DEWETRON

OXYGEN TRAINING

> FFT

> CPB

CONTENT

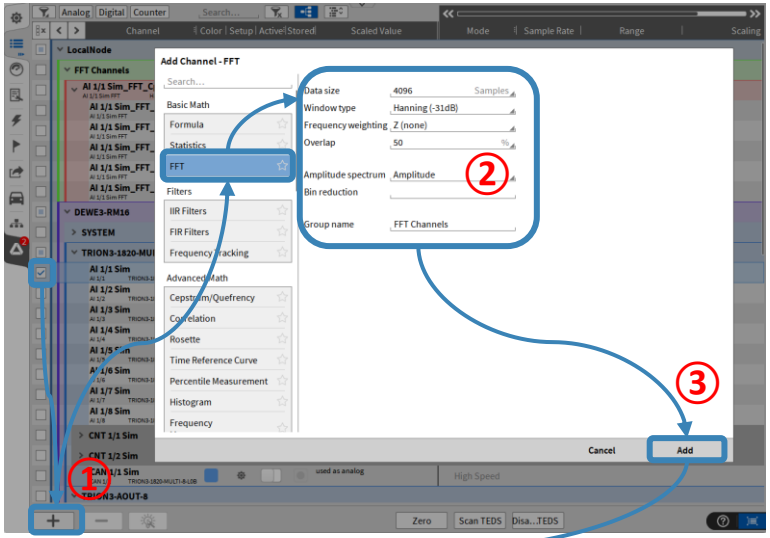
DEWETRON

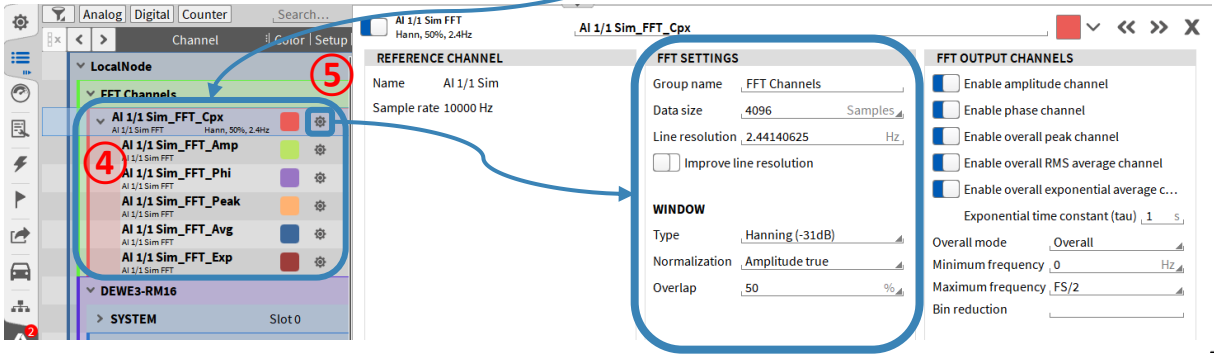
CREATING FFT MATH CHANNELS

DEWETRON

①	Select one or several channels to be filtered by checking their check boxes and press the *+* button
②	Select *FFT* and choose the proper spectral analysis options
③	Press *Add* afterwards to create these channels
④	Two output channels per reference channel will be created > Complex (*_Cpx*) including the complex spectrum > Amplitude (*_Amp*) including the amplitude spectrum
⑤	Changes can still be applied by entering the settings of the desired channel via the *Gear* button

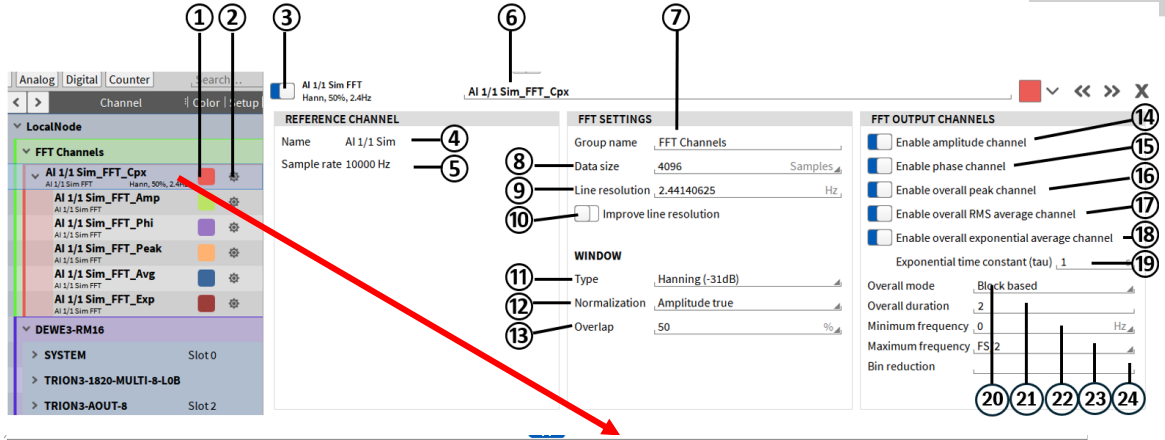
Note: phase channel and overall peak, overall RMS average and exponential average channel can be added as additional FFT output channels



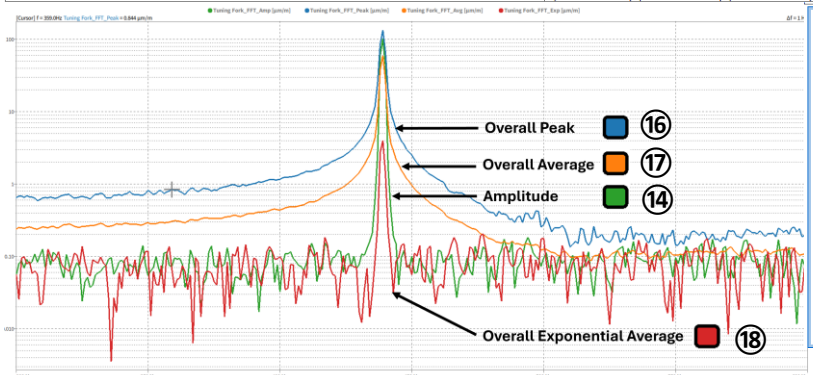


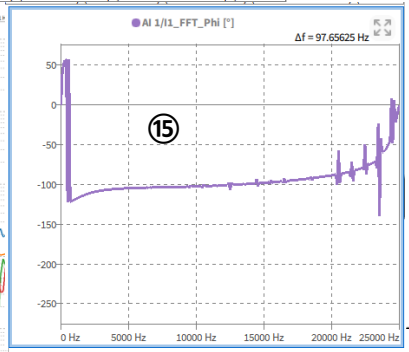
FFT SETTINGS IN DETAIL

①	Channel color
②	FFT channel setup
③	FFT channel active
④	Reference channel
⑤	Sample rate of reference channel
⑥	Channel name
⑦	FFT Group name
⑧	Samples used for FFT calculation
⑨	Resulting line resolution (Samplerate/Samples per FFT)
⑩	Improve line resolution by zero padding
⑪	Window type for calculation (Hamming, Hanning, Rectangular, Blackman, Blackman-Harris, Flattop, Flattop-Bartlett)
⑫	Normalization (amplitude, power, none)
⑬	Overlap between FFT-windows



