DEWETRON

# OXYGEN TRAINING

## > FFT

## > CPB

# CONTENT

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# ADD MATH CALCULATIONS TO THE MEASUREMENT SETUP

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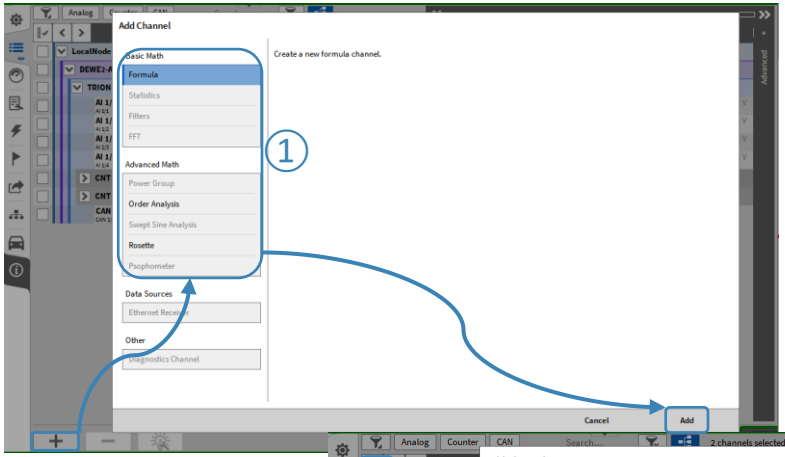
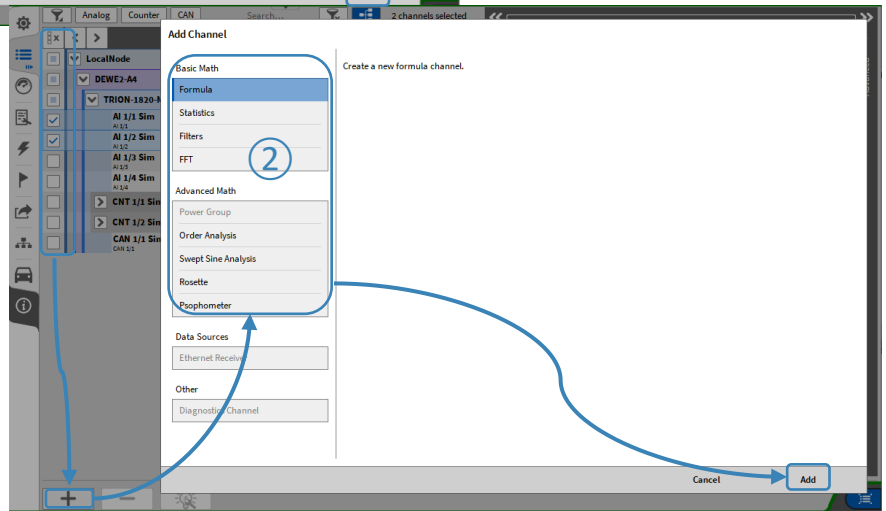
① To create
> Formulas
> Order analysis modules
> Rosette calculations
press the + button
Select the proper calculation
and press *Add*

② Reference channels must be selected before creating
> Statistics
> Filters
> FFT
> Swept sine analysis
> Psophometers



# CREATING FFT MATH CHANNELS

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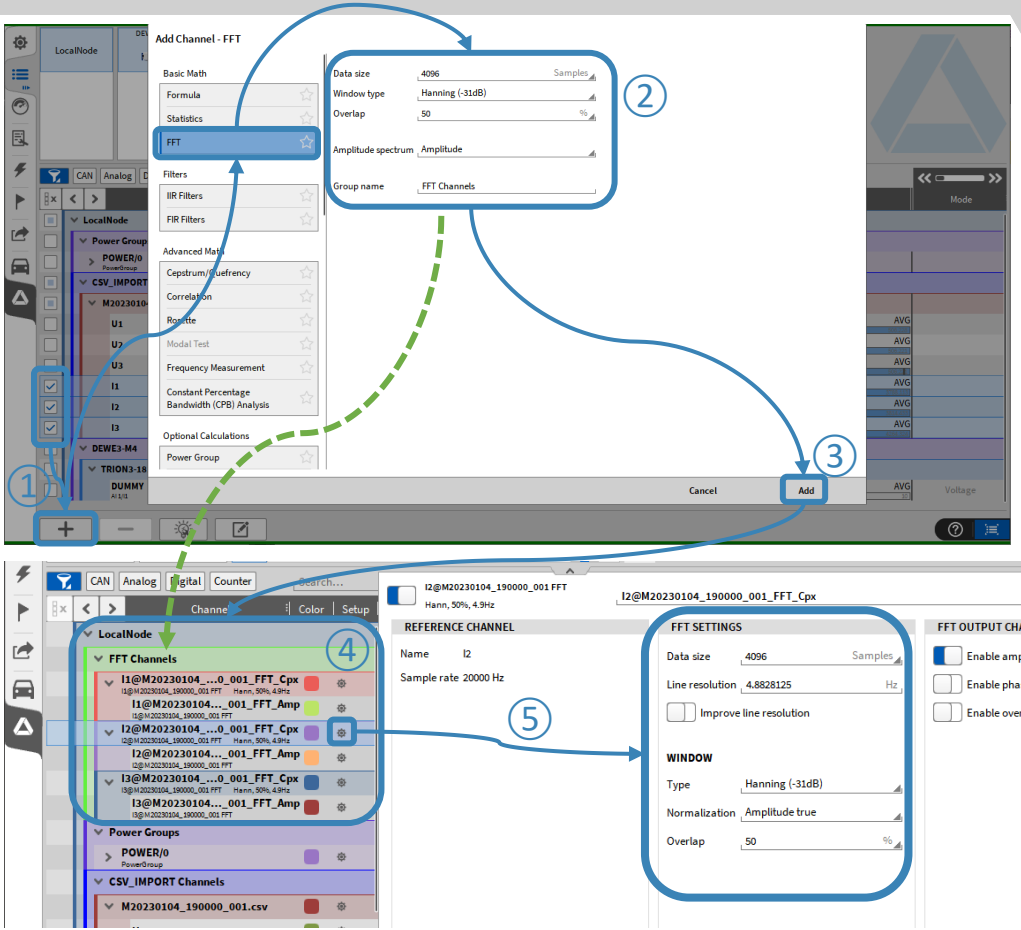
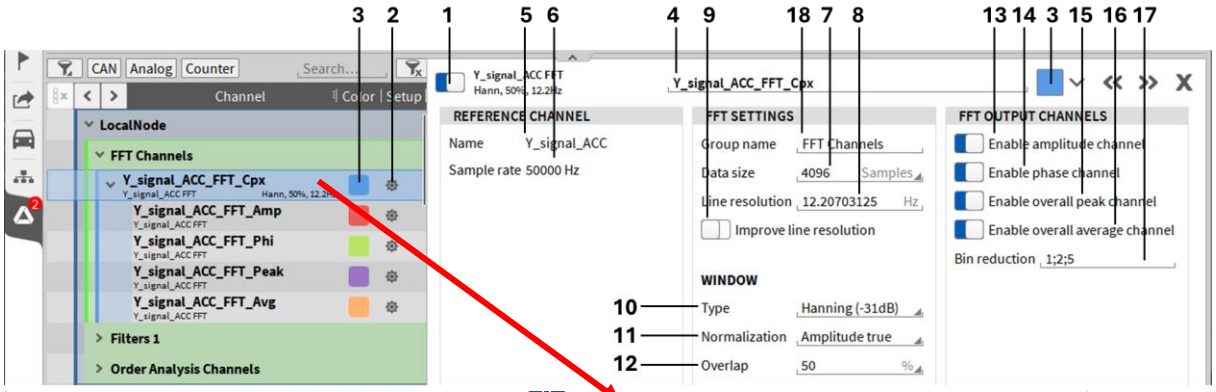
| | |
|---|---|
| ① | Select one or several channels to be filtered by checking their check boxes and press the *+* button |
| ② | Select *FFT* and choose the proper spectral analysis options |
| ③ | Press *Add* afterwards to create these channels |
| ④ | Two output channels per reference channel will be created<br>> Complex (*_Cpx*) including the complex spectrum<br>> 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 over all peak channel can be added as additional FFT output channels*

