Test Tutorial

Equipment Type: <u>Protection Relay</u>

Brand: <u>Schneider</u>

Model: <u>SEPAM T87</u>

Function: <u>32R or PDOP – Power Directional</u>

Tool Used: <u>CE-6006; CE-6707; CE-6710; CE-7012 or CE-7024</u>

Objective: <u>Perform tests on the reverse power function to verify directionality</u>

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial release	06/05/2022	M.R.C.	G.C.D.P.

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Summary

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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

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.
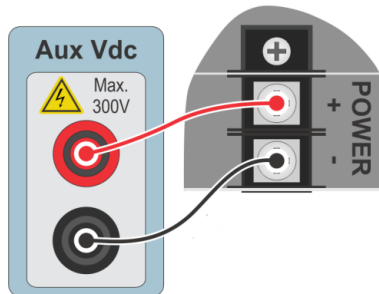
Figure 1

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.
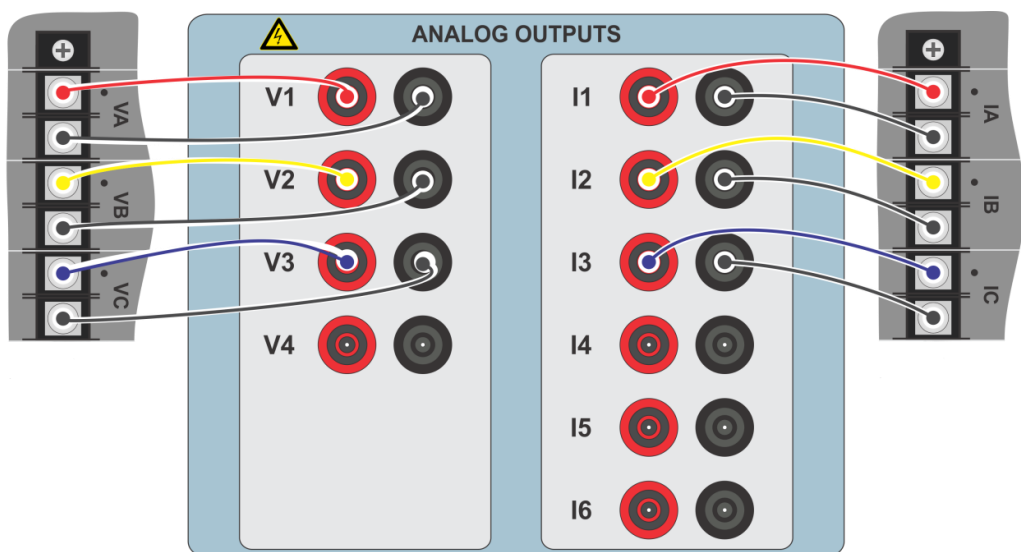
Figure 2

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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;

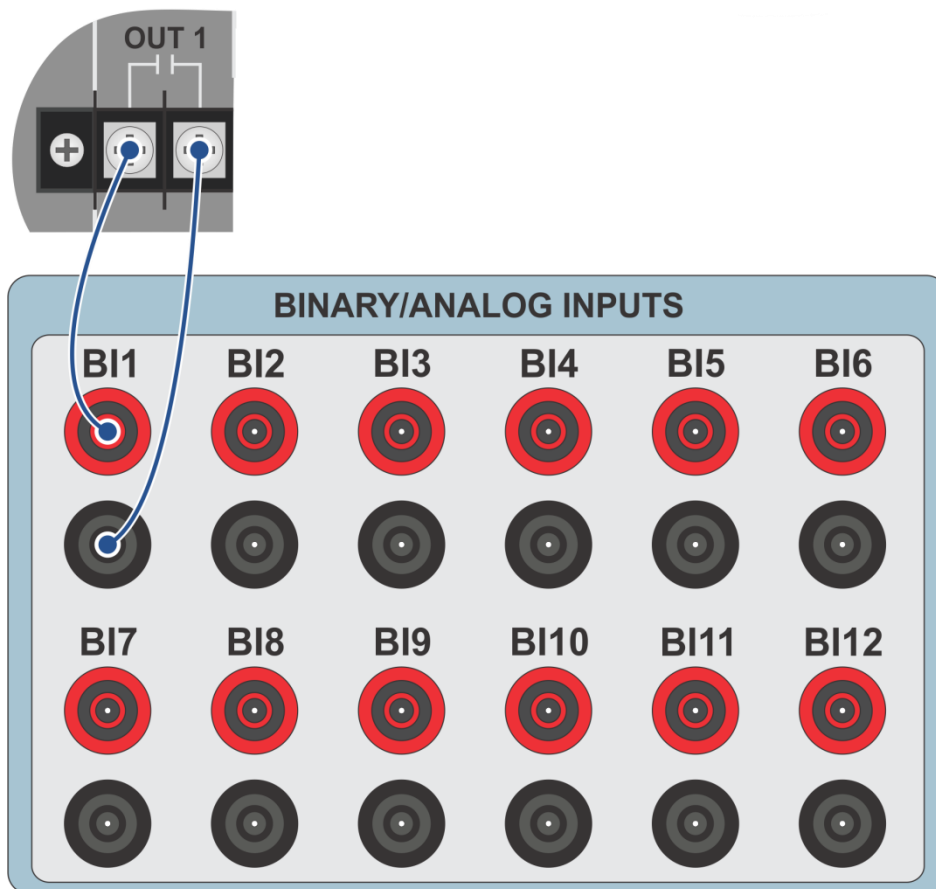The following figure shows the details of the connection.

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:

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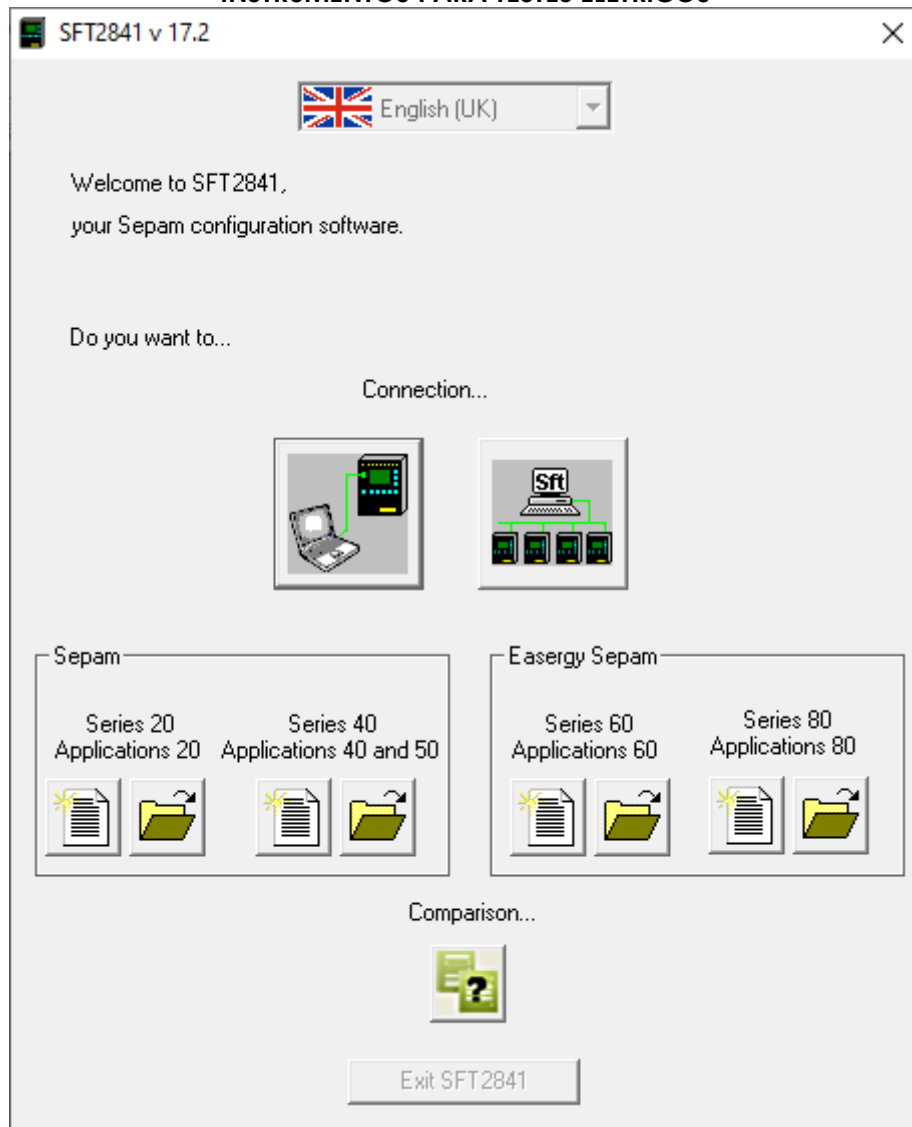
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Figure 5

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:
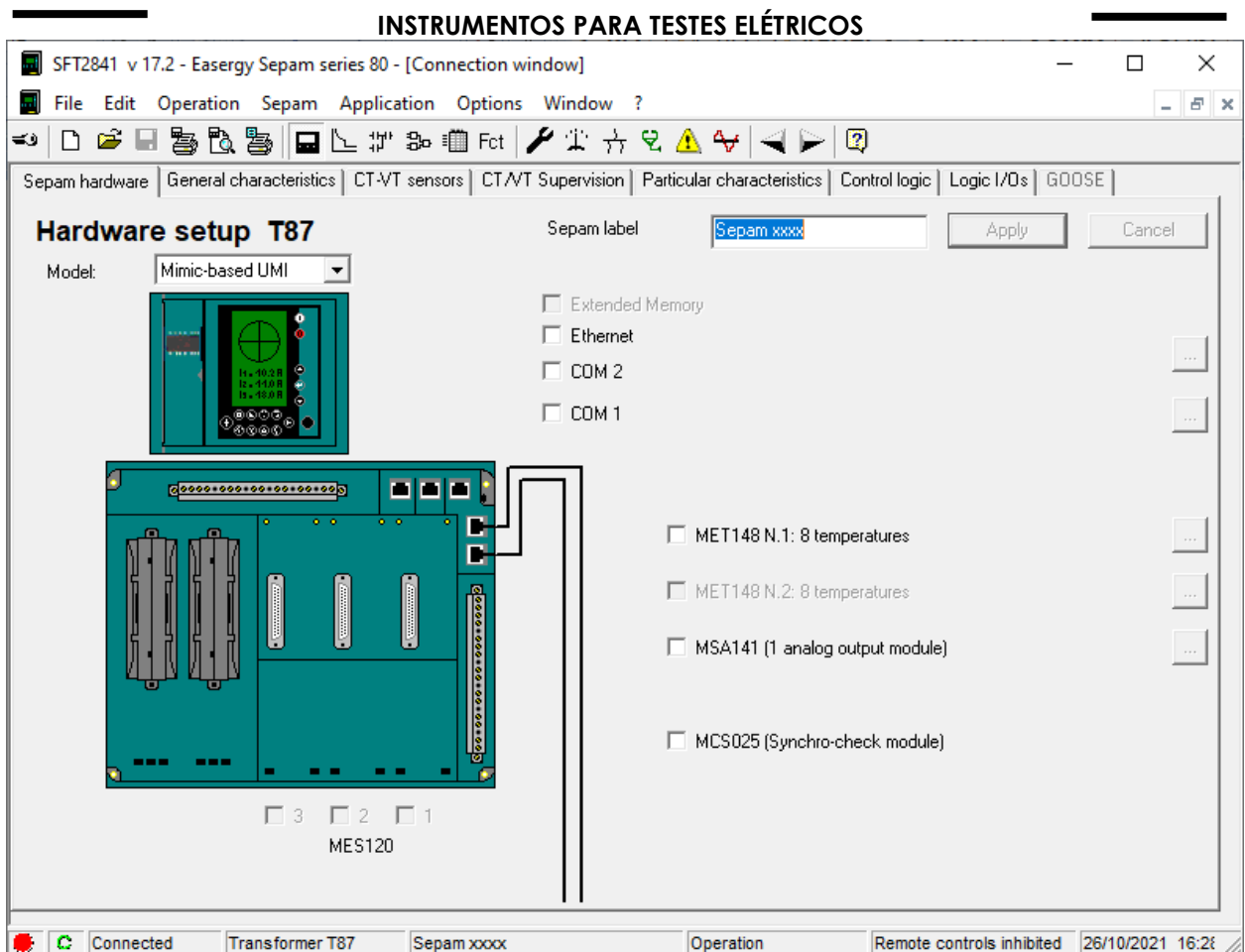
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Figure 7

