USER MANUAL

VA5 Pro
Virtual Unit
A4404 – SAB

Updated: July 15, 2025

Content:

Introduction: basic instructions

The **VA5 Pro** instrument, the **A4404 – SAB (Signal Analyzer Box)** device and the **Virtual Unit** application will be described in this user manual. This chapter should clear up the difference between them.

VA5 Pro

VA5 is a portable vibration analyzer which is based on unique *Digital Signal Processing (DSP)* board developed by *Adash*.

A4404 – SAB (Signal Analyzer Box)

A4404 – SAB is a pocket size vibration analyzer which contains input connectors for sensors. It uses the same *DSP* board as *VA5* but it doesn't contain keyboard and screen. It must be connected to a computer via USB. You need to install **Virtual Unit** application which is the same software as *VA5*. Almost all functions described in this manual work both in the instrument and in the *Virtual Unit*. You will be notified when some difference occurs. *Virtual Unit* and *A4404 – SAB* peculiarities will be described in a standalone chapter at the end of the manual.

General warnings

Before you turn on your device, you need to pay attention to the following information.

**Ignoring any recommendations mentioned below may cause failure of the device.
Operating with a power higher than 24 V can cause an accident.**

Only suitable ICP® powered sensors can be connected to the AC signal inputs.

If a measurement without ICP® power is required, ICP® power must be switched off. You can damage the external signal source, which is not protected against ICP® powering.

AC channels - voltage higher than ± 18 V (peak) can damage the instrument.

DC channels - voltage higher than ± 30 V (peak) can damage the instrument.

Always use only original cables designed for connection with sensor.

**Use only the original charger with the original connector.
Never use any reduction to connect the charger with the instrument.**

Only charge the instrument indoors, in dry environment without vibrations.

Long push and hold of the *Power* button evoke incorrect instrument switching off. Data could be lost.

If you are unsure, contact your distributor or the manufacturer.

Battery Charging

Charge the battery only at 0 - 40°C (30 - 100 °F)!

Do not use the charger during measurement (higher noise).

The socket for external charger is at the top panel. The battery LED diode lights orange during charging and lights green when fully charged.
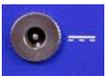
The *VA5* instrument uses Li-ION (LiON) battery. This type of battery should not be discharged completely. If the battery is discharged below a certain Voltage, we call it deep discharging. The deep discharging shortens battery life. Charging of a deeply discharged battery takes much longer.

If the instrument is not charged for a longer period of time, then the deep discharge can occur. It is caused by self-discharging of the battery. It is also a common mistake to switch the instrument to sleep by pushing the *Power* button instead of switching it off totally. When the battery is deeply discharged, it takes much longer to charge it again. Sometimes the indicator on the charger does not light when the battery is deeply discharged – it does not mean it is not charging. Please keep the battery charging even if the indicator does not light, the indicator will start to light later.

To avoid deep discharge of the instrument, charge it regularly, even when you don't use it. We recommend you to check if it is charged every 3 months.

WHAT TO DO WHEN YOU CANNOT SWITCH ON THE INSTRUMENT/ WHEN THE INSTRUMENT CANNOT BE CHARGED NORMALLY:

- *Discharged battery*
  battery needs to be charged (charging for approximately 5 hours), the instrument can be switched on normally with the charger connected
- *Deeply discharged battery, when the instrument wasn't charged for a longer period of time*

the instrument needs to be charged completely until the indicator on the charger starts to light green. It can take more than 12 hours. The indicator does not light from the beginning of charging process. It is sometimes not possible to switch on the instrument even with the charger connected.

- ***Damaged charger***
  when the charger is connected, the indicator should start to light (green or orange color). The indicator does not light immediately only in deep discharge.
- ***Sudden decrease of battery life***
  the instrument needs to be charged and discharged completely a few times (usually 2-5 times). The battery lifetime should increase this way.

Getting started (the first VA5 measurement)

The first of all, turn on your device VA5 Pro. Do it with power button on the front panel.

Step 1: Sensor connection

Commonly used sensor is acceleration sensor 100mV/g with ICP® (constant current power source). Connectors for the sensors are located on the top panel of the device. Connect the sensor to input channel IN1.

Step 2: Sensor settings

Set the sensor properties. Click on the Sensors button in main panel. Click on the screen or the button below 'Sensors' (this button is not visible on this screenshot).
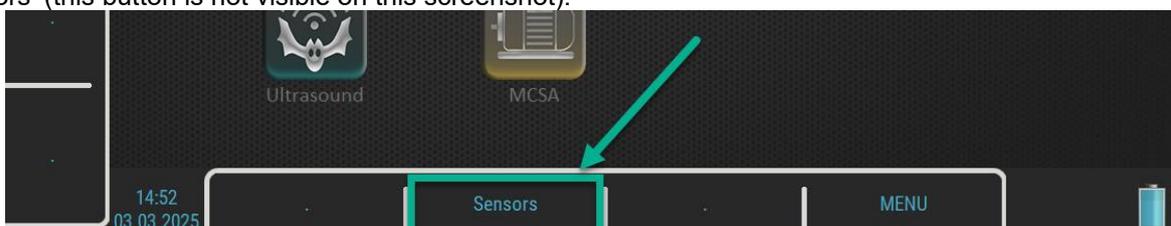
We set sensors properties for channel AC1 (input IN1, where sensor is connected).
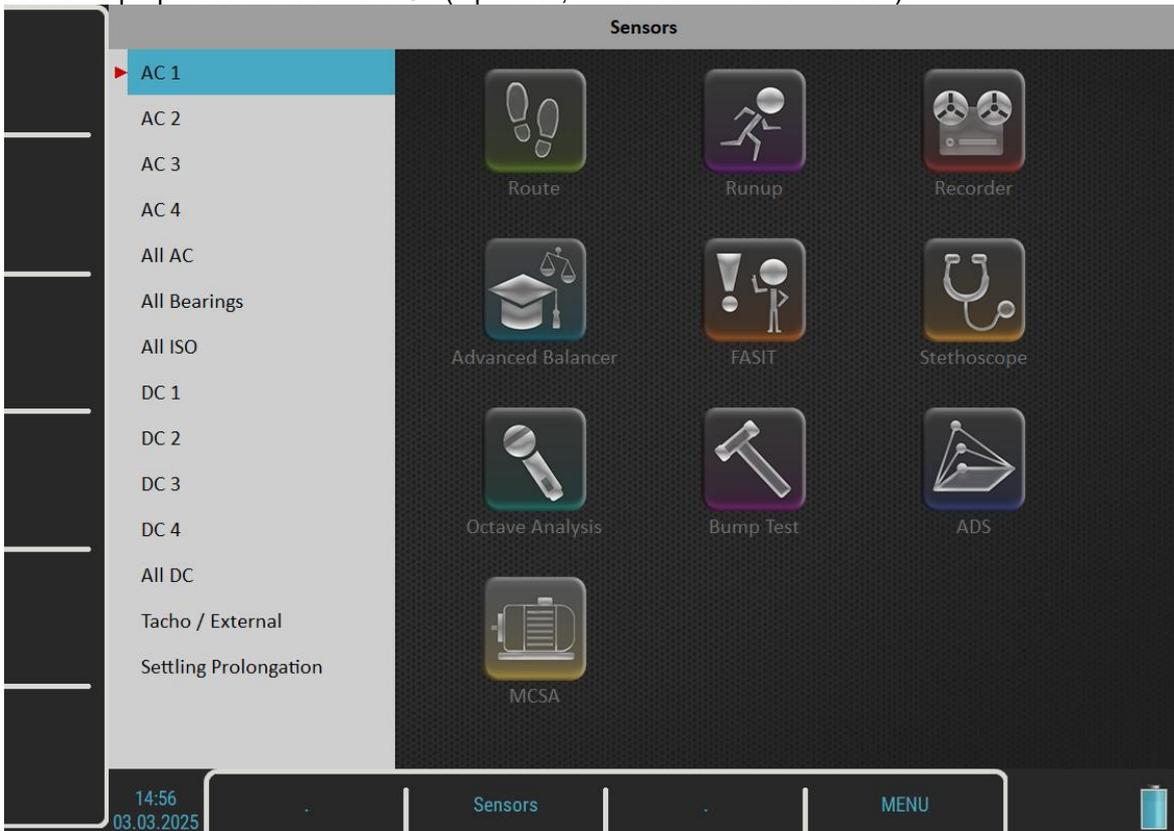
Complete parameters window looks like this.:
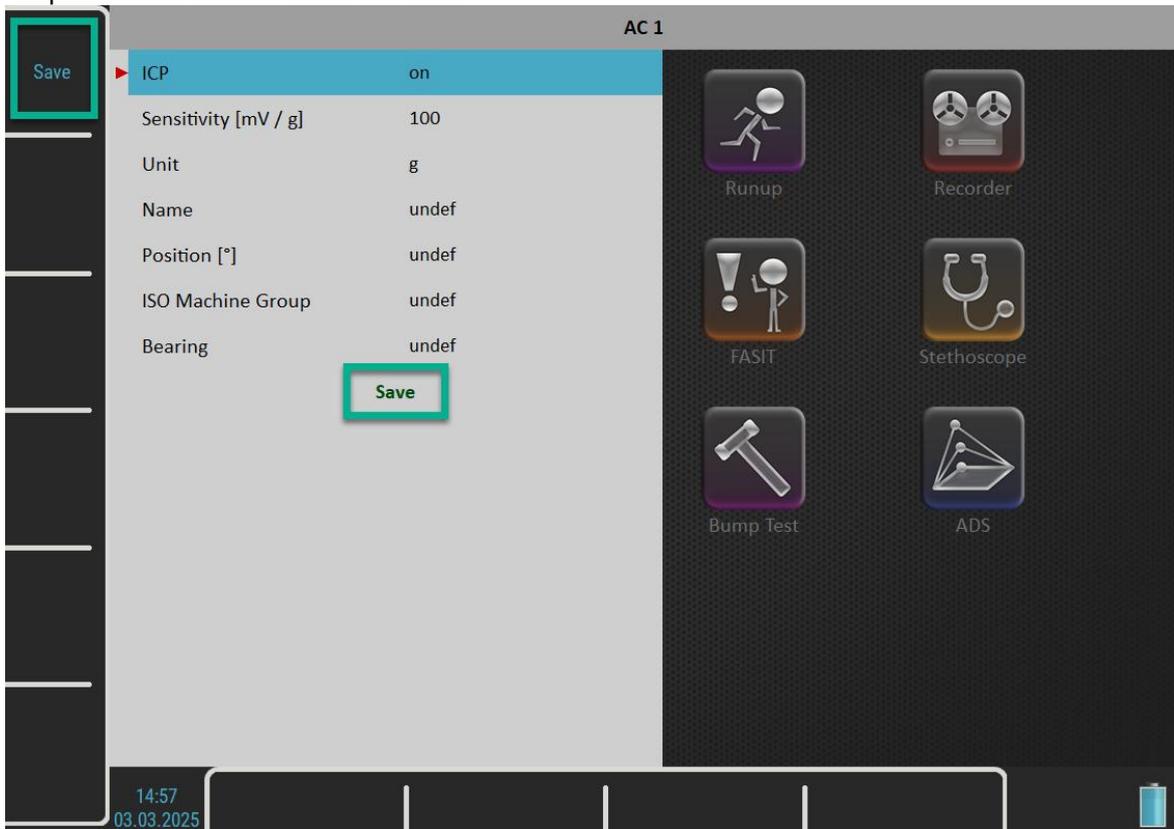
Step 3: Select module and open it

We use Analyzer module for the first measurement. Select Analyzer icon in the main menu. You can click directly on the screen (double click) or move with the arrow buttons (up/down, right/left) and confirm with the 'Enter' button.

Step 4: Create new project

New project

Click on Project. Do it with double click on Project button on the screen or use the button below it.
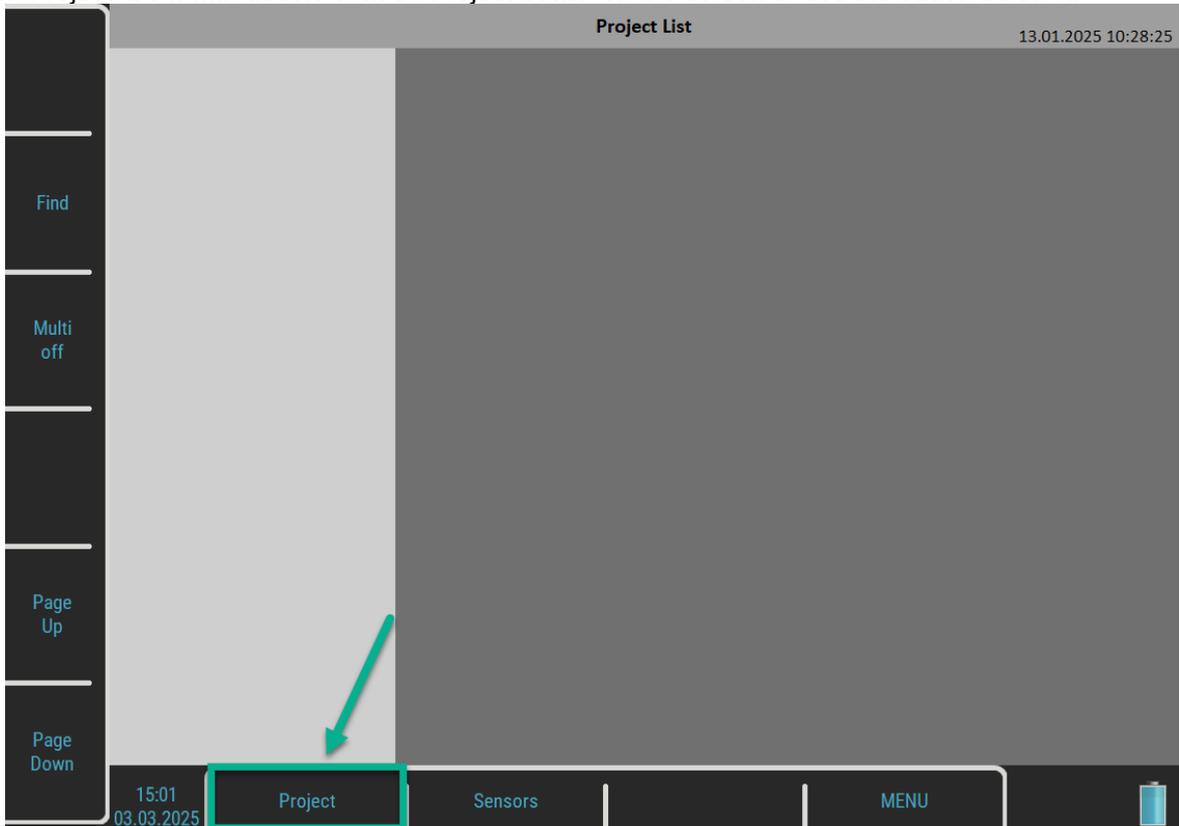
Select **New Set**. The blue color with red arrow on the left side shows you the selected option. Confirm with double click or the Enter button.
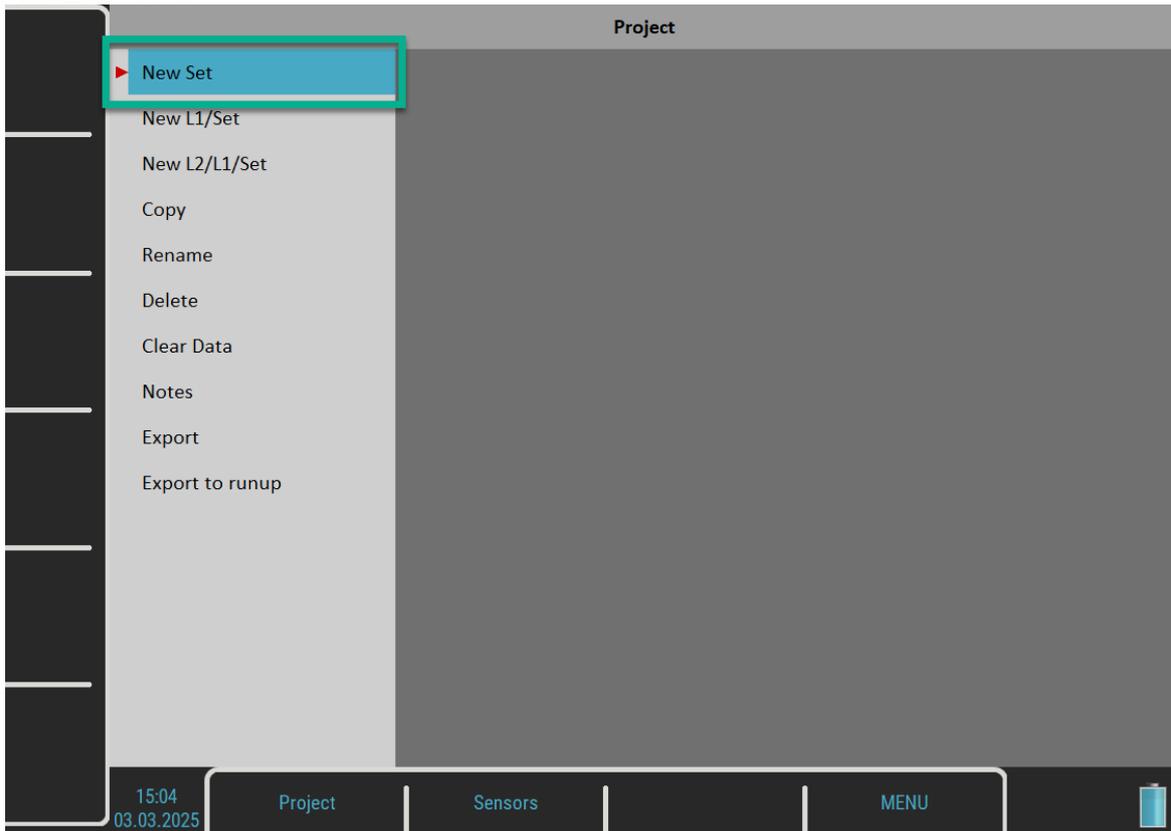
You get window to enter name of your set. There is always default name for the project. In this example the default name is Analyzer01.
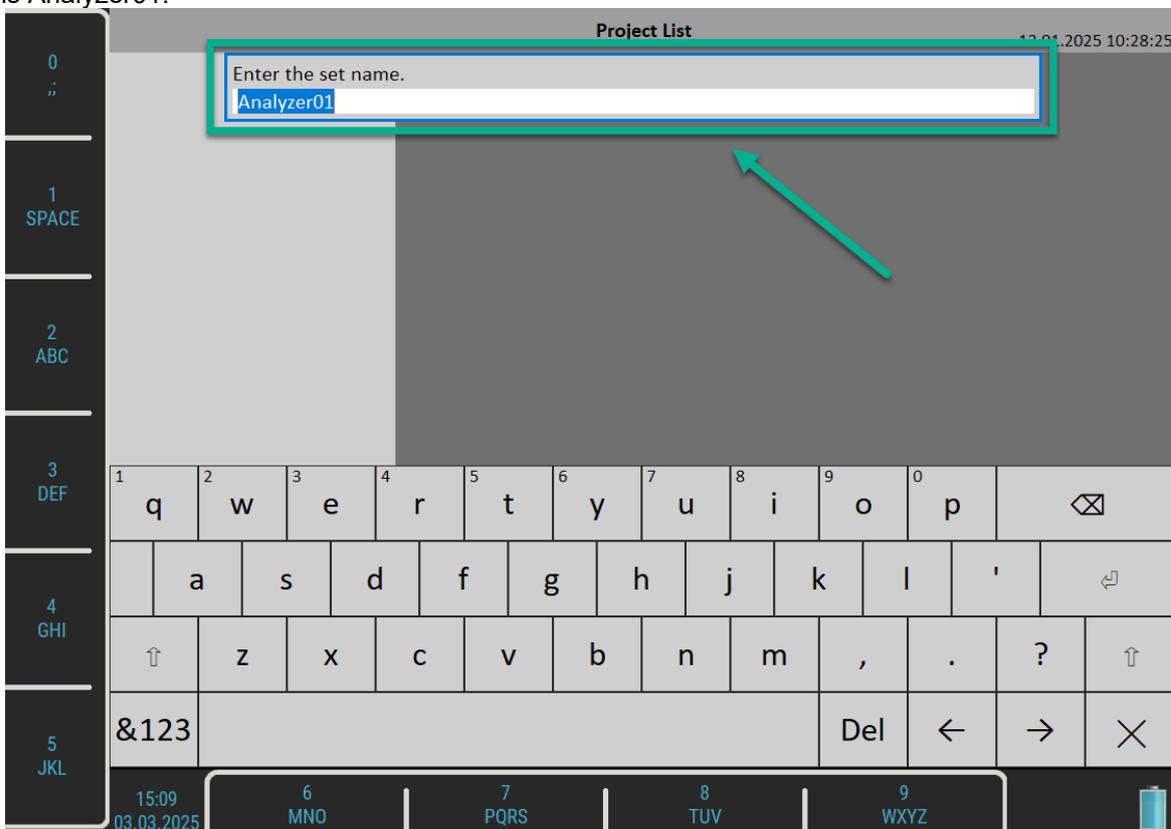
Use keyboard on the screen or use buttons around the display to change the set name. I change it to GrinderG1.
Confirm with Enter.
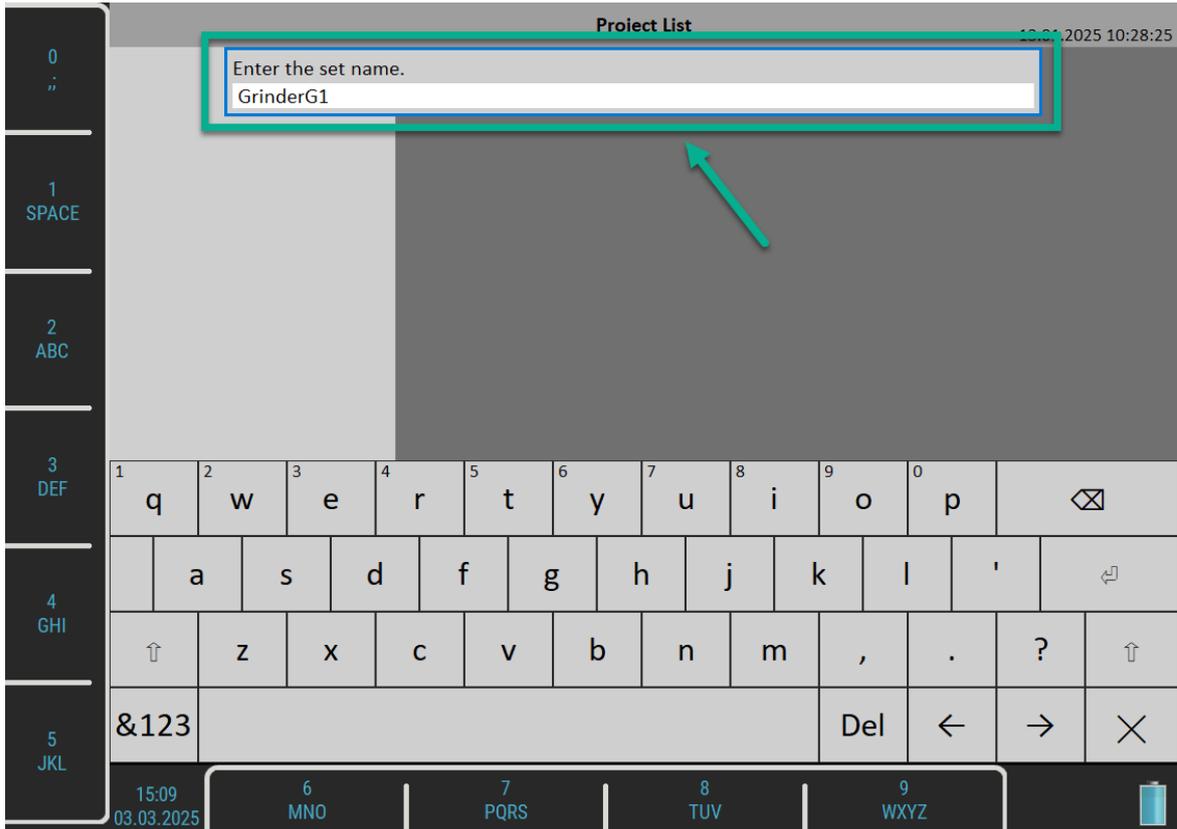
Now you can see it in the list (GrinderG1).
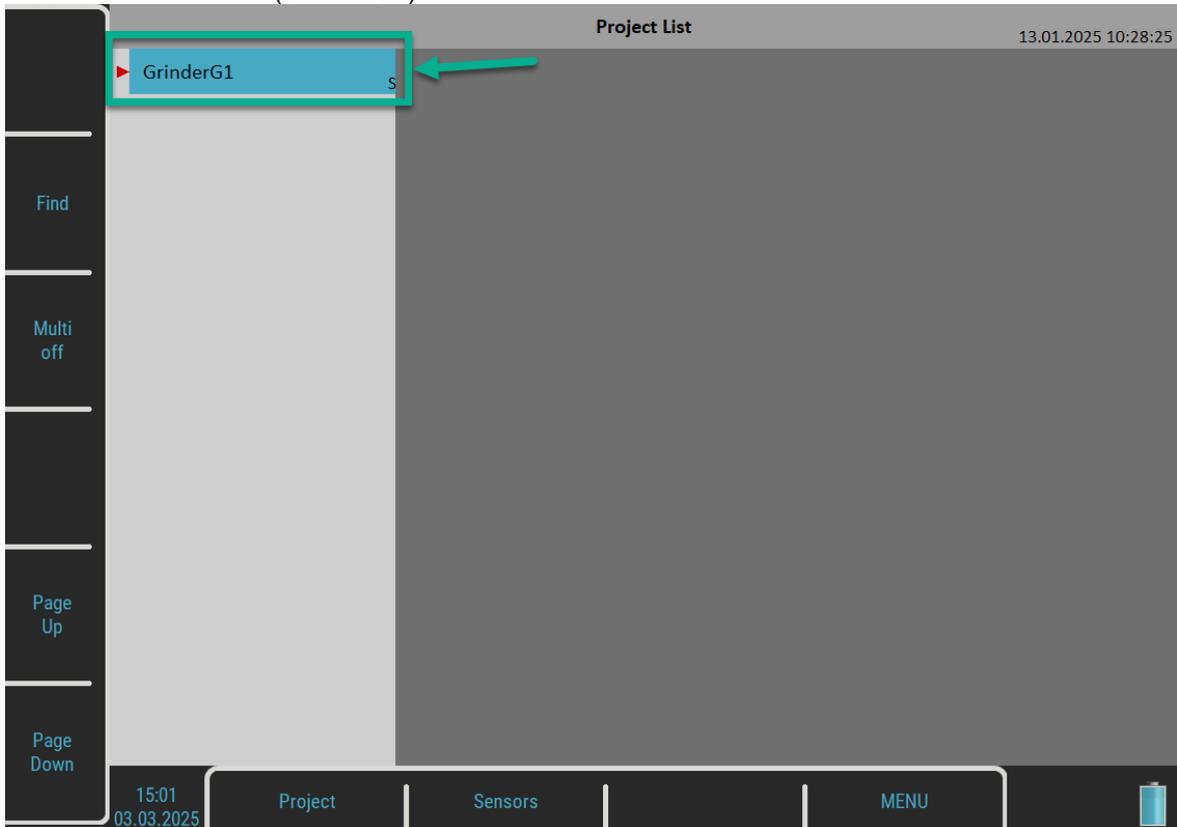
Double click on the GrinderG1 in the list. It opens the project.

Add Measurements

We add the measurements for this project. Click on Meas.
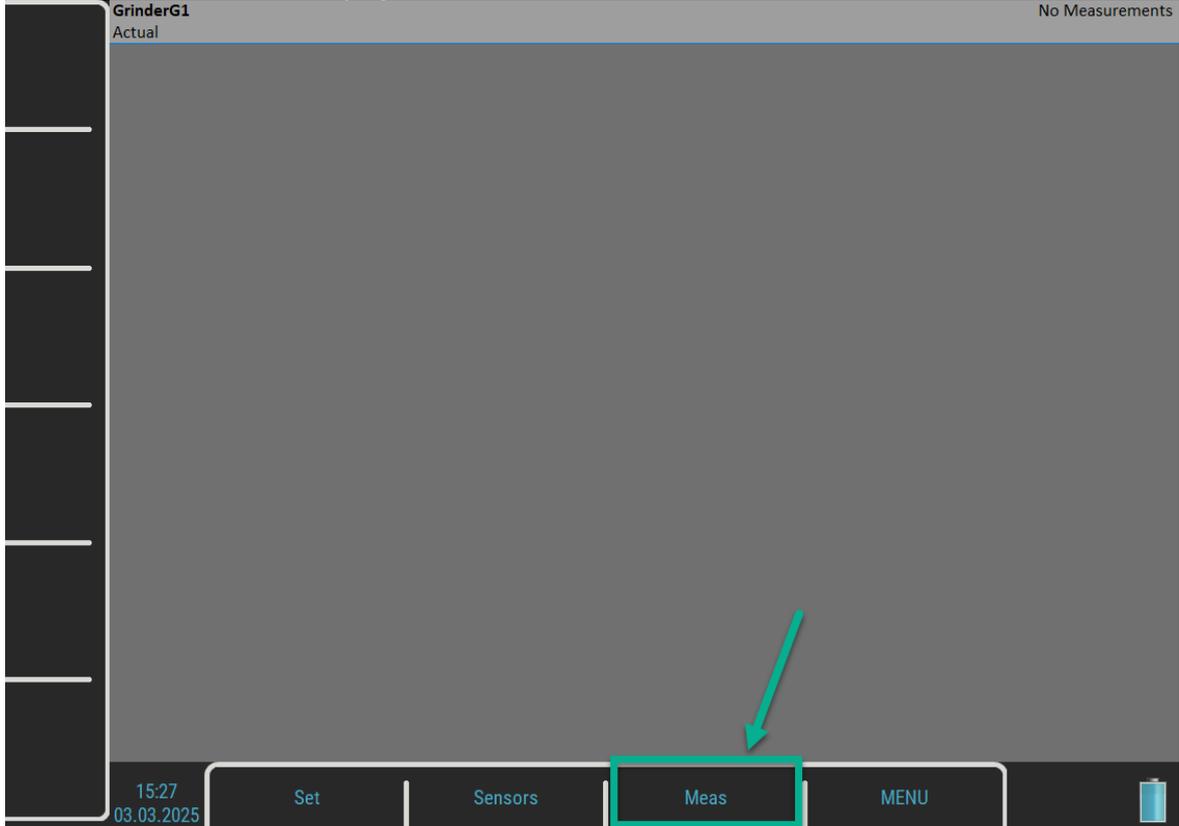
You can create **New Basic** (predefined ISO RMS, spectrum, etc.) or **New Advanced** measurements (define and choose your measurement).
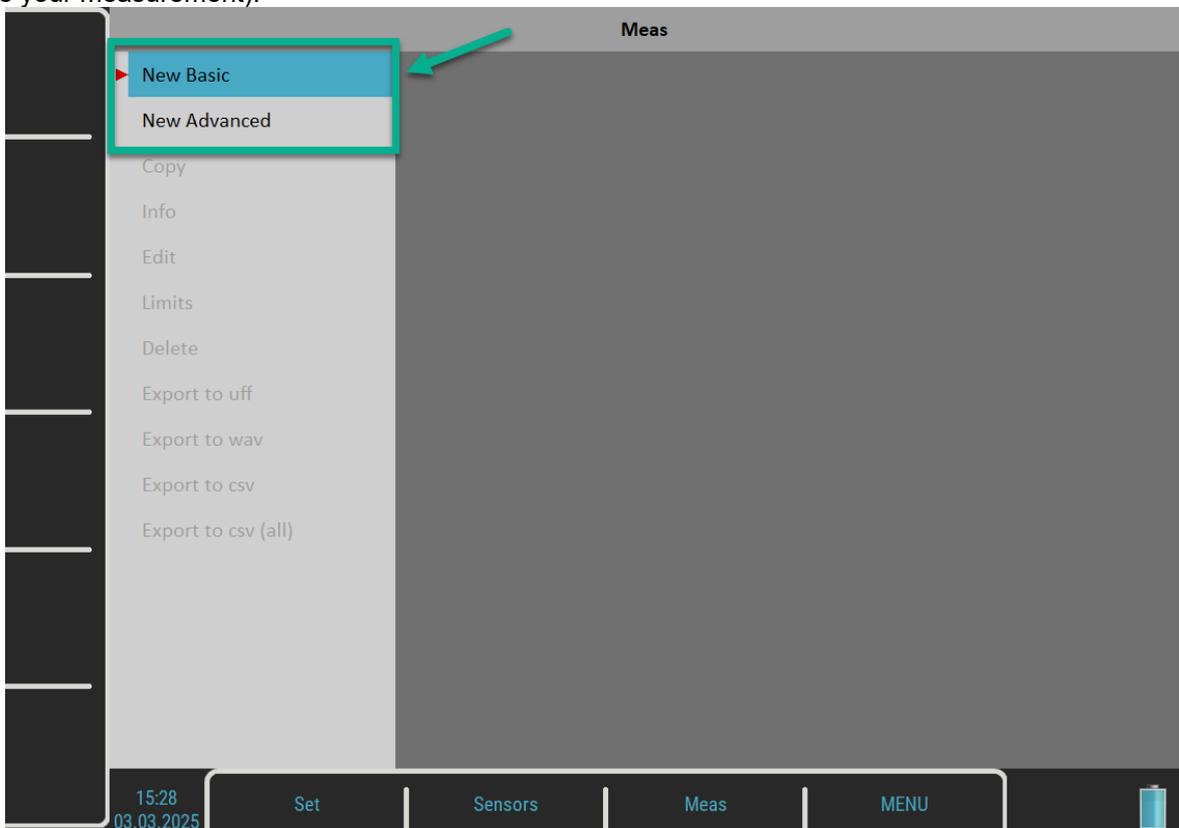
We choose **New Basic**. Now we select the measurement type. We add ISO RMS and ISO TIME.

Note! Measurements are added one by one. So firstly, we add ISO RMS.

Set ISO RMS parameters. All parameters of these New Basic measurements are predefined. Meaning of each parameter is described and explained later. For now, we keep the default setting of this measurement and save it.:
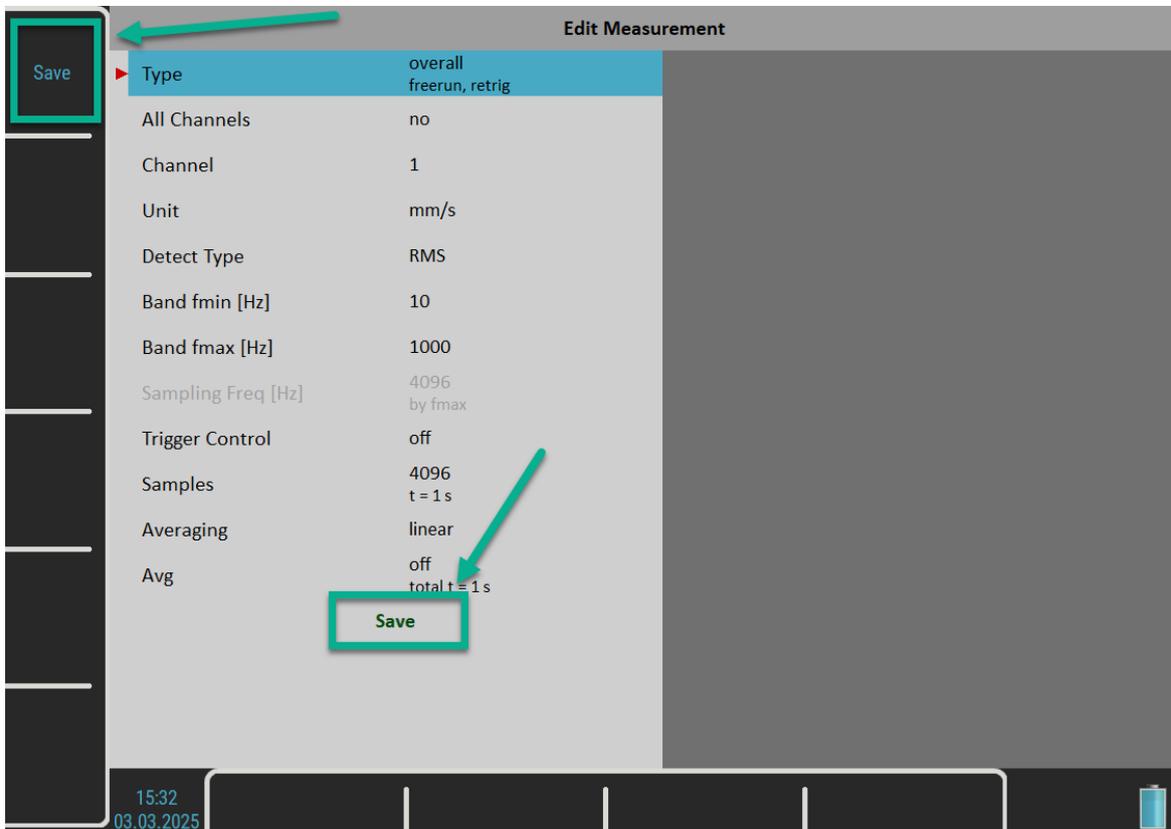
Measurement is created with **Save** button in the left upper corner or with Save at the end of this dialog. You see this window when ISO RMS is created.

GrinderG1   Graph 1 / 1
Actual

1 RMS ch:1 B:10-1000Hz FS:4096Hz NS:4096 T:1s
U:mm/s

START

No Data

Graph
Properties

15:33   Set   Sensors   Meas   MENU
03.03.2025

Now add the ISO TIME. Click on Meas again and select New Basic – ISO TIME.

Select required measurement

Properties

SPEED   S:4096 T:1s

ISO RMS

BEARING RMS

LBEARING RMS

OVERALL RMS

ISO 0-P

BEARING 0-P

LBEARING 0-P

OVERALL 0-P

▶ ISO TIME   No Data

BEARING TIME

LBEARING TIME

Page
Up   OVERALL TIME

ISO SPECTRUM

OVERALL SPECTRUM

Page
Down

15:33   Sensors   Meas   MENU
03.03.2025

Set the parameters for this measurement. We keep the default setting of this measurement.:
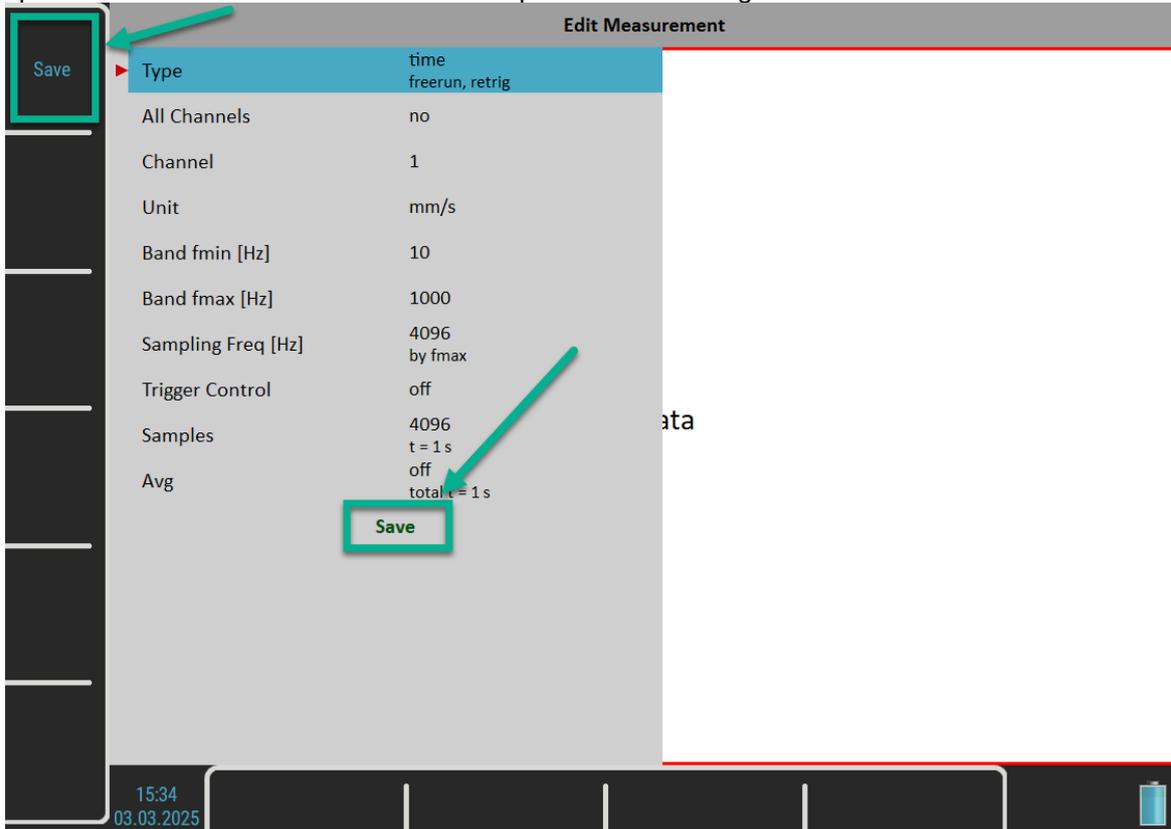
Now you have the project for GrinderG1 created. Two measurements (ISO RMS, ISO TIME) are added to it.

Step 5: Start the measurement

Measurement is started with Enter button on the keyboard. You can also use START button in the left upper corner.
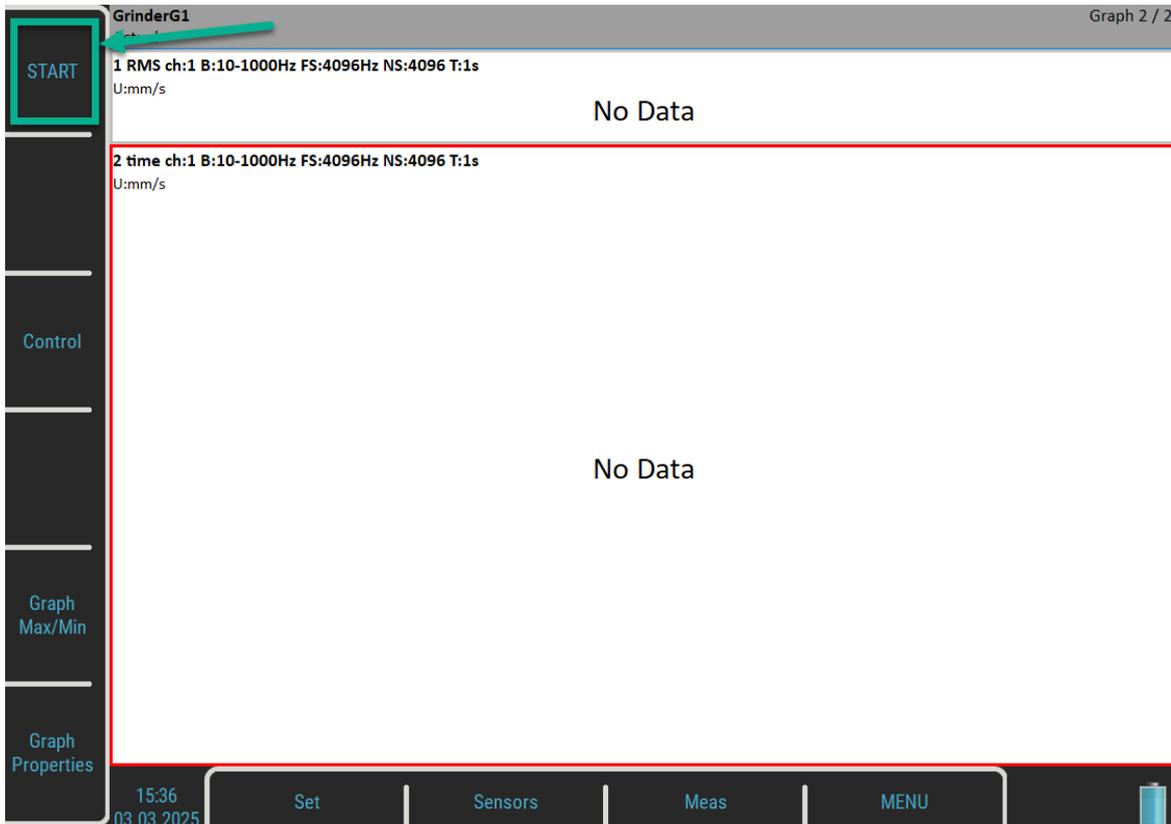
You get the first measured values in a while.
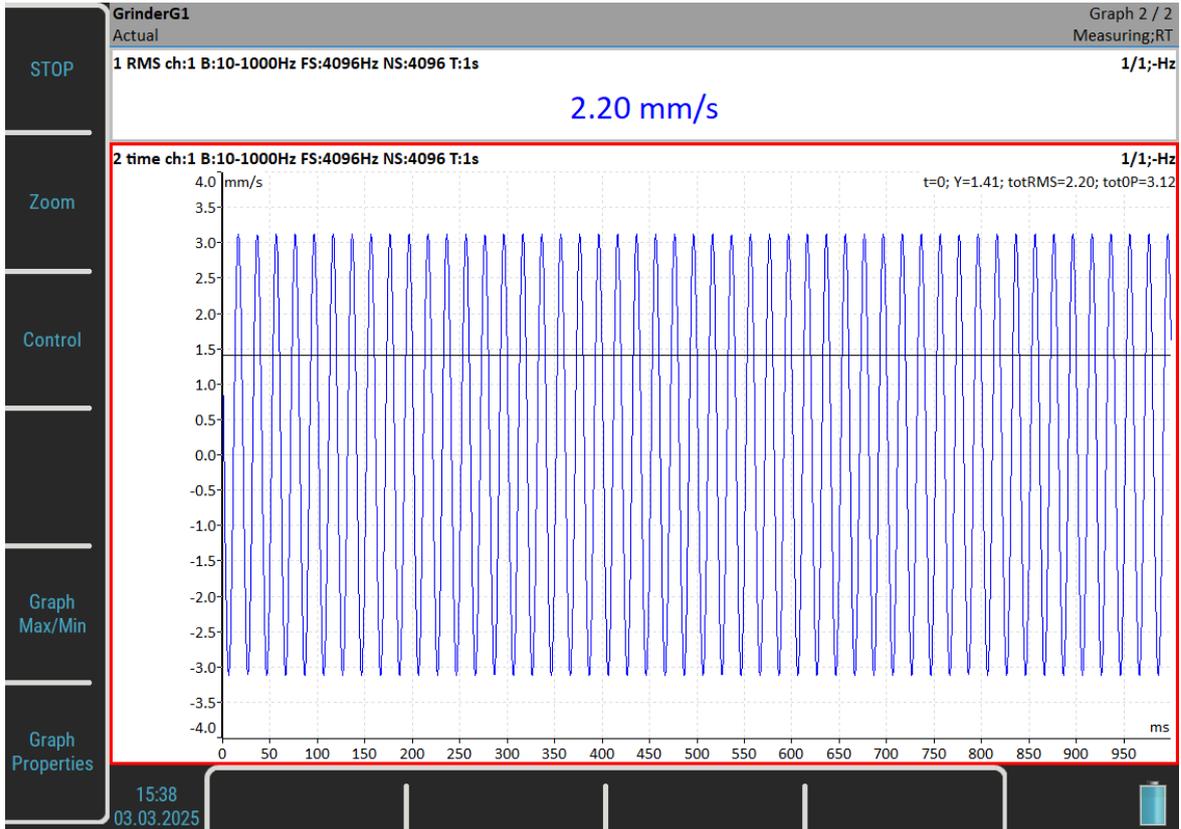
Hardware

Front View

Top View

Rear View (with IR camera connected)
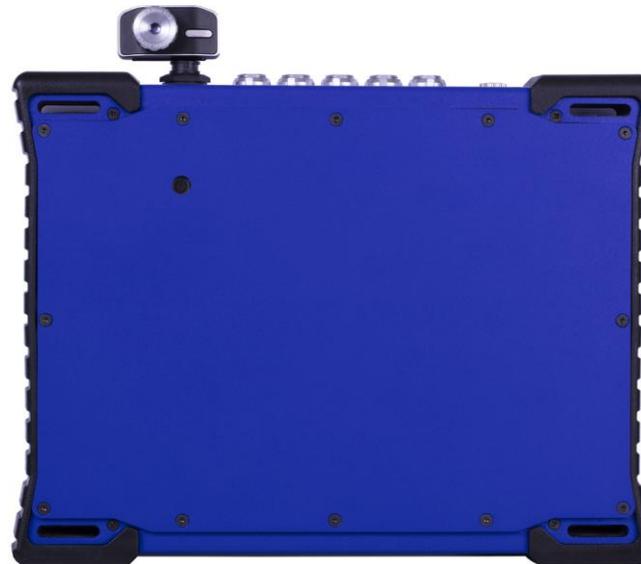
Connection to the computer

VA5_DISC

All data like projects, measurements, readings, setups and so on are stored to a high capacity hard disk which is intended for internal purposes only. Furthermore, the instrument contains the **VA5_DISC**, it is a flash memory, which is accessible from an external computer. The *VA5_DISC* is an interface for data. For example, you save a route from *DDS* to the **VA5_DISC**, the instrument copies it automatically to hard disk. Then you measure the route and then you export the route back to the *VA5_DISC*. Here you can read it from computer. You don't need to export all data from the internal hard disk. Export only the data which you want to read from a computer. A detailed description how to export will be stated later in chapters about project's control for each module.

Connection

To make a connection between a computer and an instrument (more precisely its *VA5_DISC*), use the USB cable which is the standard accessory.

The connection to a PC is indicated by the icon located on the bottom right corner next to battery icon. For data download, you must be in the main screen.

If you are not on main screen, the *VA5_DISC* remains accessible to the instrument processor and you cannot see it in your PC. The correct connection with the PC is announced by the message box.

Connected to PC
To prevent data loss, always use Safely Remove Hardware icon on your computer before unplugging the USB cable!

VAx_DISC

You may sometimes need higher capacity interface disk than the *VA5_DISC* (16GB). You can connect any external disk via USB. In order for the instrument to be able to recognize your disk, you must name it as **VAx_DISC**. Use a standard USB OTG cable (see below) to allow the instrument to act as a host. Connect the small plug to the instrument's USB socket, then connect the *VAx_DISC* to the OTG's socket. When *VAx_DISC* is connected, the instrument prefers it over *VA5_DISC*.

Note! The OTG cable is not a standard accessory of VA5 set.

Input Channels

All input sockets are on the top panel.

The input sockets IN1, IN2, IN3, IN4 are used for AC and DC signals. The TRIG input socket is used for trigger signals, usually tacho. All sockets have several pins. It enables you to connect more signals to one socket (see wire diagrams).

The AC inputs enable you to measure max voltage peak +/-12V. The DC channels enable you to measure max +/-24V.

NC - not connected
GND - ground
SHLD - shielding

IN1 Socket
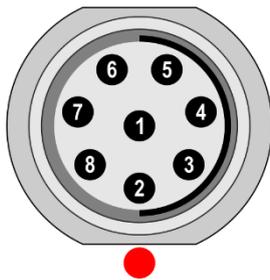
1 – NC or GND
2 – +5V/0.1A
3 – **DC1**
4 – NC
5 – SHLD
6 – +20V/5mA
7 – **GND**
8 – **AC1**

Attention! Pin 2 of IN1 socket (ultrasound sensor powering) is internally connected with pin 2 of TRIG socket (tacho / external probe powering).

IN2 Socket
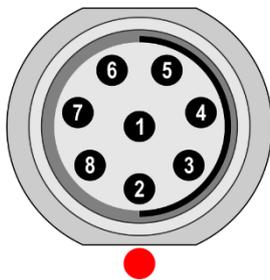
1 – NC or GND
2 – AC4
3 – **DC2**
4 – AC3
5 – SHLD
6 – AC1
7 – **GND**
8 – **AC2**

Note! Pay attention to the possibility of connecting all four AC channels to **IN2**.

IN3 Socket
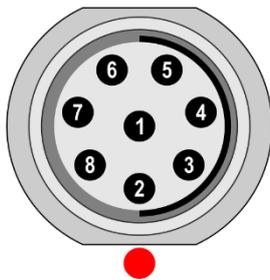
1 – NC or GND
2 – DC2
3 – **DC3**
4 – DC4
5 – SHLD
6 – DC1
7 – **GND**
8 – **AC3**

Note! Pay attention to the possibility of connecting all four DC channels to IN3.

IN4 Socket
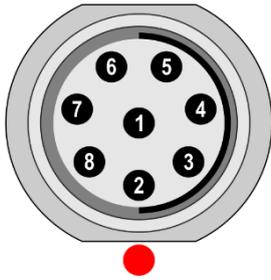
1 – NC or GND
2 – NC
3 – **DC4**
4 – NC
5 – SHLD
6 – +20V/5mA
7 – **GND**
8 – **AC4**

TRIG Socket
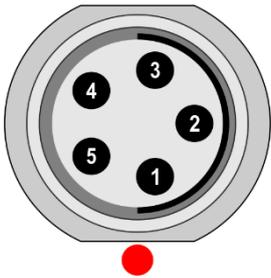
1 – TRIG
2 – +5V/0.1A
3 – SHLD
4 – GND
5 – GND

Attention! Pin 2 of IN1 socket (ultrasound sensor powering) is internally connected with pin 2 of TRIG socket (tacho / external probe powering).

Standard Cable Wiring

Standard cables which are part of the VA5 set have the sensor signal connected to the pin number 8. The second sensor wire is connected to the ground (pin 7).

When you use this cable:
In **IN1** socket, the signal will be measured on **CH1**.
In **IN2** socket, the signal will be measured on **CH2**.
In **IN3** socket, the signal will be measured on **CH3**.
In **IN4** socket, the signal will be measured on **CH4** (ver. 2.0 and higher).

If you want to use a tri-axial sensor, then you have to use the IN2 socket (pins 6, 8, 4) + ground (pin 7). You need a special cable for this purpose.

A4409 - BNC Box

This box can simplify the connection of more cables to *VA5* inputs. The BNC input connectors are used on the top panel for connection of 4 AC channels and 4 DC channels. There are two connectors on the side panel, which enable you to connect all 4 AC channels to IN2 input and all 4 DC channels to IN3 input.
See the wiring diagram of IN2 and IN3 in previous chapter. You see that all 4 AC channels can be connected to one input IN2. All 4 DC channels can be connected to one input IN3 in the same way.

First steps with VA5 device

You will learn first basic steps with VA5 device in this chapter. We mean (by basic steps) turn on/off the device or how to run sleep mode, etc.

Switching on

The **Power** button is at bottom left corner of the front panel. Press and hold the button for a few seconds until a power LED begins to light. First it blinks orange for a while, then it lights blue. A keyboard backlight blinks for a while.

Switching off

Use a **Power Off** in main *MENU* and confirm.

Attention! The *Power* button (intended for the switching on) doesn't turn the instrument off. It switches it into a sleep mode!

Sleep Mode

Use the *Power* button to switch the instrument into sleep mode. The screen is off and the power consumption is lower in the sleep mode. Use the same *Power* button to wake it up again.

Note! You can use any button to wake the instrument up. However, notice that the button push isn't ignored by the system even in the sleep mode and the push can cause some unexpected event in the application. The reaction to the button push is the same as if the instrument was not in the sleep mode.

Auto Switch off

If no button is pushed in 5 minutes from switching on, the instrument will be switched off.

Emergency Switch off

This is not the correct method to switch the instrument off. Using it can cause data corruption. Use this method only in case of emergency (e.g., when the system freezes).
Push and hold the *Power* button for about 10 seconds. The instrument will switch off.

Capacity Warning

If this warning message appears, you need to get free disc space by removing the measurements, routes or records, which are not needed.

90% of disc is full.
Longer measurements not available.

Main Screen

After initialization, the main screen appears. You can see a lot of icons (for modules) and buttons in the main screen. All of them are described in this chapter.
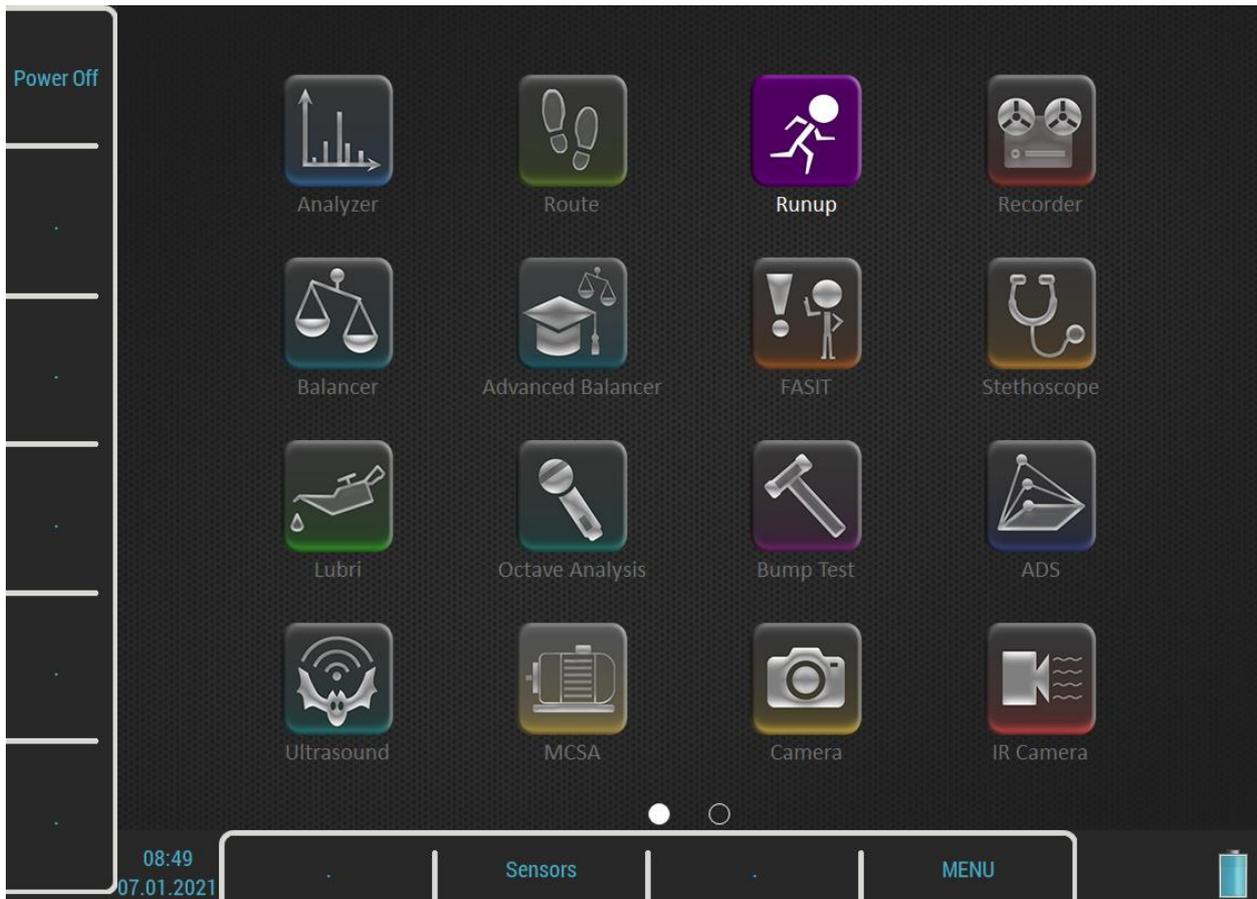
You can control the instrument by buttons around the display or by the touch screen.

Note! There can be more pages on the main screen (because of a lot of modules, there is not space enough for all of the module icons). You can see the circles in the middle of the bottom part of the screen (above the Sensors, MENU buttons). You can move through the pages with arrows or slide on the screen. Full white circle is shown for the actual page.

Buttons

Buttons on the right-side have following meanings:

                    Escape

                    Up

                    Left

                    Right

Down

Enter

Backspace

Tab

Home

The meaning of *next* buttons can vary and is always written on the screen near the button. Such approach enables you to use one button for many functions depending on current needs. You can press the button or tap the touch screen to call the function.

Modules

The *VA5* instrument contains many modules. Each module has an icon on the main screen. Select an icon using arrows or tap. Push the *Enter* button or double tap to open a module. Each module will be described in a separated chapter.

MENU button

The ***MENU*** button opens an instrument's main menu. This button is available on most screens.

Shortcuts

Left side and bottom buttons have no functionality on the main screen. They can be used for user defined shortcuts. You can define the meaning for each free button in MENU / SETTINGS / Shortcuts. The free button is marked with the "**.**" (dot) symbol. You can also call the Shortcuts menu by pressing the free key. In this case, the dialog setups only the pressed key.

Two shortcuts are set by default, ***Power Off*** on button 1 and ***Sensors*** on button 8. You can change these shortcuts as well.

The button 8 is something special for shortcuts. A shortcut defined on this button is also available in other screens, not only on the main screen.

PC Connection Indication

It is shown next to the battery icon when instrument is connected to PC. More detailed description about connection is in [Hardware](#) / [Connection to the computer](#).

Touch keyboard

1 q	2 w	3 e	4 r	5 t	6 y	7 u	8 i	9 o	0 p	⌫
a	s	d	f	g	h	j	k	l	'	↵
⇧	z	x	c	v	b	n	m	,	.	? ⇧
&123							Del	←	→	✕
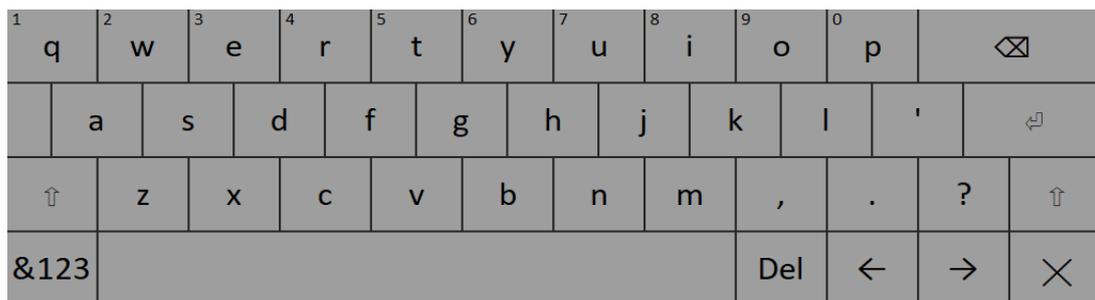
Touch keyboard is automatically opened when you enter a text. You can write by tapping keys on the keyboard.

You get an offer of alternative characters by holding a key for a while. Choose a character by moving on it and releasing.

	3	ě
ę	e	é
ê	è	ë

There are a few control buttons:

↵

              Enter confirms the text.

✕

              Escape cancels the text entering.

⌫

              Backspace moves cursor one position backwards and deletes the character on that position.

⇧

              Shift switches the keyboard to enter upper case letters.

⇧

              If you press the *shift* key, it becomes selected. Letters on keyboard are changed to upper case. When you enter one letter, the keyboard automatically returns to writing lower case letters.

⇧

              Push the *Shift* key twice and it becomes *Caps Lock*. This keeps writing upper case letters.

&123

              Switches the keyboard to typing numbers and symbols.

Note! You can also enter a number by pressing and holding a letter in the first row. Letters from the first row have a number as an alternate character. The number is written in the top left corner of the letter key.

Del

              Delete deletes one character on the current position.

←

              Left arrow moves cursor one position backwards.

→

Right arrow moves cursor one position forwards.

Battery Lifetime

The information about percentage of battery lifetime is displayed in the right bottom corner of the display.

Battery lifetime 75 – 100 %

Battery lifetime 50 – 75 %

Battery lifetime 20 – 50 %

Battery lifetime 8 – 20 %

Battery lifetime 7 %

Battery lifetime under 7 %. Instrument is switched off under 3 %.

How to work with menus

You have to define many parameters for using the instrument. All those definitions are provided by menu items and windows. The procedure for operation with all is the same. We describe it in one example, the sensor properties definition.

Item Selection

Push the **MENU** button to open the instrument's main menu. Use arrow buttons and *Enter* or double tap an item to select it. Select and open the **Sensors** menu.

AC 1
AC 2
AC 3
AC 4
All AC Sensors
All Bearings
All ISO
DC 1
DC 2
DC 3
DC 4
All DC Sensors
Tacho
Settling Prolongation
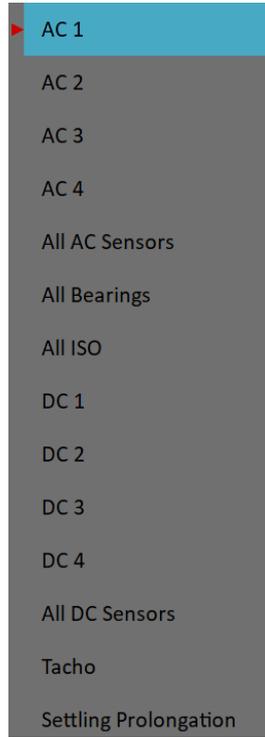
Next, open any AC sensor menu.

ICP	on
Sensitivity[mV/g]	100
Unit	g
Position[°]	undef
ISO Machine Group	undef
Bearing Type	undef
Save	
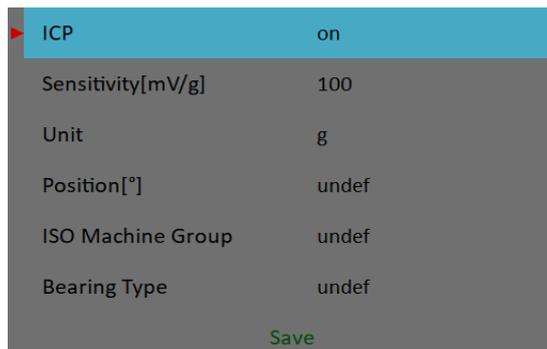
Note! If menu contains more parameters and you cannot see them all on the screen, you can drag your finger through the screen up and down.

Value Selection

Use up and down arrows to highlight an item, e.g., **Sensitivity**. Then push *Enter* or right arrow. Alternatively, you may tap the parameter you want to setup to open a submenu with possible values. Select a value by taping or pushing *Enter*.

ICP	on		1
Sensitivity[mV/g]	100		10
Unit	g		100
Position[°]	undef		user
ISO Machine Group	undef		
Bearing Type	undef		
Save			
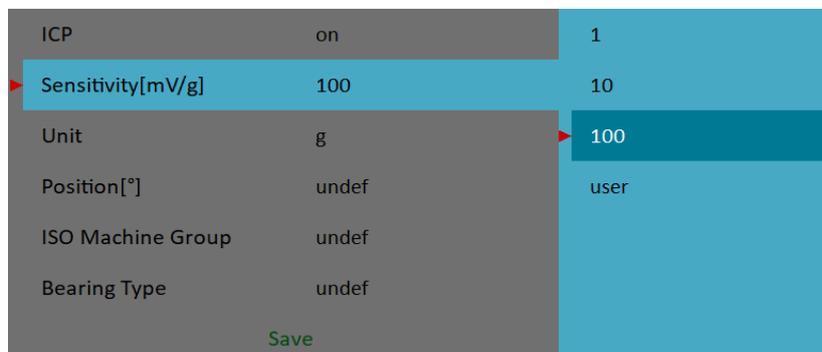
User Defined Values

You can select predefined sensitivity or you can enter a number (for example, 45 mV/g). Select the **user** item. A text entry dialog opens.
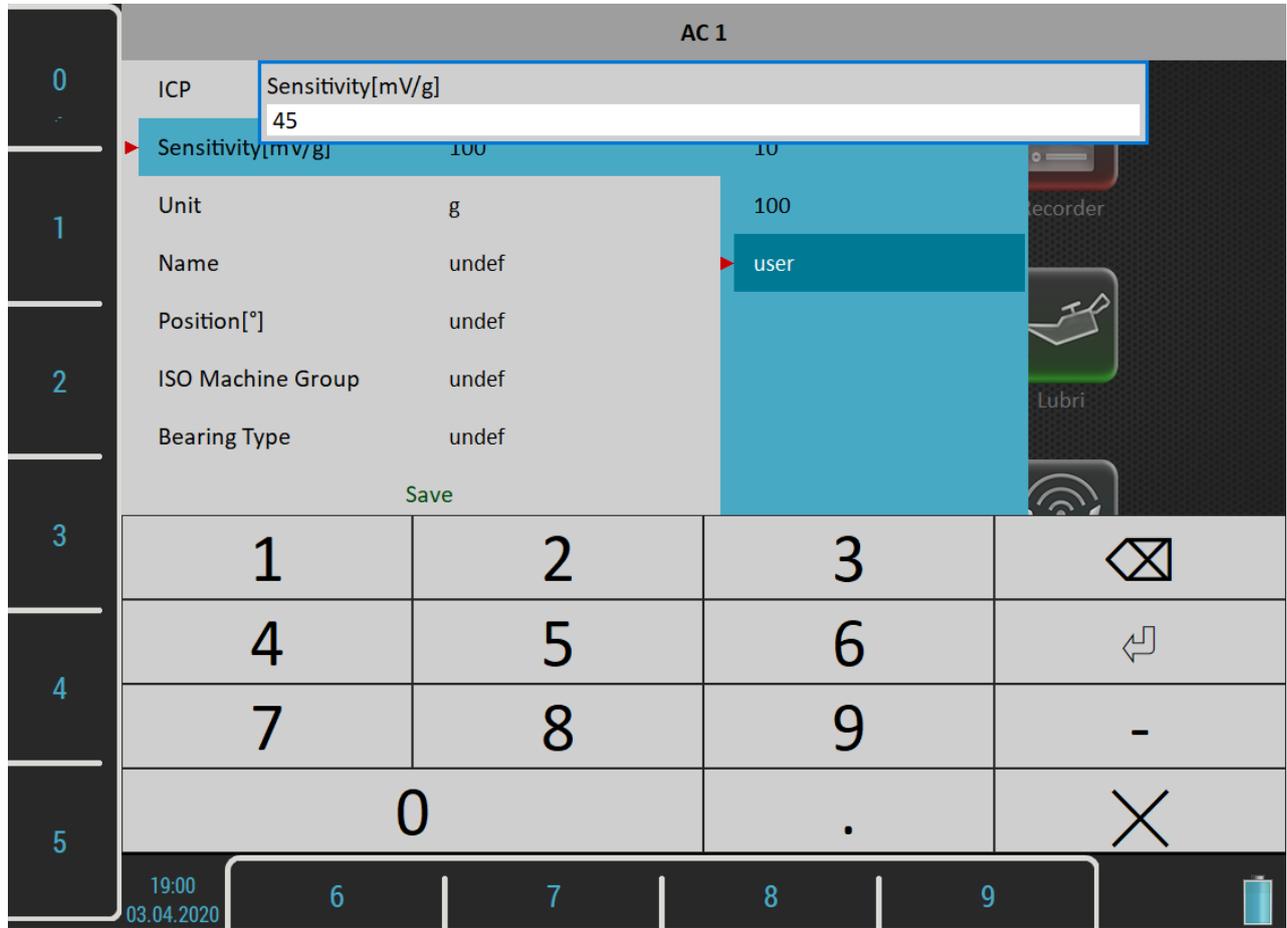
You may enter the number using buttons around the display. Decimal point or minus symbol are defined by several pushes of the **Zero** button. Use the **Backspace** button to delete entered characters. Use the **Enter** button to confirm the value or the **Escape** button to leave without any change.

You may also enter the number using touch keyboard.
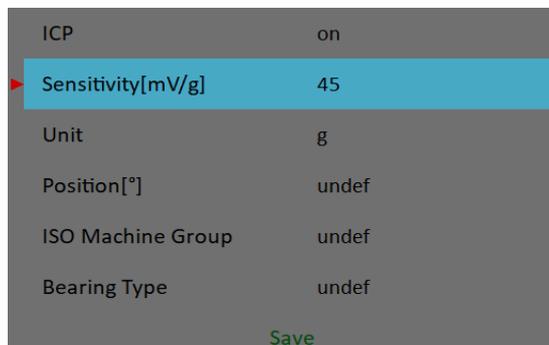
As we mentioned the value entry, the text also has to be entered in some menu items. The screen looks similar to the numerical screen. The only difference is the characters selection on buttons. It works like mobile phones keypad. For the second character selection, you must press the button two times.

Values Confirming

The last item of all menus is **Save**. When you select this item, the menu closes and all values you have set will be saved. The **Save** button at the top left also has the same meaning. When the *Escape* button is used, then the menu is closed without saving anything.
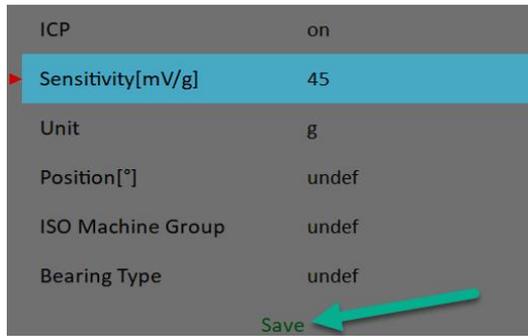
How to work with lists

Multi-selection of Items

Sometimes you may need to work with more items together. The usual example is deleting more items in one step.
The left **Multi on** / **Multi off** button enables you to select more items at once. The text of the button indicates which mode is just active. Push the button to change the mode. When you move in the list by arrows and the multi-selection is on, you can select (or unselect) more items. The *Escape* button cancels all selections.
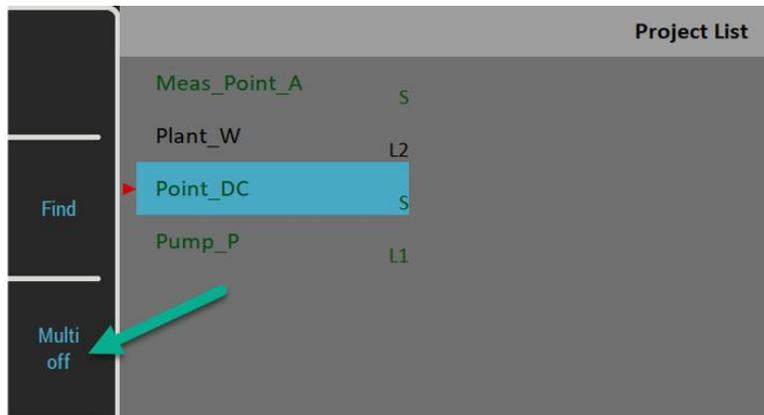
Sorting of items

Items in the lists are by default sorted alphabetically. Sometimes you may need to sort the items in the list differently.
For such a situation there is a **Sort** button. This sort button is on the left side, next to the project list. Its text is changing from **Sort off** to **Sort on**. It shows you always which mode is active.
When button shows **Sort off** it means that you **cannot move** the items in the list with arrows up and down.
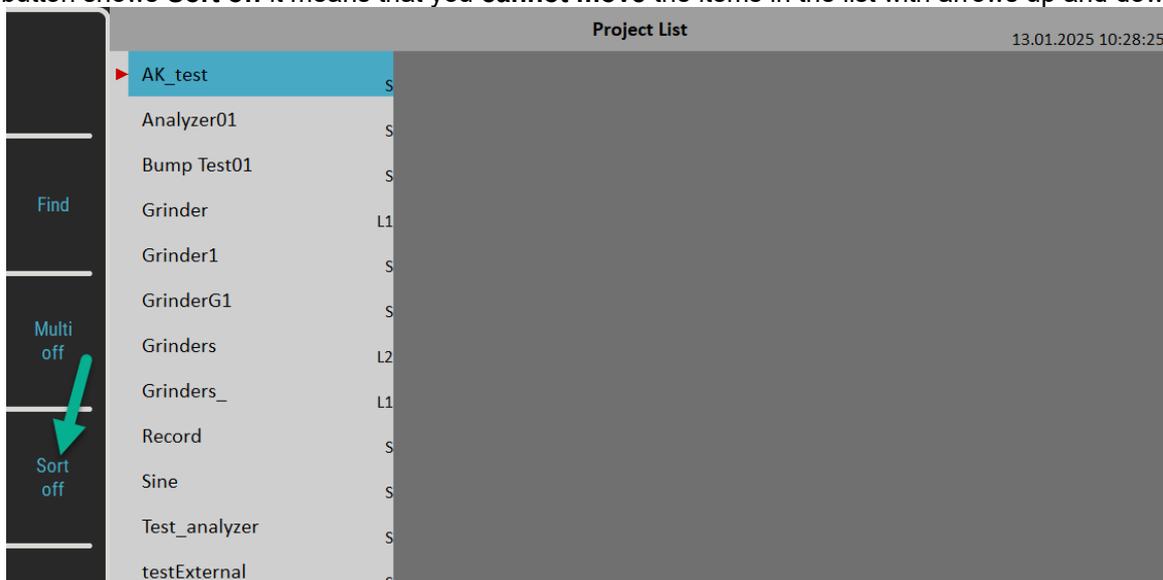
When you click on it, text changes to **Sort on**. It means that now you are in the sorting mode and you can use the **arrows up** and **down** to move with the selected item and change its position on the list.
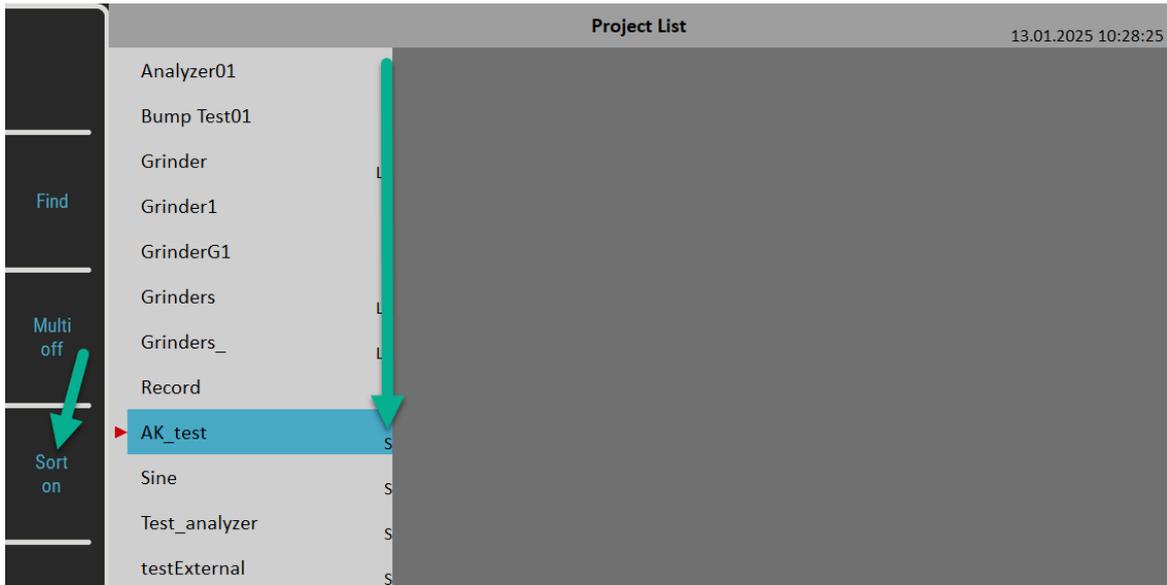
The item remains in the position where you move it. If you need to sort the projects alphabetically again, you can use the button **Project** / **Sort Alphabetically** item to reorder it back.
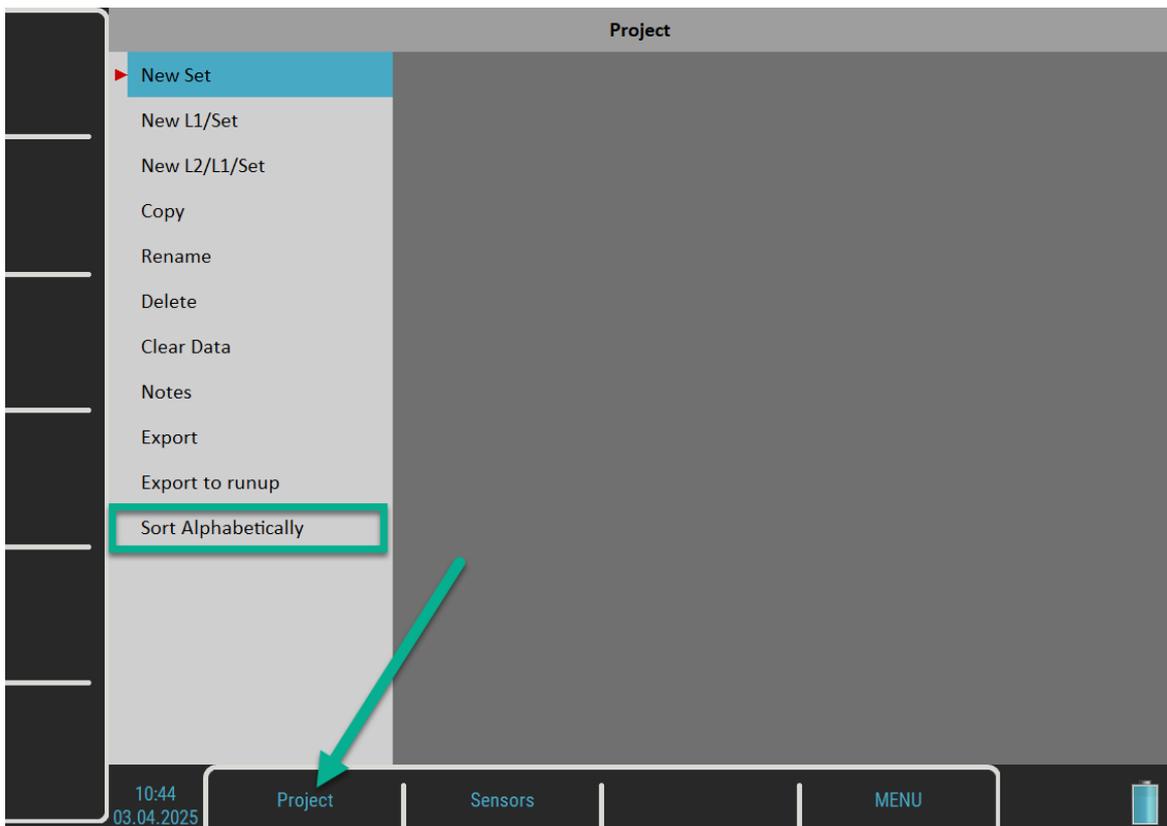
Note! If the item list is sorted alphabetically, the option 'Sort Alphabetically' is not visible in the item menu!