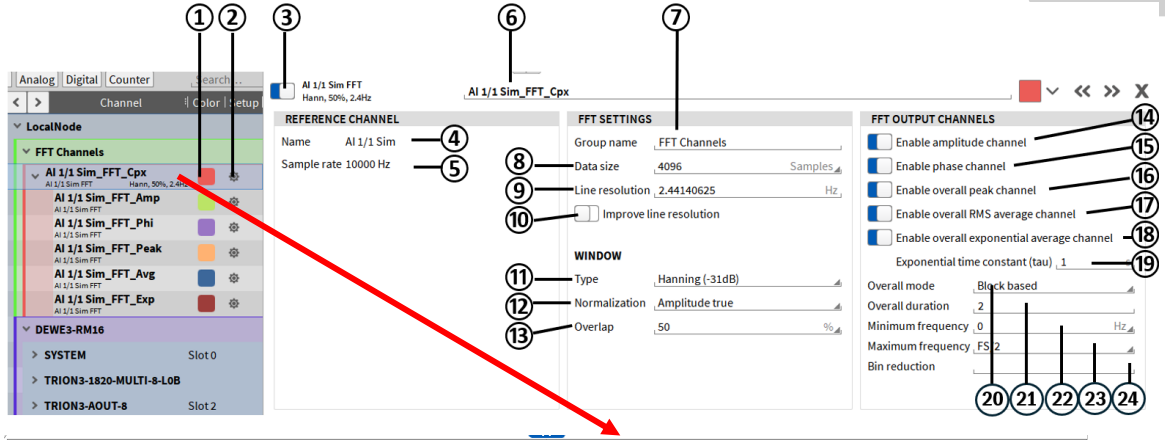
Zeit	{AI 1/I1_FFT_Cpx} [V]
0:58.7059200	(1.935+0.000i) (2.467+2.045i) (5.000+6.534i) (17.479+26.087i) (458.096+710.522i) (-1088.4…
0:58.6956800	(3.359+0.000i) (4.302+0.562i) (8.799+1.815i) (31.047+7.367i) (820.631+204.580i) (-1965.55…
0:58.6854400	(2.962+0.000i) (3.805+-1.226i) (7.828+-3.888i) (27.785+-15.346i) (738.332+-412.257i) (-177…
0:58.6752000	(0.960+0.000i) (1.245+-2.349i) (2.614+-7.483i) (9.462+-29.741i) (255.811+-805.625i) (-625.…



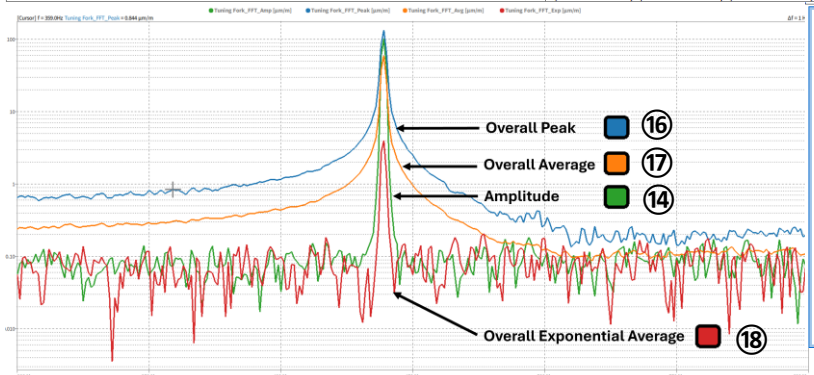


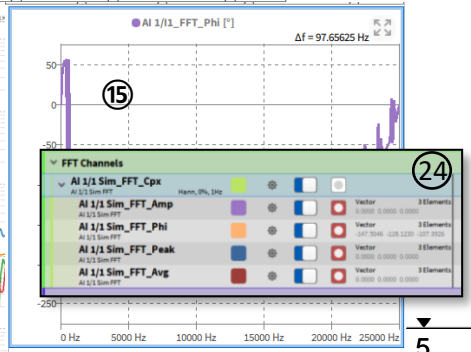
FFT SETTINGS IN DETAIL

⑭	Enable the amplitude channel
⑮	Enable phase channel
⑯	Enable overall peak of amplitude
⑰	Enable overall average of peak
⑱	Enable overall exponential average
⑲	Set Tau for ⑱. Small Tau, newest spectrum has more impact. Large Tau, older stectra have more impact.
⑳	Overall Mode: Average interval for all overall channels. Block based = certain amount of spectra. Time based spectra for a certain timespan. Overall (Default) from measurement start to stop.
㉑	Only visible for overall mode Block or Time bases and defines the block size or the timespan according to the slection
㉒	Set minimum freuquency (Default 0Hz)
㉓	Set maximum frequency (Default FS/2Hz)
㉔	Reduce the number of FFT bins, related to the line resolution. If empty all bins are active. This bin reduction is applied to all sub channels.



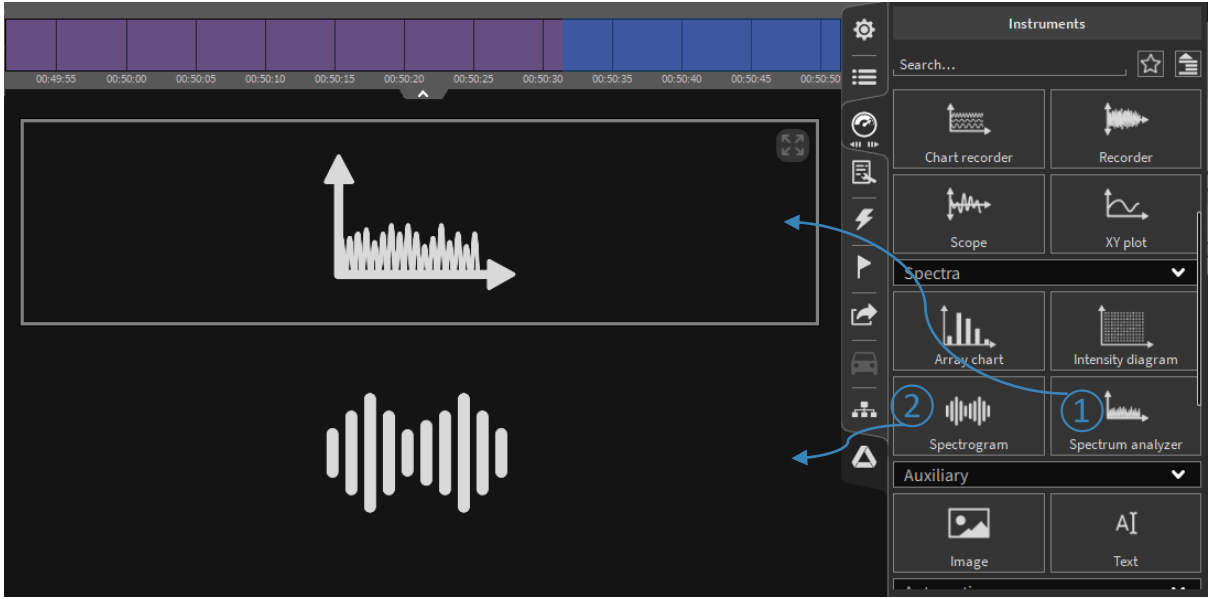
Zeit	{AI 1/I1_FFT_Cpx} [V]
0:58.7059200	(1.935+0.000i) (2.467+2.045i) (5.000+6.534i) (17.479+26.087i) (458.096+710.522i) (-1088.4…
0:58.6956800	(3.359+0.000i) (4.302+0.562i) (8.799+1.815i) (31.047+7.367i) (820.631+204.580i) (-1965.55…
0:58.6854400	(2.962+0.000i) (3.805+-1.226i) (7.828+-3.888i) (27.785+-15.346i) (738.332+-412.257i) (-177…
0:58.6752000	(0.960+0.000i) (1.245+-2.349i) (2.614+-7.483i) (9.462+-29.741i) (255.811+-805.625i) (-625.…





