

THE MEASURABLE DIFFERENCE.



DEWETRON

▼

OXYGEN TRAINING > ORDER ANALYSIS



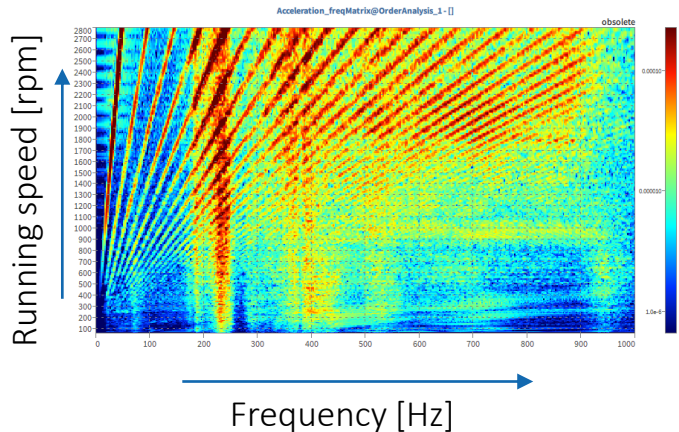


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WHAT IS AN ORDER?

- > 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
>



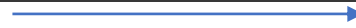
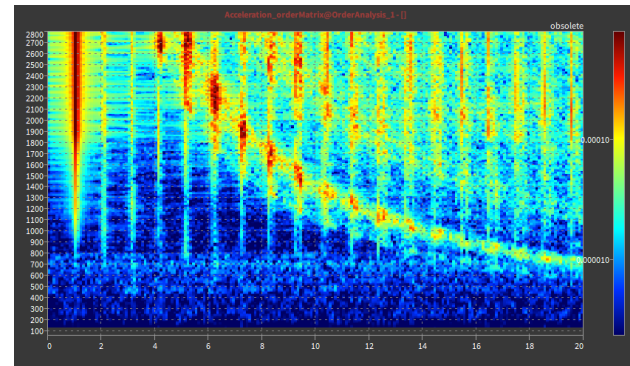
Multiple FFTs for different running speeds



???



Running speed [rpm]

