CALCULATIONS MENU.

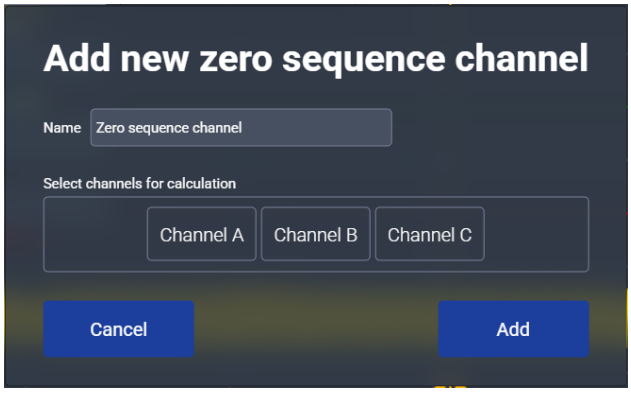
Comtrade → Calculations

Calculations menu has the next options:

Comtrade → Calculations → Add calculated channel

There are several options for operations with analog channels:

Comtrade → Calculations → Add calculated channel → Zero sequence channel



Zero sequence channel opens menu for zero sequence calculation, where you can choose channels:

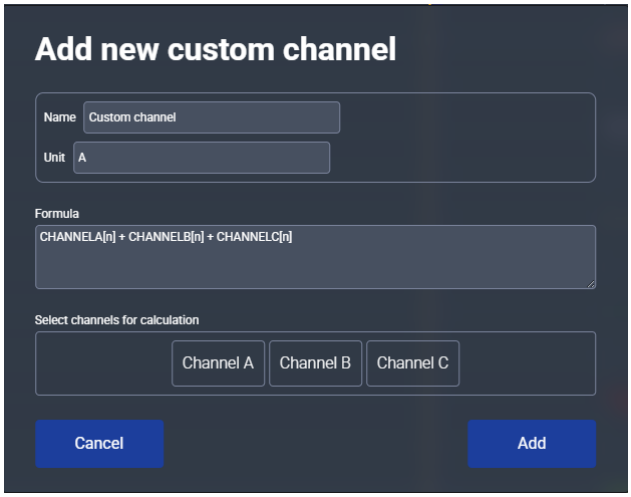
It should be noted that zero sequence channels are calculated as triple values, similar to those measured by current and voltage measuring transformers (3I0 and 3U0).

Comtrade → Calculations → Add calculated channel → Negative sequence channel

Comtrade → Calculations → Add calculated channel → Positive sequence channel

To calculate other sequences use accordingly **Negative sequence channel** and **Positive sequence channel** options.

Comtrade → Calculations → Add calculated channel → Custom channel

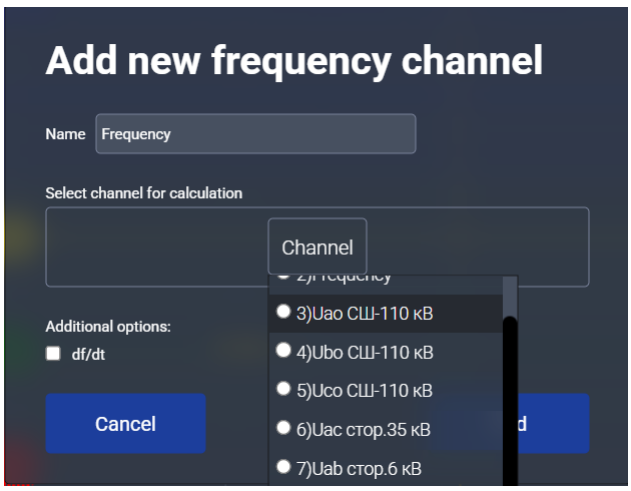


With option **Custom channel** you can add a custom calculated channel with your own formula of calculation. The formula is called for every sample of the analog channel and it's similar to Excel functions:
SIN - returns sinus of the angle in radians
COS - cosinus
TAN - tangent
ASIN - arch sinus
ACOS - arch cosinus
ATAN - arch tangent
ATAN2(x, y) - arch tangent processes separate x and y arguments, while ATAN processes the ratio of those two arguments
ABS - absolute value
SQRT - the square root

