USER MANUAL

Adash A4300 VA3 Pro

Version 1.30 – December, 14, 2022

Content:

Before you read this manual

The VA3Pro unit is continuously developed and new functions and features are added quite often. Such additions require changes in the manual and those changes are very time consuming for us. That is why we do not change all the pictures in the manual with each new version. We have not changed some pictures in the manual although they have been changed in the instrument already. This has only been done on places where such pictures have no consequence on the new function.

Before Switching On

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

General warnings

If you have purchased the A4300 EX version, please read the Appendix D: ATEX chapter.

AC, DC channels - voltage higher than ± 28 V (peak) can damage the instrument (± 25 V for Ex version).

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

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

Use only original cables designed for connection with the sensor.

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

A long push and hold of the POWER button switches the instrument off incorrectly. Data could be lost.

Batteries and charging

Use only the original charger. If you need new one, contact your dealer.

The socket for the external charger (instrument accessory) is on the bottom side of the instrument.

The charger contains LED indication:
orange: charger disconnected from unit
quick green flashes (several times per second): charging in process
slow green flashes (once per second) or continuous green: unit charged
slow orange flashes (once per second): pre-charging of deeply discharged battery (it can take hours, it depends on the level of the discharge)

The battery indicator on instrument screen doesn't correctly display the charge level during the charging. The indicator checks in this case the voltage from charger not from battery. Always disconnect the charger to check the charge level.

Normally full charging takes 5 hours. It takes longer time, when unit is switched on during charging.

Never do short circuit the charger connectors.

Recommended charging temperature is 0-40°C (32-104°F) (0 – 35°C (32-95°F) for Ex version)

Very high temperature over 50°C (122°F) decreases battery life. Don't leave the instrument on direct sun light or on other heat source.

The battery capacity decreases with low temperatures (e.g. on –10°C (14°F) only 70% capacity is available). Keep the unit in normal temperature before you begin measurement.

Don't leave the unit uncharged for the long time. The battery could be discharged completely. If you do not use the unit, charge it regularly every 6 months.

General information

A4300 VA3 Pro – general information and configuration

The A4300 VA3 Pro is a data collector and an analyzer for vibration diagnostics.
There are 2 signal inputs and 1 tacho/trigger input. Input 2 offers connectivity to a triaxial sensor, therefore all 3 channels can be measured simultaneously. The expert system developed by Adash can automatically detect machine faults such as unbalance, looseness, misalignment and bearing faults.
There is a non-contact IR temperature sensor (for immediate bearing temperature measurement) and a LED stroboscope/torch. The A4300 VA3 Pro is designed for one-handed operation. With a weight of just 780g and a battery life of more than 10 hours of operation (5 hours for Ex version), the unit is suitable for long route measurements.
The A4300 VA3 Pro instrument can be configured according to your requirements by choosing optional modes e.g. analyzer, route, balancer. Optional modules can be purchased also additionally and downloaded to the instrument without the need of sending it back to the factory.
At the moment there are 8 modes available. The modes FASIT (Expert system), Stroboscope and Meter are included in every unit.
The modes: Analyzer, Route, Balancer, Recorder and Run Up are optional and it is up to you if you wish to have them in your A4300 VA3 Pro.

Switching on

Use the **POWER** button to switch-on the device.

Push and hold the button until the right hand LED on the front panel (top right) changes colour from orange to green.

Battery

The information about % of battery lifetime is displayed on the top right corner of the display. When the battery is charged more than 25% the battery symbol is green. When the battery is charged 5-25%, the yellow symbol is used. Under 5%, the red symbol appears.

Switching off

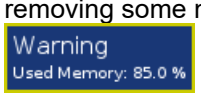
Switching off can be done on the instrument's main screen. Press the **POWER** button and confirm by pressing **Yes**.

The emergency switch off

This is not the correct method of switching off the instrument. Using it can cause data corruption. Use this method only in cases when it is absolutely necessary.
Push and hold the **POWER** button for about 5 seconds, then release the button. The instrument will switch off.

Memory capacity warning

If the memory capacity warning appears (see the picture below), you need to free up some memory space by removing some measurements or routes.



Connection to the computer

Use the mini-USB cable, which is the standard accessory of the VA3Pro set, to connect the device to the computer. There is a mini-USB port on the top side of the VA3 device for the connection.

The VA3Pro unit should be switched off or on the main menu screen.
When the VA3 is connected, the new device (new flash drive) appears on the computer. The name is VA3_DISC. If this operation fails, switch off the unit and try to connect it again.
Always use the **Safely remove hardware** function before disconnecting the VA3Pro unit from the PC!
The **va3** folder (case sensitive) is automatically created on VA3_DISC.

The DSP board

The DSP board is the most important part of the instrument. The special chip carries out all necessary operations which are required for achieving 3 channel synchronous data measurement.

The DSP status LED is the right hand LED on the top right corner and allows the operator to monitor the DSP board. Several states can appear:
- Flashing green with 0.25 sec time interval (4Hz, four times per sec) - the measurement is running.
- Flashing green with 1 sec time interval - STANDBY, the measurement is not running.
- Red - the DSP board is not working properly.

The CPU status LED

The CPU board contains the CPU chip.

The CPU status LED is the left hand LED on the top right corner and allows the operator to monitor the CPU. If this LED blinks (like a heart beat) the CPU is working properly.

Virtual Analyzers Data Processing

Many analyzers take multiple readings step by step. This means that when the user wants to get for example acceleration overall, velocity overall, velocity time signal and velocity spectrum from one sensor, then the analyzers take the overall first, then the second overall with the integration, after that the time signal and finally the spectrum. The time which is required for all 4 readings is the sum of all 4 individual times.
The VA3Pro instrument includes high speed chips and it uses a much more advanced concept. There is one virtual analyzer created in the instrument memory for every individual reading. All virtual analyzers read the data from the input DSP board and perform the required data acquisition at the same time.
What does this mean? It means that the total required time is not equal to the sum of all individual times, but it is equal to the time required for the longest reading.

How to work with the menu and lists

Special buttons

The **F1**, **F2** and **F3** buttons are on the top of the keyboard. These buttons have various functions depending on the actual running process.
The description of their functions is displayed at the bottom of the screen, directly above them.

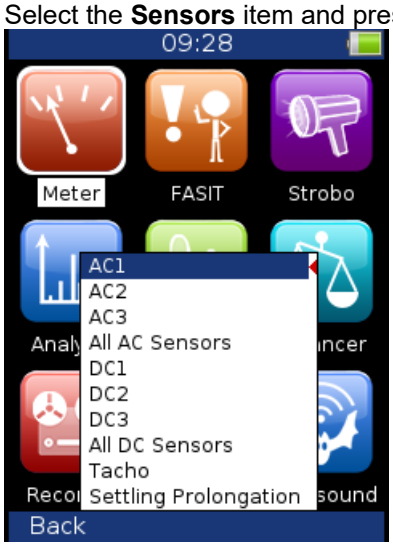
Example: F1 means Back and F3 means OK.

Item selection

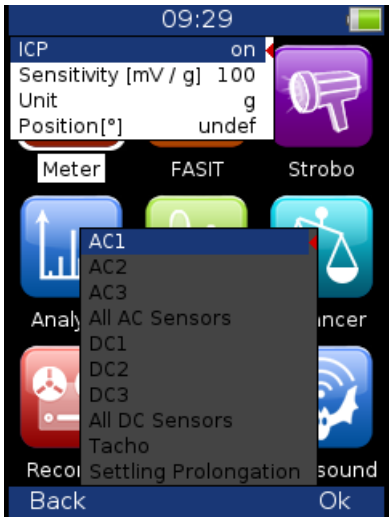
Before taking the readings you have to define several parameters. They can be set in the Menu Item. The operation procedure is the same for all menu items. We will describe it with an example - the sensor properties definition.

Press the **Menu** (**F2**) on the main screen.

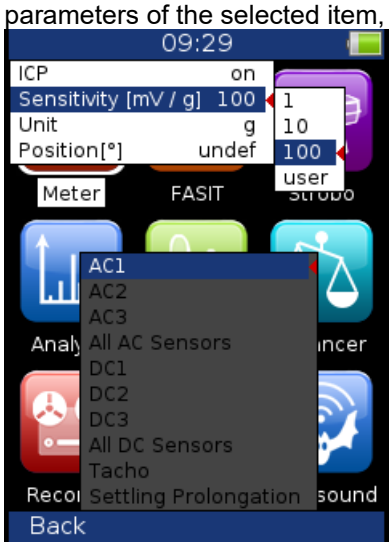
Select the **Sensors** item and press **OK**. The sensors properties menu appears.



Use the arrow buttons for the item selection. Then press the **OK** button. The second menu appears.



Use the arrow buttons for the item selection again. Then press the right arrow button to display possible parameters of the selected item, e.g. for Sensitivity.

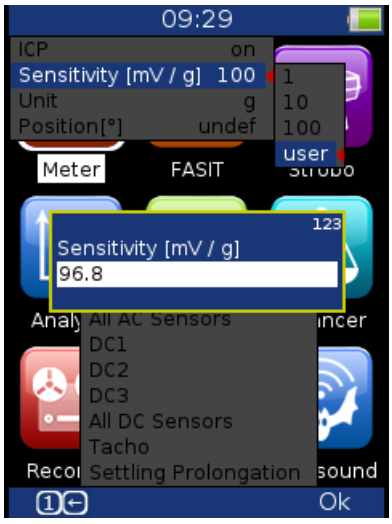


Use the arrow button for sensitivity selection (**1**,**10**,**100, user**).
Press **Ok** or right arrow to confirm.
Press **Back** (**F1**) or lefr arrow to escape.

User defined values

In most cases you would want to enter the **user** sensitivity according to the real sensor sensitivity of your sensor (e.g. 96,8 mV/g). Select the **user** and press **OK**. The next window appears and the buttons gets the numerical values entry functions.

Enter required value.



The **F1** button changes the mode of keyboard. Two modes are available. The numerical and edit modes. In edit mode you can use arrows to move in field and **Delete** (**9**) and **Backspace** (**7**).

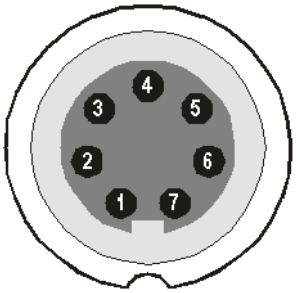
Lists

Key up	select upper item
Key down	select lower item
Key 1	page up
Key 3	page down

Input channels

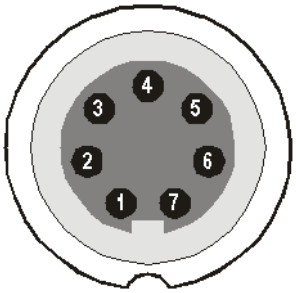
The inputs labeled IN1, IN2 are used for AC/DC signals. The input labeled TRIG is used for trigger signals, usually tacho (speed probe). All inputs have several pins. IN2 allows the user to connect a tri-axial sensor. The AC inputs allow the measurement of a maximum voltage peak of +/-12V. The DC inputs allow the measurement of a maximum voltage peak of +/-24V.

IN1 input



1 – CH1 AC/DC INPUT
2 – GROUND
3 – NOT USED
4 – SHIELDING
5 – NOT USED
6 – NOT USED
7 – +5 V DC OUTPUT (max 100 mA) for ultrasound sensor powering
Warning! Pin 7 of IN1 socket (ultrasound sensor powering) is internally connected with pin 4 of TRIG socket (tacho sensor powering).

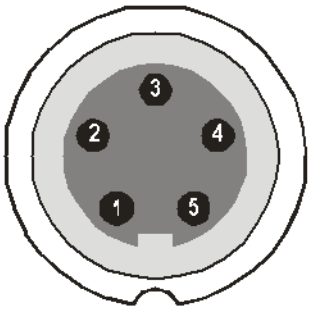
IN2 input



1 – CH2 AC/DC INPUT
2 – GROUND
3 – CH1 AC/DC INPUT
4 – SHIELDING
5 – CH3 AC/DC INPUT

6 – NOT USED
7 – NOT USED

TRIG input



1 – GROUND
2 – GROUND
3 – GROUND
4 – +5 V OUTPUT / 100mA for the tacho power supply
Warning! Pin 7 of IN1 socket (ultrasound sensor powering) is internally connected with pin 4 of TRIG socket (tacho sensor powering).
5 – TRIG INPUT - for tacho signal

Standard cable specifications

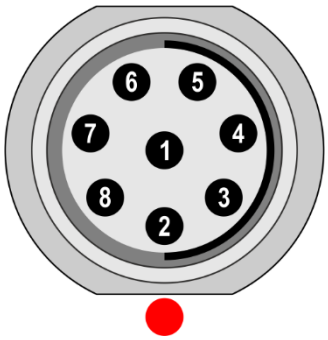
Sensor signal – pin number 1
Ground – pin number 2

When you use the standard cable:
In the IN1 socket - the signal is measured on CH1.
In the IN2 socket - the signal is measured on CH2.

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

Input channels (ODU variation)

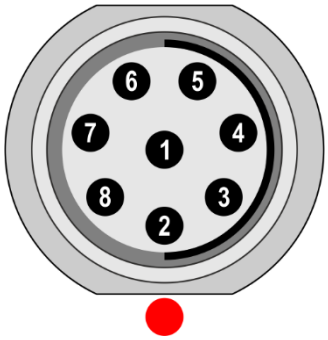
IN1 Socket



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

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

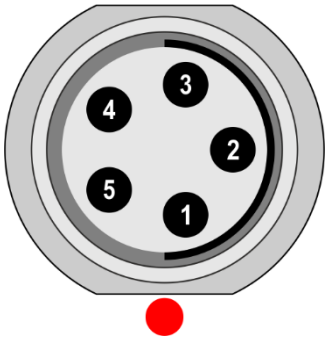
IN2 Socket



1 – NC or GND
2 – NC
3 – NC
4 – AC3 / DC3
5 – SHLD
6 – AC1 / DC1
7 – **GND**
8 – AC2 / DC2

Pay attention to possibility of connecting all three channels to **IN2**.

TRIG Socket

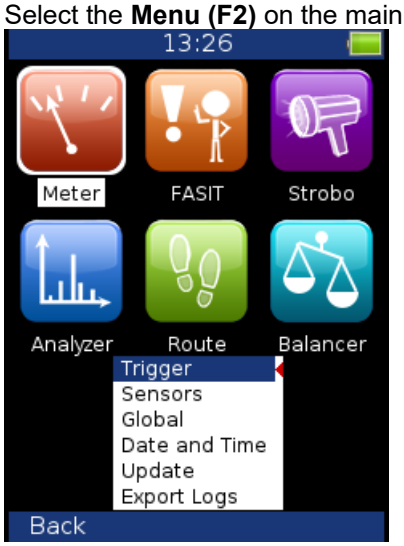


1 – TRIG
2 – +5V/0.1A
3 – SHLD
4 – GND
5 – GND

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

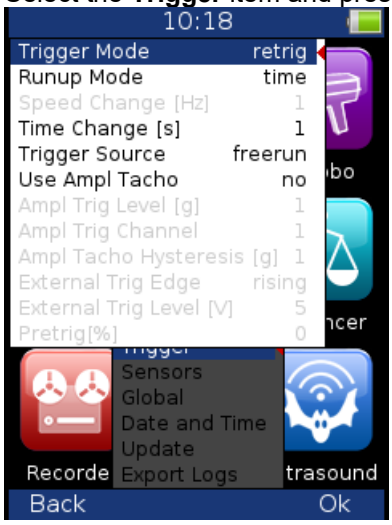
Main menu

Select the **Menu (F2)** on the main screen. The main menu appears.



Trigger

Select the **Trigger** item and press **OK**.



Trigger Mode

single Only one reading is taken and displayed.

retrig When you use the analogue oscilloscope, you always see the current signal on the screen. The retrig mode means a similar thing. The reading repeats until you press the **Stop** button. Select the **single** option when you only want one reading.

Runup Mode

Defines how often the data will be taken in the runup mode.

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

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** item, what it is significant change.

time All measurement are taken with the same time interval between them. The time interval length is defined in **Time Change**.

time or speed This option is the combination of speed and time. The next measurement is taken when one of them is changed more then the value **Speed change** or **Time Change**.

Speed change see **Runup Mode: speed** (the previous section).

Time change(s) see **Runup Mode: time** (the previous section)

Trigger Source:

freerun The measurement process begins immediately (after pressing the Start button - Analyzer mode).

external The measurement process begins, when the external signal (voltage level higher than defined in External Trig Level) appears on the trigger input. Such a signal may be generated when the machine starts to work, for example. This type of signal is usually created in the control system.

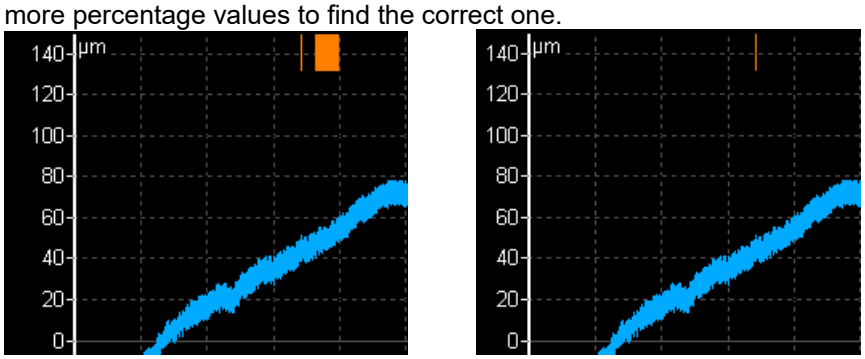
manual The measurement process begins after pressing the **Start** button and then the OK button. The first press (Start) is for preparation, the second (OK) is for triggering.

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

amplitude The measurement process begins when the signal level exceeds the **Ampl Trig Level**, which is also set by the user in this menu. Both positive (rising edge) and negative (falling edge) levels are accepted. E.g entering 5g will trigger on 5g. The signal amplitude is taken directly from the sensor input, no additional filtering is applied.
Examples:
the level is set to 100mV - triggered when the rising 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 a special type of **external** trigger. When we say tacho, we mean a signal (usually a TTL) which contains one pulse during one rotation of the shaft. It can also be understood as a series of single external pulses. The measurement process begins when the external signal (a voltage level higher than the **Tacho Trig Level** defined in tacho sensor) appears on the trigger input (the same as an **external** item). **Speed** measurement, time signal averaging, aps and order analysis are only enabled when the tacho is set.

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



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

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

Ampl Tacho Hysteresis see **Use Ampl Tacho**

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

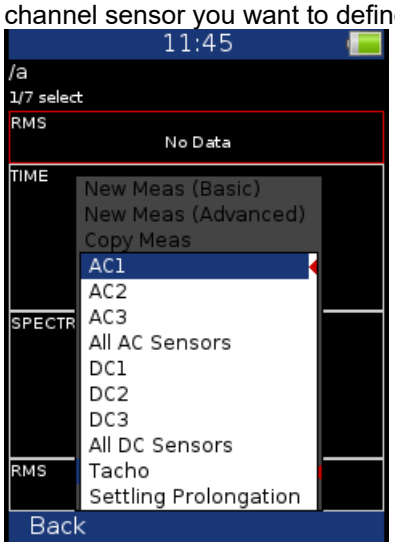
External Trig Level[V] See the description in **Trigger Source/ external**

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

Sensors

When you connect the sensors to the instrument, you have to specify what kind of sensors you are using. The Sensors button is displayed on most of the screens and once it is there, it is on the bottom.

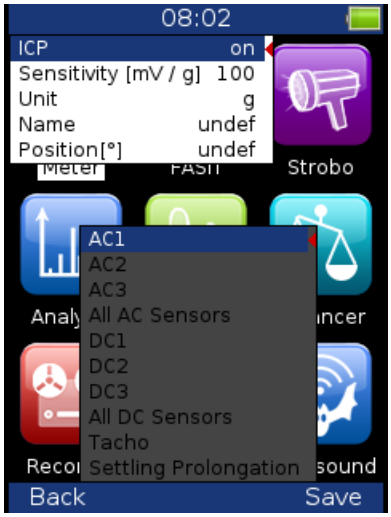
Push the **Menu** on the main screen and select **Sensors**. Push the **OK** button. In the next menu select the channel sensor you want to define.



AC1 – AC3 setting of each AC channel properties
All AC Sensors setting of all AC channels together
DC1 – DC3 setting of each DC channel properties
All DC sensors setting of all DC channels
Tacho setting of tacho channel properties
Settling Prolongation if you need longer time for sensor settling, use this item

AC sensors

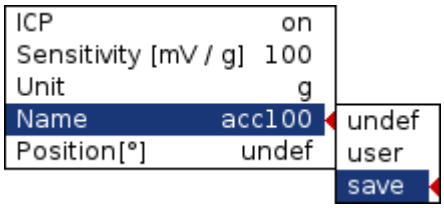
AC (alternate current) sensors are used for signals, e.g. vibrations.



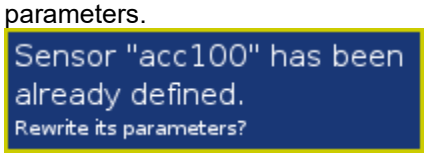
ICP **on, off** (selection of required setting accordingly to the sensor type)
Sensitivity[mV/unit] usually **1**,**10**,**100**, **user**
Unit the unit selected from the list or the user unit

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

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

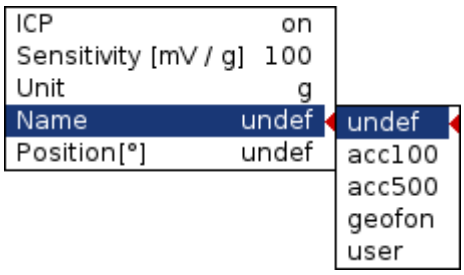


Note! If you want to save a sensor with a name which has been already defined you'll be asked to rewrite its parameters.

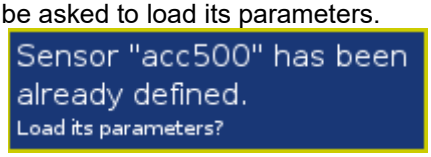


Loading sensors

Saved sensors are displayed on when you open the **Name** menu item. Select a name of a saved sensor and press OK. Then its parameters are loaded.

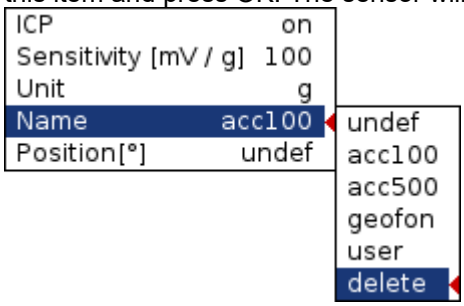


Note! If you choose "**user"** option and then enter a name which has been already saved (e.g. "acc500") you'll be asked to load its parameters.

