User Manual

Adash 4400
VA4Pro

Ver.2 - 10082011

Content:

Before Switching On

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

Never connect higher then 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 agains ICP powering.

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

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

Always use only original cables designed for connection with sensor.

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

General information

The switch-on

Use the **POWER** button for switch-on (older versions had the button in different position as in the picture).

The green LED on the front panel (right at the top) lights after switch-on.

Auto switch off

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

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 VA4 unit can be on or off.
The instrument contains the **VA4_DISC**, which is accessible from external computer. The usual windows of flash disc connection appear on the computer. Close those windows.
If this operation failed, switch off the unit and try to connect it again.

The charging

The socket for external charger (instrument accessory) is 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 (older versions had the button in different position as in the picture). 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.

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.

Virtual Analyzers

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

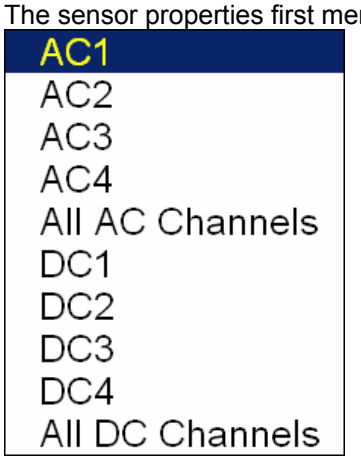
The demo VA4Pro you can download from the producer website. Only easy de-compress the zip file and run the bat file. Now you can easy try to work with all functions in your computer. Do not forget define the record as signal source. You can also download the next records from that website.

How to work with Menu

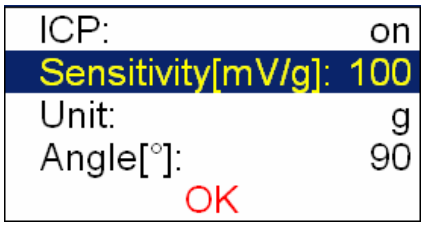
For the taking of measurements you have to define many parameters. All those definitions are providing by menu items. The procedure for operation with all menu items is the same. We describe it on example - the sensor properties definition.

Item selection

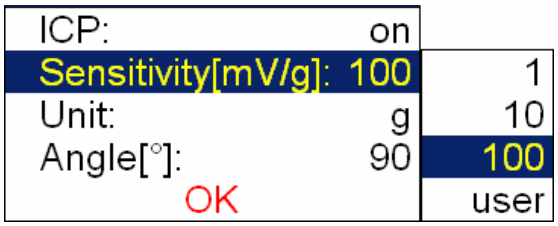
The sensor properties first menu appears after you push the **Sensors** button.



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

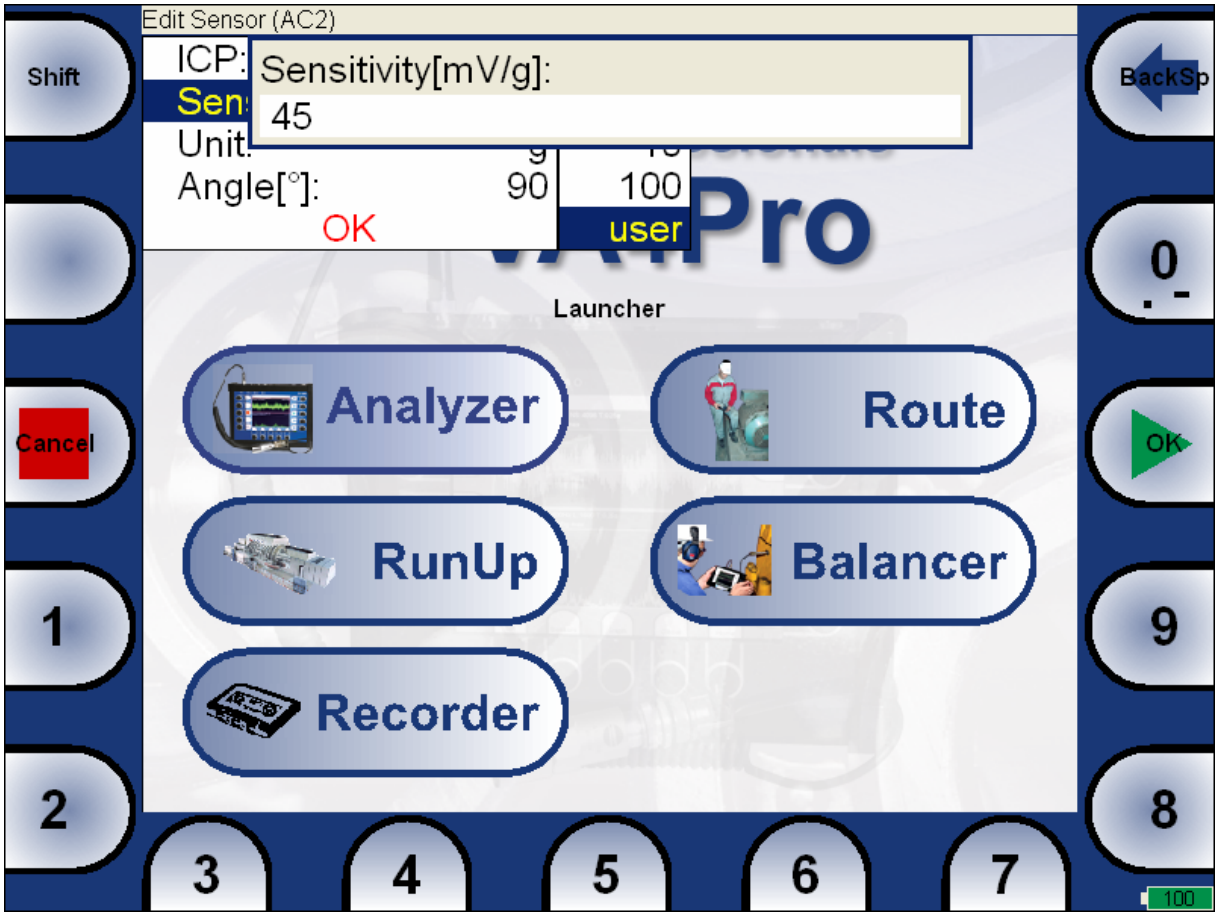


Again use the arrow button for one item selection. Then push the right arrow button to display possible parameters of selected item. E.g. for Sensitivity you see this picture:



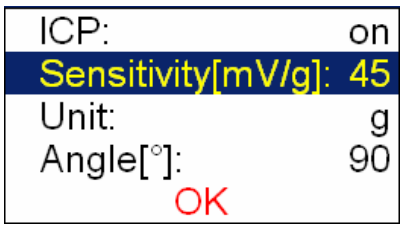
User defined values

Again use the arrow button for one sensitivity selection (**1**,**10**,**100**). In some cases also the user value is possible to enter. 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.

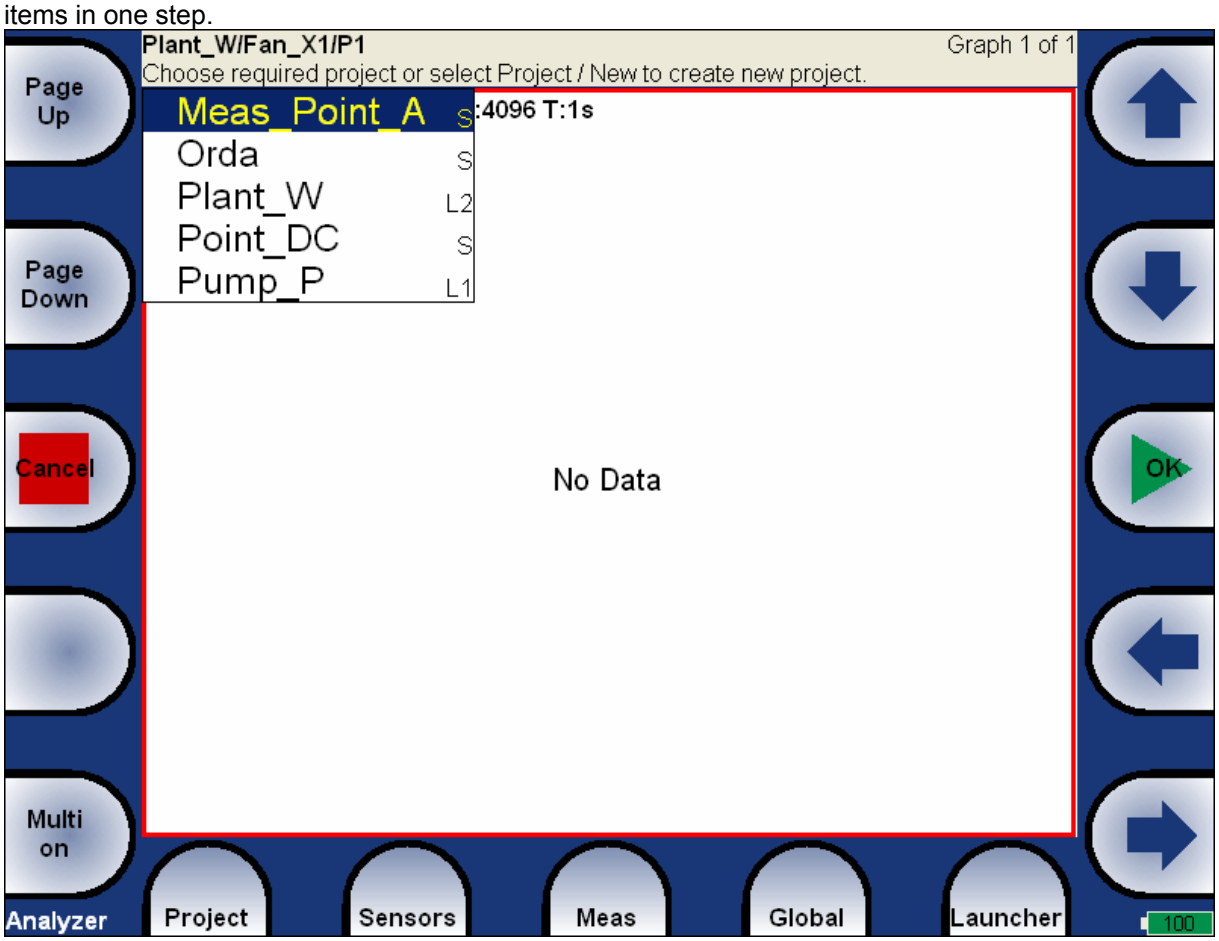


Use the arrows and select the **OK** item. Press the **OK** button and the working with sensors menu is closed.

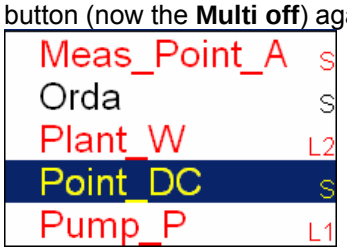
As we mentioned the value entry, also the text has to be entered in some menu items. The screen looks similar to the numerical screen. The only difference is the characters selection on buttons. It works like mobile phones keypad, for second character selection you must press the button two times. The **Shift** button switches two modes of the buttons.

Multi-selection of items

Sometimes you could need to work with more then 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.



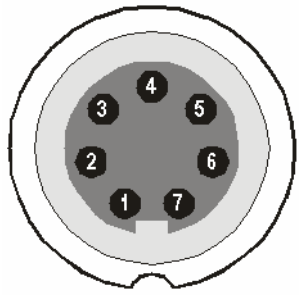
Example of multi-selected items. It needs a short time to play with and to find the right understanding of this feature. The item with the cursor (the full blue field) can be selected or unselected too. The standard yellow color means unselecting and the red color means selecting.

Input channels

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

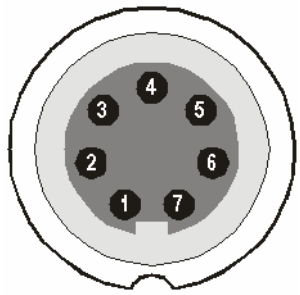
The input sockets labeled IN1, IN2, IN3, IN4 are used for AC or DC signals. The input socket labeled TRIG is used for trigger signals, usually tacho. All sockets have several pins. It enables to connect more signals to one socket (see wire diagrams).
The AC inputs enable to measure max voltage peak +/-12V. 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 – NOT USED

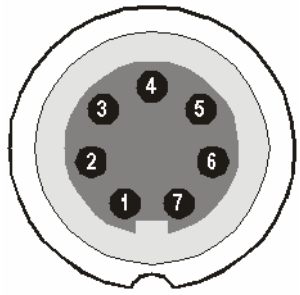
IN2 socket



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**.

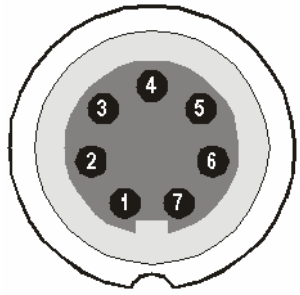
IN3 socket



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

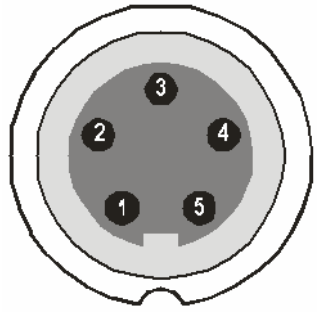
Pay attention to possibility of connecting all four DC channels to **IN3**.

IN4 socket



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

TRIG socket



1 – GROUND
2 – NOT USED
3 – NOT USED
4 – +5 V OUTPUT/ 50 mA for tacho power supplying
5 – TRIG INPUT - for tacho signal

Standard cable wiring

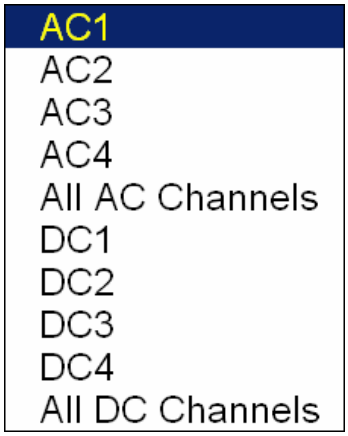
The standard cable, which are the part of the unit, have the sensor signal connected to the pin number 1. The second sensor wire is connected to the ground (pin 2).
When you use this cable:
In IN1 socket, the signal will be measured on CH1.
In IN2 socket, the signal will be measured on CH2.
In IN3 socket, 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.

Sensors properties

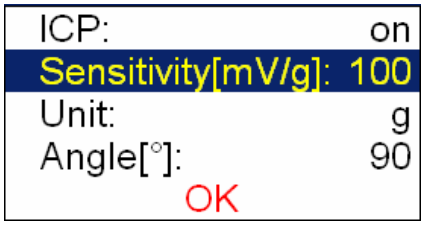
When you connect the sensors to the instrument, you have to tell what kind of sensors you use. The **Sensors** button is on most screens in the bottom.

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

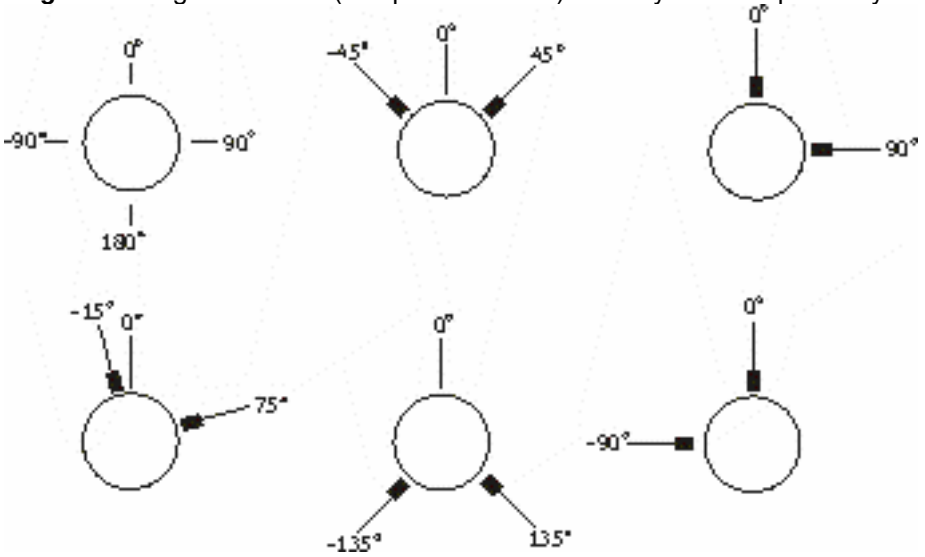


AC sensors

AC (alternate current) sensors are used for signals, e.g. vibrations.
After selection of **AC1** - **AC4** or **All AC Channels** item the sensor properties menu appears.

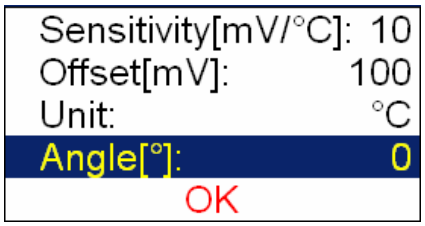


ICP **on, off** (selection of required setting accordingly the sensor type)
Sensitivity[mV/unit] usually **1**,**10**,**100**, **user**
Unit unit selected from the list or user unit
Angle the angle of sensor (see picture bellow). Usually used for proximity sensors.



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/unit] **sensitivity value**
Offset[mV] **offset value**
Unit unit selected from the list or user unit
Angle 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**.

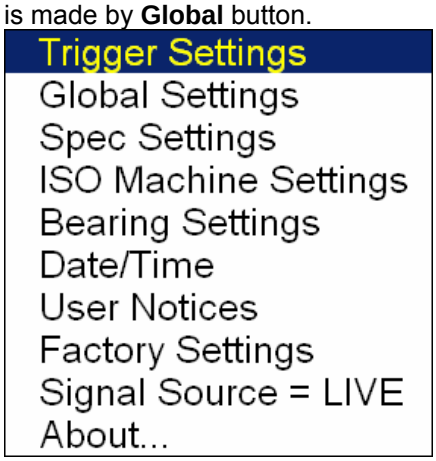
Sensor Properties of recorded signal

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.

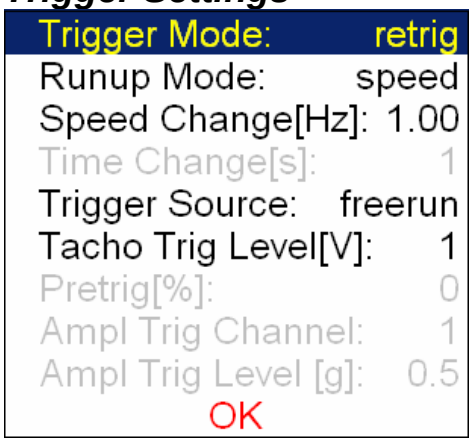
Global properties

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



The About ...

Trigger Settings



Trigger Mode

single **O**nly 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 Mode How often should be data taken in the runup has to be define.

asap The next measurement is taken immediately after previous measurement without any delay. Be careful of duration of runup, the maximum is 6400 measurements.

manual The user starts next measurement manually.

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)**.

Speed change(Hz) 1, 10, user see **RunUp** Mode section (the previous section). The RunUp Mode must be Speed for value entry.

Time change(s) see **RunUp** Mode section. The RunUp Mode must be Time for value entry.

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 mode is the frequency of measurements controlled by **RunUp Mode** at first. Then is applied the **Trigger Source**.

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 **Tacho 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.

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 and negative 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**) appears on the trigger input (the same like **external** item).

Only the **tacho** enables the **speed** measurement and time signal averaging.

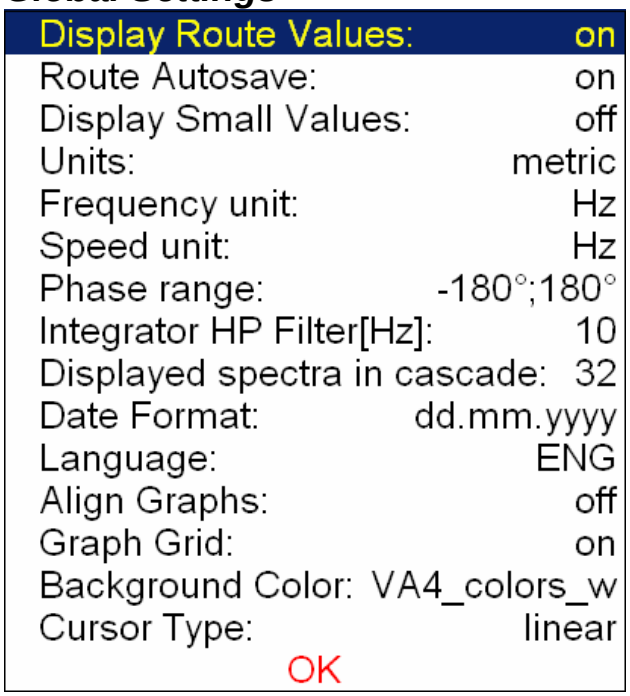
Tacho Trig Level (V) value See the description of external and tacho in previous section.

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.

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**).

Global Settings



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)

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.

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

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

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

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

Integrator HP Filter (Hz) **1**,**10** Hz

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 **yy.mm.dd**, **dd.mm.yy**

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.

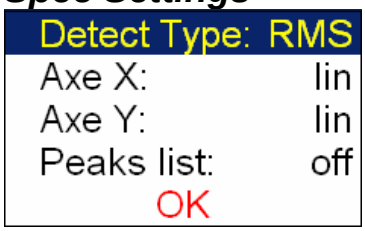
Graph Grid **on**,**off**

Background Color **black**, **white** for graphs

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.

Spec Settings



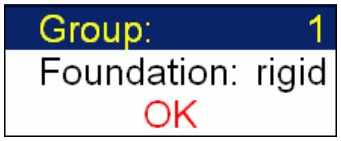
Detect Type **RMS, 0-P, P-P** the spectrum values on amplitude axe

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

Axe X **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

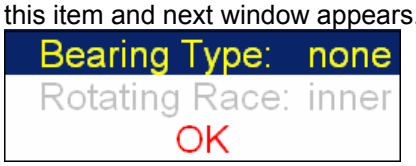
ISO Machine Settings



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

Bearing Settings

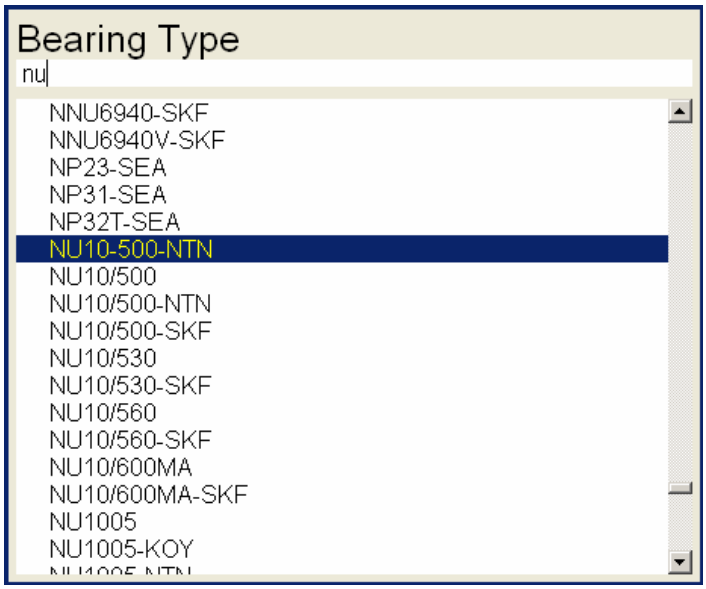
The fault bearing frequencies can be displayed in spectra. The bearing type definition is required for that. Select this item and next window appears.



Select **Bearing Type** item and press **OK** button or right arrow button. From next list select required item and press **OK** button.

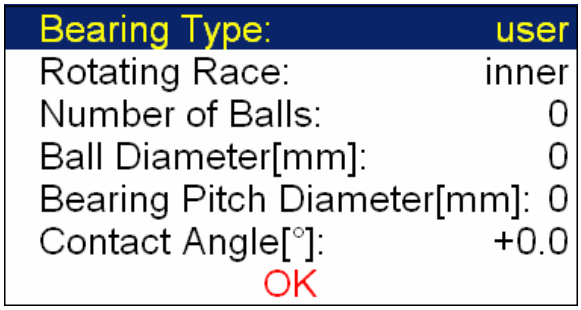
Bearing type

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



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.

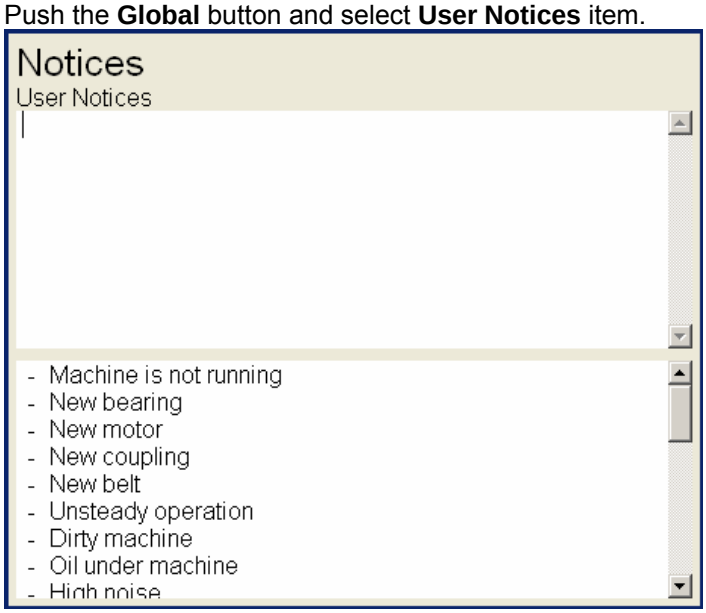
Date/ Time

Set the actual date and time.

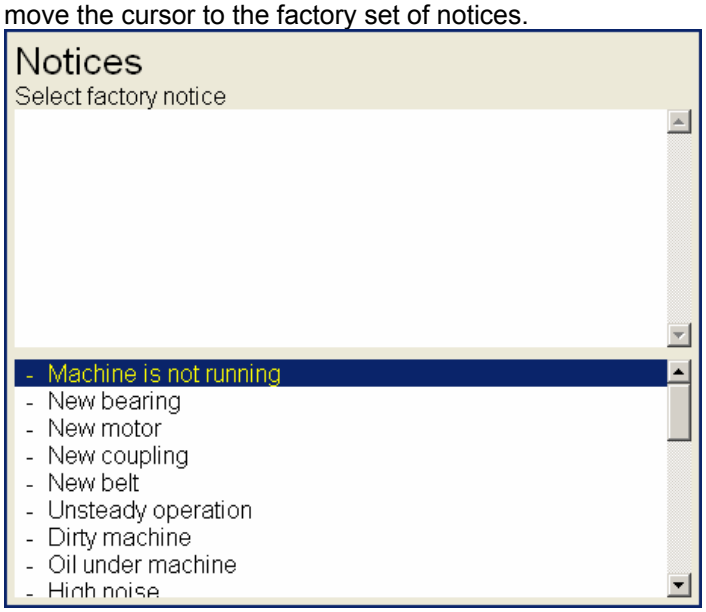
User Notices

When you collect the route or Analyzer measurements, you can add to every point or measurement the text notice. Because many notices we use regularly, we can save them to the instrument to the User Notices set. With new unit you receive also the factory predefined notices.
It is recommended to develop your User Notices set and use this set for daily work. You can write your own template and you can copy the templates from factory set.

