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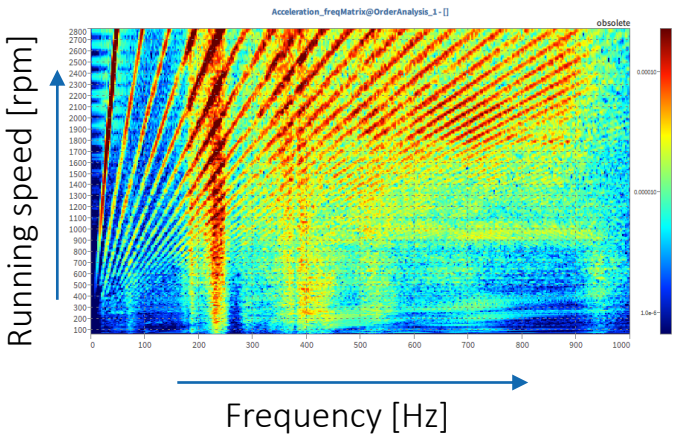
OXYGEN TRAINING
> ORDER ANALYSIS

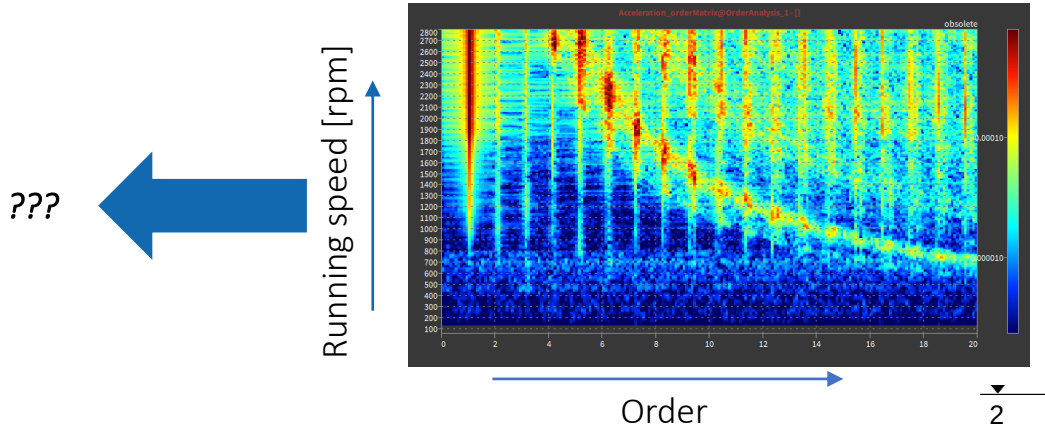
WHAT IS AN ORDER?

- Motor running with 3000 rpm
- Fundamental frequency is 3000/60 = 50 Hz
- 50 Hz is the first order
- Higher orders are integer multiples of the first order

1st order	50 Hz	60 Hz
2nd order	100 Hz	120 Hz
3rd order	150 Hz	180 Hz
4th order	200 Hz	240 Hz
5th order	250 Hz	300 Hz
…	…	…