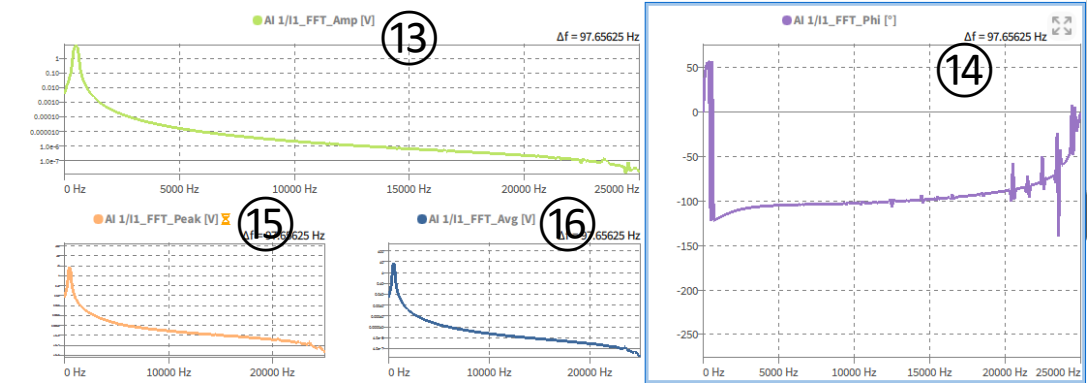


# FFT SETTINGS IN DETAIL

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

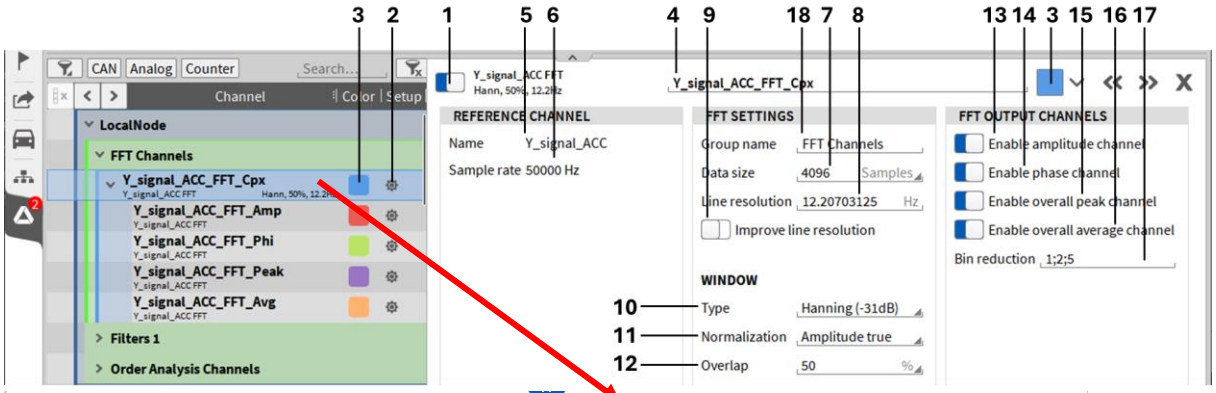



| Zeit | {AI 1/I1_FFT_Cpx} [V] |
|---|---|
| 0:58.7059200 | (1.935+0.000i) (2.467+2.045i) (5.000+6.534i) (17.479+26.087i) (458.096+710.522i) (-1088.4… |
| 0:58.6956800 | (3.359+0.000i) (4.302+0.562i) (8.799+1.815i) (31.047+7.367i) (820.631+204.580i) (-1965.55… |
| 0:58.6854400 | (2.962+0.000i) (3.805+-1.226i) (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.… |

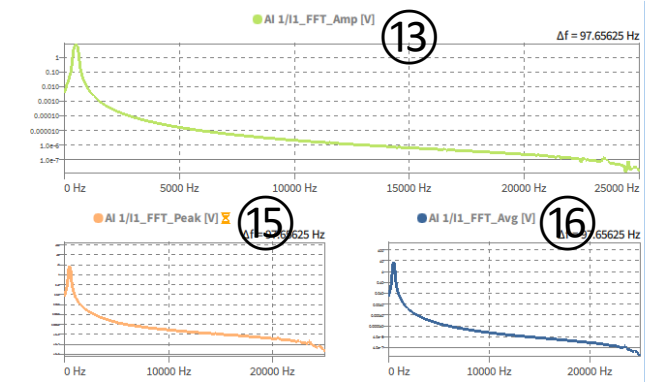


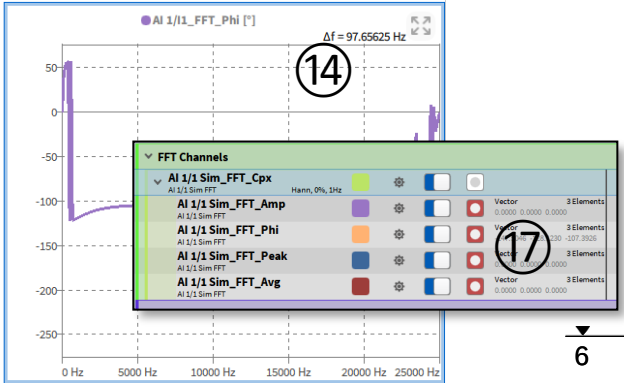
# FFT SETTINGS IN DETAIL

| | |
|---|---|
| ⑭ | Enable phase channel |
| ⑮ | Enable overall peak of amplitude (over whole measurement time) |
| ⑯ | Enable overall average of peak (over whole measurement time) |
| ⑰ | Reduce the number of FFT bins to the selected numbers, related to the line resolution. If empty all bins are active. This bin reduction is applied to all sub channels. |