VISUALIZE FFT CHANNELS

	Amplitude, phase channels and overall channels can be visualized with a *Spectrum Analyzer* or a *Spectrogram*
①	*Spectrum Analyzer* displays the actual spectrum
②	*Spectrogram* displays the time dependent spectral trend
	Complex FFT channels can‘t be visualized in OXYGEN but can only be exported after recording for post processing
	Amplitude, phase channels and overall channels can surely be exported as well for post processing



SPECTRUM ANALYZER

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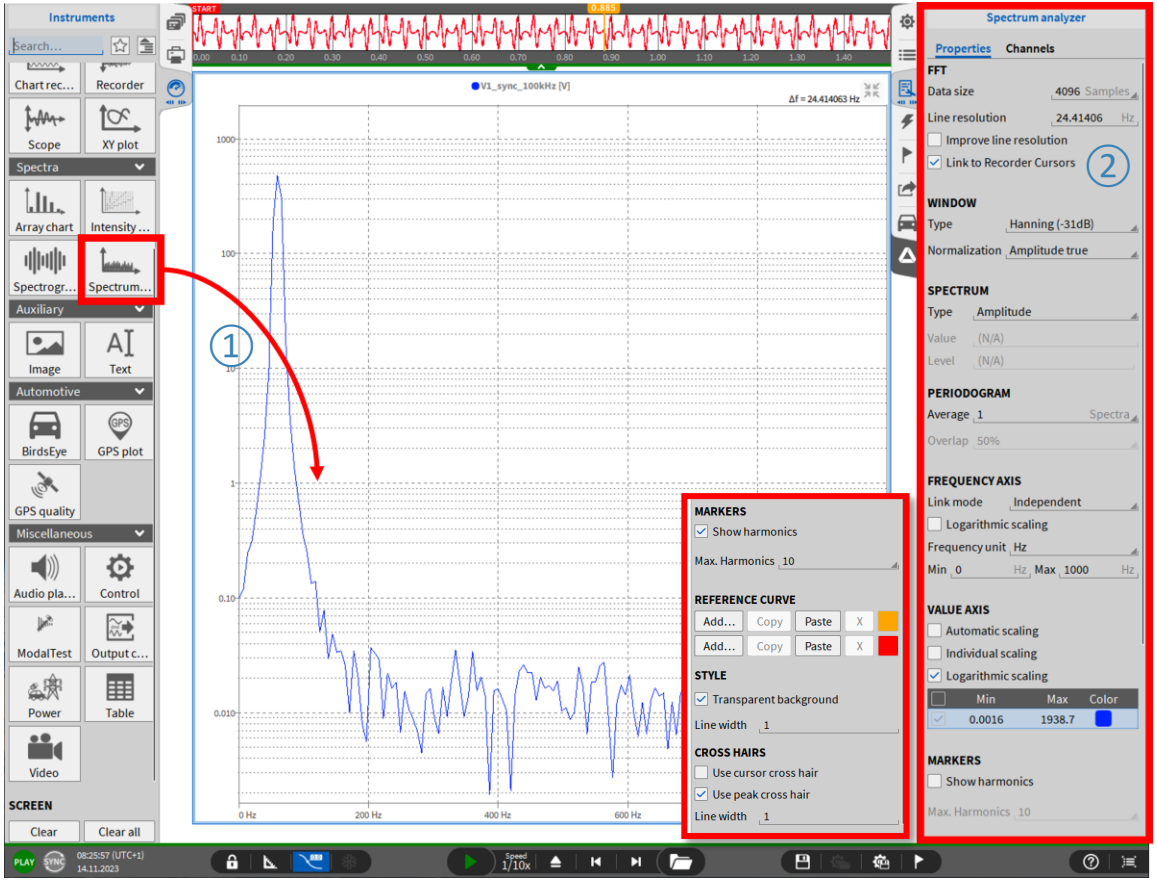
①	Drag'n Drop the spectrum analyzer instrument to the measurement screen and add an reference channel. This channel can be a FFT channel (amplitude or phase) or an other time domain channel from the channel list
②	This tool calculates an FFT without the need to create a formula beforehand. The settings are similar to the math FFT math option

Difference to math FFT:

> Data only visualized but not stored to a separate channel
> No export possible
> No deterministic calculation
> No timing information about spectrum update available



SPECTRUM ANALYZER CONT'D

DEWETRON

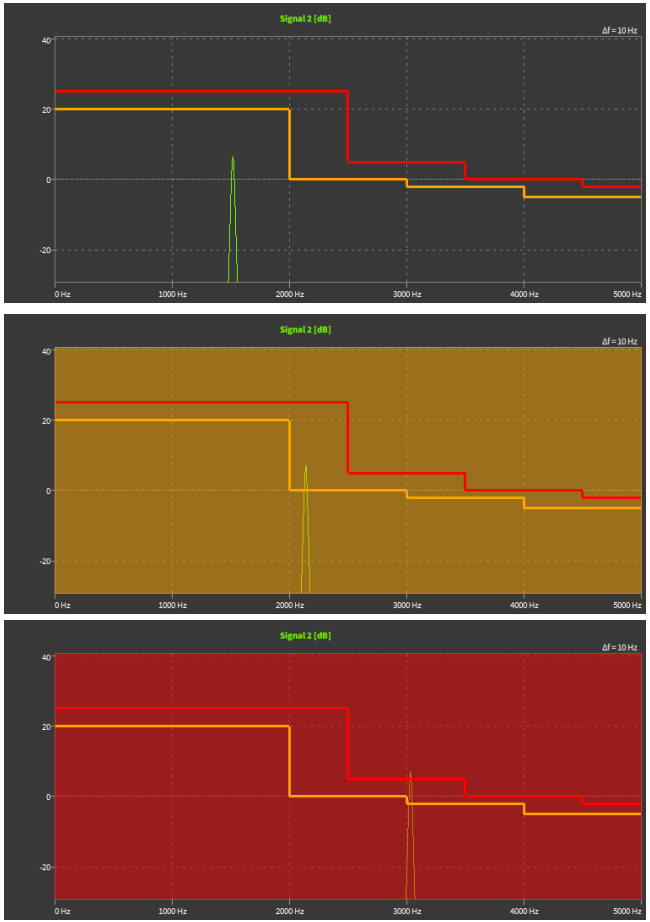
①	To calculate the FFT based on a region in the recorder between A/B cursors. The recorder needs to be on the same page and set to Link mode = Instruments on page
②	Additionally the spectrum analyzer Link to Recorder cursor has to be enabled
	This feature works in LIVE (freeze), Recording (Deja-View) and PLAY mode