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.
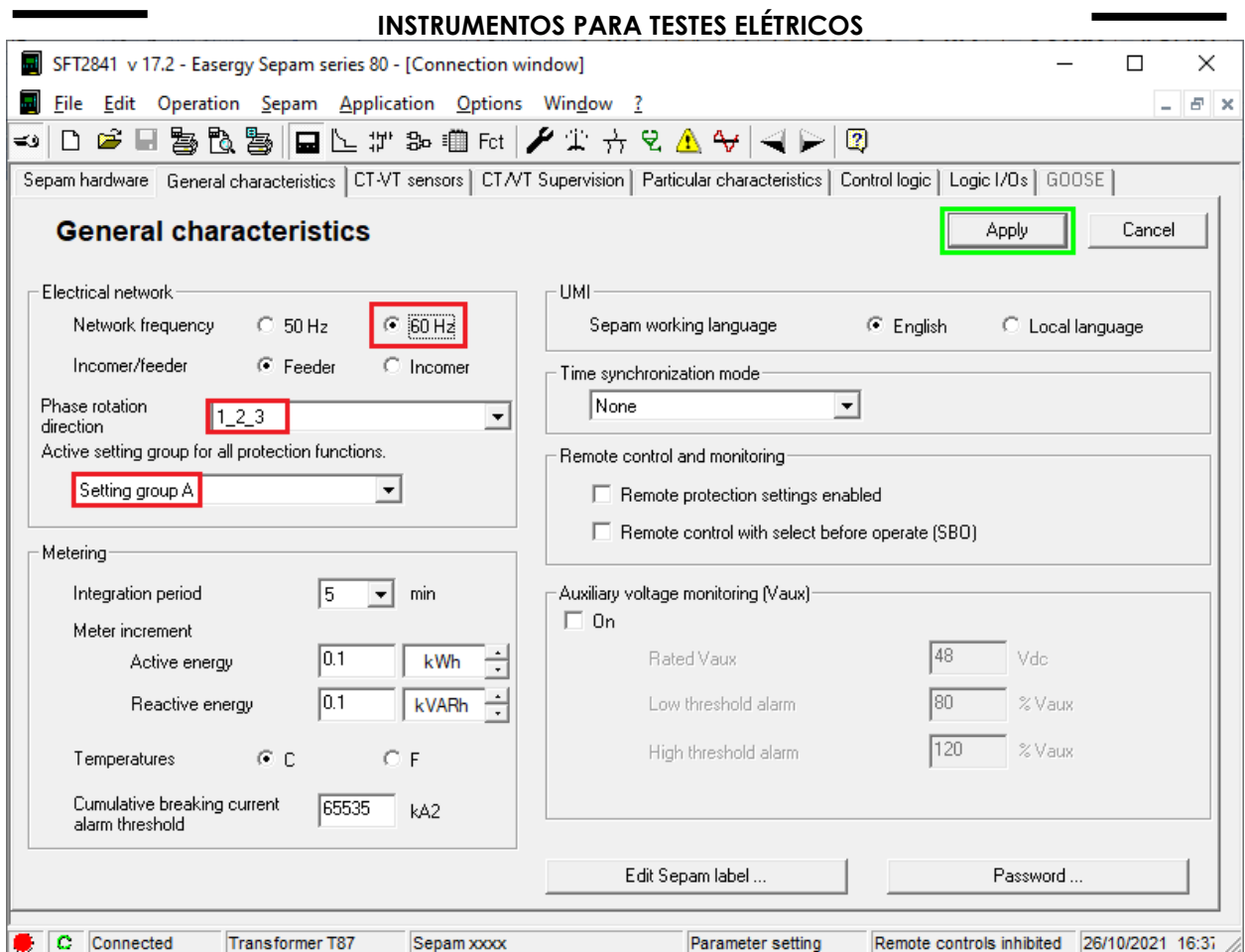
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Figure 8

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.
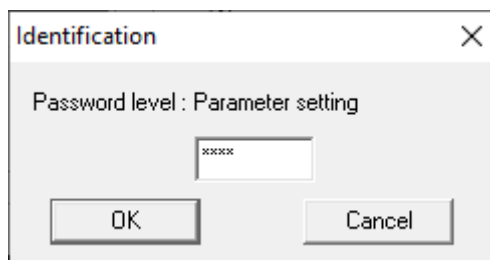

Figure 9

Enter your password for the changes to take place.

Note: The default password is 0000.

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3.2 *CT-VT sensors*

In this window, adjust the nominal values of the CTs and VTs.
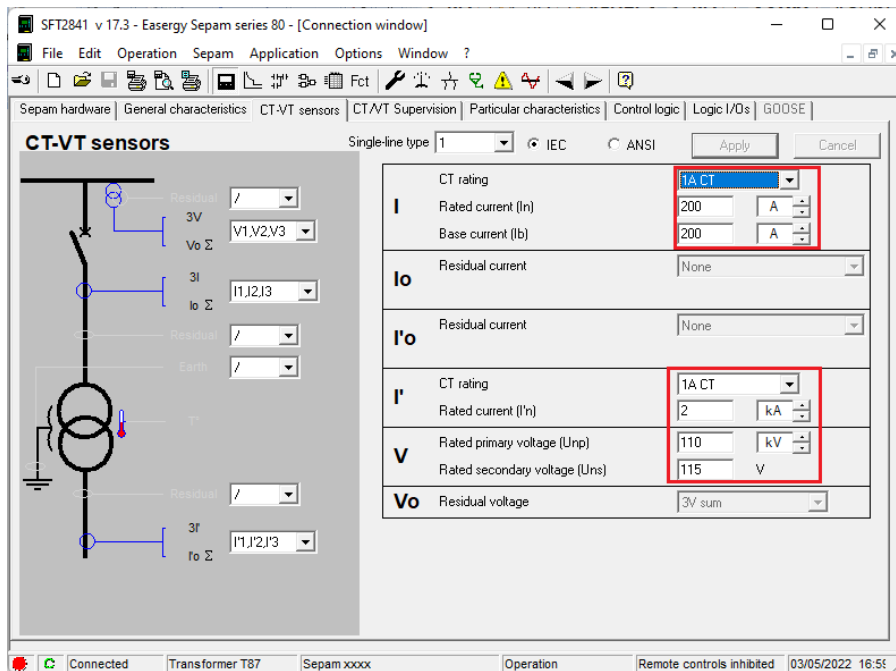
Figure 10

3.3 *CT/VT Supervision*

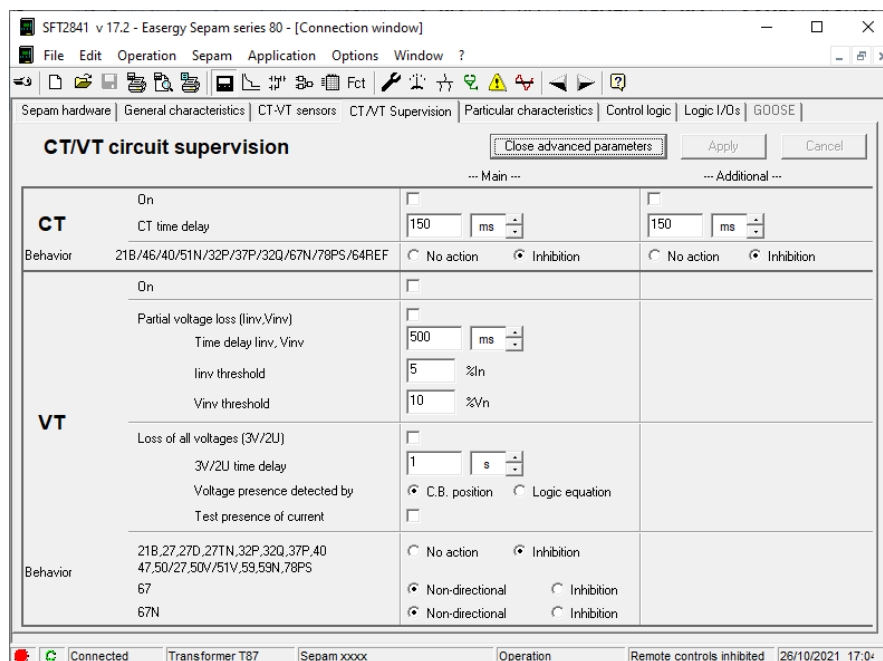In this tutorial this functionality is not used.

Figure 11

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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.
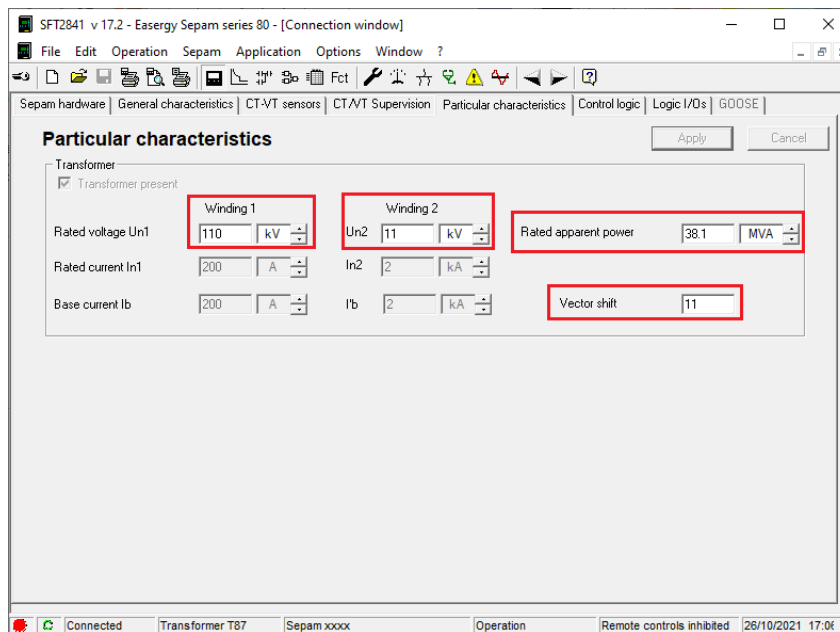

Figure 12

3.5 *Control logic*
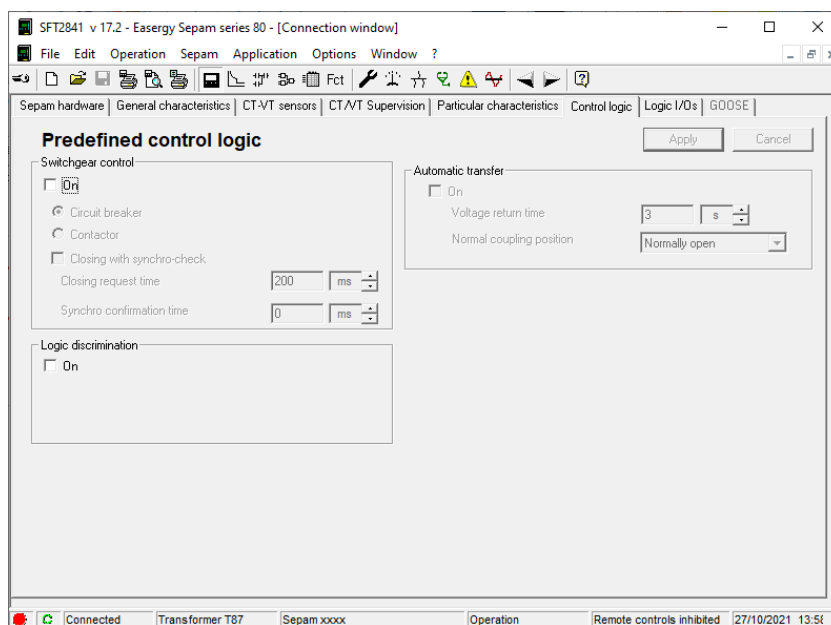
Disable the options in this field.