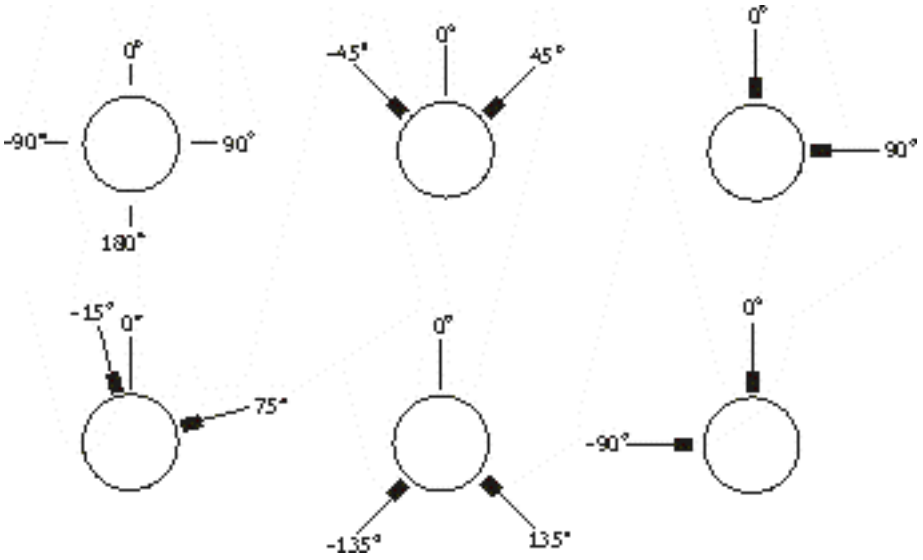


Deleting sensor

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



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



DC sensors

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

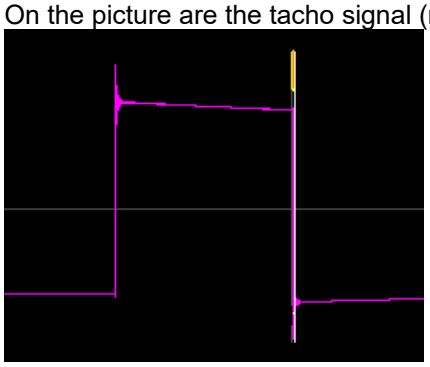
Sensitivity[mV/unit] sensitivity value
Offset[mV] offset value
Unit the unit selected from the list or the user unit
Name the name of sensor (see AC sensors for more details)
Position the angle of sensor (see picture above). Usually used for proximity sensors and **GAP** measurement.

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

Tacho

The speed is measured from the tacho channel. The signal contains one or more pulses per one rotation. The pulses can also trigger the measurement. The VA3 uses the falling edge of tacho signal for triggering.

On the picture are the tacho signal (magenta line), the trig level (grey line) and created tacho pulse (yellow line).



Tacho Trig Level [V] The tacho pulse is created on this level. We use the falling edge for that. This level must be between the minimum and maximum of tacho signal.
The signal from tacho generally occurs in two forms. It differs in signal change during reflection from reflective tape. Positive reflection means that the voltage increases during reflection. Negative reflection means that the voltage decreases during reflection.
Positive reflection example: 0V voltage increases to 5V during reflection.
Negative reflection example: 5V voltage decreases to 0V during reflection.
The A4300 – VA3 PRO instrument enables work with both types of reflection in -30V to +30V range. That means you can connect almost any kind of tacho sensor. You need to setup the Tacho Trig Level before measurement.
We have three possibilities how to setup the level.

The **factory** value 6V should work for most of tacho sensors. However when the factory value doesn't work, that is the instrument doesn't recognize tacho pulses and therefore the speed is not measured, you need to change the value.
Easy way is to use **detect** function for correct value setting.
Note! The tacho sensor must be connected and machine must be running, when you select the **detect** function.
A **Detecting level** window appears during detection.

The min, max of signal and also the new trig level value will be displayed after detection.

The instrument doesn't remember the min and max values. These values will not be displayed again after you close and reopen the tacho menu.
If the **Signal swing is too small** message is displayed, then the changes of tacho signal are too small for tacho pulse creation.
You can enter other value manually be selecting the **user** item. But to estimate functional value is not so simple. The value you need to enter is not a value directly from the sensor but after a signal processing in the tacho

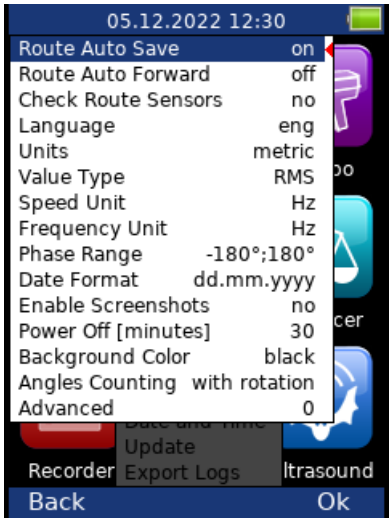
input, where a dc component of the tacho signal is removed and the signal is transformed to 0 - 10V range. The advice is to try 5V, 4.5, 5.5, 4.0, 6.0 3.5, 6.5 etc. so long until the triggering starts to work.

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

Min Speed The lowest speed, which the user is interested to measure with tacho. We suppose that there is one puls per one revolution. In other words, it means how long the instrument will wait for two tacho pulses (the speed is calculated from the time between two pulses). When the pulses are missing, then the NO SPEED error is displayed. When you choose 1Hz, then the waiting interval is 1 second. When you enter 0.1Hz, then you will wait 10 seconds. You should be aware of time prolongation of each measurement.
If the machine's speed is lower than **Min Speed**, then tacho trigger will not be used.

Global

The parameters which have effect on all or many functions are understood as Global parameters. Press the **Menu** on the main screen and select **Global**. Press the **OK** button.



Route Auto Save **off, <u>on</u>** automatically saves the data after reading is taken (in route mode)

Route Auto Forward **<u>off</u>, on**
The list of measurement points is automatically displayed after data saving and next measurement point is selected. The necessary condition is, that all measurements from last point are taken and correctly saved.

Check Route Sensors <u>yes</u>, no
Each point in the route contains the sensor setting, which is defined in DDS. The instrument contains also the sensors setting (**Sensors** button). Both settings are compared for each point during the route readings. When the sensor setting in point is not equal the sensor setting in instrument, then the **Used sensor** window appears. It is the warning to the user.

The user should connect the correct sensor to the unit with the parameters displayed in window. Confirm by pressing **Ok**. The setting in **Sensors** will be rewritten by point setting in route. You can make changes in setting now using the **Sensors** button.
The sensor can have defined a name (e.g.ACC100). It should help the user in field to use correct sensor. These names are checked in instrument. When the names are not the same, then the **Used Sensor** window appears. No checking of other parameters is done.

Language **ENG**, **CZE**

Units **<u>metric</u>, imperial**

Value Type **RMS, 0-P, P-P**

Default value type for spectral amplitude values. E.g. spectral graph in analyzer module uses this type of amplitude but you can enter another value for particular graph in its **Graph Properties** menu.

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

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

Phase Range **-180,180**
0, 360

Date Format **yyyy/mm/dd**
dd.mm.yy
mm/dd/yyyy

Enable screenshots **yes, no**

the screenshot menu items will appear in menus

Power off [minutes]

time period for switching off

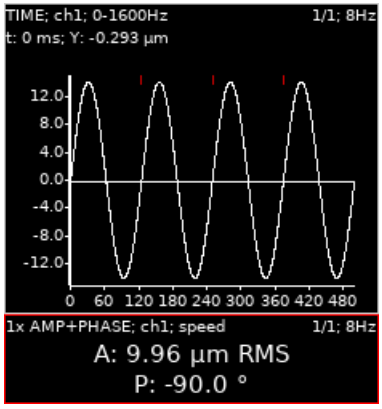
Backgroud Color **black/white**

background color of graphs

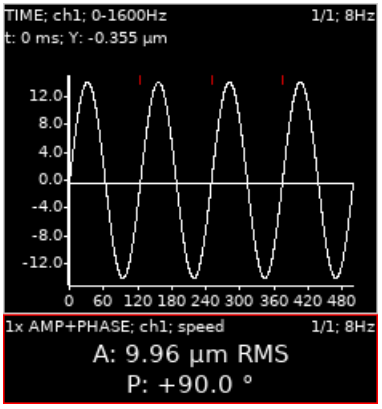
Angles Counting **with rotation, against rotation**

You can define the direction of angles (phases).

With rotation:



Against Rotation:

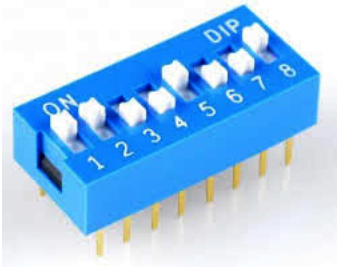


On the pictures above, you can see the time waveform with tacho marks. The tacho mark comes 90° before the maximum of the signal in the direction of rotation. If we choose the **with rotation**, then we say the tacho mark is 90° before the signal maximum and thus the angle (phase) is **-90°**.
In case of **against rotation**, we say the signal maximum is 90° behind the tacho and the angle is **+90°**.
The main use of this parameter is in balancing. Some users are used to count angles with rotation and other users want to count against rotation. The VA5 enables to set your required direction.

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

Advanced

The value of **Advanced** contains several various parameters itself. Every of them has only two available values **ON** and **OFF**. It is the same as the DIP switch in electronics.



Each individual switch is like the bit in computers. The bit also can have only two values, 1 (ON) and 0 (OFF). If we have eight bits (switches) then we can write them as the series of 0 and 1.

1 0 0 1 0 1 0 0

If we are talking about eights bits, then we call it the byte. Computers use it in the same way.

People use the decimal system for counting. For example if have the number 8567, we look at this number as

8567 = 8 x 1000 + 5 x 100 + 6 x 10 + 7 x 1

We can express it in better math formula

$8567 = 8 \times 10^3 + 5 \times 10^2 + 6 \times 10^1 + 7 \times 10^0$

The number 10 is the base of decimal system. But also other values can be used for that. The computer uses number 2 and the binary system. It has the advantage, because every bit has only two possible values 0 and 1. In decimal system each bit should have to have 10 values.

If we use 8 bits in binary system, then value of byte (all 8 bits) is

$b1 \times 2^0 + b2 \times 2^1 + b3 \times 2^2 + b4 \times 2^3 + b5 \times 2^4 + b6 \times 2^5 + b7 \times 2^6 + b8 \times 2^7$

If we express it with decimal numbers, then it is

b1 x 1 + b2 x 2 + b3 x 4 + b4 x 8 + b5 x 16 + b6 x 32 + b7 x 64 + b8 x 128

If all bits are equal 0, then result is equal 0. If all bits are equal 1, then result is equal 255.

The calculation for 8 bits (any combination of 0 and 1) we can write in next form

1 0 0 1 0 1 0 0
x x x x x x x x
1 2 4 8 16 32 64 128
" " " " " " " "

1 + 0 + 0 + 8 + 0 + 32 + 0 + 0 = 41.

The result value 41 is expressed as one number and contains uniquely information about values off all bits.

Bit description

The instrument does not use all 8 bits yet.

b1 Do not display the window with question **"Save data?"**

The default value is 0. When you close the set of measurements or before the new measurement, the instrument asks you **Save data?**. Many users save data when they need it and this warning question is useless. If you set the B1 to 1, then this question will not be used.

b2 To cancel the measurement of point after the entering of manual values

The manually entered values are required before the measurements with sensor. If the b2=1, the new window appers after manual values entering. It asks **Continue measuring?** and you can or cannot continue to measure with sensor. Default state is b2=0 and the measurement with sensor is always done.

Date and Time

Define the date and time.

Update

The list of update files appears (files, which were saved to VA3). Select required version and press OK (F3).

Export Logs

It is the tool for firmware development. You can create the log file, which is saved in **VA3_DISC/va3/logs**.

Screenshot

Only if enabled on Global. The screenshot image will be saved to disc - **VA3_DISC/va3/screenshots.**

Update of the firmware

Download the latest firmware from www.adash.com / Downloads / Adash software / A4300-VA3 Pro

Firmware update instructions:
- Download the firmware (e.g. A4300_ver0108.up) from above website and save it to your computer.
- Connect the VA3 Pro instrument to the computer via USB cable.
- Copy the firmware from the computer to the **VA3_DISC /va3/ updates**.
  (Newer devices appears on PC as e.g. VA3_626754. Depends on the serial number of the device.)
- Use **Safely remove hardware** function and disconnect the instrument from the computer.
- Switch-on the instrument and press **Menu** on the main screen.
- Select the **Update** item and press **OK**.
- Select the required firmware file from the list (more version files can be saved in the instrument). Press **OK**.
- The list of commands appears.
- The instrument is switched off.
- Switch the instrument on again.

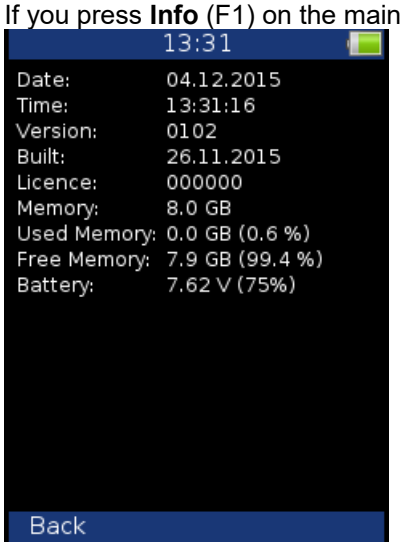
Update of the new measurement mode(s)

Once you will purchase additional measurement mode you will receive unique license file according to the serial number of your VA3 Pro instrument. The license file contains the information which measurement modes are included in particular VA3 Pro instrument.

License update instructions:
- VA3 Pro instrument has to be switched off. Connect it with PC via USB cable.
- Copy the license file (license file has **.a43** extension) into **VA3_DISC** to **va3** folder.
  (Newer devices appears on PC as e.g. VA3_626754. Depends on the serial number of the device.)
- Disconnect the VA3 Pro from PC (always use safely remove feature to avoid failure).
- Switch on the device

Info

If you press **Info** (F1) on the main screen, the system information will be displayed.



The Main screen

After switching the instrument on the Main screen appears. You can select required mode of the unit.

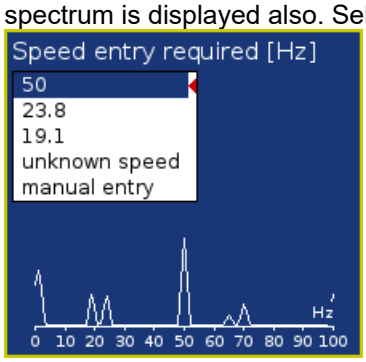
Speed detection

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

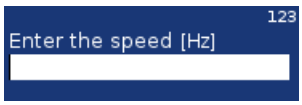
Detection is done just before the measurement itself after pressing the Start button. During the detection there is information displayed in top right corner.

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

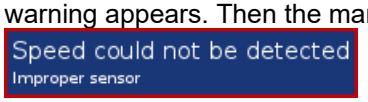
The highest peaks are found and displayed in the list. The highest amplitude speed is on the top of list. The spectrum is displayed also. Select the correct value and press **OK**.



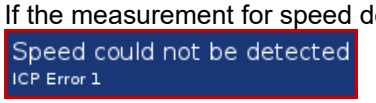
If you want to leave the speed undefined, then select **unknown speed**.
If no value in the list is correct, then select **manual entry** and enter the speed manually.



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



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



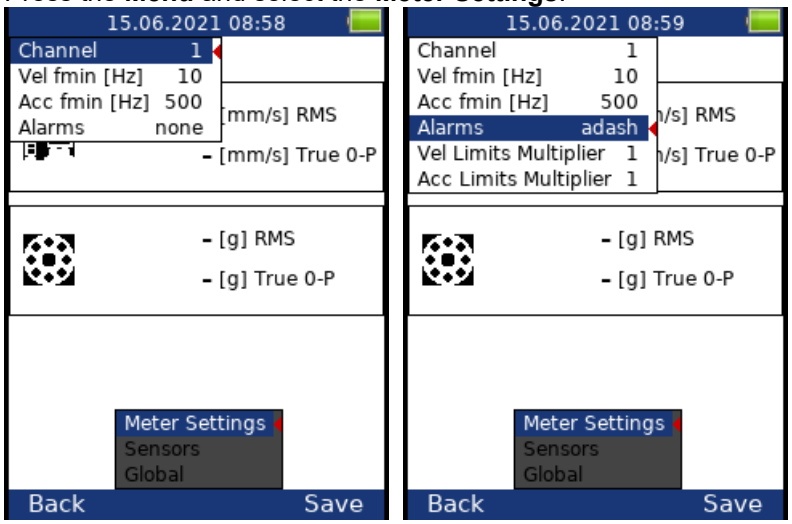
If the speed value is detected, it is automatically saved to the data header for following measurement in the same way as the speed value measured by tacho probe. If the speed is measured by tacho probe simultaneously, the value from the tacho probe has priority when saving.

Meter

It enables the user to perform basic vibrodiagnostics measurements.

Meter Settings

Press the **Menu** and select the **Meter Settings**.



Channel:

Number of the input channel
The channel can be switched also outside the settings dialog using up and down arrows.

Vel fmin [Hz]:

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

Acc fmin [Hz]:

By default, the acceleration measurement is taken in 500 – 25600 Hz range to detect bearing faults. Using the *Acc fmin* you can change the minimum frequency of the filter. E.g., in some cases, there may be vibrations above 500 Hz which are not caused by bearing faults and you know it. Then, you can set the *Acc fmin* value to 5000 Hz to filter these vibrations out.

Alarms:

Settings of standards which define the limit values for warning (yellow color) and danger (red color); see Appendix B: Standards for vibration measurements. When any alarms selected the measured values on first screen are displayed in traffic light colors.
adash: Adash Limit Values, Speed detection needed.
R13, F13, R24, F24: ISO 10816 limit values according to ISO 10-816, R means rigid, F means flexible, the number means machine group according to ISO 10816 standard.
none: no traffic-light colors used

Additional options are available when Alarms are set as **adash**:

Vel Limits Multiplier:

The Adash factory Machine Limits may be too much or too little for some machines. Therefore, for velocity measurements, you can adjust them using the *Vel Limits Multiplier*. Values greater than one increase the limits values (thus the alarm is less strict) and values less than one decrease them (alarm is stricter). A value of one means the limit remains as shown in the machine limits graph.

Acc Limits Multiplier:

Same as Vel Limits Multiplier but used for Adash Bearing Limits.

Note! The Meter Settings are connected with the FASIT Settings. Thus, the values of parameters set in this menu are also used in the FASIT module. One exception is the Alarms parameter, which is not used in the FASIT settings because FASIT only uses Adash alarms.

Sensors Settings

In the **Sensors** menu set up parameters for all channels you want to measure. All channels which have defined vibration sensor are measured together. Switch displayed channel by pressing up or down arrow.
You need to use the accelerometer to display all possible measurements. If you use a velocity sensor, the acceleration values will not be measured. If you use a proximity sensor, the acceleration values and velocity values will not be measured.

Unit Settings

The displayed units can be set up under the **Global** item. Set up the unit of speed (Hz, RPM, CPS, CPM) in the **Speed Unit** item. The vibration values are displayed according to the setting of **Units** (metric, imperial). The temperature can be displayed in degrees of Celsius or Fahrenheit.
The units used are set up in **Global/Units** as follows:

metric:

acceleration - g
velocity - mm/s
displacement - µm

imperial:

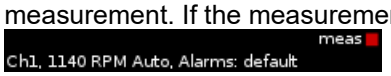
acceleration - g,
velocity – in/s
displacement – mil

Measurement

Press **Start** to initiate the measurement. The speed detection runs first (see chapter **Speed Detection**).

Status bar

There is a Status bar at the top part of the display. It provides information about the settings and status of the measurement. If the measurement is running there is a red icon labeled **meas** flashing in the top right corner.



Ch1:

The number of the channel being shown

1140 RPM Auto:

the value and unit of speed and the method of speed detection
Auto: the speed is detected from the frequency spectrum
Manual: the speed is entered manually by the user
Tacho: the speed is detected by the tacho

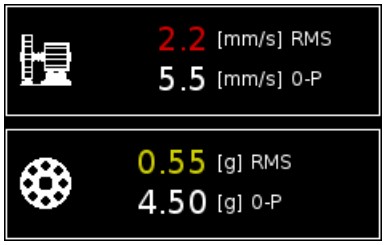
Alarms:

The standards used for stating the limit values

Measurement screens

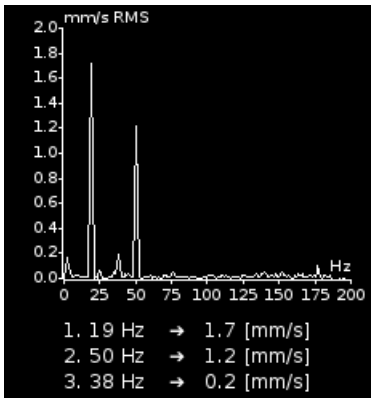
You can switch between the measurement screens with the left and right arrow buttons.

Overall (RMS) and Peak (0-P) values



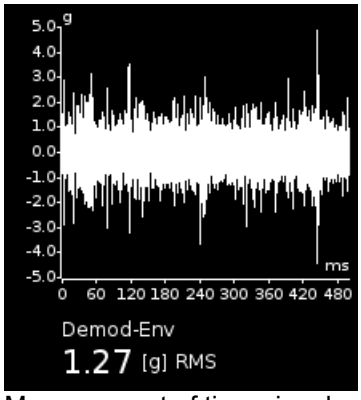
Measurement of Overall and Peak value in the following frequency bands:
velocity: 10 Hz - 1000 Hz
acceleration: 0.5 kHz – 25.6 kHz
The colour describing the condition of the machine (green, yellow, red) is determined according to the speed value and vibration value (RMS, Peak).

Spectrum up to 200Hz – mechanical looseness detection



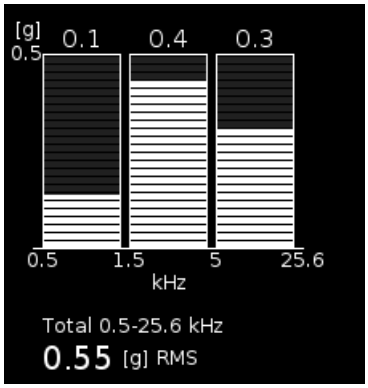
FFT analysis of vibrations in the range 2 Hz - 200 Hz in mm/s RMS
The 3 maximum peaks found are displayed
The peaks are arranged according to the vibration amplitude.

