USER MANUAL

Adash A4300 VA3 Pro

Content:

For further technical and contact information visit www.adash.com, email: info@adash.cz

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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 then 24 V can cause an accident.

General warnings

AC, DC channels - voltage higher then $\pm$ 28 V (peak) can damage the instrument.

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℃ (32-104° F).

Very high temperature over 50℃ (122℉) decreases b attery 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℃ (14℉) only 70% capacity is availa ble). 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, 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
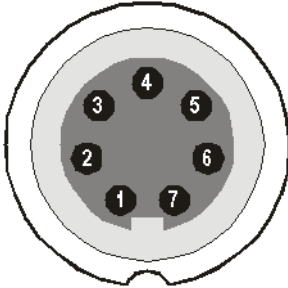
1 – CH1 AC/DC INPUT
2 – GROUND
3 – NOT USED
4 – SHIELDING
5 – NOT USED
6 – NOT USED
7 – NOT USED

IN2 input
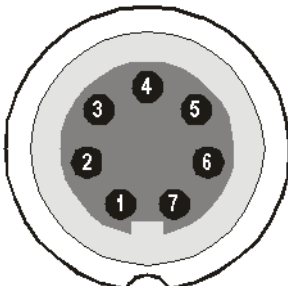
1 – CH2 AC/DC INPUT
2 – GROUND
3 – CH1 AC/DC INPUT
4 – SHIELDING
5 – CH3 AC/DC INPUT
6 – NOT USED
7 – NOT USED

TRIG input
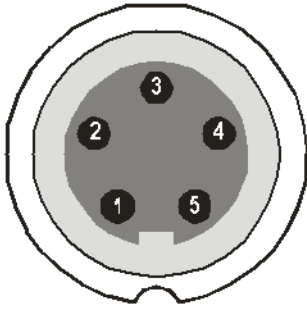
1 – GROUND
2 – GROUND
3 – GROUND
4 – +5 V OUTPUT / 100mA for the tacho power supply
5 – TRIG INPUT - for tacho signal

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.

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). S**peed** measurement, time signal averaging, aps and order analysis are only enabled when the tacho is
set.

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.

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.

External Trig Edge   <u>**rising**</u>**, falling**   The edge used for triggering

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

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.
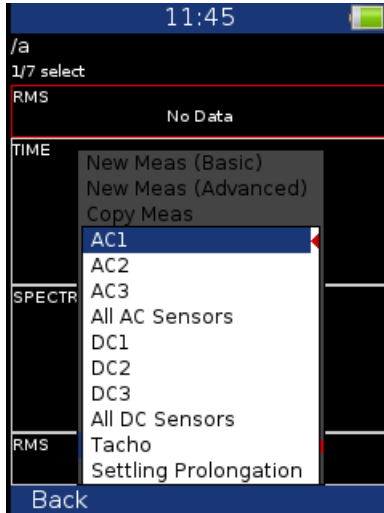
AC1 – AC3   setting of each AC channel properties
All AC Sensors   setting of all AC channels together
DC1 – DC3   setting of each DC channel properties
All DC sensors   setting of all DC channels
Tacho   setting of tacho channel properties
Settling Prolongation if you need longer time for sensor settling, 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
Position   the angle of the sensor (see picture bellow). Usually used for proximity sensors.
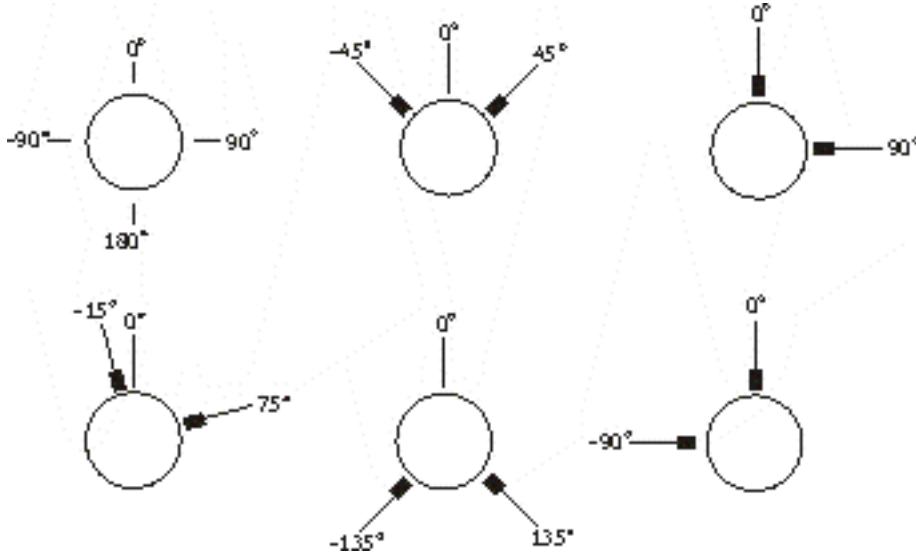
DC sensors

DC sensors are used for discrete current signals, e.g. temperature, pressure, etc .
After selection of **DC1** – **DC3** or **All DC Channels** item the sensor properties menu appears.

Sensitivity[mV/unit]   sensitivity value
Offset[mV]   offset value
Unit   the unit selected from the list or the user unit
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 (it means the end of the tacho mark).

Tacho Trig Level [V] on this the voltage level is created the tacho pulse. We use the falling edge for that. On the picture is the tacho signal (magenta line), the trig level (grey line) and tacho pulse (yellow line).
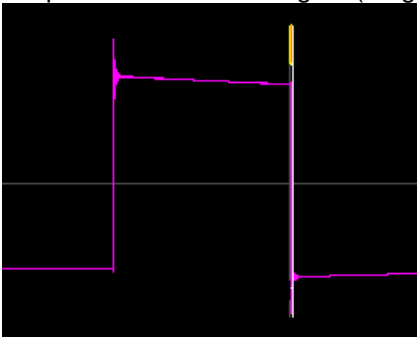
It means that the end of reflexing sticker is used. This level must be between the minimum and maximum of tacho signal. The 5V is the default value, which should work for most of tacho sensors.

You can enter other value manually (**user** item), but to estimate functional value is not so simple. The tacho signal is transformed to 0-10V range before the trig level application. 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.

VA3 can **detect** the suitable value automatically. Use the **detect** function. The min, max of signal will be displayed and also the new trig value value. The tacho sensor must be used and machine must run, when you select the **detect** function.

If the **Signal swing is too small** message is displayed, then the changes of tacho signal are too small fot tacho pulse creation.

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.

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.
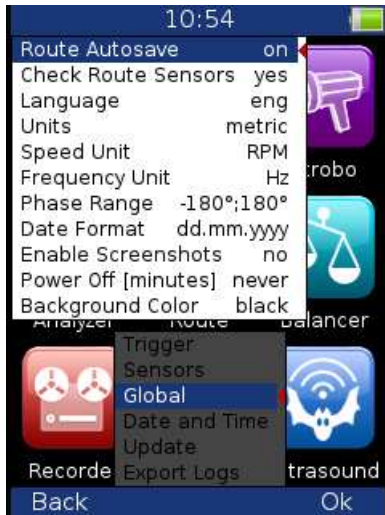
Route Autosave   **off, on**   automatically saves the data after reading is taken (in route mode)

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.

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

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

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

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

Language	**ENG**, **CZE**	
Units	**<u>metric</u>, imperial**	
Speed unit	**<u>Hz</u>**, **RPM**, **CPS**, **CPM**	
Frequency unit	**<u>Hz</u>**, **RPM**, **CPS**, **CPM**	
Phase Range	**-180,180**	
	0, 360	
Date Format	**<u>yyyy/mm/dd</u>**	
	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

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.

```
          13:31          ▐████
Date:        04.12.2015
Time:        13:31:16
Version:     0102
Built:       26.11.2015
Licence:     000000
Memory:      8.0 GB
Used Memory: 0.0 GB (0.6 %)
Free Memory: 7.9 GB (99.4 %)
Battery:     7.62 V (75%)




Back
```
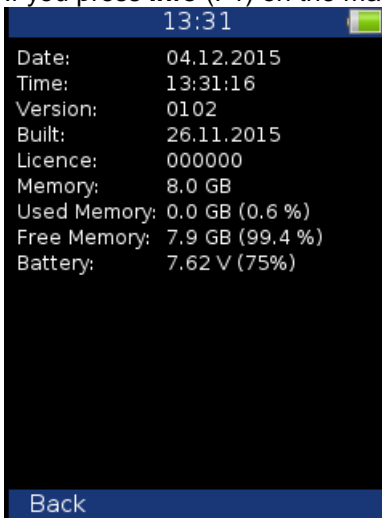
The Main screen

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

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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.

