

SOLUTION USER MANUAL

MODULE V23-2



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2. About this document

This is the user manual for Orbit Analysis module

2.1. Legend

The following symbols and formats will be used throughout the document.



Important

It gives you important information about the subject.
Please read carefully!



Hint

It gives you a hint or provides additional information about a subject.



Example

Gives you an example of a specific subject.

3. Installation

3.1. Download

“Orbit Analysis” is an option of DewesoftX®, so it already comes with the installation of the software, you just require the license to activate it.

3.2. Licensing

In DewesoftX® an additional license for the option is needed and it can also be written onto the DewesoftX® device and stored there. This way the license stays on the device and software is automatically activated once the device with the license is connected.

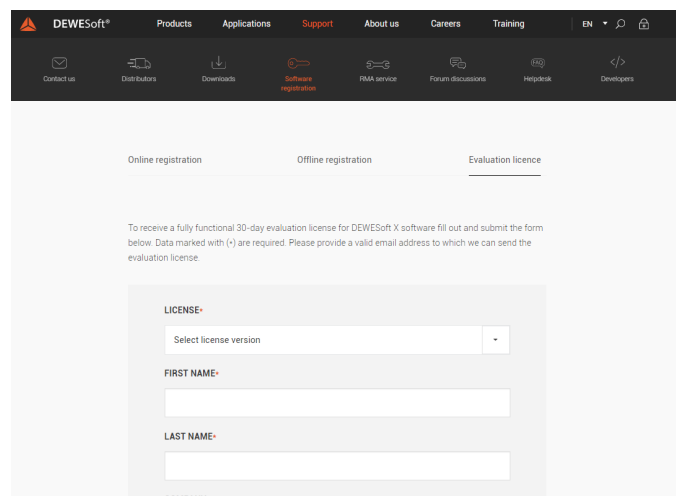
To test it, you can use a *30-days-Evaluation license*. How to obtain the license and activate the software is explained below:

3.2.1. Evaluation license

You can request an Evaluation license from our homepage:

<http://www.dewesoft.com/registration>

- (1) Click on **Evaluation license**
- (2) Fill out all the required fields
- (3) Click the **Request** Dewesoft button



The screenshot shows the DEWESoft website's 'Support' section with the 'Software registration' link highlighted. Below the navigation bar, there are three tabs: 'Online registration', 'Offline registration', and 'Evaluation licence', with the latter being selected. The form area contains a heading 'To receive a fully functional 30-day evaluation license for DEWESoft X software fill out and submit the form below. Data marked with (*) are required. Please provide a valid email address to which we can send the evaluation license.' followed by input fields for 'LICENSE*' (a dropdown menu with 'Select license version'), 'FIRST NAME*', and 'LAST NAME*'. At the bottom, there is a 'REQUEST' button.

Illustration 1: Request Evaluation License

How to request an evaluation license to DEWESoftX.

Activating the Evaluation license

When you have received your trial license key, open DewesoftX®, go to *Options / Settings*, select the Registration tab sheet and enter the license code (if you already have other licenses, you may need to click the **Create** button).

Now enter the license code and click the **Register online** button.

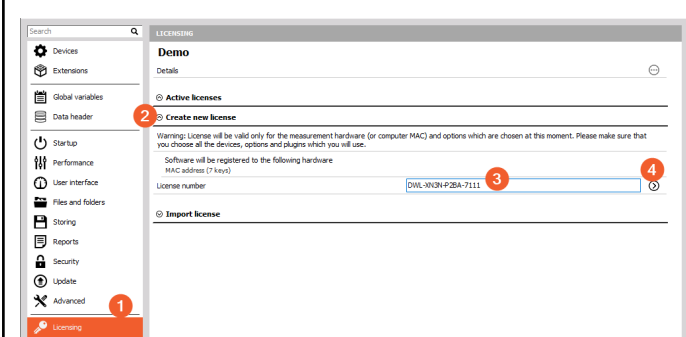


Illustration 2: Enter license key

Then your new license key will show up in the list and should have the *Status Valid*.

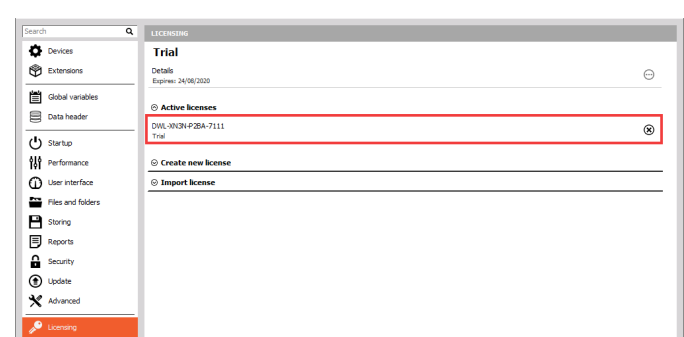


Illustration 3: Valid trial license

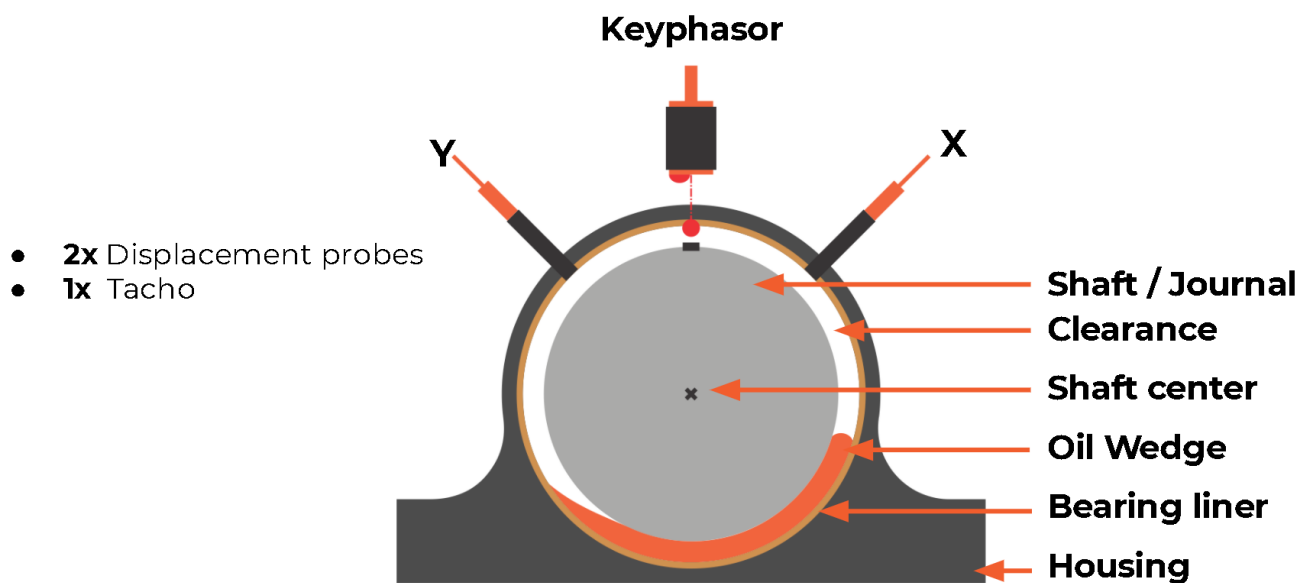
Activating a license key in DEWESoftX.

4. Introduction

Steady, continuous operation with as little malfunctions and vibration as possible is essential for maximizing the productivity and ensuring reliable operation of a machine - whether a huge rotating mass in a power plant or a high revving compressor. To achieve this, measurement and analysis of rotational vibration data is crucial.

Dewesoft Orbit analysis is an ideal analysis tool for rotor dynamic movement examination, assessment of any motion restrictions causing vibration and consequent prevention of potential, unwanted damages to rotating machinery that would result in premature wear of components and could cause critical failure. Knowing the rotor movement, then different phenomena of lubrication and bearing states can be determined and consequently machine operations can be optimized.

To make the interpretation of results and entire measurement flow as easy and complete as possible, the software interface is designed with the test engineer in mind - easy to set up and use, however with powerful analysis and advanced features.



Sketch of how shaft movement is measured at a journal bearing.

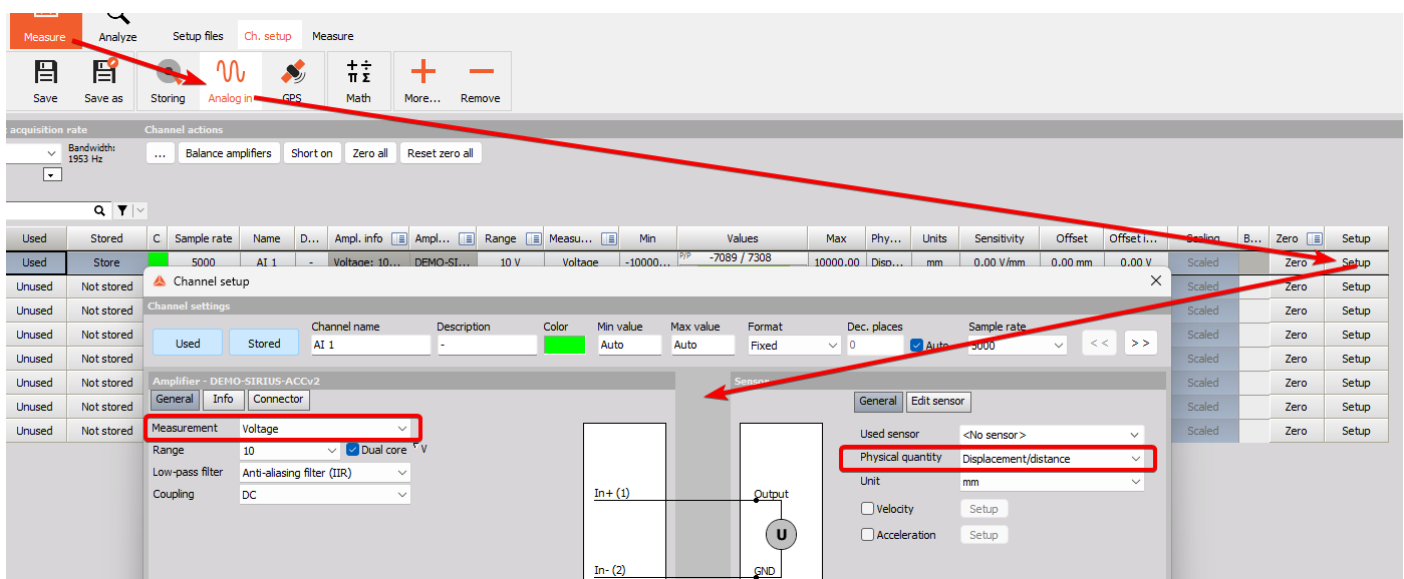
The basic measurement setup for orbit analysis consists of: pair of proximity probes (also called eddy-current probes) per bearing, a keyphasor (3rd proximity probe or a tacho sensor), a data acquisition system, orbit analysis software, and a computer. By detecting the shaft proximity in two directions (x and y) rotor movement is calculated and displayed throughout the measurement.

5. Analog in setup

In the Analog in setup, the channels need to be configured for use of proximity probes. Most often the configuration per bearing consists of three eddy-current probes: Y, X and Keyphasor.

Depending on whether the utilized eddy-current probes use a separate signal conditioner or are connected directly to the input on Dewesoft HW, different amplifiers are used.

For both cases, Voltage mode is selected under Measurement and Displacement/distance as a Physical quantity, as shown below:



Analog input setup showing front-end and sensor settings.

6. Orbit analysis module setup

The Orbit analysis module can be added to a setup by clicking on the “+ More” button where various application modules are available.

When adding the module the following module setup appears:

Frequency channel setup

Frequency source: Analog pulses
Frequency channel: Key phasor
Sensor: Tacho (Analog)
Lower frequency limit: 5 Hz
Channel setup: Buffer size: 1 h 0 min

RPM setup

Direction: Both
Delta RPM: 10
Upper RPM limit: 6000
Lower RPM limit: 600

Calculation setup

Harmonic list: 0; 1; 2
Order resolution: 1/8 (0.125)
Max order to analyse: 32
Time FFT lines: Auto
Bin update: Average
FFT window: Hanning
Amplitude: Peak
Frequency axis unit: Hz
Update interval: On time: 0 min 0,2 s
On RPM change (Delta RPM): ☒
Waterfalls: Order waterfall vs. RPM: ☒
Order waterfall vs. time: ☒
FFT waterfall vs. RPM: ☒
Overall vs. RPM: ☐ RMS
☒ Peak
☐ Peak-peak
Time DC cutoff: ☐
Order DC cutoff: ☐
Separate spectra per direction: ☒

Runout compensation

Averages: 10
Resolution: 1
DC value is subtracted from runout corrections.
☒ Apply runout compensation

Reference orbit

Averages: 10
Reference orbit averaging requires steady RPM.

Machine configuration

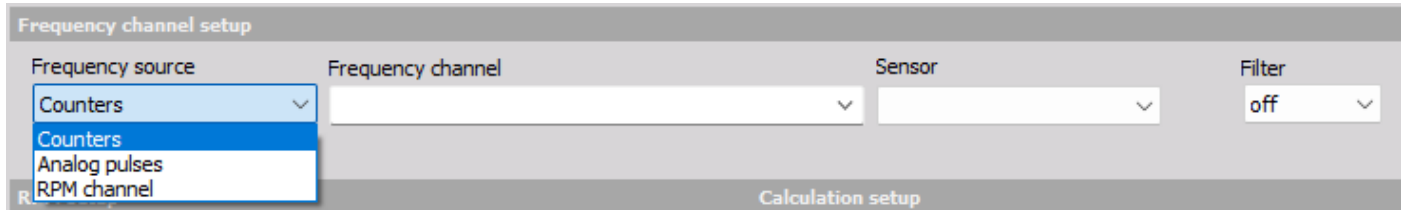
	Measurement point	Configu...	Rotation	Channel	Angle	Position	DC gap	Measure DC gap	Setup
	Bearing 1	Pair	CW						Setup
	Y			Probe Y	45,00	Left	0	Measure	
	X			Probe X	45,00	Right	0	Measure	

Orbit analysis module settings.

1. Frequency channel setup
2. RPM setup
3. Calculation setup
4. Runout compensation
5. Reference orbit
6. Machine configuration

6.1 Frequency channel setup

In order to determine the engine rotation speed, a source of frequency needs to be configured. For Orbit analysis a third proximity probe also called a keyphasor is most often used as it detects a flat or wedged section on the shaft and this generates the needed pulse per revolution from which operating speed is concluded. So as to allow different configuration possibilities to the user, Orbit Analysis module supports a number of different sensor types to be selected as the frequency source:



Frequency channel settings

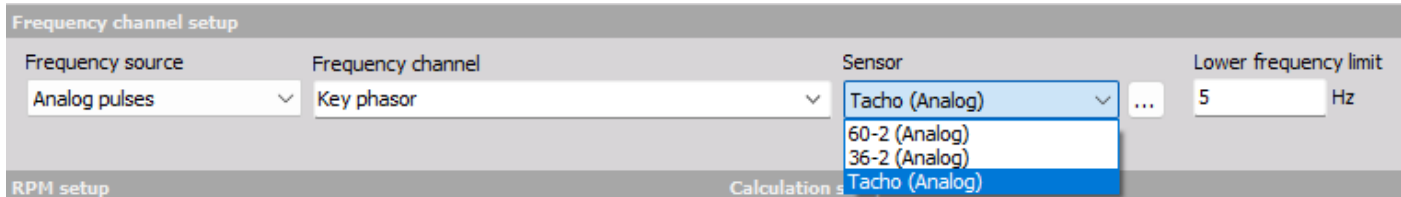
6.1.1 Analog pulses

When having the Frequency source set to Analog pulses an analog time channel must be selected:



Selection of Frequency channel.

Different sensors generating analog pulses are supported:



Sensor specific settings can be selected.

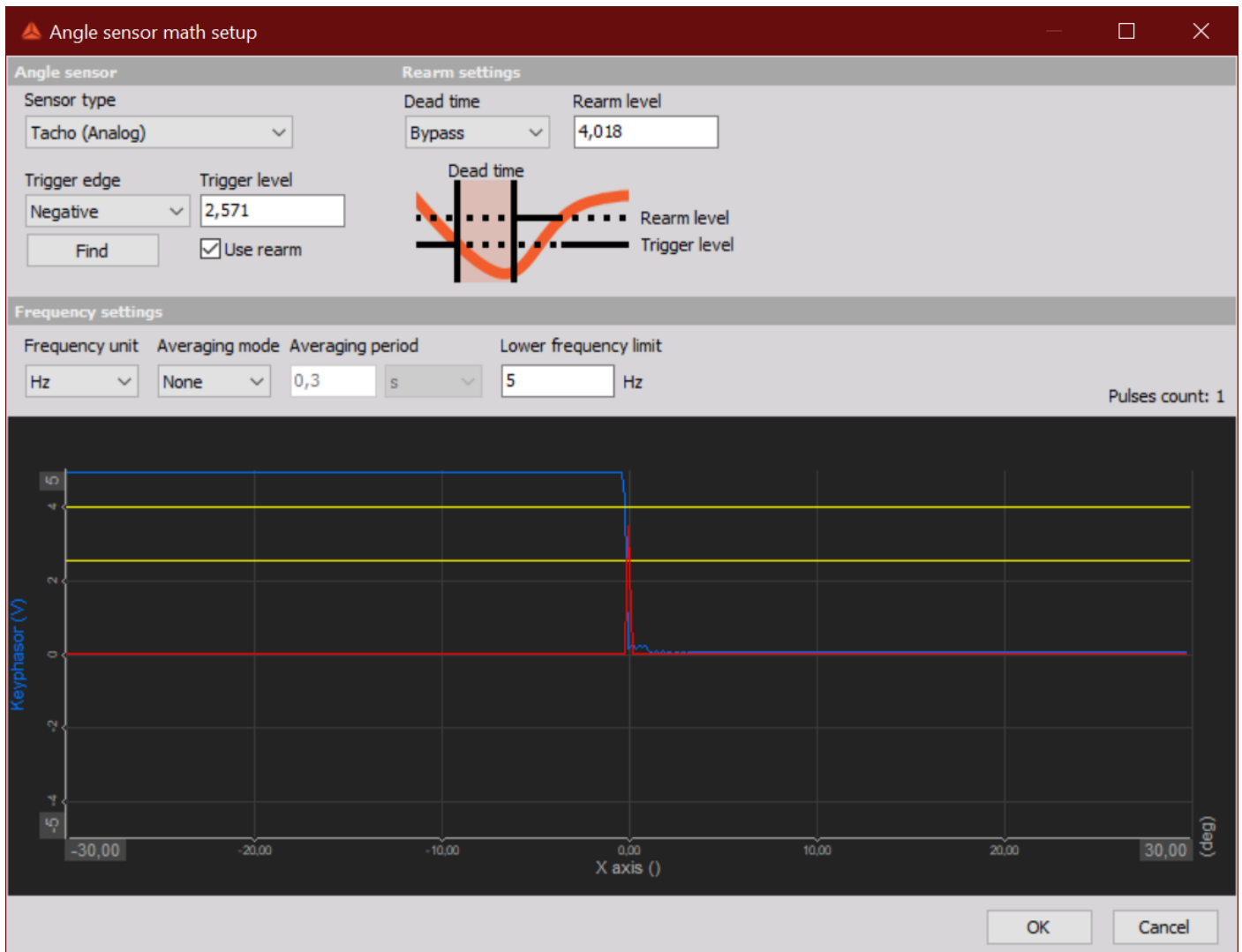
Tacho(Analog): 1 pulse per revolution using proximity probe or a similar type of analog sensor
36-2 (Analog) or **60-2 (Analog)** : sensor with 58 or 34 teeth and two missing teeth

To configure the selected Analog sensor, click on the  icon to open Angle sensor math setup



Sensor specific settings can be modified here.

In Angle sensor math setup, additional settings are available to configure the sensor: Trigger edge, Trigger level (can also be found automatically by selecting "Find"), Retrigger level, Retrigger time, Output channel unit (Hz or RPM) and Averaging as well as a preview of analog tacho signal and triggers. The Lowest detectable frequency limit is definable in the user input field - the system will not detect frequencies lower than the specified value.



By opening sensor specific settings using the [...] button an Angle sensor math module instance is shown.

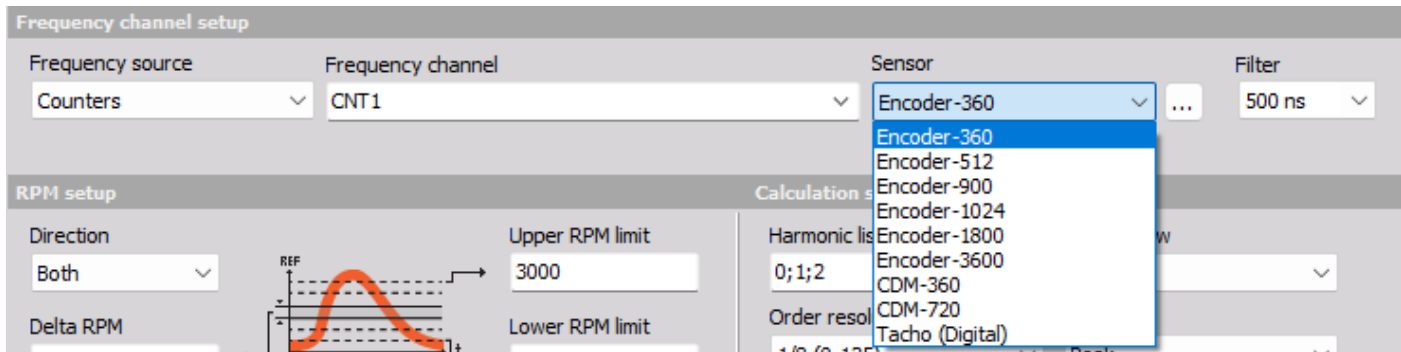
6.1.2 Counters

For Orbit Analysis a number of pulses or transient spikes per revolution is often used, meaning Tacho (digital) would be used for such application when it comes to sensors that are connected and configured as counters.

First, select the digital Frequency channel to use from the dropdown (e.g. CNT1).

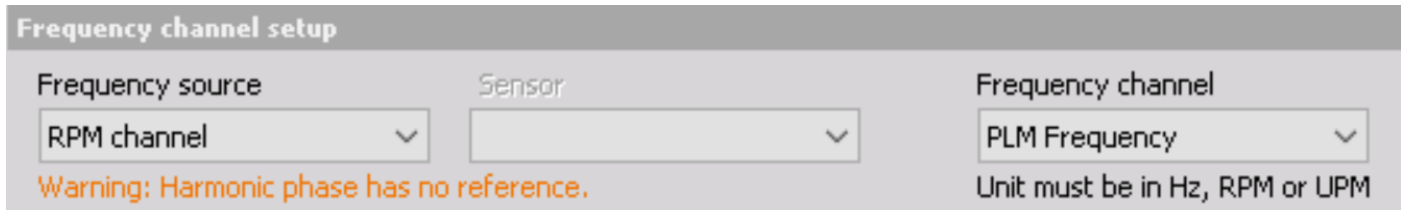


For multiple configuration possibilities a variety of additional counter sensors are available in the dropdown: multiple Encoders as well as CDM sensors.
In addition, different filter settings can be applied to selected frequency source signal:

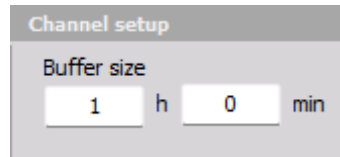


6.1.3 RPM channel

Besides analog and digital sensors, any signal or channel directly representing the RPM (e.g. 0-10V equals 0-4500 rpm) can be used as a frequency source. As this option does not contain zero-angle information the extraction of phase is not possible.