Time signal for roller bearing diagnosis



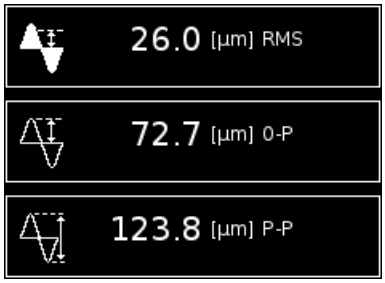
Measurement of time signal and vibrations in the range:
0.5 kHz – 25.6 kHz in g.
The screen shows the actual measured time signal and the Demod - g_{ENV} value.

Vibration in frequency ranges - gearboxes/ bearings



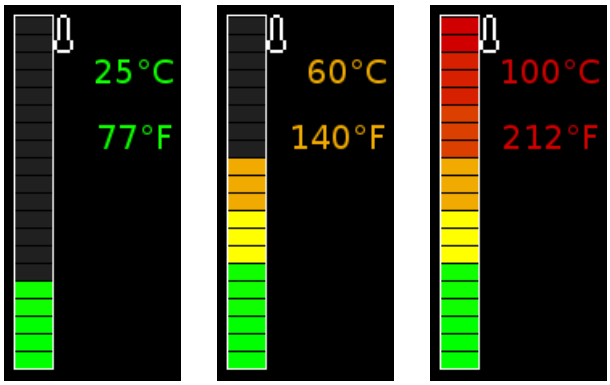
Measurement of RMS vibration values in the ranges:
0.5 kHz - 1.5 kHz in g,
1.5 kHz - 5 kHz in g,
5 kHz – 25.6 kHz in g.
It also displays the Overall RMS [g] value in the range 0.5 kHz – 25.6 kHz

Displacement values



The values of displacement in the range 2-100 Hz are displayed.

Temperature



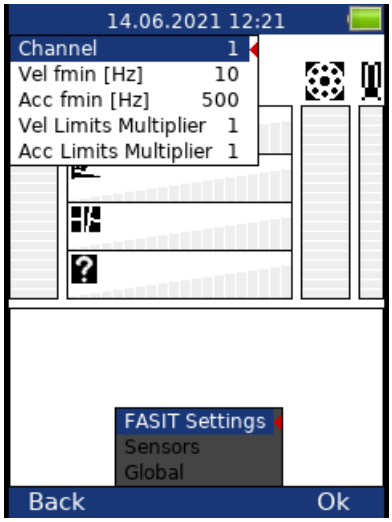
The measured temperature is displayed in degrees Celsius and degrees Fahrenheit. The values are coloured according to the measured temperature.
The ranges of colours are as follows: less than 30°C - green, 30-45°C - yellow, 45-60°C - orange, 60-75°C – red, more than 75°C – dark red.

FASIT

The FASIT means the **FA**ult **S**ource **I**dentification **T**ool. This mode should help beginners to determine the machine condition and bearing faults.

FASIT Settings

Press **Menu** and select **FASIT Settings**.



Note! The FASIT Settings are connected with the Meter Settings. Thus, the values of all parameters in this menu are remembered when you switch to the Meter module and select Alarms = Adash.

Channel:

The number of the input channel
The channel can be switched also outside the settings dialog using up and down arrows.

Vel fmin [Hz]:

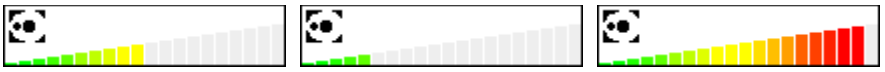
By default, the velocity measurement is taken in 10 – 1000 Hz range to detect the overall machine condition. This range is not convenient for low-speed machines (bellow 10 Hz = 600 RPM). Therefore, you can setup lower value of fmin.

Acc fmin [Hz]:

By default, the acceleration measurement is taken in 500 – 25600 Hz range to detect bearing faults. Using the *Acc fmin* you can change the minimum frequency of the filter. E.g., in some cases, there may be vibrations above 500 Hz which are not caused by bearing faults and you know it. Then, you can set the *Acc fmin* value to 5000 Hz to filter these vibrations out.

Vel Limits Multiplier:

FASIT uses Adash Limit Values, according to which alarms are displayed. The factory Adash Machine Limits may be too or too little strict for some machines. Therefore, for velocity measurements, you can adjust them using the *Vel Limits Multiplier*. Values greater than one increase the limits values and values less than one decrease them. A value of one means the limit remains as shown in the machine limits graph.
On following figures, you can see the effect of the multiplier. The first machine condition bar shows an alarm when the multiplier is set to 1. The second bar shows the same measurement, however the multiplier is set to 2, which means the limit value is twice as high as before. This means that FASIT is less strict and the alarm level is twice lower. The third case shows the situation with the multiplier set to 0.5.



Acc Limits Multiplier:

Same as Vel Limits Multiplier but used for Bearing Limits.

Sensors Settings

In the **Sensors** menu set up parameters for all channels you want to measure. All channels which have defined vibration sensor are measured together. Switch displayed channel by pressing up or down arrow.
FASIT uses the measurement of acceleration or velocity from one channel. If you will use a velocity sensor, the bearing condition is not detected. For bearing condition detection the acceleration measurement is necessary.

Units

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

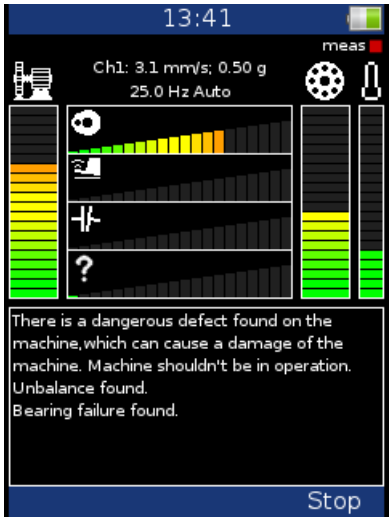
metric:
acceleration - g
velocity - mm/s

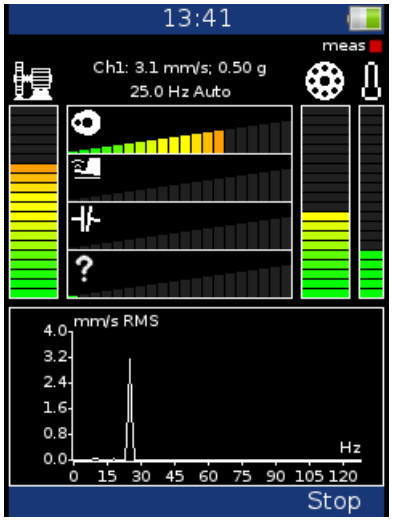
imperial:
acceleration - g,
velocity – in/s

Measurement

Press **Start** to initiate the measurement. The speed detection runs first (see chapter **Speed Detection**).

FASIT screen





The running measurement is indicated by a flashing red icon labeled **meas** in the top right corner.

Information about the measurement status and settings is displayed at the top of the screen: the number of the input channel shown, the overall RMS velocity and acceleration value, the speed value and the method of speed detection.

Auto: the speed is detected from the frequency spectrum
Manual: the speed is entered manually by user
Tacho: the speed is detected by the tacho

FASIT displays several graphs and the traffic light colours are used. Two main graphs show overall machine condition (left vertical bar) and bearing condition (right vertical bar). Next to the bearing condition bar there is a bar showing the temperature measurement. The range of the temperature bar is 100°C (212°F).

The bars show the severity of the following faults:

Overall machine condition, see *Appendix C: Standards for vibration measurements*

Overall bearing condition, see *Appendix C: Standards for vibration measurements*

Severity of unbalance fault

 Severity of mechanical looseness

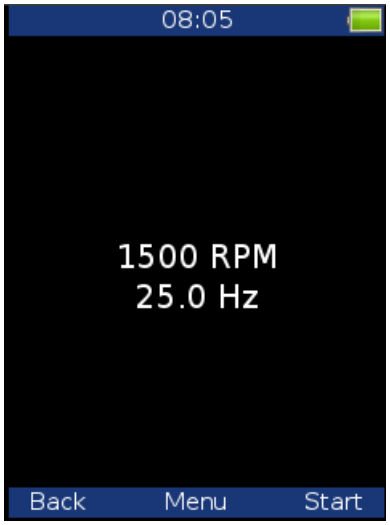
 Severity of misalignment

 The severity level of a different type of a fault.

The text message (e.g. Machine is in good condition) or the graph of the velocity spectrum is displayed at the bottom part of the screen. To switch between them press the Shift button or left/right arrow button.

Strobo

You can use the instrument as a stroboscope in this mode. White LEDs on the top panel start to flash regularly with the frequency set up on the screen. When we have to study or to visually inspect machinery which has cyclically moving parts, then the stroboscope enables us to visually slow down or freeze this movement (rotation, cyclic movement, oscillation and vibrations).
Imagine a rotating disc with one hole. When the flashes of light are synchronized with the disc rotation speed, then there is just one flash made during one rotation. It means that the disc is lit up when the hole is always in the same position. It is the principle of the illusion of frozen movement.



Press the **Menu** and select **Strobo Settings**. Define whether the tacho will be used or the user will select the frequency.

If the user frequency is selected then
- use the right/left arrow for changing the frequency in Hz,
- use the up/down arrow for changing the frequency in RPM.
- use the F1/F2 button for divide/multiply frequency by 2

Easy access

The **Strobo** mode could be ran from anywhere. You don't need to be on the main screen. Turn the light on (press key **7**). When the light is on, press **3** button. The **Strobo** mode opens.
Warning! The **Strobo** mode cannot be opened during measurement.

Analyzer

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

The Meas

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

The Graph

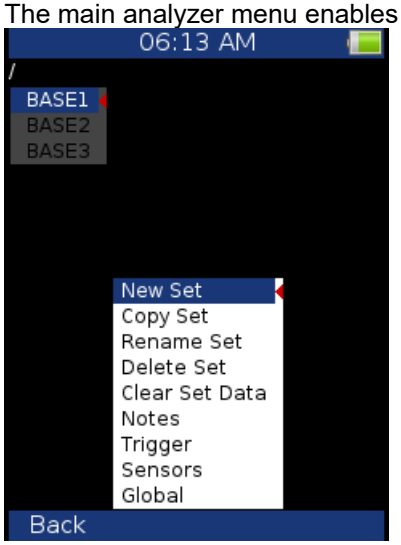
The graphical form of the reading displayed on the screen is called the **Graph** (overall value, time signal, spectrum, orbit, order analysis). One Graph works with data from one reading. You should keep in mind that one overall value is also the Graph.

The Set

The **Set** is the most important term in the Analyzer mode. The **Set** is the set (group) of one or more readings, which the user wants to take and display together. E.g. you want to take 4 readings together - overall acceleration, overall velocity, velocity time waveform and velocity spectrum. You prepare the **Set**, which includes these 4 required readings. The definition of Set is saved in the Analyzer memory. You can save many various Sets, which can contain your often used sets of readings. Then you select one Set and run it. The taking off all readings included in the set is made simultaneously. See also **Virtual Analyzers** section for better understanding.

Analyzer menu

The first Analyzer screen contains the list of Sets saved in the memory (e.g.BASE1, BASE2, BASE3) or the empty list, when no Sets were created.
The main analyzer menu enables to handle with sets.



New Set

Select the **New Set** and press **OK**. Enter the name and confirm by pressing **OK**. Use the **Shift** (F1) to change the keyboard function (abc, ABC, 123, <->). The last choice <-> enables to move in text by arrows and to delete characters (buttons 7 and 9). Press the Cancel button to cancel the New Set procedure (when the option <-> is on, otherwise the Cancel button is not available). When you do not enter the name of set and press OK, the procedure is cancelled as well.

Copy Set

Enables to copy the set to the new set.

Rename Set

Enables to rename the set.

Delete Set

Enables to delete the set.

Clear Set Data

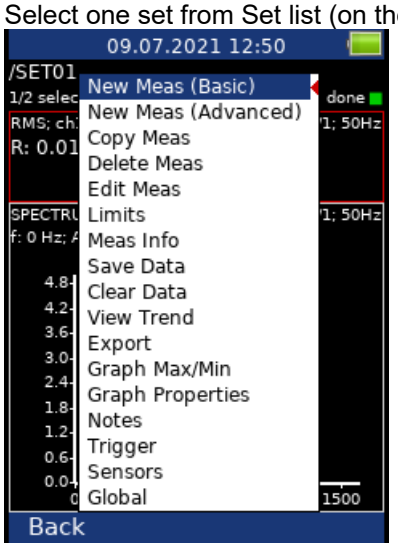
Deletes all readings saved in the Set.

Notes

See the Route chapter for details

Readings (Measurements)

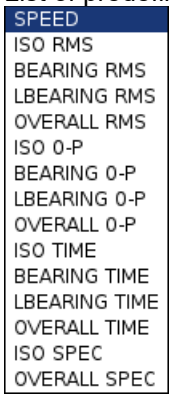
Select one set from Set list (on the Analyzer main screen) and press **OK**. Press the **Menu** button (F2).



New Meas

New Meas (Basic)

List of predefined templates appears. You can select one of them.



Note! You can modify the basic measurements list in *Virtual Unit* application (see more about Virtual Unit in VA5 / Virtual Unit manual). The modified list can be transferred into VA3 if you copy the *meas_template* file from the *data\VA4template* directory in Virtual Unit's working directory (by default *C:\ProgramData\Virtual Unit*) into *va3* directory on VA3 flash drive. Then, after starting the instrument, the file is automatically imported and the modified basic measurement list is applied. If you want to reset the basic measurement list into factory state, just place an empty *meas_templates* file into the same location. Then after starting the instrument, the basic measurements list will be restored.

New Meas (Advanced)

The menu for definition of reading appears. The content of the menu changes according to the measurement **Type** selection (first row).

Channel, A channel number, B channel number **1**, .., **3** Selection of the input signal source channel

Unit (name) The selection of the required unit to be displayed.

Detect Type **RMS**, **Scaled 0-P, Scaled P-P, True 0-P, True P-P, AVG, Crest, Kurtosis**
The detected value property (P means Peak).
Scaled 0-P it is equal 1.414 * RMS
True 0-P it is true 0-peak value in the waveform (the highest value captured in time signal).
Scaled P-P it is equal 2.828 * RMS
True P-P it is true peak-peak value in the waveform (the difference between highest positive and highest negative value in signal)
AVG it is average value of all samples (total sum of absolute values divided by number of samples)
Crest it is equal True 0-P/ RMS
Kurtosis standard statistical formula for Kurtosis

FFT Window **Rectangular**, **Hanning**, **Transient**, **Exponential, Flat top** The standard offer of FFT windows functions. If you use the Transient or Exponential window, additional items for **Shift** and **Length** will appear.

Fmin [Hz] (value) The low cut-off frequency of band pass filter, which is applied to the signal before further processing (evaluation). The **none** value (available only when no integration is applied) means, that only input DSP filter is applied (approximately 0.6 Hz).

Fmax [Hz]
It is the high cut-off frequency of band pass filter, which is applied to the signal before evaluation (removes high frequencies). Under this item is also displayed the information about sampling frequency (*fs*), which will be applied for evaluation.

The sampling frequency of input signal is derived from the required fmax so that the sampling theorem is satisfied:

$$fs > 2 * fmax$$

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

Warning! Maximum value of 90 kHz (fs = 196608 Hz) is available only for one channel.

DEMOD fmin [Hz] (value) The low cut-off frequency of band pass filter, which is applied to the signal (removing low frequencies).

DEMOD fmax [Hz] (value) The high cut-off frequency of band pass filter, which is applied to the signal (removing high frequencies).

See details about sampling frequency in Band fmax chapter.

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

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)

Averaging **linear**, **peak hold, time synchro** (for spectrum)
linear, **maximum, minimum, median** (for static values)
Time synchro averaging works in this way: the time signals are averaged (must be controlled by tacho in most cases) and from averaged time waveform is calculated the final spectrum. It can be set for non-enveloped and non-zoomed spectra.

Avg (value) averaging number
How the averaging is used depends on the type of trigger:
freerun when the measurement is started, the signal needed for averaging is taken continuously
external when the external trigger comes, the signal needed for averaging is taken continuously without waiting for next trigger
tacho every signal for averaging is triggered (constant phase)
amplitude every signal for averaging is triggered (constant phase)
manual first signal for averaging is triggered manually, next signals are taken freerun
manual sequential every signal for averaging is triggered (constant phase)

Overlap (% value) Overlapping of signals in averaging.

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

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

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

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

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

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

Next Meas functions

Copy Meas

Copies the selected measurement to the new one.

Edit Meas

Enables changes in measurement properties.

Meas info

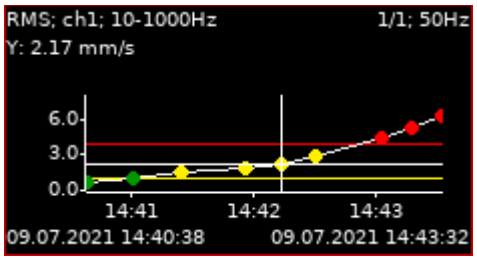
Displays measurement properties

Delete Meas

Deletes selected measurement.

Limits

You can define limit values for static measurement types (overall, speed, dc, …). Limits give a notice to you when a measured value is over some critical value. During the measurement and also during examining the measured values, the appropriate alarm is displayed in graph of measurement with defined limits. The alarm informs you about the severity of the measured value.
Each ***limit value*** divides a numerical axis into two intervals, numbers bellow the limit value and numbers above it. You can edit the ***alarm*** for each interval. Alarm represents the severity or color for the values measured in the interval. You can choose one from four severities for the alarm, ***Ok*** signaled with green color, ***Warning*** signaled with yellow color, ***Alert*** signaled with orange color and ***Danger*** signaled with red color. It's up to you what severity you assign to which interval. The particular alarm is displayed when the measured value is in appropriate interval. You can define more than one limit values and divide the numerical axis into more intervals.
In the example bellow, we have defined two limit values, 1 and 4 mm/s. We have defined the alarm bellow 1 mm/s as *Ok* (green color), the alarm between 1 and 4 mm/s as *Warning* (yellow color) and the alarm above 4 mm/s as *Danger* (red color). In the first picture, you can see an actual measured value 2.61 mm/s which is greater than 1 and less than 4 (displayed as ***> 1, < 4 mm/s*** on the right side) and thus signaled as yellow color. The second picture shows a trend of values. You can see two limit lines in the trend, a yellow line on 1 mm/s and a red line on 4 mm/s. They represent the defined limit values and their colors correspond the alarms above the limit. Each value in the trend is drawn as a small colored circle whose color corresponds the alarm.

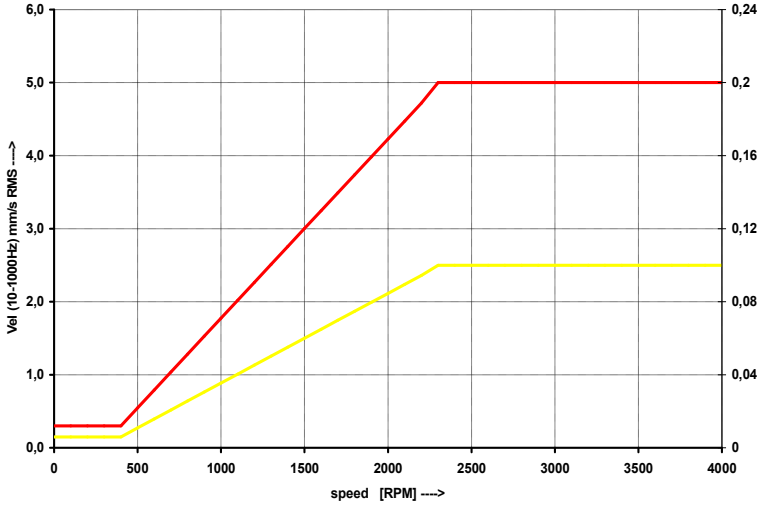


There are 3 ways how to create limits.

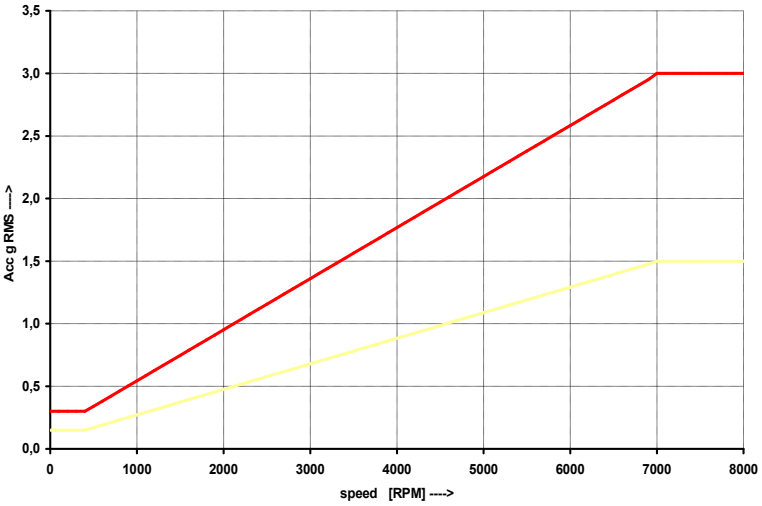
Adash Limits

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

- velocity readings in frequency interval 10-1000Hz, which is very well suited for detecting the overall condition of the machine
  Note! fmin lower than 10 Hz is also accepted , it means Adash limits can be also used for velocity measurements with fmin lower than 10 Hz.



- acceleration readings in frequency interval 500 - 16 000 Hz, which is very well suited for detecting the bearing condition
  Note! fmin lower than 500 Hz and fmax higher than 16000 are also accepted, it means Adash limits can be also used for acceleration measurements with fmin lower than 500 Hz and fmax higher than 16000 Hz



These limit values may be too or too little strict for some machines. Therefore, you can adjust them using the Limits Multiplier. Values greater than one increase the limits values and values less than one decrease them. A value of one means the limit remains as shown in the graphs above.
On following figures, you can see the effect of the multiplier. The first graph shows an alarm when the multiplier is set to 1. The second graph shows the same measurement, however this time the multiplier is set to 2, which means the limit value is twice as high as before. This means the limit is less strict and the alarm level is twice lower. The third case shows the situation with the multiplier set to 0.5.

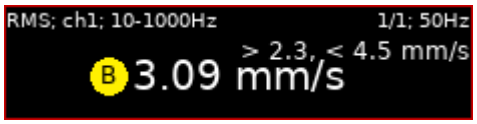
Note! For Adash limits, only the small colored circles are used in trends, the limit lines are not displayed. It is because of the relation to speed. Each reading can have different speed and therefore different limits.