Searching an Item

If the list is too long or you know the name, then use the *Find* button. Enter the name or part of the name and confirm.

MENU

Push the **MENU** button. Instrument's main menu is separated into two parts. Items in the **SETTINGS** part are used for opening next menus and items in the **RUN** part activate some tasks.

MENU		
SETTINGS		**RUN**
Global Settings	Signal Source	Stethoscope
Display	Trigger Settings	Camera
Keyboard	Runup	IR Camera
Language	Spectrum Settings	Gallery
Appearance	Sensors	Calculator
Profiles		Update
User notes list		Help
Date/Time		Screenshot
Shortcuts		Export All
		About
		Power Off

10:44
30.01.2024
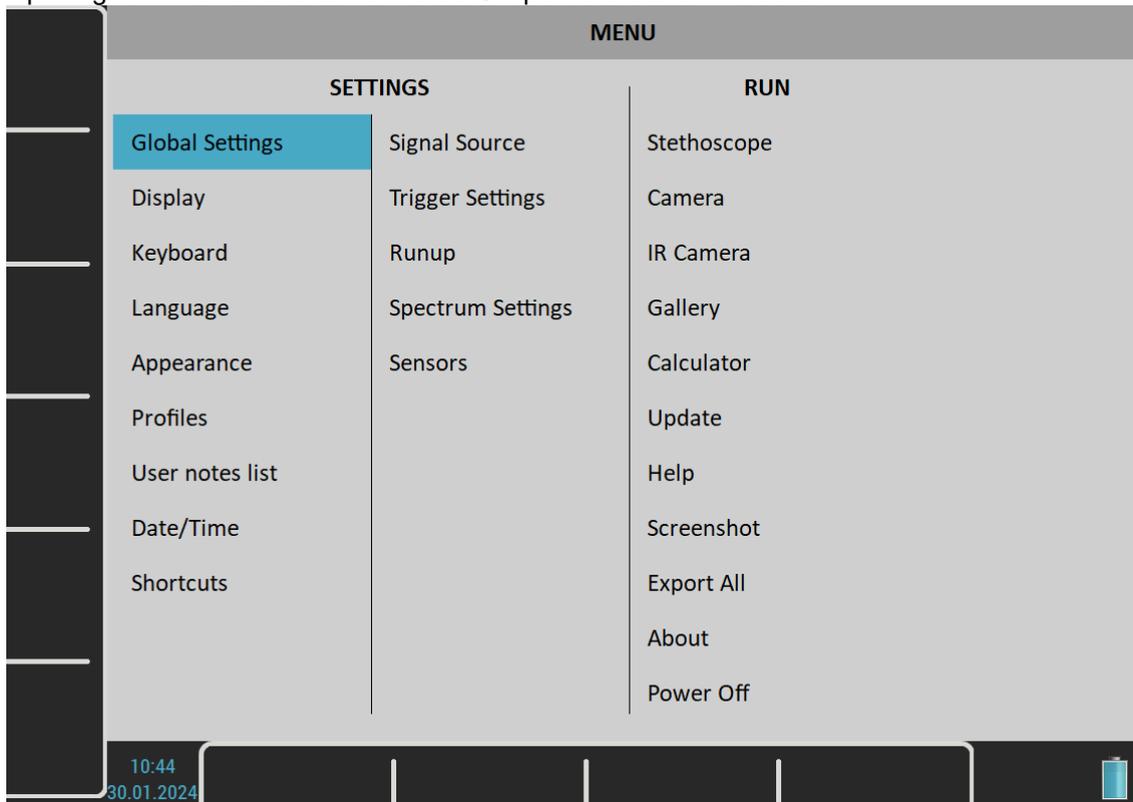
MENU / SETTINGS

This section describes particular menus. Parameters descriptions also contain lists of possible values. Default values will be underlined.

Global Settings

Display Route Values

on, **off**
When you want to go faster during the route and you do not want to look at measurement results after each point, then set it to **off**.

Route Autosave

on, off
When set to **on**, the data are saved after taking measurement at each point by itself. When set to **off**, you have to save them manually.

Route Auto Forward

on, **off**
After saving values, the screen with results automatically closes and a list of points appears. A next measurement point is selected. The necessary condition is, that all measurements from the last point are taken and correctly saved.

Check Route Sensors

yes, **no**
Each point in the route contains the sensors setting, which is defined in *DDS*. The instrument also contains the sensors setting (menu Sensors). Both settings are compared for each point during the route readings. When the sensor setting in point is not equal to the sensor setting in instrument, then the "***Used sensor***" window appears. It is the warning to the user. This check can be turned off by setting **no**.

Used Sensor
on AC1: 100 mV / g, ICP on

Display Small Values

on, **off**
When you are interested to see values under 0,001, then set it to on and the values will be displayed in scientific notation (for example, 5.26e-6). Otherwise, the 0 (zero) will be displayed for small values.

Stop if ICP Error

on
The measurement is stopped when ICP error occurs.

off
The measurement continues, ICP error is only informative.

Units

metric, **imperial**, **both**
Units available in menus.

Frequency unit

Hz, **RPM**, **CPS**, **CPM**

Speed unit

<u>Hz</u>, **RPM**, **CPS**, **CPM**

Power/Line Frequency

It is used for *Elect* value in synch table, which is displayed for spectra (<u>Synch Table</u>).

Phase range

<u>(-180, 180)</u>, **(0, 360)**
Range of phase values

Displayed Spectra in Cascade

<u>32</u>, **128**, **256**, **512**, **1024**
Number of displayed spectra in waterfall (cascade) graph. It is not the number of measured spectra!

Align Graphs

on, <u>**off**</u>
If more graphs of the same type are displayed, then the Zoom and Cursor function of all graphs can be aligned.

Graph Grid

<u>**on**</u>, **off**

Cursor Type

<u>linear</u>, **maxs**
This item must be explained in depth. The graph width (for example, spectrum frequency axis) is displayed on approx. 600 screen pixels. But the spectrum could have 25600 lines and then 42 lines are displayed in one pixel line (42=25600/600). This number of lines in one graph pixel is different for other total line number and used zoom. In the older instruments we used the cursor movement procedure by lines. It means that the cursor moves inside one pixel without any real move on the screen. The users complained about it. Now, we use another procedure. The cursor moves by pixels, not by lines. In each pixel, there are more lines hidden and the cursor must display one specific line. What line should we use? When the Cursor type is set to **linear**, then the step of the cursor movement is the number of lines in one pixel. When the **maxs** is set, then the cursor always moves to the maximum line which is contained in one pixel.

Record analysis speed

<u>fast</u>, **real time**
A record could be analyzed in two ways. Let's suppose the record length is 300 sec, it could be a run up record for example. You want to measure the amp+phase measurement during the record. If you want to watch the continuous results, then select the **real time** mode and the processing of record will take 300 sec (the analyzing time is the same time as the recording time was). If you want to save results to the memory and not watch them on the screen, then select **fast** mode. The analyzing time will be much faster than 300 sec. You can also imagine that it is like a tape recorder. You can push the button play (real time) or rewind (much faster). The instrument also enables you to analyze a record in fast (rewind) mode. For example, it enables the analysis of 1 hour of data in several seconds.

Record Analysis Start

<u>continue</u>, **begin, again, ask**
These options are used when the record is selected for analysis.
It would be better to use an example for explanation. For example, we use a record with a length of 60 sec. We define time signal measurement with a length of 8 sec. It means that when we push the Start button, the reading takes 8 sec and the position of the cursor moves by 8 sec in record.

continue: The next reading will start at the end of last reading.
begin: The next reading will start at the beginning of record.
again: The next reading will start at the beginning of last reading.

ask: You select any option before the reading.

When you moved the cursor manually, the next reading will always start from that position.

Wav Encoding

PCM, 24 bit, **PCM, 16 bit**
This is a setup of encoding for wav exports. The PCM is the shortcut for pulse-code modulation which is the most common way to encode signal into wav format. The number behind the PCM shortcut represents the number of bits per sample or bit depth.
The VA5 instrument uses 24 bit A/D converter, therefore 24 bits per sample is the default bit depth for the wav export. However, some software doesn't allow to process this bit depth and then the more common 16 bits per sample encoding can be used.
Note! The sample rate of the wav is the same as the sampling frequency of the exported signal and cannot be changed in the instrument. If you need to change it you need to use a 3rd party application to resample the exported wav (e. g., Audacity).

Angles Counting

with rotation (°WR), **against rotation (°AR)**
You can define the direction of angles (phases). The selected choice is then signed behind degree mark as WR (with rotation) or AR (against rotation).

Note! Although almost all degree symbols in the application are labeled with WR or AR mark you don't see this in the manual because many of the screenshots were taken before Angles Counting was implemented.
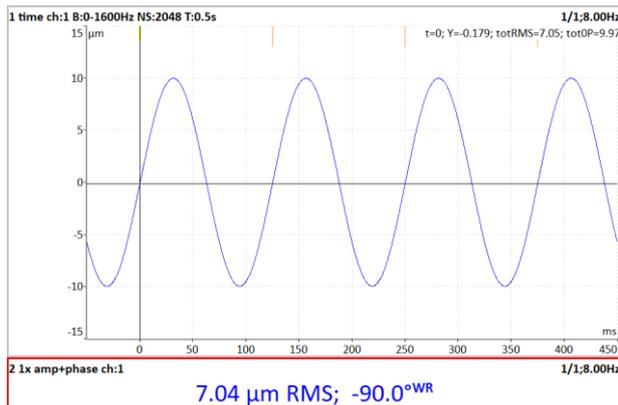
With rotation: **Against Rotation:**
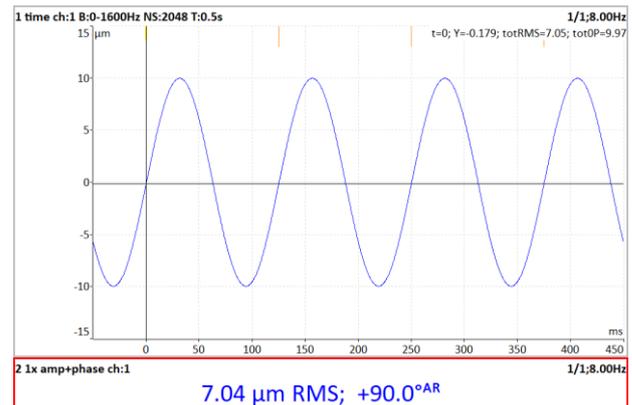
On the pictures above, you can see the time waveform with tacho marks. The tacho mark comes 90° before the maximum of the signal in the direction of rotation. If we choose **with rotation**, then we say the tacho mark is 90° before the signal maximum and thus the angle (phase) is **-90°**.
In case of **against rotation**, we say the signal maximum is 90° behind the tacho and the angle is **+90°**.
The main use of this parameter is in balancing. Some users are used to count angles with rotation and other users want to count against rotation. The instrument enables you to set your required direction.

Warning! By changing this value, all angles (phases) become opposite. Therefore, do not change it between readings if you want compare phases.

Display
Not for Virtual Unit!

Brightness

Display brightness settings

Enable Touchscreen

yes, no

Display Turn Off [minutes]

It is the value when display will be turned off. You can set it to number value (in minutes) or to value 'Never'. This parameter is set to 5 minutes by default.

Keyboard

Keyboard Backlight

on, <u>**off**</u>
The keyboard backlight is always off after instrument's startup. This setup is not saved.

Language

Language

Select your language.

Appearance

Interface Style

Note! For Virtual Unit only!
old (VA4 I), **old (VA4 II)**, <u>**new (VA5)**</u>
You can choose which user interface the *Virtual Unit* uses, **VA4** or **VA5**. The change takes effect after the application restarts.

Use Right Buttons

Note! Not for *Virtual Unit*!
yes, <u>**no**</u>
You can turn the right buttons on the display and then push them on the touch screen like in *Virtual Unit*. The change takes effect after the application restarts.
Attention! The useable area of the display decreases while using the right buttons. The PC connection icon is not visible.

Background Color

<u>**black**</u>, **white**
Background color of graphs

Profiles
All instrument parameters can be saved to the **Profile**. It is useful, for example, for saving of sensor sensitivities.

Save settings to "just opened profile name"

Save the parameters to the currently opened profile (updates the profile).
Note! You have to create and open a profile otherwise this item is not visible.

Save settings as new profile

Save the parameters to the new profile (after name entry).

Factory

Open the factory default profile.

List of saved profiles

Select an existing profile. The **Delete** button removes the selected profile.

User Notes List

You can create text notes in the instrument and attach them to various items, e. g., to route points. There are three ways how to enter a note text.
1. Enter the note text manually.
2. Select a predefined note from **Factory notes** set.
3. Select a predefined note from **User notes** set.

The user notes set is created and edited by the user here, under the *User Notes List* menu item.
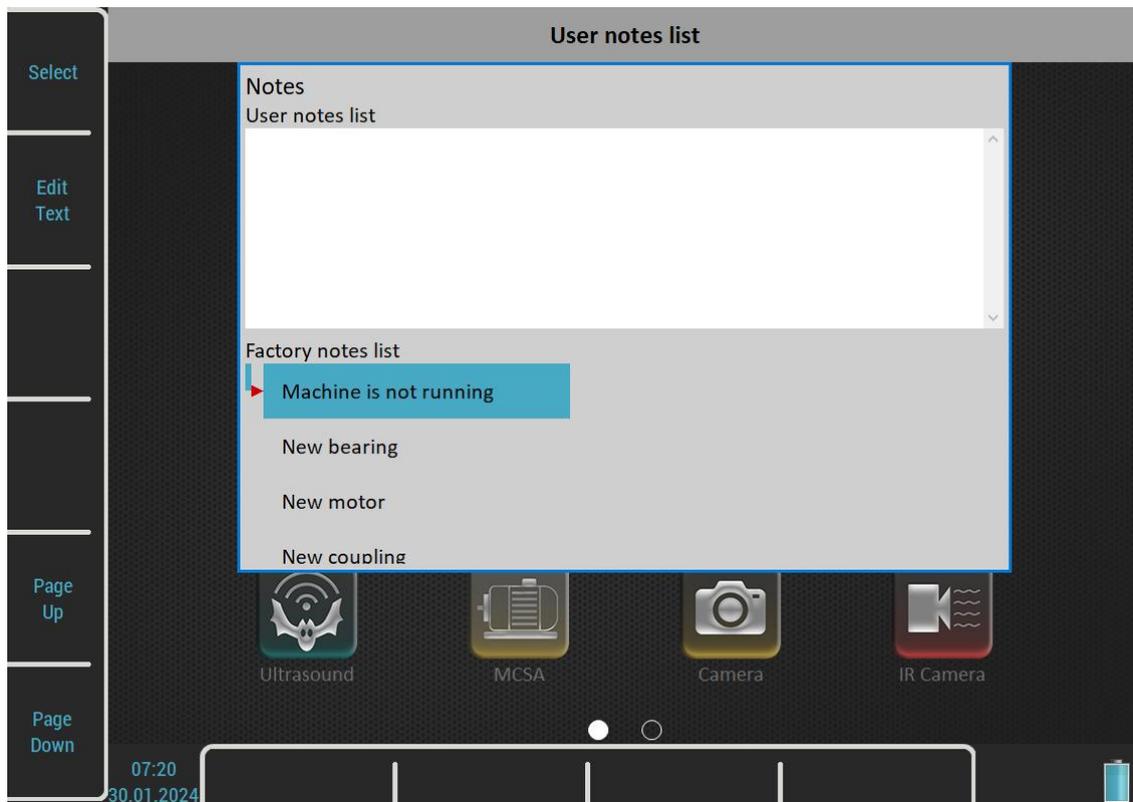
The list of existing *User notes* (now empty) is in the upper half. Predefined *Factory notes* are displayed in the lower half.
Because the user usually wants to use the *User notes* only, you can copy any factory note to the user notes. Select it by arrows and push the **Select** or *Enter* button or double tap it.
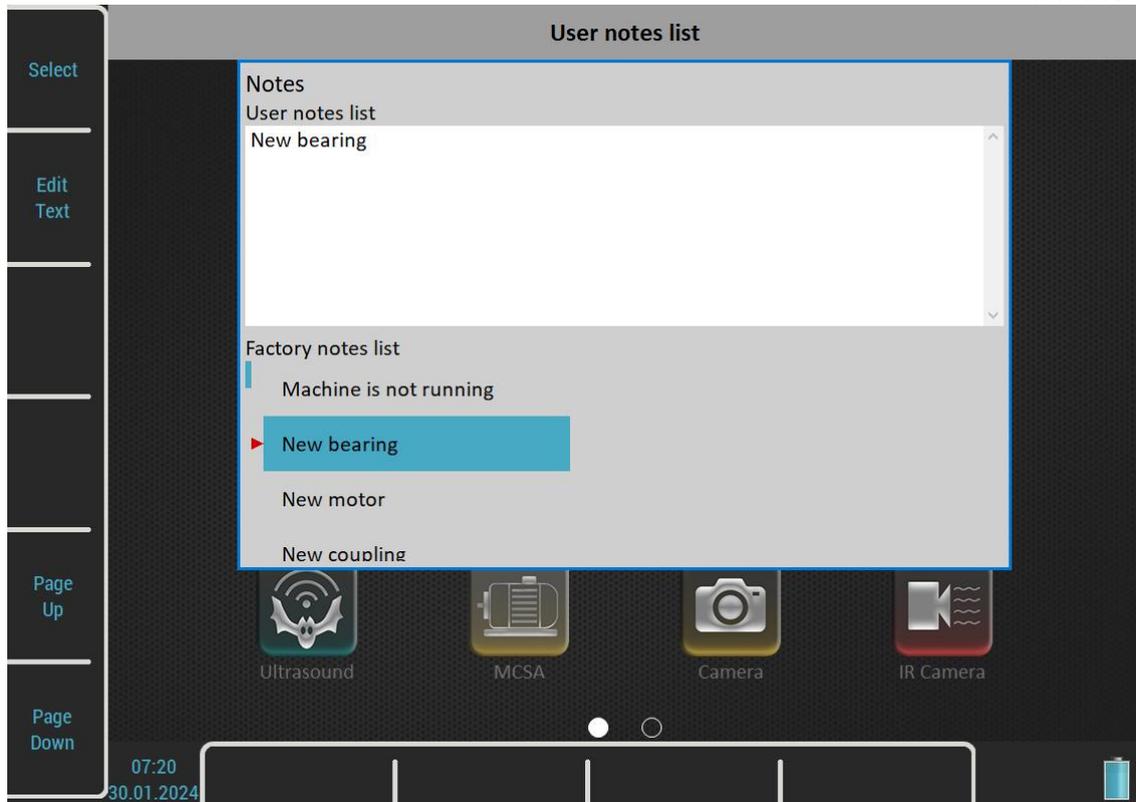
If you want to create your own note, then push the **Edit text** button. Enter your note manually. Each line in text is one note. Push the **Enter** button to add a new line.
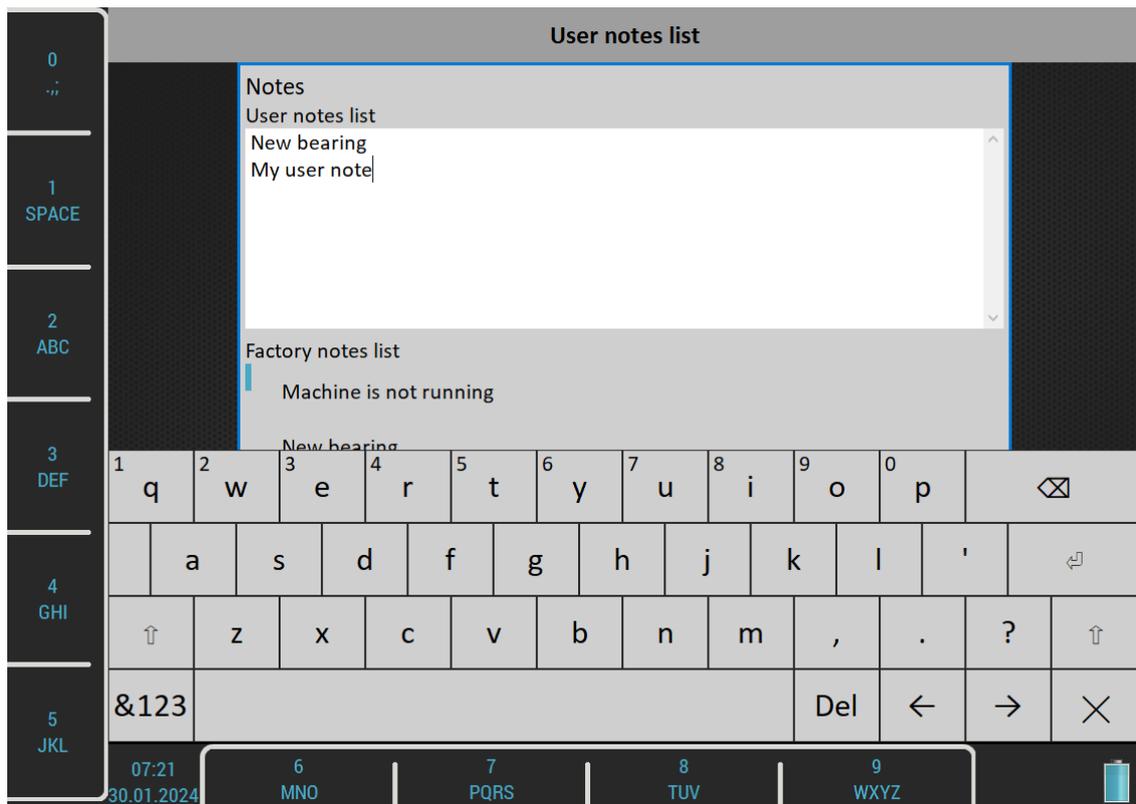
Push the *Escape* button to skip back to the *Factory notes* list.

Push the *Escape* button when *Factory notes* list is active to close the dialog. The "*Save changes*" question will appear. Confirm if you want.

Date/Time

Date format

yyyy/mm/dd
dd.mm.yy
mm/dd/yyyy (the a.m./p.m. is used)

Year, Month, Day, Hour, Minute, Second

Set the current date and time.

Shortcuts

Set the shortcuts for buttons.

Signal Source

The measurement can be taken from **LIVE** channels or from *record* (see Recorder chapter for understanding). All *records* saved in the instrument's memory are displayed in the *Signal Source* list below the **LIVE** item.

Trigger Settings

Parameters for measurement's triggering are entered in this menu.

Analyzer Trigger Mode

Measurement's trigger control for Analyzer module. It is also used in Octave Analysis module.

single
Only one *reading* of all *measurements* in a *set* is taken and displayed.

retrig
When you use the analogue oscilloscope, you always see the current new signal on the screen. This means the similar thing. The measurement is repeated until you push the *Stop* button.

Runup Trigger Mode

Measurement's trigger control for Runup module. How often the data will be taken has to be defined.
Attention! In the Runup module, new measurement can begin after all measurements in a set are finished (with one exception, **asap all** mode).

asap
The next measurement is taken immediately after the previous measurement without any delay.

manual
The user begins the next measurement manually (by pressing the *Enter* button).

speed
The next measurement is taken when the speed is significantly different from the previous measurement speed. The user defines what is a significant change in the ***Speed change*** item.
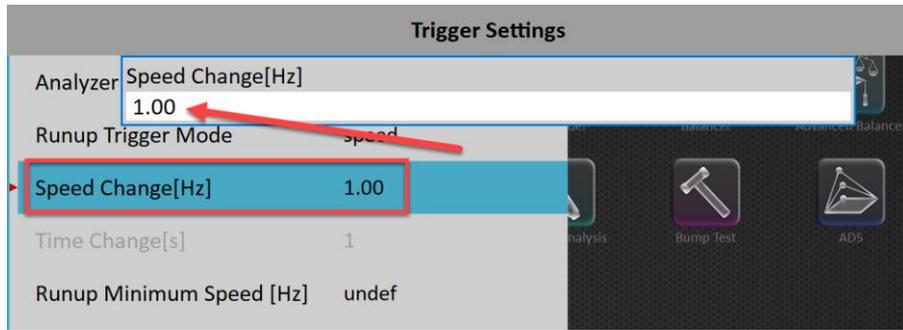
time

All measurements are taken with the same time interval between them. The time interval length is defined in **Time change** item.
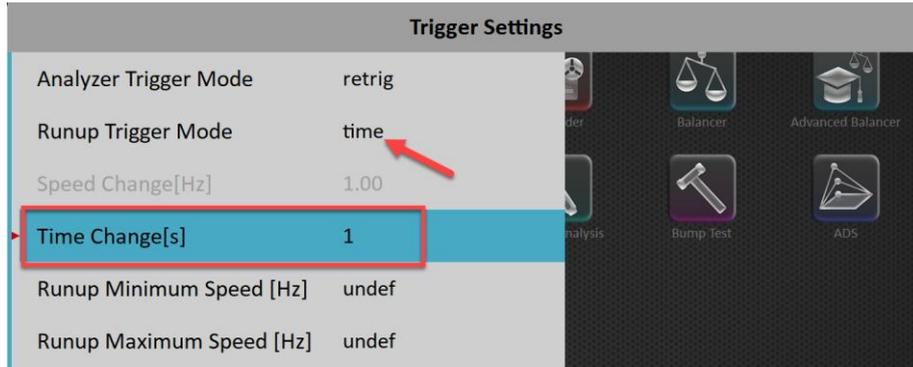
time or speed

This option is the combination of speed and time. The next measurement is taken when time or speed change occurs.

asap all

Unlike the previous trigger modes, the *asap all* mode enables **all** measurements to be taken as soon as possible. This means, the next reading of each measurement is taken immediately after the previous one. All previous modes wait for all measurement in a set to be completed before a retrig can occur. The *asap all* mode can retrig each measurement separately as soon as possible without waiting for other measurements in a set to be completed.

The following example shows the difference between the *asap* and *asap all* mode. We take three measurements with the length of 1 second, 4 seconds and 8 seconds. The first figure shows the *asap* mode. You can see three measurements, which takes 1, 4 and 8 seconds. The saving interval of all measurements is 8 seconds because the shorter measurements always wait for the longest measurement to be completed. The second figure shows the *asap all* mode where all measurements are taken as soon as possible.
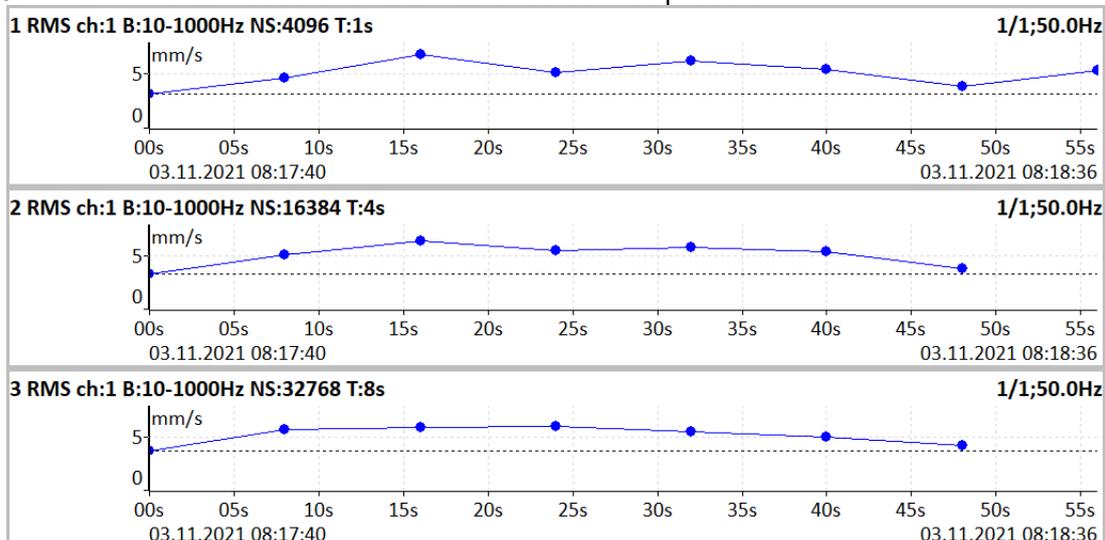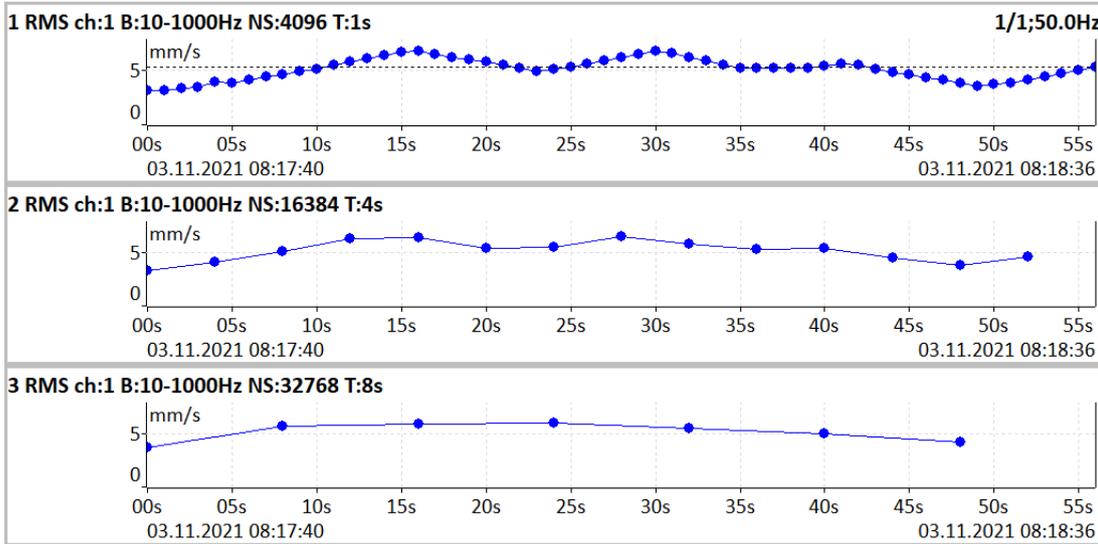
Note! When the *measurement process* waits for retrig event, a "**Waiting for retrig**" window appears. The text informs you which event is expected.

Speed Change

See the Runup Trigger Mode item.

Time Change

See the Runup Trigger Mode item.

Runup Minimum Speed, Runup Maximum Speed

undef, **user**
Runup measurements are taken only if the current speed is greater than the *Runup Minimum Speed* (if defined) and less than the *Runup Maximum Speed* (if defined). If the condition is not met the measurement is not running and a **"Waiting for runup speed"** window appears with the limit values as a note.
Note! You may define both values or just one of them.
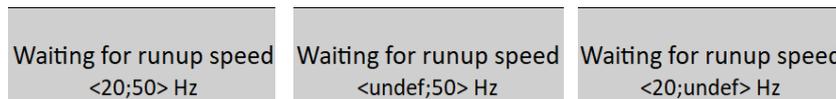
In the following figures, you can see the difference between a measurement with undefined runup minimum and maximum speeds (figure on the left) and a measurement with runup speeds set to 20Hz and 50Hz (figure on the right). As you can see, values greater than 50Hz and less than 20Hz are missing on the right figure. The example shows speed values. However, all measured data types are controlled by the speed value.
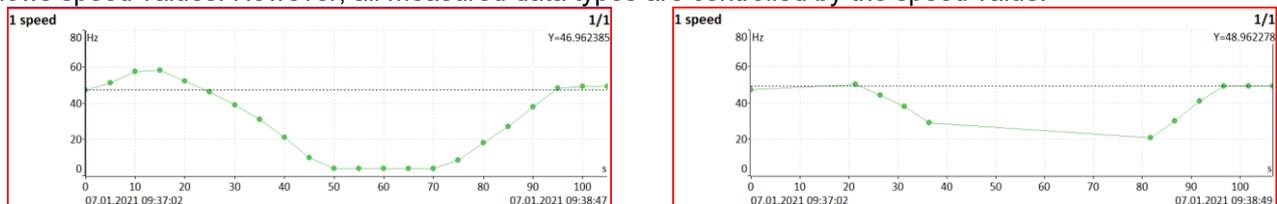
Trigger Source

Every measurement must be triggered (it means started). When you press the *Enter* button for taking the measurement, you run only the initialization. When everything is ready to take the data, then the *Trigger Source* item is applied.
In Runup mode, the frequency of measurements is controlled by Runup Trigger Mode at first. Then the *Trigger Source* is applied.

freerun
Measurement is triggered immediately after initialization without waiting for anything.

external
Measurement is triggered when the value of the external signal on TRIG input crosses the Trig Level [V] value defined in Tacho / External. Such signal may be generated, for example, when the machine starts to work.

Attention! If the external trigger source is set, a tacho probe is not supposed to be connected to the TRIG input. Therefore, in this case, no speed is evaluated. No speed dependent measurements like order analysis cannot be measured. Furthermore, no speed value is stored in data headers.

manual
Measurement is triggered after pressing the *Enter* button. Remember that you should push the *Enter* button twice. First pushing is for initialization, second for triggering.

manual sequential
Similar to manual, but every *average* during averaging must be started separately. For example, when AVG is 10, then the *Enter* button must be used 10 times.

amplitude
Measurement is triggered when signal on the **Ampl Trig Channel** input exceeds the **Ampl Trig Level** (both are also defined in this menu). Both positive (rising edge) and negative (falling edge) levels are accepted. The signal amplitude is taken directly from sensor input, no additional filtering is applied.
Examples:
the level is set to 100mV - triggered when the raising signal goes from, for example, 99mV to 101mV
the level is set to -100mV - triggered when the falling signal goes from, for example, -99mV to -101mV

tacho
Measurement is triggered when signal on TRIG input crosses the Trig Level value defined in the Tacho / External menu. The tacho is special case of an external trigger. When we talk about the tacho, we mean the signal (usually like TTL) which contains one or several pulses during one rotation of the shaft. It can also be understood like a series of single external pulses.

During averaging, tacho trigger is expected for each average, unlike in external triggering where the trigger is expected only in the beginning and then all averages are measured without triggering.

Note! When the *measurement process* waits for a trigger event, "***Waiting for trigger***" window appears. The text informs which event is expected.

Use Ampl Tacho

yes, **no**
When **yes** is set, then the tacho pulses will be created by amplitude trigger level, not from a tacho probe. Set the channel and level by the same way as for amplitude trigger. Set the **Ampl Tacho Hysteresis** to 30-50% of level to avoid creation of more pulses in near times. It could happen when signal is noisy. Sometimes you need to try more percentage values to find the correct one. See pictures for understanding.
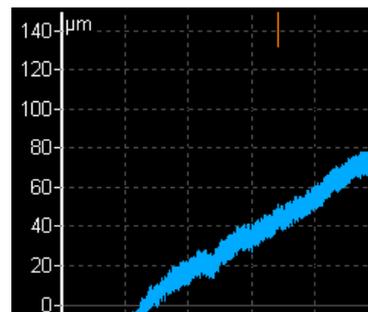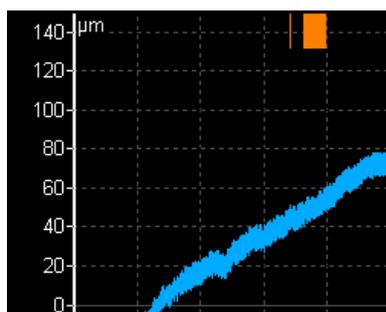
Ampl Trig Channel

See the Trigger Source set to **amplitude**.

Ampl Trig Level

See the Trigger Source set to **amplitude**. The value is set in the physical unit of the sensor on the selected channel.

Ampl Tacho Hysteresis

See the Use Ampl Tacho.

Negative Averaging

yes, <u>no</u>
Negative averaging is available only with an amplitude trigger. When turned on, a reference spectrum is taken in the beginning of the measurement after device initialization. This reference spectrum is remembered and then subtracted from each calculated spectrum. This is useful when performing a bump test on a running machine. Please don't make hits during negative averaging initialization. You are noted by this window:

> Negative Averaging Initialization
> Please don't hit
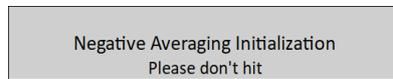
Look at the next example. On the first picture, you can see a spectrum of a hit performed on stopped machine. Exponential window is applied.
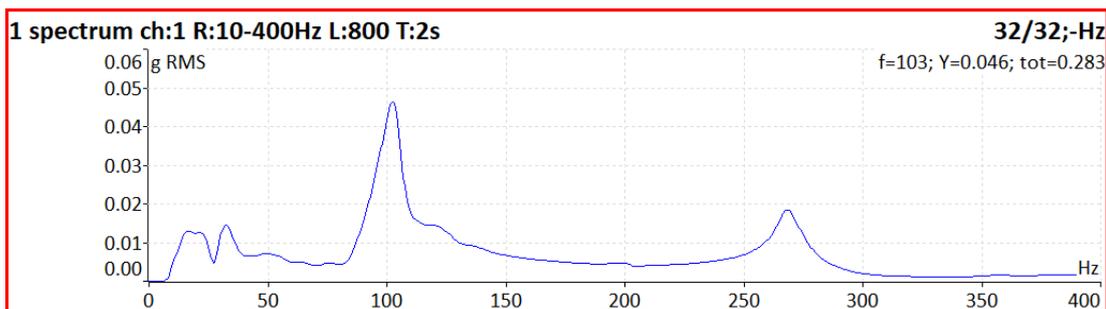
The next picture shows the hit performed on a running machine. You can see a big peak value near 50 Hz.
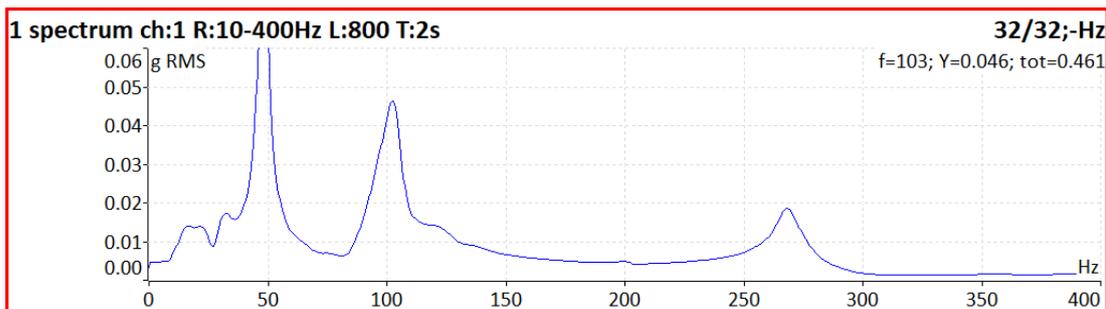
By using negative averaging, you can eliminate unwanted peaks in a spectrum, which are caused by the machine running. Not by the resonances.
Note! It is recommended to use averaging (make more hits) with the negative averaging to obtain the best possible result.
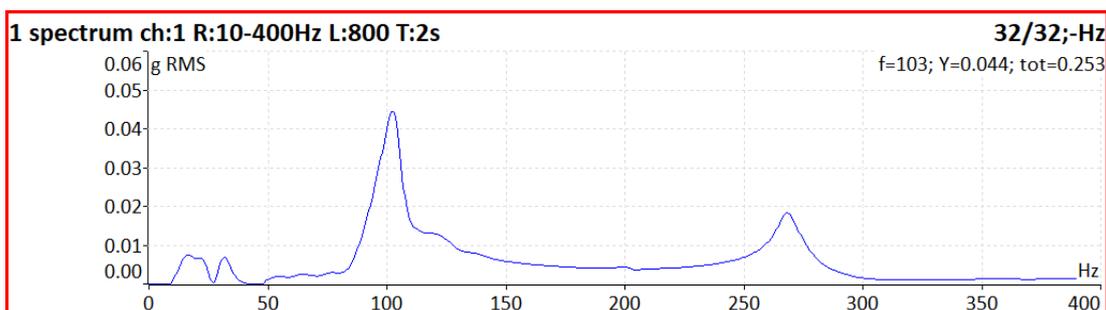
Pretrig [%]

[-100, 100]

Usually, the taking of measurement (for example, time signal) begins exactly from the trigger moment. But in some applications, you are also interested in knowing the signal before trigger. The required time should be defined in seconds, but in signal Analyzers it is usually defined as percent part of the total signal length. When a 1 second time signal is measured and pretrig is 25, then 0,25 seconds will be taken before trigger and 0,75 seconds after trigger. Also, a negative pretrig could be used. It means that the time signal will be taken later than the trigger pulse.

Runup

This menu contains parameters for Runup module.

Max Memory Size [MB]

It enables partial savings of runup measurement. If the size of measured data exceeds the value, then data are saved and new runup is opened.

Time Unit

days, **hours**, minutes – The unit of **Length** parameter (see next line)

Length

undef, **value** – If defined, measured data are then saved to individual files, where each file contains defined length.

Trend Time Axe

relative   the time axis begins from zero
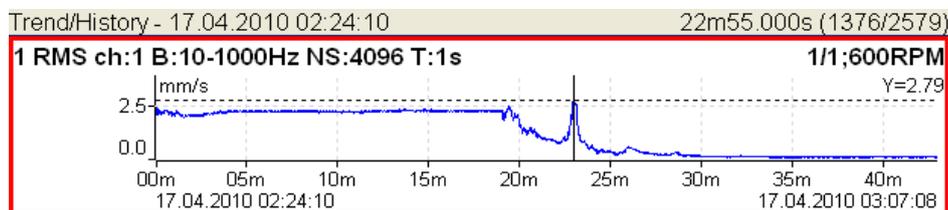
real time   the time of measurement is displayed on time axis
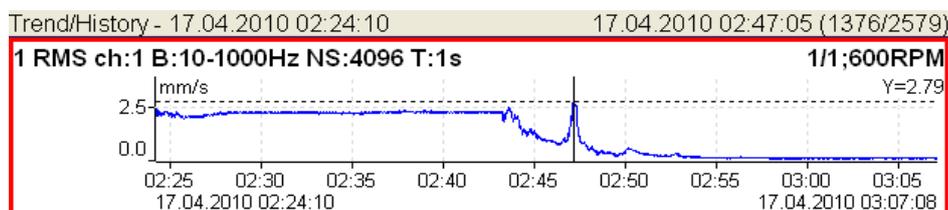
Trend Length

auto, **value** – The length of the trend graph (the range of X axis). It is used for Runup measurement and for Graph Properties / View Trend. When the auto is used, then all data in the trend are displayed.

Graph Properties

Some of Graph Properties parameters can be predefined here. Every new created graph will take these properties. Most of parameters can be later changed in the Graph Properties menu for particular graph.

Detect Type

RMS, **0-P**, **P-P** – Default detect type for spectral amplitude values.

Axe X

lin, **log**

Axe Y

lin, **log**, **dB**

Peaks list

on, **off**

Graph Lines

continuous, **discrete**

Harmonic Lines, Sideband Lines, Periodic Lines

Number of cursor lines

Sensors

When you connect the sensors to the instrument, you have to tell what kind of sensors you use. Select the *Sensors* item in the main *MENU*. In the next menu, select a channel you want to define.

AC1 – AC4

Setting of each AC channel properties (sensor, *ISO 20816* group, bearing).

All AC

Setting of all AC channels together.

All Bearings

Setting of one bearing to all AC channels.

All ISO

Setting of one *ISO 20816* group to all AC channels.

DC1 – DC4

Setting of each DC channel properties.

All DC

Setting of all DC channels.

Tacho / External

Setting of TACHO / EXTERNAL channel properties (TRIG input).

Settling Prolongation

Sometimes you may need longer time for sensor settling. Set the required additional time in seconds.

AC Sensors

AC (alternate current) sensors are used for signals, for example, vibrations. The AC sensor menu can be opened using the *MENU / Sensors / AC1 – AC4* or *All AC*.

Type

wired, **wireless**
The wired sensor is the sensor which is connected to the AC inputs (IN1 – IN4) of the instrument via a cable. The wireless sensor requires a Wi-Fi adapter to transfer the data into the instrument. The following parameters describe the setup of the wired sensor. The use of Adash wireless sensors will be described in a separate chapter Wireless Sensors.

ICP

on, **off** – Selection of a required setting according to sensor type
Note! The ICP powering is available also while measuring a DC signal because some DC sensors may use it.

Sensitivity [mV / "unit"]

1, **10**, **100**, **user** – Define the sensitivity value in the sensor's physical unit.

Unit

Select the unit according to sensor's type.

Name

undef, **user** – You can optionally enter a name of the sensor by choosing the **user** item. Use the **undef** item to reset the sensor name.

Note! The sensor's name is displayed in Sensors main menu.

Sensors	
AC 1 - acc100	
AC 2 - acc100	
AC 3	
AC 4	

Saving sensor

Parameters of a named sensor can be saved. After you enter the name, open the *Name* menu again. New item **save** is available now. When you choose this item, the sensor will be saved.

AC 1		
ICP	on	undef
Sensitivity[mV/g]	100	user
Unit	g	save
Name	acc100	
Position[°]	undef	
ISO Machine Group	undef	
Bearing Type	undef	
Save		
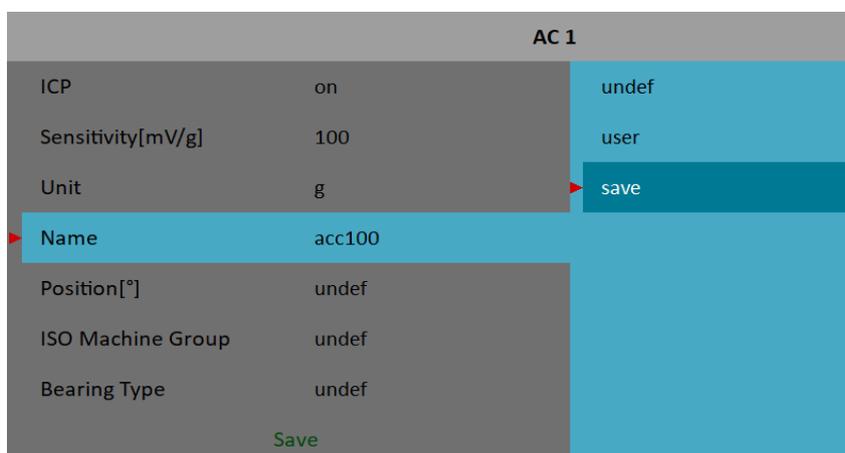
Note! If you want to save a sensor with a name which has been already defined, you'll be asked to rewrite its parameters.

> Sensor "acc100" has been already defined.
> Rewrite its parameters?

Loading sensors

Saved sensors are displayed on when you open the **Name** menu. Select a name of a saved sensor and press *Enter*. Its parameters are then loaded.

AC 1		
ICP	on	undef
Sensitivity[mV/g]	100	acc100
Unit	g	acc500
Name	undef	geofon
Position[°]	undef	user
ISO Machine Group	undef	
Bearing Type	undef	
	Save	

Note! If you choose the **user** option and then enter a name which has already been saved (e. g., **acc500**) you'll be asked to load its parameters.

> Sensor "acc500" has been already defined.
> Load its parameters?

Deleting sensor

Select a sensor which you want to delete. Open the **Name** menu again. New **delete** item appears now. Select this item and press *Enter*. The sensor will be removed from the list.

AC 1		
ICP	on	undef
Sensitivity[mV/g]	100	acc100
Unit	g	acc500
Name	acc100	geofon
Position[°]	undef	user
ISO Machine Group	undef	delete
Bearing Type	undef	
	Save	

Sensors list import

In Virtual Unit, the list of saved sensors is available as ***data\Sensors\sensors.json*** file in Virtual Unit's working directory (by default *C:\ProgramData\Virtual Unit*). You can use this file to transfer your sensors list into instruments. Copy the *sensors.json* file into the VA5_DISC root directory. Then, after starting the instrument, the file is automatically imported and the sensors list is used in the instrument.

Position

The angle of sensor (see picture below). Usually used for proximity sensors (more information in Proximity Sensors).
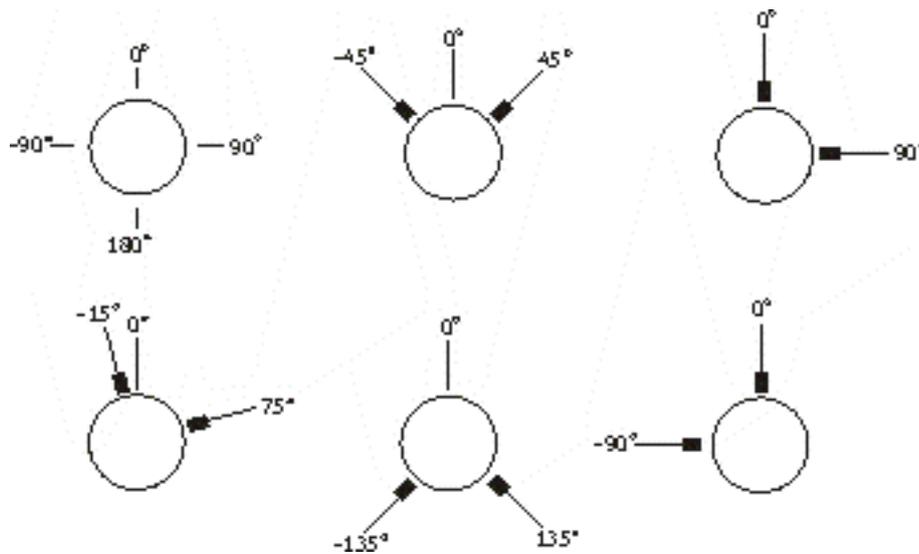
DC gap channel

In case of displacement sensor, a DC channel could also be entered, which is used for **gap** measurement (the sensor must be connected to both AC and DC input). The *gap* value is stored in time signal and orbit measurements and the value is added to a signal.

ISO Machine Group

You can set the appropriate machine group according to the **ISO 20816** for each channel separately (the *AC1 – AC4* menu) or for all channels together (the *All ISO* menu).
The *ISO 20816* group and foundation parameters are used for limit values calculations and green, orange, and red indication.

ISO Machine Foundation

rigid, **flexible**
Only available if ISO machine group is defined.

Bearing

The fault bearing frequencies can be displayed in spectra. The bearing definition is required for that. You can set the bearing for each channel separately (the *AC1 – AC4* menu) or for all channels together (the *All Bearings* menu).

database
Select bearing from a database.

Enter the name (or part of the name) and use the up/down arrows. Confirm by *Enter* or tap the item.

user
If the required bearing is not in the database, you can define the parameters manually.

undef
No bearing defined. Fault frequencies will not be displayed.

Rotating Race

inner, **outer**
Only available if a bearing is defined.
You must define which race rotates for the correct bearing fault frequencies calculation.

DC Sensors

DC sensors are used for direct current signals, for example, temperature, pressure,... The DC sensor menu can be opened using the *MENU / Sensors / DC1 – DC4* or *All DC*.

Sensitivity [mV / "unit"]

1, **10**, **100**, **user** – Define the sensor's sensitivity value in the sensor's physical unit.

Offset [mV]

0, **user** – Define the sensor's offset value in miliVolts.
The used formula:
output value in "unit" = (input value in mV - Offset) / Sensitivity.

Unit

Select the unit according to a sensor's type.

Name

The name of sensor. See AC Sensors / Name for more details.

Position

The angle of sensor. See AC Sensors / Position for more details.

Tacho / External Sensors

A tacho probe or an external trigger source is connected into the TRIG input. The TRIG input signal should contain pulses which can be used for speed calculation or for measurement triggering.

The tacho signal (magenta line), the trig level (grey line) and the created tacho pulse (yellow line) are displayed on the picture.
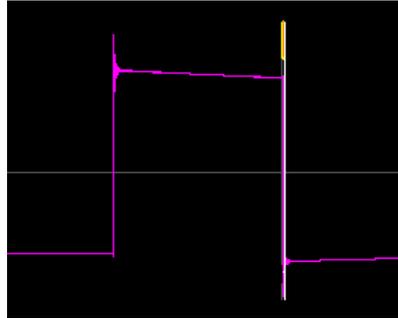
Trig Level [V]

A correct reference value has to be set. For example, when the standard tacho level is 0.5V and the pulses reach 1.5V, then the value 1V should be correct. The negative pulses are not allowed, you need to use Adash converter for them.

Trig Edge

rising, **falling** – Edge for triggering. default value changed

The trig level together with the trig edge define the time of trigger (the time when the trig or tacho mark is generated).
If the edge is set to **falling**, then the time of trigger comes when the TRIG signal **decreases** from the value higher than trig level to the value lower than the trig level.
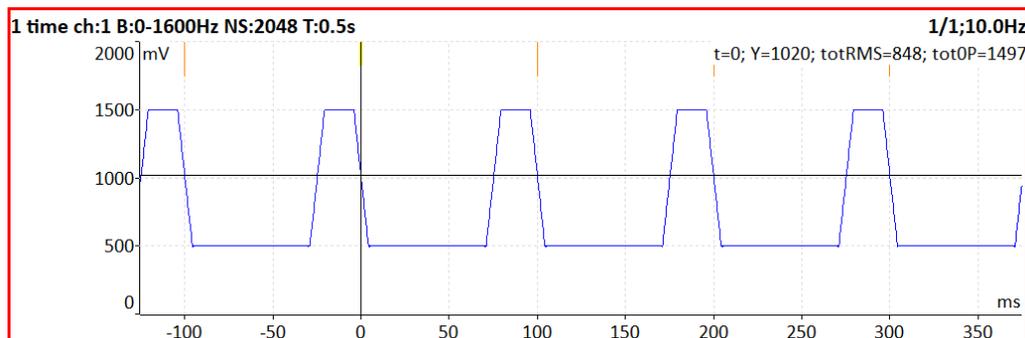
If the edge is set to **rising**, then the time of trigger comes when the TRIG signal **increases** from the value lower than trig level to the value higher than the trig level.

Pulses per rotation

This value has to be set for the correct speed evaluation when more pulses are generated during one rotation. deleted If *Pulses per rotation* does not equal one, *Trigger Source* cannot be set to **tacho**. Then, the tacho signal is used for speed calculation, but cannot be used for triggering.

Min Speed

The lowest speed which the user is interested to measure with tacho. A lower speed than this value cannot be recognized. In other words, it means how long the instrument will wait for two tacho pulses (the speed is calculated from the time between two pulses). When the pulses are missing, then the "*No Speed*" error is displayed. When you choose 1Hz, then the waiting interval is 1 second. When you enter 0.1Hz, then you will wait 10 seconds.
Attention! If the shaft speed is lower than *Min Speed*, no tacho marks are generated and no tacho trigger can occur.
Attention! By decreasing the value of *Min Speed*, you increase the time needed for tacho probe failure recognition.

Wireless Sensors

VA5 instrument can also measure vibrations with Adash wireless vibration sensor. This feature is available from firmware version 0284.
Important! Adash wireless sensor has to be used for VA5 wireless measurements!

Imagine a situation, where you have to diagnose a machine, but cannot stand in close proximity of the machine while it is running due to safety reasons. A machine or the measurement point can be enclosed in a safety cage, where it is prohibited to move around. A measurement with wired vibration sensor would be very difficult in this situation. Wireless sensor provides a perfect solution. You mount the wireless sensor to the measurement point, stand behind the safety cage in safe distance from the dangerous machine, and receive the vibration data wirelessly.

Front panel description

The wireless sensor is equipped with control buttons, which are also used as LED indicators.

When the sensor is turned off, no indicator is illuminated.

You can **turn the sensor on** by a single short press of the Power button. The Wi-Fi indicator will start glowing red and the sensor is ready for measurement.
You can **turn the sensor off** by holding the Power button (4s). The illumination of the Wi-Fi indicator will turn off.

Warning! Sensor has multiple configurations which are not used in VA5. More information later in the chapter Other sensor configuration.

Indicator colors are described in the following tables.

Power	Indicator color	
	Off	Battery mode – device powered by battery.
	Red	External power supply connected – battery charging.
	Green	External power supply connected – battery charging completed.

Wi-Fi	Indicator color	
	Off	Wi-Fi off.
	Red	Wi-Fi on, device not connected to VA5.
	Blue	Wi-Fi on, device connected to VA5.
	Green	Wi-Fi on, device connected to VA5, measurement in progress

Upper side description

The mounting hole is prepared for a screw **M6 x 45mm**. You can attach a magnet to the sensor using the screw.

See how to attach the magnet to the sensor (from the left).
1. Place the sensor to rear side.
2. Attach the magnet to the sensor.
3. Screw the magnet with a non-magnetic screw.

Rear side description
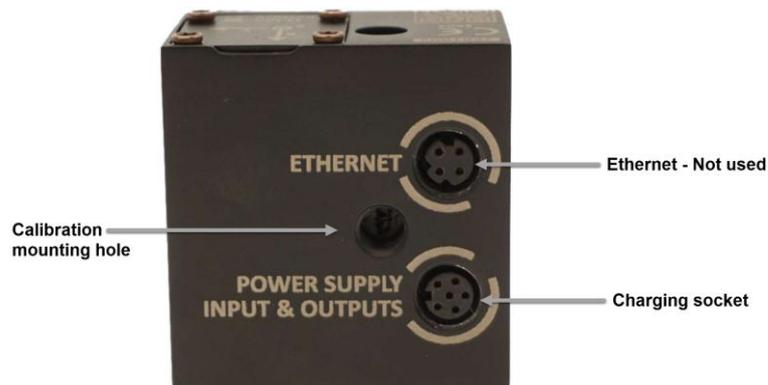
Calibration mounting hole is used to mount the sensor to a shaker during calibration.
Sensor is charged with a dedicated power cable.

The sensor automatically turns on during the charging process. It is possible to perform a measurement while the sensor is charging.
The charging process is indicated by the light of the Power indicator. Red color indicates charging. Green color indicates charging complete.

Bottom side description
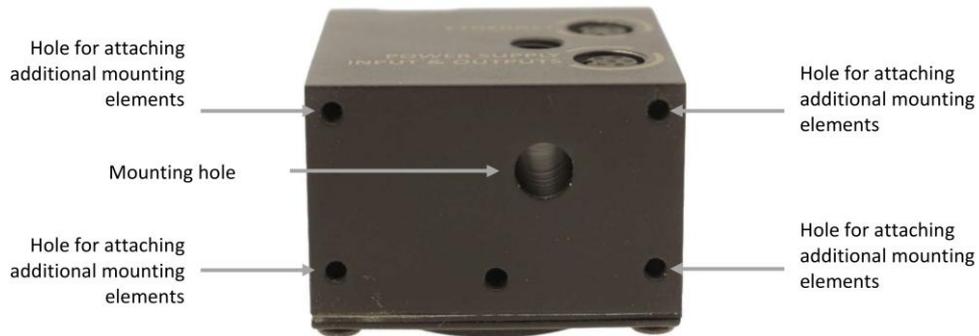
Wi-Fi adapter for VA5

VA5 needs an external Wi-Fi adapter in order to communicate with the wireless sensor. Please connect the external Wi-Fi adapter with appropriate connector reduction before every measurement and keep the adapter connected during the measurement.

USB-C to USB-A   External Wi-Fi adapter Tp-Link T2U

Wi-Fi adapter and reduction connected to VA5 device.

Sensor settings in VA5

You can redirect any of your AC input to the wireless sensor in the AC sensor setup menu.
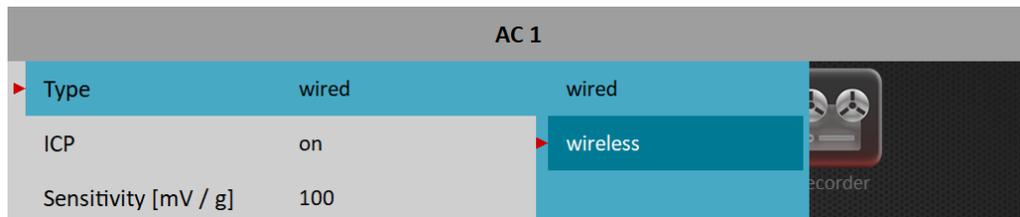
The menu is different for the wireless sensors.
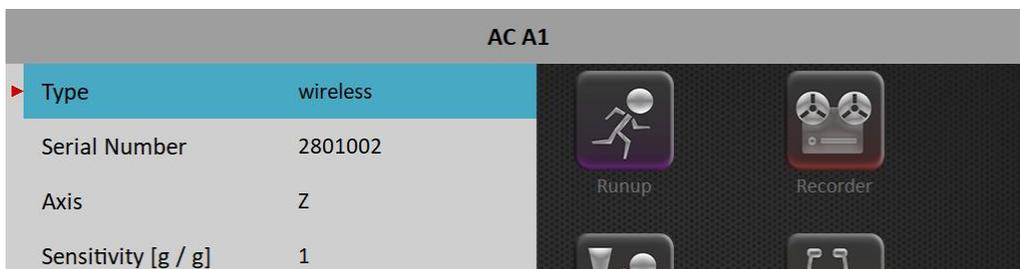
Define the serial number of the wireless sensor and the axis that is assigned to the particular AC channel. Sensor serial number and axis orientation is located on the upper side of the sensor.
When you use the channel number (channel 1 in our example) in AC channel definition (such as measurements definitions, trigger channel definitions, etc.), the signal will be taken from appropriate axis of the wireless sensor, instead of the instrument's IN1 input. It is possible to redirect any of the AC inputs this way.

The **Sensitivity [g/g]** can be used to adjust the signal. All samples will be divided by this value to obtain the calibrated signal.
If you mount the sensor on a vibration source that provides a known reference signal, you can measure the output and compare it to the expected value. If the measured value differs from the reference, use the Sensitivity parameter to correct it.
For example, if the reference value is 1 g and the measured value is 0.96 g, setting the Sensitivity to 0.96 will adjust the output to match the reference.
Note! Set the *Sensitivity* value to 1 during the calibration process.

Note! You should align the sensor so that the direction most relevant to your research or the direction with the smallest amplitude of the detected signal coincides with the sensor's Z-axis, because the measurement in the Z-axis is performed by a high precision transducer with higher frequency and amplitude range.

It is possible to use multiple wireless sensors and wired sensors at the same time.

Warning! VA5 creates a Wi-Fi network to communicate with the sensor. Do not use multiple VA5 instruments next to each other for wireless measurement, as their networks may interfere.

There are some restrictions when using wireless sensors:
- The maximum sampling frequency is 65536 Hz. Any attempt to use a higher sampling frequency will result in an error.

> Error (Graph 1)
> Improper frequency ranges

- There is no tacho synchronization input. Any attempt to use tacho input for triggering a signal from wireless sensor will result to a "Waiting for tacho trigger" state and any attempt to take a measurement which requires a tacho synchronization (e.g. speed measurement or order analysis) will result in a "No speed" error.

> Wireless 2801002
> Waiting for tacho trigger

> 1 1x amp+phase ch:1   0/1;-Hz
> U:g RMS
> **No speed**

- There is no definition for sensor position. Therefore, you are not able to take measurements that require the sensor position (e.g. orbits, full spectra).
- There is no definition for gap channel.
- It is not possible to combine signals from multiple wireless sensors or wired input into a single measurement, because the wired input and each wireless sensor are a standalone signal source. Any attempt to combine the signals from more signal sources together will result in an error.

> Error
> Signal source error

- It is not possible to set amplitude trigger when using multiple wireless sensors or wired input at the same time. This will also result in an error.

> Error
> Invalid treshold channel

Start the measurement

After AC inputs configuration for wireless sensors, simply press the Start button in order to begin the measurement process.
The **Device Initialization** info window will appear as usual. The measurements will start after a few seconds of initialization.

> Wireless 2801002
> Device Initialization
> 1s

After device initialization you will see the battery status (for 3 seconds).

> Wireless 2801002
> Battery: 99%

Note! The Wi-fi adapter is activated when the Start button is pressed for the first time. Therefore, the Device Initialization window may be displaying a little longer during first measurement. The Wi-Fi adapter then stays activated until it is unplugged or until you return to the main screen of the instrument.

As mentioned previously, the sensor's Wi-Fi indicator will glow red when the sensor is turned on. This indicates that the sensor is ready for measurement. The indicator will glow green during active measurement. When the measurement is finished, the indicator will glow blue to indicate, that the sensor is still connected to VA5 instrument ready for next measurement.

Note! When you turn the sensor on with a power button and do not perform any measurement within 15 minutes, the sensor will automatically turn off to preserve battery. However, when you perform a measurement with the sensor, the sensor will stay on indefinitely and needs to be turned off manually by holding the power button.

Some connection errors may occur:

Wireless 2801002	Wireless 2801002	Wireless 2801002
Device not found	Wi-Fi adapter not found	Wi-Fi driver not found

- **Device not found**
  Ensure the wireless sensor is turned on and within the range of the Wi-Fi signal.
- **Wi-Fi adapter not found**
  Ensure the Wi-Fi adapter is properly connected to the VA5 instrument.
- **Wi-Fi driver not found**
  If VA5 instrument is missing a driver for the Wi-Fi adapter, follow the **Driver installation** steps.

Driver installation

Some VA5 instrument may not have the necessary drivers for Wi-Fi adapter and need to be installed manually. If you see "Wi-Fi driver not found" upon starting a measurement, follow this:

1. Download driver file from Adash website: https://adash.com/downloads/adash-firmware, A4500 VA5 Pro.
2. Unzip the driver file.
3. Upload the unzipped *.driver file to VA5_DISC (root folder).
4. In VA5 main screen main menu, select Update and select the appropriate driver file.
5. Wait until the installation process ends. The Wi-Fi adapter is ready to use.

Other sensor configuration

Wireless sensor is a multi-purpose device and can operate under multiple configurations. The configurations can be changed by holding a button or combination of buttons. The sensor is preconfigured by default to correctly work with the VA5 instrument and should be operated only by pressing the Power button in order to turn the sensor on and off. However, you may need to understand the functions of remaining buttons and their color illumination.

It is possible to restore the default configuration of the sensor by holding the Wi-Fi and Status button together (for more than 5s). The configuration restoration is indicated by a short blink of the indicators.

It is possible to turn off the Wi-Fi interface of the sensor by holding the Wi-Fi button (5s). Please note, that when you turn the Wi-Fi interface off, the Wi-Fi indicator will turn off, and it is the only indication that the sensor itself is turned on. You can turn the interface on by holding the Wi-Fi button (5s) when the sensor is switched on and the Wi-Fi indicator will illuminate.

By holding the Status button (4s) it is possible to switch the sensor to autonomous mode, which is indicated by green illumination. This mode is not suitable for measurement with VA5 instrument. However, you can still start the measurement and the instrument will automatically reconfigure the sensor to the correct configuration. It is also possible to turn off the autonomous mode manually by holding the Status button (4s). The illumination will turn off.

Sensor Properties for Records

When you use the *record* (recorded signal from memory) for analysis, then the sensor properties are defined in the record, because you had to define them before the recording. You can change them for next analysis, but this change is not written to the *record*. The original values are kept in the *record*.

> The new values will be used only for analysing. Nothing is rewritten in record.

Proximity Sensors

Proximity sensors measure distance to a surface, for example to a rotating shaft. They are not in contact with this surface.
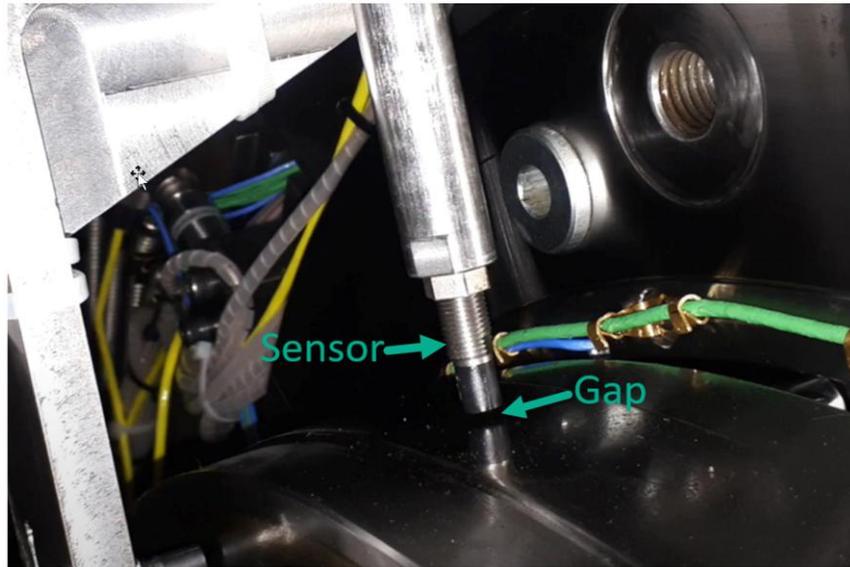
A vibration signal of a rotating shaft has an AC part and a DC part. For example, AC part represents vibrations. DC part represents the position of the shaft.

We want the DC part to be numerically zero in our measurement. To do this, we must first use the dc measurement type to measure the voltage corresponding to the DC part of the shaft's distance to the sensor (gap).

▶ Type	dc freerun, single
All Channels	no
Manual Entry	no
Channel	1
Unit	mV
Averaging	linear
Avg	off

Then we must set the measured value of voltage as Offset in DC sensor settings. This value must be negative. Offset corresponds to the distance to the shaft which we want to define as zero.

	DC 1
Sensitivity [mV / µm]	-8
Offset [mV]	-16000
Unit	µm

Output voltage on proximity sensors is negative. Lower voltage corresponds to a higher distance to the measured surface. It is usually assumed that the reverse is true, that higher voltage corresponds to a larger distance. This means that sensor sensitivity must be set as negative as well for the measured distance to be positive.

	AC 1
ICP	off
Sensitivity [mV / µm]	-8
Unit	µm

MENU / RUN

This part of main *MENU* is used for running various tasks.

Stethoscope

Runs the Stethoscope module. This is another option how to run it. The basic option is to run it from main screen.

Camera

Runs the Camera module. This is another option how to run it. The basic option is to run it from main screen.

IR Camera

Runs the IR Camera module.

Gallery

Opens the Gallery module. This is another option how to open it. The basic option is to open it from main screen.

Calculator

Opens a menu to select from various calculators.

Note! The *Calculator* item is not available when Touchscreen / Enable Touchscreen is set to **no**.

Calculator	
CALCULATOR	**VIBRATION CALCULATOR**
Standard Calculator	Vibration Units Converter
Scientific Calculator	Bearings Calculator
Units Converter	Belt Frequency Calculator
	Gearbox Calculator

Standard Calculator

Simple calculator with functions similar to a small handheld calculator.

Scientific Calculator

Advanced version of the calculator designed to solve more complex mathematical operations.

Units Converter

Allows you to convert between commonly used units. Select a known unit in the left column, the desired units in the right columns, and enter a value to generate the resulting conversion.

Vibration Units Converter

Allows you to convert between commonly used vibration units. Enter the speed and known vibration value to generate the resulting conversion.

Bearings Calculator

Allows you to calculate bearing defect frequencies. Enter the required parameters to generate fault frequencies. You can also enter just bearing designation if is available.
We have added new fault frequency named BSF2.

BSF2 = BSF*2 is the bearing failure frequency which you can see exactly in the spectrum, because a spinning defective ball hits the bearing twice during one ball revolution: once the ball hits the outer ring and once it hits the inner ring.

Belt Frequency Calculator

Allows you to calculate belt passing frequency. Enter the required parameters to generate belt frequencies.

Gearbox Calculator

Allows you to calculate shaft speeds and gearmesh frequencies. Enter the required parameters to generate gearmesh frequencies and output speed.

Update

Update of the instrument firmware. The Update item is available only when the MENU item was selected in the main screen. If any module is running, the Update item is not displayed. You can download the updated firmware from producer website. Follow the procedure:

1. Download the file for update (for example, VA5_ver0268.up3) and save it to your computer.
2. Connect the instrument to the computer.
3. Run the Explorer or other software, which you use for copy of files.
4. Copy the update file from the computer to the *VA5_DISC*.
5. Use "*Safely remove hardware*" function and disconnect instrument from the computer.
6. Select the *Update* item.
7. Select the required update file from the list (more version files can be saved in the instrument).
8. The main screen window is closed now. The procedure of update is described in the new command window.
9. After the update the instrument is reset.

Help

Displays html version of manual

Screenshot

The screenshot in png format will be saved to the *images* folder on *VA5_DISC*. You can watch the screenshots in the [Gallery](#).

Export All

Export all still unexported projects from all modules.

About

Version:	0284
Licence:	000002
Built:	29.3.2025 11:05:22
Installed:	29.3.2025 16:08:18
Disc Capacity:	57.1GB
Used Space:	9.5GB (16.7%)
Free Space:	47.6GB (83.3%)
VA5_DISC Free Space:	97.8%
Battery:	100%
CPU:	Inter(R) Celeron(R) N4020 CPU @ 1.10GHz
Computer:	UMAXVisionbook 10Wr Tab
Hw Version:	VA5.03
Charger:	12V/2A

Run the about dialog to obtain an information about instrument's software, hardware, license and disks free space.

Power Off
Switch off the instrument.

Speed detection

You need to know the speed of the measured machine in some cases. Usually, the route readings have the Detected speed set from DDS. We will describe how the speed detection works here.

Detection is done just before the measurement itself after pressing the Start button. There is an information window displayed in the bottom right corner during the detection.

If a tacho probe is used, then the speed is measured by that.

If tacho is not used, then a spectrum is displayed. The highest peaks are found and displayed in the list. The highest amplitude speed in on the top of list. You can select the correct value.
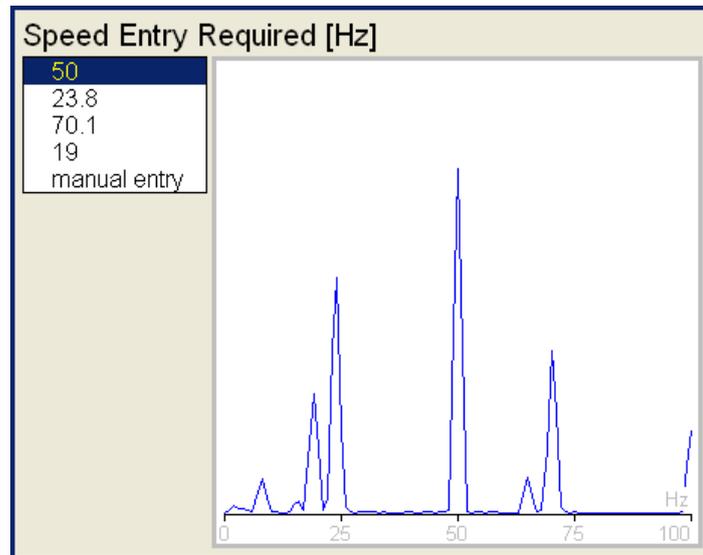
If no value in the list is correct, then select **manual entry** and enter the speed manually. If no value of speed is defined in this window, then the readings will be taken without it.

Speed detection is available only when vibration sensor is used for point reading. In other cases, a warning appears. Then the manual entry of speed is required.

If the measurement for speed detection fails, then an error message appears. For example, ICP error.

If a speed value is detected, it is automatically saved to the data header for following measurement in the same way as the speed value measured by a tacho probe. If the speed is measured by tacho probe, the value from the tacho probe has priority when saving.

<u>*Analyzer*</u>

The **Analyzer** module is the basic module for signal analysis. If you have not prepared a **Route** measurement, then you use the **Analyzer** for analysis. All required parameters must be set by hand or you can use the saved measurement parameters from memory.

Basic concepts

Meas

The *Meas* means one measurement as it is usually understood, for example, overall value or time signal or spectrum or other.

Graph

We will call the graphical form of that *Meas* values displayed on the screen *Graph*. One Graph works with data from one *Meas* item. You should keep in mind that one overall value is also the *Graph*.

Set

The *Set* is the most important term in the Analyzer mode. The *Set* is a set (or a group) of one or more *Meas* items, which the user wants to collect and display together. For example, you want to take 4 *Meas* together - acceleration overall, velocity overall, velocity time signal, and velocity spectrum. You prepare the *Set*, which includes these 4 required *Meas* items. The definition of Set is saved in the Analyzer memory. You can save many various Sets, which can contain your often used sets of measurement. Then you select one Set and run it. All measurements included in the set are made simultaneously.

Reading

The Reading means all *Meas* items (signals and values) from one set measured together at the same time.

Project

You can use various *sets* for analyzing. But sometimes, you may need more structured items than a simple *set*. We call such items **projects**.
Examples:
1. Meas_Point_A
   This is only a simple **Set Project**, which contain several measurements in one point.
2. Pump_P/ Point_1, Pump_P/Point_2, Pump_P/Point_3
   The structured *project* of 3 *sets* (3 points) on one machine (Pump_P). We call this type of *project* **L1/Set Project**. It means Level1_Name/ Set_Names.)
3. Plant_X/ Pump_P/ Points
   The structured *project* with name of Plant (Level2), names of machines (Level1) and names of Sets. This Project type we call **L2/L1/Set Project**.

Export Project to VA5_DISC (flash disk)

A computer can only read data from the *VA5_DISC*. All data are saved to an instrument's internal disk during working with a project. Therefore, a project which we want to transfer into a computer must be exported to the VA5_DISC first. The export to flash is not done automatically because the writing procedure to flash is slow. That is why the user can determine when the right moment to export the set is. VA5 asks user *"Export to VA5_DISC?"* anytime a project which has been modified is closed.

<div style="border:1px solid red; color:red; text-align:center;">Export Meas_Point_A to VA5_DISC?</div>

Push *Yes* or *No* according to your needs.
You may also export a project later using **Project/Export** menu item.

Project List

The first Analyzer screen contains a list of Projects saved in the memory or an empty list when no projects have been saved yet. The time and date of the last saving of a selected project is displayed in top right corner. Each item in the project list has a note on the right side, **S** (means *Set*), **L1** or **L2**.
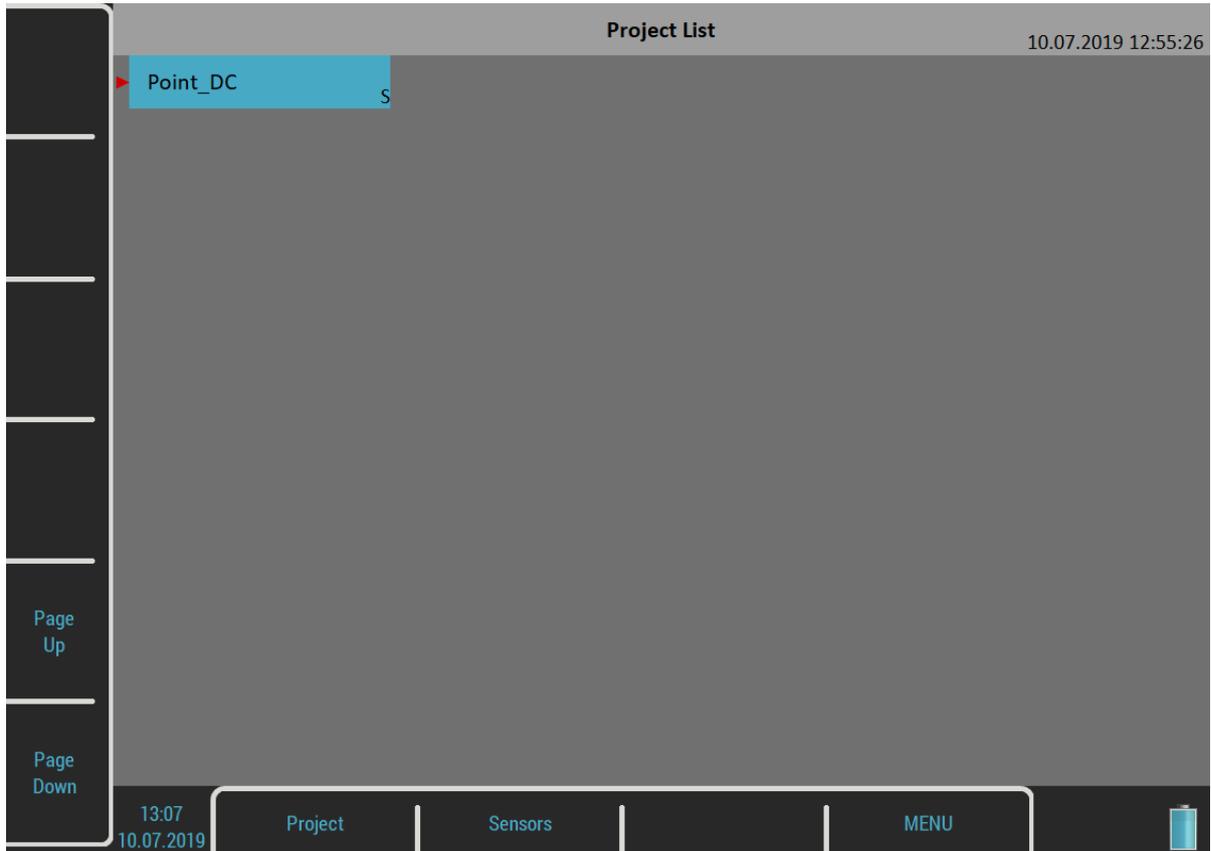
Project Menu

Push the *Project* button to open the menu.
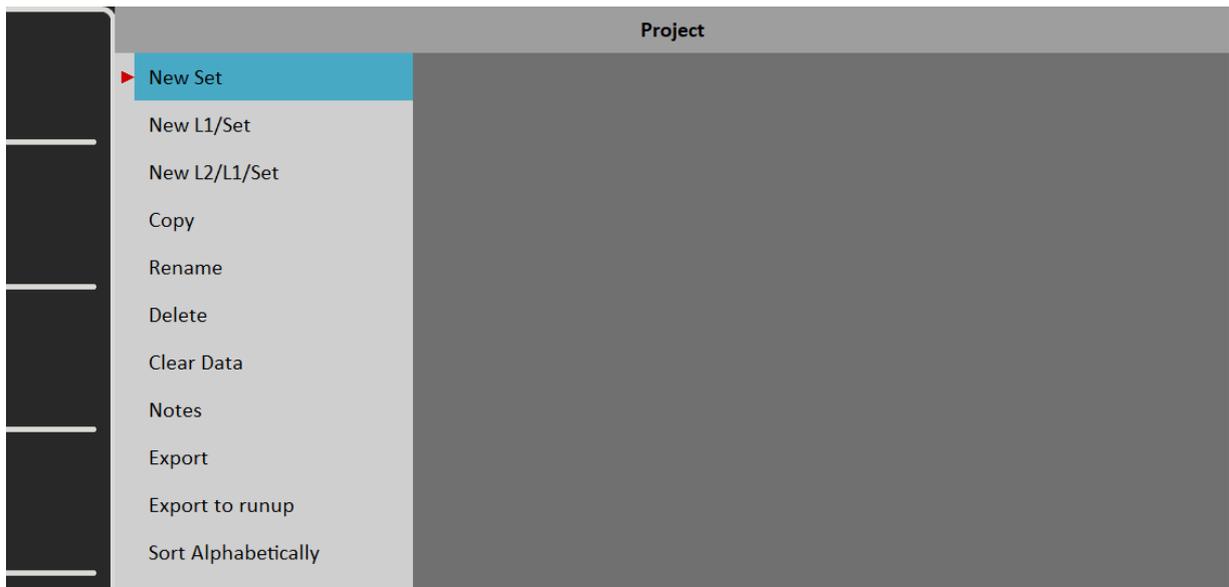
New Project - Set creation

Select the **New Set** item from the menu. The "*Enter the set name*" dialog appears.

