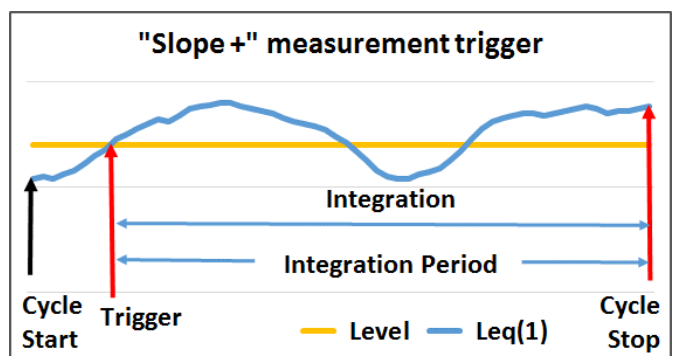
Note: When a measurement is waiting for the slope trigger, the "slope" icon appears alternatively with the „measurement" icon.

Level trigger

The **Level +** / **Level -** trigger starts the 1-second measurement/integration on condition: value of the measured result (**Source**) averaged by 0.5 ms is greater/lower than the threshold value (**Level**). In other cases, the instrument continues checking the trigger condition every 0.5 ms.

When a new measurement cycle begins (after pressing **<Start>** key or automatically after previous measurement cycle stop) the instrument checks the trigger condition every 0.5 ms and starts 1-second integration if condition is met.

After 1-second integration, the instrument repeats the trigger condition checking every 0.5 ms and starts next 1-second integration if condition is met. Instrument does it as many times as many seconds are within the Integration Period and stops the measurement cycle. Therefore, the series of 1-second measurements <u>may not be continuous,</u> and the duration of the measurement cycle may be longer than the Integration Period.
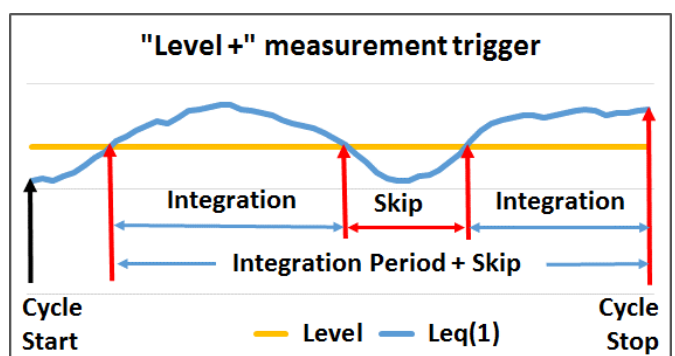
The measurement can be stopped manually at any moment with the **<Stop>** key. Summary Results are calculated on the base of series of 1-second results measured during each measurement cycle and saved in a logger file.

Note: *When a measurement is waiting for the level trigger the "level" icon appears alternatively with the „measurement" icon.*   or

Gradient trigger

The **Grad +** trigger starts the 1-second measurement/integration on condition: value of the measured result (**Source**) averaged by 0.5 ms is greater than the threshold value (**Level**) and the gradient of this Source is greater than the gradient threshold value (**Gradient**). In other cases, the instrument continues checking the trigger condition every 0.5 ms.
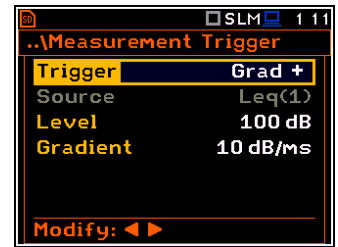
This trigger has the same logic as the **Level +** trigger, but the trigger condition requires also the gradient threshold level to be exceeded.

External trigger

When **External** is selected, the measurement is triggering by the external signal on the **I/O** socket. In this case, it is necessary to set up the **I/O Mode** parameter as **Digital In** (*path: <Menu> / Instrument / Multifunction I/O*).

After the measurement/integration start from the external trigger, the measurement/integration will continue for the **Integration Period**.
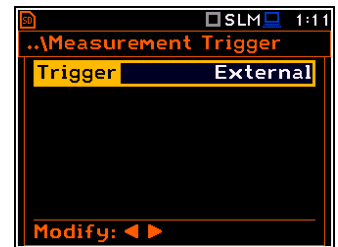
Note: *When a measurement is waiting for the gradient or external trigger the "trigger" icon appears alternatively with the „measurement" icon.*

Source result

Only one measured result (**Source**) can be used for checking trigger condition in the **Level Meter** mode, namely the instantaneous RMS from the first profile (with appropriate filter and detector), which is denoted here as **Leq(1)** in the sound mode and **RMS(1)** in the vibration mode. This position cannot be changed.

Threshold level

The threshold level for the measurement trigger (**Level**) can be set with 1 dB step in the range from 24 dB to 136 dB in sound modes and from 64dB (1.585mm/s^2) to 176dB (631 m/s^2) in vibration modes.
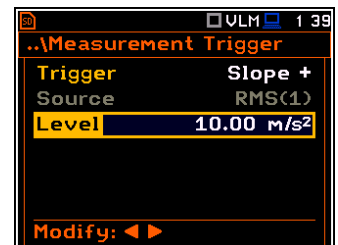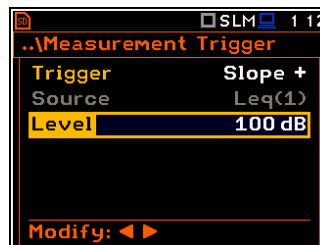
Rate of Source value changing

This position appears when the **Grad+** trigger is chosen. The rate of the Source value changing (**Gradient**) can be set in the range from 1 dB/ms to 100 dB/ms.
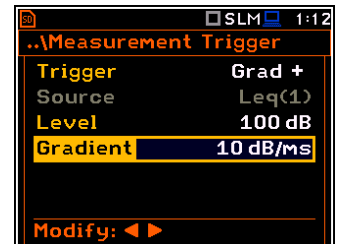
4.3 SETTING PARAMETERS FOR PROFILES – PROFILES

The **Profiles** screen enables programming of three virtual level meters (**Profiles**), which measure the set of results with the same weighting filter (**Filter**) and exponential detector time constant (**Detector**) (see Appendix D). Default values – see Chapter 2.8.

<ENT>
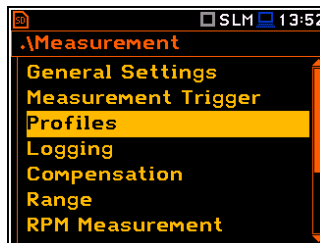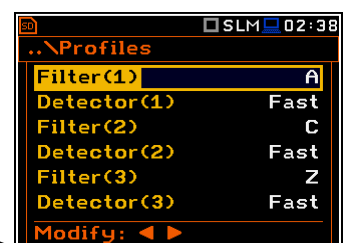
Weighting filter

Sound measurements:

- **Z**   according to IEC 61672-1:2013 for Class 1,
- **A**   according to IEC 651 and IEC 61672-1:2013 for Class 1,
- **C**   according to IEC 651 and IEC 61672-1:2013 for Class 1,
- **B**   according to IEC 651 for Class 1,
- **U**   according to IEC 61012:1990 for Class 1,
- **AU**   according to IEC 61012:1990 for Class 1,
- **D**   according to BS 5721:1979,
- **HP**   high-pass filter,
- **LF**   low frequency (20-200 Hz) real-time band pass filter.

Vibration measurements:

- acceleration measurements: **HP**, **HP1**, **HP3**, **HP10**, **Wh**,
- velocity measurements: **Vel1**, **Vel3**, **Vel10** and **VelMF**,
- displacement measurements: **Dil1**, **Dil3** and **Dil10**.

Characteristics of these filters are given in Appendix C.

RMS detector

The **Detector** position defines the type of the exponential RMS detector which is applied to RMS based results (**Leq**, **SEL**, **LEPd**, **Lden**, **Ln** results for sound measurements and **RMS** results for vibration measurements) provided that the RMS detector in **General Settings** was set to exponential (*path: <Menu> / Measurement / General Settings / RMS Integration: Exp*) and always applied to **Lmax**, **Lmin**, **Spl**, **Ltm3**, **LTeq** results for sound measurements and **Max** results for vibration measurements.

Available exponential RMS detector types (time constants): **Impulse**, **Fast** and **Slow** for sound measurements and **100ms**, **125ms**, **200ms**, **500ms**, **1.0s**, **2.0s**, **5.0s**, **10.0s** for vibration measurements.

You can easily access the **Profiles** screen from the result view screen. Select some profile field (for example, **P(1)**) with the ▲ / ▼ or ◄ / ► key and press **<ENTER>**.
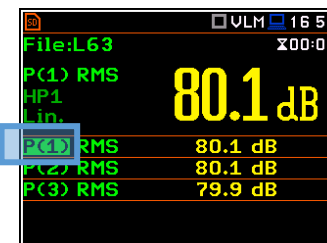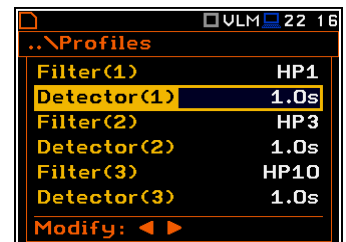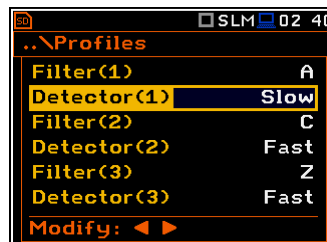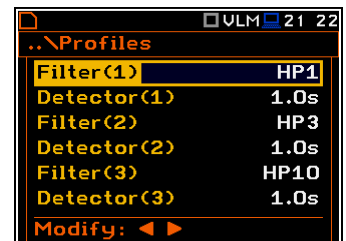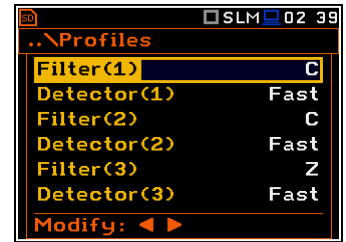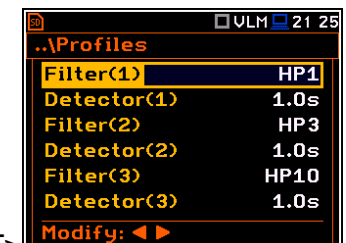
4.4   CONFIGURING DATA LOGGING – LOGGING

Summary Results (**Peak**, **Max**, **Min**, **Spl**, **Leq**, **SEL**, **Lden**, **LEPd**, **Ltm3**, **LTeq**, 10 x **Ln**, **EX**, **SD**, **LR1**, **LR2**, **OVL**, **NC**, **NR** for Sound measurements or **RMS**, **Ovl**, **Peak**, **P–P** for Vibration measurements as well as 1/1 octave, 1/3 octave or FFT spectra with Total results and meteo results) are measured and saved in the file with the step defined by the **Integration Period** parameter as many times as defined by the **Repetition Cycles** parameter (*path: <Menu> / Measurement / General Settings*).

The instrument enables also additional registration of some results with different step defined by the **Logger Step** parameter (*path: <Menu> / Measurement / Logging / Logger Setup*). Therefore, it is possible to save in parallel two sequences of measured results – one for **Summary Results** and another for so called **Logger Results**.

When logging is enabled, selected logger results from three independent profiles (**Peak**, **Max**, **Min**, **Leq**, **LXY**, **LR1** and **LR2** for Sound measurements or **Peak**, **P-P**, **Max** and **RMS** for Vibration measurements as well as 1/1 octave or 1/3 octave spectra with Total results and meteo results) can be saved simultaneously with time step down to **2ms**. Recording of logger results to a file is stopped after the period, which is equal to **Integration Period** multiplied by **Repetition Cycles** or after stopping a measurement manually.

Note: LXY is an abbreviation for the L (or Spl) result measured with X filter and Y detector time constant – see Appendix D.

Summary Results are saved in the same file with Logger Results. Blocks of summary results are recorded in the file in the end of every measurement cycle.

The figure below illustrates principles of logging measurement results.
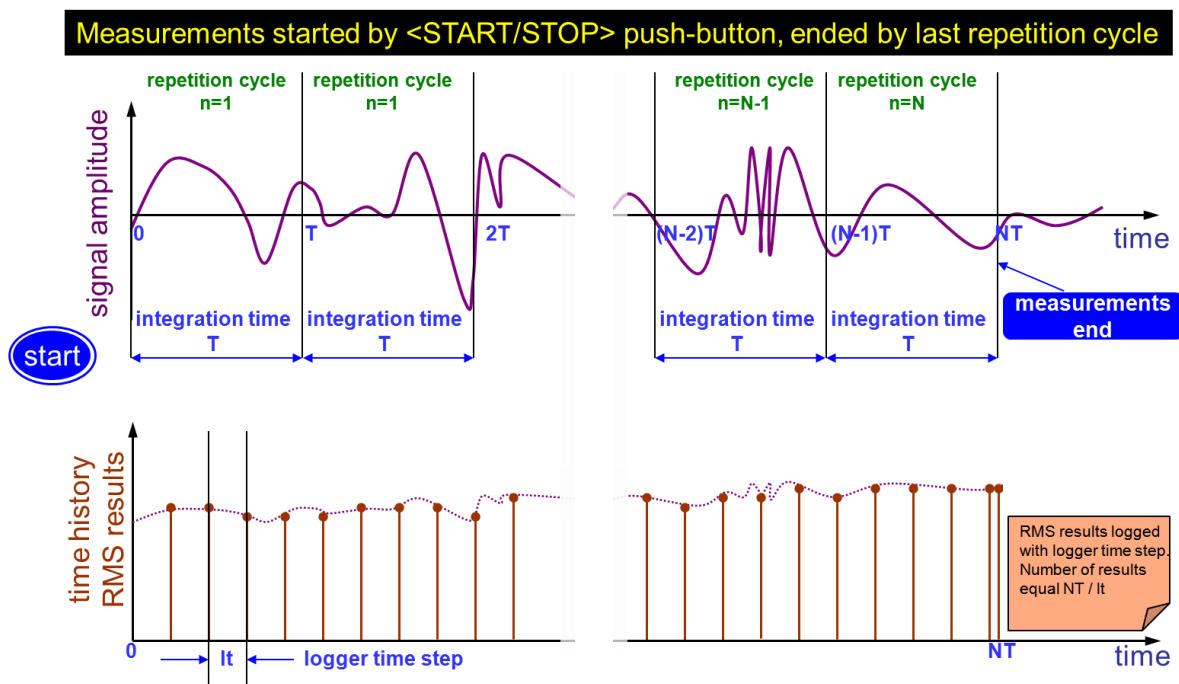
Summary Results and Logger Results logging

The **Logging** list enables programming of the logging functions: recording of summary and logger results (measurement history) in a logger file and recording of audio signal in a wave file.
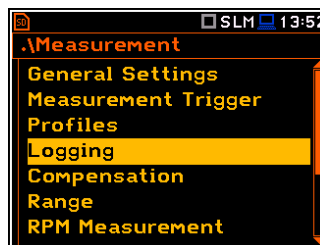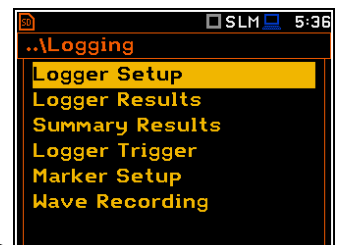
4.4.1 Setting logger general parameters – Logger Setup

The **Logger Setup** list enables activating the logger function and programming logging general parameters.

If **Logger** is disabled only **Summary Results** and **Wave Recording** positions are accessible in the **Logging** list.

<ENT>
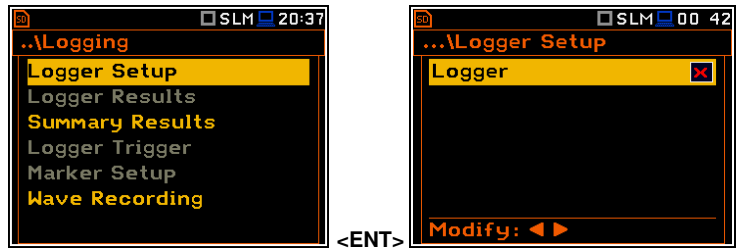
Note: If **Logger** is disabled, result files will not be created automatically, and only general results from the last measurement cycle can be saved manually!

The **Logger** position switches on saving logger results, markers, spectra as well as results, obtained from the weather station (**Meteo**), with the interval defined by the **Logger Step** parameter as well as Summary results with the interval defined by the **Integration Period** parameter. Default mode: enabled.

Summary Results saving

The **Summary Results** position enables saving of summary results for each measurement cycle including results obtained from the weather station (**Meteo** results), statistics and spectra. Default value: enabled.

Logger step

Logger Step defines a period of the logger results measuring and logging in a file. It can be selected from the set: **2 ms**, **5 ms**, **10 ms**, **20 ms**, **50 ms**, **100 ms**, **200 ms**, **500 ms** or from **1 s** to **59 s** with 1-second step or from **1 m** to **59 m** with 1-minute step and up to **1 h**. Default value: **1 s**.
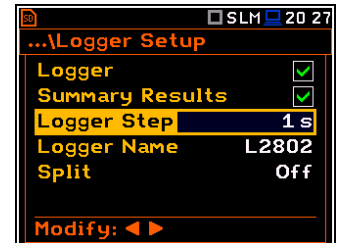
Logger file name

The **Logger Name** position allows you to define the name of the logger file, which consists of a prefix and a number. The default logger file prefix is "**L**". The name can be of up to eight characters long. After pressing the ◄ / ► key, the text editor screen is opened.

The edited name is accepted and saved after pressing the **<ENTER>** key. The special warning is displayed in case a file with the edited name already exists in the memory. The instrument waits then for your reaction (any key should be pressed except **<Shift>** or **<Alt>**).

<ENT>
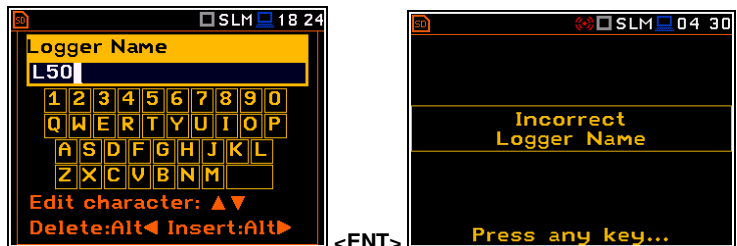
Splitting logger files

The **Split** position enables splitting the data logging into separate files. If the **Split** parameter is **Off** the data will be logged in one logger file with the name defined in the **Logger Name** position. Default value: **Off**.

In other cases, registration will be carried out in separate files and the registration in the new file will start after expiration of integration period (**Integr. Period**), or at every quarter of the RTC (**Sync. to 15m**), or at every half an hour of the RTC (**Sync. to 30m**), or at every hour of the RTC (**Sync. to 1h**), or at the specified by the user times (**Spec. Time**).
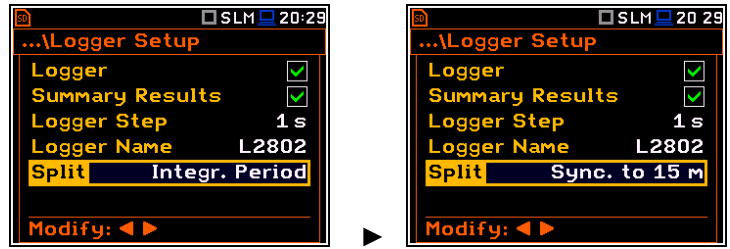
Whenever the split time is achieved the logger file is closed and the new file with the increased by one number is opened for subsequent measurement data.

If **Spec. Time** is selected, six additional positions appear in the end of the **Logger Setup** list (**Split Time X**).
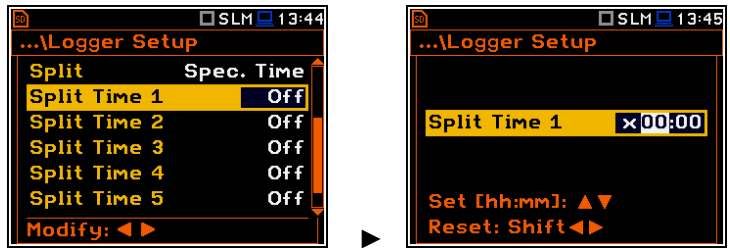
After opening each line, you can define the time of the day when splitting should occur.

The special screen with time editor is opened after pressing the ► key.

In the time edition line, you may define hour and minute of the split operation and switch on (☑) or off (☒) the current split.
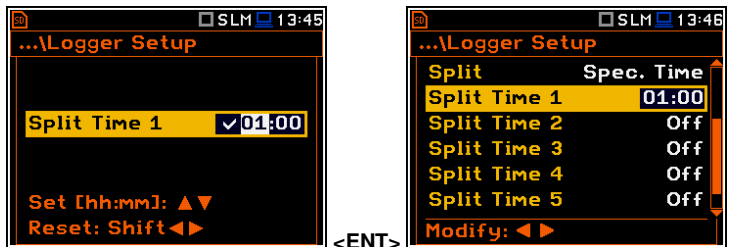
After pressing **<ENTER>** the **Split Time X** list will show the active times of the day when the logger will be split.

4.4.2   Selecting results for logging – Logger Results

In the **Logger Results** list, you can select results for three independent profiles (**Peak**, **Max**, **Min**, **Leq**, **LXY**, **LR1** and **LR2** for Sound measurements and **Peak**, **P-P**, **Max** and **RMS** for Vibration measurements) and results taken from the weather station (**Meteo**), which will be logged in a logger file with the **Logger Step**.
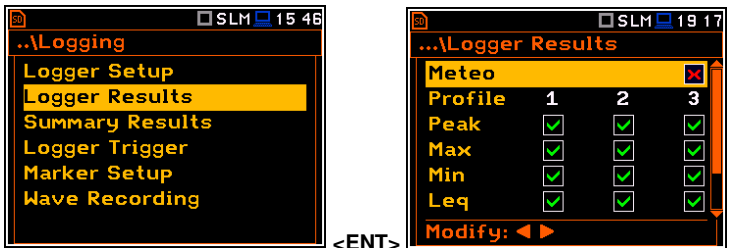
Activation / deactivation can be done with the ◄ / ► key pressed together with **<Alt>**.

> **Note:** For logger steps smaller than 1s, the running Leq results (**LR1** and **LR2**) are not saved to the logger file.

> **Note:** When **Logger** is disabled or no Logger results were selected, the logger plot cannot be activated in **Display Modes** and therefore doesn't appear on the display.

When **Logger** is enabled and results for logging selected, the logger plot will be available in measurement views.
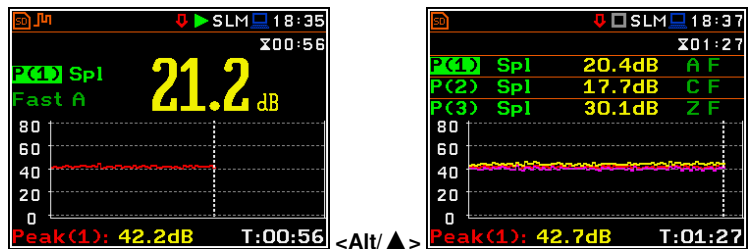
4.4.3   Selecting additional summary results for saving – Summary Results

The **Summary Results** list allows you to include/exclude logging of some summary results, like: **Statistics**, **Meteo**, **Statistics Spectrum**, **Max Spectrum** and **Min Spectrum** for Sound measurements and **Meteo**, **Max Spectrum** and **Min Spectrum** for Vibration measurements. Default modes: all enabled.

<ENT>
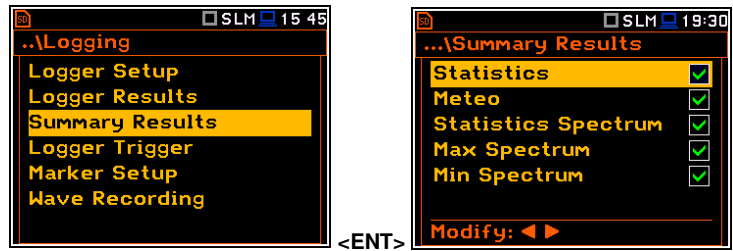
> **Note: Meteo** results are transmitted to the instrument from the weather station connected to the SV 277 monitoring station.

4.4.4   Configuring the Logger trigger – Logger Trigger

In the **Logger Trigger** list, you can configure the way the logger results will be registered in the logger file. It is a context list in which: the trigger can be disabled (**Off**) or enabled by selecting its type (**Level+** or **Level-**) in the **Trigger** position. Default value: **Off**.

<ENT>
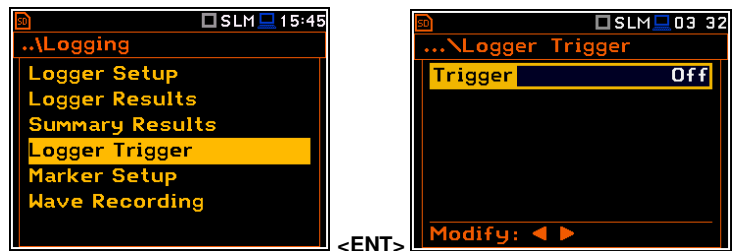
When the trigger is enabled, other parameters appear in the list: measured result that is checked for a trigger condition (**Source**), threshold level (**Level**) as well as number of results saved in the file before the first fulfilment of the trigger condition (**Pre**) and after the last fulfilment of the trigger condition (**Post**) during the measurement period

Level trigger

The **Level +** / **Level -** trigger enables logging of the Logger results with the **Logger Step** on condition: value of the measured result (**Source**) averaged over the **Logger Step** period is greater/lower than the threshold value (**Level**). In other cases, the logging is skipped.

Due to this type of trigger it is possible to separate results related to the low/high noise level.

The logging is active only when the summary results are measured, i.e., from the measurement start till the measurement stop.

This means, for example, that when the measurement is waiting for a trigger condition, logging is skipped, even if the logger trigger condition is met.
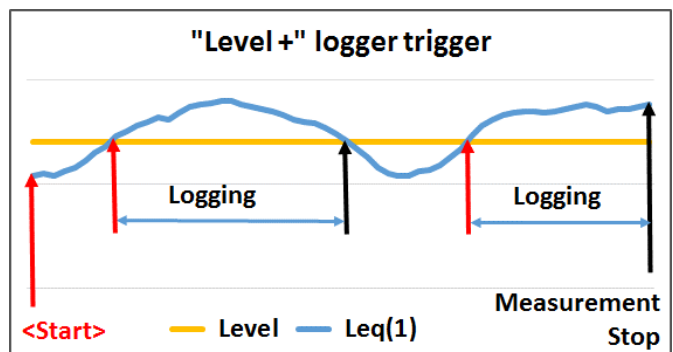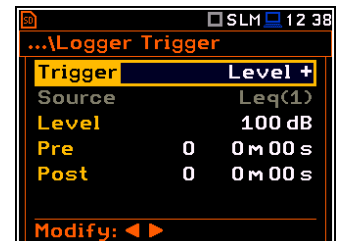
> **Note:** When logging is waiting for the level trigger the "level" icon appears alternatively with the „curve" icon.

Source result

Only one measured result (**Source**) can be used for checking trigger condition in the **Level Meter** mode, namely the instantaneous RMS from the first profile (with appropriate filter and detector), which is denoted here as **Leq(1)** in the sound mode and **RMS(1)** in the vibration mode. This position cannot be changed.

Threshold level

The threshold value (**Level**) can be set with 1 dB steps in the range from 24 dB to 136 dB in sound mode and from 1 mm/s^2 (60 dB) to 10 km/s^2 (200 dB) in vibration mode.
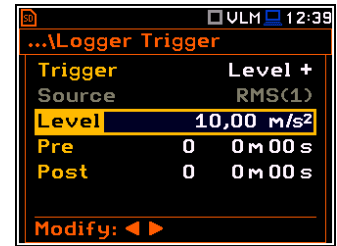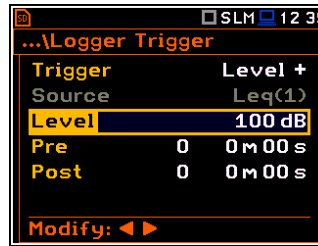
Pre and post trigger logging

In the **Pre Trigger** position, you can define the number of logger results which will be registered in the file before fulfilment of the first trigger condition. This number can be set in the range 0..50.

In the **Post Trigger** position, you can define the number of logger results which will be registered in the file after fulfilment of the last trigger condition. This number can be set in the range 0..200.

Periods of logging the logger results before and after fulfilment of the trigger condition can be calculated by multiplying the value set up in the **Pre** or **Post** positions by the value set up in the **Logger Step** position (*path: <Menu> / Measurement / Logging / Logger Setup*). The result of this calculation is presented in the same line for the **Pre** and **Post** parameters in the format **0m00s**.
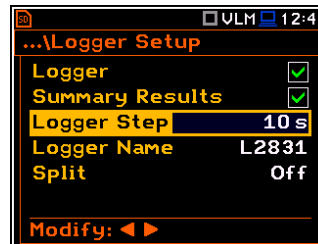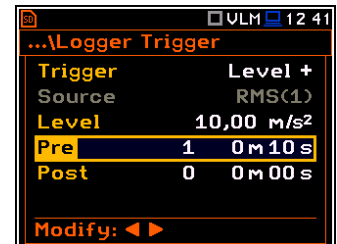
These parameters can perform double role. Firstly, when you wish to collect data right after or before the event that caused logger trigger. Secondly, when it is necessary to have continuous logging, but the source is oscillating near the threshold level. The extension of the registration window allows you to avoid the effect of pulsation.

4.4.5   Setting markers – Marker Setup

Marker is used to mark (or highlight) special events during the measurement such as "airplane flight" and is nothing but an indication of the beginning and end of the block of logger results in which the event occurred. In case of point markers, there is no start and end of the marker, but only one record in the logger file. Markers are activated in the result presentation views by pressing the arrow keys.

The **Marker Setup** screen allows you to assign a specific name for each marker, select its type (normal or **Point**) and define markers for triggering wave recording (**Trig** column).

<ENT>
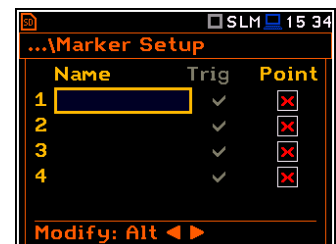
Name edition is performed in the text editor screen after pressing the ► key together with **<Alt>**.

<Alt>+►

The **Trig** column becomes active only when **Trigger on Marker** (*path: <Menu> / Measurement / Logging / Wave Recording*) is enabled.

Switching on **Trig** for some markers means, that wave recording will be triggered by activating one of these markers.

=>
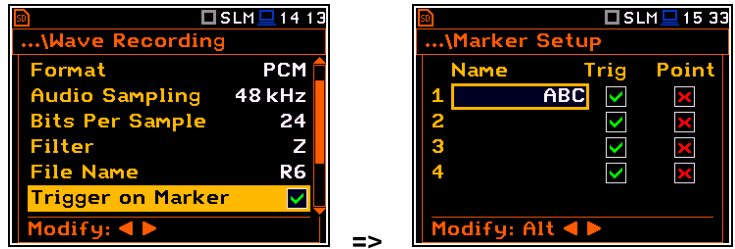
4.4.6 Configuring signal recording – Wave Recording

The **Wave Recording** position enables activating and configuring a waveform signal recording in the separate file with the extension **WAV**. WAV files are saved automatically in the working directory of the instrument's memory (SD-card).

The **Wave Rec.** parameter, if it is not **Off**, defines a way a recording should be done, continuously during the measurement (**Continuous**) or triggered conditionally (**On Trigger**). Default value: **Off**.

<ENT>
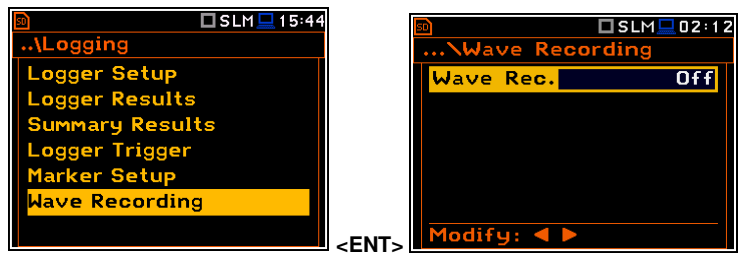
Note: The **Wave Recording** function is optional and should be unlocked by entering the activation code in the text editor screen, opened by the ► key. Once unlocked this option will be ready to use permanently.

The **Format** parameter defines the format of the wave file header: **PCM** or **Extensible**.

The **Audio Sampling** parameter defines the sampling frequency of the wave recording: **12kHz**, **24kHz** or **48kHz**.

►
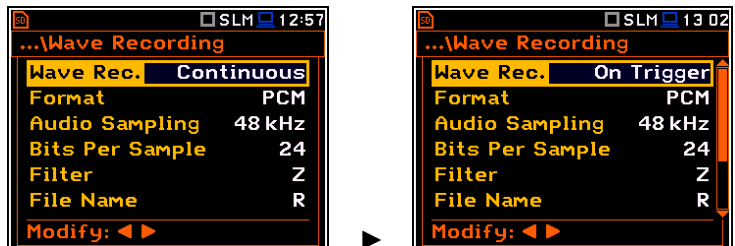
The **Bits Per Sample** parameter defines the number of bits recorded per sample: **16** or **24**.

The **Filter** parameter defines the weighting filter during event signal recording: **A**, **B**, **C**, **Z**, **U**, **AU** or **HP** for the sound signal and **HP** only for the vibration signal.
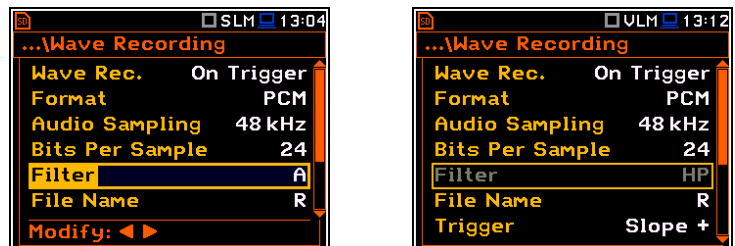
The **Signal Gain** parameter defines the gain of the recorded signal, when 16 bits per sample is selected: **0dB** … **40dB**.
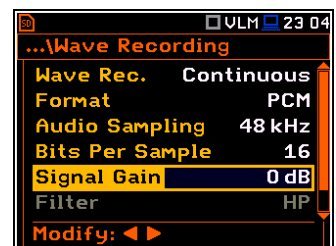
The **File Name** parameter defines the name of the wave file.

You can edit this name in the editor screen, which is opened with the ◄ / ► key.

►
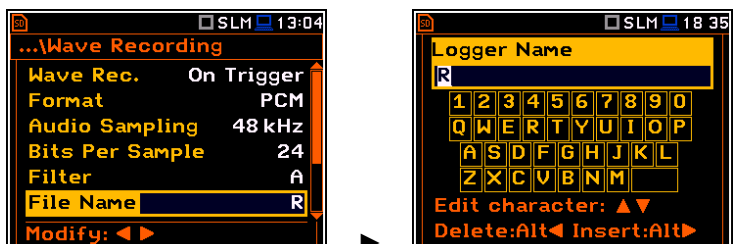
Wave Trigger

When **Trigger on Marker** is switched on, a wave recording will start by initiation of one of the markers. Markers for triggering are defined in the **Markers Setup** screen.

The **Trigger** parameter defines additional wave recording trigger, which can be disabled (**Off**) or enabled by selecting the trigger type: **Slope +**, **Slope -**, **Level +**, **Level –**, **External**, **Integr. Period** and **Int. Period Split**.

Slope trigger

The **Slope+** / **Slope-** trigger starts a signal recording on condition: rising/falling value of the measured result (**Source**) averaged over the **Trigger Period** passes above/below the threshold value (**Level**).
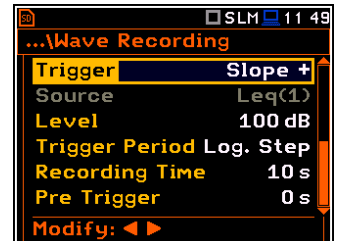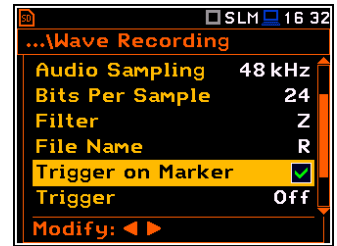
After pressing the **<Start>** key the instrument checks the trigger condition with steps, defined by the **Trigger Period** parameter, and if condition is met starts the signal recording. Recording will last **Recording Time** (unless the measurement is stopped earlier), and during this time the instrument continues to check the trigger condition with the **Trigger Period** step. If next trigger condition is met during **Recording Time** (provided that **Trigger Period** is shorter than **Recording Time**) the instrument triggers recording again, so it will continue from this moment by additional **Recording Time** and so on. If during next recording time there are no triggers, recording will be stopped after the last trigger plus **Recording Time**. Several WAV files can be created during one measurement.

The attached example shows that between measurement start and stop two records were created. The first record is equal to **Recording Time**, because during this period no second trigger condition has been met. During the second recording the measurement was stopped, and the record is shorter than **Recording Time**.
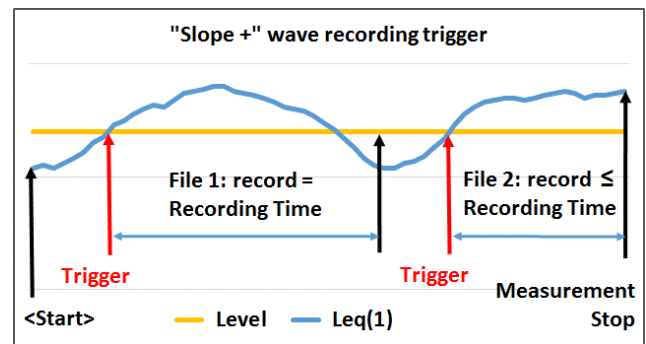
Note: *When a signal recording is waiting for the slope trigger the "slope" icon appears alternatively with the „wave" icon.*

Level trigger

The **Level +** / **Level -** trigger starts a signal recording which will last **Recording Time** (unless the measurement is stopped earlier) on condition: value of the measured result (**Source**) averaged over the **Trigger Period** is greater/lower than the threshold value (**Level**). In other cases, recording doesn't start, but if it has been already started it can be continued until **Recording Time** has elapsed.
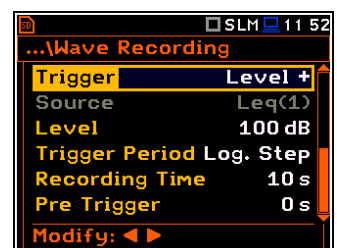
If during **Recording Time** a trigger condition appears, recording will be prolonged for another **Recording Time** from the moment of that trigger condition and so on.
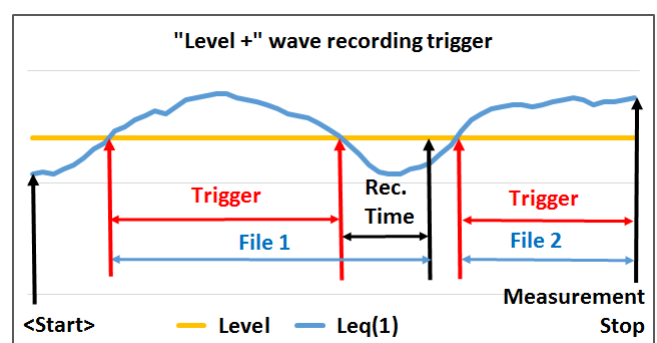
Note: When a signal recording is waiting for the level trigger the "level" icon appears alternatively with the „wave" icon.

External trigger

When **External** is selected, recording starts from the external signal on the **I/O** socket. In this case, it is necessary to set up the **I/O Mode** parameter as **Digital In** (*path: <Menu> / Instrument / Multifunction I/O*).

After triggering, recording will last **Recording Time** (unless the measurement is stopped earlier) and if during this time new external trigger appears the instrument will prolong recording for another **Recording Time**.
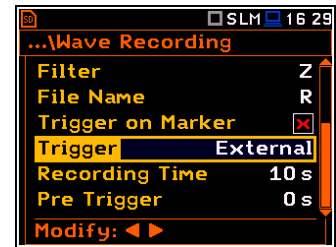
Integr. Period trigger

When the **Integr. Period** trigger is selected, recording is triggering every time the measurement starts and lasts **Recording Time** (unless the measurement is stopped earlier). If the triggering condition appears during recording (when **Integration Period** is shorter than **Recording Time**) from this moment the recording will continue for another **Recording Time** and so on.
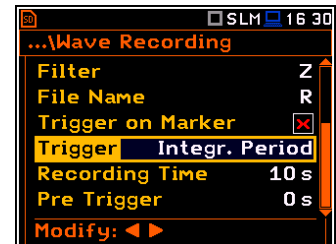
Int. Period Split trigger

When the **Int. Period Split** trigger is selected, recording is triggering every time the measurement starts and ending after the **Integration Period** time, e.g. the recording time is equal to the **Integration Period** time. In this case the instrument creates a WAV file for every measurement cycle.
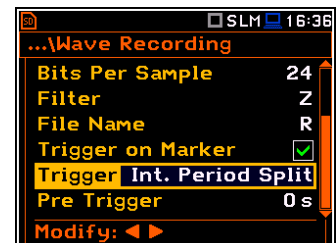
Note: When a signal recording is waiting for the **External**, **Integration Period** or **Integration Period Split** trigger the "trigger" icon appears alternatively with the „wave" icon.
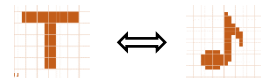
Source result

Only one measured result can be used as a trigger source (**Source**) for checking the trigger condition in the **Level Meter** mode, namely the instantaneous RMS from the first profile (with appropriate filter and detector), which is denoted here as **Leq(1)** in the sound mode and **RMS(1)** in the vibration mode. This position cannot be changed.

This result averaged for the **Trigger Period** is compared with the **Level** value with the step defined by the **Trigger Period**.

Threshold level

The threshold (**Level**) can be set with 1 dB steps in the range from 24 dB to 136 dB in the sound mode and from 1 mm/s^2 (60 dB) to 10 km/s^2 (200 dB) in the vibration mode.
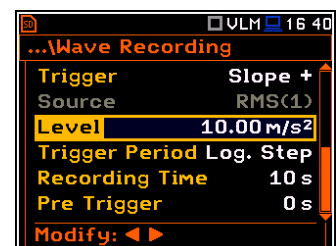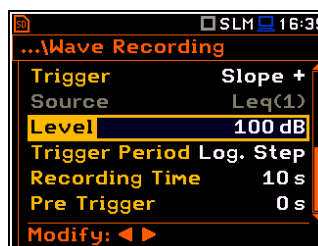
Checking the trigger condition

The **Trigger Period** parameter defines the time interval of checking the trigger conditions. This parameter can be set as: **Log. Step** (same as **Logger Step** value), **0.5ms**, **100.0ms** and **1s**.

The **Recording Time** parameter defines the time of signal recording after every trigger. The available values can be selected from **1s** to **8h** or **Inf** (recording will last until measurement stop).
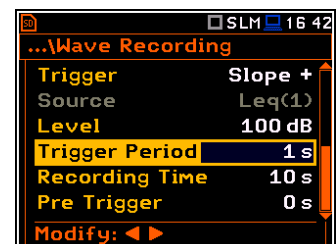
Recording before trigger

When **Pre Trigger** is higher than 0 then the wave signal starts to be recorded before the first trigger. The period of such recording depends on the sample frequency and bits per sample. The pre-trigger periods are:

- for 24 bits per sample: **2s** for 48 kHz, **4s** for 24 kHz and **8s** for 12 kHz.

- for 16 bits per sample: **4s** for 48 kHz, **8s** for 24 kHz and **16s** for 12 kHz.
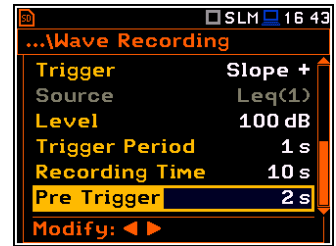
4.5 SELECTING MICROPHONE COMPENSATION – COMPENSATION

The **Compensation** position is available only in the Sound meter modes. It allows you to select the appropriate compensation for different measurement situations. Default settings – see Chapter 2.8.

<ENT>
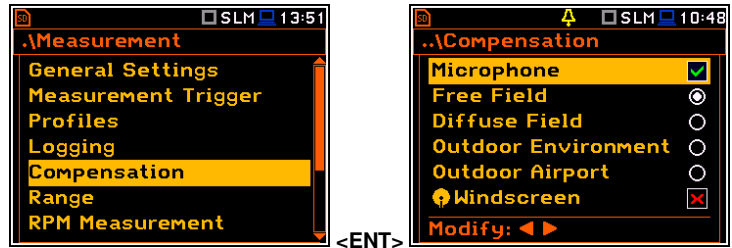
The **Microphone** compensation (microphone inner noise and thermal compensation) is switched on by default, however it is possible and necessary to switch it off for electrical measurements (e.g., laboratory calibration measurements).

The **Free Field** and **Diffuse Field** positions are intended to compensate the instrument frequency response in the free field or diffuse field conditions. The microphone supplied with SV 977D is designed for sound measurements in the free field conditions. The **Free Field** option means that the correction filter for the diffuse field conditions is switched off.

The **Windscreen** compensation should be switched on if you use the **SA 22** windscreen.

The **Outdoor Environment** and **Outdoor Airport** compensations are dedicated for the applications with the use of the **SA 277D** outdoor microphone kit (usually when the instrument is working as a part of the SV 277 monitoring station). The characteristics of the outdoor filters depend on the dominating sound incidence angle: environmental monitoring (incidence angle 90 deg) or airport monitoring (incidence angle 0 deg).

The frequency characteristics of all filters are given in Appendix C.

*Note: When using windscreen SA22 the **Windscreen** compensation filter must be switched on during windy conditions to maintain good tolerances margin of the SV 977D frequency response.*
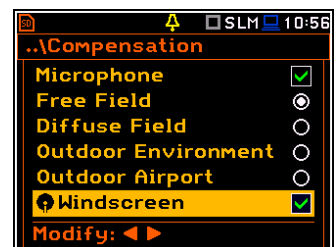
*Note: For the free filed measurements with the SA 277D outdoor microphone kit the **Outdoor Environment** or **Outdoor Airport** compensation must be selected.*
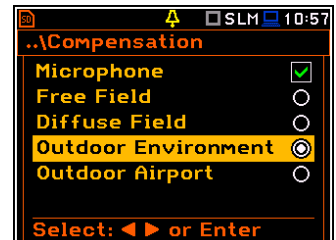
4.6   SELECTING THE MEASURING RANGE – RANGE

The **Range** position is used for selecting the measuring range of the instrument.

The **Range** screen presents for the selected range: Leq linearity range, Leq dynamic range and Peak range for 1 kHz.

There are two ranges available: **High** and **Low**. Default value: **Low**.

The detailed description of the measuring ranges parameters is given in Appendix C.

The values of ranges in sound modes depend on the settings in the **Compensation Filer** screen (*path: <Menu> / Measurement / Compensation Filter*) and in both sound and vibration modes – on the calibration factor.

> **Note:** *The calibration factor may influence the measuring range of SV 977D.*
>
> *For example, if the new calibration factor is equal to 1.0 dB, the limits of the **Low** range will be changed as shown on the attached screen.*
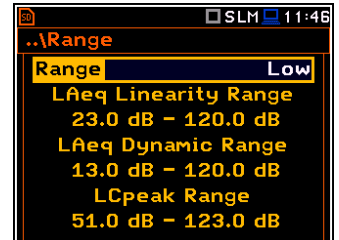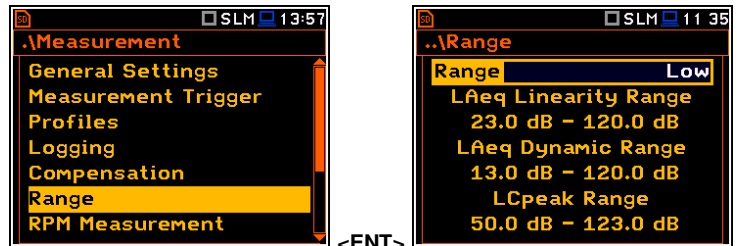
The attached screens present the **Range** for the Vibration mode and zero calibration factor.

Nonzero calibration factor always shifts the lower and upper limits of the ranges for vibration modes.
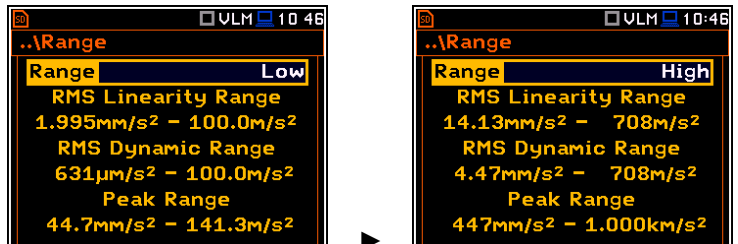
4.7   ROTATION MEASUREMENT SETTINGS – RPM MEASUREMENT

The **RPM Measurement** position enables switching on and setting rotational speed measurement by tacho probe. Default mode: disabled.
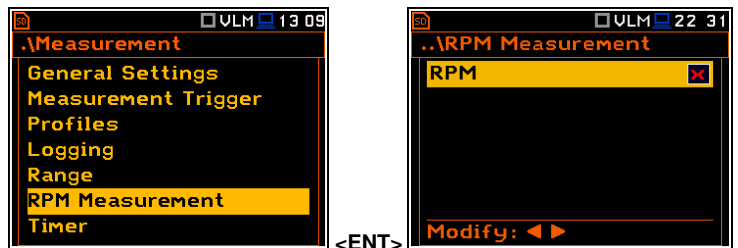
> **Note:** *The **RPM** function is optional and should be unlocked by entering the activation code in the text editor screen, which is opened during first attempt to open this position. Once unlocked this option will be ready to use permanently.*

To perform the RPM measurement the tacho probe should be connected to the **I/O** socket and the **RPM** position in the **RPM Measurement** screen should be switched on.

When you switch the **RPM** on the instrument automatically switches the **I/O Mode** to **Digital In** (*path: <Menu> / Instrument / Multifunction I/O / I/O Mode*) and makes it inactive for changing.
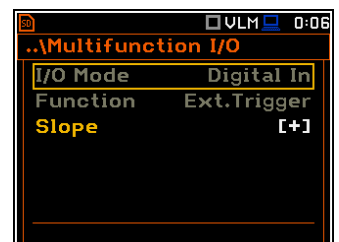
The **Pulses/Revolution** parameter defines the number of pulses per one rotation. Available values are in the range: **1**..**360**.

The **Unit** parameter defines units of measure. Two options are available: revolutions per minute (**rpm**) or revolutions per second (**rps**).
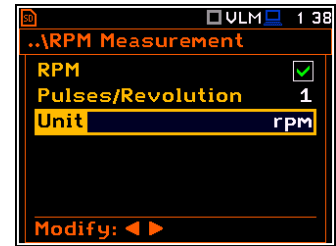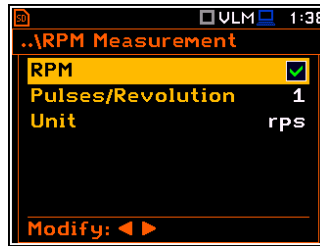
> **Note:** *The RPM results are always registered in the logger file as logger results (with the logger step) and as summary results (with the integration period step).*

4.8 SETTING THE WORKDAY EXPOSURE TIME – EXPOSURE TIME

The **Exposure Time** parameter defines the workday exposure time that is used for the calculation of **LEPd** (cf. Appendix D for definitions). This position is available only in the sound mode. The **Exposure Time** values are within the range [00h01, 08h00]. Default value: **08h00m**.
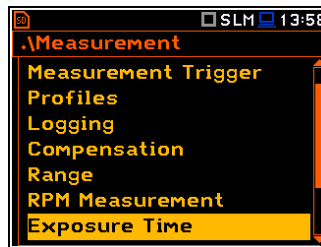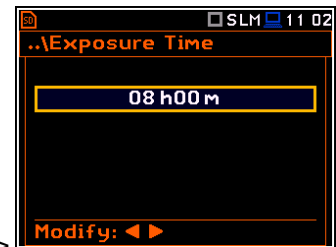
4.9 SETTING THE STATISTICAL LEVELS – STATISTICAL LEVELS

The **Statistical Levels** position is available only in the Sound meter modes.

In the **Statistical Levels** screen, you can define ten statistical levels, named from **N1** to **N10**, to be calculated, displayed and saved in a file as Summary results (see Appendix D).
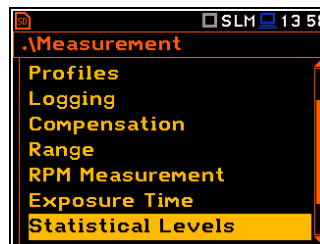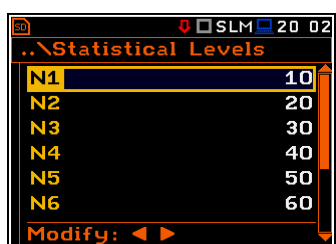
The default statistical levels have following settings: **10**, **20**, **30**, **40**, **50**, **60**, **70**, **80**, **90** and **95**. All values should be within the integer range [1, 99]. Each individual value can be set independently from others.

4.10 PROGRAMMING THE INSTRUMENT'S INTERNAL TIMER – TIMER

The **Timer** function is used for programming the automatic measurement start (and turning the instrument on if it was turned off) at a given time and day of a week.

The **Timer** position allows you to programme the internal real-time clock to act as a delayed start timer. The instrument will be switched on automatically at the programmed time and will perform the measurement with the same settings used before the instrument was turned off.
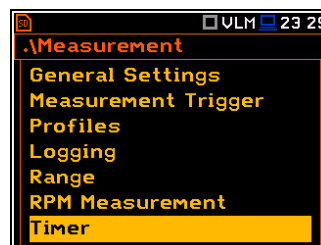
Timer modes

The timer can be switched off (**Off**), switched on only once (**Single**), or switched on many times regularly (**Multiple**) with the period between two consecutive measurements (**Repetition**). Default mode: **Off**.
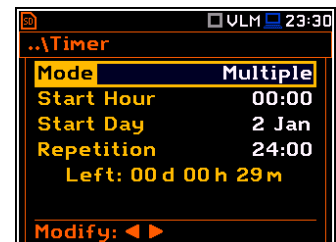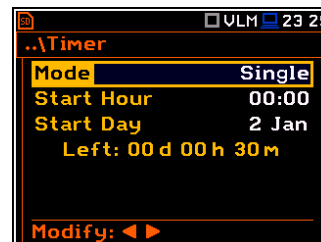
In the case the timer is active (**Single** or **Multiple**) and the instrument is switched on the "clock" icon appears until finishing the programmed measurements.

The **Start Hour** position determines the time for the measurement to start. The required hour and minute can be selected in a special screen, which is opened with the ◄ / ► key.

To set hours or minutes, select the left or right field with the ◄ / ► key and then select the proper value with the ▲ / ▼ key and press **<ENTER>** to confirm settings.
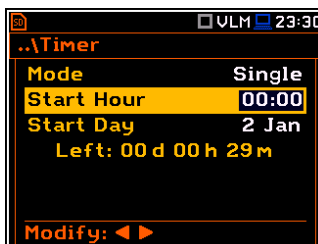
The **Start Day** position determines the date for the measurement to start. The timer can be programmed up to one month ahead. The required date can be selected in a special screen, which is opened with the ◄ / ► key.

To set the date, select its position with the ◄ / ► or ▲ / ▼ key and then press **<ENTER>**.
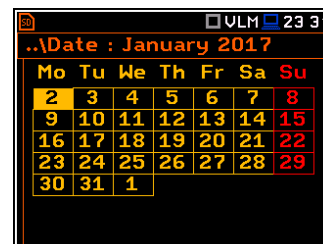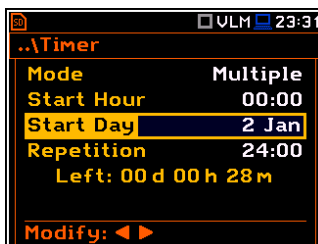
The **Repetition** position is displayed when the **Multiple** mode is selected. This parameter can be programmed in the range from **00:00** up to **96:00**. The required date can be selected in a special screen, which is opened with the ◄ / ► key same way as **Start Hour**.
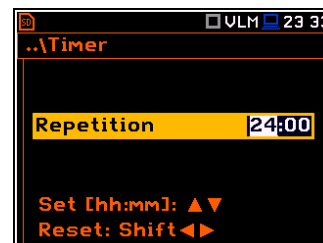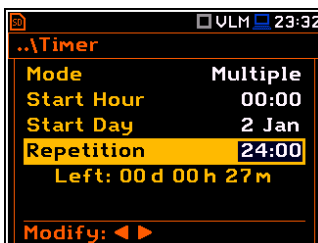
> **Note:** The **Timer** function can be used for multiple measurements (at the programmed day and time with the selected repetition number). The first start of the instrument must be within one month ahead. Make sure that the RTC is configured correctly before setting up the **Timer**.

> **Note:** Make sure that there is sufficient power available for the instrument to carry out the required measurement when it wakes up and starts measurements.

4.10.1 Example of timer execution

Let us assume that the you wish to switch on the instrument on 3rd of December at 20:00, measure noise for 1 minute and save the results in a file named **L2831**.

To do this set the **Timer** parameters, set the measurement parameters (*path: <Menu> / Measurement / General Settings*), name the file (*path: <Menu> / Measurement / Logger / Logger Setup*) as on the attached screens and finally – turn off the instrument.

The instrument will be switched on 3rd of December at 19:59 and will be warmed up for the period of 60 seconds decrementing the counter visible on the display by one after each second.

After warming up and the pre-set **Start Delay** time, the measurements will be performed by a period of one minute. Then, results will be saved in the previously named file and finally – the instrument will turn itself off.
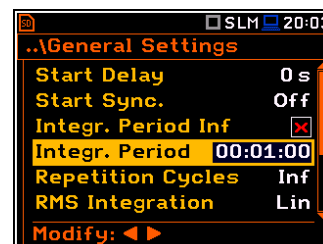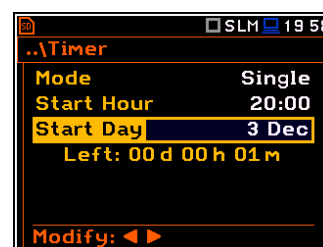
It is recommended to set the **Start Delay** time to 0 seconds for the **Timer** function.
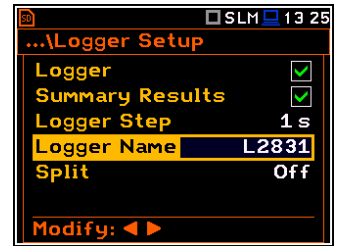
4.11 ADVANCED ALARM FUNCTION – ALARMS

The **Alarms** position appears in the **Measurement** list in the case the advanced alarms configuration file (ALARM.SVA) is uploaded to the predefined SYSTEM catalogue. It opens the screen in which you can enable or disable the advanced alarm function. Default mode: disabled.

<ENT>
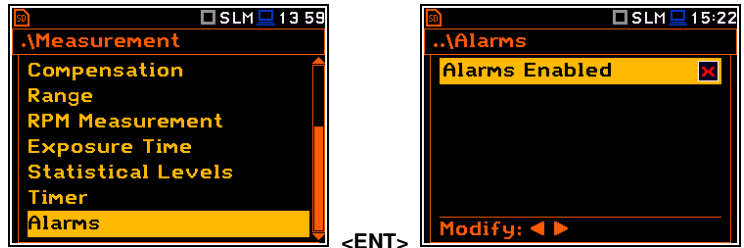
> **Note:** The advanced alarm settings are configured via the SvanPC++ software or via the SvanNET web service since this function was designed for the SV 277 monitoring stations (see Chapter).

5   CONFIGURING DATA VIEWING – Display

The **Display** section contains elements for programming presentation of measurement result and display parameters.

The content of the **Display** list depends on selected measurement function.
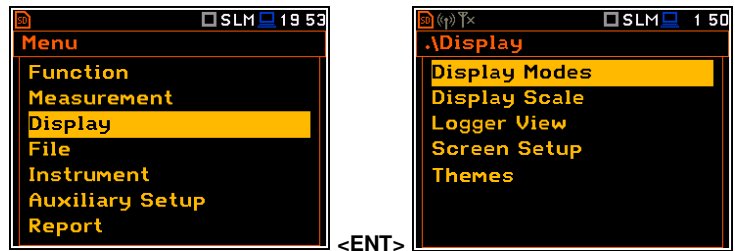
The **Display** section contains following items:

Display Modes   allowing you to enable modes of a measurement results presentation (views),

Display Scale   allowing you to adjust the scale in graphical views,

Logger View   allowing you to select and present results stored in a logger file,

Spectrum View   allowing you to select spectra to be viewed; this position becomes available in the spectrum analyser functions only,

Spectrum Type   allowing you to change the spectrum type presented on the display: acceleration, velocity or displacement; this position appears only in the spectrum analyser functions in the Vibration mode,

Screen Setup   allowing you to set up the brightness and switch on/off the energy saver function,

Themes   allowing you to set the colour theme of the display.

5.1   ENABLING VIEWS – DISPLAY MODES

The Single Profile view is always active and available. Other views can be enabled or disabled in the **Display Modes** screen.

You may change views among those, that were enabled in the **Display Modes** screen.
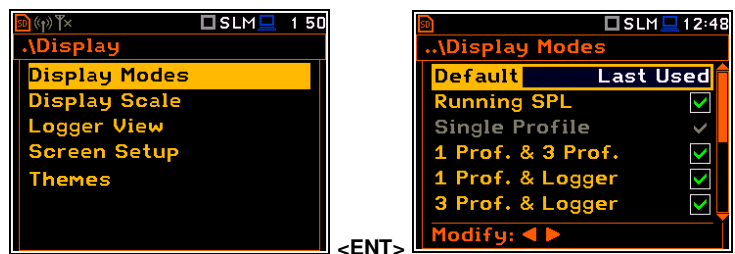
In the **Sound Level Meter** mode, following views are available: **Running SPL**, **Single Profile**,   **1 Prof. & 3 Prof**,   **1 Prof. & Logger**,   **3 Prof. & Logger**, **Logger**, **Statistics**, **Meter Table**, **GPS**, **File Info** and **Meteo**.

In the **Vibration Level Meter**, following views are available: **Single Profile**, **1 Prof. & 3 Prof.**, **1 Prof. & Logger**, **3 Prof. & Logger, Logger**, **Meter Table**, **GPS**, **File Info** and **Meteo**.
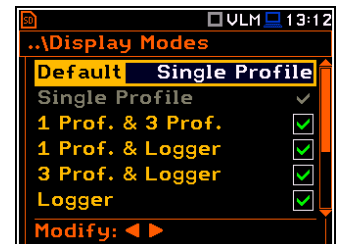
In the **Default** position, you can define which view will be presented after instrument's turn on. If you select **Last Used** the instrument will be switched to the view used before the instrument turning off.

Changing views

Being in the measurement mode you can switch between views with the ▲ / ▼ key pressed together with **<Alt>**.

5.1.1   Running SPL view

The **Running SPL** view is available in the Sound measurement modes. It shows in a large format one measured result – SPL for the selected profile (Leq with the weighting filter and detector constant defined in the **Profiles** screen for the last second).

This result is not saved in a file and gives just a first assumption of the sound level before the measurement.

The Running SPL view can be enabled and disabled in the **Display** screen.

You can hide or open this view with the **<ESC>** key.

You can change the displayed result with the ◄ / ► key.
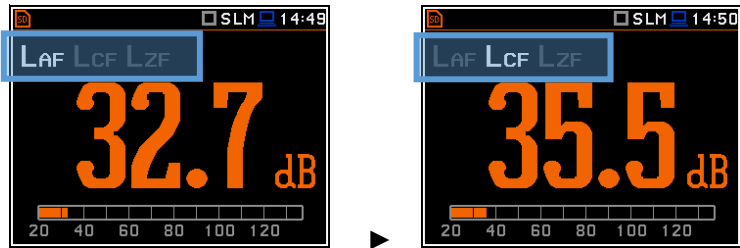
5.1.2   Single Profile view

The **Single Profile** view is always available in all measurement functions. You cannot disable it. In this view, only one measured result is displayed in a large format.
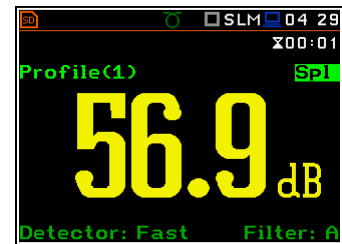
Single Profile view fields

1. Logger file name.
2. Profile number.
3. Value of the measured result.
4. Weighting filter: **Z**, **A**, **C**, **B**, **U**, **AU**, **D**, **LF, HP** for Sound measurements or **HP**, **HP1**, **HP3**, **HP10**, **Vel1**, **Vel3**, **Vel10**, **VelMF**, **Dil1**, **Dil3**, **Dil10**, **Wh** for Vibration measurements.
5. Detector type: **Linear** or **Imp.**, **Fast**, **Slow** for Sound measurements and **Linear** or **100 ms**, **125 ms**, **.. 10.0 s** for Vibration measurements.
6. Units of the measured value.
7. Result name: **Spl**, **Leq**, **SEL**, **Lden**, **LEPd**, **Ltm3**, **LTeq**, **Ln**, **EX**, **SD**, **LR1**, **LR2**, **Ovl**, **Peak**, **Max**, **Min** for Sound measurements or **RMS**, **Ovl**, **Peak**, **P–P** for Vibration measurements.
8. Elapsed time, showing the current second of the measurement. The value presented here belongs to the range [0, Integration Period].
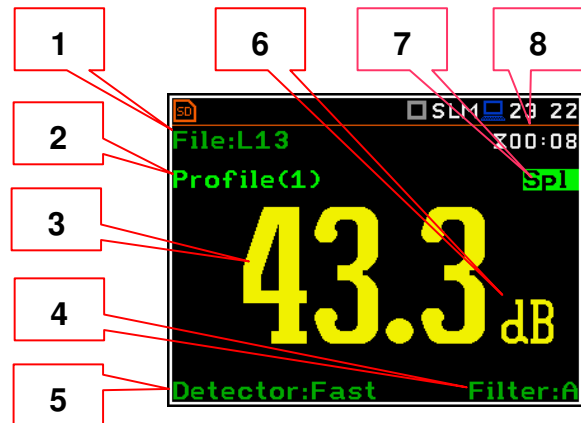
> **Note:** *Detector type for the displayed result depends on settings in the* ***General Settings*** *and* ***Profiles*** *lists (path: <Menu> / Measurement). There is no displayed indication of the detector in case of* ***Peak, P-P*** *and* ***Ovl*** *results (see Appendix D).*

Changing field content

The content of some fields can be changed with the ◄ / ► key together with **<Alt>**.

<Alt/►>
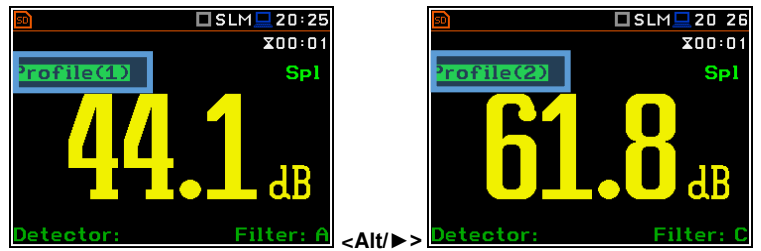
Changing active fields

You can change the active field with the ◄ / ► or ▲ / ▼ keys.

►
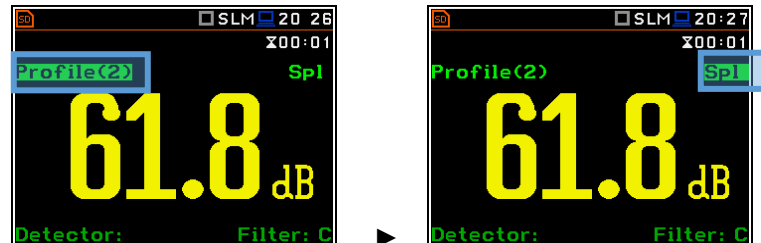
5.1.3 Combined views

There are three display modes, that combine two views: **1 Prof. & 3 Prof.**, **1 Prof. & Logger**, **3 Prof. & Logger**. These display modes allow you to compare results for profiles and to follow the history of measured results, saved in the logger file.

<Alt/▲>

<Alt/▲>
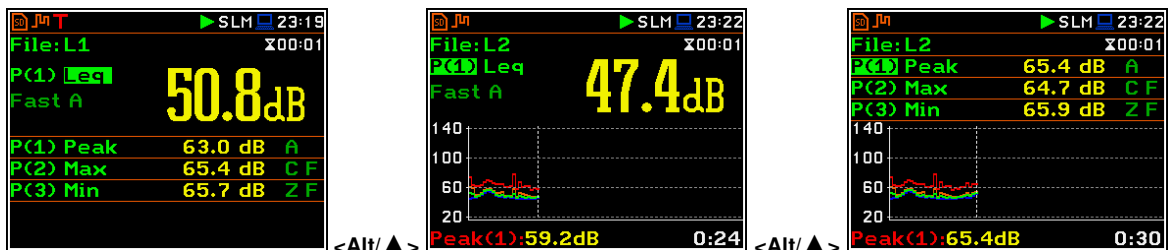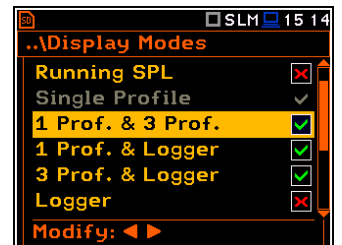
Single Profile view fields

1. Profile number.
2. Result name: **Spl**, **Leq**, **SEL**, **Lden**, **LEPd**, **Ltm3**, **LTeq**, **Ln**, **EX**, **SD**, **LR1**, **LR2**, **Ovl**, **Peak**, **Max**, **Min** for Sound measurements or **RMS**, **Ovl**, **Peak**, **P–P** for Vibration measurements.
3. Detector type: **Linear** or **Imp.**, **Fast**, **Slow** for Sound measurements and **Linear** or **100 ms**, **125 ms**, **.. 10.0 s** for Vibration measurements.
4. Weighting filter: **Z**, **A**, **C**, **B**, **U**, **UA**, **D**, **LF**, **HP** for Sound measurements or **HP**, **HP1**, **HP3**, **HP10**, **Vel1**, **Vel3**, **Vel10**, **VelMF**, **Dil1**, **Dil3**, **Dil10**, **Wh** for Vibration measurements.
5. Value of the measured result.
6. Units of the measured value.
7. Elapsed time, showing the current second of the measurement. The value presented here belongs to the range [1, Integration Period].
8. File name when **Logger** is enabled (*path: <Menu> / Measurement / Logging / Logger Setup*).
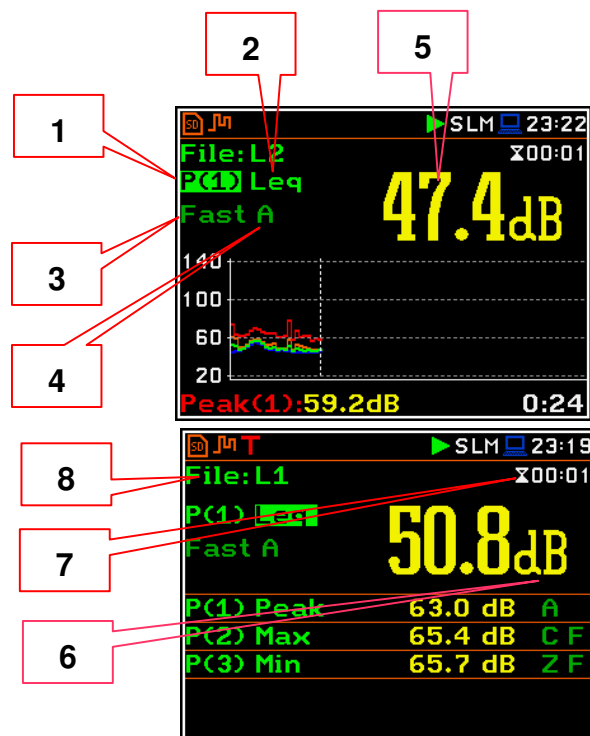
Note: *Detector type for the displayed result depends on settings in **General Settings** and **Profiles** lists (path: <Menu> / Measurement). There is no displayed indication of the detector in case of **Peak**, **P-P** and **Ovl** results (see Appendix D).*

3 Profiles view fields

1. Result line for Profile 1.
2. Result line for Profile 2.
3. Result line for Profile 3.
4. Result name: **Spl**, **Leq**, **SEL**, **Lden**, **LEPd**, **Ltm3**, **LTeq**, **Ln**, **EX**, **SD**, **LR1**, **LR2**, **Ovl**, **Peak**, **Max**, **Min** for Sound measurements or **RMS**, **Ovl**, **Peak**, **P–P** for Vibration measurements.
5. Weighting filter: **A**, **B**, **C**, **Z**, **U**, **UA**, **D**, **LF**, **HP** for Sound measurements. For Vibration measurements this field is skipped.
6. Detector type: **L** (Linear) or: **I** (Imp.), **F** (Fast), **S** (Slow) for Sound modes. For Vibration measurements this field is skipped.
7. Units of the measured value.
8. Value of the measured result.
9. Elapsed time, showing the current second of the measurement. The value presented here belongs to the range [1, Integration Period].
10. File name when **Logger** is enabled (*path: <Menu> / Measurement / Logging / Logger Setup*).
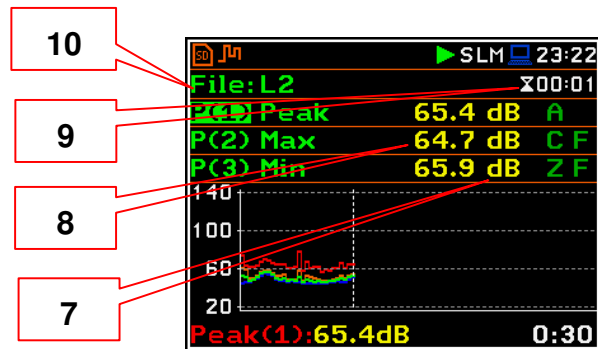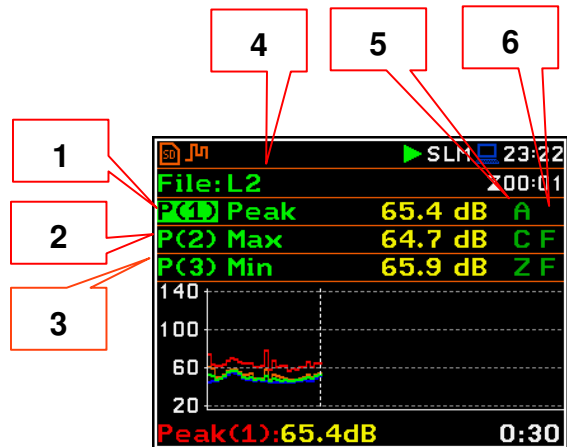
Logger view fields

1. Profile number and result name
2. Logger Plot
3. Cursor time position
4. Result value for cursor position
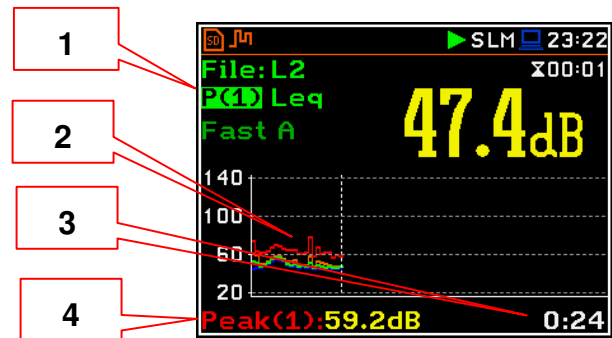
Changing field content

The content of some fields can be changed with the ◄ / ► key pressed with **<Alt>**.
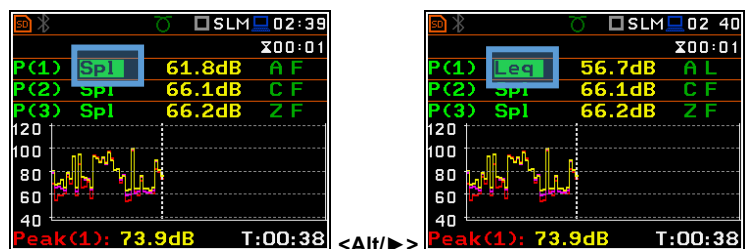
Changing active fields

You can change the active field with the ▲ / ▼ (vertically) or ◄ / ► (horizontally) key.
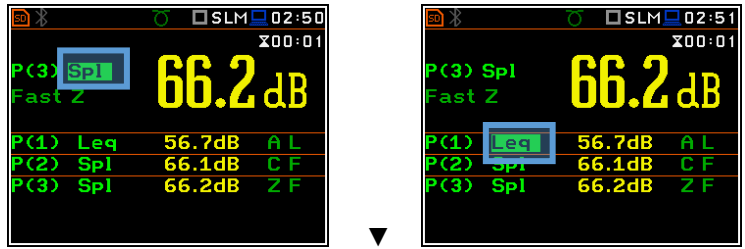
5.1.4 Logger view

The **Logger** view depends on settings made in the **Logging** list (*path: <Menu> / Measurement / Logging*). If **Logger** (*path: <Menu> / Measurement / Logging / Logger Setup)* is disabled, the **Logger** view mode is <u>not</u> active!

=>

So, to have this view active, enable the **Logger**!

=>
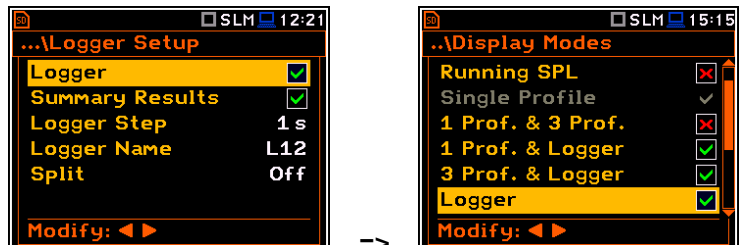
When **Logger** is enabled, and some results for profiles have been selected for logging, the logger plot can be viewed.

=>
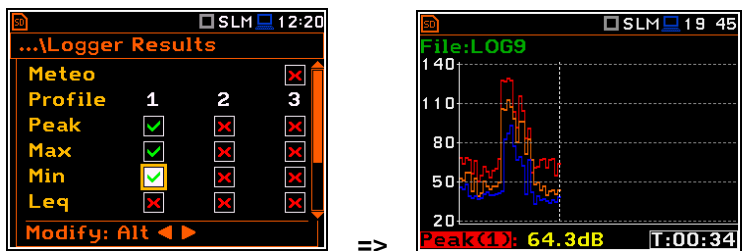
Logger view fields

1. Y-scale
2. Logger plot
3. Name of the logged result and profile number
4. Name of the file
5. Real Time Clock
6. Cursor position
7. Result value for the cursor position
8. Cursor time position
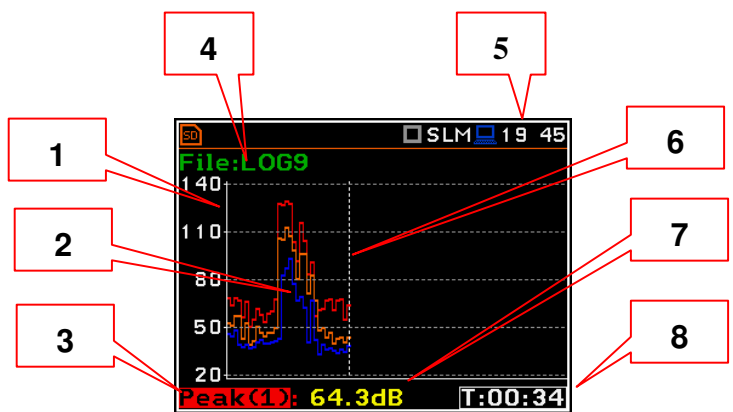
You may change the cursor position with the ◄ / ► key.

The bottom line of the screen displays the value of the result from <u>field 3</u> for the cursor position.
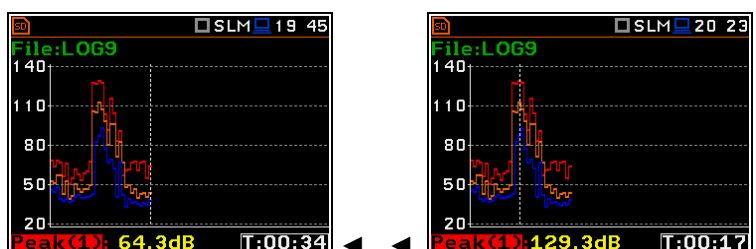
To display a different result, it is necessary to move to <u>field 3</u> with the ▲/▼ button, and then select the appropriate result with the ◄/► button pressed together with <Alt>.

<Alt>+►
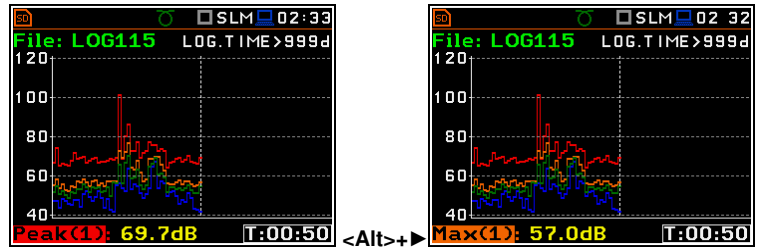
5.1.5 Spectrum view

The **Spectrum** position is accessible only in the active **1/1 Octave**, **1/3 Octave** or **FFT** functions.

The spectra views are described in Chapters 10 and 11.

=>
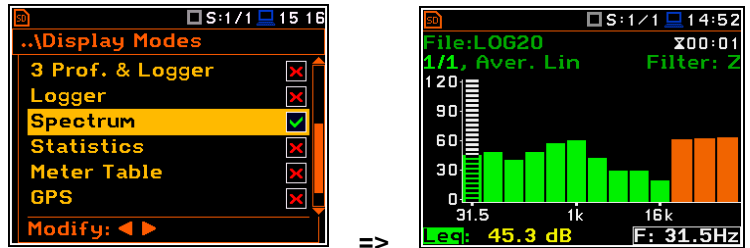
5.1.6 Statistics view

The **Statistics** position is accessible only for Sound measurements.

Statistics is the cumulative probability density function of exceeding the noise level during the measurement period. The X axis defines the probability of exceeding the noise level, statistical level **Ln**, and the axis Y defines the calculated noise level in dB.
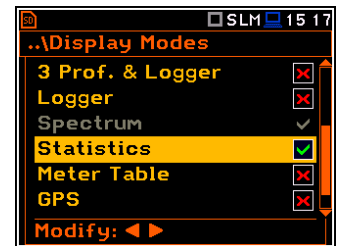
Statistics view fields

1. Result name
2. Statistics plot
3. Statistical level (**Ln** percentile value) for the active cursor position
4. Active profile (P1, P2 or P3)
5. RMS detector (**Lin.** or **Fast**, **Slow**, **Imp**.)
6. Weighting filter (**A**, **B**, **C**, **Z**, **U**, **UA**, **D**, **LF**, **HP**)
7. Sampling interval for the **Ln** values calculated by the instrument (0.1 s)
8. Cursor position
9. Value of the selected statistical level **Ln** and units (dB)
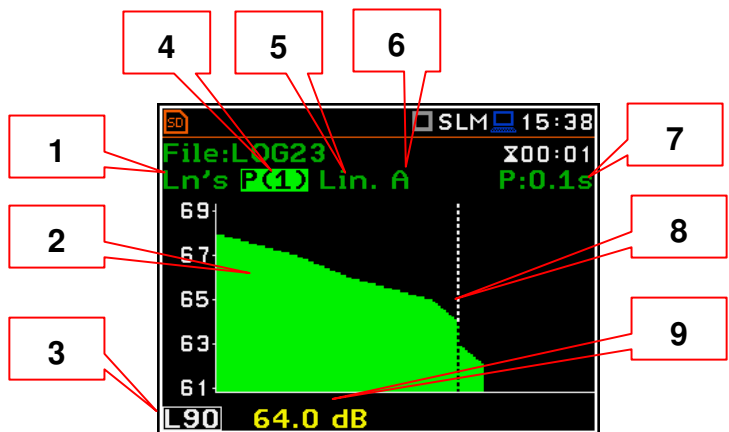
To change the profile, you should select the <u>field 4</u> and press the ◄ / ► key together with **<Alt>**.

<Alt/►>
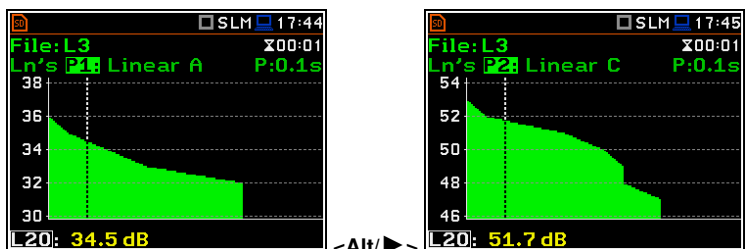
The cursor position is changing with the ◄ / ► key. The statistical level and appropriate value are presented in the line below the plot.
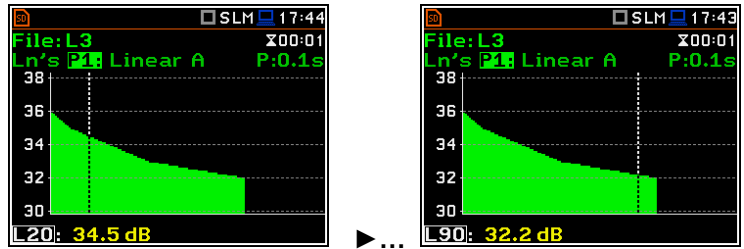
5.1.7   Meter Table view

The **Meter Table** view displays a list of predefined results with assigned weighting filters and detector type without information about profiles.

If specified in that list result is not measured in any profile, it will be of grey colour and without value ("**---**").

=>

5.1.8   GPS view

When **GPS** is enabled in the **Communication Ports** screen (*path: <Menu> / Instrument / Communication Ports*) it is possible to activate the GPS screen, which shows the GPS status, co-ordinates, etc., transmitted to the instrument from the **SV 58_H** GPS module connected to the **Serial** socket.

=>

5.1.9   File information view

The **File Info** position enables the additional file information view.

The **File Info** view displays the file name, its size, number of records made with Logger step, number of summary results blocks (records made with Integration period), free memory space etc.

=>
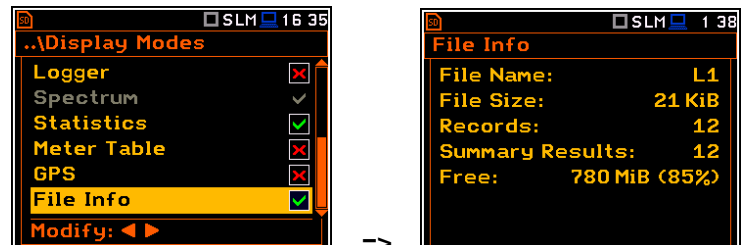
5.1.10 Meteo view

The **Meteo** view displays results measured by the weather station: ambient temperature and pressure, humidity, wind speed, wind direction and rain intensity.

These results are available when SV 977D is a part of the SV 277 PRO monitoring station and when the Meteo module is connected to the station.

=>
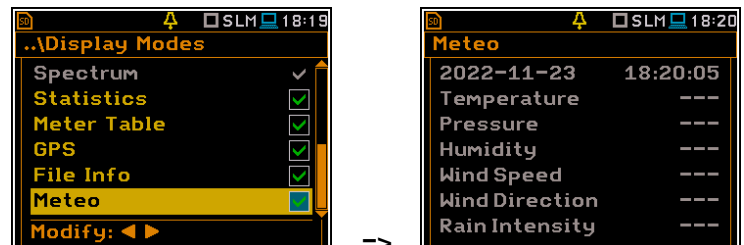
5.2   ADJUSTING GRAPH VIEWS – DISPLAY SCALE

The **Display Scale** list of parameters allows you to define the result units (absolute or logarithmic), number of digits after decimal point, decimal mark, adjust scale of charts and toggle a grid.
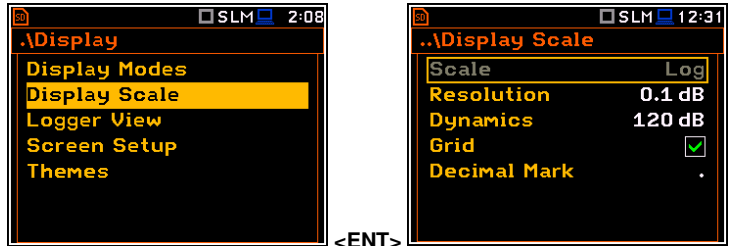
Scale of results presentation

The **Scale** parameter defines results units: linear (**Lin**) or logarithmic (**Log**).

For sound measurements the **Scale** position is not active. All results are always presented in dB.
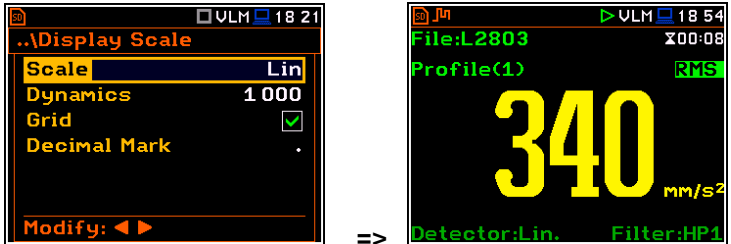
In case of **Log**, the graphical presentation is given in the logarithmic scale and the measurement results are expressed in decibels (results are calculated in relation to the values specified in the **Reference Levels** screen (*path: <Menu> / Auxiliary Setup / Reference Levels*)).

> **Note:** *In Vibration modes, parameters can be presented in **Logarithmic** (dB) or **Linear** (for example, m/s^2) units. It depends on the **Scale** parameter value. For example, 10 m/s^2 can be presented also as 140 dB.*

Resolution

The **Resolution** parameter appears <u>when Scale is Log</u> and defines the number of digits after the decimal point in the presented results: one digit after the decimal point (**0.1 dB**) or two digits after the decimal point (**0.01 dB**).
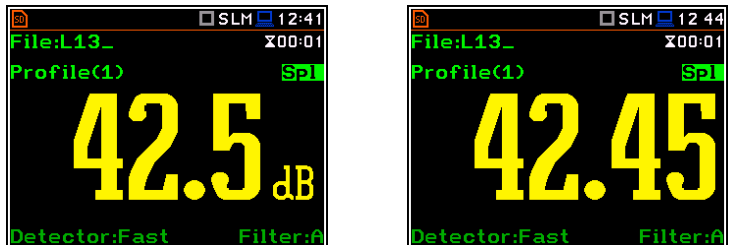
Scaling the vertical axis

The **Dynamics** parameter defines the dynamic range of the plot Y-axis scale. It is possible to select the range from the set: **10dB**, **20dB**, **40dB**, **80dB**, **100dB** and **120dB**.
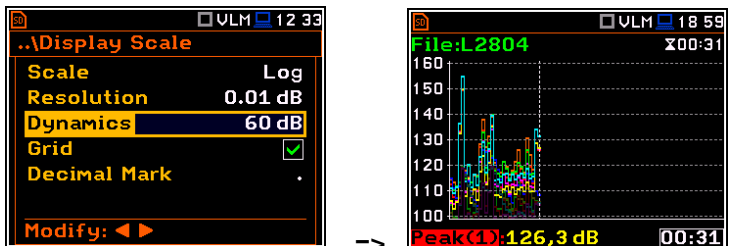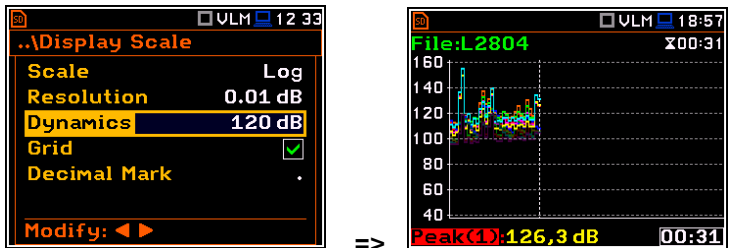
Switching grid on/off

The **Grid** position allows you to toggle the horizontal grid lines of the logger or spectrum graph.
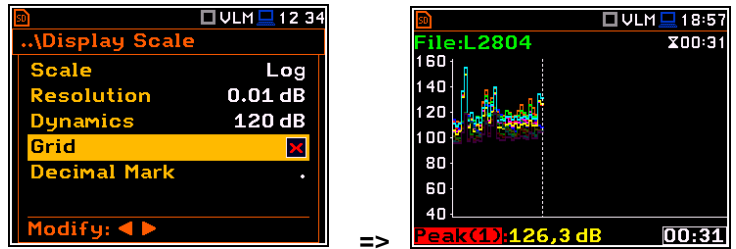
=>

Decimal Mark

The **Decimal Mark** position allows you to select which decimal mark (point or comma) will be used for data presentation in all presentation modes.
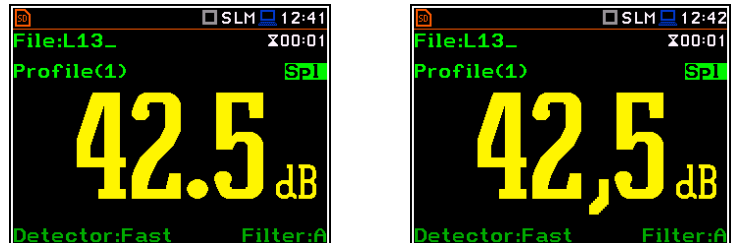
5.3 CUSTOMIZING THE LOGGER VIEW – LOGGER VIEW

The **Logger View** screen allows you to adjust the **Logger** view by choosing logged results to be displayed and colours of their curves.

Every logger curve shows the history of one result measured in a profile, like **Peak(1)**. In the **Logger View** screen, you can include or exclude the curve from the logger plot and define the colour of this curve.

<ENT>
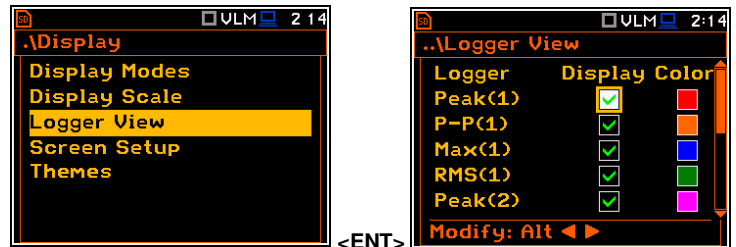
The view of the logger screen can be adjusted quickly without stopping the measurement. Highlight the function label in the bottom left corner and press **<ENTER>**. The **Logger View** list will be displayed in which you can make necessary adjustments and return to the **Logger** view after confirmation of the performed changes with the **<ENTER>** key.

<ENT>
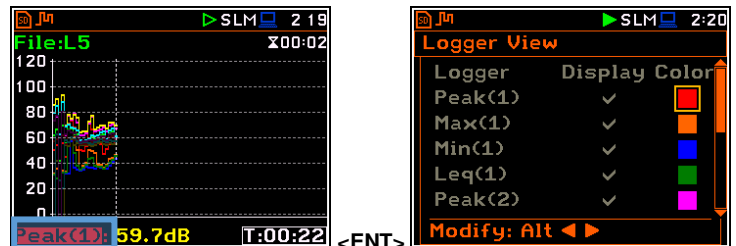
5.4 CONFIGURING DISPLAY BRIGHTNESS AND POWER SAVER – SCREEN SETUP

The **Screen Setup** screen allows you to configure brightness of the display and switching the power saver.

<ENT>
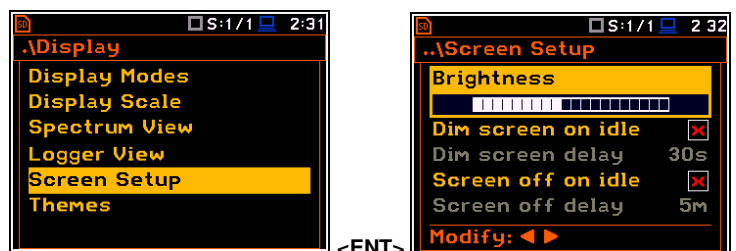
Display brightness

The **Brightness** position allows you to set the proper brightness of the display with the ◄ / ► key. You can select 20 different values of this parameter. The new value of brightness level is confirmed after each press of the ◄ / ► key.
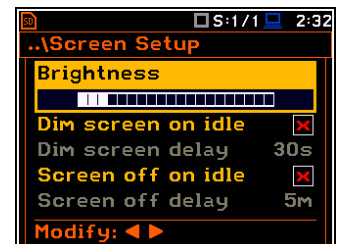
Power saver

The saving of the internal source of the instrument's power can be achieved by reducing the brightness of the screen when possible.

There are two options for the power saver function. The screen may be switched off (**Screen off on idle**) and/or dimmed (**Dim screen on idle**). When either of these options are set, after a delay from pressing any key, defined by the parameters **Dim screen delay** or **Screen off delay**, the screen is dimmed or switched off. If it has happened, the first press of any key will cause the screen to switch back on again.

Power saver delay

The power saver delay defines the delay period from the last use of any key to the power saver mode. This delay period can be set for **Dim screen on idle** from **5 s** to **60 s** and for **Screen off on idle** from **1 m** to **60 m**. The **<ENTER>** key must be pressed for confirmation of the selection, which then also closes the **Screen Setup** screen.
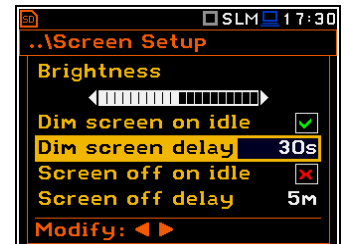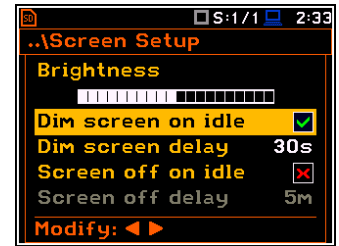
5.5 CUSTOMIZING THE COLOUR THEME OF THE DISPLAY – THEMES

The **Themes** screen allows you to set the colour theme of the display.

It is possible to choose between **Dark** and **Light** themes. **Dark** theme is presented in this Manual.

<ENT>
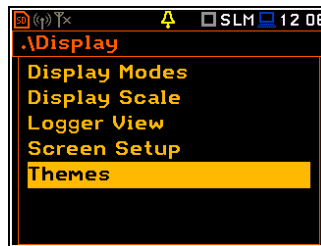
The **Light** colour theme uses more energy.
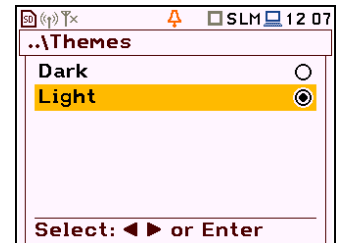
6   MANAGING FILES – File

The **File** section contains elements that enable managing measurement and setup files saved in the instrument's memory (micro-SD card).

The memory structure and files saving methods are described in Chapter 2.11.

The **File** list contains following items:
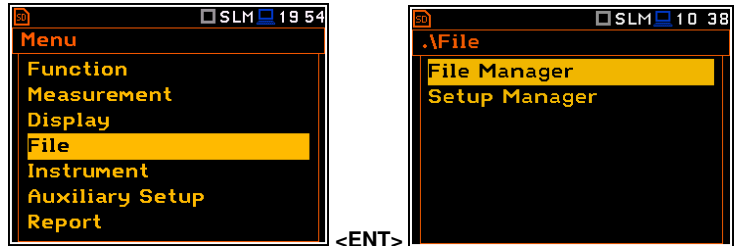
File Manager   allowing you to manage all files and directories on the SD card,

Setup Manager   allowing you to manage only setup files located in the predefined SETUP directory.

> **Note:** Both data and setup files are saved on the SD card. So, if there is no SD card in the instrument there is no possibility to create any file. Among other things, in this case, the **Logging** position in the **Measurement** list is not available.
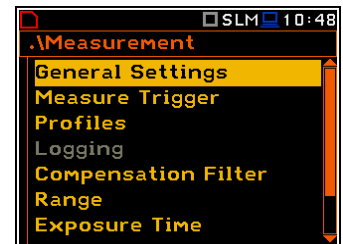
> **Note:** Positions in the **File** list are active only when the SD card is inserted into the card slot under the instrument's bottom cover. If there is no SD card, after your attempt to enter any position in the **File** list, the instrument will generate warning.
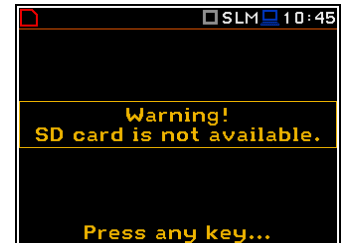
The instrument creates files of the next types:

- Logger files with measurement results (extension SVL),
- Wave files with time waveform records (extension WAV),
- Setup files with measurement and instrument configurations (extension SVT).

Logger and Wave files are created and saved automatically with default names, but you can define a specific logger file name in the **Logger Name** position of the **Logger Setup** screen (*path: <Menu> / Measurement / Logging / Logger Setup*) and a specific wave file name in the **File Name** position of the **Wave Recording** screen (*path: <Menu> / Measurement / Logging / Wave Recording*).

The logger file (.SVL) structure depends on the selected function (**Level Meter**, **1/1 Octave**, **1/3 Octave**, **FFT** or **RT60**) and logging settings and may include:

- main results, including results of statistical analysis,
- results received from the Weather station,
- time histories of logger results,
- marker recordings,
- results of the **1/1 Octave** analysis,
- results of the **1/3 Octave** analysis,
- results of the **FFT** analysis,
- results of the **RT60** measurements,
- results of the **Tonality** measurements,
- results of the **STIPA** measurements.

Detailed description of structures of all file types is given in Appendix B.

6.1 MANAGING INSTRUMENT'S FILES – FILE MANAGER

Files are stored in directories, which are organised hierarchically.

File Manager enables access to all files and directories.

<ENT>

In the **File Manager** screen, you can check the memory content, create new directories and files, select directory for automatic data files saving, rename and delete files and directories.

All these operations can be done on the selected file or directory by means of the command list which is opened with the **<ENTER>** key.

<ENT>

Creating new directory or file

The first two positions of the **File Manager** list are **New Directory** and **New File**, which serve for creation of the new directory or file.

To do this, enter the directory in which the new element will be created, press **<ENTER>** at the **New Directory** or **New File** position and edit the new directory or file name in the text editor screen.

<ENT>

Note: The **New File** position appears if the measurement was performed.

Changing directories

The marked directory can be opened with the ► key.

To return to the upper directory, press the ◄ key.

►
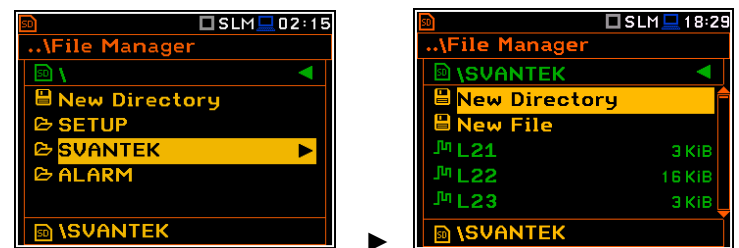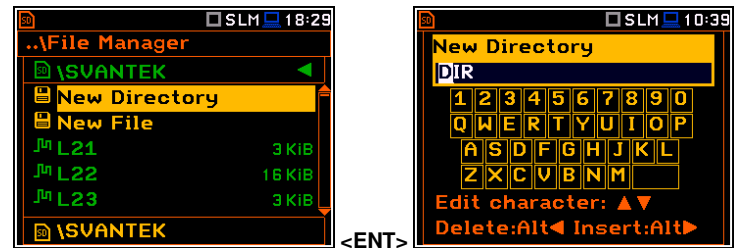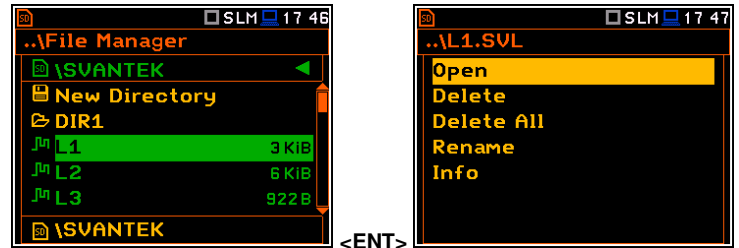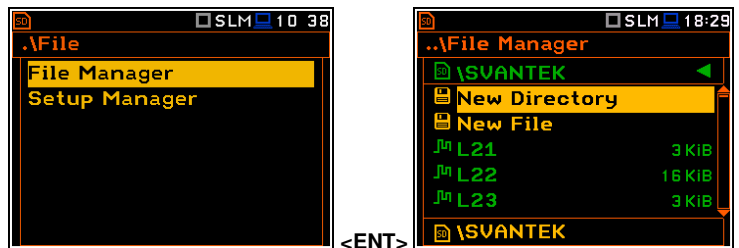
6.1.1 Assigning the directory for saving data files – Set as Working Directory

You can assign a directory for automatic saving of logger and wave files. To do this, choose the required directory and press **<ENTER>**. After opening the command list, select **Set as Working Dir.** and press **<ENTER>**.

Starting from this moment all logger and wave files will be saved in this directory.

<ENT>
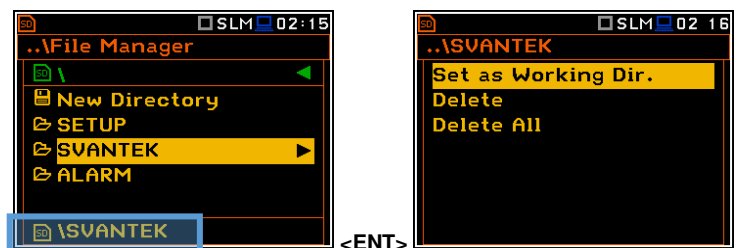
Note: The working directory name is displayed in the bottom line of the display.

6.1.2 Opening files/directories – Open

You can open a directory or a logger file. To do this, select the file/directory and press **<ENTER>**. After opening the command list, select the **Open** command and press **<ENTER>**.

The effect of such operation on a directory is similar to the effect of the ► key.

Opening the logger file means that the measurement results saved in this file will be loaded to the instrument's operation memory and may be reviewed on the screen. The results are loaded together with the **Mode** and **Measurement Function** settings, but other measurement settings are as before opening the logger file.

Note: *After loading the logger file, only summary results saved in the logger file as records can be viewed at the display. Each record contains measurement data for one cycle (measured with the* **Integration Period** *step).*

The record counter is displayed in the same line with the file name.

To see next cycle data, select the record counter position with the ▲ / ▼ key and then change the record number with the ◄ / ► key pressed together with **<Alt>**.
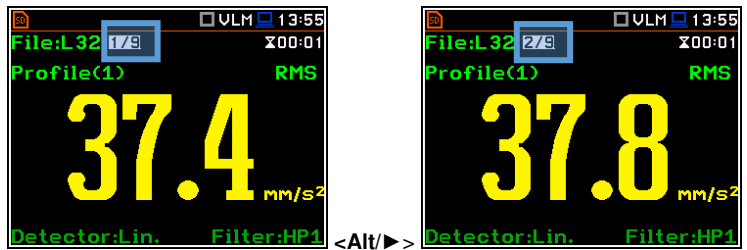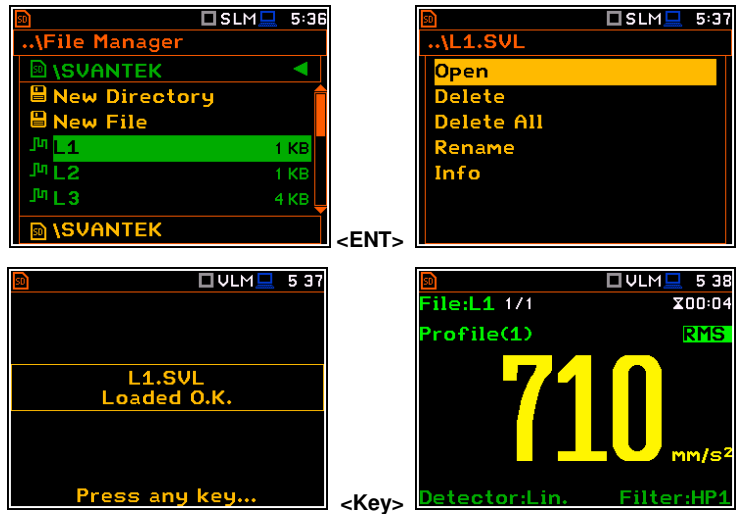
6.1.3 Deleting files/directories – Delete

You can delete a file or a directory from the file/directory list. To do this, select the file/directory and press **<ENTER>**. Select the **Delete** command in the command list and press **<ENTER>**. The instrument will ask for confirmation of this action since it cannot be undone once a file/directory has been deleted.

The delete directory command erases all files in this directory and files in all sub-directories.
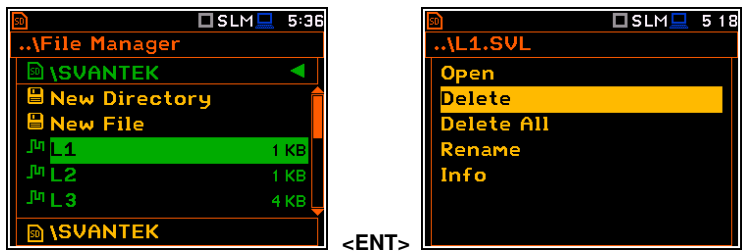
6.1.4 Erasing all files in a directory – Delete All

You can delete all elements from a directory. To do this, select the desired directory and open it with the ► key. Then select any file or subdirectory and press **<ENTER>**. Select the **Delete All** command in the command list and press **<ENTER>**. The instrument will ask for confirmation of this action since it cannot be undone once files have been erased.
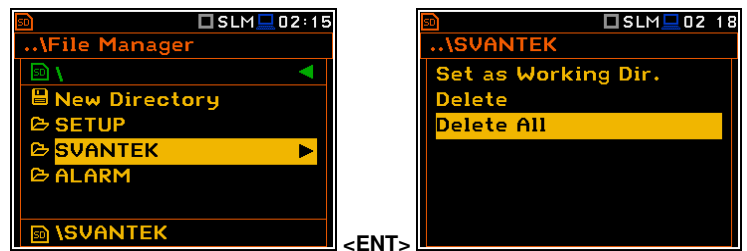
If the **Delete All** command is performed in a root directory, all files and directories in this root directory will be erased.   After this operation three directories will be created as default directories: **SETUP**, **SVANTEK** and **SYSTEM**.

<ENT>

6.1.5   Renaming files/directories – Rename

You can rename files or directories. To do this, select the desired file or directory and press **<ENTER>**. Select the **Rename** command in the command list and press **<ENTER>**. The special screen with editor function will be opened.

<ENT>
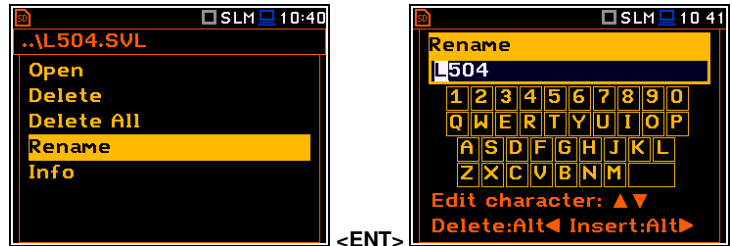
If a file with the new name is already exists in the directory, the warning will be generated and rename command will not be performed. After pressing any key, the instrument will return to the editor screen.

<ENT>
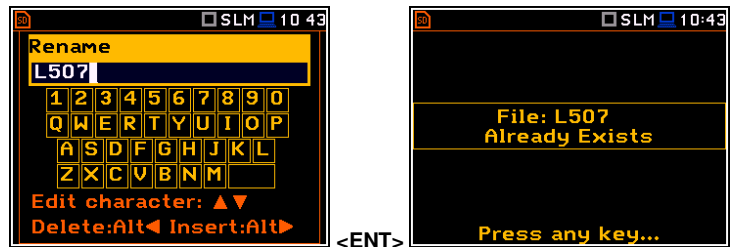
6.1.6   Viewing information about files/directories – Info

You can view information about a file or a directory. To do this, select the desired file/directory and press **<ENTER>**. Select the **Info** command in the command list and press **<ENTER>**. The information screen will be opened.

<ENT>
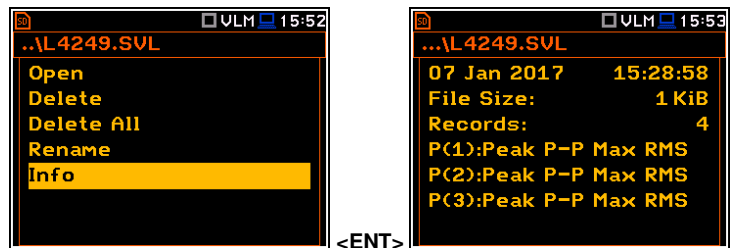
The file **Info** screen contains information about date and time of file creation, file size, number of records with summary results and results saved with the logger step for three profiles.

6.2   MANAGING SETUP FILES – SETUP MANAGER

Setup Manager enables saving new setup files, deleting, renaming or loading them as current instrument settings. You can also select the setup files which will be presented on the **Select Setup** screen appeared after turning the instrument on (see Chapter 2.7).

All setup files are stored in the default **SETUP** directory on the SD-card.

<ENT>
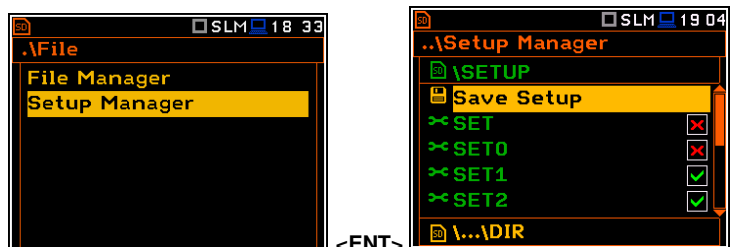
Saving setup files

It is possible to save only current instrument's settings. To save current settings in the setup file, press **<ENTER>** on the **Save Setup** position and edit the setup file name in the text editor screen. Up to 8 characters can be used to name a setup file.
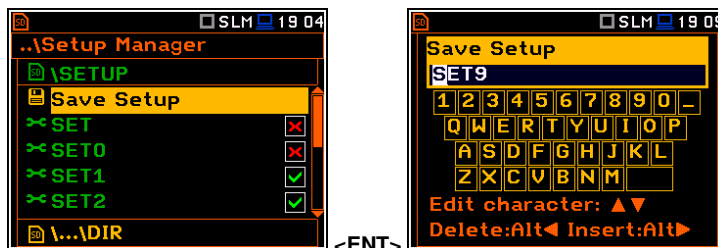
Loading setup files

Loading the setup file means that the settings saved in this file will be loaded to the instrument as current settings. So, if you press the **<Start>** key, the instrument will start the measurement with the newly loaded settings.

After loading the setup file, the instrument will be reconfigured.
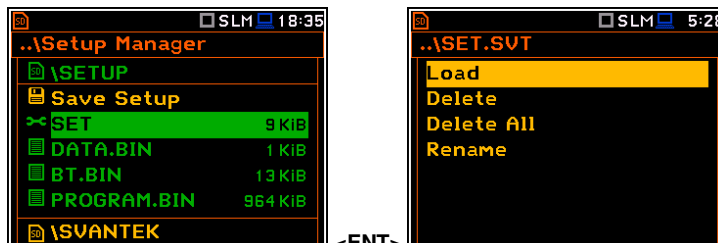
Deleting and renaming setup files

Deleting and renaming setup files is performed in the same way as files from the **File Manager** list.

Choosing pre-defined Setup

If the right-hand box of the setup file is marked, this setup will be in the list of setups during start-up of the instrument, so you can choose a pre-defined setup in the beginning of the measurement session.

So, when you are turning on the instrument, the **Select Setup or Esc** screen appears in which you can select **Last Settings** or one of the pre-defined setups and press **<ENTER>** to continue.

You can also press **<ESC>**. This will work as if you select **Last Settings**.
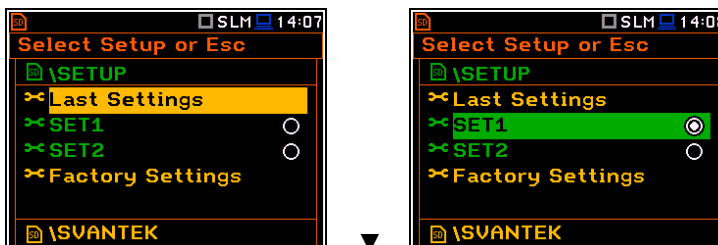
Note: *If no Setup will be checked in the* **Setup Manager***, the* **Select Setup or Esc** *screen will be skipped during the instrument turning on.*

7   CONFIGURING INSTRUMENT PARAMETERS – Instrument

The **Instrument** section is mainly related to the configuration of the hardware components of the instrument.

<ENT>
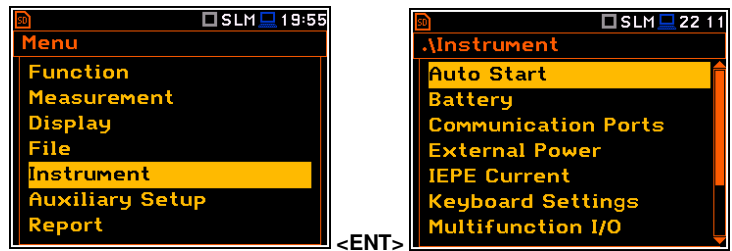
The **Instrument** section contains following positions:

Auto Start	allowing you to start the measurement automatically just after turning the instrument on,
Battery	allowing you to display information about current power source,
Communication Ports	allowing you to select the active port of the instrument,
External Power	allowing you to select the minimum voltage of the external source, when the instrument should be switched off automatically,
IEPE Current	allowing you to choose correct IEPE current supply for the used microphone and accelerometer,
Keyboard Settings	allowing you to set the operating mode of the **<Shift>** and the **<Start/Stop>** keys,
Multifunction I/O	allowing you to select the available functionality of the I/O port,
RTC	allowing you to set the Real-Time Clock,
Wireless Transfer	allowing you to select the network type and configure parameters of data transmission, when the instrument is operated in the SV 277 monitoring stations,
Unit Name	allowing you to enter the name of the instrument visible by the SvanNET web-service,
Unit Label	allowing you to display instrument properties and the standards which the instrument complies with.

7.1   MEASUREMENT AUTO START – AUTO START

The **Auto Start** position enables the measurement automatic start just after the turning the instrument on without pressing the **<Start>** key.

▶
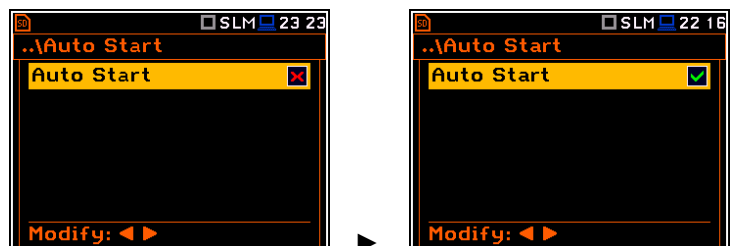
7.2   CHECKING INSTRUMENT'S POWERING – BATTERY

The **Battery** position allows you to check the condition of the internal battery and the voltage of the external power source. The instrument can be powered from four AA rechargeable batteries or standard alkaline batteries or from an external DC power supply (via the SA 15 power adapter or via the USB port).
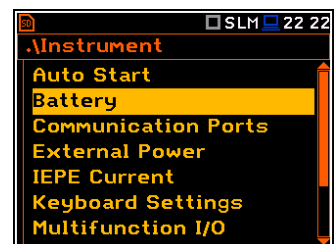
When the instrument is powered from a set of internal batteries you should select the correct battery type (**Alkaline** or **Rechargeable**). It is essential for the right detection of the capacity of the battery pack.
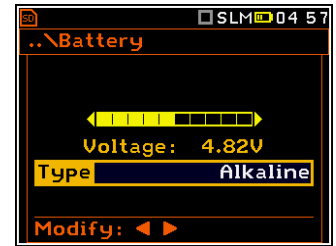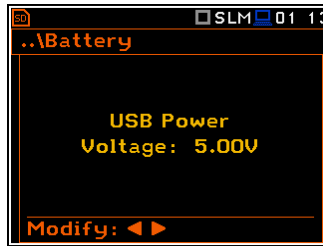
7.3   SETTING THE INTERFACE PARAMETERS – COMMUNICATION PORTS

The **Communication Ports** position enables switching GPS, selecting and programming the communication port(s) of the instrument (**RS232** or **Bluetooth**).