ISO 10816

The limits are defined according the ISO 10816 standard and are available only for velocity readings in frequency interval 10 – 1000 Hz. The Machine Group and Machine Foundation has to be defined according to the ISO 10816 standard.

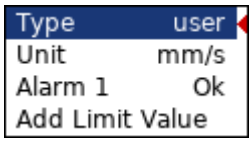
- **Group1**: Large machines (rated power above 300kW) with a shaft height greater than 315 mm.
- **Group2**: Medium-sized machines (rated power from 15 kW to 300 kW) and electrical machines with a shaft height between 160 and 315 mm.
- **Group3**: Pumps with multivane impeller and with separate driver with rated power above 15 kW.
- **Group4**: Pumps with multivane impeller and with integrated driver with rated power above 15 kW.

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

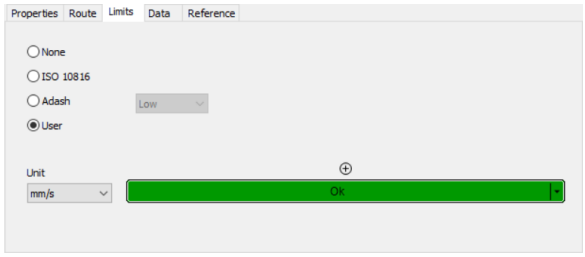


user

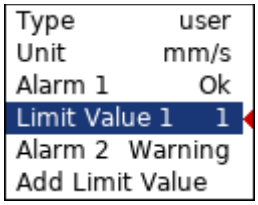
User can define your own limits.



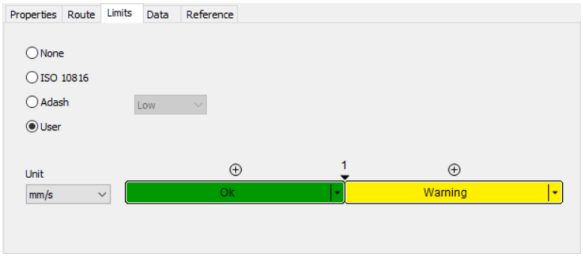
By default, there is no limit value defined yet and the Alarm is set to *Ok* for all measured values. It is same as in DDS dialog for limits.



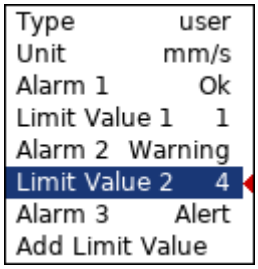
You can add a limit value using an ***Add Limit Value*** item and enter the value (eg. 1).

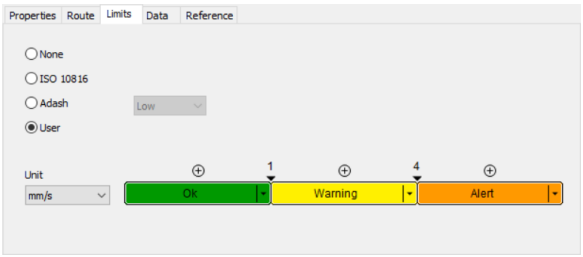


Now you have defined one limit value (1 mm/s) which divides a numerical axis into two intervals (bellow 1 mm/s and above it). You can define alarm for each interval. Alarm 1 defines the alarm bellow the Limit Value 1 and Alarm 2 defines the alarm above the Limit Value 1. The same think can be done in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

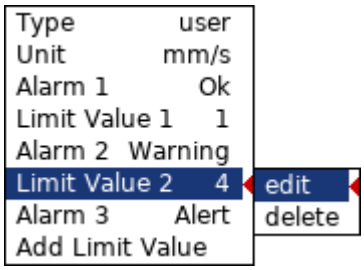


Same way you can add any number of limit values.

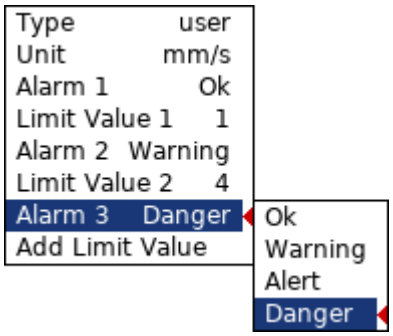


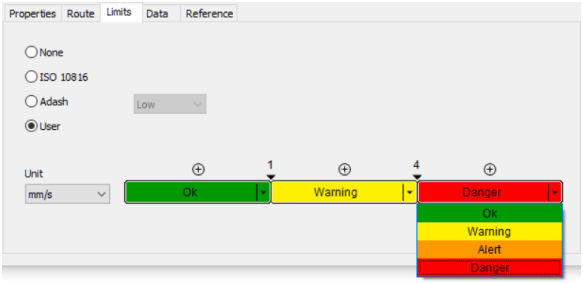


Limit values can be also edited or deleted using an appropriate ***Limit Value*** item.

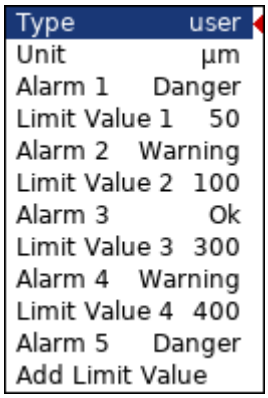


Alarms are defined using an appropriate ***Alarm*** item.





Note! You can assign alarms in any order. It's not required the Ok alarm to be the lowest. Eg., for displacement measurements, there is often the Ok alarm in the middle and Warning and Alert alarms are assigned to lower and higher intervals.



Functions for Set

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

Save data

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

Clear data

Deletes all saved data from the set.

View Trend/ View Actual

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

Clear Last Data (if the trend is displayed)

deletes last measured data in measurement point or set (according of displayed data).

Export

The next menu appears.

Export to csv

Export to csv saves one selected measurement in csv format (not available for all types)
Export to csv (all) saves all measurements in set in csv format (except types, where are csv not available)
Csv means comma-separated values. It is the basic format for tables (MS Excel). We use semicolon as separator.

Exported csv files are saved to **va3/csv folder**. Files are saved to sub-folders. In case of route export is the sub-folder name created by route name_machine name_point name. In case of runup is added the date and time (*set_yyyy_mm_dd_hh_mm_ss)*.

Export of last measurement (actual)
The name has the format : *position-number_name_yyyy_mm_dd_hh_mm_ss_msec.csv.*

The first line in the file contains information:

- **u**: unit (the serial number of the unit in which the csv was exported)
- **ch**: channel
- **n**: number of samples (lines)
- **d**: delta (the difference between two samples in x axe unit)
- **eu**: evaluation unit
- **t**: time of measurement
- **s**: speed during measurement

- **sensor**: if sensor's name is defined (see AC sensors / Name), it is also saved in the csv header
- **note**: The header can also contain a note which is automatically included from the set's notes (see Notes). Only notes created after the measurement was taken are included.

Next lines contains measured data. Each line can contain several values.

time	time [s]; value; trigger;
ACMT	time [s]; value; trigger;
orbit	time [s]; valueA; valueB; valueX; valueY; trigger;
spectrum	frequency [Hz]; amplitude; phase [°];
orders	order; amplitude; phase [°];
1x amp+phase	0; amplitude; phase [°];
phase shift	0; B/A; ΦB-ΦA [°]; coherence;
center line	0; valueA; valueB; valueX; valueY;
other	0; value;

Export of trends (history)
If you used **View trend** function, then for static measurement is exported complete trend to one csv file. The only one displayed dynamic measurement is exported - not all measurement in trend.
The file name is *position-number _name.csv*. The first column always contains date and time of measurement.

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

This menu item displays various options for graph displaying. The options depend on graph type.

Scale

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

Applied for time, g-demod time (time waveforms), orbit, spectrum, acmt.

View orbit

View orbit

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

Applied for orbit.

Axis X, Axis Y

Axis X - **lin, log**
Axis Y - **lin, log, dB**

Applied for spectrum, g-demod spectrum.

Value Type

RMS, 0-P, P-P

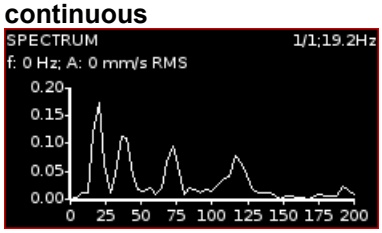
Y axis type
Applied for spectrum, g-demod spectrum, orders.

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

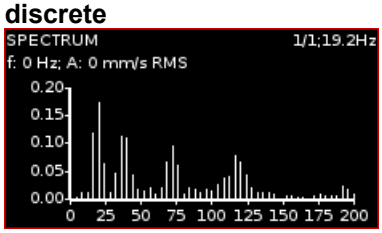
Graph Lines

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

continuous



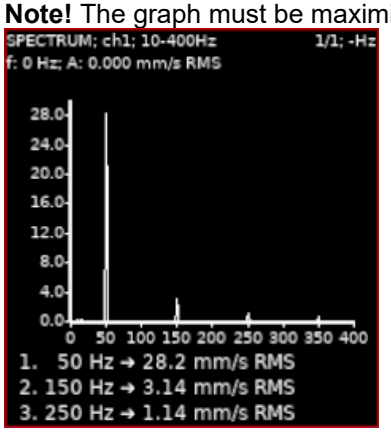
discrete



Applied for spectrum, g-demod spectrum.

Peaks List

yes, **no**
Applied for spectrum, g-demod spectrum.
Shows frequency and amplitude of 3 highest spectrum lines.
Note! The graph must be maximized in order to the peaks could be shown.



The Analyzer buttons description

The F3 button (Start / Stop)

The F3 button may have 2 functions.
The **Start** button starts the reading (measurement).
The **Stop** button stops the reading (measurement).

The Shift button

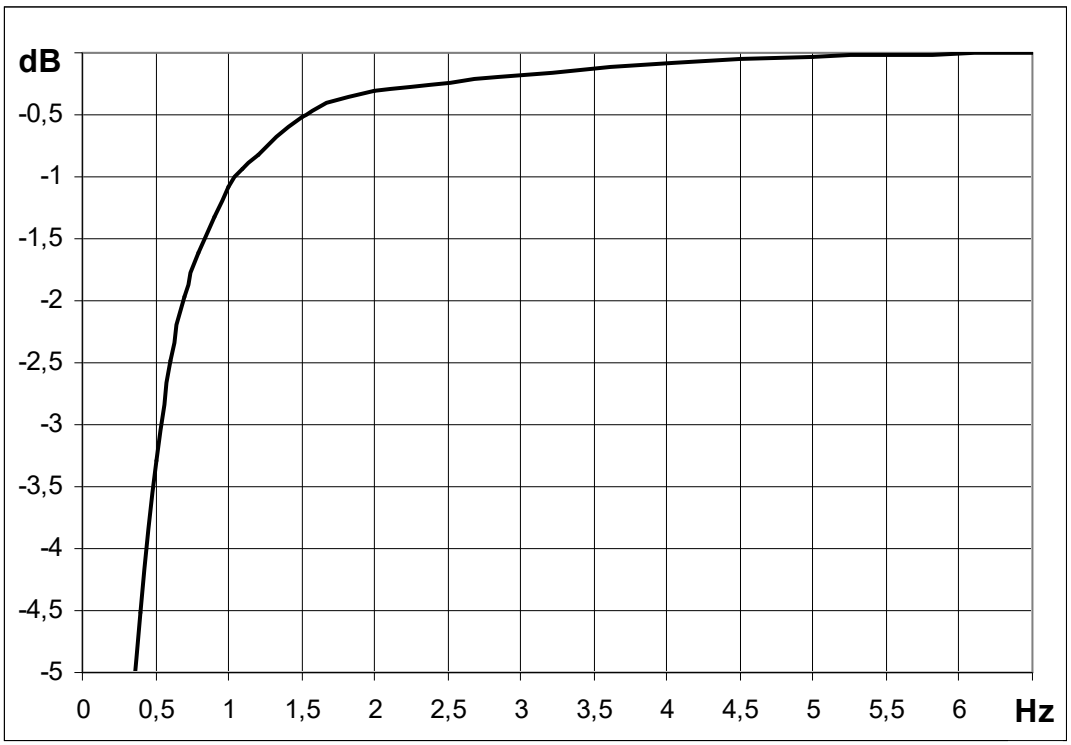
The **Shift** button switches the functions of the arrow buttons.

When Measurement Set is opened, press repeatedly the **Shift** button and notice that the mode of buttons changes. The name of the mode is written in the top left corner of the screen.

Selection - use the up and down arrow buttons to change the active graph (one graph is always selected)
Position - use the up and down arrow buttons to change the position (order) of graphs
Cursor – use the left and right arrow buttons to move with cursor,
Zoom - the arrow buttons make zoom-in or zoom-out functions on X or Y axis,
Move - when the zoom-in is applied, then you can move with the signal by the arrow buttons
Trend – when the trend is displayed, the left and right arrow buttons change the time

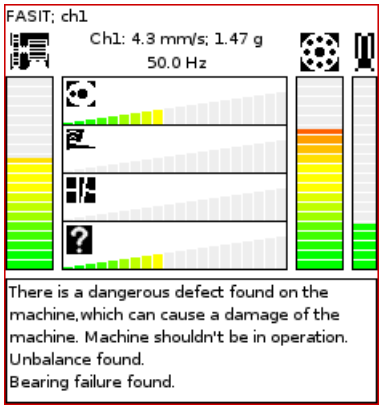
Band fmin[Hz] - HP filtering

Almost in all measurements you should define the HP filtering of input signal. You set it in **Band fmin[Hz]** parameter. You can select the **none**, **1, 2, 10** and **user** filter. The **none** value is available only for direct measurement without integration. The **none** value does not mean the DC part measurement. The HP filter on A/D converter is always used. But no additional filter is used. The frequency range with **none** filtering begins on 0.5 Hz (-3dB point). See the response graph.



FASIT measurement

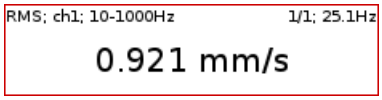
There is detailed description in the FASIT mode chapter.
If the FASIT is measured, the speed detection is done before the measurement itself (see the Speed detection chapter).



Overall measurement

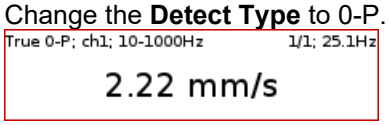
Type	overall
Channel	1
Unit	mm/s
Detect Type	RMS
Fmin [Hz]	10
Fmax [Hz]	1000
fs = 4096 Hz	
Samples	4096
t = 1 s	
Averaging	linear
Avg	off
total t = 1 s	

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



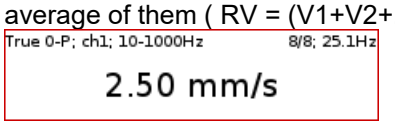
The first row contains used parameters. The 25.1Hz on the right is the speed, because the tacho sensor was used.

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

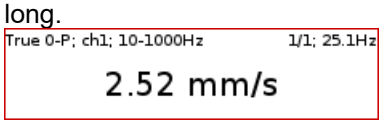


Note, that the 2.22 is not 1.414 times bigger then 0.921. Some of users mistakenly think, that the formula 0-P=1.414*RMS is valid for every signal. It is not true. That formula is valid only for pure sine wave ! The true RMS and true peak measurement are generally independent. The only rule is that the 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.

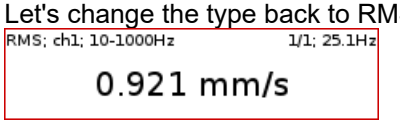


Let's change the Avg back to off and change the samples number to 32768. The measurement will be 8 sec long.

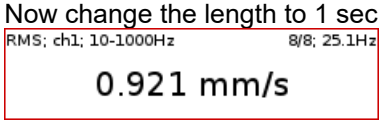


You see that the result is different from the previous value. It is clear, the max 0-P value in 8 sec signal is not equal the average of 8 0-P values (which takes 1 sec each).

Let's change the type back to RMS.



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

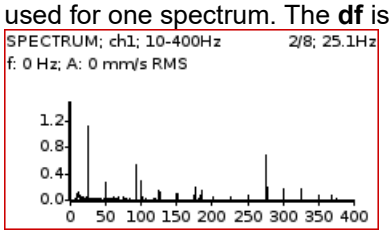


You see the same result. Both values are equal. The meaning of RMS differs from peak values. The RMS value depends only of total time of measurement. It does not care if one long signal was taken or several shorter signals were averaged.

Spectrum measurement

Type	spec
Channel	1
Unit	mm/s
Fmin[Hz]	10
Fmax[Hz]	400
fs = 1024 Hz	
Lines	1600
t = 4 s,df = 0.25 Hz	
Avg	8
total t = 32 s	
Overlap	0%

The **fs** below the Fmax means sampling frequency. The **t** below the Lines is the time signal length, which is used for one spectrum. The **df** is the frequency resolution between lines.

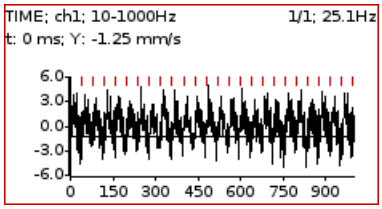


The information in top right contains averaging (2/8) and speed (25.1Hz).
The **Band fmin** defines the frequency of HP filtering, which is used for DC part removing. If you do not expect any important lines bellow 10Hz, use the 10 instead 1. The initialization time of 1Hz filter is much longer then 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.

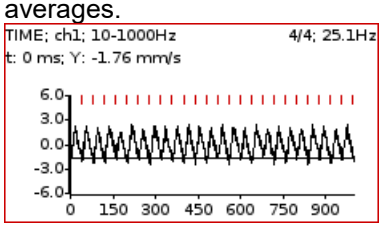
Time signal measurement

Type	time
Channel	1
Unit	mm/s
Fmin [Hz]	10
Fmax [Hz]	1000
fs = 4096 Hz	
Samples	8192
t = 2 s	
Avg	off
total t = 2 s	



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

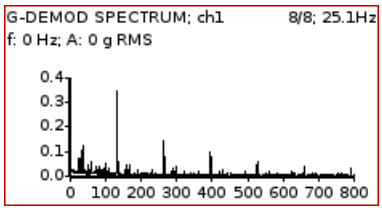
For averaging you need to set the Global/ Trigger Settings/ Trigger Source = tacho. Then define the number of averages.



You see the effect of averaging in decreasing of signal noise. The speed frequency is better seen. With the cursor values are displayed also totRMS and tot0P values.

G-demod spectrum measurement

Type	g-demod spec
Channel	1
Unit	g
DEMOD fmin[Hz]	500
DEMOD fmax[Hz]	25600
Fmax[Hz]	800
Lines	800
	t = 1 s,df = 1 Hz
Avg	8
	total t = 8 s
Overlap	0%



Example: the demodulated frequency 1322Hz with harmonics.
No integration of signal is enabled.

G-demod time signal measurement

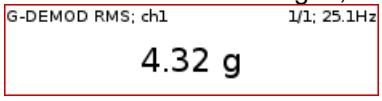
Type	g-demod time
Channel	1
Unit	g
DEMOD fmin[Hz]	500
DEMOD fmax[Hz]	25600
Samples	8192
	t = 125 ms

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

G-demod overall measurement

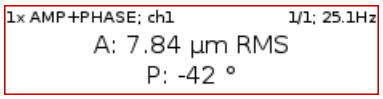
Type	g-demod overall
Channel	1
Unit	g
Detect Type	RMS
DEMOD fmin [Hz]	500
DEMOD fmax [Hz]	25600
Samples	8192
	t = 125 ms
Averaging	linear
Avg	off
	total t = 125 ms

It is very similar to standard overall measurement. The signal is filtered in (DEMOD fmin, DEMOD fmax) range and demodulated then.
The Unit cannot be changed, only the acceleration g unit can be used. No integration of signal is enabled.



1x amp+phase measurement

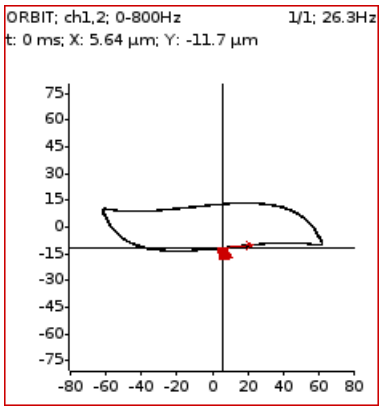
Type	1x amp+phase
Channel	1
Unit	µm
Avg	off
Resolution	speed / 4



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).

Orbit measurement

Type	orbit
A channel number	1
B channel number	2
Unit	µm
Fmin[Hz]	none
Fmax[Hz]	800
	fs = 2048 Hz
Samples	4096
	t = 2 s
Avg	off
	total t = 2 s

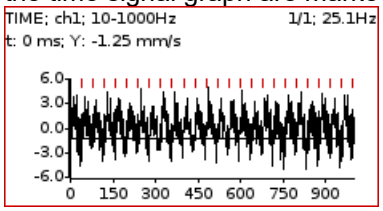


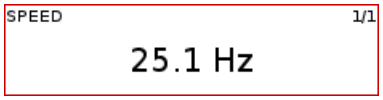
Correct sensors positions (angles) must be set for correct calculations (see Sensors definition).

Speed measurement

Type	speed
Unit	Hz
Avg	off

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.





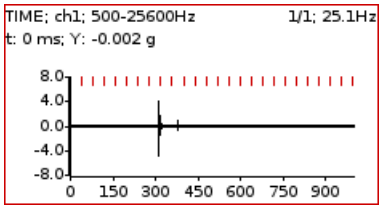
The speed measurement is taken 8 times in every second. The value is evaluated from 3 tacho events in time signal. When the averaging is required, then more values is used. But keep in mind that only 8 values is taken in one second.

ACMT measurement

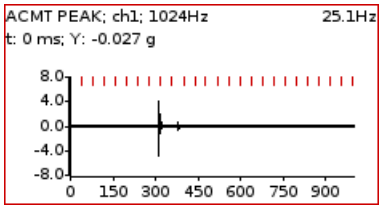
Type	acmt
Channel	1
Unit	g
Detect Type	PEAK
Fmin [Hz]	500
ACMT FS [Hz]	1024
Samples	1024
	t = 1 s

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

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



The original time signal 1 sec long, which contains shock. Signal contains 65536 samples.

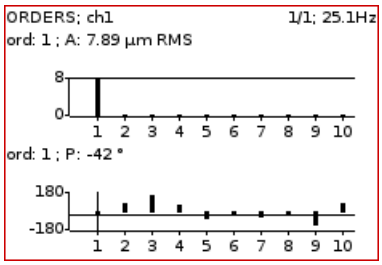


The ACMT time signal. You can see the same shock, but signal contains only 1024 samples.

Orders measurement

This name means order analysis.