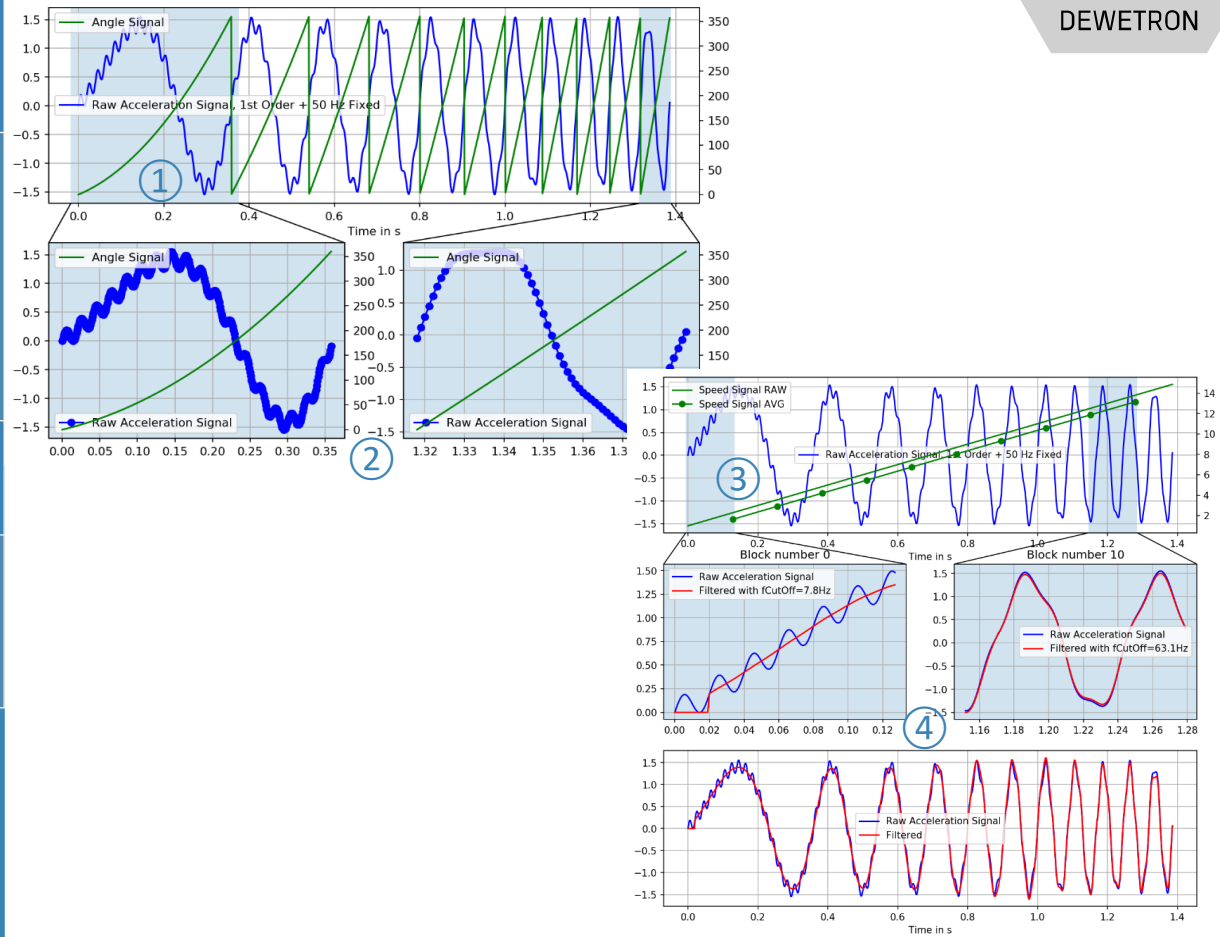


Order



DETERMINATION OF THE ORDER MATRIX

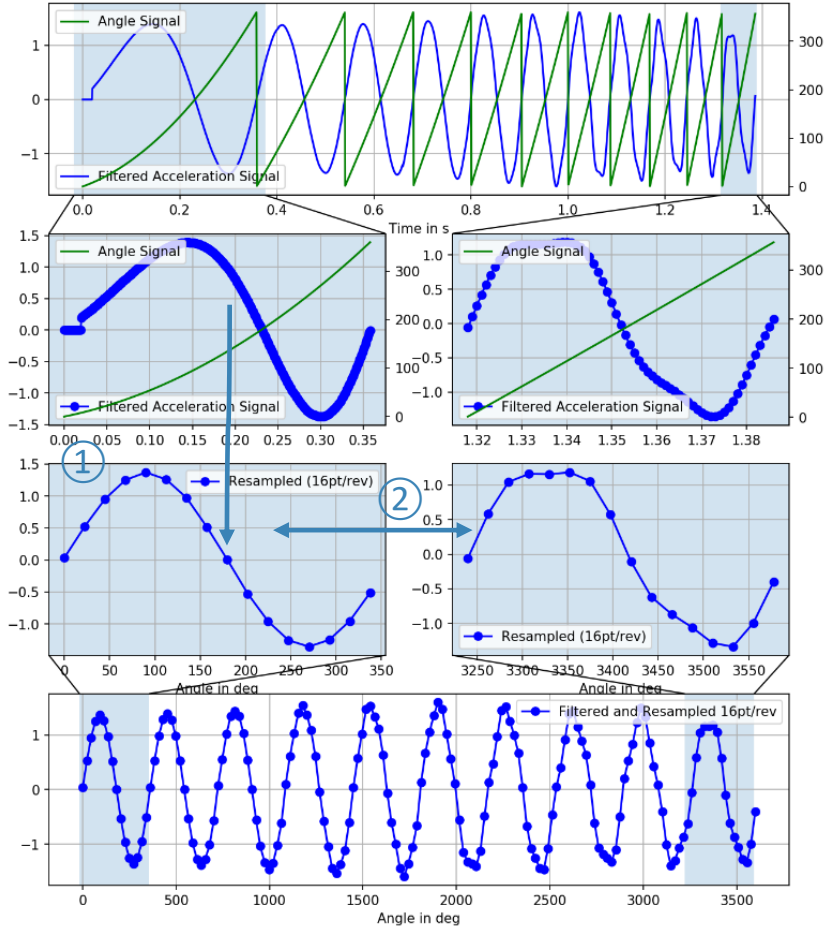
- ① Separation of the raw input signal into signal blocks per revolution
One block represents one revolution
- ② To achieve a high accuracy, the rotation angle is required
As the running speed of the DUT will change continuously and the sample rate is constant, the number of samples per revolution will 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