FFT REFERENCE CURVES - OVERVIEW

DEWETRON

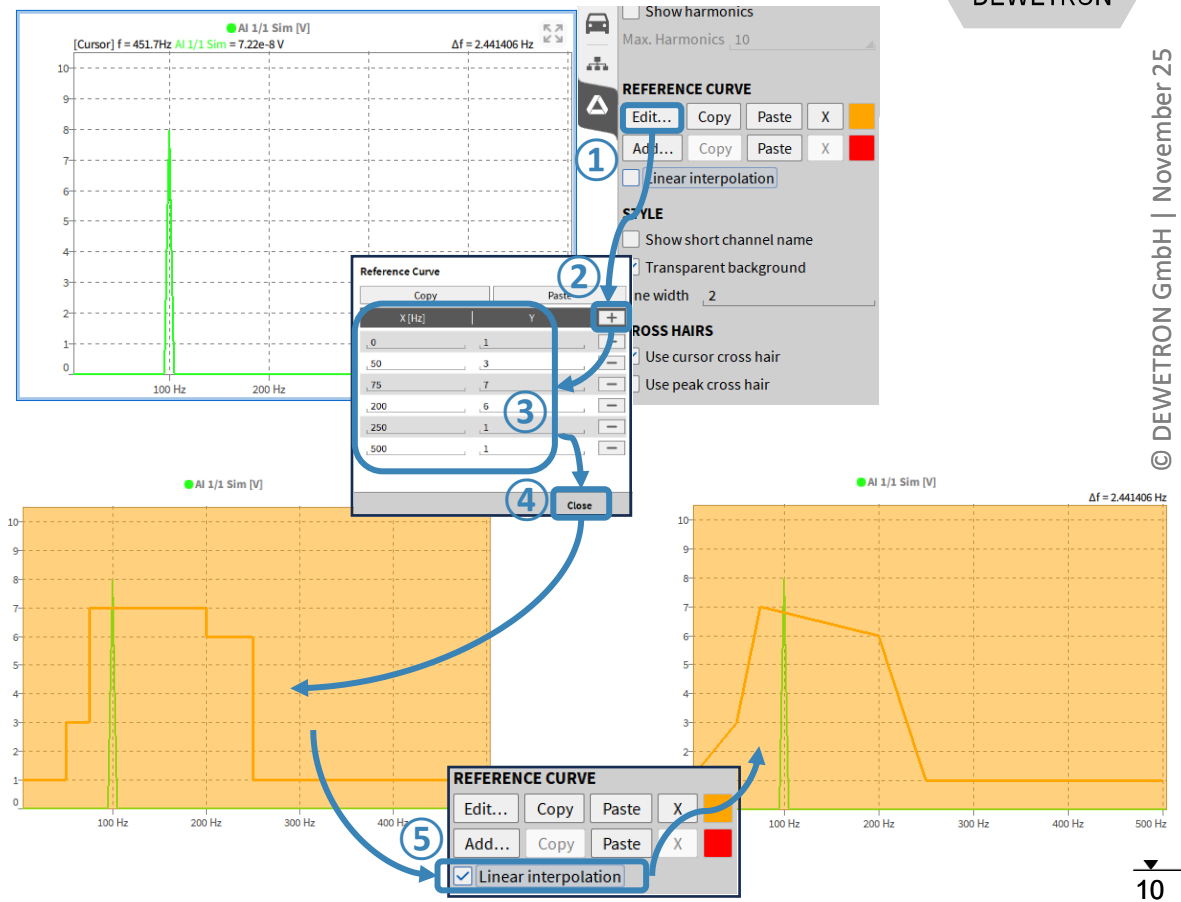
Features:

- *Two Reference curves available in Spectrum Analyzer*
- *Background changes color if threshold is exceeded*
- *Background color is reset if threshold is decreased again*
- *Definition via value table (same manner as table scaling)*
- *Copy and paste table from / into Excel*



FFT REFERENCE CURVES – HOW TO CREATE

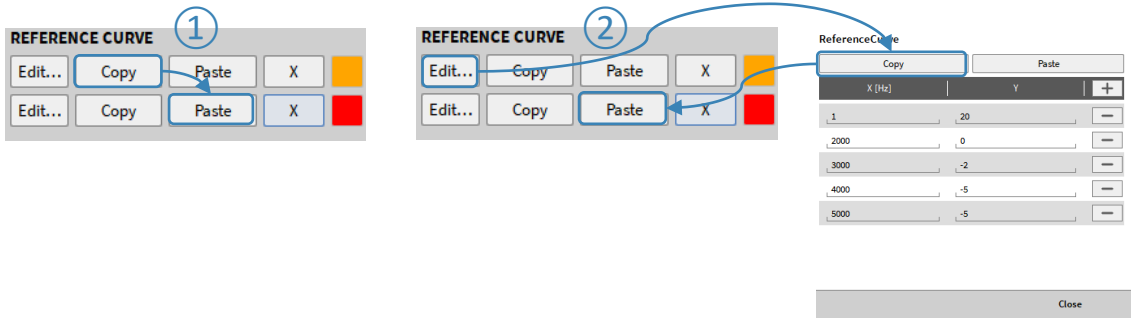
①	Press the *Edit…* button and a popup menu will open
②	Press the *+* button to add one or several lines
③	Add the frequency and the corresponding threshold
④	Press *Close* and the reference curve will be drawn in the Spectrum Analyzer
⑤	Activate Linear Interpolation to intrpolate enterred X and Y values



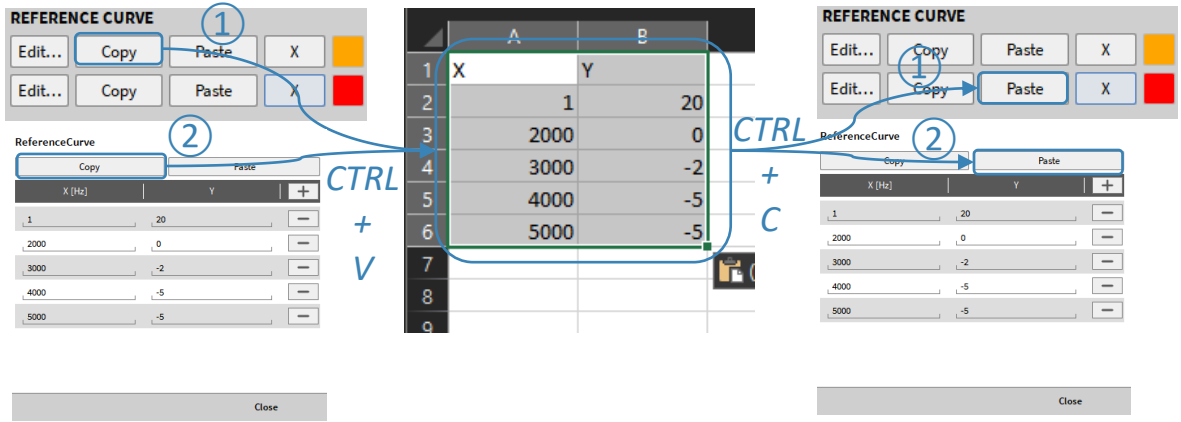
FFT REFERENCE CURVES – COPY & PASTE DATA