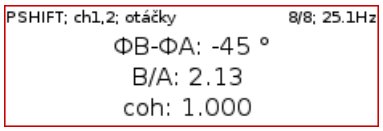
Type	orders
Channel	1
Unit	µm
Orders	1-10
Avg	off



Phase shift measurement

Type	phase shift
A channel number	1
B channel number	2
Avg	off
Frequency[Hz]	speed
Resolution	speed / 4

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

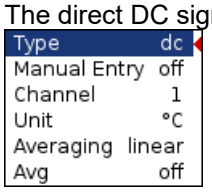


The result contains:
- phase shift value in degrees,
- amplitude ratio (ampl B/ ampl A),
- coherence

If the phase shift is reliable, then the coherence must be bigger then 0.8.

DC measurement

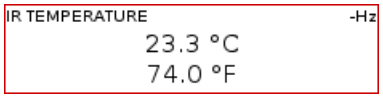
The direct DC signal can be measured by this function.



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

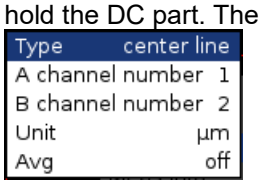
IR temperature measurement

Temperature measured from IR sensor. The sensor is on top panel of the instrument.

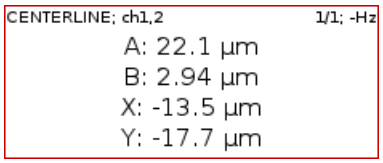


Center line measurement

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.

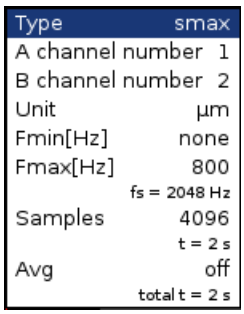


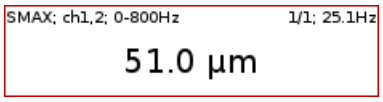
The Center line is related to the orbit measurement. We also need two sensors with known angles of mounting. Correct dc sensors positions (angles) must be set for correct calculations (see Sensors definition).
While in orbit we see the shape around the (0,0) position, in the center line we see the position of shaft center without shape of orbit.



Two couples of values are displayed - A+B and X+Y. The A,B values represent distances of sensors from the reference position defined by offset value. The X,Y values represent that positions according the Cartesian X,Y coordinates (The position (0,0) correspond the position, where A,B are equal their offsets).

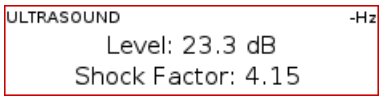
S-max measurement





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

Ultrasound measurement

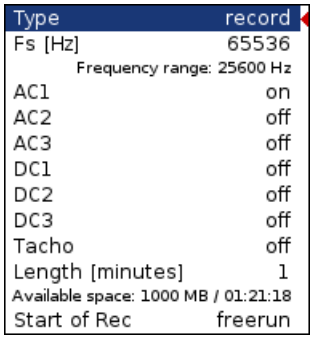


Two values are displayed. The **Level** of sound in dB (30-50kHz range) and **Shock Factor**. The Shock factor is defined as Peak value divide by RMS value. It means value 1.4 for pure sine. Higher values means that transient shock events are in the sound signal.

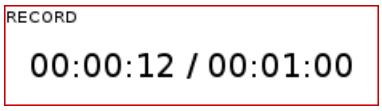
Note: The ultrasound sensor (microphone) required.

There is detailed description in the Ultrasound mode chapter.

Record



Creates and saves the record. After the download to PC it is ready for using with Virtual Unit.
There is detailed description in the Recorder mode chapter.


RECORD
00:00:12 / 00:01:00

Route

Loading the route to the instrument

The DDS software is required for the route measurement. See also the DDS user manual for more details. We do not describe all details about the DDS function in this guide.
Open the database in DDS which you want create the route from. Open the instrument window (Route/ A4300_VA3). The route window appears. Connect the instrument with a USB cable.
Press the **Connect** button, the message window with connection process description should appear. The list of data saved in the instrument appears.
Move the required points from the DDS tree to the route window (use mouse Drag'n'Drop).

You can see that the structure of the tree has changed. This is because the VA3 Pro strictly requires a tree with the following structure Tree_Name - Machine - Measuring Point - Data Cell. If there are more items in the DDS tree in a path between these items, the names of such items are combined together (like in this example "Turbo Generator/Fans/Fan 1" or "Motor/L1RV" etc.). If the item name in a route tree is longer then 45 characters the DDS tries to shorten such names. To avoid this we recommend using shortcuts in the tree items (in this case "Turbo Generator" should be "TG").

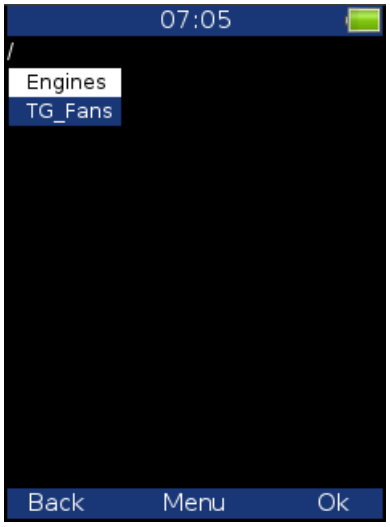
Press the **Send** button. The route data will be loaded from the computer to the instrument.

Creation of the route tree

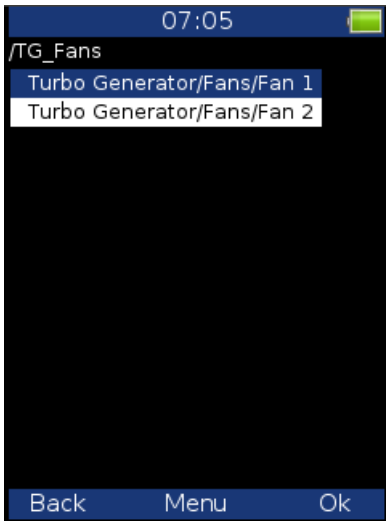
The route tree can be created also in the VA3 directly. The new database must be created in DDS for it. See DDS guide for details.

Route readings

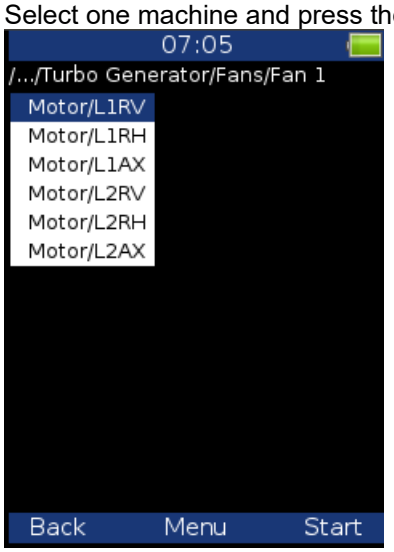
Select the **Route** mode in the VA3Pro main screen. The list of routes in the memory is displayed.



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



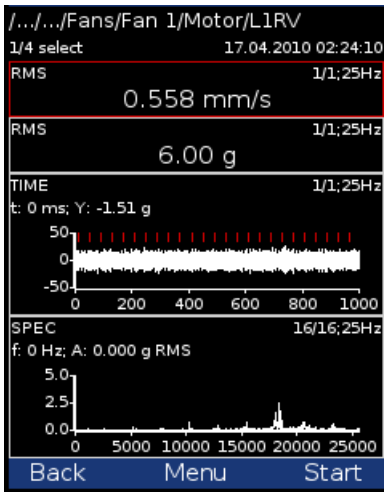
Select one machine and press the right arrow to display the list of points.



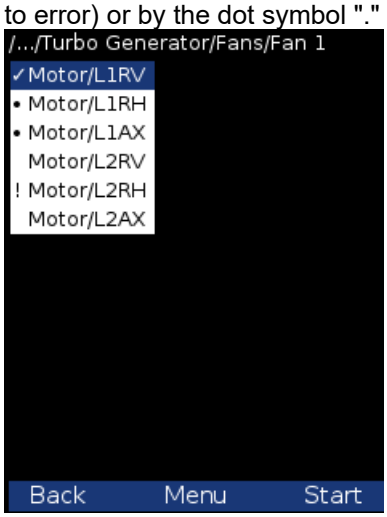
Now you can start the measurement by pressing **Start** (F3) or display the list of measurements defined in this point by pressing the right arrow button.
Use the left arrow button to return to the previous level in the tree.

When you press the **Start** button on the screen with the list of points, the graphs are displayed with the **No Data** message and the measurement begins. If the required sensor (defined in the route) is not compatible with the sensor connected to the channel input (Sensors properties) the instrument displays a warning. If this happens change the sensor or use a different sensitivity and press **Continue**.

All measurements defined in the point should be taken now. The measured data are displayed on the screen.



Press the **Back** button (F1) to return to the list of points. The measured point is labeled by the tick symbol √ (all defined measurements were taken) or by the exclamation mark symbol "!" (some readings were not taken due to error) or by the dot symbol "." (measurement not complete).



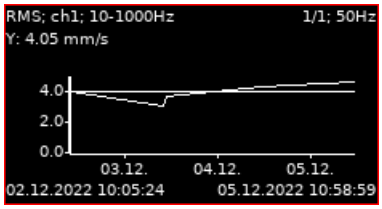
Downloading the route to the computer

Open the instrument window (Route/ A4300_VA3). The route window appears. Connect the instrument to a USB port. The information screen with the message **Connected to PC** appears on the VA3 Pro screen.
Press the **Connect** button in DDS. The list of readings saved in the instrument appears (data saved in the instrument).
Select the required route. Press the **Store** button. The data are transferred and saved to the database.

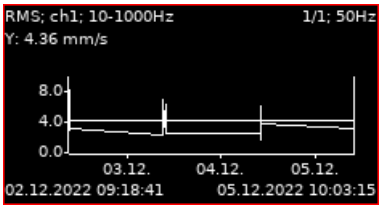
Continual Saving

In *DDS/ measurement point* properties/ *Other* tab, you may set a ***Continual Saving*** property as **Yes**. If *Continual Saving* is set, the measurement is not stopped after first reading. It continues and all readings are saved until user presses *Stop* button. It works regardless Route Autosave parameter is set as off. It is designed for short series of measured value. For example, you want to measure one elevator run or one run of press machine. See more details in *DDS* manual.

Continual Saving = No:



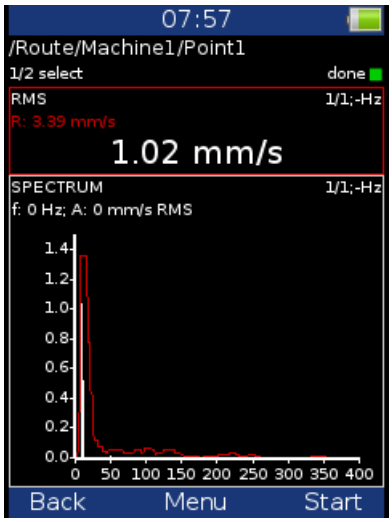
Continual Saving = Yes



Note! Available interval is displayed on the status bar before the start of measuring. The instrument enables save up to 1GB of data on each measurement (if enough memory available), but the limit of 1 million values per point cannot be exceeded.

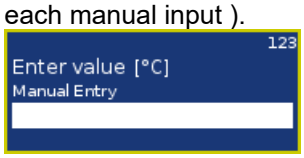
Reference values

You can download reference values from DDS to VA3 unit for spectrum and overall measurements. These values are displayed together with measured values.
Reference spectrum is displayed together with measured spectrum in the same graph.
Overall reference value is displayed in left side of graph and it is signed by “R:” or like a line in trend view.



Manual entry

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



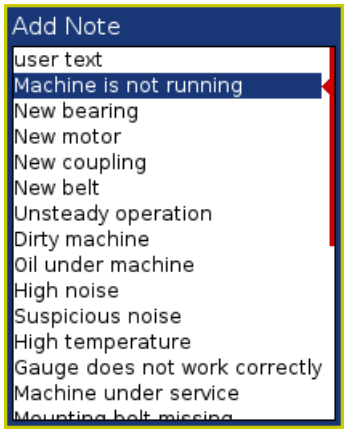
You can skip the value entering. Until the field for value entering is empty, the **F3** button means **Skip**.

The measurement automatically begins after entering of all manual values. If you want to be able to cancel the measurement, set the **b2=1** in **Advanced** parameter. See chapter **Main menu / Global** for details.

Notes

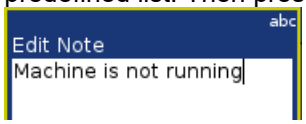
Select **Notes** item. The list of notes for point appears. It is empty, when no notes was created yet.

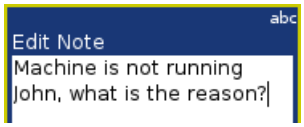
Use the **Menu / Add Note** to new note addition. The list of predefined notes appears.



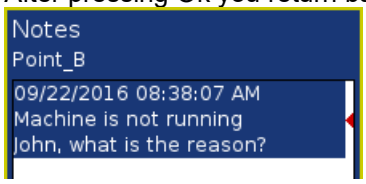
The predefined notes are saved in instrument in **va3/notes** folder. The individual file exists for each language. The user can modify the notes or can add his own notes. Use any software for text files edit.

Select one note from the list and press **Ok**.
If you want to enter the text, then select **user** text item. You can also edit the note which was selected from the predefined list. Then press **Ok**.





After pressing Ok you return back to the list of notes. The new note appears in the list.



Use the **Menu / Edit Note** to edit the selected note from the list.
Use **Menu / Delete Note** to remove selected note.
Press **Ok** to close the list.
If the note exists for point, then the **N** letter is displayed behind the point name.

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

Speed in the route

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

Speed entered in DDS

The **Default Speed** can be set in DDS as a machine parameter (**Tree Item Properties / Speed** tab). This value is sent to the instrument and it is used in place of tacho sensor value. The three options of **Default Speed** are available for the machine item.
Entered value - the value entered in Default speed is sent to the instrument. The value is used only for FASIT measurement. If the value is entered, then no speed detection is used.
Detected option runs speed detection before measurement (see the **Speed Detection** chapter).
Manually Entered option opens **Enter the speed** dialog, where you enter the value.
Detected or manually entered speed is valid for whole machine. Unless you close the machine item, the same speed value is used.
The **Default Speed** can be also set in other items, not only in the machine. In this case only numerical value is available. If you enter default speed value and in the same time you have set machine's default speed as **Detected** or **Manually Entered**, then the machine's setup has priority.

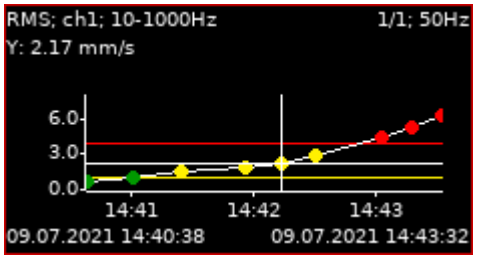
Measured Speed

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

Current entered or detected speed value (if defined) is displayed in information panel
speed: 50 Hz

Limits

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



The Route buttons description

Buttons have same meanings as in the **Analyzer** mode.
There is only one more functionality in **route** mode. If arrows function is set to **Trend**, then you can use up and down button to change displayed point while measured data are displayed.

Balancer

Introduction

The balancing process is based on standard measurements of amplitude and phase on the speed frequency. If you are not familiar with on-site balancing method, we recommend reading professional literature before you proceed.

Planes and Points

We would like to explain the difference between words 'plane' and 'point'. The sensor is mounted to the point or points (dual channel reading). The trial mass and final masses are mounted to the plane or planes. Some people talk about measuring on planes, but this is not correct. In case of overhanging rotor there is no direct relationship between points and planes.
We use the labels A and B for points and 1 and 2 for planes.

Project

The Project is the base structure in balancer. It corresponds to one balancing job. You can use the same Project for repeated jobs on the same machine. The measured data will be rewritten.
The Project contains all measured or entered data, which were used during the job.

The typical scheme looks like next list of steps:

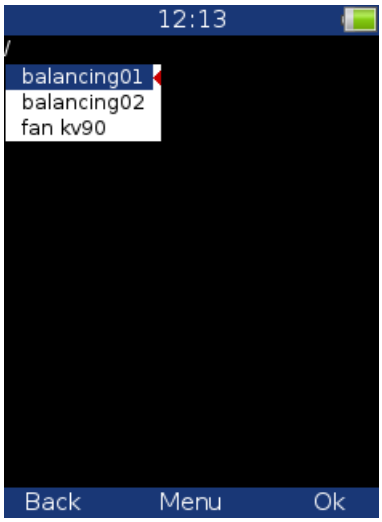
- Create new project.
- Enter balancing parameters (type of machine, number of planes etc.).
- Initial measurement of vibration amplitude and phase on required measurement points.
- Put trial weight on the rotor. Step by step to all planes.
- Trial weight response measurement. Step by step to all planes.
- Put correction weights on all planes.
- Check of effect (success).
- Trim measurements for additional weights and better results.

Every step is displayed in one screen. The movement between screens is provided by ***Left / Right*** arrows.

Attention! When you return back in the job screens and you take a repeated measurement or enter a new value, then the measured data will be erased in all screens after 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.

Project List

The list of saved projects or the Empty label is displayed on the first screen. Select one project or use the **Menu** / **New Project**. The following functions for managing projects are also enabled (**Menu** button).



New Project when you select the New Project item, you have to enter the name of the new project.

Copy Project creates the new project as a copy of the selected project. Only **Balancer Settings** are saved. No measured data are saved.

Rename Project renames the selected project.

Delete Project deletes the selected project.

Clear Project Data erases all measured data, only the Project with Balancer Settings remains in unit.

New project

Press the **Menu** button and select the **New Project** item. Enter the name of the project. The new project is added to the list of projects and it is selected (active in dark colour). Press **OK** (F3) to open the project. The list of settings appears. Define your balancer settings and press **OK** (F3).

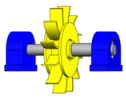
Balancer menu

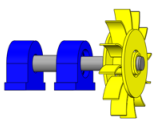
Balancer Settings

Planes **1**, **2**
Number of balancing planes.

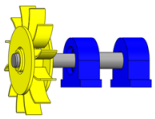
Image
Selection of machine image (for single plane balancing only)

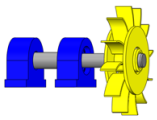
inside rotor: overhung rotor:





Look
View direction. Available only if Image has been defined. Moreover, not all images enable the look.
left: right:





Rotation

CW, CCW

clockwise or counterclockwise

Point A

1-3

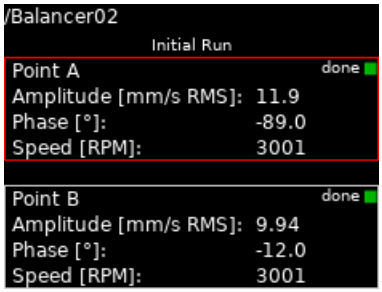
the number of the AC input which will be used for the sensor mounted on point A

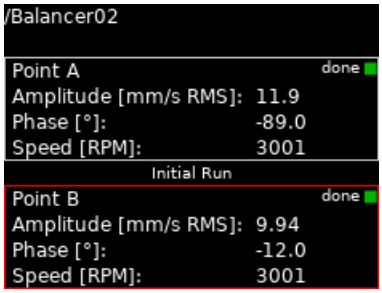
Point B

1-3

the number of the AC input which will be used for the sensor mounted on point B

Note! You can enter the same AC channel number for both A and B point. In this case, the measurement with one sensor is expected and readings for both points are not taken together. First, you take the measurement on one point. Then, you remount the sensor to the other point and take next reading. The point, which is currently measured is selected by ***Up*** / ***Down*** button (see later).





Note: The point markings A and B have only a symbolic sense. They have no relation to the balancing planes 1 and 2 and to the balancing computational procedure. You can mark any measuring point as A and the second as B.

Remove Trial Weight

yes, no

The trial weight can be left on the rotor or can be removed from the rotor after trial run.

Remove Trial Weight (Plane 1), Remove Trial Weight (Plane 2)
yes, no
For 2 planes balancing, you may remove or keep trial on each plane individually.

Correction Weights
add (mount), **remove (drill)**

Components
Number of components. This parameter is used in job requiring the split of the correction weight into components (blades for example).

Meas Mode
single, **online meter**
When you start a measurement process by pushing *Start*, then only one value can be taken (**single**) or the continual measurement values could be displayed (**online meter**). In **online meter** mode, you may look at more values and to evaluate the changing of them in time. You need to stop the measurement by pushing *Stop*, when is displayed the value, which you want to use.

Avg
The averaging of more than one measured value is available

Resolution
It's the aps measurement resolution described in Analyzer / New Meas / New Meas (Advanced) / Resolution.

Units Settings

Set the units for current project.

Amplitude
Selection from available vibration units.

Value type
RMS, 0-P, P-P

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

Speed, Mass, …
Selection from available units for particular quantity.

Rotor Settings

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

Operating Speed
One of the parameters used for Quality Grade calculation is the speed of the rotor. By default, the Quality Grade calculation uses the speed detected during the balancing process. However, sometimes the real operating speed differs from the balancing speed. In this case, you can enter the operating speed here and this speed will be used for Quality Grade calculation.

Rotor Mass
Rotor mass

Correction Radius
Radius in mm to which the correction weight will be mounted (could be different for each plane)

Quality Grade
Required quality grade according to *ISO 1940.* If this value is entered, the recommended trial weight can be offered.

Enter Trial

For trial runs only. Enter the value of the trial mass.

Enter Values

You can manually enter the values instead of measuring them (balancing calculator function).

Enter DF

For trial runs only. You can enter a dynamic factor of balanced rotor instead of processing the trial run. The value of the dynamic factor is always calculated after the trial run and can be displayed using **Menu / Display DF**. If you balance the same rotor after some time, then there is no need to measure the trial run again. Instead, you can enter DFA (Dynamic Factor Amplitude) and DFP (Dynamic Factor Phase) values.

Display DF

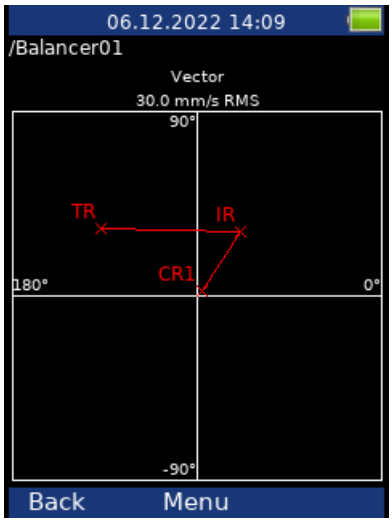
For trial runs only. If the dynamic factor is not entered manually, but is calculated during balancing from the values of the measured or entered vibrations, then it is not displayed on the screen. You can display it using this menu item.