`speed detection ■`

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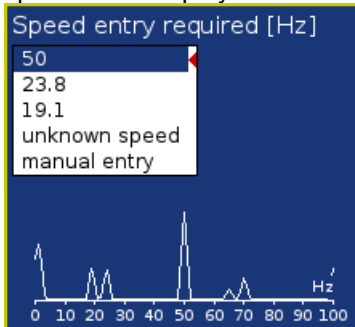
If you want to leave the speed undefined, then select **unknown speed**.
If no value in the list is correct, then select **manual entry** and enter the speed manually.

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 mode

It enables the user to perform basic vibrodiagnostics measurements.

Settings

Press the **Menu** and select the **Meter Settings**.
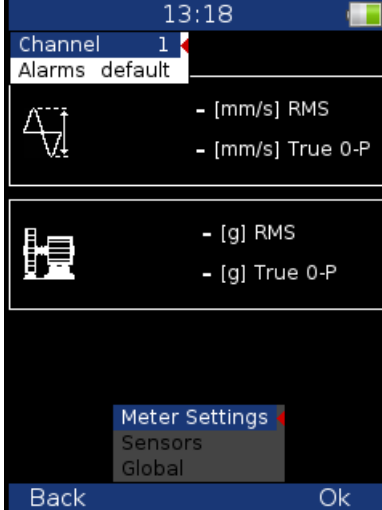
Channel:
> Number of the input channel

Alarms:
> Settings of standards which define the limit values for warning (orange colour) and danger (red colour); see *Appendix C: Standards for vibration measurements.* The measured values are displayed in traffic light colors.
> You can select the Adash standards (recommended, default item) or the ISO 10-816 standards which are much more general.
> Color indication according to ISO 10-816 standards are as follows: A and B range is displayed in green C range is displayed in orange, D range is displayed in red.
> **adash**: Adash limit values, speed detection needed
> **R13, F13, R24, F24:** limit values according to ISO 10-816
> **none**: no traffic-light colors used

Sensor Settings

In the **Sensors** item set up the parameters of the chosen sensor. 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 used

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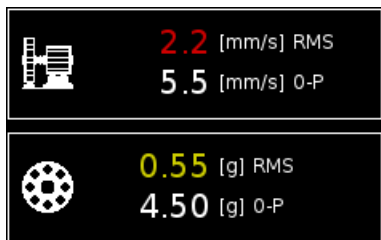
Measurement of Overall and Peak value in the following frequency bands:
velocity: 10 Hz - 1000 Hz
acceleration: 0.5 kHz – 25.6 kHz
The colour describing the condition of the machine (green, yellow, red) is determined according to the speed value and vibration value (RMS, Peak).

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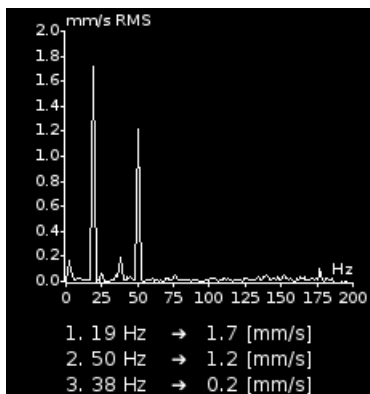
FFT analysis of vibrations in the range 2 Hz - 200 Hz in mm/s RMS
The 3 maximum peaks found are displayed
The peaks are arranged according to the vibration amplitude.

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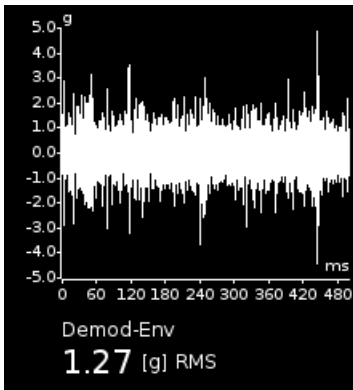
Measurement of time signal and vibrations in the range:
0.5 kHz – 25.6 kHz in g.
The screen shows the actual measured time signal and the Demod - g_{ENV} value.

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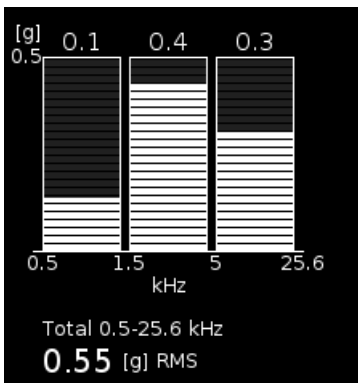
Measurement of RMS vibration values in the ranges:
0.5 kHz - 1.5 kHz in g,
1.5 kHz - 5 kHz in g,
5 kHz – 25.6 kHz in g.
It also displays the Overall RMS [g] value in the range 0.5 kHz – 25.6 kHz

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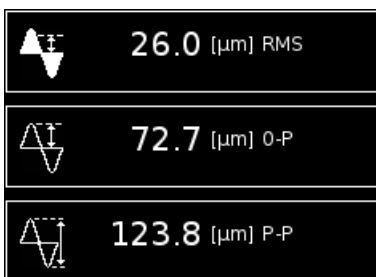
The values of displacement in the range 2-100 Hz are displayed.

For further technical and contact information visit www.adash.com, email: info@adash.cz
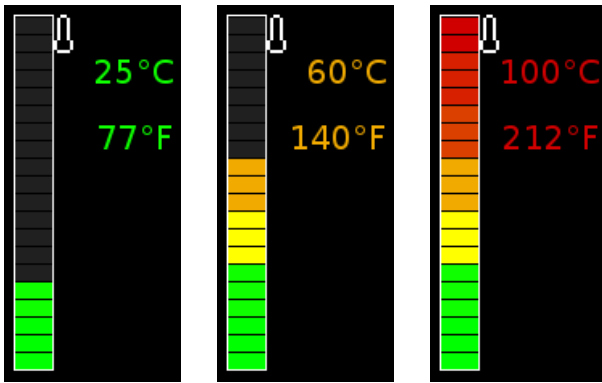
Temperature

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, 60-7 5°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.

Attention !
The FASIT correctly analyses only machines with speed over 10Hz (600 RPM). The velocity measurements is in the 10-1000Hz range.

Settings
Press **Menu** and select **FASIT Settings**.
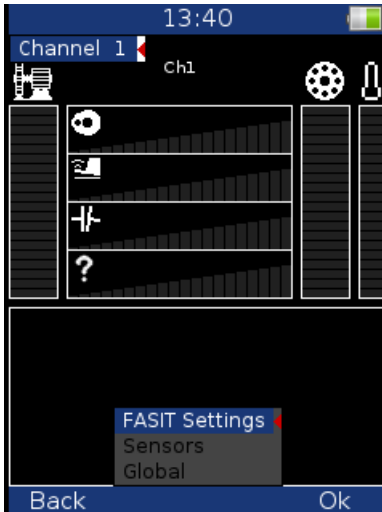
Channel:
> The number of the input channel

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

Units
The displayed units can be set up under the Global 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
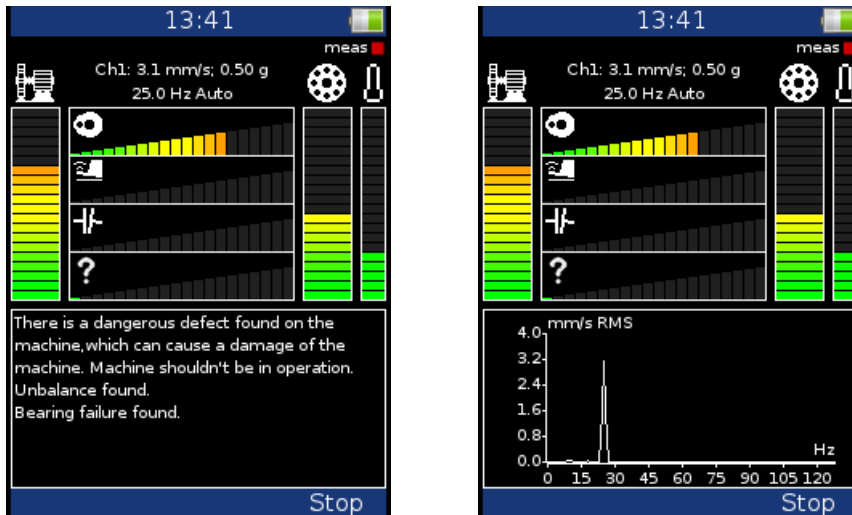
The running measurement is indicated by a flashing red icon labeled **meas** in the top right corner.

