



# USER MANUAL

## A4400 VA4 Pro

## A4404 SAB with Virtual Unit



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## **Before you begin read this manual**

The VA4 Pro device is continuously developed and new functions and features are added quite often. Such additions also require changes in manual and that changes can be very time expensive. That is why we do not change all pictures in the manual so that are related to the latest version. Some pictures (which are usually only backgrounds) remain in the manual although they were changed already. Certainly it is acceptable only on places, where such background has no consequences.

## **A4400 VA4 Pro vs. A4404 SAB**

Both of these units are described in this user manual. This chapter should clear up the difference between A4400 VA4 Pro vibration analyzer and A4404 SAB vibration analyzer.

### **A4400 VA4 Pro**

A4400 VA4 Pro is a portable vibration analyzer which is based on unique Digital Signal Processing board (DSP) developed by Adash.



A4400 VA4 Pro analyzer

### **A4404 SAB (Signal Analyzer Box)**

A4404 SAB is a pocket size vibration analyzer which contains input connectors for sensors. It does not contain keyboard and screen. It must be used with computer. It uses the same DSP board as VA4 Pro analyzer. You need to install the A4410 Virtual Unit software on your computer and then you can use all functions which are available in VA4 Pro analyzer. The software is free. It enables you to test all VA4 features before you will buy it. See the website for details.



### **Graph control by mouse**

A4410 Virtual Unit runs on PC. Therefore you control graphs by mouse.

#### **Graph selection**

Left button click

#### **Cursor Move**

Left button click on signal. Both X and Y coordinates are used, it means you should click to signal line.

#### **Maximalization / Minimalization**

Left button double click

#### **Zoom**

Mouse wheel

When the mouse cursor takes place bellow (or slightly above) the x axe, only the x axe is zoomed.

When the mouse cursor takes place to the left from the y axe, only the y axe is zoomed.

## *ADASH*

*Adash 4400 – VA4Pro*

When the mouse cursor takes place in the inner area of the graph, both the x and the y axes are zoomed.

## **Signal Move**

Move mouse with the left button pressed

## **Before Switching On**

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

### **General warnings**

Never connect higher than 30 V to the Analyzer !

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

If the 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  $\pm 18$  V (peak) can damage the instrument.

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

Always use only original cables designed for connection with sensor.

Long push and hold of POWER button evokes incorrect instrument switching off. Data could be lost.

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

### **PC USB connection warning**

Switch off the A4400 instrument when you connect/disconnect it to/from computer by USB cable.

## **Battery charging**

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

The unit uses Li-ION (LiION) batteries. This type of battery should not be discharged completely. If the battery is discharged below certain Voltage, we call it deep discharging. The deep discharging shortens battery life. The charging of deeply discharged battery takes much longer.

If the unit is not charged for longer period of time, then the deep discharge can occur. It is caused by self-discharging of the battery. Another cause of deep discharge can be a situation when the unit is switched to the SLEEP mode by the Power Off button (instead of switching off the unit).

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 light eventually.

To avoid deep discharge of the unit, charge the unit 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 UNIT/ WHEN THE UNIT CANNOT BE CHARGED NORMALLY:**

- **Discharged battery** – battery needs to be charged (charging for approximately 3 hours), the unit can be switched on normally with the charger connected
- **Deeply discharged battery**, when the unit wasn't charged for longer period of time – the unit needs to be charged completely until the indicator on the charger starts light green. It can take more than 12 hours. The indicator on the charger does not light from the beginning of charging process. Sometimes it is not possible to switch on the unit even with the charger connected.
- **Damaged charger** – when the charger is connected, the indicator should start to light (green or orange color), only with deep discharge the indicator does not light immediately.
- **Sudden decrease of battery life** – the unit needs to be charged and discharged completely few times (usually 2-5 times). The battery lifetime should increase this way.

## General information

### **The upper panel**

Version A4400 VA4 Pro II (from January 2018)



Older version A4400 VA4 Pro



### **The switching-on**

The power button is in bottom right corner of the front panel. Two LEDs are in the upper right corner. The left indicates switch on, the right indicates charging. Press the button for a few seconds until the left LED begins to light. Firstly it blinks red for a while, then it lights green.



The older version has power button on upper panel. The green LED is in the upper right corner of the front panel. Press the button and the LED lights on.



## The switch off

The switching off can be done by:

- **Power Off** button on the main screen,
- in the **Global** menu is the **Power Off** item available.



**Warning!** The general power button (intended for the switching on) doesn't turn the unit off. It switches the unit into a sleep mode!

## The Sleep mode

Use the power button (described in "The switching on" chapter) to switch the instrument into a sleep mode. The screen is off and power consumption is lower in the sleep mode. Use the same power button to wake up the unit again.

## Auto switch off

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

## The emergency switch off

This is not correct method to switch off the instrument. Using it can cause data corruption. Use this method only in case of emergency (eg. when the system freezes).

Push and hold the **POWER** button for about 5 seconds. Instrument will switch off.

## Disc free capacity warning

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

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

## Connection to the computer

### VA4\_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 a flash memory (**VA4\_DISC**), which is accessible from external computer. The **VA4\_DISC** is an interface for user's data. For example, you save a route project from DDS to the **VA4\_DISC**, the instrument stores it automatically to its hard disk, then you work with the route (make some measurements, look at data) and eventually export the modified route back to the **VA4\_DISC**, from where you can access it from external computer. You don't need to export all data from internal hard disk. Export only the data which you want to access from 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 computer and instrument (more precisely **VA4\_DISC**) use the USB cable which is the standard accessory of VA4 set. Connect the small plug to the USB socket (see the image above). Connect second plug to the computer.



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



Until you are not on main screen, the VA4\_DISC remains to be connected to the instrument processor and you cannot see it on your PC. The real connection with 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 (for VA4 II only)***

Sometimes you may need higher capacity interface disk than the VA4\_DISC (16GB for VA4 II). You can connect any external disk via USB. In order that the instrument is 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 USB socket then connect the **VAx\_DISC** to the OTG's socket. When **VAx\_DISC** is connected the instrument prefers it rather than **VA4\_DISC**.

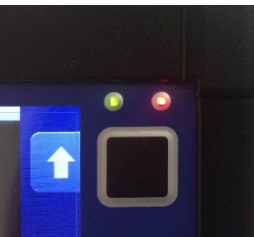
**Note:** The OTG cable is not a standard accessory of VA4 set.



### ***The charging***

The **POWER** socket for external charger is on the top panel. Indicating LED diode is in upper right corner of front panel. The LED lights red during charging and lights green when fully charged.

**Note.** Two LEDs are in upper right corner. The left one for switching on and the right one for charging.



The older version has the socket for external charger on the upper panel above the POWER button. The **BAT** LED on the upper panel lights orange during charging. When the battery is fully charged, it lights green.

### ***The DSP board - monitoring and reset***

The DSP board is the most important part of the instrument. The special chip provides all necessary operations, which are required for achieving of 4 channel synchronous data.

The STAT LED is on the top panel and enables to monitor the DSP board. Several states can appear:

- Green with 0.25sec time interval (4Hz, four times per sec) - the measurement is running.
- Green with 1 sec time interval - STANDBY, the measurement is not running.
- Red - the DSP board does not work properly. Turn the instrument off and on.

The older version enables different procedure. When the red STAT occurs, do the reset of DSP board. Do not switch-off the instrument. Use the slim not sharp thing (e.g. paper clip) and push the button, which is hidden in the **RST** hole.

Next LED is near each input connector:

- green – OK
- no light – no measurement is taken in this input
- red – error (usually ICP error).

Note: During the measurement are functional only LEDs for inputs used for measurement (e.g. red LED ends the lighting during the measurement and starts again after it).

### ***Virtual Analyzers Data Processing***

When older Analyzers would take more measurements, they took them step by step. If the user wanted e.g. acceleration overall, velocity overall, velocity time signal and velocity spectrum from one sensor, then the Analyzers took first overall, then second overall with integration, then time signal and finally spectrum. The time which was required for all 4 measurements was the sum of 4 individual times.

The instrument includes high speed chips and it uses the much more advanced concept. For every individual measurement is created one virtual Analyzer in the instrument memory. All virtual Analyzers read data from input DSP board and perform required data acquisition.

What does it mean? It means, that the total required time is not equal the sum of all individual times, but it is equal the time required for the longest measurement.

### ***Run the instrument on your computer***

The A4410 Virtual Unit you can download from the producer's website. Install it on your PC. Now you can easy try to work with all functions in your computer. Do not forget define the record as signal source. You can also download the next records from that website. See the A4410 Virtual Unit chapter for more details.

## How to work with Menu

For the taking of measurements you have to define many parameters. All those definitions are providing by menu items. The procedure for operation with all menu items is the same. We describe it on example - the sensor properties definition.

### Item selection

The sensor properties first menu appears after you push the **Sensors** button.

<b>AC 1</b>
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

Use the arrow buttons for one item selection, e.g. **AC2**. Then push **OK** button. The second menu appears.

<b>ICP:</b>	<b>on</b>
Sensitivity[mV/g]:	100
Unit:	g
Position[°]:	undef
ISO Machine Group:	undef
Bearing Type:	undef
<b>Save</b>	

Again use the arrow button for one item selection. Then push the right arrow button to display possible parameters of selected item. E.g. for Sensitivity you see this picture:

ICP:	on	
<b>Sensitivity[mV/g]:</b>	<b>100</b>	1
Unit:	g	10
Position[°]:	undef	<b>100</b>
ISO Machine Group:	undef	user
Bearing Type:	undef	
<b>Save</b>		

### User defined values

Again use the arrow button for one sensitivity selection (**1,10,100**). In most of cases you want to enter the **user** sensitivity according to the real sensor sensitivity of your sensor (e.g. 96,8 mV/g). Select the **user** and push **OK**. The next window appears and the buttons get the numerical values entry functions.



Use the buttons and enter required value (e.g.45). If you need to edit the value, push the **Shift** button. The buttons change the functions of buttons.



Now you can move the cursor, to use the **Delete** function. Press the **Shift** again and the buttons functions change back. When the value is correct, push **OK**. The menu with new value appears.

ICP:	on
<b>Sensitivity[mV/g]:</b>	<b>45</b>
Unit:	g
Position[°]:	undef
ISO Machine Group:	undef
Bearing Type:	undef
<b>Save</b>	

Use the arrows and select the **Save** item. Press the **OK** button and the working with sensors menu will close. Also you can use the **Save** button with the same function. When the **Cancel** button is used, then nothing is saved.

As we mentioned the value entry, also the text 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 second character selection you must press the button two times.

### Multi-selection of items

Sometimes you could need to work with more than one item together. The usual example is the deleting of more items in one step.

The left bottom button **Multi on** enables to select more items at once. Press the **Multi on** button. When you move in the list by arrows, the items remain selected (red color) or unselected (black color). Press the same button (now the **Multi off**) again for ending of multi-selection.

Meas_Point_A	S
Orda	S
Plant_W	L2
<b>Point_DC</b>	S
Pump_P	L1

Example of multi-selected items. It needs a short time to play with and to find the right understanding of this feature. The item with the cursor (the full blue field) can be selected or unselected too. The standard yellow color means unselecting and the red color means selecting.

### Searching of item

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

## Input channels

All input sockets are in the top panel. The versions older than 0200 had only 3 sockets in the panel.

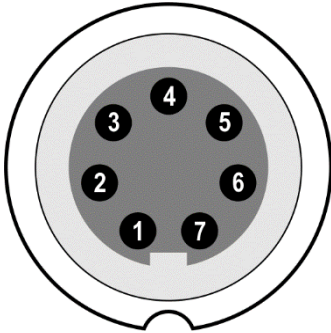


Top panel of A4400 Va4 Pro II (from 2018).

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

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

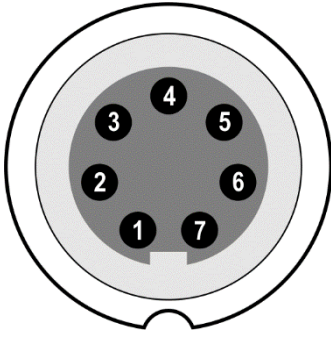
### **IN1 socket**



- 1 – CH1 AC INPUT
- 2 – GROUND
- 3 – +20V DC OUTPUT (max 10mA) for eventual sensor powering
- 4 – SHIELDING
- 5 – NOT USED
- 6 – CH1 DC INPUT
- 7 – +5 V DC OUTPUT (max 50 mA) for ultrasound sensor powering

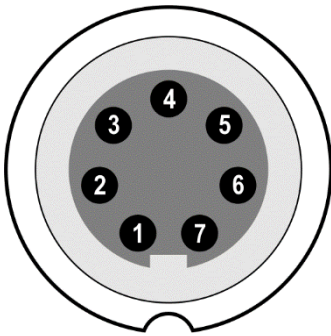
**Warning!** Pin 7 of IN1 socket (ultrasound sensor powering) is internally connected with pin 4 of TRIG socket (tacho sensor powering).



**IN2 socket**

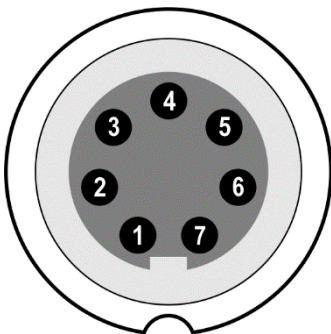
- 1 – CH2 AC INPUT
- 2 – GROUND
- 3 – CH1 AC INPUT
- 4 – SHIELDING
- 5 – CH3 AC INPUT
- 6 – CH2 DC INPUT
- 7 – CH4 AC INPUT

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

**IN3 socket**

- 1 – CH3 AC INPUT
- 2 – GROUND
- 3 – CH1 DC INPUT
- 4 – SHIELDING
- 5 – CH4 DC INPUT
- 6 – CH3 DC INPUT
- 7 – CH2 DC INPUT

Pay attention to possibility of connecting all four DC channels to **IN3**.

**IN4 socket**

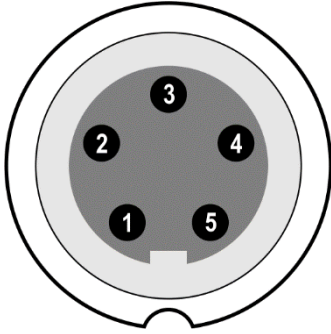
- 1 – CH4 AC INPUT

## ADASH

- 2 – GROUND
- 3 – +20V DC OUTPUT (max 10mA)
- 4 – SHIELDING
- 5 – NOT USED
- 6 – CH4 DC INPUT
- 7 – NOT USED

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## TRIG socket



- 1 – GROUND
- 2 – NOT USED
- 3 – NOT USED
- 4 – +5 V OUTPUT/ 50 mA for tachometer power supply

**Warning!** Pin 7 of IN1 socket (ultrasound sensor powering) is internally connected with pin 4 of TRIG socket (tachometer sensor powering).

- 5 – TRIG INPUT - for tachometer signal

## Standard cable wiring

The standard cable, which are the part of the unit, have the sensor signal connected to the pin number 1. The second sensor wire is connected to the ground (pin 2).

When you use this cable:

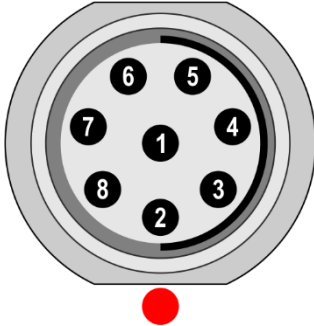
- In IN1 socket, the signal will be measured on CH1.
- In IN2 socket, the signal will be measured on CH2.
- In IN3 socket, the signal will be measured on CH3.
- In IN4 socket, the signal will be measured on CH4 (ver. 2.0 and higher).

If you want to use the 3-direction sensor, then you should use the IN2 socket (pins 3,1,5) + ground (pin 2). You need the special cable for this purpose.



## Input channels (ODU variation)

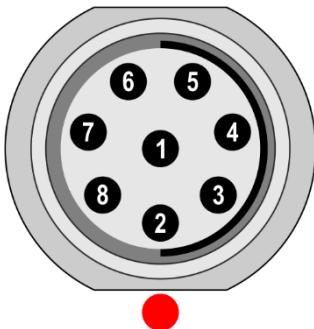
### IN1 Socket



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

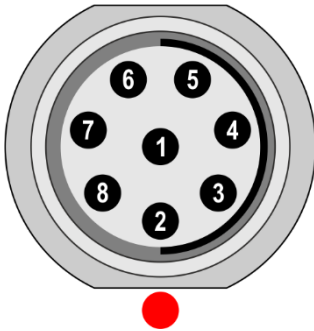
**Warning!** Pin 2 of IN1 socket (ultrasound sensor powering) is internally connected with pin 2 of TRIG socket (tacho sensor powering).

### IN2 Socket



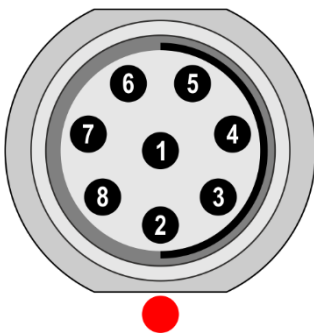
- 1 – GND
- 2 – AC4
- 3 – **DC2**
- 4 – AC3
- 5 – SHLD
- 6 – AC1
- 7 – **GND**
- 8 – **AC2**

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

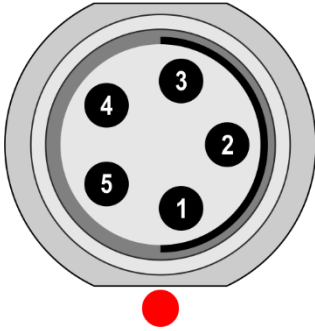
**IN3 Socket**

- 1 – GND
- 2 – DC2
- 3 – **DC3**
- 4 – DC4
- 5 – SHLD
- 6 – DC1
- 7 – **GND**
- 8 – **AC3**

Pay attention to possibility of connecting all four DC channels to **IN3**.

**IN4 Socket**

- 1 – 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

**Warning!** Pin 2 of IN1 socket (ultrasound sensor powering) is internally connected with pin 2 of TRIG socket (tacho sensor powering).

## **A4409 - BNC Box**



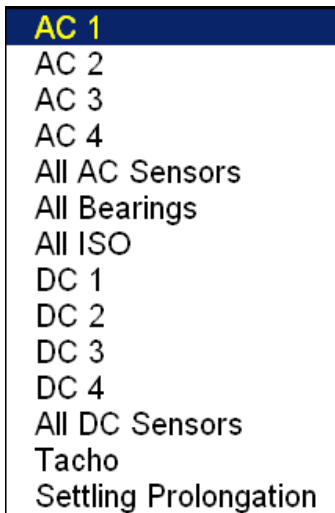
This box can simplify the connection of more cables to VA4Pro inputs. The BNC input connectors are used on the top panel for connection of 4 AC channels and 4 DC channels. On the side panel are two Binder connectors, which enable to connect all 4 AC channels to IN2 input and all 4 DC channels to IN3 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. In the same way all 4 DC channels can be connected to one input IN3.

## **Sensors properties**

When you connect the sensors to the instrument, you have to tell what kind of sensors you use. The **Sensors** button is on most screens in the bottom. You can define the bearing and ISO 10816 group for every AC channel individually.



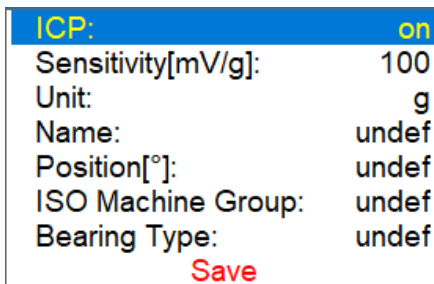
Push the **Sensors** button. In the next menu select channel sensor you want define.



- AC1 – AC4**     setting of each AC channel properties (sensor, ISO 10816 group, bearing)
- All AC Sensors**     setting of all AC channels together
- All Bearings**     setting of one bearing to all AC channels
- All ISO**     setting of one ISO 10816 group to all AC channels
- DC1 – DC4**     setting of each DC channel properties
- All DC sensors**     setting of all DC channels
- Tacho**     setting of tacho channel properties
- Settling Prolongation** if you need longer time for sensor settling, use this item

### **AC sensors**

AC (alternate current) sensors are used for signals, e.g. vibrations.



- ICP**     **on, off** (selection of required setting accordingly the sensor type)
- Sensitivity[mV/unit]**     usually **1,10,100, user**
- Unit**     unit selected from the list or user unit

**Name**     **undef, user**

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

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

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

**Saving sensor**

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

ICP:	on	
Sensitivity[mV/g]:	100	
Unit:	g	
<b>Name:</b>	<b>acc100</b>	undef
Position[°]:	undef	user
ISO Machine Group:	undef	<b>save</b>
Bearing Type:	undef	
<b>Save</b>		

**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 item. Select a name of a saved sensor and press OK. Then its parameters are loaded.

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

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

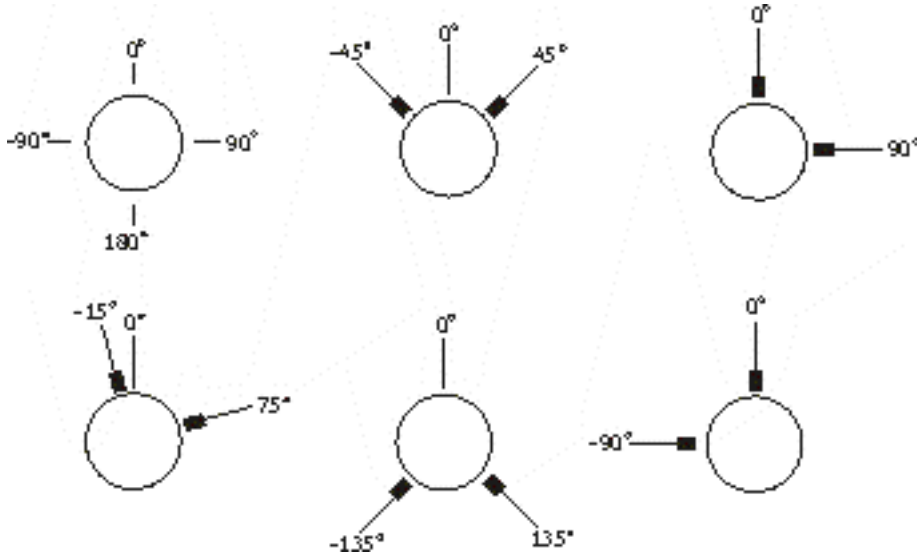
Sensor "acc500" has been already defined.  
Load its parameters?

**Deleting sensor**

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

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

**Position** the angle of sensor (see picture bellow). Usually used for proximity sensors.



**DC gap channel** In case of displacement sensor (eddy current) also DC channel could be entered, which is used for gap measurement ( eddy current sensor should be concurrently connected to 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** see next chapter ISO 10816 Machine Groups

**Bearing Type** see Bearing Settings chapter

### ISO 10816 Machine Groups

You can set the appropriate machine group according the ISO 10816 for each channel separately or for all channels together.

<b>ISO Machine Group:</b>	<b>1</b>
ISO Machine Foundation:	rigid
<b>Save</b>	

ISO 10816 Classification of machinery. These parameters are used for limit values according to machine type, nominal power or shaft height.

### Bearing Settings

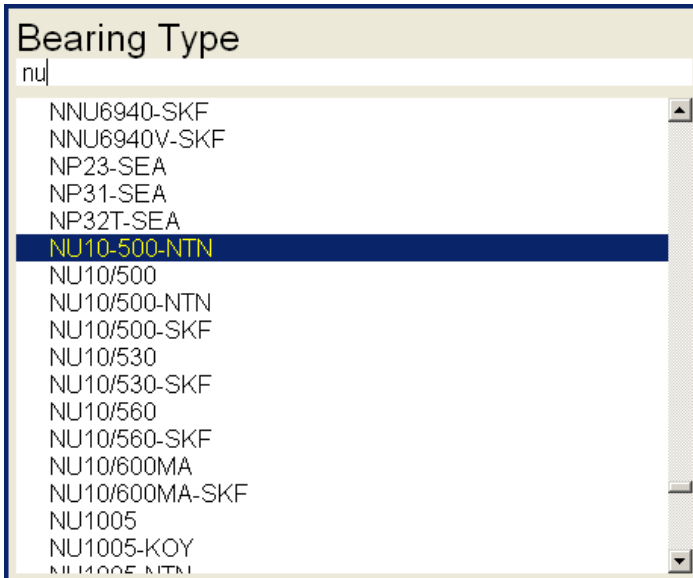
The fault bearing frequencies can be displayed in spectra. The bearing type definition is required for that.

<b>Bearing Type:</b>	undef
<b>Save</b>	

Select **Bearing Type** item and press **OK** button or right arrow button. From next list select required item and press **OK** button. Also recently used bearings are displayed.

<b>Bearing Type:</b>	<b>6205</b>	database
Rotating Race:	inner	user
<b>Save</b>		undef
		<b>6205</b>
		22228(18)-SKF
		3202

**Bearing type**  
**database** selection from database



Enter the name (or part of the name) and use the up/down arrows (use **Shift** button to change buttons function) bearing selection. Confirm by **OK**.

**user**

Bearing Type:	user
Rotating Race:	inner
Number of Balls:	0
Ball Diameter[in]:	0
Bearing Pitch Diameter[in]:	0
Contact Angle[°]:	+0.0
<b>Save</b>	

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

**none** none bearing defined, the fault frequencies will not be displayed

**Rotating Race** for correct calculation of fault frequencies the selection of rotating race is required.

### DC sensors

DC sensors are used for discrete current signals, e.g. temperature, pressure, ... .

After selection of **DC1 - DC4** or **All DC Channels** item the sensor properties menu appears.

Sensitivity[mV/μm]:	-8
Offset[mV]:	-8000
Unit:	μm
Position[°]:	45
<b>Save</b>	

- Sensitivity[mV/unit]**    sensitivity value
- Offset[mV]**            offset value
- Unit**                    unit selected from the list or user unit
- Name**                  the name of sensor (see AC sensors for more details)
- Position**              the angle of sensor (see picture above). Usually used for proximity sensors and **GAP** measurement.

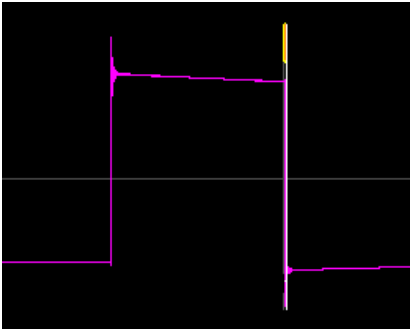
The used formula: **output value in Unit = (input value in mV - Offset) / Sensitivity.**

### Tacho

The speed is measured from tacho channel. The signal contains one or more pulses per one rotation. The pulses can also trigger the measurement.



The VA4 uses the falling edge of tacho signal for triggering (it means the end of the tacho mark).



<b>Tacho Trig Level[V]:</b> 1
Pulses per Rotation: 1
Min Speed [Hz]: 0.5
Save

**Tacho Trig Level** The correct reference value has to be set for speed measurement. E.g. when the standard tacho level is 0.5V and the pulses reach the 1.5V, then the value 1V should be correct. The negative pulses are not allowed, you need to use Adash converter for them.

**Pulses per rotation** This value has to be set for correct speed evaluation, when more pulses are generated during one rotation. The Trigger Source=tacho is not available for more than one pulse.

**Min Speed** The lowest speed, which the user is interested to measure with tacho. We suppose that there is one pulse per one revolution. 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. You should be aware of time prolongation of each measurement. If the machine's speed is lower than **Min Speed**, then tacho trigger will not be used.

### Settling prolongation

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

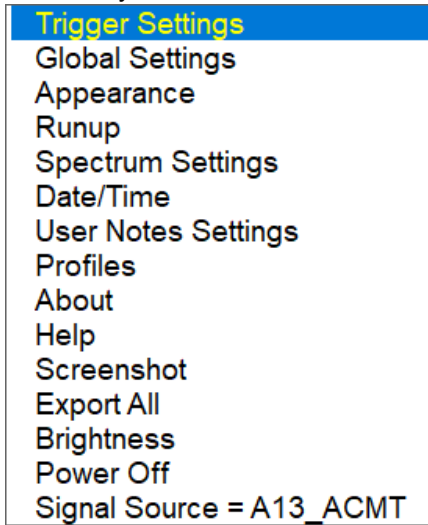
### Sensor Properties of recorded signal

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.

## **Global properties**

The parameters which have effect to all or many functions are understood as Global parameters. The definition is made by **Global** button.



### **Power Off**

Additional way for switching off.

### **Brightness**

Screen brightness settings ( for instruments made after November 2013).

### **Screenshot**

The screenshot in png format will be saved to the **images** folder on VA5\_DISC.

### **Export All**

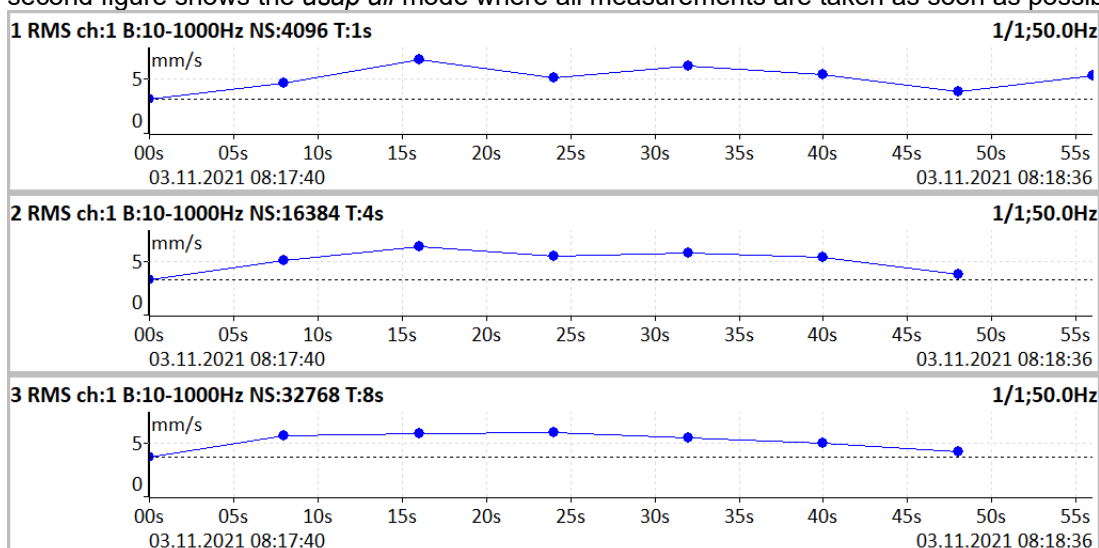
Export all unexported projects from Analyzer, Route and Runup modules.

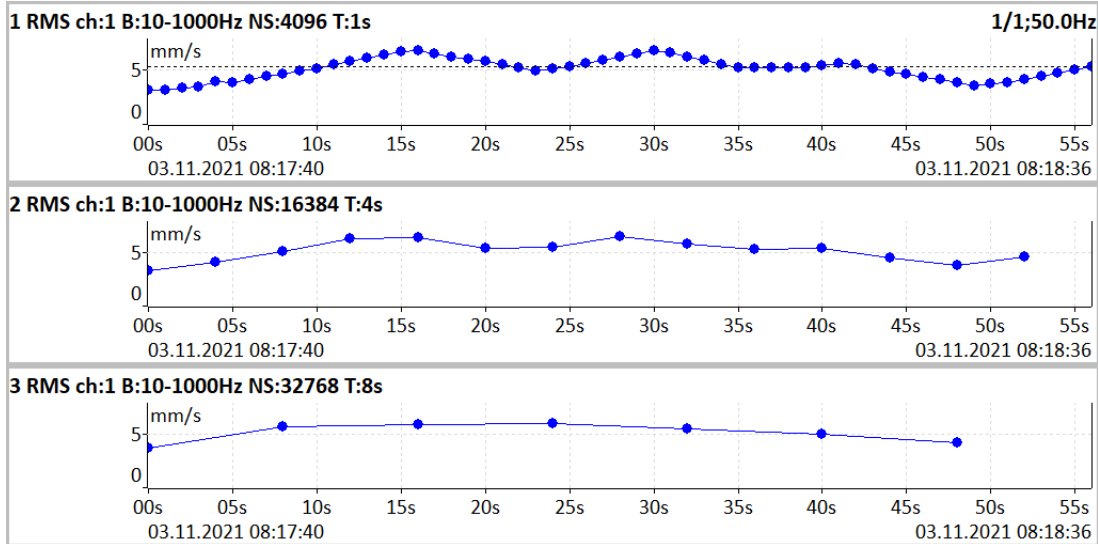
### **The About ...**

<b>Version:</b>	0275
<b>Licence:</b>	000000
<b>Built:</b>	11.01.2021 07:30:00
<b>Installed:</b>	11.01.2021 07:32:00
<b>Disc Capacity:</b>	57.1GB
<b>Used Space:</b>	10.5GB (18.4%)
<b>Free Space:</b>	40.6GB (81.6%)
<b>VA5_DISC Free Space:</b>	95.0%
<b>Battery:</b>	98%

**Help**

Displays html version of manual

**Trigger Settings****Analyzer Trigger Mode** This setting is used in Analyzer and Octave Analysis modes.**single** Only one measurement is taken and displayed**retrig** When you use the analogue oscilloscope, you see always the actual new signal on the screen. This means the similar thing. The measurement is repeated until you push the **Stop** button. Select the **single** option when you want only one measurement.**Runup Trigger Mode** Measurement's trigger control for Runup module. It has to be defined, how often the data will be taken.**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 previous measurement without any delay.**manual** The user starts next measurement manually (by pressing the **Start** button). For averaging is only one pushing of **Start** needed.**speed** The next measurement is taken when the speed is significantly different from the previous measurement speed. The user defines in **Speed change(Hz)** item, what it is significant change.**time** All measurement are taken with the same time interval between them. The time interval length is define in **Time Change(s)**.**time or speed** This option is the combination of speed and time. The next measurement is taken when one of them is changed more then the value **Speed change(Hz)** or **Time Change(s)**.**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 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 process waits for retrig event (defined in **RunUp Trigger Mode**), the **Waiting for retrig** window appears. The text informs, which event is expected.

Waiting for manual retrig Press enter for retrig	Waiting for time or speed retrig 10 s or 1.00 Hz
---	---

**Speed change(Hz)** 1, 10, user see the **Runup Trigger Mode** item.

**Time change(s)** see the **Runup Trigger Mode** item.

**Runup Minimum Speed, Runup Maximum Speed**

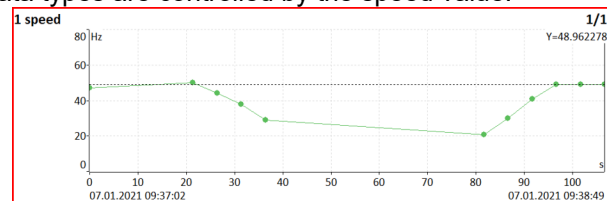
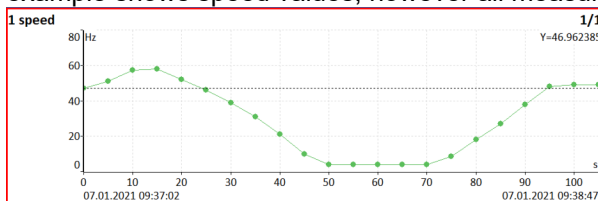
**undef, user**

Runup measurements are taken only if actual speed is greater than *Runup Minimum Speed* (if defined) and less than *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.

Waiting for runup speed <20;50> Hz	Waiting for runup speed <20;undef> Hz	Waiting for runup speed <undef;50> Hz
---------------------------------------	--	--

In the following figures, you can see the difference between measurement with undefined runup minimum and maximum speeds (figure on the left) and 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 **Start** button for taking the measurement, you run only the preparation. When everything is ready to take the data, then the **Trigger Source** item is applied.

In Runup module, the frequency of measurements is controlled by **Runup Trigger Mode** at first. Then is the **Trigger Source** applied:

**freerun** The taking of measured data begin immediately after preparation without waiting for anything.

**external** The taking of measured data begins, when the external signal (voltage level higher then defined in External Trig Level) appears on the trigger input. Such signal may be generated e.g. when the machine starts to work. This type of signal is usually created in the control system.

**manual** The taking of measured data begin after pressing the **Start** button. Remember that you should push the **Start** button twice. First pushing is for preparation, second for triggering.

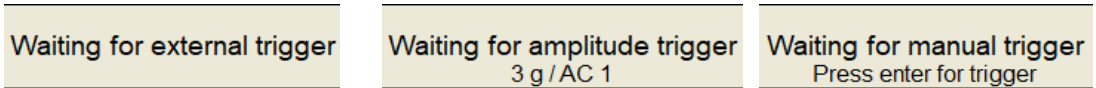
**manual sequential** Similar to manual, but every measurement for averaging must be start separately. E.g. when AVG=10, then the **START** button must be used 10 times.

**amplitude** The taking of measured data begin when the signal level exceed the **Ampl Trig Level**, which is set by user also 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 e.g.99mV to 101mV
- the level is set to -100mV - triggered when the falling signal goes from e.g.-99mV to -101mV

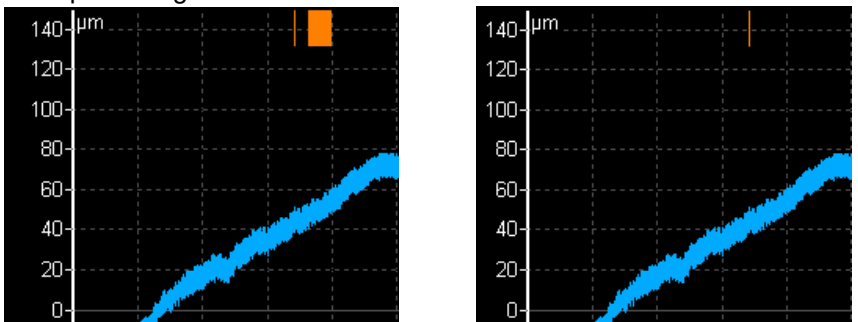
**tacho** The **tacho** is special case of **external** trigger. When we talk the tacho, we mean the signal (usually like TTL) which contains one pulse during one rotation of the shaft. It can be also understood like series of single external pulses. The taking of measured data begins, when the external signal (voltage level higher then defined **Tacho Trig Level** in tacho sensor) appears on the trigger input (the same like **external** item).

Note! If no trigger event occurs, the **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 tacho sensor. 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.



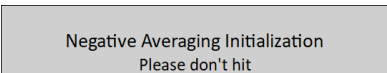
**Ampl Trig Channel**      ( 1,2,3,4)      The number of channel, which will be used for **amplitude** triggering.

**Ampl Trig Level (unit)**      **value**      See the description of **amplitude** mode (Trigger Source section). The unit is the unit of sensor on selected channel (**Ampl Trig Channel**).

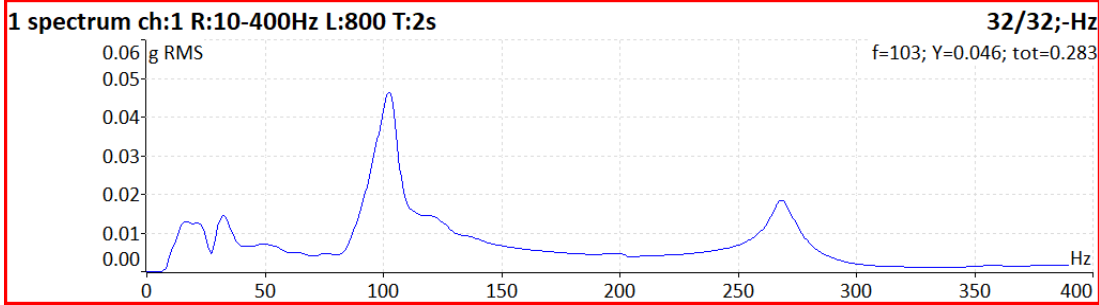
**Ampl Tacho Hysteresis**      see **Use Ampl Tacho**

**Negative Averaging**      **yes, no**

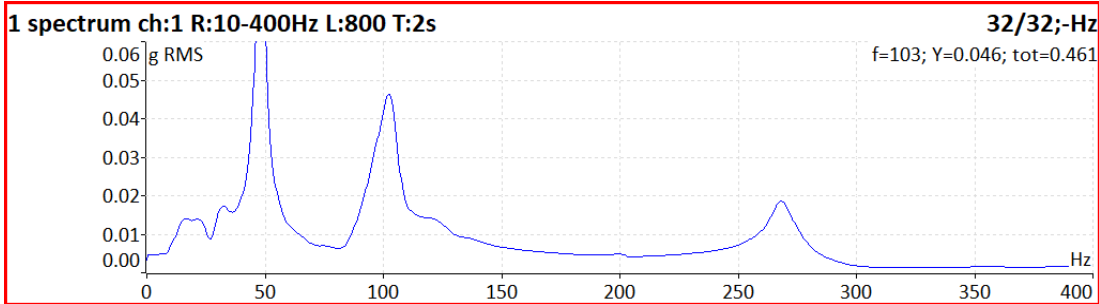
Negative averaging is available only with an amplitude trigger. When turned on, a reference spectrum is taken in the measurement beginning after device initialization. This reference spectrum is remembered and then subtracted from each calculated spectrum. This is useful when performing a bump test on running machine. Please don't make hits during negative averaging initialization. You are noted by the window.



Look at next example. On first picture, you can see a spectrum of a hit performed on stopped machine. Exponential window is applied.

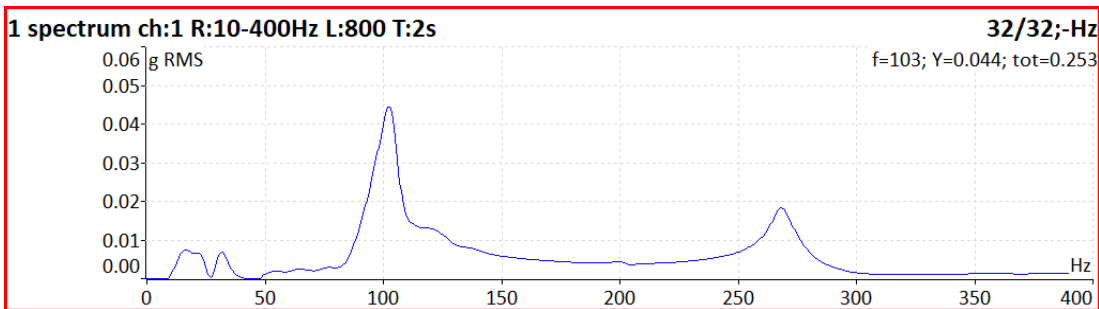


Next picture shows the hit performed on running machine. You can see a big peak value near 50 Hz.



By using negative averaging you can eliminate the unwanted peaks in spectrum, which are caused by 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.



**External Trig Edge** rising, falling edge for triggering

**External Trig Level[V]** See the description in **Trigger Source/ external**

**Pretrig (%) value in (100,-100) or user** Usually the taking of measurement (e.g. time signal) begins exactly from the trigger moment. But in some applications you are interested also to know the signal before trigger. The required time should be define in seconds, but in signal Analyzers is usually defined as percent part of the total signal length. When 1 second time signal is measured and pretrigger=25, then 0,25s will be taken before trigger and 0,75s after trigger. Also the negative pretrigger could be used. It means that the time signal will be taken later then trigger pulse.

## Global Settings

Display Route Values:	<u>on</u>
Route Auto Save:	on
Route Auto Forward:	off
Check Route Sensors:	yes
Display Small Values:	off
Stop if ICP Error:	off
Units:	metric
Frequency Unit:	Hz
Speed Unit:	Hz
Power/Line Frequency[Hz]:	undef
Phase Range:	-180°;180°
Displayed Spectra in Cascade:	32
Date Format:	dd.mm.yyyy
Language:	ENG
Align Graphs:	off
Graph Grid:	on
Cursor Type:	linear
Record Analysis Speed:	real time
Record Analysis Start:	continue
Wav Encoding:	PCM, 24 bit
<b>Save</b>	

The underlined values are the default values (factory 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 **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**, then the user after results confirmation has to save it manually ( by **Save** button)

**Route Auto Forward** off, on

The list of measurement points is automatically displayed after data saving and next measurement point is selected. The necessary condition is, that all measurements from last point are taken and correctly saved.

**Check Route Sensors** yes, no

Each point in the route contains the sensor setting, which is defined in DDS. The instrument contains also the sensors setting (**Sensors** button). Both settings are compared for each point during the route readings. When the sensor setting in point is not equal the sensor setting in instrument, then the **Used sensor** window appears. It is the warning to the user.

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

The user should connect the correct sensor to the unit with the parameters displayed in window. Confirm by pressing **Ok**. The setting in **Sensors** will be rewritten by point setting in route. You can made changes in setting now using the **Sensors** button.

The sensor can have defined the name in DDS (e.g.ACC100). It should help the user in field to use correct sensor. These names are checked in instrument. When the names are not the same, then the **Used Sensor** window appears. No checking of other parameters is done.

Used Sensor  
ACC100 on AC1: 100 mV / g, ICP on

**Display Small Values** on, off When you are interested to see values under the 0,001, then set it to **on** and the values will be displayed in exponential form ( e.g. 5,26E-6). Otherwise the 0 (zero) will be displayed.

**ICP Initialisation Delay[s]** default, user the time delay after the ICP is switched on

**Stop if ICP Error** on the measurement is stopped, when ICP error occurs  
off the measurement continues, ICP error is only information

**Units** metric, imperial, both ( all units appears in the menu)

**Frequency unit** Hz, RPM, CPS, CPM



**Speed unit**    **Hz, RPM, CPS, CPM**

**Power/Line Frequency**            it is used for Elect value in Synch table, which is displayed for spectra

**Phase range**    **(-180, 180) , (0, 360)**    the range of phase values

**Displayed Spectra in Cascade**            **32, 128, 256, 512, 1024**            the number of displayed spectra in cascade graph. It is not the number of measured spectra !

**Date Format**    **yyyy/mm/dd**  
                       **dd.mm.yy**  
                       **mm/dd/yyyy**    the a.m./p.m. is used

**Language**        **ENG, CZE, ....** select your language

**Align Graphs**    **on, off**            if more graphs of the same type are displayed, then the Zoom and Cursor function of all graphs can be aligned.