DEWETRON

> Copy & paste from orange to red curve and vice versa

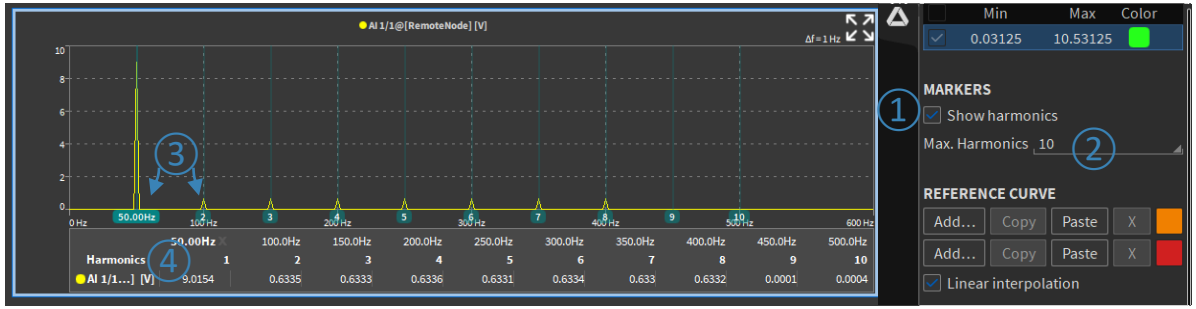


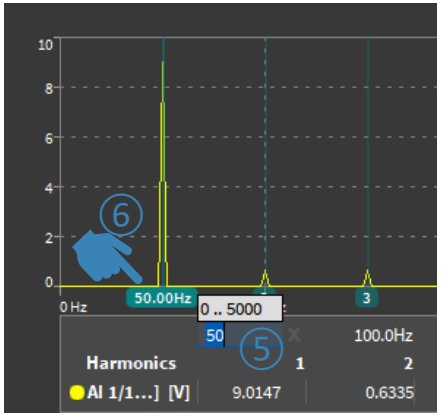
> Copy & Paste from / into Excel or others



HARMONICS CURSOR

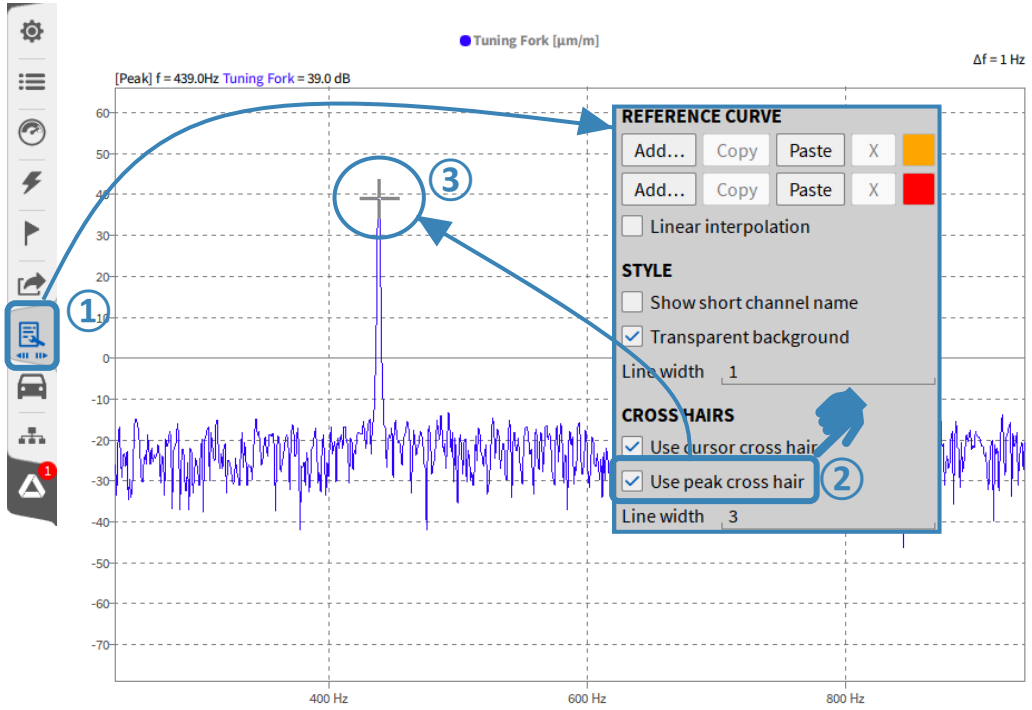
①	Harmonics Cursors can be displayed by checking *Show Harmonics*
②	The number of harmonics can be set from 1 to 10
③	Harmonics are marked with cursors
④	Harmonics amplitude is displayed at the instrument‘s bottom
⑤	The cursor position can be changed by entering a new frequency for the first harmonic The position of the higher harmonics is automatically adjusted
⑥	It is also possible to move the first harmonic cursor with the left mouse button The position of the higher harmonics is automatically adjusted





PEAK HAIR CURSOR

①	Select the Spectrum Analyzer instrument and pen the instrument properties
②	Go to the crosshairs section and select „Use peak cross hair“.
③	A crosshair will be displayed automatically in the Spectrum Analyzer instrument. It follows automatically the highest peak in the visible range of the instrument.