- 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



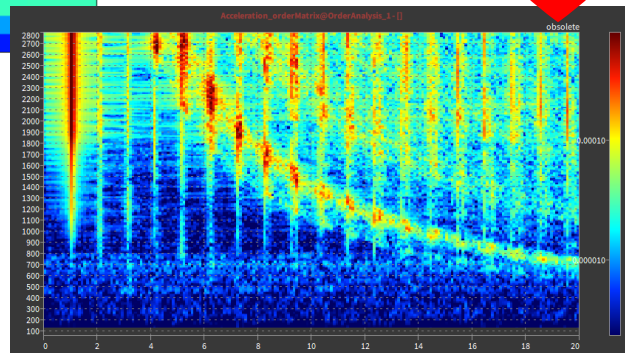
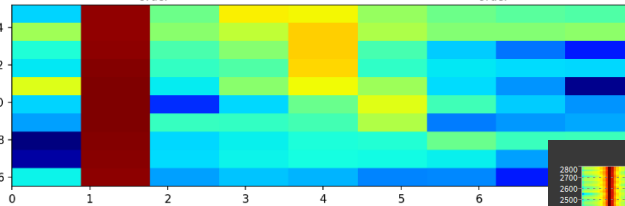
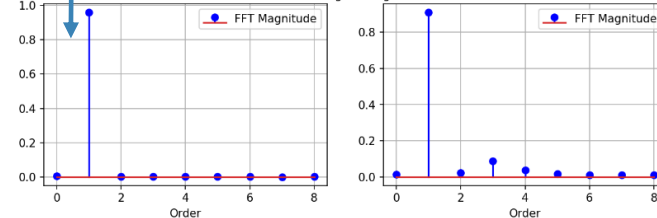
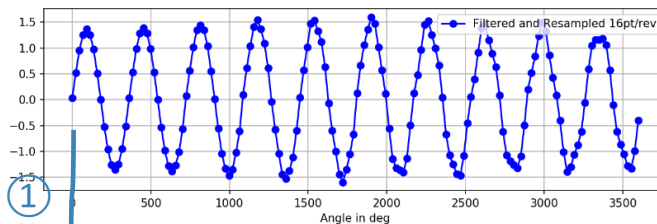


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DETERMINATION OF THE ORDER MATRIX

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



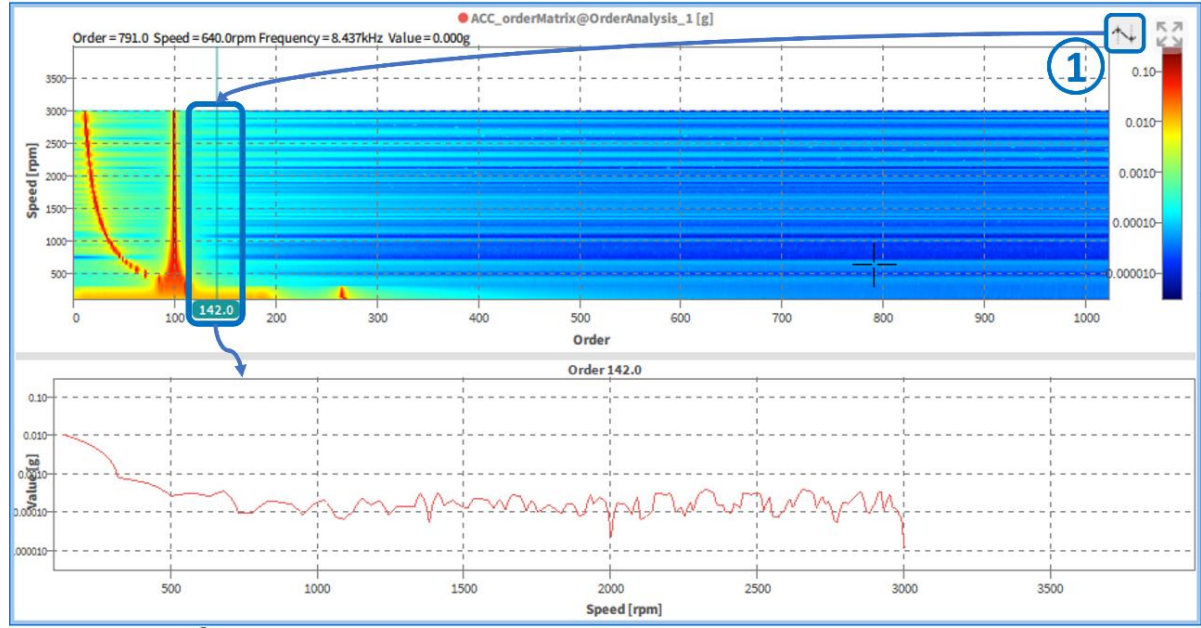
Remark: The difference to the output spectrum to the usual frequency spectrum is hereby that the frequency is no longer plotted along the x-axis but the order itself. Thus, the order spectrum can be directly extracted from this spectrum.