Report

The function creates a balancing report in .rtf format (MS Word) and saves it to the VA3_DISC (directory va3/report) for PC downloading.

Vector

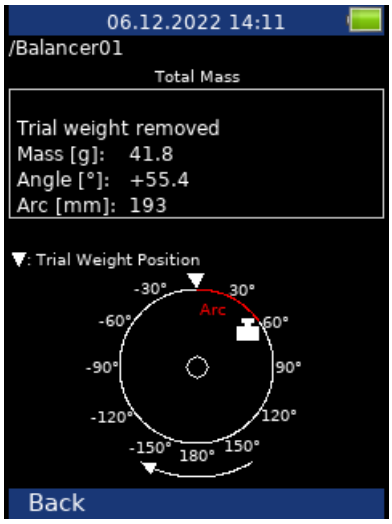
This shows the drawing of amplitude/phase vector development during the balancing process. The drawing is also included in the balancing report.



IR Initial Run
TR Trial Run
CR Correction Run

Total Mass

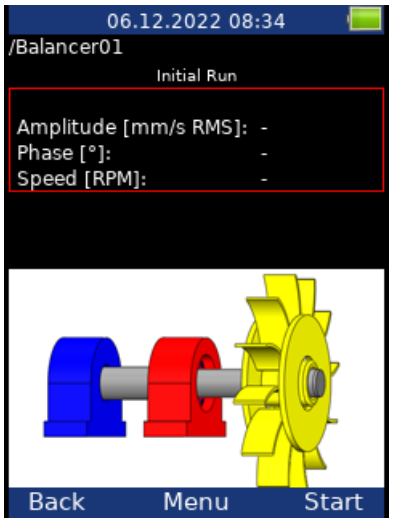
Displays the total balancing mass. It is a vector sum of all masses mounted to the rotor (all correction weights and kept trial weights).



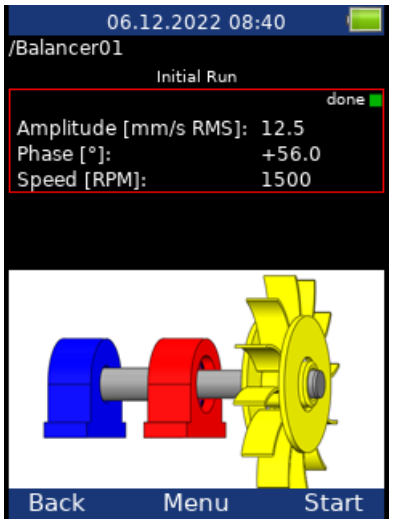
Note! For dual plane balancing, use *Left / Right* arrows to switch between planes.

Single plane balancing

Initial Run



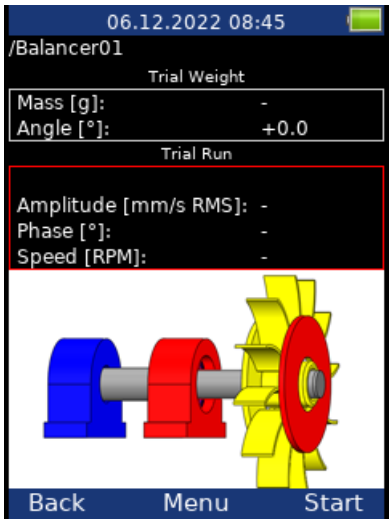
The red bearing house is the recommended point for sensor mounting. But you can use any other place, which is suitable for measurements.
Push ***Start*** button to start the measurement process. Alternatively, you may enter the values using Balancer menu / Enter Values (balancing calculator function).



Press the ***Right*** arrow to move to the next screen.

Trial Run

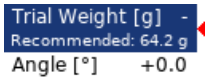
The trial weight response is measured in this run.



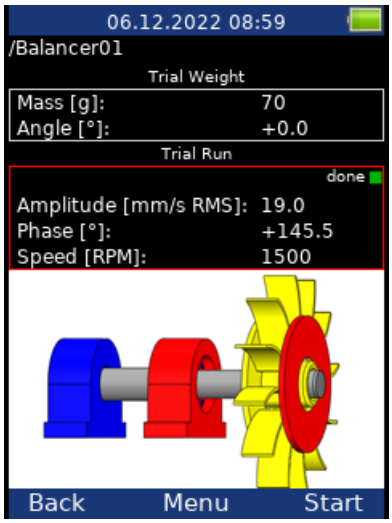
Use the Balancer menu / Enter Trial and enter the mass and angle of the trial weight. Usually, the trial weight is placed at zero angle and serves as a zero mark. However, you can set the zero mark wherever and set the trial weight angle from the zero mark. The angle of the trial weight must keep the Global / Angles Counting setup. This means, if you use **with rotation** angles counting, the angle is positive when you put the trial weight before the zero mark in the direction of rotation and negative when you put the trial weight behind the zero mark (or when the trial goes first and zero mark goes second the trial weight angle is positive). For **against rotation** angles counting, it is the opposite.
If the Balancer Settings / Components have been defined, the trial weight position is entered as the number of the component. The angles counting must be kept as well. The component number grows in the direction of rotation if with rotation is set and vice versa.

The mass can be negative, it represents removing of the weight (for example dismounting of old correction weight).

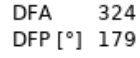
The recommended weight value is displayed only if the Rotor Settings parameters are entered.



Don't forget to mount the trial weight to the balancing plane.

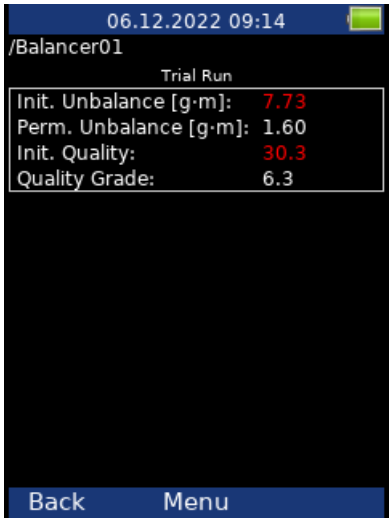


After the trial run measurement, the ***dynamic factor*** of the machine is available (Balancer menu / Display DF).



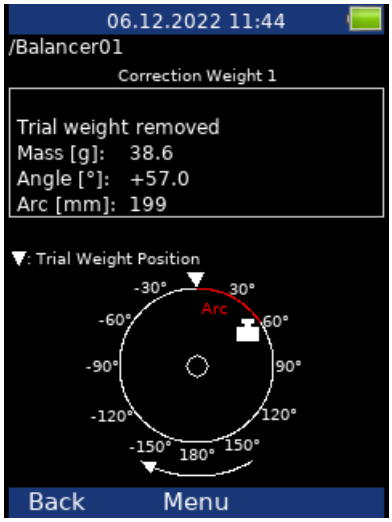
The ***DFA*** and ***DFP*** (amplitude and phase) values are the response values of standardized trial mass on the correction radius. If you will balance the same machine again after some time, then you do not need to measure the trial weight response again. Instead, you may just enter the *DFA*, *DFP* values on this screen. Use Balancer menu / Enter DF for that.

If you have entered Correction Radius and Rotor Mass values in the Rotor Settings menu, the ***Initial Unbalance*** and ***Balancer Quality*** values according to *ISO 1940* are displayed on next screen. In case the values are satisfactory, you don't need to continue with the balancing job.



Note! The initial means that trial weight is not taking account, even if it is kept.

Result



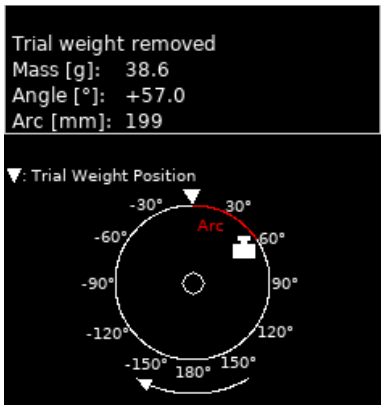
According to the Balancer Settings / Remove Trial Weight, the information window appears.

Remove trial weight! or Keep trial weight!

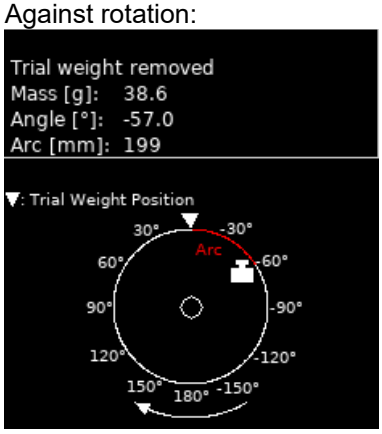
Don't forget to remove the trial weight if it is set. However, you can use it as zero mark first and remove it after correction weight mounting.

The weight and angle (position) of the correction weight are displayed.
The angles are calculated from the zero mark. The direction of the angle depends on the Global / Angles Counting value. If it is set as **with rotation**, the angle direction is same as the direction of rotation and positive values are in the direction of rotation (in the picture above it is +57° in the direction of rotation). The direction of rotation is shown by the arrow below. If the Angles Counting value is set as **against rotation**, the angles have opposite values.

With rotation:

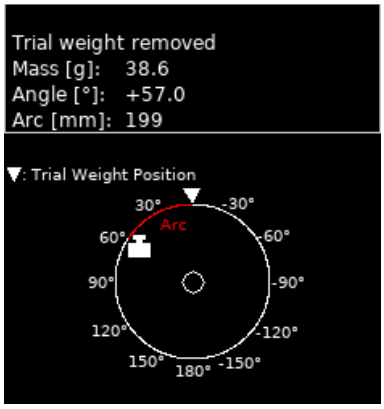


Against rotation:

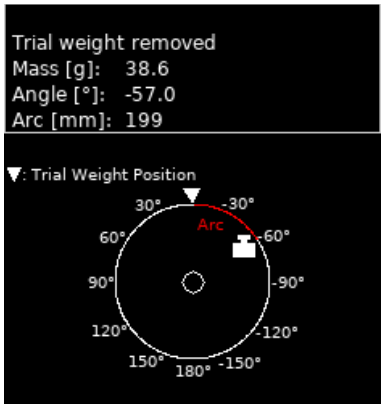


Warning! If you haven't defined the direction of rotation, the result is displayed in default direction with angles increasing counter clock wise. The angle has still the same value (+57° with rotation or -57°against rotation). However, the picture may not correspond the reality. You need to determine the right position yourself.

With rotation:



Against rotation:



Note! You cannot change the Angles Counting value during a balancer job. If the value is changed, the error message appears.

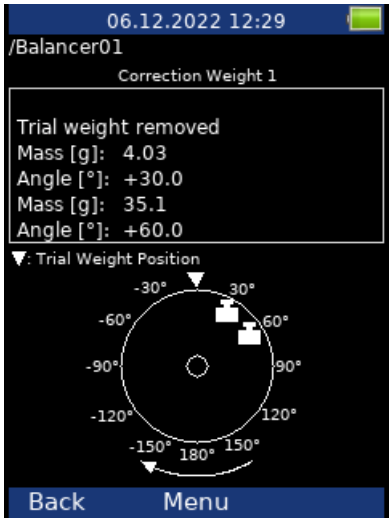
In case you have entered the Correction Radius value, the ***Arc*** value shows a circumferential distance of the correction weight from zero mark.

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

Enter the value of the first angle.

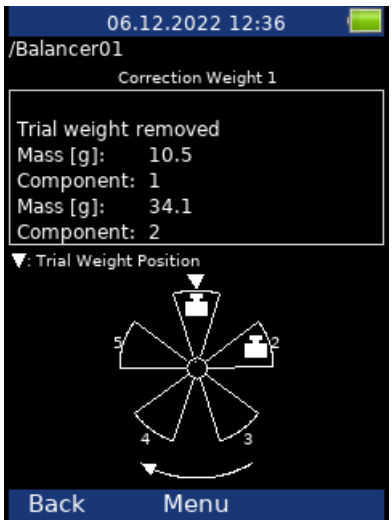
Then enter the value of the second angle.

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



Use ***Menu / Set Default Angle*** to return back to the original calculation.

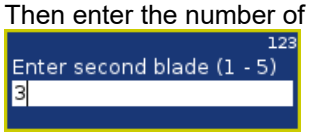
If the Components have been defined, the correction weight is divided between two nearest components. The component number is counted from the zero mark, which is the component number one. The component numbers keep the angles counting parameter. The component number grows in the direction of rotation if with rotation is set and vice versa.



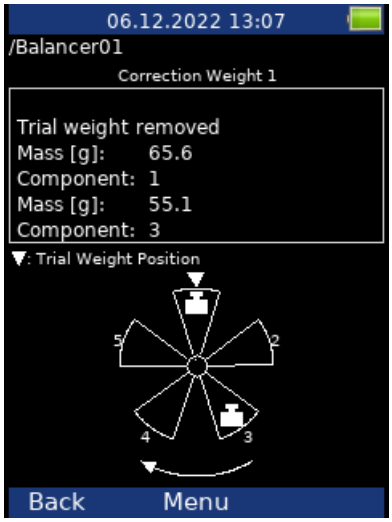
You can select other components in case when you cannot mount weight to the nearest components. Select ***Menu / Change Components*** menu item.

Enter the number of the first component.

Then enter the number of the second component.



New correction weights will be displayed.

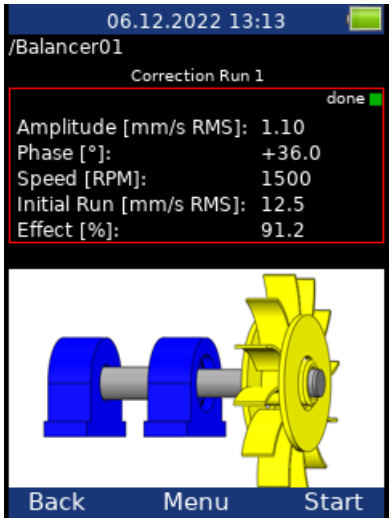


Select ***Menu / Set default components*** menu item to return to the original weights.

Mount the recommended correction weight to the machine.

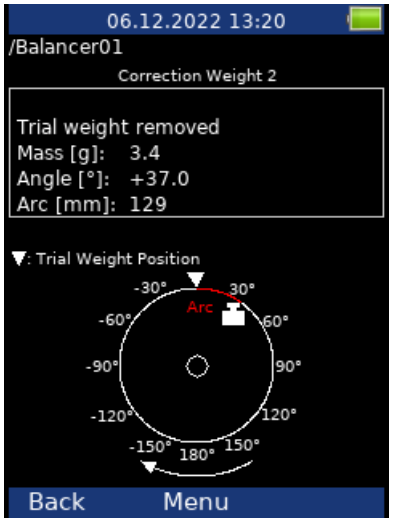
Correction Run

When the weight is mounted you want to check the job.



- ***Initial Run***
  amplitude of Initial Run
- ***Effect***
  is the reduction of balancing in %
  *Effect = (1 – A2 / A1) * 100%*
  (the 1.1mm/s is the 8.8% of 12.5 mm/s)

Residual unbalance and quality and next correction weight suggestion are available on next screens.



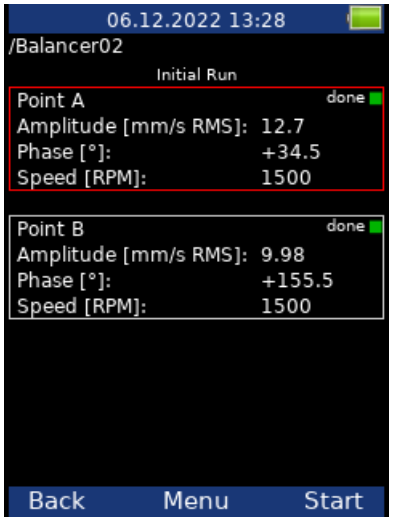
You can continue with the job until you are not satisfied with the results. These next steps do not require trial weight measurement already. After each measurement the next correction weight is recommended. However, when the result is not better (or even is worse) the next correction runs have no sense.

Dual plane balancing

Initial Run

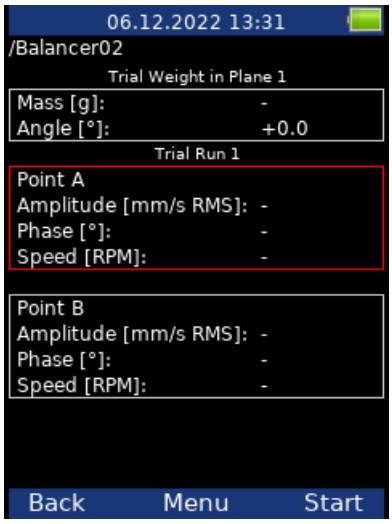
The screen is divided into two parts. The upper part corresponds to **Point A** and the lower one to **Point B**.
If you use only one sensor, then only one part is selected (red border). The other part is bordered in grey. Mount the sensor to the selected point and take the reading. Use the ***Up / Down*** arrow buttons to change the selection of the point. Do the same for the second point. With two sensors you take both points readings at once.

You can also enter the values manually.



Trial Run 1

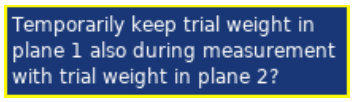
It is similar like single plane balancing, only two trial weights must be subsequently mounted to two planes.
If you know the *dynamic factor*, then you can enter all 4 values manually and you do not need to measure trial runs. See more details about dynamic factor in Single plane balancing / Trial Run.



See the Single plane balancing / Trial Run for more details about trial weight mounting.
Put the trial weight to the plane 1 and take the measurements for both points.

After both points measurements are taken, you should resolve the trial weight according to the Balancer Settings / Remove Trial Weight (Plane 1).

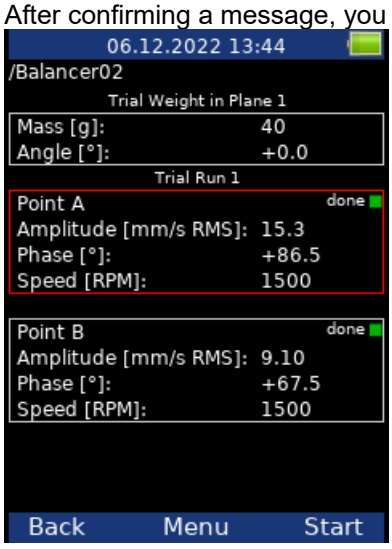
In case of Remove Trial Weight is set as **yes**, next question will appear:



If you answer *No*, then you must remove the trial weight as expected. However, you can answer *Yes* and keep the trial weight on plane 1 also during measurement with trial weight in plane 2. This can be useful, when you want to use the trial weight as the zero mark for correction weights mounting.

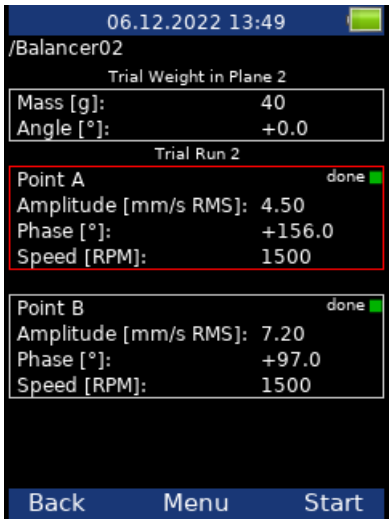
In case of Remove Trial Weight is set as **no**, next notification will appear.

After confirming a message, you can check the measured values on the Trial Run 1 screen.



Trial Run 2

The same two measurements we have to take with trial weight in plane 2. The screen for those measurement looks similarly like previous screen. Only the red disc is in the plane 2. Enter the trial weight values and put the trial weight into the plane 2. Take the measurement on both points.

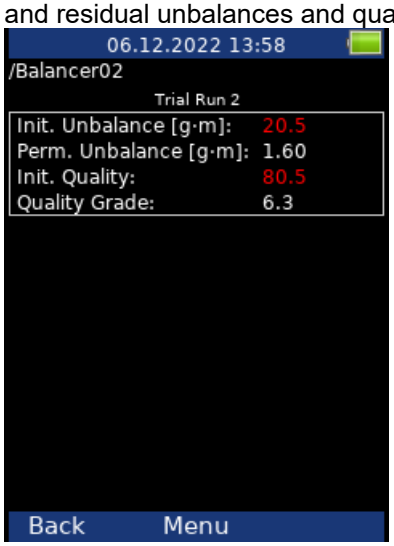


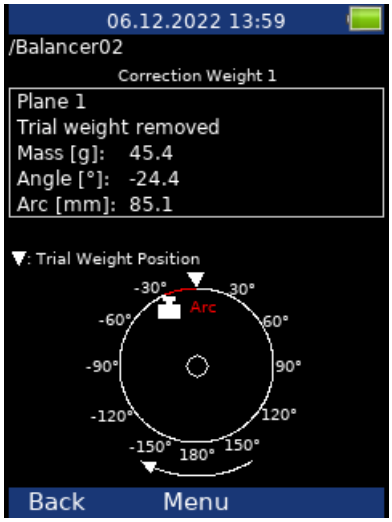
Result

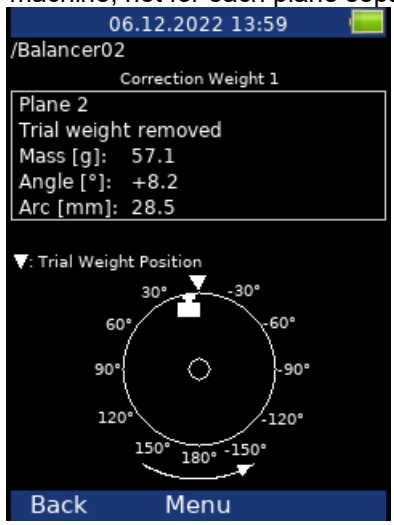
After entering the result screen, you will be notified to keep or remove the trial weight from the plane 2 according to Balancer Settings / Remove Trial Weight (Plane 2). In case you temporarily kept the trial weight, you'll be also notified to remove it now.

Don't forget to remove the trial weights if needed. However, you can use them as zero mark first and remove them after correction weights mounting.

The result screens look similar like for single plane balancing. They contain correction weights suggestion for both planes. See more details about correction weights mounting in Single plane balancing / Result. The initial and residual unbalances and qualities are calculated for the whole machine, not for each plane separately.