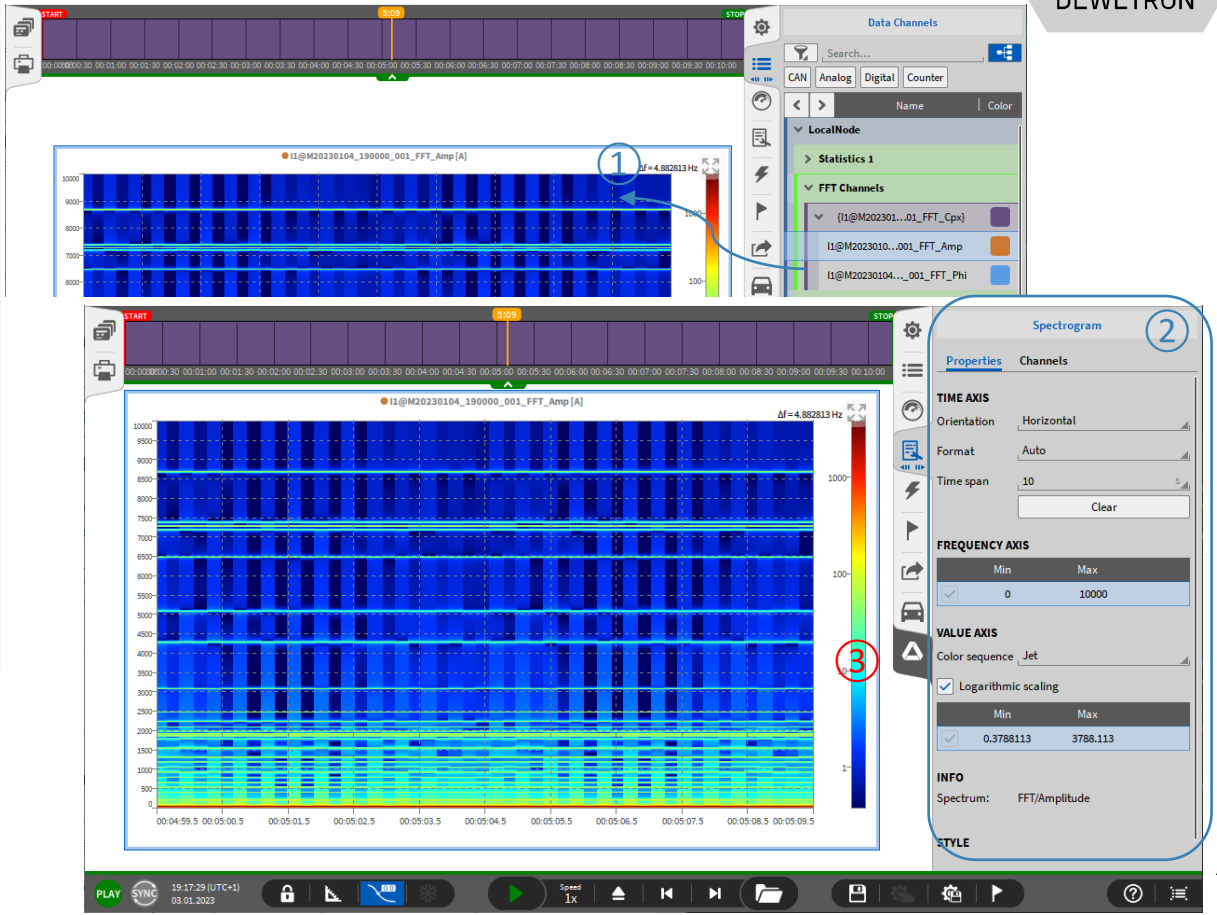


FREQUENCY AXIS SETTINGS

①	The unit of the X-Axis is Hertz [Hz] per default
②	The unit can be changed to Cycles Per Minute [CPM] which is defined as [Hz] * 60
③	The axis‘ minimum can be freely defined
④	The axis‘ maximum can be freely defined
⑤	The scaling can optionally bet set from linear to logarithmic scaling

SPECTROGRAM

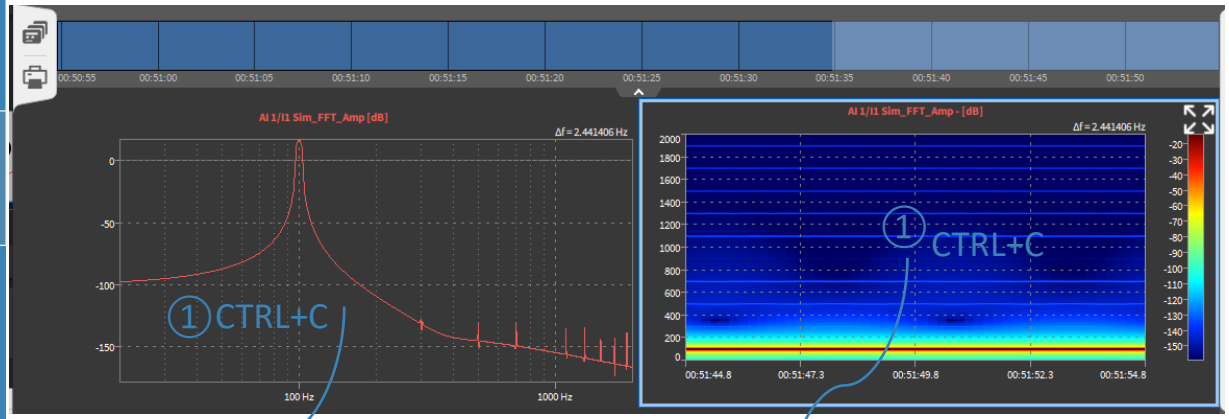
①	Amplitude and phase channels can be assigned to a Spectrogram from the Channel List
②	Settings for visualization can be edited in the instrument properties
	Per default, the Spectrogram plots > the elapsed time on the X-Axis > The frequency range on the Y-Axis > Color-codes the amplitude of the spectrum
③	> Color Resolution can be changed by moving the mouse along the color scale with a left mouse click > Color Range can be changed by pressing CTRL+ Srcolling



COPY + PASTE FFT DATA TO EXCEL

DEWETRON

①	Select the instrument with a left click (blue frame around instrument occurs) and press *CTRL+C* to copy the currently displayed data to clipboard
②	Open Excel or a different software to paste the FFT data from clipboard with *CTRL+V*



	A	B	C
1	Max Freq	AI 1/I1 Sim_FFT_Amp	
2	0	-117.949769	
3	2.441406	-111.513118	
4	4.882813	-110.447289	
5	7.324219	-109.05736	
6	9.765625	-107.613806	
7	12.207031	-106.189741	
8	14.648438	-104.830711	
9	17.089844	-103.53958	
10	19.53125	-102.307844	
11	21.972656	-101.12384	
12	24.414063	-99.975815	
13	26.855469	-98.852948	
14	29.296875	-97.745543	
15	31.738281	-96.644939	
16	34.179688	-95.543321	
17	36.621094	-94.433515	
18	39.0625	-93.308788	
19	41.503906	-92.162675	

