



INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: Schneider

Model: P545

Functions: 21 or PDIS – Distance

Tool Used: CE-6006, CE-6707, CE-6710, CE-7012 or CE-7024

Objective: Search and Point Test of Zones with MHO Characteristics

Version Control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial Version	10/09/2021	M.R.C.	M.P.S

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Statement of responsibility

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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 tested should 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 should be noted that the user must have satisfactory training in maintenance procedures, a good knowledge of the equipment under tested and also be aware of safety standards and regulations.

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Sequence for testing the P545 relay in the Distance software

1. Relay connection to CE-6006

Appendix A shows the relay terminal designations.

1.1 Auxiliary Source

Connect the positive (red terminal) of the Vdc Aux. Source to pin M2 of the relay and the negative (black terminal) of the Vdc Aux. Source to pin M1 of the relay.

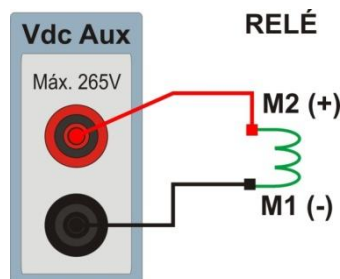


Figure 1

1.2 Current and Voltage Coils

To establish the voltage coil connection, connect V1, V2 and V3 channels to the relay terminal pins D19, D20 and D21 and the common ones to pin D22. To establish the connection of the current coils, connect I4, I5 and I6 channels to pins D1, D4 and D7 of the relay terminal and those common to pins D13. Connect the points D2, D5, D8 and D14 between them.

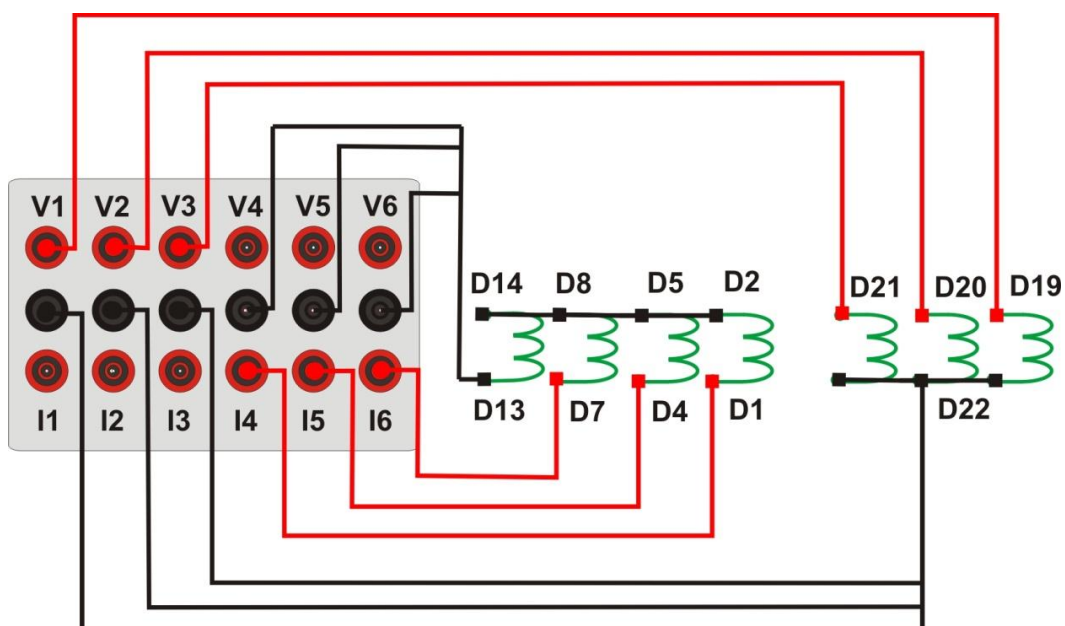


Figure 2

1.3 Binary Inputs

Connect the binary input of the CE-6006 to the binary output relay.

- BI1 to pin L1 and its common to pin L2.

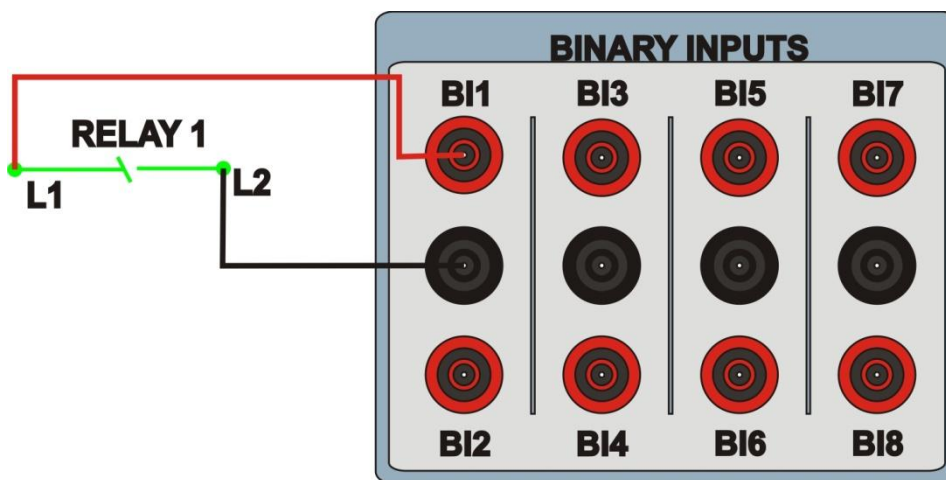


Figure 3

2. Communication with P545 relay

First, open the *Schneider Electric MICOM S1 Studio* and connect a serial cable from the notebook to the relay. Then double-click on the software icon.



Figure 4

Then click on the “*Quick Connect*” option. The relay software will automatically fetch the settings.

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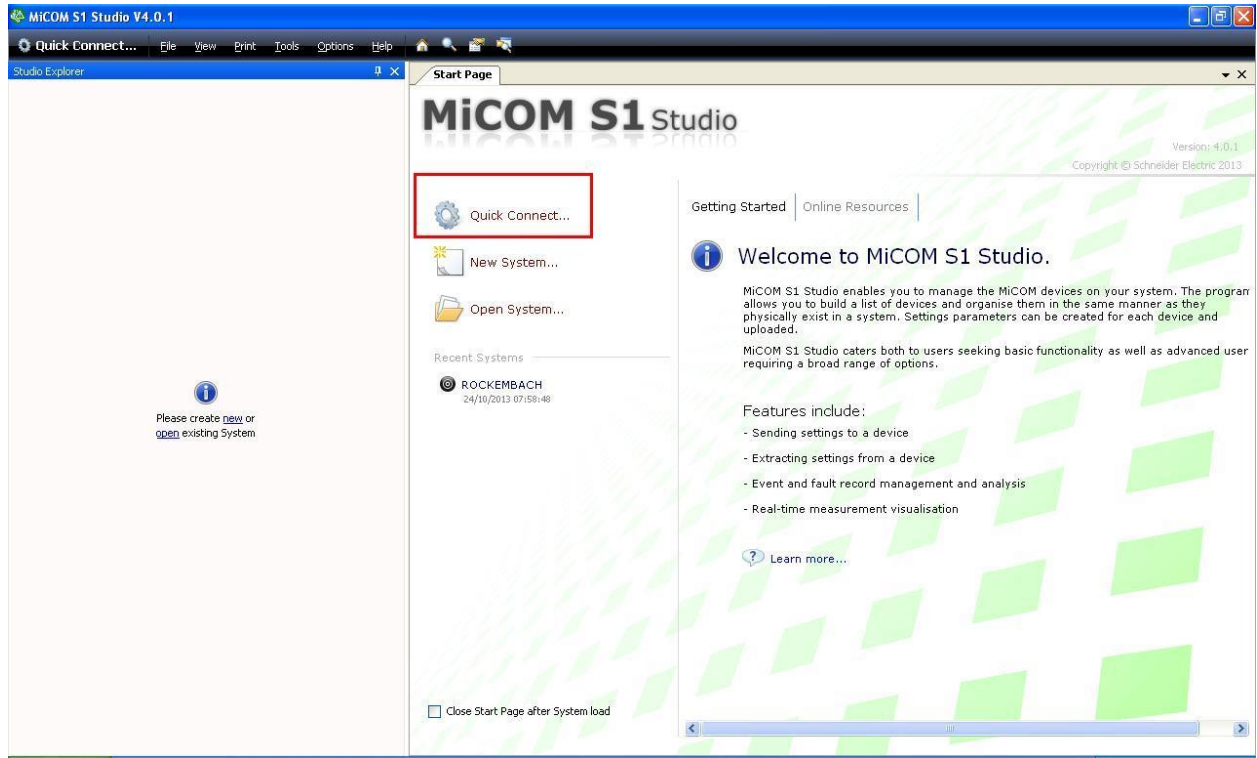


Figure 5

The next step is to create a new project and name it.

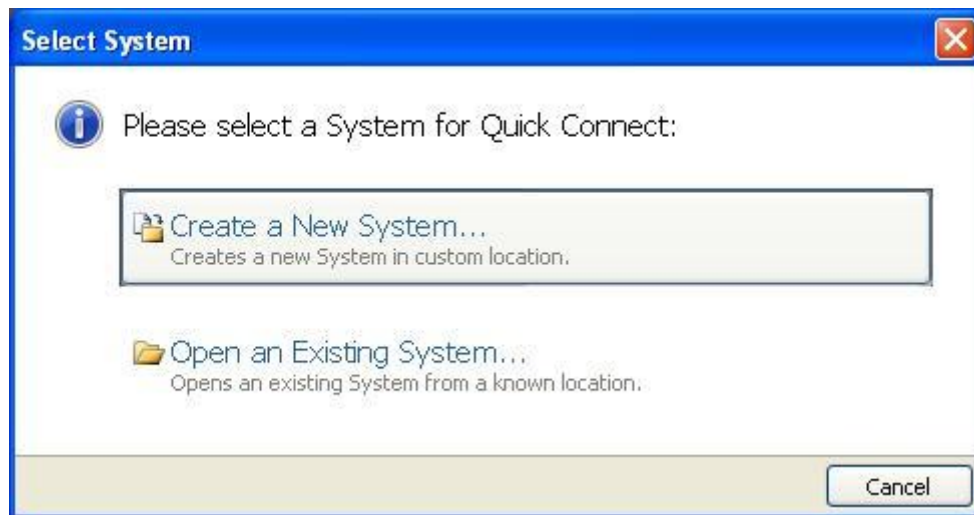


Figure 6

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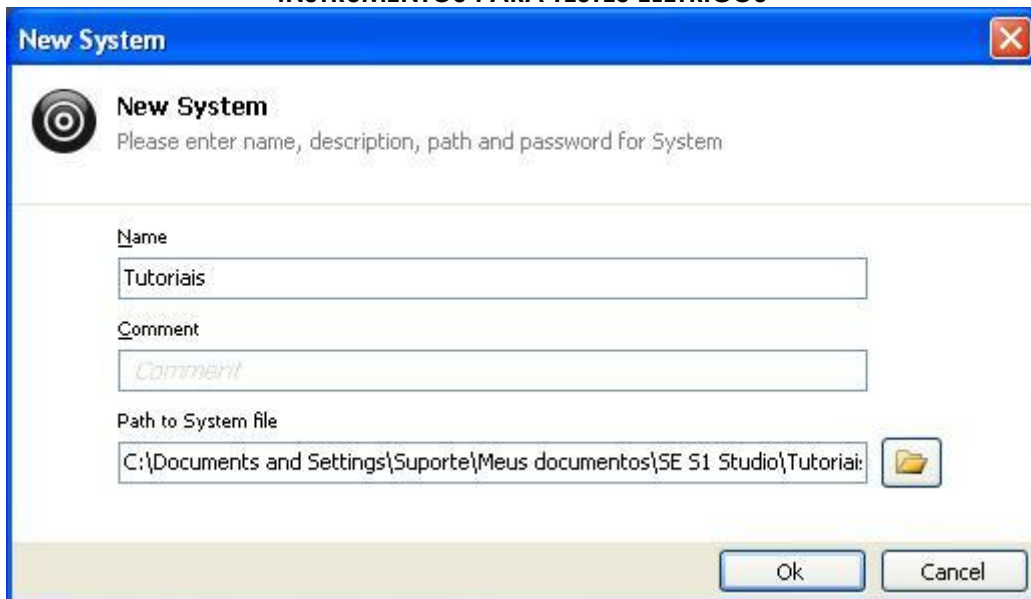


Figure 7

In the next window choose the relay model. If you don't have the model, use the "Data Model Manager" software (installed with MiCOM) to download it.



Figure 8

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Choose the way to communicate by serial port (rear or front), by Ethernet or via modem.

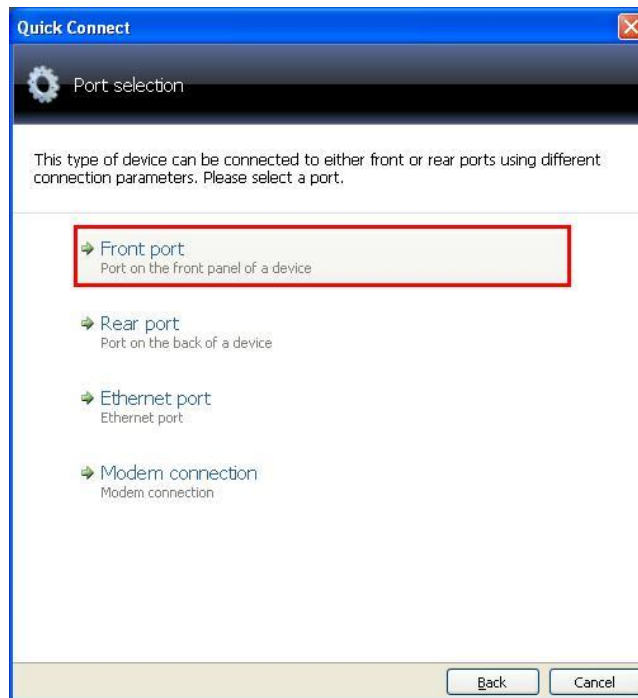


Figure 9

In the next window make sure which serial (COM) port is being used especially if you are using a USB/SERIAL converter and click on “Finish”.

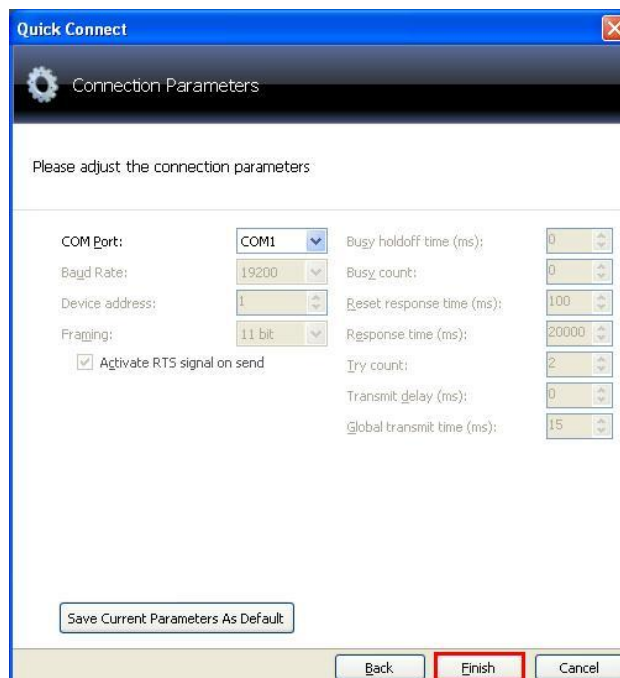


Figure 10

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The next screen shows that the connection was successful showing the type, model and serial number of the relay.

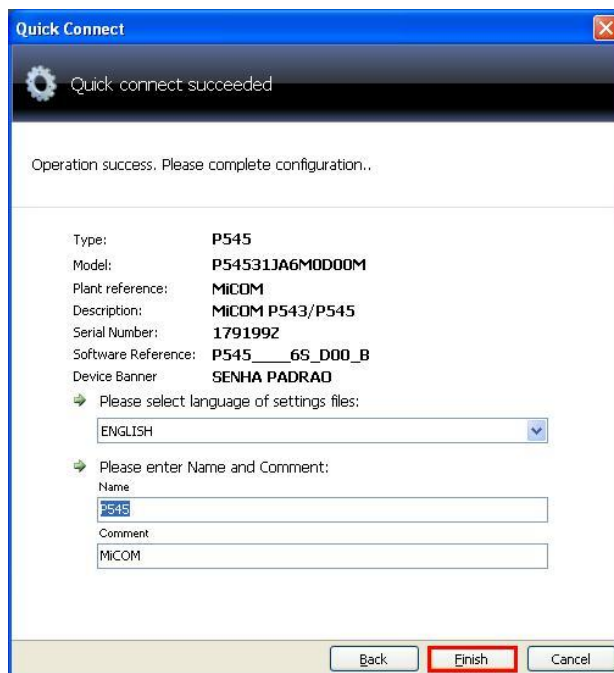


Figure 11

The next step is to extract all the information set in the relay. Right click on “Settings” and left click on “Extract Settings”.