**Graph Grid**      **on, off**

**Cursor Type**    **linear, maxs**    this item must be deeply explained. The graph width (e.g.spectrum frequency axe) is displayed on the approx. 600 screen pixels. But the spectrum could have 25600 lines and then 42 lines is 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 VA4 version 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. In the version 2 we have used another procedure. The cursor moves by pixels, not by lines. In each pixel is hidden more lines 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 cursor movement is the number of lines in one pixel. When the maxs is set, then the cursor is always move to the maximum line, which is contained in one pixel.

**Record analysis speed**            **fast, real time**            the record could be analyzed in two ways. Let's suppose the record length is 300 sec, it could be e.g. run up record. You want to measure the 1x amp+phase (ampl+phase+speed) 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 to watch them on the screen, then select **fast** mode. The analyzing time will be much faster then 300 sec.

**Record Analysis Start**            **continue, begin, again, ask**    these options are used when the record is selected for analysis.

It would be better to use example for explanation. E.g. we use record which length is 60 sec. We define time signal measurement which length is 8 sec. It means when we push Start button, the reading takes 8 sec and position of cursor moves of 8 sec in record.

**continue**            the next reading will start on the end of last reading  
**begin**                the next reading will start on the beginning of record  
**again**                the next reading will start on the beginning of last reading  
**ask**                    the user select any option before the reading

**IMPORTANT** : when you moved the cursor manually, the 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 VA4 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 same as sampling frequency of the exported signal and cannot be changed in the instrument. If you need to change it you need to use a 3<sup>rd</sup> party application to resample the exported wav (e.g. Audacity).

## Appearance



<b>Background Color: black</b>
Button Text Color: white
<b>Save</b>

**Background Color**                    **black, white**    setting of background and other colors.

You can create your own colors profile. Use the **create** item below the black and white. The **col.cpy** will be created on VA4\_DISC. You can change the RGB value of all colors and then save it with new name. When the instrument is switched on, then all cpy profiles are moved to the instrument and then used. You will find your new name in the list of Background Colors. Use the **Delete** button for removing of user defined colors.

**Button Text Color**                    **black, white**

## Runup

Contains runup global parameters.

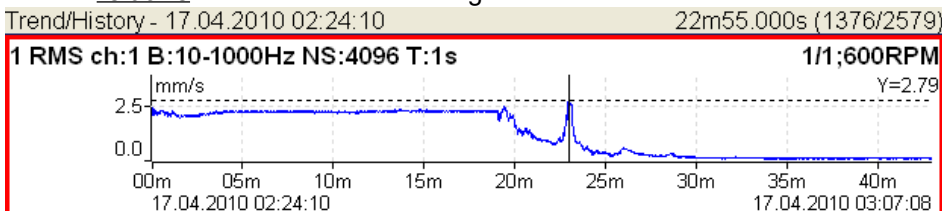
<b>Max Memory Size[MB]: 1000</b>
Time Unit:                    minutes
Length[minutes]:            undef
Trend Time Axe:            relative
Trend Length [minutes]:    auto
<b>Save</b>

**Max Memory Size[MB]**                **value**                    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.

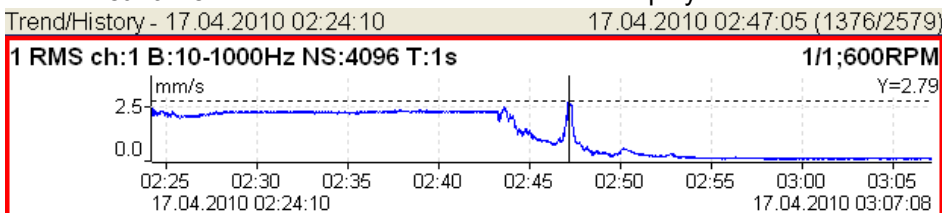
**Time Unit**                    **days, hours, minutes**                    The unit of Length parameter (see next line).

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

**Trend Time Axe**  
**relative**                    the time axe begins from zero



**real time**                    the time of measurement is displayed on time axe



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

## Spectrum Settings

These settings are the default settings, which are used for graphs.

<b>Detect Type:</b>	<b>RMS</b>
Axe X:	lin
Axe Y:	lin
Peaks List:	off
Graph Lines:	continuous
<b>Save</b>	

**Detect Type** **RMS, 0-P, P-P** the spectrum values on amplitude axe  
 Default detect type for spectral amplitude values. E.g. spectral graph in analyzer module uses this type of amplitude but you can enter another value for particular graph in its **Graph Properties** menu.

**Axe X** **lin, log** this parameter you can set in **Graph Properties** functions, which are accessible in every graph.

**Axe Y** **lin, log** this parameter you can set in **Graph Properties** functions, which are accessible in every graph.

**Peaks list** **on, off** the list of peaks can be displayed in each spectrum graph

**Graph Lines** **continuous, discrete** the spectrum can be drawn as line through the tops of line or as discrete vertical line for each frequency

**Date/ Time**

<b>Year:</b>	<b>2013</b>
Month:	07
Day:	22
Hour:	15
Minute:	11
Second:	26
<b>Save</b>	

Set the actual date and time.

**User Notes Settings**

You can attach the short text notes to route points. There are three ways how handle with notes.

1. Enter the note manually.
2. Select predefined note from **Factory notes** set.
3. Select predefined note from **User notes**. This set is created and edited by user.

**Notes**

Select factory note

- Machine is not running
- New bearing
- New motor
- New coupling
- New belt
- Unsteady operation
- Dirty machine
- Oil under machine
- High noise

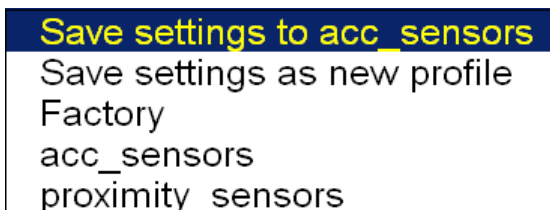
Now we describe how to create the **User notes** list. Press the **Global** button and select **User Notes Settings**. The new window appears. In upper half is the list of existed user notes (now empty). The predefined **Factory notes** are displayed in lower half.

Because usually the user wants to use only the **User notes**, you can copy any factory note to the user notes. Select it by arrows and press **Select** button.

If you want to create your own note, then push **Edit text** button. Enter your note manually. Press the **Save** button and all notes are saved to memory.

## Profiles

All instrument parameters can be saved to the **Profile**. It is useful e.g. for saving of sensor sensitivities.



**Save settings to name** saves the parameters to the Profile, which was opened.

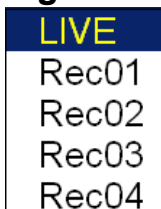
**Save settings as new profile** save the parameters to the new Profile (after name entry).

**Factory** opens the factory default Profile

**list of saved profiles (acc\_sensors, proximity\_sensors)** selection of existed profile

The **Delete** button removes selected profile.

## Signal Source



Every measurement can be taken from LIVE channels ( AC 1-4 or DC 1-4 ) or from RECORD ( see Recorder chapter for understanding). All records saved in the memory are displayed for selection. Select required item and press **OK** button. The selected signal source is also displayed in the Global window.

If you work with Virtual unit on your computer, use the Default Rec for testing.

## The Main screen

After switch-on the Main screen appears. You can select the required mode of the unit.



### **Update of the unit firmware**

You can download the updated firmware from producer website [www.adash.cz](http://www.adash.cz). Follow the procedure:

- Download the file for update ( e.g. A4400\_ver0202.up2) from website ([www.adash.cz](http://www.adash.cz)) and save it to your computer.
- Connect the instrument to the computer. Remember, it has to be switched off.
- Run the Explorer or other software, which you use for copy of files.
- Copy the update file from the computer to the **VA4\_DISC**.
- Use **Safely remove hardware** function and disconnect instrument from the computer.
- Switch-on the instrument to the main screen.
- Push the **Update** button.
- Select the required update file from the list ( more version files can be saved in the instrument). Press **OK**.
- The main screen window is closed now. The procedure of update is described in the new command window.
- After the update the main screen appears again.

### **Update of bearing database**

The bearing database you can download from website Adash/ Downloads/ Software Adash. The Bearing Database item is in A4400 - VA4Pro section. The name of the file is **bdx01.va4**.

- Connect the instrument to the computer. Remember, it has to be switched off.
- Run the Explorer or other software, which you use for copy of files.
- Copy the update file from the computer to the **VA4\_DISC**.
- Use **Safely remove hardware** function and disconnect instrument from the computer.
- Switch-on the instrument to the main screen. Bearing database is ready to use.

**Battery capacity**

The information about % of battery lifetime is displayed in the right bottom corner of the display. When the capacity is more than 30%, the green symbol appears. When the capacity is 10-30%, the yellow symbol is used. Under the 10% the red symbol appears. If less than 6%, the lifetime image begins to blink. At that time the running measurements are stopped. The next measurement is not enabled. When the 3% is achieved, the unit will switch off.

## **Instrument buttons**

Fifteen buttons are around the screen allows to control the unit. The function of every button is described on the screen near the button. Such dynamic approach enables to use one button for many functions depending of the actual needs.

### ***Control and Menu buttons***

Control buttons with the description are on the left and right screen side. The Menu items with the description are displayed in the bottom of the screen.

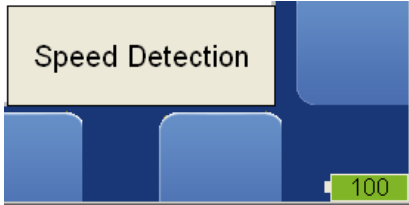
### ***The Shift button***

The Shift button changes the purposes of buttons. It is used for numerical and text inputs. Also it is used for changing of arrows properties.

## **Speed detection**

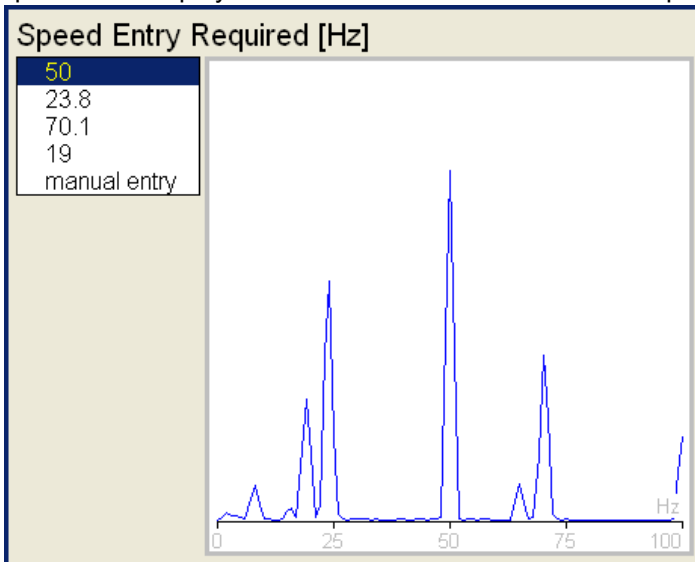
You need to know the speed of the measured machine in some cases. We will describe here how the speed detection works. In the following text, this chapter can be mentioned.

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



If the tacho probe is detected, no other speed detection will happen. The speed is measured by tacho probe.

The highest peaks are found and displayed in the list. The highest amplitude speed is on the top of list. The spectrum is displayed also. Select the correct value and press **OK**.



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.

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

**Speed could not be detected**  
Improper sensor

If the measurement for speed detection fails, then error message appears. E.g. ICP error.

**Speed could not be detected**  
ICP error

If the 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 tacho probe. If the speed is measured by tacho probe simultaneously, the value from the tacho probe has priority when saving.

## The Analyzer mode

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

### **The Meas**

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

### **The Graph**

The graphical form of that **Meas** values displayed on the screen we will call the **Graph** (overall value, time signal, spectrum, orbit, order analysis. One Graph works with data from one measurement item. You should keep in mind that also one overall value is the Graph.

### **The Set**

The **Set** is the most important term in the Analyzer mode. The **Set** is the set ( or group) of one or more measurements **Meas**, which the user wants to take and display together. E.g. 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 measurements **Meas**. 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. The taking off all measurements included in the set is made simultaneously. See also **Virtual Analyzers** section for better understanding.

### **The Project**

You can use only various **Sets** for analyzing. But sometimes you can need the more structured items than simple **Set**. Such items we call **Projects**.

Examples:

Meas\_Point\_A

This is only simple **Set**, which contain several measurements in one point.

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). This type of Project we call **L1/Set**. It means Level1\_Name/ Set\_Names.)

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**.

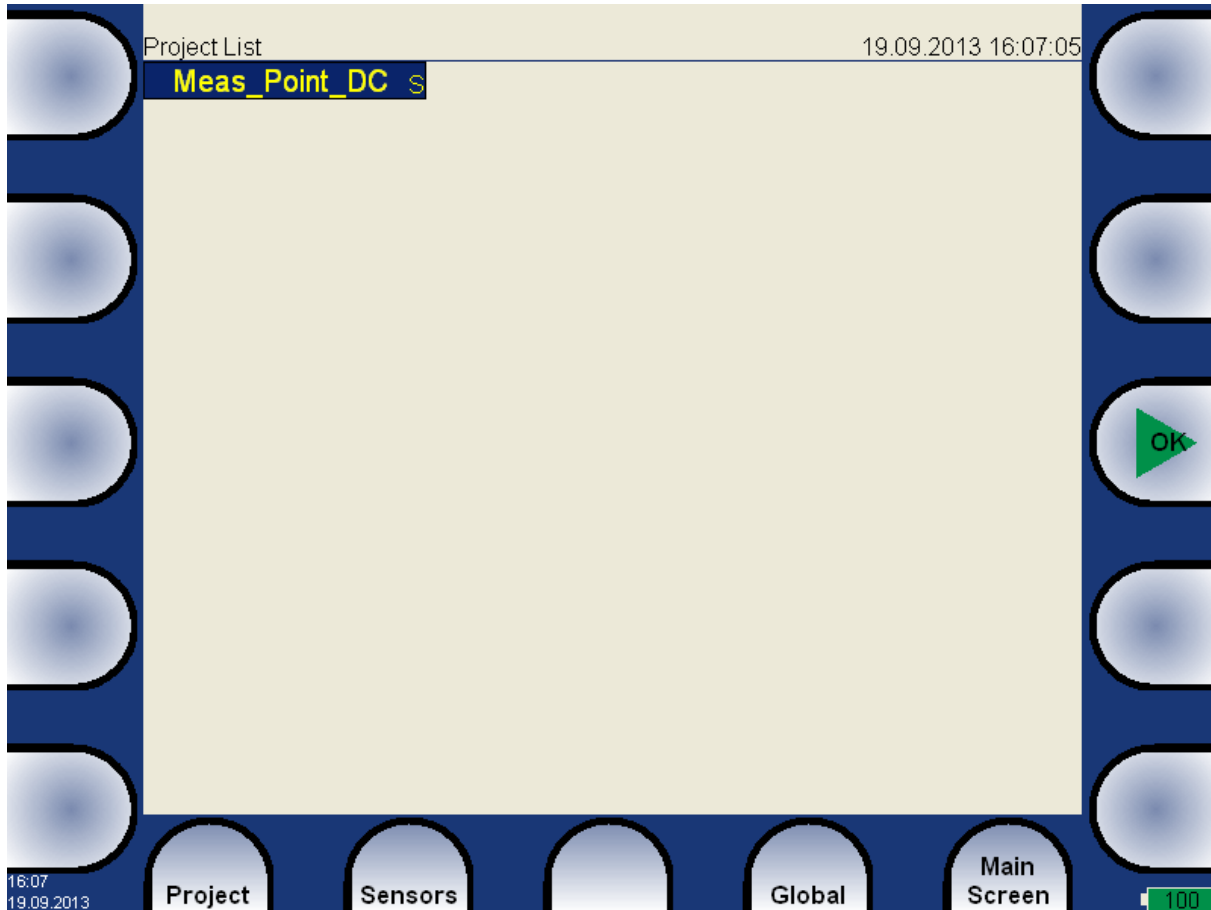
### **Export of the Project to the VA4\_DISC (flash disc)**

The computer can read any data from VA4 flash disc only. This flash disc has the name VA4\_DISC. The set with measured data has to be exported to the flash before the transfer to the PC. During the set measurement are data saved to the VA4 hard disc only (or SSD). When the set is closed, then the VA4 asks the user "Export to VA4\_Disc?" and user selects one option. 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. In the menu item **Set/ Export** you can select the set and export it manually.

### **First Analyzer screen**

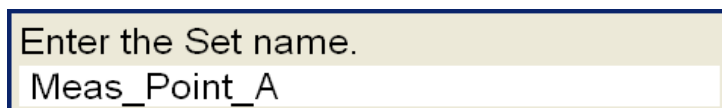
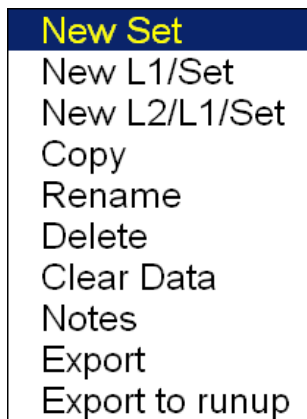
The first Analyzer screen contains the list of Projects saved in the memory or the empty list, when no Projects were saved. The time and date of last saving of selected project is displayed in top right corner.



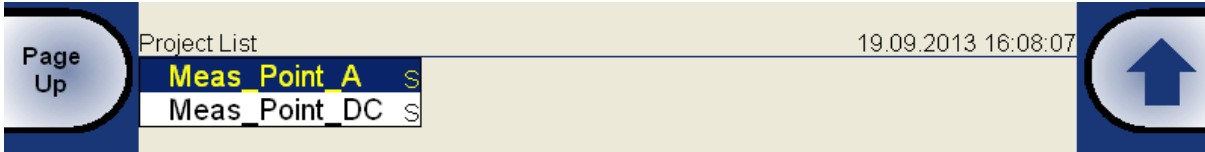


### ***New Project - Set creation***

Push the **Project** button. The menu appears, select **New Set** item.



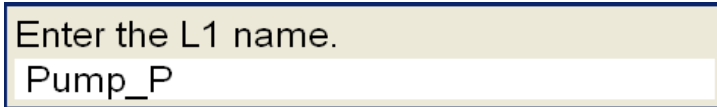
Enter the name of new set. Use the **Shift** button for next buttons displaying. Then press **OK**. Your new item appears in the displayed Project list (alphabetical order).



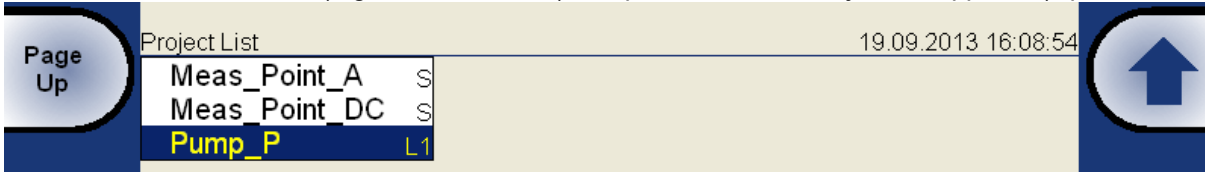
The **S** letter after the name is the **Set** type indication.

### New Project - L1/Set creation

The L1/Set structure usually enables to create the machine item with several points. Push the **Project** button and select **New L1/Set** item.

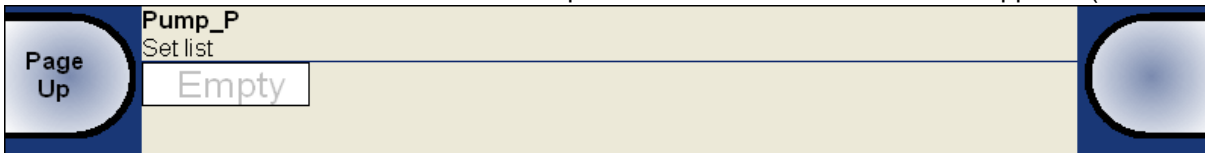


Enter the name on Level 1 (e.g. machine name) and press **OK**. The Project list appears (alphabetical order).

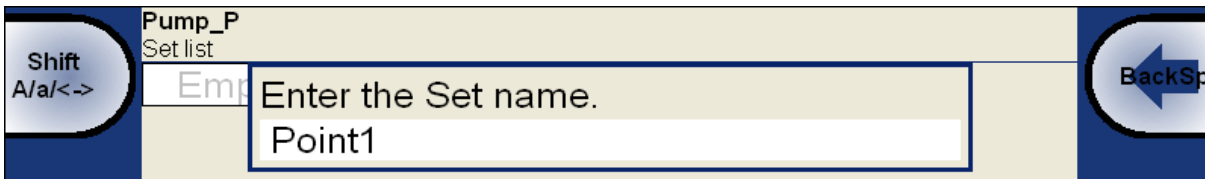


The **L1** letter after the name is the **Level 1** type indication.

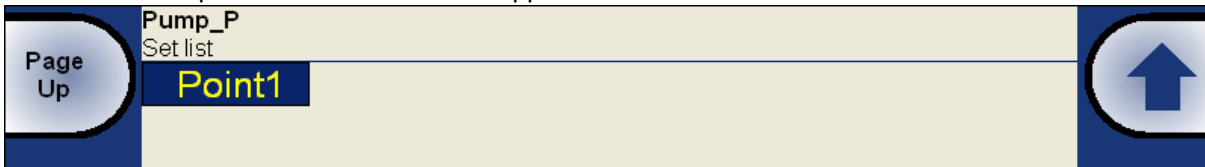
L1 item is selected. Push **OK**. The item will be opened and the list of included **Sets** appears (now it is empty).



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



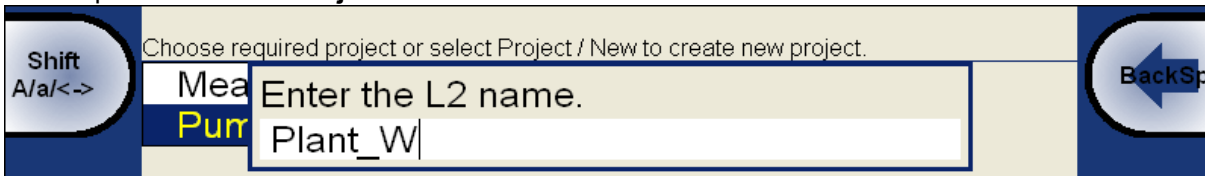
Enter name and push **OK**. The list of sets appears.



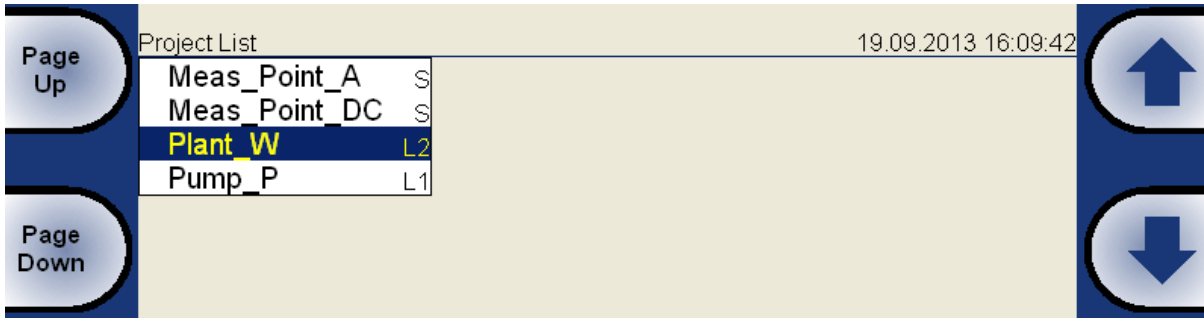
Use the **Close Project** button to return back to the project list.

### New Project - L2/L1/Set creation

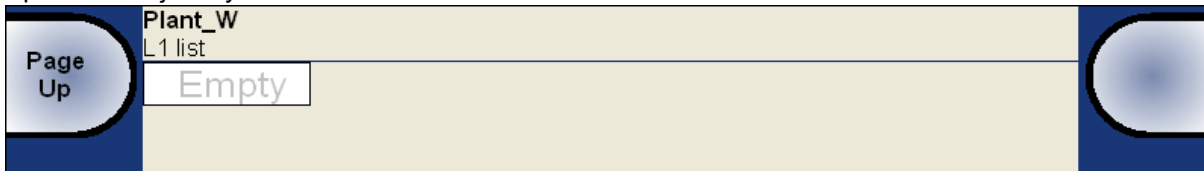
The L2/L1/Set structure usually enables to create the plant with several machines. Every machine can contain several points. Push the **Project** button and select **New L2/L1/Set** item.



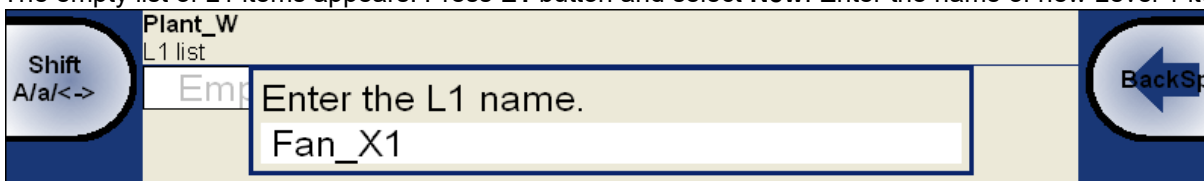
Enter the name, push **OK**. The project list appears (alphabetical order).



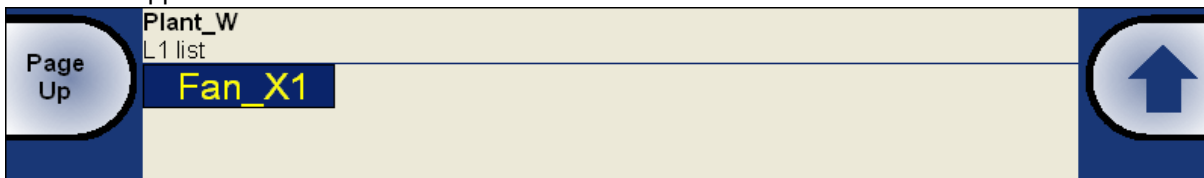
The **L2** letter after the name is the **Level 2** type indication.  
Open the Project by **OK**.



The empty list of L1 items appears. Press **L1** button and select **New**. Enter the name of new Level 1 item.



The L1 list appears.



Open the L1 item and create the Set in the same way as it the previous section.  
Use the **Back** and **Close Project** buttons to return to the Project list.

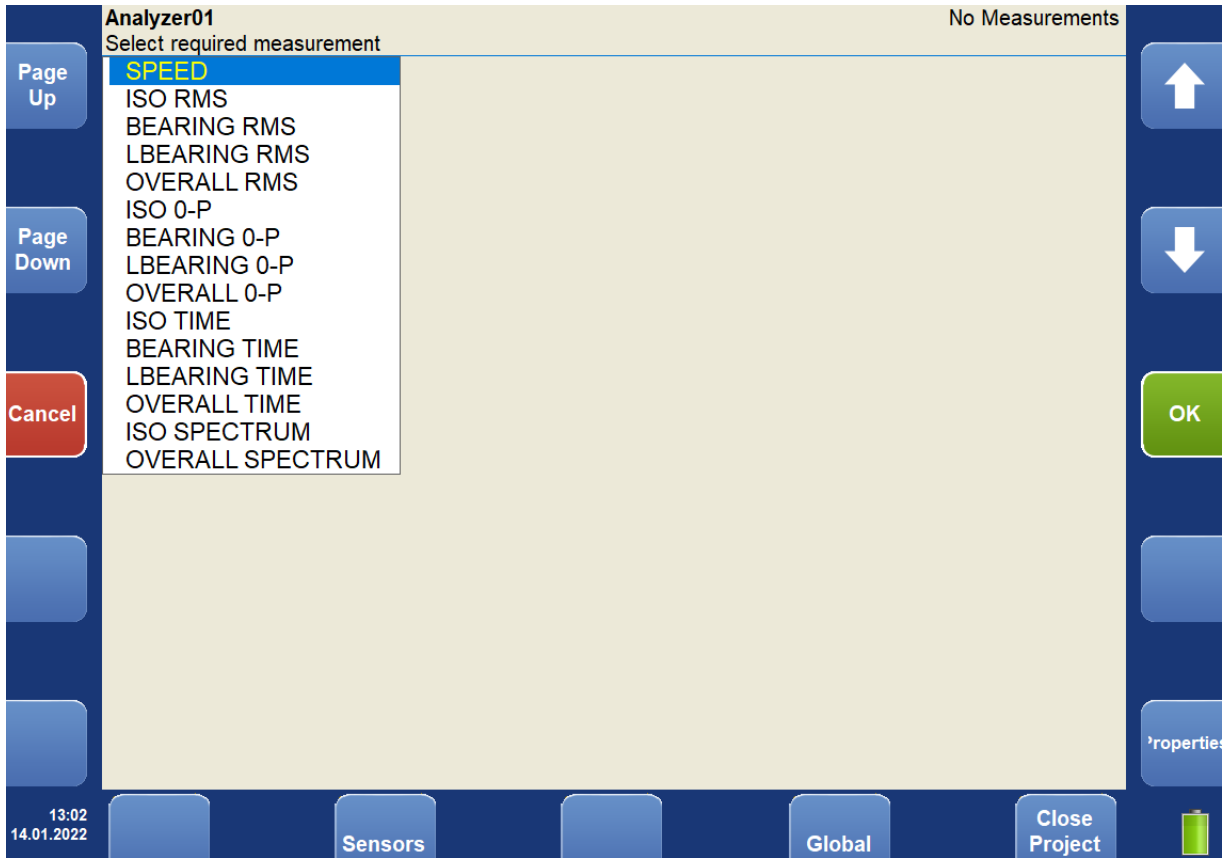
## New Meas creation

Select the set from Set list of selected Project and press **OK**. Press the **Meas** button and select **New Basic** or **New Advanced**.



### New Basic

When you want define some basic measurement use the **New Basic**. The list of predefined basic measurements appears. Select 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 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 *VA4\_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

The base menu for definition of measurements appears. The content of the menu is implication of the measurement **Type** selection (first row).

<b>Channel</b>	<b>1, .., 4</b>	The input signal source channel for evaluation.
<b>Unit</b>	<b>name</b>	The required unit for results and graph. This information is used for decision whether and how many integrations should be used.
<b>Detect Type</b>	<b>RMS, Scaled 0-P, Scaled P-P, True 0-P, True P-P, AVG, Crest, Kurtosis</b>	
		The detected value property ( P means Peak).
<b>Scaled 0-P</b>		it is equal $1.414 * RMS$
<b>True 0-P</b>		it is true 0-peak value in the waveform (the highest value captured in time signal).
<b>Scaled P-P</b>		it is equal $2.828 * RMS$
<b>True P-P</b>		it is true peak-peak value in the waveform (the difference between highest positive and highest negative value in signal)
<b>AVG</b>		it is average value of all samples (total sum of absolute values divided by number of samples)
<b>Crest</b>		it is equal True 0-P/ RMS
<b>Kurtosis</b>		standard statistical formula for Kurtosis
<b>Result Type</b>	<b>H1, H2, H3</b>	Standard frequency response functions measured between source channel and response channel
		H1- 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
<b>Band fmin (Hz) value</b>		The low cut-off frequency of band pass filter, which is applied to the signal before evaluation. The <b>none</b> value means, that only input DSP filter is applied ( approx. 0,6 Hz).
<b>Band fmax(Hz) value</b>		The high cut-off frequency of band pass filter, which is applied to the signal before evaluation. Under this item is also displayed the information about sampling frequency (fs=), which be applied for evaluation.
<b>DEMOD fmin (Hz) value</b>		The low cut-off frequency of band pass filter, which is applied to the signal (removing low frequencies).
<b>DEMOD fmax(Hz) value</b>		The high cut-off frequency of band pass filter, which is applied to the signal (removing high frequencies).
<b>Input channel</b>	<b>1, .., 4</b>	Required only for response functions.
<b>Output channel</b>	<b>1, .., 4</b>	Required only for response functions.
<b>FFT Window</b>	<b>Rectangular, Hanning, Transient, Exponential, Flat top</b>	The standard offer of FFT windows functions.
<b>Zoom spectrum</b>	<b>no</b> <b>yes</b>	standard spectrum will be made (range fro zero) zoom spectrum will be made (range around the center frequency)
<b>Center freq</b>	<b>value</b>	center frequency for zoom spectrum
<b>Range</b>	<b>value</b>	Frequency range of the graph. Under this item is also displayed the information about sampling frequency (fs=), which be applied for evaluation.
<b>ACMT FS(Hz)</b>	<b>value</b>	The sampling frequency for ACMT compression.
<b>Trigger control</b>	<b>off</b> <b>on</b>	Time signal will contain defined number of samples Time signal will contain defined number of triggers (e.g.revolutions)
<b>Number of triggers</b>	<b>value</b>	Required number of revolutions ( Speed control = on)

**Samples**                    **value**                    Number of samples ( Speed control = off). The correspondent signal time length is displayed under this item.

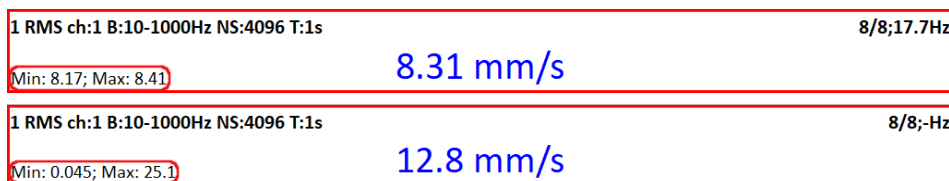
**Lines**                        **value**                        Number of lines. The correspondent signal time length is displayed under this item.

**Avg**                            **value**                        averaging number

How the averaging is used depends of type of trigger:

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

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



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.

**Averaging**                    **linear, peak hold, time synchro** (for spectrum)  
**linear, maximum, minimum, median** (for static values)

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

**Overlap**                        **% value**                        Overlapping of signals in averaging.

**Frequency**                    **speed, value**                    the frequency value for phase shift measurement can be entered manually (value) or can be used the speed frequency from tachometer sensor.

### Order

Usually user needs the measurement of amplitude and phase on speed frequency. In Order parameter you can define any multiplication of speed and to measure amplitude and phase on that frequency.

$$\text{measured frequency} = \text{Order} * \text{speed}$$

**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), (1-10)**  
 It defines which orders in order analysis will be measured.

**Resolution**                    **speed / 4 – speed / 1024**

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

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

**Attention!** When you select higher resolution (for example speed / 64 or even speed / 1024) then more revolutions must be taken and you will wait for results longer time. The higher resolution means longer time signal for evaluation. We do not recommend using always the maximum value, because you will wait for results longer (much longer). Use the 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 connected with the number of revolutions similarly as resolution in frequency spectrum is connected with 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  $\Delta_{ord} = 1 / \text{rev}$ , where rev is 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 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 actual order. However, you may still enter any user value. The nearest possible order, which will be truly used in 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 resolution in orders = 1/4 = 0.25. The available orders are for example 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. Instrument ensures this condition regardless the setup by increasing the number of revolutions.

**Full spectrum**                **yes, no**

The spectrum will have two sides, positive and negative (see literature about turbine analysis for more details). It is important to define correct sequence of channels. It must match the rotation direction. It means, the tachometer mark must come to A channel first and then to B channel. Otherwise the positive/negative parts would be transposed.

## Next Meas functions

### Copy

copy of selected measurement to the new one

### Info

displays measurement properties

### Edit

enables changes in measurement properties

**Delete**

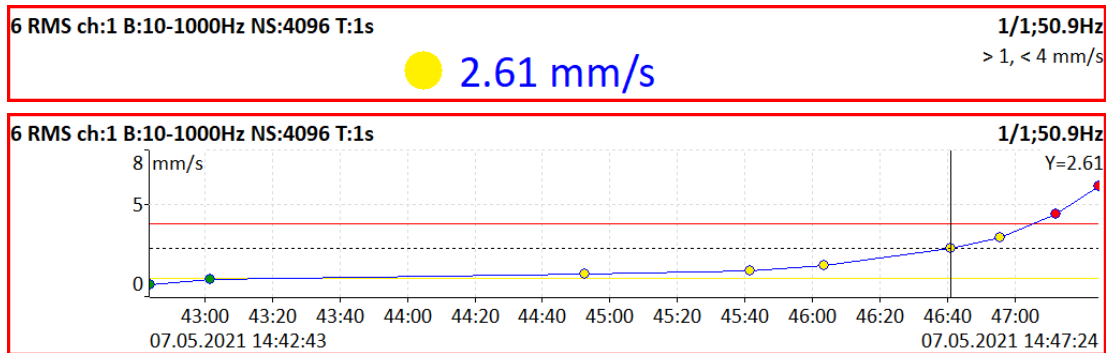
deletes selected measurement

**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 graph of 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. 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. It's up to you what severity you assign to which interval. The particular alarm is displayed when the measured value is from appropriate interval. You can define more than one limit values 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 the alarms above the limit. Each value in the trend is drawn as a small colored circle whose color corresponds the alarm.



There are 3 ways how to create limits.

**Adash Limits**

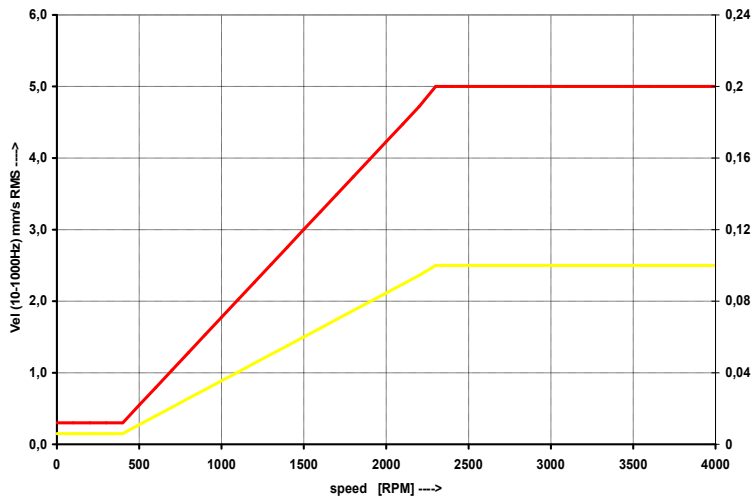
Type:	Adash
Limits Multiplier:	1
Save	

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

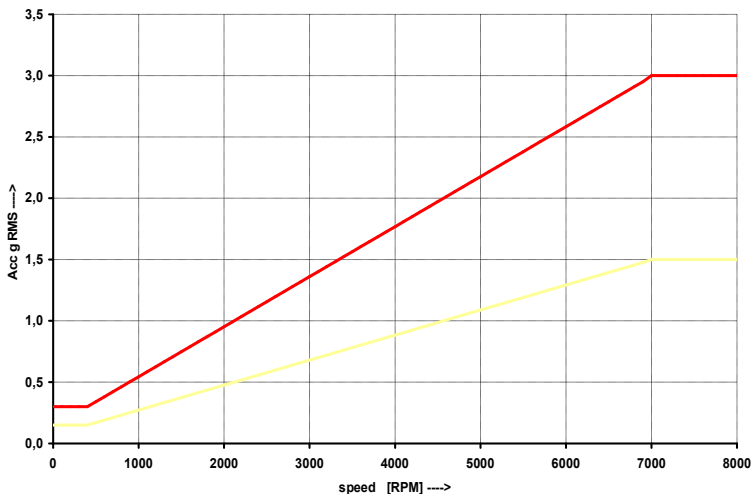
- velocity readings in frequency interval 10-1000Hz, which is very well suited for detecting the overall condition of the machine

**Note!** fmin lower than 500 Hz and fmax higher than 16000 are also accepted, it means Adash limits can be also used for acceleration measurements with fmin lower than 500 Hz and fmax higher than 16000 Hz





- acceleration readings in frequency interval 500 - 16 000 Hz (higher frequency then 16 000 Hz is accepted too), 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 be also used for acceleration measurements with fmin higher than 500 Hz and fmax higher than 16000 Hz



These limit values may be too or too little strict for some machines. Therefore, you can adjust them using the Limits Multiplier. Values greater than one increase the limits 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 twice lower. The third case shows the situation with the multiplier set to 0.5.

1 RMS ch:1 B:500-25600Hz NS:65536 T:1s	1/1;50.0Hz > 0.68, < 1.36 g
<span style="color: yellow;">●</span> 1.000 g	

1 RMS ch:1 B:500-25600Hz NS:65536 T:1s	1/1;50.0Hz < 1.36 g
<span style="color: green;">●</span> 1.000 g	

1 RMS ch:1 B:500-25600Hz NS:65536 T:1s	1/1;50.0Hz > 0.68 g
<span style="color: red;">●</span> 1.000 g	

**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 can have different speed and therefore different limits.

**ISO 10816**

The limits are defined according the ISO 10816 standard and are available only for velocity readings in frequency interval 10 – 1000 Hz. The Machine Group and Machine Foundation has to be defined for appropriate channel before using this standard (see [Sensors properties / ISO 10816 Machine Groups](#)).

**Note!** The severity in ISO limits are marked also by letter A, B, C, D. Used group and foundation is also displayed in graph.

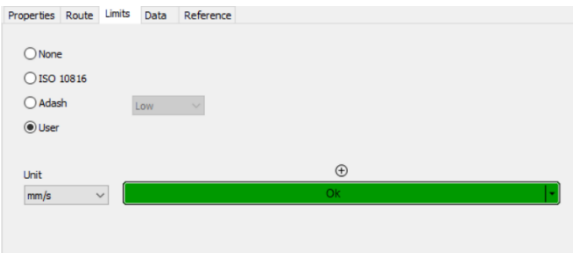


**user**

User can define own limits.

Type: user  
 Unit: mm/s  
 Alarm 1: Ok  
 Add Limit Value  
 Save

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



You can add a limit value using an **Add Limit** item and enter the value (eg. 1).

Type: user  
 Unit: mm/s  
 Alarm 1: Ok  
 Limit Value 1: 1  
 Alarm 2: Warning  
 Add Limit Value  
 Save

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



Same way you can add any number of limit values.

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



Limit values can be also edited or deleted using an appropriate **Limit Value** item.

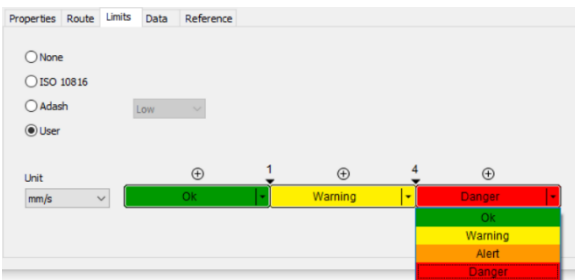
Type: user  
 Unit: mm/s  
 Alarm 1: Ok  
 Limit Value 1: 1  
 Alarm 2: Warning  
**Limit Value 2: 4**  
 Alarm 3: Alert  
 Add Limit Value  
 Save

**edit**  
 delete

Alarms are defined using an appropriate **Alarm** item.

Type: user  
 Unit: mm/s  
 Alarm 1: Ok  
 Limit Value 1: 1  
 Alarm 2: Warning  
 Limit Value 2: 4  
**Alarm 3: Danger**  
 Add Limit Value  
 Save

Ok  
 Warning  
 Alert  
**Danger**



**Note!** You can assign alarms in any order. It's not required the Ok interval to be the lowest. Eg., 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
Add Limit Value	
Save	

### **Export to uff**

exports data of selected measurement to the uff file format (not for all measurement types), the file is saved to uff folder on VA4\_DISC.

If the **Actual** measurement is displayed then only this data will be exported.

If the saved data are displayed (View Trend) then you can export just one displayed data or all data saved in memory. The unit asks you **Export (All/One)?** and then you select the button.

### **Export to wav**

exports data of selected measurement to the wav file format (time signal and orbit), the file is saved to wav folder on VA4\_DISC.

Time signal is exported as one file with two channels ( 1ch signal, 2ch trigger).

Orbit is exported as two files ( A and B channels).

before exporting you need to enter the required range of signal in wave file. It enables to obtain better resolution in file. If the true peak of signal is e.g.8mm/s, then enter e.g. 10mm/s.

Enter the wav full scale value [mm/s]
10

**Note!** You may choose the 24 bit or 16 bit encoding of the wav file using [Global properties / Global Settings / Wav encoding](#)

### **Export to csv**

exports data of selected measurement to the csv file format (see next chapter), the file is saved to csv folder on VA4\_DISC.

### **Export to csv (all)**

Export to csv for all measurements which are in the set (to a directory)

### **Export to Records**

(only when the **Record** measurement is selected)

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 the new name. The default name of the new record begins of the set

name followed by the date and time of recording (yyyy\_mm\_dd\_hh\_mm\_ss\_msec). Selected records will be exported/copied to the Recorder module (folder). Now you can work with them in Recorder module.

### ***Export to VA4\_DISC***

(only when the **Record** measurement is selected)

Very similar to previous item. Exports selected records to VA4\_DISC/ VA4recorder folder.

## ***CSV file description***

### ***Csv Header***

The first line in a csv file is a header with 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 axe unit)
- **eu**: evaluation unit
- **t**: time of measurement
- **s**: speed during measurement
- **note**: The header can also contain a note which is automatically included from the set's 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 of 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

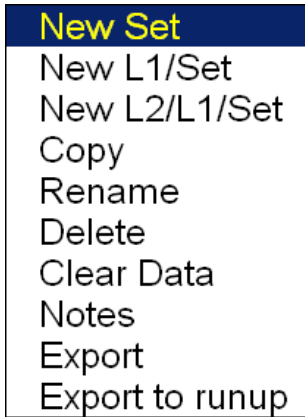
#### **Fr**

frequency, amplitude, phase, coherence

#### **Cepstrum**

frequency, amplitude

## ***Next functions available for list of projects***



**Copy** copy of selected item to the new one

**Rename** renames selected item

**Delete** erases selected item

**Clear Data** erases measured data in selected item

**Notes** see the Route chapter for details

**Export** copy of selected item to the VA4\_DISC, where is accessible for computer.

**Export to runup** export of selected item to the Runup module. Also you can export projects from Runup to the Analyzer module.

