

THE MEASURABLE DIFFERENCE.



DEWETRON



# OXYGEN TRAINING

- > Formulas
- > Statistics
- > Filters





- > Adding Math Channels
- > Creating Formulas
  - > Standard Operations
  - > Trigonometric
  - > Logical
  - > Measurement
  - > Miscellaneous
  - > Creation of Reference Curves in Time Domain
  - > Array channel support for formulas
- > Creating Statistics
  - > Array channel support for statistics
- > Creating Filters
- > Offline Math

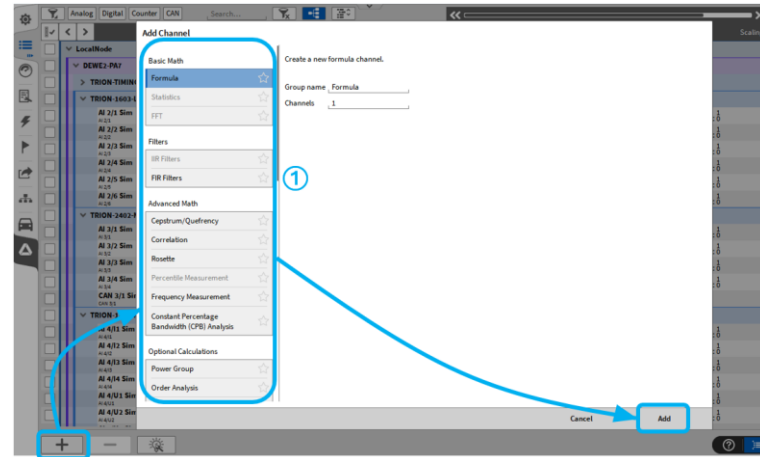
# ADD MATH CALCULATIONS TO THE MEASUREMENT SETUP



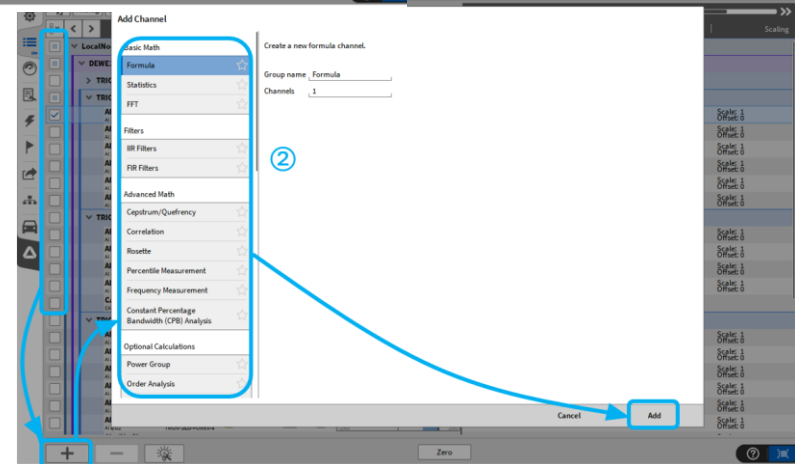
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- ① To create
- > Formulas
  - > FIR Filter
  - > Cepstrum/Quefreny
  - > Correlation
  - > Rosette calculations
  - > Frequency Measurement
  - > Constant Percentage Bandwidth (CPB)
  - > Order analysis modules
  - > Power Group
  - > Sound Level
  - > Modal Test
  - > Tape Sensor
  - > Resolver
  - > Matrix Sampler
- Press the + button. Select the proper calculation and press *Add*



- ② Reference channels must be selected before creating
- > Statistics
  - > FFT
  - > IIR Filter
  - > Percentile Measurement
  - > Swept sine analysis
  - > Psophometers

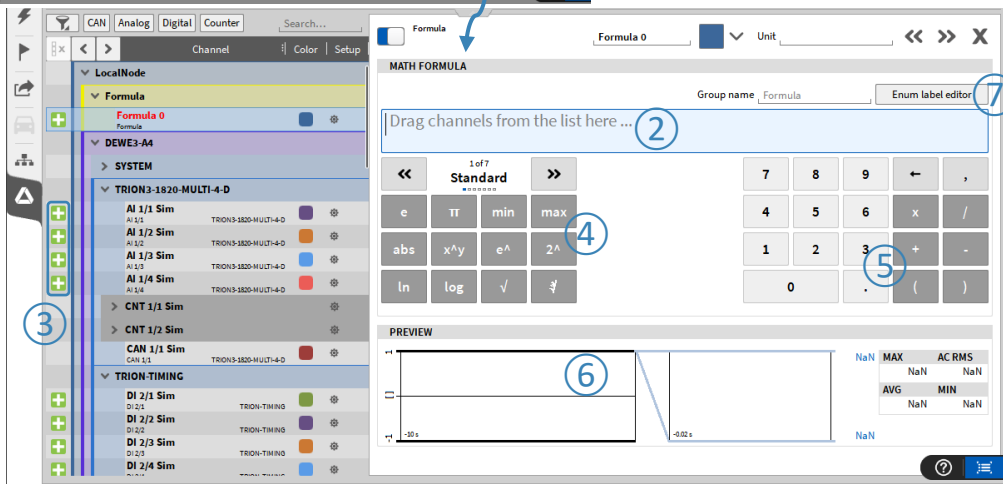
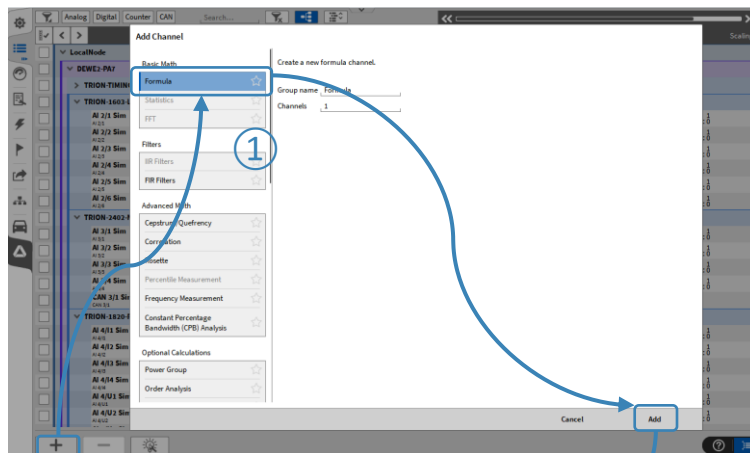




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# CREATING A FORMULA

- 1 Press the + button, select *Formula* and press *Add*  
Formula editor will open afterwards
- 2 Formula Input field
- 3 Press the + button to add a channel to the input field or use drag-and-drop
- 4 Selection of math functions
- 5 Numeric pad with basic mathematic operations
- 6 Preview of the formula output
- 7 Enum label editor  
Sets up text labels for specific values





# SIMPLE EXAMPLES

① Multiplication of 2 signals

② Mean average of 3 signals

③  $2 * \sin(2 * \pi * 1 * \text{time})$

$+ \text{chx}/x * 0$  required to determine the correct time base

Channels can have different sample rates, thus OXYGEN needs one time reference in each formula

The screenshot shows the DEWETRON software interface. On the left, a tree view shows a 'LocalNode' containing a 'Formula' channel. Below it, a 'DEWE2-A4' node contains a 'TRION-1820-POWER-4' node with three channels: 'AI 1/11 Sim', 'AI 1/12 Sim', and 'AI 1/13 Sim'. The main window displays the 'Formula' editor with the operation set to 'Multiplication' and the unit set to 'V'. The 'MATH FORMULA' field contains the expression:  $'AI\ 1/11\ Sim' * 'AI\ 1/12\ Sim'$ . A circled '1' is placed at the end of the formula.