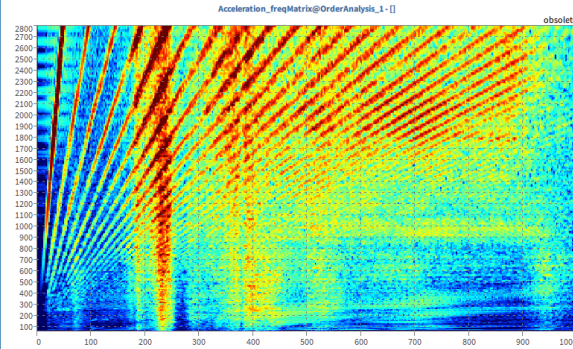


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EXTRACTION OF ORDER FROM INTENSITY DIAGRAM

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

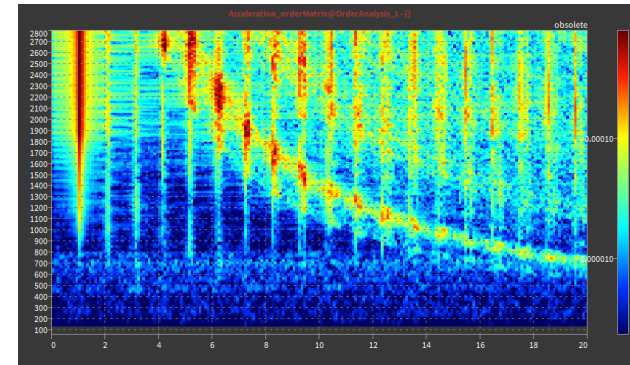




- > Order analysis from 60 rpm to 100.000 rpm
- > Up to 1000 speed steps
- > Order resolution selectable from 0.01 to 1
- > FFT-windowing and overlapping
- > Adaptive AAF for order domain analysis
- > order extraction of selected orders

Benefits:

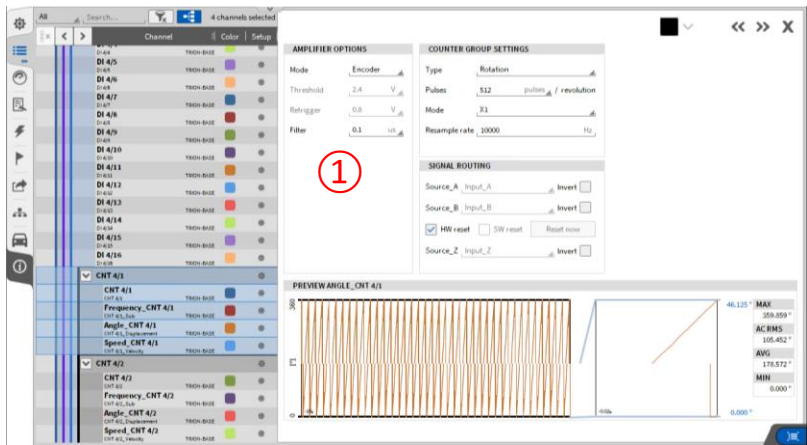
- > Gapless analysis
- > Order analysis with angle-based resampling and adaptive anti-aliasing filter
- > Simultaneous analysis in order and frequency
- > Simple configuration