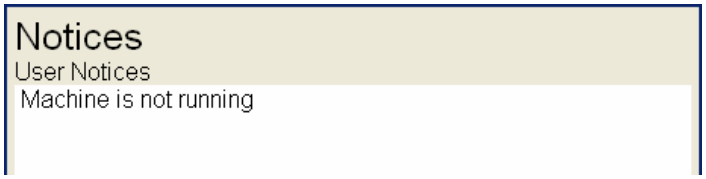
Push the **Global** button and select **User Notices** item.



In the initial screen contain the empty list of user notices and the factory notices bellow that list. Use **Select** to move the cursor to the factory set of notices.

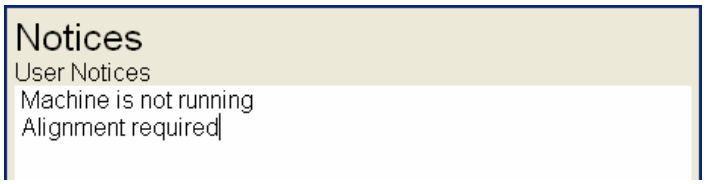


Use the arrows and select one notice and push the **Add** button. The notice will be copied to User Notices set.



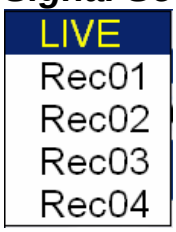
Copy all notices which you want from factory set.
Push **Select** and the cursor moves back to the User Notices field. Now you can write your own new notice.
Push the **New Line** button (for old guys - the CR LF is added). Push the **Shift A/a/<->** button, the alphabet

appears on keyboard buttons. Use the same button to change the button functions (capitals, small letters, edit arrows). Write your notice. Press the **OK** to close and save the User Notices.



The "Alignment required" was written by user.

Factory settings
All Global and Sensors parameters will be returned to default factory values.

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 demo unit on your computer, use the Default Rec for testing.

The Launcher screen

After switch-on the **LAUNCHER** 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. Follow the procedure:
- Download the file for update (e.g. A4400_ver0114.u44) from website (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 Launcher 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 Launcher window is closed now. The procedure of update is described in the new command window.
- After the update the Launcher screen appears again.

Battery capacity

The information about % of battery lifetime is displayed in the right bottom corner of the display. When the capacity is more then 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 then 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 is switched 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.

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 then 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.)

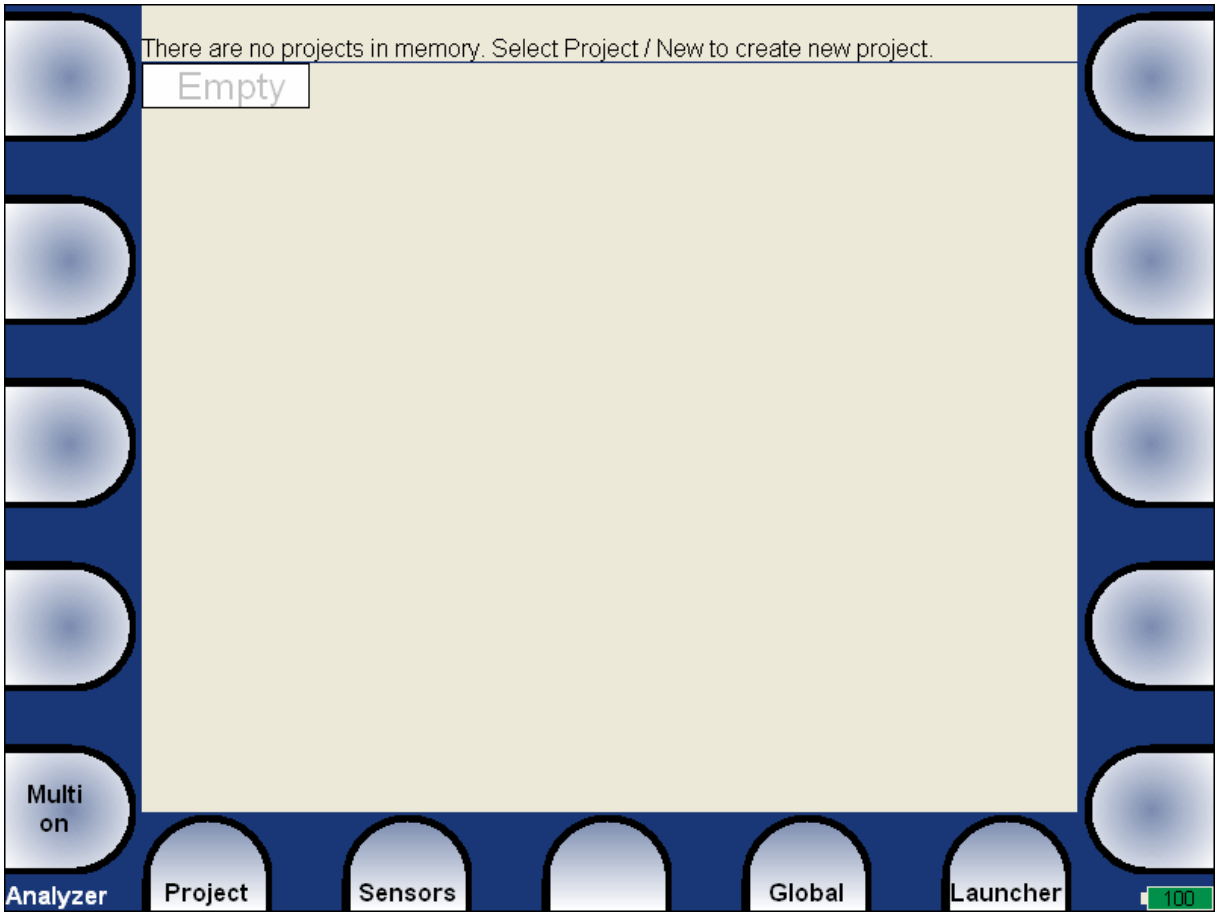
Plant_X/ Pump_P/ Points
: The structured **Project** with name of Plant (Level2) , names of machines (Level1) and names of Sets. This Project type we call **L2/L1/Set**.

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.

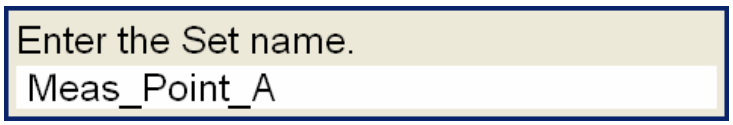
First Analyzer screen

The first Analyzer screen contains the list of Projects saved in the memory or the empty list, when no Projects were saved.

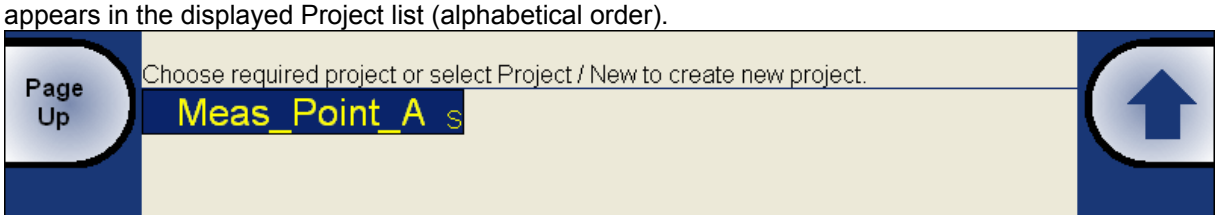


New Project - Set creation

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



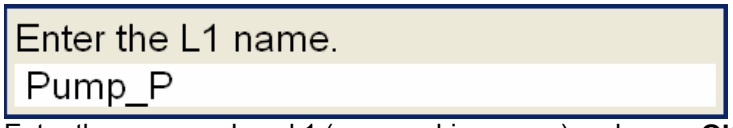
Enter the name of new set. Use the **Shift** button for next buttons displaying. Then press **OK**. Your new item appears in the displayed Project list (alphabetical order).



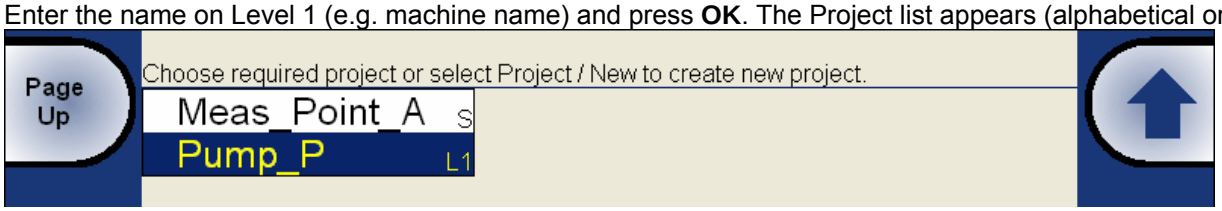
The **S** letter after the name is the **Set** type indication.

New Project - L1/Set creation

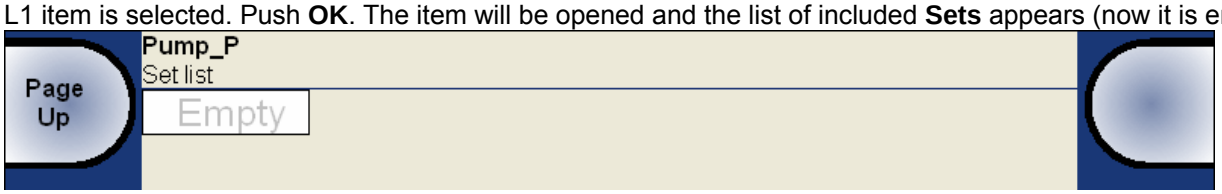
The L1/Set structure usually enables to create the machine item with several points. Push the **Project** button and select **New L1/Set** item.



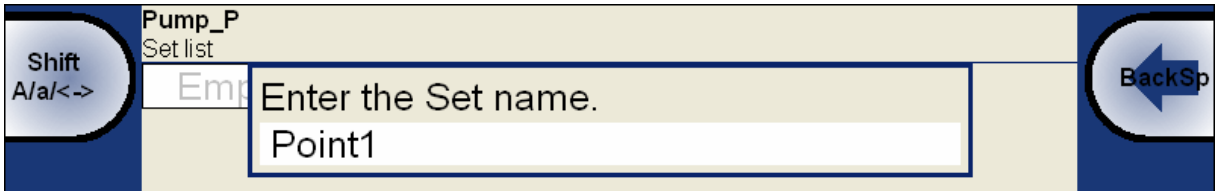
Enter the name on Level 1 (e.g. machine name) and press **OK**. The Project list appears (alphabetical order).



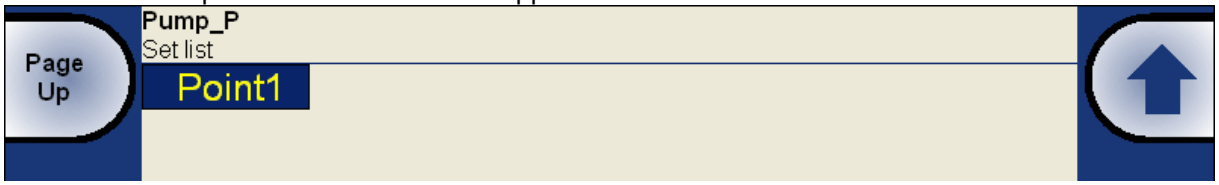
The **L1** letter after the name is the **Level 1** type indication.
L1 item is selected. Push **OK**. The item will be opened and the list of included **Sets** appears (now it is empty).



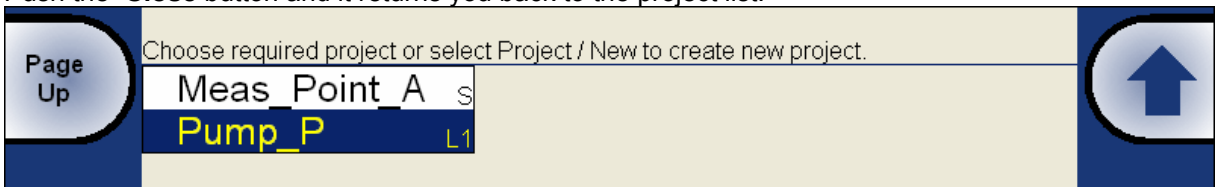
Push the **Set** button and select **New** item.



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

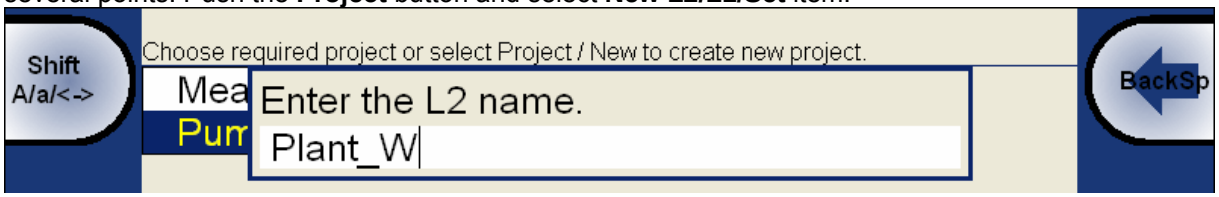


Push the **Close** button and it returns you back to the project list.

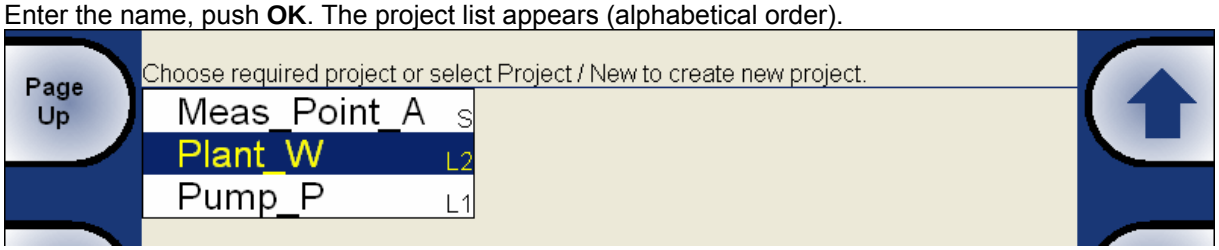


New Project - L2/L1/Set creation

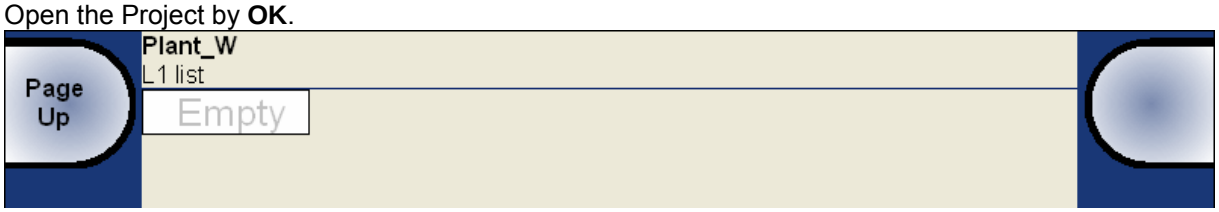
The L2/L1/Set structure usually enables to create the plant with several machines. Every machine can contain several points. Push the **Project** button and select **New L2/L1/Set** item.



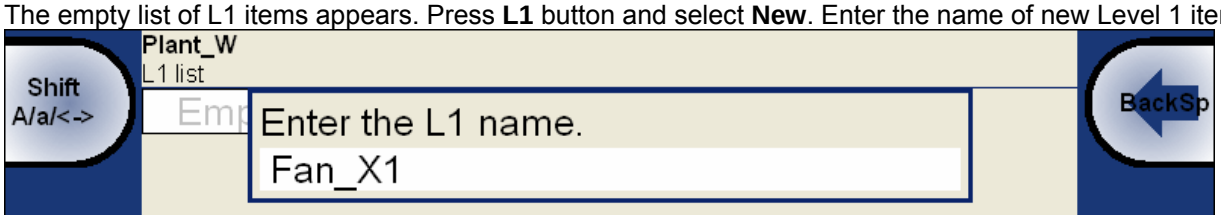
Enter the name, push **OK**. The project list appears (alphabetical order).



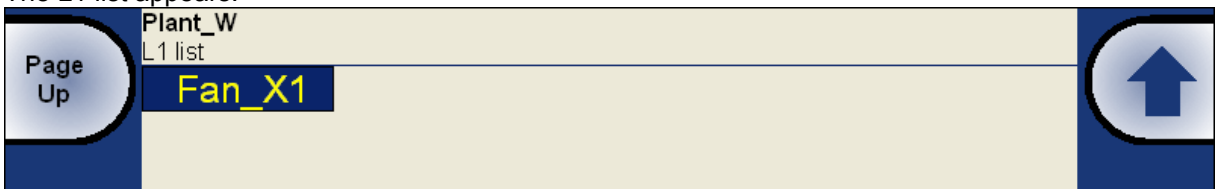
The **L2** letter after the name is the **Level 2** type indication.
Open the Project by **OK**.



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



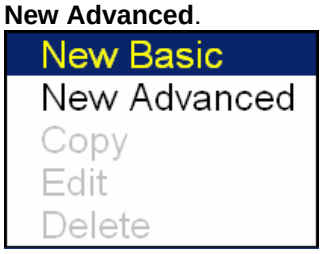
The L1 list appears.



Open the L1 item and create the Set in the same way as it the previous section.
Use the **Back** and **Close** 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**.



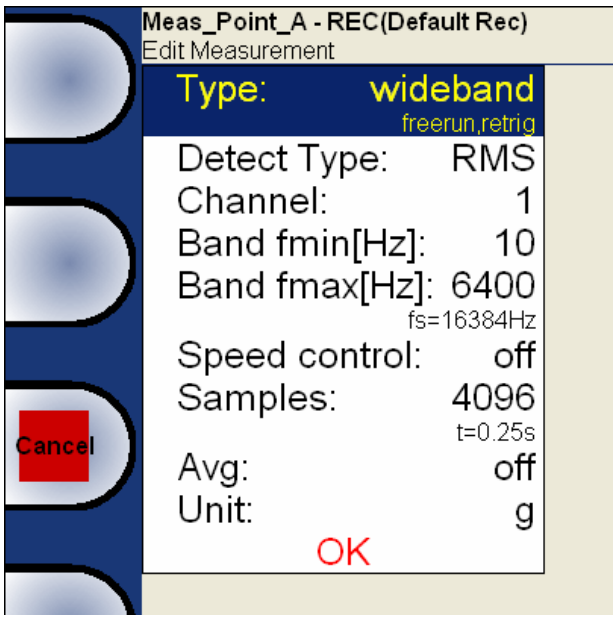
New Basic

You can create the new **Meas** by two ways. When you want define some basic measurement use the **New Basic**. Select required measurement from the list. This way is very fast.

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

New Advanced

The base menu for definition of measurements appears. The content of the menu is implication of the measurement **Type** selection (first row). See next table. The black area means, that the item from left column is used for the type of measurement (top row).



Type	wide band	g-env wide band	time signal	g-env time signal	orbit	Smax	spec	g-env spec	speed	ACMT	orda (Orders)	aps (Ampl/ Phase)	fresp (Freq Resp.)	dc	center line
Detect Type	■	■									■	■			
Result Type													■		
Channel	■	■	■	■	■	■	■	■		■	■	■		■	■
Band fmin (Hz)	■		■				■			■					
Band fmax(Hz)	■		■		■	■		■							
ENV fmin[Hz]		■		■				■							
ENV fmax[Hz]		■		■				■							
Speed control	■		■		■	■									
Input channel													■		
Output channel													■		
FFT Window							■	■					■		
Range							■	■					■		
ACMT FS(Hz)										■					
Samples	■	■	■	■	■	■				■					
Revolutions	■		■		■	■									
Lines							■	■					■		
Orders											■				
Avg	■		■		■	■	■		■		■	■	■	■	■
Overlap							■						■		
Resolution												■			
Unit	■	■	■	■	■	■	■	■	■	■	■	■		■	■

Detect Type **RMS**, **P-P**, **0-P** The detected value property (P means Peak).

Result Type **H1**, **H2**, **H3** Standard frequency response functions, H1- input noise, H2 - output noise, H3 - the average of H1 and H2.

Channel **1**, .., **4** The input signal source channel for evaluation.

Band fmin (Hz) **value** The low cut-off frequency of band pass filter, which is applied to the signal before evaluation. The **none** value means, that only input DSP filter is applied (approx. 0,6 Hz).

Band fmax(Hz) **value** 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.

ENV fmin (Hz) **value** The low cut-off frequency of band pass filter, which is applied to the signal before enveloping (removing low frequencies).

ENV fmax(Hz) **value** The high cut-off frequency of band pass filter, which is applied to the signal before enveloping (removing high frequencies).

Input channel **1**, .., **4** Required only for response functions.

Output channel **1**, .., **4** Required only for response functions.

FFT Window **Rectangular**, **Hanning**, **Transient**, **Exponential** The standard offer of FFT windows functions.

Range **value** Frequency range of the graph. Under this item is also displayed the information about sampling frequency (fs=), which be applied for evaluation.

ACMT FS(Hz) **value** The sampling frequency for ACMT evaluation. See the ACMT chapter for understanding.

Speed control **off** time signal will contains defined number of samples
on time signal will contains defined number of revolutions

Revolutions **value** 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.

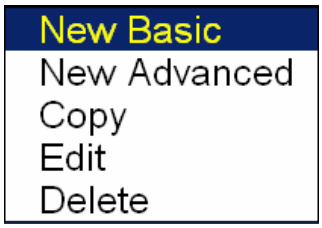
Orders **(1/2,1-5), (1-5), (1/2,1-10), (1-10)**

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 every signal for averaging is manually triggered

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

Unit **name** The required unit for results and graph. This information is used for decision whether and how many integrations should be used.

Next Meas functions



Aside the **New** functions are available next functions, which help you to work with **Meas**. The most often used is the **Edit** item, which open the list of all parameters and enables to change them. The sense both **Copy** and **Delete** items is evident.

Next Set functions

These functions are available when the Set list is displayed.

The selected Set in list or opened Set (looking to the graphs) you can **Copy** to new Set (when you want to keep the old Set and use the recently arranged new Set). You can also **Rename** or **Delete** it.

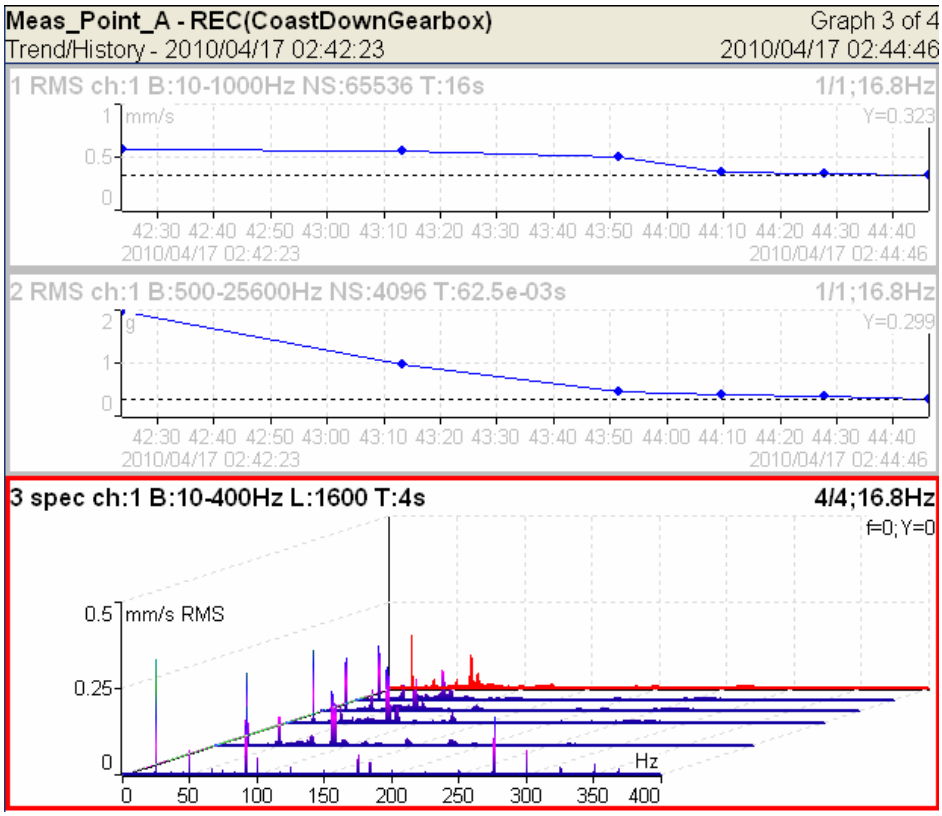
When you want to move data to the computer (DDS software), you need to export them at first. The VA4Pro disc is not accessible from PC. The VA4Pro contains the special **VA4_DISC** flash disc, which is accessible from outside PC and also from the VA4Pro processor. The **Export** function copies the data from internal disc to the **VA4_DISC** flash disc. Then the data is available from PC to read them.

The **Clear Data** function erases all saved data and leaves the Set empty like new set.

The **Project List** button enables to display the list of projects.

Save Data saves actual measurements. It means all graphs are saved.

View Trend/ View Actual
The measurement results are not saved automatically to disc (data are only in RAM memory and are lost after closing of set). Use **Save Data** item for that. When you save several data (e.g. each hour), then you can read them from the memory and display their trend. Use **View Trend** function to read and display from the disc. Use the **View Actual** to look at actual measurement results from memory.

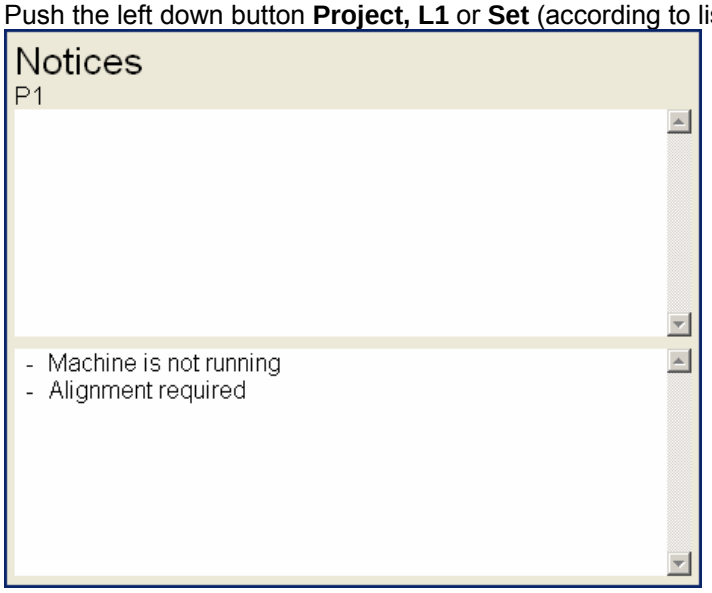


The View Trend example. The trends of wideband values is in two top graphs. The cascade graph contains several spectra.