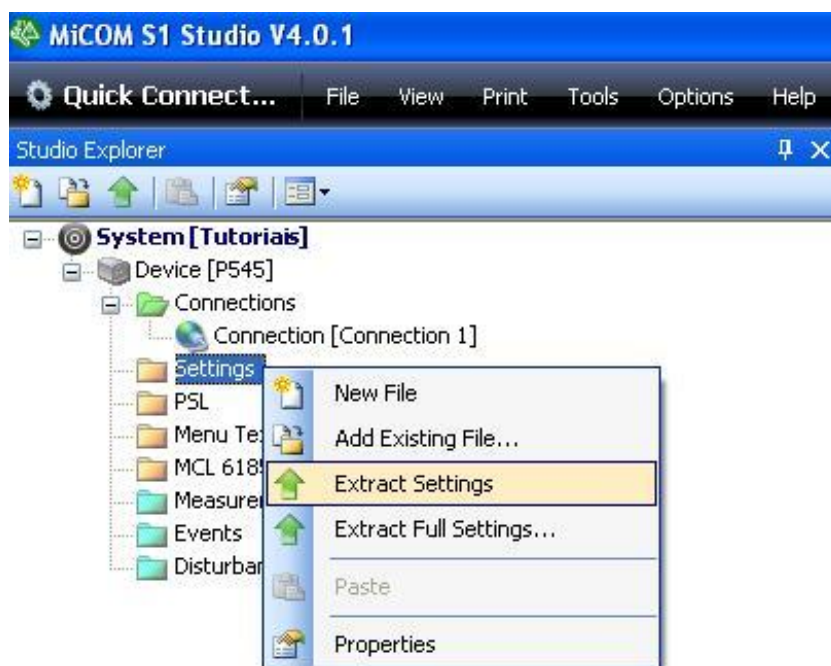


Figure 12

INSTRUMENTOS PARA TESTES ELÉTRICOS
Enter the relay password with the default “AAAA” value.



Figure 13

The reading of the settings will appear with the name of “000” and can be modified if necessary. In this case the file name was changed to “*Distância Mho*”.

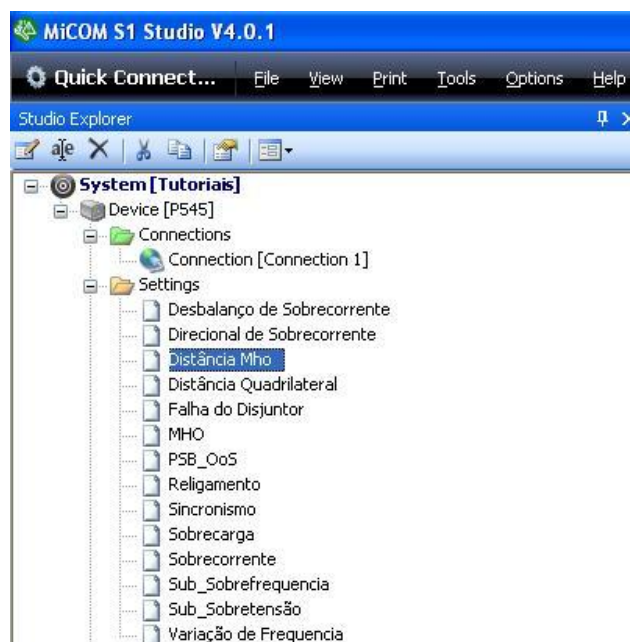


Figure 14

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3. Parameterization of the P545 relay

3.1 Frequency

After double-clicking on the “Distância Mho” file, enter “SYSTEM DATA”, and then “Frequency”. Make sure the set value is 60.0Hz.

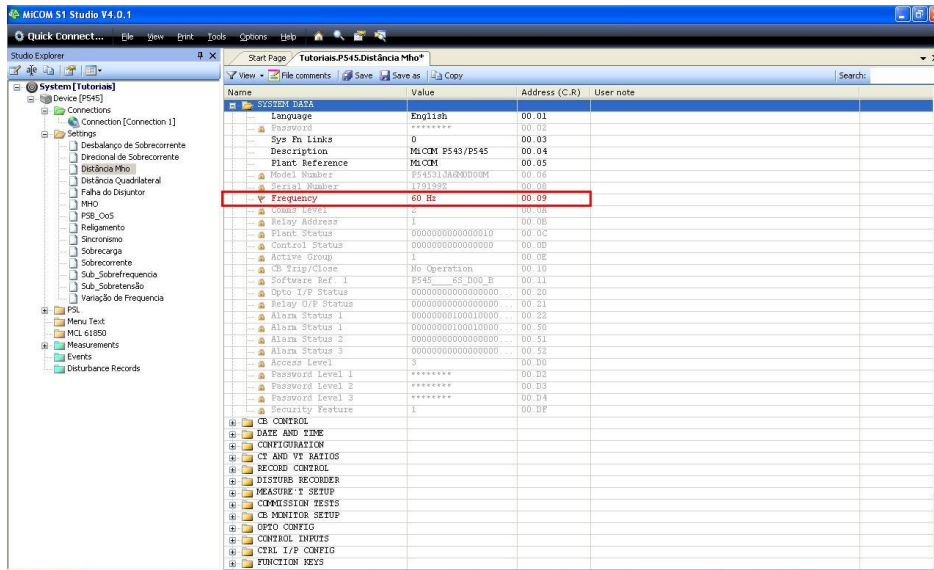


Figure 15

3.2 CONFIGURATION

Within the “CONFIGURATION” folder, group 1 and the distance function are enabled. **NOTE: All other functions must be disabled.**

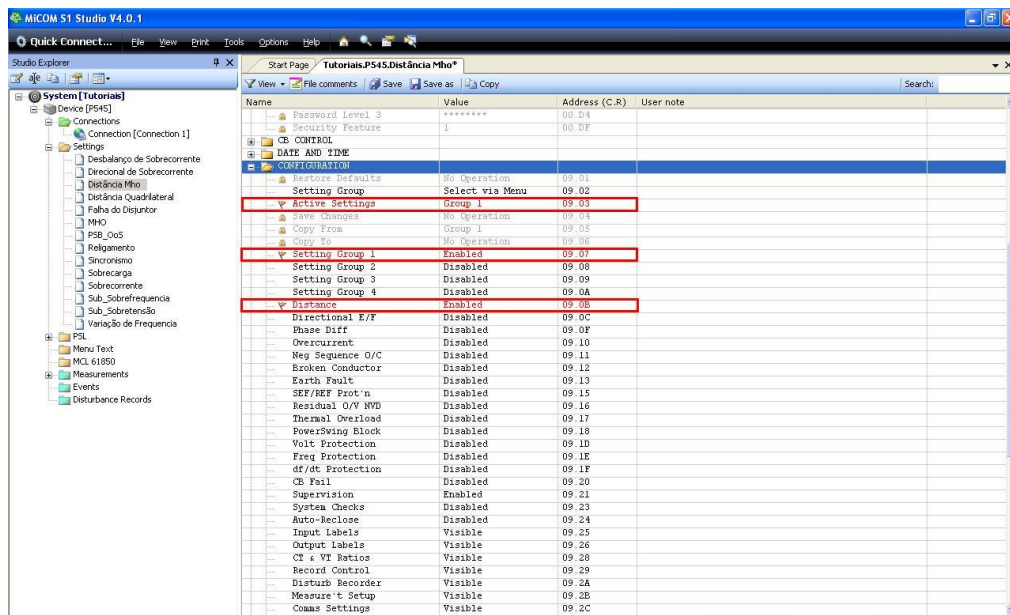


Figure 16

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3.3 Setting Values

All parameterization will be done with values referenced to the secondary.

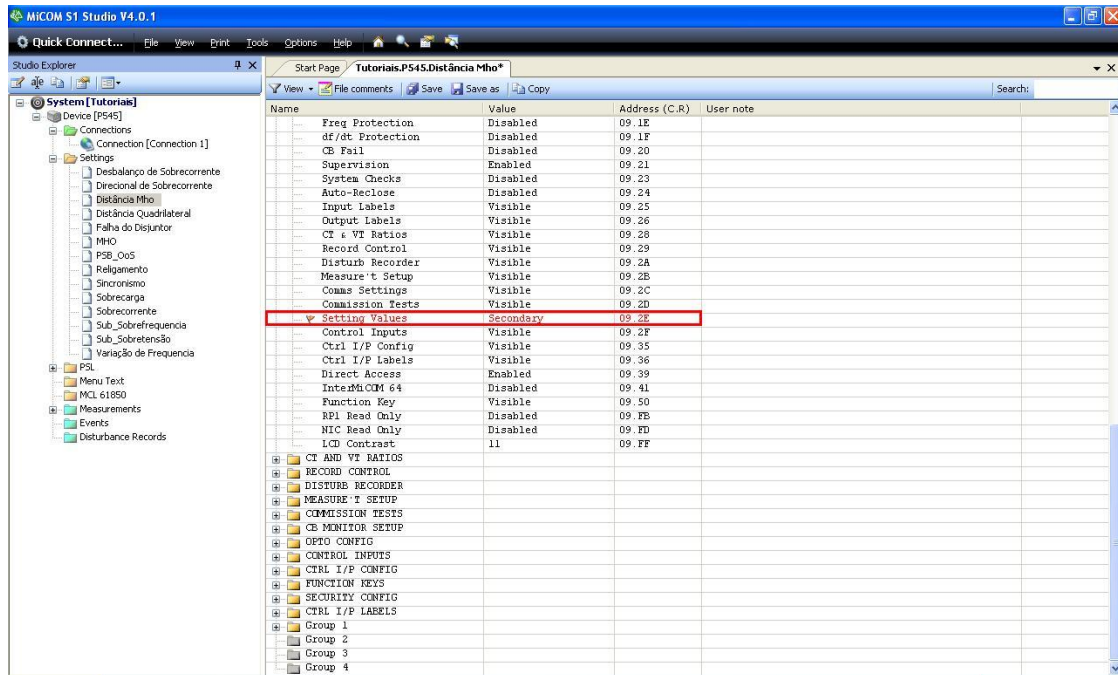


Figure 17

3.4 CT AND VT RATIOS

Adjust the values of primary and secondary voltages and currents and the CT polarity.

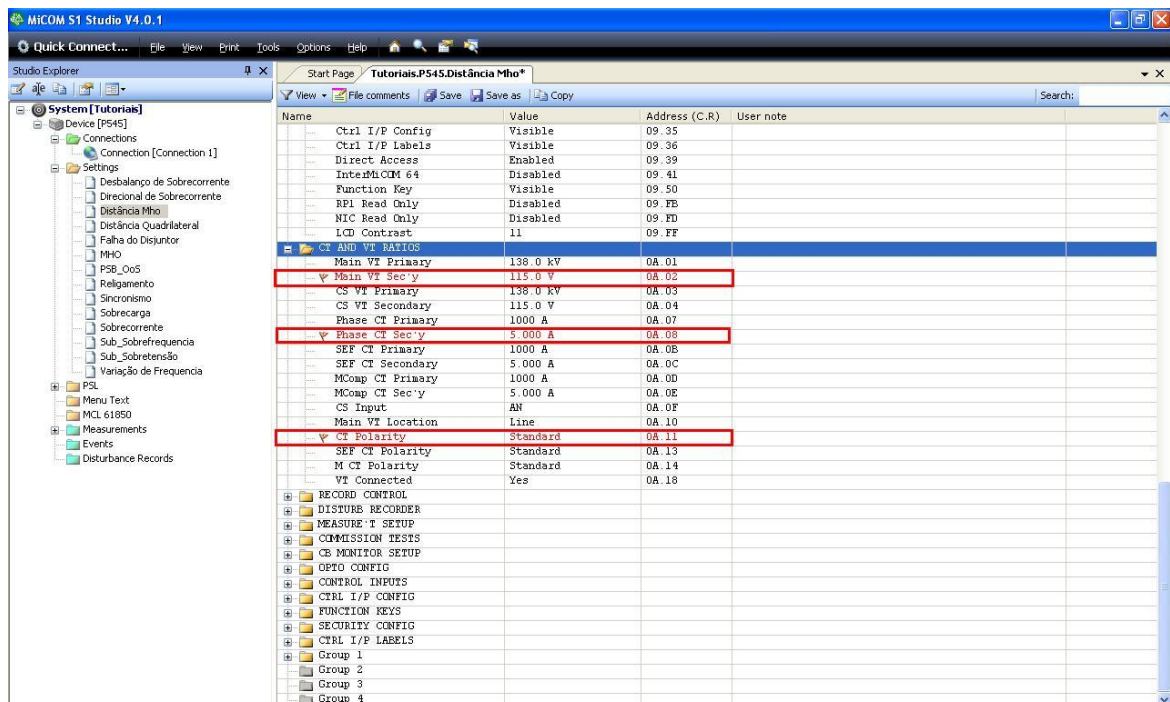


Figure 18

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3.5 GROUP 1 LINE PARAMETERS

Click on the “+” sign under “GROUP” and under “GROUP 1 LINE PARAMETERS” make adjustments for line length and angle, compensation factor for ground and phase sequence.

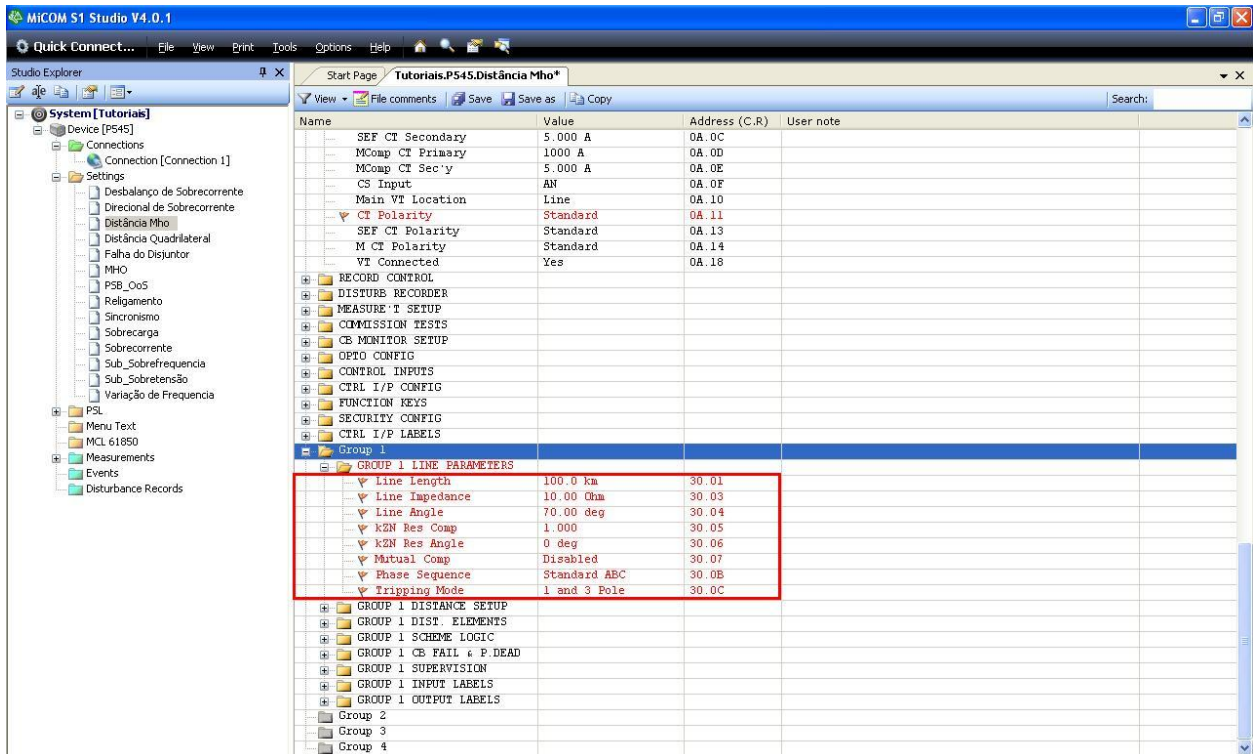


Figure 19

3.6 GROUP 1 DISTANCE SETUP

In this field, you choose which zone will be enabled and the type of parameterization in the “Setting Mode” option. In the first “Simple” the user chooses the percentage of each zone referring to the length of the line so that the relay software automatically calculates the values in ohms. If the user chooses this option when parameterization the “Distance” software, the calculated values of the “GROUP 1 DIST ELEMENTS” field must be inserted. If the second option “Advanced” is chosen, the “GROUP 1 DIST ELEMENTS” field is parameterized directly. In this tutorial, the second option will be used and the only disabled zone will be the “P” zone. The load compensation and directionality options are also disabled.