Multiple FFTs for different running speeds



DETERMINATION OF THE ORDER MATRIX

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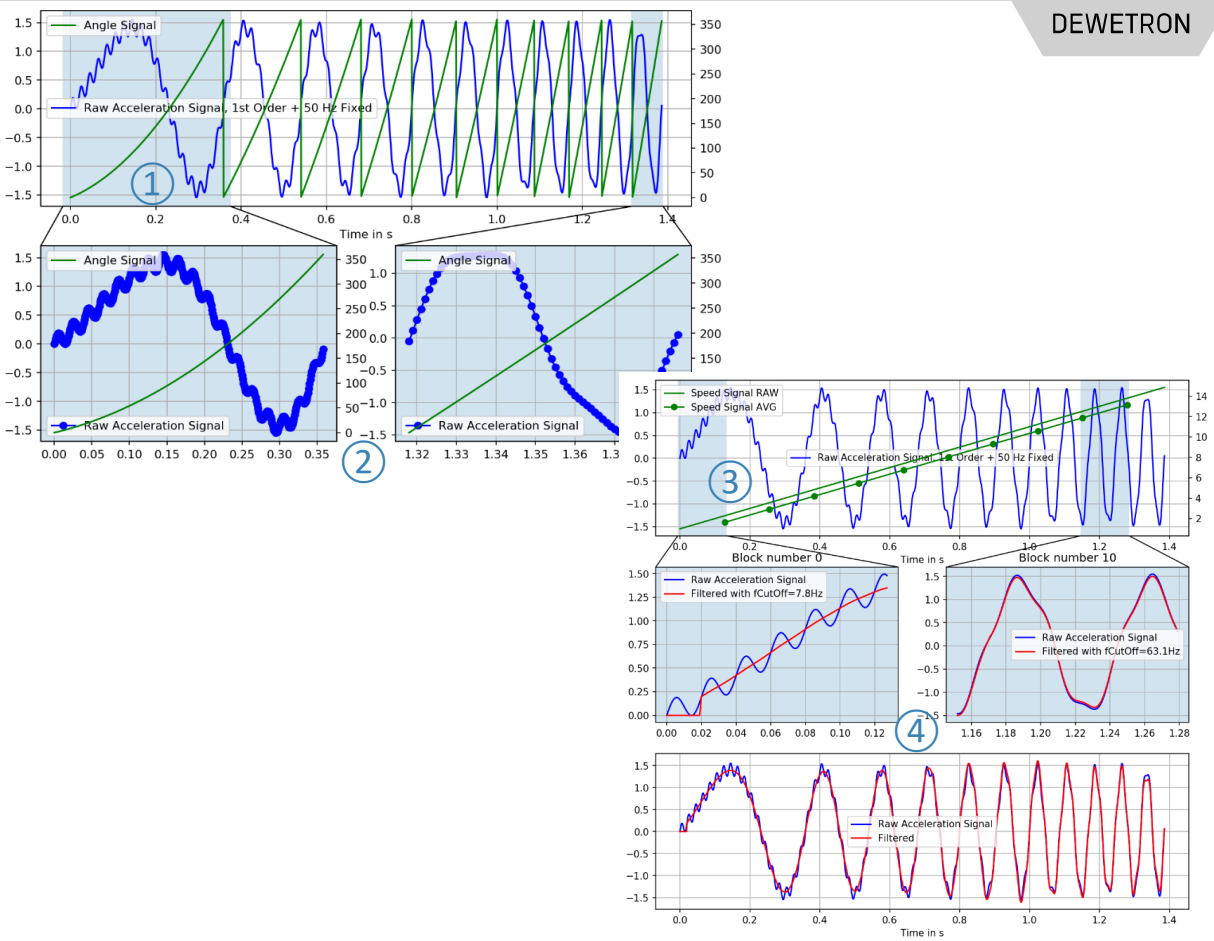
①	Separation of the raw input signal into signal blocks per revolution One block represents one revolution
②	To achieve a high accuracy, the rotation angle is required As the running speed of the DUT will change continuously and the sample rate is constant, the number of samples per revolution will decrease with increasing running speed
③	The average speed per revolution is determined
④	To avoid aliasing during the FFT explained in the following below, the signal raw signal will be filtered with an adaptive anti-aliasing filter



DETERMINATION OF THE ORDER MATRIX

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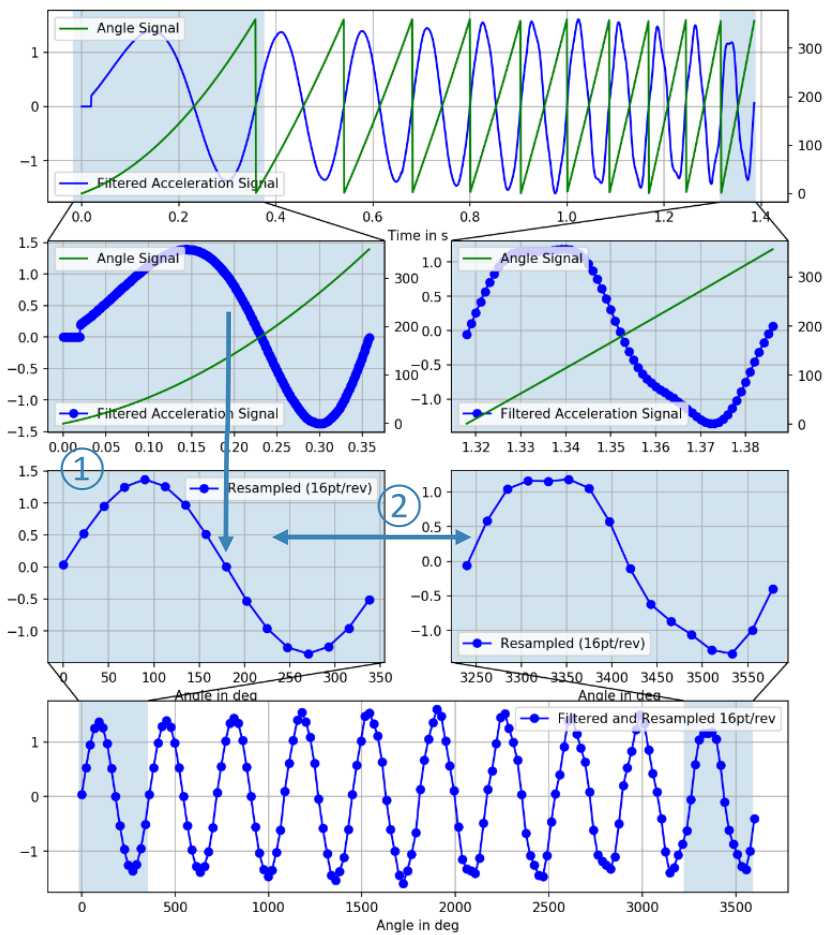
①	Due to the fact that the numbers of samples per revolution is decreasing with increasing running speed, the signal will be resampled to a defined number of samples per revolution
②	An accurate angle signal is required for this step. The more angle steps per revolution delivered by the speed sensor, the more accurate the resampling algorithm will work