Notices

In **L2, L1** or **Set** levels of VA4Pro the **Notices** item appears. This item enables to add the user comment to every level of project or route measurements. How to fill the User Notices is described in the **Global/ User Notices** section. In the route you can add the notice also to the graph.

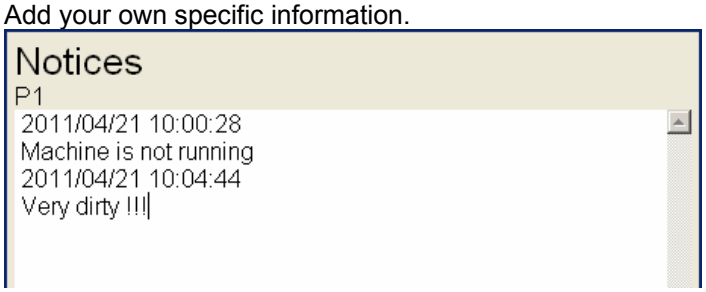
Push the left down button **Project, L1** or **Set** (according to list of items) and select **Notices**.



The notice on selected item appears. The field can be empty or contains notices written already.

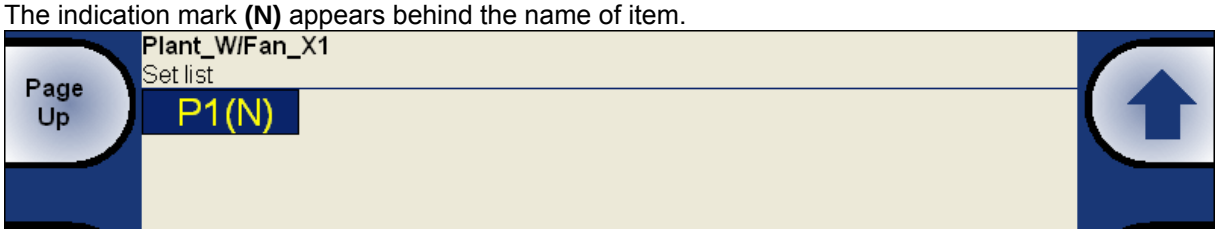
Push the **Select** and you can select one item from predefined **User Notices**. You can switch the User Notices with the factory notices by **User/Factory button.**

Use the **Shift A/a/<->** button to change the button functions (capitals, small letters, edit arrows). Use the **Time Stamp** button to add the date and time.
Add your own specific information.



The **Delete All** button erases all created notices.

Press the **OK** to close and save the User Notices.
The indication mark **(N)** appears behind the name of item.

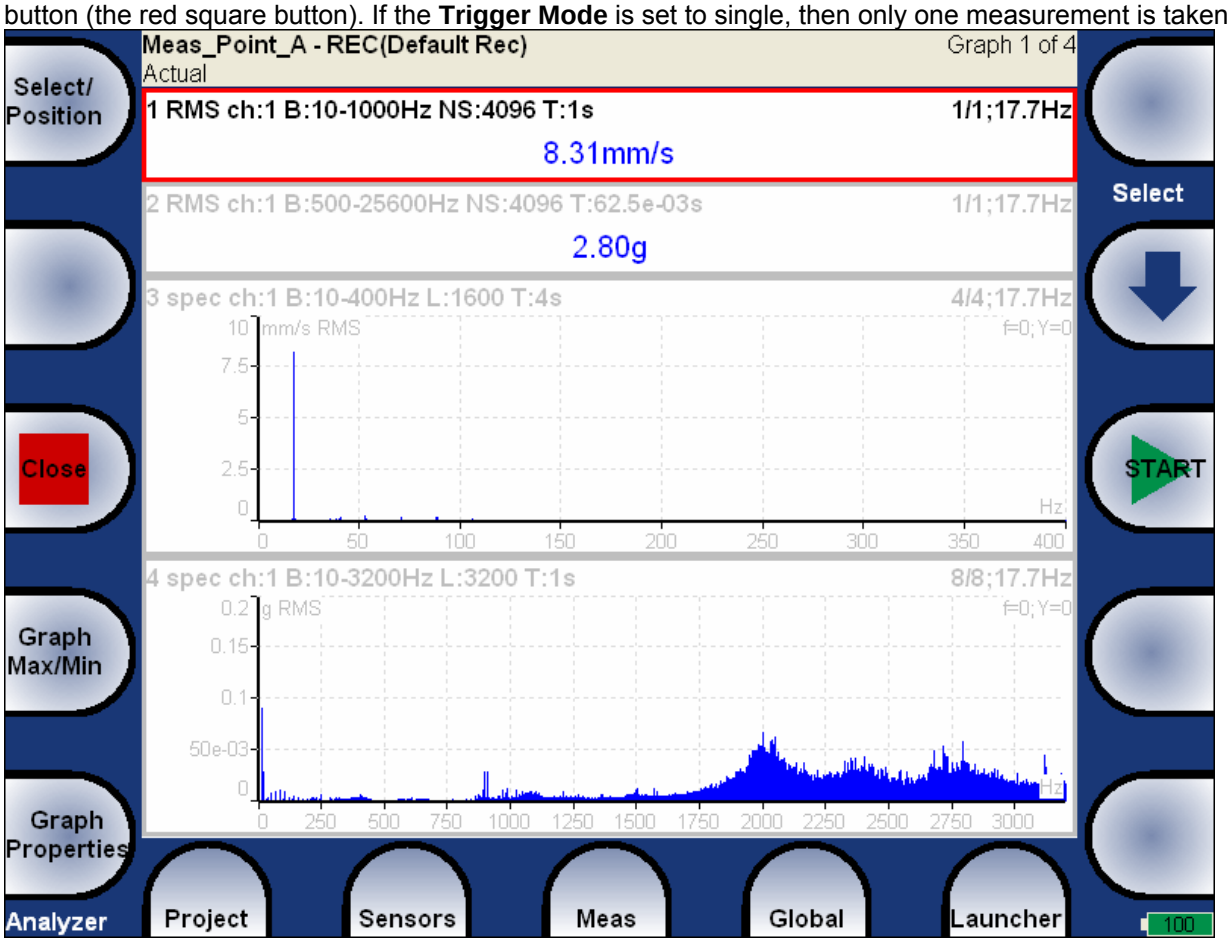


Measurement Definition in the Set

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 wideband value in mm/s, frequency band 10-1000Hz, from channel 1
Meas 2: RMS wideband 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 **Trigger Mode** is set to single, then only one measurement is taken.



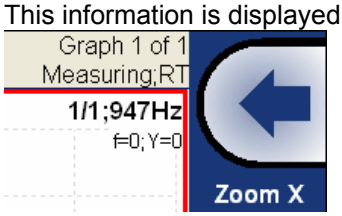
Every graph on the screen contains one measurement. More screens with graphs can be developed.

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.

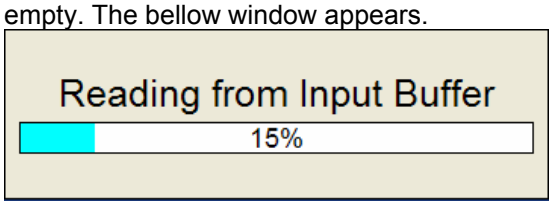
3 spec ch:1 B:10-400Hz L:1600 T:4s **4/4;17.7Hz**
The translation: Meas No.3, Spectrum from Channel 1, Range 400Hz, Lines 1600 Time length of signal 4s, 4 signals for 4 AVG used, speed 17.7Hz

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.

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 and can be edited. The scale ranges and types (lin, log,...) definitions are the typical use.

Type	wide band	g-env wide band	time signal	g-env time signal	orbit	Smax	spec	g-env spec	speed	ACMT	orda (Orders)	aps (Ampl/ Phase)	fresp (Freq Resp.)	dc	center line
Scale	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Cursor			■	■	■		■	■							
Axe X							■	■					■		
Axe Y							■	■					■		
Axe Z							■	■							
Unit							■	■					■		
Range[dB]							■	■					■		
Detect Type							■	■							
Peaks List							■	■							
Orda Table											■				
Primary Cursor					■								■		
Center Line View															■
Fresp View													■		
Aps View											■	■			
Spec View							■	■							
Orbit View					■										

!!! Important notice: All available values will be described for every item. When you will work with analyzer, you will not see all that values always. Some of them have special meaning and they are visible only when it has sense. Typical example is the **Scale** item, which has no sense for **View Actual** data and it is used only for **View Trend** data displays.

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 one user defined Y range for all graphs independently of data values

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

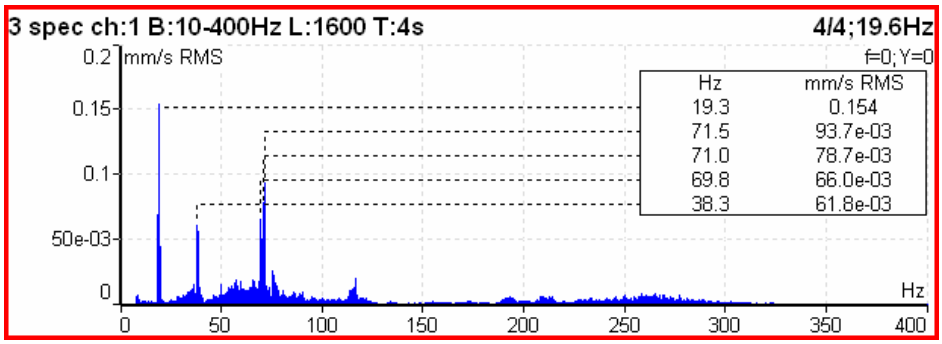
Axe X - **lin, log**

Axe Y - **lin, log**

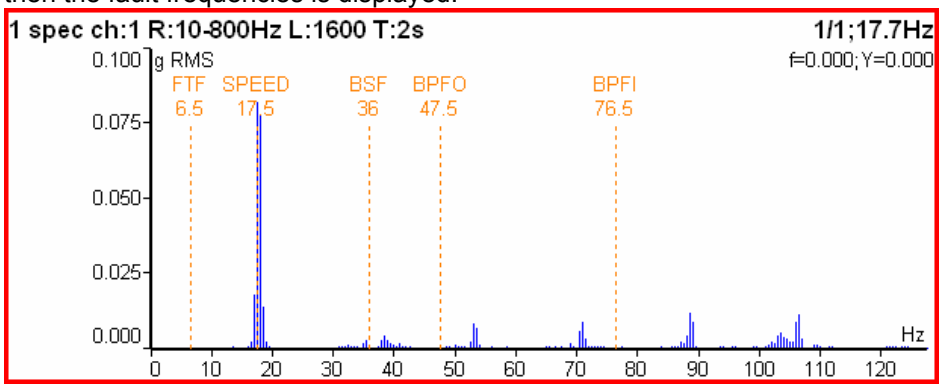
Axe Z - **time** scale according time of measurements
speed scale according the speed of machine (tacho must be used)
regular regular scale

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

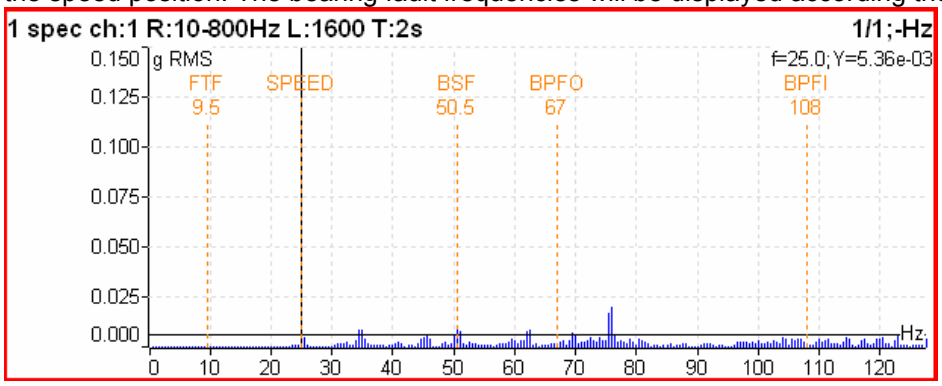
Peaks List - **on, off** the 5 highest spectrum lines table



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



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.



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

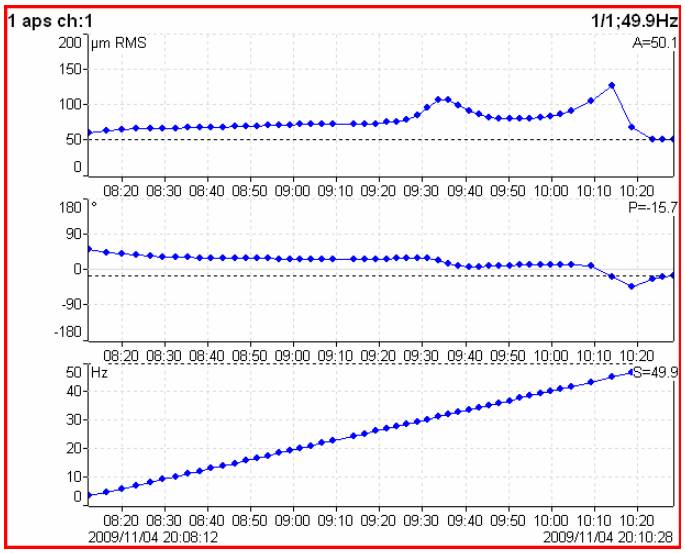
Primary Cursor - when the Global/Cursor Type is set to **max**, then is required to select the quantity (graph), to which will be this **max** searching function applied

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

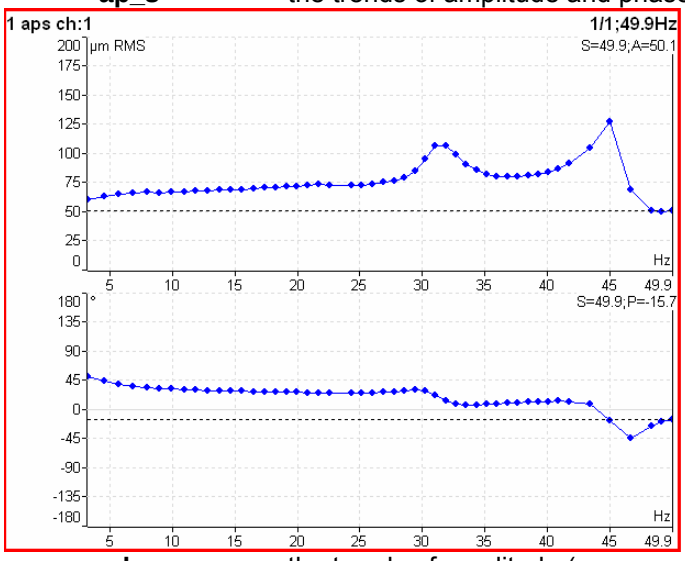
Center Line View - **orbit** standard 2D center line view, available only for **View Trend**
AB two DC values for **View Actual** or two trends for **View Trend**
XY data transferred to X and Y axes

Fresp View - **ampl, phase**
real, imag
nyquist
amplitude
phase
coherence
time

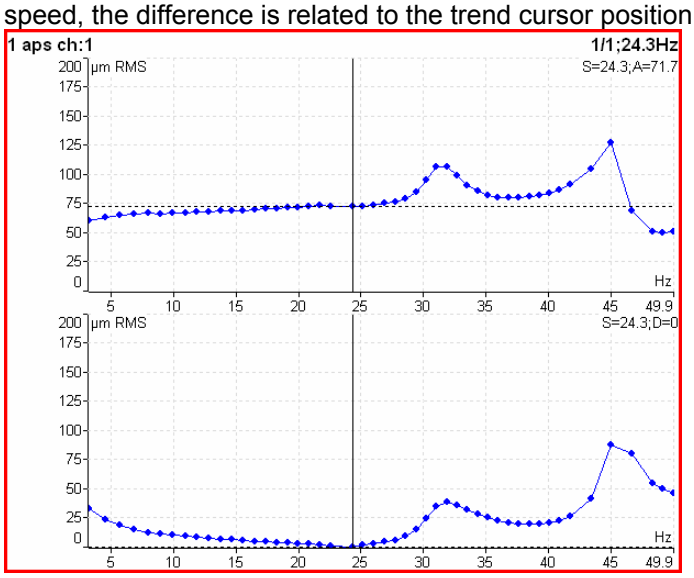
Aps View - available only for **View Trend**
aps_t the trends of amplitude, phase and speed related to time of measurement



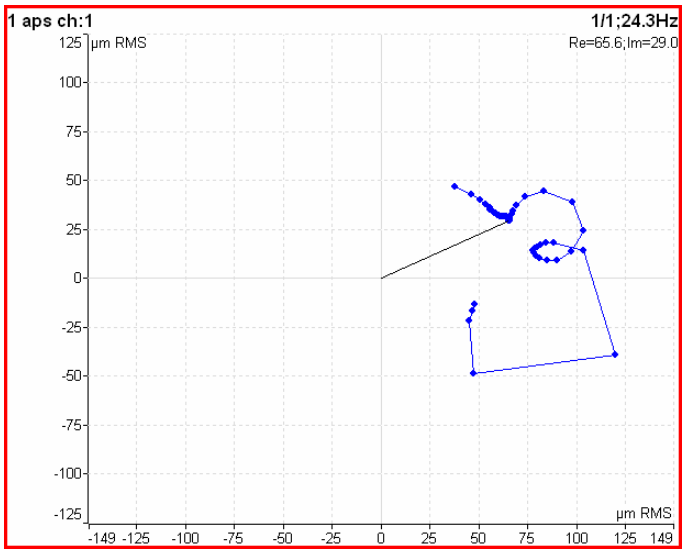
ap_s the trends of amplitude and phase related to speed



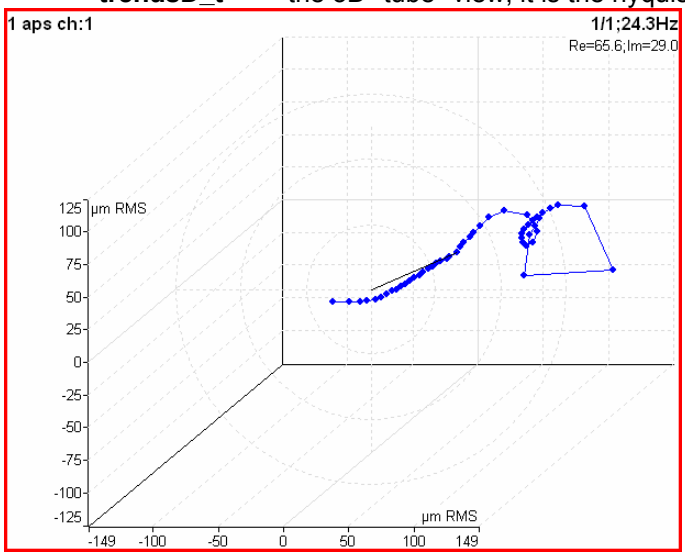
ad_s the trends of amplitude (upper graph) and difference amplitude (lower graph) related to speed, the difference is related to the trend cursor position (in that point is always zero).



nyquist 2D complex view

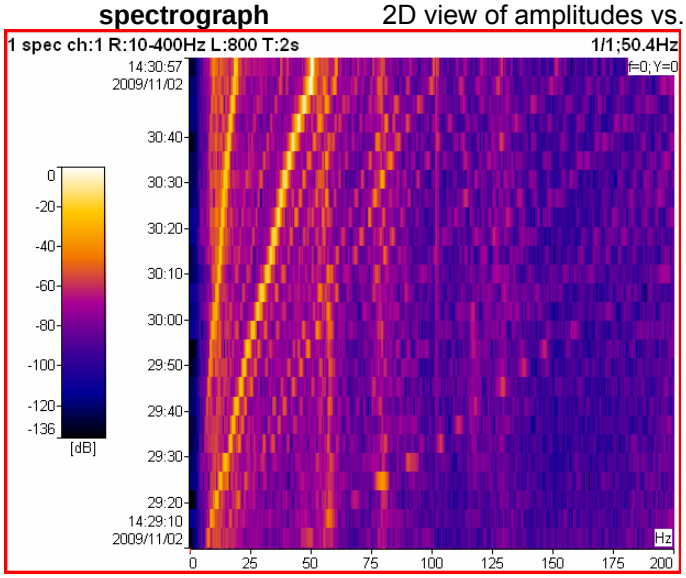


trend3D_t the 3D "tube" view, it is the nyquist graph expanded to Z axe (time scale)



Spec View - available only for **View Trend**

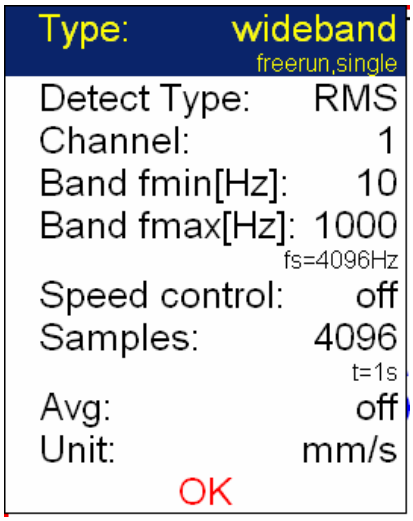
single	one spectrum graph
cascade	waterfall graph
spectrograph	2D view of amplitudes vs. time



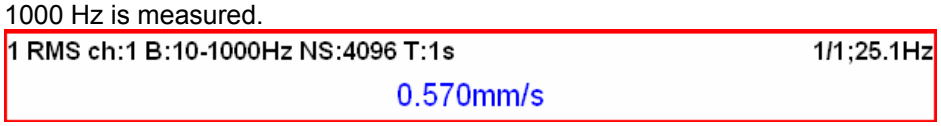
Orbit View -

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

Wideband measurement

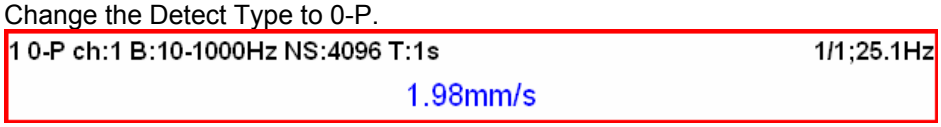


This is typical example of wideband measurement. The RMS value of vibration velocity in frequency range 10-1000 Hz is measured.



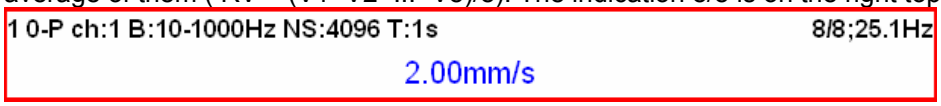
The first row contains used parameters. The 25.1Hz on the right is the speed, because the tacho sensor was used.

Change the Detect Type to 0-P.

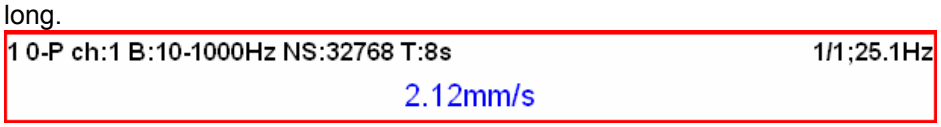


Note, that the 1.98 is not 1.414 times bigger then 0.570. Some of users mistakenly think, that the formula 0-P=1.414*RMS is valid for every signal. It is not true. That formula is valid only for pure sine wave ! The true RMS and true peak measurement are generally independent. The only rule is that the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

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.

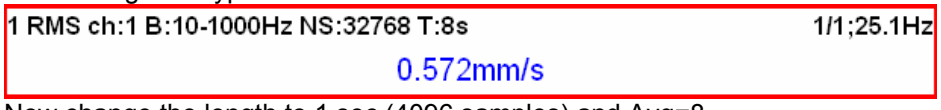


Let's change the Avg back to off and change the samples number to 32768. The measurement will be 8 sec long.

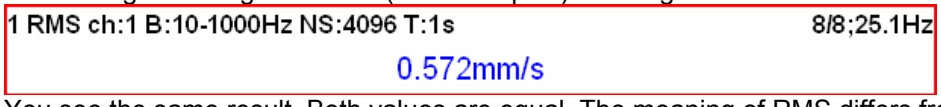


You see that the result is different from the previous value. It is clear, the max 0-P value in 8 sec signal is not equal the average of 8 0-P values (which takes 1 sec each).

Let's change the type back to RMS.

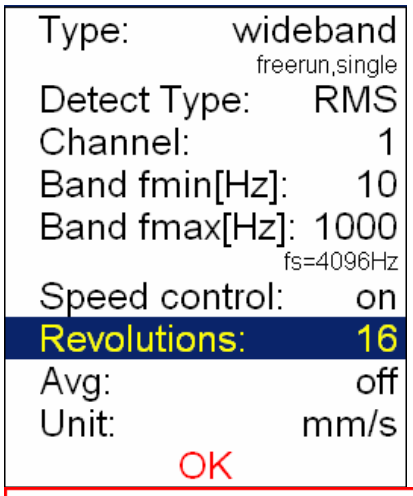


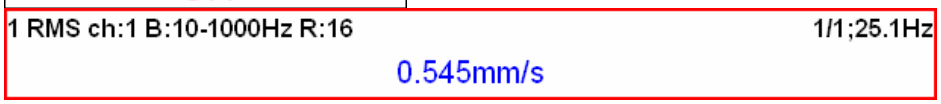
Now change the length to 1 sec (4096 samples) and Avg=8.



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.

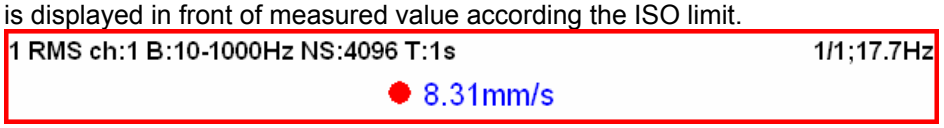
You can define the signal length also in revolutions, not only in samples (=time). The tacho signal must be available in that case.



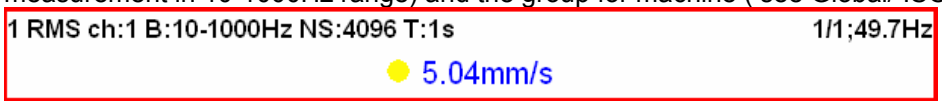


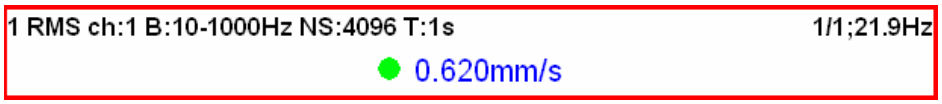
ISO 10816 wideband measurement

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

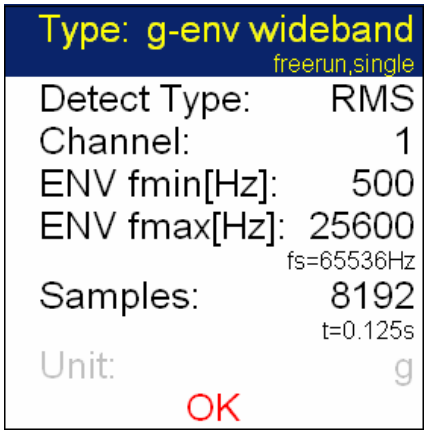


If you want to use this function you need to define the correct measurement parameters (RMS velocity measurement in 10-1000Hz range) and the group for machine (see Global/ ISO Machine Settings).