INSTRUMENTOS PARA TESTES ELÉTRICOS

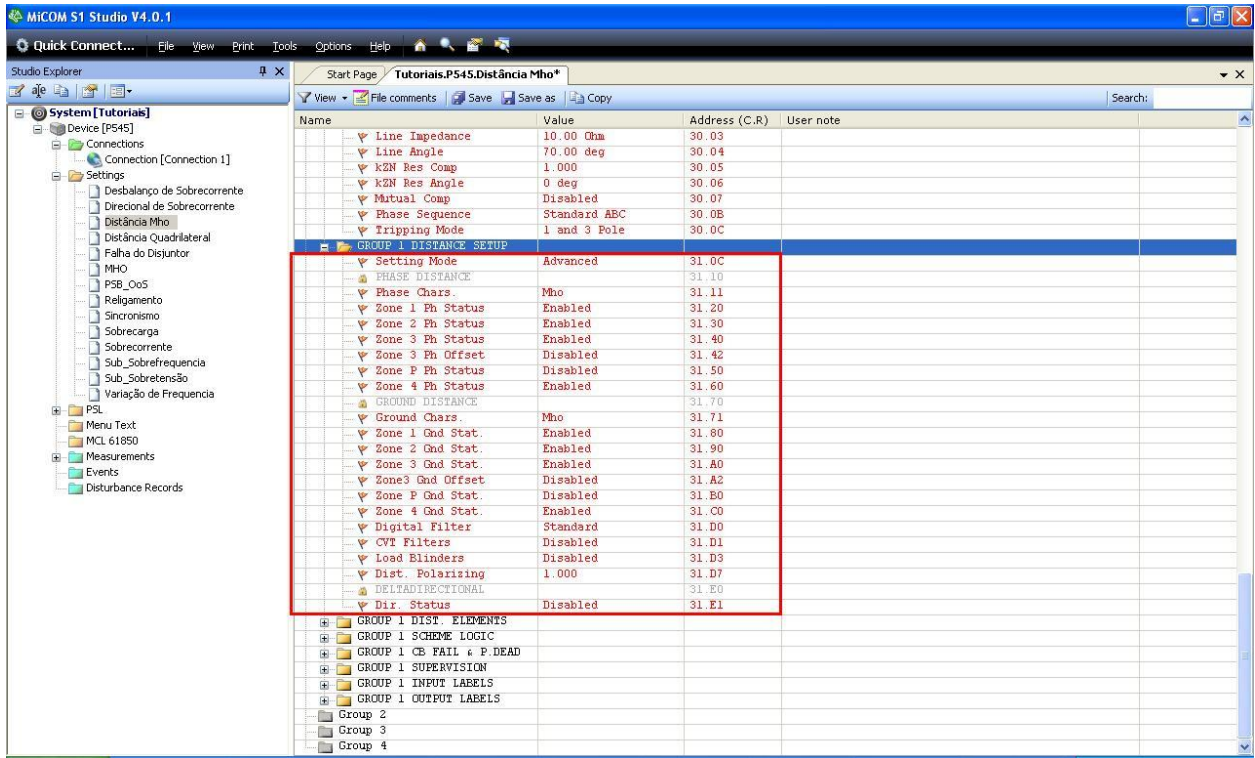


Figure 20

3.7 GROUP 1 DIST. ELEMENTS

In this option, configure the ranges of each phase zone.

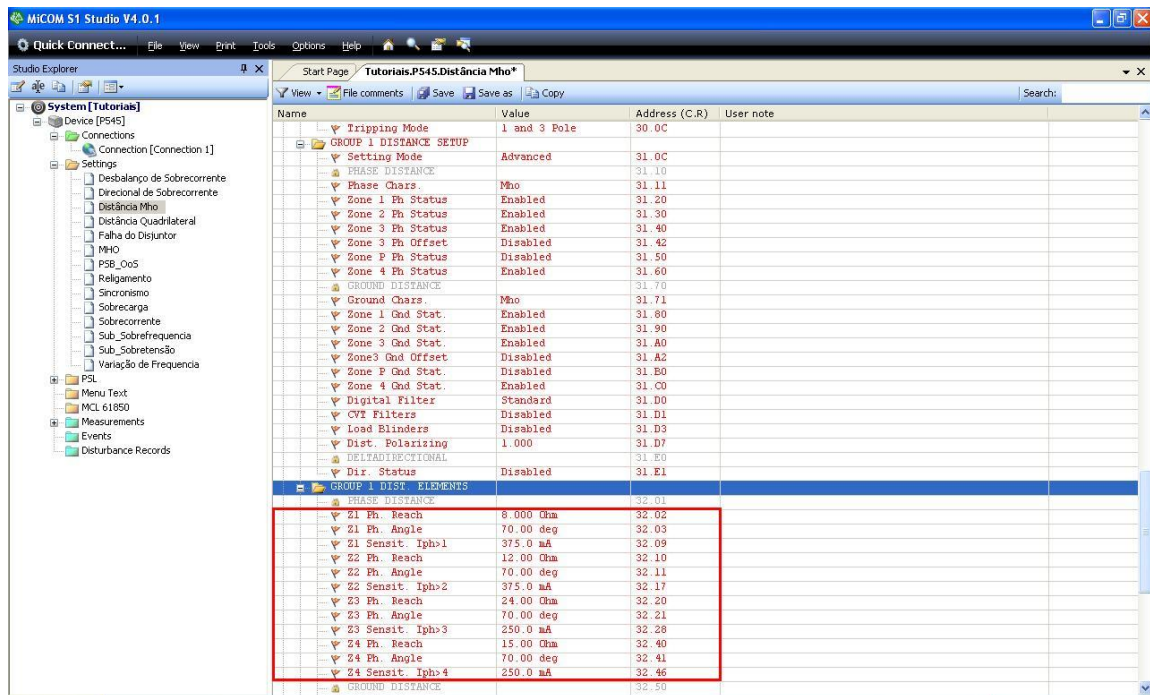


Figure 21

INSTRUMENTOS PARA TESTES ELÉTRICOS

Adjust the ranges for each ground zone.

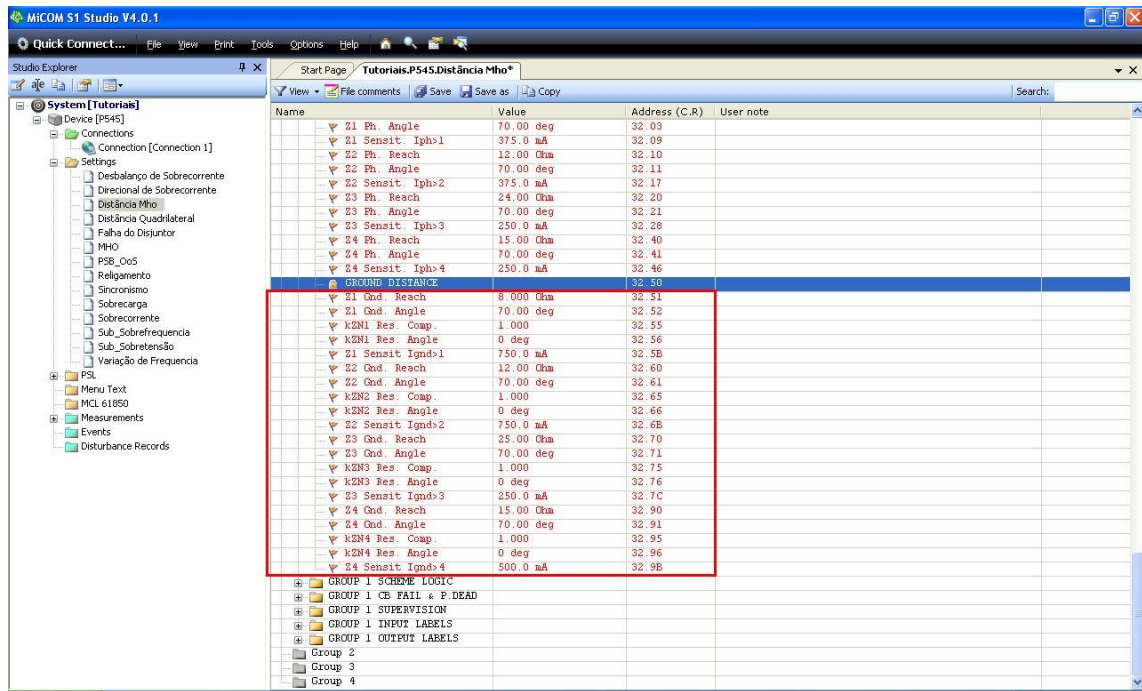


Figure 22

3.8 GROUP 1 SCHEME LOGIC

In this field sets the operating times and that each zone acts for faults involving ground and between phases.

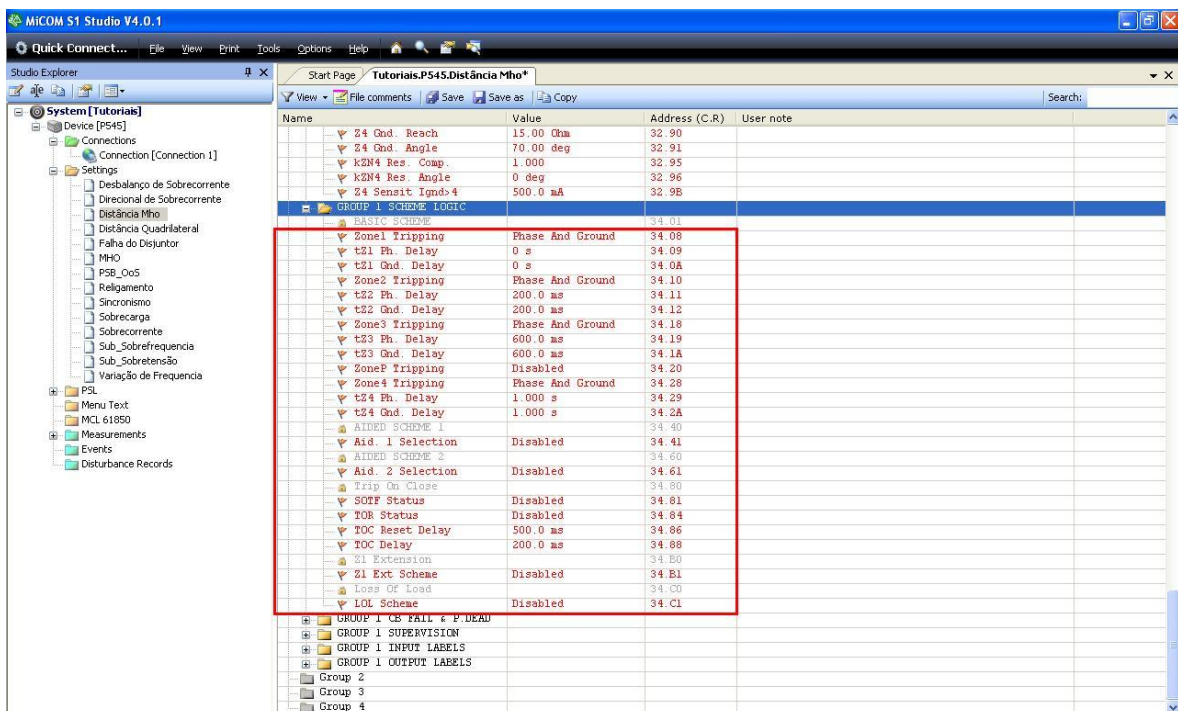


Figure 23

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The next step is to click on “Save”.

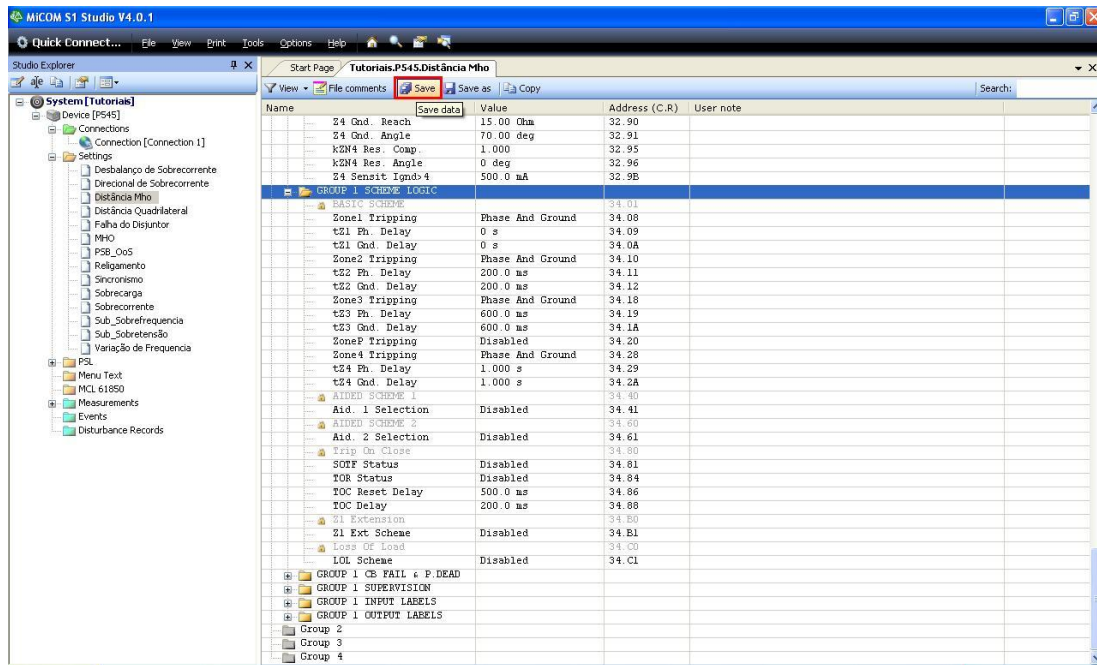


Figure 24

3.9 PSL

The configurations of binary outputs are made through logical blocks being configured in another file. Right click on the “PSL” folder and then on “New File”.

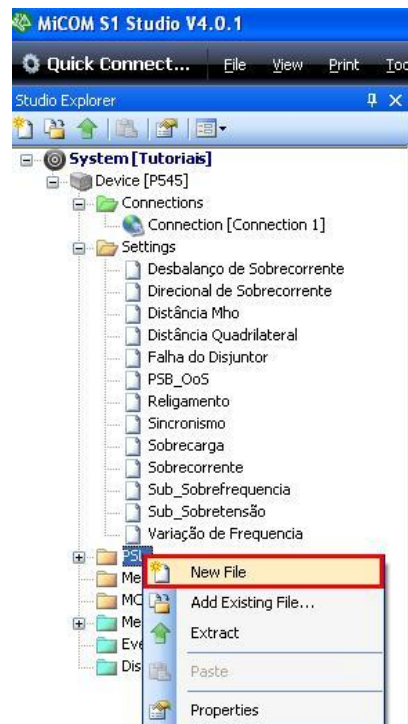


Figure 25

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The name of the file name appears as “000” change to “*Distância Mho*”.

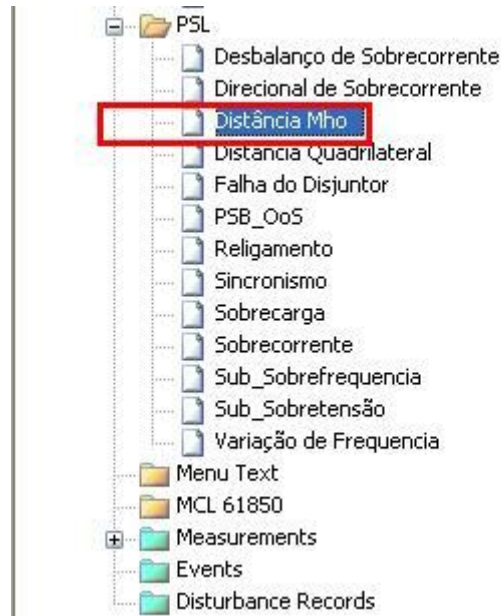


Figure 26

Double click on this file to gain access to the logical blocks. Then click on the tool highlighted in red and zoom in on the region highlighted in green.