The screenshot shows the DEWETRON software interface. The 'Formula' editor now has the operation set to 'Mean Average' and the unit set to 'V'. The 'MATH FORMULA' field contains the expression:  $('AI\ 1/11\ Sim' + 'AI\ 1/12\ Sim' + 'AI\ 1/13\ Sim') / 3$ . A circled '2' is placed at the end of the formula. A black arrow points from the text 'Channels can have different sample rates...' to the formula.

The screenshot shows the DEWETRON software interface. The 'Formula' editor has the operation set to 'Standard' and the unit set to 'V'. The 'MATH FORMULA' field contains the expression:  $2 * \sin(2 * \pi * 1 * \text{time}) + AI\ 1/11\ Sim * 0$ . A circled '3' is placed at the end of the formula. A black arrow points from the text '+chx/x\*0 required to determine the correct time base' to the  $* 0$  part of the formula.



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# MATHEMATICAL OPERATIONS – STANDARD OPERATIONS

- ① Standard operations
- ② Trigonometric operations
- ③ Logical operations
- ④ Measurement operations
- ⑤ Misc

| Function          | Description                               | Syntax     |
|-------------------|-------------------------------------------|------------|
| e                 | Euler's number                            | e          |
| $\pi$             | Constant Pi                               | pi         |
| min               | Minimum of two values                     | min(x,y)   |
| max               | Maximum of two values                     | max(x,y)   |
| abs               | Absolute value                            | abs(value) |
| $x^y$             | Exponential function with arbitrary basis | pow(x,y)   |
| $e^x$             | Exponential function with basis e         | exp(x)     |
| $2^x$             | Exponential function with basis 2         | exp2(x)    |
| ln                | Natural logarithm to basis e              | ln(x)      |
| log               | Common logarithm to basis 10              | log(x)     |
| $\sqrt{\quad}$    | Square root                               | sqrt(x)    |
| $\sqrt[3]{\quad}$ | Cube root                                 | cbirt(x)   |

*Tool tips pop up when the mouse remains on one operation*

Formula:  $\exp(|A| 1/l2 Sim)$

PREVIEW

|        |     |        |
|--------|-----|--------|
| 2981.0 | MAX | AC RMS |
| 2981.0 |     | 842.9  |
|        | AVG | MIN    |
| 0.0    |     | 0.0    |

# MATHEMATICAL OPERATIONS – TRIGONOMETRIC



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- ① Standard operations
- ② Trigonometric operations
- ③ Logical operations
- ④ Measurement operations
- ⑤ Misc

2 of 5

<< **Trigonometric** >>

|     |      |      |       |
|-----|------|------|-------|
| sin | asin | sinh | asinh |
| cos | acos | cosh | acosh |
| tan | atan | tanh | atanh |

| Function | Description            | Syntax   |
|----------|------------------------|----------|
| sin      | Sine                   | sin(x)   |
| asin     | Arc sine               | asin(x)  |
| sinh     | Hyperbolic sine        | sinh(x)  |
| asinh    | Arc hyperbolic sine    | asinh(x) |
| cos      | Cosine                 | cos(x)   |
| acos     | Arc cosine             | acos(x)  |
| cosh     | Hyperbolic cosine      | cosh(x)  |
| acosh    | Arc hyperbolic cosine  | acosh(x) |
| tan      | Tangent                | tan(x)   |
| atan     | Arc tangent            | atan(x)  |
| tanh     | Hyperbolic tangent     | tanh(x)  |
| atanh    | Arc hyperbolic tangent | atanh(x) |

Formula  $2*\sin(2*\pi*1*time)$  Unit

MATH FORMULA

$2*\sin(2*\pi*1*time)$  +Al 1/11 Sim\*0

1 of 5

<< **Standard** >>

|     |     |     |     |   |   |   |   |   |
|-----|-----|-----|-----|---|---|---|---|---|
| e   | π   | min | max | 7 | 8 | 9 | ← | , |
| abs | x^y | e^  | 2^  | 4 | 5 | 6 | x | / |
| ln  | log | √   | ∫   | 1 | 2 | 3 | + | - |
|     |     |     |     | 0 | . | ( | ) |   |

PREVIEW

|          |          |         |
|----------|----------|---------|
| -1.59483 | MAX      | AC RMS  |
| 2.00000  |          | 1.41407 |
| AVG      | MIN      |         |
| 0.00000  | -2.00000 |         |



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# MATHEMATICAL OPERATIONS – LOGIC

- ① Standard operations
- ② Trigonometric operations
- ③ Logical operations
- ④ Measurement operations
- ⑤ Misc

3 of 5  
**Logic**  
■■■■■

← >

< ≤ > ≥

= ≠ and or

not if isnan

Formula  if  Unit

MATH FORMULA

if(2\*sin(2\*pi\*1\*time)+|1/11 Sim\*0>0,1,0)

3 of 5  
**Logic**  
■■■■■

← >

< ≤ > ≥

= ≠ and or

not if isnan

7 8 9 ← ,

4 5 6 x /

1 2 3 + -

0 . ( )

PREVIEW

|         |         |
|---------|---------|
| MAX     | ACRMS   |
| 1.00000 | 0.49998 |
| AVG     | MIN     |
| 0.50005 | 0.00000 |

| Function | Description                                                                                                                                                                | Syntax                           |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| <        | If 'value1' is less than 'value2', the result is 1.0 else 0.0                                                                                                              | value1 < value2                  |
| ≤        | If 'value1' is less than or equals 'value2', the result is 1.0 else 0.0                                                                                                    | value1 <= value2                 |
| >        | If 'value1' is greater than 'value2', the result is 1.0 else 0.0                                                                                                           | value1 > value2                  |
| ≥        | If 'value 1' is greater than or equals 'value 2', the result is 1.0 else 0.0                                                                                               | value1 >= value2                 |
| =        | If 'value 1' equals 'value 2', the result is 1.0 else 0.0 (Two NaNs do not compare equal)                                                                                  | value1 == value2                 |
| ≠        | If 'value 1' is different than 'value 2', the result is 1.0 else 0.0                                                                                                       | value1 != value2                 |
| and      | Logic and:<br>value1 != 0.0 and value2 != 0.0 → 1.0<br>value1 = 0.0 and value2 != 0.0 → 0.0<br>value1 != 0.0 and value2 = 0.0 → 0.0<br>value1 = 0.0 and value2 = 0.0 → 0.0 | value1 and value2                |
| or       | Logic or:<br>value1 != 0.0 or value2 != 0.0 → 1.0<br>value1 = 0.0 or value2 != 0.0 → 1.0<br>value1 != 0.0 or value2 = 0.0 → 1.0<br>value1 = 0.0 or value2 = 0.0 → 0.0      | value1 or value2                 |
| not      | Logic negation:<br>If value = 0.0, the result is 1.0, else 0.0                                                                                                             | not value                        |
| if       | If condition is true, the result is 'true_val', otherwise 'false_val'                                                                                                      | if(condition,true_val,false_val) |
| isnan    | If value is NaN, result is 1.0, 0.0 otherwise                                                                                                                              | isnan(value)                     |