<ENT>
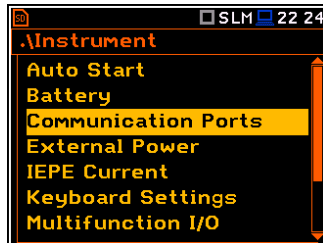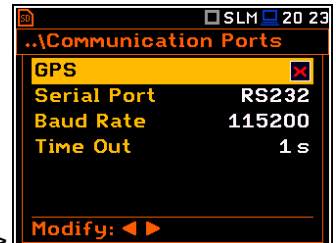
If **GPS** is switched on the **GPS** view becomes active (*path: <Menu> / Display / Display Modes*), which shows the GPS status, co-ordinates, velocity and date and time.

=>
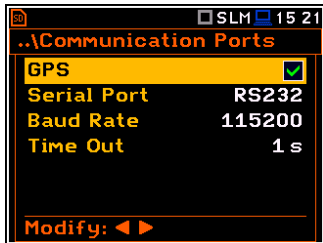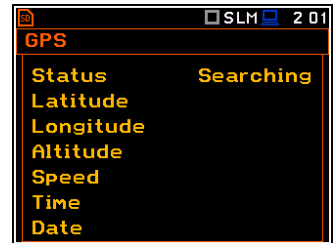
Note: *GPS results are transmitted to the instrument from the external GPS device.*

For the **RS232** serial port, two parameters should be defined: transmission speed (**Baud Rate: 1200**, **2400**, **4800**, **9600**, **19200**, **38000**, **57600** or **115200** bits/s) and the time limit during which the data transfer should be performed (**Time Out**).

The transmission speed should be the same as in the connected device to ensure successful data transfer.

The default value of the **Time Out** parameter is equal to one second, but this may be too short for the printers, which are not fast enough. In such cases, the **Time Out** parameter should be increased.

To use the *Bluetooth®* interface, you should key in the **Authorisation code** to pair another device with the instrument.

Authorisation code can be changed in the text editor screen with a virtual keyboard, which is opened with the ◄ / ► key.

▶
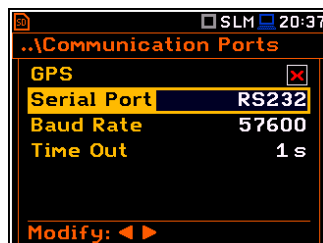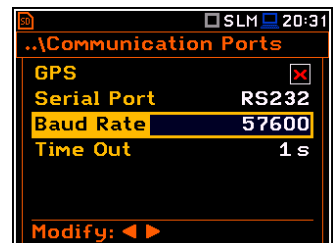
When **Bluetooth** is selected, the grey "Bluetooth" icon is displayed while there is no connection with another device. When devices are paired, the "Bluetooth" icon changes its colour to green.

▶
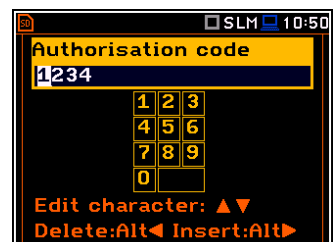
7.4   SETTING THE EXTERNAL POWER ON/OFF CONDITIONS – EXTERNAL POWER

The **External Power** position allows you to set the minimum voltage of the external DC power source, when the instrument should be switched off automatically (**Power Off**) or the voltage threshold to switch it on (**Power On**) when the voltage of the external DC power source exceeds this level.

<ENT>
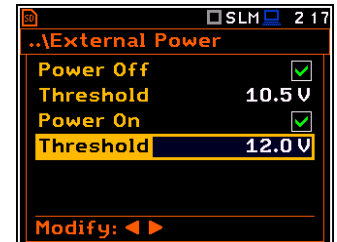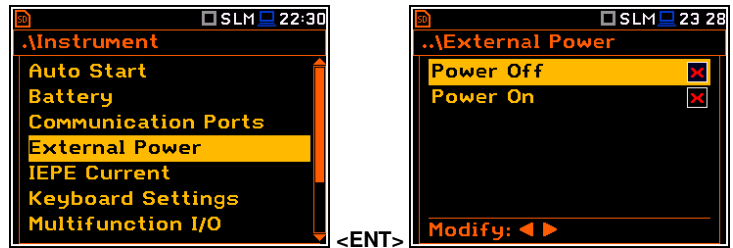
The **Threshold** parameters appear in the screen when **Power Off** and/or **Power On** parameters are enabled.

This screen appears automatically after switching on the instrument when the instrument is connected to the external DC power source.

7.5   SELECTING THE IEPE SUPPLY CURRENT – IEPE CURRENT

The **IEPE Current** position allows you to disable IEPE (**IEPE Off**) or to choose the correct IEPE supply current for the used microphone or accelerometer:

IEPE Current 1.5 mA or
IEPE Current 4.5 mA.

<ENT>
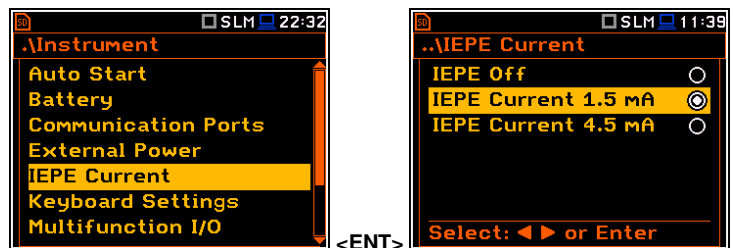
7.6   PROGRAMMING THE KEYBOARD– KEYBOARD SETTINGS

The **Keyboard Settings** position allows you to programme the functionality of the **<Shift>**, **<Alt>** and **<Start/Stop>** keys. The default settings are **Direct** for both items shown on the display screen.

<ENT>
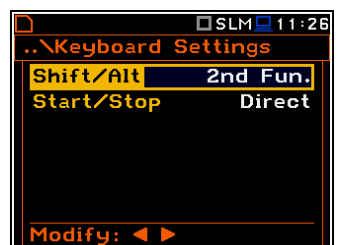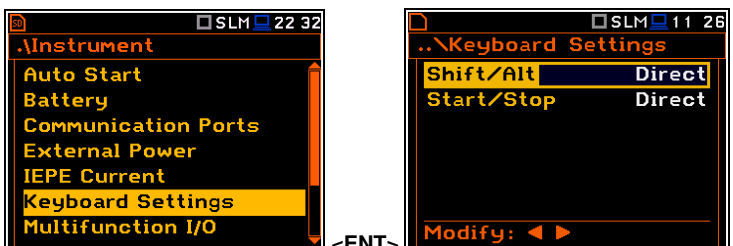
<Shift> / <Alt> key mode

In the **Shift/Alt** position, you can choose between **2nd Fun.** or **Direct**. When the **Direct** option is selected, the **<Shift>** and **<Alt>** keys operate as in a computer keyboard – to achieve the desired result, the second key should be pressed at the same time with **<Shift>/<Alt>**. When the **2nd Fun.** option is selected the **<Shift>/<Alt>** key operates in sequence with the other one - as in smartphones. Due to this you can operate the instrument with one hand.

<Start/Stop> key mode

In the **Start/Stop** position, you can choose between **Direct** and **With Shift**. When the **Direct** option is selected, the instrument reacts on each of the **<Start/Stop>** keystroke, starting or stopping the measurement.

When the **With Shift** option is selected the **<Start/Stop>** key will operate with the **<Shift>** key pressed simultaneously or in sequence. The measurements are started or stopped after pressing both keys.

7.7   SETTING THE I/O PORT PARAMETERS – MULTIFUNCTION I/O

The **Multifunction I/O** position allows you to program the functionality of the **I/O** port (3.5 mm jack socket).

<ENT>
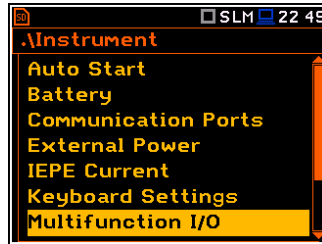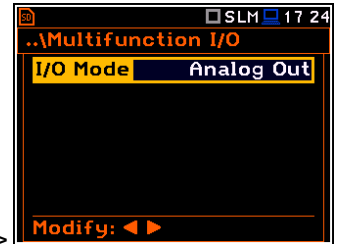
The **I/O** jack socket can be used as (**I/O Mode**):

- output of the analogue signal (**Analog Out**) transmitted from the input of the instrument to its output without any digital processing (i.e. frequency filtering, etc.),

- input of the digital signal (**Digital In**) used as an external trigger to start the measurements. The instrument is acting in this case as so called "slave instrument",

- output of the digital signal (**Digital Out**) used for triggering other "slave instrument(s)" (the instrument is acting in this case as a "master instrument"), or as a source of any alarm signal in case of certain circumstances occurred during measurements (i.e. the level of the input signal is higher than the user selected trigger alarm threshold).

More detailed description of the **I/O** port is given in Appendix C.

►
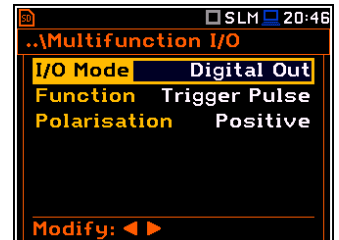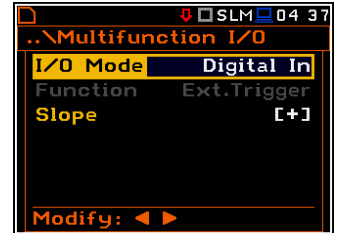
Note: If the **RPM** function is enabled (path: <Menu> / Measurement / RPM Measurement) the **Multifunction I/O** is set automatically to **Digital In** mode with the **Ext.Trigger** function.
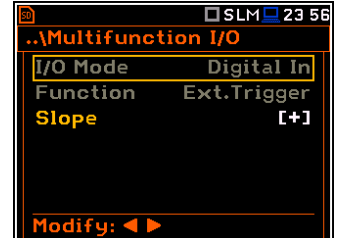
Digital In mode (External trigger function)

In the **Digital In** mode, the signal appeared on the **I/O** socket will be treated as the external trigger if the **External** trigger was chosen (path: <Menu> / Measurement / Measurement Trigger / Trigger: External or <Menu> / Measurement / Logging / Trigger: External).   In the **Digital In** mode the **Function** parameter is set to **Ext.Trigger**. It is possible to select the trigger voltage slope: **[+]** (uprising as default) or **[–]** (falling).
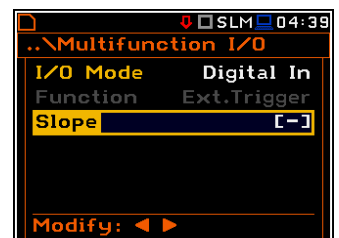
Function of the Digital Out mode

The **Function** position allows you to select the function of the digital output of the **I/O** instrument's socket. The socket can be used as a source of the trigger pulse (**Trigger Pulse**) which starts the measurement in another "slave instrument" linked to the "master instrument" or as an alarm signal, which appears there after fulfilment of certain conditions (**Alarm Pulse**).
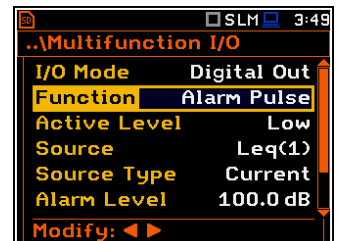
Polarisation of digital output trigger pulse

The **Polarisation** parameter defines the output trigger pulse polarisation: **Negative** or **Positive**.
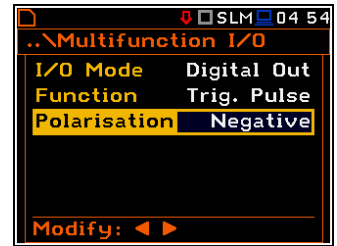
Active level of alarm pulse

The **Active Level** parameter defines which level of the signal should be treated as a valid one: **Low** or **High** ("negative" or "positive" logic).
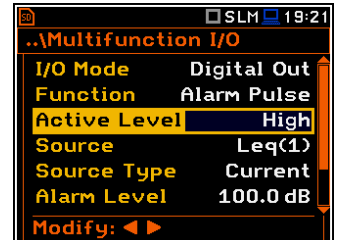
Alarm trigger result

The **Source** parameter defines the result, the level of which should be checked for the alarm triggering. If the result level is greater than the threshold level (**Alarm Level**), the instrument will generate an alarm signal on the **I/O** socket. The results from the first profile: **Leq(1)**, **Peak(1)**, **Max(1)** or **Spl(1)** can be selected as an alarm trigger source.
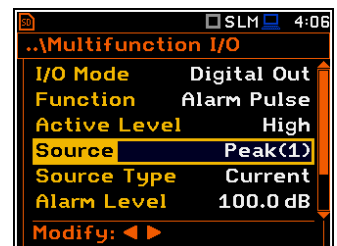
Type of Alarm source

The **Source Type** parameter defines the type of an alarm source: **Current** or **Periodic**.

Current means that the alarm pulse will be generated all the time when the Source result averaged with 1-second step is over the **Alarm Level** value.

Periodic means that the alarm pulse will be generated all the time when the Source result averaged with Integration Period step is over the **Alarm Level** value.
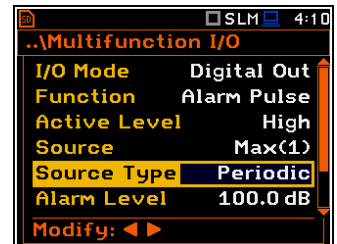
Alarm trigger threshold level

The **Alarm Level** parameter defines the threshold level for triggering an alarm pulse generation. If the **Source** value is greater than the **Alarm Level**, the instrument will generate the alarm signal with the selected logic. The available levels are within the range [30.0 dB, 140 dB] in the Sound mode and [60.0 dB, 180 dB] in the Vibration mode.
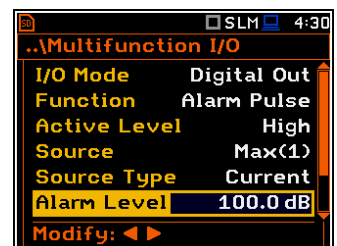
SMS alarm message

When the alarm is generated during the measurement, the SMS message may be sent (**Send SMS**) to the phone number, defined in the **SMS Option** screen (*path: <Menu> / Instrument / Wireless Transfer / SMS Options*).

–
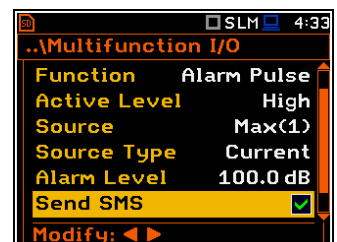
E-mail alarm message

When the alarm is generated during the measurement the e-mail message may be sent (**Send E-Mail**) to the address, defined in the **E-mail Settings** screen (*path: <Menu> / Instrument / Wireless Transfer / E-mail Settings*).

–

Note: *SMS and e-mails can be sent in the case the instrument is working with the modem (for example, as a part of the SV 277 monitoring station).*

7.8 PROGRAMMING THE INSTRUMENT'S INTERNAL REAL TIME CLOCK – RTC

The **RTC** position allows you to programme the internal Real Time Clock. This clock is displayed in the upper right corner of the display.

<ENT>
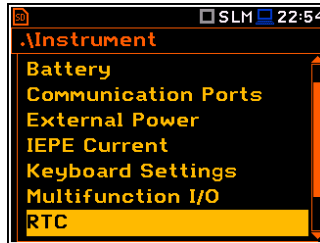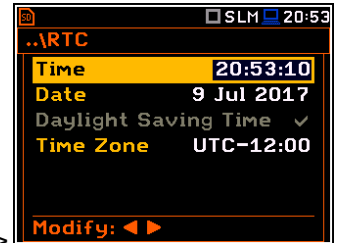
The required time (hour, minute and second) is set in a special screen, which is opened with the ◄ / ► key when the **Time** position is selected.

To set hour, minute or second, select the appropriate field with the ◄ / ► key, select value with the ▲ / ▼ key and press **<ENTER>**.

If you exit this screen with **<ESC>** the new time will be also saved.

The required date can be selected in a special screen, which is opened with the ◄ / ► key when the **Date** position is selected.

To set the date, select its position in the calendar with the ◄ / ► or ▲ / ▼ key and press **<ENTER>** to confirm the selection.

If you exit this screen with **<ESC>** the new time will be also saved.
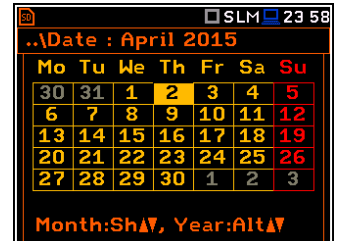
Time Zone can be selected in a special screen, which is opened by means of the ◄ / ► key.
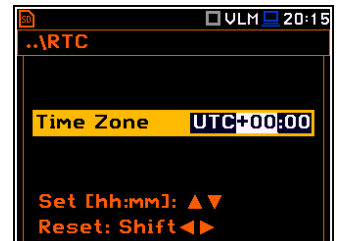
7.9 REMOTE COMMUNICATION SETTINGS – WIRELESS TRANSFER

The SV 977D instrument is not equipped with the modem and itself cannot assure data transfer via the cellular network. However, it can control data transfer via the modem that supports the cellular connection with the help of the **Wireless Transfer** functionality. Such solution is used in the SV 277 monitoring stations. The connection with the SV 277 modem is carried out via the USB port.

Settings of the **Wireless Transfer** menu are described in Chapter 15.

7.10 ASSIGNING A NAME TO THE INSTRUMENT – UNIT NAME

The **Unit Name** position allows you to edit the instrument's name in the text editor screen.

The instrument name is used in the SvanNET web-service and SvanPC++ software for the instrument simple identification.

<ENT>
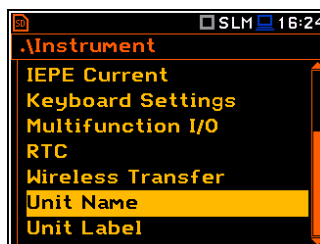
7.11 CHECKING INSTRUMENT PROPERTIES – UNIT LABEL

The **Unit Label** position allows you to check information about the instrument type, its serial number, the current software version installed and the relevant standards, which the instrument fulfils.

The displayed text is scrolled on the display after pressing the ▲ / ▼ key.

<ENT>
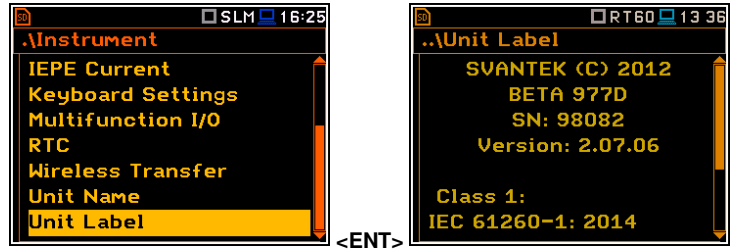
> **Note:** *The contents of the **Unit Label** screen should be always sent to the Svantek service department or official representative in case of any problems faced by the user during the instrument's normal operation.*

8   AUXILIARY SETTINGS – Auxiliary Setup

The **Auxiliary Setup** section provides additional functions that allow, for instance, customization of the device interface to a specific user requirement and are not directly related to the hardware components of the instrument.

<ENT>
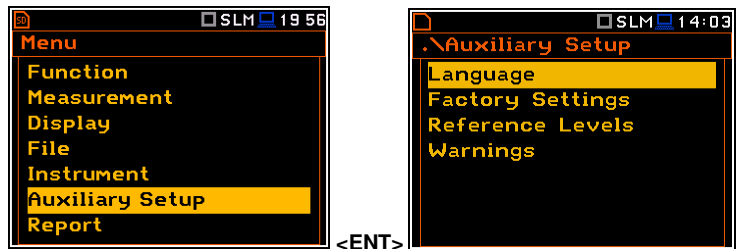
The **Auxiliary Setup** section contains following positions:

Language   allowing you to select the language of the user interface,

Factory Settings   allowing you to return to the default, factory settings,

Reference Levels   allowing you to select reference levels for Vibration measurements,

Vibration Units   allowing you to select units for Vibration results; this position appears only in the Vibration modes,

Warnings   allowing you to enable/disable warnings to be displayed during the normal operation of the instrument.

8.1   SELECTING THE LANGUAGE OF THE USER INTERFACE– LANGUAGE

The **Language** position allows you to select the language of the user interface.

If after turning the instrument on an unknown language interface appears on the display, you can reset the instrument with four **<Shift/Enter/Alt/Start>** keys pressed together. The instrument will come back to the default setup with the English interface.

<ENT>
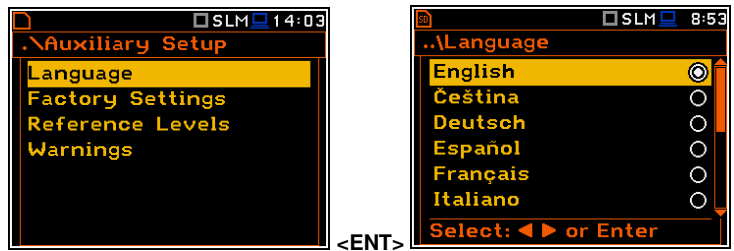
8.2   RESTORING FACTORY SETTINGS – FACTORY SETTINGS

The **Factory Settings** position allows you to restore the default settings of the instrument.

Being on the **Factory Settings** position press **<ENTER>**, select **Yes** in the opened **Factory Settings** screen and press **<ENTER>** to perform the operation. After the restoration process the instrument will inform that "**Settings restored**".

<ENT>
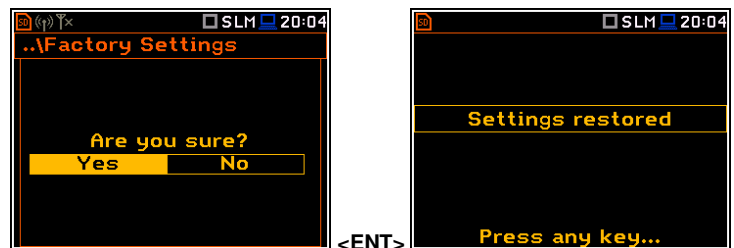
The factory settings can be installed also with four **<Shift/Enter/Alt/Start>** keys pressed together.

*Note: The **Factory Settings** command also restores the English language of the interface.*

8.3 SETTING THE REFERENCE LEVELS – REFERENCE LEVELS

The **Reference Levels** position allows you to set reference levels for the measured acceleration (**Acc**), velocity (**Vel**) and displacement (**Dil**) results. For sound measurements it only informs about the default reference sound level. The selected values will be considered during calculations of measurement results expressed in dB (Logarithmic scale).
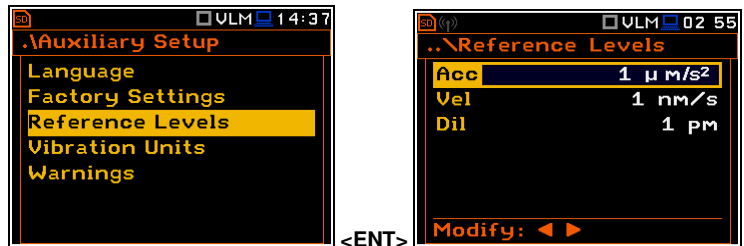
Reference levels for vibration measurements

In the **Acc** position you can set the reference level of the acceleration signal in the range: 1 μms^{-2} - 100 μms^{-2}.

In the **Vel** position you can set the reference level of the velocity signal in the range: 1 nms^{-1} - 100 nms^{-1}.

In the **Dil** position you can set the reference level of the displacement signal in the range: 1 pm - 100 pm.

Reference level for sound measurements

For sound measurements, the **Reference Levels** sub-lists is used to inform only the user that the reference level of the acoustic signal is equal to **20 μPa**.
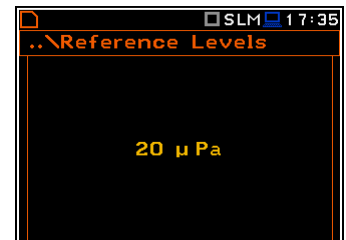
8.4 CHOOSING UNITS FOR VIBRATION RESULTS – VIBRATION UNITS

The **Vibration Units** position allows you to choose units for Vibration measurements (this position is available only in Vibration modes).

It is possible to select the **Non-Metric** units (e.g. g, ips, mil etc.) or **Metric** units (e.g. m/s^2, m/s, m etc.).
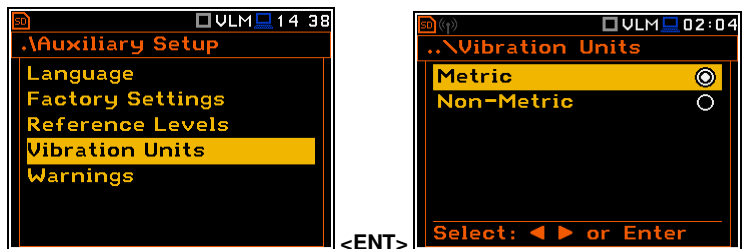
8.5 ACTIVATING WARNINGS – WARNINGS

The **Warnings** position allows you to activate messages, which will be displayed during the normal operation of the instrument.

By default, all warnings are enabled.
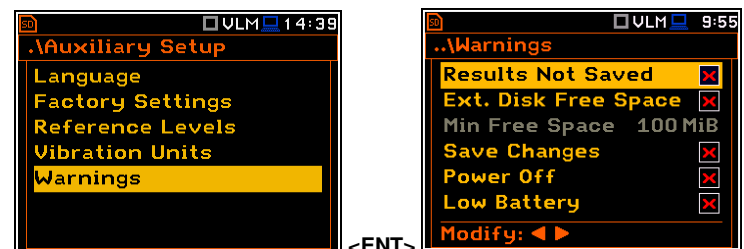
Saving measurement results

If the **Results Not Saved** warning is enabled, the special confirmation will be displayed after pressing the **<Start>** key in case results of the previous measurement were not saved.

You should select one of three answers to the question **Continue?**: **Yes**, **No** or **Save**. If **Yes** is chosen, the instrument returns to the active measurement view and starts the new measurement process. If **No** is chosen, the instrument returns to the active measurement view without starting the new measurement
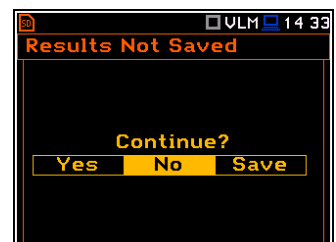
process. If **Save** option is chosen, then the measurement results are saved and after saving the instrument returns to the active measurement view and starts the new measurement process.

Checking free space of the memory

If the **Ext. Disk Free Space** warning is enabled the instrument will verify free space on the SD-card and will generate the warning when the space is lower than **Min Free Space**.

The selected limit should be within the range [**1 MB**, **1024 MB**].
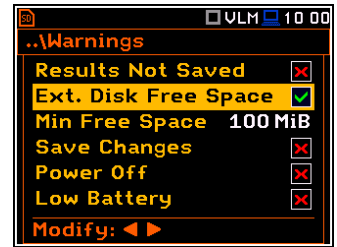
Confirmation of parameters changes

If the **Save Changes** warning is enabled, the instrument asks to confirm whether you want to save changes or not in cases you changed some parameters in the list of parameters but exiting the screen with the **<ESC>** key.

=>
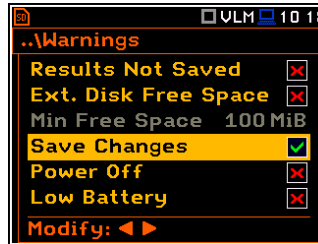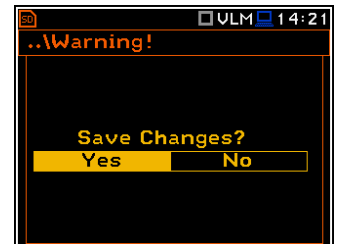
Confirmation of instrument turning off

If the **Power Off** warning is enabled, the instrument will ask for confirmation before switching off.

=>
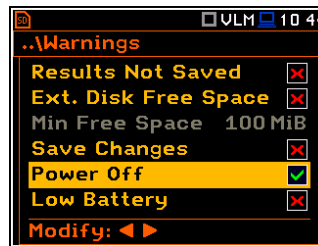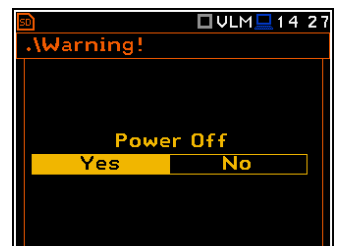
Low Battery warning

If the **Low Battery** warning is enabled, the instrument will display the message in the case the internal battery capacity drops below 10%. Warning "Low Battery" will be displayed shortly every 20 seconds.

9   PRINTING REPORTS – Report

The **Report** section allows you to print reports of the Sound or Vibration Summary results for the last measurement cycle in the predefined format on the printers directly connected to the SV 977D instrument.

This position becomes active after the first measurement.

To obtain a report, connect the instrument to the printer's RS 232 port using the **SP 75** interface. This hardware interface is hidden in the Cannon type, 9-pin RS 232 plug-in. On the other end of the **SP 75** interface, which itself looks like a cable, there is the USB-C plug-in. This plug-in should be placed in the USB-C socket of the instrument.

> *Note: The SP 75 converter serves as the RS 232 interface. The SP 75 connection to the USB socket is detected and after successful detection the blue "RS232" icon appears on the display.*

> *Note: Before printing, be sure that the **RS232** port is activated and properly configured (path: <Menu> / Instrument / Communication Ports).*

To activate the RS232 port, in the **Communication Ports** list (*path: <Menu> / Instrument / Communication Ports*), select the **RS232** in the **Serial Port** position, select proper speed of the transmission (**Baud Rate**) and the time limit during which the communication operation should be performed (**Time Out**).
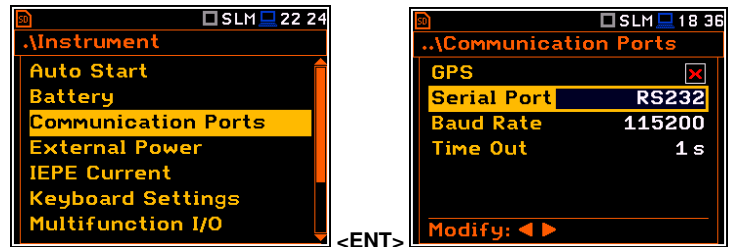
The RS 232 interface transmission speed (**Baud Rate**) can be selected from the following available values: **1200**, **2400**, **4800**, **9600**, **19200**, **38000**, **57600** or **115200** bits/s. The transmission speed should be the same as in the connected printer to ensure successful data transfer.

The default value of the **Time Out** parameter is equal to one second, but this may be too short for the printers, which are not fast enough. In such cases, the **Time Out** parameter should be increased.

Printers, which have only a USB interface, are currently not driven by the instrument.

> *Note: Switch the power off before connecting the instrument to any external device (e.g. a printer or a PC).*

> *Note: All reports are printed in the character format using the ASCII set on either A4 or A5 size paper.*

After selecting the **Report** position and pressing **<ENTER>** the instrument starts printing the report and displays the message "*Print results, printing…*".

The data are transferred from the instrument to the attached printer, while the message is displaying. The instrument returns to the **Menu** list after transferring all data.
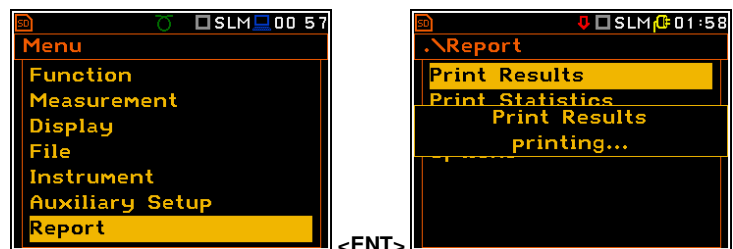
The message about the time limit is displayed if a printer is not connected or there is any other reason that it does not receive the data. The instrument waits for the reaction of the user (any key should be pressed except **<Shift>** and **<Alt>**) and after pressing a key it returns to the **Menu** list.

Below is the example of the report:
```
SVANTEK (C) 2012
SVAN 977 v.1.41.3
S/N:45456
```

```
26 Mar 2020 10:23:52

Mode: Sound Meter
Function: Level Meter
Comp. Filt: Off
Range: Low

Meas. Time: 00:00:01

Peak (1):  66.01dB
Max  (1):  56.40dB
Min  (1):  56.36dB
Spl  (1):  56.40dB
Leq  (1):  56.38dB
SEL  (1):  56.38dB
Ld   (1):  56.38dB
LEPd (1):  56.38dB
Ltm3 (1):  56.40dB
LAFTeq (1):  56.40dB
EX   (1):  56.38dB
SD   (1):   0.01dB
LR30 (1):   ---
LR60 (1):   ---
Ovl  (1):   0.0%

Peak (2):  65.37dB
Max  (2):  54.62dB
Min  (2):  54.57dB
Spl  (2):  54.62dB
Leq  (2):  54.60dB
SEL  (2):  54.60dB
Ld   (2):  54.60dB
LEPd (2):  54.60dB
Ltm3 (2):  54.62dB
LCFTeq (2):  54.62dB
EX   (2):  54.60dB
SD   (2):   0.01dB
LR30 (2):   ---
LR60 (2):   ---
Ovl  (2):   0.0%

Peak (3):  68.86dB
Max  (3):  57.23dB
Min  (3):  57.19dB
Spl  (3):  57.23dB
Leq  (3):  57.21dB
SEL  (3):  57.21dB
Ld   (3):  57.21dB
LEPd (3):  57.21dB
Ltm3 (3):  57.23dB
LZFTeq (3):  57.23dB
EX   (3):  57.21dB
SD   (3):   0.01dB
LR30 (3):   ---
LR60 (3):   ---
Ovl  (3):   0.0%

L10 (1):  56.9dB
L20 (1):  56.8dB
L30 (1):  56.7dB
L40 (1):  56.6dB
L50 (1):  56.5dB
L60 (1):  56.4dB
```

```
L70 (1):   56.3dB
L80 (1):   56.2dB
L90 (1):   56.1dB
L95 (1):   56.0dB

L10 (2):   54.9dB
L20 (2):   54.8dB
L30 (2):   54.7dB
L40 (2):   54.6dB
L50 (2):   54.5dB
L60 (2):   54.4dB
L70 (2):   54.3dB
L80 (2):   54.2dB
L90 (2):   54.1dB
L95 (2):   54.0dB

L10 (3):   57.9dB
L20 (3):   57.8dB
L30 (3):   57.7dB
L40 (3):   57.6dB
L50 (3):   57.5dB
L60 (3):   57.4dB
L70 (3):   57.3dB
L80 (3):   57.2dB
L90 (3):   57.1dB
L95 (3):   57.0dB

1/3 Aver. Lin Z
Total A : 120.0 dB
Total C : 122.9 dB
Total Z : 121.0 dB
```

10 1/1 OCTAVE AND 1/3 OCTAVE ANALYSER

The instrument operates as a real-time 1/1 octave or 1/3 octave analyser in a very similar way to the level meter. Moreover, 1/1 octave or 1/3 octave analysis is performed in parallel with the level meter measurements. All digital band-pass filters (sixteen 1/1 octave filters with centre frequencies from 31.5 kHz down to 1.0 Hz and forty eight 1/3 octave filters with central frequencies from 40 kHz down to 0.8 Hz; in the "base ten" system) work in real-time with the weighting filters (**Z**, **A**, **B**, **C**, **HP** or **HPE**) and the RMS/LEQ detector (**Linear**, **Fast** or **Slow**). This enables a spectrum pre-weighting with one of the selected broadband frequency curves if required for the application such as the provision of hearing protectors during the control of high workplace noise.

For each octave or one-third octave band, the RMS result (averaged, instantaneous, minimum or maximum) is calculated and presented as a bar on the spectrum graph. Spectra can be examined on a display in the **Spectrum** view.

The read-out of spectrum values can be done using a vertical cursor.

Besides results for bands three **Total** Leq/RMS values (averaged, instantaneous, Min or Max) are measured and displayed as additional three bars on the spectrum graph.

For sound measurements, weighting filters for the Total values are set by default and the user cannot change them: Total 1 – A filter, Total 2 – C filter, Total 3 – Z filter.

For vibration measurements, for the Total 1 value the weighting filter is always set to HP, whereas filters for Total 2 and Total 3 can be set in the **Profiles** screen (*path: <Menu> / Measurement / Profiles*) from the set: HP, HP1, HP3, HP10, Vel1, Vel3, Vel10, Dil1, Dil3, Dil10, Wh and VelMF.
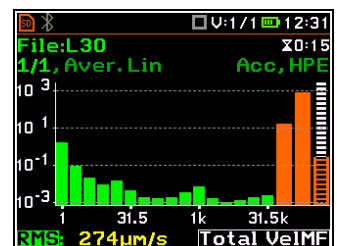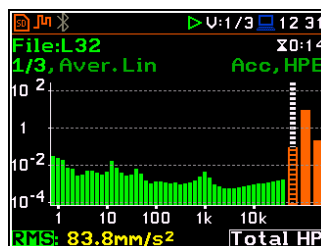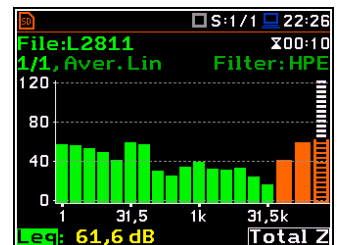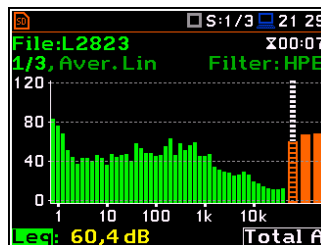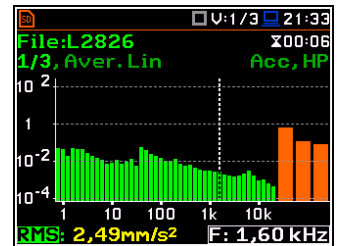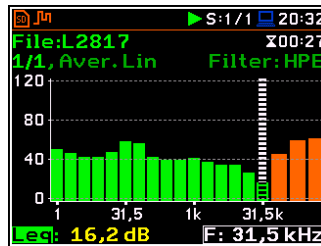
10.1 ACTIVATING THE 1/1 OCTAVE OR 1/3 OCTAVE FUNCTION

To activate the 1/1 octave or 1/3 octave analysis function, open the **Measurement Function** screen, select the **1/1 Octave** or **1/3 Octave** position and press **<ENTER>**.
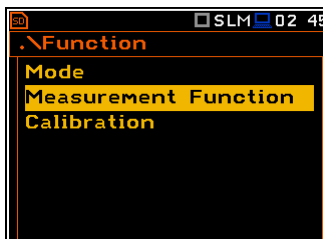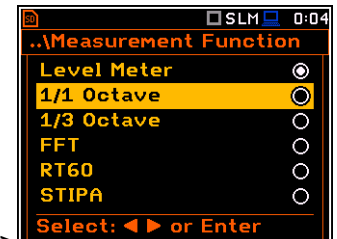
Note: The **1/3 Octave** function is optional and should be unlocked by entering an activation code in the text editor screen, which is opened after first attempt to select this option. Once unlocked this option will be ready to use permanently.

Note: It is not possible to change the current function during a running measurement. In this case, the instrument displays for about 2 seconds the message: "Measurement in Progress". To change the current function, the measurement must be stopped!

10.2 CONFIGURING THE 1/1 OCTAVE OR 1/3 OCTAVE ANALYSER

10.2.1 General measurement settings for 1/1 or 1/3 octave analysis – General Settings

Execution of the 1/1 octave or 1/3 octave analysis depends on a certain set of parameters, configured in the **Measurement** section.

Averaging of Leq/RMS results for each spectrum band is performed for the **Integration Period** and is repeated the **Repetition Cycles** times. 1/1 octave and 1/3 octave spectra are always saved as Summary Results.

The **Integration Period** and **Repetition Cycles** parameters are defined in the **General Settings** list.
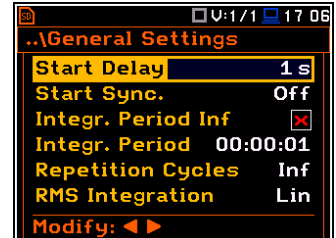
10.2.2 Selecting the measurement range for 1/1 or 1/3 octave analysis – Range

The input range for the **1/1 Octave** or **1/3 Octave** functions can be selected in the **Range** screen: **Low** or **High**.

The values of ranges in sound modes depend on the settings in the **Compensation Filer** screen (*path: <Menu> / Measurement / Compensation Filter*) and in both sound and vibration modes – on the calibration factor (see Chapter - 4.6).

10.2.3 Logging of 1/1 or 1/3 octave spectra – Logging

Spectra can be logged in a logger file with two steps: **Integration Period** step and/or **Logger Step**.

For logging 1/1 octave and 1/3 octave spectra, the **Logger** position must be enabled in the **Logger Setup** screen (*path: <Menu> / Measurement / Logging / Logger Setup*).

If you wish to save spectra together with Summary results, you must enable the **Summary Results** position. 1/1 octave and 1/3 octave spectra will be then logged with the **Integration Period** step.

The instrument allows additional logging of 1/1 octave and 1/3 octave spectra in a logger file with the **Logger Step**.

For this, you should enable logging of spectra switching on the **Spectrum** position in the **Logger Results** screen (*path: <Menu> / Measurement / Logging / Logger Results*).
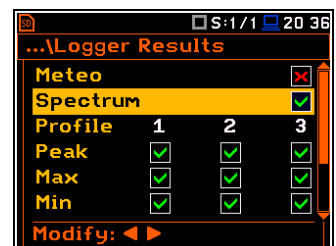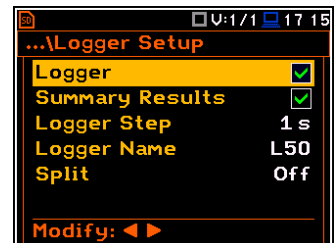
10.2.4 Setting 1/1 or 1/3 octave analysis parameters – Spectrum

For active **1/1 Octave** and **1/3 Octave** functions a context position (**Spectrum**) appears in the **Measurement** list (*path: <Menu> / Measurement / Spectrum*). In the **Spectrum** screen, you can select the band and the pre-weighting broadband frequency filter (only for sound measurements).

<ENT>
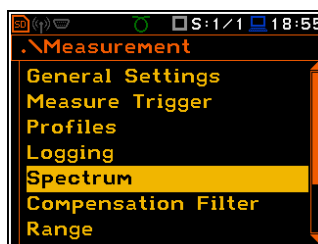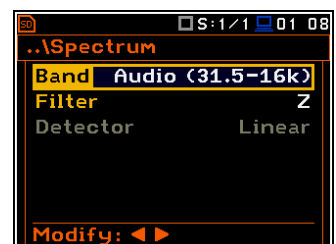
Band

The **Band** parameter defines the band of 1/1 octave or 1/3 octave analysis.

Available bands of the sound analysis are as follows:

- **1/1 Octave**:

  - **Audio (31.5-16k)** - 10 filters with centre frequencies from 31.5 Hz to 16 kHz

   =>

  - **Full (1-16k)** - 15 filters with centre frequencies from 1.0 Hz to 16 kHz

   =>

  - **Ultra (1-31.5k)** - 16 filters with centre frequencies from 1 Hz to 31.5 kHz

   =>
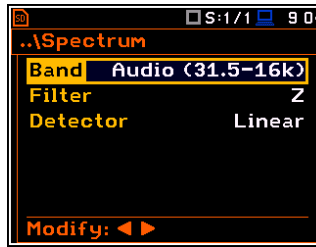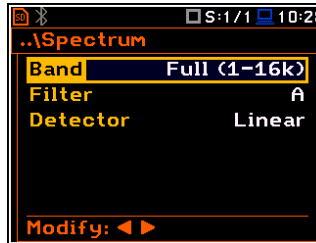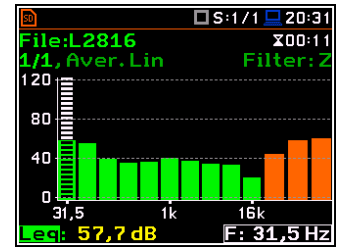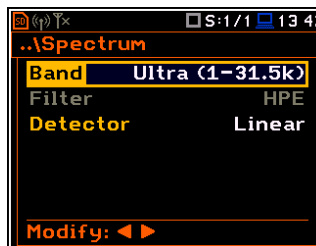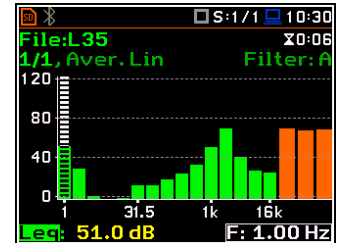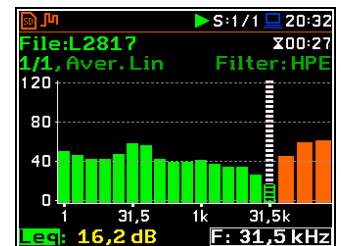
- **1/3 Octave**:

  - **Audio (20-20k)** - 31 filters with centre frequencies from 20 Hz to 20 kHz

   =>

  - **Full (0.8-20k)** - 45 filters with centre frequencies from 0.8 Hz to 20 kHz

   =>

  - **Ultra (0.8-40k)** - 48 filters with centre frequencies from 0.8 Hz to 40 kHz

   =>
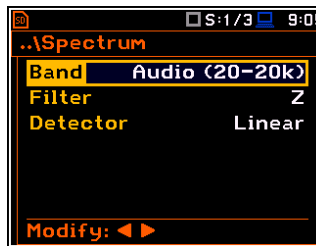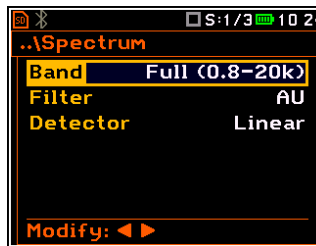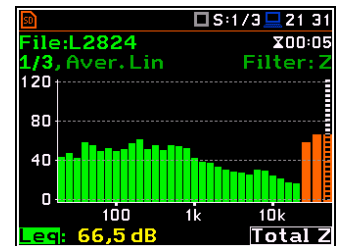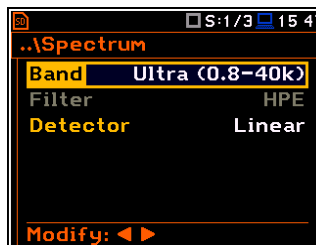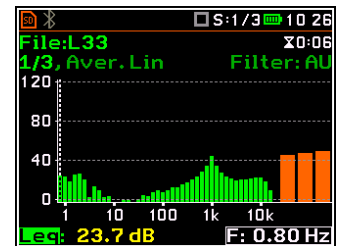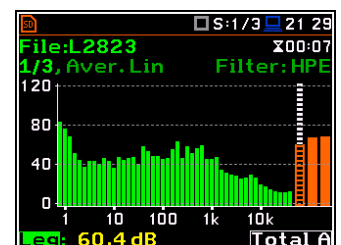
Available bands of the vibration analysis are as follows:

- **1/1 Octave**:

  - **Full (1-16k)** - 15 filters with centre frequencies from 1 Hz to 16 kHz

 =>

  - **Ultra (1-31.5k)** - 16 filters with centre frequencies from 1 Hz to 31.5 kHz

 =>
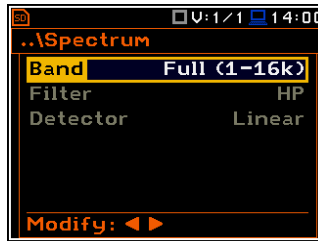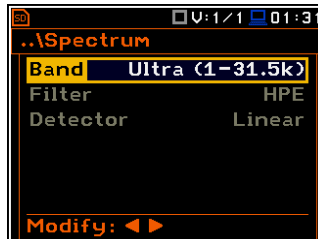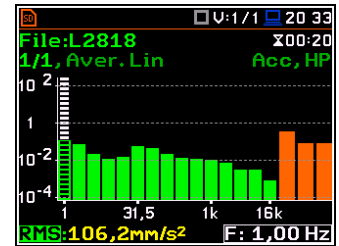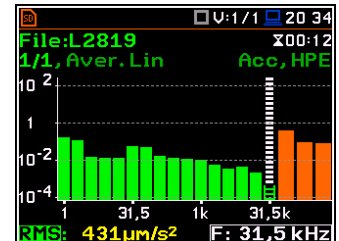
- **1/3 Octave**:

  - **Full (0.8-20k) -** 45 filters with centre frequencies from 0.8 Hz to 20 kHz

 =>

  - **Ultra (0.8-40k) -** 48 filters with centre frequencies from 0.8 Hz to 40 kHz

 =>
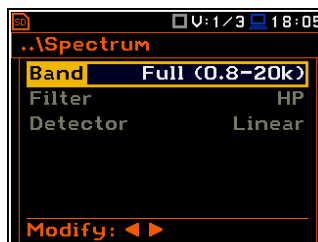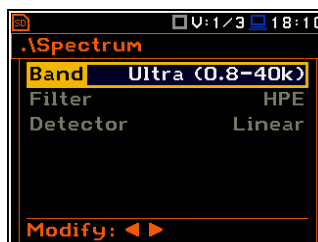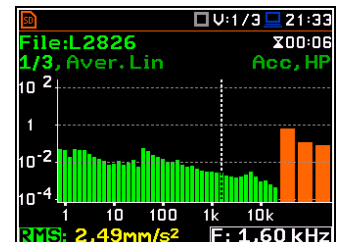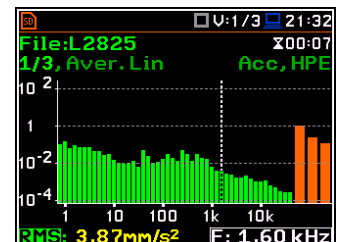
Weighting filter

Following pre-weighting filters are available for the **1/1 Octave** and **1/3 Octave** analysis.

For the analysis of sound signals with the **Audio** and **Full** bands:

- **Z** – class 1 according to IEC 61672-1:2013,
- **A** – class 1 according to IEC 651 and IEC 61672-1:2013,
- **C** – class 1 according to IEC 651 and IEC 61672-1:2013,
- **B** – class 1 according to IEC 651,
- **U** – class 1 according to IEC 61012:1990,
- **AU** – class 1 according to IEC 61012:1990,
- **HP** – high-pass filter.

For the analysis of vibration signals with the **Full** band:

- **HP** – high-pass filter.

For the analysis of sound and vibration signals with the **Ultra** band:

- **HPE** – ultra band filter.

The filter characteristics are given in Appendix C.
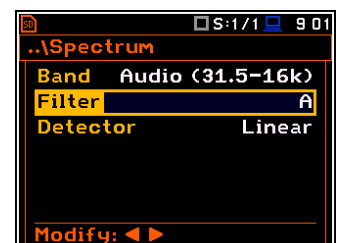
RMS detector

The **Detector** parameter defines the RMS detector for the 1/1 octave or 1/3 octave bands and Total values. For Sound measurements, it is possible to select the **Linear**, **Fast** or **Slow** detector. For Vibration measurements, only **Linear** detector is available.
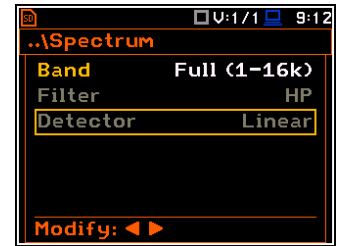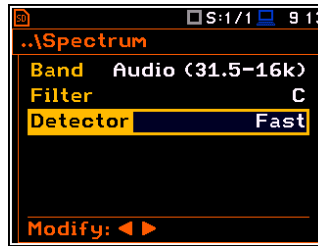
Note: Total Leq/RMS values for 1/1 octave or 1/3 octave analysis may differ from the Leq/RMS results for a level meter if the RMS detectors settings are different.

You can easily get into the **Spectrum** screen from the spectrum view. It is necessary to enter the function field (for example **1/1**) with the ▲ / ▼ key and press **<ENTER>**.
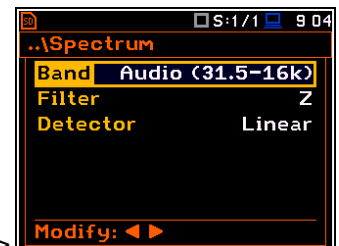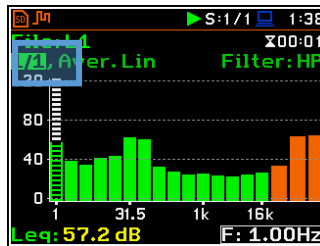
10.3 CUSTOMIZING 1/1 OR 1/3 OCTAVE SPECTRA VIEWS

The **Display** section contains elements for customizing measurement result presentation and display parameters.
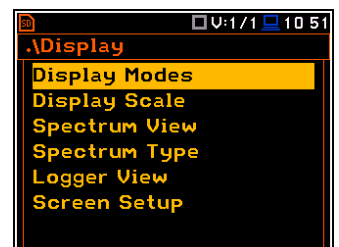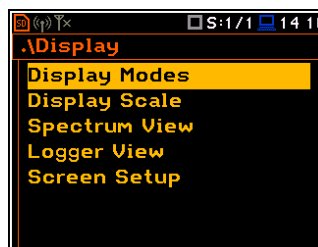
The following positions are used for customizing views of 1/1 octave or 1/3 octave results:

Display Modes   allowing you to switch on the **Spectrum** view,

Display Scale   allowing you to adjust scales of a spectrum plot and toggle the grid,

Spectrum View   allowing you to select spectra to be viewed: instantaneous, averaged, maximum or minimum,

Spectrum Type   allowing you to change the spectrum type presented on the display: acceleration, velocity or displacement; this position appears in the vibration modes.

10.3.1 Enabling the 1/1 and 1/3 octave spectra view

Spectrum view

The **Spectrum** position in the **Display Modes** list becomes available for the **1/1 Octave** and **1/3 Octave** functions and enables/disables the spectrum view.
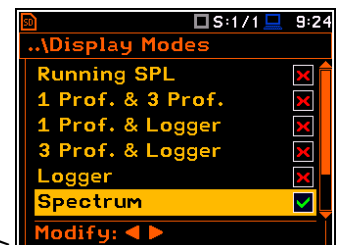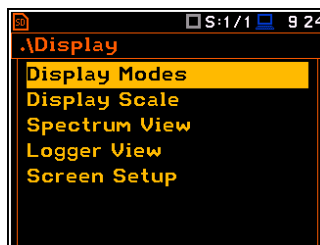
Spectrum view fields

1. Analyser function
2. Cursor position
3. Value of the cursor position
4. Averaging used
5. Spectrum plot
6. Frequency weighting filter
7. Total values
8. Central frequency for the cursor position
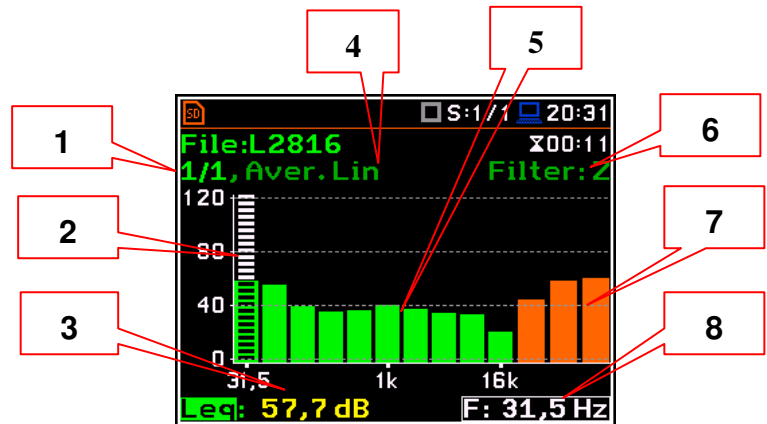
You can shift the Y-axis in the spectrum view with the **<Shift>** and ▲ / ▼ keys pressed together.
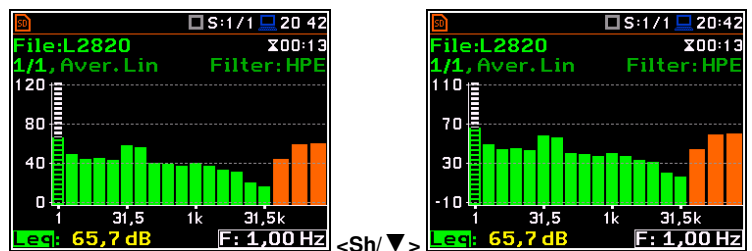
You can change the cursor position with the ◄ / ► key. You can jump to the first or last spectrum line with the **<Shift>** and ◄ / ► keys pressed together.
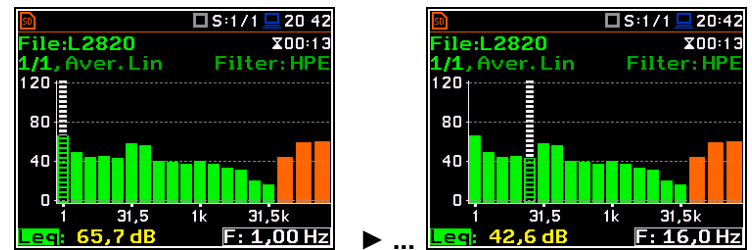
The band central frequency and the appropriate value are presented in the line below the plot.

10.3.2 Customizing the spectrum graph – Display Scale

The **Display Scale** screen allows you to define the result units (absolute or logarithmic), adjust scale of graph and toggle the grid.

Scale of results presentation

The **Scale** parameter defines results units: linear (**Lin** – m/s^2, m/s etc.) or logarithmic (**Log** - dB).

For sound measurements, the **Scale** position is not active. All results are always presented in dB.

The **Log** option means that the graphical presentation is given in the logarithmic scale and the measurement results are expressed in decibels (the result is related to the values set in the **Reference Levels** screen (*path:* *<Menu> / Auxiliary Setup / Reference Levels*).

Note: *In Vibration modes, results can be presented in the* **Logarithmic** *(dB) or* **Linear** *(for example, m/s²) units. It depends on the* **Scale** *parameter value. For example, 10 m/s² can be presented also as 140 dB.*

Resolution

The **Resolution** parameter appears when Scale is Log and defines the number of digits after the decimal point in the presented results: one digit after the decimal point (**0.1 dB**) or two digits after the decimal point (**0.01 dB**).

=>

Scaling vertical axis

The **Dynamics** parameter defines the dynamic range of the Y-axis scale.
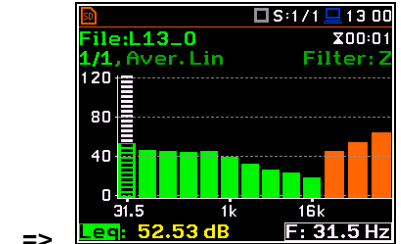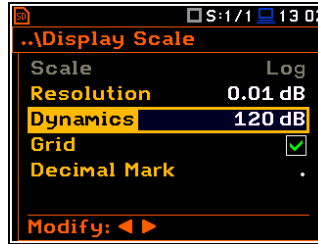
=>

It is possible to select the range from the set: **10dB**, **20dB**, **40dB**, **80dB**, **100dB** and **120dB**.

=>
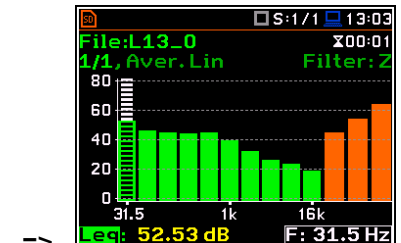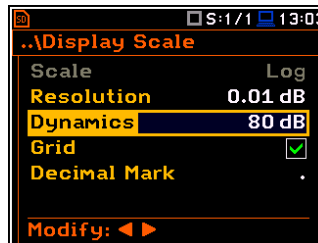
Switching grid on/off

The **Grid** position allows you to toggle the horizontal grid lines of the logger or spectrum plot.

=>
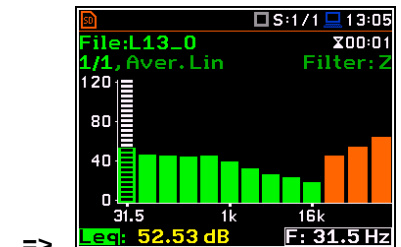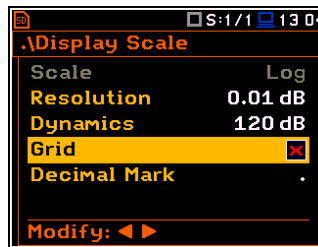
Decimal Mark

The **Decimal Mark** position allows you to select which decimal mark (point or comma) will be used for data presentation in all views.

▶
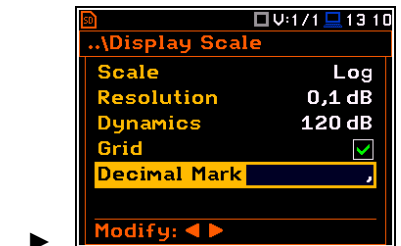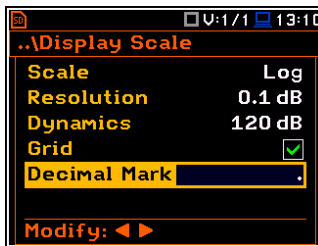
10.3.3 Selecting the spectra to be viewed – Spectrum View

In the **Spectrum View** screen, you can select different spectra to view in the **Spectrum** view.
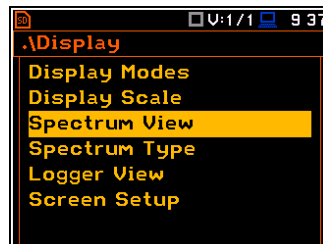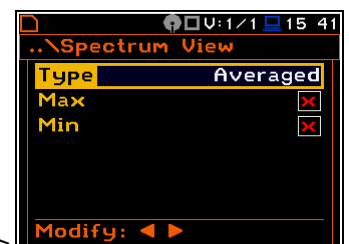
<ENT>

In the **Type** position, you may choose the spectrum type to be presented as a bar plot:

- **Instantaneous**, obtained for the Leq/RMS results integrated for 100 ms,

- **Averaged**, obtained as averaging of instantaneous spectra for the elapsed time [0, Integration Period],

- **Max**, obtained as maximum instantaneous spectrum for the elapsed time [0, Integration Period] or

- **Min**, obtained as minimum instantaneous spectrum for the elapsed time [0, Integration Period].
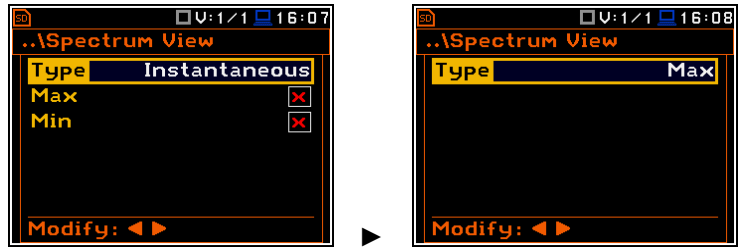
When the **Averaged** or **Instantaneous** spectrum is selected, you can additionally enable presentation of the **Max** and/or **Min** values for each band by switching the **Max** or **Min** parameters on.
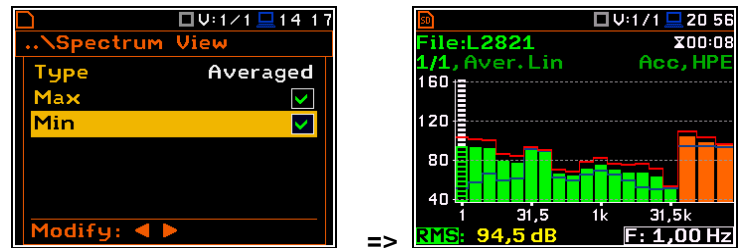
The **Max** and **Min** spectrum is presented as a stepped line – accordingly red and blue colour.

NR and NC results view

In case of 1/1 octave Sound measurements (**S:1/1**) with HP or Z filter, noise rating (**NR**) and noise criterion (**NC**) values can be additionally presented on the same plot as a main spectrum when the **NR** or/and **NC** parameter is enabled.
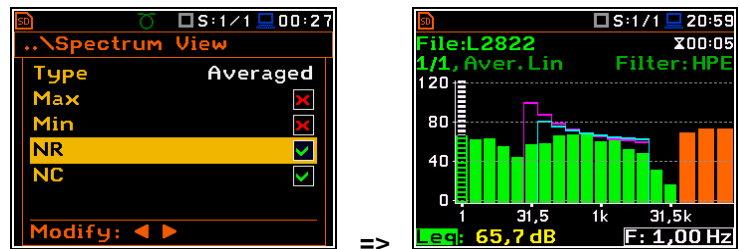
A violet line shows the **NR** results for the octave bands with central frequencies: **31.5Hz**, **63.0Hz**, **125Hz**, **250Hz**, **500Hz**, **1.00kHz**, **2.00kHz**, **4.00kHz** and **8.00kHz**. A blue line shows the **NC** results for the octave bands with central frequencies: **63.0Hz**, **125Hz**, **250Hz**, **500Hz**, **1.00kHz**, **2.00kHz**, **4.00kHz** and **8.00kHz**.

To enable reading of the **Max**, **Min**, **NR** or **NC** values, select the result field in the lower left-hand corner of the display with the ▲ / ▼ key. Then select the appropriate value with the ◄ / ► key pressed together with **<Alt>**.
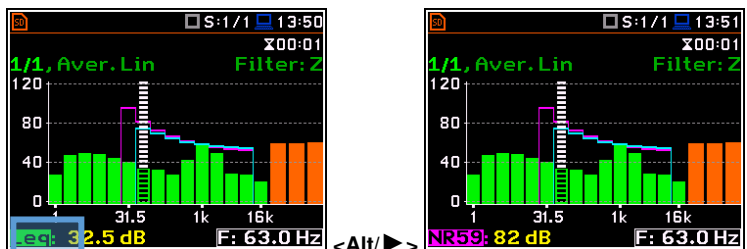
The **NR** or **NC** results can be seen also in the **1 Profile** and/or **3 Profile** modes.

If the **NC** or **NR** result exceeds the maximum value for which the curves are defined (NC=70 or NR=130) then before the displayed result the character (**>**) appears and the highest defined curve is displayed.
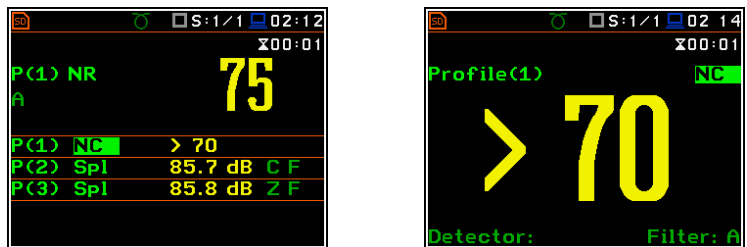
You can easily get into the **Spectrum View** screen from the **Spectrum** view to change viewed spectra by selecting the result field in the lower left-hand corner of the display with the ▲ / ▼ key and pressing **<ENTER>**.
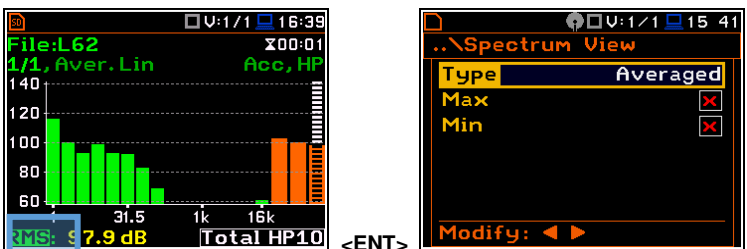
10.3.4 Changing the spectrum type in Vibration modes – Spectrum Type

In the **Spectrum Type** screen, which is available only in Vibration modes, you can select the different types of vibration spectra to be presented in the Spectrum view: **Acceleration**, **Velocity** or **Displacement**.

<ENT>
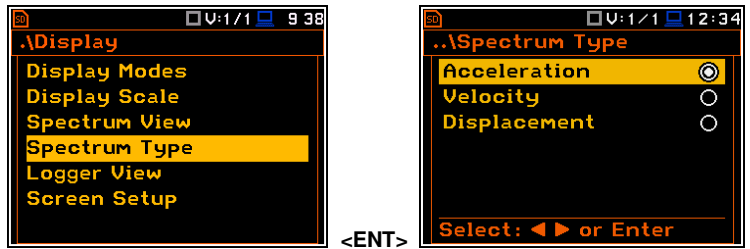
10.3.5 Spectrum statistics

The instrument calculates statistics in Sound modes for all 1/1 and 1/3 octave bands as well as for three Total results based on 100 ms Leq results. Special Ln spectrum view presents **Ln** results for all 1/1 or 1/3 octave bands and Totals.

Ln spectrum view fields

1. Ln spectrum name
2. Ln spectrum bar plot
3. Ln value for the cursor position
4. Leq value for the cursor position
5. Leq spectrum curve plot
6. Central frequency for the cursor position
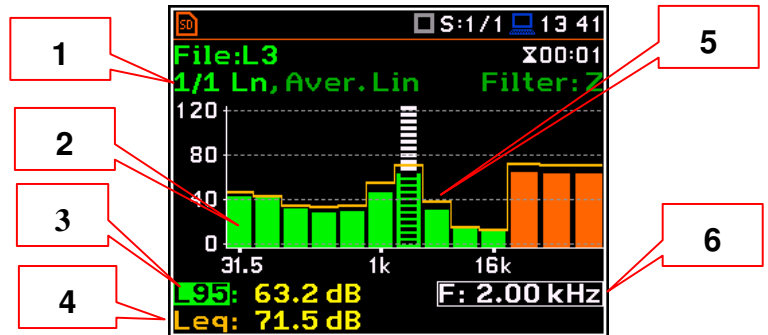
To view statistics for the selected band you should:

1. Select the **1/1** or **1/3** field with the ▲ / ▼ key.

2. Activate the Ln spectrum view, changing the field content to the **1/1 Ln** or **1/3 Ln** with the ◄ / ► key pressed together with **<Alt>**.

3. Select the **Ln** field in the Ln spectrum view with the ▲ / ▼ key.

4. Select the required **Ln** result with the ◄ / ► key pressed together with **<Alt>**.

5. Shift the cursor on the required 1/1 or 1/3 octave band or the Total value with the ◄ / ► key.

<Alt>/ ►

<Alt>/ ►

►
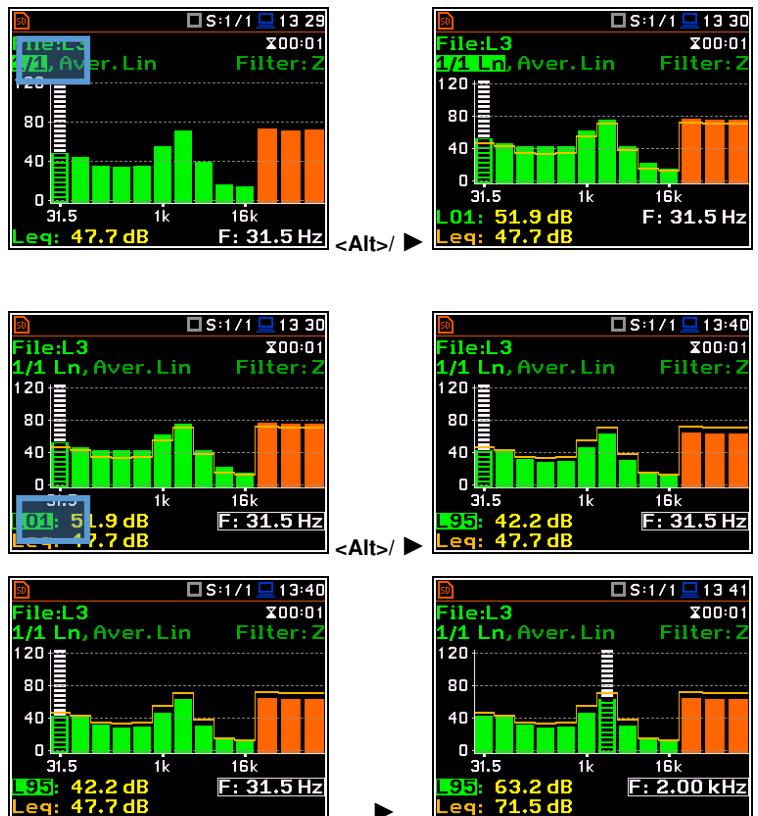
6. Select the **1/1 Ln** or **1/3 Ln** field with the ▲ / ▼ key.

7. Activate the statistics view for the selected 1/1 or 1/3 band, changing the field content to the **1/1 Ln's** or **1/3 Ln's** with the ◄ / ► key pressed together with **<Alt>**.

<**Alt**>/ ►
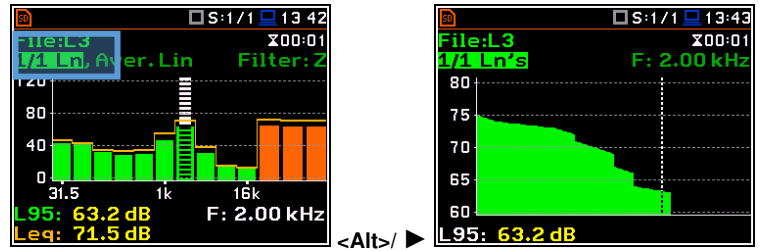
11 FFT ANALYSER

The instrument operates as the FFT analyser in a very similar way to the Level Meter. Moreover, the FFT analysis is performed in parallel with the SLM or VLM measurements.

Results of the FFT analysis (spectra) measured with preselected frequency weighting filter and window, are presented in the **Spectrum** view.

The read-out of spectrum values can be done with a vertical cursor.
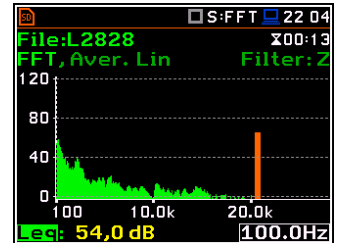
11.1 SELECTING THE FFT FUNCTION

To select the **FFT** analysis function, open the **Measurement Function** screen, select the **FFT** position and press **<ENTER>**.

<ENT>
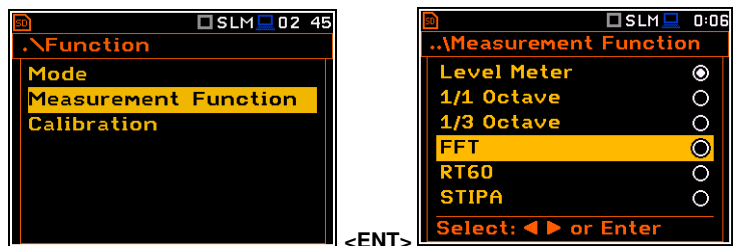
> **Note:** *The **FFT** function is optional and should be unlocked by entering the activation code in the text editor screen, which is opened after first attempt to select this option. Once unlocked this option will be ready to use permanently.*

> **Note:** *It is not possible to change the current function during a running measurement. In this case, the instrument displays for about 2 seconds the message: "Measurement in Progress". To change the current function, the measurement must be stopped!*

11.2 CONFIGURING THE FFT ANALYSER

11.2.1 General FFT analysis measurement settings – General Settings

Execution of the FFT analysis depends on a certain number of the parameters, configured in the **Measurement** section.

FFT spectra are averaged during **Integration Period** and saved as Summary Results the number of times specified by the **Repetition Cycles** parameter.

The **Integration Period** and **Repetition Cycles** parameters are defined in the **General Settings** list.
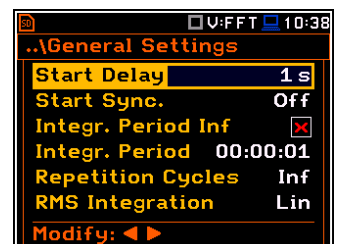
11.2.2 Selecting the measurement range for FFT analysis – Range

The input range for the **1/1 Octave** or **1/3 Octave** functions can be selected in the **Range** screen: **Low** or **High**.

The values of ranges in sound modes depend on the settings in the **Compensation Filer** screen (*path: <Menu> / Measurement / Compensation Filter*) and in both sound and vibration modes – on the calibration factor (see Chapter - 4.6).

11.2.3 Logging of FFT spectra – Logging

Spectra can be logged in a logger file with two steps: **Integration Period** step and/or **Logger Step**.

For logging FFT spectra, the **Logger** position must be enabled in the **Logger Setup** screen (*path: <Menu> / Measurement / Logging / Logger Setup*).

If you wish to save spectra together with Summary results, you must enable the **Summary Results** position. FFT spectra will be then logged with the **Integration Period** step.

The instrument allows additional logging of FFT spectra in a logger file with the **Logger Step**.

For this, you should enable logging of spectra switching on the **FFT** position in the **Logger Results** screen (*path: <Menu> / Measurement / Logging / Logger Results*).
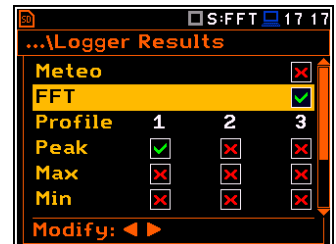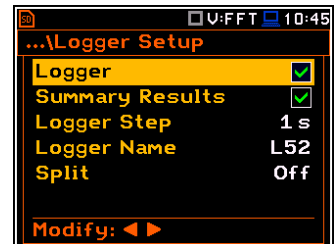
11.2.4 Setting FFT analysis parameters – FFT

The **FFT** position, which appears in the **Measurement** section after activating the **FFT** function, opens the screen in which you can select parameters of the FFT analysis: frequency band (**Band**), pre-weighting filter (**Filter**), weighting window (**Window**), number of lines (**Lines**) and averaging type (**Averaging**).

<ENT>
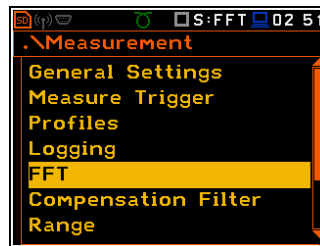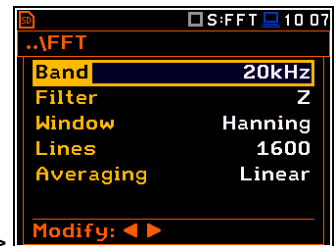
The **Band** parameter defines the band for the **FFT** analysis performance: **40kHz**, **20kHz**, **10kHz**, **5 kHz**, **2.5kHz**, **1.25kHz**, **625Hz**, **312Hz**, **156Hz** or **78Hz**.

Weighting filter

For the sound analysis, the following pre-weighting filters are available:
- **Z** – class 1 according to IEC 61672-1:2013,
- **A** – class 1 according to IEC 651 and IEC 61672-1:2013,
- **C** – class 1 according to IEC 651 and IEC 61672-1:2013,
- **B** – class 1 according to IEC 651,
- **U** – class 1 according to IEC 61012:1990,
- **AU** – class 1 according to IEC 61012:1990,
- **HP** – high-pass filter.

For the analysis of vibration signals with the band up to **20kHz**:
- **HP** – high-pass filter,

For the analysis of vibration signals with the **40kHz** band:
- **HPE** – ultra band filter.

Characteristics of filters are given in Appendix C.
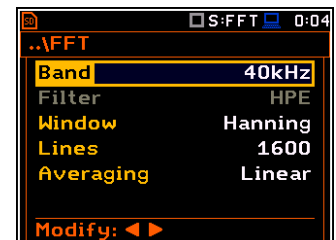
The **Window** parameter defines the weighting window for the **FFT** analysis: **Hanning**, **Rectangle**, **Flat Top** or **Kaiser-Bessel**.

The **Lines** parameter defines the number of lines for the **FFT** analysis: **1600**, **800** or **400**.

There are two averaging options (**Averaging**): **Linear** and **Exponential**. In case of **Exponential** averaging, the **Time Constant** parameter appears in this screen. You can select: **100ms**, **125ms**, **200ms**, **500ms**, **1.0s**, **2.0s**, **5.0s** or **10.0s**.

You can easily get into the **FFT** screen from the spectrum view. It is necessary to enter the function field (**FFT**) with the ▲ / ▼ key and press **<ENTER>**.

11.3 CUSTOMIZING THE FFT SPECTRA VIEW

The **Display** section contains elements for customizing measurement result presentation and display parameters.
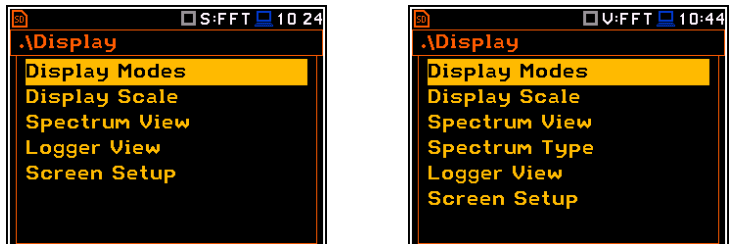
The following positions are used for customizing the presentation of **FFT** results:

Display Modes   allowing you to switch on the **Spectrum** view,

Display Scale   allowing you to adjust scales of a spectrum plot and toggle the grid,

Spectrum View   allowing you to select spectra to be viewed: instantaneous, averaged, maximum or minimum,

Spectrum Type   allowing you to change the spectrum type presented on the display in vibration modes: acceleration, velocity or displacement; this position appears in the vibration modes.

11.3.1 Enabling the FFT spectra view

Spectrum view

The **Spectrum** position in the **Display Modes** list becomes available for the **FFT** function. It enables/disables the spectrum plot view.
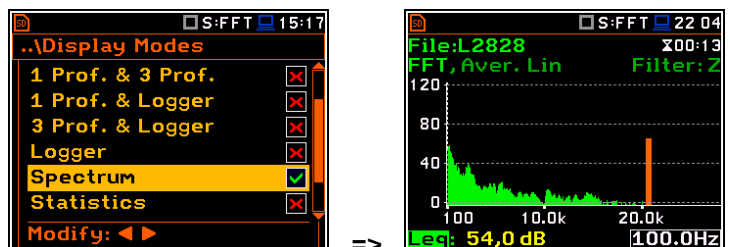
Spectrum view fields

1. Analyser function
2. Cursor position
3. Value for the cursor position
4. Averaging used
5. Spectrum plot
6. Frequency weighting filter
7. Total value
8. Line frequency for the cursor position
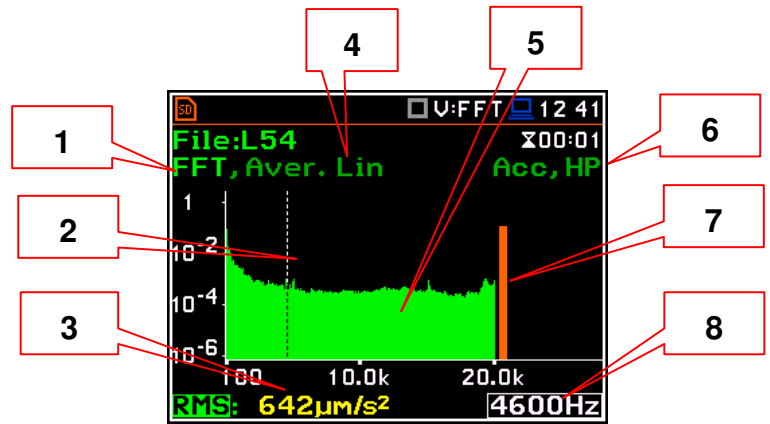
You can shift the Y-axis in the spectrum view with the **<Shift>** and ▲ / ▼ keys pressed together.
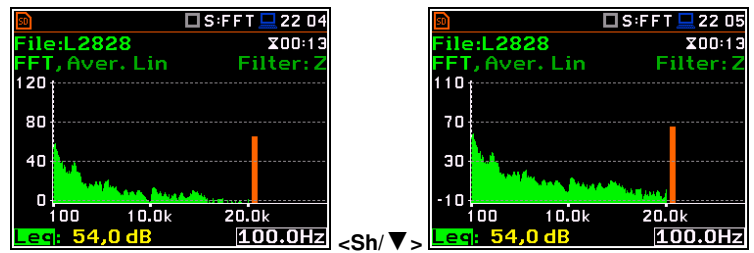
You can change the cursor position with the ◄ / ► key. You can jump to the first or last spectrum line with **<Shift>**.and ◄ / ► keys pressed together.
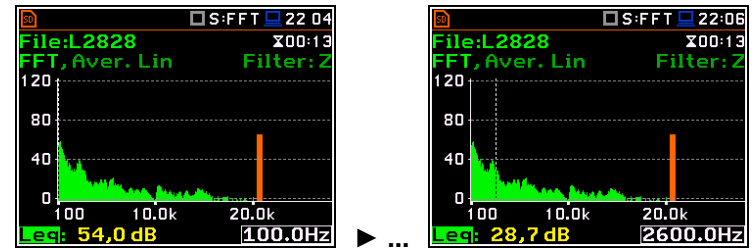
The frequency and appropriate value are presented in the line below the plot.

You can zoom in/out the frequency scale at the cursor position with the ◄ / ► key pressed together with **<Shift>**.

11.3.2 Customizing the spectrum graph – Display Scale

The **Display Scale** screen allows you to define the result units (absolute or logarithmic), adjust scale of graph and toggle the grid.

Scale of results presentation

The **Scale** parameter defines results units: linear (**Lin** – m/s², m/s etc.) or logarithmic (**Log** - dB).

For sound measurements, the **Scale** position is not active. All results are always presented in dB.

The **Log** option means that the graphical presentation is given in the logarithmic scale

and the measurement results are expressed in decibels (the result is related to the values set in the **Reference Levels** screen (*path: <Menu> / Auxiliary Setup / Reference Levels*).

Note: *In Vibration modes, results can be presented in the* **Logarithmic** *(dB) or* **Linear** *(for example, m/s²) units. It depends on the* **Scale** *parameter value. For example, 10 m/s² can be presented also as 140 dB.*

Scaling the vertical axis

The **Dynamics** parameter defines the dynamic range of the Y-axis scale.
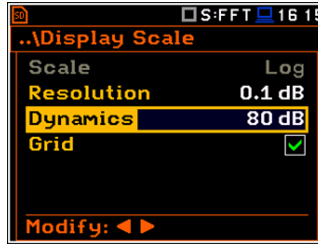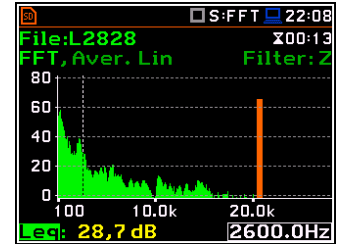
It is possible to select the range from the set: **10dB**, **20dB**, **40dB**, **80dB**, **100dB** and **120dB**.
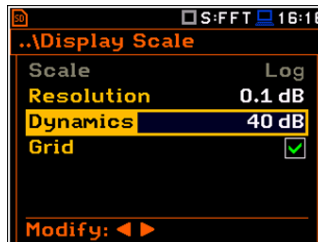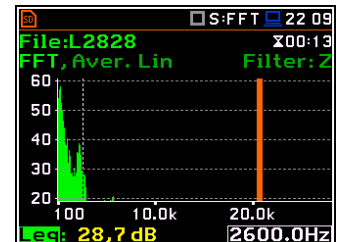
Switching grid on/off

The **Grid** position allows you to toggle the horizontal grid lines of the logger or spectrum plot.
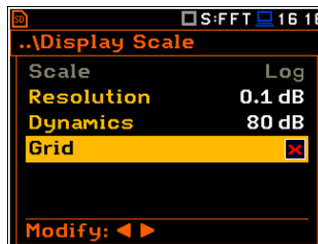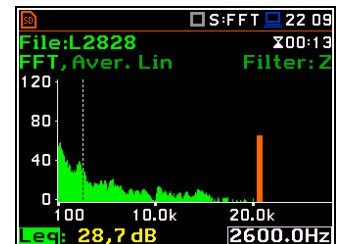
11.3.3 Selecting the spectra to be viewed – Spectrum View

In the **Spectrum View** screen, you can select the different spectra to be viewed in the **Spectrum** view.
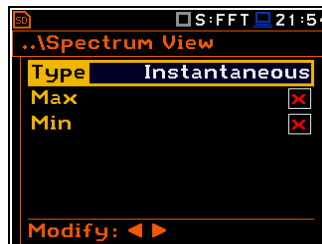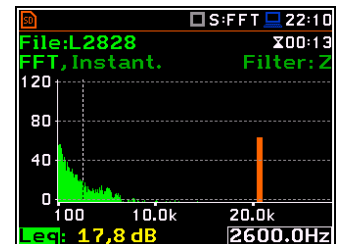
In the **Type** position, you may choose the spectrum type to be presented as a bar plot:

- **Instantaneous**, obtained for the one FFT sample,

- **Averaged**, obtained as averaging of instantaneous spectra for the elapsed time [0, Integration Period],

- **Max**, obtained as maximum instantaneous spectrum for the elapsed time [0, Integration Period] or

- **Min**, obtained as minimum instantaneous spectrum for the elapsed time [0, Integration Period].

When the **Averaged** or **Instantaneous** spectrum is selected, you can additionally switch on or off the presentation of the **Max** and/or **Min** values by switching the **Max** or **Min** parameters on.

=>

To enable reading of the **Max** or **Min** values at the cursor position, select the field in the lower left-hand corner of the display with the ▲ / ▼ key. Then select the appropriate value with the ◄ / ► key pressed together with **<Alt>**.

<Alt/►>
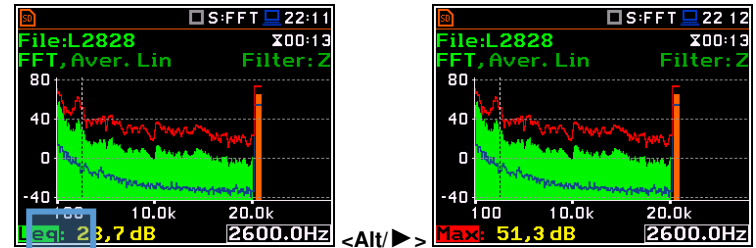
You can easily get into the **Spectrum View** screen from the **Spectrum** view by entering the result field (**Leq**/**RMS**) with the ▲ / ▼ key and pressing **<ENTER>**.

<ENT>
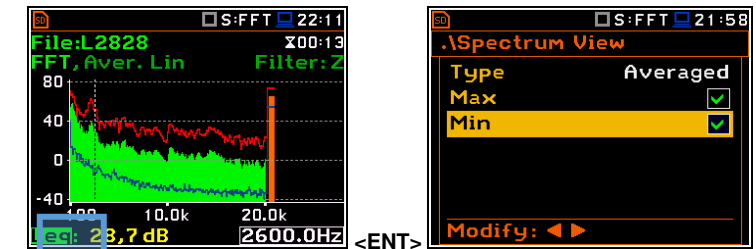
11.3.4 Changing the spectrum type in Vibration modes – Spectrum Type

In the **Spectrum Type** screen, which is available only in Vibration modes, you can select the different types of vibration spectra to be presented on the display: **Acceleration**, **Velocity** or **Displacement**.

<ENT>
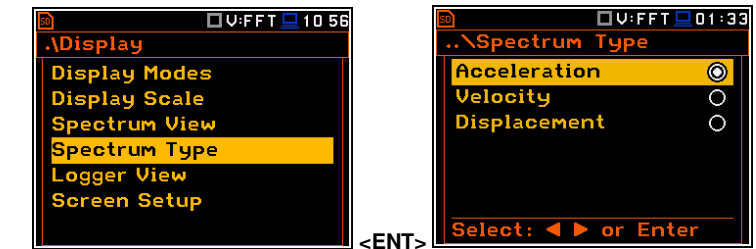
As an example, same spectrum is presented as **Acceleration** and **Velocity**.
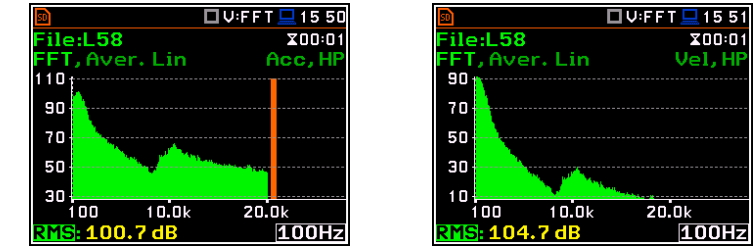
12 MEASUREMENT OF REVERBERATION TIME – RT60

The **RT60** analysis is an optional function of SV 977D, which provides reverberation time calculation for 1/1 octave bands (from 63 Hz to 16 kHz) or 1/3 octave bands (from 50 Hz to 20 kHz) and three total RMS levels (**A**, **C** and **Z** weighted). Whole measurement process and calculations implemented in SV 977D fulfil the ISO 3382 standard.

The reverberation time of the room can be obtained with the use of SV 977D by two measurement methods: Impulse Response Method (**Impulse**) and Interrupted Noise Method (**Decay**). The selection of the method depends on the type of the used sound source. The **Impulse** method is designed for measurements using the impulse sound source (like pistol shot, petard explosion), whereas the **Decay** method is intended for measurements when room is excited by broad or narrow band sound noise source (usually pink noise). For more details about the measurement and calculation process see Appendix E.

The reverberation time analysis applied in the instrument consists of two parts:

1. The measurement part during which the acoustic response of the room is registered.

2. The calculation part during which the reverberation time (**EDT**, **RT20**, **RT30** and **RTUser**) is calculated for the measured room response.

> **Note:** It is recommended to familiarize with Appendix E before proceeding. This chapter describes only the navigation of the instruments, whereas Appendix E depicts the definitions and describes the philosophy of reverberation time measurement.

12.1 SELECTING THE RT 60 FUNCTION

To activate the **RT60** analysis function, select the **RT60** position in the **Measurement Function** list and press **<ENTER>**.

<ENT>
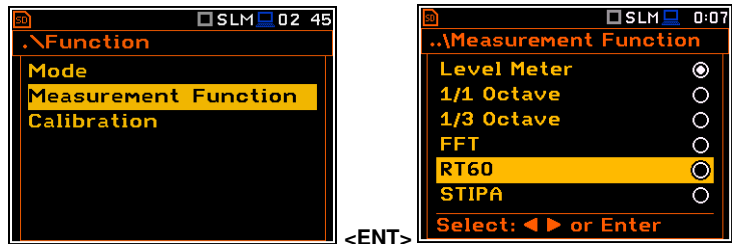
> **Note:** The **RT60** function is optional and should be unlocked by entering the activation code in the text editor screen, which is opened after first attempt to select this function. Once unlocked this option will be ready to use permanently.

> **Note:** It is not possible to change the current function during running measurements. In this case the instrument displays for about 2 seconds the warning: "Measurement in Progress". To change the current measurement function, the measurement must be stopped!

12.2 SETTING THE RT60 PARAMETERS – RT60 SETTINGS

Execution of the **RT60** analysis depends on a certain number of the parameters, which can be set in the different screens of the **Measurement** section: **RT60 Settings**, **Compensation Filter** and **Range**.

Positions **Compensation Filter** and **Range** are the same as for other instrument's functions (see Chapters 4.5 and 4.6).
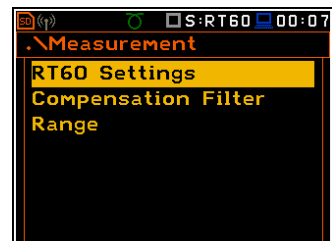
The **RT60 Settings** list allows you to select the method for **RT60** calculations, define the name of the file, where the registered data will be collected, and other parameters for **RT60** calculations.

The **Start Delay** parameter defines the delay period from the moment the **<Start>** key is pressed to the start of the actual measurement.

The **Method** parameter allows you to choose the method for **RT60** calculations: **Decay** or **Impulse**. Both methods are described in Appendix E.

The **Octave** parameter defines for which bands (**1/1** or **1/3**) the **RT60** analysis will be performed.

The **Freq. Range** parameter defines the frequency range for 1/1 or 1/3 octave calculations:

- for 1/1 octave**: 63Hz-4kHz** (7 bands) or **63Hz-16kHz** (9 bands),

- for 1/3 octave: **50Hz-5kHz** (21 bands) or **50Hz-20kHz** (27 bands).

The **Recording Time** parameter defines the recording time of the measurement data (sound pressure level decay curve). Data registration starts in the moment of the trigger condition appearance. Recording time can be set in the range **1 ÷ 30 s**.

Recording Time can be set to **Auto**. In this case, the recording length and time step are selected automatically.

If **Recording Time** is not set to **Auto**, then an additional parameter appears in the list (**Time Step**) that defines the interval with which the time-step of data registration (sound pressure level) in the file. The parameter value can be selected from the set: **2**, **5**, **10**, **20**, **50**, **100 ms**.

The **Averaging** parameter defines the averaging of the reverberation time results from several measurements.

When this option is switched on the **Averaging** position appears on the **RT60** bar plot.
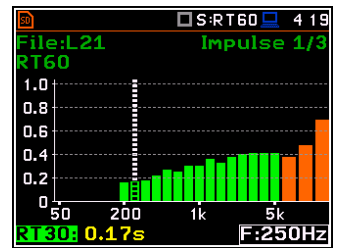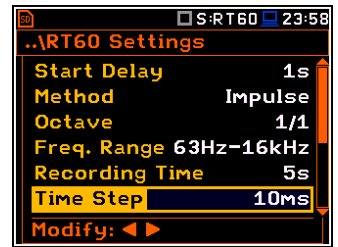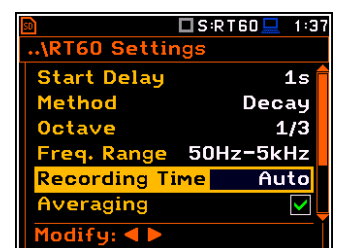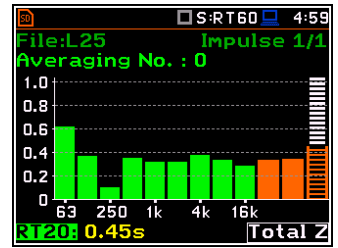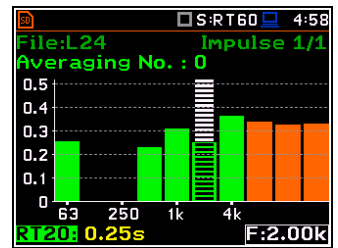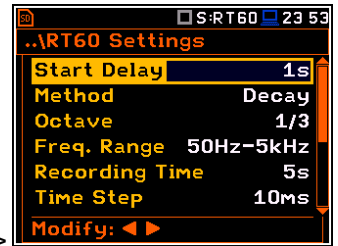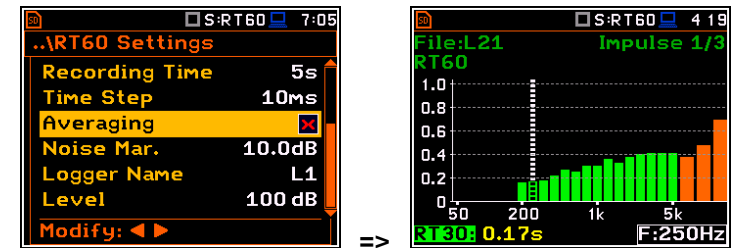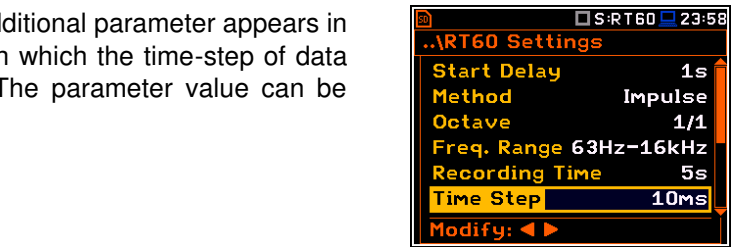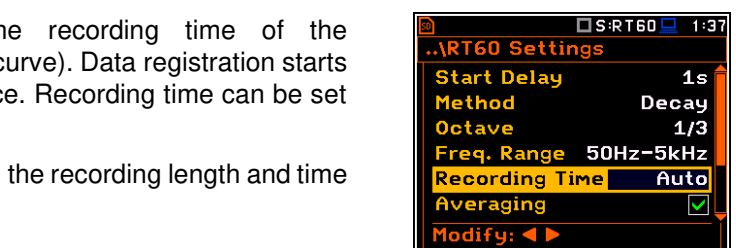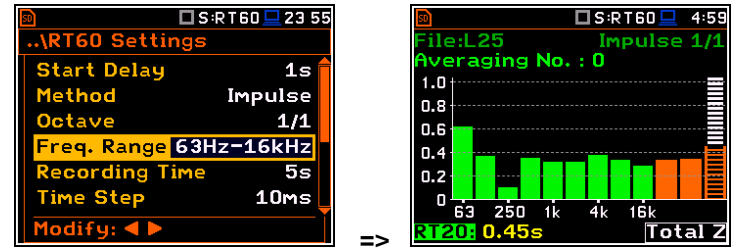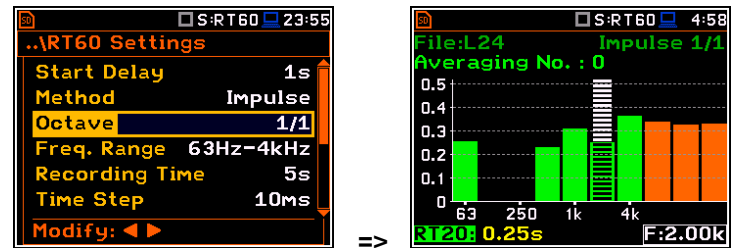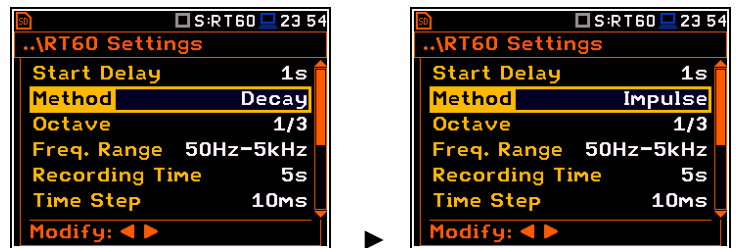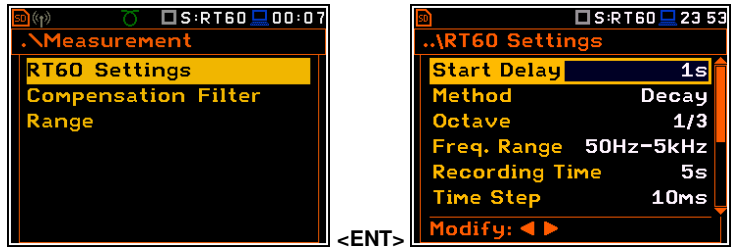
To make averaging of the new results with the results calculated earlier, select the field **Averaging** and press **<ENTER>**, select in the confirmation screen **Yes** and press **<ENTER>** again. In the field **No.: x**, the value **x** will be increased by one and the symbol √ will inform that the results have been averaged.

=>

        <Start>   **<ENT>**   **<ENT>**

When the averaging is **On** the additional columns appear in the RT60 result table, named: **AEDT**, **A20**, **A30** and **A.User**.

RT60	AEDT	A20	A30
12.5k	0.05s	0.18s	0.23s
16.0k	0.05s	0.19s	0.24s
20.0k	0.05s	0.13s	0.19s
TOT.A	0.05s	0.36s	0.43s
TOT.C	0.05s	0.36s	0.44s
TOT.Z	0.46s	---	---

To clear averaging, select the field **No.: x** and press **<ENTER>**, select in the confirmation screen **Yes** and press **<ENTER>** again.

                                                <ENT> .. <ENT>

The **Noise Mar.** parameter defines the margin value to the calculated noise level (for more detail see Appendix E). This parameter can be set in the range **0.0 dB** ÷ **20.0 dB** with 0.1 dB step (default value is **10.0 dB**).

Note: *If the measurement must fulfil the ISO 3382 standard requirements the noise margin is required to be set to 10 dB (or higher).*

The **Logger Name** position allows you to define the name of the logger file in which data of the **RT60** analysis will be recorded. The name can be up to eight characters long. After pressing the ◄ / ► key, the special screen with text editor is opened.

                                          ►

The **Level** position defines the threshold level of the sound source for triggering the RT60 measurement. If the measured sound is below the **Level** value, the RT60 measurement will not start. The parameter can be set in the range **24 ÷ 136 dB** with 1 dB step (default value is **100 dB**).

For the **Impulse** method, the source is Leq(1) integrated by 0,5 milliseconds.

For the **Decay** method, the source is Leq(1) integrated by 1 second. It also should be stable within ±0,5 dB for 2 seconds.
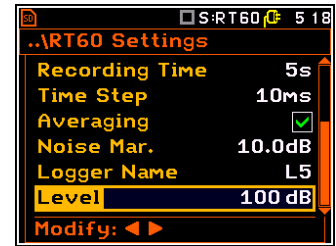
12.3 CUSTOMIZING THE RT60 VIEW

The **Display** section contains elements for programming measurement result presentation and display parameters.

The **Display Modes** list allows you to select the type of data displayed during the **RT60** calculations.

<ENT>

Time data can be viewed as a **Raw Data**, **Smoothed Data** (or **Integrated Data** in case of the **Impulse** method).

You may also switch between different data view modes during measurement in the presentation mode. For this purpose, it is necessary to select the field with **Raw**, **Smoothed** or **Integrated** text (at the right upper corner of the display) and change its content with the **<Alt>** and ◄ / ► key pressed together.

<Alt/►>   <Alt/►>
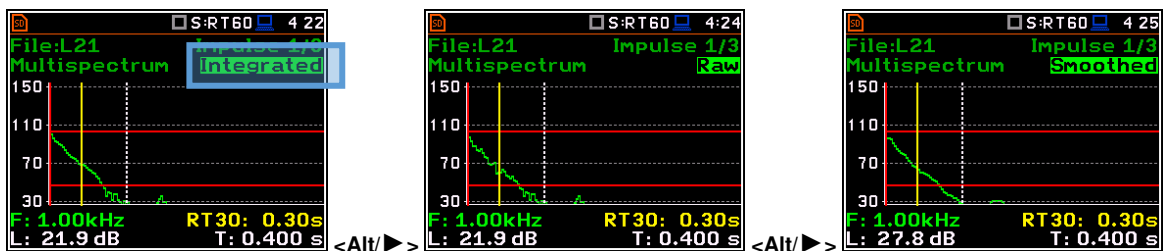
The **Smoothing** position allows you to set the number of samples, which should be taken into consideration by the smoothing algorithm. The higher is this number the smoother is a graph.

Note: this parameter influences the reverberation time results. The parameter can be set in the range **0 ÷ 15** (default value is **3**).
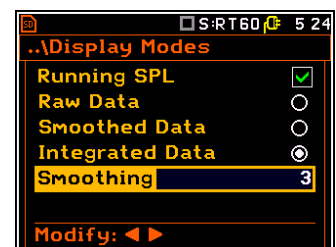
12.4 STARTING THE RT60 MEASUREMENT

Measurements using Decay method

1. Set parameters for **Decay** RT60 measurements. Most used setup is presented below.
    - **Method:** Decay
    - **Recording Time:** 7s
    - **Time Step:** 10ms
    - **Averaging:** On
    - **Smoothing:** 3
    - **Noise Mar.:** 10.0dB
    - **Level:** 100dB.
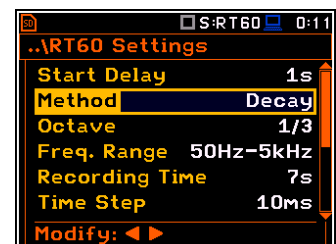
2.   Place the sound power source in the measured room (for the sound power source location - see the reverberation time measurement ISO standard).

3.   Place the microphone in one of the selected measurement points (for the measurement points location see the reverberation time measurement ISO standard).
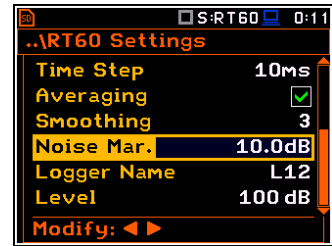
> ![warning] **Note**: *The default measurement time of the decay curve registering (**Recording Time**) is 7 seconds. It can be insufficient in some applications. It is recommended to set this value to be at least two times longer than expected reverberation time. For details see Appendix E.*

4.   Switch on the sound power source.

5.   Start the measurement process by pressing the **<Start>** key. While the instrument is waiting for the trigger condition fulfilment the **Leq** result is displayed.

6.   Switch off the sound power source (the source should work enough long to obtain the acoustic field stabilisation). After the trigger condition fulfilment, the instrument starts to collect data.

7.   After the data recording process ends, the instrument starts the calculation of the reverberation time results. During this process, the messages „Calculations…" and "Reading Logger…" appear.

8.   To save results press the **<Save>** key or use the **File** menu option.
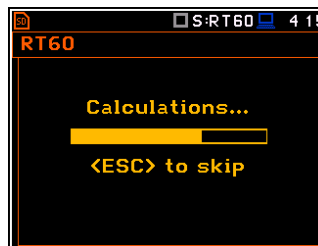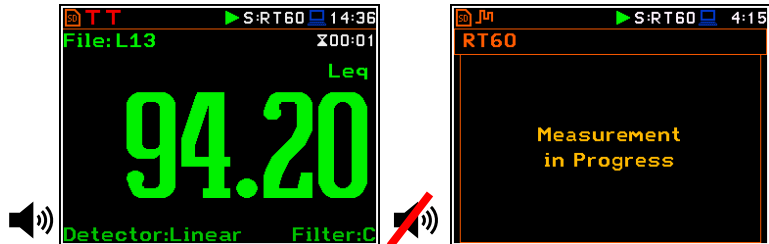
> ![warning] **Note**: *It is necessary to switch on the sound source before starting the measurement because of the trigger requirements (for more details see Appendix E). If it is necessary to start the instrument before switching on the sound source it is recommended to use the higher **Start Delay** value.*

Measurements using Impulse method

1.   Set parameters for **Impulse** RT60 measurements. Most used setup is presented below.
   - **Method:**   Impulse
   - **Recording Time:**   7s
   - **Time Step:**   10ms
   - **Averaging:**   On
   - **Smoothing:**   3
   - **Noise Mar.:**   10.0dB
   - **Level:**   100dB

2.   Place the microphone in one of the selected measurement points (for the measurement points location see the reverberation time measurement ISO standard).
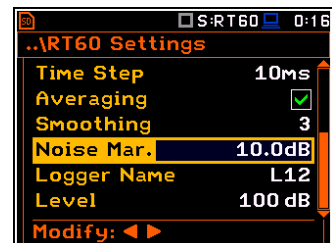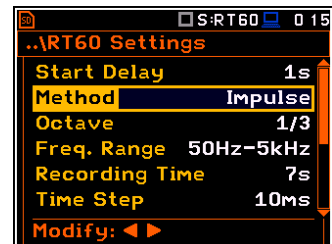
> ![warning] **Note**: *The default measurement time of the decay curve registering (**Recording Time**) is 7 seconds. It can be insufficient in some applications. It is recommended to set this value to be at least two times longer than expected reverberation time. For details see Appendix E.*

> ![warning] **Note**: *The proper value of the sound level trigger threshold should be set well above the background noise and significantly below the maximum sound level emitted by the impulse source.*

3. Start the measurement process with the **<Start>** key. The display indicates that the instrument is waiting for the trigger condition fulfilment.

4. Fire the impulse sound power source. If the trigger condition is fulfilled the instrument starts to collect data.

5. After the data recording process ends, the instrument starts the calculation of the reverberation time results. During this process, the messages „Calculations…" and "Reading Logger…" appear.

6. To save results press the **<Save>** key or use the **File** menu option.

> **Note:** *During the data collections in the tested room all other sources of sound should be suppressed to not affect the measurements.*

12.5 VIEWING THE RT60 RESULTS

The **RT60** measurement results for all 1/1 or 1/3 octave bands and three Total values can be viewed in three different view modes as:

1. Table of **EDT**, **RT20**, **RT30** and **User** results.

2. Bar plot of **EDT**, **RT20**, **RT30** and **User** results.

3. Plot of sound pressure level decay curves.

You may switch between the view modes with the **<Alt>** and ◄ / ► keys pressed together.

Table of RT60 results

The table presents reverberation time as:

* **EDT** - early decay time,

* **RT20** - reverberation time calculated with 20 dB dynamics,

* **RT30** - reverberation time calculated with 30 dB dynamics,

* **User** - reverberation time, calculated with the user defined dynamics.

> **Note:** *If "- - -" text appears in the RT indicator field, it means that for this band with the selected parameters (**Noise Mar.**) the required measurement conditions were not fulfilled to obtain the results (for more details see Appendix E).*

Bar plot of RT60 results

1. Number of averaged results
2. RT 1/3 octave plot
3. Name of the RT result and its value
4. Used **RT60** calculation method
5. Cursor position
6. RT results for Total values
7. Cursor position value (central band frequency)
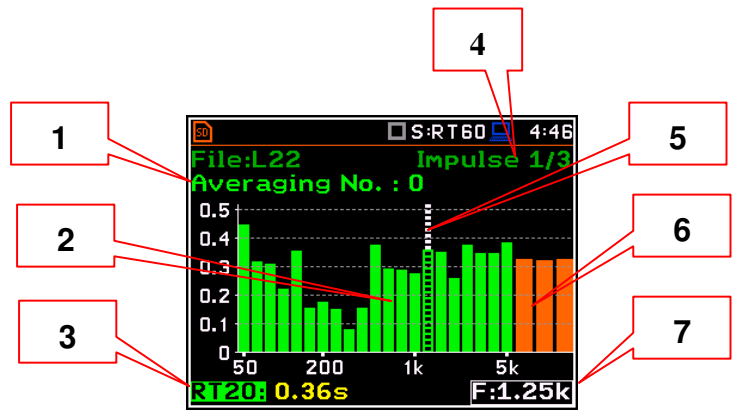
Changing RT result

When the field 3 is active the **RT60** analysis result can be changed with the ◄ / ► key pressed together with **<Alt>**.
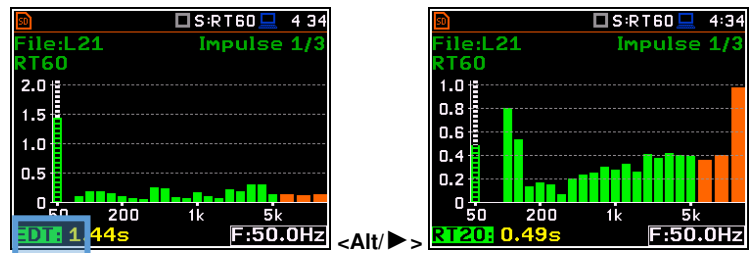
Changing cursor position

You may change the cursor position with the ◄ / ► key.
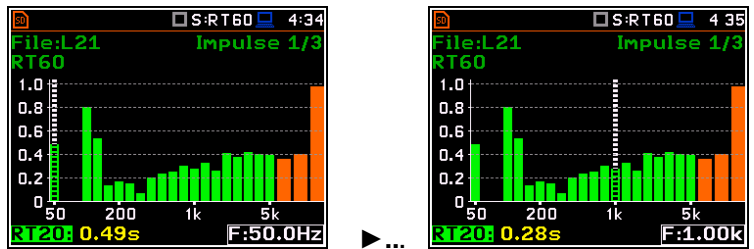
Sound pressure decay curve plot

1. Logger file content
2. T0 marker position
3. Decay curve plot
4. Central frequency of selected by cursor 1/3 octave band
5. Result value (SPL) for the cursor position
6. Name of the logger file
7. T1 marker position
8. Cursor position
9. RT60 method
10. Type of data displayed: **Raw**, **Smoothed** or **Integrated**
11. Calculated steady upper sound level value
12. Calculated steady lower sound level value
13. RT result (**RT30**, **RT20**, **EDT** and **RT User**) with calculated reverberation time
14. Cursor measurement time position
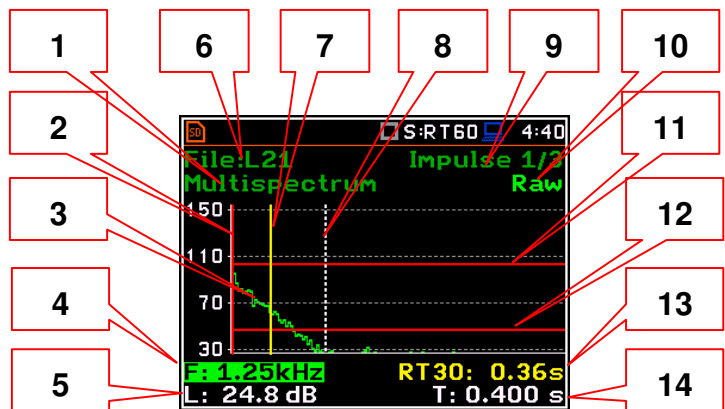
T0 marker position is used as a starting point for all three (and the **RT User** also) reverberation time results.

T1 marker position is labelled on the display (indicator **A7**) as **EDT**, **RT20** or **RT30** according to which the most restricted definition of the RT condition is fulfilled.

Changing data type

When the field 9 is active the type of data displayed (**Raw**, **Smoothed** or **Integrated**) can be changed with the ◄ / ► key pressed together with **<Alt>**.

<Alt/►>
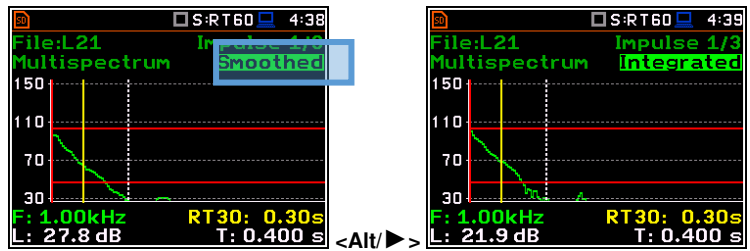
Changing band

When the field 4 is active the central frequency of the band can be changed with the ◄ / ► key pressed together with **<Alt>**.

<Alt/►>
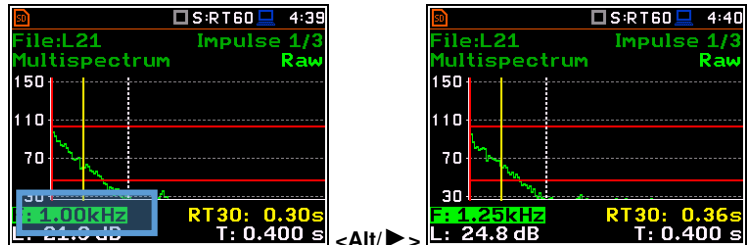
Changing RT function

When the field 13 is active the **RT60** analysis function can be changed with the ◄ / ► key pressed together with **<Alt>**.

<Alt/►>
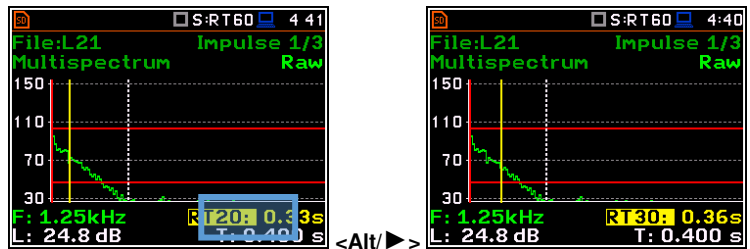
Changing cursor position

When the field 14 is active you may change the cursor position with the ◄ / ► key.

◄…
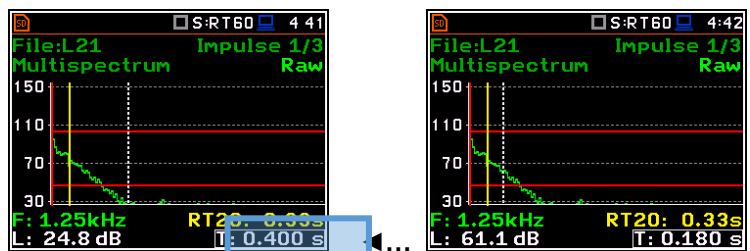
RT User reverberation time calculation

1. Select the band or one of the total levels for user reverberation time calculation process.

2. Set the position of the marker T1.
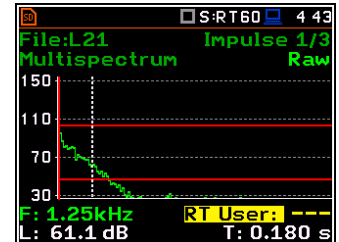
⚠ **Note:** *The marker should be located on the right side of the T0 marker but not in the noise background region (for more details see Appendix E).*

3. When the marker position is located press **<ENTER>**, then select **Yes** field and press **<ENTER>** again.

4. The **RT User** result will be calculated and presented in the field 13, as well in the Table and the bar plot.

<ENT>
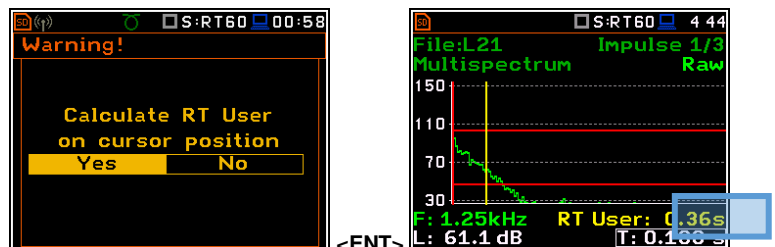
13 MEASUREMENT OF SPEECH TRANSMISSION INDEX – STIPA

13.1 INTRODUCTION

The Speech Transmission Index (STI) is applied in the deterioration of the speech intelligibility induced by the transmission channel. The STI method involves the use of a test signal applied to the transmission channel, and an analysis of the received test signal. The speech transmission quality of the channel is determined and expressed in values from 0 to 1 in the form of STI. Using the obtained STI value, it is possible to determine the potential speech intelligibility.

The applications of STI include evaluation of sound reinforcement and emergency systems, communication channels, speech intelligibility, communication in rooms and auditoria, etc.