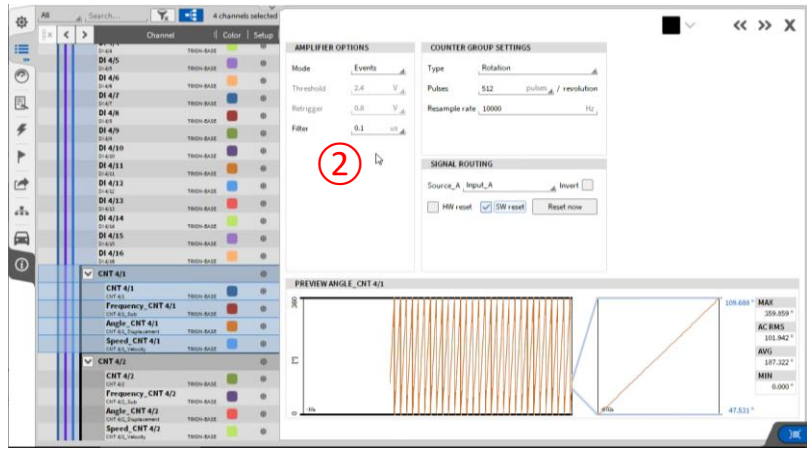


SOFTWARE CONFIGURATION

- 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.

SOFTWARE CONFIGURATION

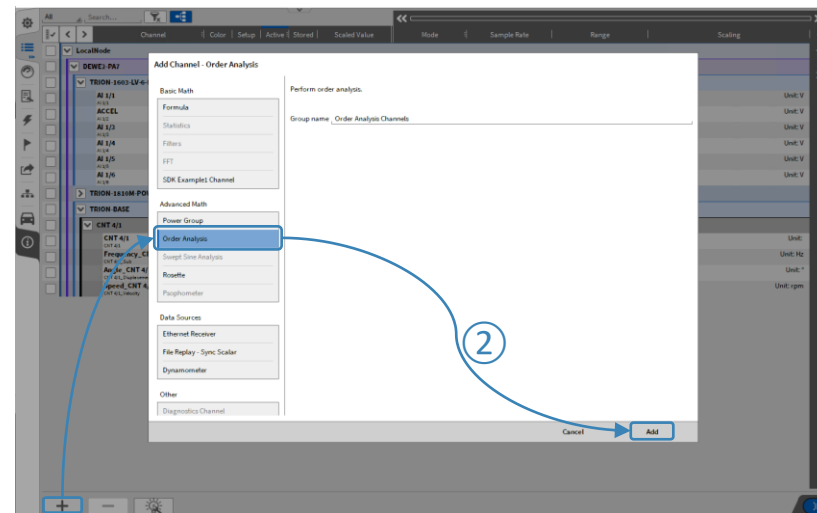


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- 1 Select the sample rate
- 2 Create order analysis module

Channel	Color	Setup	Active	Stored	Scaled Value	Mode	Sample Rate	Range	Scaling		
LocalNode											
DEWE2-A4											
TRION-BASE											
CNT 1/1 Sim											
CNT 1/1		TRION-BASE	<input type="checkbox"/>	<input type="checkbox"/>	1.387497e+5	AVG	Events	10000 Hz	-2.15e+09 .. 2.15e+09	Scale: 1 Offset: 0	Unit:
Frequency_CNT 1/1 Sim		TRION-BASE	<input type="checkbox"/>	<input type="checkbox"/>	1.000000e+6	AVG	Frequency	10000 Hz	0.001 Hz .. 80000000 Hz	Scale: 1 Offset: 0	Unit: Hz
Angle_CNT 1/1 Sim		TRION-BASE	<input checked="" type="checkbox"/>	<input type="checkbox"/>	9.755859e+4	AVG	Rotation	10000 Hz	0 ° .. 360 °	Scale: 1 Offset: 0	Unit: °
Speed_CNT 1/1 Sim		TRION-BASE	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1.171875e+5	AVG	Velocity	10000 Hz	-100000 rpm .. 100000 rpm	Scale: 1 Offset: 0	Unit: rpm
TRION-1820-MULTI-4-D											
AI 4/1 Sim		TRION-1820-MULTI-4-D	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-0.000000	AVG	IEPE	10000 Hz	-10 V .. 10 V	Scale: 1 Offset: 0	Unit: V

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





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SOFTWARE CONFIGURATION

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:

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

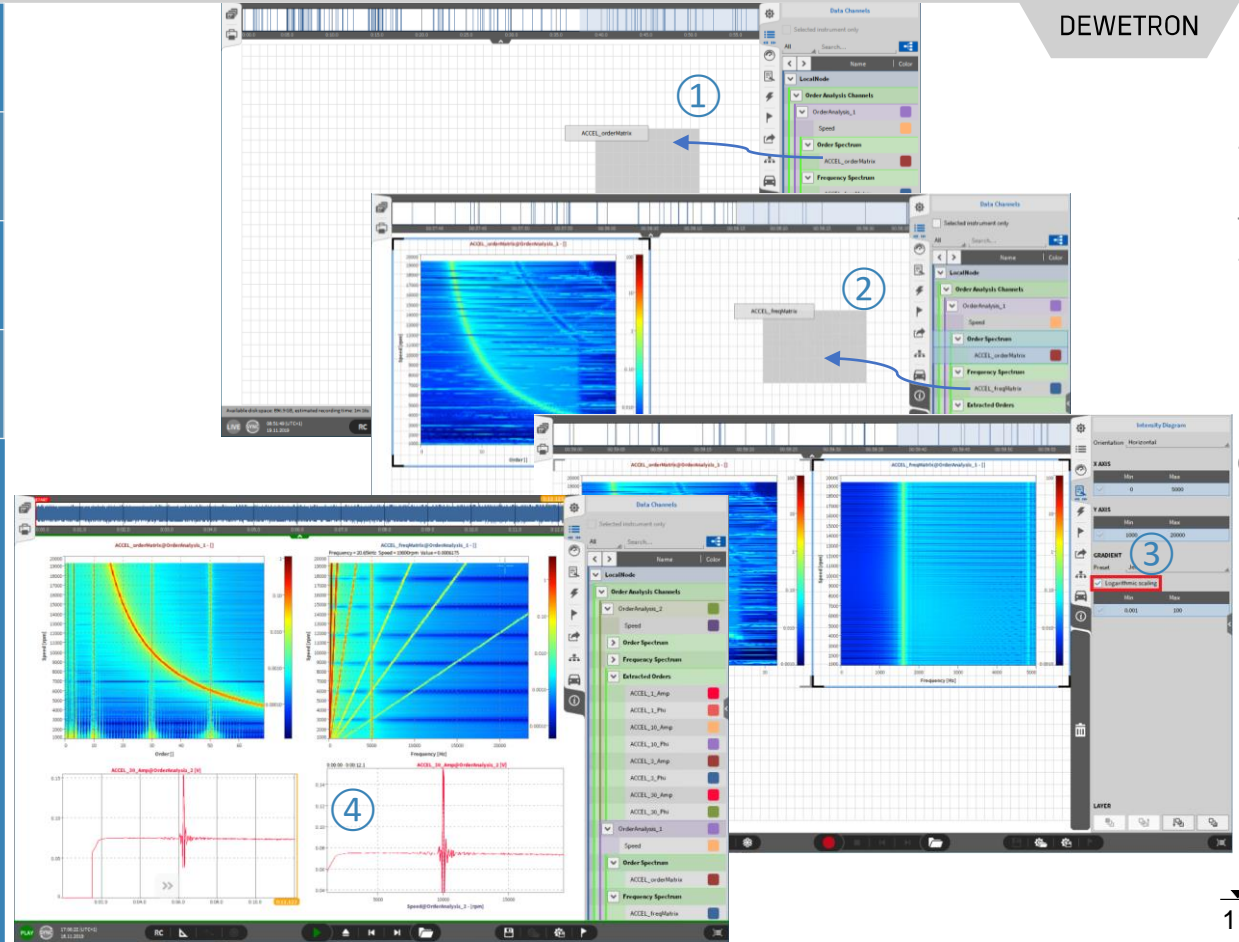


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MEASUREMENT SCREEN SETUP

- 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



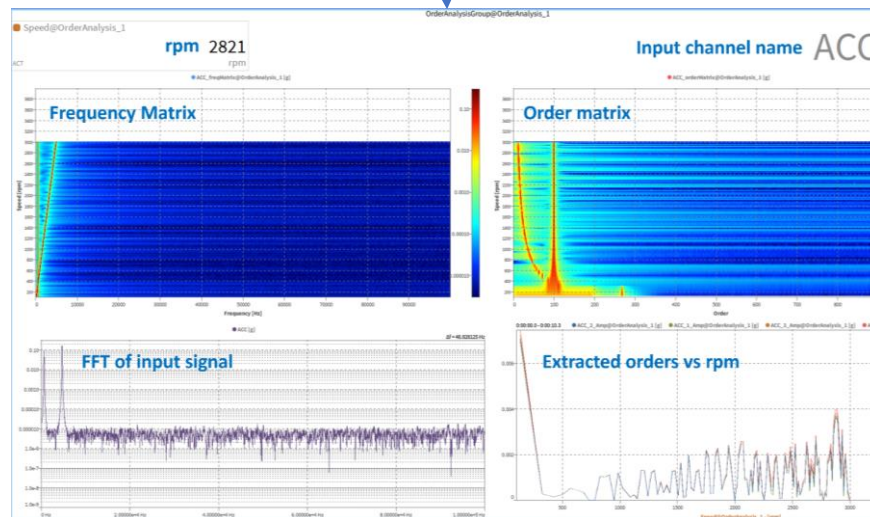
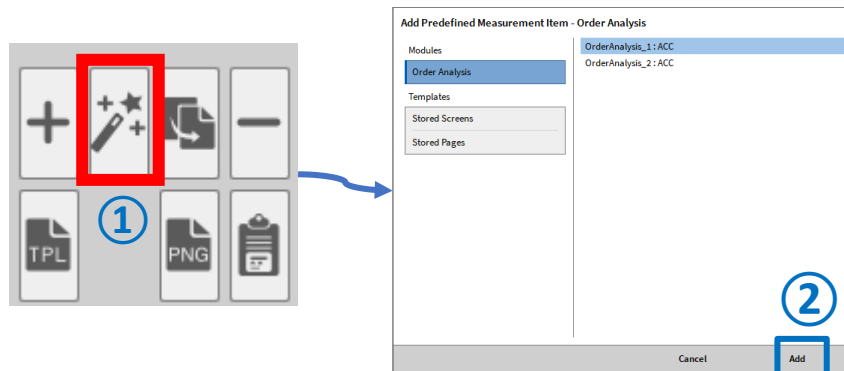


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ORDER ANALYSIS TEMPLATE

① Screen template for Order Analysis (①)

② Add order analysis template (②)





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DATA ANALYSIS AND EXPORT

① Open a data file for review, analysis and export

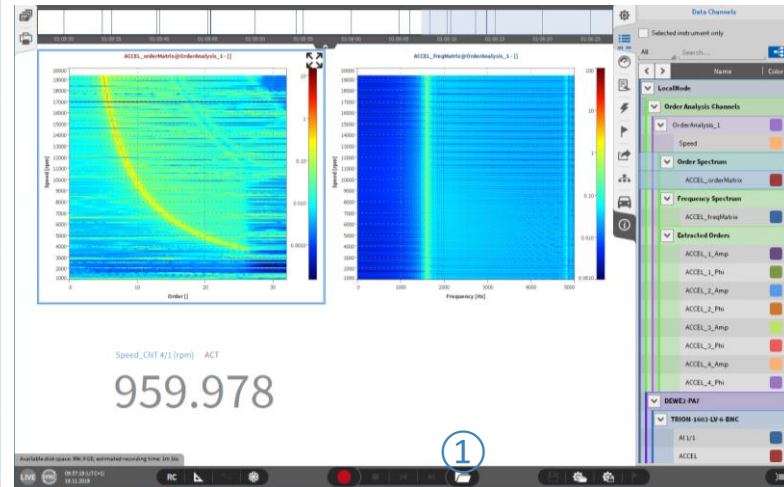
Additional order analysis modules can still be created during data analysis

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

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

The screenshot shows the DEWETRON software interface with two intensity diagrams. The top diagram is titled 'Acc_1_IEPE_orderMatrix@QA_Acc_1_Speed_1ppr' and the bottom one is 'Acc_2_V_orderMatrix@QA_Acc_1_Speed_1ppr'. A red circle with 'CTRL+C' and a '1' is placed over the top diagram. A red arrow points from this diagram to an Excel spreadsheet window titled 'Mappel - Excel'. In the Excel spreadsheet, a red circle with 'CTRL+V' and a '2' is placed over cell B7, which contains the value '0.000208'. The spreadsheet shows a table with columns labeled 'Order' and 'rpm' and rows of numerical data.