## ***Functions for Set***

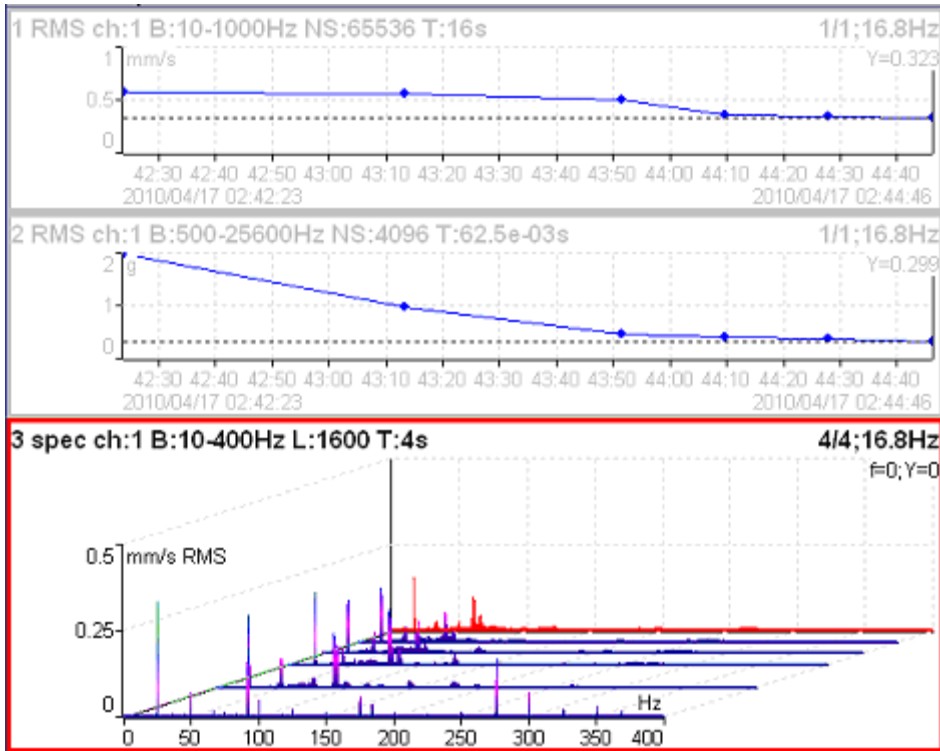
Next function are available, when the Set is opened (it means the graphs are displayed).

**Notes** see next chapter

**Save data** saves last measured data. When you close the Set without saving, the measured data will be lost.

### **View Trend/ View Actual**

The switch button for displaying of last measured data (Actual) and data saved in memory (Trend).



The View Trend example. The trends of overall values is in two top graphs. The cascade graph contains several spectra.

**Clear Last Data** if the trend is displayed, then it deletes last measured data in measurement point or set (according of displayed data).

### Enter speed

This function are available by pushing the bottom left button. This button can have various names depending of mode (Analyzer, Route) and displayed screen (Project, Machine, Set, Point, Meas).

The manual entered speed value will be saved to all next readings. It is saved to the same position in the head of data as the speed measured by tacho. If the speed is manually entered and also measured by tacho, then the tacho has priority and it is saved.

The manually entered speed is displayed on the right side at the top of the screen with the word "Speed:"

Speed: 50 Hz

You should notice, that the speed value is saved to the head of data. That is why you have to use the Tacho factor ( Machine or Point Properties) in DDS for recalculation of speed to other ratios.

The Gear Ratio (in Properties) is used with Default Speed value not with the speed value in data head. The Default speed is defined by user in Properties. It is used with machines, which have constant speed (always the same value).

### Cancel speed

It cancels (removes) manually entered speed value.

The Cancel speed function is also available in Route.

### Measurement Definition in the Set

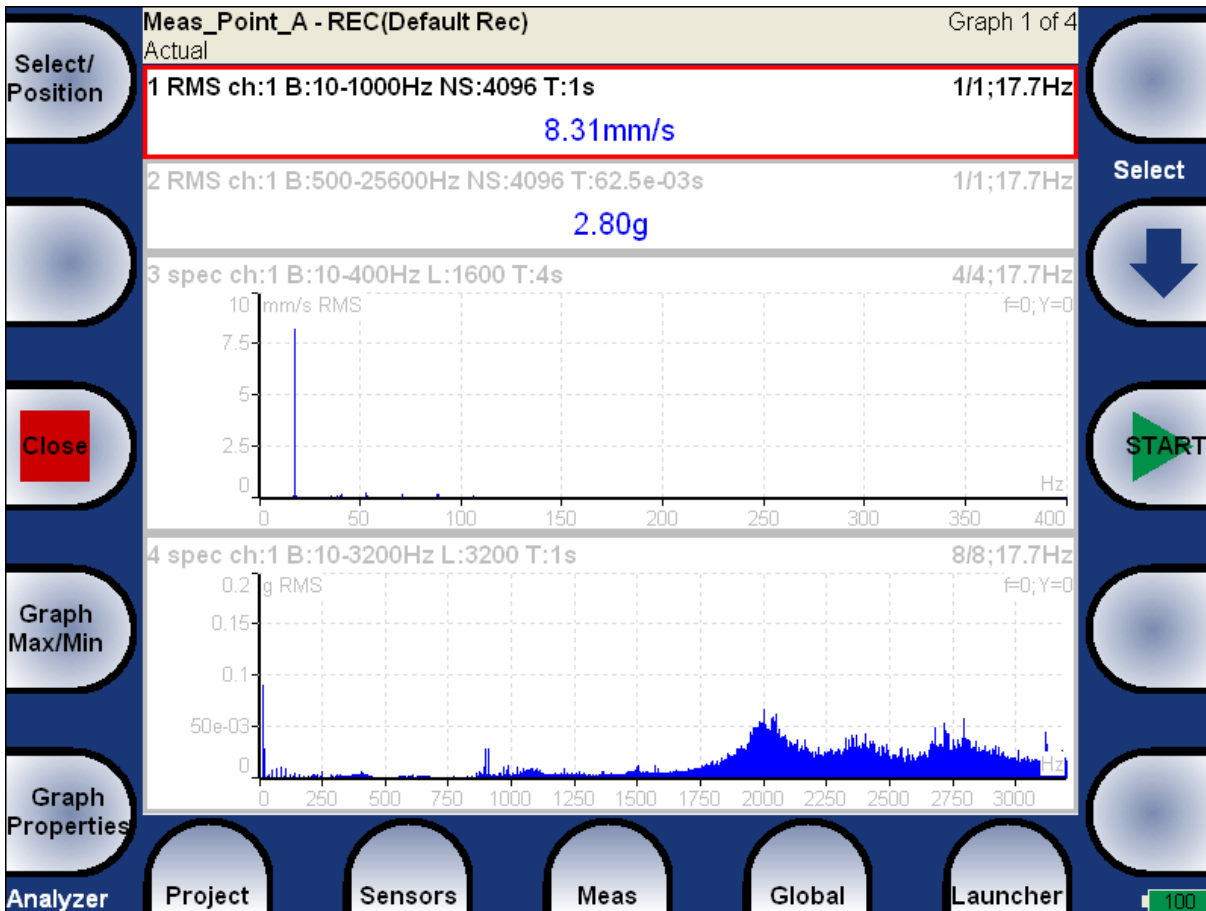
As has been described already the Set contains definitions of measurements (**Meas**), which we want to take together.

To show the example is the best way how 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: Spectrum in mm/s, range 400Hz, 1600 lines, from channel 1, number of average 4
- Meas 4 Spectrum in g, range 3200Hz, 3200 lines, from channel 1, number of average 8

When the measurements definition is made ( see the **New Meas creation** section) everything is ready to make the real measurement. Push the **Start** button (green triangle button). For stopping the measurement use **Stop** button (the red square button). If the **Analyzer Trigger Mode** is set to single, then only one measurement is taken.



Every graph on the screen contains one measurement. More screens with graphs can be developed.

The description of each graph is in the top.

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 means the time signal, from which the evaluation was made.

3 spec ch:1 B:10-400Hz L:1600 T:4s

4/4;17.7Hz

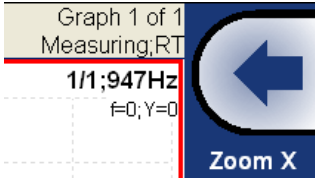
The translation: Meas No.3, Spectrum from Channel 1, Range 400Hz, Lines 1600 Time length of signal 4s, 4 signals for 4 AVG used, speed 17.7Hz

### Input Buffering

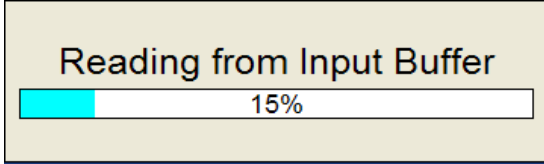
Measured signal is collected into the input memory. The analyze procedures read the signal data from the memory and compute all required results, which are displayed on the screen. In the case, when too many results are required, the computation is slow and displayed graphs are not in time - they are delayed. We are talking about **Real Time (RT)** graphs (you see the actual results) or about **Non Real Time (non RT)** graphs (delayed results).

This information is displayed in the right upper corner - **Measuring RT** or **Measuring non RT**.





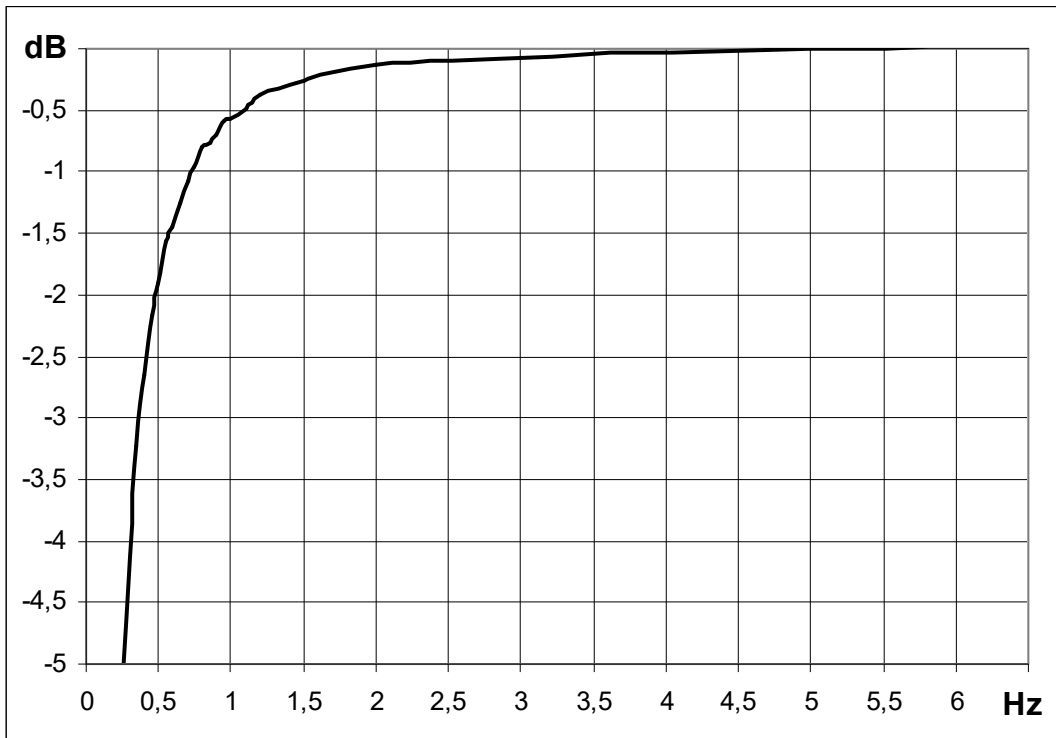
After the measurement is stopped (e.g. by **Stop** button), the computation continues until the input memory is empty. The bellow window appears.



You can wait for all data acquisition or if you are not interested of measurement from input memory press the **Stop** button to stop data processing.

### Band fmin[Hz] - HP filtering

Almost in all measurements you should define the HP filtering of input signal. You set it in **Band fmin[Hz]** parameter. You can select the **none**, **1**, **2**, **10** and **user** filter. The **none** value is available only for direct measurement without integration. The **none** value does not mean the DC part measurement. The HP filter on A/D converter is always used. But no additional filter is used. The frequency range with **none** filtering begins on 0.35 Hz (-3dB point). See the response graph.



## The Analyzer buttons description

### The Arrow Mode button

The **Arrow Mode** button switch functions of arrow buttons.

Try to push the **Arrow Mode** button and notice that the left top button changes between **Select/Position**, **Zoom X/Zoom Y** and **Move X/Move Y**.

When the delta or sideband cursor is displayed, then the additional **DeltaX** item appears.

When the measurement from disc are displayed, (**View Trend** function), then the additional **Trend** item appears.

According selected function two right top buttons change their meaning.

Functions for up and down arrows (top right buttons):

**Select** - moves the selection of active graph

**Position** - you can change the order of graphs

**Zoom** - makes zoom-in or zoom-out on vertical Y axe

**Move** - when the zoom-in is applied, then button move with the signal in defined zoom view vertically

Functions for left and right arrows:

**Zoom** - makes zoom-in or zoom-out functions on X or Y axe

**Move** - when the zoom-in is applied, then buttons move with the signal in defined zoom

**Delta X** - defines the delta X resolution for sideband or delta cursor

**Trend** - moves on the displayed measurement from disc (history).

### **The Start, OK button**

This right middle button has more purposes and it can :

**START** the measurement,

**OK** confirm the selections or entries.

### **The Stop, Cancel, Back and Close button**

This left middle button has more purposes and it can :

**STOP** the measurement,

**Cancel** the definition or selection in menu items,

**Back** moves back in structure of project

**Close** closes the measurement screen and returns you to the project list

### **Graph Max/Min**

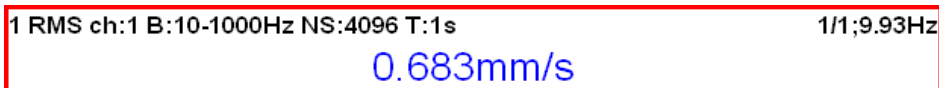
Maximizes or minimizes the selected graph to the whole screen or returns back to the initial screen with more graphs.

### **Graph Properties**

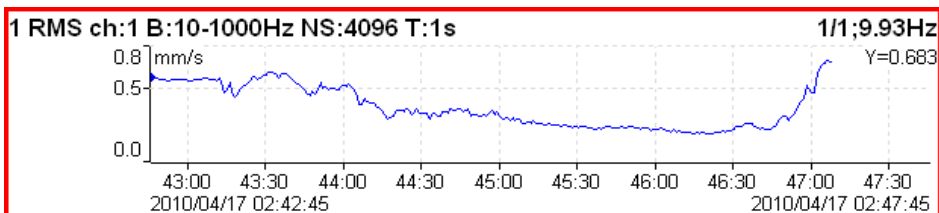
The list of properties is displayed for properties selection. The scale ranges and types (lin, log,...) definitions are the typical use.

!!! Important notice: All available values will be described for every item. But these all values are not visible always. During your work are always displayed only values/choices, which give sense at that moment. E.g. the Axe Z (third) axe is only visible in 3D graphs (e.g.cascade, spectrograph).

**Display**      value, trend



When **value** is used, then last measurement value is displayed (default setting).



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

**Scale**      max    Y autoscale for every new graph, but the range is increased when higher value comes  
                  auto    Y autoscale according data values of every new measurement

**user** user defines Y range for all graphs independently of data values

**Graph Unit** for spectra

Sets a 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, a **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.

**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

**Cursor** for spectra -

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

**Cursor position** the time or frequency position of cursor in the selected graph, manual entry available

**Delta X** the time or frequency interval used for delta cursor computation, manual entry available

**Axe X -** lin, log

**Axe Y -** lin, log

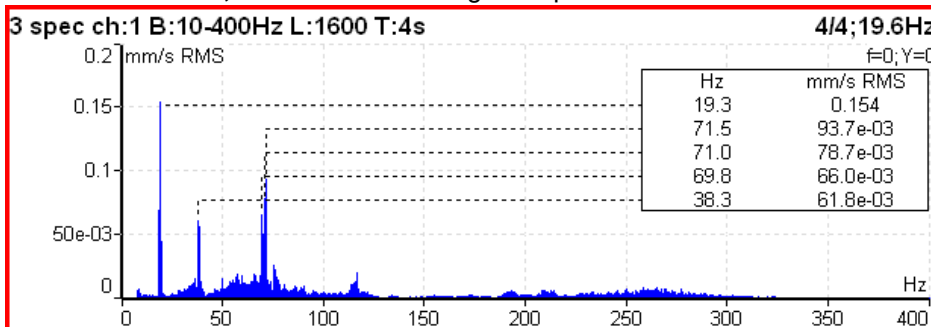
**Axe Z -** **time** scale according time of measurements  
**speed** scale according the speed of machine (tacho must be used)  
**regular** regular scale

**Order Z -** **first in front, last in front** the order of measurements on Y axe

**Detect Type -** **RMS, 0-P, P-P** Y axe type

When the spectrum is displayed first time, then the global **Spectrum Settings / Detect Type** is used. You can change it to other type here.

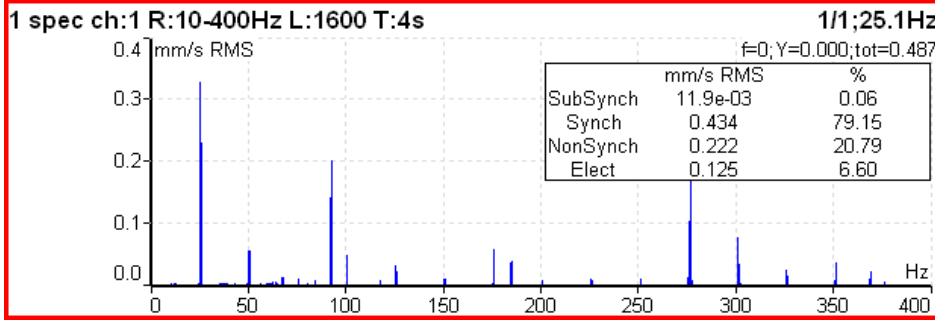
**Peaks List -** **on, off** the 5 highest spectrum lines table



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

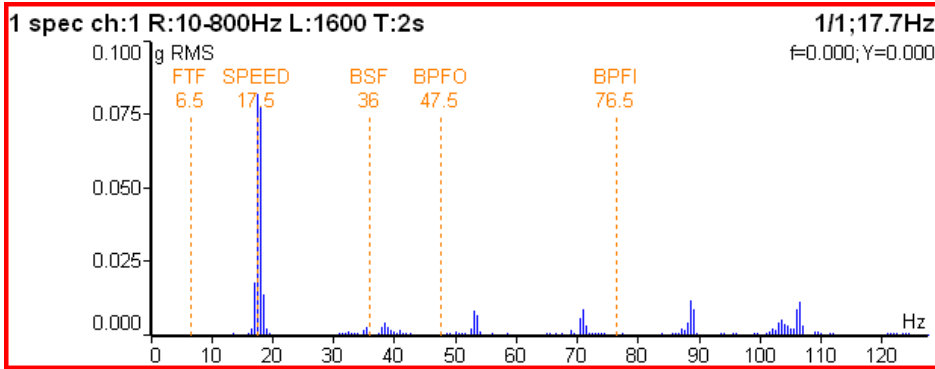
- SubSynch - value under speed frequency
- Synch - value on speed frequency and harmonics
- NonSynch - total value decreased of SubSynch and Synch
- Elect - value on line frequency and harmonics (setting in Global Settings / Power/Line Frequency)

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

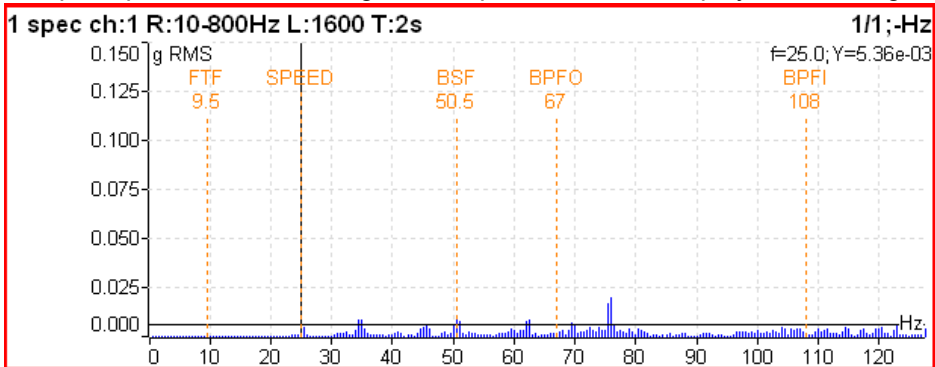


**Bearing Faults** - if the bearing type (or parameters) is defined and the tacho was used for speed measurement, then the fault frequencies are displayed in spectrum.

- **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 exactly in the spectrum, because spinning defective ball hits the bearing twice during one ball revolution: once hits outer ring and once inner ring.



If the tacho was not used (the measurement does not contain the speed information), then move the cursor to the speed position. The bearing fault frequencies will be displayed according the cursor position.



**Orders Table - on, off**      the order values table

**Statistics Table**      the basic statistic values of trend are displayed:

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

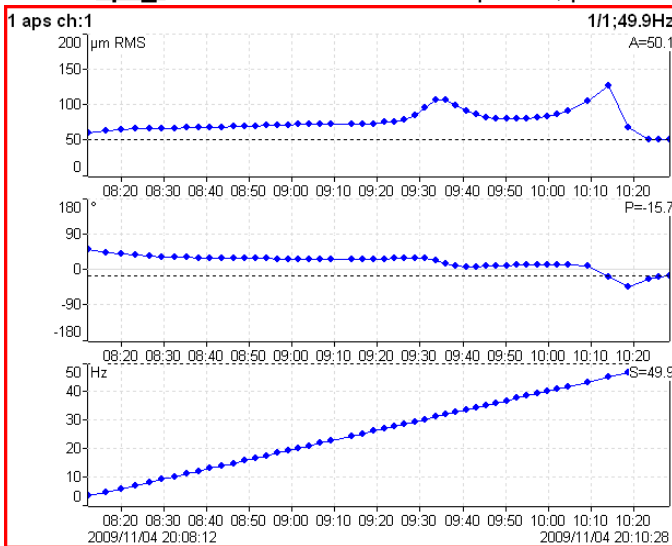
**Primary Cursor** - when the Global/Cursor Type is set to **max**, then is required to select the quantity (graph), to which will be this **max** searching function applied

**amplitude, phase, coherence** for frequency response (Frf)  
**X, Y** for orbit

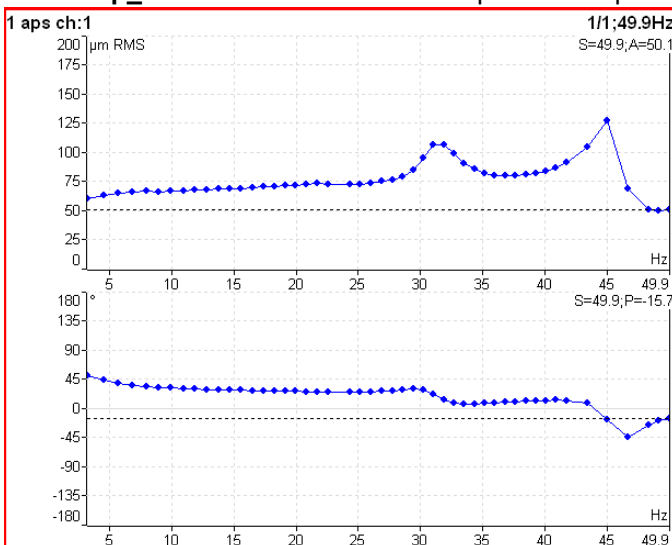
**View (center line)** **center line** standard 2D center line view, available only for **View Trend**  
**AB** two DC values for **View Actual** or two trends for **View Trend**  
**XY** data transferred to X and Y axes

**View (frf)** **ampl, phase**  
**real, imag**  
**nyquist**  
**amplitude**  
**phase**  
**coherence**  
**time**  
**amplitudes**

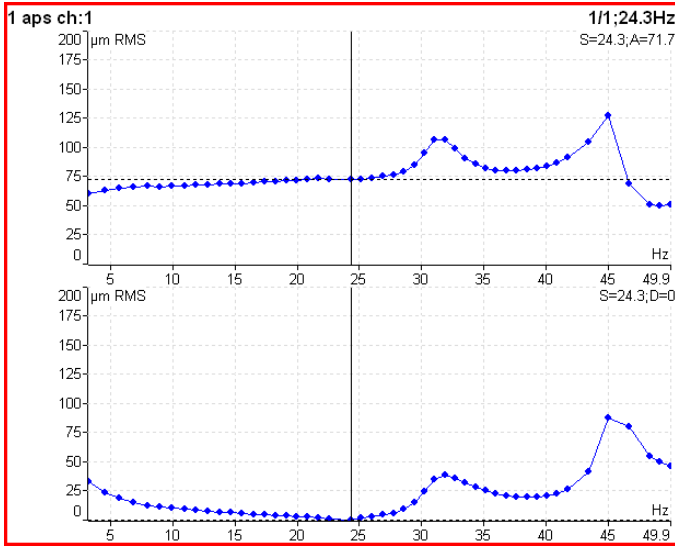
**View (amp+phase and complex Smax)** available only for trend  
**aps\_t** the trends of amplitude, phase and speed related to time of measurement



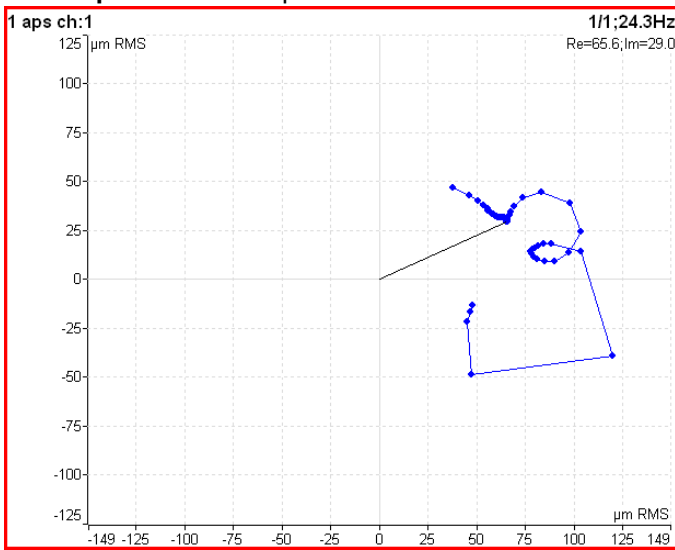
**ap\_s** the trends of amplitude and phase related to speed



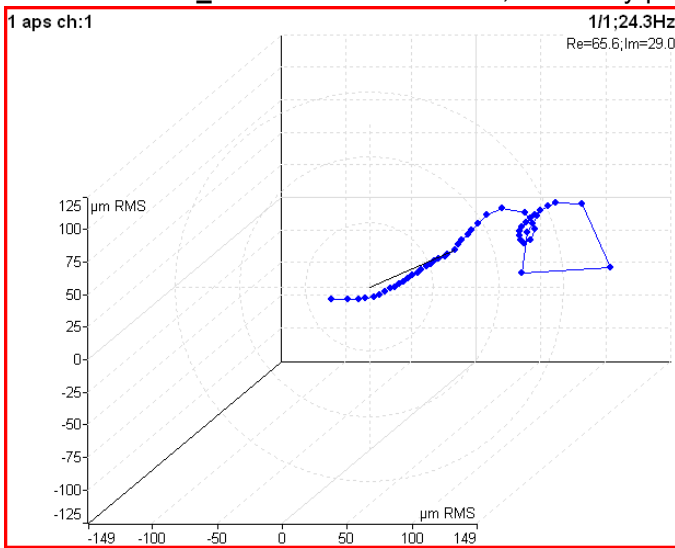
**ad\_s** the trends of amplitude (upper graph) and difference amplitude (lower graph) related to speed, the difference is related to the trend cursor position (in that point is always zero).



polar 2D complex view



trend3D\_t the 3D "tube" view, it is the nyquist graph expanded to Z axis (time scale)



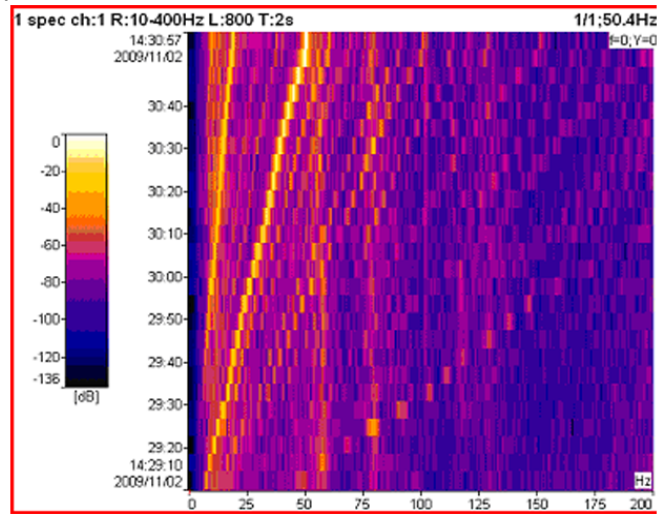
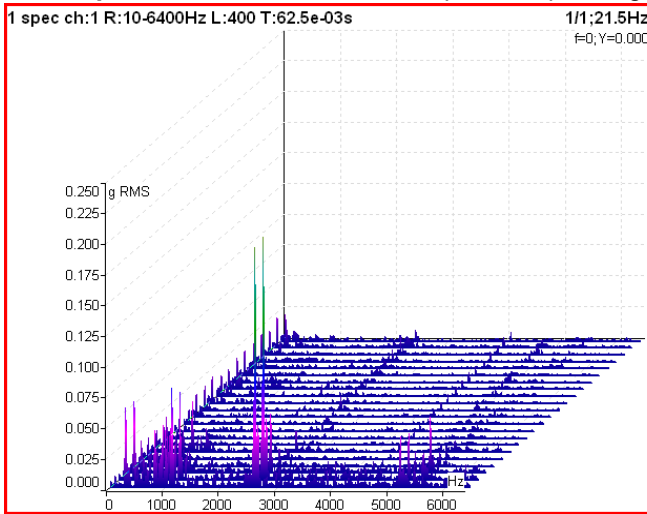
**View (phase shift)  
linear**

available only for trend graph of phase shift, amplitude ratio and coherence related to the time scale

**polar** polar plot of phase shift and amplitude ratio

**View (spectrum)-** available for trend

- amplitude** one spectrum amplitude graph
- cascade** waterfall graph
- spectrograph** 2D view of amplitudes vs. time
- phase** one spectrum phase graph



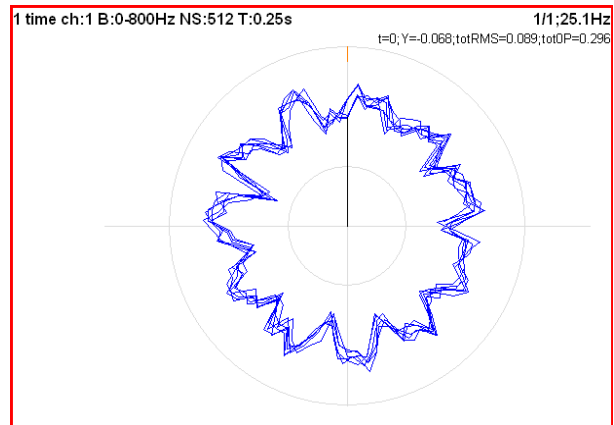
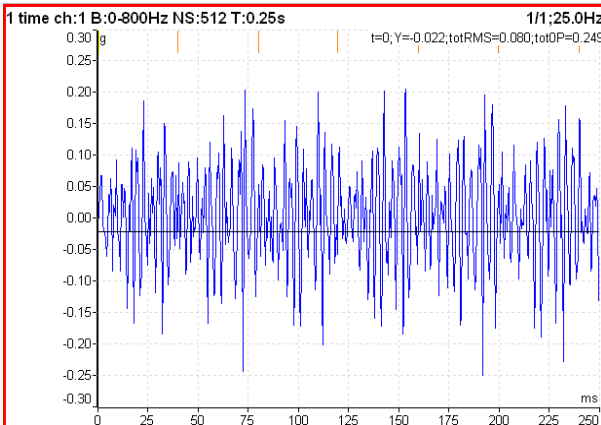
**View (spectrum)-** available for actual

- amplitude** one spectrum amplitude graph
- time** displays the time signal from which the FFT was developed
- phase** one spectrum phase graph

**View (time waveform)**

- linear** standard drawing in Cartesian coordinates
- circular** circular drawing

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



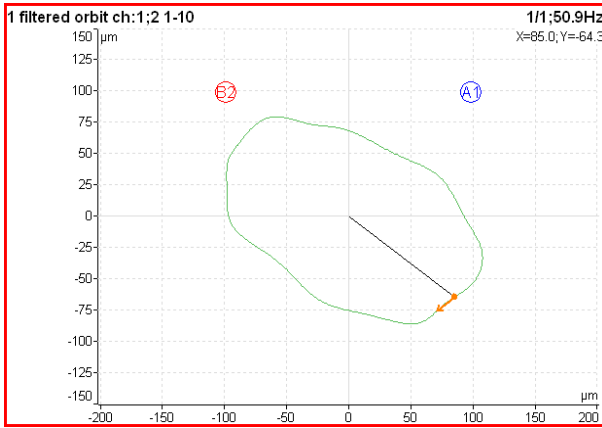
**View (orbit)**

- orbit** standard 2D orbit view
- AB** two input time signals from channels A and B
- XY** two time signals transferred to X and Y axes

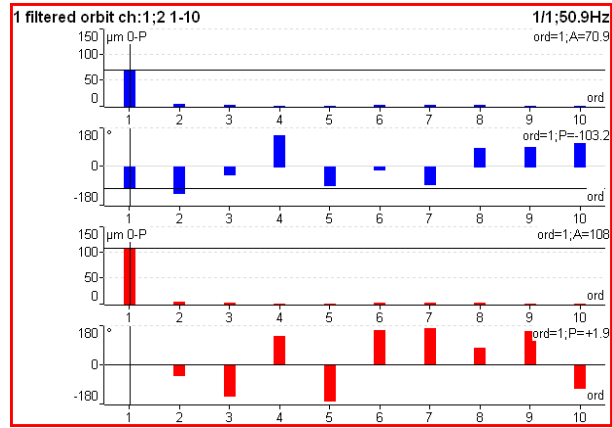
**View (filtered orbit)**

- orbit**
- orders**

## ADASH



## Adash 4400 – VA4Pro

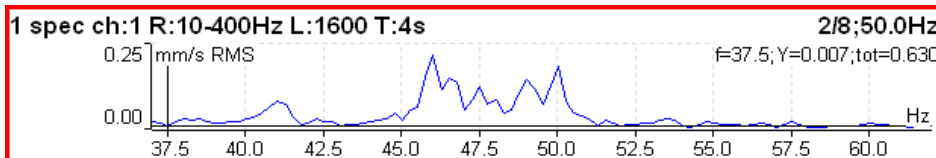


**FFT Output (spectrum)**  
**amplitude spectrum**  
**power spectrum**  
**amplitude spectral density**  
**power spectral density (PSD)**  
**energy spectral density (ESD)**

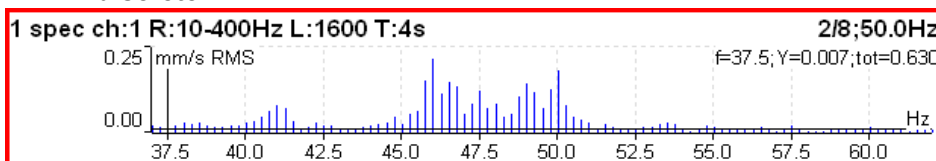
- Speed Period** **on, off** the speed time period is displayed
- FTF Period** **on, off** the FTF time period is displayed
- BSF Period** **on, off** the BSF time period is displayed
- BPFO Period** **on, off** the BPFO time period is displayed
- BPFI Period** **on, off** the BPFI time period is displayed

**Graph Lines** **continuous, discrete** the spectrum can be drawn as line through the tops of line or as discrete vertical line for each frequency

### continuous



### discrete



## 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. The alternative 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 units conversion is applied. The FRF is displayed in same units as measured.

### accelerance

acceleration / force

### mobility

velocity / force

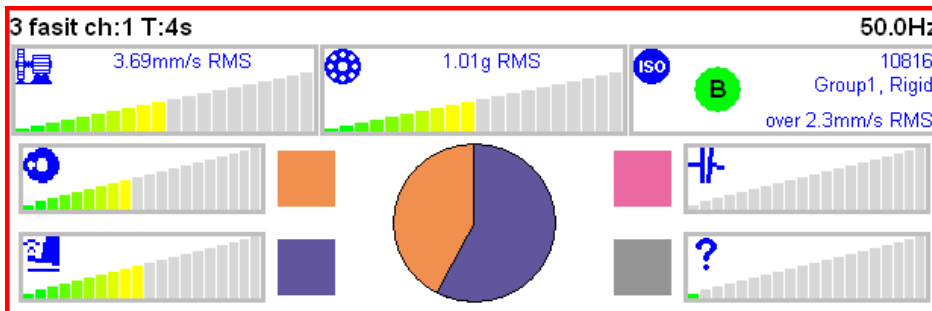
### compliance



ADASH  
 displacement / force  
**dynamic mass**  
 force / acceleration  
**mechanical impedance**  
 force / velocity  
**dynamic stiffness**  
 force / displacement

### FASIT measurement

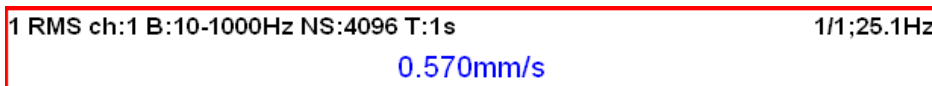
There is detailed description in the FASIT mode chapter.  
 If the FASIT is measured, the speed detection is done before the measurement itself (see the Speed detection chapter).



### Overall measurement

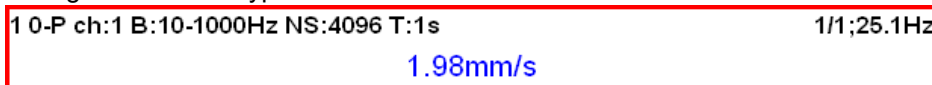
Type:	<b>wideband</b> freerun_retrig
Channel:	1
Unit:	mm/s
Detect Type:	RMS
Band fmin[Hz]:	10
Band fmax[Hz]:	1000
	<small>fs=4096Hz</small>
Trigger Control:	off
Samples:	4096
	<small>t=1s</small>
Averaging:	linear
Avg:	off
	<small>total t=1s</small>
<b>Save</b>	

This is typical example of overall measurement. The RMS value of vibration velocity in frequency range 10-1000 Hz is measured.



The first row contains used parameters. The 25.1Hz on the right is the speed, because the tachometer sensor was used.

Change the Detect Type to 0-P.



Note, that the 1.98 is not 1.414 times bigger than 0.570. Some of 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 pure sine wave! The true RMS and true peak measurement are generally independent. The only rule is that the peak value is always bigger than RMS value.

## ADASH

Adash 4400 – VA4Pro

Let's change the Avg to 8. The 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 on the right top.

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 the average of 8 0-P values ( which takes 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 of total time of measurement. It does not care if one long signal was taken or several shorter signals were averaged.

You can define the signal length also in revolutions, not only in samples (=time). The tacho signal must be available in that case.

<b>Type:</b>	<b>wideband</b> freerun, retrig
Channel:	1
Unit:	mm/s
Detect Type:	RMS
Band fmin[Hz]:	10
Band fmax[Hz]:	1000 fs=4096Hz
Trigger Control:	on
Number of Triggers:	16
Averaging:	linear
Avg:	off
<b>Save</b>	

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

## ISO 10816 overall measurement

The ISO 10816 limit values are also available for overall measurements. The green/ amber-orange/ red point is displayed in front of measured value according the ISO limit.

If you want to use this function you need to define the correct measurement parameters ( RMS velocity measurement in 10-1000Hz range) and the group for machine ( see Global/ ISO Machine Settings).

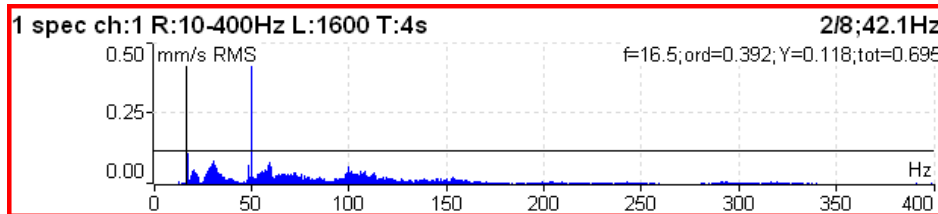
1 RMS ch:1 B:10-1000Hz NS:4096 T:1s 1/1;17.7Hz  
**D 8.30mm/s RMS** ISO 10816: Group1, Rigid  
over 7.1mm/s RMS

The color of 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 exceeding is also displayed at the bottom.

### Spectrum measurement

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

The triggering type is displayed below the spec word. The **fs** below the Range means sampling frequency. The **t** below the Lines is the time signal length, which is used for one spectrum. The **df** is the frequency resolution between lines.



The information in top right contains averaging (2/8), speed (42.1Hz) and below them cursor position (16.5Hz), order ( $f / \text{speed} = 0.392$ ), value (0.132mm/s) and total RMS of spectrum (0.619mm/s).

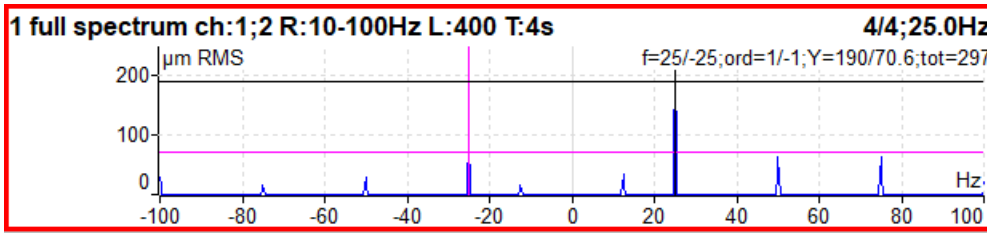
The **Band fmin** defines the frequency of HP filtering, which is used for DC part removing. If you do not expect any important lines below 10Hz, use the 10 instead 1. The initialization time of 1Hz filter is much longer than 10Hz.

The Overlap enables to you to make the averaging faster. E.g. 75% overlap means, that ending 75% of actual time signal + 25% of new signal is used for next average.

**Full spectrum**

Type:	spectrum freerun,single
A channel number:	1
Window:	hanning
B channel number:	2
Window:	hanning
Unit:	µm
Band fmin[Hz]:	10
Range[Hz]:	100
	fs=256Hz
Lines:	400
	t=4s,df=0.25Hz
Averaging:	linear
Avg:	4
	total t=16s
Overlap:	0%
Full Spectrum:	yes
	<b>Save</b>

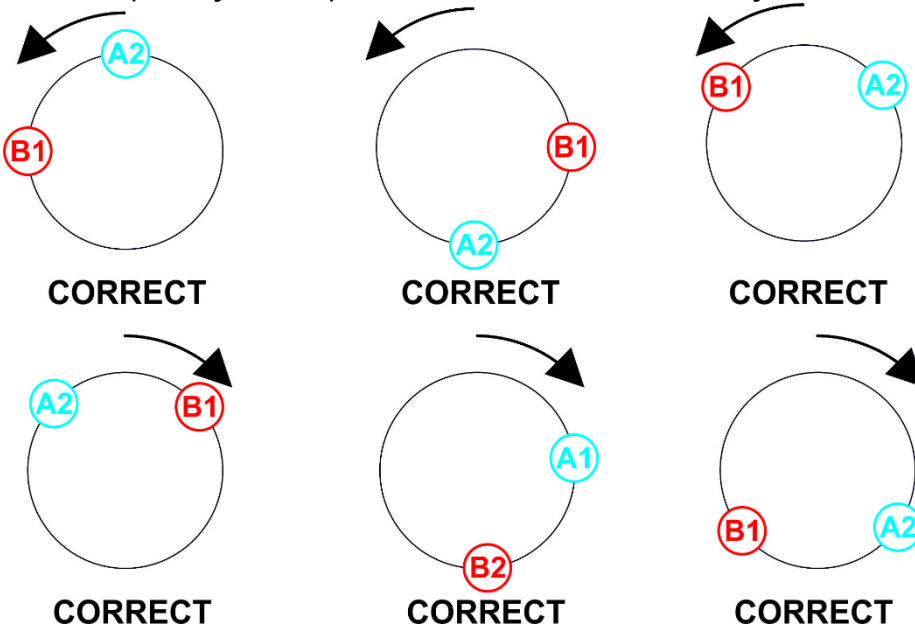
Set **Full Spectrum** to **yes**. Remember to set correct angles of both sensors. It influences the calculation. The FFT is applied to complex signal, first channel is real part and second channel is imaginary part.