Figure 13

3.6 *Logic I/O s*

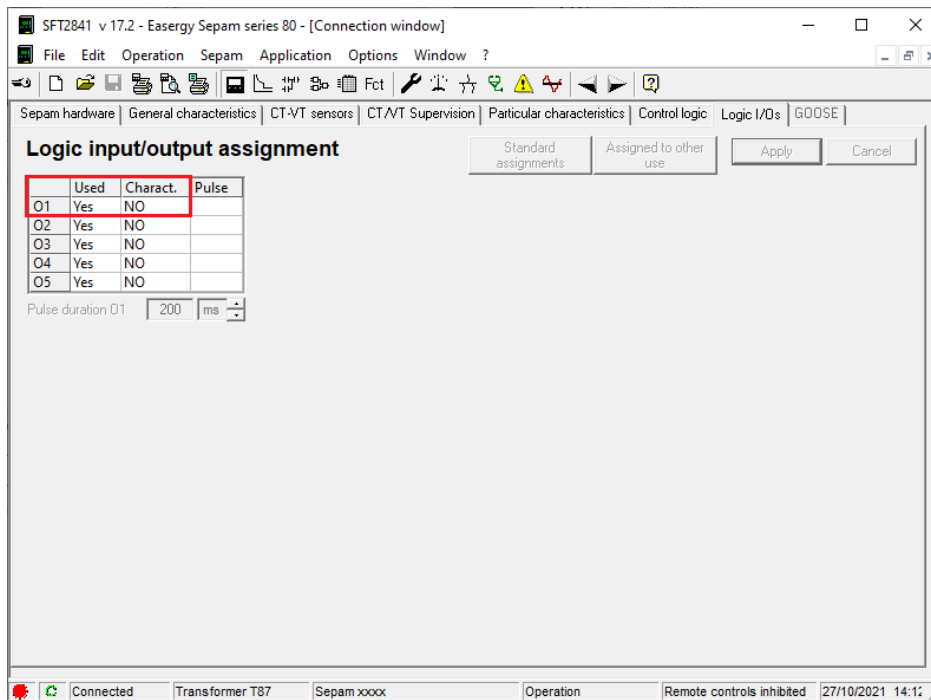In this field, the initial states of the binary outputs are set.

Figure 14

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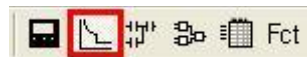

Figure 15

3.7 *32P: Active Overpower / Reverse active power*

Up to 2 stages can be set for this function, each stages being configured for overpower tripping or for reverse power tripping. This tutorial uses a single element being set as reverse power. The values found in the test will be divided by the Current Transformer Ratio (RTC) and by the Potential Transformer Ratio (RTP). For the power directional function, configure the following settings:

Table 2

Power threshold	45MW (primary)
Type	Reverse power
Delay	200ms

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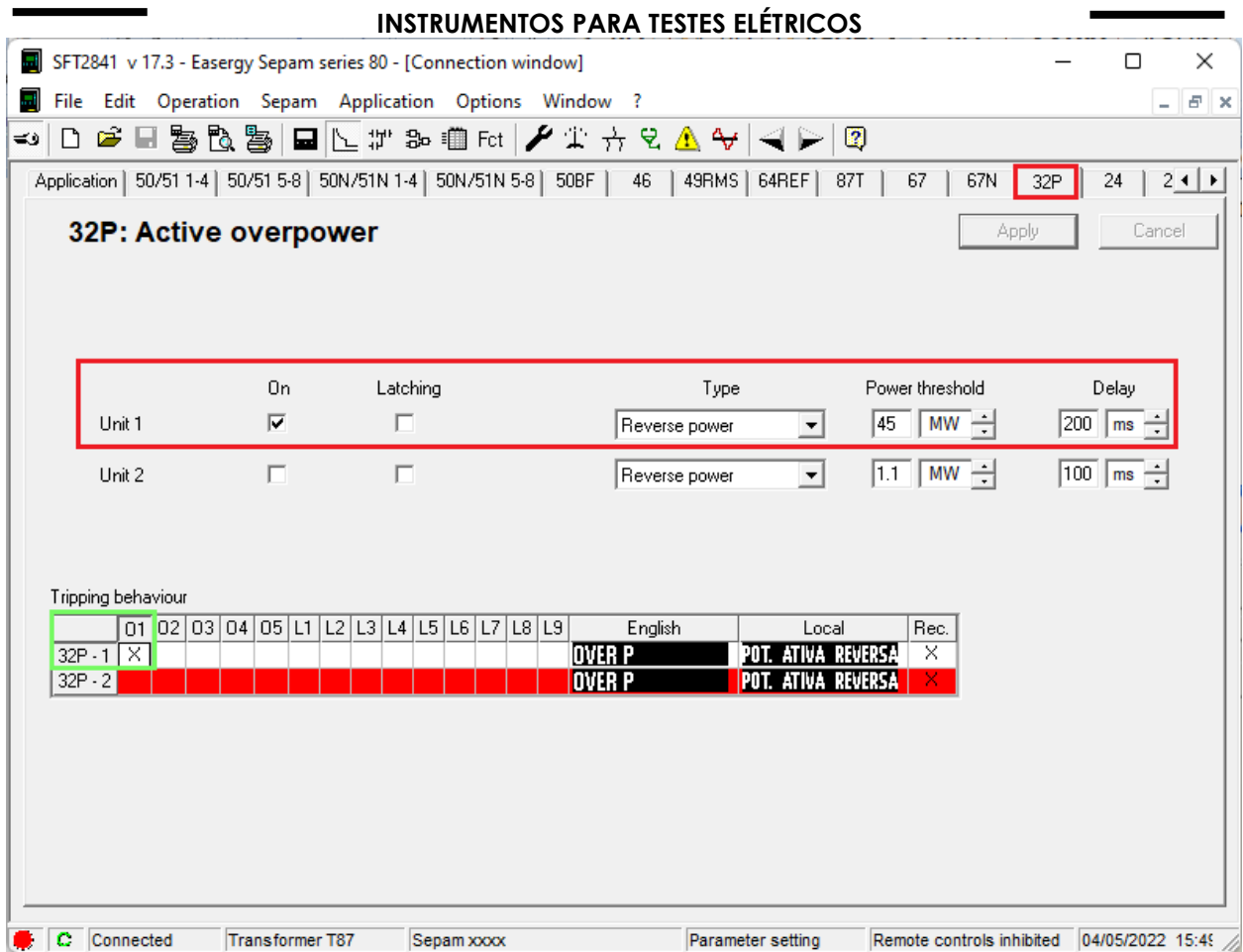
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Figure 16

3.8 *Matrix*

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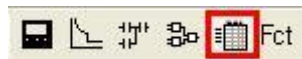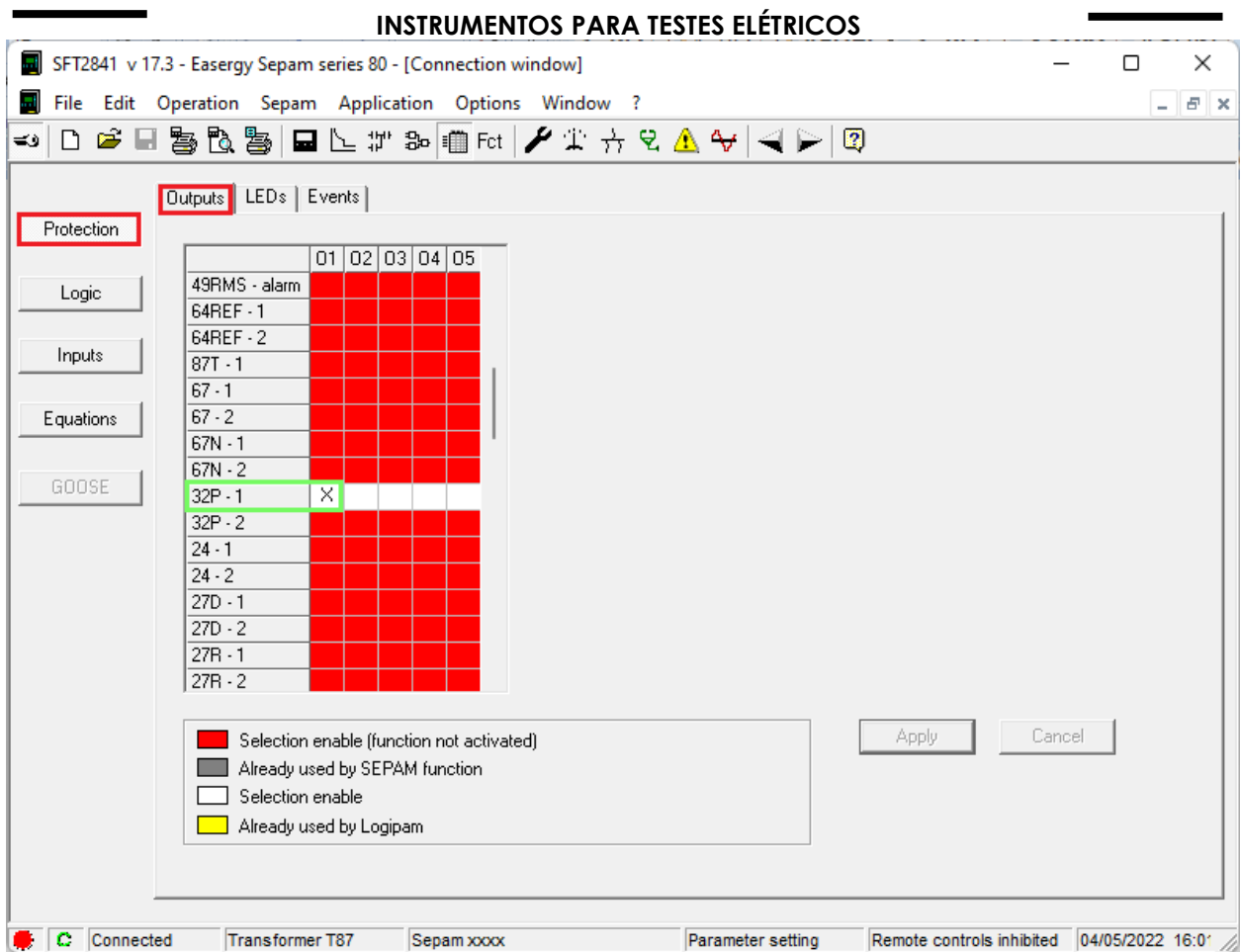

Figure 17

In the *"Protection"* field and in the *"Outputs"* tab, configure the tripping of the reverse power directional function to be sent to output number 1.

