INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: Schneider

Model: SEPAM T87

Function: 67 or PTOC - Directional Overcurrent

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

Objective: Perform tests on the directional overcurrent function using the Overcurrent software to evaluate the directionality of the overcurrent function

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial release	05/05/2022	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 test 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 test and also be aware of safety standards and regulations.

Copyright

Sequence for testing the SEPAM T87 relay in the Overcurrent software

1. Relay connection to CE-6710

Appendix A shows the relay terminal designations.

1.1 *Auxiliary Source*

Connect the positive (red terminal) of the Aux Source. Vdc to pin 1 of module A of the relay and the negative (black terminal) of the Aux Source Vdc to pin 2 of module A of the relay.

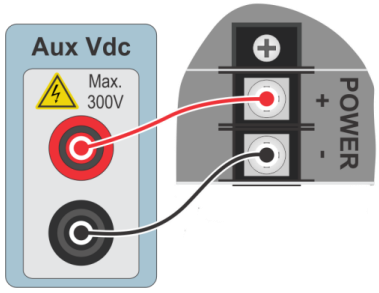

Figure 1

1.2 *Current and Voltage Coils*

To establish the connection of the voltage coils, connect the voltage channels V1, V2 and V3 to pins 1, 4 and 7 of the E module (Appendix A) of the relay and connect the commons of the voltage channels to pins 2, 5 and 8 of the relay module E. For current channels I1, I2 and I3 to pins 4, 5 and 6 of module B1 (Appendix A) of the relay and connect the commons of the current channels to pins 1, 2 and 3 of module B1 of the relay.

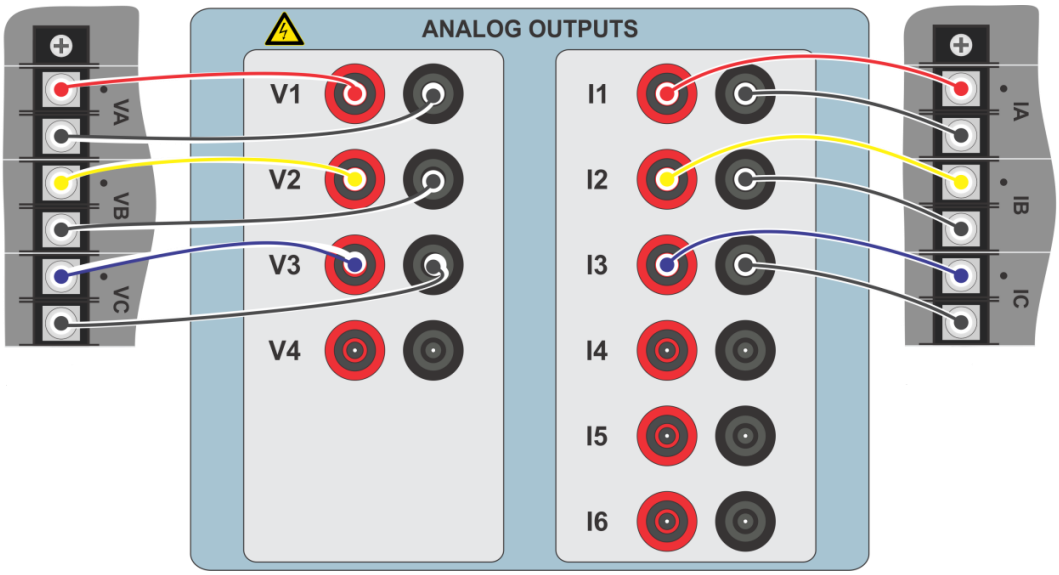

Figure 2

1.3 *Binary Inputs*

Connect the CE-6710 binary inputs to the relay binary outputs (relay module A).

- BI1 to pin 4 and its common to pin 5;

The following figure shows the details of the connection.

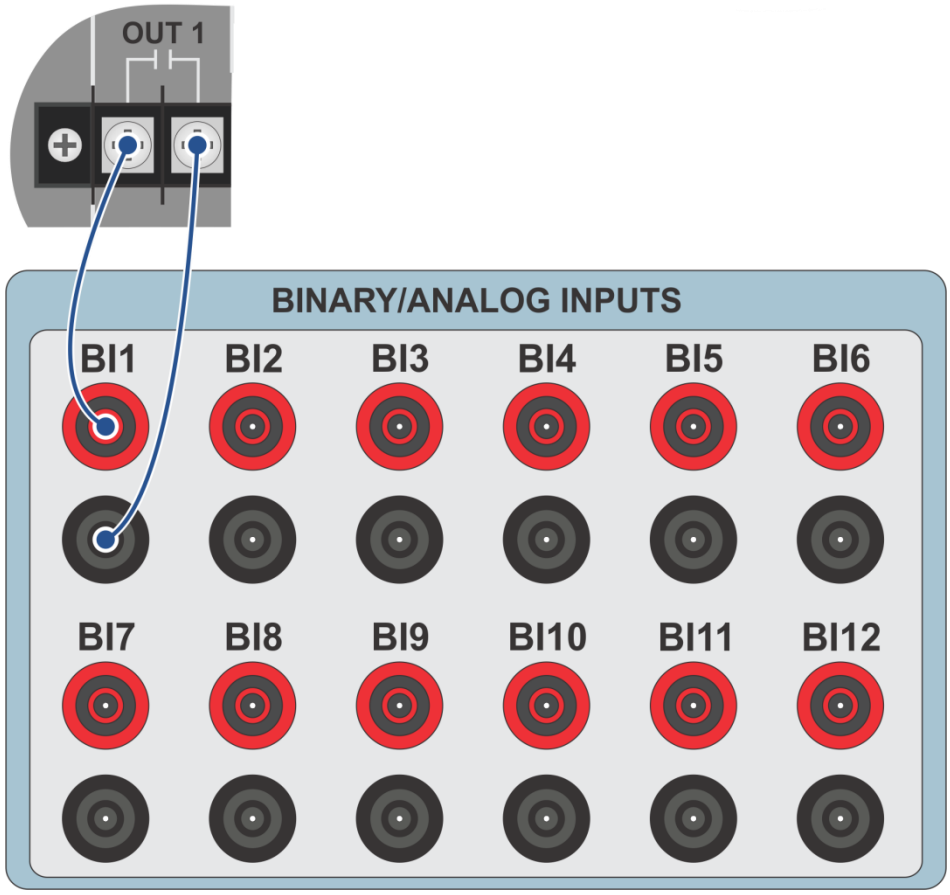

Figure 3

2. Communication with the SEPAM T87 relay

First, a serial cable from the notebook is connected to the relay. Then double-click on the *SFT2841* software icon.

Figure 4

When opening the program, the following screen is shown:

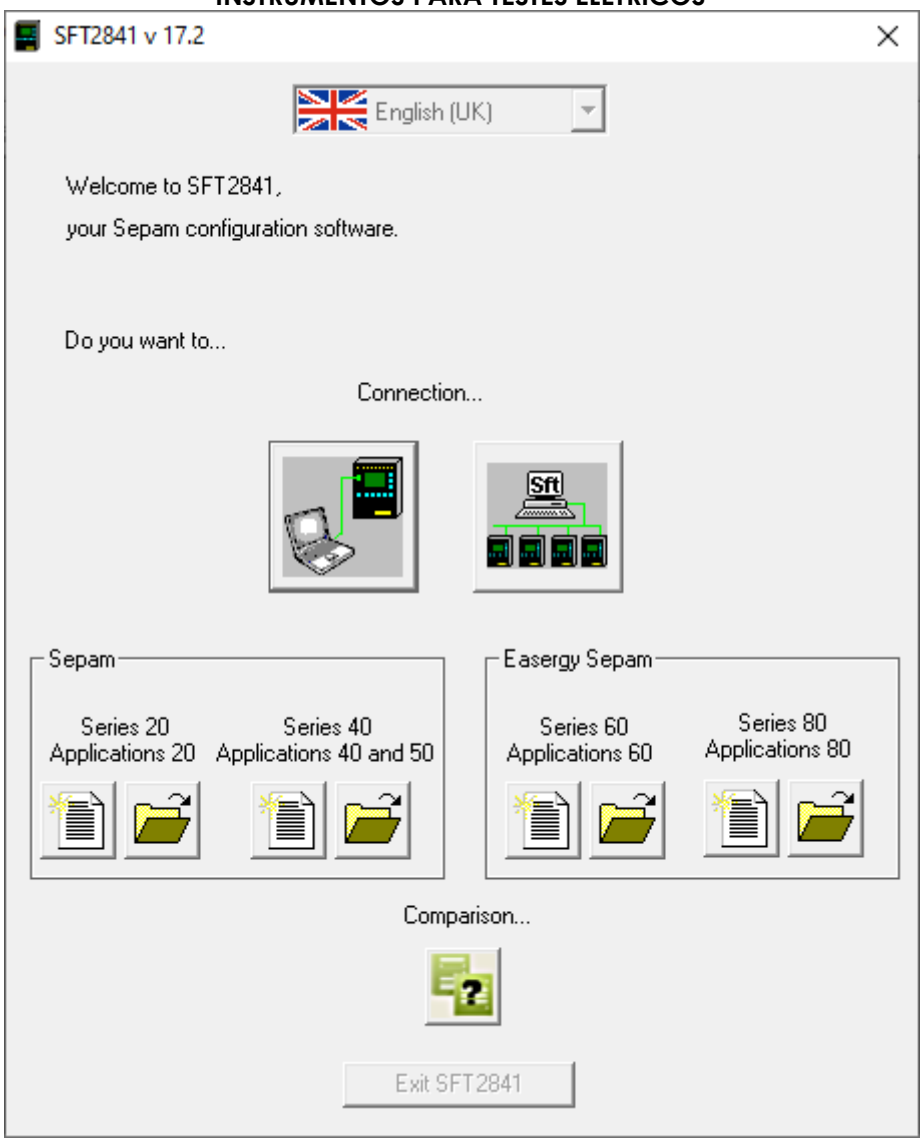

Figure 5

To start the communication click on the icon illustrated below:

Figure 6

Then the main screen appears where the tab *"Sepam hardware"* is already selected. In this tab the user indicates if there are additional modules in the relay for the software. The relay used for this tutorial has the following settings:

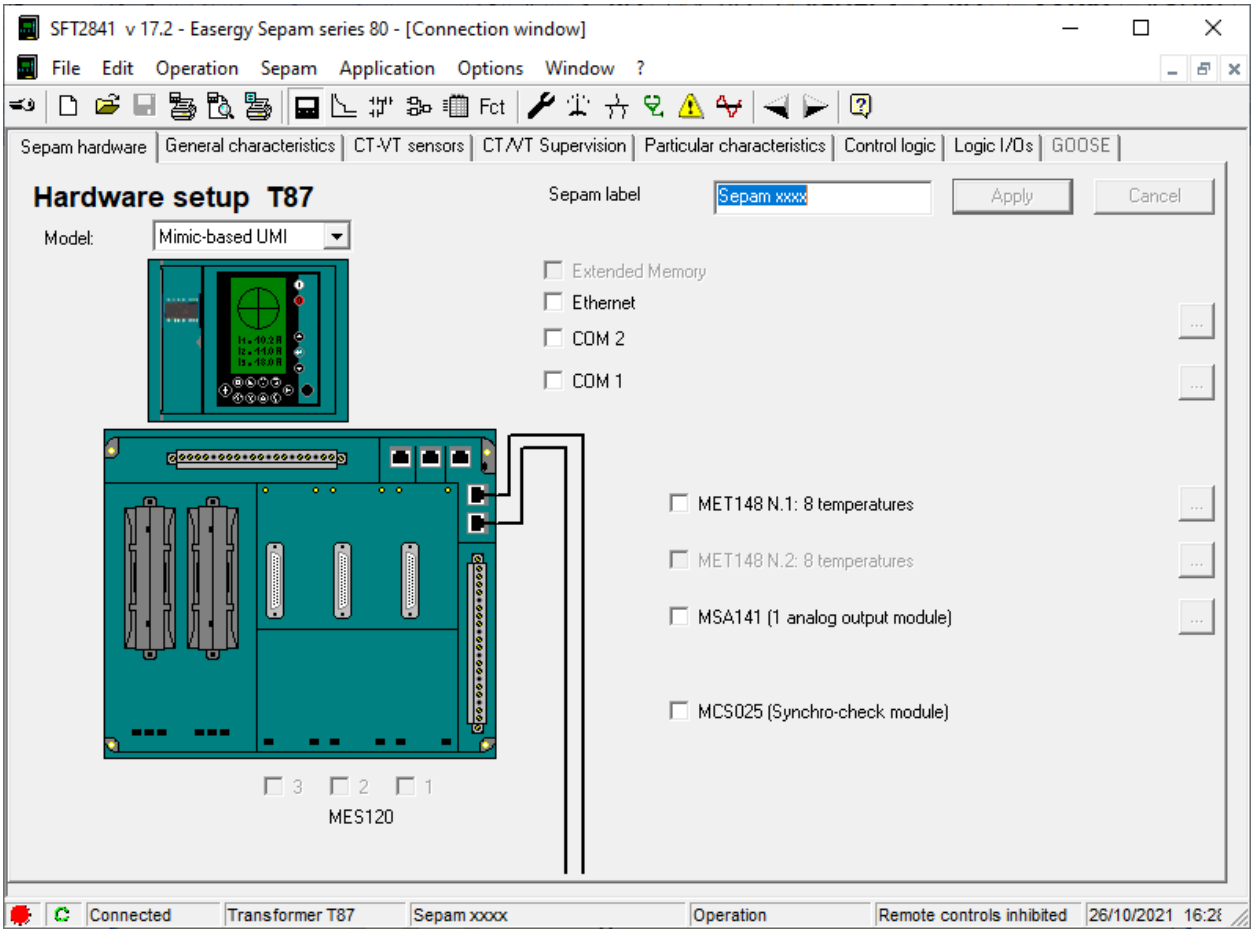

Figure 7

3. Parameterization of the SEPAM T87 relay

The next step is to set the nominal frequency, phase rotation and setting group values. The values of these parameters are in the table below:

Table 1

Network frequency	60Hz
Phase rotation direction	1_2_3
Active setting group	A

3.1 *General characteristics*

In this tab, the values described above are adjusted in addition to other fields. What is highlighted in red in the next figure needs special attention so that the test takes place properly.