# MATHEMATICAL OPERATIONS – MEASUREMENT

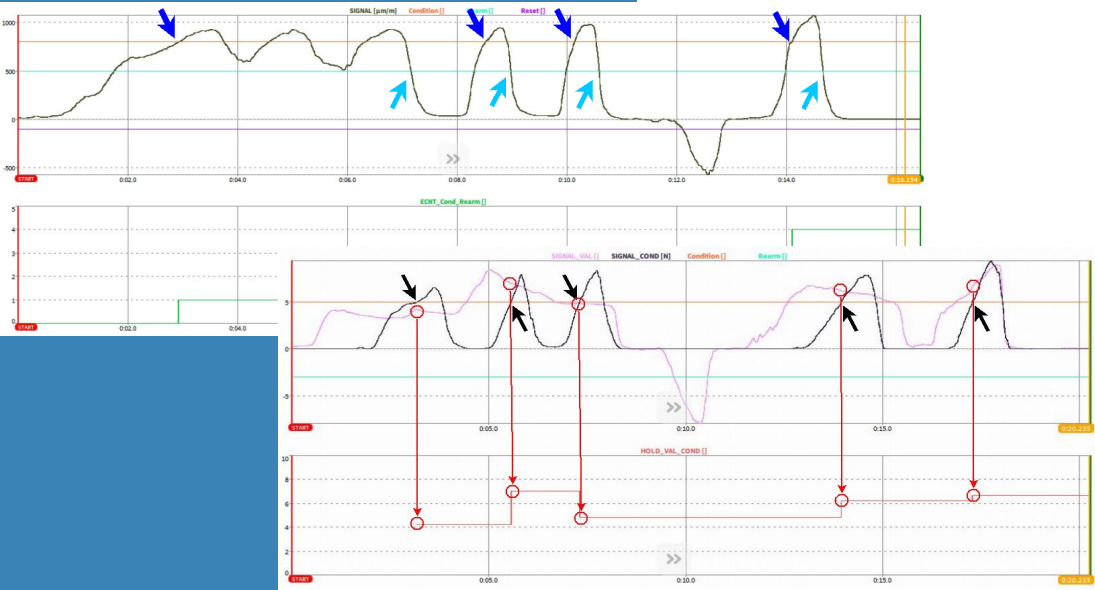
- ① Standard operations
- ② Trigonometric operations
- ③ Logical operations
- ④ Measurement operations
- ⑤ Misc

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Measurement

◀ ▶

|        |            |            |           |
|--------|------------|------------|-----------|
| ecnt   | hold       | stop watch | meas diff |
| period | duty cycle | edge       | rmin      |
| rmax   | ravg       | rrms       | rsum      |



| Function               | Description                                                                                                                                                    | Syntax                                 |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| ecnt <sup>1</sup>      | Count number of edges on condition; condition is mandatory, rearm and reset parameter optional                                                                 | ecnt(cond,rearm,reset)                 |
| hold <sup>2</sup>      | Hold value at trigger condition; value and condition parameters are mandatory, init and rearm optional                                                         | hold(value,cond,init,rearm)            |
| stopwatch <sup>3</sup> | Measure the timespan between two conditions in seconds; start and stop condition is both mandatory, reset is optional                                          | stopwatch(start_cond,stop_cond, reset) |
| measdiff <sup>4</sup>  | Measure the value difference of one channel between two conditions                                                                                             | measdiff(val,cond1,cond2)              |
| period <sup>5</sup>    | Measure the period duration in seconds between consecutive conditions with optional rearm condition                                                            | Edge(cond,rearm)                       |
| dutycycle <sup>6</sup> | Measure the dutycycle (from 0 to 1) between consecutive conditions with optional rearm condition                                                               | Dutycycle(cond,rearm)                  |
| edge <sup>7</sup>      | Generate positive edge on cond with rearm condition                                                                                                            | Edge(cond,rearm)                       |
| rmin <sup>8</sup>      | Measure rolling overall minimum of a channel during a measurement with optional reset condition                                                                | rmin(value,reset)                      |
| rmax <sup>8</sup>      | Measure rolling overall maximum of a channel during a measurement with optional reset condition                                                                | rmax(value,reset)                      |
| ravg <sup>8</sup>      | Measure rolling overall average of a channel during a measurement with optional reset condition                                                                | ravg(value,reset)                      |
| rrms <sup>8</sup>      | Measure rolling overall RMS of a channel during a measurement with optional reset condition                                                                    | rrms(value,reset)                      |
| rsum <sup>8</sup>      | Measure rolling overall sum of a channel during a measurement with optional reset condition                                                                    | rsum(value,reset)                      |
| racrms <sup>8</sup>    | Measure rolling overall ACRMS of a channel during a measurement with optional reset condition; Not included in the selection and must be typed manually        | racrms(value,reset)                    |
| rp2p <sup>8</sup>      | Measure rolling overall Peak-to-Peak of a channel during a measurement with optional reset condition; Not included in the selection and must be typed manually | Rp2p(value,reset)                      |