Enter the set name.

Meas_Point_A

Enter the name of the new set. Your new item appears in the displayed *Project List* (alphabetical order).

Project List

10.07.2019 13:09:11

▶ Meas_Point_A   S

Point_DC   S

The **S** letter after the name is the **Set** type indication. Date and time of project last modification (here creation) is displayed in the status bar right corner.

New Project - L1/Set creation

The *L1/Set* structure usually enables the creation of a machine item with several points. Select the **New L1/Set** item in the menu.

Enter the L1 name.

Pump_P

Enter the name on Level 1 (for example, machine name). The *Project List* appears (alphabetical order).

Project List

10.07.2019 13:10:30

Meas_Point_A   S

Point_DC   S

▶ Pump_P   L1

The **L1** letter after the name is the **Level 1** type indication.
A new item is selected. Open it. The project will be opened and a list of included *Sets* appears (it is empty now).

Pump_P
Set List

Empty

Push the *Set* button and select the *New* item.

Enter the set name.

Point1

Enter a set name. The *Set List* contains the new *set*.

Pump_P
Set List

▶ Point1

Use the *Escape* button to return back to the project list.

New Project - L2/L1/Set creation

The *L2/L1/Set* structure usually enables the creation of a plant with several machines. Every machine can contain several points. Select the **New L2/L1/Set** item in the menu.

Enter the L2 name.

Plant_W

Enter a name. The *Project List* appears (alphabetical order).

The **L2** letter after the name is the **Level 2** type indication.
Open the project.

An empty list of *L1* items appears. Push the *L1* button and select *New*. Enter the name of a new *Level 1* item.

The *L1 List* appears.

Open the *L1* item and create the *Set* in the same way as in the previous section.

Copy

Copy the selected item to a new one

Rename

Rename the selected item

Delete

Erase the selected item(s). You can also erase more items at once by using the *multi on* function.

Clear Data

Erase measured data in the selected item(s).

Notes

You may add notes to the selected item. See the Route / Notes chapter for more details how to deal with notes.

Export

Export the selected item to the *VA5_DISC*, where they are accessible for a computer.

Export to runup

Export the selected item to a Runup module. You can also export projects from the Runup module to the Analyzer module (the **Export to analyzer** item is available in the Runup module).

Sort Alphabetically

After changing the order of projects in the project list using the Sort button, you can reorder the items alphabetically.

Graphs Screen

Open a *set project* (noted by *S*) from the *project list* or a *set* from the *set list* of a structured project.
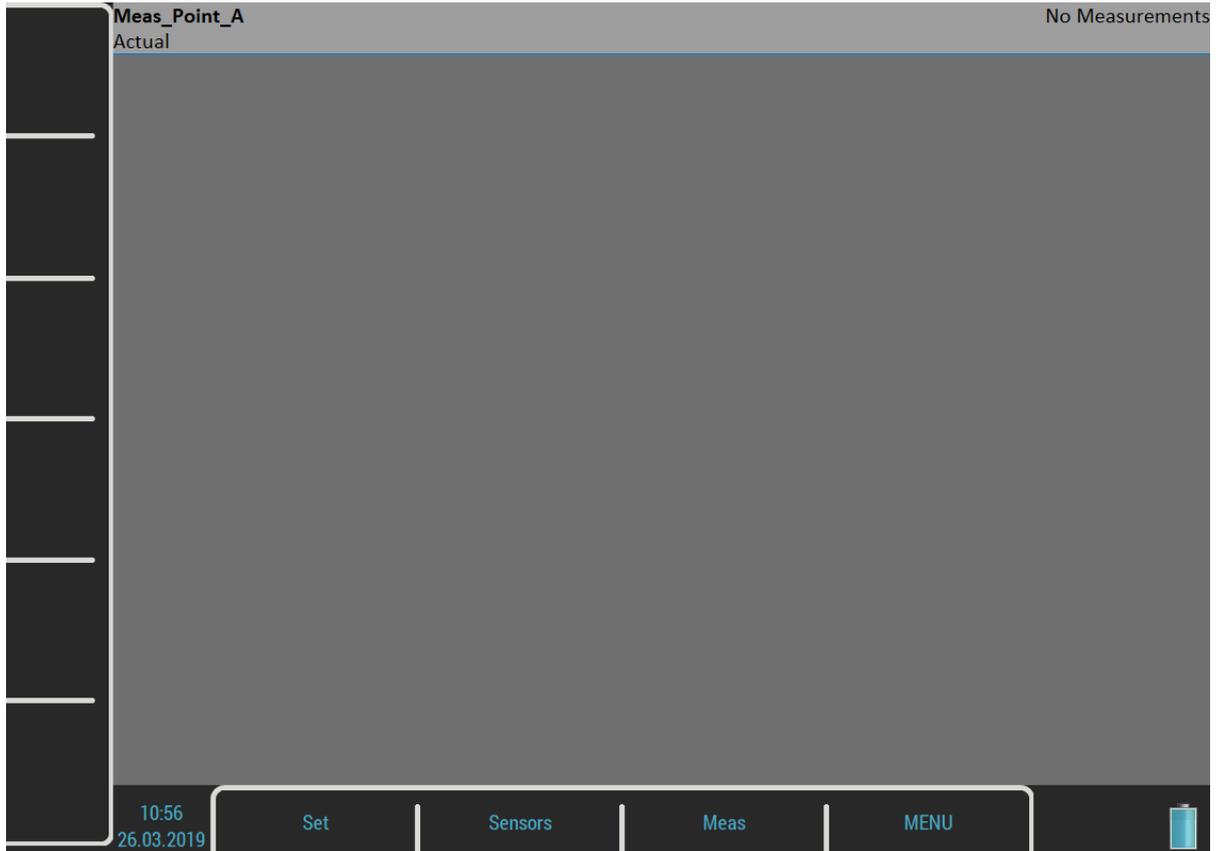
The **graphs screen** contains *graphs* of *set*'s *measurements* (now empty).

The *status bar* contains several texts. The *set*'s name (***Meas_Point_A***) is in the top left corner. The ***Actual*** indicator informs you that you are working with actual (currently measured) data. The ***Trend/History*** alternates the *Actual* if you are watching saved data. ***No Measurement*** indicates there are no measurements yet. The selected graph index and the total number of graphs is written in this place if some graphs are on screen (e.g., ***Graph 2 / 5***).

Two menus are available for the *graphs screen*, the ***Set*** menu and the ***Meas*** menu.

Measurement Definition in the Set

As has been described already, the *set* contains definitions of measurements (*meas*) which we want to take together.

Showing an example is the best way to learn the process of measurement.

The example of requirements for the Set:

Meas 1: RMS overall value in mm/s, frequency band 10-1000Hz, from channel 1
Meas 2: RMS overall value in g, frequency band 500-25600Hz, from channel 1
Meas 3: time signal in mm/s, frequency band 10-1000Hz, from channel 1
Meas 4: Spectrum in mm/s, range 400Hz, 1600 lines, from channel 1, averaging 4
Meas 5: Spectrum in g, range 3200Hz, 3200 lines, from channel 1, averaging 8

You need to define your measurements first. Push the ***Meas*** button. The ***Meas*** menu will appear.

Select the ***New Advanced*** item. An ***Edit Measurement*** menu will appear.

	Edit Measurement	
Save		
▶ Type	overall freerun, retrig	
All Channels	no	
Channel	1	
Unit	g	
Detect Type	RMS	
Band fmin [Hz]	10	
Band fmax [Hz]	1000	
Sampling Freq [Hz]	4096 by fmax	
Trigger Control	off	
Samples	4096 t = 1 s	
Averaging	linear	
Avg	off total t = 1 s	
	Save	

14:41
27.01.2024
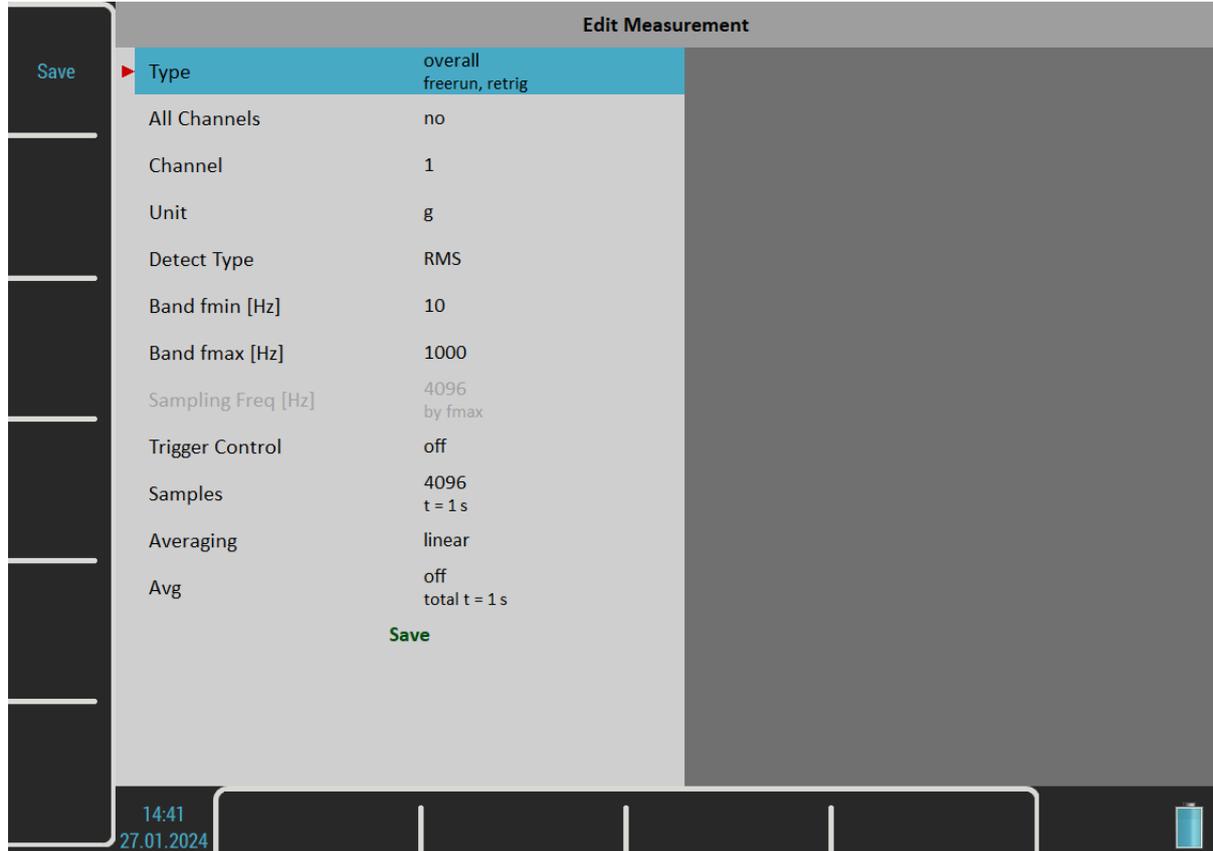
Actual trigger settings are displayed as a note under the *Type* parameter's value.
If you need to create the same measurement on all channels set *All channels* to **yes**.

Sampling Freq is newly separate menu item (it was different in older versions; sampling frequency was determined by parameter Band fmax automatically) and it can be set independently based on your preferences. **Note!** Keep in mind only one exception – for type 'overall' – sampling freq can be set independently only when band fmax value is set to '**none**' value. You can see that '**Sampling freq**' option is greyed out in the picture above.

Older versions: The *Band fmax* parameter determines a required sampling frequency. Therefore, a *fs* note is displayed under the *Band fmax* value.

The measurement's length depends on the number of samples and the number of values in an average. The time required for taking one average is under the *Samples* value. The total time for all averages is displayed under the *Avg* value.

You can edit the type and parameters of the measurement here. There are factory predefined parameters for ISO RMS which is exactly what we need as our first measurement. Just push the *Save* button and a new graph will be created.

Note! There is new button to start the measurement. You can see it in the left top corner in the following picture. You can run the measurement by using this START button. Once the measurement is done, you can use STOP button. It will show exactly in the same position as START button. But only when there is measurement running. You can see this STOP button in the picture later.
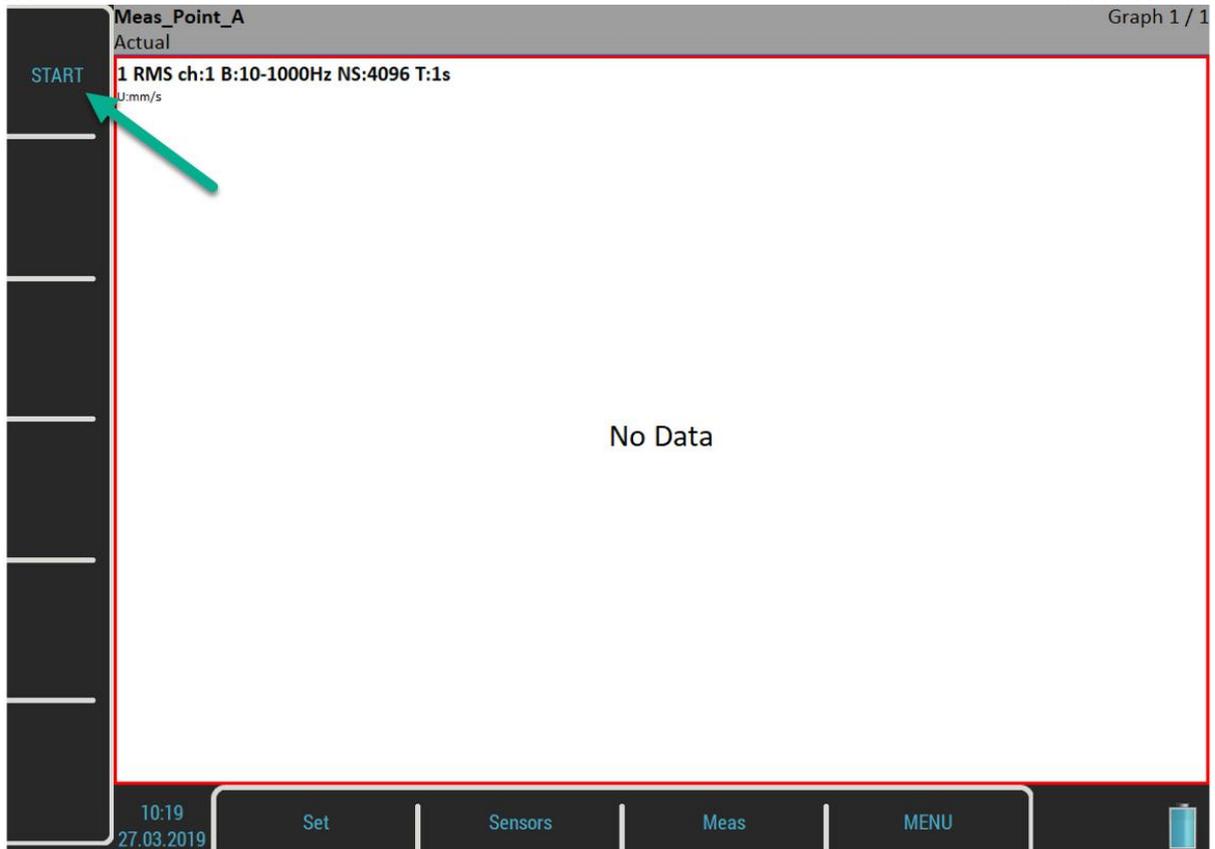
Create a second measurement. Use the *Meas / New Advanced* item again. Change the **Unit** to **g**, the **Band fmin** to 500 Hz, the **Band fmax** to 25600 Hz and the **Samples** to 65536. Confirm the dialog and the second measurement will be ready.

The number three measurement is a time signal. Change the **Type** parameter to **time**.
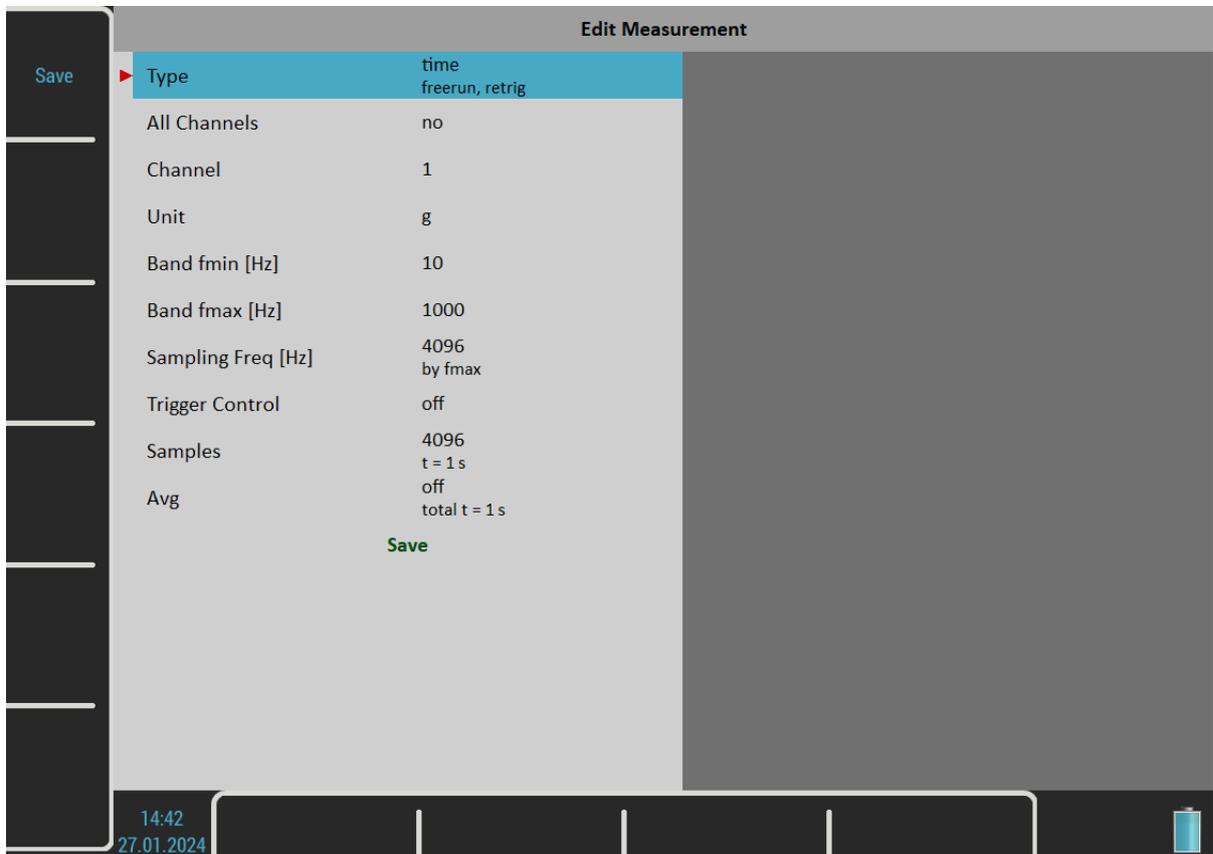
The next two measurements are spectra. The *Edit Measurement* menu for spectrum looks like this.

The *Band fmax* has been changed to **Range**. Change the **Range** parameter to 400 Hz and the **Avg** to 4 and confirm.

To finish the set definition, create another spectrum measurement with the unit of g, range of 3200 Hz, 3200 lines and Avg 8.

The screen contains five graphs of just defined measurements. The graphs don't contain data yet.

The **Graph 3 / 5** text in the status bar top right corner says that the third graph is selected (you see the red frame) and there are five graphs on the screen. Operations like edit, copy, delete are made on the selected graph. Use the up and down arrow button to change the selected graph.

The description of each graph is at the top. The complete list of symbols is stated in an appendix.

The description example:

1 RMS ch:1 B:10-1000Hz NS:4096 T:1s

The translation: Meas No.1, RMS value, Channel 1, Applied band filter 10 -1000Hz, Number of Samples of the signal 4096, Time length of signal 1s. The Signal is the time signal from which the evaluation was made.

New buttons are available now, **Control**, **Grah Max/Min**, and **Graph Properties** buttons. Their meaning will be explained later.
When the measurement's definitions are done, everything is ready to start the measurement. Push the **Enter** button.
Note! You can see new STOP button in the picture below.
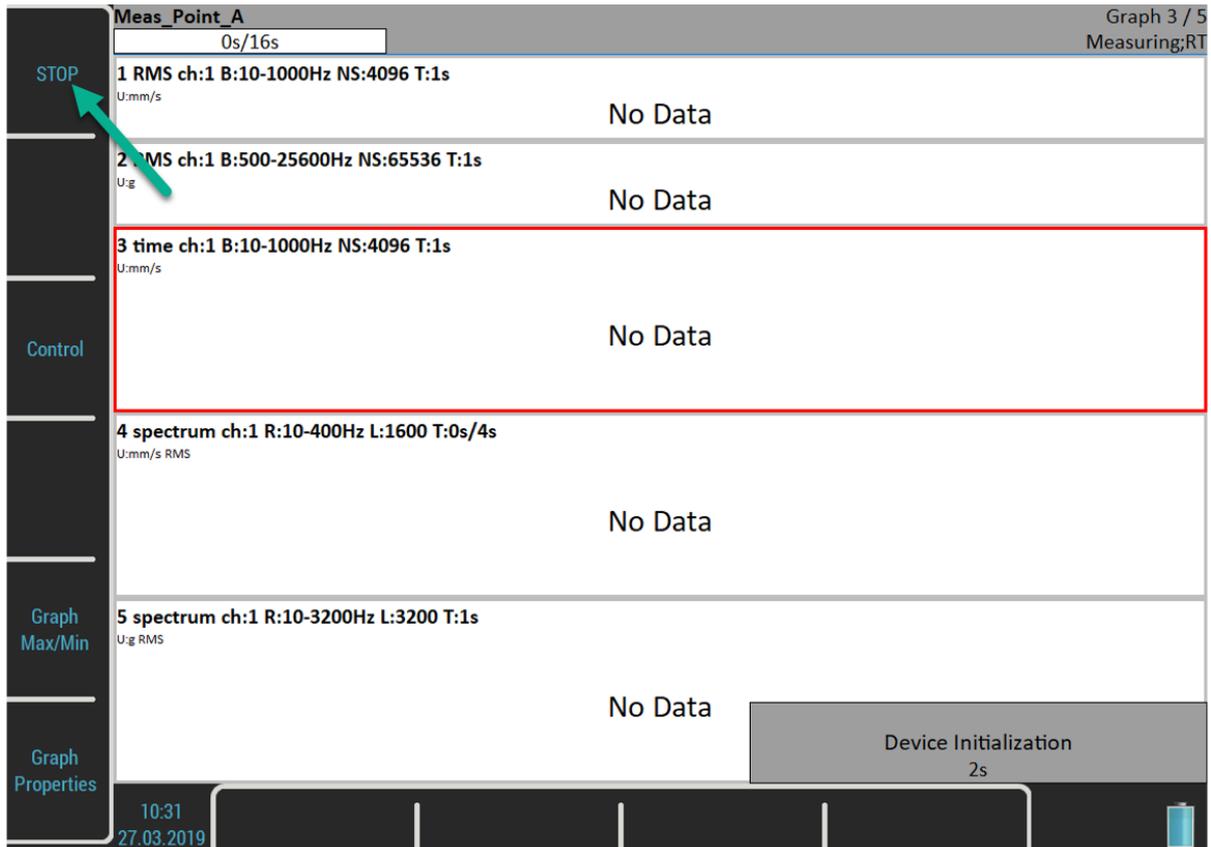
The **Device Initialization** count down appears in the bottom right corner before the measurement begins. The **Measuring** indication is in the bottom right corner of the status bar. The **RT** note means Real Time (see the Input Buffering chapter). The measurement countdown indicator appears in the top left corner of the status bar if the total time of the longest measurement takes at least four seconds.

Note! If the Analyzer Trigger Mode is set to **single**, then only one reading of each measurement is taken. Then, the measurement process stops.

Note! If the Trigger Source is set to manual, use the **Enter** button to trigger the measurement.

Use the **Stop** button to stop the measurement process. The "**Measurement is not completed**" warning appears when you push the **Stop** button and the measurement is not completed yet in the single mode. Push the **Stop Meas** button to stop it anyway or the **Continue** button otherwise.
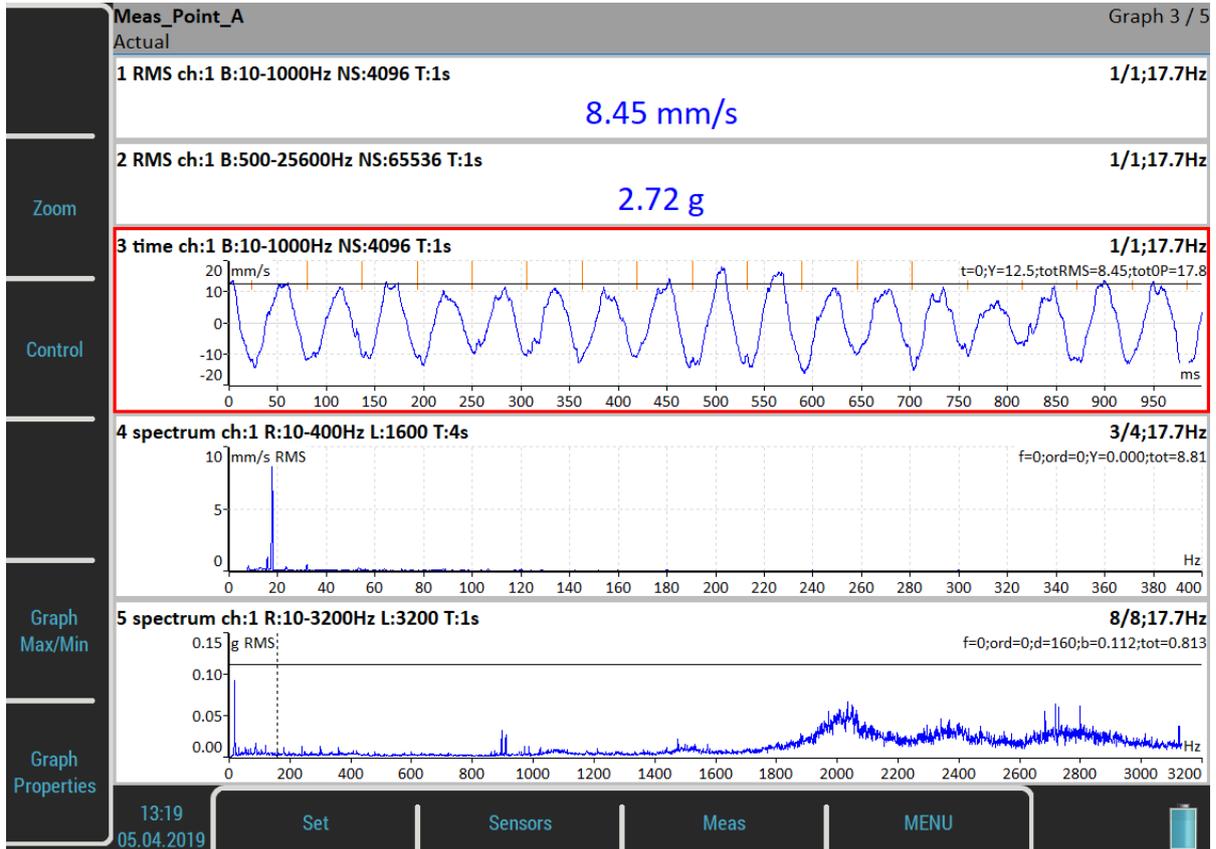
When a graph contains data, the averages and speed notification appear in the graph's top right corner. See the graph 4. The **3/4** means that 3 of 4 averages have been taken and **17.7Hz** is the speed on the beginning of the reading. The light orange lines in the time signal are **tacho marks**.

Input Buffering

A measured signal is collected into the input memory. The analyzing procedures read the signal data from the memory and compute all required results which are displayed on the screen. In case when too many results are required, the computation is slow and the displayed graphs are not in time - they are delayed. We are talking about **RT** (real time) measurement (you see the current results) or about **non RT** measurement (delayed results). This information is displayed in the status bar right bottom corner – **Measuring; RT** or **Measuring; non RT**.

After the measurement is stopped, the computation continues until the input memory is empty. The below window appears.
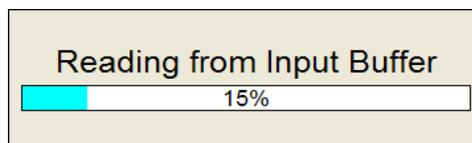
You can wait for all data acquisition. If you are not interested in measurement from input memory, press the *Escape* button to stop data processing.

Graph Max/Min

The *Graph Max/Min* button maximizes the selected graph to the whole screen or returns back to the screen with more graphs.

Buttons Modes

Use the up and down arrow button to change the selected graph. Use the left and right button to change the cursor position. You can also do it by tapping the touch screen. If you tap a non-selected graph, it becomes

selected. If you tap the selected graph, the cursor moves to the place you tapped (more precisely, it will move to the nearest place on the signal).

Another control functions are available under the side buttons. Push the **Zoom** button. The buttons mode will change. You will be able to zoom and move in the selected graph. You can zoom in axes – **Zoom X** (zoom in X axe), **Zoom Y** (zoom in Y axe). You can also zoom and move with standard gestures on the touch screen.
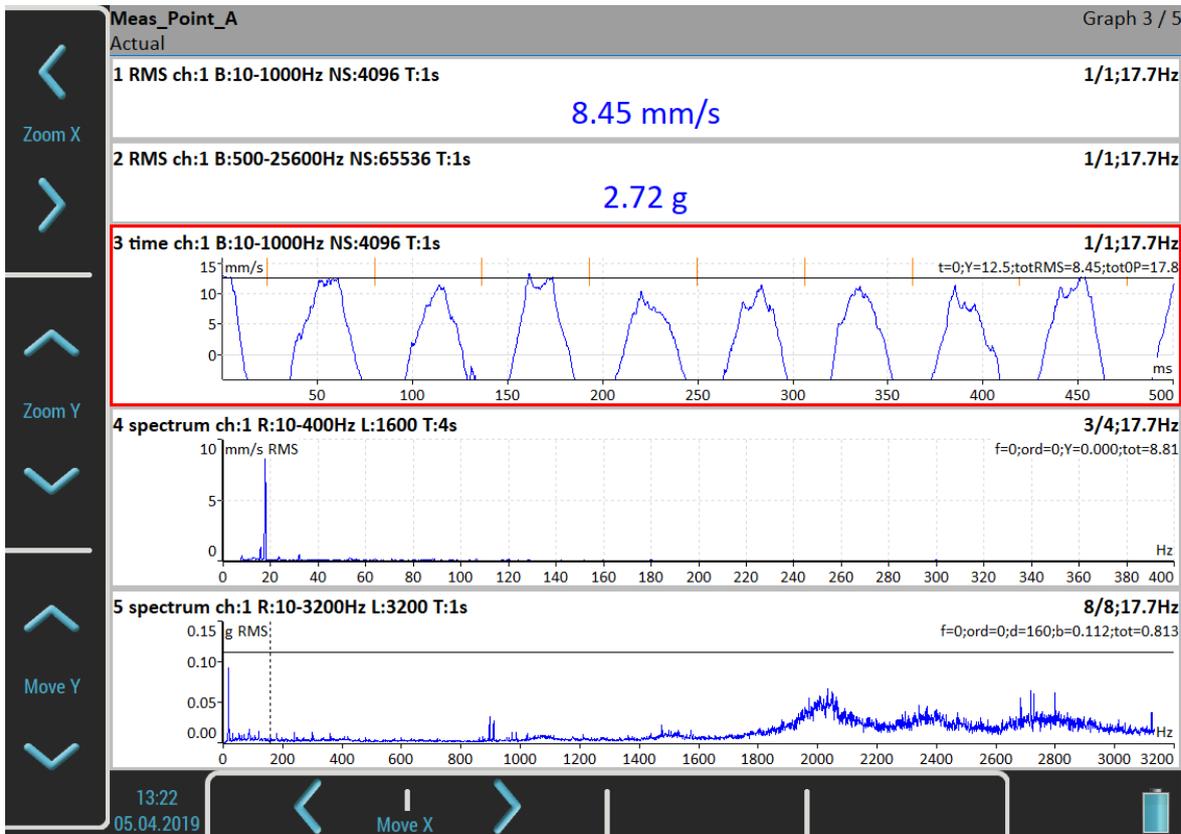
Use the **Backspace** button to restore the side buttons meaning. Then press the **Control** button. You will be able to change the selected graph's **Position**.
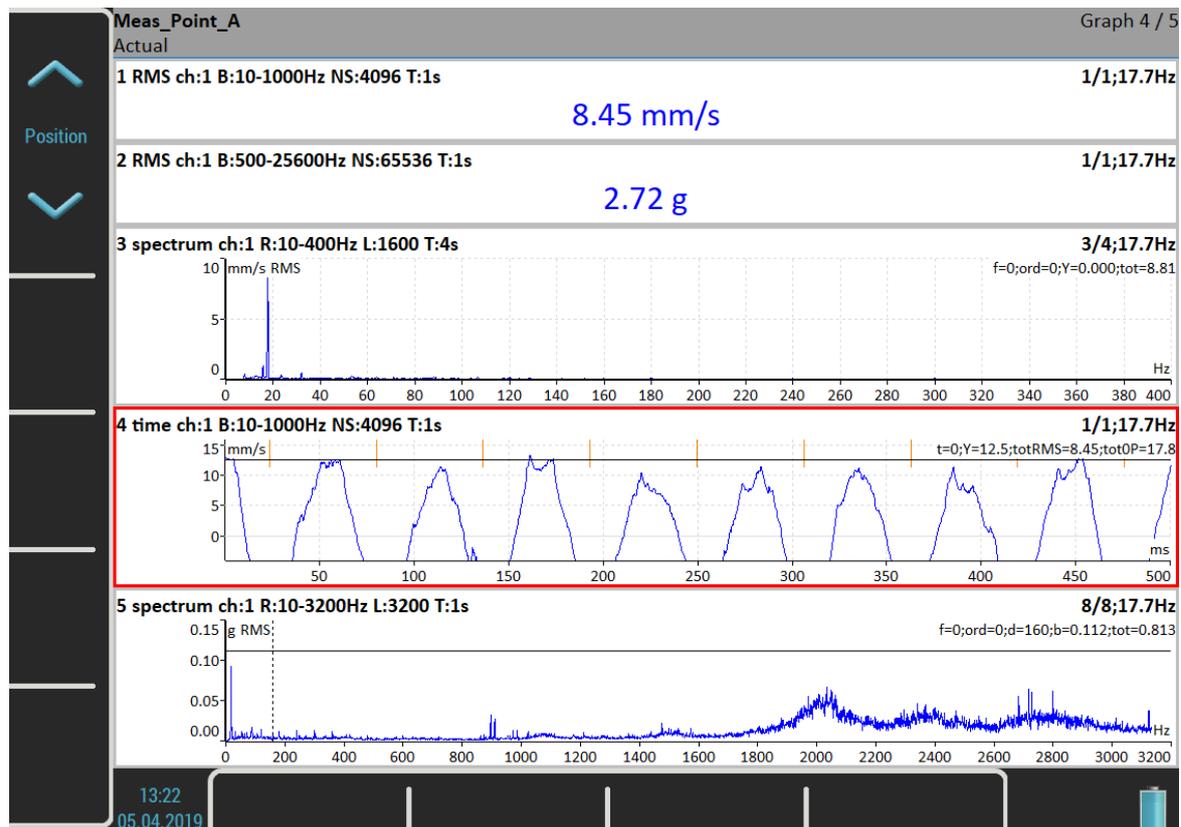
The next available functions of the *Control* mode are **Trend**, **Delta X**, **Zoom Z** and **Move Z**. These functions are hidden now and will be shown in certain situations.

The **Backspace** button restores the side buttons again.

Another possibility of switching the side buttons mode is the **Tab** button. Push the *Tab* button once and the buttons change to the *Zoom* mode. Push it again and the *Control* mode will be active. The next push will restore the initial mode. You can rotate the buttons modes this way. In some situations, there may also be more than two modes. You can use the *Backspace* button anytime to restore the initial mode.

Set Menu
Push the **Set** button. The menu appears.

Save data

Save the last measured data. When you close the set without saving, the measured data will be lost. The "*Save data?*" question appears when you are leaving the set or restarting the measurement without saving.

<div align="center">

Save data?

</div>

Notes

Open the **Notes** dialog for currently opened set. See the Route / Notes chapter for more details.

Clear Data

Clear all saved data from the set.

Enter speed / Cancel speed

Open the **Enter Speed** dialog or cancel currently entered speed. See the Route / Enter Speed chapter for more details.

View Trend / View Actual

Use the **Set / View Trend** item to load saved data of the set. The screen which displays the saved data is on the picture. Notice that the overall values are displayed as trends. The status bar contains **Trend/History** notification with the date and time of the beginning of the history. The date and time of the currently displayed value is in the bottom right corner of the status bar. The 4/8 note means that the 4th trend's item of 8 is displayed. You can move the trend cursor by the left and right arrows or by tapping the trend. This is possible only for trends of static values. Graphs like time signals or spectra use the arrows for standard axis x cursor.
The **Control** mode of the side buttons contains a **Trend** function for moving the *trend cursor*. The *trend cursor* is the same for all graphs. Values from the same time are displayed on all graphs.
Use the **Set / View Actual** item or the *Escape* button to view the current values again.
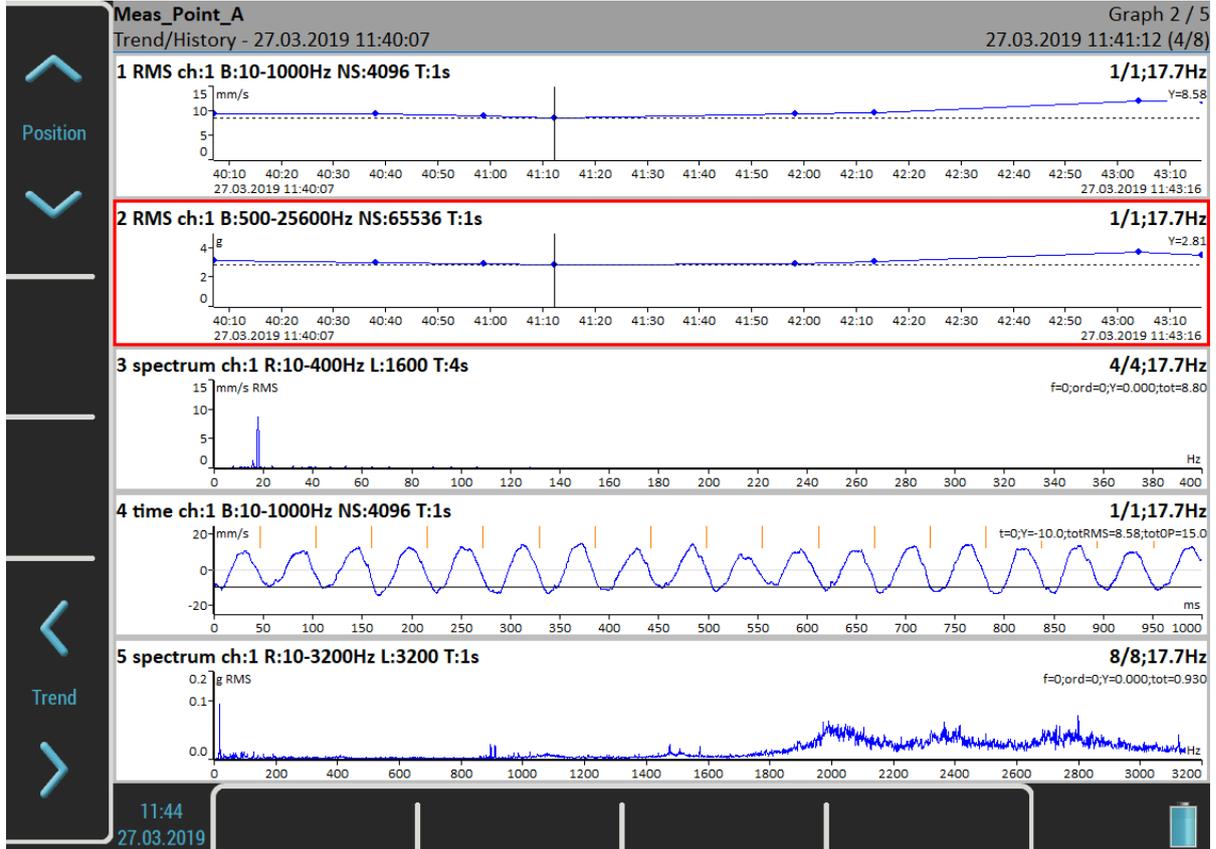
Clear Last Data

This item is available only when trend is displayed. It deletes the last saved data from the set.

Meas Menu

Push the *Meas* button. The menu will appear.

New Basic

When you want to create a measurement from a predefined list, use the **New Basic**. The list of predefined basic measurements appears. Select the required measurement from the list. This way is very fast.

The following table shows parameters of predefined basic measurements.

Name	Type	Unit	Frequency Band/Range	Length	Samples	Lines	Average
RPM	speed	RPM					
ISO RMS	wideband RMS	vel	10-1000 Hz	1 sec			
BEARING RMS	wideband RMS	acc	5000-25600 Hz	1 sec			
LBEARING RMS	wideband RMS	acc	500-25600 Hz	1 sec			
OVERALL RMS	wideband RMS	acc	1-25600 Hz	1 sec			
ISO 0-P	wideband 0-P	vel	10-1000 Hz	1 sec			
BEARING 0-P	wideband 0-P	acc	5000-25600 Hz	1 sec			
LBEARING 0-P	wideband 0-P	acc	500-25600 Hz	1 sec			
OVERALL 0-P	wideband 0-P	acc	1-25600 Hz	1 sec			
ISO TIME	time signal	vel	10-1000 Hz	1 sec	4096		
BEARING TIME	time signal	acc	5000-25600 Hz	0,5 sec	32768		
LBEARING TIME	time signal	acc	500-25600 Hz	0,5 sec	32768		
OVERALL TIME	time signal	acc	1-25600 Hz	1 sec	65536		
ISO SPEC	spectrum	vel	1600 Hz	4 sec		1600	4
OVERALL SPEC	spectrum	acc	25600 Hz	1 sec		1600	16

The **Properties** button displays the parameters of the selected basic measurement.

In addition, two more buttons are available in Virtual Unit. The **Insert** button allows you to insert a new measurement to the list and the **Delete** button allows you to delete a measurement from the list. The modified list can be transferred into instrument if you copy the *meas_templates* file from the *data\VA4template* directory in the Virtual Unit's working directory (by default *C:\ProgramData\Virtual Unit*) into the VA5_DISC root directory. Then, after starting the instrument, the file is automatically imported and the modified basic measurement list is used in the instrument.

New Advanced

Creates a new advanced measurement, where all parameters are available. You can edit type and parameters of the measurement as you need.

Copy

Creates a new measurement with properties of the selected measurement.

Info

Displays the selected measurement properties.

Edit

Enables changing the selected measurement parameters.

Delete

Deletes the selected measurement.

Limits

You can define limit values for static measurement types (overall, speed, dc, …). Limits give a notice to you when a measured value is over some critical value. During the measurement and also during examining the measured values, the appropriate alarm is displayed in the graph of a measurement with defined limits. The alarm informs you about the severity of the measured value.

Each *limit value* divides a numerical axis into two intervals, numbers below the limit value and numbers above it. You can edit the *alarm* for each interval. The alarm represents the severity or color for the values measured in the interval. You can choose one from four severities for the alarm, *Ok* signaled with green color, *Warning* signaled with yellow color, *Alert* signaled with orange color and *Danger* signaled with red color. What severity you assign to which interval is up to you. The particular alarm is displayed when a measured value is in the appropriate interval. You can define more than one limit value and divide the numerical axis into more intervals.

In the example below, we have defined two limit values, 1 and 4 mm/s. We have defined the alarm below 1 mm/s as *Ok* (green color), the alarm between 1 and 4 mm/s as *Warning* (yellow color) and the alarm above 4 mm/s as *Danger* (red color). In the first picture, you can see an actual measured value 2.61 mm/s, which is greater than 1 and less than 4 (displayed as *> 1, < 4 mm/s* on the right side) and thus signaled as yellow color. The second picture shows a trend of values. You can see two limit lines in the trend, a yellow line on 1 mm/s and a red line on 4 mm/s. They represent the defined limit values and their colors correspond to the alarms above the limit. Each value in the trend is drawn as a small colored circle whose color corresponds to the alarm.
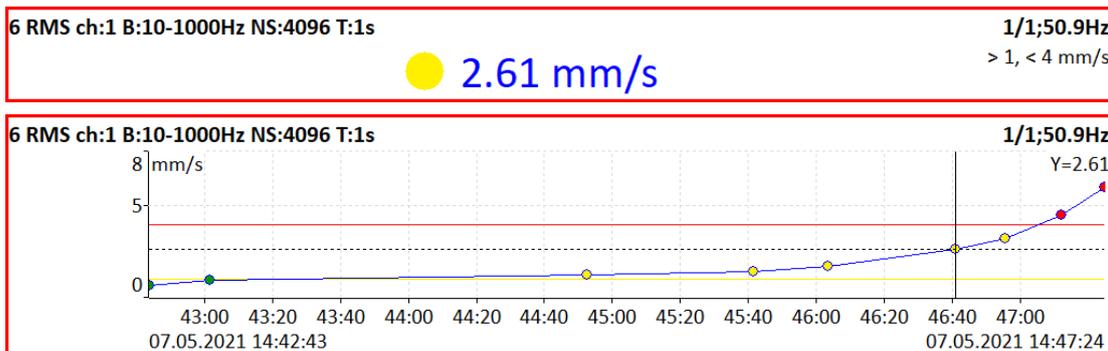
There are 3 ways how to create limits.

Adash Limits

The limits are derived from Adash rules, which were developed for many years of Adash history. These limits require knowing the speed value. Adash limits are available for two data cells types:

- velocity readings in the frequency interval 10-1000Hz, which is very well suited for detecting the overall condition of the machine

Note! fmin lower than 10 Hz is also accepted, it means Adash limits can also be used for velocity measurements with fmin lower than 10 Hz.
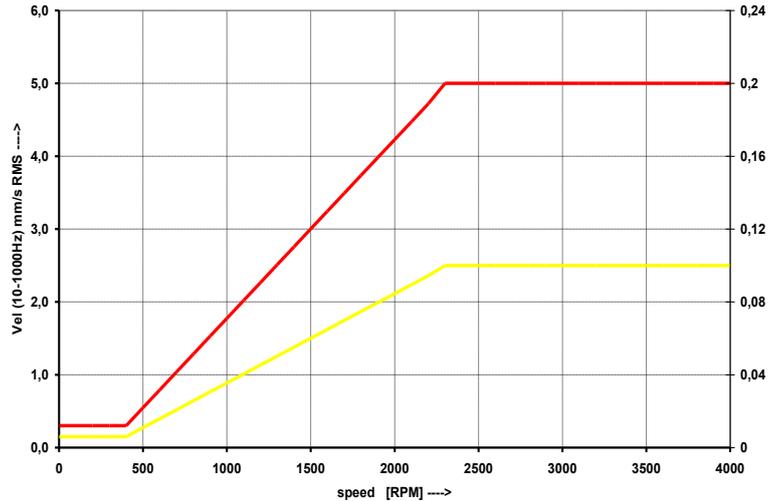
- acceleration readings in the frequency interval 500 - 16 000 Hz, which is very well suited for detecting the bearing condition.
  Note! fmin higher than 500 Hz and fmax higher than 16000 are also accepted, it means Adash limits can also be used for acceleration measurements with fmin higher than 500 Hz and fmax higher than 16000 Hz.
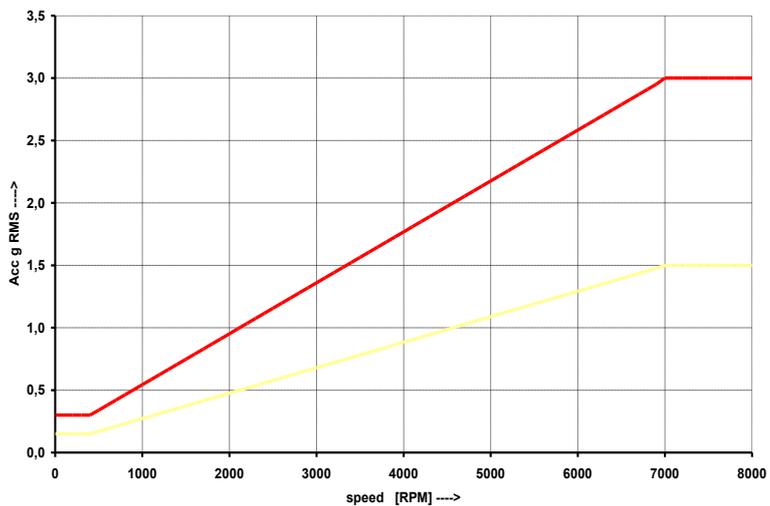
These limit values may be too strict or too little strict for some machines. Therefore, you can adjust them using the Limits Multiplier. Values greater than one increase the limit values and values less than one decrease them. A value of one means the limit remains as shown in the graphs above.
On following figures, you can see the effect of the multiplier. The first graph shows an alarm when the multiplier is set to 1. The second graph shows the same measurement. However, this time the multiplier is set to 2, which means the limit value is twice as high as before. This means the limit is less strict and the alarm level is two times lower. The third case shows the situation with the multiplier set to 0.5.

Note! For Adash limits, only the small colored circles are used in trends, the limit lines are not displayed. It is because of the relation to speed. Each reading may have a different speed and therefore different limits.

ISO 20816

The limits are defined according to the **ISO 20816** standard and are available only for velocity readings in the frequency interval 10 – 1000 Hz. The Machine Group and Machine Foundation has to be defined for the appropriate channel before using this standard (see MENU / SETTINGS / AC Sensors / ISO Machine Group and ISO Machine Foundation).

Note! The severity in ISO limits is also marked by letters A, B, C, or D. Used group and foundation is also displayed in the graph.

user

You can define your own limits.

By default, there is no limit value defined yet and the Alarm is set to *Ok* for all measured values. It is the same as in DDS dialog for limits.

You can add a limit value by using the **Add Limit Value** item and entering the value (e.g., 1).

You have now defined one limit value (1 mm/s) which divides a numerical axis into two intervals (below 1 mm/s and above it). You can define an alarm for each interval. Alarm 1 defines the alarm below the Limit Value 1 and Alarm 2 defines the alarm above the Limit Value 1. The same thing can be done in DDS by clicking on the ⊕ symbol and entering the number.

You can add any number of limit values the same way.

Type	user
Unit	mm/s
Alarm 1	Ok
Limit Value 1	1
Alarm 2	Warning
► Limit Value 2	4
Alarm 3	Alert
Add Limit Value	
	Save

Properties Route **Limits** Data Reference

○ None
○ ISO 10816
○ Adash   [Low   ⌄]
◉ User

Unit   ⊕   1   ⊕   4   ⊕
[mm/s ⌄]   [Ok   ][⌄][Warning][⌄][Alert][⌄]
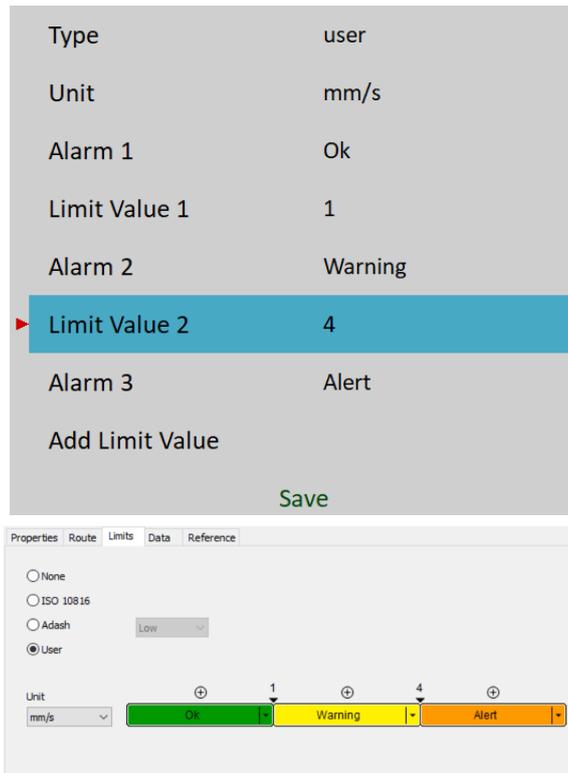
Limit values can also be edited or deleted using the appropriate *Limit Value* item.

Type	user	► edit
Unit	mm/s	delete
Alarm 1	Ok	
Limit Value 1	1	
Alarm 2	Warning	
► Limit Value 2	4	
Alarm 3	Alert	
Add Limit Value		
	Save	
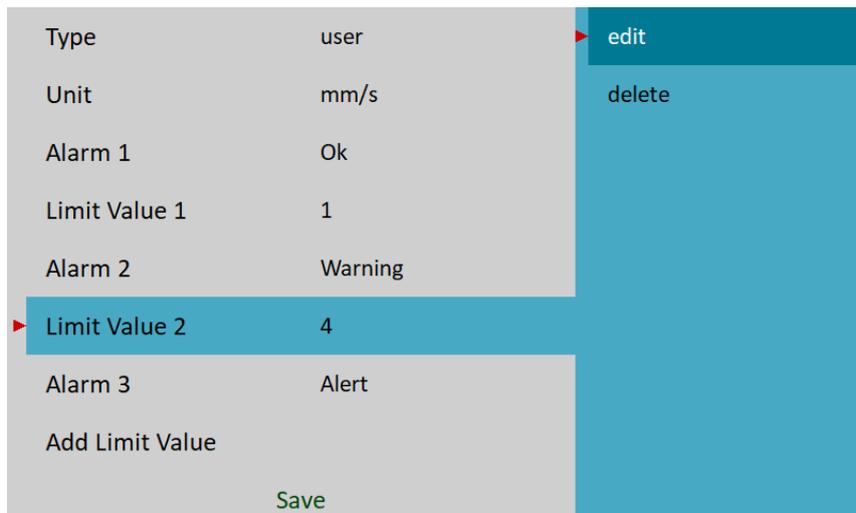
Alarms are defined using the appropriate *Alarm* item.

Type	user	Ok
Unit	mm/s	Warning
Alarm 1	Ok	Alert
Limit Value 1	1	► Danger
Alarm 2	Warning	
Limit Value 2	4	
► Alarm 3	Danger	
Add Limit Value		
	Save	
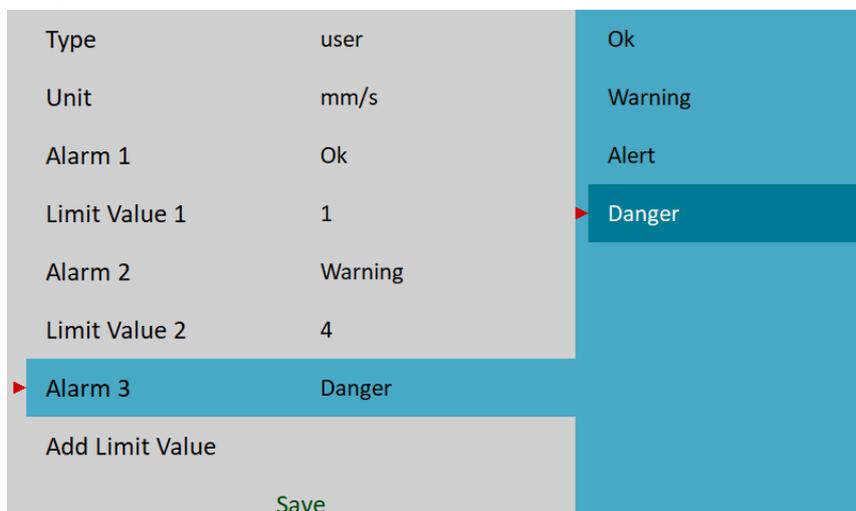
Note! You can assign alarms in any order. It's not required for the Ok interval to be the lowest. E.g., for displacement measurements, there is often the Ok interval in the middle and Warning and Alert alarms are assigned to lower and higher intervals.

Type	user
Unit	µm
Alarm 1	Danger
Limit Value 1	50
Alarm 2	Warning
Limit Value 2	100
Alarm 3	Ok
Limit Value 3	300
Alarm 4	Warning
Limit Value 4	400
Alarm 5	Danger

Export to uff

Export data of the selected measurement to the *uff* file format (not for all measurement types). The file is saved to the *uff* folder on the *VA5_DISC*.
If the **Actual** data are displayed, then only this data will be exported. If the **Trend / History** data are displayed (View Trend / View Actual), then you can export just one displayed data or all data in history. You'll be asked "**Export (All/One)?**".

Export to wav

Export data of the selected measurement to the *wav* file format (time signal and orbit only). The file is saved to the *wav* folder on the *VA5_DISC*.
Time signal is exported as one file with two channels (1st channel for signal, 2nd channel for trigger).
Orbit is exported as two files (A and B channel).
Before exporting, you need to enter the required range of the signal in the wav file. It enables you to obtain better resolution in file. If the true peak of the signal is, for example, 8mm/s, then enter 10mm/s.

Note! You may choose the 24 bit or 16 bit encoding of the wav file using MENU / SETTINGS / Global Settings / Wav Encoding

Export to csv

Exports data of the selected measurement to the *csv* file format. The file is saved to the *csv* folder on the *VA5_DISC*.

Csv Header

The first line in a csv file is a header with the information about the measurement. Parameters in the header begin with a sign and are separated by a semicolon (***sign: value;***). The following is a list of possible signs:

- **u**: unit (the serial number of the unit in which the csv was exported)
- **ch**: channel
- **n**: number of samples (lines)
- **d**: delta (the difference between two samples in x axis unit)
- **eu**: evaluation unit
- **t**: time of the measurement
- **s**: speed during the measurement
- **sensor**: if a sensor's Name is defined, it is also saved in the csv header
- **note**: The header can also contain a note which is automatically included from the set's notes (see Notes). Only notes created after the measurement was taken are included.

Csv Data

The measurement data are saved in individual lines. Each line contains values depending on the type of measurement.

Time, **g-env Time**, **ACMT**

time; amplitude; trigger

Orbit

time, amplitude A, amplitude B, amplitude X, amplitude Y, trigger

Spectrum, **g-env Spectrum**, **Octave spectrum**

frequency, amplitude

Orders, **Order spectrum**

order, amplitude, phase

Frf

frequency, amplitude, phase, coherence

Cepstrum

frequency, amplitude

Export to csv (all)

Exports to csv for all measurements which are in the set (to a folder).

Export to Records

Note! Only when the **record** measurement is selected in analyzer!

The list of all records in the selected record measurement appears. Select one or more records from the list. If you select only one record, then enter a new name. The default name of the new record begins with the set name followed by the date and time of recording (yyyy_mm_dd_hh_mm_ss_msec). The selected records will be exported/copied to the Recorder module (folder). Now you can work with them in the Recorder module.

Export to VA5_DISC

Note! Only when the **record** measurement is selected!

This item is very similar to the previous one. Export the selected records to the *VA5_DISC VA4recorder* folder.

Edit Measurement

The *Edit Measurement* menu is opened using **Meas / Edit**. This menu is also automatically opened when a new measurement is created. The content of the menu depends on the measurement type selection (first row). All parameters of all measurement types will be described here.

Type

The type of measurement. Actual Trigger Settings are displayed below the type value.

All channels

You may set this parameter to yes to create the same measurement for all channels.

Channel

The input signal source channel for evaluation.

Channel A

First channel number for orbits.

Channel B

Second channel number for orbits.

Input channel

The input channel for the frf measurement.

Output channel

The output channel for the frf measurement.

Unit

Measurement's physical unit.

The user must first define a sensor's unit according to his sensor. Then, he also defines the measurement's unit which must be convertible from the sensor's unit. That means, it can be any unit of the sensor's physical quantity. For some measurement types, there is also a possible integration or derivation of the signal. E.g., sensor's unit g (acceleration) enables measurement's unit g, m / s^2, mm / s, in / s, mil, um...

In addition, voltage unit (V, mV) is also accepted as measurement's unit regardless of the value of sensor's unit. In this case, raw input signal is measured without any recalculation to a physical unit.

Detect Type

The type of wideband value calculation (P means Peak)

RMS
root mean square or effective value

$$RMS = \sqrt{\frac{1}{n}\sum_i x_i^2}$$

Scaled 0-P

$$Scaled\ 0-P = 1.414 \cdot RMS$$

True 0-P
it is the true 0-peak value in the waveform, the maximum value of a signal's absolute values

Scaled P-P

$$Scaled\ P-P = 2 \cdot Scaled\ 0-P = 2 \cdot 1.414 \cdot RMS$$

True P-P
it is the true peak-peak value in the waveform (a difference between the highest positive and the highest negative value in a signal)

AVG
it is the average value of absolute values of all samples

$$AVG = \frac{1}{n}\sum_i ((x_i))$$

Crest
it is equal to True 0-P/ RMS

$$\text{Crest} = \frac{\text{True}0 - P}{\text{RMS}}$$

Kurtosis

$$\text{Kurtosis} = \frac{\frac{1}{n}\sum_i x_i^4}{\left(\frac{1}{n}\sum_i x_i^2\right)^2}$$

Result Type

Standard frequency response functions measured between the source channel and the response channel

<u>H1</u>
input noise,

H2
output noise,

H3
the average of H1 and H2.

PAS
Phase Assigned Spectrum – the amplitude spectrum of response channel and phase are displayed

Component

<u>ac+dc</u>, **ac**, **dc**
You can process all input signal or use only the ac or dc component.

Band fmin

none, **1**, **2**, **<u>10</u>**, **user**
The low cut-off frequency of a band pass filter, which is applied to the signal before evaluation (removing low frequencies). The **none** value means, that only A/D converter input filter is applied.

Note! If you do not expect any important signal below 10Hz, use the 10 Hz filter instead of 1 Hz. The initialization time of the 1Hz filter is much longer than for the 10Hz filter.

Note! The **none** value does not indicate the presence of a DC component in the signal measurement. The HP filter on A/D converter is always used. But no additional filter is used. The frequency range with **none** filtering begins at 0.35 Hz (-3dB point). See the response graph.

Note! The **none** value is available only for direct measurement without integration. The 1 Hz filter is automatically used if the integration is needed and the none fmin is selected.

Band fmax

It is the high cut-off frequency of band pass filter, which is applied to the signal before evaluation (removes high frequencies). The **none** value means, that the highest frequency is determined only by input filter of an A/D converter.

DEMOD fmin
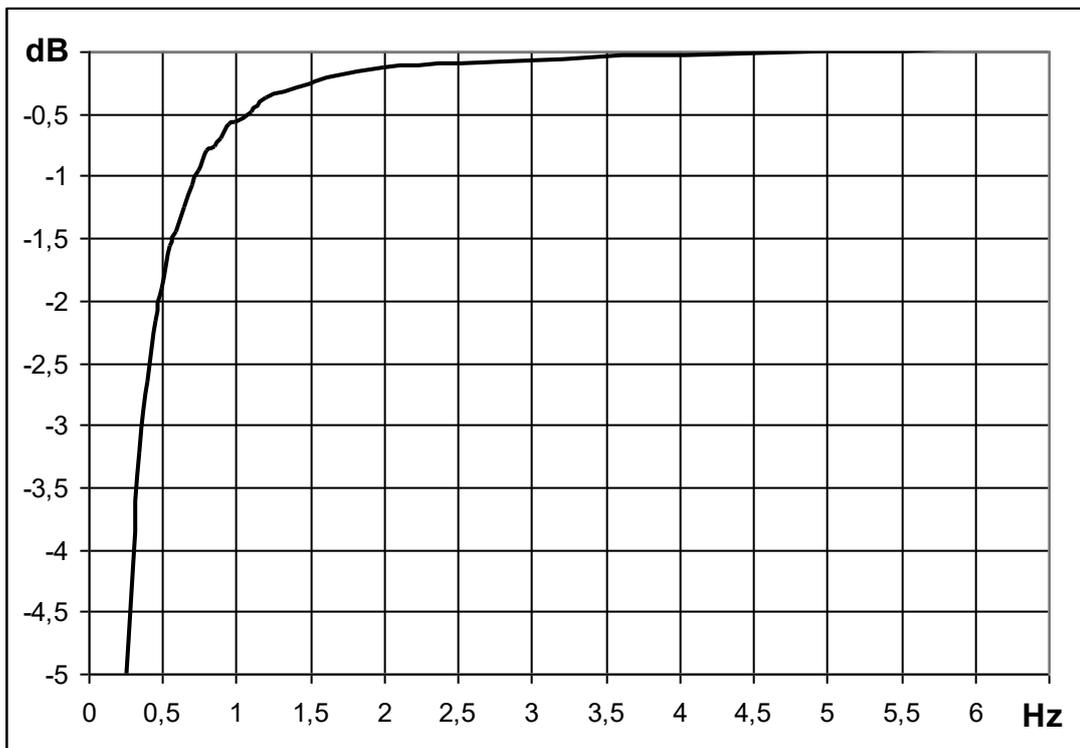
The low cut-off frequency of the band pass filter which is applied to the signal before demodulation (removing low frequencies).

DEMOD fmax

The high cut-off frequency of the band pass filter which is applied to the signal before demodulation (removing high frequencies).

The DEMOD fmax is used to determine a sampling frequency.

Sampling Freq

Sampling Freq is newly separate menu item. It was different in older versions; sampling frequency was determined by parameter Band fmax automatically. You could not to set your preferred sampling frequency. Sampling theorem was satisfied by that default setting of sampling frequency based on band fmax value:

$$fs > 2 * fmax$$

Now it can be set independently based on your preferences.

Note! Keep in mind only one exception – for type 'overall' – sampling freq can be set independently only when band fmax value is set to '**none**' value. You can see that '**Sampling freq**' option is greyed out in the picture above.

Sampling frequency can only be one of these values:
64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536, 196608 Hz
Each value is a power of two, except the last one. The highest value should be used in special cases where you need the highest possible frequency range. However, keep in mind that the fast frequency is not a power of two and as a consequence, you will not get nice values for spectrum resolution or time waveform length because the number of samples of input signal is always a power of two.

However, when you need to use a certain filter, the suggested sampling frequency may not be sufficient. Look at the sine wave with a frequency of 80 Hz. You may set *Band fmax* as 100 Hz which is a suitable lowpass frequency for your signal. If you leave the sampling frequency determined by fmax, then its value is estimated as 256 Hz. This means your signal will be sampled with 256 / 80 = 3.2 samples per period.

Band fmin[Hz]	10
Band fmax[Hz]	100
Sampling Freq[Hz]	256 by fmax
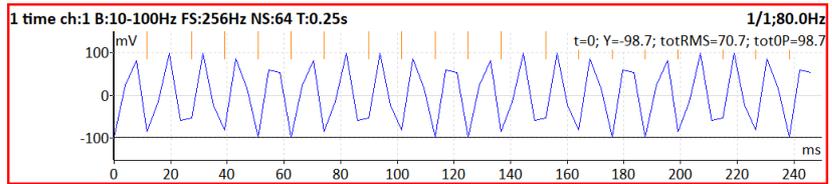
As you can see on the picture, it's hardly recognizable that it is a sine signal. It would be better if you used a higher sampling frequency. And if you still need to use the band filter with the 100 Hz fmax frequency, then the *Sampling Freq* parameter enables you to define any higher sampling frequency from the frequencies row and use the so-called **oversampling**. With oversampling, the signal is rendered more precisely.

Band fmin[Hz]	10
Band fmax[Hz]	100
Sampling Freq[Hz]	2048 oversampling: 8x

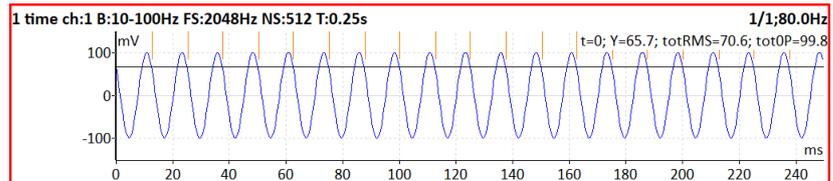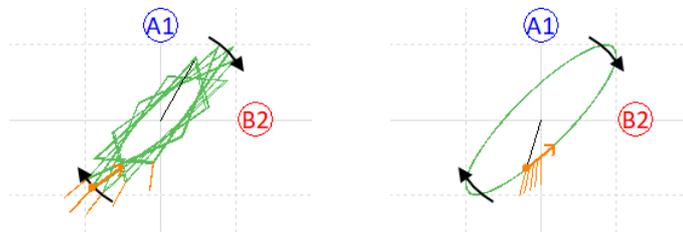Oversampling is also useful when using filters in orbits. Compare the same orbit with a different sampling frequency.

Warning! If the sampling frequency value differs from the "by fmax" value, the measurement cannot be correctly processed by instruments with a firmware older than 0282.

Note! When you set measurement type to overall, keep in mind that **fs** can be defined only for band fmax set to '**none**'.

Sampling

For aps, phase shift
standard, **fast**
Fast: It is used fs=196608Hz and the maximum possible speed will increase (but the low speed is also moved higher).

ACMT Sampling

The sampling frequency for ACMT compression. It defines the sampling frequency of the resulting signal, i.e., 1 / *ACMT Sampling* means time difference between two samples. A lesser value of *ACMT Sampling* means the signal is more compressed.

Note! The input sampling frequency is hard coded as 65536 Hz or the maximum possible frequency of input signal, i.e., when a record with lower sampling frequency is used as input, then the record's sampling frequency is used as acmt's input sampling frequency.

Note! *Input Sampling* / *ACMT Sampling* gives a compression ratio, i.e., the number of samples which are resulting in one sample. With the default value of 1024 you have 65536 / 1024 = 64 samples are stored as one value.

Range

Frequency range of the spectrum measurement. Information about sampling frequency (*fs*) which will be applied for evaluation is also displayed under this item.

Range is used to determine a sampling frequency.

Window

rectangular, **hanning**, **transient**, **exponential, flat top**
The standard offer of FFT windows functions.

When you select the Transient or the Exponential window you need to define its **Shift** and **Length**, both in milliseconds. You can enter these values directly in the menu. But this may be impossible in most cases. A better option is to use the approach from the next example (used to setup an exponential window for a bump test).

Set the **exponential** window. Keep the default values of the *Shift* and *Length* parameters. Confirm the menu. Open the Graph Properties menu and set the View parameter to **time** so it shows the measured time signal instead of spectrum. Take the first reading.
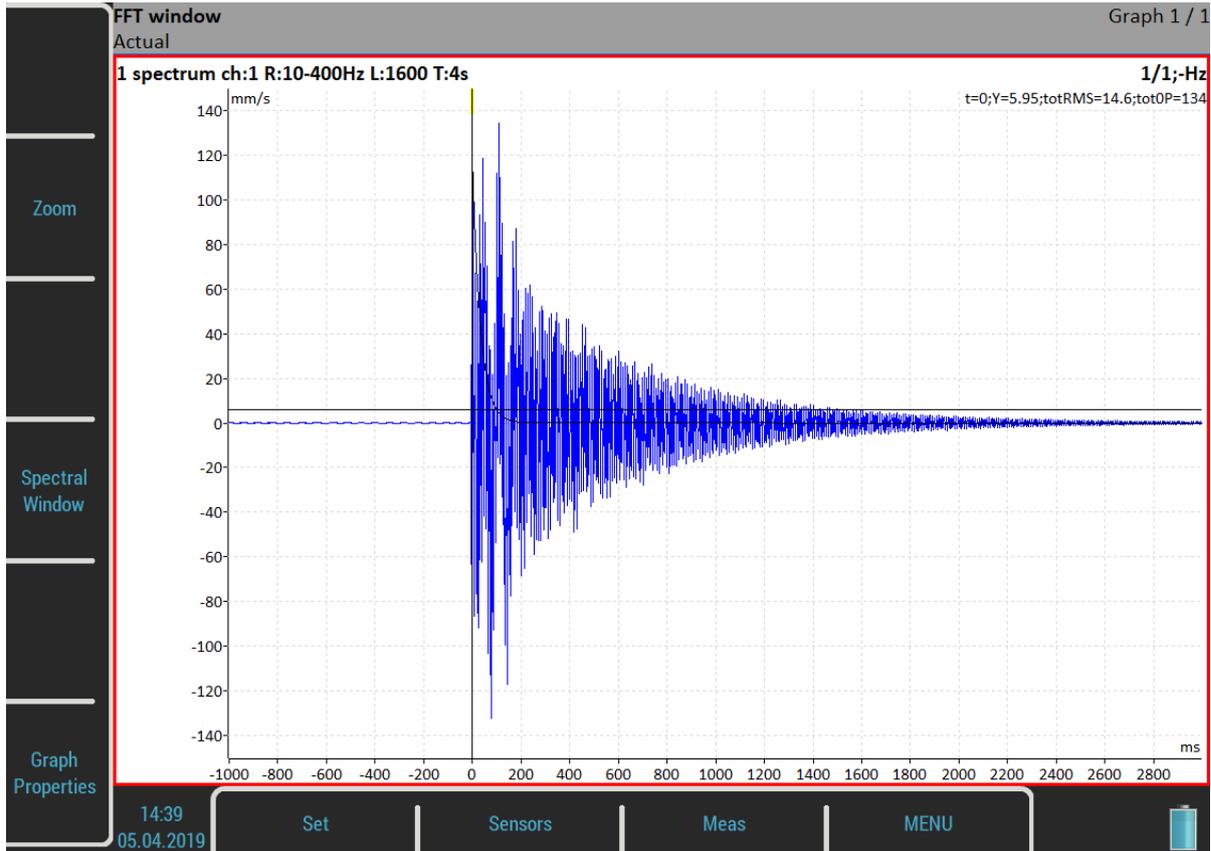
A **Spectral Window** option is available as a buttons mode now. Push the button and you will be able to setup the parameters according to the measured signal using the **Shift1** and **Length1** functions. You may also set these parameters during the measurement process.
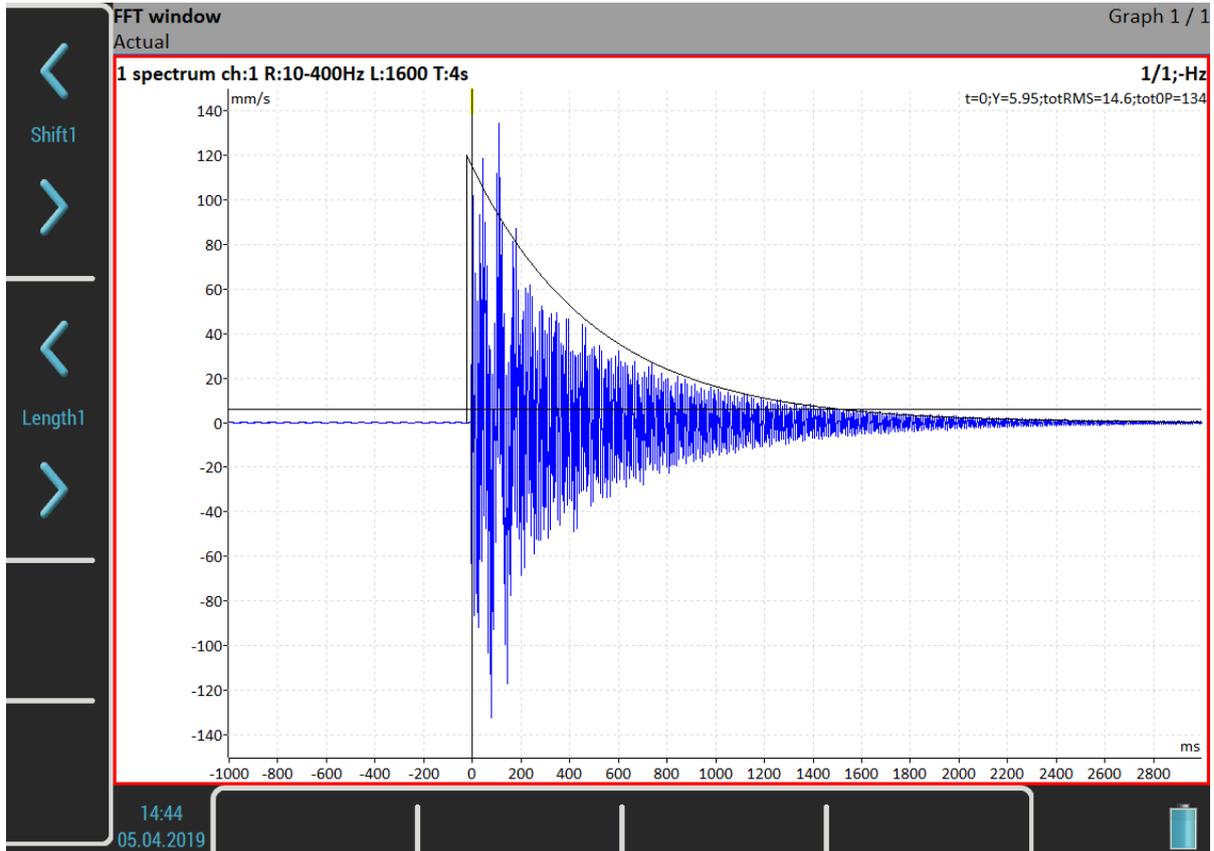
Now, when the window is set, change the view back to the spectrum and take your final reading.

In case of the frequency response function, you must setup two FFT windows for input and output signal. Then a **Shift2**, **Length2** and **Shift12** functions are available moreover.

Zoom spectrum

no
standard spectrum will be made (range from zero)

yes
zoom spectrum will be made (range around the center frequency)

Center freq

Center frequency for zoom spectrum

Trigger control

off
Time signal will contain the defined number of samples

on
Time signal will contain the defined number of triggers. E.g., if the Trigger Source is set to **tacho**, it means the number of revolutions.

Note! In the case of a freerun measurement, the pulses from tacho probe will be considered as triggers.

Samples

Number of samples. The signal time length is displayed under this item.

Number of triggers

Required number of triggers (when Trigger control is **on**).

Lines

Number of lines in spectrum. The signal time length (t) and delta frequency between two lines (df) are displayed under this item.

Averaging

<u>linear</u>, **peak hold**, **time synchro** (for spectrum)
<u>linear</u>, **maximum**, **minimum**, **median** (for static values)
Note! Averaging is used to remove variability in time signal and give us information only about values we are interested in. It can be used to filter e.g., noise from the signal we want to analyze further. Noise values are random in the time signal – with averaging these values are basically "inhibited".

Peak hold averaging – it holds the peak value – it can be used to track the minimum and maximum amplitudes in a spectrum over time.

Time synchro averaging works in this way: the time signals are averaged (must be controlled by tacho in most cases) and the final spectrum is calculated from the averaged time waveform. It can be set for non-enveloped and non-zoomed spectra.
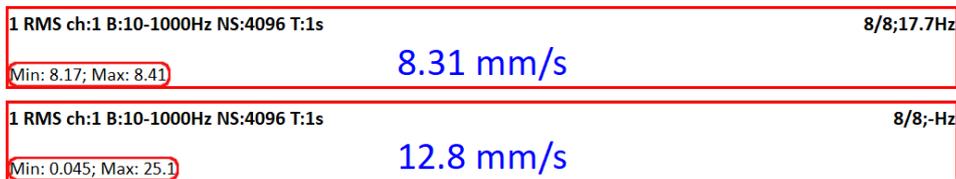
Avg

off or the number of values in the average value. The total time (*total t*) needed to take the whole measurement is displayed below this value.

Trigger Source determines how the measurement between particular values of an average is triggered:

|	
freerun	when the measurement is started, all signals needed for averaging are taken continuously
external	when the external trigger comes, all signals needed for averaging are taken continuously without waiting for the next trigger
tacho	every signal for averaging is triggered by tacho (constant phase)
amplitude	every signal for averaging is triggered by amplitude
manual	the first signal for averaging is triggered manually, next signals are taken continuously (freerun)
manual sequential	every signal for averaging is triggered manually

Note! If averaging is used, the *Min* and *Max* values are displayed in the static graph's bottom left corner. This represents the minimum and the maximum value during averaging. You can see the deviation of the measured value. These values are only displayed during measurement and are not saved to the trends.

1 RMS ch:1 B:10-1000Hz NS:4096 T:1s	8/8;17.7Hz
Min: 8.17; Max: 8.41	**8.31 mm/s**

1 RMS ch:1 B:10-1000Hz NS:4096 T:1s	8/8;-Hz
Min: 0.045; Max: 25.1	**12.8 mm/s**

In the first graph, you can see a low deviation in the value (Min: 8.17; Max 8.41). This averaged value is acceptable. On the contrary, the second graph shows a measurement with a huge deviation (Min: 0.045; Max: 25.1). Pay attention to such measurements. The measured value is almost random.

Note! If averaging is used, you probably want the measurement to be finished with the number of averaged values as defined. Sometimes, it is not possible to stop the measurement right when the averaging has been finished. Therefore, when you press the *Stop* button during a measurement with unfinished averaging, the measurement process will not stop immediately. Instead, a ***Finishing Averaging*** info window will appear. You may wait until the averaging is finished or push the *Stop* button again to stop the measurement process regardless of the averaging being finished or not.

Finishing Averaging
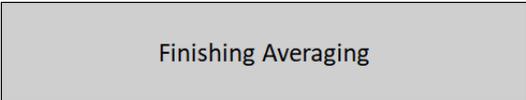
Overlap

Overlapping of signals during averaging in a percentage of signal's length.
Note! Overlapping is used to speed-up the averaging. When overlap is used, part of the signal remains and part of it is overlapped with the next one. It means, when we set overlap to 50% and we have time signal with length 1s (two averages – two signals and each of them is 1s long), the final signal will be 1,5s long (not 2s, half of the signal is overlapped as we set this value to 50%).