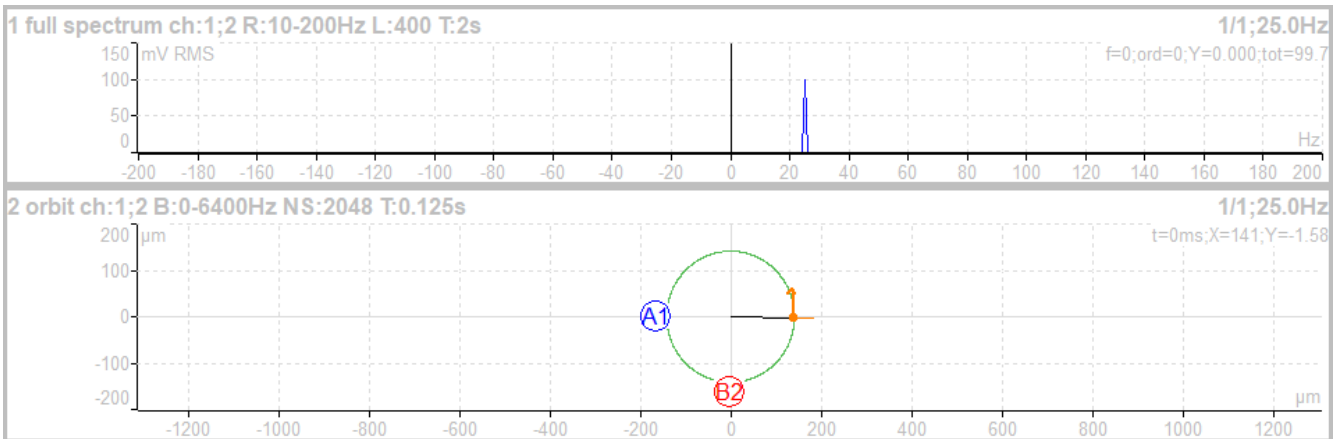
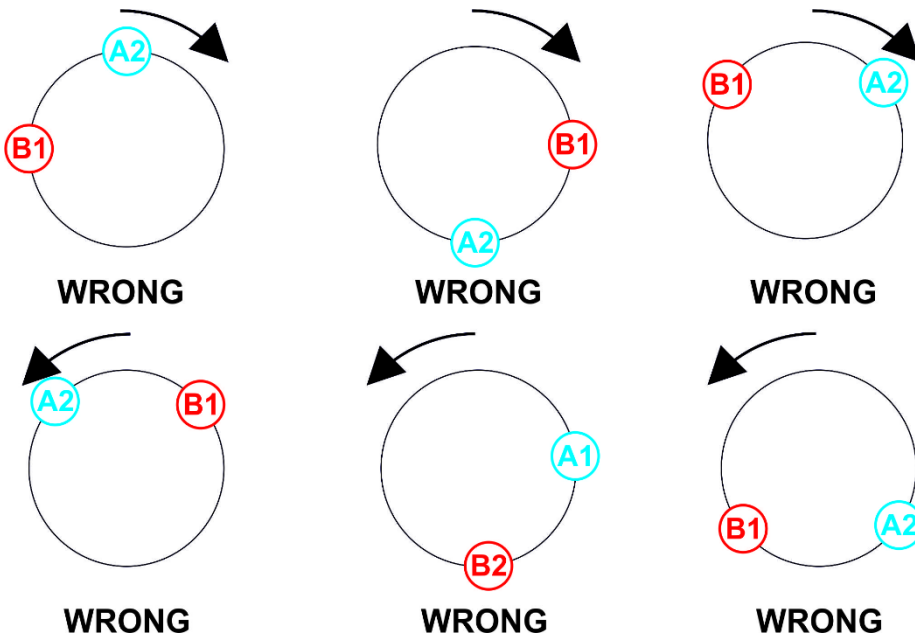


**Note:** Cursor is displayed on both sides. Different colors are used. Both cursor values are displayed.

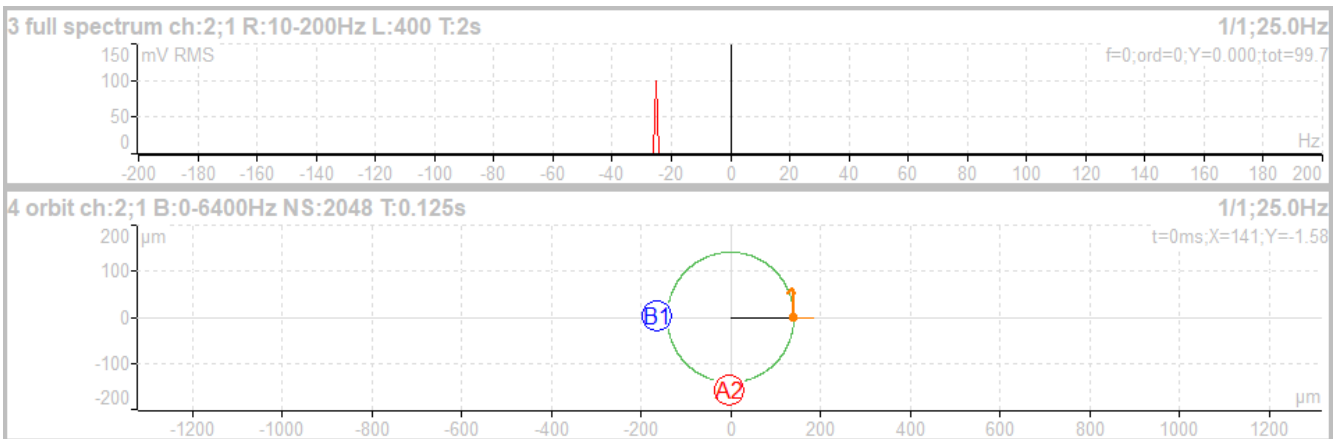
**Attention!**

The correct setting of channel A and B is critical for correct result. If this setting is wrong then the negative and positive side 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 firstly on A and then in B.





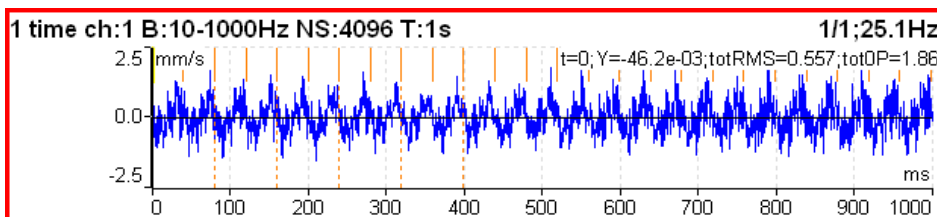
The vibration (orbit arrow) has the same direction as rotation.



The vibration (orbit arrow) has the opposite direction as rotation.

## Time signal measurement

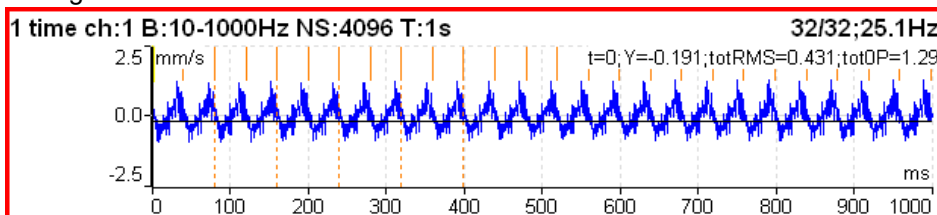
Type:	time
	freerun, retrigger
Channel:	1
Unit:	mm/s
Band fmin[Hz]:	10
Band fmax[Hz]:	1000
	fs=4096Hz
Trigger Control:	off
Samples:	4096
	t=1s
Avg:	off
	total t=1s
Save	



Similar parameter like for overall is used. The red short vertical lines at the top of graph indicates the tachometer inputs.

### Time signal averaging

For averaging you need to set the Global/ Trigger Settings/ Trigger Source = tachometer. Then define the number of averages.



You see the effect of averaging in decreasing of signal noise. The speed frequency is better seen. With the cursor values are displayed also totRMS and totOP values.

### Time signal with DC offset (gap)

You can measure a gap value from 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 channels pins take place in an **Input channels** chapter. You can order a cable with right connection from your instrument vendor.

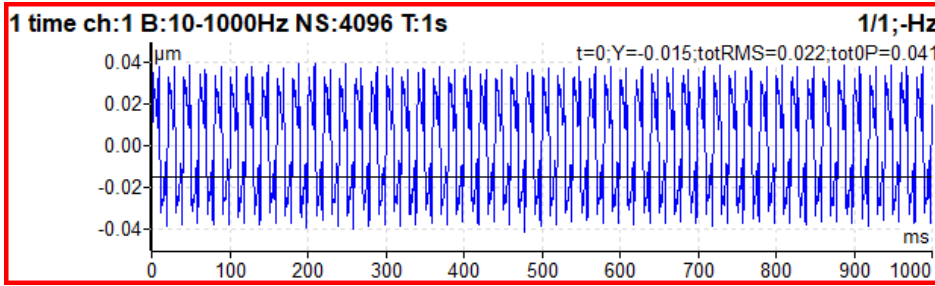
#### How to setup a sensor

Open **Sensors** menu and select used AC channel (the channel where the sensor is connected). Setup sensitivity and other values like for every sensor. 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 same as the AC channel). Then setup an associated DC sensor (sensitivity, unit and position must be same as in AC sensor).

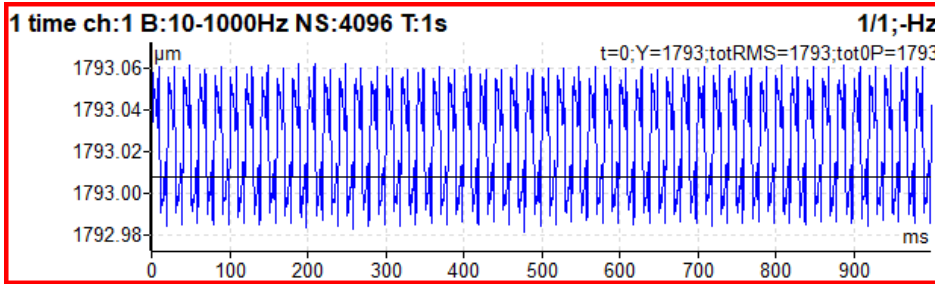
#### Measurement

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

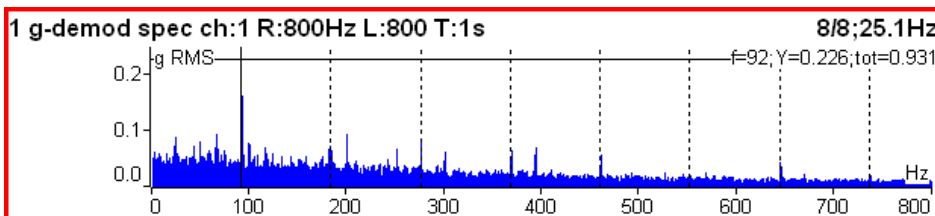


And the same signal with a gap



### G-demod spectrum measurement

Type:	<b>g-demod spec</b> freerun, retrig
Channel:	1
Window:	hanning
Unit:	g
DEMOD fmin[Hz]:	500
DEMOD fmax[Hz]:	25600
	fs=65536Hz
Range[Hz]:	800
Lines:	800
	t=1s, df=1Hz
Averaging:	linear
Avg:	8
	total t=8s
Overlap:	0%
<b>Save</b>	



Example: the demodulated frequency 92Hz with harmonics.

The Unit cannot be changed, only the acceleration g unit can be used. No integration of signal is enabled.

### G-demod time signal measurement

Type:	<b>g-demod time</b> freerun, retrig
Channel:	1
Unit:	g
DEMOD fmin[Hz]:	500
DEMOD fmax[Hz]:	25600
	fs=65536Hz
Samples:	8192
	t=0.125s
<b>Save</b>	

This function enables to see the signal, when the standard envelope demodulation is used. The Unit cannot be changed, only the acceleration g unit can be used. No integration of signal is enabled.

### G-demod overall measurement

Type:	<b>g-demod wideband</b> freerun, retrig
Channel:	1
Unit:	g
Detect Type:	RMS
DEMOD fmin[Hz]:	500
DEMOD fmax[Hz]:	25600
	fs=65536Hz
Samples:	8192
	t=0.125s
Averaging:	linear
Avg:	off
	total t=0.125s
<b>Save</b>	

It is very similar to standard overall measurement. The signal is filtered in ( DEMOD fmin, DEMOD fmax) range and demodulated then.

The Unit cannot be changed, only the acceleration g 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
<b>4.32g</b>	

### amp+phase measurement

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

Type:	<b>amp+phase</b> freerun, retrig
All Channels:	no
Channel:	1
Unit:	mm/s
Averaging:	linear
Avg:	off
Frequency:	speed
Order:	1
Resolution:	speed / 4
	t = 4 revs
<b>Save</b>	

1 1x amp+phase ch:1	1/1;50.0Hz
<b>9.71 mm/s RMS; -90.1°</b>	

By default, the 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.

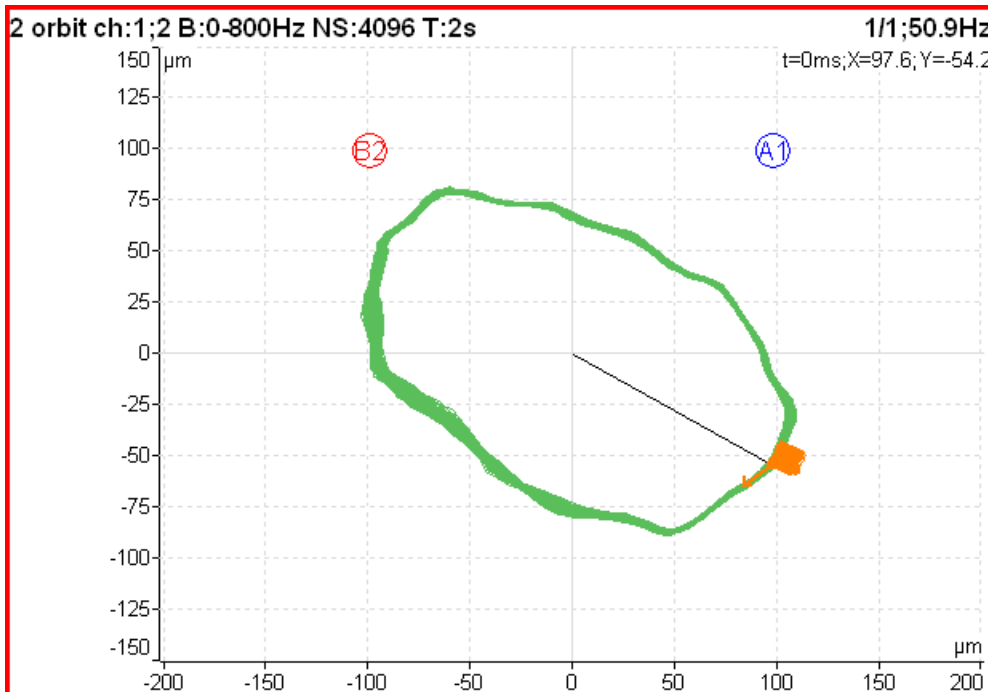
**Note!** Remember to set appropriate resolution according to used order. See **Resolution** for more details.

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 "f." label in graph's information line.



### Orbit measurement

<b>Type:</b>	<b>orbit</b>
	freerun, retrig
A channel number:	1
B channel number:	2
Unit:	µm
Band fmax[Hz]:	800
	fs=2048Hz
Trigger Control:	off
Samples:	4096
	t=2s
Avg:	off
	total t=2s
<b>Save</b>	



The A1 means, that the channel 1 is used for A orbit channel.

B2 - channel 2 is used as B.

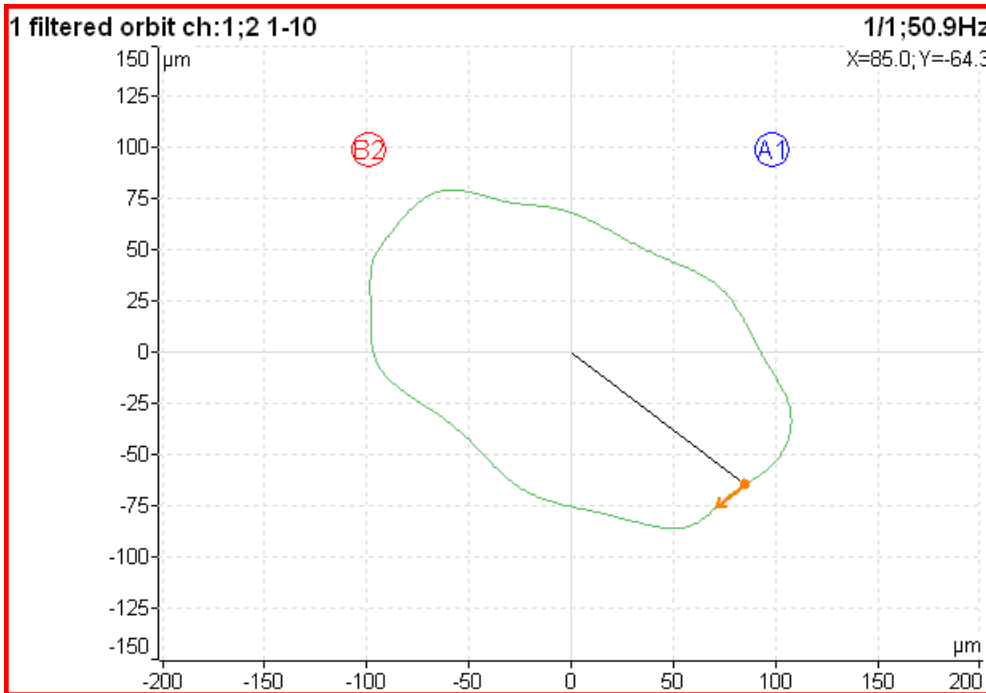
The position of A1 and B2 matches the sensor angles used for measurement (see Sensors definition). The knowledge of those angles enables to draw the correct shape of orbit.

### 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 measurement

Type:	filtered orbit
	tacho, retrig
A channel number:	1
B channel number:	2
Unit:	µm
Orders:	1-10
Averaging:	linear
Avg:	off
<b>Save</b>	

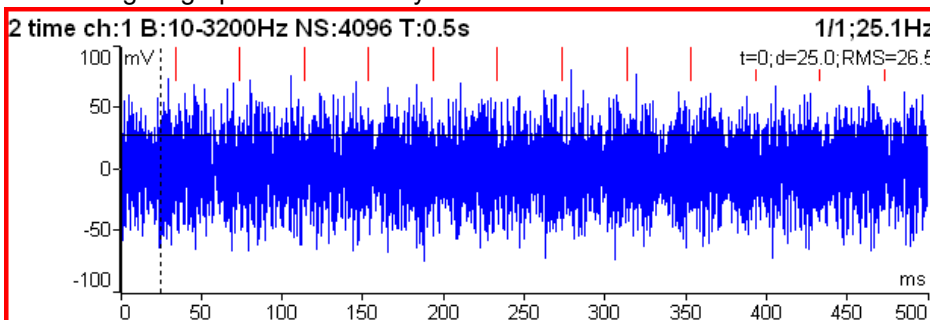


Filtered orbit is built up from two order analysis readings. Correct sensors positions (angles) must be set for correct calculations as for standard orbit graph (see Sensors definition). You can switch displayed orders on or off in **Graph Properties** menu.

### Speed measurement

The machine speed (revolutions) is measured.

When the tachometer sensor is used (connected to the tachometer input), then the impulses are added to all AC inputs. In the time signal graph are marked by short red lines.



Type:	speed
	freerun, retrig
Unit:	Hz
Averaging:	linear
Avg:	off
Save	

1 speed	25.1Hz	1/1
---------	--------	-----

The speed measurement is taken 8 times in every second. The value is evaluated from 3 tachometer events in time signal. When the averaging is required, then more values are used. But keep in mind that only 8 values are taken in one second.

### ACMT measurement

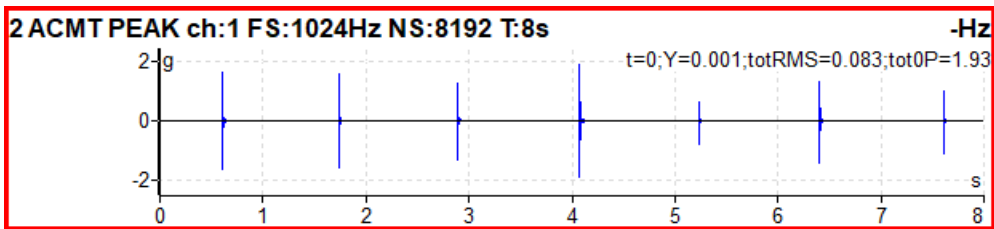
It enables to measure long time signals and compress them. It is used when you need high frequency range, for example 25.6kHz. The highpass filtering is used (Band fmin). The basic property of ACMT is resampling initial high frequency sampling (64kHz) to low ACMT FS frequency sampling (usually 1kHz).

The compressed ACMT time signal can keep the RMS or TRUE PEAK of original signal. Use the **Detect Type** parameter for selection. RMS value enables better trending.

Type:	ACMT
	freerun, retrig
Channel:	1
Unit:	g
Detect Type:	RMS
Band fmin[Hz]:	500
ACMT FS[Hz]:	1024
Samples:	4096
	t=4s
Save	



The original time signal 8 sec long, which contains shocks. Signal contains 524288 samples.

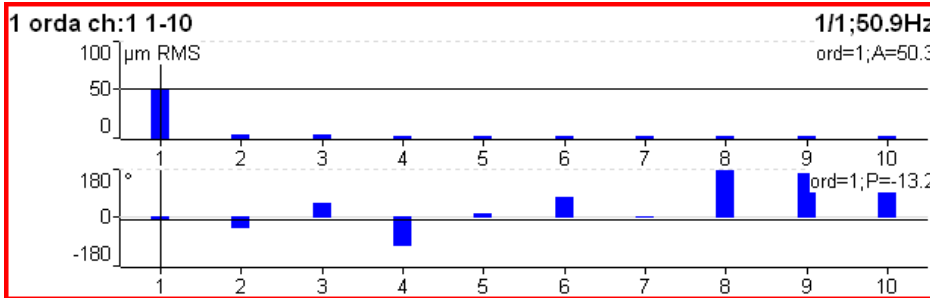


The ACMT time signal. You can see the same shocks, but signal contains only 8192 samples.

### Orders measurement

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

Type:	orders
	freerun, retrig
Channel:	1
Unit:	µm
Orders:	1-10
Averaging:	linear
Avg:	off
Resolution:	speed / 4
	t = 4 revs
Save	



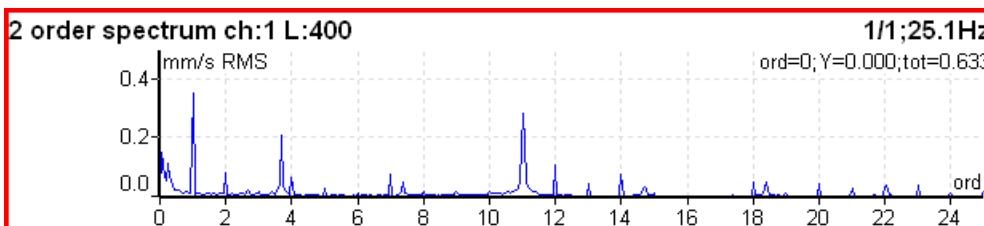
### Order spectrum measurement (order tracking analysis)

Type:	order spectrum
	freerun, retrig
Channel:	1
Unit:	mm/s
Band fmax[Hz]:	3200
	Low speed=2Hz
Lines:	400
Orders:	25
	16 revs
Averaging:	linear
Avg:	off
Save	

The **Band fmax** defines the range of spectrum. All frequencies over this range will be equal zero. To define this range is necessary, when you need high number of orders. The required range is equal number of orders multiplied by speed frequency. Be careful, higher **Band fmax** increases the minimum speed, which can be used. This minimum you can see below (**Low speed**). When the speed is lower then this value, then error appears and the measurement is stopped.

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 then orders number as the minimum.



**Order full spectrum**

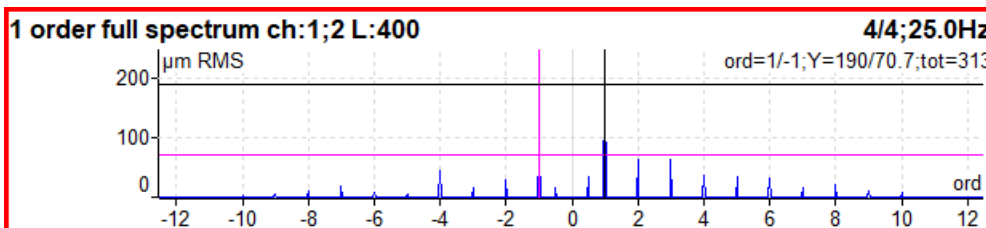
Type:	order spectrum freerun, single
A channel number:	1
B channel number:	2
Unit:	µm
Band fmax[Hz]:	3200 Low speed=4Hz
Lines:	400
Orders:	10 32 revs
Averaging:	linear
Avg:	4
Full Spectrum:	yes
Save	

Full spectrum            **yes, no**

the spectrum will have two sides, positive and negative (see literature about turbine analysis for more details). It is important to define correct sequence of channels. It must match the rotation direction. It means, the tacho mark must come to A channel CH1 first and then to B channel. Otherwise the positive/negative parts would be transposed.

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

**Note:** Cursor is displayed on both sides. Different colors are used. Both cursor values are displayed.



**Attention!**

The correct setting of channel A and B is critical for correct result. If this setting is wrong then the negative and positive side are interchanged. See Full spectrum for details.

**Phase shift measurement**

The measurement of phase shift (between two channel A and B), amplitude ratio and coherence on speed frequency (with tacho) or manually entered frequency.

Type:	phase shift freerun, retrig
A channel number:	1
B channel number:	2
Avg:	off
Frequency:	speed
Order:	1
Resolution:	speed / 4 t = 4 revs
Save	



The result contains:

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

If the phase shift is reliable, then the coherence must be bigger then 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 “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 measurement

The direct DC signal can be measured by this function.

<b>Type:</b>	<b>dc</b> <small>freerun, retrig</small>
Manual Entry:	no
Channel:	1
Unit:	°C
Averaging:	linear
Avg:	off
<span style="color: red; font-weight: bold;">Save</span>	

1 dc ch:1

22.6 °C

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

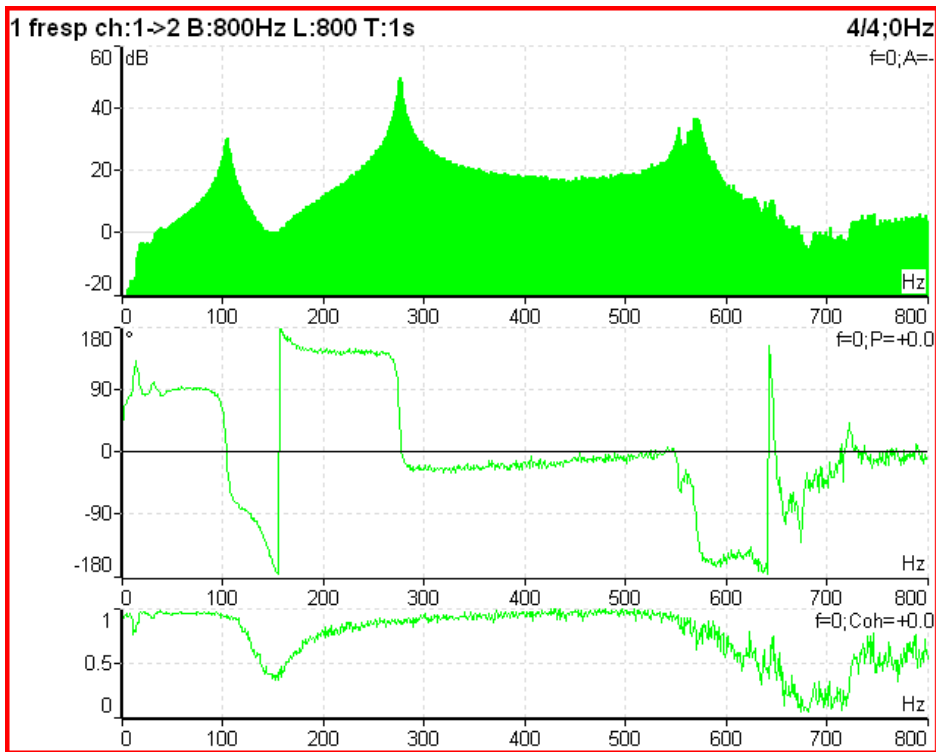
**Enter value [°C]**

Manual Entry (Graph1)

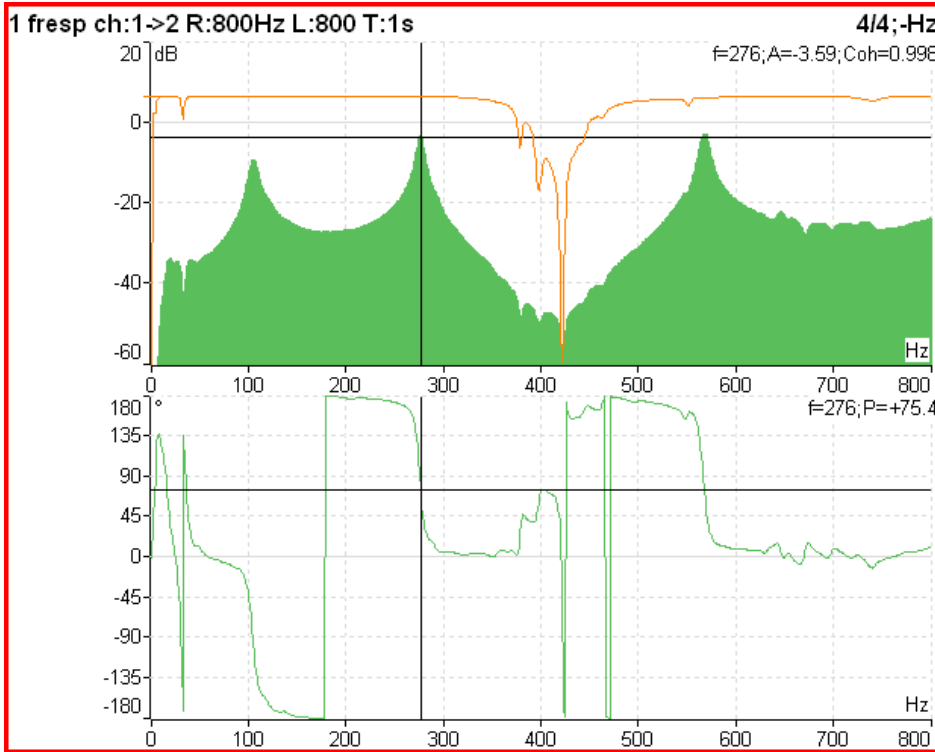
22.6|

**Frf measurement - frequency response function**

Type:	fresp freerun,retrig
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=2048Hz
Lines:	800
	t=1s,df=1Hz
Avg:	4
	total t=4s
Overlap:	0%
	Save



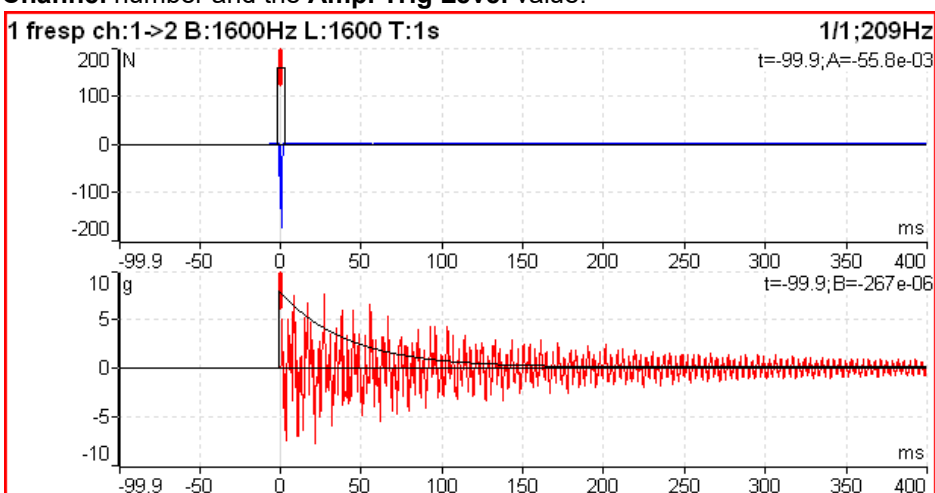
From ver.2.32 is the coherence displayed in the amplitude graph. The short horizontal line on Y axe is on position of value=1 for coherence.



This display is created by this Graph Properties.

<b>Cursor Position [Hz]:</b>	<b>0</b>
Scale:	auto
Axe X:	lin
Axe Y:	dB
Range[dB]:	80
Fresp View:	ampl,phase
Primary Cursor:	amplitude
<b>Save</b>	

When you set the Frf view to **time**, you see the time signals from both channels. When you use the hammer, the remember to set the **Trigger Settings/ Trigger Source** to **amplitude**, the **Pretrig** to e.g. 25%, select **Ampl Trig Channel** number and the **Ampl Trig Level** value.



Use the **Arrow mode** button and set **Shift** or **Length** top right buttons. Now you can simply shift with FFT windows or change the length. When you use the **Shift1** button, you change the **Shift1** to **Shift2** or to **Shift12** (shift both windows together) by using the top left button **Shift1/Shift2/Shift12**. The frf function do not use the any HP filter. If you want to compare the time signal from frf with standard time signal, you must set the **Band fmin** to none.



**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 measurement**

All parameters are described in Octave Analysis chapter. The exponential averaging is not available in Analyzer mode.

**Center line measurement**

This measurement is often used for turbines. The **Center line** values define the static position of shaft in bearing.

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

<b>Type:</b>	<b>center line</b> freerun_retrig
DC A channel number:	1
DC B channel number:	2
Unit:	µm
Avg:	off
<b>Save</b>	

The Center line is related to the orbit measurement. We also need two sensors with known angles of mounting. Correct dc sensors positions (angles) must be set for correct calculations (see Sensors definition).

While in orbit we see the shape around the (0,0) position, in the center line we see the position of shaft center without shape of orbit.

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 offset value. The X,Y values represent that positions according the Cartesian X,Y coordinates ( The position (0,0) correspond the position, where A,B are equal their offsets). The polar graph is displayed for trend.

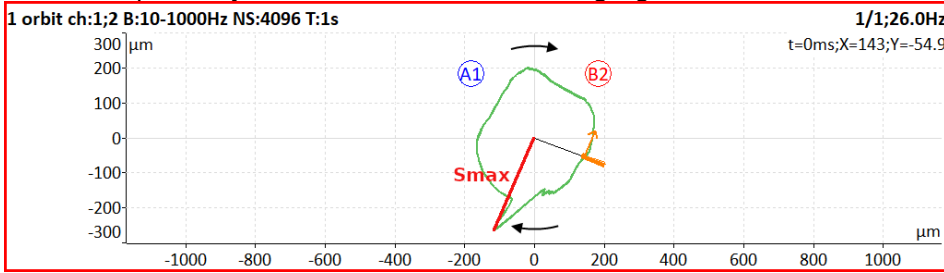
**Smax measurement**

<b>Type:</b>	<b>Smax</b> freerun_retrig
A channel number:	1
B channel number:	2
Unit:	µm
Band fmax[Hz]:	800 fs=2048Hz
Trigger Control:	off
Samples:	512 t=0.25s
Averaging:	linear
Avg:	off total t=0.25s
<b>Save</b>	

1 Smax ch:1;2 B:800Hz NS:512 T:0.25s	4/4;50.9Hz
115µm	

It is standard Smax measurement as the maximum vector amplitude of displacement. Correct sensors positions (angles) must be set for correct calculations as for standard orbit graph (see Sensors definition).

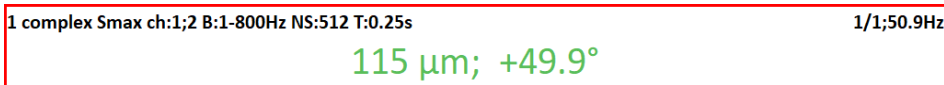
In the next picture, you can see the Smax value highlighted on the orbit.



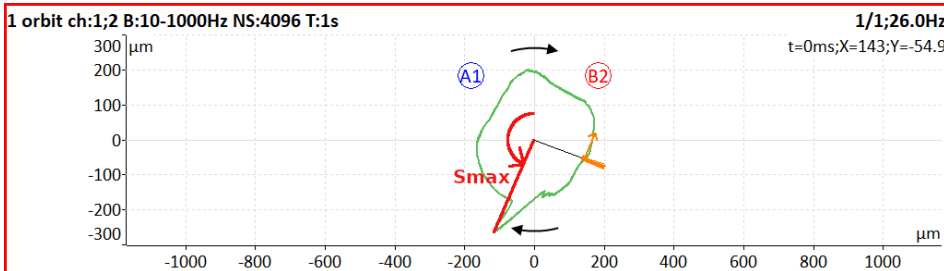
### Complex Smax

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

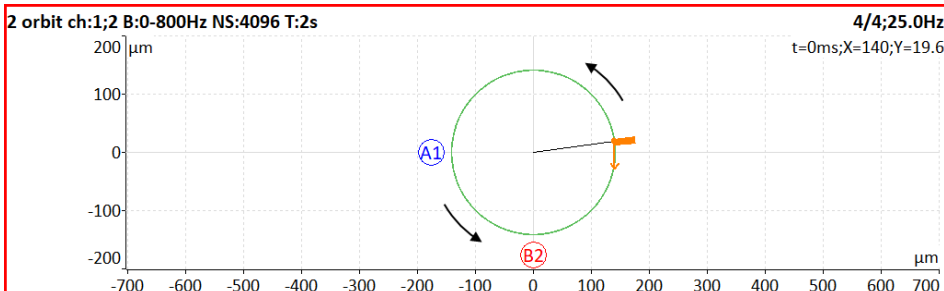
Type:	complex Smax freerun, retrigger
A channel number:	1
B channel number:	2
Unit:	μm
Band fmin[Hz]:	1
Band fmax[Hz]:	800
fs =	2048 Hz
Trigger Control:	off
Samples:	512
t =	0.25 s
Averaging:	linear
Avg:	off
total t =	0.25 s
Save	



In the next picture, you can see the Smax value and its position highlighted on the orbit.

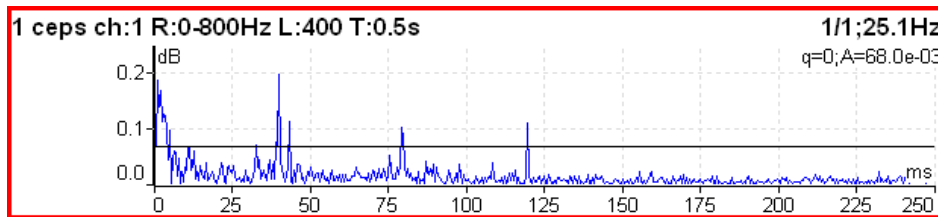


**Note!** The angle of the maximum displacement can be sometimes ambiguous. Let's consider an orbit with a perfect circle shape as an example (see a picture below). The Smax angle in this case is a random number, and when averaging such Smax, the angle is undefined.



### Cepstrum measurement

<b>Type:</b>	<b>cepstrum</b> freerun, retrig
Channel:	1
Window:	hanning
Unit:	g
Band fmin[Hz]:	10
Range[Hz]:	800 fs=2048Hz
Lines:	400 t=0.5s, df=2Hz
Avg:	off total t=0.5s
Overlap:	0%
<b>Save</b>	



Used algorithm is  $\text{cepstrum}(x) = \text{inv}(\text{fft}(\log_{10}(\text{abs}(\text{fft}(x))))))$

- x frequency
- fft fourier transform
- abs absolute value
- log10 common logarithm
- inv inverse function

### Ultrasound measurement

<b>Type:</b>	<b>ultrasound</b> freerun, retrig
<b>Save</b>	



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

**Note:** The ultrasound sensor (microphone) required.

There is detailed description in the Ultrasound mode chapter.

**Record**

<b>Type:</b>	<b>record</b>
	freerun, retrig
Sampling Frequency[Hz]:	65536
	Range=25600Hz
AC1:	on
AC2:	off
AC3:	off
AC4:	off
DC1:	off
DC2:	off
DC3:	off
DC4:	off
Trigger Channel:	on
Time[minutes]:	1
Start of Rec:	freerun
<b>Save</b>	

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

Creates and saves the record. After the download to PC it is ready for using with VA4\_Virtual Unit (see the **A4410 Virtual Unit** chapter).

There is detailed description in the Recorder mode chapter.

# **The Balancer**

## **Introduction**

The balancing process is based on standard measurements of amplitude, phase on the speed frequency. If you are not familiar with field balancing method, please see any special literature.

## **The Project**

The Project is the base structure in balancer. It corresponds of one balancing job. You can use the same Project for repeated jobs on the same machine. The measured data will be re-written.

The Project contains all measured or entered data, which were be used during the job. The typical scheme looks like next list of steps:

- Project name enter.
- Mode (machine type and number of planes) enter.
- RUN 1 - Initial measurement of vibration amplitude and phase in required number of planes.
- Trial mass put on the rotor. Step by step to all planes.
- RUN 2 - Trial mass response measurement. Step by step to all planes.
- Final masses put on all planes.
- RUN 3 - Check of effect (success) measurement.
- Trim measurements for additional masses and better results.

## **The Project Screen**

**Every step is displayed in one screen.**

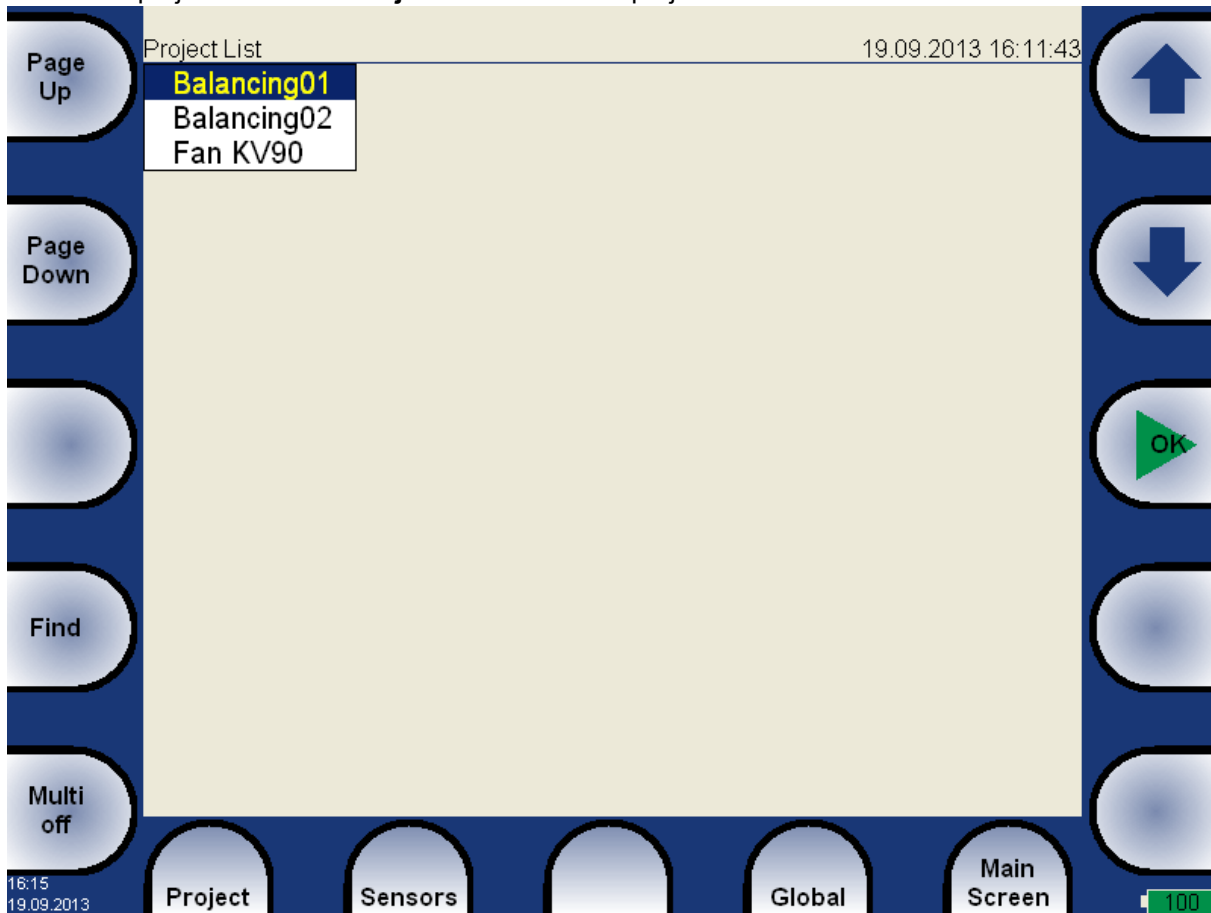
**The movement between screens is provided by up/down arrows.**

The usual Enter button is not used, it could confuse the user. The movement enables to return back anytime. The important property must be clearly told. When you return back in the job screens and you take again repeated measurement or value enter, then the measured data will be erased in all screens after actual screen. The reason is simple. The implications are derived from every screen to the next screens. When you repeat the measurement, you change the parameters for those implications. That is why all next screen implications must be removed and you have to make all necessary measurements again.

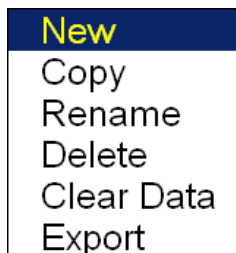
## The first screen

The list of saved projects or the Empty label is displayed on the first screen. The time and date of last saving of selected project is displayed in top right corner.

Select one project or use the **Project** button for **New** project creation.



Also next functions for projects managing are enabled.



**New** when you select the New item, then you will entry the name of new project. The screen for manual entry was in details described in **Menu - how to work with ...** section.

**Copy** creates the new project as the copy of selected project ( like Save As function in MS Word). Only the header data are saved (machine name, balancing type,...). No measured data are saved.