6.1.4 Channel setup

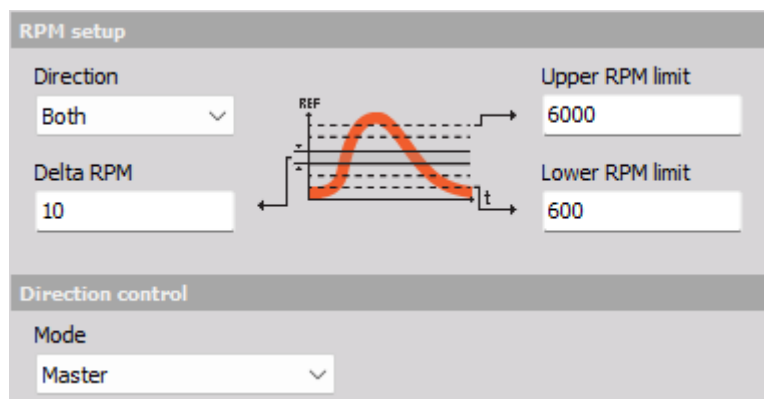


Channel buffer settings.

At the top right corner of the module properties you can modify the async data buffer size used for the display widgets. If a test lasts longer than the set Buffer size then data points older than that time size will no longer be shown on the display widgets. All data will still be stored for all channels set to Store.

6.2 RPM setup and Direction control

Under the RPM setup section, Lower and Upper RPM limits are defined as well as Delta RPM width and the direction of the test.



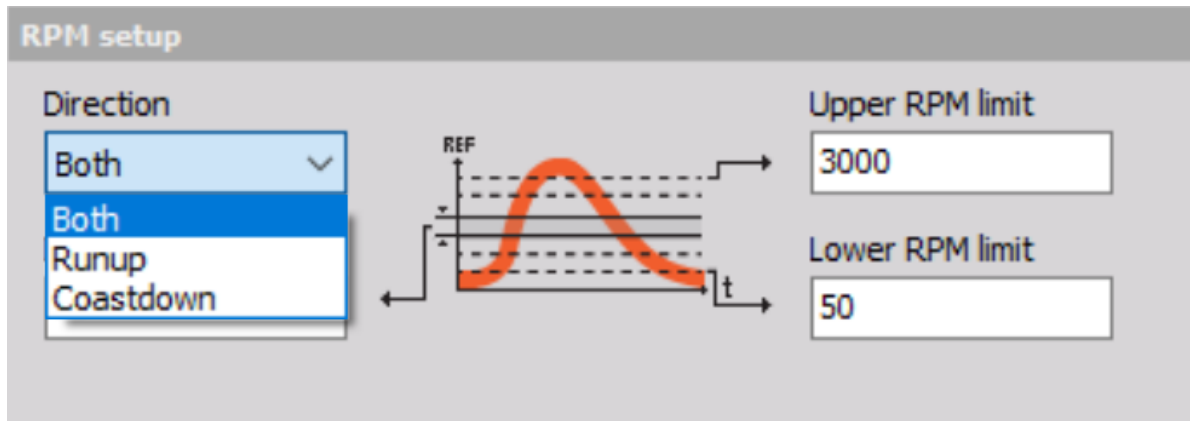
Settings for the RPM speed axis and direction control.

To configure the analysis according to the test conditions of the particular rotating machinery during the measurement and to get all of the needed data **RPM setup** section includes the necessary settings that apply to the direction, speed range of operation as well as the density of calculation of values during the test run.

6.2.1 Direction

Orbit analysis supports measurement of different machine operation scenarios: whether only the runup, coastdown or both need to be measured, the analysis is easily configured accordingly via a dedicated dropdown. As turbomachinery often runs for long periods of time in steady state conditions between the runup and coastdown, selecting **Both** in the dropdown will automatically create a third operating condition as well: **Steady state**. Each **Direction** creates a dedicated set of channels for display of

measured data so they can be displayed on separate widgets or all together on the same one for comparison.



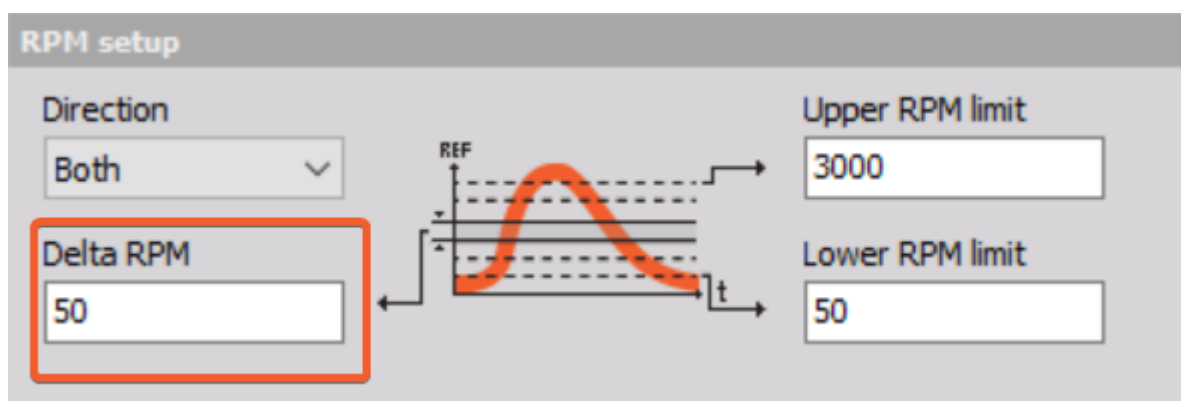
Selection of test Direction for the speed profile.



User controls the current state of operation during the measurement via a dedicated dropdown which is automatically put on the predefined display. More information on this control dropdown can be found in the later sections of this manual covering Measurement & Visualization.

6.2.2. Delta RPM

Delta RPM defines the change of speed at which data is updated during the measurement for the speed channel and all Orbit Analysis output channels containing speed information: Filtered orbit(e.g. Orbit H1), Shaft centerline, Polar plot, Order Waterfall vs. RPM and FFT waterfall vs. RPM



Delta RPM also referred to as the speed axis bin width can be adjusted.



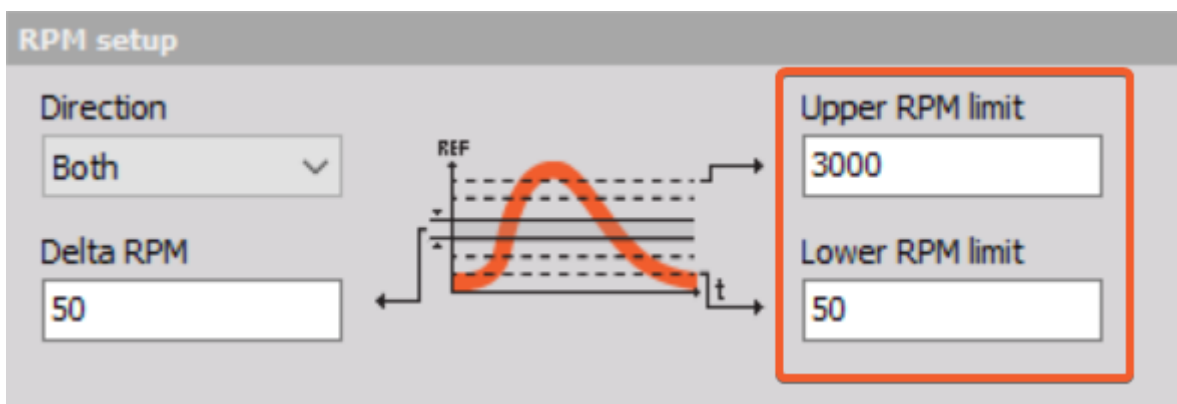
For example, delta RPM of 50 will update the channels each time during the runup or coastdown the speed of the machine changes for 50 RPM.



During the steady state operation conditions the speed of the machine usually varies very little. This means that delta RPM criterion will not be fulfilled and update of measured data on affected channels will not be triggered. That is why Orbit Analysis can be also updated on time or both (whichever is true first), More info on how to configure update on time criterium can be found in the following section.

6.2.3 Lower and Upper RPM limits

Upper and Lower RPM limits define the range for calculation and are used to correctly set up the resampling algorithm, depending on the max order extracted. They should be set in accordance to the expected speed range of the machine being measured:



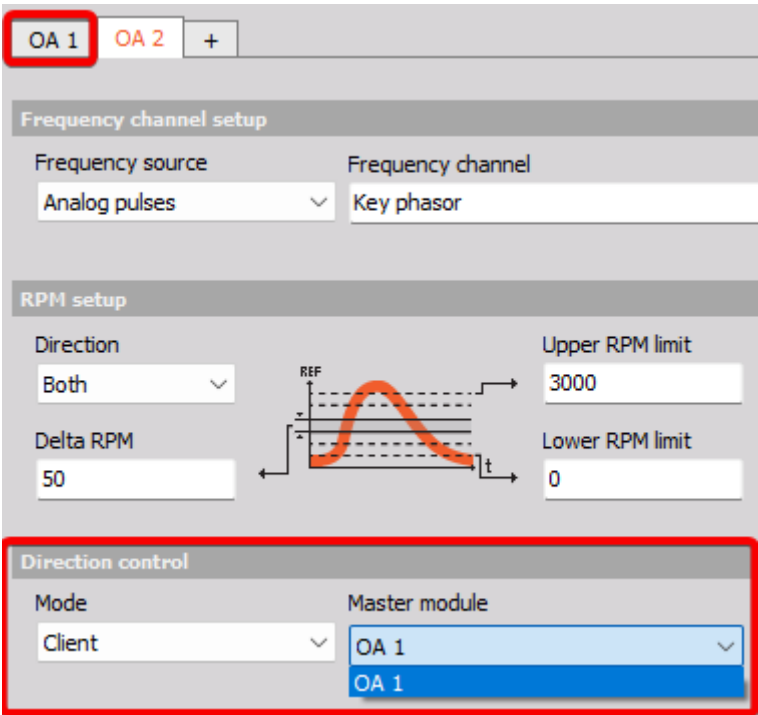
Upper- and Lower RPM axis limits.

6.2.4 Direction control

This makes it possible to control the Direction under Measure for multiple Orbit Analysis modules at the same time. In setups with multiple added Orbit Analysis modules and at the same time using the Direction Both, you can select to link the Direction control together instead of having to change the Direction for each module individually.

The Mode parameter can be set to Master or Client. For Clients you must select which Master it should be linked to.

For example, if module OA1 is Master and module OA2 is client to OA1, then these two modules are linked and Direction changes under Measure for one of them will also apply the same change to the other one:



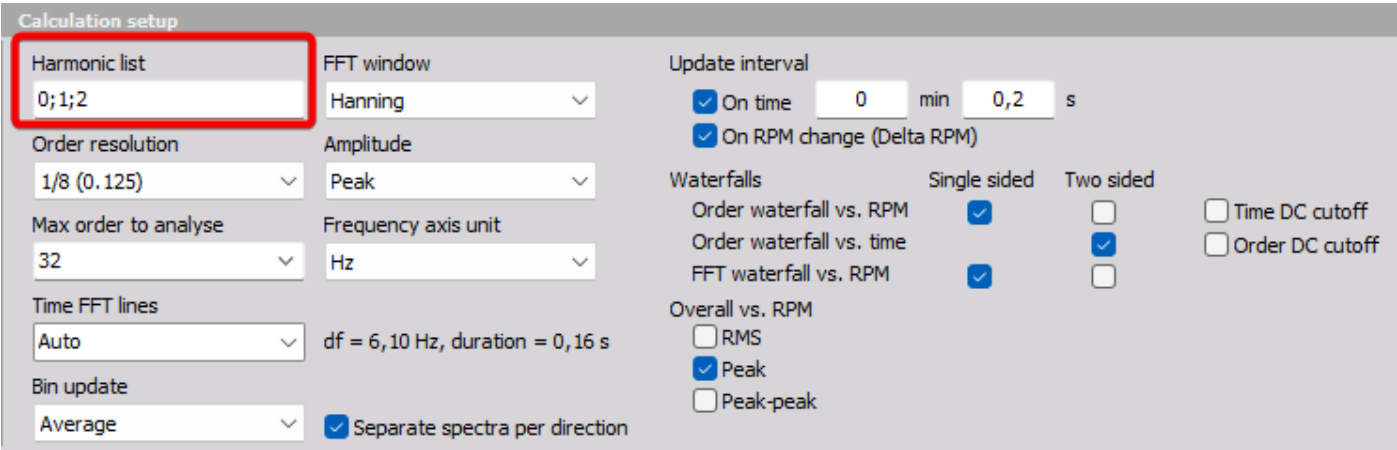
Direction control can be used to link multiple OA instances to the same Master control channel.

6.3 Calculation setup

The settings in this section are dedicated for defining the calculations done in the Orbit Analysis module.

6.3.1 Harmonic list

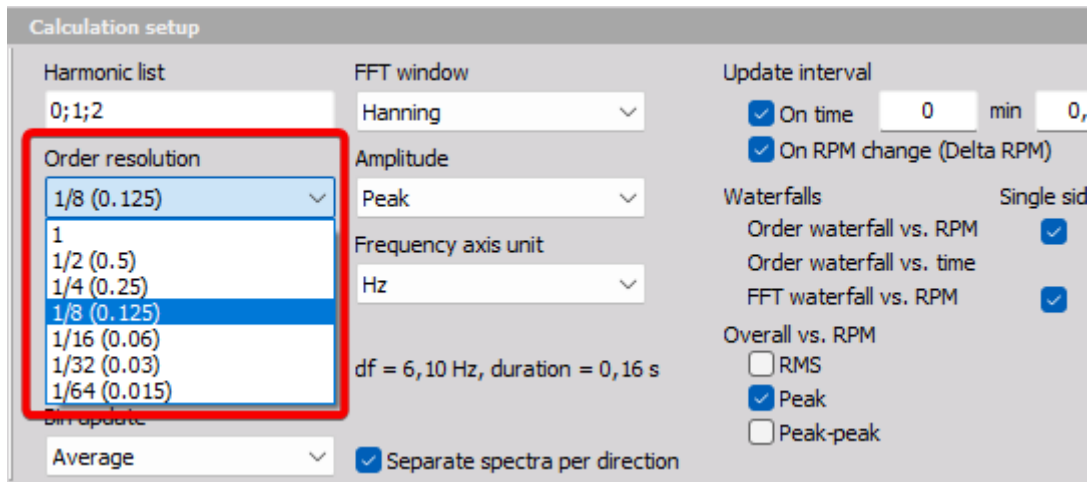
The extraction of desired filtered orbits is configured by inputting the order numbers in the harmonic list field, separating the entries in the list with a semicolon (;). In the below example first, second and third harmonic orbits are extracted.



List of extracted harmonics / orders with magnitude and phase information.

6.3.2 Order resolution

Selected order resolution defines the steps on the order waterfall between individual extracted orders. The higher the resolution the higher the number of lines between the orders.

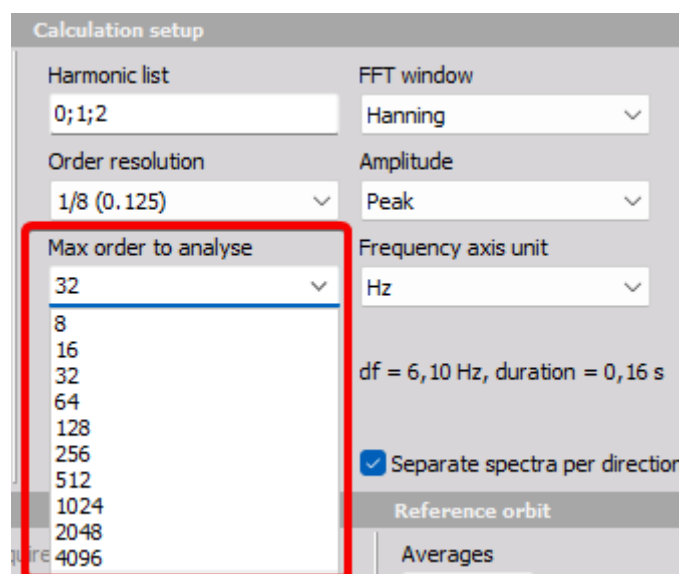


Order resolution settings.



In an FFT, if the line resolution is 0.5 Hz, the required data window must be 2s. The same is true for the ordered resolution: If the resolution is set to 0,25 orders, 4 revolutions are required for one data block. The higher the required order resolution, the slower the rpm must change.

6.3.3. Max order to analyze



The maximum order sets the limit on the Order waterfall outputs and highest possible extracted harmonic.

Depending on the measurement application, maximum order to analyze needs be set high enough to still capture all the wanted orders. If, for example, a higher number of orders are not needed in the analysis, a lower value can be selected from the dropdown to consequently lower the needed sample rate and the amount of data stored.



The needed sample rate is determined by the Orbit Analysis module using the following formula: Upper RPM limit in [Hz] * max order to analyze *2 (Nyquist). To cover 3600 RPM with 32 set as the highest order to analyze, the needed sample rate would be. $60 * 32 * 2 = 3840$ Hz



By default, 32 is set as the highest order to analyze. As the orbit analysis utilizes parts of order tracking math to calculate the data, this setting needs to be configured also in Options->Settings->Extensions->Order tracking. The system will take the highest of the two settings into account.



Order tracking

Math application, Machinery diagnostics
Version: 1.0.0

Settings

Max order to analyze

32

In order to set the highest order to analyze to 8, this value has to be selected both in the OA Ch. setup dropdown and input in the above field in the Settings.



Order tracking

Math application, Machinery diagnostics
Version: 1.0.0

Settings

Max order to analyze

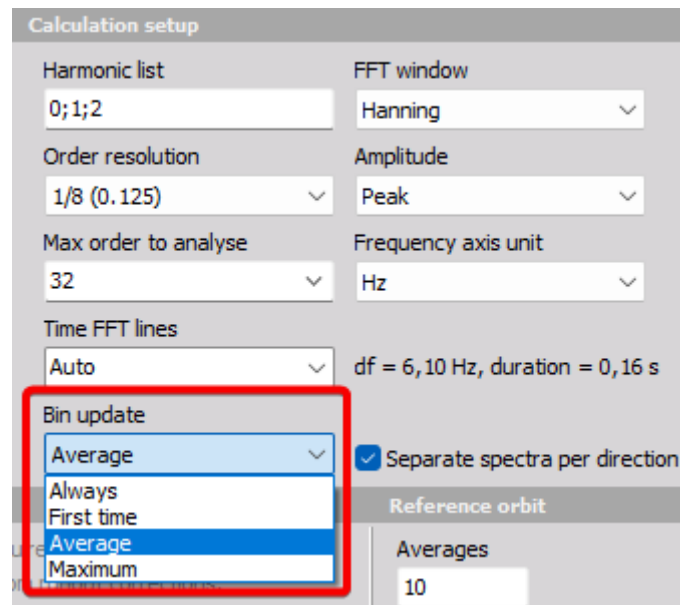
8

6.3.4. Time FFT lines

supports Auto, predefined values selection from dropdown or arbitrary definition of number of lines. Affects the FFT cascade output, higher number of lines results in better resolution and higher CPU load.

6.3.5. Bin update

Bin update is used to define how the output data for each RPM speed bin is calculated:



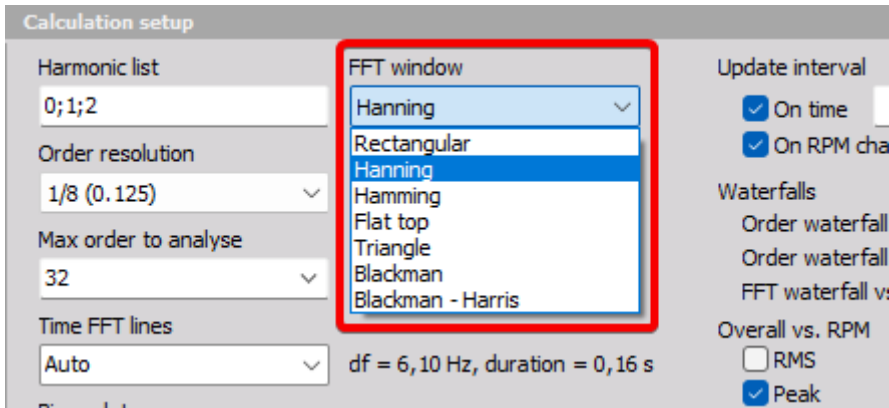
Spectral bin update settings.

You can select the following Bin update types:

- **Always** - When multiple values or spectra belong to the same bin, then the newest bin values will overwrite previous values and the newest values will be used in the output for that bin.
- **First time** - When multiple values or spectra belong to the same bin, then only the first bin values will be used in the output for that bin.
- **Average** - When multiple values or spectra belong to the same bin, then averaging for the values and individual and spectral lines will be performed over all values belonging to that bin.
- **Maximum** - When multiple values or spectra belong to the same bin, then the maximum value for all values and individual spectral lines across all spectra belonging to that bin will be kept.

6.3.6. FFT window

Different windows are available for the FFT: Rectangular, Hanning, Hamming, Flat top, Triangle, Blackman, Exponential down and Blackman - Harris.

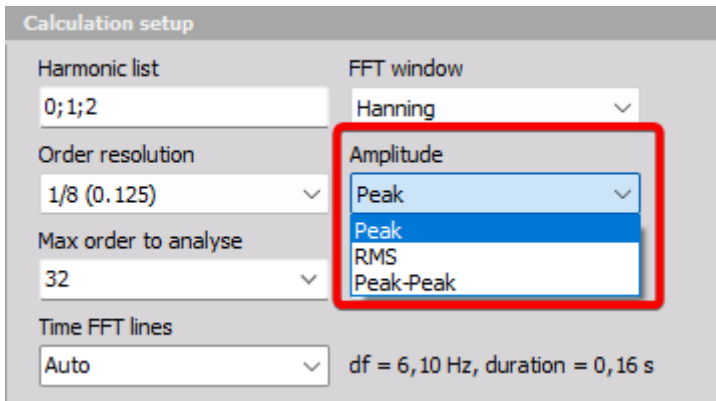


FFT window filter type settings.

By default, the Blackman window is selected and other windows can be selected instead from the dedicated dropdown.

6.3.7. Amplitude

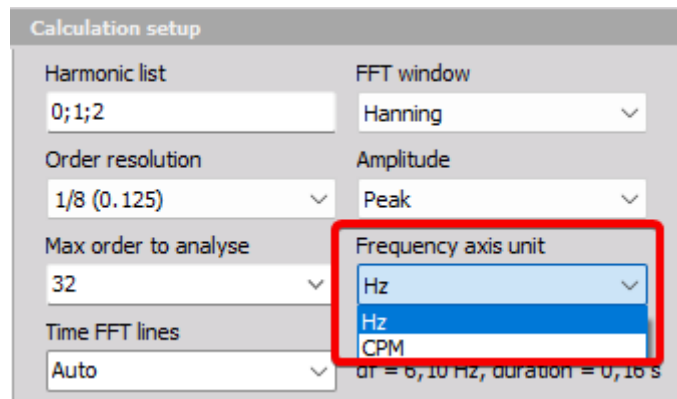
Depending on the selected amplitude in the dropdown, the following scaling is applied to Bode plot and Polar plot: Peak, RMS, Peak-peak



Value scaling for output data.

6.3.8. Frequency axis unit

Frequency axis unit for FFT waterfall vs. RPM can be selected from the dropdown list.



Frequency axis unit settings.



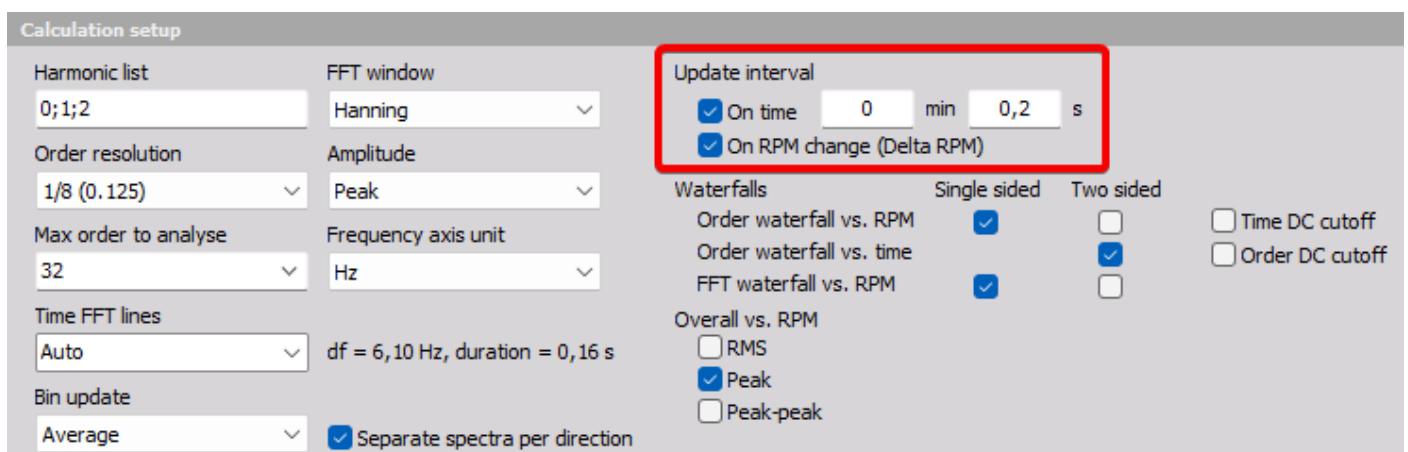
Using CPM(cycles per minute) instead of RPM(revolutions per minute) for naming of the units prevents confusion when showing FFT waterfall vs. RPM the 3D graph. In this case, CPM is used on the frequency axis and RPM on the speed axis.

