TEST TUTORIAL

EQUIPMENT TYPE: Protection Relay.

BRAND: ZIV.

MODEL: DLF.

FUNCTION: 68 or RPSB - Power Swing Blocking (PSB) & 78 or PPAM - Out of step (OoS).

TOOL USED: CE-6006, CE-6707, CE-6710, CE-7012 or CE-7024.

OBJECTIVE: Test of PSB and OoS in Conditions of Synchronous and Asynchronous Power Oscillations.

CONPROVE
INDÚSTRIA & COMÉRCIO

INSTRUMENTOS PARA TESTES ELÉTRICOS

VERSION CONTROL:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial Version	15/03/2022	M.R.C.	G.C.D.P.

SUMMARY

Statement of responsibility

The information contained in this tutorial is constantly verified. However, differences in description cannot be completely excluded; in this way, CONPROVE disclaims any responsibility for errors or omissions contained in the information transmitted.

Suggestions for improvement of this material are welcome, just user contacts us via email suporte@conprove.com.br.

The tutorial contains knowledge gained from the resources and technical data at the time was writing. Therefore, CONPROVE reserves the right to make changes to this document without prior notice.

This document is intended as a guide only the manual of the equipment under testshould always be consulted.

ATTENTION!

The equipment generates high current and voltage values during its operation. Improper use of the equipment can result in material and physical damage.

Only suitably qualified people should handle the instrument. It is noted that the user must have satisfactory training in maintenance procedures a good knowledge of the equipment under test and still be aware of safety rules and regulations.

Copyright

PROCEDURE FOR TESTING THE ZIV DLF RELAY IN PSB_OoS SOFTWARE

1. Relay Connection to CE-6710

In this section, all the connections necessary to run the test in question are discussed. In appendix B of this document you can find the terminal designations of the ZIV DLF relay used.

1.1. Auxiliary Source

For relay power, connect the positive terminal (red) of the Aux. Vdc Source of the test set to terminal 3 of slot A of the relay and the negative terminal (black) to terminal 2 of slot A, as shown in the following figure.

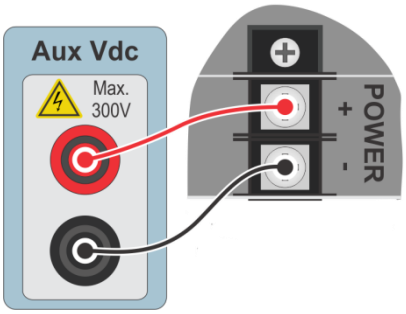

Figure 1

1.2. Analog Outputs

Connect the CE-6710's analog outputs V1, V2 and V3 to terminals 01, 03 and 05 of the relay's D slot and their common to terminals 02, 04 and 06. Then I1, I2 and I3 go to terminals 11, 13 and 15 of the relay and their common to terminals 12, 14 and 16, respectively. The figure below shows the procedure.

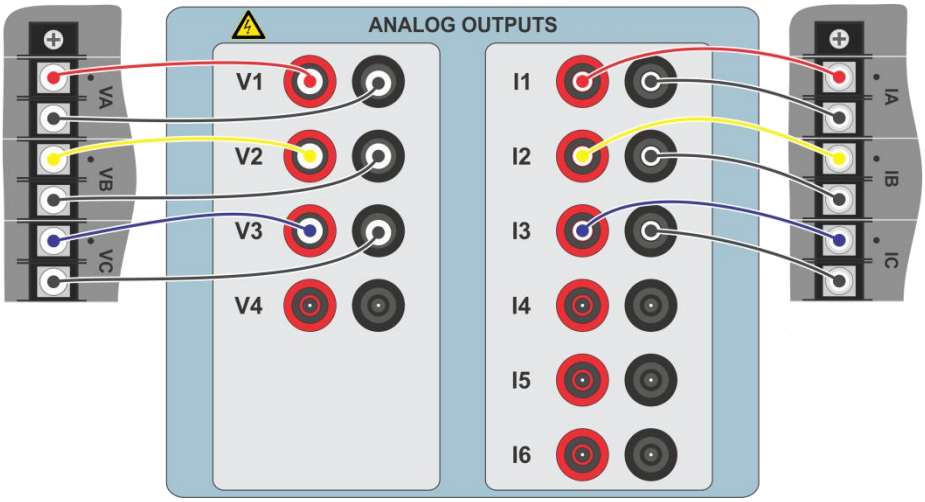

Figure 2

1.3. Binary Inputs

Connect the binary inputs to the binary outputs of the relay in slot A as shown in the table and figure below.

Table 1

CE-6710 (*Binary Inputs*)	DLF (*Slot A*)
BI1	OUT 1 (07 and 08)
BI2	OUT 2 (09 and 10)
BI3	OUT 3 (11 and 12)

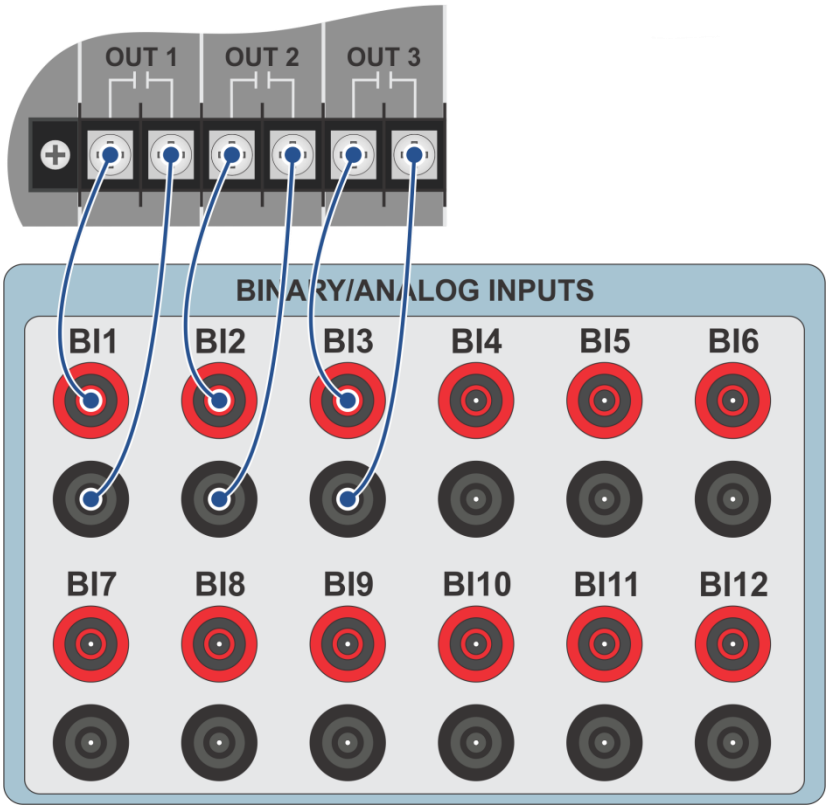

Figure 3

2. First steps with the DLF relay

2.1. Communication between PC and relay

Communication with the relay is done through an Ethernet cable connected between the relay and the computer that has the ZivercomPlus software. Double click on the relay software icon.

Figure 4

Enter the username and password. To gain access use ***"zivercom"*** and the password ***"ziv".***

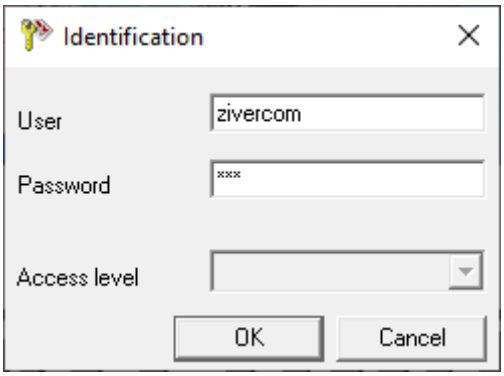

Figure 5

Then, from the main menu, go to *"IEDs" > "Installations".*

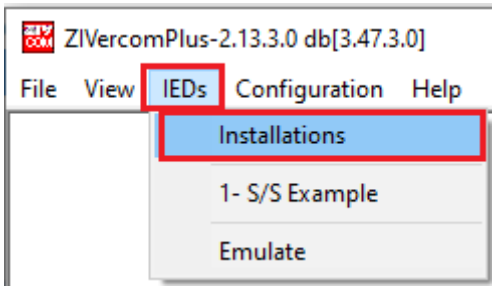

Figure 6

Select the default file *"SubExamples.sds"* and click *"Edit".*

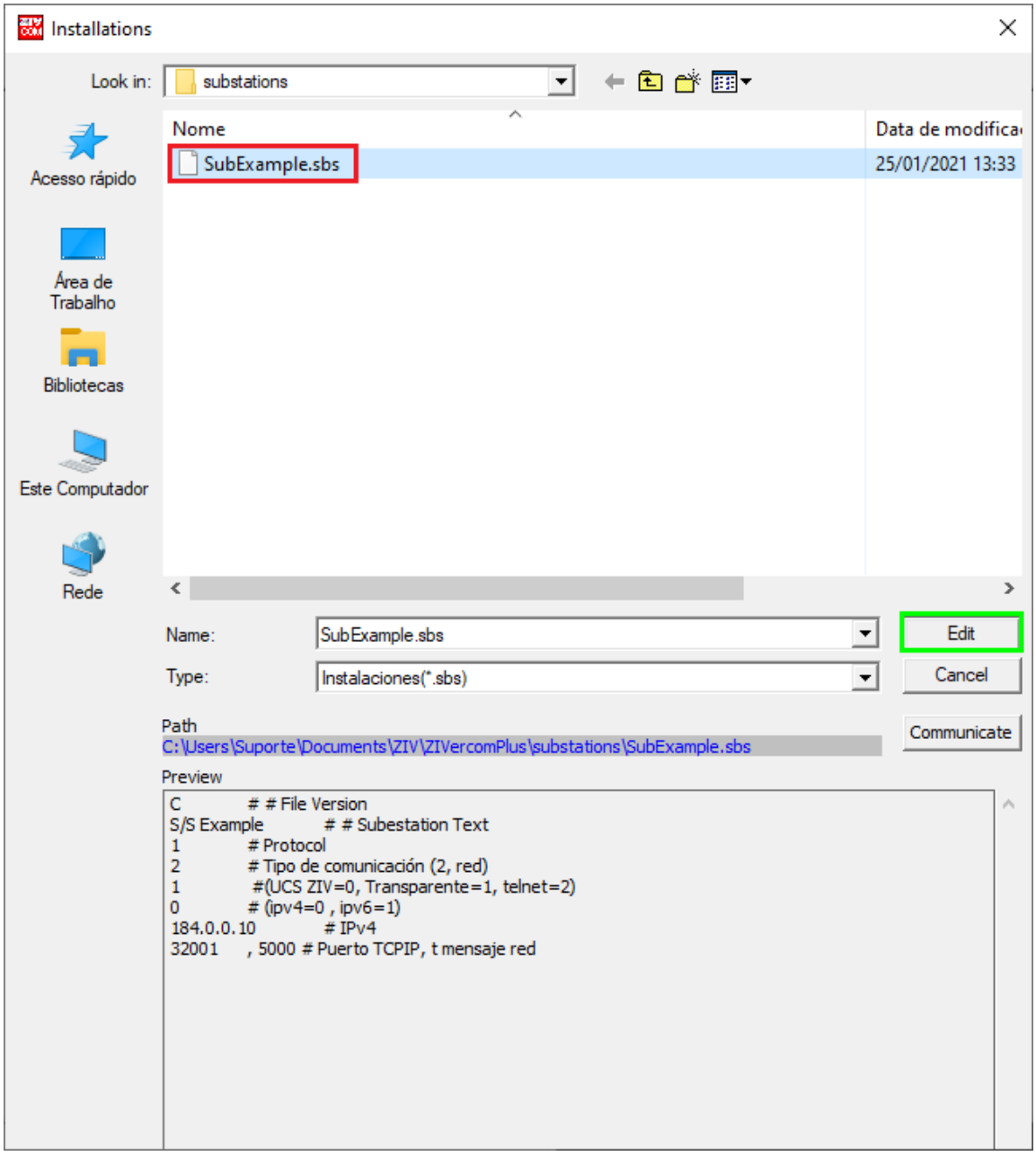

Figure 7

The next step is to check the data set for communication on the relay front panel. This data must be entered into the software for successful communication to occur.

CONPROVE
INDÚSTRIA & COMÉRCIO

INSTRUMENTOS PARA TESTES ELÉTRICOS

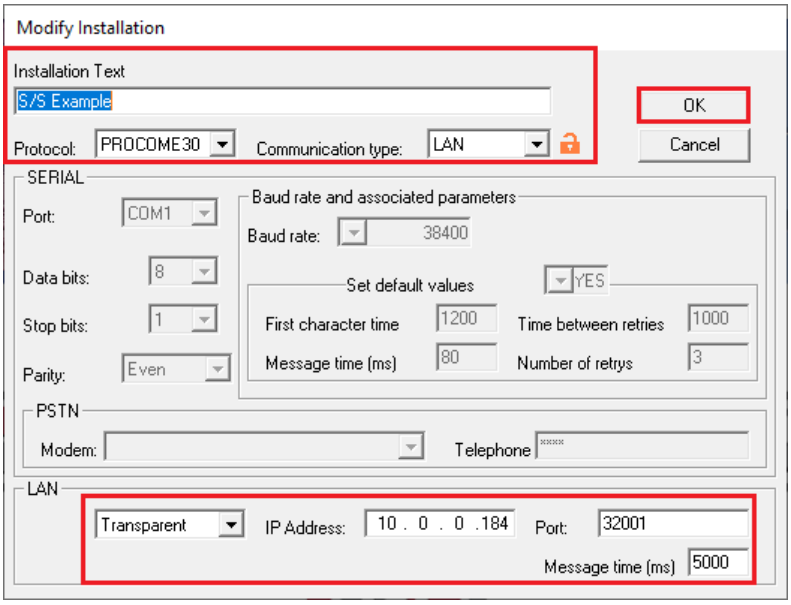

Figure 8

By clicking on the *"OK"* button, you will return to figure 7, select the file again and click on *"Communicate".*

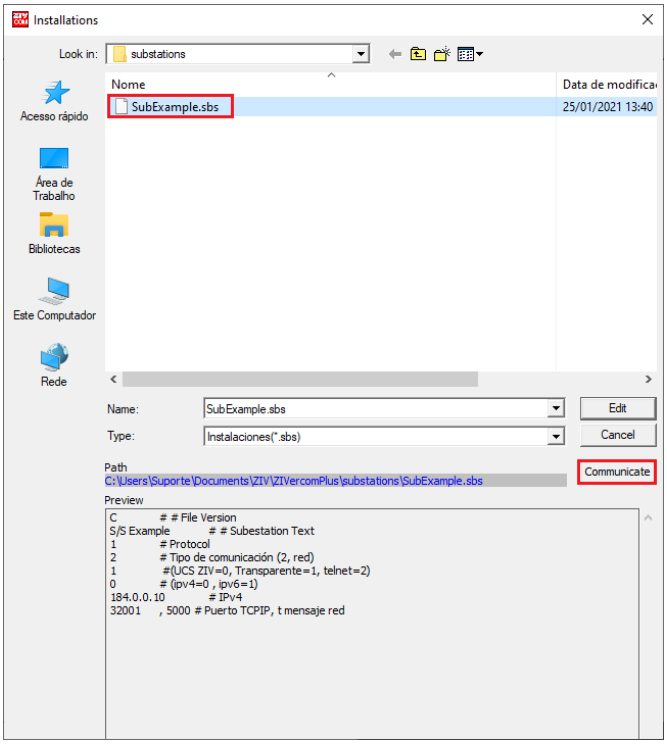

Figure 9

Click *"OK"* again.

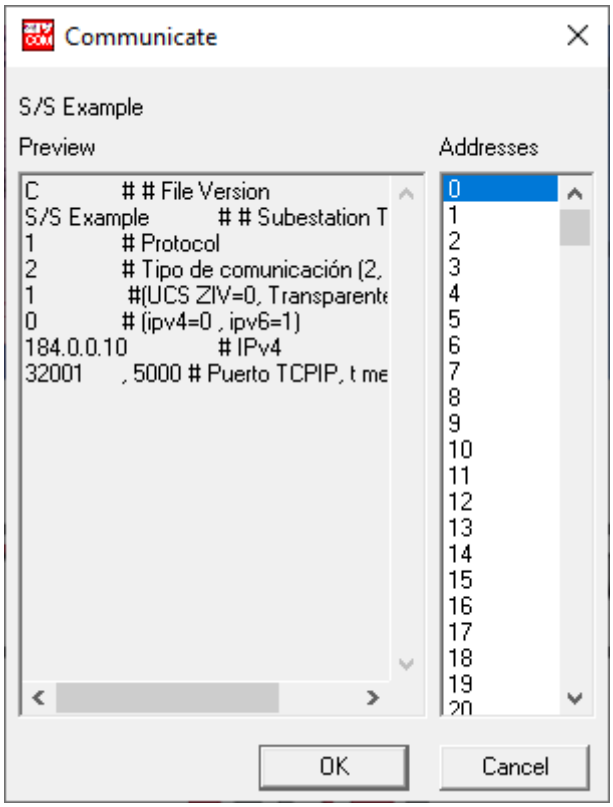

Figure 10

If the field *"Communications type"* is configured as *"LAN-TLS"*, a second level of access will be requested, use the default user ***"admin"*** and the default password ***"Passwd@02".***

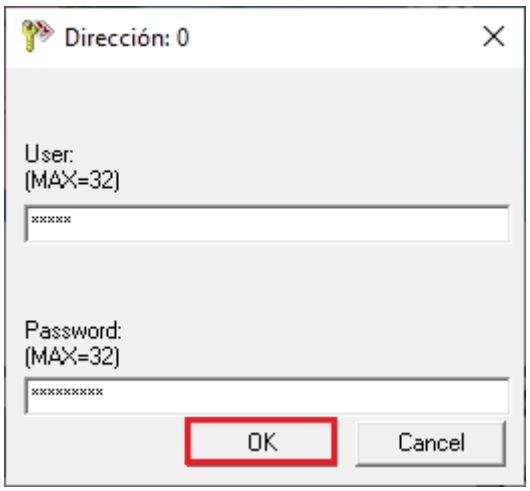

Figure 11

3. Parameterization of the ZIV DLF relay

3.1. Nominal Values

Click on the highlighted *"+"* signs until you reach the *"Nominal Values"* option. In this option, nominal voltage 115.0V, nominal phase current 5.0A and nominal frequency 60.00Hz must be set.