DETERMINATION OF THE ORDER MATRIX

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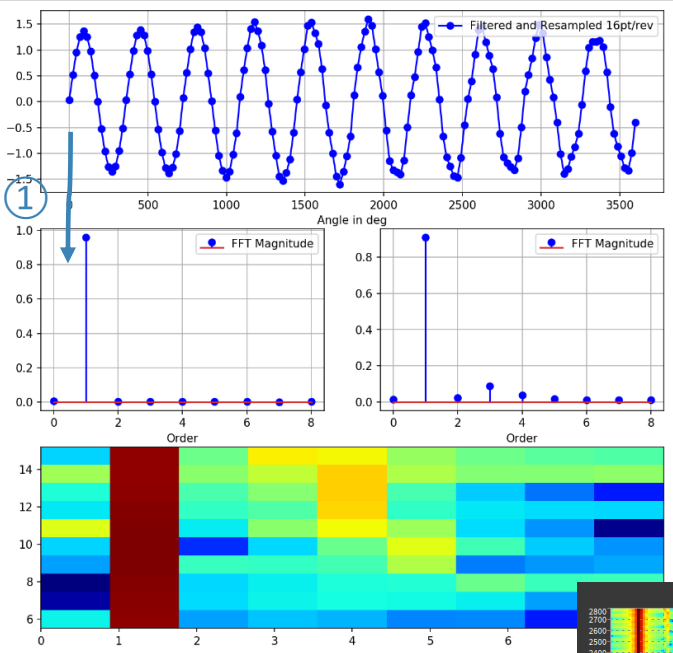
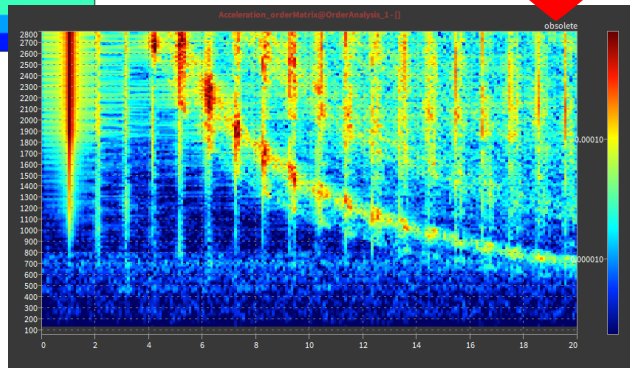
① The order spectrum is now calculated by transforming the resampled signal (fixed number of samples per revolution) into the frequency domain.





Remark: The difference to the output spectrum to the usual frequency spectrum is hereby that the frequency is no longer plotted along the x-axis but the order itself. Thus, the order spectrum can be directly extracted from this spectrum.

EXTRACTION OF ORDER FROM INTENSITY DIAGRAM

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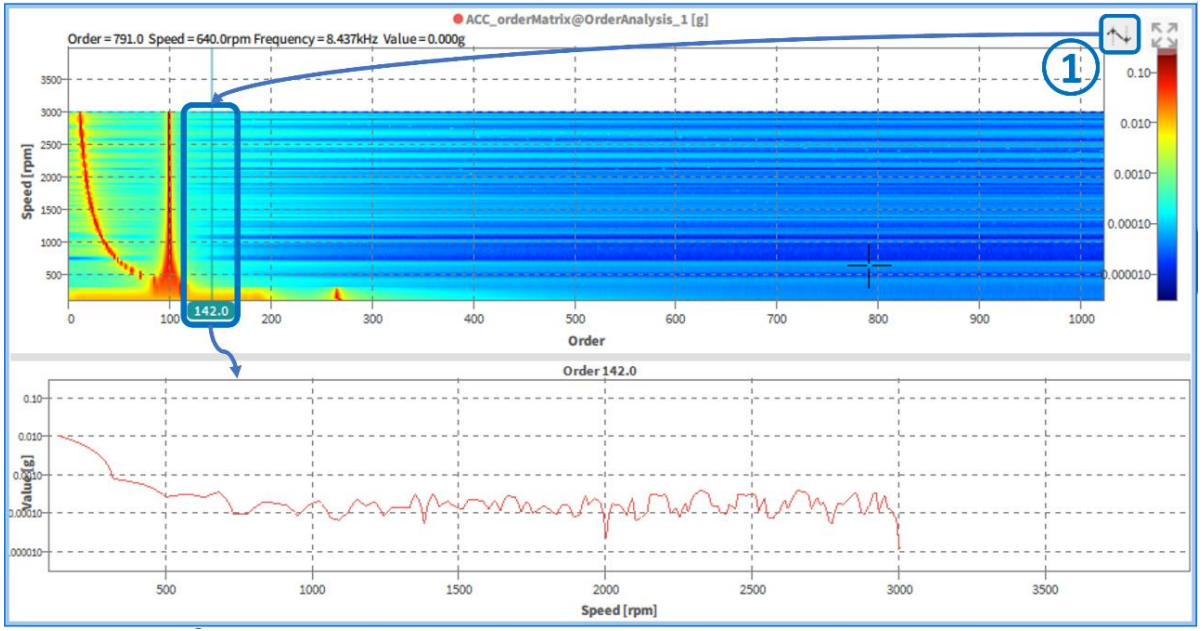
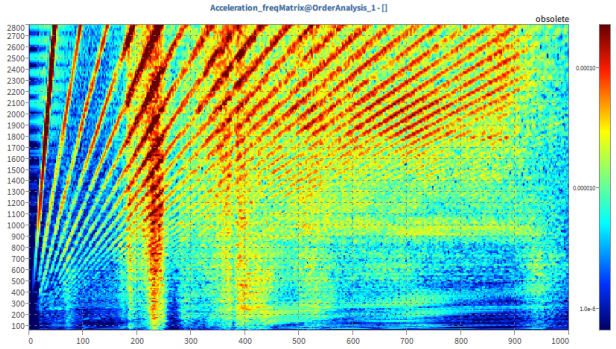
① Possibility to extract orders from intensity diagram via cursor (①)
- Vizualization of order vs rpm