6.3.9 Separate spectra per direction

Separate spectra per direction will create the selected spectral channels under all Directions channel groups. When disabled the spectral results will be combined across all directions.

6.3.10 Update interval

Update interval defines the criteria on which data, such as speed, shaft centerline and polar will be updated during the measurement.



Data update interval settings

There are two different criteria for update of data:

On RPM change (Delta RPM) - data is updated each time a defined Delta RPM value is exceeded. This is usually selected if the measurement consists of runup or coastdown or both.

On time - Values are updated on a defined time interval, regardless of the Delta RPM specified. This update criteria is suitable for steady state operating conditions when RPM change criteria is not going to be triggered.

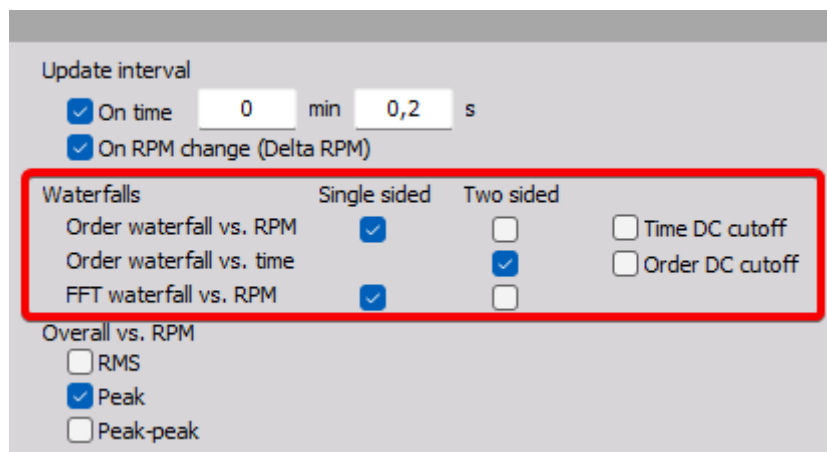
Both update criterias can be selected at the same time to appropriately cover different operating conditions.



A measured turbine is going to do a runup from 50 RPM to 4500 RPM, perform a steady state operation at maximum speed for hours and finish with a coastdown back to idle speed. The user inputs 50 as delta RPM, meaning data will be updated in 50 RPM intervals during runup and coastdown. During the steady state machine is running stable and the speed varies very little (± 10 RPM) so Update on time is switched on as well and 10 minutes is defined as update time criteria. During hours of steady state operation, values are updated each 10 minutes, resulting in a good overview of the operation.

6.3.11 Orbit analysis waterfalls

The Orbit Analysis module supports Order waterfall spectrograms vs. RPM and vs time, and at the same time FFT waterfall vs. RPM. They are enabled easily by ticking the checkbox in the Ch. setup section. They are shown using the 3D Graph widget which is further explained in the Measurement & Visualisation section



Waterfalls	Single sided	Two sided	
Order waterfall vs. RPM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Time DC cutoff
Order waterfall vs. time	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Order DC cutoff
FFT waterfall vs. RPM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Overall vs. RPM

☐ RMS

☒ Peak

☐ Peak-peak

Settings for 3D waterfall outputs.

Vs. RPM spectra can be created both as Single sided or Two-sided spectra. Single sided spectra will have an order or frequency axis starting from 0. Two-sided spectra will have an order or frequency axis

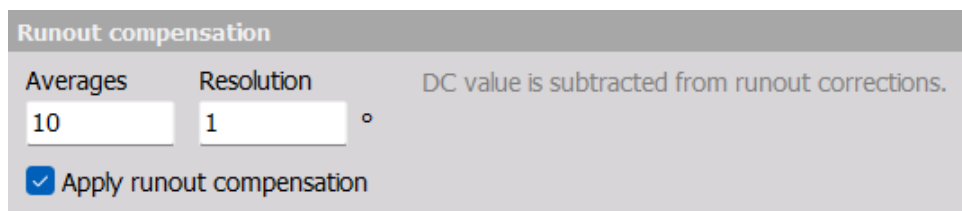
centered around 0. Two-sided spectra can be of interest when analyzing the phase difference between the X and Y bearing sensors..

6.3.12 Overall vs. RPM

Overall vs. RPM results are 2D arrays with overall displacement levels across the defined RPM speed range. Such results can be a good way to overview and document critical speed intervals which should be avoided.

6.4 Runout compensation

Runout compensation is performed to remove shaft irregularities from the measured values during the analysis. In the Ch. setup, the desired speed RPM at which the compensation is going to be performed is defined by the user, as well as the number of Averages (revolutions) to be taken into the calculation and the desired angle Resolution.



The image shows a software dialog box titled "Runout compensation". It contains two input fields: "Averages" with the value "10" and "Resolution" with the value "1". To the right of these fields is a text label "DC value is subtracted from runout corrections." Below the input fields is a checked checkbox labeled "Apply runout compensation".

Runout compensation settings.

Under Measure the Orbit analysis module provides a display template design for the runout compensation measurement. When the runout Start button is pressed the runout measurement will start and the number of Averages will begin to count up. See more in section: [7.4. Runout compensation display](#).

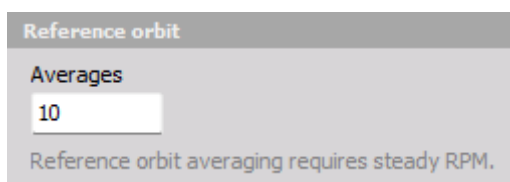
The Runout compensation values are calculated in the angle-domain. This means that you can perform runout compensation measurements while running with variable speeds.



Runout compensation and DC offset / Gab (explained under the Machine configuration section) are independent of one another.

6.5 Reference orbit

Reference orbit is a great tool for easy comparison of current operating conditions to those from a previous measurement. During the measurement, reference orbit can be easily acquired through a dedicated measurement screen as described more in section: [7.4. Reference orbit display](#). The number of averages taken into the measurement are defined by the user in the Averages field.



The dialog box titled "Reference orbit" contains a section labeled "Averages" with a text input field containing the value "10". Below the input field, a message states: "Reference orbit averaging requires steady RPM."

Reference orbit settings.

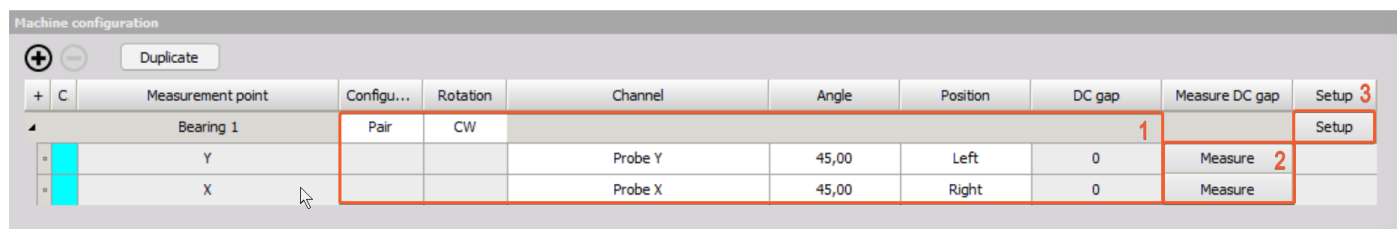


Note: Reference orbit measurements should be performed while maintaining a steady rotation speed.

6.6 Machine configuration

Any number of bearings can be defined with Dewesoft OA into the machine train.

Machine configuration setup can be further broken down into for subsections:



The screenshot shows the "Machine configuration" window with a table of settings for "Bearing 1". The table has columns for Measurement point, Configu..., Rotation, Channel, Angle, Position, DC gap, Measure DC gap, and Setup. Red boxes and numbers 1, 2, and 3 highlight specific areas: box 1 is around the "Pair" and "CW" cells; box 2 is around the "Measure" cell in the "Measure DC gap" column; and box 3 is around the "Setup" cell in the "Setup" column.

	Measurement point	Configu...	Rotation	Channel	Angle	Position	DC gap	Measure DC gap	Setup
Bearing 1		Pair	CW						Setup
	Y			Probe Y	45,00	Left	0	Measure	
	X			Probe X	45,00	Right	0	Measure	

The Machine configuration table.

- 1 - Quick settings**
- 2 - DC gap**
- 3 - Bearing setup**

6.6.1 Quick settings

Under the Channel, the right input channels need to be assigned as probe X and Y for the individual bearing.

+	C	Measurement point	Configu...	Rotation	Channel	Angle	Position	DC gap	Measure DC gap	Setup
▲		Bearing 1	Pair	CW						Setup
"		Y			Probe Y	45,00	Left	0	Measure	
"		X			Probe X	45,00	Right	0	Measure	

Selection of displacement signals to use for a bearing.

Next, the angle and position at which the probes are mounted needs to be configured.

+	C	Measurement point	Configu...	Rotation	Channel	Angle	Position	DC gap	Measure DC gap	Setup
▲		Bearing 1	Pair	CW						Setup
"		Y			Probe Y	45,00	Left	0	Measure	
"		X			Probe X	45,00	Right	0	Measure	

Defining the sensor's position relative to the key phasor position.

To make the configuration of the Angle and position easier, the graphical representation is available upon entering the Bearing setup, as shown in [section 6.9.3](#).

6.6.2 DC Gap

Most of the times when proximity probes are mounted, there will be a certain DC component present. Dewesoft Orbit Analysis supports easy measurement of the DC gap by clicking on the Measure button next to the individual probe.

+	C	Measurement point	Configu...	Rotation	Channel	Angle	Position	DC gap	Measure DC gap	Setup
▲		Bearing 1	Pair	CW						Setup
"		Y			Probe Y	45,00	Left	0	Measure	
"		X			Probe X	45,00	Right	0	Measure	

Ability to quickly measure the present DC offset which can be applied to the other measurements.

After the DC gap is measured, a value will be shown in the DC Gap column. DC Gap can also be input manually in the Bearing setup window as explained in the next section.

6.6.3 Bearing setup

Upon selecting Setup under Machine configuration, a dedicated Bearing Setup window is opened, containing all of the advanced settings for configuration of the bearing settings: sensor configuration, subsynchronous orbit extraction, shaft and clearance circle configuration, average orbit definition and DC gap manual input.

Inside this setup window the user defines the runout compensation as well as the reference orbit. These are further explained in sections [7.4. - Runout compensation display](#) And [7.5. - Reference orbit display](#) of this document.

Setup

Bearing properties

Bearing name

Bearing 1

Sensors

Configuration

Pair

Tacho angle

Left

at

0

°

Y position

Probe Y

X position

Probe X

Y angle

Left

at

45

°

X angle

Right

at

45

°

Runout compensation

Add

Remove

Paste

Import

Export

Angle[°]	Y [-]	X [-]
0,00	0,00	0,00
1,00	0,00	0,00
2,00	0,00	0,00
3,00	0,00	0,00
4,00	0,00	0,00
5,00	0,00	0,00
6,00	0,00	0,00
7,00	0,00	0,00
8,00	0,00	0,00
9,00	0,00	0,00
10,00	0,00	0,00
11,00	0,00	0,00
12,00	0,00	0,00

Left

0°

Right

Left

Right

180°

Calculate subsynchronous orbit

Tracking filter bandwidth

10

Hz

Shaft

Rotation

CW

Position

Center

Clearance

Shape

Circle

Radius

0

DC Gap

Sensor Y

0

Sensor X

0

Average orbit

Periods

1

Averages

2

Channel colors

Runup

Steady state

Coastdown

OK

Cancel

Bearing setup page. Accessed by clicking on Setup for the individual bearings under the Machine configuration table.

6.6.3.1 Bearing properties

Under Bearing name a unique name can be input by the user to easily recognize which component it corresponds to.

Bearing properties

Bearing name

Bearing 1

6.6.3.2 Sensors

The graphical representation of the shaft together with direction and angle helps with correct configuration of the sensor settings. In this section, the user selects the configuration: **Pair** is selected when two probes per bearing are used and **Mono** in case only one is used. Besides selecting the configuration, the right probe channels need to be assigned into Y and X position as well as their angle and direction need to be set. The same needs to be done for the Keyphasor under **Tacho angle**.

Sensors

Configuration

Pair

Tacho angle

Left

at

0

°

Y position

Probe Y

X position

Probe X

Y angle

Left

at

45

°

X angle

Right

at

45

°

Left

0°

Right

180°

Y

X

x

☐ Calculate subsynchronous orbit

Tracking filter bandwidth

10

Hz

Runout compensation

Add

Remove

Paste

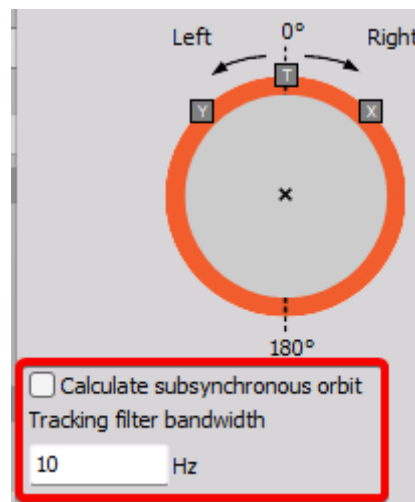
Import

Export

Angle[°]	Y [-]	X [-]
0,00	0,00	0,00
1,00	0,00	0,00
2,00	0,00	0,00
3,00	0,00	0,00
4,00	0,00	0,00
5,00	0,00	0,00
6,00	0,00	0,00
7,00	0,00	0,00
8,00	0,00	0,00
9,00	0,00	0,00
10,00	0,00	0,00
11,00	0,00	0,00
12,00	0,00	0,00

Parameters for configuring the sensor positions.

Dewesoft Orbit Analysis supports extraction of subsynchronous orbit which can be used to detect fluid-induced instabilities such as whirl & whip. The calculation of the subsynchronous orbit is enabled via a dedicated checkbox and tracking filter bandwidth is defined in the corresponding input field:



Variable sub-synchronous orbit order extraction settings.

Runout compensation is necessary whenever shaft irregularities in shape are present which could be misinterpreted as movement during the measurement. Dewesoft OA supports multiple ways of establishing the runout compensation:

Paste - allows the user to paste values for runout compensation from previous measurements. The angle step needs to be defined the same in the Ch. setup (see 6.7. Run out compensation) as it was for the data that will be pasted and the data structure of the columns needs to be as stated below in the **Import** paragraph.

Import - allows import of .txt files containing the runout compensation data. The data structure is important as it needs to contain angle in the first column, Y value in the second and X in the third. A good way to achieve correct structure is to input it in separate columns in Microsoft Excel and then save it as a .txt file. Example .txt file is seen below:

runout 1.txt - Notepad

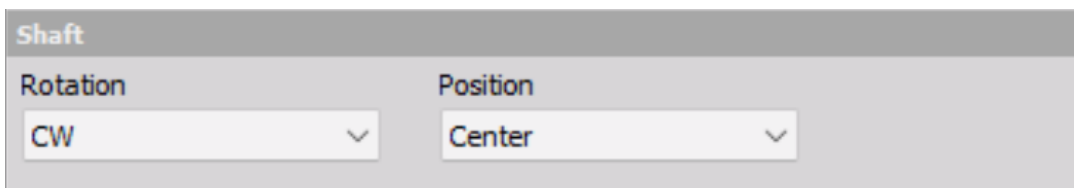
File	Edit	Format	View	Help
10	-1,02	1,69		
20	1,54	1,16		
30	1,29	-1,36		
40	-1,06	-1,36		
50	-1,27	0,73		
60	0,49	1,06		
70	0,86	-0,32		

Example of runout compensation data in a text file that can be imported under Bearing settings. First column is angle degrees, the second column is Y displacements, and the third column is X displacements.

Measure - The last and perhaps most important way of determining the runout compensation is to measure it directly with Dewesoft. This is also the easiest way of doing it as it requires a single click operation in Measure and calculated values are automatically stored in the Ch. setup. The runout compensation measurement display and instructions are explained under section [7.4. Runout compensation display](#).

6.6.3.3 Shaft

This section of channel setup is dedicated to configuration of shaft related settings. The direction of shaft rotation is selected in the **Rotation** dropdown. The drop down allows the user to select between: **CW** - clockwise direction and **CCW** - counterclockwise direction.

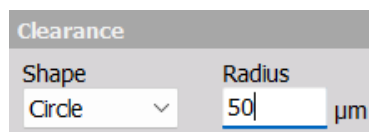


Shaft settings.

The **Position** dropdown defines the starting position of the shaft in regards to the diameter of the bearing.

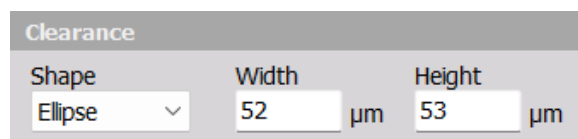
6.6.3.4 Clearance

Dewesoft Orbit Analysis supports a straightforward definition of the clearance circle under the **Clearance** section of the **Machine Configuration Setup**. Such defined clearance circles will be available to add in addition to orbit plot displays widgets as mentioned under section: [7.2. Creation of industry typical displays for Orbit Analysis](#)



Clearance circle settings.

Users can select between **Circle** and **Ellipse** shapes for the clearance circle and use the input field to input the clearance circle **Radius** (circle) or **Width & Height** (ellipse).



Clearance ellipse settings.

6.6.3.5 Average orbit

Average orbit can be configured to show more than a single revolution at once. This is defined by the input value in the field **Periods** - 5 periods means the average orbit will show 5 revolutions. The user also defines the number of averages to take into the calculation of the average orbit by inputting the desired number into the **Averages** input field.



Periods	Averages
4	1

Averaged orbit channel settings.

6.6.3.6 DC Gap

Besides measuring and automatically compensating for the DC gap as described in the section [6.9.2. DC Gap](#), Dewesoft Orbit Analysis allows the user to manually input the DC gap values. This is especially useful with large turbines as seen in power plants where completely static conditions with 0 RPM are rarely seen. In such cases, DC gap was measured upon mounting of the probes and is manually input for later measurements.



Sensor Y	Sensor X
0,33 µm	0,41 µm

Manual DC Gap value input fields.

7. Measurement & Visualisation

7.1. Output channels overview

In total the Orbit analysis module contains many different result types of which many of the types will generate multiple channel results.

The full list of output results from the Orbit analysis module, including a small description, how many of such types will be created, and which display widgets to use for illustration, are all listed in the table below:

Function Type	Description	# of channels	Display widgets
Orbit [X]X	[X] order orbit showing displacement in two directions	Per bearing, per order	Orbit Plot
r[X]+	Positive sided component of [X] order	Per bearing, per order	Digital meter
r[X]-	Negative sided component of [X] order	Per bearing, per order	Digital meter
G[X]	[X] order orbit ellipse semi-major axis, a.	Per bearing, per order	Digital meter
K[X]	[X] order orbit ellipse semi-minor axis, b.	Per bearing, per order	Digital meter
Shaft center	Bearing shaft center displacement	Per bearing, per direction	Orbit Plot
Raw orbit	Orbit with all orders over time.	Per bearing	Recorder, Scope
Bearing [X] Raw orbit	Orbit with all orders over time, with angle info for bearing [X].	Per bearing	Orbit Plot
Average orbit	Orbit with all orders averaged over a number of blocks	Per bearing	Orbit Plot, 2D graph
Bearing [X] waveform	Waveform with all orders of probe X or Y over time or revolutions	Per bearing, per probe	Orbit waveform
Subsynchronous orbit	Oil whirl/whip orbit	Per bearing	Orbit Plot
Subsynchronous order	Oil whirl/whip variable fractional order number	Per bearing	Digital meter
DC gap	Probe DC gap over time	Per bearing, per probe	Digital meter
Time [X]X	[X] order data over time	Per bearing, per probe, per order	Recorder, Digital meter
Polar [X]X	[X] order data with RPM stamps	Per bearing, per direction, per probe, and per order	Polar plot
Order waterfall vs. speed [two-sided]	Two-sided order spectra across the RPM speed range	Per bearing, *per direction*, and per probe	3D graph
Order waterfall vs. time [two-sided]	Two-sided order spectra over time	Per bearing, *per direction*, and per probe	2D graph, 3D graph
FFT waterfall vs. speed [two-sided]	Two-sided FFT spectra across the RPM speed range	Per bearing, *per direction*, and per probe	3D graph
Order waterfall vs. speed	Order spectra across the RPM speed range	Per bearing, *per direction*, and per probe	3D graph
FFT waterfall vs. speed	FFT spectra across the RPM speed range	Per bearing, *per direction*, and per probe	3D graph
Bode plot [X]X	[X] order bode showing magnitude and phase vs. RPM speed.	Per bearing, *per direction*, per probe and per order	2D graph

Overall RMS	Total RMS value across the RPM speed range	Per bearing, *per direction*, and per probe	2D graph
Overall peak	Total peak value across the RPM speed range	Per bearing, *per direction*, and per probe	2D graph
Overall peak-peak	Total pkpk value across the RPM speed range	Per bearing, *per direction*, and per probe	2D graph
SPP Average orbit SPPy	Average orbit longest y direction pkpk displacement	Per bearing	Digital meter
SPP Average orbit SPPx	Average orbit longest x direction pkpk displacement	Per bearing	Digital meter
SPP Average orbit SPPmax	Average orbit longest overall pkpk displacement	Per bearing	Digital meter
SPP Raw orbit SPPy	Raw orbit longest y direction pkpk displacement	Per bearing	Recorder, Digital meter
SPP Raw orbit SPPx	Raw orbit longest x direction pkpk displacement	Per bearing	Recorder, Digital meter
SPP Raw orbit SPPmax	Raw orbit longest overall pkpk displacement	Per bearing	Recorder, Digital meter
SPP orbit [X]X SPPy	[X] order orbit longest y direction pkpk displacement	Per bearing, per order	Digital meter
SPP orbit [X]X SPPx	[X] order orbit longest x direction pkpk displacement	Per bearing, per order	Digital meter
SPP orbit [X]X SPPmax	[X] order orbit longest overall pkpk displacement	Per bearing, per order	Digital meter
Speed	Speed RPM for the OA instance	1	Digital meter
Direction	Test direction for the OA instance	1	Input control, Discrete display
<i>*per direction* - is a user selectable option with the checkbox "Separate spectra per direction".</i>			

7.2 Output channels and visual representation

Each bearing with assigned channels added to the machine train will automatically create a dedicated pre-defined display. On the predefined display there will be a set of **Orbit plots**, **Polar plots**, **2D graphs** as well as a **Digital meter** for speed and **Input control** dropdown to select between different operating conditions if **Both** is selected under **RPM setup**.