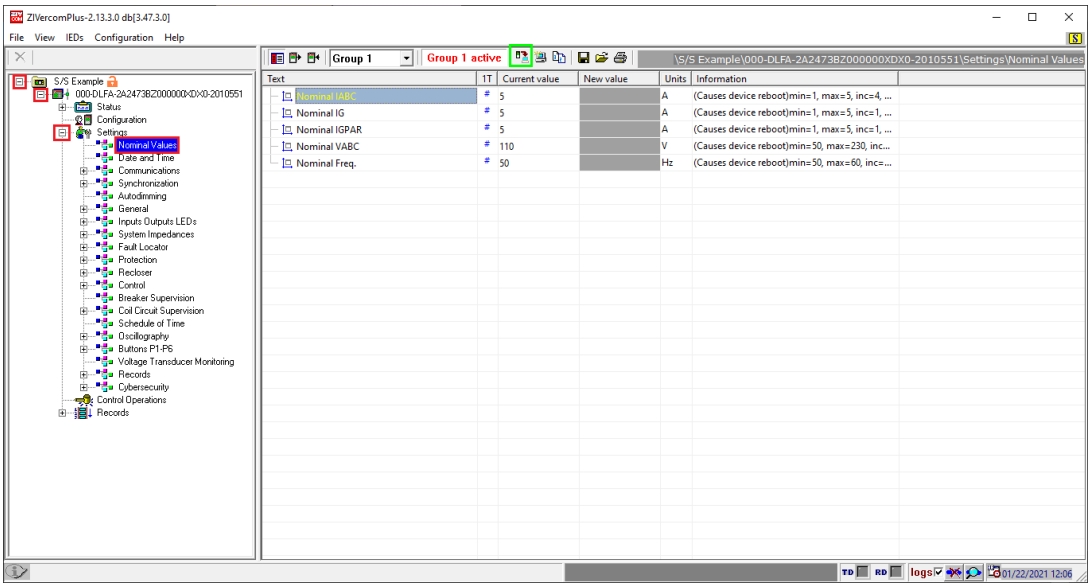

Figure 12

To change the voltage and frequency value, click on the icon highlighted in green in the previous figure.

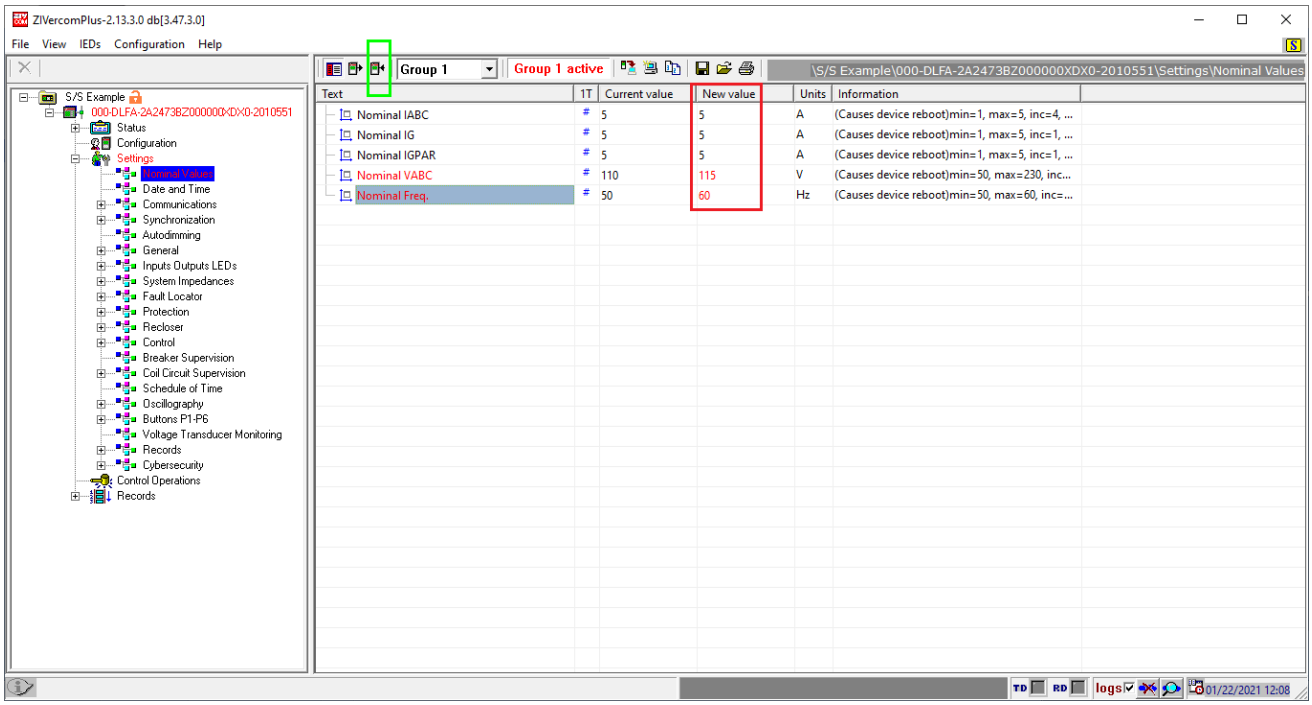

Figure 13

After changing the new value, click again on the icon highlighted in green in the previous figure to send the adjustment to the relay.

3.2. General

Click on the *"General"* option and configure the transformer ratios of the phase, neutral, voltage transformer current transformers and the phase sequence.

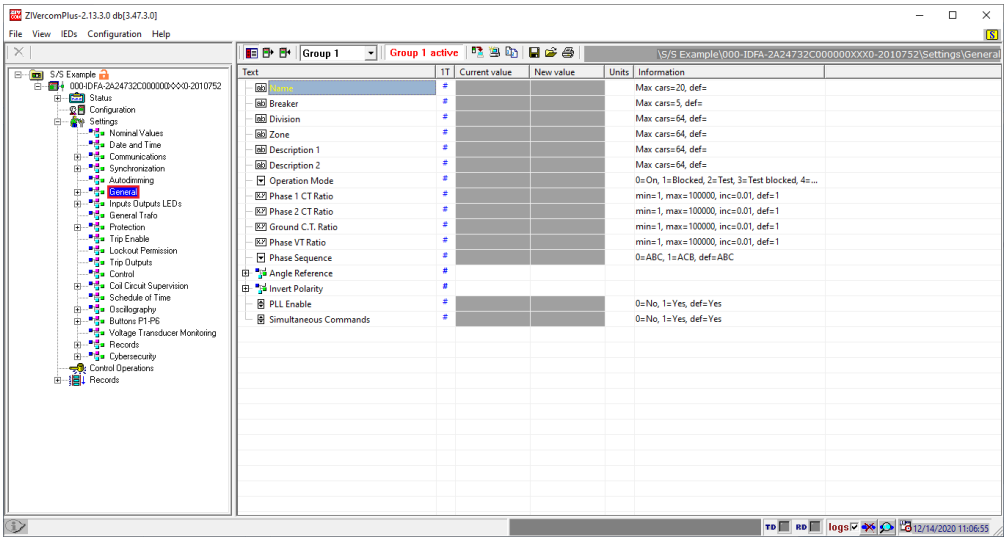

Figure 14

It can be seen in the previous figure that the values in the column *"Current Value"* and *"New value"* are hidden. To allow visualization and configuration click on the buttons highlighted in red and then green.

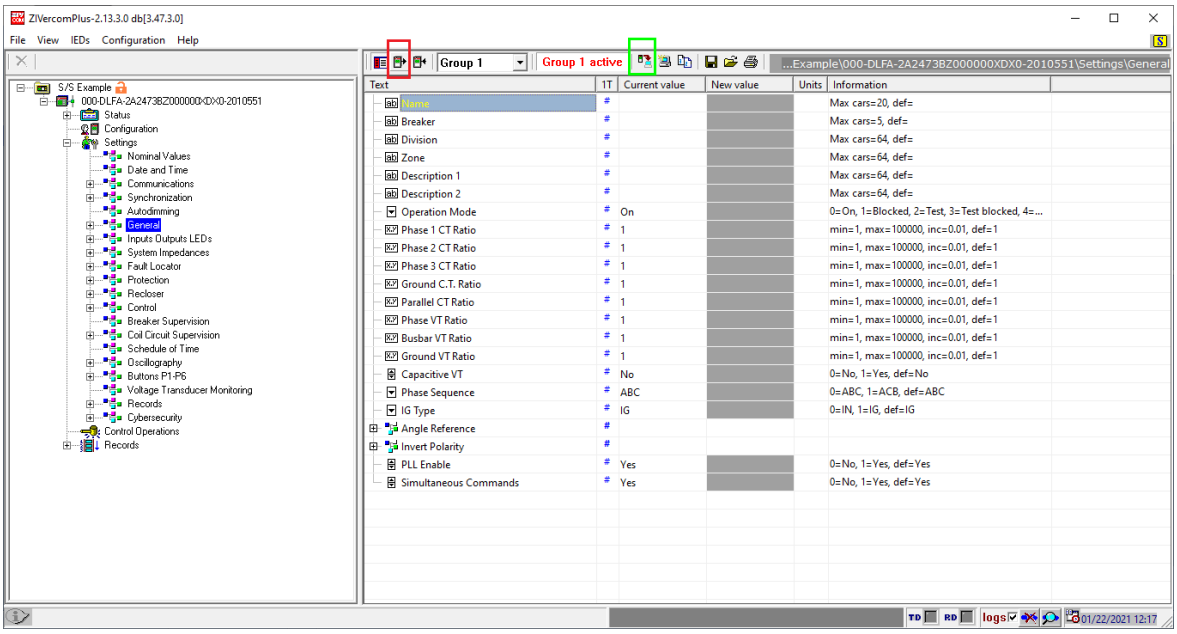

Figure 15

3.3. Characteristic

Click on the *"+"* signs until you reach the *"Characteristic"* option. In this option, the zone types are set as MHO. Then send the adjustments by clicking on the icon highlighted in green.

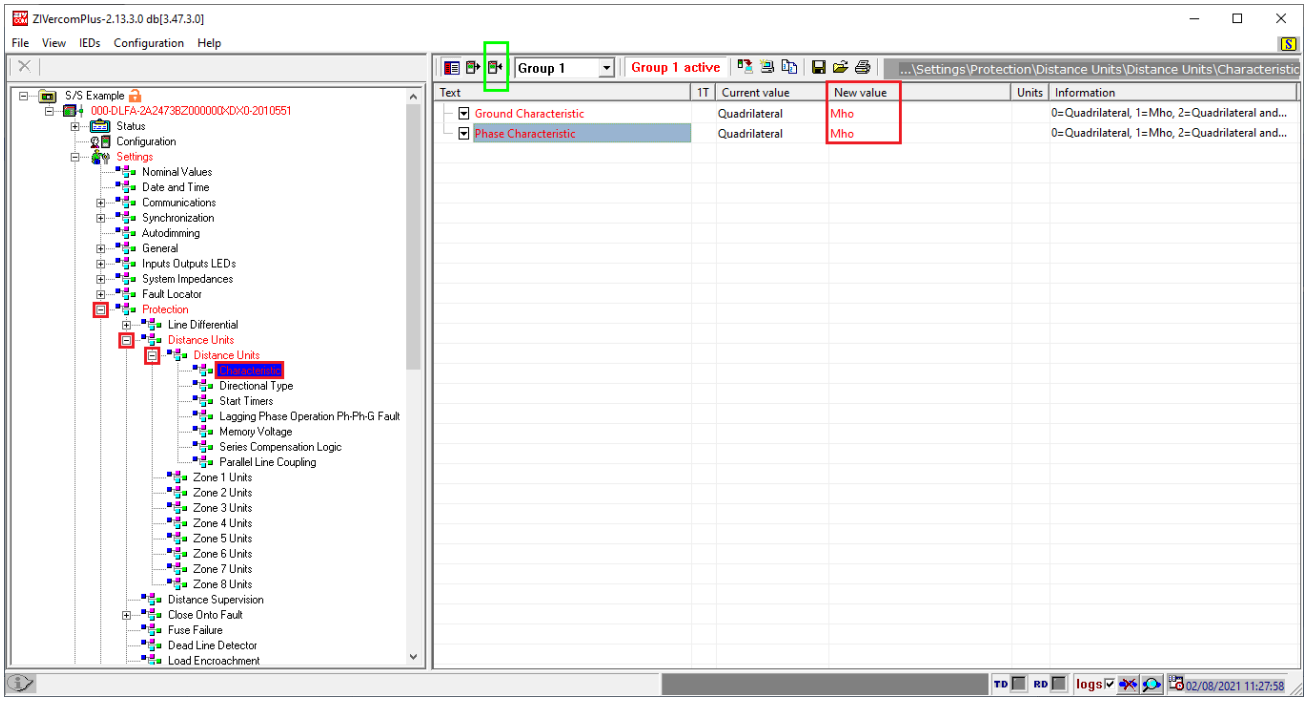

Figure 16

3.4. Zone 1 Units

Select the *"Zone 1 Units"* option, activate the neutral and phase unit, directionality, zone reach, timing, positive and zero sequence angles, earth compensation factor and zone blocking due to power swing. Submit the adjustments by clicking on the icon highlighted in green.

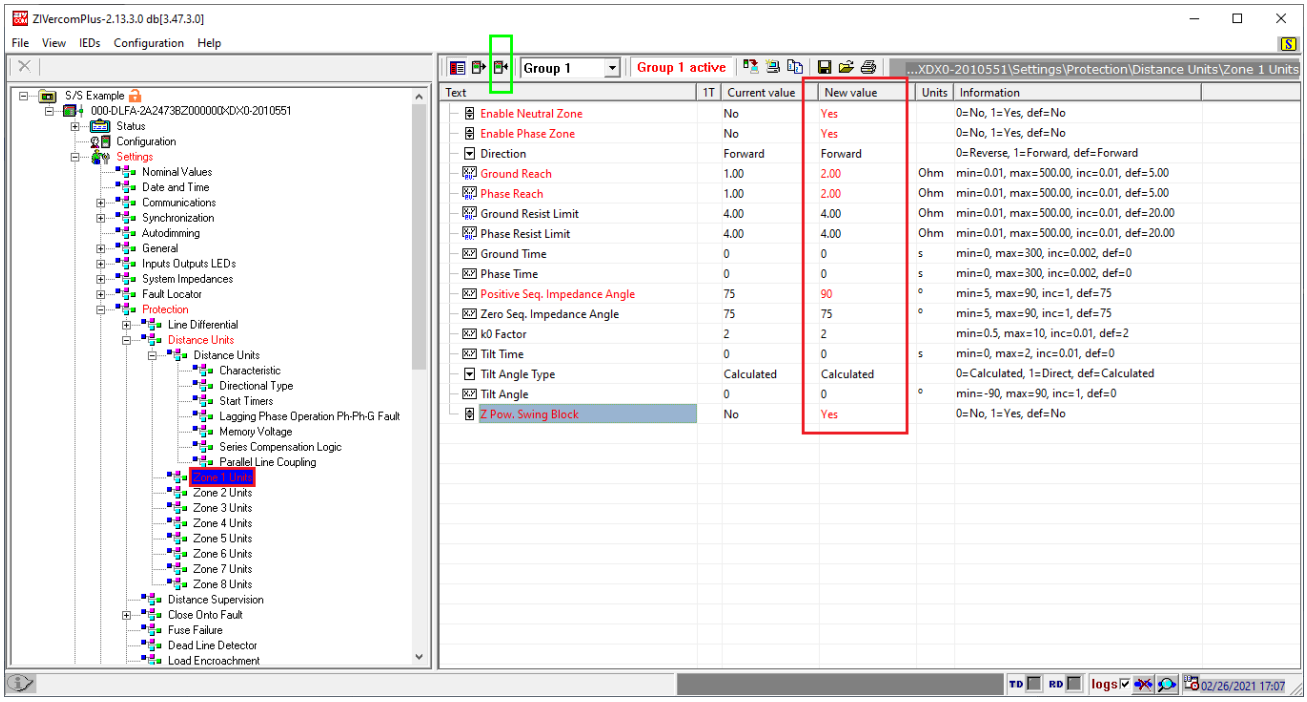

Figure 17

3.5. Power Swing Detector

Activate the synchronous and asynchronous oscillation detection units. Configure zone ranges: outer, middle, and inner. Adjust the timings and send the settings to the relay.

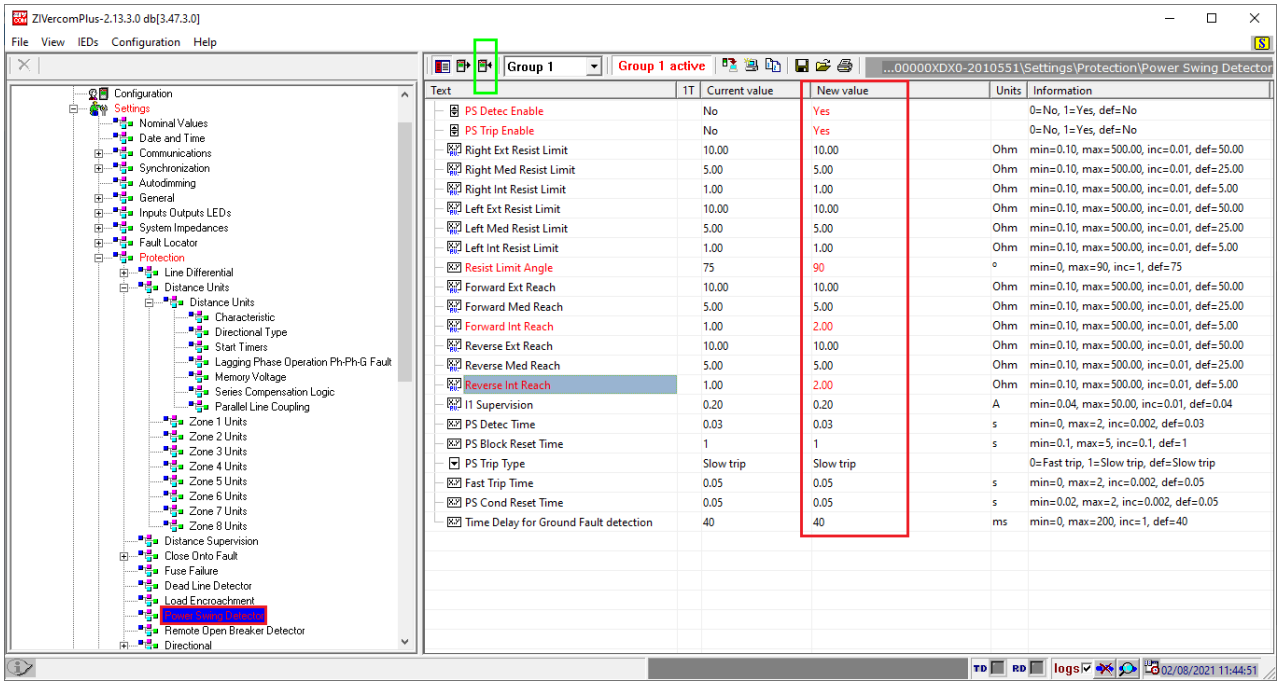

Figure 18

3.6. Outputs

In order to test the tripping signal of function 21, as well as the blocking and tripping signals of the Power swing, 3 relay output binaries will be used to collect these signals by the test set. In the figure below, configure the first output as a zone 1 trip for both neutral and phase.