Attention! The overlap is not used for **time synchro** Averaging.

Attention! The overlap is used only for Trigger Source which doesn't wait for trigger between averages, i.e., **freerun**, **external**, **manual**.

Frequency

speed, **user**
The frequency value for phase shift measurement can be entered manually (user), or the speed frequency from a tacho probe may be used.

Order

The user usually needs the measurement of amplitude and phase on speed frequency. You can define any multiplication of speed in Order parameter and measure amplitude and phase on that frequency.

$$measured\ frequency = Order * speed$$

Caution! You may enter any number as an order, but the phase can only be evaluated for integer orders.

Orders

1/2,1-5, **1-5**, **1/2,1-10**, <u>**1-10**</u>
It defines which orders in order analysis will be measured.

Resolution

speed / value
This number defines the bandwidth of the spectrum line. When two near frequencies exist and they are contained in one spectrum line, the line shows the sum of both. For example, when we want to get the correct amplitude and phase value on speed frequency, we must ensure that the spectrum speed line bandwidth contains just the speed frequency. If other frequency exists in the speed line, then it causes a disturbance and we get a wrong value. The next important feature of the **speed / N** resolution is that the number N is number of revolutions in the required time signal, from which the spectrum is made.

Example! The speed is 25 Hz. The entered resolution is **speed / 4** (it means that the time signal contains 4 revolutions), i.e., 6.25 Hz. The line bandwidth in FFT will be 6.25 Hz. It means the speed line contains all frequencies in the interval (21.875, 28.125). If any disturbing frequency is in that interval, then a higher resolution must be used, for example, **speed / 8**.

Attention! When you select a higher resolution (for example, speed / 64 or even speed / 1024), then more revolutions must be taken and you will be waiting for results a longer time. A higher resolution requires a longer time signal for evaluation. We do not recommend always using the maximum value, because you will be waiting for results longer (much longer). Use a high resolution only in cases when your signal contains two close frequencies and you need to separate them.

Resolution in orders. The resolution value in order analysis is related to the number of revolutions like the frequency spectrum is related to the number of seconds. Resolution in frequency domain can be expressed as $\Delta f = 1 / T$, where T is the number of seconds per FFT record. Similarly, resolution in order analysis can be expressed as $\Delta ord = 1 / rev$, where rev is the number of revolutions per FFT record. This resolution is defined in orders. If you want to express the order analysis resolution in frequency unit, you need to multiply the resolution in orders by the speed frequency. Therefore, the value of resolution is entered as the fraction of speed frequency and the required number of revolutions is displayed in the note below the resolution value.

Resolution	speed / 4
	t = 4 revs

Attention! For measurements with adjustable order value, take care to correctly setup suitable resolution according to the demanded order. The order value must be an integer multiple of the resolution in orders, i.e., an integer multiply of the 1 / rev. The menu itself helps you meet this condition. Any time you enter the order, the lowest appropriate resolution is automatically set. Then, you may increase the resolution value according to your needs. The resolution submenu always contains suitable values for the actual order. However, you may still enter any user value. The nearest possible order, which will be used in the calculation, is shown as a note if the actual order is not possible for the entered resolution.

For example, when the resolution in Hz = speed/4, then the resolution in orders = 1/4 = 0.25. For example, the available orders are 1.25, 1.5, 1,75 etc.

Order	1.2 nearest possible = 1.25
Resolution	speed / 4 t = 4 revs

Attention! The order value should be at least four times higher than Resolution in orders. The instrument ensures this condition is met regardless of the setup by increasing the number of revolutions.

Full spectrum

yes, <u>**no**</u>
The spectrum will have two sides, positive and negative (see literature about turbine analysis for more details).
It is important to define the correct sequence of channels. It must match the rotation direction. It means, the tacho mark must come to A channel first and then to B channel. The angle must be less than 180 degrees. Otherwise, the positive/negative parts would be transposed.

Graph Properties

In addition to measurement parameters, you may also set graph properties which influence the way how signals and values are displayed, e.g., axes scale, logarithmic axis and so on.

Note! All available properties will be described now. But not all these properties are always displayed. Only values/choices which currently make sense are displayed during your work. For example, the Axis Z (third) axis is only visible in 3D graphs (for example, cascade or spectrograph).

Display

<u>**value**</u>, **trend**
Available for overall values in the <u>Runup</u> module. It enables the instrument to display a trend during a measurement process. When **value** is used, then only the last measured value is displayed (default setting).

When **trend** is used, all measured values are displayed in the trend.

Scale

max   Y autoscale for every new signal, but the range is only increasing when a higher value is measured next.
auto   Y autoscale according to data values of every new signal.
user   The user defines Y scale for an axis independently of data values.

Graph Unit (for spectra)

Set the physical unit which is used to display a signal in the graph. The unit may differ from the unit in which the signal was measured and stored (Edit Measurement / Unit). You can choose any unit from a menu. By default, the **same as meas** value is used, i.e., no recalculation is applied and the signal is displayed in the same unit as it was measured in.

Note! Integration and derivation of the signal is available in spectra.

Cursor (for time signals)

single   standard simple cursor
periodic   multiplied cursor with several additions of delta time
delta   band cursor with delta time length

When you use periodic or delta cursor you need to setup the **Delta X** value. This can be done in the *Graph Properties* menu or by using **Delta X** function available in the **Control** mode of the side buttons.
During initialization, the *Delta X* value is set according to speed if possible.

Cursor (for spectra)

single   standard cursor
harmonic   cursor with several additions of delta
sideband   cursor with one addition of delta
delta   cursor with one addition of delta

When you use sideband or delta cursor you need to setup a **Delta X** value. This can be done in the *Graph Properties* menu or by using **Delta X** function available in the **Control** mode of the side buttons.
During initialization, the *Delta X* value is set according to speed if possible.

Cursor Position

Time or frequency position of the cursor in the selected graph.

Delta X

Time or frequency interval used for delta cursor computation.

Axe X

lin, **log**

Axe Y

lin, **log**, **dB**

Axe Z

time   Signals are ordered according to a reading's time.
speed   Signals are ordered according to a reading's speed.
regular   Signals are ordered according to a reading's time but drawn with constant space between two readings regardless of when the readings were taken.

Order Z

first in front, **last in front**
The order of spectra on Z axis.

### Detect Type

RMS, **0-P**, **P-P**
Detect type for spectral amplitude values. P is for peak.

Note! This value is the same as the global value defined in MENU / SETTINGS / Spectrum Settings / Detect Type until you change it here. That means, if you change the global value, it will also be changed here. This will stop after the first time you enter a value here.

Peaks List

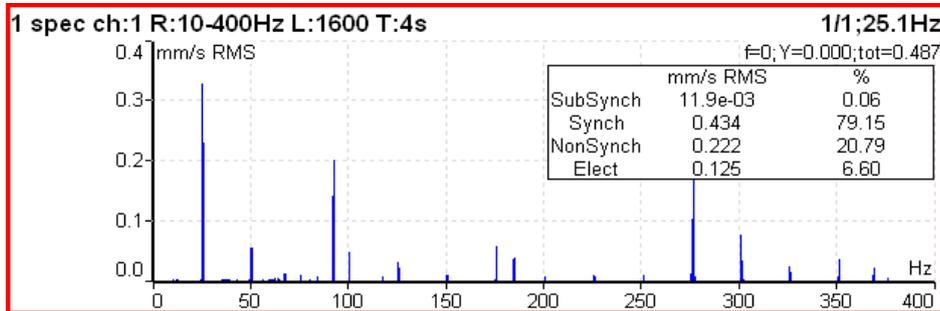**on**, **off**
The 5 highest spectrum lines table.
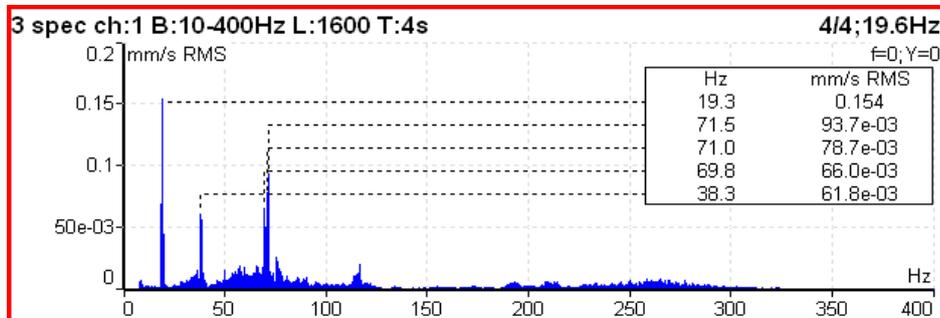
Synch Table

on, **off**
Table of values synchronized with speed and line frequency.

SubSynch	value below speed frequency
Synch	value on speed frequency and harmonics
NonSynch	total value without SubSynch and Synch
Elect	value on line frequency and harmonics (setting in Global Settings / Power/Line Frequency

All values are in displayed a spectrum unit and in % of total value.

Orders Table

on, **off**
Table of values for particular orders in order analysis.

Statistics Table

The basic statistic values of trend are displayed:

n	number of measurements in trend
EX	means value (arithmetic average)
σ (sigma)	deviation average
Xmax	maximum value
Xmin	minimum value
Xmax-Xmin	the interval of measured values

Primary Cursor

When Global Settings / Cursor Type is set to **max**, you may choose to which signal will the max searching be applied to.

amplitude, **phase** for frf
**X**, **Y** for orbit

View (for center line trend)

|	
center line	Standard 2D center line view in the xy plane.
AB	Two trends of values measured on A and B inputs.
XY	Two trends of values transferred to X and Y

View (for frf)

ampl, phase
real, imag
nyquist
amplitude
phase
coherence
time
amplitudes

View (for amp+phase trend and complex Smax)

aps_t
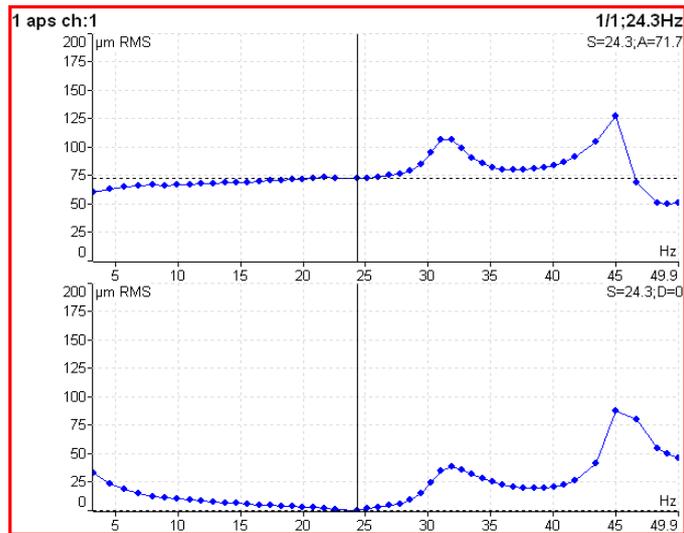Trends of amplitude, phase and speed related to time of reading.
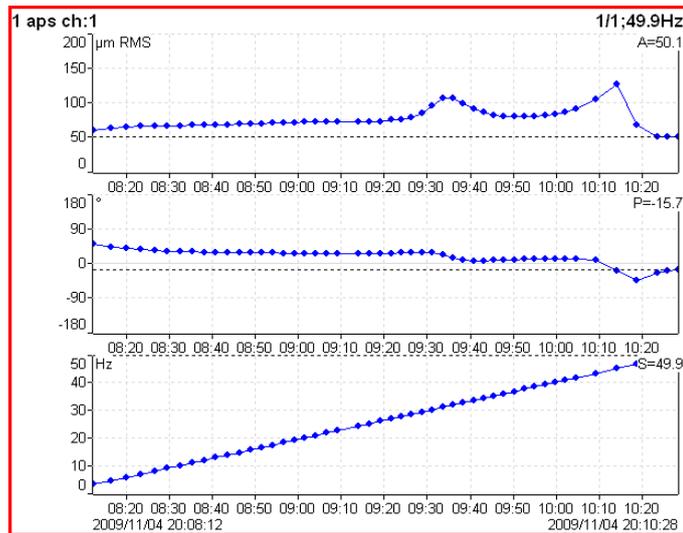
ap_s
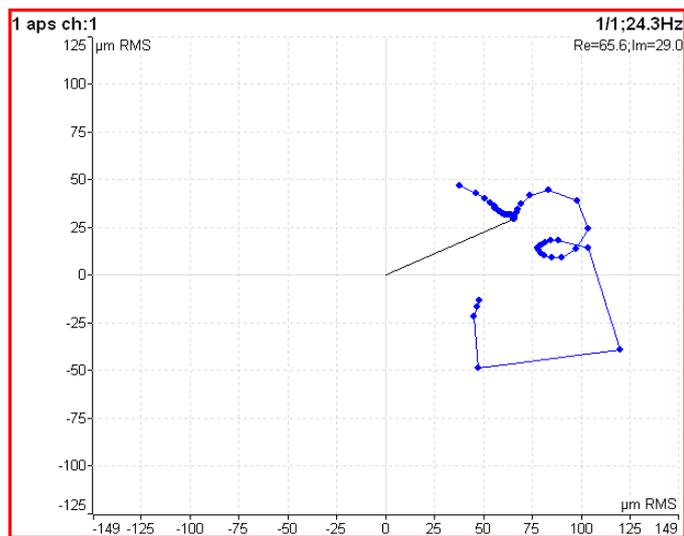Trends of amplitude and phase related to speed.
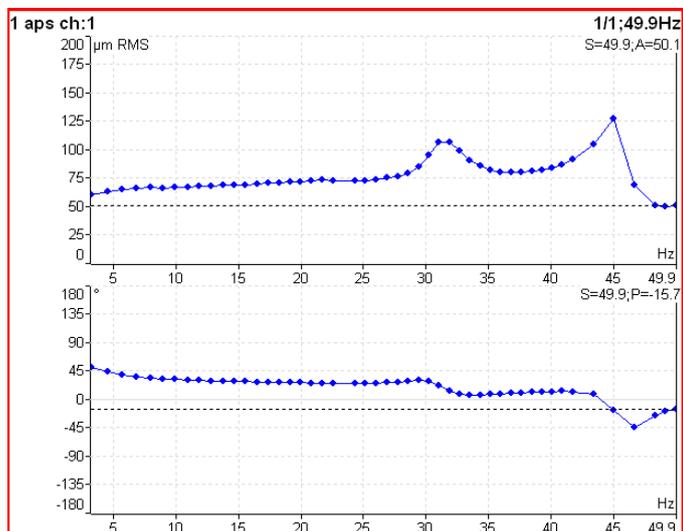
ad_s
Trends of amplitude (upper graph) and *difference amplitude* (lower graph) related to speed. The difference is related to the *trend cursor* position, thus it is always zero in the cursor position.
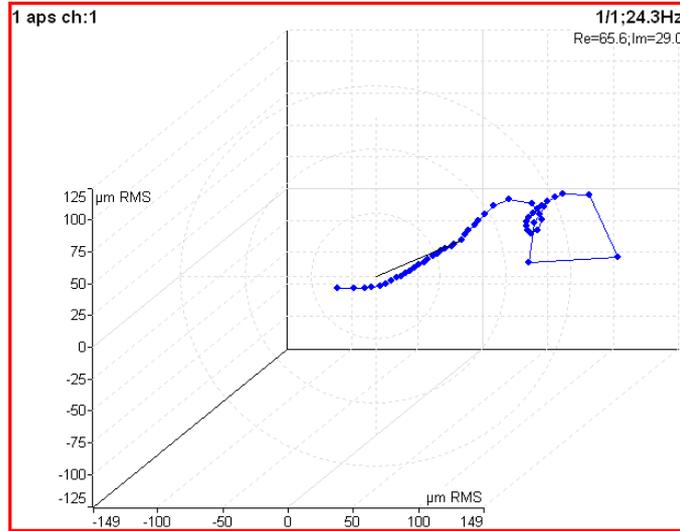

polar
2D complex view

trend3D_t
The 3D "tube" view. It is the Nyquist graph expanded to z axis (time scale).

View (for phase shift trend)

linear   Trend of phase shift, amplitude ratio, and coherence related to time scale.
polar   Polar plot of phase shift and amplitude ratio.

View (for spectrum trend)

amplitude
One amplitude graph.

cascade
Cascade graph.

spectrograph
2D view of amplitudes vs. time

phase
One spectrum phase graph
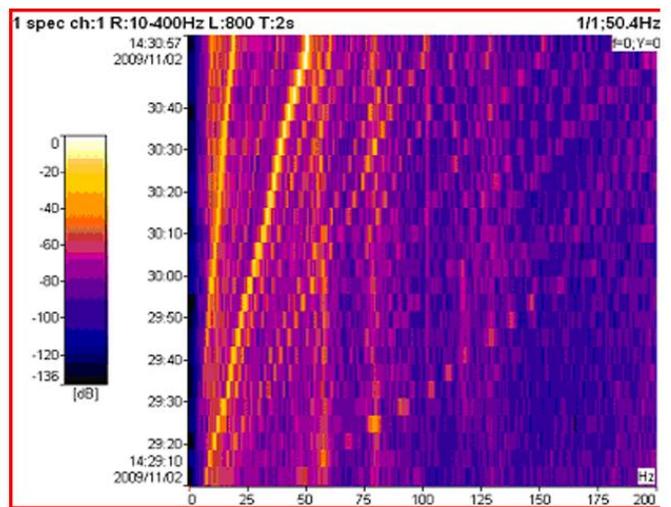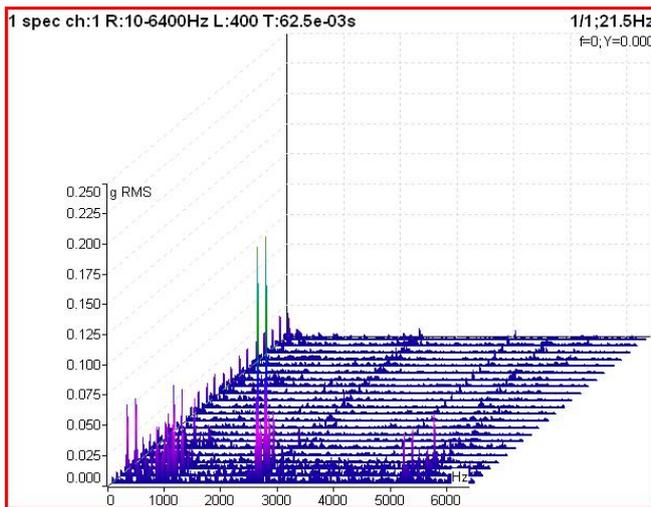
View (for actual spectrum)

amplitude
One amplitude graph.

time
Displays the time signal from which a FFT was developed.

phase
One phase graph.

View (for time waveform)

<u>**linear**</u>
Standard drawing of time signal.

<u>**circular**</u>
Circular drawing

Note! When the signal contains tacho pulses, one rotation length is 360° (one circle). If not, then a complete signal is drawn in only one circle.
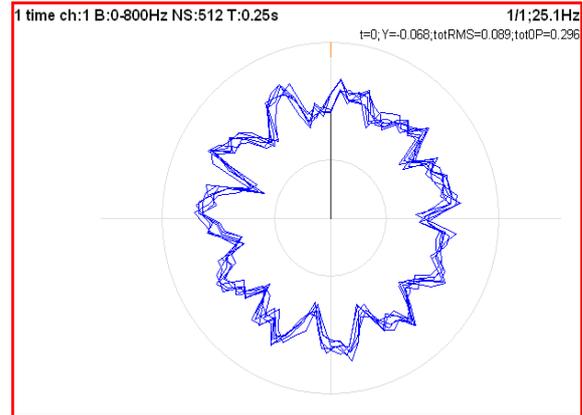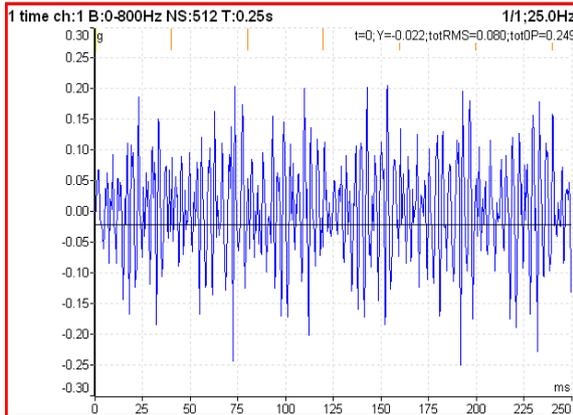
View (for orbit)

<u>**orbit**</u>
Standard 2D orbit view in xy plane.

AB
Two input time signals from channels A and B.

XY
Two time signals transferred to X and Y axes.

View (for filtered orbit)

<u>**orbit**</u>, **orders**
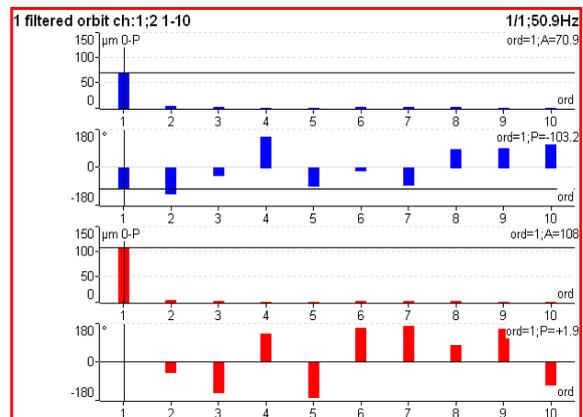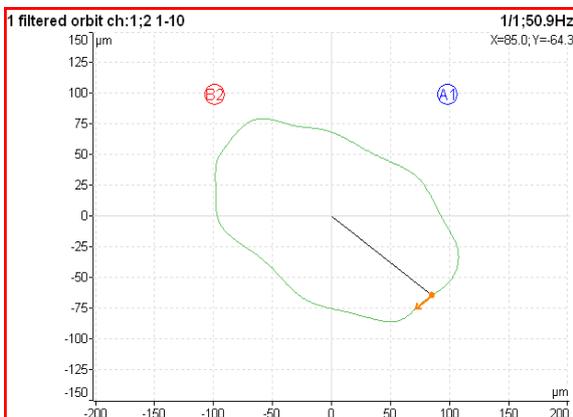
Time Axe Unit

<u>**time unit**</u>, **degrees**

By default, the time axis is marked with time units (milliseconds or seconds). However, you can set the time axis unit as degrees to determine the angle. The angle between two tacho marks is supposed to be 360°. According to Angles Counting setup, degrees are negative (for with rotation) or positive (for against rotation). This corresponds to the amp+phase measurement (the phase is negative when the signal maximum is behind the tacho mark and with rotation is set as Angles Counting).

Time Axis Unit = time unit:
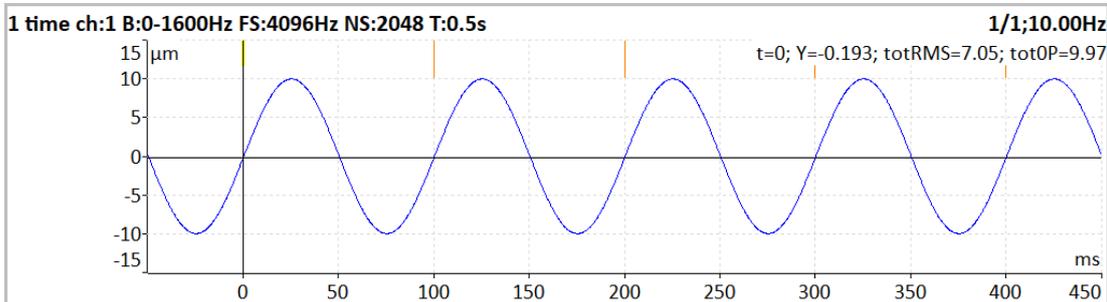
Time Axis Unit = degrees, Angles Counting = with rotation:
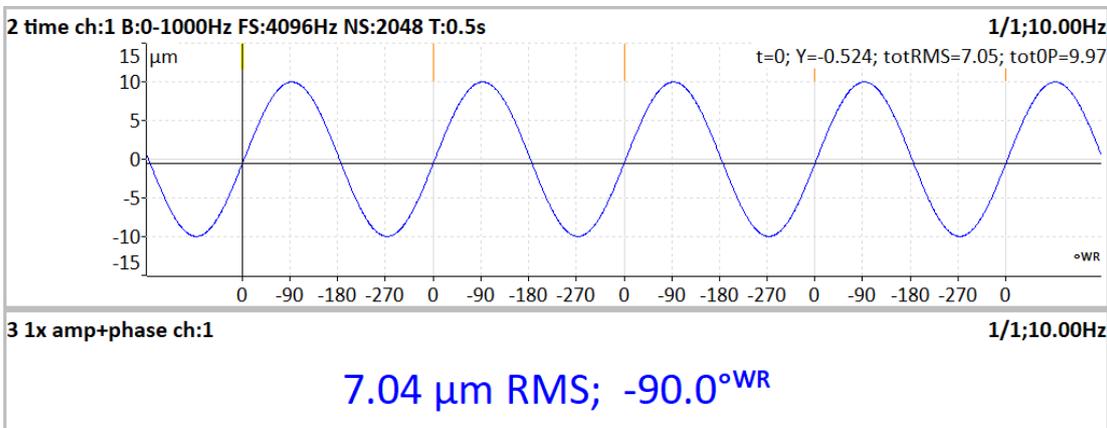
Time Axis Unit = degrees, Angles Counting = against rotation:
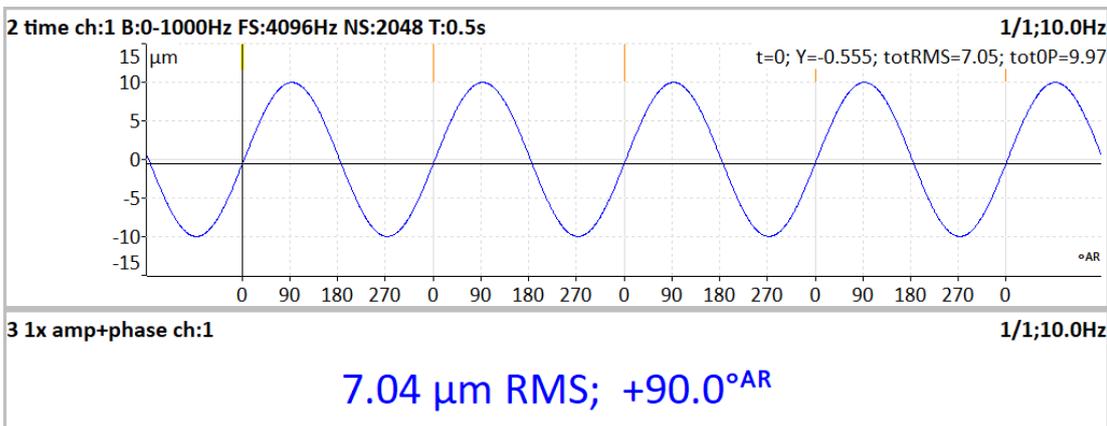
FFT Output (for spectrum)

amplitude spectrum
power spectrum
amplitude spectral density
power spectral density (PSD)
energy spectral density (ESD)

Frf Format (for frf)

When a FRF is used with force units on one channel and some vibration units on another channel, you may display the FRF in different units than the one in which it was measured. Alternate formats are created by performing math operations on the FRF:

Integration and differentiation: Acceleration can be changed to velocity or displacement.

Inversion: The FRF can be inverted, so it is input over output, rather than output over input.

default
No conversion of units is applied. The FRF is displayed in the same units as measured.
accelerance
acceleration / force
mobility
velocity / force
compliance
displacement / force
dynamic mass
force / acceleration
mechanical impedance
force / velocity
dynamic stiffness
force / displacement

## *Bearing Faults*

on, **off**
If a bearing is defined in Bearing Settings and the measurement contains speed, then fault frequencies are displayed in spectrum.

FTF   Fundamental Train Frequency
BPFI   Ball Pass Frequency of Inner ring
BPFO   Ball Pass Frequency of Outer ring
BSF2   *Ball Spin Frequency * 2 = Ball defect frequency*
BSF2 is the bearing failure frequency which you can see in the spectrum, because a spinning defective ball hits the bearing twice during one ball revolution: once the outer ring and once the inner ring.
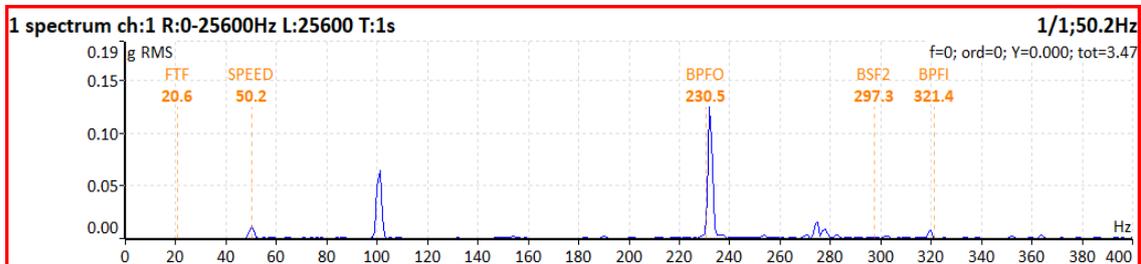
Note! If the measurement doesn't contain a speed information, then the cursor position represents the speed frequency.

FTF Period

on, **off**
The FTF time period is displayed in the time signal

BSF2 Period

on, **off**
The BSF2 time period is displayed in the time signal

BPFO Period

on, **off**
The BPFO time period is displayed in the time signal

BPFI Period

on, **off**
The BPFI time period is displayed in the time signal

Speed Period

on, **off**
the speed time period is displayed in the time signal

Graph Lines

the spectrum can be drawn as a line through the tops of lines or as a discrete vertical line for each frequency
continuous
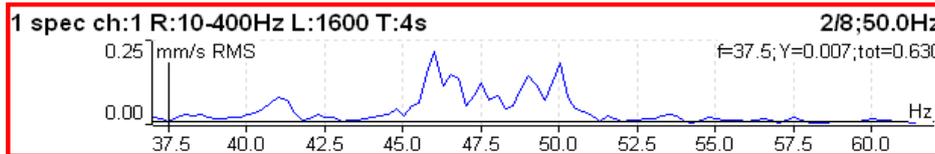
discrete
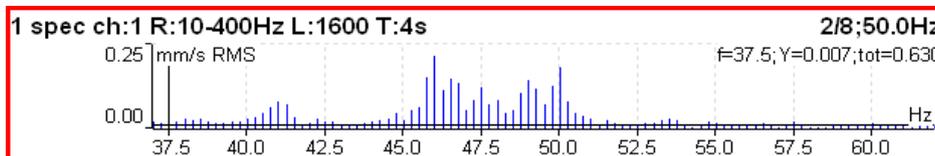
FASIT

It's a measurement type to find out machine's faults. There is a detailed description in the FASIT module chapter.
If FASIT is measured, the Speed detection is done before the measurement process.
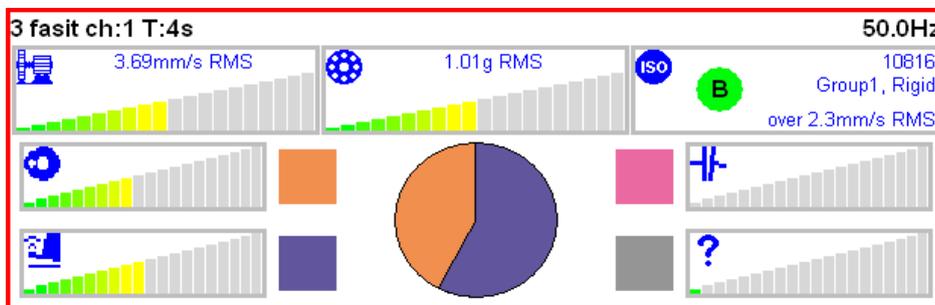
Overall

Typical example of the overall measurement is RMS value. You can see parameters settings in the picture below.

Type	overall freerun, retrig
All Channels	no
Channel	1
Unit	g
Detect Type	RMS
Band fmin [Hz]	10
Band fmax [Hz]	1000
Sampling Freq [Hz]	4096 by fmax
Trigger Control	off
Samples	4096 t = 1 s
Averaging	linear
Avg	off total t = 1 s

Save

Note! Overall measurement is such a measurement where you get one value. This value is a great pointer to evaluate machine's condition. It may be the easiest way how to inform the user that something is ongoing on the machine. Typical example is RMS value mentioned above.
Type, All channels, Channel, Unit, Detect Type, Band fmin, Band fmax, Sampling Freq, Trigger control, Samples, Averaging, Avg

Note! Sampling Freq can be set for overall measurement type only when parameter band fmax value is set to '**none**'. Otherwise, the option to set sampling frequency is greyed out.

Here is the example: RMS value of vibration velocity in the frequency range 10-1000 Hz is measured.

> 1 RMS ch:1 B:10-1000Hz NS:4096 T:1s   1/1;25.1Hz
>
> **0.570mm/s**

The first row contains used parameters. In the right top corner, there is an averaging index and number and a speed value.

Change the Detect Type to **True 0-P**.

> 1 0-P ch:1 B:10-1000Hz NS:4096 T:1s   1/1;25.1Hz
>
> **1.98mm/s**

Note! You can see that 1.98 is not 1.414 times bigger than 0.570. Some users mistakenly think that the formula 0-P=1.414*RMS is valid for every signal. It is not true. **That formula is valid only for a pure sine wave!** The true RMS and true peak measurement are generally independent. The only rule is that the peak value is always larger than the RMS value.

Let's change the Avg to 8. Eight individual values (1 sec length) will be taken and the result will be the linear average of them (RV = (V1+V2+...+V8)/8). The indication 8/8 is in the top right corner.

> 1 0-P ch:1 B:10-1000Hz NS:4096 T:1s   8/8;25.1Hz
>
> **2.00mm/s**

Let's change the Avg back to off and change the samples number to 32768. The measurement will be 8 sec long.

> 1 0-P ch:1 B:10-1000Hz NS:32768 T:8s   1/1;25.1Hz
>
> **2.12mm/s**

You see that the result is different from the previous value. It is clear, the max 0-P value in 8 sec signal is not equal to the average of 8 0-P values (which take 1 sec each).

Let's change the type back to RMS.

1 RMS ch:1 B:10-1000Hz NS:32768 T:8s   1/1;25.1Hz
0.572mm/s

Now change the length to 1 sec (4096 samples) and Avg=8.

1 RMS ch:1 B:10-1000Hz NS:4096 T:1s   8/8;25.1Hz
0.572mm/s

You see the same result. Both values are equal. The meaning of RMS differs from peak values. The RMS value depends only on the total time of measurement. It does not care if one long signal was taken or several shorter signals were averaged.

You can also define the signal length by the Number of triggers, when you set the Trigger control to **on**.

Type	overall freerun, single
All Channels	no
Channel	1
Unit	mm/s
Detect Type	RMS
Band fmin [Hz]	10
Band fmax [Hz]	1000
Sampling Freq [Hz]	4096 by fmax
▶ Trigger Control	on
Number of Triggers	16
Averaging	linear
Avg	off
Save	

The *T* note changes to *R*, which means *Revolutions*, because the number of revolutions and tacho triggering is the most common usage.

1 RMS ch:1 B:10-1000Hz R:16   1/1;25.1Hz
0.545mm/s

ISO 20816 overall measurement

ISO 20816 limit values are also available for overall measurements. A green / amber-orange/ red point is displayed in front of the measured value according to the ISO limit.
If you want to use this function, you need to define the correct measurement parameters (RMS velocity measurement in the 10-1000Hz range) and a ISO Machine Group in the Sensors menu.

1 RMS ch:1 B:10-1000Hz NS:4096 T:1s   1/1;17.7Hz
⬤ 8.30mm/s RMS   ISO 10816: Group1, Rigid
   over 7.1mm/s RMS

The color of the circle is related to the machine condition class A, B, C, D (green for A or B, orange for C and red for D). The information about machine group and foundation are also displayed. The limit which the value is exceeding is also displayed at the bottom.

Spectrum

Type	spectrum freerun,retrig
All Channels	no
Channel	1
Window	hanning
Unit	mm/s
Zoom Spectrum	no
Band fmin[Hz]	10
Range[Hz]	400 fs = 1024 Hz
Lines	1600 t = 4 s,df = 0.25 Hz
Averaging	linear
Avg	8 total t = 32 s
Overlap	0%
Full Spectrum	no
	Save

Type, All channels, Channel, Window, Unit, Zoom spectrum, Band fmin, Range, Lines, Averaging, Avg, Overlap, Full spectrum

Note! Sampling is used for signal discretization in the time domain. Sampling frequency should be at least 2 times higher than signal frequency (low sampling frequency may cause signal distortion). Adash devices use sampling frequency 2,56 times higher than Fmax value.
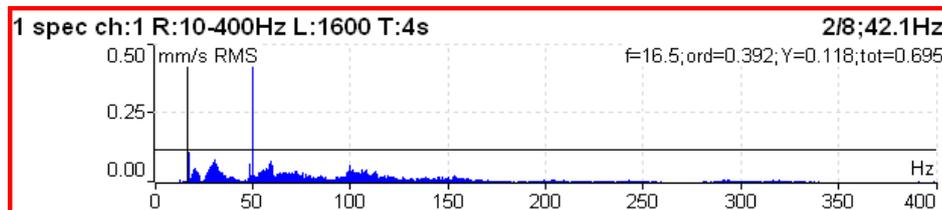
The information in top right corner contains averaging and speed and the cursor position (f) below them, order = f / speed (ord), cursor y-value (Y) and total RMS of spectrum (tot). The full list of symbols is in Appendix C: Symbols and Abbreviations.

Note! Peak tracking from the beginning of the measurement until I move the cursor.

Full spectrum

Set Full spectrum to **yes**. Remember to set the correct angles of both sensors. It influences the calculation. FFT is applied to a complex signal, the first channel is the real part and the second channel is the imaginary part.
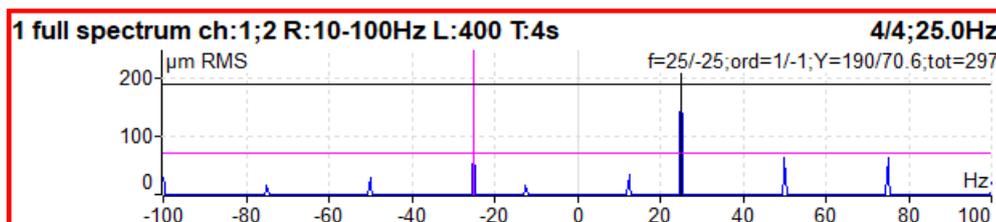
Note! A cursor is displayed on both sides. Different colors are used. Both cursor values are displayed.

Attention! The correct setting of A channel number and B is critical for the correct result. If this setting is wrong, then the negative and the positive sides are interchanged. Firstly, we find the angle between A and B, which is less than 180° (usually it is 90°). The rotation mark must be on A first and then on B.
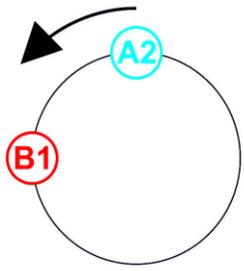
CORRECT **CORRECT** **CORRECT**
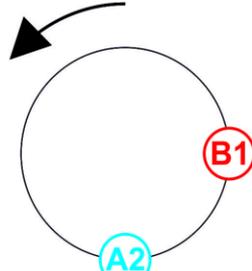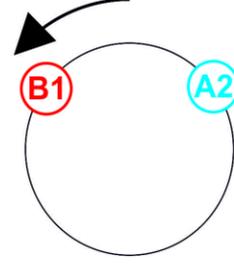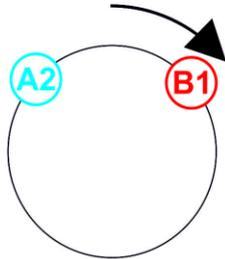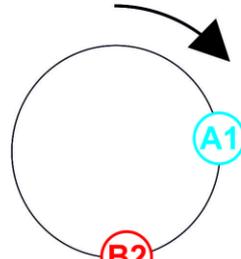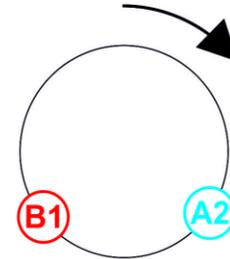
CORRECT **CORRECT** **CORRECT**
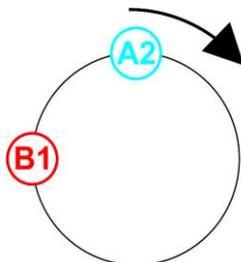
WRONG **WRONG** **WRONG**
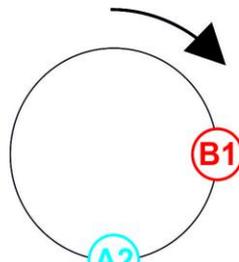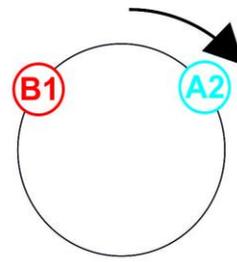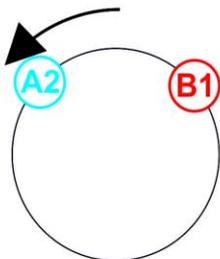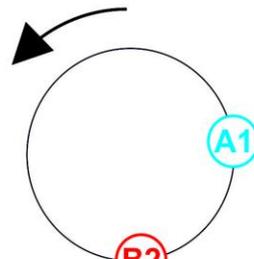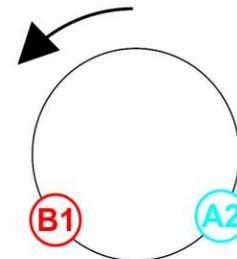
WRONG **WRONG** **WRONG**

Vibration (orbit arrow) has the same direction as rotation.
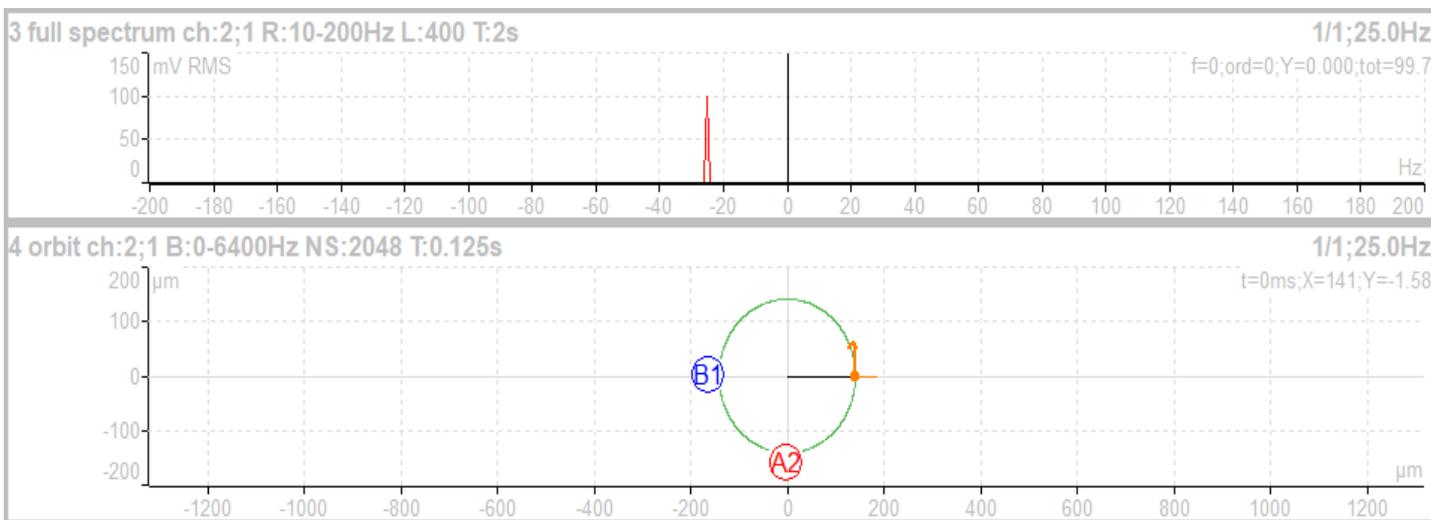
Vibration (orbit arrow) has the opposite direction as rotation.

Time

Type, All channels, Channel, Unit, Band fmin, Band fmax, Sampling Freq, Trigger control, Samples, [Avg](Avg)

Similar parameter like for overall is used. Orange short vertical lines at the top of the graph indicate tacho inputs. Total RMS (totRMS) and true peak (tot0P) values are displayed beside the cursor value.

Time signal averaging

For averaging, you need to set some Trigger Source in the Trigger Settings menu, because only triggered time signals can be averaged.
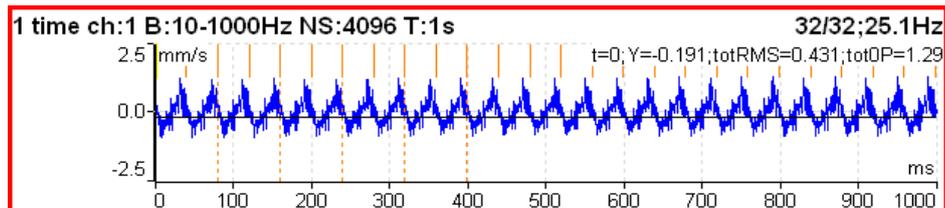
You see the effect of averaging. The signal noise decreases.

Time signal with DC offset (gap)

You can measure a gap value from a DC channel simultaneously with a **displacement** time signal. This gap value is added to the time signal.

How to connect a sensor
A displacement sensor must be connected to an AC and to a DC channel at the same time. You can find where all channel pins are in the Input Channels chapter. You can order a cable with the right connection from your instrument vendor.

How to setup a sensor
Open the Sensors menu and select the used AC channel (the channel where the sensor is connected). Setup sensitivity and other values like usually. There is one more item for a displacement sensor, DC gap channel. Its value is not defined by default. You need to enter the value of your DC channel here (this number is usually the same as the AC channel). Then setup an associated DC sensor (sensitivity, unit and position must be the same as in AC sensor).

Measurement
Setup and measure a time signal as usually. Time signal is modulated to a DC gap value measured from the associated DC channel.

First picture shows the signal without gap.
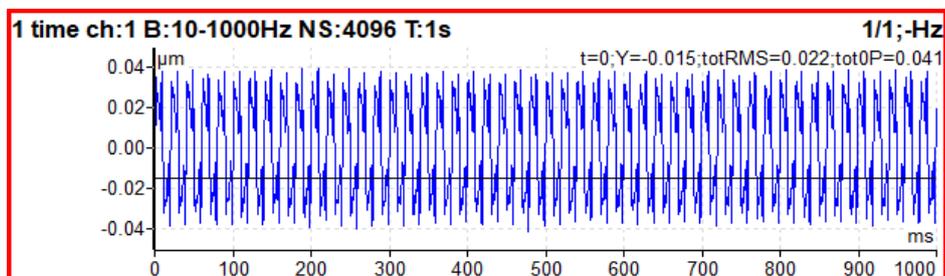
And the same signal with a gap is in the picture below.
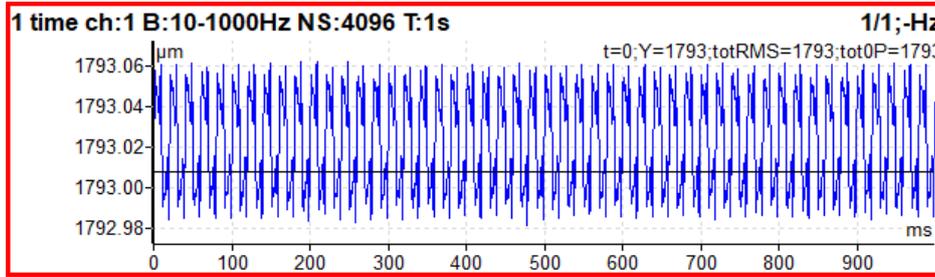
G-demod Spectrum

▶ Type	g-demod spectrum freerun,retrig	
All Channels	no	
Channel	1	
Window	hanning	
Unit	g	
DEMOD fmin[Hz]	500	
DEMOD fmax[Hz]	25600 fs = 65536 Hz	
Range[Hz]	800	
Lines	800 t = 1 s,df = 1 Hz	
Averaging	linear	
Avg	8 total t = 8 s	
Overlap	0%	
	Save	

Type, All channels, Channel, Window, Unit, DEMOD fmin, DEMOD fmax, Range, Lines, Averaging, Avg, Overlap

The signal is filtered in set range (DEMOD fmin, DEMOD fmax) and then demodulated. Only an acceleration or a voltage unit can be used. No integration of signal is enabled.
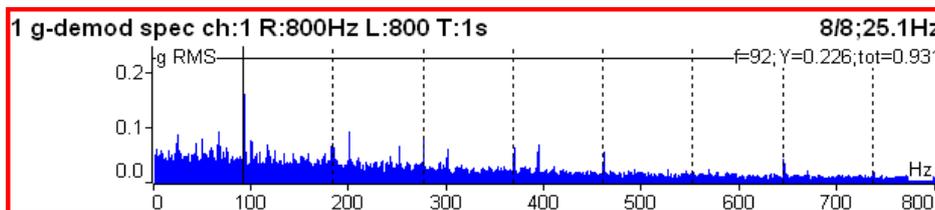
Example: the demodulated frequency 92Hz with harmonics.

Note! Demodulated spectrum is mostly used for bearing faults.

G-demod Time

► Type	g-demod time freerun,retrig
All Channels	no
Channel	1
Unit	g
DEMOD fmin[Hz]	500
DEMOD fmax[Hz]	25600 fs = 65536 Hz
Samples	512 t = 0.00781 s
	Save

Type, All channels, Channel, Unit, DEMOD fmin, DEMOD fmax, Samples

This function enables you to see the signal, when the standard envelope demodulation is used. The signal is filtered in a range (DEMOD fmin, DEMOD fmax) and then demodulated. Only an acceleration or a voltage unit can be used. No integration of signal is enabled.

G-demod Overall

► Type	g-demod overall freerun, retrig
Channel	1
Unit	g
Detect Type	RMS
Component	ac+dc
DEMOD fmin [Hz]	500
DEMOD fmax [Hz]	25600 fs = 65536 Hz
Samples	4096 t = 62.5 ms
Averaging	linear
Avg	off total t = 62.5 ms
	Save

Type, All channels, Channel, Unit, Detect Type, Component, DEMOD fmin, DEMOD fmax, Samples, Averaging, Avg

The signal is filtered in a set range (DEMOD fmin, DEMOD fmax) and then demodulated. Only an acceleration or a voltage unit can be used. No integration of signal is enabled.

1 g-demod RMS ch:1 B:500-25600Hz NS:8192 T:0.125s	1/1;25.1Hz
4.32g	

Note! You can set the component value as you need. However, we recommend to use **ac+dc**, because it has diagnostic reason.

Vfd Bearing

Many machines are powered by VFD. It means variable frequency drives. These drives generate strong noise on high frequencies. The bearing condition we also measure on high frequencies. The high frequency noise from variable frequency drives makes bearing condition measurement almost impossible. But we have the solution. The vfd bearing measurement removes the VFD noise from the signal. Then bearing signal just remains and we

can take the perfect measurement of bearing condition. The VFD noise removing procedure is not filtering. It is much more complicated.
The VFD bearing value is always RMS.

Type	vfd bearing freerun, retrig
Channel	1
Unit	g
Band fmin [Hz]	500
Band fmax [Hz]	25600 fs = 65536 Hz
Averaging	linear
Avg	off total t = 1 s
Save	

Type, Channel, Unit, Band fmin, Band fmax, Averaging, Avg

amp+phase

The amplitude and phase on speed frequency or its multiple (order) or on manually entered frequency.

Type	amp+phase freerun, single
Channel	1
Unit	mm/s
Sampling	standard
Averaging	linear
Avg	off
Frequency	speed
Order	1
Resolution	speed / 4 t = 4 revs
Save	

Type, All channels, Channel, Unit, Sampling, Averaging, Avg, Frequency, Order, Resolution

1 1x amp+phase ch:1	1/1;50.0Hz
10.1 mm/s RMS; -178.8°	

By default, amp+phase is measured on speed frequency (Order = 1). However, you may define any value as the Order for the measurement. For example, if you want to measure amplitude and phase on 1/3x speed frequency, then you enter the order as 0.333333. The order value is announced in the graph's information line, the "*1x*" on the picture above means the order value is 1. Thus, the speed frequency is used for measurement.

Note! Remember to set the appropriate resolution according to the used order. See Resolution for more details.

Furthermore, you may enter any frequency using the Frequency parameter. In this case, the *order* parameter is not available. The Resolution parameter is entered as a fraction of the entered frequency. The entered frequency is announced by the "*f:*" label in graph's information line.

1 amp+phase ch:1 f:33Hz	1/1;50.0Hz
7.18 mm/s RMS; -35.7°	

Orbit

Type	orbit freerun, retrig
All Channels	no
Channel A	1
Channel B	2
Unit	µm
Band fmin [Hz]	none 1 Hz (integrator)
Band fmax [Hz]	800
Sampling Freq [Hz]	2048 by fmax
Trigger Control	off
Samples	4096 t = 2 s
Avg	off total t = 2 s

Save

Type, All channels, Channel A, Channel B, Unit, Band fmin, Band fmax, Sampling Freq, Trigger control, Samples, Avg
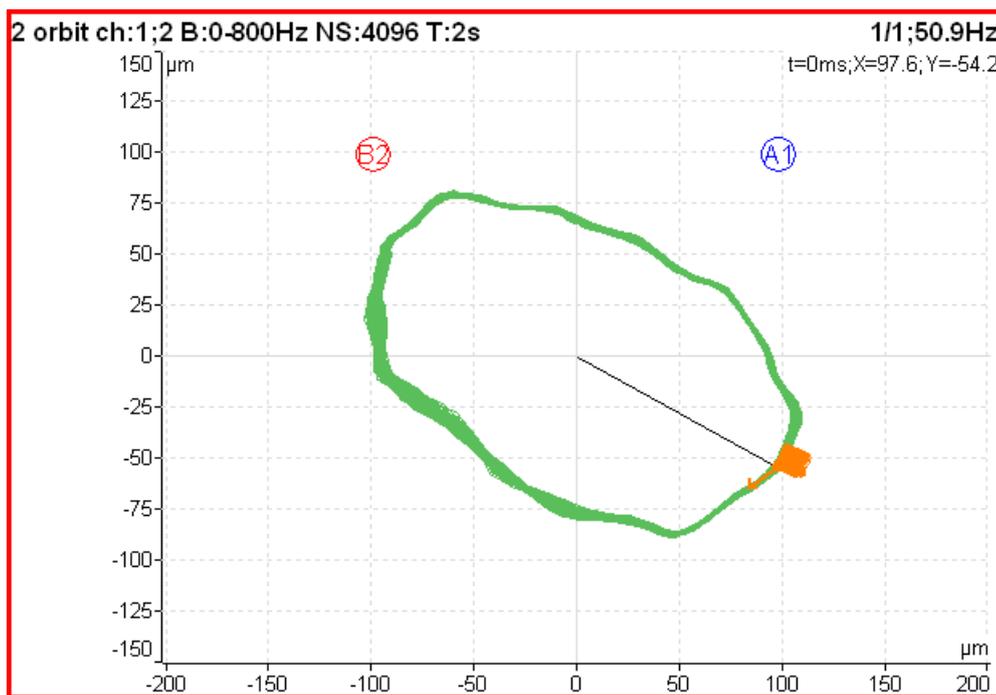
The **A1** means, that the A channel number is set to AC1 input and similarly **B2** means B channel number is set to AC2 input.

The position of *A1* and *B2* matches the sensor angles defined in AC Sensors / Position. Knowledge of those angles enables the drawing of the correct shape of the orbit.

Attention! Correct AC sensors Position must be set for the correct calculations.

Orbit averaging

Trigger Source must be set to enable orbit averaging like in Time signal averaging.

Orbit measurement with DC offset (gap)

An orbit contains two time signals. Each time signal could be modulated to a gap value as referred in Time signal with DC offset (gap) chapter. If you setup gap channels for orbit's time signals, the resulting orbit will be displayed with an offset.

Filtered Orbit

► Type	filtered orbit freerun, retrig
All Channels	no
Channel A	1
Channel B	2
Unit	µm
Orders	1-10
Averaging	linear
Avg	off
	Save

Type, All channels, Channel A, Channel B, Unit, Orders, Averaging, Avg
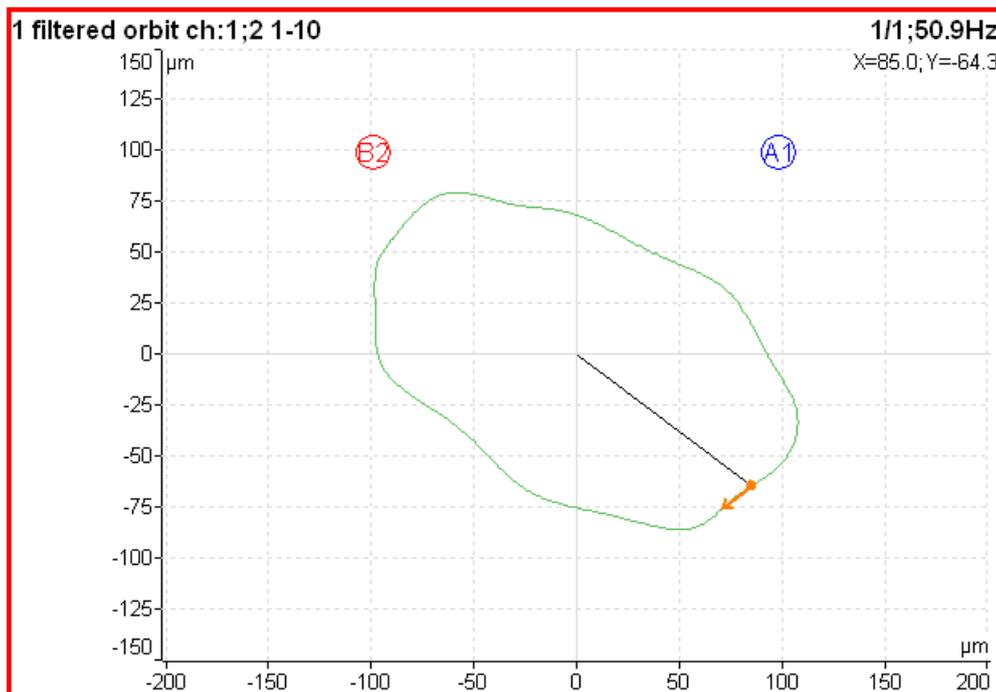
Filtered orbit is built up from two order analysis readings. Correct sensors Position (angle) must be set for the correct calculations as for standard orbit graph. You can switch displayed orders on or off in the Graph Properties menu.

Speed

The machine speed (revolutions) is measured.

Type, Unit, Averaging, Avg

When a tacho probe is used (connected to the TRIG input), then the measurement is triggered when a signal on TRIG input exceeds the Tacho / External / Trig Level [V] value. Tacho impulses are marked by short lines in the time signal graph.
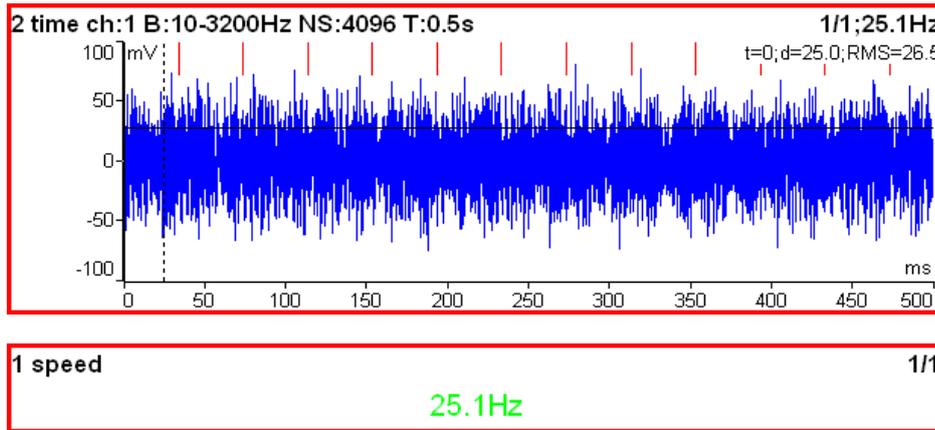
The speed measurement is taken 8 times every second. The value is evaluated from 3 tacho events in a time signal. When averaging is required, then more values are used. But keep in mind that only 8 values are taken in one second.

Note! The TRIG input signal is evaluated regardless of you having the speed measurement defined. If the signal contains pulses, the speed will be calculated and stored in data headers of all measurements in the set. Only if the Trigger Source is set to **external**, no speed is evaluated.

ACMT time

Type, Channel, Unit, Band fmin, ACMT FS, Samples

It enables the measurement of long time signals and compresses them. It is used when you need high frequency range, for example, 25.6kHz. The highpass filtering is used (Band fmin). The basic property of ACMT is resampling the initial high frequency sampling to low ACMT Sampling frequency sampling.
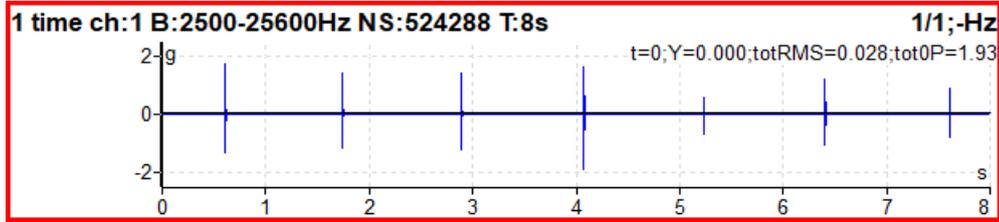
The original time signal which contains shocks is 8 sec long. The signal contains 524288 samples.
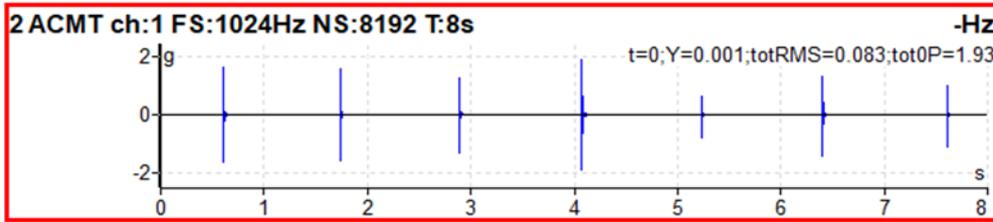
 ACMT je bez detect

The ACMT time signal. You can see the same shocks, but the signal contains only 8192 samples.

ACMT g-demod time

The ACMT time record processed through demod filter.

▶ Type	ACMT g-demod time freerun, single
Channel	1
Unit	g
DEMOD fmin [Hz]	500
ACMT FS [Hz]	1024
Samples	8192 t = 8 s
	Save

Type, Channel, Unit, DEMOD fmin, ACMT FS, Samples
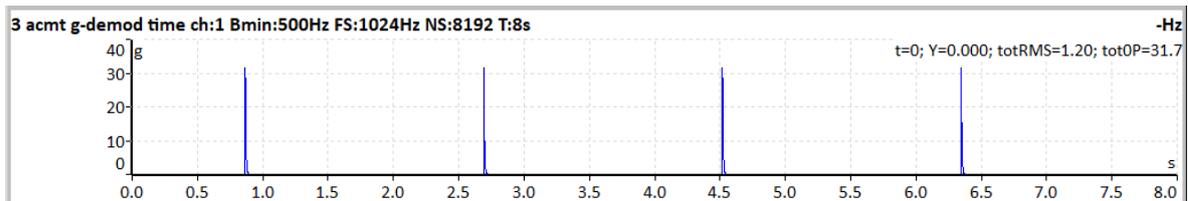
ACMT g-demod spectrum

FFT of the ACMT g-demod time.
Note! You can see Range under ACMT Sampling – you don't have to enter it manually as in type demod spectrum, it is automatically derived from the ACMT Sampling.

Type	ACMT g-demod spectrum
	freerun, single
Channel	1
Window	hanning
Unit	g
DEMOD fmin [Hz]	500
ACMT FS [Hz]	1024
	Range = 400 Hz
Lines	3200
	t = 8 s, df = 0.125 Hz
Averaging	linear
Avg	off
	total t = 8 s
Overlap	0%
	Save

Type, Channel, Window, Unit, DEMOD fmin, ACMT FS, Lines, Averaging, Avg, Overlap
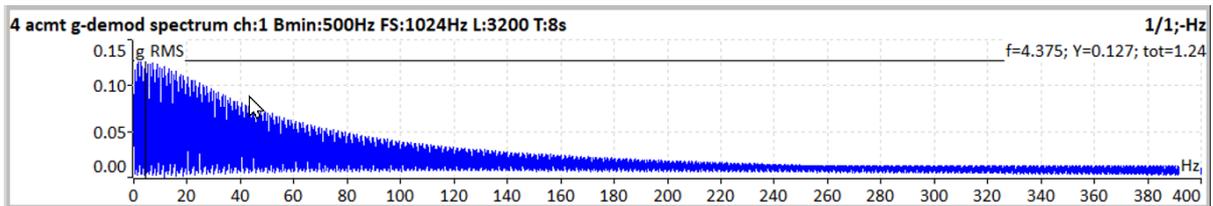
Orders

The amplitude and phase on speed frequency, harmonic frequencies and possibly a subharmonic frequency.

Type	orders
	freerun, retrig
All Channels	no
Channel	1
Unit	µm
Orders	1-10
Averaging	linear
Avg	off
Resolution	speed / 4
	t = 4 revs
	Save

Type, All channels, Channel, Unit, Orders, Averaging, Avg, Resolution
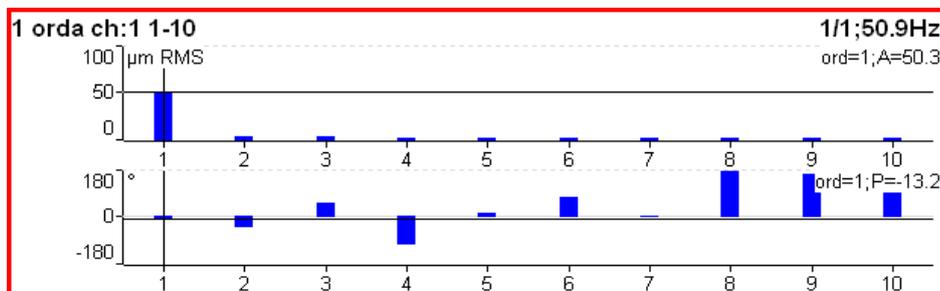
Order Spectrum (Order Tracking Analysis)

► Type	order spectrum freerun,retrig
All Channels	no
Channel	1
Window	hanning
Unit	mm/s
Band fmax[Hz]	3200 Low speed = 0.5 Hz
Lines	400
Orders	25 t = 16 revs
Averaging	linear
Avg	off
Full Spectrum	no
	Save

Type, All channels, Channel, Window, Unit, Band fmax, Lines, Orders, Averaging, Avg, Full spectrum

The Band fmax defines the range of a spectrum. All frequencies above this range will be zeroed. Defining this range is necessary when you need high number of orders. The required range is equal to the number of orders multiplied by a speed frequency. Be careful, higher Band fmax increases the minimum speed which can be used. You can see this minimum below as the note "*Low speed*". When the speed is lower than this value, then a measurement error shows.

The number of revolutions is displayed below the number of orders (16 revs in image). Such number of revolutions is needed for one spectrum calculation. We cannot display it in time, like for spectrum. One revolution is the time quantity for order spectrum.
The 4 revolutions is the minimum number. It means that lines number must be 4 times greater than orders number as the minimum.
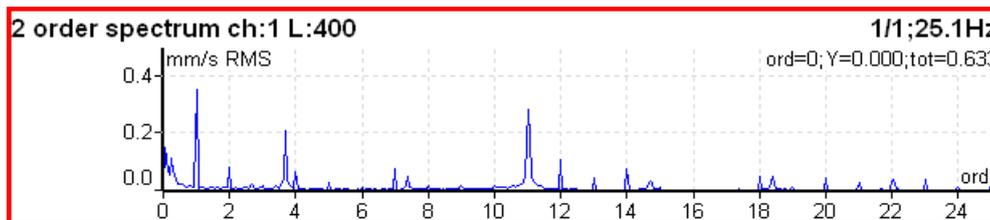

```
2 order spectrum ch:1 L:400                              1/1;25.1Hz
                                                 ord=0;Y=0.000;tot=0.633
```

Order full spectrum

Set Full spectrum to **yes**. Remember to set the correct angles of both sensors. It influences the calculation. FFT is applied to a complex signal, the first channel is the real part and the second channel is the imaginary part.


```
1 order full spectrum ch:1;2 L:400                      4/4;25.0Hz
                                              ord=1/-1;Y=190/70.7;tot=313
```
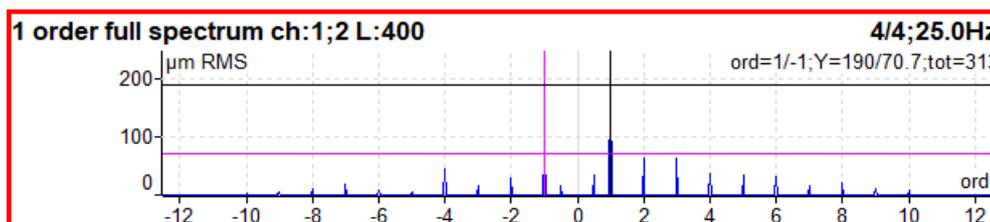
Note! A cursor is displayed on both sides. Different colors are used. Both cursor values are displayed.

Attention! The correct setting of Channel A and Channel B is critical for the correct result. If this setting is wrong, then the negative and the positive sides are interchanged. See the Full spectrum chapter for details.

Phase Shift

Measurement of phase shift between two channels, amplitude ratio, and coherence on speed frequency or on manually entered frequency.

▶ Type	phase shift freerun, retrig
All Channels	no
Channel A	1
Channel B	2
Sampling	standard
Avg	off
Frequency	speed
Order	1
Resolution	speed / 4 t = 4 revs
Save	

Type, All channels, Channel A, Channel B, Sampling, Avg, Frequency. Order, Resolution

---

1 1x phase shift ch:1;2   **3/8;50.0Hz**

ΦB-ΦA: +38.3°; B/A: 2.44; coh: 0.91

The result contains:
- phase shift value in degrees,
- amplitude ratio (ampl B/ ampl A),
- coherence

If phase shift is reliable, coherence must be higher than 0.8.

By default, the phase shift is measured on speed frequency (Order = 1). However, you may define any value as the Order for the measurement. For example, if you want to measure amplitude and phase on 1/3x speed frequency, then you enter the order as 1/3. The order value is announced in the graph's information line, the "*1x*" on the picture above means the order value is 1. Thus, the speed frequency is used for measurement.

Furthermore, you may enter any frequency using the Frequency parameter. In this case, the order parameter is not available, the Resolution parameter is entered as a fraction of the frequency and the entered frequency is announced by the "*f:*" label in graph's information line.

---

1 phase shift ch:1;2 f:38Hz   **1/1;50.0Hz**

ΦB-ΦA: +98.3°; B/A: 0.342; coh: 0.91

DC

A direct DC signal can be measured by this function.

Type	dc freerun, retrig
All Channels	no
Manual Entry	no
Channel	1
Unit	mV
Averaging	linear
Avg	off
	Save

Type, All channels, Channel, Unit, Averaging, Avg

1 dc ch:1

22.6 °C

If you want to enter the value manually, select **Manual Entry** as **yes**. All manual inputs are required before the measurement. A new window for each one appears.

Enter value [°C]
Manual Entry (Graph1)
22.6

Frf
Frequency Response Function

Type	frf freerun,retrig
All Channels	no
Input	1
Window	transient
Shift[ms]	97.2
Length[ms]	6.35
Output	2
Window	exponential
Shift[ms]	97.7
Length[ms]	196
Result Type	H1
Range[Hz]	800 fs = 2048 Hz
Lines	1600 t = 2 s,df = 0.5 Hz
Avg	4 total t = 8 s
Overlap	0%
	Save

Type, All channels, Input channel, Output channel, Window, Result Type, Range, Lines, Avg, Overlap

Coherence is displayed in the amplitude graph. The short horizontal line on Y axis is on the position of value = 1 for coherence.
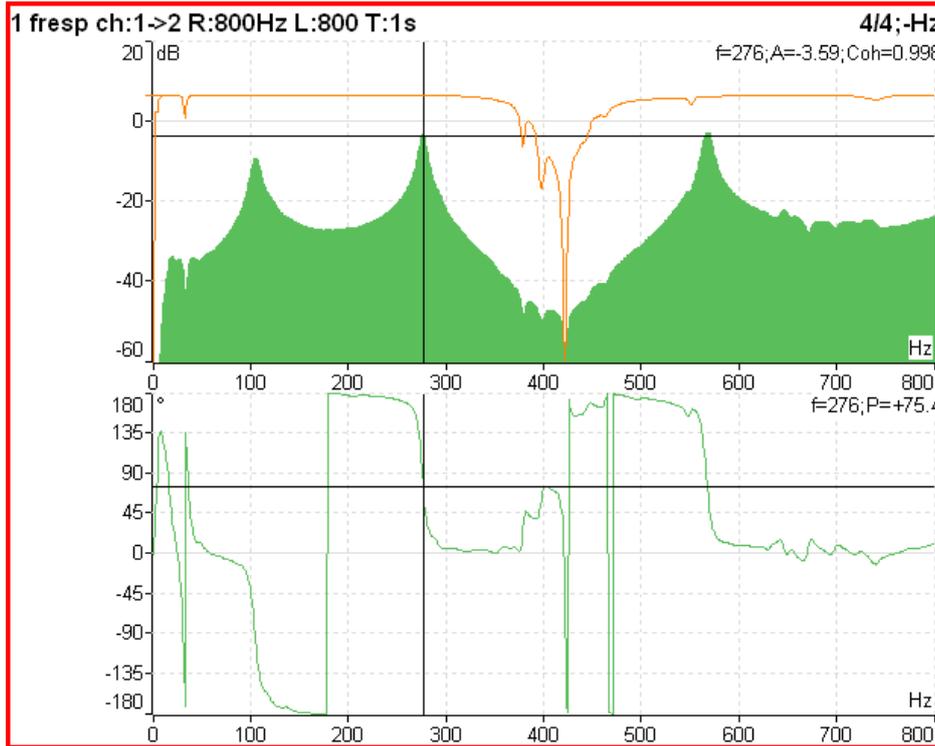
When you set the View (for frf) Frf view to **time**, you see the time signals from both channels.
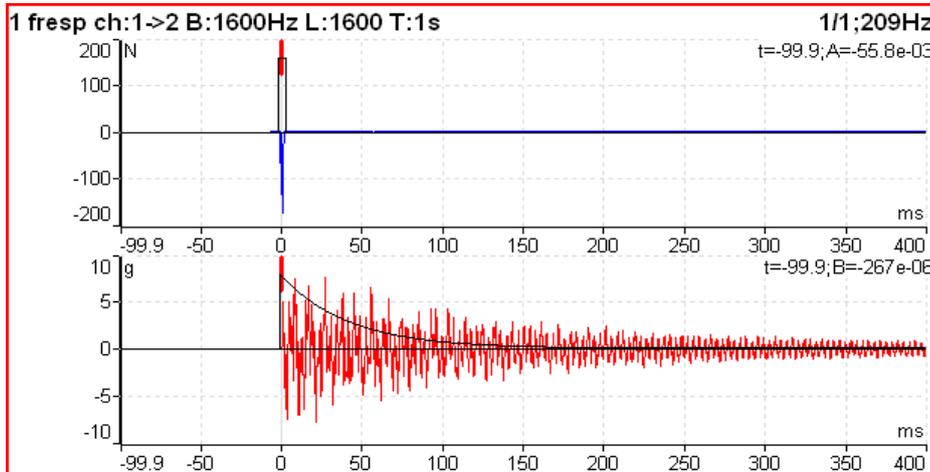
You may use this view to easily set Window parameters. Set the button mode to *Spectral window*. Now you can simply shift the windows or change their length.

Frf Format

When a FRF is used with force units on one channel and some vibration units on another channel, you may change the units in which the frf is displayed using Graph Properties / Frf Format.

Octave Spectrum, Sound Level and Equivalent Sound Level

All parameters are described in the Octave Analysis chapter. Exponential averaging is not available in the Analyzer module.

Center line

This measurement is often used for turbines. Its values define the static position of a shaft in a bearing.

Signals from proximity sensors must be connected to DC channels. We need to remove the AC part and hold the DC part. The DC inputs work in that way.

Type	center line freerun, retrig
All Channels	no
Channel A	1
Channel B	2
Unit	µm
Avg	off
	Save

Type, All channels, Channel A, Channel B, Unit, Avg

Center line is related to the Orbit measurement. In orbit, we see the shape around the (0,0) position. In center line, we see the position of the shaft center without the shape of an orbit.

Attention! The correct DC sensors Position must be set for correct calculations.

1 center line ch:1;2	1/1;-Hz
A:2767µm; B:1768µm; X:-706µm; Y:-3206µm	

Two couples of values are displayed, A+B and X+Y. The A, B values represent distances of sensors from the reference position defined by the offset value. The X, Y values represent these positions according to the Cartesian X, Y coordinates (The position (0,0) corresponds to the position where A, B are equal to their offsets). The polar graph is displayed for trend.

Smax

It is the measurement of the maximum deflection on an Orbit. The correct sensors position must be set for the correct calculations as for standard orbits.

Type	Smax freerun, retrig
All Channels	no
Channel A	1
Channel B	2
Unit	µm
Band fmin [Hz]	10
Band fmax [Hz]	1000
Sampling Freq [Hz]	4096 by fmax
Trigger Control	off
Samples	4096 t = 1 s
Averaging	linear
Avg	off total t = 1 s
	Save

Type, All channels, Channel A, Channel B, Unit, Band fmin, Band fmax, Sampling Freq, Trigger control, Samples, Averaging, Avg

1 Smax ch:1;2 B:10-1000Hz NS:4096 T:1s	1/1;25.8Hz
288 µm	

In the next picture, you can see the Smax value highlighted on the orbit.
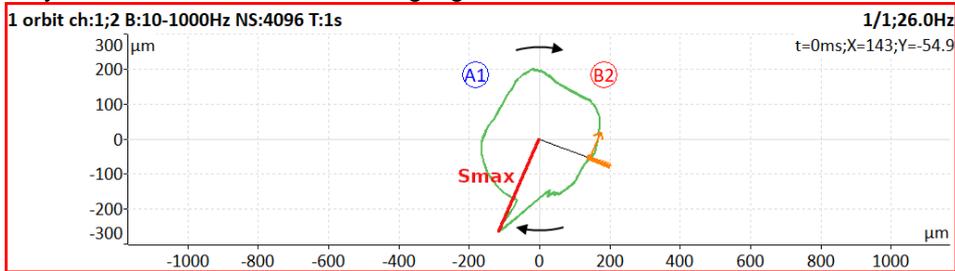
Complex Smax

It is the measurement of the maximum deflection on an Orbit together with an angle (i.e., position) of this deflection. In other words, it is an Smax measurement with the position of maximum deflection. The correct sensors position must be set for correct calculations as for standard orbits.

► Type	complex Smax freerun, retrig
All Channels	no
Channel A	1
Channel B	2
Unit	µm
Band fmin [Hz]	10
Band fmax [Hz]	1000
Sampling Freq [Hz]	4096 by fmax
Trigger Control	off
Samples	4096 t = 1 s
Averaging	linear
Avg	off total t = 1 s
Save	

Type, All channels, Channel A, Channel B, Unit, Band fmin, Band fmax, Sampling Freq, Trigger control, Samples, Averaging, Avg

1 complex Smax ch:1;2 B:10-1000Hz NS:4096 T:1s	1/1;25.8Hz
288 µm; -156.2°	

In the next picture, you can see the Smax value and its position highlighted on the orbit.
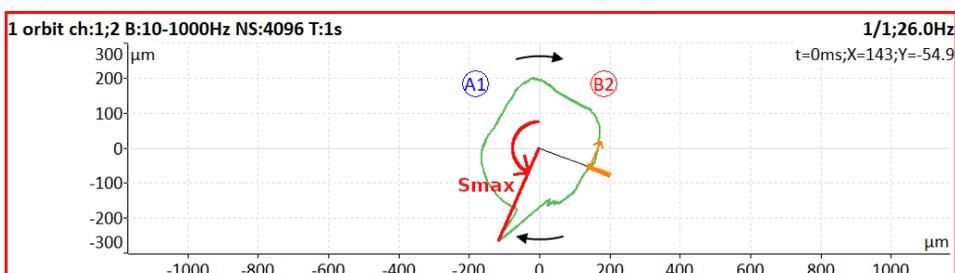
Note! The angle of the maximum displacement can sometimes be accidental. Let's consider a perfect circle shape orbit as an example below. In this case, the Smax angle is a random number, and when averaging such Smax, the angle is undefined.
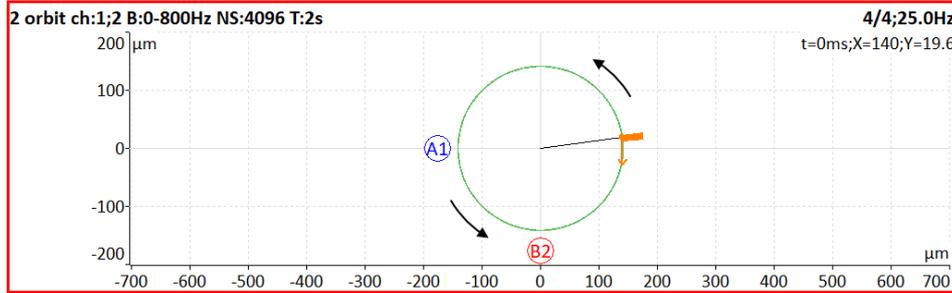
Cepstrum

[Type](#), [All channels](#), [Channel](#), [Window](#), [Unit](#), [Band fmin](#), [Range](#), [Lines](#), [Avg](#), [Overlap](#)
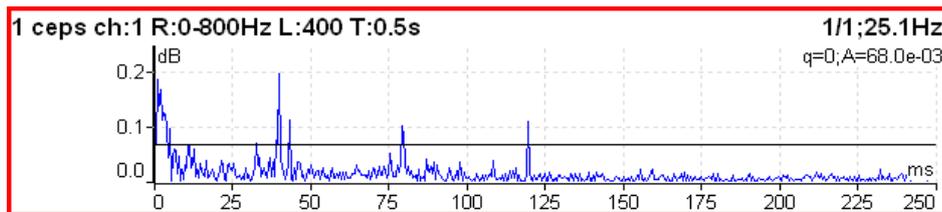
Used algorithm is:

cepstrum(x) = ifft(fft(log10(abs(fft(x)))))

x   input signal
fft   fast fourier transform
abs   absolute value
log10   common logarithm
ifft   inverse fast fourier transform

Ultrasound

1 ultrasound   -Hz
Level: 52 dB, Shock Factor: 1.4

Two values are displayed. The **Level** of sound in dB (30-50kHz range) and **Shock Factor**. The *Shock factor* is defined as Peak value divided by RMS value. It means a value of 1.4 for pure sine. Higher values mean that transient shock events are in the sound signal.