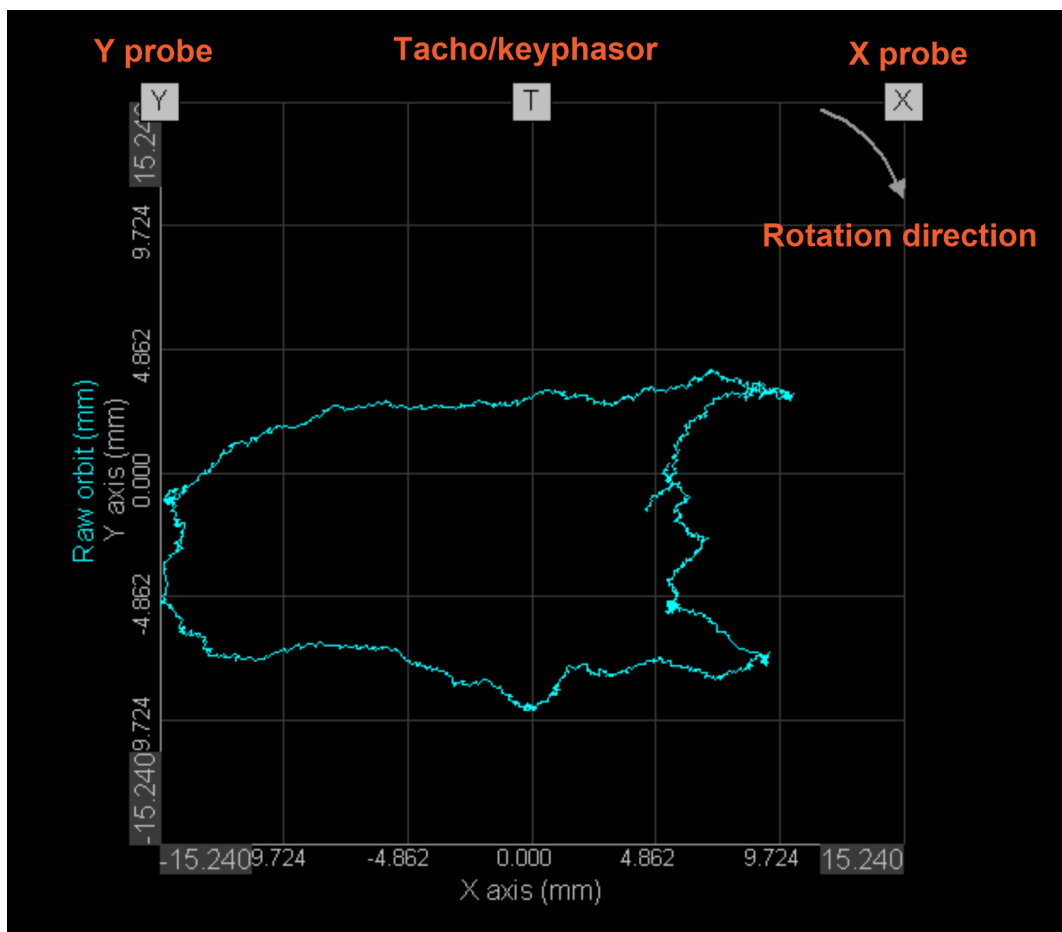
7.2.1 Orbit plot

The Orbit plot is a specific widget for the **Orbit Analysis** module. The plot shows data from two time domain channels, plotting a two dimensional visual picture of the motion of a rotating shaft.

The widget shows graphically the position of the proximity probes together with the tachometer (keyphasor) position and direction of rotation.

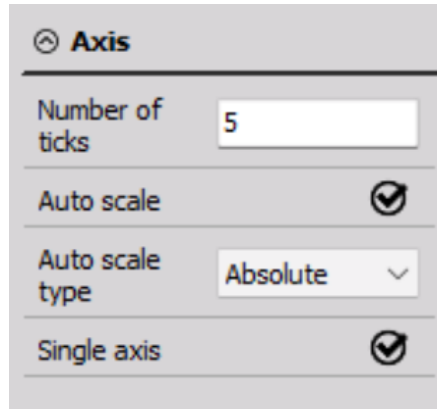
There are different output channels available in the **Orbit Analysis** module that can be shown on the **Orbit plot**:

- **Raw orbit,**
- **Average orbit,**
- **Filtered orbit (e.g. Orbit H1, Orbit H1, ...),**
- **Subsynchronous orbit** and
- **Shaft centerline.**



The Orbit plot display widget.

When the **Orbit Plot** widget is selected, on the left side of the **Measure** display a tab of settings is available for configuration of axis to the user:



Axis

Number of ticks: 5

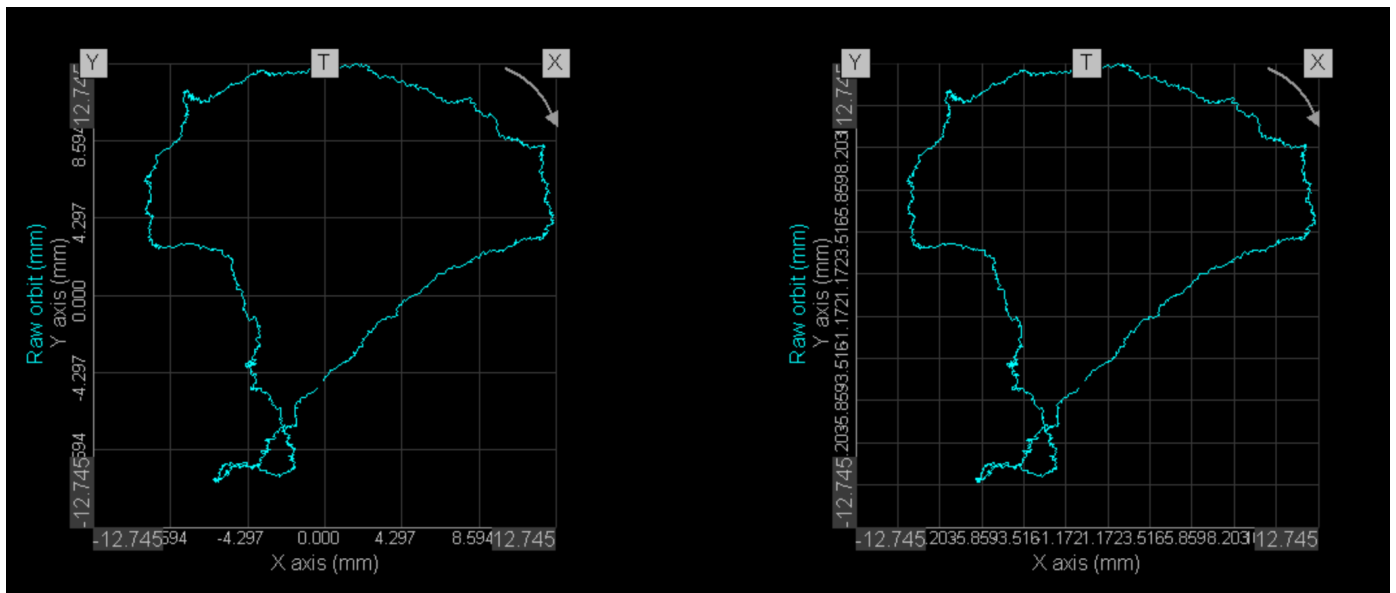
Auto scale: ☒

Auto scale type: Absolute

Single axis: ☒

Orbit plot Axis settings.

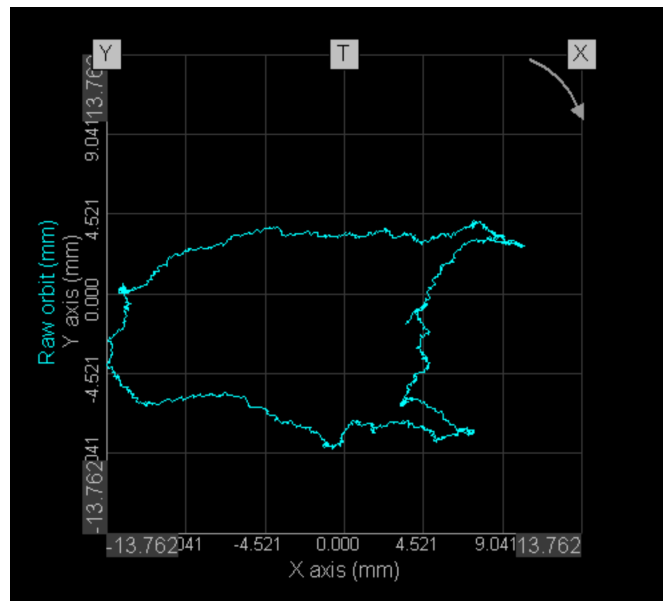
Number of ticks - changing the number of ticks will increase them on the Orbit plot accordingly. Left picture below shows 5 ticks and right picture shows 15 ticks:



Orbit plot with different Axis Tick settings.

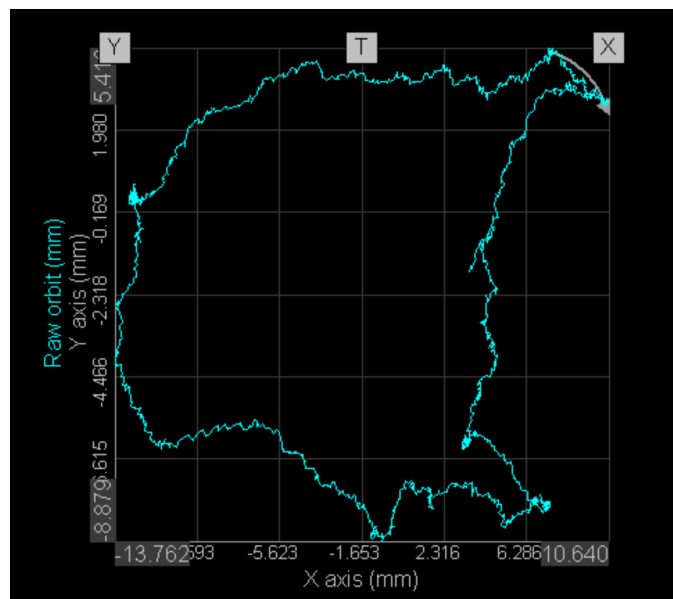
Auto scale - ticking the checkbox will automatically scale the axes of **Orbit plot**. There are two different Auto scale types: **Absolute** and **Relative**.

Absolute auto scale always keeps the zero in the center of the plot and therefore gives a better indication of orbit size and position relative to the center of the bearing:



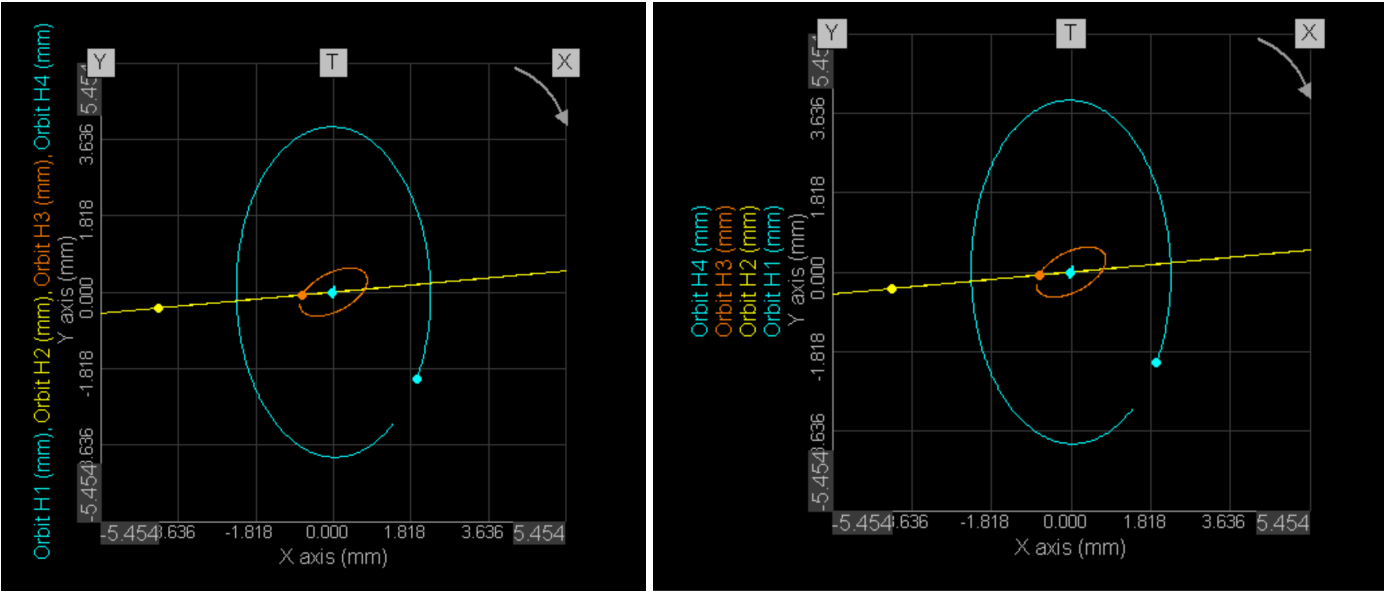
*Raw orbit on Orbit Plot using **Absolute** scaling*

Relative auto scale sizes the axes according to maximum current dimension of the measured orbit. This makes the orbit shape easier to observe and acts as a sort of zoom. The zero in this case is not always in the center position:



*Raw orbit on Orbit Plot using **Relative** scaling*

Single axis - this checkbox determines the behavior of how channel names are shown next to the orbit plot when showing multiple channels on the same graph. In the below example, two harmonic orbits are shown on the same orbit plot. The left image shows single axis switched on and the right image shows single axis switched off:



Orbit Plot widget showing **Filtered orbits** (H1 & H2) with **Single axis** option switched on (left image) and off (right image)

Besides axis configuration, there are different **Drawing Options** available when the Orbit plot widget is selected:

Drawing options

Graph type

Grid

Display type

RPM

Clearance

☐

Color

History type

Revolutions

Revolutions

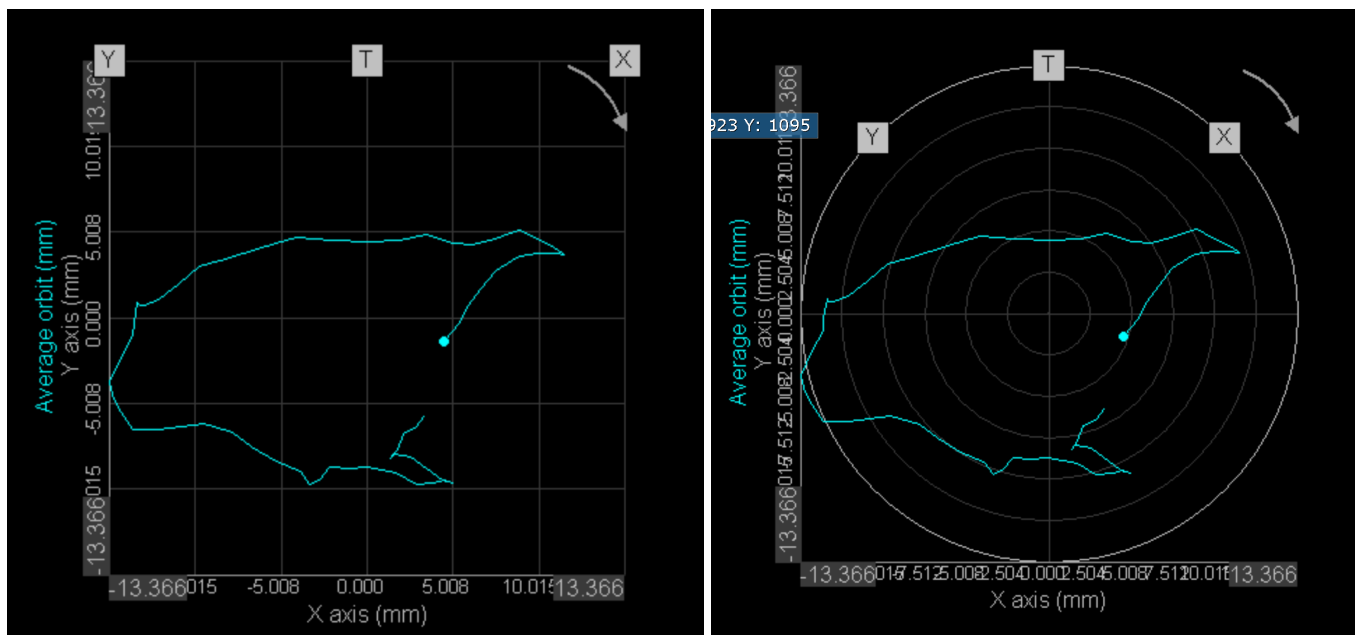
1

Show only last position

☐

Drawing options section of *Orbit Plot* widget settings

Graph type - user has the ability to select either **Grid** or **Circle**. The difference between the two graph types is shown below - left image shows Grid and right image shows Circle:



Orbit plot showing **Grid**(left image) and **Circle**(right image) **Graph type**

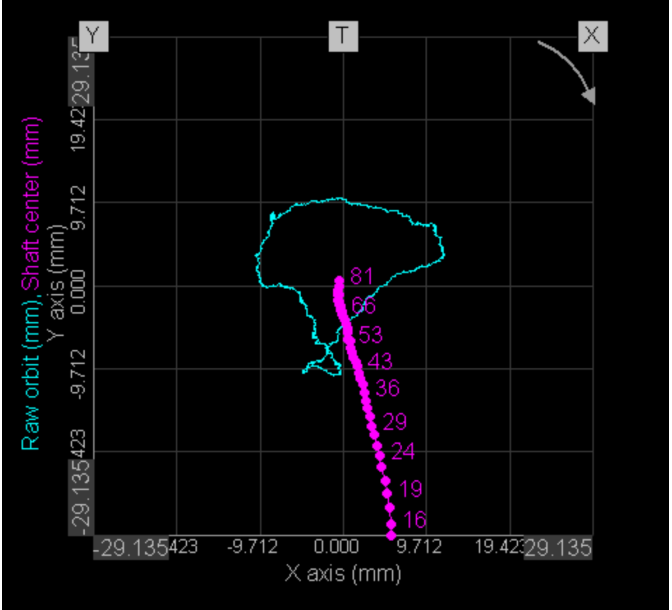
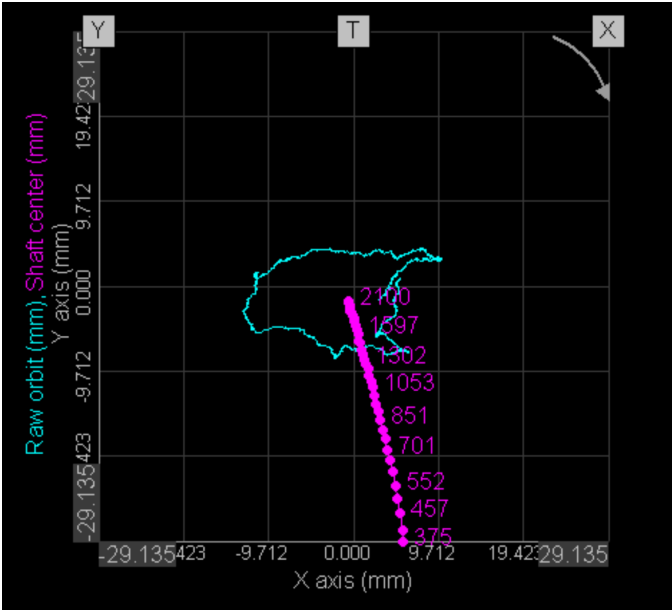


When **Circle** is selected as **Graph type**, only **Absolute** auto scale will be available.



The selected **Graph type** is applied to all of the **Orbit plots** in the individual display in order to unify the visual representation of the particular display.

Display type - User has the option to select either RPM or Time (in seconds) to be displayed when the Shaft center is assigned to the Orbit plot. Below images show the difference, the left image displays RPM and right image displays Time together with the shaft center points:



Orbit plot showing the difference between **RPM**(left image) and **Time**(right image) **Display type**

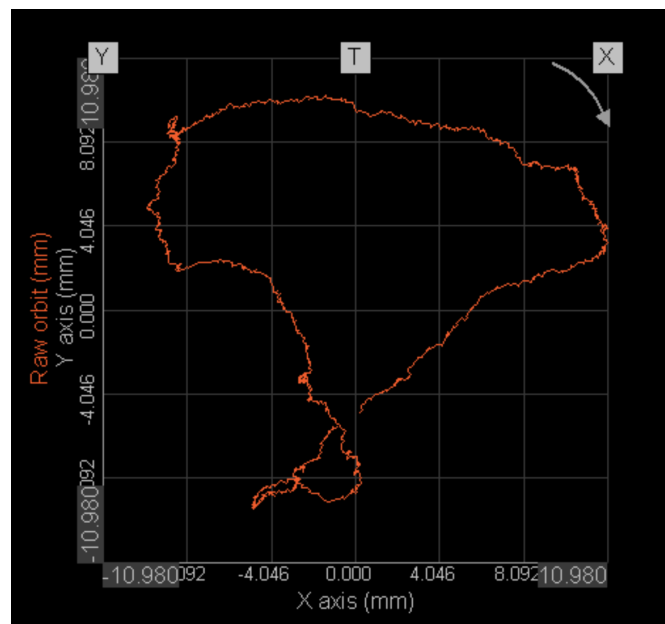


Time Display type shows relative time - elapsed time since the beginning of the measurement

7.2.2 Raw Orbit

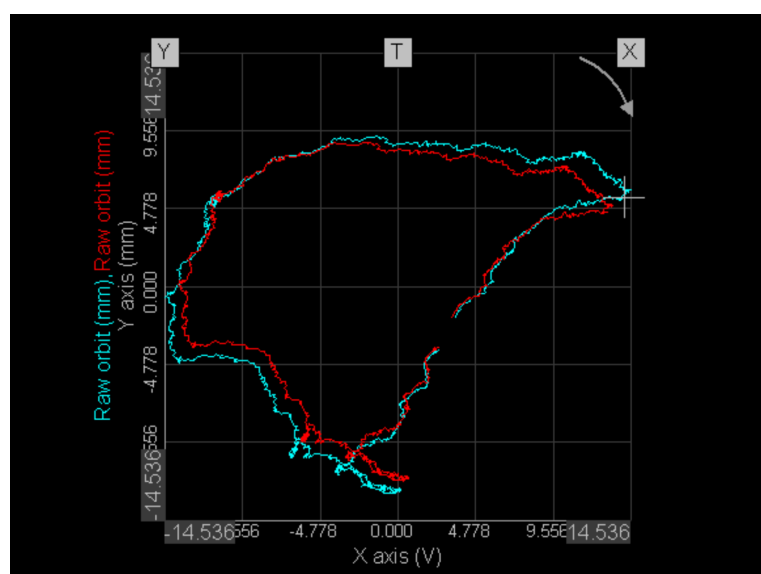
Raw orbit, also called Direct orbit, directly plots scaled time-domain data from a pair of orthogonal probes mounted at the same axial position on the rotating machine.

Raw orbit channel group can be displayed on the Orbit plot as explained in the section [7.1.1. Orbit Plot](#).