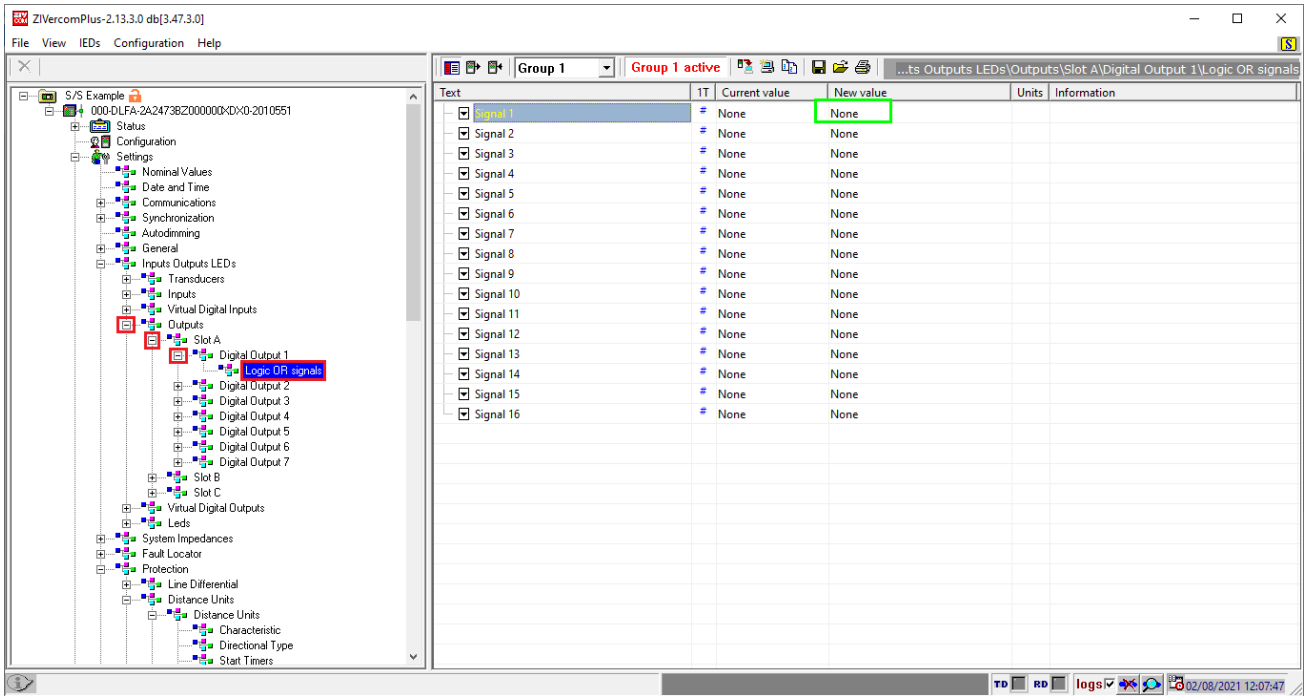

Figure 19

Clicking on the *"None"* option highlighted in the previous figure, make the following adjustment.

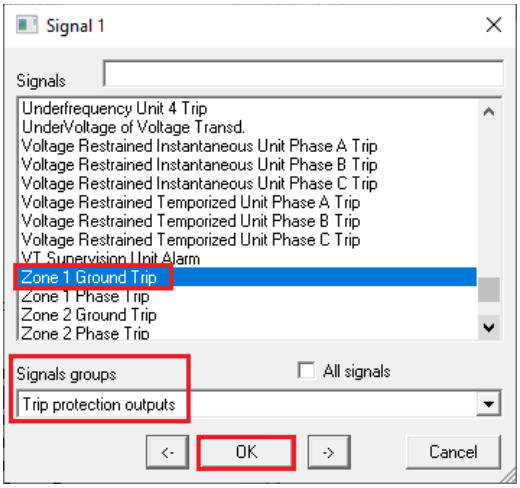

Figure 20

Repeat the previous procedure for the phase trip.

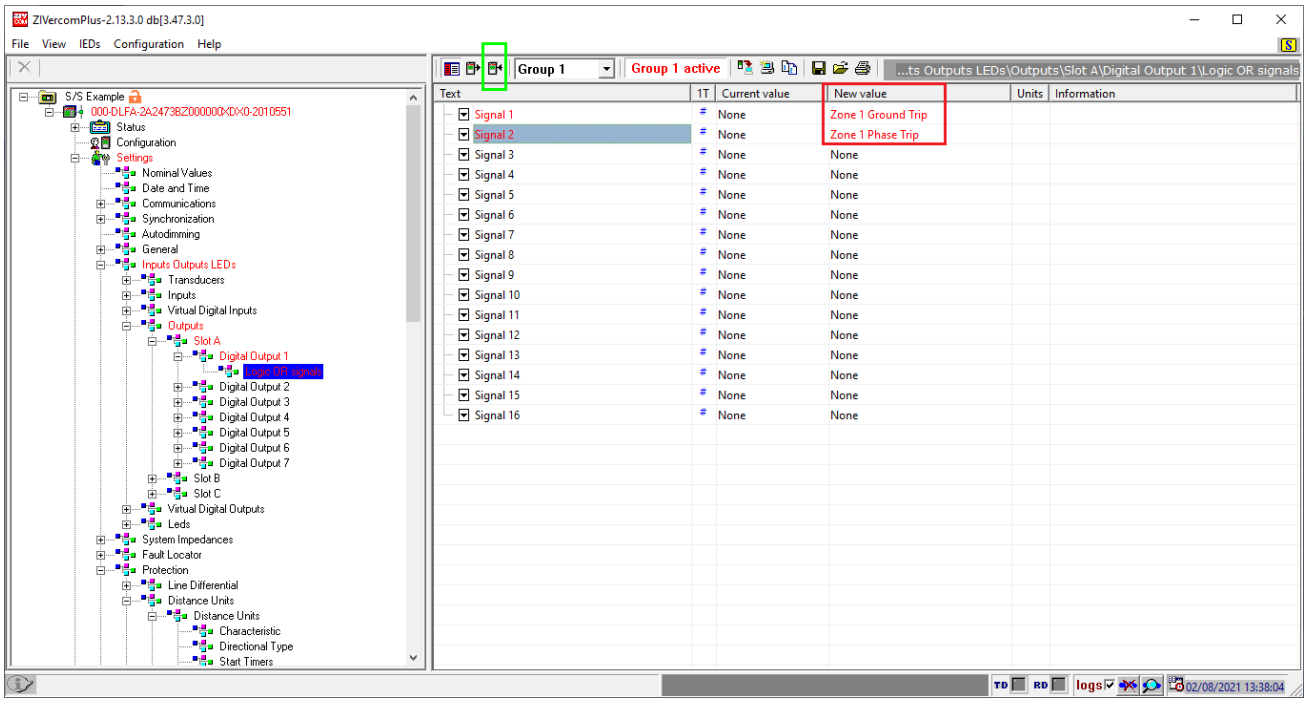

Figure 21

On the second output configure the 78 or OoS trip signal.

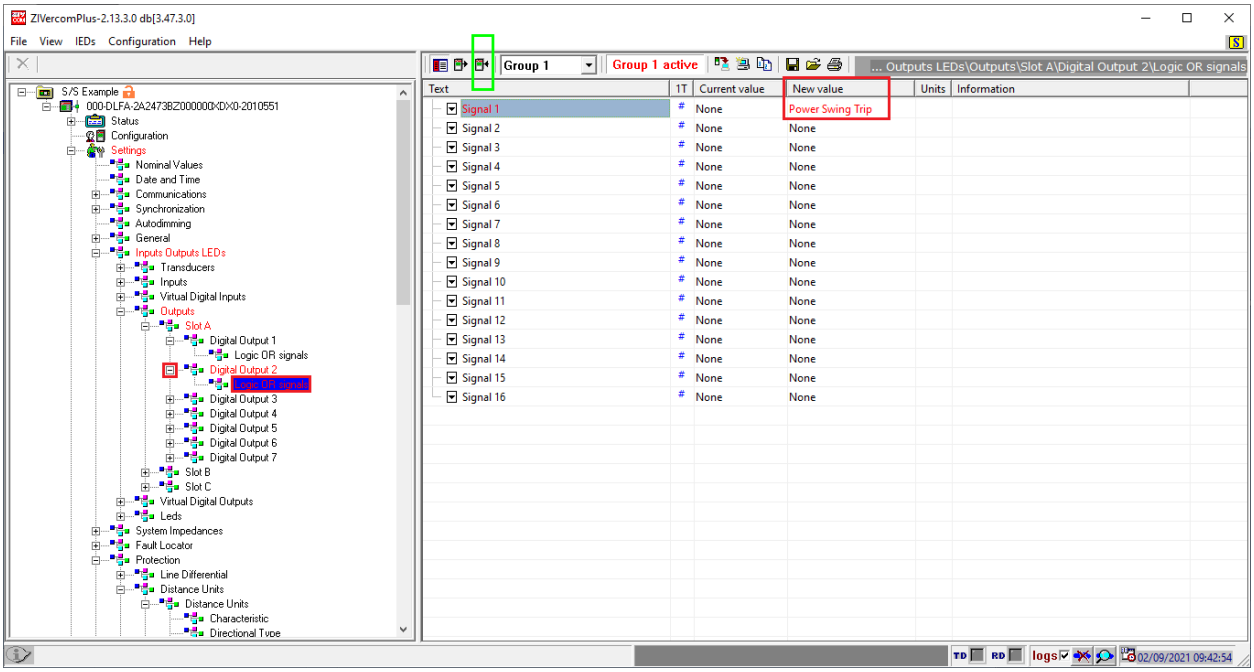

Figure 22

On the third output, configure the Power swing blocking signal (68).

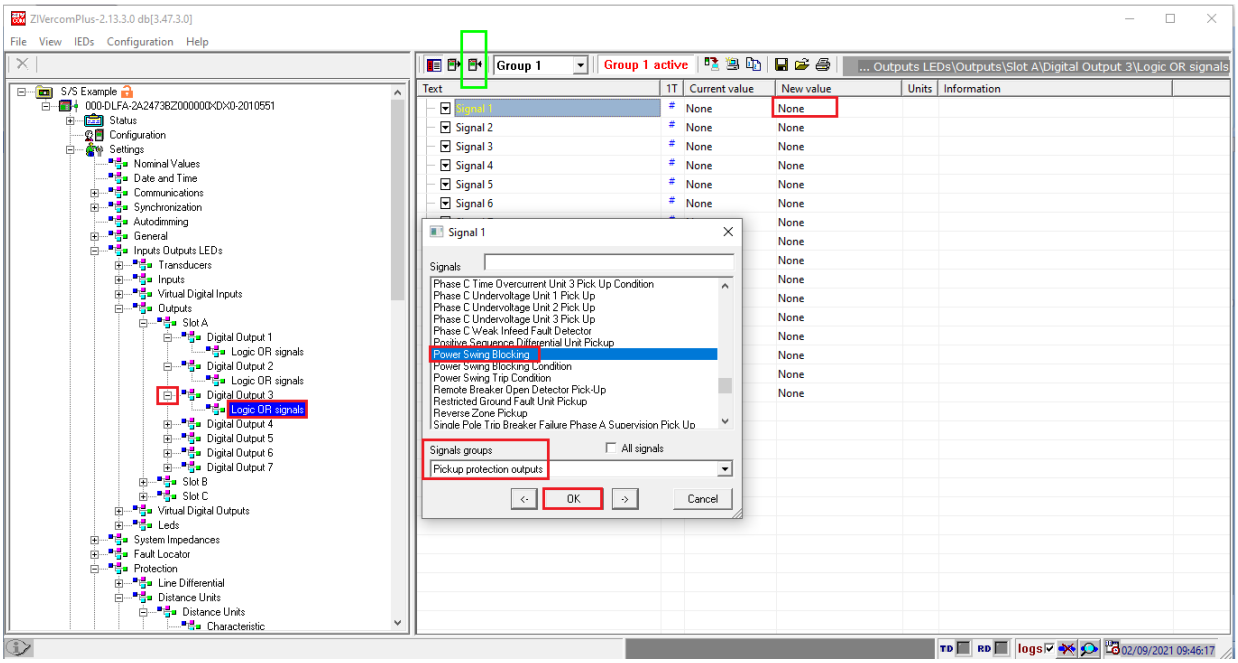

Figure 23

4. Application Manager

Open the Conprove Test Center (CTC) software, shown in the figure below.

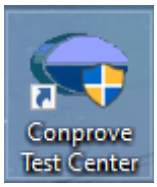

Figure 24

4.1. PSB_OoS software adjustments

Open the PSB_OoS software within the Conprove Test Center (CTC) software area, as shown in the figure below.

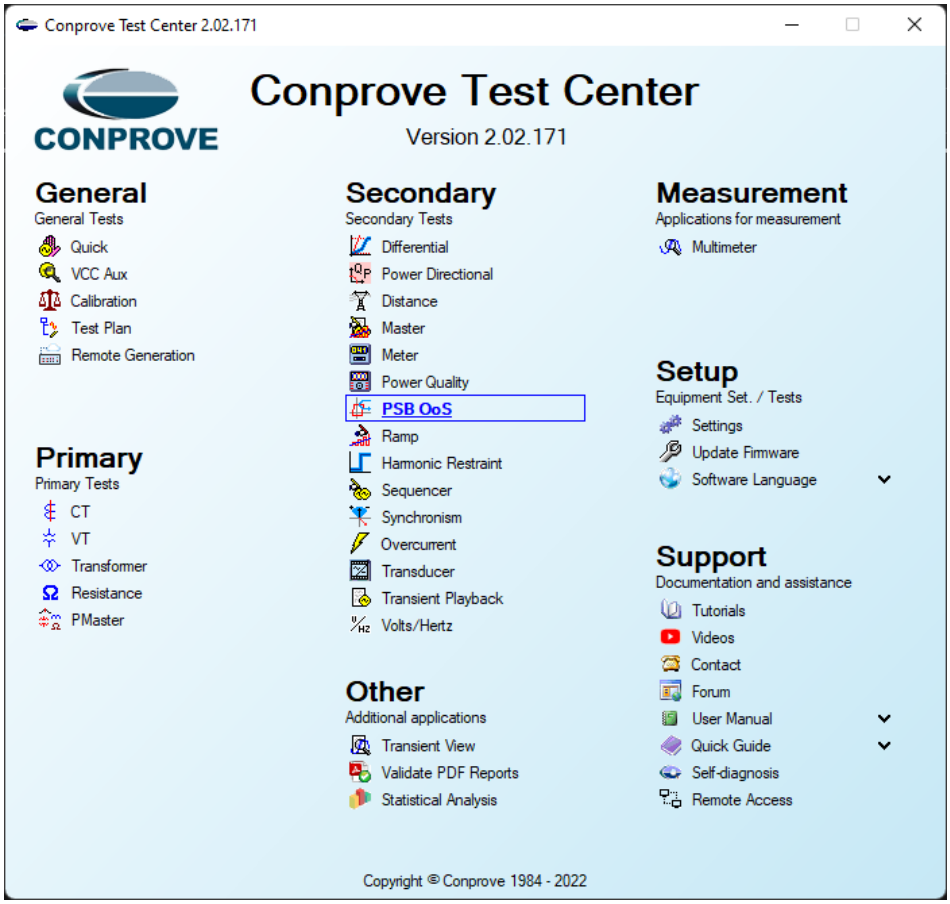

Figure 25

When opening the software, the *"Settings"* screen will open automatically (provided that the option *"Open Settings when Start"* found in the *"Software Options"* menu is selected). Otherwise, click directly on the *"Settings"* icon. Fill in the *"General Inform."* with details of the tested device, installation location and the person responsible. This facilitates the preparation of the report, and this tab will be the first to be shown.

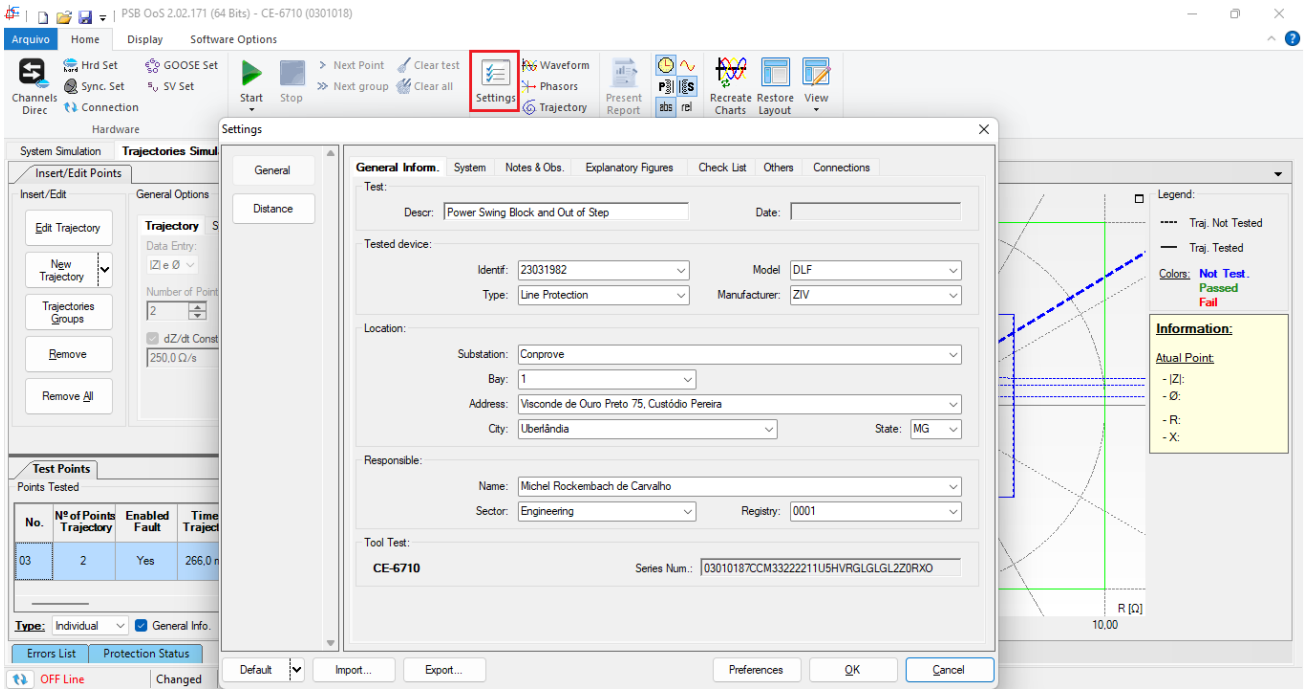

Figure 26

Also in the *"Settings"* area, there are other useful tabs for the user. In the figure below, within the *"System"* tab, the values of frequency, phase sequence, primary and secondary voltages, primary and secondary currents, transformation ratios of VTs and CTs are configured. There are also two sub tabs *"Impedance"* and *"Source"*, whose data is not used for this test.