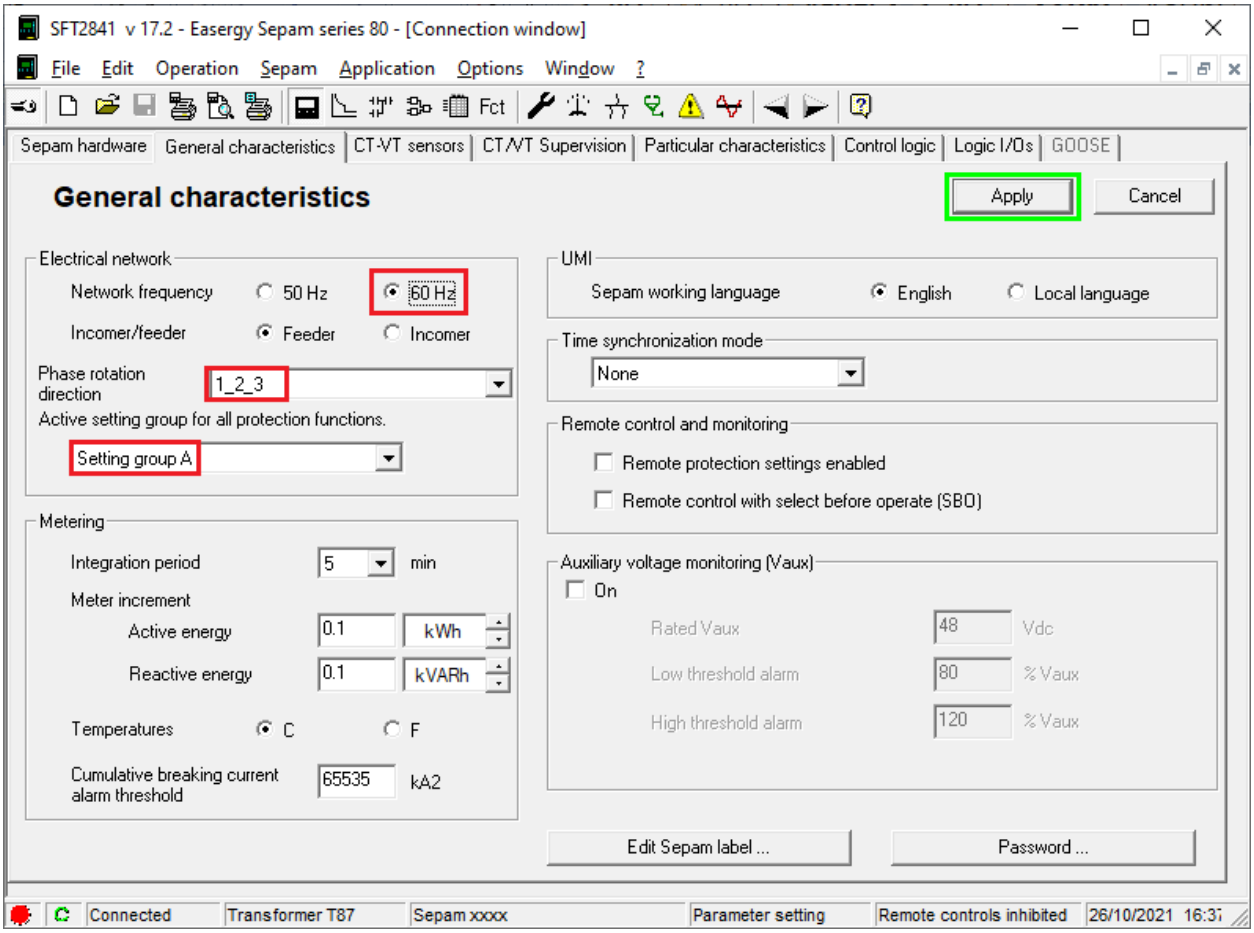

Figure 8

After configuring the settings, click on the *"Apply"* icon highlighted in green in the previous figure for the software to send the modifications to the relay. Before the settings are sent a password is requested.

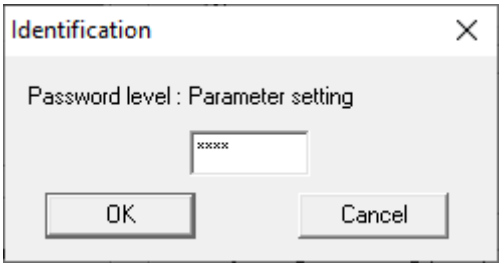

Figure 9

Enter your password for the changes to take place.

Note: The default password is 0000.

3.2 *CT-VT sensors*

In this window, adjust the nominal values of the CTs and VTs.

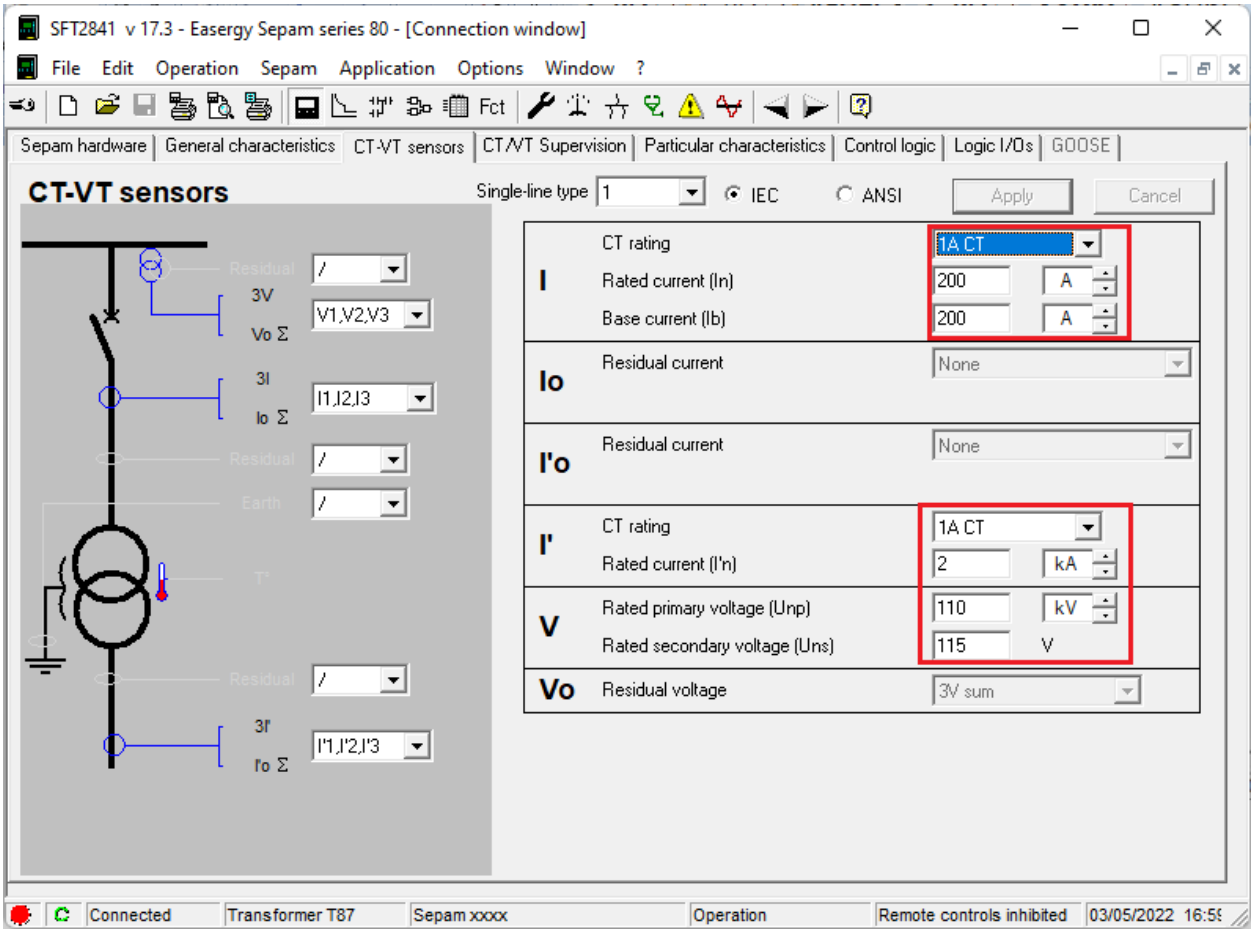

Figure 10

3.3 *CT/VT Supervision*

In this tutorial this functionality is not used.

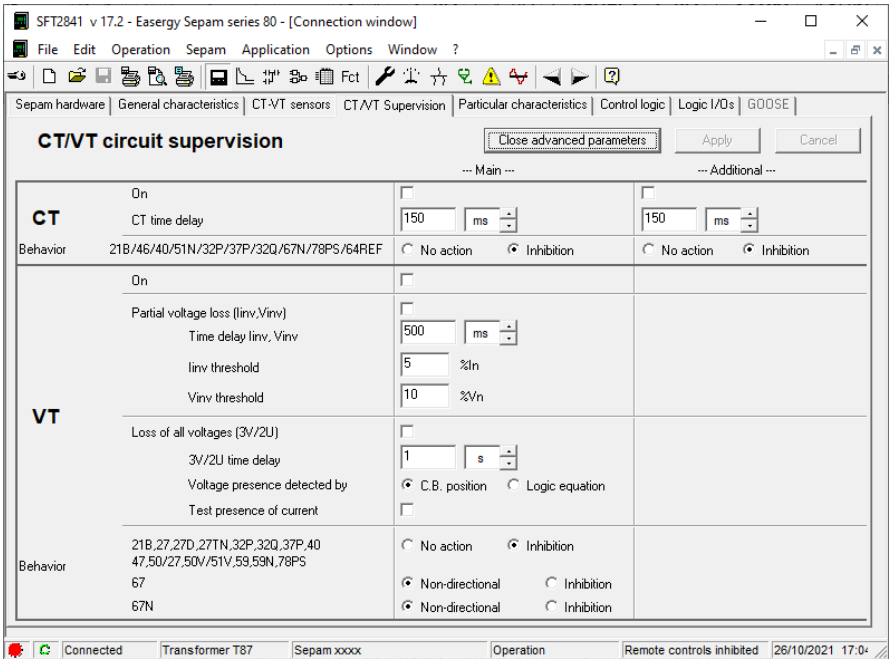

Figure 11

3.4 *Particular characteristics*

In this field, the nominal voltages of the transformer, its nominal power and the angular difference between the two windings are adjusted.

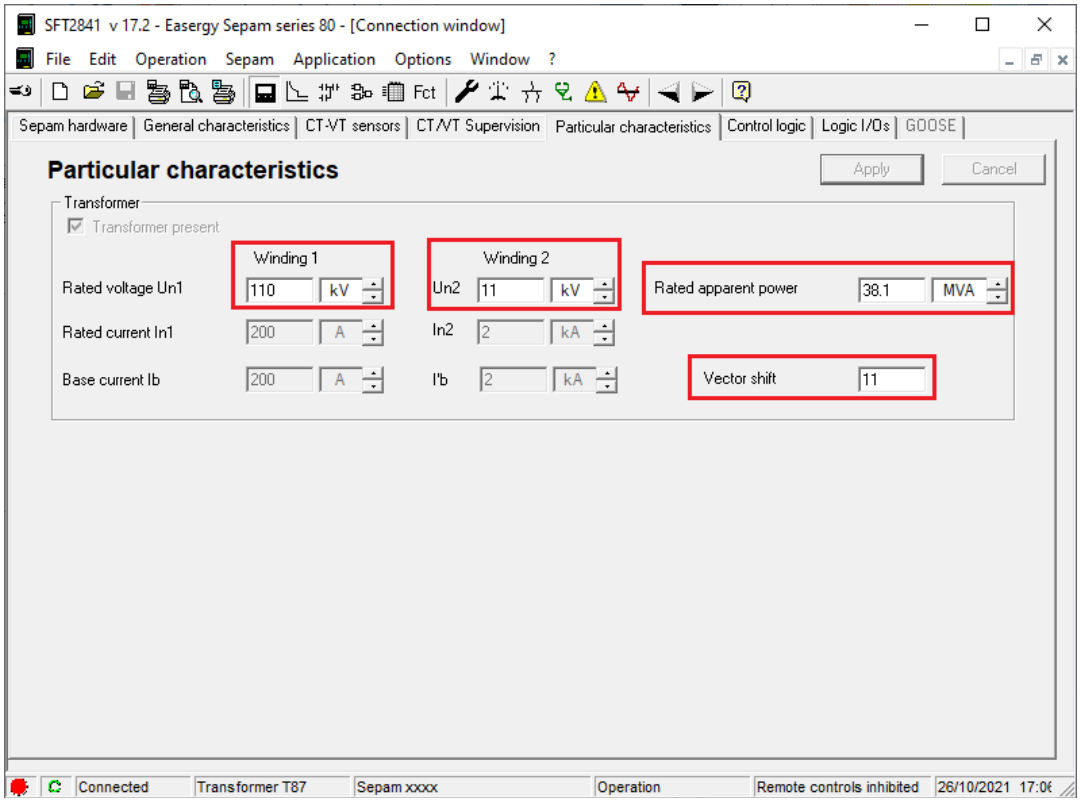

Figure 12

3.5 *Control logic*

Disable the options in this field.

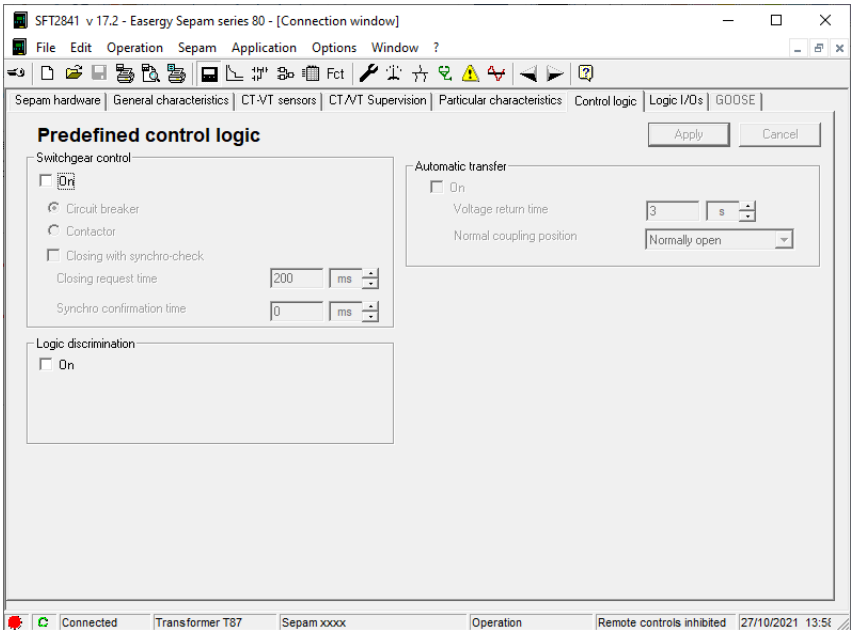

Figure 13

3.6 *Logic I/O s*

In this field, the initial states of the binary outputs are set.

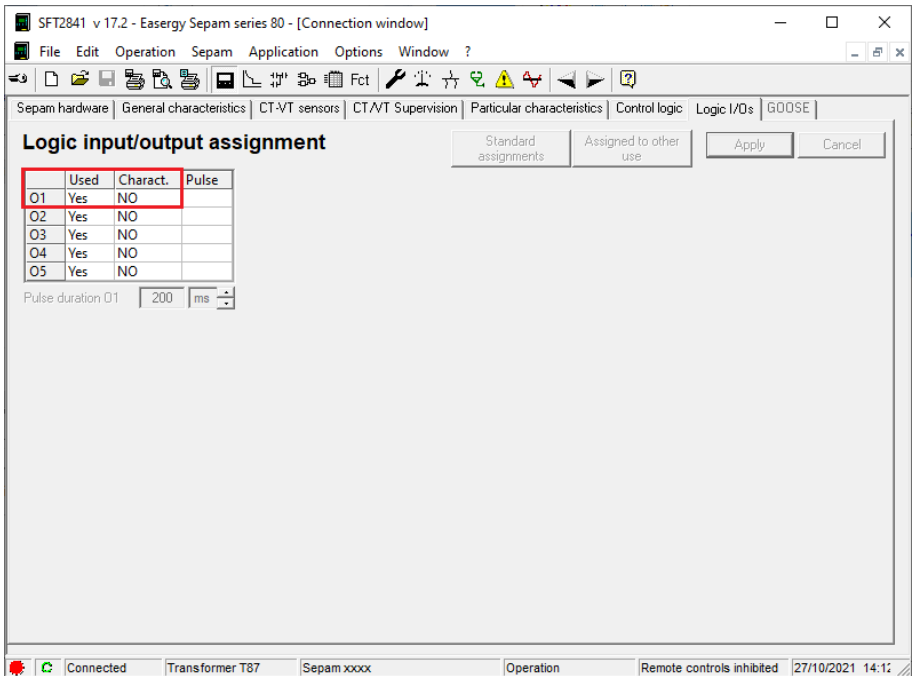

Figure 14

The next step is to adjust the directional overcurrent function. To do this click on the icon below:

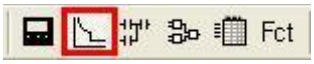

Figure 15

3.7 *67: Directional Overcurrent*

Up to four stages can be set for this function. There are two stages in each group. In this tutorial only group A and a single definite time element are used. The relay has the pick-up value setting referenced to the primary. Therefore, the values found in the test will be divided by the Current Transformed Ratio (RTC). As the current transformer is 200/1, the values found will be divided by a factor of 200. In the *"Direction"* field, the *"Line"* option is equivalent to the direct direction, while the *"Busbar"* option would be reverse. For the directional overcurrent function, configure the following settings.