Note! An ultrasound sensor (microphone) is required.

There is detailed description in the Ultrasound chapter.

Record

▶ Type	record freerun, retrig	
Sampling Freq [Hz]	65536 Frequency Range = 25600 Hz	
AC1	on	
AC2	off	
AC3	off	
AC4	off	
DC1	off	
DC2	off	
DC3	off	
DC4	off	
Speed	off	
Length	manually stopped	
Start of Rec	freerun	
	Save	

1 record
00:00:25 / 00:01:00

Creates and saves the record during measurement. There is a detailed description in the Recorder chapter.

Route

The route module is used for route measurements. DDS software is required for creation of route measurement structure. For more details see also DDS manual – all functions are described there.

Loading of the route to the instrument

Open the database in DDS which you want create the route from. Open the instrument window (**Route – VA5 Pro**).

The route window appears (left bottom corner).
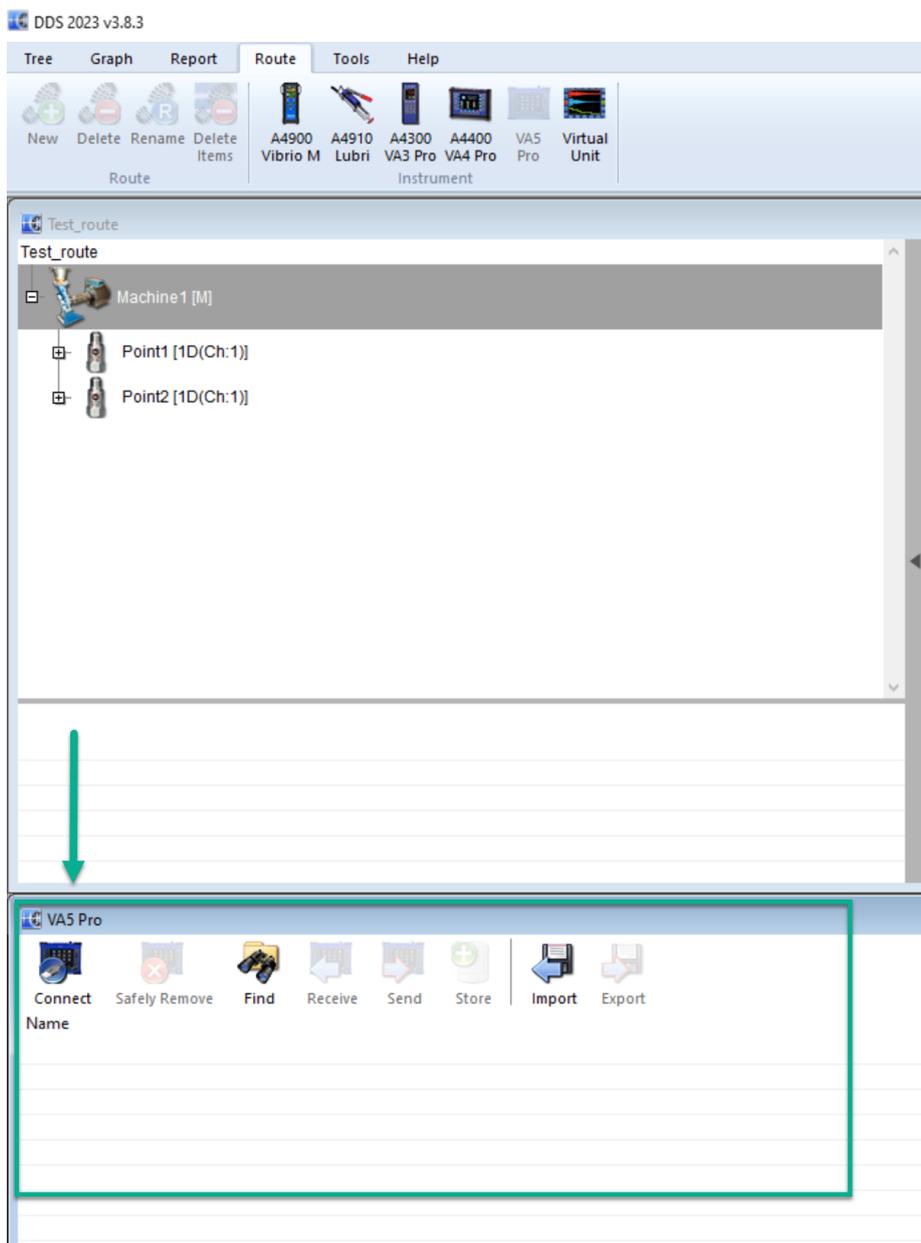
Connect the instrument with **USB** cable.

Press the **Connect** button. The message window with connection process description should appear.
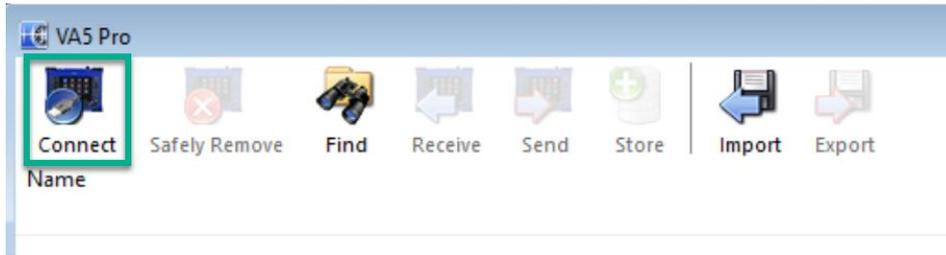
The list of data saved in the instrument appears.

Move the required points from the DDS tree to the route window (use mouse **Drag and Drop**).
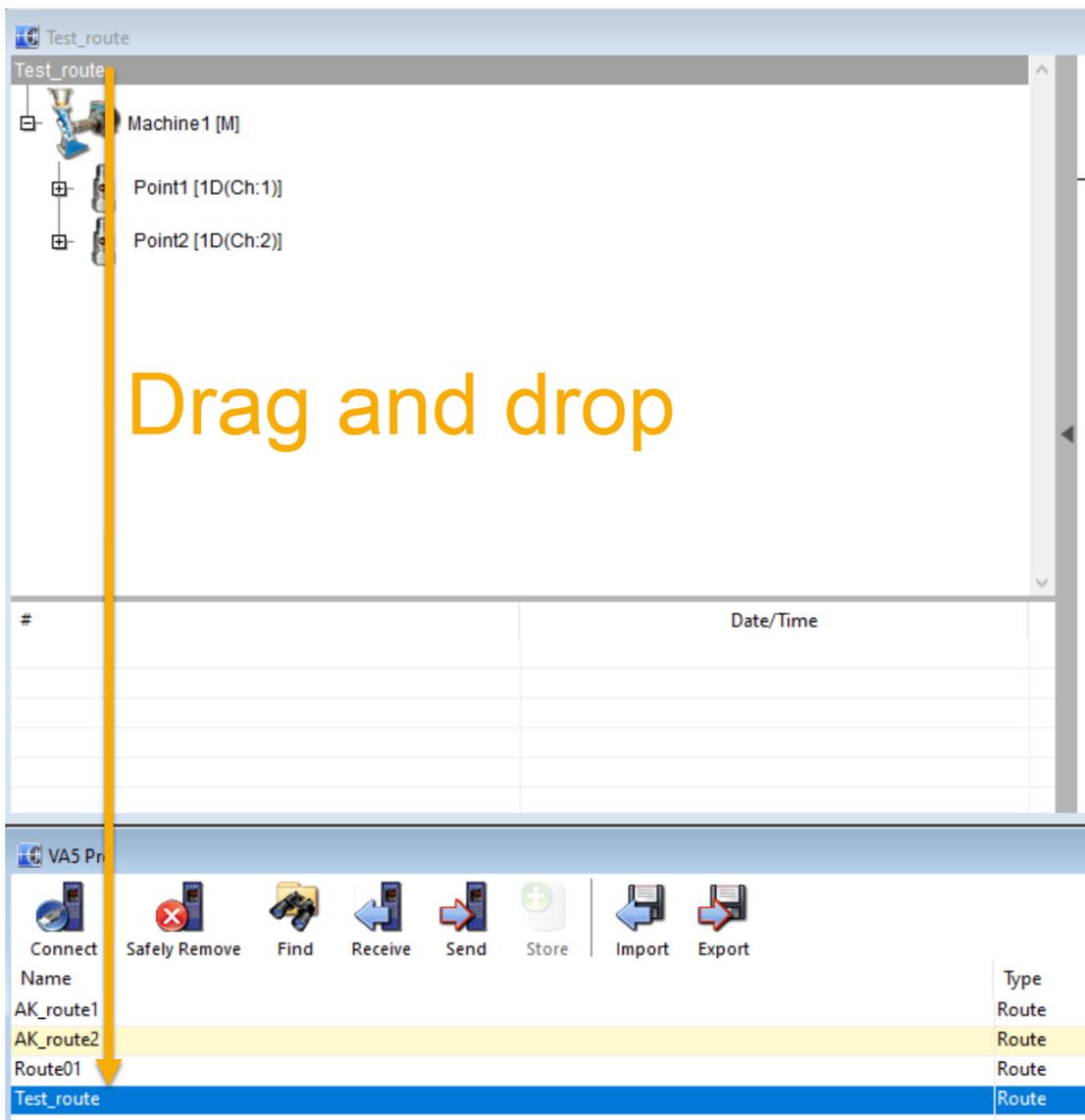
Press the **Send** button. The route data will be loaded from the computer to the instrument.
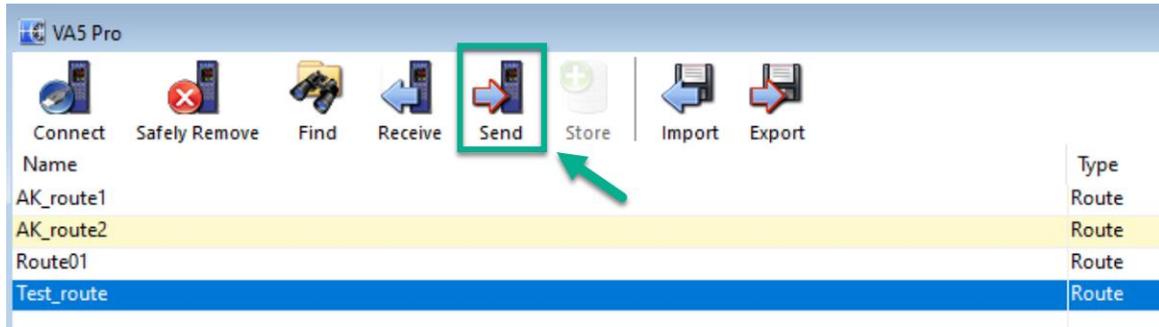
Note! Keep in mind that the structure of tree is changed when you create a route from a part of a tree in DDS. This is because the VA5 instrument strictly requires the tree with the following structure *Route - Machine - Measuring Point - Measurement*. If there are more items in a DDS tree in a path between these items, the names of such items are combined together (like in this example *Turbo Generator/Fans/Fan 1* or *Motor/L1RV* etc.). If the item name in a route tree is longer than 45 characters, DDS tries to truncate such names. To avoid this, we recommend using shortcuts in tree items (in this case "Turbo Generator" should be "TG").

Route Creation in VA5 Device

The route tree can also be created in the instrument. When you want to transfer this route to DDS you must prepare a database for it. More information can be found in DDS manual.
Go to **Route** module on main VA5 screen. You can see the list of routes in the device.
Click on **Route** (in the left bottom corner), choose '**New**' and enter route name.

Routes Sorting

When routes are loaded or created in your instrument, they are always sorted alphabetically. You can change it with Sorting button.
Sort off means that you cannot move with the routes in the list.
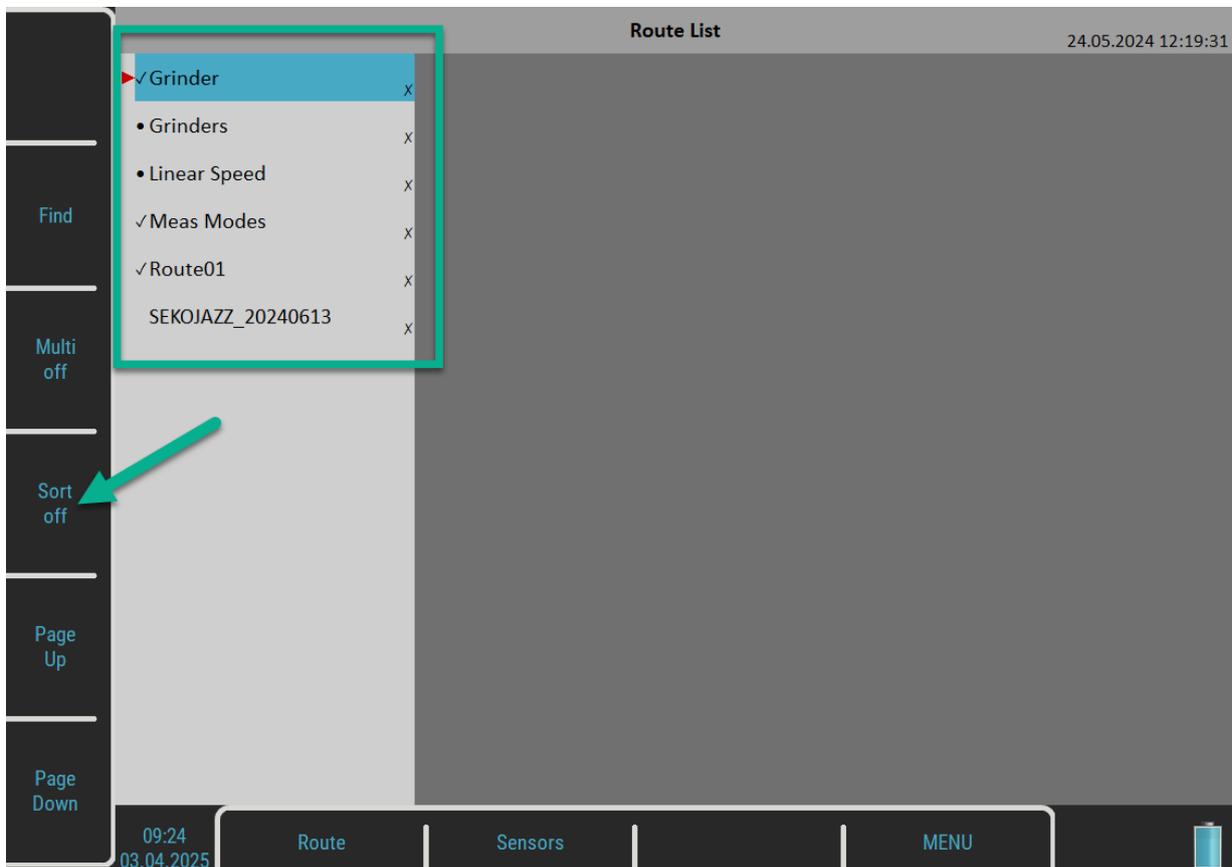
When you click on Sort off button it changes to **Sort on** and you are in the sorting mode. You can sort your routes in the list based on your requirements. Use the **arrows up** and **down** for it.
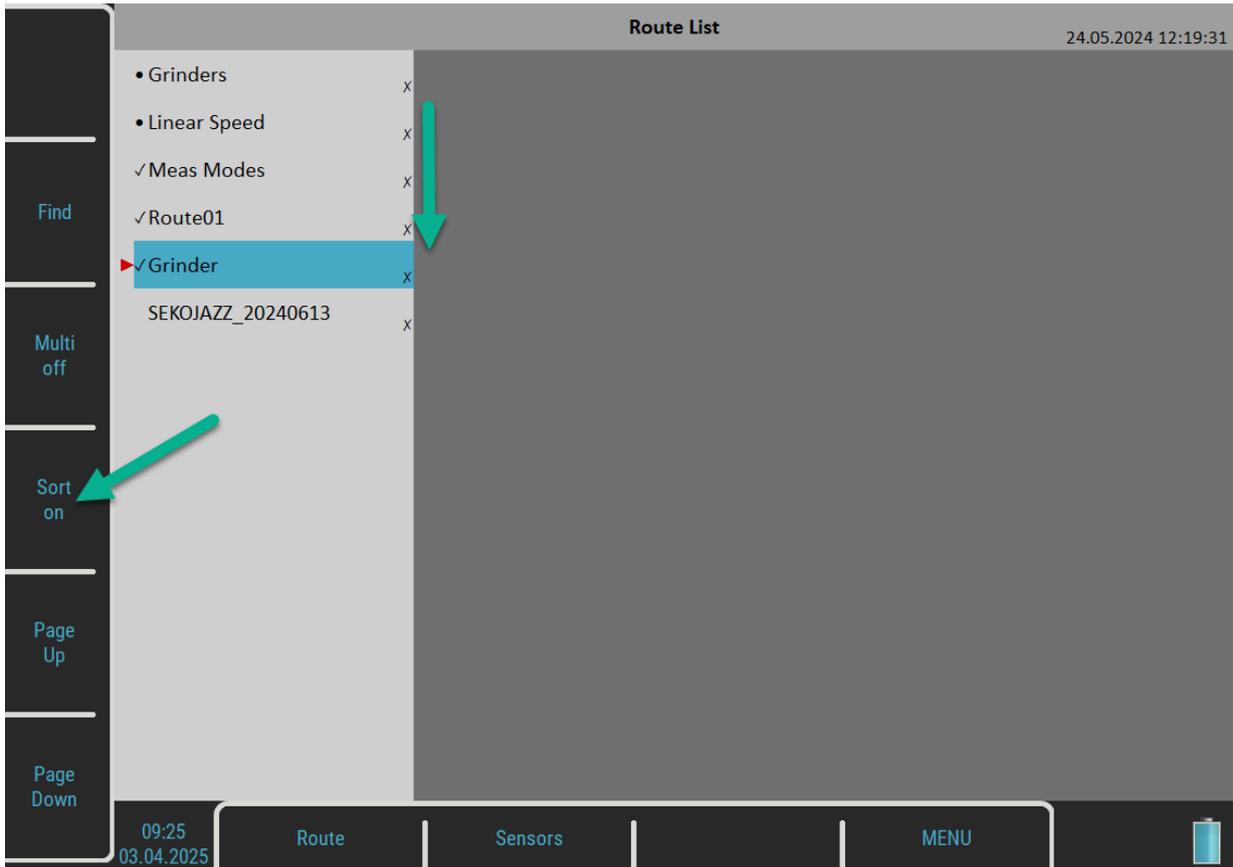
If you want to reorder items back alphabetically, click on **Route** button and click **Sort alphabetically** in menu.
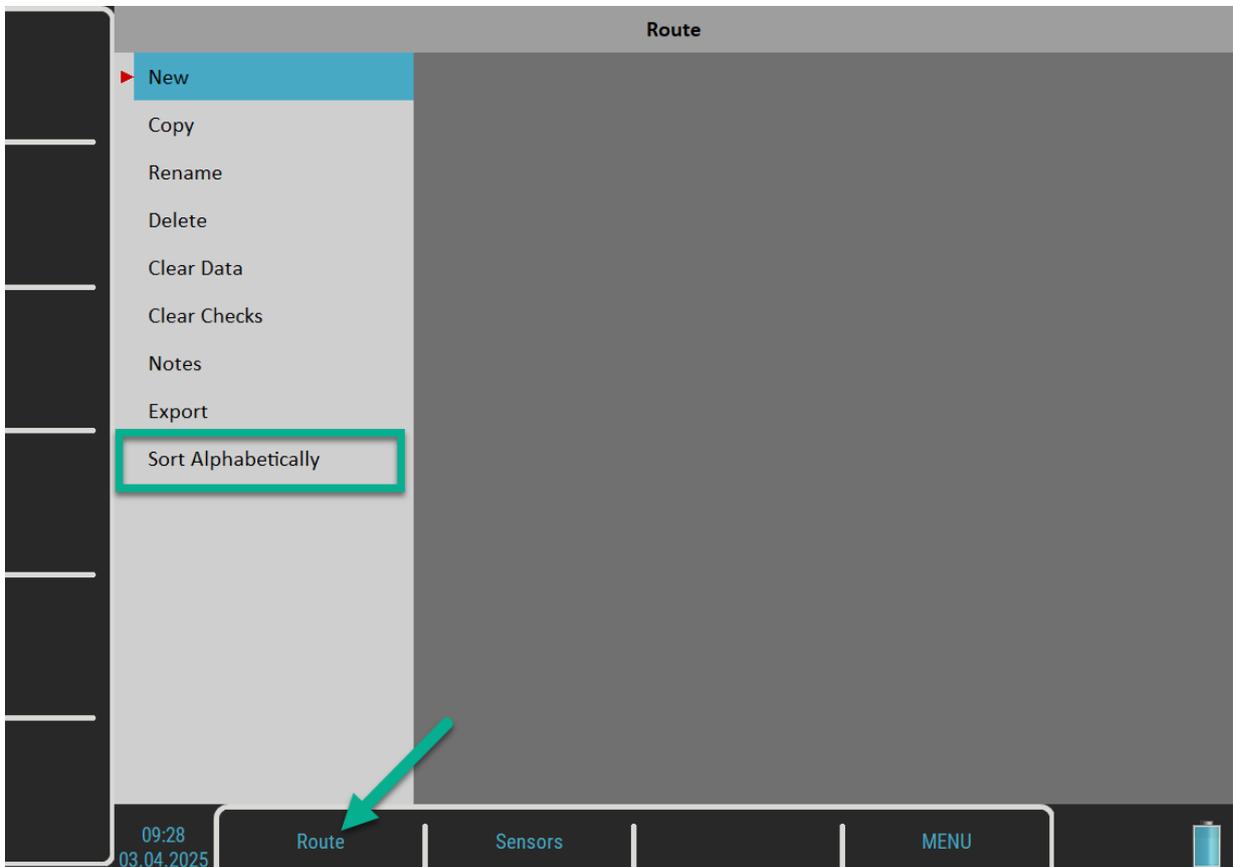
Note! If the route list is sorted alphabetically, this option 'Sort Alphabetically' is not visible in the route menu!

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Route Tree

Routes are similar to *L1 Projects* in the [Analyzer](#) module. After opening the module, import of routes from the *VA5_DISC* is done. Then, a **Route List** of all routes in the instrument is displayed. The date and time of the last modification of the selected item is displayed in the top right corner.

Note! Routes that are only modified on internal disk and have not yet been exported to the [VA5_DISC](#) are marked with a cross symbol (*X*).

Select one route and push *Enter* or tap twice. A route tree is loaded and a **Machine List** of machines in the opened route is displayed.

The opened route's name is marked in the status bar by bold font. The list type is below the name, this indicates the current tree level.

Walking through the tree is straightforward. Use up and down arrows to select an item. *Enter*, right arrow or double tap opens an item and its members are displayed in a new list. *Escape* or left arrow returns you one level higher. If a *Machine List* is opened, *Escape* closes the route.

Open any machine. A **Point List** is displayed.

An item's complete path is displayed in status bar by bold font. Long names could be shortened.

The number of AC channels for each point is displayed behind the point name.

When no data has been taken yet, the *Last* (**L**) and *reference* (**R**) values of overall measurements within the selected point may be displayed next to the point list. These values are initially taken from the database and are stored together with the route. The last value is always changed when data is saved, while the refence value remains unchanged.

After taking a measurement, the measured values of overall measurements are displayed together with their difference in percent from the previous (L) and reference (R) values.
Note! If you decide to clear the data from the route in device, you can do it with "Clear data" option. Data measured will be deleted, but the LAST measured value will be still kept – for comparison with the new measured data in route. If you want to have route completely without data (and without this last value), it is needed to import it again from DDS without data.

TG Fans/Fan1
Point List

►✓Motor/B1RV	1ch	**ISO RMS** 2.14 mm/s [L-3%, R+7%] **BEARING RMS** 0.912 g [L+8%, R-9%]
Motor/B1RH	1ch	
Motor/B2RV	1ch	
Motor/B2RH	1ch	
Triax	3ch	

You may start a measurement process of the selected point by pressing *Enter*. However, in the Route module, you may walk the tree down to a particular measurement level. Thus, you may work with any single measurement independently, e.g., you may measure only one measurement in the point. Open any measurement by pushing the right button or double tap. In the **Meas List**, an index of a channel is before a name.

TG Fans/Fan1/Motor/B1RV
Meas List

► 1.ISO RMS	**ISO RMS** L: 2.20 mm/s R: 2.00 mm/s
1.BEARING RMS	
1.ISO TIME	
1.ISO SPECTRUM	

If *Point List* or *Meas List* are displayed, the *Enter* button starts the measuring process on the selected item. If you want to open the graphs window and you don't want to start the measurement immediately, use the **Point (or Meas) / View Actual** menu item. **Point (or Meas) / View Trends** opens trends of the selected item.

QR

This feature will definitely make your route measurements easier – each QR code identifies one machine in a route. After you scan it, the instrument opens the right machine.
Note! QR codes are generated in DDS software. More information can be found in DDS manual. It is not the part of this VA5 manual.

How to use this feature is described in following steps.
Go to Route module in your VA5 device. Choose the route which you are going to measure in the route list.

Now you can see the '**QR**' button. Click on it.

Grinders
Machine List

▶√Grinder1	
Grinder2	

Find

Multi
off

QR

Page
Up

Page
Down

13:58
25.06.2024

Machine   Sensors   MENU
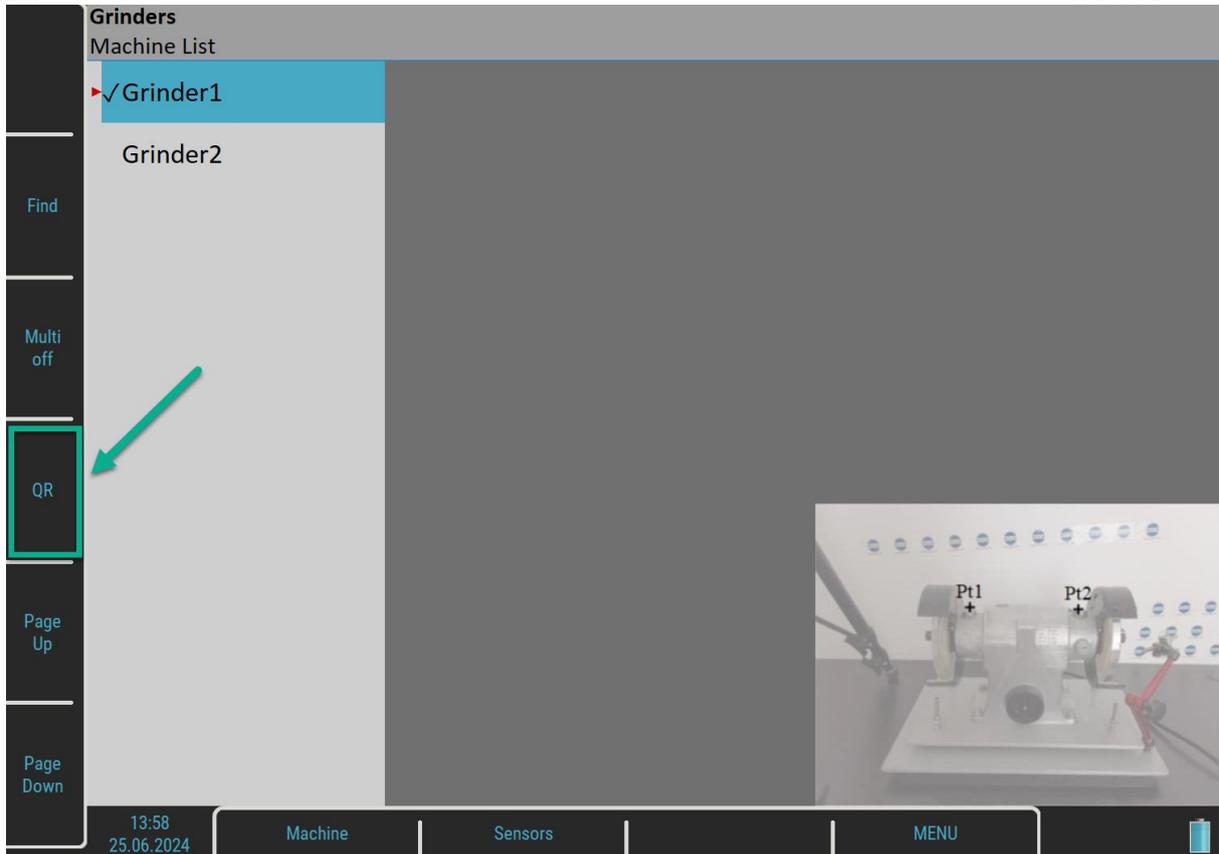
You can see the '**Loading**' note on the screen.

Scan a QR code

Loading...

09:38
27.01.2024
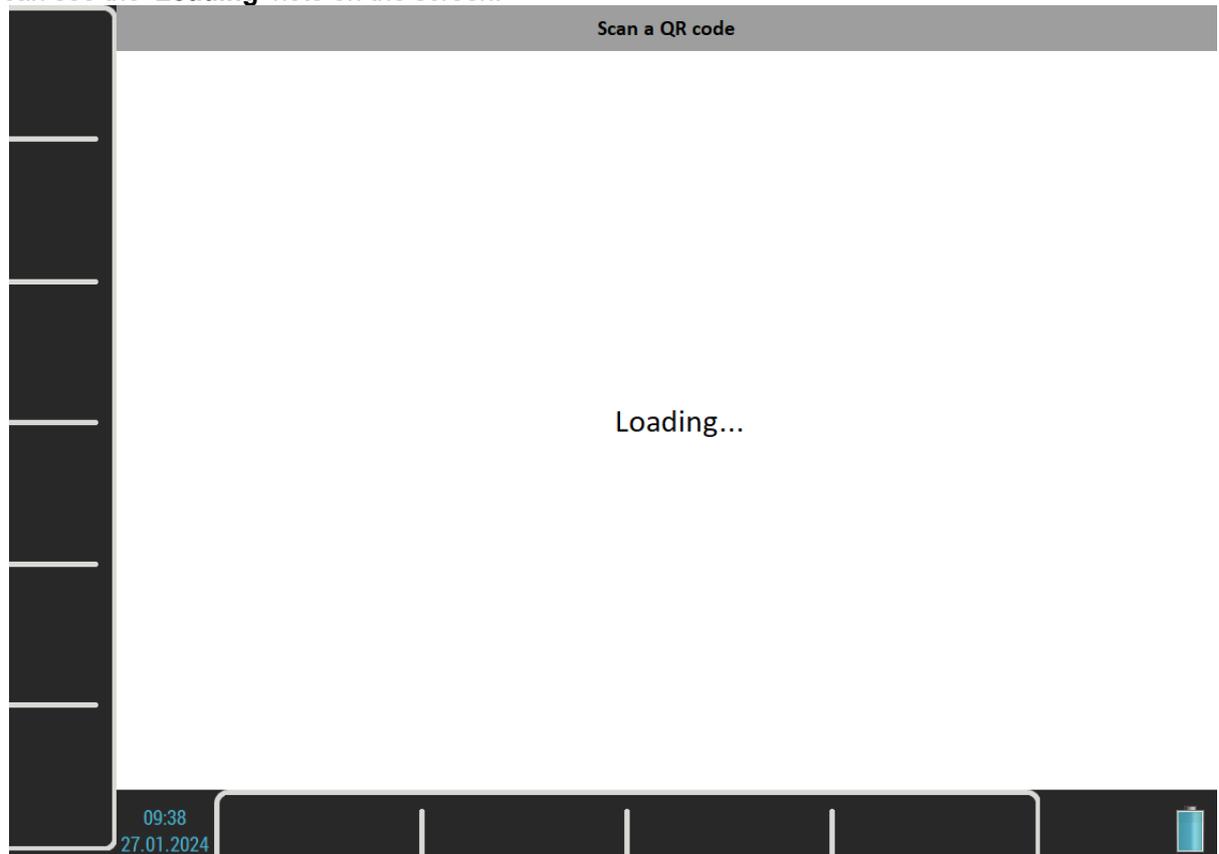
Once you can see through the VA5 camera, you can direct it to the QR code on the machine and it will be scanned with VA5 device.

After the QR code is read, you can see the loaded list of measurement points on the machine from the particular route measurement.
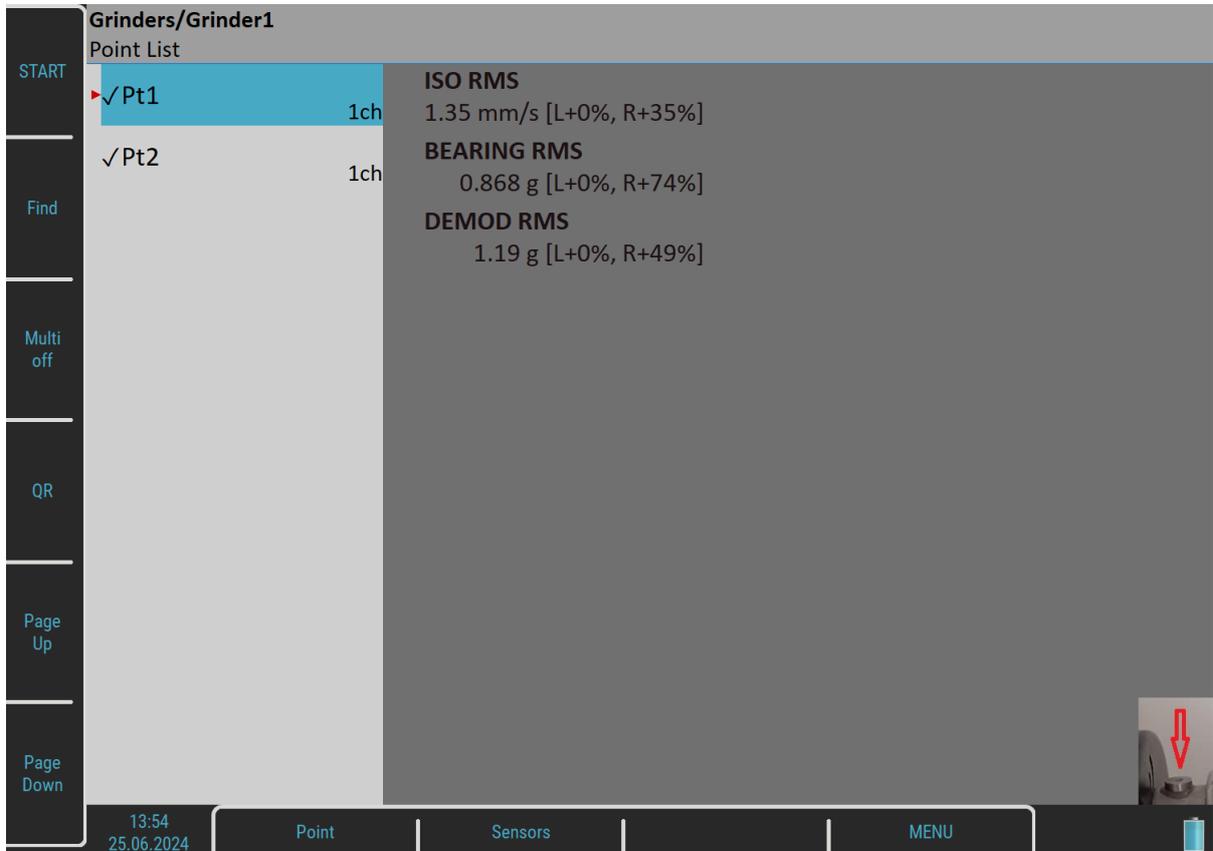
Note! It can happen that QR scanning will end up with an error message. The reason for it can be that you scan QR code from the different route, or that QR code structure is incompatible.

Route images

You can add the picture to particular parts in the tree. You can add the image of the machine and also you can add picture for particular measurement points on this machine. This image can be added in DDS software (see how to do it in DDS manual). These images are visible in the VA5 device once you click through the tree. The image is shown always in the right bottom corner (see pictures below – 1. machine image, 2. particular points).
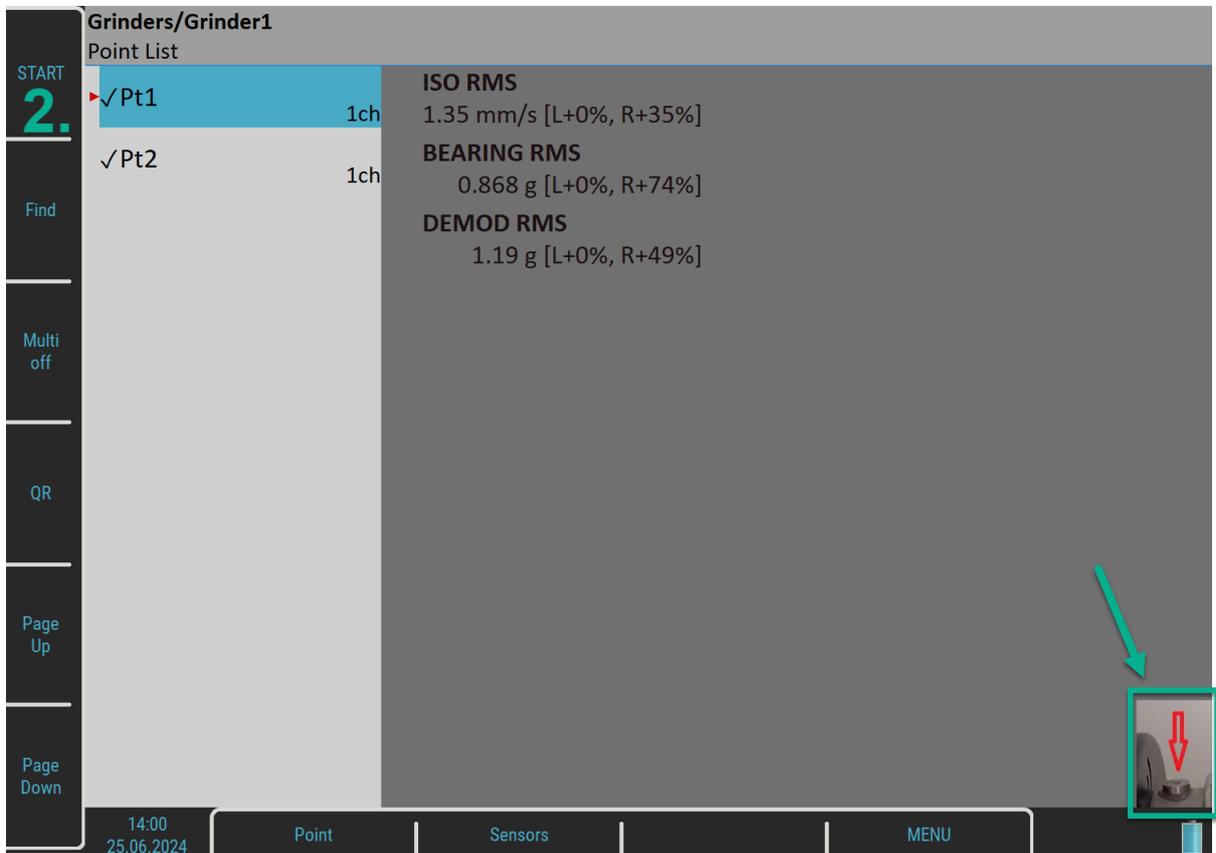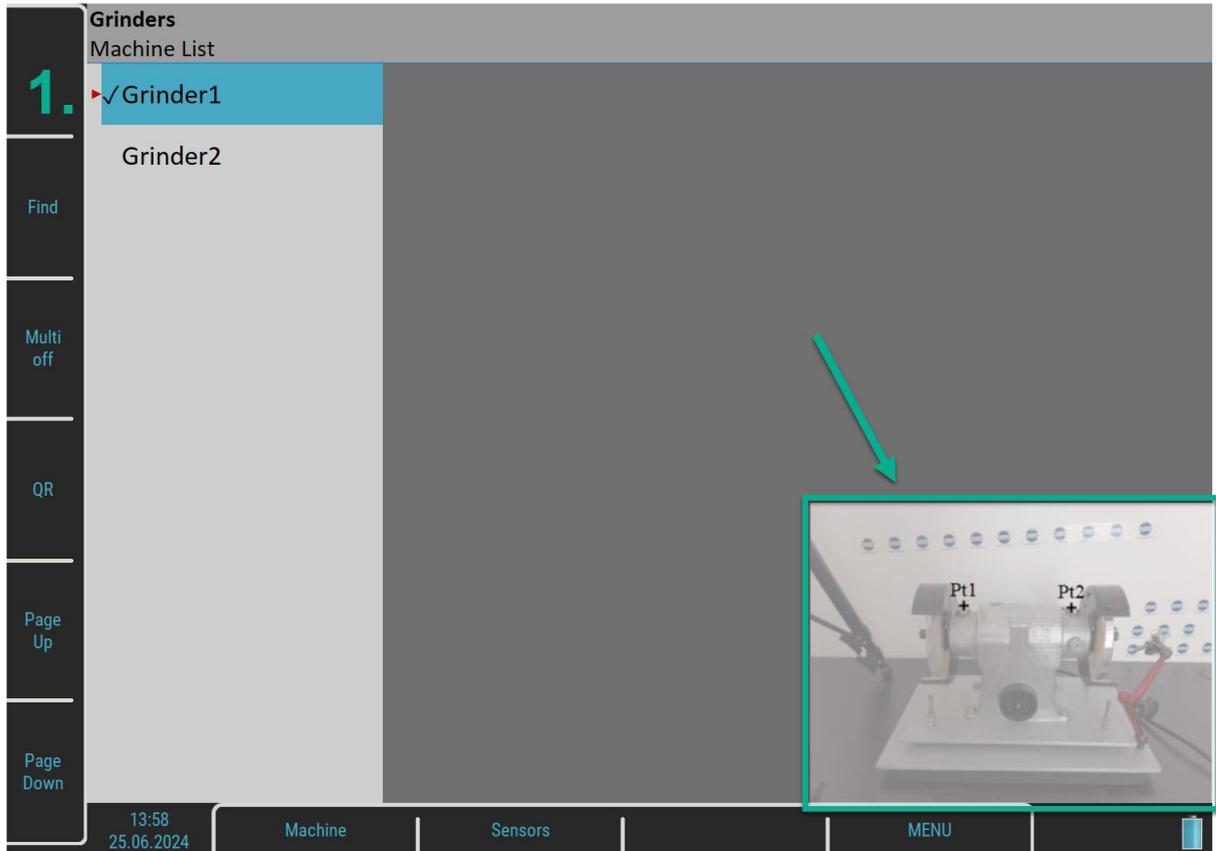
Note! If the image is added only to the machine and not for the measurement points under it, the image is "inherited" from the machine level. It means, that you can see the machine image also when you click through measurement points (see below – the picture for points is the same as for the machine).
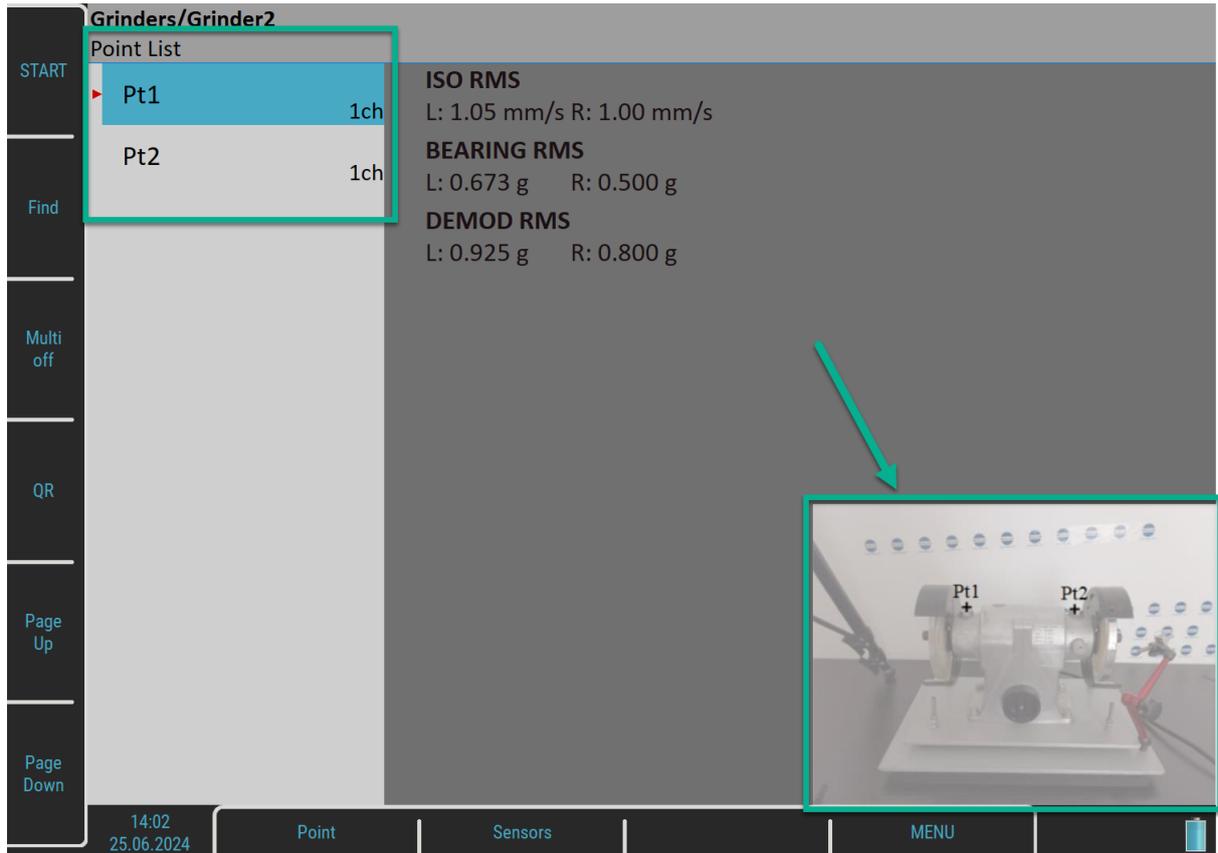
Sensors Check

Each point in the route contains the sensor setting, which is defined in DDS. The instrument also contains the sensors setting. Both settings are compared for each point while opening graphs window. When the sensors settings are not equal, the "***Used sensor*"** message appears.

Connect the requested sensor and confirm the message. Sensors setting will be stored in the instrument automatically and you don't need to set it. In case the "Used Sensor" message appears, measurement will not be started automatically. If you need to change any parameter you can do it in the Sensors menu.

There is a different approach for sensors with a Name defined. If one of the compared sensors has the name defined, then only names are compared. If names are the same, the sensors are supposed to be equal regardless of other parameters' setup and no parameters are redefined in the instrument. E.g., y ou may use it to setup different sensitivity of a sensor. In case the names differ, a "*Used Sensors*" message will appear with the sensor's name.

When you first open a point in Route module the "*Used Sensor*" message appears even if the sensors are the same just to inform you which sensor you have currently defined.

You can turn the sensors check off and on again in Global Settings / Check Route Sensors.

Measurement process

Push the *Enter* button to begin the measurement process. All defined measurements will be taken together. The measured data are or are not displayed on the screen depending on the Display Route Values parameter in the Global Settings menu.
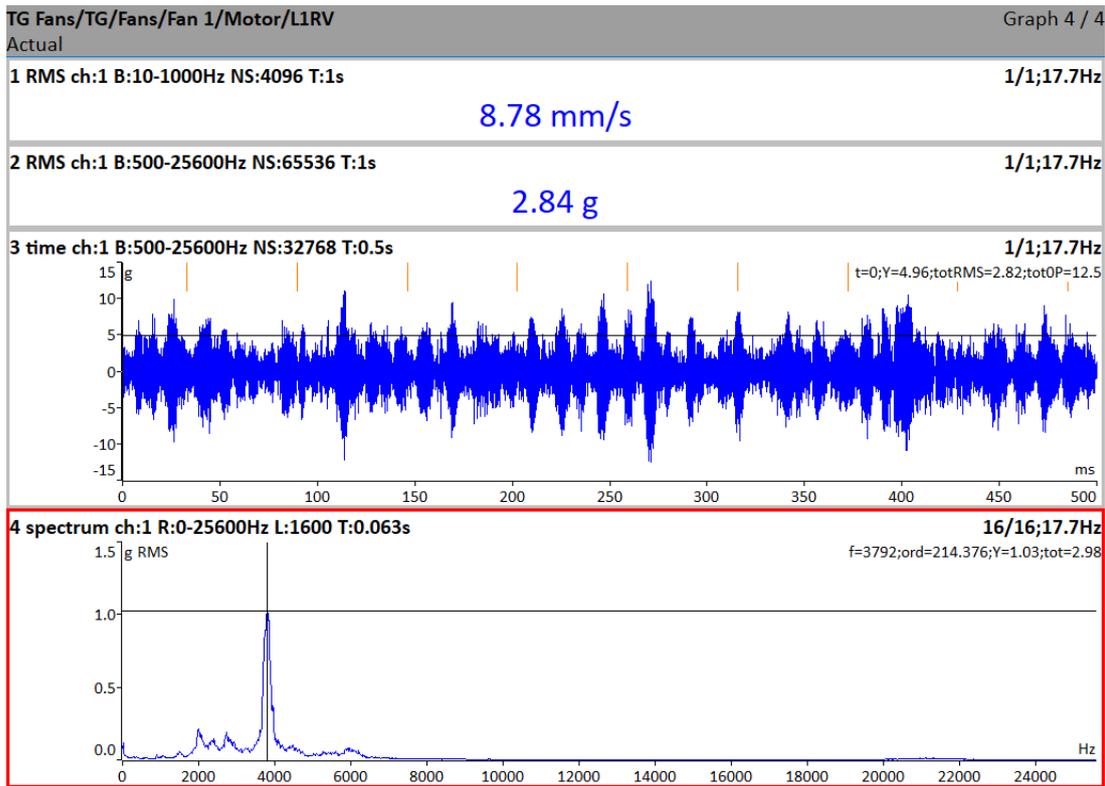
All values are automatically saved unless you set the Route Autosave parameter in the Global Settings menu to **off**.

If the Route Auto Forward parameter in the Global Settings menu is set to **on**, then the graphs window will be automatically closed after all data are saved. Otherwise, use the *Escape* to return back to the list. The measured point is labelled by the symbol √ (all defined measurement were taken). The next point in the list will be selected if all measurements are taken correctly.

Route Meas Mode

In DDS measurement point properties / Other tab, you may set the *Route Meas Mode* property.

If **Single** is set, only one reading is taken and the measurement process is stopped.

If **Retrig** is set, the measurement process runs until the user presses the *Stop* button. No values are saved during the measurement. For both of these modes, it depends on the Global Settings / Route Autosave, whether the reading after finishing the measurement is saved or not.

If **Continual Saving** is set, the measurement process also runs until the user presses the *Stop* button. Moreover, all readings are saved regardless of whether the Route Autosave parameter is set or not. It is designed for short series of measured values. For example, you want to measure one elevator run or one run of a press machine. See more details in *DDS* manual.

Trend without continual saving: Trend using continual saving:
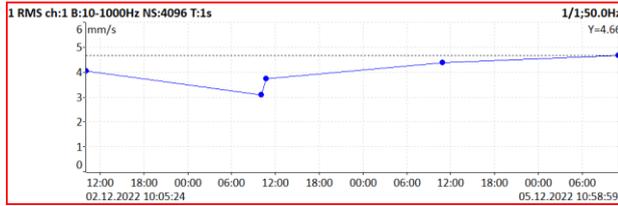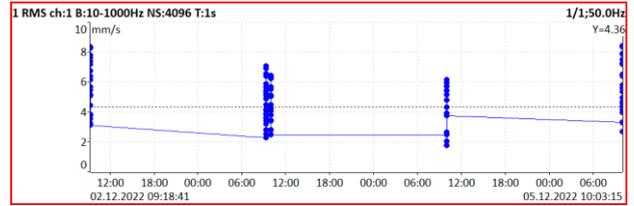
In case of *Continual Saving*, the *Measuring* indicator in status bar changes into *Continual Saving* and contains additional information, the number of saved readings (15) and the free memory size (30.2GB).

Route Status

All items in the route tree (points, machines or even whole routes) can be marked by a status symbol.

✓   all measurements of the route tree item were correctly taken.
!   error during measurement process.
.   only some measurements of the route item were taken

Note! The symbol can be cleared using *Route* / *Clear Checks*. This action does not erase any data. It can be useful when you want to take the route again without transferring data into the database.

Last and reference values

The last measured and reference values can be downloaded from a database inside a route. In DDS, you'll be asked whether to store reference values during route creation. Last values are stored automatically by default (this can be turned off). See the DDS manual for more details.

For overall measurement, the last (L) and reference (R) values are displayed on the left side of the graph. The reference value is also displayed like a line in the trend view.
The differences in percentage from the previous (L) and reference (R) values are displayed behind the measured value.
The last value is always changed when data is saved, while the refence value remains unchanged.

Reference spectrum is displayed together with measured spectrum in the same graph.
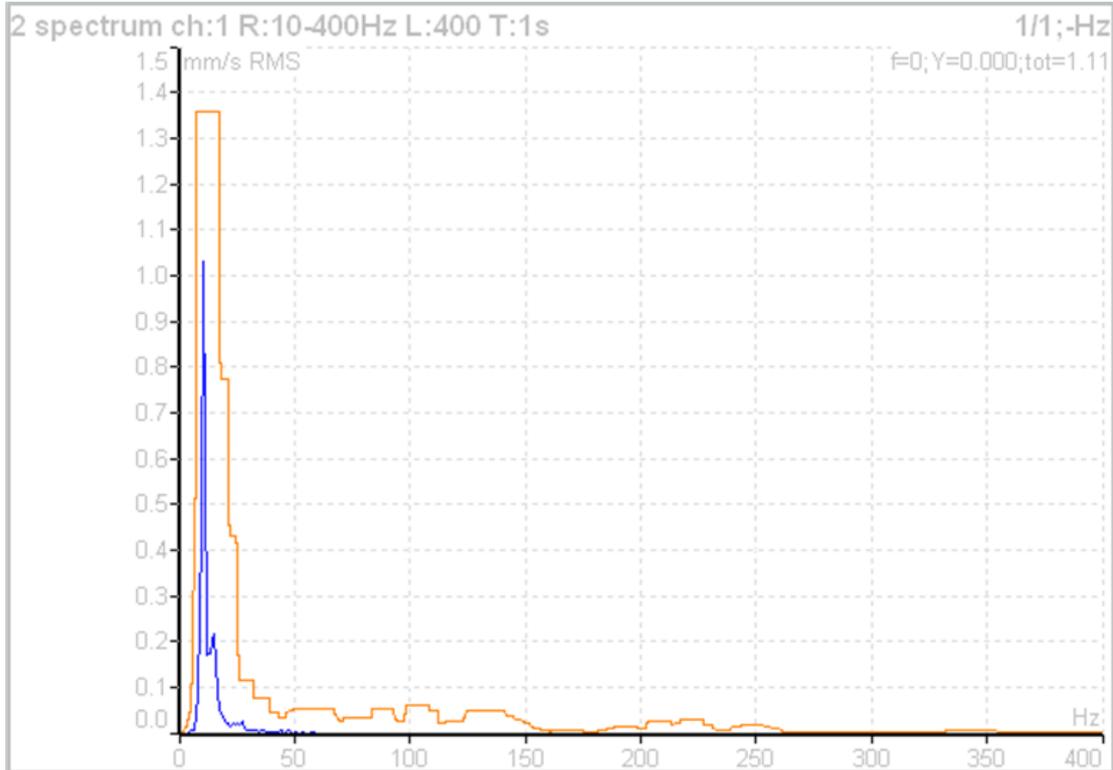
Manual Entry

The route may contain the measurements which have to be entered manually (for example, temperatures read from analogue display). These measurements are defined by the **Manual Entry** choice in DDS. An entry dialog is displayed for all manual entries during measurement process initialization. These values are saved together with the measured values.

Notes

You can attach short text notes to a tree item in the route. The same is available in the Analyzer and Runup modules.

Push the left menu button (named as *Route*, *Machine* or *Point*, depending on which level is currently displayed). Select the **Notes** item. The list of existing notes for the selected item appears. It is empty when no note has been created yet.

Push the **Add** button to create a new note. New window appears. You can directly type the note in the upper half area. The User notes list is displayed at the bottom. Several ways how to create a new note exist.

- Select one note from User notes list and press **Select**. The selected note is copied to the upper area.
- Push the **User/Factory** button to change the User notes to Factory notes or back. Then choose the note from the list and press **Select**.
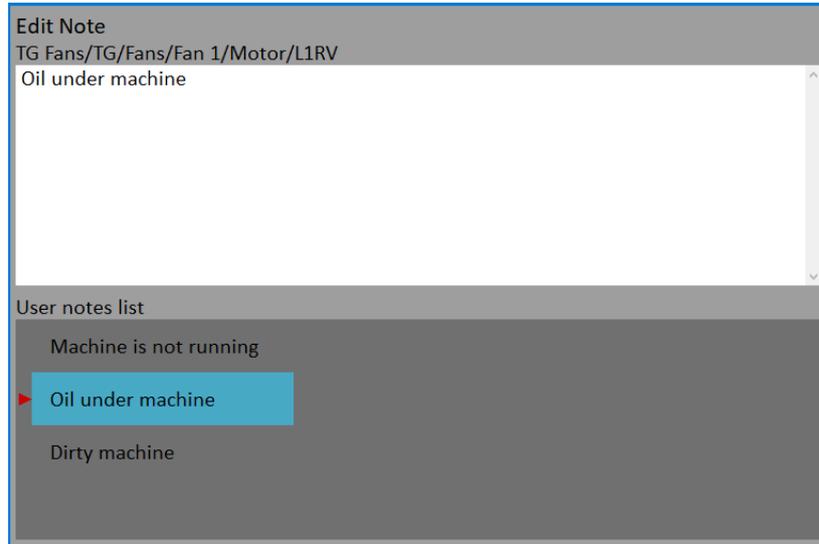
- If you want to enter your own text, then press the **Edit Text** button. The cursor appears in the upper area and you can enter the required note. Push *Escape* to return back to the selection of User/Factory note.

If the note is done, press the *Escape* button. You return back to the list of all notes for the selected point.
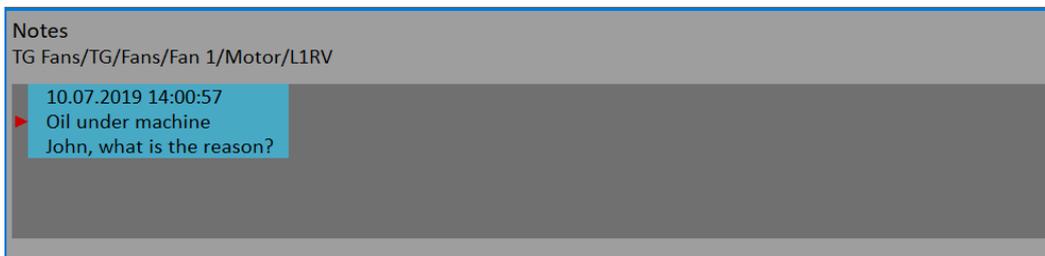
You can also edit any defined note. Press the *Enter* or the **Edit** button when the Notes list is opened. The selected note opens for editing.

Press the **Delete** button to delete the selected note.

Push *Escape* to leave the list of notes. The **N** letter appears behind the point name in the list.

Attention! The notes created at a measurement point (or set) after performing a measurement at a point are automatically included into csv header during export to csv (see Analyzer / Meas Menu / Export to csv).

Speed in the Route

There are various ways how to get the speed and transfer it to DDS. The ways are described here in the order from the lowest priority to the highest priority.

Speed entered in DDS

The **Default Speed** can be set in DDS as a machine parameter. This value is sent to the instrument and it is used in place of the tacho probe value. The three options of *Default Speed* are available for the machine item.

- **Entered value –** the value is sent to the instrument. The value is used only for FASIT measurement. If the value is entered, then no speed detection is used.
- **Detected –** option runs speed detection before measurement (see the Speed detection chapter).
- **Manually Entered –** opens "**Enter the speed**" dialog, where you enter the value, before the measurement process

The current entered or detected speed value (if defined) is displayed in the information panel at the right (if the measurement is not in progress).
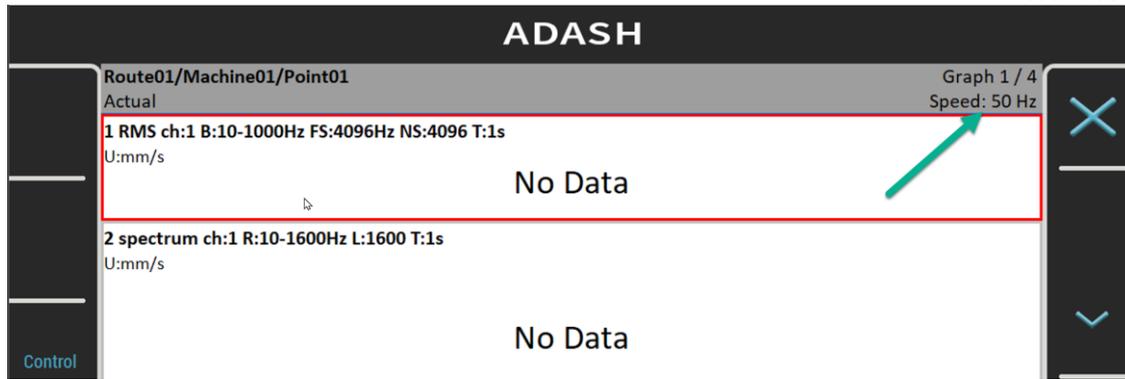
Note! Detected or manually entered speed is valid for the whole machine. Unless you close the machine item, the same speed value is used.

Entered Speed

You can manually enter the speed value which is then used instead of a tacho measurement.
Push the left menu button (named as *Route*, *Machine* or *Point*, depending which level is currently displayed). Select the *Enter Speed* item. A dialog will open. Enter the value and confirm.

The entered speed value will be saved to all following readings. It is saved to the same position in the data head as the speed measured by tacho. If the speed is manually entered and also measured by tacho, then the tacho is prioritized and saved.
The manually entered speed is displayed on the right side at the top of the screen with the word "*Speed:*"

The *entered speed* can be cancelled using the **Cancel Speed** item in the same menu. The *entered speed* is automatically closed when closing a machine.
Note! Entered speed is prioritized above the speed entered in DDS.

Measured Speed

If the speed is measured by a tacho probe, it is always saved with data regardless of them having been already defined using one of the previous ways or not.

Linear speed

You can enter a speed to VA5 in Hz (standard, see the chapter above Speed in the Route) or you can choose to enter a linear speed instead. This is new option available from VA5 firmware version 0282. The linear speed option allows you to enter the speed value in displacement units – it means you don't need to enter the speed value in Hz, but it is possible to enter speed value in m/min.
Typical example of the machines which can use this feature is the paper mills machines.
Setting of the linear speed is done in DDS software. It is not set directly in VA5 device. For more information, please see DDS manual.

Note! Keep in mind, that if any of the machines has roller diameter defined in DDS and this part of the tree is sent to VA5 device, you will be asked to enter the linear speed when you start to measure first measurement point. The window looks like this:

This linear speed information will be used for the whole machine. You can see also the speed in Hz (this value is recalculated from the linear speed you have entered). This information is shown at the left top corner of the screen.

You can also enter linear speed to measurement afterwards (if you didn't enter it at the beginning of the measurement – you will not be asked again to enter the linear speed automatically). Click on "Point" button and choose option "Enter linear speed".

Note! You can see "Point" button in the screenshot above. This button can have different name based on the location where you are in the route tree (e.g. it could be named "Machine", "Set", etc., but you can still find linear speed setting here).

You get the same window to enter the linear speed.

There is also an option to cancel the entered linear speed. You can do it with the same button for Point. (This option is not shown unless linear speed is entered.)

Note! Speed can be also left undefined.
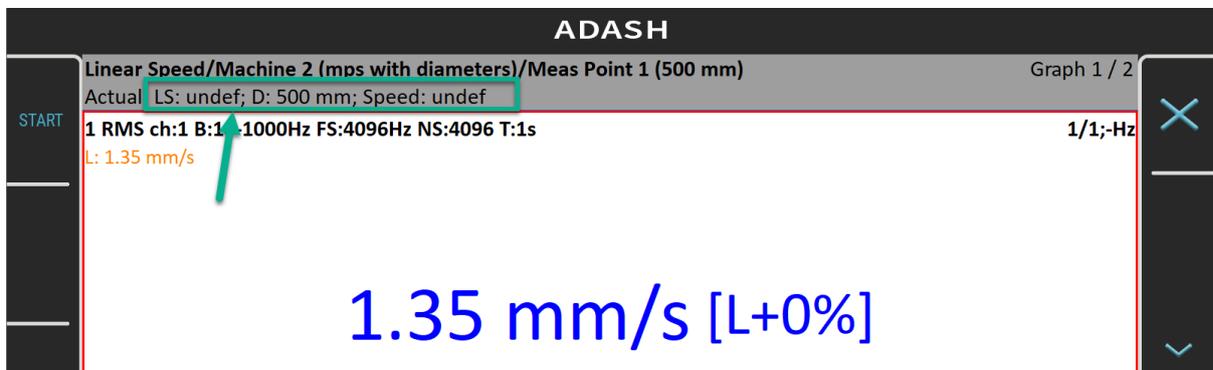
Limits

In DDS, you can define limit values and alarm colors (see the DDS manual to find out how to do it). For static data cells, these limits are transferred into the instrument together with the route. Exceeding the limit values is signaled during the measurement and also in trends.
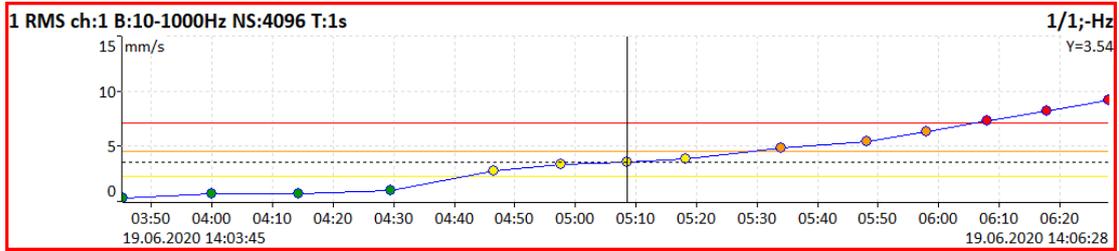
Export to VA5_DISC

The computer can read any data from the *VA5_DISC* only. The route with measured data has to be exported to this memory before the transfer. During the route measurement, all data are saved to the VA5 hard disk only. When the route is closed the VA5 asks the user "***Export to VA5_DISC?***" and the user selects one option. The export to the VA5_DISC is not done automatically because the writing procedure to flash is slow. A large route export can take several minutes. That is why the user can determine when the right moment to export the route is.

You can select the route and export it manually in the menu item ***Route / Export***. Furthermore, there is the option MENU / RUN / Export All which exports all unexported projects from all modules.

Runup

When you need to measure Run Up or Coast Down of the machines, then you should use the Runup module. It enables the same measurements as the Analyzer module, but with controlled continual saving of values.

What does it mean "controlled"? In the Analyzer mode, you can measure the set and then you have to save the measurements manually. The Runup is different. The values are automatically saved during the measurement process.

You may control the number of saved values by several ways. The setup can be done in Trigger Settings / Runup Trigger Mode. The **speed** is usually used for that control and new a measurement is made when the speed changes from previous measurement by a defined value (for example,10 RPM). Also, the **time** can be used to control that procedure. Then you can take the measurement in a defined time interval (for example, each 60 sec). The **asap** is the next choice. It means no delay between measurements - **a**s **s**oon **a**s **p**ossible. Be careful with such mode. You can fill the instrument's memory quickly.

The last choice is the **manual** mode.

In the Runup module, there is a number of readings and free memory space displayed in the status bar besides common information.

Runup Measurement

The meaning of the *set* and also the meaning of the other terms is the same as in the Analyzer module.

We show the runup measurement on an easy example. For example, we define only one measurement in the set. The proximity sensor on channel 1 is used. The sensor must be defined in the Sensors menu. The Runup Trigger Mode is set to **speed** and the value is **1Hz**. The measurement is defined like in the picture.

Edit Measurement	
▶ Type	1x amp+phase freerun,time
All Channels	no
Channel	1
Unit	µm
Averaging	linear
Avg	off
Resolution	speed / 4
Save	

Push the *Enter* button to start the measurement process.
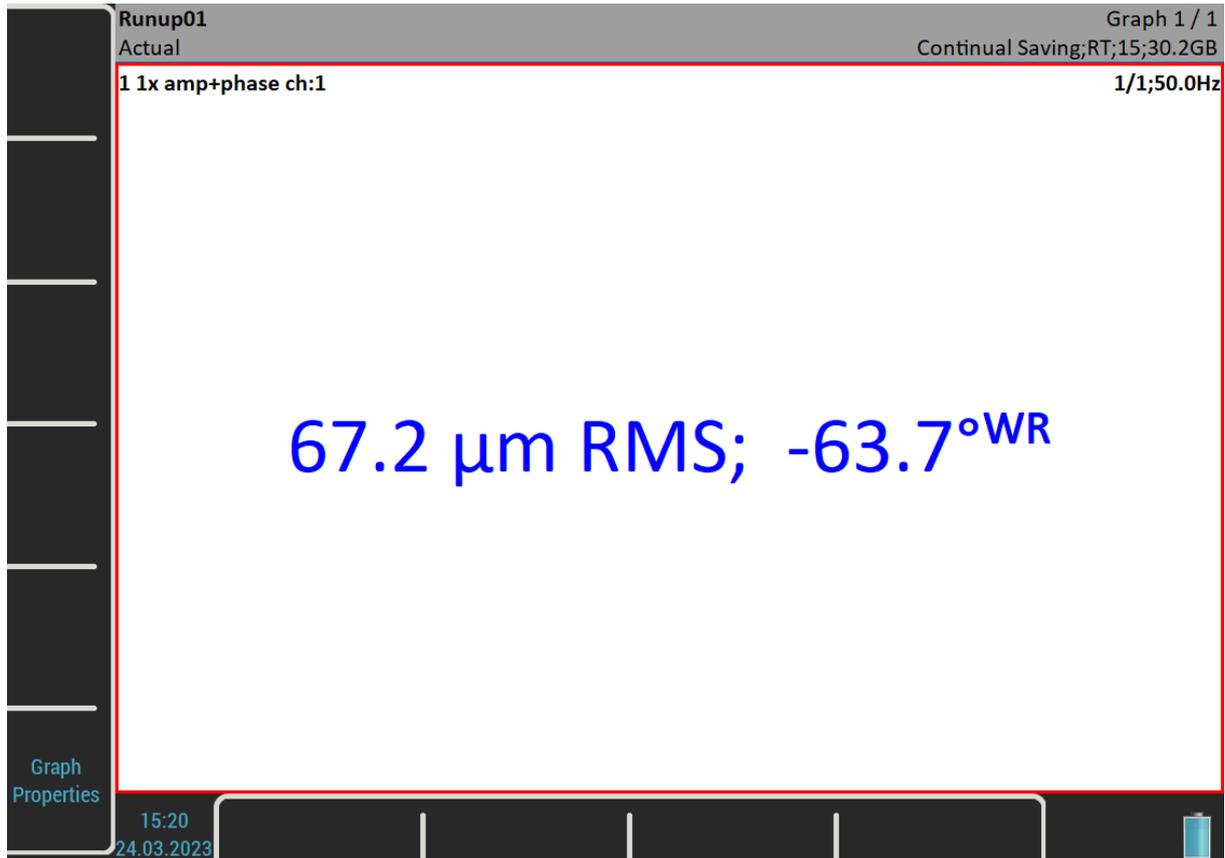
The *Measuring* indicator in the status bar changes into *Continual Saving* during the runup measurement and contains additional information, the number of saved readings (15) and the free memory size (30.2GB).

The set screen looks the same as in the Analyzer module. But there is one difference. The values are saved during the measurement.

The current value is displayed in the picture above. Nevertheless, in the Runup module, you may display a trend during the measurement process already. Use the Graph Properties / Display for it.

Push the *Escape* button when you want to stop the measurement process.

Trends

In the Runup module, unlike in the Analyzer module, one trend is saved during each measurement process. Push the *Set* button and select the ***View Trend*** item to open a ***Trend List***. The date and time of the trends are displayed in the list. If the analysis was made from record, two time stamps are displayed. The analysis time is the first and the record time is the second.

One runup measurement can be divided into more files (into more trends), for example, if the measurement is too long. See MENU / SETTINGS / Runup.
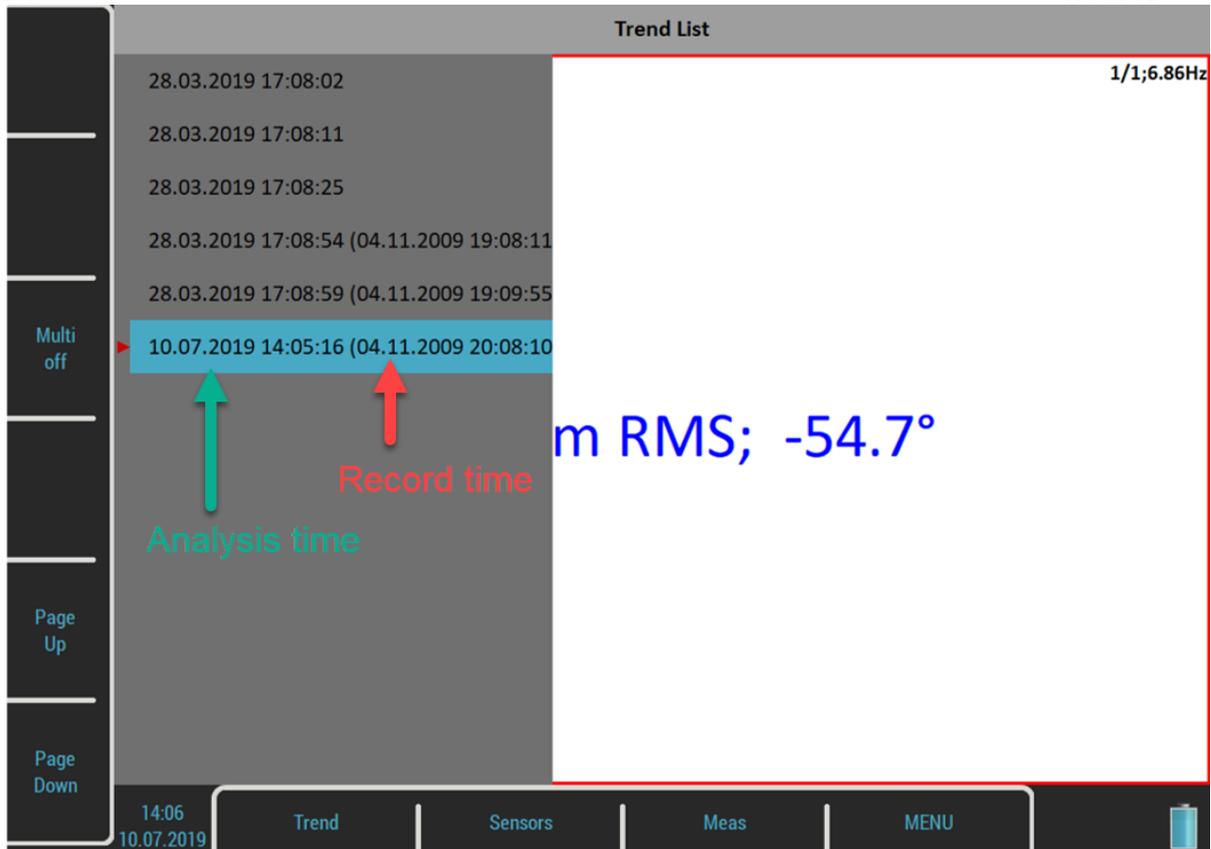
Select one item in the list and open it. The selected trend will be loaded and displayed.
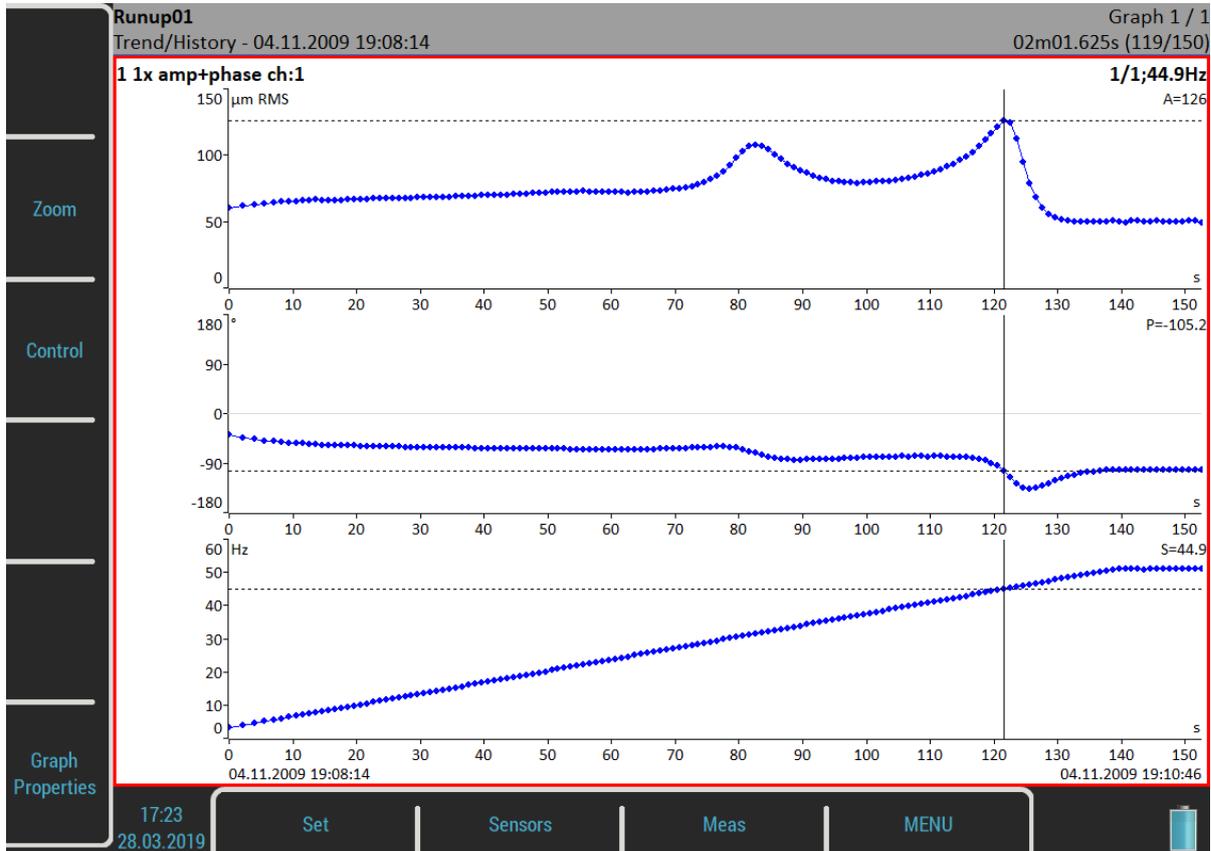
The date and time after the *Trend/History* indicator in the status bar means the beginning of the measurement. The time stamp in the bottom right corner of the status bar means the actual *trend cursor* position and the 119/150 means the index and the total number of readings in the trend. The trend axis is marked from the beginning. This is the default setup. If you want absolute date and time, change the Trend Time Axis parameter in MENU / SETTINGS / Runup to a **real time** value.

Trend Menu

When the *trend list* is displayed, a menu to work with the trend list items is available. Push the **Trend** button to open the menu.

Delete

Delete the selected trends.

Export

It is not necessary to export the whole set with all trends. You can export only the trends you need. You find them in the folder named as the current project (set) in the *VA4runup* folder on the *VA5_DISC*. Then you are able to work with them the same way like you would export the whole project (for example, import to DDS or copy to virtual unit). The project is partially exported.

Recorder

Many of older engineers remember the past time, when the signal was recorded to the tape-recorder and consequently analyzed in Analyzer. Such approach had one important benefit. You can analyze the signal again and again. When you need to make all required analysis in real-time, you are under time pressure. If, for example, the runup can only be run once, the pressure is extreme. The tape-recorder was the solution. It was a simple unit with simple operation, no danger of losing the data. The same solution offers the Recorder module. It enables you to simultaneously record all four AC and DC inputs and the TRIG input into the memory.