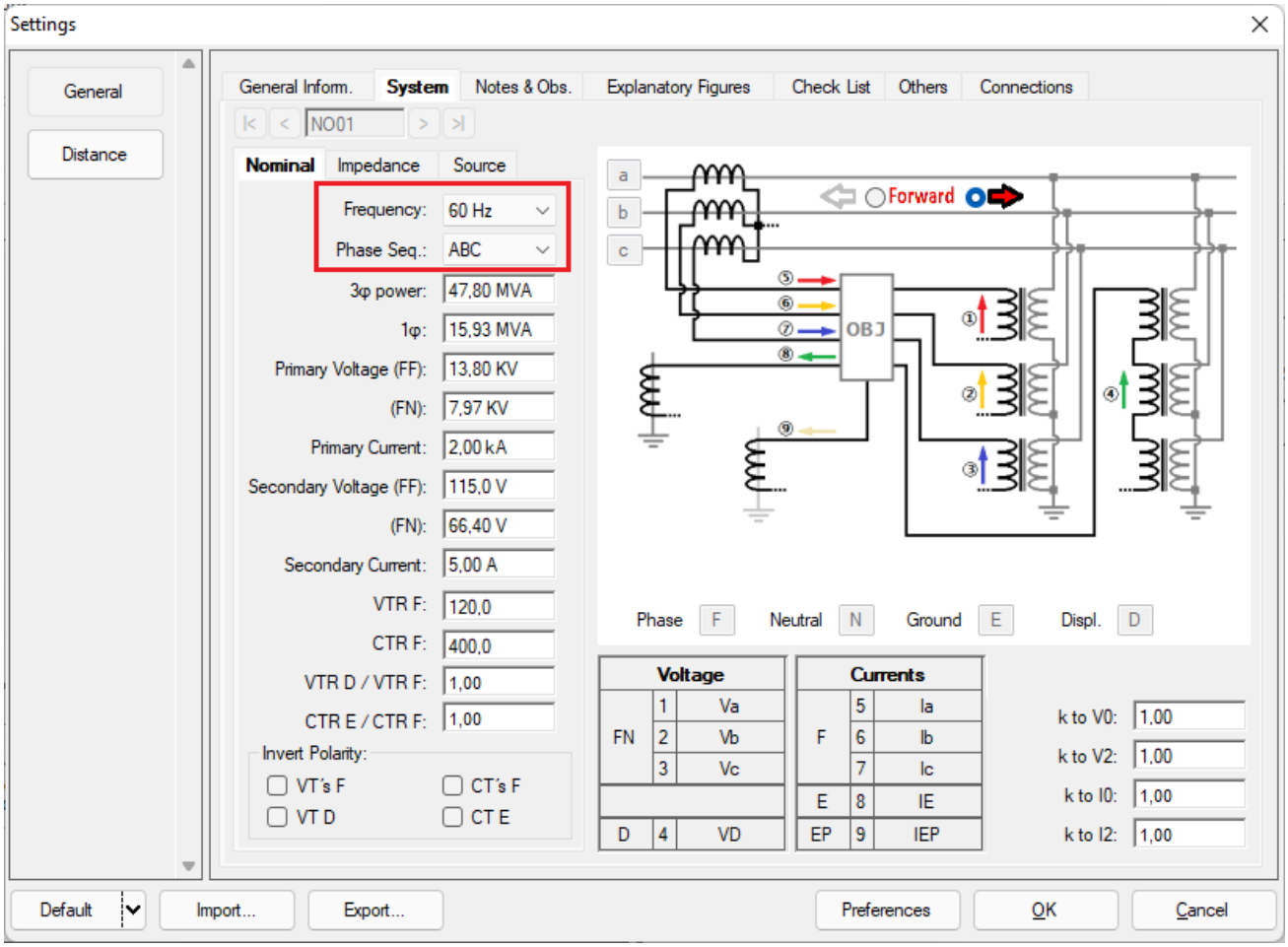

Figure 27

There are other tabs where the user can enter *"Notes & Obs."*, *"Explanatory Figures"*, can create a *"Check List"* of the procedures for carrying out the test and also create a schematic of the connections between the test set and the test equipment.

4.2. Distance screen > Distance Prot. Settings

Click on the *"Distance"* button, the screen shows the parameters of length, line angle and ground compensation factor. For this specific test there is no need to adjust these values.

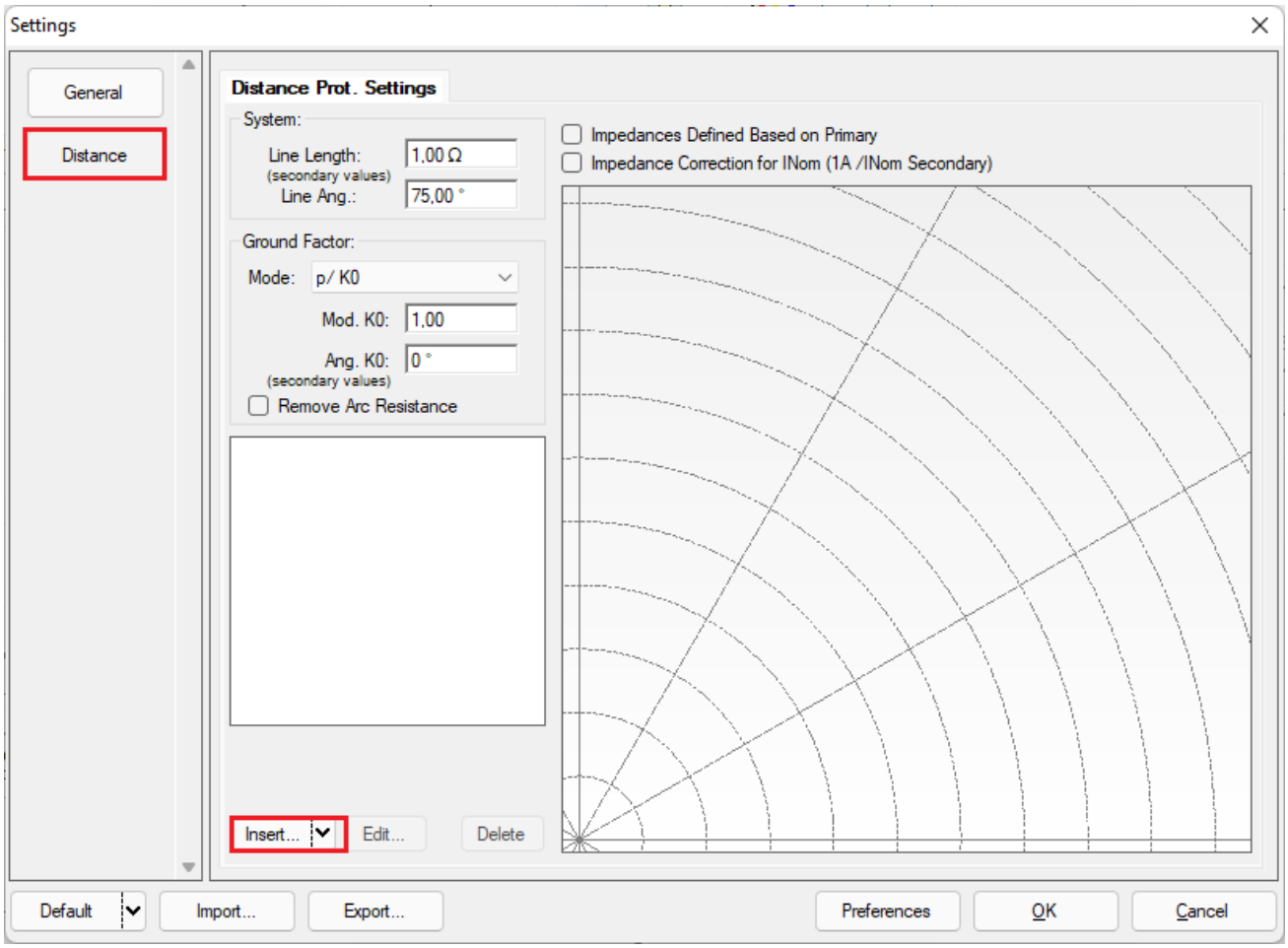

Figure 28

4.3. Entering Zone 1

Click on the *"Insert"* field highlighted in the previous figure. In the settings screen, first choose the relay mask *"ZIV DLF – Mho"*. You must adjust the actuation time, choose the

type of fault (loop) enter the zone characteristics and directionality. Adjust the tolerance values and finally click on *"OK"*.

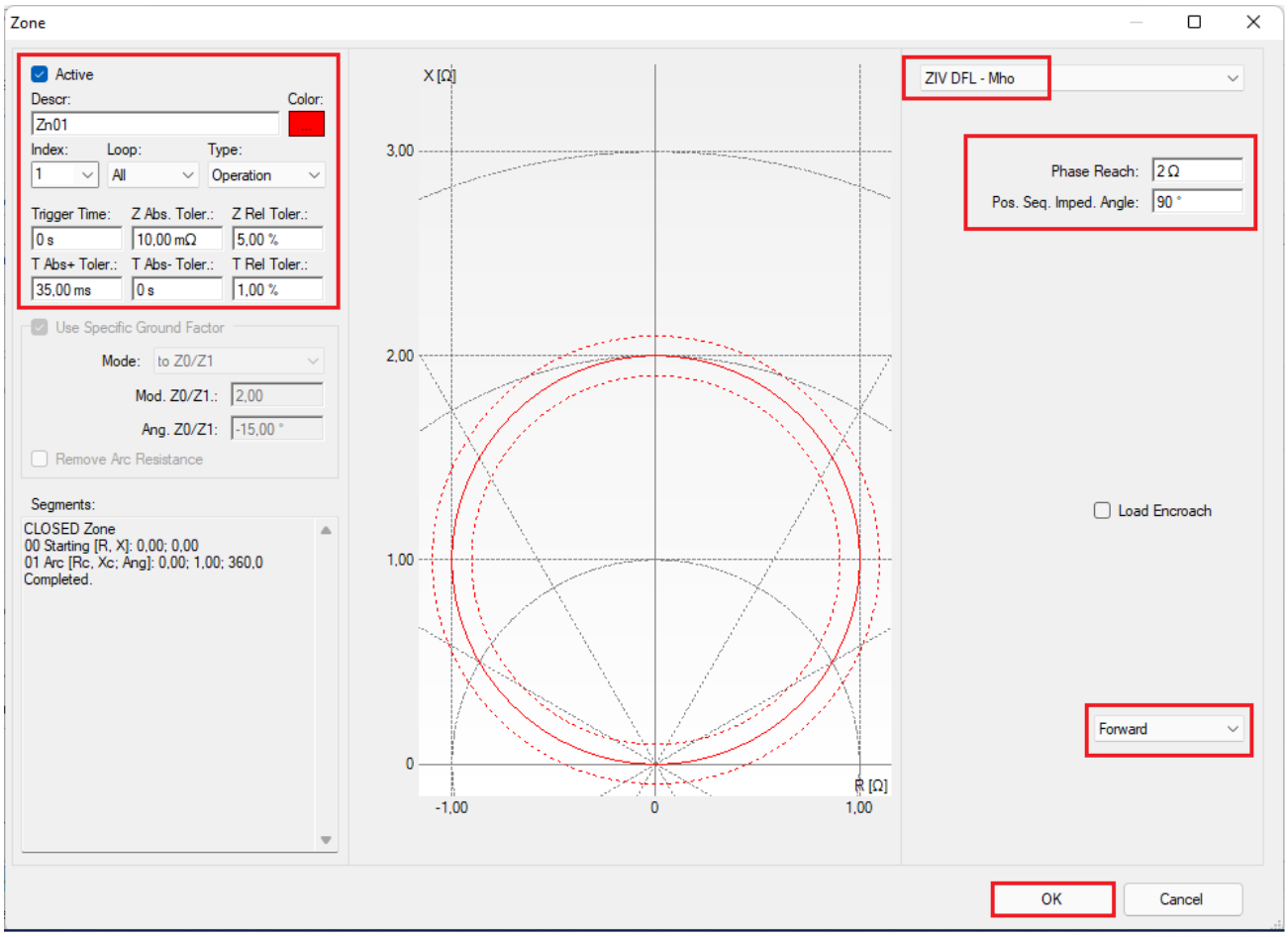

Figure 29

4.4. Inserting the zones: inner, middle and outer

Click on the *"Insert"* field again. In the settings screen, choose the generic mask *"Quadrilateral"* then adjust the resistance and reactance values according to the relay settings for the internal zone. Remove the tolerances and change the name to *"INNER"*.

