

ROTATIONAL AND TORSIONAL VIBRATIONS



SOLUTION USER MANUAL

ROTATIONAL AND TORSIONAL VIBRATIONS V22-1



1. Table of contents

1. Table of contents	2
2. About this document	4
2.1. Legend	4
3. Introduction	4
3.1. System Overview	4
3.2. Enabling Torsional Vibration (includes Rotational Vibration) Module	5
3.3. Basic operating concept	6
3.4. General setup	7
3.5. Counter Sensor Editor	9
4. Rotational Vibration	10
4.1. RV Introduction	10
4.2. RV Setup	11
4.2.1. Input filter	12
4.2.2. Rotational DC filter	12
4.2.3. Output channels	13
4.3. RV Measurement	13
5. Torsional Vibration	15
5.1. TV Introduction	15
5.2. TV Setup	16
5.2.1. Gearbox ratio	17
5.2.2. Output channels	18
5.2.3. Angle offset	18
5.2.4. Reference curve	19
5.3. TV Measurement	20
6. Advanced analysis and export	21
6.1. Order extraction	21
6.2. FFT peak calculation	23
6.3. Angle-based data export	25
7. Measurement accuracy	30
7.1. Error sources	30
7.2. Counter accuracy	30
7.2.1. Counter architecture	30
7.2.2. Angle resolution	31
7.2.3. Angle accuracy	32
7.2.4. Frequency accuracy	33
7.3. Sensor accuracy	34
7.3.1. Non centered mounting	34
7.3.2. Resolution error	34

8. Warranty information	37
8.1. Calibration	37
8.2. Support	37
8.3. Service/repair	37
8.4. Restricted Rights	37
8.5. Printing History	37
8.6. Copyright	38
8.7. Trademarks	38
9. Safety instructions	38
9.1. Safety symbols in the manual	38
9.2. General Safety Instructions	38
9.2.1. Environmental Considerations	39
9.2.2. Product End-of-Life Handling	39
9.2.3. System and Components Recycling	39
9.2.4. General safety and hazard warnings for all Dewesoft systems	39
10. Documentation version history	41

2. About this document

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. Introduction

The “Torsional Vibration” software option of DewesoftX® is used to obtain - or enhance an existing DewesoftX® system to - a rotational/torsional vibration monitoring and analyzing solution, for research, development and optimization. With the small form factor of the Dewesoft instruments (e.g. SIRIUS, DEWE-43, etc.) the perfect mobile solution for test engineers and consultants is born.

Torsional and Rotational vibration are calculated, as well as the corresponding velocities, the software can compensate for uncentered mounting of the sensor and can also take care about the gearbox ratio. Furthermore the possibilities of DewesoftX® allow angle-domain visualization and export.

With DewesoftX® solutions, data from other sources: e.g. Video, CAN, Ethernet, ... are easily synchronized in one datafile.

If the powerful integrated post processing features of DewesoftX® are not enough, you can even export the data to several different file formats.

In addition to Torsional Vibration, the system can be expanded with the Order Tracking option to complete the picture of the measurement situation.

3.1. System Overview

As the torsional vibration measurements are very critical in terms of accuracy, only precise counter sensors are supported. At least one (Rotational vibration), but usually two (Torsional Vibration) encoders are necessary.

Either an encoder or a special RIE sensor can be used. The RIE sensor has less resolution, but is much less sensitive to vibration (which could damage standard encoders over time).

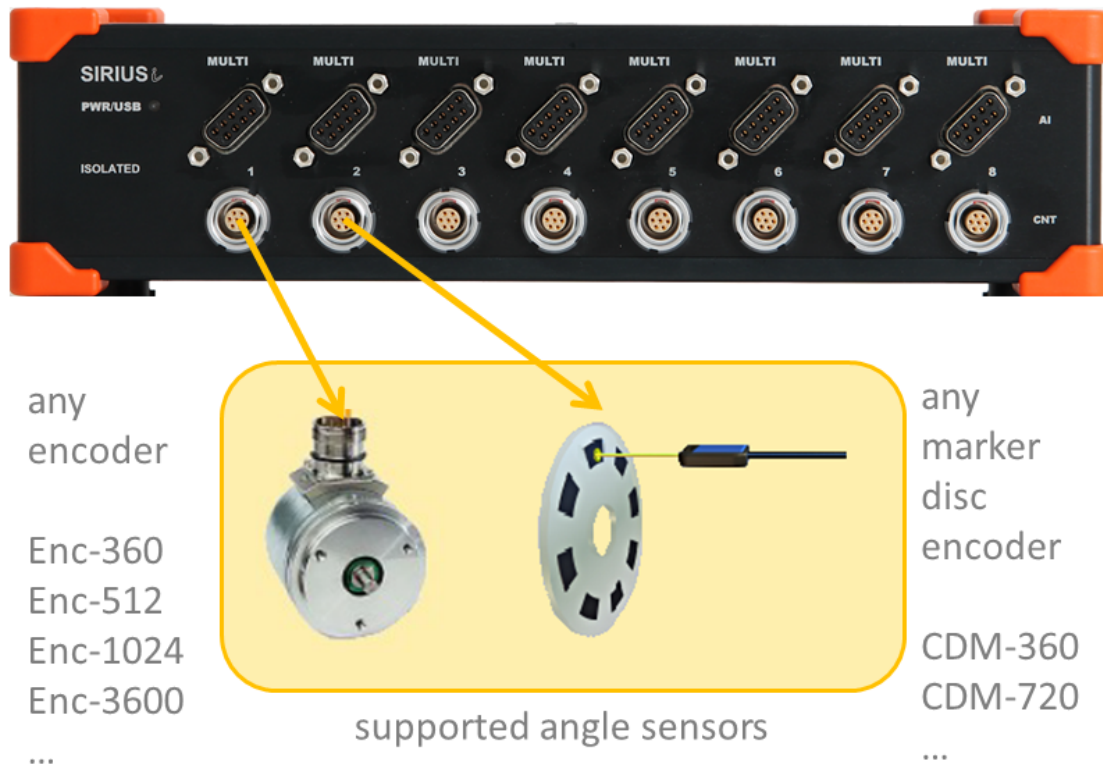


Illustration 1: Supported angle sensors



Important

Angular sensors need to have a zero pulse. A variety of angular sensors are supported: Encoder, CDM with zero pulse, Geartooth sensor with missing teeth, Zebra tape sensor (with DS-TACHO4 and auto-gap detection).

3.2. Enabling Torsional Vibration (includes Rotational Vibration) Module

Like many additional mathematics modules, Torsional Vibration is an option to the standard DewesoftX® package and needs to be enabled with the More button in the Channel setup.



Illustration 2: Adding Torsional Vibration Module

3.3. Basic operating concept

The Torsional Vibration Module inside DewesoftX® is just one out of several other application modules which offers dedicated mathematics and dedicated visual controls like an angel-based XY-diagram.

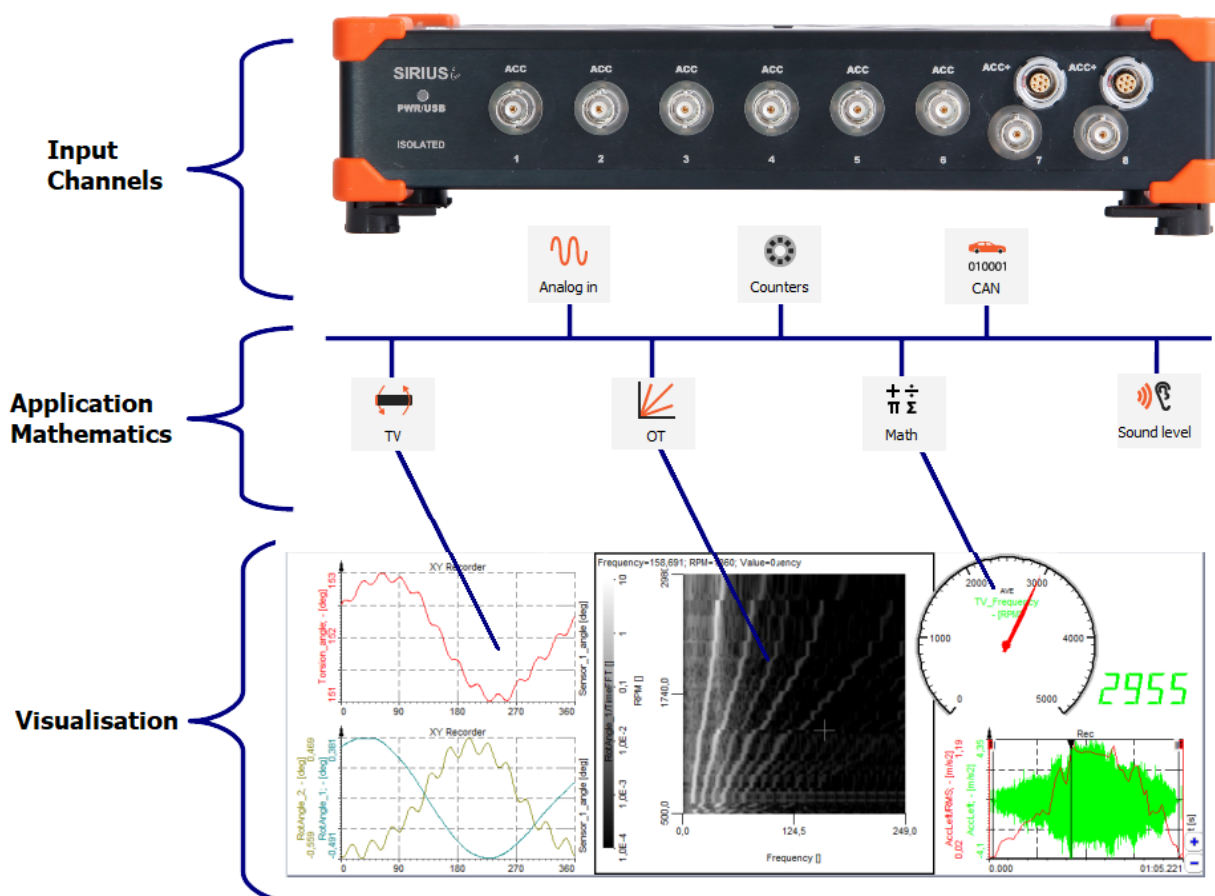


Illustration 3: Basic operating concept



Example

You can use the output channels of the Torsional Vibration Module as an input for the Order Tracking Module, and apply additional mathematics to it.

3.4. General setup

In the first step we add one module with the + button:

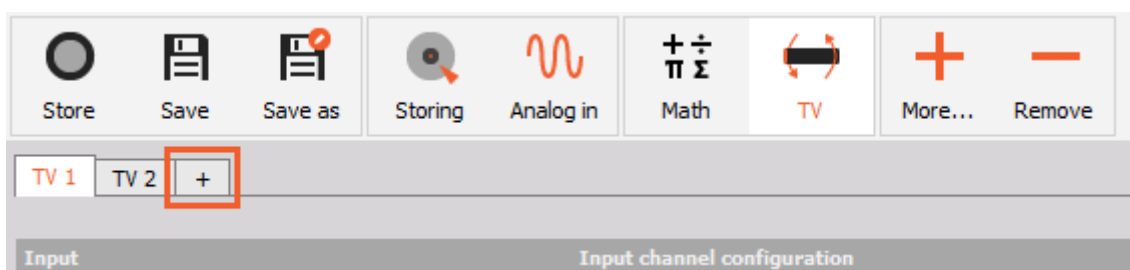


Illustration 4: Adding TV Module

The input mask of the TV Module is split into following sections:

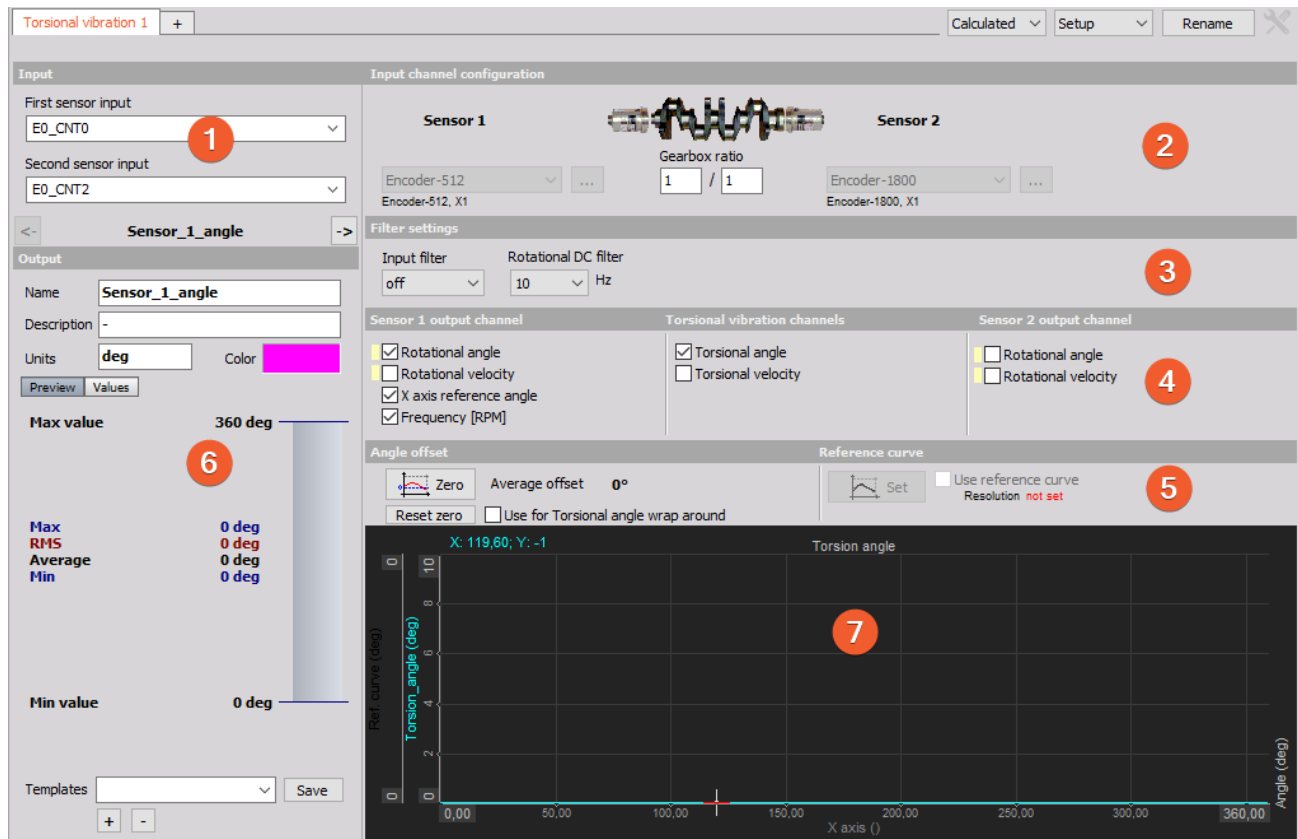


Illustration 5: Torsional Vibration setup

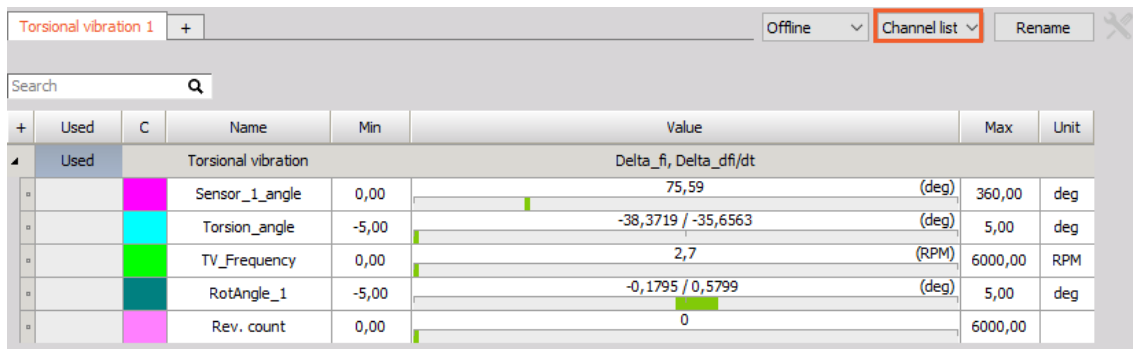
- Input (label 1): define the counter channels for input (e.g. CNT1, CNT2)
- Input channel configuration (label 2): define type of angle sensor (e.g. Enc-512, CDM-360), and select ratio, if gearing used
- Filter settings (label 3): specify glitch filter and rotational filter
- Output channels (label 4): select which calculations to be done, e.g. rotational velocity, torsional angle...
- Correction (label 5): compensate constant angle offset, uncentered mounting, sensor errors
- Output (label 6): preview of output channels / switch through with the arrow buttons
- Preview (label 7): preview of torsional angle



Hint

There is no need to configure the Counter inputs separately in the Counter setup, all the settings are done out of the Torsional Vibration Module. The setup of the Counters is done out of the Torsional Vibration Module. Used Counters will be locked (greyed out) in Counter setup.

Switch to “Channel list” on the right upper corner to see a list of the calculated output channels.



+	Used	C	Name	Min	Value	Max	Unit
+	Used		Torsional vibration				
			Delta_fi, Delta_df/dt				
+			Sensor_1_angle	0,00	75,59	(deg)	360,00 deg
+			Torsion_angle	-5,00	-38,3719 / -35,6563	(deg)	5,00 deg
+			TV_Frequency	0,00	2,7	(RPM)	6000,00 RPM
+			RotAngle_1	-5,00	-0,1795 / 0,5799	(deg)	5,00 deg
+			Rev. count	0,00	0		6000,00

Illustration 6: Channel list

It is important to know that we actually have two different parameters that can be measured with the Torsional Vibration Module: **rotational vibration** and **torsional vibration**.

3.5. Counter Sensor Editor

There are some typical sensors predefined. However, if your type is not listed, you can define your own sensor in the Counter Sensor Editor. Note, that for the Torsional Vibration Module the sensor has to be either Encoder or CDM type.

Go to Settings → Editors → Counter sensors ...

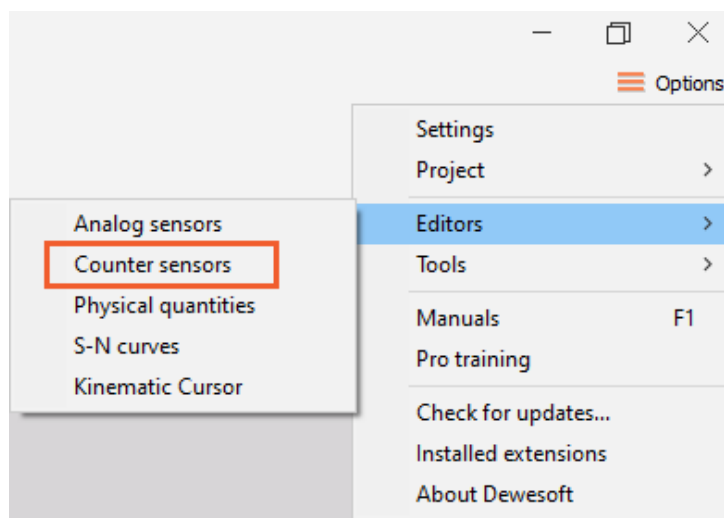


Illustration 7: Counter sensor editor

... and click plus button to add the new sensor, then enter a name, and set all other parameters. Depending on the sensor different parameters are available. When finished, click on the save button and close the editor. .

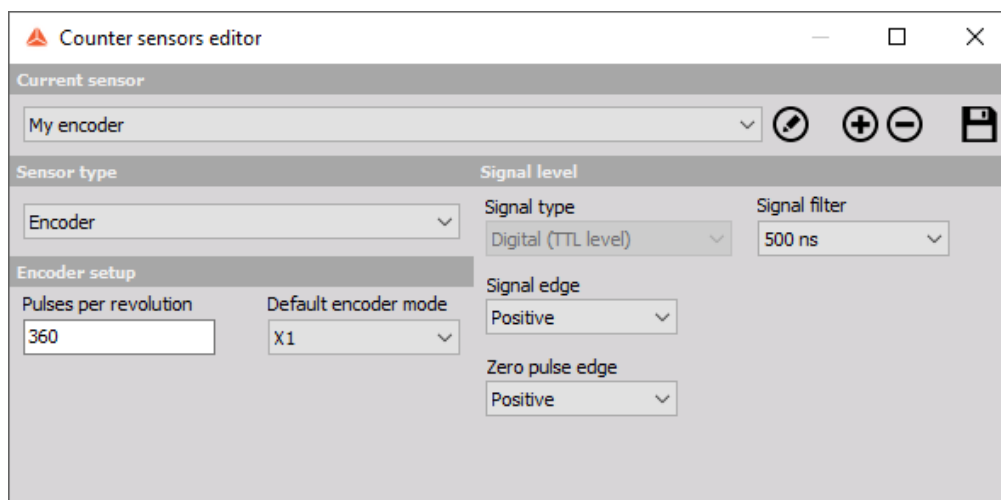


Illustration 8: Counter sensor editor

Now the sensor can be accessed from the dropdown menu of the Torsional Vibration Module.

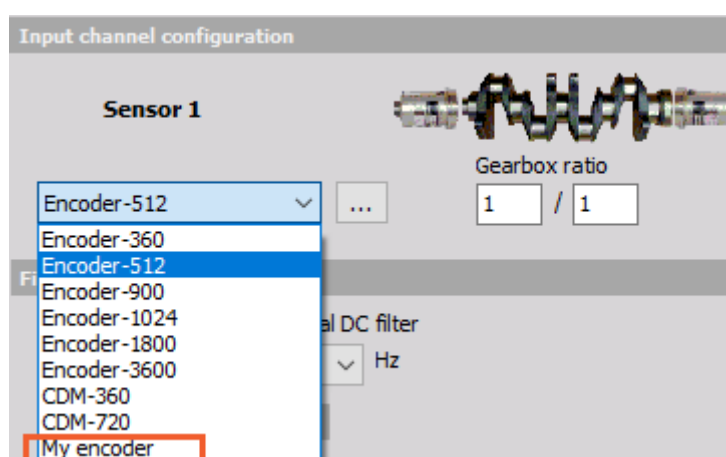


Illustration 9: Choosing sensor in Input channel configuration



Hint

You can press F1 in any menu in DewesoftX® and the help for the specific topic will open.

4. Rotational Vibration

4.1. RV Introduction

Rotational vibration is simply the dynamic deviation of the rotation speed. If we measure the rotation speed of the shaft with high precision, we will notice that we get a high deviation of rotation speed in some regions of the run up. This is caused by the angular vibration crossing the angular natural frequency of the shaft. It is calculated by cutting off the DC component of the rotation speed or rotation angle.

In the graph below we see two curves, the one above is the RPM, and the curve below shows the deviation in degrees, which is actually the rotation angle vibration. During coastdown the max. vibrations appear at the same RPM's again.

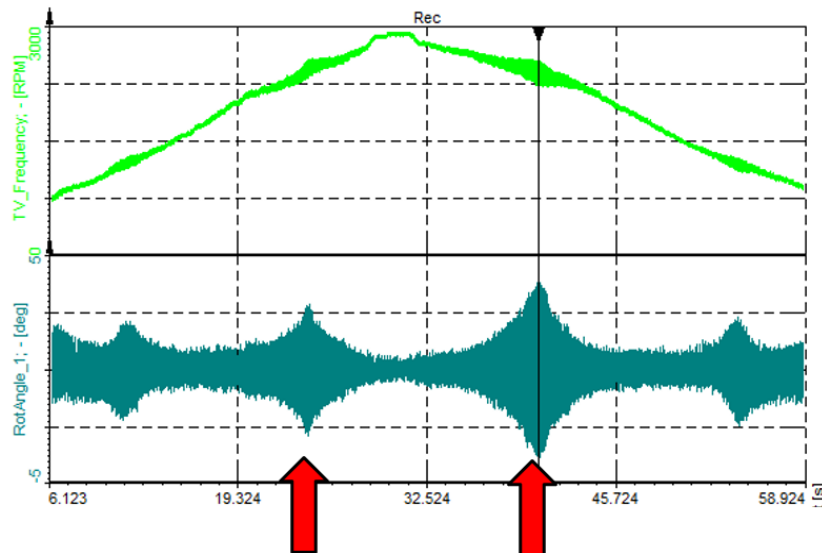


Illustration 10: Rotational Vibration

4.2. RV Setup

For our test, we take the Torsional Vibration Demo Kit, which consists of an electric motor (in the middle) and two encoders. The encoder on the right is connected with a coupling and the encoder on the left with a spring to the motor, to create high vibration.

Because we are currently only interested in rotational vibration, we will only use the encoder on the left side, connected with the spring.

Connect the Encoder to the Dewesoft instrument on a Counter input.