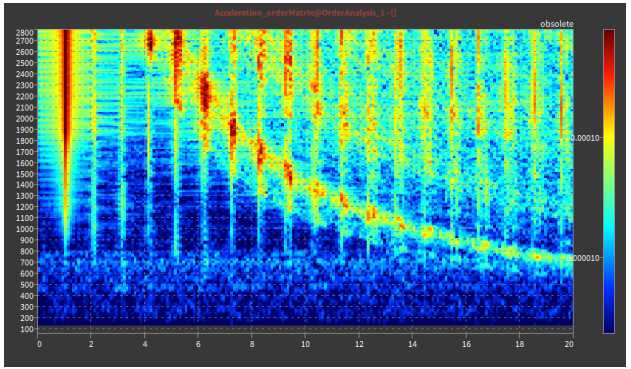
GENERAL



- Order analysis from 60 rpm to 100.000 rpm
- Up to 1000 speed steps
- Order resolution selectable from 0.01 to 1
- FFT-windowing and overlapping
- Adaptive AAF for order domain analysis
- order extraction of selected orders

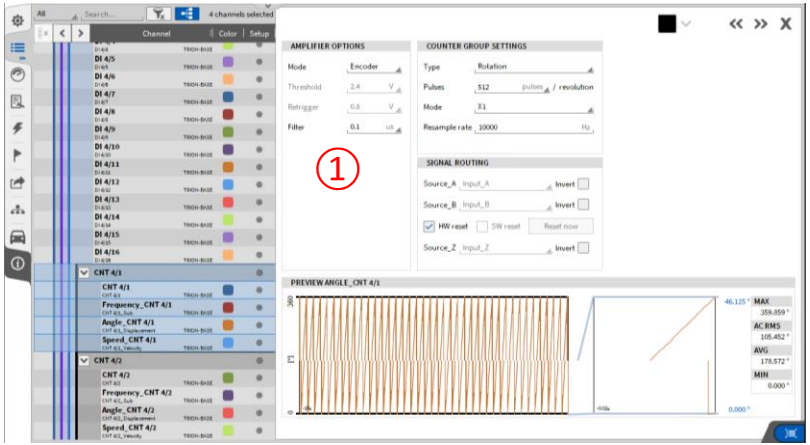
Benefits:

- Gapless analysis
- Order analysis with angle-based resampling and adaptive anti-aliasing filter
- Simultaneous analysis in order and frequency
- Simple configuration

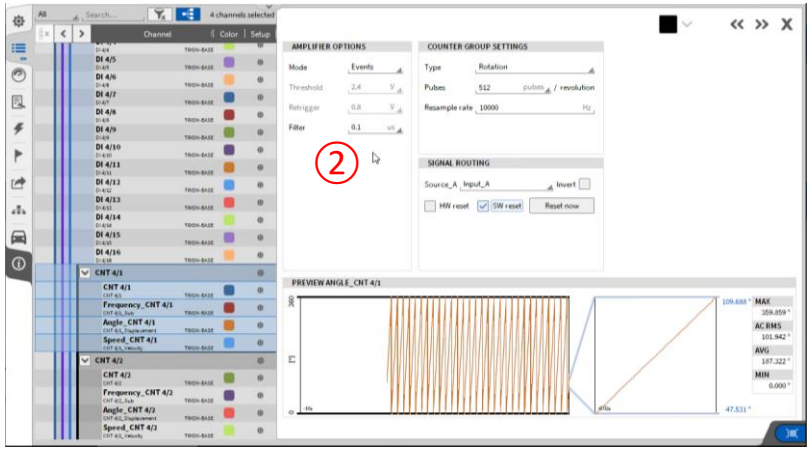


SOFTWARE CONFIGURATION

	Connect sensors for acceleration and angle of rotation
	Select settings for the acceleration sensors in the channel setup (mostly IEPE mode and measuring range)
	Setup counter input for the speed / angle measurement in the channel setup
①	When using an encoder with A, B, Z signals
②	When using a tacho sensor with a single output



Open detail setup of Main Counter Channel, set Counter Mode to Encoder and enter the number of pulses per revolution



Open detail setup of Main Counter Channel, set counter mode to Events, enter the number of pulses per revolution and, if necessary, change the Source channel. Additionally, check HW-Reset (if available) otherwise use SW-Reset.