Table 2

Is threshold	100A (primary)
Tripping curve	Definite Time
Delay	200ms
Angle	30°

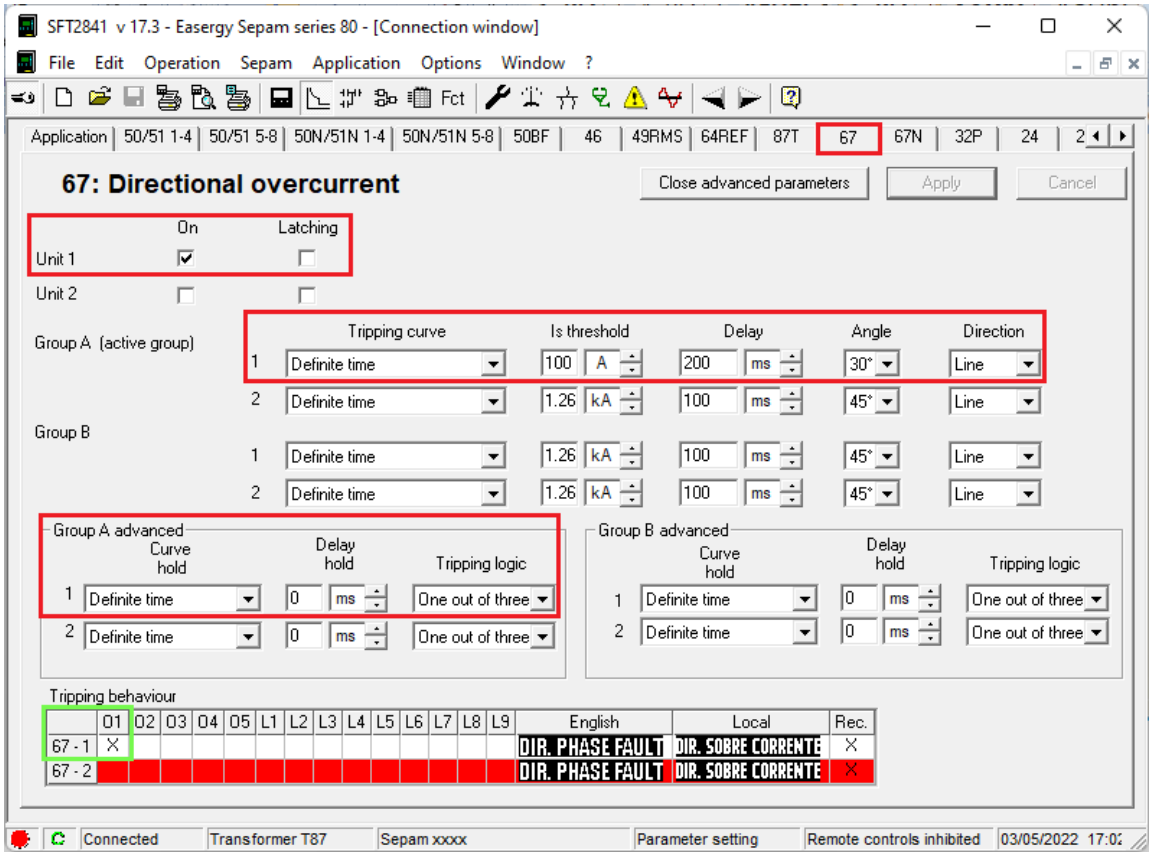

Figure 16

3.8 *Matrix*

Click on the icon illustrated below to specify the binary output of each relay function.

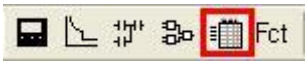

Figure 17

In the *"Protection"* field and in the *"Outputs"* tab, configure the trip of each function with a certain binary output.

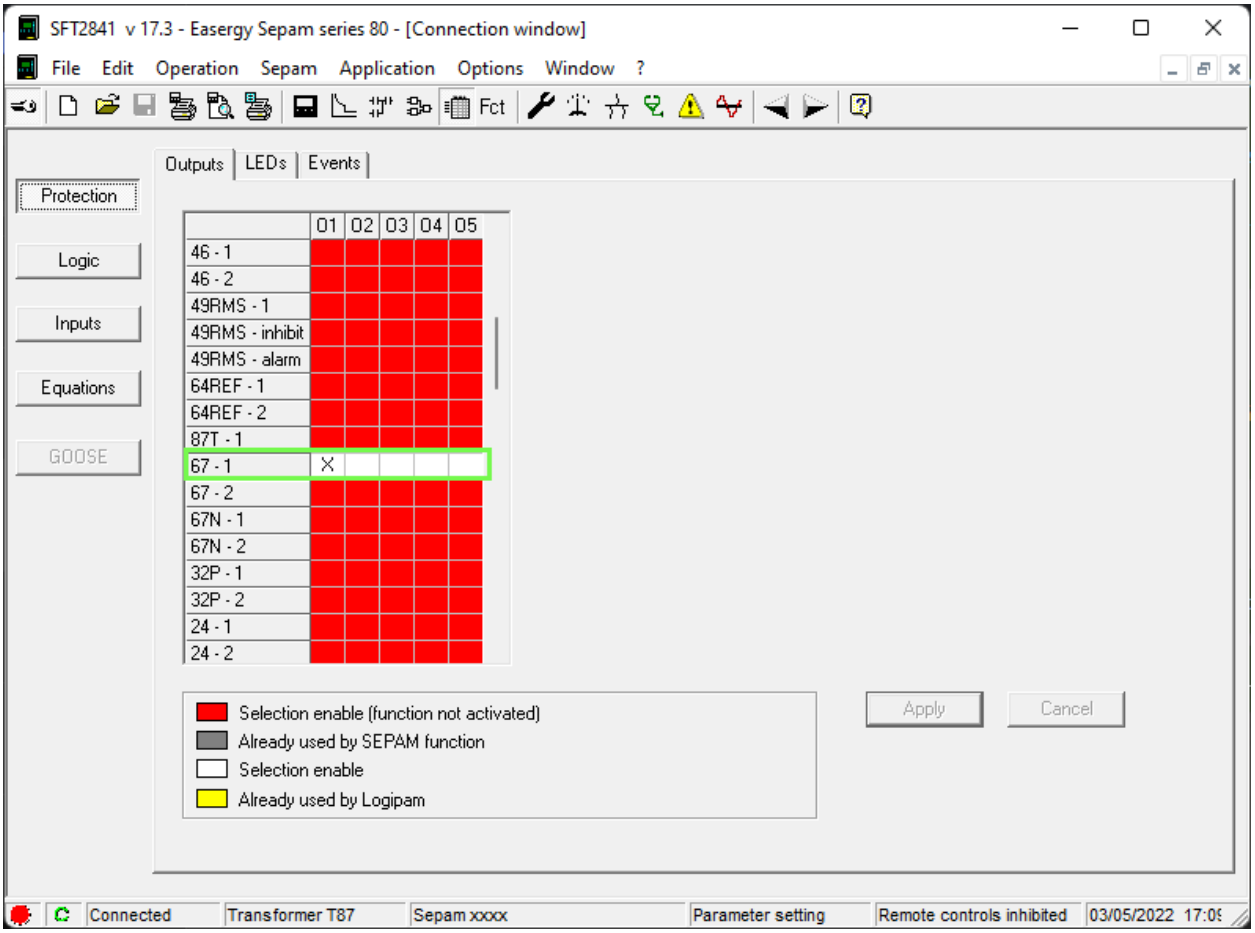

Figure 18

4. Overcurrent software adjustments

4.1 *Opening the Overcurrent*

Click on the *"Conprove Test Center"* application manager icon.

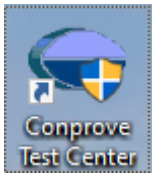

Figure 19

Click on the Overcurrent software icon.

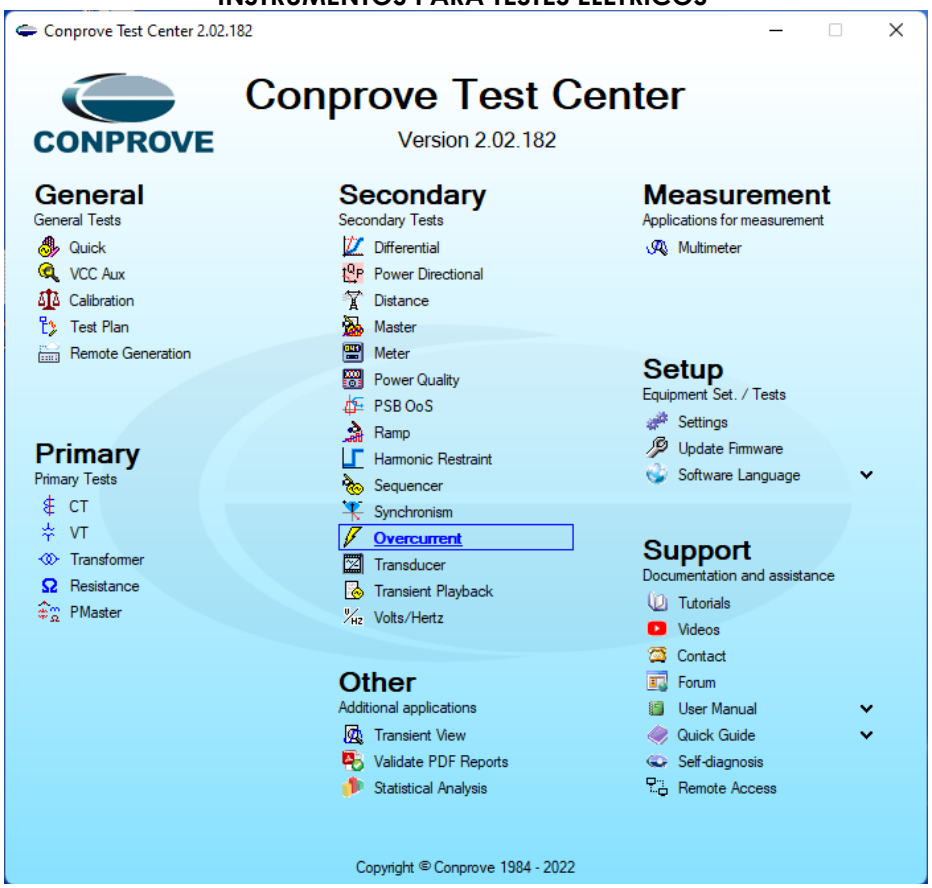

Figure 20

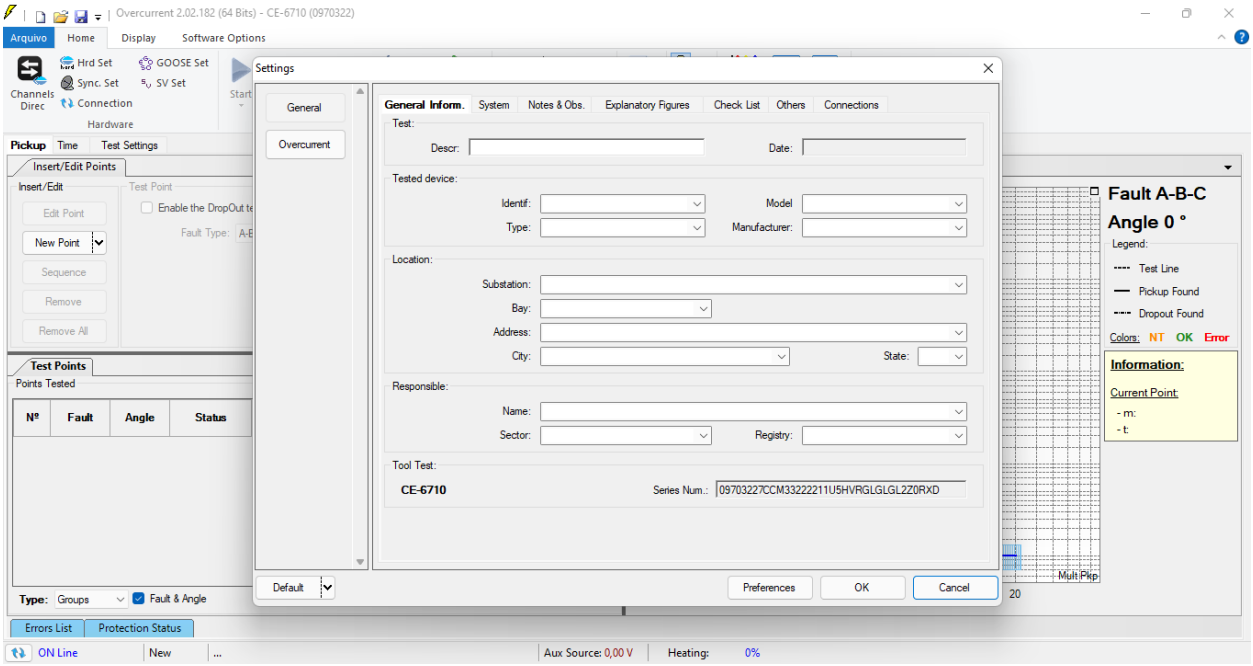

Figure 21

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.

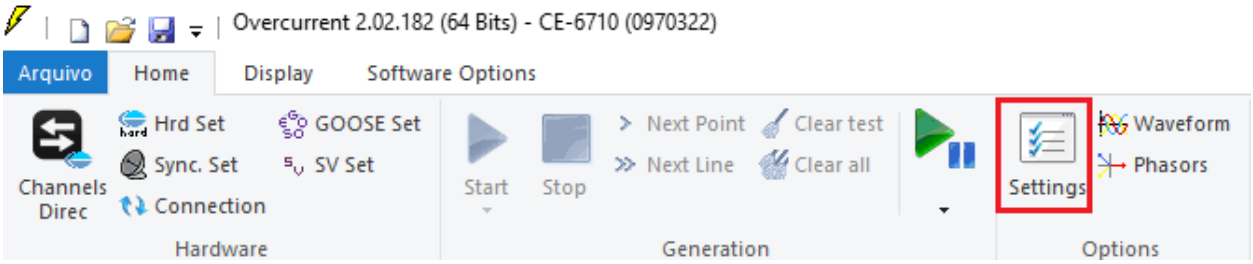

Figure 22

Inside the *"Settings"* screen, fill in the *"General Inform."* with details of the tested device, installation location and the person responsible. This makes reporting easier, as this tab will be the first to be shown.