As mentioned, there is nothing to be setup in the analog or counter channels setup. Let's just go to the Torsional Vibration Module, where we first add a new Module by clicking the + button. Next we select the first sensor input. Since we have connected the first sensor to CNT1, we need to select it from the list. Then we define the sensor. In our case we have 1800 pulses per revolution, so we choose Encoder-1800. If the sensor used is not defined so far, we need to create it in the Counter sensor editor first (see chapter Counter sensors Editor)

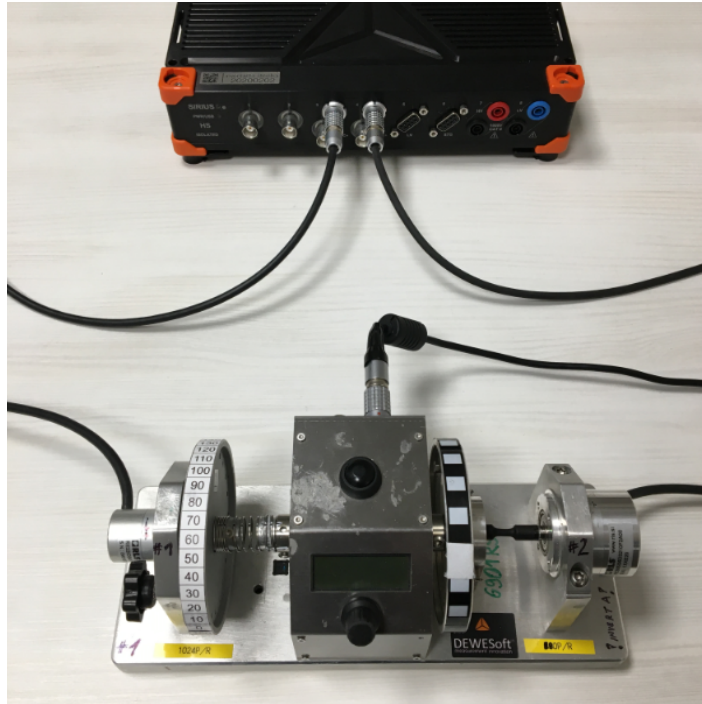


Illustration 11: Demo kit with two encoders

4.2.1. Input filter

The **input filter** can be used to prevent glitches and spikes in the digital encoder pulse signal. It can be set from 100ns to 5us, the optimal setting is derived from following equation:

$$InputFilter[s] \leq \frac{1}{10 \times \frac{RPM_{max}}{60} \times PulsesPerRev}$$

RPM_{max} ... max revolutions per minute [min^{-1}]

$PulsesPerRev$... pulses per revolution of encoder

4.2.2. Rotational DC filter

The *Rotational DC filter* needs to be set to cut the DC component of the RPMs. We need to set the filter to include all wanted frequencies, but not too low, otherwise we will have static DC deviations on the output signal. It can be set from 0.1 to 10 Hz. You have to ensure that your lowest RPM is not filtered out!

$$RotDCFilter[Hz] \leq \frac{RPM_{min}}{60}$$

$$RPM_{min} \dots min \text{ revolutions per minute } [min^{-1}]$$

A 10 Hz filter for example would mean, frequencies below 600 RPM would be suppressed.

4.2.3. Output channels

Sensor 1 output channel	Torsional vibration channels	Sensor 2 output channel
<input checked="" type="checkbox"/> Rotational angle <input type="checkbox"/> Rotational velocity <input checked="" type="checkbox"/> X axis reference angle <input checked="" type="checkbox"/> Frequency [RPM]	<input checked="" type="checkbox"/> Torsional angle <input type="checkbox"/> Torsional velocity	<input type="checkbox"/> Rotational angle <input type="checkbox"/> Rotational velocity

Illustration 12: Output channels

The output channels are

- Rotational angle (filtered angle value of vibration)
- Rotational velocity (filtered velocity vibration value)
- X axis reference angle (the reference angle, which is always from 0 to 360 and can be used as a reference in angle based xy diagrams)
- Frequency, in RPM unit

4.3. RV Measurement

When you switch to measure mode, the calculated channels of the TV Module are shown in the channel selector on the right side. First idea would be to select the TV_Frequency channel and display in analog/digital meter or a recorder.

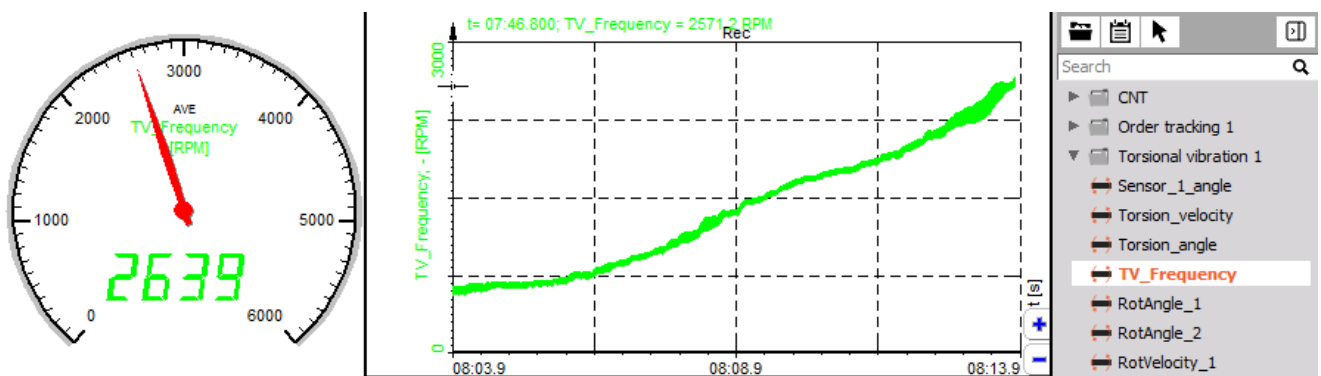


Illustration 13: Measurement display

The Sensor_1_angle is the reference angle and can be used for angle-based display of XY recorder. Add XY recorder and click on Sensor_1_angle first (=x axis), then on RotAngle_1 (=y axis). Then set the recorder to “Angle based x-y” in the properties on the left side. Select e.g. 2 periods to be displayed. This xy recorder now displays the rotational angle of the current revolution. It is like a scope, but with an angle reference instead of a time reference.

Vary the RPM and when you come close to the resonance frequency until the amplitude reaches its maximum value.

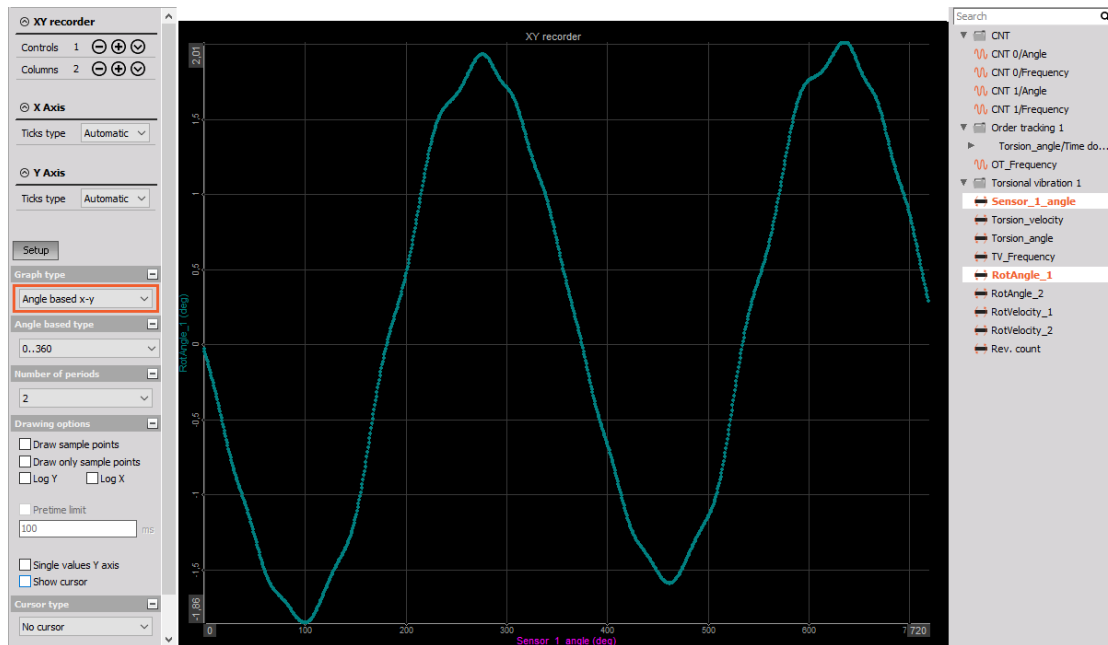


Illustration 14: XY recorder

In the next graph also the rotational velocity is added (first derivation on the angle), theoretically shifted by 90 degrees.

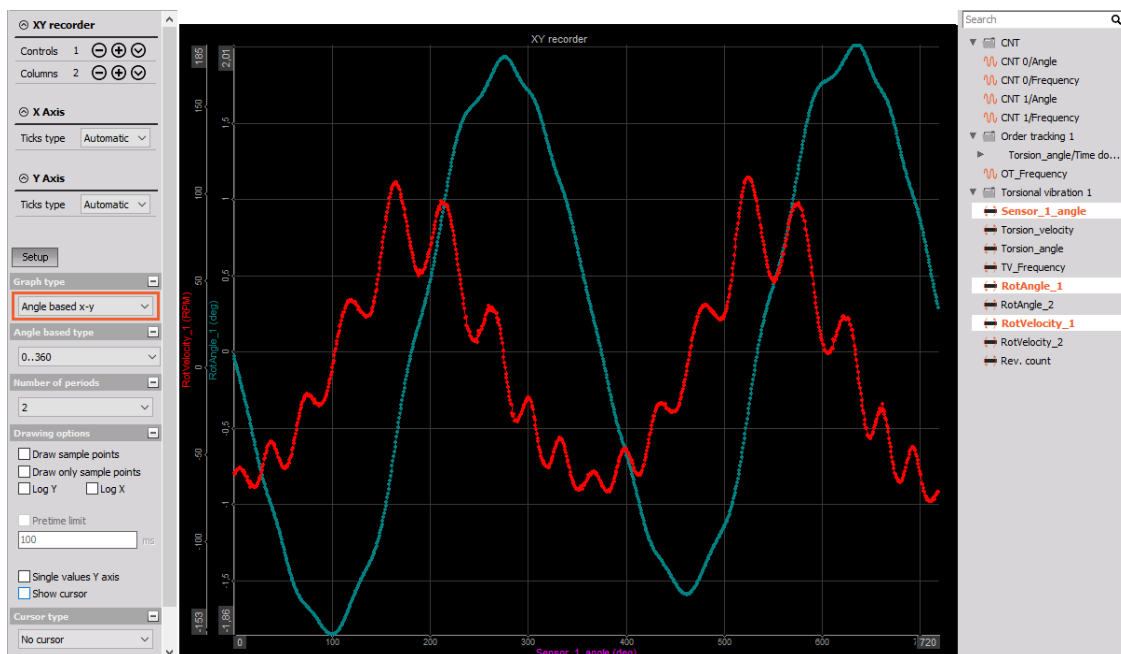


Illustration 15: XY recorder

The last channel out of the module is called “Rev. count”, a revolution counter:

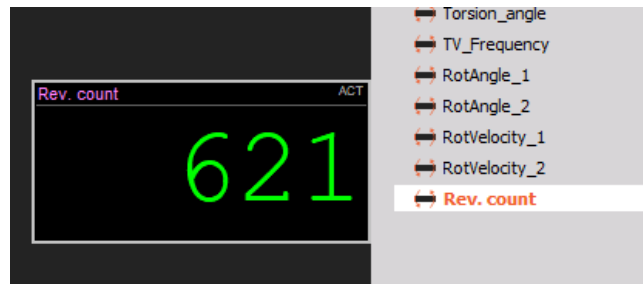


Illustration 16: Digital meter

5. Torsional Vibration

5.1. TV Introduction

Torsional vibration is an oscillation of angular motions (twist) which occur along rotating parts, such as gear trains, crank shafts or clutches. We need two encoders to measure the torsional vibration, so the torsional vibration is actually a difference between angles of the two encoders. The torsional vibration also measures the static twist of the shaft with higher RPMs.



Illustration 17: How looks torsional vibration

The graph below shows the run up and coast down where we can nicely see the static twist of the shaft, and when passing through the natural frequency, the angular vibration of the shaft reaches its maximum rotational vibration.

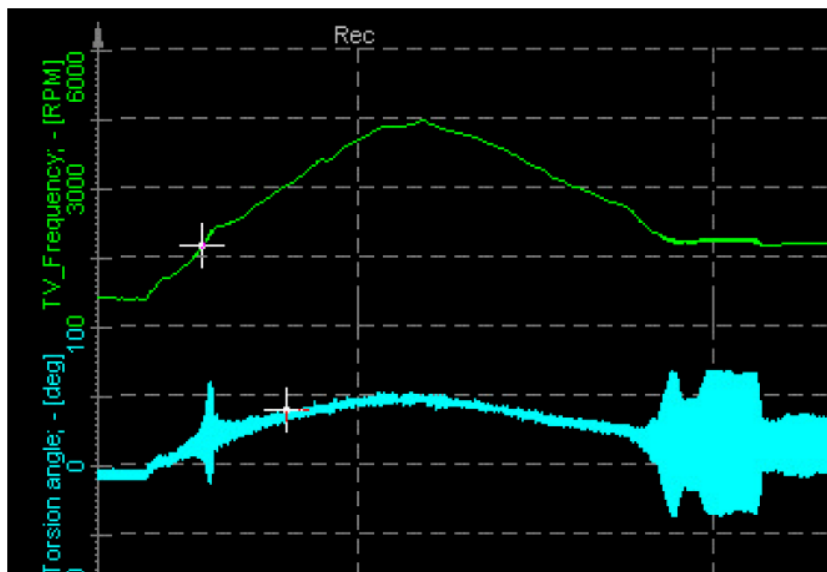


Illustration 18: Torsional vibration while run up and coast down

5.2. TV Setup

We extend the setup from the Rotational Vibrations Measurement by also connecting now the second encoder.