Information about the measurement status and settings is displayed at the top of the screen: the number of the input channel used, 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.

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

The Analyzer mode

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.
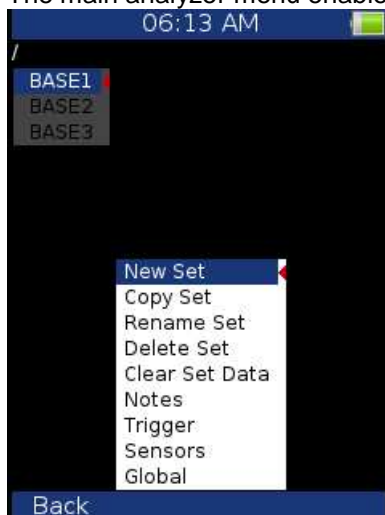
New Set

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).
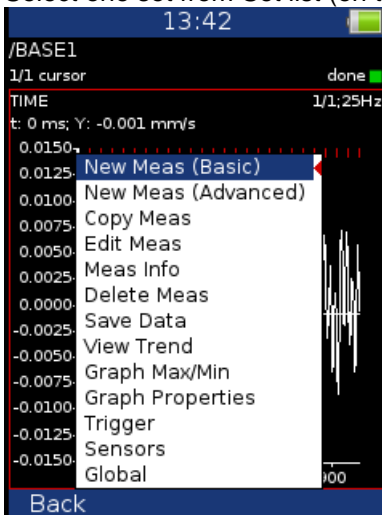
New Meas

New Meas (Basic)

List of predefined templates appears. You can select one of them.
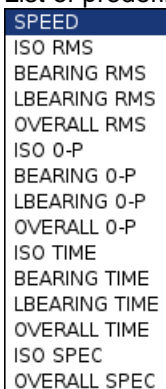
New Meas (Advanced)

The menu for definition of reading appears. The content of the menu changes according to the measurement **Type** selection (first row). See next images.
For detailed description of parameters see the VA4Pro manual.

```
Type      wideband
Channel          1
Unit             g
Detect Type   RMS
Fmin[Hz]        10
Fmax[Hz]    1000
           fs = 4096 Hz
Samples      4096
               t = 1 s
Avg            off
        total t = 1 s
```

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

```
Type          time
Channel          1
Unit             g
Fmin[Hz]        10
Fmax[Hz]   1000
           fs = 4096 Hz
Samples     4096
               t = 1 s
Avg            off
        total t = 1 s
```

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

```
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
```

```
Type              smax
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
```

```
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%
```

```
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%
```

```
Type  speed
Unit      Hz
Avg       off
```

```
Type              acmt
Channel                1
Unit                   g
Fmin[Hz]             500
ACMT FS[Hz]         1024
Samples             4096
                  t = 4 s
```

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

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

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

```
Type      dc
Channel   1
Unit      µm
Avg       off
```

```
Type          center line
A channel number  1
B channel number  2
Unit              µm
Avg               off
```

```
Type   fasit
Channel  1
```

```
Type  ir temperature
```

```
Type  ultrasound
```

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

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] (value)   The high cut-off frequency of band pass filter, which is applied to the signal before further processing (evaluation). The information about sampling frequency (fs=) is displayed under this item.

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).

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 (for spectra)
                        linear, maximum, minimum, median (for static values)

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   When you use the tacho for e.g. APS measurement, the choice of resolution is available. The number of FFT lines must be chosen in the computational procedure. The FFT with fewer lines is faster and displays results more often. When you select higher resolution (e.g.speed/64), then more lines must be used and you will wait for the results longer. If you have some considerable spectrum amplitude near the speed frequency, then you need to select the higher resolution. It eliminates the disturbing influence of the non speed frequency near the speed.
Example: the speed is 25 Hz. The resolution is speed/4, i.e. 6.25 Hz. The speed line bandwidth in FFT will be 6.25Hz. 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.

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.

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.

Functions for Set

Next function 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.

View Trend/ View Actual

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

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	**<u>max</u>**	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

<u>orbit</u>	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.

Detect Type

Detect Type -   **<u>RMS</u>, 0-P, P-P**   Y axis type

Applied for spectrum, g-demod spectrum, orders.

Graph Lines

Graph Lines   **<u>continuous</u>, discrete**   the spectrum can be drawn as line through the tops of line or as discrete vertical line for each frequency
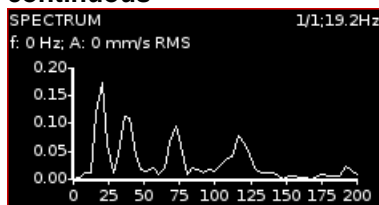
continuous   **discrete**
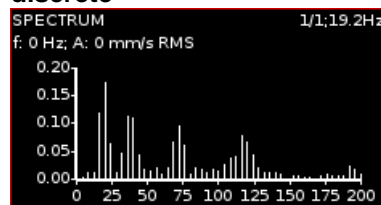
Applied for spectrum, g-demod spectrum.

The Analyzer buttons description

The Start and Start/S button

The **Start** button (F3) starts the reading (measurement).
The **Start/S** button (F3) can be used for two functions:
- press it shortly - then new reading is started
- press and keep it for 2 seconds - then the data are saved

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 0.35 Hz (-3dB point). See the response graph.

For further technical and contact information visit www.adash.com, email: info@adash.cz
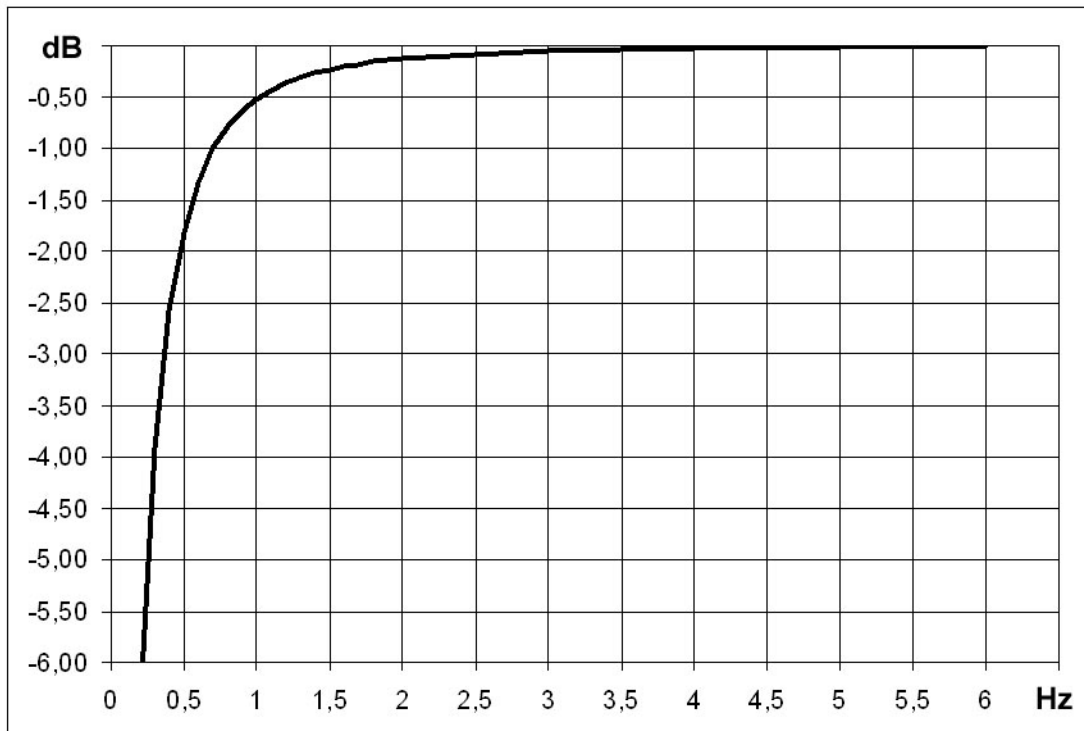
The Route mode

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 VA4 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.
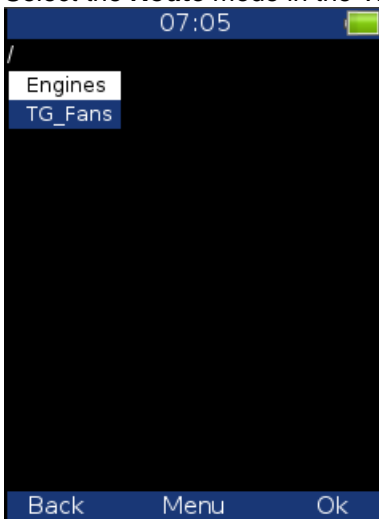
Select one route and press **OK**. The list of machines appears.

