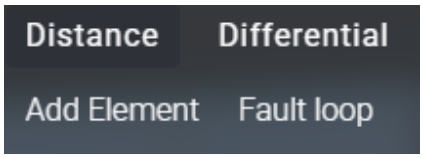
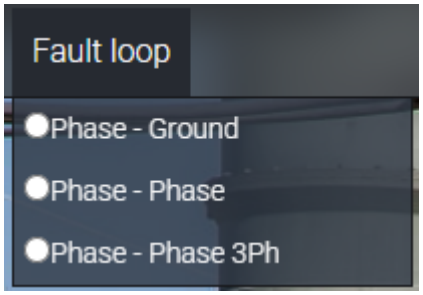
DISTANCE PROTECTION.

Protection → **Distance**



By default, the protection page is loaded with active distance protection.
Distance protection has two additional menus.

Add Element menu is used to add an impedance calculator, RIO loader and device settings modules.



Fault loop menu is used to select an appropriate short circuit loop and it determines the calculation algorithm in the impedance calculator and characteristics of distance zones shown (they may differ for single and multiphase short circuits).

Protection → **Distance** → **Add Element** → **Impedance calculator**

Where:

1 Inputs for phase voltages (top) and currents (bottom).

2 Inputs for zero sequence current.

3 Settings for the grounding factor.

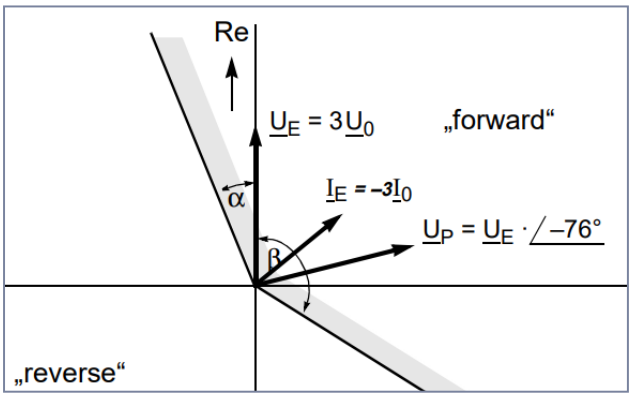
4 Calculation result viewed as R and X with tabs for changing color and trajectory switch.

All input data can be inserted manually or linked from the event file. In case of manual insertion watch carefully for units, if you inserted **kV** you have to insert **kA**.
When you select any protection calculator it in the **Calculations** menu of the COMTRADE page. Then you need select analog channels with phase voltages, currents, zero sequence current.

List of inputs for impedance calculator that you need link:

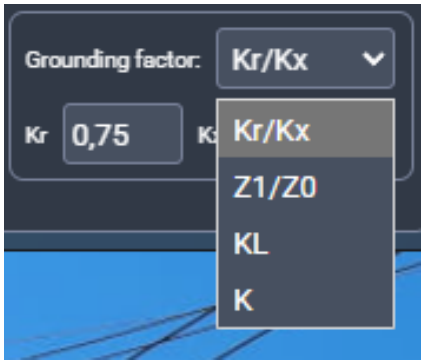
UA UB UC are the phase voltages.
IA IB IC are the phase currents.
3I0 is zero sequence current.

It should be noted that the zero sequence current section has an **Inversion** switch that inverse direction of this current.



Our algorithm developed for use with calculated zero sequence current. But if you decide to use recorded zero sequence current you have to clearly understand what current you will use and how this switch can be used. For example, Siemens relays records current named as **IE**. If you check the manual, you'll see that this current is equal to **-3I0** and if you link this current to the 3I0 input of the impedance calculator you need to turn **Inversion** switch.

We have several options for the grounding factor.



Impedance calculator includes algorithms depending on the selected fault loop.

For **Phase-Ground** loop impedance calculated as follows:

$$Z = \frac{U_{ph}}{I_{ph} + KL \times 3I0}$$

Where **Uph** - phase voltage,
Iph - phase current,
KL - complex grounding factor,
3I0 - tripled zero sequence current.
When you change the grounding factor you change how **KL** is calculated.

Exception is for **Kr/Kx**, in this case impedance is calculated as:

$$R = \frac{U_{ph}}{I_{ph}} \times \frac{\cos(\varphi_U - \varphi_I) + \frac{3I0}{I_{ph}} \times K_X \times \cos(\varphi_U - \varphi_{3I0})}{1 + (K_R + K_X) \times \frac{3I0}{I_{ph}} \times \cos(\varphi_{3I0} - \varphi_I) + K_R \times K_X \times \left(\frac{3I0}{I_{ph}}\right)^2}$$

$$X = \frac{U_{ph}}{I_{ph}} \times \frac{\sin(\varphi_U - \varphi_I) + \frac{3I0}{I_{ph}} \times K_R \times \sin(\varphi_U - \varphi_{3I0})}{1 + (K_R + K_X) \times \frac{3I0}{I_{ph}} \times \sin(\varphi_{3I0} - \varphi_I) + K_R \times K_X \times \left(\frac{3I0}{I_{ph}}\right)^2}$$

For **Z1/Z0**:

$$KL = \frac{1}{3}\left(\frac{Z0}{Z1} - 1\right)$$

For **K**:

$$KL = \frac{K}{3} \times e^{j0^\circ}$$

K - is used with Ukrainian Hartron relays and it can be used for KPC-4 distance relay analysis.