On the right side is an encoder with a fixed (coupled) connection to the motor (first orange box), on the right side is another encoder (second orange box). So we measure the torsion vibrations of the metal spring between.

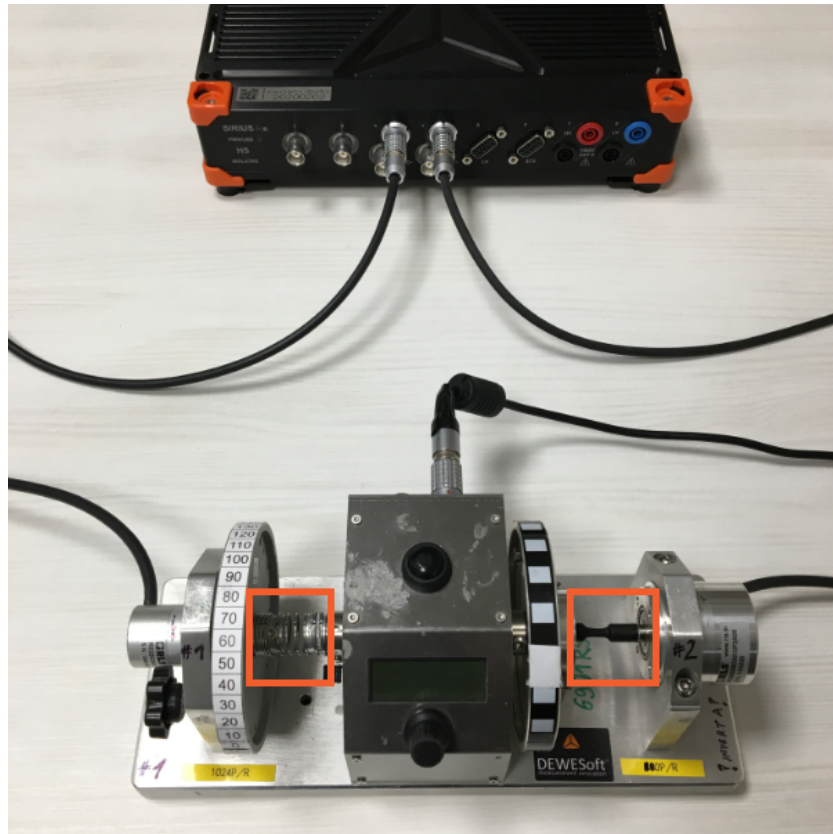


Illustration 19: Couplings on Demo kit

Add a Torsional Vibration Module with the + button.

Select CNT0 as first and CNT1 as second sensor input. Then further define the encoders by selecting the correct type from the dropdowns on the right side (in our case Encoder-512 and Encoder-1800).

As already explained in the rotational vibration section, you can use the input filter for cleaning the signal from eventual glitches, and the rotational filter removes the DC offset from the difference signal.

5.2.1. Gearbox ratio

Gearbox ratio stays 1/1 in our case. This is used for measuring the torsion angle across a gearbox.

5.2.2. Output channels

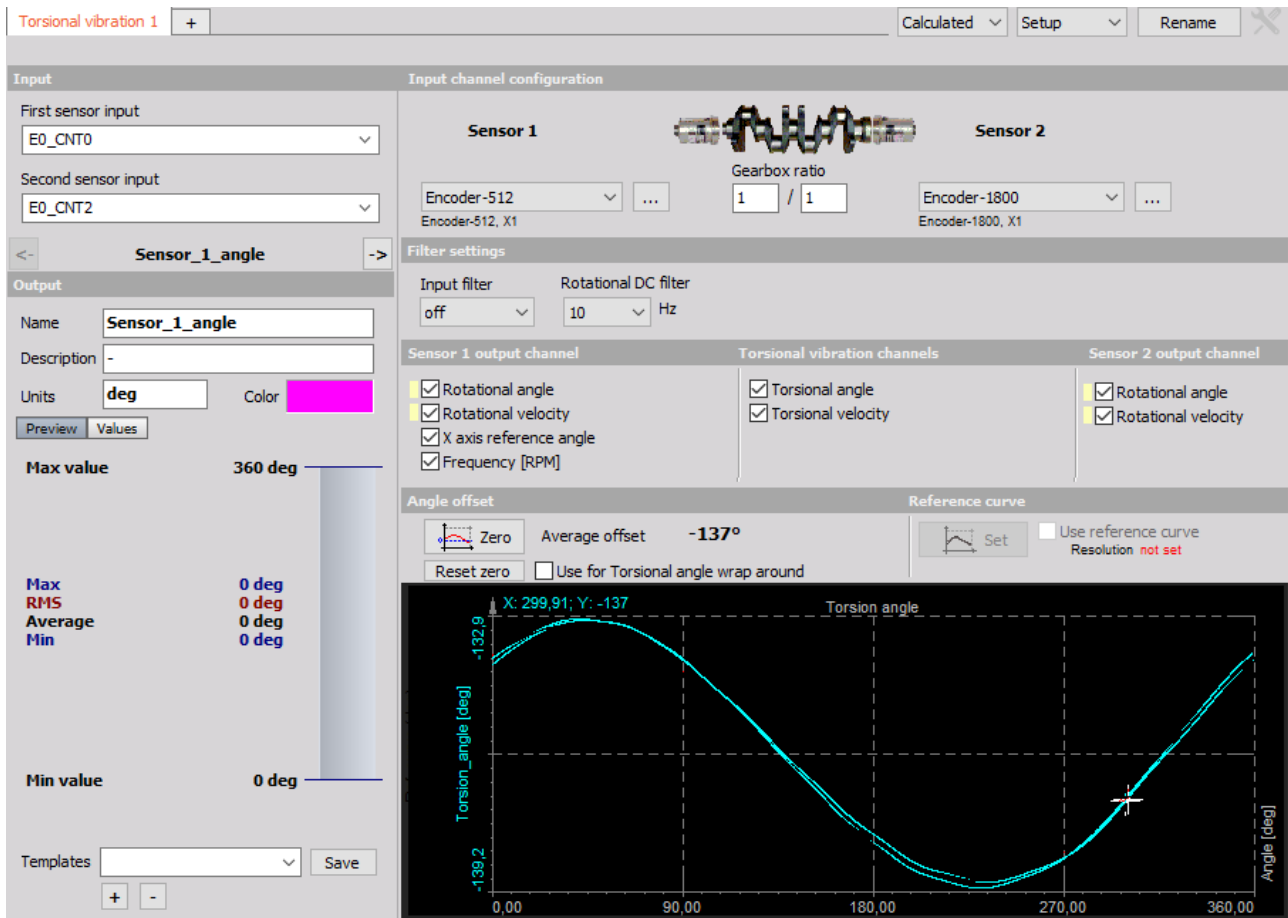


Illustration 20: Torsional vibration setup

- Torsional angle (dynamic torsional angle that is the angle difference from sensor 1 to sensor 2)
- Torsional velocity (difference in angular velocity from sensor 1 to sensor 2)
- Sensor 1 Rotational angle
- Sensor 2 Rotational angle
- Sensor 1 Rotational velocity
- Sensor 2 Rotational velocity
- X axis reference angle (the reference angle, which is always from 0 to 360 and can be used as a reference in angle based xy diagrams)
- Frequency, in RPM unit

5.2.3. Angle offset

In the section “Angle offset” you see the angular difference between the two sensors (-137°). Click on **“Zero”** to **remove this static offset**. The current average value of the signal will be subtracted. Then click on the y axis to auto-scale the signal. It is now approximately 0.

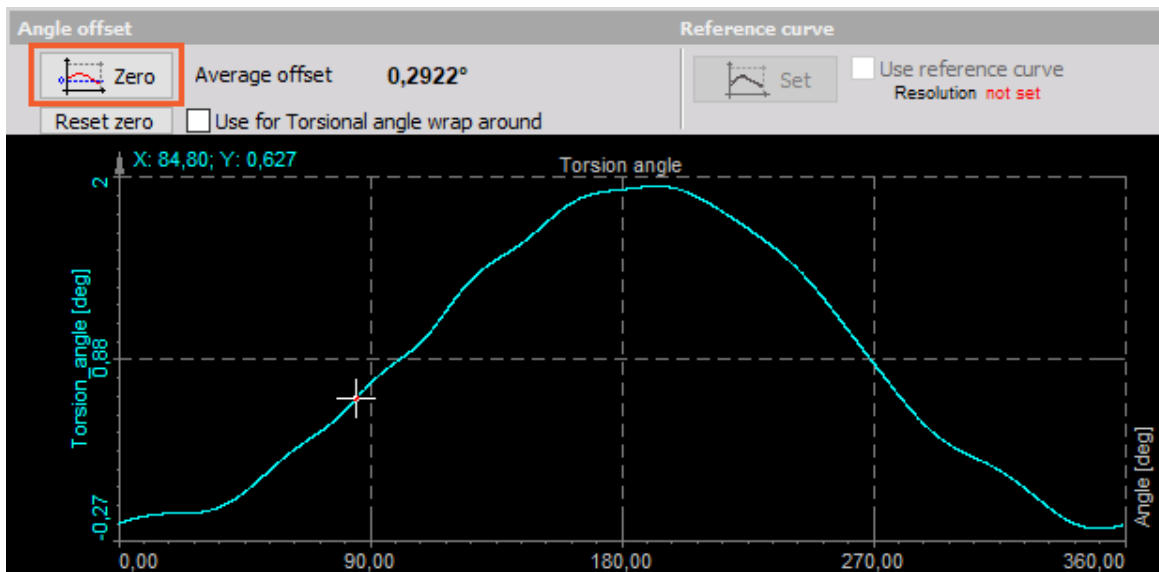


Illustration 21: Zeroing the angle

5.2.4. Reference curve

Now there is also an option how to **compensate for uncentered mounting** and **unsteady pulses from the encoder**.

Centered mounting is very important. In the first picture (1) there is no problem, the disk is mounted perfectly. However in real life, uncentered mounting like in picture (2) will appear. Let's draw on the disk a red line on 0 degree and a blue line on 90 degree position. When the disk is turned, the sensor (black box) will count the pulses and after a certain number detect the 90 degree position. But if you look at the disk now, it is far from 90 degrees!

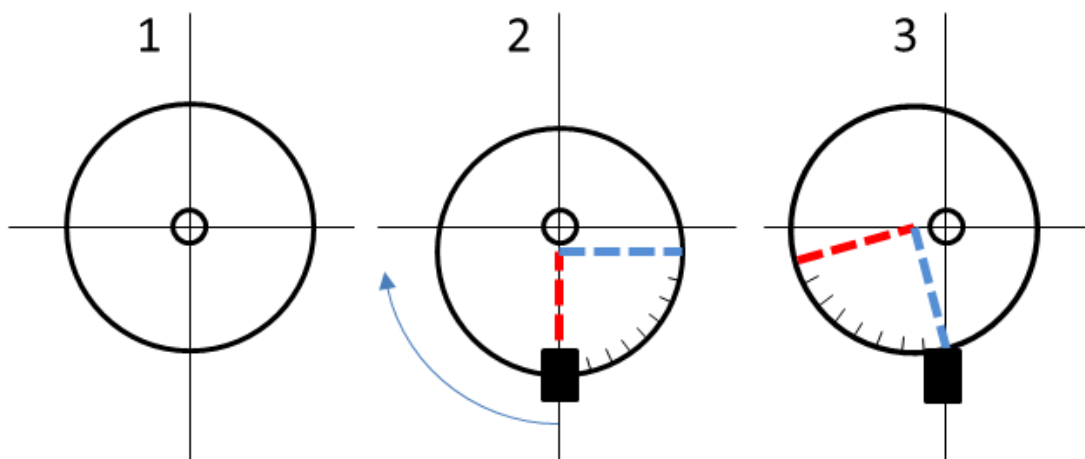


Illustration 22: How uncentered mounting looks like

Think of it rotating, then a constant sine wave will be generated additionally to the rotational vibrations. This can be compensated in DewesoftX® using the reference curve.

Note that the load must be removed from the engine! It must be free-run, otherwise you would cancel out the vibration you want to analyze. When the machine is running, press the “Set” button.