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SOFTWARE CONFIGURATION

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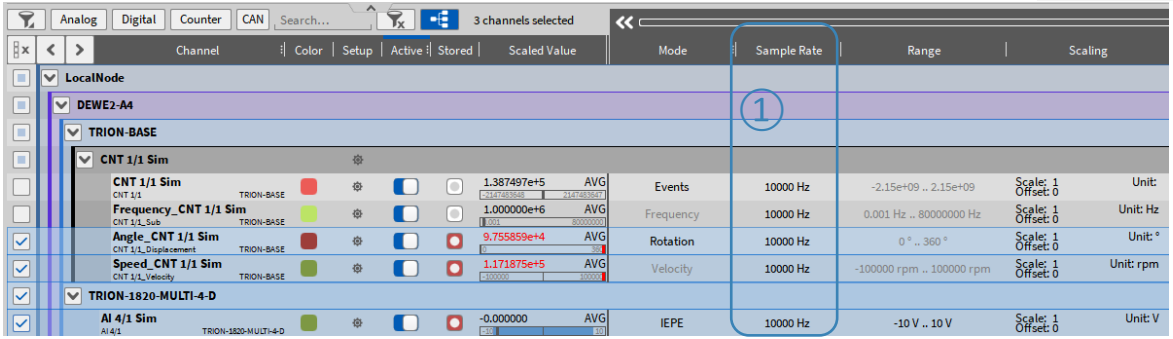
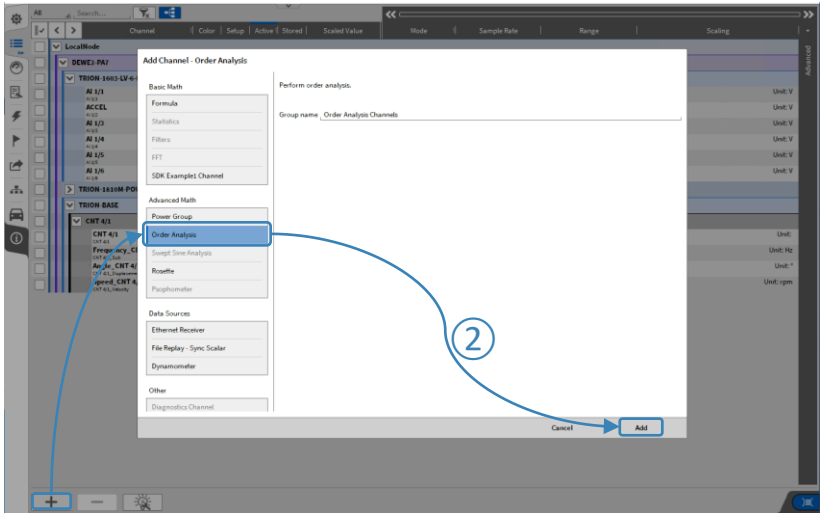
1. Select the sample rate
2. Create order analysis module



Recommendation for minimum sample rate:
Maximum speed / 60 * highest order * 3
Example: 6000 rpm / 60 * 100 * 3 = 30 kS/s