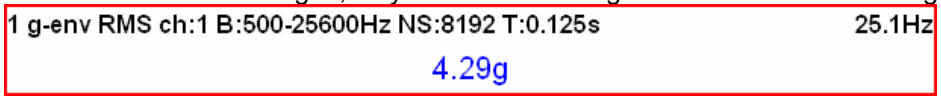


G-env wideband measurement



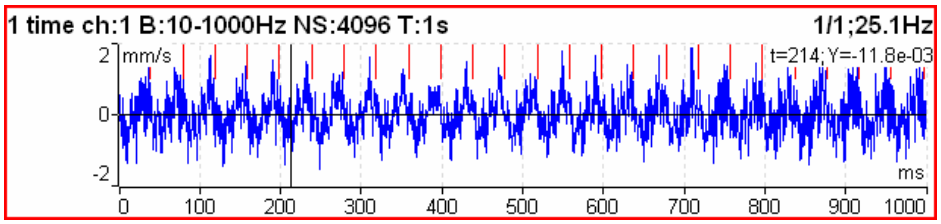
It is very similar to standard wideband measurement. The signal is filtered in (ENV fmin, EN fmax) range and then it is enveloped. It means the envelope modulator was applied. See other sources for more information about enveloping, if you need it.

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



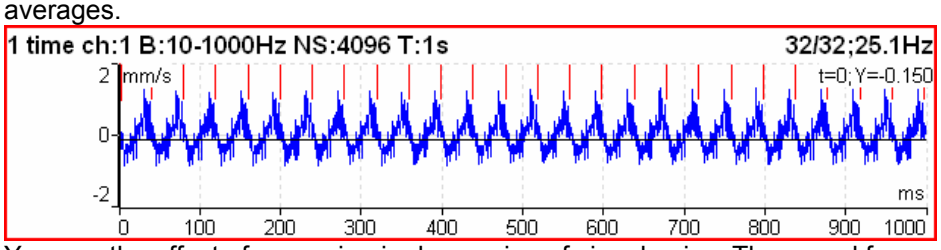
Time signal measurement

Type:	time
	freerun,single
Channel:	1
Band fmin[Hz]:	10
Band fmax[Hz]:	1000
	fs=4096Hz
Speed control:	off
Samples:	4096
	t=1s
Avg:	off
Unit:	mm/s
OK	



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

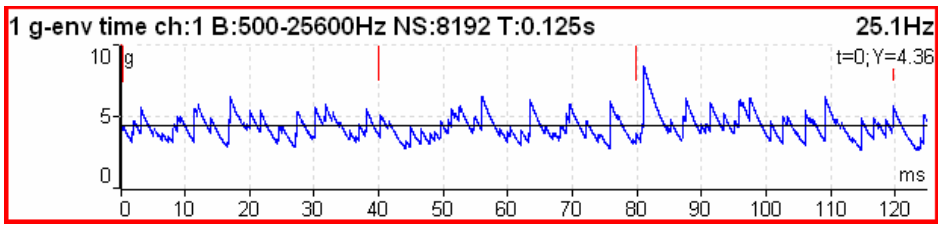
For averaging you need to set the Global/ Trigger Settings/ Trigger Source = tacho. Then define the number of averages.



You see the effect of averaging in decreasing of signal noise. The speed frequency is better seen.

G-env time signal measurement

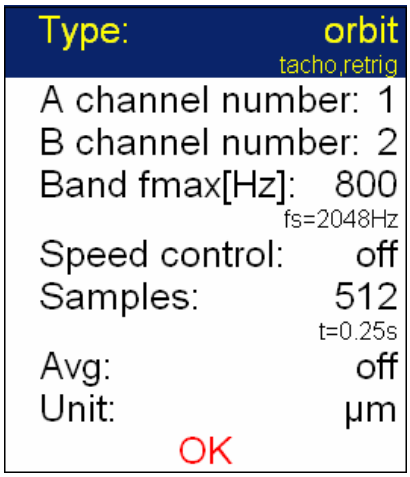
Type:	g-env time
	tacho,single
Channel:	1
ENV fmin[Hz]:	500
ENV fmax[Hz]:	25600
	fs=65536Hz
Samples:	8192
	t=0.125s
Unit:	g
OK	

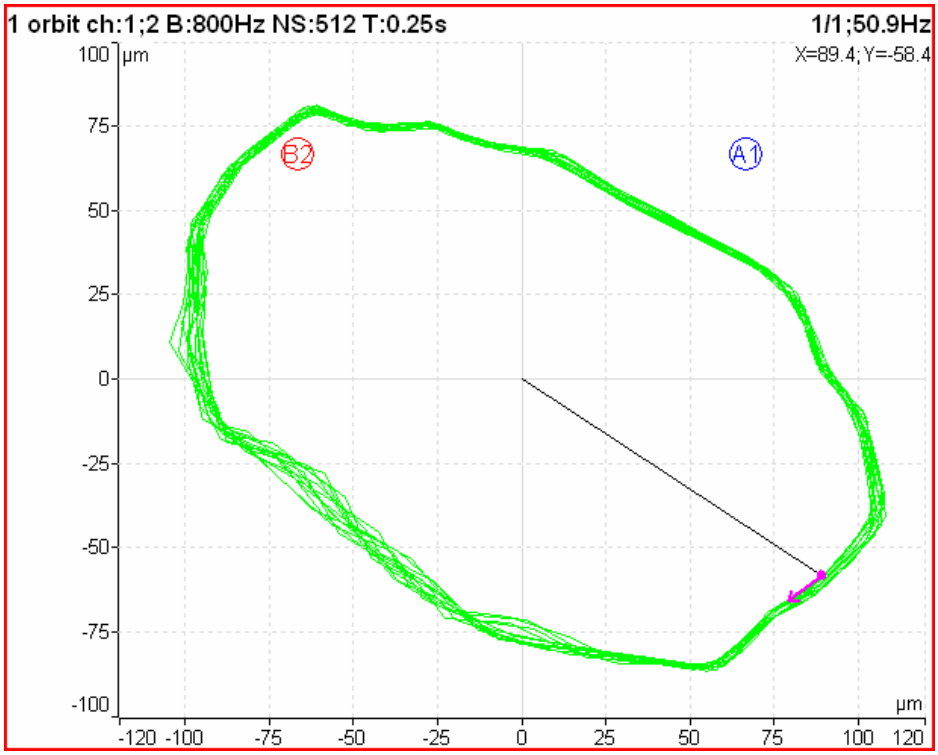


This function enables to see the enveloped signal. The g-env wideband values are calculated from this signal.

It is very similar to standard time signal measurement. But the signal is additionally filtered in (ENV fmin, EN fmax) range and then it is enveloped. It means the envelope modulator was applied. See other sources for more information about enveloping, if you need it.
The Unit cannot be changed, only the acceleration g unit can be used. No integration of signal is enabled.

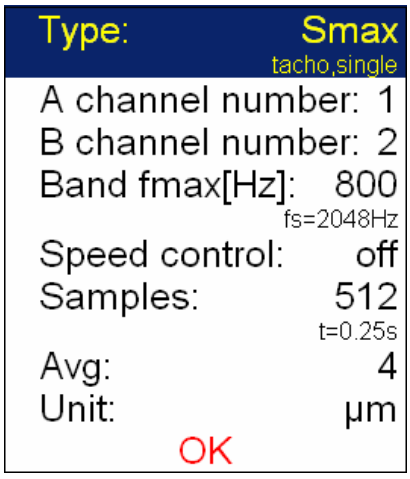
Orbit measurement





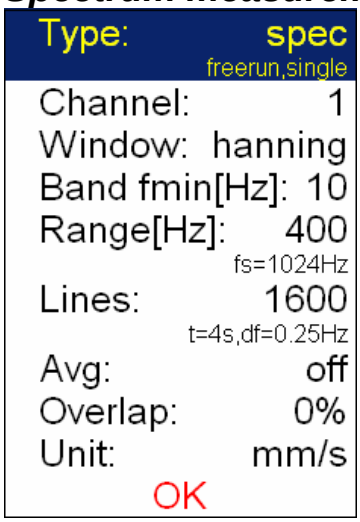
The A1 means, that the channel 1 is used for A orbit channel.
B2 - channel 2 is used as B.
The position of A1 and B2 matches the sensor angles used for measurement (see Sensors definition). The knowledge of those angles enables to draw the correct shape of orbit.

S-max measurement

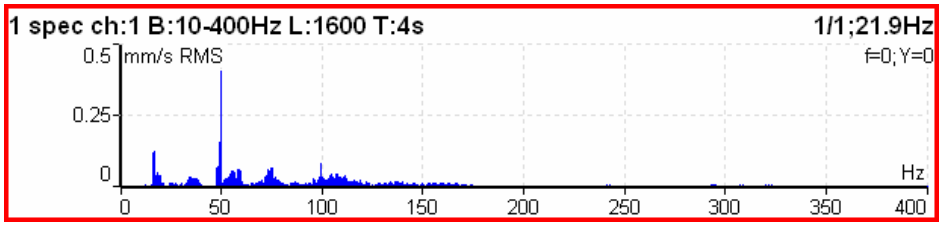


It is standard S-max measurement as the maximum vector amplitude of displacement.

Spectrum measurement



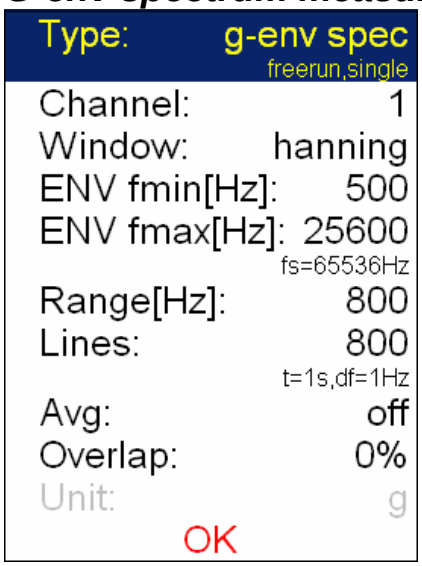
The triggering type is displayed bellow the spec word. The **fs** below the Range means sampling frequency. The **t** below the Lines is the time signal length, which is used for one spectrum. The **df** is the frequency resolution between lines.

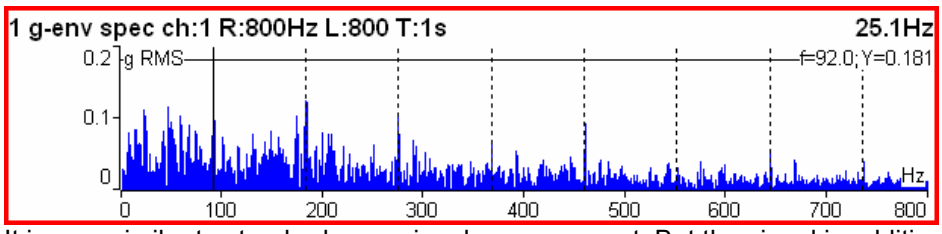


The **Band fmin** defines the frequency of HP filtering, which is used for DC part removing. If you do not expect any important lines bellow 10Hz, use the 10 instead 1. The initialization time of 1Hz filter is much longer then 10Hz.

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.

G-env spectrum measurement

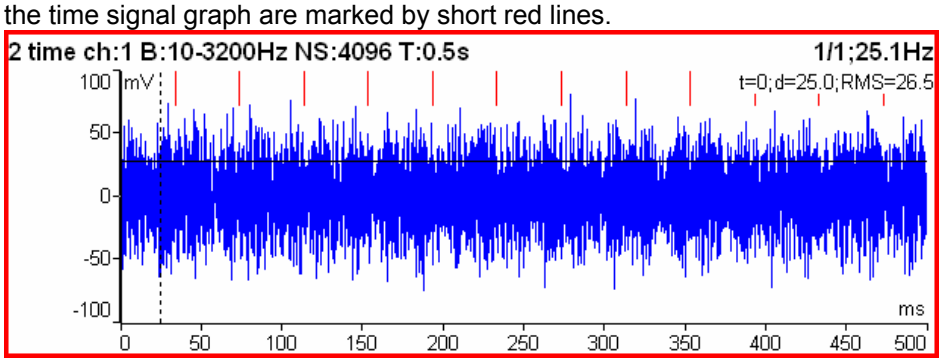


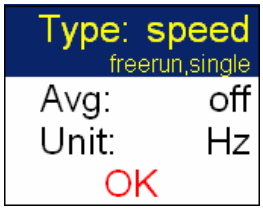


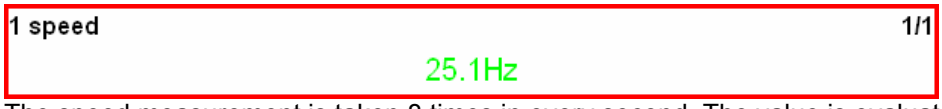
It is very similar to standard spec signal measurement. But the signal is additionally filtered in (ENV fmin, EN fmax) range and then it is enveloped. It means the envelope modulator was applied. See other sources for more information about enveloping, if you need it.
The Unit cannot be changed, only the acceleration g unit can be used. No integration of signal is enabled.

Speed measurement

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



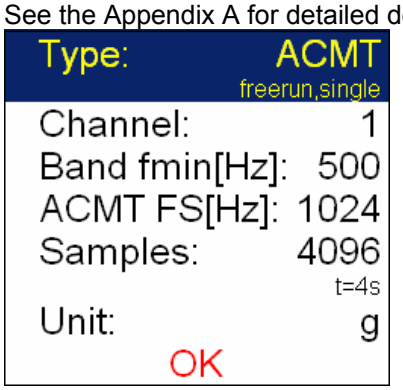


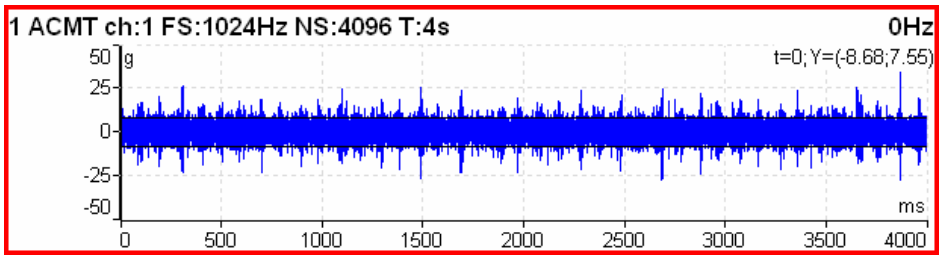


The speed measurement is taken 8 times in every second. The value is evaluated from 3 tacho events in time signal. When the averaging is required, then more values is used. But keep in mind that only 8 values is taken in one second.

ACMT measurement

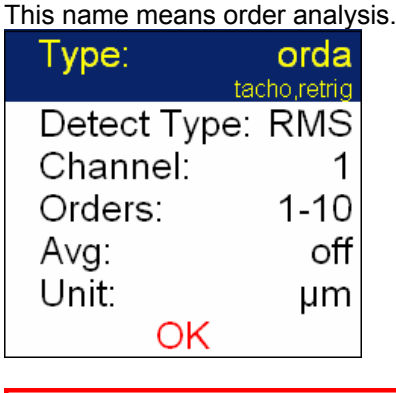
See the Appendix A for detailed description of ACMT method.

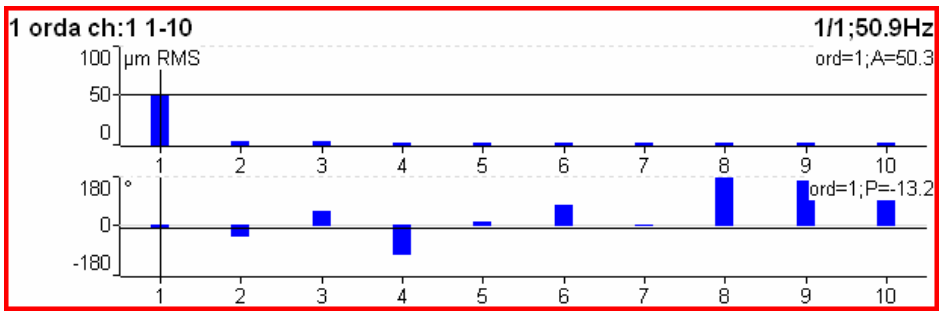




Orda measurement

This name means order analysis.





Aps measurement

Aps means amplitude+phase+speed measurement.

Type:	aps
	tacho,retrig
Detect Type:	RMS
Channel:	1
Avg:	off
Unit:	µm
Resolution:	speed / 4

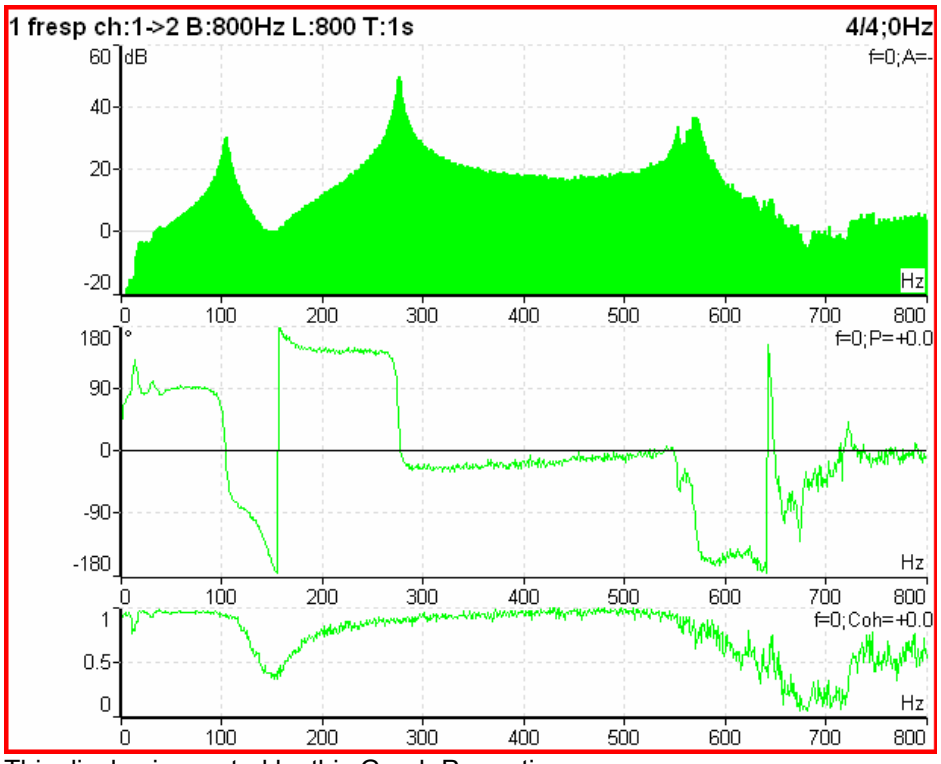
OK

The smaller resolution means longer time signal for evaluation. We do not recommend to use always the minimum value (speed/64), because you will wait for results longer (much longer). Use the small resolution only in cases, when your signal contains two close frequencies and you need to separate them. For 50Hz speed the speed/4 means the band (43.75Hz, 56.25Hz) and the speed/64 means (49.61Hz, 50.39Hz).

Fresp - frequency response measurement

Type:	fresp
	amplitude,single
Result Type:	H1
Input:	1
Output:	2
Window:	transient
Shift[ms]:	97.2
Length[ms]:	6.35
Window:	exponential
Shift[ms]:	97.7
Length[ms]:	196
Range[Hz]:	800
	fs=2048Hz
Lines:	800
	t=1s,df=1Hz
Avg:	4
Overlap:	0%

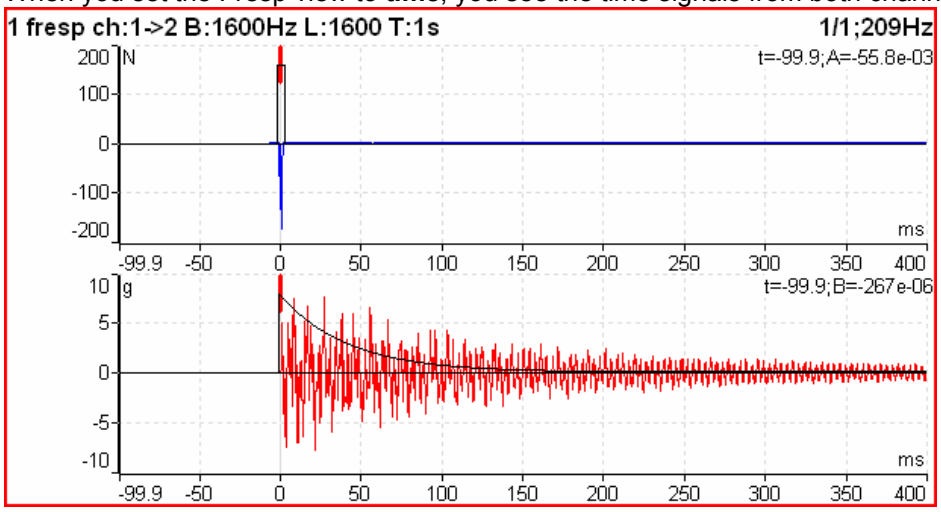
OK



This display is created by this Graph Properties.

Scale:	auto
Axe X:	lin
Axe Y:	log
Unit:	dB
Range[dB]:	80
Fresp View:	ampl,phase
Primary Cursor:	amplitude
OK	

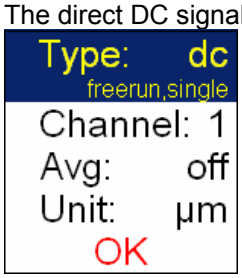
When you set the Fresp view to **time**, you see the time signals from both channels.



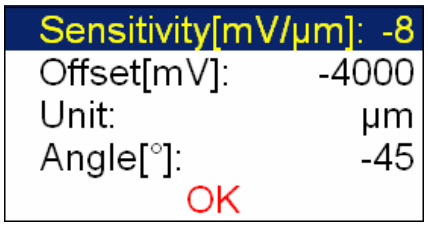
Use the **Arrow mode** button and set **Shift** or **Length** top right buttons. Now you can simply shift with FFT windows or change the length. When you use the **Shift1** button, you change the **Shift1** to **Shift2** or to **Shift12** (shift both windows together) by using the top left button **Shift1/Shift2/Shift12**.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

DC measurement

The direct DC signal can be measured by this function.



The DC1 sensor must be set according the required unit.



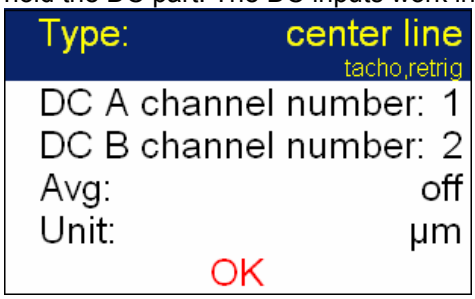
This set correspond the usual eddy current sensor (proximity). Each um of distance between sensor and metal surface (shaft) adds 8mV of negative voltage. The -4V (-4000mV) level is zero distance. See examples in table.

distance	voltage
um	mV
0	-4000
100	-4800
500	-8000
1000	-12000

Center line measurement

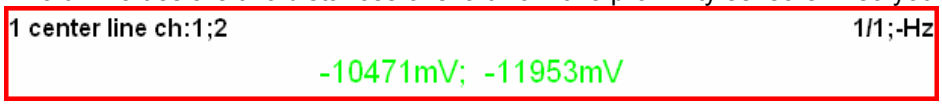
This measurement is often used for turbines. The **Center line** values define the static position of shaft in bearing.

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.



The Center line is related to the orbit measurement. We also need to sensors with known angles of mounting. 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.

Two um values are two distances of shaft from two proximity sensors. Also you can see the mV values.



The Balancer

Introduction

The balancing process is based on standard measurements of amplitude, phase on the speed frequency. The VA4Pro balancer includes many special internal functions, which remove the influence of noise, speed changes etc. 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

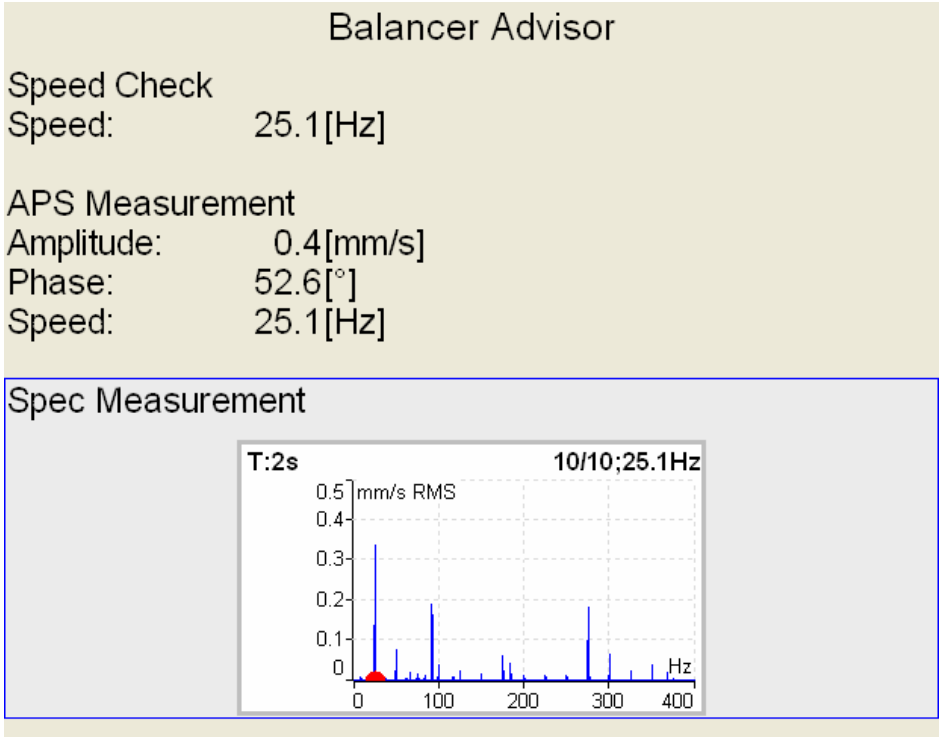
Every step is displayed in one screen.

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 Advisor function

This function helps you with decision whether to balance or to not balance and make different maintenance job. This function works automatically.
Press the button **Advisor**. Define the input channel. When you want to make two channel balancing, then use the channel with higher vibration level. Then the main Advisor screen appears and the recommendation window blinks.