| Zeit | {AI 1/1_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

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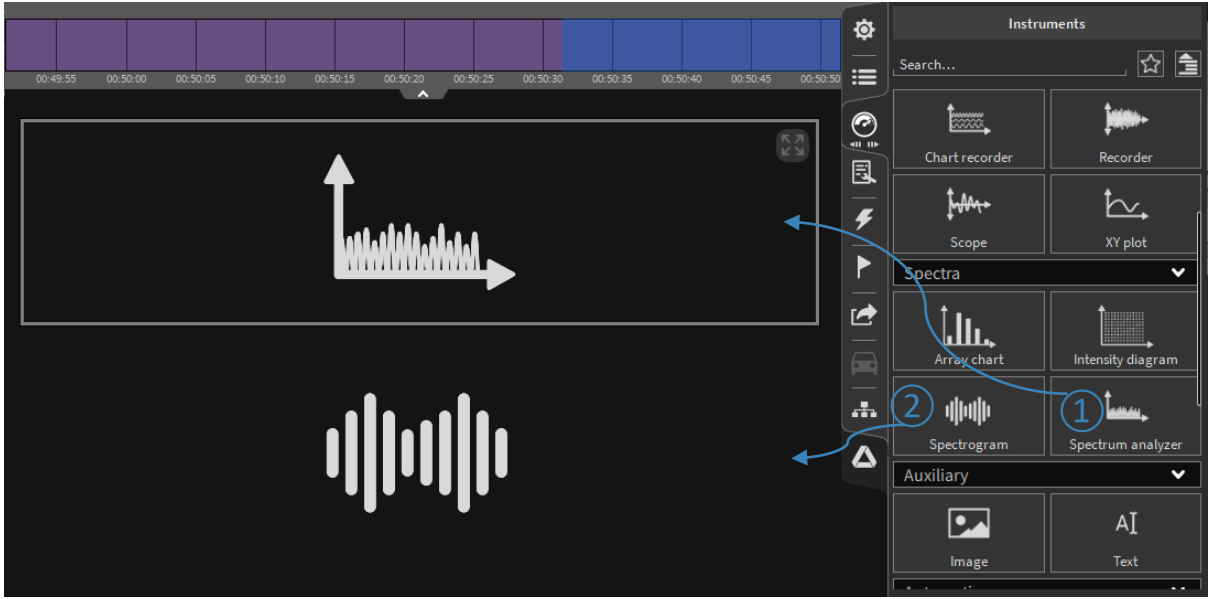
| | |
|---|---|
| | *Amplitude* an *phase* channels can be visualized with a *Spectrum Analyzer* or a *Spectrogram* |
| ① | *Spectrum Analyzer* displays the actual spectrum |
| ② | *Spectrogram* displays the time dependent spectral trend |
| | |
| | *Complex* FFT channels can‘t be visualized in OXYGEN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



# SPECTRUM ANALYZER

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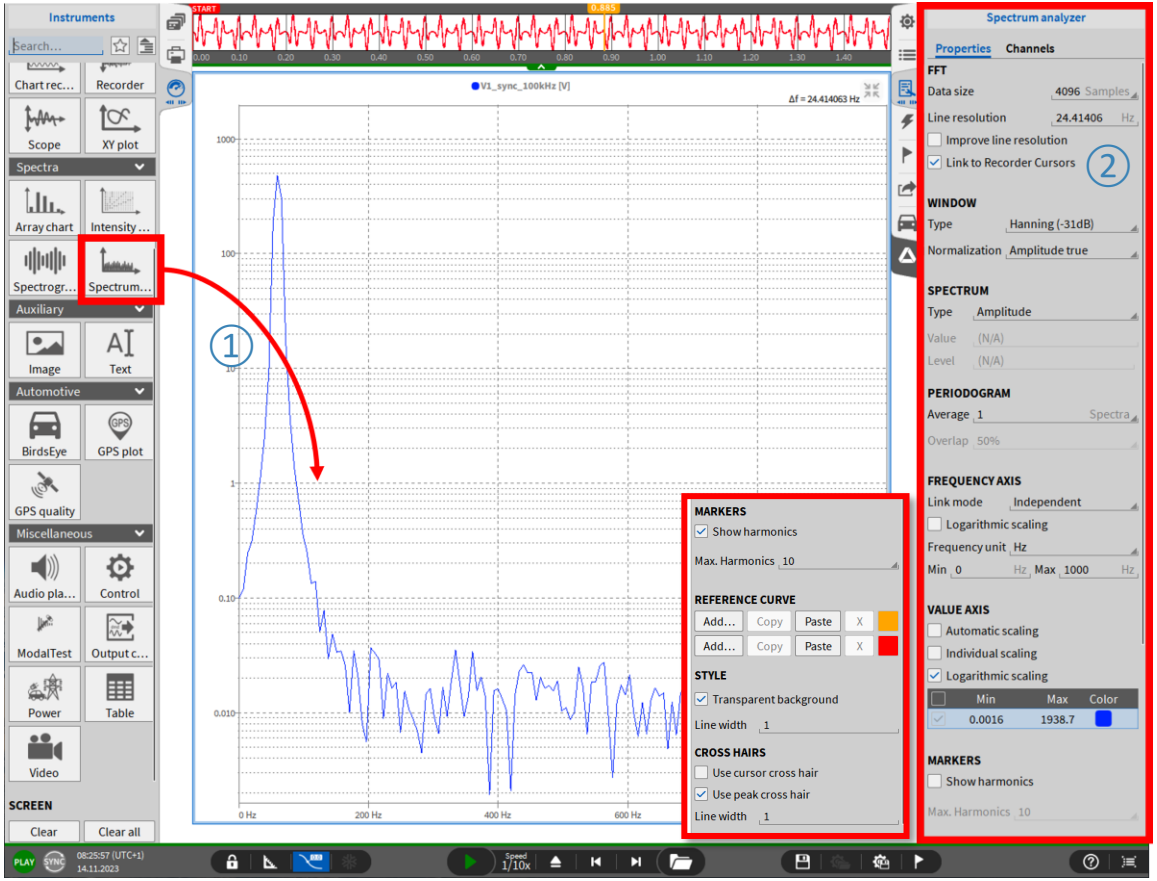
| | |
|---|---|
| ① | Drag'n Drop the spectrum analyzer instrument to the measurement screen and add an reference channel. This channel can be a FFT channel (amplitude or phase) or an other time domain channel from the channel list |
| ② | This tool calculates an FFT without the need to create a formula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