SOFTWARE CONFIGURATION

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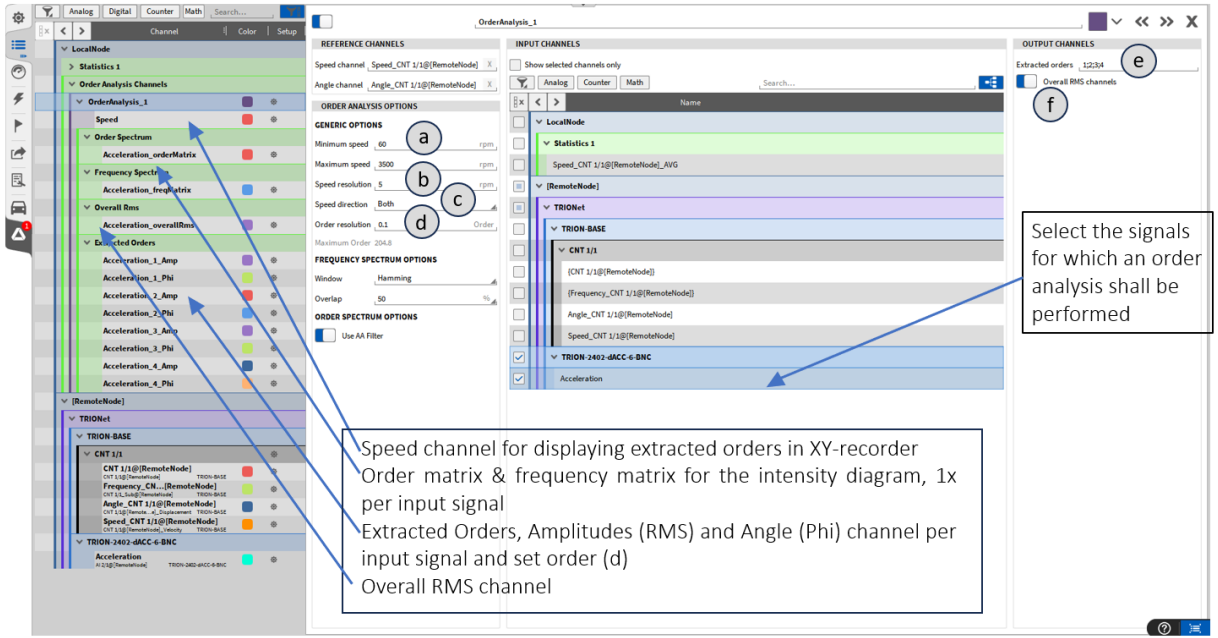
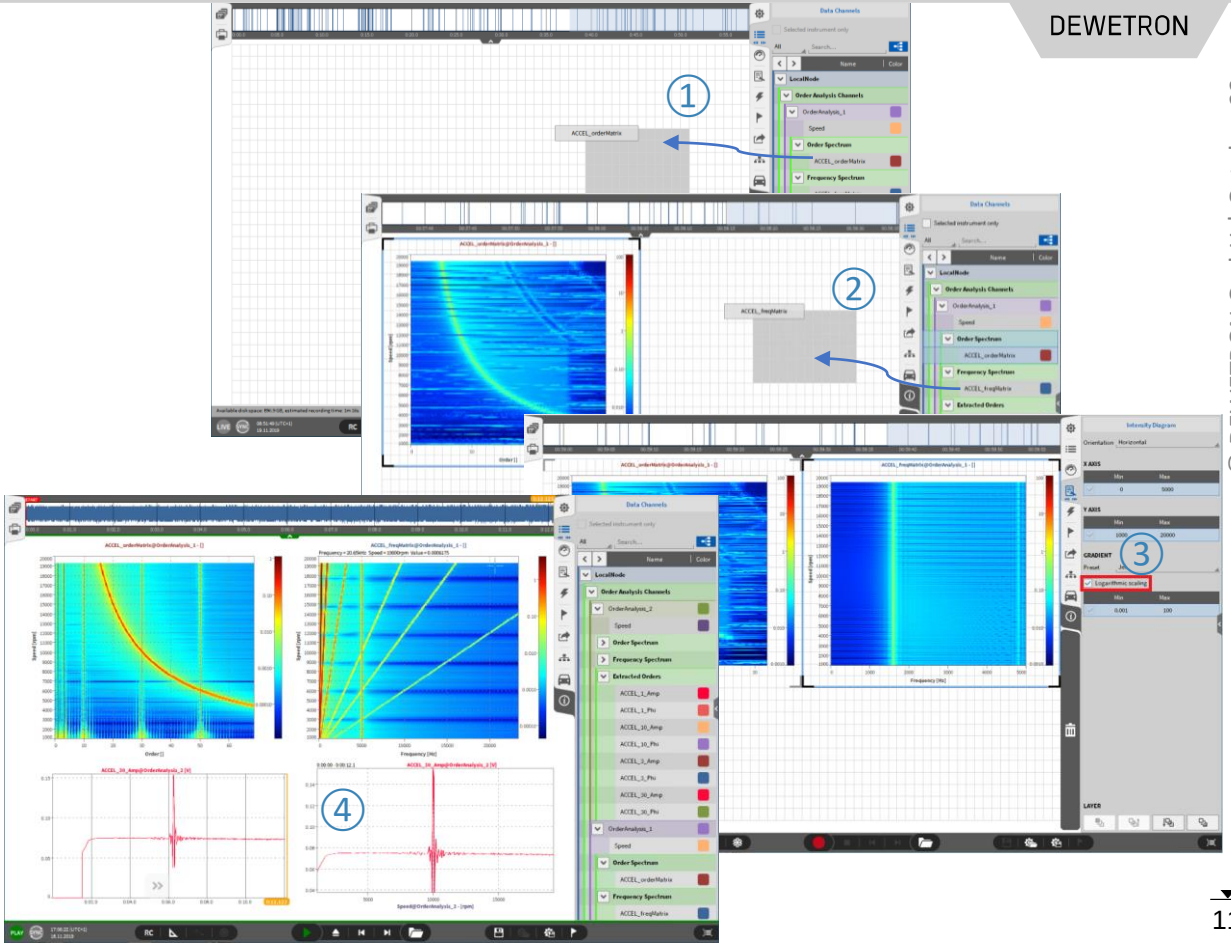
	Adapt settings to the application
A	Select MIN / MAX speed
B	Adjust resolution for the matrix display
C	Select speed direction: Both: Update will be performed if speed goes up or down Down: Update will be performed only if speed goes down Up: Update will be performed only if speed goes up
D	Adjust order resolution
E	Enter the order(s) to be extracted
F	Calculates RMS for each input channel for the current order spectrum. Formula:



$$Overall_{RMS}\sqrt{\sum_{i=1}^{n} Order_i^2}$$

MEASUREMENT SCREEN SETUP

①	Drag order matrix channel to the screen
②	Drag frequency matrix channel to the screen
③	If necessary, enable the logarithmic scale
④	Place additional instruments like a Recorder or a X/Y plot