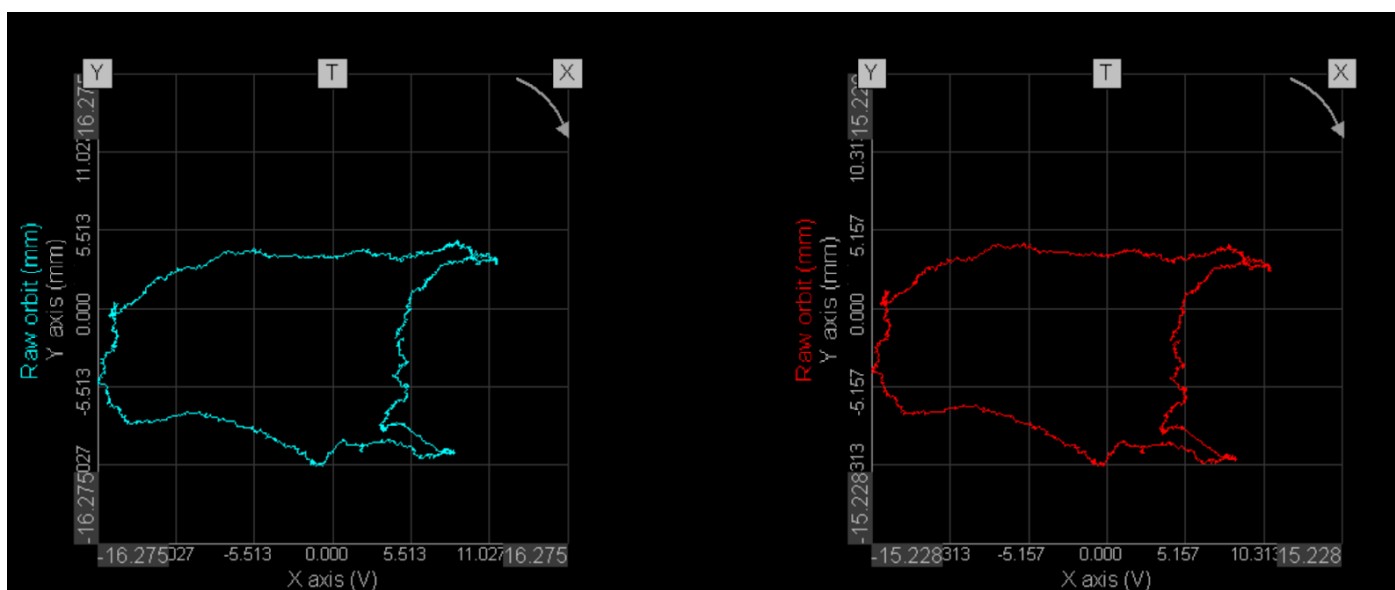


*Orbit Plot showing **Raw orbit** data with **Absolute** scaling selected*

Raw orbit can be displayed in multi-trace (multiple channels on one widget) and multi-graph (single channel per widget) mode:



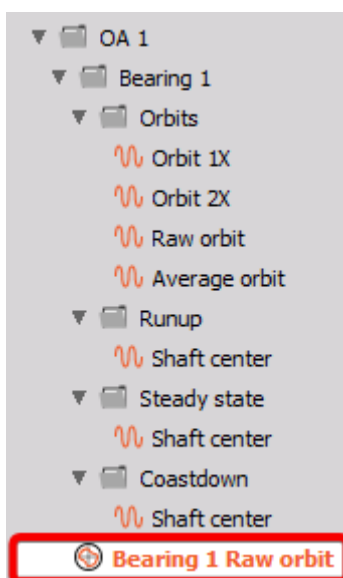
Raw orbits** from two bearings positioned closely along the shaft length displayed in multi-trace mode on **Orbit Plot



*Raw orbits from two bearings positioned closely along the shaft length displayed in multi-graph mode on **Orbit Plot***



To plot the raw orbit using the Orbit plot widget you should select the Raw orbit channel group from the channel list. The Raw orbit channel group is located under the Bearing name level as shown below:

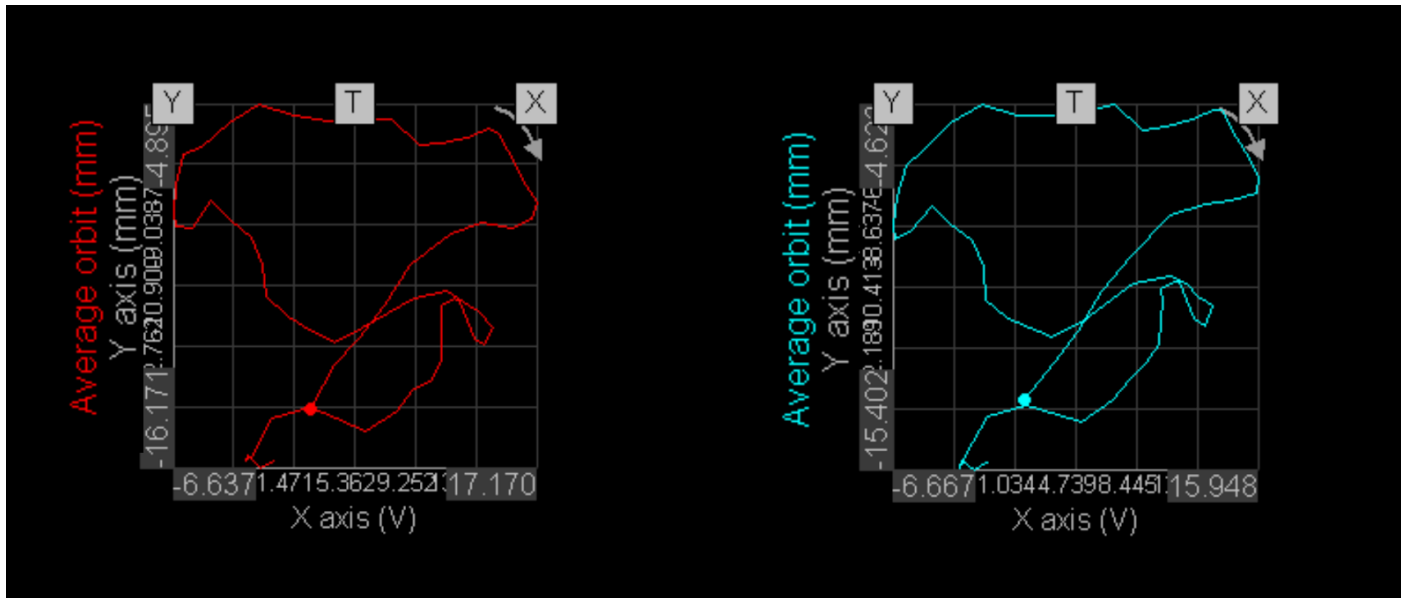


The Raw orbit channel group (marked red) should be selected for the Orbit plot widget to get such data plotted.

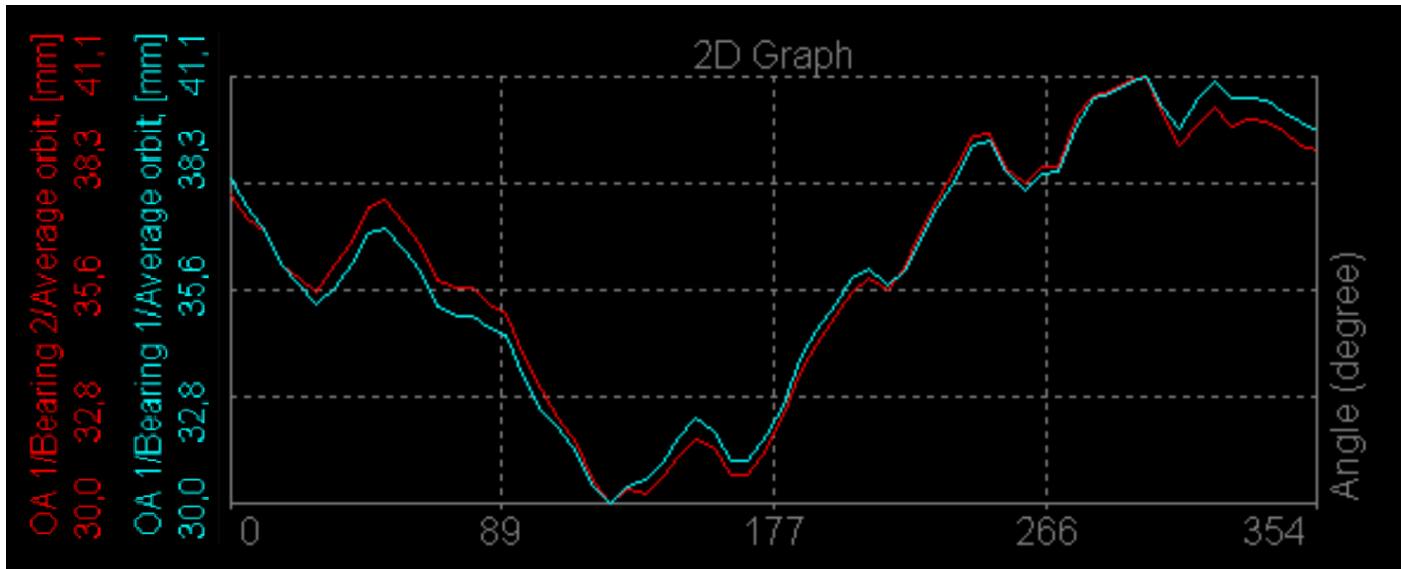
7.2.3 Average orbit

Averages the time domain data according to settings explained in section [6.9.3.5. - Average orbit](#). Average orbit can be displayed either on orbit plot or **2D graph**.

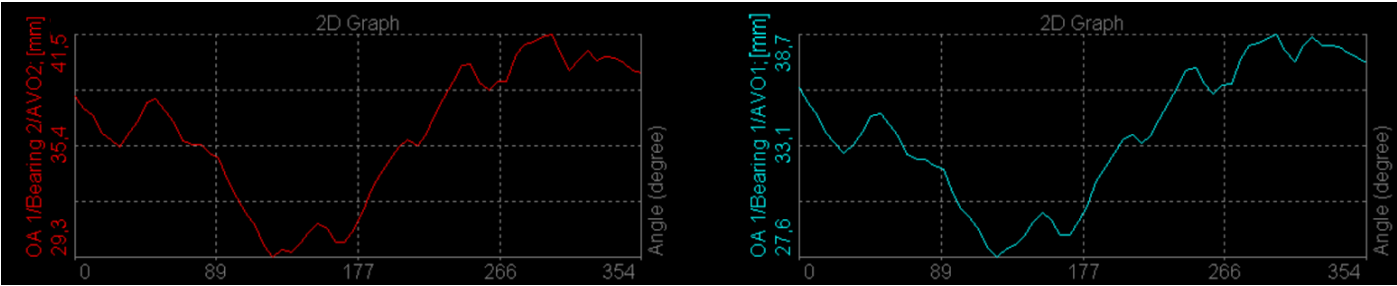
The **2D graph** widget supports multi-trace and multigraph display of data meaning average orbit can be shown both ways on the **2D graph**. Average orbits from different bearings can be displayed on the **Orbit Plot** in multigraph mode. Examples are shown in the images below:



Average orbits from two bearings positioned closely along the shaft length displayed in multi-graph mode on Orbit Plot



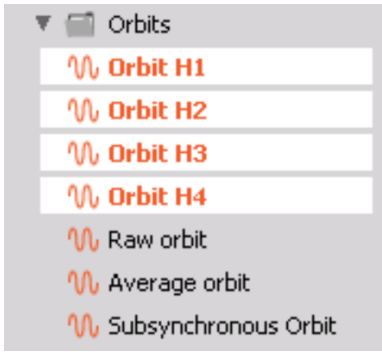
Average orbits from two bearings positioned closely along the shaft length displayed in multi-trace mode on 2D graph



Average orbits from two bearings positioned closely along the shaft length displayed in multi-graph mode on 2D graph

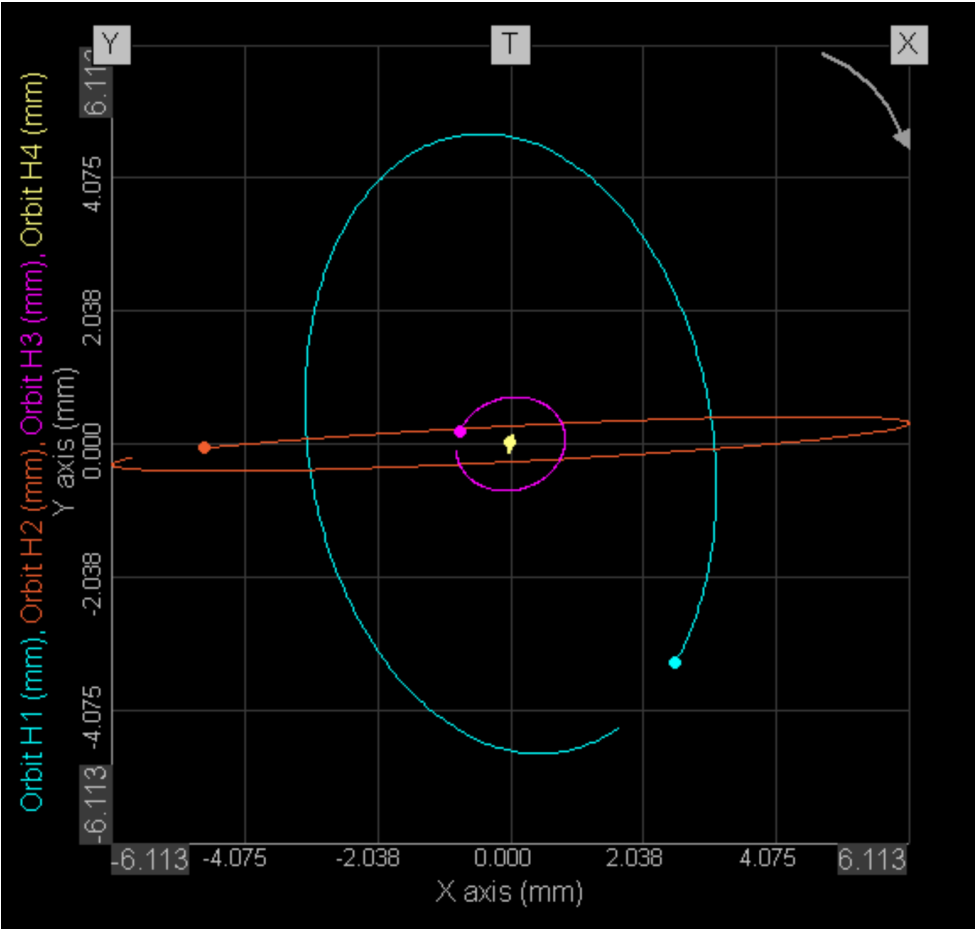
7.2.4 Filtered orbit

Filtered orbit, also called harmonic orbit, represents the extracted orbit of the order that has been input by the user in the **Harmonic list** section of the **Calculation setup**. For each harmonic entered into the harmonic list, a separate channel is created:

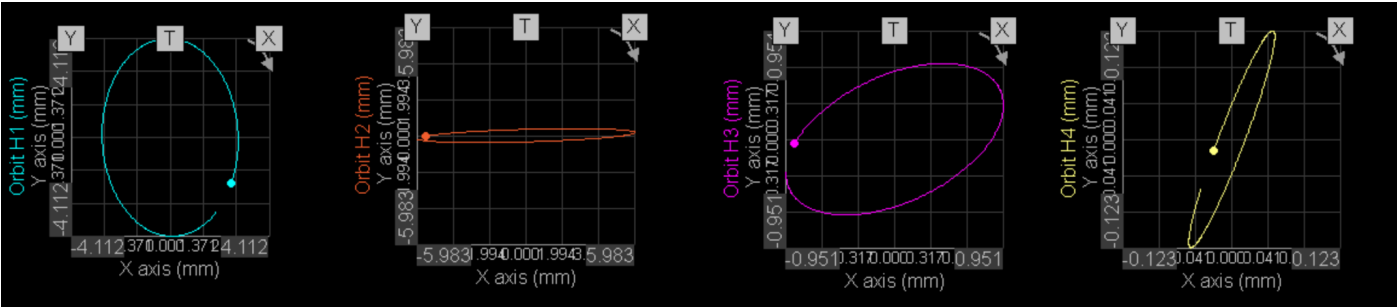


Multiple filtered harmonic orbit components are selected to be plotted on the same display widget

Each created **Filtered orbit** channel data can be displayed on the **Orbit Plot** widget. As with Raw orbit and Average orbit, the Filtered orbit can be shown in multi-trace and multigraph modes:



Filtered orbits H1-H4 displayed in multi-trace mode on Orbit plot



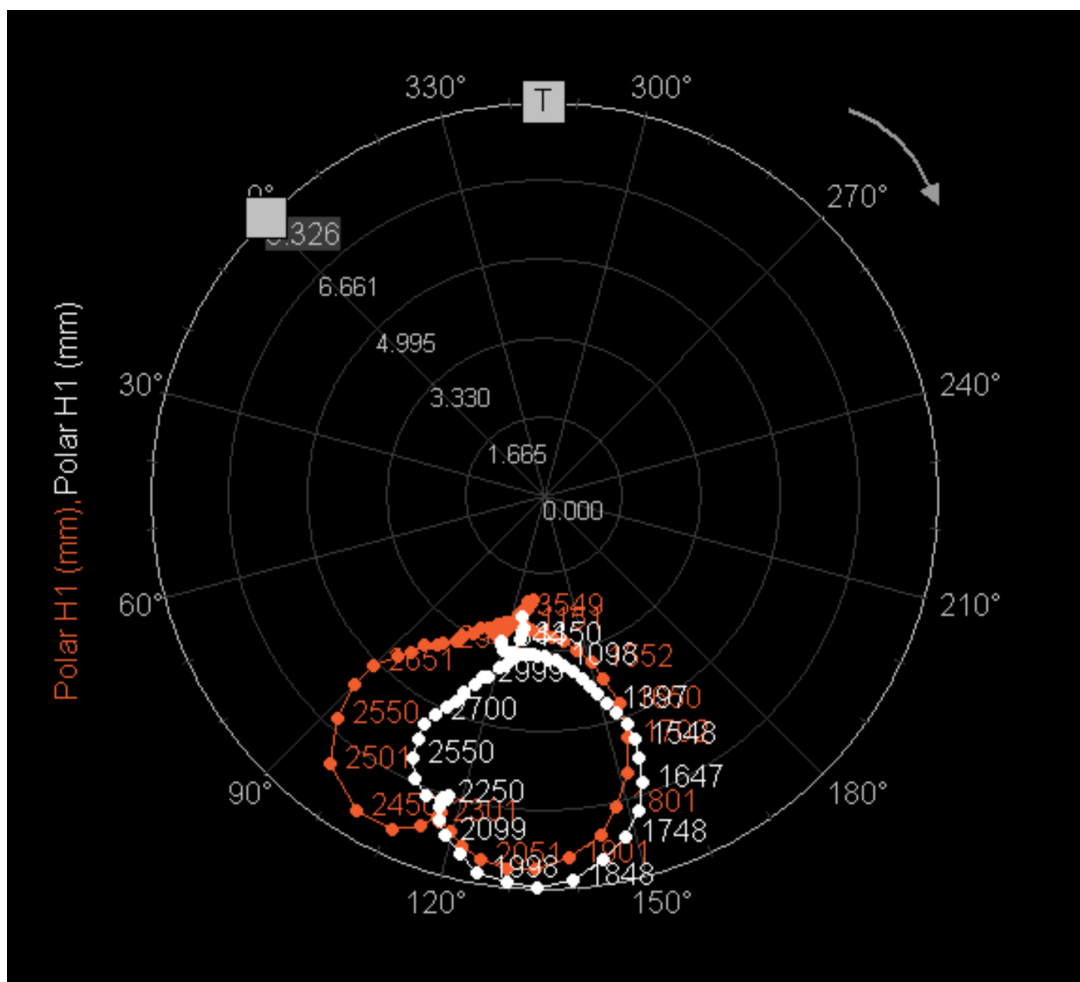
Filtered orbits H1-H4 displayed in multi graph mode on Orbit plot

7.2.5 Polar plot

Polar plot is a dedicated widget, featured in the Dewesoft Orbit Analysis module. It allows representation of Amplitude, Phase and Speed together with the shaft center on the same display for a comprehensive, single widget overview of the machine operation.

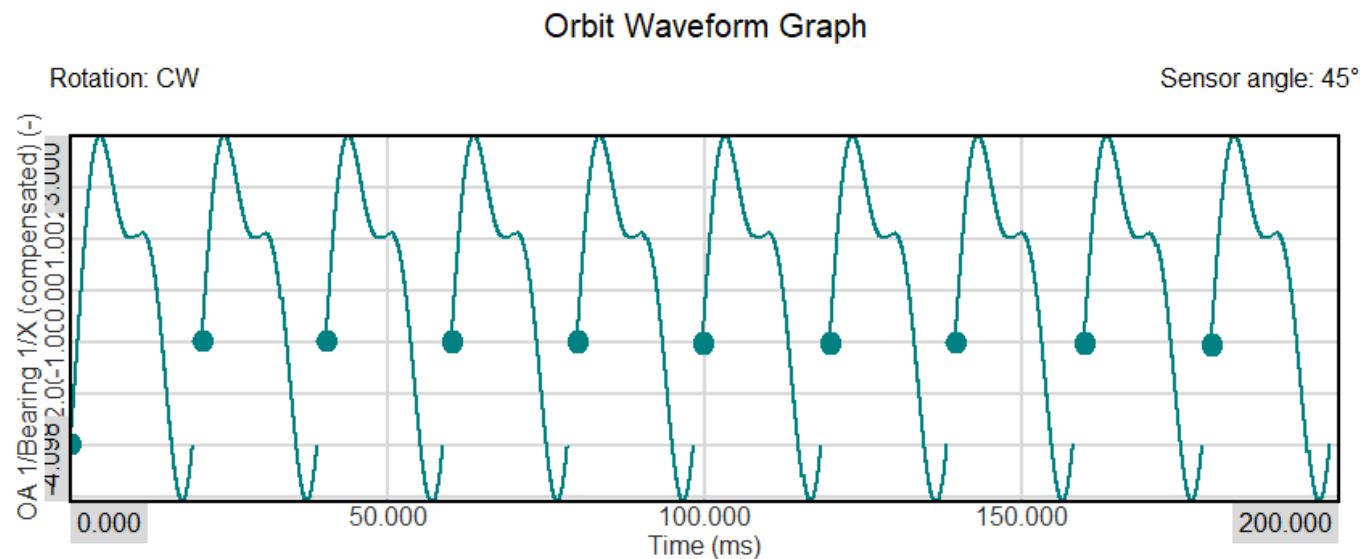
Each probe has a set of dedicated, corresponding polar plots for each order of extracted filtered/harmonic orbit. The polar plots for runup, coastdown and steady state are written into separate channels, depending on the selection of the dropdown Input control as explained under section 7.1. Output channels and visual representation.

The predefined Orbit analysis measurement display comes with a Polar plot widget for each of the used probes per bearing. When using OA with a pair of probes this means a pair of Polar plots is autogenerated and each one represents data from one of the probes - Y and X.



7.2.6 Orbit waveform graph

The Orbit waveform graph widget plots bearing X and Y sensor displacement data across a user-defined time duration or across a specific number of revolutions. Each new tacho key phaser crossing is indicated with a dot in the graph as illustrated below:



Orbit waveform plot with fixed time duration

When a fixed time duration is selected, then the number of revolutions varies as time goes, as illustrated above. A fixed time duration can be selected by setting the **History type** parameter to **Time**. Here you will be able to determine the time duration (Display time) shown in the graph.

Orbit Waveform

Controls 1 ⊖ ⊕ ⌵

Columns 1 ⊖ ⊕ ⌵

Transparency OFF ⌵

Drawing options

History type Time ⌵

Display time (ms) 100

Tick type Automatic ⌵

Autoscale ⊙

Orbit Waveform

Controls 1 ⊖ ⊕ ⌵

Columns 1 ⊖ ⊕ ⌵

Transparency OFF ⌵

Drawing options

History type Revolutions ⌵

Revolutions 1

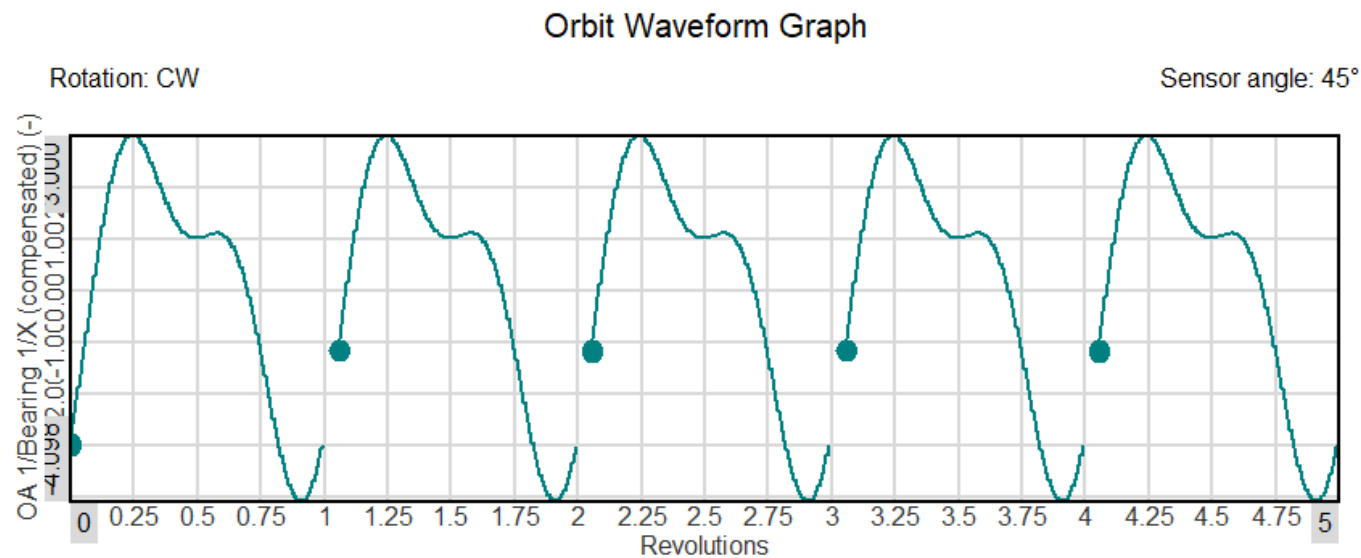
Revolutions display mode Time ⌵

Tick type Automatic ⌵

Autoscale ⊙

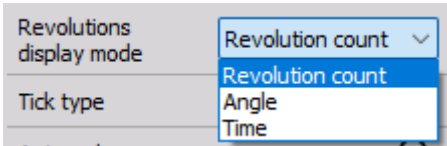
Orbit waveform widget properties. Left: History type Time. Right: History type Revolutions.