STIPA (speech transmission index for public address systems) is a STI derivative approach that was developed for fast measurements of electro-acoustic and acoustic environments effects that affect the speech intelligibility in the room acoustics and/or public address systems.

STIPA calculations are realized in SV 977D in accordance with IEC 60268-16:2011.

Note: *In addition to the fact that measurements can be made using only SV 977D, Svantek also provides an application (**BA Assistant**) for mobile devices (smartphone, tablet) with Android 7.0 platform or higher, which performs STIPA measurements using SV 977D but has a more convenient user interface (see BA Assistant User Manual).*

13.2 STI METHOD BACKGROUND

The STI method is based on measurements of the STI test signal comprising seven octave band noise signals corresponding with the octave bands from 125 Hz up to 8 kHz. Each noise carrier is modulated with one or more modulation frequencies at one-third octave intervals ranging from 0,63 Hz up to and including 12,5 Hz. Such test signal which simulates speech fluctuations is reproduced in a room or through a communication channel and received at a listener position (superimposed by distortions presented in the room like echoes or noise) by means of omnidirectional microphone.

The STI method determines the modulation transfer function $m(F)$ – reduction in the modulation depth for modulation frequency - of the transmission channel for the seven octave bands. The RMS level of each octave-band carrier matches the relative level of the average, long term spectrum of speech material. Each octave band has a contribution to speech intelligibility which is weighted according to that band. Using the weighted sum of these transmission index values, the overall STI value for the transmission channel is determined.

STIPA method uses two modulation frequencies per octave band that are generated simultaneously giving a total of 14 modulation indices.

13.3 SELECTING THE STIPA FUNCTION

To activate the **STIPA** function, select the **STIPA** position in the **Measurement Function** list and press **<ENTER>**.
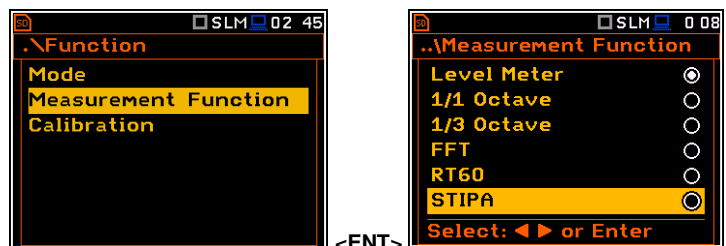
Note: *The **STIPA** function is optional and should be unlocked by entering the activation code in the text editor screen, which is opened after first attempt to select this function. Once unlocked this option will be ready to use permanently.*

Note: *It is not possible to change the current function during running measurements. In this case the instrument displays for about 2 seconds the warning: "Measurement in Progress". To change the current measurement function, the measurement must be stopped!*

13.4 STIPA MEASUREMENT AND CALCULATION PROCESS

STI measurements usually relate to objects (buildings), which may consist of several areas (rooms) in which measurements are made in a given number of points (in practice, from 1 up to several dozen). In addition, especially in case of assessing speech intelligibility in a room on the directly, i.e. without an amplification system, tests are performed for a given number of source positions (in practice from one to several). It may happen that a given area is examined in several configurations - e.g. a theatre hall with a raised and lowered curtain, or a rail vehicle at a standstill and while moving. The result for a given point is obtained on the basis of several measurements (in practice from 1 to 6) - most often as an average value. Analyses are performed independently for areas in a given configuration.

13.4.1 Measured results

The **STIPA** function enables measuring and calculating the next results:

- **STI** - Speech Transmission Index representing the transmission quality of speech with respect to intelligibility by a speech transmission channel, ranging between 0 and 1. STI is calculated for individual measurements and averaged for the measurement point and for the area.

- **Δ** – difference between maximum and minimum values of STI index obtained for the measurement point of the tested area.

- **LAeq** – A weighed time-averaged sound level for 15-seconds integration period, in dB.

- **LCeq** – C weighed time-averaged sound level for 15-seconds integration period, in dB.

- **LZeq** – Z weighed time-averaged sound level for 15-seconds integration period, in dB.

- **LAS** – time weighted sound level expressed at observation time (15-seconds integration period), in dB.

- **m(f1), m(f2)** - modulation transfer ratios as a function for two modulation frequency per each of 7 octave bands, ranging between 0 and 1.

- **CIS** - Common Intelligibility Scale $CIS = 1 + log(STI)$.

- **σ** - standard deviation of measured STI indexes for the tested area.

- **Min** – minimal STI value obtained within measurements.

There are some additional indications:

- The STI qualification band: **A+** trough **U** (see Annex G to IEC 60268-16:2011).

- Errors detected during measurements and calculation of STI indexes.

These results are displayed in different views:

- *Area* view - main STIPA view that allows you to create new measurement points, delete measurement points or exclude them from the calculation of averaged indexes for the Area as well as to go to the *Point* view for the selected point. This view presents a list of measurement points and next results:

  - o Averaged STI (or CIS) index with consideration of the Ambient noise distortions (**Avg.**) and STI spread (**Δ**) for the tested area.

  - o Averaged STI (or CIS) indexes with consideration of the Ambient noise distortions (**STI**) and STI spreads (**Δ**) for measurement points.

  - o The STI qualification band (**A+** through **U**) and error indication is displayed for each measurement point.

- *Area summary* view - main STIPA view that presents summary results for the current area:

[screen: Area: AREA_001 (S1) — STI 0.74, σ 0.06, Min 0.69, LAeq 70.0 dB, Meas. points 3, Standard met Yes, Setup / Back]	o Averaged STI (or CIS) index with consideration of the Ambient noise distortions.

  - o Averaged STI (or CIS) index with consideration of the Ambient noise distortions.
  - o **σ** - standard deviation of measured STI indexes for the tested area.
  - o **Min** – minimal STI value.
  - o **LAeq** – averaged LAeq for the area.
  - o Number of measurement points taken into consideration for the summary results calculations.
  - o Conformity of measurements with the standard: **Yes** or **No**.

- *Point* view - main STIPA view. The *Point* view allows you to see the modulation function, to delete measurements (only for the last measurement point) and exclude measurement results from the calculation of the averaged STI index. This view corresponds with the measurement point selected in the *Area* view. This view presents a list of measurements for the measurement point with following results:
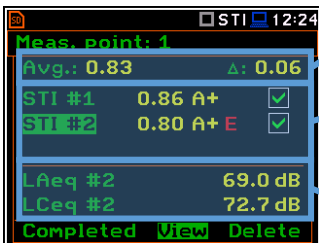
  - o Averaged STI (or CIS) index with consideration of the Ambient noise distortions (**Avg.**) and STI spread (**Δ**) for the measurement point.
  - o **STI** (or **CIS**) index with consideration of the Ambient noise distortions, the STI qualification band and error indication for individual measurements (**#1**, **#2** ..).
  - o **LAeq** and **LCeq** for the selected measurement.

- *Modulation function* view corresponds with the measurement selected in the *Point* view. Modulation function presents LZeq and modulation transfer ratios ($m(f1), m(f2)$) for seven octave bands with central frequency from 125 Hz up to 8 kHz:
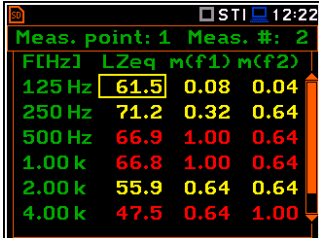
  In case the modulation ratios are greater than 1 due to errors or disruptions detected during the measurement, they are given a value of 1, and the results for this band are highlighted in red.

  Note: *You can switch between above views with the ▼/▲ key pressed together with* **<Alt>**.

- *Measurement* view appears when you start a new measurement (manually or automatically). This view presents measured results which are updated every second and a progress bar of the measurement that lasts 15 seconds.
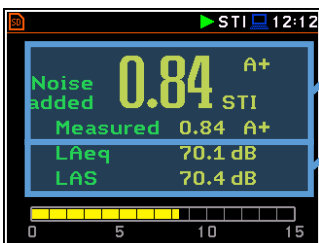
  - o **STI** index with consideration of the Ambient noise (**Noise added**) or without (**Measured**) and the STI qualification band.
  - o **LAeq** and **LAS** for the current measurement time.

  After completion of the measurement, the instrument will automatically switch to the *Point* view and the measurement results will be placed in the measurement list. If you stop the measurement manually, the instrument switches to the *Point* view, but the measurement result will not be included in the measurement list (see Chapter 13.4.6).

  Note: *Averaged* **CIS** *is displayed instead of STI in the main STIPA views (Area, Area summary and Point) when this parameter is selected as* **Index** *in the* **STIPA Settings** *screen.*

13.4.2 Project structure

Speech intelligibility measurements are organized in the structure of projects. The name of the project is equal to the name of the directory in the instrument's memory. Its subdirectories have names of tested areas. Next down level directories have names of test signal positions (so called sources). The source position directory contains measurement point directories with predefined names (**P1**, **P2** etc.) where the measurement files are saved. The measurement file contains measured results for the single measurement. Projects are saved in the predefined STIPA catalogue in the instrument's memory. Projects can be accessed through **File Manager**.

For example, in the below screens the project directory (**PROJ_001**) contains one area directory (**AREA_001**), which contains one source position directory (**S1**), which contains two points directories (**P1** and **P2**) and file with the ambient noise distortions (**NOISE.SVL**).

Directory **P1** contains files with measurement results (**M1.SVL**, **M2.SVL …**).

First three directories are created by the user during configuration of the **STIPA Settings** in the **Project**, **Area** and **Source** positions.
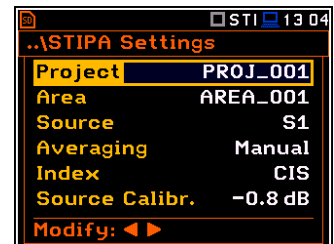
Point directories are created automatically when the user presses the **<Next>** soft-key in the *Area* view.

Note: *To press the soft-key on the display, select it with the ◄ / ►key and press* **<ENTER>**.

If you delete the point in the *Area* view, the appropriate directory will be deleted with all contained files.
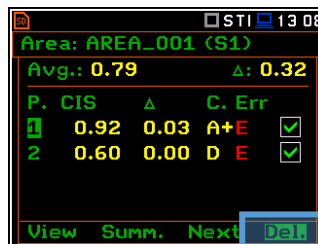
Every time you start a new measurement with the **<Start>** key, a new file will be created and saved in the point directory after the measurement is completed.

If you break the measurement with the **<Stop>** key, the measurement file will not be created.

If you delete the measurement in the *Point* view, the appropriate file will be deleted from the point directory.

<Start>

=>

Note: *Project, Area and Source directories can be created, renamed or deleted via the* **File Manager** *- see Chapter 6.*

Note: *You cannot delete or rename point directories and measurement file via the* **File Manager***. You can delete a point directory and a measurement file using the mechanism described in Chapter 13.4.6.*

13.4.3 Averaging results

STIPA measurements require averaging of STI/CIS indexes. This averaging concerns two aspects:

1) averaging of results for a measurement point.

Averaged **STI/CIS** for the measurement point is displayed in the left upper corner of the *Point* view and in the measurement points list of the *Area* view.
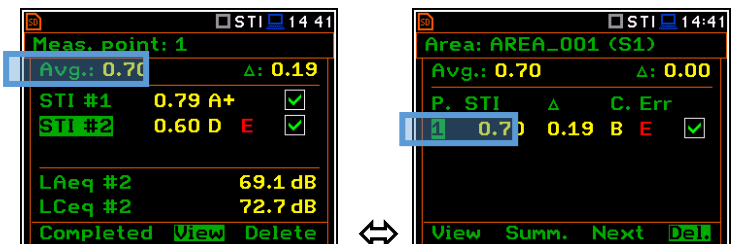
2) averaging of results for a tested area.

Averaged **STI/CIS** for the tested area is displayed in the left upper corner of the *Area* view and in the second line of the *Area summary* view.
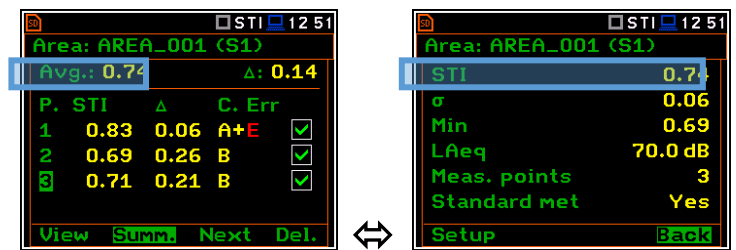
According to most standards, it is good practice to average the results for measurement points for two or three measurements. In case of noise fluctuations during measurements, it is recommended to make not less than three measurements and check whether the spread of the STI index does not exceed 0.03.

13.4.4 STIPA settings

STIPA measurements are configured in the **STIPA Settings** and **Ambient noise** screens. To configure a STIPA project follow these steps:

1. Select the **STIPA Settings** position in the **Measurement** section and open it with the **<ENTER>** key.

<ENT>
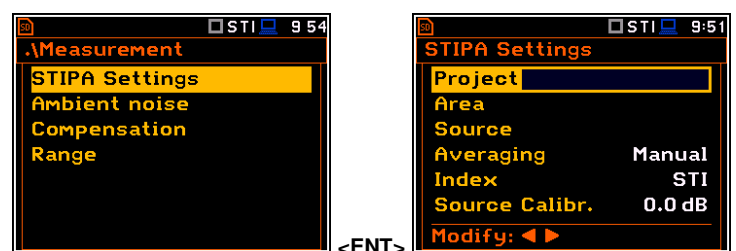
2. Being at the **Project** position, press the ► key and, in the **Select Project** screen, select **New Directory** to create a new project directory or select the directory of the previously created Project and press **<ENTER>**.

In case of **New Directory**, the instrument will propose a default name for the new Project directory which can be modified in the editor screen opened after pressing the **<ENTER>** key.

After edition of the project name it should be confirmed by the **<ENTER>** key.

Being at the new created directory line in the **Select Project** screen press **<ENTER>** to return to the **STIPA Settings** screen.

The selected project name will be displayed in the **Project** position of the **STIPA Settings** screen.

3. Go to the **Area** position and press the ► key. In the **Select Area** screen create a new area directory (**New Directory**) or select the directory of the previously created Area in the selected Project.

After creation of a new area directory or selection of the existed one press **<ENTER>** and the selected area name will be displayed in the **Area** position of the **STIPA Settings** screen.

4. Go to the **Source** position and press the ► key. In the **File Manager** screen create a new source directory (**New Directory**) or select the directory of the previously created Source in the selected Area.

After creation of a new source directory or selection of the existed one press **<ENTER>** and the selected source name will be displayed in the **Source** position of the **STIPA Settings** screen.

5. Select the **Averaging** type: **Manual** or **Auto**.

   Manual averaging means that you may perform as many measurements for the measurement point as you need, and you will decide when to stop series of measurements by using the **<Completed>** soft-key – see Chapter 13.4.6.

Automatic averaging assumes that the measurements will be averaged according to IEC 60268-16:2011 which assumes two averaging procedures – for standard measurements (**IEC 60268-16x2**) and for measurements with fluctuating noise (**IEC 60268x3**). In the standard name abbreviation **x2** means that no less than two measurements should be made, and **x3** means that no less than three measurements should be made. When the automatic averaging is selected, additional position **Standard** appears in the **STIPA Settings** screen.

6. In case of automatic averaging, choose the **Standard** that defines the averaging type: **IEC 60268-16x2** or **IEC 60268x3**.

   In the automatic averaging mode, you make measurements the same way as in the manual mode. The difference is that in the automatic mode, the instrument decides when to end the series of measurements and ends it automatically when the appropriate condition is met.
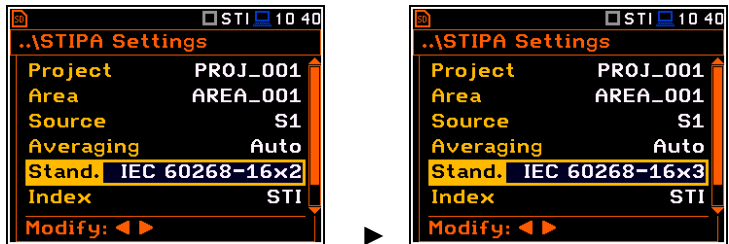
7. The **Index** position allows you to define which index **STI** or **CIS** will be displayed in the main STIPA views.
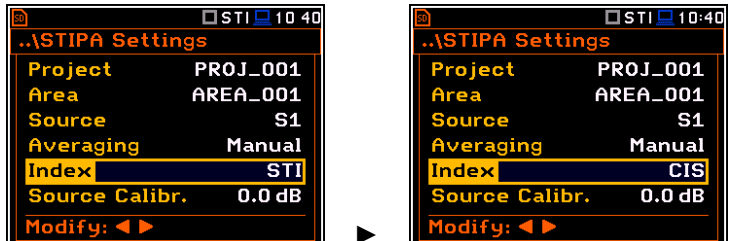
8. In the **Source Calibration** position, set the adjustment of the reference STIPA signal level to the level of a real voice signal in the tested area.

   LAeq of both signals must be measured and if the difference between the real signal and STIPA signal is different than -3 dB, enter it as the Source calibration.
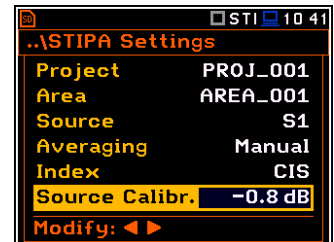
13.4.5 Considering ambient noise distortions

During the measurement, the effect of ambient noise distortions can be considered in combination with the STIPA signal in the 1/1 octave bands with central frequencies from 125 to 8000 Hz. These sound pressure values are not necessarily should be the result of some measurements. They can be defined on the basis of the user's knowledge, design assumptions, literature, etc.

In the **Ambient noise** screen, you can set noise levels for octave bands that will be considered in the STIPA calculations.
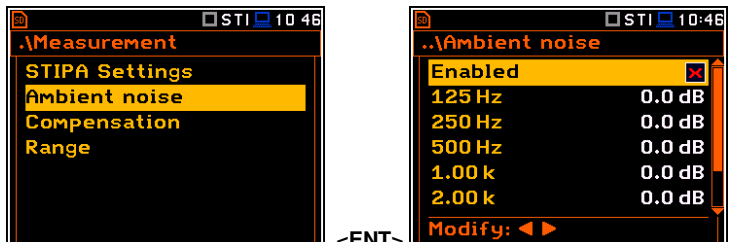
To set the ambient noise, select the 1/1 octave band and with the ◄/► key, set the required value.
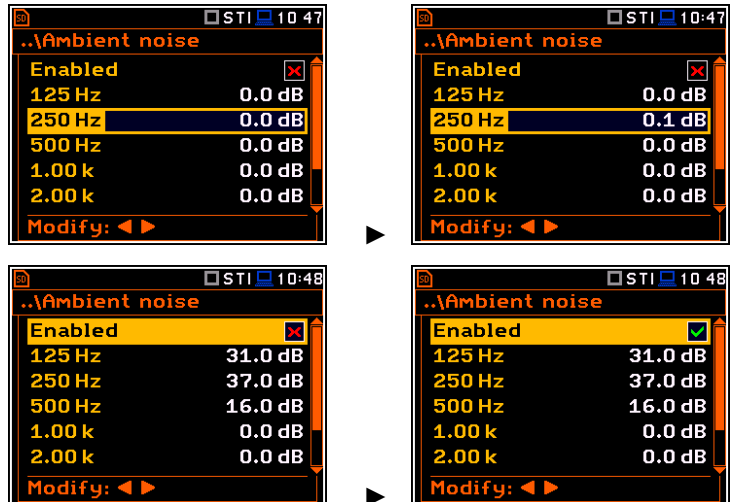
In the **Enabled** position, you can enable or disable the consideration of ambient noise for subsequent measurements.

Note: *The table with ambient noise distortions can be updated also from the Point view before the first measurement – see next Chapter.*

13.4.6 STIPA measurements

When STIPA settings are complete, you can start measuring.

1. To perform measurements, go to the measurement mode (escape from the configuration menu).

   If you begin measurements, the *Area* view will show the first measurement point with zero STI value.

   If you have already made the measurements for some measurement points, you should create a new measurement point – see step 5.

2. To start measurement, press the **<Start>** key. The *Measurement* view appears, showing the measurement progress bar and STI index calculated with considered ambient noise, measured STI index, STI qualification band, LAeq and LAS results.

   The measurement lasts 15 seconds during which the displayed results are updated every 1 second.
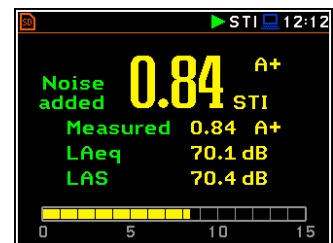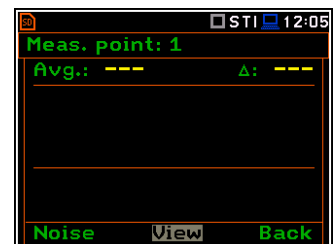
Note: *Ambient noise distortions will be considered in accordance with the values set in the **Ambient noise** table – see Chapter 13.4.5.*

Note: *Pressing the **<Stop>** key during the measurement will break it without recording the measurement results.*

After completing the measurement, the instrument shows the *Point* view with current measurement results.

3. Press the **<Start>** key if you wish to perform another measurement.
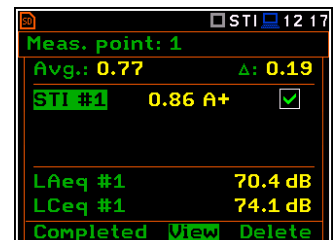
4. To finish measurement series for the measurement point, you should complete them pressing the **<Completed>** soft-key.

    The instrument switches to the *Area* view.
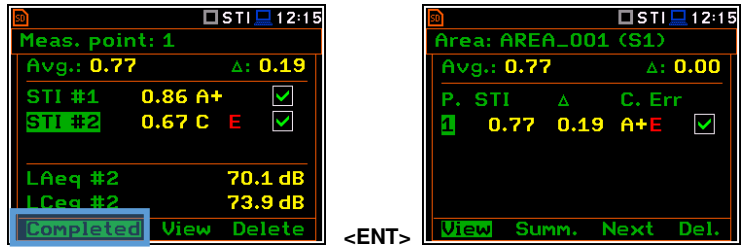
Note: *In case of automatic averaging the series of measurements will be completed automatically after meeting the conditions specified in the selected standard.*

If you select a measurement in the *Point* view and press the **<View>** soft-key, you can view the modulation function coefficients for seven octave bands and two modulation frequencies (f1 and f2) for this measurement.

To return to the *Point* view press **<ENTER>** or **<ESC>**.
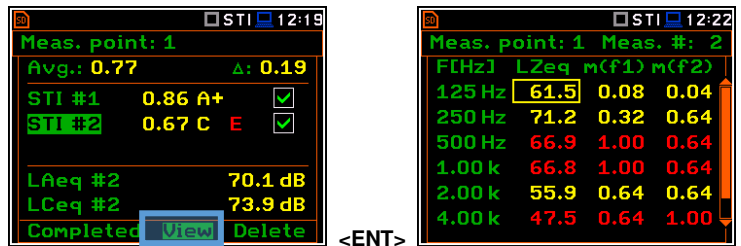
You can delete the selected measurement pressing the **<Delete>** soft-key.

After deleting the measurement, the instrument will change the numeration of measurements in the *Point* view. At the same time the file with the measurement results will be deleted from the Point directory.
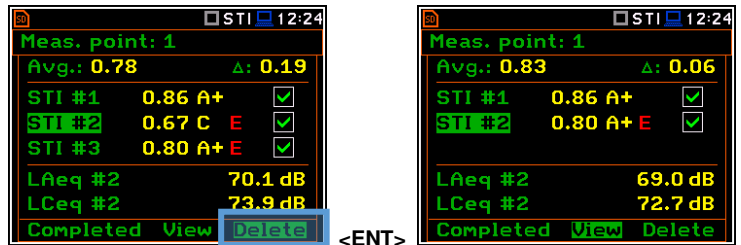
You can exclude/include the selected measurement from the averaging by pressing the **◄/►** key together with **<Alt>**. The file with the excluded measurement results will have the "_" character instead of "M".
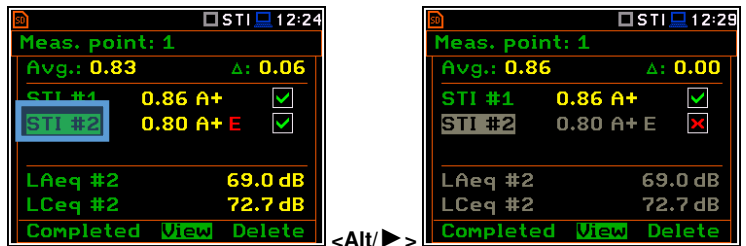
5. After completion of the measurement series for the measurement point, you can create a new measurement point pressing the **<Next>** soft-key in the *Area* view. The instrument will create a new point directory and switch to the *Point* view.

    To start measurements in the new measurement point, press the **<Start>** key and follow steps 2 – 4.
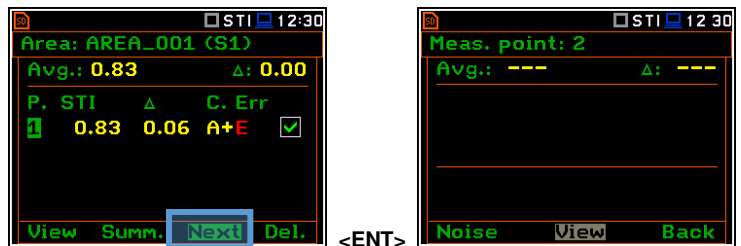
In some cases, it may be necessary to change ambient noise levels for a new measurement point.

In such a case, before making first measurement in the *Point* view press the **<Noise>** soft-key and in the **Ambient noise** screen make necessary adjustments of the noise levels for octaves.
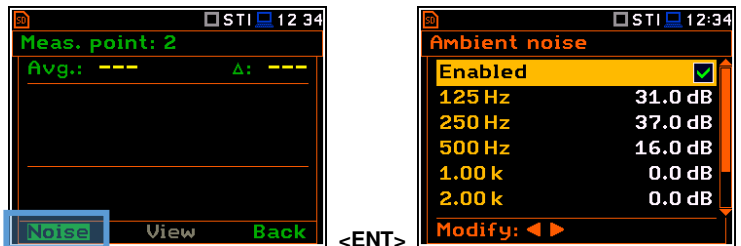
After confirmation of the changes with the **<ENTER>** key you will return to the measurement mode with new ambient noise distortion parameters.

Note: *Any confirmed changes in the **Ambient noise** table will replace the previous ones and new ambient noise distortions will be considered during the next measurements!*

If you press the **<Summ.>** soft-key in the *Area* view, the instrument will switch to the *Area summary* view.

<ENT>
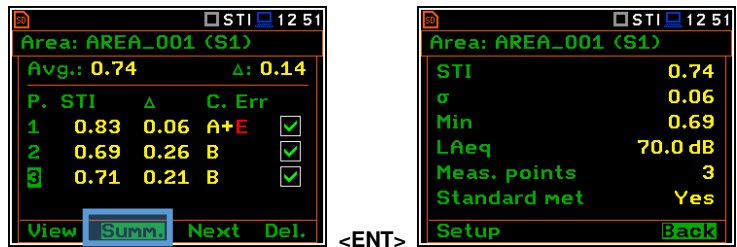
From the *Area summary* view, you can return to the *Area* view with the **<Back>** soft-key or you can go to the **STIPA Settings** screen with the **<Setup>** soft-key.
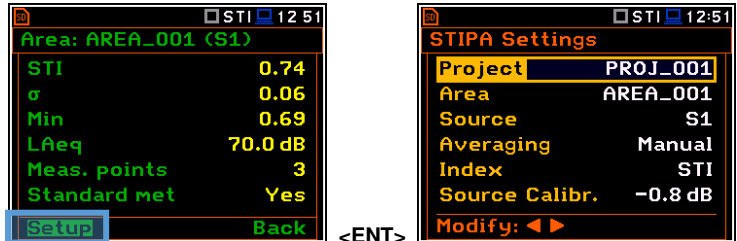
In the **STIPA Settings** screen you can create new Project, Area or Source and continue measurements for the new area.

<ENT>

You can exclude/include a measurement point(s) from averaging. For this, select it with the ▼/▲ key and press the ◄/► key together with **<Alt>**. Values in the *Area summary* view will be recalculated without consideration of the excluded point(s).
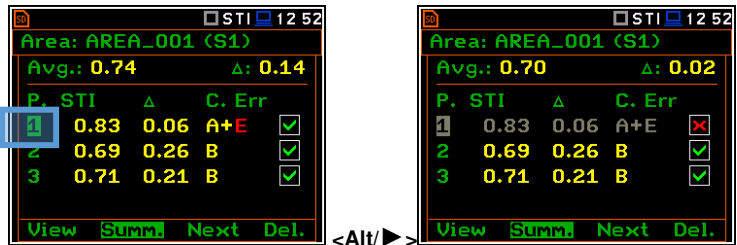
The directory of the excluded point will have the "_" character instead of "P".

<Alt/► >

You can delete a measurement point. For this, select it with the ▼/▲ key and press the **<Delete>** soft-key. After confirmation the selected point will be deleted.
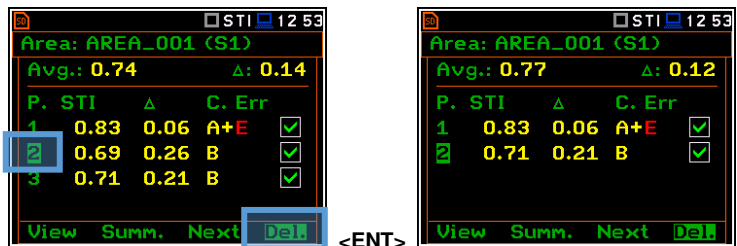
The point directory with all measurement files will be deleted from the Source directory.

<ENT>

To view measurements for the measurement point, select it with the ▼/▲ key and press the **<View>** soft-key.

<ENT>
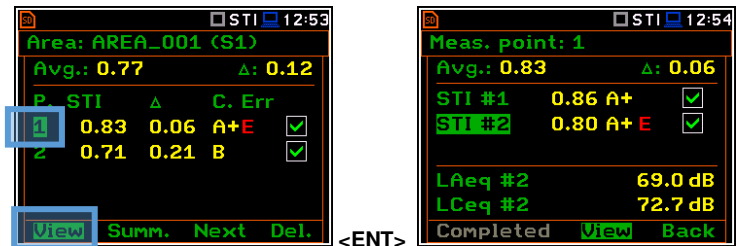
You can finish measurements for the selected **Project/Area/Source** at any time and if necessary create next **Project/Area/Source** combination in the **STIPA Settings** screen.

13.5 DOWNLOADING FILES AND PROCESSING DATA

The measurement files created during the STIPA measurements by SV 977D can be download and analysed with the use of SvanPC++ software.

The SvanPC++ software allows you to download files and analyse measurement data made with the use of the SV 977D instrument as well as projects created by the BA Assistant application for smartphones.

13.5.1 Measurement with BA Assistant

BA Assistant is an application for mobile devices (smartphones, tablets) with the Android 7.0 or newer operating system that uses Svantek measuring instruments to measure the building acoustics, including STIPA speech intelligibility.

After taking measurements using *BA Assistant* a project (zip file containing files with the results obtained during the measurement) will be automatically copied to the measuring instrument. Project zip file is named BAxxx.ZIP and you can download it to a PC and open with the SvanPC++ program using the "SVAN Files" option (available in the menu "SVAN -> SVAN Files" or using the meter icon 📱 on the toolbar). If you have the SvanPC++ software installed on your PC, you can open the project directly by doble clicking on it.
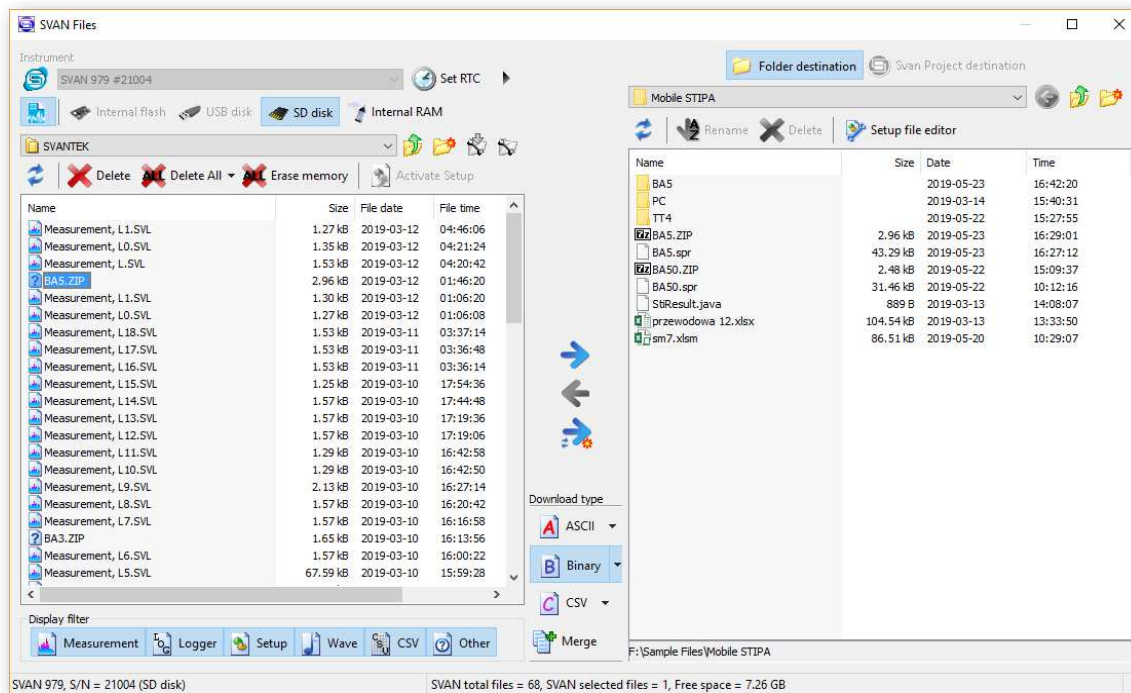
To open the project:

- Connect your Svantek instrument to the PC,

- Launch SvanPC++,

- select the project file in the list on the left side of the window and then use the right arrow button. As a result, the file will be downloaded to the folder on the right side of the window.

- Then just double click on the downloaded file and it will be automatically opened in the SvanPC++ program. The STIPA results window will appear.

You can skip downloading the file and double-click on the file in the list on the left panel - then the file will be downloaded to the temporary folder and opened.

13.5.2 Direct measurement with SV 977D (without BA Assistant)

When using the instrument directly STIPA function, the measurement files are grouped in catalogues for points. Point catalogues are grouped into source catalogues. Those, in turn, are grouped in the catalogues for the area, and the catalogues for the area are grouped in the project catalogue.

To download files with SvanPC++, use the "SVAN Files" window. Select the appropriate catalogue with required data in the instrument section and then click the right arrow to download them. You can select the entire project catalogue or only a catalogue for the area or point (or even a single SVL file).
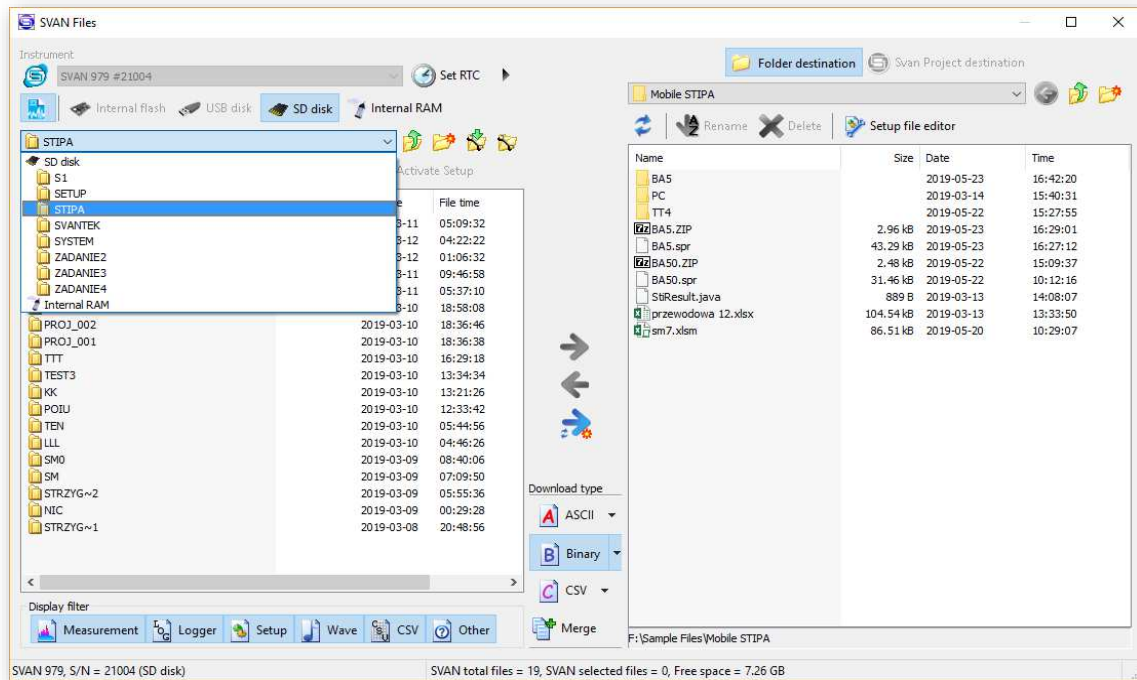
If you downloaded a file, you can open it with a double-click, if you downloaded the whole folder, you need to link the downloaded data set. The easiest way for this is to use the SvanPC++ project functionality. For this, close the "SVAN Files" window and create a new project ("File -> New Project" and select "Simple project" as the project type).

A window on the left side with a list of project files (empty for now) will appear. Add files / folders to the project that you wish to combine. The easiest way to do this is through drag & drop operations from the file explorer by selecting the folder / files and dragging it to the SvanPC++ window. The program will automatically link all files from the folder, whereby the program may ask how to link files - in case of STIPA, the option you choose is irrelevant because STIPA measurements are linked by grouping on matching projects, areas, sources, points. After this operation, the STIPA results window will appear automatically.
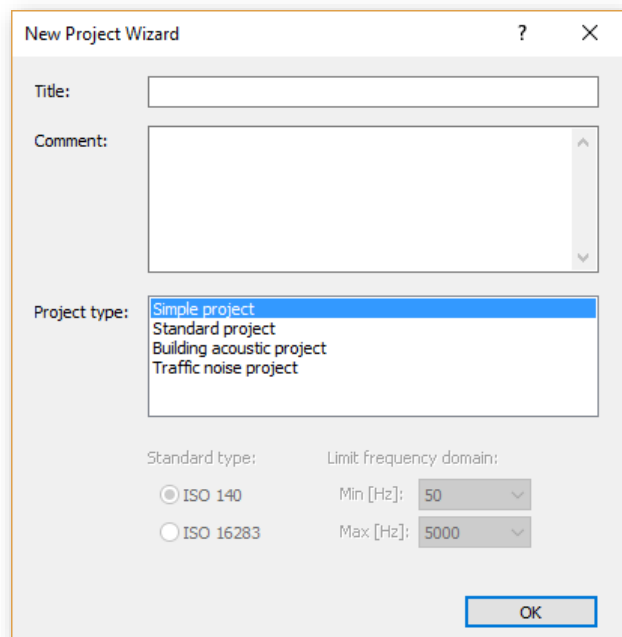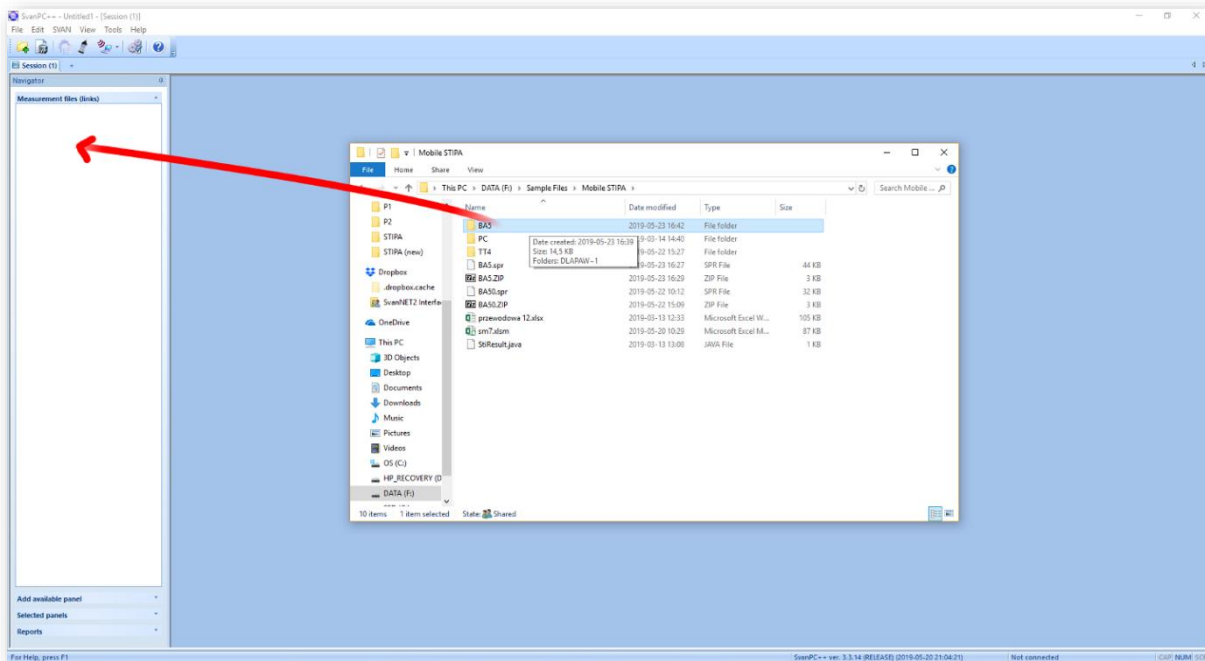
13.5.3 Presentation of STIPA results

The STIPA results are grouped in one window with the appropriate division into areas, sources and points for the selected project. When opening a project from the BA Assistant application or creating a "Simple project" project in SvanPC++, the STIPA window will open automatically. When opening individual SVL files, the results pane is accessed via the "STI" button on the toolbar.

In case of "Simple project" projects, this window can also be opened via the "Add available panel" tab and selecting "STI".
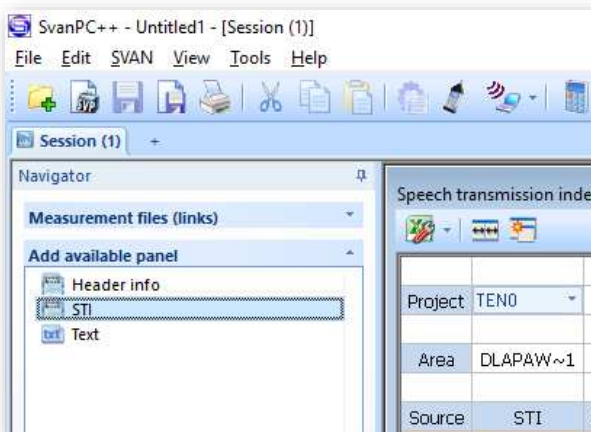
STIPA results by default appear for areas, sources and points. Each point on the view is a button which, when pressed, shows measurement results for a given point.

Each measurement has a "checkbox" which can be used to enable / disable a given measurement - in this situation the STIPA results for the point and higher groups will be automatically recalculated after the measurement is turned on / off.

Each point after the expansion has background noise results at the end of the measurement list.

Source	STI	Category	σ	Δ	CIS	STI (Measure)	Category (Measure)	CIS (Measure)	LAeq [dB]	LCeq [dB]	Status
S1	0,59	E	0,10	0,20	0,77	0,62	D	0,79	112,85	113,49	E
[-]P1	0,69	B	0,05	0,11	0,84	0,71	B	0,85	71,15	80,97	✓
☑ 1	0,63	D	-	-	0,80	0,65	C	0,81	71,14	81,07	✓
☑ 2	0,74	A	-	-	0,87	0,77	A+	0,89	70,77	80,68	✓
☑ 3	0,70	B	-	-	0,85	0,72	A	0,86	71,50	81,14	✓
Background noise	-	-	-	-	-	-	-	-	-	-	-
[+]P2	0,49	G	0,13	0,34	0,69	0,53	F	0,72	115,86	116,50	E

13.5.4 Changing background noise values

The cells with the background noise results are editable, i.e. you can manually enter values for individual octaves (just double click on the selected background noise value). Such a change will automatically convert the results for a point and above.

You can also import background values using the paste option (CTRL+V or menu "Edit -> Paste") after selecting the value from which you want to paste the results. Data that are in the clipboard will be inserted for the next octaves starting from the selected cell. You can copy data to the clipboard from Excel, from another program as well as you can copy values from another view of SvanPC++ (thanks to that you can import results from another SVL file). If the clipboard has numerical values separated by a white space (space, tab, enter), the program will accept them correctly.

13.5.5 Generating reports

There are two ways to generate a report:

1. Using the Excel icon in the upper left corner of the view - an Excel spreadsheet will automatically open with all the data visible on the view.

2. Selecting cells in the table and using the copy-paste option (CTRL+C or menu "Edit -> Copy" or from the right-click context menu), you can transfer a fragment or the whole view, for example, to the Word application.
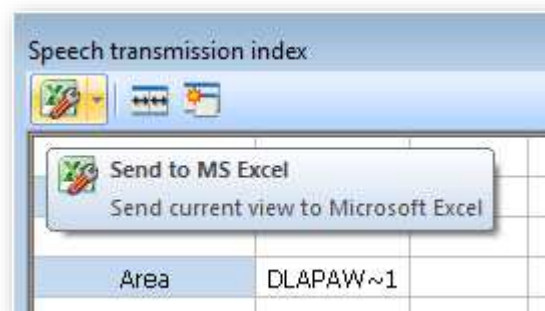
14 MEASUREMENT OF TONES – Tonality

The instrument assesses the audibility of tones based on the next standards:
- ISO 20065:2016,
- ISO 226:2003,
- ISO 226:1987.

See Appendix F.

Note: *It is recommended to familiarize with the Appendix F before proceeding. This chapter describes only the navigation of the instruments, whereas Appendix F describes the Objective Method for Assessing the Audibility of Tones in Noise – Engineering Method (according to ISOS 20065:2016) applied in the instrument.*

Note: *The Tonality analysis is performed after collecting the necessary data measured with the Sound Level function and, depending on the standard, the 1/3 Octave or FFT function.*

14.1 SELECTING THE TONALITY FUNCTION

To activate the **Tonality** analysis function, select the **Tonality** position in the **Measurement Function** list and press **<ENTER>**.
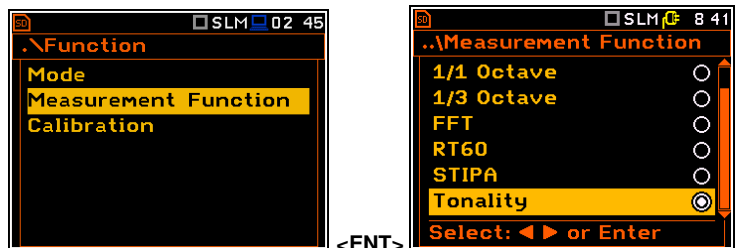
Note: *The Tonality function is optional and should be unlocked by entering the activation code in the text editor screen, which is opened after first attempt to select this function. Once unlocked this option will be ready to use permanently.*

Note: *It is not possible to change the current function during running measurements. In this case the instrument displays for about 2 seconds the warning: "Measurement in Progress". To change the current measurement function, the measurement must be stopped!*

14.2 TONALITY SETTINGS

The execution of the **Tonality** function depends on the standard selected in the **Tonality** list of the **Measurement** section.

Other settings are set automatically but some of them can be modified in the different items of the **Measurement** menu.
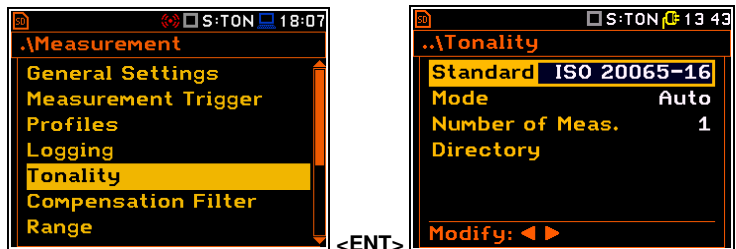
In the **Standard** position, you can select the standard according to which tones will be defined: **ISO 20065-16**, **ISO 226-2003** or **ISO 226-1987**.
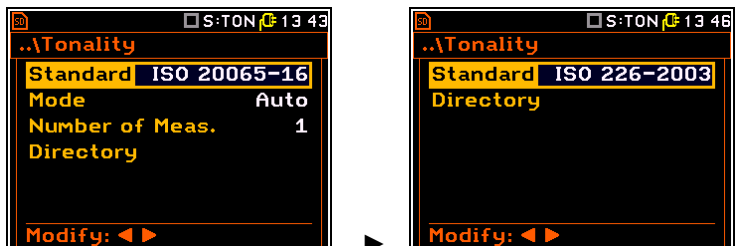
For the **ISO 20065-16** standard, you can choose the measurement **Mode**: **Auto** or **Manual**, and the maximum number of measurements (**Number of Meas.**).

In the **Auto** mode, the measurements are performed one by one without pauses after pressing the **<Start>** key, until the number of measurements reaches the **Number of Meas.** value.

In the **Manual** mode, the measurements are performed one by one by the user pressing the **<Start>** key.

When the number of measurements reaches the **Number of Meas.** value, the instrument automatically performs post-processing calculations.

If you want to continue measuring, please make sure the **Number of Meas.** value has previously been increased. The maximum number of measurements in a specific folder can reach a maximum of 20.

Post-processing calculations are essential for the standard report, since the analysis of all measured files is required for calculating the mean Audibility parameter and the Extended Uncertainty parameter.

All files with measurement results should be saved in the dedicated directory, which should be defined manually in the **Directory** position through the **File Manager**.

To define the directory, press the ► key to enter the File Manager screen.

Then press **<ENTER>** on the **<New Directory>** position and confirm the automatically proposed directory name with **<ENTER>** or press the ► key to edit this name.

If you already have previously created directories, you can choose them.

In this case, all measurement will be loaded to the instrument for viewing. You also will be able to make more measurements. Just care about **Number of Meas.**, which should be increased by the number of additional measurements.
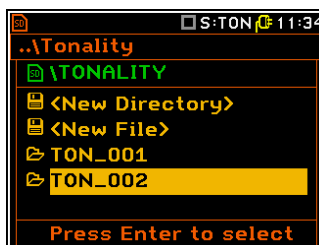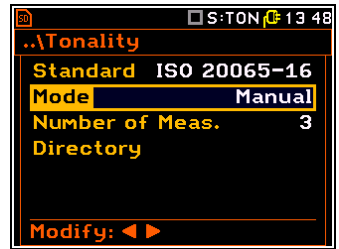
> **Note:** The selection of the directory is important step. If the directory is not defined, the measurements will not start.

You can change the **Integration Period** time in the **General Settings** screen (*path: <Menu> / Measurement / General Settings*).
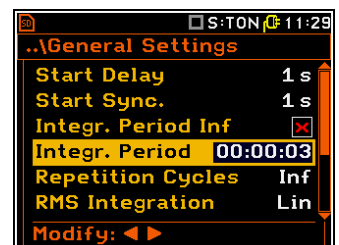
The **Logger Name** can be changed in the **Logger Setup** screen (*path: <Menu> / Measurement / Logging / Logger Setup*) before the first measurement in a new folder. After the first measurement have been done, the logger's name cannot be changed manually. Every new measurement file name will be created automatically and the name of the automatically created files will consist of the first name plus measurement number.

Settings for the standards are shown in the below table. Parameters that can be changed are in **red**.

Standard	Description	
	Parameters	**Outcome**

ISO 20065-16	**Spectrum: FFT**
	  Band: 5kHz
	  Filter: A
	  Averaging: Linear
	  Investigation region: 50-4575 Hz
	  Line spacing: 3.125 Hz
	General Settings:
	  Integr. Period: 3 s
	  Cycles: 1
	Logger Setup:
	  Name: L1, L2, …
	Tonality:
	  Mode: Auto / Manual
	  Number of Meas.: 1..20
	  Directory: TON_xxx
		FFT spectrum View and the Tonality results Table.
		
		Tonality results Table consists of:
		• All found tones and their audibilities,
		• Maximum tone Critical bandwidth, tone level Lt, noise level Lg, audibility ΔL,
		• Mean audibility for the number of spectra 'mean L', extended uncertainty of the mean audibility 'U90%', spectrum penalty Kt.

ISO 226-2003	**Spectrum:1/3 Octave**
	  Band: Audio (20-20k)
	  Filter: Z
	  RMS Detector: Lin
	  Min,Max Detector: Fast
	  Investigation region: 25Hz-12.5kHz
	General Settings:
	  Integr. Period: 3 s
	  Cycles: 1
		Equal-loudness level contour corresponding to the highest tone in the spectrum according to ISO 226: 2003.
		Loudness levels [phon] of each tone are available in the additional View. All tones that satisfy the standard conditions are shown in the main View (orange colour). Main tone is distinguished by its colour as well (yellow colour). Spectrum Penalty Kt.

ISO 226-1987	**Logger Setup:**
	  Name: L1, L2, …
	Tonality:
	  Directory: TON_xxx
		Equal-loudness level contour corresponding to the highest tone in the spectrum according to ISO 226: 1987.
		The views are the same as in the previous standard.

Note: Integrational Period is 3 s by default for the Tonality function setup. However, it's possible to settle other integration period, that will be kept in the memory of the Tonality setup and will be loaded next time.		
Note: For the 1/3 octave Tonality measurement it's recommended to set the integrational time for 1 s. For the FFT Tonality measurement it's recommended to set the integrational time for 3 s.		
Note: The repetition **Cycles** parameter in the **General Settings** for Tonality according to **ISO 20065-16** is always 1. The repetition **Cycles** for Tonality according to **ISO 226-2003** and **ISO 226-1987** can be changed and set by user.		
Note: The user has the right to stop a measurement or calculations by clicking the **<ESC>** button. This will lead to the loss of measured data and results.		

14.3 TONALITY MEASUREMENTS

The instrument performs **Tonality** measurements together with SLM measurements.

To start measurements, press the **<Start>** key.

If you use the **ISO 226-2003** or **ISO 226-1987** standards, each press of the **<Start>** key will start series of measurements defined by the **Cycles** parameter, which the user can set. The tonality results for the last cycle will be saved in the file. These results can be viewed as the 1/3 octave spectrum graph.

If you use the **ISO 20065-16** standard, you cannot change the number of **Cycles**, but you can set the **Number of Meas.** parameter, which limits the number of measurements. In the **Auto** mode, the instrument will perform just these number of measurements and will stop. In the **Manual** mode, you should press **<Start>** to start new measurement.

After reaching the **Number of Meas.**, the instrument performs postprocessing calculations which is accompanied by a message "Calculations…".
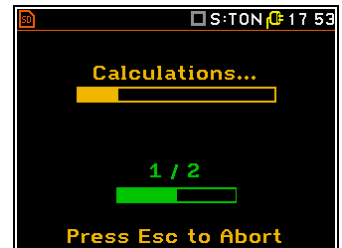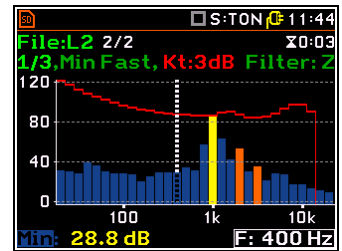
14.4 TONALITY RESULTS

Results of the Tonality analysis are presented as a spectrum – FFT in case of the **ISO 20065-16** standard or 1/3 octave in case of the **ISO 226-2003** and **ISO 226-1987** standards.

In case of the **ISO 20065-16** standard**,** you can view tonality results in a table form: **Tonality Results**.

The **Tonality Results** view presents:

1) results of Tonality analysis for the currently displayed measurement:

- **Tones(x)** - a list of tones causing penalty, x – number of tones,
  - Tones' frequencies and the corresponding audibilities in dB (ΔL)

- **Critical Band (y)** - frequency band with a bandwidth of a decisive tone, **y** – number of this tone in the list of all detected tones, **XX Hz – YY Hz** - Critical Band frequency boundaries and calculated for this critical band results:
  - **Lt** – tone level
  - **Lg** – critical band level of noise that is assigned to the critical band
  - **ΔL** – audibility, difference between the tone level and the masking threshold

2) averaged results for the series of measurements:

- **mean L** – averaged Audibility result of all measurements
- **U90%** – extended uncertainty of the mean audibility with a coverage probability of 90% in a bilateral confidence interval
- **Kt** – spectrum adjustment
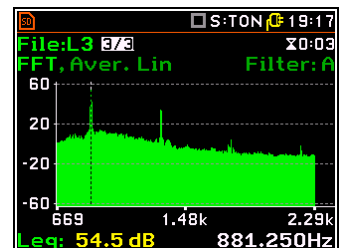
The full Results Table is available to see in the SavnPC++ program. It allows you to view all the measured parameters according to ISO 20065:2016.

1/3 octave results

In the left example, the most pronounced tone can be seen (yellow colour) as well as additional tones (1/3 bandwidths) are marked by orange colour. The equal-loudness level contour corresponding to the highest tone in the spectrum according to ISO 226:1987 or ISO 226:2003, depending on the Standard settings, is shown as red line.
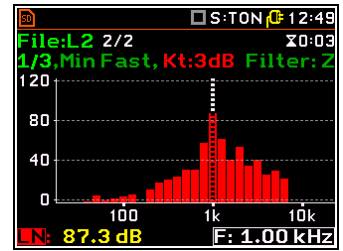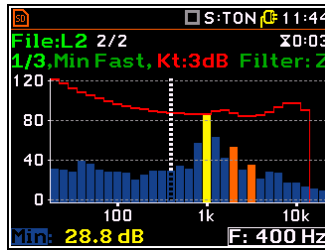
In the right example, the corresponding loudness levels (Phon) to each 1/3 band are shown. The absence of the result in a particular bandwidth indicates that the loudness level doesn't meet the requirements of the current standard.

FFT results

The spectrum view shows the FFT spectrum for the selected measurement, recorded in the file (in the presented example with the name **L3**).

You can shift manage this view same way as normal FFT spectrum, e.g., shift cursor position, zoom the spectrum etc.
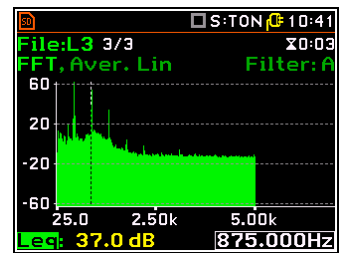
Changing the measurement file in the current measurement series

To change the measurement file in the current measurement series, select the field with measurements count and press the ◄ / ► key together with **<Alt>**.
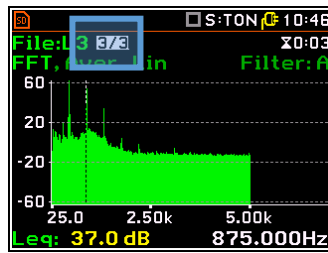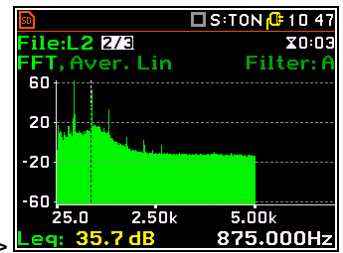
Opening files of a new measurement series

When the **File** field is active you may open files of a new measurement series.

For this, press **<ENTER>**, and in the **File Manager** open the required catalogue and then select any measurement file and press **<ENTER>**.
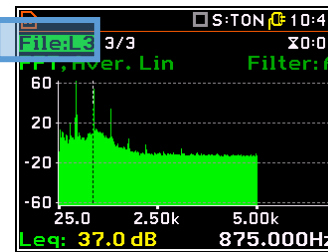
Changing the cursor position

When the measurement result field is active, you may change the cursor position with the ◄ / ► key.
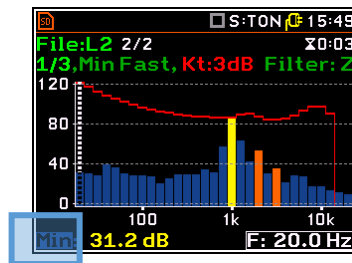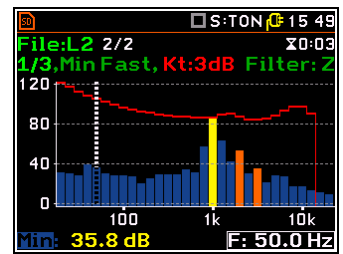
15 SV 277 MONITORING STATIONS

The **SV 277** type outdoor monitoring stations based on the **SVAN 977** instrument and **SA 277** outdoor microphone kit are recommended for short term and semi-permanent noise measurement in the environment.

The station contains an internal battery for autonomic work from four to eight days. The station can be powered from the optional **SB 271** solar panel.

The station allows you to measure all results that the SVAN 977 instrument can measure. In addition, the **SP 275** or **SP 276** weather station can be integrated in the system allowing you measuring most essential weather parameters - barometric pressure, humidity, precipitation, temperature, wind speed and direction as well as rain intensity. All measurement results from the weather stations are transmitted to SVAN 977 and saved in the SVL data files in the instrument' memory.

The SA 277 outdoor microphone kit protects the SVAN 977 preamplifier and microphone from weather conditions. SA 277 is made of lightweight materials and can be easily installed on a mast with standard mounting threads.

The monitoring station uses a cellular modem for remote communication with the Internet. *SvanNET*, a web server, that supports the connection between PC and station. Thanks to *SvanNET* you may use also a mobile phone or tablet to check the status of the monitoring station.

Note: *For more details see SV 277 monitoring stations User Manuals.*

15.1 SVAN 977 SETTINGS SPECIFIC FOR MONITORING STATIONS

When SVAN 977 is operated in the SV 277 monitoring station few additional settings should be taken into consideration:

1. You can enable logging of the results obtained from the weather station (**Meteo**) to the data file as the Logger Results with the Logger step (*path: <Menu> / Measurement / Logging / Logger Results*).

2. You can enable logging of the results obtained from the weather station (**Meteo**) to the data file as the Summary Results with the step equal to the Integration Period (*path: <Menu> / Measurement / Logging / Summary Results*).
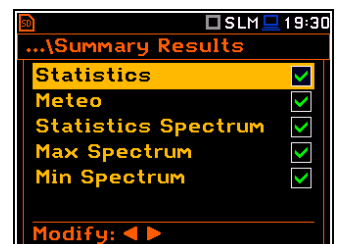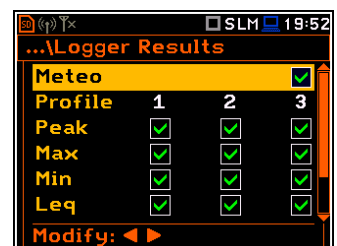
*Note: Both **Meteo** positions are active even when the instrument is operated out of the monitoring station, but the weather results will not be gathered without an associated weather station.*

3. You must set the **Outdoor Environment** and **Outdoor Airport** compensations since the monitoring station uses the SA 277 outdoor microphone kit. The characteristics of the outdoor filters depend on the dominating sound incidence angle: environmental monitoring (incidence angle 90 deg) or airport monitoring (incidence angle 0 deg) (*path: <Menu> / Measurement / Compensation*).

4. You can enable advanced alarms (**Alarms Enabled** – *path: <Menu> / Measurement / Alarms*), which are configured via the *SvanPC++* software or via the *SvanNET* web service.

    If you enable advanced alarms, the „alarm" icon appears, and the instrument will generate alarms according to the programmed settings.

    The advanced alarms configuration is described in the SvanPC++ and SvanNET manuals
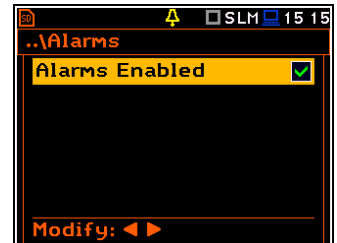
> ⚠ **Note:** The **Alarms** position appears in the **Measurement** list in the case the advanced alarms configuration file (ALARM.SVA) is uploaded to the predefined SYSTEM catalogue.

Alarms settings can be seen in the special measurement views: **Alarm Actions**, **Alarm Events** and **Alarm Conditions**.

These views can be changed with the ▲ / ▼ key pressed together with **<Alt>**.

The event, action and condition record can be changed with the ◄ / ► key pressed together with **<Alt>**.

<Alt/▼>
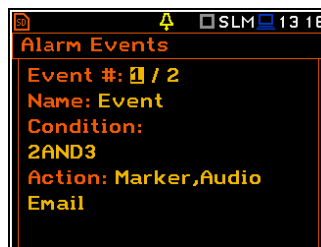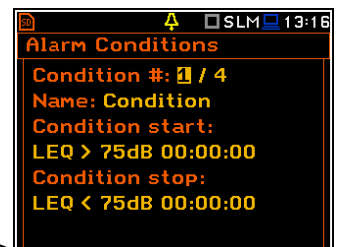
15.2 REMOTE COMMUNICATION SETTINGS – WIRELESS TRANSFER

SVAN 977 controls data transfer via the modem that supports the cellular connection with the help of the **Wireless Transfer** functionality. The connection with the SV 277 modem is carried out via the USB port.

The **Wireless Transfer** position allows you to select the network type and set the parameters of data transmission and the **Network Reset** position to carry out the factory setting of the network.

<ENT>
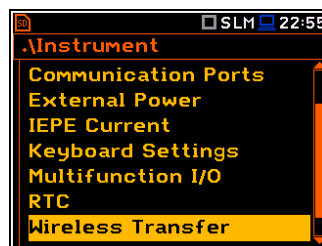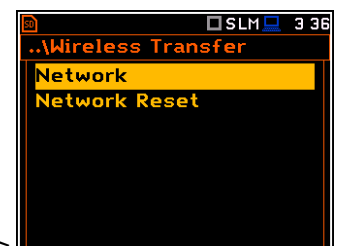
15.2.1 Selecting network type – Network

In the **Network** screen you can disable (**Off**) data transfer or enable it selecting **GPRS**.

<ENT>
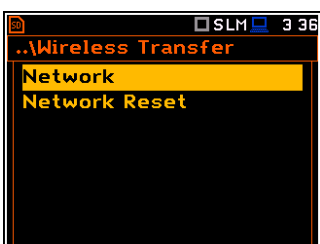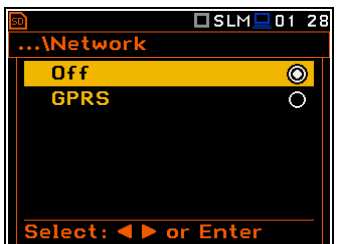
If the **GPRS** network is selected the **Wireless Transfer** screen will have additional positions enabling configuring GPRS connection: **Modem**, **Modem Connection**, **SMS Options** and **E-mail Settings**.
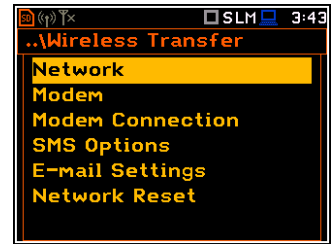
15.2.2 Configuring modem basic settings – Modem

The **Modem** position allows you to configure modem and data transmission settings.

<ENT>
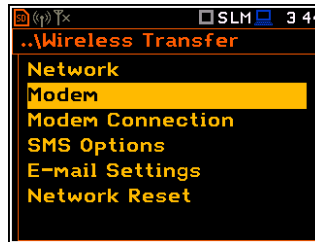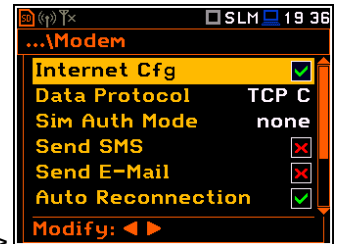
Note: *For connection with the **SvanNET** server, the positions in the **Modem** list should be set on default values as is shown on the screenshots above and on the right-hand.*

The **Modem** screen contains following parameters:

- **Internet Cfg** – if it is switched on, the instrument will automatically configure the modem right after turning on.
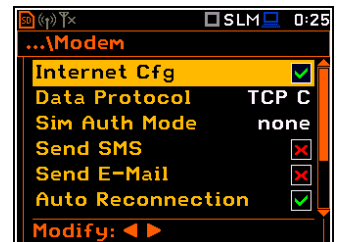
- **Data Protocol** – defines connection type for data exchange. Available types are **TCP S** (server mode), **TCP C** (client mode) and **UDP**.

▶
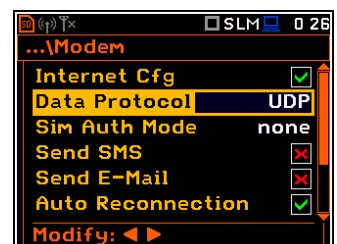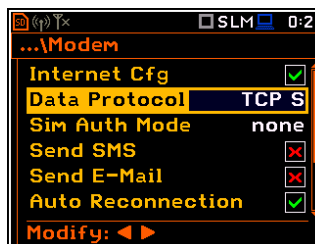
- **Sim Auth Mode** – defines the method of user verification by a SIM card type. Depending on the SIM card, several options are possible, some of them are recognized by the modem:
  - **none** – no verification required.
  - **PAP**
  - **CHAP**
  - **MsChap** – denotes MsChap in version 1.

- **Send SMS** – selecting this option will enable SMS alarm notifications.
- **Send E-Mail** – selecting this option will enable e-mail alarm notifications.
- **Auto Reconnection** – selecting this option will make the device attempt to reconnect the modem in case of errors or sudden disconnection.
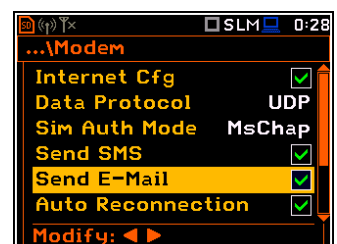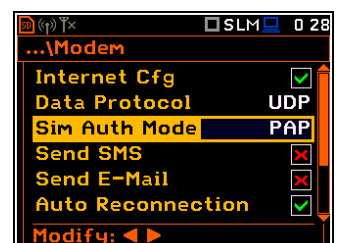
- **Reconnection Delay** – defines time between each reconnection attempts.
- **TCP IRT** - defines TCP Initial Retransmission Timeout. In some cases, extending this timeout may be helpful in case of slow connections, but the default setting is recommended.
- **TCP Max. Ret.** - defines maximum reconnection attempts performed within a simple connection cycle. In some cases, setting higher value may be helpful in case of slow connections, but the default setting is recommended.
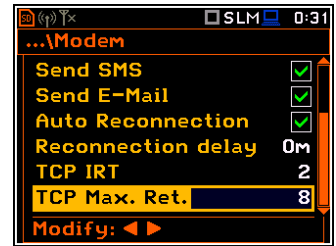
15.2.3   Configuring connections – Modem Connection

The **Modem Connection** position allows you to configure several parameters to establish internet connection.

<ENT>
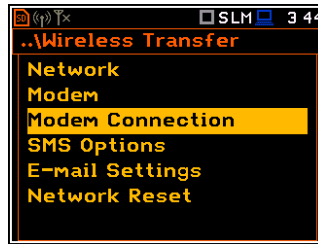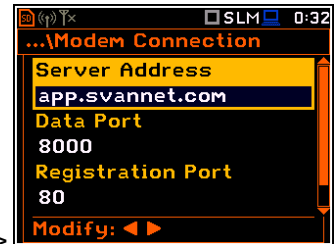
Note: For connection with the **SvanNET** server the parameters in the **Modem Connection** list should be set on default values as is shown on the screenshots above and below.

The **Modem Connection** screen contains the following positions:

- **Server Address** – allows you to enter up to 32 characters of either IP or domain address, where the registration data will be sent during the registration process (**Data Protocol: TCP S** or **UDP**) or to which the modem will connect to (**Data Protocol: TCP C**). By default, the server address is **app.svannet.com** and all other settings, presented in this chapter, are default settings, which enabled the connection with the SvanNET server.

- **Data Port** – allows you to enter up to 5 characters for the port number. This number denotes a port on which a communication socket will be configured for data exchange between the remote host and the station.

- **Registration Port** – allows you to enter up to 5 characters for the port number. This number denotes a port on which a communication socket will be configured to transmit registration package (Register Mode: On) or exchange Http data (Register Mode: AS or SMT. AS).

- **APN** – allows you to enter up to 20 characters of APN name of the SIM card used with the modem.

- **APN User** – allows you to enter up to 20 characters of user's name used for verification by the SIM card used with the modem.

- **APN Password** – allows you to enter up to 20 characters of password used for verification by the SIM card used with the modem.

- **DNS Server** – allows you to enter up to 15 characters of IP address of DNS server used for establishing connection with the internet. In most cases, leaving the default value of "0.0.0.0" will be sufficient, but some SIM cards may require a specific address to be entered.
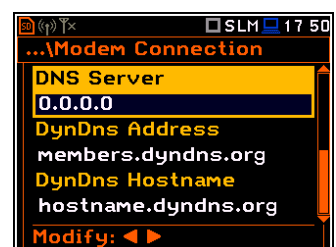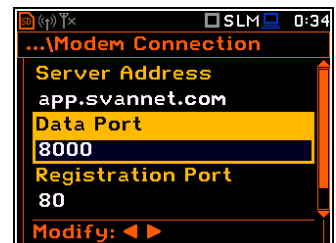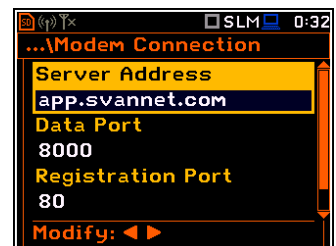
- **DynDns Address**,   **DynDns Hostname**,   **DynDns Login**   and **DynDns Password** - allow you to define the server and login information when using DynDNS service in case of dynamic IP address.

Edition of each position is performed in the special screen with the text editor function, which is opened with the ◄ / ► key.

In the text editor screens, you can switch the keyboard from uppercase letters to lowercase letters and special characters with the ▲ / ▼ key pressed together with **<Shift>**.
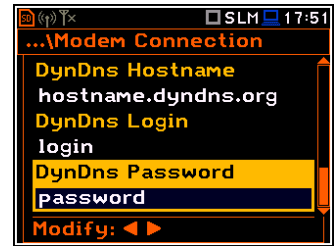
15.2.4 Configuring SMS service – SMS Options

The **SMS Options** position allows you to configure SMS service used for alarm notification.

The **SMS Options** screen contains the following positions:

- **Phone Number** – allows you to enter up to 20 characters of the phone number where the text messages will be sent.
- **Text Message** – allows you to enter up to 20 characters of additional text, which will be appended into a standard alarm message template.

Edition of each position is performing in the special screen with the text editor function, which is opened with the ◄ / ► key.
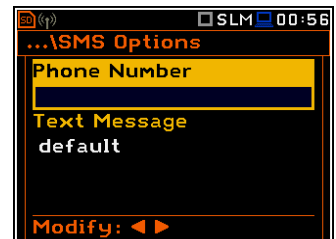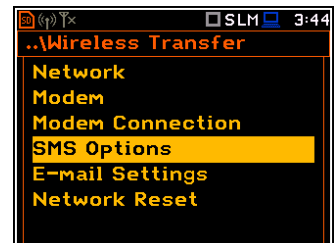
15.2.5 Configuring e-mail service – E-mail Settings

The **E-mail Settings** position allows you to configure the e-mail service used for alarm notification.

If the **SvanMail** position is enabled, you should define only positions: **Recipient e-mail**, **E-mail Subject** and **E-mail Message**. The **SvanMail** option allows instruments, compatible with SvanNET, send e-mails without additional parameters, simplifying the process of configuring alarm notifications.

- **Recipient e-mail** – allows you to enter up to 48 characters of e-mail address to which the e-mail message will be sent.
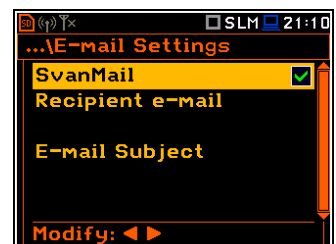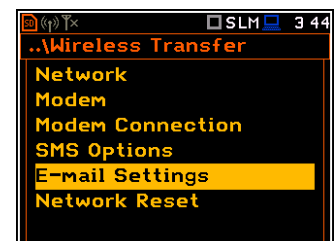
- **E-mail Subject** – allows you to enter up to 20 characters of the message's subject.
- **E-mail Message** – allows you to enter up to 20 characters of additional text which will be appended to standard e-mail message template used for alarm notification.

If **SvanMail** position is disabled, you should define some additional positions:

- **SMTP Address** – allows you to enter up to 32 characters of SMTP server address which will be used to send e-mail messages.
- **Login Type** – **None**, **Login**, **Plain** or **Cram**. These options define authentication method, which depends on the SMTP server used for sending e-mails. In most cases, **Plain** value is used.

- **User Login** – allows you to enter up to 20 characters of user login text for establishing verified connection with SMTP server.
- **User Password** – allows you to enter up to 20 characters of user password text for establishing verified connection with SMPT server.

If **Login Type** is **None**, **User Login** and **User Password** positions do not appear in the **E-mail Settings** list. **None** value should be used when SMTP server requires no authentication.

- **Sender e-mail** – allows you to enter up to 48 characters of e-mail address from which e-mail message will be sent.

- **SSL Encryption** – when switched on means that the device will attempt to configure the modem to connect to the mail server used the encryption protocol SSL.
- **Default Port** - when switched on means that the device will try to communicate with the mail server on the default port (25 for normal calls, 465 with SSL).

Disabling of **Default Port** will initiate the **Port** position, where the user will be able to define its own port.

Editing of some positions is performed in the special screen with the text editor function, which is opened after pressing the ◄ / ► key.
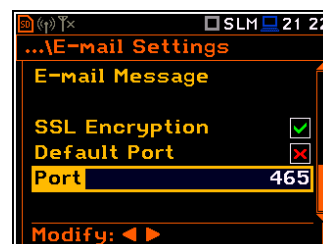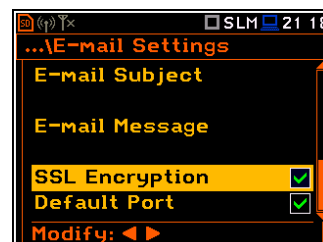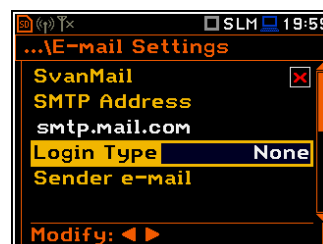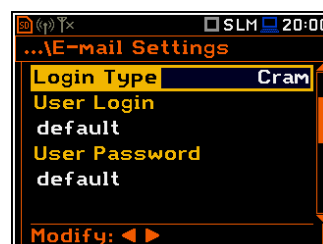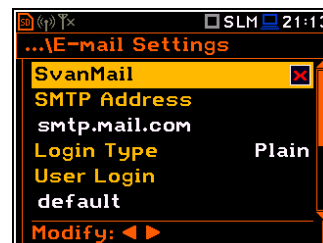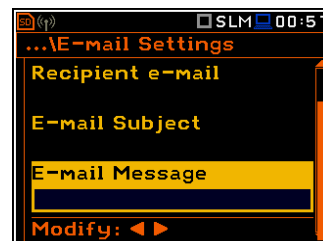
16 REMOTE CONTROL AND DATA PROCESSING TOOLS

SVANTEK offers few software solutions for data downloading and processing as well as remote control and communication with SV 977D depending on the user's needs and capabilities:

- *SvanPC++* - data downloading and uploading, data post-processing, reporting and remote control via the USB or RS232 connection with a PC,

- *BA Assistant* – building acoustics and speech intelligibility measurements via the Bluetooth® connection with a smartphone.

The *SvanPC++* installation package can be downloaded from the Svantek official web-side. *BA Assistant* can be installed via the *Play Store* application.

When SV 977D is a part of the SV 277 monitoring station it can be controlled via the cellular connection. Cellular connection opens wider possibilities for remote communication. There are two communication options for the cellular connection, which depend on the Internet access, provided by cellular operators.

First and easiest option is to use the SvanNET web-service, which enables basic features for the user as: instrument performance control, data files downloading and setup files uploading. SvanNET allows usage of all type of SIM cards with a station modem regardless of having a public or private IP. The connection over SvanNET allows you to:

- use a PC, mobile phone or tablet with the access to the Internet,
- watch real time measurement results, start measurements, download files and reconfigure your stations.

Another option is to use Remote Communication module for *SvanPC++* (*SvanPC++_RC*), which offers different ways of connections and enables continuous data transfer from the monitoring station to a PC. The connections with the use of *SvanPC++_RC* allows you to:

- use a PC with installed *SvanPC++_RC* and access to the Internet,
- use all types of the SIM card with public or private, static or dynamic IP,
- watch real time measurement results, start measurements, download files, reconfigure your stations, archive data, web-publish, etc.
- post-process data and make a report.

All software functionalities are described in the User Manuals, which can be downloaded from the Svantek official web-side:
- SvanPC++ User Manual
- SvanNET User Manual
- BA Assistant User Manual.

17 MAINTENANCE

17.1 REPLACING BATTERIES

SV 977D is delivered with four AA alkaline batteries, but you may also use AA rechargeable batteries.

The "**battery**" icon shows the condition of the internal batteries.

The instrument is not equipped with an internal charger; therefore, the rechargeable batteries can be charged only with the use of optionally provided charger (SA 31) after removal them out of the instrument.

To change or charge the batteries, switch off the instrument, unscrew coin-operated screw, take off the black bottom cover of the instrument and slide the battery tubes out.

> **Note**: *While changing the batteries, observe the correct polarity.*

17.2 MEMORY CARD EXTRACTION AND INSERTION

SV 977D is delivered with 16 GB micro-SD card - Kingston Industrial (SDCIT/16GBSP).

You may exchange it with the high-capacity card (up to 32GB), but before insertion the card must be formatted as FAT32.

> **Note:** *The originally supplied Kingston Industrial memory card has been tested by SVANTEK and cards of this type are strongly recommended for use when the original card is going to be replaced.*

> **Note:** *If you would like to use card with higher capacity, call to the local distributer for confirmation.*

To extract the memory card from the card-slot, switch off the instrument, unscrew the coin-operated screw and take off the black bottom cover of the instrument.

The card is installed in the slot. To extract the card, push on the card and then pull it out of the slot.

While insertion the SD-card, a click sound indicates that the card is inserted properly. If necessary, use a tool (e.g. pen) to push the card right in.

17.3 TRANSDUCERS

SV 977D is equipped with the TNC connector as an input of the measured signal taken from the microphone preamplifier or the vibration transducer.

Microphone

The SV 977D set includes prepolarised ½" microphone (MK 255) and microphone preamplifier with IEPE power supply (SV 12L).

The microphone is delivered in a special box, and you must screw it onto the preamplifier threads themselves.

When unscrewing the microphone, care must be taken not to drop the microphone. To avoid this, unscrew the microphone so that it ended up in the user's palm.
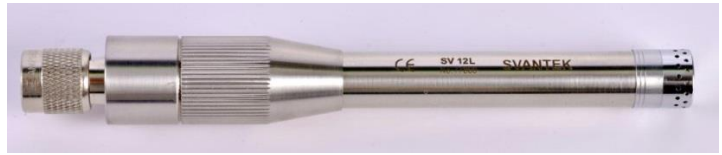
To disconnect the preamplifier from the instrument, unscrew the outer sleeve, pull it to up to have access to the fixing ring and unscrew it. Then pull the preamplifier from the socket.
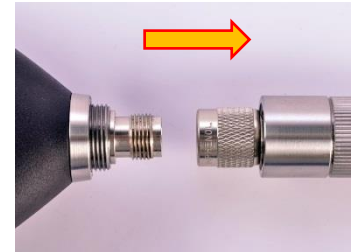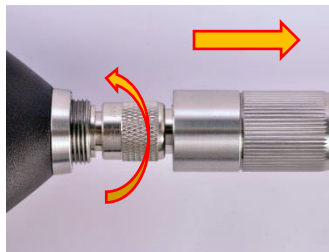
To connect the preamplifier to the instrument, first insert the tip of the preamplifier into the socket and tighten the fixing ring to the first screw thread. Then move the preamplifier outer sleeve in the direction to the instrument and tighten it to the screw thread.
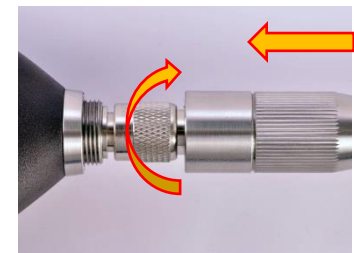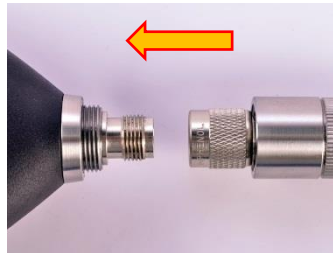
Note: *Do not disconnect the preamplifier by turning the preamplifier body (turn only rings/collars) because it may damage the preamplifier!*

Accelerometer

Optionally, the SV 80 general-purpose vibration accelerometer 100 mV/g (10 mV/ms^{-2}) with the SC 27 2 m coiled cable can be used.

The SV 80 is an industry standard IEPE accelerometer offered for SV 977D. It is an ideal choice for walk-around measurement points in the rugged environments of industrial machinery monitoring, such as pumps, motors or fans. The accelerometer is mounted on a vibrating surface with the mounting magnet.

The design of SV 80 features the low electronic noise and wide temperature operating range.

The connection of the accelerometer to the instrument is like the microphone preamplifier, but there is only one ring to be tighten to the first screw thread.
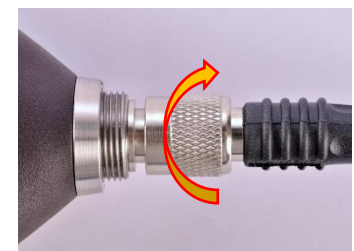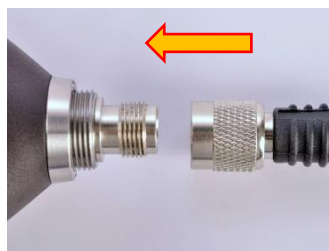
Note: *After connecting the preamplifier or the accelerometer cable to the measurement input, the screw should be tightened to light resistance only. Do not over tighten this connector!*

17.4 RESETTING INSTRUMENT

- **SYSTEM RESET:** internal software reset clears any setup configuration and brings back the default factory settings. See **Factory Settings** (*path: <Menu> / Auxiliary Setup*).

- **HARDWARE RESET:** internal hardware reset; no user data is changed. Make sure the battery is not exhausted, and the unit is turned off. Hold down the **<Alt>** and **<Start/Stop>** keys for more than 15 seconds, and then release them. Turn on the instrument as usually.

Note: *Hardware reset is only to be used in extreme situations such as an instrument hang-up.*

Be aware, that a hardware reset:

- will stop any pre-programmed auto-run modes,

- will stop measurement run!

17.5 FIRMWARE UPGRADE

SVANTEK is committed to continuous innovation path of development, and as such reserves the right to provide firmware enhancements based on user's feedback.

To update the instrument firmware:

- Unpack the provided firmware package (provided as a suitable compressed file).
- Make sure the unit is turned off.

- Connect SC 158 cable to the computer and SV 977D instrument (USB interface).
- Keeping pressed the **<ENTER>** and ▲ keys switch on the instrument - the following message should appear on the unit's screen: BOOTSTRAP v1.06 (or higher).
- Wait for the message **<USB>** on the unit's screen and start from the PC: **go-usb.bat**.
- The changing number and final message: "..... o.k." should appear on the computer screen.
- Successful firmware update will be indicated by the message: *Program loaded!*
- Switch off the instrument.

Note: *With the use of the **SvanPC++** software it is very easy to check if there are any new firmware releases available for download.*

17.6 PRESERVATION OF INTERNAL BATTERIES

- To preserve the life of the internal batteries, it is recommended that the instrument is turned off when it is stored. In case of alkaline batteries, it is recommended to extract them out of the instrument.

- When the instrument is turned off, it still draws a small amount of battery power. Therefore, it is recommended to charge the cell every few months if it is not going to be used regularly.

17.7 TRANSPORTATION AND STORAGE

For transportation or storage purpose, we recommend using the packaging provided by the manufacturer. In a potentially dirty industrial environment, it is advisable to use the carrying case provided by the manufacturer such as the fabric material case (SA 47), lightweight case (SA 143) or waterproof case (SA 79), which ensures excellent mechanical and environmental protection and long-term storage conditions.

17.8 CLEANING

Clean the surface of the instrument with damp soft cloth.

The instrument sockets should be cleaned with the use of compressed air.

> **Note:** *In cases of larger dirt, such as oil or grease, contact your Local Authorized Distributor or Svantek Service Office.*

17.9 TROUBLESHOOTING

- In case your instrument does not respond proceed with hardware reset of the instrument (see Chapter 17.4).
- In case the reset does not help call your Local Authorized Distributor or Svantek Service Office.

Should your SVANTEK professional measurement equipment need to be returned for repair or for calibration, please contact the service office at the following number or contact via the SVANTEK website.

Service Office: +48 (22) 51-88-320 or +48 (22) 51-88-322.

Office hours are 9:00 a.m. to 5:00 p.m. Central European Time.
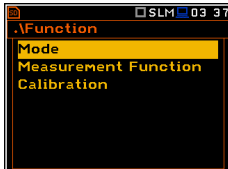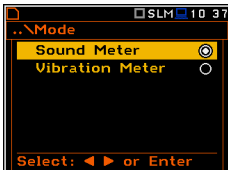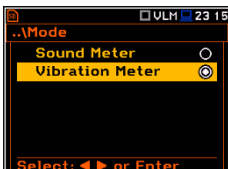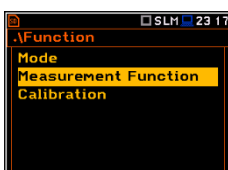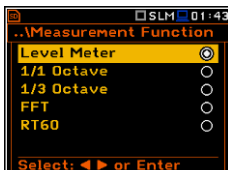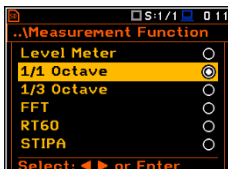
E-mail: office@svantek.com.pl
            support@svantek.com.pl
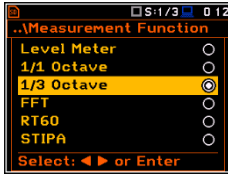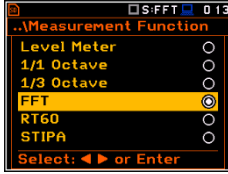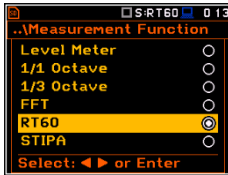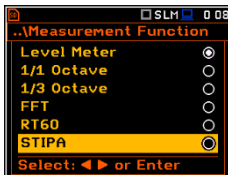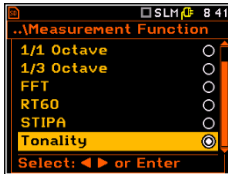
Internet: www.svantek.com

Address: SVANTEK Sp. z o.o.
          Strzygłowska 81
          04-872 Warszawa,
          Poland
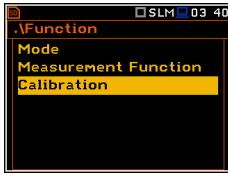
18 GLOSSARY
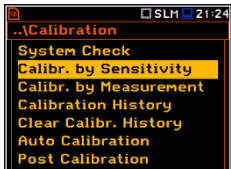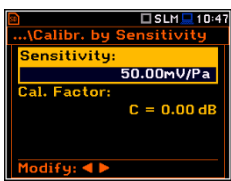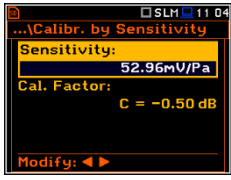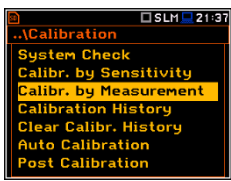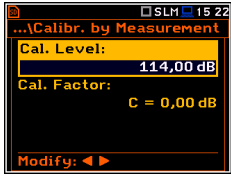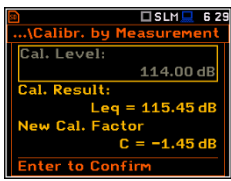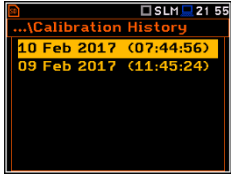
18.1 MODES AND MEASUREMENT FUNCTIONS

Name	Description	Screen	Reference
Function	The menu section enabling selection of the measurement *Mode*, *Measurement Function* and perform *Calibration* of the instrument.		Chapter 3
Mode	Mode of the instrument operation defined by the connected transducer: - noise parameters measurement (*Sound Meter*) or - vibration parameters measurement (*Vibration Meter*).		Chapter 3.1
Sound Meter	Measurement of sound parameters with connected microphone. When *Sound Meter* is selected all abbreviations of the *Measurement Function* start from S letter.		Chapter 3.1
Vibration Meter	Measurement of vibration parameters with connected accelerometer. When *Vibration Meter* is selected all abbreviations of the *Measurement Function* start from V letter.		Chapter 3.1
Measurement Function	Type of calculations the instrument currently performs (its abbreviation in the icon line of the display): - *Level Meter* (SLM or VLM), - *1/1 Octave* (S:1/1 or V:1/1), - *1/3 Octave* (S:1/3 or V:1/3), - *FFT* (S:FFT or V:FFT), - *RT60* (RT60), - *Tonality* (TON), - *STIPA* (STI).		Chapter 3.2
Level Meter	*Measurement Function* enabling calculation of broad band results (*Summary Results*) and time-history for sound measurements in accordance with Class 1 IEC 61672-1:2013 accuracy or vibration measurements in accordance with ISO 20816-1:2016. All results can be calculated in parallel by three virtual meters (so called profiles) using different weighting filters and LEQ/RMS detectors. When the *Level Meter* function is active the SLM or VLM abbreviation appears in the icon line.		Chapter 3.2
1/1 Octave	*Measurement Function* enabling calculation of *Level Meter* results and 1/1 octave results for sound or vibration measurements in accordance with Class 1 IEC 61260-1: 2014. 1/1 octave results are presented as a spectrum plot - a function of result vs central band frequency and can be saved as a time-history. When the *1/1 Octave* function is active the S:1/1 or V:1/1 abbreviation appears in the icon line.		Chapter 3.2, 10

1/3 Octave	*Measurement Function* enabling calculation of *Level Meter* results and 1/3 octave results for sound or vibration measurements in accordance with Class 1 IEC 61260-1: 2014. 1/3 octave results are presented as a spectrum plot - a function of result vs central band frequency and can be saved as a time-history. When the *1/3 Octave* function is active the S:1/3 or V:1/3 abbreviation appears in the icon line.		Chapter 3.2, 10
FFT	*Measurement Function* enabling calculation of *Level Meter* results and FFT spectrum for sound or vibration measurements. FFT spectrum is calculated based on Fast Fourier Transform algorithm and is presented as a function of signal amplitude vs frequency and can be saved as a time-history. When the *FFT* function is active the S:FFT or V:FFT abbreviation appears in the icon line.		Chapter 3.2, 11
RT60	*Measurement Function* enabling calculation of reverberation time in 1/1 octave bands (from 63Hz to 16kHz) or 1/3 octave bands (from 50 Hz to 20 kHz) including three total RMS levels (A, C and Z weighted). This analysis is used for building acoustic purposes. Depend on the type of the sound source used by the user two methods can be applied: Impulse Response Method and Interrupted Noise Method. Results are presented for 1/1 or 1/3 octave bands. When the *RT60* function is active the RT60 abbreviation appears in the icon line.		Chapter 3.2, 12
STIPA	*Measurement Function* enabling analysis of the speech intelligibility with the STIPA method. When the *STIPA* function is active the STI abbreviation appears in the icon line.		Chapter 3.2, 13
Tonality	*Measurement Function* enabling assessing the audibility of tones in the noise. The results are presented in a special presentation view. When the *Tonality* function is active the TON abbreviation appears in the icon line.		Chapter 3.2, 14

18.2 CALIBRATION

Name	Description	Screen	Reference
Calibration	Position on the *Function* screen that opens a screen with positions allowing you to perform calibration or system check of the instrument: *System Check, Calibration by Sensitivity, Calibration by Measurement, Calibration History, Clear Calibration History, Auto Calibration* and *Post Calibration*.		Chapter 3.3
System Check	Position in the *Calibration* screen allowing you to perform system check. The IEC 61672-1:2013 standard advises users to perform in-situ checks of measuring instruments. Checking should be carried out immediately before and after the measurement.		Chapter 3.3.1

Calibration by Sensitivity	Type of calibration with the use of microphone's published sensitivity information. This calibration doesn't perform any calibration measurement and doesn't require any calibrator.		Chapter 3.3.2, 3.3.3
Sensitivity	Transducer's sensitivity, given by the producer, which should be set during the *Calibration by Sensitivity*. For microphones the sensitivity is usually given in mV/Pa and for accelerometers – in mV/ms^{-2}.		Chapter 3.3.2, 3.3.3
Calibration Factor	A value which the sensor reading has to be multiplied with to get the correct reading. In the instrument, the calibration factor is presented in dB, therefore it is always added to the results.		Chapter 3.3.2, 3.3.3
Calibration by Measurement	Type of calibration based on the reference signal measurement with the use of a microphone or accelerometer calibrator.		Chapter 3.3.4, 3.3.5
Calibration Level	Level of the reference signal generated by used calibrator.		Chapter 3.3.4, 3.3.5
Calibration Result	Measured by the instrument reference signal level without calibration factor correction.		Chapter 3.3.4, 3.3.5
Calibration History	Records of previously performed calibrations of the instrument. Each record contains information about calibration date and time, calibration type, calibration factor etc.		Chapter 3.3.6
Clear Calibration History	Operation that clears all calibration records.		Chapter 3.3.7
Auto Calibration	Feature that enables automatic calibration when the reference sound or vibration signal is detected by the instrument.		Chapter 3.3.8
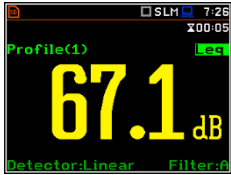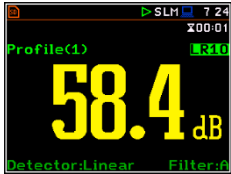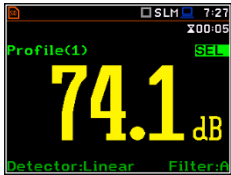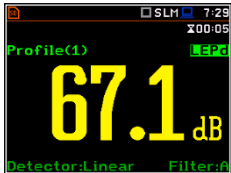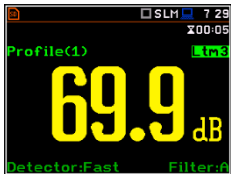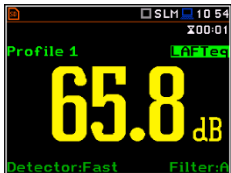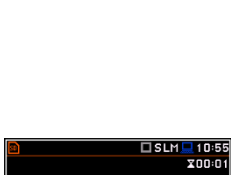
| Post Calibration | Feature that enables performance of additional calibration in the end of the measurement session and add the new calibration factor to some files already saved in the instrument's memory. | | Chapter 3.3.9 |
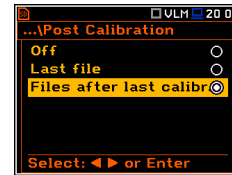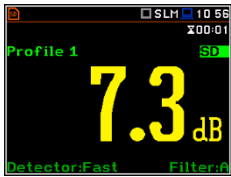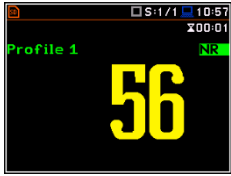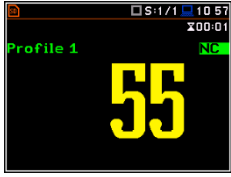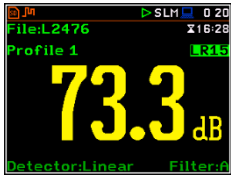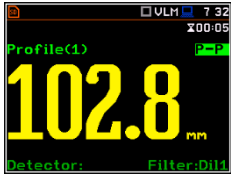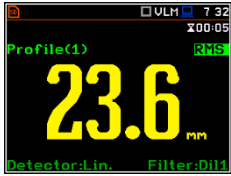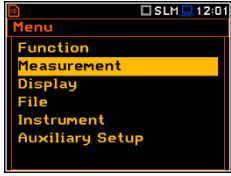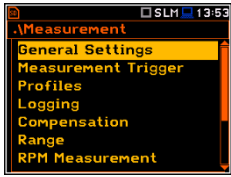
18.3 MEASURED RESULTS
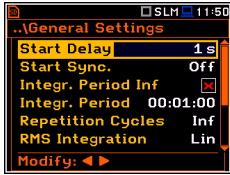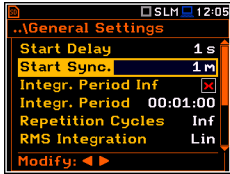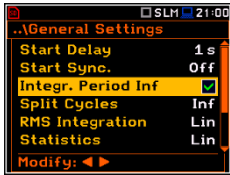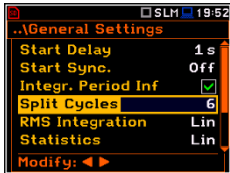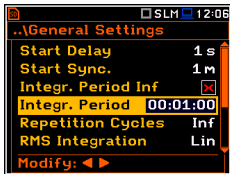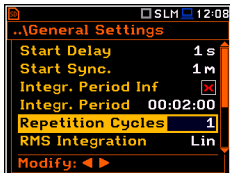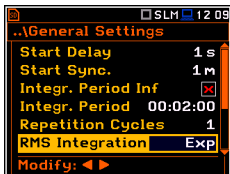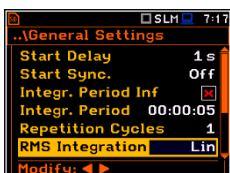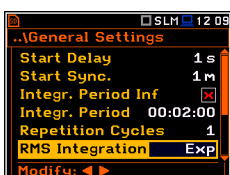
Position	Description	Screen	Reference
Elapsed time	Time from the measurement start, that is displayed in the right upper corner of the display in the format ⧖ mm:ss in the range from 00:00 to 59:59, or in the format ⧖ hh:mm:ss in the range from 01:00:00 to 99:59:59, or in format ⧖ xxxh from 100h to 999h, and ⧖ >999h if the elapsed time exceeds 999 hours. Its maximum value is equal to the *Integration Period* and the elapsed time is zeroed when new measurement cycle starts.		Chapter 5.1
Ovl	Percentage of the overloaded input signal, which occurred within the elapsed measurement time.		Appendix D D.1.2
Peak	For sound measurements: Peak Sound Level, the greatest instantaneous value of a standard frequency weighted sound pressure level within the elapsed measurement time. For vibration measurements: the greatest instantaneous value of a standard frequency weighted vibration (acceleration, velocity or displacement) within the elapsed measurement time.		Appendix D D.1.2, D.2.2
Spl	Sound Pressure Level, the maximal value of the frequency and time-weighted sound pressure level at the exponential RMS detector output for the last second.		Appendix D D.1.2
Max	For sound measurements: maximal value of the time-weighted sound pressure level at the exponential RMS detector output within the elapsed measurement time. The *Max* result for the 1 second period is equal to the Spl result. For vibration measurements: maximal value of the time-weighted vibration (acceleration, velocity or displacement) level at the exponential RMS detector output within the elapsed measurement time.		Appendix D D.1.2, D.2.2
Min	Minimal value of the time-weighted sound pressure level at the exponential RMS detector output within the elapsed measurement time.		Appendix D D.1.2
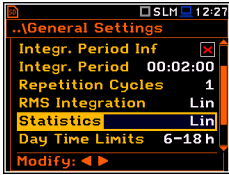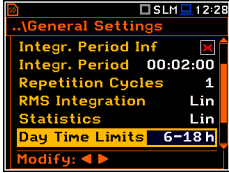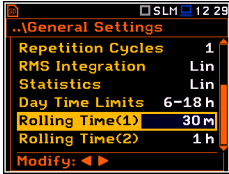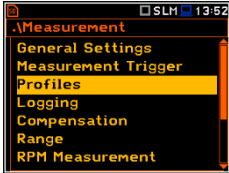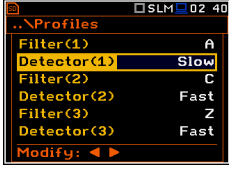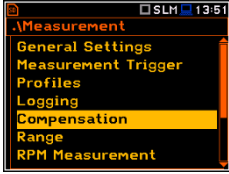
Leq	Equivalent continuous sound level, time-averaged sound level for the elapsed measurement time (equivalent sound level).		Appendix D D.1.2
LRm	Rolling (sliding) *Leq* screen for the last m minutes of measurement (m x 60 seconds) moving with 1 second step.		Chapter 4.1 Appendix D D.1.2
SEL	Sound Exposure Level, the constant sound level that has the same amount of energy in one second as the original noise event and is the subset of the *Leq* result so, for the integration time equal to 1 s, *SEL* is always equal to *Leq*.		Appendix D D.1.2
LEPd	Daily Personal Noise Exposure, the noise exposure level for a nominal 8-hour working day, used for assessing the noise exposure of a worker during a working day. The *LEPd* result is calculated on the base of the *Leq*.		Appendix D D.1.2
Ltm3	Takt-Maximal Level calculated according to the German standard TA Lärm.		Appendix D D.1.2
LTeq	Takt-Maximal Level calculated according to the German standard TA Lärm.		Appendix D D.1.2
Ln	Statistical Noise Levels, the certain boundary level surpassed by the temporary noise level values in not more than nn% of the observation period. *Ln* are calculated on the base of 100ms Leq results and renewed every second on the display as cumulated statistics over the current measurement time.		Appendix D D.1.2, D.4
L(den)	Day-evening-night equivalent level, *Leq*. Sound Level, measured over the 24 hour period, with a 10 dB penalty added to the levels between 23.00 and 07.00 hours and a 5 dB penalty added to the levels between 19.00 and 23.00 hours to reflect people's extra sensitivity to noise during the night and the evening. The instrument displays: Ld, Le, Ln, Lde, Len, Lnd, or Lden depending on the day and nighttime which the measurement covers. Due to different country requirements, it is possible to shift daytime from 7h-19h to 6h-18h.		Appendix D D.1.2
EX	Expected value. Calculated on the basis of 100ms RMS results.		Appendix D D.1.2
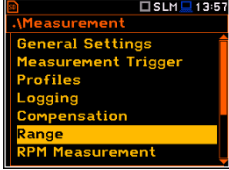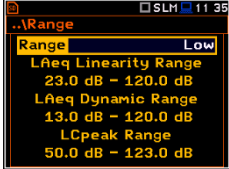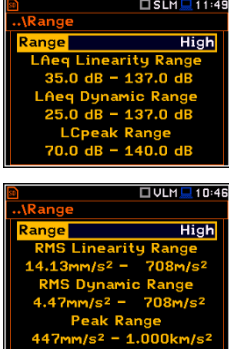
SD	Standard deviation. Calculated on the basis of 100ms RMS results.		Appendix D D.1.2
NR	Noise Rating, measured noise level that takes into account the frequency content of the noise. NR is calculated if 1/1 Octave function is active.		Appendix D D.1.2
NC	Noise Criterion, measured noise level that takes into account the frequency content of the noise. NC is calculated if 1/1 Octave function is active.		Appendix D D.1.2
LRxx	Rolling *Leq* - Leq for the window of the last xx seconds/minutes of the measurement moving with 1 second step.		Appendix D D.1.2
P–P	Peak-to-peak, the difference between highest and lowest value of the signal within the elapsed measurement time.		Appendix D D.2.2
RMS	Root Mean Square result of the time-weighted vibration (acceleration, velocity or displacement) level within the elapsed measurement time.		Appendix D D.2.2
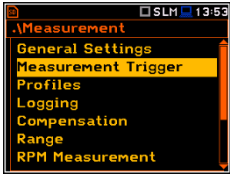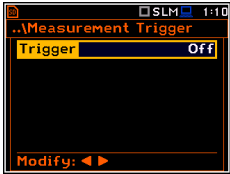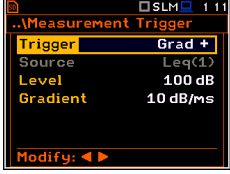
18.4 MEASUREMENT PARAMETERS
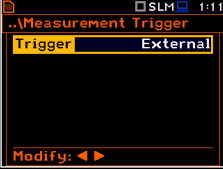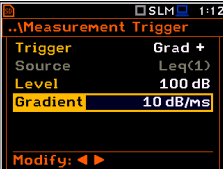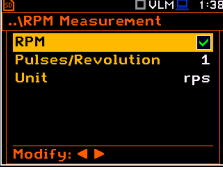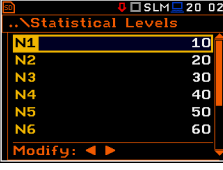
Position	Description	Screen	Reference
Measurement	Section of the Main Menu that enables selecting the measurement parameters in the screens: *General Settings, Measurement Trigger, Profiles, Logging, Spectrum, FFT, RT60 Settings, Tonality, Compensation, Range, RPM Measurement, Exposure Time, Statistical Levels, Timer* and *Alarms*.		Chapter 4
General Settings	General measurement settings: *Start Delay, Start Sync., Integration Period Inf., Integration Period, Repetition Cycles, RMS Integration, Day Time Limits* and *Rolling Time*.		Chapter 4.1
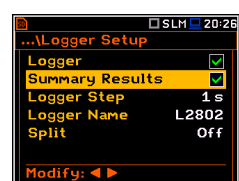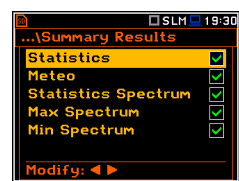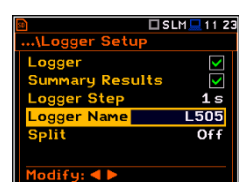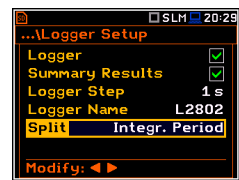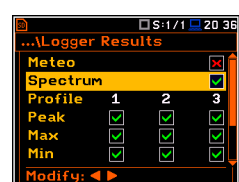
Start Delay	Delay between pressing the <Start> key and the start of measurement integration.		Chapter 4.1
Start Synch.	Synchronization of the measurement/integration start to the nearest full minute or hour of the instrument real-time clock. It helps to measure in full cycles.		Chapter 4.1
Integr. Period Inf	Infinitive averaging of *Summary Results* that lasts from start of the measurement till its cancellation with the <Stop> key, remotely or if number of splits of the logger file exceeds *Split Cycles*.		Chapter 4.1
Split Cycles	Maximum number of splits of the data registration in separate files.		Chapter 4.1
Integration Period	Time of averaging of *Summary Results*: from 1 second to Infinitive. For example, with 8 hours integration period the LEQ result will be averaged for 8 hours. In case of Infinitive, the measurement will last until the user presses the <Stop> key.		Chapter 4.1
Repetition Cycles	Number of measurement/integration repetitions after the <Start> key pressure. This enables to make a series of measurements without pressing the <Start> key and save this series in the results file.		Chapter 4.1
RMS Integration	Type of integration of RMS based results (RMS detector): *Linear* or *Exponential*. The IEC 61672-1:2013 standard requires Linear integration, without time weighting, however in some countries old regulation refers to the Exponential RMS integration with standard time weighting: Fast or Slow.		Chapter 4.1
Linear	Linear type of integration of RMS based results (RMS detector), without time weighting according to the IEC 61672-1:2013 standard.		Chapter 4.1
Exponential	Exponential type of integration of RMS based results (RMS detector), where averaging is a continuous process that weighs current and past data differently. The amount of weight given to past data as compared to current data depends on the exponential time constant. In the exponential averaging, the averaging process continues indefinitely.		Chapter 4.1
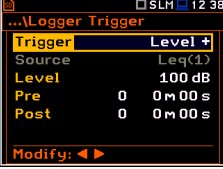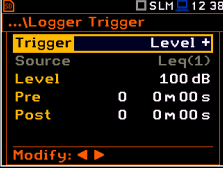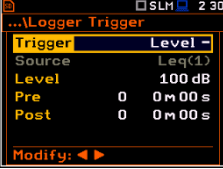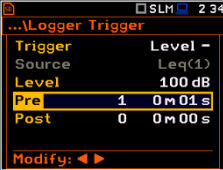
Statistics	Method for calculation of statistics for RMS results: with linear detector (Lin) or exponential detector (Exp), e.g. Impulse, Fast or Slow time constant.	Chapter 4.1
Day Time Limits	Definition of the day and night periods required by local standards: 6–18h and 7–19h. These limits are used for the calculation of the L(den) function.	Chapter 4.1
Rolling Time	Time frame for the "Rolling Leq" calculation. The Rolling Leq is presented as LR+<time frame>. For example, if the *Rolling Time* is equal to 30 minutes, the appropriate result will be named as LR30 and calculated each second as Leq integrated during last 30 minutes.	Chapter 4.1
Profiles	Virtual broadband level meters, which calculate the set of results with own weighting filter (*Filter*) and exponential detector time constant (*Detector*).	Chapter 4.3

Filter	Weighting filter applied in the profile in accordance with most applicable world standards:
	- for sound measurements: Z, A, C, B, U, AU, LF,
	- for vibration measurements:
	   o acceleration: HP, HP1, HP3, HP10, Wh,
	   o velocity: Vel1, Vel3, Vel10 and VelMF,
	   o displacement: Dil1, Dil3 and Dil10.
		Chapter 4.3
		Appendix C
		Appendix D