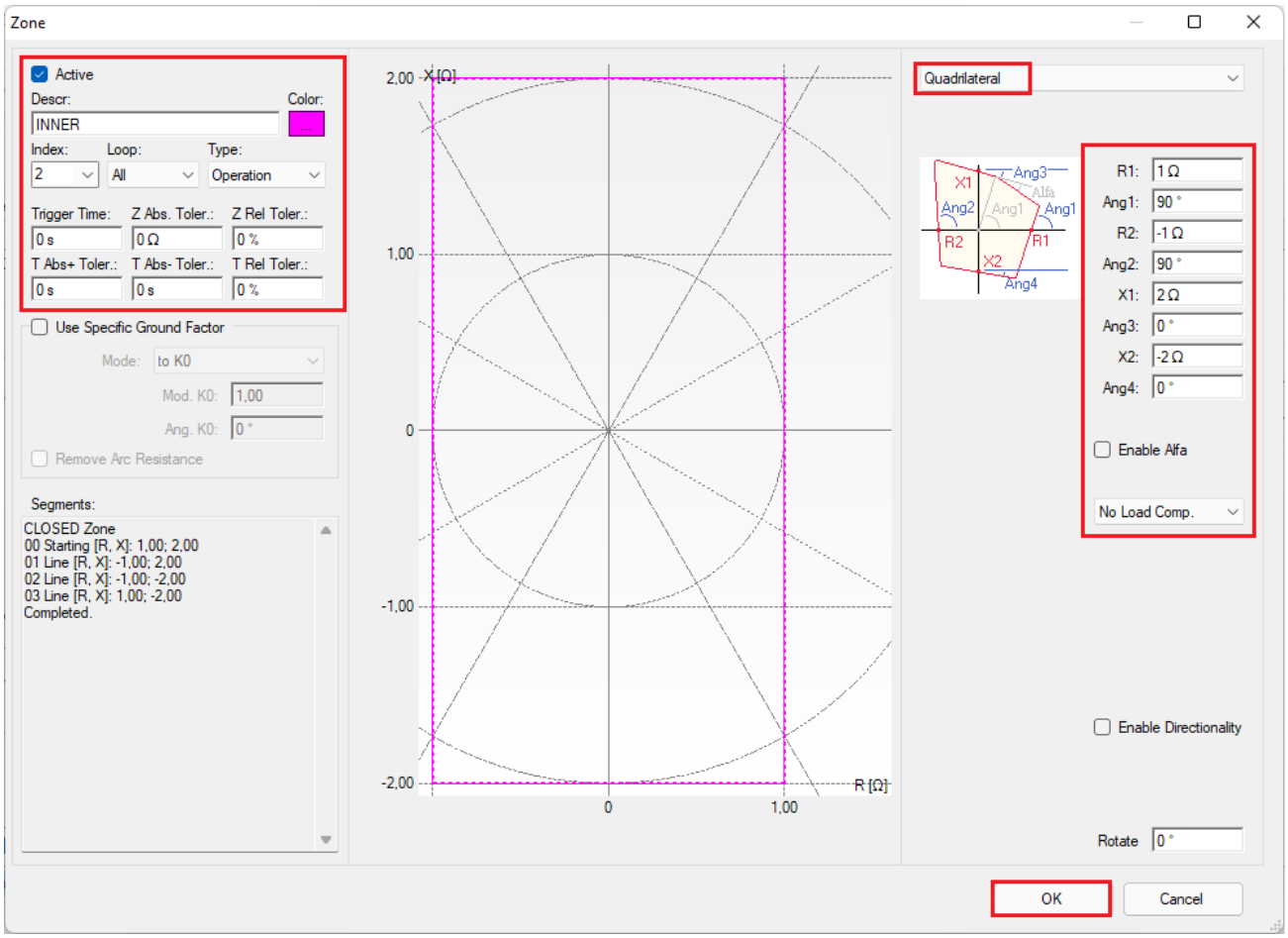

Figure 30

Repeat the procedure and adjust the middle zone. Change your name to *"MIDDLE".*

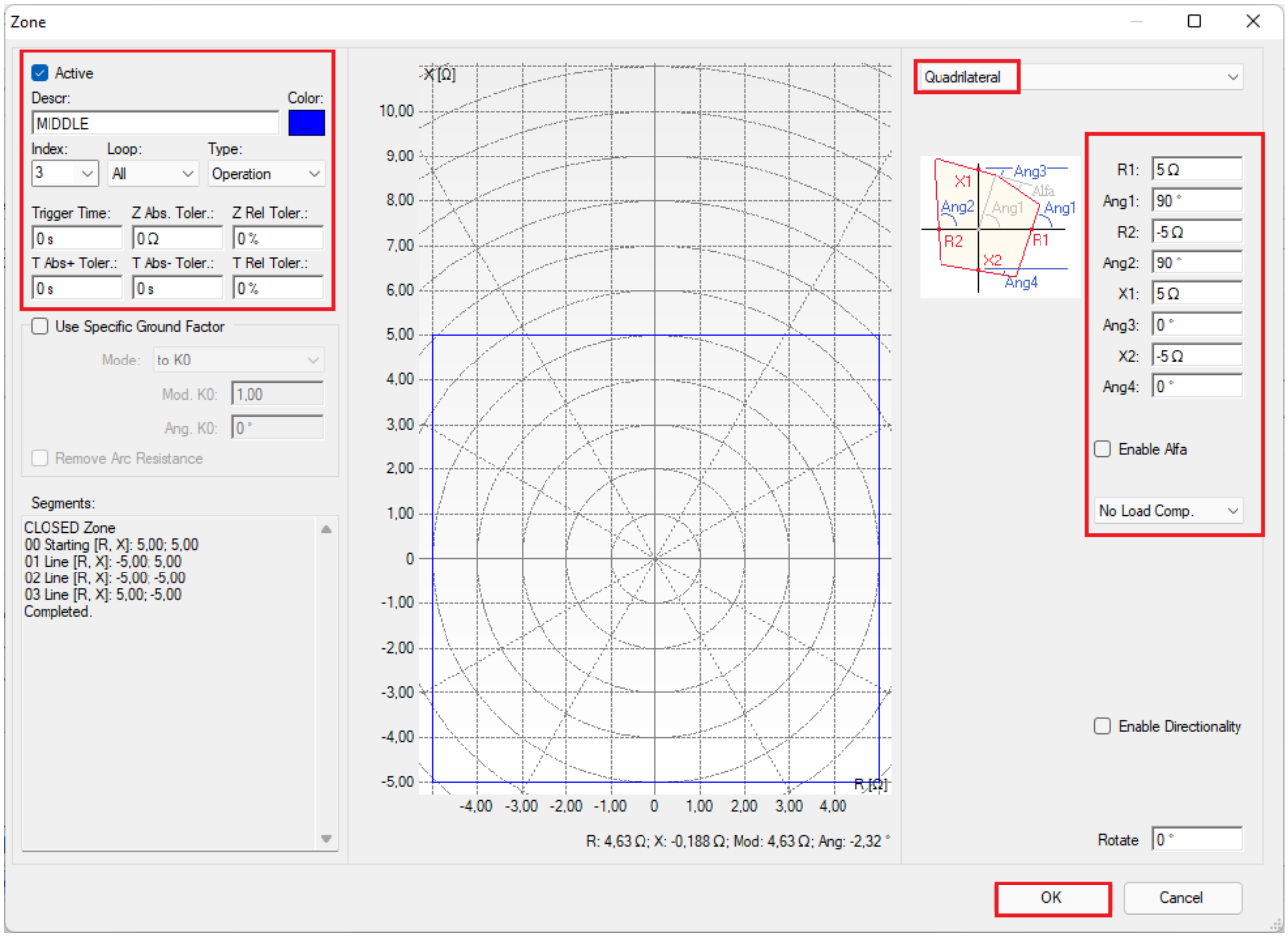

Figure 31

The last zone to be entered is the outer. Change your name to *"OUTER".*

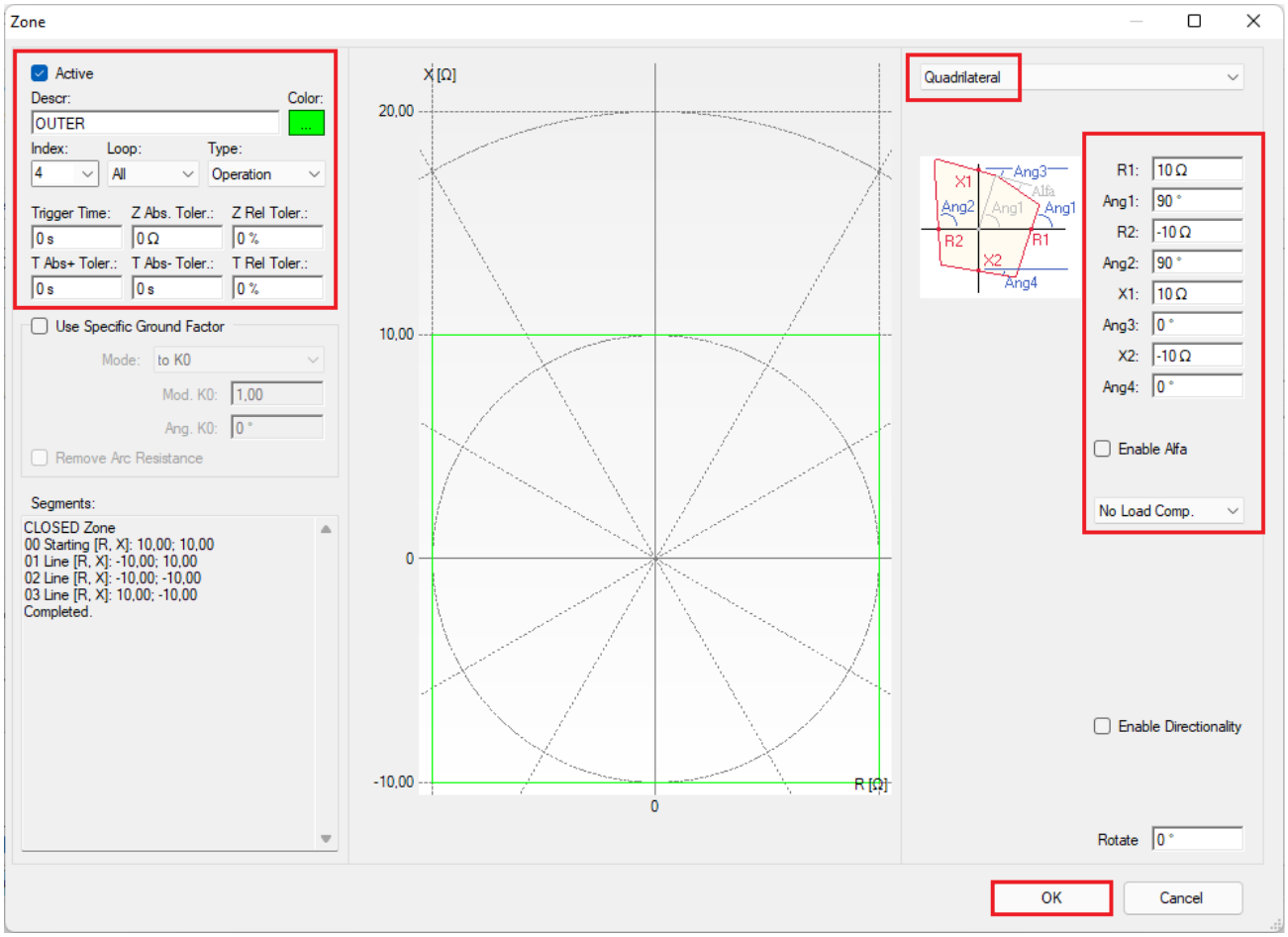

Figure 32

5. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

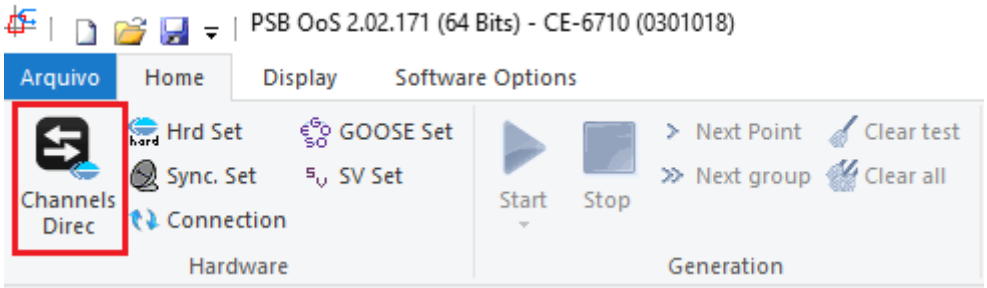

Figure 33

Then click on the highlighted icon to configure the hardware.

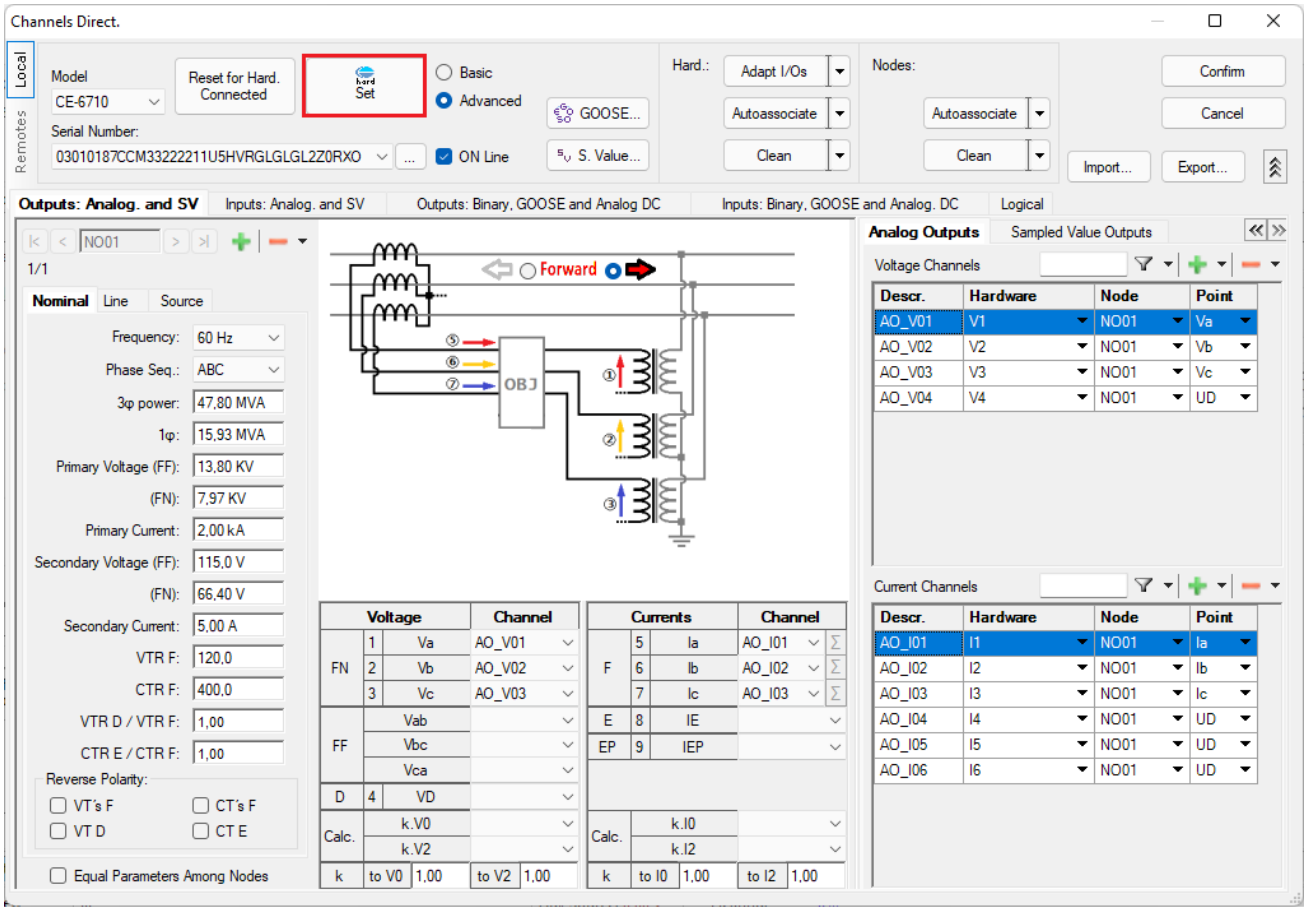

Figure 34

Choose the configuration of the channels adjust the auxiliary source and the stopping method of the binary inputs. To finish click on *"OK"*.

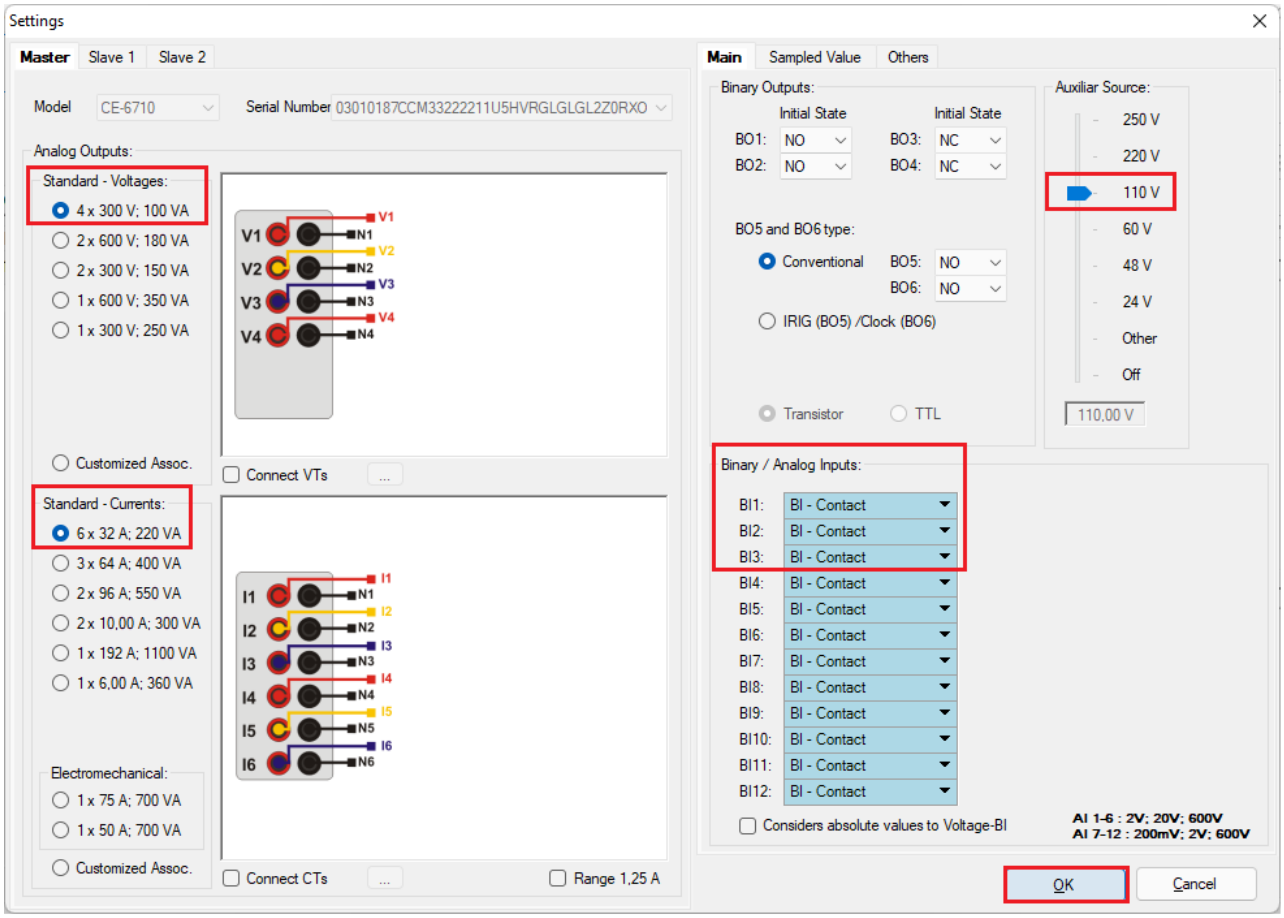

Figure 35

On the next screen choose *"Basic"* and on the next window (not shown) choose *"YES"*. Finally, click on *"Confirm"*.

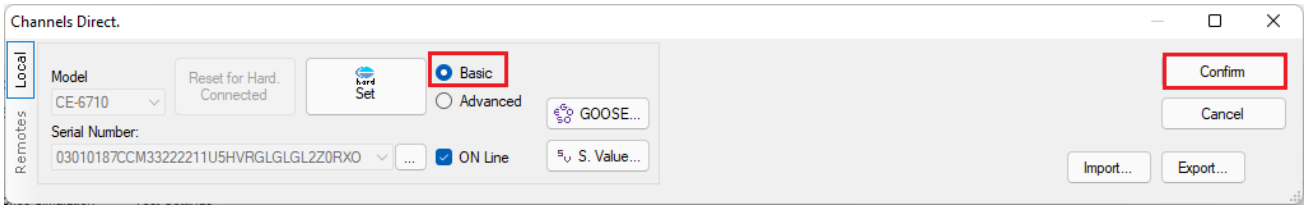

Figure 36

6. Restore Layout

Due to the great flexibility that the software presents allowing the user to choose which windows are displayed and in which position the command is used to restore the default settings. Click on the *"Recreate Charts"* button and then click on *"Restore Layout"*.

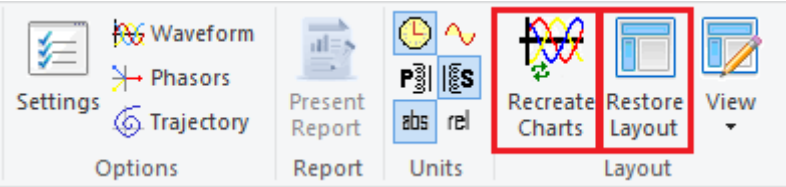

Figure 37

7. Test Structure for PSB and OoS functions

7.1. Test Settings

In this tab you must configure the generation channels, enable a pre-simulation with nominal conditions and adjust the binary inputs with the trip signals.