CBRT - the cube root
SQUARE - number in power of two
CUBE - number in power of three
ROUND - rounding
DEGREES - converts radian angle to degree angle
RADIANS - converts degree angle to radian angle

Also, there are some important variables:
CHANNELA - variable that contains sample values of selected channel A (Here “A” doesn't mean only phase “A”, it could by any channel)
CHANNELB - variable that contains sample values of selected channel B
CHANNELC - variable that contains sample values of selected channel C
ANGLEA - variable that contains calculation angles of selected channel A
ANGLEB - variable that contains calculation angles of selected channel B
ANGLEC - variable that contains calculation angles of selected channel C
RMSA - variable that contains calculation RMS values of selected channel A
RMSB - variable that contains calculation RMS values of selected channel B
RMSC - variable that contains calculation RMS values of selected channel C
n - current sample number
There are some formula examples below:
CHANNELA[n] + CHANNELB[n] + CHANNELC[n] - Zero sequence calculation, where Channel A, B, C - phase currents or phase voltages of one bay;
-**CHANNELA[n]** - Mirror the channel;
RMSA[n]*RMSB[n]*COS(ANGLEA[n]-ANGLEB[n]) - Single phase active power, where Channel A and Channel B are voltage and current of one phase.

Comtrade → **Calculations** → **Add calculated channel** → **Frequency channel**



Frequency channel opens a menu for frequency calculation, where you can select the channel based on which the frequency will be calculated.
Note that you need to select the voltage channel for the correct calculation. To calculate the frequency, we use one period: the algorithm calculates the exact time of the zero crossing at the beginning of each half-cycle of the period and then frequency is calculated based on this data for each half-cycle.
df/dt checkbox is used to add the rate of frequency change channel. It is calculated based on the frequency channel for each half-cycle.

Note that with nonperiodic signals you should look at **InstVal**.

Comtrade → Calculations → Add calculated channel → Clarke transform

Clarke transform is used to calculate **α**, **β** and **zero** channels.
α channel calculated based on phase parameters as follows (e.g. for currents):

$$\alpha = \frac{1}{3}(2I_A - I_B - I_C)$$

β channel calculated as follows:

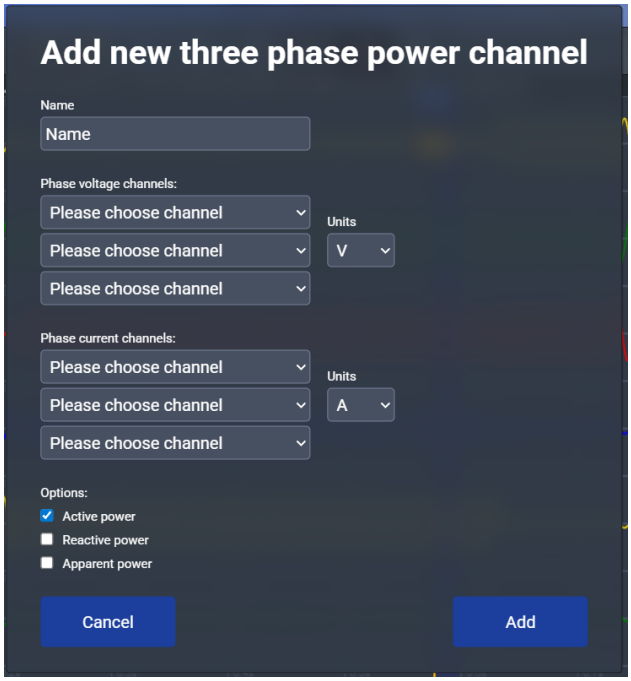
$$\beta = \frac{1}{\sqrt{3}}(I_B - I_C)$$

Zero channel calculated as follows:

$$0 = \frac{1}{3}(I_A + I_B + I_C)$$

As you can see it's calculated as zero sequence current but not tripled. So, depending on your needs you can calculate tripled (**Zero sequence channel - 3I0**) and usual (**Zero channel - I0**) zero sequence currents.