**Rename** renames the selected project. The project with old name does not exist anymore.

**Delete** deletes selected project.

**Clear Data** erases all measured data, only the project header remains in unit.

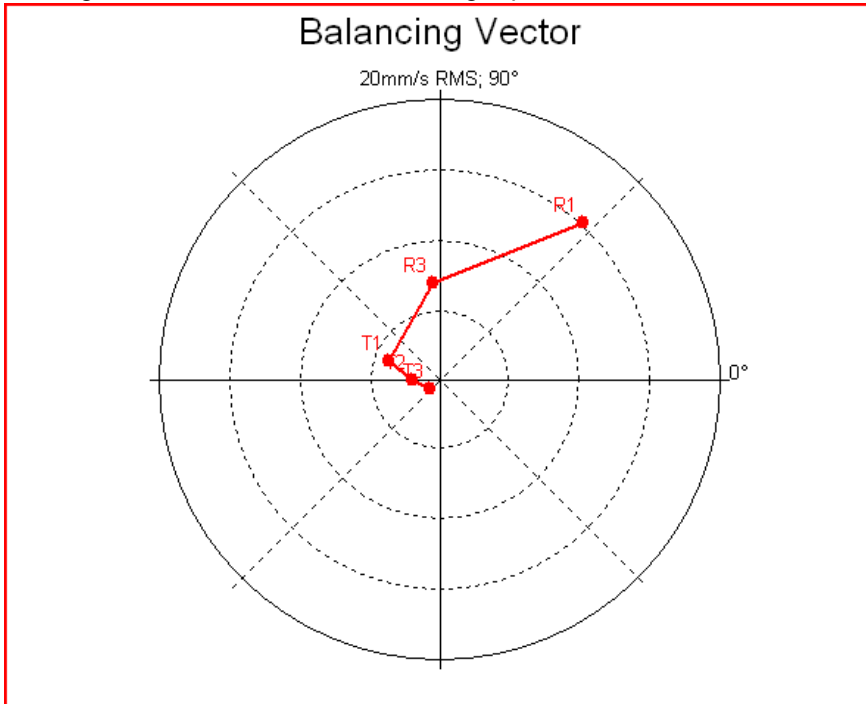
**Export** exports selected project to VA4\_DISC.

Next functions are available for opened project.

<b>Balancing Report</b>
Balancing Vectors
Total Mass

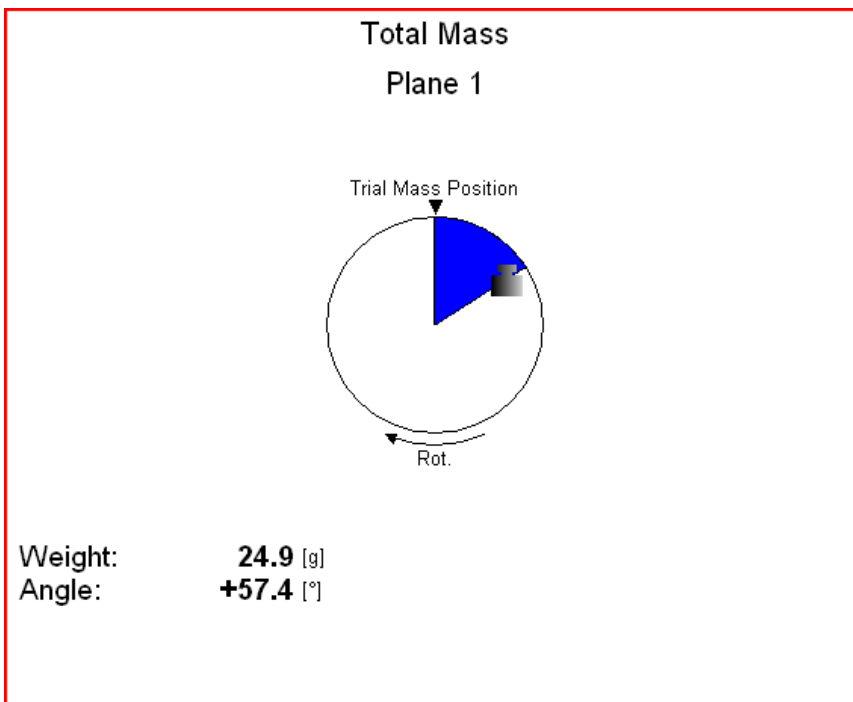
**Balancing Report** creates balancing report in rtf format (MS Word) and save it to VA4\_DISC for PC downloading.

**Balancing Vectors** the drawing of amplitude/phase vector development during the balancing process. The drawing is also included to the balancing report.



Description: R1-RUN1, R3-RUN3, T1-T3 -trims 1-3.

**Total Mass** displays the total balancing mass. It is the vector sum of all masses mounted to the rotor (basic+all trims).



## New project

Push the **Project** button and select the **New** item. Enter the name of project. The new project is added to the list of projects and it is selected (active in dark color). Press **OK**, it will be opened. The list of basic properties appears. Define your values and press **OK**.

## Balancer Settings

All project properties are defined under this button. When you push it, the menu with several items appears.

### Basic Settings

Počet rovin:	jedna
Zobrazení:	nedef
Směr otáčení:	CW
Kanál pro bod:	1
Odebrat test.závaží:	ano
Vyvažovací hmoty:	přidej (přípevni)
Lopatky:	nepoužity
Režim měření:	jedno měření
Průměrování:	vypnuto
Rozlišení:	otáčky / 4
Uložit	

<b>Planes</b>	<b>single, dual</b>	plane(s) balancing
<b>Image</b>	selection of machine image, different images are available for single and dual plane balancing	
<b>Look</b>	<b>left, right</b>	view direction (only for single plane balancing)
<b>Rotation</b>	<b>CW, CCW</b>	clockwise or counterclockwise
<b>Inputs</b>	<b>single, dual</b>	one or two AC inputs (sensors) can be used (only for dual planes balancing)
<b>Channel</b>	<b>1-4</b>	the number of AC input, which will be used for sensor mounted on the bearing (only for single plane balancing)
<b>Channel A</b>	<b>1-4</b>	the number of AC input, which will be used for sensor mounted on the bearing A (only for dual planes balancing)
<b>Channel B</b>	<b>1-4</b>	the number of AC input, which will be used for sensor mounted on the bearing B (only for dual planes balancing)
	<b>Note:</b> The bearing marking A and B has only the symbolic sense. It has no relation to the balancing planes 1,2 and to the balancing computational procedure. You can mark any bearing as A and the second as B.	
<b>Remove Trial</b>	<b>yes, no</b>	The trial mass can be left on the rotor or can be removed from the rotor after trial run.
<b>Remove Trial (Plane 1), Remove Trial (Plane 2)</b>	<b>yes, no</b>	For dual plane balancing, you may remove or keep trial on each plane individually.
<b>Balancing Masses</b>	<b>add (mount) / remove (drill)</b>	
<b>Blades</b>	the number of blades ( for rotors with blades). This parameter is used in job figuring to split the mass to blades.	
<b>Meas Mode</b>	<b>single, online meter</b> when you push the <b>Start</b> button, then only one measurement value can be taken (single) or the continual measurement values displayed (online meter). In online meter mode you can look at more values and to evaluate the changing of them in time. You need to <b>STOP</b> the measurement, when is displayed the value, which you want to use.	
<b>Avg</b>	the averaging of more then one measured values is available	
<b>Resolution</b>	read the explanation in the Meas functions/ New Advanced section.	



**Units Settings**

<b>Amplitude:</b>	mm/s
Detect Type:	RMS
Speed:	RPM
Mass:	g
<b>Save</b>	

**Amplitude** selection from available units for used sensor

**Detect Type** **RMS, 0-P, P-P**

Initially the global **Spectrum Settings / Detect Type** is used. You can change it to other type here.

**Speed** selection from available units for speed

**Mass** selection of unit for mass

**Rotor Settings**

<b>Rotor Mass[kg]:</b>	-
Correction Radius[mm]:	-
Balance Quality Grade:	-
<b>Save</b>	

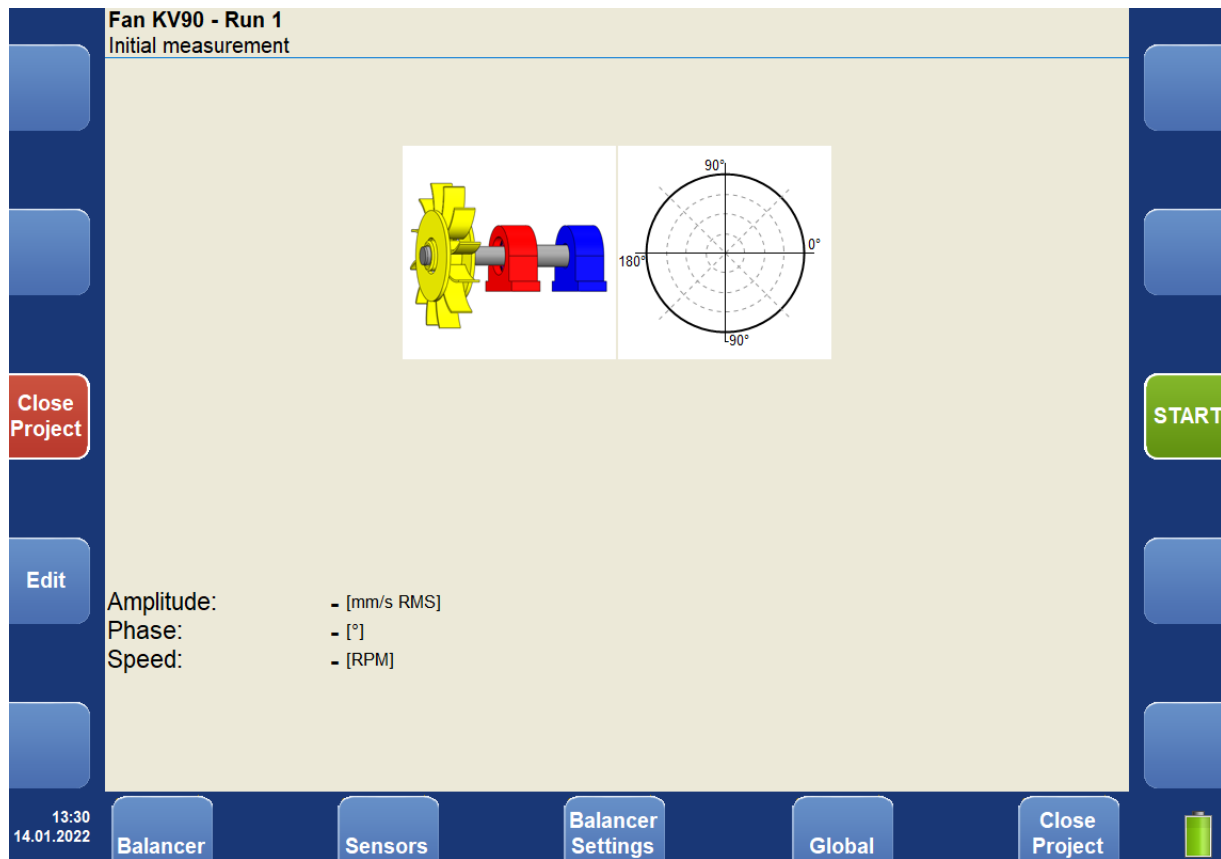
All parameters are optional. It enables to calculate balancing quality factor according ISO1940.

**Rotor Mass** rotor mass in kg

**Correction Radius** radius to which the balancing mass will be mounted,  
(could be different for each plane).

**Balance Quality Grade** demanded quality grade according to ISO 1940,  
if entered, the recommended trial can be computed.

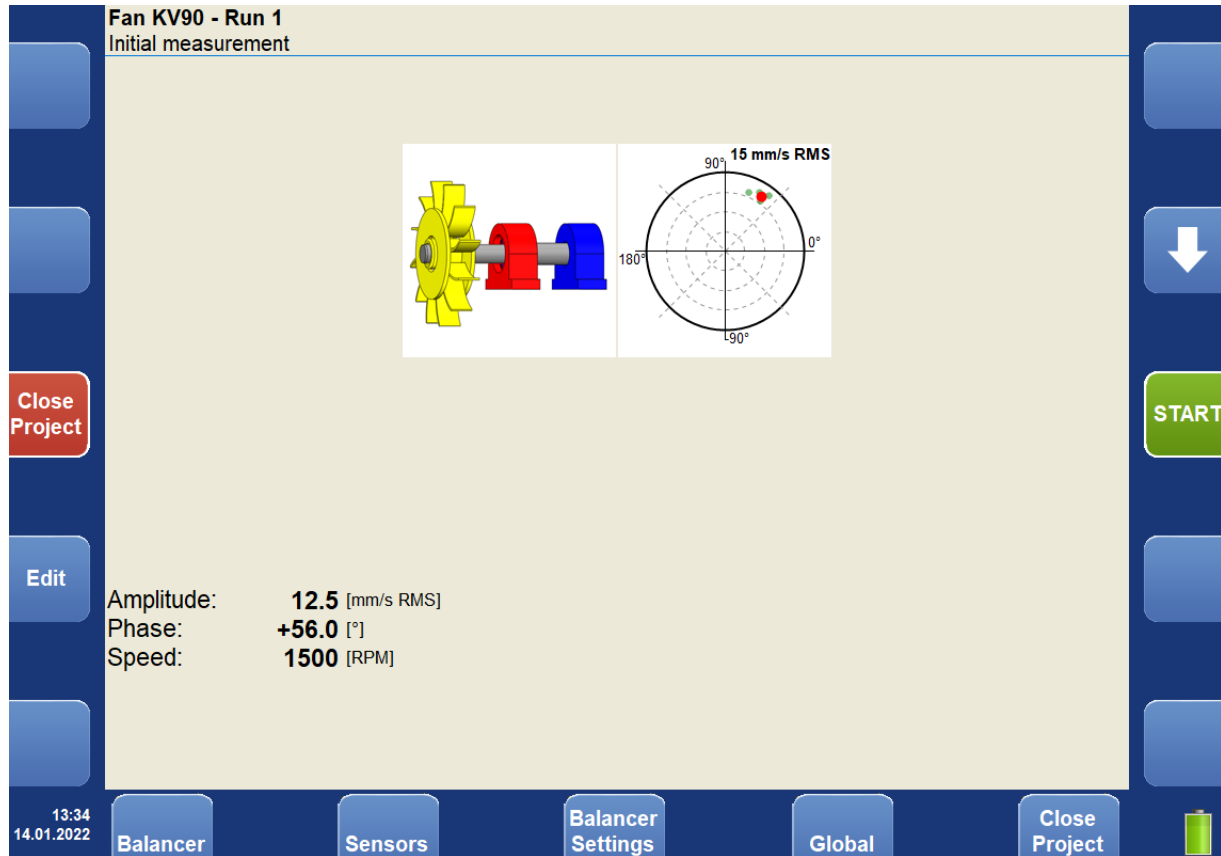
**Run 1**



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.

Press **START** button and measurement will be taken.

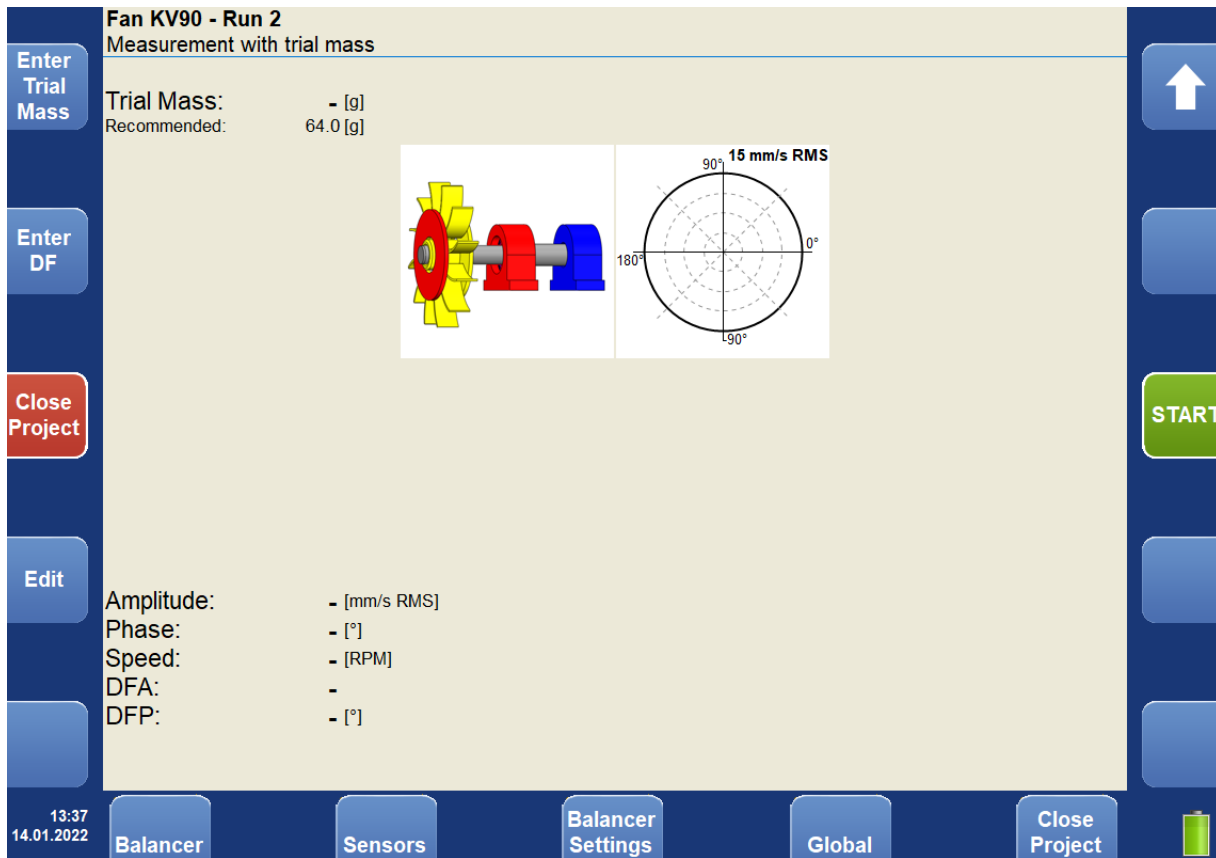
If you press the **Edit** button, then you can manually enter all values (balancing calculator function). Use the **Tab** for shift between values.



The red dot in the polar graph shows the current amplitude and phase in the complex plane. Smaller green dots show all values during measurement process when the Meas Mode is set as **online meter**.  
Use the **down arrow** to move to the next screen.

### Run 3 – Trial Mass

The trial mass mounting and response measurement is required to take on RUN 2 screen.



Push the **Enter Trial** button and enter the weight of trial. Confirm by **OK**. The weight can be negative, it represents removing of mass ( for example dismounting of old balancing mass). The recommended weight is displayed only if the **Rotor settings** parameters are entered.

Push **START** button for measurement.

Push **Edit** and all values can be manually entered ( balancing calculator function). Use **Tab** (in left) for cursor movement.

Amplitude:	<b>19.0</b> [mm/s RMS]
Phase:	<b>+145.0</b> [°]
Speed:	<b>1500</b> [RPM]

After the RUN2 measurement the dynamic factor is displayed. The **DFA** and **DFP** ( amplitude and phase) values are the response values of standardized trial mass ( mm/s<sub>RMS</sub> / 1kg regardless the selected unit for balancing). If you will balance the same machine again after some time, then you do not need to measure the RUN2. Instead of that you only will enter the DFA,DFP values in this screen. Use **Enter DF** button for that.

DFA:	<b>322</b>
DFP:	<b>+178.6</b> [°]

Moreover, if you have entered Correction Radius and Rotor Mass values in the Rotor Settings menu, the **Unbalance** and **Bal.Quality** values according to *ISO 1940* are displayed. In case the values are satisfactory, you don't need to continue with the balancing job.

Unbalance:	<b>7.76</b> [gm]
Bal.Quality:	<b>40.0</b>

**Note!** If the trial mass is kept, it is included in the unbalance calculation.

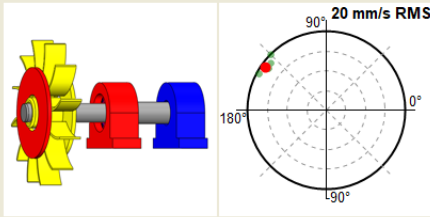
**Fan KV90 - Run 2**  
Measurement with trial mass

Enter Trial Mass  
Trial Mass: **70.0** [g]  
Recommended: 64.0 [g]

Enter DF

Close Project

Amplitude: **19.0** [mm/s RMS]  
Phase: **+145.0** [°]  
Speed: **1500** [RPM]  
DFA: **322**  
DFP: **+178.6** [°]  
Unbalance: **7.76** [gm]  
Bal. Quality: **40.0**



13:40  
14.01.2022

Balancer Sensors Balancer Settings Global Close Project

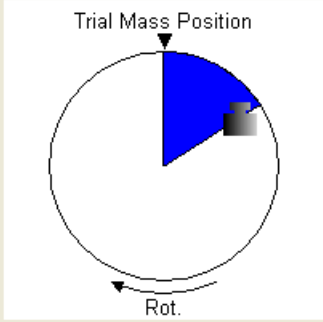
Use the **Down** arrow to move to the next screen.

### Run 2 – Result

The weight and phase(position) of the final balancing mass are displayed. Mount the final mass. The angle is applied from the trial mass position, which represents the 0 (zero) degrees. The direction of the angle is the same as the direction of rotation. E.g. +57 degrees means from the trial mass position in the direction of rotation. Minus degrees means against the direction of rotation.

Fan KV90 - Run 2  
Weight and position of balancing mass

Trial mass removed



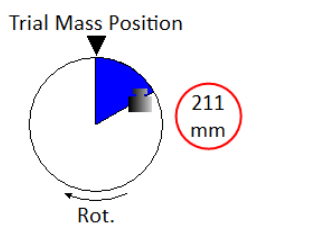
Angle: **+57.4 [°]**  
Weight: **24.9 [g]**

01:45p.m.  
06/23/2017

Balancer Sensors Balancer Settings Global Close Project

100

In case you have entered the **Correction Radius** value, there is a circumferential distance of the balancing mass from the trial mass displayed on the side.



You can split correction mass to two arbitrary angles (in case if it is not possible to place the correction mass into calculated position). Go to menu **Balancer / Split Balancing mass**

Enter the value of the first angle.

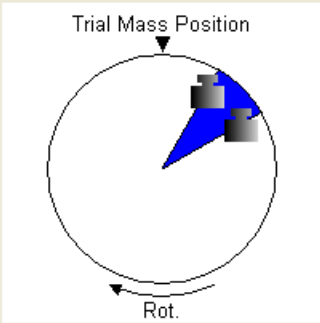
Enter first angle [°]  
30

Then enter the value of the second angle.

Enter second angle [°]  
60

The balancing mass will be recalculated (split) into two required angles.

**Trial mass removed**

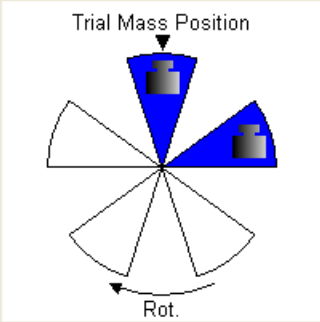


Angle:	<b>+30.0</b>	
Weight:	<b>2.30</b>	[g]
Angle:	<b>+60.0</b>	
Weight:	<b>22.9</b>	[g]

Select **Balancer / Set Default Angle** to return back to the original calculation.

If the number of blades was defined, the final mass is divided between the two nearest blades. The blade number is always counted from the position of the trial mass. It means the trial mass is mounted to blade number one.

**Trial mass removed**



Blade:	<b>1</b>	
Weight:	<b>6.63</b>	[g]
Blade:	<b>2</b>	
Weight:	<b>22.1</b>	[g]

You can select other blades in case when you cannot mount weight to the nearest blade (blades). Select **Balancer / Change Blades** menu item.

Enter the number of the first blade.

Enter first blade (1 - 5)  
1

Then enter the number of the second blade.

Enter second blade (1 - 5)  
3

New balancing masses will be displayed.

**Trial mass removed**

Blade:	<b>1</b>
Weight:	<b>42.3</b> [g]
Blade:	<b>3</b>
Weight:	<b>35.7</b> [g]

Select **Balancer / Set Default Blades** menu item to return to the original masses.

### Run 3 – Success Check

When the mass or masses are mounted you want to check the job. The screen is very similar to RUN 1 screen. Make the measurement or manually enter the values.

Amplitude:	<b>1.10</b> [mm/s RMS]
Phase:	<b>+36.0</b> [°]
Speed:	<b>1500</b> [RPM]
Run 1:	<b>12.5</b> [mm/s RMS]
Effect:	<b>91.2</b> [%]
Unbalance:	<b>0.683</b> [gm]
Bal.Quality:	<b>6.30</b>

**RUN1**            amplitude of RUN1

**Effect**            is the reduction of balancing in % (the 1.1mm/s is the 9.2% of 12.5 mm/s according to rounding)

**Unbalance**      the residual unbalance after the correction mass was applied

**Bal.Quality**     balancing quality factor according ISO 1940 (mass of rotor and radius of balancing required)



### Trim – Further Improvement

After RUN3 measurement you can continue (press down arrow) with the job when you are not satisfied with the results. These next steps do not required trial mass measurements already. After each measurement the next mass (masses) is recommended. The trim screens are very similar to screens described beyond.

#### Trim 1

Angle: **+38.4** [°]  
 Weight: **2.22** [g]

The recommended trim mass is displayed. After the mounting press the down arrow.

The TRIM 1 screen appears. It is the same screen as RUN 3 screen. Run the measurement or enter the values. Then the new results, effect and quality value are displayed.

Amplitude: **0.900** [mm/s RMS]  
 Phase: **+59.0** [°]  
 Speed: **1500** [RPM]  
 Run 1: **12.5** [mm/s RMS]  
 Effect: **92.8** [%]  
 Unbalance: **0.559** [gm]  
 Bal.Quality: **2.50**

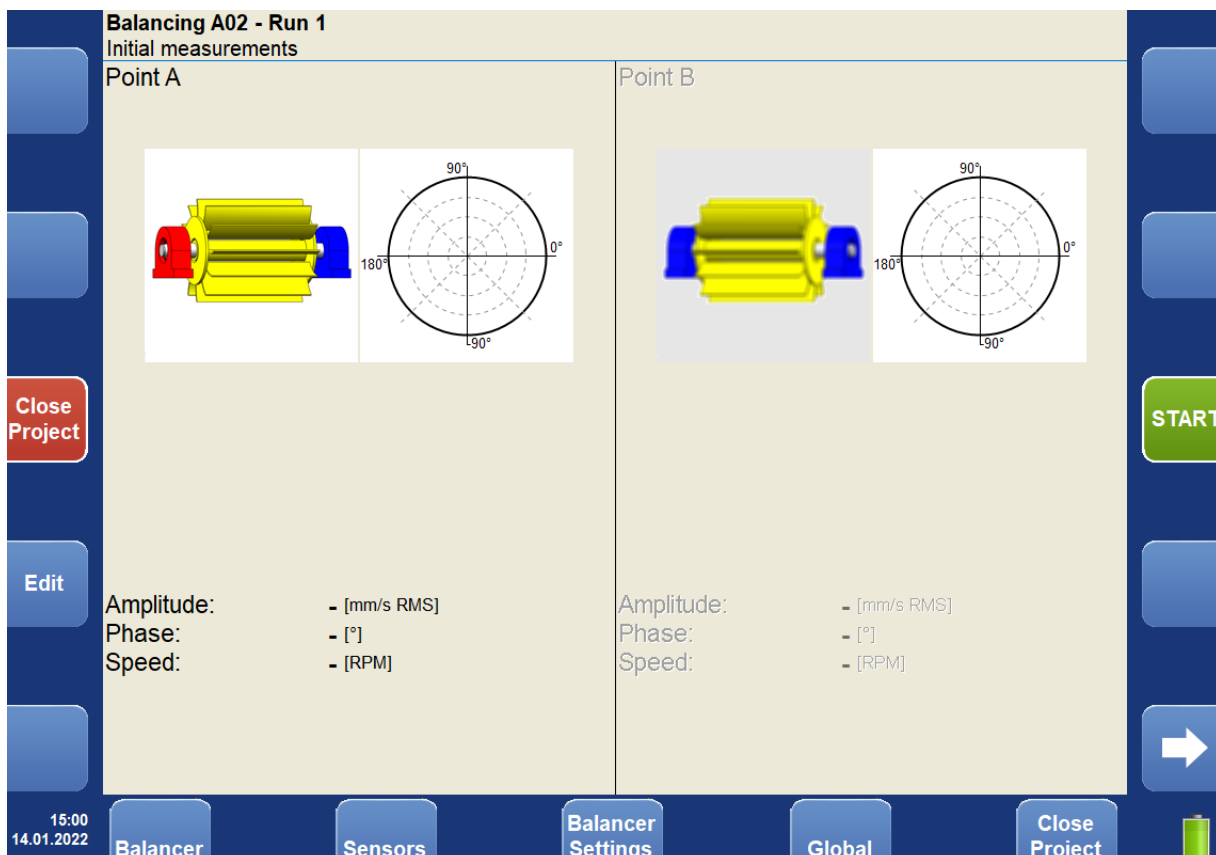
Press the down arrow and continue with TRIM 2 in same way as with TRIM 1. You can use how many trims you want. But when after trim the result is not better (or even is worse) the next trims has not sense.

## Dual plane balancing

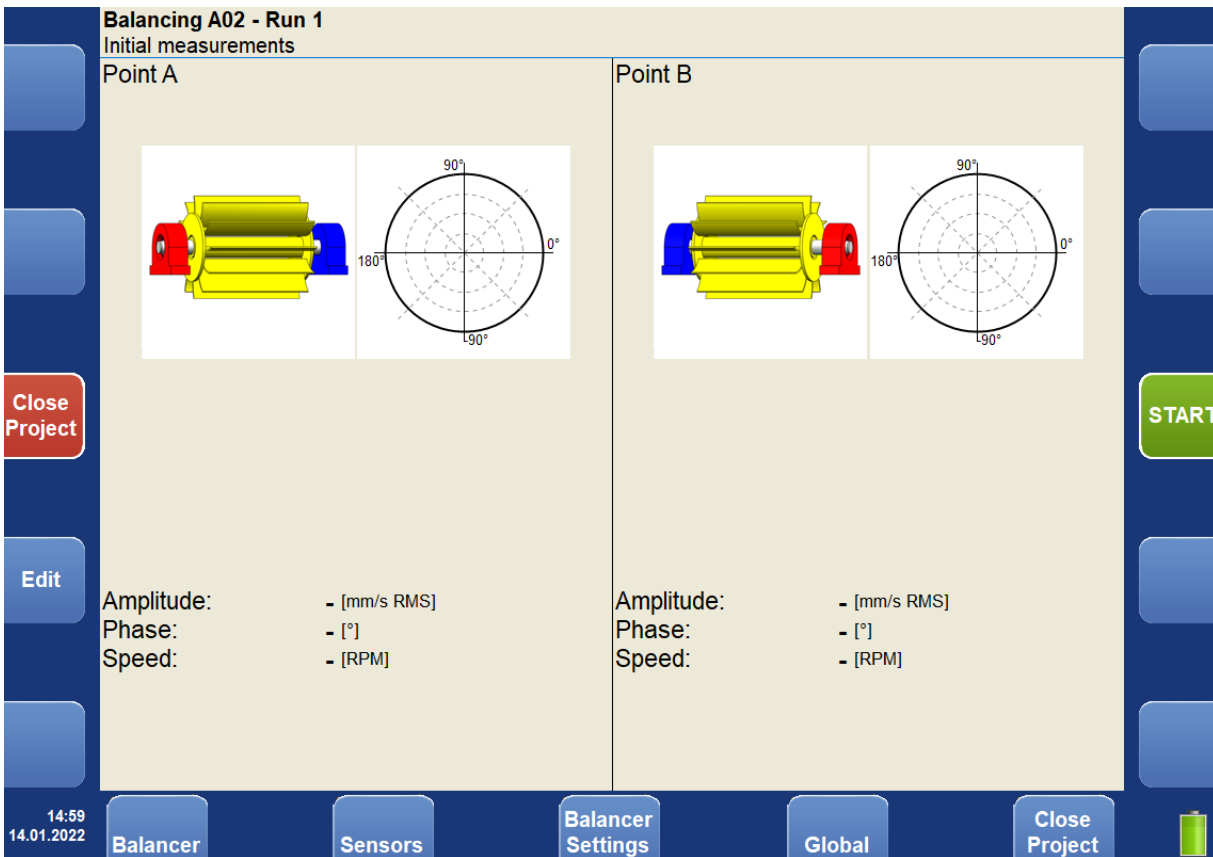
### Run 1 screen

The screen is divided to two parts. The left part corresponds to plane 1 and right to plane 2.

If you use only one sensor (the Inputs parameter is set to **single**), then only one part is active. The non-active part is grey and contains un-sharpened image. Mount the sensor to the active plane point and start the measurement. Corresponding bearing house is red colored. Use the **Right / Left** arrow button to move the active focus.



You make both plane measurements together at once with two sensors (the [Inputs](#) parameter of the set to **dual**). Then the screen should look like next picture.



Push **Enter** button and measurement will be taken. If you press the **Edit** button, then you can manually enter all values (balancing calculator function). Use the **Tab** for shift between values.

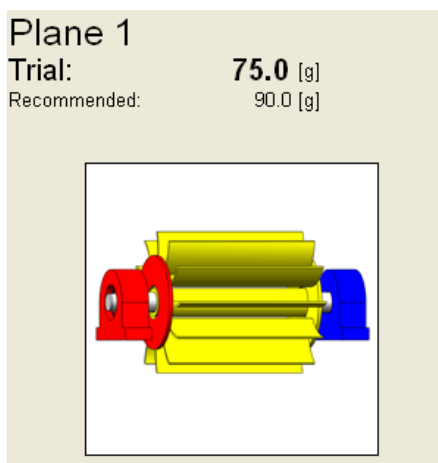
Amplitude:	<b>12.8</b> [mm/s RMS]	Amplitude:	<b>10.0</b> [mm/s RMS]
Phase:	<b>+35.0</b> [°]	Phase:	<b>+156.0</b> [°]
Speed:	<b>1500</b> [RPM]	Speed:	<b>1500</b> [RPM]

Use the **Down** arrow to move to the next screen.

### Run 2 – Trial Mass in Plane 1

It is similar like single plane balancing, only two trial masses must be subsequently mount to two planes. If you know the *dynamic factor*, then you can enter all 4 values manually and you do not need measure the Run 2.

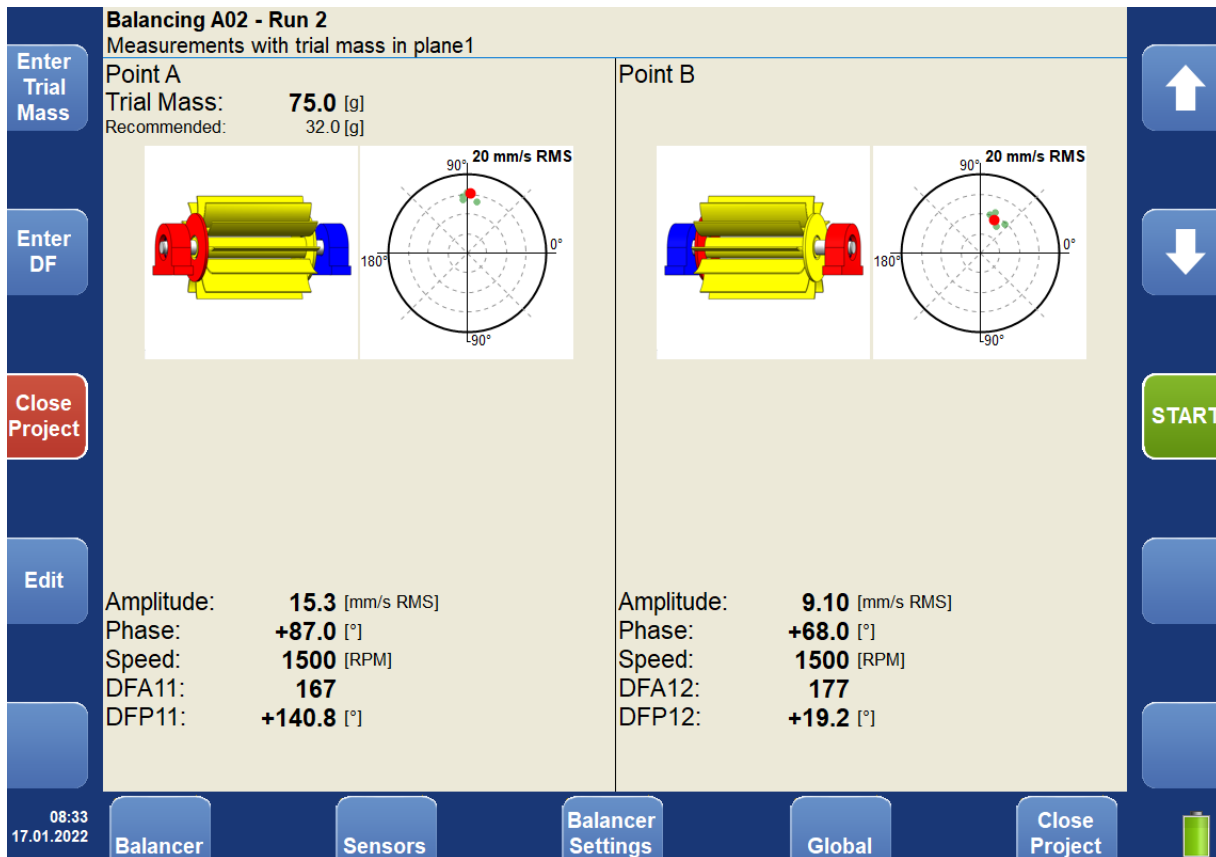
The red disc on the screen is displayed on the plane, to which should be just mount the trial mass. Enter the trial mass value.



Use the **Enter Trial** button for re-entering of the trial mass, if it is required.

The corresponding plane for trial mass mounting is demonstrated by the red disc. After the measurement of plane 1 take the measurement on plane 2 (or take them at once, when you use 2 channels). The trial mass remain in the plane 1.

After measurements of both planes with trial mass on the plane 1 remove the trial mass from plane 1. The Run 2 with trial in plane 1 completed screen is in the next picture.



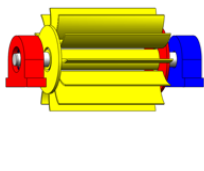
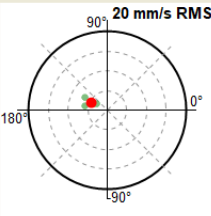
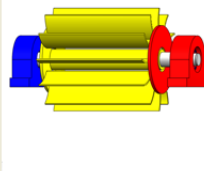
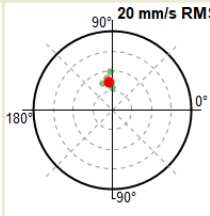
Press **down arrow**.

### Run2 – Trial Mass in Plane 2

The same two measurements we have to take with trial mass on plane 2. The screen for those measurement looks similarly like previous screen. Only the red disc is in the plane 2. Press down arrow button after both measurements.

The Run 2 completed screen is in the next picture.

**Balancing A02 - Run 2**  
Measurements with trial mass in plane2

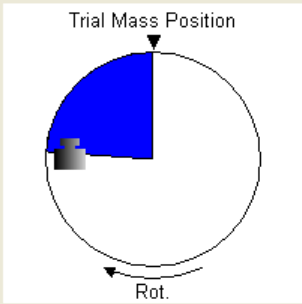
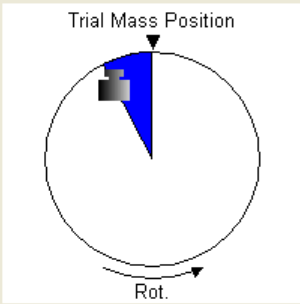
Point A	Point B
 	 
<b>Trial Mass:</b> 75.0 [g] <b>Recommended:</b> 32.0 [g]	
<b>Amplitude:</b> 4.50 [mm/s RMS] <b>Phase:</b> +156.0 [°] <b>Speed:</b> 1500 [RPM] <b>DFA21:</b> 208 <b>DFP21:</b> -159.3 [°] <b>Unbalance:</b> 58.1 [gm] <b>Bal. Quality:</b> 100	<b>Amplitude:</b> 7.20 [mm/s RMS] <b>Phase:</b> +97.0 [°] <b>Speed:</b> 1500 [RPM] <b>DFA22:</b> 117 <b>DFP22:</b> +20.4 [°] <b>Unbalance:</b> 107 [gm] <b>Bal. Quality:</b> 250

08:37 17.01.2022

Balancer Sensors Balancer Settings Global Close Project

Press down arrow.

**Run 2 - Result**

Plane 1	Plane 2
Trial mass kept 	Trial mass kept 
<b>Angle:</b> -85.4 [°] <b>Weight:</b> 33.7 [g]	<b>Angle:</b> +28.1 [°] <b>Weight:</b> 34.1 [g]

Mount the final masses to both planes. The angle is counted from trial mass position, which represents the 0 (zero) degrees. Each balancing mass can be split into two angles (blades) or into two blades as in one plane balancing.

### Run 3 – Success Check

When the masses are mounted then you want to check the job. The measurements on both planes are required.

Amplitude:	3.50 [mm/s RMS]	Amplitude:	4.30 [mm/s RMS]
Phase:	+24.0 [°]	Phase:	+65.0 [°]
Speed:	1500 [RPM]	Speed:	1500 [RPM]
Run 1:	12.8 [mm/s RMS]	Run 1:	10.0 [mm/s RMS]
Effect:	72.7 [%]	Effect:	57.0 [%]
Unbalance:	39.2 [gm]	Unbalance:	42.0 [gm]
Bal. Quality:	100	Bal. Quality:	100

The screen is in fact the same as screen for Run 1 with additional information.

**Run 1** original amplitude of Run 1

**Effect** is the reduction of vibrations in %

**Unbalance** the residual unbalance after the correction mass was applied

**Bal. Quality** balancing quality factor according ISO 1940 (mass of rotor and radius of balancing required)

### Trim – Further Improvement

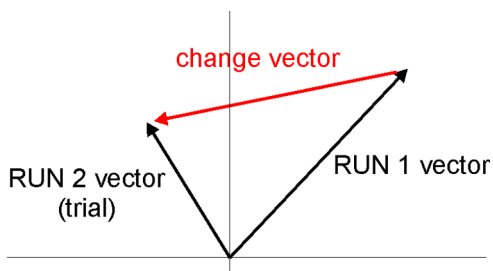
After Run 3 measurement you can continue with the job when you are not satisfied with the results. These next steps do not required trial mass measurements already. After each measurement the next masses are recommended. The trim screens are very similar to screens in single plane balancing.

### 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 mass is low.



The percentual value is derived from ratio (amplitude of change vector/ amplitude of RUN1 vector).

The percentage value is derived from the ratio (amplitude of vector change/ amplitude of RUN 1 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.

# The RunUp

## Measurement Control

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 mode, but controlled by speed, time or uncontrolled.

What does it mean "controlled"? In Analyzer mode you can measure the Set and then you have to save measurements manually.

The RunUp is different. The measurements are saved automatically and additionally the measurements are regularly repeated under the control. The trigger function is used for that control. The menu item **Global/ Trigger Settings/ Runup Trigger Mode** is used for setting.

Usually the **speed** is used for that control and new measurement is made, when the speed changes from previous measurement of defined value (e.g.10 RPM).

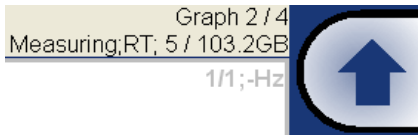
Also the **time** can be used to control that procedure. Then you can take the measurement in defined time interval ( e.g. each 60 sec ).

The **asap** is the next choice. It means no delay between measurements - **As Soon As Possible**. Be careful for such mode. You can use all memory quickly.

The last choice is the **Manual** mode. You can press the **Start** button at any suitable moment to make a new measurement.

The ending of run up is usually made manually by pushing **STOP** button.

The information about used and free memory is displayed during the measurement ( e.g. 5 / 103.2GB).



## The Set and other items

The meaning of the **Set** and also meaning of other items in the RunUp menu are the same as in the Analyzer mode.

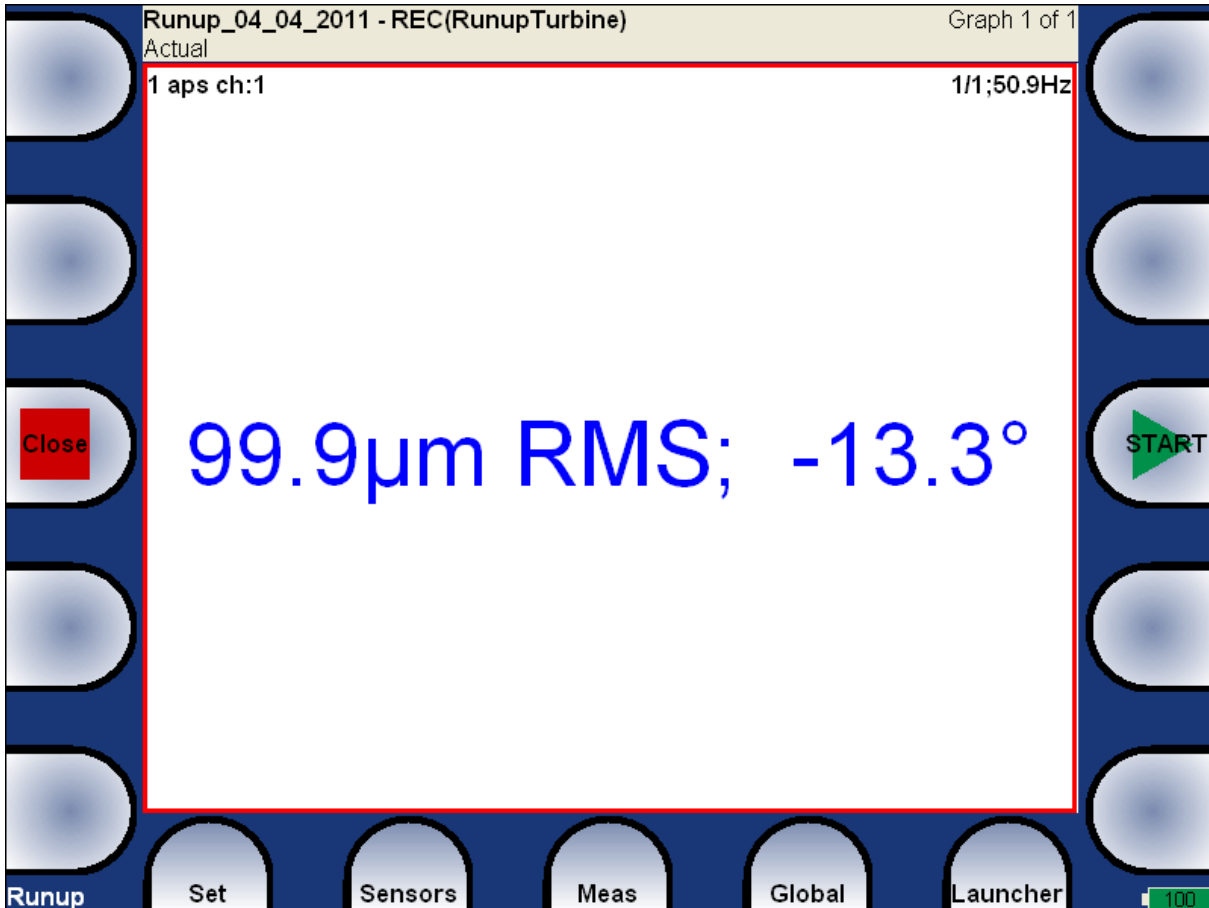
## Run up measurement

For example we define only one measurement in set. The proximity sensor on channel 1 is used.