Detector	Exponential RMS detector time constant applied in the profile: - *Impulse*, *Fast* or *Slow* for sound results like *Leq, Lmax, Lmin, SEL, LEPd, Lden, Spl, Ltm3 and LTeq*; - from 100ms to 10s for vibration results like *RMS, MAX*.	Chapter 4.3 Appendix D D.1.2
Compensation	Digital filter that compensates some effect: *Microphone, Free Field, Diffuse Field, Outdoor Environment, Outdoor Airport* and *Windscreen*.	Chapter 4.5
Microphone	Digital filter that compensates the microphone inner noise. It is switched on by default, however it is possible to switch it off for electrical measurements (e.g. laboratory calibration measurements).	Chapter 4.5
Free Field	This option should be selected for sound measurements in the free field conditions. The microphone supplied with SV 977D is designed for sound measurements in the free field conditions.	Chapter 4.5
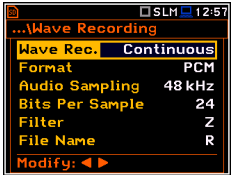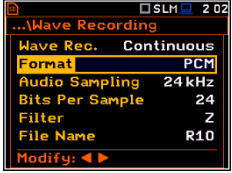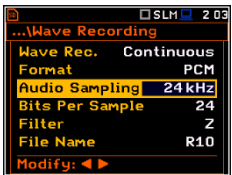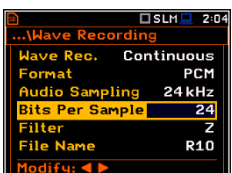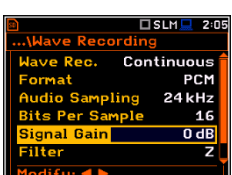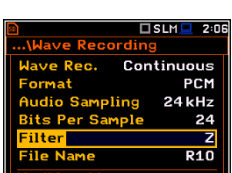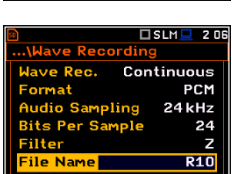
Diffuse Field	Digital filter that compensates the diffuse field effect.		Chapter 4.5
Outdoor Environment	Digital filter that compensates the effect of the SA 277D outdoor microphone kit in the free field for the reference acoustic wave incidence angle 90 deg.		Chapter 4.5
Outdoor Airport	Digital filter that compensates the effect of the SA 277D outdoor microphone kit in the free field for the reference acoustic wave incidence angle 0 deg.		Chapter 4.5
Windscreen	Digital filter that compensates the effect of the SA 22 windscreen when *Free Field* or *Diffuse Field* option is selected.		Chapter 4.5
Range	Position that enables selecting the linear operating range for the sinusoidal signal: *Low* or *High*. The calibration factor is always added to the upper range limits. The ranges depend on the selected *Compensation*.		Chapter 4.6
Low	Low linear operating range for the sinusoidal signal. The values of ranges in sound modes depend on the settings in the *Compensation Filer* screen and in both sound and vibration modes – on the calibration factor.		Chapter 4.6 Appendix C
High	High linear operating range for the sinusoidal signal. The values of ranges in sound modes depend on the settings in the *Compensation Filer* screen and in both sound and vibration modes – on the calibration factor.		Chapter 4.6 Appendix C
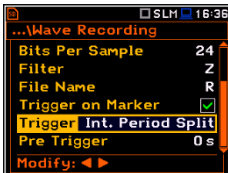
Measurement Trigger	Screen that enables configuring trigger of the measurement/integration process with parameters: *Trigger, Source, Level* and *Gradient*.		Chapter 4.2
Trigger	Position that switches *Off* or on the measurement trigger by selecting its type: *Slope +, Slope –, Level +, Level –, Grad +* or *External*. If the instrument is waiting for the trigger condition, the appropriate trigger icon is flashing on the display alternatively with the „measurement" icon.		Chapter 4.2
Slope +	Type of trigger that starts the measurement/integration by the duration of the *Integration Period* on condition: rising value of the RMS result (*Source*) integrated during 0,5 ms passes above the threshold value (Level).		Chapter 4.2
Slope -	Type of trigger that starts the measurement/integration by the duration of the *Integration Period* on condition: falling value of the RMS result (*Source*) integrated during 0,5 ms passes below the threshold value (Level).		Chapter 4.2
Level +	Type of trigger that starts the 1-second measurement/ integration on condition: value of the RMS result (*Source*) integrated during 0,5 ms is greater than the threshold value (*Level*). In other cases, the instrument continues checking the trigger condition every 0,5 mc. During one measurement cycle the instrument performs as many 1-second integrations as many seconds the *Integration Period* consists and stops the measurement cycle.		Chapter 4.2
Level -	Type of trigger that starts the 1-second measurement/ integration on condition: value of the RMS result (*Source*) integrated during 0,5 ms is lower than the threshold value (*Level*). In other cases, the instrument continues checking the trigger condition every 0,5 mc. During one measurement cycle the instrument performs as many 1-second integrations as many seconds the *Integration Period* consists and stops the measurement cycle.		Chapter 4.2
Grad +	Type of trigger that starts the 1-second measurement/ integration on condition: value of the RMS result (*Source*) integrated during 0,5 ms is greater than the threshold value (Level) and the gradient of this Source is greater than the threshold level (*Gradient*). In other cases, the instrument continues checking the trigger condition every 0,5 mc. During one measurement cycle the instrument performs as many 1-second integrations as many seconds the *Integration Period* consists and stops the measurement cycle. This type of trigger has the same logic as *Level +* trigger, but the trigger condition requires also gradient level to be exceeded.		Chapter 4.2
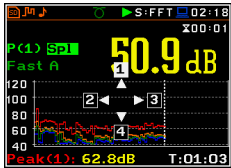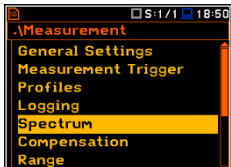
External	Type of trigger that starts the measurement/integration when the trigger signal appears on the I/O socket of the instrument. After the measurement/ integration start from the trigger, the measurement/integration will continue by the *Integration Period*.		Chapter 4.2
Source	Measured result that is compared with the threshold value (Level) for triggering – RMS measured in the first profile: Leq(1) in sound modes and RMS(1) in vibration modes.		Chapter 4.2
Level	Threshold level of *Source* for triggering condition fulfilment.		Chapter 4.2
Gradient	Threshold level of the *Source* gradient for triggering condition fulfilment.		Chapter 4.2
RPM Measurement	Screen that enables configuring measurement of the rotation per minute/second. To perform the RPM measurement the RPM probe should be connected to the I/O socket.		Chapter 4.7
Exposure Time	Screen that enables setting a duration of worker's exposition to the noise. This duration is considered in LEPd calculations.		Chapter 4.8 Appendix D D.1.2
Statistical Levels	Screen that enables setting a boundary level (*Ln*) surpassed by the temporary noise level values in not more than nn**%** of the observation period. The user can define ten statistical levels, named from N1 to N10, to be calculated, displayed and saved in the files together with the main results.		Chapter 4.9 Appendix D D.4
Timer	Screen that enables configuring automatic switching *On* the instrument and performing the measurement on the programmed time with defined setup. Timer can be *Single* or repeatable (*Multiple*). After every timer cycle, the instrument automatically switches itself off.		Chapter 4.10
Logging	Screen that enables switching the logger function on and setting the main logging parameters: *Logger*, *Summary Results*, *Logger Step*, *Logger Name* and *Split*.		Chapter 4.4
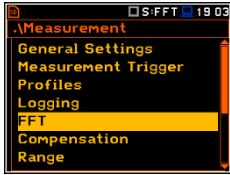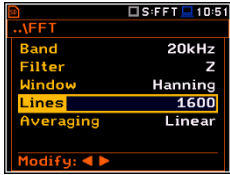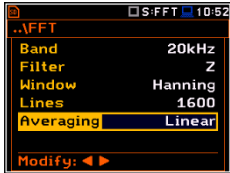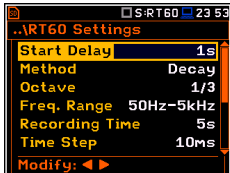
Logger Setup	Screen that enables setting the main logging parameters: *Logger*, *Summary Results*, *Logger Step*, *Logger Name* and *Split*.		Chapter 4.4.1
Logger	Position in the *Logger Setup* list that switches on or off the *Logging* function. If *Logger* is switched off only *Wave Recording* is available.		Chapter 4.4.1
Summary Results	Position in the *Logger Setup* list that switches on or off saving of the summary results measured with the *Integration Period* step: *Spl, Leq, Sel, LEPd, Ltm3, LTeq, 10xLn, Ovl, Peak, Max, Min, EX, SD, NC, NR, 2xLR* for sound measurements and *RMS, Ovl, Peak, P–P* for vibration measurements. *Summary Results* are measured, displayed and saved in a logger file as records as many times as defined by the *Repetition Cycles* parameter. They are renewed at the display every second when the measurement is running.		Chapter 4.4.1
Summary Results	Screen in the Logging list enabling configuring of the *Summary Results* structure which may include also: results from the meteorological station (*Meteo*), *Statistics*, statistics for 1/1 and 1/3 octaves (*Statistics Spectrum*), spectra for max and min results (*Max Spectrum* and *Min Spectrum*).		Chapter 4.4.3
Logger Step	Time of measuring/integrating *Logger Results* and recording them to the logger file (same meaning as *Integration Period* for *Summary Results*). *Logger Step* can be selected from the set: 2 ms, 5ms, 10ms, 20ms, 50ms, 100ms, 200ms, 500ms or from 1 second to 59 seconds with 1-second step or from 1 minute to 59 minutes with 1-minute step and up to 1 hour.		Chapter 4.4.1
Logger Name	Position in the *Logger Setup* screen that enables defining the name of file in which *Logger Results*, *Summary Results* and *Markers* will be saved.		Chapter 4.4.1
Split	Position in the *Logger Setup* screen that enables saving of the logger records in separate files according to different rules: after the integration period, or every quarter / half an hour / hour, or on specific times of a day.		Chapter 4.4.1
Logger Results	Screen in the *Logging* list enabling selecting results that will be logged to a logger file with *Logger Step* as time-histories: *Peak, Max, Min, Leq, 2xLR* and *LXY* for sound measurements and *Peak, P-P, Max* and *RMS* for vibration measurements as well as the series of results obtained from the weather station (*Meteo*). For the 1/1 Octave and 1/3 Octave functions also spectra can be logged.		Chapter 4.4.2
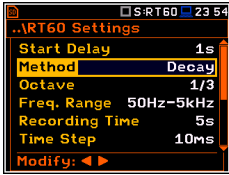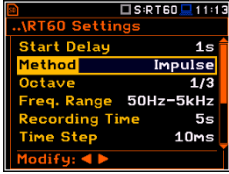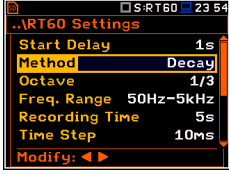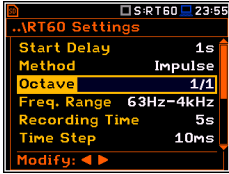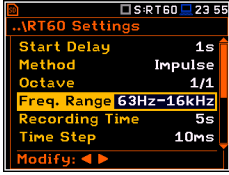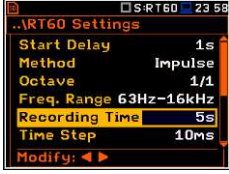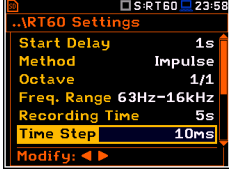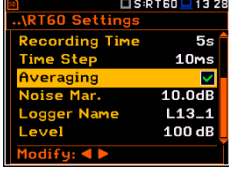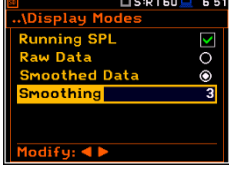
Logger Trigger	Screen that enables configuring parameters for triggering of *Logger Results* recording to the logger file: *Trigger, Source, Level, Pre* and *Post*.		Chapter 4.4.4
Trigger	Position that switches Off or On the logger trigger by selecting its type: *Level +* or *Level –*. If the instrument is waiting for the trigger condition, the appropriate trigger icon is flashing on the display alternatively with the „logger" icon.		Chapter 4.4.4
Level +	Type of trigger, that starts logging of *Logger Results* on condition: value of the Leq/RMS result (*Source*) integrated by the *Logger Step* period is greater than the threshold value (Level). In other cases, the logging is skipped.		Chapter 4.4.4
Level -	Type of trigger, that starts logging of *Logger Results* on condition: value of the Leq/RMS result (*Source*) integrated by the *Logger Step* period is lower than the threshold value (Level). In other cases, the logging is skipped.		Chapter 4.4.4
Source	Measured result that is compared with the threshold value (Level) for triggering – RMS measured in the first profile: Leq(1) in sound modes and RMS(1) in vibration modes.		Chapter 4.4.4
Level	Threshold level of *Source* for triggering condition fulfilment.		Chapter 4.4.4
Pre	Period of additional logging before triggering condition fulfilment.		Chapter 4.4.4
Post	Period of additional logging after triggering condition fulfilment.		Chapter 4.4.4
Wave Recording	Recording of the waveform signal to a file with the extension WAV. Files WAV are created automatically. Every time a wave recording starts the new WAV file is created and is closed when recording stops.		Chapter 4.4.6
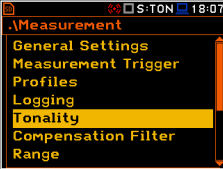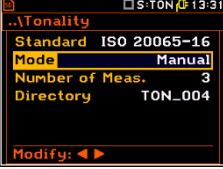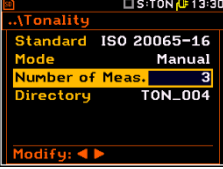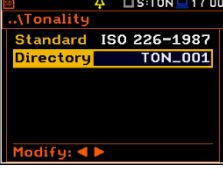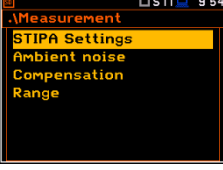
Wave Rec.	Switching on the wave recording by selecting its type: *Continuous* or *On Trigger*. *Continuous* means that the wave signal will be recorded continuously from the start of the measurement till its end. *On Trigger* recording put additional conditions for triggering and ending of the recording.		Chapter 4.4.6
Format	WAV file format: PCM or Extensible. PCM is typical supported by the audio players.		Chapter 4.4.6
Audio Sampling	Sampling frequency of the wave recording: 12kHz, 24kHz or 48kHz. The higher sampling corresponds with the better quality of the recorded signal but increases size of the file.		Chapter 4.4.6
Bits Per Sample	Number of recorded bits per sample: 16 or 24.		Chapter 4.4.6
Signal Gain	Gain of the recorded signal, when 16 bits per sample was selected: 0dB … 40dB.		Chapter 4.4.6
Filter	Weighting filter during the wave signal recording: A, B, C or Z for sound and HP for vibration. The Z filter is recommended for audio listening.		Chapter 4.4.6
File Name	Name of the WAV type file.		Chapter 4.4.6
Trigger	Parameter that enables switching Off or selecting the trigger type for triggering wave recording: *Slope +, Slope –, Level +, Level –, External, Integr. Period* and *Int. Period Split*. If the instrument is waiting for the trigger condition, which is checked with *Trigger Period* intervals, the appropriate trigger icon is flashing on the display alternatively with the „note" icon.		Chapter 4.4.6
Slope +	Type of trigger that starts the wave recording for *Recording Time* on condition: rising value of the Leq/RMS result (*Source*) integrated during *Trigger Period* passes above the threshold value (Level).		Chapter 4.4.6
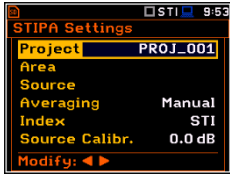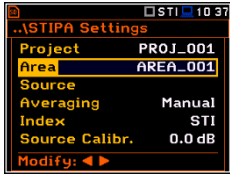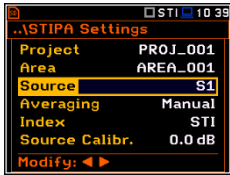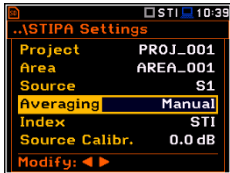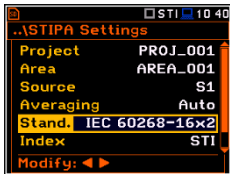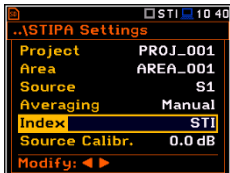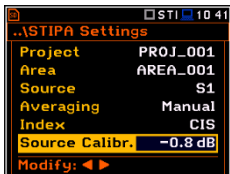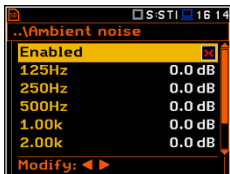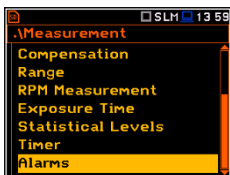
Slope -	Type of trigger that starts the wave recording for *Recording Time* on condition: falling value of the Leq/RMS result (*Source*) integrated during *Trigger Period* passes below the threshold value (Level).	Chapter 4.4.6
Level +	Type of trigger that starts the wave recording for *Recording Time* on condition: value of the Leq/RMS result (*Source*) integrated during *Trigger Period* is greater than the threshold value (Level).	Chapter 4.4.6
Level -	Type of trigger that starts the wave recording for *Recording Time* on condition: value of the Leq/RMS result (*Source*) integrated during *Trigger Period* is lower than the threshold value (Level).	Chapter 4.4.6
External	Type of trigger that starts the wave recording for *Recording Time* when the triggering signal appears on the I/O socket of the instrument.	Chapter 4.4.6
Integr. Period	Type of trigger, enabling the wave recording start for *Recording Time* every time the measurement starts. If *Integration Period* is shorter than *Recording Time,* the wave recording will be continued for additional *Recording Time*.	Chapter 4.4.6
Int. Period Split	Type of trigger, enabling the wave recording start for *Integration Period* every time the measurement starts.	Chapter 4.4.6
Source	Measured result that is compared with the threshold level for triggering (*Level*) measured in the first profile: Leq(1) in the sound mode and RMS(1) in the vibration mode.	Chapter 4.4.6
Level	Threshold level of the trigger condition.	Chapter 4.4.6
Trigger Period	Time interval of checking the triggering conditions. This parameter can be set as: Log. Step (same as *Logger Step* value), 0.5ms, 100.0ms and 1s.	Chapter 4.4.6
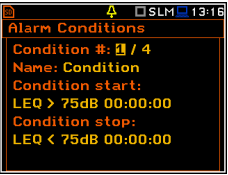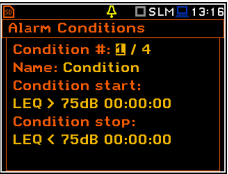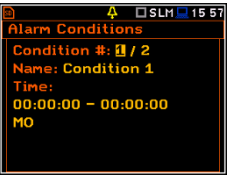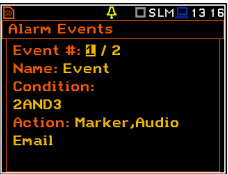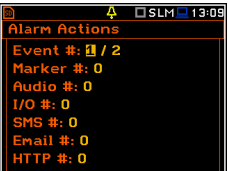
Recording Time	Time of signal recording after meeting every trigger condition. The available values can be selected from 1s to 8h or Infinite. Recording stops after *Recording Time* or earlier if the measurement is stopped manually.	Chapter 4.4.6
Pre Trigger	Period of signal recording before the first trigger condition fulfilment. The length of pre-recording depends on sampling rate.	Chapter 4.4.6
Marker	Marker is used to mark (or highlight) special point or event during the measurement. For example, for an airplane flight it can be marked the beginning and end of the block of logger results in which this event occurred. In case of point markers there is only one record (start) in the logger file. Markers are activated in the result presentation screen by pressing the arrow keys.	Chapter 2.6
Marker Setup	Position in the Menu that enables to set up the markers – name them and define them as Event or Point type.	Chapter 4.4.5
Spectrum	Screen that enables setting the *1/1 Octave, 1/3 Octave* spectrum parameters: *Band*, *Filter* and *Detector*.	Chapter 10.2.4
Spectrum	Position in the *Logger Results* screen that switches on / off spectra saving as a time-history in a logger file.	Chapter 10.2.3
Band	Frequency range of 1/1 or 1/3 spectrum. Depending on the function and mode of the instrument the frequency range can be selected for sound measurements: *Audio (31.5-16k), Ultra (1-31.5k)* for *1/1 Octave* and *Audio (20-20k), Ultra (0.8-40k)* for *1/3 Octave*; and for vibration measurements: *Full (1-16k), Ultra (1-31.5k)* for *1/1 Octave* and *Full (0.8-20k), Ultra (0.8-40k)* for *1/3 Octave*.	Chapter 10.2.4
Filter	Weighting filters for the *1/1 Octave* and *1/3 Octave* analysis: *A, B, C, Z* for sound analysis with *Audio* band, *HP* for vibration analysis with *Full* band and *HPE* for sound and vibration analysis with *Ultra* band.	Chapter 10.2.4
Detector	Type of integration of RMS based results for *1/1 Octave* and *1/3 Octave* analysis: *Linear, Fast or Slow* for sound measurements and *Linear* for vibration measurements.	Chapter 10.2.4

FFT	Screen that enables setting the FFT spectrum parameters: *Band*, *Filter*, *Screen*, *Lines* and *Averaging*.		Chapter 11.2.4
Band	Frequency band in which the FFT analysis is performed: *20 kHz, 10 kHz, 5 kHz, 2.5 kHz, 1.25 kHz, 625 Hz, 312 Hz, 156 Hz* and *78 Hz*.		Chapter 11.2.4
Filter	Weighting filters used during the FFT analysis: A, C, B, Z in the sound mode and HP in the vibration mode.		Chapter 11.2.4
Window	Weighting window for the FFT analysis: *Hanning, Rectangle, Flat Top* or *Kaiser-Bessel*.		Chapter 11.2.4
Lines	Number of lines in the FFT spectrum: *1600, 800* or *400*.		Chapter 11.2.4
Averaging	Averaging used in the FFT analysis: *Linear* or *Exponential*.		Chapter 11.2.4
Time Constant	Time constant used in the exponential averaging of FFT spectra.		Chapter 11.2.4
RT60 Settings	Screen that enables setting the reverberation time measurement parameters: *Start Delay, Method, Octave, Freq. Range, Recording Time, Time Step, Averaging, Noise Mar., Logger Name* and *Level*.		Chapter 12.2 Appendix E
Start Delay	Delay between pressing the <Start> key and the start of measurement integration.		Chapter 12.2
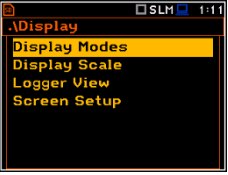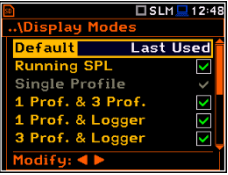
Method	Method of the RT60 calculation: *Decay* (Interrupted Noise Method) or *Impulse* (Impulse Response Method). The selection of the method depends on the used type of the sound source.	Chapter 12.2 Appendix E
Impulse	Method of RT60 calculation that uses the impulse sound source (like pistol shot, petard explosion).	Chapter 12.2 Appendix E
Decay	Method of RT60 calculation intended for measurements when room is excited by broad or narrow band sound noise source (usually pink noise).	Chapter 12.2 Appendix E
Octave	Type of spectrum (1/1 octave or 1/3 octave) based on which the RT60 analysis is performed.	Chapter 12.2 Appendix E
Freq. Range	Frequency range for RT60 calculations: *63Hz-4kHz* (7 bands) and *63Hz-16kHz* (9 bands) for 1/1 octave; *50Hz-5kHz* (21 bands) and *50Hz-20kHz* (27 bands) for 1/3 octave.	Chapter 12.2 Appendix E
Recording Time	Time of measurement data (sound pressure level decay curve) registration during RT60 calculations: *1s .. 30 s*.	Chapter 12.2 Appendix E
Time Step	Time-step of data registration (sound pressure level) in the file during RT60 calculations: *2, 5, 10, 20, 50, 100 ms*.	Chapter 12.2 Appendix E
Averaging	Process of averaging of the reverberation time results from several measurements during RT60 calculations.	Chapter 12.2 Appendix E
Smoothing	Process of smoothing of the raw reverberation time results. This is used for better visualization of the RT60 results. The value of this parameter means number of samples taken into consideration by the smoothing algorithm. The higher is this number the smoother is a graph.	Chapter 12.2 Appendix E

Noise Mar.	Margin value to the calculated noise level for RT60 calculations: *0 ÷ 20 dB*.	Chapter [12.2](#) Appendix E
Logger Name	Name of the Logger file in which data of the RT60 analysis will be recorded.	Chapter [12.2](#)
Level	Threshold level of the sound source for triggering the RT60 measurement. If the measured sound is below the *Level* value, the RT60 measurement will not start.	Chapter [12.2](#) Appendix E
Tonality	Screen that enables setting the tonality measurement parameters: *Standard, Mode, Number of Meas.* and *Directory*.	Chapter [14.2](#) Appendix F
Standard	Standard according to which tones will be defined: *ISO 20065-16*, *ISO 226-2003* or *ISO 226-1987*.	Chapter [14.2](#) Appendix F
Mode	Measurement mode for the ISO 20065-16 standard: *Auto* or *Manual*. In the *Auto* mode, the measurements are performed one by one without pauses after pressing the <Start> key, until the number of measurements reaches the *Number of Meas.* value. In the *Manual* mode, the measurements are performed one by one by the user pressing the <Start> key.	Chapter [14.2](#) Appendix F
Number of Meas.	Maximum number of measurements.	Chapter [14.2](#) Appendix F
Directory	Directory for saving measurement files.	Chapter [14.2](#) Appendix F
STIPA Settings	Screen that enables setting the STIPA parameters: *Project, Area, Source, Averaging, Standard, Measurement Unit,* and *Source Calibration*.	Chapter [13.4.4](#)
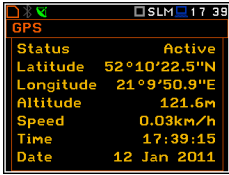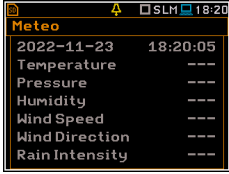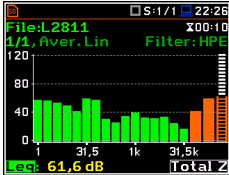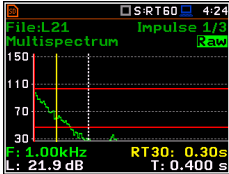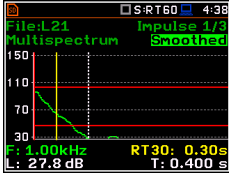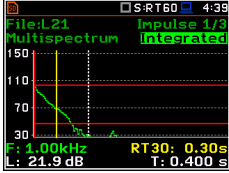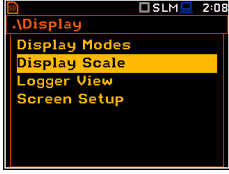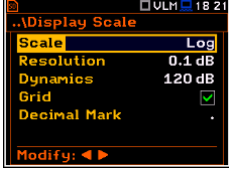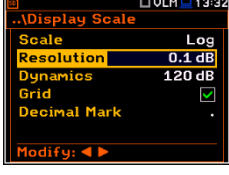
Project	Position enabling selecting the catalogue in the instrument memory which contains Area catalogues.		Chapter 13.4.4
Area	Position enabling selecting the catalogue in the instrument memory which contains Source catalogues.		Chapter 13.4.4
Source	Position that enables selecting the catalogue in the instrument memory which contains files with STIPA measurement results.		Chapter 13.4.4
Averaging	Type of STIPA results averaging: Manual or Auto.		Chapter 13.4.4
Standard	Standard according to which STIPA averages will be performed in the automatic mode: IEC 60268-16x2 or IEC 60268x3.		Chapter 13.4.4
Index	Results to be displayed: STI or CIS.		Chapter 13.4.4
Source Calibration	Adjustment of the reference STIPA signal level to the level of a real voice signal in the tested area.		Chapter 13.4.4
Ambient noise	Screen that enables setting the ambient noise distortions in the way of sound pressure in the 1/1 octave bands with central frequencies from 125 to 8000 Hz. This screen is connected with the STIPA function.		Chapter 13.4.5
Alarms	Instrument's function, enabling alarm setting, generation and alerting. The alarm setting can be done through the SvanPC++ software. If *Alarms* were defined the they can be seen in the instrument's screens. Some terms, used in the SvanPC++ software, are presented below:		Chapter 4.11
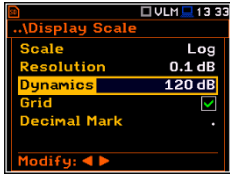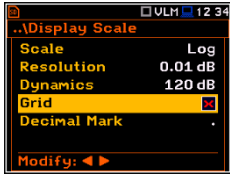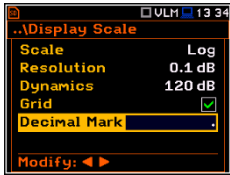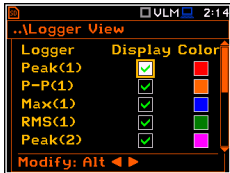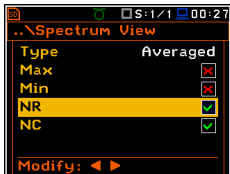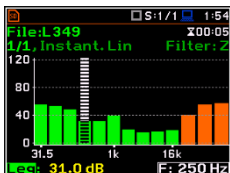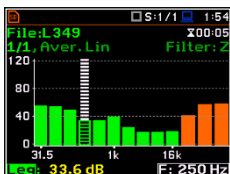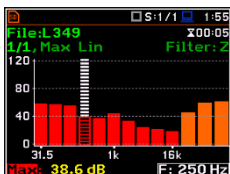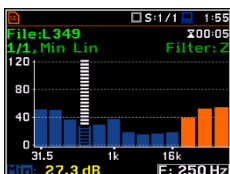
Alarm Conditions	List of alarm conditions. Alarm condition can be a *Threshold* or *Time* type.		Chapter 4.11
Threshold	Alarm condition type. Alarm is generated if the selected result (*Leq, Lpeak, Lmax, Lmin* or sliding *Leq* for screens of 15 or 60 minutes) exceeds the threshold level.		Chapter 4.11
Time	Alarm condition type. Alarm is generated in the selected days of the week and during the defined time period.		Chapter 4.11
Event	Event that generates alarm based on combination of *Threshold* and *Time* conditions. For each event, a different type of *Action* can be set.		Chapter 4.11
Action	Type of action in case of alarm: marker, audio, external I/O, SMS text message, or e-mail.		Chapter 4.11
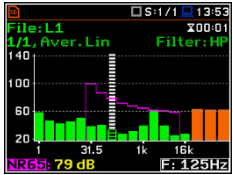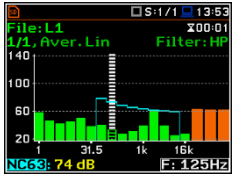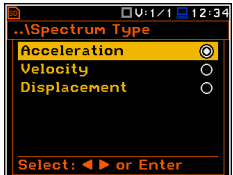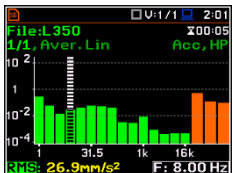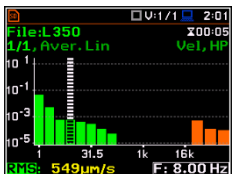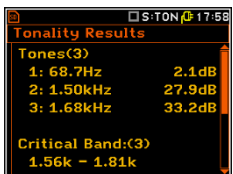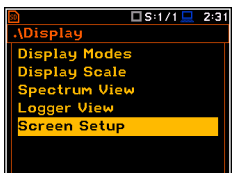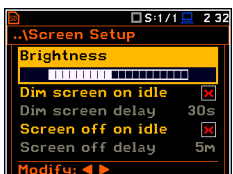
18.5 DISPLAY PARAMETERS

Name	Description	Screen	Reference
Display	Section of the Main Menu that enables setting of the measurement views.		Chapter 5
Display Mode	Mode of measurement results presentation/view. Modes can be activated in the *Display Modes* screen.		Chapter 5.1
Default view	Mode of measurement results view that will be presented after instrument's turn on.		Chapter 5.1

Running SPL view	Mode of the running SLP result view in Sound measurement modes. This mode is used for the noise level estimation before the measurement start.		Chapter 5.1.1
Single Profile view	Mode of the one result view. This mode is always available and cannot be disabled in most functions: *Level Meter*, *1/1 Octave*, *1/3 Octave* and *FFT*.		Chapter 5.1.2
1 Prof. & 3 Prof. view	Mode of presentation of one result in the upper part of the screen and three results in the lower part of the screen.		Chapter 5.1.3
1 Prof. & Logger view	Mode of presentation of one result in the upper part of the screen and time history (logger) results in the lower part of the screen.		Chapter 5.1.3
3 Prof. & Logger view	Mode of presentation of three results in the upper part of the screen and time history (logger) results in the lower part of the screen.		Chapter 5.1.3, 5.1
Logger view	Mode of presentation of time-history (logger) results.		Chapter 5.1.4
Statistics view	Mode of presentation of statistics of sound results.		Chapter 5.1.6
File Info view	Presentation of information regarding file: name, size, number of records, etc.		Chapter 5.1.9
Meter Table view	List of predefined results with assigned weighting filters and detector type.		Chapter 5.1.7

GPS view	Presentation of GPS information: *Status, Latitude, Longitude, Altitude, Speed, Time* and *Date*.	Chapter 5.1.8
Meteo view	Presentation of results from weather station: ambient temperature and pressure, humidity, wind speed, wind direction and rain intensity.	Chapter 5.1.10
Spectrum view	Mode of presentation of different spectra: *1/1 Octave, 1/3 Octave* and *FFT*.	Chapter 5.1.5, 10.3, 11.3
Raw Data view	Presentation of decay curve of *Leq* results for 1/1 or 1/3 octave bands, integrated within *Time Step* interval.	Chapter 12.5
Smoothed Data view	Presentation of smoothed decay curve of *Leq* results for 1/1 or 1/3 octave bands.	Chapter 12.5
Integrated Data view	Presentation of the integrated raw decay curve (Schroeder curve).	Chapter 12.5
Display Scale	Screen that enables setting parameters of results presentation: *Scale, Resolution, Dynamics, Grid* and *Decimal Mark*.	Chapter 5.2
Scale	Scale and units of results presentation: linear (Lin) or logarithmic (Log). In case of Lin, results are presented in absolute units and the Y-scale of the time history or spectrum plot is linear. In case of Log, results are presented in logarithmic units (dB) and the Y-scale of the time history or spectrum plot is logarithmic. Sound measurement results are presented always in logarithmic units (dB).	Chapter 5.2
Resolution	Number of digits after the decimal point of the results presentation: one digit after the decimal point (*0.1 dB*) or two digits after the decimal point (*0.01 dB*).	Chapter 5.2

Dynamics	Range of the plot scale: *10dB, 20dB, 40dB, 80dB, 100dB* and *120dB*.		Chapter 5.2
Grid	Grid swither on or off during the time history or spectrum presentation.		Chapter 5.2
Decimal Mark	Parameter that defines which decimal mark (point or comma) will be used for data presentation in all presentation modes.		Chapter 5.2
Logger View	Screen that enables selecting of time-history results, which will be presented on the display and colours of their plots.		Chapter 5.3
Spectrum View	Screen that enables selecting of types of spectra for displaying: *Averaged*, *Instantaneous*, *Max*, *Min, NR* and *NC*.		Chapter 10.3.3, 11.3.3
Instantaneous	Spectrum of instantaneous Leq results for the *1/1 octave* or *1/3 octave* bands.		Chapter 10.3.3, 11.3.3
Averaged	Spectrum of averaged Leq results for the *1/1 octave* or *1/3 octave* bands.		Chapter 10.3.3, 11.3.3
Max	Spectrum of Max results for the *1/1 octave* or *1/-octave* bands.		Chapter 10.3.3, 11.3.3
Min	Spectrum of Min results for the *1/1 octave* or *1/3 octave* bands.		Chapter 10.3.3, 11.3.3

NR	Noise rating values for 1/1 octave sound measurements.		Chapter 10.3.3
NC	Noise criterion values for 1/1 octave sound measurements.		Chapter 10.3.3
Spectrum Type	Screen that enables selecting of types of spectra for displaying during vibration measurement: *Acceleration*, *Velocity* or *Displacement*.		Chapter 10.3.4, 11.3.4
Acceleration	Acceleration spectrum which is displayed if it has been selected in the *Spectrum Type* screen.		Chapter 10.3.4, 11.3.4
Velocity	Velocity spectrum which is displayed if it has been selected in the *Spectrum Type* screen.		Chapter 10.3.4, 11.3.4
Displacement	Displacement spectrum which is displayed if it has been selected in the *Spectrum Type* screen.		Chapter 10.3.4, 11.3.4
Tonality Results	Display view that presents the results of the tonality analysis.		Chapter 14.4
Screen Setup	Screen that enables setting screen brightness and power saving.		Chapter 5.4
Brightness	Brightness of the instrument display. Is setting up in the *Screen Setup* screen.		Chapter 5.4

Dim screen on idle	Screen dimming in no activity after certain delay. Is setting up in the *Screen Setup* screen.		Chapter 5.4
Screen off on idle	Screen switching off in no activity after certain delay. Is setting up in the *Screen Setup* screen.		Chapter 5.4
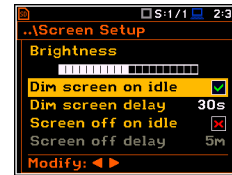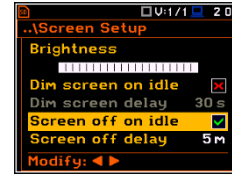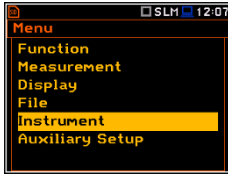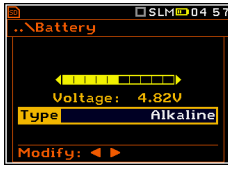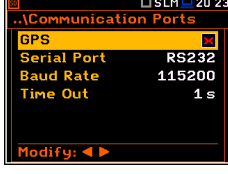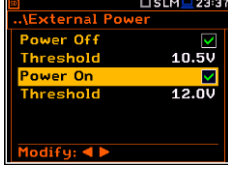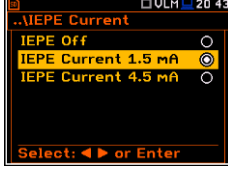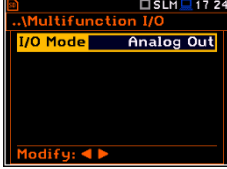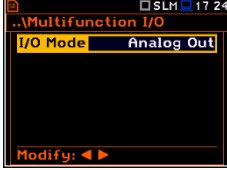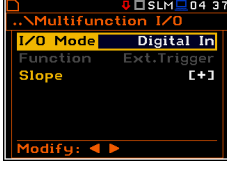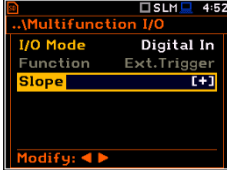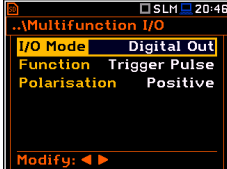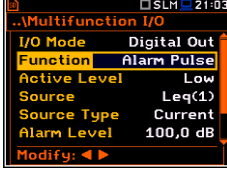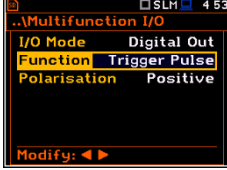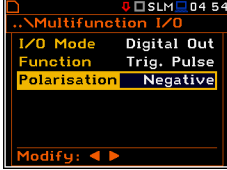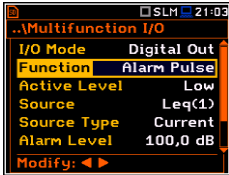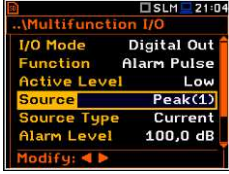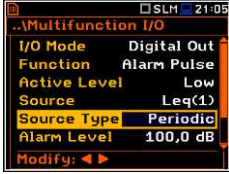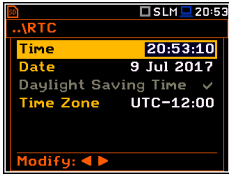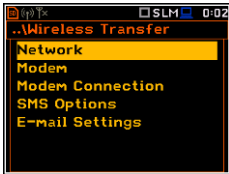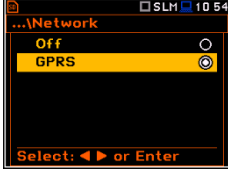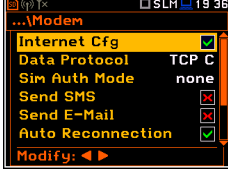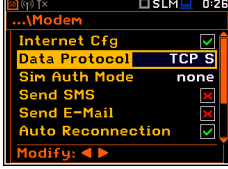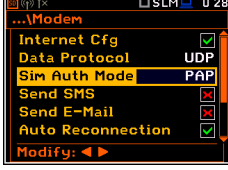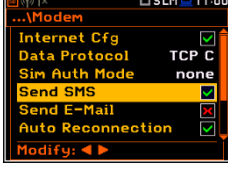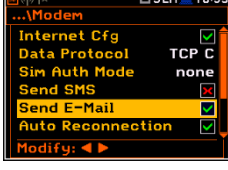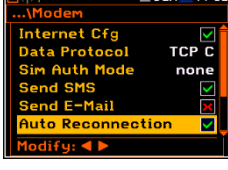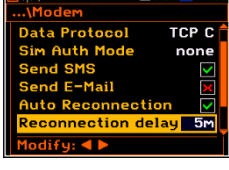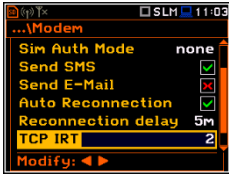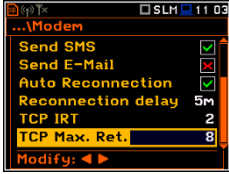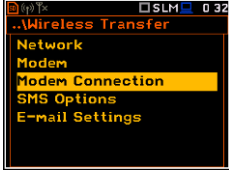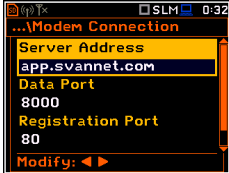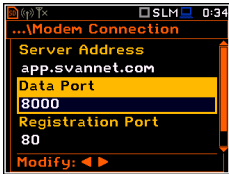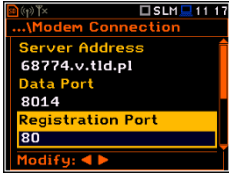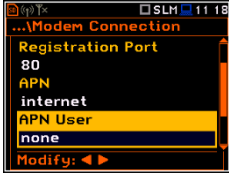
18.6 INSTRUMENT PARAMETERS
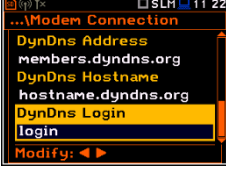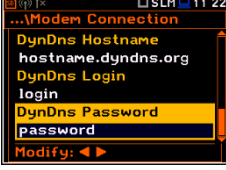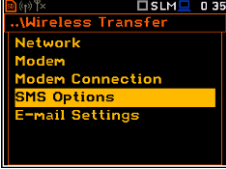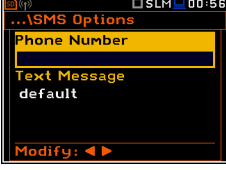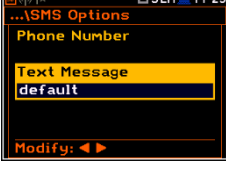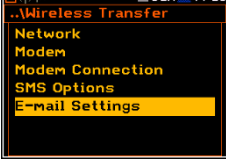
Name	Description	Screen	Reference
Instrument	Section in the Main Menu that enables setting the hardware components of the instrument in the screens: *Auto Start, Battery, Communication Ports, External Power, IEPE Current, Keyboard Settings, Multifunction I/O, RTC, Wireless Transfer, Unit Name* and *Unit Label.*		Chapter 7
Auto Start	Instrument function that enables the measurement start right after the instrument is turning on without pressing the <Start> key.		Chapter 7.1
Battery	Screen allowing you to check the instrument power source status.		Chapter 7.2
Communication Ports	Screen that enables configuring the instrument communication ports: *GPS and Serial Port – RS232* or *Bluetooth*.		Chapter 7.3
External Power	Screen that enables configuring automatic instrument switching on or off in case the voltage of the external DC power exceeds or becomes lower than the threshold level.		Chapter 7.4
IEPE Current	Screen enabling setting the supply current of the microphone or accelerometer: *Off, 1.5mA* or *4.5mA*.		Chapter 7.5
Keyboard Settings	Screen that enables setting the Shift, Alt, Start, Stop keys functionality.		Chapter 7.6
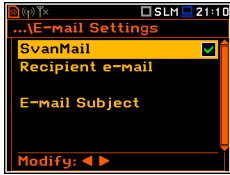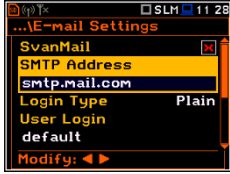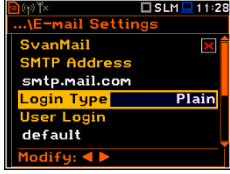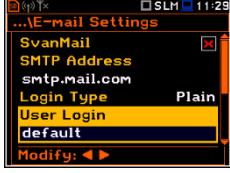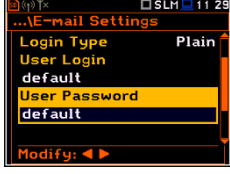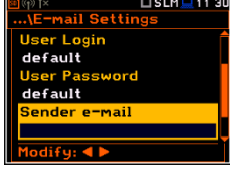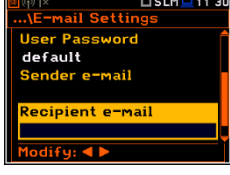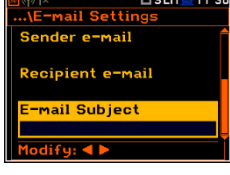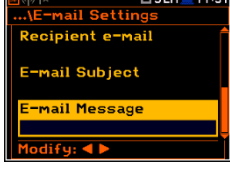
Multifunction I/O	Screen that enables configuring the instrument's I/O port parameters: I/*O Mode, Function, Slope*, *Polarisation, Active Level, Source, Source Type, Alarm Level, Send SMS* and *Send E-Mail*. Detailed description of the I/O port is given in Appendix C.	Chapter 7.7 Appendix C
I/O Mode	Mode of the I/O port: *Analog Out*, *Digital In*, *Digital Out*.	Chapter 7.7 Appendix C
Analog Out	Mode of the I/O port when analogue signal is transmitted from the input of the instrument to its output without any digital processing (i.e. frequency filtering).	Chapter 7.7 Appendix C
Digital In	Mode of the I/O port when external digital signal is used as an external trigger to start measurements. The instrument is acting in this case as so called "slave instrument".	Chapter 7.7 Appendix C
Slope	Trigger voltage slope defined for the *Digital In* I/O mode: [+] (uprising as default) or [–] (falling).	Chapter 7.7 Appendix C
Digital Out	Mode of the I/O port when digital signal is used for triggering other "slave instrument(s)" (the instrument is acting in this case as a "master instrument"), or as a source of alarm signal.	Chapter 7.7 Appendix C
Function	Functionality of the *Digital Out* I/O mode: *Trigger Pulse* or *Alarm Pulse*.	Chapter 7.7 Appendix C
Trigger Pulse	Functionality of the *Digital Out* I/O mode when digital signal used for triggering other "slave instrument(s)" (the instrument is acting in this case as a "master instrument"). One additional parameter is used for this functionality of the *Digital Out* I/O mode: *Polarisation.*	Chapter 7.7 Appendix C
Polarisation	Parameter of the *Digital Out* I/O mode defining which polarisation of the signal (*Negative* or *Positive*) will be applied to the output trigger pulse.	Chapter 7.7 Appendix C
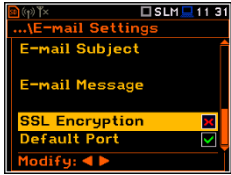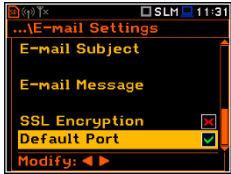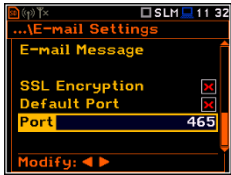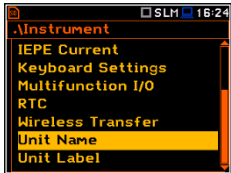
Alarm Pulse	Functionality of the *Digital Out* I/O mode when digital signal is used as a source of alarm signal in case of certain circumstances occurred during measurements (i.e. the level of the input signal was higher than a user selected trigger alarm setting). A set of additional parameters are used for this functionality of the *Digital Out* I/O mode: *Active Level, Source, Source Type, Alarm Level, Send SMS* and *Send E-mail*.	Chapter 7.7 Appendix C
Active Level	Parameter, when *Alarm Pulse* is selected as a function of the *Digital Out* I/O mode, defining the level of the signal, treated as an alarm: *Low* (0 V) or *High* (3 V).	Chapter 7.7 Appendix C
Source	Parameter, when *Alarm Pulse* is selected as a function of the *Digital Out* I/O mode, defining the measured result, the level of which should be checked for alarm generation. The measurement results from the first profile: *Peak(1), Spl(1), Max(1)* or *Leq(1)* can be used.	Chapter 7.7
Source Type	Parameter, when *Alarm Pulse* is selected as a function of the *Digital Out* I/O mode, defining the type of *Source*: *Current* (measured with 1 second step) or *Periodic* (measured with *Integration Period* step).	Chapter 7.7
Alarm Level	Parameter, when *Alarm Pulse* is selected as a function of the *Digital Out* I/O mode, defining the threshold level of the result to be monitored during the measurement. If the result is greater than the alarm level, the instrument will generate the alarm signal in the selected logic.	Chapter 7.7
Send SMS	Activation of alarm SMS sending via *Wireless Transfer* when *Alarm Pulse* is selected as a function of the *Digital Out* I/O mode.	Chapter 7.7
Send E-Mail	Activation of alarm e-mail sending via *Wireless Transfer* when *Alarm Pulse* is selected as a function of the *Digital Out* I/O mode.	Chapter 7.7
RTC	Screen that enables programming the instrument's real-time clock. This clock is displayed in the upper right corner of the display.	Chapter 7.8
Wireless Transfer	Screen that enables configuring data transfer control via external modem supporting cellular connection through additional screens: *Network, Modem, Modem Connection, SMS Options* and *E-mail Settings*.	Chapter 15.2

Network	Screen that enables selecting the wireless network option: *Off* or *GPRS*.		Chapter [15.2.1](#)
Modem	Screen that enables configuring the modem basic settings: *Internet Cfg, Data Protocol, Sim Auth Mode, Send SMS, Send E-Mail, Auto Reconnection, Reconnection Delay, TCP IRT* and *TCP Max. Ret.*		Chapter [15.2.2](#)
Internet Cfg	Parameter of the *Modem* screen enabling automatic modem configuration after switching the instrument on.		Chapter [15.2.2](#)
Data Protocol	Parameter of the *Modem* screen defining the connection type for data exchange: *TCP S* (server mode), *TCP C* (client mode) or *UDP*.		Chapter [15.2.2](#)
Sim Auth Mode	Parameter of the *Modem* screen defining the method of user verification by SIM card. Depending on the SIM card, several options are possible, some of them are recognized by the modem: *none* – no verification required, *PAP, CHAP, MsChap*.		Chapter [15.2.2](#)
Send SMS	Parameter of the *Modem* screen switching on the SMS alarm notification.		Chapter [15.2.2](#)
Send E-Mail	Parameter of the *Modem* screen switching on the e-mail alarm notification.		Chapter [15.2.2](#)
Auto Reconnection	Parameter of the *Modem* screen switching on the device attempting to reconnect the modem in case of errors or sudden disconnection.		Chapter [15.2.2](#)
Reconnection Delay	Parameter of the *Modem* screen defining period between each reconnection attempts.		Chapter [15.2.2](#)
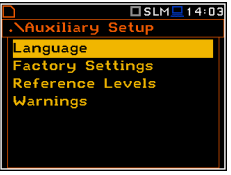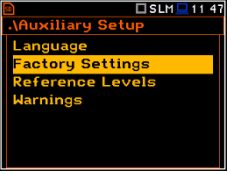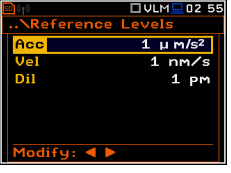
TCP IRT	Parameter of the *Modem* screen defining TCP Initial Retransmission Timeout.		Chapter 15.2.2
TCP Max. Ret.	Parameter of the *Modem* screen defining maximum reconnection attempts performed within a simple connection cycle.		Chapter 15.2.2
Modem Connection	Screen that enables configuring supporting options required by the cellular modem to establish internet connection: *Server Address, Data Port, Registration Port, APN, APN User, APN Password, DNS Server, DynDns Address, DynDns Hostname, DynDns Login and DynDns Password*.		Chapter 15.2.3
Server Address	Parameter of the *Modem Connection* screen defining either IP or domain address, where the registration data will be sent during registration process (*Data Protocol: TCP S* or *UDP*) or to which the modem will be connected to (*Data Protocol: TCP C*). By default, the server address is app.svannet.com.		Chapter 15.2.3
Data Port	Parameter of the *Modem Connection* screen defining the port number that denotes a port on which a communication socket will be configured for data exchange between the remote host and the station.		Chapter 15.2.3
Registration Port	Parameter of the *Modem Connection* screen defining the port number that denotes a port on which a communication socket will be configured to transmit registration package (*Register Mode: On*) or exchange Http data (*Register Mode: AS* or *SMT. AS*).		Chapter 15.2.3
APN	Parameter of the *Modem Connection* screen defining the APN name of the SIM card used with the modem.		Chapter 15.2.3
APN User	Parameter of the *Modem Connection* screen defining the user name used for verification by the SIM card of the modem.		Chapter 15.2.3
APN Password	Parameter of the *Modem Connection* screen defining the password used for verification by the SIM card of the modem.		Chapter 15.2.3

DNS Server	Parameter of the *Modem Connection* screen defining the IP address of DNS server used for establishing connection with the internet. In most cases, leaving the default value of "0.0.0.0" will be sufficient, but some SIM cards may require a specific address.	Chapter 15.2.3
DynDns Address	Parameter of the *Modem Connection* screen defining the server address when using DynDNS service in case of dynamic IP address.	Chapter 15.2.3
DynDns Hostname	Parameter of the *Modem Connection* screen defining the server hostname address when using DynDNS service in case of dynamic IP address.	Chapter 15.2.3
DynDns Login	Parameter of the *Modem Connection* screen defining the login when using DynDNS service in case of dynamic IP address.	Chapter 15.2.3
DynDns Password	Parameter of the *Modem Connection* screen defining the password when using DynDNS service in case of dynamic IP address.	Chapter 15.2.3
SMS Option	Screen that enables configuring SMS service used for alarm notification: *Phone Number* and *Text Message*.	Chapter 15.2.4
Phone Number	Parameter of the *SMS Option* screen defining the phone number where the text messages will be sent.	Chapter 15.2.4
Text Message	Parameter of the *SMS Option* screen defining additional text, which will be appended into a standard alarm message template.	Chapter 15.2.4
E-mail Settings	Screen that enables configuring parameters of the E-mail service used for alarm notification: *SvanMail, SMTP Address, Login Type, User Login, User Password, Sender e-mail, Recipient e-mail, E-mail Subject, E-mail Message, SSL Encryption, Default Port and Port*.	Chapter 15.2.5

SvanMail	Parameter of the *E-mail Settings* screen switching the option that allows sending e-mails without additional parameters, simplifying the process of configuring alarm notifications.	Chapter 15.2.5
SMTP Address	Parameter of the *E-mail Settings* screen defining SMTP server address used for sending e-mail messages.	Chapter 15.2.5
Login Type	Parameter of the *E-mail Settings* screen defining authentication method, which depends on the SMTP server used for sending e-mails: *None, Login, Plain* or *Cram*.	Chapter 15.2.5
User Login	Parameter of the *E-mail Settings* screen defining user login used to establish verified connection with SMTP server.	Chapter 15.2.5
User Password	Parameter of the *E-mail Settings* screen defining user password used to establish verified connection with SMPT server.	Chapter 15.2.5
Sender e-mail	Parameter of the *E-mail Settings* screen defining e-mail address from which the e-mail message will be sent.	Chapter 15.2.5
Recipient e-mail	Parameter of the *E-mail Settings* screen defining e-mail address to which the e-mail message will be sent.	Chapter 15.2.5
E-mail Subject	Parameter of the *E-mail Settings* screen defining e-mail message's subject.	Chapter 15.2.5
E-mail Message	Parameter of the *E-mail Settings* screen defining additional text which will be appended to the standard e-mail message template used for alarm notification.	Chapter 15.2.5

Name	Description	Screen	Reference
SSL Encryption	Parameter of the *E-mail Settings* screen switching on the option enabling attempt to configure the modem for connecting to the mail server used the encryption protocol SSL.		Chapter 15.2.5
Default Port	Parameter of the *E-mail Settings* screen switching on the option enabling attempt to communicate with the mail server on the default port (25 for normal calls, 465 with SSL).		Chapter 15.2.5
Port	Parameter of the *E-mail Settings* screen defining user's own port.		Chapter 15.2.5
Unit Name	Screen that enables editing of the instrument name visible by the SvanNET web-service.		Chapter 7.10
Unit Label	Screen that displays information about the instrument type, its serial number, the current software version installed and the relevant standards, which the instrument fulfils.		Chapter 7.11

18.7 AUXILIARY PARAMETERS

Name	Description	Screen	Reference
Auxiliary Setup	Section in the Main Menu that enables customizing the instrument interface to specific user requirements in the screens: *Language, Factory Settings, Reference Levels, Vibration Units* and *Warnings*.		Chapter 8
Language	Selection of the user interface language.		Chapter 8.1
Factory Settings	Restoration of the default settings of the instrument.		Chapter 8.2
Reference Levels	Screen that enables defining reference levels of the vibration signal for acceleration (Acc), velocity (Vel) and displacement (Dil).		Chapter 8.3

Vibration Units	Screen that enables selecting units for vibration measurements.		Chapter 8.4
Warnings	Screen that enables activating warning messages, which are to be displayed during the normal operation of the instrument.		Chapter 8.5
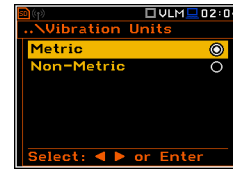
APPENDIX A. REMOTE CONTROL

The **USB 2.0 interface** is the Type C serial interface working with 480 MHz clock which enables one to control remotely the unit. Its speed is relatively high, and it ensures the common usage of USB-C in most produced nowadays Personal Computers.

Alternatively, all commands described in this appendix are valid for any other kinds of interfaces (if present) like **Bluetooth** communication **or RS232**.

Note: *For reliable operation of the RS 232, proper synchronisation of the transmission by **CTS** and **RTS** lines (according to their definitions) is required.*

The functions, which are developed in order to control data flow in the serial interfaces, ensure:

- bi-directional data transmission,

- remote control of the instrument.

The user, in order to programme the serial interface, has to:

1. send "the function code",

2. send an appropriate data file

or

3. receive a data file.

The following basic input/output transmission types (called functions) are available:

#1   input / output of the control setting codes,

#2   read out of the main measurement results,

#3   read out of the measurement results in **1/x OCTAVE** or **FFT** mode,

#7   special control functions,

#D   read / write the data files from the external memory (SD-card).

A.1. FUNCTION #1 – INPUT/OUTPUT OF THE CONTROL SETTING CODES

#1 function enables the user to send the control setting codes to the instrument and read out a file containing the current control state. A list of the control setting codes is given in Tab. A.1. The format of **#1** function is defined as follows:

#1,Xccc,Xccc,(...),Xccc;

or

#1,Xccc,X?,Xccc,(...),X?,Xccc;

where:

        X   - the group code, **ccc** - the code value,

        X?   - the request to send the current X code setting.

The instrument outputs in this case a control settings file for all requests X? in the following format:

#1,Xccc,Xccc,(...),Xccc;

In order to read out all current control settings the user should send to the device the following sequence of characters:

#1;

The instrument outputs in this case a file containing all control settings given in Tab. A1 in the format:

#1,Xccc,Xccc,(...),Xccc;

> **Note:** *All bytes of that transmission are ASCII characters.*

A.2. FUNCTION #2 – READ OUT OF THE MAIN MEASUREMENT RESULTS

A.2.1. Read-out the profile results

#2 function enables one to read out the current measurement results from the selected profile.
#2 function has the formats defined as follows:

#2 [,<aver>] [,<profile>] [[[,X?] ,X?] ,(...)];

or

#2 [,<aver>] ,<rot>;

where:

<aver> – type of results:

    i – instantaneous results, i.e. results from the current cycle (default),

    a – averaged results, i.e. results from the previous cycle.

<profile> – profile number:

    0 – means "all profiles", i.e. results from the all profiles will be sent (default value),

    1, 2 or 3 – one of the profile, i.e. only results from the given profile will be sent;

<rot> – rotation results:

    rpm – all rotations results will be sent (unit of the results wil be [rpm]),

    rps – all rotations results will be sent (unit of the results wil be [rps]);

X – code of the specified result (see below); if no code are specified all results will be sent;

In case of <profile> = 1, 2 or 3 the instrument sends results in the format defined as follows:

#2 [,<aver>],<profile>,Xc,(...);

    where **c** is the value of the result **X** or question mark (**?**) if result **X** is not available;

In case of <profile> = 0 the instrument sends results in the format defined as follows:

#2 [,<aver>],1,Xc,(...),2,Xc,(...),3,Xc,(...),;

    where **c** is the value of the result **X** or question mark (**?**) if result **X** is not available;

If no results are available, the instrument will send:

#2,?;

The codes of results in the case of **Sound Meter** mode are defined as follows:

C   number of measurement cycle;

V   overload flag (c equals to 0 or 1);

T   time of the measurement cycle (c – value in seconds);

P   **Peak** value (c – the value in dB);

M   **Max** value (c – the value in dB);

N   **Min** value (c – the value in dB);

S   **Spl** result (c – the value in dB);

R   **Leq** result (c – the value in dB).

U   **SEL** result (c – the value in dB);

B(k)   **Lden** result (c – the value in dB); k – flag determining the kind of the result:

      $k = 1$ – **Ld** result,

      $k = 2$ – **Le** result,

      $k = 3$ – **Lde** result,

      $k = 4$ – **Ln** result,

      $k = 5$ – **Lnd** result,

      $k = 6$ – **Len** result,

      $k = 7$ – **Lden** result;

I   **LEPd** result (c – the value in dB).

Y   **Ltm3** result (c – the value in dB);

Z   **LTeq** result (c – the value in dB);

g   **LR1** (rolling Leq 1st) result (c – the value in dB);

h   **LR2** (rolling Leq 2nd) result (c – the value in dB);

L(nn) statistic levels (c – the value in dB);

k   **EX** result (c – the value in dB);

s   **SD** result (c – the value in dB);

O   **NR** result (c equal to 131 means that NR result exceeds the maximum value for which is defined – i.e. 130);

K   **NC** result (c equal to 14 or 71 means that NR result exceeds the minimum or maximum value for which is defined – i.e. 15 or 70 respectively);

The codes of results in the case of **VLM** mode are defined as follows:

C   number of measurement cycle;

V   overload flag (c equals to 0 or 1);

T   time of the measurement cycle (ccc – value in seconds);

P   **Peak** value (c – the value in dB);

Q   **P–P** value (c – the value in dB);

M   **Max** value (c – the value in dB);

R   **RMS** value (c – the value in dB);

Example: After sending to the instrument the string:

   #2,a,1,C?,V?,T?,P?,M?,R?;

the unit sends out the results of measurement coming from the first profile in predefined, described above, order:

#2,a,1,C5,V0,T60,P125.41,M117.60,R105.43;

A.2.2. Read-out the RT60 results

In the case of RT60 function there are additional codes:

#2,EDT; this function allows you to read the current EDT results.

#2,T20; this function allows you to read the current RT20 results.

#2,T30; this function allows you to read the current RT30 results.

The function's answer is in the one of the following format:

#2,<type>,0,<status>; when results are not available

#2,<type>,1,<results>; when results are available.

<type> accepts the following values: **EDT/T20/T30**

<status> is the status of device (0 – no results, 1 – waiting for trigger, 2 – measurement in progress, 3 – calculations)

<results> is the full list of frequencies with corresponding results in the format: **freq1:value1,freq2:value2,…,freqN:valueN**

The exemplary answer:

#2,T30,1,50.0Hz:---,63.0Hz:---,80.0Hz:---,100Hz:0.48s,125Hz:--- ,160Hz:0.31s,200Hz:0.61s,250Hz:0.62s,315Hz:0.65s,400Hz:0.56s,500Hz:0.66s,630Hz:0.81s,800Hz:0.69s ,1.00k:0.74s,1.25k:0.75s,1.60k:0.70s,2.00k:0.69s,2.50k:0.58s,3.15k:0.63s,4.00k:0.61s,5.00k:0.60s,6.30k: 0.45s,8.00k:0.35s,10.0k:0.26s,12.5k:0.20s,16.0k:0.25s,20.0k:0.18s,TOT.A:0.70s,TOT.C:0.72s,TOT.Z:0.8 2s;

A.2.3. Read-out the STIPA results

#2,STI,CP; this command creates new project and returns new project name.

#2,STI,CA; this command creates new area and returns new area name.

#2,STI,CS; this command creates new source and returns new source name. e.g. **#2,STI,CS,"S2";**

#2,STI,PL; this command returns the project list. e.g. **#2,STI,PL,2,"PROJ0001","PROJ0002";**

#2,STI,AL; this command returns the area list. e.g. **#2,STI,AL,2,"AREA1","AREA2";**

#2,STI,SL; this command returns the source list. e.g. **#2,STI,SL,2,"S1","S2";**

The following list of commands require prior setting of the project, area and source.

#2,STI,NP; this command adds the new point and returns the new point ID.

#2,STI,PC; this command returns the count of the measurement points and list of point IDs, **e.g. #2,STI,PC,n,1,2,3;**

#2,STI,MC,p; this command returns the count of measurements at the point p.

#2,STI,AP,p; this command allows you to read and set average flag at the point p.

#2,STI,AM,p,m; this command allows you to read and set average flag for the m measurement at the point p.

#2,STI,DP,p; this command deletes the point p.

#2,STI,DM,p,m; this command deleted the measurement m at the point p.

#2,STI,MR,p,m,mrn; this command allows you to read the results of the m measurement at the point p.

#2,STI,FR,p,m,frn; this command allows you to read the modulation results of the m measurement at the point p.

#2,STI,SN; this command allows you to read and write Ambient Noise parameters. e.g. **#2,STI,SN,enabled,90.0,91.0,...,95.0;**

p: 0..PointCount-1

m: 0..MeasurementCount-1

mrn: STI,LAQ,LCQ,LAS,STM,FLG

frn: LZQ,MF1,MF2,ERR
enabled: 0/1
flags: UNDERRANGE = 1, OVERLOAD = 2

> **Note:** *All bytes of that transmission are ASCII characters.*

A.3. FUNCTION #3 – READ OUT OF THE MEASUREMENT RESULTS IN 1/X OCTAVE OR FFT MODE

#3 function enables one to read out the current measurement results in **1/x OCTAVE** or **FFT** mode.

   #3 function format is defined as follows:

#3;   – displayed spectrum

#3,A; – averaged spectrum

#3,I; – instantaneous spectrum

#3,M; – max spectrum

#3,N; – min spectrum

The device responds, sending the last measured spectrum (when the instrument is in STOP state) or currently measured spectrum (when the instrument is in RUN state) in the following format:

#3;<Status Byte> <LSB of the transmission counter> <MSB of the transmission counter> <data byte> (...) <data byte>

Status Byte gives the information about the current state of the instrument.

D7	D6	D5	D4	D3	D2	D1	D0

   where:

   D7   = 0   means that "overload does not happen"
           = 1   means that "overload appeared"
   D6   = 0   means that "spectrum is not averaged"
           = 1   means that "spectrum is averaged"
   D5   = 0   the instantaneous current result (RUN State)
           = 1   the final result (STOP State)
   D0 to D4 reserved bits

> **Note:** *The measurement result is coded in binary form as dB•100 (e.g. 34.52 dB is sent as binary number 3452).*

A.4. FUNCTION #7 – SPECIAL CONTROL FUNCTIONS

#7 function enables the user to perform special control functions. **Some of them should be used with the extreme care.**

#7 function format is defined as follows.

To read settings a query should be send to the device:

> **#7,<code>;**

where **<code>** is a two ASCII letter code.

The device responds with a control settings:

> **#7,<code>,set1[,set2[,set3[,...[,setN]]]];**

where **<code>** is the same code sent in the query and **set1, set2,... setN** are settings.

To write settings to the device follow the opposite procedure. Send to the device:

> **#7,<code>,set1[,set2[,set3[,...[,setN]]]];**

In case of success the device responds with:

> **#7,<code>;**

In case of an unknown function or error the device returns:

> **#7,?;**

Codes and settings for #7 function are described in Chapter A.7.

> **Note:** *#7 function protocol consist of ASCII characters only.*

> **Note:** *Some of the #7 functions are blocked during measurements running state (#1,S1;). Stop the measurements (#1,S0;) before changing these settings.*

A.5. FUNCTION #D – READ / WRITE THE DATA FILES FROM THE EXTERNAL MEMORY (SD-CARD)

<disk>	logical disk number: 0 – SD-card,
<address>	directory address (cluster number)
<count>	directory size in bytes
<offsetB>	offset the first byte to read (an even number).
<nB>	number of bytes to read (an even number)
<data>	binary data.

#D,c,?; this function returns the list of available disks in format:

    #D,c,<disk1>[,<disk2>[,<disk3>]];

#D,d,?; this function returns the parameters of the working directory in format:

    #D,d,<disk>,<address>,<count>;

#D,d,<disk>,<address>; this function enables to change the working directory

    Response:
    #D,d;   - command was executed
    #D,d,?;   - command cannot be executed

#D,r,<disk>,<address>,<offsetB>,<nB>;this function enables the user to read the file

    Response:
    #D,r,<disk>,<address>,<offsetB>,<nB>; [<data>]

#D,s,?; this function returns the parameters of the setup directory in format:
    #D,s,<disk>,<address>;

#D,l,?; this function returns the parameters of the current logger in format:
    #D,l,<name>,<nB>;

#D,a,?; this function returns the parameters of the alarm directory in format:
    #D,a,<disk>,<address>,<first_clust>,<file_length>;

#D,t,?; this function returns the parameters of the system directory in format:
    #D,t,<disk>,<address>;

#D,e; this function deletes all files in working directory.

    Response:
    #D,e;

#D,e,<name>; this function deletes the file in working directory specified by the name.

    Response:
    #D,e;

#D,m,<address>,<name>; this function makes directory specified by the name.

    Response:
    #D,m;

#D,f,0; this function erases active disk.

    Response:
    #D,f;

#D,f,<address>; this function deletes the directory specified by the cluster number.

    Response:
    #D,f;

#D,z,<disk>,<address>,<offsetB>,<nB>; this function enables the user to read the file with CRC.

    Response:
    #D,z,<disk>,<address>,<offsetB>,<nB>; [<data><CRC>]

#D,w,<name>,<nB>; [<data>]; this function enables the user to write the file (in the working directory)

    Response:

#D,w;

A.6. FUNCTION #R – AUTOMATIC RESULTS TRANSMISSION DURING THE MEASUREMENT

#R remote command is used to configure the instrument to automatically send results during measurements. The command and response formats described below are available as part of the command.

1 – Turn off command

#R,0;

  Response:

  #R,0;

Note: If any additional characters appear in the command after the number 0 (zero), they will be ignored, and the command will not be treated as incorrect.

2 – Turn on command

#R,1[:[f][:[r][:[d]]]],C$_1$[,C$_2$[..[,C$_n$]]];

where:

  []   – square brackets mean that the parameter is optional,

  1   – a number indicating the activation of the 1-second results sending mode,

  f,r,d – transferred data format parameters

  C$_k$ – results or result parameter identifier (k = 1..n)

The parameters of data transmission format have following meanings:

  f   – line separator parameter – allows to send an additional character or line separator characters after each transmission:

   f = 0   – no line separator sent (default)

   f = 1   – *line feed* character sent (LF, ASCII value 10),

   f = 2   – *carriage return* character sent (CR, ASCII value 13),

   f = 3   – *carriage return* i *line feed* character sent,

  r   – results separator parameter – allows for change of results separator character (comma character as default, ASCII value 44):

   r   – any ASCII character from range 1 to 255

  d   – decimal separator parameter – allows for change of decimal separator character (dot character as default, ASCII value 46):

   d   – any ASCII character from range 1 to 255

Note: The lack of any data transmission format parameter between the colon characters will keep the default value of the parameter. For example, command:

   #R,1::9:44,(...);

will change the result separator to the horizontal tab (HT, ASCII value 9), change the decimal point to the decimal point (ASCII value 44) and will not change the default line separator parameter.

Note: If the results separator and decimal separator characters are identical, the command will not be accepted, and the command error message will be returned - see point 4.

Each C_k identifier consists of a letter and possible numeric parameters separated by a colon. If the identifier is given without the required parameters, default values of missing parameters will be zero. If the identifier will contain more parameters than required, the command will not be accepted, and the command error message will be returned - see point 4.

Available identifiers:

F[:p₁]   – measurement start date; date is sent in a format depending on the parameter:

      p₁ = 0   – DD-MM-YYYY (default),

      p₁ = 1   – YYYY-MM-DD,

G[:p₁]   – measurement start time; time is sent with a second or millisecond resolution depending on the parameter:

      p₁ = 0   – HH:MM:SS (default),

      p₁ = 1   – HH:MM:SS.mmm,

V   – overload flag,

P:p₁   – **Peak** result value:

      p₁   – profile number (1..3),

Q:p₁   – **P–P** result value:

      p₁   – profile number (1..3),

M:p₁   – **Max** result value:

      p₁   – profile number (1..3),

N:p₁   – **Min** result value:

      p₁   – profile number (1..3),

R:p₁   – **RMS** result value: (for vibration) or **Leq** (for sound):

      p₁   – profile number (1..3),

X[:p₁[:p₂]]   – octave or fractional-octave bandwidth values:

      p₁   – index of first band (0..182),

      p₂   – number of results sent (0..183) (zero means all results from the specified index of first band to last total result included)

      Note: If the index of the first band is larger than the index of the last total result calculated, the spectrum results will not be sent.

      Note: If the number of results sent is greater than the number of available results, only available results will be sent.

Note: If the parameter values are outside the acceptable range, the command will not be accepted, and the command error message will be returned – see point 4.

Note: The identifier of any result or parameter can appear in the command only once. If any identifier occurs again, the command will not be accepted, and the command error message will be returned - see point 4.

Note: The order of identifiers in the mode enable command determines the order in which the results will be sent. The exception are the spectrum results that will always be sent last!

If the format order is correct, instrument will send full information about the mode settings in the answer - see point 3.

If the format order is incorrect, the error message will be returned - see point 4.

3 – Read current mode set command

```
#R;
```

If the mode of automatic sending of results is off, then instrument will send:
```
#R,0;
```

If the mode of automatic sending of results is enabled, then instrument will send full information about the mode settings in the following format:
```
#R,1[:f:r:d],C₁,..,Cₙ;
```
where:

1 – a number denoting the mode of sending 1-second results

f,r,d – data transmission format parameters described in point 2,

C_k – identifier of the result or measurement parameter (k = 1..n) described in point 2.

Note: Data transmission format parameters are given only when at least one of them has been given in the command to enable the mode.

Note: The number of C_k identifiers and their alignment is consistent with their appearance in the order to enable the mode and determines the order in which the results will be sent during the measurement. The exceptions are spectral results, which regardless of the place of occurrence of the identifier in the mode enable command will be sent last - see the corresponding "warning" in point 2. For this reason, in the above response sent by the instrument the spectral identifier (provided it was given in the order to switch mode) will always be the last one.

Note: All identifiers appearing in the above response will be given with all parameters, even if the parameters were not given in the command to enable the mode

4 – Command error response

```
#R,?;
```

The instrument will send this response after receiving an incorrect instruction. Sending this response by the instrument also means that the automatic sending of results mode is turned off.

5 – Results transmission

```
#R,V₁,..,Vₙ;[CR][LF]
```
where:

V_k – identifier of the result or measurement parameter (k = 1..n) described in point 2.

CR   – *carriage return* sing sent optionally, according to the line separator parameter described in point 2,

LF   – *line* feed sing sent optionally, according to the line separator parameter described in point 2,

If the mode of automatic sending of results is turned on, after every second of measurement the device will send data in accordance with the above format.

Measurement parameters (such as date and time) will be sent in accordance with the format described in point 2.

Overload flag will be sent as 0 or 1, where 0 means no overload.

The measurement results will be sent as numerical values in dB.

Note: If the result separator character set is different from the comma sign, in the above format the character will be sent instead of commas and additionally this character will be sent before the final semicolon mark.

Example 1

In the instrument, the measurement of the 1/3 octave spectrum is set in the "Full" band in the sound measurement mode. We want to take the following results every second:

   - measurement time (with seconds resolution),
   - overload information,
   - second profile Peak results,
   - first profile Leq results,
   - 1/3 octave results between 20.0Hz to 20kHz (without Total results).

To do this, we send command:

    #R,1,G,V,P:2,R:1,X:14:31;

In response instrument sends:

    #R,1,G:0,V,P:2,R:1,X:14:31;

After measurement start, instrument will send below data every second:

#R,13:27:54,0,93.54,71.29,60.67,63.57,69.93,75.29,87.73,75.24,66.34,63.63,60.82,66.65,61.17,71.03,66.60,64.23,62.27,65.70,64.17,56.26,57.68,54.91,57.38,53.00,52.35,50.90,55.02,51.95,50.74,52.74,52.27,51.75,56.18;

#R,13:27:55,1,123.78,91.24,62.51,65.20,70.08,78.82,101.13,84.21,74.35,74.55,72.48,74.91,73.17,81.27,81.76,80.51,80.55,80.36,81.58,78.94,80.25,80.17,79.56,79.32,79.21,78.46,78.51,77.67,76.90,75.86,76.07,76.24,76.15;

#R,13:27:56,1,123.62,93.45,72.19,75.20,78.78,83.65,103.80,88.12,82.32,79.41,74.86,77.43,76.41,83.58,83.85,82.13,81.68,82.88,82.98,80.14,81.48,81.09,81.48,81.78,81.50,81.75,81.54,81.19,81.02,80.88,80.28,80.31,80.19;

#R,13:27:57,1,123.82,93.62,73.59,76.01,78.85,83.59,103.10,86.77,77.58,78.62,81.30,81.19,78.04,83.42,84.42,83.16,82.34,83.15,82.99,82.45,82.80,82.93,82.67,81.60,81.72,80.63,80.34,79.97,78.50,78.43,78.51,78.08,77.98;
etc.

Interpretation of the data obtained from the first measurement is as follows:

    13:27:54   – time of start of current measurement second,
    0   – no overload,
    93.54   – second profile Peak result in dB

`71.29`	– first profile Leq result in dB
`60.67`	– 20.0Hz spectrum band result in dB,
`63.57`	– 25.0Hz spectrum band result in dB,
`(...)`	
`51.75`	– 16.0kHz spectrum band result in dB,
`56.18`	– 20.0kHz spectrum band result in dB,.

Example 2

We want to get the following results every second:

- measurement time (with seconds resolution),
- overload information,
- first profile Leq results,
- second profile Leq results,
- third profile Leq results,

and then import them into a spreadsheet program (e.g. Excel) where the decimal separator is the comma.

To do this, we send command:

`#R,1:3:9:44,G,V,R:1,R:2,R:3;`

In response, instrument sends:

`#R,1:3:9:44,G:0,V,R:1,R:2,R:3;`

After measurement start, instrument will send below data every second:

#R<HT>11:22:56<HT>0<HT>94,64<HT>97,05<HT>98,92<HT>;<CR><LF>
#R<HT>11:22:57<HT>0<HT>95,09<HT>97,73<HT>98,90<HT>;<CR><LF>
#R<HT>11:22:58<HT>0<HT>94,25<HT>97,34<HT>99,08<HT>;<CR><LF>
#R<HT>11:22:59<HT>0<HT>96,49<HT>98,27<HT>99,12<HT>;<CR><LF>
#R<HT>11:23:00<HT>0<HT>95,74<HT>98,01<HT>99,13<HT>;<CR><LF>
#R<HT>11:23:01<HT>0<HT>95,52<HT>98,08<HT>99,10<HT>;<CR><LF>
#R<HT>11:23:02<HT>0<HT>97,83<HT>98,77<HT>99,10<HT>;<CR><LF>
#R<HT>11:23:03<HT>0<HT>95,06<HT>98,95<HT>99,11<HT>;<CR><LF>

where:

    <HT> – *horizontal tab sign* (HT, ASCII value 9),

    <CR> –*carriage return sign* (CR, ASCII value 13),

    <LF> –*line feed* sign (LF, ASCII value 10).

After importing the data into the spreadsheet program, we get results grouped into separate columns:

Indexes of 1/1 octave bands

Nominal frequency	Audio band	Full band	Ultra band
1.00 Hz		0	0
2.00 Hz		1	1
4.00 Hz		2	2
8.00 Hz		3	3
16.0 Hz		4	4
31.5 Hz	0	5	5
63.0 Hz	1	6	6
125 Hz	2	7	7
250 Hz	3	8	8
500 Hz	4	9	9
1.00 kHz	5	10	10
2.00 kHz	6	11	11
4.00 kHz	7	12	12
8.00 kHz	8	13	13
16.0 kHz	9	14	14
31.5 kHz			15
Total 1	10	15	16
Total 2	11	16	17
Total 3	12	17	18

Indexes of 1/3 octave bands

Nominal frequency	Audio band	Full band	Ultra band
0.80 Hz		0	0
1.00 Hz		1	1
1.25 Hz		2	2
1.60 Hz		3	3

2.00 Hz		4	4
2.50 Hz		5	5
3.15 Hz		6	6
4.00 Hz		7	7
5.00 Hz		8	8
6.30 Hz		9	9
8.00 Hz		10	10
10.0 Hz		11	11
12.5 Hz		12	12
16.0 Hz		13	13
20.0 Hz	0	14	14
25.0 Hz	1	15	15
31.5 Hz	2	16	16
40.0 Hz	3	17	17
50.0 Hz	4	18	18
63.0 Hz	5	19	19
80.0 Hz	6	20	20
100 Hz	7	21	21
125 Hz	8	22	22
160 Hz	9	23	23
200 Hz	10	24	24
250 Hz	11	25	25
315 Hz	12	26	26
400 Hz	13	27	27
500 Hz	14	28	28
630 Hz	15	29	29
800 Hz	16	30	30
1.00 kHz	17	31	31
1.25 kHz	18	32	32
1.60 kHz	19	33	33
2.00 kHz	20	34	34
2.50 kHz	21	35	35
3.15 kHz	22	36	36
4.00 kHz	23	37	37
5.00 kHz	24	38	38
6.30 kHz	25	39	39
8.00 kHz	26	40	40
10.0 kHz	27	41	41
12.5 kHz	28	42	42
16.0 kHz	29	43	43
20.0 kHz	30	44	44
25.0 kHz			45
31.5 kHz			46
40.0 kHz			47
Total 1	31	45	48
Total 2	32	46	49
Total 3	33	47	50

A.7. CONTROL SETTING CODES

The control setting codes used in the SVAN 977A instrument are given in the table below.

Table A.1.   Unit parameters

Group name	#1 code	#7 code	#S code	Code description
Unit type	U			977 (read only)
Unit subversion (read only)		US		x unit subversion
Serial number	N			xxxx (read only)
Software version	W			x.xx.x x.xx.x - revision number (read only)
Meter mode	Z		BE	0 - **Vibration Meter** 1 - **Sound Meter**
Voltage Input	V			0 - **Off** 1 - **On**
Measurement function	M		AL	1 - **Level Meter** 2 - **1/1 Octave** 3 - **1/3 Octave** 6 - **FFT** 8 - **RT60** 19 - **STIPA**
Microphone Compensation		MC	PN	0 - **Off** 1 - **Free Field** 2 - **Diffuse Field** 3 - **Outdoor Environment** 4 - **Outdoor Airport**
Remote Control Mode		RZ		0 - **Off** 1 - **On**
Windscreen		WD		0 - **Off** 1 - **On**
Range	R		AM	1 - **Low** 2 - **High**

Table A.2.   Calibration parameters

Group name	#1 code	#7 code	#S code	Code description
Auto Calibration		AC		0 - **Off** 1 - **On**
Calibration factor	Q			n.nn n.nn - calibration factor in dB

Table A.3. Measurement parameters

Group name	#1 code	#7 code	#S code	Code description
Delay in the start of measurement	Y		AE	nn — nn delay given in seconds (0 ÷ 60)
Start Synchronization	u			0 — Off 1 — Sync. to full minute 15 — Sync. to the full 15 minutes 30 — Sync. to the full 30 minutes 60 — Sync. to a full hour
Integration period	D			0 - infinity (measurement finished by pressing the **<STOP>** push-button or remotely by sending S0 control code) nns — nn number in seconds nnm — nn number in minutes nnh — nn number in hours
Repetition of the measurement cycles (RepCycle)	K			0 - infinity (measurement finished by pressing the **<STOP>** push-button or remotely - by sending S0 control code) .... nnnn - nnnn number of repetitions ∈(1 ÷ 1000)
Leq / RMS detector type	L			0 - **Linear** 1 - **Exponential**
Detector type for statistic calculations		SE		0 - **Linear** 1 - **Exponential**
Day Time Limits		DL		0 - **6h-18h** 1 - **7h-19h**
Rolling Time		LR		**#7,LR;** This function returns Rolling Time values in the format: **#7,LR,x1[m],x2[m];** where: **x1** – rolling time 1st value (1..59 if seconds, 1m..60m if minutes), **x2** – rolling time 2nd value (1..59 if seconds, 1m..60m if minutes) **#7,LR,n,xn;** This function sets Rolling Leq time values where: **n** – result index (1 or 2), **xn** – rolling time nth value (1..60 if seconds, 1m..60m if minutes). and it returns the following sequence of characters: **#7,LR;**
Exposure Time	e			n - n = time in minutes ∈(1 ÷ 480)
Reference Level ACC	Xa			x - x = reference level ∈(1 ÷ 100) in µm/s^2
Reference Level VEL	Xv			x - x = reference level ∈(1 ÷ 100) in nm/s
Reference Level DIL	Xd			x - x = reference level ∈(1 ÷ 100) in pm

Table A.4. Profile parameters

Group name	#1 code	#7 code	#S code	Code description
Filter type in profile n in SLM mode	F			1:n **Z** filter for profile n 2:n **A** filter for profile n 3:n **C** filter for profile n 5:n **B** filter for profile n
Detector type in profile n in SLM mode	C			0:n - **Impulse** detector in profile n 1:n - **Fast** detector in profile n 2:n - **Slow** detector in profile n
Logger type in profile n in SLM mode	B			x:n - x - sum of the following flags: 1 - logger with **Peak** values in profile n 2 - logger with **Max** values in profile n 4 - logger with **Min** values in profile n 8 - logger with **RMS** values in profile n
Filter type in profile n in VLM mode	I			0:n **HP** filter for profile n 1:n **HP1** filter for profile n 2:n **HP3** filter for profile n 3:n **HP10** filter for profile n 4:n **Vel11** filter for profile n 5:n **Vel3** filter for profile n 6:n **Vel10** filter for profile n 7:n **VelMF** filter for profile n 8:n **Dil1** filter for profile n 9:n **Dil3** filter for profile n 10:n **Dil10** filter for profile n 21:n **Wh** filter for profile n
Detector type in profile n in VLM mode	E			0:n - **100ms** detector in profile n 1:n - **125ms** detector in profile n 2:n - **200ms** detector in profile n 3:n - **500ms** detector in profile n 4:n - **1.0s** detector in profile n 5:n - **2.0s** detector in profile n 6:n - **5.0s** detector in profile n 7:n - **10.0s** detector in profile n
Logger type in profile n in VLM mode	G			x:n - x - sum of the following flags: 1 - logger with **Peak** values in profile n 2 - logger with **P–P** values in profile n 4 - logger with **Max** values in profile n 8 - logger with **RMS** values in profile n

Table A.5.   Logger parameters

Group name	#1 code	#7 code	#S code	Code description
Logger	T			0 - Off 1 - On
Summary Results	XXE			0 - Off 1 - On
Logger Meteo	p			0 - Off 1 - On
Logger step	d			n n = number in milliseconds $\in$(**2**, **5**, **10**, **20**, **25**, **50**, **100**, **200**, **500**, **1000**) ns n = number in seconds $\in$(1 ÷ 60) nm n = number in minutes $\in$(1 ÷ 60)
Logger Split Mode	XA			0 Off -1 Sync to the Integration Period 15 Sync. to the full 15 minutes 30 Sync. to the full 30 minutes 60 Sync. to a full hour 1440 Sync. at the Specified Time

Specified Time for Logger Splitting	XD			n:p n = -1 (switched off)
				           n = 0..1439 (time in minutes)
				           p = 1..6 (specified time number)

Logger Name			JT	xxxxx - xxxxx up to 8 characters (permitted characters: 0-9,A-Z,_)
Summary Statistics Results			MR	0 - Off 1 - On
Summary Meteo Results			MS	0 - Off 1 - On
Summary Spectrum Statistics Results			MT	0 - Off 1 - On
Summary Spectrum Max Results			MU	0 - Off 1 - On
Summary Spectrum Min Results			MV	0 - Off 1 - On

Table A.6.   Spectrum parameters

Group name	#1 code	#7 code	#S code	Code description
Spectrum Band	A			0 - **Full** 1 - **Audio** 2 - **Ultra**
Filter type in 1/x Octave or FFT analysis in SLM mode (for Audio band only)	f			1 - **Z** filter 2 - **A** filter 3 - **C** filter 5 - **B** filter

Group name	#1 code	#7 code	#S code	Code description
Detector type in 1/x Octave analysis in SLM mode (for Audio band only)	XXB			0 **– Linear** 1 **– Fast** 2 **– Slow**
Storing the results of 1/x Octave analysis in logger's file in SLM mode	b			0 - switched Off 8 - logger with **Leq** spectrum
Filter type in 1/x Octave or FFT analysis in VLM mode	i			0 - **HP** filter
Storing the results of 1/x Octave analysis in logger's file in VLM mode	g			0 - switched off 8 - logger with **RMS** spectrum

Table A.7.   FFT parameters

Group name	#1 code	#7 code	#S code	Code description
Averaging in FFT analysis	a			0 - **Linear** 1 - **Exponential**
Time Constant for exponential averaging in FFT analysis	j			100 - **100ms** 125 - **125ms** 200 - **200ms** 500 - **500ms** 1000 - **1.0s** 2000 - **2.0s** 5000 - **5.0s** 10000 - **10.0s**
FFT analysis band	r			1 - **20 kHz** 2 - **10 kHz** 3 - **5 kHz** 4 - **2.5 kHz** 5 - **1.25 kHz** 6 - **625 Hz** 7 - **312 Hz** 8 - **156 Hz** 9 - **78 Hz**
Window in FFT analysis	w			0 - **Hanning** 1 - **Rectangle** 2 - **Flat Top** 3 - **Kaiser-Bessel**
FFT lines	y			0 - **1600** 1 - **800** 2 - **400**
Storing the results of FFT analysis in logger's file	q			0 - switched off 8 - logger with **RMS** spectrum

Table A.8.   Measurement trigger parameters

Group name	#1 code	#7 code	#S code	Code description
Triggering mode	m			0 - switched off (**Off**) 1 - **Slope +** 2 - **Slope –** 3 - **Level +** 4 - **Level –** 6 - **Grad +** 7 - **External**
Source of the triggering signal	s			0 - **RMS**
Level in SLM mode	l			x - x = level in dB $\in (24 \div 136)$
Gradient in SLM mode	O			x - x = gradient in dB/ms $\in (1 \div 100)$
Level in VLM mode	n			x - x = level in dB $\in (60 \div 200)$
Gradient in VLM mode	k			x - x = gradient in dB/ms $\in (1 \div 100)$

Table A.9.   Logger trigger parameters

Group name	#1 code	#7 code	#S code	Code description
Trigger Mode	XT			0 - switched off 3 - **Level +** 4 - **Level –**
Level in SLM mode	XL		CE	x - x = level in dB $\in (24 \div 136)$
Level in VLM mode	Xy			x - x = level in dB $\in (60 \div 200)$
Logger Pre-triggering Number of records taken into account before the fulfilment of the triggering condition	XQ			x - x = number of records saved in logger before the fulfilment of the triggering condition; nn $\in (0 \div 50)$
Logger Post-Triggering Number of records taken into account after the fulfilment of the triggering condition	Xq			x - x = number of records saved in logger after the fulfilment of the triggering condition; nn $\in (0 \div 200)$

Table A.10.   Wave recording parameters

Group name	#1 code	#7 code	#S code	Code description
Wave Recording			KC	0 - **Off** 1 - **Continuous** 2 - **On Trigger**
Format			IN	0 - **PCM** 1 - **Extensible**

Group name	#1 code	#7 code	#S code	Code description
Audio Sampling			FH	0 - 48kHz 1 - 24kHz 2 - 12kHz
Bits Per Sample			GO	0 - 24 1 - 16
Signal Gain			GP	x - x = signal gain level in dB $\in (0 \div 40)$
Filter in SLM mode			NI	0 - **HP** filter 1 - **Z** filter 2 - **A** filter 3 - **C** filter 5 - **B** filter
Filter in VLM mode			NJ	0 - **HP** filter
Wave Name			KE	xxxxx - xxxxx up to 8 characters (permitted characters: 0-9, A-Z and '_')
Trigger Mode			EZ	1 - **Slope +** 2 - **Slope -** 3 - **Level +** 4 - **Level –** 7 - **External** 10 - **Integr. Period** 11 - **Integr. Period Split**
Trigger Level in SLM mode			FD	x - x = level in dB $\in (24 \div 136)$
Trigger Level in VLM mode			FE	x - x = level in dB $\in (60 \div 200)$
Trigger Period			MB	0 - Log. Step 5 - 0.5 ms 1000 - 100 ms 10000 – 1 second
Recording Time			FI	0 - Inf s - s = time in seconds $\in (1 \div 60)$ m - m = time in minutes multiplied by 60 $\in (1 \div 60)$ h - h = time in hours multiplied by 3600 $\in (1 \div 8)$
Pre Trigger			FJ	n - n = time in seconds $\in (0 \div 4)$

Table A.11.   Warnings

Group name	#1 code	#7 code	#S code	Code description
Results Not Saved		WS		0 - **Off** 1 - **On**
Ext. Disk Free Space		WF		0 - **Off** 1 - **On**
Min Free Space		WM		x - x minimum disk free space $\in (1 \div 1024)$

Table A.12.   GPRS parameters

Group name	#1 code	#7 code	#S code	Code description
GPRS Mode	**Xk**			0 - switched off 1 - switched on
Internet Configure (GPRS)	**Xo**			0 - switched off 1 - switched on
Registration Mode (GPRS)	**Xw**			0 - switched off 1 - normal (Connection Request Packets) 2 - AS (Address Server registration) 3 - Smart AS (Address Server registration – only if necessary)
Data Protocol (GPRS)	**XB**			0 - TCP Server 1 - TCP Client 2 - UDP
Auth Mode (GPRS)	**XF**			0 - none 1 - PAP 2 - CHAP 3 - MsChapV1
Automatic Reconnection (GPRS)	**XG**			0 - switched off 1 - switched on
Reconnection Delay (GPRS)	**XH**			xxs - xx number of seconds between reconnection attempts (1 ÷ 59) xxm - xx number of minutes between reconnection attempts (1 ÷ 60)
Modem Alphabet	**XXA**			0 - Off 1 - On
Server Address (GPRS)	**XI**			xxxxx - xxxxx up to 32 characters (permitted characters: 0-9, a-z, '.', '-' and '_')
Data Port (GPRS)	**XJ**			xxxxx - xxxxx up to 5 decimal characters (0 ▯ 65535)
Registration Port (GPRS)	**XK**			xxxxx - xxxxx up to 5 decimal characters (0 ▯▯65535)
APN (GPRS)	**XN**			xxxxx - xxxxx up to 20 characters (permitted characters: 0-9, a-z, '.', '-' and '_')
APN User (GPRS)	**XO**			xxxxx - up to 20 characters (permitted characters: 0-9, a-z, A-Z)
APN Password (GPRS)	**XU**			xxxxx - up to 20 characters (permitted characters: 0-9, a-z, A-Z)
DNS Server (GPRS)	**XV**			xxxxx -xxxxx up to 15 characters (permitted characters: 0-9 and '.')
Phone Number (GPRS)	**XXa**			xxxxx - xxxxx up to 15 characters (permitted '+',0-9)
Text Message (GPRS)	**XXb**			xxxxx - xxxxx up to 20 characters (permitted characters: 0-9, a-z, '.', '-' and '_')
Send SMS (GPRS)	**XXc**			0 - Off 1 - On

Group name	#1 code	#7 code	#S code	Code description
Send e-mail (GPRS)	**XXk**			0 - Off 1 - On
E-mail SMTP Address (GPRS)	**XXd**			xxxxx - xxxxx up to 32 characters (permitted characters: 0-9, a-z, '.')
E-mail SMTP User (GPRS)	**XXe**			xxxxx - xxxxx up to 20 characters (permitted characters: 0-9, a-z, A-Z)
E-mail SMTP Password (GPRS)	**XXf**			xxxxx - xxxxx up to 20 characters (permitted characters: 0-9, a-z, A-Z)
E-mail Sender (GPRS)	**XXg**			xxxxx - xxxxx up to 20 characters (permitted characters: 0-9, a-z, '.', '@')
E-mail Recipient (GPRS)	**XXh**			xxxxx - xxxxx up to 20 characters (permitted characters: 0-9, a-z, '.', '@')
E-mail Subject (GPRS)	**XXi**			xxxxx - xxxxx up to 20 characters (permitted characters: a-z, A-Z, 0-9, '.', ',', ':', ';', '!', '?')
E-mail Message (GPRS)	**XXj**			xxxxx - xxxxx up to 20 characters (permitted characters: a-z, A-Z, 0-9, '.', ',', ':', ';', '!', '?')

Table A.13.   RT60 parameters

Group name	#1 code	#7 code	#S code	Code description
RT60 Method			**CX**	1 - **Decay** 2 - **Impulse**
Octave			**DD**	1 - **1/1** 2 - **1/3**
Frequency Range in **1/1** mode			**EK**	1 - 63Hz÷4kHz 2 - 63Hz÷16kHz
Frequency Range in **1/3** mode			**EO**	1 - 50Hz÷5kHz 2 - 50Hz÷20kHz
Recording Time			**DC**	0 - Auto n - n = time in seconds $\in (1 \div 30)$
Time Step			**DE**	0 - 2 ms 1 - 5 ms 2 - 10 ms 3 - 20 ms 4 - 25 ms 5 - 50 ms
Averaging			**NG**	0 - Off 1 - On
Smoothing			**CV**	n - n = graph smoothing factor $\in (1 \div 15)$
Noise Margin			**CW**	n - n = Value in dB multiplied by 10 $\in (0 \div 200)$

Table A.14. RPM parameters

Group name	#1 code	#7 code	#S code	Code description
RPM Measurement	**Xr**			0 - switched **Off** 1 - switched **On**
RPM Pulse	**Xp**			n - n = Pulses/Revolution (1 ÷ 360)
RPM Unit	**Xu**			0 - rps 1 - rpm

Table A.15. Communication ports parameters

Group name	#1 code	#7 code	#S code	Code description
Bluetooth		**BT**		0 - Off 1 - On
GPS Host Port		**GH**		0 - Off 1 - On

Table A.16. RS232 ports parameters

Group name	#1 code	#7 code	#S code	Code description
Baud Rate			**AQ**	7 - 115200 6 - 57600 5 - 38400 4 - 19200 3 - 9600 2 - 4800 1 - 2400 0 - 1200
Time Out			**BB**	n - n = time in seconds ∈(1 ÷ 60)

Table A.17. GPS parameters

Group name	#1 code	#7 code	#S code	Code description
Time Zone		**TZ**		x - number of minutes with step 15; x ∈ (-720 ÷ 840)
GPS position (read only)		**GP**		**#7,GP;** This command returns the position of the instrument from the GPS module in the format: **#7,GP,qq,YY,MM,DD,hh,mm,ss,LaD,LaM,LaS, LaS10,Ladir,LoD,LoM,LoS,LoS10,Lodir;** where: 　qq　　– Fix (qq>0), Not fix (qq=0), 　YY　　– Year, 　MM　　– month,

Group name	#1 code	#7 code	#S code	Code description
				DD — day, hh — hour, mm — minute, ss — seconds, LaD — Latitude degree, LaM — Latitude minutes, LaS — Latitude seconds, LaS10 — Latitude fraction of seconds, Ladir — Latitude direction (N- north, S- south), LoD — Longitude degree, LoM — Longitude minutes, LoS — Longitude seconds, LoS10 — Longitude fraction of seconds, Lodir — Longitude direction (E- east, W- west) Alt10 — Altitude (0.1 m), Speed10 — Speed (0.1 km/s2),

Table A.18.   IEPE parameters

Group name	#1 code	#7 code	#S code	Code description
IEPE Current		IE		0 - **IEPE Off** 1 - **IEPE Current 1.5 mA** 2 - **IEPE Current 4.5 mA**

Table A.19.   Multifunction I/O parameters

Group name	#1 code	#7 code	#S code	Code description
IO Mode	Xx			0 - **Analog Out** 1 - **Digital In** 2 - **Digital Out** 3 - **Analog In**
Function in **Digital Out** Mode	Xz			0 - **Trigger Pulse** 1 - **Alarm Pulse**
Active Level	Xc			0 - **Low** 1 - **High**
Source in **Digital Out** mode	Xs			0 - **Leq(1) / RMS(1)** 1 - **Peak(1)** 2 - **Max(1)** 3 - **Spl(1) / P–P(1)**
Source Type	Xt			0 - **Current** 1 - **Periodic**
Alarm Level	Xn			x - x = alarm level in dB multiple by 10 $\in (300 \div 1400)$

Group name	#1 code	#7 code	#S code	Code description
Polarisation	**Xg**			0 - **Positive** 1 - **Negative**
Slope	**Xh**			0 - **Slope +** 1 - **Slope -**

Table A.20. STIPA parameters

Group name	#1 code	#7 code	#S code	Code description
Result Mode			**IH**	18 - measurement list view 19 - frequency table 21 - area view 22 - summary view
Project Name			**QR**	xxxxx - xxxxx up to 8 characters (permitted characters: 0-9, A-Z and '_')
Area Name			**QS**	xxxxx - xxxxx up to 8 characters (permitted characters: 0-9, A-Z and '_')
Source Name			**QX**	xxxxx - xxxxx up to 8 characters (permitted characters: 0-9, A-Z and '_')
Source Level			**QZ**	x - source calibration level in dB multiple by 10 ∈ (-300 ÷ 300)

Table A.21. CSV export settings

Group name	#1 code	#7 code	#S code	Code description
Summary results saved in CSV file		**CV**		Reading (response from the instrument): #7,CV,\<prof1\>,\<prof2\>,\<prof3\>,\<spec\>,\<err\>; Writing: #7,CV,\<prof1\>,\<prof2\>,\<prof3\>,\<spec\>; where \<err\> - CSV file error; 0 – no error \<prof1\>, \<prof2\>, \<prof3\> - profile summary results defined as a sum of the following flags: b0 - **Time**, b1 - **Lpeak**, b2 - **Lmax**, b3 - **Lmin**, b4 - **L**, b5 - **Leq**, b6 - **LE**, b7 - **Lden**, b8 - **LEPd**, b9 - **Ltm3**, b10 - **LTeq**, b11 - **Lnn**, b12 - **LR1**, b13 - **LR2**, b14 - **OVL** \<spec\> - spectrum results defined as a

Group name	#1 code	#7 code	#S code	Code description
				sum of the following flags: b0 - averaged 1/x Octave spectrum, b1 - maximum 1/x Octave spectrum, b2 - minimum 1/x Octave spectrum, *Note: the command accepts values in hex format! E.g. If <prof1> = 1A (26 in decimal, sum of bits b1, b2, b4), it means that Lpeak, Lmin and L values from 1st profile are saved into CSV file.*
			PK0	<u><prof1></u> - profile 1 summary results *Note: the command accepts values in decimal format!*
			PK1	<u><prof2></u> - profile 2 summary results *Note: the command accepts values in decimal format!*
			PK2	<u><prof3></u> - profile 3 summary results *Note: the command accepts values in decimal format!*
			PK3	<u><spec></u> - spectrum results *Note: the command accepts values in decimal format!*

Table A.22.   Other control setting codes

Group name	#1 code	#7 code	#S code	Code description
State of the instrument (Stop or Start)	**S**			0 - STOP 1 - START
Battery state (read only)		**BS**		**#7,BS;** This function returns battery state in percentage. If the instrument is powered from the external power, this function return -1 or if it is powered from the USB interface, the function returns -2.
Battery voltage (read only)		**BV**		**#7,BV;** This function returns the battery voltage.
USB voltage (read only)		**UV**		**#7,UV;** This function returns the USB voltage.
External voltage (read only)		**EV**		**#7,EV;** This function returns the external voltage.
Statistical levels		**SL**		**#7,SL;** This function returns all statistical levels in the format **#7,SL,sl1,sl2,sl3,sl4,sl5,sl6,sl7,sl8,sl9,sl10;** **#7,SL,sl_index,sl_level;** This function sets statistical levels where **sl_index** is the statistical index, **sl_level** is the statistical level and it returns the following sequence of characters: **#7,SL;**
Power off (write only)		**PO**		This function powers off the instrument.
Last logger name (read only)		**LB**		**#7,LB;** This function returns the name of last logger in format **#7,LB,logger_name;**
SD-card file system		**FT**		-1 - SD card not available

Group name	#1 code	#7 code	#S code	Code description
type (read only)				1 - FAT16 2 - FAT32 3 - FAT12
SD-card number of sectors (read only)		NS		**#7,NS;** This function returns the number of sectors (sector = 512 bytes) on the SD-card in the format **#7,NS,x;** where **x** – number of sectors (in case of **x = -1** SD-card is not available).
SD-card number of free sectors (read only)		NF		**#7,NF;** This function returns the number of free sectors (sector = 512 bytes) on the SD-card in the format **#7,NF,x;** where **x** – number of free sectors (in case of **x = -1** SD-card is not available).
PIC version (read only)		PI		x.xx - internal microcontroller firmware version number
Hardboot version (read only)		VH		x.xx - hardboot program version number
Bootstrap version (read only)		VB		x.xx - bootstrap program version number
File system version (read only)		FS		x.xx – file system version number
Bluetooth internal software version (read only)		BR		x.xx – bluetooth version number
Real time clock settings		RT		Current real time clock settings in the format: **#7,RT,hh,mm,ss,DD,MM,YYYY;** where **hh:mm:ss** denote the time and **DD/MM/YYYY** gives the date.
Temperature (read only)		TP		x - temperature*10 $^{\circ}$C
Factory settings (write only)		CS		**#7,CS;** This function clears current setup (without RS232 and Bluetooth).
Marker definition		CM		**#7,CM,<no>,"<name>",<event>,<point>;** where: <no> – marker number , "<name>" – marker name, <event> – 0 (Off) or 1 (On), <point> – 0 (Off) or 1 (On),
Marker status		MR		**#7,MR;** This function returns the status of all logger markers in the format: **#7,MR,<state1>,<state2>,<state3>,<state4>;** where: <state1> – status of the 1st marker (0 or 1), <state2> – status of the 2nd marker (0 or 1), <state3> – status of the 3rd marker (0 or 1), <state4> **–** status of the 4th marker (0 or 1). **#7,MR,<no>;** This function returns the status of the selected logger marker in the format: **#7,MR,<no>,<state>;** where: <no> – marker number , <state> – marker status,
External Power		EP		**#7,EP;** This function returns the parameters of

Group name	#1 code	#7 code	#S code	Code description
				the **External Power** functionality in the format: **#7,EP,x,V_{Off},y,V_{On};** $$\#7,EP,x,V_{Off},y,V_{On};$$ **#7,EP,x,V$_{off}$,y,V$_{on}$;** This function sets the parameters of the **External Power** functionality. where: **x = 0** – Power Off functionality disabled, **x = 1** – Power Off functionality enabled (the instrument will be switched-off after reaching the threshold level **V$_{Off}$**), **V$_{Off}$** – switch-off threshold level in [V] (from 6.0 to 14.5), **y = 0** – Power On functionality disabled, **y = 1** – Power On functionality enabled (the instrument will be switched-on after reaching the threshold level **V$_{On}$**), **V$_{On}$** – switch-on threshold in [V] (from 6.5 to 15.0). note: if (**x = 1**) and (**y = 1**) then (**V$_{On}$**–**V$_{Off}$**) must be greater then or equal to 0.5V.
Time History		TL		**#7,TL;** This function allows to read buffered time history results. The time history buffer is organized in circular mode; when the buffer is full new TH results are written in place of the oldest results. The function has an auto-increment feature with possibility to reset the data pointer. To read as many results as possible (max 1024B) send **#7,TL;** To read selected results send **#7,TL,<mask>,<nr>;** where **<mask>** - mask of the returned results, see below **<nr>** - number of the results to read Instrument's response: **#7,TL,<run>,<mask>,<step>,<cnt>,<left>,<dd/ mm/yyyy>,<hh:mm:ss>,<result1>,<result2>,... <result>;** where **<run>** - measurements run flag 0 - measurements are running 1 - measurements are stopped **<mask>** - mask of the returned results in hexadecimal notation 00001 - **Lpeak** values in profile 1 00002 - **Lmax** values in profile 1 00004 - **Lmin** values in profile 1 00008 - **Leq** values in profile 1 00010 - **LR1** values in profile 1 00020 - **LR2** values in profile 1

Group name	#1 code	#7 code	#S code	Code description
				00040 - **Lpeak** values in profile 2 00080 - **Lmax** values in profile 2 00100 - **Lmin** values in profile 2 00200 - **Leq** values in profile 2 00400 - **LR1** values in profile 2 00800 - **LR2** values in profile 2
				00040 - **Lpeak** values in profile 3 00080 - **Lmax** values in profile 3 00100 - **Lmin** values in profile 3 00200 - **Leq** values in profile 3 00400 - **LR1** values in profile 3 00800 - **LR2** values in profile 3
				Notes: in order to read results from the time history buffer, the corresponding results must be enabled.
				\<step\> - time history buffer step [s] (equals to logger step)
				\<cnt\> - returned records count
				\<left\> - number of records left unread in the buffer
				\<dd/mm/yyyy\> - date of the first returned record
				\<hh:mm:ss\> - time of the first returned record
				\<resultX\> - results according to \<mask\>
				For example #7,TL,0,20A,1,2,0,17/06/2020,14:45:27,28.80,28.04,44.75,45.12,39.50,49.33;
				0 – measurements are stopped 20A – Lmax and Leq from profile 1 and Leq from profile 2 has been returned 1 – buffer (logger) step is 1s 2 – 2 records where returned 0 – zero records left unread in the buffer 17/06/2020 – date of the first record 14:45:27 – time of the first record First record:
				28.80 – Leq profile 2 28.04 – Leq profile 1 44.75 – Peak profile 1
				Second record:
				45.12 – Leq profile 2 39.50 – Leq profile 1 49.33 – Peak profile 1
				To reset data pointer of the time history buffer send **#7,TL,0,0;**
				Notes: the function is not available when logger step is below 1s!

APPENDIX B. DATA FILE STRUCTURES (revision 2.08)

Each file consists of blocks of parameters followed by the logger data. The number and sequence of the blocks of parameters may vary depending on the type of measurement performed, however, the header block (see Table B.1) is always first in the file. Each data block consists of a specified number of words. The term word means two consecutive bytes, with the lower byte preceding the higher. If the words contain ASCII text characters, the low byte of the word also precedes the high byte. The number of words in a block is constant (as in the case of a file header) or is defined in the first or second word of a block. Exception is the block of the primary results record (see Table B.27), the length of which depends on the parameters placed in the respective blocks of parameters. The following chapters describe the structure of each block.

The date and time (of file, measurement, calibration, etc.) are each encoded on one 16-bit word according to the algorithm shown on the example of the decoding procedure presented in chapter B.4. The time is encoded with two-second resolution.

B.1. DESCRIPTION OF BLOCKS OF PARAMETERS

Table B.1.   File header

Word number	Name	Comment
0..2	SvanPC	text „SvanPC"
3	001Ah	value 001Ah
4..15		reserved

Table B.2.   File information

Word number	Name	Comment
0	0nn01h	01h = block identifier 0nnh = block length in words
1..4	FileName	file name (8 ASCII characters)
5		reserved
6	FileDate	date of file creation
7	FileTime	hour of file creation
…		reserved

Table B.3.   Unit and software specification

Word number	Name	Comment
0	0nn02h	02h = block identifier 0nnh = block length in words

1	UnitSubtype	subtype of the instrument: 1 – SVAN 977 3, 13 – BSWA 801, АЛГОРИТМ 05 4, 14 – СПРУТ-9 5 – SVAN 977W 11 – SVAN977A 21 – SV 977D
2	UnitType	device type identifier: 977 – SVAN 977, SVAN 977A, SV 977D, SVAN 977W, АЛГОРИТМ 05, СПРУТ-9 801 – BSWA 801
3..4	UnitNumber	serial number of the instrument
5	FirmwareVersion	firmware version number; for example, value 203 means version 2.03
6	FirmwareSubVer	additional number identifying internal firmware conversion; for example, the complete software version number is 2.03.1
7	FirmwareBetaSubVer	additional internal software upgrade number for Beta version; number is relevant only if the internal software upgrade is zero; for example, Beta version is 2.03.06
8	FirmwareDate	internal software date
9	FileSysVersion	version number of the result files system; for example, 321 means version 2.03
…		reserved

Table B.4.   Information about calibration

Word number	Name	Comment
0	0nn47h	47h = block identifier, 0nnh = block length in words
1	PreCalibrType	calibration "Pre" (performed before measurement) type: 0 – no calibration 1 – calibration **By Measurement** 2 – calibration **By Sensitivity** 3 – factory calibration
2	PreCalibrDate	date of the calibration "Pre" (parameter important only for the performed calibration)
3	PreCalibrTime	hour of the calibration "Pre" (parameter important only for the performed calibration)
4	PreCalibrFactor	calibration "Pre" factor in 0.01 dB format (parameter important only for the performed calibration)
5	PostCalibrType	calibration "Post" (performed after measurement) type: 1 – calibration **By Measurement** 2 – calibration **By Sensitivity** 0xFFFF– calibration not performed
6	PostCalibrDate	date of the calibration "Post" (parameter important only for the performed calibration)
7	PostCalibrTime	hour of the calibration "Postre" (parameter important only for the performed calibration)
8	PostCalibrFactor	calibration "Post" factor in 0.01 dB format (parameter important only for the performed calibration)
…		reserved

Table B.5. User's text

Word number	Name	Comment
0	0nn03h	03h = block identifier 0nnh = block length in words
1..	TitleText	comment text; ASCII character row (terminated by zero byte)

Table B.6. Information about the instrument name

Word number	Name	Comment
0	0nn58h	58h = block identifier 0nnh = block length in words
1	UnitNameID	instrument name identifier (text "UN")
2..	UnitName	ASCII character row (terminated by zero byte) specifying the instrument name
…		reserved

Table B.7. Measurement parameters

Word number	Name	Comment
0	0nn04h	04h = block identifier 0nnh = block length in words
1	MeasureStartDate	start date of the measurement
2	MeasureStartTime	start time of the measurement

3	DeviceMode	measurement mode:
		    0 – vibration measurement mode
		    1 – sound measurement mode

4	DeviceFunction	measurement function
		    1 – **Level Meter**
		    2 – **1/1 Octave**
		    3 – **1/3 Octave**
		    6 – **FFT**
		    7 – **Tonality**
		    8 – **RT60**
		    19 - **STIPA**

5	MeasureInput	measurement Input type:
		    2 – measurement with the microphone
		    5 – measurement with the vibration accelerometer

6	Range	measurement range:
		    1 – **Low**
		    2 – **High**

7	StatDet	for sound measurement mode:
		    0 – measurement of statistical results with the linear detector
		    1 – measurement of statistical results with the exponential detector

Word number	Name	Comment
8	RepCycle	number of measurement cycles (zero means infinity) - the parameter is important if the duration of the measurement cycle (IntTimeSec) is finite; for infinite measuring cycle time this parameter is irrelevant (see SplitCycles)
9	NofProf	number of measurement profiles
10	StartDelay	measurement start delay in seconds
11..12	IntTimeSec	duration of one measurement cycle in seconds (zero means infinity)

13	StartSync	measurement start synchronization:
		    0 – no synchronization
		    1 – synchronization to full minute
		    15 – synchronization to full 15 minutes
		    30 – synchronization to full 30 minutes
		    60 – synchronization to full hour.

14	RmsInt	detector type for RMS/Leq results:
		    0 – measurement with linear detector
		    1 – measurement with exponential detector.

15	SpecLogg	bit mask of logged spectra results:
		    8 – RMS/Leq spectrum (applies to octave spectra)
		    8 – average spectrum (applies to FFT spectrum)
		the remaining masks are reserved

16	SummaryResLog	bit mask of logged cyclic results (Summary Results):
		    1 – Main Results
		    2 – Statistical Levels,
		    4 – Spectrum,
		    8 – Spectrum Max,
		    16 – Spectrum Min,
		    32 – Spectrum Peak,
		    64 – Statistical analysis in profiles
		    128 – Statistical analysis in spectrum
		    256 – RPM
		    512 – Meteo
		other masks are reserved

17	ExposureTime	exposure time in minutes (sound mode only)

18	RefAcc/LR1Time	for vibration measurement mode:
		    – value of reference vibration acceleration in 0.01dB relative to 1µm/s²
		for sound measurement mode:
		    – „Rolling Leq's" first result in seconds

19	RefVel/LR2Time	for vibration measurement mode:
		    – value of reference vibration speed at 0.01dB relative to 1nm/s
		for sound measurement mode
		    – Second „Rolling Leq's" score in seconds

20	RefDil	for vibration measurement mode:
		    – value of reference vibration displacement at 0.01dB relative to 1pm
		for sound measurement mode:
		    – reserved value

Word number	Name	Comment

21	RPM_On	rotation measurement mode:
		  0 – disabled
		  1 – enabled.

22	RPM_Pulse	Number of pulses per rotation

23	Widscreen	windscreen (only for sound measurement mode):
		  0 – measurement without windscreen
		  1 – measurement with windscreen

24	CompensationFilter	compensation filter (only for sound measurement mode):
		  1 – measurement with the free field compensation filter
		  2 – measurement with the diffuse field compensation filter
		  3 – measurement with the Outdoor Environment (90°) filter
		  4 – measurement with the Outdoor Airport (0°) filter

25		reserved

26	IEPE_Current	IEPE preamplifier currency:
		  0 – no current supply
		  1 – 1,5 mA
		  2 – 4,5 mA

27	SplitMode	logger file splitting mode:
		    0 – no splitting
		   -1 – split after each measurement cycle
		   15 – split after each full 15 minutes of real time clock
		   30 – split after each full 30 minutes of real time clock
		   60 – split after each full hour of the real time
		 1440 – split at defined times.

28..33	SplitTimeN	Six timestamp values of logger file splitting (only if SplitMode is 1440):
		    -1 – value is inactive
		  0..1439 – time in minutes (for example, 100 means 1:40 AM)

34		reserved
35..36	MeasureStartTimeMs	measurement start time in milliseconds
37	SplitCycles	number of split measurement files (zero means infinity) - the parameter is important if the duration of the measurement cycle (IntTimeSec) is set to infinity; for finite measuring cycle times this parameter is irrelevant (see: RepCycle)

38	MicComp	microphone compensation (only for sound measurement mode):
		  0 – off
		  1 – on

39		reserved

40	TonalityStandard	Tonality standard:
		  0 – **ISO 20065-16**
		  1 – **ISO 226-2003**
		  2 – **ISO 226-1987**

41	TonalityMode	Tonality measurement mode:
		  0 – **Auto**
		  1 – **Manual**

42	MeasCount	[1…20] – numer of measuremets
43	FileLastID	last file ID in a folder
44…47	Directory	directory name
…		reserved

Table B.8.   Measurement trigger parameters

Word number	Name	Comment
0	0nn2Bh	2Bh = block identifier, 0nnh = block length in words.

1	TriggerMode	trigger mode:
		    0 – measurement without triggering
		    1 – positive slope (**Slope +**)
		    2 – negative slope (**Slope –**)
		    3 – positive level trigger (**Level +**)
		    4 – negative level trigger (**Level –**)
		    6 – positive gradient (**Grad +**)
		    7 – external pulse

2	TriggerSource	trigger source (parameter relevant only to modes in which triggering is related to signal level):
		    0 – triggering RMS/Leq level from the first profile
		        - Other remaining values.