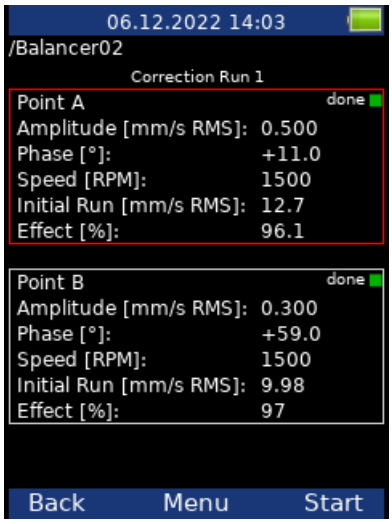


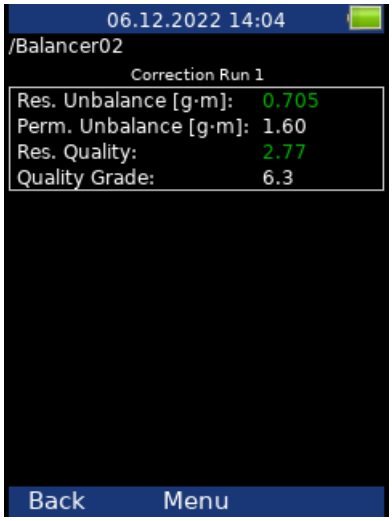


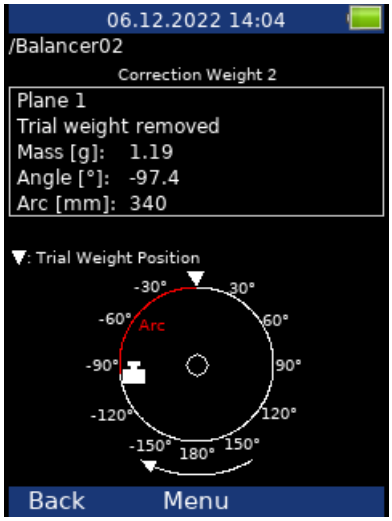


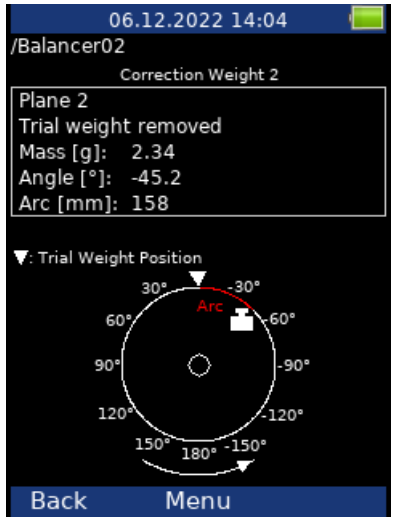
Correction Run

See Single plane balancing / Correction Run for more details.







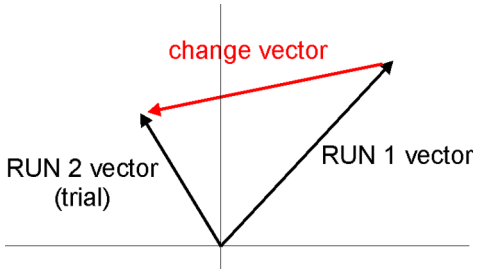


Balancing Errors

Balancing errors and warnings can occur during the job.

The effect of trial weight is low

This message informs you that the effect of the trial weight is low.



The percentual value is derived from ratio (amplitude of change vector/ amplitude of Run1 vector).

A warning is displayed when the change is less than 20% but bigger than 1%. You can continue with balancing after this warning and use these values.

An error is displayed when the change is less than 1%. You cannot continue with balancing after this error, because such a small change is not acceptable. You could get incorrect results.

Unacceptable speed change

The balancing procedure must be executed on constant speed during all runs. The balancing speed is checked and when it changes more than 5% the error occurs.

Unstable phase

The phase stability can be checked only if the averaging is used (Balancer Settings / Avg). If the phase during averaging changes, this probably means the unbalance is not the main problem of the machine. Thus, the error is indicated and the balancing procedure stops.

Recorder

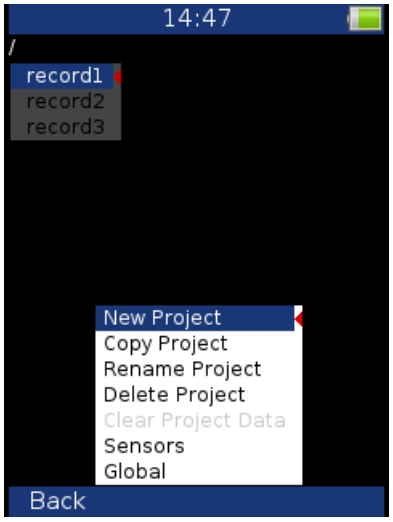
Some of you maybe remember that in the past a signal was recorded to a tape-recorder and afterwards it was processed (analyzed) in an analyzer. This method had a huge advantage; the signal could be analyzed repeatedly over and over. If you wish to make all the requested analyses in real time, you are under time pressure. For example the runup of the machine can be run only once, you are under extreme pressure. The tape-recorder was an excellent solution for those cases. It is a simple unit with a simple operation and no danger of loosing the data.
The recorder mode offers the same solution. The recorder mode enables you to record the raw signal from the sensor without any post-processing or filtering.
It enables you to record all the channels (3 AC channels, 3 DC channels and a tacho channel) to the memory of the VA3 unit simultaneously. The sampling frequency is from 64 Hz to 65536 Hz. The record is saved in the memory and you can analyze it later according to your requirements.

Record length

The length of the record is limited to 1000 MB of data, which is 81 minutes of record from 1 AC channel with a sampling frequency of 65536 Hz.

First screen

The first screen of the record mode shows the list of saved projects or an empty list. The Menu is at the bottom (F2).



New Project

This creates a new project. Enter the name of the project and confirm by pressing **OK**.

Copy Project

This creates a new project with the same settings as the selected project. Enter the name of the new project and confirm by pressing OK.
Note: Only project settings are copied, no measured data are copied.

Rename Project

This function renames the selected project. Enter the new name and confirm by pressing **OK**.

Delete Project

Deletes the selected project.

Clear Project Data

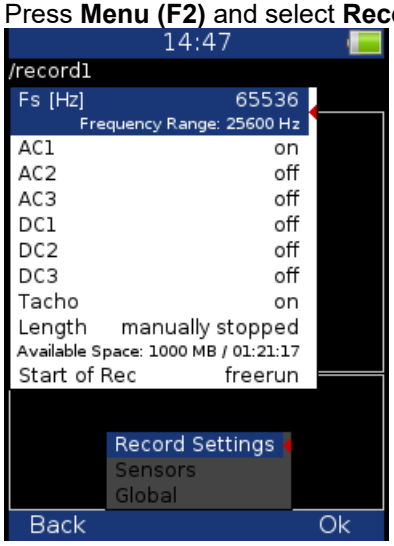
Deletes the measured data in the project.

Project screen

Select the required project and press OK. If the selected project contains measured data, the record preview is shown. If there are no measured data, the record project settings appear.

Record Settings

Press **Menu (F2)** and select **Record Settings.**



Fs:

Record sampling frequency (max 65536 Hz).
The record frequency range is shown below.

AC1 – AC3:

Switches the required AC channels on/off.

DC1 – DC3:

Switches the required DC channels on/off.

Tacho:

Switch this on if you wish to record the Tacho channel.

Length:

You can set up the required record length. You can enter the required length in minutes or seconds. If you select the option Manually stopped, the record will be stopped when you press the **Stop** button or when the available memory is full.
The available space is displayed below – the available space in memory (MB) and possible record length (hh:mm:ss).
If the entered length exceeds the 1000 MB limit, it will be shortened automatically. The message **Required length shortened!** appears in this case.

Start of Rec:

freerun The recording starts immediately after pressing Start (F3).

external The recording starts when the signal appears in Tacho channel.

amplitude The recording starts when the signal from the Tacho channel exceeds the amplitude trigger level (see **Ampl Trig Level** below

Pretrig:

You can enter the length of the record before the Trigger (in minutes or seconds).

Ampl Trig Level:

This is the level of the trigger in sensor units. You can enter either positive (rising edge) or negative (falling edge) level value. The signal amplitude is taken directly from the sensor input, no additional filtering is applied.

Examples:

the level is set to 1 g - triggered when the rising signal exceed 1 g

the level is set to -1 g - triggered when the falling signal drops under -1 g

Ampl Trig Channel:

The number of the channel which is used for amplitude triggering.

Sensors settings

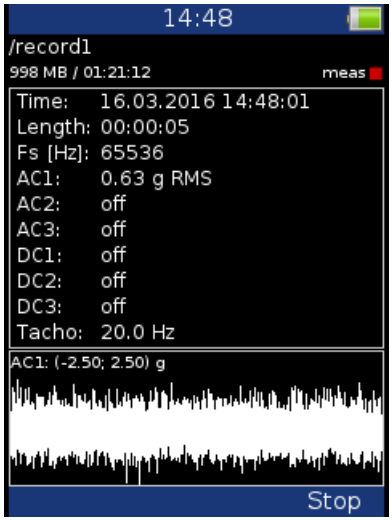
Set up the parameters of sensors to be used in **Menu/Sensors**. The sensor settings will be saved in the project.

Recording

To start recording, press the **Start** button (F3).

The recording stops when one of the following states appears:
- the set-up time is over
- you press the Stop button
- the 1000 MB memory limit is reached
- there is no free space in the memory

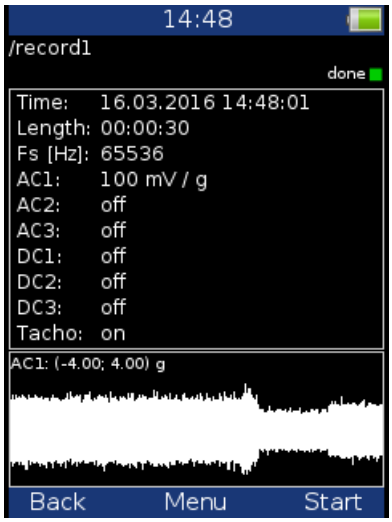
When the recording is on, the currently measured value is displayed next to the corresponding channel or there is information about ICP error and overload. There is the preview of the record of one AC channel at the bottom; you can switch between the preview of the recorded channels by pressing the up/down arrow buttons. There is information about the available memory and remaining signal length displayed at the top. The remaining signal time length is displayed in the format: hh:mm:ss.



Preview of recorded data

After the recording, the preview of measured data is displayed.

The setting of each channel is displayed. In the graph there is a preview of the record from 1 channel. You can change the displayed channel by pressing the up/down arrow buttons.



Record analysis

For record analysis you need to use the A4410 Virtual Unit application. The A4410 Virtual Unit application can be downloaded from the Adash website for free:
http://www.adash.com/downloads_software_adash.php
Download the Virtual Unit application to the PC and you can analyze the signal in for example Analyzer mode. For more information see the A4400 VA4 manual, which describes the functions of the Virtual Unit.

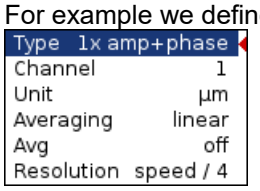
Run Up

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 **Menu/Trigger/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. You can use all memory quickly.
The last choice is the **Manual** mode. You can press the **Ok** button at any suitable moment to make a new measurement.
Available interval is displayed on the status bar before the start of measuring. The instrument enables save up to 1GB of data on each measurement (if enough memory available), but the limit of 1 million values per set cannot be exceeded.

Measurement settings

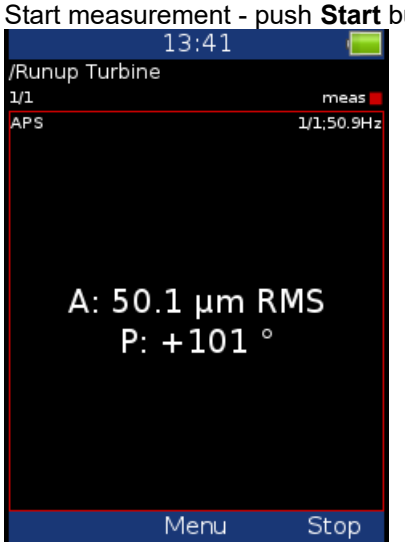
Measurements are defined in sets, use the same way as in **Analyzer** mode.
For example we define only one measurement in set. The proximity sensor on channel 1 is used.



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

Measurement

Start measurement - push **Start** button. After the final speed is achieved press **Stop**.

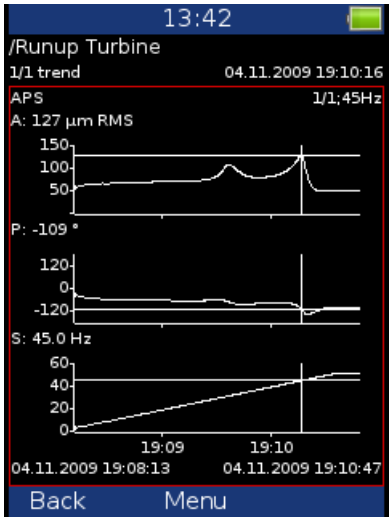


The last measured value is on the screen.

Trends

Use **Menu/View Trend** to display the list of measured trends. 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 trend is loaded and displayed.



Use the **Shift** button to change arrow buttons meaning. Set the arrow buttons to **trend**.

Use left and right arrow buttons to change cursor position.

Deleting trends

When trend list is displayed, use **Delete** button to delete selected trend.

Ultrasound

Introduction

We would like to explain a few terms in the beginning of this chapter.
Higher frequency energy above 20kHz is best detected with an ultrasonic sensor. Most useful information is found between 30 and 50kHz. The Adash ultrasonic module enables monitoring ultrasonic energy.

Ultrasound utilizes a solid, liquid or gas to transmit (will not exist in a vacuum), and is a very directional and short waveform. It has several things in common with the vibration, for instance the ability to detect the ultrasound energy requires the sensor to be focused in the direction of the waveforms.

Field applications for airborne ultrasound detection:

- Consider the wave energy is easily reflected and attenuated.
- When looking to detect airborne ultrasound energy a rule of half distance twice amplitude is a good thing to consider, this is called the “inverse rule”.
- Remember airborne ultrasound is easily reflected, when detecting a leak, you should turn in the other direction to determine if the sound is coming from behind you.
- Use shields such as cardboard to isolate the potential defect from other sources.

For airborne ultrasound the instrument microphone attachment will detect:

- Air leaks
- Vacuum leaks
- Electrical Arcing
- Electrical Corona
- Tightness testing where a signal generator is located within a sealed unit, then by scanning the sealed areas from the outside leaks can be detected.

The probe attachment that enables direct transmission ultrasound will detect:

- Early signs of poor lubrication in anti-friction roller bearings
- Impacting noise from defects in roller bearings including bearings with shaft speeds under 100 rpm.
- Steam trap leakage and failures
- Gearbox defects
- Valve leakage
- Actuator malfunctions

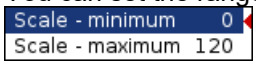
Sensor setting

The ultrasound measurement is available only on AC CH1. You need the ultrasound microphone for that. When you run the module, then the sensor is changed automatically to Pascal sensor.

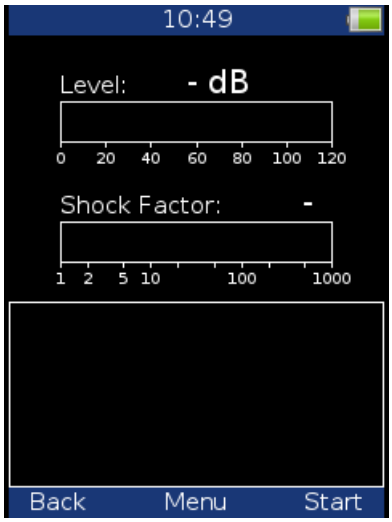
Use the **Menu / Sensors / AC1** to change the sensitivity if needed. The new setting is saved and used in next run.
The original sensor is set, when you leave the module.

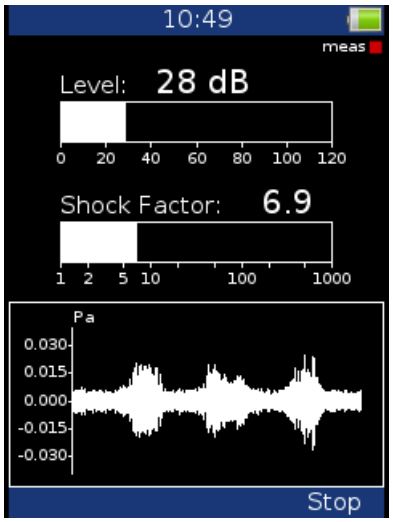
Settings

You can set the range of measurement. Use **Menu / Ultrasound Settings.** Enter required range.



Measurement





Press **Start** button. Two values are displayed. The **Level** of sound in dB and **Shock Factor**. The Shock factor is defined as Peak value divide by RMS value. It means value 1.4 for pure sine. Higher values means that transient shock events are in the sound signal.
The time waveform is displayed at the bottom of the screen. Use **arrow up button** to fit the scale of the graph.
Press **Stop** to stop the reading.

Appendix A: Technical Specification

Inputs

Dynamic Channels (AC)

Number of synchronous parallel channels (AC):	3 AC
Frequency range (-3dB):	0.5 - max 90000 Hz (196608 Hz 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 28 V (up to 25 V for Ex version)
Input impedance:	100 kOhm
Input type:	acceleration, velocity, displacement, any non-vibration AC voltage
Integration:	single or double fully digital integration
2D Processing:	axis rotation according sensor mounting
Accuracy:	< 0.5 %
ICP drive:	18 V, 3.8 mA
User HP filtering:	0.5Hz - 12800 Hz
User LP filtering:	25Hz - 90000 Hz
Connector:	Binder 712 series

Tacho Channel

Number:	1 independent tacho input
Speed range:	0.5 Hz - 1000 Hz
Input impedance:	55 kOhm
Input type:	voltage
Input range:	+/-30 V
Accuracy:	<0.5 %
Trigger level:	0.1 V - 9.9 V, user defined
Input protection:	up to 48 V
Connector:	Binder 712 series

Static Channels (DC)

Number:	3 DC
Input range:	+/- 24 V
Input impedance:	100kOhm (V-DC)
A/D Resolution:	12 bit input
Accuracy:	0.1% fsd
Input protection:	up to 28 V (up to 25 V for Ex version)

Measurement Functions

Data Analysis Speed:	0.1 sec for 25600 lines FFT spectrum
Amplitude Units:	Metric, Imperial (English) or user programmable
Frequency Units:	Hz, CPS, RPM, CPM, Orders
Amplitude scale:	Acceleration, Velocity, Displacement, User defined
Scaling:	Linear or Log, both X and Y axes
Cursor:	Single
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
	order analysis
	Amplitude + phase values on speed frequency
	speed measurement
	process static DC
	Envelope demodulation
	ACMT procedure for low speed machines bearings
Time waveform samples:	256 – 65 536
Waveform (ACMT) length:	max 1024 sec
Spectrum ranges:	25 Hz – 25 600 Hz
Spectrum lines:	100 – 25 600
Spectrum units:	RMS, 0-P and P-P
Windows:	Hanning
Order analysis parameters:	1/2 - 10th order
Averaging:	1-255
Overlap:	yes

Stroboscope

Frequency Range:	1 Hz – 111 Hz (60 RPM – 6660 RPM)
Stroboscope Frequency:	User defined / Externally triggered

Other Accessories

Flashlight:	Yes
Temperature Measurement:	Yes
Temperature Measurement Type:	Infrared
Temperature Range:	-70 °C – 380 °C (-94 °F – 716 °F)

General:

Processor:	ARM Cortex A8
RAM:	1 GB
Display:	TFT colour 117 x 88 mm (3.5'' diagonal), 240x320 resolution
Data Memory:	8 GB (Flash)
Interface:	USB
Powering:	Li-Ion battery pack (more then 8 hours of measurement)
Operating temperature:	-10 °C - +50 °C, 15°F-120°F
Dimensions:	230 x 82 x 32 mm
Weight:	780 g

Appendix B: Standards for vibration measurements

Using standards is a frequent topic in vibration diagnostics. As there are a lot of different types of machines it is impossible to determine the critical limits of vibrations for a wide range of machines. Its reliability would be then low. It could happen that you would repair a machine unnecessarily. The standards should rather be determined for a narrow range of machines.

Adash Limit Values

Adash limits are not rewritten from any existing standard. It is a result of more than 20 years of the **Adash** engineering team's experience. It is difficult to invent a critical value definition which would be simple (which means not many parameters such as speed, power, bearing type, machine type and so on) and reliable.

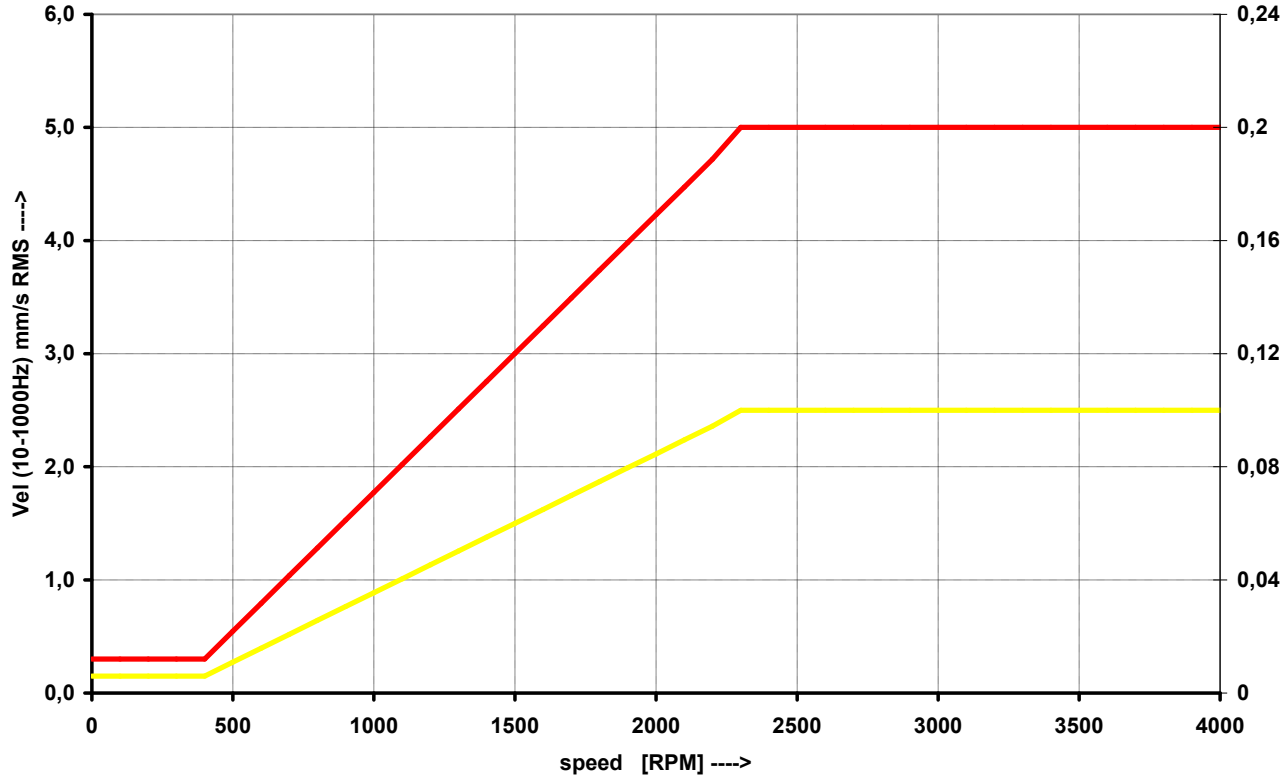
In the figures below you can see how to derive Adash limit values. There are three levels of machine condition defined: GOOD, ALERT (Machines that lay in this range are not acceptable for a long period of operation, they can be operated until time when they can be repaired) and DANGER (Vibration values in this range are considered as very dangerous and machines should not be operated). The corresponding colours are taken from traffic lights - green, yellow and red.
All limit values are related to the speed value. Low speed machines should generate lower vibration than higher speed machines.