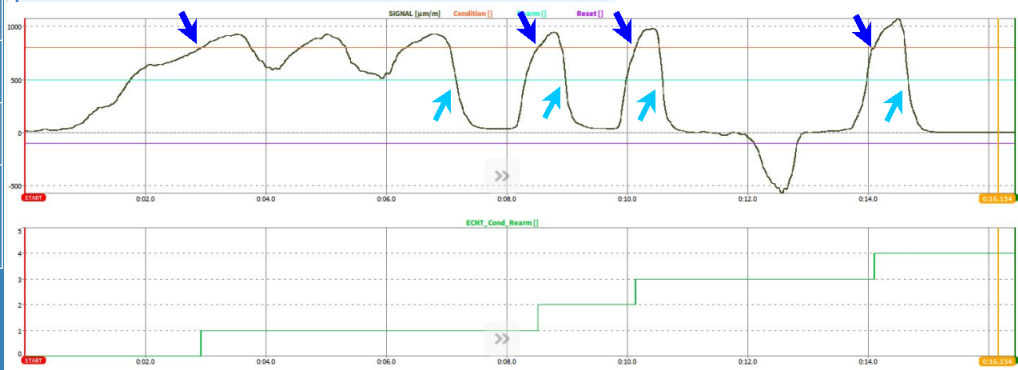
# MATHEMATICAL OPERATIONS – MEASUREMENT



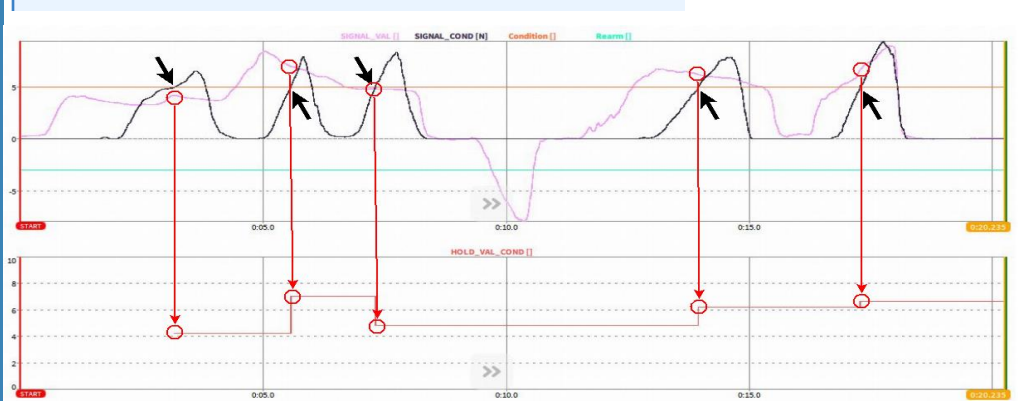
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- ① Standard operations
- ② Trigonometric operations
- ③ Logical operations
- ④ Measurement operations
- ⑤ Misc

```
ecnt('SIGNAL'>800,'SIGNAL'<500)
```



```
hold('SIGNAL_VAL','SIGNAL_COND'>5)
```





# MATHEMATICAL OPERATIONS – MISC

- ① Standard operations
- ② Trigonometric operations
- ③ Logical operations
- ④ Measurement operations
- ⑤ Misc

5 of 5

<< **Miscellaneous** >>

□ □ □ □ □

|      |       |       |       |
|------|-------|-------|-------|
| time | mtime | scnt  | sr    |
| mod  | noise | atan2 | floor |
| ceil | round | trunc |       |

Formula  Sample Count  Unit  << >> X

MATH FORMULA

scnt ← =AI 1/1 Sim\*0

|     |        |          |     |   |   |   |   |   |
|-----|--------|----------|-----|---|---|---|---|---|
| <<  | 1 of 5 | Standard | >>  | 7 | 8 | 9 | ← | , |
| e   | π      | min      | max | 4 | 5 | 6 | x | / |
| abs | x^y    | e^       | 2^  | 1 | 2 | 3 | + | - |
| ln  | log    | √        | ≠   | 0 | . | ( | ) |   |

PREVIEW

|                 |                 |                |
|-----------------|-----------------|----------------|
| 7616907...      | MAX             | AC RMS         |
| 7610000.00000 s | 2886.89568 s    |                |
|                 | AVG             | MIN            |
| 7616707...      | 7605000.00007 s | 000000.00000 s |

| Function | Description                                                                   | Syntax     |
|----------|-------------------------------------------------------------------------------|------------|
| time*    | Returns the elapsed time since acquisition (re)start in seconds               | time       |
| mtime*   | Returns the elapsed time since measurement star in secondst                   | mtime      |
| scnt*    | Counts the number of samples since acquisition (re)start                      | scnt       |
| sr*      | Returns the Sample Rate in Hz                                                 | sr         |
| mod      | Remainder of division x/y, sign of x                                          | mod(x,y)   |
| noise    | Creates Noise signal in the range [-x...+x]                                   | noise(x)   |
| atan2    | Arc tangent of y/x using signs of arguments to determine the correct quadrant | atan2(y,x) |
| floor    | Rounds x towards minus infinity                                               | floor(x)   |
| ceil     | Rounds x towards plus infinity                                                | ceil(x)    |
| round    | Round to nearest integer                                                      | round(x)   |
| trunc    | Round x towards zero                                                          | trunc(x)   |

\* A channel to which the function refers must be specified, i.e. in the following manner: 'Ref\_Ch'\*0+time



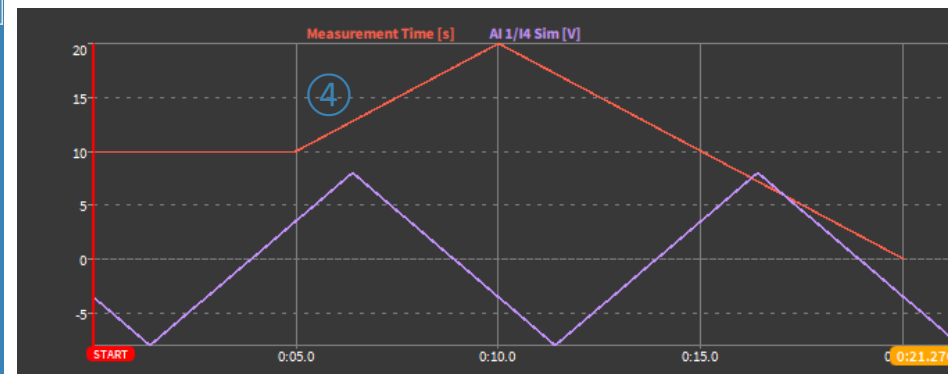
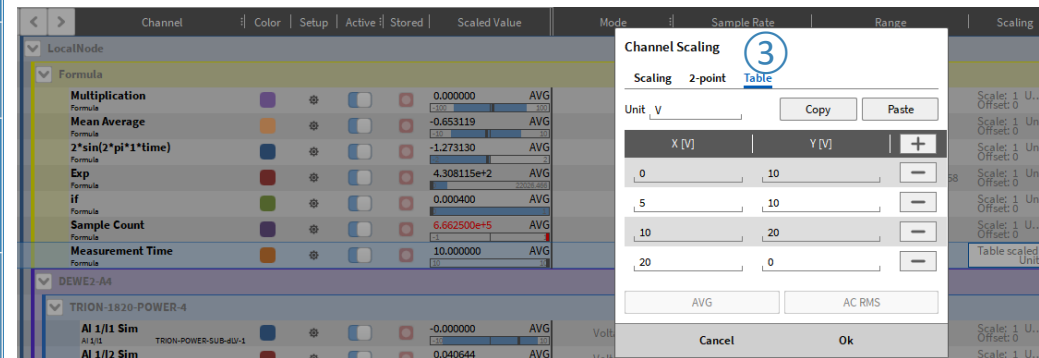
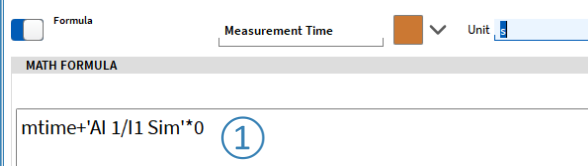
# MATHEMATICAL OPERATIONS – MEASUREMENT TIME