| | |
|---|---|
| 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

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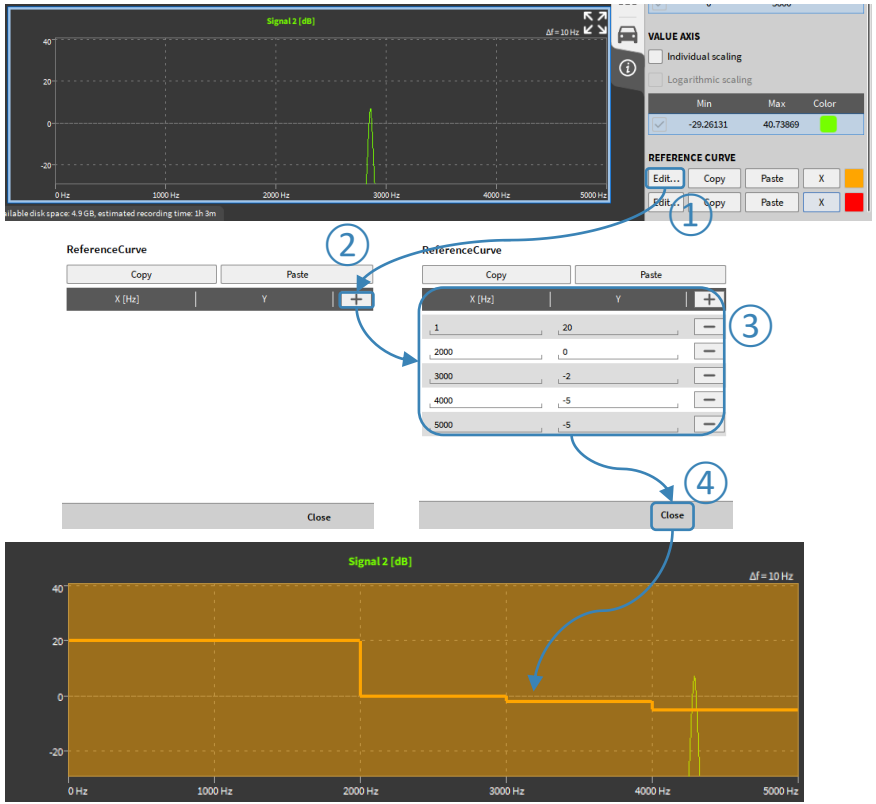
*Features:*

- *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 |



# FFT REFERENCE CURVES – COPY & PASTE DATA

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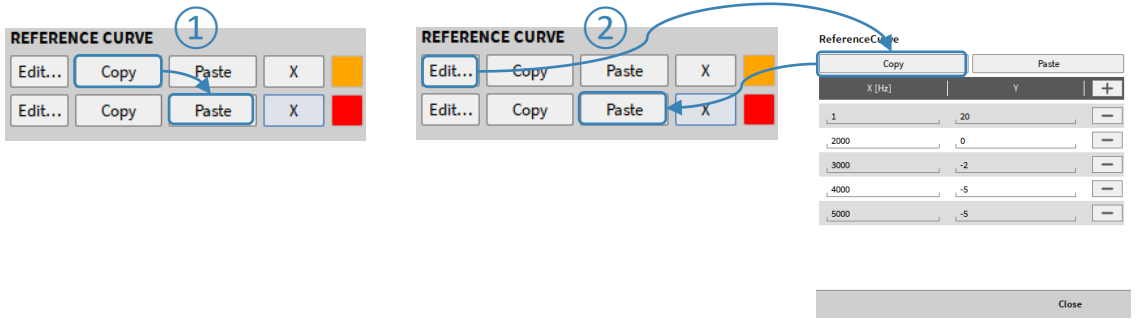
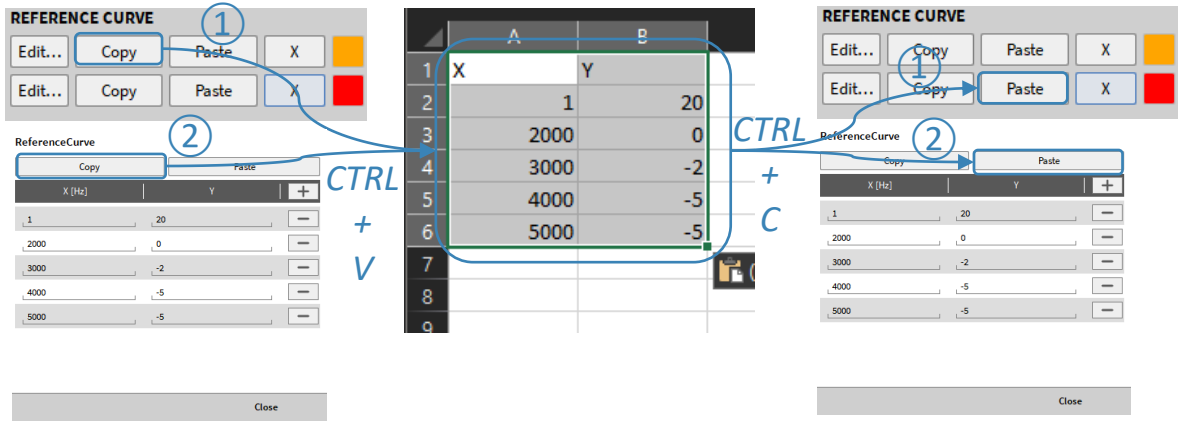
> Copy & paste from orange to red curve and vice versa