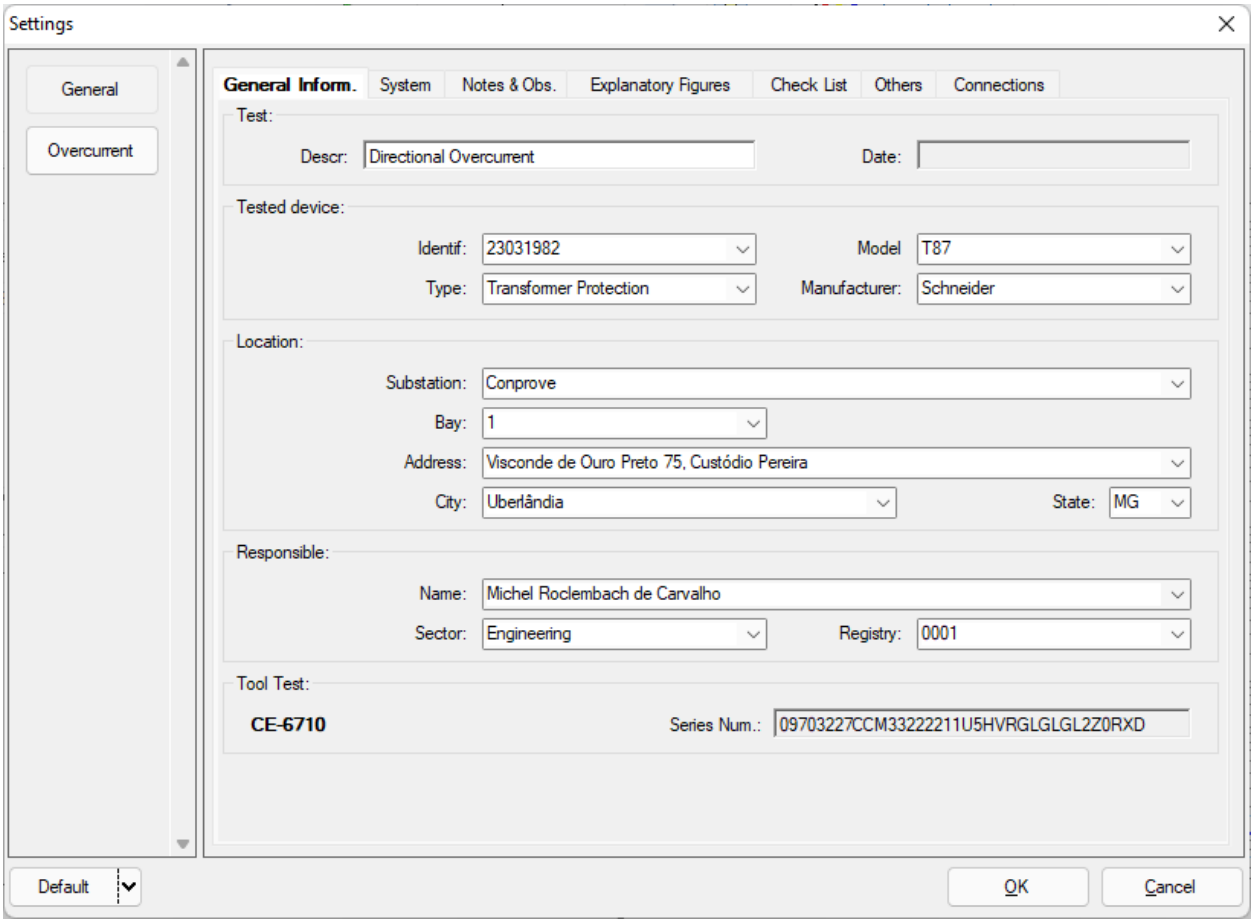

Figure 23

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 are not relevant for this test.

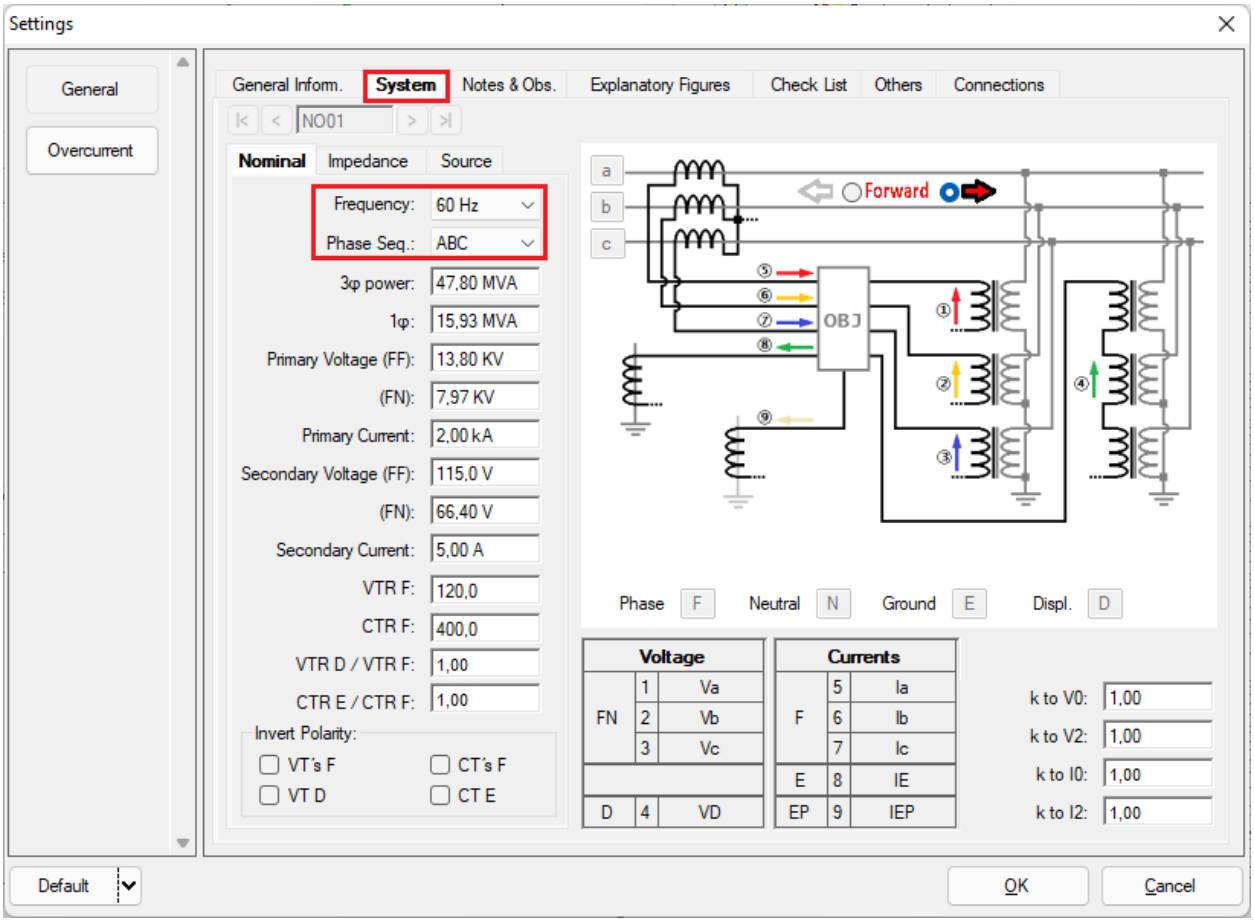

Figure 24

There are other tabs where the user can insert *"Notes & Obs."*, *Explanatory Figures, and "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. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

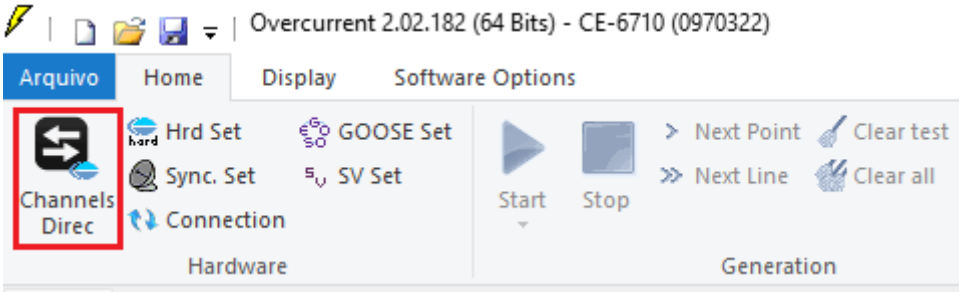

Figure 25

Then click on the highlighted icon to configure the hardware.

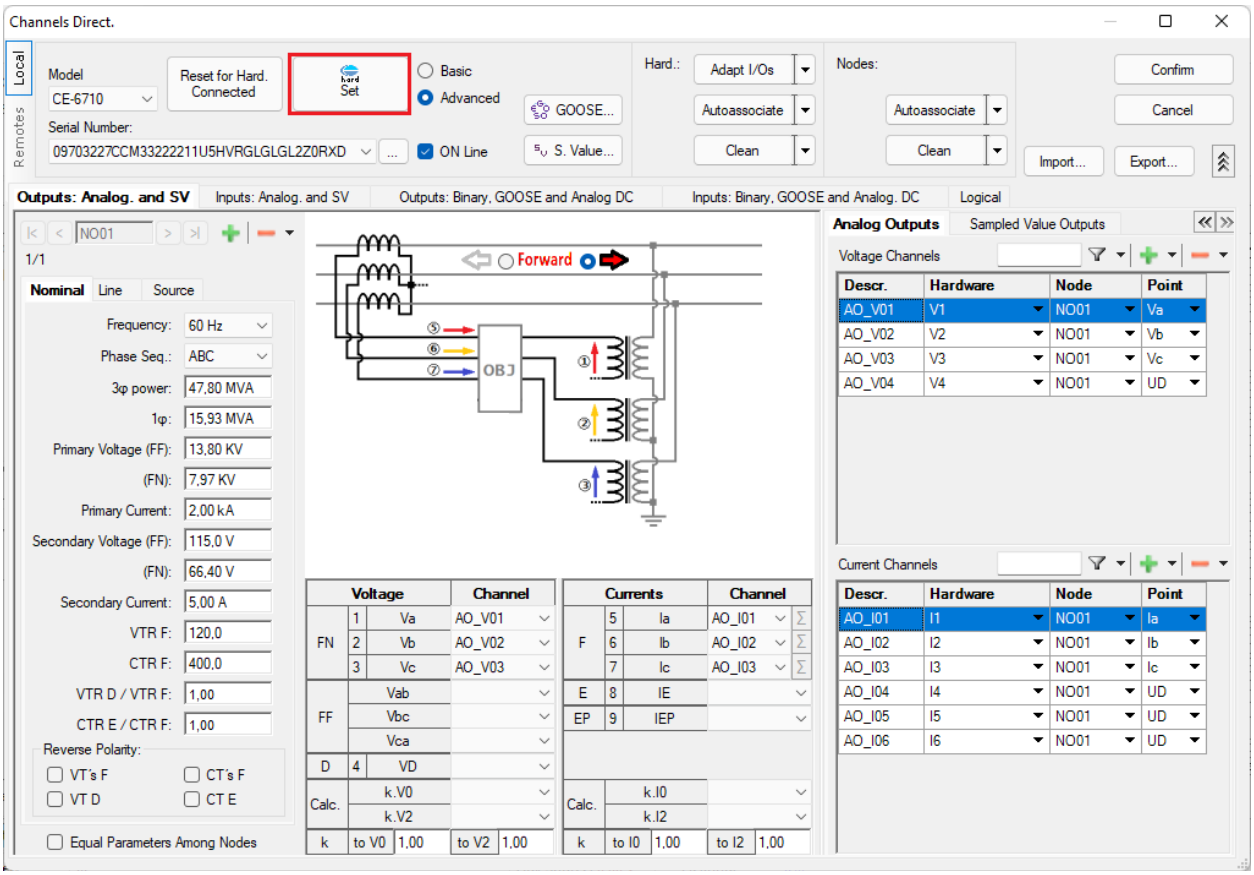

Figure 26

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

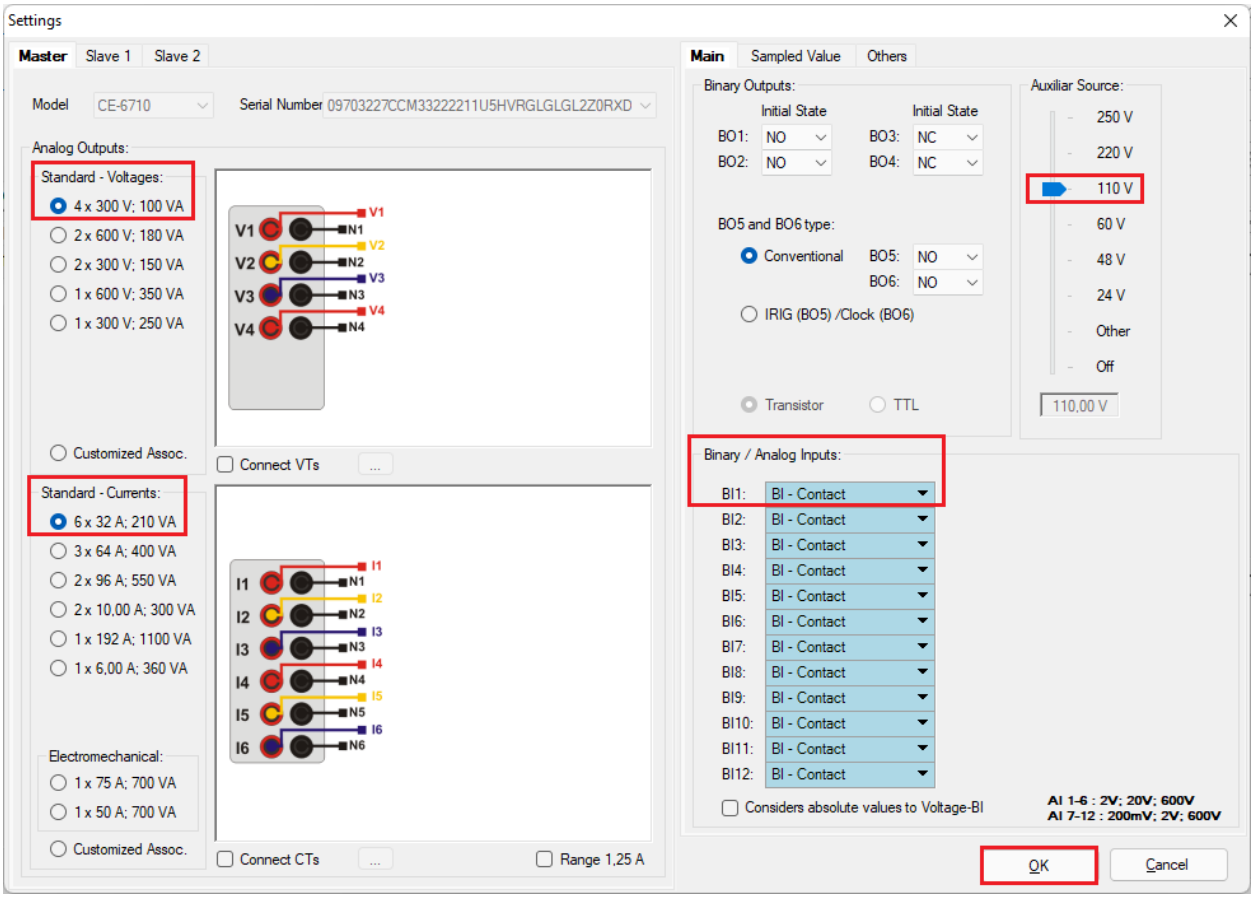

Figure 27

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

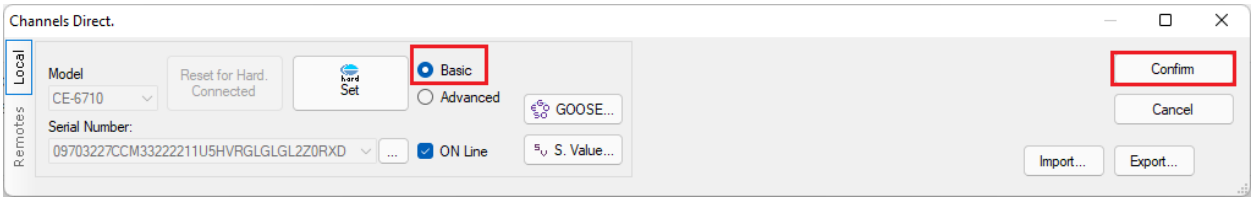

Figure 28

6. Polarization of SEPAM T87

The relay polarization is made in quadrature (90°) as shown below.