The speed value and APS (amplitude/ phase/ speed) values are displayed. The advisor function has next results:

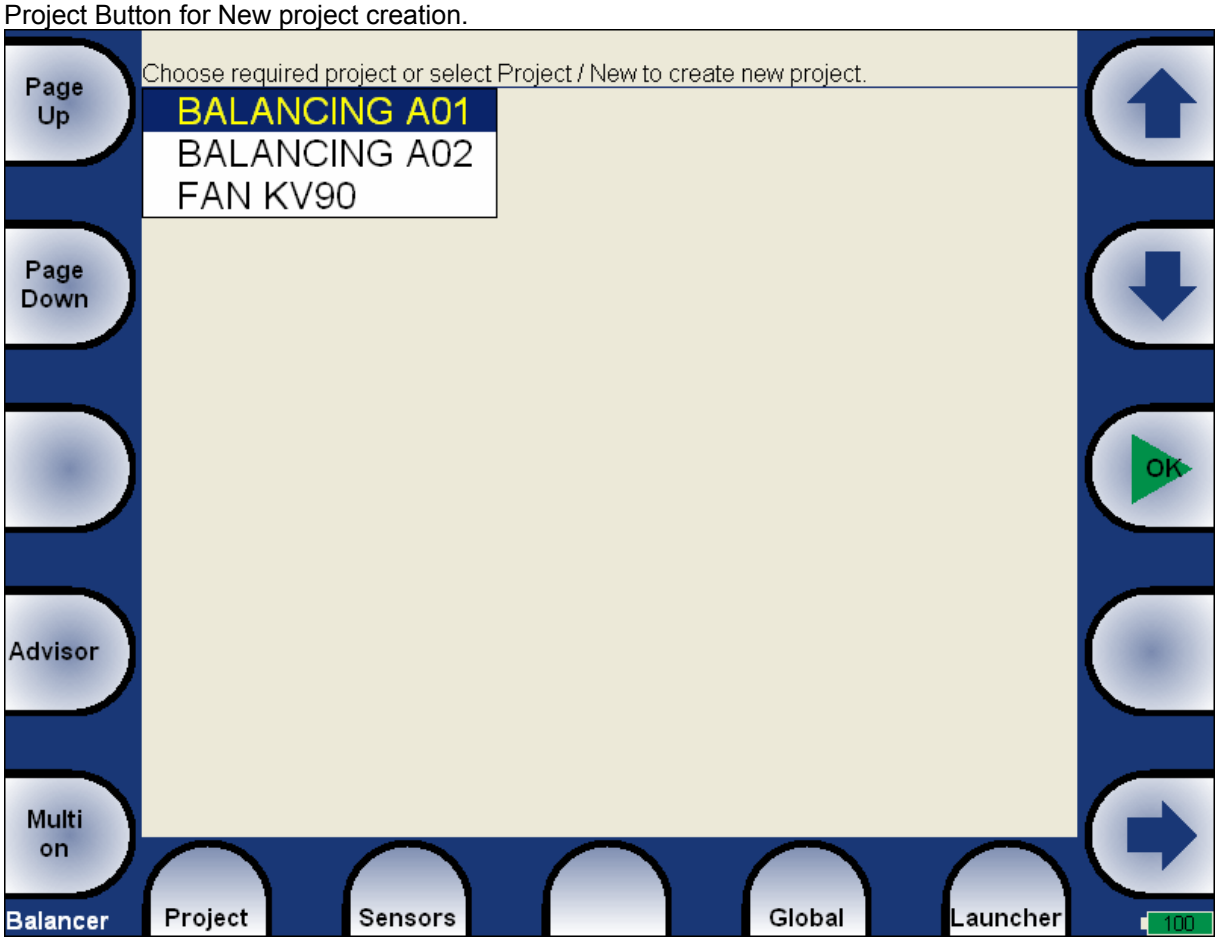
Balancing recommended.
Balancing not recommended.

When the balancing is not recommended, then also the reason is displayed:

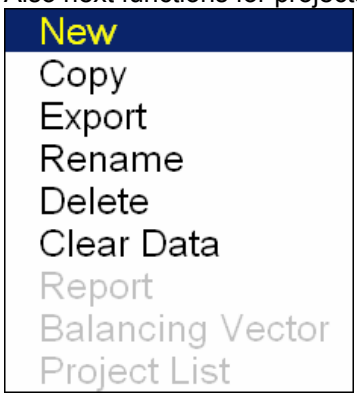
Balancing is possible but very small vibration level on speed frequency.
More vibration sources are found in the system.
The looseness is found.
Low amplitude is on speed frequency. The total vibration value is caused by different reason.
The speed is not stable.
The amplitude is not stable.
The phase is not stable.

The first screen

The list of saved projects or the Empty label is displayed on the first screen. Select one project or use the Project Button for New project creation.



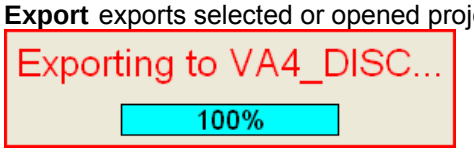
Also next functions for projects managing are enabled.



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 just opened project (like Save As function in MS Word). Only the header data are saved (machine name, balancing type,...). No measured data are saved.

Export exports selected or opened project to VA4_DISC.



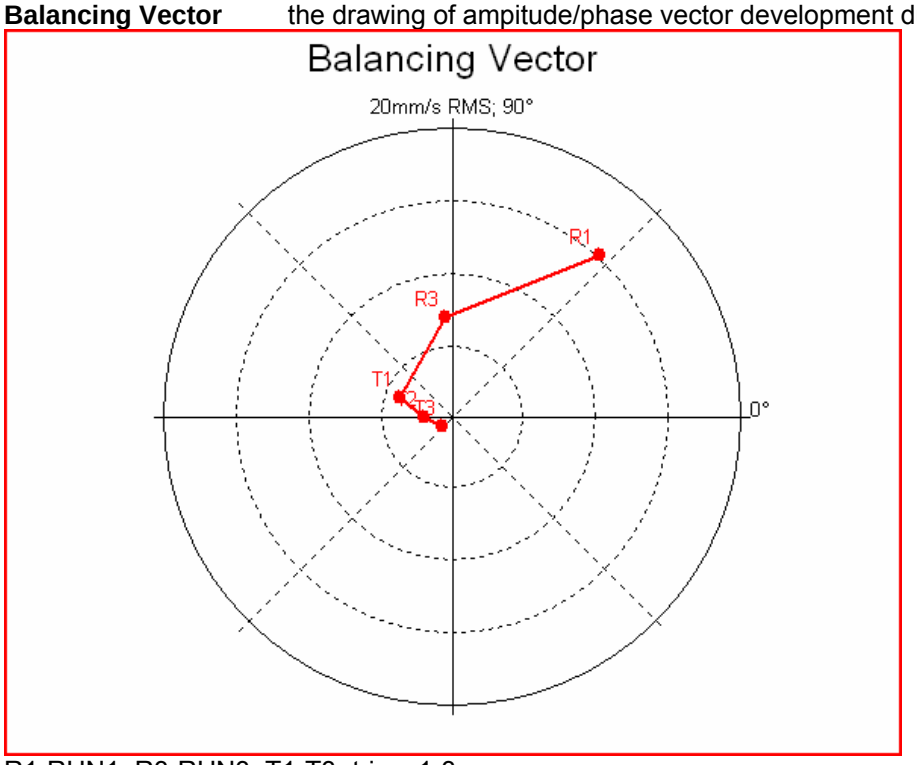
Rename renames the selected or opened project. The project with old name does not exist anymore.

Delete deletes the selected or opened project.

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

Report creates balancing report in rtf format (MS Word) and save it to VA4_DISC for PC downloading.

Balancing Vector the drawing of ampitude/phase vector development during the balancing process.

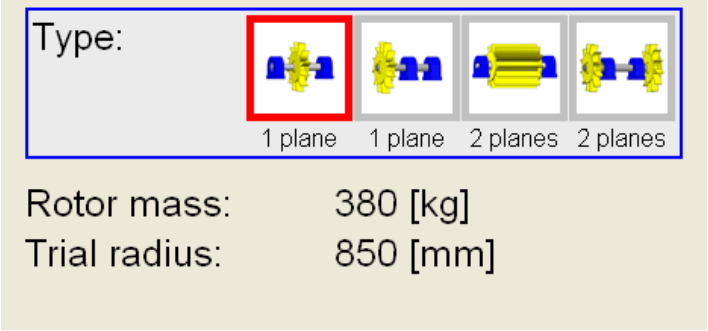


R1-RUN1, R3-RUN3, T1-T3 -trims 1-3.

Project List display the list of projects, the same list was displayed after starting of Balancer mode.

Machine properties, planes number screen

Create the new project in the first screen.
The machine properties and number of planes are the initial information of each Project. When the Project name is entered the next screen with properties selection appears.



Select the mode of balancing (red bordered). Use the left/right arrows to select required mode.

Use the **Tab** button (left side) to select next parameters inputs.

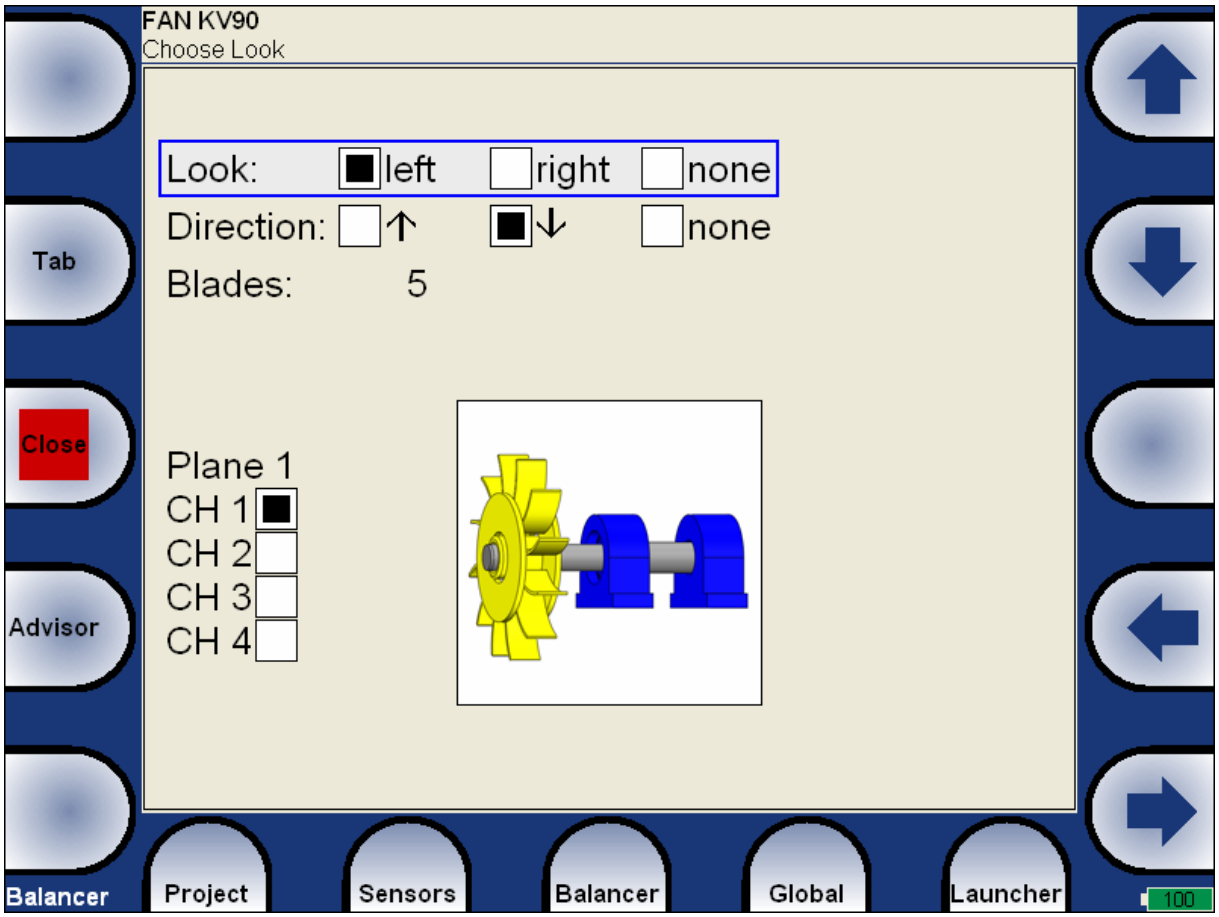
Rotor mass rotor mass in kg

Trial radius radius to which the balancing mass will be mounted
Both parameters are optional. It enables to calculate balancing quality factor according ISO1940.

Use **down arrow** to go to the next measurement properties screen.

Single plane balancing

The measurement properties screen for 1 plane balancing



Use the **Tab** button for moving in parameters field (selection of item to entry).

Look select the look of the machine accordingly your place in the field. Use the **left/right arrows** to change the parameters value.
It should help you to measure always the right things on the right points. Try to select to both options to understand this item. The **none** choice means any images will be used on the screens. The **Look** parameter has no effect in job calculations.

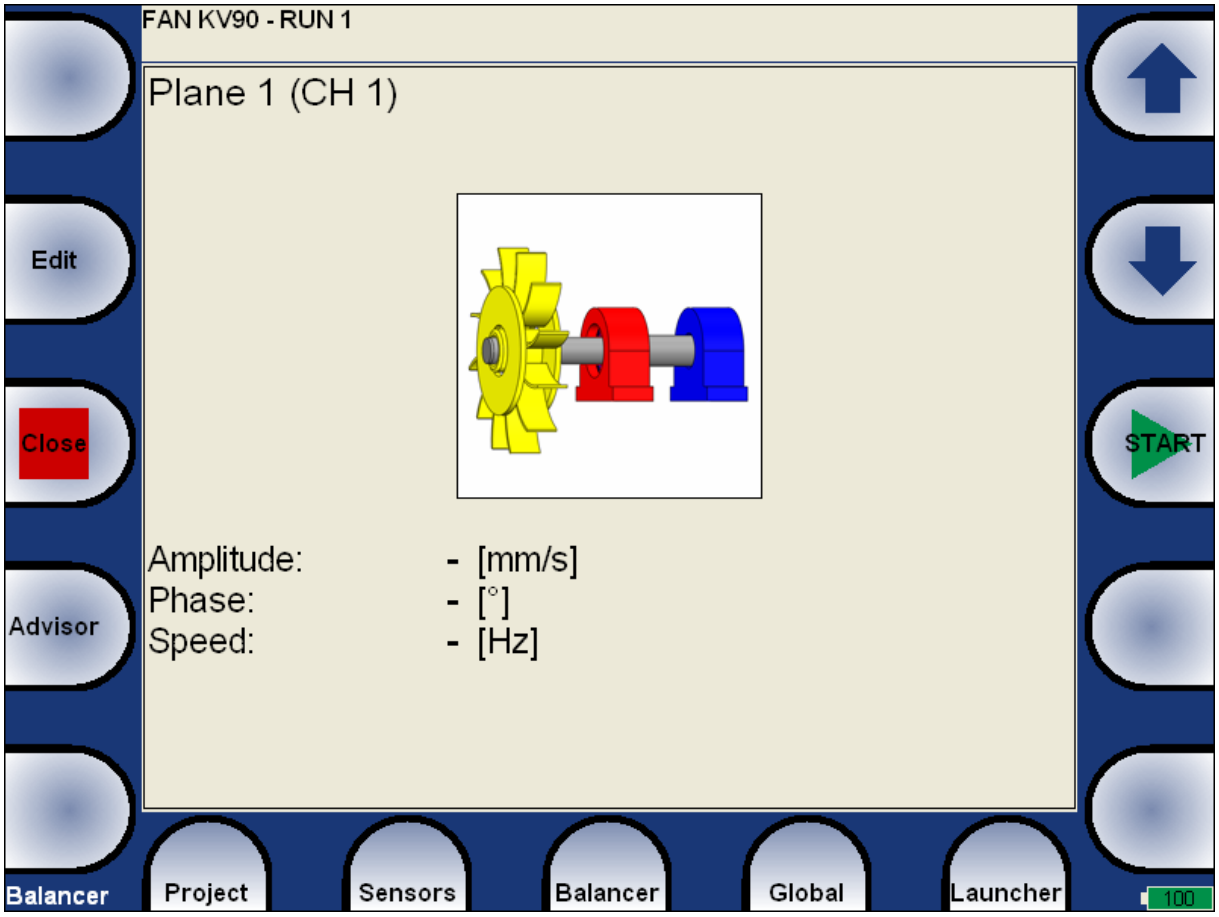
Direction means the rotation direction in the image. This parameter has no effect in calculations. It is only graphical matter. Use the **left/right arrows** to change the parameters value.

Blades - the number of blades (for rotors with blades). This parameter is used in job calculations to split the mass to blades. Use the **left/right arrows** to change the parameters value.

Plane 1 the selection of channel number. It will be used for measurement.

Press down arrow to go to the next screen (RUN 1) or **up arrow** to return back to first screen.

RUN 1 screen



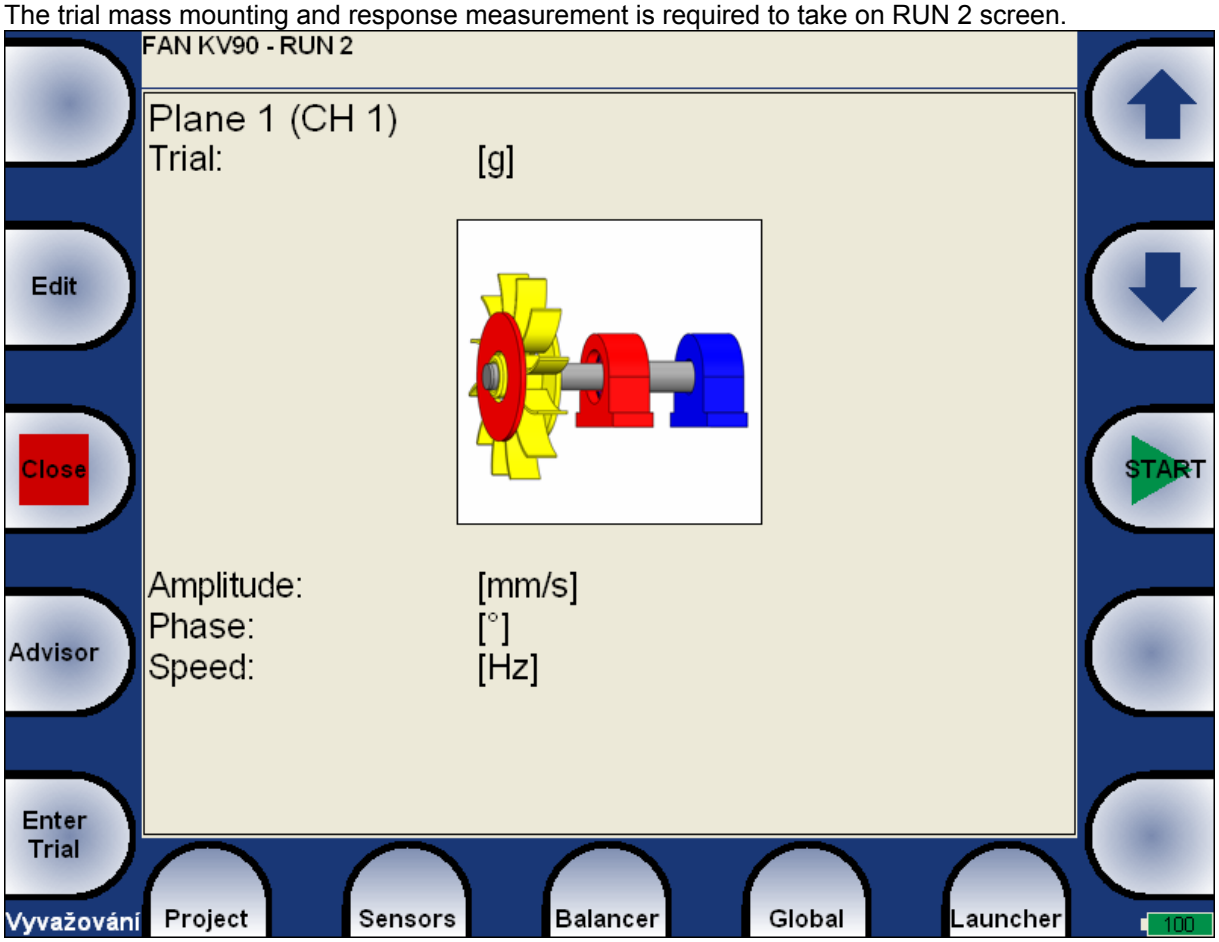
The red bearing house is the recommended point for sensor mounting. But you can use any other place, which is suitable for measurements.
Press **START** button and measurement will be taken.
If you press the **Edit** button, then you can manually enter all values (balancing calculator function). Use the **Tab** for shift between values.

Amplitude: **12.5** [mm/s]
Phase: **+56.0** [°]
Speed: **25.0** [Hz]

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

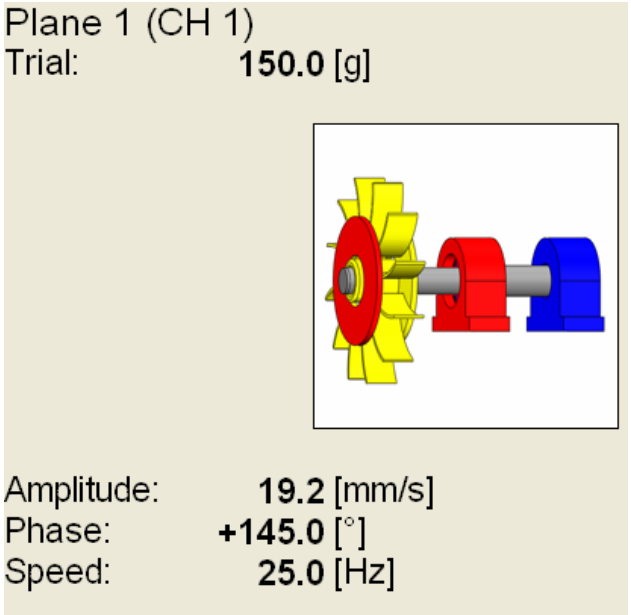
RUN 2 - the TRIAL MASS screen

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



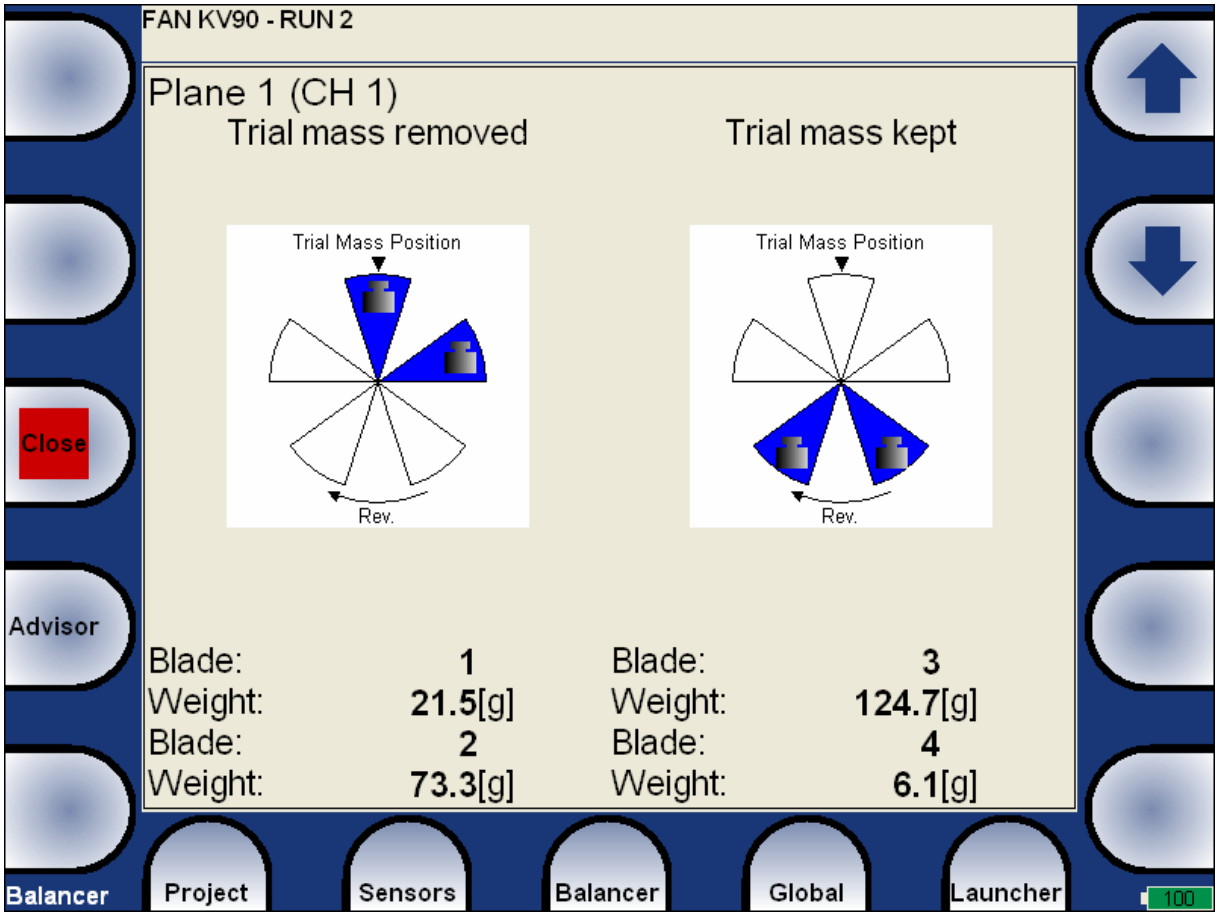
Use the **Enter Trial** button and enter the trial mass.

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.



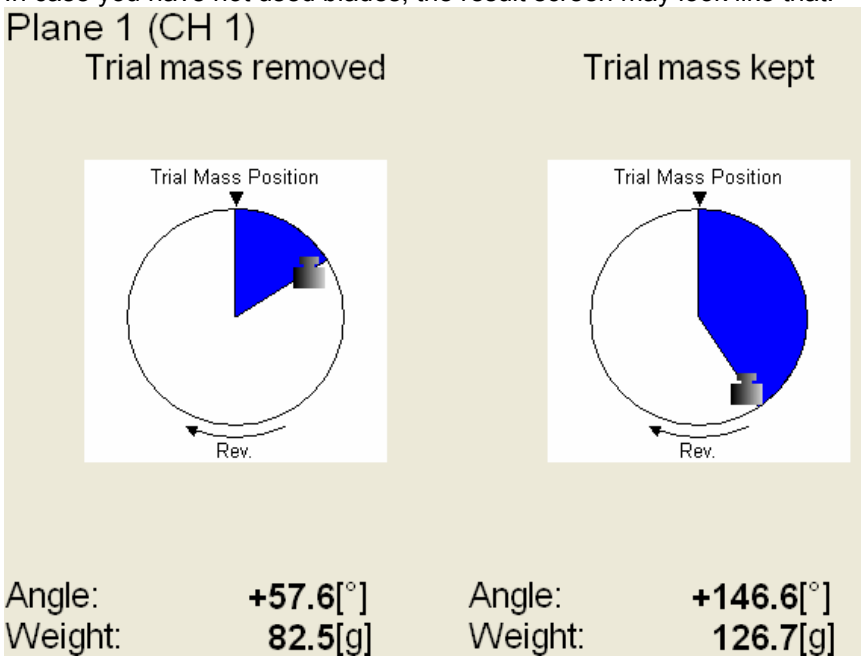
Use the **down arrow** to move to the next screen.

RUN 2 - the RESULT screen



Because the number of blades was defined, the final mass is divided to the nearest blades of the exact balancing angle. The angle position is always measured from position of trial mass.
You can continue in two ways. The left side determines two masses, if the trial mass is removed from the rotor. The right side determines two masses, if the trial mass is kept on the rotor.