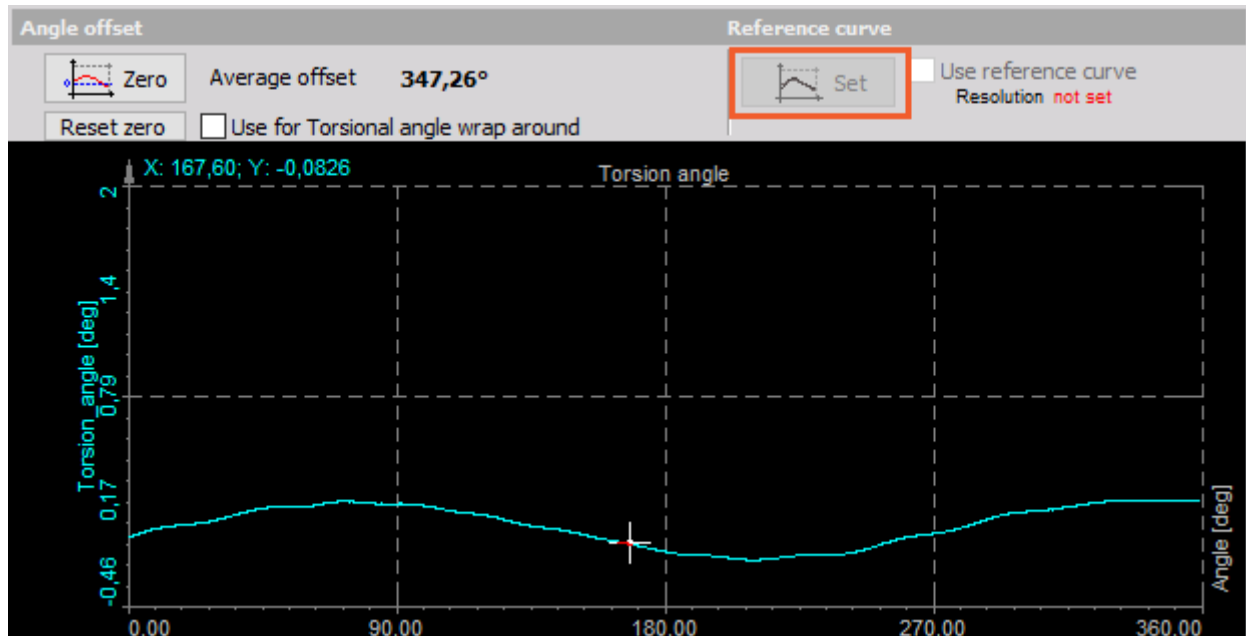


Illustration 23: Setting the reference curve

The current curve is now recorded over one revolution as a reference, you will notice a large reduction in amplitude..

5.3. TV Measurement

Below you see an example setup screen with some typical widgets. Similar to the rotational vibration setup we can use the XY recorder to display the result angle-based. After the runup / coastdown you see typical resonances and can analyze the data further.

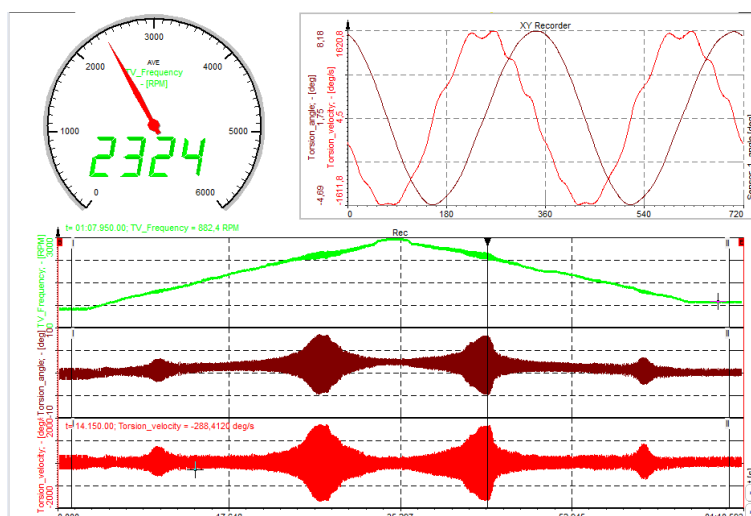


Illustration 24: Typical measurement display

6. Advanced analysis and export

6.1. Order extraction

Let us look a little bit further and extend the functions by adding the Order Tracking option.

Usually it is included in the DSA package, we can use it to extract the orders of the torsional / rotational vibration.

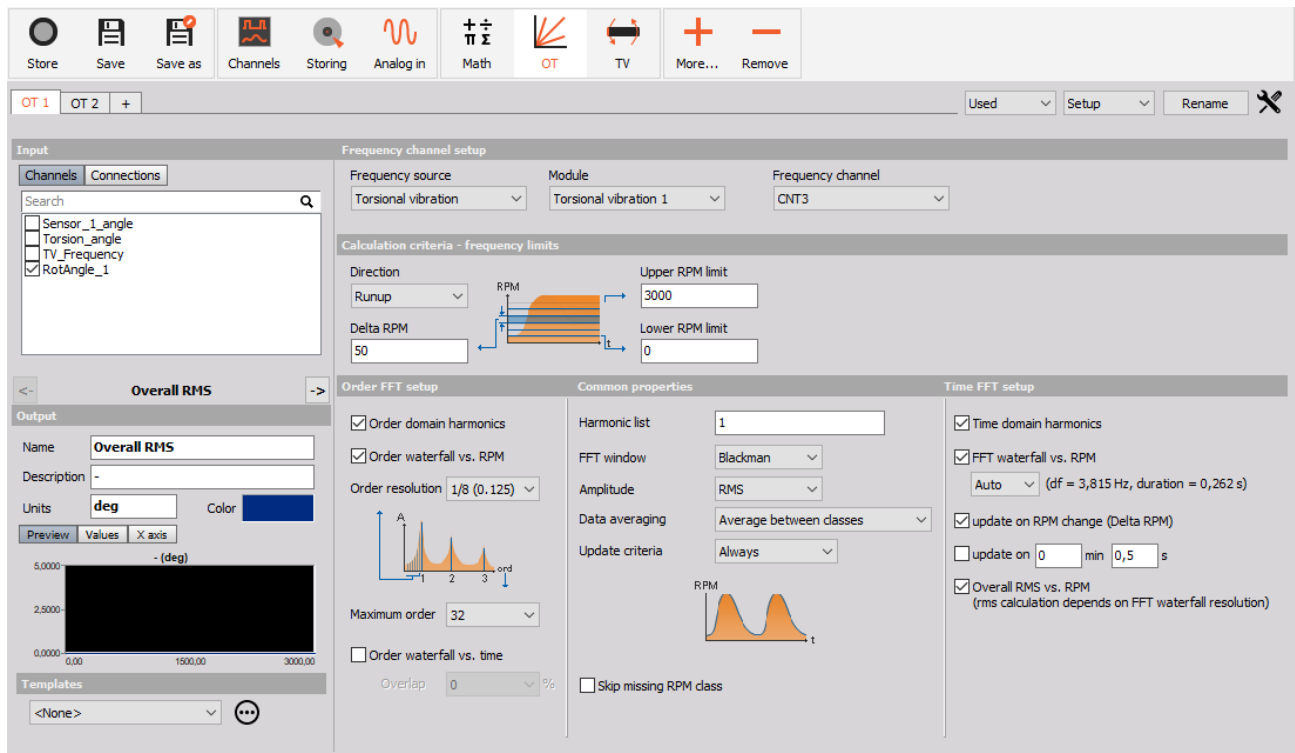


Illustration 25: Order tracking setup

Add an Order Tracking Module. For the frequency source we need to define the Torsional Vibration Module and the Module created before. Define the upper and lower RPM limit. This is used to reserve the memory for waterfall FFT. The waterfall will be drawn from the lower to the upper limit in the delta RPM step. In this case, we will have $(3000-0) / 50 = 60$ steps of waterfall. We choose to extract the first three orders by entering "1;2;3" in the Harmonics field. The yellow field indicates that you have to press enter to overtake the values.

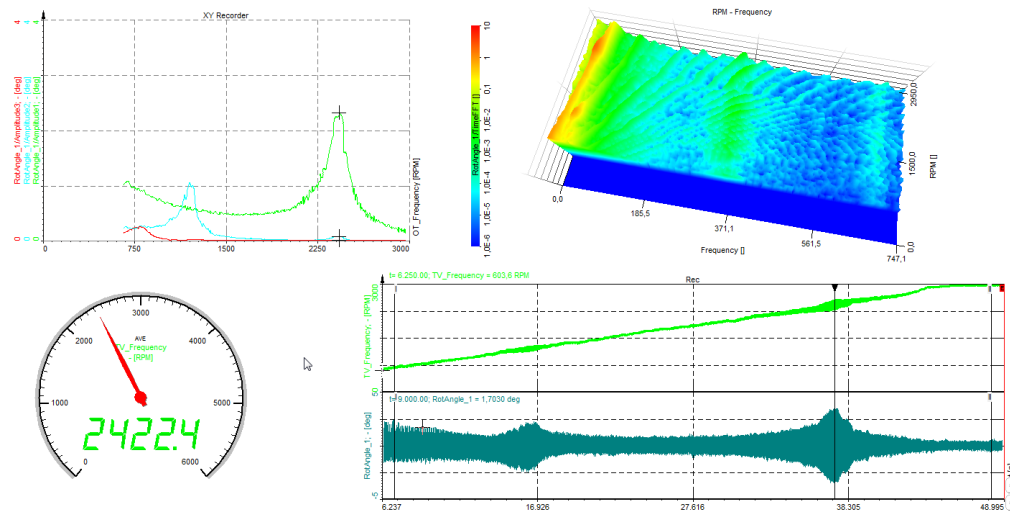


Illustration 26: Typical Order tracking display

We can get a better picture of the situation with the 3D waterfall plot. In this case we are plotting frequency against RPM, or Orders against RPM. On the left picture one can easily separate frequencies related and not-related to RPM.

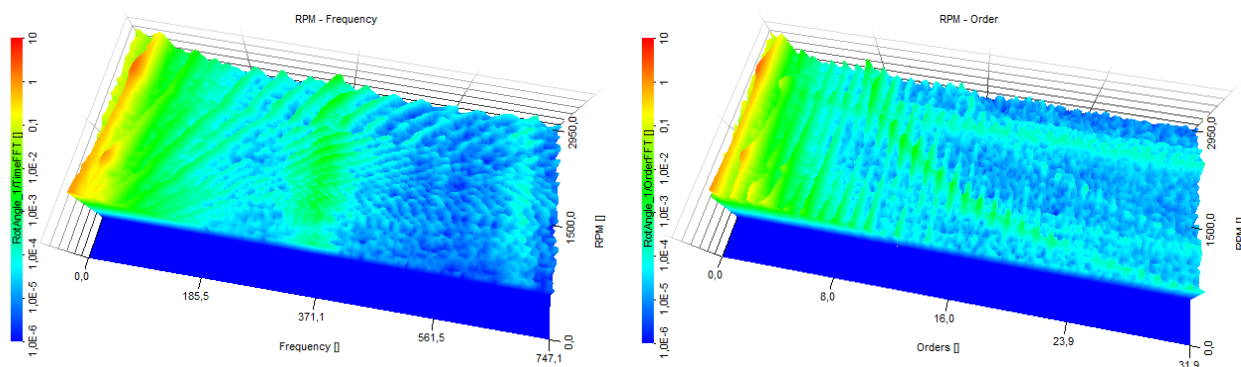


Illustration 28: 3D graph

Furthermore the amplitudes / phases (or even real and imaginary part) of the Orders can be plotted against the frequency.

Again, take the XY recorder, but now set graph type to “Single x axis” to get a Bode plot.

Here you see the first harmonic (green line) with its maximum around 2400 RPM, matching nicely to the previous measurements. Turning of the phase also indicates resonance.

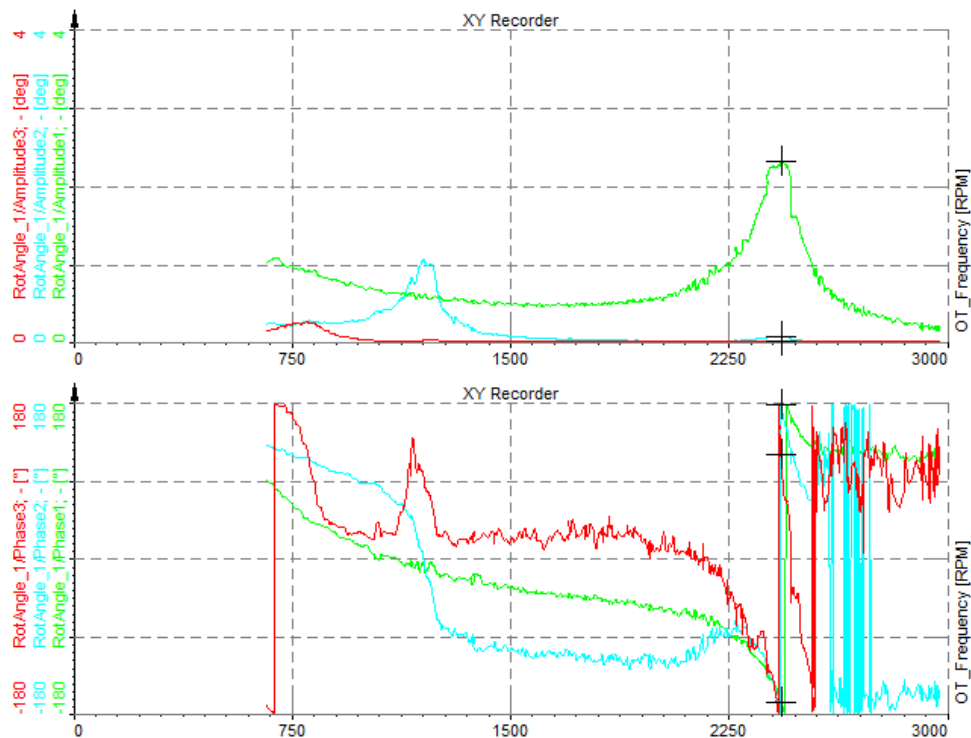


Illustration 29: Bode plot



Hint

Settings can also be added / modified “offline” (=after measurement) on the datafile.