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4. Power Directional software adjustments

4.1 *Opening the Power Directional*

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

Figure 18

Click on the Power Directional software icon.

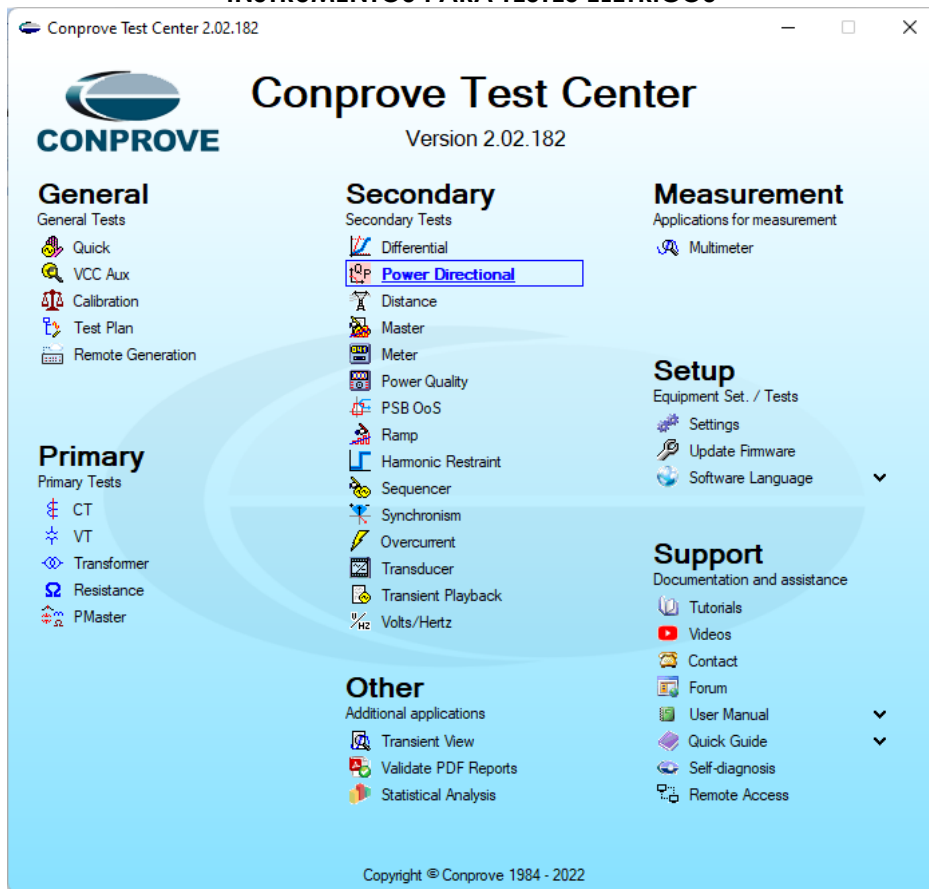Rua Visconde de Ouro Preto, 77 - Bairro Custódio Pereira - Uberlândia – MG - CEP 38405-202.
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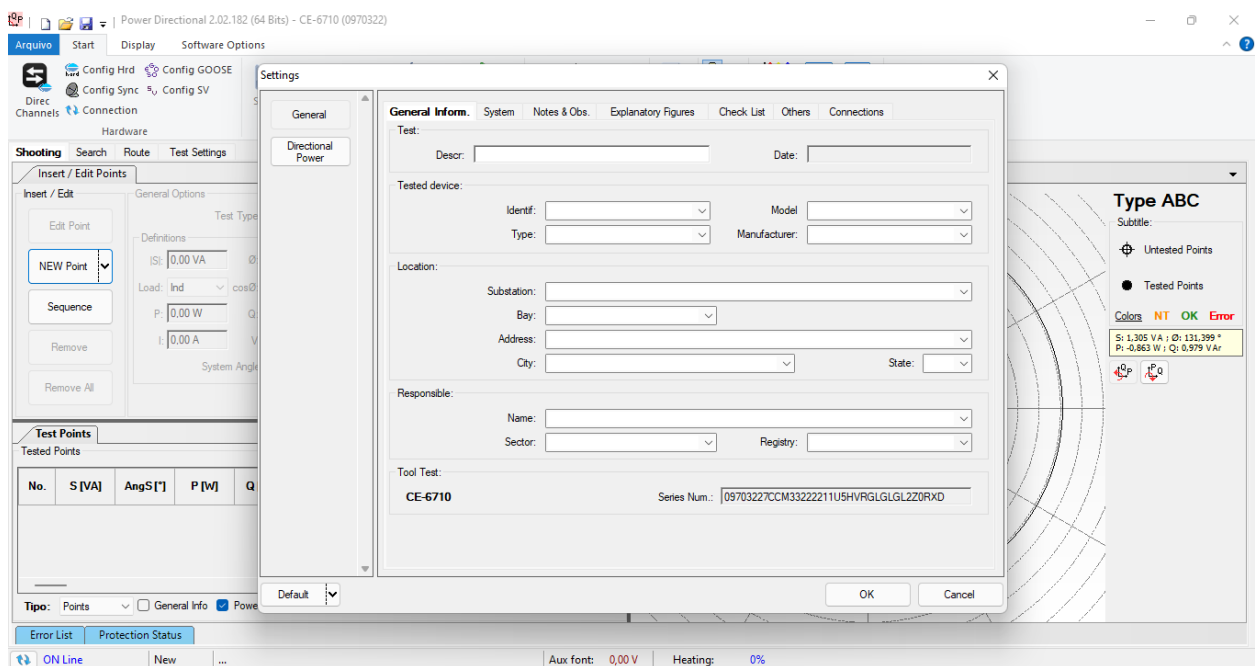
Figure 19

Figure 20

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.
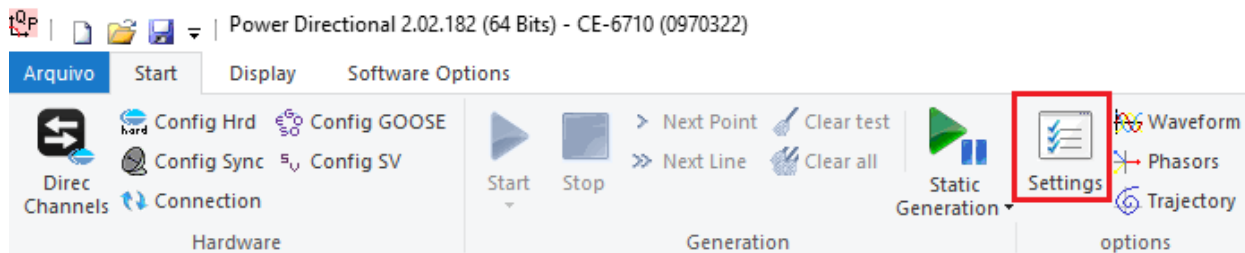

Figure 21

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.
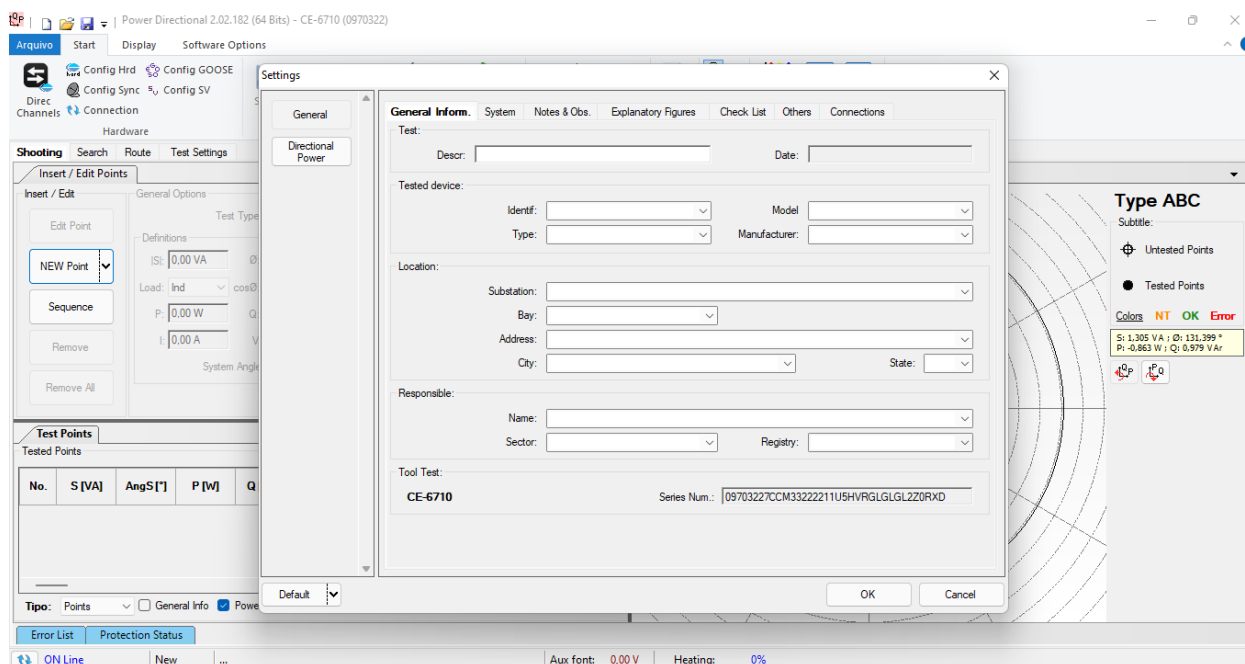

Figure 22

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.

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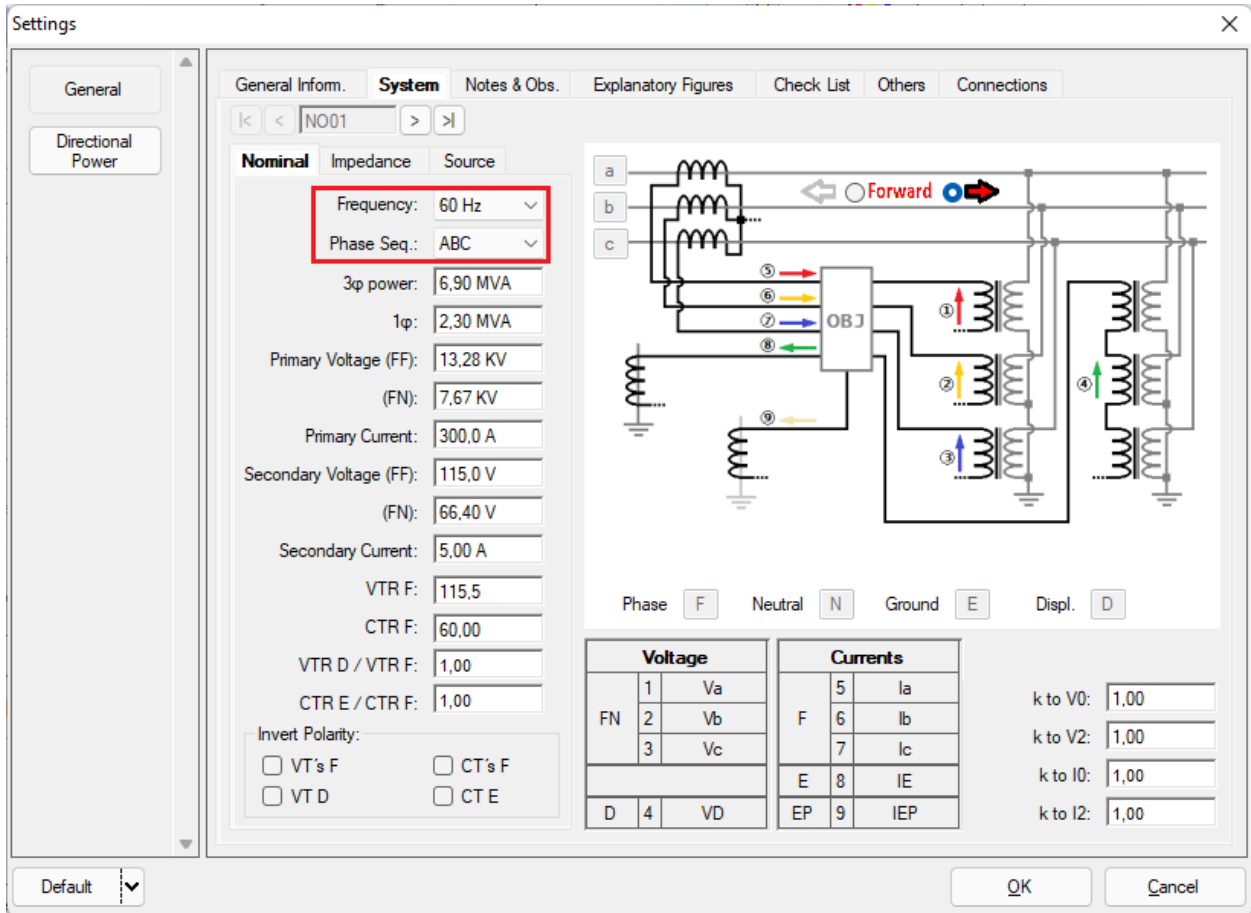
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Figure 23