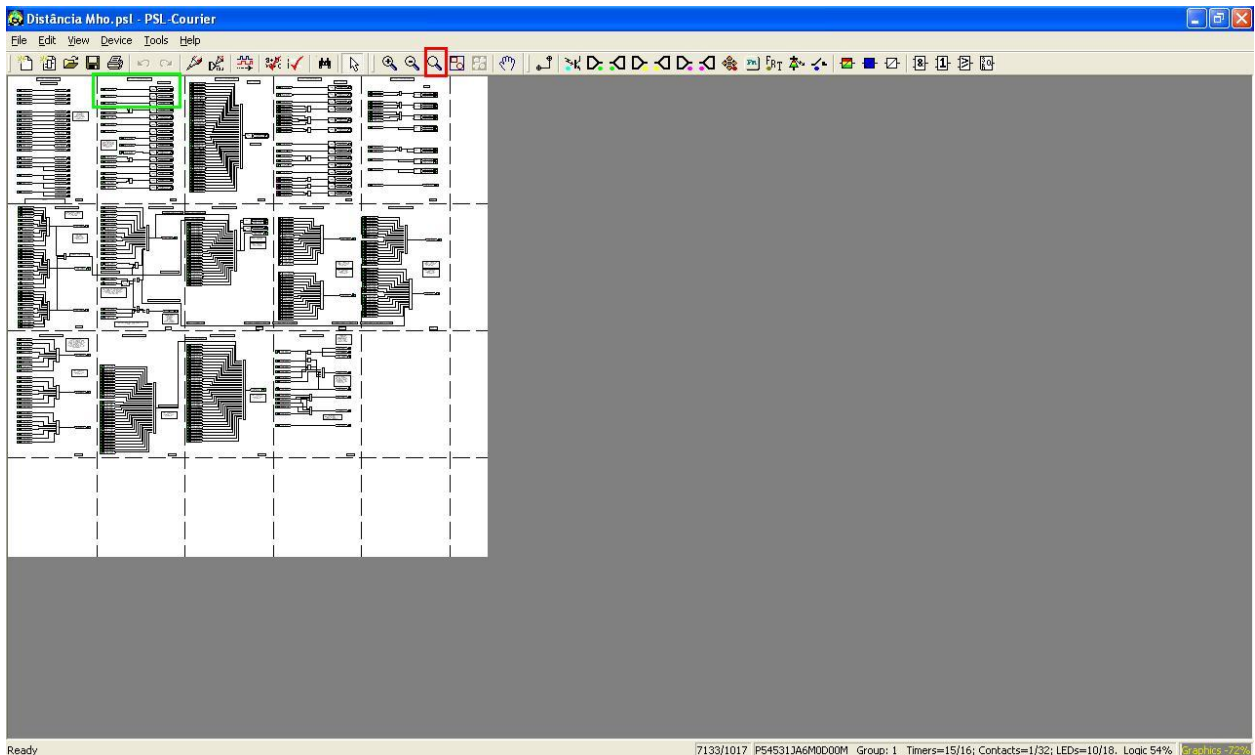


Figure 27

INSTRUMENTOS PARA TESTES ELÉTRICOS

Note that the following figure shows the first output (highlighted in red) associated only with the zone 1 trip. A logic “OR” must be made by inserting the trip of the other three zones.

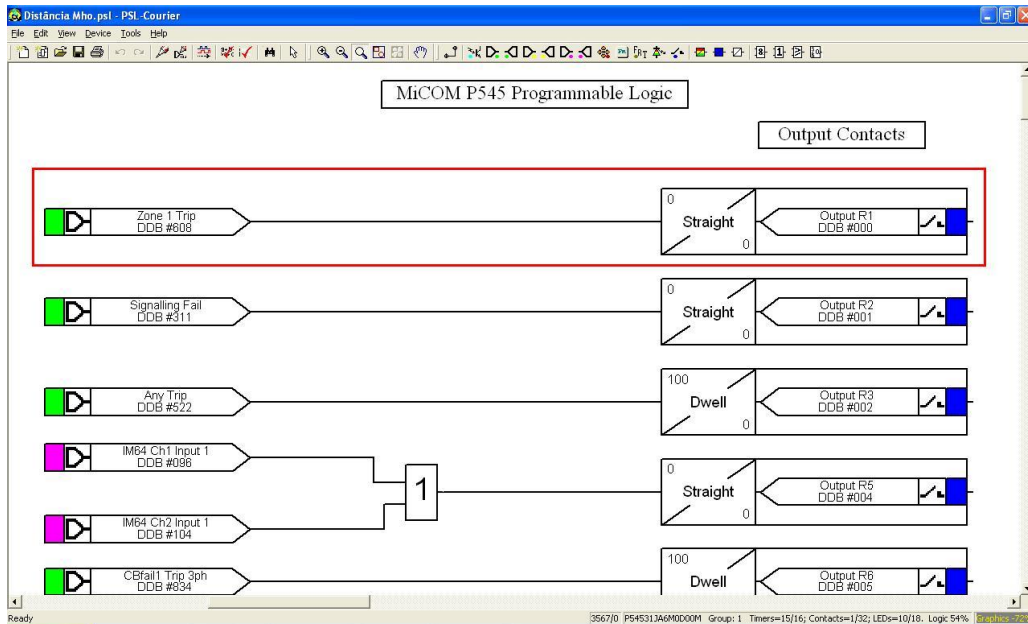


Figure 28

Click on the highlighted arrow and then on the line that joins the block “Zone 1 Trip” with the output “OutputR1” with the right button and on “Delete” to remove it.

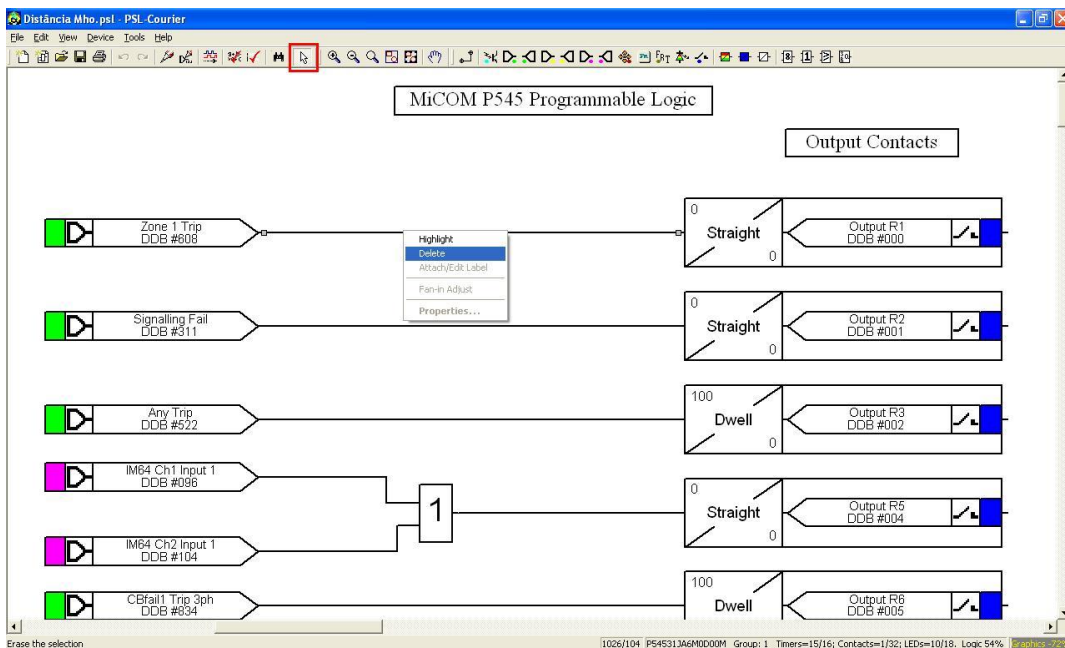


Figure 29

INSTRUMENTOS PARA TESTES ELÉTRICOS

Click on the “OutputR1” block and change the “Mode” to “Pickup” and on the option “Pickup Value (ms)” adjusts the value to zero.

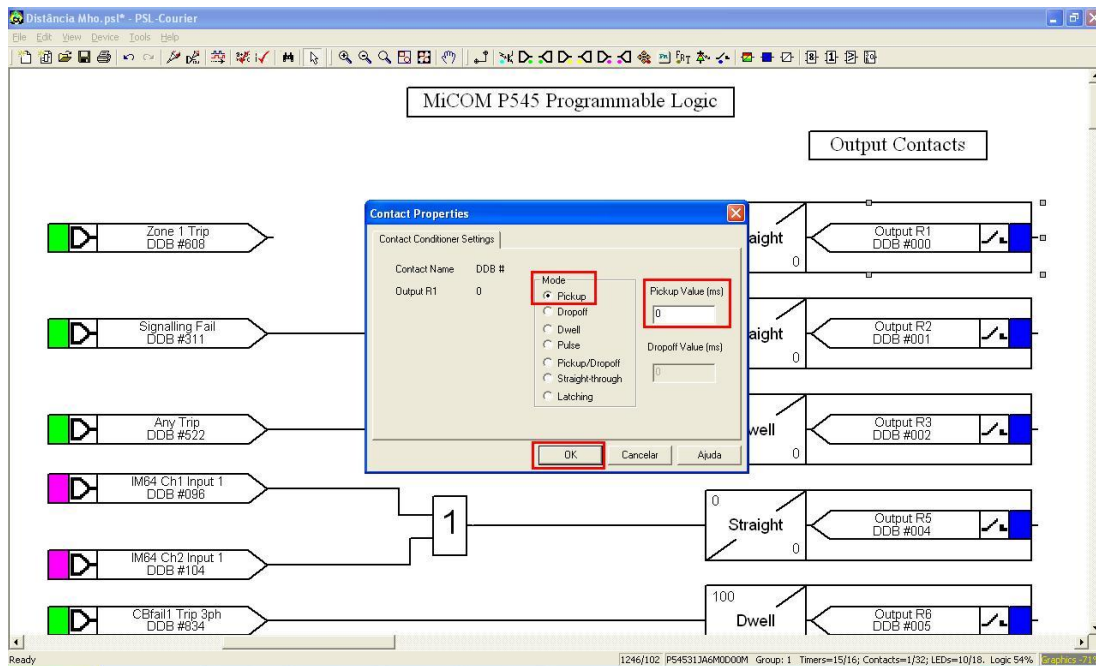


Figure 30

The next step is to associate the trip signals of the other zones with logic and the “OutputR1” output block. Click on the button highlighted in red and choose the following sign.

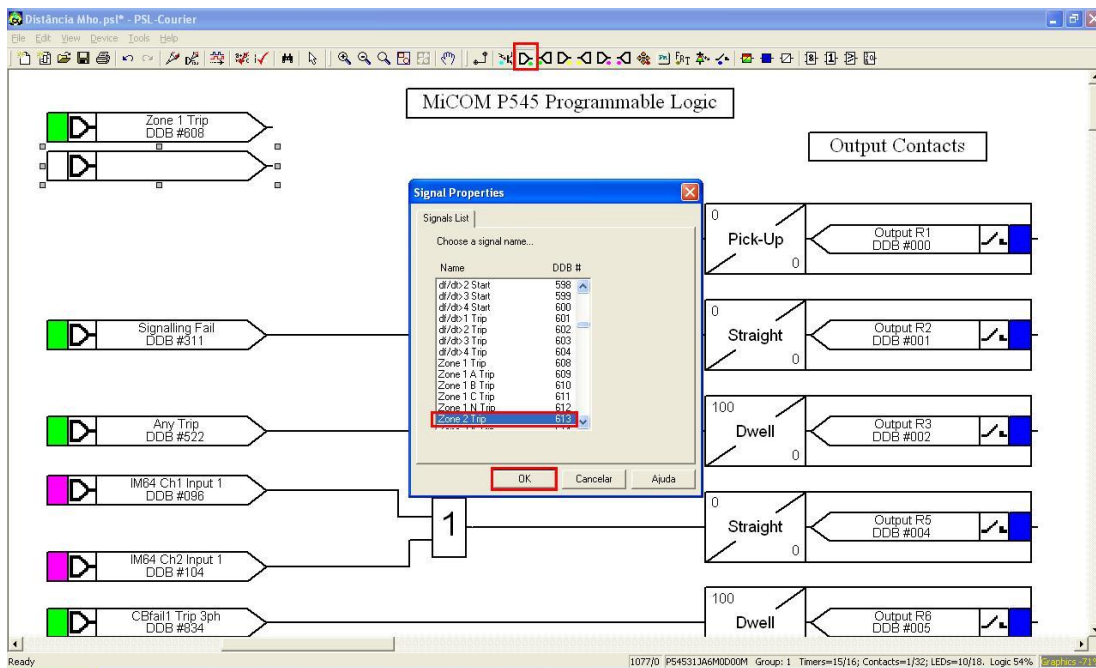


Figure 31

INSTRUMENTOS PARA TESTES ELÉTRICOS

Repeat the previous procedure inserting the signals “Zone 3 Trip” and “Zone 4 Trip” then create a logical block “OR” by clicking on the icon highlighted in green.

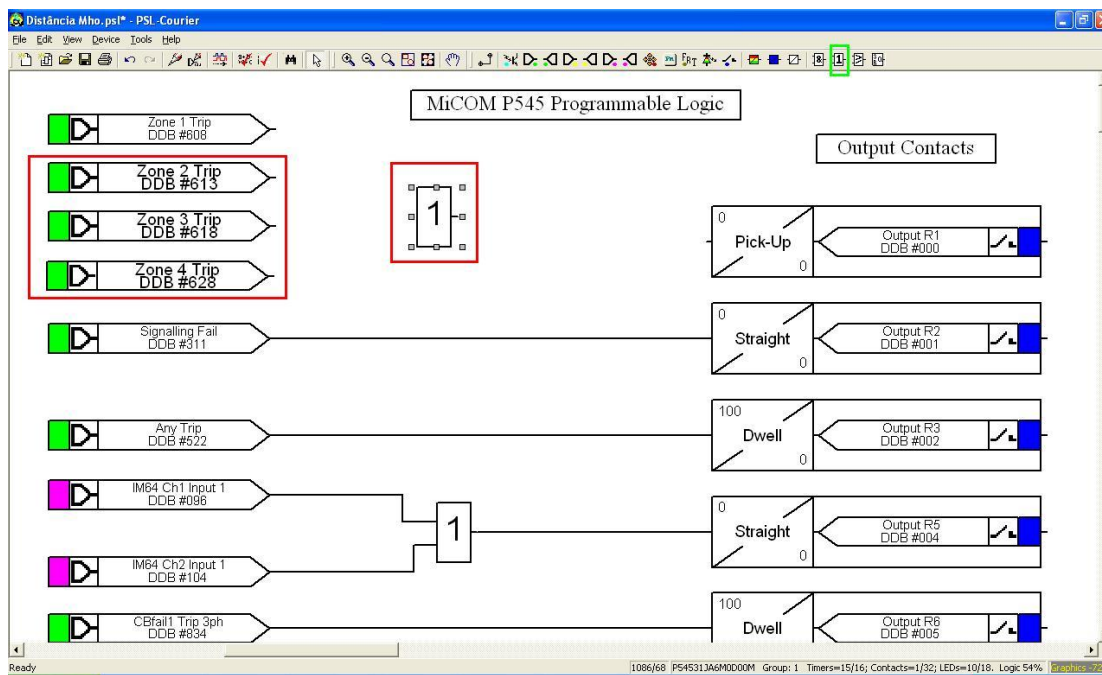


Figure 32

Now click on the icon highlighted in green and connect the blocks.

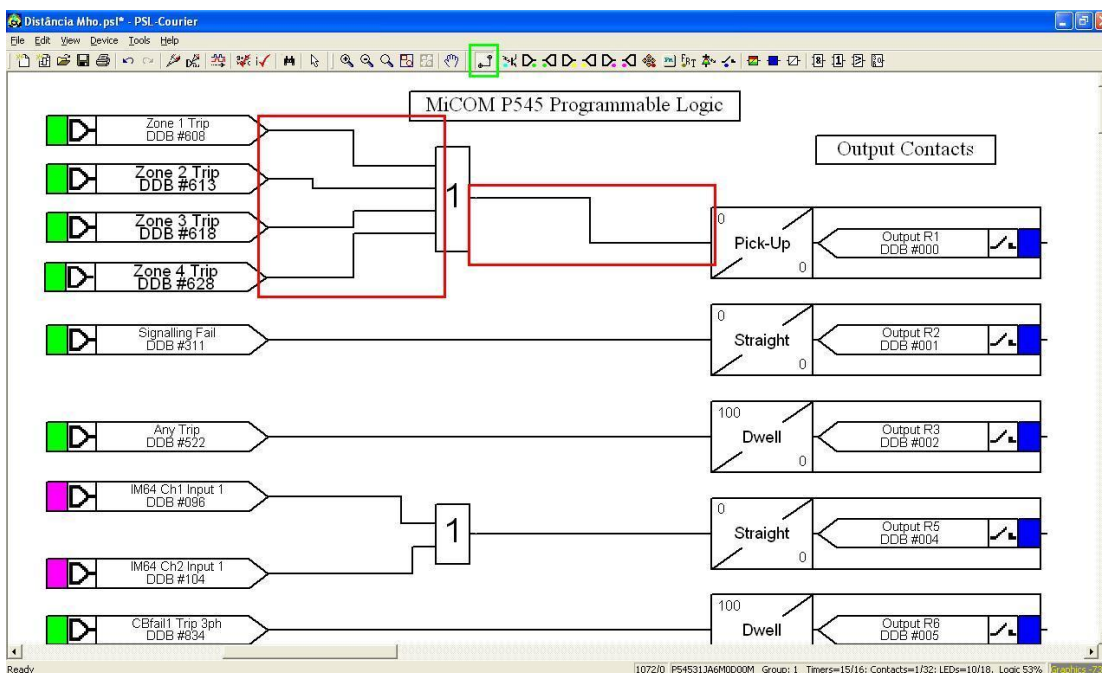


Figure 33

INSTRUMENTOS PARA TESTES ELÉTRICOS

Click on the highlighted icon to save the file, then close the logical block editor and return to the “MiCOM” software.