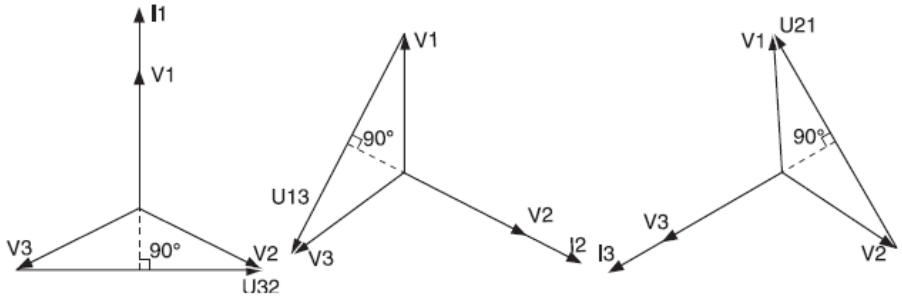

Figure 29

7. Directional Overcurrent Adjustment

7.1 *Overcurrent Screen > Definitions*

On this screen, you must enable the directionality, polarization, the curves display mode, the scale used and the time, current and angle tolerances. These tolerances should be taken from the relay manufacturer's manual (Appendix A).

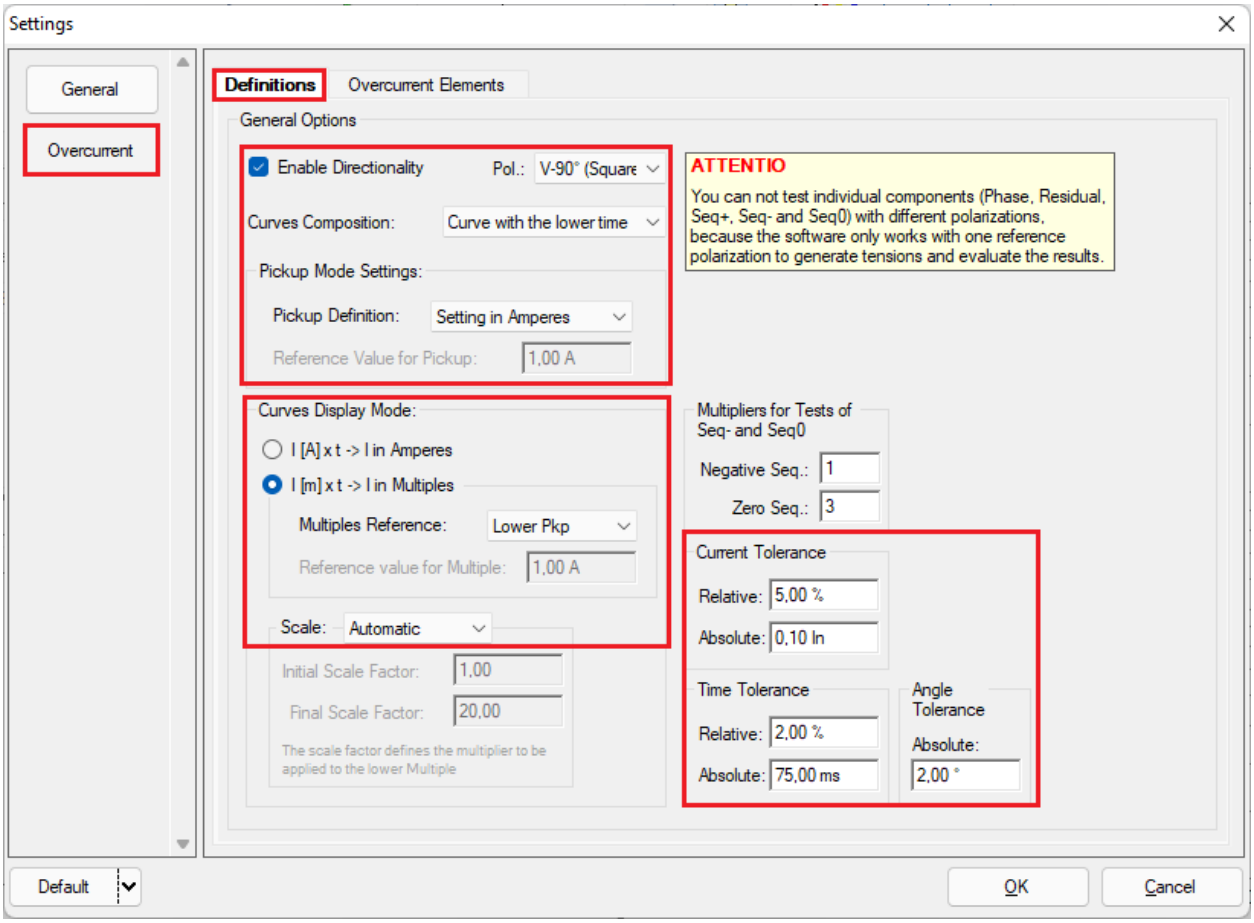

Figure 30

7.2 *Overcurrent Screen > Overcurrent Elements > Phase*

Here the element must be configured. To do this, click on *"Phase"* and once on the highlighted icon.

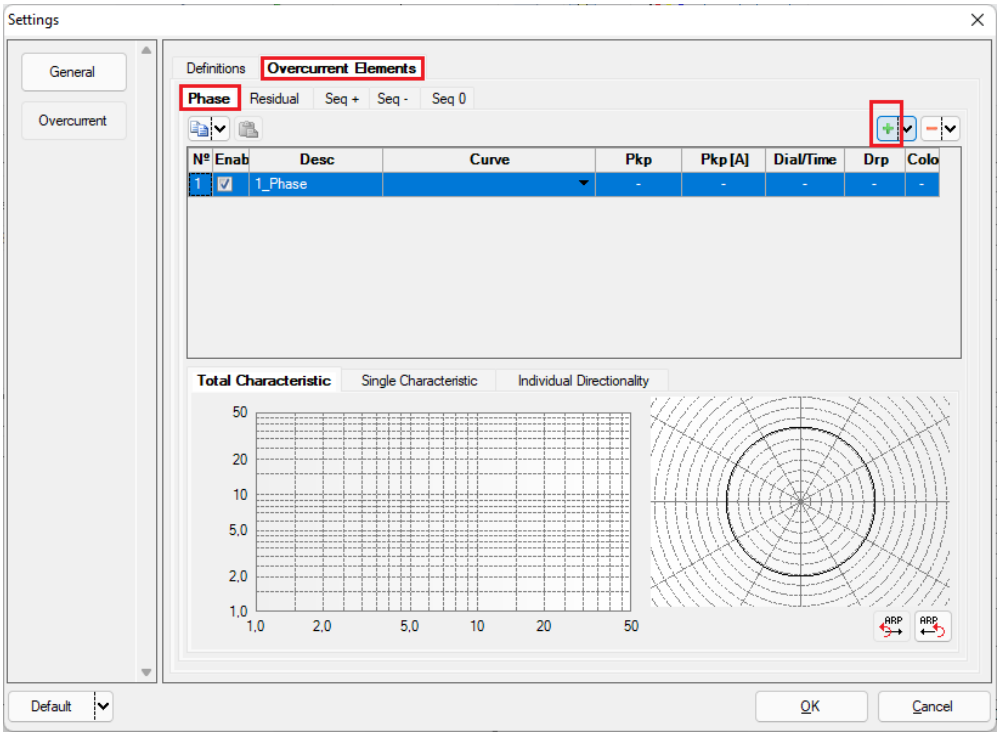

Figure 31

Change element name to *"67"* choose curve type equal to defined time, pickup value equal to 0.50A, time to 200ms and dropout factor equal to 0.935.

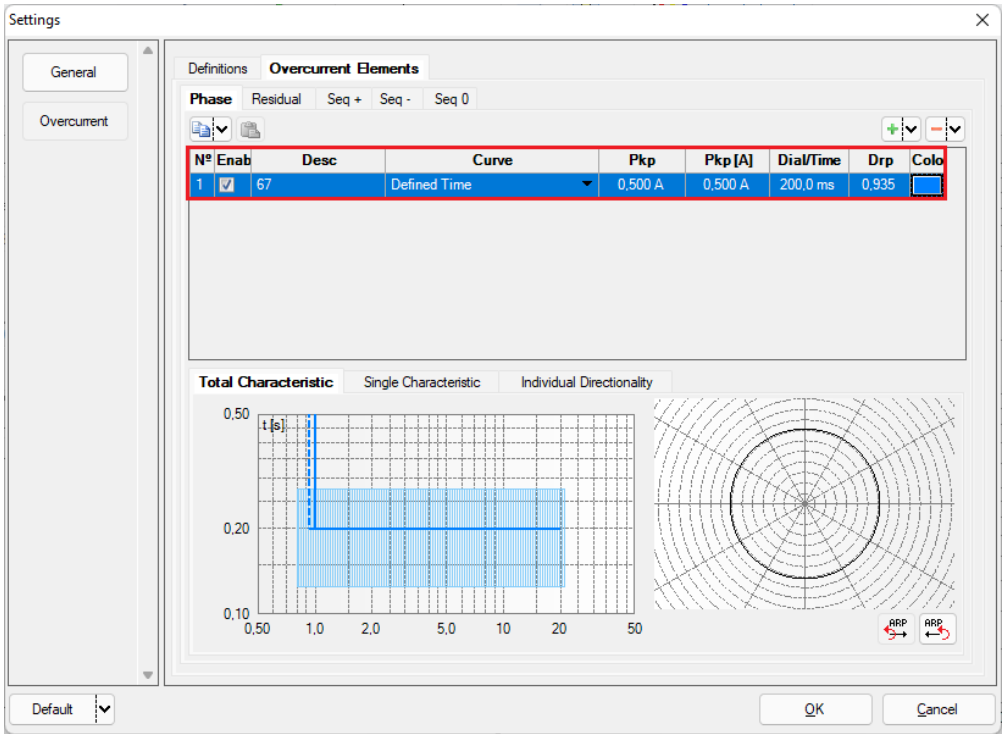

Figure 32

Choose the *"Individual Directionality"* tab and set the *"Forward"* option, the maximum torque angle *"ATM"* should be set as 30° and the positive and negative angular offset as 90° and -90°.

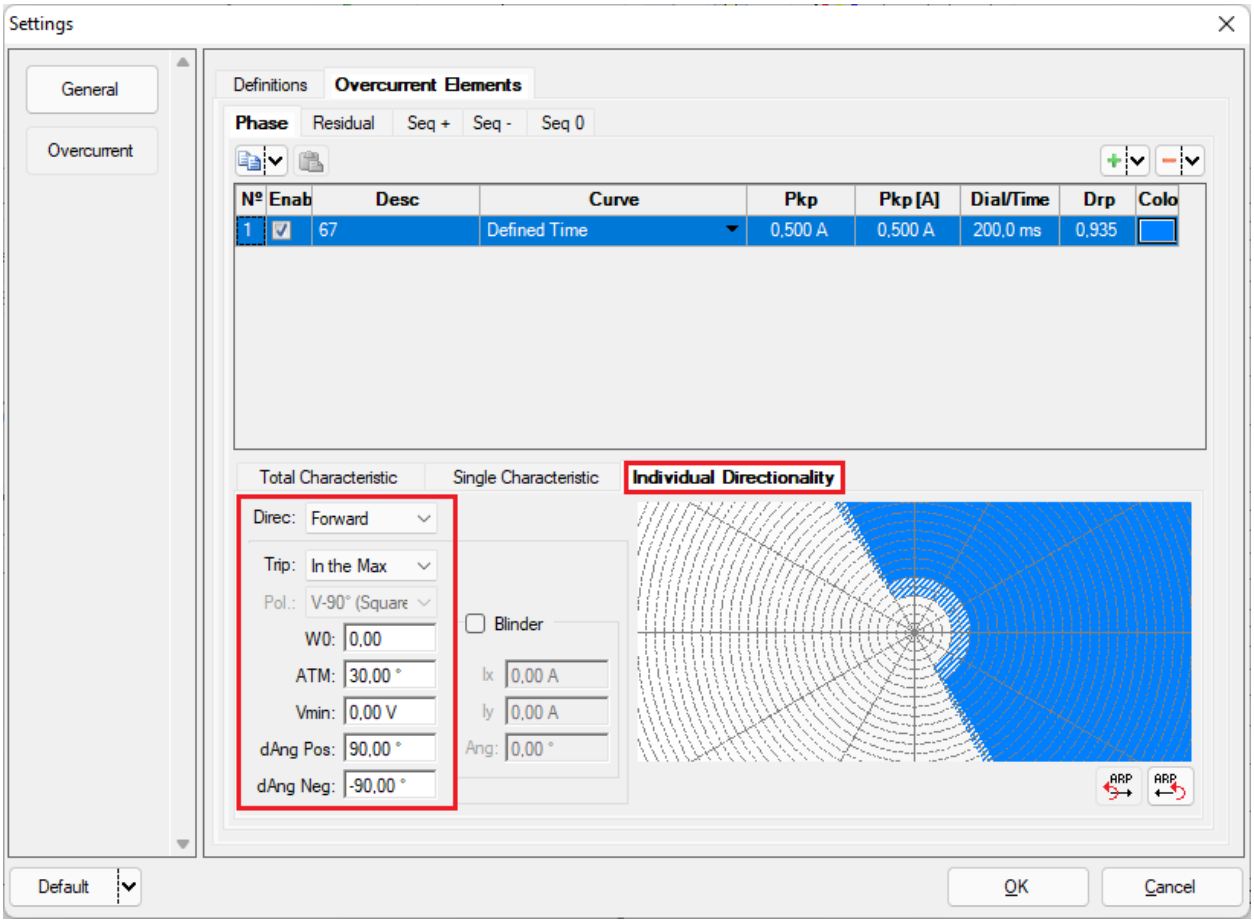

Figure 33

8. Test structure for function 67

8.1 *Test Settings*

On this tab, configure the trip signal with the binary input and configure a pre-fault with rated voltage and current lower than 0.50A. An important adjustment is the field *"Maximum Waiting Time of No-Operation Region"* which must be a value greater than the relay's operating time and low enough so that the test does not take too long.

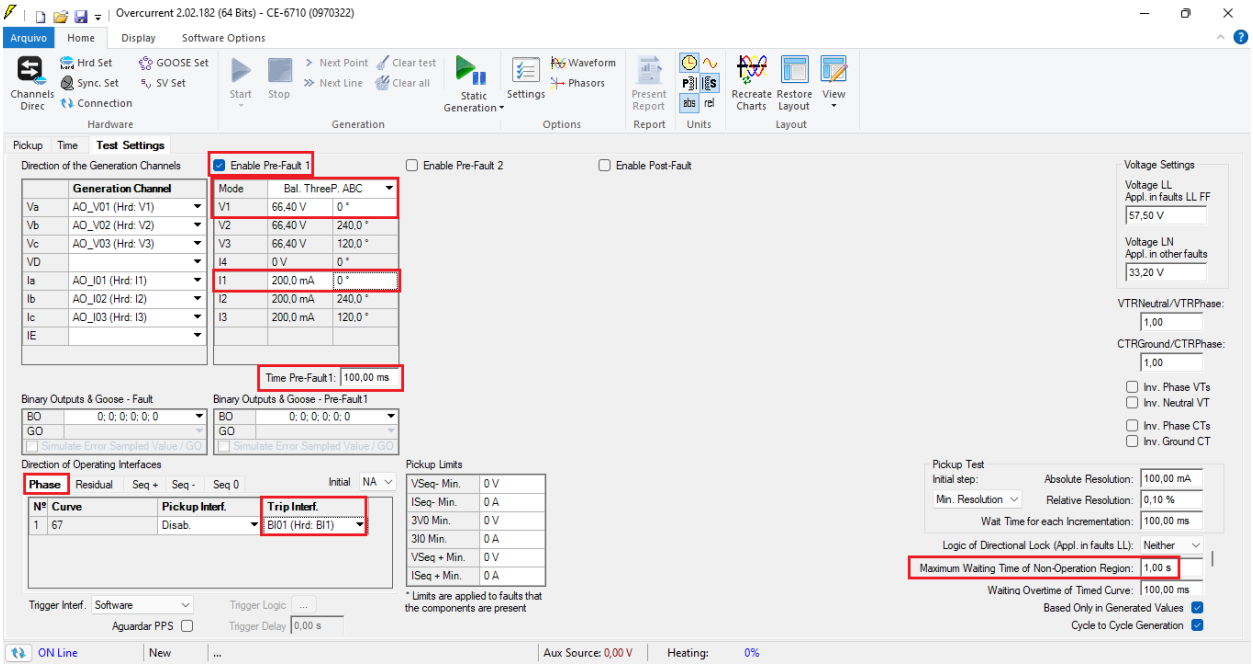

Figure 34

8.2 *L-E and Three-Phase Faults*

At first, only phase-to-ground (LE) and three-phase faults will be performed, for two-phase faults, two separate tests will be carried out.