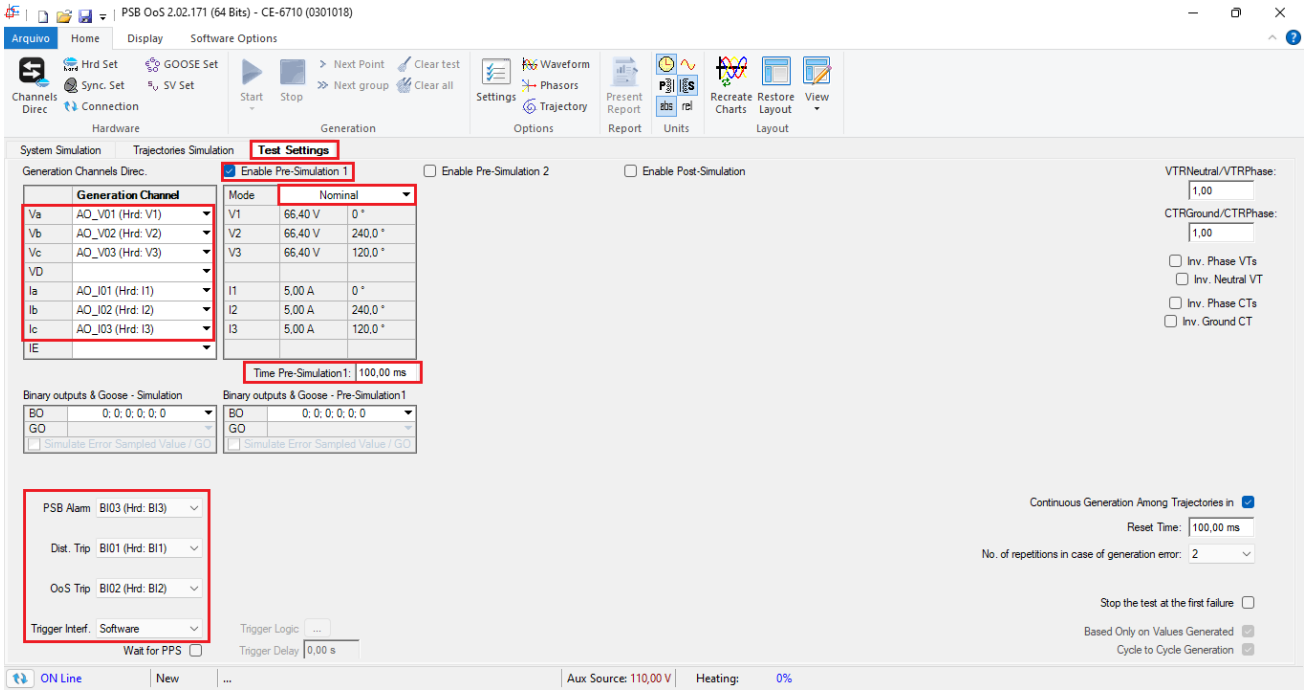

Figure 38

7.2. Trajectories Simulation

The *"Trajectories Simulation"* test makes it possible to create the same tests as the *"System Simulation"* however it has the convenience of not having to make an equivalent of the system (in some cases the necessary data are difficult to obtain). In the *"Trajectories Simulation"* option, the user has complete freedom to control the impedance trajectory (dZ/dt). In this way, it is possible to simulate fault conditions where function 21 must act, conditions of synchronous power swing where function 68 must act and even conditions of asynchronous power swing where function 78 must act.

7.3. Trajectories Simulation > Synchronous Oscillation

For the Power Swing signal to occur, the trajectory time between the external zone (OUTER) and the intermediate zone (MIDDLE), whose difference is 5.0Ω, must be greater than the setting in *"PS Detec Time",* that is, 0.03s. So 5/0.03 is equal to 166.67Ω/s so you must use a dZ/dt lower than 166.67 Ω/s, in this case use 150 Ω/s.

In the following test, a synchronous oscillation is simulated, where the activation of the Power Swing Alarm is expected. To perform the test click on *"New Trajectory"* then choose the number of points, impedance and angle values. It is important to point out that these points can be obtained just by clicking on the graph, in order to produce the trajectory. The next step is to enter the impedance rate of change which must be different from *"0"* and less than 166.67.

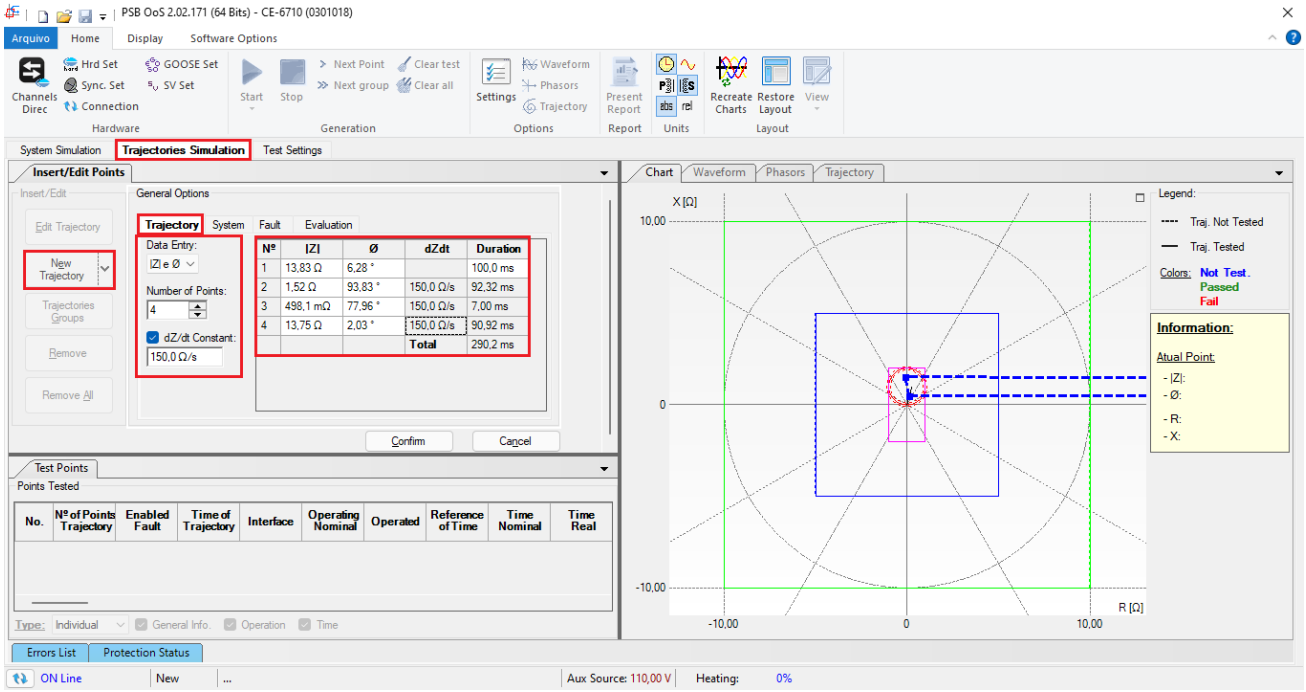

Figure 39

The next step is to parameterize the *"System"* tab.

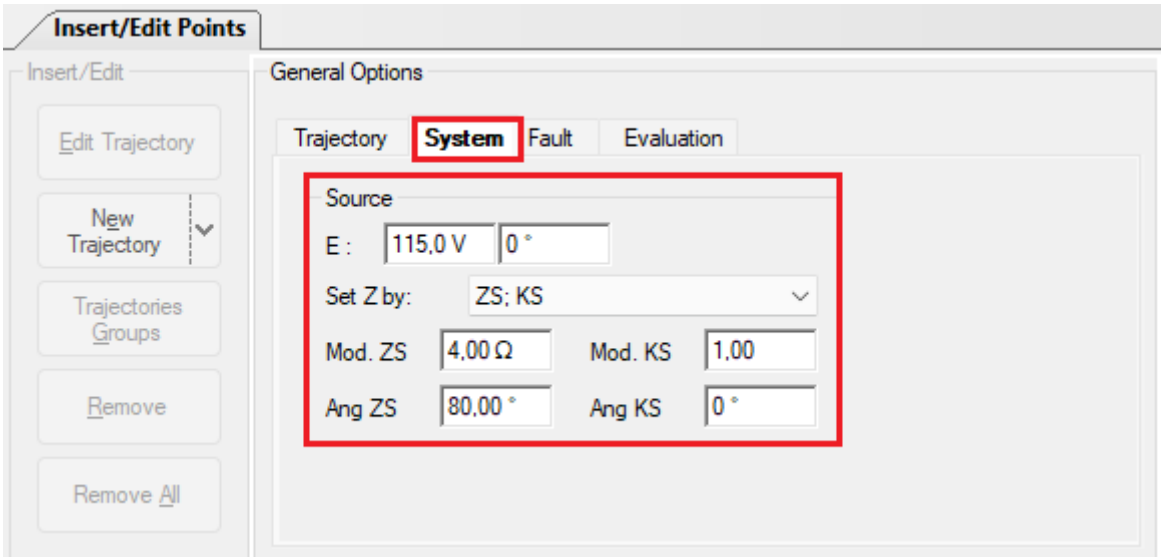

Figure 40

It is not necessary to make any adjustments in the *"Fault"* tab. The next step in the *"Evaluation"* tab is to set the *"Operation"* field to *"Yes"* and the *"Interface"* to *"PSB Alarm"*. Then click on *"Confirm"*.

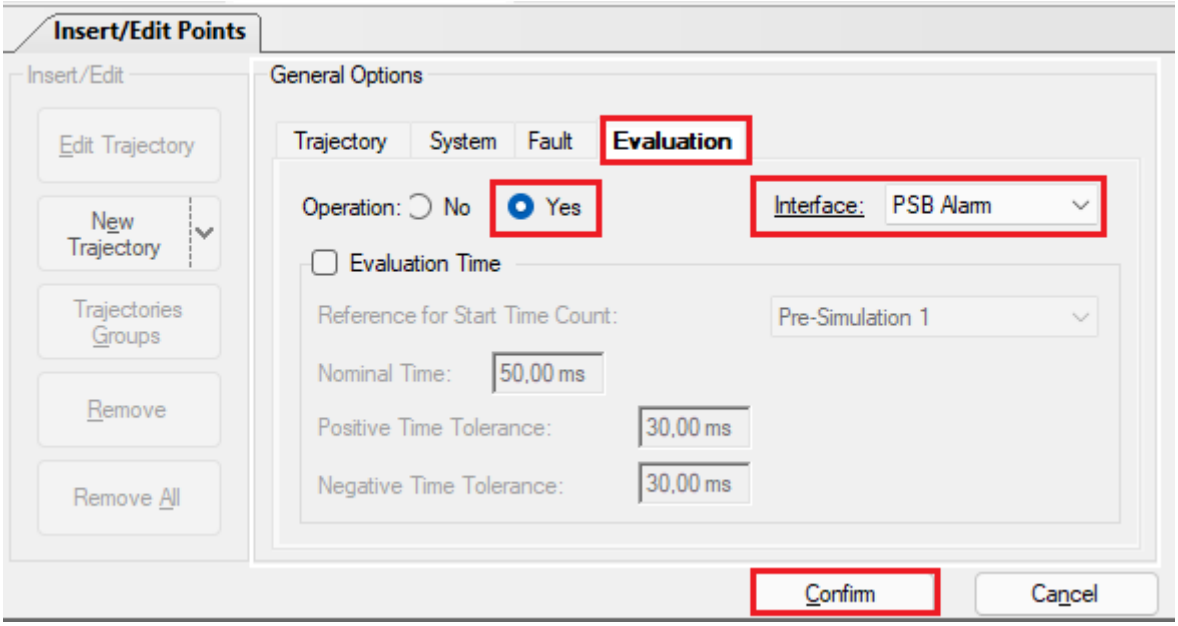

Figure 41

Start the generation by clicking on the icon highlighted below or using the command *"Alt +G".*

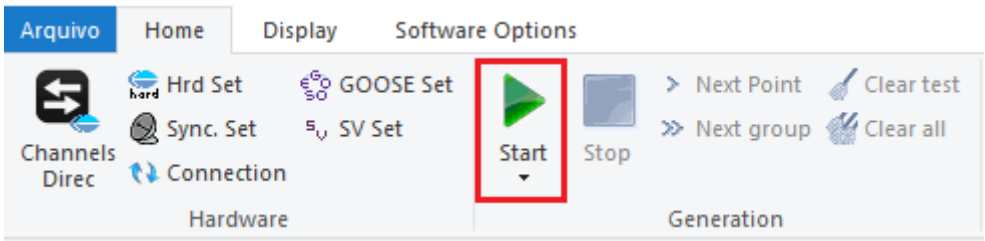

Figure 42

It is verified that the blocking of the distance function and the actuation of the blocking by synchronous power oscillation occurred.

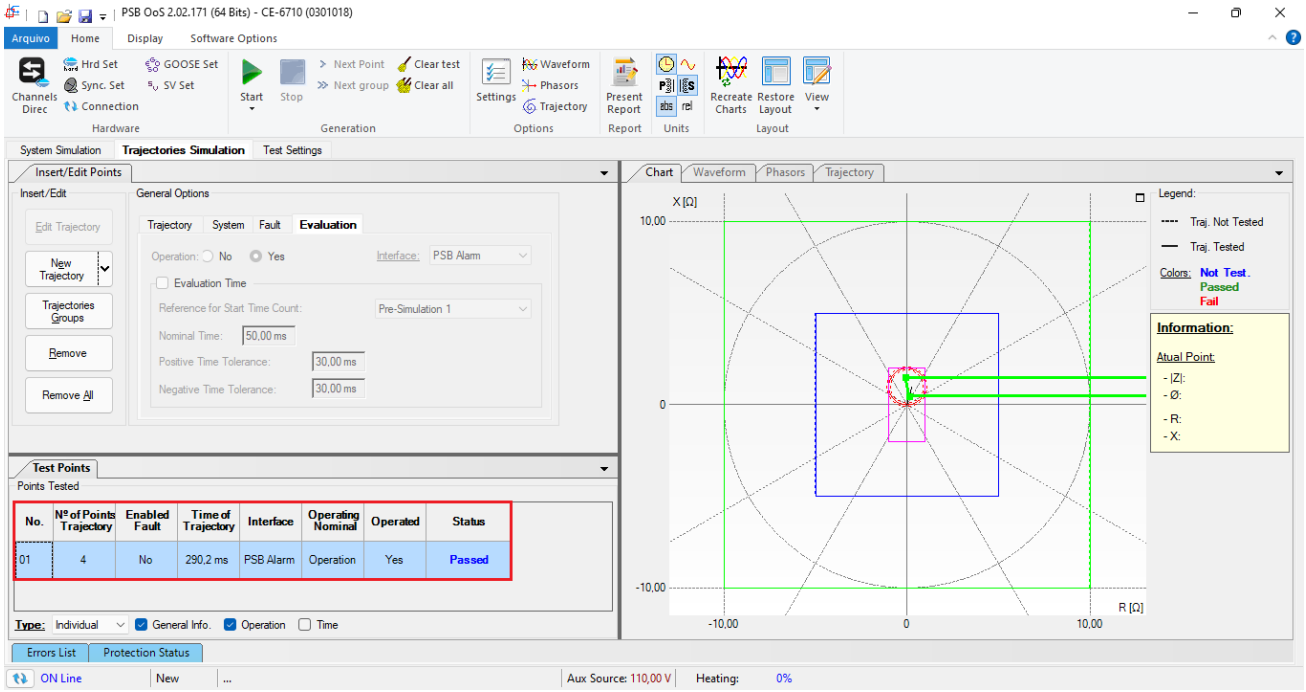

Figure 43

7.4. Trajectories Simulation > Asynchronous Oscillation

To verify the *"OoS"* tripping, the PSB signal must be active and the time to cross the internal region (INNER) must be greater than the time set in the *"Fast Trip Time"* field. As the zone width is 2.0Ω and the time is 0.05s, 2/0.05 comes to 40Ω/s, so dZ/dt must be less than 40Ω/s.

In the following test, an asynchronous oscillation is simulated, where the OoS Trip actuation is expected. To perform the test click on *"New Trajectory"* then choose the number of points, impedance and angle values. It is important to point out that these points can be obtained just by clicking on the graph, in order to produce the trajectory.

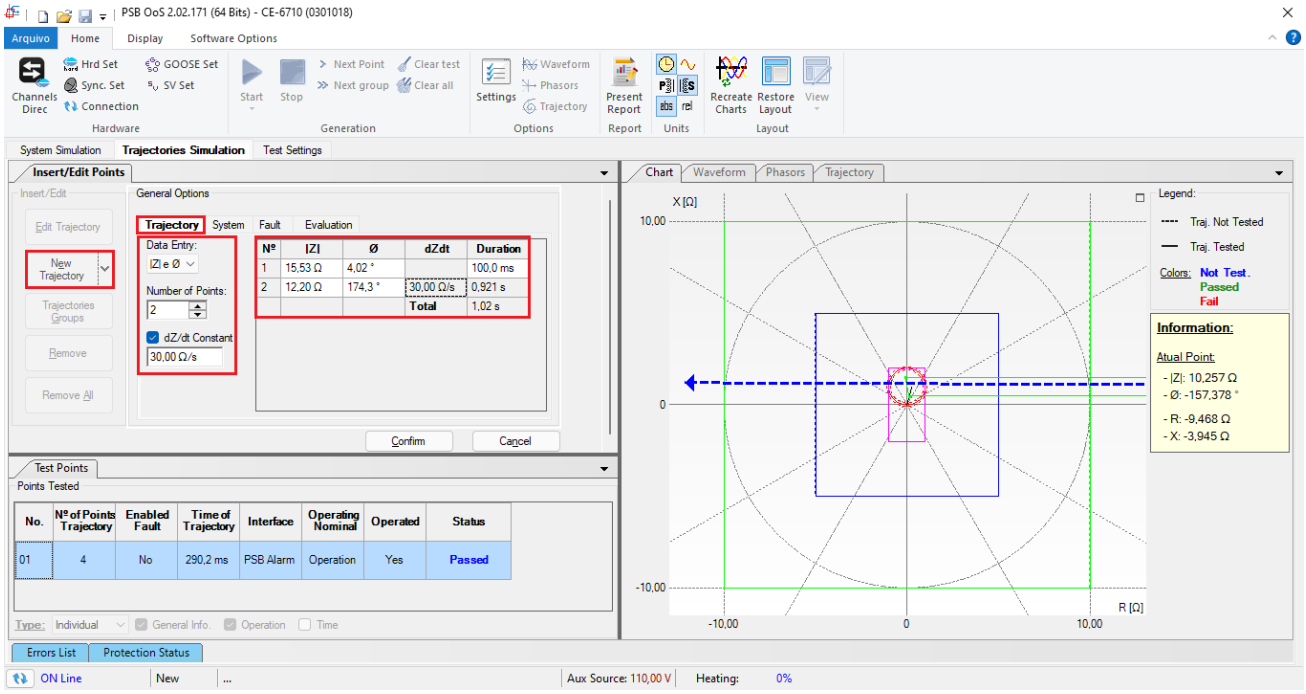

Figure 44

The next step is to parameterize the *"System"* tab.