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

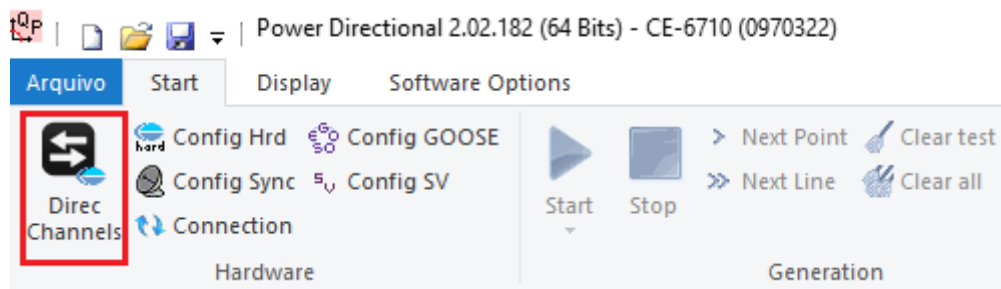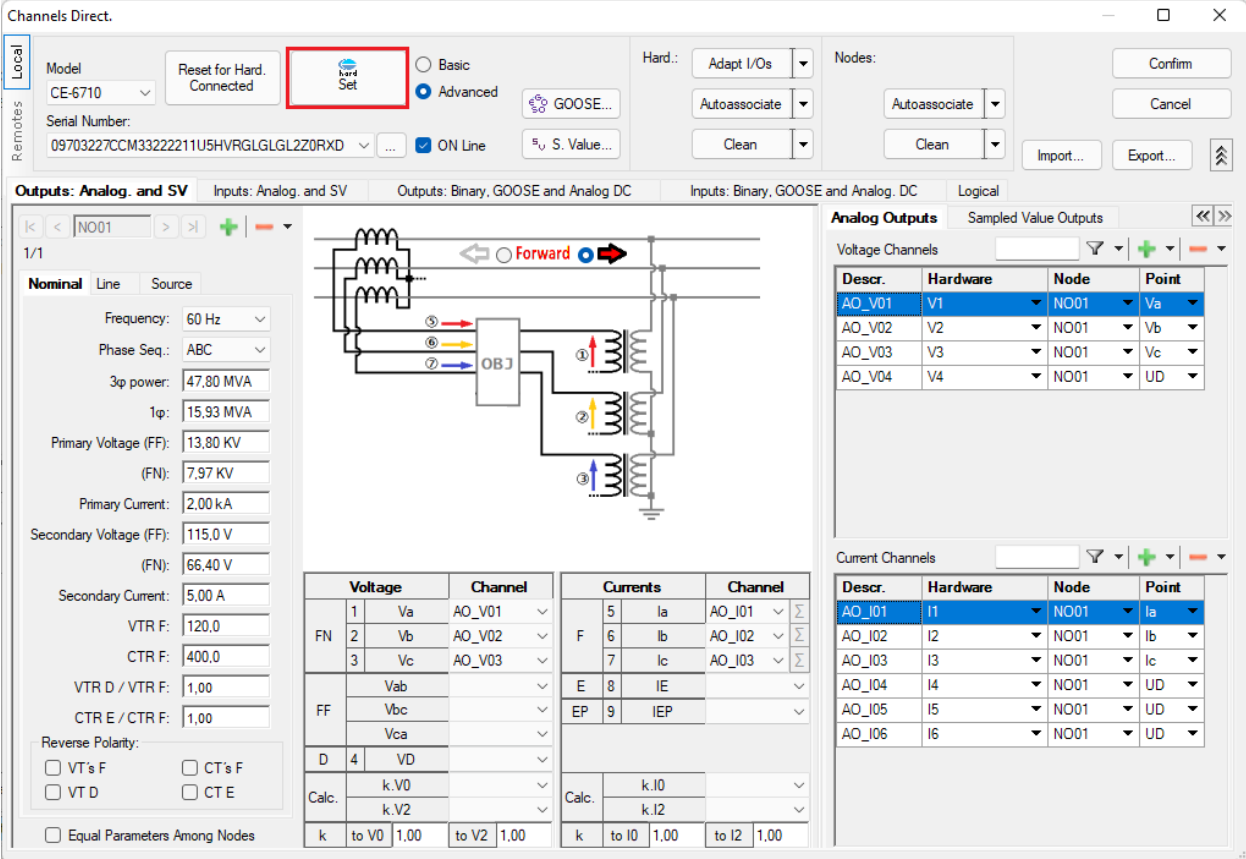Click on the icon illustrated below.

Figure 24

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Then click on the highlighted icon to configure the hardware.

Figure 25

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

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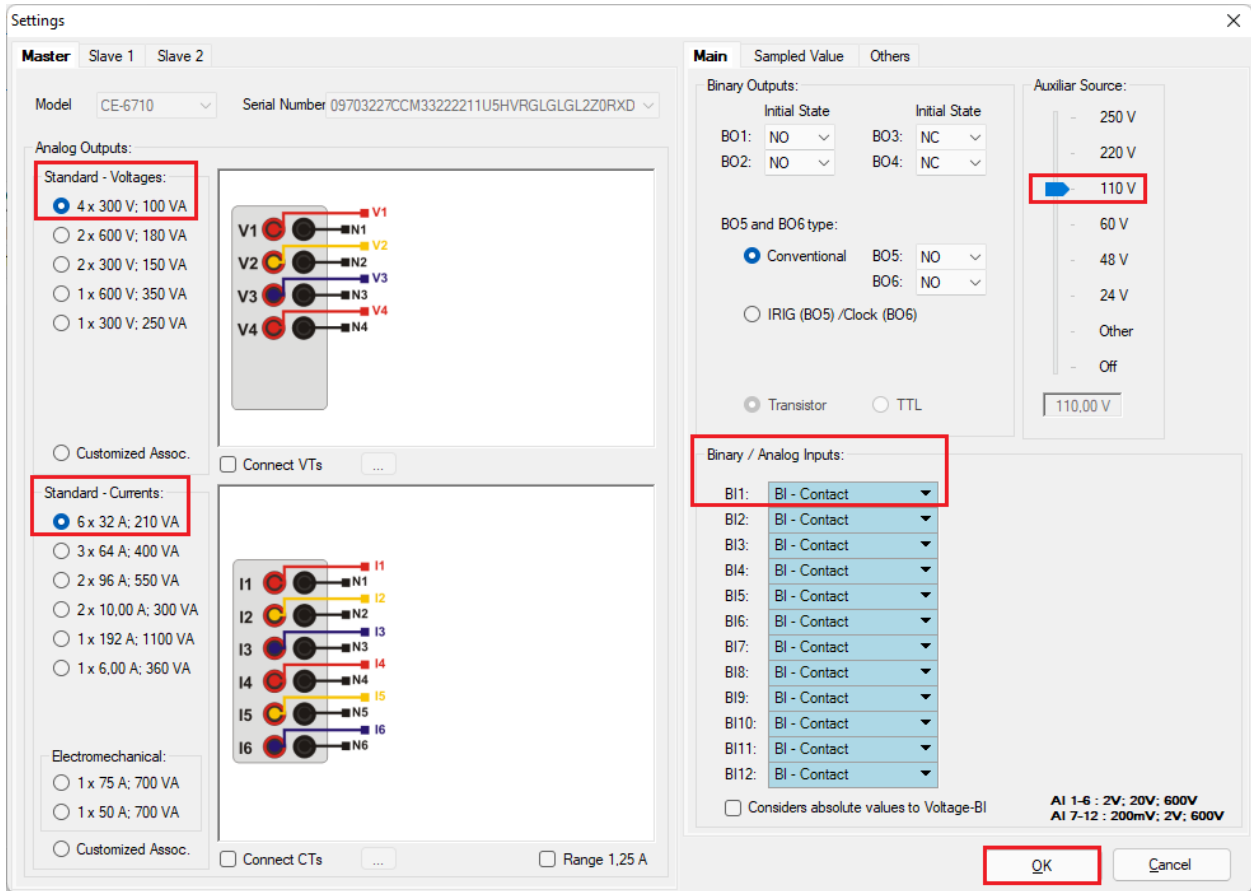
Figure 26

On the next screen choose *"Basic"* and on the next window (not shown) choose *"YES",* finally click on *"Confirm"*.
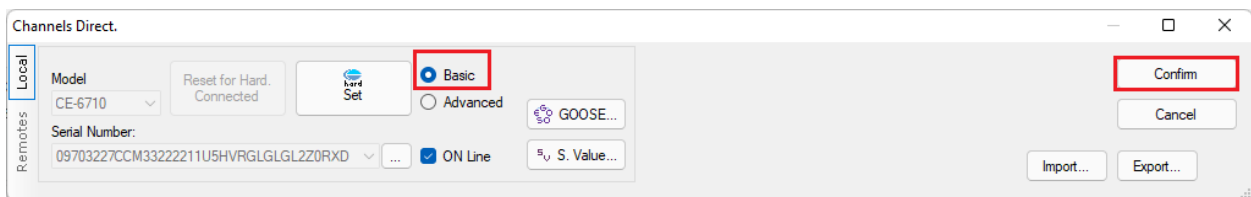
Figure 27

6. Power Directional Adjustment

6.1 *Directional Power Screen > Definitions*

In this tab you can adjust the pickup definition, power, time and angle tolerances. These tolerances should be consulted in the relay manufacturer's manual (available in Appendix A). There is also the option of limiting a maximum value for both voltage and current.

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Figure 28

6.2 *Directional Power Screen > Directional Power Elements > Active*

Here the reverse power directional element is configured. To do this, click once on the highlighted *"+"* icon.