For further technical and contact information visit www.adash.com, email: info@adash.cz
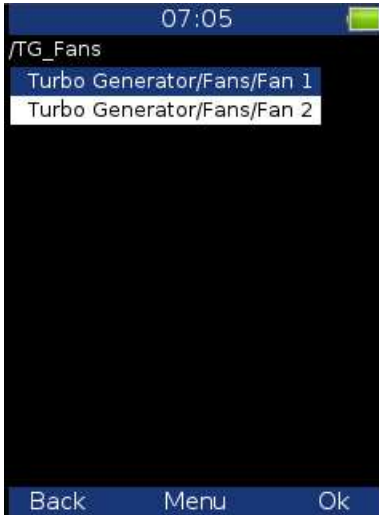
Select one machine and press the right arrow to display the list of points.
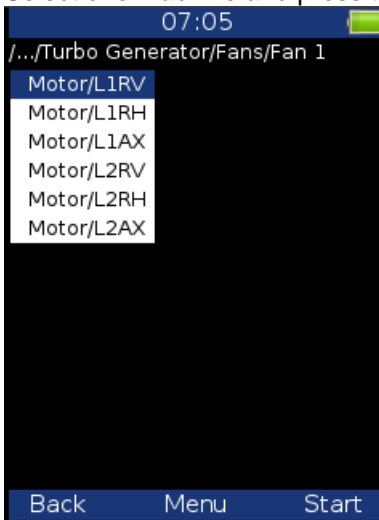
Now you can start the measurement by pressing **Start** (F3) or display the list of measurements defined in this point by pressing the right arrow button.
Use the left arrow button to return to the previous level in the tree.

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.

For further technical and contact information visit www.adash.com, email: info@adash.cz
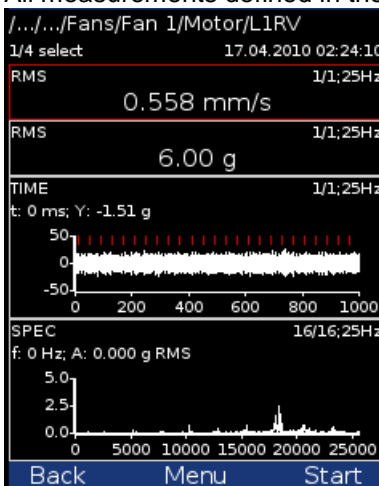
Press the **Back** button (F1) to return to the list of points. The measured point is labeled by the tick symbol √ (all defined measurements were taken) or by the exclamation mark symbol "!" (some readings were not taken due to error) or by the dot symbol "." (measurement not complete).
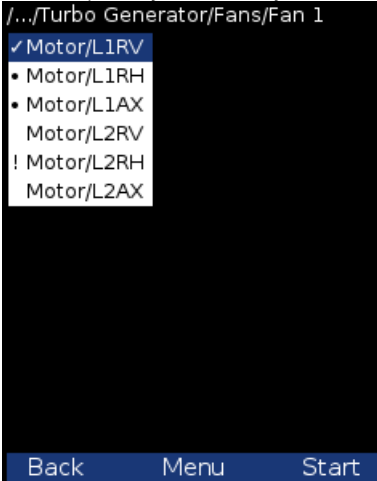
Downloading the route to the computer

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.

Reference values

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

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

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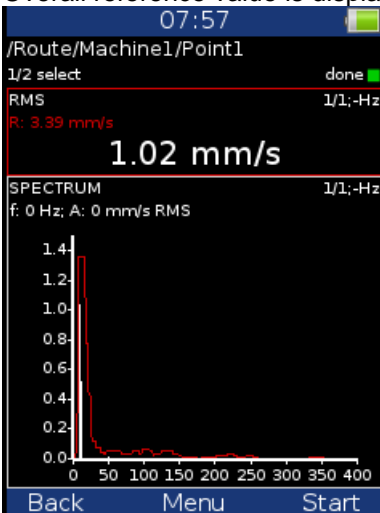
Manual entry

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

Enter value [°C]
Manual Entry

Notes

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

Notes
Point_B
empty list

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

Add Note
user text
Machine is not running
New bearing
New motor
New coupling
New belt
Unsteady operation
Dirty machine
Oil under machine
High noise
Suspicious noise
High temperature
Gauge does not work correctly
Machine under service
Mounting bolt missing

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**.

Edit Note
Machine is not running

Edit Note
Machine is not running
John, what is the reason?

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

Notes
Point_B
09/22/2016 08:38:07 AM
Machine is not running
John, what is the reason?

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.

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 up on DDS as the tree item parameter. **Default Speed** can by entered as a value or as a **Variable Speed**. The **Variable Speed** is detected before the measurement itself (see the **Speed Detection** chapter). Detected speed is valid for whole machine. Unless you close the machine item, the same speed value is valid and no other detection takes place.

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

The Balancer

Introduction

The balancing process is based on standard measurements of amplitude and phase on the speed frequency. The VA3 balancer includes many special internal functions, which remove the influence of noise and speed changes etc. 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 the words 'plane' and 'point'. The sensor is mounted to the point or points (dual channel reading). The trial mass and final masses are mounted to the plane or planes. Some people talk about measuring on planes, but this is not correct. In case of overhanging rotor there is no direct relationship between points and planes.

We use the labels A and B for points and 1 and 2 for planes.

The Project

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

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

- Create the project.
- Enter the parameters of the project.
- RUN 1 - Initial measurement of the vibration amplitude and phase is taken at the required number of points.
- Place a trial mass on the plane. Repeat this step on the second plane if required.
- RUN 2 - Trial mass response measurement is taken. Repeat this step on the second plane if required.
- Place final masses put on all planes.
- RUN 3 – This checks the effect (success) of the balancing job.
- Trim - Additional trimming can be carried out for better results.

The Project Screen

Every step is displayed on its own screen. You can move between screens by pressing the left/right arrow buttons.

This movement enables you to return back anytime.
Attention: When you return back to the job screens and take the reading again or enter the value, then the measured data will be erased in all screens after the current screen. The reason is simple; the implications are derived from every screen to the following screens. When you repeat the measurement, you change the parameters for those implications. That is why all the following screen implications must be removed and you have to take all the necessary readings again.

The first screen

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).
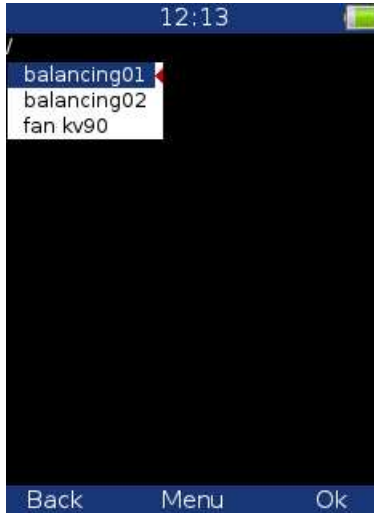
New Project	when you select the New Project item, you have to enter the name of the new project.
Copy Project	creates the new project as a copy of the selected project. Only **Balancer Settings** are saved. No measured data are saved.
Rename Project	renames the selected project.
Delete Project	deletes 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).

Project menu

Balancer Settings

All project properties are defined here as follows:

Planes	**single**, dual	plane(s) balancing
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: 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 **yes, no** the trial masses can be left on the rotor or removed after the trial run. When the trial mass is kept on the rotor, then it must be included into the final mass calculation.