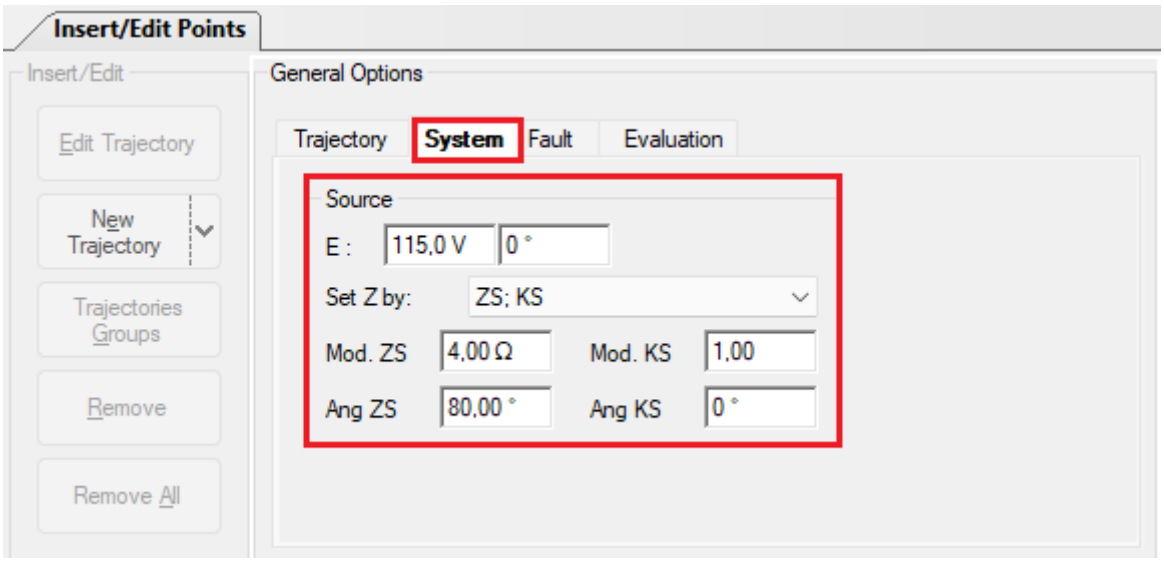

Figure 45

It is not necessary to make any adjustments in the *"Fault"* tab. The next step in the *"Evaluation"* tab is to set the *"Operation"* field to *"Yes"* and the *"Interface"* to *"Trip OoS"*. Then click on *"Confirm"*.

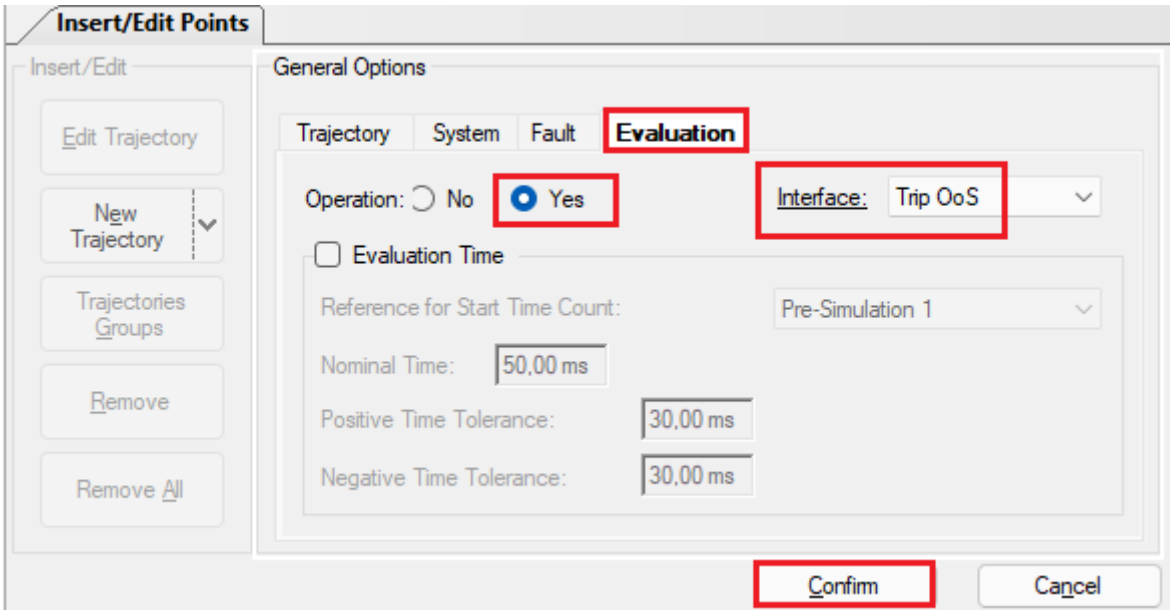

Figure 46

Start the generation by clicking on the icon highlighted below or using the command *"Alt +G"*.

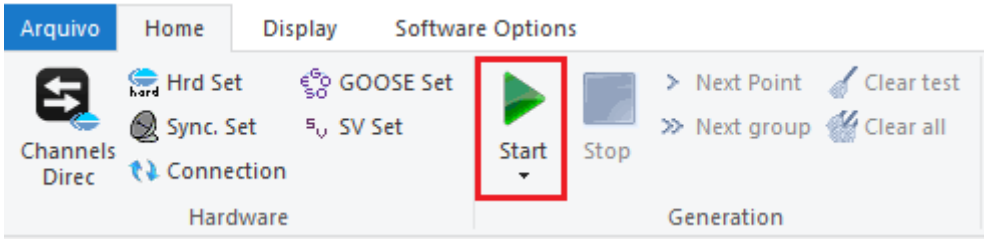

Figure 47

It is verified that the OoS trip occurred.

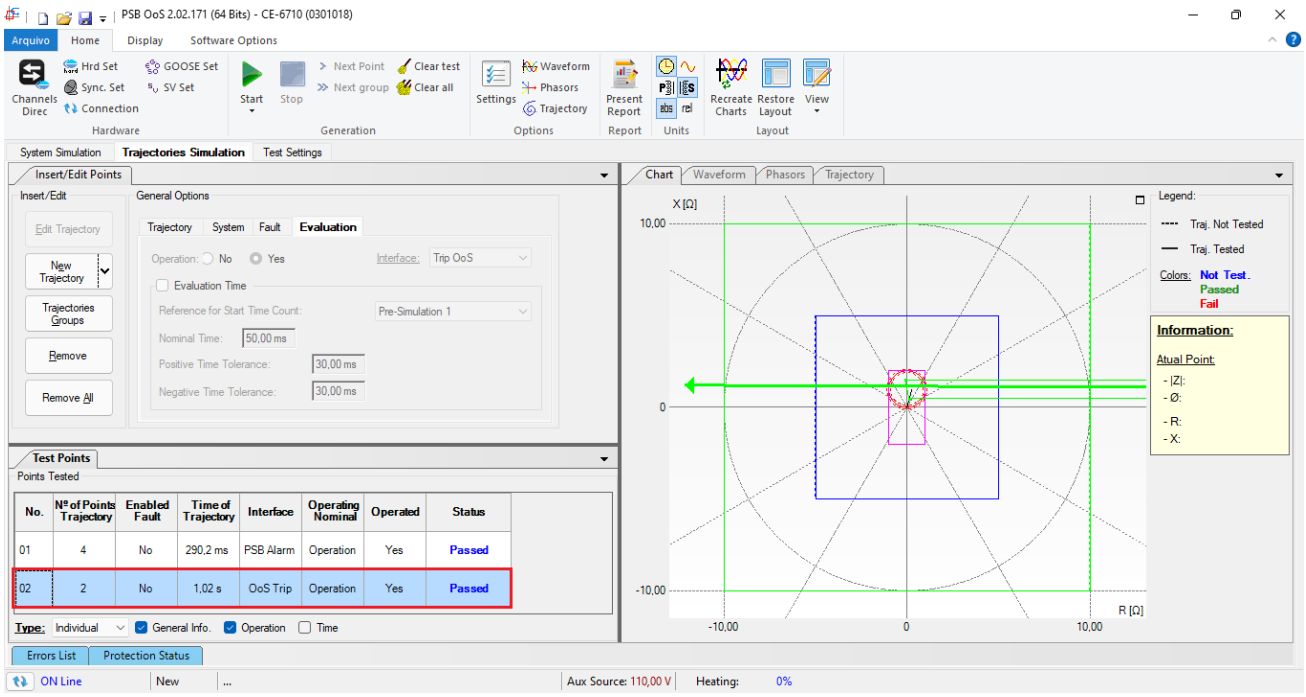

Figure 48

7.5. Trajectories Simulation > Fault Situation

In this test, the performance of the distance trip is verified. To do so, click on *"New Oscillation"* and on the *"Trajectory"* tab, make the following adjustments. It is important to remember that the impedance variation rate must be greater than 166.67 Ω/s.

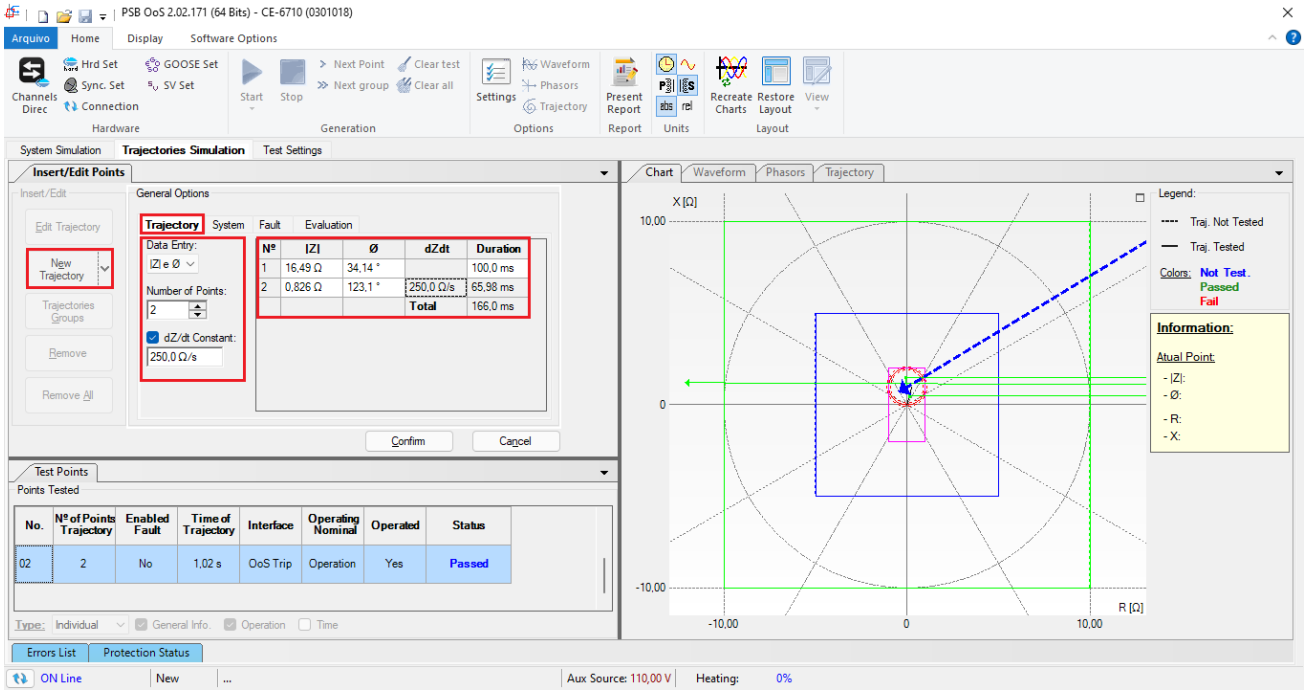

Figure 49

The next step is to parameterize the *"System"* tab.

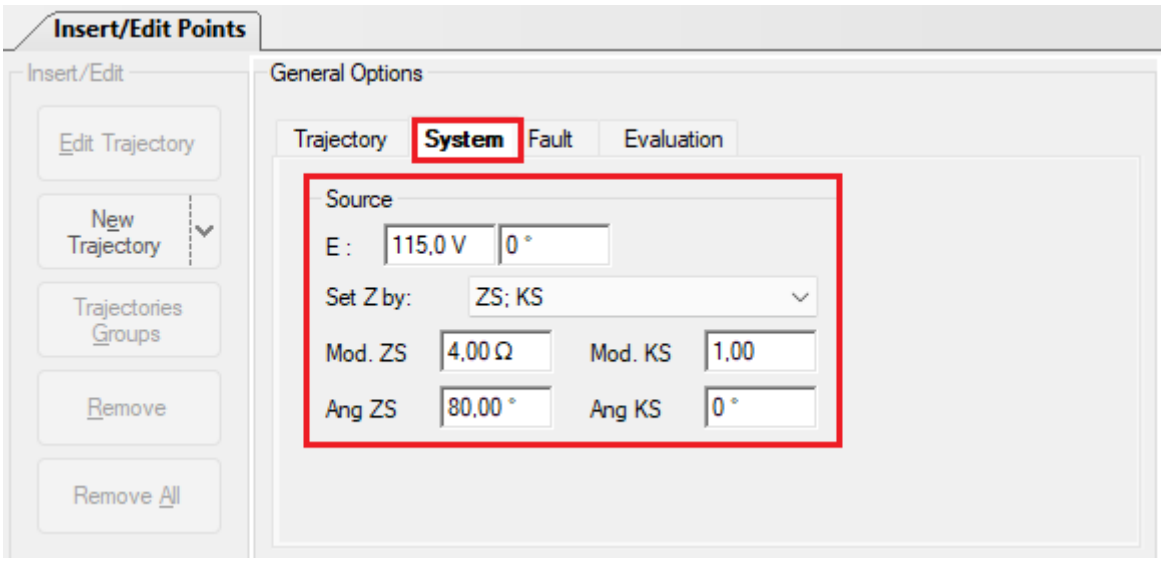

Figure 50

The next step is to set an ABC fault, so click on the *"Fault"* tab and then on *"Enable Fault"*. Set the *"Constant Current"* value to 15A and the fault duration time to 100ms. The fault time must always be greater than the protection zone delay. In this case, the activation time for zone 1 is 100ms. Another detail is the *"Fault Location"* which must be set to 0.1 ensuring that the fault occurs in zone 1.

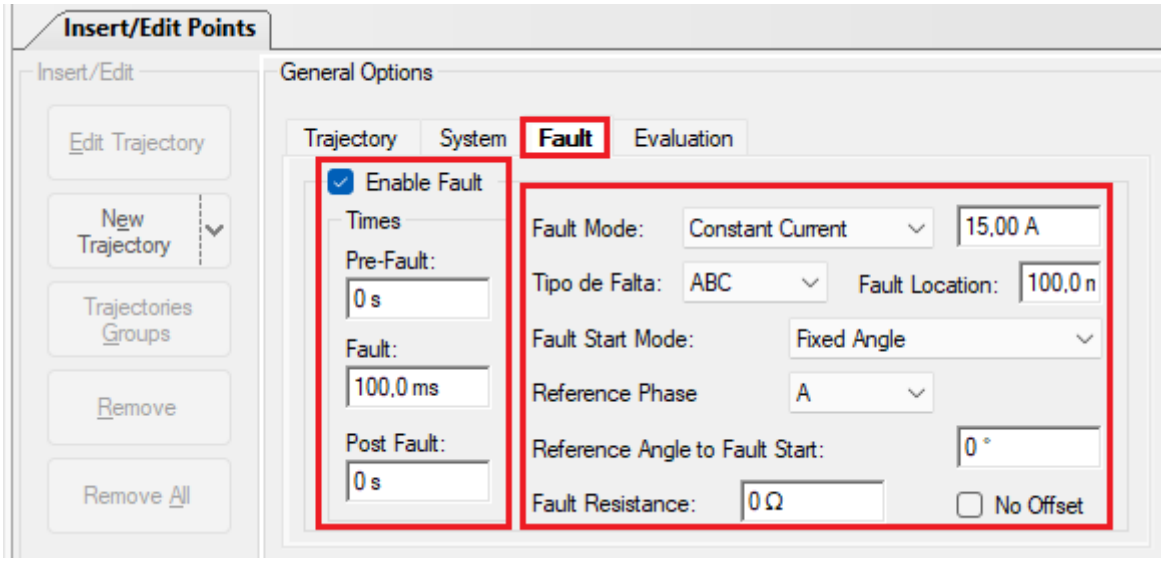

Figure 51

The next step in the *"Evaluation"* tab is to set the *"Operation"* field to *"Yes"* and the *"Interface"* to *"Trip Dist"*. Then click on *"Confirm"*.

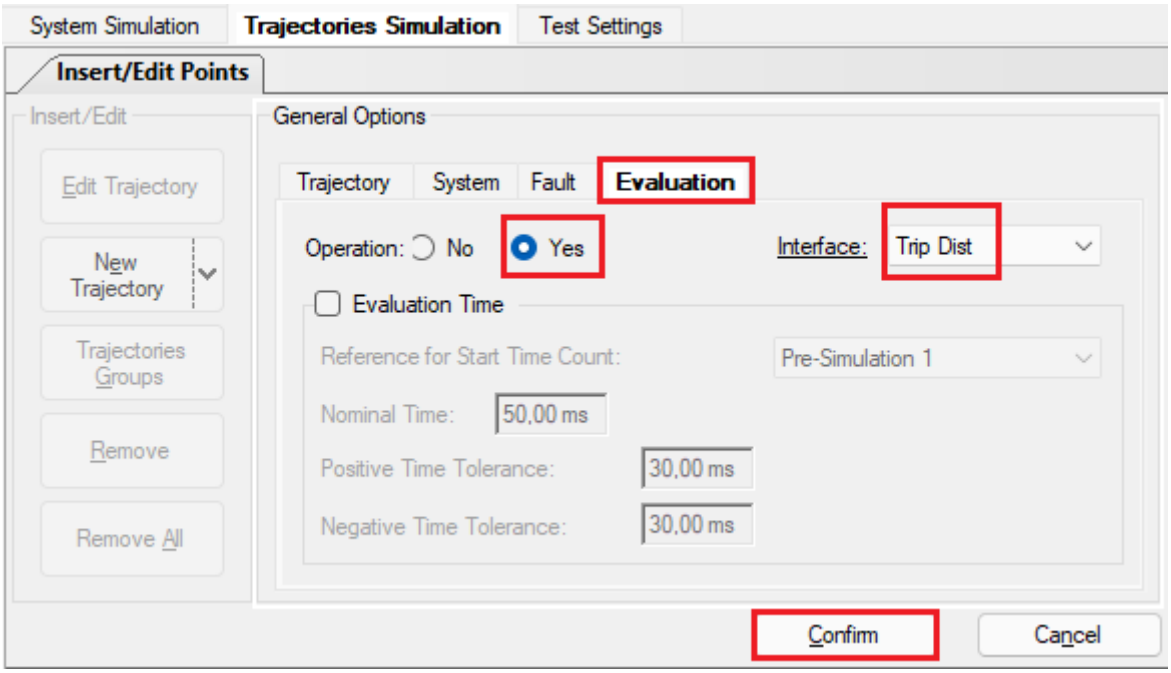

Figure 52

Start the generation by clicking on the icon highlighted below or using the command *"Alt +G"*.