Project List

For management purposes, **records** are referred as **projects**. The list of saved projects opens when you enter the Recorder module. The list is empty if you have no saved records yet. The recording date and time of the selected project is displayed in the status bar in the bottom right corner.
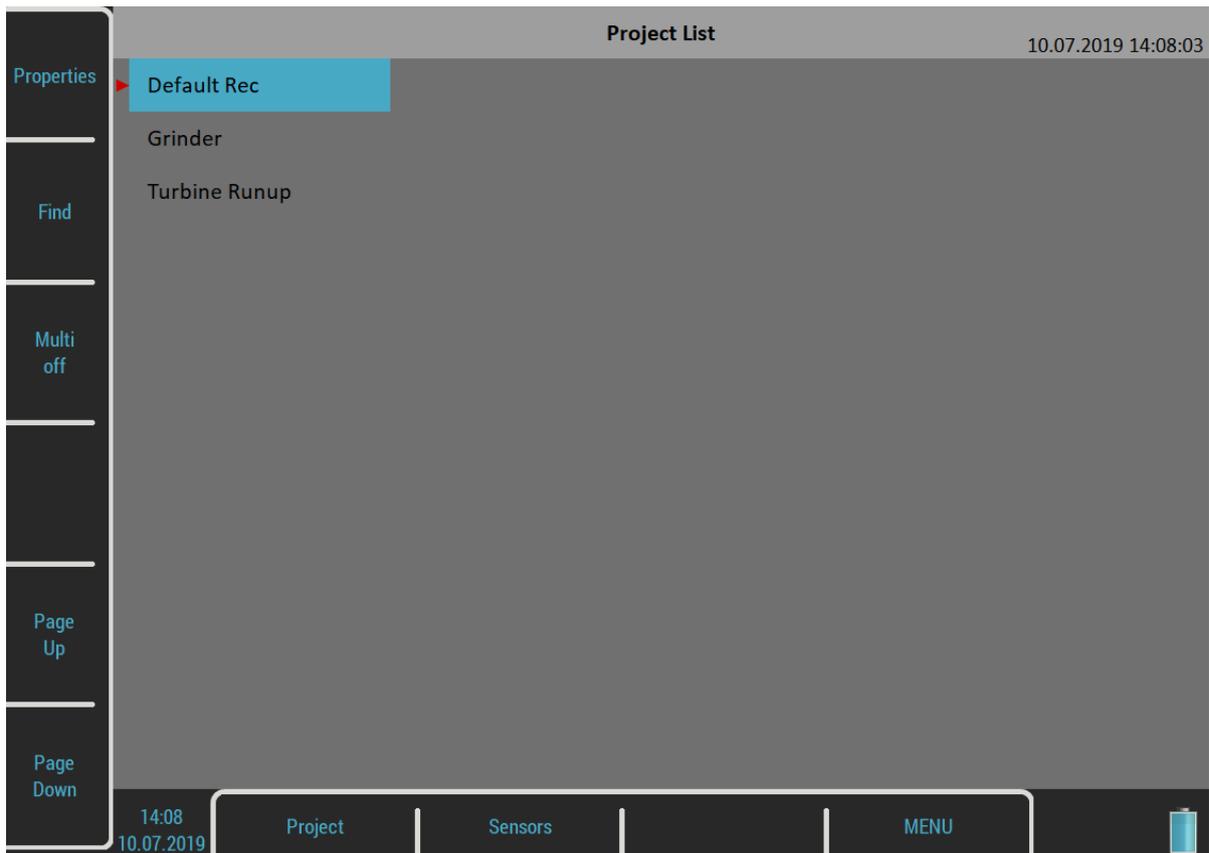
Project Menu

Use the **Project** button to manage the records in the list.

Project
▶ New
Copy
Rename
Delete
Clear Data
Notes
Export
Export to wav
Export to wav Settings

New

Creates a new project (record) and adds it to the *Project List*.

Copy

Copies only the parameters of the selected project, no recorded signals will be copied.

Rename

Renames the selected project.

Delete

Deletes the selected project.

Clear Data

Deletes the signal in the selected project, all record's parameters are kept.

Notes

Adds a note to the selected project. The Notes dialog had already been introduced in the Route module.

Export

Exports the selected project to VA5_DISC.

Attention! The maximum record size that can be exported is 4 GB which represents 80 minutes of 4 channel recording with 65536 Hz sampling frequency. When you want to export a larger record, then the error "*Not enough space*" appears. You need to split a large record to several smaller records. See the Record Preview chapter.

Export to wav

Exports the selected project as a wav data format. The wav files are saved to a *wav* folder on *VA5_DISC*. You may choose the 24 bit or 16 bit encoding of the wav file using MENU / SETTINGS / Global Settings / Wav Encoding. Additional settings can be done using the Export to wav Settings.

Export to wav Settings

Opens the Export to wav Settings menu.

Export to csv

Exports the selected project as a csv file. The csv files are saved to a *csv* folder on *VA5_DISC*.

On the first line of the csv, there is a record's sampling frequency in Hz in format:
fs:65536;

The next line contains used channels and their physical units:
AC1[g];AC2[g];TRIG;

Then, the values of all signals and eventually the trigger are stored by columns.
0.499992;0;1;
0.499992;0.00238538;0;
0.499975;0.00478721;0;
0.499942;0.00718904;0;
…

Record Settings

The *Record Settings* menu opens automatically when you open a project without data. You can also open the menu by the **Recorder** button when a record is opened. You don't lose any measured data by editing the settings.
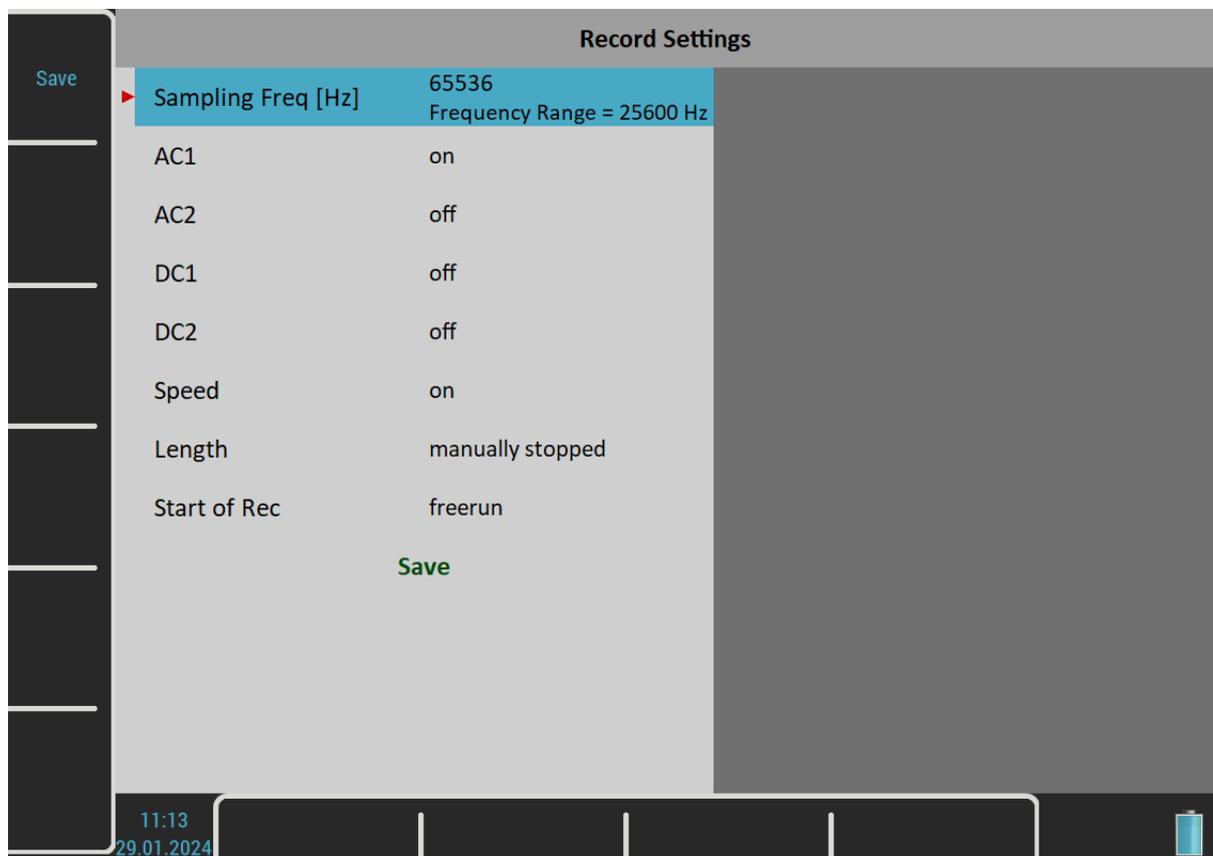
Sampling Frequency

The sampling frequency used by recording. The available frequency range of the recorded signal is in the note under the value.

AC1 – AC4, DC1 – DC4

Switch to **on** at all channels you want to record.

Speed

You set here if the speed is in the preview. Tacho pulses are always saved.

Time

Defines the length of the record in minutes or **manually stopped**.

Start of Rec

<u>freerun</u>
The recording is started immediately after the measurement's preparation.

External
The recording is started when a signal on TRIG input exceeds a threshold level which is defined in MENU / SETTINGS / Trigger Settings / External Trig Level [V]t. Such signal may be generated, for example, when a machine starts to work. This type of signal is usually created in the control system.

amplitude
The recording is started when the signal level on the *Ampl Trig Channel* exceeds the *Ampl Trig Level*. The *Ampl Trig* parameters are available only if the **amplitude** is chosen.

Start of Rec	amplitude
Ampl Trig Channel	1
Ampl Trig Level [g]	1
Pretrig[minutes]	0

Pretrig

When the Start of Rec event occurs, the recording is started. But you are able to save a signal before the event by defining the *Pretrig* length.

Recording

Remember to setup all sensor properties before recording. Use the Sensors menu. When the sensors and record parameters are set, use the *Enter* button to start the recording.

If the record already contains data, you will be warned and you can cancel the measurement.

<div style="border:1px solid red; color:red;">
Record contains data.
Data will be rewritten.
</div>

All recorded input signals are displayed on the screen during the recording.
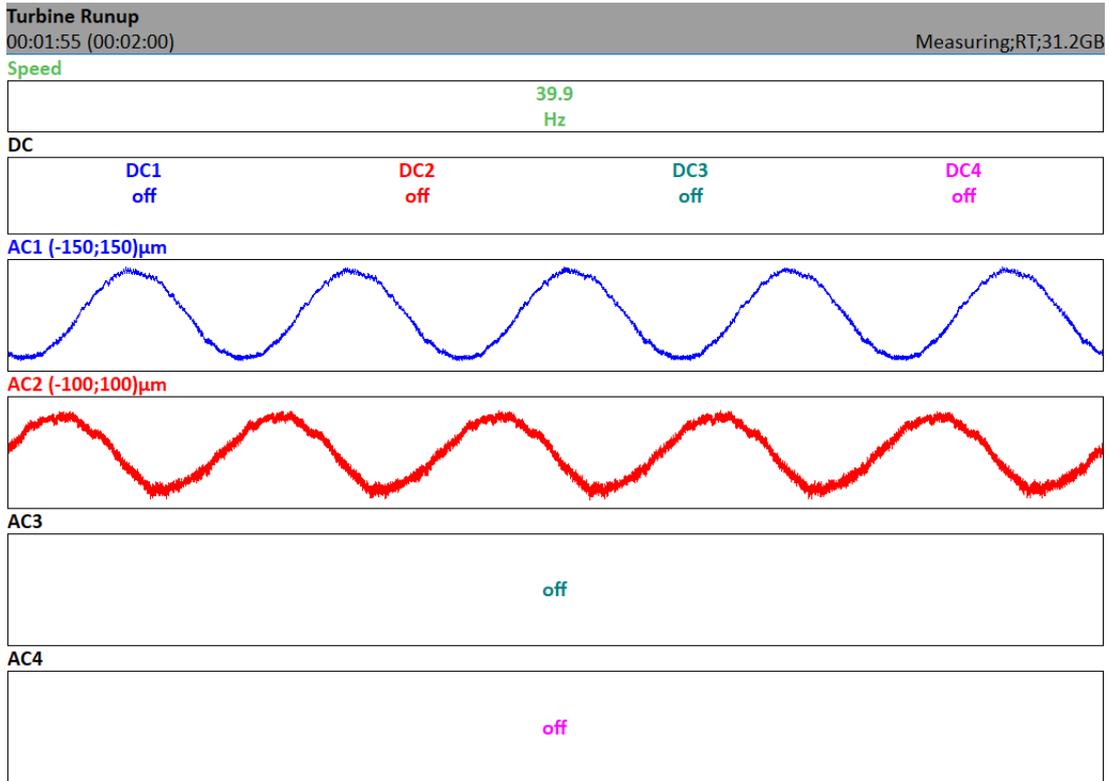
Elapsed and demanded time is displayed in the status bar bottom left corner. The available memory is in the bottom right corner.

The recording is finished when
- the time is over,
- manually, by the *Escape* button,
- the memory is full.

Record Preview

The preview of recorded signals is displayed after the record is taken.
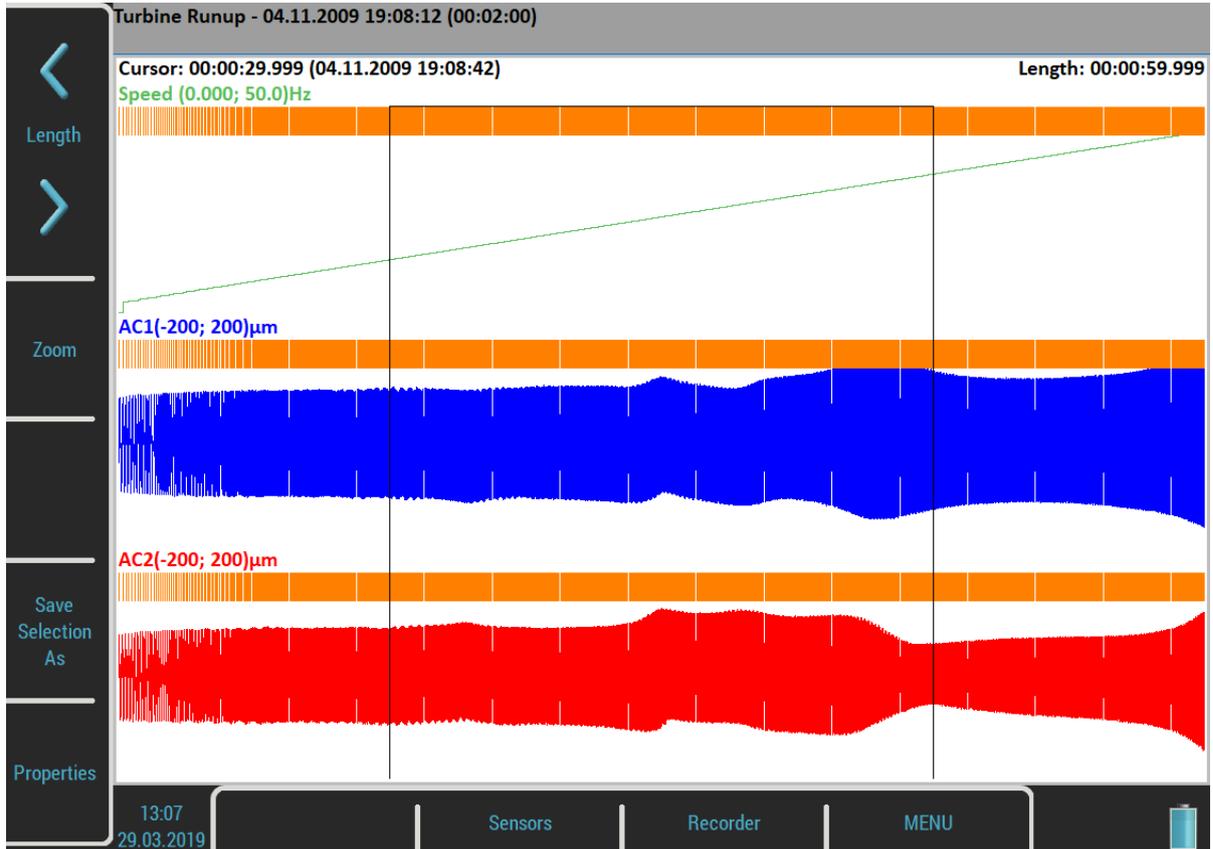
The record date, time and length are displayed behind the record's name in the status bar.

The selection cursor is displayed over the signals. The **Cursor** label shows the beginning of the selection measured from to the beginning of the record and also in absolute time. You can move the cursor with the *Left* and *Right* buttons. The **Length** of the selection can be changed with the **Length** arrows. You can also use touch screen gestures.

You can zoom the record using the **Zoom** button. Zoom X is applied to the selection area.

The **Tab** button switches the side buttons meaning between the *Zoom* and initial mode. The **Backspace** button returns the initial mode.

When the record contains longer data than you need for analysis, you can select any part and save it as a new record. The **Save Selection As** does it. The *Cursor* defines the beginning of the new record. The *Length* defines the length of the new record.

The **Properties** button opens a window with the information about the record.

The **Enter** button starts a new recording if you want to rewrite the signals. You will be warned before the data erasing.

The **Escape** button closes the preview and skips back to the Project List.

Export to wav Settings

This menu can be opened by the **Project** button when the Project List is on screen.

Export to wav Settings	
► AC1	1
AC2	1
AC3	1
AC4	1
Tacho / External	off
Mixer	off
Range [V]	max
Save	

AC1 – AC4

All channels can be mixed to one channel into a wav file (like in music studio). The gain factor can be defined for each channel. When zero is used, this channel will not be used for mixing.

Tacho / External

on, **off**
If it is turned on, tacho / external pulses will be exported as standalone channel.

Mixer

on, **off**
Select **on** when you want to mix all channels to one channel wav file. If the **off** is used, then multichannel wav file will be created. The gain factors are used in both options.

Range [V]

The full AC range of the instrument is +/- 13.8 V (even if a value above 12 V is considered an overload). This range is also used for wav export, i.e., a sample with 13.8 V will be saved as maximum in wav. But it is usually too much, because the real voltage level is much lower, e.g., hundreds of millivolts with an accelerometer 100mV/g. The wav file is then very quiet. The *Range* option enables you to apply better wav range and better hearing from headphones.

1.5
This range should generally be acceptable in most of cases.

max
The value of 13.8 V is saved as maximum in wav. The range of wav is 13.8 V.

auto
The reached maximum value in a signal is used as wav range.

user
You may enter any value.

Attention! If you need to compare two signals in headphones (for example, the noise of old and new bearing), then the same range must be used.

Attention! When the range value is lower than the range of the signal, then the warning "***Wav overload***" appears after the export.

Temporary record

Records can be stored in the DDS database. For record analysis, the DDS copies one record into the list of records in the Virtual Unit and runs the Virtual Unit. We call this record temporary. It will be deleted once you close the Virtual Unit.

Balancer

The balancing process is based on standard measurements of amplitude and phase on the speed frequency. If you are not familiar with field balancing method, please see any special literature.

Planes and Points

We would like to explain the difference between the words 'plane' and 'point'. The sensor is mounted to the point or points (dual channel reading). The trial mass and final masses are mounted to the plane or planes. Some people talk about measuring on planes, but this is not correct. In case of overhanging rotor there is no direct relationship between points and planes.

We use the labels A and B for points and 1 and 2 for planes.

Project

The Project is the base structure in balancer. It corresponds to one balancing job. You can use the same Project for repeated jobs on the same machine. The measured data will be rewritten.

The Project contains all measured or entered data, which were used during the job.

The typical scheme looks like the following list of steps:
- Create new project.
- Enter balancing parameters (type of machine, number of planes etc.).
- Initial measurement of vibration amplitude and phase on required measurement points.
- Put trial weight on the rotor. Step by step to all planes.
- Trial weight response measurement. Step by step to all planes.
- Put correction weights on all planes.
- Check of effect (success).
- Trim measurements for additional weights and better results.

Every step is displayed in one screen. The movement between screens is provided by *Up / Down* arrows.

Attention! When you return back in the job screens and you take a repeated measurement or enter a new value, then the measured data will be erased in all screens after the current screen. The reason is simple. The parameters in the next screen are derived from the previous screen. When you repeat the measurement, you change these parameters. That is why all following screen parameters must be removed and you have to make all necessary measurements again.

Project List

The list of saved projects opens when you enter the Balancer module. The list is empty if you do not have saved projects yet. The modification time stamp of the selected project is displayed in the status bar in the bottom right corner.

Project Menu

New

Creates a new project with default properties.

Copy

Creates a new project as a copy of the selected project. Only the header data are saved. No measured data are saved.

Rename

Renames the selected project. The project with the old name does not exist anymore.

Delete
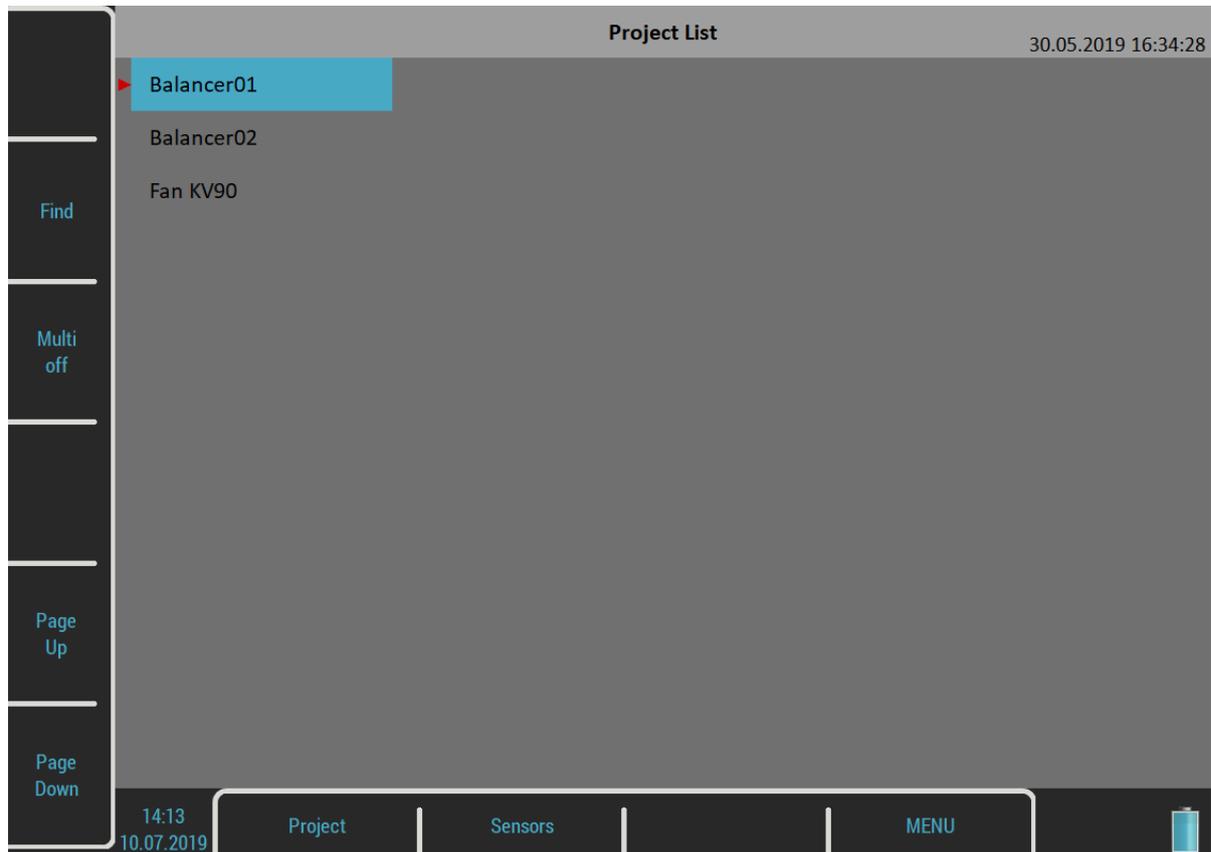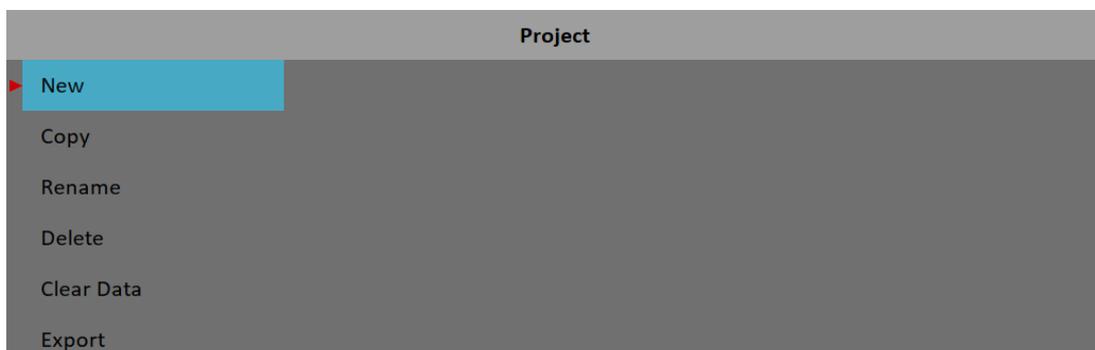
Deletes the selected project.

Clear Data

Erases all measured data, only the project header remains.

Export

Exports the selected project to *VA5_DISC.*

Note! The Balancer projects are automatically exported during closing. You don't need to export them manually. The *Export* item can be used in case you delete the project from the *VA5_DISC* and want to export it again.

Balancer Settings

A Basic Settings menu automatically opens when you open a project which has no data yet. You may open the menu later using the **Balancer Settings** button. There are three separate menus under this button, Basic Settings, Units Settings and Rotor Settings.

	Balancer Settings
► Basic Settings	
Units Settings	
Rotor Settings	

Basic Settings

	Basic Settings
► Planes	1
Image	undef
Rotation	undef
Point Channel	1
Remove Trial Weight	yes
Correction Weights	add (mount)
Components	not used
Meas Mode	single
Avg	off
Resolution	speed / 4
Save	
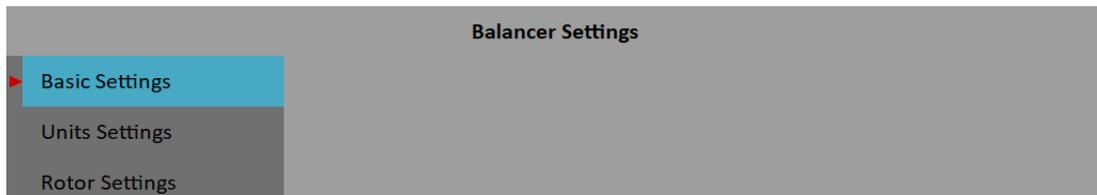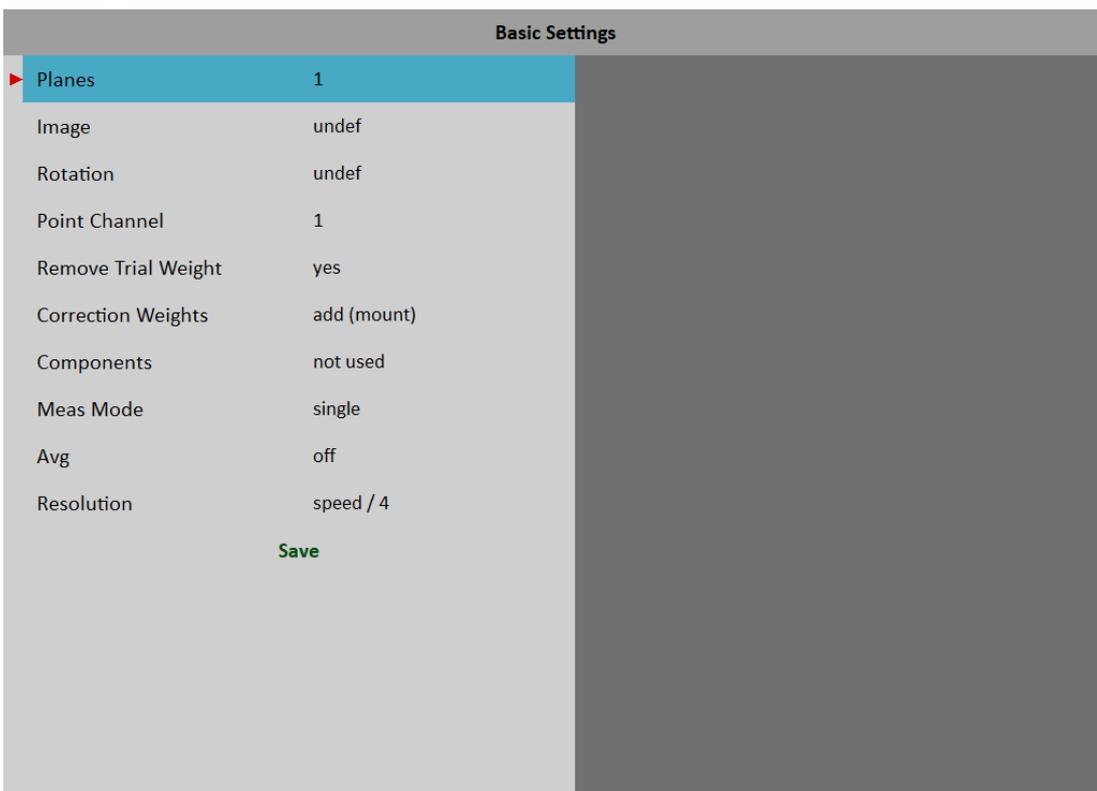
Planes

1, **2**
Number of balancing planes.

Image

Selection of the machine image, different images are available for 1 or 2 plane balancing

Look

left, **right**
View direction. Available only if the Image has been defined. Moreover, not all images enable the look.

Image	overhung rotor
Look	right
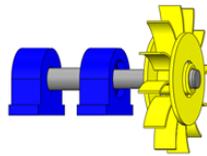
Right: **Left**:
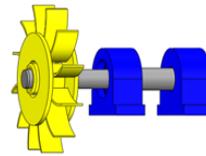
Rotation

CW, **CCW**
Clockwise or counterclockwise

Point Channel

The number of AC input, which will be used for the sensor mounted on the measurement point, for 1 plane balancing

Point A Channel, Point B Channel

Numbers of AC inputs, which will be used for the sensors mounted on the measurement points, for 2 planes balancing

Note! You can enter the same AC channel number for both A and B point. In this case, the measurement with one sensor is expected and readings for both points are not taken together. First, you take the measurement on one point. Then, you remount the sensor to the other point and take next reading. The point which is currently measured is selected by the Left / Right button (see later).
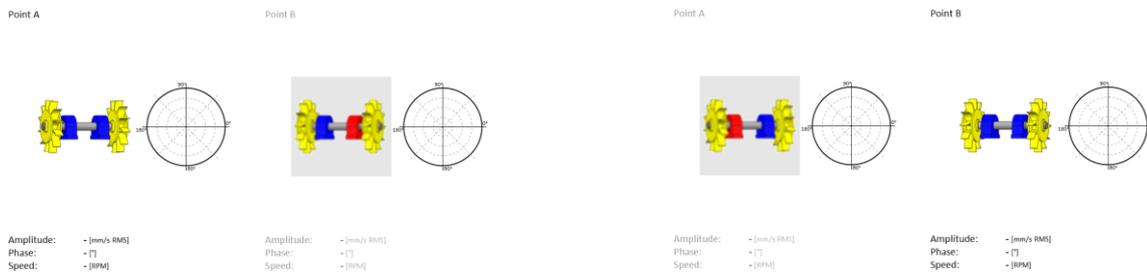
Note! The measurement points marking A and B only have a symbolic meaning. It has no relation to the balancing planes 1, 2 and to the balancing computational procedure. You can mark any point as A and the second as B.

Remove Trial Weight

yes, **no**
The trial mass can be left on the rotor or it can be removed from the rotor after trial run.

Remove Trial Weight (Plane 1)

yes, no
For 2 planes balancing, you may remove or keep trial on each plane individually.

Remove Trial Weight (Plane 2)

yes, no
For 2 planes balancing, you may remove or keep trial on each plane individually.

Correction Weights

<u>**add (mount)**</u>, **remove (drill)**

Components

Number of components. This parameter is used in a job requiring you to divide the correction weight between components (blades, for example).

Meas Mode

<u>**single**</u>, **online meter**
When you start a measurement process by pushing *Enter*, only one value can be taken (**single**), or continual measurement values could be displayed (**online meter**). In **online meter** mode, you may look at more values and evaluate their change in time. You need to stop the measurement by pushing *Escape/Stop* when the value you want to see is displayed.

Avg

The averaging of more than one measured value is available.

Resolution

It's the aps measurement resolution described in <u>Analyzer</u> / <u>Edit Measurement</u> / <u>Resolution</u>.

Units Settings
Set the units for the current project.

Units Settings	
► Amplitude	mm/s
Detect Type	RMS
Speed	RPM
Mass	g
Rotor Mass	kg
Correction Radius	mm
Unbalance	g·m
Save	

Amplitude

Selection from available vibration units.

Detect Type

<u>**RMS**</u>, **0-P**, **P-P**
Detect type for amplitude value

Note! This value is the same as the global value defined in <u>MENU / SETTINGS</u> / <u>Spectrum Settings</u> / <u>Detect Type</u> until you change it here. That means, if you change the global value, it will also be changed here. This will stop after the first time you enter a value here.

Speed, Mass, …

Selection from available units for a particular quantity.

Rotor Settings

Rotor Settings	
▶ Operating Speed [RPM]	same as balancing speed
Rotor Mass [kg]	-
Correction Radius [mm]	-
Quality Grade	-
Save	

All parameters are optional. It enables you to calculate unbalance and balancing quality factor according to *ISO 21940*.

Operating Speed

One of the parameters used for Quality Grade calculation is the speed of the rotor. By default, the Quality Grade calculation uses the speed detected during the balancing process. However, sometimes the real operating speed differs from the balancing speed. In this case, you can enter the operating speed here and this speed will be used for Quality Grade calculation.

Rotor Mass

Rotor mass

Correction Radius

Radius to which the correction weight will be mounted (could be different for each plane)

Quality Grade

Required quality grade according to *ISO 21940.* If this value is entered, the recommended trial weight can be offered.

Initial Run
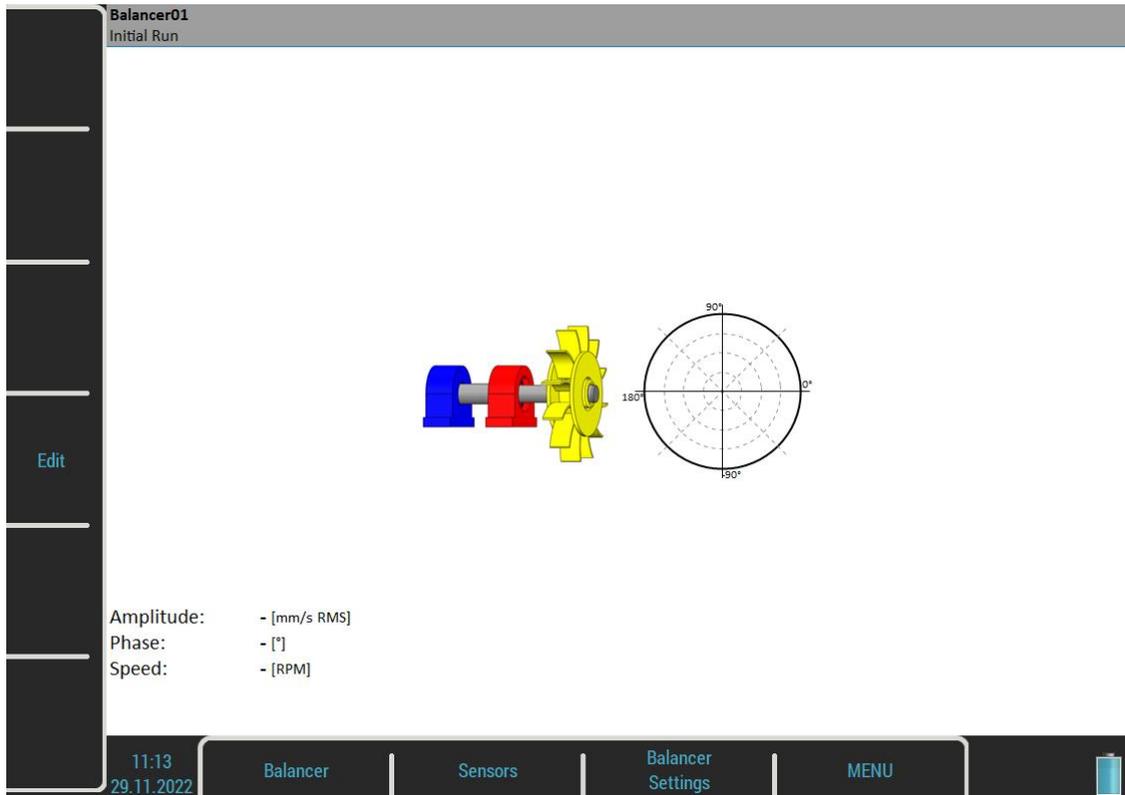
The red bearing house is the recommended point for sensor mounting, but you can use any other place which is suitable for measurements. The polar graph is prepared to display measured values.

Push the *Enter/Start* button to start the measurement process. Alternatively, you may press the *Edit* button and enter all values manually (balancing calculator function).
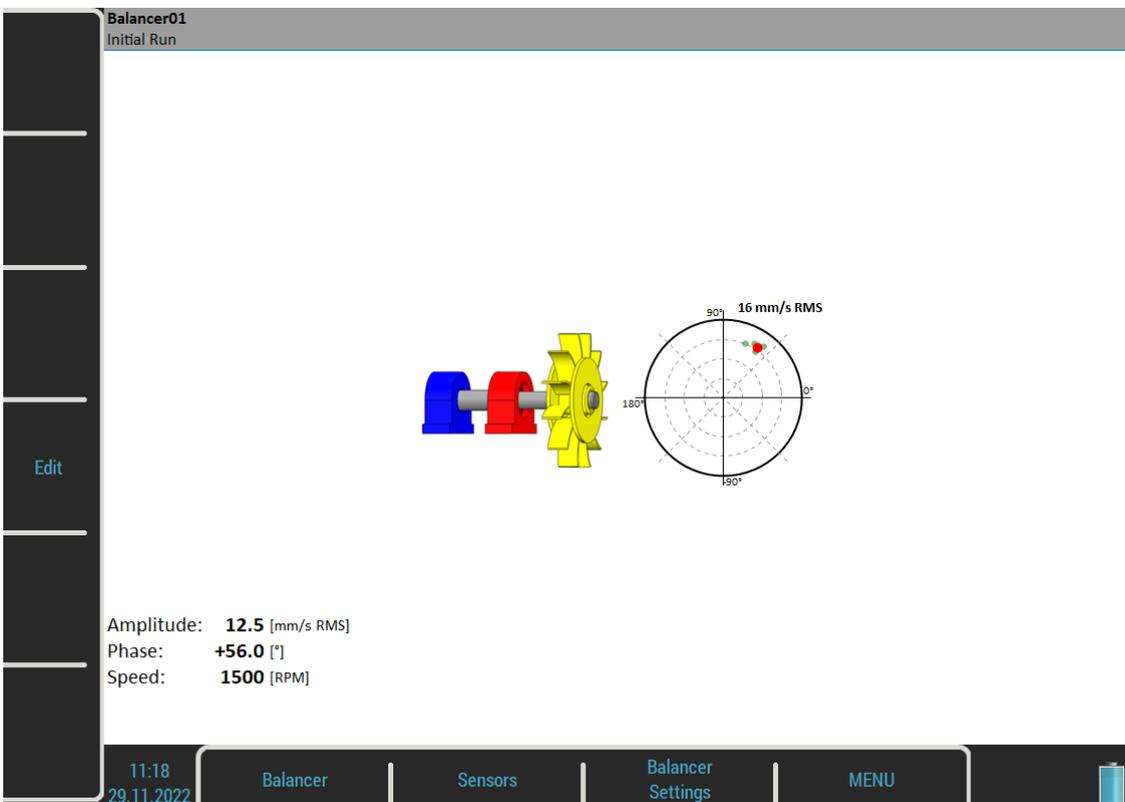
The red dot on the polar graph shows the current amplitude and phase in the complex plane. Smaller green dots show all values during the measurement process when the Meas Mode is set as **online meter**.

Warning! The polar graph represents the complex plane, which only graphically illustrates the amplitude and phase of measured value as complex number. It is not intended to show a heavy spot in a real position and direction. Therefore, no setup (as angles counting, direction of rotation or view unit) has an effect on the polar graph orientation.

Press the *Down* arrow to move to the next screen.

Trial Run

Trial weight response is measured in this run.
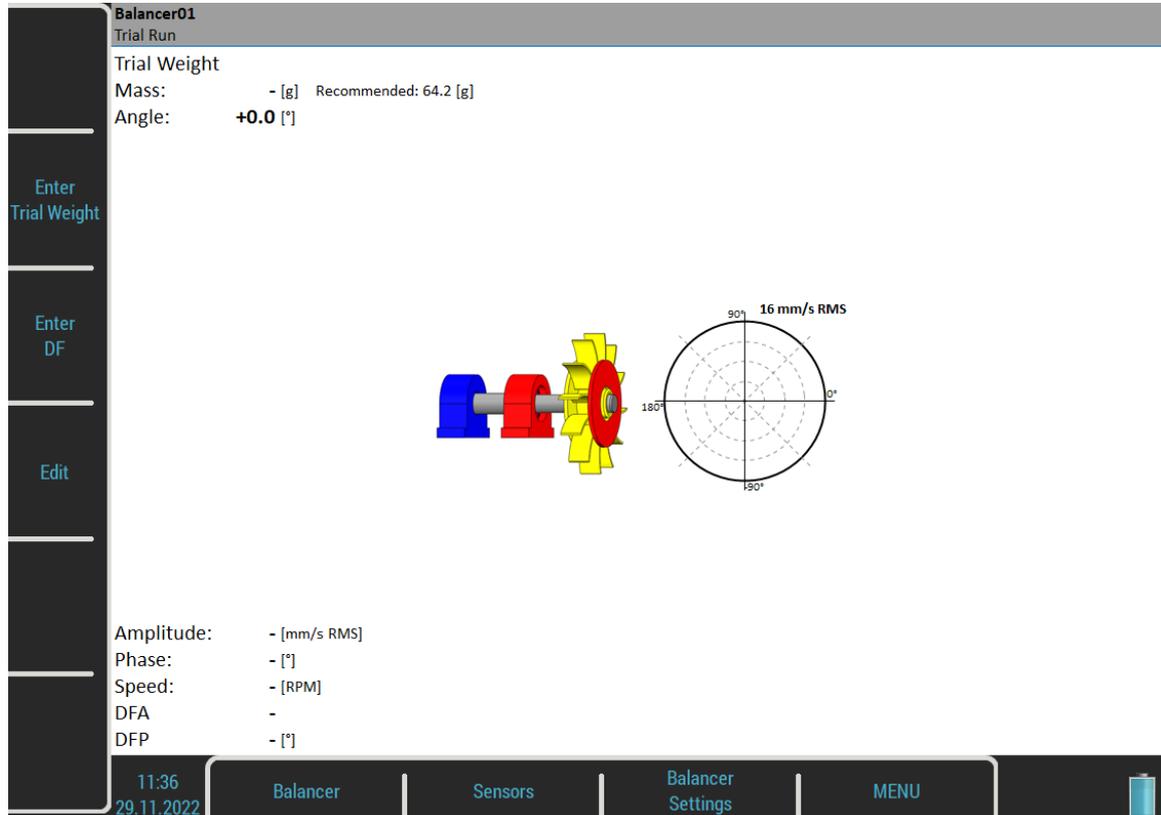
Push the *Enter Trial Weight* button and enter the mass and angle of the trial weight. The trial weight is usually placed at zero angle and serves as a zero mark. However, you can set the zero mark wherever and set the trial weight angle from the zero mark. The angle of the trial weight must keep the Global Settings / Angles Counting setup. This means, if you use **with rotation** angles counting, the angle is positive when you put the trial weight before the zero mark in the direction of rotation, and negative when you put the trial weight behind the zero mark (or when the trial goes first and the zero mark goes second, the trial weight angle is positive). For **against rotation** angles counting, it is the opposite.
If the Components have been defined, the trial weight position is entered as the number of the component. The angles counting must be kept as well. The component number grows in the direction of rotation if **with rotation** is set and vice versa.

The mass can be negative, it represents removing of the weight (for example, dismounting an old correction weight).

The recommended weight value is displayed only if the Rotor Settings parameters are entered.

Don't forget to mount the trial weight to the balancing plane.

Balancer01
Trial Run

Trial Weight
Mass: **70** [g]   Recommended: 64.2 [g]
Angle: **+0.0** [°]

Enter
Trial Weight

Enter
DF

Edit
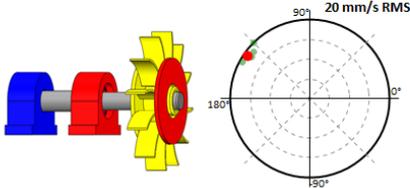
Amplitude: **19** [mm/s RMS]
Phase: **+145.0** [°]
Speed: **1500** [RPM]
DFA   **322**
DFP   **+178.6** [°]

| 11:54 29.11.2022 | Balancer | Sensors | Balancer Settings | MENU | |

After the trial run measurement, the **dynamic factor** of the machine is displayed. The **DFA** and **DFP** (amplitude and phase) values are the response values of a standardized trial mass on the correction radius. If you balance the same machine again after some time, then you do not need to measure the trial weight response again. Instead, you may just enter the *DFA*, *DFP* values on this screen. Use the **Enter DF** button for that.

Result

Balancer01
Mass and position of correction weight

Init. Unbalance: **7.75** [g·m]   max: 1.6 [g·m]
Init. Quality: **30.4**   max: 6.3

▼: Trial Weight Position
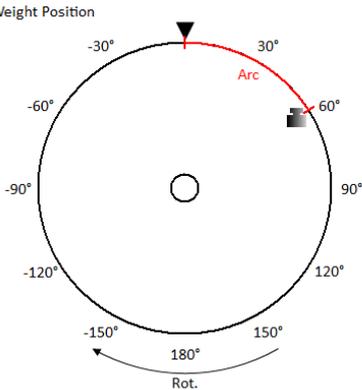
Correction Weight 1
Trial weight removed

Mass: **38.8** [g]
Angle: **+57.4** [°]
Arc: **200** [mm]

| 13:06 29.11.2022 | Balancer | Sensors | Balancer Settings | MENU | |

According to the Basic Settings / Remove Trial Weight. the information window appears.

| Remove trial weight! | or | Keep trial weight! |

Don't forget to remove the trial weight if it is set. However, you can use it as a zero mark first and remove it after correction weight mounting.

If you have entered Correction Radius and Rotor Mass values in the Rotor Settings menu, the **Initial Unbalance** and **Balancer Quality** values according to *ISO 21940* are displayed. In case the values are satisfactory, you don't need to continue with the balancing job.

Note! The **Initial unbalance** means that a trial weight is not taken into account, even if it is kept.

The mass and angle (position) of the correction weight are displayed.
The angles are calculated from the zero mark. The direction of the angle depends on the MENU / SETTINGS / Global Settings / Angles Counting value. If it is set as **with rotation**, the angle direction is the same as the direction of rotation and positive values are in the direction of rotation (in the picture above it is +57° in the direction of rotation). If the Angles Counting value is set as **against rotation**, the angles have opposite values.

With rotation:

Init. Unbalance: **7.75** [g·m]   max: 1.6 [g·m]
Init. Quality: **30.4**   max: 6.3
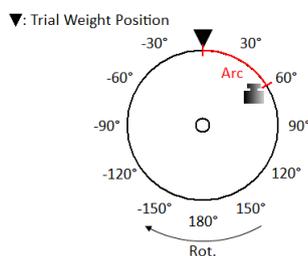
Correction Weight 1
Trial weight removed

Mass: **38.7** [g]
Angle: **+57.4** [°]
Arc: **200** [mm]

Against rotation:

Init. Unbalance: **7.75** [g·m]   max: 1.6 [g·m]
Init. Quality: **30.5**   max: 6.3
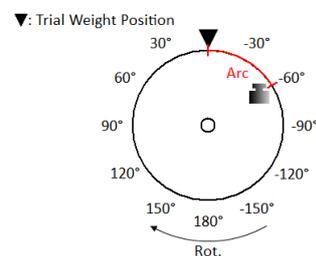
Correction Weight 1
Trial weight removed

Mass: **38.8** [g]
Angle: **-57.4** [°]
Arc: **200** [mm]

Warning! If you had not defined the direction of rotation, the result is displayed in the default direction with angles increasing counter clock wise. The angle still has the same value (+57° with rotation or -57° against rotation). However, the picture may not correspond the reality. You need to determine the right position yourself.

With rotation:

Init. Unbalance: **7.76** [g·m]   max: 1.6 [g·m]
Init. Quality: **30.5**   max: 6.3
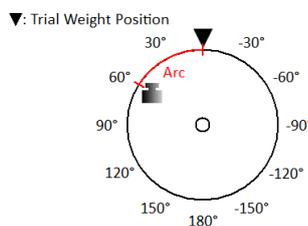
Correction Weight 1
Trial weight removed

Mass: **38.8** [g]
Angle: **+57.4** [°]
Arc: **200** [mm]

Against rotation:

Init. Unbalance: **7.75** [g·m]   max: 1.6 [g·m]
Init. Quality: **30.5**   max: 6.3
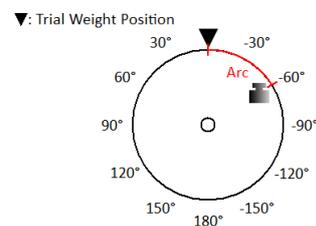
Correction Weight 1
Trial weight removed

Mass: **38.8** [g]
Angle: **-57.4** [°]
Arc: **200** [mm]

Note! You cannot change the Angles Counting value during a balancer job. If the value is changed, this error message appears.

Balancing Error
Angles counting in project is different from settings in instrument.
Change the value in menu Global Settings / Angles Counting or create new project.

In case you have entered the Correction Radius value, the *Arc* value shows a circumferential distance of the correction weight from zero mark.

You can split the correction mass into two arbitrary angles (in case it is not possible to place the correction mass into calculated position). Use menu *Balancer / Split correction weight*

Enter the value of the first angle.

Enter first angle [°]

30

Then enter the value of the second angle.

Enter second angle [°]

60

The balancing mass will be recalculated (split) into two required angles.

Init. Unbalance: **7.76** [g·m]   max: 1.6 [g·m]
Init. Quality: **30.5**   max: 6.3

▼: Trial Weight Position
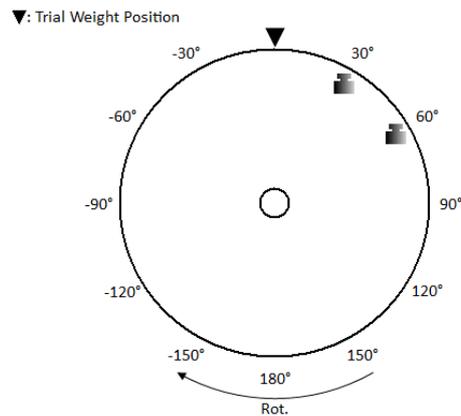
Correction Weight 1
Trial weight removed
Mass 1:   **3.55** [g]
Angle 1:   **+30.0** [°]
Mass 2:   **35.7** [g]
Angle 2:   **+60.0** [°]

Use *Balancer / Set Default Angle* to return back to the original calculation.

If the Components have been defined, the correction weight is divided between the two nearest components. The component number is counted from the zero mark, which is the component number one. The component numbers keep the angles counting parameter. The component number grows in the direction of rotation if with rotation is set and vice versa.

Init. Unbalance: **7.76** [g·m]   max: 1.6 [g·m]
Init. Quality: **30.5**   max: 6.3

▼: Trial Weight Position
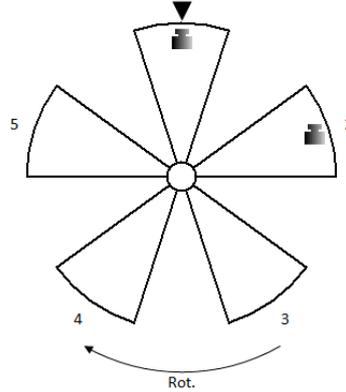
Correction Weight 1
Trial weight removed

Mass 1:   **10.3** [g]
Component 1:   **1**
Mass 2:   **34.3** [g]
Component 2:   **2**

You can select other components in case when you cannot mount the weight to the nearest components. Select the **Balancer / Change Components** menu item.

Enter the number of the first component.

Enter first component (1 - 5)
1

Then enter the number of the second component.

Enter second component (1 - 5)
3

New correction weights will be displayed.

Init. Unbalance: **7.76** [g·m]   max: 1.6 [g·m]
Init. Quality: **30.5**   max: 6.3

▼: Trial Weight Position
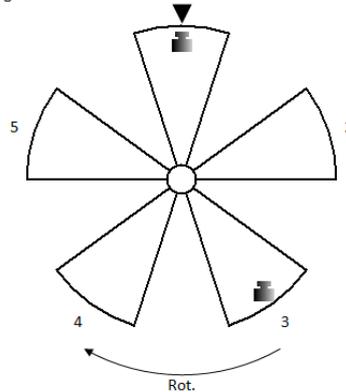
Correction Weight 1
Trial weight removed

Mass 1:   **65.9** [g]
Component 1:   **1**
Mass 2:   **55.6** [g]
Component 2:   **3**

Select the **Balancer / Set Default Components** menu item to return to the original weights.

Mount the recommended correction weight to the machine.

Correction Run

When the weight is mounted you want to check the job.
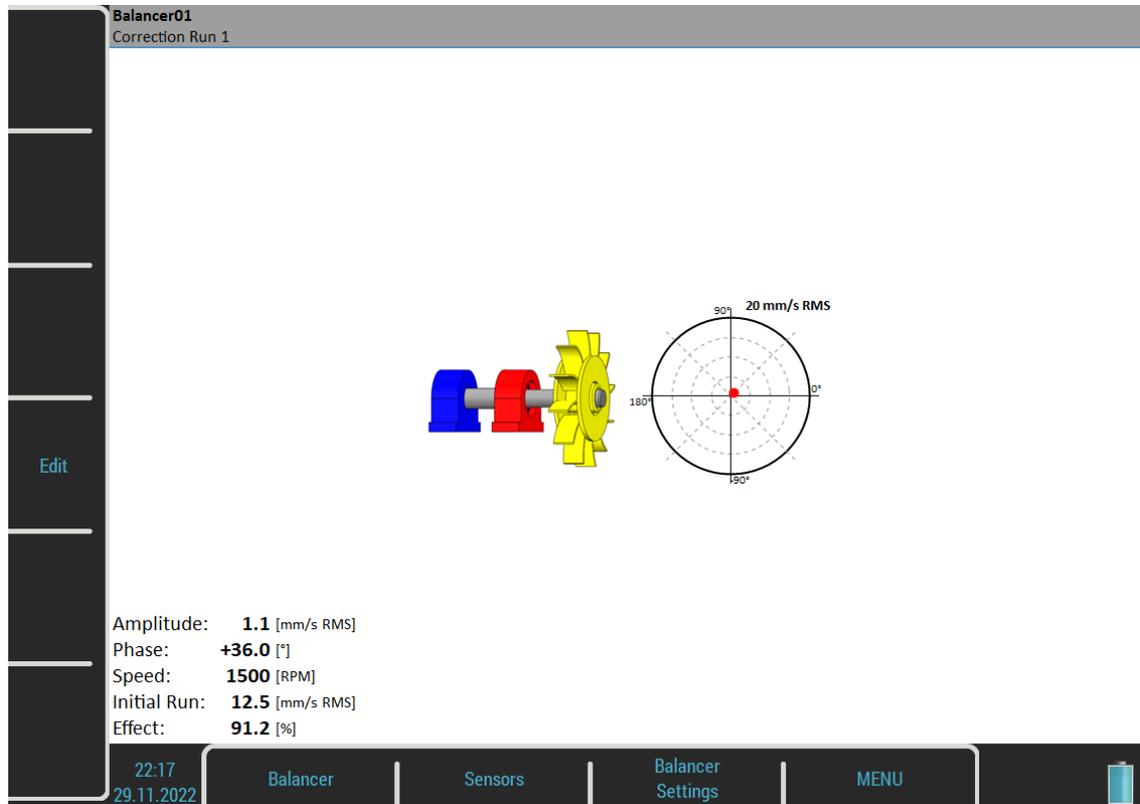
- *   **Initial Run**
    amplitude of Initial Run
- *   **Effect**
    is the reduction of balancing in %
    *Effect = (1 – A2 / A1) * 100%*
    (the 1.1mm/s is the 8.8% of 12.5 mm/s)

Residual unbalance and quality are available in the next screen together with next correction weight suggestion.

Balancer01
Mass and position of correction weight

Res. Unbalance: **0.684** [g·m]   max: 1.6 [g·m]
Res. Quality: **2.69**   max: 6.3

▼: Trial Weight Position

Correction Weight 2
Trial weight removed

Mass: **3.42** [g]
Angle: **+37.4** [°]
Arc: **130** [mm]

| 22:28 29.11.2022 | Balancer | Sensors | Balancer Settings | MENU | |
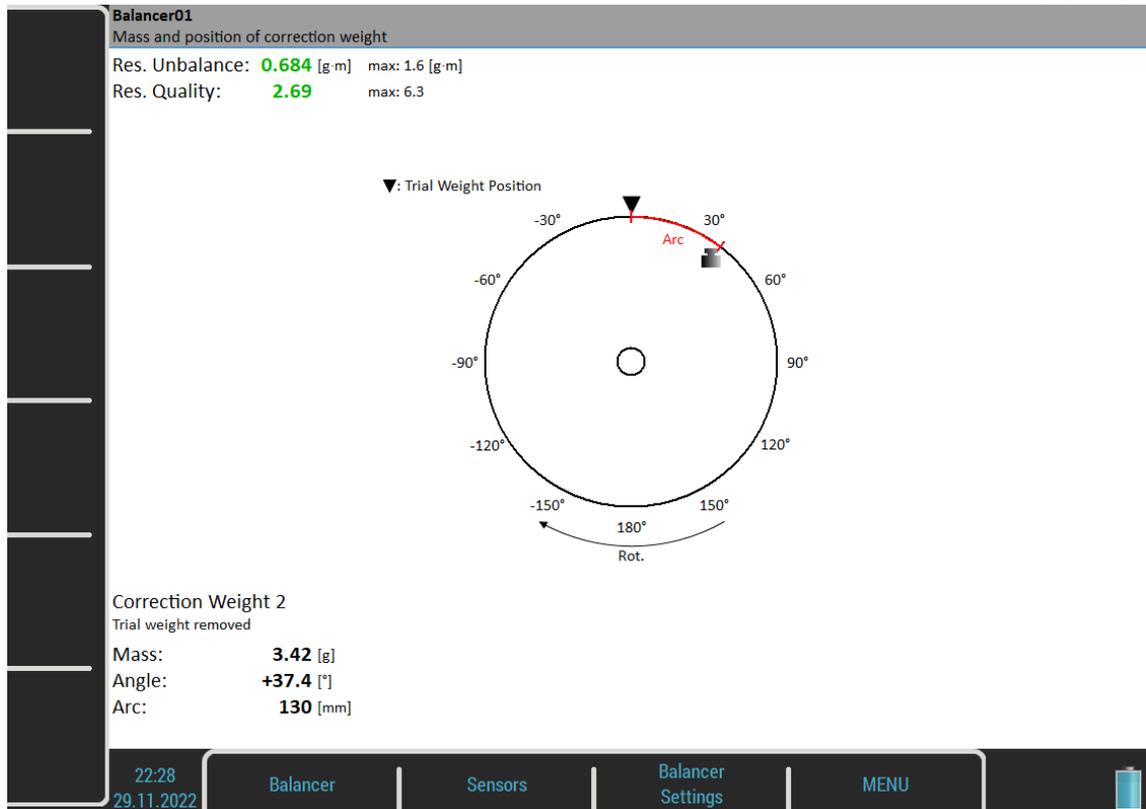
You can continue with the job until you are satisfied with the results. These next steps do not require trial weight measurement. After each measurement, using another correction weight is recommended. However, when the result is not better (or is even worse), additional correction runs are meaningless.

Dual Plane Balancing

Initial Run

The screen is divided into two parts. The left part corresponds to point A measurements and plane 1 results, the right part corresponds to point B measurements and plane 2 results.
If you only use one sensor (Point A Channel, Point B Channel are the same), then only one part is active. The non-active part is grey and shows a blurry image. Mount the sensor to the active plane point and start the measurement. Use the *Right* / *Left* arrow button to move the active focus.
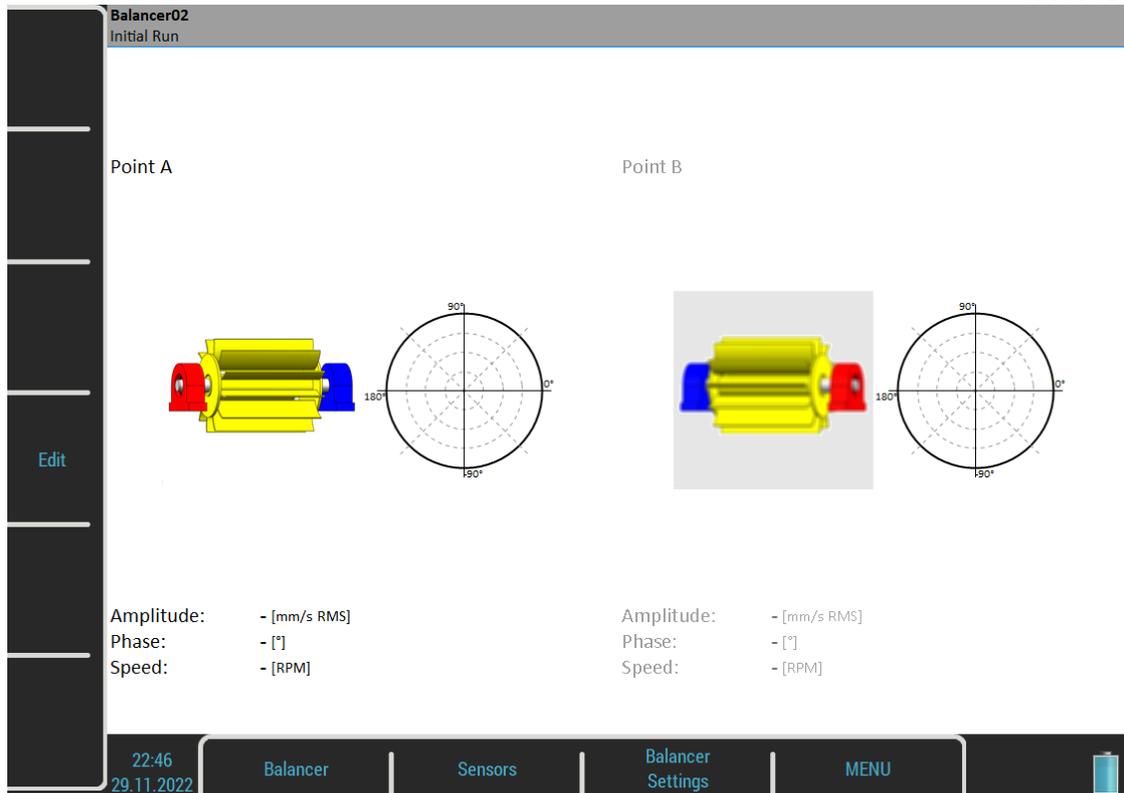
You can make both points measurements together with two sensors (set the Point A Channel, Point B Channel to different values). Then the screen should look like the next picture.
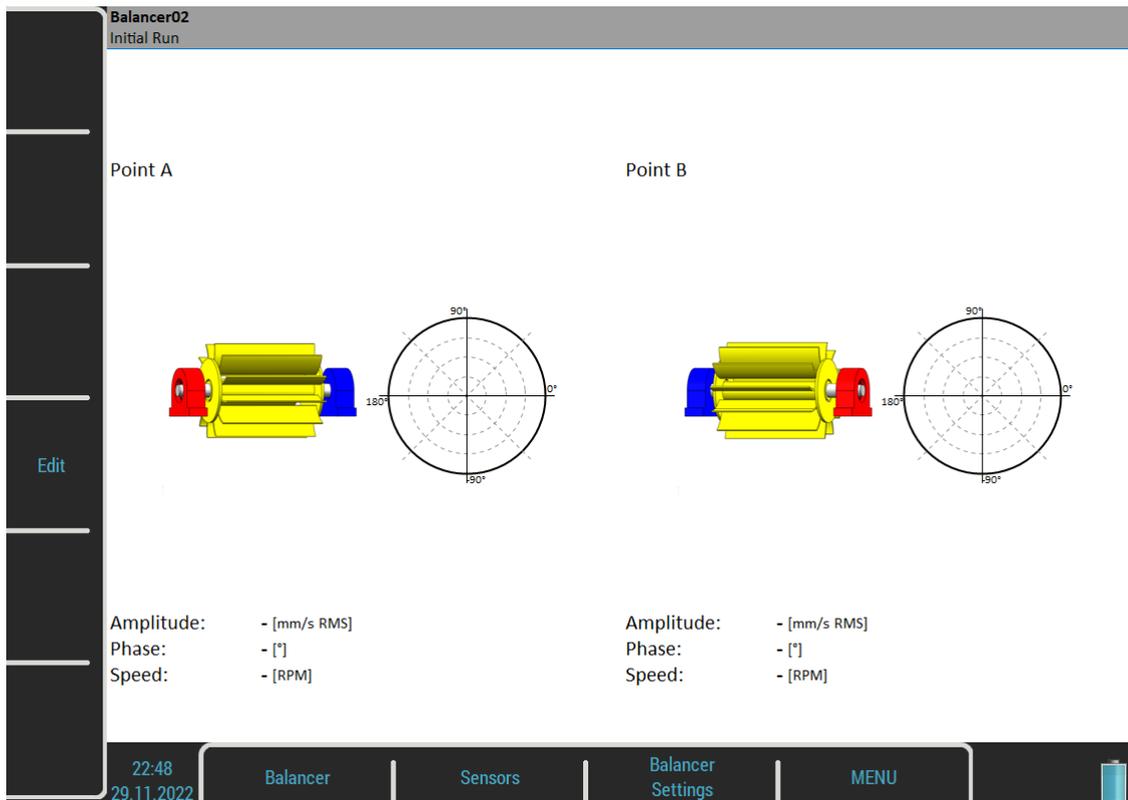
The red bearing house is the recommended point for mounting the sensor, but you can use any other place which is suitable for measurements. The polar graph is prepared to display the measured values.
Push the *Enter/Start* button and a measurement will be taken. Alternatively, you may press the *Edit* button and enter all values manually (balancing calculator function).
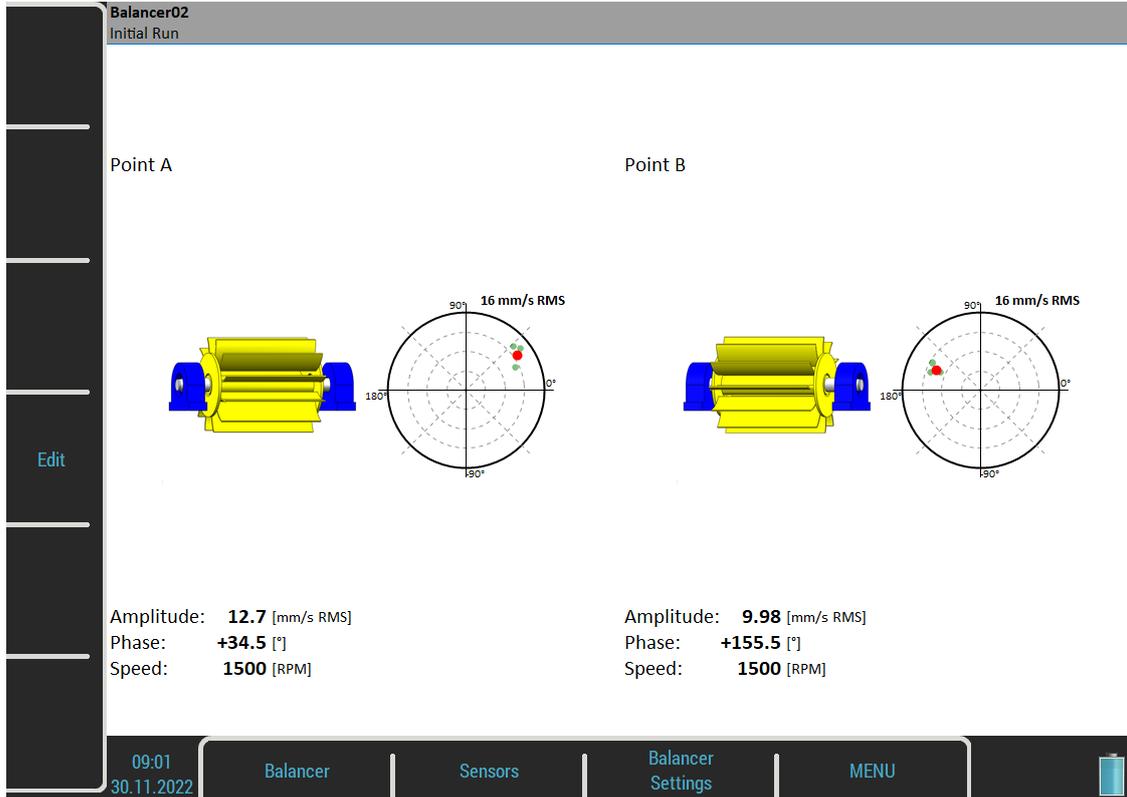
The red dot in the polar graph shows the current amplitude and phase in the complex plane. Smaller green dots show all values during the measurement process when the Meas Mode is set as **online meter**.
Press the **Down** arrow to move to the next screen.

Trial Run 1

It is similar to the single plane balancing, only two trial weights must be subsequently mounted to two planes.
If you know the *dynamic factor*, you can enter all 4 values manually and you do not need to measure trial runs.
See more details about dynamic factor in Single Plane Balancing / Trial Run.
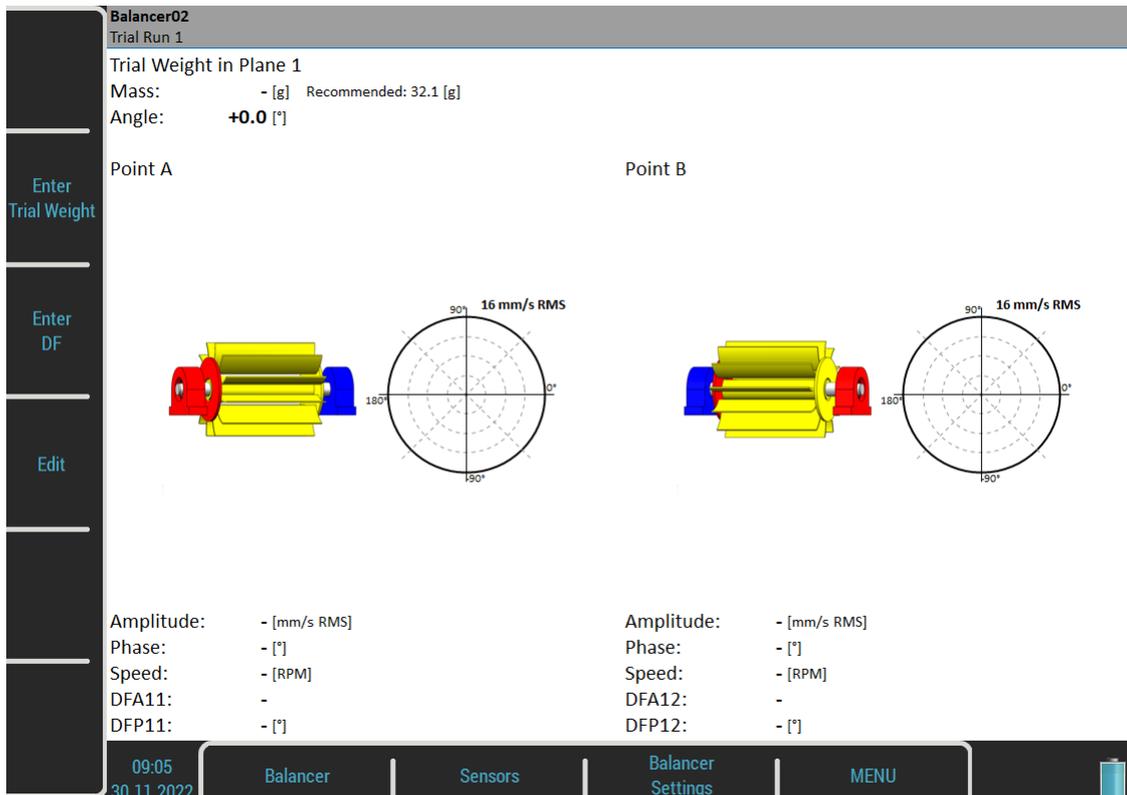
The plane for trial weight mounting is highlighted by a red disc. See the Single Plane Balancing / Trial Run for more details about trial weight mounting.
Put the trial weight to the plane 1 and take the measurements for both points.

After both points measurements are taken, you should resolve the trial weight according to the Basic Settings / Remove Trial Weight (Plane 1).

If **Remove Trial Weight** is set to **yes**, the following question will appear:

> Temporarily keep trial weight in plane 1 also during measurement with trial weight in plane 2?

If you answer *No*, then you must remove the trial weight as expected. However, you can answer *Yes* and keep the trial weight on plane 1 also during measurement with trial weight in plane 2.
Note! The keeping of the trial weight can be useful if this trial weight is placed in zero position. It represents the zero mark for you and you count from it where to mount the correction weights (based on balancing results).

If **Remove Trial Weight** is set as **no**, the following notification will appear.

> Keep trial weight in plane 1!

After confirming a message, you can check the measured values on the Trial Run 1 screen.

Trial Run 2

We have to take the same two measurements with the trial weight in the plane 2. The screen for those measurement looks similar to the previous screen. Only the red disc is in the plane 2. Enter the trial weight values and put the trial weight into the plane 2. Take the measurement on both points.

Result

After entering the result screen, you will be asked to keep or remove the trial weight from the plane 2 according to Basic Settings / Remove Trial Weight (Plane 2). In case you temporarily kept the trial weight, you'll be prompted to remove it now.

> Remove trial weight from plane 1!
> Remove trial weight from plane 2!

Don't forget to remove the trial weights if needed. However, you can use them as the zero mark first and remove them after the correction weights mounting.

The result screen looks similar to the one in the single plane balancing. It contains correction weights suggestions for both planes. See more details about correction weights mounting in Single Plane Balancing / Result. The initial and residual imbalances and qualities are calculated for the whole machine, not for each plane separately.
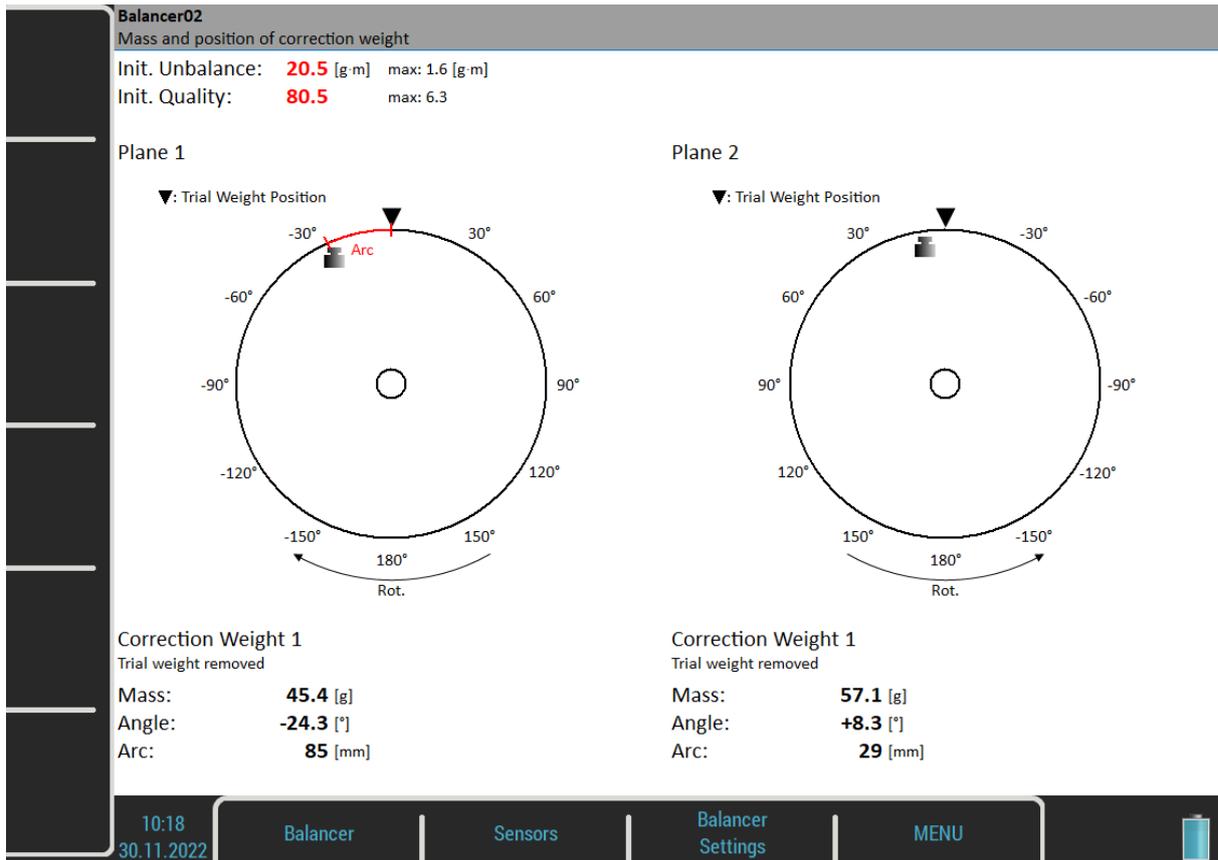
Correction Run

See Single Plane Balancing / Correction Run for more details.

Balancer02
Correction Run 1

Point A

Point B

16 mm/s RMS

16 mm/s RMS

	Point A			Point B	
Amplitude:	**0.5** [mm/s RMS]		Amplitude:	**0.3** [mm/s RMS]	
Phase:	**+11.0** [°]		Phase:	**+59.0** [°]	
Speed:	**1500** [RPM]		Speed:	**1500** [RPM]	
Initial Run:	**12.7** [mm/s RMS]		Initial Run:	**9.98** [mm/s RMS]	
Effect:	**96.1** [%]		Effect:	**97** [%]	

10:28 30.11.2022	Balancer	Sensors	Balancer Settings	MENU	

Balancer02
Mass and position of correction weight

Res. Unbalance: **0.704** [g·m]   max: 1.6 [g·m]
Res. Quality: **2.77**   max: 6.3

Plane 1

▼: Trial Weight Position

Plane 2

▼: Trial Weight Position

Correction Weight 2
Trial weight removed

Correction Weight 2
Trial weight removed

	Plane 1		Plane 2	
Mass:	**1.18** [g]	Mass:	**2.34** [g]	
Angle:	**-97.3** [°]	Angle:	**-44.9** [°]	
Arc:	**340** [mm]	Arc:	**157** [mm]	

10:31 30.11.2022	Balancer	Sensors	Balancer Settings	MENU	

Balancing Errors

Balancing errors and warnings can occur during the job.

The effect of trial weight is low

This message informs you that the effect of the trial weight is low.
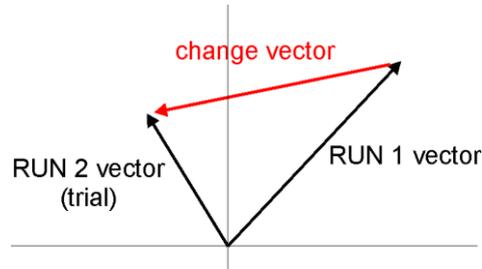
The percentual value is derived from ratio of the amplitude of change vector to the amplitude of Run1 vector.

A warning is displayed when the change is less than 20% but bigger than 1%. You can continue with balancing after this warning and use these values.

An error is displayed when the change is less than 1%. You cannot continue with balancing after this error, because such a small change is not acceptable. You could get incorrect results.

Unacceptable speed change

The balancing procedure must be executed on a constant speed during all runs. The balancing speed is checked and when it changes by more than 5%, the error occurs.

Unstable phase

The phase stability can be checked only if averaging is used (Basic Settings / Avg). If the phase during the averaging changes, it probably means that the unbalance is not the main problem of the machine. Thus, the error is indicated and the balancing procedure stops.

Balancer Menu

The next functions are available for an opened project. Push the **Balancer** button and the menu with the additional functions appears.

Balancing Report

Create a balancing report in rtf format and save it to the *VA5_DISC* to the *VA4balancer_protocol* folder.

Balancing Report (csv)

Simple format.

Balancing Vectors

Creates a drawing of the amplitude / phase vector development during the balancing process. The drawing is also included to the balancing report.
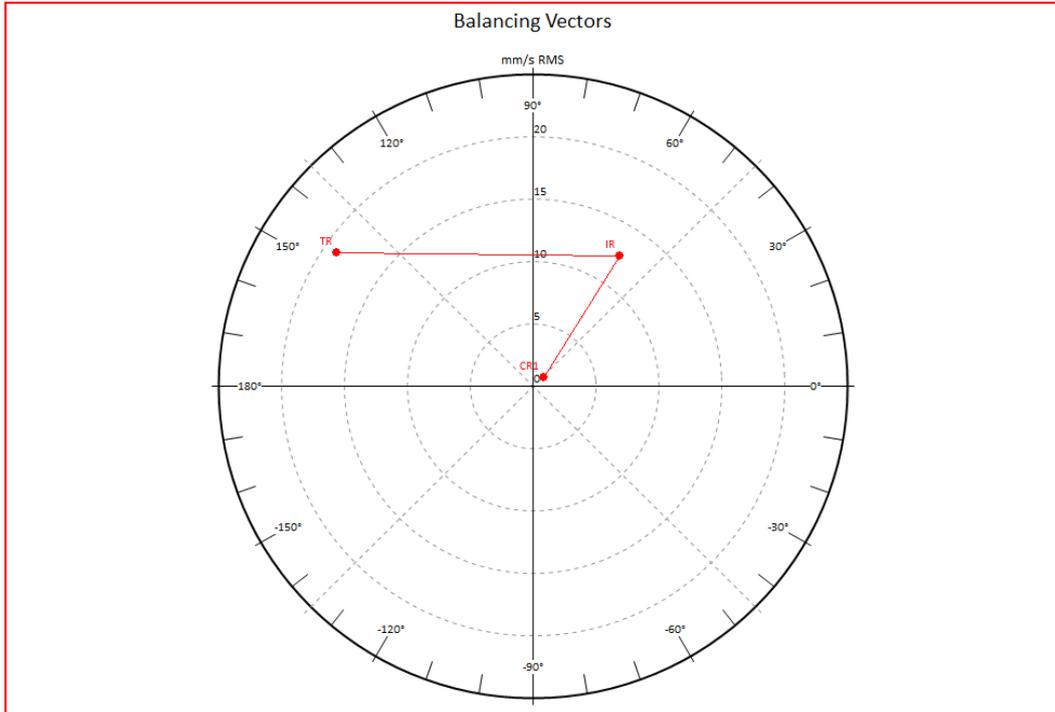
IR   Initial Run
TR   Trial Run
CR   Correction Run

Total Mass

Displays the total balancing mass. It is a vector sum of all masses mounted to the rotor (all correction weights and kept trial weights).