Comtrade → Calculations → Add calculated channel → Power

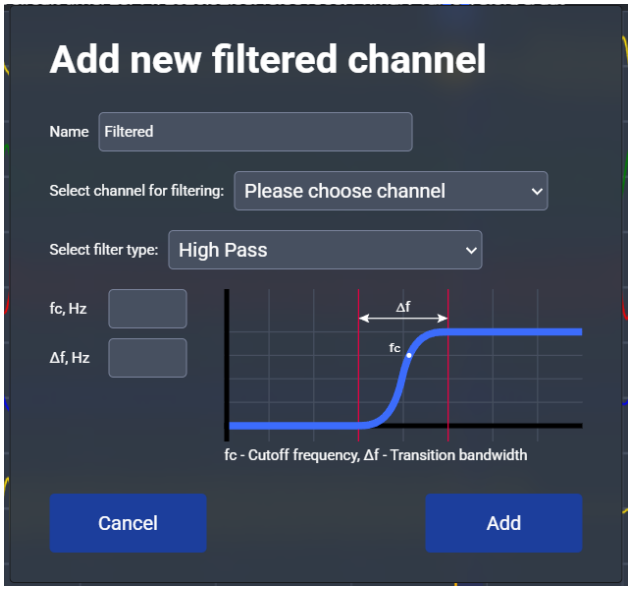


Power allows you to calculate active, reactive and apparent power for one or three phases.

You should select the corresponding phase voltage and current, choose units (we calculate power in **MW, MVar, MVA**) and select wanted power for calculation using checkboxes at the bottom.

RelayHelper
You can just see

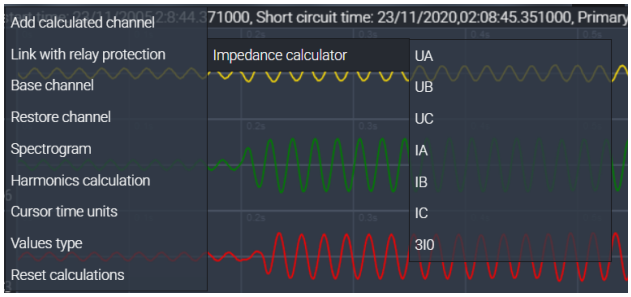
Comtrade → Calculations → Add calculated channel → Filter



Option **Filter** is used to filter analog channels.

There are three FIR filter types with Blackman-Harris windowing: low pass, high pass and band pass filters.

Comtrade → Calculations → Link with relay protection



Option **Link with relay protection** used to link analog channels from the COMTRADE page to various calculators from the Protection page.

You also can link analog channels with relay protection calculators by using this toolbar button.

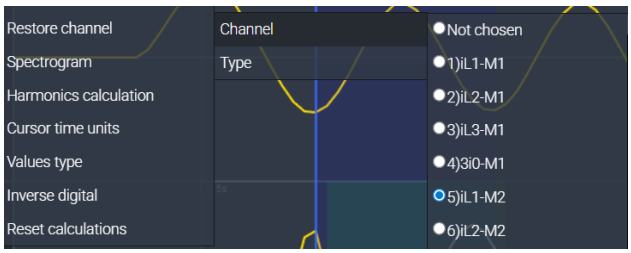
Firstly, you need to add the desired relay protection calculator. After that this calculator appears in the menu and the link button can be used. When the it is pressed, corresponding buttons appear which allow you to link the analog channel to the calculator.
In the next example, an impedance calculator is added, and corresponding channels are linked with it.

Comtrade → **Calculations** → **Base channel**

Option **Base channel** allows you to change base channel for angle measurement. Typically, waveform analysis programs use the first analog channel as the base channel. This is supposed to be phase A voltage. But in our experience, the first channel may not be convenient for analysis. Note that the calculated channel can also be the base channel.

B Also base channel can be selected using corresponding button at channel measurement section.

Comtrade → **Calculations** → **Restore channel** → **Channel**



Option Restore channel used to restore the analog channel in case of distortion. First, you need to select a channel for recovery.

Also, channel to be recovered can be selected using corresponding button at channel measurement section.