8.3 *Time Screen*

On this screen, the operating time and directionality are evaluated. For convenience, a sequence of values will be inserted. Click on the *"Faults..."* option and choose the following fault types: AE, BE, CE and ABC.

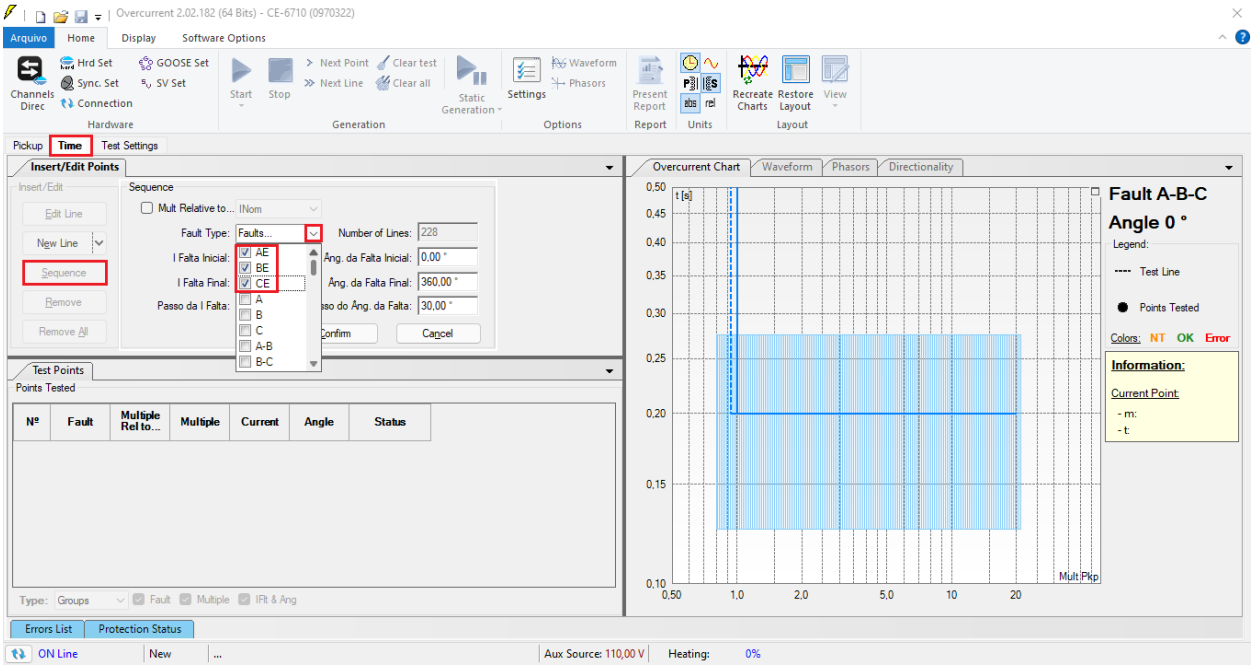

Figure 35

The value 5.00A was chosen as the initial value, 5.00A as the final value and 1.00A as the increment step. In the angles choose 0.0° as the initial value for the step choose 35° and final value choose 360.0°. Select the *"Directionality"* tab.

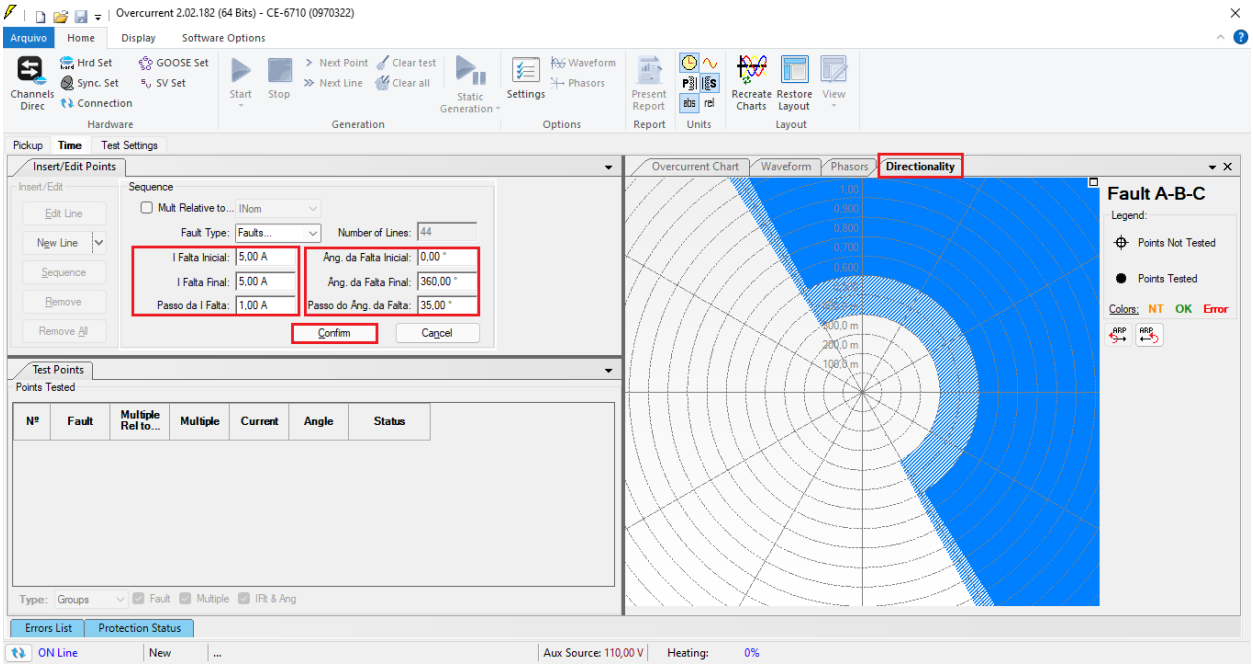

Figure 36

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

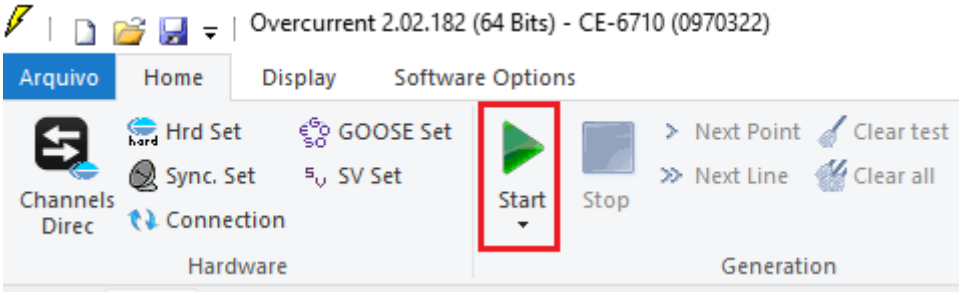

Figure 37

8.4 *Time Test Final Result / L-E and L-L-L Faults*

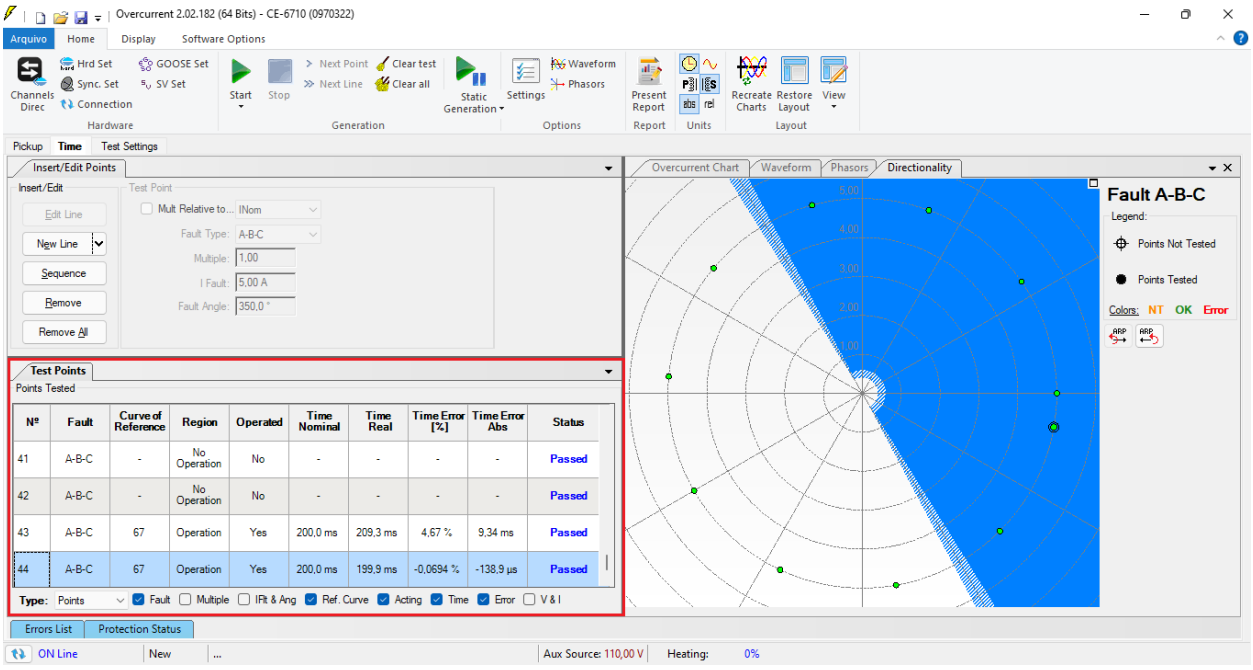

Figure 38

It is verified that all points in the operating region acted with times within the tolerance given by the relay manufacturer.

8.5 *Two-Phase Faults / Union*

In a two-phase fault, for example, A-B the operating region could be the union of region A plus region B as long as the relay field *"Tripping logic"* is set to *"One out of three"*.

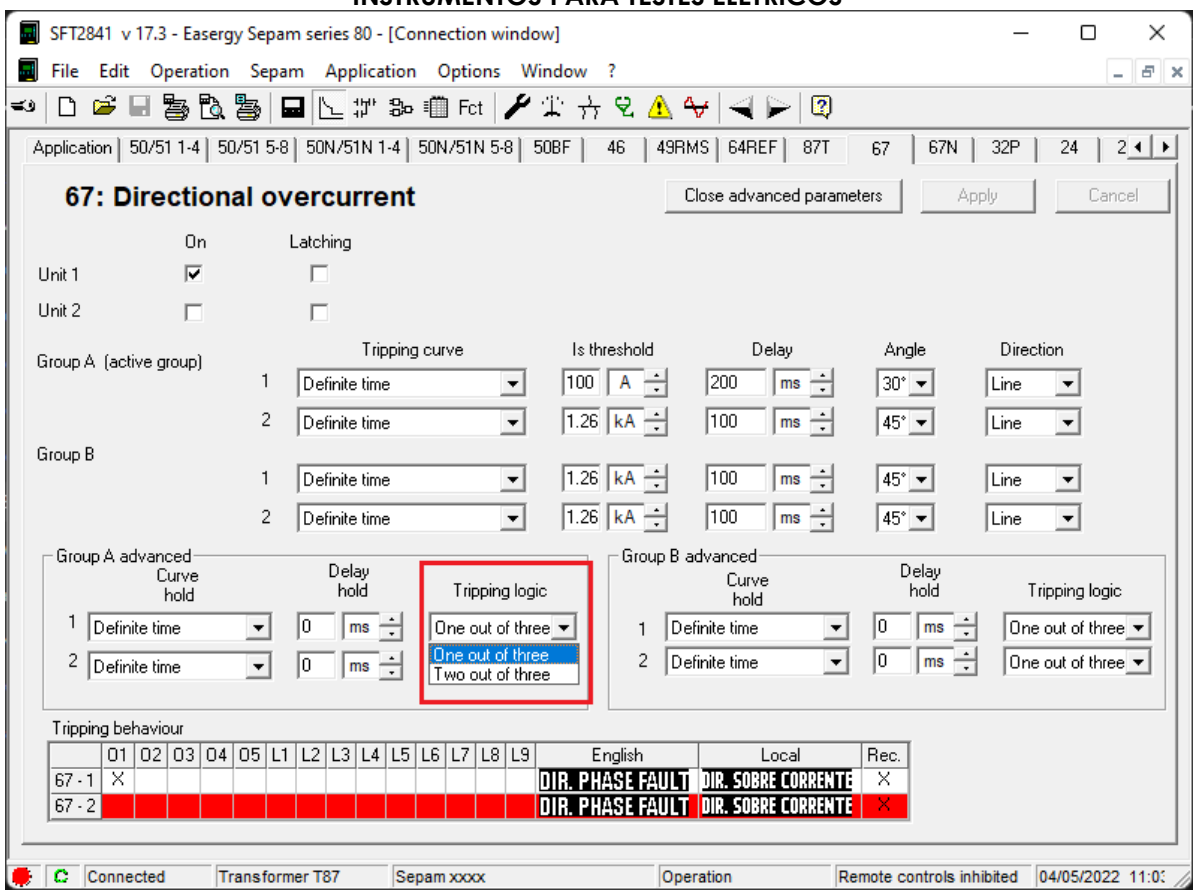

Figure 39

In order for the Overcurrent software to properly evaluate two-phase faults, adjust the following parameter.

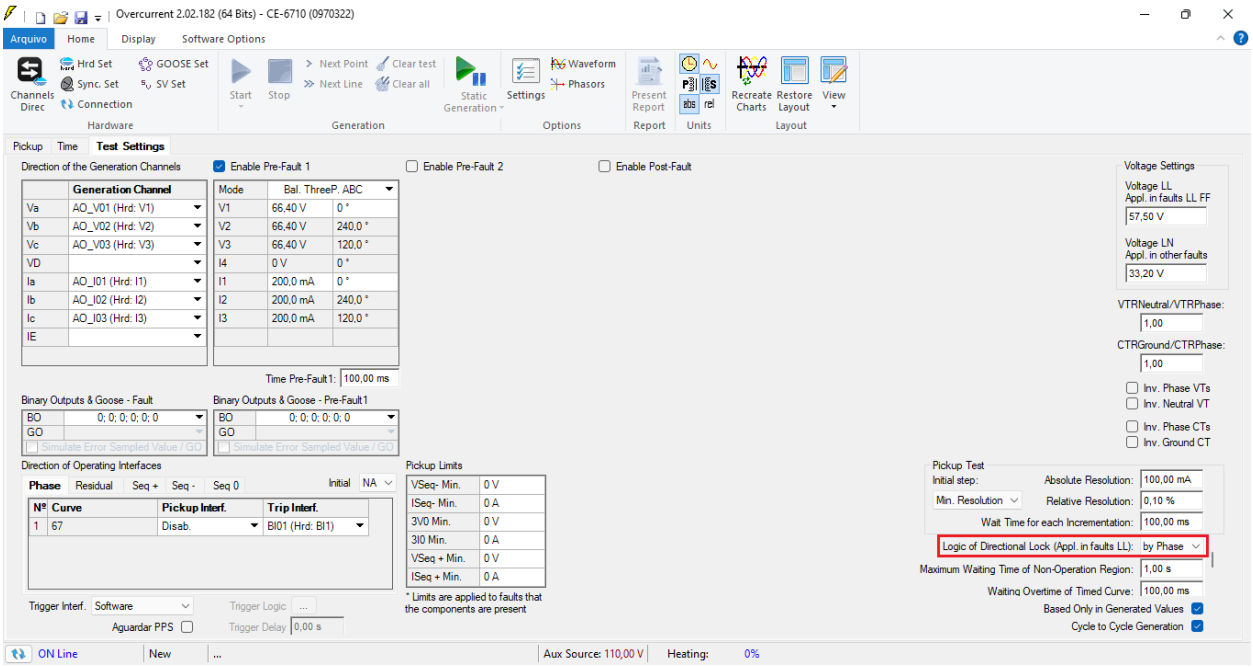

Figure 40

8.6 *Time Screen*

On this screen, the operating time and directionality are evaluated. For convenience, a sequence of values will be inserted. Click on the *"Faults..."* option and choose only the following fault types: AB, BC and CA.