① Measurement time function can be used to generate reference curves in time domain  
 Create a formula determining the measurement time

② Open the scaling options of this channel which are accessible in the Channel List

③ The table scaling can be used to define the boundary points of the reference curve

④ Can be displayed in a Recorder to check if the channel(s) exceeds the limit or is within the limit





# MATHEMATICAL OPERATIONS – MEASUREMENT TIME

- ① Measurement time can be easily displayed on the screen as it can be dragged and dropped to a Text instrument directly from its properties

The screenshot shows a software interface with a top timeline bar displaying time intervals from 0:22.0 to 0:34.0, with a current time of 0:35.337. Below the timeline is a large white rectangular display area containing the text "Measurement Time: 0:35.351". To the right of this display is a "Properties" panel for a "Text" instrument. The panel includes a "Channels" tab, a "TEXT" section with the text "Measurement Time: #{Measurement Time}", and various styling options such as "Size" (set to Auto), "Color", "Style" (with checkboxes for Bold and Italic), "Horizontal Alignment" (set to center), and "Vertical Alignment" (set to middle). Below these are "SYSTEM DATA" sections for "Time" and "Date", and a "Measurement Time" section with a circled "1" next to it. At the bottom of the panel is a "STYLE" section with a checked "Transparent background" option. A black arrow points from the "Measurement Time" property in the panel to the text in the display area.

# ARRAY MATH FORMULAS



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Array channels such as Harmonics, FFT or CPB channels can be used in Formulas

① Basic math operations for arrays with same dimensions supported: + - \* /

② Operations (+ - \* /) with constants supported

Output is always a new array channel with same dimensions

Formula 0 Unit

MATH FORMULA

② ① Group name Formula

10\*'U1\_hrMS@POWER\_1PH'/'I1\_hrMS@POWER\_1PH'

Standard 1 of 6

7 8 9 ← ,

4 5 6 × /

1 2 3 + -

0 . ( )

PREVIEW

1.00000e+9

0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48

# ARRAY MATH FORMULAS



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Possibility to use

- ③ Standard operators
- ④ Trigonometric operators
- ⑤ Logic operators

↓

$10 \cdot \log('U1\_hRMS@POWER\_1PH'/1)$

|     |                                    |     |     |
|-----|------------------------------------|-----|-----|
| <<  | 1 of 6<br><b>Standard</b><br>..... | >>  | ③   |
| e   | π                                  | min | max |
| abs | x^y                                | e^  | 2^  |
| ln  | log                                | √   | ∫   |

'U1\_hRMS@POWER\_1PH'/'I1\_hRMS@POWER\_1PH'  
\*cos('I1\_hPHI@POWER\_1PH')

|     |                                         |      |       |
|-----|-----------------------------------------|------|-------|
| <<  | 2 of 6<br><b>Trigonometric</b><br>..... | >>   | ④     |
| sin | asin                                    | sinh | asinh |
| cos | acos                                    | cosh | acosh |
| tan | atan                                    | tanh | atanh |

↓

'U1\_hRMS@POWER\_3PH' and 'U2\_hRMS@POWER\_3PH'

|     |                                 |       |    |
|-----|---------------------------------|-------|----|
| <<  | 3 of 6<br><b>Logic</b><br>..... | >>    | ⑤  |
| <   | ≤                               | >     | ≥  |
| =   | ≠                               | and   | or |
| not | if                              | isnan |    |

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# ARRAY MATH FORMULAS



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- > Extraction of adjacent elements into a new array in C++ / Python syntax (6)
  - > First element of array is always 0!
  - > Optional step size definition (7)
- > Creation of arrays with constants (8)

1<sup>st</sup> Inclusive ← Last Exclusive

'U1\_hrMS@POWER\_1PH'[0:10] (6)

PREVIEW

| Index | Value |
|-------|-------|
| 0     | 0     |
| 1     | 400   |
| 2     | 0     |
| 3     | 0     |
| 4     | 0     |
| 5     | 50    |
| 6     | 0     |
| 7     | 50    |
| 8     | 0     |
| 9     | 50    |

Formula 0 Unit v

MATH FORMULA

'U1\_hrMS@POWER\_1PH'[0:10:2] (7)

PREVIEW

| Index | Value |
|-------|-------|
| 0     | 0     |
| 1     | 250   |
| 2     | 0     |
| 3     | 0     |
| 4     | 0     |

Formula

MATH FORMULA

'U\_1/2'\*0+[1,2,3,4,5] (8)

PREVIEW

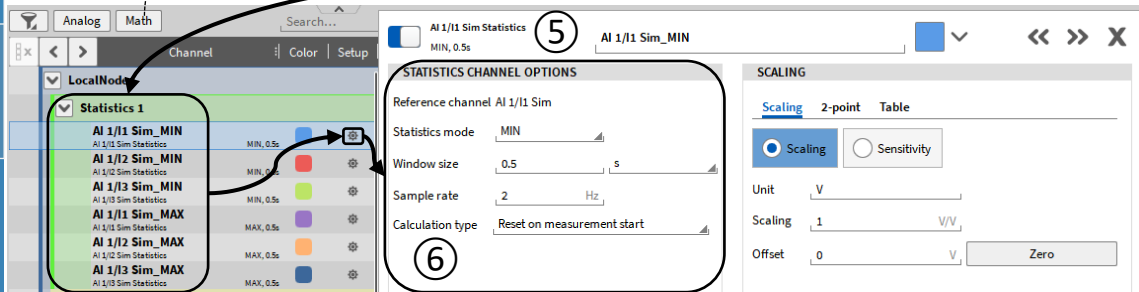
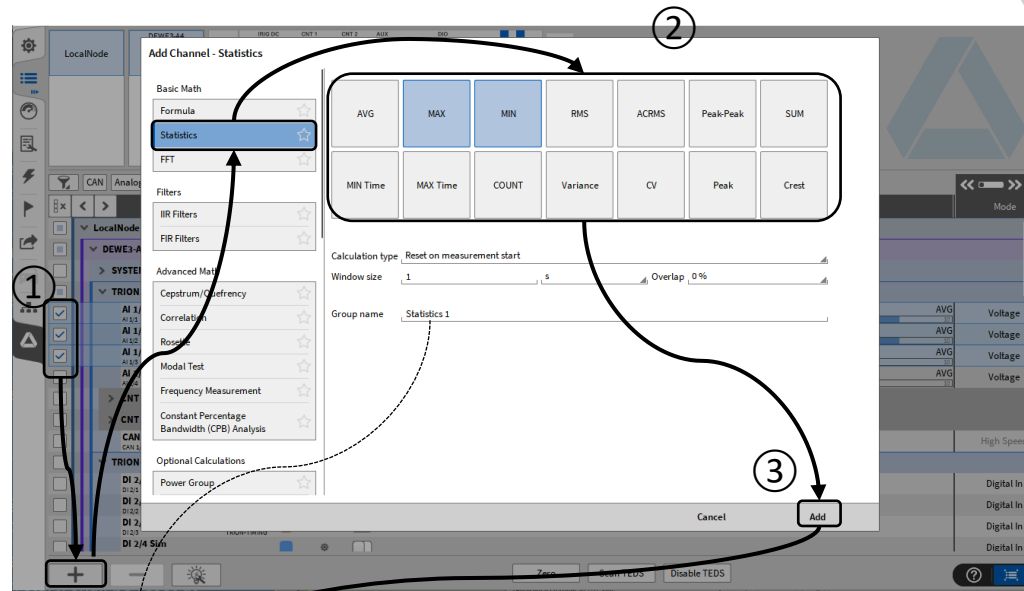
| Index | Value |
|-------|-------|
| 0     | 0     |
| 1     | 2     |
| 2     | 3     |
| 3     | 4     |
| 4     | 5     |