Balancing Masses **add (mount**) / **remove (drill)**

Blades the number of blades (for rotors with blades). This parameter is used in calculations to split the mass between blades.

Meas Mode **single, online meter** when you press the **Start** button, then only one measurement value can be taken (**single**) or the continual measurement values displayed (**online meter**). In the **online meter** mode you can look at more values and evaluate their changes over time. When the value which you want to use is displayed, you need to **STOP** the measurement.

Avg the averaging of more then one measured value is available

Resolution read the explanation in the Analyzer mode chapter: Meas functions/ New Advanced section.

Amplitude   amplitude unit
Value type   **RMS**, 0-P, P-P
Speed   speed unit
Mass   mass unit

Rotor Settings

Parameters of the rotor are defined here. All parameters are optional. It enables calculation of the balancing quality factor according to ISO1940.

Rotor mass	rotor mass in kg
Correction Radius	radius to which the balancing mass will be mounted
Balance Quality Grade	the value, which is defined by rotor type according to ISO1940
	If entered, the recommended trial can be computed.

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 the dynamic factor of the rotor. The trial run measurement is not needed in this case. The value of the dynamic factor is known from previous measurements on the same rotor. See below.

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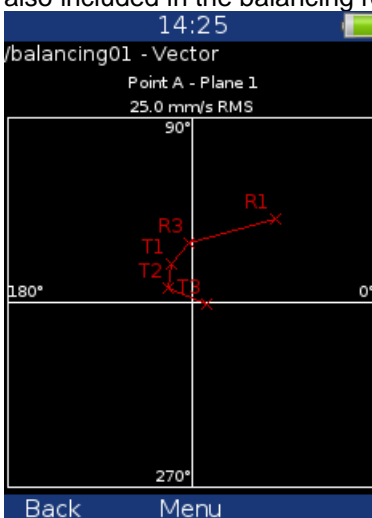
Description: R1-RUN1, R3-RUN3, T1-T3 -trims 1-3.

RUN 1 screen – Initial measurement

Press the **Start** button and the reading will be taken (or enter the values manually).

```
          15:14
/balancing01 - Run 1
      Initial measurement
                              done
Amplitude [mm/s RMS]: 12.5
Phase [°]:              +56
Speed [RPM]:           1500




    Back      Menu      Start
```

Use the **right arrow** button to move to the next screen.

RUN 2 screen – Measurement with trial

You need to mount the trial mass in order to take the RUN 2 screen – response reading.

You can mount the trial mass anywhere on the plane (mark this position because it will be your zero position).

Enter the weight of the trial mass (Menu/Enter Trial) and mount the mass onto the plane. The weight can be negative, it represents removing of mass (for example dismounting of old balancing mass).
The recommended weight is displayed if the **Rotor settings** parameters are entered.

Press the **Start** button and reading will be taken (or enter the values manually).

```
          15:14
/balancing01 - Run 2
      Measurement with trial
Trial [g]:             45    done
Amplitude [mm/s RMS]: 19.0
Phase [°]:             +145
Speed [RPM]:           1500
DFA:                   501
DFP [°]:               +179




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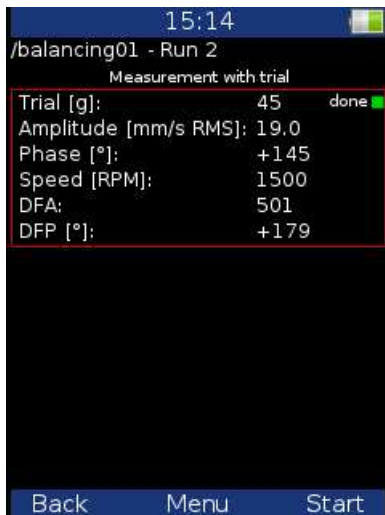
After the RUN2 reading the dynamic factor is displayed. The **DFA** and **DFP** (amplitude and phase) values are the response values of standardized trial mass (mm/s$_{RMS}$ / 1kg regardless of the selected unit for balancing). If you balance the same machine again after some time, then you do not need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

Use the right arrow button to move to the next screen.
The trial mass reminder message appears.
Remove trial mass - if the **Remove Trial** option is set to yes
Do not remove trial mass - if the **Remove Trial** option is set to no

RUN 2 - the RESULT screen

The weight and phase(position) of the final balancing mass are displayed. Mount the final mass. The angle is applied from the trial mass position, which represents the 0 (zero) degrees. The direction of the angle is the same as the direction of rotation. E.g. +57 degrees means from the trial mass position in the direction of rotation. Minus degrees means against the direction of rotation.
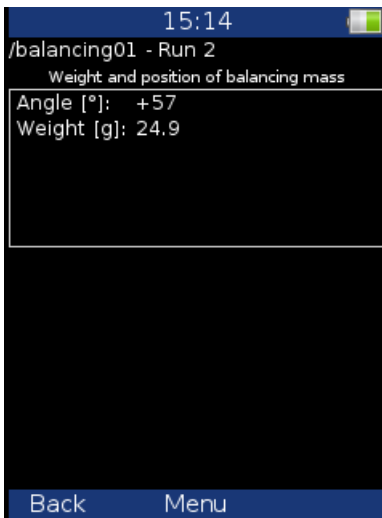
```
                  15:14           
/balancing01 - Run 2
       Weight and position of balancing mass
 Angle [°]:   +57
 Weight [g]: 24.9




 Back        Menu
```

If the number of blades was defined, the final mass is divided between the two nearest blades to the exact balancing angle. The angle position is always measured from the position of the trial mass.

```
                  15:15           
/balancing01 - Run 2
       Weight and position of balancing mass
 Blade:       1
 Weight [g]: 6.63
 Blade:       2
 Weight [g]: 22.1




 Back        Menu
```
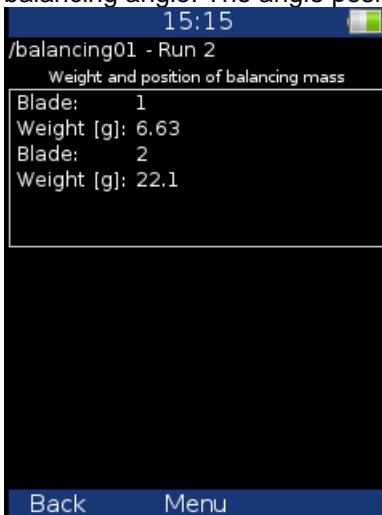
The RUN 3 screen

When the mass or masses are mounted then it is the time to check the balancing job. The screen is very similar to the RUN 1 screen.
Take the reading or manually enter the values.
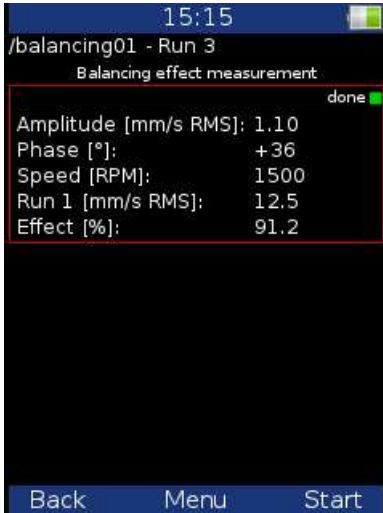
RUN 1	amplitude of RUN 1
Effect	the reduction of balancing in % (the 1.1mm/s is 91.2% less than 12.5 mm/s)
Quality	balancing quality factor according to ISO 1940 (mass of rotor and radius of balancing required)
	If the rotor settings are entered then the **Quality** factor is displayed instead of **Effect**. Press the **Shift button** and the **Effect** will be displayed.

Trim Screens

If you are not satisfied with the results then you can continue the balancing job after the RUN 3 measurement (press the **right arrow** button). These next steps do not require the trial mass measurements anymore. After each reading the next mass (or masses) is recommended. The trim screens are very similar to the screens described before.
The recommended trim mass is displayed. After mounting the trim mass, press the right arrow button.
The TRIM 1 screen appears. It is the same screen as the RUN 3 screen. Run the measurement or enter the values.
Then the new results, effect and quality value are displayed.
Press the right arrow and continue with TRIM 2 in same way as with TRIM 1. You can use as many trims as you want. However, when the trim result is not better (or even is worse) it makes no sense to keep trimming.

Dual plane balancing

RUN 1 screen

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.