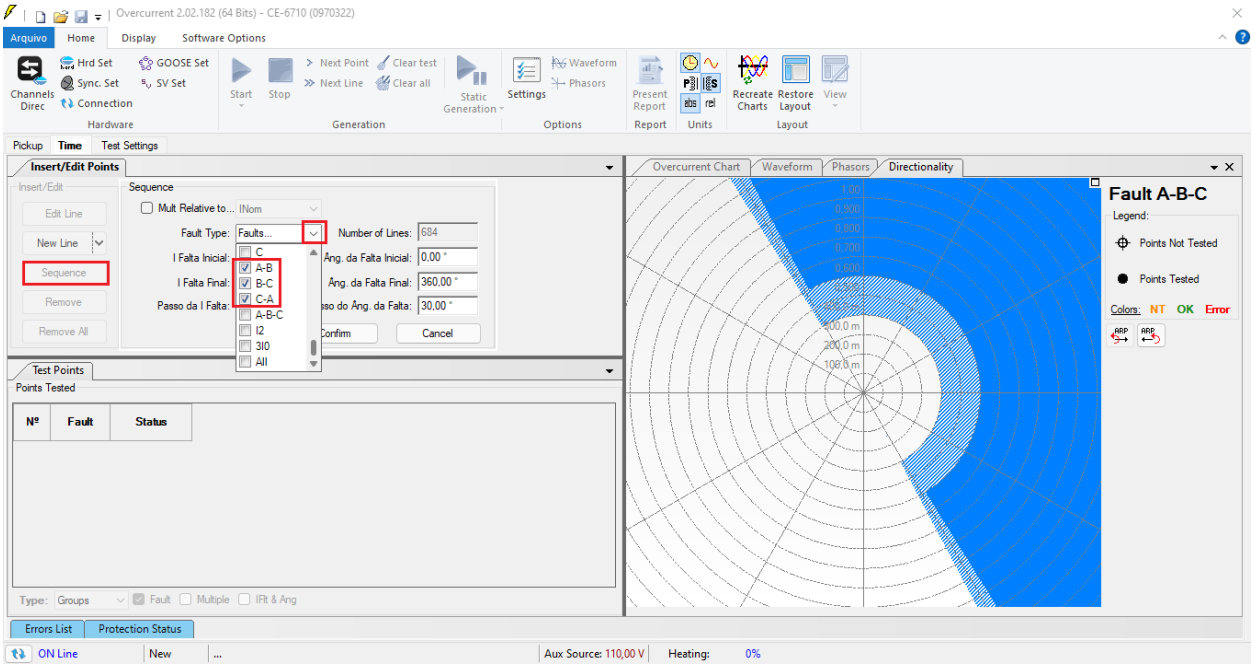

Figure 41

The value 5.00A was chosen as the initial value, 5.00A as the final value and 1.00A as the increment step. In the angles choose 0.0° as the initial value for the step choose 35° and final value choose 360.0°. Select the *"Directionality"* tab and it is verified that the operating region has increased.

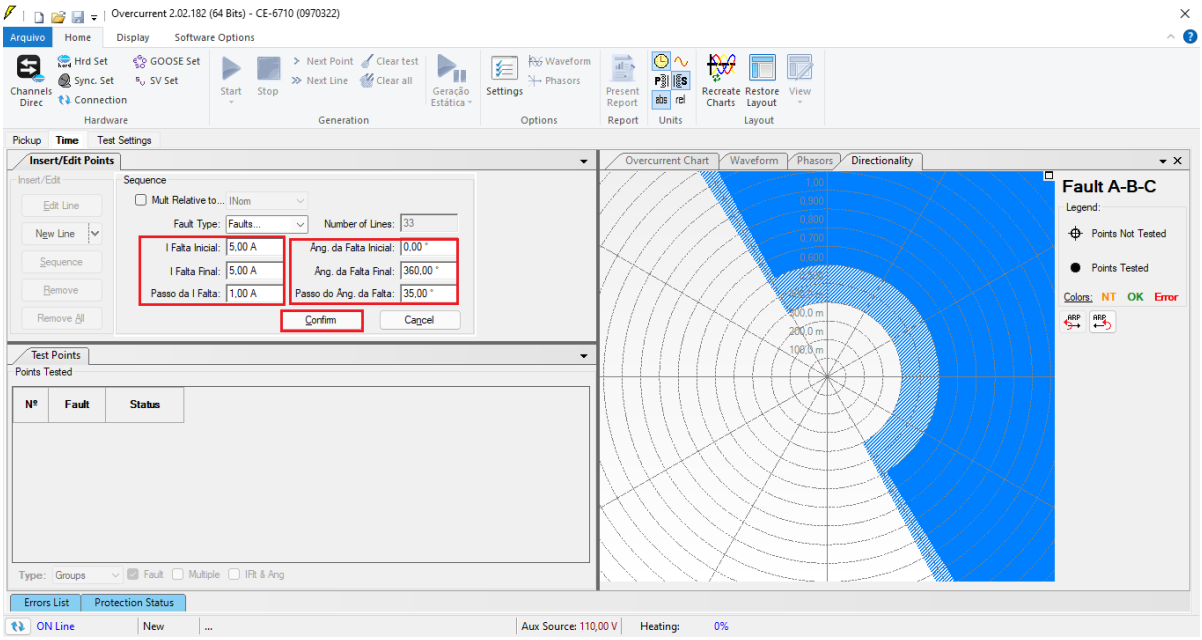

Figure 42

Start the generation through the command *"Alt +G"*.

8.7 *Time Test Final Result / L-L Fault / Union*

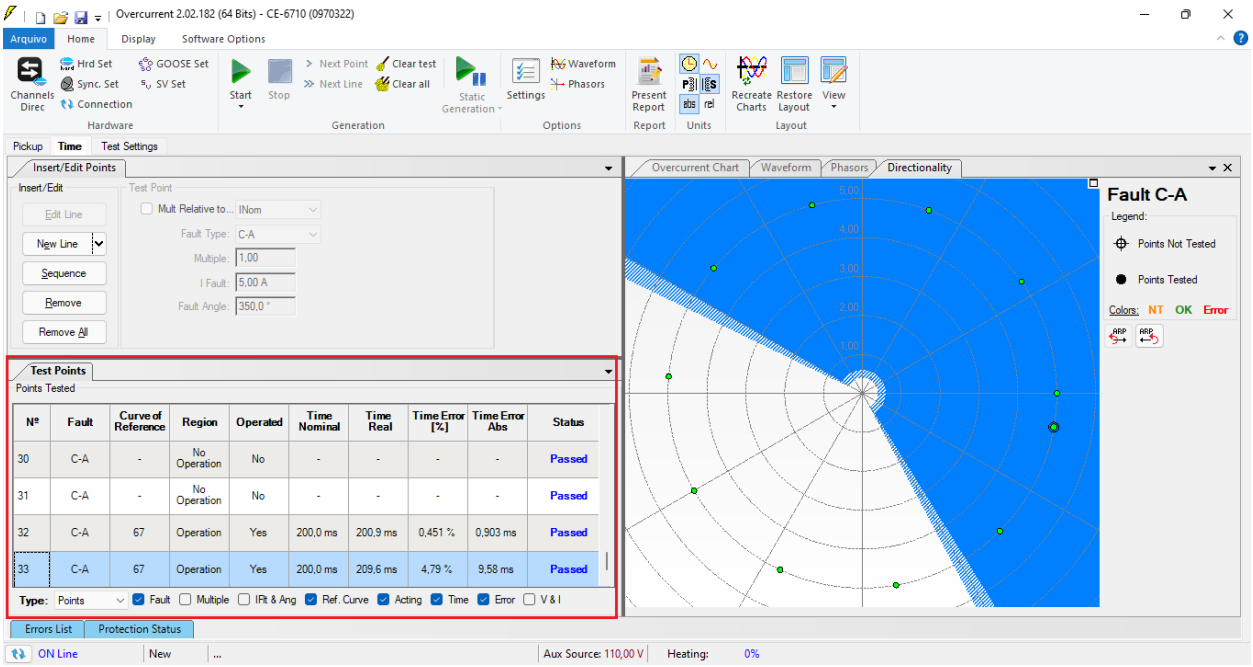

Figure 43

It is verified that all points in the operating region acted with times within the tolerance given by the relay manufacturer.

8.8 *Two-Phase Faults / Intersection*

In a two-phase fault, for example, A-B, the operating region could be the intersection of region A and region B as long as the relay field *"Tripping logic"* is set to *"Two out of three"*. Make this relay change.

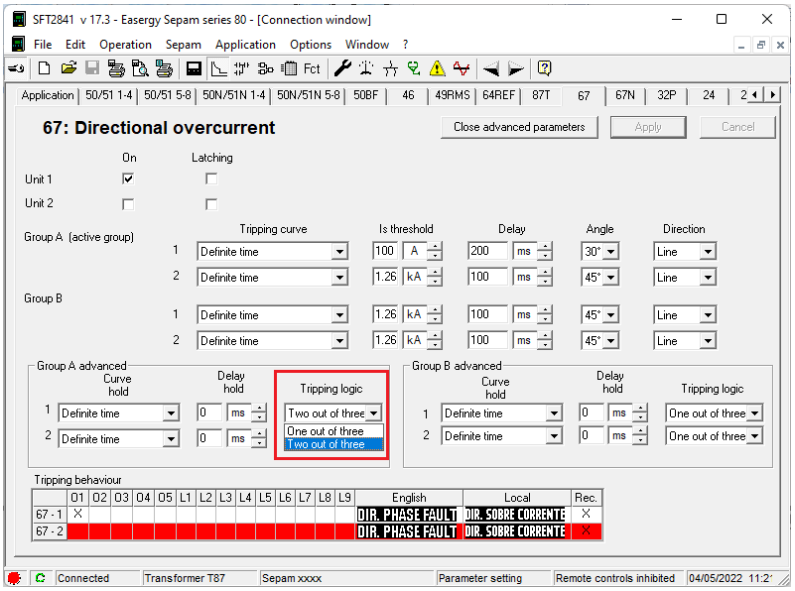

Figure 44

In order for the Overcurrent software to properly evaluate the two-phase faults, adjust the following parameter.

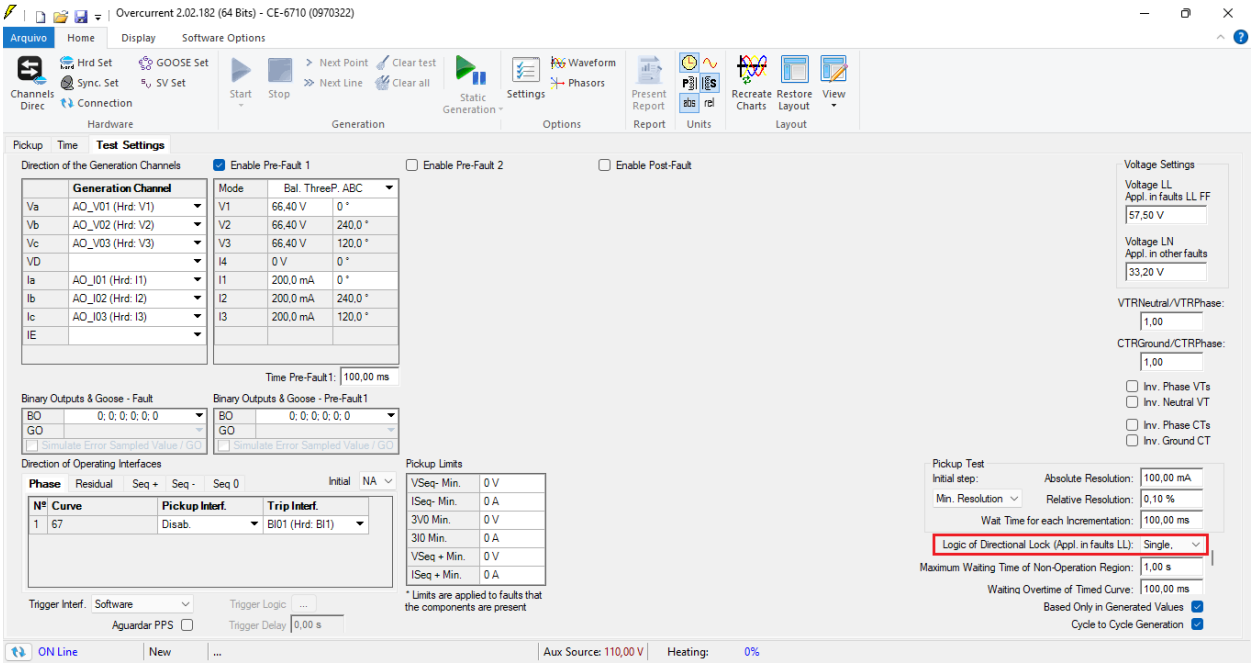

Figure 45

8.9 *Time Screen*

On this screen, the operating time and directionality are evaluated. For convenience, a sequence of values will be inserted. Click on the *"Faults..."* option and choose only the following fault types: AB, BC and CA.

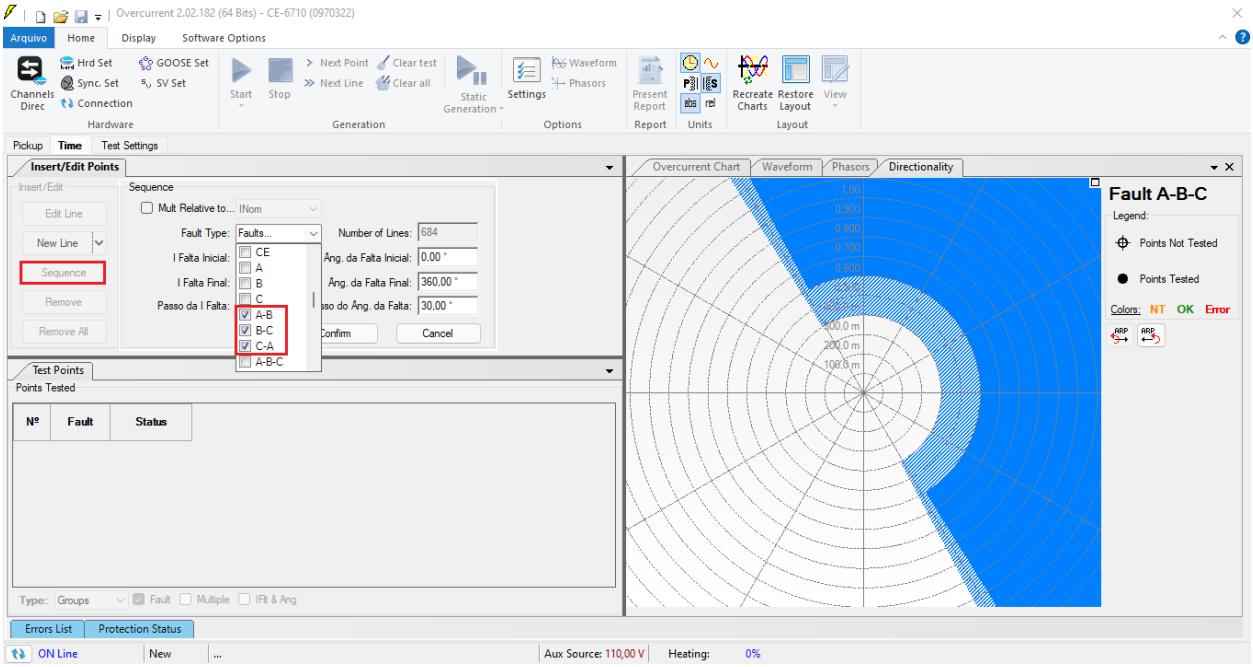

Figure 46

The value 5.00A was chosen as the initial value, 5.00A as the final value and 1.00A as the increment step. In the angles choose 0.0° as the initial value for the step choose 35° and final value choose 360.0°. Select the *"Directionality"* tab and it is verified that the operating region has decreased.