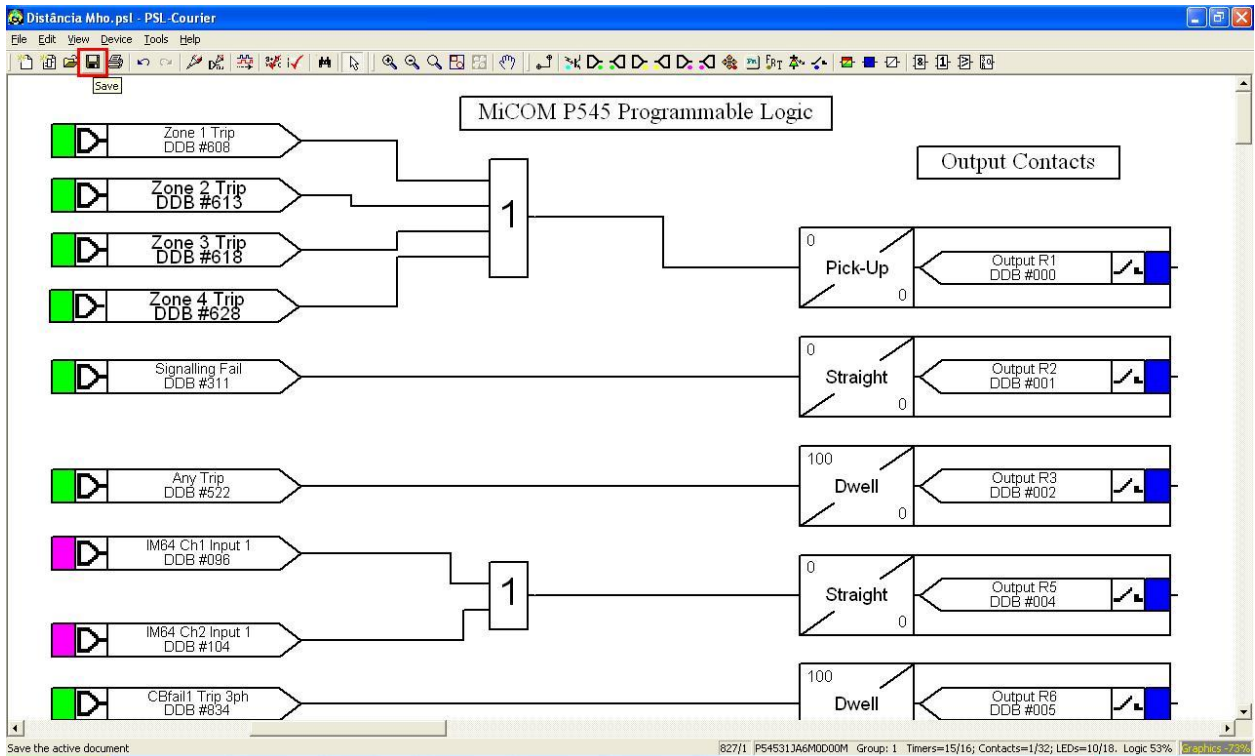


Figure 34

3.10 Sending Settings to the Relay

Click on the “Device [P545]” icon then on the icon highlighted in green.



Figure 35

INSTRUMENTOS PARA TESTES ELÉTRICOS

Send both the function settings and group 1 from the “*Distância Mho*” logic block.

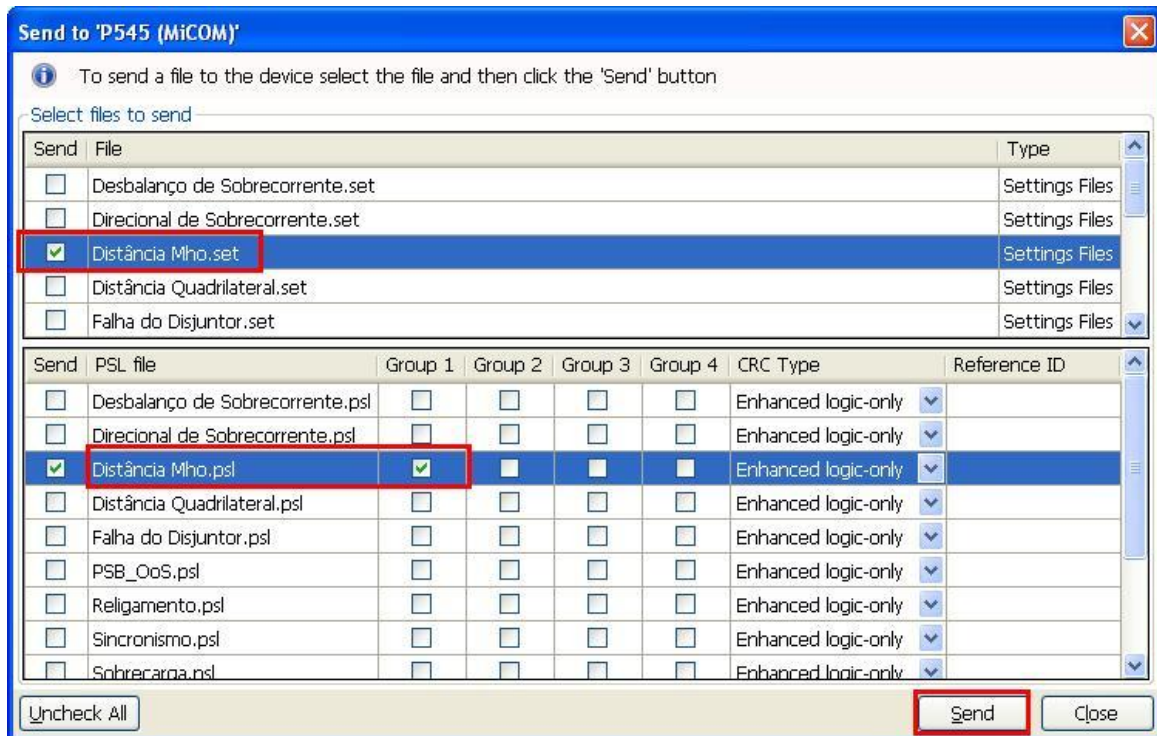


Figure 36

4. Distance software adjustments

4.1 Opening the Distance

Click on the CTC application manager icon.

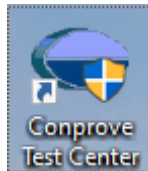


Figure 37

Make a click on the software icon “Distance”.

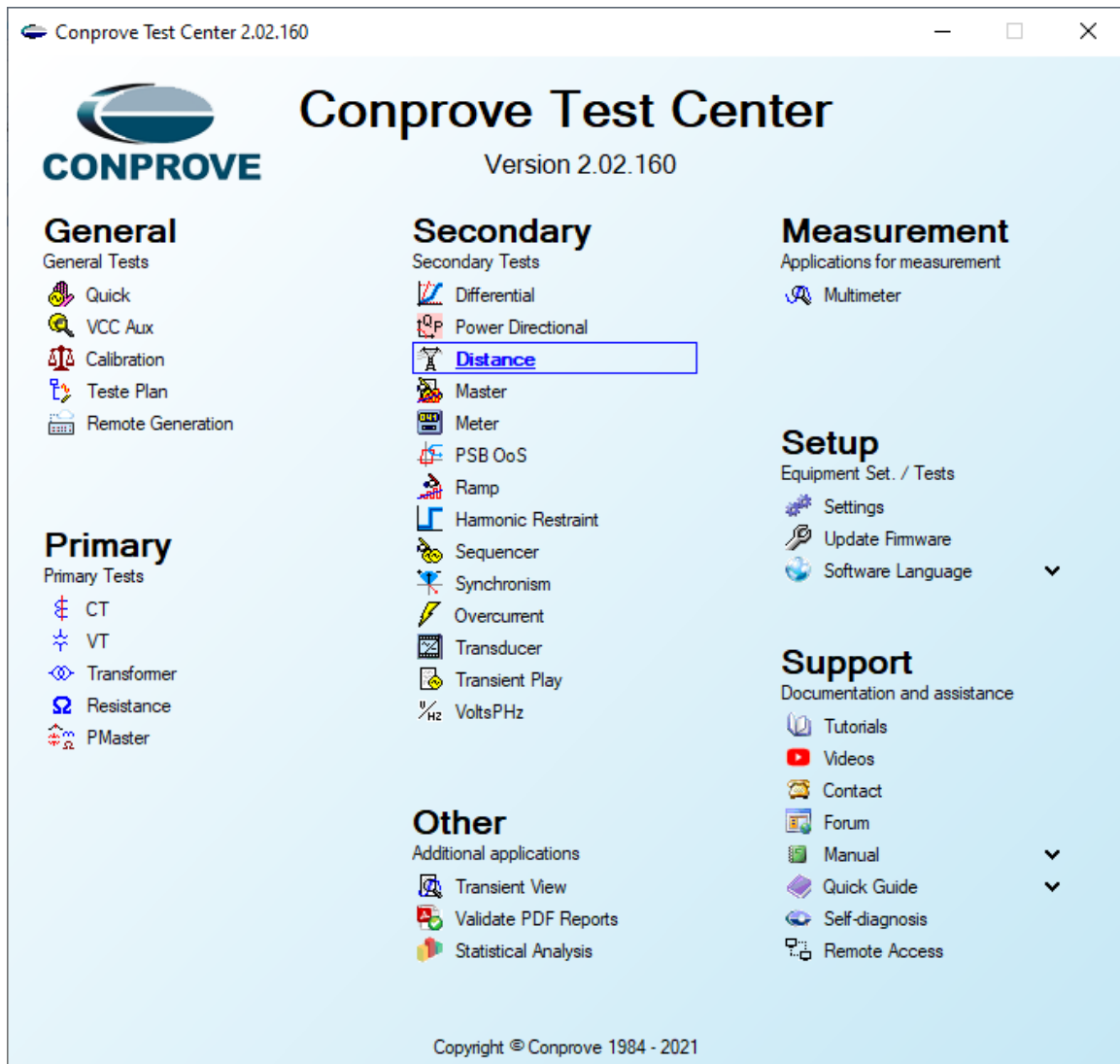


Figure 38

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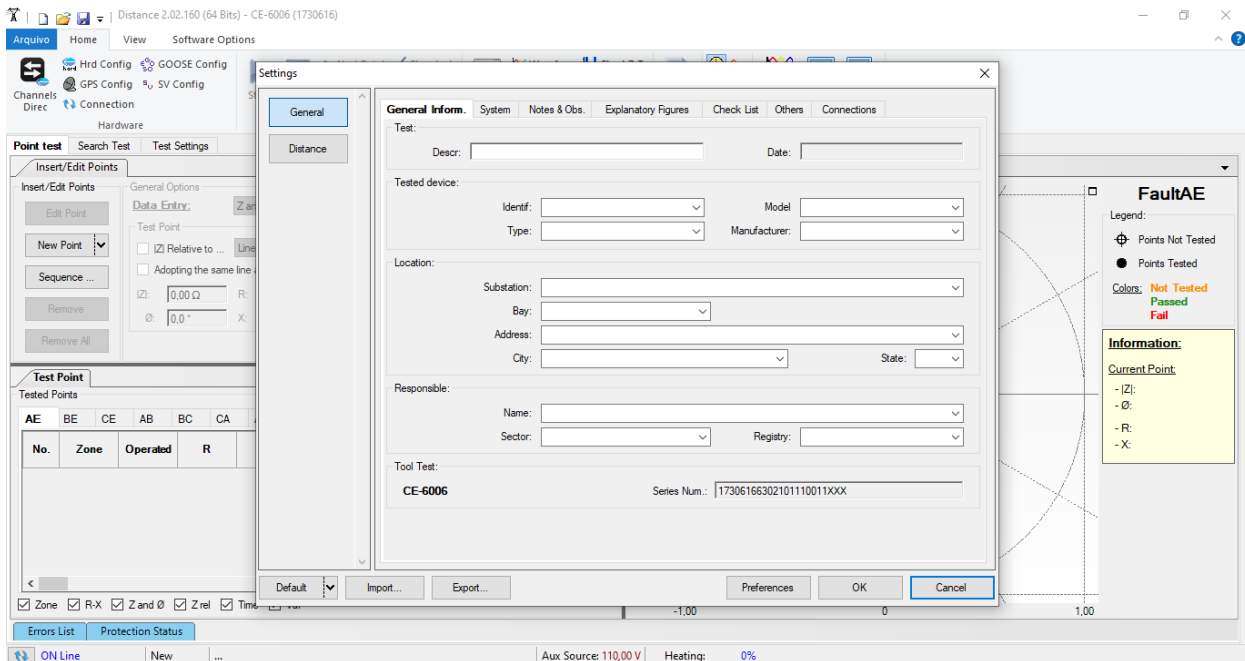


Figure 39

4.2 Configuring the Settings

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.

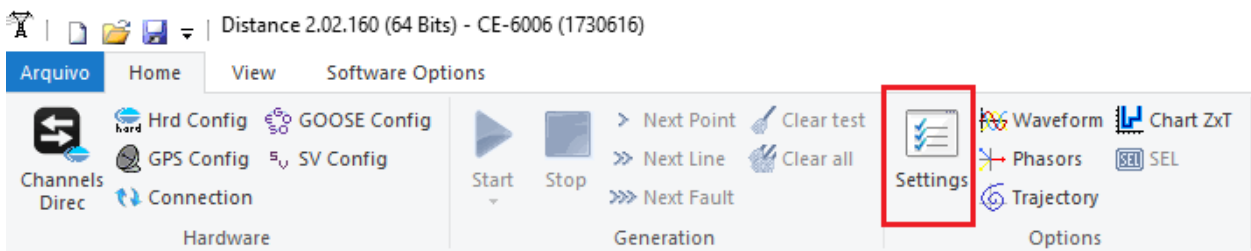
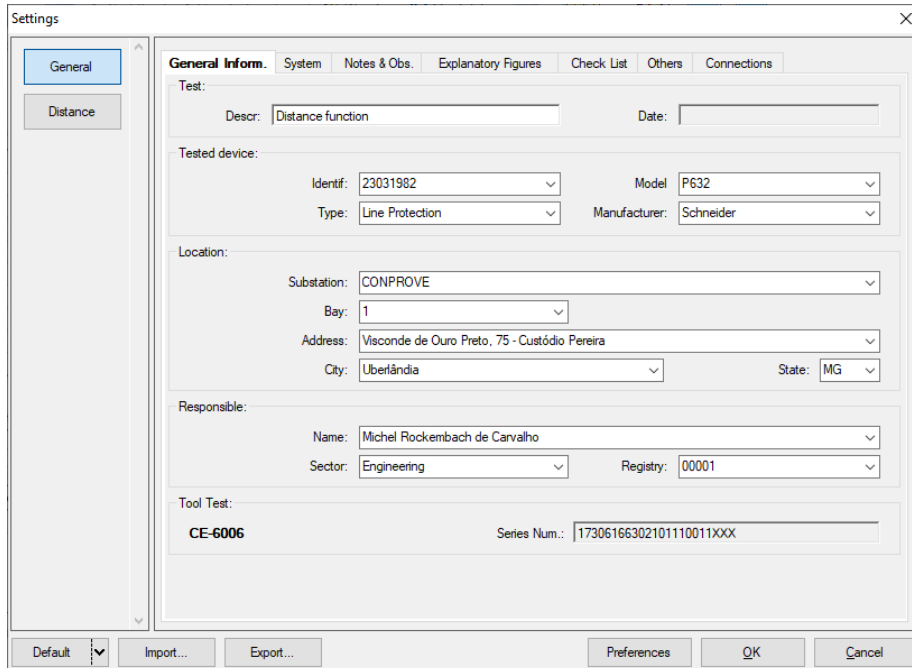


Figure 40

Inside the “*Settings*” screen, fill in the “*General Inform.*” with details of the tested device, installation location and the person responsible. This facilitates the elaboration of the report as this tab will be the first to be shown.