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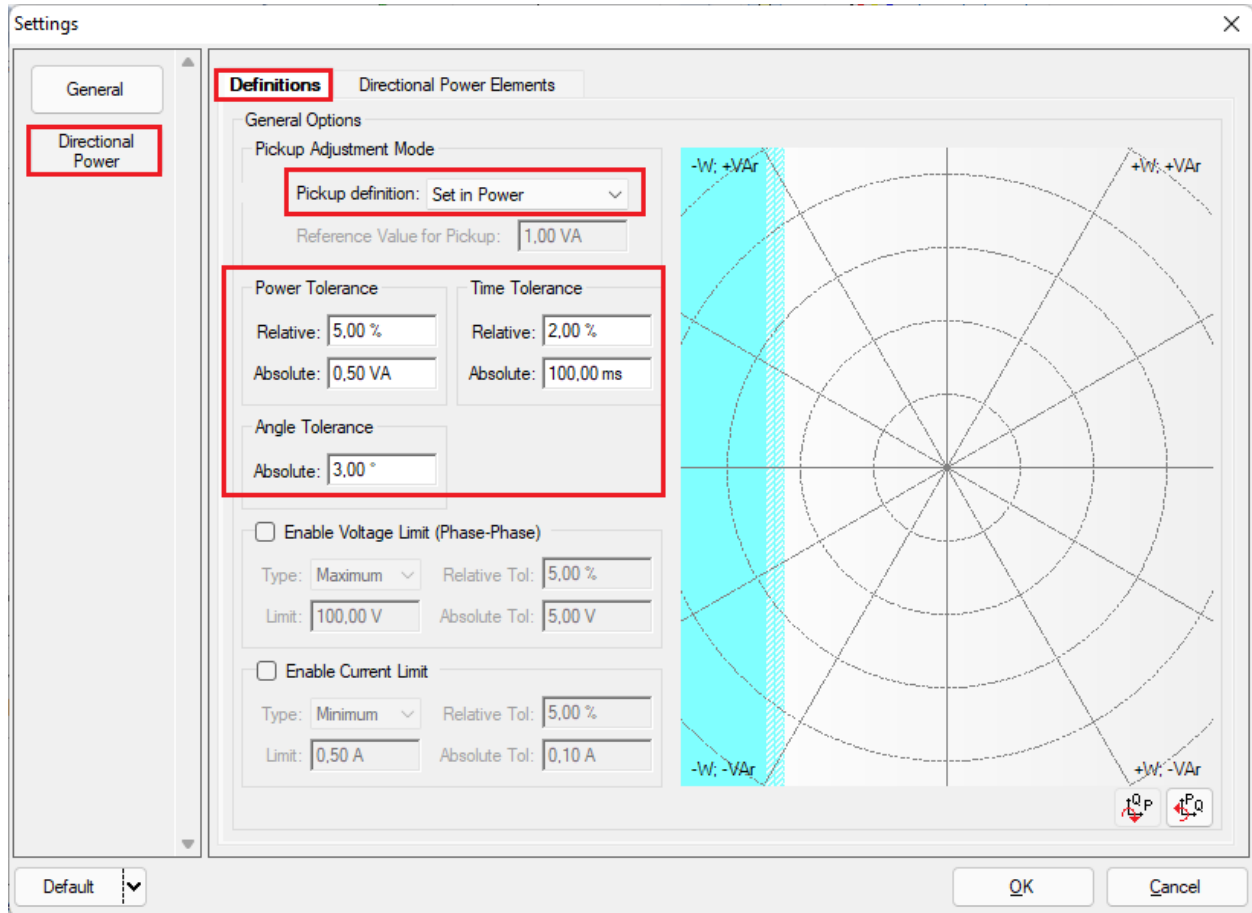Home Page: www.conprove.com.   -   E-mail: conprove@conprove.com.br
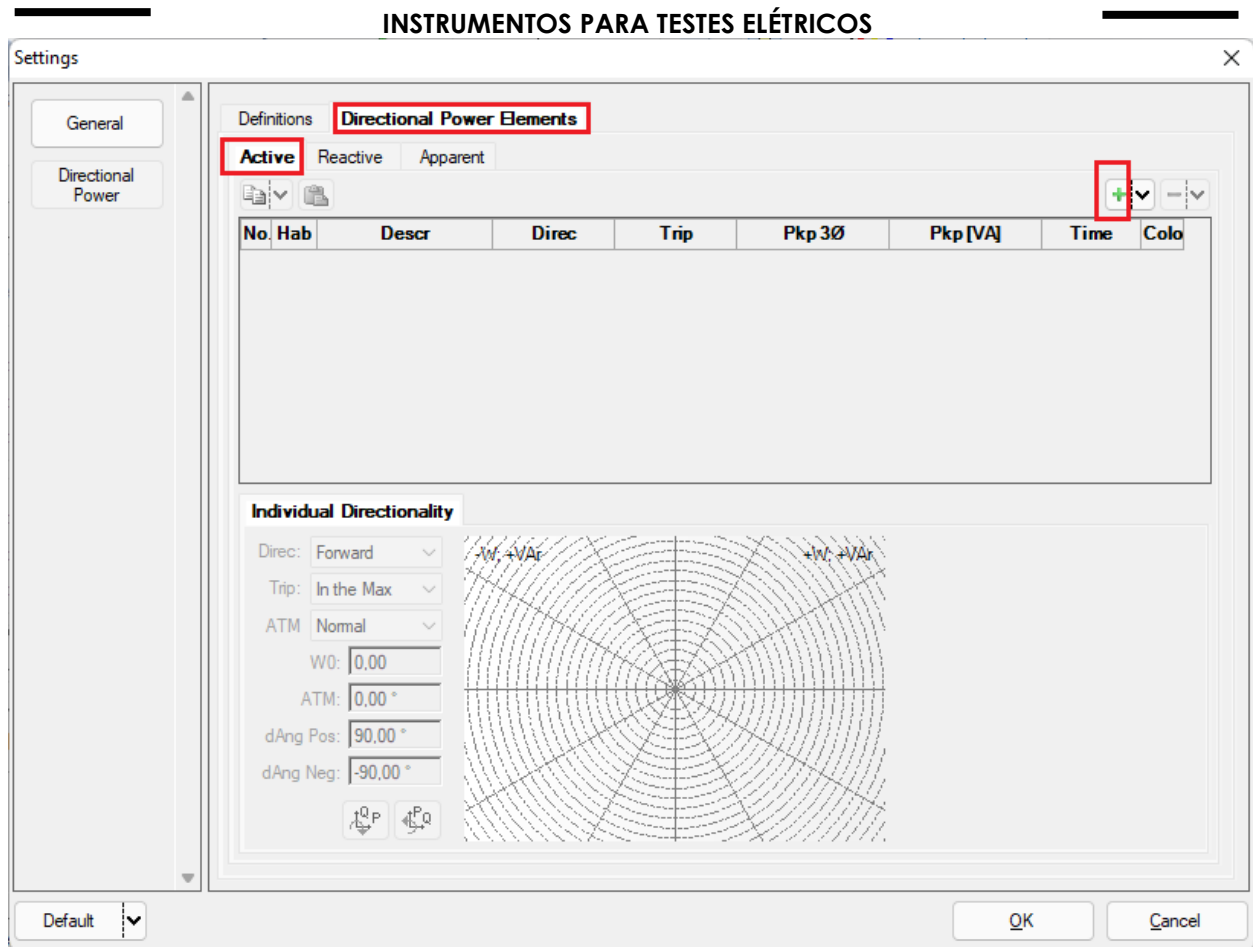
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Figure 29

For the first element change the name to 32R, choose the directionality as reverse, set the pickup value and the run time. Remembering that the pickup value must be referenced to the secondary according to the following formula:

$$P_{secundary} = \frac{P_{primary}}{VTR * CTR}$$

$$P_{secundary} = \frac{45M}{\left(\frac{110K}{115}\right) * \left(\frac{200}{1}\right)}$$

$$P_{secundary} = 235,22W$$

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

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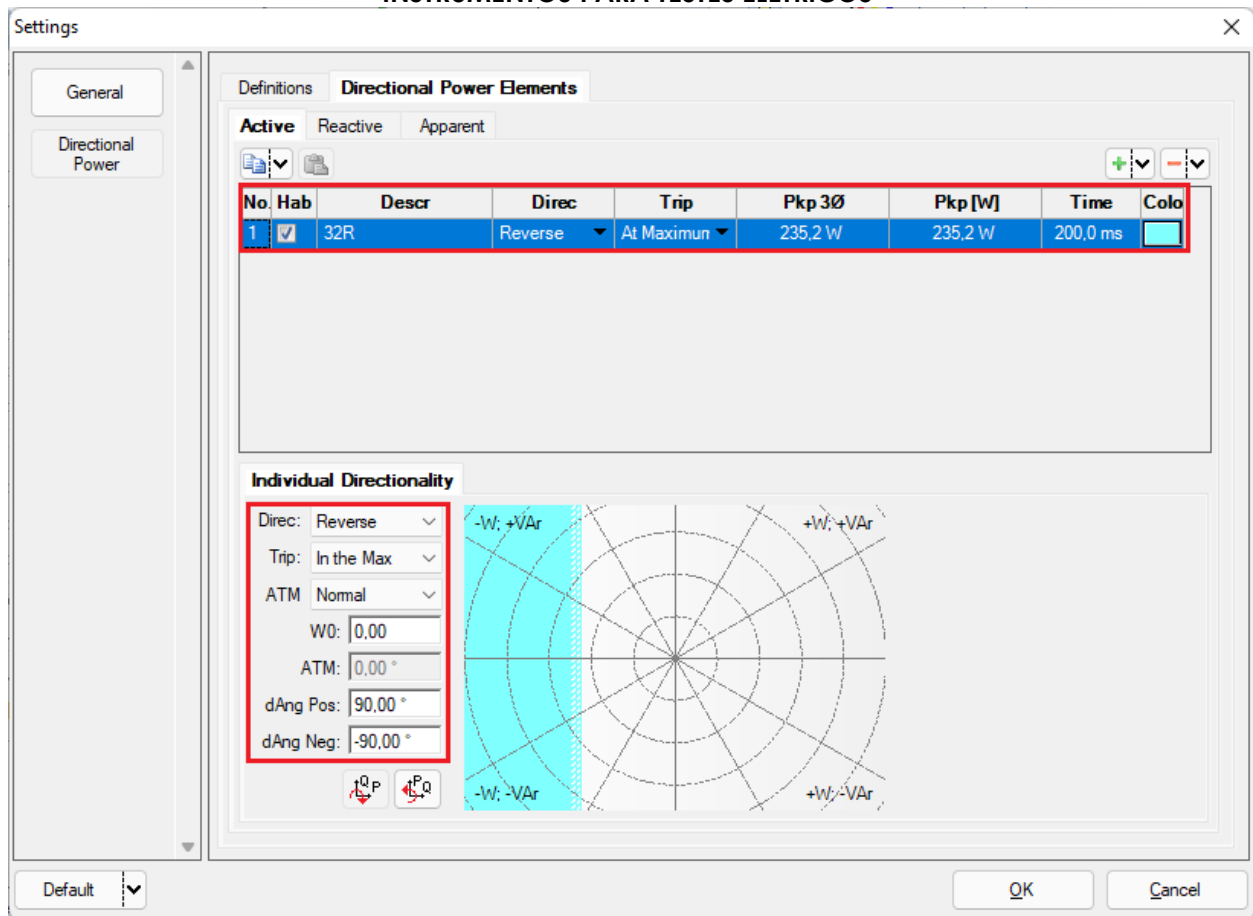
Figure 30

7. Test Structure for function 32

7.1 *Test Settings*

In this tab, you must configure the trip signal direction with the binary input, in addition to configuring the generation channels. Enter a pre-fault with rated voltage and current with a time of 100ms.