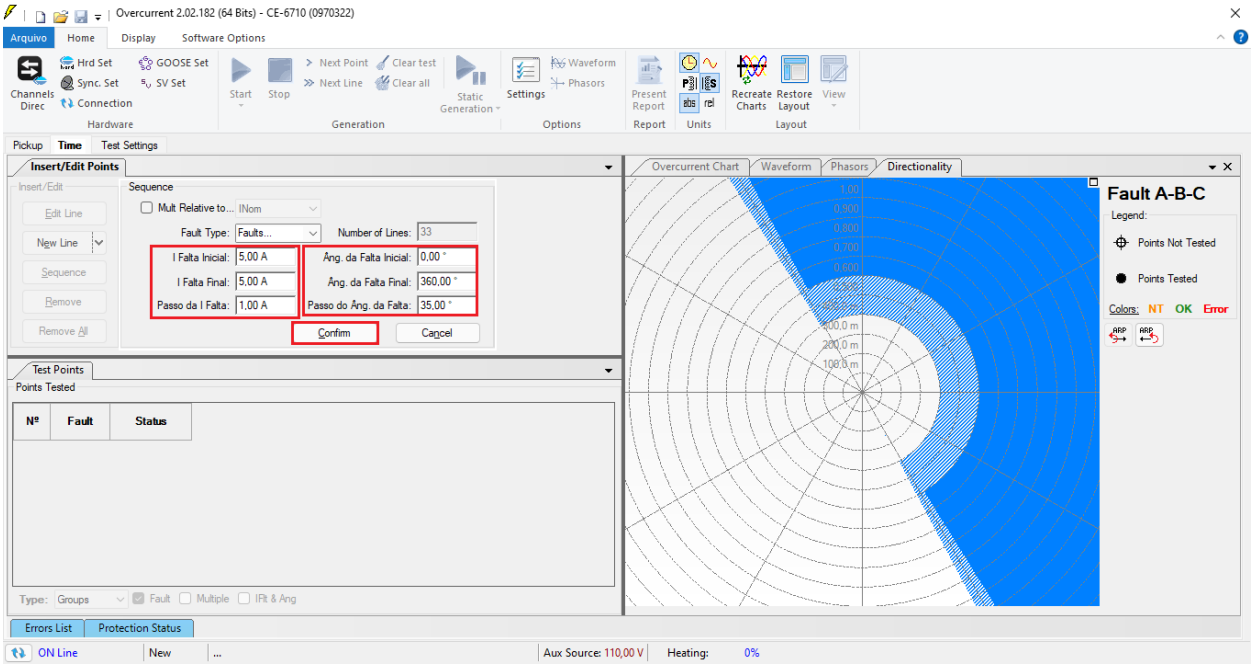

Figure 47

Start the generation through the command *"Alt +G"*.

8.10 *Time Test Final Result / L-L Fault / Intersection*

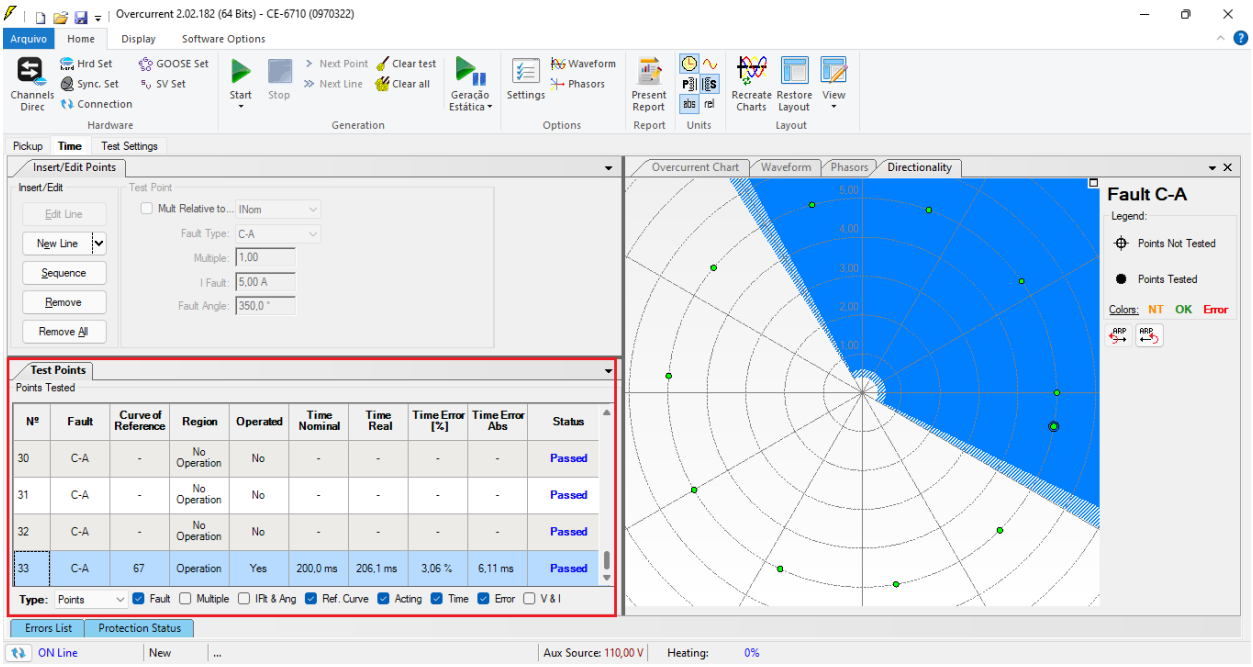

Figure 48

It is verified that all points in the operating region acted with times within the tolerance given by the relay manufacturer.

9. Report

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

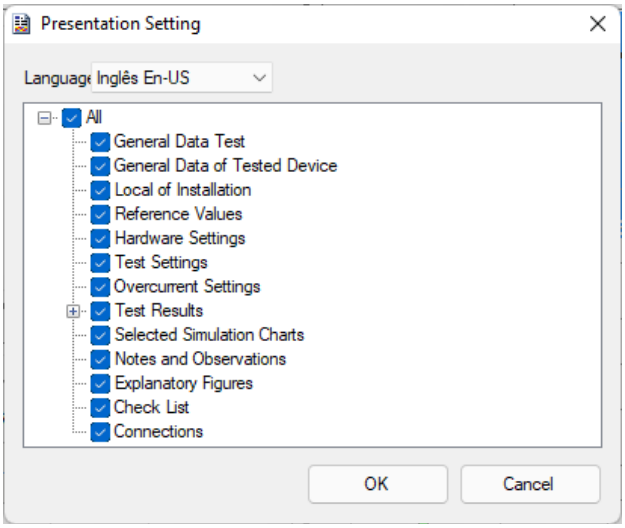

Figure 49

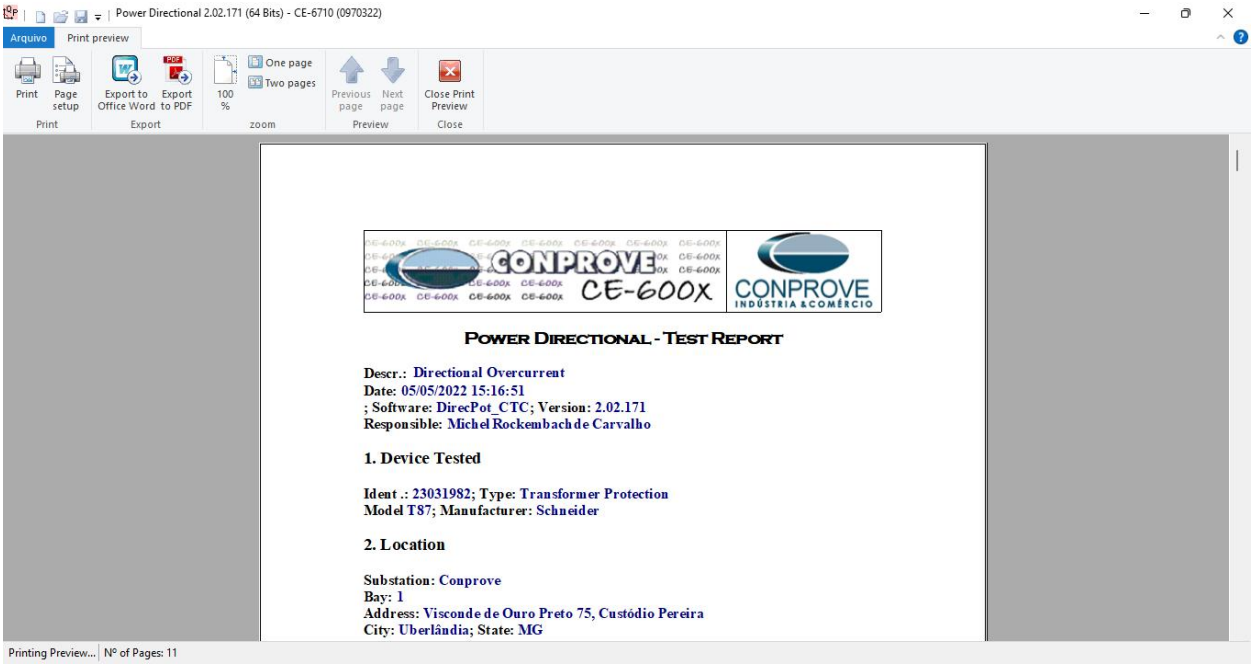
Power Directional 2.02.171 (64 Bits) - CE-6710 (0970322)
Arquivo
Print preview
Print
Page setup
Export to Office Word
Export to PDF
100 %
One page
Two pages
zoom
Previous page
Next page
Preview
Close Print Preview
Close
CONPROVE
CE-600X
CONPROVE
INDÚSTRIA &COMÉRCIO
POWER DIRECTIONAL - TEST REPORT
Descr.: Directional Overcurrent
Date: 05/05/2022 15:16:51
; Software: DirecPot_CTC; Version: 2.02.171
Responsible: Michel Rockembach de Carvalho
1. Device Tested
Ident .: 23031982; Type: Transformer Protection
Model T87; Manufacturer: Schneider
2. Location
Substation: Conprove
Bay: 1
Address: Visconde de Ouro Preto 75, Custódio Pereira
City: Uberlândia; State: MG
Printing Preview...
Nº of Pages: 11

Figure 50

APPENDIX A

A.1 Terminal Designations

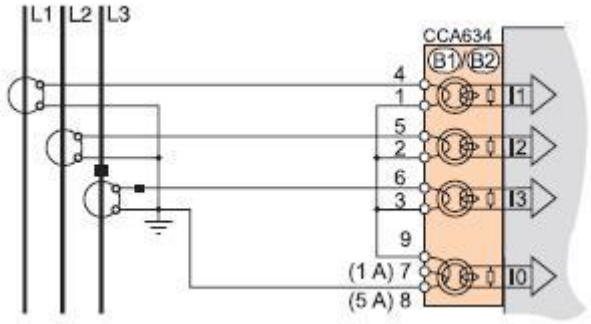

Figure 51

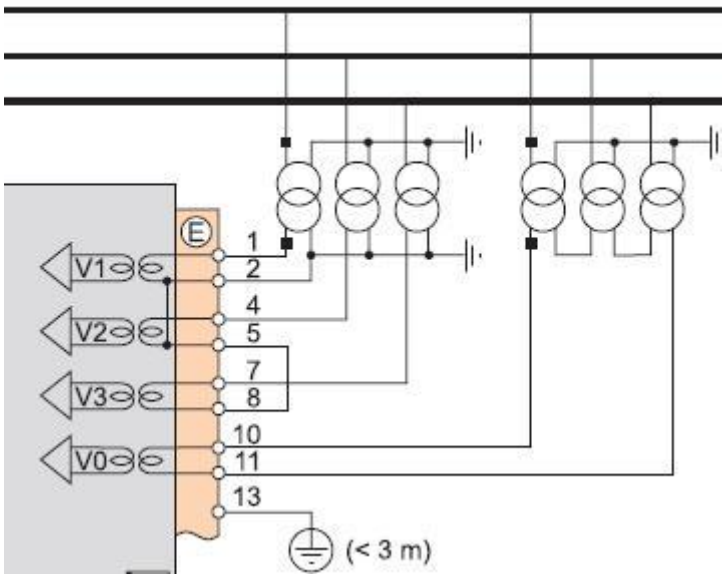

Figure 52

A.2 Technical Data

Characteristics

Settings				
Characteristic angle θ				
Setting range		30°, 45°, 60°		
Accuracy (1)		±2 %		
Tripping curve				
Setting range		See list above		
Is set point				
Setting range	definite time	0.1 In ⩽ Is ⩽ 24 In in amperes		
	IDMT	0.1 In ⩽ Is ⩽ 2.4 In in amperes		
Accuracy (1)		±5 % or ±0.01 In		
Resolution		1 A or 1 digit		
Drop out/pick up ratio		93.5 % ±5 % or > (1 - 0.015 In/Is) x 100 %		
Time delay T (operation time at 10 Is)				
Setting range	definite time	Inst, 50 ms ⩽ T ⩽ 300 s		
	IDMT	100 ms ⩽ T ⩽ 12.5 s or TMS (2)		
Accuracy (1)	definite time (4)	±2 % or from -10 ms to +25 ms		
	IDMT	Class 5 or from -10 ms to +25 ms		
Resolution		10 ms or 1 digit		
Advanced settings				
Tripping direction				
Setting range		Busbar / line		
Tripping logic				
Setting range		One out of three / two out of three		
Timer hold T1				
Setting range	definite time	0; 0.05 to 300 s		
	IDMT (3)	0.5 to 20 s		
Resolution		10 ms or 1 digit		
Characteristic times				
Operation time		pick-up < 75 ms at 2 Is (typically 65 ms) Inst. < 90 ms at 2 Is (confirmed instantaneous) (typically 75 ms)		
Overshoot time		< 45 ms at 2 Is		
Reset time		< 55 ms at 2 Is (for T1 = 0)		
Inputs				
Designation	**Syntax**	**Equations**	**Logipam**	
Protection reset	P67_x_101	■	■	
Protection inhibition	P67_x_113	■	■	
Outputs				
Designation	**Syntax**	**Equations**	**Logipam**	**Matrix**
Instantaneous output (pick-up)	P67_x_1	■	■	
Delayed output	P67_x_3	■	■	■
Drop out	P67_x_4	■	■	
Instantaneous output (reverse zone)	P67_x_6	■	■	
Phase 1 fault	P67_x_7	■	■	
Phase 2 fault	P67_x_8	■	■	
Phase 3 fault	P67_x_9	■	■	
Protection inhibited	P67_x_16	■	■	
Instantaneous output at 0.8 Is	P67_x_21	■	■	
1 out of 3 delayed output	P67_x_36	■	■	
2 out of 3 delayed output	P67_x_37	■	■	

Figure 53

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 3

Overcurrent Software		Schneider SEPAM T87 Relay	
Parameter	**Figure**	**Parameter**	**Figure**
Pkp	**32**	**Is threshold**	**16**
Tmp	**32**	**Delay**	**16**
ATM	**33**	**Angle**	**16**