Type:	aps
	freerun.asap
Channel:	1
Unit:	µm
Averaging:	linear
Avg:	off
Resolution:	speed / 4
	Save

The **Runup Trigger Mode** is set to **speed** and the value is 1Hz.

Start measurement - push **Start** button. After the full speed is achieved press **STOP**.



The last measured value is on the screen.

Press **Set/ View Trend** and in the left upper screen corner the list of measured run ups appear. Every new measurement creates new item in this list. The date and time of measurement is displayed. Select one trend from the list and press **OK**.

If the analyze is made from record, then two time stamps are displayed. The analyze time is the first and the measurement time is the second.

One runup measurement can be divided into more files (e.g. runup is very long). See the Global/Runup chapter.

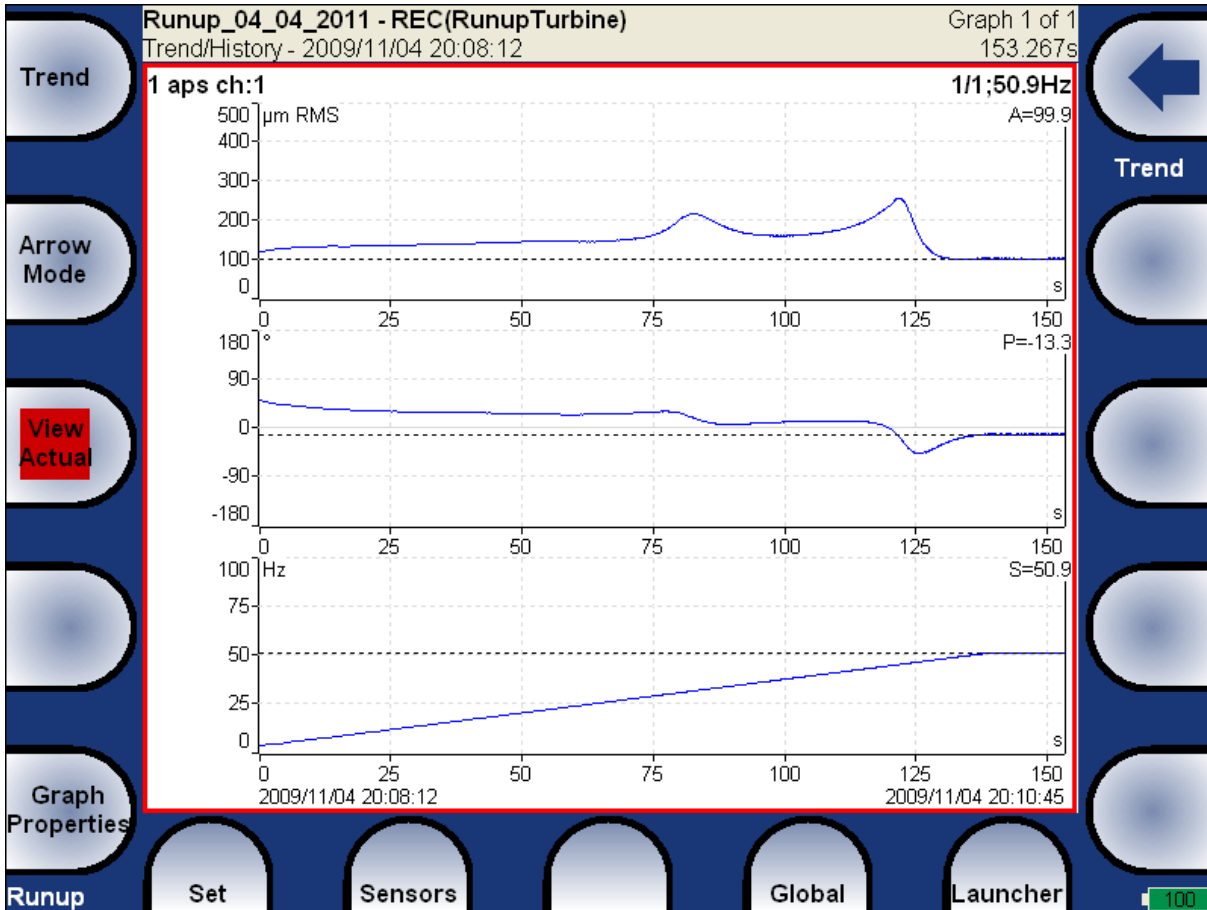
2014/01/24 09:56:21
2014/01/24 10:01:05
2014/01/24 10:04:45 (2010/04/17 02:24:10)
2014/01/24 10:05:13 (2010/04/17 02:39:00)
<b>2014/01/24 10:05:42 (2010/04/17 02:54:00)</b>

## Menu Trend

When the list of trends is displayed, then the Menu Trend button is available. It contains next functions:

**Delete** deletes selected trends

**Export** exports selected trends



The aps - amplitude+phase+speed graphs appear. Several types of graphs is available under the **View** item. All items are in details described in chapter

**The Analyzer Mode/The Analyzer buttons description/Graph Properties.**

Use **Arrow Mode** button for functions selection.



## The Route

### **Loading of the route to the instrument**

The co-operation with DDS2014 software is required for the route measurement. See also the DDS user manual for more details. We do not describe all details about DDS2014 function in this guide.

Open the database in DDS2014, from which you want create the route. Use menu Route / A4400-VA4Pro.

Connect the unit with the computer. See **Connection to the computer** chapter.

Press the **Connect** button and DDS2014 will automatically connect and receive projects (Off-route, Runup, Route...) from VA4Pro.

There are two options - move required points directly from DDS2014 tree to the projects list or from predefined list of routes (use mouse Drag'n'Drop ).

You can see that the structure of tree is changed. This is because in VA4Pro strictly requires the tree with the following structure Tree\_Name - Machine - Measuring Point - Data Cell. If there are more items in DDS tree in a path between this 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 then 45 characters DDS is trying to truncate such names. To avoid this we recommend to use shortcuts in a tree items (in this case "Turbo Generator" should be "TG").

Select route(s) in projects windows and press "Send" button in instrument window.

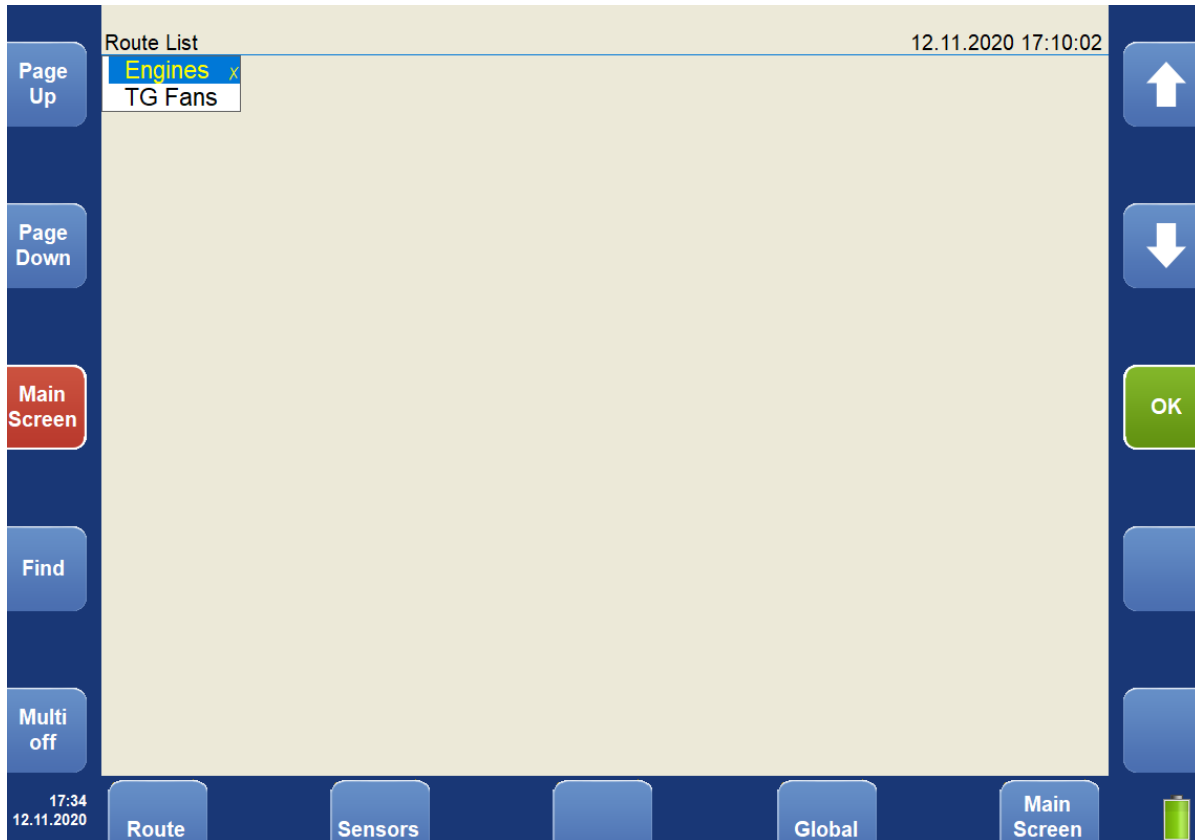
### **Creation of the route tree**

The route tree can be created also in the VA4 directly. The new database must be created in DDS for it. See DDS guide for details.

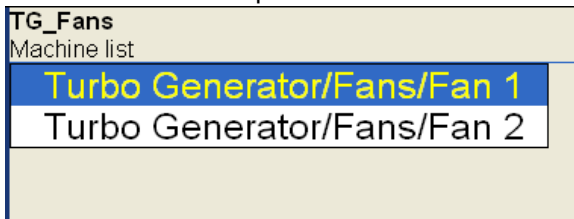
### **Route measurement**

In VA4Pro select the **Route** mode in main screen. The list of routes in the memory is displayed. The time and date of last saving of selected project is displayed in top right corner.

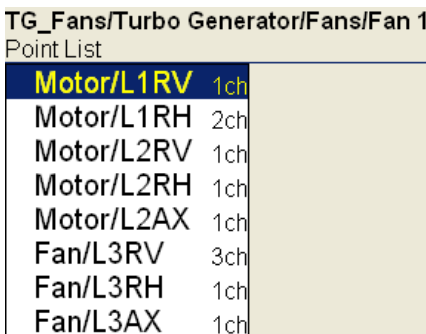
**Note!** Routes that are only modified on internal disk and have not yet been exported to VA4\_DISC are marked with a cross symbol (x).



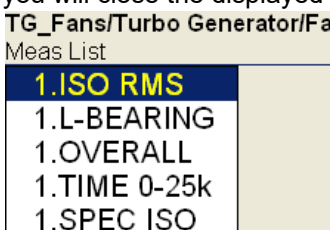
Select one route and press OK. The list of machines appears.



Select the machine and press right arrow to develop the list of measurement points. The number of AC channels for each point is displayed behind the point name.



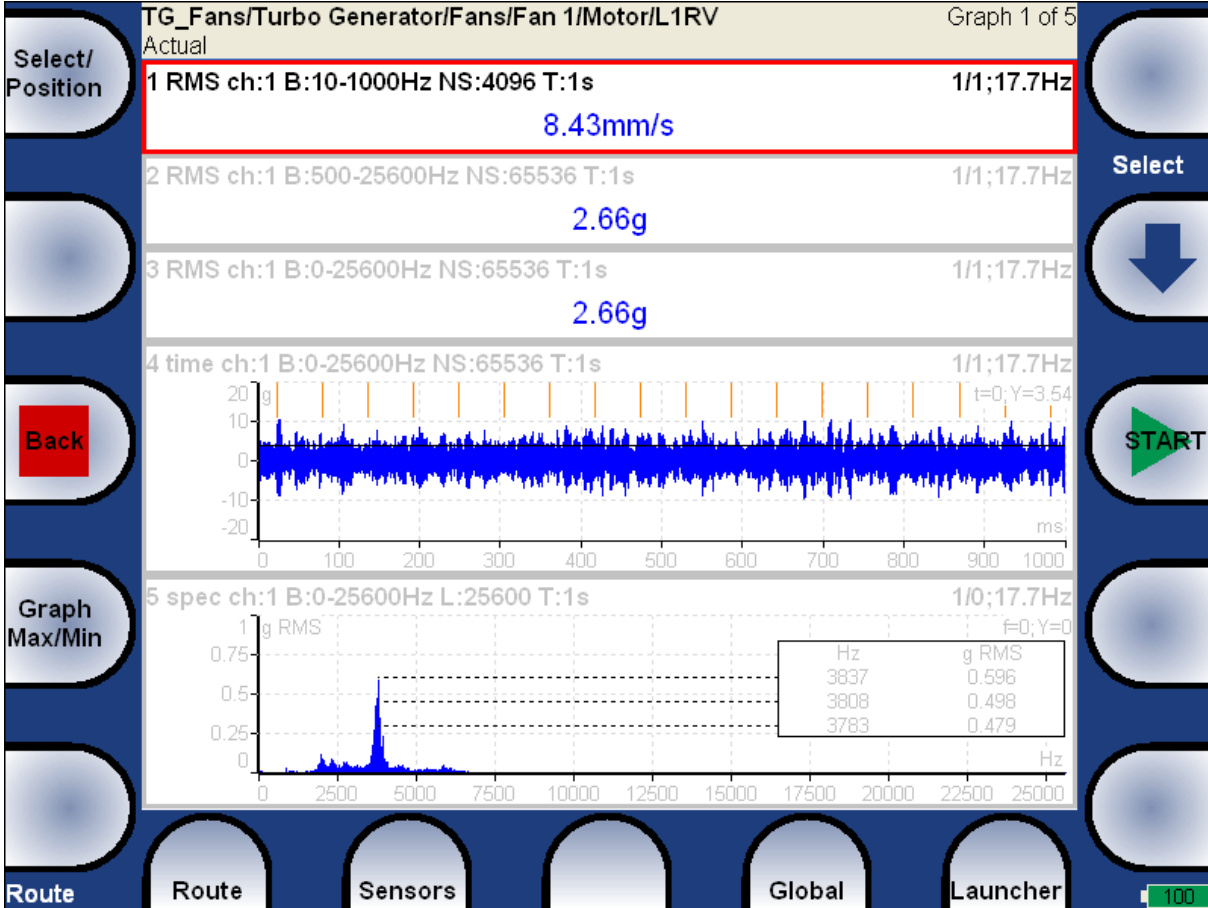
In this moment you can start the measurement or by right arrow display the list of measurements, which are defined for this point. The channel number is displayed in front of name of measurement. By left arrow button you will close the displayed list and you return back to the previous level.



When you press the **Start** button in the points list, the measurement graphs are drawn with the **No\_Data** message. If the required sensor (defined in the route) is not compatible with the sensor connected to channel input (Sensors properties) instrument warns us about this. In this case change the sensor or use the different sensitivity and press **Continue**.

Press the **START** to begin the point measurement. All defined measurement will be taken together.

The complete point measurement should be taken now. The measured data are or are not displayed on the screen regarding the **Display Route Values** parameter in **Global Settings**.



Use the Back to return back to points list. The measured point is labeled by the symbol ✓ (all defined measurement were taken). The next point in the list will be selected if all measurements are correctly taken.

TG Fans/TG/Fans/Fan 1  
Point List

✓ Motor/L1RV	1ch
Motor/L1RH	1ch
Motor/L2RV	1ch
Motor/L2RH	1ch
Triax	3ch

**Route Status**

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

✓ means all measurements of the route tree item were correctly taken.

! means error during measurement process.

. means only some measurements of the route item were taken

TG Fans/TG/Fans/Fan 1  
Point List

✓ Motor/L1RV	1ch
! Motor/L1RH	1ch
. Motor/L2RV	1ch
. Motor/L2RH	1ch
Triax	3ch

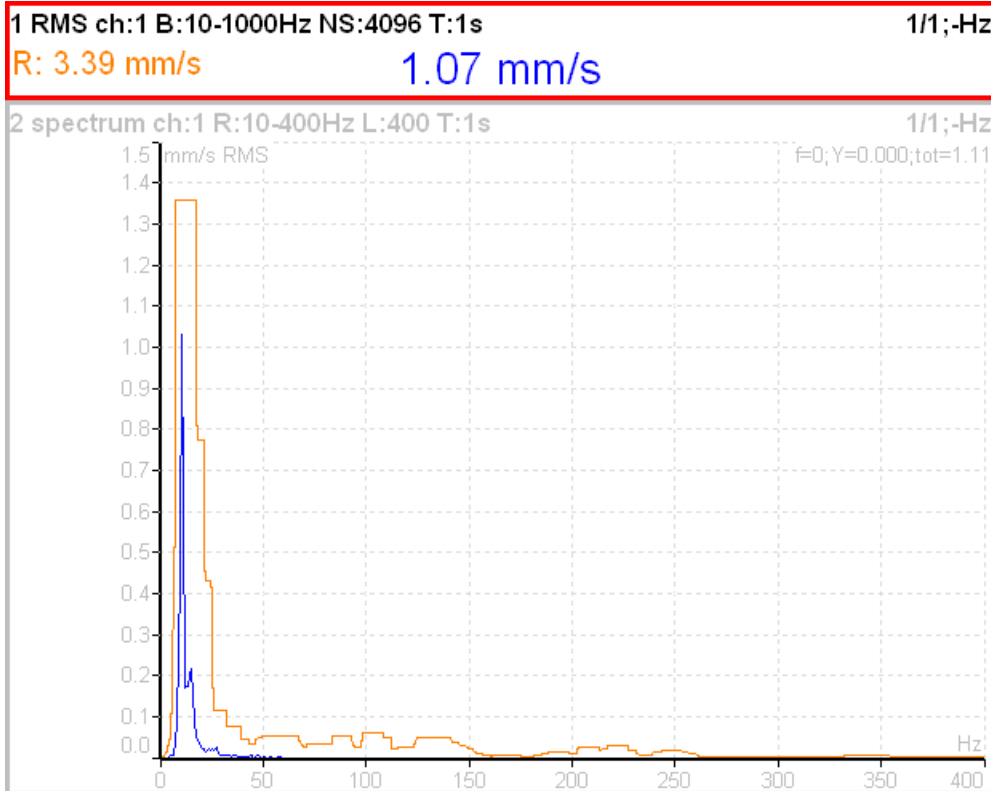
**Note!** The symbol can be cleared using **Route (Machine, Point, Meas) / Clear Checks**

### Reference values

You can download reference values from DDS to VA4Pro unit for spectrum and overall measurements. These values are displayed together with measured values.

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

Overall reference value is displayed in left side of graph and it is signed by "R:" or like a line in trend view.



### Manual entry

The route may contain the measurements, which have to be entered manually ( e.g. temperatures read from analogue display). The measurement with subtype **MANUAL** in DDS is defined. Before beginning of measurements from sensors (after you press START button) the window for manual input appears ( one for each manual input ).

Enter value [°C]

Temp (Graph1)

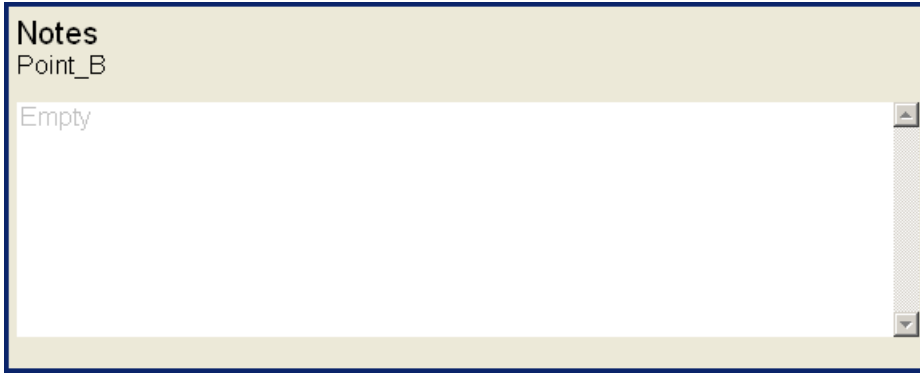
### Notes

You can attach the short text notes to route points.

There are three ways how handle with notes.

1. Enter the note manually.
2. Select predefined note from **Factory notes** set.
3. Select predefined note from **User notes**. This set is created and edited by user.

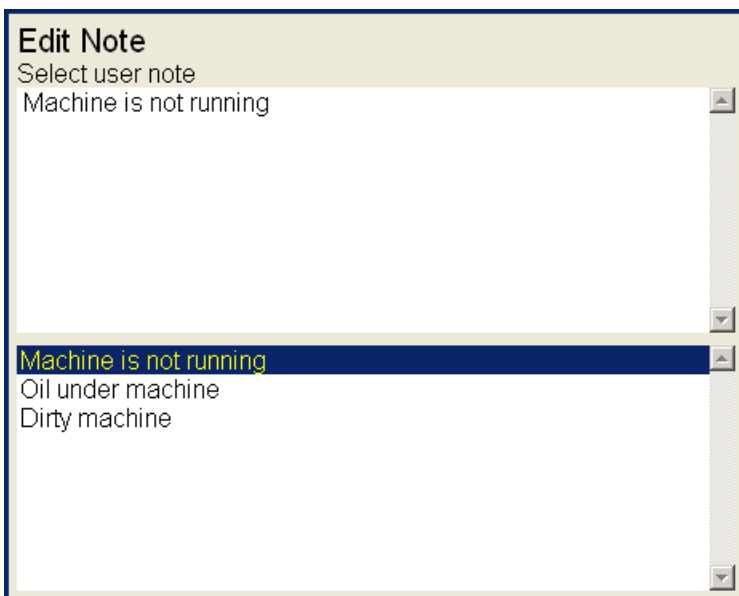
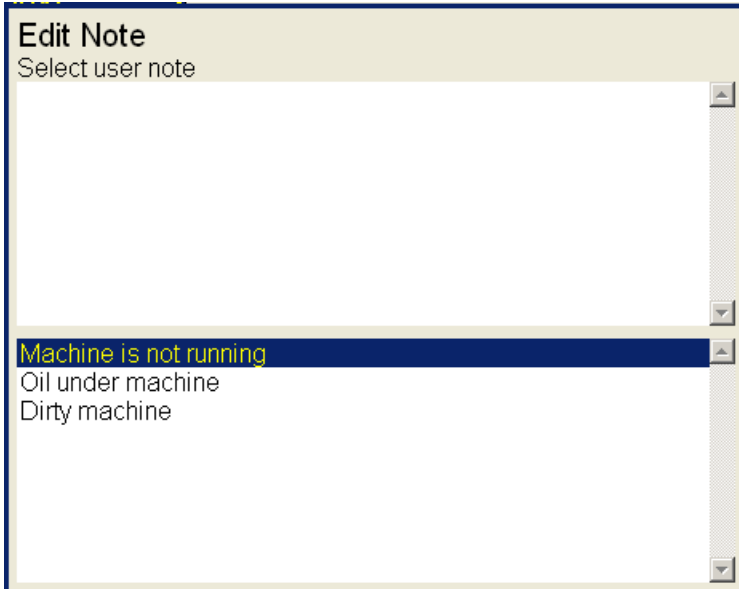
Press the button on the left bottom ( it can have more names as **Route, Machine** or **Point**). Select **Notes** item. The list of existed notes for selected point appears. It is empty when no note was created yet.



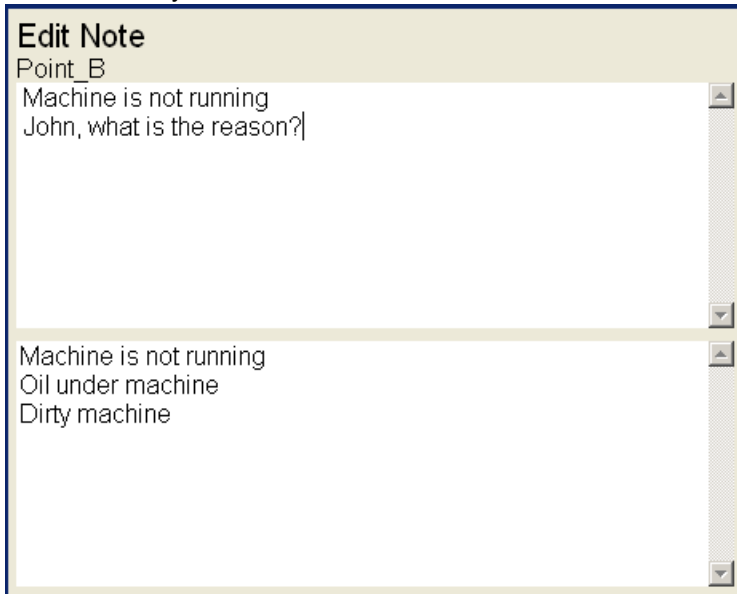
### New note

Press **Add** button to create new note. New window appears. In the upper half area you can directly type the note. The User notes list is displayed in the bottom. The several ways how to create new note exist.

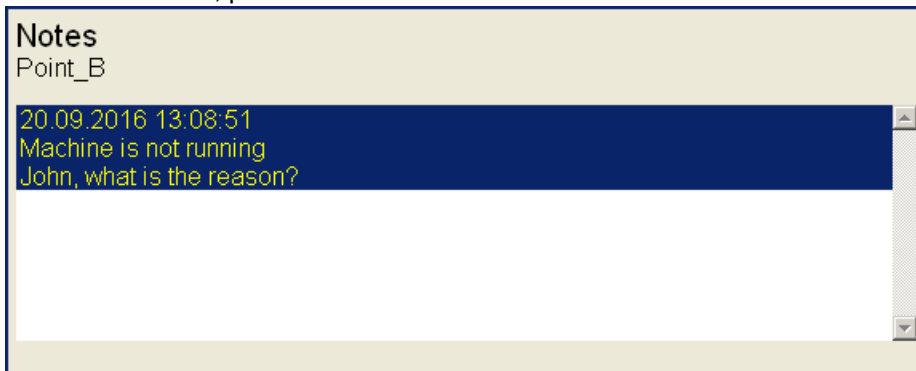
- Select one note from User notes list and press **Select**. Selected note is copied to the upper area.
- Press **User/Factory** button to change the User notes to Factory notes or back. Then select the note and press **Select**.



- If you want to enter your own text, then press **Edit Text** button. The cursor appears in upper area and you can enter the required note. Press **Notes List** (the same button position as **Edit Text**) to return back to the selection of User/Factory note.



If the note is done, press **Save** button. You return back to the list of all notes for selected point.



Press **OK** to leave the list of notes. The **N** letter appears behind the point name.

### Note edit

Select the note from the list and press **Edit** button. Then use the same procedures as for new note for editing.

To delete the selected note press **Delete**.

Press **OK** to leave the list of notes. The **N** letter appears behind the point name.

**Attention!** The notes created at a measurement point (or set) after performing a measurements at a point are automatically included into csv header during export to csv.

### Export to VA4\_DISC

The computer can read any data from VA4\_DISC only. The route with measured data has to be exported to this memory before the transfer. During the route measurement are data saved to the VA4 hard disc only. When the route is closed the VA4 asks the user "Export to VA4\_DISC?" and user selects one option. The export to VA4\_DISC is not done automatically because the writing procedure to flash is slow. The large route export can take several minutes. That is why the user can determine, when the right moment to export the route is. In the menu item **Route/ Export** you can select the route and export it manually.

## Download of the route to the computer

The process is the same as the load of route to the instrument. In **VA4Pro instrument window** use the **Receive** button and select the required route from the list ( all routes saved in the VA4\_DISC). The list of all points appears in instrument window. The grey items were not measured. Press **Store to database** to save data.

## 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 the VA4

The speed can be entered manually with the function Enter Speed (described before).

### Speed entered in DDS

The **Default Speed** can be set in DDS as a machine parameter (**Tree Item Properties / Speed** tab). This value is sent to the instrument and it is used in place of tacho sensor value. The three options of **Default Speed** are available for the machine item.

**Entered value** - the value entered in Default speed 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** option opens **Enter the speed** dialog, where you enter the value.

Detected or manually entered speed is valid for whole machine. Unless you close the machine item, the same speed value is used.

The **Default Speed** can be also set in other items, not only in the machine. In this case only numerical value is available. If you enter default speed value and in the same time you have set machine's default speed as **Detected** or **Manually Entered**, then the machine's setup has priority.

### Measured Speed

If the speed is measured by tacho probe, it is saved always with data regardless the fact if there were already defined by one of the previous ways (speed entered in device or DDS).

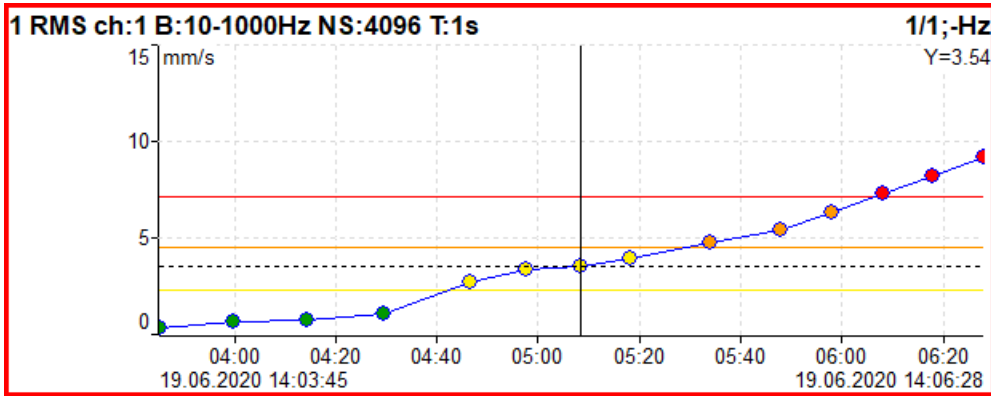
Current entered or detected speed value (if defined) is displayed in information panel at the right (if the measurement is not in progress).

Speed: 50.8 Hz

## 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.

1 RMS ch:1 B:10-1000Hz NS:4096 T:1s	1/1;-Hz
<b>B</b> 3.14 mm/s	> 2.3, < 4.5 mm/s
	ISO 10816: Group2, flexible

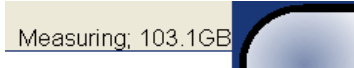




## The Recorder

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 additionally the e.g. runup can be run only once, the pressure is extreme. The tape-recorder was the solution. It was simple unit with simple operation, no danger to loose the data.

The same solution offers the VA4 Recorder. It enables to record simultaneously all 4 AC channels, tacho channel and 4 DC process values channels into the unit memory. The sampling frequency is from 64Hz to 196kHz. The maximum record length depends of free memory size, which is displayed in right upper corner.



### **New Record**

Run the Recorder. The list of records which are saved already in the memory appears on the screen. Push the **Project/ New** button and enter the name. The new item appears in the list. Select it and push **OK**.

Sampling Frequency[Hz]: 65536	
Range=25600Hz	
AC1:	on
AC2:	off
AC3:	off
AC4:	off
DC1:	off
DC2:	off
DC3:	off
DC4:	off
Trigger Channel:	on
Time[minutes]:	manually stopped
Start of Rec:	freerun
<b>Save</b>	

Select the **Sampling Frequency**. Switch to **on** all channels you want to record. Define the length of record (or how it will be stopped). Select the **Start of Rec** way.

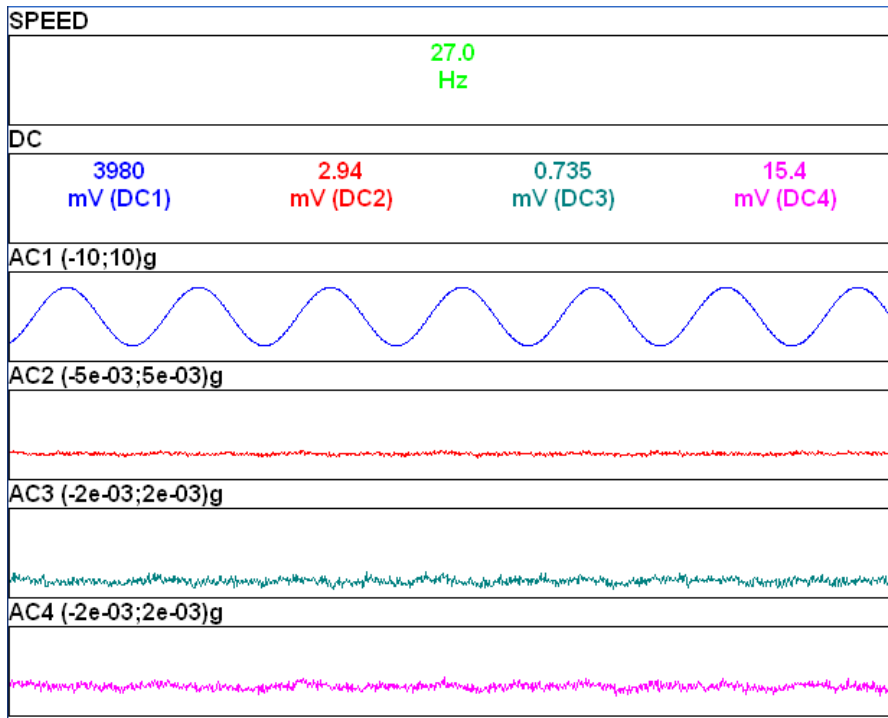
#### **Start of Rec**

**freerun** After the measurement preparation is the recording started immediately.

**external** The **external** signal (voltage level higher then defined threshold level in the **Global** menu) starts the recording. Such signal may be generated e.g. when the machine starts to work. This type of signal is usually created in the control system.

**amplitude** The recording is started when the signal level exceed the **Threshold level**, which is set by user in **Global** menu. Both - positive and negative levels are accepted.

When the **Record** parameters are set, use the **Start** button for start of the recording. During the recording all recorded input signals are displayed on the screen.



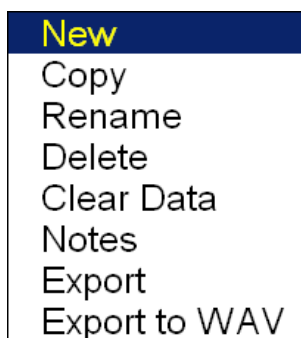
The process is finished when

- the time is over,
- manually by Stop button,
- the memory is full.

## Editing of Record

Run the Recorder. The list of records which are saved already in the memory appears on the screen. The time and date of last saving of selected record is displayed in top right corner. Select one of them (arrows and OK). The preview of recorded signals appears.

### Project button



**New** the new project for recording  
**Copy** copies all record parameters to new project without the recorded data  
**Rename** renames the project  
**Delete** deletes project from memory  
**Clear Data** deletes recorded data, all record parameters is kept  
**Notes** adds the notice to the record, see **Global Properties/ User Notes** chapter  
**Export** exports the record to **VA4\_DISC**

**Note!** The max size of exported record is 4 GB. The total size of flash drive is 8GB. The 4 GB represents 80 minutes of 4 channel recording with 65kHz sampling frequency. One second takes 800kB. When you want to export bigger record, then the error **Not enough space** appears. Large record you need to split to several smaller records. Use the **Recorder** module, open the record and by using of **Cursor** and **Length** buttons select part of record. Press **Save selection as** and define new name. Do not forget to delete record from VA4\_DISC after

downloading to PC.

**Export to wav** Exports the selected project as wav data format. The wav files are saved to a *wav* folder on *VA4\_DISC*. You may choose the 24 bit or 16 bit encoding of the wav file using [Global properties](#) / [Global Settings](#) / [Wav Encoding](#). Additional settings can be done using the [Export to wav Settings](#)

**Export to wav Settings** setting of next export parameters (see next chapter)

### **Export to wav Settings**

Contains setting of advanced parameters.

<b>AC1:</b>	<b>0</b>
AC2:	0
AC3:	0
AC4:	0
Mixer:	off
Range [V]:	max
<b>Save</b>	

**AC1 – AC4** all channels can be mixed to one channel into wav file (like in music studio). The gain factor can be defined for each channel. When the zero is used, then this channel will not be used for mixing.

**Mixer on, off** Select **on** when you want 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]** 1.5, **max**, **auto**, **user**

The full AC range of VA4 Pro is +/- 12V. This range is also used for wav export. But it is usually too much, because the real voltage level is much lower. For example the range hundreds of millivolts measured from accelerometer 100mV/g. The wav file is then very quiet. The **Range** option enables to apply better wav range and better hearing from headphones.

**1.5** this range should be generally acceptable in most of cases

**max** the 12V is used as range

**auto** the reached maximum value in signal is used as range

**user** any value from (0.1 - 12) interval

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.

When the range value is lower then the range of signal, then the warning **Wav overload** appears.

### **Sensors button**

You can change the sensor parameters for next recording.

### **Record button**

The record parameters are displayed. You can change them, but it will influence the next record.

### **START button**

It starts new recording. The old recorded data will be rewritten.

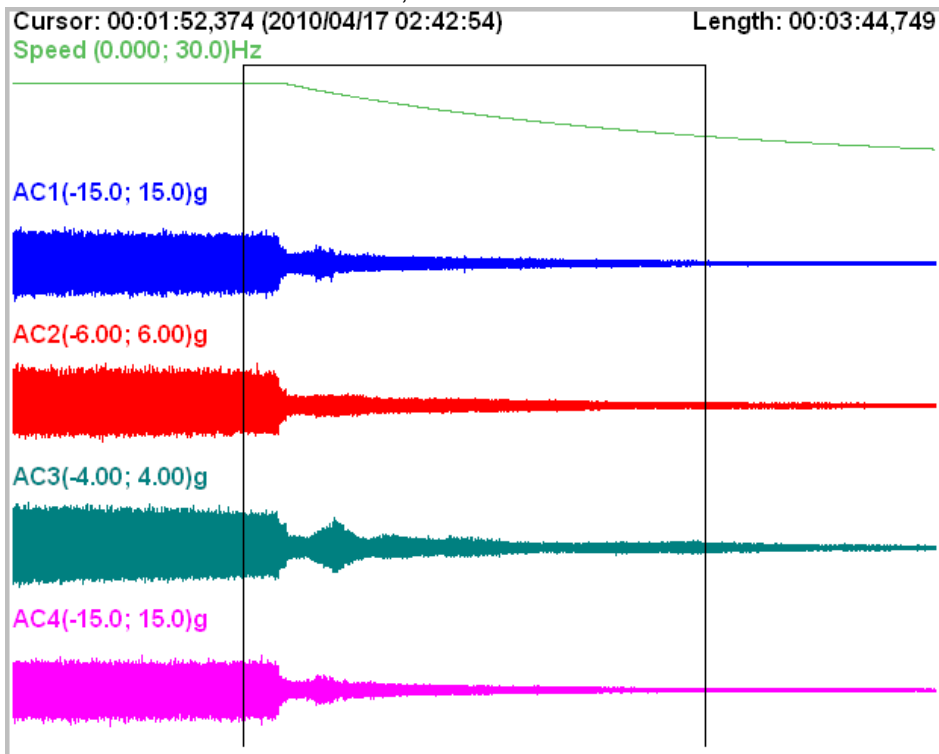
### **Properties button**

It displays all record properties.

### **Cursor and Length arrow buttons**

When the record contains longer data then you need to analyzing you can select any part of record and save it as new record.

The **Cursor** arrow defines the beginning of new record. The **Length** defines the length of new record. when you defined the borders of new record, use the **Save Selection As** button.



### **Arrow mode**

It changes the arrows from **Cursor+Length** to **ZoomX+Y**.

### **Zoom X button**

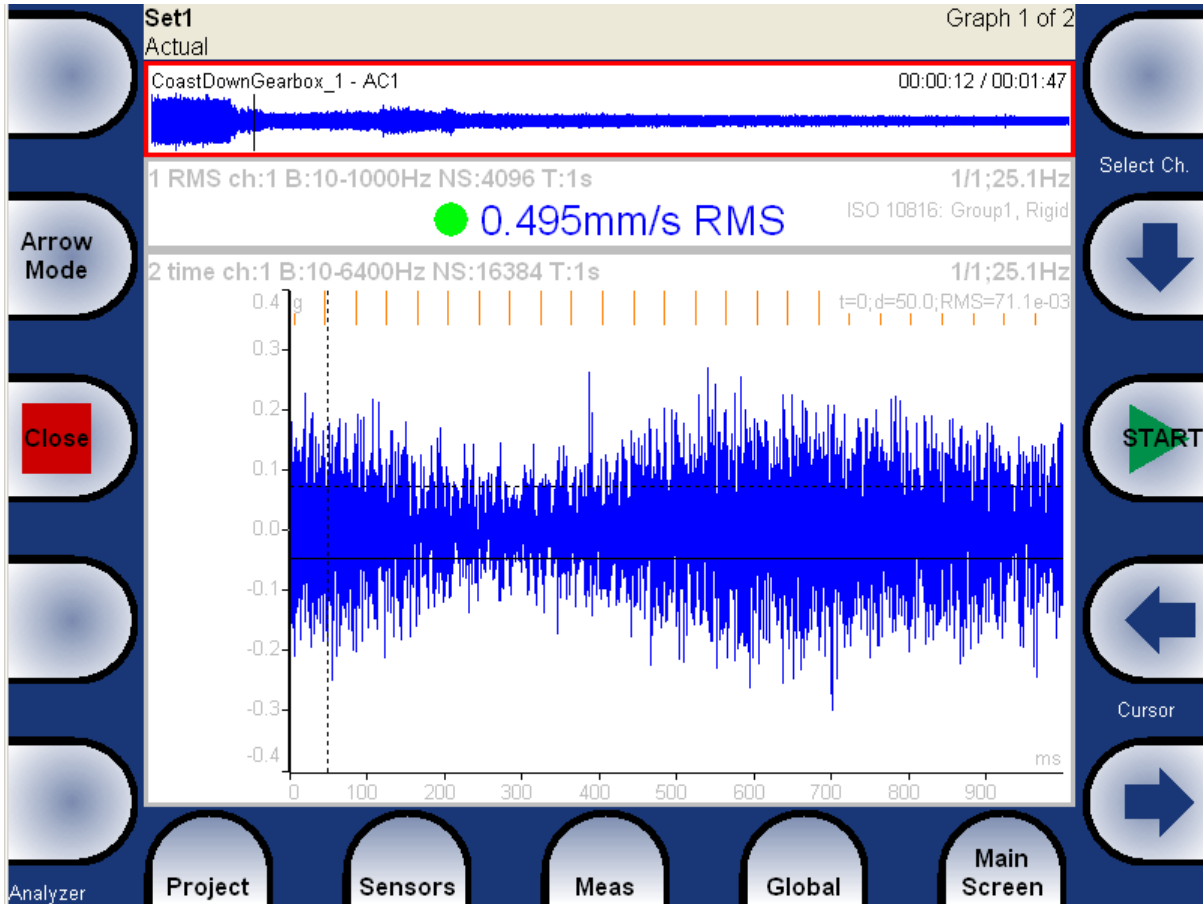
It switches the display between complete record and the zoom selection made by **Cursor+Length**.

### **Zoom Y button**

It is standard Y zooming.

## **Using of record for analyzing**

When you select the record for analyzing in any VA4 module, then the preview appears on the top of display.



During the analyzing of record the cursor is displayed in the record preview. The moving of cursor is available and it enables to select the required position for analyses.

When you need to move the cursor then you have to select the record area ( to move the red border to the record). There are two ways how to do it:

Analyzer, Route and RunUp modules - use the **Arrow Mode** button repetitively until the red border is on the record.

The rest of the modules - use the **Record** button to select and de-select the record.

Also the selection of record channel is available for preview (the record can contain more channels then one).

Also the DC channels or speed channel can be used for navigation. When the record is selected, use the **Select Ch.** arrows in the right top of display. Sound of selected channel is also on audio output.

### **Temporary records**

Records can be stored in the DDS database. For record analysis, the DDS copies the record into the list of records in Virtual Unit and run the Virtual Unit. It will be deleted once you will close the Virtual Unit. See more instructions in DDS manual.

## **The 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. The FASIT module also advises you, what the most probable source of vibration is, **Unbalance**, **Misalignment** or **Looseness**. The three individual bars are displayed.

### **Adash Vibration Limits**

Because there are a lot of different types of machines it is impossible to determine the critical limits of vibrations for wide range of machines. Its reliability would be low then. It could happen, you will repair machine, which do not require it. The standards should be rather 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 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.

On the figures below is clear how we derived limit values. Three levels of machine condition are defined: GOOD, WARNING (Machines lays in this range are not acceptable for a long period operation, they could be operated till time when could be repaired) and DANGER (Vibration values in this range are considered as very dangerous and they can cause a damage of the machine). The corresponding colors are taken from traffic semaphore - green, amber and red.

All limit values are related to the speed value. The low-speed machine should generate lower vibration then higher-speed machine.