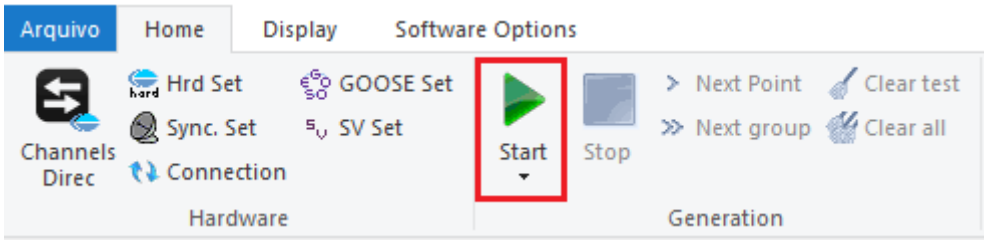

Figure 53

It is verified that the trip of the distance function has occurred.

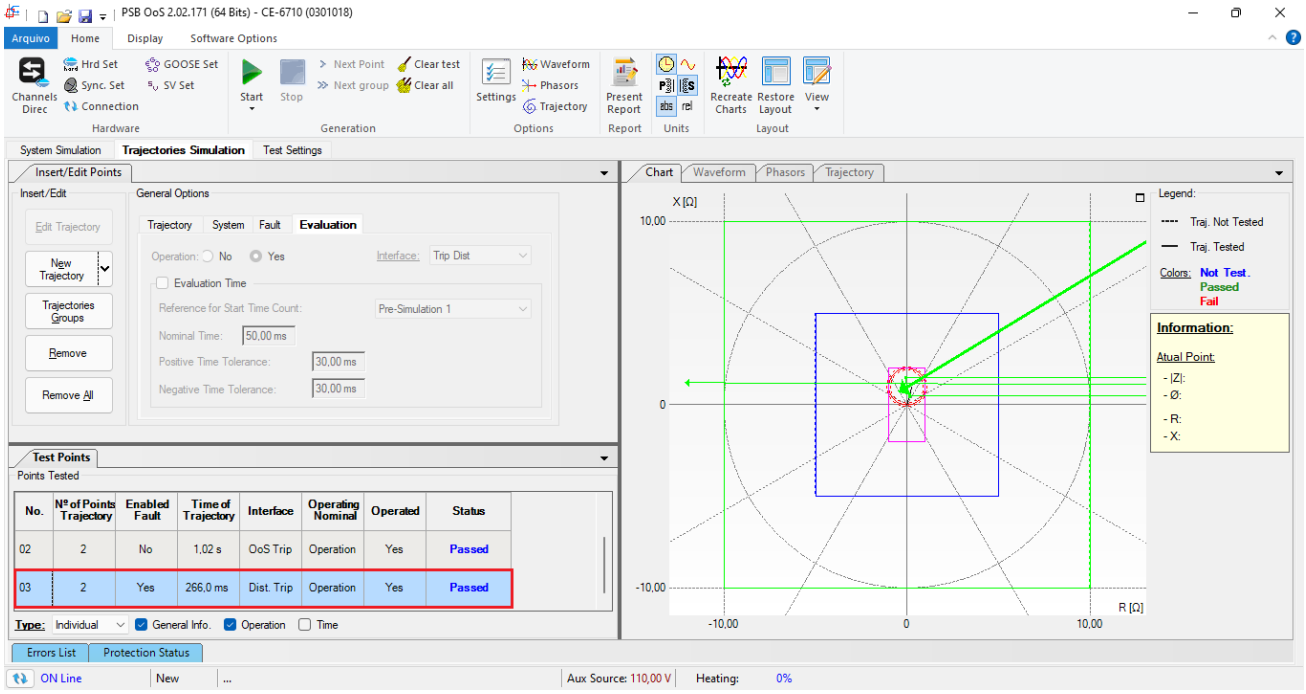

Figure 54

8. Report

After finishing the test, click on the *"Present Report"* icon in the previous figure or through the command *"Ctrl +R"* call the report pre-configuration screen. Choose the desired language as well as the options that should be part of the report.

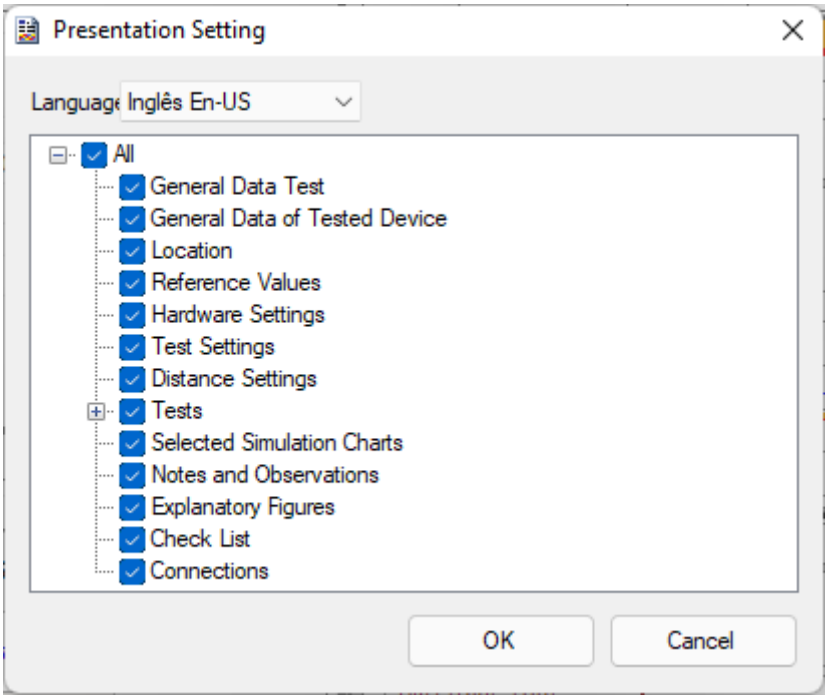

Figure 55

The figure below shows the beginning of a report. It is worth mentioning that within the Conprove Test Center (CTC) there is a tool called *"Settings",* which allows the user to insert a figure to fill the report header image with the company's logo, for example. In addition, as the figure below highlights, it is possible to convert the report to .pdf and .rtf, therefore, this last format allows editing through Microsoft Office Word, even if the characteristics that make the report a fully produced document by Conprove software are lost.

CONPROVE
INDÚSTRIA & COMÉRCIO

INSTRUMENTOS PARA TESTES ELÉTRICOS

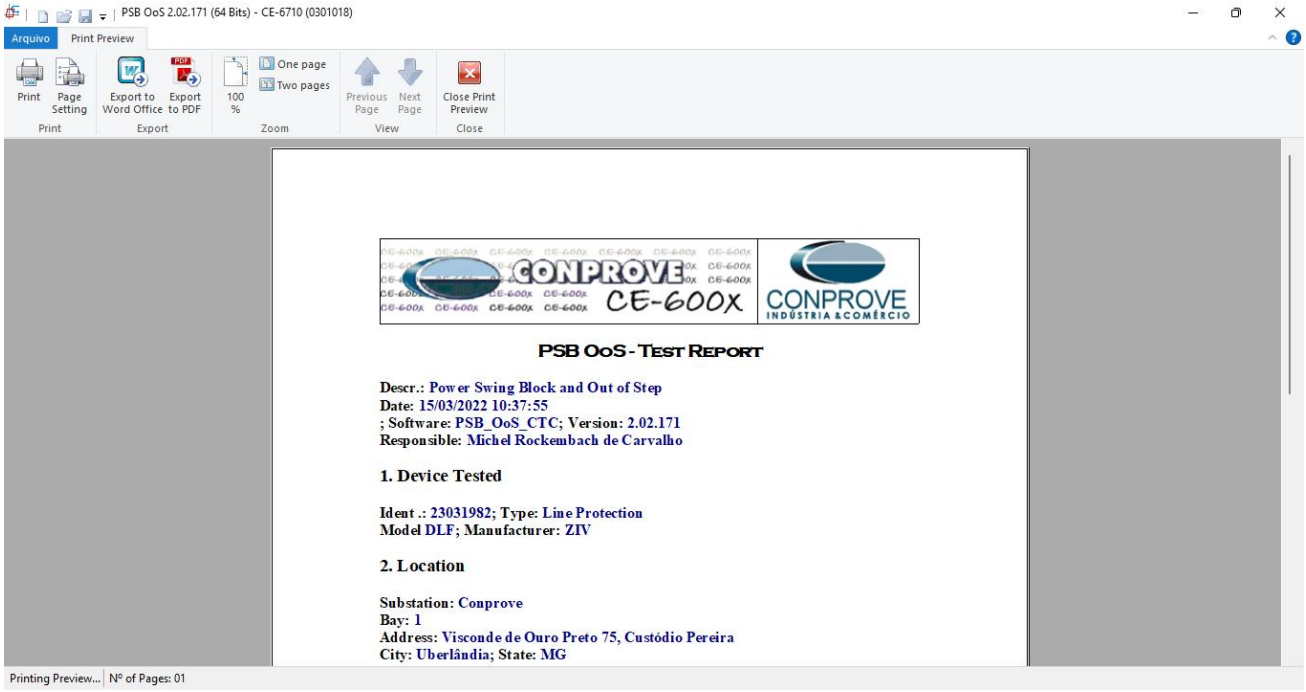

Figure 56

9. Appendix A - Manufacturer Tolerances

1.3.12 Accuracy of the Pickup and Reset of the Distance Elements

Distance Elements	
Pickup in Line Angle (static test)	**±5%** or **±0.01 Ω (V>0.5 V)** of the theoretical value (the greater)

Time Measurement	
Fixed Time	**±1%** of the setting or **±35 ms** (the greater)

10. Appendix B - Terminal Diagram

- **Analog Channels DLF-A**

Magnitude	Analog Channels	Analog Channels description	SLOT (1/2 rack)	PINS
PHASE AG VOLTAGE	VA	VOLTAGE INPUT 1	D	1-2
PHASE BG VOLTAGE	VB	VOLTAGE INPUT 2	D	3-4
PHASE CG VOLTAGE	VC	VOLTAGE INPUT 3	D	5-6
SYNCHRONISM VOLTAGE	VSYNC	VOLTAGE INPUT 4	D	7-8
NEUTRAL VOLTAGE	VG	VOLTAGE INPUT 5	D	9-10
PHASE A CURRENT	IA	CURRENT INPUT 1	D	11-12
PHASE B CURRENT	IB	CURRENT INPUT 2	D	13-14
PHASE C CURRENT	IC	CURRENT INPUT 3	D	15-16
PARALLEL LINE NEUTRAL CURRENT	IPAR	CURRENT INPUT 4	D	17-18
GROUNDING CURRENT	IG	CURRENT INPUT 5	D	19-20

Figure 57

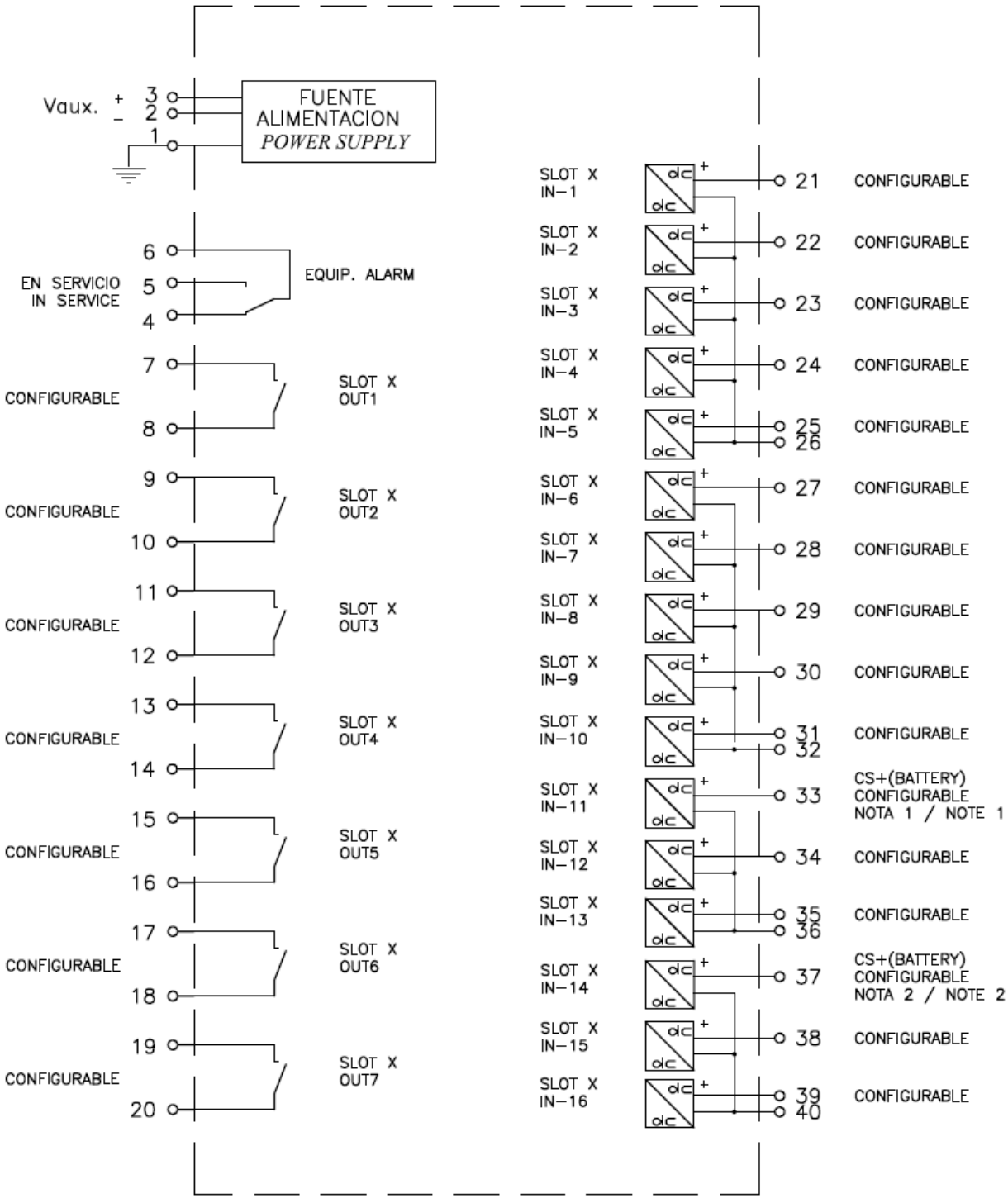
Vaux.
+
3
2
−
1
FUENTE
ALIMENTACION
POWER SUPPLY
6
5
4
EN SERVICIO
IN SERVICE
EQUIP. ALARM
7
8
CONFIGURABLE
SLOT X
OUT1
9
10
CONFIGURABLE
SLOT X
OUT2
11
12
CONFIGURABLE
SLOT X
OUT3
13
14
CONFIGURABLE
SLOT X
OUT4
15
16
CONFIGURABLE
SLOT X
OUT5
17
18
CONFIGURABLE
SLOT X
OUT6
19
20
CONFIGURABLE
SLOT X
OUT7
SLOT X
IN−1
21
CONFIGURABLE
SLOT X
IN−2
22
CONFIGURABLE
SLOT X
IN−3
23
CONFIGURABLE
SLOT X
IN−4
24
CONFIGURABLE
SLOT X
IN−5
25
26
CONFIGURABLE
SLOT X
IN−6
27
CONFIGURABLE
SLOT X
IN−7
28
CONFIGURABLE
SLOT X
IN−8
29
CONFIGURABLE
SLOT X
IN−9
30
CONFIGURABLE
SLOT X
IN−10
31
32
CONFIGURABLE
SLOT X
IN−11
33
CS+(BATTERY)
CONFIGURABLE
NOTA 1 / NOTE 1
SLOT X
IN−12
34
CONFIGURABLE
SLOT X
IN−13
35
36
CONFIGURABLE
SLOT X
IN−14
37
CS+(BATTERY)
CONFIGURABLE
NOTA 2 / NOTE 2
SLOT X
IN−15
38
CONFIGURABLE
SLOT X
IN−16
39
40
CONFIGURABLE

Figure 58

11. Parameter Equivalence between Relay and Software

Table 2

PSB_OoS Software		ZIV DLF Relay	
Parameter	Figure	Parameter	Figure
Zn01		Zone 1 Units	
Phase Reach	29	Phase Reach	17
Pos. Seq. Imped. Angle	29	Pos. Seq. Impedance Angle	17
Trigger Time	29	Phase Time	17
INNER		INT	
R1	30	Right Int Resit Limit	18
Ang 1	30	Resist Limit Angle	18
R2	30	Left Int Resit Limit	18
Ang 2	30	Resist Limit Angle	18
X1	30	Forward Int Reach	18
Ang 3	30	no equivalent	
X2	30	Reverse Int Reach	18
Ang 4	30	no equivalent	
MIDDLE		MID	
R1	31	Right Mid Resit Limit	18
Ang 1	31	Resist Limit Angle	18
R2	31	Left Mid Resit Limit	18
Ang 2	31	Resist Limit Angle	18
X1	31	Forward Mid Reach	18

Ang 3	31	no equivalent	
X2	31	Reverse Mid Reach	18
Ang 4	31	no equivalent	
OUTER		EXT	
R1	32	Right Ext Resit Limit	18
Ang 1	32	Resist Limit Angle	18
R2	32	Left Ext Resit Limit	18
Ang 2	32	Resist Limit Angle	18
X1	32	Forward Ext Reach	18
Ang 3	32	no equivalent	
X2	32	Reverse Ext Reach	18
Ang 4	32	no equivalent	