INSTRUMENTOS PARA TESTES ELÉTRICOS



Settings

General Inform. System Notes & Obs. Explanatory Figures Check List Others Connections

Test:
Descr: Distance function Date:

Tested device:
Identif: 23031982 Model: P632
Type: Line Protection Manufacturer: Schneider

Location:
Substation: CONPROVE
Bay: 1
Address: Visconde de Ouro Preto, 75 - Custódio Pereira
City: Uberlândia State: MG

Responsible:
Name: Michel Rockembach de Carvalho
Sector: Engineering Registry: 00001

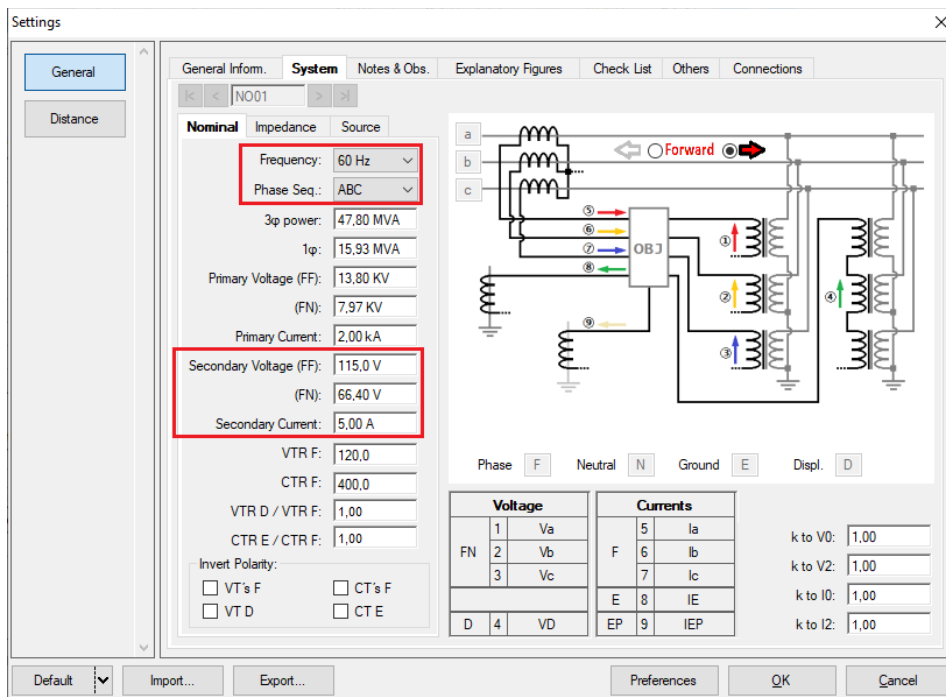
Tool Test:
CE-6006 Series Num.: 17306166302101110011XXX

Default Import... Export... Preferences OK Cancel

Figure 41

4.3 System

In the following screen, within the “Nominal” sub 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 relevant for this test.



Settings

General Inform. **System** Notes & Obs. Explanatory Figures Check List Others Connections

NO01

Nominal Impedance Source

Frequency: 60 Hz
Phase Seq.: ABC

3 ϕ power: 47,80 MVA
T ϕ : 15,93 MVA

Primary Voltage (FF): 13,80 KV
(FN): 7,97 KV

Primary Current: 2,00 kA

Secondary Voltage (FF): 115,0 V
(FN): 66,40 V

Secondary Current: 5,00 A

VTR F: 120,0
CTR F: 400,0
VTR D / VTR F: 1,00
CTR E / CTR F: 1,00

Invert Polarity:
 VT's F CT's F
 VT D CT E

Phase F Neutral N Ground E Displ. D

Voltage

1	Va
2	Vb
3	Vc
4	VD

Currents

5	Ia
6	Ib
7	Ic
8	IE
9	IEP

k to V0: 1,00
k to V2: 1,00
k to I0: 1,00
k to I2: 1,00

Default Import... Export... Preferences OK Cancel

Figure 42

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There are other tabs where the user can enter notes and observations, explanatory figures, can create a “check list” of the procedures for carrying out the test and even create a diagram with all the schematic of the connections between the test set and the test equipment.

5. Distance Adjustments

5.1 Distance Screen > Distance Prot. Settings

The first step is to adjust the ground compensation factor.

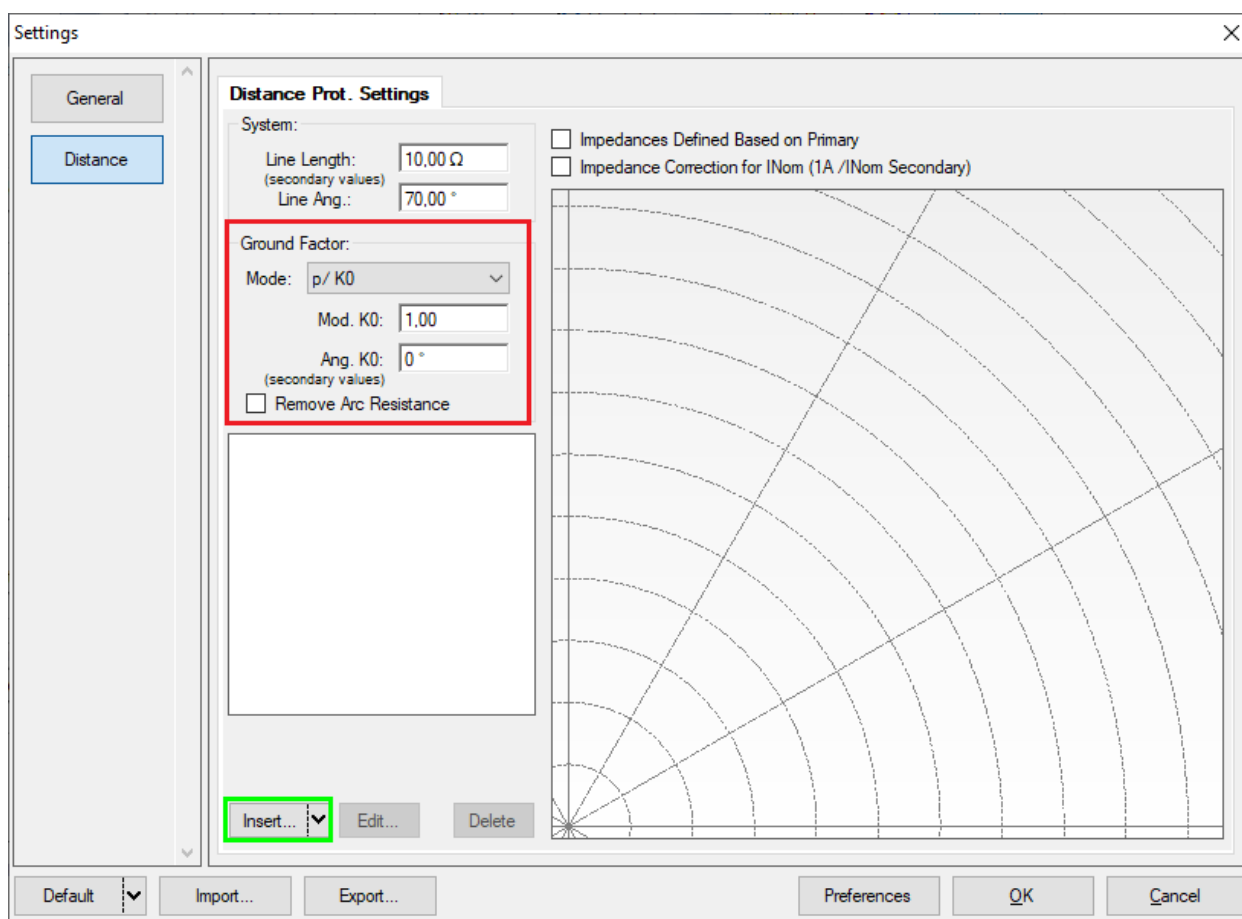


Figure 43

5.2 Inserting Zones

Click on the “Insert” field highlighted in green in the previous figure. In the settings screen, first choose the relay mask “Schneider/Areva P54x, P446 - Mho”. You must adjust the actuation time, choose the type of fault (loop), and enter the zone characteristics and directionality. Adjust the tolerance values and finally click on “OK”.

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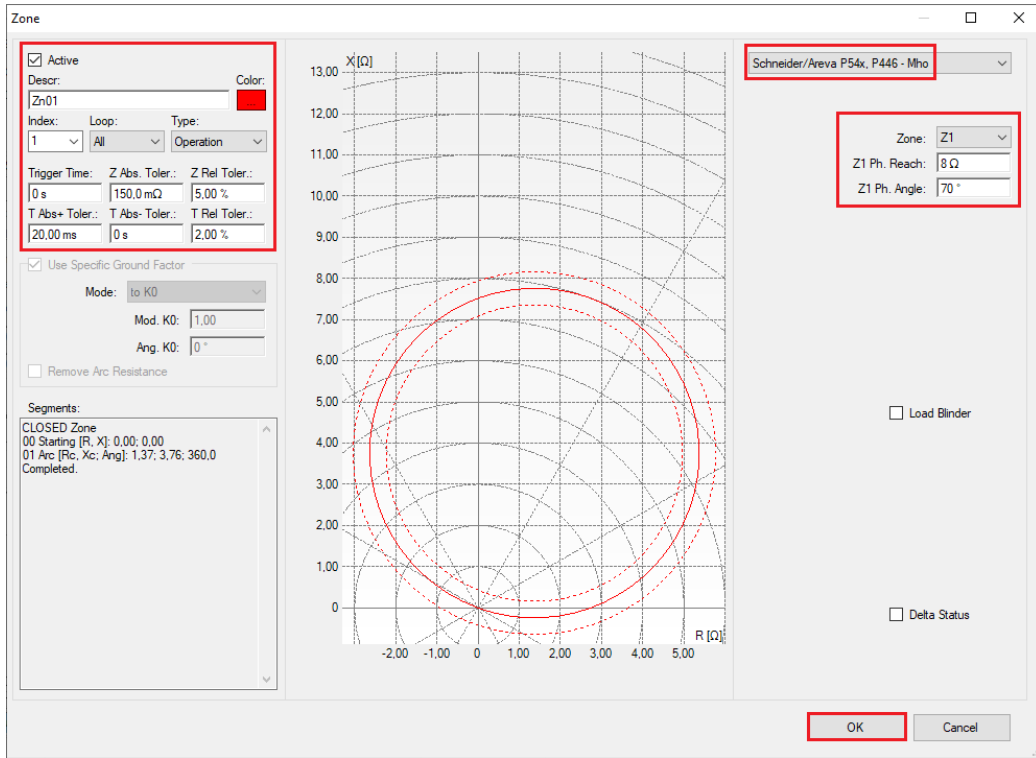


Figure 44

Clicking “Insert” again adjusts the values for zone 2.

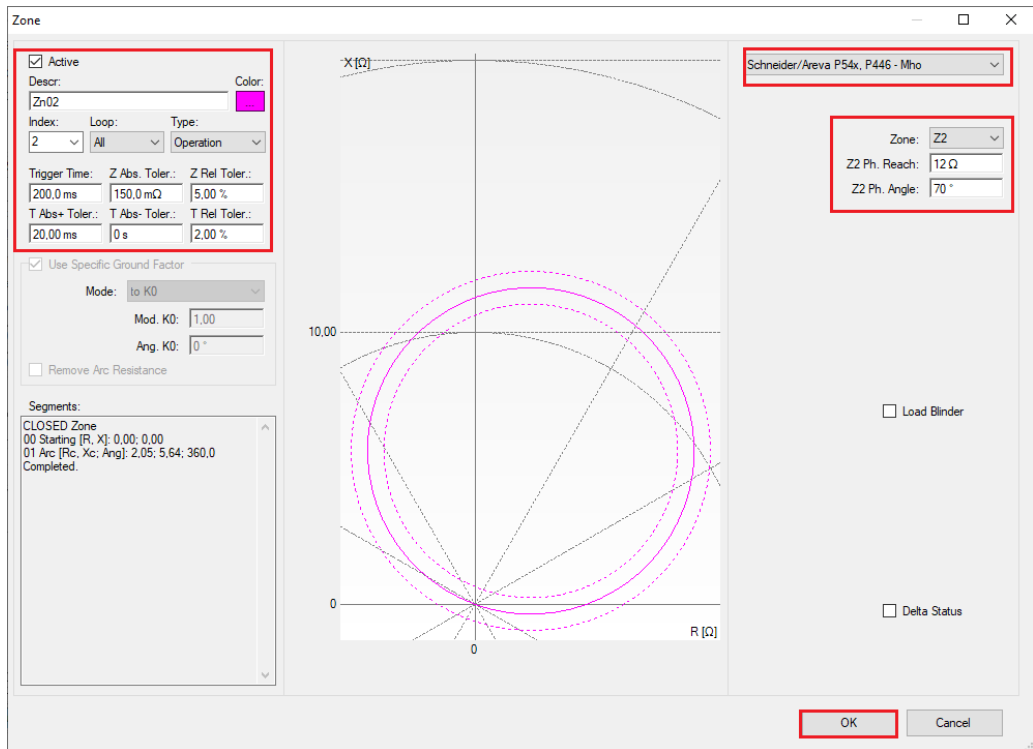


Figure 45

INSTRUMENTOS PARA TESTES ELÉTRICOS

By clicking on “Insert” the values for zone 3 are adjusted.

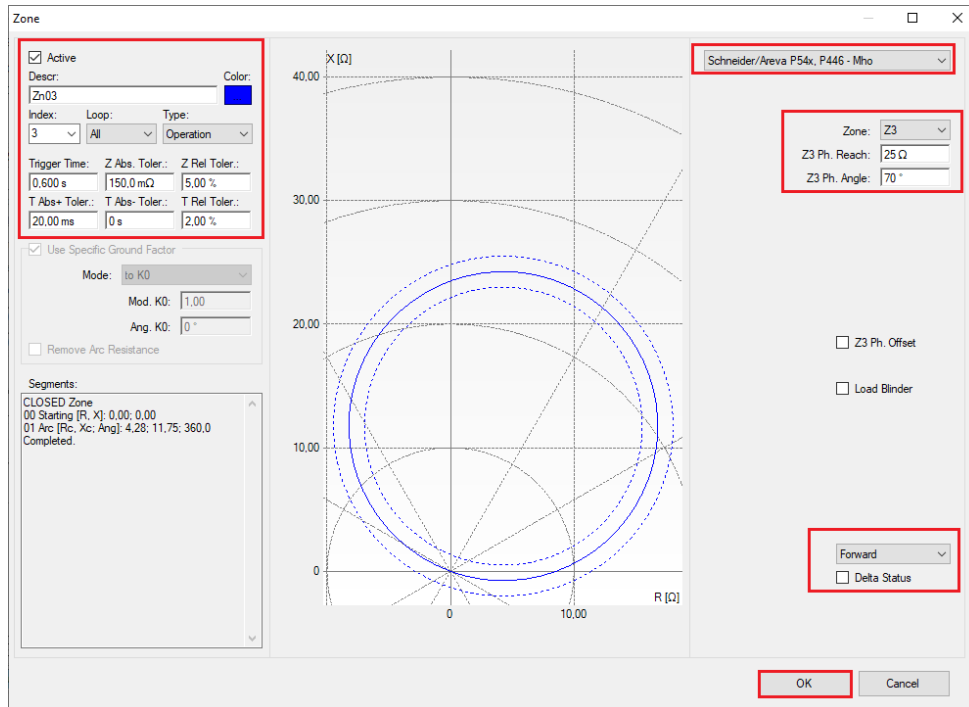


Figure 46

Clicking on “Insert” adjusts the values for zone 4.

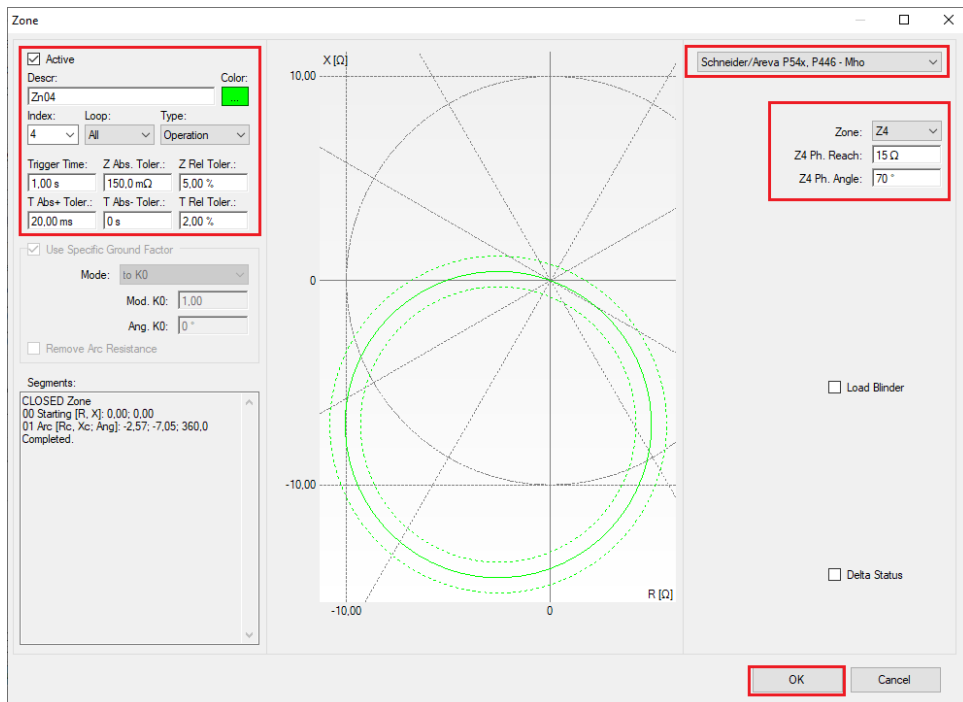


Figure 47

6. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

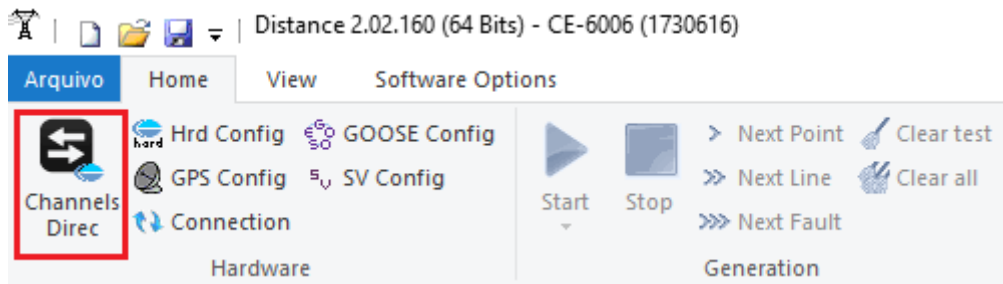


Figure 48

Then click on the highlighted icon to configure the hardware.