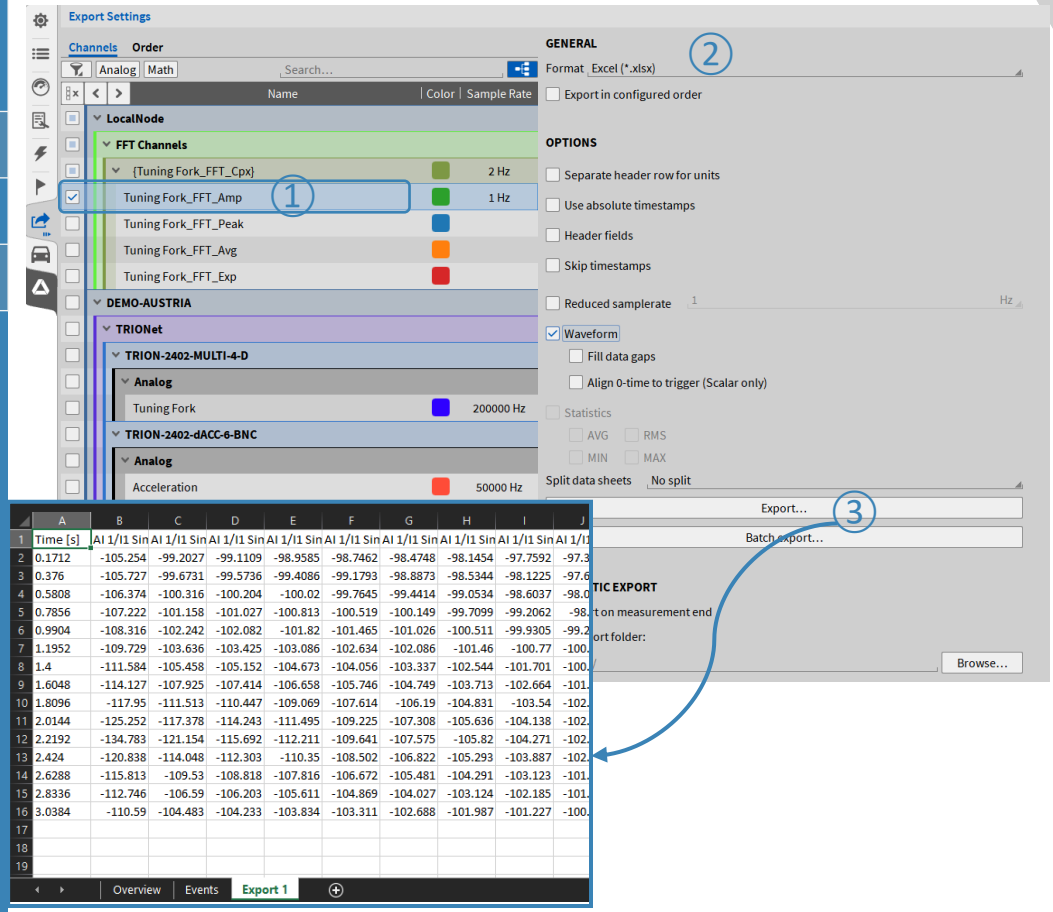
CTRL+V ②

	A	B	C	D	E	F
1	Time	0	2.441406	4.882813	7.324219	9.765625
2	-10.1112	-106.027144	-99.971455	-99.866541	-99.692831	-99.451941
3	-9.9064	-105.470072	-99.417674	-99.322481	-99.164474	-98.944577
4	-9.7016	-105.076522	-99.026209	-98.937187	-98.789199	-98.582789
5	-9.4968	-104.832205	-98.783095	-98.697639	-98.555456	-98.356896
6	-9.292	-104.728891	-98.680269	-98.596263	-98.456445	-98.261089
7	-9.0872	-104.763238	-98.714455	-98.629971	-98.489372	-98.292958
8	-8.8824	-104.936348	-98.886734	-98.799781	-98.655161	-98.453303
9	-8.6776	-105.253912	-99.202683	-99.110946	-98.958546	-98.74619
10	-8.4728	-105.726986	-99.673123	-99.573596	-99.408578	-99.179287
11	-8.268	-106.373647	-100.315689	-100.20409	-100.019635	-99.76448
12	-8.0632	-107.222092	-101.157756	-101.027442	-100.813129	-100.518767
13	-7.8584	-108.316478	-102.241861	-102.081608	-101.820217	-101.465279
14	-7.6536	-109.728589	-103.636296	-103.425206	-103.085746	-102.633579
15	-7.4488	-111.583669	-105.457642	-105.151712	-104.672582	-104.055808

FFT DATA EXPORT

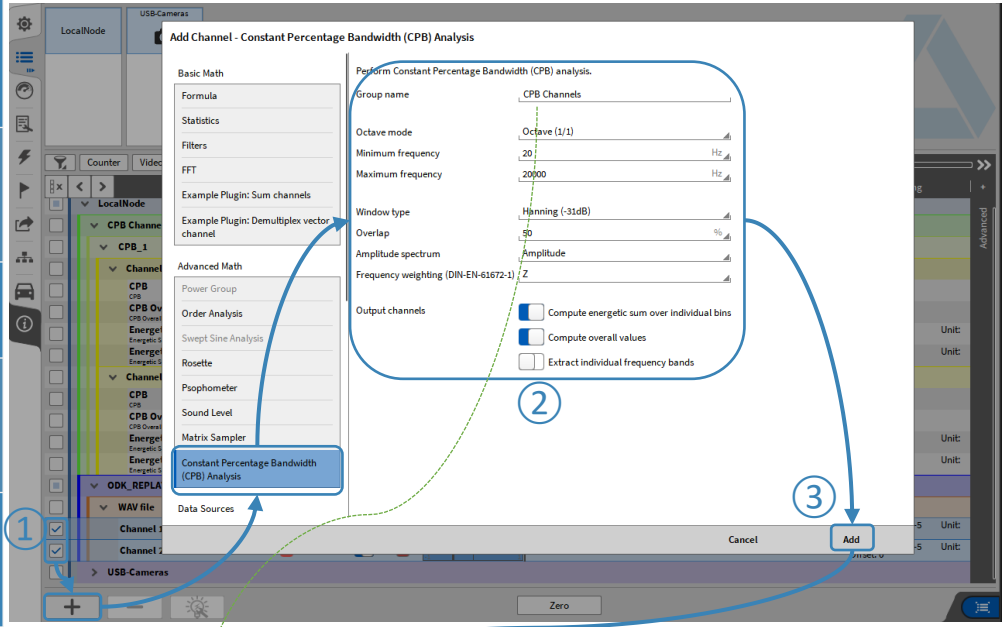
DEWETRON

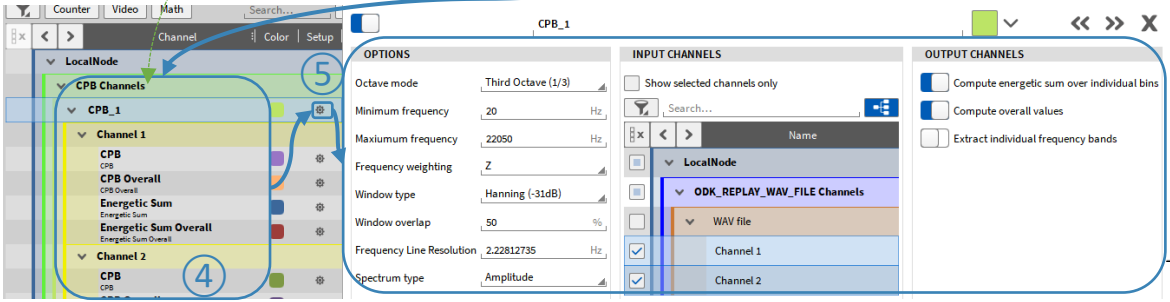
	FFT data can be exported after recording as well. To do so, open the data file and go to the Export menu
①	Select the channels to be exported
②	Select the Export Format
③	Press *Export…* button



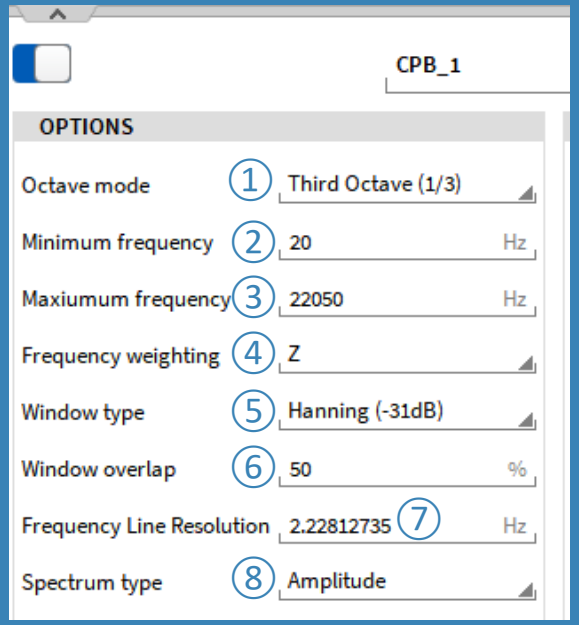
CREATING A CPB ANALYSIS

①	Select one or several channels by checking their check boxes and press the + button
②	Select *CPB Analysis*, choose the proper calculation options and enable the required output channels
③	Press *Add* afterwards to create these channels
④	A separate output channel for each reference channel and calculation is created
⑤	Changes can still be applied by entering the settings of the desired channel via the *Gear* button