Comtrade → **Calculations** → **Restore channel** → **Type**

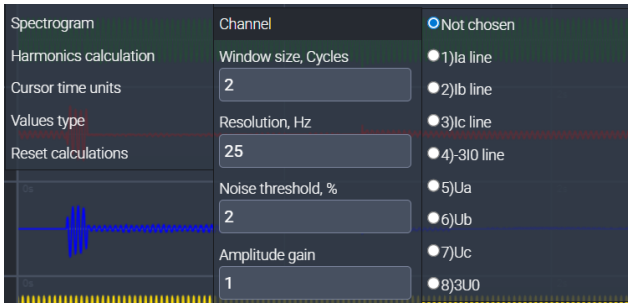
Minus-Plus (default): This algorithm finds a zero crossing of the signal and then calculates a sine wave from two values - one negative, the other the first positive value. In our opinion, this algorithm gives the smallest error.

Amplitude: This algorithm finds the maximum value of the signal and calculates a sine wave based on this value.

Cursor-based: This algorithm takes the first two values to the right of the cursor and calculates a sine wave from them. The idea is that you choose a section of the signal without distortion, and the entire signal is calculated from this section.

The example below uses the **Minus-Plus** algorithm. The restored value (look at channel Number 5) is shown at the bottom of the measurement section and called **RMSRestore**. In this case, the restored value (**10289 A**) is very close to the measured one (channel number 1 with **RMS1: 10774 A**). It should be noted that all these algorithms are evaluative in nature.

Comtrade → **Calculations** → **Spectrogram**

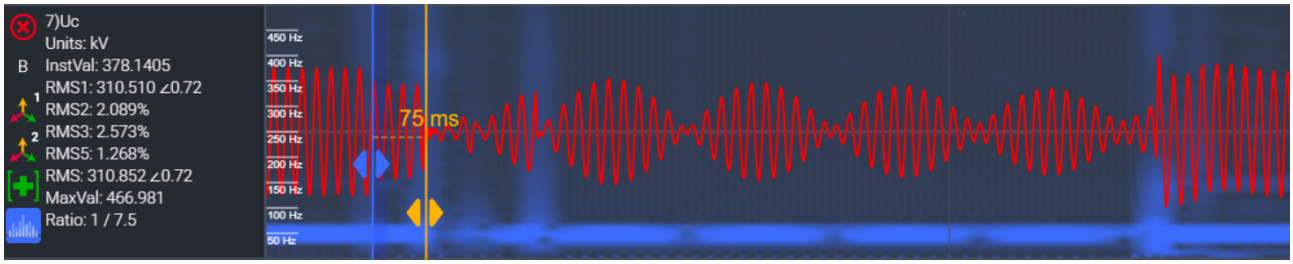


Spectrogram option allows you to visualize harmonic components in selected channel.

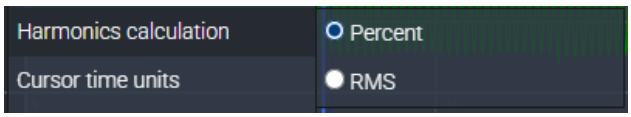
Increasing **Window size**, you increase frequency resolution but decreasing time precision. Frequency **Resolution** is calculated automatically based on file sampling frequency and window size. **Noise threshold** – removes all data bellow selected value (in percent of maximum value). Using **Amplitude gain** you can increase brightness of visualization.

Also, channel can be selected can be using corresponding button at channel measurement section.

Spectrogram activated on 750 kV transmission line phase C voltage channel during single phase AR.



Comtrade → **Calculations** → **Harmonics calculation**

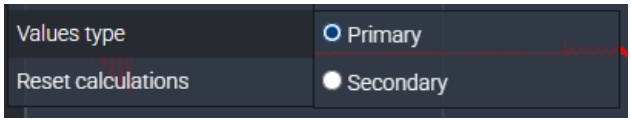


Option H**armonics calculation** allows you to change high harmonics measurement type from percent to channel units.

Comtrade → **Calculations** → **Cursor time units**

Option **Cursor time** units allows you to change time measurement type between cursors.

Comtrade → **Calculations** → Reset calculations



Option **Reset calculations** allows you to reset all calculations and links.