Angle: **+55.7** [°]
Mass: **42** [g]
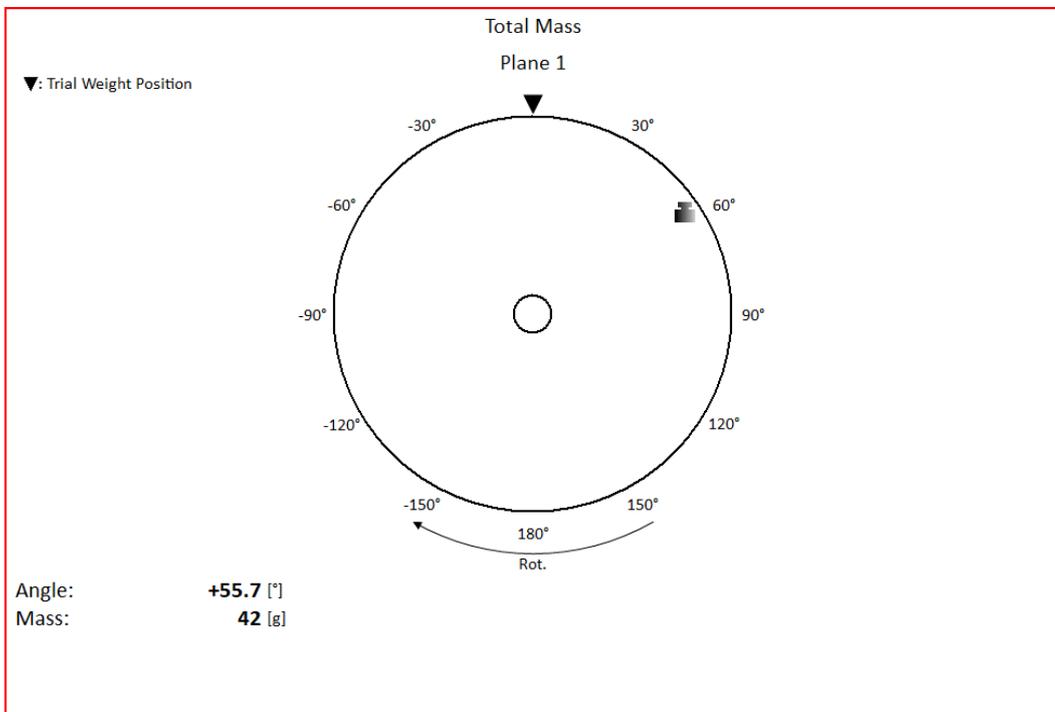
Advanced Balancer

This module supports an advanced balancing process. It enables balancing on up to eight planes. Moreover, it enables the number of measurement points to be greater than the number of planes. This is useful in situations when not all planes are accessible for trial mass mounting.

Project

Like in the previous [Balancer](#) module, the balancing job is organized as a project. The project contains all entered parameters of the balancing procedure and all measured or entered data.

The typical balancing job scheme looks like in the [Balancer](#) module:
- Create new project.
- Enter balancing parameters (type of machine, number of planes etc.).
- Initial measurement of the vibration amplitude and phase on the required measurement points.
- Put trial weight on the rotor. Step by step to all planes.
- Trial weight response measurement. Step by step to all planes.
- Put correction weights on all planes.
- Check of effect (success).
- Trim measurements for additional weights and better results.

Every step is displayed in one screen. The movement between screens is provided by *Up / Down* arrows.

Attention! When you return back in the job screens and you take a repeated measurement or enter a new value, then the measured data will be erased in all screens after the current screen. The reason is simple. The parameters in the next screen are derived from the previous screen. When you repeat the measurement, you change these parameters. That is why all following screen parameters must be removed and you have to make all necessary measurements again.

Project List

The list of saved projects opens when you enter the module. The list is empty if you have no saved projects yet. The modification time stamp of the selected project is displayed in the status bar in the bottom right corner.

Project Menu

New

Creates a new project with default properties.

Copy

Creates a new project as a copy of the selected project. Only the header data are saved. No measured data are saved.

Rename

Renames the selected project. The project with the old name does not exist anymore.

Delete
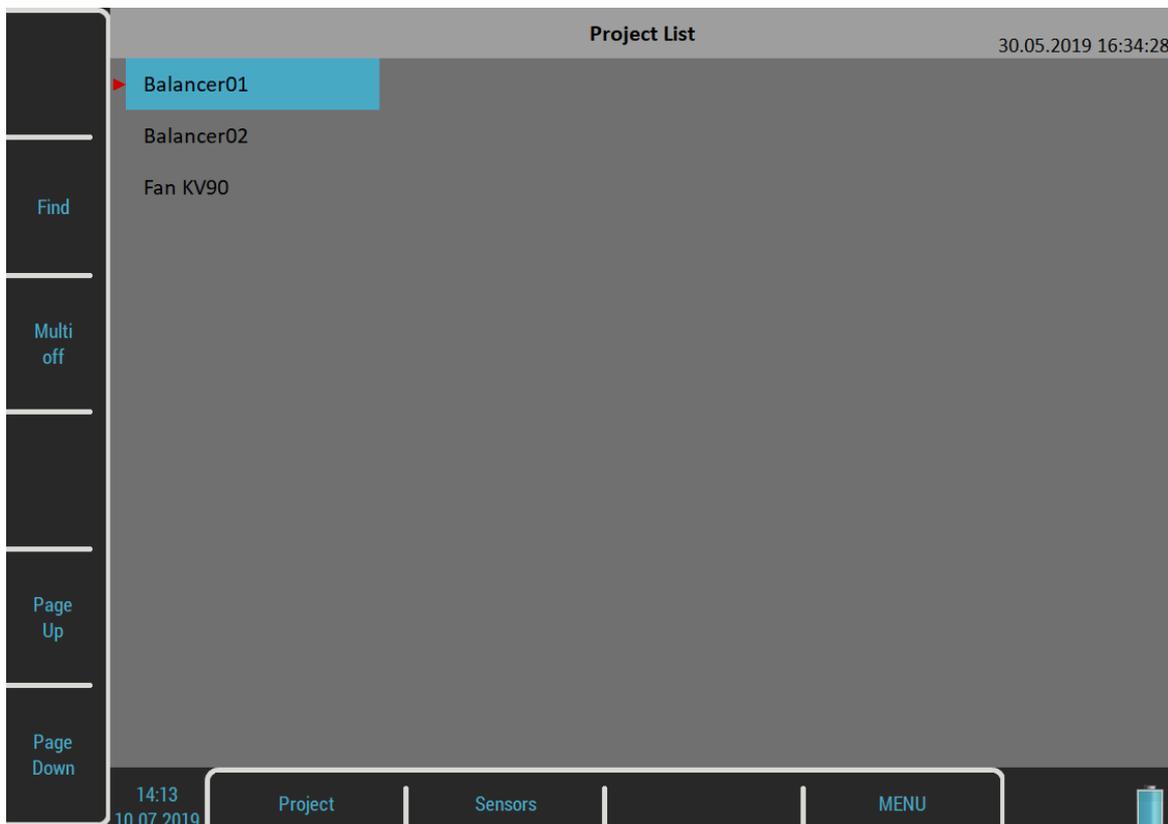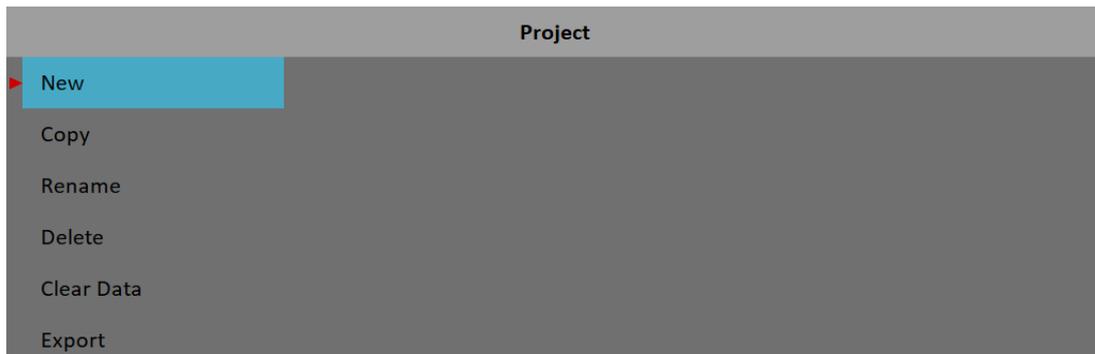
Deletes the selected project.

Clear Data

Erase all measured data, only the project header remains.

Export

Exports the selected project to *VA5_DISC.*

Balancer Settings

Settings menus automatically open when you open a project which has no data yet. Later, you may open the menus using the **Balancer Settings** button. There are two separate menus under this button, Basic Settings and Units Settings.
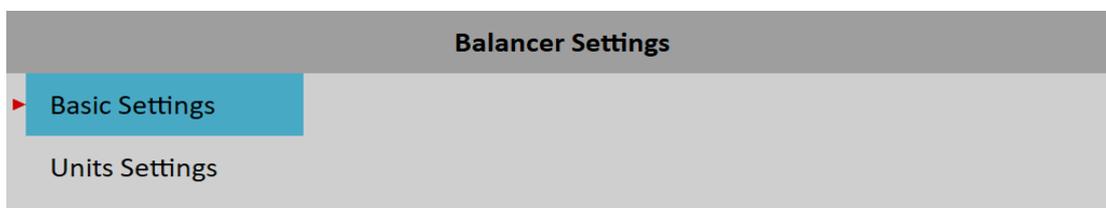
Basic Settings

Basic Settings	
▶ Planes	1
Points	1
Meas Mode	single
Avg	off
Resolution	speed / 4 t = 4 revs
Point A - Channel	1
Plane 1 - Remove Trial Mass	yes
Save	

Planes

Number of balancing planes.
Note! Planes are marked with numbers, Plane 1, Plane 2 etc.

Points

Number of measurement points. Must be greater or equal to the number of balancing planes.
Note! Points are marked with letter, Point A, Point B etc.

Meas Mode

single, **online meter**
When you start a measurement process by pushing *Enter*, then only one value can be taken (**single**) or the continual measurement values could be displayed (**online meter**). In **online meter** mode you can look at more values and evaluate how they change in time. You need to stop the measurement by pushing *Escape*, when the value you want to see is displayed.

Avg

The averaging of more than one measured value is available

Resolution

It's the aps measurement resolution described in <u>Analyzer</u> / <u>Edit Measurement</u> / <u>Resolution</u>.

Point A - Channel, Point B - Channel,...

The AC input for each point.

Note! The marking of the measurement points as A and B only has a symbolic meaning. It has no relation to the balancing planes 1, 2 and to the balancing computational procedure. You can mark any point as A and any other as B and so on.

Since it is possible to use up to eight measurement points and the instrument contains only four AC inputs or you can use even less sensors, you may sometimes need to use one AC input for more points. You can setup the same channel repeatedly for more points. Then, the points are divided into groups, so no AC input is used twice during one measurement process. A point where the channel is already used in a previous group is the beginning of a new group.

E.g., You want to use six measurement points and you only have two sensors connected to AC1 and AC2. You enter:

Point A - Channel: 1
Point B - Channel: 2
Point C - Channel: 1
Point D - Channel: 2
Point E - Channel: 1
Point F - Channel: 2

The points will be grouped as A with B as first group, C with D as the next group and E with F as the last group.

In a run screen which will be explained later, the group of points which is going to be measured is marked by an asterisk *. Points A and B on the next picture are to be measured after you push the *Enter* button.

Point	A*	B*	C	D	E	F
Channel	1	2	1	2	1	2
Amplitude [mm/s 0-P]						
Phase [°]						

The marked group is automatically switched after the measurement is completed. You can also switch it manually by pressing the **Shift (*)** button.

Point	A	B	C*	D*	E	F
Channel	1	2	1	2	1	2
Amplitude [mm/s 0-P]						
Phase [°]						

Edit

Shift
(*)

Note! You can change the channel numbers anytime during the balancing procedure by tapping the channel display. You don't need to open the menu.

Note! The number of channels can be set as **off**. Then, this point is not included to any group and therefore is not measured.

Plane 1 – Remove Trial Mass, Plane 2 – Remove Trial Mass, …

yes, **no**
You can decide if you remove a trial mass on each plane or not.

Units Settings

Units Settings	
► Amplitude	mm/s
Detect Type	RMS
Speed	RPM
Mass	g
	Save

Amplitude

Selection from units available for the used sensor

Detect Type

RMS, **0-P**, **P-P**
Detect type for amplitude value

Note! This value is the same as the global value defined in MENU / SETTINGS / Spectrum Settings / Detect Type until you change it here. That means, if you change the global value, it will also be changed here. This will stop after the first time you enter a value here.

Speed

Selection from available units for speed

Mass

Selection of unit for mass

Balancing Procedure

Let's describe the balancing procedure on an example with two planes and four points, which should clarify the procedure for any possible combination of number of planes and points in general.

Create a new project using menu Project / New. Enter the name, e.g., **Bal2x4**.
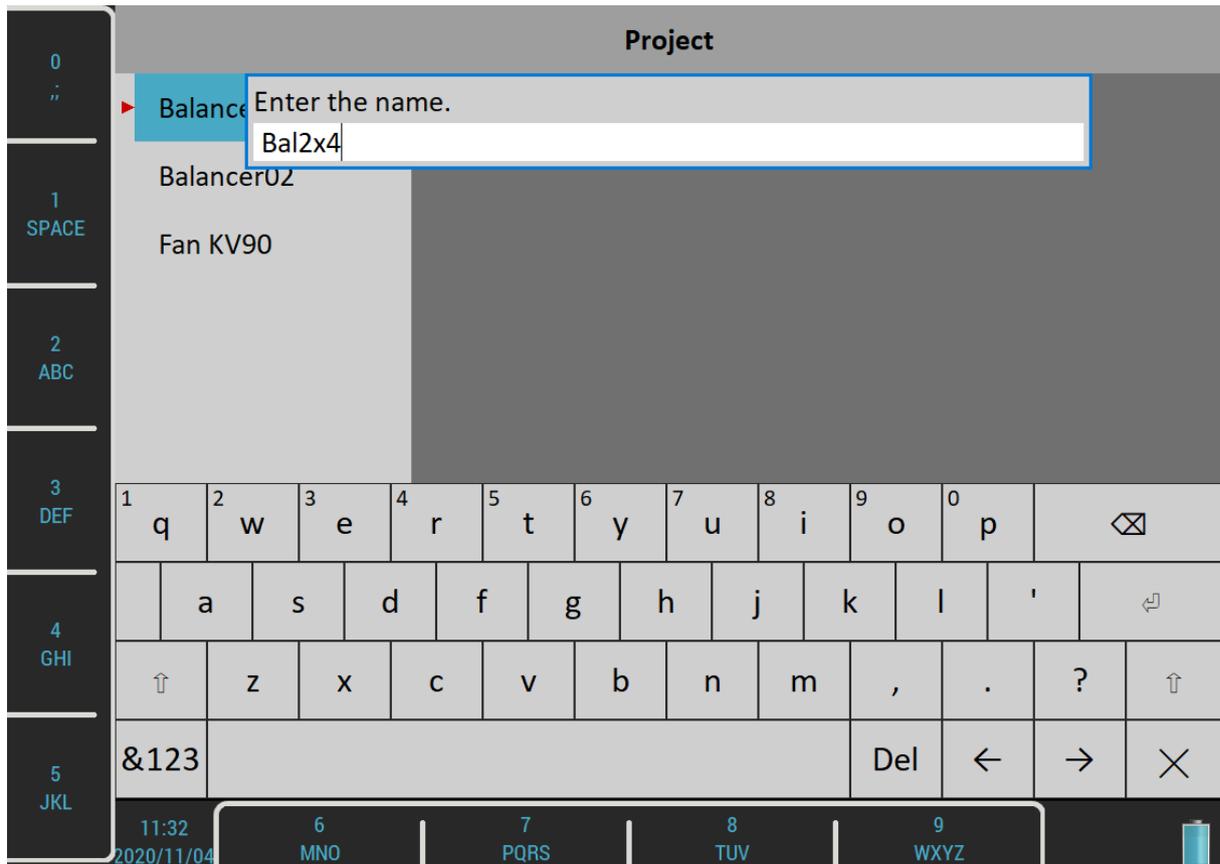
Open the project. Since the project has no data yet, the Basic Settings menu appears. In the menu, enter the Planes value as 2 and the Points value as 4. Let's suppose we are using two AC sensors mounted on inputs AC1 and AC2. Therefore, enter the points channels as 1 for Point A and Point C and as 2 for Point B and Point D. Other values can stay on defaults.

Basic Settings	
Planes	2
Points	4
Meas Mode	single
Avg	off
Resolution	speed / 4 t = 4 revs
Point A - Channel	1
Point B - Channel	2
Point C - Channel	1
Point D - Channel	2
Plane 1 - Remove Trial Mass	yes
Plane 2 - Remove Trial Mass	yes
▶ Save	

Confirm the Basic Settings menu. The Units Settings menu appears. Let's confirm the default values.

Units Settings	
▶ Amplitude	mm/s
Detect Type	RMS
Speed	RPM
Mass	g
Save	

Initial Run

After we have entered and confirmed all parameters, the ***Initial Run*** screen appears.

Bal2x4
Initial Run

Speed [RPM]

Point	A*	B*	C	D
Channel	1	2	1	2
Amplitude [mm/s RMS]	-	-	-	-
Phase [°]	-	-	-	-

Edit

Shift
(*)

| 18:39 30.11.2022 | | Sensors | Balancer Settings | MENU | |
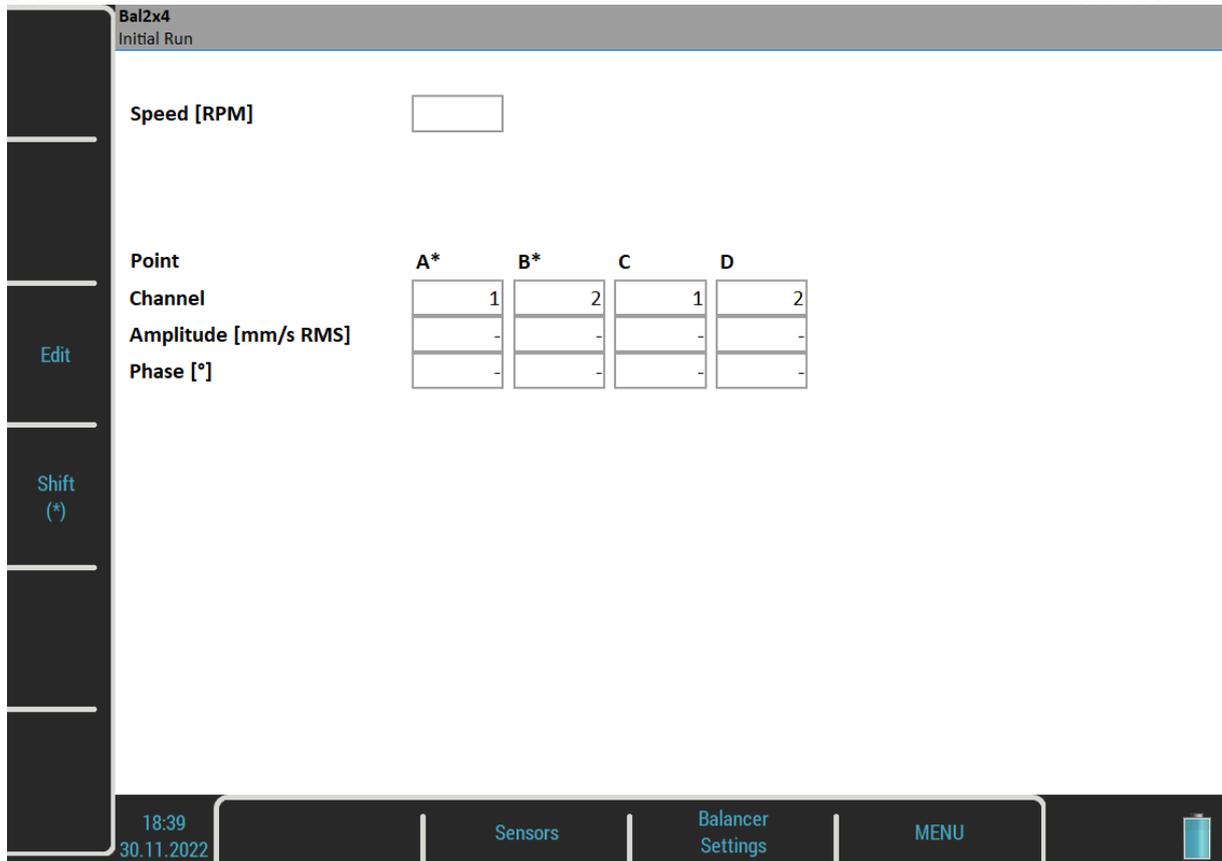
Now, you need to make the **Initial measurement**. Points A and B are marked to be measured as has been described in the Basic Settings / Point A - Channel, Point B - Channel, ... Remember to mount sensors to the correct measurement points on the machine. Start the measurement process on marked channels by pressing the **Enter/Start** button.

Speed [RPM]   3000

Point	A	B	C*	D*
Channel	1	2	1	2
Amplitude [mm/s RMS]	9.3	5.8	-	-
Phase [°]	+58.0	-175.0	-	-

After you have finished the measurement on the marked points, marks automatically shift to the next points. Remount the sensors and start the measurement again.

Speed [RPM]   3000

Point	A	B	C*	D*
Channel	1	2	1	2
Amplitude [mm/s RMS]	9.3	5.8	5	3.9
Phase [°]	+58.0	-175.0	-104.0	+12.0

Now, all measurements of the **Initial Run** are completed. Marked points stay as they are, so you can continue without sensor remounting on the next run. You can still change the marked points anytime using the **Shift (*)** button.

Note! The speed value is displayed only on the first screen. However, the speed is checked during all measurements and when it differs, the balancing procedure is stopped.

Note! Values don't need to be measured. You can push the ***Edit*** button and enter all values manually (balancing calculator function). You can also start the value editing by tapping on any value display. Entries continue automatically on other displays until the last value is entered or the *Esc* key is pressed.

Note! You can change the channel numbers anytime during the balancing procedure by tapping the channel display.

Press the ***Down*** button to continue to the next run.

Trial Runs
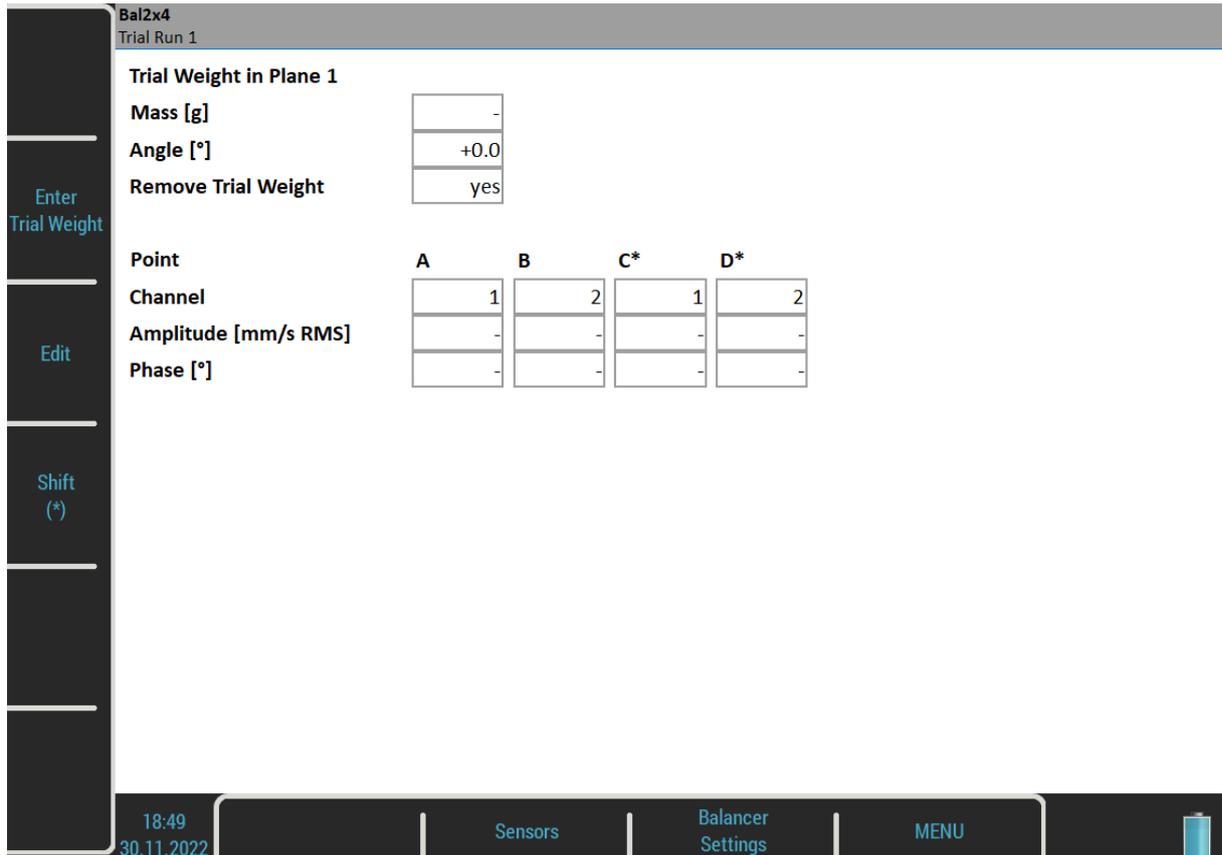
The procedure continues with measurements with trial mass on all planes. First, enter the trial weight mass and angle by pushing the ***Enter Trial Weight*** button or tapping the *Trial Mass* display. See Balancer / Single Plane Balancing / Trial Run for more details about trial weight mounting.
Remember to mount the weight to the appropriate plane. By default, you don't need to remount sensors, because marked points have stayed as you used them in the end of the previous run. However, you can remount them and push the *Shift (*)* button if you need. Take all measurements gradually the same way as on Initial Run.

Note! You may also change the *Remove Trial Mass* value by tapping the display. You must do it before the measurement.

Trial Weight in Plane 1				
Mass [g]	100			
Angle [°]	+0.0			
Remove Trial Weight	yes			
Point	A*	B*	C	D
Channel	1	2	1	2
Amplitude [mm/s RMS]	3.1	1.5	3	7.8
Phase [°]	+59.0	-162.0	+54.6	+15.3

After all points measurements are taken, you should resolve the trial weight according to the **Remove Trial Weight** setup.

In case the *Remove Trial Weight* is set as **yes**, the next question will appear:

Temporarily keep trial weight in plane 1 also during measurements with trial weight in next planes?

If you answer *No*, then you must remove the trial weight as expected. However, you can answer *Yes* and keep the trial weight on the plane 1 also during measurements with trial weight in the next planes. This can be useful when you want to use the trial weight as the zero mark for the correction weights mounting.

In case the *Remove Trial Weight* is set as **no**, the next notification will appear.

Keep trial weight in plane 1!

Push the *Down* button. Repeat the same steps for all planes (once more in our case of two planes).

Trial Weight in Plane 2

Mass [g]	100
Angle [°]	+0.0
Remove Trial Weight	yes

Point	A*	B*	C	D
Channel	1	2	1	2
Amplitude [mm/s RMS]	3.1	4.3	1.3	4.1
Phase [°]	-162.0	+11.6	+55.6	-64.0

Now, you have done all needed measurements for the correction weight calculation.

Result Screen (Option: the number of points is greater than the number of planes)

After entering the result screen, you will be asked to keep or remove the trial weight from the last trial plane according to its Remove Trial Weight setup. In case you temporarily kept a trial weight on any of the previous planes, you'll be prompted to remove it now.

Remove trial weight from plane 1!
Remove trial weight from plane 2!

Don't forget to remove the trial weights if needed. However, you can use them as a zero mark first and remove them after the correction weights mounting.

Bal2x4
Mass and position of correction weight

Plane	1	2
Mass L2 [g]	74.7	70.7
Angle L2 [°]	+14.0	-13.7
Mass L∞ [g]	77	70
Angle L∞ [°]	+16.3	-13.0

Residual Vibrations [mm/s RMS]

Point	A	B	C	D
L2	1.79	1.49	1.32	1.51
L2 5%	2.23	1.86	1.68	1.94
L2 10%	2.67	2.23	2.03	2.38
L2 20%	3.54	2.96	2.74	3.24
L∞	1.56	1.56	1.56	1.56
L∞ 5%	2	1.93	1.92	1.99
L∞ 10%	2.44	2.3	2.28	2.42
L∞ 20%	3.32	3.04	3.01	3.29

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In case the number of points is greater than the number of planes, some residual vibrations remain on each point. You are not able to get zero on all points. There could be many ways of how to optimize these residual vibrations. However, there are two ways which are meaningful. You can minimize the L2 or L∞ norm of the vector of residual vibrations.

Let's write the vector of residual vibrations as:

$$res=(res_1, res_2,..., res_{number\ of\ points}),$$

then the L2 norm of the vector of residual vibrations is defined as:

$$\|res\|_2 = \sqrt{res_1^2 + res_2^2 +...+ res_{number\ of\ points}^2}$$

and the L∞ norm of the vector of residual vibrations is defined as:

$$\|res\|_\infty=\max(|res_1|, |res_2|,..., |res_{number\ of\ points}|)$$

Then, minimizing the L2 norm means that you want the sum of squares of residual vibrations to be as low as possible. In other words, this is the least squares method. Minimizing the L∞ norm means you want the maximum amplitude of all residual vibrations to be as low as possible.

The instrument offers you both results with the smallest L2 and L∞ norm. You can choose which is more convenient to you. The weights and positions of the resulting correction weights for both norms for each plane are displayed in the upper part of the screen.

Plane	1	2
Mass L2 [g]	74.7	70.7
Angle L2 [°]	+14.0	-13.7
Mass L∞ [g]	77	70
Angle L∞ [°]	+16.3	-13.0

The residual vibrations for both norms for each point are displayed in the lower part of the screen.

Residual Vibrations [mm/s RMS]

Point	A	B	C	D
L2	1.79	1.49	1.32	1.51
L2 5%	2.23	1.86	1.68	1.94
L2 10%	2.67	2.23	2.03	2.38
L2 20%	3.54	2.96	2.74	3.24
L∞	1.56	1.56	1.56	1.56
L∞ 5%	2	1.93	1.92	1.99
L∞ 10%	2.44	2.3	2.28	2.42
L∞ 20%	3.32	3.04	3.01	3.29

The L2 line shows you the residual vibrations of the L2 result. The L∞ line shows you the residual vibrations for the L∞ result.

Moreover, there are three more lines for each norm. They represent residual vibrations in case you mount the balancing mass with 5%, 10% or 20% inaccuracy. This gives you the information about the sensitivity of the residual vibrations to the mounting position. If the values on the next lines increase a lot, you can say that the system is very sensitive to the balancing mass position and you should be careful while mounting it.

Note! See Global Settings / Angles Counting and Balancer / Single Plane Balancing / Result for more details about correction weight angles.

Result Screen (Option: number of points equals number of planes)
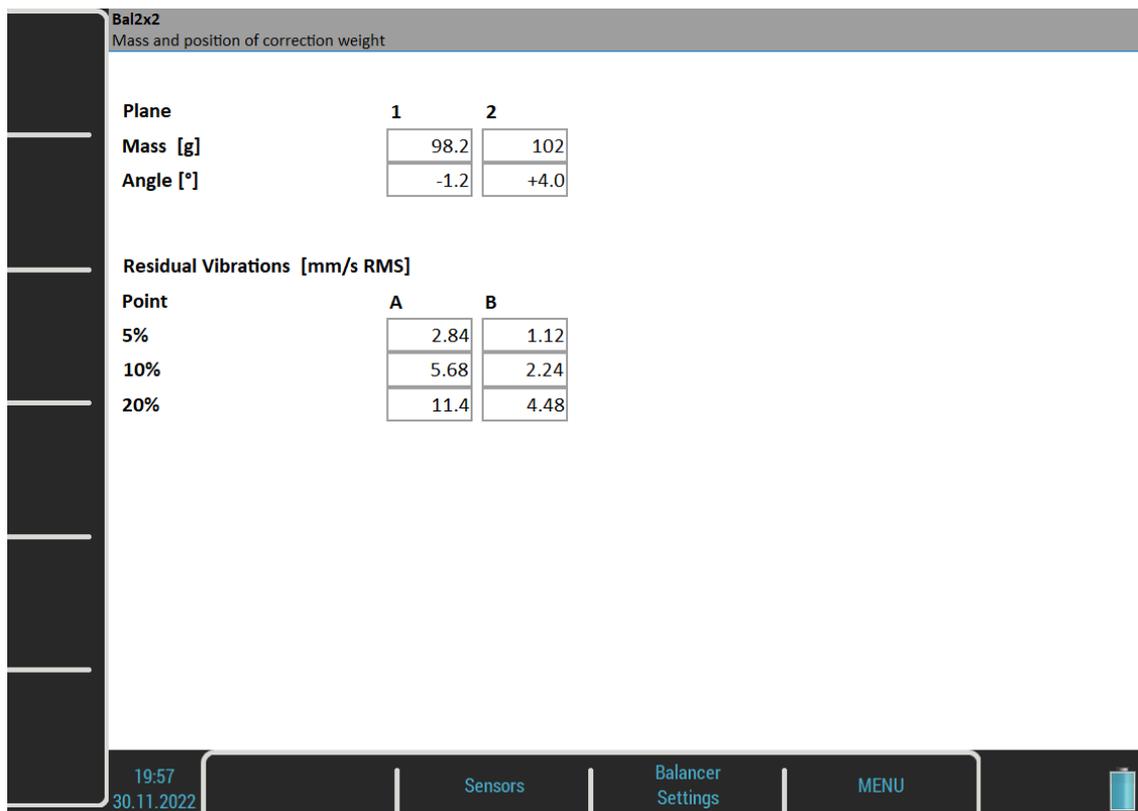
In case the number of points equals the number of planes, there are of course no residual vibrations. You don't need to minimalize them because they all are zero. Therefore, there is just one result. However, it still makes sense to show the residual vibrations representing the sensitivity to the balancing mass position.

Correction Run

When the mass or masses are mounted to the planes you should take one more measurement where you check the effect of the balancing mass. Push the *Down* button and perform the measurement in a known manner.

Bal2x4
Correction Run 1

Point	A*	B*	C	D
Channel	1	2	1	2
Amplitude [mm/s RMS]	2.1	1.7	1.5	1
Phase [°]	+60.0	+125.0	+59.0	+99.0

Edit

Shift
(*)

19:59
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Settings   MENU

You can continue (push the *Down* button) with the job when you are not satisfied with the results. These next steps do not require trial mass measurements. After each measurement, using another correction weights is recommended. However, when the result is not better (or is even worse), the next correction runs are meaningless.

Balancing Errors

Errors and warnings can occur during the balancing job as described in the Balancing Errors chapter in Balancer module.

Balancer Menu

The next functions are available for opened project. Push the **Balancer** button and the menu with the additional functions appears.

Balancing Report

Create a balancing report in txt format and save it to the *VA5_DISC* to the *VA4balancer_protocol* folder.

FASIT

The FASIT means the **FA**ult **S**ource **I**dentification **T**ool. This mode should help beginners to determine the machine condition or bearing faults.

Adash Vibration Limits

Because there are a lot of different types of machines, it is impossible to determine the critical limits of vibrations for a wide range of machines. Its reliability would be low. It could happen, you will repair a machine, which do not require it. The standards should rather be determined for a narrow range of machines.

The instrument uses the Adash limit values. These limits are not rewritten from any existing standard. It's a result of many years of Adash engineering team experiences. It's difficult to invent a critical value definition which would be simple (that means not many parameters such as speed, power, bearing type, machine type and so on) and reliable.

It is clear how we derived the limit values on the figures below. Three levels of machine condition are defined: **GOOD**, **WARNING** (A long period operation is not acceptable on these machines. They could be working till the time when they could be repaired), and **DANGER** (Vibration values in this range are considered very dangerous and they can cause a damage to the machine). The corresponding colors are taken from the traffic semaphore - green, amber and red.

All limit values are related to the speed value. The low-speed machine should generate lower vibration than a higher-speed machine.

You can find three particular areas in the graphs area. The GOOD condition is the space below the yellow line, which means operation without restriction. The space above yellow but under red line is a WARNING condition. Possible to operate the machine but it has to be checked more. It's necessary to determine the source of the worse condition and plan a repair (for instance changing the bearing) or maintenance (balancing, alignment). The space above red line is a DANGER condition and the machine should not be operated.

First figure contains the values for overall machine condition and you search unbalance, misalignment, and mechanical looseness above all. They are called "overall" because we can measure them on most of the measuring points. Second figure contains the limit values of a roller bearing condition. This condition is local and can be measured only on appropriate bearing house.

Work with figures is simple. It's necessary to know the speed. Instrument determines it automatically or the user can enter it manually. On the bottom horizontal axis, you should find the point which corresponds with speed. Above this point you will find an intersection with yellow and red line. Projections to the vertical axis will determine limit values for yellow or red state. If the measured value is lower than yellow, the condition is GOOD – green. If the value is above yellow but under red then the condition is WARNING – yellow. If the value is higher than red line, then the condition is DANGER – red.

Machine Limits

The machine limits are used for velocity RMS value in the 10-1000Hz frequency range. This value helps you define the complete health of a machine.
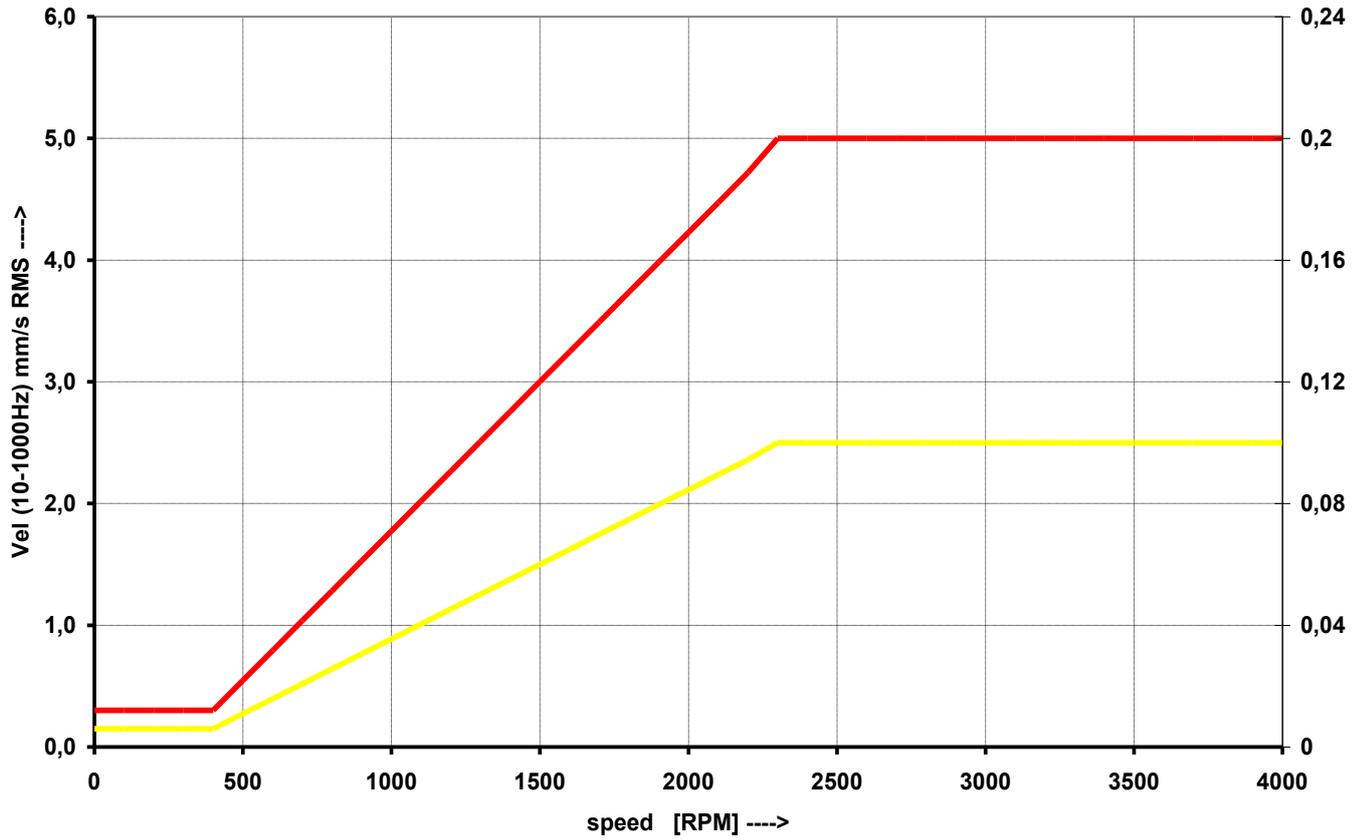
Bearing Limits

The roller bearing limits are used for acceleration RMS value in the 500-25600Hz frequency range.
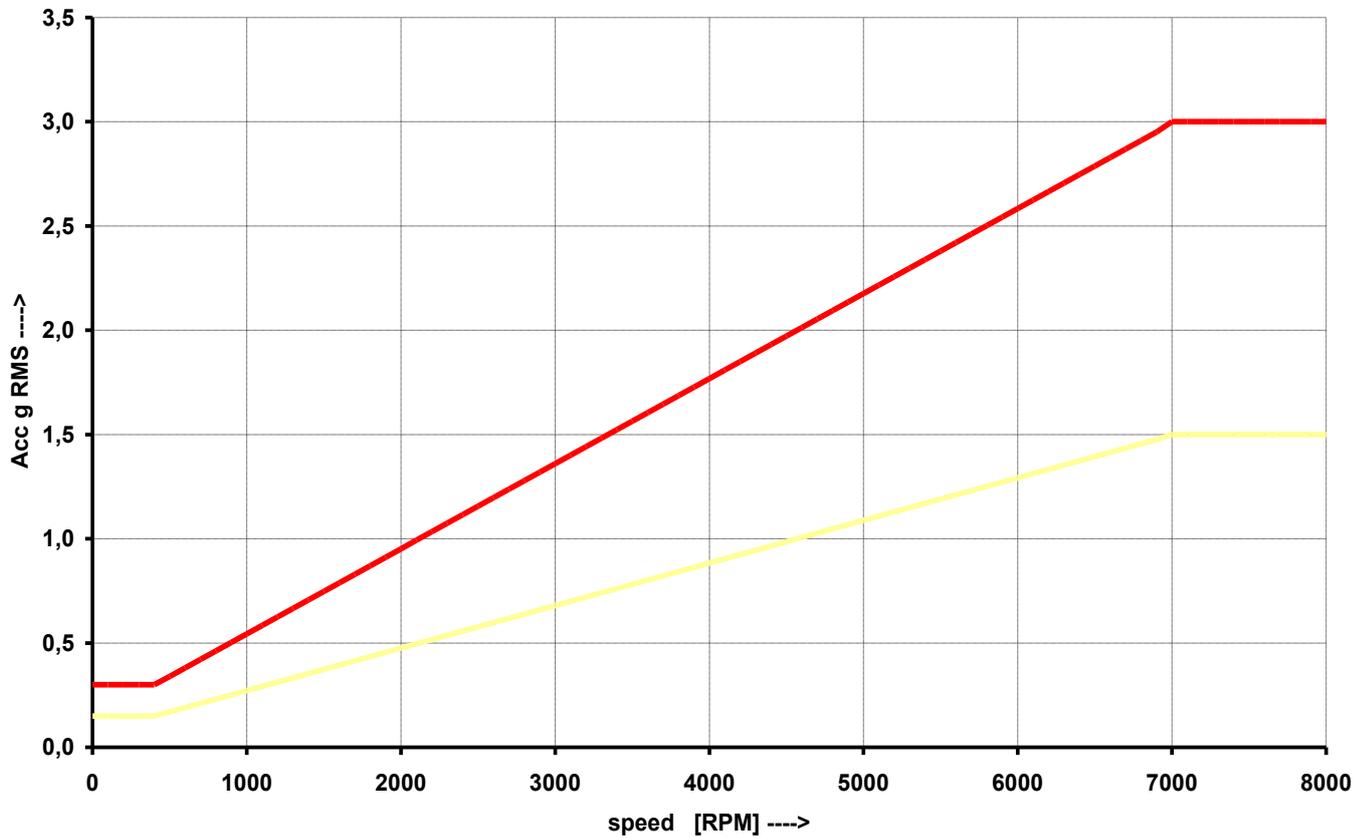
FASIT Settings

The menu automatically opens after you enter the FASIT module. The menu can be repeatedly opened by the **FASIT Settings** button.

FASIT Settings	
► Channel	1
Vel fmin [Hz]	10
Vel Limits Multiplier	1
Acc fmin [Hz]	500
Acc Limits Multiplier	5
Save	

Channel

The number of the input channel

Vel fmin [Hz]

By default, the velocity measurement is taken in the 10 – 1000 Hz range to examine the overall machine condition. This range is not convenient for low-speed machines (below 10 Hz = 600 RPM). Therefore, you can setup a lower value of fmin.

Vel Limits Multiplier

FASIT uses Adash Vibration Limits, according to which alarms are displayed. The factory Machine Limits may be too strict or too little strict for some machines. Therefore, for velocity measurements, you can adjust them using the *Vel Limits Multiplier*. Values greater than one increase the limit values and values less than one decrease them. A value of one means the limit remains as shown in the machine limits graph.

On following figures, you can see the effect of the multiplier. The first machine condition bar shows an alarm when the multiplier is set to 1. The second bar shows the same measurement, however this time the multiplier is set to 2, which means the limit value is twice as high as before. This means that FASIT is less strict and the alarm level is twice lower. The third case shows the situation with the multiplier set to 0.5.
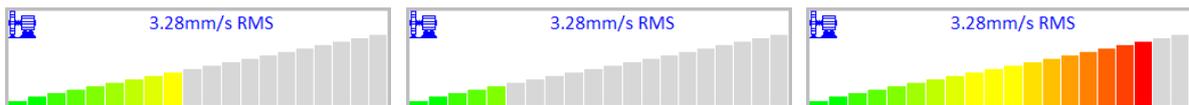
Acc fmin [Hz]

By default, the acceleration measurement is taken in the 500 – 25600 Hz range to detect bearing faults. Using the Acc fmin you can change the minimum frequency of the filter. E.g., in some cases, there may be vibrations above 500 Hz which are not caused by bearing faults and you know it. Then, you can set the Acc fmin value to 5000 Hz to filter these vibrations out.

Acc Limits Multiplier

The same as Vel Limits Multiplier but used for Bearing Limits.

Sensor Settings

In the Sensors menu, set the parameters of the used sensor. FASIT measures acceleration and velocity from one channel. If you use a velocity sensor, the bearing condition is not detected. For bearing condition detection, the acceleration measurement is necessary.

Units

Vibration values are displayed in units according to <u>Global Settings</u> / <u>Units</u>.

metric
- acceleration – g
- velocity – mm/s

imperial
- acceleration – g,
- velocity – ips

Measurement

Push the *Enter* button to start the measurement. The speed needs to be known for the processing. The speed detection is described in the <u>Speed detection</u> chapter.

FASIT screen
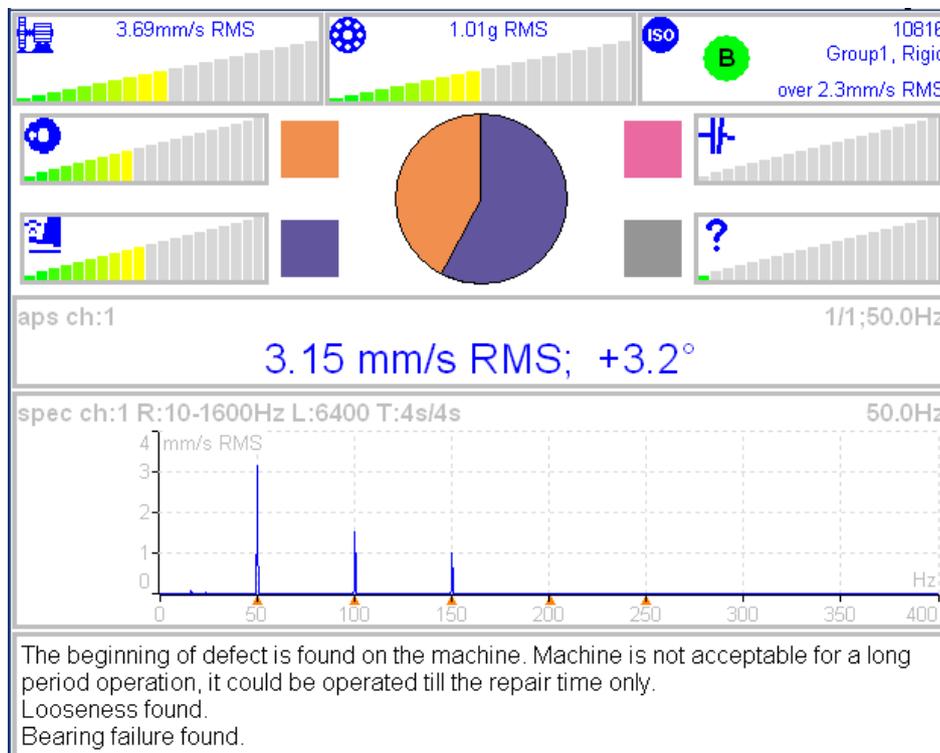
Each horizontal bar displays the severity of an individual item. It starts from green color on the left to the red on the right.

The machine condition bar, see the Machine limits description above.

The bearing condition bar, see the Bearings limits description above.

The Unbalance severity level.

The Looseness severity level.

The Misalignment severity level,

The severity level of a different type of a fault.

ISO 20816 limits (see the ISO overall measurements), the color of the circle is related to the machine condition class A, B, C, D (the green for A or B, the orange for C and the red for D). Also, the information about machine group and foundation are displayed. The limit which is exceeded is also displayed at the bottom.

The pie chart displays the percentages of severity of individual faults. The colors in the pie chart correspond to the colors of the rectangle next to the individual graphs.

The 1x amp+phase value and velocity spectrum with speed and harmonics (marked by red triangles) are displayed in the middle of the screen.
Note! the 1x amp+phase value is displayed only when the speed is measured by a tacho probe.

The condition report and advices are in the bottom.

Stethoscope

This module enables you to listen to vibrations. Use the standard headphones and connect them to the audio output on the top panel.

Enter the Stethoscope module. Four displays appear. Push *Enter*. Each input signal level will be displayed.
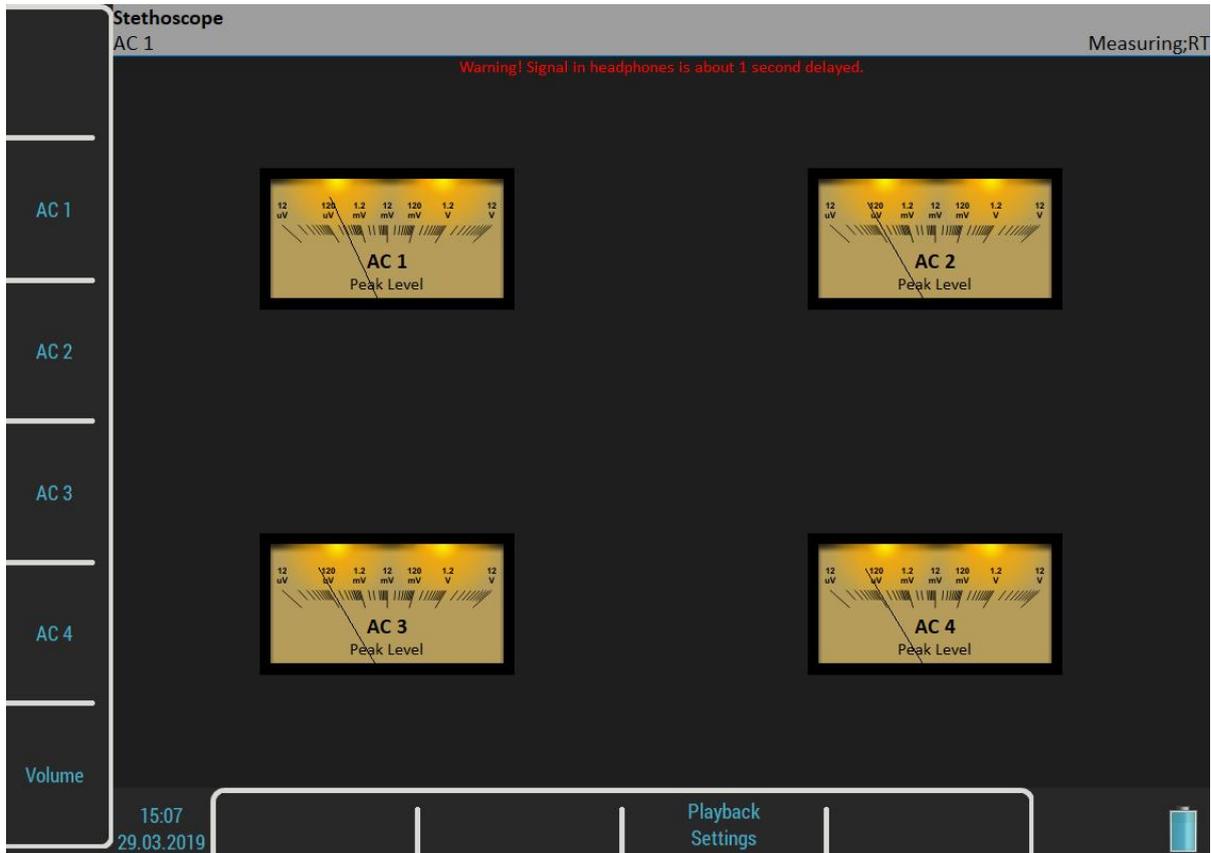
The **TRUE PEAK** level is displayed. You choose the channel for listening by the buttons on the left side. The selected channel is written in the status bar.

The **Volume** button changes the buttons mode to volume regulation.

The delay of audio output

Because all signal conditioning is digitally arranged, the delay of signal appears. The delay is usually 1 second. You can test it by knocking to the sensor. You will hear this knock after the delay time.

Playback Settings

Push the **Playback Settings** button for playback settings.
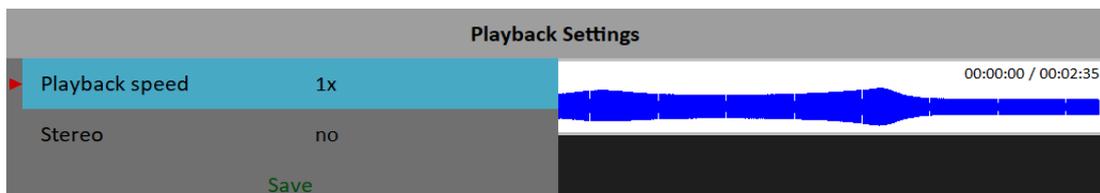
Playback speed

This function is available only when a record is listened to. It speeds up (larger than 1) or slows down (lesser than 1) the playback speed.

Stereo

yes, <u>**no**</u>

It enables you to define two channels for playback, one channel for the left headphone and the second for the right one. The current setting of left/right output is displayed on the status line on the left top (**L: AC 1, R: AC 2**). The *Left* note in the bottom left corner says that you setup the left channel at this moment. Push the *AC1 – AC4* to change the number of the left channel. Push the *Left/Right* button and the *Left* note changes to *Right*. Then the *AC1 – AC4* buttons enable you to setup the number of the right channel.

Lubri - the greasing control

There is an increasing demand for an instrument which is able to easily check the lubrication of rolling bearings and also the condition of these bearings.

For every machine, it is specified how much lubricant every one of its bearings uses in a specific number of operational hours. A task of each technician or engineer is to regularly check all the lubricated points and maintain the sufficient levels of a lubricant. Either state, lack or excess of a lubricant are harmful for a rolling bearing element. The result is always an excessive stress on the bearing and consequently excessive wear. Every lubricating point has a lubrication time interval (in hours of service) and also an amount of lubricant that needs to be replenished. This manner of lubrication control has a significant disadvantage.

The amount of lubricant that any bearing actually needs for proper operation changes during its lifetime. Longer lubricating intervals in case of a new machine are usually not sufficient for a machine after several years of operation.

It is clear that it would be useful for technicians to be able to determine a state of a bearing somehow and replenish only as much lubricant as is actually needed. Controlled lubrication increases the bearing service life and lowers the costs for lubrication and repairs.

The main use of this Lubri module is in the lubrication replenishment process. During this process, the instrument measures the current lubrication condition of a bearing and tells the operator when the amount of lubricant is ideal. This way, it is ensured that we do not under lubricate or over lubricate. This module exactly determines the ideal amount of lubricant needed.

As a result, your machines will be maintained in their best lubrication condition. The Lubri module enables you to make the whole lubricating process simpler and it normally reduces the consumption of very expensive lubricants.

You can find more detailed information about lubrication in the A4910 – Lubri manual.

Two Ways How to Mount a Sensor

A standard accelerometer mounted on a bearing housing is used to measure lubrication.

You have two possibilities of doing this:

1. ***The sensor is mounted on a lubrication head.***
   This option enables a quick service since the lubrication head is transferred together with the sensor. The disadvantage is a partial loss of sensitivity, since the lubrication head attenuates the measured signal.
2. ***The sensor is mounted next to a lubrication point on a bearing housing (measurement pad recommended).***
   This option enables a perfect measurement. The disadvantage is a longer preparation, since the lubrication head and sensor must be mounted separately.
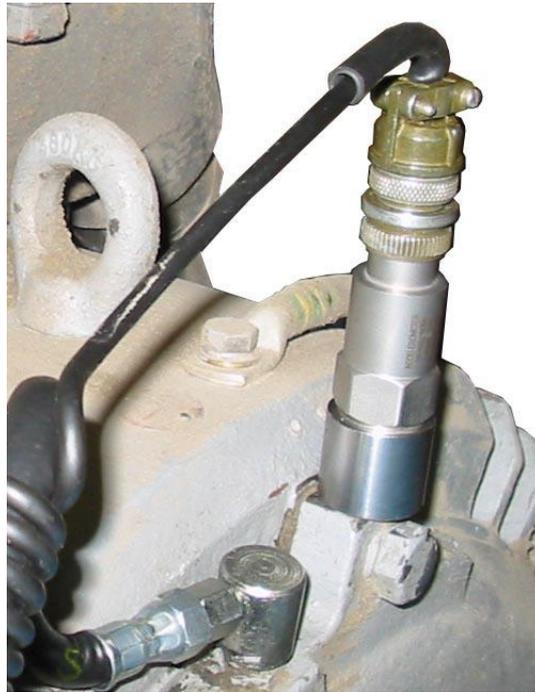
Sensor mounted close to a lubrication point

If vibration diagnostic measurements are performed on a machine, then a measurement pad is already mounted. This pad can also be used for lubrication measurements.

Procedure

Mount the sensor near the bearing. Prepare the greasing gun for use.

Open the Lubri module and select the input channel which will be used for measurement. Push the *Enter* button to start the measurement. Then, the instrument will measure the current lubrication state.
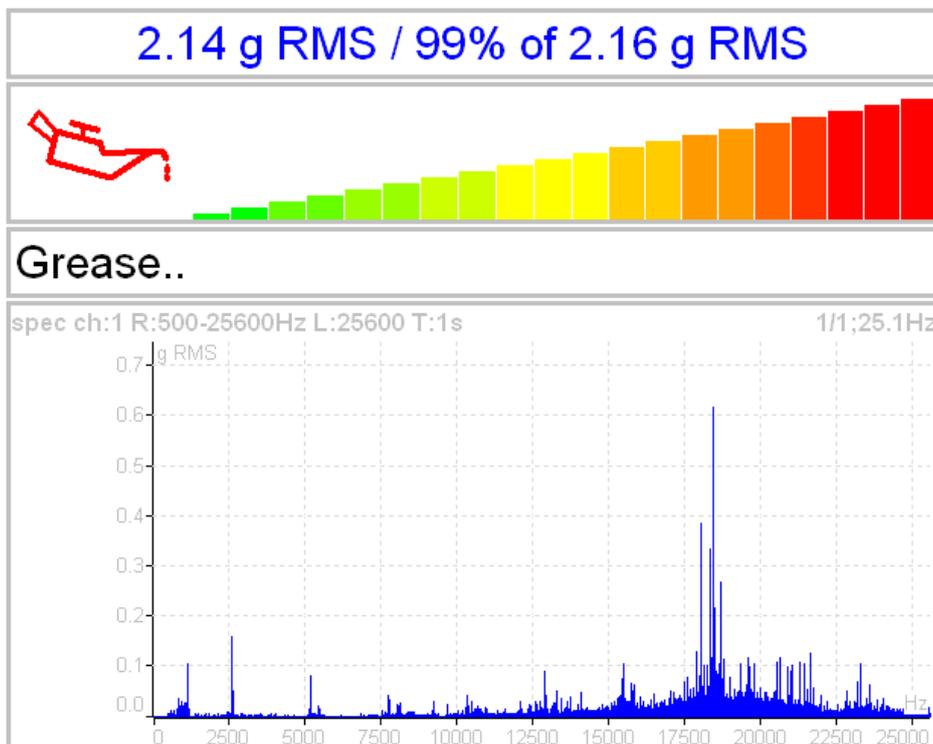
The instrument continually takes a g RMS value in the frequency band 500 - 25600 Hz and compares it to the initial value. The first line contains the current g RMS value and the proportion to initial value in %.

Below the first line is a horizontal bar, which indicates the current lubrication state. Its level always reaches a maximum after the procedure start.

The recommendations are also displayed below the bar. The acceleration spectrum is displayed in the bottom. You can look at the spectrum changes during the procedure.

You need to slowly start adding lubricant while monitoring the height of the column on the display. There is usually not much going on in the beginning, which means that the lubricant is pushed towards the bearing, however it is not there yet. At the moment when the lubricant reaches the bearing, the column decreases (usually its red part disappears and only the green part remains). You need to add a little more lubricant, and if there is no further decrease, you end the lubrication process.
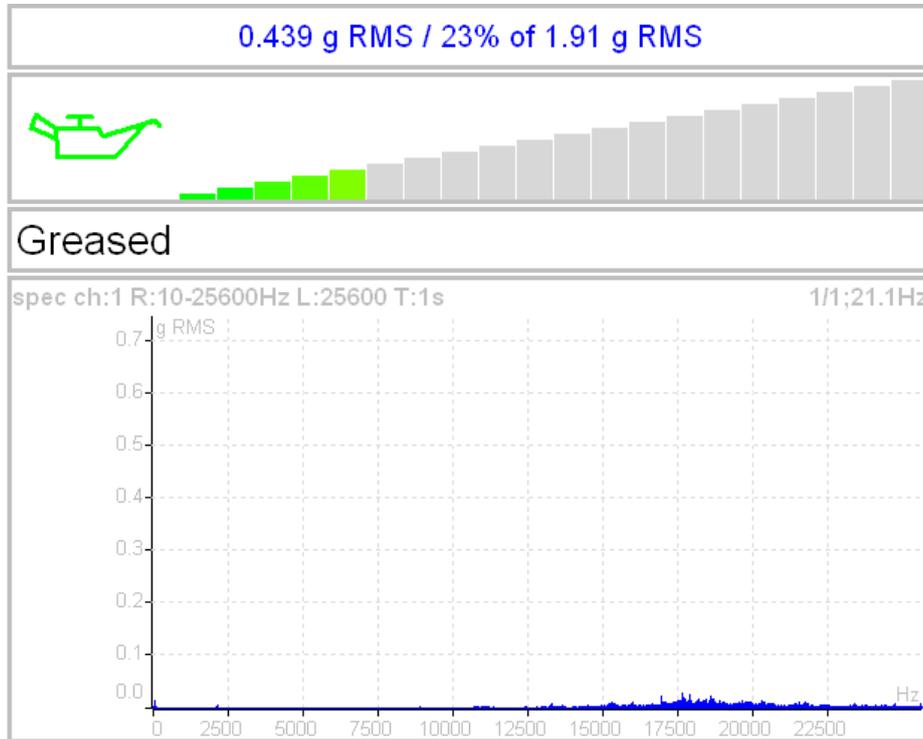
Note! If, at the beginning of measurement, the value of vibrations is low and oilcan is green, then we have either a new or a very well-greased bearing.

Octave Analysis

The Octave Analysis module is designed for sound measurements. It works the same as the Analyzer module. It enables exponential averaging.

Measurement Settings

Edit Measurement	
► Type	octave spectrum freerun, retrig
All Channels	no
Channel	1
Unit	Pa
Resolution	1/1
Frequency Range[Hz]	16-16000
Frequency Weighting	none
Averaging	linear
Avg	off total t = 0.125 s
Save	

Type

octave spectrum

sound level
The sound pressure level in dB is defined as 20log10(pRMS/p0), p0=0,00002 Pa (p is sound pressure)

equivalent sound level
When the sound level changes during a time interval, then the equivalent sound level is the average sound level of the whole interval.

Channel

1 - 4

Unit

The unit of measurement (has to be compatible with sensor settings)

Resolution

1/1, 1/3, 1/12, 1/24

Frequency Range

1-63 Hz, …, 16-16000 Hz
The central frequencies of the lowest and highest octave.

Frequency Weighting

none, **A**, **B**, **C**, **D**

The human ear has the subjective characteristic known as loudness. It is the function of sound intensity and frequency. For example, the 20Hz pure tone with sound level 20dB would be clearly audible. The 100Hz with the same level would not be heard, it lies below the threshold of hearing. The unit of loudness is **phon**. The loudness level in phons of any sound is defined as being numerically equal to the intensity level in dB of a 1000Hz tone. The purpose of weighting is to make the readings correspond to the loudness level as closely as possible. Historically, four weighting were defined:

A   used for loudness levels below 55 phons.
B   used for loudness levels between 55 and 85 phons.
C   used for loudness levels over 85 phons.
D   used especially for aircraft noise.

However, A-weighting is frequently specified today for measurements irrespective of level.

Averaging

linear
The standard arithmetic mean for every line

peak hold
The maximum value during the measurement for every line

exponential
The continuous measurement where the older spectra have less weighting than the newer

Avg

off or the number of values in an average

Measurement
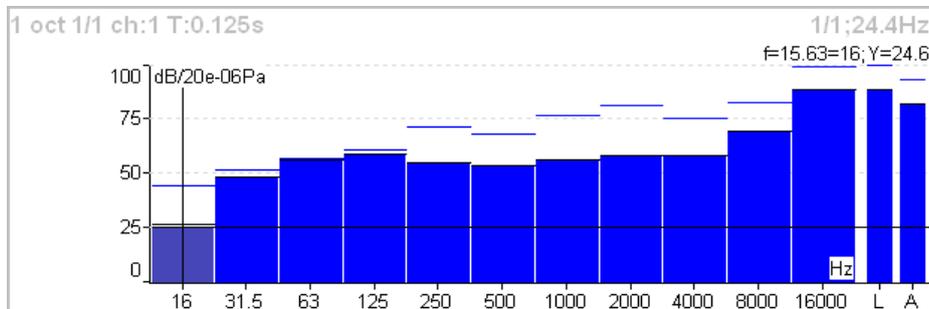
Each spectrum is combined with two bars at the right side. The total sound level **L** and the used weighting level **A** – **D** are displayed. The line over each line is the maximum peak reached during the measurement.
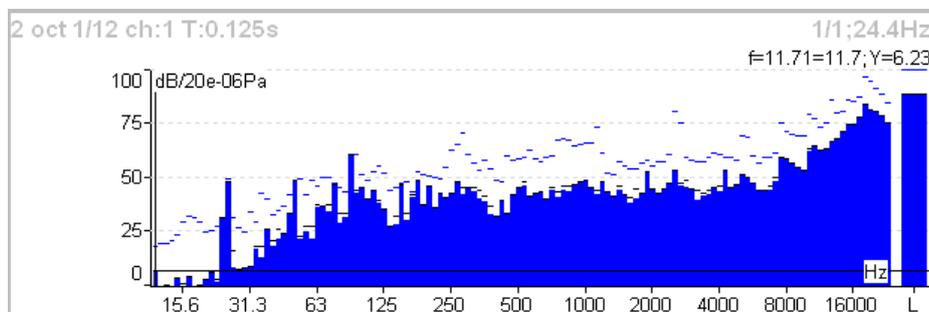
Octave Analysis Algorithm

Octave analysis uses a set of digital filters. Each filter has a designated center frequency and bandwidth. Filters are designed according to ANSI S1.11:2004 and IEC1260:1995.

Bump Test

It enables you to find the resonance frequency of the machine's body.

The test contains two parts. The level of amplitude trigger is found in the first part. The response spectrum is developed in the second part.

Settings

The *Settings* menu opens after you enter the Bump Test module. You can open it later using the **New Test** button.

Settings	
► Channel	1
Hits	4
Range[Hz]	400
Unit	mm/s
Neg. Averaging	no
Save	

Channel

Input channel number

Hits

Number of hits. It's the same as the number of signals for averaging in spectrum.

Range

Frequency range (maximum frequency) of the analysis.

Unit

Measurement unit. Integration of a signal is also possible.

Negative Averaging

See MENU / SETTINGS / Trigger Settings / Negative Averaging

Amplitude Trigger

In the first part of the test, we need to detect the correct value for triggering. The system sets it automatically. Start the test by the *Enter* button. Make the hit and look at the movement of the hand on the display. Make all hits with approximately the same force. More than one hit is recommended (3-4). Push *Escape* to finish the first part. The second part begins automatically.

Attention! Make all hits with approximately the same force throughout the whole test.

Bump Test
AC 1   Measuring;RT

Make several hits for trigger setting, then press Stop

15:49
29.03.2019

Response Spectrum

Continue with hits in part 2. The spectrum with resonance frequencies is displayed after the first hit and the averaging is used for the next hits. Look at the top right corner and make the hit when the message "*Waiting for trigger*" is displayed. The test is stopped after reaching the specified number of hits. You can also stop it by the *Escape* button anytime.

Note! You don't need to wait for the "*Waiting for trigger*" message. The hit can be performed immediately after the spectrum on the screen is updated.

Note! A 10 Hz high pass filter is used during signal processing. Frequencies below this value are removed.
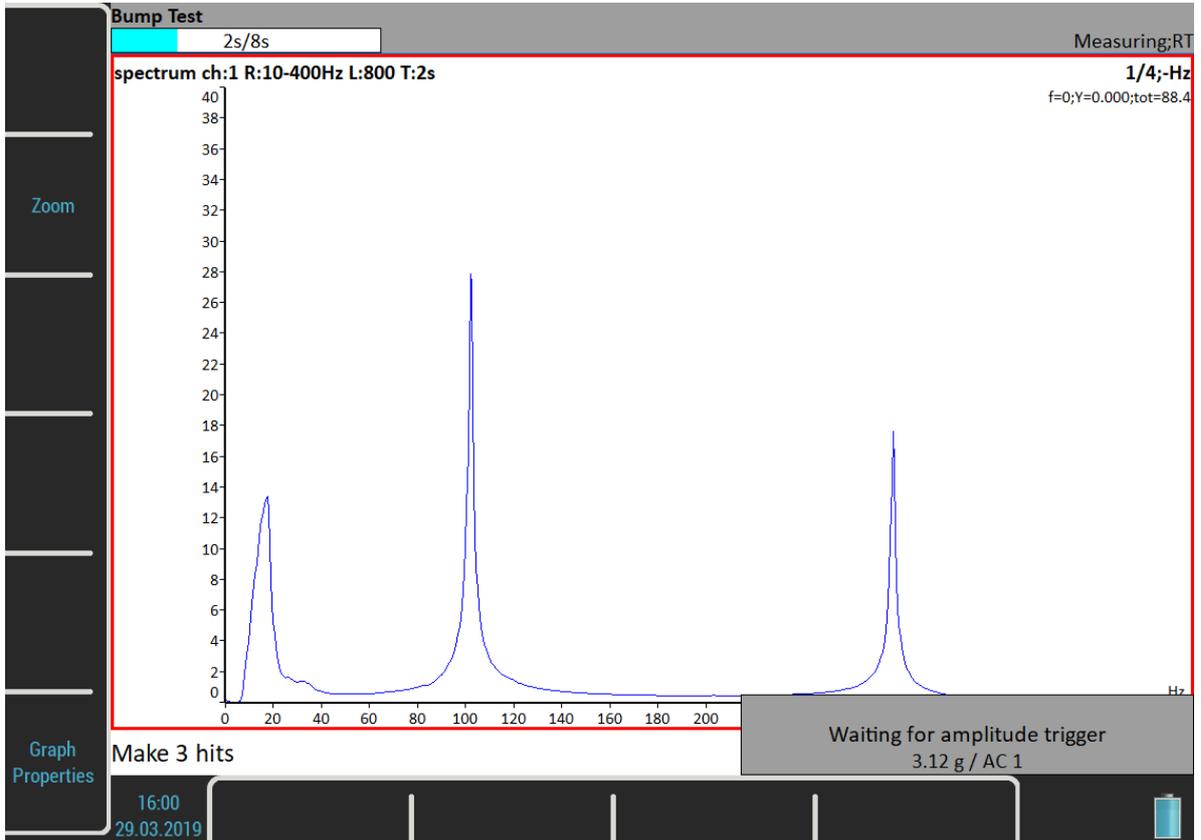
Analysis

The spectrum graph has the same properties like in the Analyzer mode. Using of the Graph Properties/ Peaks List helps you detect required frequencies.
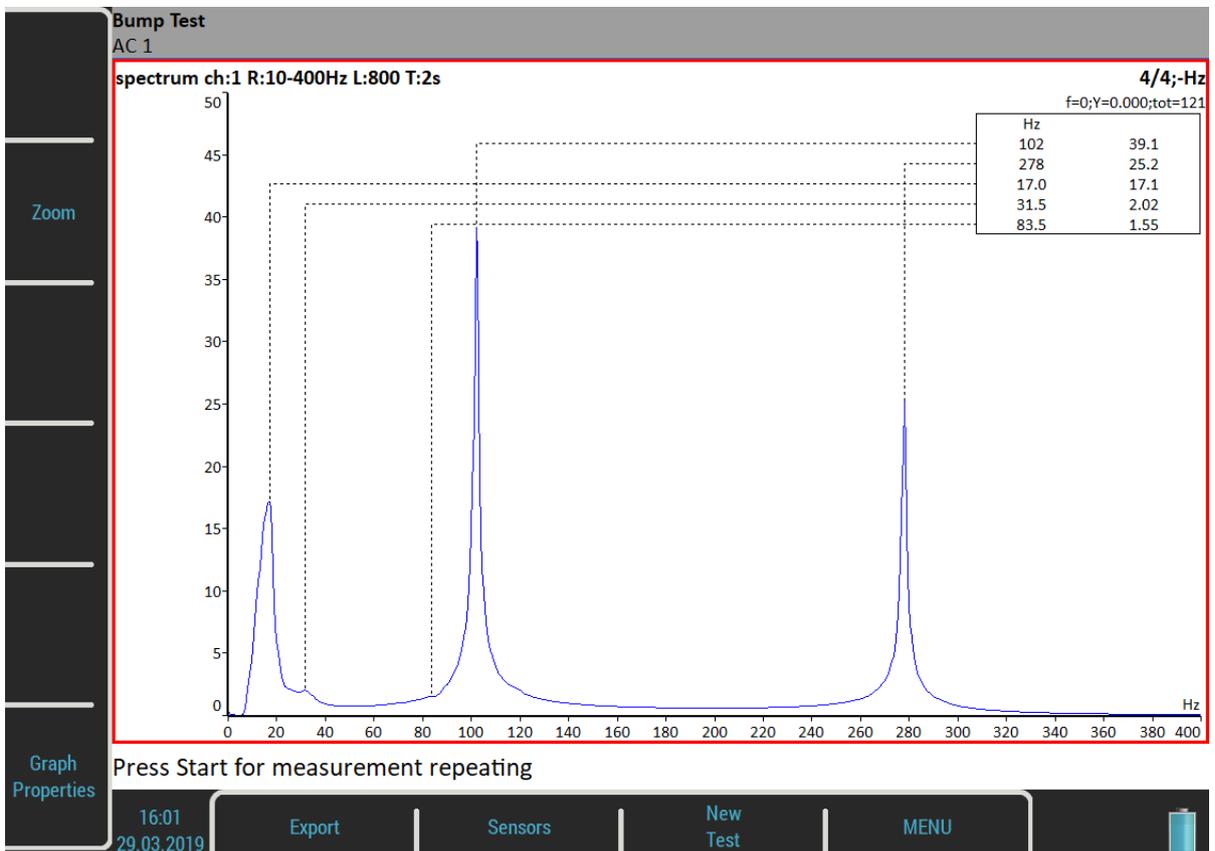
Buttons

Enter

Repeats the second part with the same trigger level.

New test

Starts a new test including the trigger level initialization.

Export

Exports spectrum from **bumptest** to Analyzer or to the *VA5_DISC* as an Analyzer project. This project can be imported to DDS.

ADS

The ADS (Adash Deflection Shapes) module enables you to measure operating deflection shapes of the machine.

ADS project

The project must be created on the computer. The ADS software enables you to create the geometry of the machine (points, lines and directions).

Project Import to VA5

On PC, copy the project file (ads extension) to the *VA5_DISC* either to the root or to the *VA4ads* folder. The project will be moved to the instrument memory after entering the ADS module. The file on the *VA5_DISC* will be deleted.
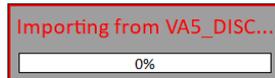
Rewriting of geometry

The user usually creates the simple geometry first and takes the measurements. After that first test, he changes the geometry (adds next points, lines, and directions). When the project is imported to the instrument again, then only the geometry file will be rewritten. The already taken data will not be deleted.

Project List

The project list opens after entering the module.
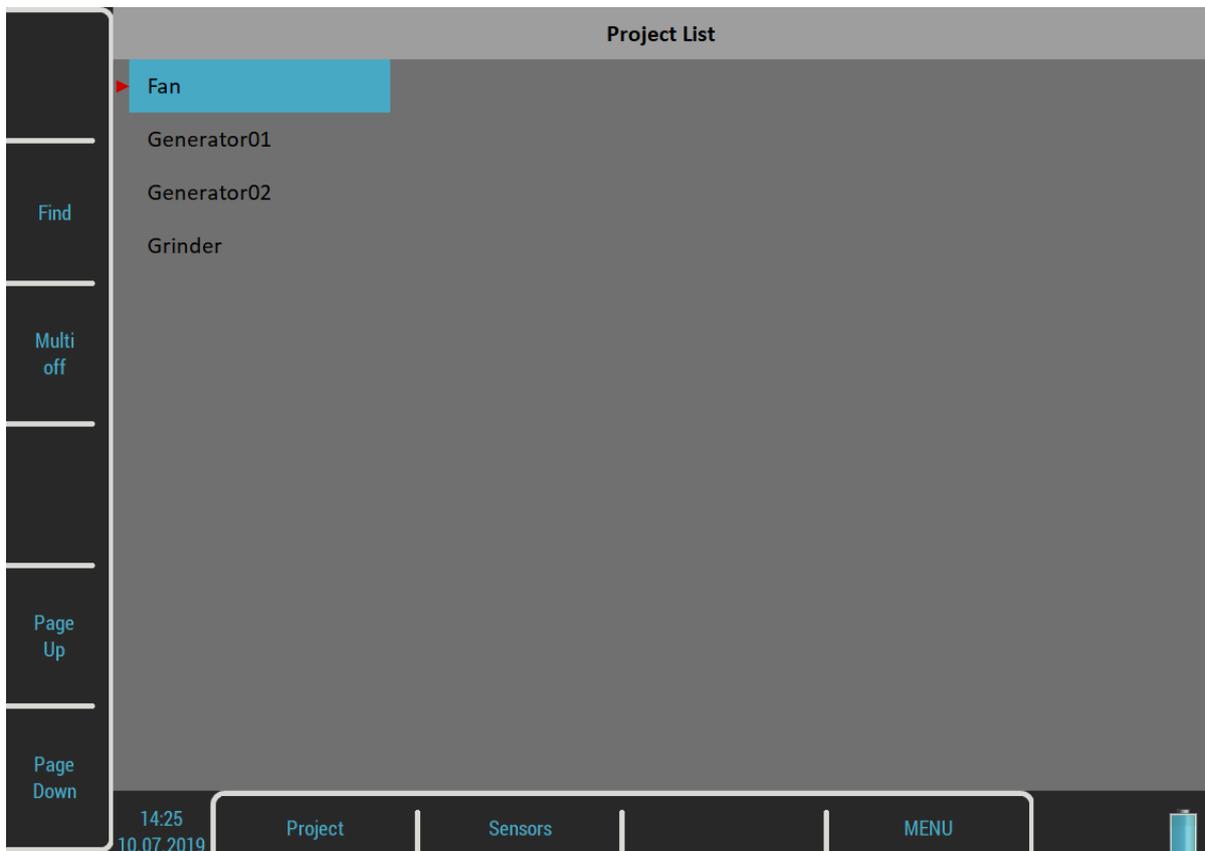
Project Menu

Push the **Project** button to open the menu. The **Create** item is missing here. You can create an ADS project only by importing geometry from computer (see above).

Copy

Copies the selected project to a new project without measured data.

Rename

Renames the selected project.

Delete

Deletes the selected project(s).

Clear Data

Deletes all readings in the selected project(s).

Export Data

Exports readings to the *VA5_DISC*. File with **"name".dsd** will be saved to the *VA4ads* folder. It is prepared for import in the ADS application.

Export Project

Exports the whole project, both readings and geometry, to the *VA5_DISC*. This project can then be used in Virtual Unit application.

ADS Settings

Select the required project in the project list and open it. The settings of measurement parameters are required when the project is opened the first time. You can change the settings any time later using the **ADS Settings** button.

ADS Settings

▶ Type	frf freerun, single	
Input	1	
Window	hanning	
Output	2	
Window	hanning	
Result Type	H1	
Range[Hz]	800 fs = 2048 Hz	
Lines	800 t = 1 s,df = 1 Hz	
Avg	4 total t = 4 s	
Overlap	0%	
Reference Direction	1	
Frequency for Animation [Hz]	50	
Vibration Scale	0.5	
	Save	

Measurement Definition

The amp+phase, Orders, or Frf are available measurement types for ADS. All parameters are the same as in Analyzer / Edit Measurement.