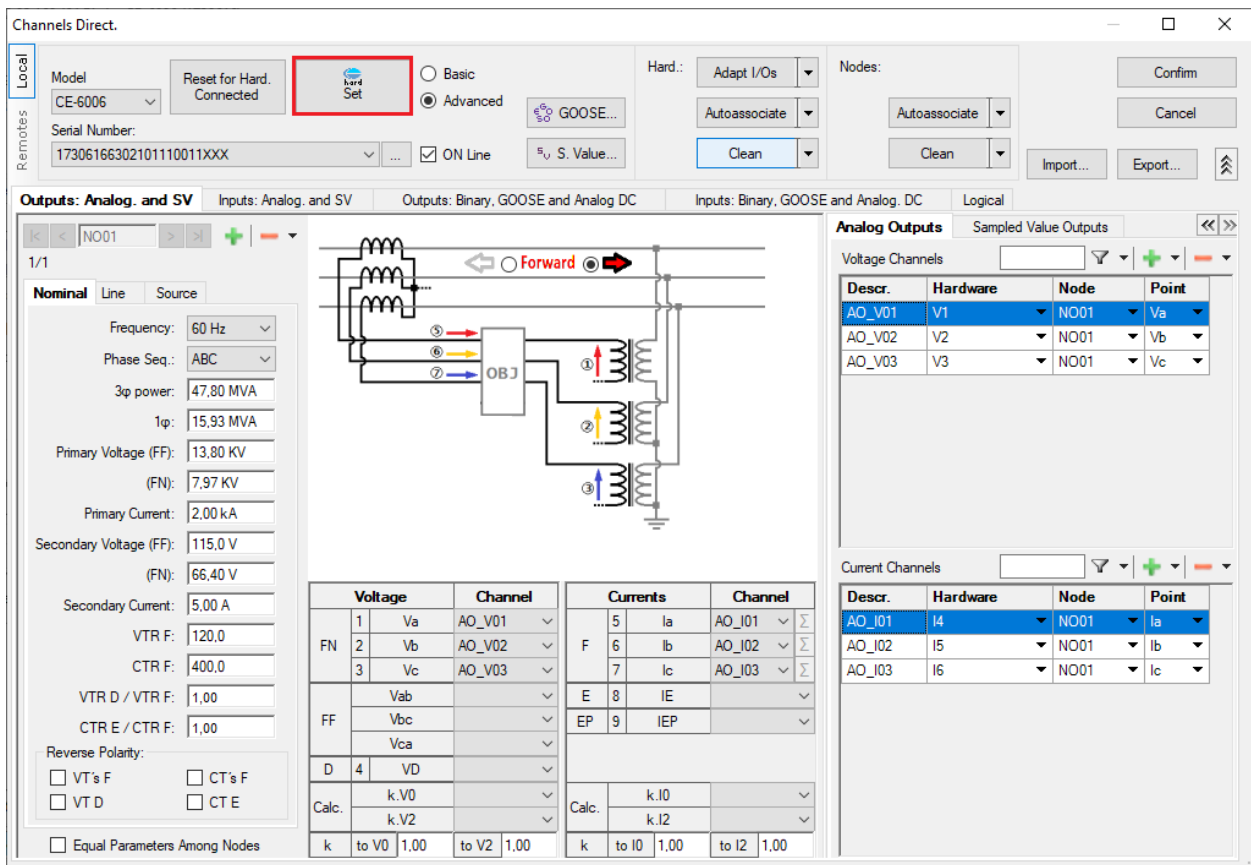


Figure 49

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

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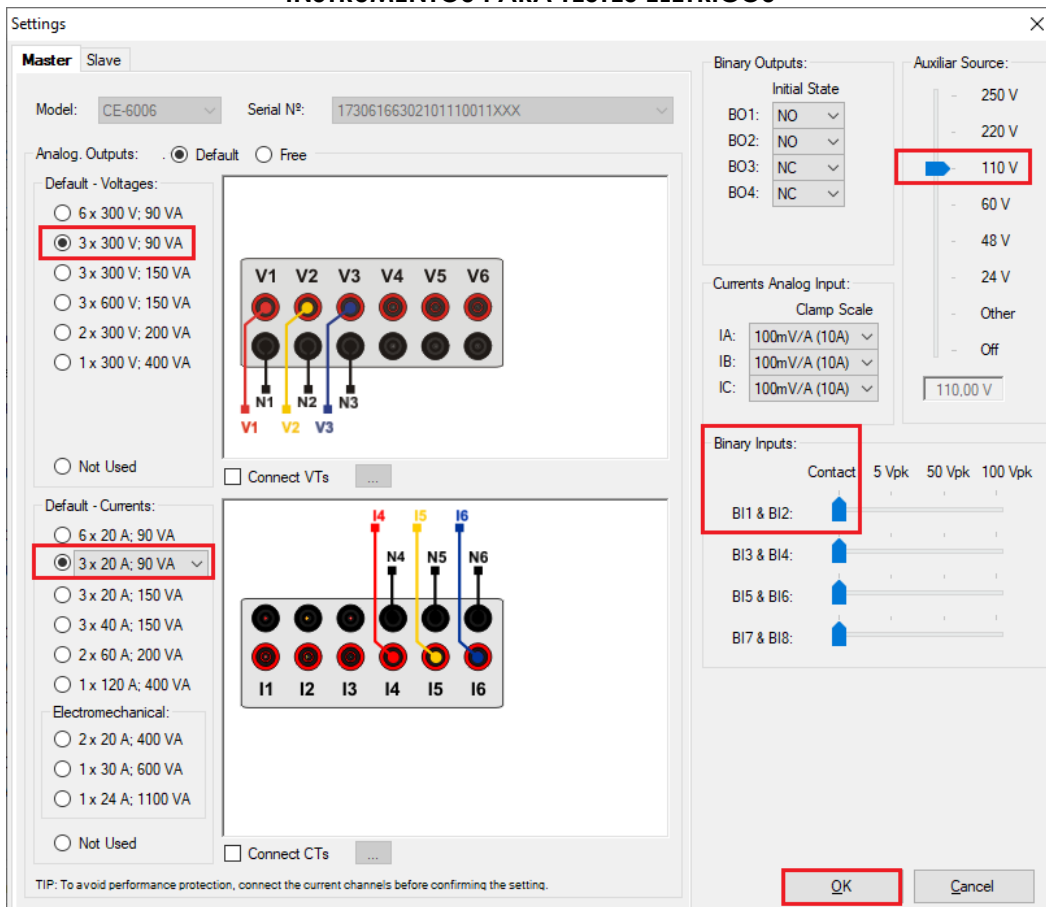


Figure 50

On the next screen choose “Basic” and on the next window (didn’t shown) choose “YES”, finally click on “Confirm”.



Figure 51

7. Test structure for function 21

7.1 Test Settings

By clicking on the settings tab, set the test mode to “Intelligent” and use binary input 1 for stop interface. Insert a pre-fault with nominal voltage and current equal to zero. Set the overtime waiting to 50ms

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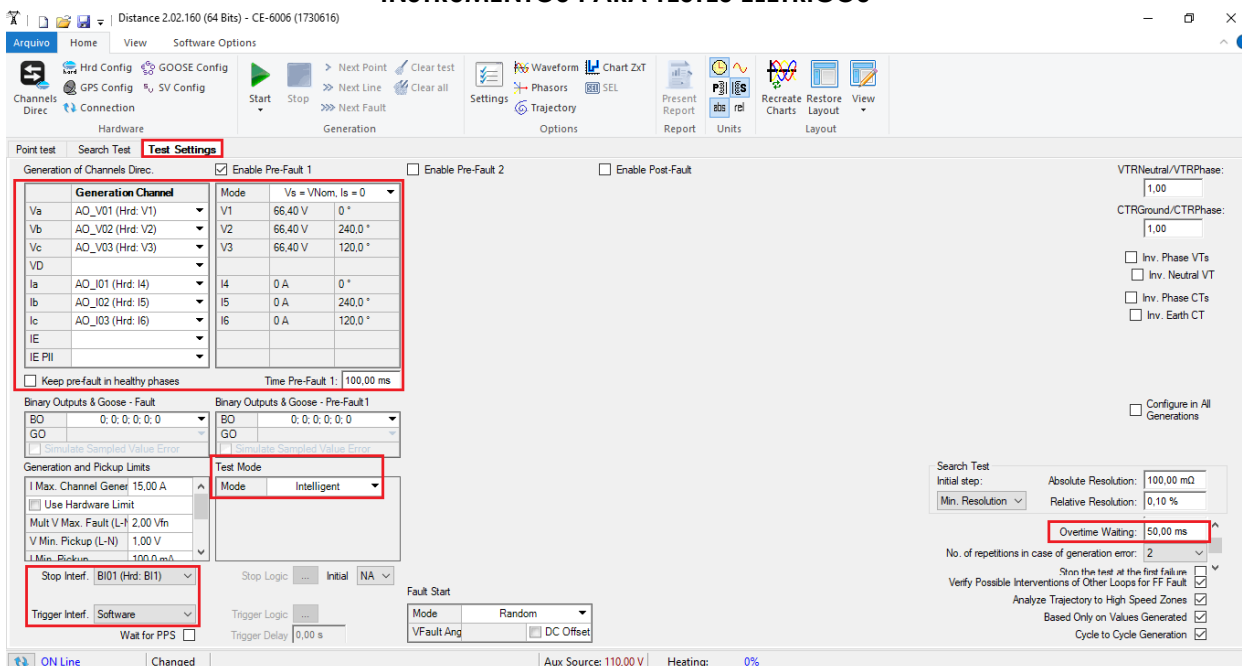


Figure 52

7.2 Search Screen

Click on the “*Search Test*” tab. To facilitate the test, a “*Sequence*” of lines is inserted to perform the search. To do this, position the mouse cursor in the internal region of zones 1, 2, 3 and check the impedance value.

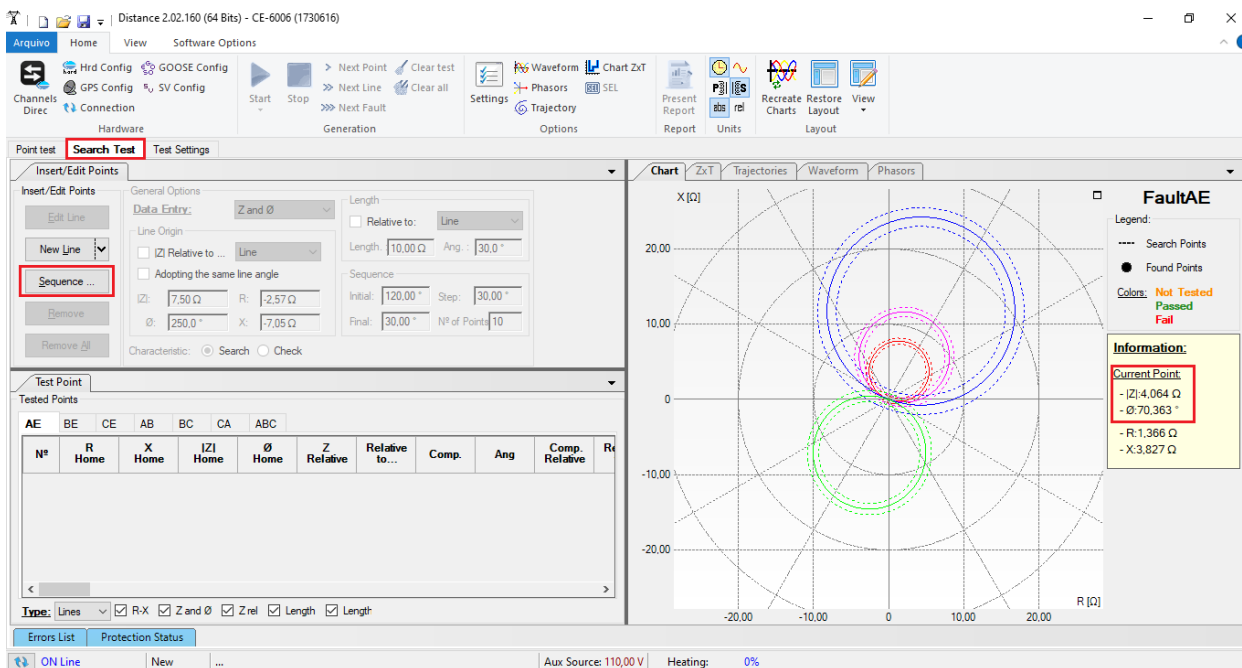


Figure 53

7.3 Faults

The starting point is $|Z|$ equal to $4,0\Omega$ e θ equal to 70° . From that point and with a length of $25,0\Omega$, the angle varies from 0 to 360° with a step of 30° . So click on the “Sequence” button and then on the AE, AB and ABC fault type.

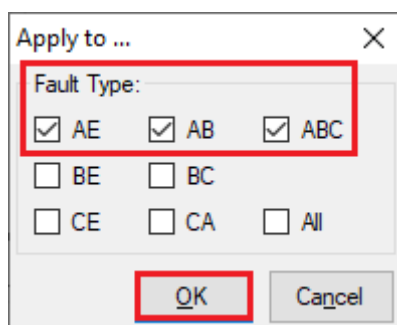


Figure 54

The following figure shows the settings for creating the sequence of lines to be tested:

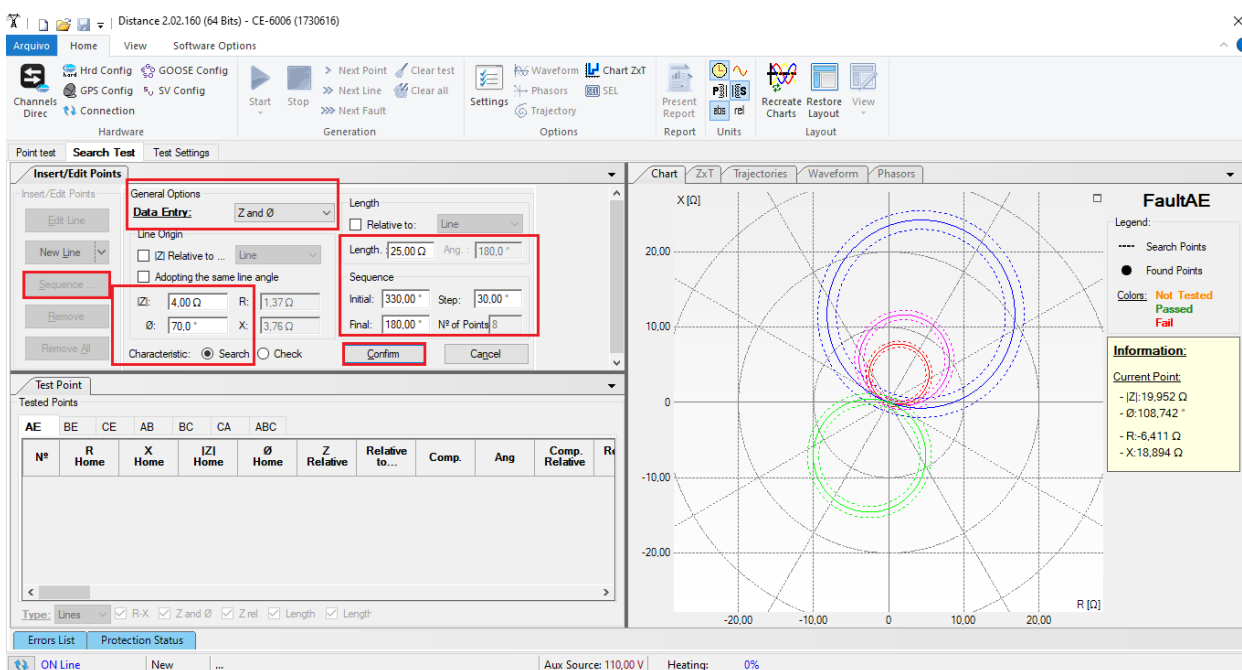


Figure 55

After confirmation the lines are created automatically.