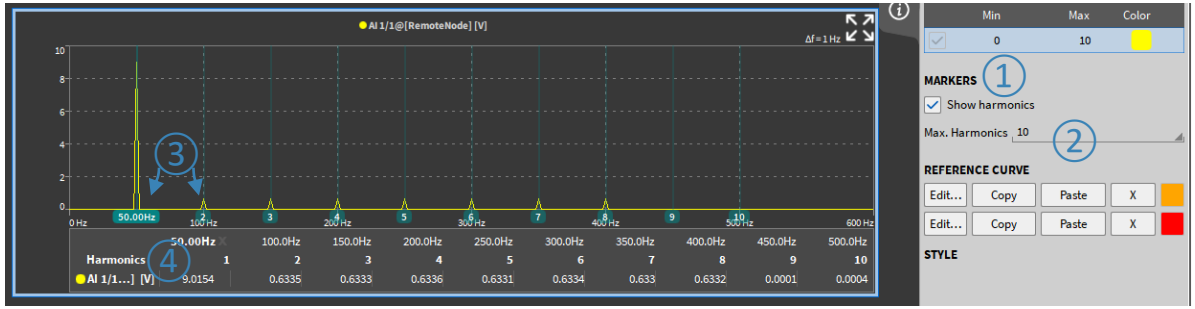


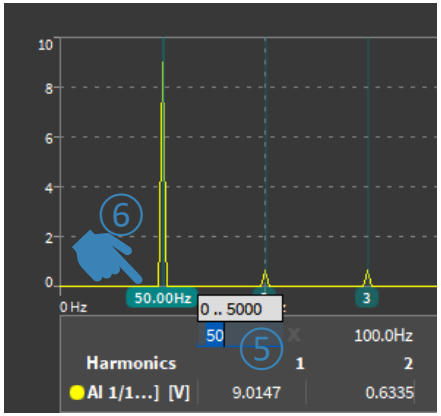

> Copy & Paste from / into Excel or others



# HARMONICS CURSOR

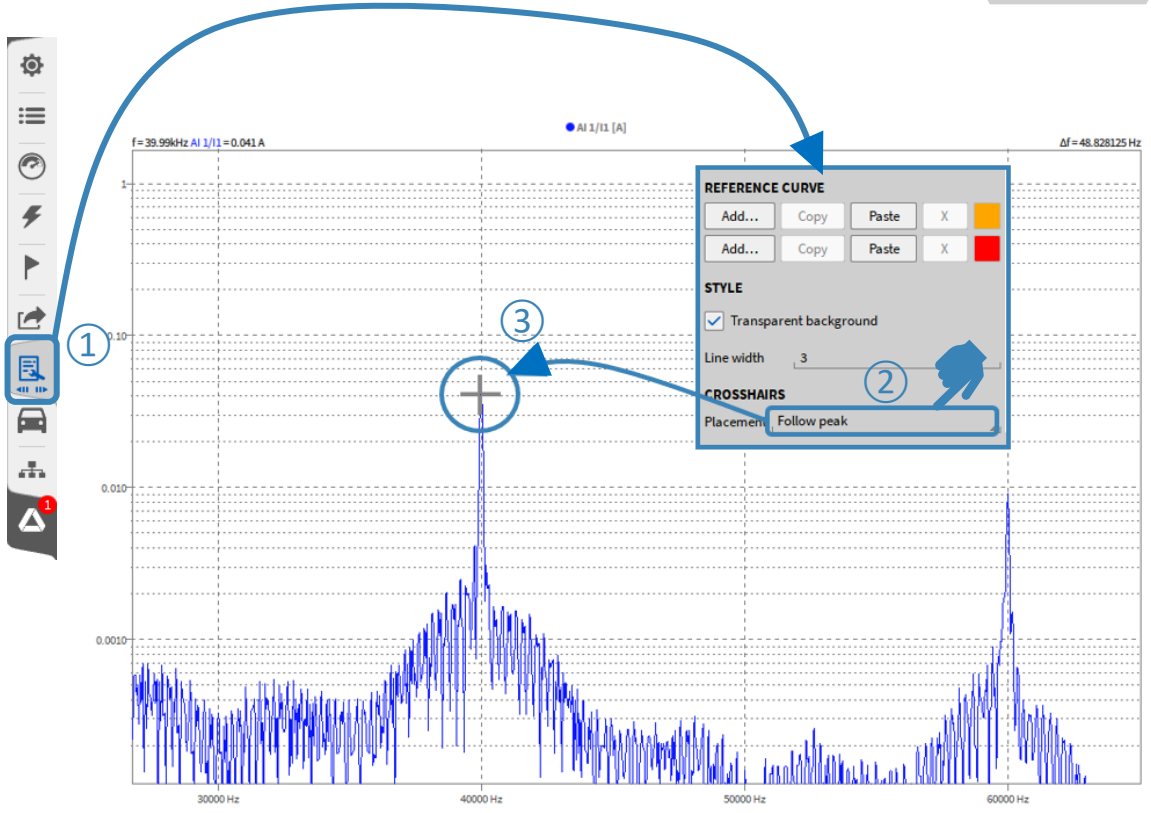
| | |
|---|---|
| ① | Harmonics Cursors can be displayed by checking *Show Harmonics* |
| ② | The number of harmonics can be set from 1 to 10 |
| ③ | Harmonics are marked with cursors |
| ④ | Harmonics amplitude is displayed at the instrument‘s bottom |
| ⑤ | The cursor position can be changed by entering a new frequency for the first harmonic<br>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<br>The position of the higher harmonics is automatically adjusted |



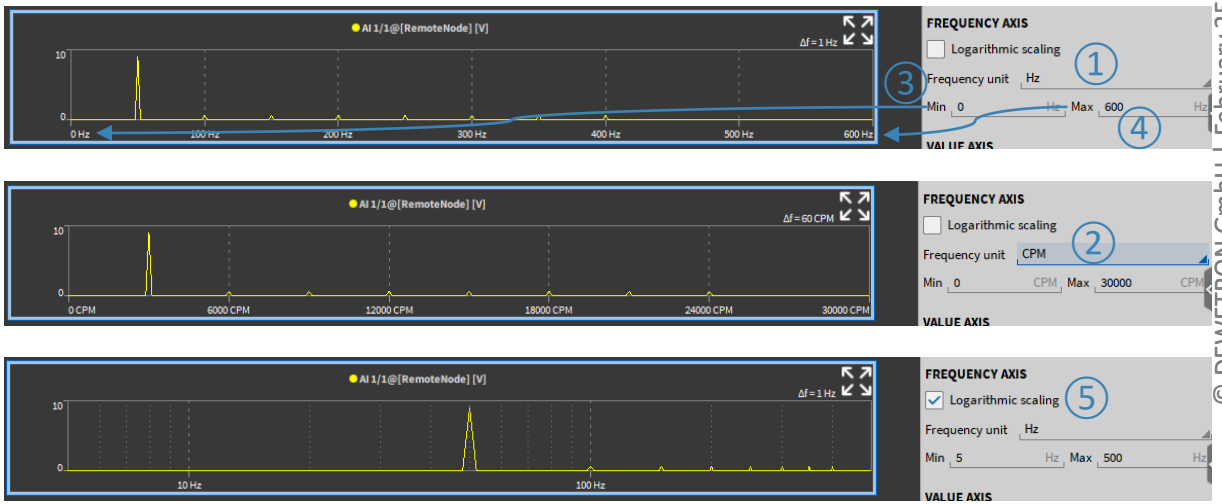
# PEAK HAIR CURSOR

| | |
|---|---|
| ① | Select the Spectrum Analyzer instrument and pen the instrument properties |
| ② | Go to the crosshairs section and select „Follow peak“ in the dropdown box for the placement |
| 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. |