6.2. FFT peak calculation

One of the standard measurements is, to perform a run up of the machine, and then calculate the max amplitude over the FFT. Add a FFT function in Math. Then select the input channel, here for example Torsion_angle. Set to amplitude, Overall, and averaging type peak.

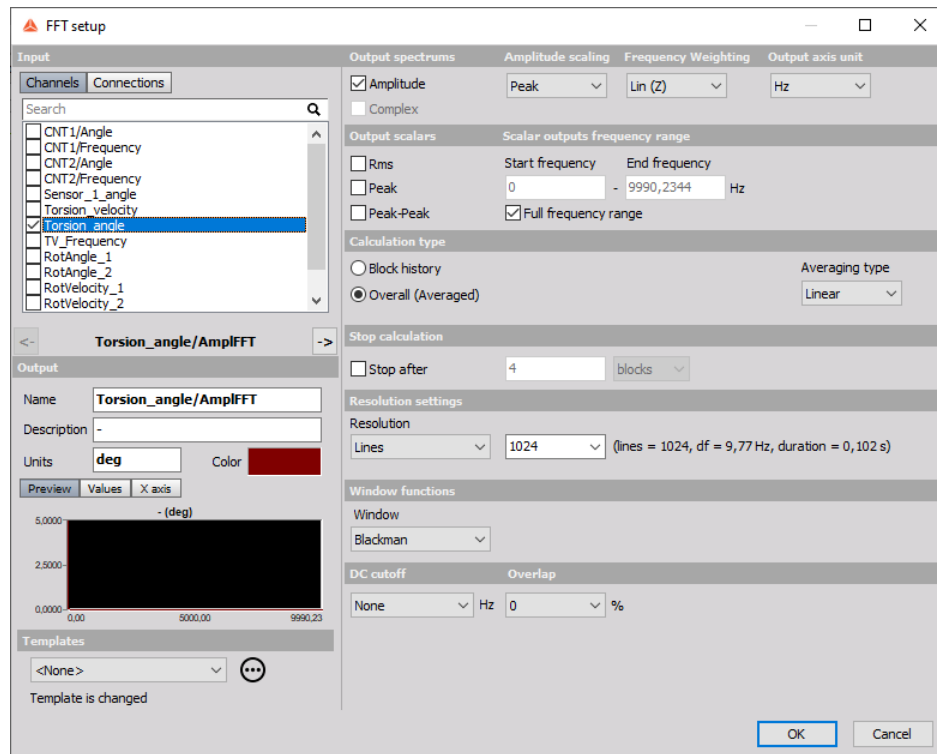


Illustration 30: FFT setup

Here is an example, done offline on a datafile (of course you also can do it online, during measurement). A section has been selected in the recorder instrument below (green line) to only analyze the runup of the machine.

Then a 2D graph was added (see instrument bar, red box) and the AmplFFT math channel assigned.

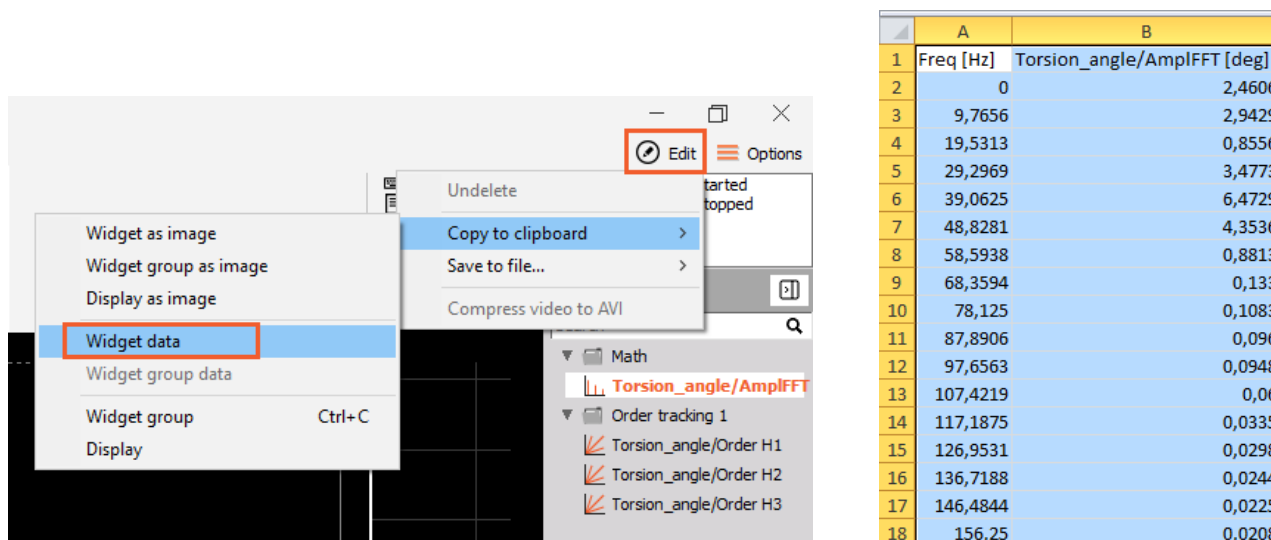
Y axis type can be set to logarithmic in the 2D graph properties (left side) for convenience.



Illustration 31: 2D graph

You can do the standard export, or just click on the 2D instrument, and use “Edit” → “Copy data to clipboard”.

Pasting, e.g. into Excel gives following result:



The screenshot shows the DEWESoft interface with the 'Edit' menu open. The 'Copy to clipboard' option is highlighted. Below the menu, a table of data is displayed, which is the result of copying the data to the clipboard.

	A	B
1	Freq [Hz]	Torsion_angle/AmplFFT [deg]
2	0	2,4606
3	9,7656	2,9429
4	19,5313	0,8556
5	29,2969	3,4773
6	39,0625	6,4729
7	48,8281	4,3536
8	58,5938	0,8813
9	68,3594	0,133
10	78,125	0,1083
11	87,8906	0,096
12	97,6563	0,0948
13	107,4219	0,06
14	117,1875	0,0335
15	126,9531	0,0298
16	136,7188	0,0244
17	146,4844	0,0225
18	156,25	0,0208

Illustration 32: Copy to clipboard and paste into Excel

6.3. Angle-based data export

The angle-based display of measurement data is often very useful. In the XY recorder you assign the reference angle “Sensor_1_angle” to the x axis; then set the view either to:

- **Angle-based xy:** working like a scope, see the current cycle
- **Single x axis:** see all cycles laid over each other (“persistence mode”), easy to see min/max over all cycles; persistence can be adjusted with the Pretime limit in the properties

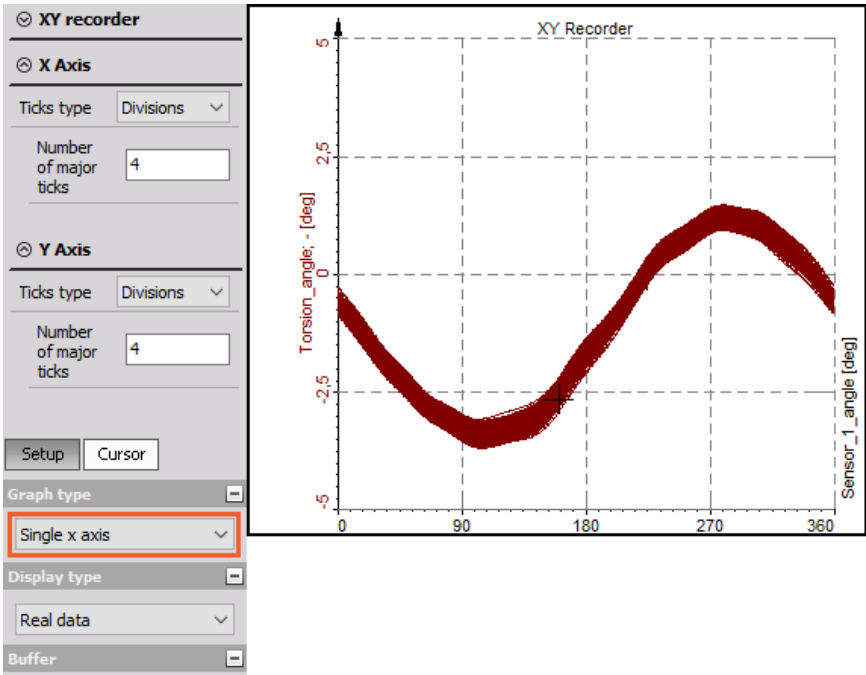


Illustration 34: Single x axis

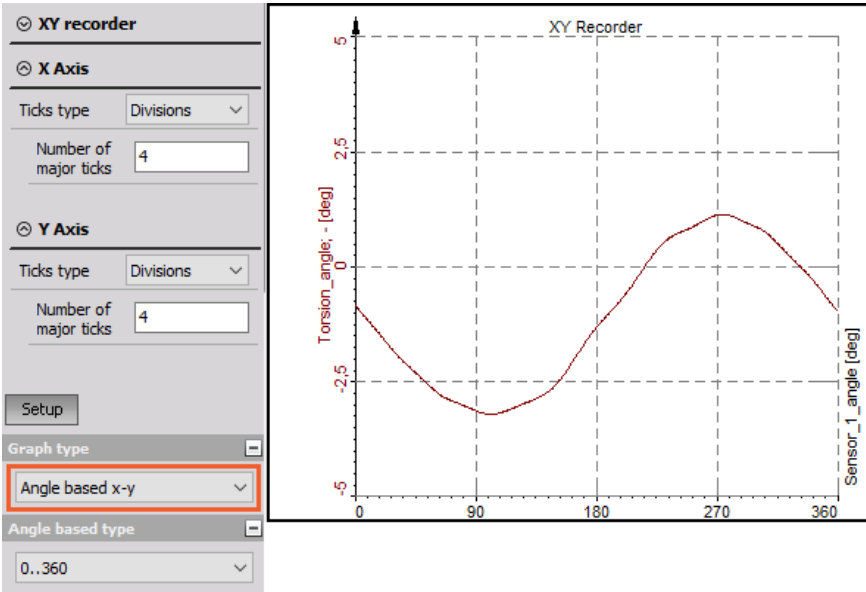


Illustration 35: Angle base x-y axis

Now, how is it possible to export this cycle-based data? Go to Math and add a “Time-to-vector transform”.

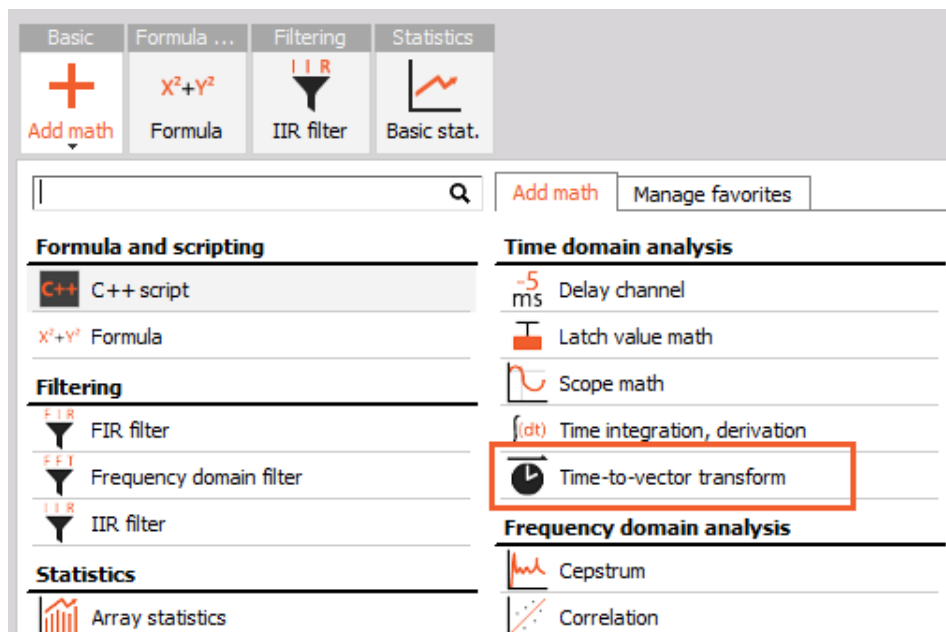


Illustration 36: Adding Time-to-vector transform mathematics

With this great tool DewesoftX® arranges the input data, e.g. “Torsion_angle” over the “Sensor_1_angle” in a matrix by resampling the values to the angle-base, you also can select resolution, in this example we use 1 degree. The output data is MIN, MAX and AVG over all cycles.