If the **History type** is set to **Revolutions** then you can select the number of Revolutions you want plotted.



Orbit waveform plot with a fixed number of revolutions and the axis set to Revolution count.

With History type set to Revolutions you also have the option to either have an axis with a fixed **Revolution count** or **Angle**, or to have a varying **Time** length on the axis that changes as the revolution speed changes, such that the number of plotted revolutions are kept constant.



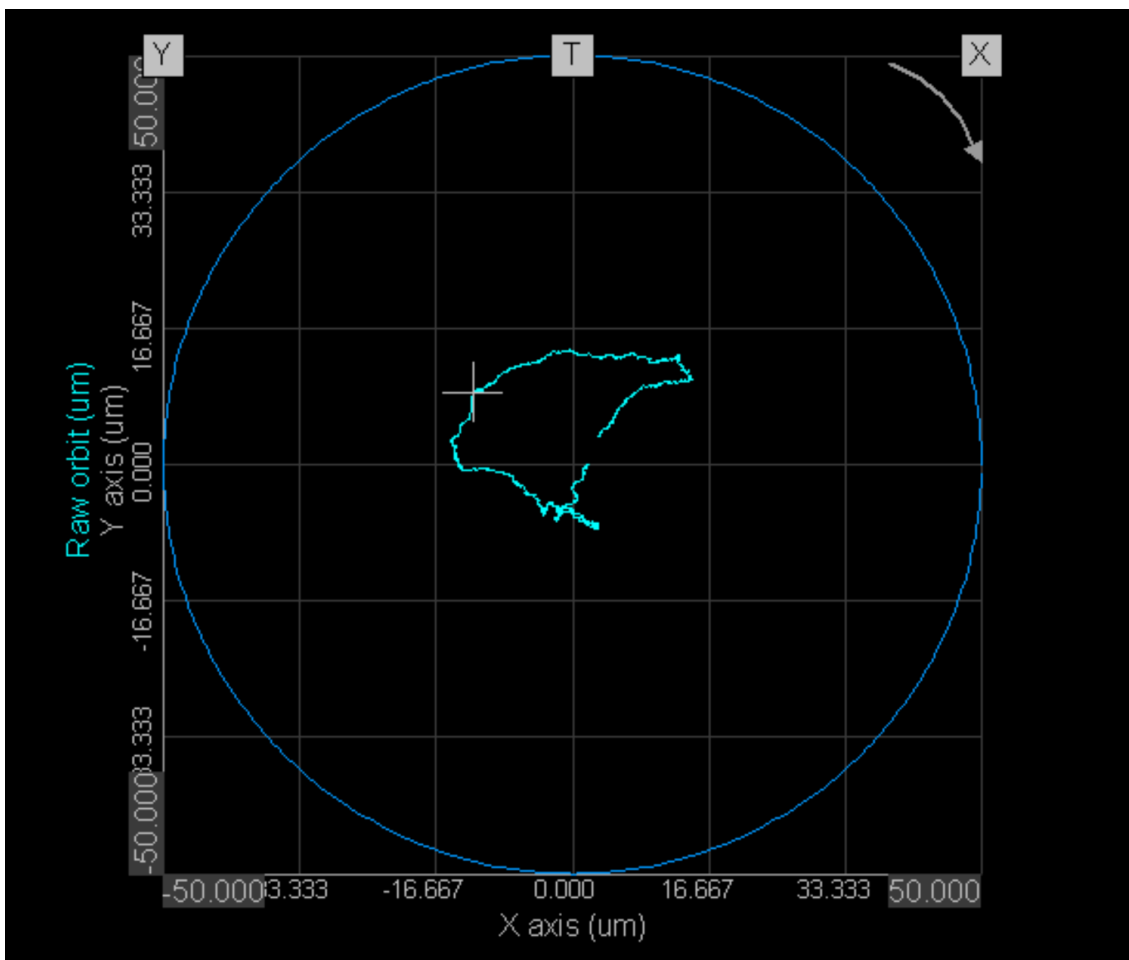
Revolution display mode options that are available when the History type is set to Revolutions.

7.3 Creation of industry typical displays for Orbit Analysis

Throughout the years of Orbit Analysis evolution, there was a set of display layout designs developed that are typical for the application. As Dewesoft offers advanced customization possibilities it is easy to create, edit and transform the typical display layouts within a few clicks. In the following sections you will find examples of how to generate such display layout templates.

7.3.1 Raw orbit with clearance circle

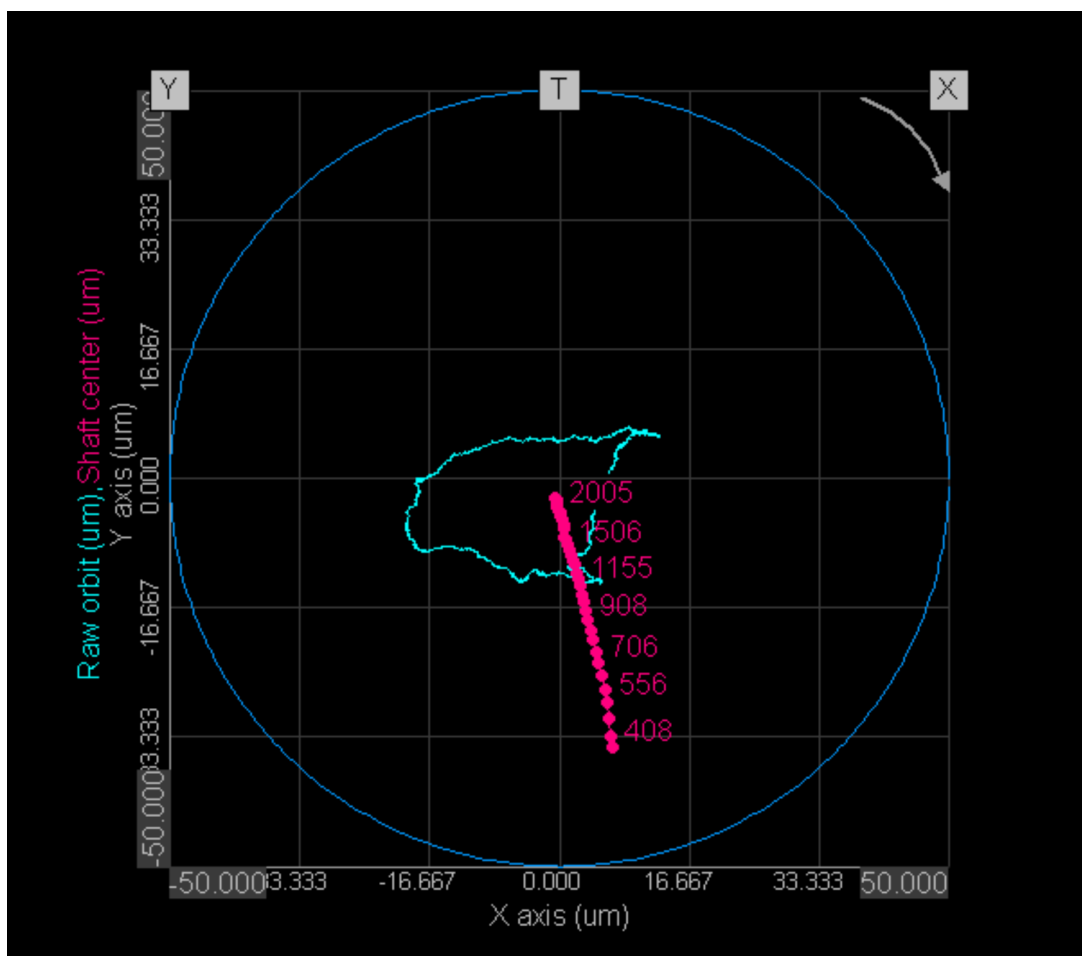
Created by assigning the Raw Orbit channel group to Orbit Plot widget and switching the clearance circle option on in the left side widget settings. Clearance circle needs to be defined beforehand in the Orbit Analysis channel setup as described in the section [6.6.3.4 Clearance](#) of this document.



Raw orbit with Clearance circle shown on the Orbit plot widget

7.3.2 Full motion Graph

Created from Raw orbit with Clearance circle (as described in [7.3.1 Raw orbit with clearance circle](#)) by adding the Shaft center channel to the Orbit plot. In other words, it is created by assigning the Raw orbit and Shaft center to the Polar plot widget and switching on the Clearance circle. Clearance circle needs to be defined beforehand in the Orbit Analysis channel setup as described in the section [6.6.3.4 Clearance](#) of this document.



*Raw orbit together with **Shaft center** and **Clearance circle** shown on the **Orbit plot widget***

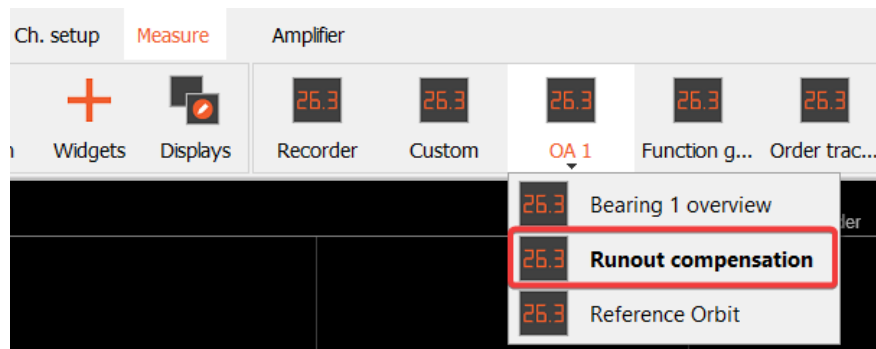
7.4 Runout compensation display

Runout compensation, sometimes called **slow-roll compensation**, is applied to compensate for any shaft irregularities (flattennings or other variations in diameter along the circumference variations) that would have otherwise been picked up by the proximity probes together with the actual movement of the shaft.

The compensation is typically performed at low rotational speeds, when the shaft is rotating slow enough for it to remain stationary (in regards to the movement inside the bearing clearance). However, not all rotating machinery is the same and some of the machines require compensation to be performed at higher speeds.

To cover all different runout compensation scenarios, DEWESoft Orbit Analysis performs such measurements in the angle domain which enaat variable speeds, and allows users to determine the angle resolution and number of rotations to be averaged into the compensation. This is explained under section [6.4 Runout compensation](#) of this document.

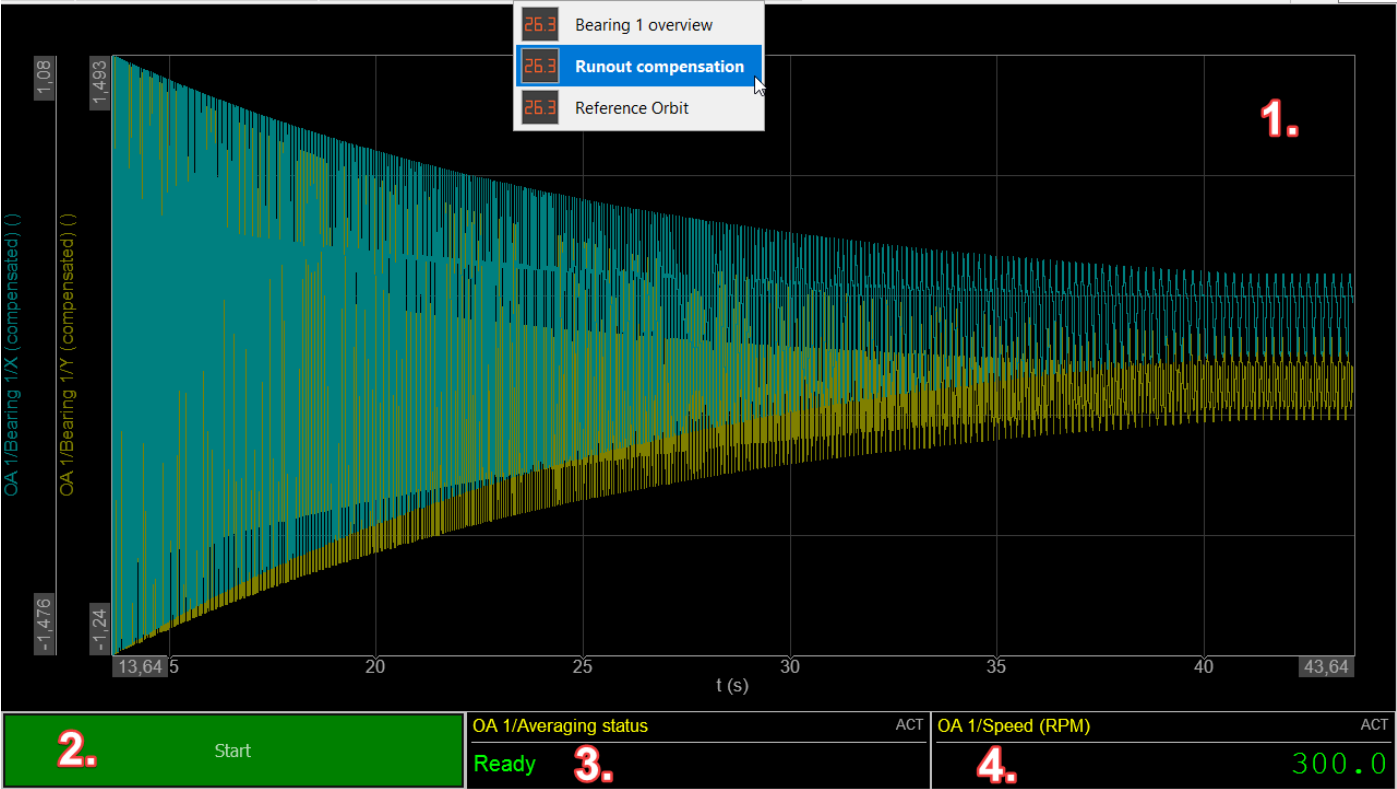
After it has been set up in the Ch. setup, the compensation itself is performed through a dedicated measurement display, that is generated automatically together with predefined Overviews for each Bearing and and a Reference Orbit display.



Pre-defined Measure display templates for Orbit analysis, including a sub-display used for runout compensation measurements.

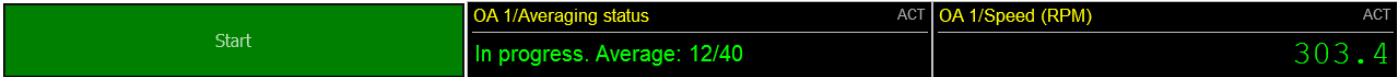
The predefined Runout compensation display consists of the following elements:

1. Recorder with raw signals from proximity probes
2. Start button to initiate the runout compensation
3. Measurement status
4. Current speed of the machine



Runout compensation measurement display

Upon starting the measurement, status in the measurement status bar switches from Ready to displaying the measurement progress. The measurement itself takes the number of averages that was user-defined in the [Ch. setup section under Runout compensation.](#)



Runout status displaying progress together with Start button and machine speed

The system displays status **Done** after the measurement of runout compensation has been completed successfully:



Runout status displaying Done measurement together with Start button and machine speed

After the Runout compensation measurement is Done,, the calculated values are automatically added to the setup and can be seen under Ch. setup under the Machine configuration - Bearing Setup page:

Setup

Bearing properties

Bearing name
Bearing 1

Sensors

Configuration

Pair

Tacho angle

Left

at

0

°

Y position

Probe Y

X position

Probe X

Y angle

Left

at

45

°

X angle

Right

at

45

°

Left

0°

Right

Calculate subsynchronous orbit

Tracking filter bandwidth

5

Hz

180°

Runout compensation

Add

Remove

Paste

Import

Export

Angle[°]	Y [mm]	X [mm]
0,00	-3,12	4,01
1,00	-2,98	4,44
2,00	-2,93	4,80
3,00	-2,94	5,04
4,00	-3,00	5,42
5,00	-3,14	5,80
6,00	-2,94	6,04
7,00	-2,83	6,17
8,00	-2,90	6,35
9,00	-2,73	6,54
10,00	-2,53	6,72
11,00	-2,38	6,98
12,00	-2,30	7,27

Shaft

Rotation

CW

Position

Center

Clearance

Shape

Circle

Radius

20

mm

DC Gap

Sensor Y

0

mm

Sensor X

0

mm

Average orbit

Periods

3

Averages

3

Channel colors

Runup

Steady state

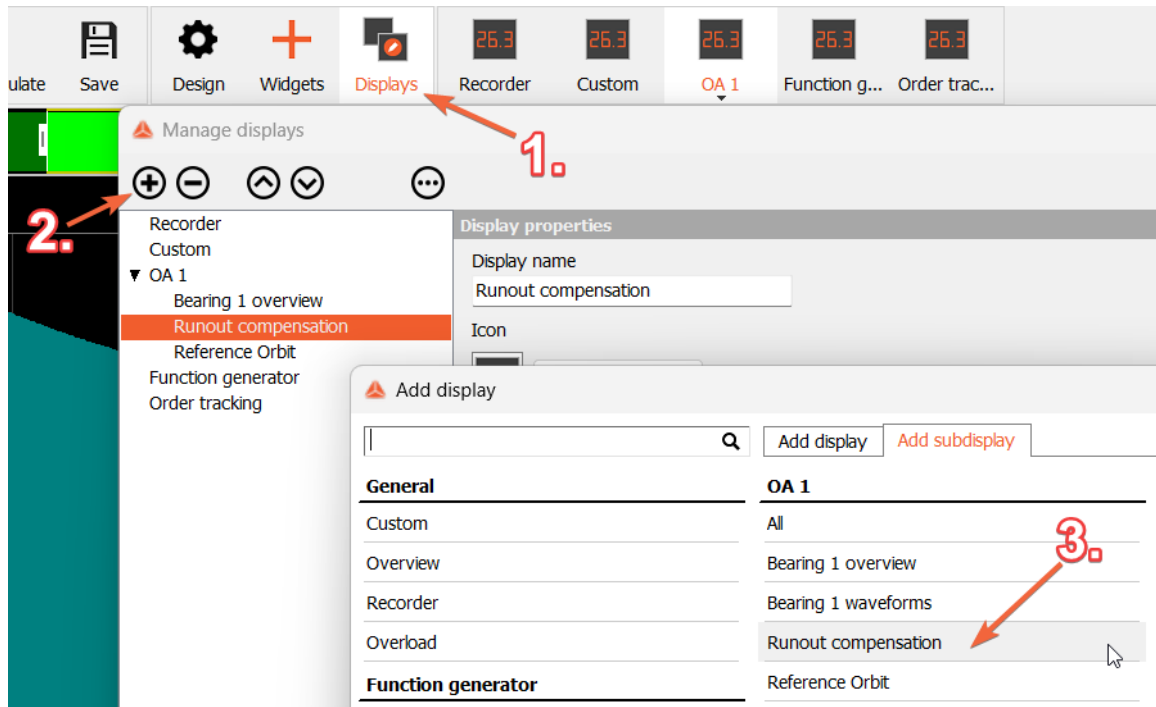
Coastdown

OK


Cancel

Measured runout compensation data will automatically overwrite the values in the runout compensation table under the Bearing Setup.

In case the Runout compensation display needs to be manually added, this is done through the following steps:

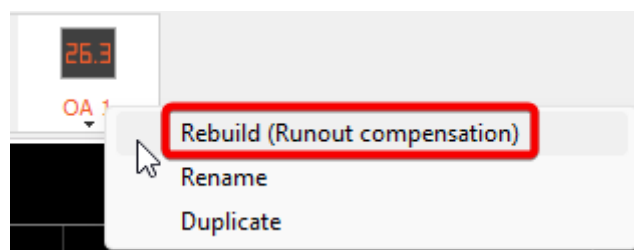


In Measure mode under the Displays button you can manually add displays and sub-displays.

1. Select **Displays**
2. Select the  button
3. (Optionally) go to the Add subdisplay tab
4. Select **Runout compensation**



If you need to update OA display templates then right click on the relevant display tab or sub-display and select **Rebuild**.



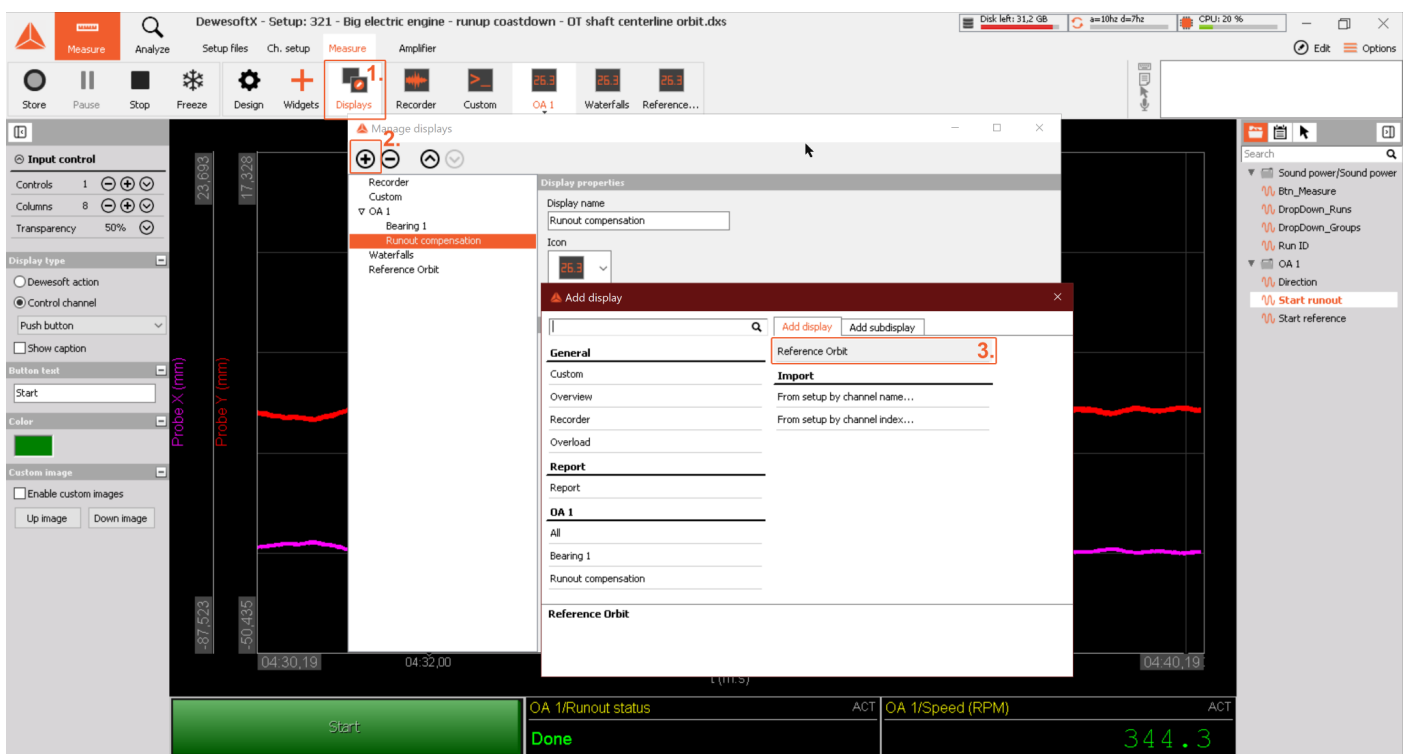
*Changes to the setup configuration will take effect on the display templates after **Rebuild**.*

7.5 Reference orbit display


Reference orbit allows acquisition of current orbit and storing of its values directly in the setup file. From these orbit values, stored in setup as a reference orbit a dedicated channel is created, which can be displayed during a different measurement together with the currently measured orbit to compare the two. This allows evaluation of current machine operation against the operation during the previous measurements on the same Orbit Plot widget.