You can find three particular areas in the graphs below. The GOOD condition is the area up to the yellow line which means operation without restriction. The area above the yellow line and under the red line is the ALERT condition. It is possible to operate the machine but is has to be checked more frequently and it is necessary to determine the source of the worse condition and plan the repair (for instance change the bearing) or maintenance (balancing, alignment). The area above the red line is the DANGER condition and the machine should not be operated. The first figure contains the values for overall machine condition. The value of overall machine condition can determine unbalance, misalignment or mechanical looseness. They are called “overall” because we can measure them on most of the measuring points on the machine. The second figure contains the limit values of roller bearing condition. This condition is local and can be measured only on the appropriate bearing house.

It is easy to understand the graphs below. It is necessary to know the speed. The instrument (A4900) determines the speed automatically or it can be entered manually by the user. Look at the graph and find the point on the horizontal axis which corresponds to the speed. You will find an intersection with the yellow and red lines above this point. Projections to the vertical axis will determine limit values for yellow (ALERT) or red (DANGER) states. If the measured value is lower than the yellow value the condition is GOOD – green. If the value is above the yellow value and under the red value then the condition is ALERT – yellow. If the measured value is higher then the red value then the condition is DANGER – red.

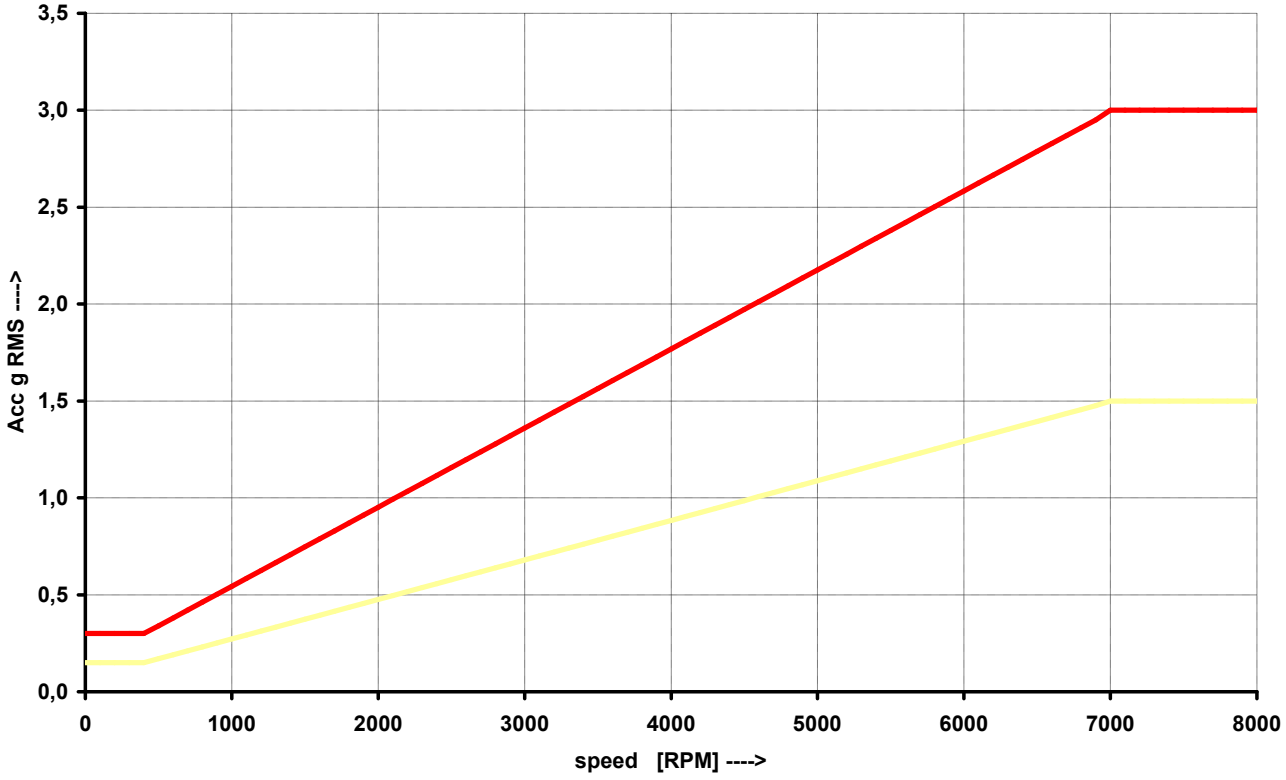
Machine Limits

The machine limits are used for velocity RMS value in 10-1000Hz frequency range.



Bearing Limits

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



ISO 10816 limit values

There is a wide range of valid standards but we would like to mention ISO 10816. It has several sections and it also deals with procedures of obtaining limit values for particular machines. It contains 3 tables of values, which are applicable for the A4300 – VA3Pro unit.

Classification according to machine type, nominal power or shaft height

Select the group which best describes the general size, type, and speed of the machinery being measured. Note that these machine group classifications are set according to ISO 10816-3, which rates overall velocity vibration levels for industrial machines with rated power above 15kW and nominal speeds between 120 RPM and 15000 RPM when measured on site.

ISO Groups 1-4 classifications define the following types of machinery:

Group 1
Large machines (rated power above 300kW) with a shaft height greater than 315 mm. These machines are normally equipped with sleeve bearings.

Group 2
Medium-size machines (rated power from 15 kW to 300 kW) and electrical machines with a shaft height between 160 and 315 mm.
These machines are normally equipped with rolling element bearings.

Group 3
Pumps with multi-vane impeller and with separate driver with rated power above 15 kW.

Group 4
Pumps with multi-vane impeller and with integrated driver with rated power above 15 kW.

Classification according to foundation

An additional setting allows the specification (when defining the overall alarm levels) of measurements taken from machinery with Rigid or Flexible foundations.

Evaluation ranges

The following evaluation ranges are defined for evaluation of the machine health according to vibrations:

Range A: New machine vibrations should be occasionally in this range.

Range B: Machines in this range can be operated for unlimited period.

Range C: Machines in this range are not acceptable for a long period of operation; they can be operated until the repair time only.

Range D: Machines with vibration values in this range should not be operated. There is an acute danger of damage to the machine.

Classification of vibration values for machines groups 1 and 3

Foundation class	**RMS velocity values**		**border zone**
	mm/s	**in/s**	
Rigid **(R13)**	2,3	0,09	A/B
	4,5	0,18	B/C
	7,1	0,28	C/D
Flexible **(F13)**	3,5	0,14	A/B
	7,1	0,28	B/C
	11,0	0,43	C/D

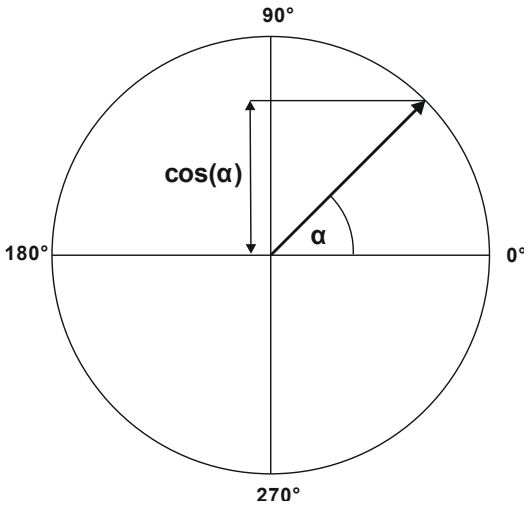
Classification of vibration values for machines groups 2 and 4

Foundation class	**RMS velocity values**		**border zone**
	mm/s	**in/s**	
Rigid **(R24)**	1,4	0,06	A/B
	2,8	0,11	B/C
	4,5	0,18	C/D
Flexible **(F24)**	2,3	0,09	A/B
	4,5	0,18	B/C
	7,1	0,28	C/D

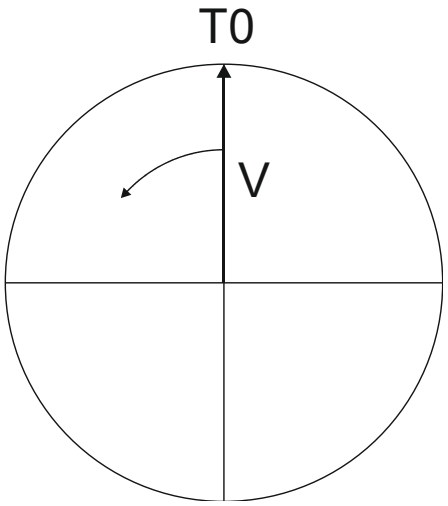
Appendix C : Phase measurement conventions

Single channel measurement with tacho

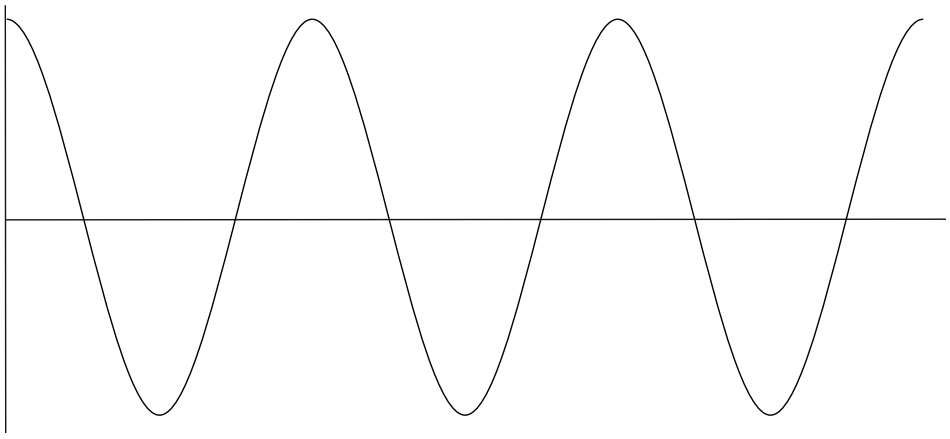
Let's assume the time signal defined as y=cos(ωt). We use the cosine function because FFT uses it too. It simplifies the calculations and understanding.



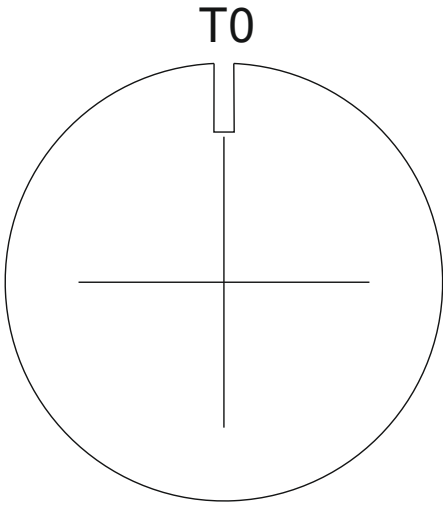
Our starting position of rotating vector V will be 90°, we will mark it as T0.



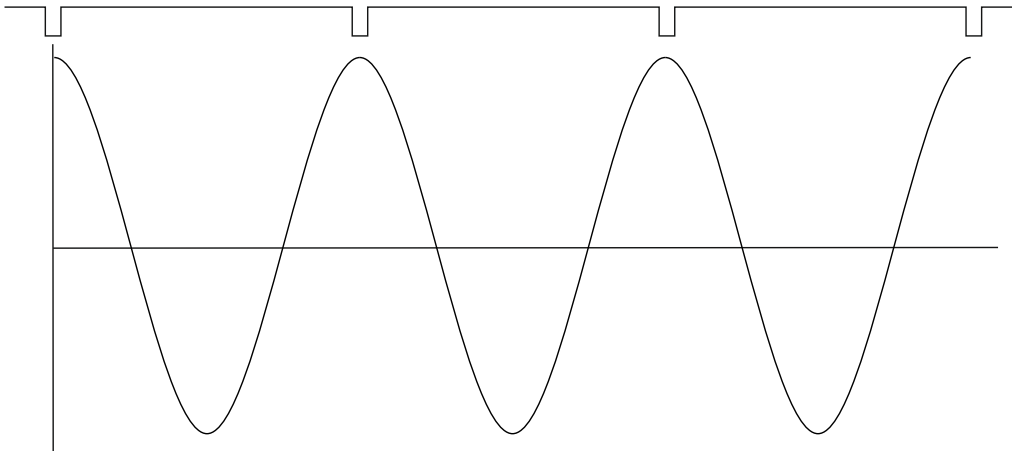
When the vector V rotates for example 3 times, then we get the time signal as follows.



Now we assume the tacho signal. The tacho pulse we put to the T0 position.

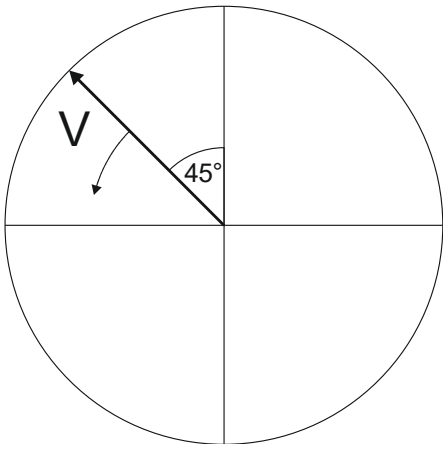


Corresponding time signal with tacho pulses is on the following picture.

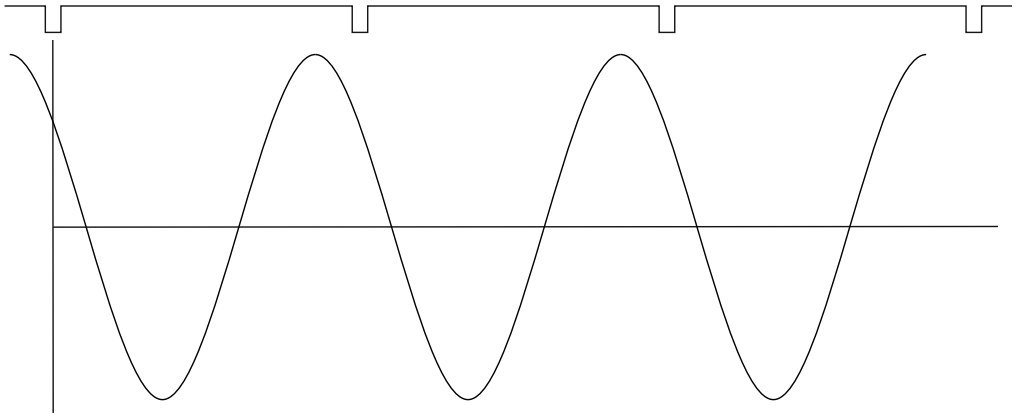


Now we begin to assume the phase shift (marked as φ) of time signal vs. tacho signal. The signal formula changes to y=cos(ωt + φ). The previous picture corresponds with φ=0°. And this value is displayed on the instrument screen. When the tacho pulses are in the maximum time signal positions, then phase value is equal to zero.

Now assume the φ=45°. We use the degrees unit to make it simple for all readers. The radians have to be used in exact math formula.

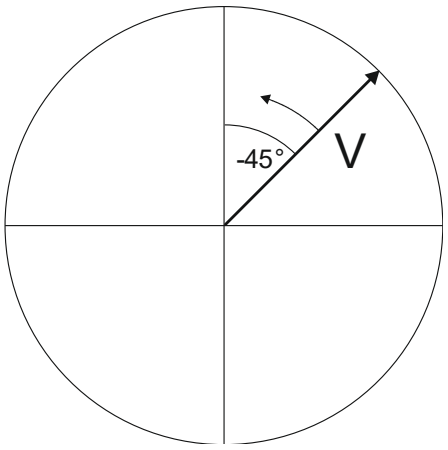


On the next picture is the corresponding time signal with tacho pulses.

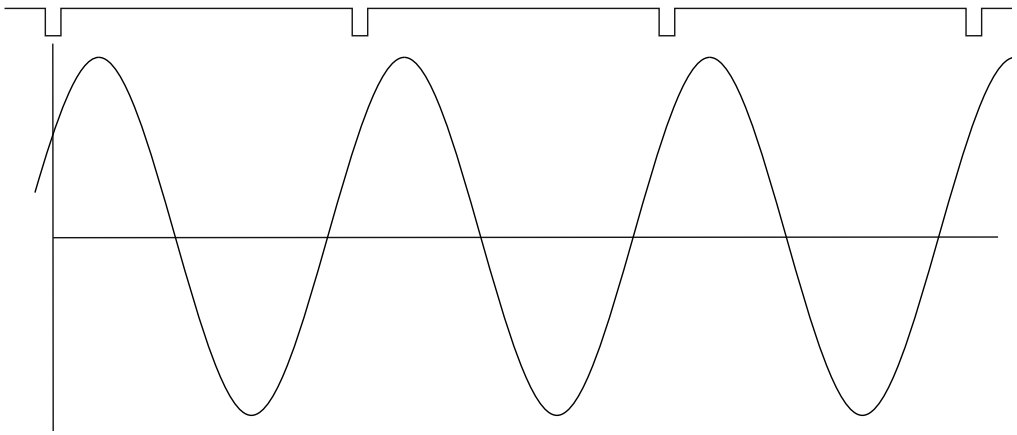


The time signal foreruns (gets ahead of) the tacho signal of the 45°. The 45° appears on instrument screen in this case.

Now we assume the φ=-45°.



On the next picture is the corresponding time signal.



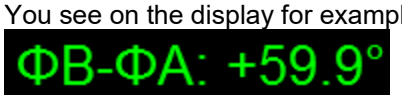
The time signal is delayed. The -45° appears on instrument screen in this case.

This approach is used for single channel measurement as 1xamp+phase and orders.

Dual channel measurement

We must always define the channels of A and B. For example we use channel 1 as A and channel 2 as B. You have to always assign the channel numbers of A and B. The A represents the input channel and B the output channel. You can imagine it as black box and you need to measure the phase response of that.

You see on the display for example this:



The logic is the same as for single channel measurement. The A has the same function as tacho signal. This 60° means that B is ahead (foreruns) the A of 60°.

This approach is used for double channel measurements as phase shift.

Last reminder

We talk about time signals and their positions in time in this chapter. We have used a words such as “signal is ahead”, “foreruns” and on the other side that signal is delayed.

You should always keep in mind:

To be ahead of for example 60° is the same as to be delayed of 300°. Don’t forget that we are working with periodic pure cosine time waveform.

Appendix D: ATEX (optional)

Optionally, the instrument can be in Ex implementation.

Number of certificate

FTZÚ 21 ATEX 0040X

Specification according to 94/9/EC (ATEX) directive

II 3G Ex ic op is IIC T3 Gc

II	Non-mining
3	Zone 2
G	Gas atmosphere
Ex ic	Principe of protection – Intrinsic Safety EN 60079-11, Zone 2
op is	The optical beam of the LED will not cause ignition
IIC	All gasses with temperature classes T1 to T3, see IEC 80079-20-1
T3	Max. surface temperature (during failure) 200°C.
Gc	EPL (Equipment protection level) – Zone 2

Zone 2 – the occurrence of an explosive atmosphere is unlikely, but cannot be ruled out. If it occurs, then only for a short time. this is a probability of less than 0.1% of operating time or less than 10 hours per year in the case of continuous operation.

The instrument is certificated for Zone 2 hazardous areas and must not be used in Zones 0 and 1.

Ambient temperature (operation and storage)

Ta = -10 to +50°C.

When using the recommended speed probe Mini VLS 210/ia, the maximum permitted ambient temperature is +40°C

Certificated accessories

Accelerometers

CTC AC90X, AC91X, AC95X or AC905.
Use only with original cable.

Speed probe

Mini VLS 210/ia.
Use only with original cable.
Maximum ambient temperature, Ta max = +40°C.

Antistatic cover

For carrying the device on the shoulder or behind the waist, a cover is supplied as an optional accessory, which is made of antistatic VINYTOL 752 DUO NV leather. The case is equipped with a removable strap made of the same material and a belt clip. The device is inserted into the package and secured with Velcro.

Attention! The cover is a universal accessory that covers the production label with the device specification. To access the data on the label, the device must be removed from the packaging.
Unapproved standard packaging that comes with a different type of device cannot be used for potentially explosive atmospheres!

Signal specifications

IN1, IN2 connectors for accelerometer

Quantity	Description	max. value	standard value
Uo	Output voltage	<25.2V	21.5V
Io	Output current	<58mA	3.8mA
Co	Sensor capacity	<100nF	70nF
Lo	Sensor inductance	<60uH	51uH

TRIG connector for speed probe

Quantity	Description	max. value	standard value
Uo	Output voltage	<6.0V	5.0V
Io	Output current	<425mA	100mA
Lo	Sensor capacity	<100uH	0uH
Co	Sensor inductance	<10uF	0uF

Using the instrument

Grounding

The operator must be grounded and the instrument is thus grounded through the operator.

Charging

Charge only with the supplied FRIWO FW7290 GPP18Li/8.4V/1.5A charger. Charge only in indoor areas with a non-explosive environment. The ambient temperature during charging must not exceed 0-35°C.

Data transfer into PC

The instrument can only be connected to the host PC in a non-explosive environment. The power supply of the connected PC must comply with IEC60950, IEC61010-1 or must be powered by a battery.

Warning

Only certificated sensors, cables and other accessories such as a protective cover can be connected to the instrument. Disassembling the instrument, any repairs or replacement of the battery by the user, sticking labels and foil on the antistatic surfaces of the instrument, cleaning the instrument with aggressive cleaning agents (alcohol, gasoline, etc.) or any other intervention that could cause a violation of the intrinsic safety of the device is prohibited.

Instrument sticker