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Figure 31

7.2 *Shooting Screen*

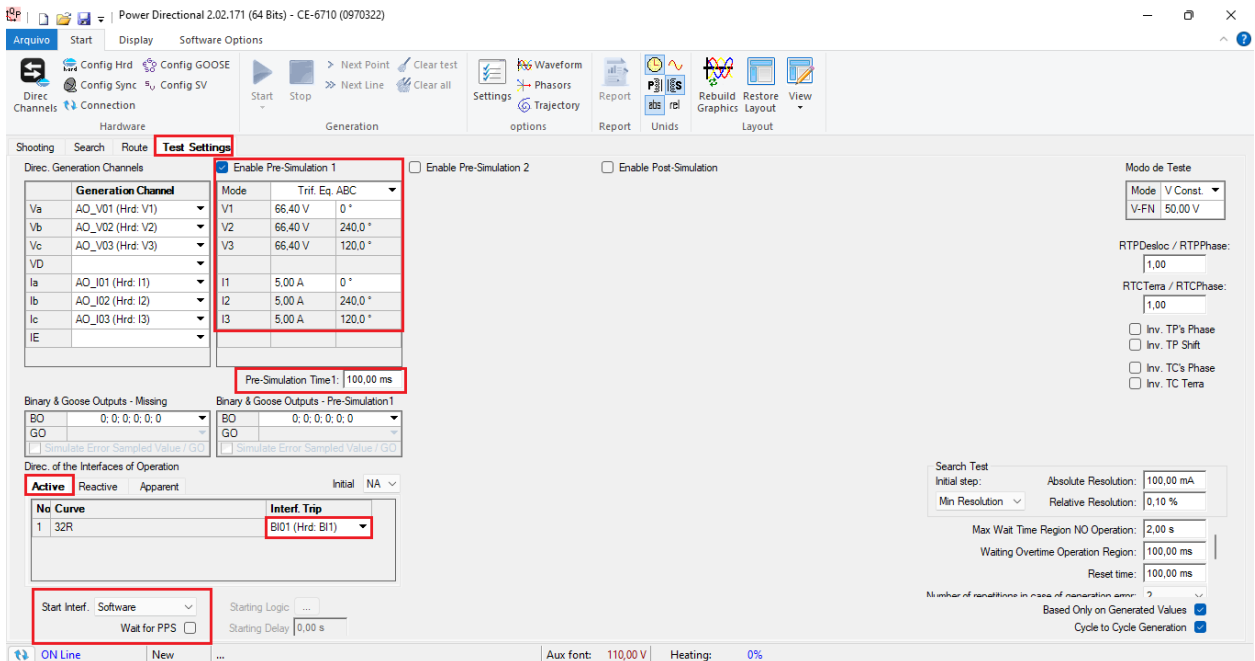In this tab click on *"Sequence"* and choose the value of the initial and final power and the step. Repeat the process for the angles as shown in the following figure.
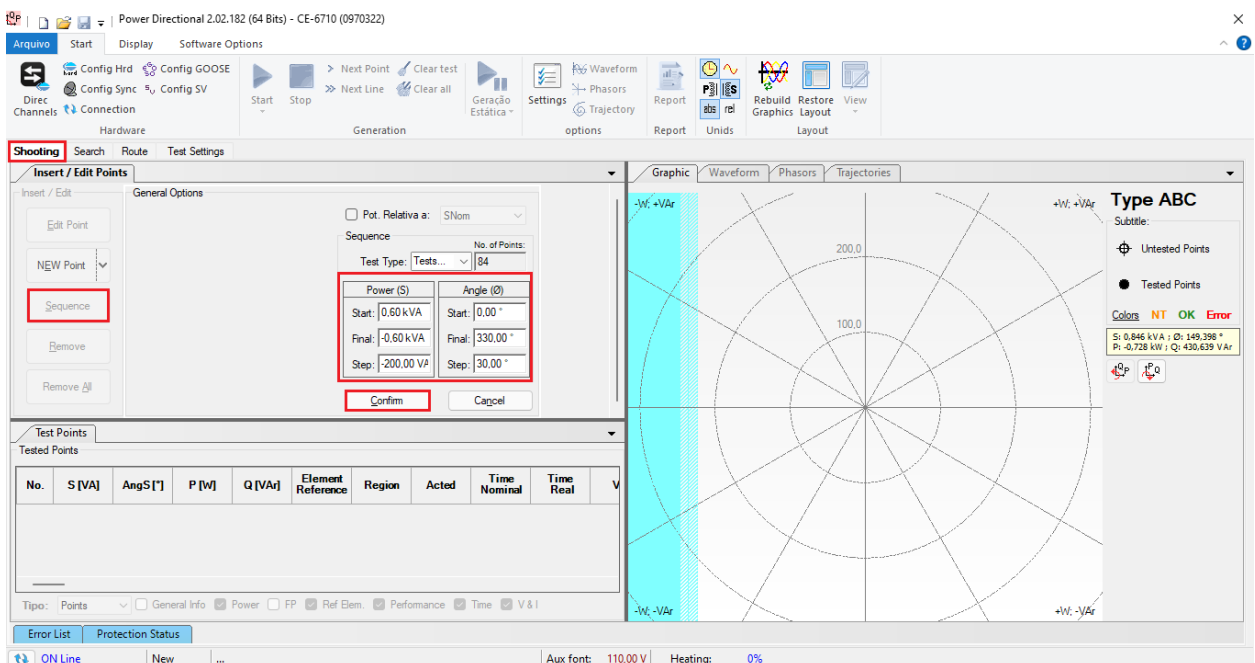

Figure 32

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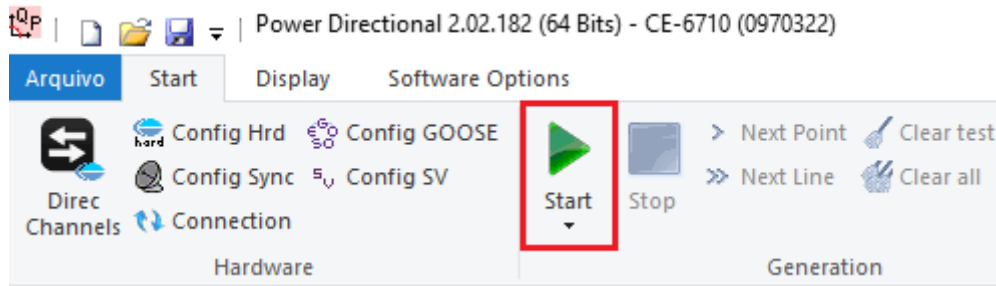

Figure 33

7.3 *Final Result of the Shooting Test*

In this test, it can be verified that within the operating region the relay operates within the predicted time plus its tolerance. In the case of the non-operation region, the relay does not act, proving the correct functioning of the function.
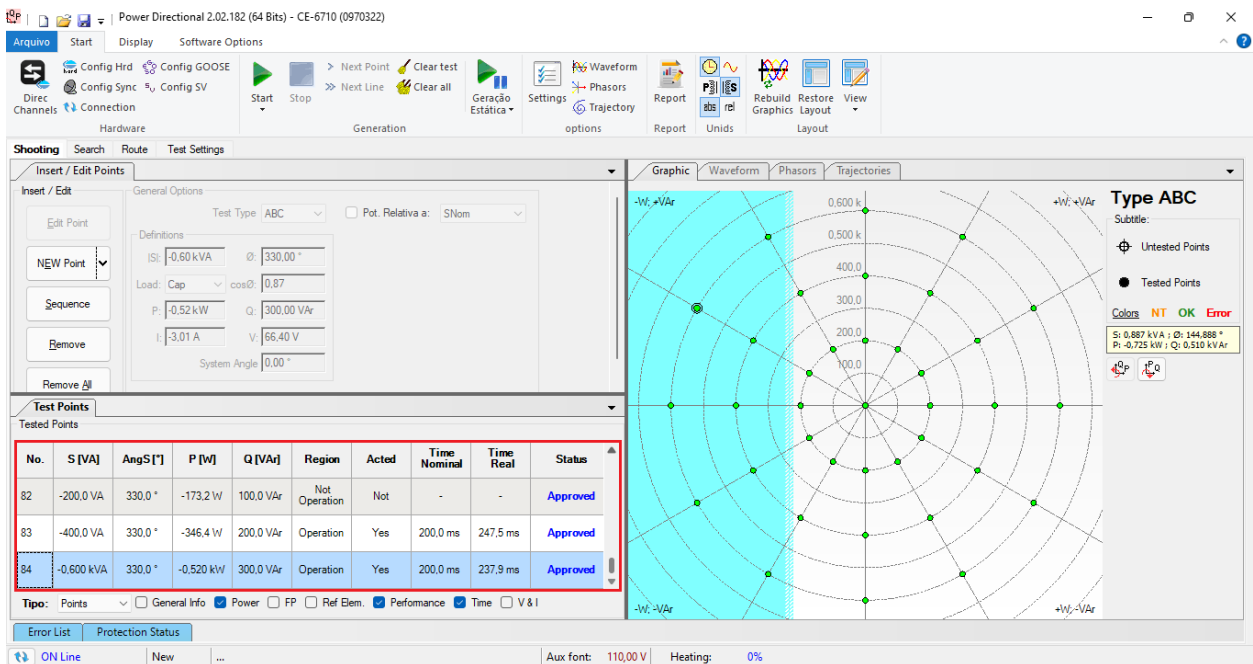
Figure 34

7.4 *Search screen*

In this tab, the power value that starts the relay is evaluated. For convenience, a sequence of values will be inserted, set the *"Test Type"* field to *"ABC"*. The field *"Line Definition"* was defined as *"P"*, with an initial value of -150.0W and a final value of -300.0W. In the *"Variable (Q)"* field, the initial value was 600.0Var, the final value was -600.0Var and with a step of -200.0Var.

Figure 35

Start the generation by clicking on the icon highlighted below or using the command "*Alt +G*".
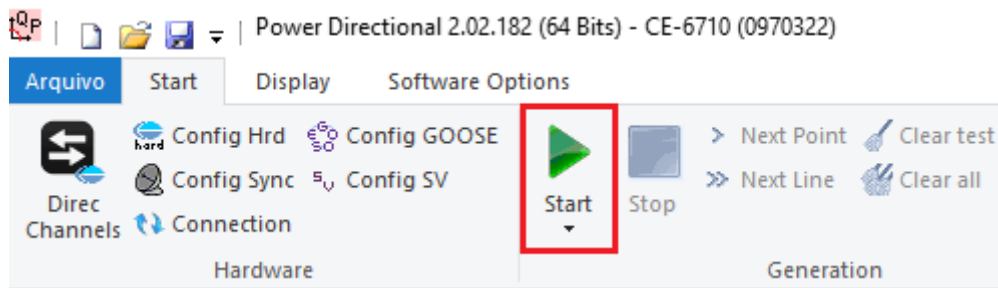
Figure 36