In case you have not used blades, the result screen may look like that.



The RUN 3 screen

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:	**0.4** [mm/s]
Phase:	**+49.5** [°]
Speed:	**25.1** [Hz]
RUN 1:	**12.5**[mm/s]
Effect:	**97.1**%
Bal.Quality:	**2.1**

RUN1 amplitude of RUN1

Effect is the reduction of balancing in % (the 0.4mm/s is the 2.9% of 12.5 mm/s according to rounding)

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

Trim Screens

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	
Blade:	**1**
Weight:	**0.9**[g]
Blade:	**2**
Weight:	**2.0**[g]

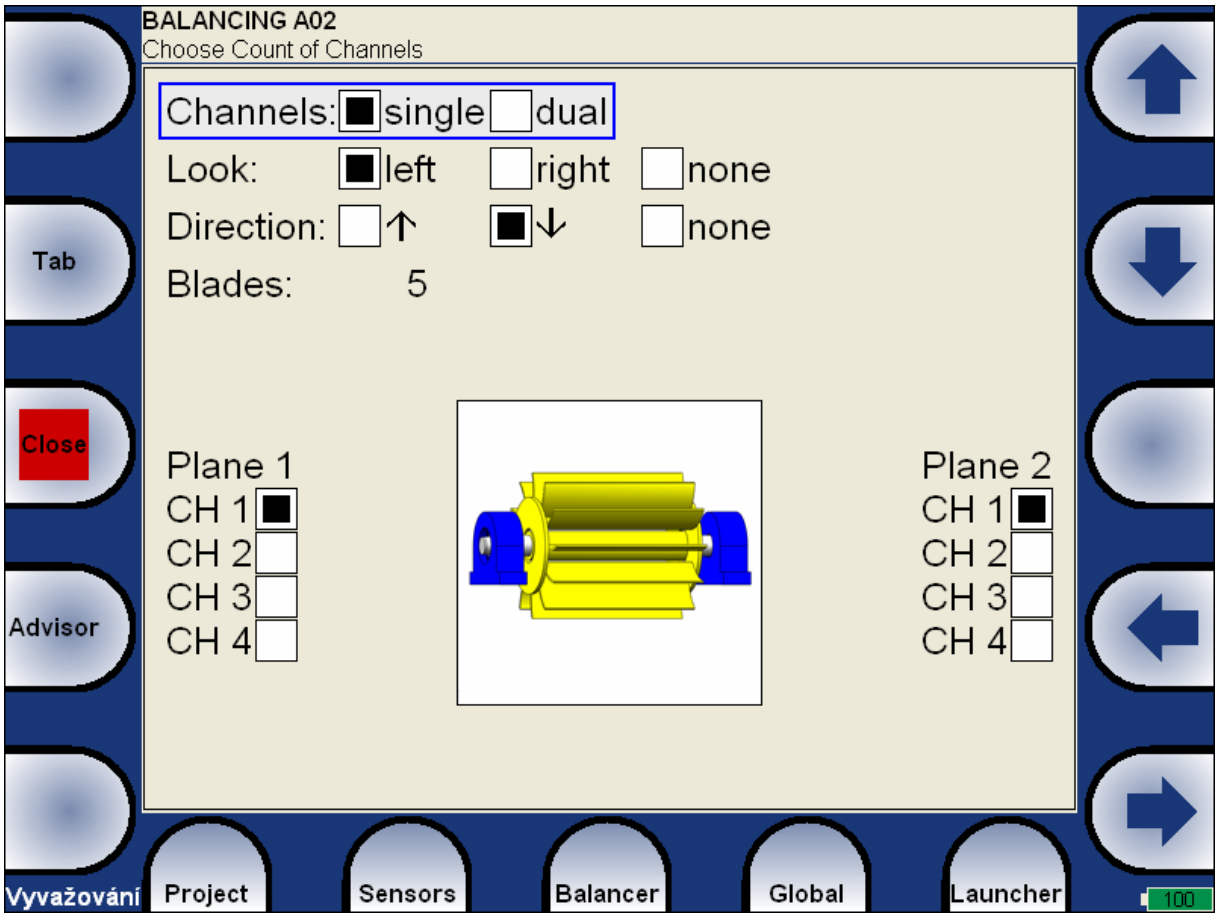
The recommended trim masses are displayed. After the mounting press the down arrow.
The TRIM 1 screen appears. It is the same screen as RUN 3 screen. Run the measurement or enter the values. Then the new results, effect and quality value are displayed.

Amplitude:	**0.4** [mm/s]
Phase:	**+20.0** [°]
Speed:	**25.1** [Hz]
RUN 1:	**12.5**[mm/s]
Effect:	**96.8**%
Bal.Quality:	**2.4**

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

The measurement properties screen for 2 planes balancing



Only two new items appears compared to single plane balancing.

Channels select the number of channels

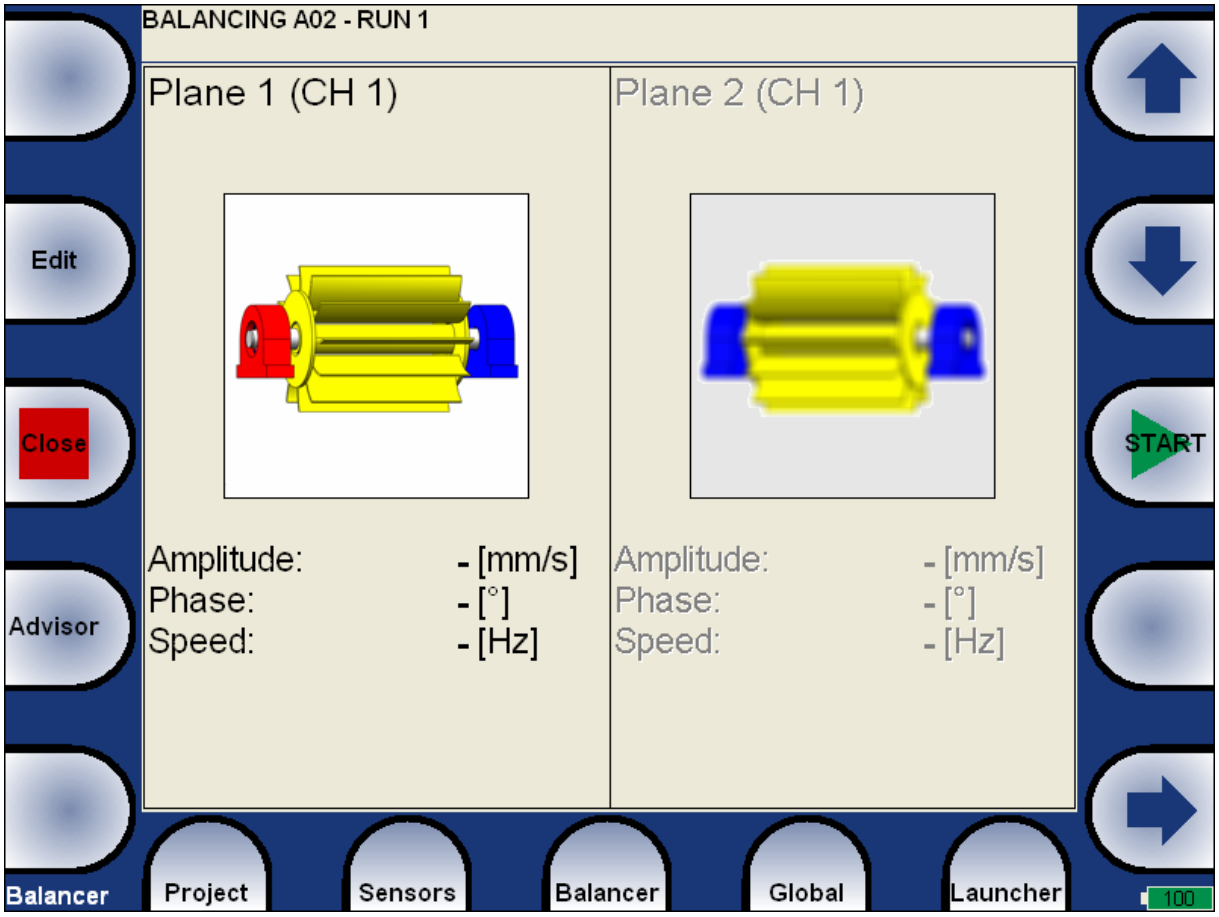
single only one sensor will be used for balancing. The sensor will have to be mount to Plane 1 or Plane 2 repeatly.

dual two sensors will be used. One for each plane. During the balancing will be the sensor mounted without any replacement.

Plane 1, Plane 2 the selection of channel numbers. They will be used for measurement.

Press down arrow to go to the next screen (RUN 1) or **up arrow** to return back to first screen.

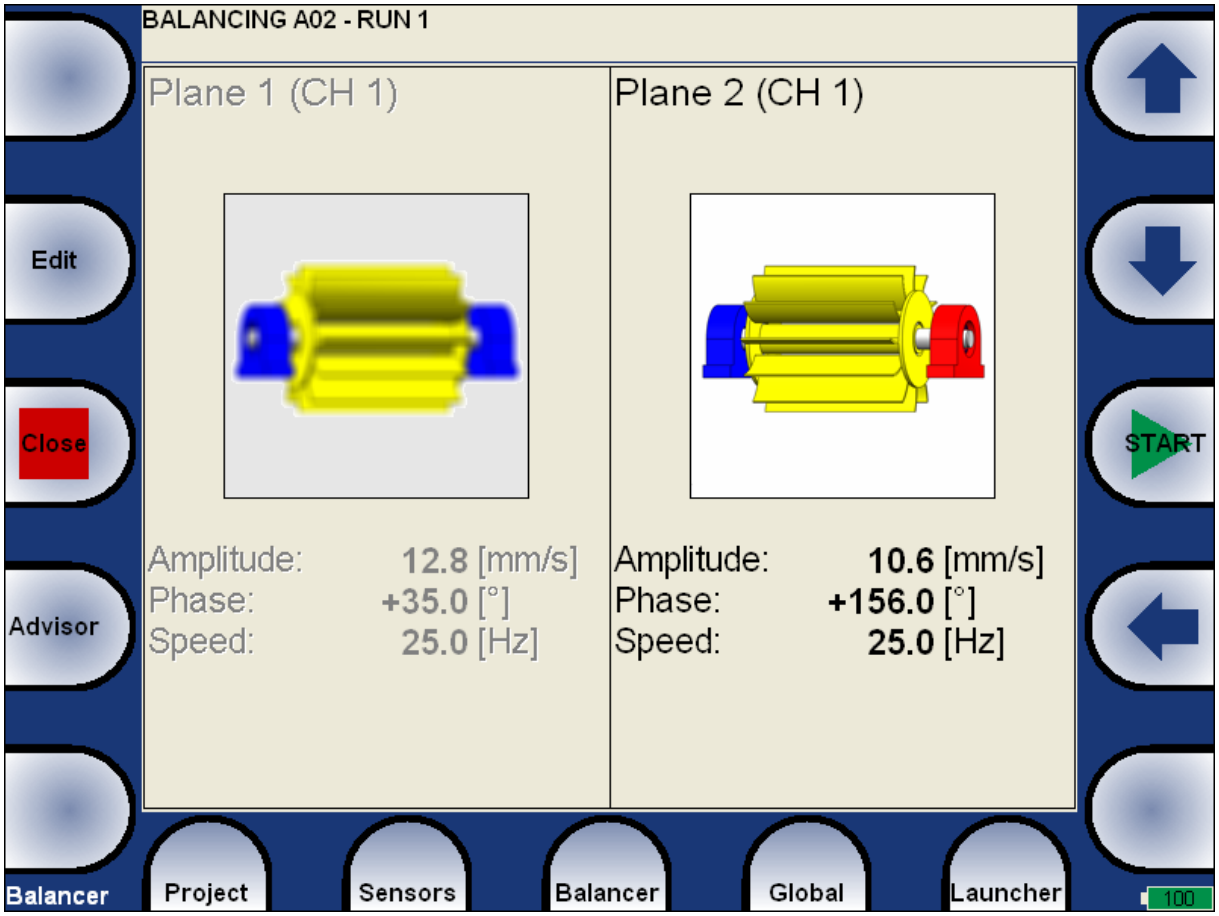
RUN 1 screen



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, 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. The results appear in the bottom. Use the right/left arrow button to move the active focus. Make the same for the second plane.
With two sensors you make both plane measurements together at once.

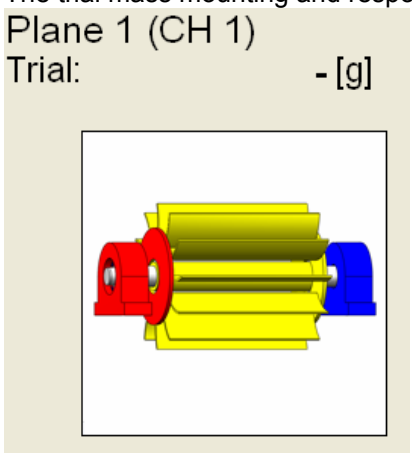
You can also use the **Edit** button, when you want to enter the values manually. Use the **Tab** for shift between values.

Then the screen should look like next picture.



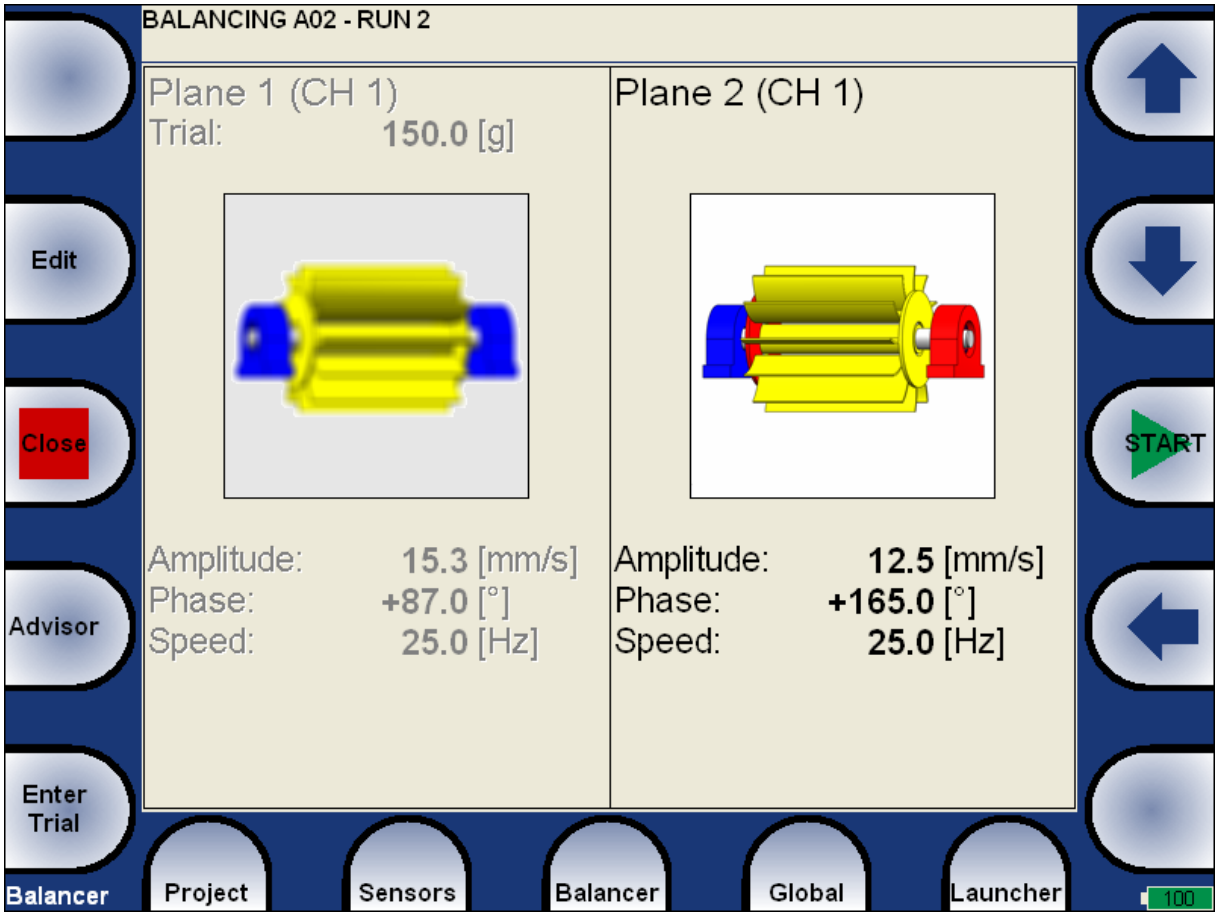
RUN 2 with trial mass in plane 1

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



Use the **Enter Trial** button and enter the trial mass for plane 1.

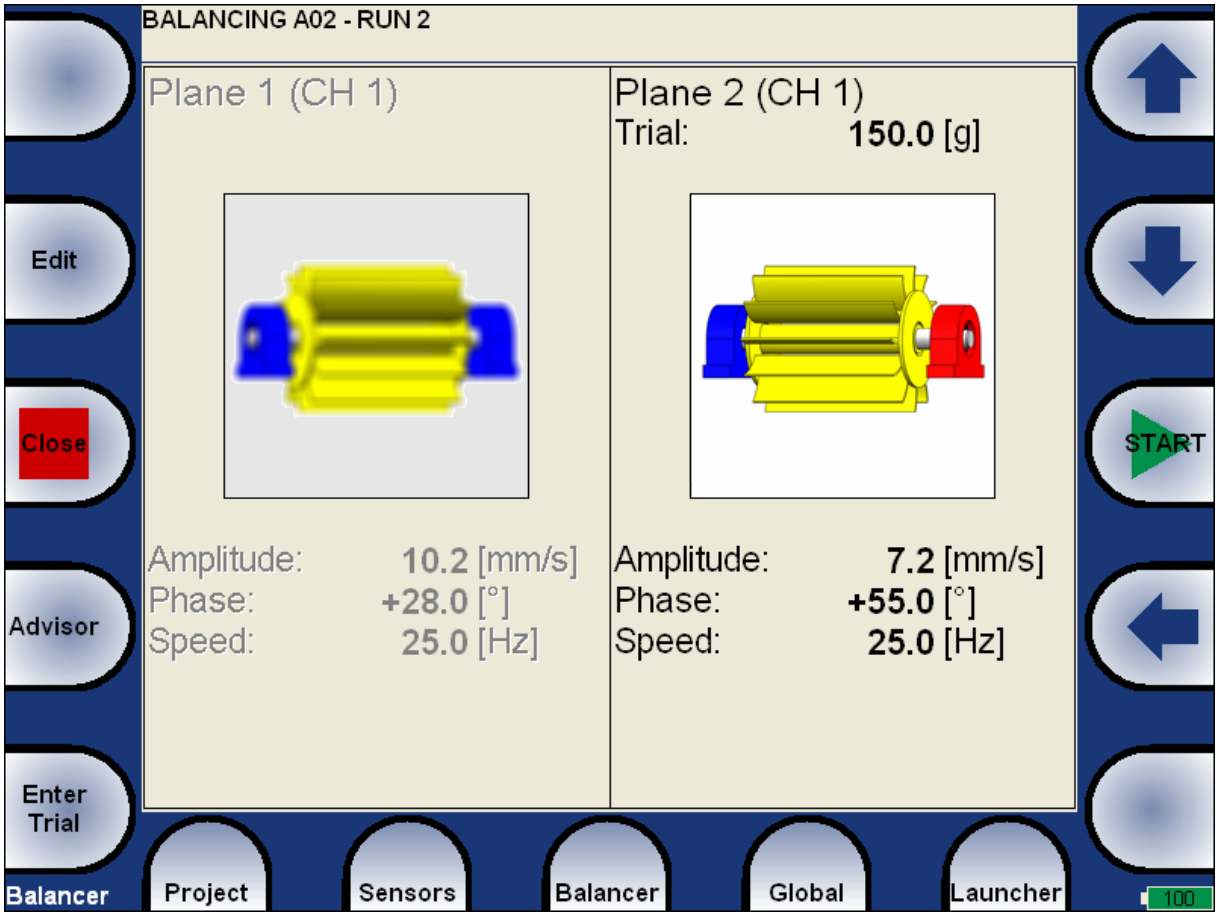
The corresponding plane for trial mass mounting is demonstrated by the red disc. After the measurement of plane 1 take the measurement on plane 2 (or take them at once, when you use 2 channels). The trial mass remain in the plane 1.
After measurements of both planes with trial mass on the plane 1 remove the trial mass from plane 1.
The RUN 2 with trial in plane 1 completed screen is in the next picture.



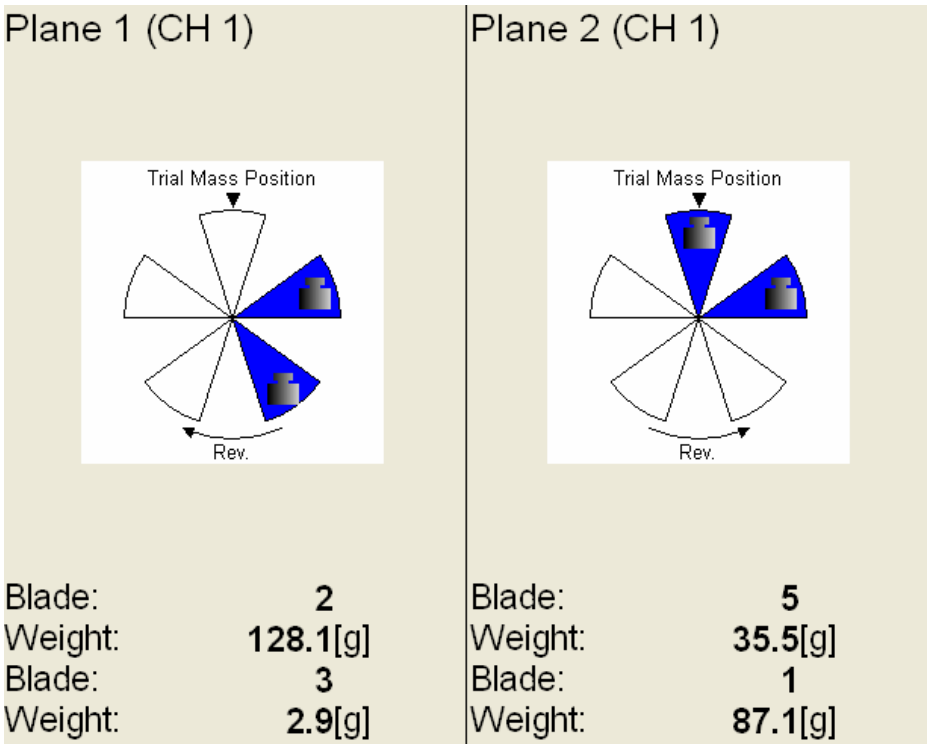
Press **down arrow**.

RUN 2 with 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.

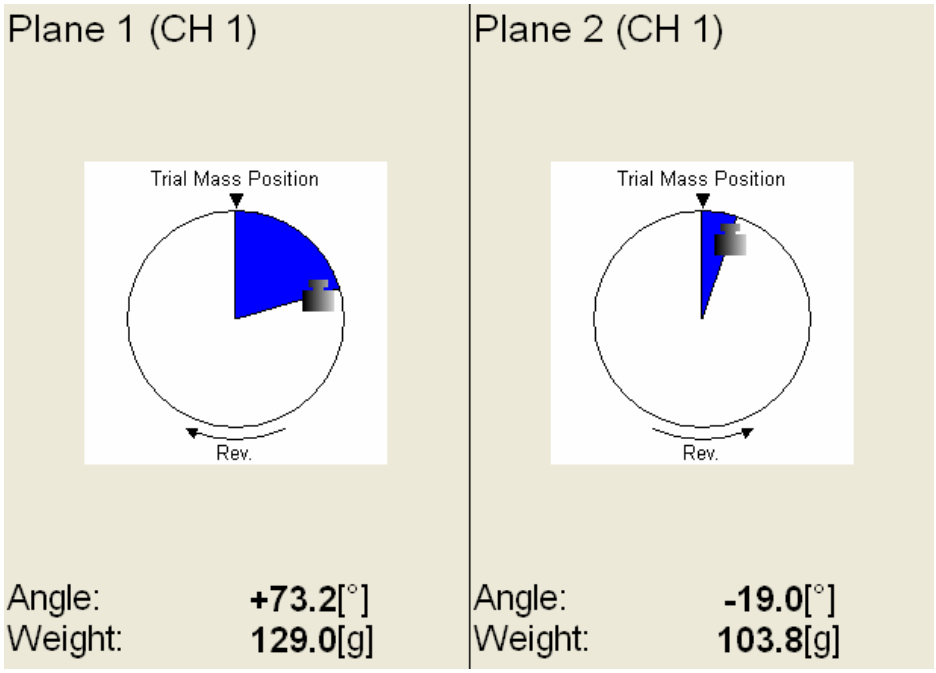


RUN 2 - Result screen



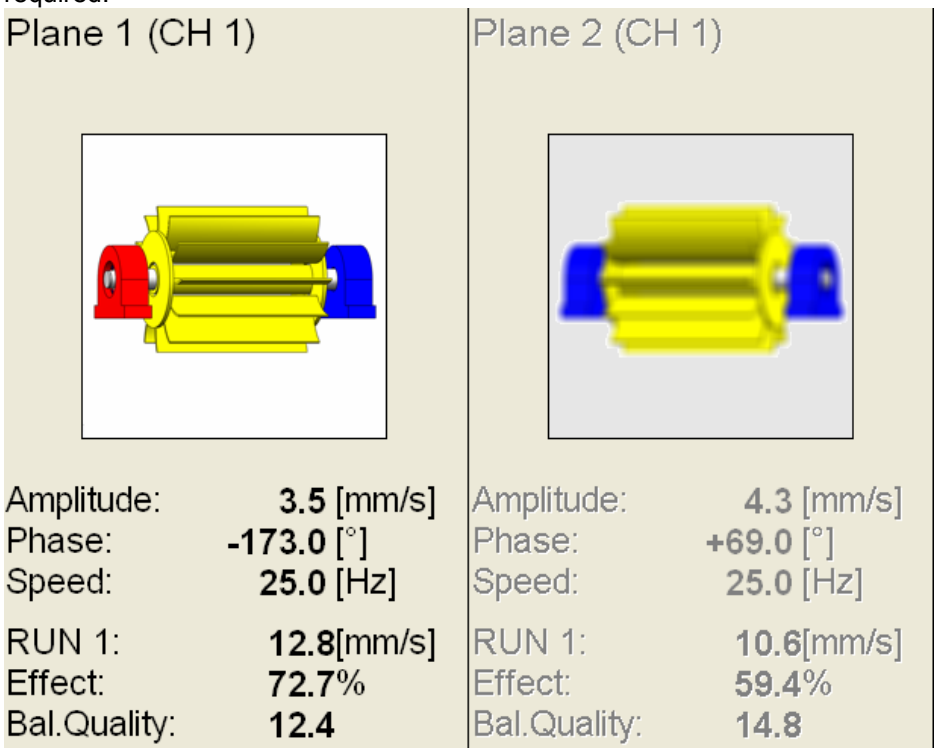
Remove the trial mass and mount the final masses to both planes. The angle is applied from trial mass position, which represents the 0 (zero) degrees.