3	TriggerLevel	trigger threshold value in 0.01 dB format (parameter relevant only to modes in which triggering is related to signal level)
4	TriggerGrad	trigger gradient value in 0.01 dB/ms format (parameter relevant only to „Grad+" mode)
5		reserved
6		reserved
7	TriggerStep	trigger time check in 0.1ms format
…		reserved

Table B.9.   Logging triggering parameters

Word number	Name	Comment
0	0nn2Ch	2Ch = block identifier 0nnh = block length in words

1	TriggerMode	triggering mode:
		    0 – logging without triggering,
		    1 – positive slope (**Slope +**) - RT60 Impulse mode only
		    3 – positive level (**Level +**)
		    4 – negative level (**Level –**)
		    5 – **Decay**- RT60 Decay mode only

2	TriggerSource	triggering source:
		    0 – triggering by RMS/Leq level from the first profile
		        – remaining values reserved

3	TriggerLevel	trigger threshold value in 0,01 dB format
4		reserved
5	TriggerPre	number of records logged before trigger condition occurred
6	TriggerPost	number of records logged after trigger condition disappears
…		reserved

Table B.10.   Reserved block

Word number	Name	Comment
0	0nn31h	31h = block identifier 0nnh = block length in words
…		reserved

Table B.11.   Waveform signal registration (wave recording)

Word number	Name	Comment
0	0nn2Dh	2Dh = block identifier 0nnh = block length in words

1	RecordingMode	recording mode:
		  0 – no recording
		  1 – continuous recording
		  2 – recording on trigger

2	TriggerMode	triggering mode (parameter relevant only to triggering mode):
		  0 – recording without triggering
		  1 – positive slope (**Slope +**)
		  2 – negative slope (**Slope –**)
		  3 – positive level (**Level +**)
		  4 – negative level (**Level –**)
		  7 – external pulse
		 10 – triggering after every measurement cycle
		 11 – recording with file division after every measurement cycle

3	TriggerSource	triggering source (parameter relevant only to modes in which triggering is related to signal level):
		  0 – triggering by RMS/Leq level from the first profile,
		      – remaining values reserved

4	TriggerLevel	triggering threshold value in 0.01 dB format (parameter relevant only for modes in which triggering is related to signal level)
5		reserved
6	TriggerPre	recording period before triggering condition occurs in the 10 ms format (parameter relevant only for recording on trigger)
7		reserved
8	TriggerStep	triggering status check period in 0.1 ms format - zero means period equal to logger step (parameter relevant only for recording with triggering)
9	SamplingFreq	signal rate Sample in 10 Hz format
10	RecTime	maximum recording time in seconds - zero means no registration time limit (parameter relevant only for recording with triggering)

Word number	Name	Comment

11	RecFilter	measurement filter for the recorded signal:
		  0 – **HP**
		  1 – **Z**
		  2 – **A**
		  3 – **C**
		  5 – **B**
		  7 – **U**
		  8 – **AU**

12	BitsPerSample	number of bits per sample

13	TriggerOnMarker	marker triggering (parameter relevant only to triggering mode):
		  0 – disabled
		  1 – enabled

14	RecordingGain	signal amplification value in 0.01 dB format
…		reserved

Table B.12.   Parameters of external port settings (Multifunction I/O)

Word number	Name	Comment
0	0nn2Eh	2Eh = block identifier 0nnh = block length in words

1	Mode	port mode:
		  0 – analogue output (**Analog Out**)
		  1 – digital input (**Digital In**),
		  2 – digital output (**Digital Out**)

2	Function	port function for digital input mode:
		  0 – external triggering input
		port function for digital output mode:
		  0 – external triggering pulse output
		  1 – alarm pulse output

3	ActiveLevel	impulse active level (parameter relevant only to alarm pulse function in digital output mode):
		  0 – low active level (Low)
		  1 – high active level (High)

4	Source	triggering source (parameter relevant only for alarm pulse function in digital output mode):
		  0 – triggering by RMS/Leq level from the first profile
		  1 – triggering by the Peak level from the first profile
		  2 – triggering by max level from the first profile
		  3 – triggering by P-P/Spl level from the first profile mode

5	SourceType	triggering type (parameter relevant only for alarm pulse function in digital output mode)):
		  0 – triggering condition checked every second (**Current**)
		  1 – triggering condition checked after the end of the measurement cycle (**Periodic**)

6	AlarmLevel	triggering threshold value in 0.01 dB format (parameter relevant only to alarm function in digital output mode)

Word number	Name	Comment

7	Polarisation/Slope	polarity of external triggering pulse (parameter relevant only to instantaneous triggering pulse function):
		    0 – positive polarity
		    1 – negative polarity
		active slope of external triggering pulse (essential for out-of-range performance):
		    0 – active positive slope
		    1 – active negative slope

…		reserved

Table B.13.   Main block of profile parameters

Word number	Name	Comment
0	0nn05h	05h = block identifier 0nnh = block length in words
1	00nxxh	n = number of profiles, 0xxh = profile bit mask (bit mask informs which parameter profiles are available)
2..	Profile[1]	inner block with identifier 06h containing parameters of the first profile (if the first profile bit mask is set) – see Table B.14
...	...	...
...	Profile[n]	inner block with identifier 06h containing parameters of the last profile (if the bit mask of the last profile is set) – see Table B.14
…		reserved

Table B.14.   Profile parameters (block exists only inside the main block - see Table B.13)

Word number	Name	Comment
0	0nn06h	06h = block identifier 0nnh = block length in words

1	Detector	type of exponential detector in vibration measurement mode:
		    0 – 100 ms time constant detector
		    1 – 125 ms time constant detector
		    2 – 200 ms time constant detector
		    3 – 500 ms time constant detector
		    4 – 1 s time constant detector
		    5 – 2 s time constant detector
		    6 – 5 s time constant detector
		    7 – 10 s time constant detector
		type of exponential detector in sound measurement mode:
		    0 – **Impulse**
		    1 – **Fast**
		    2 – **Slow**

2	Filter	measurement filter in vibration measurement mode:
		    0 – **HP**
		    1 – **HP1**
		    2 – **HP3**

Word number	Name	Comment
		3 − **HP10**
		4 − **Vel1**
		5 − **Vel3**
		6 − **Vel10**
		7 − **VelMF**
		8 − **Dil1**
		9 − **Dil3**
		10 − **Dil10**
		21 − **Wh**
		measurement filter in sound measurement mode:
		0 − **HP**
		1 − **Z**
		2 − **A**
		3 − **C**
		5 − **B**
		6 − **LF**
		7 − **U**
		8 − **AU**
3	LoggerRes	bit mask of results written to logger in vibration measurement mode:
		1 − Peak
		2 − P–P
		4 − Max
		8 − RMS
		bit mask of results written to logger in sound measurement mode:
		1 − Peak
		2 − Max
		4 − Min
		8 − Leq
		16 − LR1
		32 − LR2
		64 − LXY
…		reserved

Table B.15.   Reserved block

Word number	Name	Comment
0	0nn21h	21h = block identifier 0nnh = block length in words
…		reserved

Table B.16.   Marker parameters

Word number	Name	Comment
0	0043h	43h = block identifier
1	BlockLength	block length in words

Word number	Name	Comment
2	MarkerCount	number of markers
3..7	MarkerName[1]	name of the first marker (10 ASCII symbols)
8		reserved
9	MarkerType[1]	type of the first marker: 　0　– block marker 　1　– point marker
...		parameters of further markers
…		reserved

Table B.17.　Statistical analysis parameters (relevant only in Sound measurement mode)

Word number	Name	Comment
0	0nn09h	09h　= block identifier 0nnh　= block length in words
1	00pxxh	p = number of profiles, 0xxh = profile bit mask (bit mask informs for which profiles parameters are available)
2..	ProfileStat[1]	Internal block with identifier 0Ah containing parameters of the first profile (if the first profile bit mask is set)
...	...	...
...	ProfileStat[p]	internal block with 0Ah containing parameters of the last profile (if the last profile bit mask is set)
…		reserved

Table B.18.　Parameters of the profile histogram (block exists only inside the main block – see Table B.17)

Word number	Name	Comment
0	0nn0Ah	0Ah　= block identifier 0nnh　= block length in words
1	N	number of statistical class histogram
2	BottomClass	first class histogram in 0.01 dB format
3	ClassWidth	class histogram width in 0.01 dB format
…		reserved

Table B.19.　Octave and partial octave spectra analysis

Word number	Name	Comment
0	004Ah	4Ah　= block identifier
1	BlockLength	block length in words
2		reserved
3	SystemBase	filter database (2 or 10)

Word number	Name	Comment
4	OctaveDivider	octave division (type of filters): 　1　– octave filters 　3　– 1/3 octave filters
5	FirstFreqIndex	index of the first filter; the exact centre filter frequency in Hertz according to its index is given by the following formula: 　　$f = 1000 \cdot G^{\,i/b}$　　　　– for odd value b 　　$f = 1000 \cdot G^{\,(2i+1)/(2b)}$　– for even value b where: 　　$G = 2$　　　　– for filter base 2 　　$G = 10^{0.3}$　　– for filter base 10 　　i　　　　　　– filter index 　　b　　　　　　– octave division
6	N	number of octave or partial octave filters
7	T	number of total results; total results, depending on the measurement mode, are calculated with the following filters: in vibration measurement mode: 　Total[1]　– measurement with HP filter 　Total[2]　– measurement with a filter from the second profile 　Total[3]　– measurement with a filter from the third profile in sound measurement mode: 　Total[1]　– measurement with A filter 　Total[2]　– measurement with C filter 　Total[3]　– measurement with Z filter
8	Filter	spectrum measurement filter: 　0　– **HP** 　1　– **Z** 　2　– **A** 　3　– **C** 　5　– **B** 　7　– **U** 　8　– **AU**
9	Detectors	type of RMS detectors for spectra: 　0　– linear detector (**Linear**) 　1　– exponential detector **Fast** 　2　– exponential detector **Slow**
10	Band	frequency range: 　0　– full band (**Full**) 　1　– audible band (**Audio**) 　2　– ultrasonic band (**Ultra**)
11	MinMaxDetectors	type of RMS detectors for Max and Min spectra: 　0　– linear detector (**Linear**) 　1　– exponential detector **Fast** 　2　– exponential detector **Slow**
…		reserved

Table B.20.　　Parameters of 1/1 and 1/3 octave spectra histograms

Word number	Name	Comment
0	0nn13h	13h = block identifier 0nnh = block length in words
1	N	number of histograms (spectra bands and total results)
2	NofClasses	number of statistical histogram classes
3	BottomClass	first class histogram level in 0.01 dB format
4	ClassWidth	histogram classes width in 0.01 dB format
…		reserved

Table B.21.   Parameters of FFT analysis

Word number	Name	Comment
0	0051h	51h = block identifier
1	BlockLength	block length in words
2..6		reserved
7..8	M	frequency resolution (total value of the mantissa)
9	E	frequency resolution (binary exponent); exact resolution of the frequency in Hertz is given by the following formula: $$\Delta F = M \cdot 2^{E}$$
10	N	number of spectra bands
11	T	number of total results (if there is only one total result, it is calculated with the same filter and in the same band as the spectrum – see offset 17)
12	Band	analysis band (approximate values): 0 – 40 kHz band 1 – 20 kHz band 2 – 10 kHz band 3 – 5 kHz band 4 – 2,5 kHz band 5 – 1,25 kHz band 6 – 625 Hz band 7 – 312 Hz band 8 – 156 Hz band 9 – 78 Hz band
13	Window	window function: 0 – **Hanning** 1 – **Rectangular** 2 – **Flat Top** 3 – **Kaiser-Bessel**
14	WindowFactor	window correction factor in 0.01 dB format
15	Averaging	type of averaging: 0 – linear averaging 1 – exponential averaging
16	TimeConst	time averaging constant in milliseconds (exponential averaging only)

Word number	Name	Comment
17	Filter	spectrum measurement filter: 0 – **HP** 1 – **Z** 2 – **A** 3 – **C** 5 – **B** 7 – **U** 8 – **AU**
18	InstFreq	frequency of instantaneous spectra counting
…		reserved

Table B.22.   Reverberation time analysis parameters (RT60)

Word number	Name	Comment
0	0nn1Ah	1Ah = block identifier 0nnh = block length in words
1	ResultsType	type of results included in the block with the identifier 1Bh: 1 – single measurement results 2 – averaged results
2	Method	measurement method: 1 – **Decay** 2 – **Impulse**
3	Spectrum	Type of measured spectra: 1 – 1/1 octave 2 – 1/3 octave
4	TimeStep	measurement step in milliseconds
5	MeasureTime	measurement time in seconds
6		reserved
7	DispSmooth	parameter "smoothing" of the time curve (0 means no smoothing)
8	NoiseMargin	level of noise margin in the format 0,01 dB
9		reserved
10	AverNo	number of averaged results
…		reserved

Table B.23.   RT60 T0 offset parameters

Word number	Name	Comment
0	0xnn71h	71h = block identifier 0nnh = block length in words
1	SystemBase	filter database (2 or 10)
2	OctaveDivider	octave division (type of filters): 1 – octave filters 3 – 1/3 octave filters

3	FirstFreqIndex	index of the first filter; the exact centre filter frequency in Hertz according to its index is given by the following formula: $f = 1000 \cdot G^{i/b}$ – for odd value b $f = 1000 \cdot G^{(2i+1)/(2b)}$ – for even value b where: $G = 2$ – for filter base 2 $G = 10^{0.3}$ – for filter base 10 i – filter index b – octave division
4	N	number of values
5	T0_Offset[1]	First offset value
...	...	...
5+N-1	T0_Offset[N]	Last offset value
...		reserved

Table B.24.   Alarms events parameters

Word number	Name	Comment
0	0060h	60h = block identifier
1	BlockLength	block length in words
2	EventCount	number of defined events (Events)
3..10	EventName[1]	name of the first event (16 ASCII symbols)
11		reserved

12	EventType[1]	type of the first event:
		    0 – block event
		    1 – point event

...		parameters of the following events
...		reserved

Table B.25.   STIPA parameters

Word number	Name	Comment
0	0063h	63h = block identifier
1	BlockLength	block length in words

2	Standard	standard:
		    0 – IEC 60268-16x2
		    1 – IEC 60268-16x3

3	Averaging	averaging type:
		    0 – Manual
		    1 – Auto

4	N	Project name length
5..	ProjectName[N]	Project name
5+N	M	Area name length
6+N..	AreaName[M]	Area name
6+N+M	PointId	Point Id
7+N+M	K	Source name length

Word number	Name	Comment
8+N+M..	SourceName[K]	Source name
8+N+M+K	CalibrLevel	Source calibration factor in 0.01 dB format
…		reserved

Table B.26.   Logger parameters

Word number	Name	Comment
0	0nn0Fh	0Fh = block identifier 0nnh = block length in words
1	Ts	logger step in seconds
2	Tms	logger step in milliseconds; actual logger step in seconds is expressed as: $T = Ts + Tms / 1000$
3..4	LoggLength	total block size of recorded results in bytes
5..6	NofLoggRec	number of saved records
7..8	NofAllRec	number of all records measured during the entire measurement
9..10		reserved
11	MStUnitNumber	serial number of the monitoring station (if the parameter value is equal to 0FFFFh this parameter is irrelevant)

12	MStUnitType	type of monitoring station (if parameter value is 0FFFFh this parameter is irrelevant):
		  210 – SV 210 monitoring station
		  211 – SV 211 monitoring station

13	MStFirmwareVersion	firmware version number of the monitoring stations; for example, 123 means version 1.23 (if the parameter value is 0FFFFh this parameter is not relevant)
14..15	MStIntTimeSec	meteorological results averaging time used in the monitoring station in seconds (if the parameter value is 0FFFF'FFFFh this parameter is negligible)
16..17	NofSummaryRes	number of records saved as the summary results
…		reserved

B.2. DESCRIPTION OF LOGGER'S DATA BLOCKS

The logger consists of data records of basic results that are recorded with a fixed logger step (see Table B.1.23, Ts and Tms parameters) and various additional information blocks (markers). Markers contain information about events that occurred during the registration process, as well as additional measurement results independent of the basic results records. Markers can only appear between full base result records and occur entirely asynchronously.

The identification of the logger block is based on the four highest bits of the first and last block words:

08xxxh – block of user markers,

09xxxh – reserved block,

0Axxxh – pause marker block,

0Bxxxh – marker block of discontinuity of basic results records,

0Cxxxh – other marker blocks.

In general, the rule is that in the first word of the block the bit b11 is deleted and in the last word the bit b11 is set, except for the user marker block (08xxxh), because the block consists of only one word. If the highest four bits of the start or end of a block word are not any of the numbers from 08h to 0Ch, then we are dealing with a block of the basic result record. The table below shows the structure of the record of the basic results record and the structure of the markers.

Table B.27. Block of primary results record (data name in square brackets means data is optional)

Word number	Name	Comment
0	Flags	bit 0 (overload flag): 0 – no overload 1 – overload occurred bit 1 (excessive vibration flag): 0 – no excessive vibration 1 – excessive vibration bits 2..7 – reserved bits 8..(7+n) – underrange flags in "n" profiles: 0 – the signal level is equal to or greater than the declared lower range of measured values 1 – the signal level is lower than the declared lower range of measured values remaining bits are reserved
1..	[ResProf_1[..]]	measurement results of the first profile: – number and order of results is determined by the result bit mask in the profile parameter block (see Table B.14, the word "LoggerRes") – results are in format 0,01 dB
...	...	...
...	[ResProf_n[..]]	measurement results of the nth profile: – number and order of results is determined by the result bit mask in the profile parameter block (see Table B.13, the word "LoggerRes") – results are in format 0,01 dB – The number of profiles comes from the corresponding parameter in the main parameter block (see Table B.12, the word "00nxxh")
...	[ResRPM[2]]	lowest and highest word of the RPM measurement result value: – result is available if the RPM measurement is enabled (see the word "RPM_On" in the measurement parameter block - Table B.7) – value of the result is calculated according to the formulas given in the comment of the RPM measurement results block (see Table B.44)

Word number	Name	Comment
...	[ResSpec[..]]	results of the spectrum measurement: – results are available if the spectra recording during measurement is enabled (see the word "SpecLogg" in the measurement parameter block – see Table B.7) – results are in format 0,01 dB

Table B.28.   Block of user marker (only one word)

Word number	Name	Comment

0	08nnnh	08h = block identifier
		0nnnh= bit mask of markers states:
		  – each bit specifies the state of one marker (the lowest bit defines the state of the first marker, the next bit defines the state of the next marker, and so on.)
		  – set bit indicates that the marker is active
		  – erased bit indicates that the marker is inactive
		  – number of available markers (maximum 12) and marker type (block or spot) are defined in the corresponding parameter block (see Table B.16)

Table B.29.   Reserved block

Word number	Name	Comment
0	09xxxh	09h = block identifier 0xxxh = any value (bit b11 is zero)
1	0nnnnh	block length in words
2..		reserved
...	0nnnnh	block length in words
...	09xxxh	09h = block identifier 0xxxh = any value (bit b11 is set)

Table B.30.   Block of pause marker

Word number	Name	Comment
0	0A0nnh	0A0h = ID of the first word of the block 0nnh = first (the lowest) byte of the parameter
1	0A1xxh	0A1h = ID of the second word of the block 0xxh = second byte of the parameter
2	0A2yyh	0A0h = ID of the third word of the block 0yyh = third byte of the parameter
3	0A3zzh	0A3h = ID of the forth (last) word of the block 0zzh = forth (last) byte of the parameter – value 0zzyyxxnnh specifies the duration of the pause in milliseconds

Table B.31.   Block of marker for lack of continuity of record results

Word number	Name	Comment
0	0B0nnh	0B0h = ID of the first word of the block 0nnh = first (the lowest) byte of the parameter
1	0B1xxh	0B1h = ID of the second word of the block 0xxh = second byte of the parameter
2	0B2yyh	0B0h = ID of the third word of the block 0yyh = third byte of the parameter
3	0B3zzh	0B3h = identifier of the fourth (last) word of the block 0zzh = forth (last) byte of the parameter – value 0zzyyxxnnh specifies the number of results records that have not been registered

Table B.32.   Block of meteorological data calculated with step of the measurement cycle

Word number	Name	Comment
0	0C1nnh	0C1h = block start identifier 0nnh = block length in words
1	Temperature	temperature measurement result in format 0,1°C
2	Pressure	atmospheric pressure measurement result in hectopascals
3	Humidity	relative humidity measurement result in format 0,1%
4	AvgWindSpeed	average wind speed measurement result in the format 0,1 m/s
5	WindDirection	wind direction in degrees for maximum wind speed (if the parameter value is equal to 0FFFFh the direction is undefined)
6	MaxWindSpeed	maximum wind speed measurement result in the format 0,1 m/s
7..8	WindDirTotalPuffs	number of wind measurement samples
9	RainDetection	flag of rain show
...		reserved
...	0C9nnh	0C9h = block end identifier 0nnh = block length in words

Table B.33.   Block of marker for meteorological data block calculated with the logger step

Word number	Name	Comment
0	0C704h	0C704h= block start identifier
1	0nnnnh	block length in words
2	N_1s	number of averaged 1 second results
3	Temperature	temperature measurement result in format 0,1°C
4	Pressure	atmospheric pressure measurement result in hectopascals
5	Humidity	relative humidity measurement result in format 0,1%
6	WindDirTotalPuffs	number of non-zero wind sample
7	AvgWindSpeed	average wind speed measurement result in the format 0,1 m/s
8	WindDirection	wind direction in degrees for maximum wind speed (if the parameter value is equal to 0FFFFh the direction is undefined)
9	MaxWindSpeed	maximum wind speed measurement result in the format 0,1 m/s
...		reserved
...	0nnnnh	block length in words
...	0CF04h	0CF04h = block end identifier

Table B.34. Block of marker for meteorological rainfall calculated with the logger step

Word number	Name	Comment
0	0C705h	0C705h= block start identifier
1	0nnnnh	block length in words
2	RainIntensity	rainfall intensity in 0.1 mm / h format (this is a rolling average for 1-minute measurement)
3..4	RainAccumulation	sum of rainfall in 0.01 mm format
5..6	RainDuration	duration of precipitation in seconds
7	HailIntensity	hail intensity in the format 0,1/cm^{2}h (this is a rolling average for 1-minute measurement)
8..9	HailAccumulation	sum of hail in the format 0,1/cm^2
10..11	HailDuration	duration of the hail in seconds
...		reserved
...	0nnnnh	block length in words
...	0CF05h	0CF05h = block end identifier

Table B.35. Block of marker for wave file recording

Word number	Name	Comment
0	0C2nnh	0C2h = block start identifier 0nnh = block length in words
1..4	FileName	File name (8 ASCII symbols)
...		reserved
...	0CAnnh	0CAh = block end identifier 0nnh = block length in words

Table B.36. Block for Summary Results

Word number	Name	Comment
0	0C300h	0C300h= block start identifier
1	0nnnnh	block length in words
2..	SumResBlock[..]	set of cyclic results blocks; each block has its own header with ID and block length; blocks of cyclic results are described in Chapter B.3.
...	0nnnnh	block length in words
...	0CB00h	0CB00h = block end identifier

Table B.37. Block of marker for alarms

Word number	Name	Comment
0	0C5nnh	0C5h = block start identifier 0nnh = block length in words

Word number	Name	Comment
1	AlarmEventStateP	point event state bit mask: – each bit specifies the state of one event (the lowest bit defines the state of the first event, the next one – the second event, and so on), – set bit indicates that the event is active – cleared bit indicates that the event is inactive – number of available events and the type (block or point) are defined in the corresponding block of parameters (see Table B.24)
2	AlarmEventState	block event state bit mask: – each bit specifies the state of one event (the lowest bit defines the state of the first event, the next one – the second event, and so on) – set bit indicates that the event is active – cleared bit indicates that the event is inactive – number of available events and the type (block or point) are defined in the corresponding block of parameters (see Table B.24)
3	AlarmEventSMS	bit mask of sent SMS: – each bit specifies the sending status of the SMS for one event (the lowest bit specifies the SMS sending status for the first event, the next one for the second event, and so on) – set bit indicates that SMS has been sent – cleared bit indicates that SMS has not been sent – number of available events is defined in the corresponding block of parameters (see Table B.24)
4	AlarmEventEmail	bit mask of sent e-mail: – each bit specifies the sending status of the e-mail for one event (the lowest bit specifies the e-mail sending status for the first event, the next one for the second event, and so on) – set bit indicates that e-mail has been sent – cleared bit indicates that e-mail has not been sent – number of available events is defined in the corresponding block of parameters (see Table B.24)
...		reserved
...	0CDnnh	0CDh = block end identifier 0nnh = block length in words

Table B.38. Blocks for reserved markers

Word number	Name	Comment
0	0C7kkh	0C7kkh = block start identifier (0kkh is an additional number from 0 to 127 identifying the block)
1	0nnnnh	block length in words
2..		reserved
...	0nnnnh	block length in words
...	0CFkkh	0CFkkh = block end identifier (0kkh is an additional number from 0 to 127 identifying the block)

B.3. DESCRIPTION OF CYCLICAL RESULTS BLOCKS (SUMMARY RESULTS)

Table B.39.   Block of counters

Word number	Name	Comment
0	0nn59h	59h = block identifier 0nnh = block length in words
1..2	CycleNo	measurement cycle number
…		reserved

Table B.40.   Block of Summary Results

Word number	Name	Comment
0	0nn07h	07h = block identifier 0nnh = block length in words
1	00pxxh	p = number of profiles, 0xxh = profile bit mask (the bit mask indicates for which profiles the results are available)
2..	Profile[1]	internal block with identifier 08h with the results for the first profile whose bitmask is set - see Table B.41
...	...	...
...	Profile[p]	internal block with identifier 08h with the results for the last profile whose bitmask is set - see Table B.41
...	MeterTableRes	Internal block with the identifier 0Ch with the results of "Meter Table" - see 0
…		reserved

Table B.41.   Results for one profile (block exists only inside the Summary results block – see Table B.40)

Word number	Name	Comment
0	0nn08h	08h = block identifier, 0nnh = block length in words

1..2	Time	for the results of the first profile:
		        – measurement time in seconds
		for the results of the second profile:
		        – overload duration in seconds
		for the results of the third profile:
		        – duration of excessive vibration in seconds

3	Peak	value of the "Peak" result in the format 0.01 dB
4	P–P/SEL	"P-P" value in 0.01 dB format for vibration measurement mode or "SEL" value in 0.01 dB format for sound measurement mode
5	Max	value of the "Max" result in the format 0.01 dB
6	Reserved/ Min	value reserved for vibration measurement mode or „Min" value in 0.01 dB format for sound measurement mode
7	Reserved/ Spl	value reserved for vibration measurement mode or „Spl" value in 0.01 dB format for sound measurement mode

Word number	Name	Comment
8	RMS/Leq	"RMS" value in 0.01 dB format for vibration measurement mode or "Leq" value in 0.01 dB format for sound measurement mode
9	Reserved/ Lden	value reserved for vibration measurement mode or „Lden" value in 0.01 dB format for sound measurement mode
10	Reserved	
11	Reserved/ LTeq	value reserved for vibration measurement mode or „LTeq" value in 0.01 dB format for sound measurement mode
12	Reserved/ LR1	value reserved for vibration measurement mode or „LR1" value in 0.01 dB format for sound measurement mode
13	Reserved/ LR1	value reserved for vibration measurement mode or „LR2" value in 0.01 dB format for sound measurement mode
14		reserved

15	Underrange	underrange flag:
		    0 – signal level values are equal to or greater than the declared lower range of measured values,
		    1 – signal level values are less than the declared lower range of measured values

16	ResultsFlags	bit 1 (overload flag):
		    0 – no overload,
		    1 – overload occurred
		bits 5..3 (Lden result type - only for sound measurement mode):
		  000 – no Lden result
		  001 – Ld result
		  010 – Le result
		  011 – Lde result
		  100 – Ln result
		  101 – Lnd result
		  110 – Len result
		  111 – Lden result
		remaining bits are reserved

17	Reserved/ EX	value reserved for the vibration measurement mode or EX result value in the format 0.01 dB for the sound measurement mode
18	Reserved/ SD	value reserved for the vibration measurement mode or SD result value in the format 0.01 dB for the sound measurement mode
…		reserved

Table B.42. "Meter Table" results (this block appears only inside the main result block – see Table B.40)

Word number	Name	Comment
0	0nn0Ch	0Ch = block identifier 0nnh = block length in words
1	LCpeak	value of the **LCpeak** result in the format 0.01 dB
2	LCeq	value of the **LCeq** result in the format 0.01 dB
3	LAFmax1s	value of the **LAFmax1s** result in the format 0.01 dB
4	LAeq	value of the **LAeq** result in the format 0.01 dB
5	LAFeq	value of the **LAFeq** result in the format 0.01 dB
6	LAIeq	value of the **LAIeq** result in the format 0.01 dB
…		reserved

Table B.43. Statistical analysis results (only for sound measurement mode)

Word number	Name	Comment
0	0nn17h	17h = block identifier 0nnh = block length in words
1	00pxxh	p = number of profiles, 0xxh = profile bit mask (bit mask informs about which profile results are available)
2	N	number of statistical levels
3	nn[1]	first level number (common to all profiles)
4	Lnn[1][1]	first level Lnn value for the first profile whose bit mask is set
...	...	...
...	Lnn[1][p]	first level Lnn value for the last profile whose bit mask is set
...	nn[i]	number of the next level (common for all profiles): i = 2..N
...	Lnn[i][1]	next level Lnn value for the first profile whose bit mask is set
...	...	...
...	Lnn[i][p]	next level Lnn value for the last profile whose bit mask is set
…		reserved

Table B.44. RPM measurement results

Word number	Name	Comment
0	0nn1Fh	1Fh = block identifier 0nnh = block length in words

1..2	ROT	lower and higher word of the last value of RPM measured during the measurement cycle; the value of the result is calculated according to the formulas:
		        rps = 1/d – number of revolutions per second
		        rpm = 60/d – number of revolutions per minute
		where:
		        $d = m \cdot 2^{w}$
		        m = ((H & 7Fh)<<16) + ((L & 7FFFh)<<1)
		        w = ((H>>8) & 7Fh) – 87
		        L – lower word of the result
		        H – higher word of the result
		        & – bit product operator

Word number	Name	Comment
		>> – bit right shift operator << – bit left shift operator
3..4	RMAX	lower and higher word of the maximum value of the rpm measured during the measurement cycle; the value of the result is calculated according to the formulas given in the comment of the ROT result
5..6	RMIN	lower and higher word of the minimum value of the rpm measured during the measurement cycle; the value of the result is calculated according to the formulas given in the comment of the ROT result
…		reserved

Table B.45. Reserved block

Word number	Name	Comment
0	001Eh	1Eh = block identifier
1	BlockLength	block length in words
…		reserved

Table B.46. Results of octave and partial-octave analysis

Word number	Name	Comment

0	0nnxxh	0xxh = block identifier:
		    04Bh – results of averaged spectrum
		    04Ch – results of minimum spectrum
		    04Dh – results of maximum spectrum
		0nnh = block length in words

1		reserved
2	Result[1]	value of the first result in the format 0,01 dB
3	Result[2]	value of the second result in the format 0,01 dB
...	...	...
...	Result[N+T−1]	value of the penultimate result in the format 0,01 dB
...	Result[N+T]	value of the last result in the format 0.01 dB (the number of spectral bands and the number of total results are specified in the corresponding octave and partial-octave analysis block of results - see Table B.19)
…		reserved

Table B.47. Results of FFT analysis

Word number	Name	Comment

0	00xxh	0xxh = block identifier:
		    052h – results of averaged spectrum
		    053h – results of minimum spectrum
		    054h – results of maximum spectrum

1	BlockLength	block length in words
2		reserved
3..4	NofAver	number of averaged spectra

Word number	Name	Comment
5	Result[1]	value of the first result in the format 0,01 dB
6	Result[2]	value of the second result in the format 0,01 dB
...	...	...
...	Result[N+T–1]	value of the penultimate result in the format 0,01 dB
...	Result[N+T]	value of the last result in the format 0,01 (number of spectral lines and the number of aggregate results are determined in the corresponding FFT analysis block of results - see Table B.21)
…		reserved

Table B.48.   Results of statistical analysis

Word number	Name	Comment
0	0xx0Bh	0Bh = block identifier 0xxh = profile bit mask
1	BlockLength	block length in words
2..3	Histogram[1]	histogram counter of the first class
4..5	Histogram[2]	histogram counter of the second class
...	...	...
...	Histogram[N–1]	histogram counter of the penultimate class
...	Histogram[N]	histogram counter of the last class (number of statistical classes of the histogram N is given in the block of profile histogram parameters - see Table B.18)
…		reserved

Table B.49.   Results of statistical analysis for 1/1 and 1/3 octaves

Word number	Name	Comment
0	0xx14h	14h = block identifier 0xxh = spectrum band number (counted from 1) for which the histogram is calculated
1	BlockLength	block length in words
2..3	Histogram[1]	histogram counter for the first class
4..5	Histogram[2]	histogram counter for the second class
...	...	...
...	Histogram[N–1]	histogram counter for the penultimate class
...	Histogram[N]	histogram counter for the last class (number of statistical classes of the histogram N is given in the block of 1/1 and 1/3 octave histogram parameters – see Table B.20)
…		reserved

Table B.50.   Results of GPS measurements

Word number	Name	Comment

0	0nnxxh	0xxh = block identifier:
		   34h – GPS measurement results at the beginning of the measurement cycle
		   35h – GPS measurement results at the end of the measurement cycle
		0nnh = block length in words

1	Quality	GPS signal quality:
		   0 – no signal
		   1 – „FIX"
		   2 – „FIX–DIF"

2	TimeSec	value of seconds of real-time clock
3	TimeMin	value of minutes of real-time clock
4	TimeHour	value of hours of real-time clock
5	DateDay	day number
6	DateMonth	month number
7	DateYear	year number
8	LatitudeDeg	latitude - number of degrees
9	LatitudeMin	latitude - number of minutes
10	LatitudeSec	latitude - number of seconds
11	LatitudeMSec	latitude - number of milliseconds in the format 10 ms

12	LatitudeDir	latitude - orientation (ASCII symbol):
		   N – latitude north
		   S – latitude south

13	LongitudeDeg	longitude - number of degrees
14	LongitudeMin	longitude - number of minutes
15	LongitudeSec	longitude - number of seconds
16	LongitudeMSec	longitude - number of milliseconds in the format 10 ms

17	LongitudeDir	longitude - orientation (ASCII symbol):
		   E – longitude east
		   W – longitude west

18	Altitude	altitude - the number of meters
19	Altitude10	absolute altitude - number of decimetres
20	Speed	speed in format 0,01 km/h
…		reserved

Table B.51.   Meteorological measurement results (Meteo)

Word number	Name	Comment
0	002Ah	2Ah = block identifier
1	BlockLength	block length in words
2	MStUnitNumber	serial number of the monitoring station

3	MStUnitType	type of monitoring station:
		   210 – SV 210 monitoring station
		   211 – SV 211 monitoring station

Word number	Name	Comment
4	MStFirmwareVersion	firmware version number of the monitoring stations; for example, 123 means version 1.23
5..6	MStIntTimeSec	meteorological results averaging time used in the monitoring station
7	Temperature	temperature measurement result in format 0,1°C
8	Pressure	atmospheric pressure measurement result in hectopascals
9	Humidity	relative humidity measurement result in format 0,1%
10	AvgWindSpeed	average wind speed measurement result in the format 0,1 m/s
11	WindDirection	wind direction in degrees for maximum wind speed (if the parameter value is equal to 0FFFFh the direction is undefined)
12	MaxWindSpeed	maximum wind speed measurement result in the format 0,1 m/s
13..14	WindDirTotalPuffs	number of wind measurement samples
15	N	number of directions of wind direction distribution
16..	WindDir[N]	wind direction distribution table - values in the format 0.1%
16+N	M	number of directions of measurement of maximum wind speed
...	WindMax[M]	table of maximum wind speeds - values in 0.1 m / s format
16+N+M	V	number of directions for measuring average wind speeds
...	WindAver[V]	table of average wind speeds - values in the format 0,1 m/s
16+N+M+V	RainDetection	flag of precipitation: **Note:** if the flag is zero, the next 10 words of precipitation parameters are not present in this block
+[0]	[RainIntensity]	rainfall intensity in 0.1 mm / h format (this is a rolling average for 1 minute measurement)
+[1..2]	[RainAccumulation]	sum of rainfall in 0.01 mm format
+[3..4]	[RainDuration]	duration of precipitation in seconds
+[5]	[HailIntensity]	hail intensity in the format $0,1/cm^2 h$ (this is a rolling average for 1 minute measurement)
+[6..7]	[HailAccumulation]	sum of hail in the format $0,1/cm^2$
+[8..9]	[HailDuration]	duration of the hail in seconds
…		reserved

Table B.52.   STIPA results

Word number	Name	Comment
0	0061h	61h = block identifier
1	BlockLength	block length in words
2	STI	STI result in the format 0.01dB
3	LAeq	LAeq result in the format 0.01dB
4	LCeq	LCeq result in the format 0.01dB
5	N	number of frequencies of the STIPA analysis
6	LZeq[1]	LZeq result number for the first frequency in the format 0.01dB
7	Err1[1]	m(f1) error flag for the first frequency (0,1)
8	Mf1[1]	m(f1) result value for the first frequency in the format 0.01
9	Err2[1]	m(f2) error flag for the first frequency (0,1)
10	Mf2[1]	m(f2) result value for the first frequency in the format 0.01
i*5+1	LZeq[i]	LZeq result number for the next frequency in the format 0.01 dB
i*5+2	Err1[i]	m(f1) error flag for the next frequency (0,1)

Word number	Name	Comment
i*5+3	Mf1[i]	m(f1) result value for the next frequency in the format 0.01
i*5+4	Err2[i]	m(f2) error flag for the next frequency (0,1)
i*5+5	Mf2[i]	m(f2) result value for the next frequency in the format 0.01
N*5+6	Flags	bit 0 – underrange flag bit 1 – overload flag
N*5+7	STI-Measured	STI result not considering Ambient Noise
…		reserved

Table B.53. STIPA Ambient noise results

Word number	Name	Comment
0	0062h	62h = block identifier
1	BlockLength	block length in words
2	N	number of frequencies of the STIPA analysis
3..	Distortion[N]	STIPA Ambient noise table in the format 0.01 dB
…		reserved

Table B.54. RT60 results

Word number	Name	Comment

0	00xxh	0xxh = block identifier:
		   1Bh – instantaneous results,
		   1Ch – averaged results

1	BlockLength	block length in words
2	ReferenceFreq	reference frequency in 0.01 Hz format (nominal value)
3		reserved

4	Ntot	total number of summary results; Total results are calculated with the following filters:
		   Total[1] – measured with filter A
		   Total[2] – measured with filter C
		   Total[3] – measured with filter Z

5	NF1	index of the lower analysis frequency related to the reference frequency
6	NF2	index of the upper analysis frequency related to the reference frequency

7	CalcFlag[1]	flag of the calculated results for the first frequency:
		   0 – no calculated results
		   1 – results calculated

8	EDT[1]	EDT result value for the first frequency in milliseconds
9	RT20[1]	RT20 result value for the first frequency in milliseconds
10	RT30[1]	RT30 result value for the first frequency in milliseconds
11	RTuser[1]	RTuser result value for the first frequency in milliseconds

12	N_EDT[1]	in the instantaneous results block:
		   – reserved value
		in the averaged results block:
		   – number of EDT averaged results for the first frequency

Word number	Name	Comment

13	N_RT20[1]	in the instantaneous results block:
		    – reserved value
		in the averaged results block:
		    – number of RT20 averaged results for the first frequency

14	N_RT30[1]	in the instantaneous results block:
		    – reserved value
		in the averaged results block:
		    – number of RT30 averaged results for the first frequency

15	N_RTuser[1]	in the instantaneous results block:
		    – reserved value
		in the averaged results block:
		    – number of RTuser averaged results for the first frequency

6+i*9+1	CalcFlag[i]	flag of the calculated results for the next frequency:
		  0 – no calculated results
		  1 – results calculated

6+i*9+2	EDT[i]	EDT result value for the next frequency in milliseconds
6+i*9+3	RT20[i]	RT20 result value for the next frequency in milliseconds
6+i*9+4	RT30[i]	RT30 result value for the next frequency in milliseconds
6+i*9+5	RTuser[i]	RTuser result value for the next frequency in milliseconds

6+i*9+6	N_EDT[i]	in the instantaneous results block:
		    – reserved value
		in the averaged results block:
		    – number of averaged EDT results for the next frequency

6+i*9+7	N_RT20[i]	in the instantaneous results block:
		    – reserved value
		in the averaged results block:
		    – number of averaged RT20 results for the next frequency

6+i*9+8	N_RT30[i]	in the instantaneous results block:
		    – reserved value
		in the averaged results block:
		    – number of averaged RT30 results for the next frequency

6+i*9+9	N_RTuser[i]	in the instantaneous results block:
		    – reserved value
		in the averaged results block:
		    – number of averaged RTuser results for the next frequency

…		reserved

Table B.55. Tonality results (ISO 20065:2016)

Word number	Name	Comment
0	0072h	72h = block identifier
1	BlockLength	block length in words
2	df	line spacing of the FFT spectrum in the format 0.001 Hz
3	N	number of lines if the FFT spectrum
4	TonPenalty	number of tones in the FFT spectrum
5	maxToneIndex	index of the maximum tone in the FFT spectrum
i*4+1	centerLine[i]	tone line index
i*4+2	L[i]	audibility of the tone in the format 0.01 dB

Word number	Name	Comment
i*4+3	F1_index[i]	left boundary of the critical bandwidth, line index
i*4+4	F2_index[i]	right boundary of the critical bandwidth, line index
i*4+5	Lt[i]	tone level in the format 0.01 dB
i*4+6	Ls[i]	averaged signal level of the tone in the format 0.01 dB
i*4+7	Lg[i]	noise level of the tone in the format 0.01 dB
i*4+8	av[i]	masking index of the tone in the format 0.01 dB
i*4+9	Kt[i]	Spectrum level tuning in dB
i*4+10	sigma[i]	measurement uncertainty in the format 0.01 dB
…		reserved

Table B.56.   Tonality partial results for postprocessing (ISO 20065:2016)

Word number	Name	Comment
0	0073h	73h = block identifier
1	BlockLength	block length in words
2	L[maxToneIndex]	partial L(max) result for post-processing, 0.01 dB
3	sigma[maxToneIndex]	partial sigma result (max) for post-processing, 0.01 dB

B.4. DATE AND TIME (EXAMPLE DECODING PROCEDURE)

Following function written in C explain how the date and time are coded:

```c
void ExtractDateTime(int date, unsigned int time, int dt[])
{
    dt[0] = time % 30;                      /* sec */
    dt[1] = (time/30) % 60;                 /* min */
    dt[2] = time/1800;                      /* hour */

    dt[3] = date & 0x001F;                  /* day */
    dt[4] = (date>>5) & 0x000F;             /* month */
    dt[5] = ((date>>9) & 0x007F) + 2000;    /* year */
}
```

APPENDIX C. TECHNICAL SPECIFICATIONS

C.1. SPECIFICATION OF SV 977D AS SOUND LEVEL METER (SLM)

C.1.1   Specification of SV 977D as SLM in the standard configuration

Statement of performance

SV 977D working as the SLM with all listed below accessories meets requirements of the IEC 61672:2013 for the Class 1 Group X instruments.

Configuration of the complete SLM in its normal mode of operation

SV 977D	sound & vibration level meter and analyser comprising:
SV 12L	microphone preamplifier
MK 255	prepolarised free-field microphone (1/2", nominal sensitivity 50 mV/Pa)
Recommended calibrator:	
SV 36	Class 1 sound calibrator: 94/114 dB@1000 Hz or equivalent (not included in the standard set)

Accessories included in the SV 977D instrument set

SC 158	USB-C cable
SA 22	windscreen

Accessories available:

SP 75	RS 232 interface for SV 977D
SA 277D	outdoor microphone kit
SC 26	extension cable for SV 12L (TNC plug to TNC socket)
SA 15	power supply unit

Measured quantities

The measured quantities in the sound meter mode are: **Peak**, **Max**, **Min**, **Spl**, **Leq**, **SEL**, **Lden**, **LEPd**, **Ltm3**, **LTeq**, **Ln** (Leq statistics), **EX** (expected Leq), **SD** (standard Leq deviation), **LR1** and **LR2** (rolling Leq), **OVL** (overload time %).

Definitions for parameters are given in Appendix D.

Additional features

- Overload indication
- Underrange indication
- Battery state indication

Normal operating mode

SV 977D in configuration with the **SV 12L** microphone preamplifier and **MK 255** microphone with following settings: **High** or **Low** measurement range (*path: <Menu> / Measurement / Range* – see Chapter 4.6), switched on **Microphone** compensation, selected **Free Field** compensation and switched off **Windscreen** compensation (path: <Menu> / Measurement / Compensation – see Chapter 4.5).

Conformance testing

This chapter contains the information needed to conduct conformance testing according to the specified standards.

Mounting for acoustical tests   The microphone must be mounted on the preamplifier.

Electrical substitute for the microphone   To obtain a BNC type electrical input, the microphone must be replaced by an electrical equivalent impedance ST 02 with the serial capacitance 18 pF ± 10%.

*Note: The ST 02 impedance has equivalent electrical impedance to the microphone MK 255. However, some other features of these two devices are different! One important difference is microphone sensitivity fluctuation versus temperature. To ensure better accuracy of SV 977D the microphone temperature drift is digitally compensated. The correction factor is equal to 0.01 dB/K re 23ºC This correction is controlled by switching the Microphone compensation in the **Compensation** settings screen (path: <Menu> / Measurement / Compensation).*

*Note: For electrical environmental conformance tests with the ST02 impedance, the **Microphone** compensation must be switched off.*

*Note: For acoustic conformance tests (with the microphone installed), the **Microphone** compensation must be switched on.*

*Note: For acoustic conformance tests with the installed SA 22 windscreen, the **Windscreen** compensation must be switched on.*

Periodical test upper frequency   8 kHz

Weighting filters (see part C.3)

- **Z**   meeting requirements of IEC 61672-1:2013 for the Class 1 "Z" filters
- **A**   meeting requirements of IEC 651 and IEC 61672-1:2013 Class 1 "A" filters
- **B**   meeting requirements of IEC 651 and IEC 61672-1:2013 for Class 1 "B" filters
- **C**   meeting requirements of IEC 651 and IEC 61672-1:2013 for Class 1 "C" filters
- **D**   meeting requirements of BS 5721:1979
- **U**   meeting requirements of IEC 61012:1990 for Class 1 "U" filters,
- **AU**   meeting requirements of IEC 61012:1990 for Class 1 "AU" filters,
- **D**   meeting requirements of BS 5721:1979,
- **HP**   high-pass filter,
- **LF**   low frequency (20-200 Hz) real-time band pass filter.

Linear operating ranges

Two measurement ranges are available: **High** (primary) and **Low**.

The starting point at which tests of level linearity shall begin is 94.0 dB for the frequencies specifies below. For the **Low** measurement range and A weighting linearity test at 31.5 Hz, the starting point is 74 dB.

Table C.1.1. Linear operating ranges for the **Low** measurement range (for the sinusoidal signal and microphone sensitivity 50 mV/Pa)

[dB]	$L_{AS/F}$		$L_{BS/F}$		$L_{CS/F}$		$L_{ZS/F}$		L_{AeqT}		L_{BeqT}		L_{CeqT}		L_{AE} (t_{int} = 2 s)		L_{Cpeak}	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
31.5 Hz	23	80	25	103	25	117	30	120	23	80	25	103	25	117	26	83	50	120
500 Hz	23	116	25	119	25	120	30	120	23	116	25	119	25	120	26	119	50	123
1 kHz	23	120	25	120	25	120	30	120	23	120	25	120	25	120	26	123	50	123
4 kHz	23	121	25	119	25	119	30	120	23	121	25	119	25	119	26	124	50	123
8 kHz	23	119	25	117	25	117	30	120	23	119	25	117	25	117	26	122	50	120
12.5 kHz	23	115	25	114	25	114	30	120	23	115	25	114	25	114	26	118	50	117

Table C.1.2. Linear operating ranges for the **High** (primary) measurement range (for the sinusoidal signal and microphone sensitivity 50 mV/Pa)

[dB]	$L_{AS/F}$		$L_{BS/F}$		$L_{CS/F}$		$L_{ZS/F}$		L_{AeqT}		L_{BeqT}		L_{CeqT}		L_{AE} (t_{int} = 2 s)		L_{Cpeak}	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
31.5 Hz	35	97	35	120	35	134	40	137	35	97	35	120	35	134	38	100	70	137
500 Hz	35	133	35	136	35	137	40	137	35	133	35	136	35	137	38	136	70	140
1 kHz	35	137	35	137	35	137	40	137	35	137	35	137	35	137	38	140	70	140
4 kHz	35	138	35	136	35	136	40	137	35	138	35	136	35	136	38	141	70	139
8 kHz	35	136	35	134	35	134	40	137	35	136	35	134	35	134	38	139	70	137
12.5 kHz	35	132	35	131	35	131	40	137	35	132	35	131	35	131	38	135	70	134

Note: *For the signals with the crest factor **n > 1.41** upper measuring range of the RMS (**LEQ** and **SPL**) is reduced. The valid upper limit can be calculated according to the below given formula:*

$$A_n = 137 - 20\,\log\left(n/\sqrt{2}\right),$$ *where **A** is the upper limit for the sinusoidal signal*

*Example: For the crest factor **n = 10** the upper limit is **A_{10} = 120 dB***

Table C.1.1. Self-generated noise for selected weighting filters

Weighting filter / Range	Electrical *)			Acoustical compensated		
	A	C	Z	A	C	Z
Low	< 12 dB	< 12 dB	< 17 dB	< 16 dB	< 17 dB	< 23 dB
High	< 22 dB	< 22 dB	< 26 dB	< 28 dB	< 28 dB	< 33 dB

*) measured with the **ST 02** microphone equivalent impedance **18 pF ± 10%**, averaging time – 30 s

Measurement ranges

Reference measurement range of the acoustic pressure — **High**

Measuring frequency range of the acoustic pressure (-3 dB) — 3.5 Hz ÷ 20 000 Hz.

Basic measurement error of the acoustic pressure — < 0.7 dB (measured for the reference conditions, see below).

Special filters

- **Diffuse Field**   compensation filter that improves the complete instrument frequency response in the diffuse acoustic field (see below)

- **Windscreen**   compensation filter that improves the instrument frequency response in the free acoustic field when the SA22 windscreen is mounted on the microphone (see Chapter C.1.2)
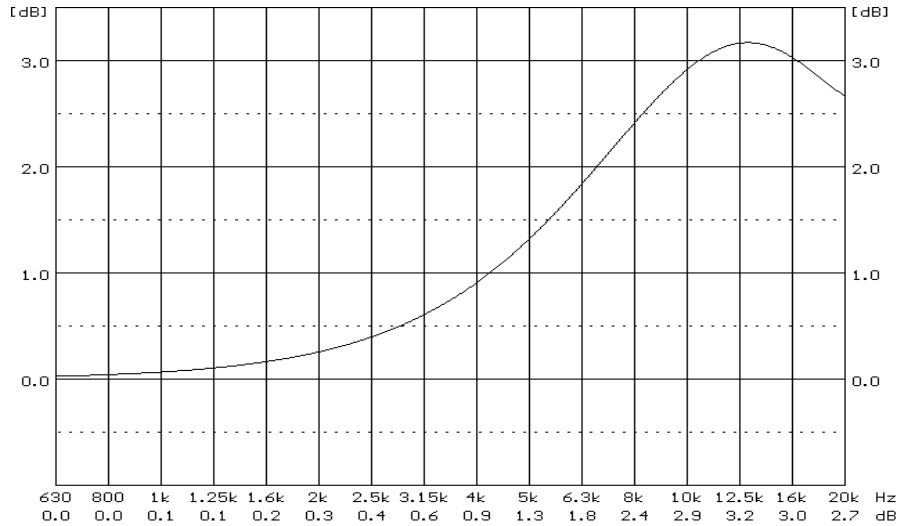
SV 977D Diffuse Field compensation filter

Note: *Using special filters might change the frequency response and measuring ranges of SV 977D. Please check the below given specification.*

Linear operating ranges for LEQ measurements with the **Diffuse Field** filter

The starting point at which tests of level linearity shall begin is 94.0 dB for the frequencies specifies below. For the **Low** measurement range and A weighting linearity test at 31.5 Hz, the starting point is 74 dB.

Table C.1.2. Linear operating ranges for the **Low** measurement range with the **Diffuse Field** filter (for the sinusoidal signal and microphone sensitivity 50 mV/Pa)

[dB]	$L_{AS/F}$		$L_{BS/F}$		$L_{CS/F}$		$L_{ZS/F}$		L_{AeqT}		L_{BeqT}		L_{CeqT}		L_{AE} (t_{int} = 2 s)		L_{Cpeak}	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
31.5 Hz	24	80	26	103	26	117	32	120	24	80	26	103	26	117	27	83	51	120
500 Hz	24	116	26	119	26	120	32	120	24	116	26	119	26	120	27	119	51	123
1 kHz	24	120	26	120	26	120	32	120	24	120	26	120	26	120	27	123	51	123
4 kHz	24	121	26	119	26	119	32	120	24	121	26	119	26	119	27	124	51	123
8 kHz	24	119	26	117	26	117	32	120	24	119	26	117	26	117	27	123	51	120
12.5 kHz	24	115	26	114	26	114	32	120	24	115	26	114	26	114	27	118	51	117

Table C.1.3. Linear operating ranges for the **High** measurement range with the **Diffuse Field** filter (for the sinusoidal signal and microphone sensitivity 50 mV/Pa)

[dB]	$L_{AS/F}$		$L_{BS/F}$		$L_{CS/F}$		$L_{ZS/F}$		L_{AeqT}		L_{BeqT}		L_{CeqT}		L_{AE} ($t_{int} = 2$ s)		L_{Cpeak}	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
31.5 Hz	36	97	36	120	36	134	42	137	36	97	36	120	36	134	39	100	71	137
500 Hz	36	133	36	136	36	137	42	137	36	133	36	136	36	137	39	136	71	140
1 kHz	36	137	36	137	36	137	42	137	36	137	36	137	36	137	39	140	71	140
4 kHz	36	138	36	136	36	136	42	137	36	138	36	136	36	136	39	141	71	139
8 kHz	36	136	36	134	36	134	42	137	36	136	36	134	36	134	39	139	71	137
12.5 kHz	36	132	36	131	36	131	42	137	36	132	36	131	36	131	39	136	71	134

Linear operating ranges with the SA 22 windscreen

The SA 22 windscreen doesn't change the linear operating ranges given in tables C.1.4 and C.1.5 (see Chapter C.1.2).

RMS detector

- Digital   "True RMS" with Peak detection,
- Resolution   0.1 dB
- Range   327.7 dB
- Crest Factor   unlimited (for signals in 20 kHz band).

Overload detector

The instrument has the built-in overload detectors. Both A/D converter and input amplifier overload conditions are detected. The overload in the measurement channel (in its analogue part) and the overload of the analogue / digital converter are both detected. The "overload" indication appears when the input signal amplitude is 0.5 dB above the declared "Peak measurement range".

Underrange detector

The instrument has the built-in under-range detector. The "underrange" indication appears when the Leq value for the elapsed time or the last second SPL value is below the lower linear operating range.

Time weighting characteristics (Exponential averaging)

Slow   "**S**" according to IEC 61672-1:2013 for Class 1, Equivalent Time Constant 1000 ms
Fast   "**F**" according to IEC 61672-1:2013 for Class 1, Equivalent Time Constant 125 ms
Impulse   "**I**" according to IEC 60804:2000 for Class 1, Equivalent Time Constant 35 ms, Hold Time 1500 s

Reference conditions as per IEC 61672-1:2013

- Class of the acoustic field   Free field
- Reference acoustic pressure   114.0 dB (related to 20 µPa)
- Reference frequency   1000 Hz
- Reference temperature   +23°C
- Reference relative humidity   50 %
- Reference static pressure   1013.25 hPa
- Reference incidence direction   perpendicular to the microphone diaphragm.

Maximum peak voltage	28 V Peak-Peak (Maximum peak voltage of input sinusoidal signal, which can be lead to the SLM without destruction the meter)
Warm-up time	1 min. (for 0.1 dB accuracy)
Typical stabilization time after change in environmental conditions by 20°C	1 hour
Nominal delay between operating of the **<Start>** (Reset) key and beginning of a new measurement	≥ 1 sec
Time shift after completion of a measurement, before a measurement is shown	< 1 sec

> ⚠️ **Note:** When SV 977D is moved from a warm environment with high humidity to a colder environment, care should be taken not to produce condensation inside the instrument. In this case, much longer stabilization periods may be necessary.

Environmental, electrostatic and radio frequency criteria

Effect of humidity	< 0.5 dB (for 30%<RH<90% at 40°C and 1000 Hz)
Effect of magnetic field	< 15 dB (A) or < 25 dB (Z) (for 80 A/m and 50 Hz)
Effect of radio frequency fields	< +/-0.5 dB @ 74 dB and 10V/m electromagnetic field

The greatest susceptibility (the least immunity) is achieved when the SLM is placed parallel to the radio frequency field and the **Z** filter and time weighting **Fast** are selected and the SPL measurements are considered.

The instrument produces greatest radio-frequency emission when an extension cable is connected. The cable placed as a solenoid may produce unexpected emission depending on its physical dimensions. Any configuration w/o extension cable reduces emission below 30 dB/uV/m.

Effect of electrostatic discharge	meets requirements of IEC 61672-1:2013

During electrostatic discharge, the influence of the displayed results could be observed.
No changes in instrument operation state, configuration or stored data corruption were found out.

Effect of ambient pressure	< 0.01 dB/kPa
Effect of temperature	< 0.5 dB (from -10°C to + 50°C)
Operating temperature	from -10°C to + 50°C
Storage temperature	from -20°C to + 60°C

Calibration

Acoustical **-** with the SV 36 sound calibrator (or equivalent):

- Calibration level   114.0 dB (equal to the calibrator pressure level - see calibration chart of the used calibrator)

> ⚠️ **Note:** The above levels correspond to 114 dB of calibrator's sound pressure. If the calibrator has a different sound pressure than 114 dB, the calibration levels must be accordingly adjusted.

Microphone

MK 255	prepolarised free-field ½" condenser microphone
Nominal sensitivity	50 mV/Pa (corresponding to -26 dB re 1 V/Pa)
Capacitance	17 pF
Reference point	geometric centre of the microphone diaphragm.

⚠️ **Note:** *Maximum sound pressure level that can be applied to a microphone without destroying it: 146 dB.*
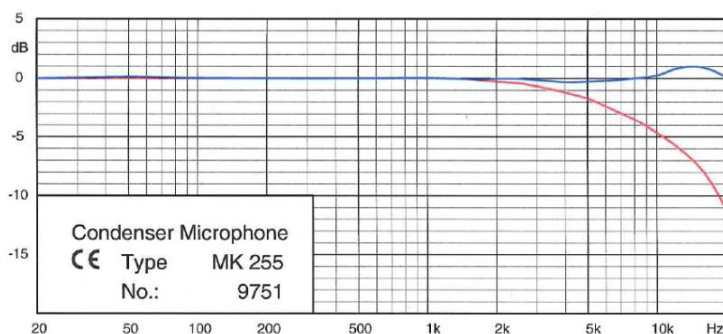
Typical MK 255 Free Field frequency response (source: Microtech Gefell Gmbh)

Table C.1.4. MK 255 free field corrections using the electrostatic actuator for 0 deg incidence angle

[dB]	Frequency [Hz]																
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800
Correction factors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.05	-0.07	-0.07	-0.06	-0.04
Uncertainty (IEC 62585)	--	--	--	--	--	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

[dB]	Frequency [Hz]													
	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Correction factors	-0.04	-0.03	0.02	0.13	0.30	0.55	1.00	1.55	2.21	3.35	4.83	6.94	9.16	11.59
Uncertainty (IEC 62585)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.35	0.35	0.35	0.35	0.50	0.50	0.50

Preamplifier

SV 12L	nominal preamplifier attenuation: 0.7 dB;
	IEPE Type – power supply 1.5 mA@30 V
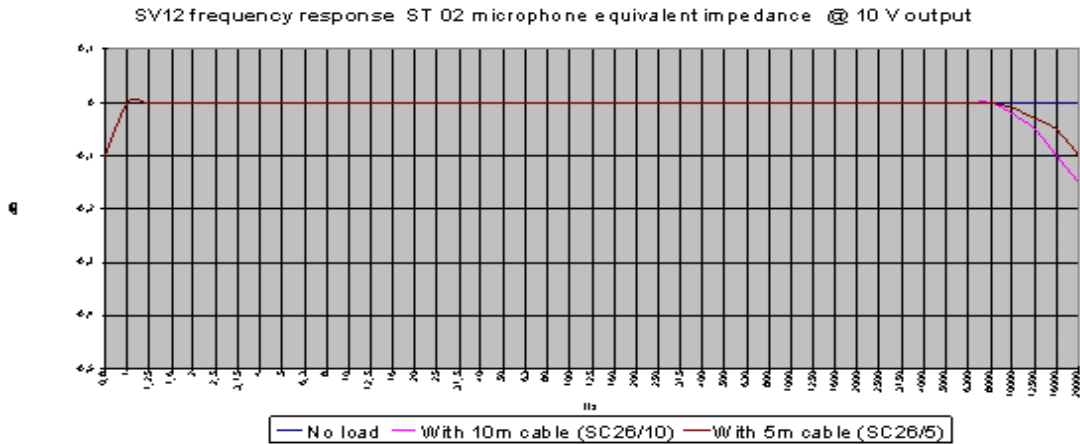
SV12L typical frequency response

SV 977D Free Field frequency response

Typical Free Field frequency responses of SV 977D are presented on the below figure together with the effect of reflections and diffraction of the acoustic plane wave from the SV 977D case ("Case Effect").
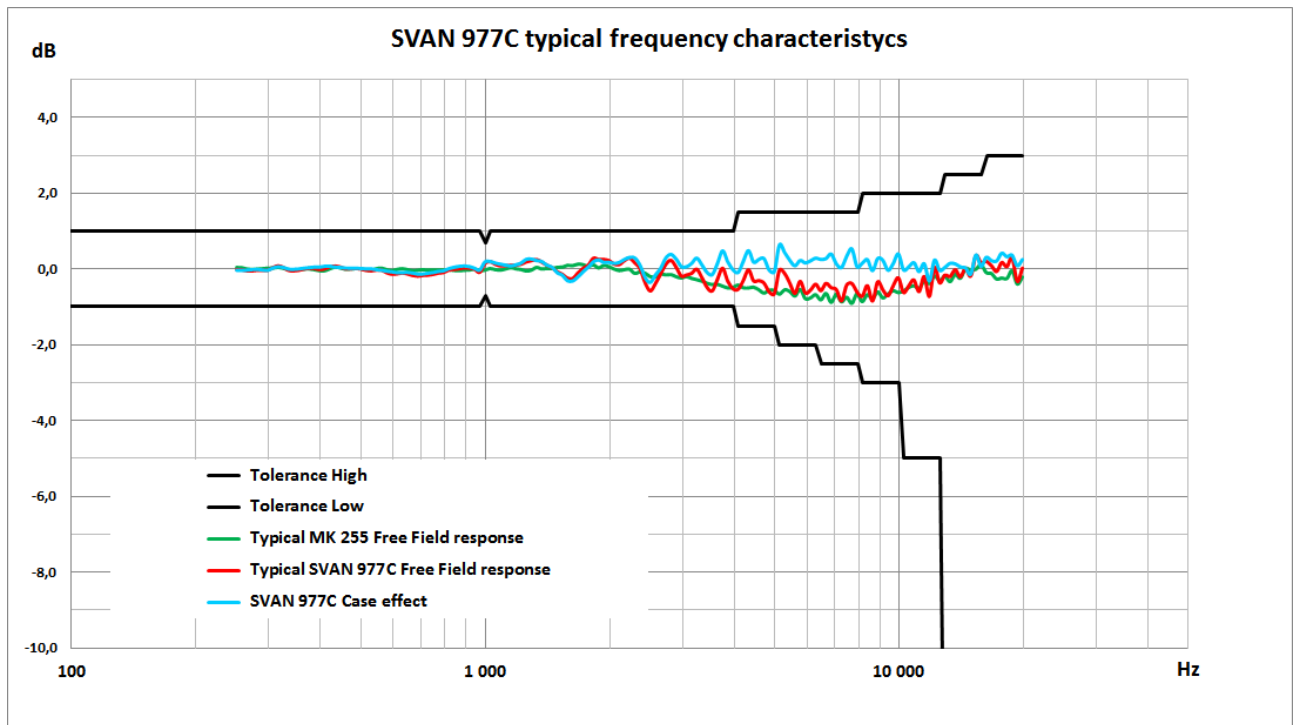
Table C.1.5.   SV 977D typical Free Field frequency characteristics and Case Effect

Frequency	MK 255 typical Free Field response	SV 977D typical Free Field response	SV 977D Case Effect	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
251	0.03	-0.01	-0.05	0.25
259	0.02	-0.02	-0.05	0.25
266	-0.01	-0.05	-0.04	0.25
274	-0.02	-0.05	-0.03	0.25
282	-0.01	-0.04	-0.02	0.25

Frequency	MK 255 typical Free Field response	SV 977D typical Free Field response	SV 977D Case Effect	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
290	0.00	-0.04	-0.04	0.25
299	0.02	-0.03	-0.05	0.25
307	0.02	0.03	0.01	0.25
316	0.04	0.08	0.05	0.25
325	0.01	0.04	0.03	0.25
335	-0.02	-0.04	-0.02	0.25
345	-0.03	-0.05	-0.02	0.25
355	-0.02	-0.04	-0.01	0.25
365	-0.01	0.00	0.01	0.25
376	0.00	0.02	0.02	0.25
387	-0.02	0.01	0.04	0.25
398	-0.05	-0.01	0.04	0.25
410	-0.05	0.00	0.06	0.25
422	0.00	0.06	0.06	0.25
434	0.04	0.08	0.04	0.25
447	0.02	0.05	0.03	0.25
460	-0.01	0.00	0.01	0.25
473	-0.01	0.00	0.01	0.25
487	0.00	0.01	0.01	0.25
501	0.00	0.00	0.00	0.25
516	-0.03	-0.04	-0.01	0.25
531	-0.04	-0.05	-0.01	0.25
546	0.00	-0.03	-0.03	0.25
562	0.02	-0.03	-0.04	0.25
579	-0.02	-0.10	-0.07	0.25
596	-0.05	-0.14	-0.09	0.25
613	-0.02	-0.13	-0.11	0.25
631	0.00	-0.11	-0.11	0.25
649	-0.02	-0.13	-0.11	0.25
668	-0.05	-0.17	-0.12	0.25
688	-0.04	-0.19	-0.15	0.25
708	-0.02	-0.17	-0.15	0.25
729	-0.04	-0.16	-0.12	0.25
750	-0.03	-0.14	-0.11	0.25
772	-0.03	-0.11	-0.08	0.25
794	-0.03	-0.09	-0.06	0.25
818	-0.03	-0.03	-0.01	0.25
841	-0.04	-0.01	0.03	0.25
866	-0.05	0.00	0.06	0.25
891	-0.04	0.03	0.07	0.25
917	-0.03	0.02	0.05	0.25
944	-0.01	0.00	0.01	0.25
972	-0.05	-0.09	-0.04	0.25
1 000	-0.04	0.14	0.17	0.25
1 029	0.01	0.19	0.19	0.25
1 059	-0.02	0.12	0.14	0.25
1 090	-0.04	0.08	0.11	0.25
1 122	-0.01	0.08	0.09	0.25
1 155	0.03	0.09	0.07	0.25
1 189	0.00	0.10	0.10	0.25

Frequency	MK 255 typical Free Field response	SV 977D typical Free Field response	SV 977D Case Effect	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
1 223	-0.02	0.12	0.14	0.25
1 259	-0.06	0.18	0.24	0.25
1 296	-0.04	0.21	0.25	0.25
1 334	0.03	0.24	0.21	0.25
1 372	-0.01	0.18	0.19	0.25
1 413	0.01	0.10	0.09	0.25
1 454	0.00	0.03	0.03	0.25
1 496	0.04	-0.07	-0.11	0.25
1 540	0.04	-0.14	-0.18	0.25
1 585	0.09	-0.24	-0.32	0.25
1 631	0.08	-0.25	-0.33	0.25
1 679	0.12	-0.11	-0.22	0.25
1 728	0.10	0.01	-0.09	0.25
1 778	0.06	0.10	0.03	0.25
1 830	0.10	0.28	0.18	0.25
1 884	0.02	0.25	0.23	0.25
1 939	0.08	0.25	0.16	0.25
1 995	0.05	0.22	0.16	0.25
2 054	-0.01	0.13	0.13	0.25
2 113	-0.05	0.11	0.16	0.25
2 175	-0.02	0.22	0.24	0.25
2 239	-0.01	0.28	0.29	0.25
2 304	-0.12	0.16	0.28	0.25
2 371	-0.08	0.01	0.10	0.25
2 441	-0.12	-0.35	-0.24	0.25
2 512	-0.20	-0.57	-0.37	0.25
2 585	-0.21	-0.38	-0.17	0.25
2 661	-0.13	-0.13	0.00	0.25
2 738	-0.16	0.11	0.27	0.25
2 818	-0.15	0.22	0.37	0.25
2 901	-0.20	0.05	0.25	0.25
2 985	-0.24	-0.18	0.05	0.25
3 073	-0.20	-0.16	0.04	0.25
3 162	-0.25	-0.11	0.13	0.25
3 255	-0.28	-0.01	0.28	0.25
3 350	-0.32	-0.23	0.09	0.25
3 447	-0.37	-0.48	-0.11	0.25
3 548	-0.41	-0.57	-0.16	0.25
3 652	-0.40	-0.27	0.13	0.25
3 758	-0.45	0.02	0.47	0.25
3 868	-0.49	-0.32	0.18	0.25
3 981	-0.48	-0.51	-0.03	0.25
4 097	-0.42	-0.53	-0.11	0.35
4 217	-0.49	-0.30	0.19	0.35
4 340	-0.50	-0.02	0.47	0.35
4 467	-0.48	-0.31	0.17	0.35
4 597	-0.54	-0.30	0.24	0.35
4 732	-0.63	-0.37	0.26	0.35
4 870	-0.55	-0.59	-0.04	0.35
5 012	-0.56	-0.64	-0.09	0.35

Frequency	MK 255 typical Free Field response	SV 977D typical Free Field response	SV 977D Case Effect	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
5 158	-0.66	-0.03	0.62	0.35
5 309	-0.54	-0.12	0.42	0.35
5 464	-0.59	-0.37	0.21	0.35
5 623	-0.70	-0.63	0.07	0.35
5 788	-0.53	-0.32	0.21	0.35
5 957	-0.77	-0.62	0.15	0.35
6 131	-0.75	-0.55	0.20	0.35
6 310	-0.67	-0.40	0.27	0.35
6 494	-0.80	-0.56	0.24	0.35
6 683	-0.64	-0.38	0.26	0.35
6 879	-0.87	-0.49	0.38	0.35
7 079	-0.66	-0.54	0.12	0.35
7 286	-0.85	-0.83	0.03	0.35
7 499	-0.74	-0.42	0.32	0.35
7 718	-0.90	-0.38	0.52	0.35
7 943	-0.65	-0.60	0.05	0.35
8 175	-0.85	-0.71	0.14	0.35
8 414	-0.67	-0.43	0.24	0.35
8 660	-0.78	-0.83	-0.06	0.35
8 913	-0.60	-0.33	0.26	0.35
9 173	-0.76	-0.54	0.21	0.35
9 441	-0.65	-0.70	-0.05	0.35
9 716	-0.57	-0.44	0.13	0.35
10 000	-0.62	-0.23	0.38	0.35
10 292	-0.58	-0.61	-0.04	0.35
10 593	-0.48	-0.44	0.04	0.35
10 902	-0.44	-0.28	0.16	0.35
11 220	-0.51	-0.59	-0.08	0.35
11 548	-0.32	-0.20	0.13	0.35
11 885	-0.38	-0.71	-0.33	0.35
12 232	-0.19	0.04	0.22	0.35
12 589	-0.31	-0.36	-0.05	0.35
12 957	-0.19	-0.16	0.03	0.35
13 335	-0.33	-0.20	0.14	0.35
13 725	-0.14	-0.02	0.12	0.35
14 125	-0.25	-0.21	0.04	0.35
14 538	0.00	0.02	0.01	0.35
14 962	-0.04	-0.19	-0.15	0.35
15 399	-0.01	0.34	0.36	0.35
15 849	0.10	0.16	0.06	0.35
16 312	-0.10	0.20	0.30	0.35
16 788	-0.12	0.09	0.21	0.35
17 278	-0.26	-0.07	0.20	0.35
17 783	-0.24	0.17	0.41	0.35
18 302	-0.25	0.06	0.31	0.35
18 836	-0.05	0.30	0.35	0.35
19 387	-0.39	-0.32	0.07	0.35
19 953	-0.21	0.02	0.23	0.35

Table C.1.6. SV 977D combined Free Field correction with the use of the electrostatic actuator for 0 deg incidence angle (microphone corrections + Case Effect)

[dB]	Frequency [Hz]																
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800
Correction factors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.05	0.0	-0.03	-0.07	-0.17	-0.10
Complex uncertainty	--	--	--	--	--	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35

[dB]	Frequency [Hz]													
	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Correction factors	0.13	0.21	-0.30	0.29	-0.07	0.68	0.97	1.46	2.48	3.40	5.21	6.89	9.22	11.82
Complex uncertainty	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.49	0.49	0.49	0.49	0.61	0.61	0.61

SV 977D directional characteristics

Directional response of SV 977D with the MK 255 microphone and SV 12L preamplifier for specified frequencies.
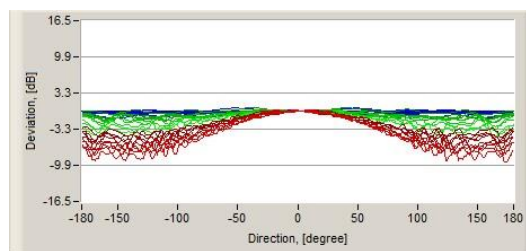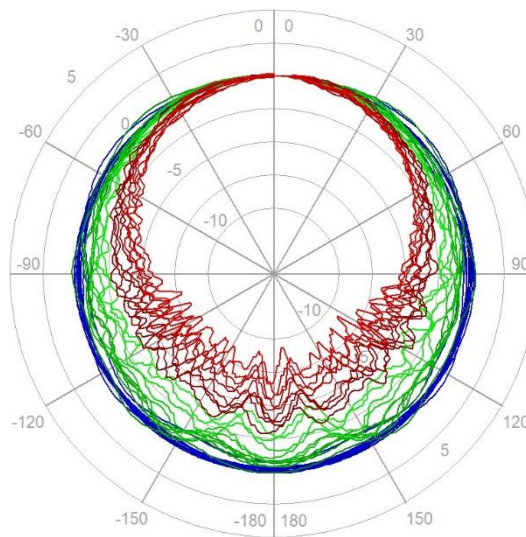
Combined typical directional characteristics

The round charts show the directional characteristic and the charts below shows the errors for angles.

250 Hz

250Hz

250Hz

315 Hz

315Hz

315Hz

400 Hz

400Hz

400Hz

500 Hz

500Hz

500Hz

630 Hz

630Hz

800 Hz

800Hz

1000 Hz

1000Hz

1250 Hz

1250Hz

1600 Hz

1600Hz

2000 Hz

2000Hz

2240 Hz

2240Hz
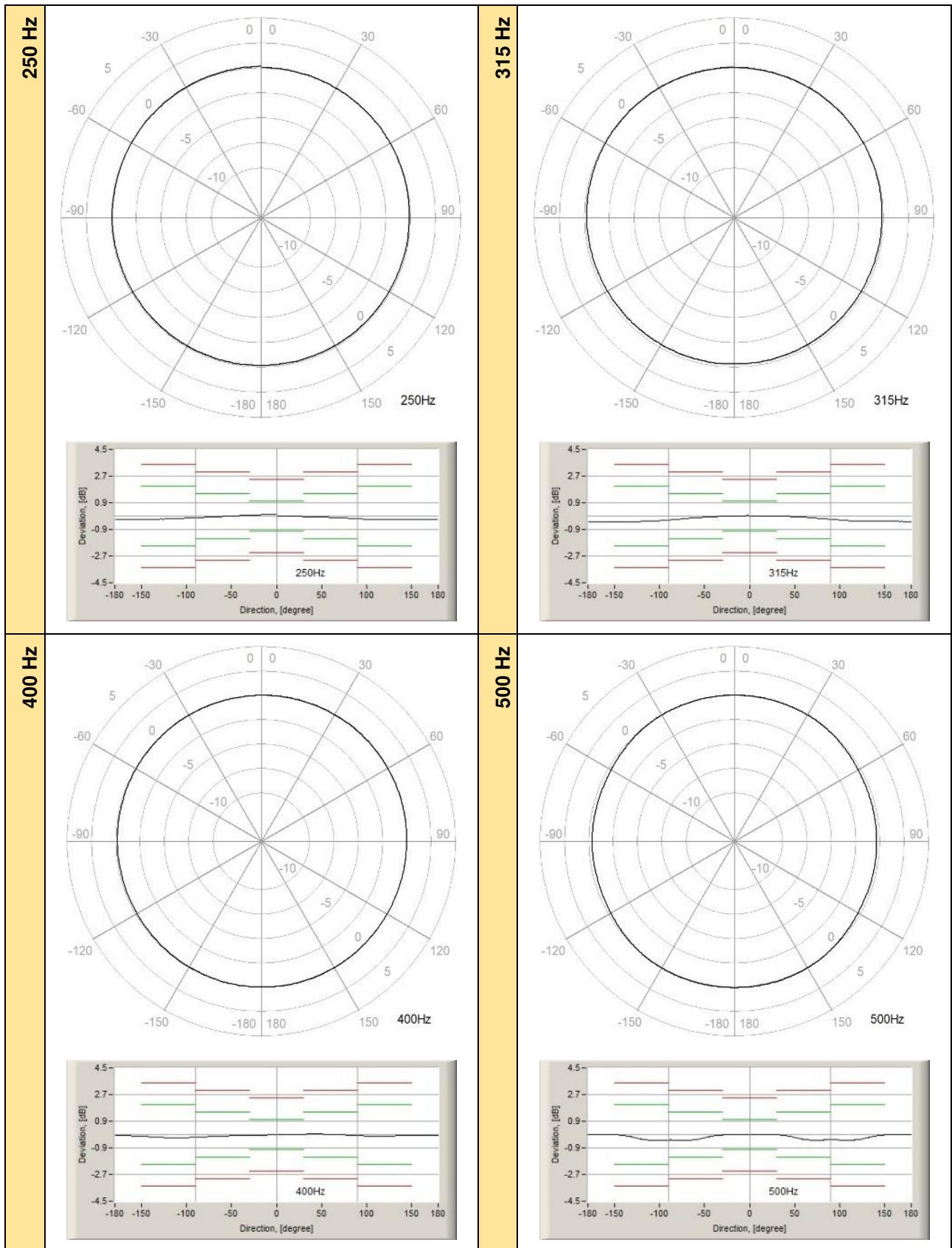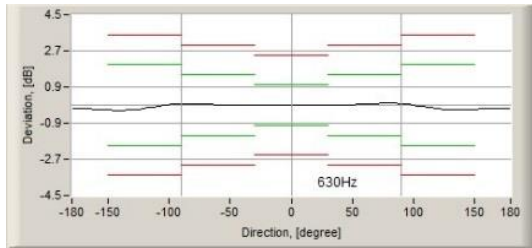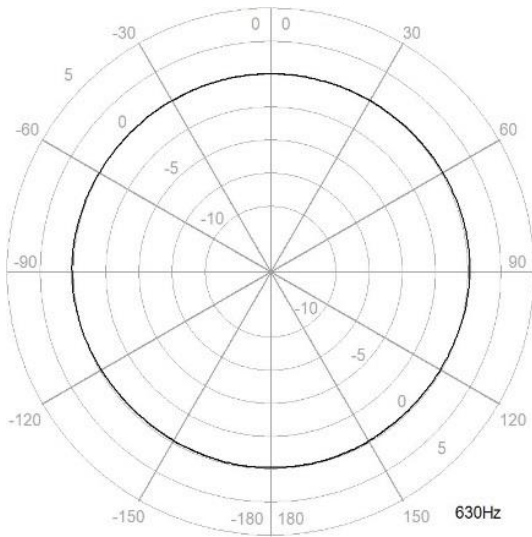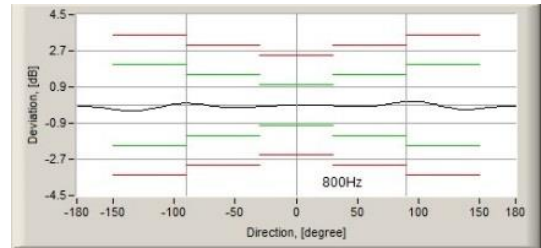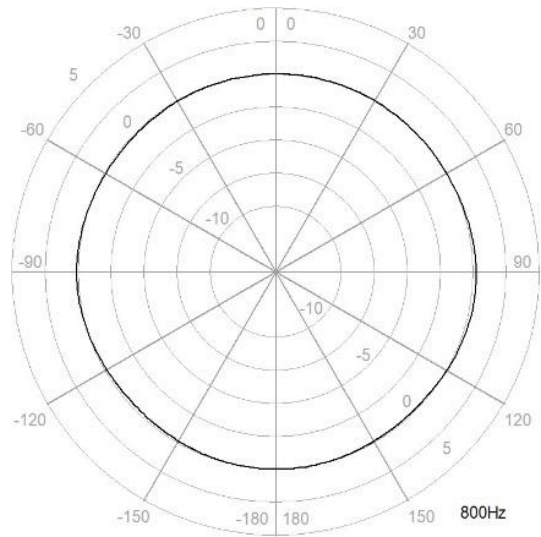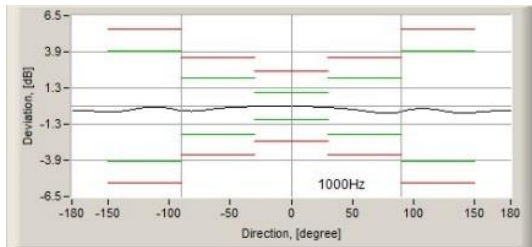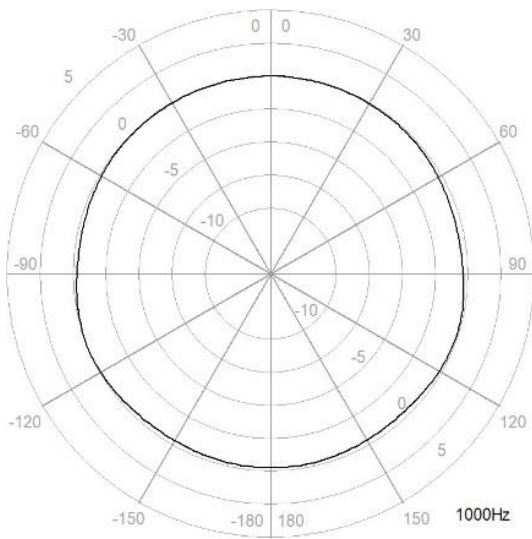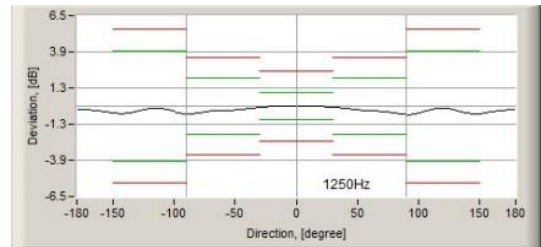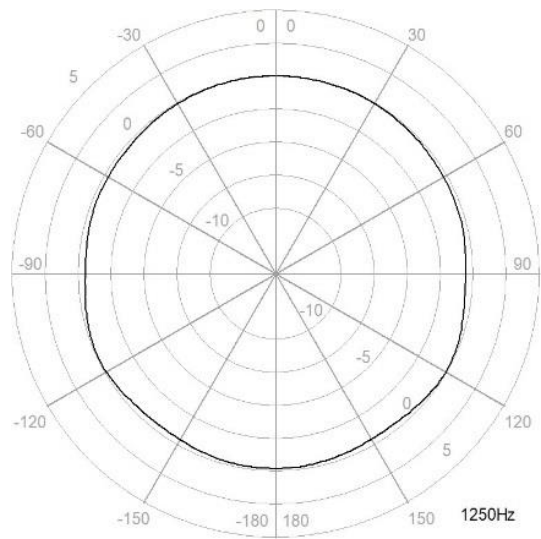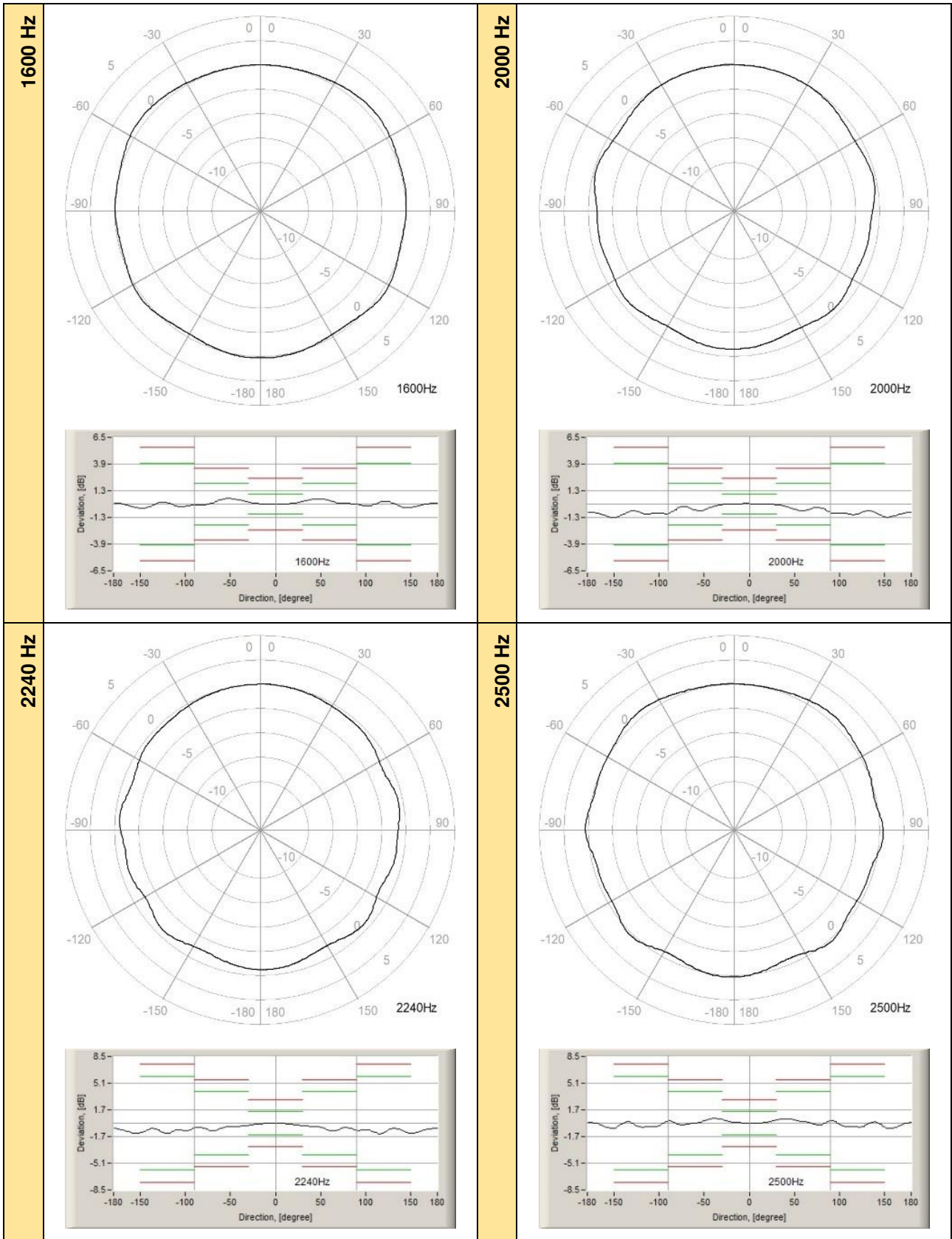
2500 Hz

2500Hz

2800 Hz

3150 Hz

3550 Hz

4000 Hz

4500 Hz

4500Hz

5000 Hz

5000Hz

5600 Hz

5600Hz

6300 Hz

6300Hz

7100 Hz

7100Hz

8000 Hz

8000Hz

8500 Hz

8500Hz

9000 Hz

9000Hz

9500 Hz

9500Hz

10000 Hz

10000Hz

10600 Hz

10600Hz

11200 Hz

11200Hz

11800 Hz
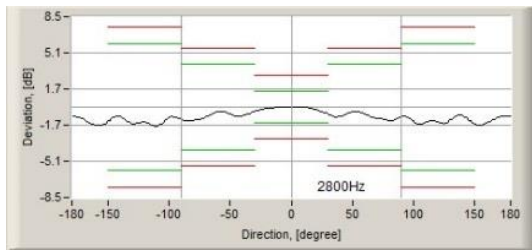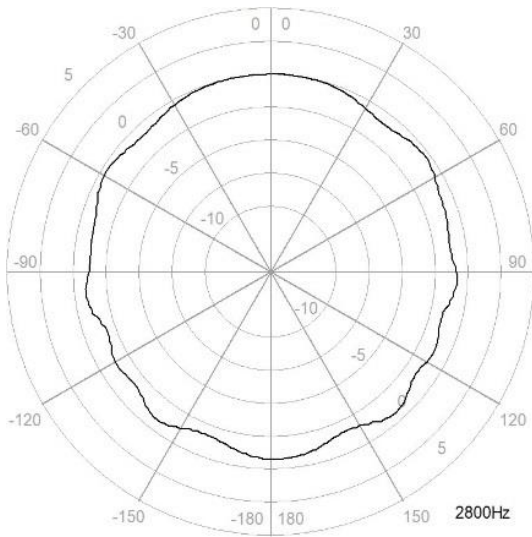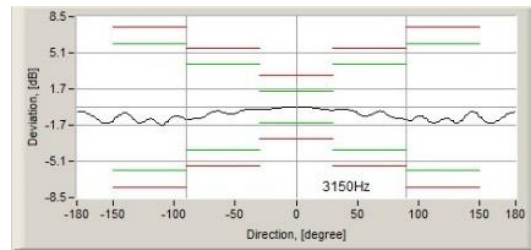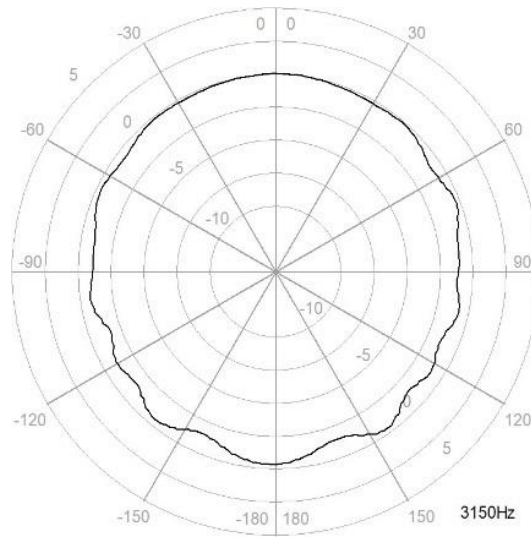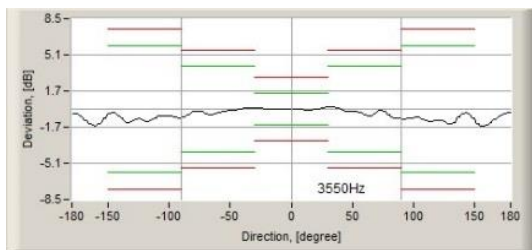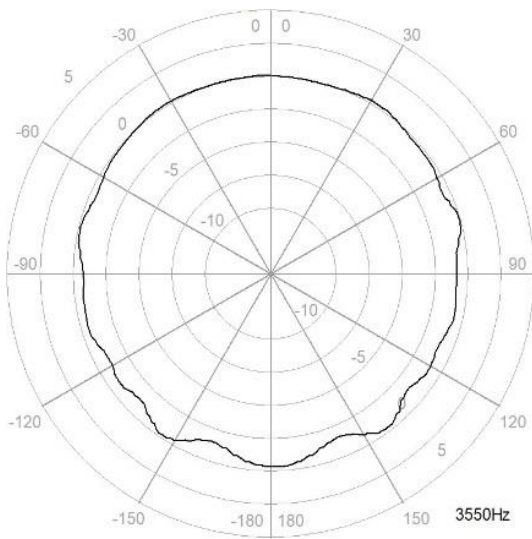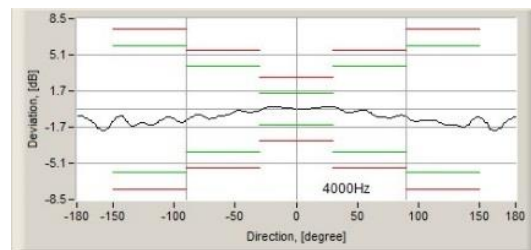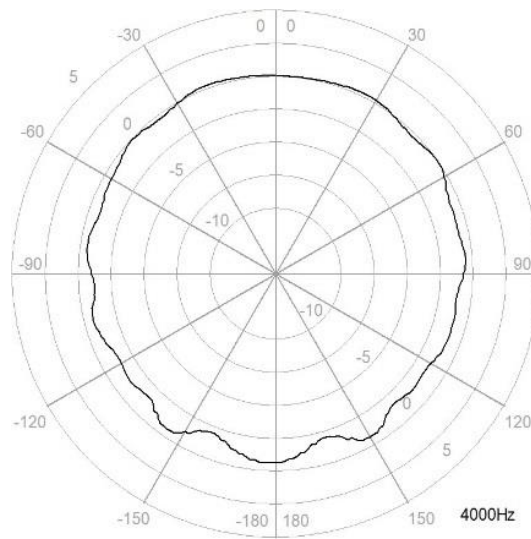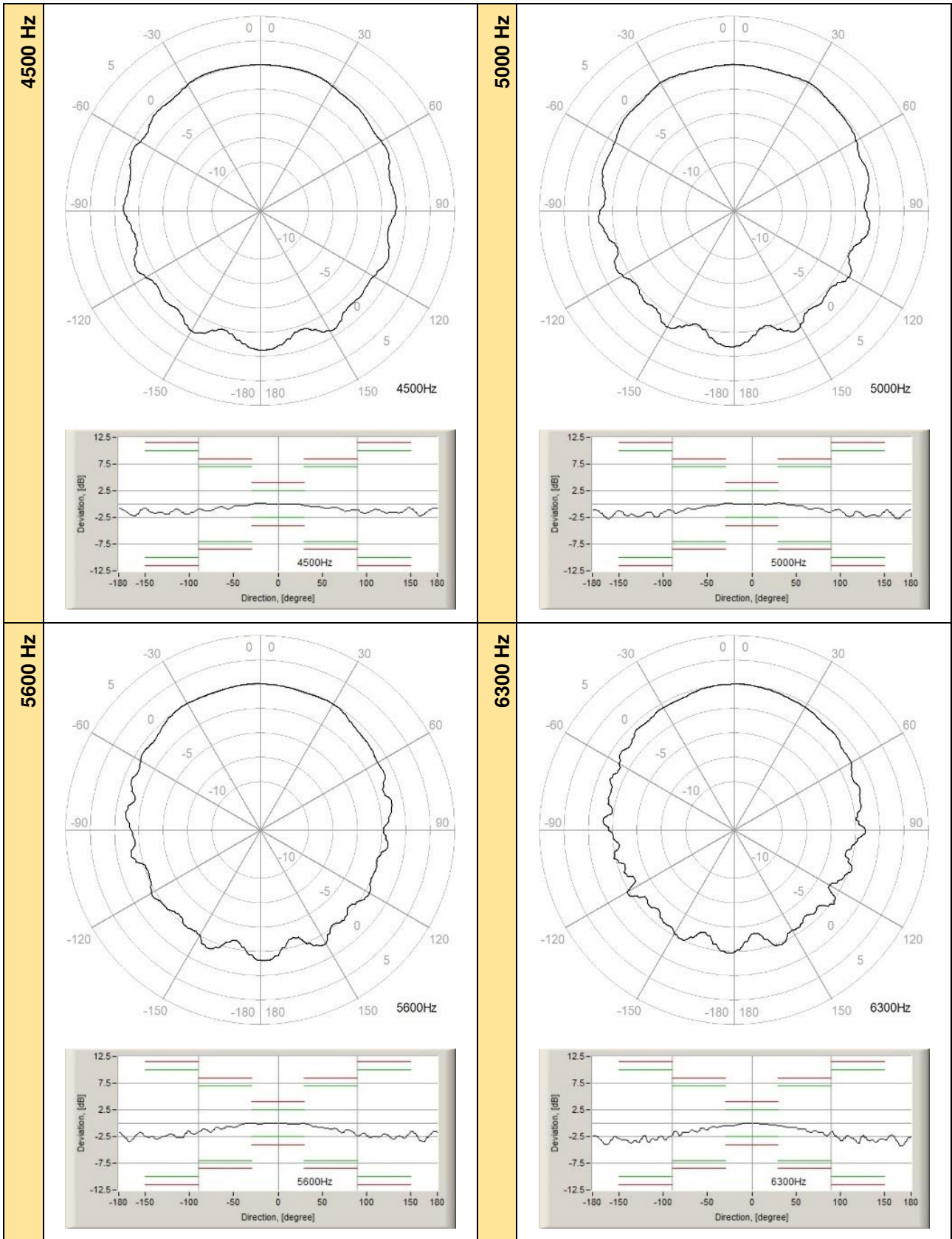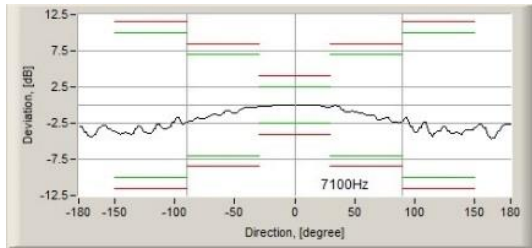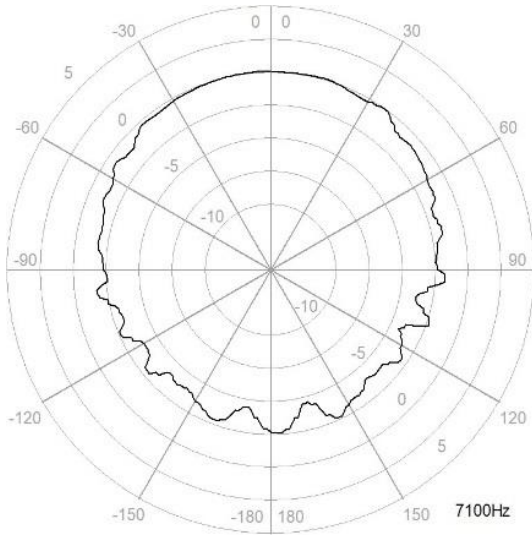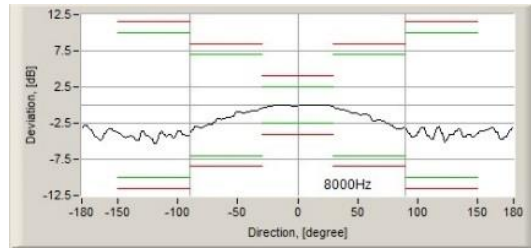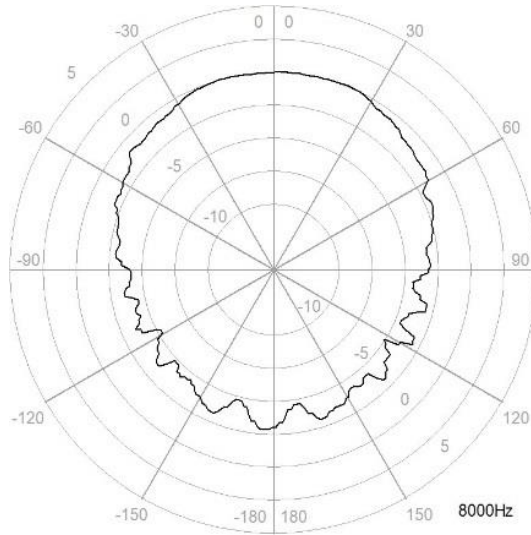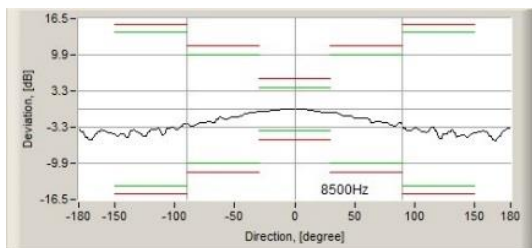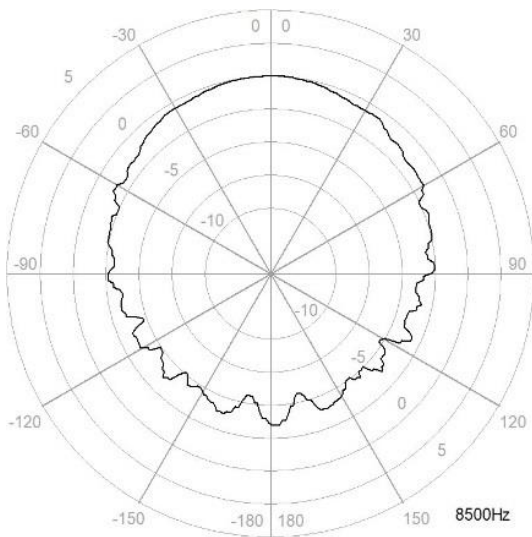
12500 Hz
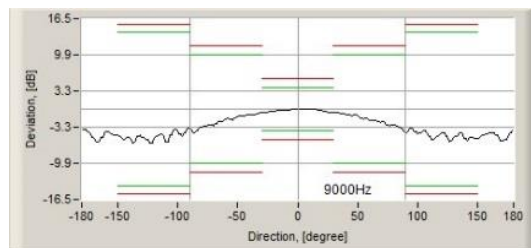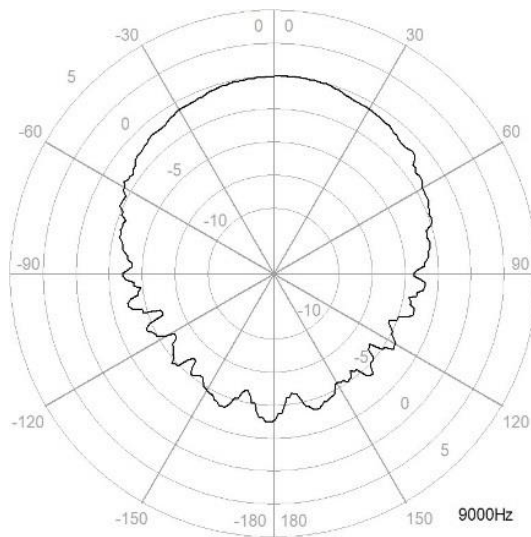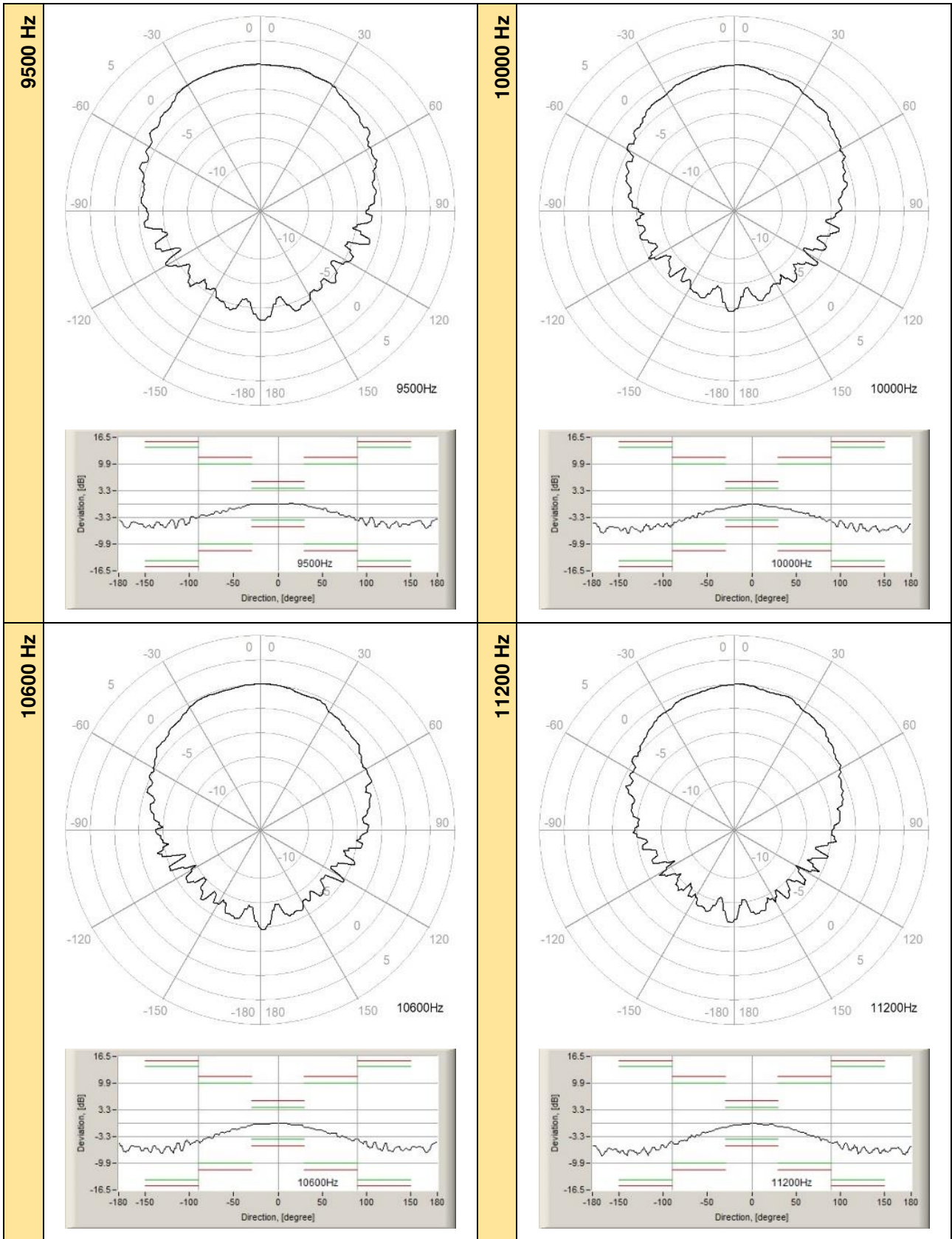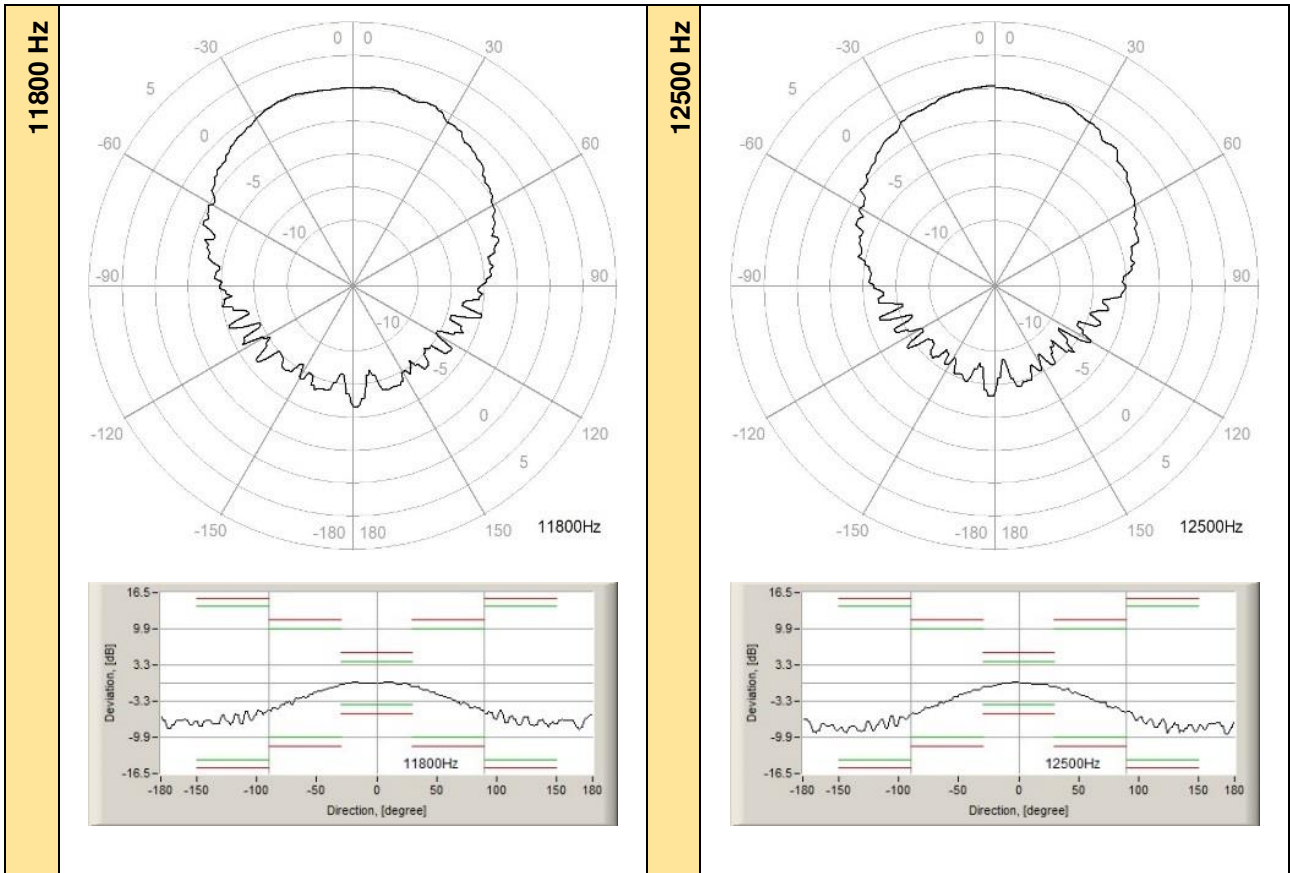
Table C.1.7.   Typical directional response of SV 977D

Frequency	Angle [º]									
[Hz]	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
250	0.00	-0.01	-0.03	-0.05	-0.07	-0.10	-0.13	-0.15	-0.18	-0.20
315	0.02	0.02	0.01	-0.02	-0.04	-0.08	-0.12	-0.17	-0.22	-0.26
400	0.01	0.02	0.02	0.03	0.03	0.02	-0.01	-0.04	-0.07	-0.09
500	0.01	0.01	-0.01	-0.07	-0.20	-0.32	-0.37	-0.38	-0.37	-0.37
630	0.00	0.00	0.00	0.00	0.02	0.05	0.08	0.10	0.10	0.07
800	0.01	-0.01	-0.03	-0.05	-0.07	-0.07	-0.05	0.10	0.18	0.19
1 000	-0.02	-0.05	-0.11	-0.15	-0.25	-0.37	-0.46	-0.51	-0.50	-0.35
1 250	-0.01	-0.03	-0.09	-0.17	-0.27	-0.33	-0.38	-0.52	-0.61	-0.61
1 600	0.01	0.09	0.25	0.45	0.52	0.50	0.27	0.06	0.05	-0.19
2 000	0.01	-0.01	-0.06	-0.22	-0.52	-0.68	-0.64	-0.37	-0.87	-0.93
2 240	-0.05	-0.17	-0.34	-0.38	-0.51	-0.98	-1.00	-0.74	-0.91	-0.91
2 500	0.02	0.14	0.40	0.57	0.56	0.32	0.17	-0.25	0.32	0.32
2 800	-0.03	-0.23	-0.78	-0.92	-0.82	-0.79	-1.01	-1.31	-1.31	-1.28
3 150	-0.03	-0.20	-0.28	-0.26	-0.60	-0.87	-0.61	-1.02	-1.19	-1.24
3 550	-0.06	-0.07	0.19	0.20	-0.26	-0.50	-0.65	-0.55	-0.91	-0.91
4 000	0.04	0.17	0.22	-0.27	-0.34	-0.32	-0.79	-0.82	-0.78	-1.20
4 500	0.03	0.06	-0.25	-0.42	-0.69	-0.80	-0.96	-1.34	-1.14	-1.73
5 000	-0.05	-0.09	0.24	0.23	-0.25	-0.56	-0.96	-1.01	-1.61	-1.31
5 600	-0.08	-0.16	-0.14	-0.56	-0.83	-1.10	-1.56	-1.80	-2.36	-2.39
6 300	-0.08	-0.32	-0.44	-0.78	-0.99	-1.25	-1.73	-1.88	-2.46	-3.26
7 100	0.04	0.05	-0.30	-0.57	-0.98	-1.40	-1.98	-2.27	-2.54	-3.80
8 000	-0.02	0.03	-0.40	-0.74	-1.23	-1.90	-2.26	-3.06	-3.35	-4.40
8 500	-0.12	-0.49	-0.72	-1.25	-1.66	-1.93	-2.55	-2.87	-3.42	-3.97
9 000	-0.02	-0.32	-0.61	-0.96	-1.20	-2.01	-2.43	-3.09	-4.36	-4.62
9 500	0.08	0.15	-0.19	-0.86	-1.35	-2.09	-2.76	-3.17	-4.14	-5.42

10 000	-0.26	-0.63	-0.98	-1.24	-1.85	-2.50	-2.99	-3.75	-4.28	-5.52
10 600	-0.14	-0.42	-0.95	-1.44	-1.88	-2.66	-3.51	-3.82	-4.42	-5.10
11 200	-0.28	-0.38	-0.82	-1.08	-1.84	-2.51	-3.16	-4.23	-4.94	-5.92
11 800	0.18	-0.20	-0.66	-1.20	-2.07	-2.77	-3.82	-4.57	-5.52	-6.57
12 500	-0.16	-0.28	-0.66	-1.27	-2.13	-2.79	-3.57	-4.49	-5.35	-6.73
f [Hz]	**100-110**	**110-120**	**120-130**	**130-140**	**140-150**	**150-160**	**160-170**	**170-180**	**180-190**	**190-200**
250	-0.22	-0.24	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.24	-0.24
315	-0.31	-0.33	-0.34	-0.36	-0.36	-0.36	-0.37	-0.37	-0.38	-0.38
400	-0.10	-0.10	-0.10	-0.09	-0.07	-0.05	-0.04	-0.05	-0.07	-0.09
500	-0.38	-0.38	-0.34	-0.21	-0.09	-0.02	0.01	0.01	0.01	0.01
630	-0.10	-0.19	-0.23	-0.23	-0.23	-0.20	-0.17	-0.16	-0.18	-0.21
800	0.17	-0.09	-0.18	-0.22	-0.21	-0.17	-0.11	-0.06	-0.08	-0.14
1 000	-0.22	-0.29	-0.44	-0.50	-0.50	-0.44	-0.38	-0.32	-0.33	-0.38
1 250	-0.47	-0.21	-0.33	-0.50	-0.55	-0.53	-0.38	-0.29	-0.28	-0.38
1 600	-0.19	0.28	0.28	-0.31	-0.36	-0.32	-0.10	0.10	0.10	-0.26
2 000	-0.97	-1.02	-0.90	-0.89	-1.25	-1.27	-1.17	-0.88	-0.89	-1.15
2 240	-1.22	-1.35	-1.04	-0.97	-1.30	-1.29	-1.05	-0.70	-0.88	-1.24
2 500	-0.44	-0.48	-0.49	0.16	-0.53	-0.67	-0.57	-0.12	0.10	-0.49
2 800	-1.64	-1.46	-1.57	-1.20	-1.58	-1.69	-1.35	-0.88	-1.20	-1.74
3 150	-1.37	-1.50	-1.45	-1.50	-0.92	-1.52	-1.49	-0.80	-0.70	-1.44
3 550	-1.05	-1.19	-1.43	-1.40	-1.15	-1.62	-1.47	-0.61	-1.01	-1.55
4 000	-1.10	-1.51	-1.54	-1.71	-1.45	-1.88	-2.06	-1.31	-1.10	-2.04
4 500	-1.61	-1.67	-1.68	-1.65	-1.30	-2.11	-2.14	-1.08	-1.51	-2.26
5 000	-2.42	-2.40	-2.37	-2.33	-2.31	-2.39	-2.80	-2.08	-1.78	-2.74
5 600	-2.65	-2.59	-2.98	-2.98	-2.76	-3.32	-3.49	-1.98	-3.18	-3.36
6 300	-3.34	-3.69	-3.15	-3.54	-3.44	-3.06	-4.16	-3.88	-3.10	-4.05
7 100	-3.80	-4.36	-3.92	-4.02	-3.51	-3.75	-4.62	-3.20	-4.42	-4.35
8 000	-4.49	-4.61	-5.12	-4.40	-4.32	-3.59	-4.67	-4.68	-4.40	-4.81
8 500	-4.29	-5.32	-5.32	-5.12	-5.12	-4.42	-5.70	-4.88	-5.64	-5.23
9 000	-5.01	-5.56	-6.02	-5.43	-5.70	-5.08	-5.73	-5.86	-5.67	-5.94
9 500	-5.47	-5.67	-6.03	-5.48	-5.23	-4.49	-5.96	-5.29	-5.91	-5.71
10 000	-6.04	-6.88	-6.55	-6.85	-6.93	-6.54	-6.99	-6.99	-6.94	-7.13
10 600	-6.23	-6.83	-6.99	-6.89	-6.89	-5.90	-7.24	-6.70	-7.19	-6.10
11 200	-6.52	-7.71	-7.20	-7.51	-7.45	-7.31	-7.72	-7.82	-7.95	-7.95
11 800	-7.25	-7.73	-7.54	-7.83	-7.95	-6.85	-8.51	-8.13	-8.26	-7.01
12 500	-7.43	-8.13	-9.17	-9.10	-8.83	-8.40	-7.84	-9.37	-9.08	-8.57
f [Hz]	**200-210**	**210-220**	**220-230**	**230-240**	**240-250**	**250-260**	**260-270**	**270-280**	**280-290**	**290-300**
250	-0.23	-0.22	-0.21	-0.20	-0.18	-0.16	-0.14	-0.11	-0.08	-0.05
315	-0.39	-0.39	-0.39	-0.38	-0.36	-0.34	-0.29	-0.25	-0.20	-0.15
400	-0.12	-0.16	-0.19	-0.21	-0.21	-0.21	-0.20	-0.17	-0.15	-0.12
500	-0.01	-0.06	-0.19	-0.31	-0.38	-0.39	-0.38	-0.37	-0.39	-0.38
630	-0.25	-0.26	-0.26	-0.22	-0.14	-0.05	0.07	0.07	0.06	0.03
800	-0.22	-0.28	-0.29	-0.27	-0.17	-0.06	0.09	0.09	-0.04	-0.11
1 000	-0.42	-0.42	-0.36	-0.21	-0.08	-0.16	-0.33	-0.37	-0.36	-0.27
1 250	-0.50	-0.54	-0.50	-0.31	-0.17	-0.41	-0.57	-0.57	-0.46	-0.34
1 600	-0.42	-0.41	-0.21	0.20	-0.19	-0.24	-0.17	-0.07	0.11	0.47
2 000	-1.31	-1.28	-0.96	-0.90	-1.00	-0.93	-0.94	-0.85	-0.33	-0.60
2 240	-1.31	-1.12	-0.90	-1.30	-1.24	-0.97	-0.97	-0.59	-0.98	-0.97
2 500	-0.66	-0.49	0.17	-0.49	-0.49	-0.45	0.28	0.28	-0.18	-0.09
2 800	-1.75	-1.11	-1.60	-1.59	-1.82	-1.75	-1.27	-1.30	-1.20	-0.87
3 150	-1.54	-0.93	-1.45	-1.45	-1.69	-1.56	-1.14	-1.16	-1.01	-0.48
3 550	-1.37	-0.85	-1.28	-1.13	-1.15	-0.65	-0.82	-0.74	-0.39	-0.52
4 000	-2.04	-1.12	-1.59	-1.52	-1.50	-0.99	-1.23	-0.82	-0.91	-0.82
4 500	-1.84	-1.77	-1.77	-1.92	-1.34	-1.95	-1.64	-1.27	-1.26	-0.79
5 000	-2.31	-2.16	-2.32	-2.42	-2.30	-2.45	-1.48	-1.71	-1.25	-0.94

5 600	-2.56	-2.69	-2.99	-2.46	-2.72	-2.65	-2.06	-1.58	-1.73	-1.09
6 300	-3.19	-3.23	-3.72	-3.57	-3.62	-3.19	-3.08	-2.30	-1.79	-1.66
7 100	-3.70	-4.01	-4.06	-3.92	-3.26	-3.23	-2.58	-2.24	-1.86	-1.40
8 000	-3.90	-4.55	-4.80	-5.29	-5.29	-4.48	-4.20	-3.44	-2.95	-2.05
8 500	-4.79	-5.14	-4.69	-4.92	-4.71	-4.31	-3.65	-3.13	-2.44	-2.46
9 000	-4.91	-5.52	-6.15	-6.21	-6.06	-5.95	-4.88	-4.24	-3.19	-2.66
9 500	-5.75	-6.04	-5.52	-5.82	-5.91	-5.14	-3.54	-2.99	-2.77	-2.35
10 000	-6.26	-7.26	-6.49	-7.02	-6.31	-5.66	-5.72	-4.57	-4.15	-3.40
10 600	-6.90	-7.13	-7.48	-6.81	-7.47	-6.87	-5.43	-5.00	-3.69	-2.89
11 200	-7.39	-8.00	-7.93	-7.49	-8.14	-6.70	-5.99	-5.19	-4.34	-3.46
11 800	-7.66	-7.93	-7.51	-7.63	-7.39	-6.86	-5.81	-5.08	-3.88	-2.99
12 500	-8.71	-8.99	-8.80	-8.60	-8.33	-7.86	-6.53	-5.63	-4.58	-4.22

f [Hz]	300-310	310-320	320-330	330-340	340-350	350-360				
250	-0.02	0.03	0.06	0.08	0.11	0.13				
315	-0.11	-0.07	-0.03	0.01	0.02	0.03				
400	-0.09	-0.07	-0.06	-0.04	-0.03	-0.02				
500	-0.33	-0.21	-0.07	-0.02	-0.01	0.00				
630	-0.01	-0.01	-0.01	-0.01	0.00	0.00				
800	-0.13	-0.13	-0.11	-0.07	-0.03	-0.01				
1 000	-0.14	-0.09	-0.05	-0.03	-0.02	-0.03				
1 250	-0.31	-0.27	-0.18	-0.09	-0.02	0.01				
1 600	0.53	0.51	0.33	0.14	0.04	0.01				
2 000	-0.66	-0.50	-0.18	-0.03	0.04	0.05				
2 240	-0.52	-0.42	-0.37	-0.19	-0.09	-0.03				
2 500	0.28	0.61	0.61	0.36	0.15	0.04				
2 800	-0.66	-0.85	-0.76	-0.27	-0.10	-0.03				
3 150	-0.65	-0.53	-0.21	-0.21	-0.14	-0.02				
3 550	-0.29	-0.12	0.13	0.10	0.04	0.05				
4 000	-0.57	-0.31	-0.34	0.23	0.22	0.10				
4 500	-0.89	-0.39	-0.39	0.16	0.13	0.03				
5 000	-0.76	-0.29	0.21	0.21	-0.05	0.02				
5 600	-0.75	-0.72	-0.11	-0.09	-0.09	0.04				
6 300	-1.23	-0.96	-0.73	-0.47	-0.33	-0.05				
7 100	-1.09	-1.09	-0.36	-0.18	-0.06	0.05				
8 000	-1.77	-1.07	-0.81	-0.38	-0.05	-0.09				
8 500	-1.87	-1.52	-0.71	-0.50	-0.27	-0.04				
9 000	-1.96	-1.34	-1.05	-0.63	-0.34	-0.11				
9 500	-1.85	-1.20	-0.68	0.04	0.06	0.08				
10 000	-2.63	-2.04	-1.23	-1.02	-0.60	-0.23				
10 600	-2.28	-1.56	-1.02	-0.38	-0.24	-0.08				
11 200	-2.97	-2.02	-1.39	-0.96	-0.50	-0.24				
11 800	-2.73	-1.49	-0.77	-0.30	0.13	-0.02				
12 500	-3.36	-2.15	-1.21	-0.69	-0.37	0.15				

C.1.2 Effect of the SA 22 windscreen

Note: *When using the SA22 windscreen the **Windscreen** compensation filter must be switched on to ensure good tolerances margin of the SV 977D frequency response.*
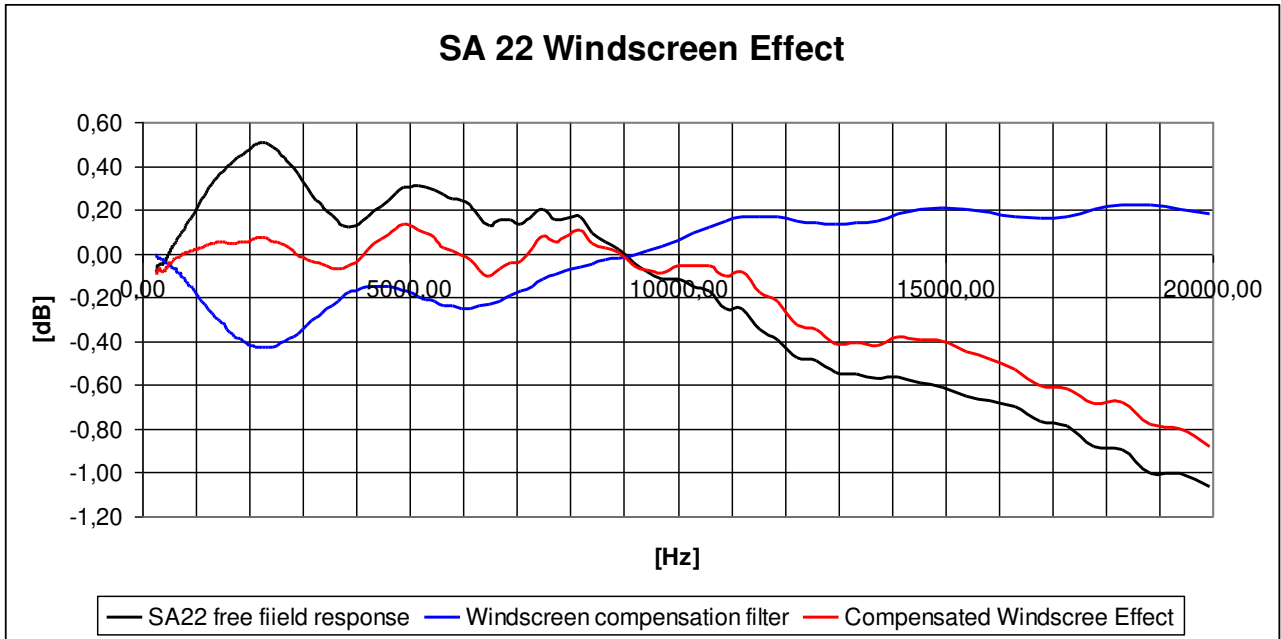
Windscreen SA22 Free Field response and compensated effect

Table C.1.8.   Effect of the SA 22 windscreen

Frequency [Hz]	SA 22 Free Field response [dB]	Compensation filter [dB]	Compensated SA 22 effect [dB]	Uncertainty (IEC 62585:2012) [dB]
251	-0.08	-0.01	-0.09	0.20
259	-0.08	-0.01	-0.09	0.20
266	-0.08	-0.01	-0.09	0.20
274	-0.07	-0.02	-0.09	0.20
282	-0.07	-0.02	-0.09	0.20
290	-0.06	-0.02	-0.08	0.20
299	-0.06	-0.02	-0.08	0.20
307	-0.05	-0.02	-0.07	0.20
316	-0.05	-0.02	-0.07	0.20
325	-0.05	-0.02	-0.07	0.20
335	-0.05	-0.02	-0.07	0.20
345	-0.05	-0.02	-0.07	0.20
355	-0.05	-0.03	-0.08	0.20
365	-0.05	-0.03	-0.08	0.20
376	-0.05	-0.03	-0.08	0.20
387	-0.05	-0.03	-0.08	0.20
398	-0.05	-0.03	-0.08	0.20

Frequency [Hz]	SA 22 Free Field response [dB]	Compensation filter [dB]	Compensated SA 22 effect [dB]	Uncertainty (IEC 62585:2012) [dB]
410	-0.05	-0.03	-0.08	0.20
422	-0.04	-0.04	-0.08	0.20
434	-0.03	-0.04	-0.07	0.20
447	-0.03	-0.04	-0.07	0.20
460	-0.02	-0.04	-0.06	0.20
473	-0.01	-0.05	-0.06	0.20
487	-0.01	-0.05	-0.06	0.20
501	0.00	-0.05	-0.05	0.20
516	0.01	-0.05	-0.04	0.20
531	0.01	-0.06	-0.05	0.20
546	0.02	-0.06	-0.04	0.20
562	0.03	-0.06	-0.03	0.20
579	0.03	-0.07	-0.04	0.20
596	0.04	-0.07	-0.03	0.20
613	0.05	-0.07	-0.02	0.20
631	0.05	-0.08	-0.03	0.20
649	0.06	-0.08	-0.02	0.20
668	0.07	-0.09	-0.02	0.20
688	0.08	-0.09	-0.01	0.20
708	0.08	-0.10	-0.02	0.20
729	0.09	-0.10	-0.01	0.20
750	0.10	-0.11	-0.01	0.20
772	0.11	-0.11	0.00	0.20
794	0.12	-0.12	0.00	0.20
818	0.12	-0.13	-0.01	0.20
841	0.13	-0.13	0.00	0.20
866	0.14	-0.14	0.00	0.20
891	0.15	-0.15	0.00	0.20
917	0.16	-0.15	0.01	0.20
944	0.17	-0.16	0.01	0.20
972	0.18	-0.17	0.01	0.20
1 000	0.19	-0.18	0.01	0.20
1 029	0.21	-0.19	0.02	0.20
1 059	0.22	-0.2	0.02	0.20
1 090	0.23	-0.21	0.02	0.20
1 122	0.25	-0.22	0.03	0.20
1 155	0.26	-0.23	0.03	0.20
1 189	0.28	-0.24	0.04	0.20
1 223	0.29	-0.25	0.04	0.20
1 259	0.30	-0.26	0.04	0.20
1 296	0.31	-0.27	0.04	0.20
1 334	0.33	-0.28	0.05	0.20
1 372	0.34	-0.29	0.05	0.20
1 413	0.35	-0.30	0.05	0.20
1 454	0.36	-0.31	0.05	0.20
1 496	0.37	-0.32	0.05	0.20
1 540	0.38	-0.33	0.05	0.20
1 585	0.39	-0.35	0.04	0.20
1 631	0.40	-0.36	0.04	0.20
1 679	0.41	-0.37	0.04	0.20
1 728	0.42	-0.38	0.04	0.20
1 778	0.43	-0.38	0.05	0.20
1 830	0.44	-0.39	0.05	0.20

Frequency [Hz]	SA 22 Free Field response [dB]	Compensation filter [dB]	Compensated SA 22 effect [dB]	Uncertainty (IEC 62585:2012) [dB]
1 884	0.45	-0.40	0.05	0.20
1 939	0.46	-0.40	0.06	0.20
1 995	0.47	-0.41	0.06	0.20
2 054	0.48	-0.42	0.06	0.20
2 113	0.50	-0.43	0.07	0.20
2 175	0.50	-0.43	0.07	0.20
2 239	0.50	-0.43	0.07	0.20
2 304	0.50	-0.43	0.07	0.20
2 371	0.50	-0.43	0.07	0.20
2 441	0.48	-0.43	0.05	0.20
2 512	0.47	-0.42	0.05	0.20
2 585	0.45	-0.41	0.04	0.20
2 661	0.44	-0.40	0.04	0.20
2 738	0.41	-0.39	0.02	0.20
2 818	0.39	-0.38	0.01	0.20
2 901	0.36	-0.37	-0.01	0.20
2 985	0.33	-0.35	-0.02	0.20
3 073	0.30	-0.33	-0.03	0.20
3 162	0.27	-0.31	-0.04	0.20
3 255	0.24	-0.29	-0.05	0.20
3 350	0.22	-0.27	-0.05	0.20
3 447	0.20	-0.25	-0.05	0.20
3 548	0.17	-0.24	-0.07	0.20
3 652	0.15	-0.22	-0.07	0.20
3 758	0.13	-0.2	-0.07	0.20
3 868	0.12	-0.18	-0.06	0.20
3 981	0.13	-0.17	-0.04	0.20
4 097	0.15	-0.16	-0.01	0.30
4 217	0.17	-0.15	0.02	0.30
4 340	0.19	-0.15	0.04	0.30
4 467	0.21	-0.15	0.06	0.30
4 597	0.24	-0.15	0.09	0.30
4 732	0.27	-0.16	0.11	0.30
4 870	0.30	-0.17	0.13	0.30
5 012	0.31	-0.18	0.13	0.30
5 158	0.31	-0.2	0.11	0.30
5 309	0.30	-0.21	0.09	0.30
5 464	0.29	-0.22	0.07	0.30
5 623	0.27	-0.24	0.03	0.30
5 788	0.25	-0.24	0.01	0.30
5 957	0.24	-0.25	-0.01	0.30
6 131	0.22	-0.25	-0.03	0.30
6 310	0.17	-0.24	-0.07	0.30
6 494	0.12	-0.23	-0.11	0.30
6 683	0.15	-0.22	-0.07	0.30
6 879	0.15	-0.19	-0.04	0.30
7 079	0.14	-0.17	-0.03	0.30
7 286	0.17	-0.15	0.02	0.30
7 499	0.20	-0.12	0.08	0.30
7 718	0.15	-0.10	0.05	0.30
7 943	0.16	-0.08	0.08	0.30
8 175	0.17	-0.06	0.11	0.30
8 414	0.09	-0.05	0.04	0.30

Frequency [Hz]	SA 22 Free Field response [dB]	Compensation filter [dB]	Compensated SA 22 effect [dB]	Uncertainty (IEC 62585:2012) [dB]
8 660	0.05	-0.03	0.02	0.30
8 913	0.02	-0.02	0.00	0.30
9 173	-0.04	-0.01	-0.05	0.30
9 441	-0.09	0.01	-0.08	0.30
9 716	-0.12	0.03	-0.09	0.30
10 000	-0.12	0.06	-0.06	0.30
10 292	-0.15	0.09	-0.06	0.30
10 593	-0.17	0.12	-0.05	0.30
10 902	-0.25	0.15	-0.10	0.30
11 220	-0.25	0.17	-0.08	0.30
11 548	-0.35	0.17	-0.18	0.30
11 885	-0.39	0.17	-0.22	0.30
12 232	-0.47	0.15	-0.32	0.30
12 589	-0.49	0.14	-0.35	0.30
12 957	-0.54	0.13	-0.41	0.30
13 335	-0.55	0.14	-0.41	0.30
13 725	-0.57	0.15	-0.42	0.30
14 125	-0.56	0.18	-0.38	0.30
14 538	-0.59	0.20	-0.39	0.30
14 962	-0.61	0.21	-0.40	0.30
15 399	-0.65	0.20	-0.45	0.30
15 849	-0.67	0.19	-0.48	0.30
16 312	-0.70	0.17	-0.53	0.30
16 788	-0.77	0.16	-0.61	0.30
17 278	-0.79	0.17	-0.62	0.30
17 783	-0.88	0.20	-0.68	0.30
18 302	-0.90	0.22	-0.68	0.30
18 836	-1.00	0.22	-0.78	0.30
19 387	-1.00	0.20	-0.80	0.30
19 953	-1.06	0.18	-0.88	0.30

Note: For the conformance of acoustical tests, the **Microphone** and **Free Field** compensations must be switched on and the **Windscreen** compensation must be switched off (path: <Menu> / Measurement / Compensation).