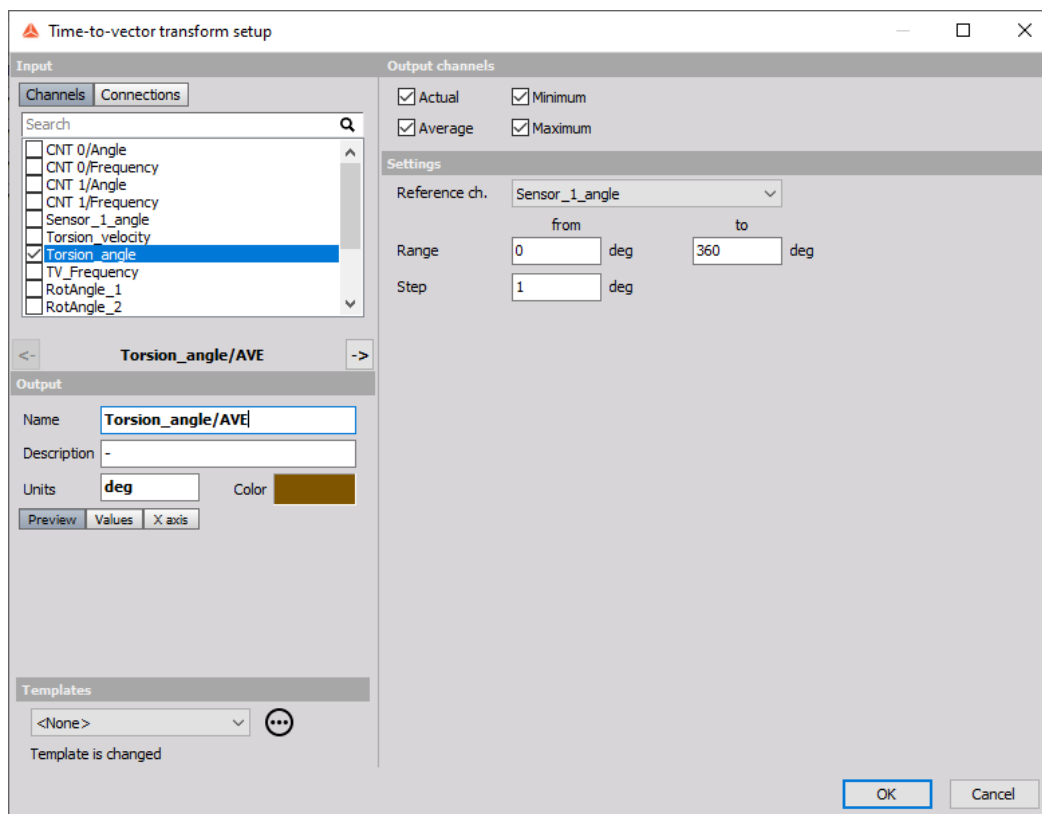


Illustration 37: Time-to-vector transform setup

For displaying the matrix data you have to use a different visual instrument, the 2D graph. Then you can assign the AVE, MIN and MAX channels from the Math function.

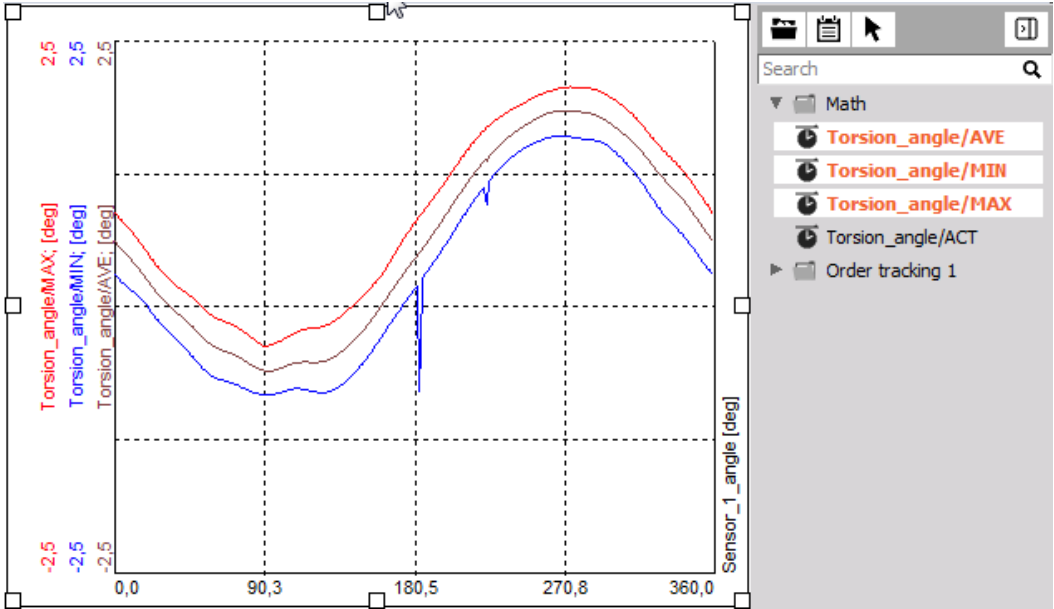


Illustration 38: 2D graph

Store a datafile, afterwards in the Export section only select the 3 matrix channels (in order that data has the same format):

13	No	Math 0 (Torsional vibrati...	20000	Scalar	RotVelocity_2
14	No	Math 0 (Torsional vibrati...	65,9	Scalar	Rev. count
15	Yes	Math 3 (Reference scop...	single	Vector (361)	Torsion_angle/AVE
16	Yes	Math 3 (Reference scop...	single	Vector (361)	Torsion_angle/MIN
17	Yes	Math 3 (Reference scop...	single	Vector (361)	Torsion_angle/MAX

Illustration 39: Export the data

Here we have done the export to Excel, instead of the time axis, we have angle-based data.

	A	B	C	D	E	F	G	H		MU	MV	MW	MX	MY
1	Sensor_1_angle	deg	0	1	2	3	4		355	356	357	358	359	360
2	Torsion_angle/AVE	deg	0,691408	0,675741	0,655573	0,637096	0,617458	0,599...	0,445	0,784162	0,761108	0,738833	0,718306	0,702214
3	Torsion_angle/MIN	deg	0,464674	0,454879	0,436415	0,419164	0,410838	0,39...	0,4133	0,540239	0,528965	0,506269	0,484947	0,475034
4	Torsion_angle/MAX	deg	0,8667	0,856126	0,834045	0,812448	0,802175	0,79...	0,977694	0,951462	0,938873	0,914317	0,890305	0,863698
5														
6														

Illustration 40: Data in Excel

If you copy the data, then use the “paste special...” function in Excel, you can “Transpose” columns and rows automatically and get the angle from top down instead of left to right.

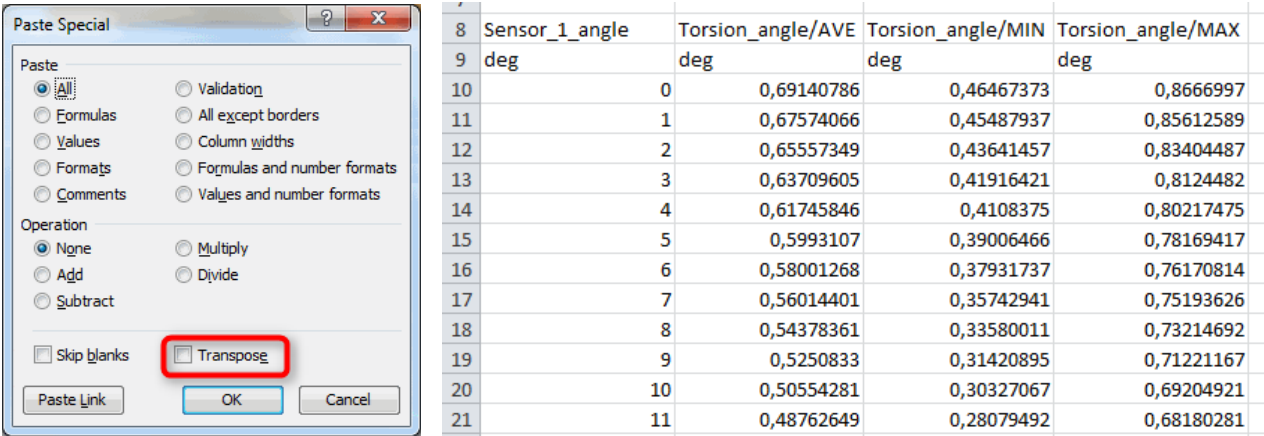


Illustration 41: Paste options in Excel

Selective export:

Use the recorder instrument to zoom into a section of your datafile in DewesoftX® (position both white cursors I and II and click between them),then the calculation and export is only done over the selected data.

7. Measurement accuracy

7.1. Error sources

The overall error of the measurement has to be split up into errors from the sensor and the counter measurement uncertainty. Usually the sensor tolerance comprises the majority of the measurement uncertainty..

7.2. Counter accuracy

7.2.1. Counter architecture

To understand how the angle resolution is determined, it is most important to understand the internal architecture of the DewesoftX® Counters. A combination of main and sub counter is used internally for getting higher precision at the frequency measurement. The main counter is running on event counting (or encoder mode). The sub counter is used for time measurement, it measures exactly the time of the input event with a resolution of 9,77 nsec ($= 1 / 102,4 \text{ MHz}$) relative to the sample clock. At every rising edge on the Counter Source the counter value of the sub counter is stored in a register. At every Sample Clock the values of both counters are read out.

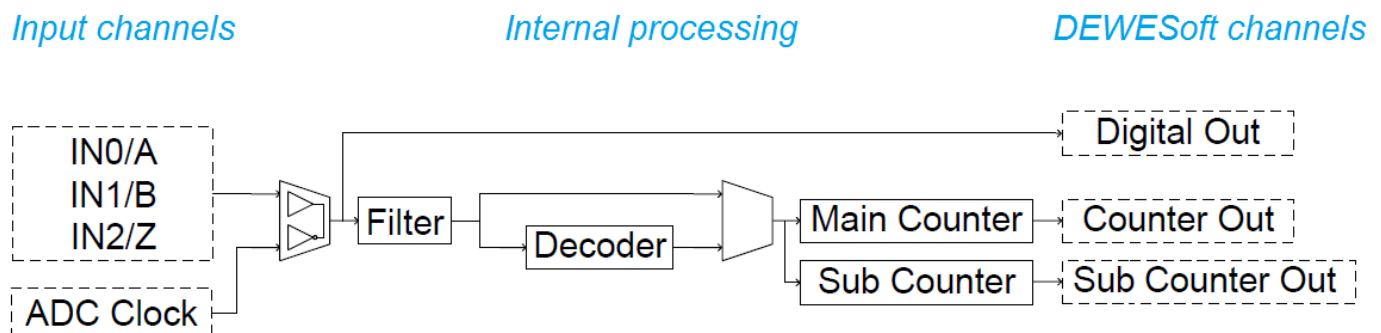


Illustration 43: Counter architecture

With DEWESoft's Super-Counter Technology, not only the frequency can be calculated in a precise way, but also the event counter result can be shown in fractions because the exact time when the event occurs at the input is known. The event counting result is recalculated with interpolation to the sample point like shown in the diagram below.

Here the improvement of the measurement result is shown. While a standard counter input shows the value up to one sample delayed, the counter input of the Dewesoft instrument calculates the exact counter result at the sample point.



Hint

For more information on our SUPERCOUNTER® please navigate to our [Youtube channel](#).

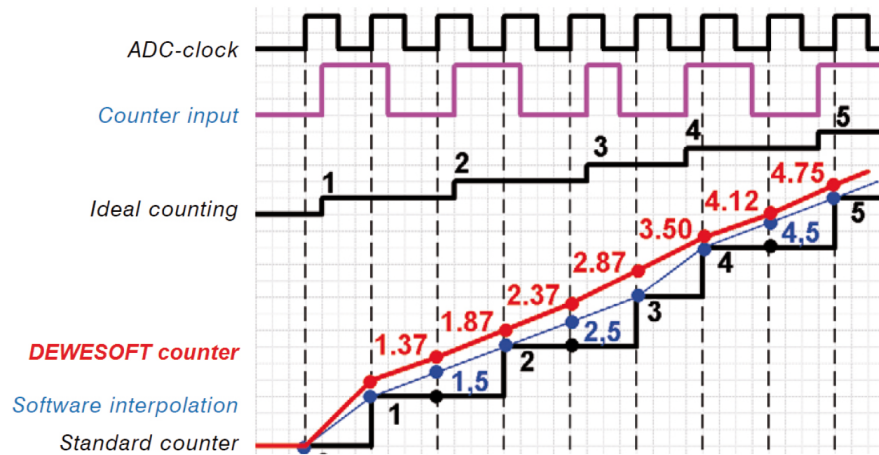


Illustration 44: Supercounter



Important

The Counter value in the software is updated with the sample rate!

7.2.2. Angle resolution

The counter result is read out with the sample rate, therefore the same update rate applies for the calculated angle.

Furthermore the angle resolution depends on the rotation speed (RPM).