In case you have not used blades, the result screen may look like that.



The RUN 3 screen

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



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

RUN1 original amplitude of RUN1

Effect is the reduction of balancing in %

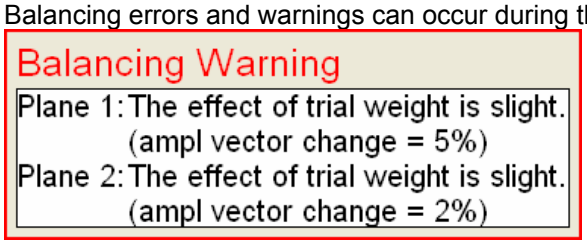
Quality balancing quality factor according ISO 1940 (mass of rotor and radius of balancing required)

Trim Screens

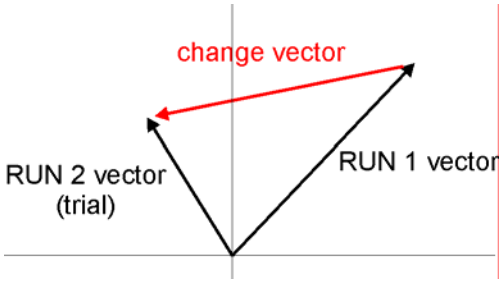
After RUN3 measurement you can continue with the job when you are not satisfied with the results. These next steps do not required trial mass measurements already. After each measurement the next masses are recommended. The trim screens are very similar to screens in single plane balancing.

Balancing Errors

Balancing errors and warnings can occur during the job.



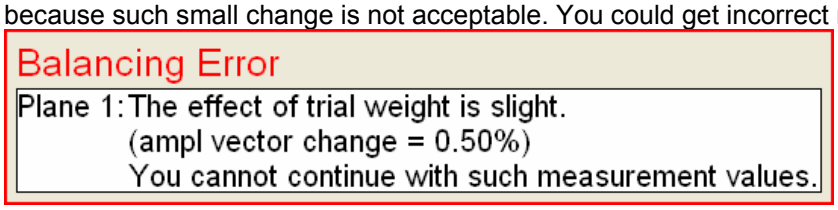
The frequent message is concerned the low effect of the trial mass.



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

The warning is displayed when the change is less then 20% but greater then 1%. You can continue with balancing after this warning and use that values.

The error is displayed when the change is less then 1%. You can not continue with balancing after this error, because such 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 mode. It enables the same measurements as in 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 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 - **A**s **S**oon **A**s **P**ossible. Be careful for such mode. When you want to measure e.g. **aps** only, then the maximum measurement number can be reached very soon (1 minute). The runup measurement will be stopped then.

The ASAP measurements can achieve
the maximum number of measurements (6400)
very quickly (e.g. 60 sec for APS).
Is it correct and acceptable
for your runup time duration?

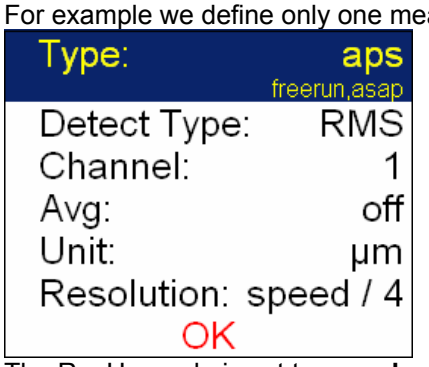
The last choice is the **Manual** mode. You can press the **Start** button at any suitable moment to make a new measurement.
The ending of run up is usually made manually by pushing **STOP** button.

The Set and other items

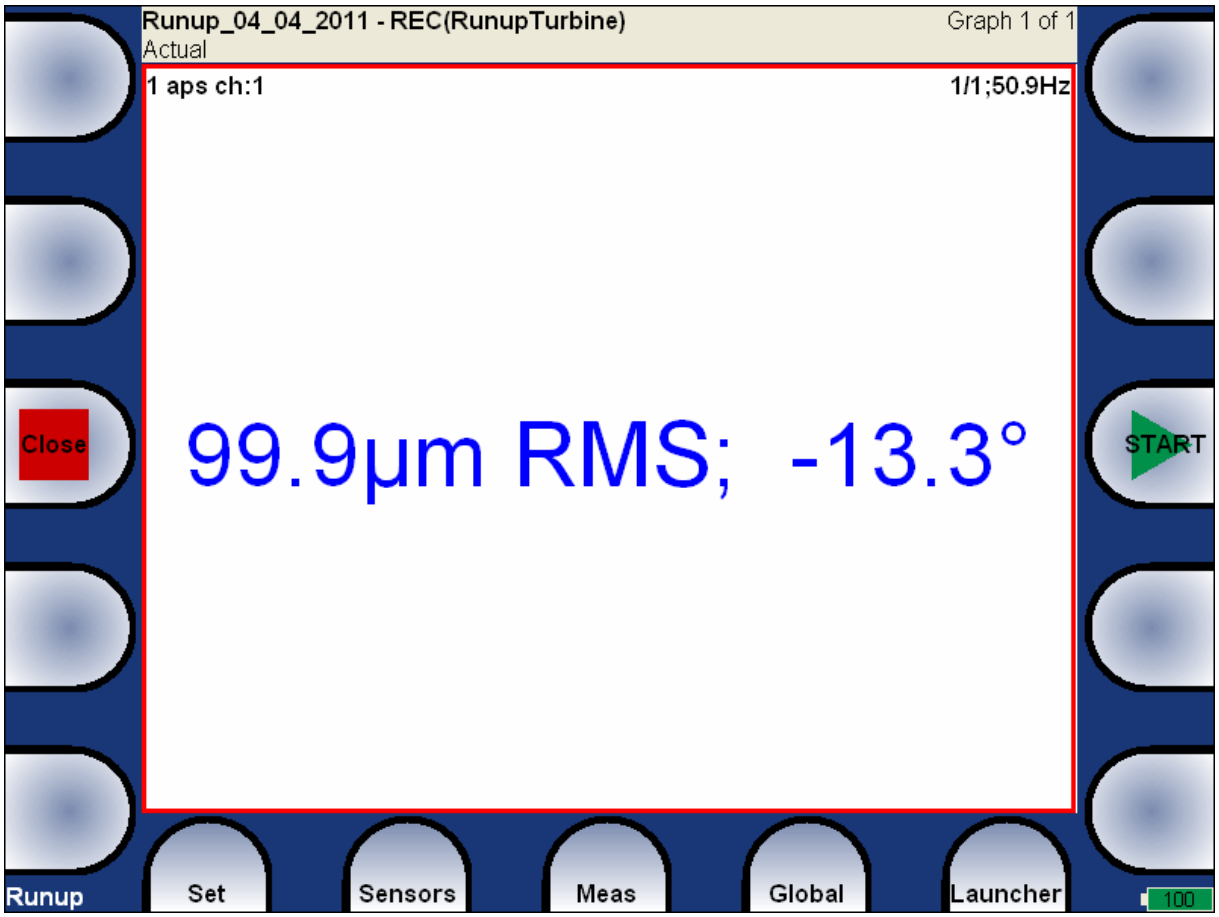
The meaning of the **Set** and also meaning of other items in the RunUp menu are the same as in the Analyzer mode.

Run up measurement

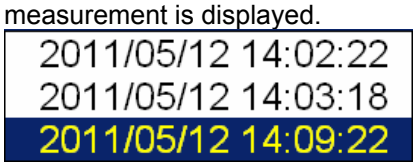
For example we define only one measurement in set. The proximity sensor in channel 1 is used.



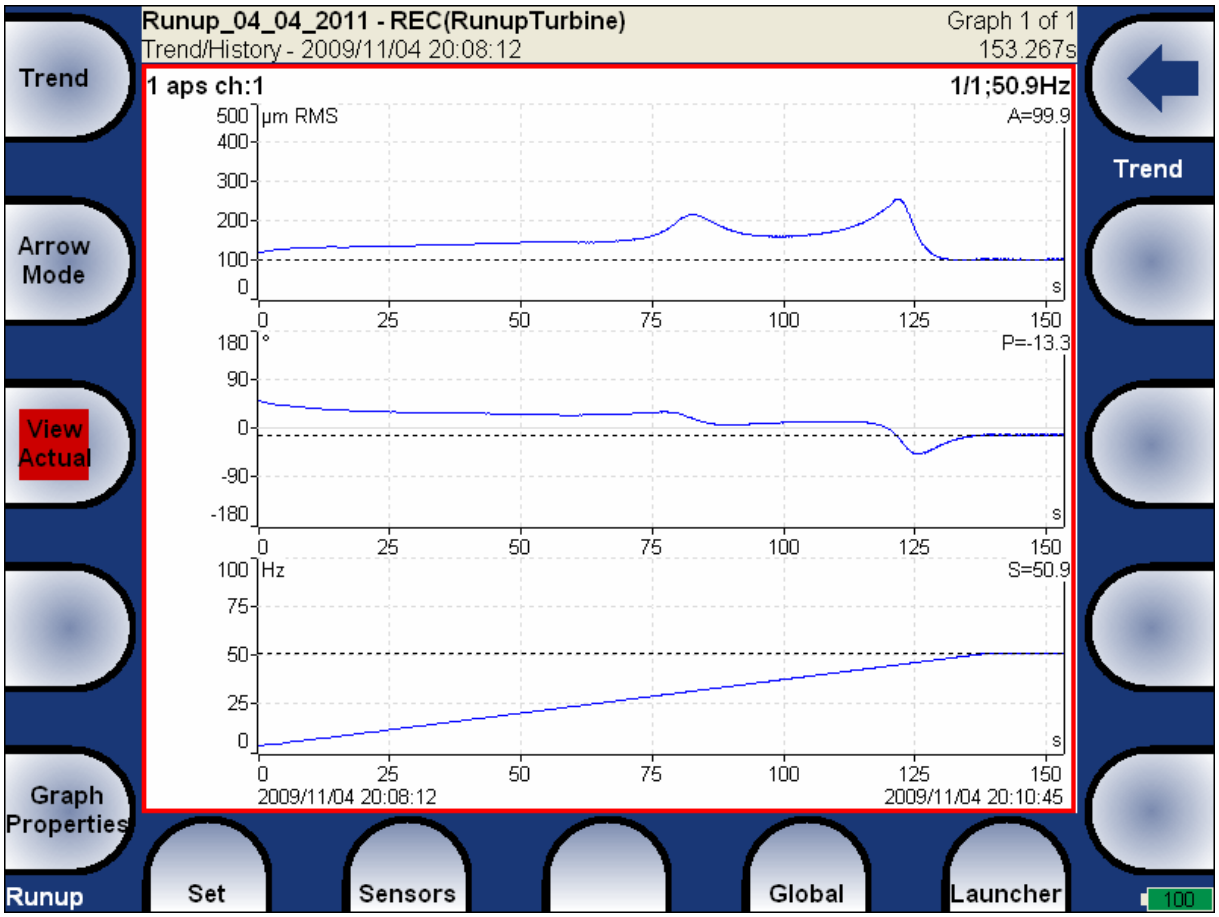
The RunUp mode is set to **speed** and the value is 1Hz.
Start measurement - push **Start** button. After the full speed is achieved press **STOP**.



The last measured aps 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**.



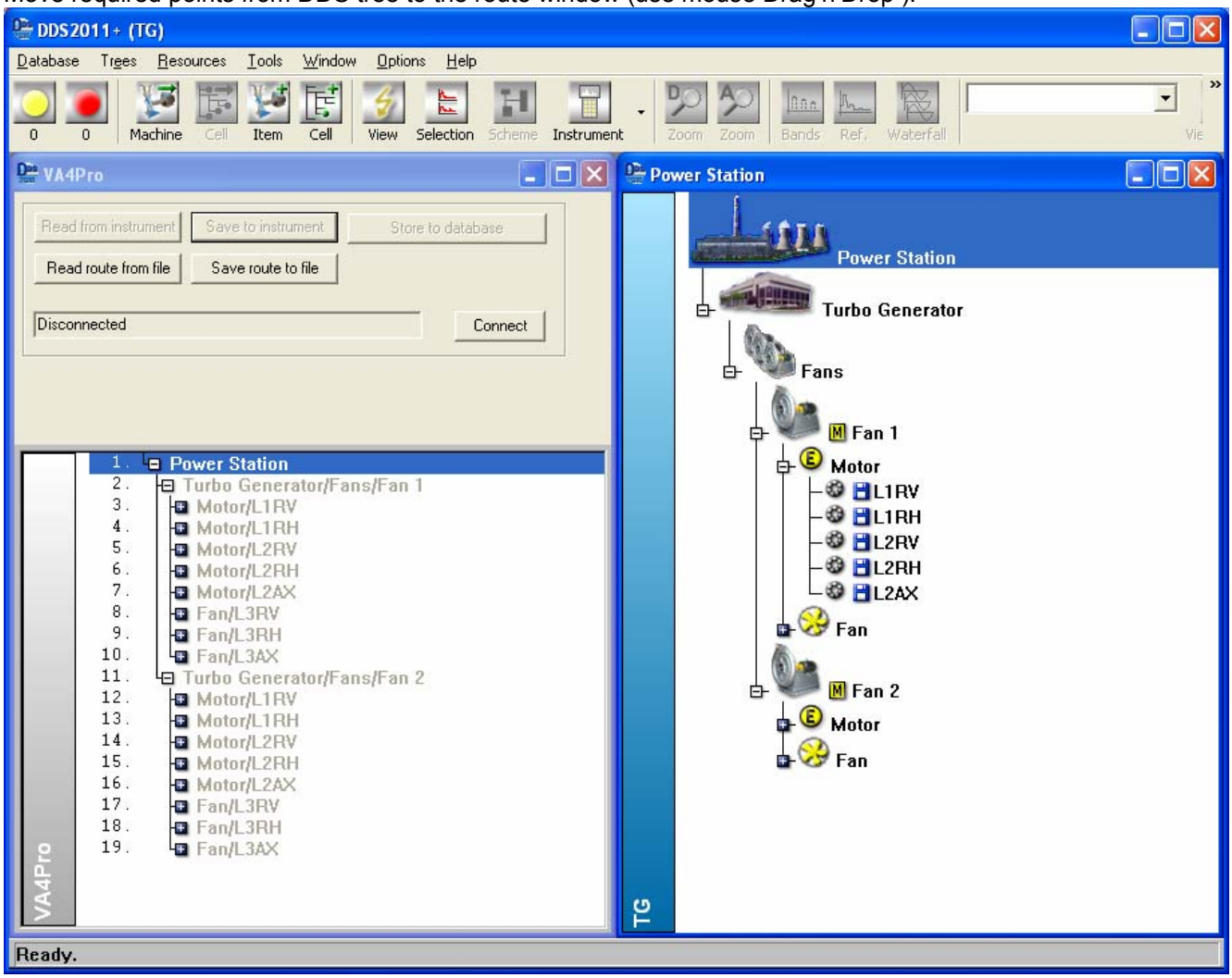
The aps - amplitude+phase+speed graphs appear. Several types of graphs is available under the **View** item. All items are in details described in chapter
The Analyzer Mode/The Analyzer buttons description/Graph Properties.

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

The Route

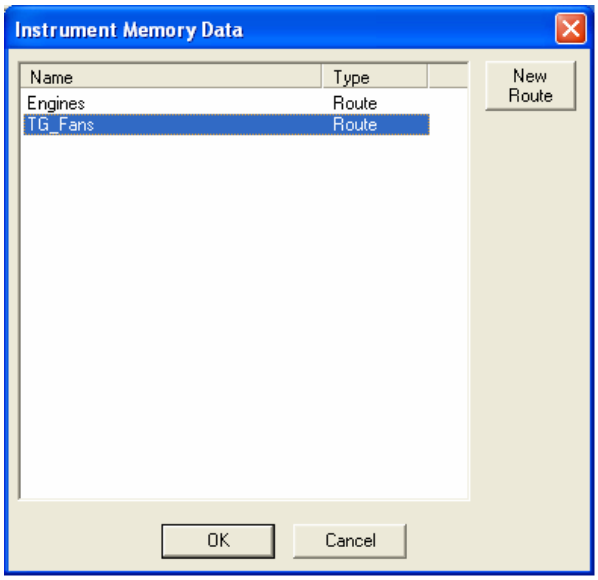
Loading of the route to the instrument

The co-operation with DDS software is required for the route measurement. See also the DDS user manual for more details. We do not describe all details about DDS function in this guide.
Open the database in DDS, from which you want create the route. Use Connect **Instrument function** and the route window appears.
Connect the unit with the computer. See **Connection to the computer** chapter.
Press the **Connect** button, the message window with connection process description should appear.
Move required points from DDS tree to the route window (use mouse Drag'n'Drop).



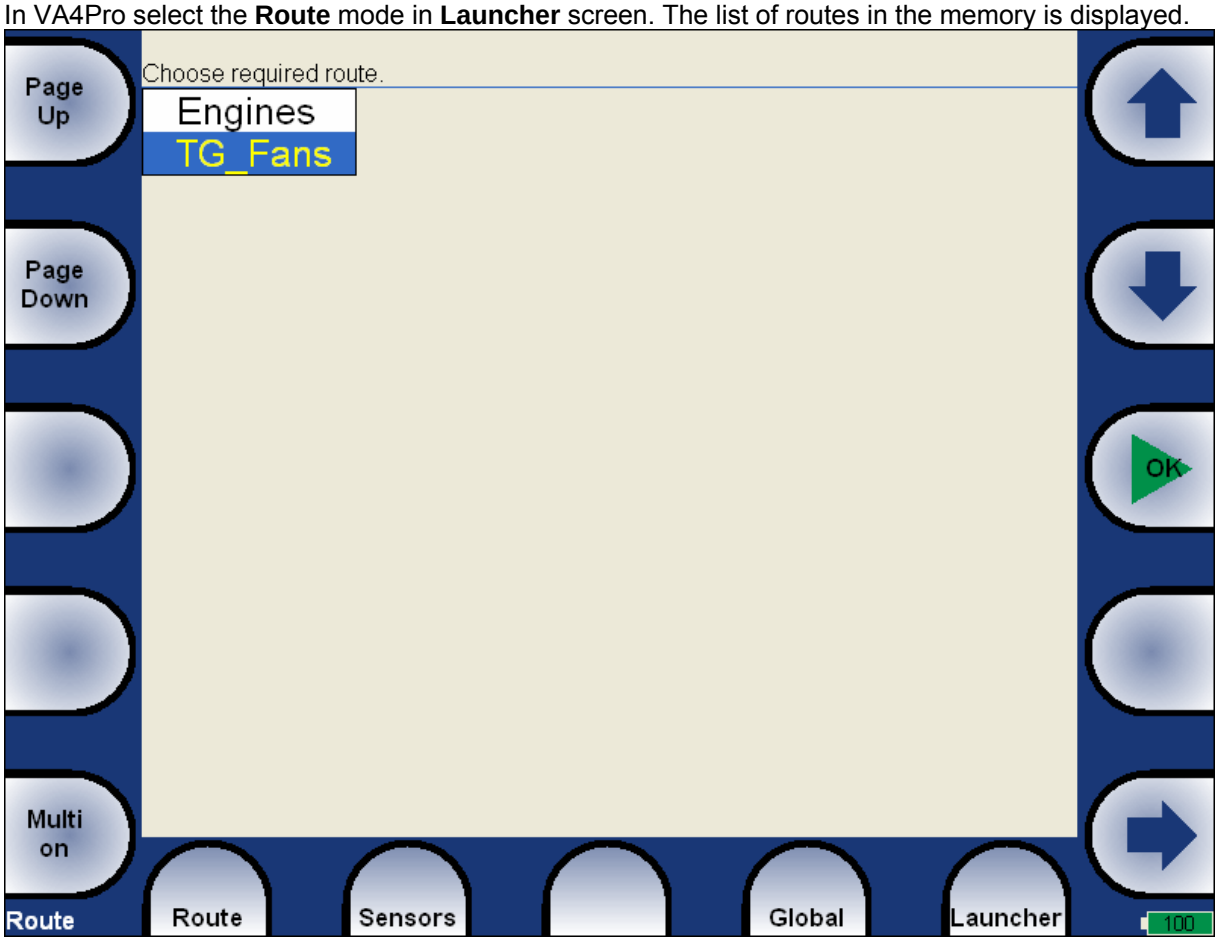
You can see that the structure of tree is changed. This is because in VA4Pro strictly requires the tree with the following structure Tree_Name - Machine - Measuring Point - Data Cell. If there are more branches in DDS tree in a path between this items, the names of such items are combined together (like 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").

Press the **Save to Instrument** button. In the next window select the route in the instrument memory and rewrite it or define new name. Press **OK**. The route data will be loaded from computer to the instrument.

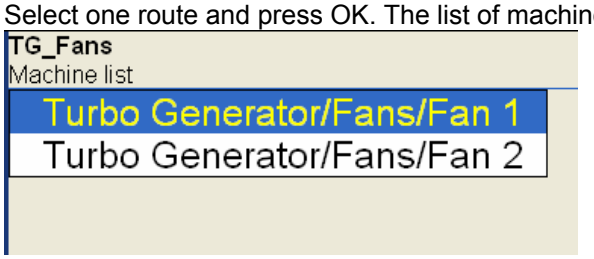


Route measurement

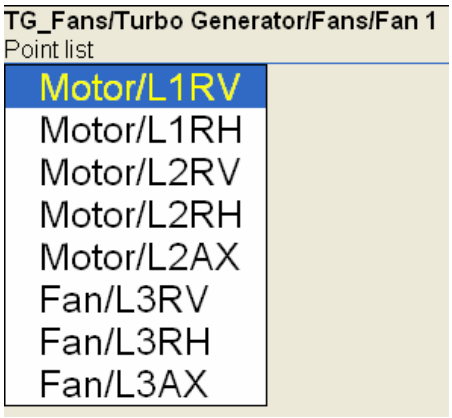
In VA4Pro select the **Route** mode in **Launcher** screen. The list of routes in the memory is displayed.



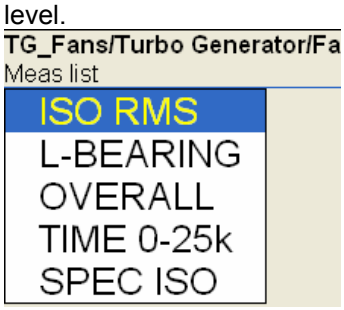
Select one route and press OK. The list of machines appears.



Select the machine and press right arrow to develop the list of measurement points.



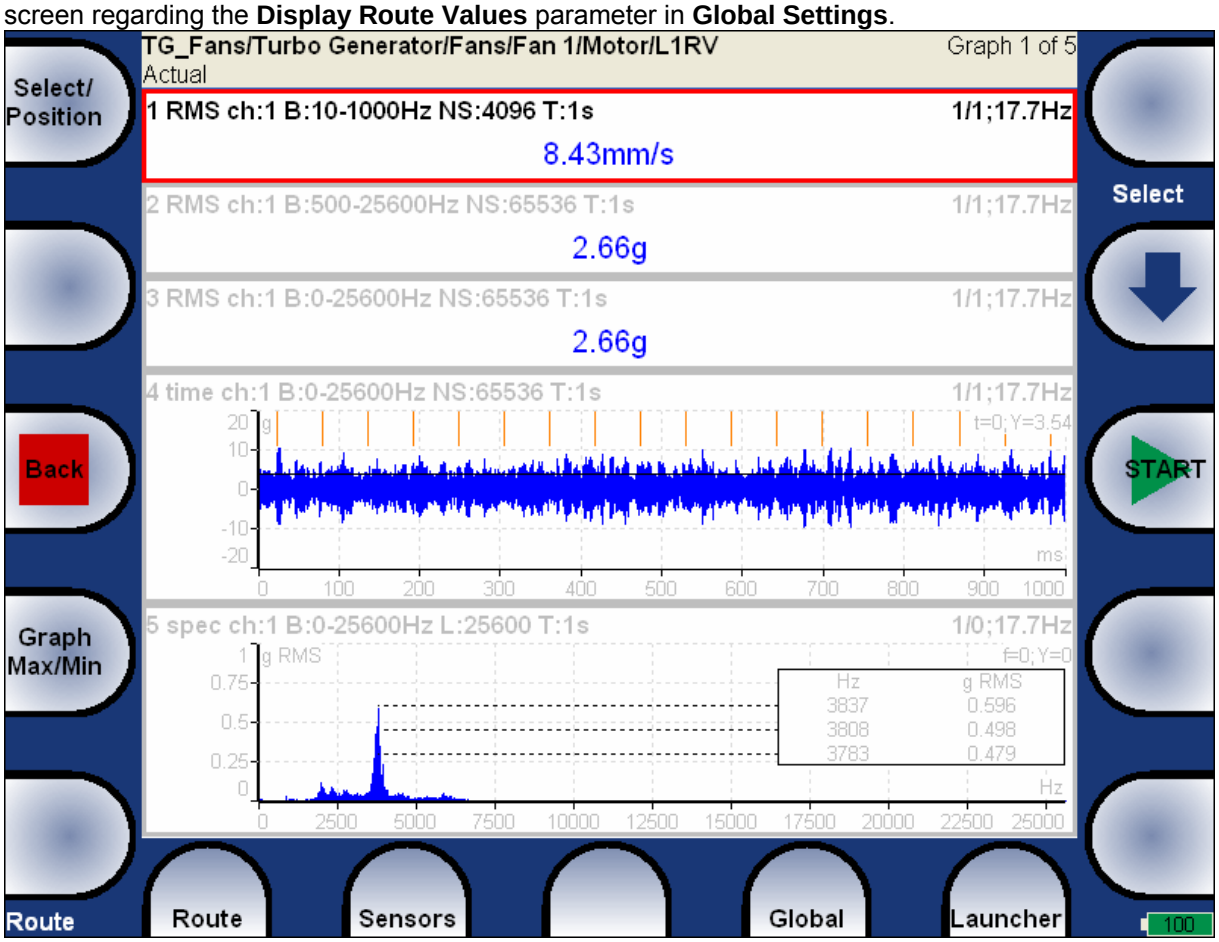
In this moment you can start the measurement or by right arrow display the list of measurements, which are defined for this point. By left arrow button you will close the displayed list and you return back to the previous level.



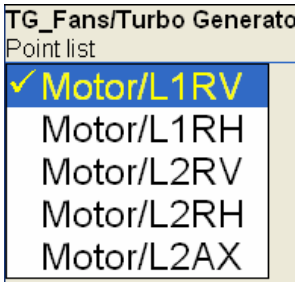
When you press the **Start** button in the points list, the measurement graphs are drawn with the **No_Data** message. If the required sensor (defined in the route) is not compatible with the sensor connected to channel input (Sensors properties) instrument warns us about this. In this case change the 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) or by the cross (some measurements were not taken due to error).