# CREATING STATISTICS

- 1 Select one or several channels by checking their check boxes and press the + button
- 2 Select *Statistics*, choose the proper calculations (several can be selected) and the desired time window
- 3 Press *Add* afterwards to create these channels
- 4 A separate output test 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
- 6 Select if calculation (starting at acquisition start) shall be reset at recording start





# CALCULATION REMARKS

Calculation remarks can be seen on the right hand side

If rolling (overall) statistics, i.e. maximum value during the measurement are required, refer to the functions in the table below which are available in the formula setup

*These formulas are reset at measurement start*

Additionally, user defined reset events can be defined, i.e. ch1 decreases 0

*racrms* and *rp2p* are not available in the menu but can be typed into the formula editor manually

$$AVG = \frac{1}{N} \sum_{i=1}^N SignalLevel_i$$

$$MIN = MIN\{SignalLevel_i\}$$

$$MAX = MAX\{SignalLevel_i\}$$

$$ACRMS = \sqrt{\frac{1}{N} \sum_{i=1}^N (SignalLevel_i - AVG)^2}$$

$$RMS = \sqrt{\frac{1}{N} \sum_{i=1}^N (SignalLevel_i)^2} = \sqrt{AVG^2 + ACRMS^2}$$

$i = 1 \dots N$

$N = \text{Sample Rate of Input Channel} * \text{Window Size}$

|               |                                                                                                                                                                |                     |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>rmin</b>   | Measure rolling overall minimum of a channel during a measurement with optional reset condition                                                                | rmin(value,reset)   |
| <b>rmax</b>   | Measure rolling overall maximum of a channel during a measurement with optional reset condition                                                                | rmax(value,reset)   |
| <b>ravg</b>   | Measure rolling overall average of a channel during a measurement with optional reset condition                                                                | ravg(value,reset)   |
| <b>rrms</b>   | Measure rolling overall RMS of a channel during a measurement with optional reset condition                                                                    | rrms(value,reset)   |
| <b>rsum</b>   | Measure rolling overall sum of a channel during a measurement with optional reset condition                                                                    | rsum(value,reset)   |
| <b>racrms</b> | Measure rolling overall ACRMS of a channel during a measurement with optional reset condition; Not included in the selection and must be typed manually        | racrms(value,reset) |
| <b>rp2p</b>   | Measure rolling overall Peak-to-Peak of a channel during a measurement with optional reset condition; Not included in the selection and must be typed manually | Rp2p(value,reset)   |



# FURTHER STATISTICS (AVAILABLE SINCE R6.1)

- > *Peak-Peak*: Calculates the peak-peak value
- > *SUM*: Calculates the sum
- > *MIN Time*: Determines the time, where the minimum of the signal was reached
- > *MAX Time*: Determines the time, where the maximum of the signal was reached
- > *COUNT*: Counts the number of samples in one measurement block
- > *Variance*: Calculates the variance (squared ACRMS value)
- > *Coefficient of Variance (CV)*: Calculates the Coefficient of variance (division of ACRMS and AVG)
- > *Peak*: Calculates the peak value
- > *Crest*: Calculates the crest factor (division of the MAX and RMS value)

Add Channel - Statistics

Basic Math

|                                            |
|--------------------------------------------|
| Formula                                    |
| <b>Statistics</b>                          |
| Filters                                    |
| FFT                                        |
| Frequency Measurement                      |
| Example Plugin: Sum channels               |
| Example Plugin: Sample Interpolator        |
| Example Plugin: Demultiplex vector channel |

Advanced Math

|                     |
|---------------------|
| Power Group         |
| Order Analysis      |
| Swept Sine Analysis |
| Rosette             |
| Psophometer         |
| Sound Level         |
| Matrix Sampler      |

|          |          |       |          |       |           |       |
|----------|----------|-------|----------|-------|-----------|-------|
| AVG      | MAX      | MIN   | RMS      | ACRMS | Peak-Peak | SUM   |
| MIN Time | MAX Time | COUNT | Variance | CV    | Peak      | Crest |

Calculation type:

Window size:  s Overlap:

Group name:

Cancel Add

# OVERLAPPING STATISTICS (AVAILABLE SINCE R6.1)



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## > Overlapping Window size

- > 0 % (behaviour until now)
- > 50 %
- > 75 %
- > 80 %
- > 90 %
- > 95 %

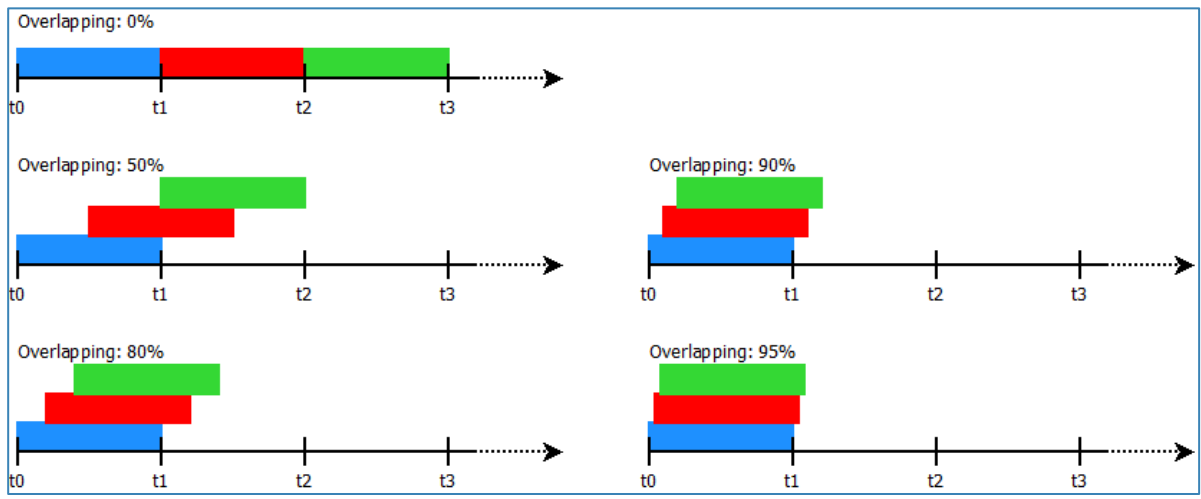
Calculation type

Window size  s

Group name

Overlap

- 0 %
- 50 %
- 75 %
- 80 %
- 90 %
- 95 %



# OVERALL STATISTICS (AVAILABLE SINCE R6.1)



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- > Outputs one overall value from recording start to recording end
  - Reset on measurement start
- > No time history included