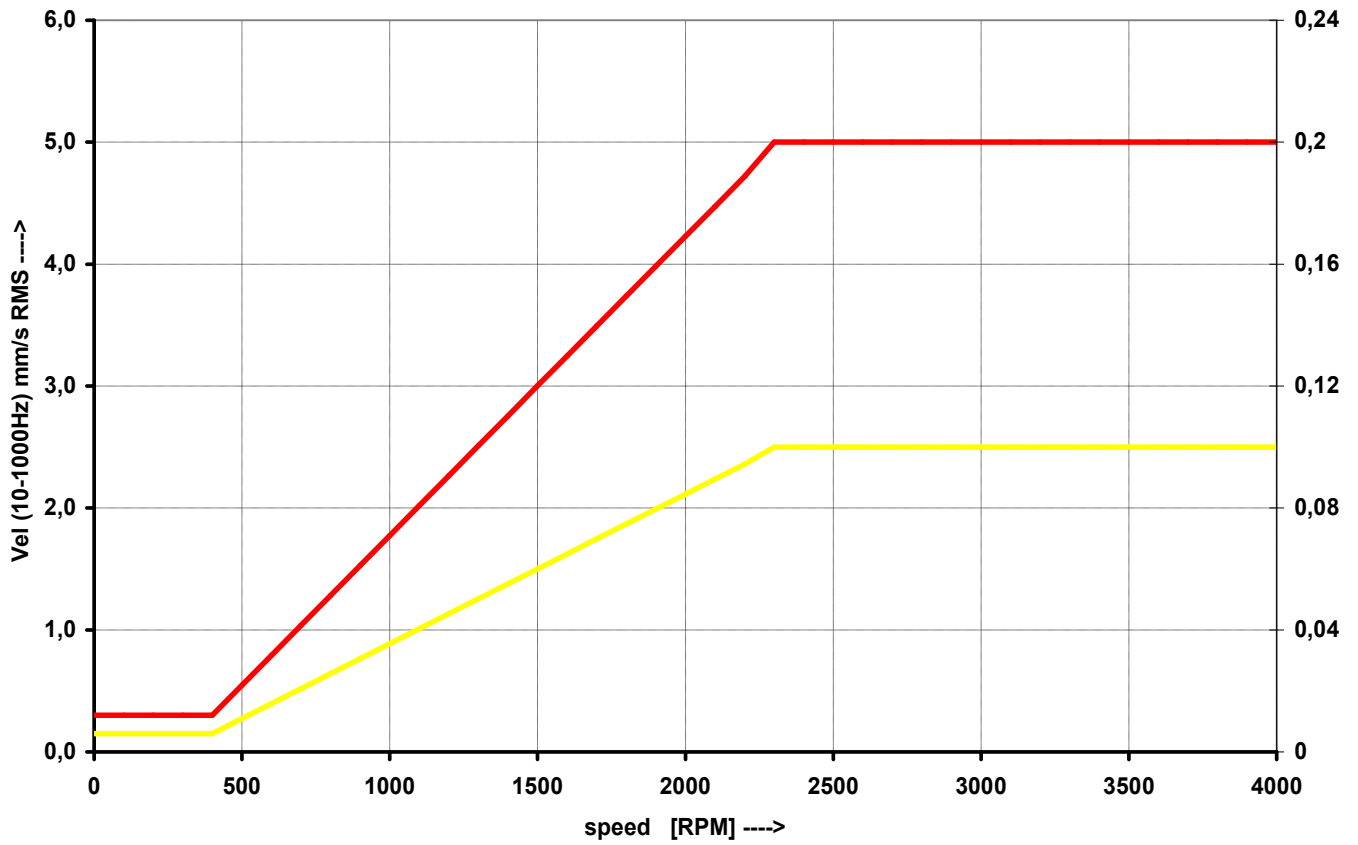
In the graphs area you found three particular areas. The GOOD condition is the space bellow the yellow line that means operation without restriction. The space above yellow but under red line is an WARNING condition. Possible to operate the machine but have to be more checked. It's necessary to determine the source of worse condition and plan repair (for instance change 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 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.

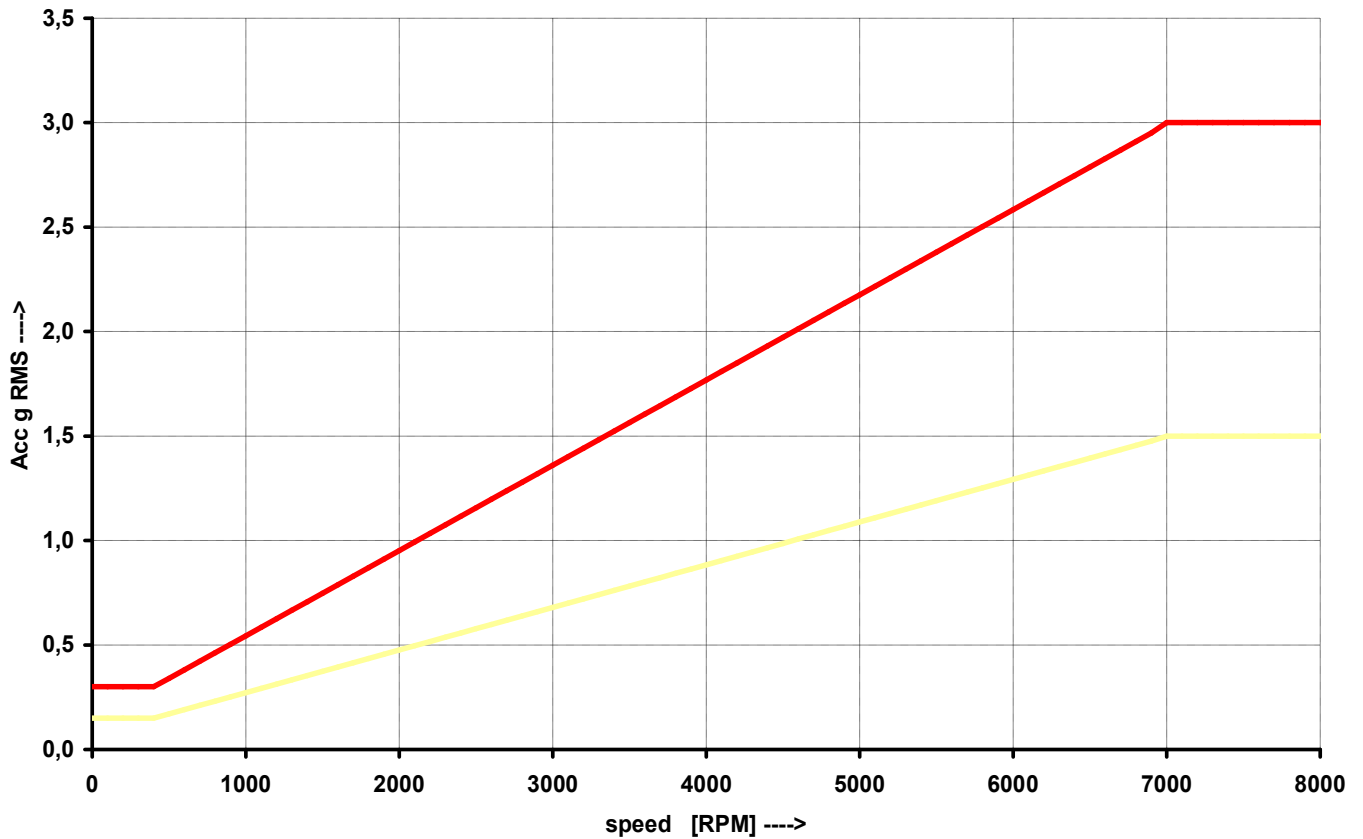
### **Machine Limits**

The machine limits are used for velocity RMS value in 10-1000Hz frequency range. This value helps to define the complete health of machine.



**Bearing Limits**

The roller bearing limits are used for acceleration RMS value in 500-25600Hz frequency range.



## Setup

Select the FASIT mode. The menu appears. The menu can be repeatedly opened by pressing **FASIT Settings** button.

Channel:	1
Vel fmin [Hz]:	10
Vel Limits Multiplier:	1
Acc fmin [Hz]:	500
Acc Limits Multiplier:	1
Save	

### Channel:

The number of the input channel

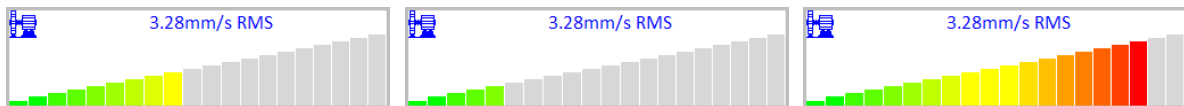
### Vel fmin [Hz]:

By default, the velocity measurement is taken in 10 – 1000 Hz range to detect the overall machine condition. This range is not convenient for low-speed machines (below 10 Hz = 600 RPM). Therefore, you can setup 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 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 limits 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 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:

Same as [Vel Limits Multiplier](#) but used for [Bearing Limits](#).

## Sensor Settings

In the **Sensors** item set up the parameters of the chosen sensor. FASIT uses the measurement of acceleration or velocity from one channel. If you will use a velocity sensor, the bearing condition is not detected. For bearing condition detection the acceleration measurement is necessary.

## Units

The displayed units can be set up under the **Global/Global Settings**. Set up the unit of speed (Hz, RPM, CPS, CPM) in the **Speed Unit** item. The vibration values are displayed according to the setting of **Units (metric, imperial)**.

The units are set up as follows:

### metric:

acceleration - g  
velocity - mm/s

### imperial:

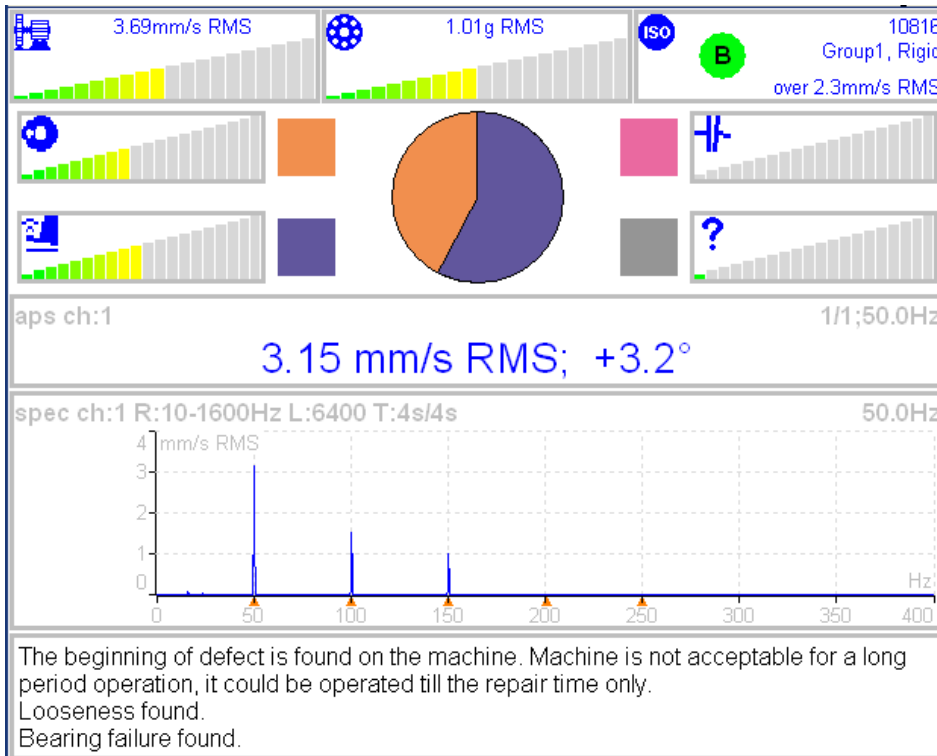
acceleration - g,  
velocity – in/s



## Measurement

Press the Start button to start the measurement. The speed needs to be known for the processing of this measurement. The speed detection is described in the **Speed Detection** chapter.

### FASIT screen



Each horizontal bar displays the severity of 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 10816 limits (see the ISO overall measurements), the color of 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 exceeding is also displayed at the bottom.

The pie chart displays the percentages of severity of individual faults. The colours in pie chart correspond to the colours 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 screen.

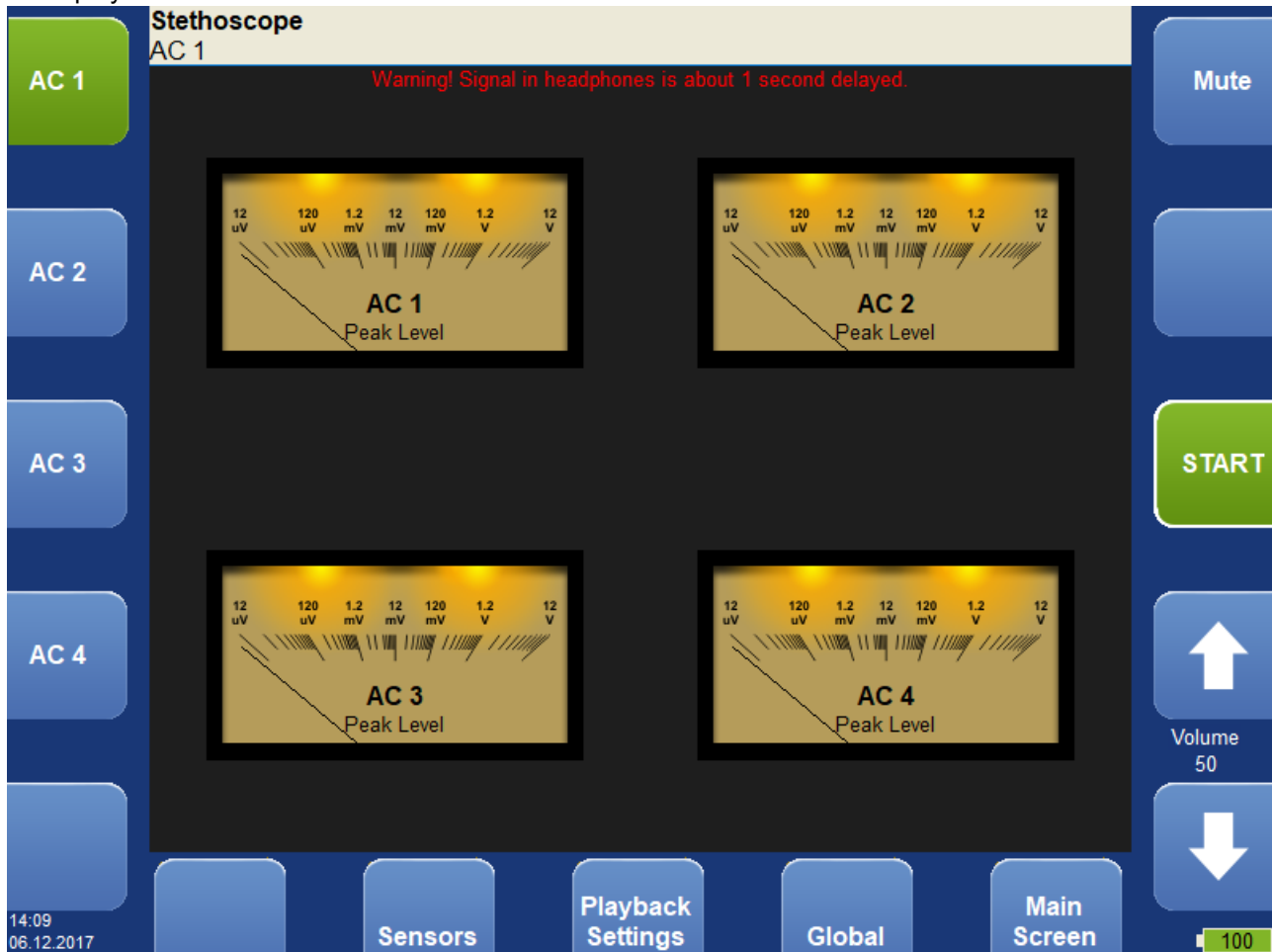
**Note:** the 1x amp+phase value is displayed only when the speed is measured by a tachometer.

The condition report and advises are in the bottom.

## The Stethoscope

This mode enables listening of vibrations. Use the standard headphones and connect them to the audio output on top panel.

Select the Stethoscope mode and push **OK**. The 4 displays appear. Push **START**. Each input signal level will be displayed.



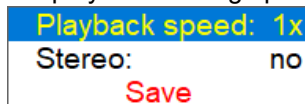
The TRUE PEAK level is displayed. By buttons on the left side you choose the channel for listening. The volumes buttons are on right side.

### ***The delay of audio output***

Because all signal conditioning is digitally arranged, the delay of signal appears. Typically the delay is 1 sec. You can clearly test to knock to the sensor and you will listen this knock after the delay time.

### ***Playback Settings***

For playback settings push **Playback Settings** button.



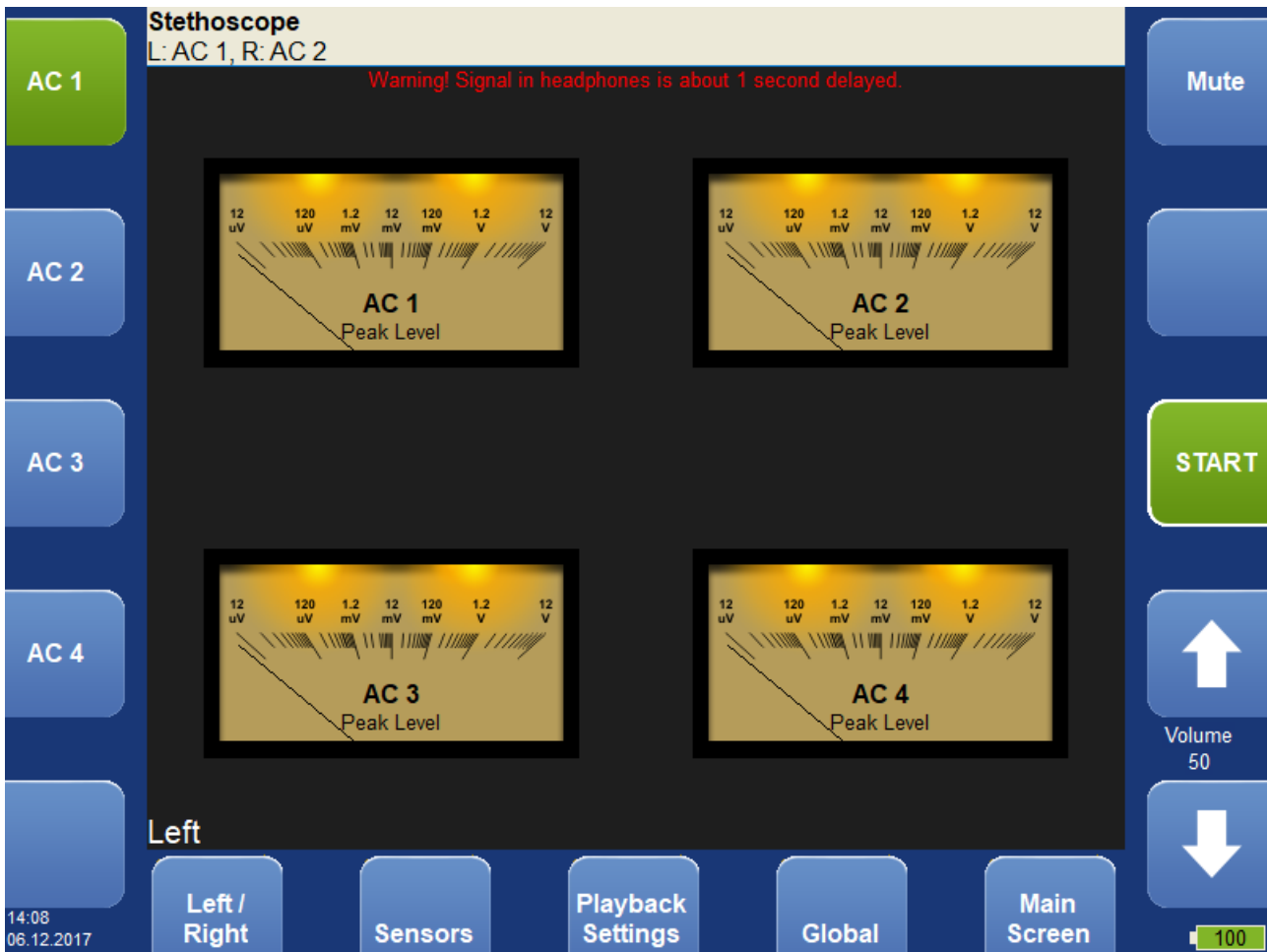
#### **Playback speed**

This function speed up (bigger then 1) or slow down (lesser then 1) the playback speed.

#### **Stereo      yes, no**

It enables to define two channels for playback. One channel for right headphone and second for left.

### Stereo channels setup



The current setting of left/right output is displayed on status line on the left top (**L: AC 1, R: AC 2**). Use the **Left/Right** button for output side selection and the **AC 1 – AC 4** buttons for channel selection.

## **The Lubri - the greasing control**

There is an increasing demand for an instrument which is able to simply check lubrication of rolling bearings and also the condition of these bearings.

Every machine does have in its specifications how much lubricant every one of its bearings uses in a specific amount of operational hours. A task of each technician or engineer is to regularly check all the lubricated points and maintain lubricant at sufficient levels. Either state, lack or excess of lubricant are harmful for a rolling element bearing. The result is always 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 the 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 to be able to determine a state of a bearing somehow and replenish only as much lubricant as is actually needed. Controlled lubrication increases bearing service life and lowers costs for lubrication and repairs.

The main use of this Lubri mode is in the lubrication replenishment process. During this process the mode measures the actual 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 or over lubricate.

This mode exactly determines the ideal amount of lubricant needed.

As a result, your machines will be maintained in their best lubrication condition. The Lubri mode enables you to make the whole lubricating process simpler and it normally reduces the consumption of very expensive lubricants.

### ***Two Possible Ways How to Measure***

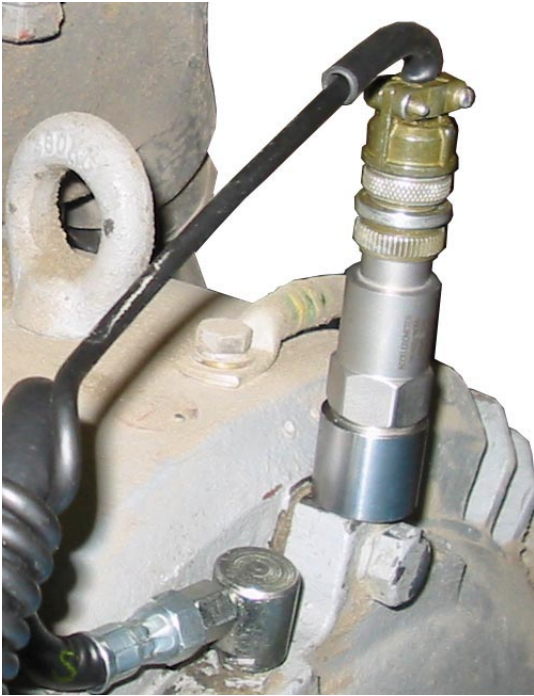
A standard accelerometer (sensitivity 100mV/g and ICP power) mounted on a bearing housing is used to measure lubrication.

You have two possibilities how to do 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 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.

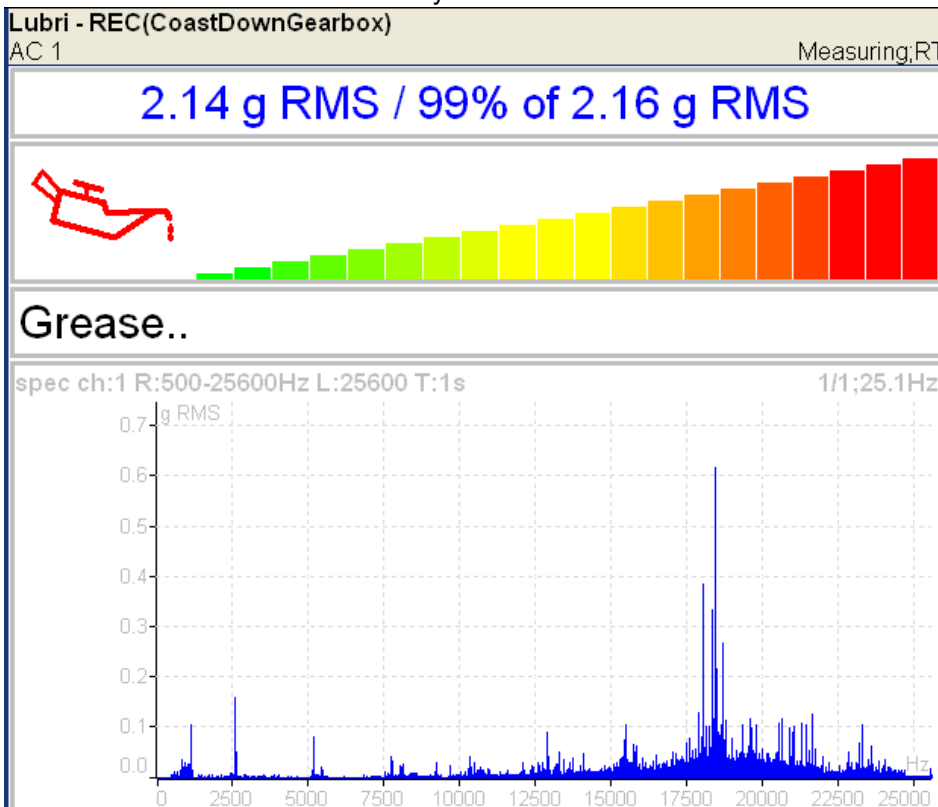


Sensor mounted near to lubrication point

If vibration diagnostic measurements are performed on a machine, then a measurement pad is already mounted. This pad can be used also for lubrication measurements.

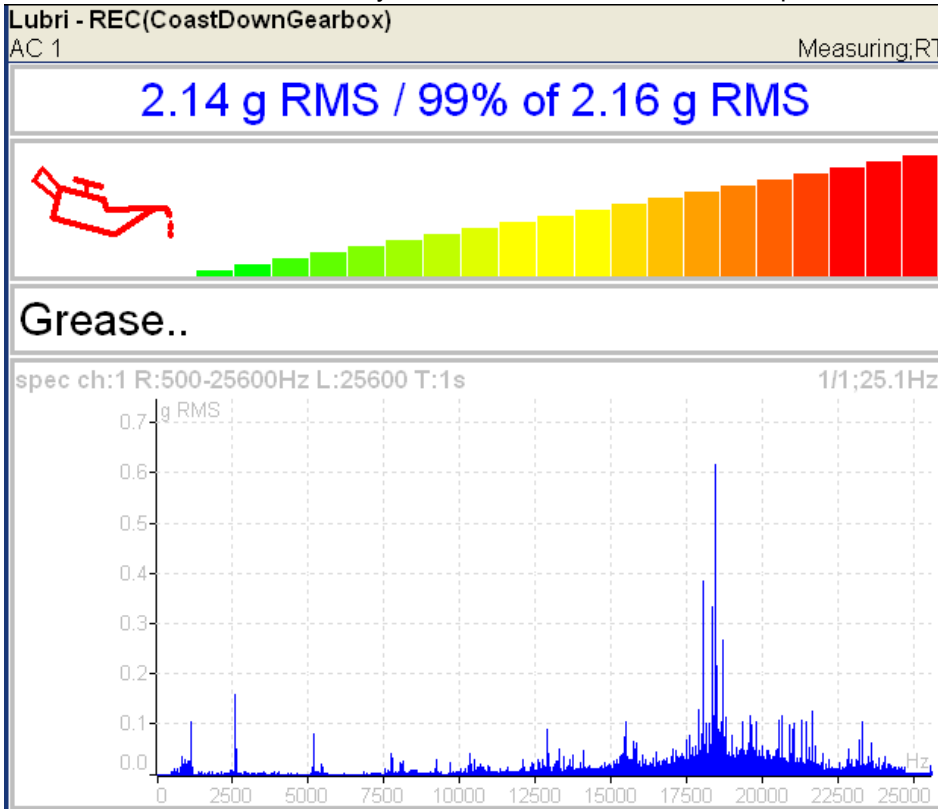
**The procedure**

1. Mount the sensor near to the bearing. Prepare the greasing gun for use.
2. Select the Lubri Mode and the input channel, which will be used for measurement. Push the **START** button. Then the instrument will automatically measure an actual lubrication state.



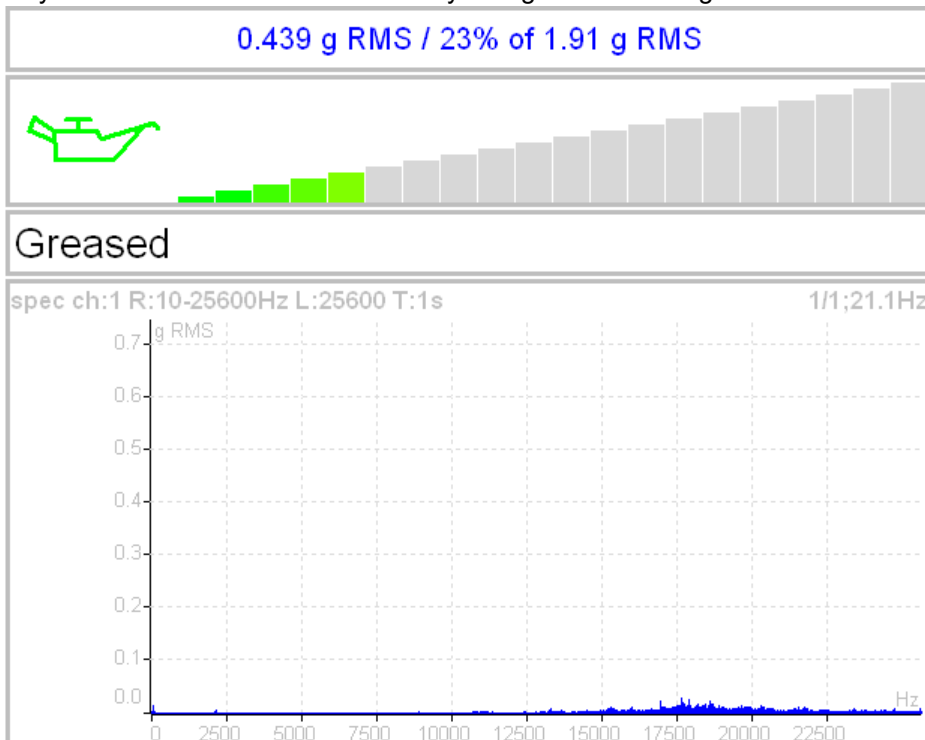
In the beginning the instrument takes the initial g RMS value in the frequency band 500 - 25600 Hz.

The first line contains the actual g RMS value (re-triggered) and the proportion to initial value in %. Below first line is horizontal bar, which always reaches a maximum level after procedure start.



You need to slowly start adding lubricant, while monitoring the height of the column on the display. Usually there is not much going on in the beginning, which means that the lubricant is pushed toward 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.

If, at the beginning of measurement, value of vibrations and oilcan are green, then the signal from a bearing is very low. We have either new or a very well greased bearing.



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 can find more detailed information about lubrication in the A4910-Lubri manual.

## Octave Analysis

Using of this mode is similar to Analyzer mode. You need to create Set and Measurements like in Analyzer.

Measurement parameters are:

<b>Type:</b>	<b>octave spectrum</b>
	retrig
Channel:	1
Unit:	Pa
Resolution:	1/12
Frequency Range:	high
Frequency Weighting:	none
Averaging:	linear
Avg:	off
	total t=0.125s
<b>Save</b>	

**Type** **octave spectrum**  
**sound level** the sound pressure level in dB is defined as  $20\log_{10}(p_{RMS}/p_0)$ ,  
 $p_0=0,00002$  Pa ( p is sound pressure)  
**equivalent sound level** when during time interval the sound level changes, 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** high 16 - 16000 Hz for noise measurements (central octave frequencies)  
 low 1 - 1000 Hz for vibrations

**Frequency Weighting** none, A, B, C, D

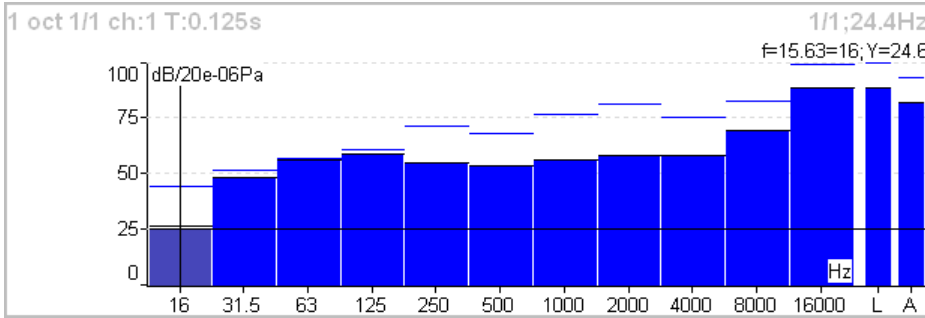
The human ear has the subjective characteristics known as the loudness. It is the function of sound intensity and frequency. For example the 20Hz pure tone with sound level 20dB would be clearly audible. The 100Hz with the same level would not be heard, it lies below the threshold of hearing. The unit 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 as closely as possible to the loudness level. 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.

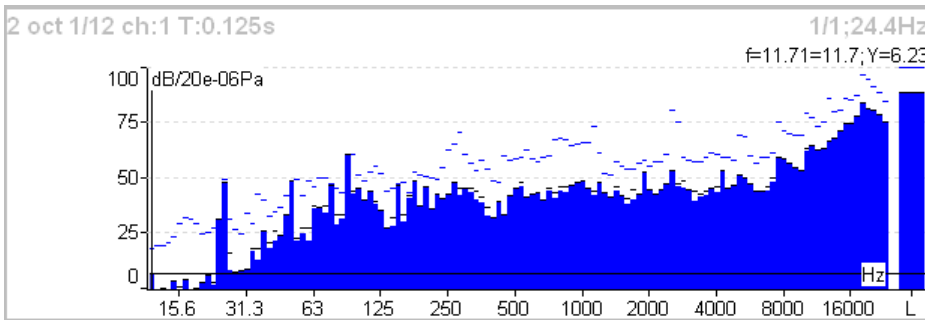
However today is A-weighting frequently specified for measurements irrespective of level.

**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 then the newer

**Avg** number of averages



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.



For each line is used also the short time peak memory. It looks like snowing.

### Octave Analysis Algorithm

Octave analysis uses set of digital filters. Each filter has designated a center frequency and bandwidth. Filters are designed according to ANSI S1.11:2004 and IEC1260:1995.



## **Bump Test**

It enables to find the resonance frequency of machine body. Set the used channel and the number of hits for averaging.

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**

Channel:	1
Hits:	4
Range[Hz]:	400
Unit:	mm/s
Neg. Averaging:	no
<b>Save</b>	

<b>Channel</b>	channel with the accelerometer
<b>Hits</b>	number of hits
<b>Range</b>	Frequency range (maximum frequency of the analysis)
<b>Unit</b>	Measurement unit. Integration of signal is also available.
<b>Negative Averaging</b>	see <a href="#">Global properties</a> / <a href="#">Trigger Settings</a> / Negative Averaging

### **Amplitude trigger setting**

Bump Test  
AC 1 Measuring;RT

12 uV 120 uV 1.2 mV 12 mV 120 mV 1.2 V 12 V

AC 1  
Peak Level

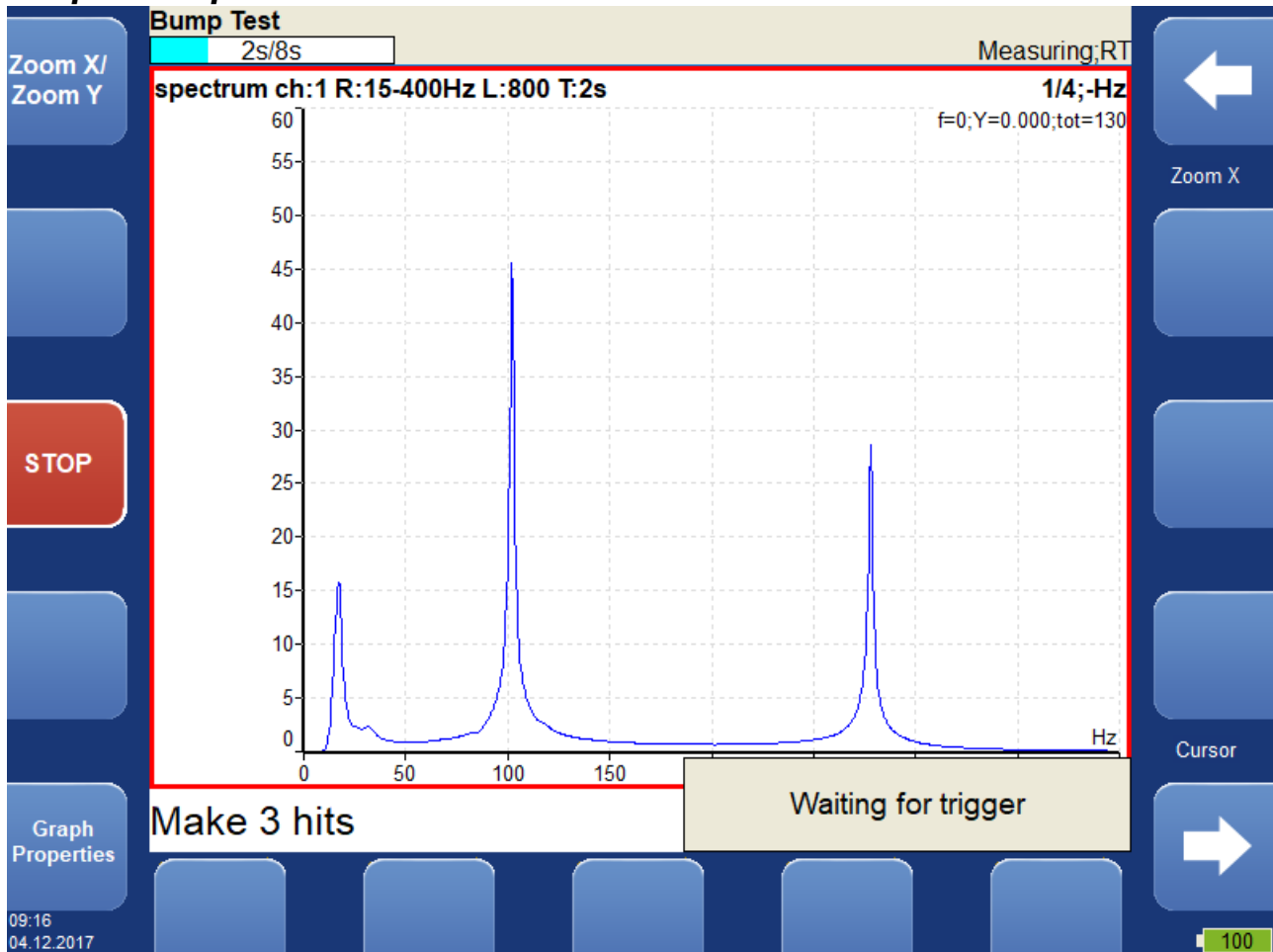
STOP

Make several hits for trigger setting, then press Stop

09:15  
04.12.2017 100

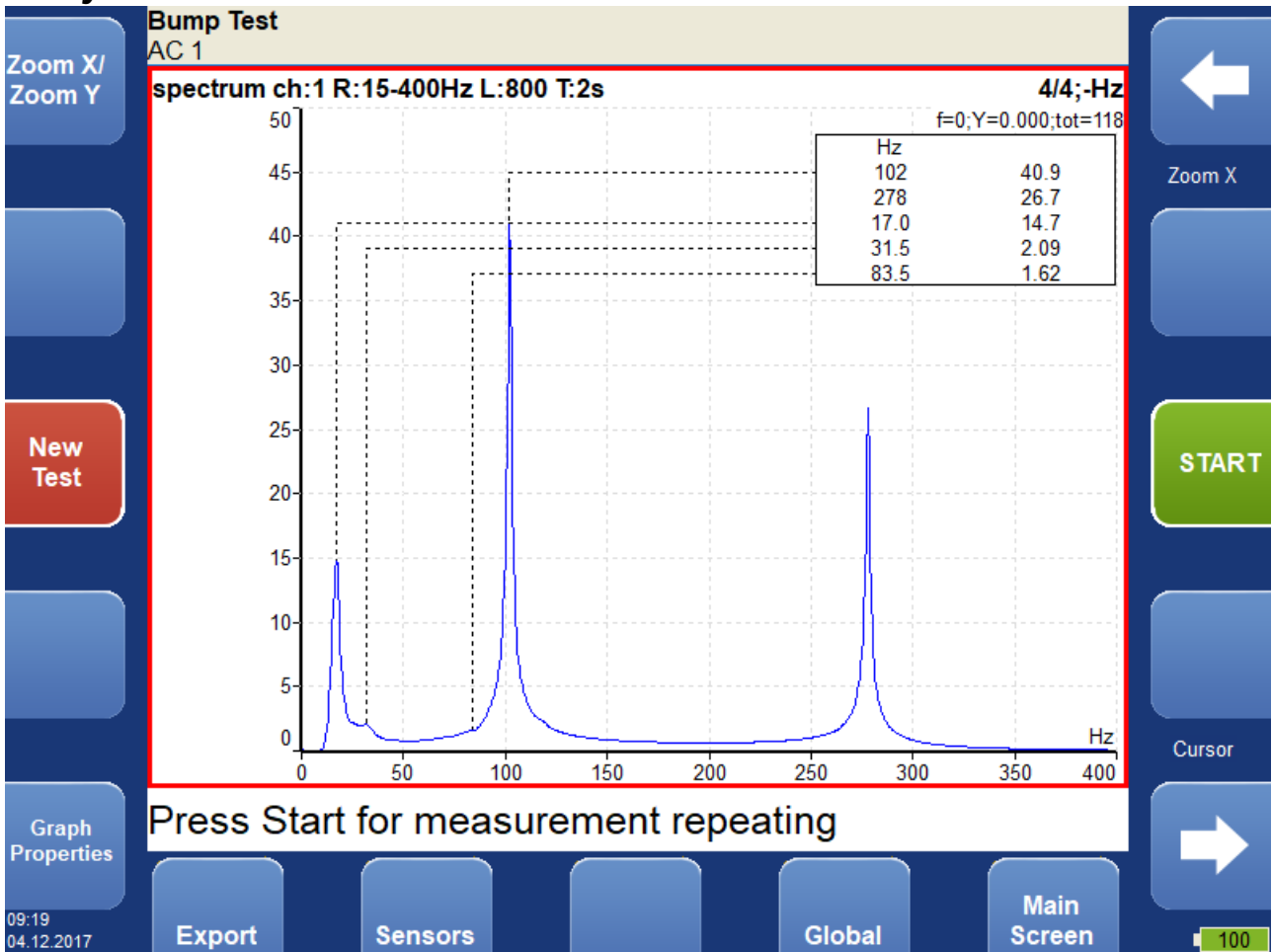
In the first part of test we need to detect the correct value for triggering. The system set it automatically. Make the hit and look the moving of the hand on display. Make all hits with the same force. More then one hit is recommended (3-4). Push **Stop** to finish it.

## Response spectrum



In part 2 continue with hits. The spectrum is displayed after first hit and the the average is used for next hits. Look at the top right corner and make the hit only when the message **Waiting for trigger** is displayed. You can stop the test anytime by **Stop** button. Spectrum graph has the same properties like in Analyser mode.

**Note!** A 10Hz high pass filter is used during signal processing. Frequencies bellow this value are removed.



Using of the **Peaks list** helps to detect required frequencies.

- Start** repeats part 2 (the same trigger level)
- New test** new test
- Export** spectrum export to VA4\_DISC or to Analyzer

## **ADS**

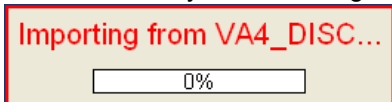
The Adash Deflection Shapes mode enables to measure operating deflection shapes of the machine.

### **ADS project**

The project must be created on the computer. The ADS software enables to create the geometry of the machine (points, lines and directions).

#### **Import of project from computer to VA4**

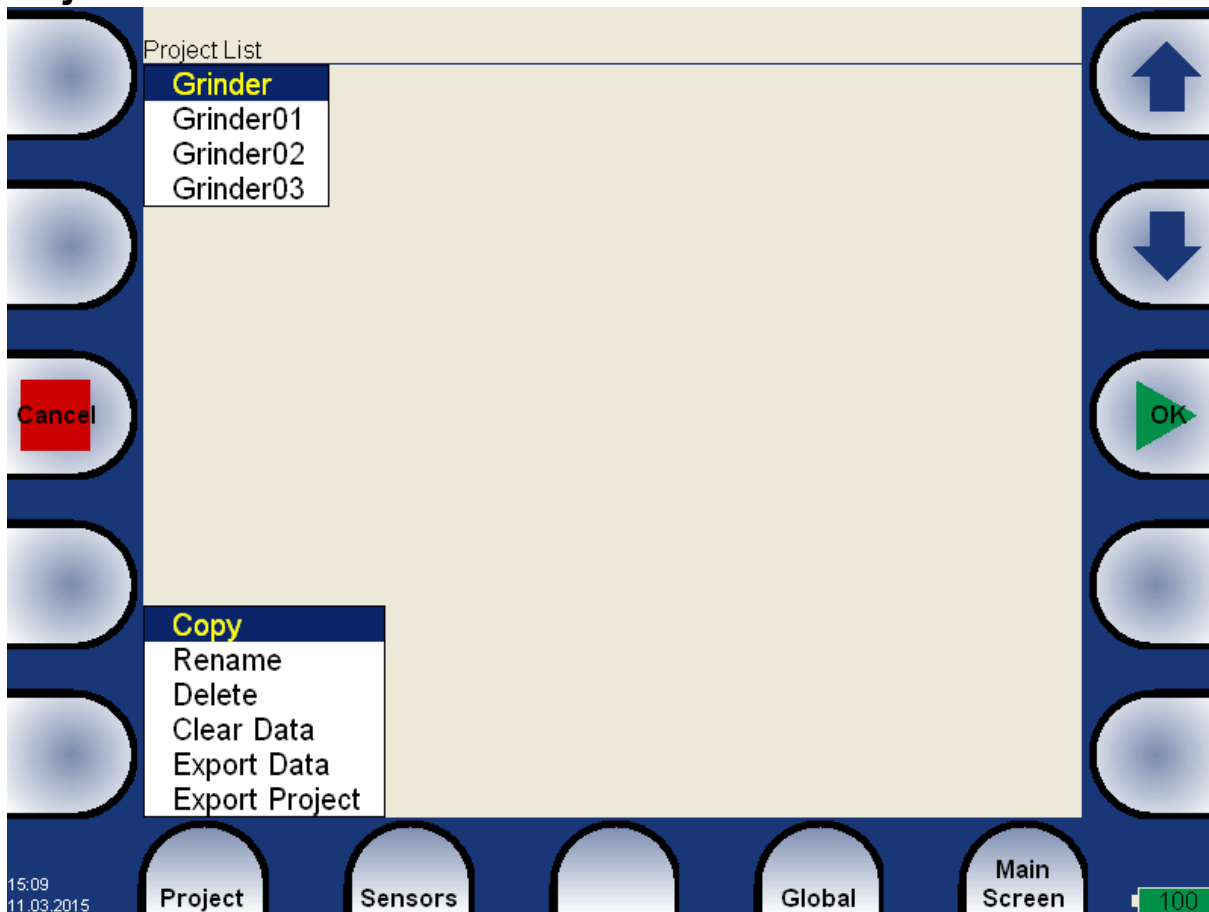
Copy the project file (ads extension) to VA4\_DISC (to the root or VA4ads folder). The project will be moved to the VA4 memory after entering the ADS module. The file in VA4\_DISC will be deleted.