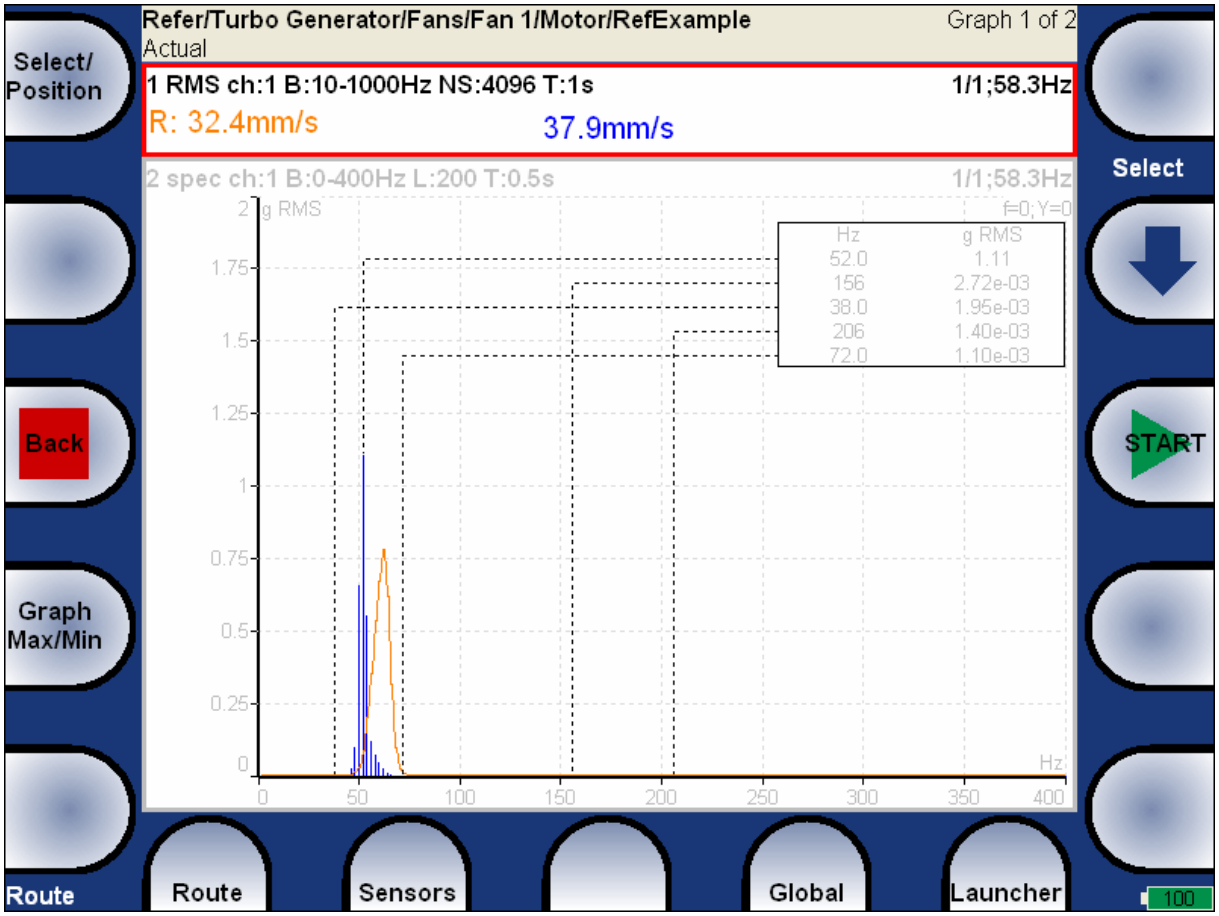


Point button enables to work with the measurement point data.

Copy - Creates the new point with the same setup. It is usable, when you need create new out of route point on the machine.
Export - Makes copy of route from hard disc to VA4_DISC. Then the route is accessible from DDS software.
Rename - Renames the actual item
Delete - Deletes the actual item
Clear Data - Erases all measured data in selected point.
Notices - Add a notice to this measurement point
Clear Checks - When the point data is measured, the check inform about that. When you want to measure the route again, it is better to erase checks and begin with empty list.
Save Data - When autosave is off, then you have to use this item for saving.
View Trend - The instrument enables repeat the measurement in the route. It means that also inside the route the trend exists. Use this item to view that.
View Actual – View the just measured data are displayed
Route list - Display the list of all routes in the instrument.

Reference values

You can download reference values from DDS to VA4Pro unit for spectrum and wideband measurements.
These values are displayed together with measured values.
Reference spectrum is displayed together with measured spectrum in the same graph.
Wideband 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).

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 **Connect instrument** window use the **Read from Instrument** button. Select the required route from the list (all routes saved in the VA4_DISC) and read it. The list of all points appears in instrument window. The grey items were not measured. Press **Store to database** to save data.

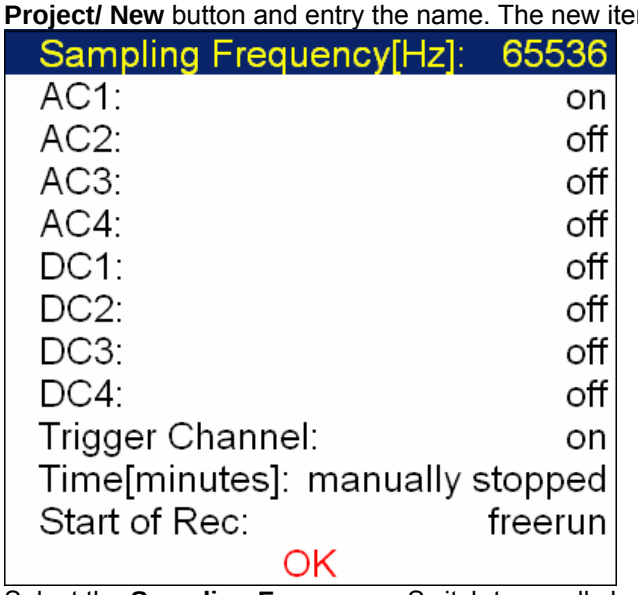
Recorder

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.

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 entry the name. The new item appears in the list. Select it and push **OK**.



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.

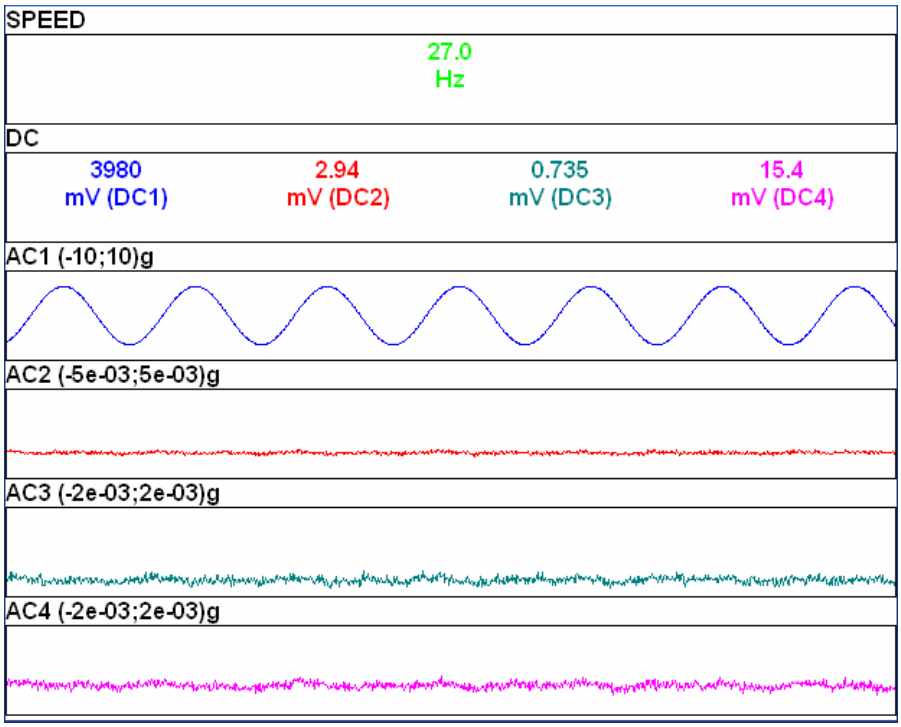
Start of Rec

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 **Treshold level**, which is set by user in **Global** menu. Both - positive and negative levels are accepted.

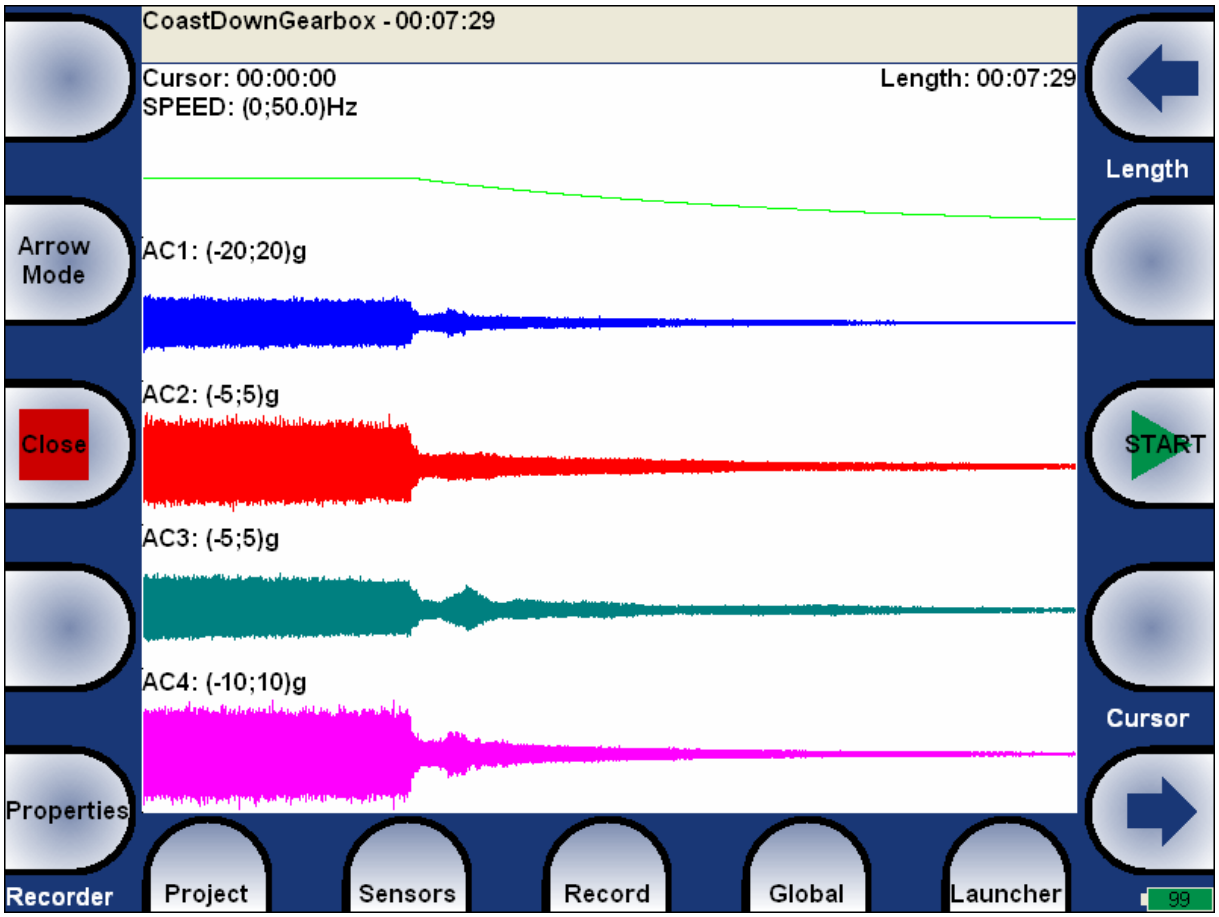
When the **Record** parameters are set, use the **Start** button for start of the recording. During the recording all input signals (included channels, which are not recorded) are displayed on the screen.



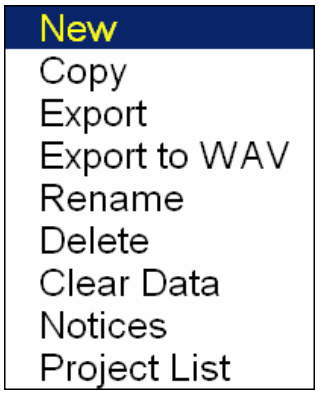
The process is finished when
- the time is over,
- manually by Stop button,
- the memory is full.

Editing of Record

Run the Recorder. The list of records which are saved already in the memory appears on the screen. Select one of them (arrows and OK). The preview of recorded signals appears.
When you want to display the list of projects again, use **Project** button and **Project List** item.



Project button



New	the new project for recording
Copy	copies all record parameters to new project without the recorded data
Export	exports the record to **VA4_DISC**
Export to WAV	exports the record to wav data format
Rename	renames the project
Delete	deletes project from memory
Clear Data	deletes recorded data, all record parameters is kept
Notices	adds the notice to the record, see **Global Propertie/ User Notices** chapter
Project List	the list of Projects is displayed

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

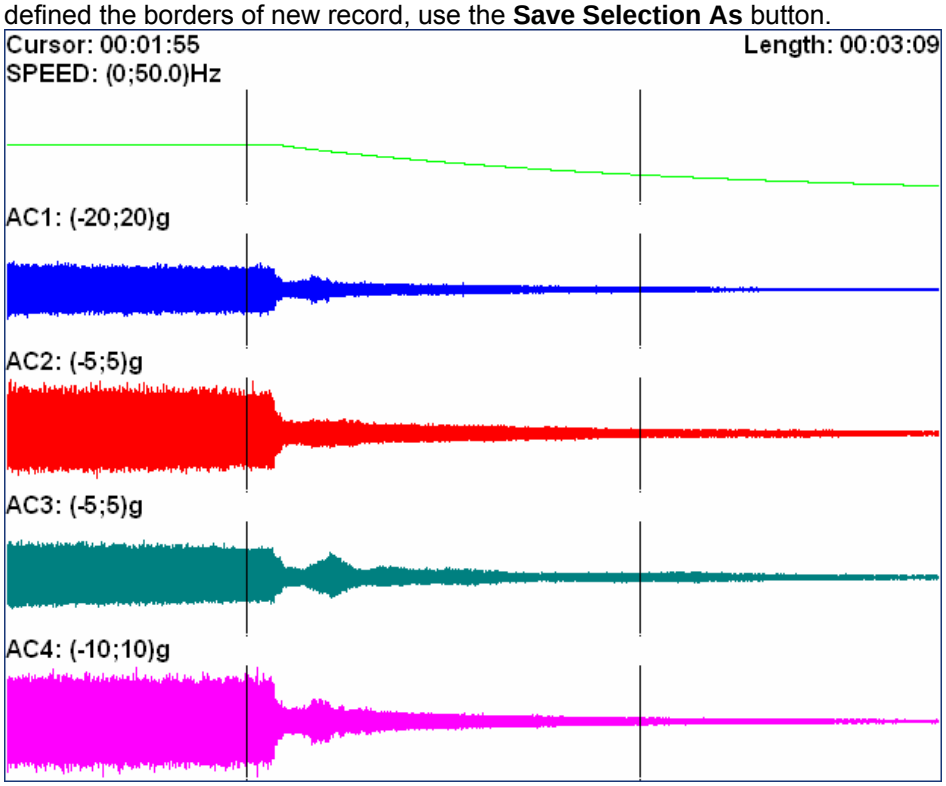
It starts new recording. The old recorded data will be rewritte.

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

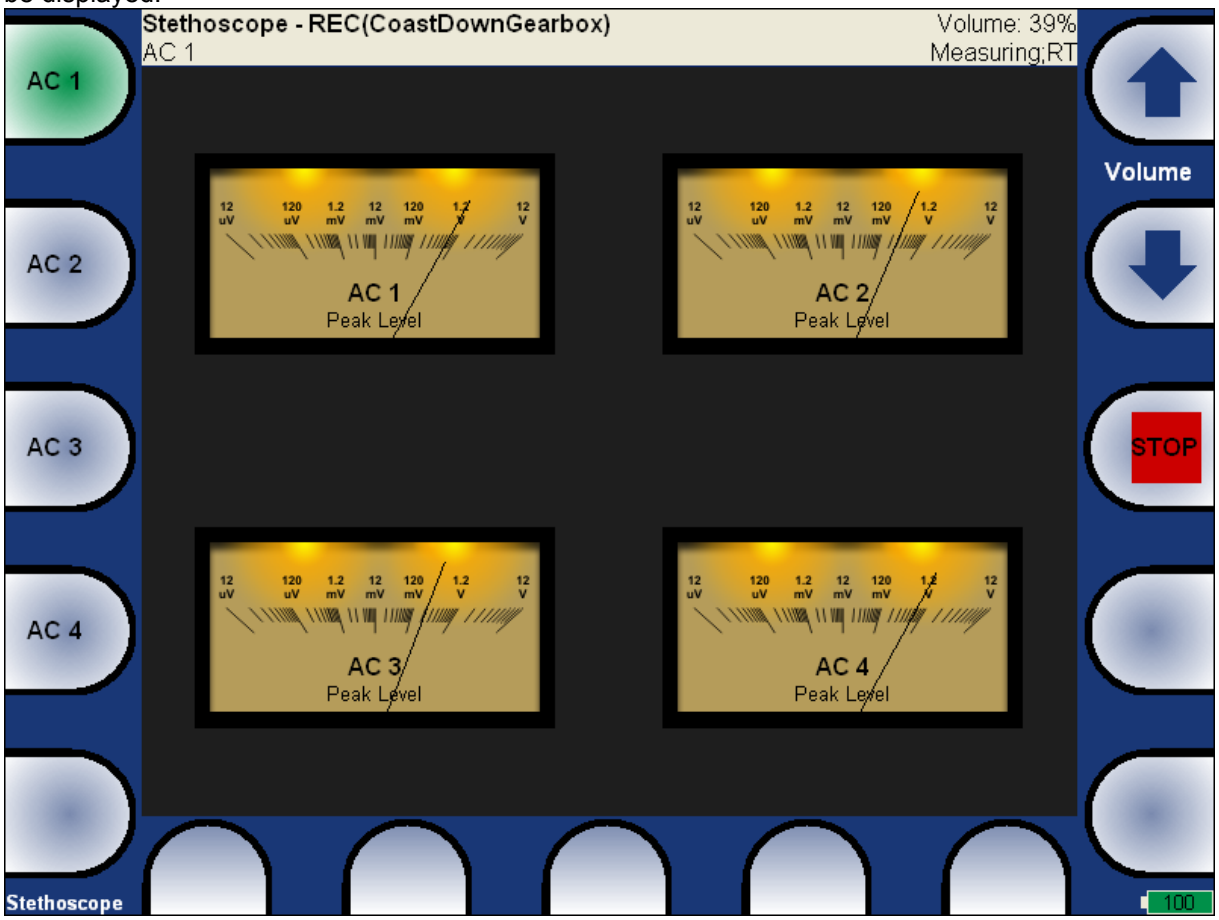
It switches the display between complete record and the zoom selection made by **Cursor+Length**.

Zoom Y button

It is standard Y zooming.

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.

Appendix A: Technical Specification

Inputs

Dynamic Channels (AC)

Number of synchronous parallel channels (AC):	4 AC
Frequency range:	max 76800 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
High pass filter:	1Hz -12800 Hz (user definition)
Low pass filter:	25Hz -76800 Hz (user definition)
Connector:	Binder 712 series

Tacho Channel

Number:	1 independent tacho input
Speed range:	0,8 Hz - 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:	0.25 sec for 25600 lines FFT spectrum
Amplitude Units:	Metric, Imperial (English) or user programmable
Frequency Units:	Hz, CPS, RPM, CPM, Orders
Amplitude scale:	Acceleration, Velocity, Displacement, User defined
Scaling:	Linear or Log, both X and Y axes
Cursor:	Single, Harmonics, Sidebands
Triggering:	free run

	tacho
	amplitude (positive or negative)
	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 (65 536 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 - 65536
Waveform length:	max 1024sec
Spectrum ranges:	25 - 76800 Hz
Spectrum lines:	100 - 25600
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 tacho signal)
	(100GB memory enables over 30 hours of full 64kHz recording,
	lower sampling frequency enables much longer record))

Balancing:

Planes:	1 or 2
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:

Processor:	Atom 1.6 GHz
RAM:	1 GB
Display:	LCD colour 174 x 127 mm (8.5” diagonal), 800x600 resolution
Memory (Internal SSD):	160 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: ACMT bearing and gearbox measurement

Applications

The ACMT is the brilliant tool for condition of low-speed machines like paper machines, rolling mills, transport mechanisms… .

Description

Various processes produces short duration pulses are in slow speed machinery. Pulses are often caused by rolling element bearings, gearbox wear, etc. It is important to be able to accurately detect and analyse these pulses for correct diagnosis.
The individual pulse can have very short duration. Consequently it is necessary to set a high sampling frequency for measurement. Only in this way ensures to obtain a correct measurement of signal amplitude.
The time interval between pulses can be very long when the speed is low (seconds, minutes). We need to see the time signal which contains several pulses as minimum for correct evaluation. The long length of time signal is required. This matter needs to use the low sampling frequency.

These two aspects produce the conflict in the measurement setting:
1. We need to use high frequency sampling for pulse measurement, which means the measured signal will very short e.g. 100ms. When the time interval between pulses is in seconds we have low chance to catch it. And we have no chance to have more pulses in one time signal.
2. We need the low sampling frequency for long time record e.g. 10s to obtain more pulses in one signal. But with such sampling we cannot measure the pulse, because cut out by anti-aliasing filter. If we switch off this filter, we have also no chance to catch it, because pulse duration is short and time period between samples is long.

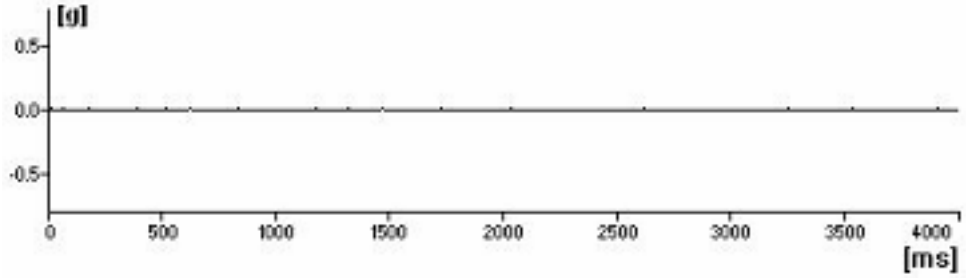
ACMT is the solution

This method implements both contradictory requests by double sampling the data. The high sampling frequency is used in the beginning. Then the data are compressed. That is why we can take long time signal for evaluation.

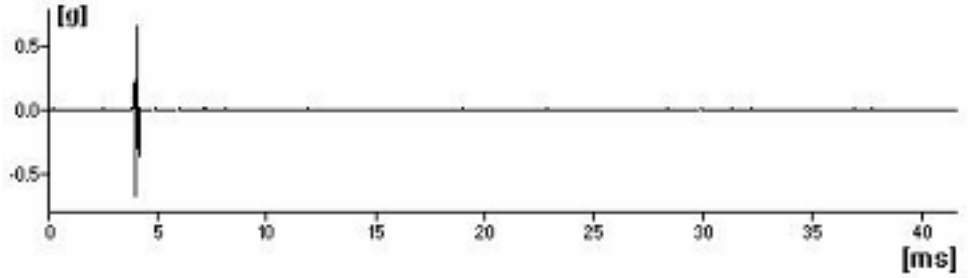
Example

All measurements were taken on a slow-speed 23132-TOR rolling bearing rotating at 60 rpm (1 Hz). Outer race defect is on the bearing. The short pulses are generated during the operation.

We measure the signal with a record length of 4sec. When 2048 samples (standard value) is used, then 200Hz anti aliasing filter is used. We take the signal without any pulses. All of them are cut off by filter.



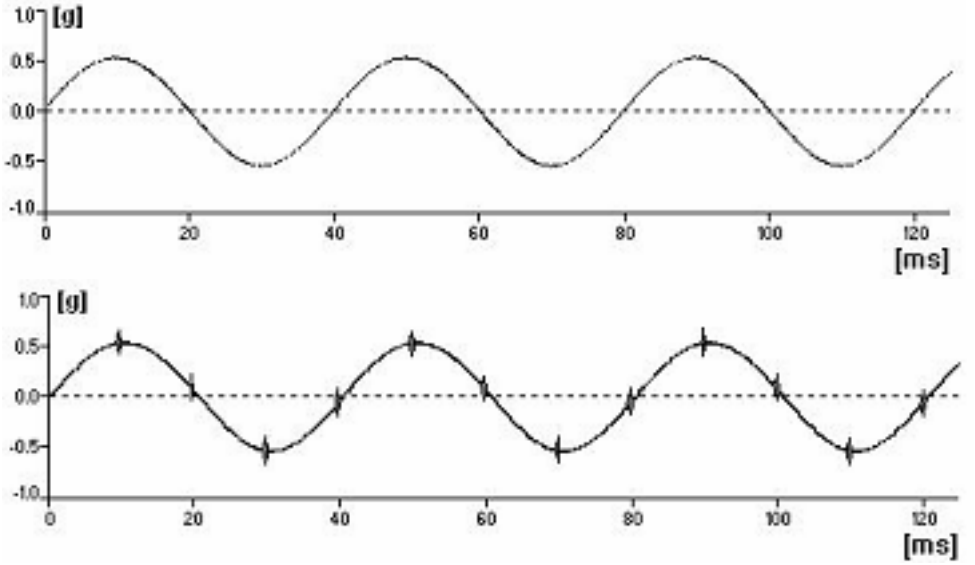
We use the 19200Hz sampling frequency. But we can measure only 42ms time signal. The time between the pulses is 114 ms. We need to be lucky and to hit the pulse.



Next measurement uses the ACMT method. You see, it works. Long time signal contains required number of pulses and the peak of each of them is captured. That is what we need.

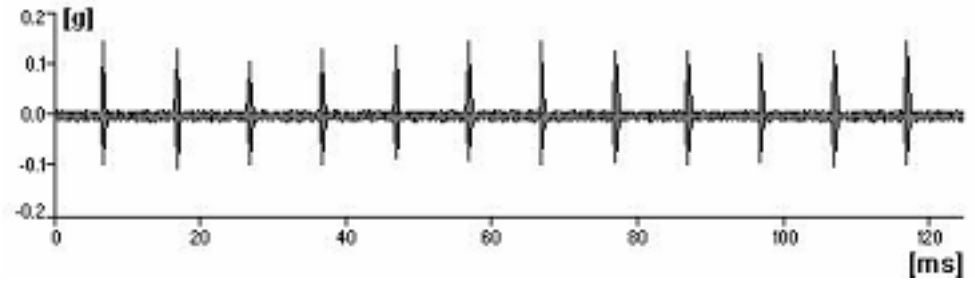
The ACMT method can do even more

Short duration pulses have usually small amplitude. They are often modulated by speed frequency.
We use standard measurement and result is in the next picture.



You see only speed sine wave and no or small pulses, which are filtered by anti aliasing.

The standard ACMT is used in next picture. We used the ACMT together with band pass filtering which removes the speed sine wave from the signal.
The all short-pulses are held and amplitude are modulated for better view.



This result is much better, because Y axe scale corresponds with real pulses amplitude, not with speed sine wave amplitude.