Directional characteristics of SV 977D with SA 22

Directional response of SV 977D with the MK 255 microphone, SV 12L preamplifier and SA 22 windscreen for specified frequencies.
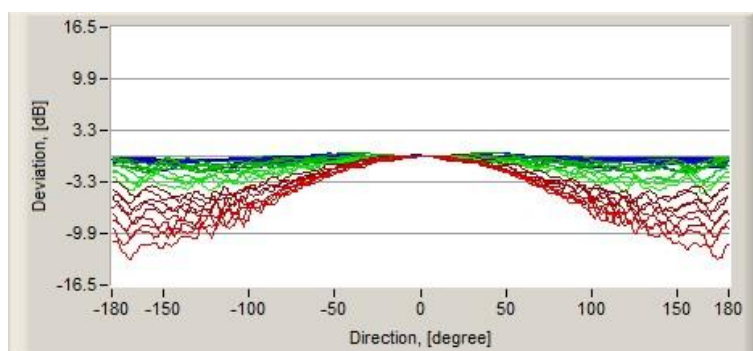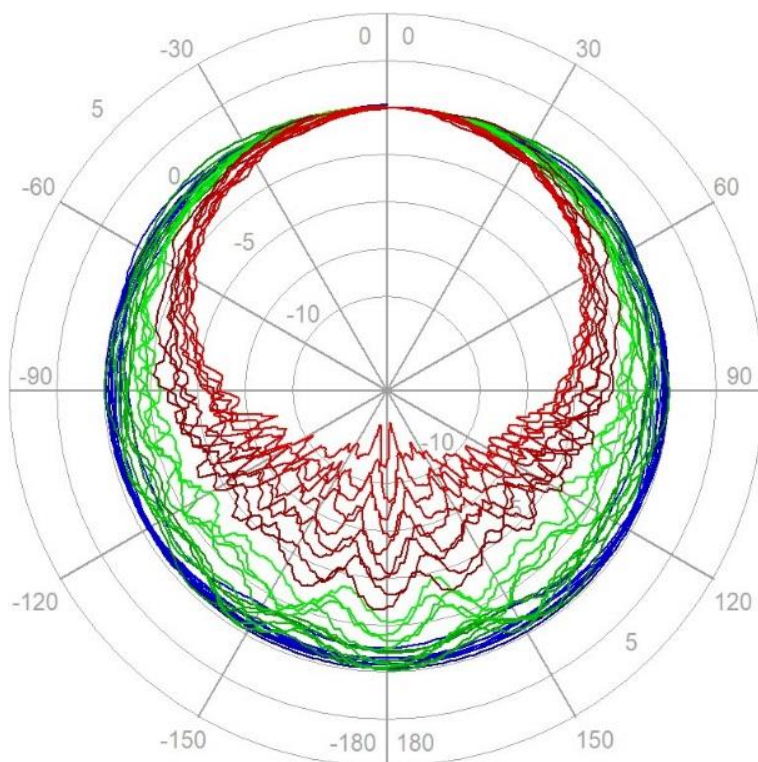
Combined typical directional characteristics

The round charts show the typical directional characteristic and the charts below shows the errors for angles.

250 Hz

250Hz

315 Hz

315Hz

400 Hz

400Hz

500 Hz

500Hz

630 Hz — 630Hz

800 Hz — 800Hz

1000 Hz — 1000Hz

1250 Hz — 1250Hz

1600 Hz

2000 Hz

2240 Hz

2500 Hz

2800 Hz

2800Hz

3150 Hz

3150Hz

3550 Hz

3550Hz

4000 Hz

4000Hz

4500 Hz

4500Hz

4500Hz

5000 Hz

5000Hz

5000Hz

5600 Hz

5600Hz

5600Hz

6300 Hz

6300Hz

6300Hz

7100 Hz

8000 Hz

8500 Hz

9000 Hz

9500 Hz

9500Hz

9500Hz

10000 Hz

10000Hz

10000Hz

10600 Hz

10600Hz

10600Hz

11200 Hz

11200Hz

11200Hz

11800 Hz
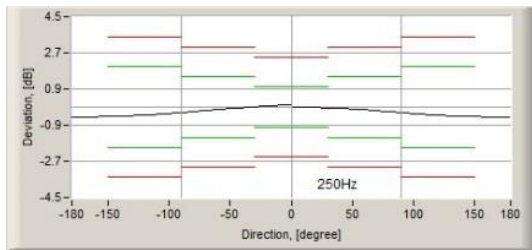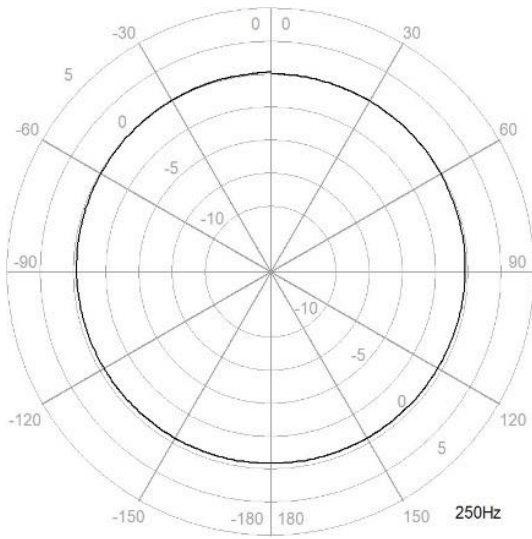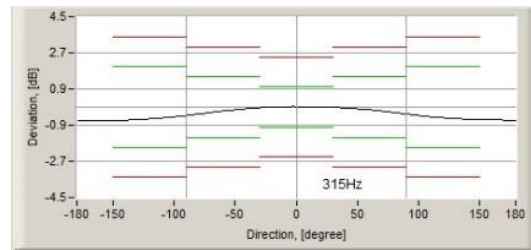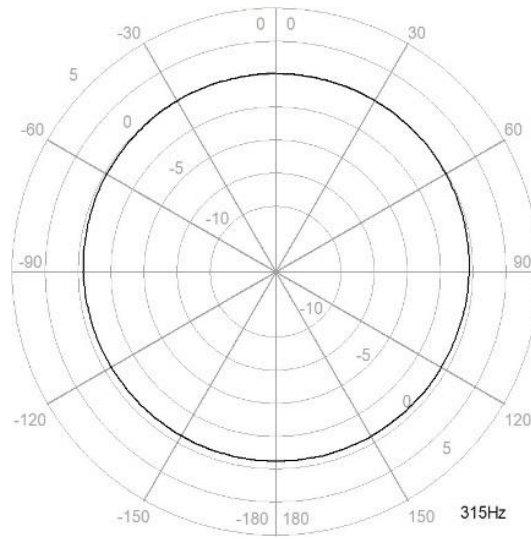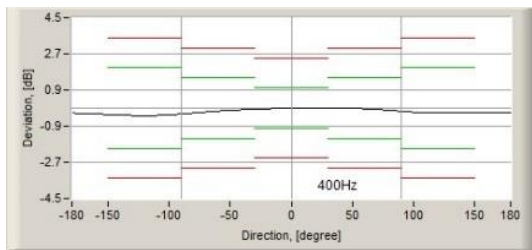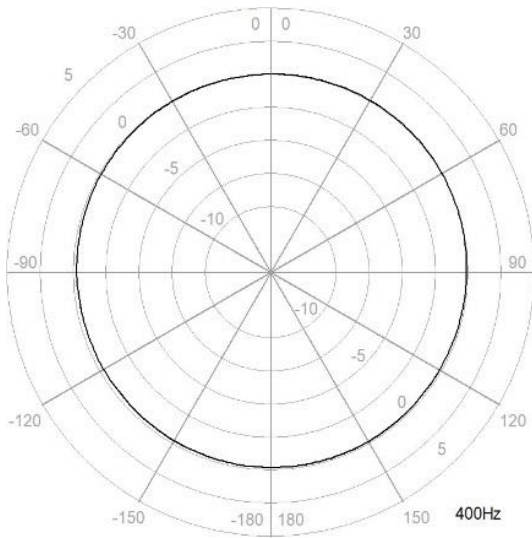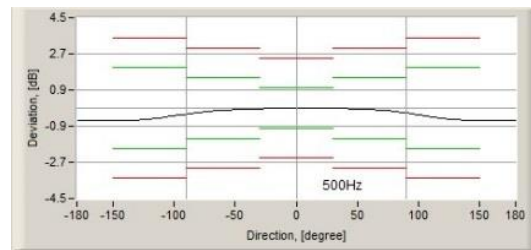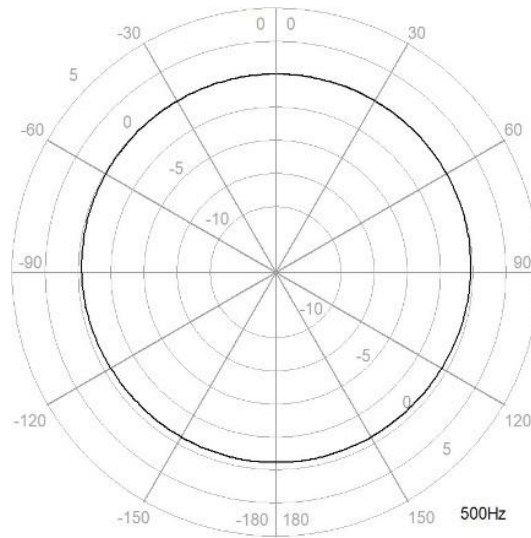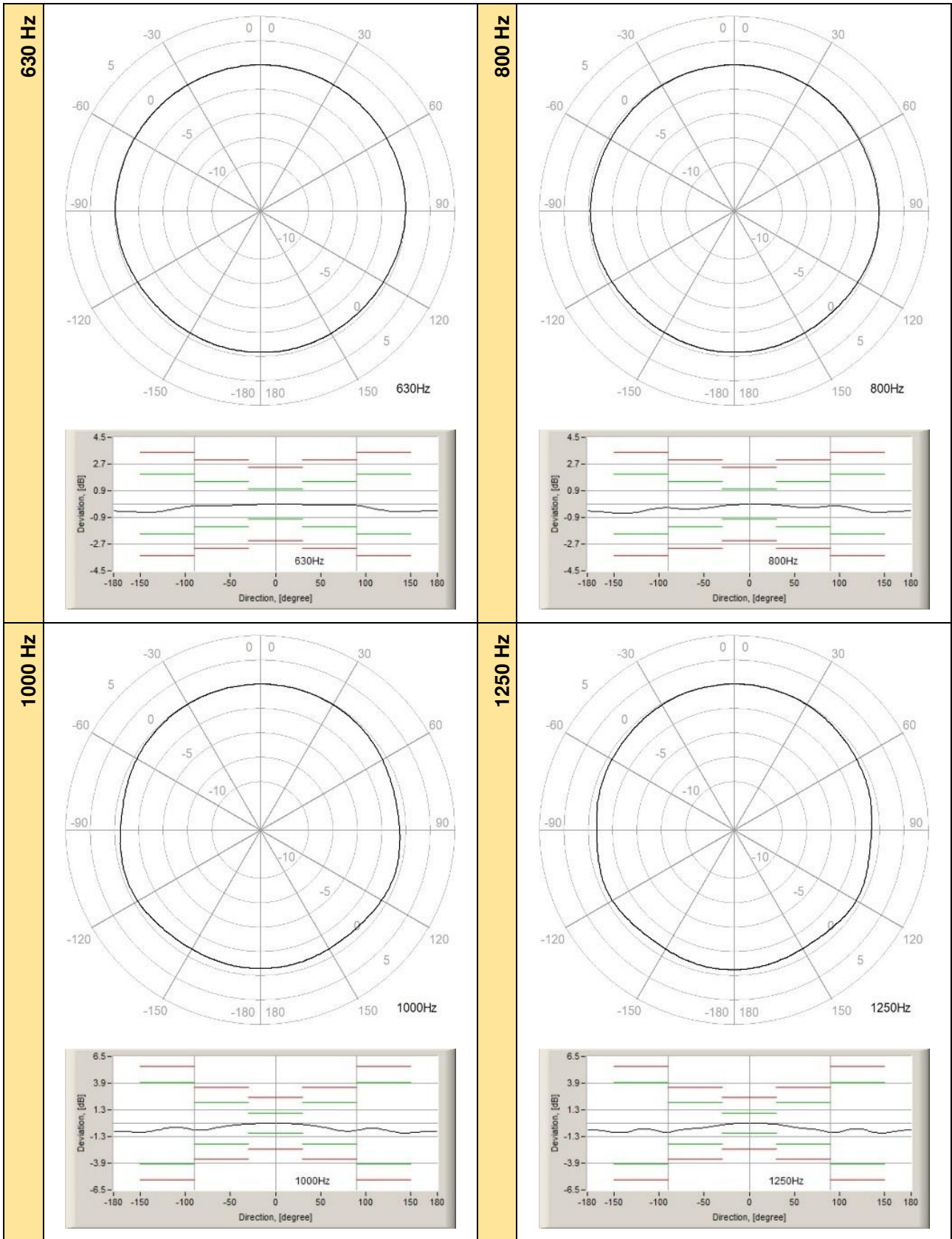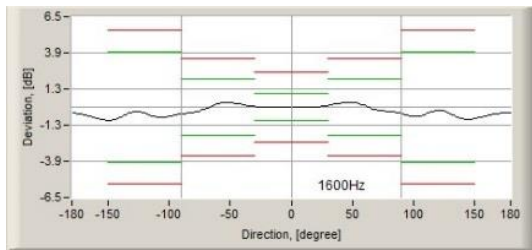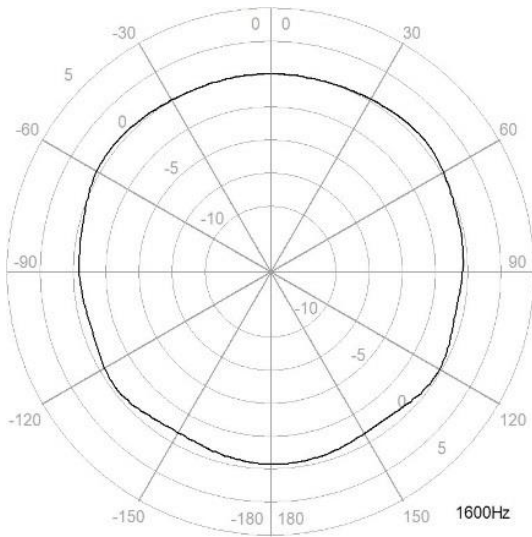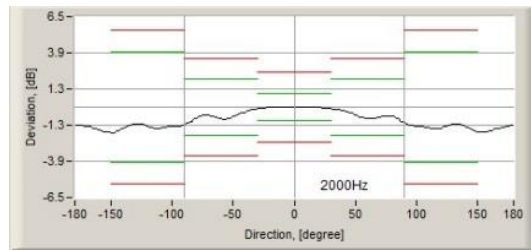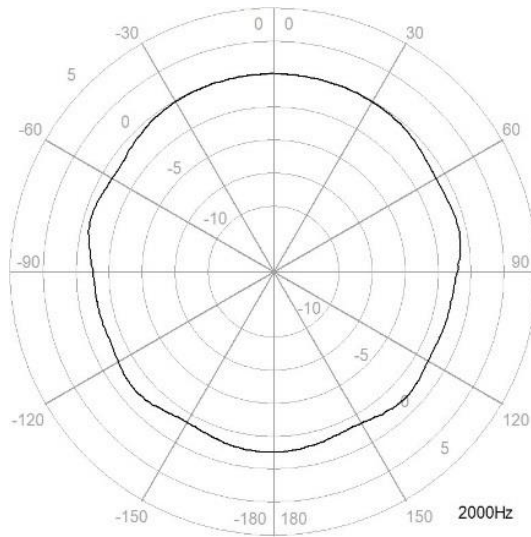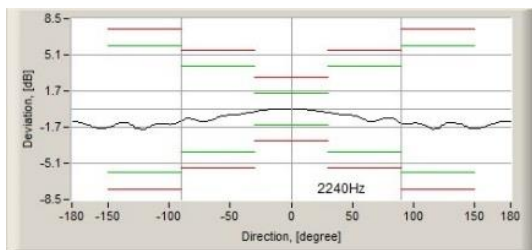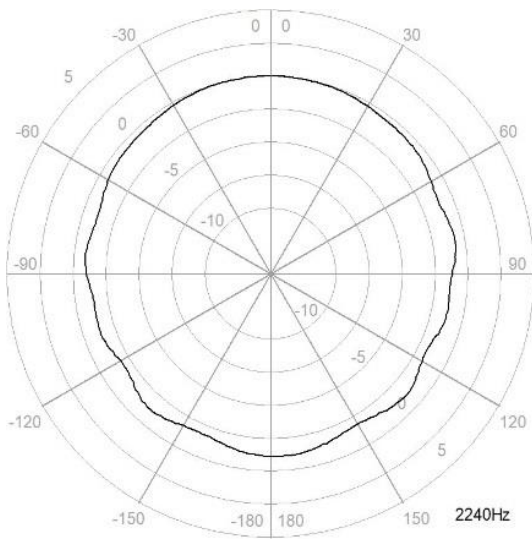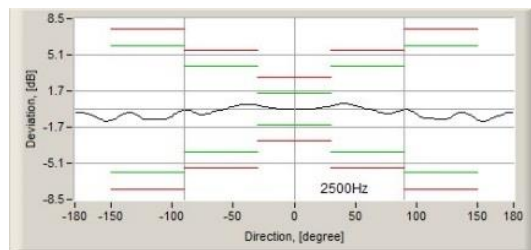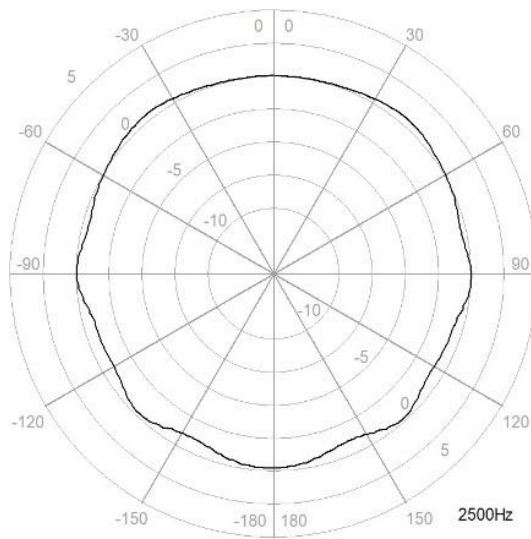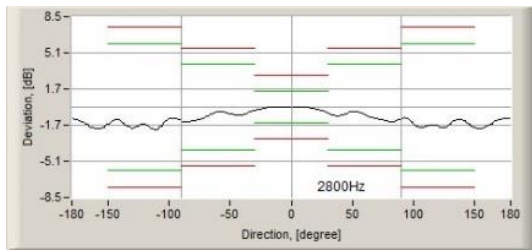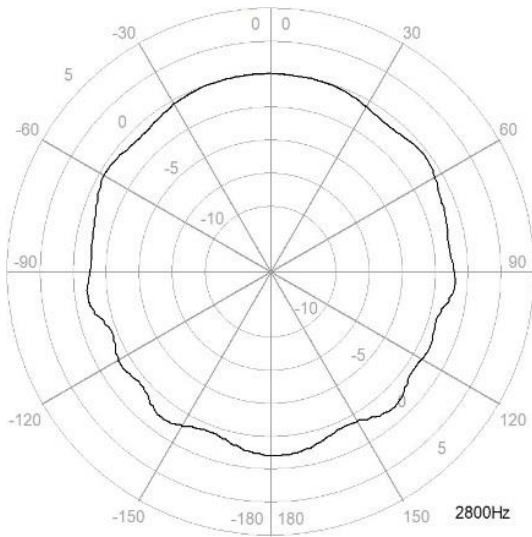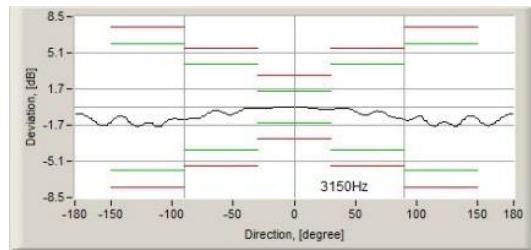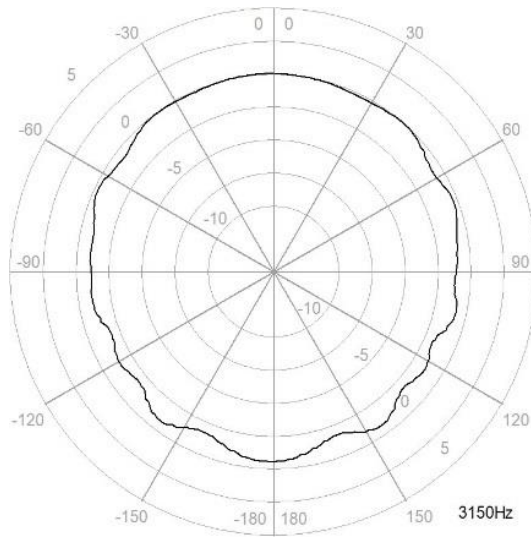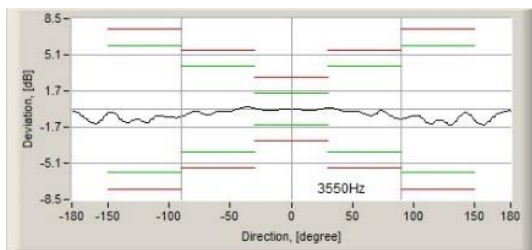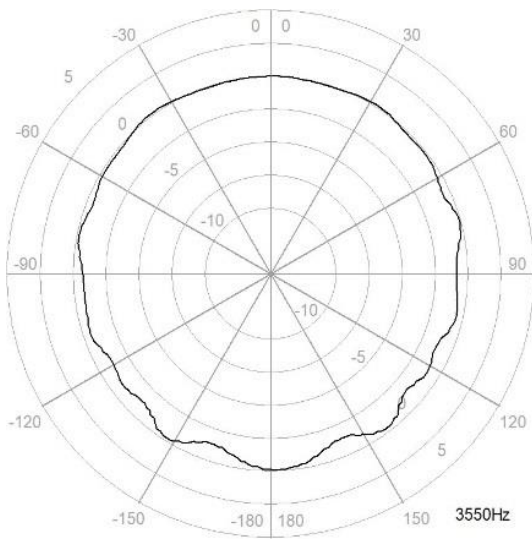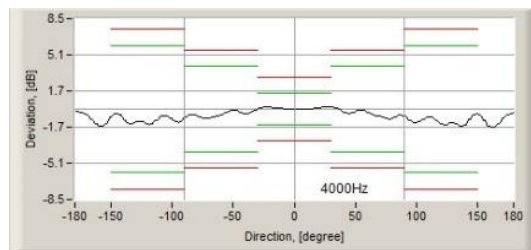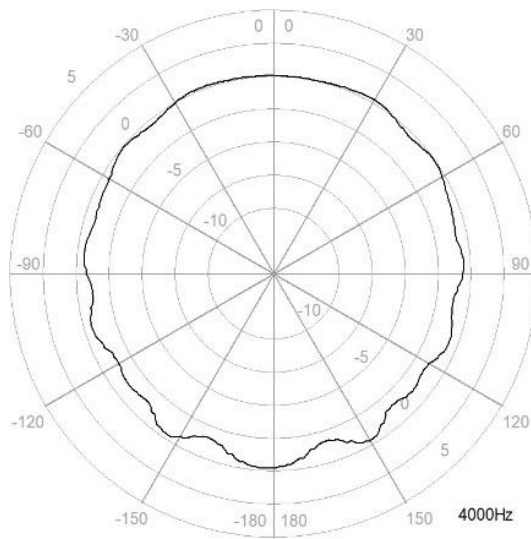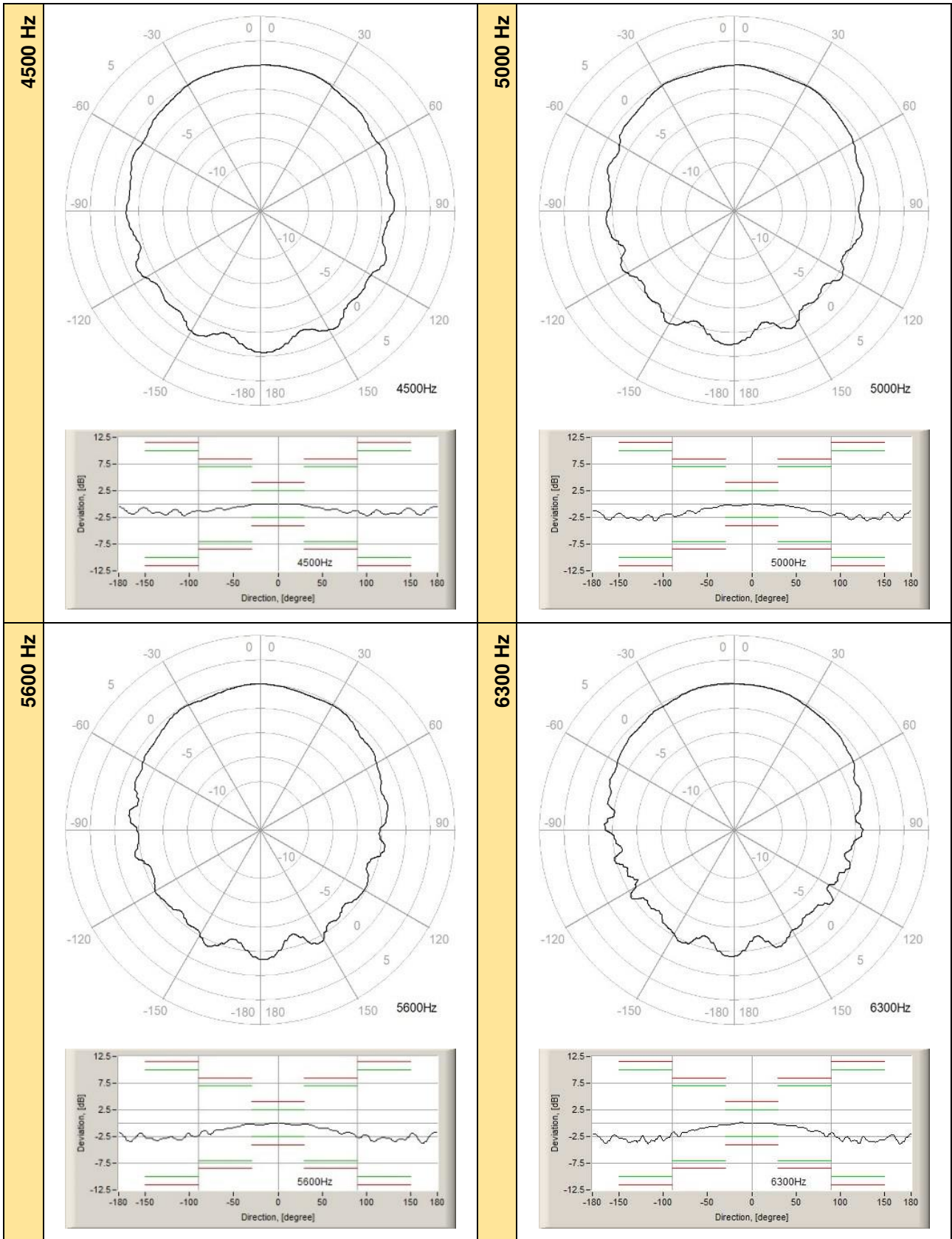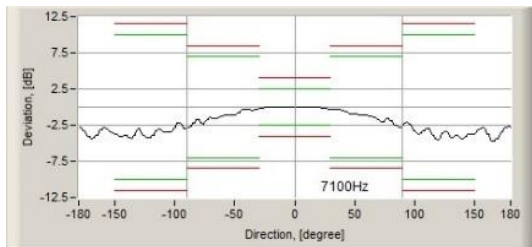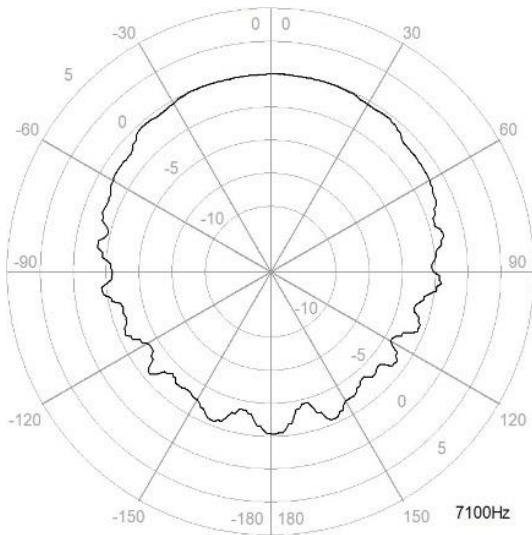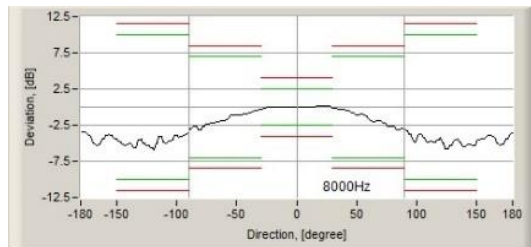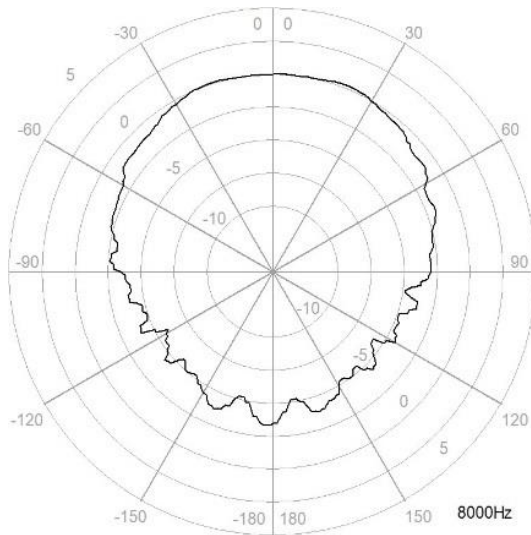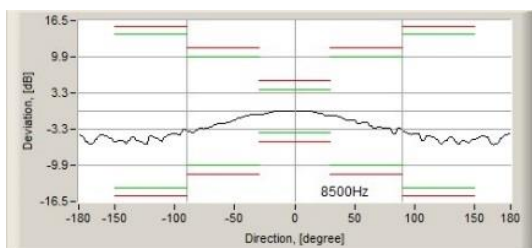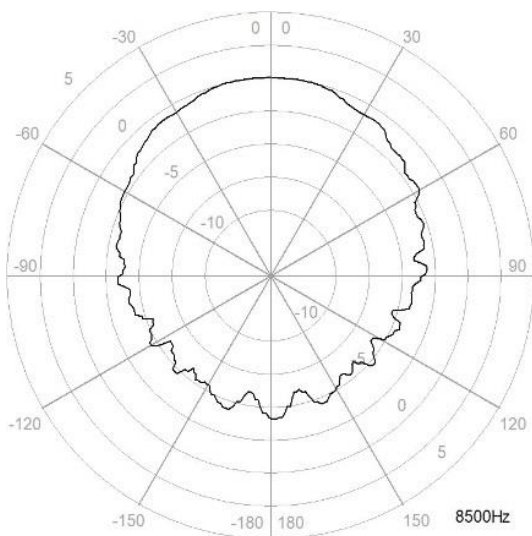
12500 Hz
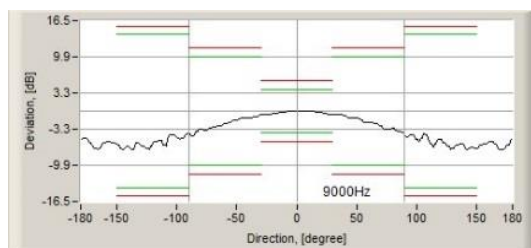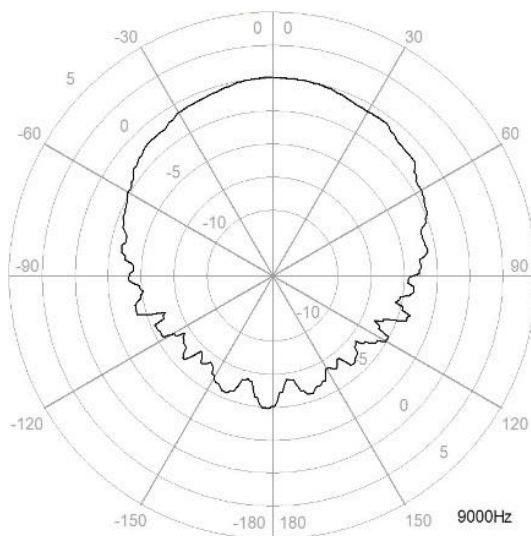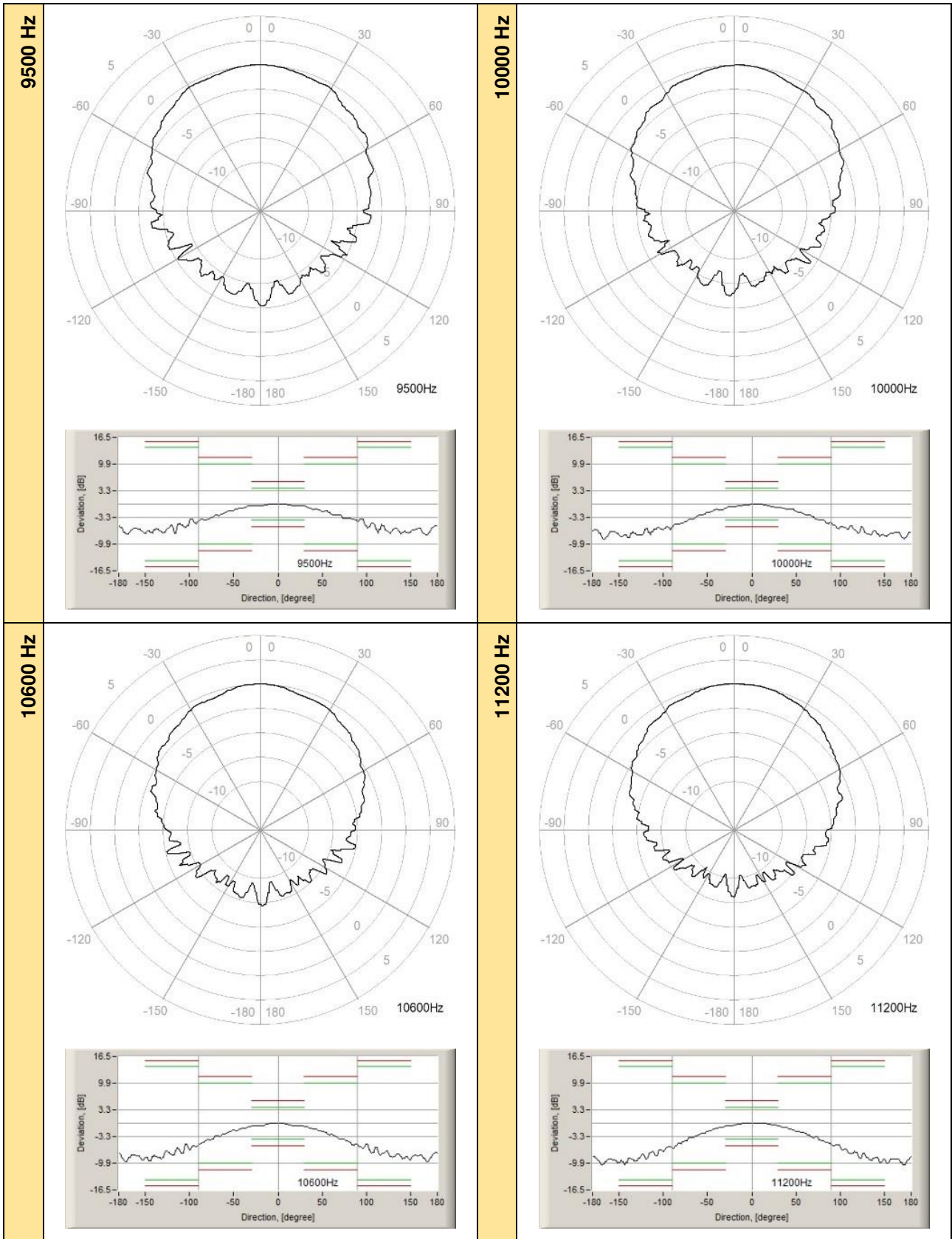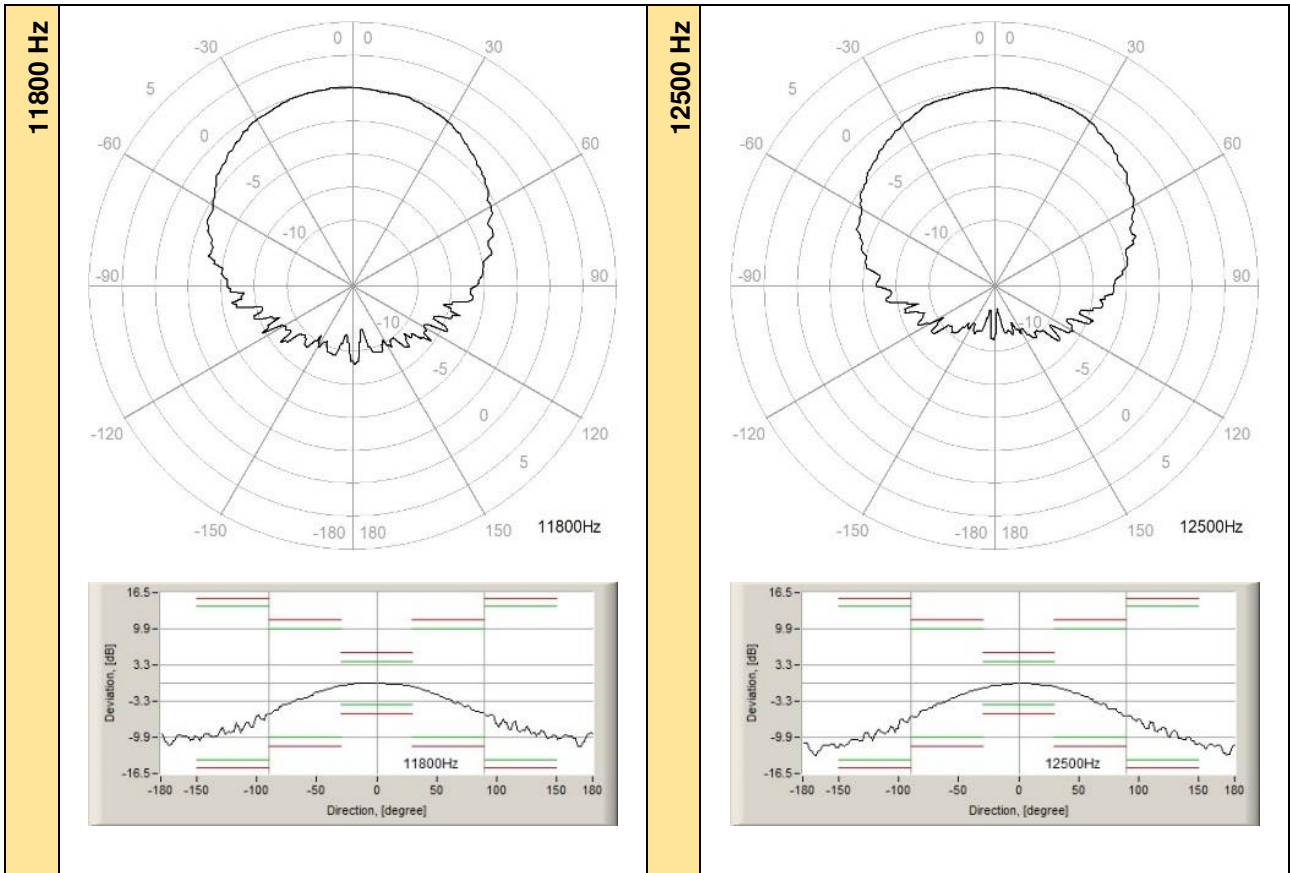
Table C.1.9.   Typical directional response of SV 977D with SA 22

Frequency	Angle [°]									
[Hz]	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
250	-0.01	-0.02	-0.03	-0.07	-0.10	-0.13	-0.19	-0.22	-0.28	-0.33
315	0.02	0.02	0.01	-0.04	-0.09	-0.14	-0.20	-0.28	-0.36	-0.42
400	0.01	0.02	0.02	0.02	0.01	-0.03	-0.06	-0.12	-0.17	-0.21
500	0.00	0.00	-0.01	-0.02	-0.05	-0.07	-0.11	-0.17	-0.24	-0.33
630	0.00	-0.01	-0.03	-0.04	-0.05	-0.05	-0.04	-0.04	-0.11	-0.19
800	0.00	-0.02	-0.05	-0.11	-0.18	-0.23	-0.24	-0.23	-0.18	-0.13
1 000	-0.02	-0.06	-0.12	-0.21	-0.37	-0.51	-0.73	-0.79	-0.79	-0.69
1 250	-0.01	-0.05	-0.12	-0.25	-0.40	-0.50	-0.58	-0.72	-0.90	-0.93
1 600	-0.01	0.02	0.14	0.27	0.34	0.32	-0.23	-0.31	-0.48	-0.67
2 000	-0.01	-0.04	-0.11	-0.26	-0.57	-0.83	-0.83	-0.66	-1.14	-1.39
2 240	-0.03	-0.16	-0.36	-0.48	-0.63	-1.04	-1.17	-1.06	-1.33	-1.40
2 500	0.01	0.09	0.31	0.49	0.48	0.22	-0.28	-0.46	-0.35	-0.45
2 800	-0.02	-0.21	-0.54	-0.80	-0.76	-0.71	-1.08	-1.37	-1.39	-1.56
3 150	-0.04	-0.17	-0.22	-0.18	-0.41	-0.78	-0.64	-0.97	-1.19	-1.29
3 550	-0.07	-0.10	0.10	0.10	-0.24	-0.55	-0.65	-0.61	-0.92	-0.89
4 000	0.00	0.13	0.23	-0.28	-0.39	-0.32	-0.69	-0.92	-0.73	-1.25
4 500	-0.01	0.00	-0.38	-0.59	-0.84	-1.16	-1.18	-1.67	-1.56	-2.13
5 000	-0.11	-0.30	-0.30	-0.33	-0.64	-0.92	-1.47	-1.56	-2.19	-2.10
5 600	-0.15	-0.33	-0.32	-0.45	-0.97	-1.21	-1.97	-1.99	-2.66	-2.82
6 300	0.01	0.03	-0.30	-0.44	-0.61	-0.88	-1.63	-1.89	-2.50	-3.08
7 100	-0.02	-0.06	-0.36	-0.42	-1.00	-1.19	-1.78	-2.09	-2.79	-3.22
8 000	-0.02	0.19	0.19	-0.42	-1.10	-1.93	-2.00	-2.68	-3.23	-4.83
8 500	-0.01	-0.51	-0.89	-1.49	-1.93	-2.20	-3.04	-3.77	-4.08	-4.26
9 000	-0.03	-0.30	-0.62	-0.88	-1.20	-2.04	-2.69	-3.33	-4.60	-5.23
9 500	-0.16	-0.45	-0.61	-1.36	-1.78	-2.65	-2.70	-3.52	-4.48	-5.38

f [Hz]										
10 000	-0.10	-0.55	-0.75	-1.29	-1.89	-2.60	-3.41	-3.97	-4.91	-6.23
10 600	-0.25	-0.59	-0.89	-1.38	-1.99	-2.88	-3.85	-4.70	-5.71	-6.11
11 200	0.01	-0.30	-0.68	-1.21	-1.97	-2.56	-3.62	-4.32	-5.62	-5.91
11 800	-0.13	-0.28	-0.66	-1.41	-2.10	-3.07	-3.72	-4.98	-6.05	-7.34
12 500	-0.12	-0.37	-0.66	-1.24	-2.07	-2.93	-3.88	-4.81	-6.03	-6.93

f [Hz]	100-110	110-120	120-130	130-140	140-150	150-160	160-170	170-180	180-190	190-200
250	-0.37	-0.41	-0.43	-0.45	-0.47	-0.48	-0.49	-0.49	-0.49	-0.48
315	-0.48	-0.54	-0.57	-0.61	-0.62	-0.64	-0.65	-0.66	-0.66	-0.67
400	-0.24	-0.25	-0.25	-0.25	-0.24	-0.24	-0.24	-0.25	-0.27	-0.29
500	-0.43	-0.52	-0.57	-0.61	-0.62	-0.63	-0.63	-0.63	-0.63	-0.64
630	-0.33	-0.44	-0.50	-0.51	-0.51	-0.49	-0.48	-0.47	-0.49	-0.52
800	-0.24	-0.35	-0.51	-0.56	-0.56	-0.55	-0.51	-0.48	-0.50	-0.55
1 000	-0.52	-0.65	-0.85	-0.94	-0.95	-0.93	-0.84	-0.80	-0.81	-0.86
1 250	-0.84	-0.59	-0.69	-0.93	-0.96	-0.94	-0.82	-0.70	-0.69	-0.79
1 600	-0.67	-0.42	-0.46	-0.84	-0.89	-0.82	-0.59	-0.44	-0.55	-0.84
2 000	-1.51	-1.56	-1.48	-1.37	-1.77	-1.82	-1.69	-1.43	-1.42	-1.63
2 240	-1.63	-1.87	-1.66	-1.53	-1.85	-1.84	-1.50	-1.21	-1.38	-1.80
2 500	-0.86	-0.98	-1.00	-0.56	-1.04	-1.15	-0.90	-0.50	-0.47	-0.97
2 800	-1.95	-1.81	-1.92	-1.42	-1.92	-2.03	-1.68	-1.15	-1.60	-2.02
3 150	-1.73	-1.85	-1.83	-1.83	-1.04	-1.76	-1.60	-0.99	-0.94	-1.68
3 550	-1.23	-1.33	-1.48	-1.48	-1.03	-1.48	-1.14	-0.29	-0.81	-1.39
4 000	-1.19	-1.43	-1.51	-1.63	-1.28	-1.62	-1.74	-0.90	-0.56	-1.63
4 500	-2.17	-1.96	-1.93	-1.87	-1.15	-2.02	-2.02	-0.70	-1.49	-1.95
5 000	-2.77	-2.91	-3.08	-2.99	-2.92	-2.87	-3.16	-2.30	-2.09	-3.01
5 600	-3.49	-2.97	-3.48	-3.48	-3.14	-3.63	-3.82	-2.51	-3.27	-3.48
6 300	-3.38	-3.76	-3.76	-3.57	-3.50	-2.70	-3.85	-3.47	-3.20	-3.72
7 100	-3.78	-4.53	-4.16	-4.35	-4.03	-3.71	-4.72	-3.39	-4.34	-4.34
8 000	-4.92	-4.96	-5.84	-5.45	-5.33	-4.48	-5.26	-5.22	-4.93	-5.25
8 500	-5.42	-5.70	-5.96	-5.95	-5.81	-4.99	-6.16	-5.01	-6.05	-5.72
9 000	-5.99	-6.63	-7.01	-6.59	-6.99	-6.52	-6.98	-7.06	-6.82	-7.03
9 500	-6.20	-7.14	-7.25	-7.33	-7.17	-6.38	-7.63	-7.06	-7.43	-7.02
10 000	-6.11	-7.17	-7.33	-7.54	-8.01	-7.95	-8.21	-8.57	-8.03	-8.66
10 600	-7.50	-7.89	-8.49	-8.89	-9.04	-8.01	-9.57	-8.49	-9.51	-8.44
11 200	-7.47	-8.70	-8.70	-9.34	-9.73	-9.82	-10.24	-10.28	-10.36	-10.36
11 800	-8.42	-8.84	-9.32	-9.72	-10.29	-10.04	-11.64	-10.69	-11.26	-10.53
12 500	-8.25	-8.96	-9.83	-10.37	-11.17	-11.93	-12.75	-13.29	-13.12	-13.12

f [Hz]	200-210	210-220	220-230	230-240	240-250	250-260	260-270	270-280	280-290	290-300
250	-0.47	-0.46	-0.44	-0.42	-0.39	-0.35	-0.31	-0.27	-0.21	-0.16
315	-0.67	-0.66	-0.65	-0.62	-0.58	-0.53	-0.47	-0.40	-0.33	-0.25
400	-0.32	-0.35	-0.37	-0.37	-0.37	-0.36	-0.33	-0.28	-0.24	-0.19
500	-0.64	-0.64	-0.63	-0.59	-0.53	-0.45	-0.36	-0.27	-0.20	-0.14
630	-0.55	-0.56	-0.55	-0.50	-0.40	-0.28	-0.18	-0.11	-0.09	-0.09
800	-0.61	-0.64	-0.64	-0.59	-0.47	-0.36	-0.26	-0.30	-0.34	-0.34
1 000	-0.90	-0.89	-0.80	-0.61	-0.42	-0.49	-0.66	-0.68	-0.66	-0.51
1 250	-0.91	-0.93	-0.91	-0.69	-0.58	-0.80	-0.90	-0.87	-0.69	-0.56
1 600	-0.94	-0.94	-0.65	-0.49	-0.72	-0.75	-0.63	-0.45	-0.35	0.26
2 000	-1.84	-1.83	-1.36	-1.44	-1.53	-1.49	-1.41	-1.15	-0.69	-0.86
2 240	-1.83	-1.57	-1.64	-1.89	-1.68	-1.44	-1.40	-0.99	-1.17	-1.08
2 500	-1.14	-0.94	-0.53	-1.00	-0.99	-0.97	-0.45	-0.41	-0.50	-0.32
2 800	-2.03	-1.46	-1.97	-1.92	-2.12	-2.01	-1.35	-1.37	-1.24	-0.85
3 150	-1.75	-1.11	-1.81	-1.81	-1.85	-1.77	-1.20	-1.12	-1.05	-0.58
3 550	-1.24	-0.93	-1.30	-1.27	-1.25	-0.77	-0.80	-0.68	-0.52	-0.52
4 000	-1.63	-1.04	-1.40	-1.46	-1.37	-1.07	-1.23	-0.65	-0.85	-0.74
4 500	-1.24	-1.74	-1.86	-1.98	-1.63	-2.17	-1.57	-1.47	-1.36	-1.05
5 000	-2.85	-2.69	-3.03	-3.05	-3.12	-3.12	-2.14	-2.32	-2.02	-1.68

5 600	-2.74	-3.08	-3.34	-2.79	-3.13	-3.13	-2.51	-2.01	-2.13	-1.32
6 300	-2.74	-3.57	-3.67	-3.38	-3.89	-3.31	-3.18	-2.57	-1.78	-1.36
7 100	-3.81	-4.04	-4.31	-4.27	-3.85	-3.48	-3.01	-2.88	-2.32	-1.60
8 000	-4.61	-5.24	-5.55	-5.95	-5.04	-4.94	-4.15	-3.08	-2.67	-2.16
8 500	-5.48	-5.93	-5.54	-5.92	-5.53	-4.76	-4.28	-3.99	-3.21	-2.72
9 000	-6.27	-6.91	-7.09	-7.05	-6.14	-6.42	-5.14	-4.45	-3.55	-2.81
9 500	-7.21	-7.14	-7.16	-6.99	-7.15	-5.74	-4.86	-4.02	-3.61	-2.83
10 000	-7.60	-8.25	-8.28	-7.70	-7.68	-6.38	-6.35	-5.12	-4.68	-3.77
10 600	-9.07	-9.25	-8.87	-7.91	-7.80	-7.38	-6.44	-5.15	-4.18	-3.30
11 200	-9.86	-10.28	-9.56	-8.97	-8.51	-8.04	-6.50	-6.21	-4.56	-3.55
11 800	-10.44	-10.55	-9.87	-9.18	-8.98	-7.95	-6.73	-5.50	-4.00	-3.25
12 500	-11.79	-11.60	-10.56	-10.44	-9.34	-9.06	-7.14	-6.28	-5.03	-3.70

f [Hz]	300-310	310-320	320-330	330-340	340-350	350-360				
250	-0.11	-0.06	-0.02	0.05	0.09	0.12				
315	-0.18	-0.12	-0.07	-0.02	0.02	0.03				
400	-0.14	-0.11	-0.08	-0.05	-0.03	-0.01				
500	-0.10	-0.07	-0.05	-0.03	-0.01	0.00				
630	-0.09	-0.09	-0.07	-0.04	-0.02	0.00				
800	-0.32	-0.26	-0.19	-0.11	-0.05	-0.01				
1 000	-0.31	-0.21	-0.13	-0.07	-0.04	-0.02				
1 250	-0.50	-0.41	-0.26	-0.13	-0.05	-0.01				
1 600	0.31	0.29	0.15	0.02	-0.01	0.01				
2 000	-0.87	-0.67	-0.25	-0.08	-0.01	0.02				
2 240	-0.69	-0.54	-0.41	-0.19	-0.05	0.01				
2 500	0.25	0.47	0.47	0.29	0.09	0.03				
2 800	-0.69	-0.78	-0.63	-0.23	-0.05	0.02				
3 150	-0.72	-0.51	-0.10	-0.11	-0.07	0.04				
3 550	-0.23	-0.19	0.16	-0.10	-0.10	-0.04				
4 000	-0.47	-0.41	-0.39	0.17	0.14	0.05				
4 500	-1.01	-0.59	-0.41	0.01	-0.04	-0.05				
5 000	-1.11	-0.76	-0.45	-0.29	-0.31	-0.16				
5 600	-0.94	-0.77	-0.28	-0.37	-0.32	-0.07				
6 300	-1.01	-0.66	-0.46	-0.33	0.08	0.07				
7 100	-1.12	-0.99	-0.41	-0.09	-0.06	-0.05				
8 000	-1.69	-1.10	-0.79	-0.16	0.06	-0.06				
8 500	-2.19	-1.43	-0.77	-0.59	-0.16	0.03				
9 000	-2.31	-1.48	-1.20	-0.65	-0.42	-0.06				
9 500	-2.10	-1.28	-0.81	-0.39	-0.31	-0.03				
10 000	-2.61	-2.07	-1.45	-0.83	-0.64	-0.17				
10 600	-2.55	-1.85	-1.32	-0.65	-0.61	-0.10				
11 200	-2.63	-1.91	-1.17	-0.59	-0.49	-0.04				
11 800	-2.59	-1.63	-1.01	-0.40	-0.06	0.06				
12 500	-3.03	-2.06	-1.41	-0.84	-0.33	-0.19				

C.1.3 Effect of the SA 277D outdoor microphone kit

See Chapter C.7 for the details related to using of the SA 277D outdoor microphone kit.

C.1.4 Effect of Vibration

1. Mechanical vibration with an acceleration of 1 m/s² perpendicular to the membrane of the microphone for the frequencies 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz and 1000 Hz increases the low level of the linear operation range according to the Table C.1.12.

2. Mechanical vibration with an acceleration of 1 m/s² parallel to the membrane of the microphone for the frequencies 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz and 1000 Hz increases the low level of the linear operation range according to the Table C.1.13.

Test conditions:

SV 977D with microphone and preamplifier is mounted on the shaker.

Ref 1. Vibration is applied in a direction perpendicular to the plane of the microphone diaphragm.

Ref 2. Vibration is applied in a direction parallel to the plane of the microphone diaphragm.

Table C.1.10. Typical effect of vibration perpendicular to the plane of microphone diaphragm

f (Hz)	15.6	31.25	62.5	125	250	500	1000	2000
Typical effect of vibration [dB]	66.13	66.36	67.03	64.55	67.46	71.66	57.59	61.58

Table C.1.11. Typical effect of vibration parallel to the plane of microphone diaphragm

f (Hz)	15.6	31.25	62.5	125	250	500	1000	2000
Typical effect of vibration [dB]	48.99	54.98	57.19	54.25	52.11	54.89	59.60	57.07
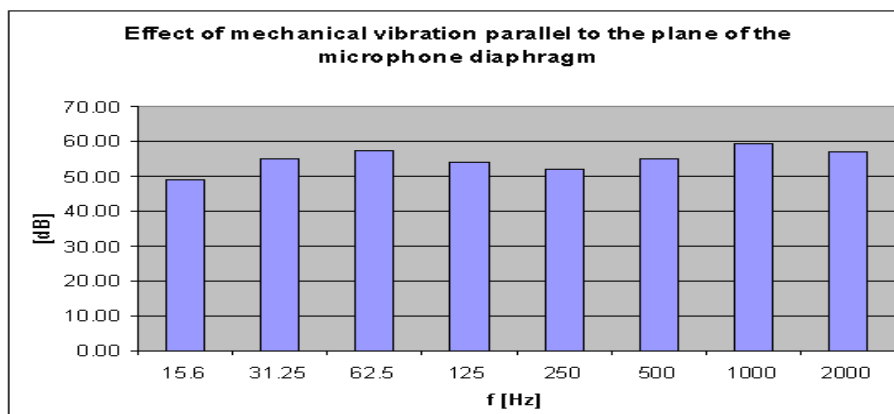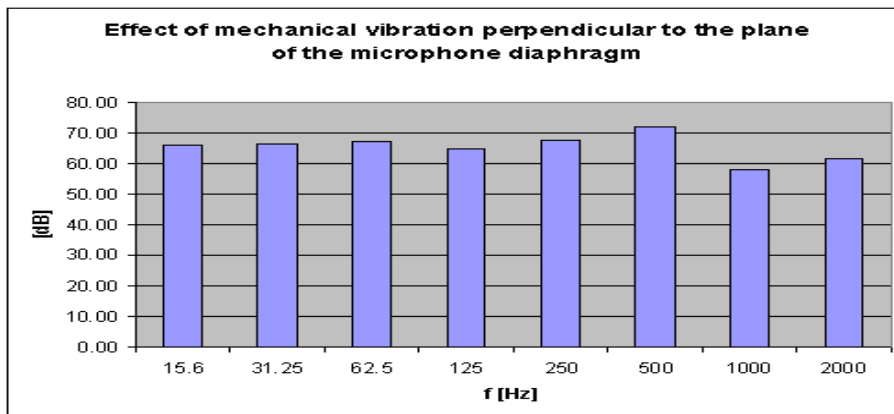
C.2. SPECIFICATION OF SV 977D AS VIBRATION LEVEL METER (VLM)

Configuration of the complete VLM in its normal mode of operation

SV 977D	sound & vibration level meter and analyser
SV 80	10 mV/ms^{-2}, IEPE accelerometer (see C.6 for details)
SC 27	coiled cable for accelerometer 2 m

Accessories included in the SV 977D instrument set

SC 158	USB-C cable

Accessories available

SP 75	RS 232 interface
SC 61	TNC to BNC integrated connector
SC 27	TNC (plug) to TNC (plug) 2 m coil cable
SA 17A	external battery pack
SA 27	permanent magnet
SA 15	power supply unit
SV 110	vibration calibrator (or equivalent)

Measured quantities

Measured quantities in the vibration meter mode: **RMS**, **PEAK**, **P–P** and **MAX**.

Definitions for mentioned parameters are given in Appendix D.

Mounting for vibration tests

The accelerometer can be connected with the VLM using proper cable provided by the manufacturer.

The accelerometer can be mounted on the shaker in various ways:
- using threaded stud onto a flat, smooth surface,
- using thin layer of beeswax for sticking the accelerometer into the plate,
- using mica washer and isolates stud, where the body of accelerometer should be electrically isolated from the measuring object,
- using permanent magnet.

Linear operating ranges

Linear operating ranges for the acceleration (with SV 80 accelerometer with a sensitivity equal to 10 mV/ms^{-2} @ 79.58 Hz).

Two ranges with the nominal values:

Low	100 ms^{-2} (160 dB related to 10^{-6} ms^{-2})
High	354 ms^{-2} (171 dB related to 10^{-6} ms^{-2}).

- Linear measurement with the **Wh** filter:
  from 2.02 mms^{-2} to 338.8 ms^{-2} (the sinusoidal signal RMS)
  from 2.86 ms^{-2} to 479.2 ms^{-2} (PEAK)

Table C.2.1.   Linear operating ranges with the **Wh** filter

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 12.5 Hz sine signal	
Low	from 2.02 mms^{-2} (66.1 dB)	to 95.7 ms^{-2} (159.6 dB)
High	from 20.2 mms^{-2} (86.1 dB)	to 338.8 ms^{-2} (170.6 dB)

- Linear measurement with the **HP, HP1**, **HP3** and **HP10** filters:
  from 10.0 mms^{-2} to 354 ms^{-2} (the sinusoidal signal RMS)
  from 14.1 mms^{-2} to 500 ms^{-2} (PEAK)

Table C.2.2.   Linear operating ranges with the **HP**, **HP1**, **HP3** and **HP10** filters

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 80 Hz sine signal	
Low	from 10 mms^{-2} (80 dB)	to 100 ms^{-2} (160 dB)
High	from 100 mms^{-2} (100 dB)	to 354 ms^{-2} (171 dB)

- Linear measurement with the **Vel1** filter:
  from 1.56 mms^{-1} to 55.4 ms^{-1} (the sinusoidal signal RMS)
  from 2.21 mms^{-1} to 78.3 ms^{-1} (PEAK)

Table C.2.3.   Linear operating ranges with the **Vel1** filter

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 1 Hz sine signal	
Low	from 1.56 mms^{-1}	to 15.6 ms^{-1}
High	from 15.6 mms^{-1}	to 55.4 ms^{-1}

- Linear measurement with the **Vel3** filter:
  from 0.469 mms^{-1} to 16.7 mms^{-1} (the sinusoidal signal RMS)
  from 0.663 mms^{-1} to 23.6 mms^{-1} (PEAK)

Table C.2.4.   Linear operating ranges with the **Vel3** filter

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 3 Hz sine signal	
Low	from 0.469 mms^{-1}	to 4.69 ms^{-1}
High	from 4.69 mms^{-1}	to 16.7 ms^{-1}

- Linear measurement with the **Vel10** and **MFVel** filters:
  from 0.145 mms^{-1} to 5.13 ms^{-1} (the sinusoidal signal RMS)
  from 0.205 mms^{-1} to 7.25 ms^{-1} (PEAK)

Table C.2.5.   Linear operating ranges with the **Vel10** filter

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 10 Hz sine signal	
Low	from 0.145 mms^{-1}	to 1.44 ms^{-1}
High	from 1.45 mms^{-1}	to 5.13 ms^{-1}

- Linear measurement with the **Dil1** filter
  from 248 μm to 8.81 m (the sinusoidal signal RMS)
  from 351 μm to 12.45 m (PEAK)

Table C.2.6.   Linear operating ranges with the **Dil1** filter

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 1 Hz sine signal	
Low	from 248 μm	to 2.48 m
High	from 2.48 mm	to 8.81 m

- Linear measurement with the **Dil3** filter
  from 24.8 μm to 880 mm (the sinusoidal signal RMS)
  from 35.1 mm to 1.245 m (PEAK)

Table C.2.7.   Linear operating ranges with the **Dil3** filter

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 3 Hz sine signal	
Low	from 24.8 μm	to 248 mm
High	from 0.248 mm	to 880 mm

- Linear measurement with the **Dil10** filter
  from 2.3 μm to 81.6 mm (the sinusoidal signal RMS)
  from 3.25 μm to 115.4 mm (PEAK)

Table C.2.8.   Linear operating ranges with the **Dil10** filter

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 10 Hz sine signal	
Low	from 2.3 μm	to 23 mm
High	from 23 μm	to 81.6 mm

⚠️ *Note: In the measurement of the signal with the **crest factor n > 1.41 the upper linear operating range for the RMS value is reduced**. Its value can be calculated from the equation: $A_n = A + 10 - 20\log(n / \sqrt{2})$ [m], where **A** is the given range for the sinusoidal signal. E.g. for **n = 10** and **A = 180** the value of A_{10} is equal to **= 173 dB**.*

Frequency range

For the acceleration measurement (+/- 10%)   1 Hz ÷ 5 kHz (in the linear measurements with the **HP** or **HP1** filter)

⚠️ *Note: With the application of another vibration transducer, the frequency range given above for the **HP** filter can be different (i.e. wider).*

See Chapter C.4 for the **Wh** and **VelMF** filters characteristics

Basic error for the acceleration measurement   < ± 0.5 dB

Calibration

Direct   by measuring a standard signal generated by an external vibration calibrator.

Indirect   by declaring the sensitivity of the transducer (in accordance with the calibration card).

⚠️ *Note: Calibration procedure is given in Chapter 3.3.5 of the Manual.*

Accelerometer input

- **Connector**   TNC
- **Impedance**   40 kΩ / 100 pF (typical)
- **Vibration transducers powering**   IEPE type, 28 V / 1.5 mA current source

Maximum input voltage

SV 977D is the instrument with the II security class according to the international standard IEC 348.

The input voltage should be within the 28 V Peak – Peak

RMS detector (Linear averaging)

- **Digital**   "True RMS" with Peak detection
- **Resolution**   0.1 dB
- **Range**   327.7 dB
- **Crest Factor**   unlimited for signals within 40 kHz band.

Overload detector

The instrument has the built-in overload detectors. Both A/D converter and input amplifier overload conditions are detected. The overload in the measurement channel (in its analogue part) and the overload of the analogue / digital converter are both detected. The "overload" indication appears when the input signal amplitude is 0.5 dB above the declared "Peak measurement range".

Underrange detector

The instrument has the built-in under-range detector. The "underrange" indication appears when the RMS value is below the lower linear operating range.

Analogue/Digital conversion   24 bits resolution.

Antialiasing filter

Built-in antialiasing filter (eighth-order elliptic type) ensuring correct sampling of the measured signal.
- **Pass band (-1 dB)**   22.200 kHz or 44.4 kHz
- **Pass band (-3 dB)**   23.520 kHz or 47.0 kHz
- **Stop band**   26.256 kHz or 52.53 kHz
- **Attenuation in the stop band**   > 100 dB.

Reference conditions as per ISO 8041-1:2017

- **Reference frequency**   79.58 Hz
- **Reference temperature**   +23°C
- **Reference relative humidity**   50 %
- **Reference range**   **High**.

Pre-heating time   1 minute (for 0.1 dB accuracy).

Typical stabilization time after change in environmental conditions is 1 minute.

> **Note:** *When the instruments are moved from a warm environment with high humidity, to a colder environment, care should be taken not to produce condensation inside the instruments. In this case, much longer stabilization periods may be necessary.*

Digital filters

High-pass filters   (see Chapter C.5 for frequency response characteristics)
- **HP**
- **HP1**
- **HP3**
- **HP10**

Frequency weighting filter (filter includes Band Limiting filter).
Conforms with ISO 8041-1:2017 (see Chapter C.5 for frequency response characteristics)
- **Wh**   from 0.8 Hz to 4000 Hz

Integrating filters   (see Chapter C.5 for frequency response characteristics):
- **Vel1**   from 0.2 Hz to 4100 Hz
- **Vel3**   from 0.2 Hz to 4100 Hz
- **Vel10**   from 0.2 Hz to 4100 Hz
- **Dil1**   from 0.1 Hz to 260 Hz

- **Dil3**   from 0.2 Hz to 510 Hz
- **Dil10**   from 1 Hz to 2050 Hz

Special filter

Filter for the evaluation of the machinery condition:

- **VelMF**   from 0.2 Hz to 4100 Hz; conforms with ISO 10816 (see Chapter C.5 for the frequency response characteristics)

Environmental, electrostatic and radio frequency criteria

> **Note:** *In the measurement conditions with the strong electromagnetic disturbances (e.g. near the high-voltage transmission lines) the lower measurement limit can be drastically shifted as the result of the external field influence on the measurement cables. In such cases, the careful shielding of the measurement cables is strongly recommended. It is worth to underline that the estimation of the external influence can be performed in-site by the observations of the measurement signal spectrum.*

Effect of humidity   < 0.5 dB (for 30% < RH < 90% at 40°C and 1000 Hz)

Effect of radio frequency fields   meets requirements of ISO 8041-1:2017

The greatest susceptibility (the least immunity) is achieved for RMS measurements with the **HP1** weighting filter.

The greatest susceptibility is achieved when the VLM and accelerometer with cable is placed along field and the cable is coil as solenoid.

Effect of electrostatic discharge   meets requirements of ISO 8041-1:2017

During electrostatic discharge, the influence of the displayed results could be observed.

No changes in the instrument operation state, configuration or stored data corruption were found out.

Effect of temperature   < 0.5 dB (from -10°C to + 50°C)

Effect of vibration   < 0.1 dB (measured at the instrument vibration 1 m/s2 in the 2 kHz band)

Temperature range

Operating   from -10°C to + 50°C

Storage and transportation   from -20°C to + 60°C

C.3. SPECIFICATION OF SV 977D AS 1/1 OCTAVE AND 1/3 OCTAVE ANALYSER

C.3.1 Specification of SV 977D as 1/1 and 1/3 octave analyser in the standard configuration for sound measurements

Statement of performance

SV 977D can operate as 1/1 octave or 1/3 octave analyser with all listed below accessories meeting requirements of the IEC 61260-1:2014 standard for the pass band filters for the Class 1 Group X instruments.

> **Note:** Simultaneously to the frequency analysis, SV 977D operates as a Sound Level Meter - see Chapters C.1 for specification.

Configuration of the complete analyser

SV 977D	sound & vibration level meter and analyser
SV 12L	microphone preamplifier
ST 02	adapter (input impedance 18 pF)

Normal operating mode

SV 977D in configuration with the **SV 12L** microphone preamplifier and **ST 02** adapter with following settings: **High** or **Low** measurement range (path: *<Menu> / Measurement / Range* – see Chapter 4.6), switched off **Microphone** compensation, selected **Free Field** compensation and switched off **Windscreen** compensation (path: *<Menu> / Measurement / Compensation* – see Chapter 4.5).

> **Note:** When the 1/1 or 1/3 octave analyser is used with the microphone installed (for acoustic signals), the **Microphone** compensation must be switched on (path: <Menu> / Measurement / Compensation).

Signal input

- SV 12L preamplifier throughout the ST 02 adapter
- Maximum input voltage: SV 977D meets the requirements IEC 348 for the 2nd class device. The input voltage shall not exceed the limits between 0 V and +28 V.
- Impedance: 18 pF.

Digital filters

Weighting filters

- **Z**   according to IEC 61672-1:2013 for Class 1,
- **A**   according to IEC 651 and IEC 61672-1:2013 for Class 1,
- **C**   according to IEC 651 and IEC 61672-1:2013 for Class 1,
- **B**   according to IEC 651 for Class 1,
- **U**   according to IEC 61012:1990 for Class 1,
- **AU**   according to IEC 61012:1990 for Class 1,
- **D**   according to BS 5721:1979,
- **HP**   high-pass filter,
- **HPE**   high-pass filter for the **Ultra** frequency band.

See Chapter C.4 for filters characteristics.

1/1 and 1/3 octave filters – see Chapter C.3.3 for filters characteristics.

Linear operating ranges

Two measurement ranges are available: **Low** and **High**.

Table C.3.1.   Linear operating range with SV 12L preamplifier and ST 02 adapter

Range	Linear operating range (with 10 dB margin from noise) (RMS for the sinusoidal signal at reference conditions @ 1 kHz, 0.0 dB calibration factor)	
Low	from 15 µV$_{RMS}$ "A" – weighting	to 1.08 V$_{RMS}$ "A" – weighting
	from 18 µV$_{RMS}$ "B" – weighting	to 1.08 V$_{RMS}$ "B" – weighting
	from 18 µV$_{RMS}$ "C" – weighting	to 1.08 V$_{RMS}$ "C" – weighting
	from 32 µV$_{RMS}$ "Z" – weighting	to 1.08 V$_{RMS}$ "Z" – weighting
	from 32 µV$_{RMS}$ "HP" – weighting	to 1.08 V$_{RMS}$ "HP" – weighting
	from 15 µV$_{RMS}$ "AU" – weighting	to 1.08 V$_{RMS}$ "AU" – weighting
	from 32 µV$_{RMS}$ "U" – weighting	to 1.08 V$_{RMS}$ "U" – weighting
	from 32 µV$_{RMS}$ "D" – weighting	to 1.08 V$_{RMS}$ "D" – weighting
High	from 56 µV$_{RMS}$ "A" – weighting	to 7.64 V$_{RMS}$ "A" – weighting
	from 56 µV$_{RMS}$ "B" – weighting	to 7.64 V$_{RMS}$ "B" – weighting
	from 56 µV$_{RMS}$ "C" – weighting	to 7.64 V$_{RMS}$ "C" – weighting
	from 100 µV$_{RMS}$ "Z" – weighting	to 7.64 V$_{RMS}$ "Z" – weighting
	from 100 µV$_{RMS}$ "HP" – weighting	to 7.64 V$_{RMS}$ "HP" – weighting
	from 56 µV$_{RMS}$ "AU" – weighting	to 7.64 V$_{RMS}$ "AU" – weighting
	from 100 µV$_{RMS}$ "U" – weighting	to 7.64 V$_{RMS}$ "U" – weighting
	from 126 µV$_{RMS}$ "D" – weighting	to 7.64 V$_{RMS}$ "D" – weighting

Table C.3.2. Peak for the sinusoidal signal 1 kHz, at reference conditions with the SV 12L preamplifier, and ST 02 adapter

Peak for the sinusoidal signal **1 kHz**, at reference conditions @ 1 kHz (0.0 dB calibration factor)	
Range	**Max Peak value**
Low	1.51 V "A" – weighting
	1.53 V "B" – weighting
	1.53 V "C" – weighting
	1.53 V "Z" – weighting
	1.53 V "HP" – weighting
	1.53 V "AU" – weighting
	1.53 V "U" – weighting
	1.53 V "D" – weighting
High	10.8 V "A" – weighting
	10.8 V "B" – weighting
	10.8 V "C" – weighting
	10.8 V "Z" – weighting
	10.8 V "HP" – weighting
	10.8 V "AU" – weighting
	10.8 V "U" – weighting
	10.8 V "D" – weighting

*Note: For the signals with the crest factor **n >1.41** upper measuring range of the RMS is reduced. The valid upper limit can be calculated according to the below given formula:*

An dB(re1µV) = A dB(re1µV) – 20log(n/√2),

*where **A** is the upper limit for the sinusoidal signal in dB(re1µV)*

*Example: For the crest factor **n = 10** the upper limit is $A_{10} = $ **120 dB(re1µV)***

Measuring frequency range	2.6 Hz ÷ 22.4 kHz with the **Z** filter (-3 dB)
	0.35 Hz ÷ 22.4 kHz with the **HP** filter (-3 dB)
	0.35 Hz ÷ 44.6 kHz with the **HPE** filter (-3 dB)
Maximum peak voltage	30 V Peak-Peak (Maximum peak voltage of input sinusoidal signal, which can be applied to the SLM without destruction the meter)

RMS detector

- Digital — "True RMS" with Peak detection
- Resolution — 0.1 dB
- Range — 327.7 dB
- Crest Factor — unlimited (for signals in the 20 kHz band)

Reference conditions as per IEC 61260-1:2014

- Reference temperature   +23°C
- Reference relative humidity   50%
- Static pressure   101.325 kPa

Calibration (electrical)

Calibration level	0.5 V$_{RMS}$ (114 dB re 1 µV)
Basic accuracy	< ± 0.2 dB (for the temperature T=+23°C ± 5°C for sinusoidal signal 1 V$_{RMS}$ in the band 5 Hz ÷ 20 kHz with the **Z** filter)
Measurement deviation	< ± 0.1 dB (when the temperature is from -10°C to +50°C for the sinusoidal signal 1 V$_{RMS}$ in the band 5 Hz ÷ 20 kHz with the **Z** filter)

Overload detector

The instrument has the built-in overload detectors. Both A/D converter and input amplifier overload conditions are detected. The overload in the measurement channel (in its analogue part) and the overload of the analogue / digital converter are both detected. The "overload" indication appears when the input signal amplitude is 0.5 dB above the declared "Peak measurement range".

Warm-up time	1 min. (for 0.1 dB accuracy).
Effect of humidity	< 0.5 dB (for 30%<RH<90% at 40°C re Reference conditions)
Effect of temperature	< 0.5 dB (from -10°C to + 50°C)
Effect of magnetic field	< 5 µV$_{RMS}$ (A) or < 20 µV$_{RMS}$ (Z) (for 80 A/m and 50 Hz)
Effect of Vibration	< 0.1 dB (from 20 Hz to 1000 Hz at 1 m/s^2)

Electrostatic and radio frequency criteria – see Chapter C.1.1

Sampling frequency	48 kHz or 96 kHz (internal only).
Analogue to digital converter	1 x 24 bit
Reference range	**High**
Input attenuator accuracy	± 0.1 dB (for f = 1 kHz and T = +23°C)
Internal oscillator accuracy	0.01 % (for f = 1 kHz and T = +23°C)

Antialiasing filter

Built-in antialiasing filter. Second-order analogue filter, passive Class, combined with on-chip FIR digital filter of the analogue-to-digital converter, ensuring correct sampling of the measured signal.

Pass band (-1 dB)	22.200 kHz or 44.4 kHz
Pass band (-3 dB)	23.520 kHz or 47.0 kHz
Stop band	26.256 kHz or 52.53 kHz
Attenuation in the stop band	> 80 dB

1/1 and 1/3 octave filters noise levels

Typical electrical noise levels Z and A weighted for SV 977D in configuration with the SV 12L microphone preamplifier, ST 02 adapter and 50 Ohm BNC terminal for 1/1 octave filters. Averaging time 30 s.

Table C.3.3.   Typical electrical noise levels Z and A weighted for SV 977D in configuration with the SV 12L microphone preamplifier, ST 02 adapter and 50 Ohm BNC terminal for 1/1 octave filters

1/1 octave central frequency [Hz]	Z weighting		A weighting	
	Low range [µV]	High range [µV]	Low range [µV]	High range [µV]
1	0.7	0.9	0.1	0.7
2	1.9	2.2	0.1	0.7
4	2.4	3.2	0.1	0.7
8	2.0	2.8	0.1	0.7
16	1.5	2.4	0.1	0.7
31.5	1.2	2.3	0.1	0.8
63	0.9	2.4	0.1	0.8

1/1 octave central frequency [Hz]	Z weighting		A weighting	
	Low range [µV]	High range [µV]	Low range [µV]	High range [µV]
125	0.8	2.8	0.2	1.0
250	0.7	3.5	0.3	1.6
500	0.8	4.6	0.6	3.4
1 000	1.0	6.3	1.0	6.4
2 000	1.3	8.8	1.5	10.2
4 000	1.8	12.4	2.0	13.7
8 000	2.5	17.3	2.2	15.0
16 000	3.6	24.3	1.7	11.4

Typical electrical noise levels Z and A weighted for SV 977D in configuration with the SV 12L microphone preamplifier, ST 02 adapter and 50 Ohm BNC terminal for 1/3 octave filters. Averaging time 30 s.
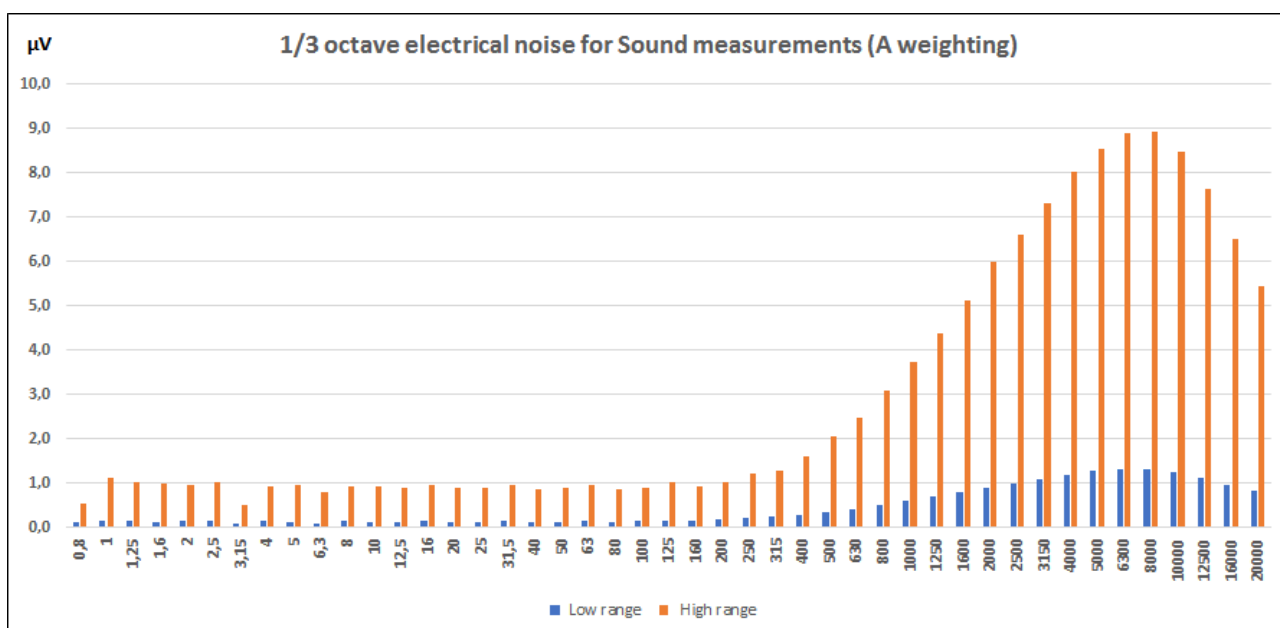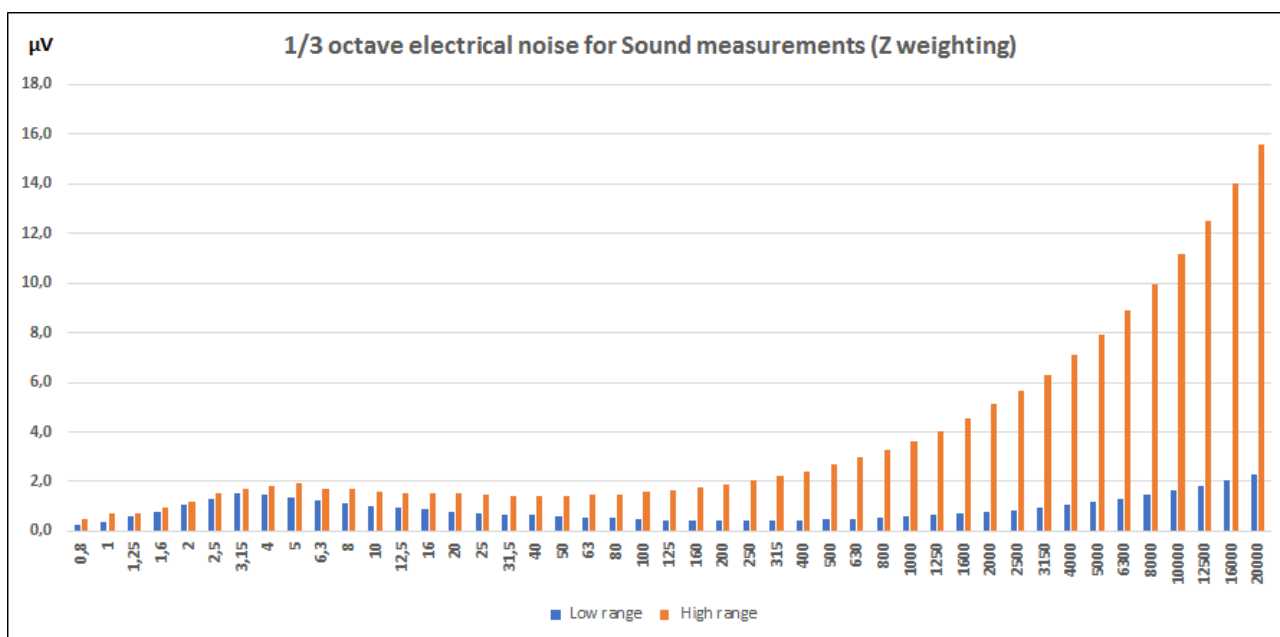
Table C.3.4. Typical electrical noise levels Z and A weighted for SV 977D in configuration with the SV 12L microphone preamplifier, ST 02 adapter and 50 Ohm BNC terminal for 1/3 octave filters.

1/3 octave central frequency [Hz]	Z weighting		A weighting	
	Low range [µV]	High range [µV]	Low range [µV]	High range [µV]
0.8	0.3	0.5	0.1	0.5
1	0.4	0.7	0.2	1.1
1.25	0.6	0.7	0.1	1.0
1.6	0.8	0.9	0.1	1.0
2	1.1	1.2	0.1	1.0
2.5	1.3	1.5	0.1	1.0
3.15	1.5	1.7	0.1	0.5
4	1.5	1.8	0.1	0.9
5	1.4	2.0	0.1	0.9
6.3	1.2	1.7	0.1	0.8
8	1.1	1.7	0.1	0.9
10	1.0	1.6	0.1	0.9
12.5	1.0	1.5	0.1	0.9
16	0.9	1.6	0.1	0.9
20	0.8	1.5	0.1	0.9
25	0.7	1.5	0.1	0.9
31.5	0.7	1.4	0.1	1.0
40	0.6	1.4	0.1	0.9
50	0.6	1.4	0.1	0.9
63	0.5	1.5	0.1	1.0
80	0.5	1.5	0.1	0.9
100	0.5	1.6	0.1	0.9
125	0.5	1.7	0.2	1.0
160	0.4	1.7	0.1	0.9
200	0.4	1.9	0.2	1.0
250	0.4	2.1	0.2	1.2
315	0.4	2.2	0.2	1.3
400	0.5	2.4	0.3	1.6
500	0.5	2.7	0.3	2.0
630	0.5	3.0	0.4	2.5
800	0.5	3.3	0.5	3.1
1 000	0.6	3.6	0.6	3.7
1 250	0.6	4.0	0.7	4.4
1 600	0.7	4.5	0.8	5.1
2 000	0.8	5.1	0.9	6.0
2 500	0.9	5.6	1.0	6.6
3 150	0.9	6.3	1.1	7.3
4 000	1.1	7.1	1.2	8.0
5 000	1.2	7.9	1.3	8.5
6 300	1.3	8.9	1.3	8.9
8 000	1.5	10.0	1.3	8.9
10 000	1.6	11.2	1.2	8.5
12 500	1.8	12.5	1.1	7.6
16 000	2.1	14.0	1.0	6.5
20 000	2.3	15.6	0.8	5.4

C.3.1 Specification of SV 977D as 1/1 and 1/3 octave analyser in the standard configuration for vibration measurements

Note: *Simultaneously to the frequency analysis, SV 977D operates as a Vibration Level Meter - see Chapters C.1 for specification.*

Configuration of the complete analyser

SV 977D	sound & vibration level meter and analyser
ST 08	adapter (resistance 5.1 kOmh)

Normal operating mode

SV 977D in configuration with the **ST 08** adapter with following settings: **High** or **Low** measurement range (path: *<Menu> / Measurement / Range* – see Chapter 4.6), **1,5 mA** IEPE current (path: *<Menu> / Instrument / IEPE Current* – see Chapter 7.5**Error! Reference source not found.**).

Signal input

- BNC type input throughout the ST 08 adapter
- Maximum input voltage: SV 977D meets the requirements IEC 348 for the 2nd class device. The input voltage shall not exceed the limits between 0 V and +28 V
- Resistance: 5.1 kOmh

Digital Filters

High-pass filters: HP, **HP1**, **HP3**, **HP10**, **HPE**

Frequency weighting filters (filter includes Band Limiting filter): **Wh - c**onforms to ISO 8041-1:2017

Integrating filters: Vel1, **Vel3**, **Vel10**, **Dil1**, **Dil3**, **Dil10**

Special filter: VelMF (filter for evaluation of the machinery condition) **-** conforms to ISO 10816

See Chapter C.5 for filters characteristics.

Linear operating ranges

Two measurement ranges are available: **Low** and **High**.

Table C.3.5.   Linear operating ranges with the **Wh** filter

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 12.5 Hz sine signal	
Low	from 20.2 µV (66.1 dB)	to 957 mV (159.6 dB)
High	from 202 µV (86.1 dB)	to 3.39 V (170.6 dB)

Table C.3.6.   Linear operating ranges with the **HP**, **HP1**, **HP3** and **HP10** filters

Range (RMS)	Linear operating ranges (RMS) With the SV 80 (10 mV/ms^{-2}) accelerometer sensitivity @ 79.58 Hz Measured at the ref. environmental conditions, at 80 Hz sine signal	
Low	from 100 µV (80 dB)	to 1.0 V (160 dB)
High	from 1.0 mV (100 dB)	to 3.54 V (171 dB)

Table C.3.7.   Peak for the sinusoidal signal 1 kHz, at reference conditions

Peak for the sinusoidal signal 1 kHz, at reference conditions @ 1 kHz (0.0 dB calibration factor)	
Range	Max Peak value
Low	1.35 V "Wh" – weighting
	1.41 V "HP" – weighting
	1.41 V "HP1" – weighting
	1.41 V "HP3" – weighting
	1.41 V "HP10" – weighting
High	4.78 V "Wh" – weighting
	4.99 V "HP" – weighting
	4.99 V "HP1" – weighting
	4.99 V "HP3" – weighting
	4.99 V "HP10" – weighting

> **Note:** For the signals with the crest factor **n >1.41** upper measuring range of the RMS is reduced. The valid upper limit can be calculated according to the below given formula:
>
> **An dB(re1µV) = A dB(re1µV) – 20log(n/√2),**
>
> where **A** is the upper limit for the sinusoidal signal in dB(re1µV)
>
> Example: For the crest factor **n = 10** the upper limit is **A$_{10}$ = 120 dB(re1µV)**

Measuring frequency range	0.35 Hz ÷ 22.4 kHz with the **HP** filter (-3 dB)
Measuring frequency range	0.35 Hz ÷ 44.6 kHz with the **HPE** filter (-3 dB)

> **Note:** *When another vibration transducer is used, the frequency range given above for the HP filter can be different.*

Maximum peak voltage	30 V Peak-Peak (Maximum peak voltage of input sinusoidal signal, which can be applied to the VLM without destruction the meter)

RMS detector (Linear averaging)

- Digital   "True RMS" with Peak detection
- Resolution   0.1 dB
- Range   327.7 dB
- Crest Factor   unlimited (for signals in 20 kHz band)

Reference conditions as per ISO 8041-1:2017

- Reference frequency   79.58 Hz
- Reference temperature   +23°C
- Reference relative humidity   50 %
- Reference range   **High**.

Calibration (electrical)

Calibration level	100 mV$_{RMS}$ (140 dB re 0.01 µV)
Test frequency	79.6 Hz
Weighting filter	HP10
Basic accuracy	< ± 0.1 dB (for the temperature T=+23°C ± 5°C for the sinusoidal signal)
Measurement deviation	< ± 0.2 dB (when the temperature is from -10°C to +50°C for the sinusoidal signal)

Overload detector

The instrument has the built-in overload detectors. Both A/D converter and input amplifier overload conditions are detected. The overload in the measurement channel (in its analogue part) and the overload of the analogue / digital converter are both detected. The "overload" indication appears when the input signal amplitude is 0.5 dB above the declared "Peak measurement range".

Warm-up time	1 min. (for 0.1 dB accuracy).
Effect of humidity	< 0.5 dB (for 30%<RH<90% at 40°C re Reference conditions)
Effect of temperature	< 0.5 dB (from -10°C to + 50°C)
Effect of magnetic field	< 5 µV$_{RMS}$ (A) or < 20 µV$_{RMS}$ (Z) (for 80 A/m and 50 Hz)
Effect of vibration	< 0.1 dB (from 20 Hz to 1000 Hz at 1 m/s^2)

Electrostatic and radio frequency criteria – see Chapter C.1.1

Sampling frequency	48 kHz or 96 kHz (internal only)
Analogue to digital converter	1 x 24 bit
Reference range	**High**
Input attenuator accuracy	± 0.1 dB (for f = 1 kHz and T = +23°C)
Internal oscillator accuracy	0.01 % (for f = 1 kHz and T = +23°C)

Antialiasing filter

Built-in antialiasing filter. Second-order analogue filter, passive Class, combined with on-chip FIR digital filter of the analogue-to-digital converter, ensuring correct sampling of the measured signal.

Pass band (-1 dB)	22.200 kHz or 44.4 kHz
Pass band (-3 dB)	23.520 kHz or 47.0 kHz
Stop band	26.256 kHz or 52.53 kHz
Attenuation in the stop band	> 80 dB

1/1 and 1/3 octave filters noise levels

Typical electrical noise levels HP/HPE-weighted for SV 977D in configuration with ST 08 adapter and 50 Ohm BNC terminal for 1/1 octave filters. Averaging time 30 s.

Table C.3.8.   Typical electrical noise levels HP/HPE-weighted for SV 977D in configuration with ST 08 adapter and 50 Ohm BNC terminal for 1/1 octave filters

1/3 octave central frequency [Hz]	Low range [μV]	High range [μV]
1	0.4	2.8
2	0.4	2.5
4	0.3	2.4
8	0.4	2.5

1/3 octave central frequency [Hz]	Low range [μV]	High range [μV]
16	0.4	2.6
31.5	0.4	3.6
63	0.5	3.3
125	0.4	3.1
250	0.5	3.7
500	0.6	4.8
1 000	0.8	6.4
2 000	1.1	8.8
4 000	1.5	12.2
8 000	2.1	17.0
16 000	2.9	23.8
31 500	4.4	34.1

Typical electrical noise levels HP/HPE-weighted for SV 977D in configuration with ST 08 adapter and 50 Ohm BNC terminal for 1/3 octave filters. Averaging time 30 s.
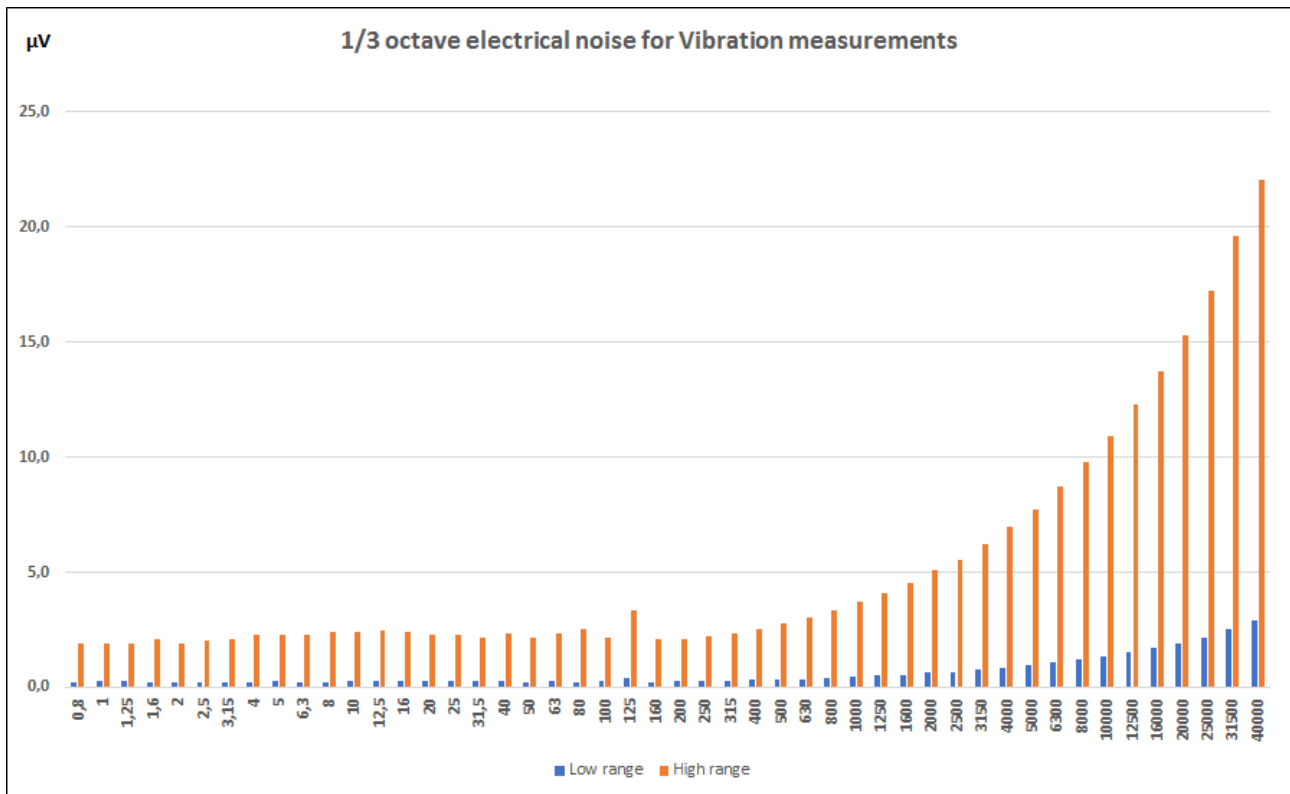
Table C.3.9.   Typical electrical noise levels HP/HPE-weighted for SV 977D in configuration with ST 08 adapter and 50 Ohm BNC terminal for 1/3 octave filters

1/3 octave central frequency [Hz]	Low range [μV]	High range [μV]
0.8	0.2	1.9
1	0.3	1.9
1.25	0.3	1.9
1.6	0.2	2.1
2	0.2	1.9

1/3 octave central frequency [Hz]	Low range [µV]	High range [µV]
2.5	0.2	2.1
3.15	0.2	2.1
4	0.2	2.3
5	0.2	2.3
6.3	0.2	2.3
8	0.2	2.4
10	0.3	2.4
12.5	0.3	2.4
16	0.3	2.4
20	0.3	2.3
25	0.3	2.3
31.5	0.3	2.2
40	0.3	2.3
50	0.2	2.1
63	0.3	2.3
80	0.2	2.5
100	0.3	2.2
125	0.4	3.3
160	0.2	2.1
200	0.3	2.1
250	0.3	2.2
315	0.3	2.3
400	0.3	2.6
500	0.3	2.8
630	0.4	3.0
800	0.4	3.4
1 000	0.5	3.7
1 250	0.5	4.1
1 600	0.6	4.5
2 000	0.6	5.1
2 500	0.7	5.6
3 150	0.8	6.3
4 000	0.9	7.0
5 000	0.9	7.8
6 300	1.1	8.7
8 000	1.2	9.8
10 000	1.3	10.9
12 500	1.5	12.3
16 000	1.7	13.7
20 000	1.9	15.3
25 000	2.2	17.3
31 500	2.5	19.6
40 000	2.9	22.1

C.3.2   1/1 and 1/3 octave filters characteristics

1/1 octave filters   16 filters with centre frequencies from 1 Hz to 31.5 kHz (base 10), meeting IEC 61260-1:2014 standard for Class 1
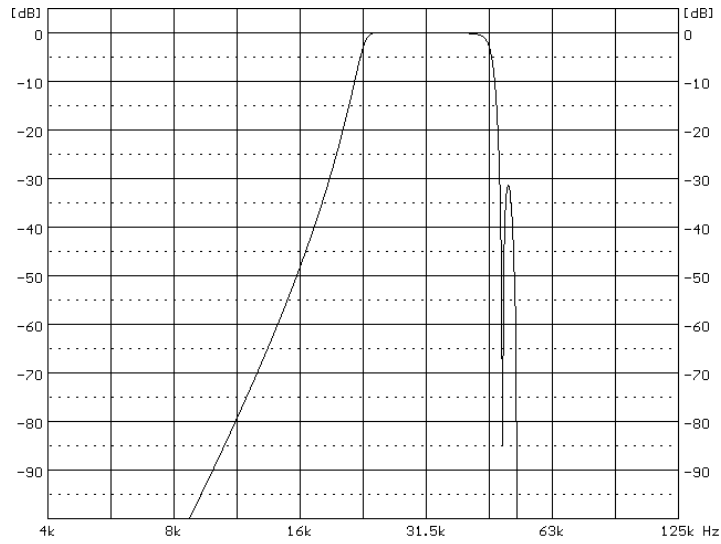
31.5 kHz 1/1 octave filter
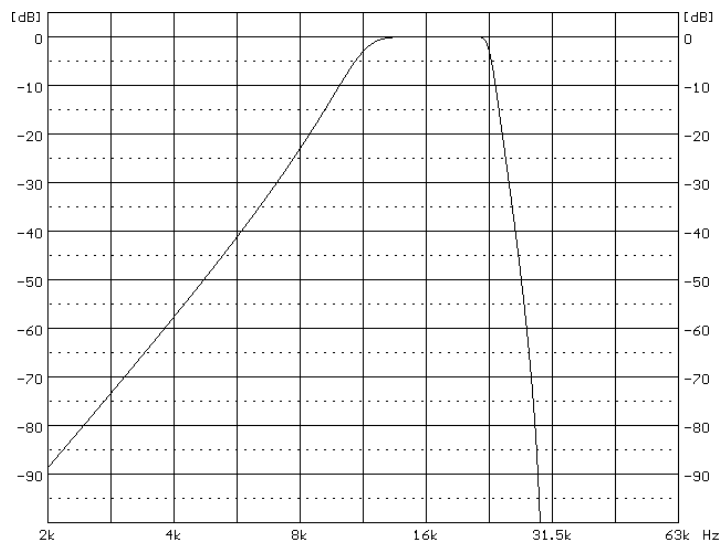
16.0 kHz 1/1 octave filter (Ultra band)
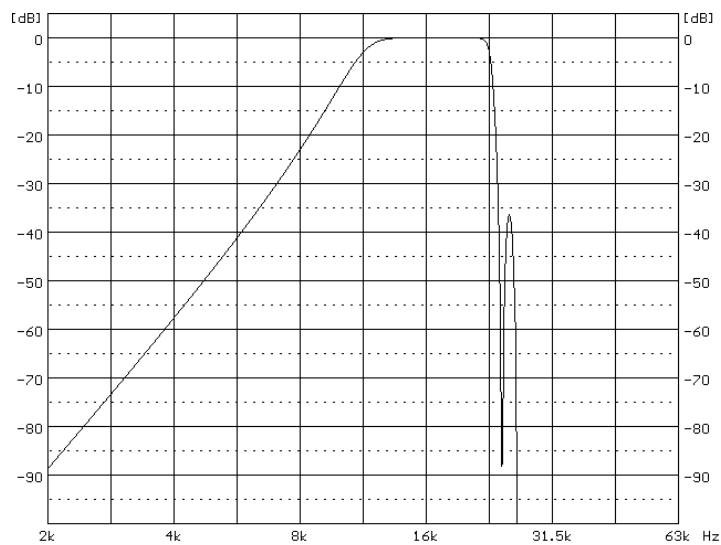
16.0 kHz 1/1 octave filter (Audio/Full band)
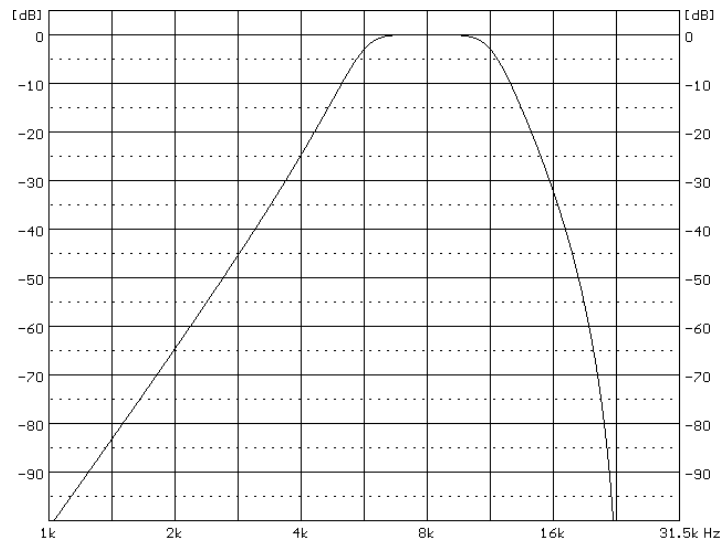
8.0 kHz 1/1 octave filter
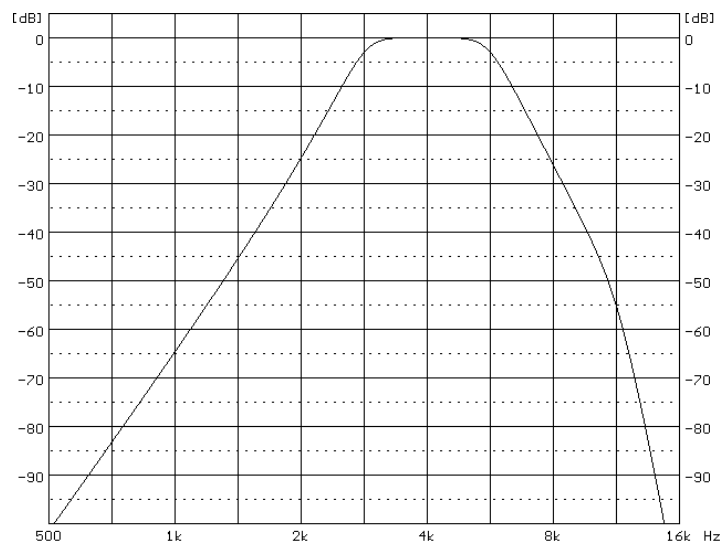
4.0 kHz 1/1 octave filter
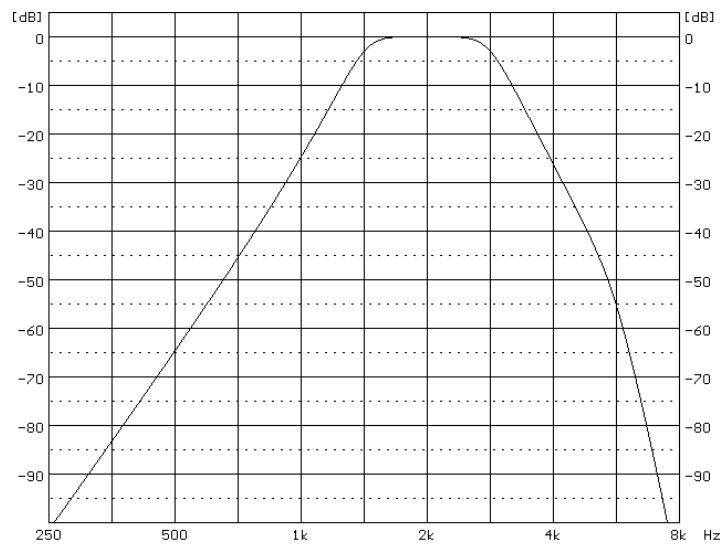
2.0 kHz 1/1 octave filter
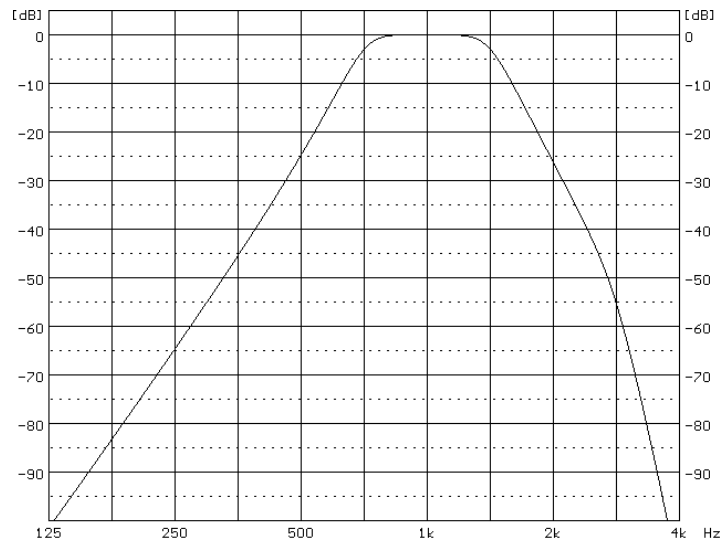
1.0 kHz 1/1 octave filter
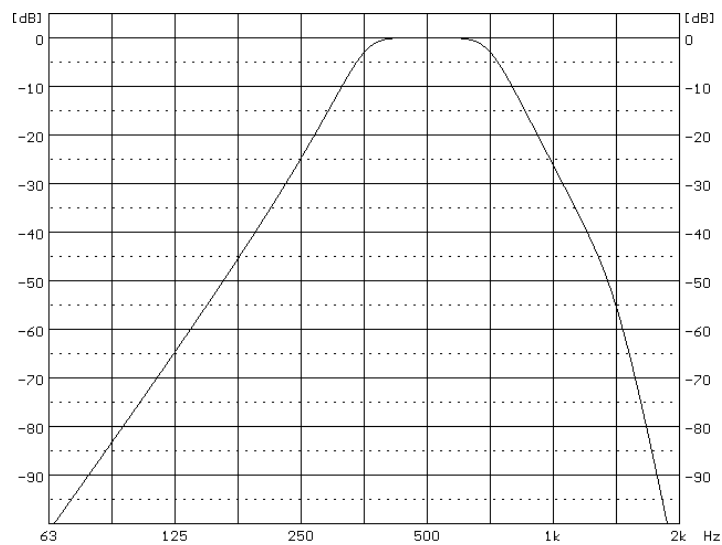
500 Hz 1/1 octave filter
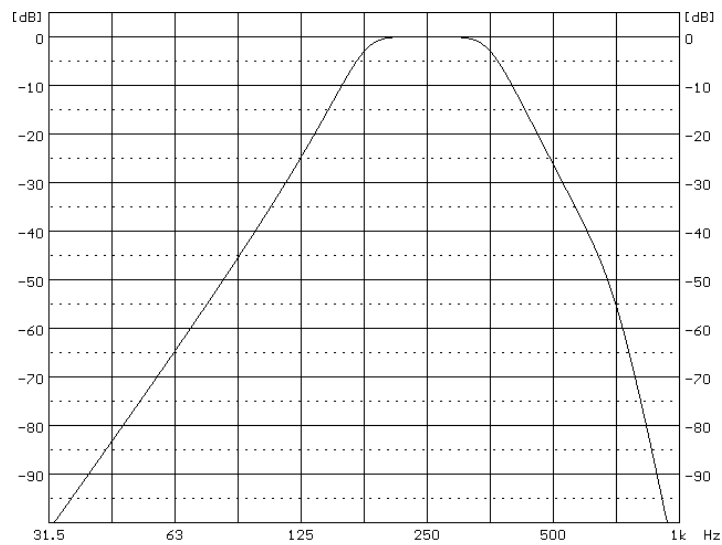
250 Hz 1/1 octave filter
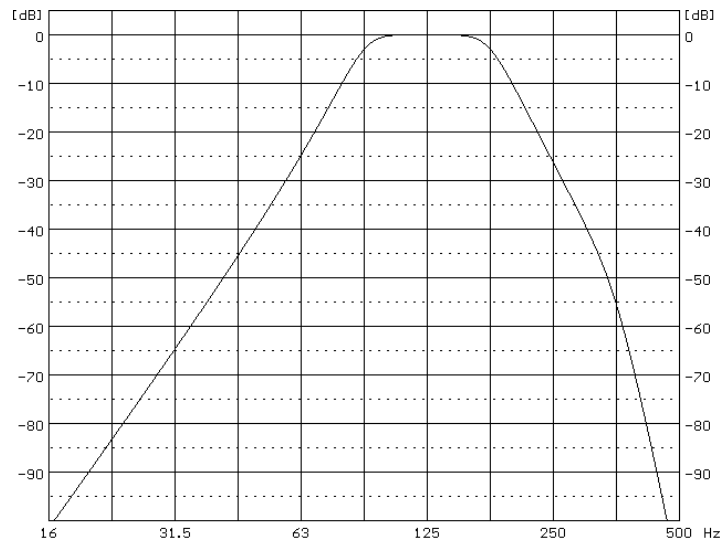
125 Hz 1/1 octave filter
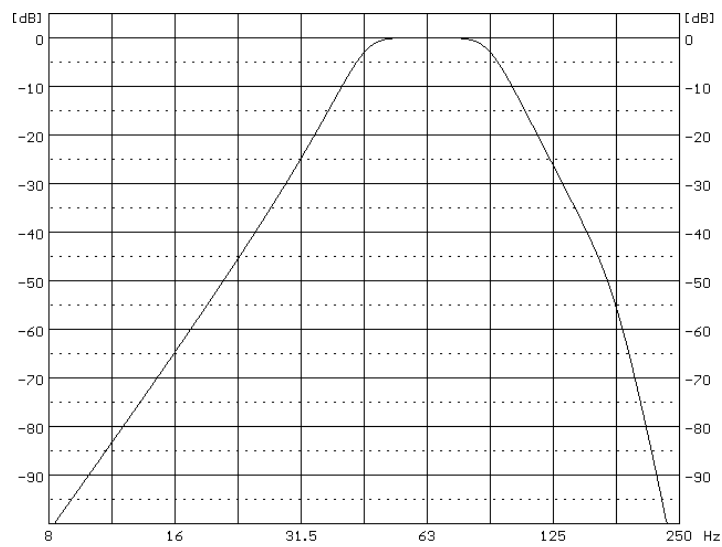
63.0 Hz 1/1 octave filter
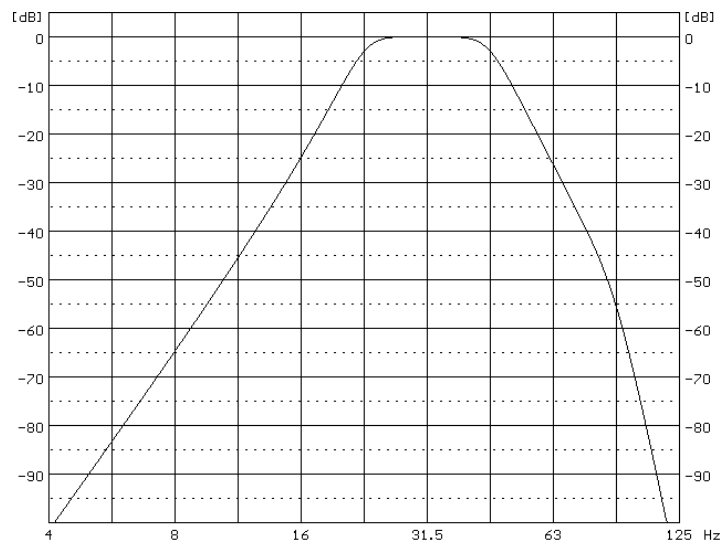
31.5 Hz 1/1 octave filter
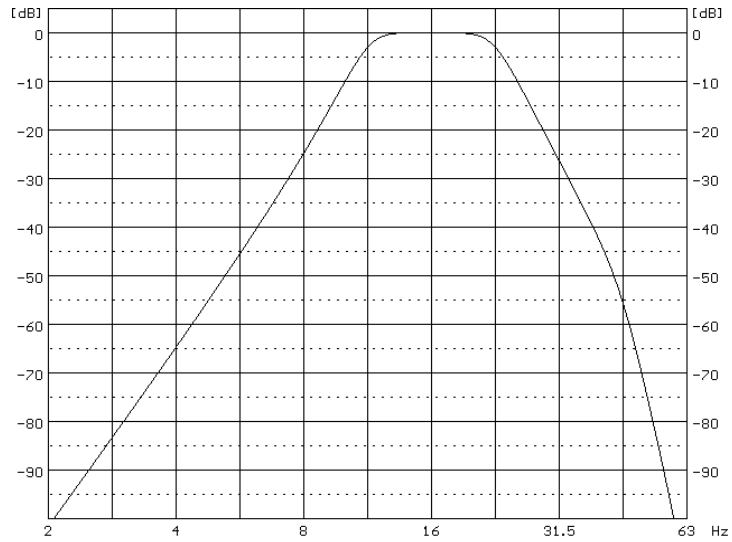
16.0 Hz 1/1 octave filter
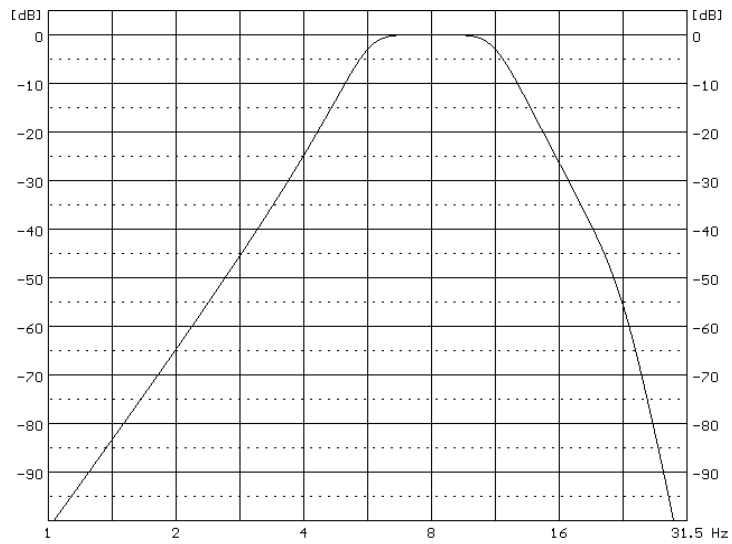
8.00 Hz 1/1 octave filter
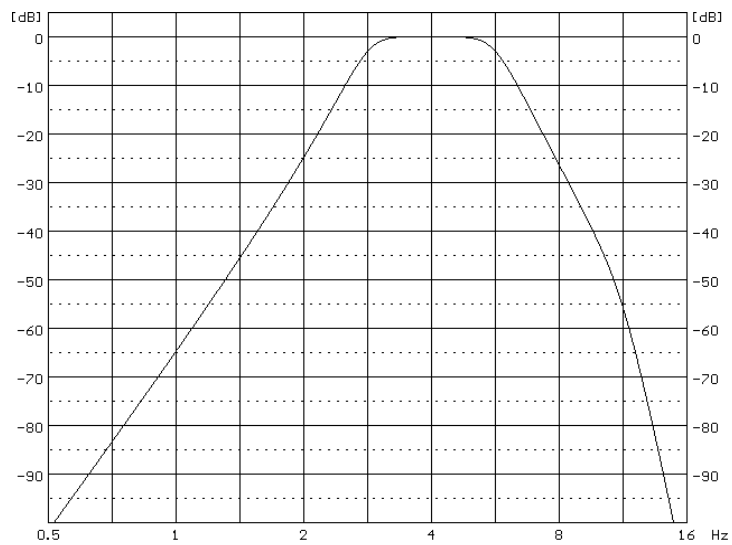
4.00 Hz 1/1 octave filter
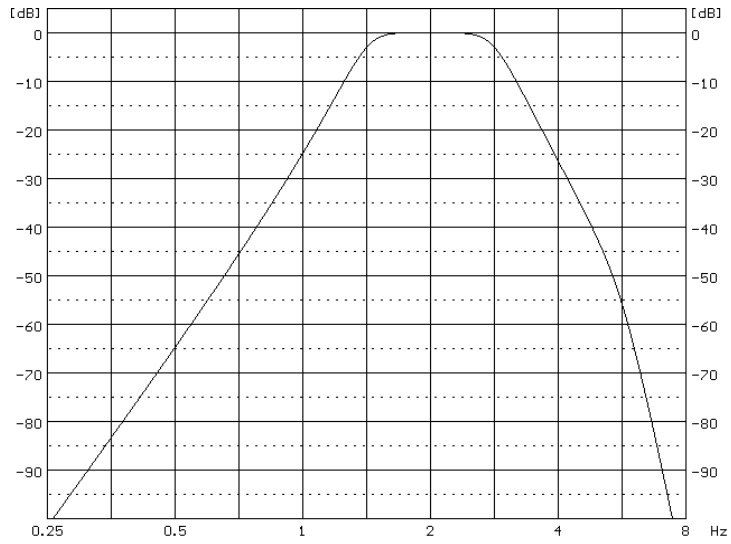
2.00 Hz 1/1 octave filter
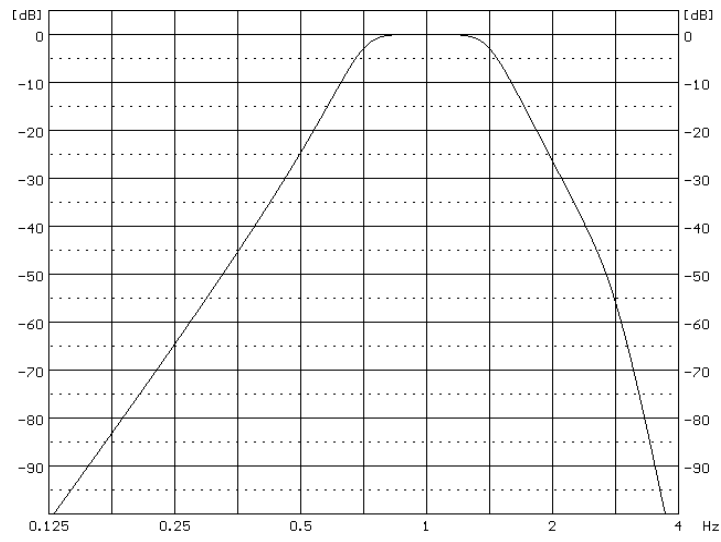
1.00 Hz 1/1 octave filter
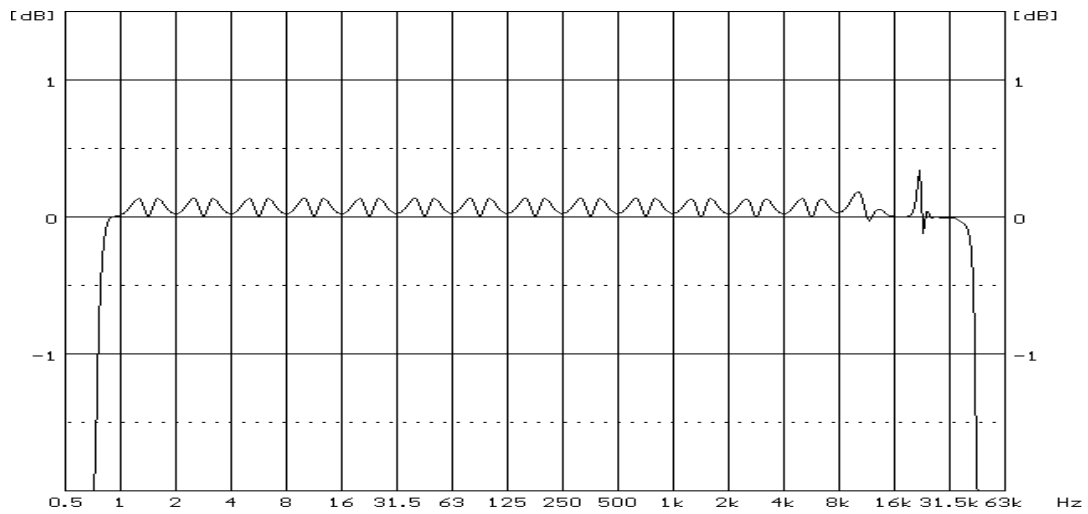
Summary curve of the Ultra Band
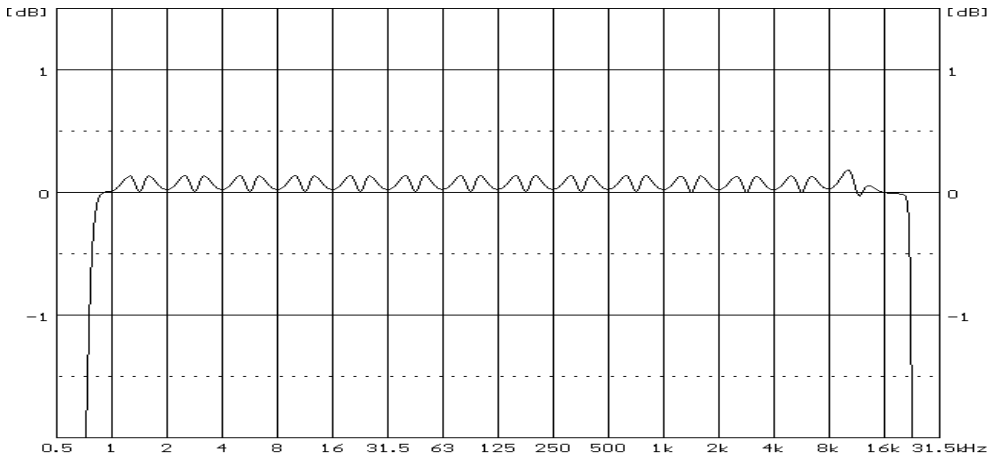
Summary curve of the Audio/Full Band