```
┌─────────────────────────────────┐
│          15:14          ▮▮       │
│ /balancing02 - Run 1            │
│        Initial measurement      │
│ ┌───────────────────────────┐   │
│ │ Point A           done ▇  │   │
│ │                           │   │
│ │ Amplitude [mm/s RMS]: 12.8│   │
│ │ Phase [°]:          +35   │   │
│ │ Speed [RPM]:       1500   │   │
│ └───────────────────────────┘   │
│                                 │
│   Point B            done ▇     │
│                                 │
│   Amplitude [mm/s RMS]: 10.0    │
│   Phase [°]:          +156      │
│   Speed [RPM]:       1500       │
│                                 │
│  Back       Menu       Start    │
└─────────────────────────────────┘
```
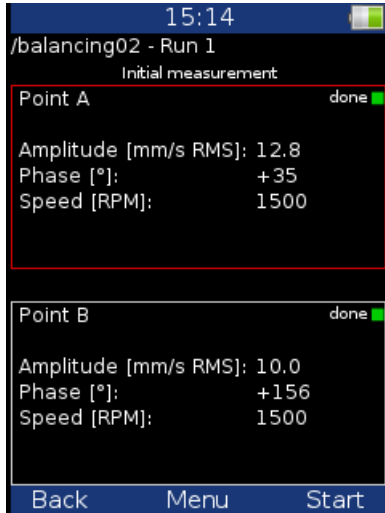
RUN 2 with trial mass on Plane 1

This is similar to single plane balancing, except that two trial masses must be mounted onto the two planes. If you know the dynamic factor, then you can enter all 4 values manually and you do not need to measure the RUN 2.

Enter the weight of the trial mass (Menu/Enter Trial). The weight can be negative, it represents removing of mass (for example dismounting of old balancing mass).
The recommended weight is displayed if the **Rotor settings** parameters are entered.

After the reading at Point A take the reading at Point B (or take them both at the same time, if you are using 2 channels). The trial mass remains on Plane 1.
After measuring both planes with the trial mass on Plane 1, remove the trial mass from Plane 1.

Press the **right arrow** button.
The trial mass reminder message appears.
Remove trial mass – if the **Remove Trial** option is set to yes
Do not remove trial mass – if the **Remove Trial** option is set to no

RUN 2 with trial mass on Plane 2

Now we have to take the readings with the trial mass on Plane 2. The screen for those measurement is similar to the previous screen.

Press the **right arrow** button.
The same reminder message appears as in the previous run.

RUN 2 - Result screen

Mount the final masses onto both planes. The angle is applied from the trial mass position, which represents 0 (zero) degrees. The direction of the angle is the same as the direction of rotation.

If the number of blades was defined, the final mass is divided between the two nearest blades to the exact balancing angle. The angle position is always measured from the position of the trial mass.

The RUN 3 screen

When the masses are mounted then it is the time to check the balancing job. The readings on both planes are required. The screen is similar to the screen in single plane balancing.

Trim Screens

If you are not satisfied with the results then you can continue the balancing job after the RUN 3 measurement (press the **right arrow** button). These next steps do not require trial mass readings anymore. After each reading the next masses are recommended. The trim screens are similar to the screens in single plane balancing.

Balancing Errors

Balancing errors and warnings can occur during the job.

The effect of trial weight is low

This message informs you that the effect of the trial mass is low.
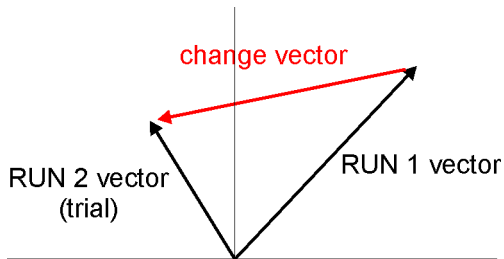
The percentage value is derived from the ratio (amplitude of vector change/ amplitude of RUN 1 vector).

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

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

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).
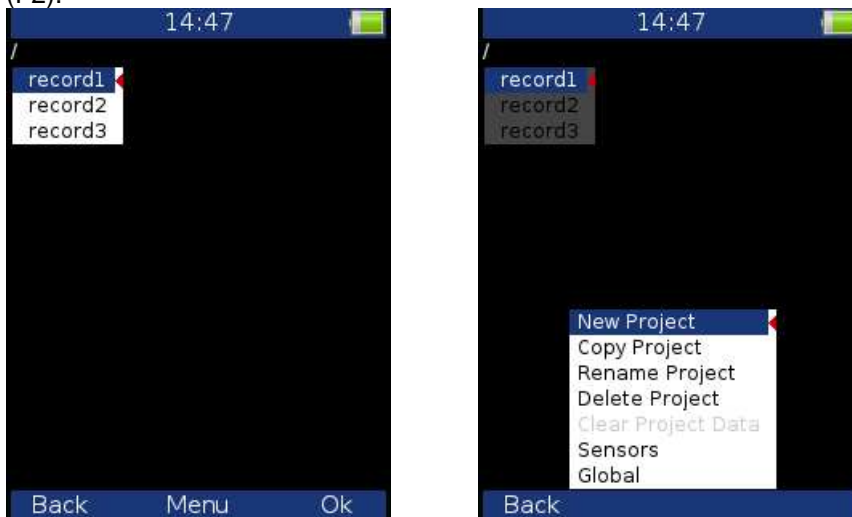
New Project

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)**.**

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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.
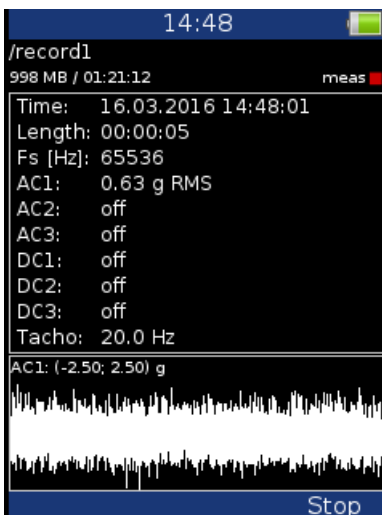
Recording

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.
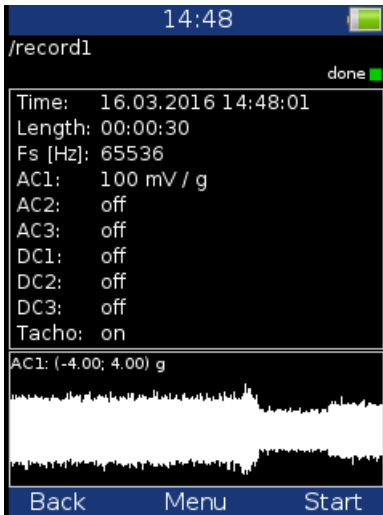
Record analysis

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.
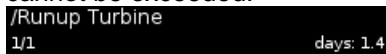
Measurement settings

Measurements are defined in sets, use the same way as in **Analyzer** mode.

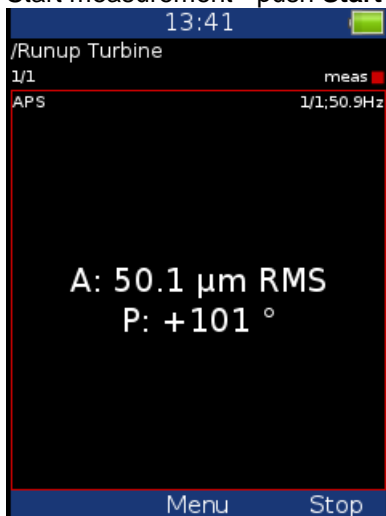For example we define only one measurement in set. The proximity sensor on channel 1 is used.
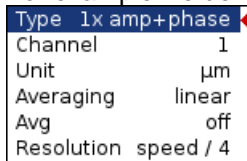
The **Runup mode** is set to **speed** and the value is 1Hz.

Measurement

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

The last measured value is on the screen.

For further technical and contact information visit www.adash.com, email: info@adash.cz

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.