Attention! The change of the measurement parameters requires deleting all saved readings when they are not compatible with the new definition. The only parameter you can change without losing readings is the channel number.

Reference Direction

This parameter is available only for **frf** measurement type. One reference sensor is mounted to one point (one direction) on the machine and is in that place all the time. The second sensor is moved sequentially to all other directions.

Attention! The change of the *Reference Direction* number requires deleting all saved readings, because they are not compatible with new reference direction number.

Frequency for Animation

Specifies which frequency of frf will be used for animation on the VA5 screen. This setup is available only for frf measurement. In case of amp+phase or orders, the speed frequency (1X) will be used for animation.

Vibration Scale

<0, 1>
Scales amplitudes of vibrations in animation.

Views

Three types of screen view are available. Use the *View* button to switch it.

Machine View

The geometry is displayed. Directions contain numbers. The reference direction is marked as **R**.
Just the selected point contains a small circle. Just the selected direction is drawn by a different color.
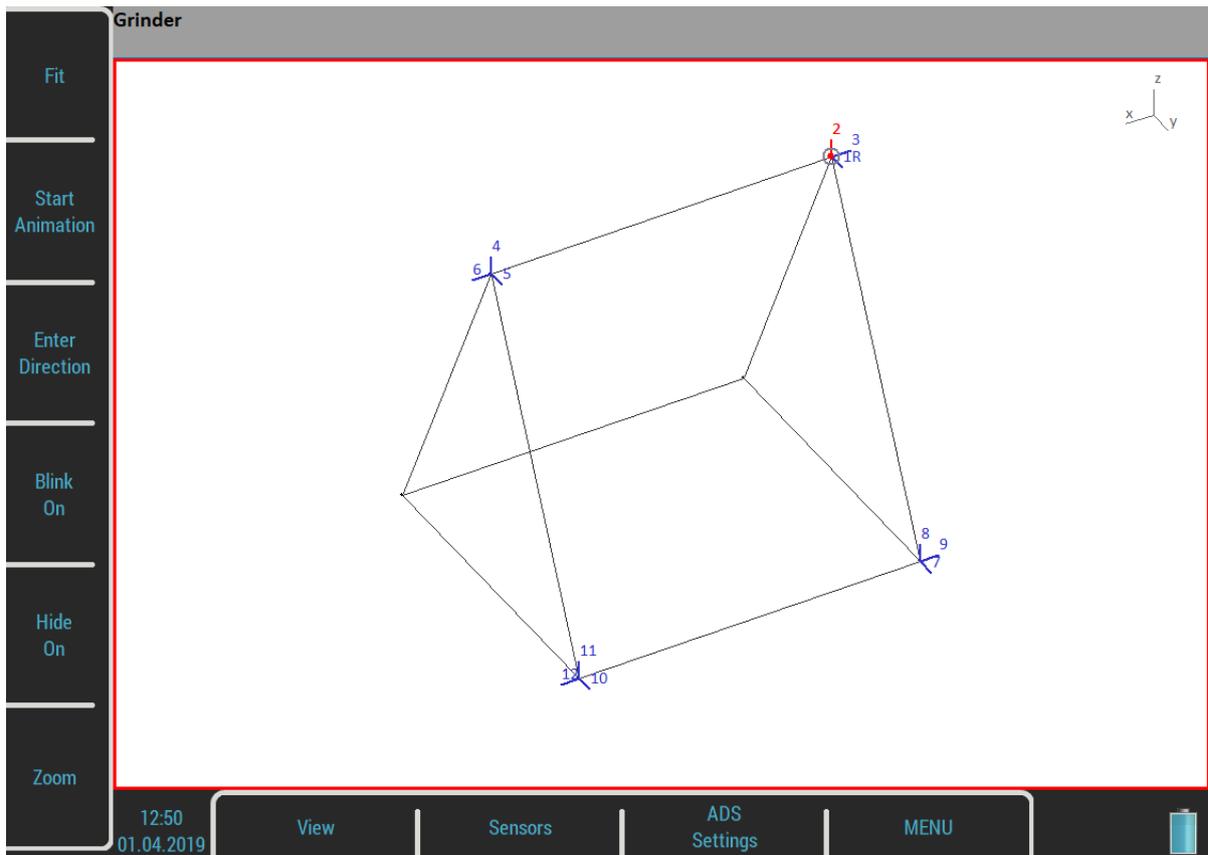
Measurement View

The standard graph with measurement is displayed. The number of the selected direction is displayed in front of the measurement type (**2** frf ….)
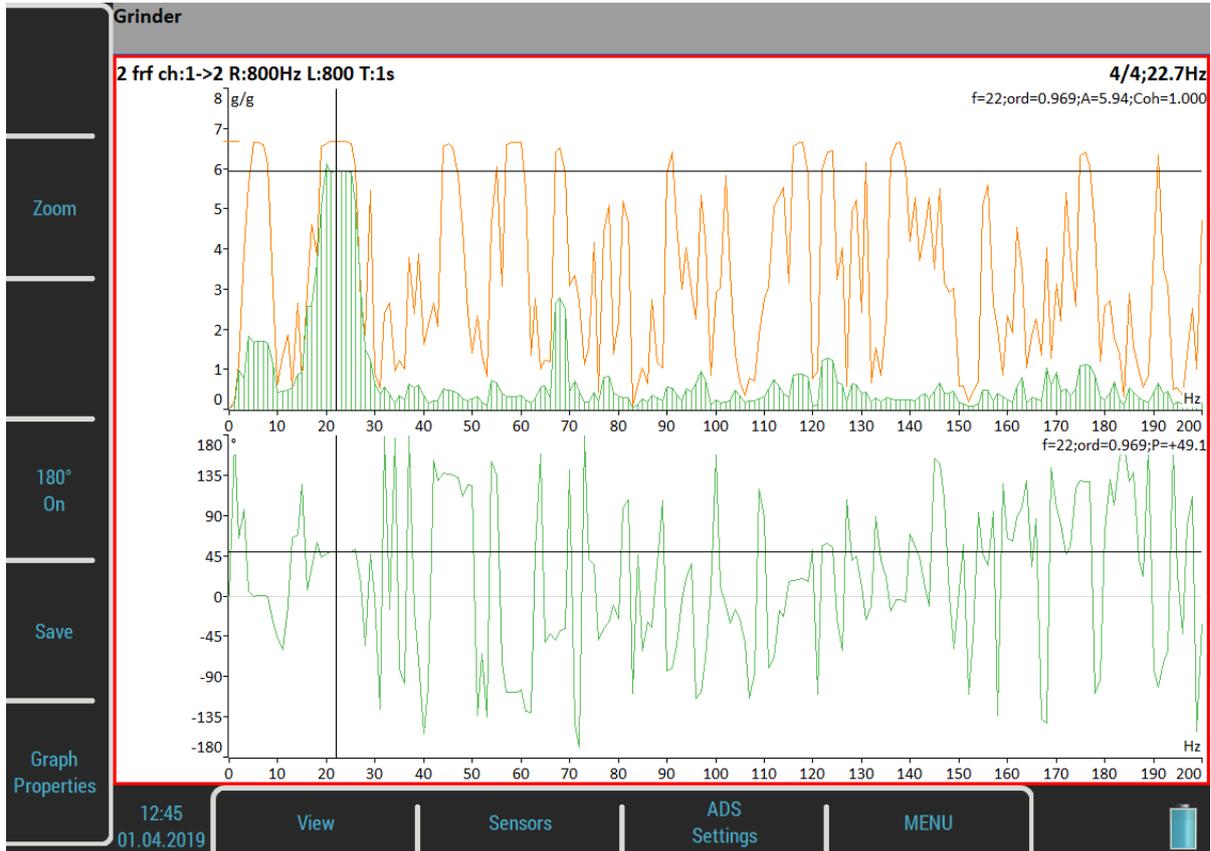
Machine+Measurement View

Both previous screens are displayed together. The user can select one of them to be focused (the red border) with the **View** button and to work with it.
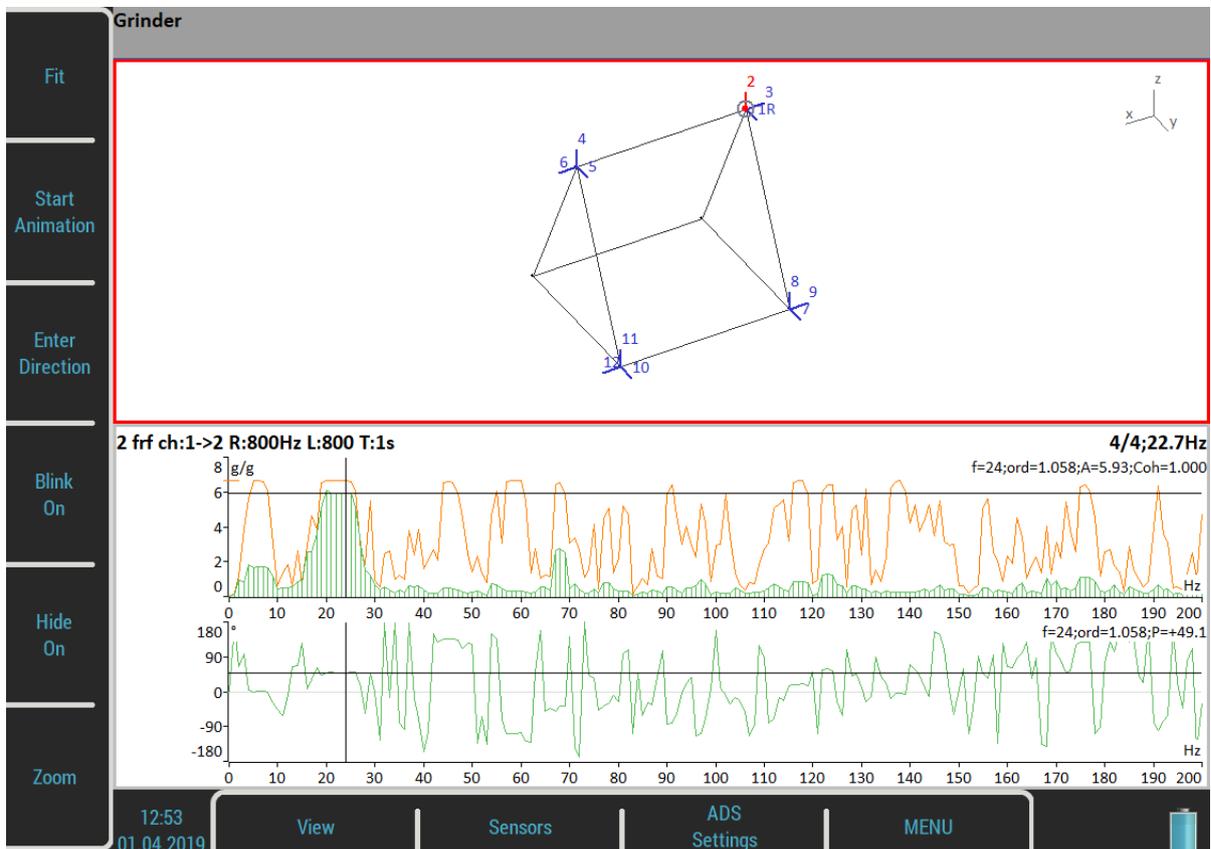
Automatic change of view

When the measurement starts, the machine view is replaced by the measurement view.

Buttons for Machine View

Fit

Auto-zoom of the machine in window

Start/Stop Animation

Runs or stops the animation.

Enter Direction

Opens a dialog to manually enter the direction number.

Blink on/Blink off

The directions, which have not been measured yet, can blink.

Hide on/Hide off

The directions, which have been measured yet, can be hidden.

Zoom

Switches buttons to the *Zoom* / *Move* / *Rotate*. Push the *Tab* or the *Backspace* button to return the initial mode. Zoom and move functions are also available using the touch screen.

Left / Right Arrow - Direction

Changes the direction number on the selected point. The new direction can also be entered by the <u>Enter Direction</u> button.

Up / Down Arrow - Point

Moves the point selection (blinking circle). When the new selection is confirmed by *Enter*, then the selected direction is also moved to that point.

Enter

Starts a new measurement on the active direction.

Buttons for Measurement View

Zoom

Switches buttons to *Zoom*. Push the *Tab* or the *Backspace* button to return to the initial mode.

Graph Properties

Open the **Graph Properties** dialog which is described in the **Analyzer** module.

180° on/180°off

Sometimes, it is not possible to mount the sensor to a direction which is defined in geometry. In such case, it is usually possible to mount the sensor in the opposite direction. Use this button then and change the phase about 180 degrees.

Save

Saves the reading.
The saved readings are displayed in a graph while selecting directions in a model. Directions already measured are color coded in the model. When you select a measured direction, its signal is displayed in the graph.
Direction number, amplitude, phase, and frequency of animation are displayed in the status bar for the selected direction.

Grinder
2: A = 5.69 g 0-P, P = +45.0°, f = 50 Hz

Ultrasound

We would like to explain a few terms at the beginning of this chapter.
Higher frequency energy above 20 kHz is best detected with an ultrasonic sensor. Most useful information is found between 30 and 50 kHz. The ultrasonic module enables the monitoring of ultrasonic energy.

Ultrasound utilizes a solid, liquid or a gas to transmit (will not exist in a vacuum), and it is a very directional and short waveform. It has several things in common with vibration, for instance, the ability to detect ultrasound energy requires the sensor to be focused in the direction of the waveforms.

Field applications for airborne ultrasound detection:
- Consider that the wave energy is easily reflected and attenuated.
- When looking to detect airborne ultrasound energy, a rule of half distance twice amplitude is a good thing to consider, this is called the "inverse rule".
- Remember airborne ultrasound is easily reflected, when detecting a leak, you should turn in the other direction to determine if the sound is coming from behind you.
- Use shields such as cardboard or isolate the potential defect from other sources.

For airborne ultrasound, the instrument microphone attachment will detect:
- Air leaks
- Vacuum leaks
- Electrical Arcing
- Electrical Corona
- Tightness testing where a signal generator is located within a sealed unit. By scanning the sealed areas from the outside, leaks can be detected.

A probe attachment that enables a direct transmission of ultrasound will detect:
- Early signs of poor lubrication in anti-friction roller bearings
- Impacting noise from defects in roller bearings including bearings with shaft speeds under 100 rpm.
- Steam trap leakage and failures
- Gearbox defects
- Valve leakage
- Actuator malfunctions

Sensor Setting

Ultrasound measurement is available only on AC1 which has the specific powering for the ultrasound microphone (see Input Channels / IN1 Socket). When you enter the module, the sensor is automatically changed to Pascal sensor.

Use the Sensors / AC1 to change the sensitivity if needed. The new setting is saved and used in the next run.

Note! The original sensor is set when you leave the module.

Settings

You can set the scale of the displayed bar graph. Open the menu by the *Ultrasound Settings* button.
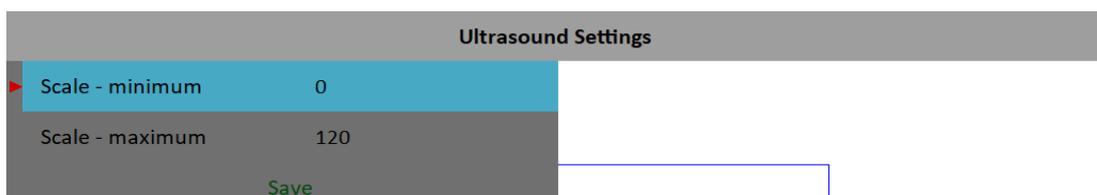
Scale – minimum

The minimum value on the bar graph.

Scale – maximum

The maximum value on the bar graph.

Measurement
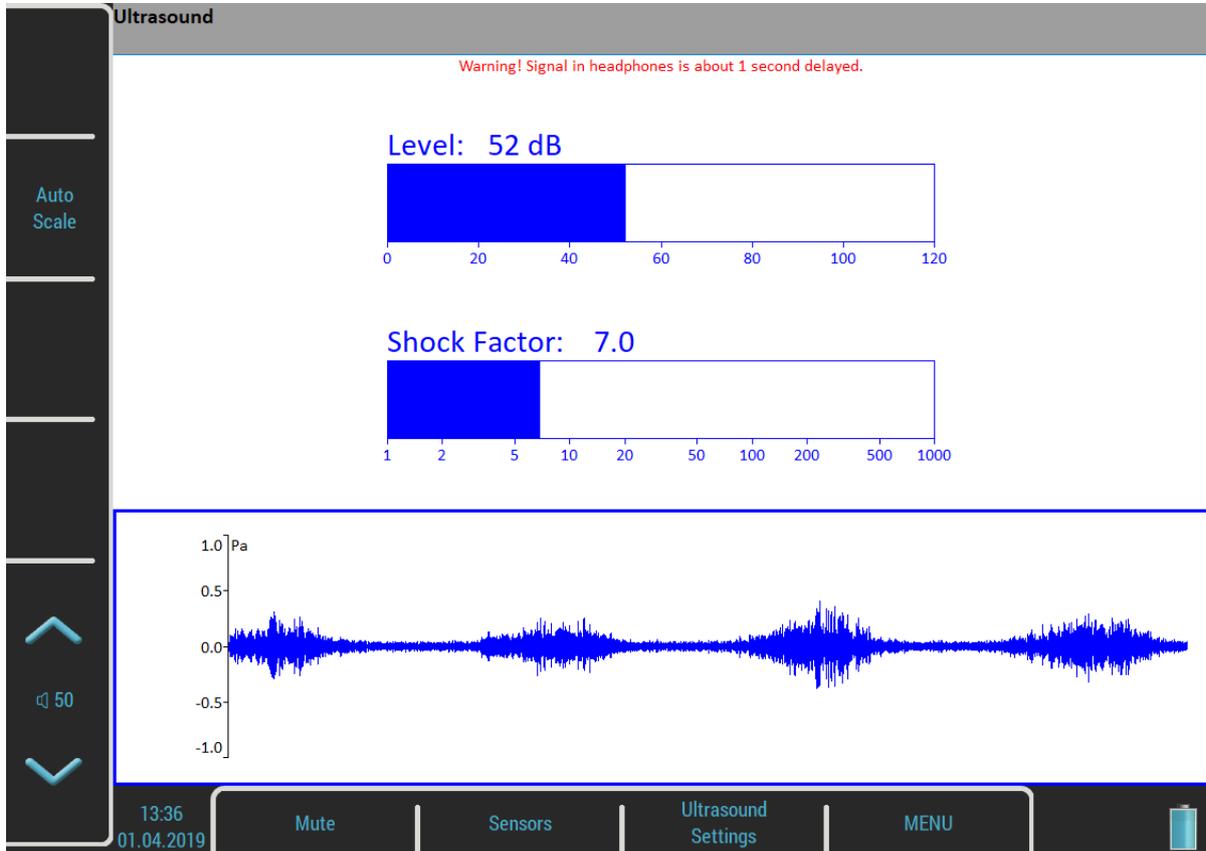
Push the *Enter* button. Two values are displayed, the **Level** of sound in dB and **Shock Factor**. The *Shock Factor* is defined as Peak value divided by RMS value. It means the value 1.4 for pure sine. Higher value means that transient shock events are in the sound signal.

The time waveform is displayed at the bottom of the screen. Use the ***Auto Scale*** button to fit the scale of the graph.

The ultrasound is demodulated to the frequencies around 1kHz and you can hear it in headphones. Use the volume buttons to set the correct level.

Push *Escape* to stop the reading.

Attention! The signal in headphones is about 1 second delayed. It is because of digital processing, which takes this time.

Camera

The VA5 instrument is equipped with an optical camera. The picture from the camera is automatically on the screen a few seconds after opening the module.

Buttons

Pause / Run

Freezes a picture from the camera and then runs it again.

Capture

Takes a picture. All images are saved to the *images* folder on the *VA5_DISC*.

Gallery

Open a Gallery so you can watch taken pictures.

IR Camera

The IR camera can be connected to the micro USB slot on the instrument's top panel. The IR camera is not a part of the standard VA5 instrument set. You can order it at your vendor.

Operation

1/ Plug the supported IR camera into the micro USB slot.
2/ Run the **IR Camera** module.
3/ Wait a few seconds until the camera initializes.
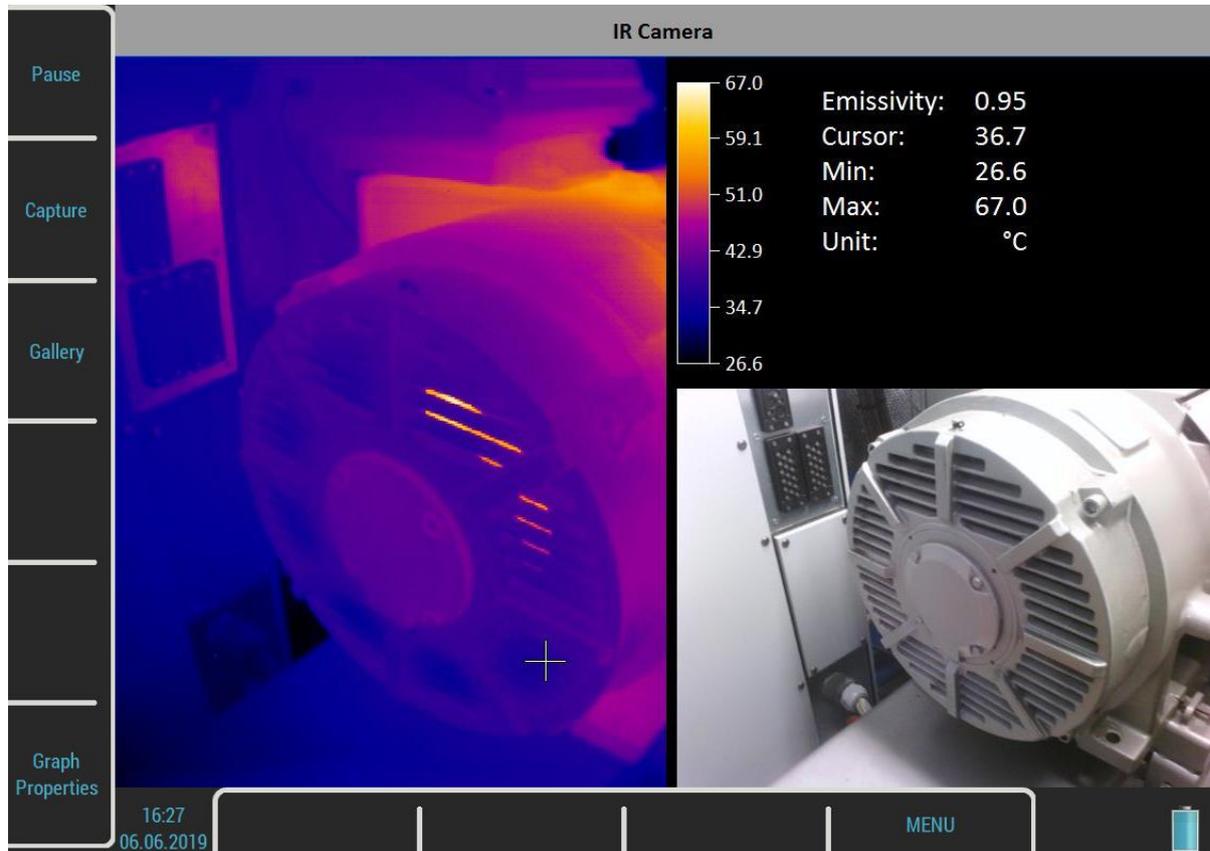
The image from the IR camera is in the left half of the screen. The image of nearly the same scene from the optical camera is in the bottom right corner. The information panel is in the top right corner. You can see the minimum and maximum temperature and the temperature of the point under the cursor. Use arrows or tap the touch screen to change the cursor position.

Focus

The supported IR camera uses manual focus. You may adjust the focus (refocus) by turning the lens to sharpen the focus for the distance of the target.

Warming Up

The IR camera needs some time to warm up after connection. During warm-up, you may notice a slow decrease of temperature. It is in units of percent. This typically takes about five minutes.

Cursor

Use arrow buttons or tap the IR image to move the cursor cross. The temperature of the point under the cursor is written in the table.

Buttons

Pause / Run

Pauses and then runs the scene again.

Capture

Takes the image of the scene. Two files will be stored in the *images* folder on the *VA5_DISC*. One file stores the raw temperatures from the IR camera in the special thm format. You can work with this file in the DDS software. The second file is the png picture of the screen. You can watch the picture but you are not able to make a further analysis.

Gallery

Opens a Gallery so as you can watch taken pictures.

Calibration

Opens a menu where you can choose one of two possible types of calibration.

Calibration
► Temperature Calibration

IR Image Correction
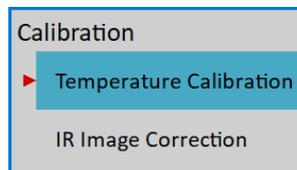
Attention! For both types of calibration, calibration constants are stored in the instrument and not in the camera itself. Thus, you need to perform the calibration procedure again when you connect another camera. Similarly, you need to perform the new calibration procedure when you connect the camera into another instrument.

Temperature Calibration

Aging of camera electronics can cause inaccurate temperature measurement. For this case, you can use this IR camera calibration tool.
In the calibration process, you will be asked to make IR pictures of two objects with different temperature and entering their real temperatures into device. These two objects should be made from the same material with the same color and surface structure if possible. Another option is to cover the surface of the calibration objects with black adhesive tape. You have to know the real temperature of these objects for the calibration.

Take two captures (the **Capture** button changes into **Capture 1** and later into **Capture 2**) and enter the temperature value at the cursor position for each.

The calibration procedure automatically ends after entering the second temperature. New calibration constants are calculated and used. The procedure can be terminated by the *Escape* button. The **Reset Calibration** button erases the calibration constants from the instrument.

If you are not able to measure the real temperature of objects, there is a solution for you. Set the Emissivity to 0.96 and take an IR picture of boiling water surface and assign the temperature 100°C (212°F). As a second calibration picture, capture the surface of water from melting ice and assign the temperature 0°C (32°F).

IR Image Correction

You may sometimes notice a corona effect or bad pixels on the IR image. The IR Camera Correction function should solve this problem.
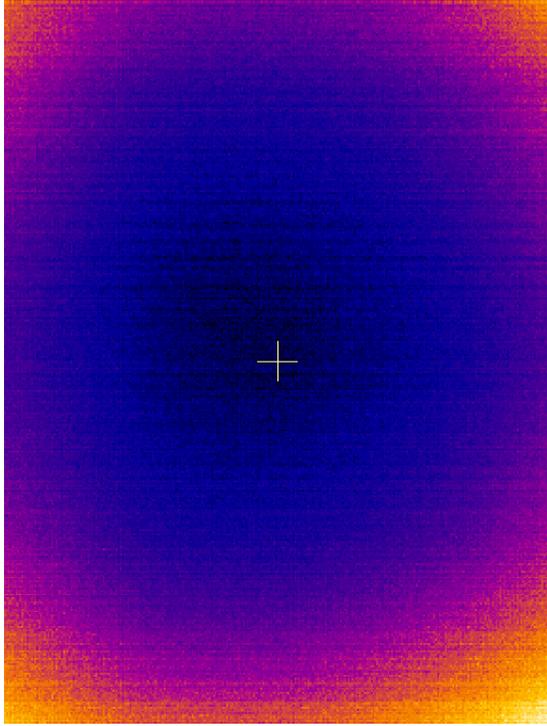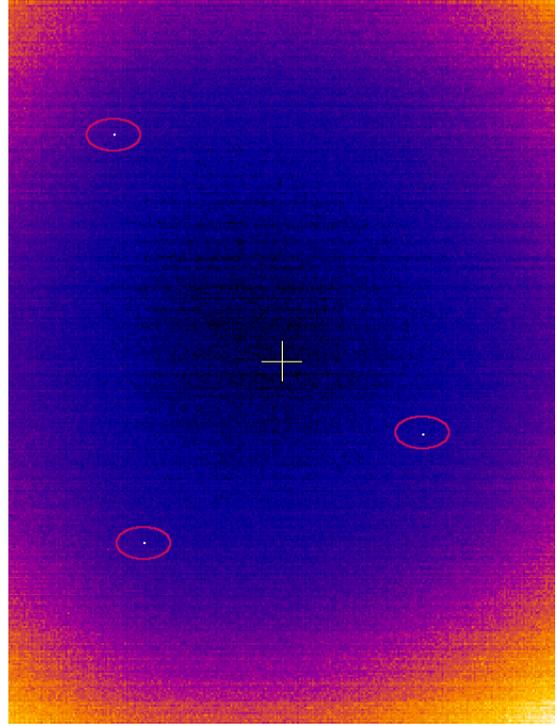
During this procedure, simply set the IR camera to see a uniform scene (e.g., the wall). Then press **Calibrate** and the image should be repaired. The uniform scene should then look like this:
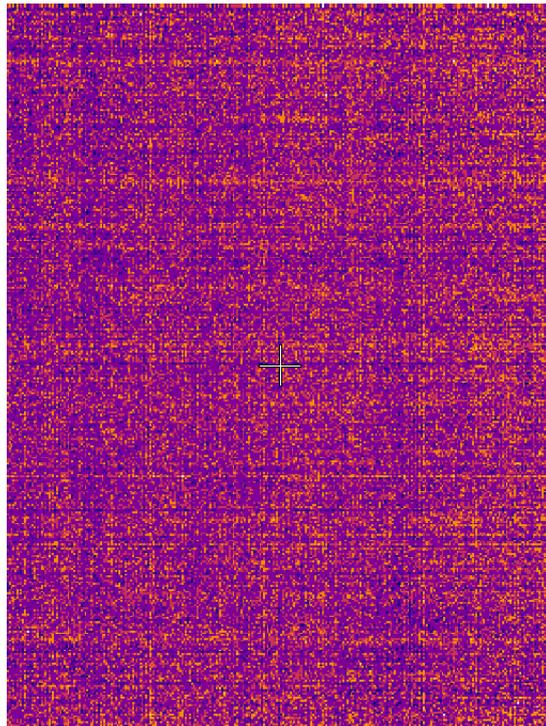
Attention! IR image distortion may be caused by insufficient warm-up of the IR camera. After connecting the IR camera, wait at least 5 minutes before running the IR Image Correction.

Graph Properties

Unit

Choose the temperature unit.

Emissivity

The emissivity value of the observed place is needed to calculate the right temperature.

Color spectrum

Choose the colors of the images, **colored** or **black and white**.

Scale

<u>auto</u>, **user**

The **auto** scale ensures the highest possible contrast of the picture. With the **user** scale, you have a fixed color for each temperature.

Gallery

The images from the camera, IR camera and also all screenshots ([MENU / RUN](#) / [Screenshot](#)) can be watched in the Gallery. You can watch the images as icons or one image on screen. Use the *Enter* button or double tap an image to maximize it. Then use the *Escape* button to restore the icons mode.
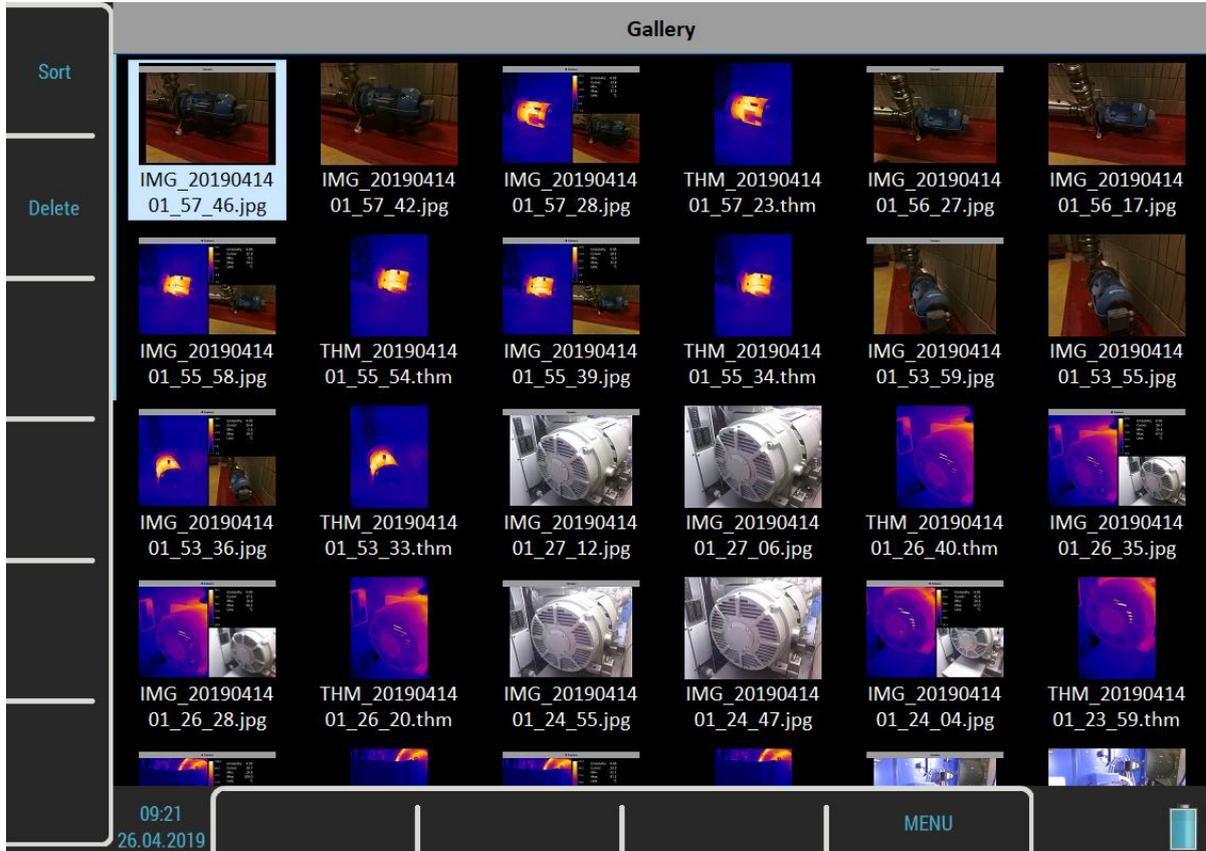
Buttons

Sort

You can sort the images by name or by time, in ascending or descending order.
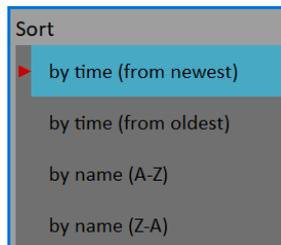
Delete

Delete the selected image.

Buttons for maximized IR Camera picture
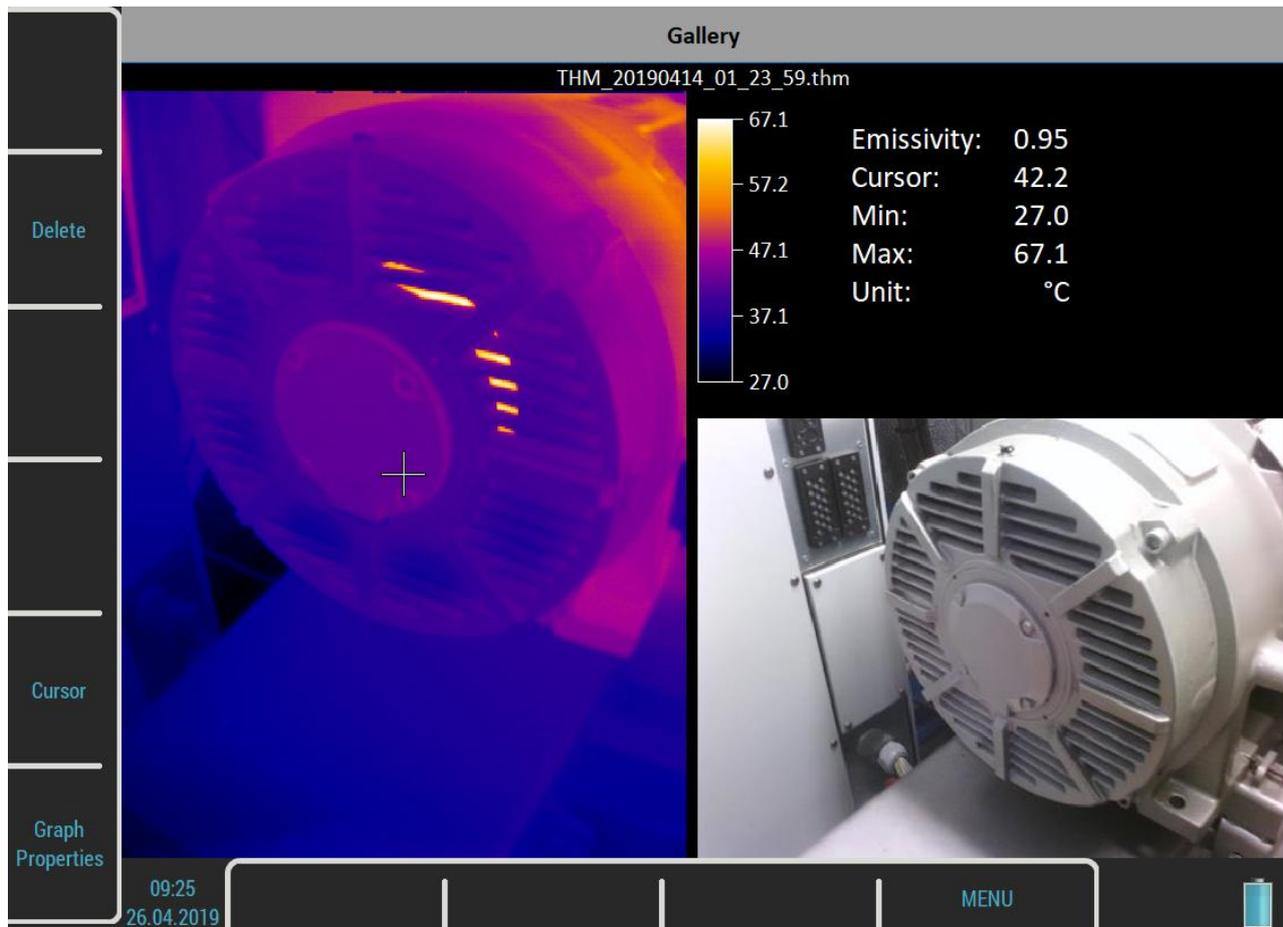
Cursor

When a picture from IR Camera is maximized, you can also move the cursor. Push the **Cursor** button to switch arrows into the cursor mode. Then press the same button, now named **Gallery**, to return. You can also switch the mode by tapping the screen. Tap the IR camera picture to switch into the *Cursor* mode or tap outside the picture to switch into the *Gallery* mode.

Graph Properties

Opens the Graph Properties menu like in the IR Camera module.

MCSA

The MCSA (Motor Current Signature Analysis) module is used to determine induction motor faults by analyzing stator currents. You need three phases measurement for the whole analysis but most can be performed only with a single current measurement. Current clamps are used for the current measurements.

The module evaluates broken rotor bars or cracked rotor rings, shorted turns in stator windings, air-gap eccentricity, and power quality.

Sensors Settings

The MCSA module is based on current measurements, therefore you need to define suitable current sensors. When you enter the module from main screen, predefined sensors will be automatically set. A "***Used Sensors***" message box informs you about it.

Note! The acceleration sensor on AC4 has no purpose for now. It may be used in the future.

Used Sensors
on AC1: 10 mV / A, ICP off
on AC2: 10 mV / A, ICP off
on AC3: 10 mV / A, ICP off
on AC4: 100 mV / g, ICP on

If you want to use different sensors you can setup them in the menu.

Note! The sensors menu is not available immediately after confirming the message box, because the MCSA Settings menu appears first.

Note! Once you have changed the sensors, your new setup will be saved and used as predefined sensors for the next time.

Note! Any sensors setup in the MCSA module applies just in this module. When you leave the module back to the main screen, the previous sensors will be restored to a state before entering the module. Therefore, if you want to make some further analysis in other modules you need to setup the sensors in the Sensors menu while not having opened the MCSA module.

MCSA Settings

The *MCSA Settings* menu automatically appears after confirming used sensors. Enter a few parameters which are needed in the MCSA algorithm. This menu can also be opened later by pressing the *MCSA Settings* button.

MCSA Settings	
3 Phases	yes
Phase 1	1
Phase 2	2
Phase 3	3
Poles	2
Rotor Bars	undef
Line Frequency [Hz]	detect from AC 1
Speed Frequency [Hz]	tacho
Save	

3 Phases

yes, **no**

If you want to use all three phases to perform a complete MCSA analysis then select **yes**. One phase measurement doesn't enable you to check phase shifts and amplitude differences among phases. Thus, it doesn't enable you to evaluate stator faults.

Phase 1 – 3

1, **2**, **3**, **4**
Select channel number for each phase.

The "*Improper sensor*" note appears if there's currently no sensor defined on this channel.

Phase 1	1
	Improper sensor

Poles

<u>**2**</u>, **4**, **6**, **8**, **10**, **12**, **14**, **16**, **18**, **20**, **user**
Number of poles of analyzed motor. The number must be divisible by two.

Rotor Bars

<u>**undef**</u>, **user**
Number of rotor bars of the analyzed motor
This catalog information may not always be available. If you leave this parameter undefined the measurement can normally continue but the eccentricity cannot be evaluated.

Line Frequency

<u>**detect**</u>, **user**
Enter the value of the line (power grid) input frequency. If you don't know the value, then the **detect** choice can help you.

Signal for the detection is taken from *Phase 1* input channel. A note "*from AC 1*" informs you about it (the number in the note is always the same as *Phase 1* value).

Line Frequency [Hz]	detect
	from AC 1

The *Line Frequency Detection* is similar to [Speed detection](#) which is described in a stand alone chapter.

The "*Improper sensor*" note appears if there's currently no sensor defined on *Phase 1* channel.

Line Frequency [Hz]	detect
	Improper sensor

The line frequency detection runs before MCSA measurement.

Speed Frequency

<u>**tacho**</u>, **user**
Enter the value of speed frequency (rotor speed). If you don't know the value, then use a tacho probe.

Speed from the tacho probe is detected before MCSA measurement.

Measurement

Push the *Enter* button to start the measurement. The line frequency and / or speed detection runs first if needed.

The duration of one reading can vary from about one second to a few tens of seconds. It depends on measured motor properties. A count down bar is displayed in status bar for longer measurements.

MCSA
3s/16s

221

The measurement is automatically stopped when finished, or you can interrupt it by pushing the *Escape* button.

MCSA Screen
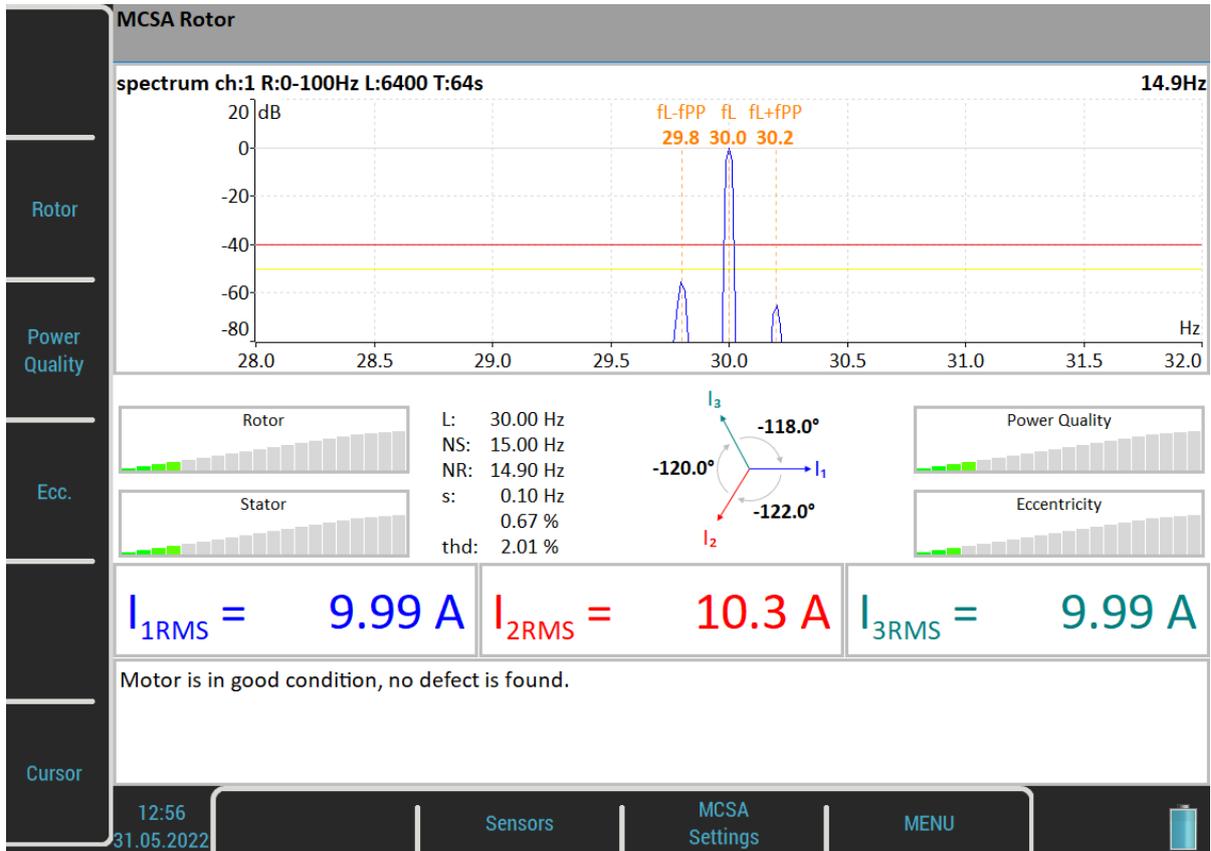
You can switch the displayed spectrum by pressing *Rotor*, *Power Quality* or the *Ecc.* button. The current choice is written to the status bar as "*MCSA Rotor*" and so on.

By pressing the *Cursor* button, you may turn a cursor in spectra on or off. You can use the cursor to explore the spectrum like in the analyzer module.

The *Sensors* button opens the Sensors menu. This is the default shortcut which can be changed.

The *MCSA Settings* button opens the MCSA menu.

The *MENU* button opens the main global menu.

The screen contains several indicators. Let's discuss them.

Rotor spectrum

It's displayed by default. Push the *Rotor* button to display it again when another spectrum had been chosen.
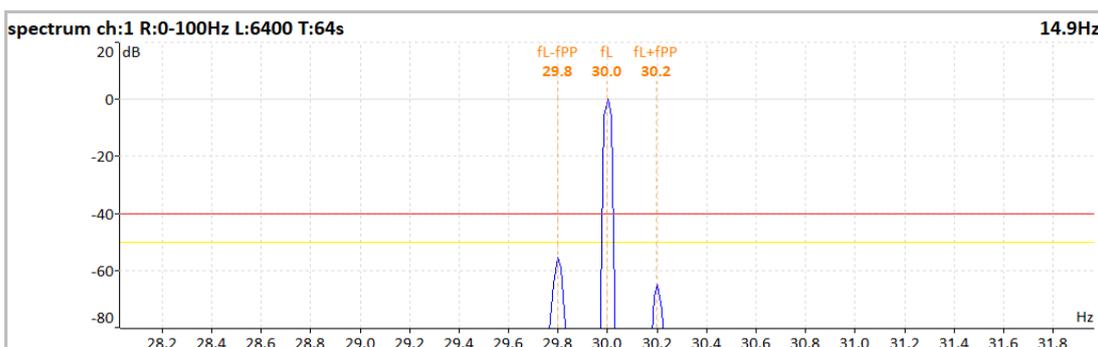
It is a frequency spectrum around line frequency. The spectrum is displayed in dB with line frequency as a reference value.

Three frequencies are marked:
fL means line frequency.
fL +/ – fPP means pole pass sideband around the line frequency.

Two limits are marked:
- **-50 dB** for warning
- **-40 db** for danger

There is a simple rule. If the difference between the main and the sideband components is greater than 50dB, a rotor has no faults. When the difference ranges between 40 and 50 dB there is probably one bar broken. With the difference greater than 50 dB, there are several broken bars or a broken end ring (as mentioned in *Brief Review of Motor Current Signature Analysis* statement by Dubravko Miljković, Croatia).

Power quality spectrum

Push the *Power Quality* button to display it.
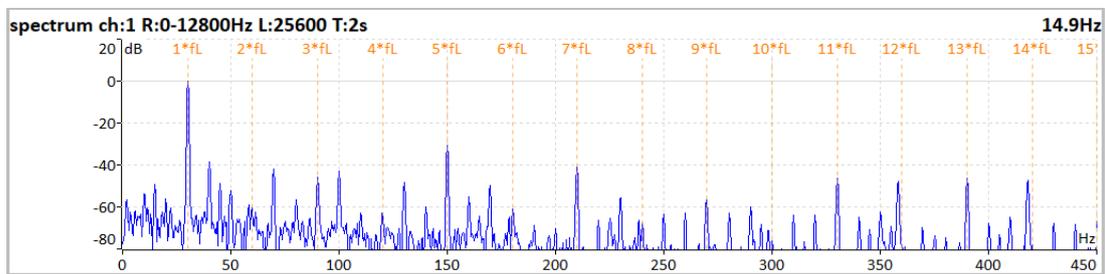
Line frequency harmonics are marked in this spectrum.

Eccentricity spectrum

Push the *Ecc*. button to display it.
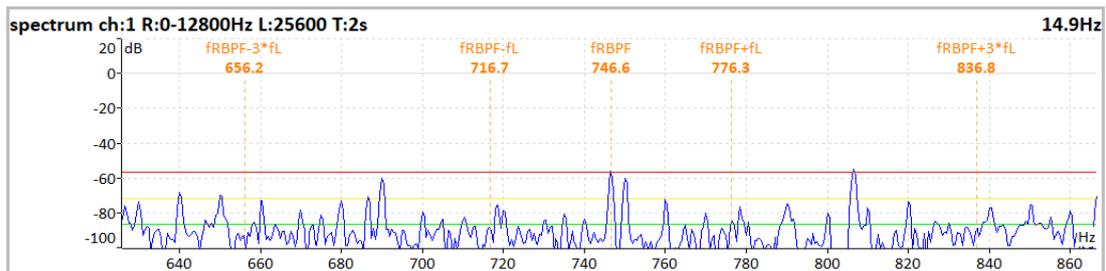
Eccentricity characteristic frequencies are marked in this spectrum. That means the *rotor bar pass frequency* (*fRBPF*) and its odd sidebands (*fRBPF +/- fL* and *fRBPF +/- 3fL*). Limits for eccentricity detection are also marked. fRBPF = speed frequency * number of rotor bars

Severity bars
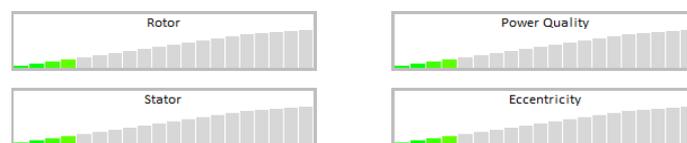
Each horizontal bar displays the severity of the individual item. It starts from green color on the left to the red on the right.

Rotor severity is detected from the values on pole pass sidebands.

Stator severity is detected from the difference between 3 current values.

Power Quality is detected from total harmonic distortion of the current signal.

Eccentricity is detected from values on Eccentricity characteristic frequencies.

Phasor diagram
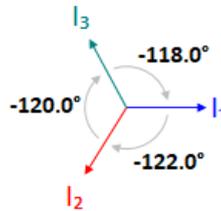
You can check phase shifts among phases. Furthermore, direction of arrows in the phasor diagram corresponds to the direction of rotation of a motor, whether it is clockwise or counter clockwise.

Frequency table and thd

L:	30.00 Hz
NS:	15.00 Hz
NR:	14.90 Hz
s:	0.10 Hz
	0.67 %
thd:	2.01 %

- **L** line frequency
- **NS** synchronous speed
- **NR** rotor speed
- **s** slip
- **thd** total harmonic distortion of power supply signal

Current values

$I_{1RMS} =$ 9.99 A $I_{2RMS} =$ 10.3 A $I_{3RMS} =$ 9.99 A

Current RMS values of all phases are displayed.

Information window

Motor is in good condition, no defect is found.

All detected faults are summarized here in text form. The displayed message describes severity bars states and brings some additional information.
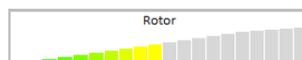
Attention! There is probably a resistance change in the rotor winding. Rotor bars or rings could be broken.

Danger! Rotor bars are broken.
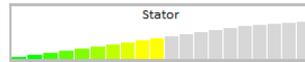
Attention! A stator winding probably has a current imbalance. This fault could be caused by a change of winding resistance.
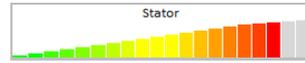
Danger! There are probably shorted turns in the stator winding. Another short circuit is possible.

Attention! Phase currents include harmonics. They are probably caused by drive influencing or electromagnetic asymmetry in motor.

Danger! Phase currents include harmonics. They are probably caused by drive influencing or electromagnetic asymmetry in motor.

Attention! A motor air gap could be variable. It is caused by eccentric rotor.
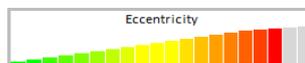
Danger! A motor air gap is variable. It is caused by eccentric rotor.

Errors and warnings

Unstable line frequency or speed

MCSA analysis may be influenced by unstable line frequency or speed. If one of these values varies, you'll be informed by a notification text above right severity bar.

In addition, a message box appears after the measurement completes.

High speed

When the speed is too close to the synchronous speed, that means slip approaches zero and the "*High Speed*" error is thrown. In this case, rotor faults cannot be detected.

One phase measurement

MCSA Rotor

spectrum ch:1 R:0-100Hz L:6400 T:64s   14.9Hz

Rotor	L: 30.00 Hz
Stator	NS: 15.00 Hz
undef	NR: 14.90 Hz
	s: 0.10 Hz
	0.67 %
	thd: 2.01 %

Power Quality

Eccentricity

$I_{1RMS} =$ 9.99 A $I_{2RMS} =$ - A $I_{3RMS} =$ - A

Motor is in good condition, no defect is found.

13:11
31.05.2022   Sensors   MCSA Settings   MENU
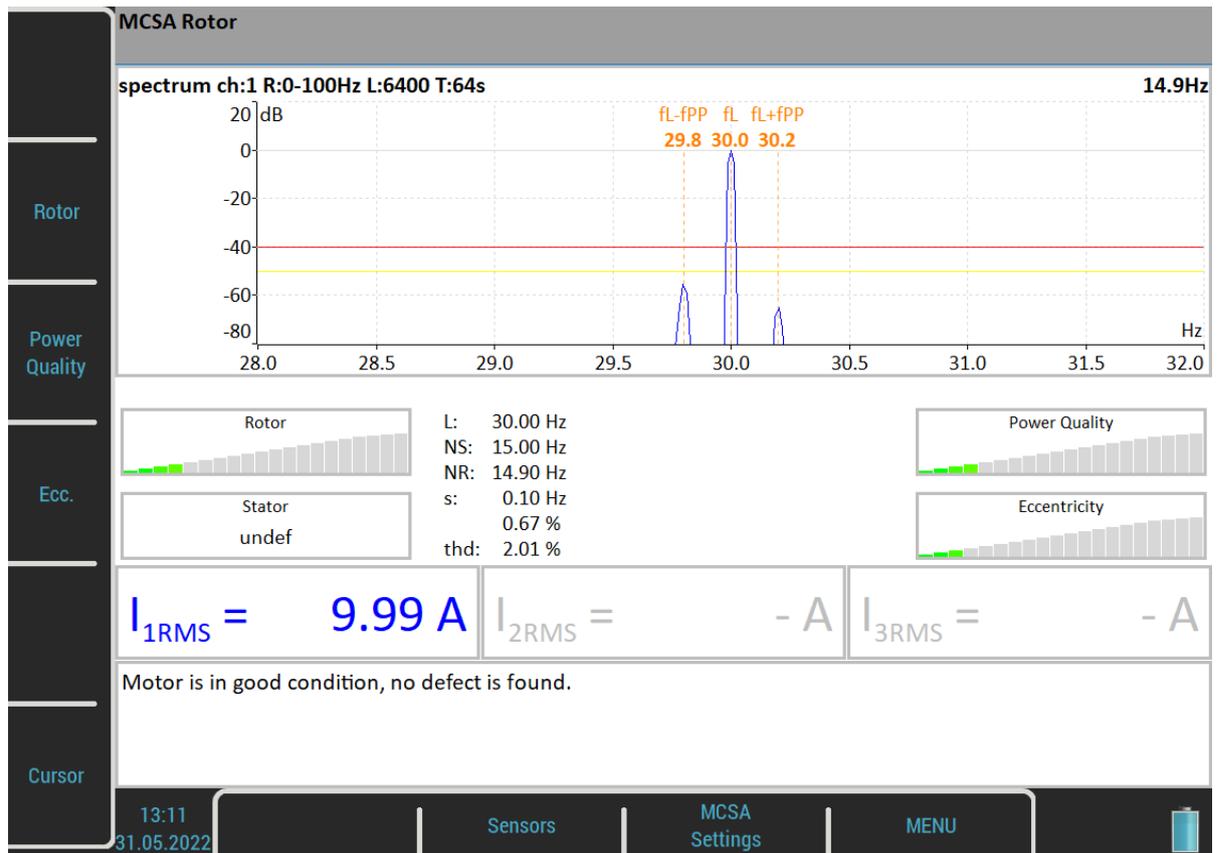
In case you use one phase measurement, some indicators are not available. The stator severity is not defined. Of course, phasor diagram and current values are missing.

A4404 – SAB and Virtual Unit

Virtual Unit is the same software as the one used in ***VA5*** vibration analyzer. You can use the Virtual Unit in demo mode and see the VA5 instrument working environment. In other words, you can download and install the Virtual Unit free of charge and see all the measurement capabilities of the instrument.

You can also use the Virtual Unit to post process your records from a real instrument.

Furthermore, the Virtual Unit is designed for measurement with the ***A4404 – SAB***.

Installation

A4404 – SAB Drivers Installation

Connect the SAB to a computer via USB cable which is a part of SAB accessories. The drivers should be installed automatically from the internet. In case you have no internet connection or some problem occurs, follow these instructions:
1. Download a driver file from https://adash.com/downloads/third-parties-software or from the supplied SAB installation flash drive.
2. Uncompress the file anywhere on your computer (for example, *C:\A4404*).
3. Connect the A4404 – SAB to your PC via USB cable.
4. The "*Add Hardware Wizard*" window should open when drivers are not found on your PC. Follow the wizard instructions.
5. Select "*Install from a list or specific location*" and click the *Next* button.
6. Check "*Include this location in the search*".
7. Click the *Browse* button and select the folder where you uncompressed the driver.
8. Click the *Next* button and wait for the installation to complete.
9. You may delete the downloaded file and folder with the uncompressed driver (not required).

Virtual Unit Installation

Download Virtual Unit from the Adash website http://www.adash.com/downloads/adash-software or from SAB installation flash drive. Run the file and follow the installation wizard instructions. You'll be asked to enter the installation destination path (the default value is *C:\Program Files (x86)\Adash\Virtual Unit*) and the path for working folder where all data of the application will be stored (the default value is *C:\ProgramData\Virtual Unit*). In this folder, two subfolders will be created after the first run, ***data*** and ***VA5_DISC***. The data folder is equivalent to the instrument's internal disk and the *VA5_DISC* folder is equivalent to the instrument's flash drive (see General Information / Connection to the computer).

Note! You don't need to export routes nor other projects to the *VA5_DISC* in the Virtual Unit. DDS can find them directly in the data folder.

License file

Each A4404 – SAB device is supplied with a unique license file. The Virtual Unit needs the license file ***adashx123456.a44*** in order to control the A4404 – SAB (the 123456 is the serial number of A4404). Copy this file from the supplied flash drive into the working folder ***data\VA4licence*** folder.

Update
To update the software, just run the installation file with the newer version. The old version will be replaced. The application data will not be lost.

Operation
If you want to use the A4404 – SAB, plug it before you launch the Virtual Unit application. The computer with the connected SAB and running Virtual Unit then behaves like a VA5 instrument.

Live signal is measured only with the A4404 – SAB. It's possible to post process records without this device. Virtual Unit installation contains one record (*Default Rec*) for demonstration. You can download more Records here: http://adash.com/download/Records.zip. You can also post process your own records from the instrument.

VA5 Virtual unit and VA5 Pro connection

How to share projects between the instrument and the Virtual Unit will be described in this chapter.
Connect the instrument to a computer via USB cable. The instrument will be found as the *VA5_DISC* (removable disk) on your system. It's possible to copy the data between Virtual Unit's working folder and the instrument's *VA5_DISC*.

Copying projects into the instrument

Copy the *data\VA4analyser\ProjectName* project folder from Virtual Unit's working folder into the *VA4analyser* folder on the instrument's *VA5_DISC*. Attention! The *VA5_DISC* is the real removable storage device here, NOT the Virtual Unit's folder! You have to create an **empty file** with the name ***script.dds*** in the project folder on the instrument's *VA5_DISC*. This ensures importing of the project into the instrument's internal disk after entering the Analyzer module. The same file is created by DDS.
Runup (*VA4runup* folder), Route (*VA4route* folder), and Octave Analysis (*VA4octave* folder) projects are copied the same way.

Example:
You've got a route called *Power Station* in Virtual Unit and you want to have it in a real instrument as well.
1. Connect the instrument with the computer via USB cable. The instrument must be turned off or on the main screen.
2. A new USB drive called *VA5_DISC* appears among the computer's disks.
3. Open the *VA4route* folder on VA5_DISC.
4. Open the *data\Va4route* folder in the Virtual Unit's working folder. Find the *Power Station* folder in this folder.
5. Copy the *Power Station* folder to the VA4route folder on the *VA5_DISC*.
6. Create an empty file named ***script.dds*** in *VA4route\Power Station* on *VA5_DISC*.
7. Enter the Route module in the instrument.
8. The *Power station* route will be automatically imported and shown in the project list.

Projects and records copy from the instrument

Attention! Projects have to be exported to the *VA5_DISC* first, just like an export for DDS.

Copy the *VA4analyzer\ProjectName* folder from the instrument's *VA5_DISC* folder into the Virtual Unit's working folder. In this case, you don't need to create the *script.dds* file as in copying into an instrument.
Runup (*VA4runup* folder), Route (*VA4route* folder), Octave Analysis (*VA4octave* folder), Balancer (*VA4balancer* folder), and Recorder (*VA4recorder* folder) are copied the same way.

Example:
You've got a route called *Power Station* in the instrument and you want to have it in Virtual Unit as well.
1. Open the *data\Va4route* folder in the Virtual Unit's working folder.
2. Open the Route module in the instrument.
3. Select the *Power Station* route.
4. Export the route to the *VA5_DISC* using the *Route / Export* menu item.
5. Connect the instrument with the computer via USB cable.
6. New USB drive called *VA5_DISC* appears among the computer's disks.
7. Open the *VA4route* folder on the *VA5_DISC*. Find the *Power Station* folder in this folder.
8. Copy the *Power Station* folder from the *data\Va4route* folder in the Virtual Unit's working folder.
9. Open the Route module in the Virtual Unit. The *Power Station* route is in the list with other routes.

Import wav into Virtual Unit

The **Analyzer** module (or any other module) can use a wav file as **Signal Source**. Place your wav file into the data/wav directory of your Virtual Unit – by default it is this location **C:\ProgramData\Virtual Unit\data** (it depends which folder you selected during installation). If there is no **Wav folder** in the data folder, create it.

Note! The wav file must have PCM, 16 bit or PCM, 24 bit encoding. It must also have a sampling frequency which Adash instruments can process (powers of 2 up to 65536 Hz, and 196608 Hz). If the wav file does not meet these conditions, it must first be modified in a 3rd party software (e.g., Audacity).

To use the imported wav file as a signal source, go to **Menu** – **Signal Source** and choose it.

Appendix A: Technical Specification

Inputs

Dynamic Channels (AC)

Number of synchronous parallel channels (AC):	4 AC
Frequency range (-3dB):	0.35 - max 90000 Hz
	(196 kHz sampling frequency)
Input range:	+/- 12V (only one range, no gains)
Measurement timing:	fully synchronous
A/D Resolution:	24 bit input, 64 bit double floating point internal precision
	(no gain procedures used!)
Dynamic range:	120 dB
Channel configuration:	voltage or ICP (individually for every channel)
Input protection:	up to 30 V
Input impedance:	100 kOhm
Input type:	acceleration, velocity, displacement, any non-vibration AC voltage
Integration:	single, double fully digital integration
2D Processing:	axis rotation according to sensor mounting
Accuracy:	< 0.5 %
ICP drive:	18 V, 3.8 mA
User HP filtering:	0.35Hz - 12800 Hz
User LP filtering:	25Hz - 90000 Hz
Connector:	ODU

Tacho / External Channel

Number:	1 independent tacho input
Speed range:	0.01Hz - 1000 Hz
Input impedance:	80 kOhm
Input type:	voltage
Input range:	+ 10V (only one range, no gains)
	or +/-30V (tacho / external signal + DC) with optional tacho signal converter
Accuracy:	<0.5 %
Trigger level:	0.1 -9.9 V, user defined
Input protection:	up to 48 V
Connector:	ODU

Static Channels (DC or 4-20mA)

Number:	4 DC or 4-20mA (has to be specified in order)
Input range:	+/- 24 V or 4-20mA
Input impedance:	100kOhm (V-DC), 250 Ohm (4-20mA-DC)
A/D Resolution:	12 bit input
Accuracy:	0.1% fsd
Input protection:	up to 30 V

Measurement Functions

Data Analysis Speed:	0.1 sec for 25600 lines FFT spectrum
Amplitude Units:	Metric, Imperial (English), or user programmable
Frequency Units:	Hz, CPS, RPM, CPM, Orders
Amplitude scale:	Acceleration, Velocity, Displacement, User defined
Scaling:	Linear or Log, both X and Y axes
Cursor:	Single, Harmonics, Sidebands
Triggering:	free run
	tacho
	amplitude (positive or negative)

ADASH   VA5 Pro
                                                                external (voltage)
Signal Range: full, No Auto ranging
Data acquisition: TRUE RMS, TRUE PEAK, TRUE PEAK-PEAK, overall, or band values
                          user defined high, low, and band pass filters for band measurement
                                              time waveforms (8 388 608 samples max)
                                                                     real-time FFT
                                                     3D graphs (waterfall, cascade)
                                                                    order analysis
                                       Amplitude + phase values on speed frequency
                                                               speed measurement
                                               process static DC or 4-20mA values
                                                            Envelope demodulation
                              ACMT procedure for low-speed machines bearings
Time waveform samples: 256 – 8 388 608
Waveform (ACMT) length: max 131 072 sec (36 hours)
Spectrum ranges: 25 – 90 000 Hz
Spectrum lines: 100 – 3 276 800
Spectrum peaks listing: yes
Spectrum units: RMS, 0-P and P-P
Windows: Rectangular, Hanning, Exponential, Transient, Flat top
Order analysis parameters: 1/2 - 10th order
Averaging: 1-255
Overlap: yes
Smax, Gap, and Centerline displays for proximity sensors: yes

Recording:

Sampling frequency: user defined in the range 64Hz - 196 kHz
Record length example:
          3 GB for 1 hour record with 64kHz sampling (4ch AC+4ch DC+1ch tacho / external signal)
                          (100GB memory enables over 30 hours of full 64kHz recording,
                              a lower sampling frequency enables a much longer record))

Balancing:

Planes: 1 or 2
Speed range: 0,5 Hz - 1000 Hz
Balancing Advisor for automatic fault detection: yes
Balancing Quality factor according to ISO21940:   yes
Balancing vector graph for balancing process reporting: yes
Balancing Report: yes
Trim function: yes
Vector split (for example, to blades positions):   yes
Manual entry: yes
Intuitive graphic user interface: yes
Trial mass: get out or leave in

Camera:

Resolution: 5 mpx, 2592 x 1944 px
Focus: auto

IR camera:

Resolution: 384 x 288 px
Temperature Range: -10℃ ~ 250℃ (-10℃ ~ 150℃)
Lens: 6.8mm F 1.3
NETD: < 50mK

Wireless sensor:

Acceleration sensor for X, Y direction

Range maximum:	± 16 g
Frequency band:	0 ÷ 6.4 kHz
Noise level:	up to 75 µg/√Hz for ± 2 g range

Acceleration sensor for Z direction

Range maximum:	± 50 g
Frequency band:	0 ÷ 15 kHz
Noise level:	up to 25 µg/√Hz for ± 50 g range

Wireless communication interface

Standard:	IEEE 802.11 b/g/n Wi-Fi, WPA2
Frequency range:	2.4 to 2.4835 GHz
Transmit power:	19.5 dBm@11b, 16.5 dBm@11g, 15.5 dBm@11n

Working and storage conditions

Range:	up to 15 meters
Battery life in standby:	8 hours
Battery life while measuring:	3 hours
Temperature (Li-Ion battery):	-10 to +70°C
Humidity:	10 – 100% RH
Degree of protection:	IP67, dustproof housing, resistant to immersion in water

Dimensions and weight

|	
Dimension:	40 x 42 x 27 mm (SxWxG)
Weight:	110 g

General:

Processor:	Atom 1.9 GHz
RAM:	2 GB
Display:	LCD color 191 x 134 mm (9.1" diagonal), 1140x800 resolution
Memory (Internal SSD):	64 GB
Memory (VA5_DISC flash):	16 GB
Interface:	USB
Powering:	Li-Ion long life battery (more than 8 hours of measurement)
Li-Ion long battery remark:	

Because all of our batteries are defined as "articles", they are exempt from the requirements of the Hazard Communication Standard, hence a MSDS is not required.

|	
Operating temperature:	-10 °C - +50 °C, 15°F-120°F
EMC:	CE tested
Dimensions:	280 x 205 x 55 mm
Weight:	2.2 kg
Electromagnetic Compatibility (EMC):	ČSN EN IEC 61326-1:2022

Appendix B : Phase measurement conventions

Single channel measurement with tacho

Let's assume a time signal defined as y=cos(ωt). We use the cosine function because FFT uses it too. It simplifies the calculations and understanding.
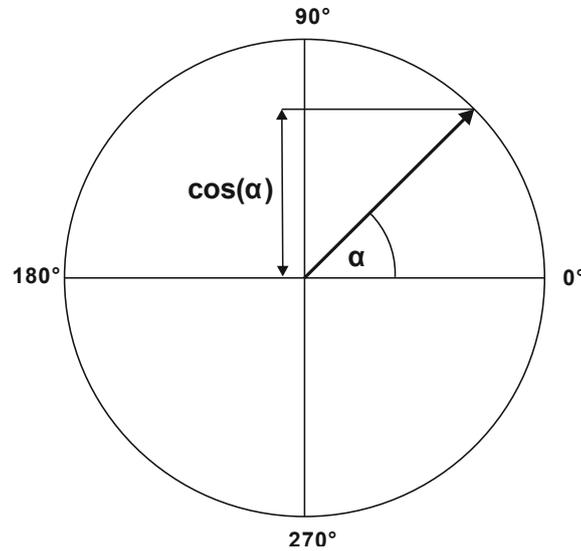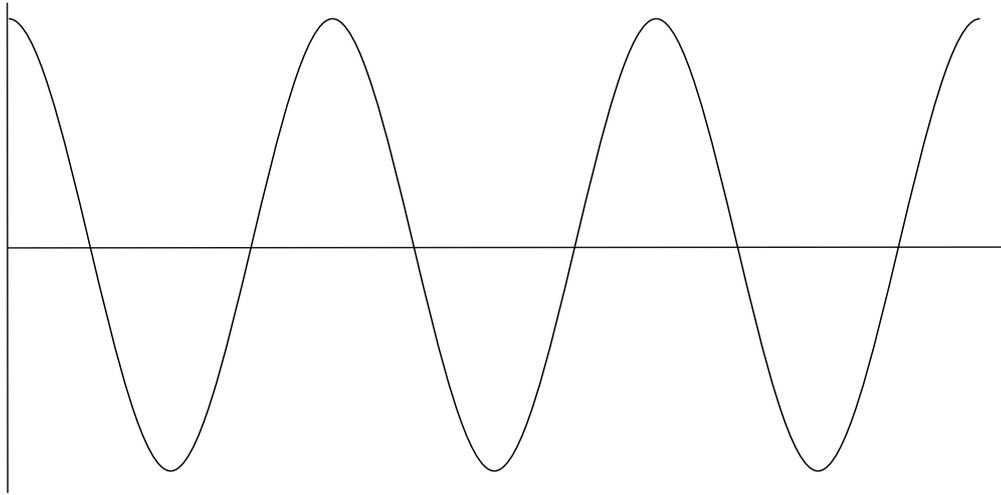

Our starting position of a rotating vector V will be 90°. We will mark it as T0.
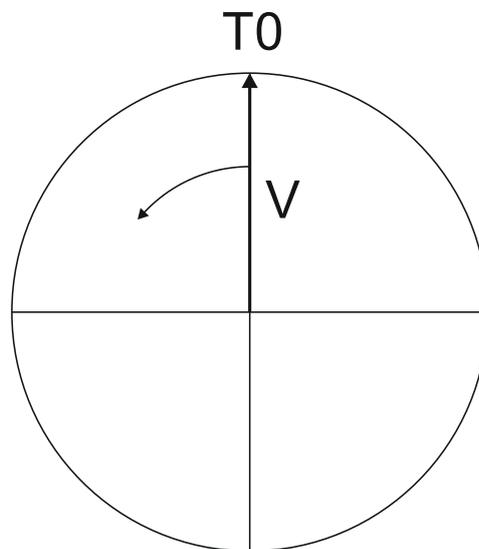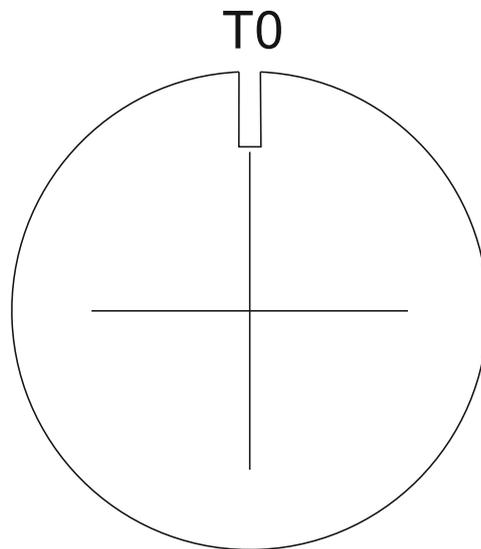

When the vector V rotates, for example, 3 times, then we get the time signal as follows.
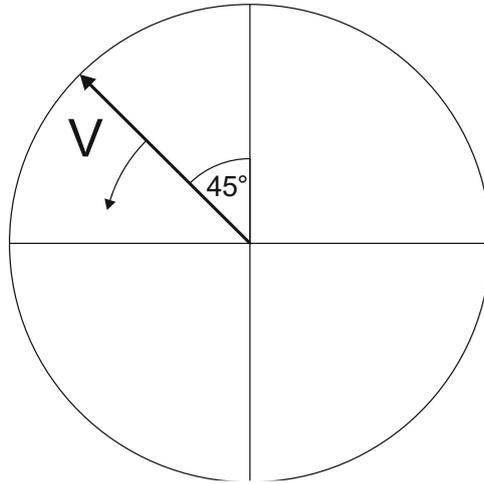
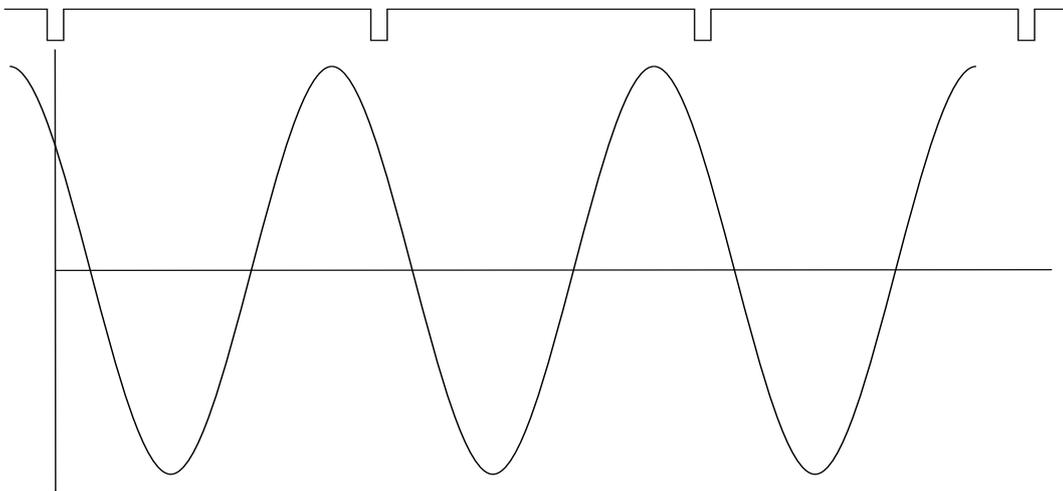Now we assume the tacho signal. We put the tacho pulse to the T0 position.

The corresponding time signal with tacho pulses is on the following picture.

Now, we begin to assume the phase shift (marked as φ) of the time signal vs. the tacho signal. The signal formula changes to y=cos(ωt + φ). The previous picture corresponds to φ=0°, and this value is displayed on the instrument screen. When the tacho pulses are in the maximum time signal positions, then the phase value is equal to zero.

Now, assume the φ=45°. We use the degrees unit to make it simple for all readers. Radians have to be used for an exact math formula.
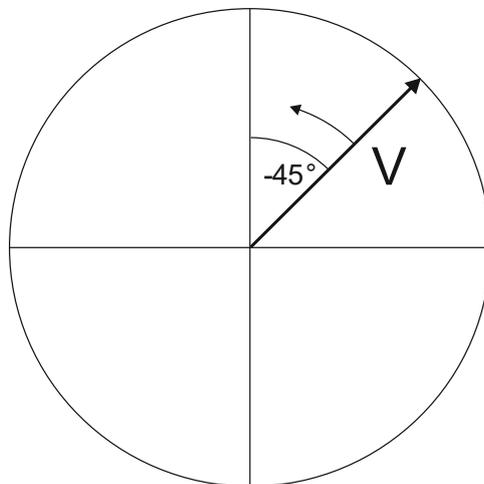
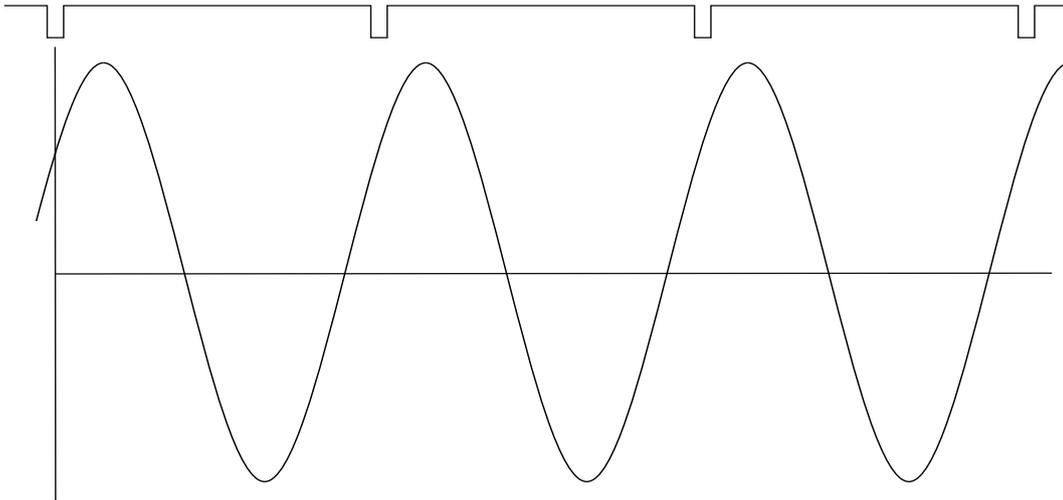The corresponding time signal with tacho pulses is in the next picture.

The time signal gets ahead of the tacho signal by 45°. A 45° value appears on the instrument screen in this case.

Now we assume the φ=-45°.

The corresponding time signal is in the next picture.

The time signal is delayed. A -45° value appears on the instrument screen in this case.

This approach is used for single channel measurement as amp+phase and orders.

Dual channel measurement

We must always define the channels of A and B. For example, we use channel 1 as A and channel 2 as B. You always have to assign the channel numbers of A and B. The A represents the input channel and B the output channel. You can imagine it as a black box and you need to measure the phase response of that.

For example, you can see this on the display:

The logic is the same as for a single channel measurement. The A has the same function as a tacho signal. This 60° means that B is ahead of the A by 60°.

This approach is used for double channel measurements as phase shift and frf.

Last reminder

We talk about time signals and their positions in time in this chapter. We have used words such as "the signal is ahead" and on the other side that "the signal is delayed".

You should always keep in mind:
To be ahead of, for example, by 60° is the same as to be delayed by 300°. Don't forget that we are working with periodic pure cosine time waveform.

Appendix C: Symbols and Abbreviations

Inputs

AC1 – AC4	alternating current signal, channel 1 – 4
DC1 – DC4	direct current signal, channel 1 – 4

Abbreviations in Graphs

ch	channel, input
NS	number of samples
R	number of revolutions
L	number of lines
B	frequency band
R	frequency range
FS, fs	sampling frequency
Y	y value on cursor's position
t	cursor position on the time axis
f	cursor position on the frequency axis
df	frequency resolution (delta)
A	A value on the cursor's position (orbit, center line)
B	B value on the cursor's position (orbit, center line)
A	amplitude value on the cursor's position (spectrum, frf)
P	phase value on the cursor's position
Coh	coherence value on the cursor's position
Re	real value on the cursor's position
lm	imag value on the cursor's position
X	value calculated from signals A and B to axis X (orbit, center line)
Y	value calculated from signals A and B to axis Y (orbit, center line)
S	speed value
D	difference value
d	delta cursor length
b	value of the band bounded by delta cursor in spectrum
tot	value of the whole band in spectrum
RMS, 0P	rms and 0P value in the time signal bounded by delta cursor
totRMS, tot0P	rms and 0P value in the whole time signal

 HYPERLINK \l "_toc2720"