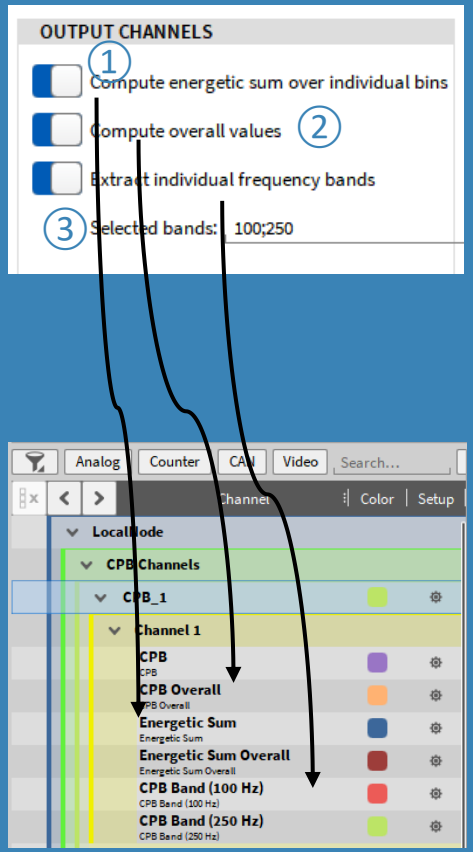


CPB ANALYSIS OPTIONS



① Select Octave, Third, or Twelfth octave band resolution (EN 61260)
② Select the minimum frequency for the CPB analysis
③ Select the maximum frequency for the CPB analysis
④ Select between A-, B-, C-, D-, or Z (linear) weighting (DIN-EN 61672)
⑤ Select a widow type for the specral analysis
⑥ Select an overlapping factor 0 … 90% for the spectral analysis
⑦ Adjust the frequency resoluton if required
⑧ Select between an Amplitude spectrum and a decibel spectrum with freely definable reference value and reference level

CREATING A CPB ANALYSIS



The actual CPB spectrum (changing in time) is calculated per default. The channel name is *CPB*

① The energetic sum for the spectrum is calculated.
The channel name is *Energetic Sum*

For Amplitude Spectrum: $Energetic\ Sum = \sqrt{\sum_{i=1}^{n} x_i^2}$

For Decibel Spectrum: $Energetic\ Sum = 10 * log\sqrt{\sum_{i=1}^{n}(10^{\frac{x_i}{10}})^2}$

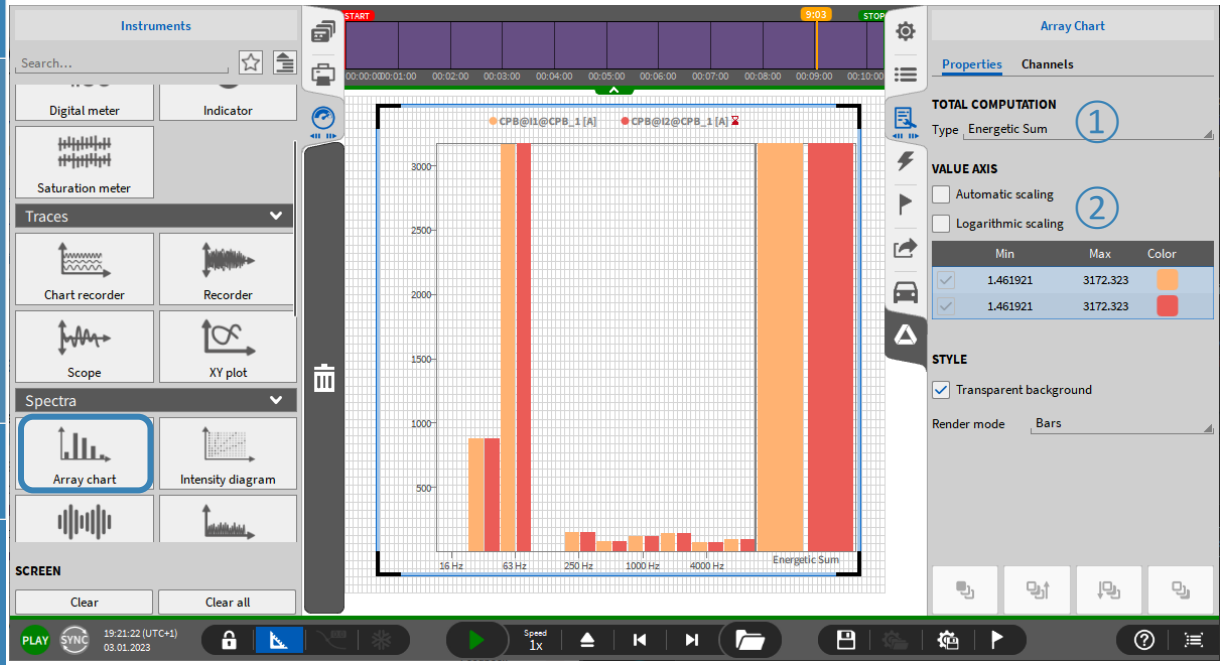
② One CPB spectrum and energetic sum averaged for the entire measurement time with reset at Recording start.
The channel name is *CPB Overall* and *Energetic Sum Overall*

③ If *Extract individual frequency bands* is enabled, frequency bands can be output as time domain channels. I.e. If 100 Hz is entered, the 100 Hz band will be extracted as time domain channel to analyze the time dependent trend.

CPB CHANNEL VISUALIZATION WITH ARRAY CHART

DEWETRON

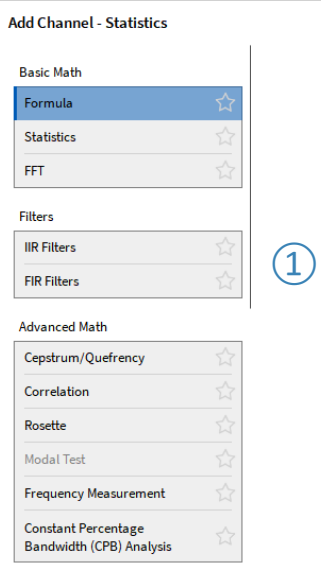
	Array Chart Instrument can be used to visualize a CPB spectrum
①	Total Computation: Optionally add an additional column on the right hand instrument side which displays the - Minimum - Maximum - Energetical Sum Of the CPB spectrum
②	Values Axis: Change the scaling of the Y-Axis



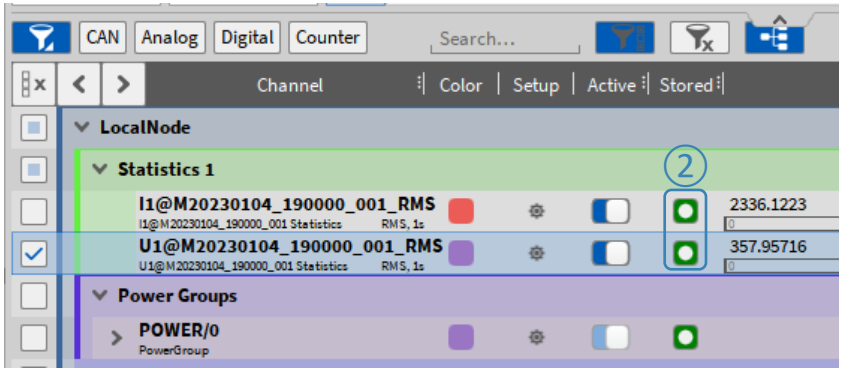
OFFLINE MATH – ADDING CALCULATIONS TO THE DATA FILE

DEWETRON

①	Basic and Advanced Math (except Power Groups) can be created offline
②	Offline created channels are marked with a green *Stored* button
③	Any changes to a data file can be stored with the *Store* button



①



③

Remarks:

- *After closing and reopening a data file again, the offline created channels cannot be edited any more*
- *Thus, it's not possible to edit settings of an online calculated channel*
- *It is not possible to edit the settings of an analog channel, digital or counter channel offline*
- *Please keep in mind that the results of an offline calculated channel can differ from an online calculated channel, i.e. filters as they are oscillating at the beginning*