Add Channel - Statistics

Basic Math

Formula

Statistics

Filters

FFT

Frequency Measurement

Example Plugin: Sum channels

Example Plugin: Sample Interpolator

Example Plugin: Demultiplex vector channel

Advanced Math

Power Group

Order Analysis

Swept Sine Analysis

Rosette

Psophometer

Sound Level

Matrix Sampler

|          |          |       |          |            |           |       |
|----------|----------|-------|----------|------------|-----------|-------|
| AVG      | MAX      | MIN   | RMS      | ACRMS      | Peak-Peak | SUM   |
| MIN Time | MAX Time | COUNT | Variance | Covariance | Peak      | Crest |

Calculation type: Overall

Group name: Statistics 1

Cancel Add



# TRIGGERED STATISTICS (AVAILABLE SINCE R6.2)

- > Begins statistics calculation on trigger
- > Trigger event can be on rising or falling edge
- > Stop modes:
  - Retrigger
  - Duration
  - Stop trigger

Add Channel - Statistics

Basic Math

|          |          |       |          |       |           |       |
|----------|----------|-------|----------|-------|-----------|-------|
| AVG      | MAX      | MIN   | RMS      | ACRMS | Peak-Peak | SUM   |
| MIN Time | MAX Time | COUNT | Variance | CV    | Peak      | Crest |

Calculation type: Triggered

Start trigger channel: AI 1/1 Sim

Start trigger level: 0.2 V, Rising edge  Rearm level: 0 V

Stop mode: Stop trigger

Stop trigger channel: AI 1/1 Sim

Stop trigger level: 2.4 V, Falling edge  Rearm level: 0 V

Group name: Statistics 1

Cancel Add

Stop mode

- Stop trigger
- Retrigger
- Duration
- Stop trigger

# RUNNING STATISTICS (AVAILABLE SINCE R6.2)



- > Inherits sample rate of input channel
- > Looks back the window size on each new sample
- > Calculates statistic for this „look back“-window

Add Channel - Statistics

Basic Math

|          |          |       |          |       |           |       |
|----------|----------|-------|----------|-------|-----------|-------|
| AVG      | MAX      | MIN   | RMS      | ACRMS | Peak-Peak | SUM   |
| MIN Time | MAX Time | COUNT | Variance | CV    | Peak      | Crest |

Calculation type: Running

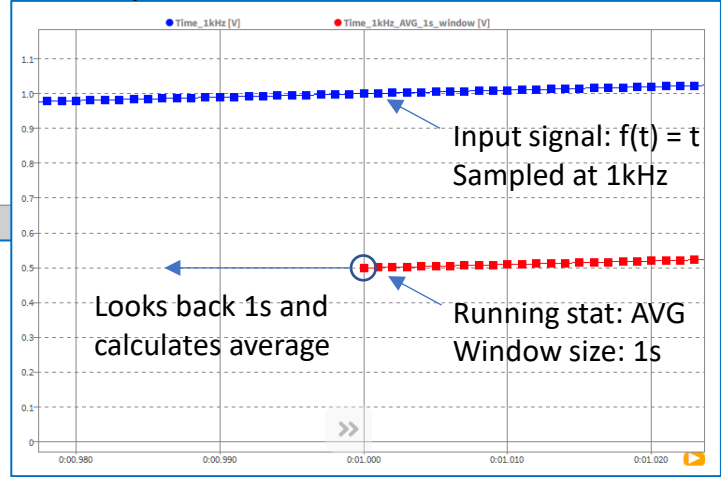
Window size: 1

Group name: Statistics 1

Advanced Math

- Power Group
- Order Analysis
- Swept Sine Analysis
- Rosette
- Psophometer
- Sound Level

### Example:

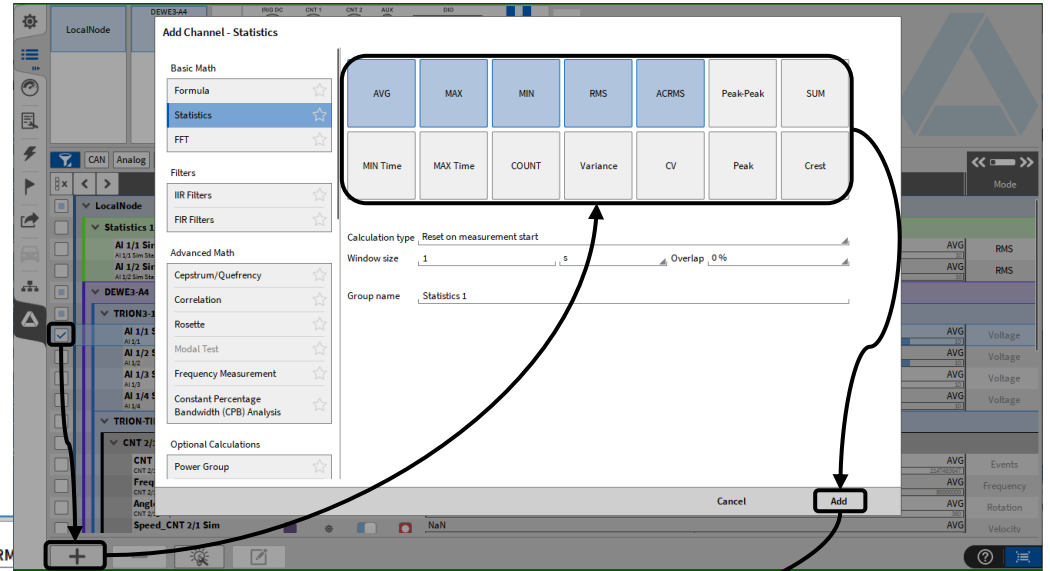


# ARRAY MATH STATISTICS

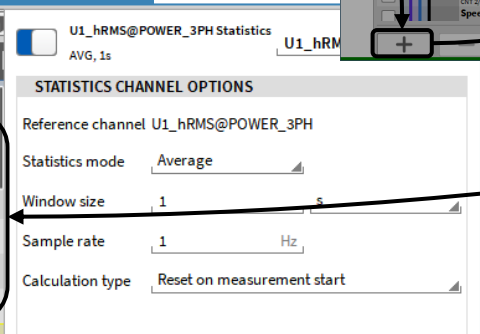
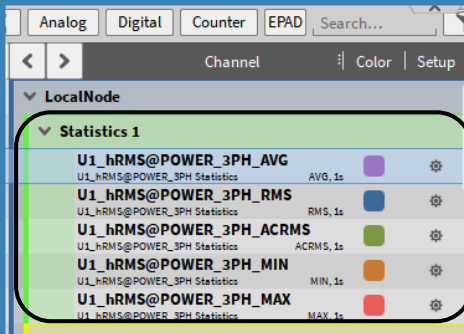


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- > Arrays can be assigned to Statistics
- > Output is always a new array channel with same dimensions



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# CREATING IIR-FILTERS

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

The screenshot illustrates the process of creating IIR filters in the DEWETRON software. It is divided into two main parts: the 'Add Channel - IIR Filters' dialog and the 'FILTER OPTIONS' panel.