7.5 *Final search test result*

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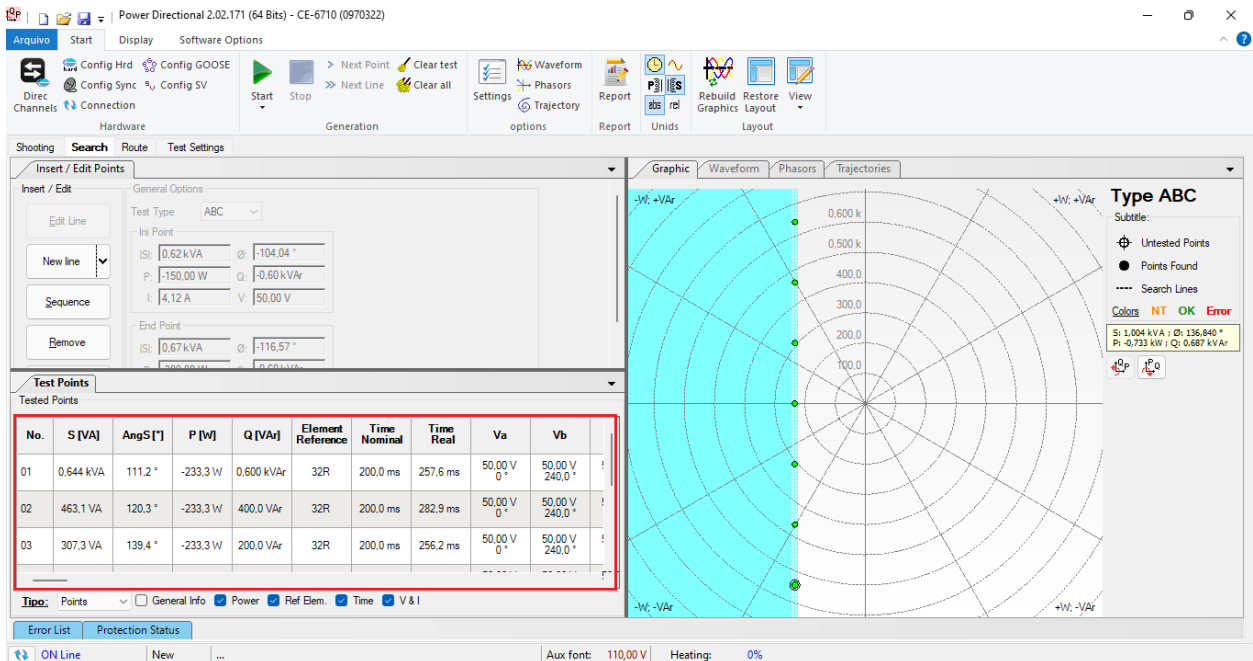
Figure 37
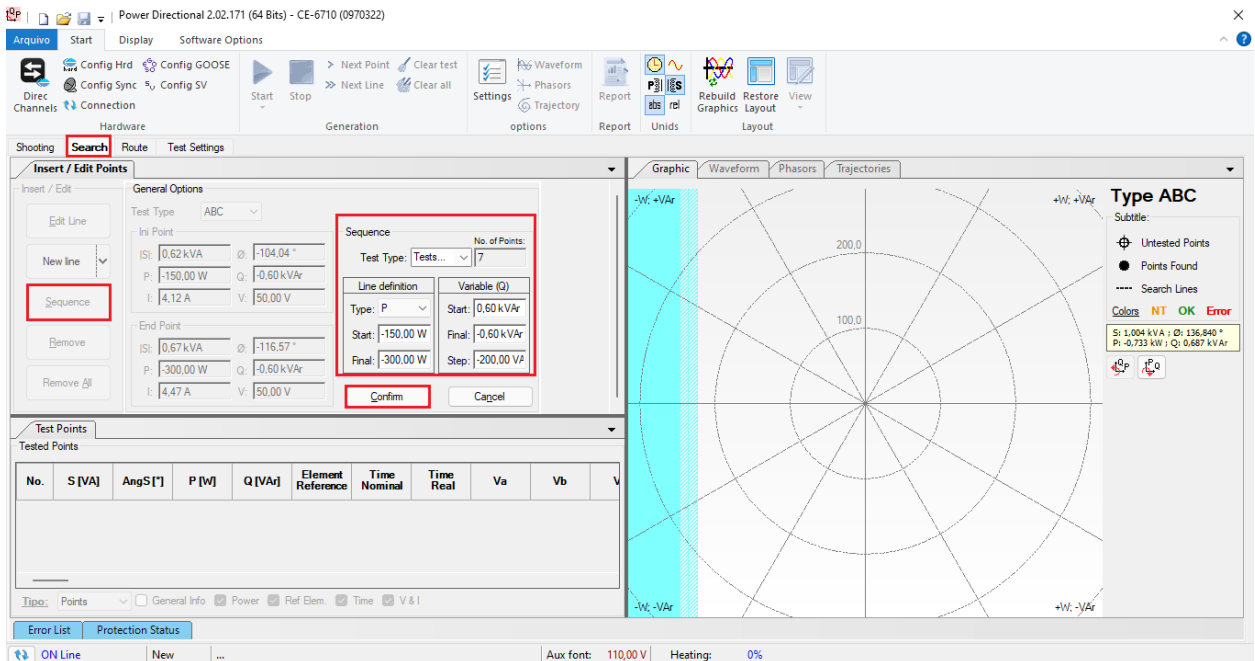
It is verified that all active power values are then within the tolerance region provided by the manufacturer.

8. 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 38

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Figure 39

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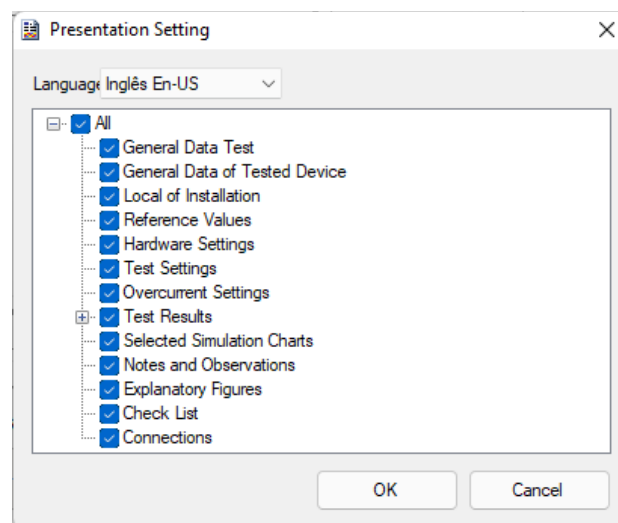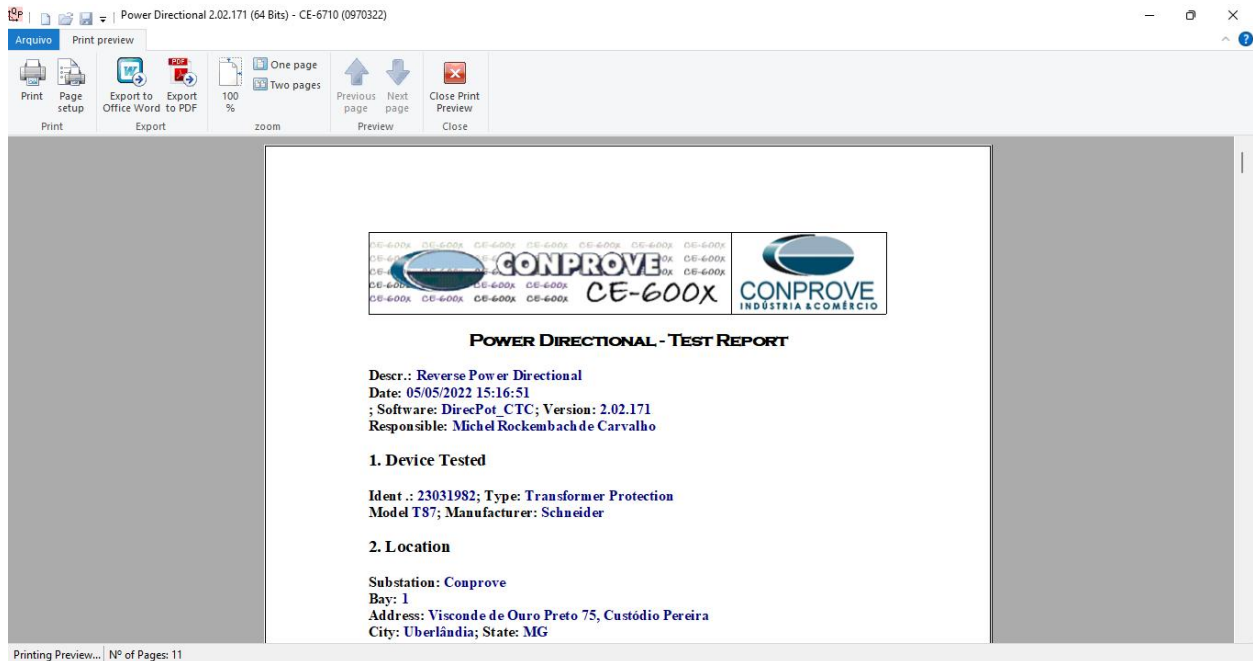
APPENDIX A

A.1 Terminal Designations

Figure 40

Figure 41

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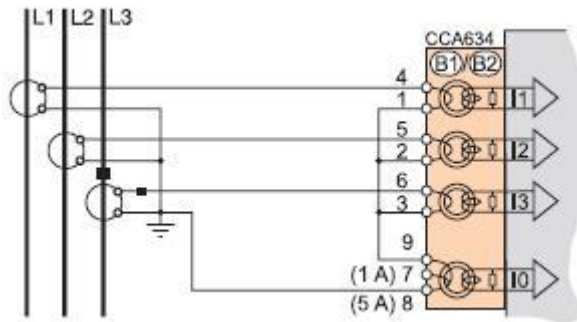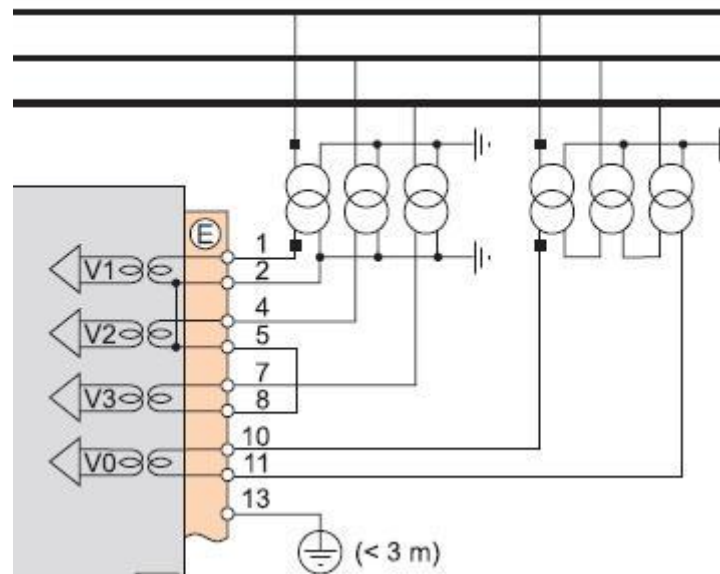
A.2 Technical Data

Characteristics

Settings	
Tripping direction	
Setting range	Normal / reverse
Ps set point	
Setting range	5 % of Sn [2] to 100 % of Sn [2]
Accuracy [1]	±5 % for Ps between 5 % Sn and 40 % Sn ±3 % for Ps between 40 % Sn and 120 % Sn
Resolution	0.1 kW
Drop out/pick up ratio	106 %
Time delay T	
Setting range	100 ms to 300 s
Accuracy [1]	±2 % or -10 ms to +25 ms
Resolution	10 ms or 1 digit
Characteristic times	
Operation time	< 120 ms
Overshoot time	< 65 ms
Reset time	< 60 ms

Inputs				
Designation	**Syntax**	**Equations**	**Logipam**	
Protection reset	P37P_x_101	■	■	
Protection inhibition	P37P_x_113	■	■	
Outputs				
Designation	**Syntax**	**Equations**	**Logipam**	**Matrix**
Instantaneous output (pick-up)	P37P_x_1	■	■	
Delayed output	P37P_x_3	■	■	■
Protection inhibited	P37P_x_16	■	■	

x: unit number.
(1) Under reference conditions (IEC 60255-6).
(2) Sn = $\sqrt{3}$.Un In.

Figure 42

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APPENDIX B

Equivalence of software parameters and the relay under test.

Table 3

Power Directional Software		SEPAM T87 Relay	
Parameter	**Figure**	**Parameter**	**Figure**
Pkp 3Φ	**30**	**Power threshold**	**16**
Direc.	**30**	**Type**	**16**

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