Order	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30
740.0 [rpm]	0.000157	0.000136	0.000163	0.000164	0.000165	0.000165	0.000224	0.000311	0.000307	0.000235	0.000621	0.000574	0.000302	0.000324
750.0 [rpm]	0.000167	0.000153	0.000181	0.000185	0.000181	0.000199	0.000253	0.000305	0.000379	0.000364	0.000744	0.000612	0.000346	0.000346
760.0 [rpm]	0.000178	0.00017	0.000199	0.000205	0.000224	0.000215	0.000282	0.00039	0.000451	0.000494	0.000867	0.000665	0.000346	0.000369
770.0 [rpm]	0.000188	0.000187	0.000218	0.000226	0.000244	0.00024	0.00031	0.00043	0.000523	0.000623	0.000991	0.000687	0.000369	0.000391
780.0 [rpm]	0.000198	0.000204	0.000236	0.000247	0.000266	0.000265	0.000339	0.00047	0.000595	0.000753	0.001114	0.000725	0.000391	0.000413
790.0 [rpm]	0.000208	0.000221	0.000254	0.000267	0.000287	0.000289	0.000368	0.000509	0.000667	0.000882	0.001237	0.000762	0.000413	0.000435
800.0 [rpm]	0.000218	0.000238	0.000272	0.000288	0.000309	0.000314	0.000397	0.000549	0.000739	0.001012	0.00136	0.0008	0.000435	0.000457
810.0 [rpm]	0.000229	0.000255	0.000291	0.000309	0.00033	0.000339	0.000425	0.000589	0.000811	0.001141	0.001483	0.000838	0.000457	0.000479
820.0 [rpm]	0.000239	0.000272	0.000309	0.00033	0.000352	0.000364	0.000454	0.000628	0.000883	0.001271	0.001606	0.000875	0.000479	0.000501
830.0 [rpm]	0.000249	0.000289	0.000327	0.00035	0.000373	0.000389	0.000483	0.000668	0.000955	0.001401	0.001773	0.000913	0.000501	0.000523
840.0 [rpm]	0.000259	0.000306	0.000345	0.000371	0.000395	0.000414	0.000511	0.000708	0.001027	0.00153	0.001853	0.00095	0.000523	0.000545
850.0 [rpm]	0.00027	0.000324	0.000363	0.000392	0.000416	0.000439	0.00054	0.000748	0.001099	0.00166	0.001976	0.000988	0.000545	0.000567
860.0 [rpm]	0.00028	0.000341	0.000382	0.000412	0.000438	0.000464	0.000569	0.000787	0.001171	0.001789	0.002099	0.001026	0.000567	0.000589
870.0 [rpm]	0.00029	0.000358	0.0004	0.000433	0.000459	0.000489	0.000597	0.000827	0.001243	0.001919	0.002222	0.001063	0.000589	0.000612
880.0 [rpm]	0.0003	0.000375	0.000418	0.000454	0.000481	0.000514	0.000626	0.000867	0.001315	0.002048	0.002346	0.001011	0.000612	0.000634
890.0 [rpm]	0.000311	0.000392	0.000436	0.000474	0.000502	0.000539	0.000655	0.000906	0.001387	0.002178	0.002469	0.001038	0.000634	0.000656
900.0 [rpm]	0.000321	0.000409	0.000455	0.000495	0.000524	0.000563	0.000684	0.000946	0.001459	0.002307	0.002592	0.001176	0.000656	0.000678
910.0 [rpm]	0.000331	0.000426	0.000473	0.000516	0.000545	0.000588	0.000712	0.000986	0.001531	0.002437	0.002715	0.001214	0.000678	0.0007
920.0 [rpm]	0.000341	0.000443	0.000491	0.000536	0.000567	0.000613	0.000741	0.001026	0.001603	0.002566	0.002838	0.001251	0.0007	0.000722
930.0 [rpm]	0.000352	0.00046	0.000509	0.000557	0.000588	0.000638	0.00077	0.001065	0.001675	0.002696	0.002961	0.001289	0.000722	0.000744
940.0 [rpm]	0.000362	0.000477	0.000528	0.000578	0.00061	0.000663	0.000798	0.001105	0.001747	0.002825	0.003085	0.001326	0.000744	0.000766
950.0 [rpm]	0.000372	0.000494	0.000546	0.000599	0.000631	0.000688	0.000827	0.001145	0.001819	0.002955	0.003208	0.001364	0.000766	

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