**Add Channel - IIR Filters Dialog:**

- 1:** A red box highlights the '+' button in the channel list.
- 2:** A box highlights the 'IIR Filters' category in the left sidebar.
- 3:** A box highlights the 'Add' button at the bottom right of the dialog.
- 4:** A box highlights the 'Filters 1' folder in the channel list.
- 5:** A box highlights the gear icon for the 'AI 1/11 Sim\_LP' channel.

**Creates an IIR filter settings:**

- Filter type:  Low pass,  High pass,  Band pass,  Band stop,  Differentiator,  Integrator
- Filter frequency: 2500 Hz
- Filter characteristic: Bessel
- Order: 4
- Group name: Filters\_1

**FILTER OPTIONS Panel:**

- Reference channel: AI 1/11 Sim
- Filter mode: Lowpass
- Frequency: 2500 Hz
- Characteristic: Bessel
- Order: 4

**GAIN PREVIEW:** A graph showing the filter's magnitude response, with a flat line at 0dB until approximately 1000Hz, then a roll-off to -100dB at 10000Hz.

**SCALING:** Scaling type: Scaling (selected), Sensitivity. Unit: V, Scaling: 1, Offset: 0.

**PREVIEW:** A waveform plot showing a sine wave with a peak of 7.9974 V and a trough of -7.9974 V.



# CREATING FIR-FILTERS

- 1 Select one or several channels to be filtered by checking their check boxes and press the + button
- 2 Select *Filters*, choose the proper one and its settings
- 3 Press *Add* afterwards to create these channels
- 4 A separate output channel for each filtered reference channel is created
- 5 Changes can still be applied by entering the settings of the desired channel via the *Gear* button
- 6 Additional channels can be added or deselected

The screenshot illustrates the software interface for creating FIR filters. It is divided into several key areas:

- Channel List (Top Left):** Shows a list of channels under 'LocalNode'. Channels 'AI 1/11 Sim' through 'AI 1/13 Sim' are checked, and a '+' button is visible at the bottom.
- Filter Selection Dialog (Top Right):** A dialog titled 'Add Channel - FIR Filters' allows selecting a filter type (Low pass, High pass, Band pass, Band stop), setting the filter frequency (2500 Hz), window (Kaiser), and filter length (31). The 'Add' button is circled with a '3'.
- Channel Setup (Bottom Left):** Shows the 'FIR Filter Channels' section where individual filtered channels (e.g., 'AI 1/11 Sim\_filtered') are listed. A gear icon for settings is circled with a '4'.
- Filter Options Panel (Bottom Center):** A detailed 'FIR FILTER OPTIONS' panel for 'FIR\_1' showing filter type (Lowpass), length (31), window (Kaiser), and delay (0.00215 s). A '5' is circled near the filter type.
- Input Channels Panel (Bottom Right):** Shows the 'INPUT CHANNELS' section with a list of channels and checkboxes to show selected channels only. A '6' is circled near the 'Show selected channels only' checkbox.
- Preview (Bottom):** A frequency response plot showing the filter's magnitude response from 0dB to -100dB across a frequency range up to 100kHz.

# FILTER SETTINGS



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## Available Filters:

- > Lowpass
- > Highpass
- > Bandpass
- > Bandstop
- > Integrator (Single or Double)
- > Differentiator (Single or Double)

- > Lowpass & Highpass:
  - >  $f_{C\ max} = \frac{f_s}{2} - 50\ Hz$
  - > Bessel or Butterworth characteristic
  - > 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 8<sup>th</sup> or 10<sup>th</sup> order
- > Bandpass & Bandstop
  - >  $f_l = 0 \dots f_h - 1\ Hz$
  - >  $f_h = f_l + 1\ Hz \dots \frac{f_s}{2} - 50\ Hz$
  - > Bessel or Butterworth characteristic
  - > 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 8<sup>th</sup> or 10<sup>th</sup> order
- > Integrator & Differentiator
  - > Single or Double Integration/Differentiation
  - > Enable low (Integrator) or high (Differentiator) frequency component filtering
    - >  $f_{C\ max} = \frac{f_s}{2} - 50\ Hz$
    - > Bessel or Butterworth characteristic
    - > 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 8<sup>th</sup> or 10<sup>th</sup> order
- > Why filter frequency components during Integration / Differentiation or not?
  - > → Integration of a velocity:
    - > With filtering enabled (no DC components), this calculation determines only the distance travelled from one data sample to the next one
    - > With filtering disabled (DC components included), this calculation determines the entire travelled distance as the determined distance from one data sample to the next is summed up



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# OFFLINE MATH – ADDING CALCULATIONS TO THE DATA FILE

- ① Basic and Advanced Math 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

## Add Channel

### Basic Math

#### Formula

#### Statistics

#### Filters

#### FFT

### Advanced Math

#### Power Group

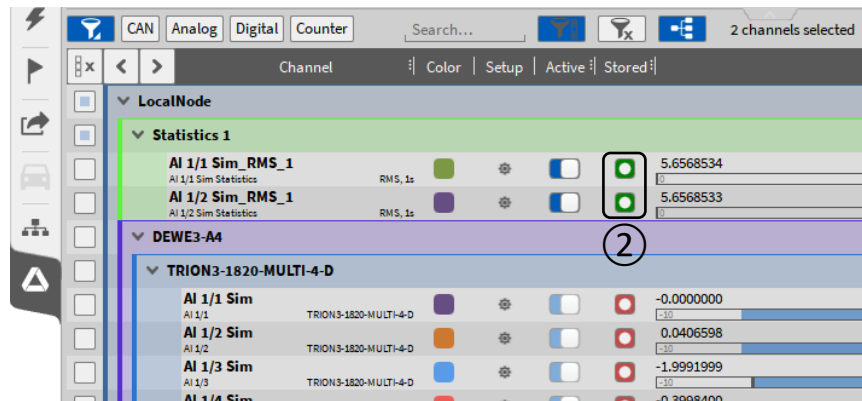
#### Order Analysis

#### Swept Sine Analysis


#### Rosette

#### Psophometer

①



## Remarks:

- > Possibility to edit settings of software channels in \*.dmd-files. Function must be activated once after opening \*.dmd-file (④) 
- > All existing channels and calculations created with + button can be edited if source channels are stored
- > It is also possible to edit the settings of hardware channels, but only the name and the unit.
- > 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