1/3 octave filters   48 filters with centre frequencies from 0.8 Hz to 40 kHz (base 10), meeting IEC 61260-1:2014 standard for Class 1
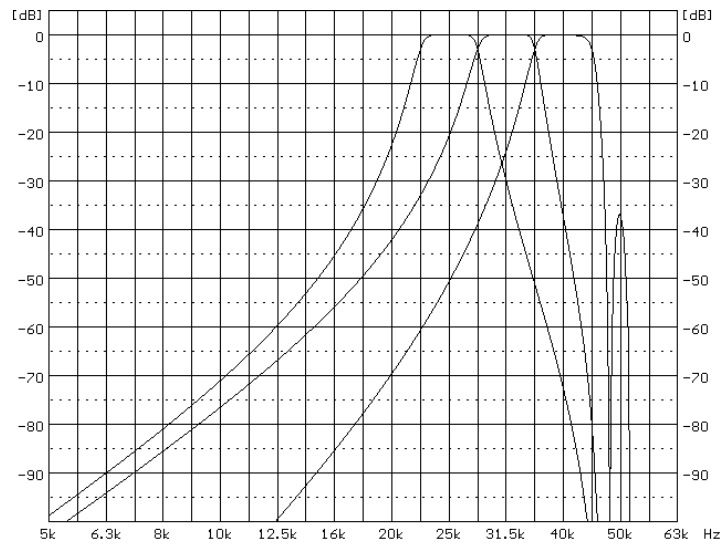
1/3 octave filters for 31.5 kHz 1/1 octave filter
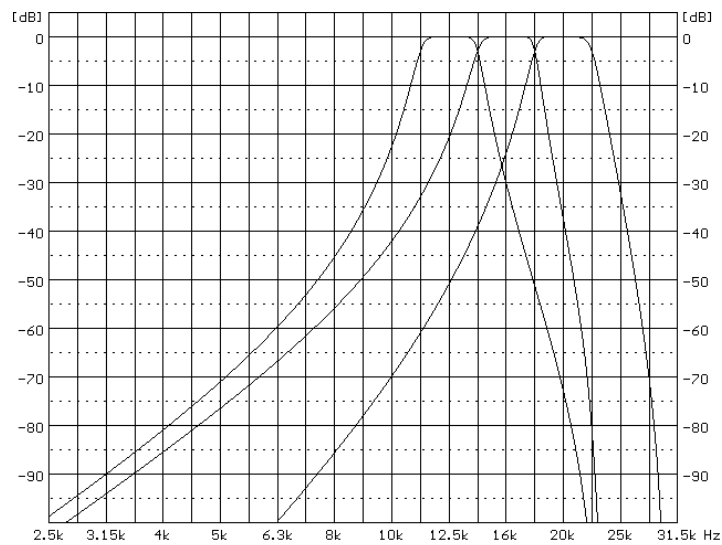
1/3 octave filters for 16.0 kHz 1/1 octave filter (Ultra band)
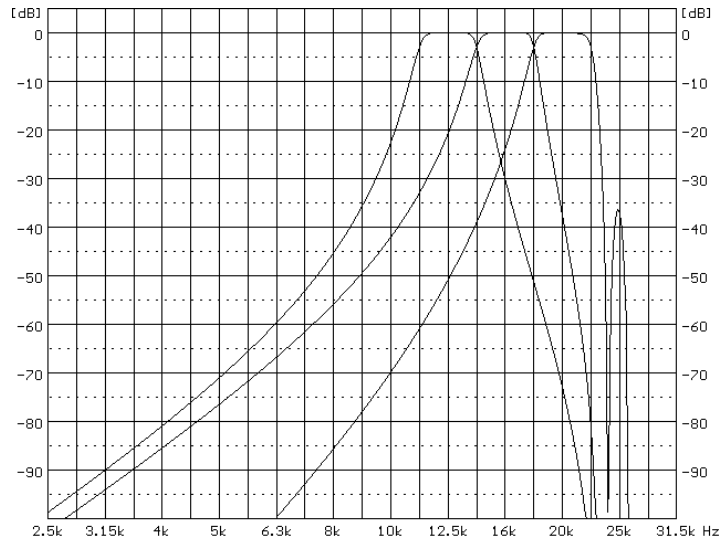
1/3 octave filters for 16.0 kHz 1/1 octave filter (Audio/Full band)
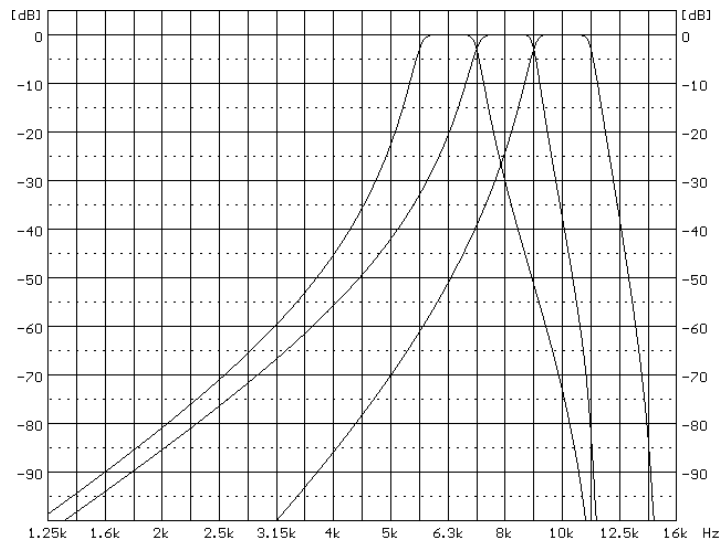
1/3 octave filters for 8.0 kHz 1/1 octave filter
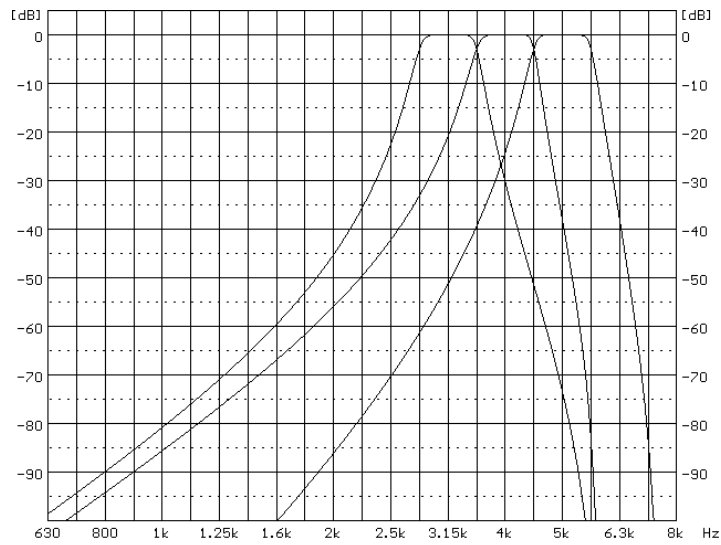
1/3 octave filters for 4.0 kHz 1/1 octave filter
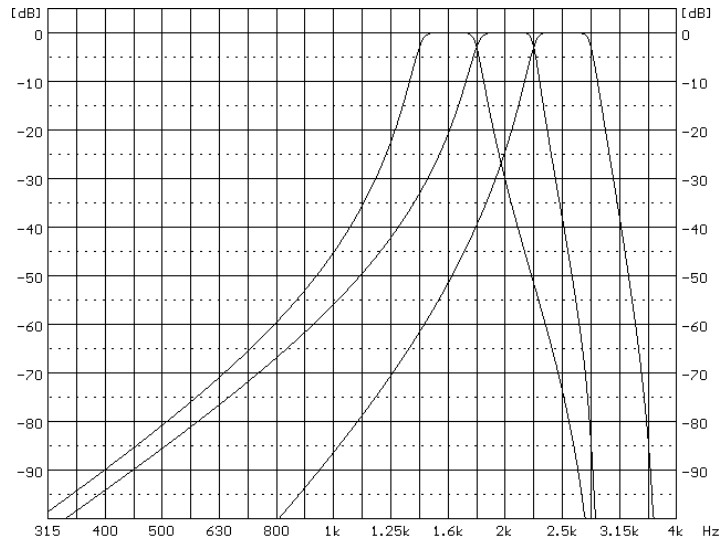
1/3 octave filters for 2.0 kHz 1/1 octave filter
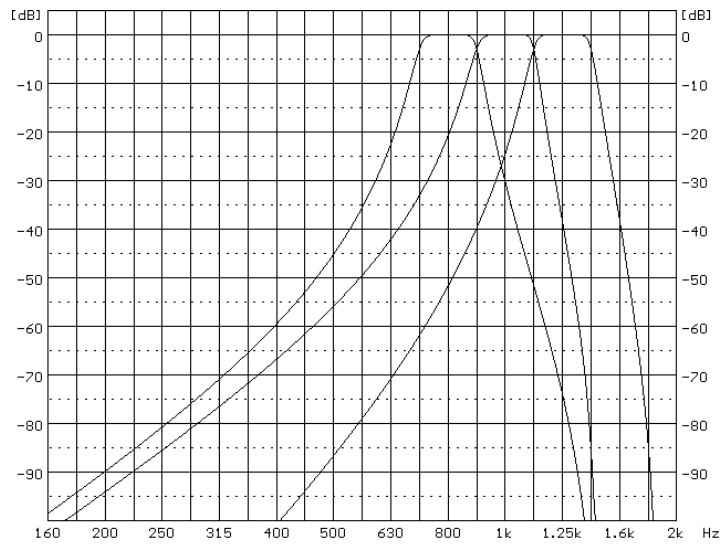
1/3 octave filters for 1.00 kHz 1/1 octave filter
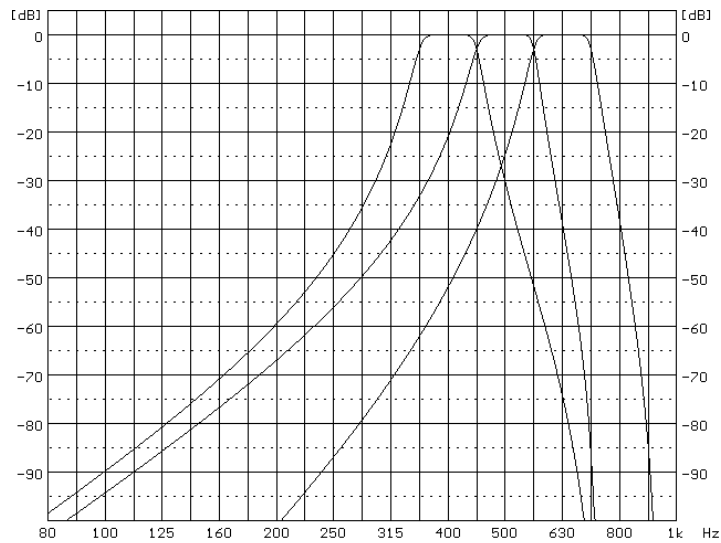
1/3 octave filters for 500 Hz 1/1 octave filter
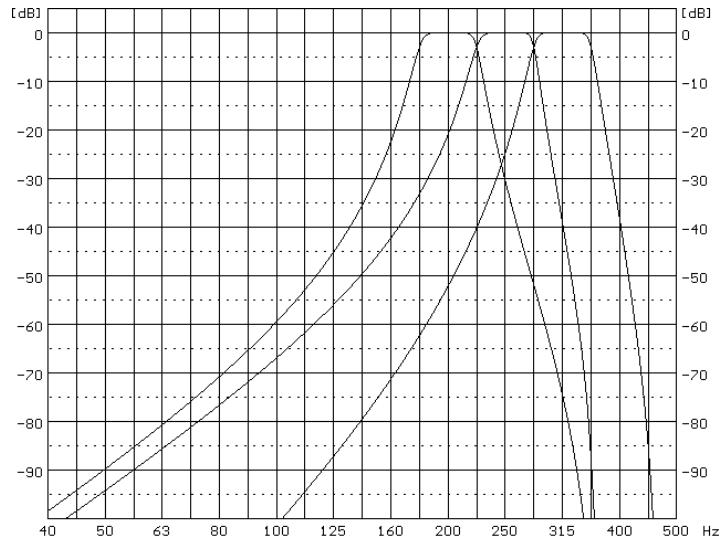
1/3 octave filters for 250 Hz 1/1 octave filter
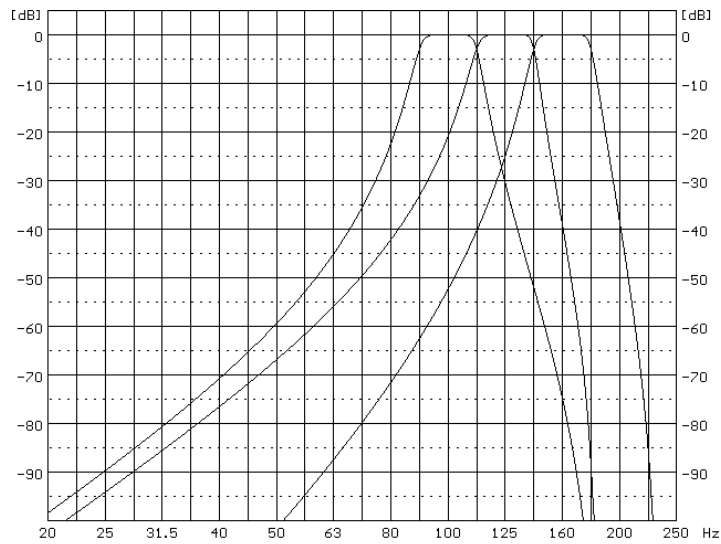
1/3 octave filters for 125 Hz 1/1 octave filter
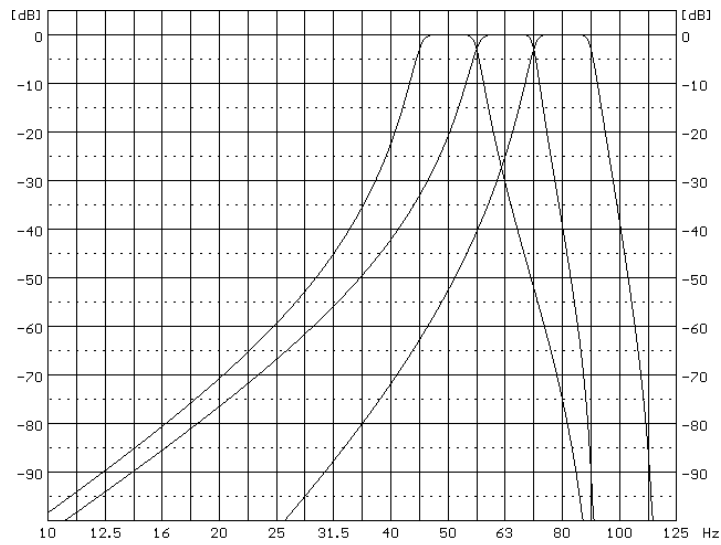
1/3 octave filters for 63.0 Hz 1/1 octave filter
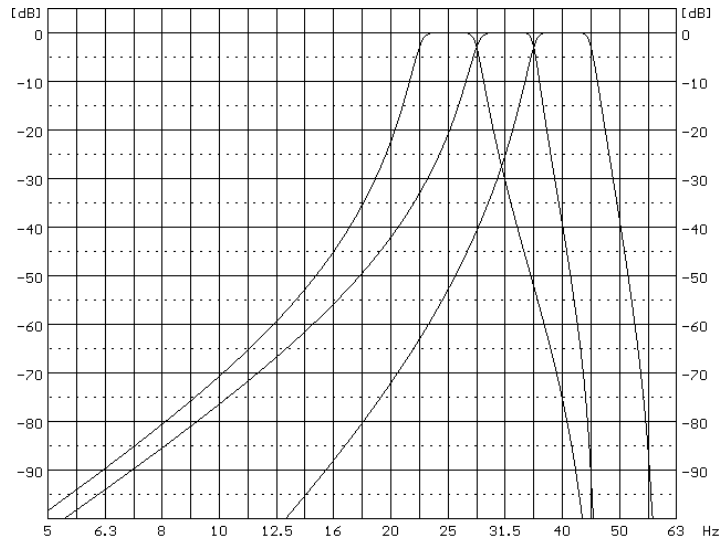
1/3 octave filters for 31.5 Hz 1/1 octave filter
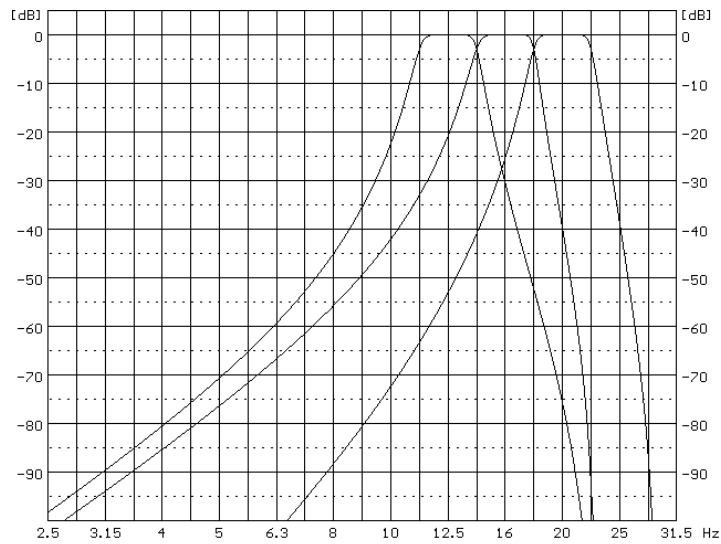
1/3 octave filters for 16.0 Hz 1/1 octave filter
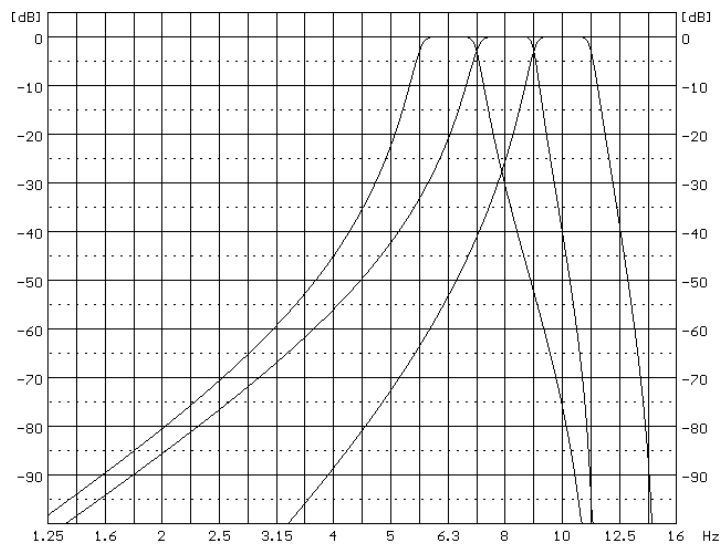
1/3 octave filters for 8.00 Hz 1/1 octave filter
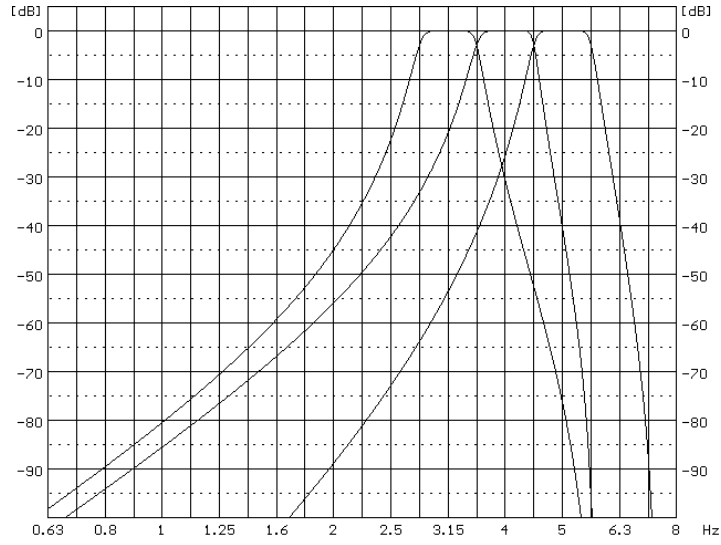
1/3 octave filters for 4.00 Hz 1/1 octave filter
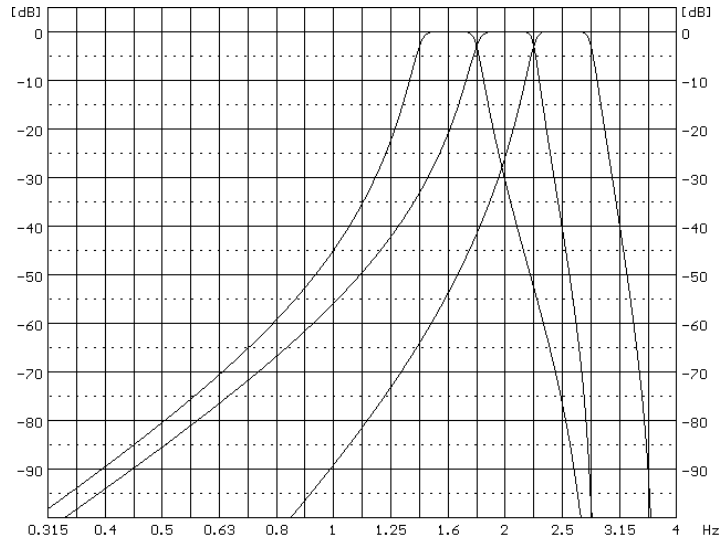
1/3 octave filters for 2.00 Hz 1/1 octave filter
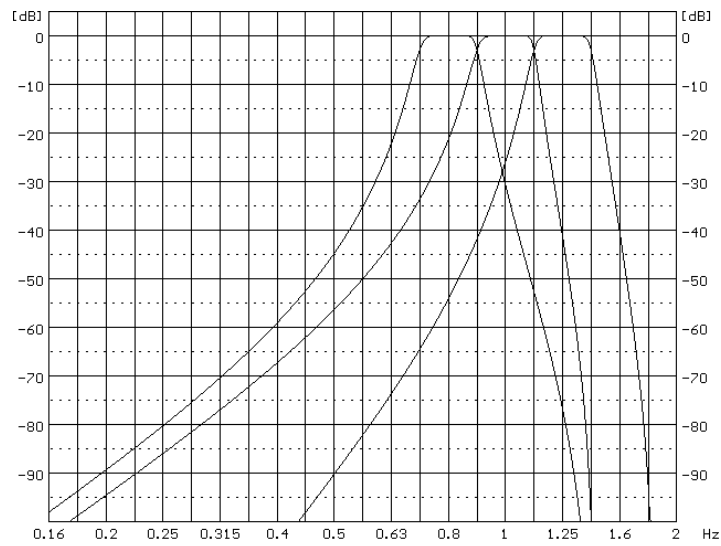
1/3 octave filters for 1.00 Hz 1/1 octave filter
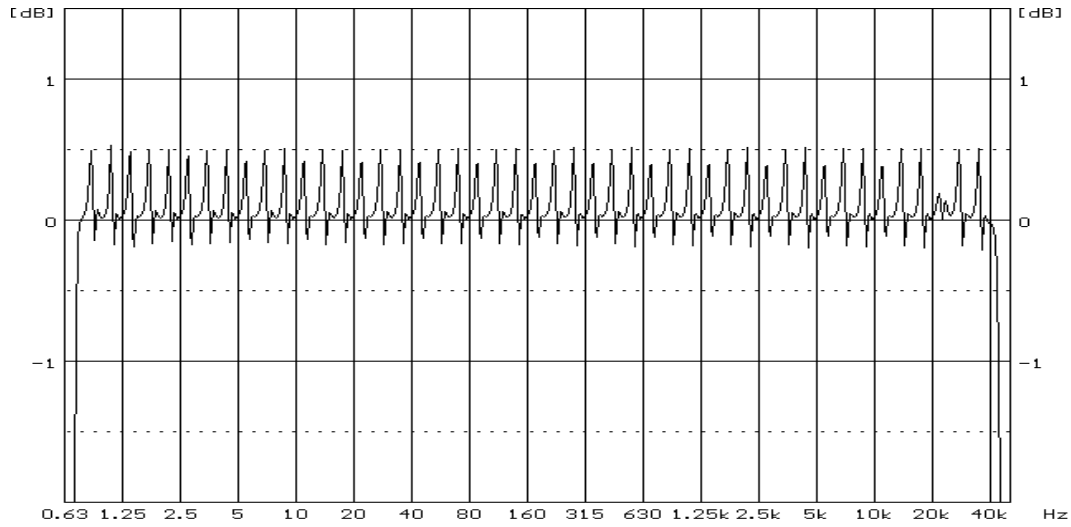
Summary curve of the Ultra Band
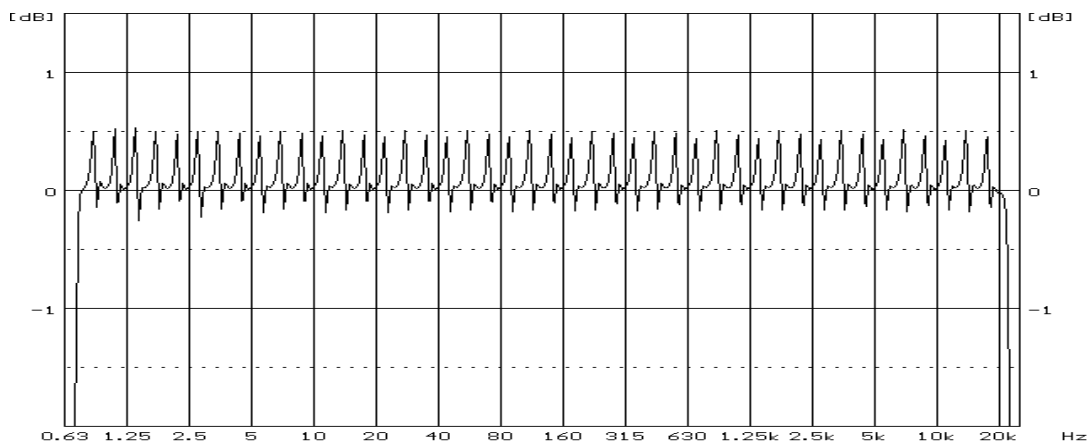
Summary curve of the Audio/Full Band

Table C.3.10. 1/1 and 1/3 octave filters RT60 decay time

Nominal Frequency [Hz]	1/3 octave filters RT60 [ms]	1/3 octave filters RT60 [ms]
50	550	
63	500	150
80	370	
100	250	
125	210	70
160	160	
200	130	
250	110	40
315	90	
400	80	
500	60	20
630	50	
800	40	
1 000	30	10

1 250	20	
1 600	20	
2 000	20	< 10
2 500	10	
3 150	10	
4 000	10	< 10
5 000	10	
6 300	< 10	
8 000	< 10	< 10
10 000	< 10	
12 500	< 10	
16 000	< 10	< 10
20 000	< 10	

C.4. FREQUENCY CHARACTERISTICS OF THE IMPLEMENTED BROADBAND DIGITAL FILTERS

"A" filter   Class 1 according to IEC 651 and IEC 61672-1:2013
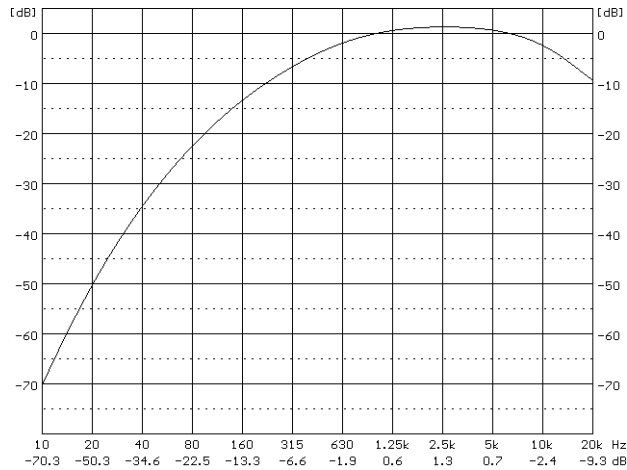
"A" filter characteristics

"C" filter   Class 1 according to IEC 651 and IEC 61672-1:2013
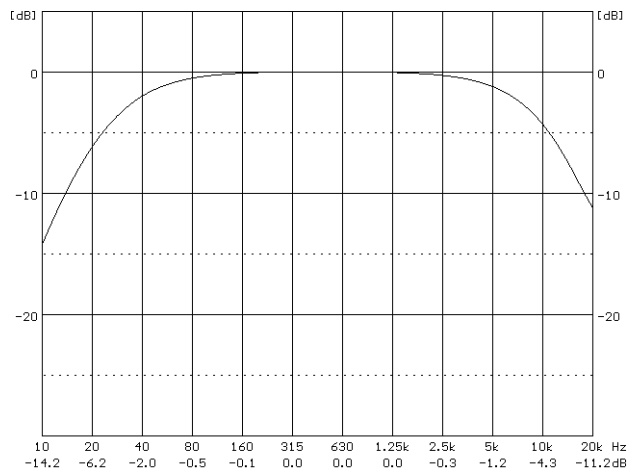
"C" filter characteristics

"B" filter   Class 1 according to IEC 651
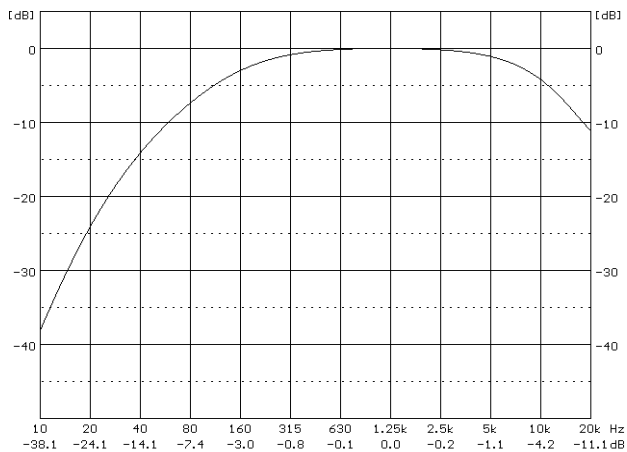
"B" filter characteristics

"Z" filter   Class 1 according to IEC 61672-1:2013
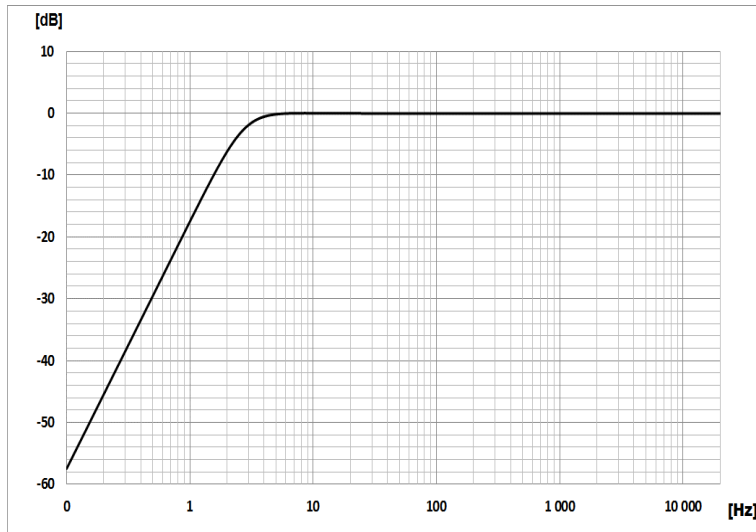
"Z" filter characteristics

"D" filter   according to BS 5721:1979
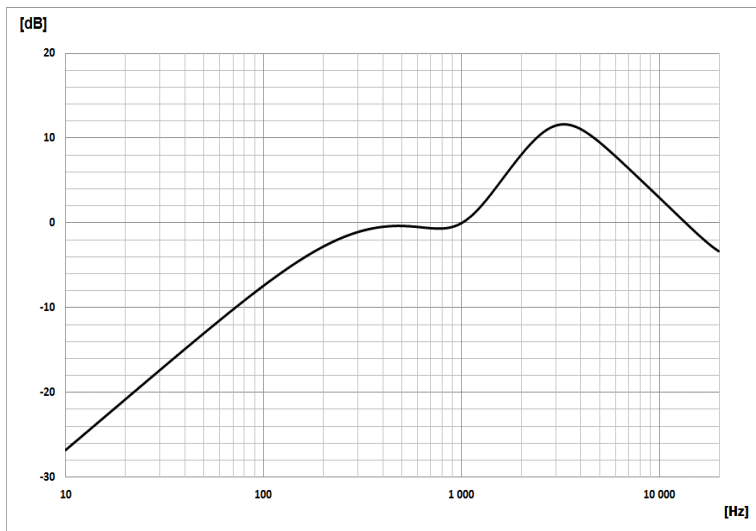
"D" filter characteristics

"U" filter   Class 1 according to IEC 61012:1990
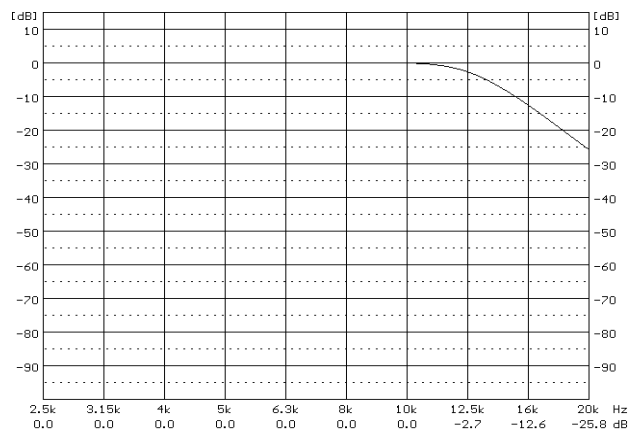
"U" filter characteristics

"AU" filter   Class 1 according to IEC 61012:1990
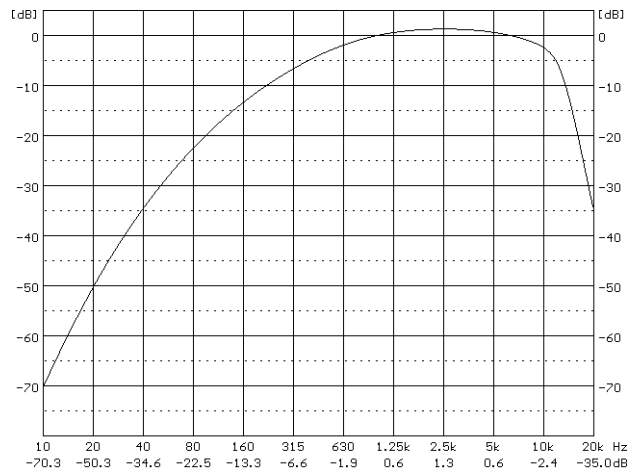
"AU" filter characteristics

"LF" filter   according to EPA-93-F105-02-104 Low Frequency Noise Control Regulations
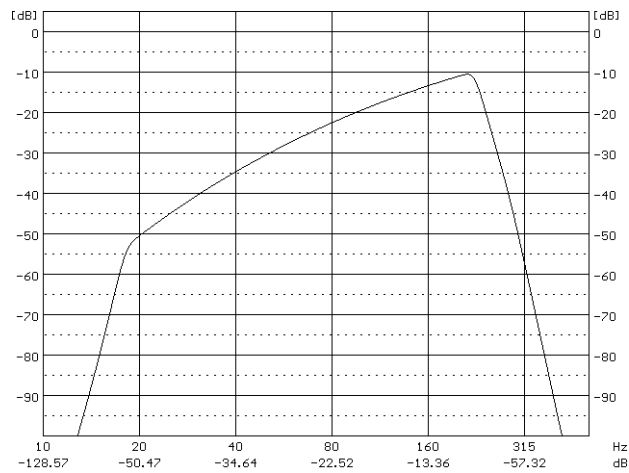
"LF" filter characteristic

"**HP1**" **filter** is used for the acceleration measurements (the vibration signal) in the frequency range from 1 Hz to 20 kHz.
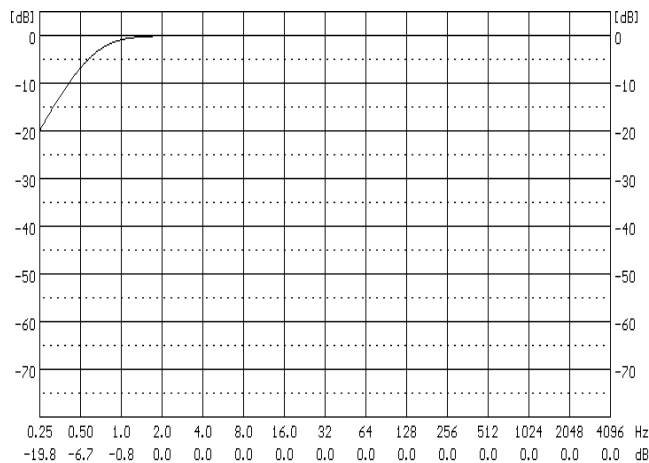
"HP1´ filter characteristics

"HP3" filter is used for the acceleration measurements (the vibration signal) in the frequency range from 3.5 Hz to 20 kHz

[dB]															[dB]
0.25	0.50	1.0	2.0	4.0	8.0	16.0	32	64	128	256	512	1024	2048	4096	Hz
-59.1	-39.7	-21.5	-5.6	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
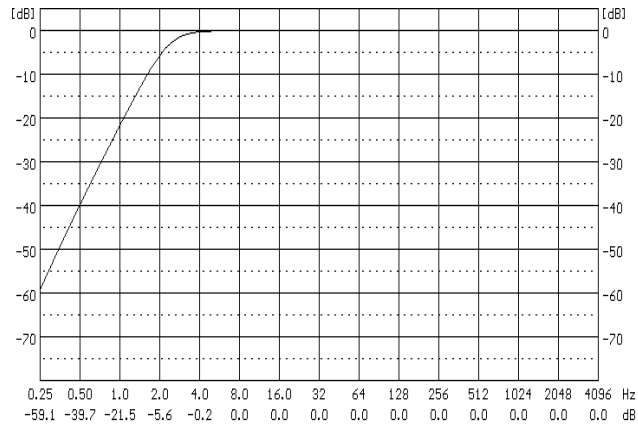
"HP3" filter characteristics

"HP10" filter is used for the acceleration measurements (the vibration signal) in the frequency range from 10 Hz to 20 kHz

[dB]															[dB]
0.25	0.50	1.0	2.0	4.0	8.0	16.0	32	64	128	256	512	1024	2048	4096	Hz
-78.3	-59.0	-41.2	-25.1	-11.2	-1.9	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
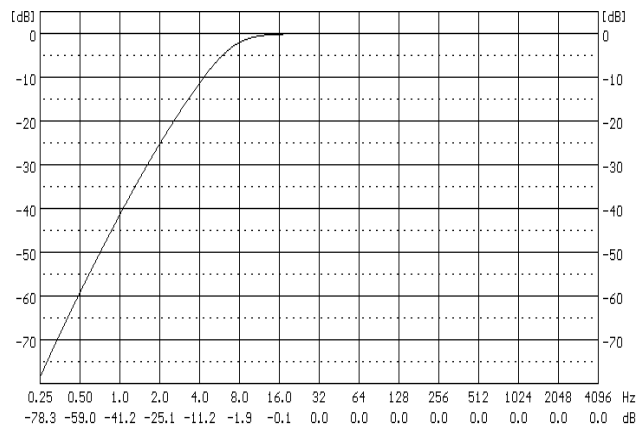
"HP10" filter characteristics

"Vel1" filter is used for the velocity measurements (the vibration signal) in the frequency range from 1 Hz to 20 kHz

[dB]															[dB]
0.25	0.50	1.0	2.0	4.0	8.0	16.0	32	64	128	256	512	1024	2048	4096	Hz
-37.3	-20.0	-16.8	-21.9	-28.0	-34.0	-40.0	-46.1	-52.1	-58.1	-64.1	-70.1	-76.2	-82.2	-88.1	dB
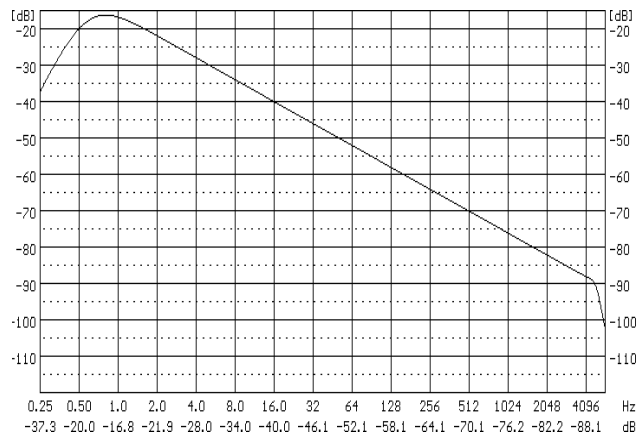
"Vel1" filter characteristics

"**Vel3" filter** is used for the velocity measurements in the frequency range from 1 Hz to 20 kHz
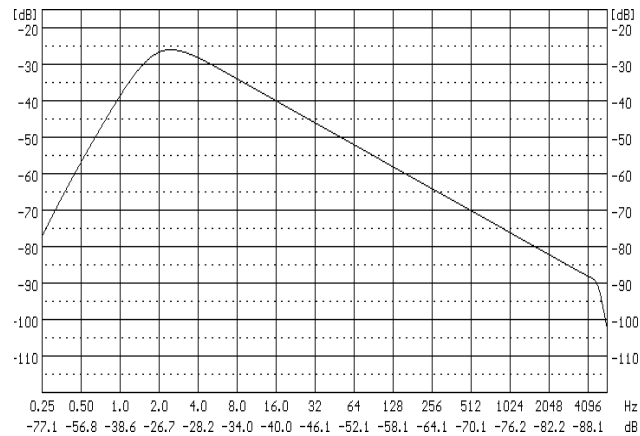
"Vel3" filter characteristics

"**Vel10" filter** is used for the velocity measurements in the frequency range from 1 Hz to 20 kHz
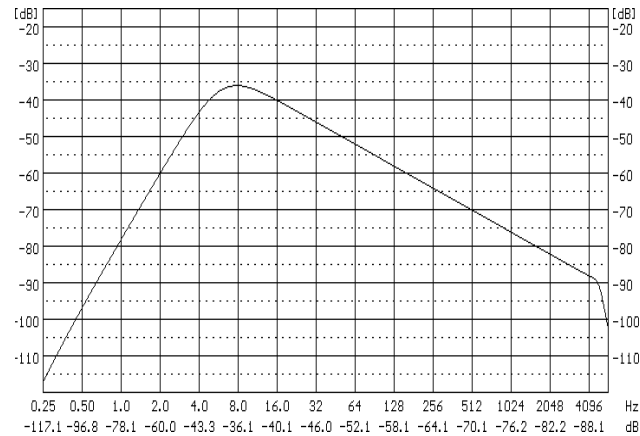
"Vel10" filter characteristics

"**VelMF" filter** is used for the evaluation of the state of the machines. This filter is used for the measurements in the frequency range from 10 Hz to 1000 Hz and conforms with ISO 10816
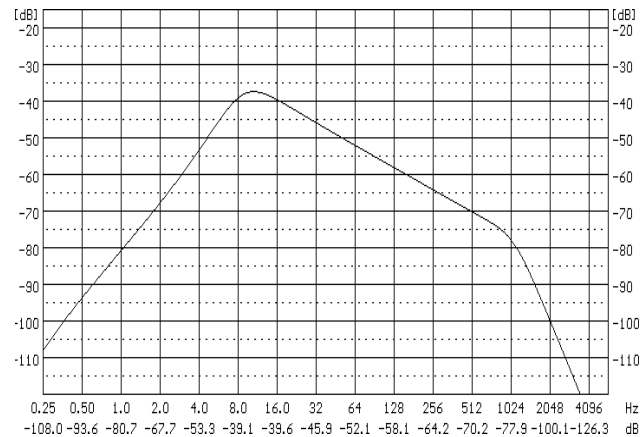
"VelMF" filter characteristics

"**Dil1" filter** is used for the displacement measurements in the frequency range [1 Hz to 20 kHz].
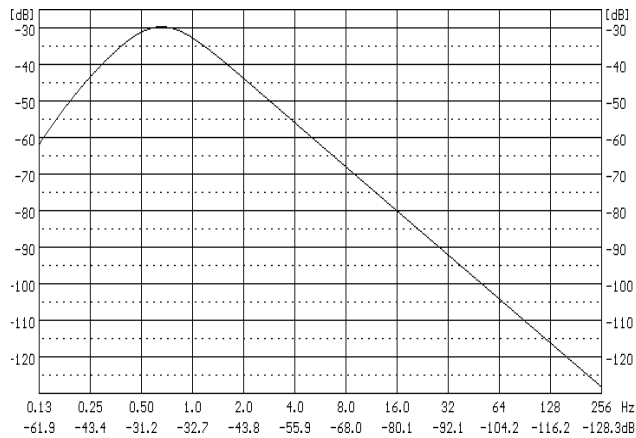
"Dil1" filter characteristics

"**Dil3" filter** is used for the displacement measurements in the frequency range [1 Hz to 20 kHz]
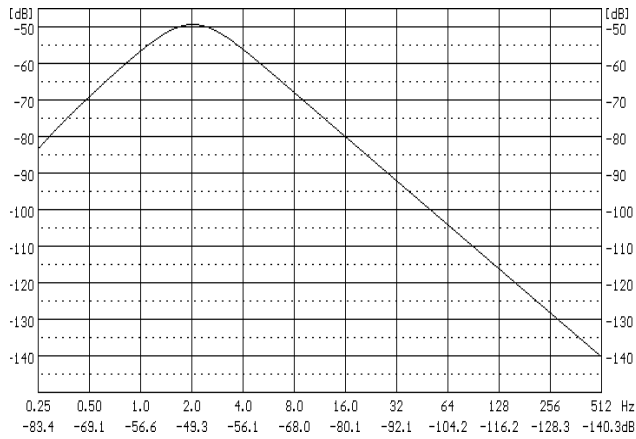
"Dil3" filter characteristics

"**Dil10" filter** is used for the displacement measurements in the frequency range [1 Hz to 20 kHz]
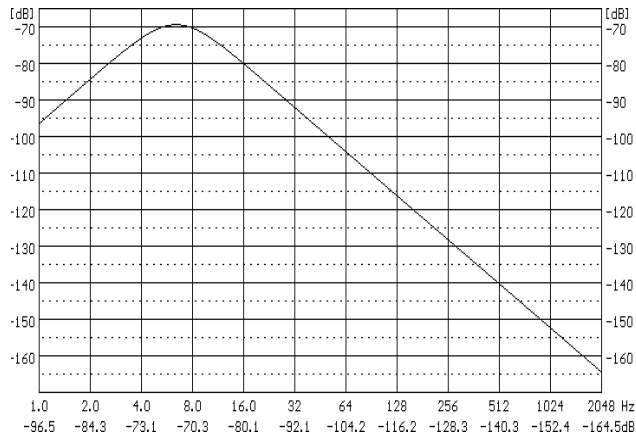
"Dil10" filter characteristics

"Wh" filter is used for the assessment of the influence of the vibration on the human body. It conforms with ISO 5349 and ISO 8041-1:2017
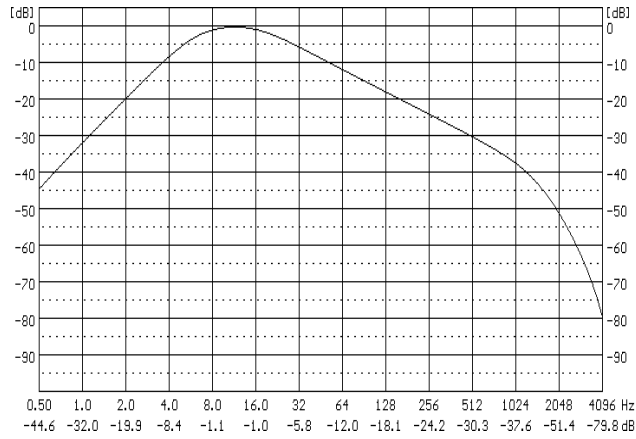
"Wh" filter characteristics

"HP" filter is a high-pass filter
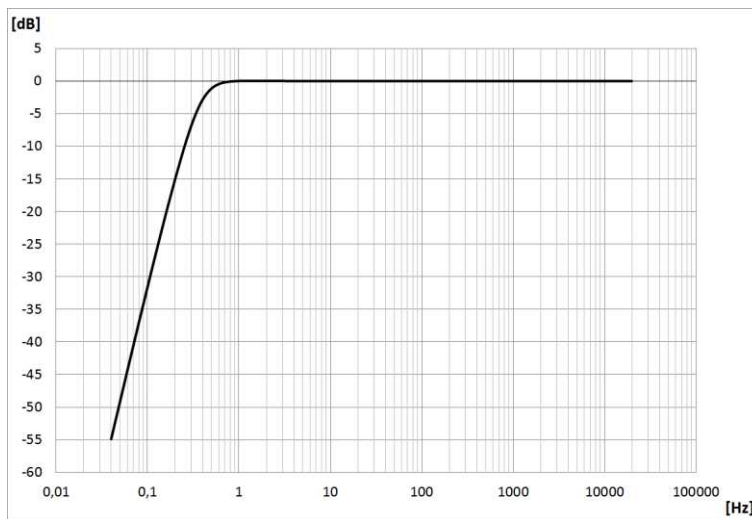
"HP" filter characteristics

"HPE" filter is a high-pass filter for the **Ultra** frequency band
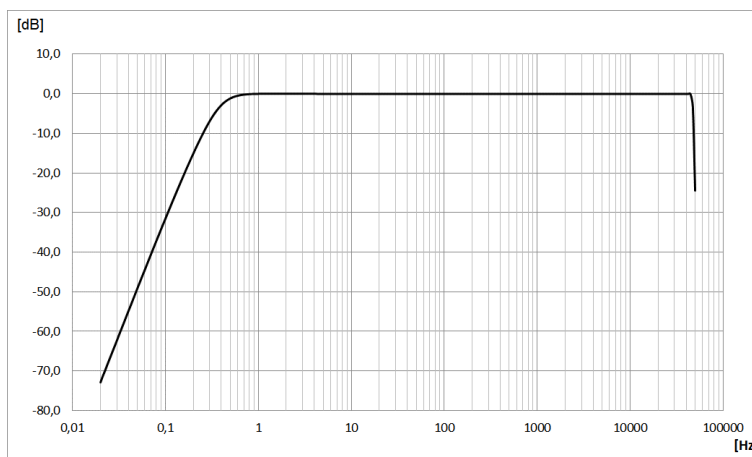
"HPE" filter characteristics

C.5. MISCELLANEOUS SPECIFICATION OF SV 977D

Display

Blanview TFT-LCD 2.4" colour display (320 x 240 pixels).

Memory

2 MB RAM memory.

128 MBit flash memory allocated to the program.

Memory card

Typical Micro SD or Micro SDHC cards can be used. Supported for up to 128 GB (if card was formatted as FAT32).

⚠️ **Note:** The originally supplied <u>Kingston Industrial</u> memory card has been tested by SVANTEK and cards of this type are strongly recommended for use when the original card is going to be replaced.
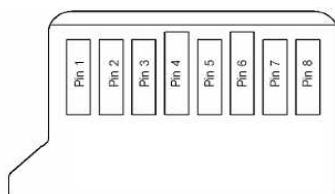
MicroSD contact pad assignment - outer view

Table C.5.1. Pin out of the MicroSD contact

Pin No.	Name	Description
1	DAT2	Data Line [Bit 2]
2	CD/DAT3	Card Detect / Data Line [Bit 3]
3	CMD	Command / Response
4	V_{DD}	Supply voltage
5	CLK	Clock
6	V_{SS}	Supply voltage ground
7	DAT0	Data Line [Bit 0]
8	DAT1	Data Line [Bit 1]

Signal input

The input of the measured signal (taken form the microphone preamplifier or the vibration transducer):
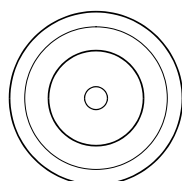
TNC connector (external view)

Table C.5.2. Pin out of the TNC connector

Pin number	TNC
Central	Input
Shield	Ground

Power supply

Instrument is dedicated for the operation from the internal replaceable battery.

Power consumption from the 6V source is approx. **130 mA (at + 20°C)**

So, typical operating time from 4 x AA alkaline batteries will be about **12 hours**.

SV 977D can be also powered from the AA Type rechargeable batteries.

> **Note:** *For the temperatures below 0℃ operating time may be shortened (depending on the batteries)!*

Instrument can be also powered from the external source (e.g., SA 17A or car battery) with the DC Voltage from 7 V to 16 V.

Voltage ripple should not exceed ± 5%.

External Power requirement is voltage dependent:

for 7 V	- 110 mA DC,
for 15.5 V	- 60 mA DC.
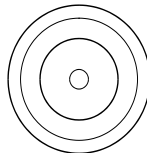
Power supply connector 5.5 / 2.1 mm (external view)

Table C.5.3. Pin out of the power supply connector

Internal Pin	5.5/2.1
Shield	Ground
1	+ 7 V ÷ 16 V

Interface USB Type C

The SV 977D USB-C 2.0 interface enables remote control of the instrument and data transfer with the speed up to that attainable with 480 MHz clock.

> **Note:** *For effective operation with the USB, the **High 480Mbps** speed mode should be used, however when the interference RF field strength may exceed the value of 3V/m, then it is recommended to switch to the **Full 12Mbps** speed mode.*

The USB-C interface can work as an external power source for the instrument.

USB-C socket (external view)
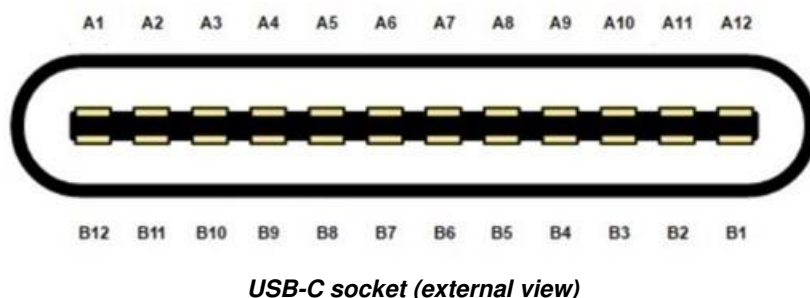
Table C.5.4.   Pin-out of the USB-C device connector

Contact no.		Signal name	Description
A1	B1	GND	Ground return
A2	B2	SSTXp1	not used
A3	B3	SSTXn1	not used
A4	B4	V_{BUS}	Bus power (5VDC ±0.5V)
A5	B5	CC1	Configuration channel (5.1kΩ to ground as UFP receiver)
A6	B6	Dp1	USB 2.0 differential pair, position 1, positive
A7	B7	Dn1	USB 2.0 differential pair, position 1, negative
A8	B8	SBU1	not used
A9	B9	V_{BUS}	Bus power (5VDC ±0.5V)
A10	B10	SSRXn2	not used
A11	B11	SSRXp2	not used
A12	B12	GND	Ground return

RS 232 interface (optional)

The RS 232 interface option for SV 977D is provided by means of the **SP 75** interface. It conforms to the EIA Standard RS 232C. It enables the user to programme remotely all instrument functions and the transmissions to and from the meter with the speed from 300 bit/s to 115200 bit/s.

⚠️ *Note: The SP 75 interface must be connected to the SV 977D USB port and proper operation of this port has to be configured in the instrument's SETUP Menu before!*

The SP 75 - DB 09 F - pin female connector pin-out is given below.

Table C.5.5. SP 75 interface description

PC RS 232, 9 - pin connector Signal name	SP 75 connector (DB 09 F) Pin number
1 – LSD	1 (not connected)
2 – RXD	3
3 – TXD	2
4 – DTR	6 connected to pin 4
5 – GND	5
6 – DSR	4 connected to pin 6
7 – RTS	8
8 – CTS	7
9 – GND	9 (not connected)

I/O – User programmable Analogue Outputs, Digital Input / Output connector
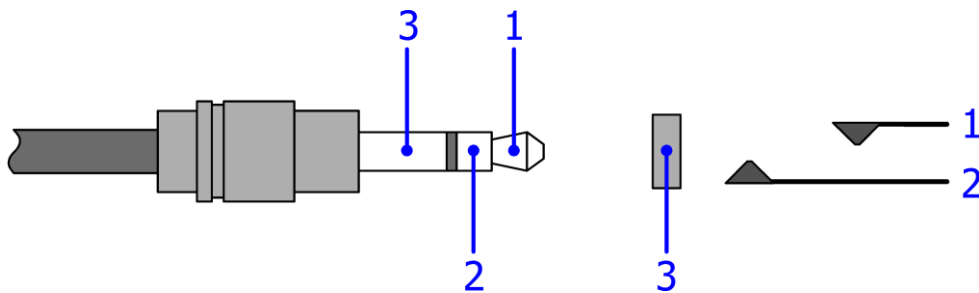
3.5 mm Mini Stereo Jack type (cable plug and instrument socket are shown)

Table C.5.6. Pin out of the 3.5 mm Mini Stereo Jack

Pin Number	Function
1	Analog Output
2	Digital Input / Output (*)
Chassis (3)	Ground

*depending on instrument set-up

The user may set-up the I/O mode in the screen <**Menu> / Instrument / Multifunction I/O**:

1. **I/O Mode: Analog Out**. When this option is selected, the measured signal from the selected channel is fed to the terminal [1] of the **I/O** connector. Output voltage, frequency band and the output impedance are following:
   - a) Output Voltage:
     The output voltage is equal to 1.0 V_{RMS} (± 5 %) at:
     - 120 dB indication of the instrument, on measurement range "L"
     - 137 dB, indication of the instrument, on measurement range "H",
       when calibration factor is set to 0.0 dB.
   - b) Frequency Band (-3 dB):   0.02 Hz ÷ 40 kHz.
   - c) Output Impedance: 51 Ω / 5%

2. **I/O Mode: Analog In** – future feature.

3. **I/O Mode: Digital In**. When the **Ext. Trigger** function is activated, the external triggering of the instrument may be provided. To do that the user should select **Trigger: External** (*path: <Menu> / Measurement / Measurement Trigger*). The external signal for triggering is specified as follows:

   a) Trigger voltage threshold level is set to +1 V.

   b) Trigger voltage slope (*path: <Menu> / Measurement / Measurement Trigger*) set by the user as **Slope [+]** (uprising as default) or **Slope [–]** (falling, auxiliary).

   c) Minimal duration of the trigger impulse: 10 µsec.

   d) 100 µsec. release time after previous measurement is necessary before next trigger.

   e) Recommended trigger voltage should not exceed ± 5 V.

   f) Input impedance in the **Digital In** mode – ca. 10 kΩ / 100 pF, ESD type safety.

   g) When the instrument is switched-off in the **Digital In** mode, the voltage impulse on the pin [1] will be able to switch-on the instrument, however in this case the minimal duration of the trigger impulse of 100 msec is necessary, with uprising voltage slope.

4. **I/O Mode: Digital Out**. Two different functions are available in this mode:

   4.1. **Function: Trigger Pulse**. When this function is selected, the terminal [1] is set as output, which enables one to trigger another instrument (one instrument or more with trigger inputs connected together in parallel), output trigger impulse meets specification given below:

   a) trigger impulse is generated before every measurement,

   b) output voltage range from 0 V or 3 V,

   c) triggering slope: rising or falling,

   d) output impedance: 51 Ω,

   e) duration of the impulse: ca. 30 µsec.

   4.2. **Function: Alarm Pulse**. When this function is selected, the terminal [1] is set as an output, which changes its output level, when current result of measurement exceeds user-programmable threshold level. In this case the terminal [1] output operates as an output of analogue comparator with user-programmable threshold. This feature enables one to control an external device as alarm-indicator or similar:

   a) electrical specification of this output are as follows: 0 V to 3 V voltage range, 51 Ω output impedance,

   b) output produces a voltage level (not impulse),

   c) **Active Level** setting may be selected by the user in menu as **Low** or **High**. When **High** is selected, the output alternates from 0 V to 3 V till measurement result is greater than threshold value,

   d) **Source** setting selects source of measurement result to be compared with the threshold value. One of three results sources may be selected **Leq(1)**, **Peak(1)**, **Max(1)**, **Spl(1)**,

   e) **Source Type** setting selects **Current** or **Periodic,** according to last result became of settled **Integr. Period** (*path: <Menu> / Measurement / General Settings),*

   f) **Level** enables setting-up the threshold value.

Real Time Clock

Built-in real time. Accuracy better than 1 minute/month. Additional built-in CR1220 battery provides power to the RTC for a minimum of 2 years (typically 10 years).

Wireless Bluetooth®2 5.2 Connectivity

This dosimeter supports wireless connection via Bluetooth® 5.2 (Low energy). This connectivity is compatible with mobile and PC devices that support Bluetooth® 5.2.

- TX power: up to 8 dBm
- Receiver sensitivity: -90 dBm
- Range: typically >50m line-of-sight and depending on local RF conditions.

The instrument contains a wireless transmission module, BGM121 from Silicon Laboratories technologies. Copies of the modules regional approvals certificates may be obtained from Svantek or Silicon Laboratories.

FCC and ISEDC

This product contains an FCC and Industry Canada certified Bluetooth® Low energy wireless transmission module:

- **FCC IDENTIFIER:** QOQBGM12LMA
- **Industry Canada IC:** 5123A-BGM12LMA
- Producer: Silicon Laboratories Inc.
- Model: BGM121A Bluetooth smart module
- Modular Type: Single Modular

FCC Statements:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter meets both portable and mobile limits as demonstrated in the RF Exposure Analysis and SAR test report. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

ISEDC Statements:

This radio transmitter has been approved by Industry Canada to operate with its embedded antenna. Other antenna types are strictly prohibited for use with this device. This device complies with Industry Canada's license-exempt RSS standards. Operation is subject to the following two conditions:

(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Exception from routine SAR evaluation limits are given in RSS-102 Issue5. BGM121N meets the given requirements when the minimum separation distance to human body is less than equal to 15 mm. RF exposure or SAR evaluation is not required when the separation distance is 15 mm or more. BGM121A module has been tested for worst case RF exposure. As demonstrated in the SAR test report, BGM121A and BGM123A can be mounted in touch with human body without further SAR evaluation.

GPS

The instrument has a built-in GPS module A2235-H produced by Maestro Wireless Solutions Ltd. intended for logging position and time definition.

GPS is an antenna module with SiRF Star IV ROM based chip and an on-board integrated antenna.

- Position Accuracy (horizontal):   < 2.5 m CEP (autonomous),
- Tracking Sensitivity: -163dBm
- Time accuracy: <1µs (directly depends on position deviation)

---

2 "The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by SVANTEK is under license. Other trademarks and trade names are those of their respective owners.

Weight	600 g (with batteries).
Dimensions	343 x 79 x 39 mm (with microphone and preamplifier).

Environmental parameters

- **Working temperature range**   -10°C ÷ +50°C
- **Storing temperature range**   -20°C ÷ +50°C (-30°C ÷ +60°C without batteries)
- **Humidity**   90% RH in 40°C (uncondensed vapour)

Compliance with EU Directives (see Chapter C.8)

CE mark indicates compliance with RED Directive 2014/53/EU:

- Art 3.1a: Safety

- Art 3.1b: Electromagnetic Compatibility

- Art 3.2: Radio.

> **Note:** *Electromagnetic compatibility is guaranteed only with the original accessories supplied by SVANTEK!*

C.6. SPECIFICATION OF SV 80 ACCELEROMETER

Performance

Number of axis 1

Sensitivity (± 5 %) ....10 mV/(ms^{-2}) ~ 100 mV/g

Measurement range ....0.01 ms^{-2}RMS ÷ 500 ms^{-2} Peak

Frequency response (by design guideline, ± 3 dB) ....0.5 Hz ÷ 14 000 Hz

Linearity ....± 1 %

Residual noise (1 Hz, 24°C) ....30 μg RMS

Residual noise (1 Hz to 25 kHz, 24°C) ....300 μg RMS

Transverse response sensitivity (20 Hz, 50 m/s2) ....< 5 %

Resonant frequency ....25 kHz

Electrical

Electrical grounding ....Isolated from machine grounding

Isolation (Case to Shield) ....> 100 MΩ

Capacitance to ground (Nominal) ....70 pF

Supply current ....2 mA ÷ 10 mA

Supply voltage ....22 V ÷ 28 V

Bias voltage ....+12 VDC

Output impedance (Nominal) ....50 Ω

Charge / discharge time constant (start-up time)...............< 1 sec. typ.

Environmental

Maximum vibration (shock survival) ....50 000 ms^{-2} Peak

Thermal sensitivity coefficient ....0.07 %/° C F.S.

Operating temperature range ....from -55 °C to +120 °C

Operating temperature range (recommended) ....from -10 °C to +50 °C

Humidity / Enclosure ....IP67, epoxy sealed

Physical

Connector...TNC socket, top radially mounted

Material housing & connector..Stainless steel

Dimensions...drawing above

Mounting thread..10-32 UNF 2B

Weight...40 grams

Accessories

Mounting stud 10-32 to M5 (included)

SA 27/10-32..Mounting magnet base (optional)

SC 27..Coil cable TNC plug – TNC plug,
                                                                                              2 meters (optional)

C.7. USING THE SA 277D OUTDOOR MICROPHONE KIT

The **SA 277D** outdoor microphone kit protects the instrument's preamplifier and microphone from weather conditions. Using an outdoor microphone kit requires an extension cable between the instrument and its preamplifier (**SC 277**).

SA 277D is made of lightweight materials and is easy to install on a tripod. This solution is recommended for short term outdoor noise measurements.

The outdoor microphone kit has ¾" screw on its bottom which allows the use of standard tripods or other user specific mounts.

As an option the user may use desiccator – Silica gel. Desiccator absorbs moisture commonly contained in the air.

⚠️ **Note**: Desiccator should be regenerated after some period of use, when it changes colour to light grey, by drying it for 3 hours in a temperature of 150°C. Desiccator should be inspected at least every 2 weeks, and more often when used in conditions of high air humidity.

⚠️ **Note**: See also Appendix F to learn how to assemble and disassemble the outdoor microphone kit.

⚠️ **Note:** Using SA 277D changes the frequency response and measuring ranges of SV 977D. Please check the below given specification.

Depending on the measurement task SA 277D can be used in two operational modes:

1. With reference incidence angle 90 deg – so called "Environment" mode.
2. With reference incidence angle 0 deg – so called "Airport" mode.

The wave incidence angle is oriented to the microphone membrane surface. 0 deg means direction orthogonal to the membrane surface. 90 deg means direction parallel to the membrane surface.
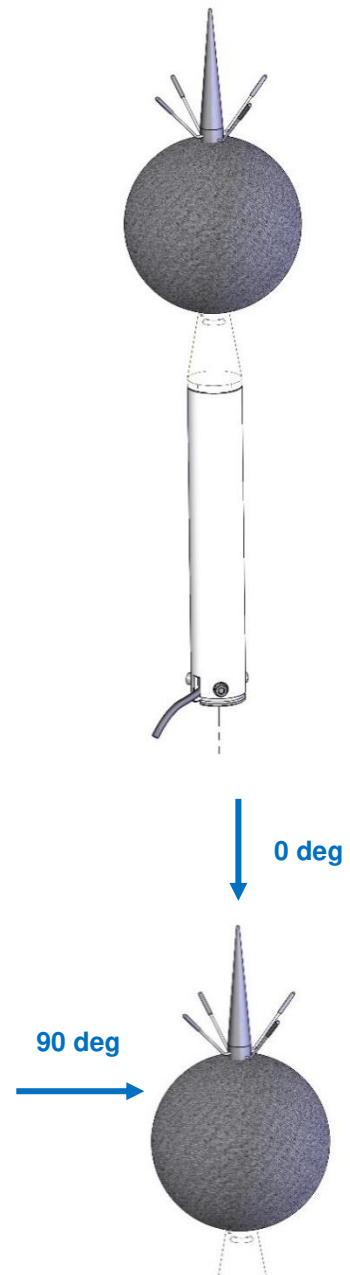
Frequency response of SV 977D with the SA 277D outdoor microphone kit is compensated by means of two digital filters which can be set in the **Compensation** screen (*path: <Menu> / Measurement / Compensation*):
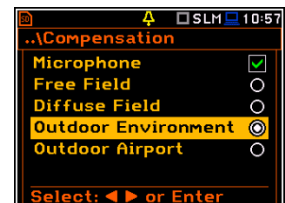
- **Outdoor Environment**   compensation filter that improves the complete instrument frequency response in the free field for the reference acoustic wave incidence angle 90 deg

- **Outdoor Airport**   compensation filter that improves the complete instrument frequency response in the free field for the reference acoustic wave incidence angle 0 deg

⚠️ **Note:** *For the conformance acoustical tests with SA 277D, the **Microphone** compensation and the **Outdoor Environment** or **Outdoor Airport** compensation must be switched on (path: <Menu> / Measurement / Compensation).*

Statement of performance

SV 977D working as the SLM with SA 277D meets requirements of IEC 61672:2013 for the Class 1 Group X instruments.

Linear operating ranges with the Outdoor Environment filter

The starting point at which tests of level linearity shall begin is 94.0 dB for the frequencies specifies below. For the **Low** measurement range and A weighting linearity test at 31.5 Hz, the starting point is 74 dB.

Table C.7.1. Linear operating ranges for the **Low** measurement range and the **Outdoor Environment** filter (for the sinusoidal signal and microphone sensitivity 50 mV/Pa)

[dB]	$L_{AS/F}$		$L_{BS/F}$		$L_{CS/F}$		$L_{ZS/F}$		L_{AeqT}		L_{BeqT}		L_{CeqT}		L_{AE} (t_{int} = 2 s)		L_{Cpeak}	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
31.5 Hz	25	80	27	103	27	117	32	120	25	80	27	103	27	117	28	83	52	120
500 Hz	25	116	27	119	27	120	32	120	25	116	27	119	27	120	28	119	52	123
1 kHz	25	120	27	120	27	120	32	120	25	120	27	120	27	120	28	123	52	123
4 kHz	25	121	27	119	27	119	32	120	25	121	27	119	27	119	28	124	52	123
8 kHz	25	119	27	117	27	117	32	120	25	119	27	117	27	117	28	122	52	120
12.5 kHz	25	115	27	114	27	114	32	120	25	115	27	114	27	114	28	118	52	117

Table C.7.2. Linear operating ranges for the **High** measurement range and the **Outdoor Environment** filter (for the sinusoidal signal and microphone sensitivity 50 mV/Pa)

[dB]	$L_{AS/F}$		$L_{BS/F}$		$L_{CS/F}$		$L_{ZS/F}$		L_{AeqT}		L_{BeqT}		L_{CeqT}		L_{AE} (t_{int} = 2 s)		L_{Cpeak}	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
31.5 Hz	37	97	37	120	37	134	42	137	37	97	37	120	37	134	40	100	72	137
500 Hz	37	133	37	136	37	137	42	137	37	133	37	136	37	137	40	136	72	140
1 kHz	37	137	37	137	37	137	42	137	37	137	37	137	37	137	40	140	72	140
4 kHz	37	138	37	136	37	136	42	137	37	138	37	136	37	136	40	141	72	139
8 kHz	37	136	37	134	37	134	42	137	37	136	37	134	37	134	40	139	72	137
12.5 kHz	37	132	37	131	37	131	42	137	37	132	37	131	37	131	40	135	72	134

Table C.7.3. Self-generated noise for different weighting filters

Weighting filter / Range	Electrical *)			Acoustical compensated		
	A	C	Z	A	C	Z
Low	< 15 dB	< 15 dB	< 20 dB	< 17 dB	< 19 dB	< 24 dB
High	< 25 dB	< 25 dB	< 32 dB	< 30 dB	< 30 dB	< 34 dB

*) measured with the **ST 02** microphone equivalent impedance 18 pF +/-10%, averaging time – 30 s

MK 255 Free Field frequency response for 90 deg incidence angle

MK 255 typical Free Field frequency response for 90 deg incidence angle
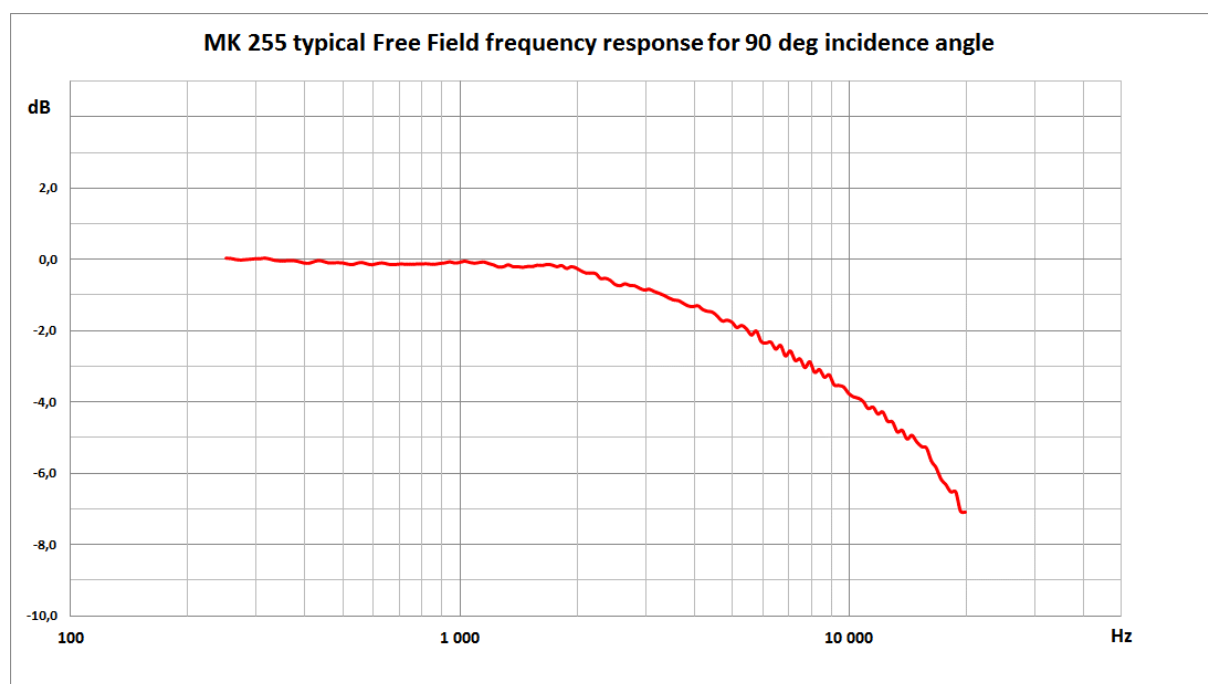
Table C.7.4.   MK 255 typical Free Field frequency response for 90 deg incidence angle

Frequency	MK 255 typical Free Field response	Frequency	MK 255 typical Free Field response	Frequency	MK 255 typical Free Field response
[Hz]	[dB]	[Hz]	[dB]	[Hz]	[dB]
251	0.03	1 090	-0.11	4 732	-1.73
259	0.02	1 122	-0.09	4 870	-1.71
266	-0.01	1 155	-0.07	5 012	-1.76
274	-0.02	1 189	-0.12	5 158	-1.91
282	-0.01	1 223	-0.16	5 309	-1.85
290	0.00	1 259	-0.21	5 464	-1.95
299	0.02	1 296	-0.21	5 623	-2.13
307	0.02	1 334	-0.15	5 788	-2.01
316	0.03	1 372	-0.21	5 957	-2.31
325	0.01	1 413	-0.21	6 131	-2.35
335	-0.03	1 454	-0.22	6 310	-2.32
345	-0.04	1 496	-0.20	6 494	-2.52
355	-0.04	1 540	-0.20	6 683	-2.41
365	-0.04	1 585	-0.16	6 879	-2.71
376	-0.04	1 631	-0.17	7 079	-2.57
387	-0.07	1 679	-0.14	7 286	-2.84
398	-0.10	1 728	-0.16	7 499	-2.80
410	-0.11	1 778	-0.20	7 718	-3.04
422	-0.07	1 830	-0.17	7 943	-2.87
434	-0.03	1 884	-0.26	8 175	-3.17
447	-0.06	1 939	-0.20	8 414	-3.09
460	-0.10	1 995	-0.25	8 660	-3.31
473	-0.10	2 054	-0.32	8 913	-3.24
487	-0.09	2 113	-0.38	9 173	-3.52

Frequency	MK 255 typical Free Field response	Frequency	MK 255 typical Free Field response	Frequency	MK 255 typical Free Field response
[Hz]	[dB]	[Hz]	[dB]	[Hz]	[dB]
501	-0.10	2 175	-0.39	9 441	-3.54
516	-0.13	2 239	-0.40	9 716	-3.59
531	-0.15	2 304	-0.54	10 000	-3.77
546	-0.10	2 371	-0.53	10 292	-3.86
562	-0.09	2 441	-0.59	10 593	-3.90
579	-0.13	2 512	-0.71	10 902	-3.99
596	-0.15	2 585	-0.74	11 220	-4.19
613	-0.12	2 661	-0.69	11 548	-4.15
631	-0.10	2 738	-0.73	11 885	-4.34
649	-0.12	2 818	-0.74	12 232	-4.28
668	-0.15	2 901	-0.81	12 589	-4.54
688	-0.14	2 985	-0.86	12 957	-4.56
708	-0.13	3 073	-0.84	13 335	-4.85
729	-0.14	3 162	-0.90	13 725	-4.80
750	-0.14	3 255	-0.95	14 125	-5.04
772	-0.13	3 350	-1.01	14 538	-4.94
794	-0.13	3 447	-1.08	14 962	-5.12
818	-0.12	3 548	-1.14	15 399	-5.26
841	-0.13	3 652	-1.16	15 849	-5.29
866	-0.14	3 758	-1.23	16 312	-5.66
891	-0.11	3 868	-1.31	16 788	-5.85
917	-0.10	3 981	-1.32	17 278	-6.17
944	-0.07	4 097	-1.30	17 783	-6.33
972	-0.10	4 217	-1.41	18 302	-6.53
1 000	-0.09	4 340	-1.46	18 836	-6.53
1 029	-0.05	4 467	-1.48	19 387	-7.07
1 059	-0.08	4 597	-1.60	19 953	-7.10

Table C.7.5.   MK 255 Free Field corrections for 90 deg incidence angle with the use of the electrostatic actuator

[dB]	Frequency [Hz]																
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800
Correction factors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.05	-0.12	-0.17	-0.16	-0.14
Uncertainty (IEC 62585)	--	--	--	--	--	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

[dB]	Frequency [Hz]													
	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Correction factors	-0.09	-0.18	-0.23	-0.17	-0.20	-0.10	0.16	0.35	0.56	1.12	1.68	2.71	3.76	4.71
Uncertainty (IEC 62585)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.35	0.35	0.35	0.35	0.50	0.50	0.50

Free Field frequency response of SV 977D with SA 277D for 90 deg incidence angle

Free Field frequency characteristics of SV 977D with SA 277D for 90 deg incidence angle ('Outdoor Environment' filter)

- Class 1 tolerance upper limits
- Class 1 tolerance lower limits
- 'Outdoor Environment' compensation filter
- Typical compensated Free Field response

SA 277D Case Effect for 90 deg incidence angle ('Outdoor Environment' filter)

- SA 277D Case Effect
- SA 277D compensated Case Effect
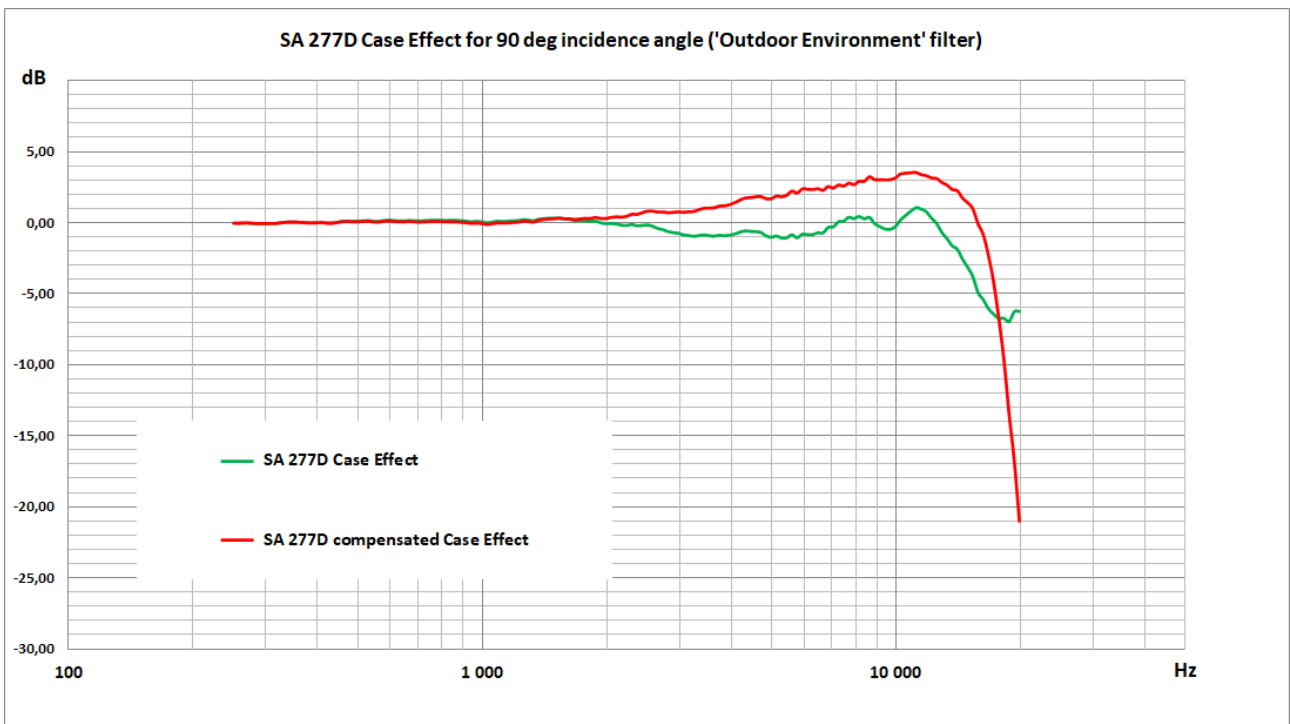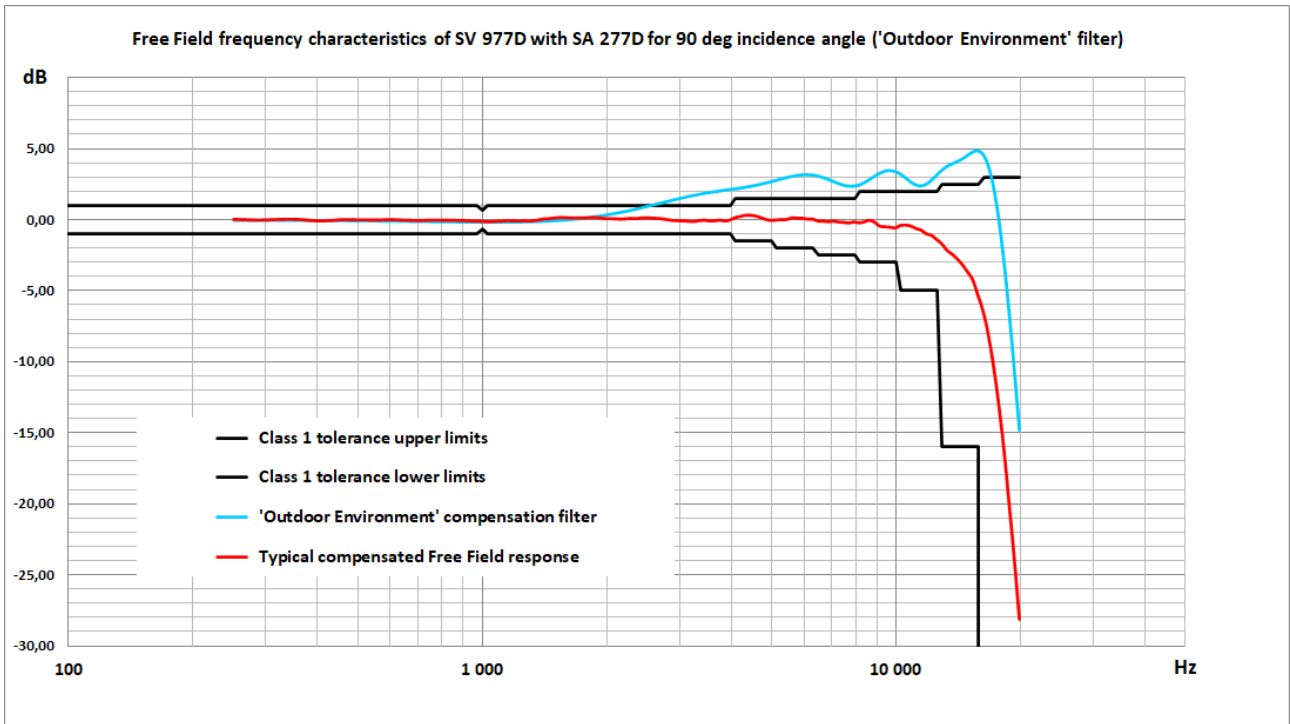
Table C.7.6.   Typical Free Field frequency characteristics of SV 977D with SA 277D for 90 deg incidence angle

Frequency	Compensation filter for 90 deg incidence angle "Outdoor Environment"	Typical compensated response of SV 977D with SA 277D for 90 deg incidence angle	Compensated Case Effect of SA 277D for 90 deg incidence angle	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
251	-0.02	0.00	-0.03	0.25
259	-0.02	-0.01	-0.04	0.25
266	-0.02	-0.02	-0.02	0.25
274	-0.02	-0.04	-0.02	0.25
282	-0.02	-0.05	-0.05	0.25
290	-0.02	-0.06	-0.06	0.25
299	-0.02	-0.05	-0.07	0.25
307	-0.03	-0.03	-0.05	0.25
316	-0.03	-0.02	-0.05	0.25
325	-0.03	-0.01	-0.01	0.25
335	-0.03	0.01	0.03	0.25
345	-0.03	0.01	0.05	0.25
355	-0.03	0.00	0.04	0.25
365	-0.04	-0.02	0.02	0.25
376	-0.04	-0.05	-0.01	0.25
387	-0.04	-0.08	-0.02	0.25
398	-0.04	-0.11	-0.01	0.25
410	-0.04	-0.11	0.00	0.25
422	-0.05	-0.10	-0.03	0.25
434	-0.05	-0.08	-0.05	0.25
447	-0.05	-0.05	0.01	0.25
460	-0.05	-0.02	0.07	0.25
473	-0.06	-0.02	0.08	0.25
487	-0.06	-0.03	0.06	0.25
501	-0.06	-0.04	0.06	0.25
516	-0.07	-0.04	0.09	0.25
531	-0.07	-0.04	0.11	0.25
546	-0.07	-0.05	0.06	0.25
562	-0.08	-0.04	0.04	0.25
579	-0.08	-0.03	0.10	0.25
596	-0.08	-0.02	0.13	0.25
613	-0.09	-0.03	0.09	0.25
631	-0.09	-0.04	0.06	0.25
649	-0.10	-0.06	0.06	0.25
668	-0.10	-0.07	0.08	0.25
688	-0.10	-0.08	0.06	0.25
708	-0.11	-0.08	0.04	0.25
729	-0.11	-0.08	0.06	0.25
750	-0.12	-0.06	0.08	0.25
772	-0.12	-0.06	0.08	0.25
794	-0.13	-0.06	0.07	0.25
818	-0.13	-0.07	0.06	0.25
841	-0.13	-0.07	0.07	0.25

Frequency	Compensation filter for 90 deg incidence angle "Outdoor Environment"	Typical compensated response of SV 977D with SA 277D for 90 deg incidence angle	Compensated Case Effect of SA 277D for 90 deg incidence angle	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
866	-0.14	-0.07	0.06	0.25
891	-0.14	-0.08	0.03	0.25
917	-0.15	-0.10	0.00	0.25
944	-0.15	-0.12	-0.05	0.25
972	-0.15	-0.13	-0.02	0.25
1 000	-0.15	-0.15	-0.06	0.25
1 029	-0.15	-0.17	-0.12	0.25
1 059	-0.16	-0.16	-0.08	0.25
1 090	-0.16	-0.13	-0.02	0.25
1 122	-0.15	-0.12	-0.03	0.25
1 155	-0.15	-0.09	-0.02	0.25
1 189	-0.15	-0.11	0.01	0.25
1 223	-0.15	-0.12	0.04	0.25
1 259	-0.14	-0.11	0.11	0.25
1 296	-0.13	-0.12	0.08	0.25
1 334	-0.12	-0.11	0.05	0.25
1 372	-0.11	-0.04	0.17	0.25
1 413	-0.10	0.02	0.23	0.25
1 454	-0.08	0.05	0.27	0.25
1 496	-0.06	0.09	0.29	0.25
1 540	-0.04	0.12	0.32	0.25
1 585	-0.01	0.12	0.28	0.25
1 631	0.02	0.11	0.28	0.25
1 679	0.05	0.09	0.23	0.25
1 728	0.09	0.11	0.26	0.25
1 778	0.13	0.10	0.30	0.25
1 830	0.18	0.12	0.30	0.25
1 884	0.23	0.12	0.37	0.25
1 939	0.28	0.09	0.29	0.25
1 995	0.34	0.05	0.29	0.25
2 054	0.40	0.05	0.37	0.25
2 113	0.47	0.03	0.41	0.25
2 175	0.54	0.01	0.40	0.25
2 239	0.62	0.04	0.44	0.25
2 304	0.69	0.06	0.60	0.25
2 371	0.78	0.05	0.58	0.25
2 441	0.86	0.10	0.69	0.25
2 512	0.95	0.11	0.81	0.25
2 585	1.04	0.08	0.82	0.25
2 661	1.13	0.07	0.75	0.25
2 738	1.22	0.03	0.76	0.25
2 818	1.31	-0.04	0.70	0.25
2 901	1.40	-0.09	0.72	0.25
2 985	1.48	-0.10	0.76	0.25
3 073	1.57	-0.11	0.73	0.25

Frequency	Compensation filter for 90 deg incidence angle "Outdoor Environment"	Typical compensated response of SV 977D with SA 277D for 90 deg incidence angle	Compensated Case Effect of SA 277D for 90 deg incidence angle	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
3 162	1.65	-0.13	0.77	0.25
3 255	1.72	-0.16	0.79	0.25
3 350	1.79	-0.09	0.92	0.25
3 447	1.86	-0.06	1.02	0.25
3 548	1.92	-0.11	1.03	0.25
3 652	1.98	-0.10	1.05	0.25
3 758	2.03	-0.06	1.17	0.25
3 868	2.09	-0.12	1.19	0.25
3 981	2.14	-0.05	1.28	0.25
4 097	2.19	0.12	1.42	0.35
4 217	2.24	0.20	1.61	0.35
4 340	2.30	0.29	1.74	0.35
4 467	2.36	0.29	1.77	0.35
4 597	2.43	0.23	1.82	0.35
4 732	2.51	0.12	1.85	0.35
4 870	2.60	-0.02	1.69	0.35
5 012	2.69	-0.08	1.69	0.35
5 158	2.79	-0.04	1.87	0.35
5 309	2.89	-0.02	1.83	0.35
5 464	2.98	-0.01	1.94	0.35
5 623	3.06	0.10	2.23	0.35
5 788	3.13	0.07	2.08	0.35
5 957	3.17	0.08	2.38	0.35
6 131	3.18	0.01	2.36	0.35
6 310	3.15	0.01	2.33	0.35
6 494	3.08	-0.12	2.40	0.35
6 683	2.98	-0.13	2.28	0.35
6 879	2.85	-0.17	2.55	0.35
7 079	2.70	-0.13	2.44	0.35
7 286	2.56	-0.19	2.65	0.35
7 499	2.44	-0.21	2.58	0.35
7 718	2.37	-0.25	2.78	0.35
7 943	2.37	-0.19	2.68	0.35
8 175	2.45	-0.25	2.92	0.35
8 414	2.62	-0.18	2.92	0.35
8 660	2.83	-0.07	3.24	0.35
8 913	3.07	-0.21	3.03	0.35
9 173	3.29	-0.49	3.04	0.35
9 441	3.43	-0.53	3.01	0.35
9 716	3.48	-0.56	3.03	0.35
10 000	3.40	-0.61	3.15	0.35
10 292	3.21	-0.43	3.43	0.35
10 593	2.94	-0.41	3.49	0.35
10 902	2.66	-0.48	3.52	0.35
11 220	2.45	-0.65	3.54	0.35

Frequency	Compensation filter for 90 deg incidence angle "Outdoor Environment"	Typical compensated response of SV 977D with SA 277D for 90 deg incidence angle	Compensated Case Effect of SA 277D for 90 deg incidence angle	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
11 548	2.39	-0.76	3.39	0.35
11 885	2.52	-1.02	3.32	0.35
12 232	2.80	-1.13	3.15	0.35
12 589	3.16	-1.43	3.12	0.35
12 957	3.50	-1.73	2.83	0.35
13 335	3.77	-2.19	2.65	0.35
13 725	3.95	-2.46	2.34	0.35
14 125	4.11	-2.79	2.25	0.35
14 538	4.30	-3.21	1.73	0.35
14 962	4.54	-3.72	1.40	0.35
15 399	4.78	-4.29	0.97	0.35
15 849	4.86	-5.38	-0.08	0.35
16 312	4.58	-6.51	-0.85	0.35
16 788	3.77	-8.15	-2.30	0.35
17 278	2.29	-10.35	-4.17	0.35
17 783	0.05	-13.04	-6.71	0.35
18 302	-2.91	-16.20	-9.66	0.35
18 836	-6.49	-20.01	-13.49	0.35
19 387	-10.50	-23.86	-16.79	0.35
19 953	-14.78	-28.15	-21.05	0.35

Table C.7.7.   SV 977D with SA 277D combined Free Field correction with the use of the electrostatic actuator for 90 deg incidence angle (microphone corrections + compensated Case Effect)

[dB]	Frequency [Hz]																
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800
Correction factors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.03	-0.10	-0.13	-0.11	-0.10	-0.07
Complex uncertainty	--	--	--	--	--	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35

[dB]	Frequency [Hz]													
	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Correction factors	-0.15	-0.07	0.05	0.12	0.61	0.67	1.44	2.04	2.89	3.80	4.83	5.83	3.68	-16.34
Complex uncertainty	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.49	0.49	0.49	0.49	0.61	0.61	0.61

Linear operating ranges with the **Outdoor Airport** filter

The starting point at which tests of level linearity shall begin is 94.0 dB for the frequencies specifies below. For the **Low** measurement range and A weighting linearity test at 31.5 Hz, the starting point is 74 dB.

Table C.7.8.   Linear operating ranges for the **Low** measurement range and the **Outdoor Airport** filter (for the sinusoidal signal and microphone sensitivity 50 mV/Pa)

[dB]	$L_{AS/F}$		$L_{BS/F}$		$L_{CS/F}$		$L_{ZS/F}$		L_{AeqT}		L_{BeqT}		L_{CeqT}		L_{AE} (t_{int} = 2 s)		L_{Cpeak}	
	from	to	from	to	from	to	from	to	from	to	from	to	From	to	from	to	from	to
31.5 Hz	25	80	27	103	27	117	32	120	25	80	27	103	27	117	28	83	52	120
500 Hz	25	116	27	119	27	120	32	120	25	116	27	119	27	120	28	119	52	123
1 kHz	25	120	27	120	27	120	32	120	25	120	27	120	27	120	28	123	52	123
4 kHz	25	121	27	119	27	119	32	120	25	121	27	119	27	119	28	124	52	123
8 kHz	25	119	27	117	27	117	32	120	25	119	27	117	27	117	28	122	52	120
12.5 kHz	25	115	27	114	27	114	32	120	25	115	27	114	27	114	28	118	52	117

Table C.7.9.   Linear operating ranges for the **High** measurement range and the **Outdoor Airport** filter (for the sinusoidal signal and microphone sensitivity 50 mV/Pa)

[dB]	$L_{AS/F}$		$L_{BS/F}$		$L_{CS/F}$		$L_{ZS/F}$		L_{AeqT}		L_{BeqT}		L_{CeqT}		L_{AE} (t_{int} = 2 s)		L_{Cpeak}	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
31.5 Hz	37	97	37	120	37	134	42	137	37	97	37	120	37	134	40	100	72	137
500 Hz	37	133	37	136	37	137	42	137	37	133	37	136	37	137	40	136	72	140
1 kHz	37	137	37	137	37	137	42	137	37	137	37	137	37	137	40	140	72	140
4 kHz	37	138	37	136	37	136	42	137	37	138	37	136	37	136	40	141	72	139
8 kHz	37	136	37	134	37	134	42	137	37	136	37	134	37	134	40	139	72	137
12.5 kHz	37	132	37	131	37	131	42	137	37	132	37	131	37	131	40	135	72	134

Table C.7.10.   Self-generated noise for different weighting filters

Weighting filter / Range	Electrical *)			Acoustical compensated		
	A	C	Z	A	C	Z
Low	< 15 dB	< 14 dB	< 20 dB	< 17 dB	< 19 dB	< 24 dB
High	< 25 dB	< 25 dB	< 32 dB	< 30 dB	< 30 dB	< 34 dB

*) measured with the **ST 02** microphone equivalent impedance 18 pF +/-10%, averaging time – 30 s

Free Field Frequency response of SV 977D with SA 277D for 0 deg incidence angle

Typical Free Field frequency characteristics of SV 977D with SA 277D for 0 deg incidence angle ('Outdoor Airport' filter)

- Class 1 tolerance upper limits
- Class 1 tolerance lower limits
- 'Outdoor Airport' compensation filter
- Typical compensated Free Field response

SA 277D Case Effect for 0 deg incidence angle ('Outdoor Airport' filter)

- SA 277D Case Effect
- SA 277D compensated Case Effect
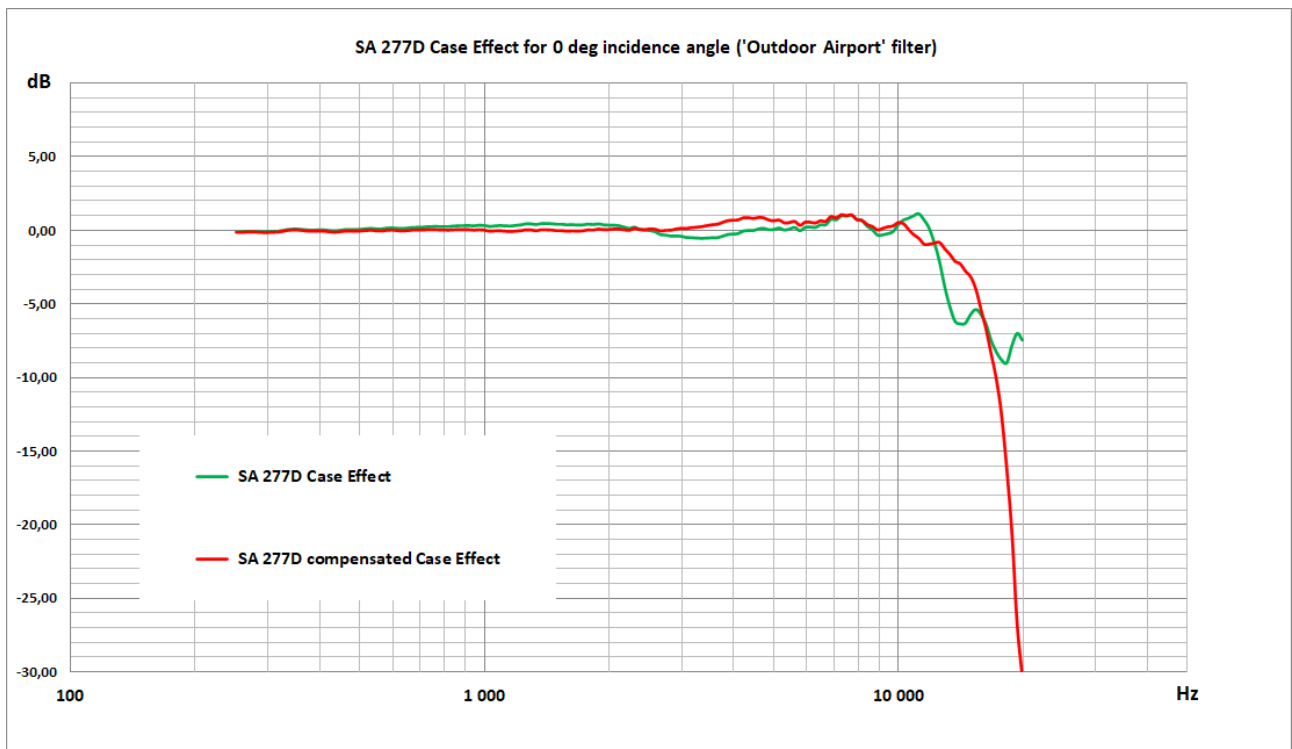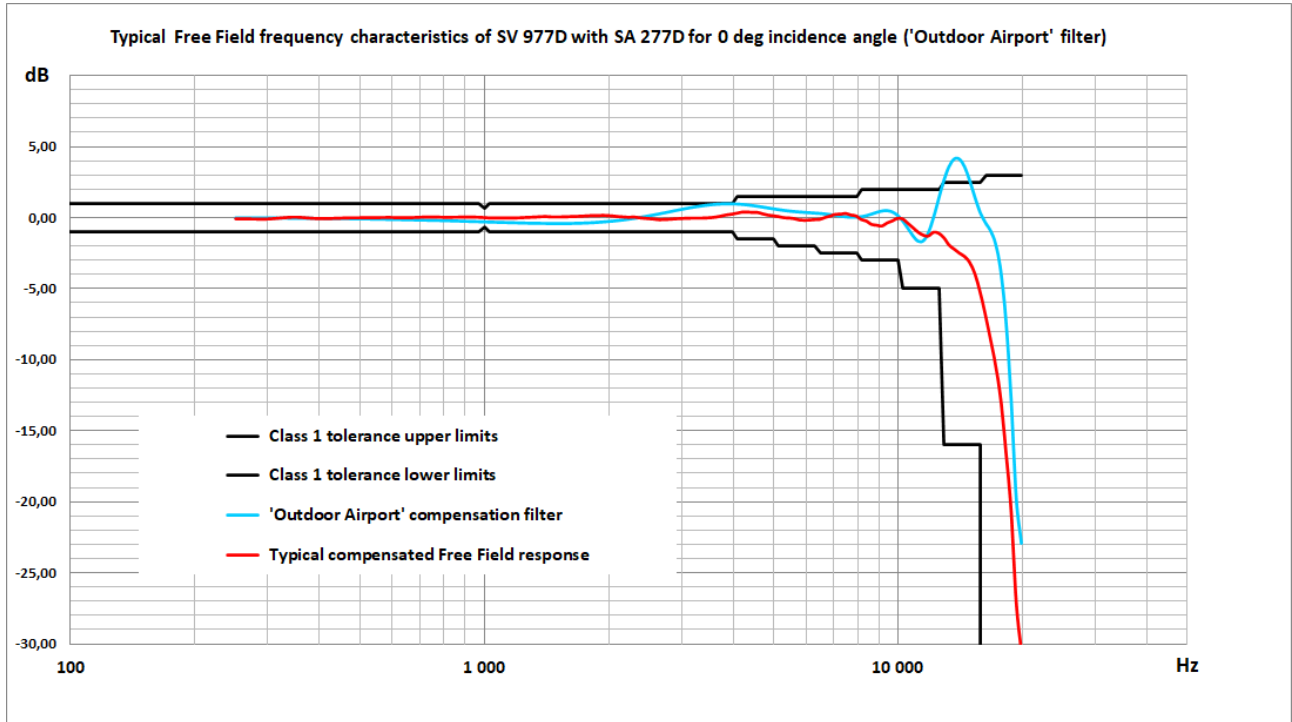
Table C.7.11. Typical Free Field frequency characteristics of SV 977D with SA 277D for 0 deg incidence angle

Frequency	Compensation filter for 0 deg incidence angle "Outdoor Airport"	Typical compensated response of SV 977D with SA 277D for 0 deg incidence angle	Compensated Case Effect of SA 277D for 0 deg incidence angle	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
251	-0.03	-0.07	-0.11	0.25
259	-0.03	-0.08	-0.10	0.25
266	-0.03	-0.08	-0.08	0.25
274	-0.03	-0.09	-0.07	0.25
282	-0.03	-0.10	-0.09	0.25
290	-0.03	-0.10	-0.10	0.25
299	-0.04	-0.10	-0.11	0.25
307	-0.04	-0.07	-0.09	0.25
316	-0.04	-0.05	-0.08	0.25
325	-0.04	-0.01	-0.03	0.25
335	-0.04	0.02	0.04	0.25
345	-0.05	0.03	0.06	0.25
355	-0.05	0.03	0.05	0.25
365	-0.05	0.01	0.02	0.25
376	-0.06	-0.02	-0.02	0.25
387	-0.06	-0.05	-0.02	0.25
398	-0.06	-0.06	-0.01	0.25
410	-0.07	-0.07	-0.02	0.25
422	-0.07	-0.06	-0.06	0.25
434	-0.07	-0.05	-0.09	0.25
447	-0.08	-0.04	-0.06	0.25
460	-0.08	-0.02	-0.01	0.25
473	-0.09	-0.01	-0.01	0.25
487	-0.09	-0.01	-0.02	0.25
501	-0.10	-0.01	-0.01	0.25
516	-0.10	0.00	0.03	0.25
531	-0.11	0.00	0.04	0.25
546	-0.11	0.00	0.00	0.25
562	-0.12	0.01	-0.01	0.25
579	-0.13	0.01	0.04	0.25
596	-0.13	0.01	0.06	0.25
613	-0.14	0.01	0.02	0.25
631	-0.15	0.00	0.00	0.25
649	-0.15	-0.01	0.02	0.25
668	-0.16	0.00	0.05	0.25
688	-0.17	0.02	0.06	0.25
708	-0.18	0.03	0.06	0.25
729	-0.19	0.04	0.08	0.25
750	-0.20	0.05	0.08	0.25
772	-0.21	0.04	0.07	0.25
794	-0.22	0.03	0.06	0.25
818	-0.23	0.02	0.05	0.25
841	-0.24	0.03	0.07	0.25
866	-0.25	0.03	0.09	0.25

Frequency	Compensation filter for 0 deg incidence angle "Outdoor Airport"	Typical compensated response of SV 977D with SA 277D for 0 deg incidence angle	Compensated Case Effect of SA 277D for 0 deg incidence angle	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
891	-0.26	0.04	0.08	0.25
917	-0.27	0.04	0.08	0.25
944	-0.28	0.04	0.05	0.25
972	-0.29	0.03	0.08	0.25
1 000	-0.30	0.01	0.05	0.25
1 029	-0.32	-0.02	-0.02	0.25
1 059	-0.33	-0.03	0.00	0.25
1 090	-0.34	-0.03	0.01	0.25
1 122	-0.35	-0.03	-0.02	0.25
1 155	-0.36	-0.02	-0.04	0.25
1 189	-0.37	-0.02	-0.02	0.25
1 223	-0.38	-0.01	0.01	0.25
1 259	-0.39	0.01	0.07	0.25
1 296	-0.40	0.03	0.06	0.25
1 334	-0.41	0.04	0.01	0.25
1 372	-0.41	0.07	0.08	0.25
1 413	-0.42	0.08	0.07	0.25
1 454	-0.42	0.05	0.05	0.25
1 496	-0.42	0.05	0.01	0.25
1 540	-0.42	0.06	0.01	0.25
1 585	-0.42	0.07	-0.02	0.25
1 631	-0.41	0.08	0.00	0.25
1 679	-0.41	0.09	-0.02	0.25
1 728	-0.39	0.11	0.00	0.25
1 778	-0.38	0.13	0.06	0.25
1 830	-0.36	0.15	0.05	0.25
1 884	-0.34	0.14	0.12	0.25
1 939	-0.31	0.17	0.08	0.25
1 995	-0.28	0.15	0.09	0.25
2 054	-0.25	0.12	0.12	0.25
2 113	-0.21	0.08	0.12	0.25
2 175	-0.17	0.05	0.08	0.25
2 239	-0.12	0.03	0.04	0.25
2 304	-0.06	0.05	0.17	0.25
2 371	-0.01	0.00	0.08	0.25
2 441	0.06	-0.04	0.08	0.25
2 512	0.12	-0.07	0.13	0.25
2 585	0.19	-0.10	0.11	0.25
2 661	0.26	-0.14	-0.01	0.25
2 738	0.33	-0.13	0.03	0.25
2 818	0.41	-0.11	0.04	0.25
2 901	0.48	-0.08	0.12	0.25
2 985	0.55	-0.06	0.17	0.25
3 073	0.62	-0.04	0.16	0.25
3 162	0.69	-0.03	0.22	0.25
3 255	0.75	-0.03	0.25	0.25

Frequency	Compensation filter for 0 deg incidence angle "Outdoor Airport"	Typical compensated response of SV 977D with SA 277D for 0 deg incidence angle	Compensated Case Effect of SA 277D for 0 deg incidence angle	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
3 350	0.81	-0.03	0.29	0.25
3 447	0.86	-0.02	0.36	0.25
3 548	0.90	0.00	0.41	0.25
3 652	0.93	0.05	0.45	0.25
3 758	0.95	0.12	0.57	0.25
3 868	0.96	0.20	0.69	0.25
3 981	0.96	0.24	0.73	0.25
4 097	0.95	0.32	0.74	0.35
4 217	0.92	0.40	0.89	0.35
4 340	0.89	0.40	0.89	0.35
4 467	0.84	0.37	0.85	0.35
4 597	0.79	0.37	0.91	0.35
4 732	0.73	0.26	0.89	0.35
4 870	0.67	0.18	0.73	0.35
5 012	0.61	0.13	0.69	0.35
5 158	0.55	0.07	0.73	0.35
5 309	0.50	0.00	0.54	0.35
5 464	0.46	-0.01	0.57	0.35
5 623	0.42	-0.07	0.64	0.35
5 788	0.39	-0.16	0.38	0.35
5 957	0.36	-0.18	0.59	0.35
6 131	0.34	-0.17	0.59	0.35
6 310	0.31	-0.13	0.53	0.35
6 494	0.29	-0.12	0.69	0.35
6 683	0.25	0.01	0.65	0.35
6 879	0.20	0.12	0.98	0.35
7 079	0.15	0.23	0.89	0.35
7 286	0.10	0.24	1.10	0.35
7 499	0.05	0.30	1.04	0.35
7 718	0.02	0.19	1.08	0.35
7 943	0.02	0.12	0.77	0.35
8 175	0.06	-0.13	0.72	0.35
8 414	0.13	-0.23	0.44	0.35
8 660	0.24	-0.47	0.30	0.35
8 913	0.36	-0.53	0.07	0.35
9 173	0.46	-0.58	0.17	0.35
9 441	0.48	-0.38	0.27	0.35
9 716	0.40	-0.23	0.33	0.35
10 000	0.16	-0.06	0.56	0.35
10 292	-0.23	-0.08	0.49	0.35
10 593	-0.74	-0.39	0.10	0.35
10 902	-1.28	-0.70	-0.26	0.35
11 220	-1.66	-1.02	-0.51	0.35
11 548	-1.64	-1.23	-0.90	0.35
11 885	-1.07	-1.29	-0.91	0.35
12 232	0.00	-1.02	-0.84	0.35

Frequency	Compensation filter for 0 deg incidence angle "Outdoor Airport"	Typical compensated response of SV 977D with SA 277D for 0 deg incidence angle	Compensated Case Effect of SA 277D for 0 deg incidence angle	Uncertainty (IEC 62585:2012)
[Hz]	[dB]	[dB]	[dB]	[dB]
12 589	1.33	-1.10	-0.79	0.35
12 957	2.61	-1.41	-1.22	0.35
13 335	3.59	-1.93	-1.60	0.35
13 725	4.11	-2.22	-2.07	0.35
14 125	4.10	-2.50	-2.25	0.35
14 538	3.56	-2.73	-2.74	0.35
14 962	2.59	-3.16	-3.13	0.35
15 399	1.42	-3.96	-3.95	0.35
15 849	0.38	-5.23	-5.33	0.35
16 312	-0.35	-6.81	-6.71	0.35
16 788	-0.91	-8.54	-8.42	0.35
17 278	-1.84	-10.38	-10.12	0.35
17 783	-3.75	-12.80	-12.56	0.35
18 302	-7.21	-16.47	-16.22	0.35
18 836	-12.73	-20.62	-20.57	0.35
19 387	-19.71	-27.10	-26.71	0.35
19 953	-22.89	-30.55	-30.34	0.35

Table C.7.12. SV 977D with SA 277D combined Free Field corrections with the use of the electrostatic actuator for 0 deg incidence angle (microphone corrections + compensated Case Effect)

[dB]	Frequency [Hz]																
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800
Correction factors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.16	-0.08	-0.04	-0.08	-0.17	-0.04
Complex uncertainty	--	--	--	--	--	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
[dB]	Frequency [Hz]													
	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Correction factors	0.18	0.28	-0.32	0.38	0.06	0.90	1.70	2.15	3.01	4.17	5.77	6.10	3.89	-18.52
Complex uncertainty	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.49	0.49	0.49	0.49	0.61	0.61	0.61

Free Field Directional characteristics of SV 977D with SA 277D

Directional response of SV 977D with the MK 255 microphone, SV 12L preamplifier and SA 277D outdoor microphone kit for specified frequencies.