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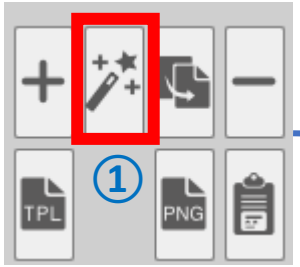
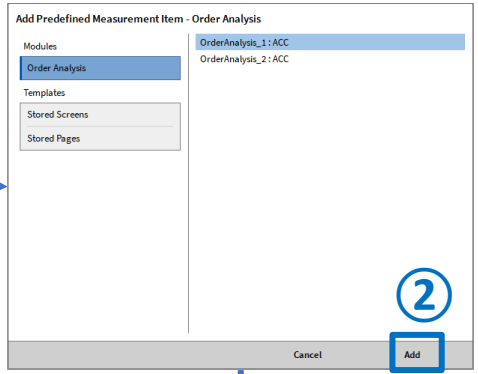
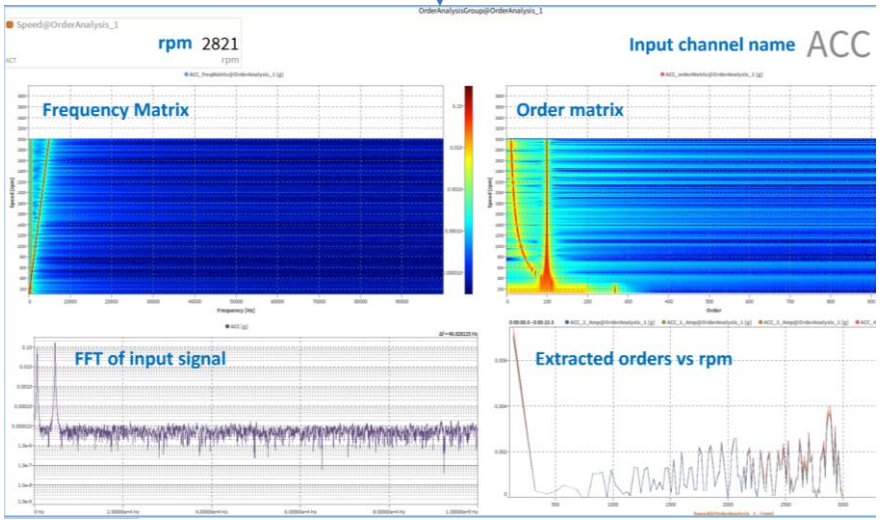
ORDER ANALYSIS TEMPLATE

①	Screen template for Order Analysis (①)
②	Add order analysis template (②)