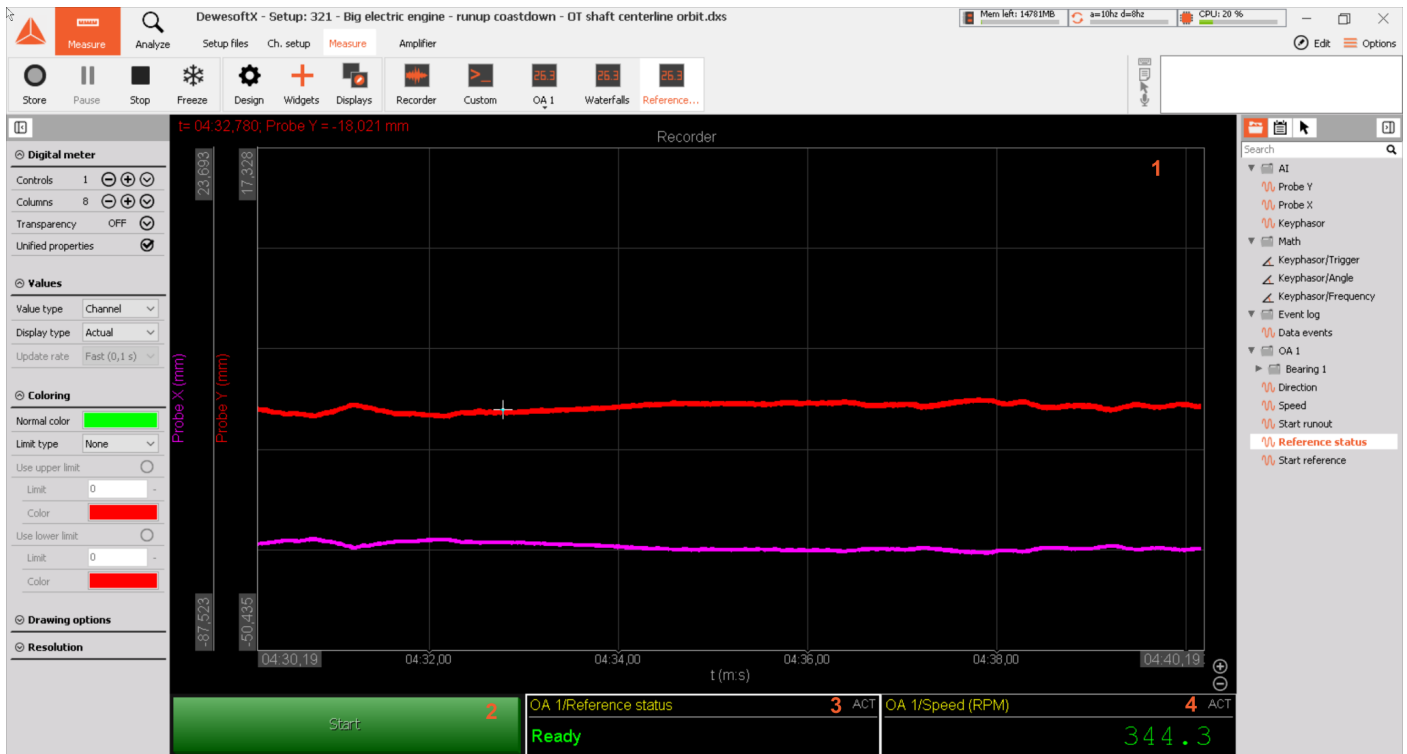
Similar to the Runout compensation, Reference orbit measurements can be managed via a dedicated measurement display.

To manually add the Reference orbit display, this is done through the following steps:



In Measure mode under the Displays button you can manually add displays and sub-displays.

1. Select **Displays**
2. Select the  button
3. (Optionally) go to the Add subdisplay tab
4. Select **Reference Orbit**

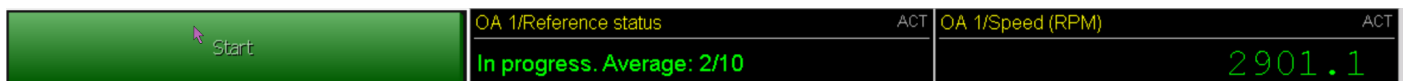


Reference orbit measurement display.

The pre-defined Reference orbit sub-display consists of the following elements:

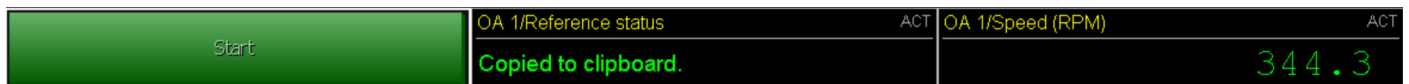
1. Recorder with raw signals from proximity probes
2. Start button to initiate the runout compensation
3. Measurement status
4. Current speed of the machine
5. Analyze mode and post processing

After the rotating speed of the machine is in the desired range at which the Reference orbit wishes to be stored, the acquisition of Reference orbit is initiated by clicking on the button Start. Upon starting the measurement, status in the measurement status bar switches from Ready to displaying the measurement progress. The measurement itself takes a number of averages that was defined under the [Reference orbit section](#) of the Ch. setup.



Reference status displaying progress together with Start button and machine speed.

The system displays status **Copied to clipboard** after the measurement of runout compensation has been completed successfully.



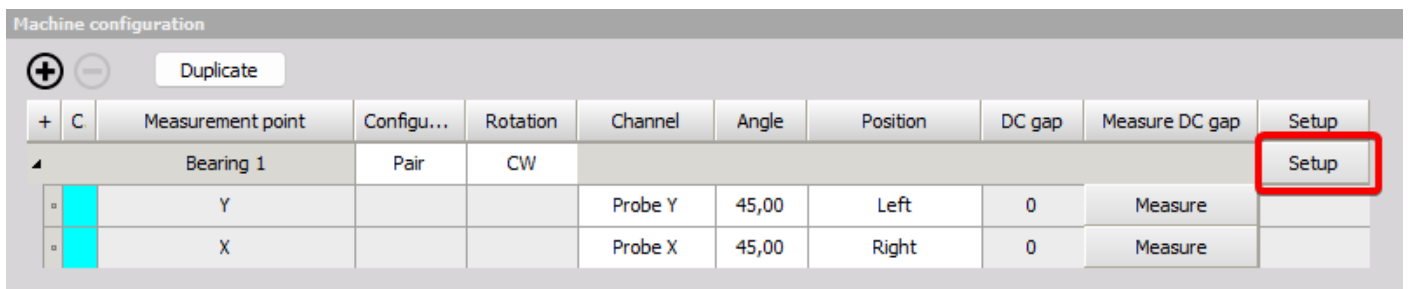
Reference status displaying "Copied to clipboard" with Start button and machine speed.

7.5.1 Add reference data to the setup

After the **Reference orbit** measurement has been completed and values copied to clipboard, they can be pasted directly into the [Reference orbit table](#) found under the Machine configuration bearing settings, in Ch. setup.

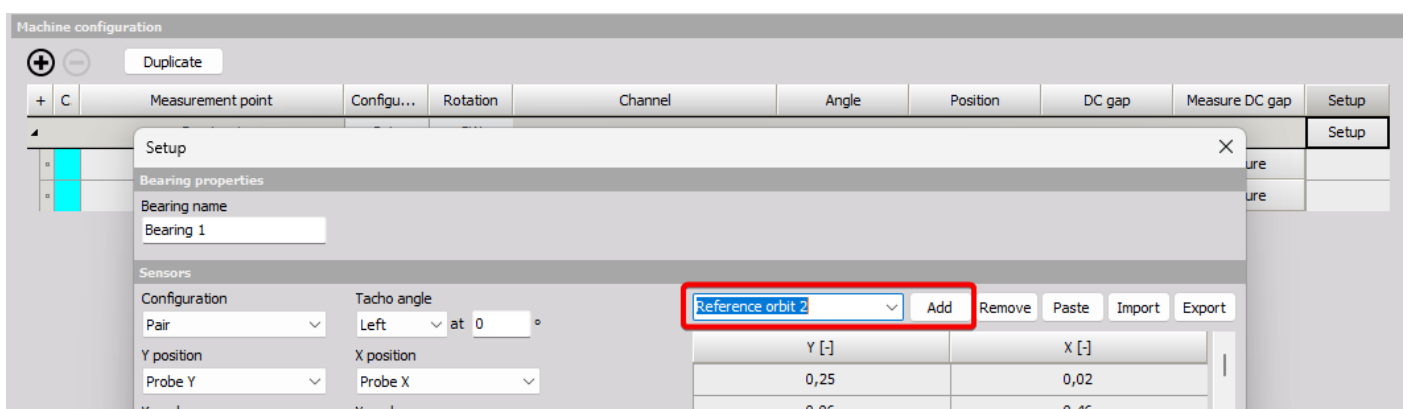
Open Dewesoft and navigate to the **Orbit Analysis** module under Ch. setup:

1. Select the **Setup** button in the **Machine configuration** section to open **Bearing Setup**:



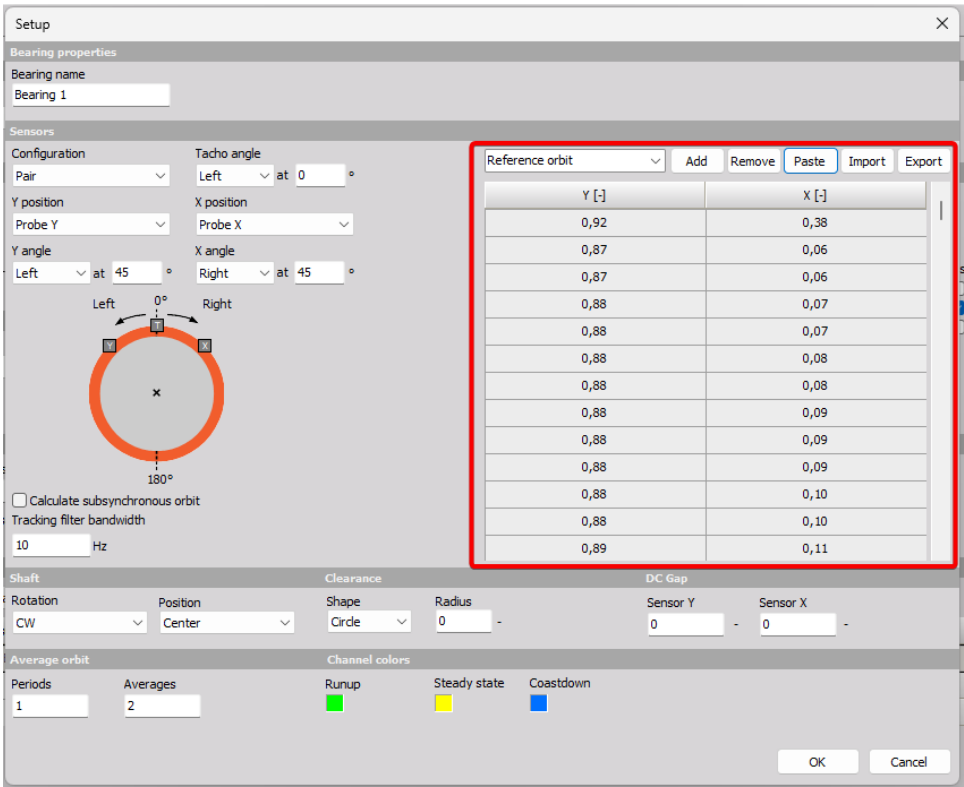
Entering the Bearing Setup page via the Machine configuration section.

2. Select **Reference orbit** in the dropdown. If there aren't any to select then create a new one by pressing **Add**.



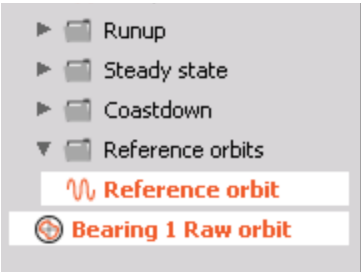
Adding a new Reference orbit data table to the setup.

3. Press **Paste**, or alternatively press **Import** and select the .txt document with previously pasted **Reference orbit** data.
4. The **Reference orbit** values can now be observed in the table and will be stored in the setup file.



Showing values for a reference orbit. The Reference orbit data can be pasted from clipboard to one of the user-added reference orbit tables.

5. In **Measure** mode, the **Reference orbit** data can now be found written to a dedicated channel that can be displayed on the **Orbit Plot** or the **2D graph**

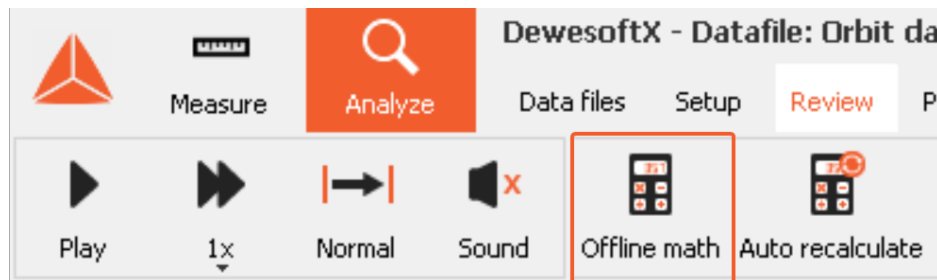


In Measure mode the Reference orbit channels are selectable from the Channels list to be added to Orbit plot or 2D graph widgets.

Under the Bearing settings you can **Add** one or multiple reference orbit tables where the measured data can be **pasted** to. In this way you can have multiple Reference orbits that can be overlaid with real-time data in Orbit plot widgets under Measure.

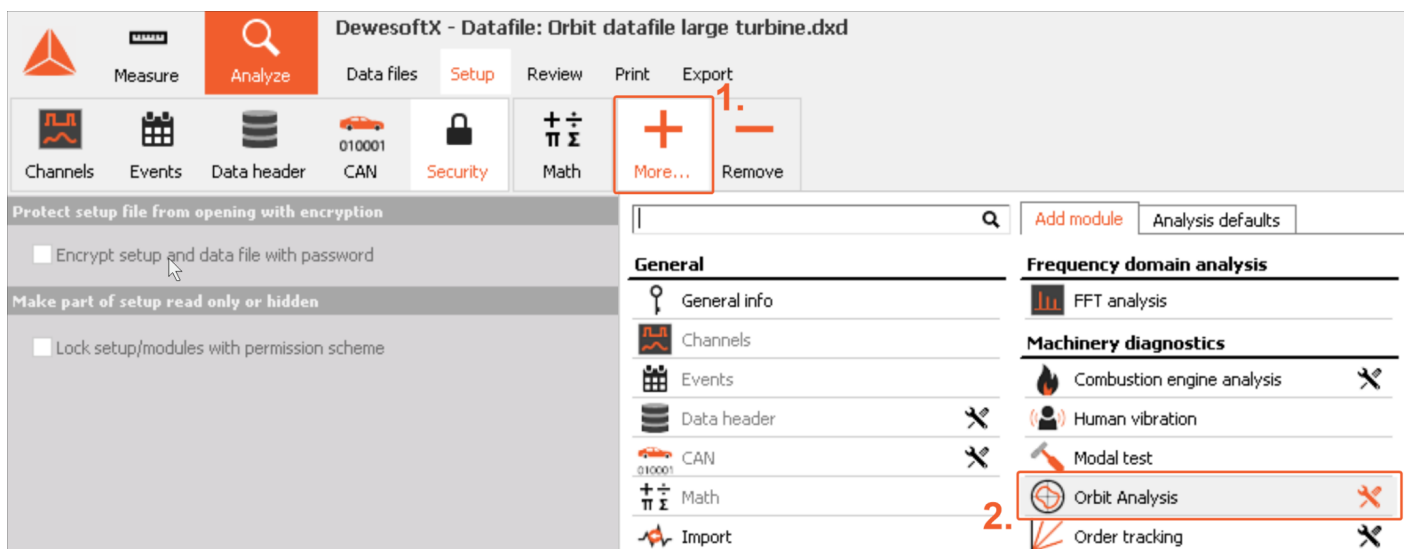
8. Recalculating Orbit analysis data

Orbit analysis can be recalculated using the raw signals from the proximity probes and the frequency source that have been stored during the measurement. To recalculate data simply open the datafile with the raw signals included and in **Analyze** mode navigate to **Offline math**:



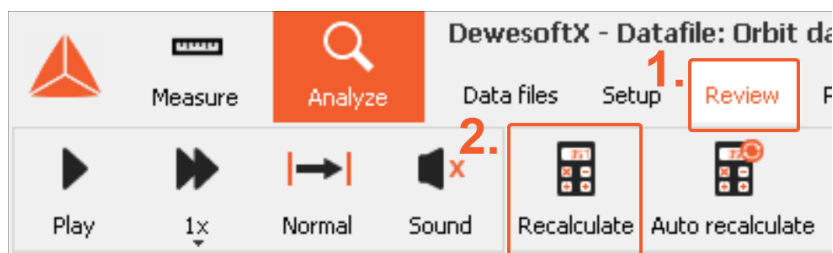
The Offline math button will direct you back to the Setup configuration if you are in Review mode.

1. When in **Setup**, add the Orbit Analysis by selecting **More...** and choosing **Orbit Analysis** from the list of modules:



How to add the Orbit analysis application module to the datafile if it wasn't already added while the data was acquired.

2. Having added the Orbit Analysis module, configure it by following the same steps described in the previous section of this document - [6. Orbit analysis module setup](#)
3. Return to **Review** and select **Recalculate**

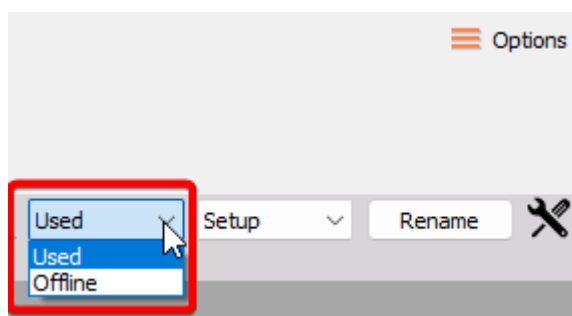


If calculation settings have changed or if you have set modules to Offline, then you can recalculate results by pressing **Recalculate**.

4. The recalculated output channels are now displayed on the predefined display.



If you see an Offline math button instead of the Recalculate button, then go to Setup and set the Orbit analysis module to Offline.



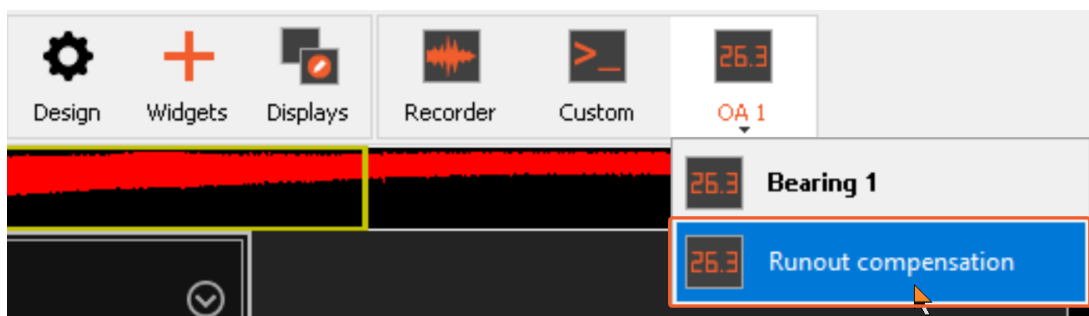
If you want to **Recalculate** and old data is already available, then you might need to set the related module to **Offline** first.

8.1 Recalculating Runout correction

Together with all of the output channels from Orbit Analysis, Runout compensation can also be recalculated in post-processing using the raw data from the proximity probes.

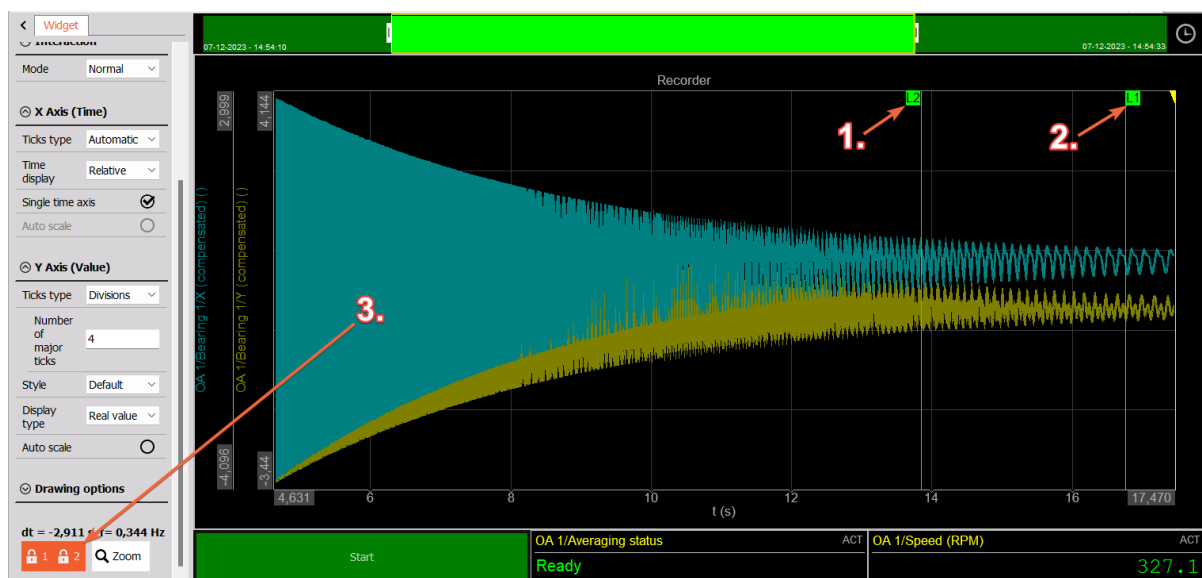
To recalculate and apply runout compensation in Analyze mode, please follow the steps below:

1. Navigate to the **Runout compensation** sub-display template.



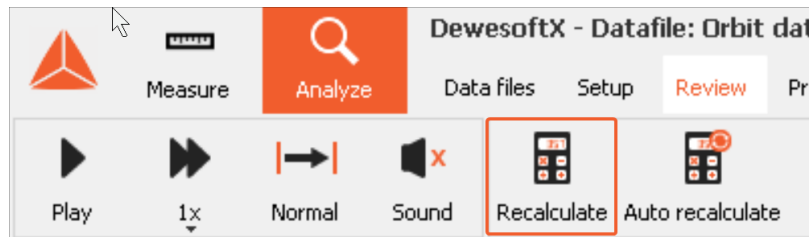
Going to the Runout compensation pre-defined sub-display template.

2. In the Runout compensation display, place the two cursors over the section of raw data you wish to use for the runout compensation and lock them.



The L1 and L2 lockable cursors are placed and locked around the area to use for the Runout compensation recalculation..