Below there are two angle-based 2D graphs showing the Sensor angle on the x axis at the same RPM. The option “draw sample points” was enabled. On the left side the sample rate was set to 500 Hz, on the right to 2500 Hz:

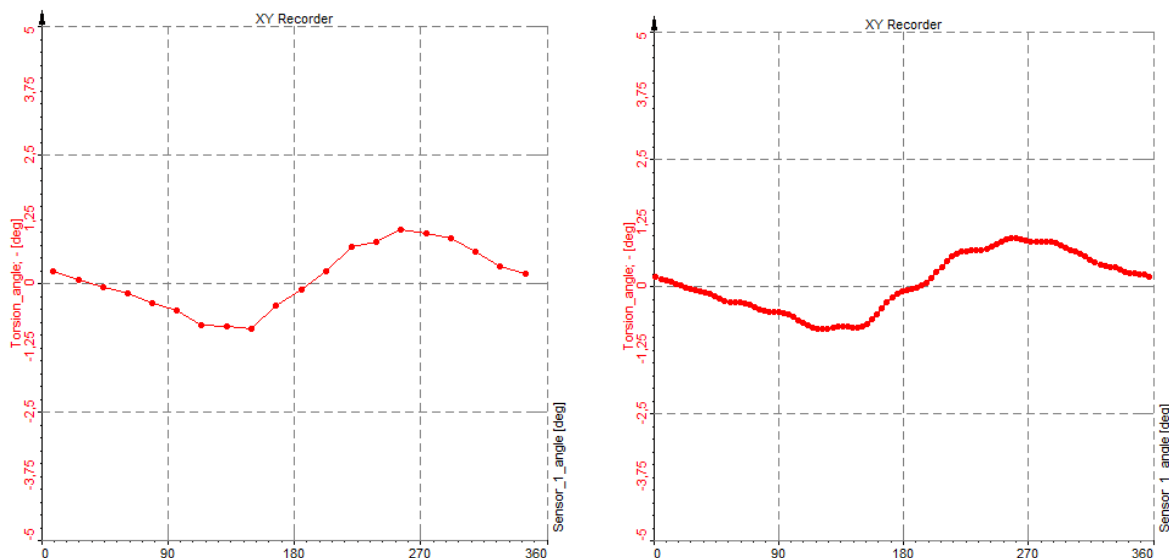


Illustration 45: Angle based data

Since rotational and torsional calculations are all based on the sample rate, the angle resolution is the same.

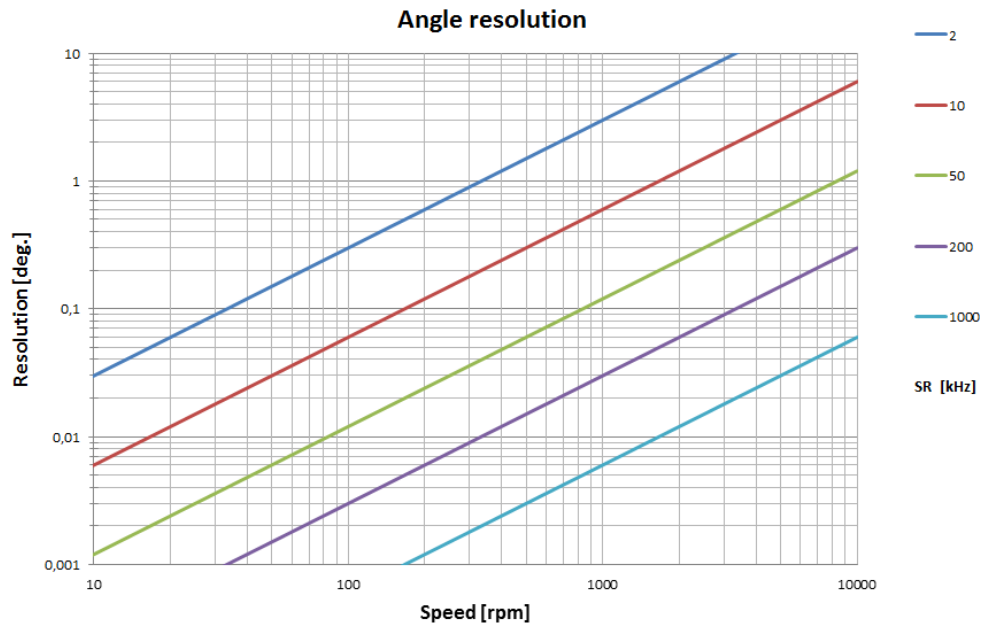


Illustration 47: Angle resolution

7.2.3. Angle accuracy

As the Counter is working on an internal timebase of 102.4 MHz, the angle accuracy is only depending on the rotation speed (RPM).

The following formula shows how to calculate the angle accuracy:

$$\Phi_{res} = \frac{\frac{RPM}{60} \times 360}{102.4 \times 10^6}$$

102,4 MHz is the Counter Timebase.

The numerator shows the angle which is passing by in one second, this is then divided by the timebase of the counter, in one second we will get 102.4 million samples.

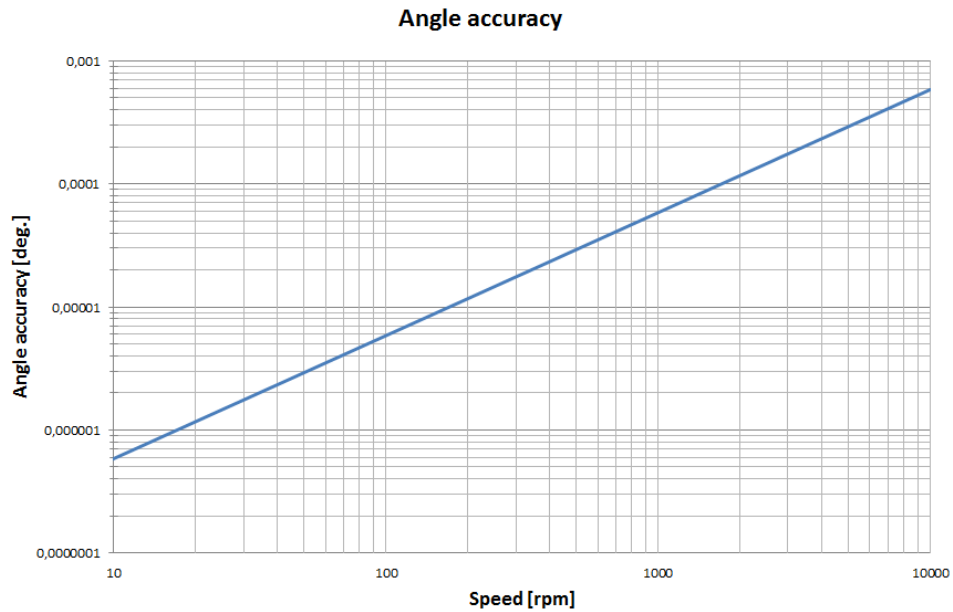


Illustration 48: Angle accuracy

7.2.4. Frequency accuracy

Any digital frequency measurement is based on period time measurement. The time between two edges of the input signal is “sampled” with the counter time base of 102.4Mhz. With this simple measurement method the accuracy of the measured frequency is given by ratio between the input signal frequency and the counter time base frequency:

$$f_{error} = \frac{f_{in}}{102.4 \times 10^6}$$

We can see, the error increases with input frequency. For example at 10MHz the accuracy goes down to 10%!

Like explained above, the advanced counter structures of DewesoftX® are using two counters internal counters and the output rate is synchronous with the acquisition rate. With this technology we can limit the maximum error to the used acquisition rate.

The illustration below shows the accuracy at different input signals between 2 kS/sec to 1000 kS/sec taking also the typical counter time base accuracy of 5 ppm in account.

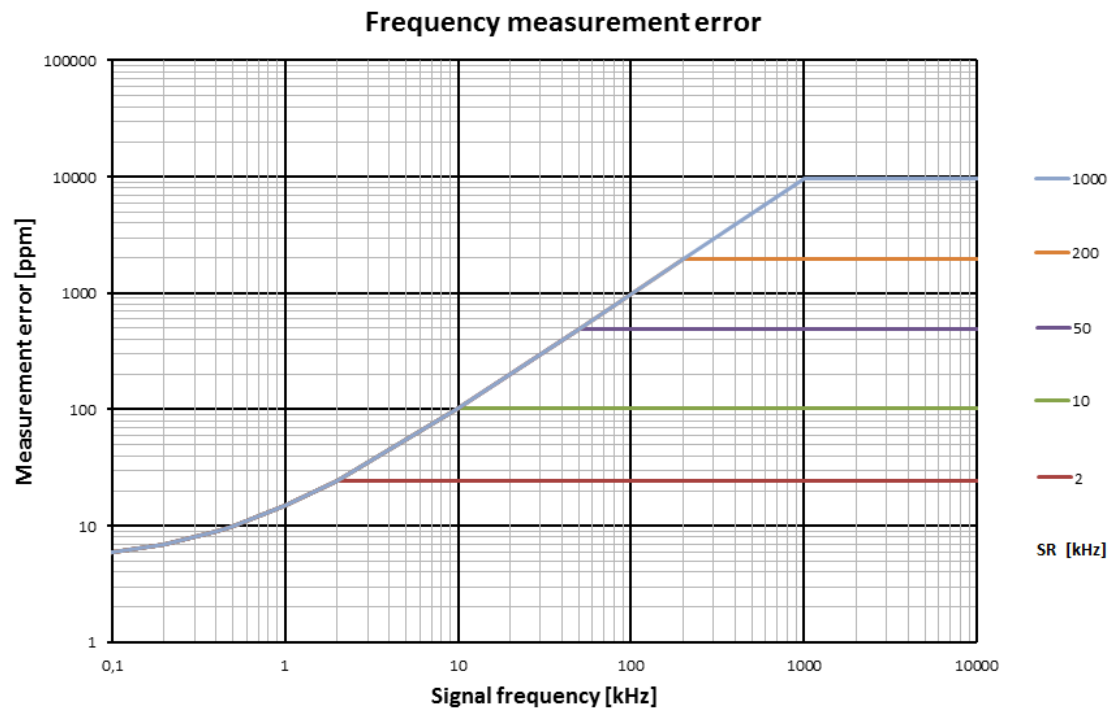


Illustration 49: Frequency measurement error

7.3. Sensor accuracy

7.3.1. Non centered mounting

Can be corrected under certain conditions, see chapter Reference curve in this document.

7.3.2. Resolution error

An additional error occurs due to mechanical tolerances of the used encoder. Depending on the encoder mode setting used (X1, X2, X4), they have influence on the measurement.

X1 mode: For this mode only the rising edge is important. If the sensor marks are not precisely repeating at constant delta angles (have a constant "jitter"), this also can be compensated with the reference curve option

Good:



Bad:



Illustration 50: X1 mode

X2 mode: For X2 mode both the rising and falling edge of the first encoder track are used, which doubles the resolution. But if the duty cycle is not exactly 50%, another error is introduced.

Good:



Bad:

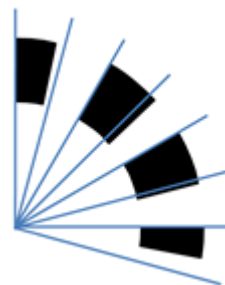
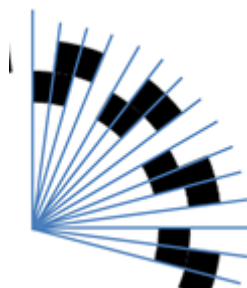


Illustration 52: X2 mode

X4 mode: Both falling and rising edges of both encoder tracks are used in X4 mode to get 4 times the precision. The phase shift between the two tracks must be exactly 90° and the duty cycle 50%.

Good:



Bad:

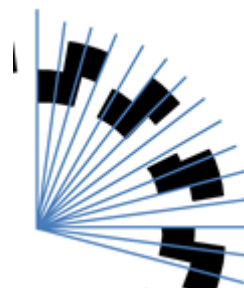


Illustration 54: X4 mode

Therefore, the higher the mode used (e.g. X4 compared to X1), the more noise will be in the measurement due to the discussed mechanical tolerances, because all effects appear together. In a manner of speaking an encoder with a high resolution (e.g. 3600 pulses), is difficult to manufacture

precisely, and therefore will have more noise in X4 mode than one with lower resolution (e.g. 360 pulses) in X4 mode.

Of course, if using two encoders (as in torsional vibration), the errors are doubled.

8. 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>.

8.1. 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.

8.2. 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)

8.3. 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>.

8.4. Restricted Rights

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

8.5. Printing History

Version 2.0.0, Revision 217 Released 2015 Last changed: 23. July 2018 at 16:54.

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9. Safety instructions

Your safety is our primary concern! Please be safe!

9.1. 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.

9.2. 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 d.o.o. 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.

9.2.1. Environmental Considerations

Information about the environmental impact of the product.

9.2.2. Product End-of-Life Handling

Observe the following guidelines when recycling a Dewesoft system:

9.2.3. 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.

9.2.4. 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 gases, 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 gases, 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. Acclimatise 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.

10. Documentation version history

Version	Date [dd.mm.yyyy]	Notes
1.0	28.11.13	<input checked="" type="checkbox"/> initial revision
V20-1	03.09.2020	New template, partially new screenshots
V22-1	24.3.2022	Added Important note in System Overview