For **Phase-Phase** loop impedance calculated as follows:

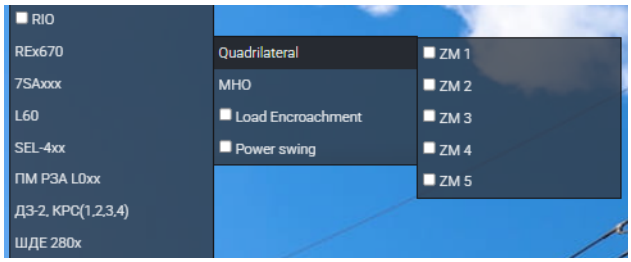
$$Z = \frac{U_{ph1} - U_{ph2}}{I_{ph1} - I_{ph2}}$$

For **Phase-Phase 3ph** loop impedance calculated as follows:

$$Z = \frac{U_{ph}}{I_{ph}}$$

You need to understand which loop and calculation algorithm to choose for analysis. For example, if you are analyzing **KPC-2** electromechanical relay which is wired to phase voltage and phase current you have to select the **Phase-Phase 3ph** loop with any type of fault. Same as the case when this relay is wired to phase-to-phase voltage and phase-to-phase current you have to select the **Phase-Phase** loop with any type of the fault.

DEVICE SETTINGS

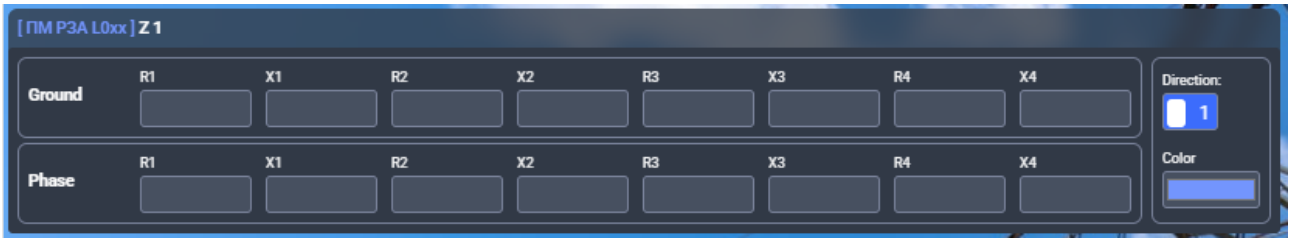


We have modules for famous European and American manufacturers modern devices but also for Ukrainian and old USSR protection systems.

All you need is to add desired module, insert specified settings and choose measurement loop to draw characteristics.

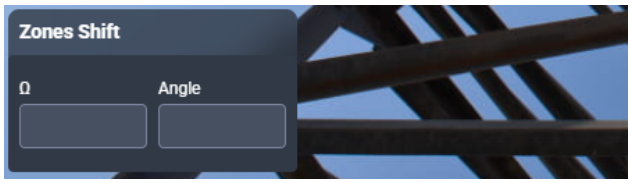
If you have device RIO file you can use our module for characteristic drawing, in that case you need just drop RIO file into it.

If you can't find device you need, please contact us, as alternative you can use ПМ РЗА L0xx modules if you know characteristic points.

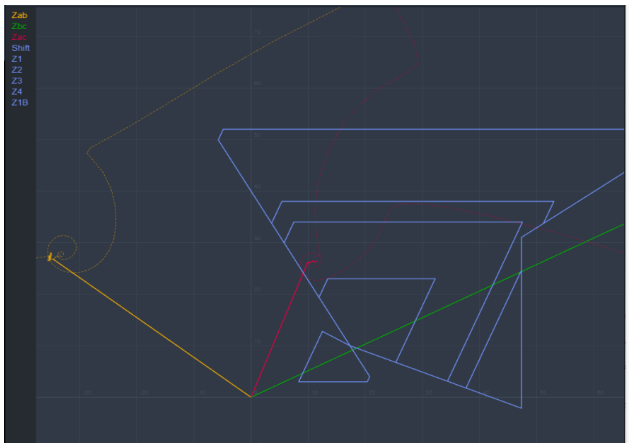


ZONES SHIFT.

Relay → **Distance protection** → **Add Element** → **Zones shift**



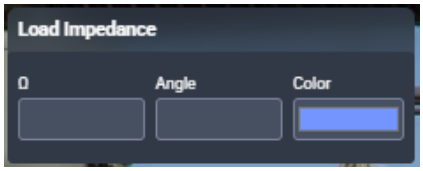
This feature allows you to shift all zones by specified vector.



The result of such shifting is shown below.

LOAD IMPEDANCE

Relay → **Distance protection** → **Add Element** → **Load impedance**



This is simple module just to draw any vector you want. It can be useful when you use RelayHelper just to visualize characteristics and want to add load impedance to them.