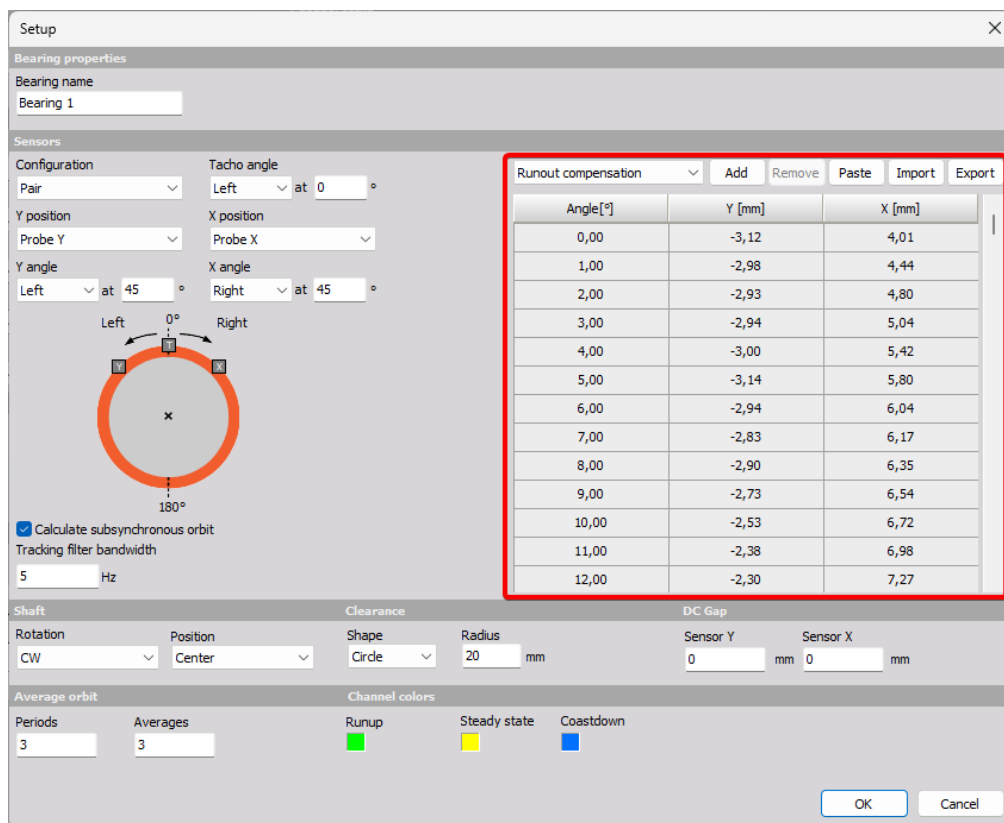
- Click on **Recalculate** to determine the runout compensation data:



Recalculate Offline math.

If you see an **Offline math** button instead of the **Recalculate** button then set the Orbit analysis module to **Offline** first under Setup.

- After Recalculation, the calculated values are automatically added to the setup and can be seen under the Machine configuration - Bearing Setup page:



Recalculated runout compensation data will automatically overwrite the values in the runout compensation table under the Bearing Setup.

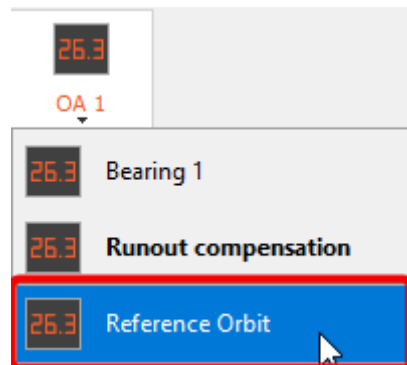


Make sure to save the setup after measuring the runout compensation in order to be able to simply load and have it ready the next time you use the setup

8.2 Recalculating Reference orbit

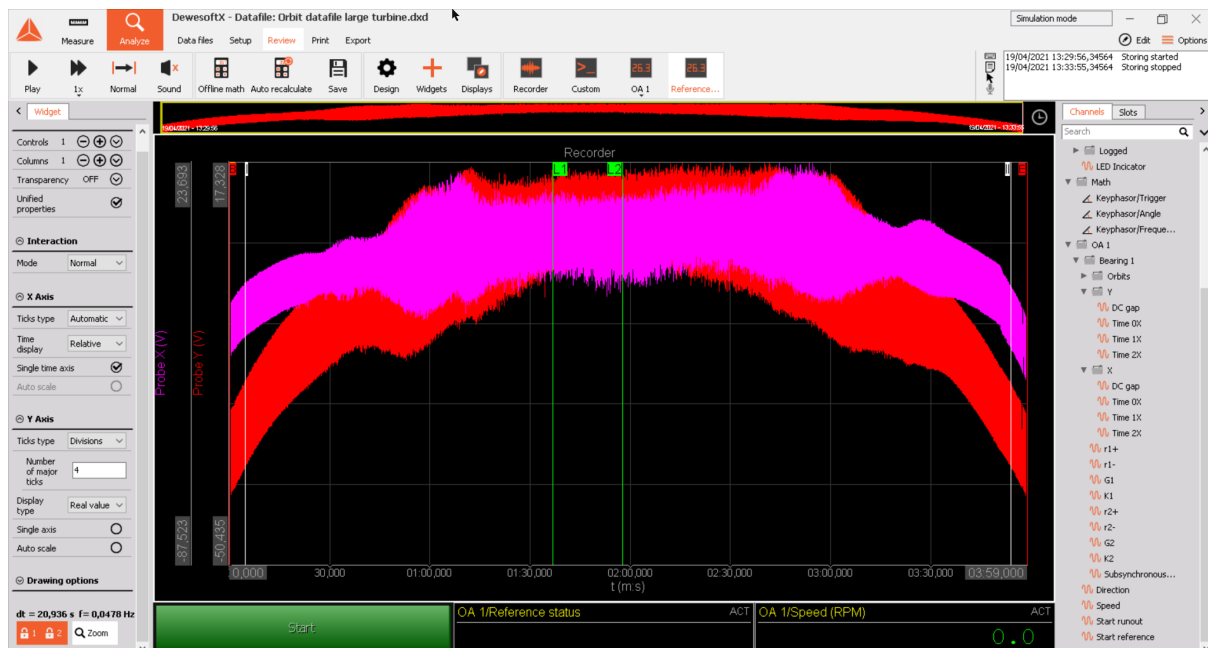
From acquired raw data it is possible to define the reference orbit also in Analyze mode. To recalculate and store the reference orbit in Analyze mode, please follow below steps:

1. Navigate to the pre-defined Reference orbit sub-display template:



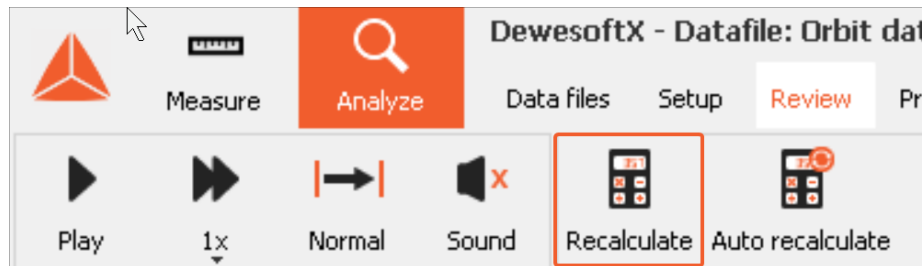
Going to the Reference orbit pre-defined sub-display template.

2. Place the two cursors over the desired region from which you wish to acquire data to define the Reference orbit, and then **lock the cursors**:



The L1 and L2 lockable cursors are placed and locked around the area to use for the Reference orbit recalculation..

3. Select Recalculate:



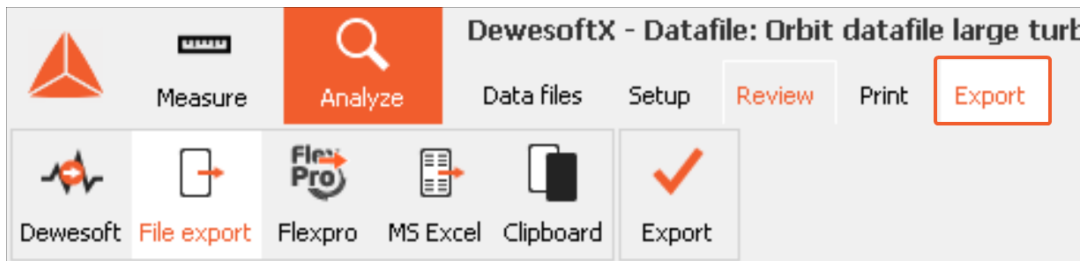
Recalculate Offline math.

If you see an **Offline math** button instead of the **Recalculate** button then set the Orbit analysis module to **Offline** first under Setup.

4. Now the new calculated Reference orbit data are copied to clipboard and can be pasted directly into a Reference orbit data table found under the Bearing Setup page.
How this is done is described in the section [7.5.1 Add reference data to the setup](#).

9. Export

By navigating to the Export tab, the data stored in the datafile can be exported in different formats:



In Analyze mode you can Export data.

More about different formats and setting when it comes to exporting can be read in the dedicated pro tutorial:

<https://training.dewesoft.com/online/course/exporting-data>

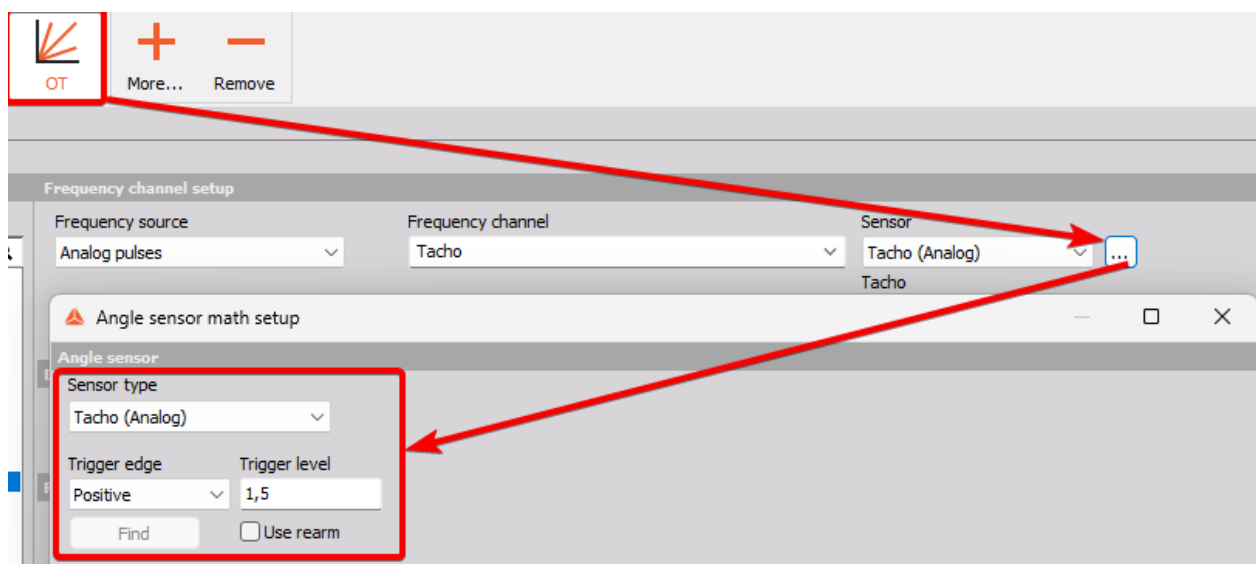
10. Phase definition differences between Orbit analysis and Order Analysis

Order tracking and Orbit analysis are used in different user domains and have their own common ways to interpret phase information. To accommodate both user domains the phase values from Order tracking and from Orbit analysis should be interpreted differently.

10.1 Phase information from Order tracking analysis

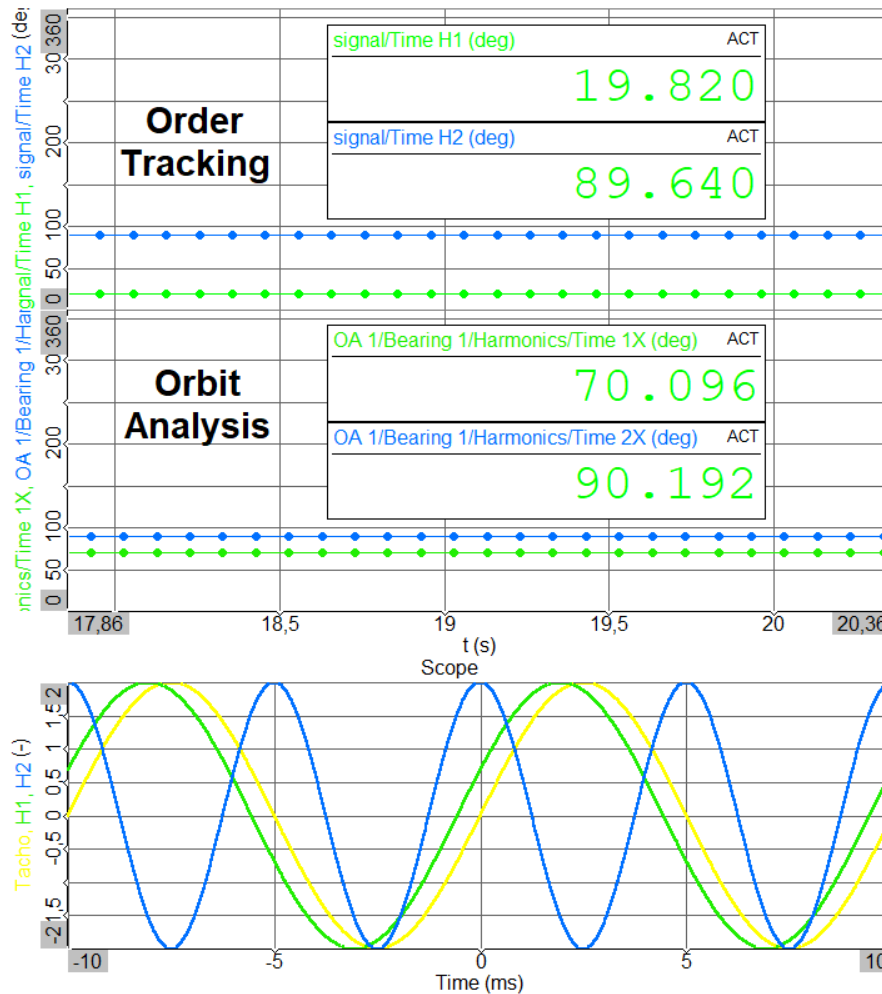
The phase information for extracted order components in Order tracking are relative to the detected Frequency source events.

The selected trigger condition for the Frequency source will be used to trigger the reference phase which will also be the zero-phase point.



Angle sensor setup can be opened through the Order Analysis module..

For example if the first order component is 20 degrees shifted compared to the triggered Frequency source events then the phase information for the 1st. order will also indicate 20 degrees, as illustrated below:



1st and 2nd order phase value comparison between Order analysis and Orbit analysis module results. At the bottom the used tachometer signal is shown across time together with the 1st and 2nd order signal component.

10.2 Phase information from Orbit analysis

Compared to Order tracking, Orbit analysis is changing the zero-phase reference from sine to cosine, subtracting 90 degrees. The zero-phase is hereby related to sinusoidal peak location instead of a zero-crossing location. Also, compared to Order tracking, Orbit analysis flips the sign of the phase since the majority of users for Orbit analysis refer and expect to see a lagging phase instead of a leading phase.

As an example let's use the illustration above again: The 1st order, Order tracking phase is 20 degrees and the 2nd order is 90 degrees. In Orbit analysis this is transformed like: $-(OT_phase - 90^\circ \cdot \text{order number})$

For the 1st order this gives: $-(20^\circ - 90^\circ \cdot 1) = 70^\circ$

For the second order this gives: $-(90^\circ - 90^\circ \cdot 2) = 90^\circ$

When this calculation equals a negative number then 360° is added, giving: $360^\circ - (OT_phase - 90^\circ \cdot \text{order number})$.

11. Warranty information

Notice

The information contained in this document is subject to change without notice.

Note:

Dewesoft d.o.o. shall not be liable for any errors contained in this document. Dewesoft MAKES NO WARRANTIES OF ANY KIND WITH REGARD TO THIS DOCUMENT, WHETHER EXPRESS OR IMPLIED. DEWESOFT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Dewesoft shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory, in connection with the furnishing of this document or the use of the information in this document.

The copy of the specific warranty terms applicable to your Dewesoft product and replacement parts can be obtained from your local sales and service office. To find a local dealer for your country, please visit <https://dewesoft.com/support/distributors>.

11.1 Calibration

Every instrument needs to be calibrated at regular intervals. The standard norm across nearly every industry is annual calibration. Before your Dewesoft data acquisition system is delivered, it is calibrated. Detailed calibration reports for your Dewesoft system can be requested. We retain them for at least one year, after system delivery.

11.2 Support

Dewesoft has a team of people ready to assist you if you have any questions or any technical difficulties regarding the system. For any support please contact your local distributor first or Dewesoft directly.

Dewesoft d.o.o.
Gabrsko 11a
1420 Trbovlje Slovenia

Europe Tel.: +386 356 25 300
Web: <http://www.dewesoft.com>
Email: Support@dewesoft.com

The telephone hotline is available Monday to Friday from 07:00 to 16:00 CET (GMT +1:00)

11.3 Service/repair

The team of Dewesoft also performs any kinds of repairs to your system to assure a safe and proper operation in the future. For information regarding service and repairs please contact your local distributor first or Dewesoft directly on <https://dewesoft.com/support/rma-service>.

11.4 Restricted Rights

Use Slovenian law for duplication or disclosure. Dewesoft d.o.o. Gabrsko 11a, 1420 Trbovlje, Slovenia / Europe.

11.5 Copyright

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11.6 Trademarks

We take pride in our products and we take care that all key products and technologies are registered as trademarks all over the world. The Dewesoft name is a registered trademark. Product families (KRYPTON, SIRIUS, DSI, DS-NET) and technologies (DualCoreADC, SuperCounter, GrandView) are registered trademarks as well. When used as the logo or as part of any graphic material, the registered trademark sign is used as a part of the logo. When used in text representing the company, product or technology name, the ® sign is not used. The Dewesoft triangle logo is a registered trademark but the ® sign is not used in the visual representation of the triangle logo.

12. Safety instructions

Your safety is our primary concern! Please be safe!

12.1 Safety symbols in the manual



Warning

Calls attention to a procedure, practice, or condition that could cause the body injury or death



Caution

Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

12.2 General Safety Instructions



Warning

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Dewesoft GmbH assumes no liability for the customer's failure to comply with these requirements.

All accessories shown in this document are available as an option and will not be shipped as standard parts.

12.2.1 Environmental Considerations

Information about the environmental impact of the product.

12.2.2 Product End-of-Life Handling

Observe the following guidelines when recycling a Dewesoft system:

12.2.3 System and Components Recycling

Production of these components required the extraction and use of natural resources. The substances contained in the system could be harmful to your health and to the environment if the system is improperly handled at its end of life! Please recycle this product in an appropriate way to avoid unnecessary pollution of the environment and to keep natural resources.



This symbol indicates that this system complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). Please find further information about recycling on the Dewesoft web site www.dewesoft.com



Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment and is outside the scope of the 2002/95/EC RoHS Directive. However, we take care of our environment and the product is lead-free.

12.2.4 General safety and hazard warnings for all Dewesoft systems

Safety of the operator and the unit depend on following these rules.

- Use this system under the terms of the specifications only to avoid any possible danger.
- Read your manual before operating the system.
- Observe local laws when using the instrument.
- DO NOT touch internal wiring!
- DO NOT use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- You may not connect higher voltages than rated to any connectors.
- The power cable and connector serve as Power-Breaker. The cable must not exceed 3 meters, the disconnect function must be possible without tools.
- Maintenance must be executed by qualified staff only.
- During the use of the system, it might be possible to access other parts of a more comprehensive system. Please read and follow the safety instructions provided in the manuals of all other components regarding warning and security advice for using the system.
- With this product, only use the power cable delivered or defined for the host country.
- DO NOT connect or disconnect sensors, probes or test leads, as these parts are connected to a voltage supply unit.
- Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), a non-interruptible safety earth ground must be provided from the mains power source to the product input wiring terminals.
- Please note the characteristics and indicators on the system to avoid fire or electric shocks. Before connecting the system, please read the corresponding specifications in the product manual carefully.
- The inputs must not, unless otherwise noted (CATx identification), be connected to the main circuit of category II, III and IV.
- The power cord separates the system from the power supply. Do not block the power cord, since it has to be accessible for the users.
- DO NOT use the system if equipment covers or shields are removed.
- If you assume the system is damaged, get it examined by authorized personnel only.
- Adverse environmental conditions are Moisture or high humidity Dust, flammable gasses, fumes or dissolver Thunderstorm or thunderstorm conditions (except assembly PNA) Electrostatic fields, etc.
- The measurement category can be adjusted depending on module configuration.
- Any other use than described above may damage your system and is attended with dangers like short-circuiting, fire or electric shocks.
- The whole system must not be changed, rebuilt or opened.

- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until the safe operation can be verified by service-trained personnel. If necessary, return the product to Dewesoft sales and service office for service and repair to ensure that safety features are maintained.
- If you assume a more riskless use is not provided anymore, the system has to be rendered inoperative and should be protected against inadvertent operation. It is assumed that a more riskless operation is not possible anymore if the system is damaged obviously or causes strange noises. The system does not work anymore. The system has been exposed to long storage in adverse environments. The system has been exposed to heavy shipment strain.
- Warranty void if damages caused by disregarding this manual. For consequential damages, NO liability will be assumed!
- Warranty void if damage to property or persons caused by improper use or disregarding the safety instructions.
- Unauthorized changing or rebuilding the system is prohibited due to safety and permission reasons (CE).
- Be careful with voltages >25 VAC or >35 VDC! These voltages are already high enough in order to get a perilous electric shock by touching the wiring.
- The product heats during operation. Make sure there is adequate ventilation. Ventilation slots must not be covered!
- Only fuses of the specified type and nominal current may be used. The use of patched fuses is prohibited.
- Prevent using metal bare wires! Risk of short circuit and fire hazard!
- DO NOT use the system before, during or shortly after a thunderstorm (risk of lightning and high energy over-voltage). An advanced range of application under certain conditions is allowed with therefore designed products only. For details please refer to the specifications.
- Make sure that your hands, shoes, clothes, the floor, the system or measuring leads, integrated circuits and so on, are dry.
- DO NOT use the system in rooms with flammable gasses, fumes or dust or in adverse environmental conditions.
- Avoid operation in the immediate vicinity of high magnetic or electromagnetic fields, transmitting antennas or high-frequency generators, for exact values please refer to enclosed specifications.
- Use measurement leads or measurement accessories aligned with the specification of the system only. Fire hazard in case of overload!
- Do not switch on the system after transporting it from a cold into a warm room and vice versa. The thereby created condensation may damage your system. Acclimatize the system unpowered to room temperature.
- Do not disassemble the system! There is a high risk of getting a perilous electric shock. Capacitors still might be charged, even if the system has been removed from the power supply.
- The electrical installations and equipment in industrial facilities must be observed by the security regulations and insurance institutions.
- The use of the measuring system in schools and other training facilities must be observed by skilled personnel.
- The measuring systems are not designed for use in humans and animals.
- Please contact a professional if you have doubts about the method of operation, safety or the connection of the system.
- Please be careful with the product. Shocks, hits and dropping it from already- lower level may damage your system.

- Please also consider the detailed technical reference manual as well as the security advice of the connected systems.
- This product has left the factory in safety-related flawlessness and in proper condition. In order to maintain this condition and guarantee safety use, the user has to consider the security advice and warnings in this manual.

EN 61326-3-1:2008

IEC 61326-1 applies to this part of IEC 61326 but is limited to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3.

The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1.

Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard, IEC 61326-3-1.

Devices and systems according to IEC 61508 or IEC 61511 which are considered as “operationally well-tried”, are excluded from the scope of IEC 61326-3-1.

Fire-alarm and safety-alarm systems, intended for the protection of buildings, are excluded from the scope of IEC 61326-3-1.

13. Documentation version history

Version	Date [dd.mm.yyyy]	Notes
V20-1	25.5.2021	Creation of the Orbit Analysis manual version 1
V21-1	30.6.2021	Orbit in Analyze mode
V23-1	22.06.2023	Updated images and added caption texts. Added extra Hints and Important notes around the manual. Updated the manual section structure. Added description of OA phase definition compared to OT. Added section for Orbit waveform graph widget. Added output channels overview table. Updated the workflow for runout compensation and reference orbit.
V23-2	07.12.2023	Runout compensation setup section updated Runout compensation display section updated Runout compensation recalculate section updated