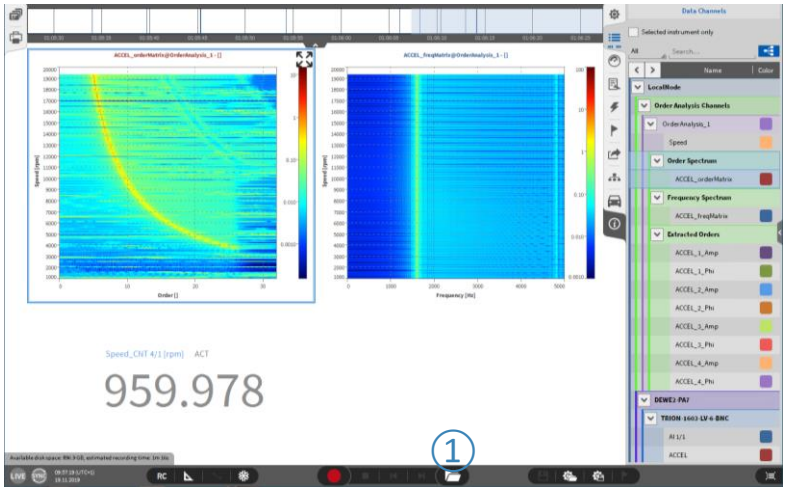


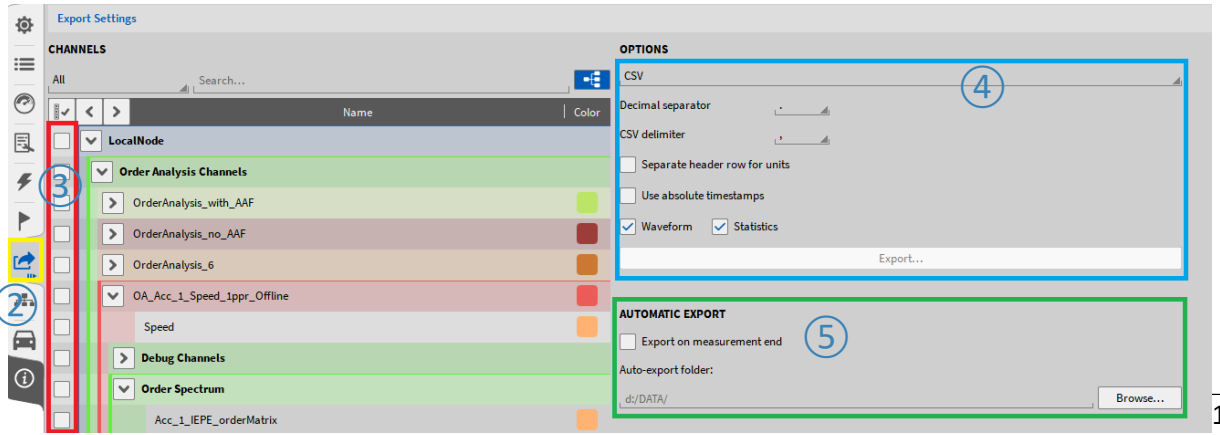




DATA ANALYSIS AND EXPORT

①	Open a data file for review, analysis and export
	Additional order analysis modules can still be created during data analysis
②	For data export (*.txt, *.csv, *.xlsx, *.mat and *.mdf4.0/4.1), open the export menu
③	Select the channels to be exported
④	Set additional options and press *Export…*
⑤	It is also possible to automatically export the data after measurement end





COPY AND PASTE DATA

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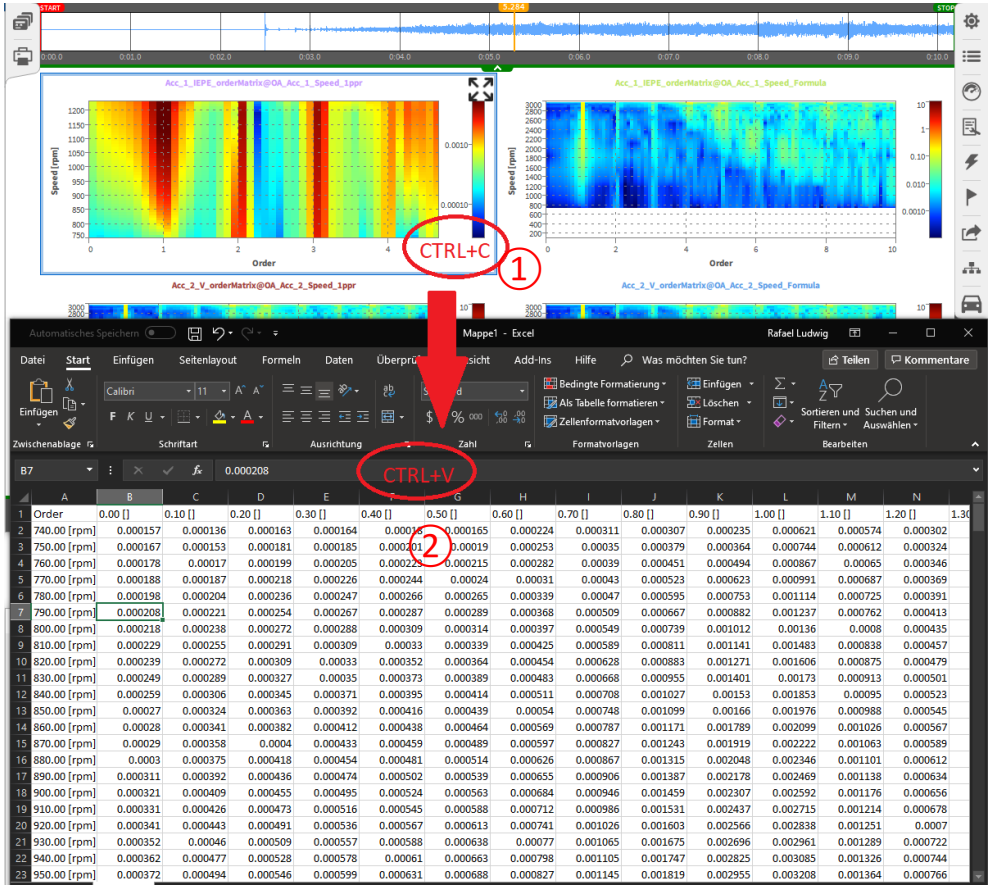
It is possible to copy and paste the order spectrum and frequency spectrum data displayed in an intensity diagram into another software package, like Excel

① Select the intensity diagram of the data you want to copy and press CTRL+C

② Open the software package, like Excel, to which the data shall be pasted and press CTRL+V

As the data is stored to the clipboard, it can also be pasted into other software packages but Excel



SAVE DATA AS IMAGE

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	It is possible to save the order analysis data as an image file
①	Highlight instrument
②	Save as png
③	Copy to clipboard