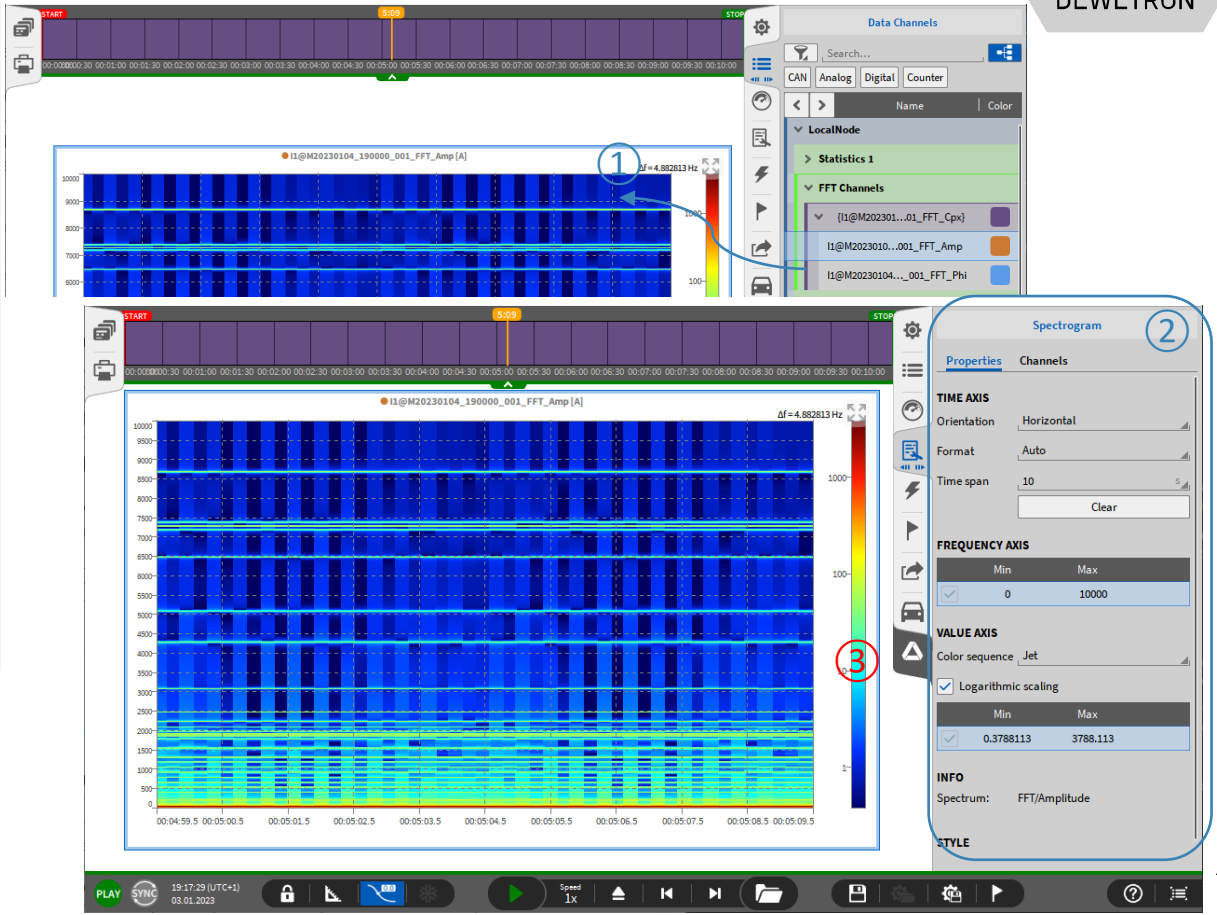
# FREQUENCY AXIS SETTINGS

| | |
|---|---|
| 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<br>> the elapsed time on the X-Axis<br>> The frequency range on the Y-Axis<br>> 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<br><br>> Color Range can be changed by pressing CTRL+ Srcolling |



# COPY + PASTE FFT DATA TO EXCEL

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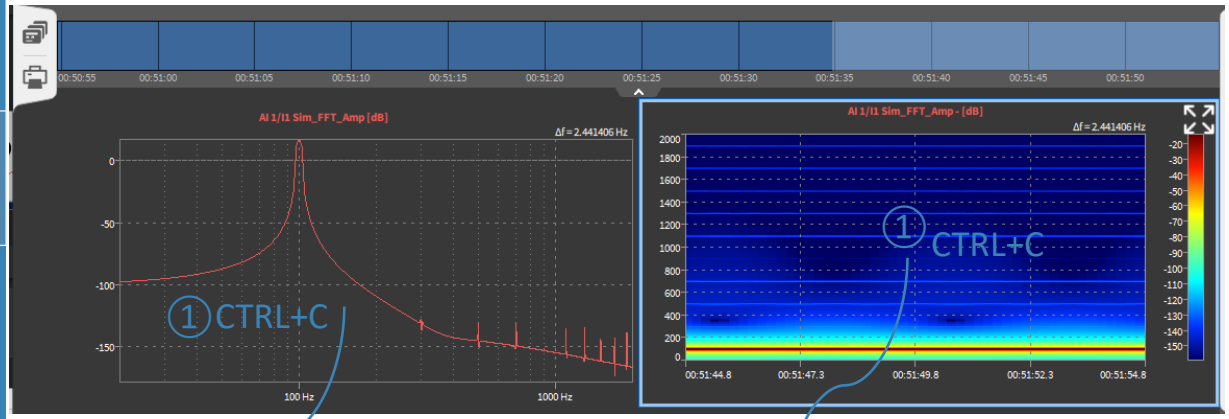
| | |
|---|---|
| ① | Select the instrument with a left click (blue frame around instrument occurs) and press *CTRL+C* to copy the currently displayed data to clipboard |
| ② | Open Excel or a different software to paste the FFT data from clipboard with *CTRL+V* |




| | 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 | |

| | 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

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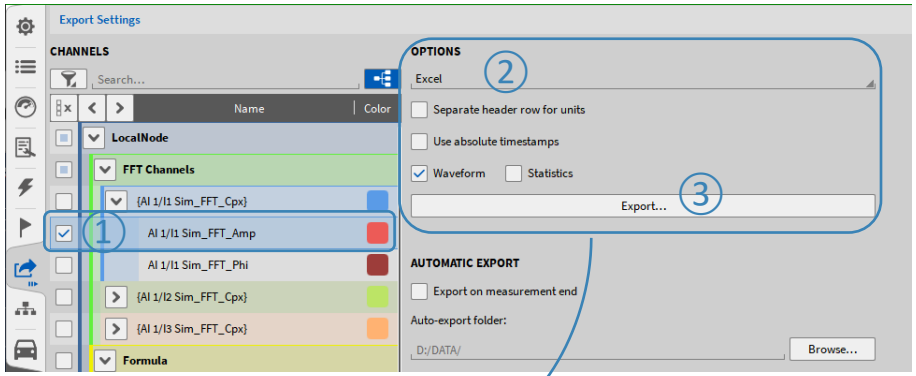
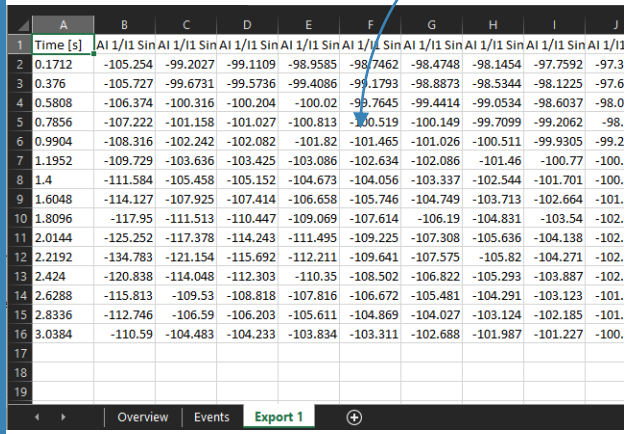
| | |
|---|---|
| | FFT data can be exported after recording as well. To do so, open the data file and go to the Export menu |
| ① | Select the channels to be exported |
| ② | Select the Export Format |
| ③ | Press *Export…* button |