```
01.11.2009 12:31:08
02.11.2009 16:32:55
03.11.2009 15:32:14
04.11.2009 19:08:13
```

Select one trend from the list and press **OK**. The trend is loaded and displayed.
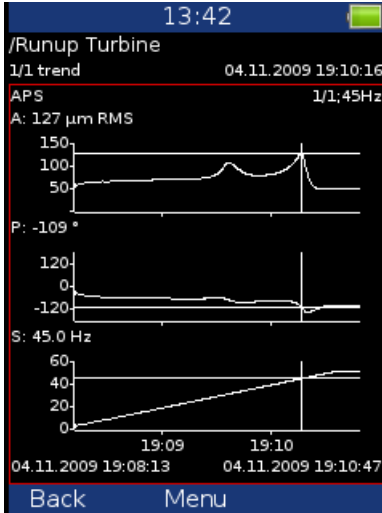
Use the **Shift** button to change arrow buttons meaning. Set the arrow buttons to **trend**.

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.
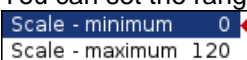
Used Sensor
on AC1: 200 mV / Pa; ICP off

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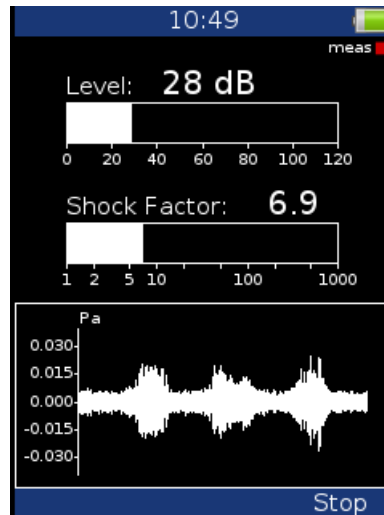
The original sensor is set, when you leave the module.

Settings

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

Scale - minimum   0
Scale - maximum   120

Measurement

10:49	10:49 meas ▪
Level: - dB	Level: 28 dB
0 20 40 60 80 100 120	0 20 40 60 80 100 120
Shock Factor: -	Shock Factor: 6.9
1 2 5 10 100 1000	1 2 5 10 100 1000
	Pa 0.030 0.015 0.000 -0.015 -0.030
Back Menu Start	Stop
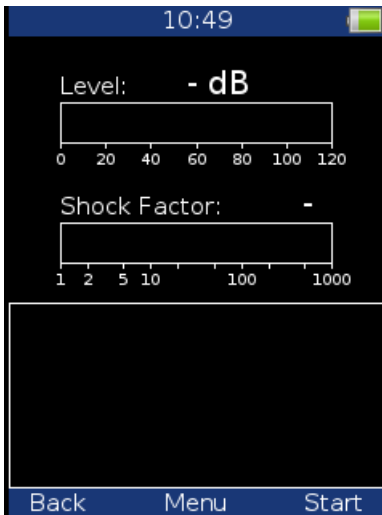
Press **Start** button. Two values are displayed. The **Level** of sound in dB and **Shock Factor**. The Shock factor is defined as Peak value divide by RMS value. It means value 1.4 for pure sine. Higher values means that transient shock events are in the sound signal.
The time waveform is displayed 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:	max 25600 Hz
	(65536 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
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
High pass filter:	1Hz -12800 Hz (user definition)
Low pass filter:	25Hz -25600 Hz (user definition)
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

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 ℃ – 380 ℃ (-94 ℉ – 716 ℉)

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 ℃ - +50 ℃, 15℉-120℉
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.

For further technical and contact information visit www.adash.com, email: info@adash.cz

Adash Limit Values of Machine Vibrations

The machine limits are used for velocity RMS value in 10-1000Hz frequency range.
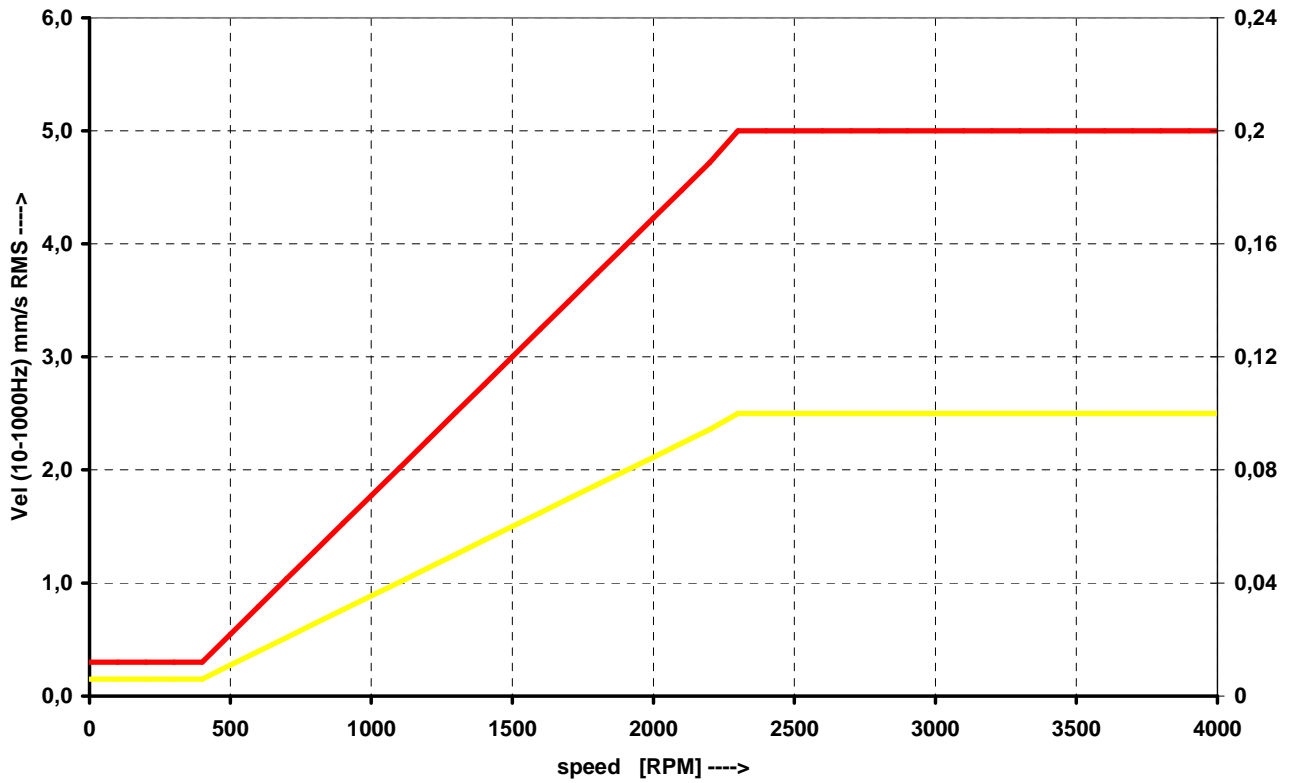
Adash Limit Values of Bearing Vibrations

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

For further technical and contact information visit www.adash.com, email: info@adash.cz
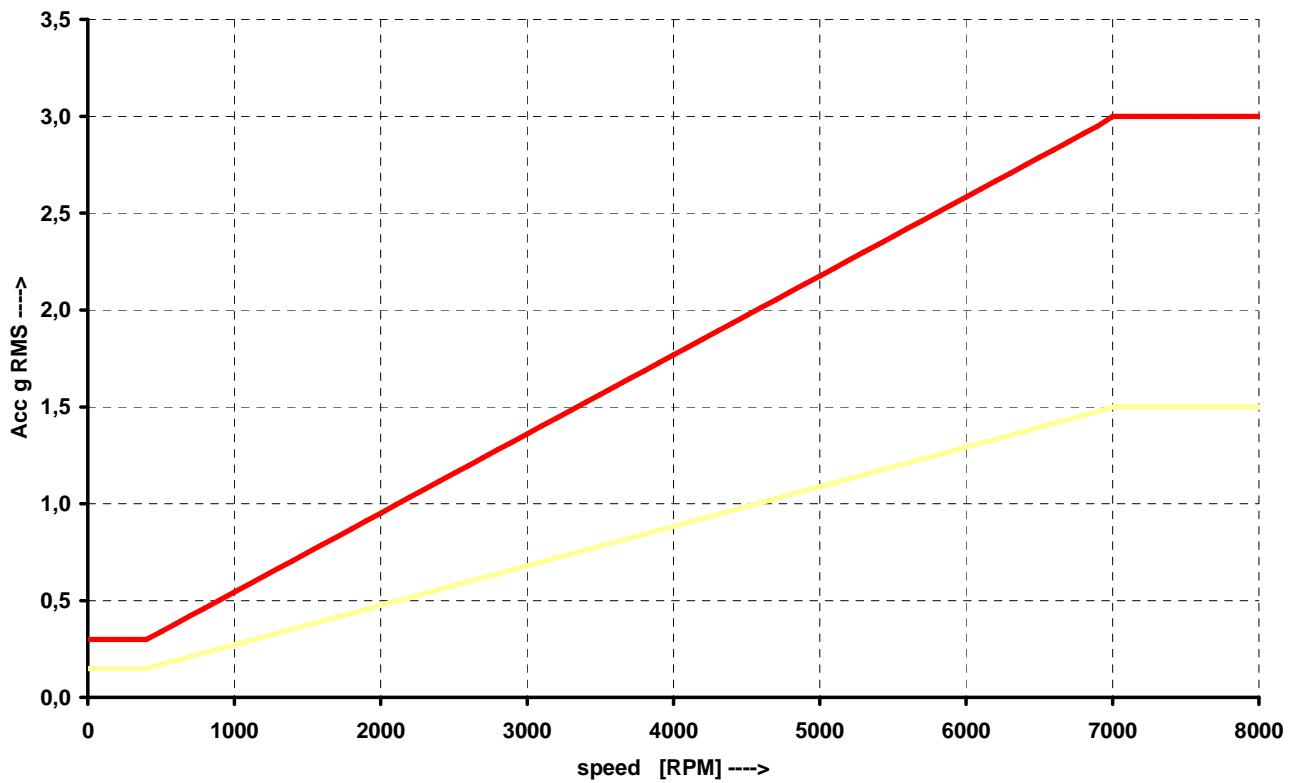
ISO 10816 limit values

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.

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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

<u>Appendix C: ACMT bearing and gearbox measurement</u>

Applications

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

Description