#### **Rewriting of geometry**

Usually the user creates the simple geometry firstly and takes the measurements. After that first test he changes the geometry (adds the 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 menu**



**Copy**

Copy of selected project to new project.

**Rename**

Renames project.

**Delete**

Deletes project.

**Clear Data**

All readings (measurements) will be deleted.

**Export Data**

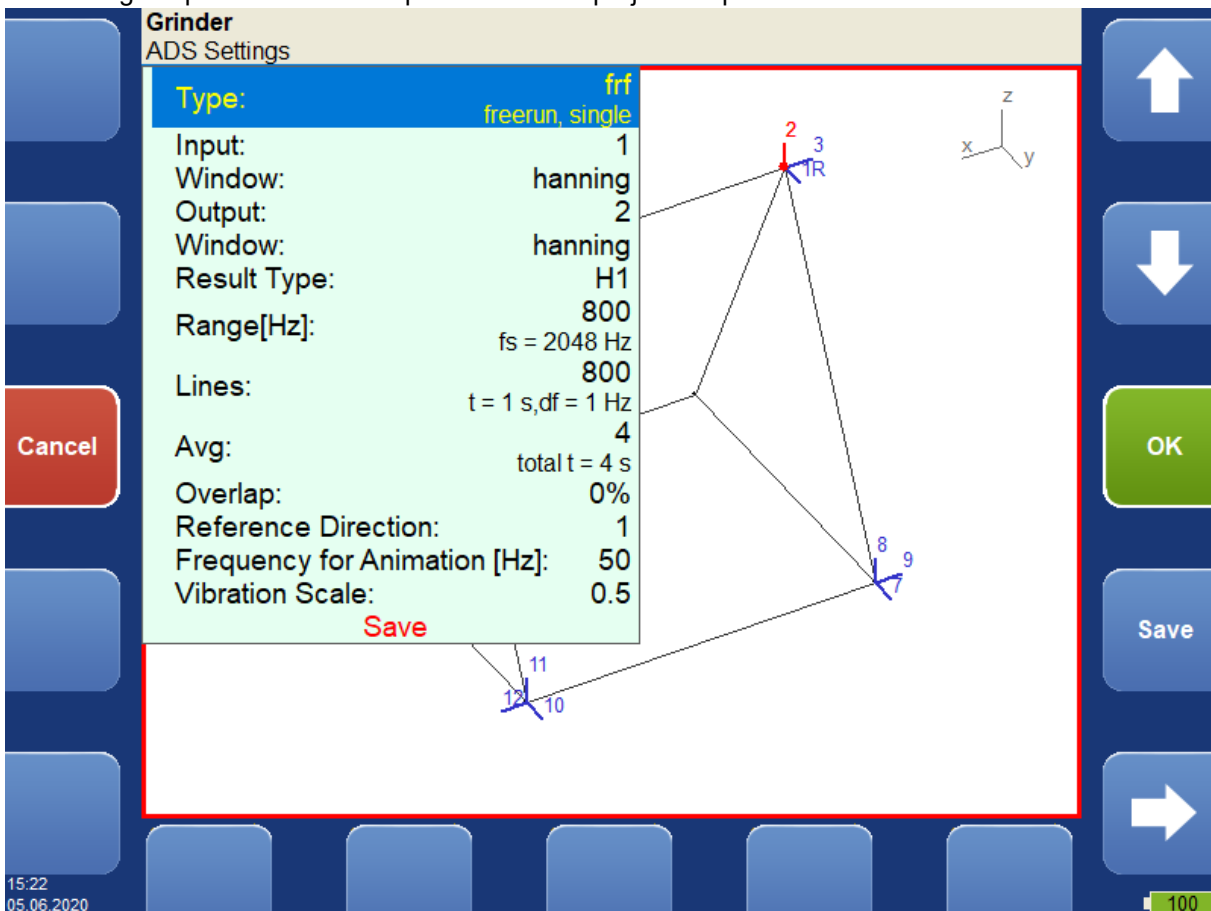
Export of readings (measurements) to VA4\_DISC. File with dsd extension will be saved to VA4ads folder. Here is prepared for download to the computer.

**Export Project**

Exports both of data (readings and geometry) to VA4\_DISC. It could be useful when user wants to use A4410 Virtual Unit software for next readings.

**ADS Settings**

The settings of parameters are required when the project is opened first time.



### **Measurement definition**

The 1x amp+phase, orders and frf are available measurement for ADS. All parameters are the same as in Analyser mode.

The settings you can change any time later, use the ADS Settings button.

The change of measurement parameters requires to delete all saved readings, because they are not compatible with old definition. The only parameter you can change without losing readings is the channel number.

### **Reference direction**

This parameter is available only for frf measurement with two accelerometers. One reference sensor is mounted to one point (one direction) on the machine and is on that place all the time. The second sensors is moved sequentially to all other directions.

The change of Reference Direction number requires to delete all saved readings, because they are not compatible with new reference direction number.

### **Frequency for Animation**

This frequency will be used for animation on VA4 screen. It works only for frf measurement. In case of 1x amp+phase or orders will be the speed frequency used (1X).

### **Vibration Scale**

<0, 1>

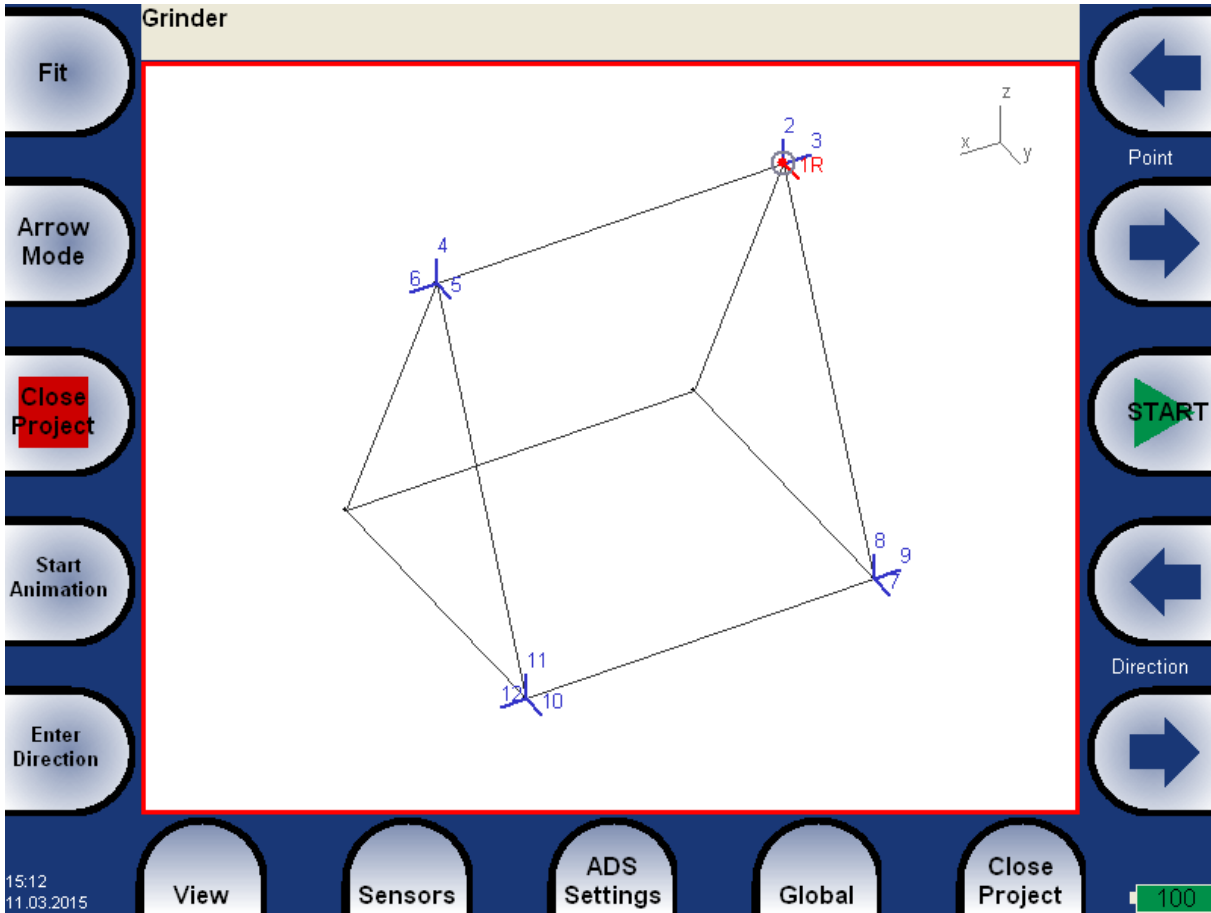
Scales amplitudes of vibrations in animation.

## **Views**

Three types of screen view are available.

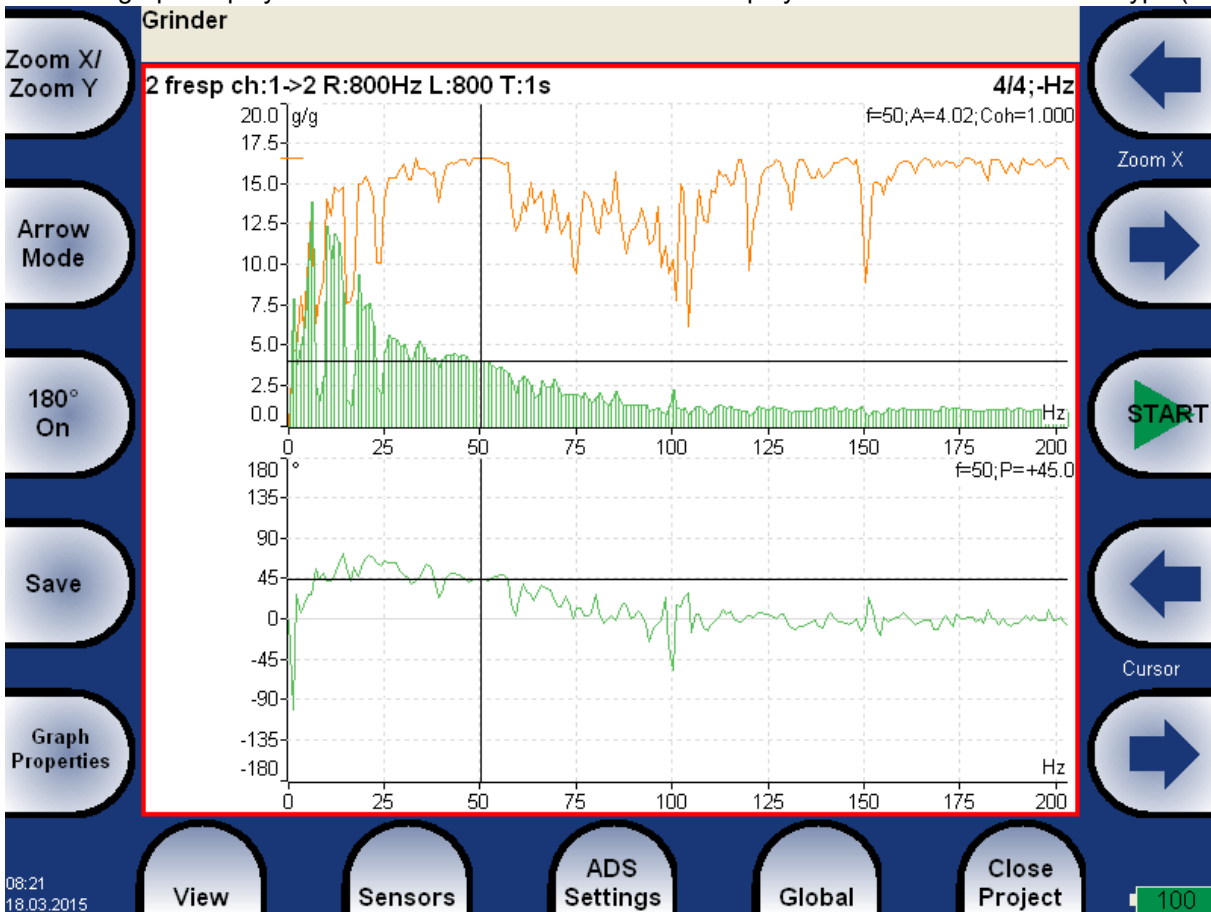
### **Machine View**

The geometry is displayed. The directions contains the numbers. The reference direction is marked as R. Just selected point contains the small circle. Just selected direction is drawn by different color.



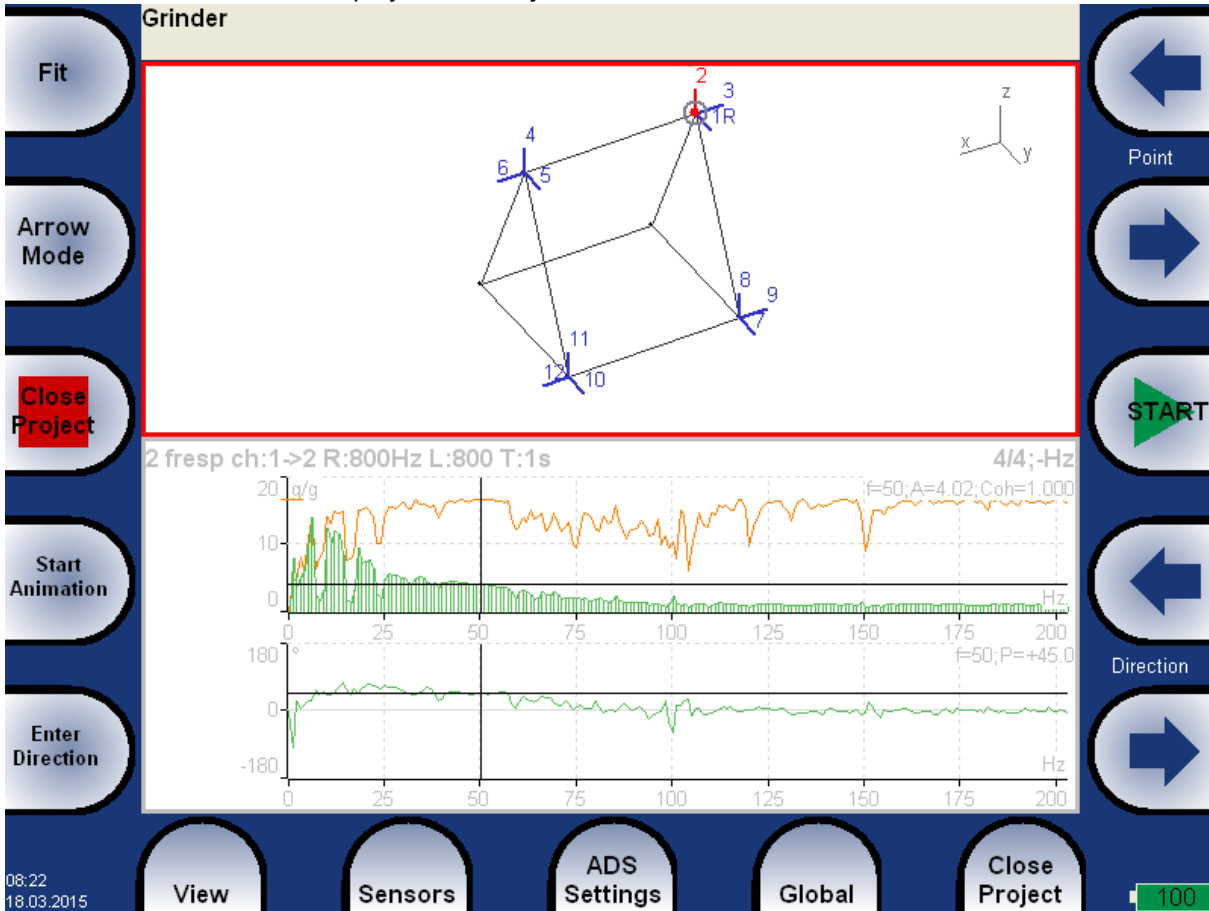
### Measurement View

Standard graph display. The number of selected direction is displayed in front of measurement type (2 frf ....)

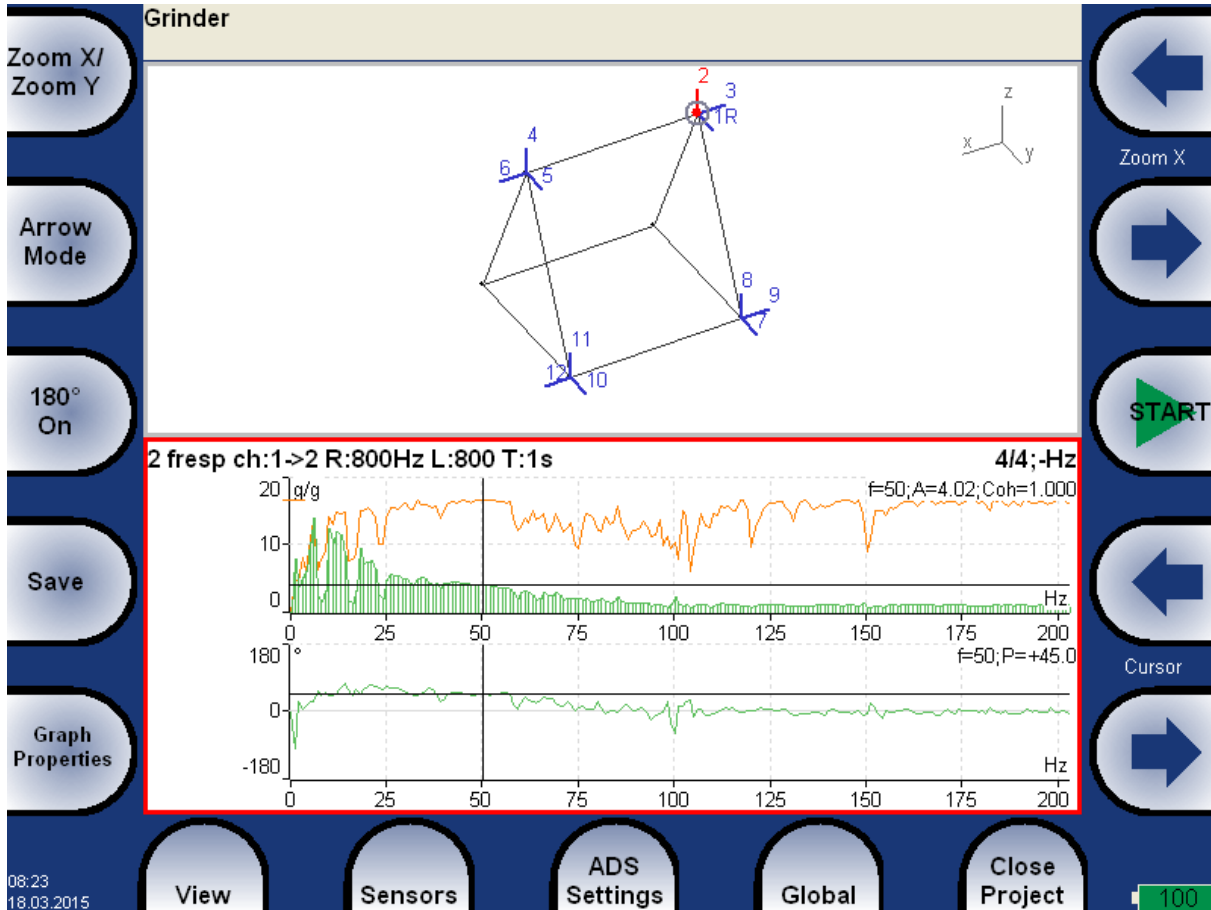


### Machine+Measurement View

Both previous screens in one together. The user can select one of them (the red border) and to work with it. The different set of buttons are displayed for every selected area of screen.







### **Automatic change of view**

When the measurement is ran, the machine view replaced by measurement view.

### **Buttons in Machine View**

#### **Fit**

Auto-zoom of machine in window.

#### **Arrow Mode**

Changes the arrows functions.

#### **Point**

Moves the point selection (blinking circle). When the new selection is confirmed by OK, then the selected direction is also moved to that point.

#### **Direction**

Moves the direction selection (on selected point). The new direction for measurement can be manually entered by **Enter Direction** button.

#### **Zoom/Move/Rotation**

Zoom/Move/Rotation of machine.

Zoom and move functions are also available by touch screen.

**Blink on/Blink off**

The directions which are not measured yet can be blinking.

**Hide on/Hide off**

The directions which are measured yet can be hide.

**Start/Stop Animation**

Run or stop animation.

**Enter Direction**

Manual entry for direction number.

**Start**

Starts new measurement.

**Buttons in Measurement View**

The most of buttons have the same function as in Analyzer mode.

**180° on/180°off**

Sometimes it is possible to mount the sensor to direction which is defined in geometry. Usually in such case is possible to mount the sensor in opposite direction. The use this button and change the phase of 180 degrees.

**Save**

Saves the measurement (reading). In the first row are displayed: direction number, amplitude, phase on selected speed.

**Grinder**

2: A = 5.69 g 0-P, P = +45.0°, f = 50 Hz

# Ultrasound

## Introduction

We would like to explain a few terms in the beginning of this chapter.

Higher frequency energy above 20kHz is best detected with an ultrasonic sensor. Most useful information is found between 30 and 50kHz. The Adash ultrasonic module enables monitoring ultrasonic energy.

Ultrasound utilizes a solid, liquid or gas to transmit (will not exist in a vacuum), and is a very directional and short waveform. It has several things in common with the vibration, for instance the ability to detect the ultrasound energy requires the sensor to be focused in the direction of the waveforms.

Field applications for airborne ultrasound detection:

- Consider 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 to 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, then by scanning the sealed areas from the outside leaks can be detected.

The probe attachment that enables direct transmission 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

The ultrasound measurement is available only on AC CH1. You need the ultrasound microphone for that. When you run the module, then the sensor is changed automatically to Pascal sensor.

Used Sensor  
on AC1: 200 mV / Pa, ICP off

Use the **Sensors / AC1** to change the sensitivity if needed. The new setting is saved and used in next run. The original sensor is set, when you leave the module.

## Settings

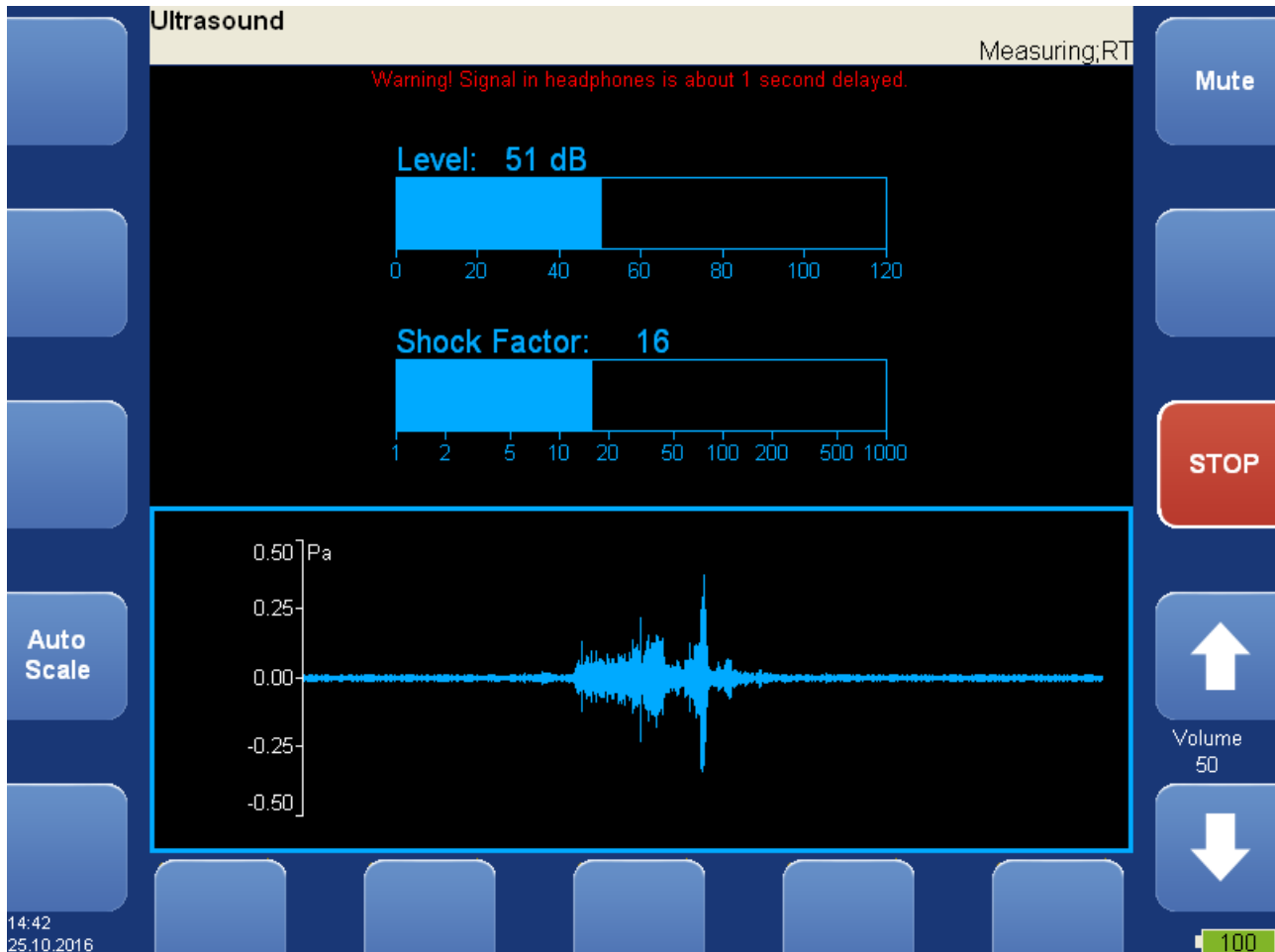
You can set the range of measurement. Use **Menu / Ultrasound Settings**. Enter required range.

Scale - minimum: 0

Scale - maximum: 120

Save

## Measurement



Press **Start** button. Two values are displayed. The **Level** of sound in dB and **Shock Factor**. The Shock factor is defined as Peak value divide by RMS value. It means value 1.4 for pure sine. Higher values means that transient shock events are in the sound signal.

The time waveform is displayed at the bottom of the screen. Use **Auto Scale** button to fit the scale of the graph. Press **Stop** to stop the reading.

## Listening

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.

### Important note !

The signal in headphones is delayed 1 sec. It is because of digital processing, which takes this time.

## **A4410 Virtual Unit**

A4410 Virtual unit is the computer application. It emulates the A4400 VA4 Pro analyzer on your computer screen.

The A4410 Virtual unit is designed for measurement with the **A4404 - SAB** (it is a 4 channel signal analyzer with USB connection to the computer).



### **Installation**

Download the A4410 Virtual Unit from website or run it from installation drive.

#### **A4404 – SAB drivers installation**

The A4404 SAB needs special drivers. Follow next instructions:

- 1) Download FTDI drivers file from [www.adash.com](http://www.adash.com) / Download / Third parties software / A4404 SAB driver / CDM20828\_WHQL\_Certified.zip
- 2) Uncompress the file into any selected directory (e.g. C:\CDM20828\_WHQL\_Certified).
- 3) Connect the A4404 - SAB to your PC via USB cable.
- 4) **Add hardware Wizard** window will 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 (do not accept any automatic downloads).
- 6) Check **Include this location in the search**.
- 7) Click the **Browse** button and select the driver folder, where you uncompressed the file (e.g. C:\CDM20828\_WHQL\_Certified).
- 8) Click the **Next** button and wait for installation completing.
- 9) Delete the driver folder (not required).

### **Software Installation**

Run the A4410 Virtual Unit installation.

During the installation you will be asked to enter the directory path where data will be stored.

### **License file**

Each A4404 SAB device is supplied with a unique license file which is paired with the A4410 Virtual Unit software.

The A4410 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 supplied flash drive into the **workdir\data\VA4licence** folder (workdir is the directory path you have defined during installation, C:\ProgramData\A4410 Virtual Unit by default).

The ver.0226 and older use the file name **adash.a44**.

### **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**

The A4410 Virtual unit contains the same functions as the A4400 VA4 Pro vibration analyzer. The only difference is in controlling of the Virtual unit, which is controlled by mouse and keyboard. Live signal is measured only with the A4404 - SAB. Without this device it's possible to post process records. A4410 Virtual Unit contains one record (**Default Rec**) for demonstration. Next records you need to measure directly or import them from A4400 VA4Pro device (see A4410 - Virtual unit and A4400 VA4 Pro connection chapter below).

### **VA4\_DISC**

**VA4\_DISC** folder is created in the data folder after the first run of the application. A4410 Virtual unit use **VA4\_DISC** folder the same way as the real instrument.

### **VA4\_DISC Folders Structure**

- VA4analyser** - analyzer projects are exported here
- VA4balancer** - balancing projects are exported here
- VA4balancer\_protocol** - balancing reports are exported here
- VA4route** - route projects are exported here
- VA4runup** - runup projects are exported here
- VA4recorder** - records are exported here
- va4ver** file - unit version information (for DDS)

These folders are created when the unit needs them, not actually in the first run.

### **A4410 Virtual unit and A4400 VA4Pro connection**

How to share projects between the real and virtual unit will be described in this chapter.

Connect the real Va4Pro instrument to the computer with installed Virtual unit (via USB cable). The VA4Pro unit will be found as **VA4\_DISC** (removable disc) on your system. It's possible to copy the data to and from the Virtual **VA4\_DISC** folder.

### **Copying projects to the VA4Pro instrument**

Copy the **workdir\Data\VA4analyser\ProjectName** project folder (workdir is the directory path you have defined during installation, C:\ProgramData\A4410 Virtual Unit by default, ProjectName is your folder name which you want to copy) into the VA4Pro **VA4\_DISC\VA4analyser** folder (**VA4\_DISC** is the real removable storage device here, NOT the virtual unit folder !!!). You have to create **empty** file with the name **script.dds** in VA4Pro **VA4\_DISC\VA4analyser** after project copy (it has the label sense only). RunUp and Route projects (*VA4runup* and *VA4route* folders) are copied the same way. Next mode projects are not available to copy.

Example:

We've got the analyzer project called Power Station in the virtual unit and we want to add it to the real instrument.

- 1) Connect the instrument with the computer.
- 2) **VA4\_DISC** removable storage device appears. Open **VA4analyser** folder on this device.
- 3) Open **workdir\Data\Va4analyser** folder. Find **Power Station** folder in this folder. Copy folder into the VA4Pro **VA4\_DISC**.
- 4) Create the empty file **script.dds** in VA4Pro **VA4\_DISC\VA4analyser\Power Station** folder.

### **Projects and records copy from the VA4Pro instrument**

**!!! Attention:** Projects has to be exported to the VA4Pro **VA4\_DISC** first (the same as export to the DDS).

Copy the VA4Pro **VA4\_DISC\VA4analyser\ProjectName** (the real removable storage device here, NOT the virtual unit folder!!! ) into the **workdir\Data\VA4analyser** folder (workdir is the directory path you have defined during installation, C:\ProgramData\A4410 Virtual Unit by default). In this case there is no need of script.dds file. RunUp, Route, Records and Balancer projects (*VA4runup*, *VA4route*, *VA4recorder* and *VA4Balancer* directories) are able to copy.

Example:

We've got the analyzer project called Power Station in the real instrument and we want to add it to the virtual unit.

- 1) Connect the instrument with the computer.
- 2) **VA4\_DISC** removable storage device appears. Open **VA4analyser** folder on this device. Find **Power Station** folder in this folder.
- 3) Open **workdir\Data\Va4analyser** folder.
- 4) Copy the **Power Station** folder from the VA4\_DISC into the **workdir\Data\Va4analyser** folder.

### **The Virtual Unit vs. the real instrument differences**

- The Virtual unit use VA4\_DISC directory for export and import instead of VA4\_DISC flash drive.
- Update button does not work in the Virtual unit (see instructions above for Virtual unit upgrade).
- The Virtual unit application runs in window.
- It is not possible to measure live signal without the A4404 - Signal Analyzer Box.



## **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 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:	Binder 712 series

#### **Tacho 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 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:	Binder 712 series

#### **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



## ADASH

## Adash 4400 – VA4Pro

	amplitude (positive or negative)
	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
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 range 64Hz - 196 kHz
Record length example:	3 GB for 1 hour record with 64kHz sampling (4ch AC+4ch DC+1ch tach signal)
	(100GB memory enables over 30 hours of full 64kHz recording,
	lower sampling frequency enables 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 ISO1940:	yes
Balancing vector graph for balancing process reporting:	yes
Balancing Report:	yes
Trim function:	yes
Vector split (e.g. to blades positions):	yes
Manual entry:	yes
Intuitive graphic user interface:	yes
Trial mass:	get out or leave in

## General VA4 Pro II (from 2018):

Processor:	Atom 1.9 GHz
RAM:	2 GB
Display:	LCD colour 191 x 134 mm (9.1" diagonal), 1140x800 resolution
Memory (Internal SSD):	64 GB
Memory (VA4_DISC)	16 GB
Interface:	USB
Powering:	Li-Ion long life battery pack (more then 8 hours of measurement)
Operating temperature:	-10 °C - +50 °C, 15°F-120°F
EMC:	CE tested
Dimensions:	280 x 205 x 55 mm
Weight:	2.2 kg

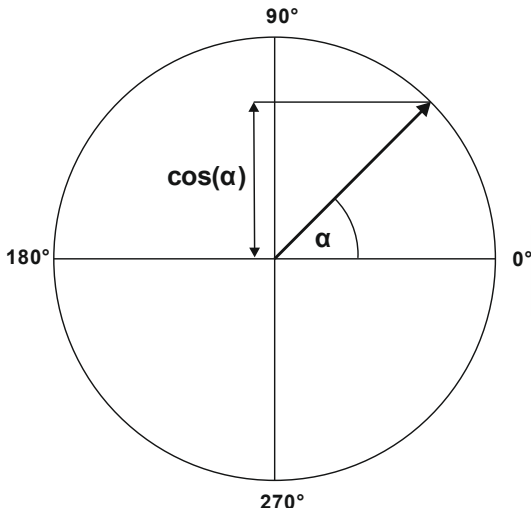
**General VA4 Pro (up to 2018):**

Processor:	Atom 1.6 GHz
RAM:	1 GB
Display:	LCD colour 174 x 127 mm (8.5" diagonal), 800x600 resolution
Memory (Internal SSD):	128 GB
Memory (VA4_DISC)	8 GB
Interface:	USB
Powering:	Li-Ion long life battery pack (more then 5 hours of measurement)
Operating temperature:	-10 °C - +50 °C, 15°F-120°F
EMC:	CE tested
Dimensions:	280 x 205 x 55 mm
Weight:	2.5 kg

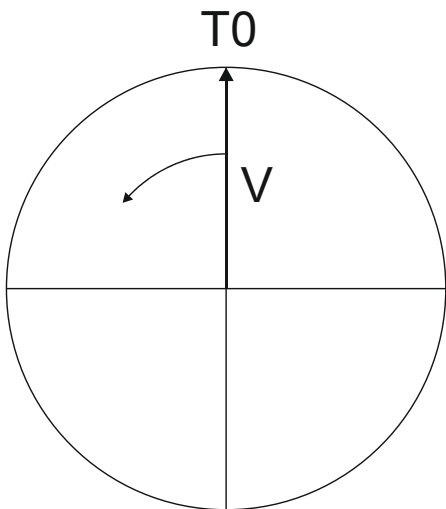
## Appendix B : Phase measurement conventions

### **Single channel measurement with tachometer**

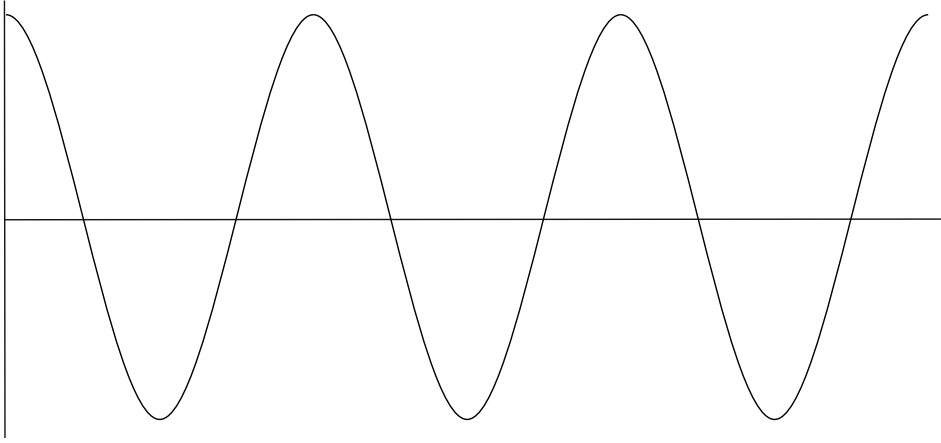
Let's assume the time signal defined as  $y = \cos(\omega t)$ . We use the cosine function because FFT uses it too. It simplifies the calculations and understanding.



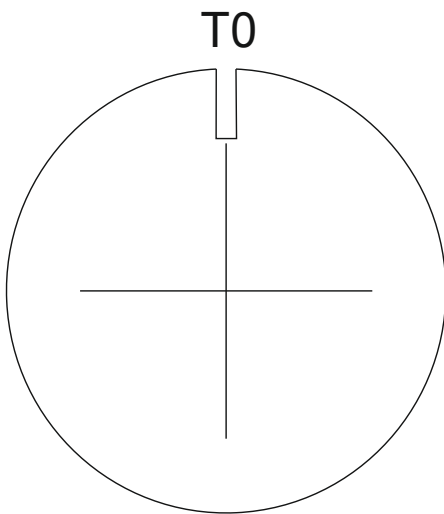
Our starting position of rotating vector  $V$  will be  $90^\circ$ , we will mark it as  $T_0$ .



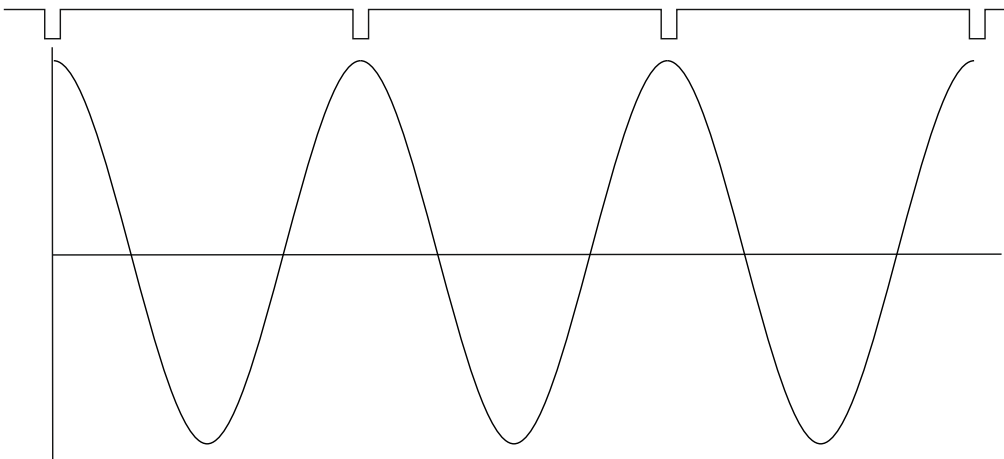
When the vector  $V$  rotates for example 3 times, then we get the time signal as follows.



Now we assume the tacho signal. The tacho pulse we put to the T0 position.

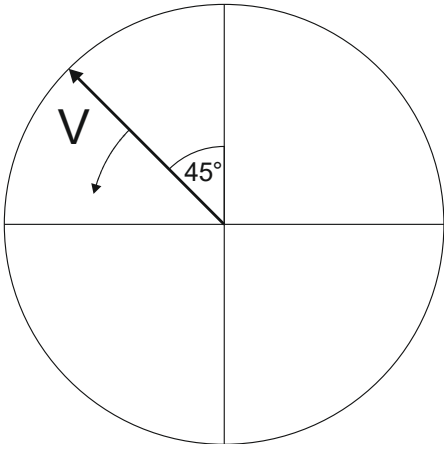


Corresponding time signal with tacho pulses is on the following picture.

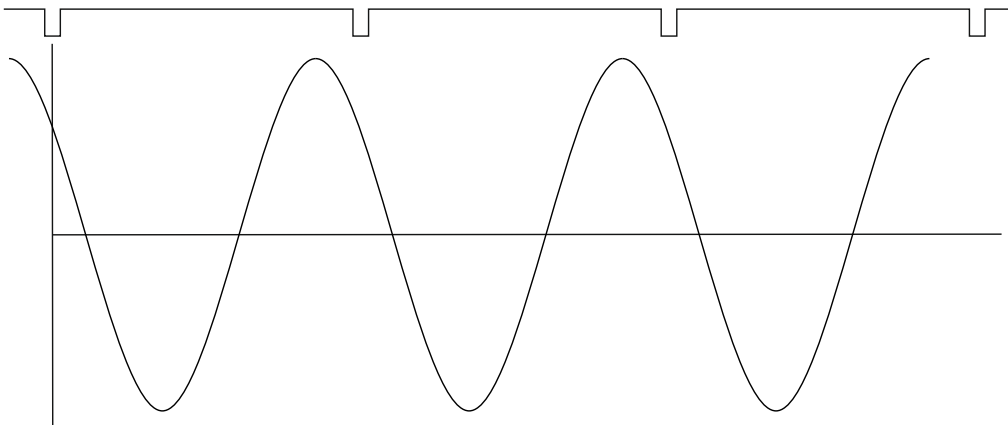


Now we begin to assume the phase shift (marked as  $\varphi$ ) of time signal vs. tacho signal. The signal formula changes to  $y = \cos(\omega t + \varphi)$ . The previous picture corresponds with  $\varphi = 0^\circ$ . And this value is displayed on the instrument screen. When the tacho pulses are in the maximum time signal positions, then phase value is equal to zero.

Now assume the  $\varphi = 45^\circ$ . We use the degrees unit to make it simple for all readers. The radians have to be used in exact math formula.

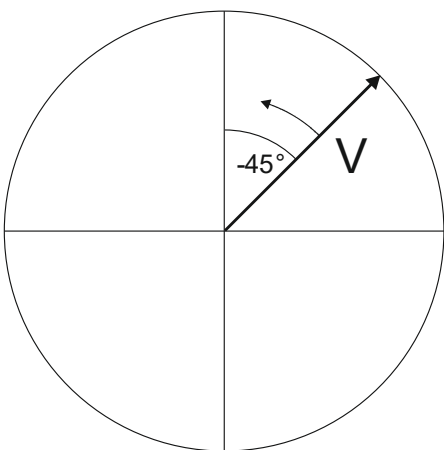


On the next picture is the corresponding time signal with tacho pulses.

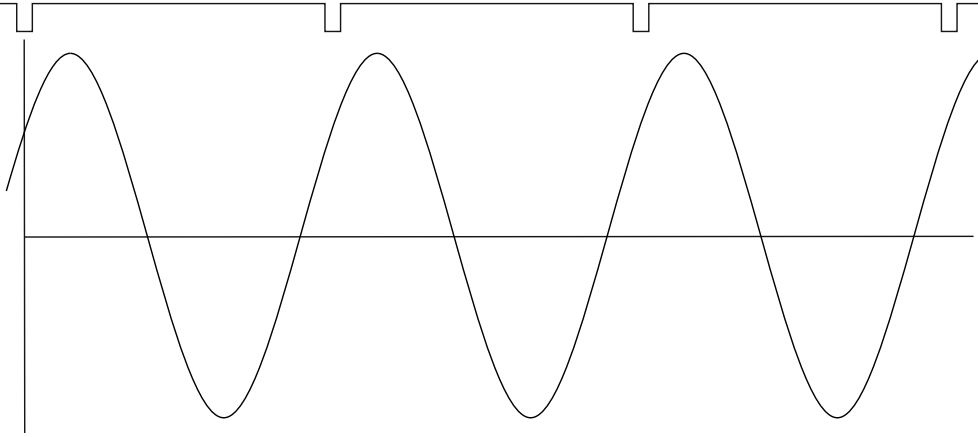


The time signal foreruns (gets ahead of) the tacho signal of the  $45^\circ$ . The  $45^\circ$  appears on instrument screen in this case.

Now we assume the  $\varphi = -45^\circ$ .



On the next picture is the corresponding time signal.



The time signal is delayed. The  $-45^\circ$  appears on instrument screen in this case.

This approach is used for single channel measurement as  $1xamp+phase$  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 have to always assign the channel numbers of A and B. The A represents the input channel and B the output channel. You can imagine it as black box and you need to measure the phase response of that.

You see on the display for example this:

**$\Phi_B - \Phi_A: +59.9^\circ$**

The logic is the same as for single channel measurement. The A has the same function as tacho signal. This  $60^\circ$  means that B is ahead (foreruns) the A of  $60^\circ$ .

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 a words such as “signal is ahead”, “foreruns” and on the other side that signal is delayed.

You should always keep in mind:

**To be ahead of for example  $60^\circ$  is the same as to be delayed of  $300^\circ$ . Don't forget that we are working with periodic pure cosine time waveform.**