INSTRUMENTOS PARA TESTES ELÉTRICOS

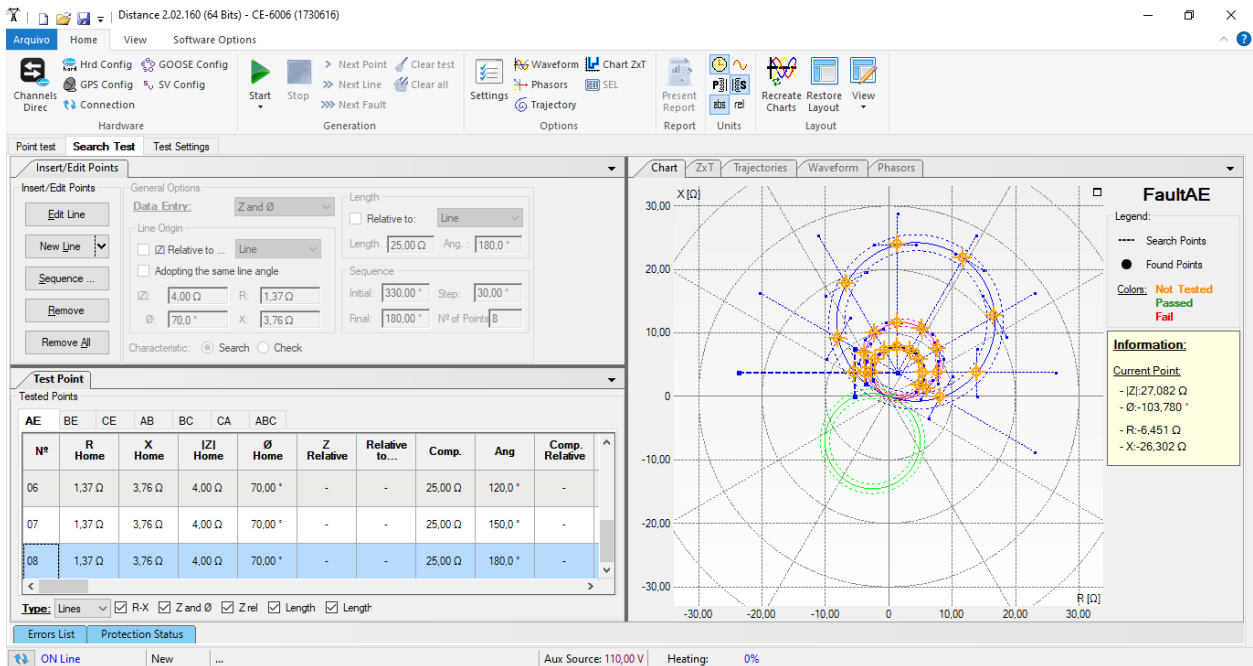


Figure 56

Repeat the reasoning of the last four figures and create a sequence of lines having as the point of origin a central impedance value in zone 4.

Start the generation by clicking on the icon below or through the shortcut “Alt + G”.

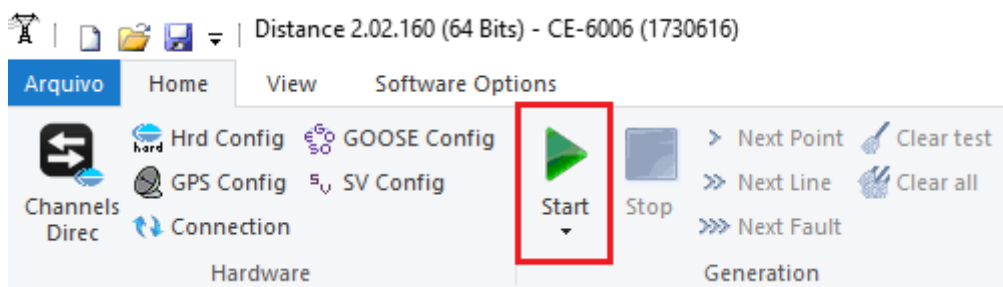


Figure 57

The final result is shown below showing the characteristics of the zones.

INSTRUMENTOS PARA TESTES ELÉTRICOS

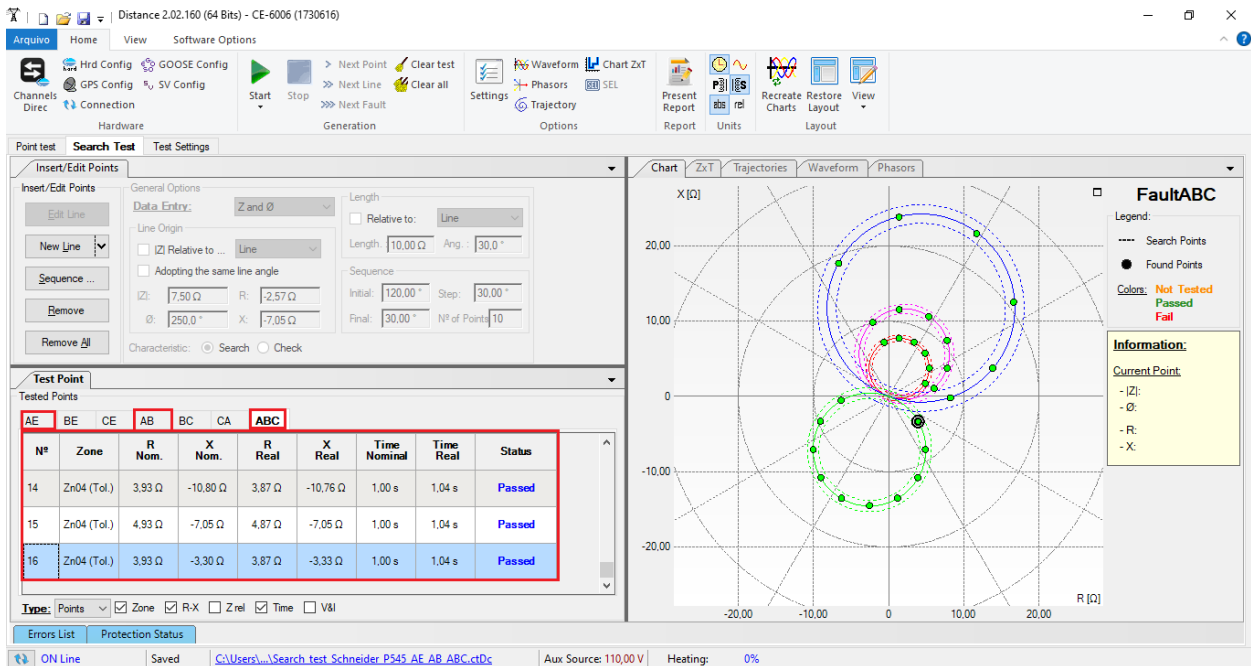


Figure 58

8. Report

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

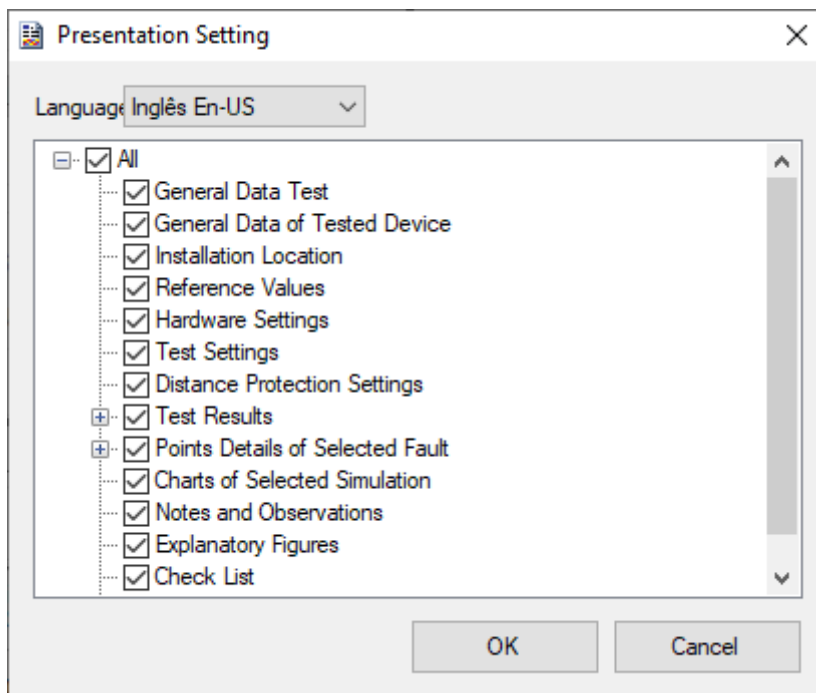


Figure 59

INSTRUMENTOS PARA TESTES ELÉTRICOS

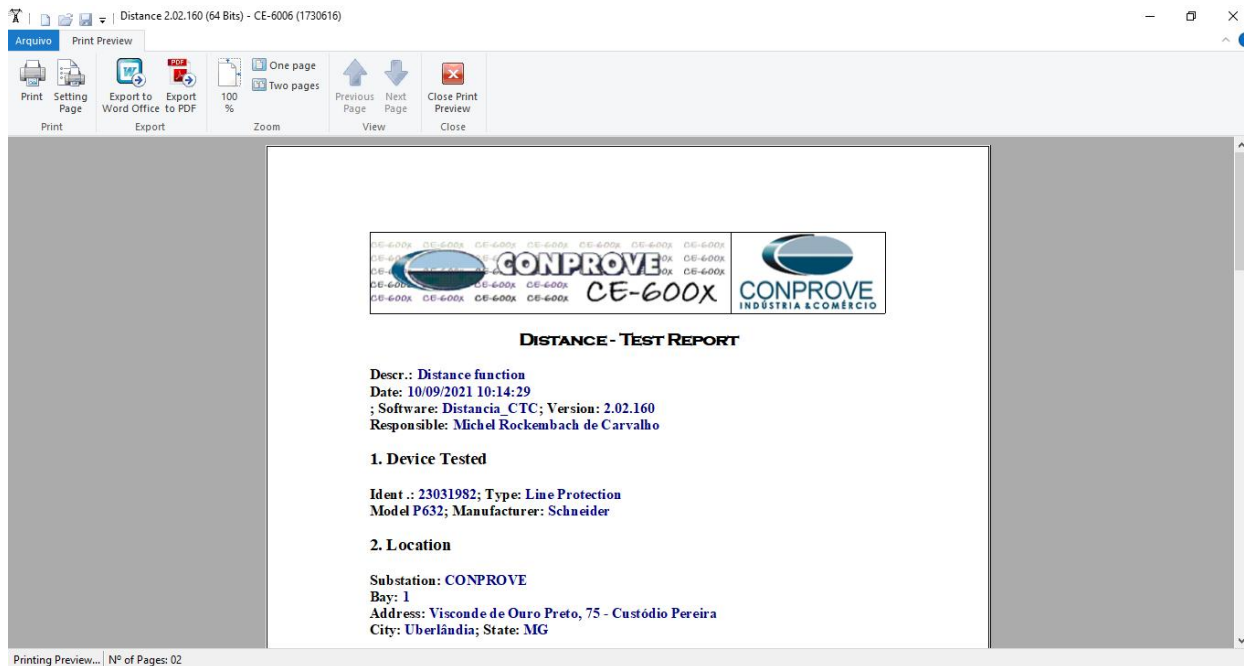


Figure 60

APPENDIX A

A.1 Terminal Designations

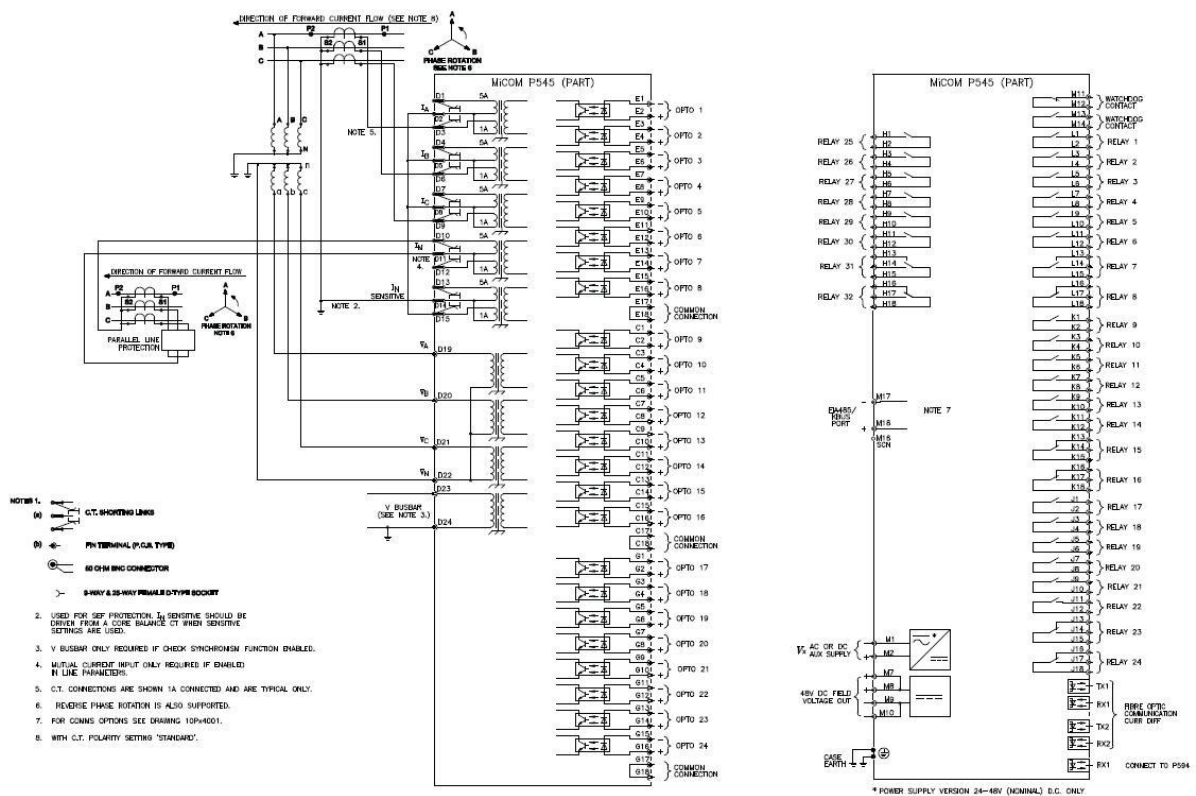


Figure 61

A.2 Technical data

Accuracy

Characteristic shape, up to SIR = 30:

±5% for on-angle fault (the set line angle)

±10% off-angle

(Example: For a 70 degree set line angle, injection testing at 40 degrees would be referred to as "off-angle").

Zone time delay deviations:

±20 ms or 2%, whichever is greater.

Sensitivity

Settings < 5/In Ω: $(0.05 \text{ In}^2 / (\text{setting} \cdot \text{In})) \pm 5\%$

Settings > 5/In Ω: $0.05 \text{ In} \pm 5\%$

APPENDIX B

Software parameter equivalence and the relay under test

Table 1

Distance Software		Schneider P545 Relay	
Parameter	Figure	Parameter	Figure
Mod Z0/Z1	43	KZN Res Comp	19
Ang Z0/Z1	43	KZN Res Angle	19
Zn1		Z1	
Z1 Ph Reach	44	Z1 Ph Reach	21
		Z1 Gnd. Reach	22
Z1 Ph Angle	44	Z1 Ph Angle	21
		Z1 Gnd. Angle	22
Trigger Time	44	tZ1 Ph. Delay	23
		tZ1 Gnd Delay	23
Zn2		Z2	
Z2 Ph Reach	45	Z2 Ph Reach	21
		Z2 Gnd. Reach	22
Z2 Ph Angle	45	Z2 Ph Angle	21
		Z2 Gnd. Angle	22
Trigger Time	45	tZ2 Ph. Delay	23
		tZ2 Gnd Delay	23
Zn3		Z3	
Z3 Ph Reach	46	Z3 Ph Reach	21
		Z3 Gnd. Reach	22
Z3 Ph Angle	46	Z3 Ph Angle	21
		Z3 Gnd. Angle	22
Trigger Time	46	tZ3 Ph. Delay	23
		tZ3 Gnd Delay	23
Zn4		Z4	
Z4 Ph Reach	47	Z4 Ph Reach	21
		Z4 Gnd. Reach	22
Z4 Ph Angle	47	Z4 Ph Angle	21
		Z4 Gnd. Angle	22
Trigger Time	47	tZ4 Ph. Delay	23
		tZ4 Gnd Delay	23

NOTE: In this specific test the settings for phase units are the same as for ground units.