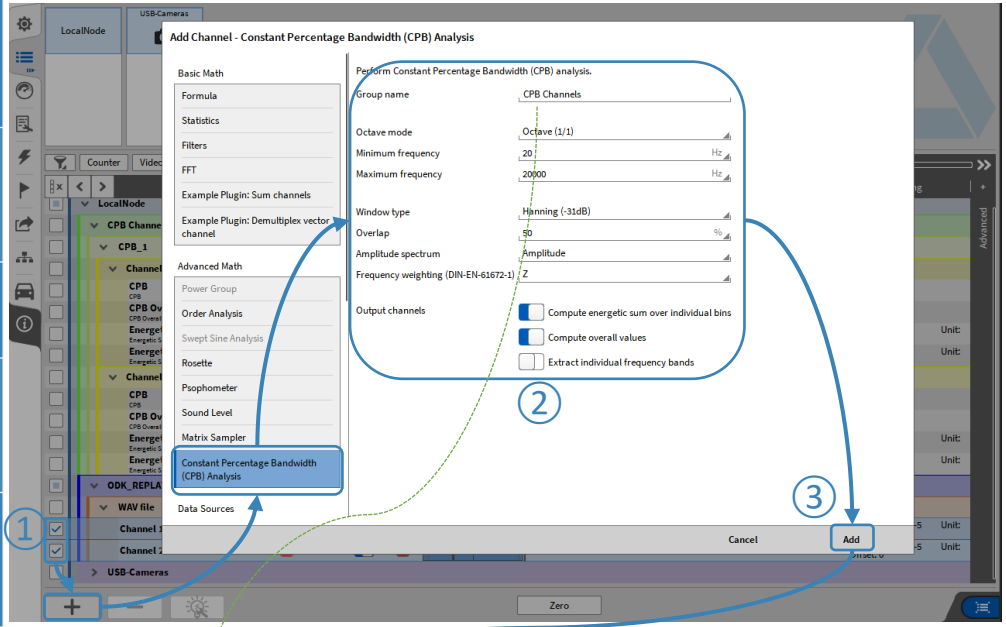



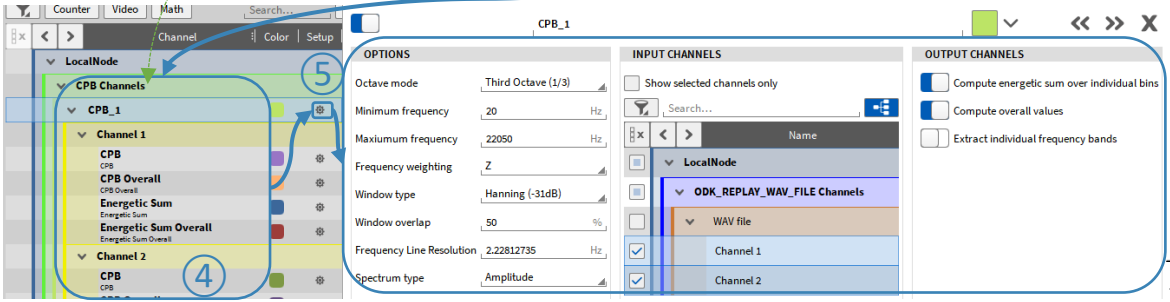
| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Time [s] | AI 1/I1 Sin | AI 1/I1 Sin | AI 1/I1 Sin | AI 1/I1 Sin | AI 1/I1 Sin | AI 1/I1 Sin | AI 1/I1 Sin | AI 1/I1 Sin | AI 1/I1 |
| 2 | 0.1712 | -105.254 | -99.2027 | -99.1109 | -98.9585 | -98.7462 | -98.4748 | -98.1454 | -97.7592 | -97.3 |
| 3 | 0.376 | -105.727 | -99.6731 | -99.5736 | -99.4086 | -99.1793 | -98.8873 | -98.5344 | -98.1225 | -97.6 |
| 4 | 0.5808 | -106.374 | -100.316 | -100.204 | -100.02 | -99.7645 | -99.4414 | -99.0534 | -98.6037 | -98.0 |
| 5 | 0.7856 | -107.222 | -101.158 | -101.027 | -100.813 | -100.519 | -100.149 | -99.7099 | -99.2062 | -98. |
| 6 | 0.9904 | -108.316 | -102.242 | -102.082 | -101.82 | -101.465 | -101.026 | -100.511 | -99.9305 | -99.2 |
| 7 | 1.1952 | -109.729 | -103.636 | -103.425 | -103.086 | -102.634 | -102.086 | -101.46 | -100.77 | -100. |
| 8 | 1.4 | -111.584 | -105.458 | -105.152 | -104.673 | -104.056 | -103.337 | -102.544 | -101.701 | -100. |
| 9 | 1.6048 | -114.127 | -107.925 | -107.414 | -106.658 | -105.746 | -104.749 | -103.713 | -102.664 | -101. |
| 10 | 1.8096 | -117.95 | -111.513 | -110.447 | -109.069 | -107.614 | -106.19 | -104.831 | -103.54 | -102. |
| 11 | 2.0144 | -125.252 | -117.378 | -114.243 | -111.495 | -109.225 | -107.308 | -105.636 | -104.138 | -102. |
| 12 | 2.2192 | -134.783 | -121.154 | -115.692 | -112.211 | -109.641 | -107.575 | -105.82 | -104.271 | -102. |
| 13 | 2.424 | -120.838 | -114.048 | -112.303 | -110.35 | -108.502 | -106.822 | -105.293 | -103.887 | -102. |
| 14 | 2.6288 | -115.813 | -109.53 | -108.818 | -107.816 | -106.672 | -105.481 | -104.291 | -103.123 | -101. |
| 15 | 2.8336 | -112.746 | -106.59 | -106.203 | -105.611 | -104.869 | -104.027 | -103.124 | -102.185 | -101. |
| 16 | 3.0384 | -110.59 | -104.483 | -104.233 | -103.834 | -103.311 | -102.688 | -101.987 | -101.227 | -100. |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |

Overview | Events | Export 1

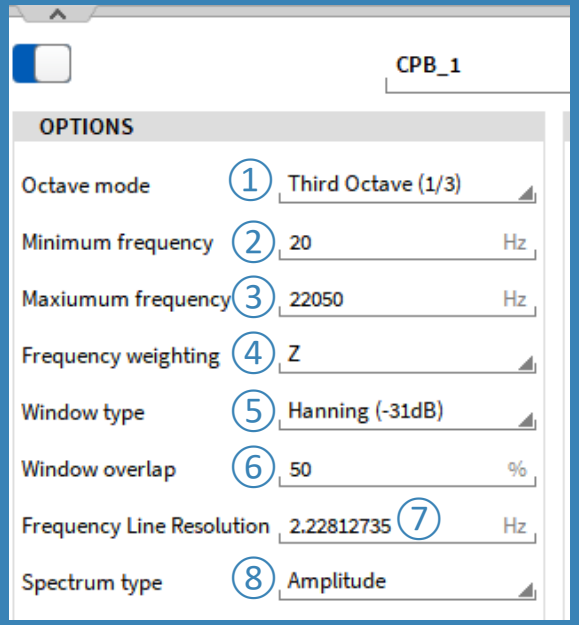
# CREATING A CPB ANALYSIS

| | |
|---|---|
| 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 |



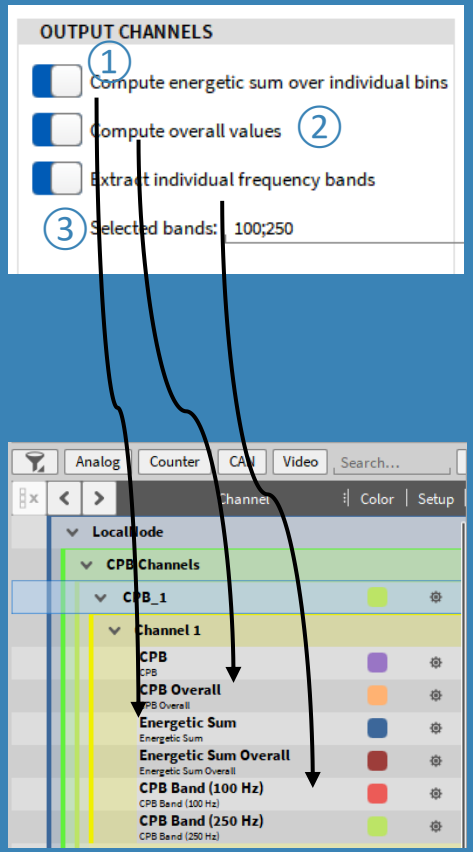



# CPB ANALYSIS OPTIONS




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

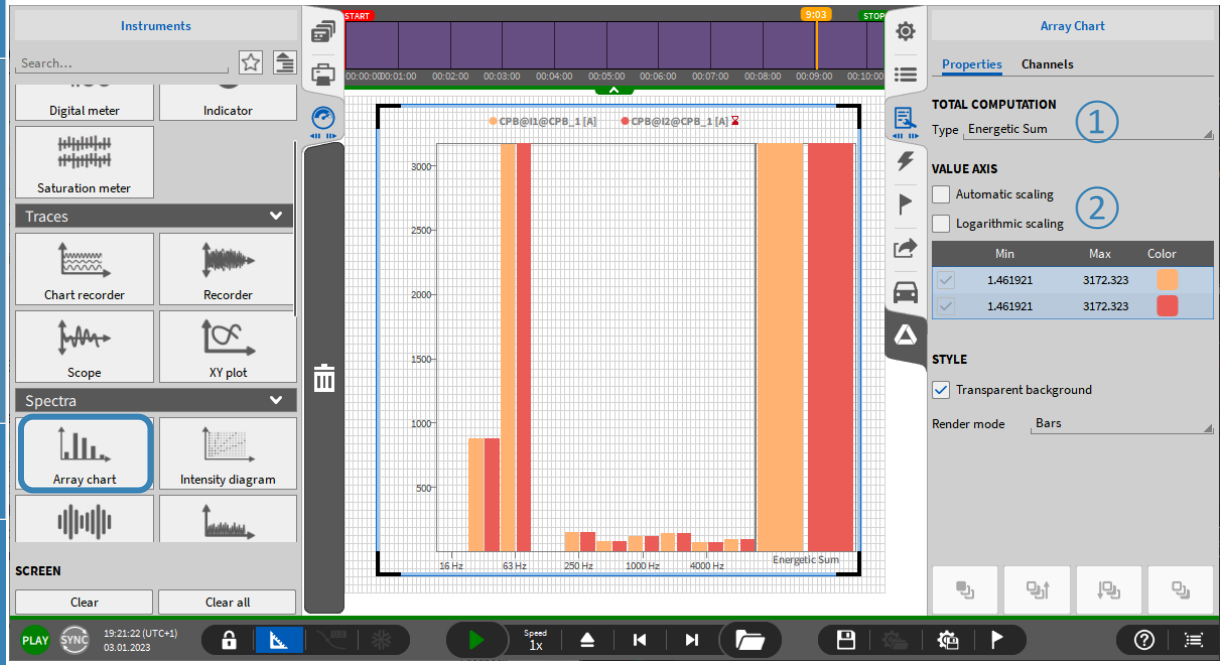
② One CPB spectrum and energetic sum averaged for the entire measurement time with reset at Recording start.
The channel name is *CPB Overall* and *Energetic Sum Overall*

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

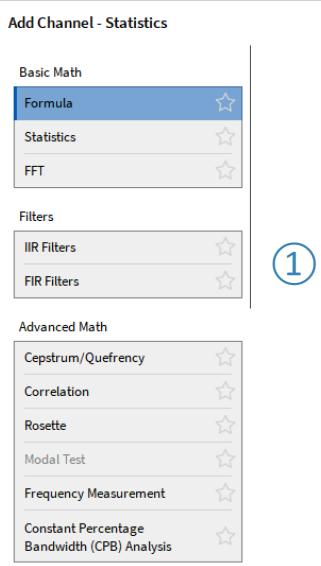
DEWETRON

| | |
|---|---|
| | 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<br><br>- Minimum<br>- Maximum<br>- Energetical Sum<br><br>Of the CPB spectrum |
| ② | Values Axis: Change the scaling of the Y-Axis |

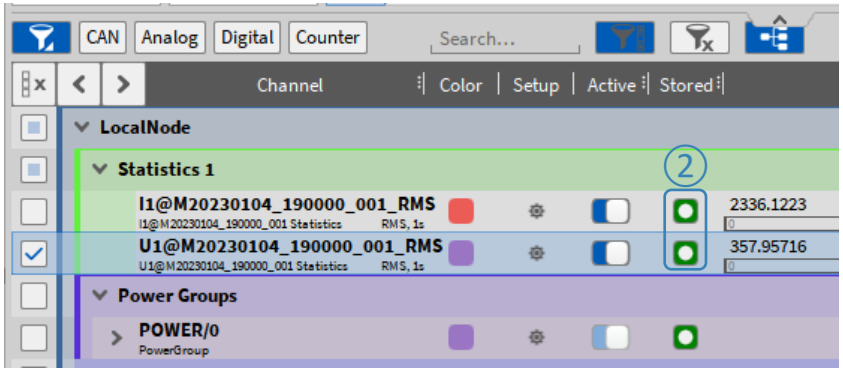


# OFFLINE MATH – ADDING CALCULATIONS TO THE DATA FILE

| | |
|---|---|
| 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*