There are various processes which produce short duration pulses in slow speed machinery. These pulses are often caused by rolling element bearings, gearbox wear, etc. It is important to be able to accurately detect and analyze these pulses for correct diagnosis.

The individual pulse can have very short duration. Consequently it is necessary to set a high sampling frequency for the measurement. Only in this way it ensures to obtain a correct measurement of signal amplitude.

The time interval between pulses can be very long when the speed is low (seconds, minutes). We need to see the time signal which contains several pulses as minimum for correct evaluation. The long length of time signal is required, so we need to use the low sampling frequency.

These two aspects cause a conflict in the measurement setting:

1. We need to use high frequency sampling for pulse measurement, which means the measured signal will be very short e.g. 100ms. When the time interval between pulses is in seconds we have a low chance to catch it. And we have no chance to have more pulses in one time signal.

2. We need a low sampling frequency for long time record e.g. 10s to obtain more pulses in one signal. But with such sampling we cannot measure the pulse, because the high frequencies (pulses as well) are cut out by anti-aliasing filter. If we switch off this filter, we have also no chance to catch it, because pulse duration is short and time period between samples is long.

ACMT is the solution

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

Example

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

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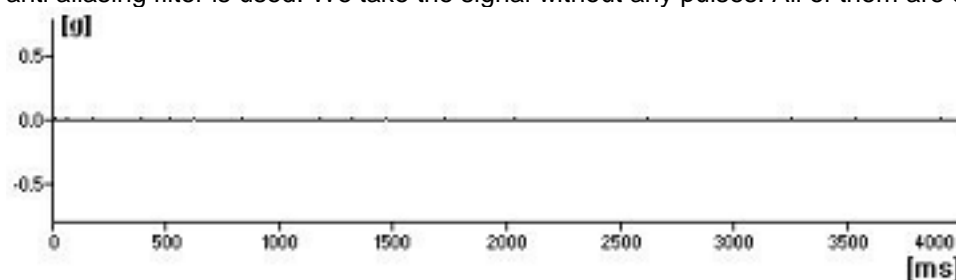

We use the 19200 Hz sampling frequency. But we can measure only 42ms time signal. The time between the pulses is 114 ms. We need to be lucky and to hit the pulse.
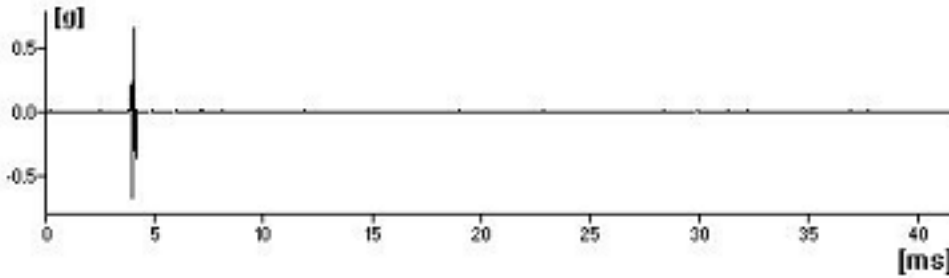
Next measurement uses the ACMT method. As you can see, it works. Long time signal contains required number of pulses and the peak of each of them is captured. That is what we need.

The ACMT method can do even more

Short duration pulses have usually small amplitude. They are often modulated by speed frequency.
We use standard measurement and result is in the next picture.
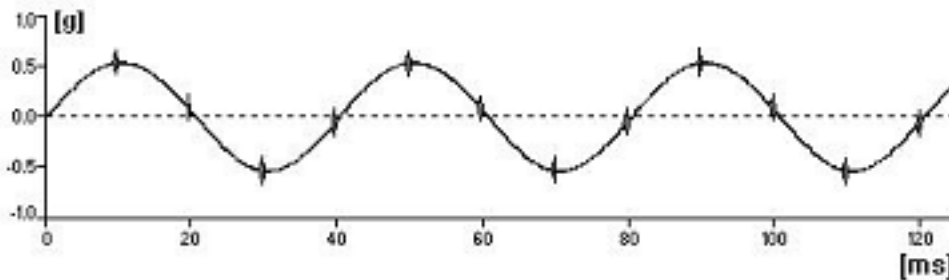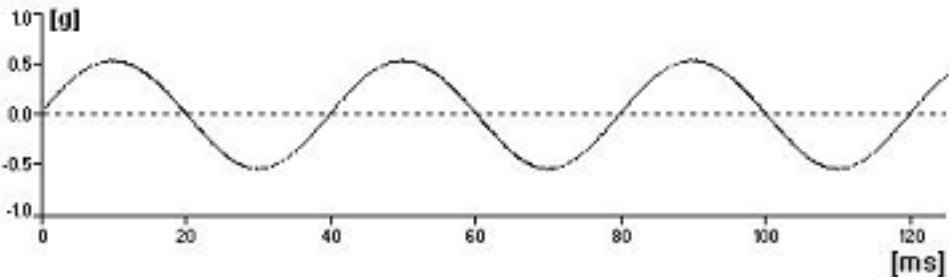
You see only speed sine wave and none or small pulses, which are filtered by anti aliasing.

The standard ACMT is used in the picture below. We used the ACMT together with band pass filtering which removes the speed sine wave from the signal.
The all short-pulses are held and amplitude is modulated for better view.
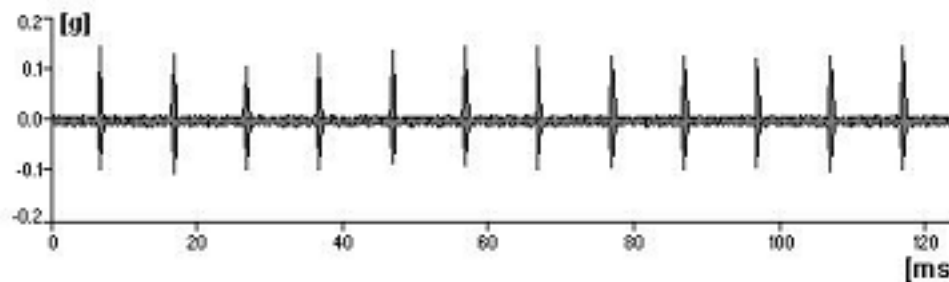
This result is much better, because Y axis scale corresponds with real pulses amplitude, not with speed sine wave amplitude.