Combined typical directional characteristics (0 deg and 90 deg incidence angle ref. 0 deg)
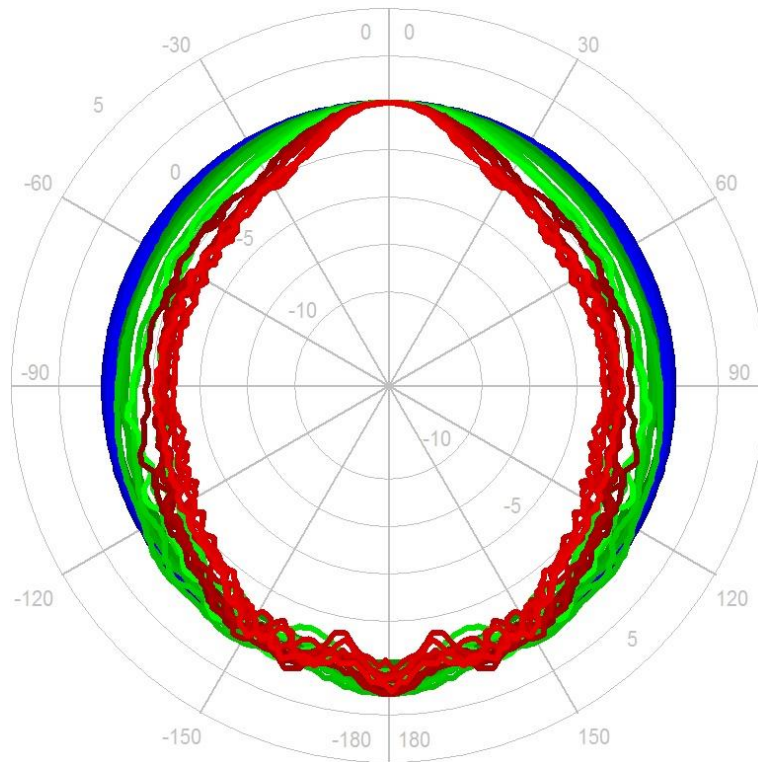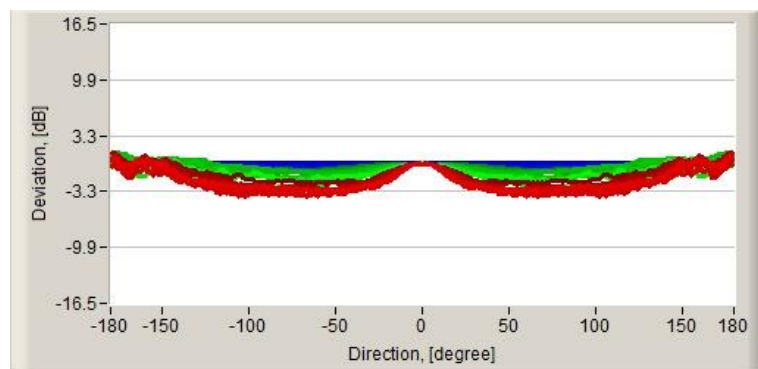
The round charts show the typical directional characteristics (0 deg and 90 deg incidence angle ref. 0 deg), and the charts below shows the errors for 0 deg and 90 deg incidence angles.

250 Hz

500Hz

250Hz

315 Hz

315Hz

315Hz

400 Hz

400Hz

400Hz

500 Hz

500Hz

500Hz

630 Hz

630Hz

800 Hz

800Hz

1000 Hz

1000Hz

1250 Hz

1250Hz

1600 Hz

2000 Hz

2240 Hz

2500 Hz

2800 Hz

2800Hz

2800Hz

3150 Hz

3150Hz

3150Hz

3550 Hz

3550Hz

3550Hz

4000 Hz

4000Hz

4000Hz

4500 Hz

4500Hz

4500Hz

5000 Hz

5000Hz

5000Hz

5600 Hz

5600Hz

5600Hz

6300 Hz

6300Hz

6300Hz

7100 Hz

8000 Hz

8500 Hz

9000 Hz

9500 Hz

9500Hz

10000 Hz

10000Hz

10600 Hz

10600Hz

11200 Hz

11200Hz

11800 Hz

12500 Hz

Table C.7.1.   Typical directional response of SV 977D with SA 277D (0 deg and 90 deg incidence angle ref. 0 deg)

Frequency	Angle [º]									
[Hz]	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
250	-0.02	-0.03	-0.04	-0.04	-0.03	-0.03	-0.02	-0.01	0.01	0.03
315	0.00	0.01	0.02	0.02	0.04	0.04	0.06	0.07	0.09	0.11
400	0.00	0.00	-0.01	-0.03	-0.04	-0.07	-0.09	-0.12	-0.14	-0.16
500	0.01	0.02	0.03	0.04	0.05	0.05	0.06	0.06	0.07	0.07
630	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.03	0.02
800	-0.01	-0.03	-0.06	-0.10	-0.13	-0.15	-0.15	-0.14	-0.13	-0.16
1 000	0.02	0.04	0.05	0.06	0.06	0.05	-0.04	-0.08	-0.09	-0.07
1 250	-0.01	-0.05	-0.10	-0.17	-0.21	-0.22	-0.22	-0.29	-0.33	-0.33
1 600	0.01	-0.05	-0.10	-0.15	-0.21	-0.28	-0.35	-0.34	-0.25	-0.20
2 000	-0.01	-0.07	-0.19	-0.35	-0.48	-0.51	-0.48	-0.50	-0.51	-0.35
2 240	-0.02	-0.09	-0.21	-0.35	-0.53	-0.73	-0.76	-0.71	-0.76	-0.74
2 500	-0.03	-0.11	-0.26	-0.59	-0.72	-0.71	-0.92	-0.97	-0.86	-0.94
2 800	-0.05	-0.25	-0.52	-0.69	-0.77	-0.92	-0.93	-0.96	-1.09	-0.93
3 150	-0.12	-0.35	-0.52	-0.80	-1.02	-1.03	-0.96	-0.96	-1.03	-0.97
3 550	-0.03	-0.20	-0.44	-0.73	-0.91	-0.94	-0.95	-0.86	-0.85	-0.83
4 000	-0.12	-0.38	-0.64	-0.93	-1.04	-1.03	-0.90	-0.81	-0.60	-0.44
4 500	-0.09	-0.41	-0.92	-1.35	-1.48	-1.52	-1.67	-1.65	-1.51	-1.29
5 000	-0.27	-0.73	-1.29	-1.76	-1.78	-2.07	-2.07	-2.05	-1.88	-1.44
5 600	-0.16	-0.69	-1.17	-1.63	-2.03	-2.49	-2.69	-2.81	-2.86	-2.75
6 300	-0.29	-0.90	-1.55	-1.84	-2.28	-2.70	-2.97	-3.05	-3.13	-2.98
7 100	-0.11	-0.75	-1.09	-1.47	-1.57	-1.89	-2.11	-2.15	-1.95	-1.53
8 000	-0.61	-1.47	-2.35	-2.51	-2.33	-2.30	-2.53	-2.30	-2.34	-2.22

f [Hz]	100-110	110-120	120-130	130-140	140-150	150-160	160-170	170-180	180-190	190-200
8 500	-0.33	-1.07	-1.98	-2.30	-2.69	-2.38	-2.53	-3.03	-2.89	-2.62
9 000	-0.76	-1.79	-2.54	-2.87	-3.18	-3.24	-3.14	-3.07	-2.93	-2.66
9 500	-0.41	-1.37	-2.80	-3.04	-3.49	-3.65	-3.65	-3.55	-3.56	-3.34
10 000	-0.96	-1.73	-2.54	-3.30	-3.76	-3.65	-3.55	-3.23	-3.64	-3.54
10 600	-0.49	-2.10	-2.38	-3.28	-3.88	-4.05	-4.05	-3.69	-3.35	-3.32
11 200	-0.93	-2.90	-3.03	-3.23	-3.35	-3.62	-3.15	-3.21	-3.01	-3.97
11 800	-0.61	-1.98	-3.02	-3.24	-3.57	-3.99	-3.95	-3.94	-3.62	-3.51
12 500	-1.30	-2.15	-2.68	-2.99	-3.40	-3.25	-3.51	-3.11	-2.97	-3.10
f [Hz]	**100-110**	**110-120**	**120-130**	**130-140**	**140-150**	**150-160**	**160-170**	**170-180**	**180-190**	**190-200**
250	0.05	0.06	0.08	0.11	0.12	0.13	0.13	0.13	0.13	0.12
315	0.14	0.17	0.20	0.23	0.26	0.28	0.29	0.30	0.29	0.28
400	-0.16	-0.16	-0.16	-0.14	-0.12	-0.10	-0.08	-0.06	-0.05	-0.06
500	0.08	0.10	0.12	0.16	0.19	0.22	0.23	0.23	0.22	0.21
630	-0.02	-0.02	-0.02	0.04	0.09	0.14	0.17	0.19	0.18	0.17
800	-0.21	-0.24	-0.24	-0.22	-0.16	-0.08	0.02	0.03	0.03	-0.05
1 000	-0.02	-0.02	-0.06	-0.06	0.04	0.14	0.20	0.23	0.22	0.18
1 250	-0.23	-0.25	-0.35	-0.37	-0.36	-0.23	-0.10	-0.02	-0.10	-0.20
1 600	-0.16	-0.13	-0.15	-0.30	-0.31	-0.23	0.11	0.18	0.18	0.10
2 000	-0.29	-0.27	-0.26	-0.45	-0.48	-0.36	-0.09	0.09	-0.12	-0.34
2 240	-0.40	-0.62	-0.61	-0.50	-0.70	-0.69	-0.42	-0.13	-0.15	-0.52
2 500	-0.90	-0.91	-0.89	-0.86	-1.07	-1.01	-0.62	-0.38	-0.58	-0.99
2 800	-1.07	-0.76	-0.47	-0.38	-0.46	-0.50	-0.23	0.33	0.33	-0.34
3 150	-0.92	-0.40	-0.25	0.22	0.18	0.15	0.64	0.75	0.67	0.19
3 550	-0.75	-0.65	0.24	0.21	0.40	-0.13	0.56	0.89	0.88	0.44
4 000	-0.29	-0.28	0.66	0.72	0.87	0.44	1.20	1.38	1.27	0.54
4 500	-1.13	-0.59	-0.56	0.41	0.61	0.51	0.62	1.10	1.08	0.42
5 000	-1.71	-1.48	-1.01	-0.63	-0.54	-0.71	-0.49	0.59	-0.43	-0.82
5 600	-2.77	-2.26	-2.26	-1.56	-1.39	-1.33	-1.46	-0.69	-0.69	-1.55
6 300	-2.63	-2.44	-1.79	-1.42	-1.26	-1.17	-1.13	0.56	-1.14	-1.14
7 100	-1.94	-1.47	-1.47	-0.68	-0.41	0.75	-0.73	1.03	0.99	-0.74
8 000	-1.90	-1.52	-1.48	-0.55	0.46	0.67	-0.68	1.08	-0.77	-0.63
8 500	-2.80	-2.20	-1.54	-1.23	-0.57	0.68	-0.67	1.11	1.05	-0.74
9 000	-2.51	-1.77	-1.33	-0.78	0.63	1.15	0.75	1.55	0.97	0.93
9 500	-3.15	-2.46	-1.67	-1.23	-0.61	1.05	0.89	1.32	1.25	0.83
10 000	-3.27	-2.78	-2.35	-1.91	-0.75	-0.75	-1.18	0.93	-1.26	0.61
10 600	-3.90	-3.46	-3.06	-2.51	-1.48	-1.40	-1.74	-1.37	-1.73	-1.68
11 200	-3.63	-3.38	-2.54	-1.96	-1.21	-1.14	-1.49	-0.50	-1.46	-1.37
11 800	-3.82	-3.31	-2.82	-2.19	-1.94	-0.97	-1.33	-1.33	-1.31	-1.06
12 500	-2.99	-2.52	-2.03	-1.79	0.89	1.12	0.77	1.26	-0.94	0.81
f [Hz]	**200-210**	**210-220**	**220-230**	**230-240**	**240-250**	**250-260**	**260-270**	**270-280**	**280-290**	**290-300**
250	0.11	0.09	0.07	0.04	0.01	-0.03	-0.05	-0.07	-0.08	-0.09
315	0.25	0.22	0.20	0.15	0.12	0.10	0.07	0.05	0.03	0.02
400	-0.08	-0.10	-0.11	-0.13	-0.13	-0.13	-0.12	-0.11	-0.10	-0.08
500	0.17	0.14	0.10	0.06	0.04	0.02	0.01	0.00	-0.01	-0.01
630	0.13	0.08	0.03	-0.02	-0.02	-0.01	0.01	0.01	0.01	-0.01
800	-0.14	-0.19	-0.20	-0.21	-0.18	-0.14	-0.10	-0.11	-0.13	-0.13
1 000	0.09	-0.09	-0.14	-0.15	-0.15	-0.20	-0.26	-0.28	-0.27	-0.22
1 250	-0.32	-0.35	-0.34	-0.26	-0.24	-0.36	-0.37	-0.34	-0.28	-0.29
1 600	-0.22	-0.27	-0.24	-0.09	-0.07	-0.10	-0.15	-0.22	-0.31	-0.30
2 000	-0.51	-0.50	-0.26	-0.33	-0.34	-0.45	-0.59	-0.58	-0.58	-0.63
2 240	-0.67	-0.67	-0.48	-0.62	-0.61	-0.44	-0.74	-0.73	-0.75	-0.80
2 500	-1.09	-0.94	-0.88	-0.98	-0.96	-1.01	-0.93	-1.04	-1.02	-0.82
2 800	-0.55	-0.48	-0.56	-0.60	-1.02	-1.19	-1.16	-1.19	-0.97	-1.03
3 150	-0.18	-0.26	-0.40	-0.69	-1.13	-1.13	-1.22	-1.13	-1.14	-1.16
3 550	-0.19	0.28	-0.30	-0.43	-0.87	-1.13	-1.13	-1.16	-1.21	-1.26

f [Hz]										
4 000	0.83	0.76	0.64	0.38	-0.35	-0.49	-0.79	-1.03	-1.13	-1.25
4 500	0.43	0.43	-0.29	-0.83	-1.01	-1.44	-1.55	-1.77	-1.81	-1.76
5 000	-0.40	-0.85	-1.24	-1.79	-1.83	-1.44	-1.67	-1.88	-1.94	-1.93
5 600	-1.26	-1.62	-1.92	-2.52	-2.77	-3.01	-3.02	-3.05	-2.83	-2.55
6 300	-1.27	-1.59	-1.67	-2.28	-2.56	-3.21	-3.21	-3.07	-3.07	-2.67
7 100	0.65	-0.47	-0.64	-1.37	-1.43	-1.66	-1.37	-1.90	-1.99	-1.86
8 000	-0.61	-0.65	-1.25	-1.64	-1.99	-2.14	-2.23	-2.19	-2.58	-2.53
8 500	-0.74	-0.87	-1.38	-2.19	-2.34	-3.13	-3.11	-3.15	-2.97	-2.63
9 000	0.46	-1.05	-1.43	-1.87	-2.83	-2.90	-3.24	-3.44	-3.31	-2.99
9 500	-0.60	-0.76	-1.50	-1.94	-2.80	-3.35	-3.51	-3.42	-3.13	-3.56
10 000	-0.99	-1.83	-2.34	-2.79	-3.24	-2.81	-2.84	-2.71	-3.15	-3.17
10 600	-1.43	-2.16	-2.78	-3.26	-3.78	-3.99	-3.01	-3.33	-3.51	-3.81
11 200	-1.44	-2.34	-2.57	-3.87	-3.64	-3.77	-3.42	-3.43	-3.22	-3.67
11 800	-1.17	-2.47	-2.76	-3.35	-3.75	-4.00	-4.00	-3.97	-4.03	-3.87
12 500	-0.72	-2.20	-2.38	-2.68	-2.72	-2.76	-2.77	-2.97	-3.34	-3.14

f [Hz]	300-310	310-320	320-330	330-340	340-350	350-360				
250	-0.10	-0.11	-0.11	-0.11	-0.11	-0.11				
315	0.01	0.01	-0.01	-0.01	-0.02	-0.02				
400	-0.06	-0.04	-0.02	0.01	0.01	0.01				
500	-0.01	-0.02	-0.02	-0.02	-0.01	-0.01				
630	-0.02	-0.02	-0.02	-0.01	-0.01	0.00				
800	-0.12	-0.10	-0.07	-0.04	-0.02	-0.01				
1 000	-0.15	-0.11	-0.07	-0.06	-0.03	0.01				
1 250	-0.29	-0.26	-0.20	-0.11	-0.06	-0.02				
1 600	-0.23	-0.19	-0.13	-0.08	-0.03	0.03				
2 000	-0.60	-0.48	-0.29	-0.16	-0.09	-0.03				
2 240	-0.74	-0.55	-0.40	-0.23	-0.12	0.02				
2 500	-0.83	-0.73	-0.44	-0.21	-0.09	-0.03				
2 800	-0.93	-0.79	-0.72	-0.47	-0.24	-0.03				
3 150	-1.15	-0.93	-0.63	-0.38	-0.18	0.01				
3 550	-1.19	-1.17	-0.92	-0.49	-0.28	-0.07				
4 000	-1.25	-1.10	-0.91	-0.47	-0.23	-0.03				
4 500	-1.59	-1.50	-1.34	-0.97	-0.44	-0.10				
5 000	-1.69	-1.60	-1.30	-0.71	-0.31	0.03				
5 600	-2.17	-2.00	-1.63	-1.17	-0.61	-0.08				
6 300	-2.19	-1.84	-1.58	-0.98	-0.47	-0.02				
7 100	-1.73	-1.64	-1.60	-1.36	-0.77	-0.17				
8 000	-2.32	-2.18	-2.08	-1.39	-0.62	0.05				
8 500	-2.27	-2.33	-2.17	-1.67	-1.09	-0.28				
9 000	-3.08	-2.95	-2.58	-1.82	-0.90	0.06				
9 500	-3.55	-3.09	-2.55	-1.99	-1.14	-0.14				
10 000	-3.35	-3.15	-2.52	-1.86	-1.12	0.06				
10 600	-3.72	-3.20	-2.75	-2.26	-1.72	-0.38				
11 200	-3.53	-3.25	-2.55	-2.39	-0.81	0.06				
11 800	-3.65	-3.77	-3.37	-2.87	-1.71	-0.46				
12 500	-3.32	-3.39	-2.86	-2.31	-1.69	-0.12				

C.8. EU DECLARATION OF CONFORMITY

Manufacturer:	**SVANTEK Sp. z o. o**
	Strzyglowska 81
Address:	04-872 Warszawa
	Poland
Kind of product:	SOUND LEVEL METER – ANALYZER
	VIBRATION LEVEL METER – ANALYZER
Type:	**SV 977D**
Directive:	**Directive 2014/53/EU** of The European Parliament and of The Council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC (OJ L 153/62 of 22.5.2014).
Standards: Art 3.1a: Safety	EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
Art 3.1b: EMC	ETSI EN 301 489-1 V2.2.3. Electromagnetic compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised standard for Electromagnetic Compatibility.
	ETSI EN 301 489-17 V3.2.4. Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised standard for Electromagnetic Compatibility.
	EN 61000-4-2:2009. Electromagnetic compatibility (EMC). Testing and measurement techniques. Part 4-2; Electrostatic discharge immunity test.
	EN 61000-4-3:2006 + A1:2008 + A2:2010 + ISI:2009. Electromagnetic compatibility (EMC). Testing and measurement techniques. Part 4-3; Radiated, radio-frequency, electromagnetic field immunity test.
	EN 61000-4-8:2010. Electromagnetic compatibility (EMC). Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test.
	EN 61000-4-20:2010. Electromagnetic compatibility (EMC). Testing and measurement techniques. Part 4-20: Emission and immunity testing in traverse electromagnetic (TEM) waveguides.
Art 3.2: Radio	ETSI EN 300 328 V2.2.2. Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised standard for access to radio spectrum.
Directive:	**Restriction of Hazardous Substances** (ROHS II) 2011/65/EU
Standards:	EN 50581:2012 *Assessment of electronic products with respect to RoHS*
	Auxiliary industry standards:
	EN 61672-1:2013 *Electroacoustics – Sound level meters: Class 1*
	EN 61260-1:2014 *Octave-band filters*
	EN ISO 8041-1:2017 *Human response to vibration – Measuring instruments*

APPENDIX D. DEFINITIONS AND FORMULAE OF MEASURED VALUES

D.1.   SOUND LEVEL METER

D.1.1   Basic terms and definitions (SLM mode)

T   current time period of the measurement in seconds.

T_1   last second of the measurement.

T_e   exposure time in seconds (time period during which a person is exposed to the action of noise). This parameter can be set in the **Exposure Time** setup (**Measurement** menu). The available values are from 1 minute to 12 hours with 1-minute step.

T_{8h}   time period equal to 8 hours (28 800 seconds).

τ   exponential time constant in seconds for the given time-weighting. Three time constant are available: **Slow** (1000 ms), **Fast** (125 ms), **Impulse** (35 ms, but on falling values a longer time constant of 1500 ms is applied).

W   Frequency-weighting filter (**A**, **C, B**, **Z**, **U**, **AU** or **LF**).

$p_W(t)$ instantaneous frequency-weighted sound pressure with the weighting filter **W**. Sound pressure is expressed in pascals (Pa).

$p_{W\tau}(t)$ instantaneous frequency and time-weighted sound pressure with the weighting filter **W** and time constant τ calculated from the equation:

$$p_{W\tau}(t) = \sqrt{\frac{1}{\tau} \int_{-\infty}^{t} p_W^2(\xi)\, e^{-(t-\xi)/\tau}\, d\xi}$$

where: ξ – variable of integration.

$r(t)$ instantaneous sound pressure depended on the **RMS Integration** parameter:

$$r(t) = \begin{cases} p_W(t) & \text{RMS Integration} = \text{Lin} \\ p_{W\tau}(t) & \text{RMS Integration} = \text{Exp} \end{cases}$$

p_0   reference value (20 μPa).

$\log(x)$ logarithm of x to the base 10.

D.1.2 Definitions and formulas of SLM results

The instrument calculates the sound measurement results for three profiles. The calculation flow diagram for one profile is presented below:
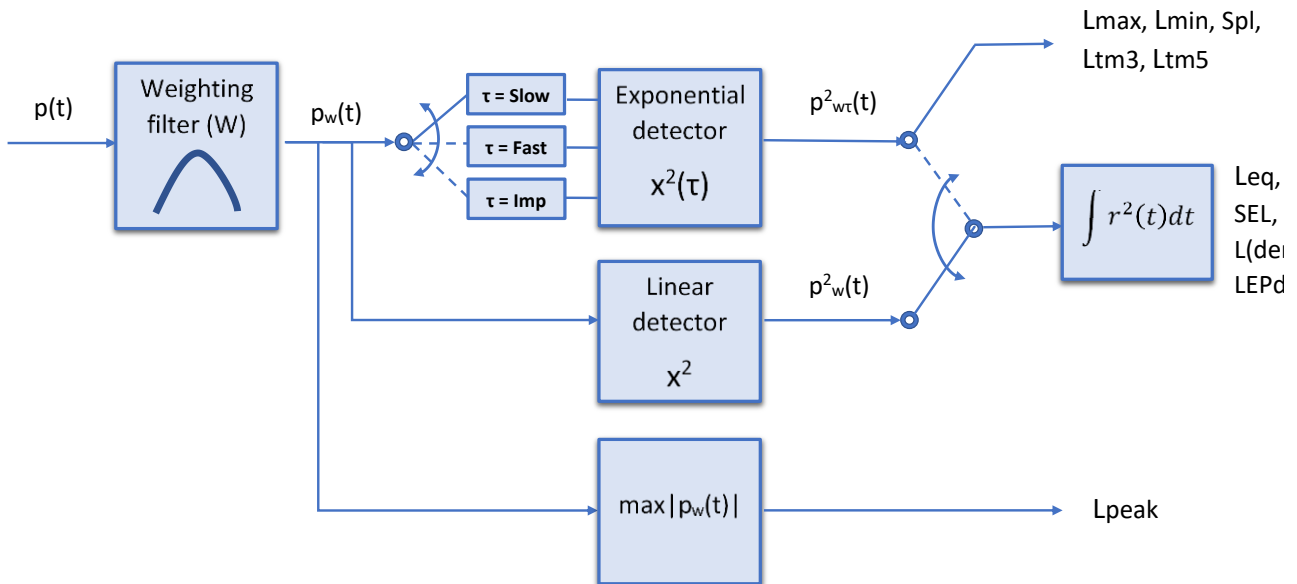
Ovl   Percentage of the overloaded input signal, which occurred during the current time period of the measurement (**T**)

Lpeak   Peak sound level is calculated for the given **T**

$$\textbf{Peak} = \textbf{10 log} \left(\textbf{max}_\textbf{T} \; \frac{\textbf{p}_\textbf{w}^{\textbf{2}}(\textbf{t})}{\textbf{p}_\textbf{0}^{\textbf{2}}} \right)$$

Spl or **LXY**   Maximal value of the frequency and time-weighted sound pressure level for the last second of the measurement

$$\textbf{Spl} = \textbf{10 log} \left(\textbf{max}_{\textbf{T}_\textbf{1}} \; \frac{\textbf{p}_{\textbf{w}\tau}^{\textbf{2}}(\textbf{t})}{\textbf{p}_\textbf{0}^{\textbf{2}}} \right)$$

Lmax   Maximal value of the time-weighted sound pressure level for current time period of the measurement (**T**). The **Max** result for the 1 second period is equal to the value of the **Spl** result

$$\textbf{Max} = \textbf{10 log} \left(\textbf{max}_\textbf{T} \; \frac{\textbf{p}_{\textbf{w}\tau}^{\textbf{2}}(\textbf{t})}{\textbf{p}_\textbf{0}^{\textbf{2}}} \right)$$

Lmin   Minimal value of the time-weighted sound pressure level for current time period of the measurement (**T**)

$$\textbf{Min} = \textbf{10 log} \left(\textbf{min}_\textbf{T} \; \frac{\textbf{p}_{\textbf{w}\tau}^{\textbf{2}}(\textbf{t})}{\textbf{p}_\textbf{0}^{\textbf{2}}} \right)$$

Leq   Equivalent sound level - time-averaged sound level for the current time period of the measurement (**T**)

$$\textbf{Leq} = \textbf{10 log} \left(\frac{\textbf{1}}{\textbf{T}} \int_\textbf{0}^\textbf{T} (\, \textbf{r(t)}/\textbf{p}_\textbf{0})^{\textbf{2}} \textbf{dt} \right)$$

LRxx(s)

Rolling Leq measured in the time window for the last **xx** minutes/seconds of the measurement (**Tw**) moving with 1 second step.

$$LR(Tw) = 10\,log\,\left(\frac{1}{Tw}\int_{T-Tw}^{T}(\,r(t)/p_0)^2dt\right)$$

*Note: If the current measurement time **T** is less than the time window **Tw** the **LRxx(s)** result is undefined.*

SEL

Sound Exposure Level is essentially the subset of the **Leq** result. Its value is equal to the **Leq** result referred to the integration time equal to one second (so, for the Integration time equal to 1 s, **SEL** is always equal to **Leq**)

$$SEL = 10\,log\,\left(\int_{0}^{T}(\,r(t)/p_0)^2dt\right) = Leq + 10\,log\,\frac{T}{1s}$$

LEPd

Daily Personal Noise Exposure is the noise exposure level for a nominal 8-hour working day. The **LEPd** result is calculated on the base of the **LEQ**

$$LEPd = Leq + 10\,log\,\frac{T_e}{T_{8h}}$$

Ltm3 and **LTeq**

The **Ltm3** and **LTeq** results (Takt-Maximal Levels) are calculated according to the German standard TA Lärm.

Ln

Statistical level is the certain boundary level surpassed by the temporary noise level values in not more than **n%** of the observation period

see Chapter D.3

L(den)

Only one result from: **Lday**, **Leve**, **Lnight**, **Lde**, **Len**, **Lnd**, and **Lden** is available in the instrument. It depends on the day and night time in which the measurement was performed. Day and night time depend on the **<Day Time Limits>** option (**6h-18h** or **7h-19h**).

If **<6h-18h>** option is selected for the <**Day Time Limits>** in the instrument then:

T_d (day-time) starts from 6 am and ends at 6 pm,
T_e (evening-time) starts from 6 pm and ends at 10 pm,
T_n (night-time) starts at 10 pm and ends at 6 am.

If **<7h-19h>** option is selected for the <**Day Time Limits>** in the instrument then:

T_d (day-time) starts from 7 am and ends at 7 pm,
T_e (evening-time) starts from 7 pm and ends at 11 pm,
T_n (night-time) starts at 11 pm and ends at 7 am.

Lday

Lday is calculated for: $T_d \neq 0$, $T_e = 0$, $T_n = 0$.

$$Ld = 10\,log\,\left(\frac{1}{T_d}\int_{T_d}(r_w(t)/p_0)^2dt\right)$$

Leve   **Leve** is calculated for: $T_d = 0$, $T_e \neq 0$, $T_n = 0$.

$$Le = 5\ dB + 10\ log\left(\frac{1}{T_e}\int_{T_e}(r_w(t)/p_0)^2 dt\right)$$

Lnight   **Lnight** is calculated for: $T_d = 0$, $T_e = 0$, $T_n \neq 0$.

$$Ln = 10\ dB + 10\ log\left(\frac{1}{T_n}\int_{T_n}(r_w(t)/p_0)^2 dt\right)$$

Lde   **Lde** is calculated for: $T_d \neq 0$, $T_e \neq 0$, $T_n = 0$.

$$Lde = 10\ log\left[\frac{1}{12+4}\left(12\cdot10^{Ld/10} + 4\cdot10^{Le/10}\right)\right]$$

Len   **Len** is calculated for: $T_d = 0$, $T_e \neq 0$, $T_n \neq 0$.

$$Len = 10\ log\left[\frac{1}{4+8}\left(4\cdot10^{Le/10} + 8\cdot10^{Ln/10}\right)\right]$$

Lnd   **Lnd** is calculated for: $T_d \neq 0$, $T_e = 0$, $T_n \neq 0$.

$$Lnd = 10\ log\left[\frac{1}{8+12}\left(8\cdot10^{Ln/10} + 12\cdot10^{Ld/10}\right)\right]$$

Lden   **Lden** is calculated for: $T_d \neq 0$, $T_e \neq 0$, $T_n \neq 0$.

$$Lden = 10\ log\left[\frac{1}{12+8+4}\left(12\cdot10^{Ld/10} + 4\cdot10^{Le/10} + 8\cdot10^{Ln/10}\right)\right]$$

EX   Expected value. Calculated on the basis of 100ms RMS results.

SD   Standard deviation. Calculated on the basis of 100ms RMS results.

NR   Noise Rating, measured noise level that takes into account the frequency content of the noise.

NR is calculated if 1/1 Octave function is active.

To calculate the NR value, the noise level in each 1/1 octave band (from 31.5Hz to 8kHz) is compared to the "NR curves" for each corresponding band. The NR curve number which applies to each frequency band is the highest numerical value that is not exceeded in that band. The overall NR value is the highest of the individual NR values for the frequency bands.

NC   Noise Criterion, measured noise level that takes into account the frequency content of the noise.

NC is calculated if 1/1 Octave function is active.

To calculate the NC value, the noise level in each 1/1 octave band (from 63Hz to 8kHz) is compared to the "NC curves" for each corresponding band. The NC curve number which applies to each frequency band is the lowest numerical value that is not exceeded by each individual frequency band. The overall NC value is the highest of the individual NC values for the frequency bands.

D.2.   VIBRATION LEVEL METER

D.2.1   Basic terms and definitions (VLM mode)

T   current time period of the measurement in seconds.

τ exponential time constant in seconds for the given time-weighting. The following time constants are available: **100 ms**, **125 ms**, **200 ms**, **500 ms**, **1.0 s**, **2.0 s**, **5.0 s**, **10.0 s.**

W   frequency-weighting filter (**HP**, **HP1**, **HP3**, **HP10**, **Vel1**, **Vel3**, **Vel10**, **VelMF**, **Dil1**, **Dil3**, **Dil10**, or **Wh**).

$a_W(t)$ instantaneous frequency-weighted signal with the weighting filter **W**.

$a_{W\tau}(t)$ instantaneous frequency and time-weighted signal with the weighting filter **W** and time constant τ calculated from the equation:

$$a_{W\tau}(t) = \sqrt{\frac{1}{\tau} \int_{-\infty}^{t} a_W^2(\xi)\, e^{-(t-\xi)/\tau}\, d\xi}\ ,$$

where: ξ – variable of integration.

$v(t)$ instantaneous vibration signal depends on the <**RMS Integration**> parameter:

$$v(t) = \begin{cases} a_W(t) & \textbf{RMS Integration} = \textbf{Lin} \\ a_{W\tau}(t) & \textbf{RMS Integration} = \textbf{Exp} \end{cases}$$

D.2.2   Definitions and formulas of the VLM result

The instrument calculates the vibration measurement results for three profiles. The calculation flow diagram for one profile is presented below:
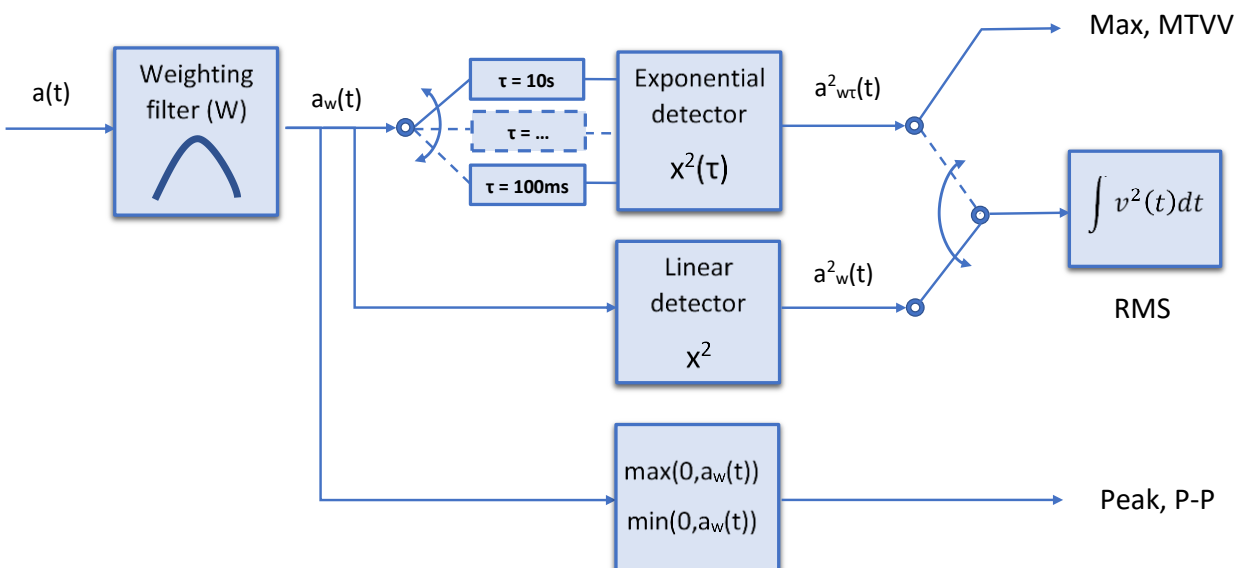
Ovl Percentage of the overloaded input signal, which occurred during the current time period of the measurement (**T**)

Peak Maximum absolute value of the signal calculated for the given **T**

$$\text{Peak} = \max_T \left| a_w(t) \right|$$

P–P Peak-to-peak (**P-P**) result is the difference between highest and lowest value of the signal calculated for the given **T**

$$P - P = \max_T(0, a_w(t)) - \min_T(0, a_w(t))$$

Max Maximal value of the time-weighted signal for current time period of the measurement (**T**)

$$\text{Max} = \max_T \left(a_{w\tau}(t) \right)$$

RMS **RMS** (root mean square) result for current time period of the measurement (**T**)

$$\text{RMS} = \sqrt{\frac{1}{T} \int_0^T v^2(t)\, dt}$$

D.3. STATISTICAL LEVELS – LN DEFINITION

The noise level **L(t)** is the continuous random variable. The probability that the temporary noise level **L(t)** belongs to the interval $\langle L_k, L_k + \Delta L \rangle$ is called the class density and it can be expressed by the equation:

$$P_k \left[L_k \le L(t) \le L_k + \Delta L \right] = \sum_{i=1}^{n} \Delta t_i \Big/ P$$

where: Δt_i - time intervals, in which the noise level $L(t) \in \langle L_k, L_k + \Delta L \rangle$ occurs,

ΔL - so-called class interval or distribution class of the series,

P - total observation period.

In case when the class interval approaches infinity, the probability of **L(t)** tends to the probability of L_k. In practice, ΔL value is strictly determined for the measuring instrument. For SV 977D, there are 240 classes and the width of each class is 0.5 dB. The histogram is the set of the class density values calculated for all classes.

The statistical distribution function, which determines the probability (expressed in %) of the noise occurrence on the level equal or less than $L_k + \Delta L$ is given by the formulae:

$$P \left[L(t) \le L_j \right] = \sum_{k=1}^{j} P_k(L)$$

The cumulative density function, expressed by the equation:

$$P \left[L(t) > L_j \right] = 1 - P \left[L(t) \le L_j \right]$$

is directly used to determine so-called statistical levels **Ln** or position parameters of the distribution.

The **Ln** is the certain boundary level surpassed by the temporary noise level values in not more than **n%** of the observation period.

Example:

Let us assume that **L35** is equal to 76.8 dB. It means that during the measurements the noise level 76.8 dB was exceeded in not more than 35% of the observation period.

The cumulative density function for the exemplary data is presented in Figure on the right side. In order to determine the **Ln** level, one must draw the horizontal cursor and find out the crossing point between the cumulative density function and the cursor. In the instrument the user can determine 10 statistical levels - from **L01** to **L99** (1% step of observation period).

The statistical level **Ln** value, the profile's number the statistics are taken from, the RMS detector (**Lin.**, or **Exp.**: **Fast**, **Slow** or **Imp**.), the filter's name (**A**, **C** or **Z**) and real time are displayed in the top-right side of the display in one-result view mode.

Exemplary cumulative density
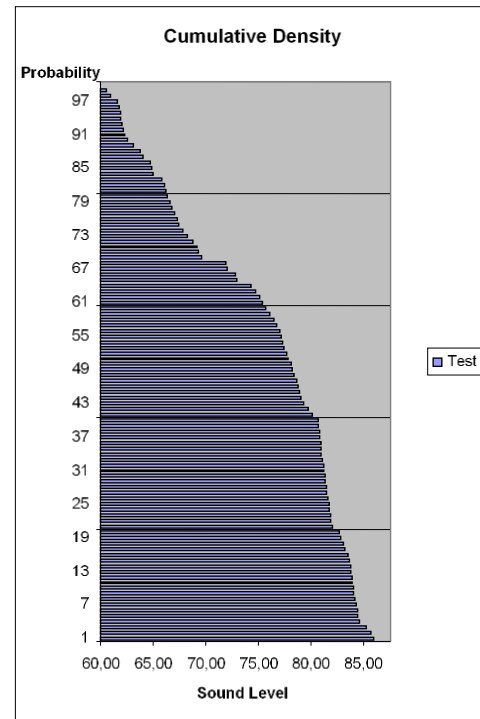
APPENDIX E. REVERBERATION TIME CALCULATIONS

E.1. INTRODUCTION

If an impulsive sound is generated in a room with reflecting boundaries, repeated reflections at the boundaries result in the rapid establishment of a more or less uniform sound field. This field then decays as the sound energy is absorbed by the bounding materials. The rate at which the sound energy decays is determined by the absorptive properties of the reflecting surfaces and the distances between them. The time taken for the sound intensity or the sound pressure level to decay by 60 dB is called the **reverberation time** (RT). The values of RT may range from fractions of a second to a few seconds and depend upon the size of the room and the nature of the materials used in its construction.

The graphs below present the reverberation time nature (in the case when only one frequency is emitted):
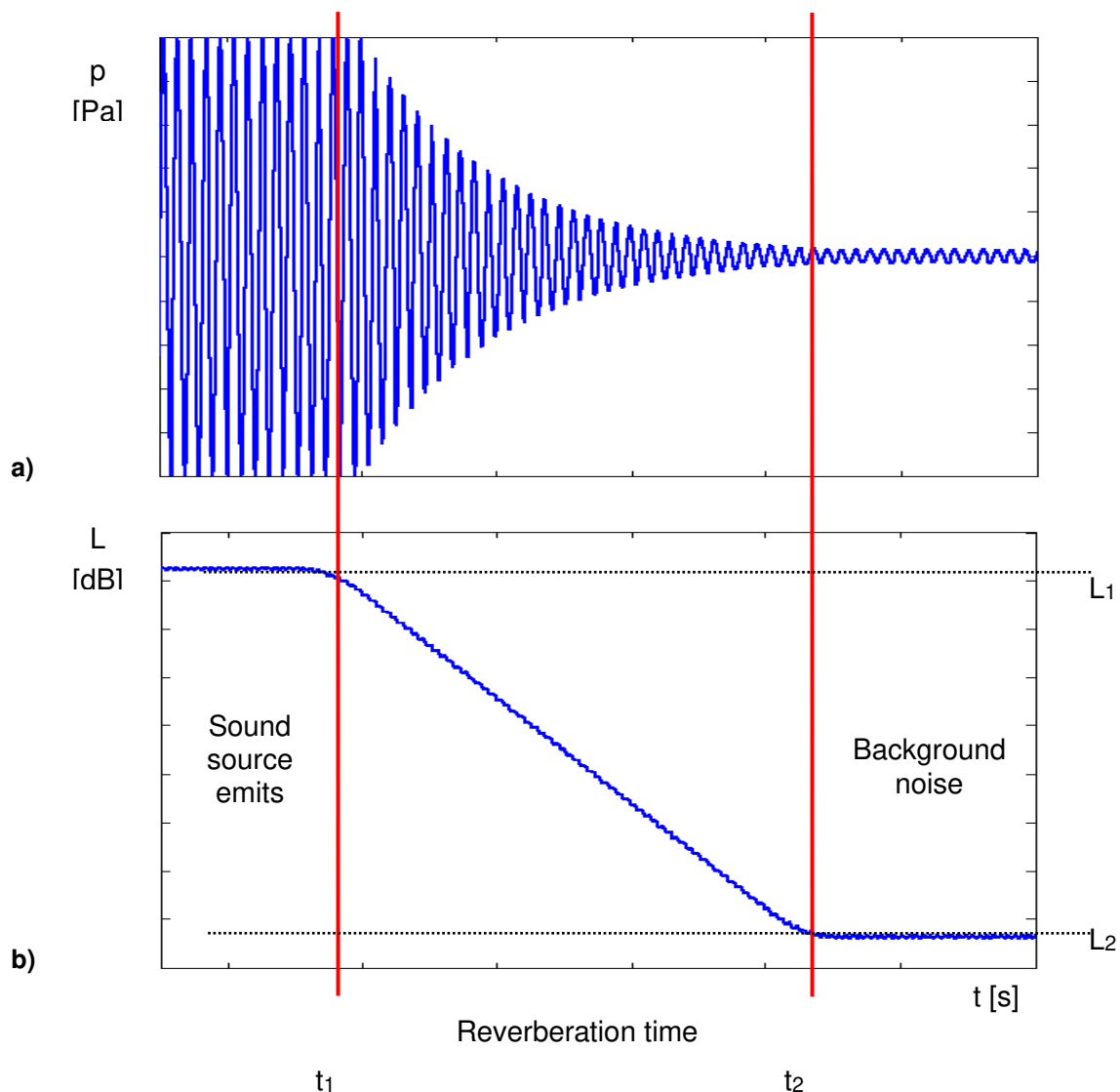
Fig 1. The acoustic pressure versus time (a) and the value of the sound pressure level versus time, so-called decay curve (b)

The marker t_1 indicates the moment when the sound source was switched off. From this moment the acoustic sound pressure / acoustic power (reflected waves propagate in the room) decreases till the moment indicated by the marker t_2. The lower graph presents so-called the **decay curve**. The reverberation time value is equal to $t_2 - t_1$ when the difference between sound pressure levels L_1 and L_2 is

60 dB. The 60 dB dynamic condition is impractical in real measurements (very difficult to fulfil) hence the reverberation time (RT 60) is obtained using the slope coefficient of the decay curve. The type of the definition from which slope coefficient is calculated (EDT, RT 20, RT 30 or user defined) depends on the difference between levels L_1 and L_2 (the difference between background noise level and sound source level) of the decay curve and it depends on significantly from the acoustic source ability. If the level difference is larger than 45 dB, the RT 60 parameter can be calculated using three definitions: EDT, RT 20 and RT 30.

The real measurement results are not as smooth as the curves presented on graphs in Figure 1. In order to point out the interesting decay curve region (the position of the markers t_1 and t_2) some measurement data processing (in general signal smoothing by averaging) need to be applied.

E.2. DEFINITIONS AND CALCULATION OF RT 60 REVERBERATION TIME

➢ **EDT (early decay time):**

The EDT decay curve region is pointed out by markers t_1 and t_3 (cf. Fig. 2). It is checked whether the selected decay curve region has proper dynamics for the EDT calculation:

$$L_1 - L_2 >= 10\ dB$$

$$L_2 - L_3 >= noise\ margin$$

It is recommended by the ISO-3382 standard to set 10 dB value for noise margin.

In case of the **impulse method**, the sound pressure level values between points t_1 (with L_1 level) and t_2 (with L_2) are approximated with the straight line ($y = a \cdot x + b$) by the linear regression. Before approximation the EDT value is calculated using the slope coefficient 'a' according to the formula:

$$EDT = -60.0\ /\ a$$

In case of the **decay method**, the EDT value is calculated according to the formula:

$$EDT = 6 \cdot (t_2 - t_1)$$
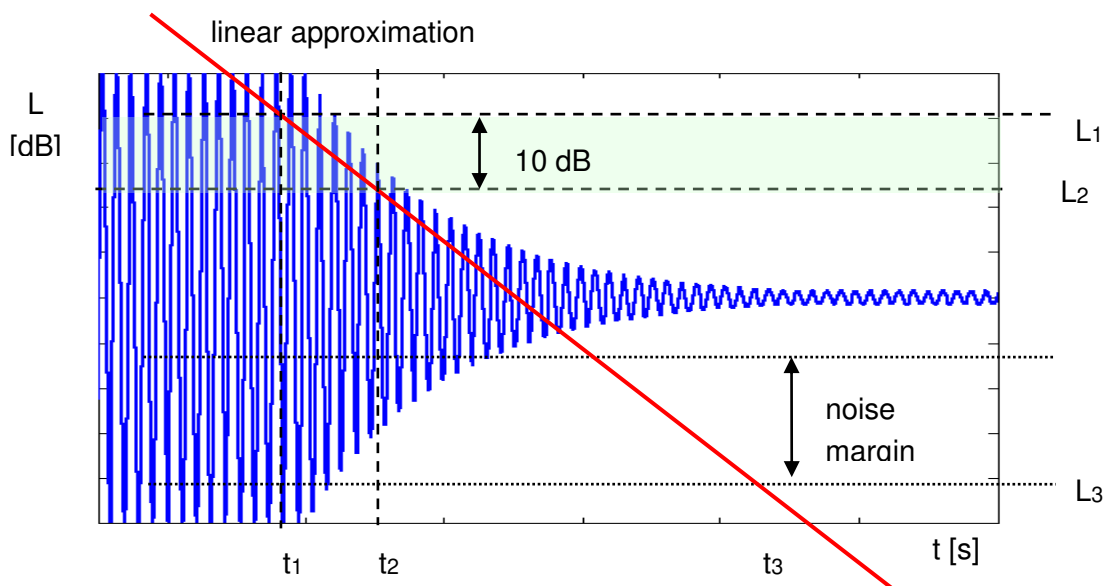
Fig 2. The EDT evaluation

➢ **RT 20 (reverberation time calculated with 20 dB dynamics):**

The RT 20 decay curve region is pointed out by markers t_1 and t_4 (cf. Fig. 3). It is checked whether the selected decay curve region has proper dynamics for the RT 20 calculation:

$$L_1 - L_4 > 5 \text{ dB} + 20 \text{ dB} + \text{noise margin}$$

It is recommended by the ISO-3382 standard to set 10 dB value for noise margin.

In case of the **impulse method**, the sound pressure level values between points t_2 and t_3 are approximated with the straight line ($y = a \cdot x + b$) by the linear regression. The RT 20 value is calculated using the slope coefficient 'a' according to the formula:

$$RT\ 20 = -60.0 / a$$

In case of the **decay method**, the RT 20 value is calculated according to the formula:

$$RT\ 20 = 3 \cdot (t_3 - t_2)$$
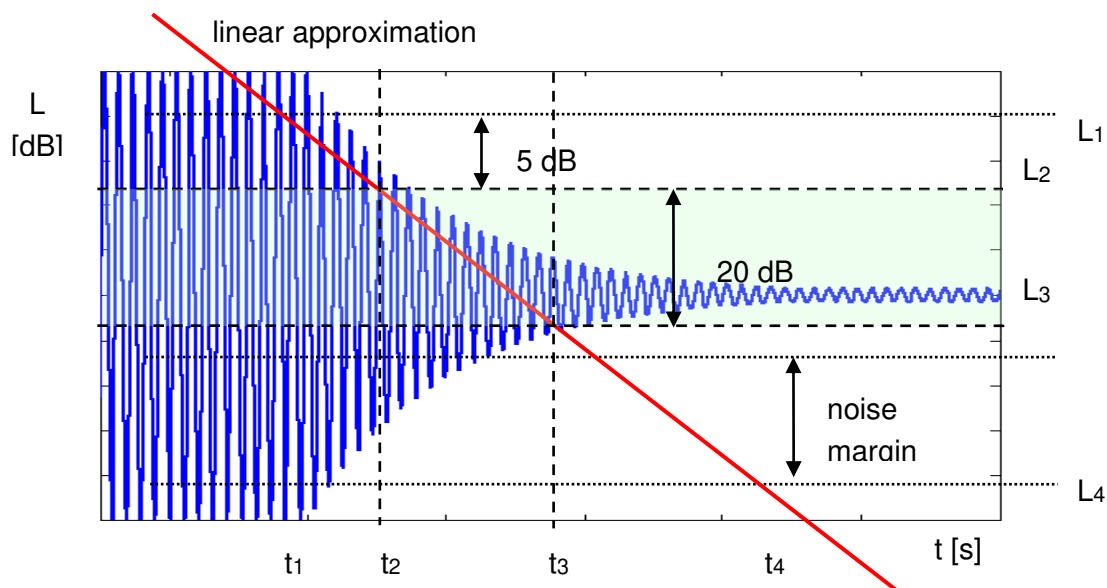
Fig 3. The RT 20 evaluation

➢ **RT 30 (reverberation time calculated with 30 dB dynamics):**

The RT 30 decay curve region is pointed out by markers t_1 and t_4 (cf. Fig. 4). It is checked whether the selected decay curve region has proper dynamics to the RT 30 calculation:

$$L_1 - L_4 > 5 + 30 \text{ dB} + \text{noise margin}$$

It is recommended by the ISO-3382 standard to set 10 dB value for noise margin.

In case of the **impulse method**, the sound pressure level values between points t_2 and t_3 are approximated with the straight line ($y = a \cdot x + b$) by the linear regression. The RT 30 value is calculated using the slope coefficient 'a' according to the formula:

$$RT\ 30 = -60.0 / a$$

In case of the **decay method**, the RT 30 value is calculated according the formula

$$RT\ 30 = 2 \cdot (t_3 - t_2)$$
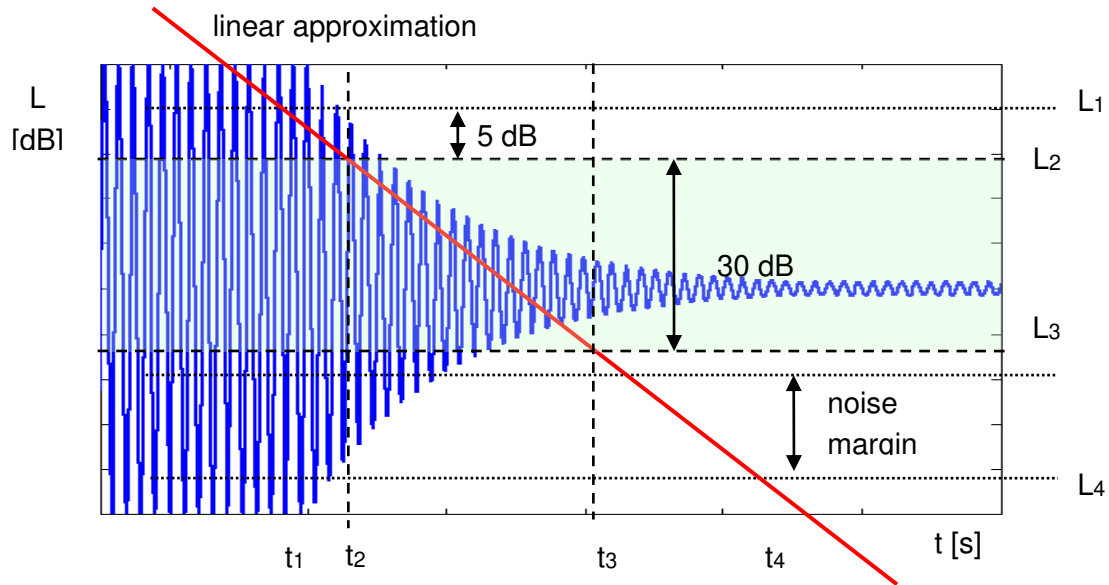
Fig 4. The RT 30 evaluation

E.3. DESCRIPTION OF DECAY CURVE RECORDING IN DIFFERENT MEASUREMENT METHODS

➢ **DECAY method**

This RT 60 measurement method requires omnidirectional sound source which emits pink noise in appropriate frequency band. The most critical parameter of the omnidirectional sound source is emitted sound pressure level as it was mentioned in the beginning of the appendix.

The graphical illustration of the data recording in this method is presented in Figure 5.
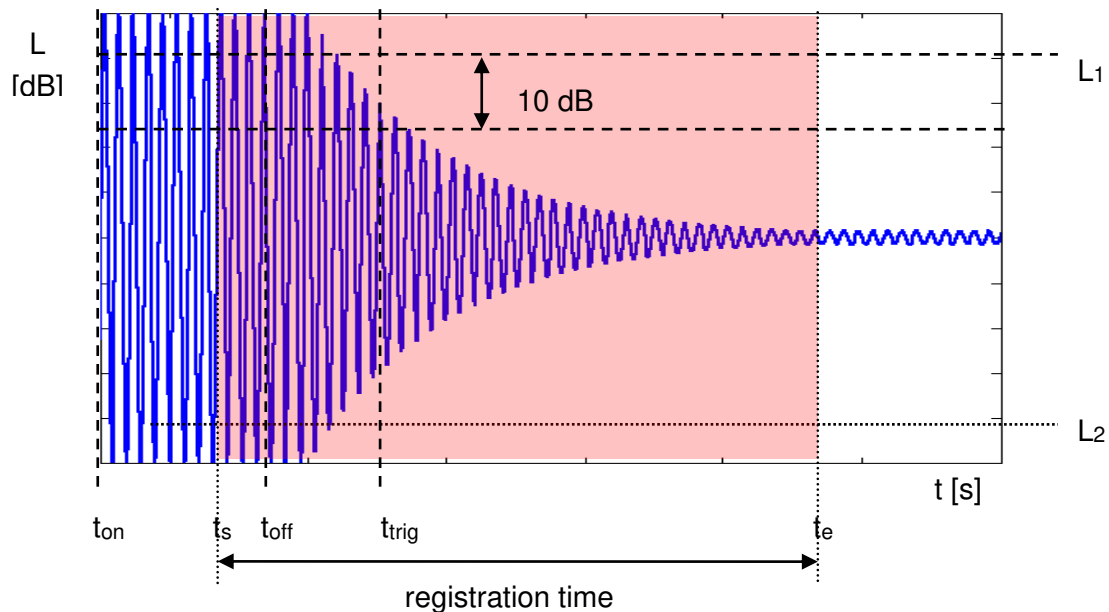
Fig 5. Data recording in the decay method of the reverberation time evaluation

The measurement time in this method consists of:

- The time between markers t_{on} and t_{off} in which the omnidirectional sound source emits acoustic power and the SVAN xxx analyser measures the actual sound pressure level.

- The time between markers t_{off} and t_{trig} in which the omnidirectional sound source is switched off and the SVAN xxx instrument waits for trigger condition fulfilment.

- The time between markers t_s and t_{trig} registered since the trigger condition fulfilment back till point t_s to allow recognising the beginning of the decay region. In the SVAN xxx instruments this time is equal to the **Time Step** (*path: <Menu> / Measurement / RT60 Settings*) parameter value multiplied by 50.

- The time between markers t_{trig} and t_e registered since t_{trig} forward to record whole decay curve together with significantly long period of the noise level. This time in SVAN xxx instruments is adjusted by **Recording Time** (*path: <Menu> / Measurement / RT60 Settings*) parameter.

The above graph shows that the proper setting of the **Recording Time** value is very important. The registration time has to be long enough to acquire sufficient number of background noise level values. In other case the decay curve region could not be properly analysed or decay region could not fulfil the dynamic condition mentioned above. It is recommended to set the **Recording Time** parameter two times longer than expected reverberation time.

➢ **IMPULSE method**

In the Impulse method, Reverberation Time is computed by using the reverse-time integrated impulse response. This way of measuring sound decay was introduced firstly by M. R. Schroeder in two historical articles:

o New Method of Measuring Reverberation Time, *Journal of Acoust. Soc. Am.1965*

o Integrated-Impulse Method Measuring Sound Decay without Using Impulses, *Journal of Acoust. Soc. Am. Vol. 66(2) 1979*
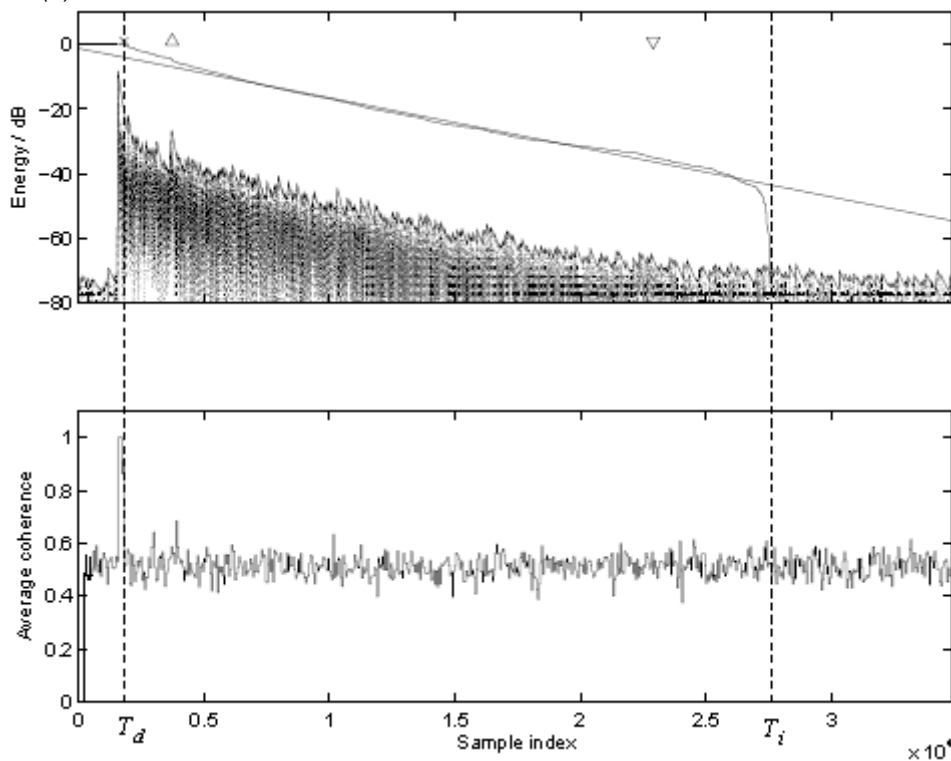

Fig. 6 An example of Schroeder integration with the limits Ti and Td

This RT 60 measurement method requires impulse sound source like pistol, petard or other sound source which emits impulse signal with very high sound pressure level.

The graphical illustration of data registering in this method is presented in Figure 7.
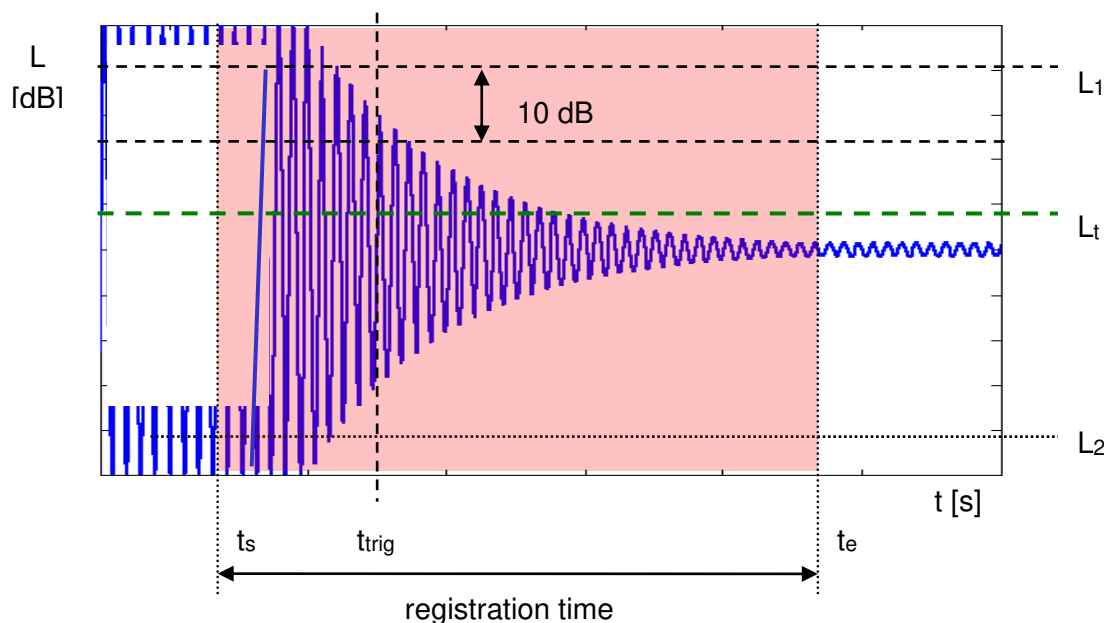
Fig 7. Data recording in the impulse method of the reverberation time evaluation

The measurement time in this method consists of:

- The time before marker t_{trig} in which the SVAN xxx analyser measures the actual sound pressure level and waits for the very high impulse sound pressure level which will fulfil the trigger condition. The trigger conditions will be fulfilled only when emitted impulse has maximal sound pressure level higher than L_t level (cf. Fig. 6). The L_t level in the SVAN xxx analyser is adjusted by parameter **Level** (*path: <Menu> / Measurement / RT60 Settings*).

- The time between markers t_s and t_{trig} registered since the trigger condition fulfilment back till point t_s to allow recognising the beginning of the decay region. In the SVAN xxx instruments this time is equal to the **Time Step** (*path: <Menu> / Measurement / RT60 Settings*) parameter value multiplied by 50.

- The time between markers t_{trig} and t_e registered since t_{trig} forward to record whole decay curve together with significantly long period of the noise level. This time in SVAN xxx instruments is adjusted by **Recording Time** (*path: <Menu> / Measurement / RT60 Settings*) parameter.

The above graph shows that the proper setting of the **Recording Time** value is very important. The registration time has to be long enough to acquire sufficient number of background noise level values. In other case the decay curve region could not be properly analysed or decay region could not fulfil the dynamic condition mentioned above. It is recommended to set the **Recording Time** parameter two times longer than expected reverberation time.

APPENDIX F. OBJECTIVE METHOD FOR ASSESSING THE AUDIBILITY OF TONES IN NOISE – ENGINEERING METHOD (according to ISO/PAS 20065:2016(E))

F.1. INTRODUCTION

This annex provides measurement procedures for verification the presence of audible tones if their presence is in dispute. Based on the prominence of tones, this procedure also provides recommended levels of adjustment. The aim of the objective method is to assess prominence of tones in the same way as listeners do on the average. The method is based on the psychoacoustic concept of critical bands, which are bands defined so that sound outside a critical band does not contribute significantly to the audibility of tones inside that critical band.

The method includes procedures for steady and varying tones, narrow-band noise, low-frequency tones, and the result is a graduated adjustment of 0 dB to 6 dB.

F.2. OBJECTIVE METHOD

F.2.1. General

The method uses the following steps:

1) Narrow-band frequency analysis (FFT analysis)

2) Determination of prominent tones and their audibility, ΔL_i, and the uncertainties σ_i of ΔL_i

3) Grouping the tones inside the common critical bands and recalculating the parameters σ_i and ΔL_i

4) Calculation of the mean audibility, ΔL, and the extended uncertainty, U, of all spectra measured

5) Calculation of the tone adjustment, spectrum penalty, K

F.2.2. Frequency analysis

A narrow-band A-weighted spectrum is measured by linear averaging for 3 s, that is recommended. If the shorter averaged time is used, then the number of spectra shall be merged to receive the 3 s averaged spectrum. Svantek sound measuring instruments do not provide additional spectra merging.

The constant line spacing Δf is equal to 3,125 Hz (the standard requires the line spacing is withing 1,9 – 4 Hz).

The investigation range in Svantek instruments is equal to [50;4575] Hz. The spectrum is measured for the range of [0;5000] Hz.

It is recommended that the measurement results, including the frequency analyser, be presented in dB re 20 µPa, and that Hanning weighting be used as the window function. The distortions of stochastic signals are avoided through weighting Hanning function. The Hanning window is used as well as time window to reduce lateral bands.

NOTE 1. Mean audibility is calculated for the number of spectra that are measured separately.

NOTE 2. The extended uncertainty, U, of the mean audibility, ΔL, with a coverage probability of 90% in a bilateral confidence interval shall not exceed ±1.5 dB. This is generally the case with evaluation of at least 12 time-staggered narrow-band averaged spectra. If there are less than 12 averaged spectra, then the uncertainty shall be taken into consideration.

NOTE 3. With the recommended Hanning time window, the effective analysis bandwidth (or the effective noise bandwidth) is 1.5 times the frequency resolution. The frequency resolution is the distance between the lines in the spectrum.

F.2.3. Determination of prominent tones

Bandwidth and centre frequency of critical bands

The widths Δf_c of the critical band about the tone frequency f_T is given in equation (C.1):

$$\Delta f_c = 25{,}0\,\text{Hz} + 75{,}0 \left[1{,}0 + 1{,}4 \left(\frac{f_T/\text{Hz}}{1\,000} \right)^2 \right]^{0,69} \text{Hz} \qquad (C.1)$$

The corner frequencies can be delivered as given in equations (C.2) and (C.3), since the central frequency of the critical band is a geometric mean of the boundaries:

$$f_1 = \frac{-\Delta f_c}{2} + \frac{\sqrt{\left(\Delta f_c\right)^2 + 4 f_T^2}}{2} \qquad (C.2)$$

$$f_2 = f_1 + \Delta f_c \qquad (C.3)$$

For the definition of the centre frequency of a critical band, only tones with level higher than the adjoining ones should be regarded as significant.

NOTE. A tonal audibility is performed for a tone only if its distinctness is at least 70%, that means it should satisfy the set of requirements that is given by the following standard together with edge steepness and maximal bandwidth.

Mean narrow-band level of the masking noise, L_s

The mean narrow-band level is derived in an iterative procedure from the lines of the critical band about the line under investigation. The investigation range is determined by boundaries of the critical band of a pending tone.

The procedure commences with the energy averaging of all lines of the critical band with the exception of the central frequency line. The next step is repeating the procedure excluding the lines above the mean level calculated in the previous step by 6 dB.

The mean narrow-band level is given by equation (C.4).

$$L_S = \left[10\lg\left(\frac{1}{M} \sum_{i=1}^{M} 10^{0,1 L_i / \text{dB}} \right) + 10\lg\left(\frac{\Delta f}{\Delta f_e} \right) \right] \text{dB} \qquad (C.4)$$

The procedure ends, if the subsequent mean narrow-band sound level of the masking noise is equal to the calculated in the current calculations loop within a tolerance of ±0.005 dB. The procedure also ends, if the number of lines contributing to the subsequent mean narrow-band level to the right or left of the line under investigation falls below a value of 5.

NOTE 1. The second addend of the equation (C.4) could be simplified and used as a constant summand equal to -1.76 dB. It's possible since we apply the Hanning window, that provides the effective bandwidth Δf_e be 1.5 times the frequency resolution Δf.

NOTE 2. If the iteration is discontinued, because the remaining number of spectral lines to be averaged on one or both sides fall below 5, then the audibility may be somewhat greater than the audibility calculated with this mean narrow-band level.

NOTE 3. In principle, a tone may only be present if the level of the spectral line considered is at least 6 dB greater than the corresponding mean narrow-band level L_s.

Tone level of a tone in a critical band, L_T

The mean narrow-band level is derived in an iterative procedure from the lines of the critical band about the line under investigation.

Neighbouring spectral lines should be used for summation purposes if - they differ from the narrow-band level at a frequency, f_T, by less than 10 dB, and - they differ from the mean narrow-band level, L_S, of the masking noise within the critical band about the tone by more than 6 dB.

In case there are no other spectral lines than the line under investigation meets the requirements, the tone level of a tone is equal to the narrow-band level of the spectral line of this critical band with tone energy, in decibels (dB).

In case there are more spectral lines with tone energy, the tone level of a tone is calculated as in the equation (C.5):

$$L_T = \left[10 \lg \left(\sum_{i=1}^{K} 10^{0,1 L_i / dB} \right) + 10 \lg \left(\frac{\Delta f}{\Delta f_e} \right) \right] dB \qquad (C.5)$$

NOTE 1. The second addend of the equation (C.5) could be simplified and used as a constant summand equal to -1.76 dB. It's possible since we apply the Hanning window, that provides the effective bandwidth Δf_e be 1.5 times the frequency resolution Δf.

NOTE 2. The individual levels of the spectral lines with tone energy also contain energy components of the masking noise. These can generally be neglected.

Distinctness of a tone

The distinctness of a tone depends on the bandwidth of the tone and its edge steepness; if the corresponding criteria are not satisfied then the tone is not audible to individuals with normal hearing.

If a tone based on bandpass noise has a distinctness of 70% relative to that of a sinusoidal tone, then the maximum permitted bandwidth Δf_R as a function of the tone frequency f_T is approximated by equation (C.6):

$$\Delta f_R = 26,0 \left(1,0 \, Hz + 0,001 f_T \right) \qquad (C.6)$$

First criterion: The bandwidth of the tone (the number of spectral lines used in the equation (C.5) multiplied by the line spacing, Δf.) shall not exceed the maximum permitted bandwidth given by equation (C.6).

Second criterion: The edge steepness shall be at least 24 dB/octave. This yields the level differences between the maximum narrow-band level of the tone, L_{Tmax}, and the narrow-band levels of the first spectral line below the tone L_u and above the tone L_o must meet the criteria (C.7) and (C.8):

$$\Delta L_u = \frac{f_T}{2} \frac{L_{Tmax} - L_u}{f_T - f_u} \geq 24 \, dB \qquad (C.7)$$

$$\Delta L_o = f_T \frac{L_{Tmax} - L_o}{f_o - f_T} \geq 24 \, dB \qquad (C.8)$$

where

f_u is the frequency of the first spectral line below the tone, in Hertz (Hz);

f_o is the frequency of the first spectral line above the tone, in Hertz (Hz);

f_T is the frequency of the maximum narrow-band level, in Hertz (Hz).

Critical band level of the masking noise, L_G, masking index, a_v

The critical band level, L_G, of the masking noise is given by equation (C.9):

$$L_G = L_S + \left[10 \lg \left(\frac{\Delta f_c}{\Delta f}\right)\right] dB \qquad (C.9)$$

where

L_S is the mean narrow-band level;

Δf_c is the width of the critical band about the tone frequency, f_T, in Hertz (Hz);

Δf is the line spacing (frequency resolution), in Hertz (Hz).

The masking index, a_v, is given by equation (C.10):

$$a_v = \left\{-2 - \lg \left[1 + \left(\frac{f/\text{Hz}}{502}\right)^{2,5}\right]\right\} dB \qquad (C.10)$$

where

f is the central frequency of the critical band.

NOTE1. Masking is the raising of the audibility threshold for a sound as a result of the influence of another sound.

The masking threshold, L'_T, is that sound pressure level of a sinusoidal test tone that is required for it to be just perceivable in the presence of a masking noise (critical band level, L_G). The masking threshold is determined in repeated tests in which a group of subjects with normal hearing can just perceive the tone in 50% of the cases.

The masking index, $a_v = L'_T - L_G$, is the difference between the level of the test tone, L'_T, and the critical band level, L_G. At low frequencies, the masking index has a value of approximately −2 dB. Above a transition range between 0.2 kHz and 1 kHz, it falls at a constant logarithmic rate to −6 dB at 20 kHz.

Determination of the decisive audibility of a narrow-band spectrum, ΔL_i

Every tone, that is distinguishable in terms of this standard, has the assigned audibility value, that is calculated as shown in the equation (C.11):

$$\Delta L_j = L_{T,j} - L_{S,j} - 10 \lg \left(\frac{\Delta f_{c\,j}}{\Delta f}\right) dB - a_{v,j} \qquad (C.11)$$

where

j – index of the next tone under investigation.

Since the all components of the above formula are found according to the previous sections, the decisive audibility of the individual narrow-band spectra can be calculated.

Uncertainty of the audibility ΔL_i, σ_i

Using the Gaussian uncertainty propagation principle, the uncertainty of the audibility could be found as:

$$\sigma_{\Delta L_j} = \sqrt{\left[\frac{\sum_{i=1}^{K}\left(10^{0,1L_{T_{j,i}}/dB}\right)^2}{\left(\sum_{i=1}^{K}10^{0,1L_{T_{j,i}}/dB}\right)^2} + \frac{\sum_{i=1}^{M}\left(10^{0,1L_{S_{j,i}}/dB}\right)^2}{\left(\sum_{i=1}^{M}10^{0,1L_{S_{j,i}}/dB}\right)^2}\right]\sigma_{L_j}^2 + \left(4{,}34\frac{\Delta f}{\Delta f_{c_j}}dB\right)^2} \tag{C.12}$$

where index i corresponds to the spectral lines around a tone, and index j corresponds to the next tone under investigation.

F.2.4. Grouping the tones

If a number of tones are present in a critical band, then their tone levels, $L_{Tm,n}$ (run index n across all tones in the critical band; H is the number) are summed in terms of energy (equation (C.13)).

$$L_{Tm} = \left[10\lg\left(\sum_{n=1}^{H}10^{0,1L_{Tm,n}/dB}\right)\right]dB \tag{C.13}$$

where

H is the total number of all tones in the critical band,

$L_{Tm,n}$ is the tone level with the run index *m* across all audible tones and the run index *n* across all tones in the critical band, in decibels (dB).

This tone level, L_{Tm} is used to recalculate the decisive audibility of the critical band.

NOTE 1. It is possible for the energy of individual spectral lines to be assigned to a number of neighbouring tones at the same time. Upon addition of the tone levels of neighbouring tones, the energy of these individual spectral lines may not be summed more than once.

NOTE 2. If the exactly 2 tones appear in one critical band, then they evaluated separately if both lie below 1000 Hz and their frequency difference exceeds certain value, determined in the standard, then the human ear can distinguish them separately.

F.2.5. Calculation of the mean audibility, ΔL, and the extended uncertainty, U, of a number of spectra

When the several averaged spectra are measured, their maximum tone's audibility shall be averaged and the extended uncertainty is calculated.

In each measured spectrum the maximum tone audibility and its uncertainty are chosen for the post-processing step. This audibility is called the decisive audibility of a particular spectrum.

Mean audibility is calculated as shown in the equation (C.14).

$$\Delta L = 10\lg\left(\frac{1}{J}\sum_{j=1}^{J}10^{0,1\Delta L_j/dB}\right)dB \tag{C.14}$$

where ΔL_j is a decisive audibility of each spectrum and corresponds to the most audible tone.

The extended uncertainty is the uncertainty of the coverage probability region. In this standard the 90% coverage was assumed, hence the coverage factor of 1,645 have to be used. To receive the value of it, the mean averaged estimated value of all sigma shall be recalculated and multiplied by the coverage factor.

NOTE 1. The experience shows that with fluctuating noise, one achieves an extended uncertainty, U, of the audibility, ΔL, of about ±1.5 dB with 12 averages.

NOTE 2 To ensure the above-mentioned uncertainty, ±1.5 dB, it is necessary to have a minimum number of spectra with an averaging time of approximately 3 s. The number of spectra necessary to achieve the above-mentioned uncertainty will depend on the variability of the noises. Investigations have shown that even with strongly fluctuating noises (e.g. wind turbines), the number of spectra necessary does not generally exceed 12.

F.2.5. The tone adjustment

The value of the audibility can be used to determine whether or not a tone is prominent and if a tonal penalty or adjustment is to be allocated to a certain source.

The tone adjustment is the audibility-depending function, that returns 7 different values. The table below shows the corresponding K values:

Mean audibility ΔL in dB	Tonal adjustment K_T in dB
$\Delta L \leq 0$	0
$0 < \Delta L \leq 2$	1
$2 < \Delta L \leq 4$	2
$4 < \Delta L \leq 6$	3
$6 < \Delta L \leq 9$	4
$9 < \Delta L \leq 12$	5
$12 < \Delta L$	6

The adjustment, Kt, is the value to be added to the value of L_{Aeq} for a time interval to give the tone-corrected rating level for that interval.

NOTE. Neither ISO/PAS 20065 nor ISO 1996-1 specifies at present how to determine the magnitude of the tonal adjustment, K_T. In the meantime, it is possible to determine K_T from the mean audibility, ΔL, using abowe table. ΔL is defined in ISO/PAS 20065.

F.3 DOCUMENTATION

As documentation for the analysis, the following information shall be given:

a) For the analysis:
- number of averaged spectra, measurement time period and effective analysis bandwidth, line spacing,
- time window (e.g. Hanning), time weighting (Lin), and frequency weighting (A),
- one typical spectrum (at least) with an indication of the position of the critical band and the average noise level in that band.

b) For the calculations in the decisive critical band:
- statement regarding whether the results were obtained by visual inspection (survey method) or by automatic calculation (engineering method),
- frequency limits of the critical band and the range for the visual averaging or linear regression (see C.4.3),
- frequencies and levels of the tones and the total tone level (Ls and Lt re 20 µPa in decibels),
- masking noise level in the critical band (L_G re 20 µPa in decibels),
- audibility of the tones (ΔL_i re 20 µPa in decibels),
- size of the adjustment (K in decibels).

c) For the averaged noise spectrum
- the mean audibility, (ΔL re 20 µPa in decibels),
- the extended uncertainty (U in decibels).

d) A diagrammatic representation of the narrow-band levels across the frequency of the 3-second averaged spectrum with the greatest ΔL.

e) Tones in other critical bands that may cause an adjustment should be mentioned by their frequencies.
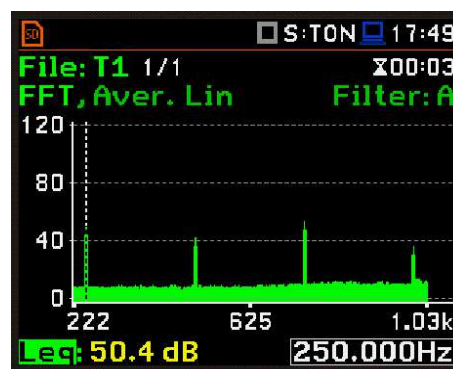
F.4 EXAMPLES

The examples in this subclause have been analysed with an manual procedure based on 5 spectra and a measurement time of 3 seconds.
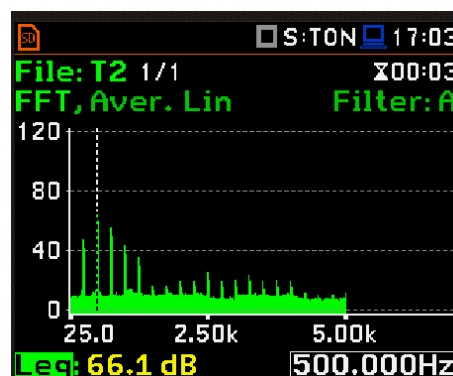
EXAMPLE 1:

Tones found: 7.

- Critical band: 203Hz – 306Hz;
- Tone level, L_T: 50,4 dB;
- Noise level, L_G: 21.3 dB;
- Audibility, L: 31.2 dB
- Tonal adjustment, Kt: 6.0 dB;
- Mean L: 56.8 dB;
- U90%, extended uncertainty: 2.5dB

EXAMPLE 2:

Tones found: 6.

- Critical band: 443Hz – 559Hz;
- Tone level, L_T: 66.1 dB;
- Noise level, L_G: 25.3 dB;
- Audibility, L: 43.1 dB
- Tonal adjustment, Kt: 6.0 dB;
- Mean L: 56.8 dB;
- U90%, extended uncertainty: 2.5dB

EXAMPLE 3:

Tones found: 17.

- Critical band: 921Hz – 1.08kHz;
- Tone level, L_T: 85.5 dB;
- Noise level, L_G: 27.8 dB;
- Audibility, L: 60.5 dB
- Tonal adjustment, Kt: 6.0 dB;
- Mean L: 56.8 dB;

U90%, extended uncertainty: 2.5dB
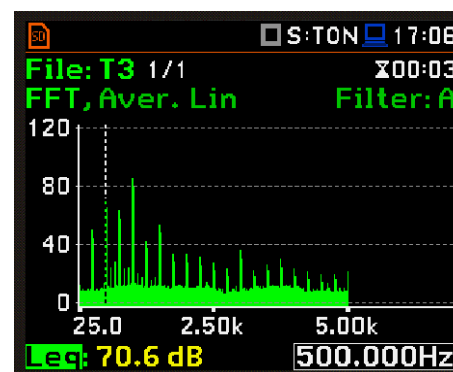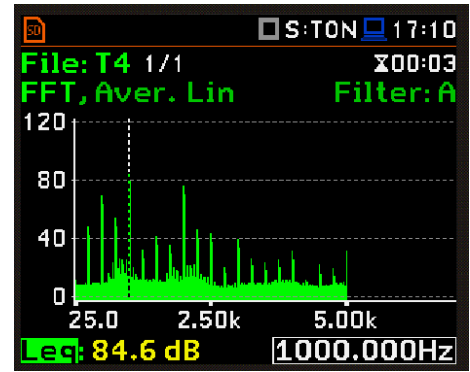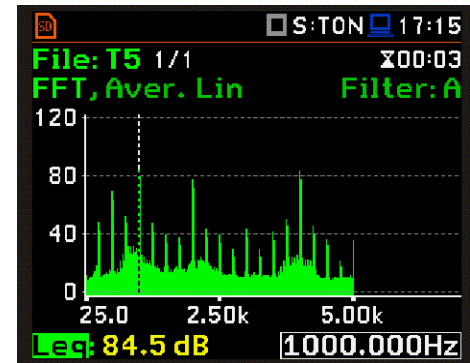
EXAMPLE 4:

Tones found: 14.

- Critical band: 921Hz – 1.08kHz;
- Tone level, L_T: 84.6 dB;
- Noise level, L_G: 28.4 dB;
- Audibility, L: 59.1 dB
- Tonal adjustment, Kt: 6.0 dB;
- Mean L: 56.8 dB;

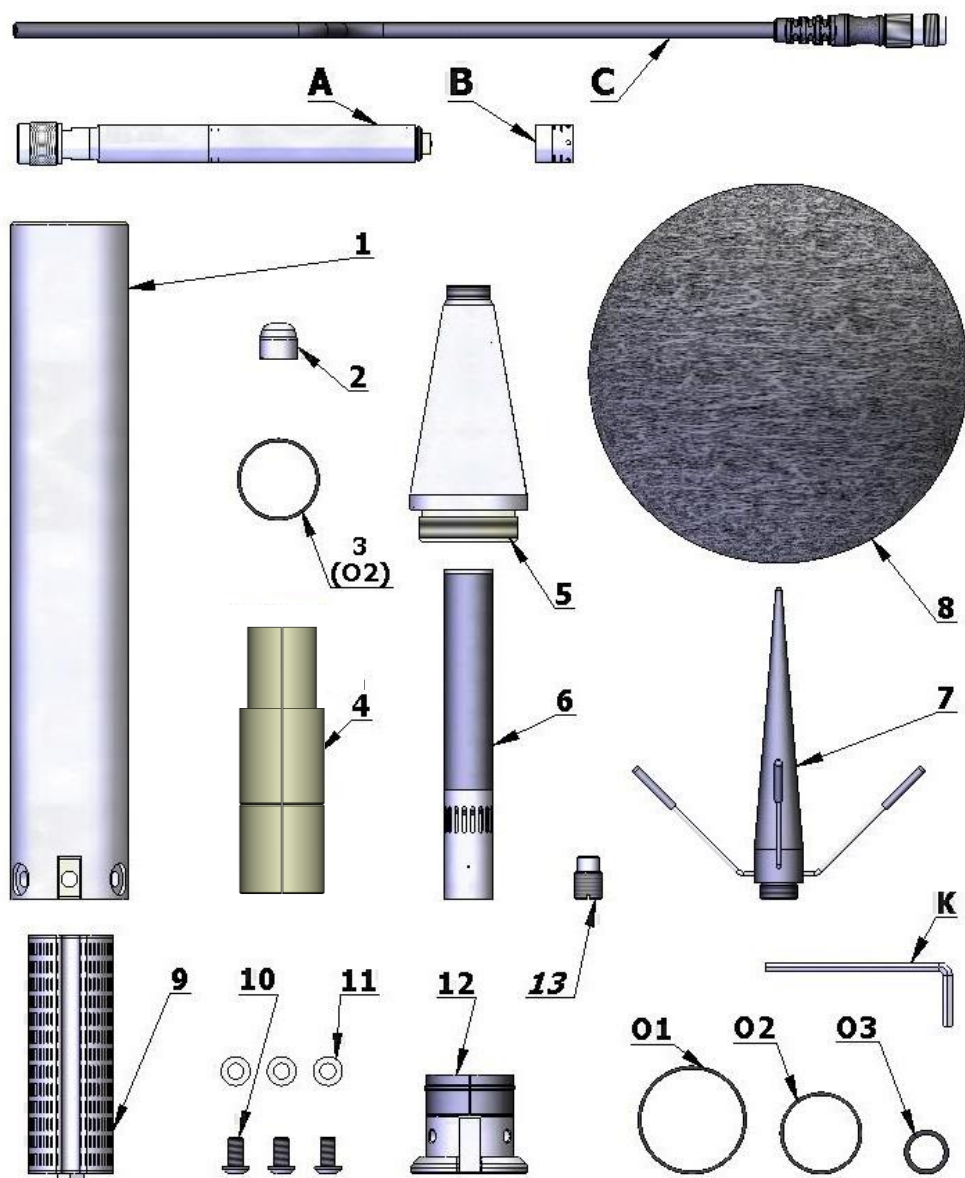U90%, extended uncertainty: 2.5dB

EXAMPLE 5:

Tones found: 20.

- Critical band: 921Hz – 1.08kHz;
- Tone level, L_T: 84.5 dB;
- Noise level, L_G: 30.7 dB;
- Audibility, L: 56.6 dB
- Tonal adjustment, Kt: 6.0 dB;
- Mean L: 56.8 dB;

U90%, extended uncertainty: 2.5dB

APPENDIX G. SA 277D OUTDOOR MICROPHONE KIT ASSEMBLY GUIDE

G.1. PART SET

SA 277D kit:
 1 - tube
 2 - dummy microphone
 3 - O-ring type gasket
 4 - clamp (2 halves)
 5 - upper cone
 6 - microphone protecting tube
 7 - anti-bird spikes
 8 - windscreen (SA 209)
 9 - desiccator (not included)
 10 - M5x10 hex socket raised screw
 11 - washer
 12 - bottom
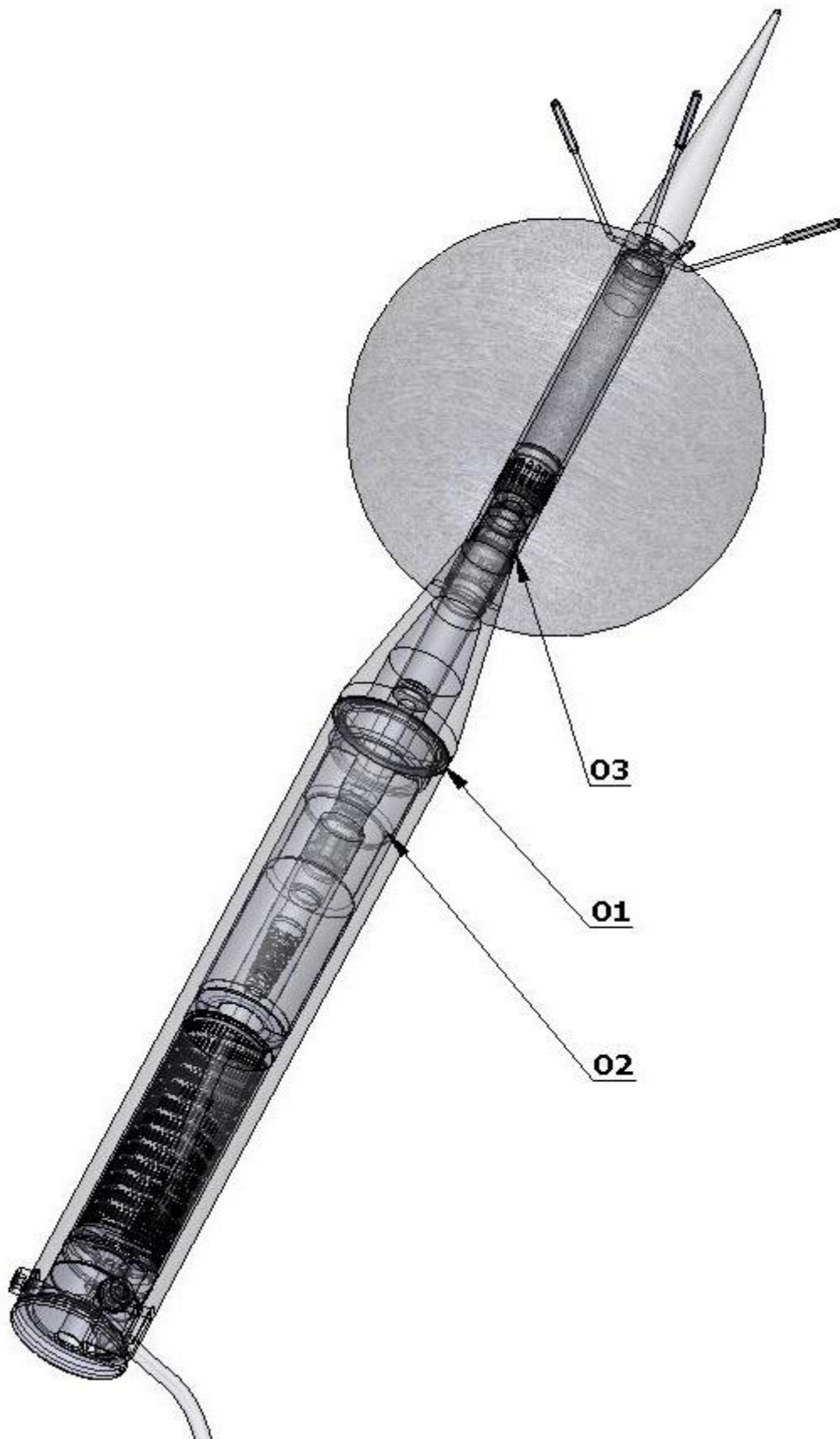 **13** - ¼" thread adapter (not included)

Tools:
K - 3mm Allen key

Spare parts:
O1 - O-ring type gasket Ø35x1
O2 - O-ring type gasket Ø26x1
O3 - O-ring type gasket Ø12x1.5

Parts not included:
A – SV 12L preamplifier
B – MK 255 microphone
C – SC 236 / SC 26 cable

O3

O1

O2

O-ring gasket locations inside

G.2. ASSEMBLY OF SA 277D

1. Secure preamplifier (**A**) with the dummy microphone (**2**) and connect the cable (**C**).
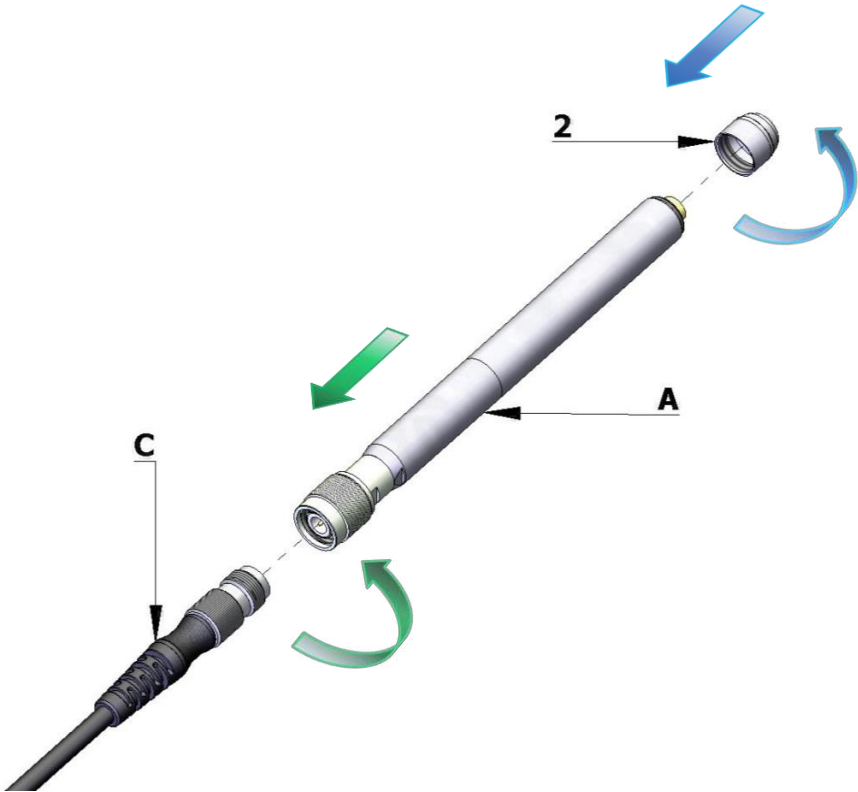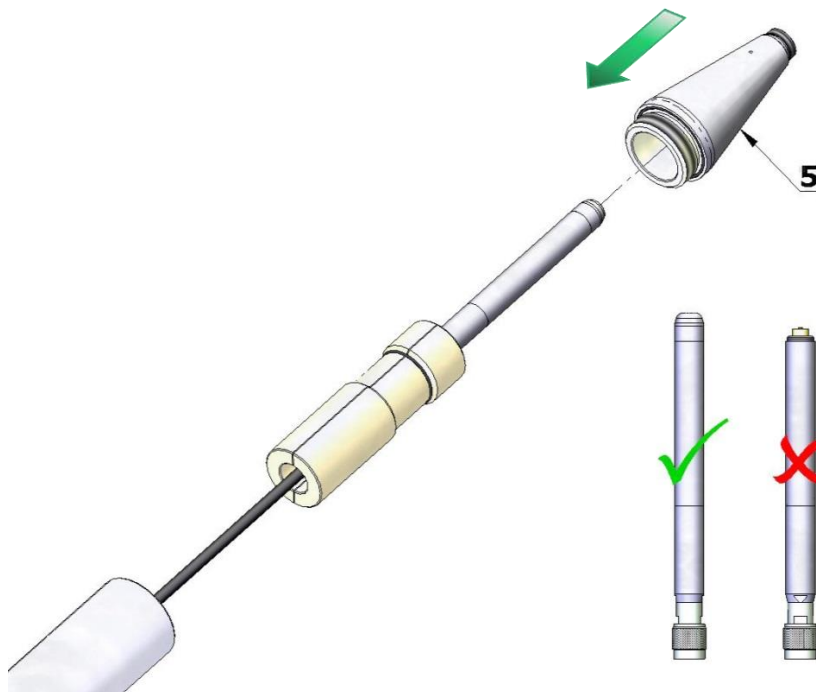

2. Pull tube (**1**) over the cable.

3. Connect the clamp halves (**4**) to the connector and insert O-ring gasket (**3**) on the lightning signed place.
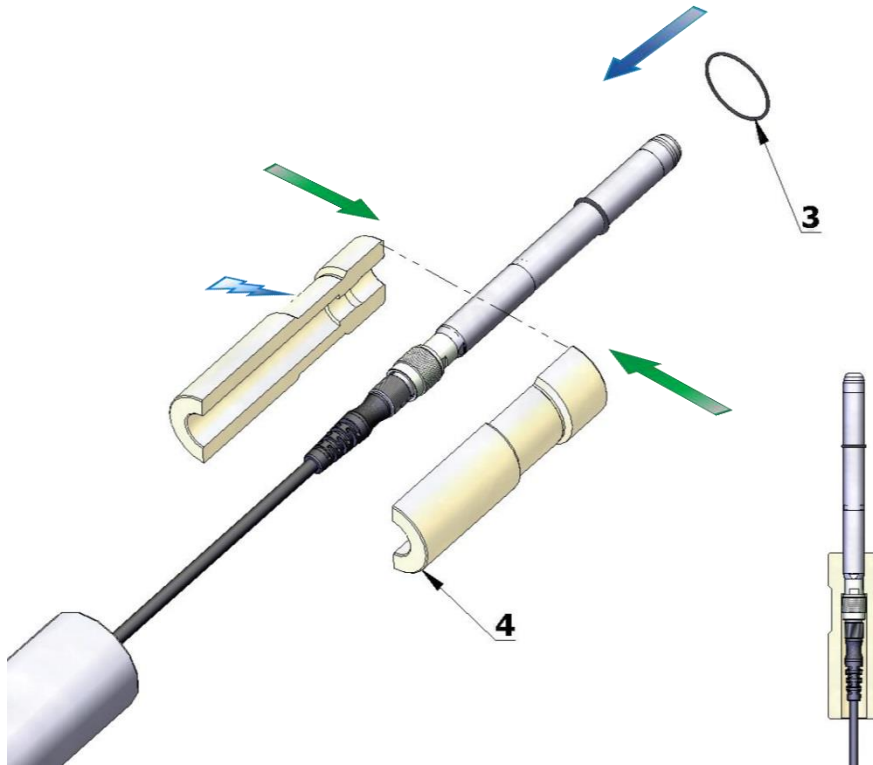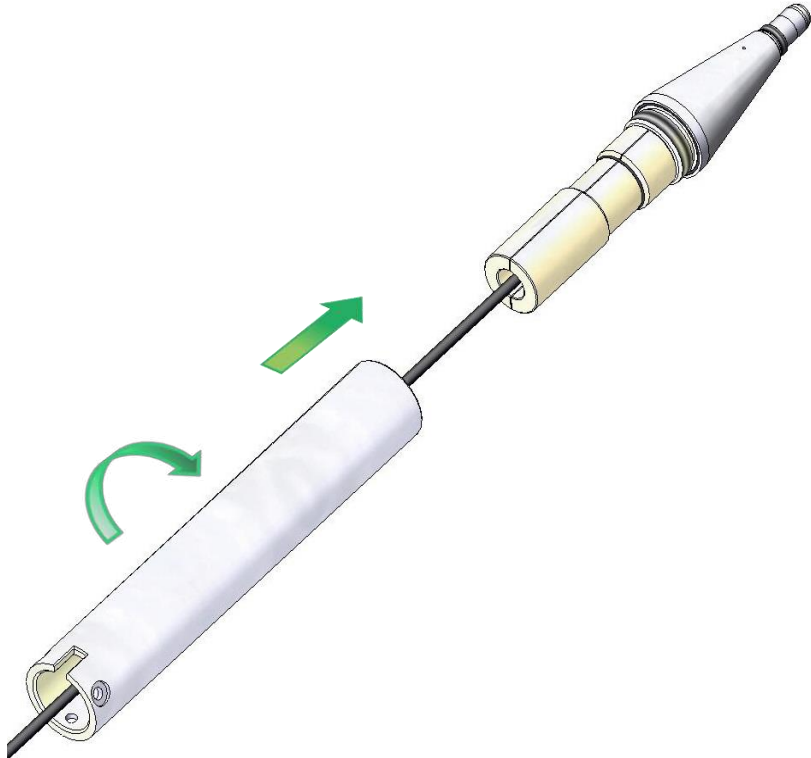

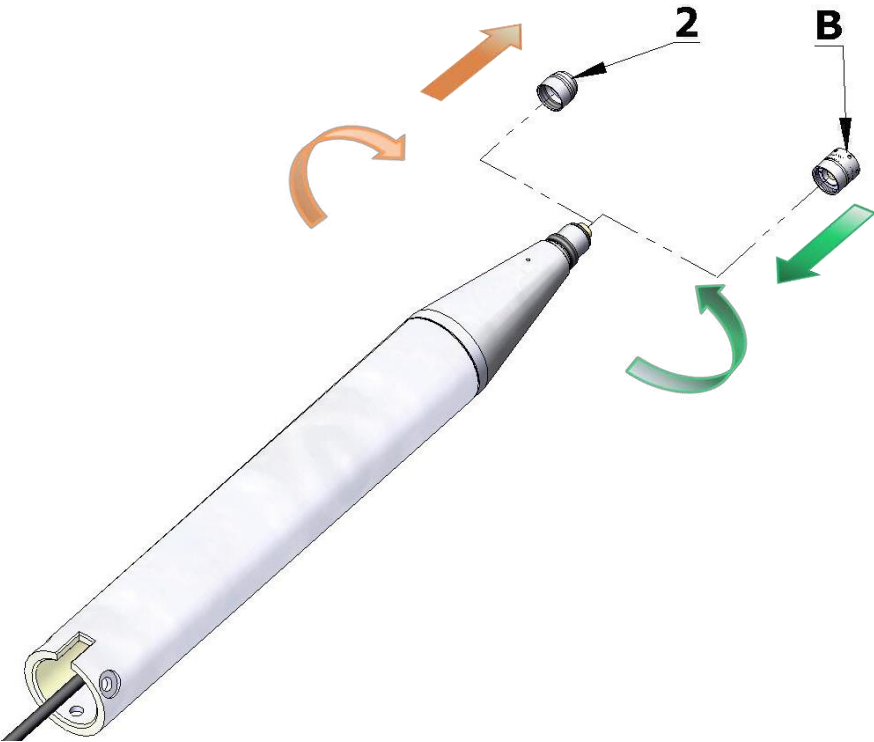4. Apply the upper, conical part (**5**) on the preamplifier.

Note: *Do not use preamplifier without the dummy microphone. It can cause damage of the O-ring gasket inside the cone.*

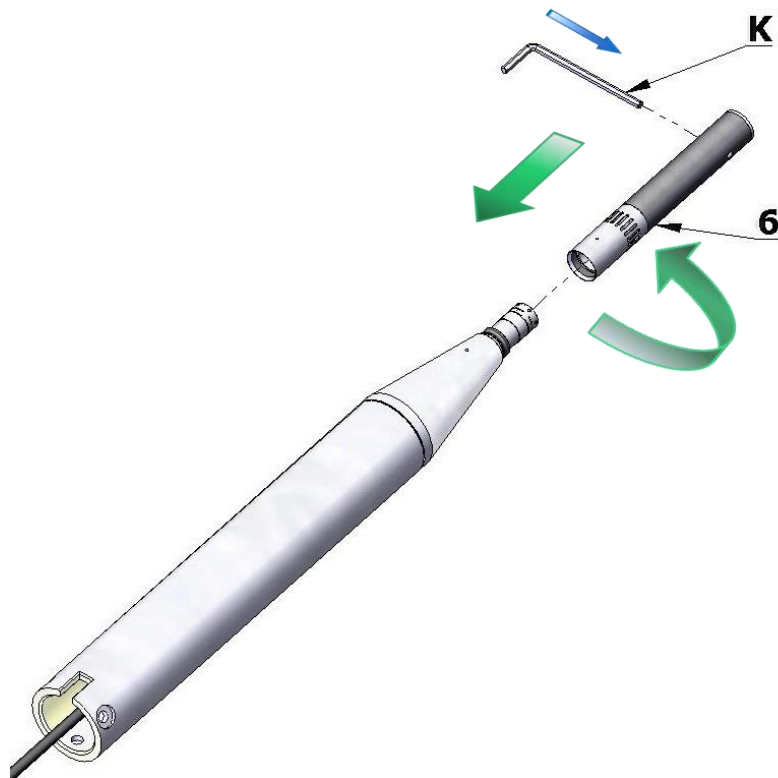5. Screw the tube on the cone by rotating the tube – so as to not twist the cable.

6. Replace the dummy microphone (**2**) with the ½" microphone cartridge (**B**).
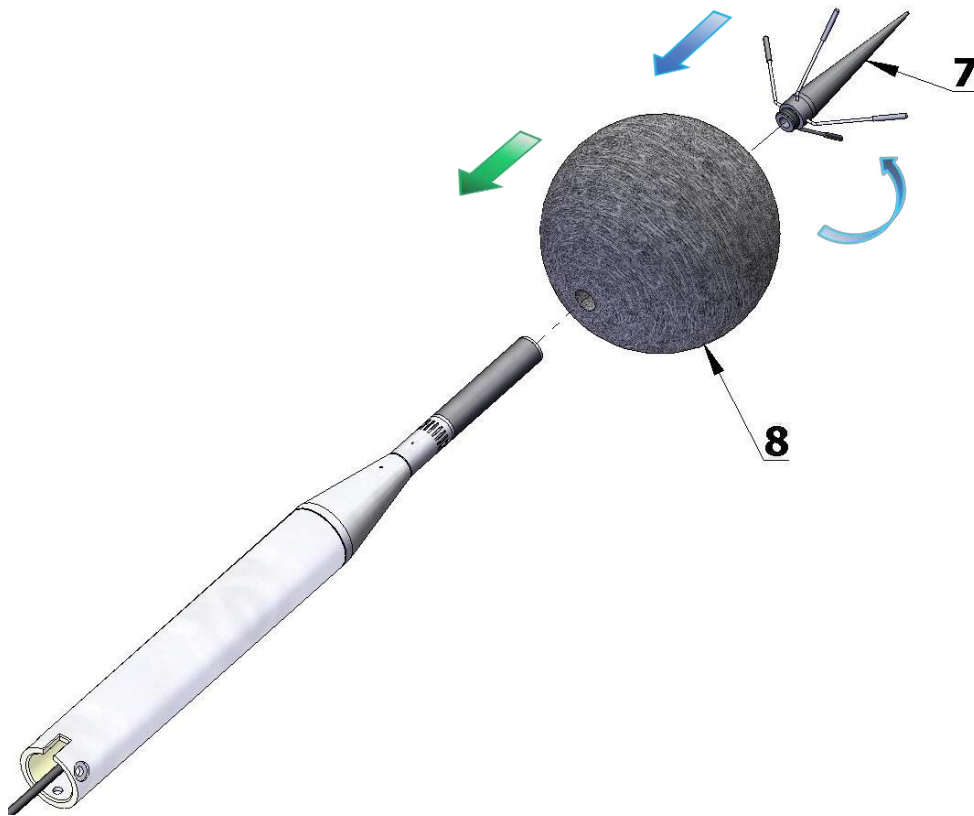
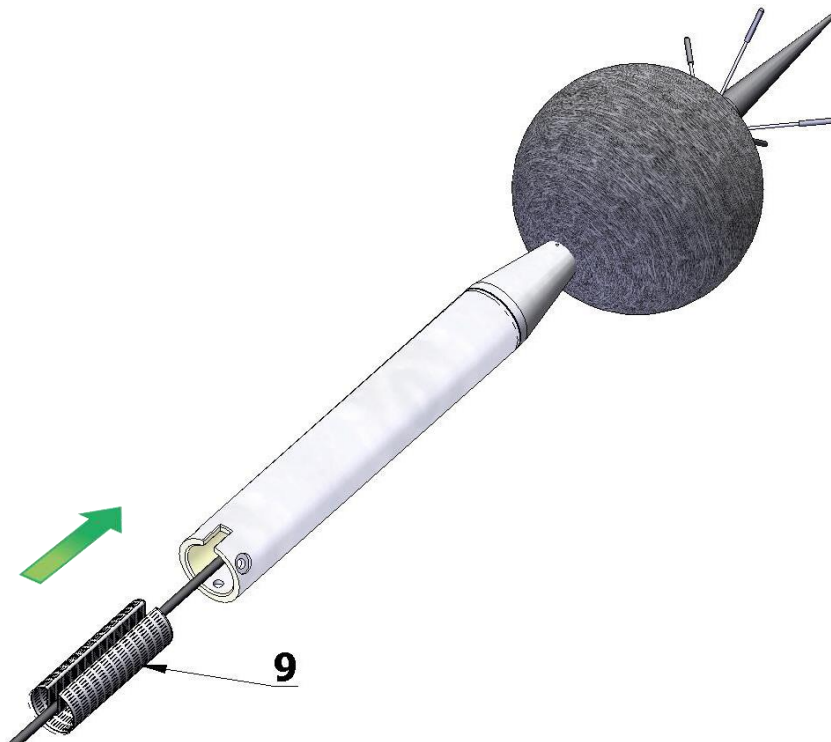7. Calibrate the complete system using SVANTEK acoustic calibrator.

8. Install the microphone protection tube (**6**). Use the Allen key (**K**) as a pin at protecting tube orifice.
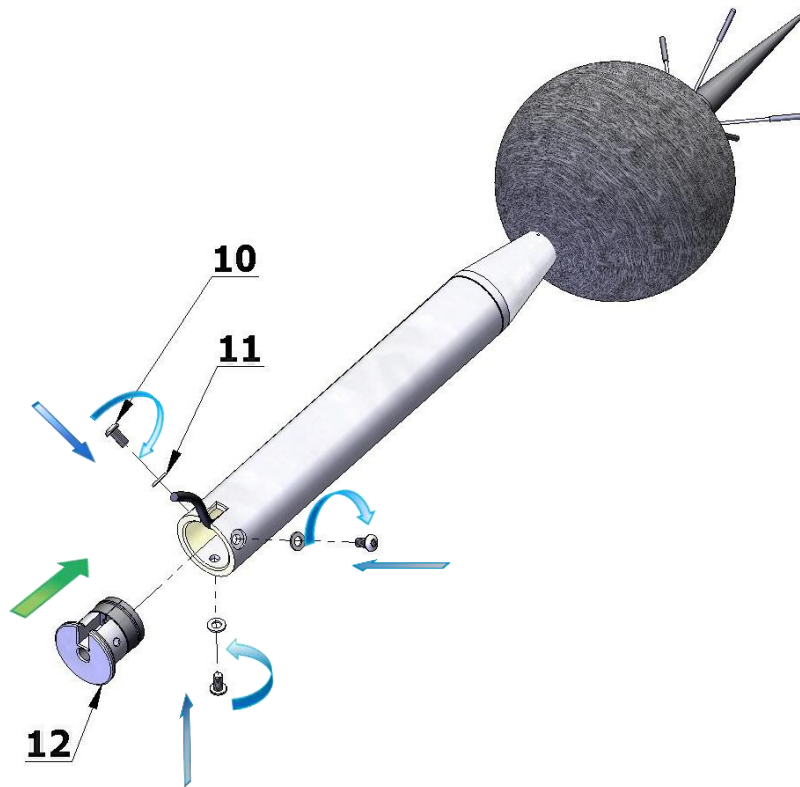
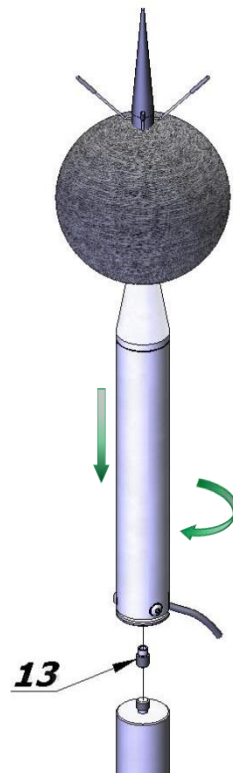9. Mount windscreen (**8**) and the anti-bird spikes (**7**).

10. Slide the desiccator (**9**) inside the tube.

11. Place the cable in the slot and connect the bottom part (**12**) by three screws (**10**) with washers (**11**). Use the Allen key (**K**).

12. Mount the completed system on the dedicated tripod or pole. Use ¼" thread adapter (**13**) (if necessary) (see last note on next page).

G.3. IMPORTANT NOTES

⚠️ **Note:** *The SA 209 (**8**) at the part set picture) foam windscreen protects microphone from wind and rain. If the SA 209 windscreen is used continuously for a long period of time it is recommended to replace it at least once a year.*

⚠️ **Note:** *During continuous usage the SA 209 windscreen is exposed to different weather conditions with possibility of causing physical damage to the foam's structure. Therefore, it is recommended, at least once a quarter (3 months), to check the condition of the windscreen by examining the surface for cracks by squeezing the foam. If cracks or holes are observed, the SA 209 windscreen must be replaced. Take care when examining the foam, as squeezing it too aggressively can damage the surface.*

Color of the silica gel used in the desiccator (part 9) when it is dry is amber. If color of the silica gel turns light grey it means that the gel is soaked (wetted) and the desiccator is not able to absorb more moisture. Color of the silica gel is visible through the window of the desiccator. If color of the gel becomes light grey, the desiccator should be regenerated by drying it for 3 hours in temperature of 150°C.
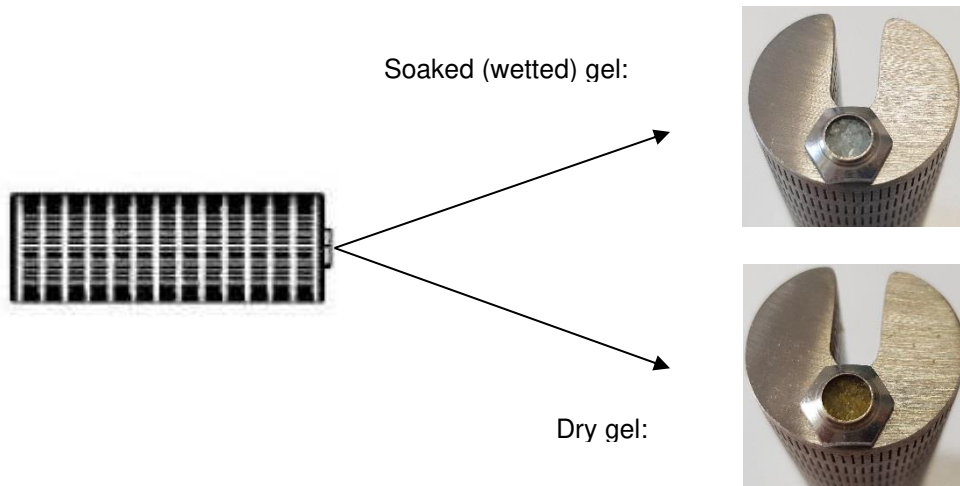
Soaked (wetted) gel:

Dry gel:

⚠️ **Note**: *Desiccator should be inspected at least every 2 weeks, and more often when used in conditions of high air humidity.*

⚠️ **Note:** *Desiccator must be stored in a hermetic container when is not installed in SA 277D to prevent absorbing moisture unnecessarily.*

⚠️ **Note:** *Tripod or pole with ¼" thread is not recommended for stormy weather.*