INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: Siemens

Model: 7UM6

Function: 32R or PDOP – Power Directional

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

Objective: Perform tests on the reverse power function to verify its directionality

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial release	09/05/2022	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 Siemens 7UM6 relay in the Power Directional 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 F1 (UH+) of the relay and the negative (black terminal) of the Aux Vdc Source to pin F2 (UH-) of the relay.

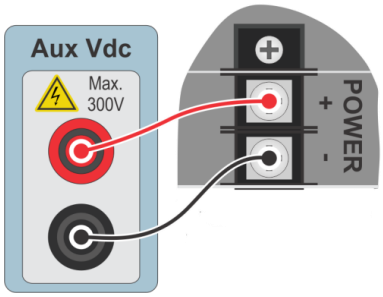

Figure 1

1.2 *Current and Voltage Coils*

Connect the current channels I1, I2 and I3 of the CE-6710 to the pins Q1, Q3 and Q5 of the relay respectively, connect the three commons to the pins Q2, Q4 and Q6 of the relay. Similarly, to establish the connection of the voltage coils, connect the voltage channels V1, V2 and V3 to the relay pins R15, R17 and R18 respectively, connecting the three common ones to the R16 pin.

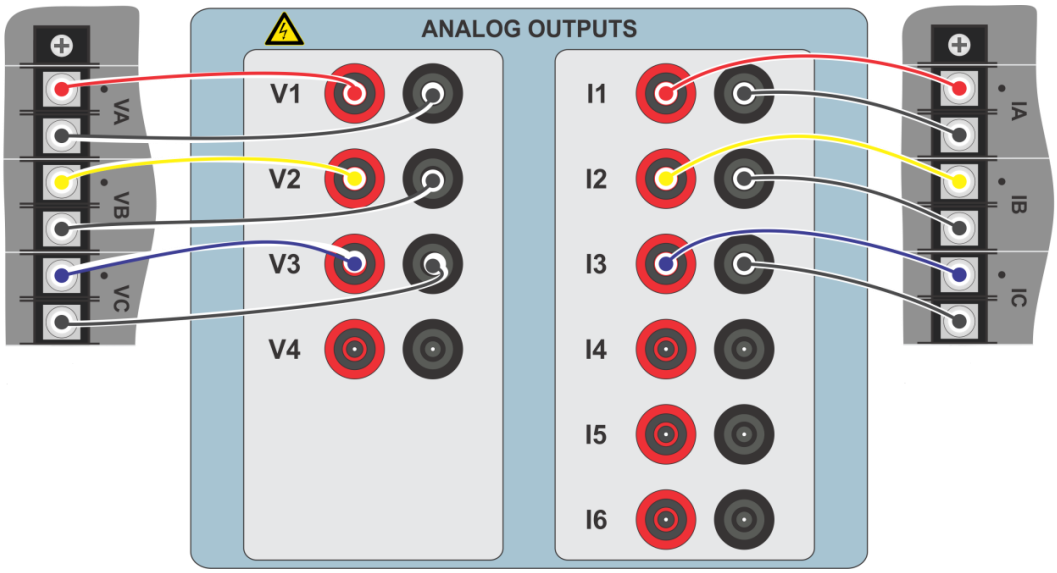

Figure 2

1.3 *Binary Inputs*

Connect the CE-6710 binary inputs to the relay binary outputs.

- BI1 to pin R1 and its common to pin R5;

The following figure shows the details of the connection.

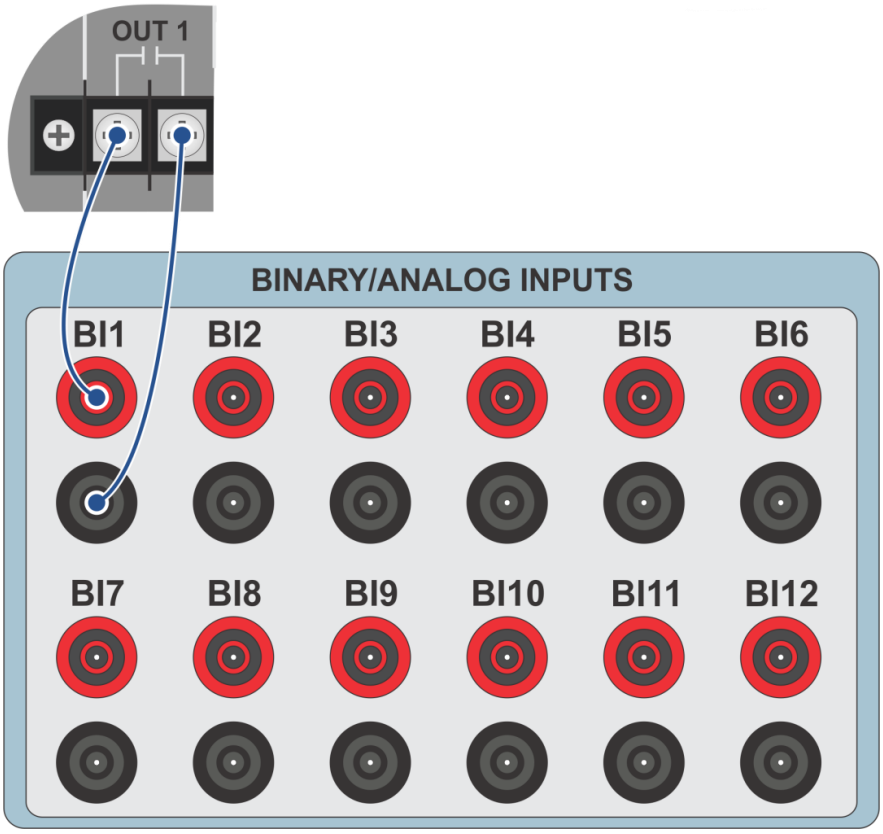

Figure 3

2. Communication with 7UM62 relay

First open the *"DIGSI"* and connect an Ethernet cable (or serial) from the notebook with the relay. Then double click on the software icon.

Figure 4

When opening the program, the substation that contains the relay is selected (7UM62). After selecting the relay, click the right button and select the *"Open Object"* and then select the connection mode, as is shown in s following figures.

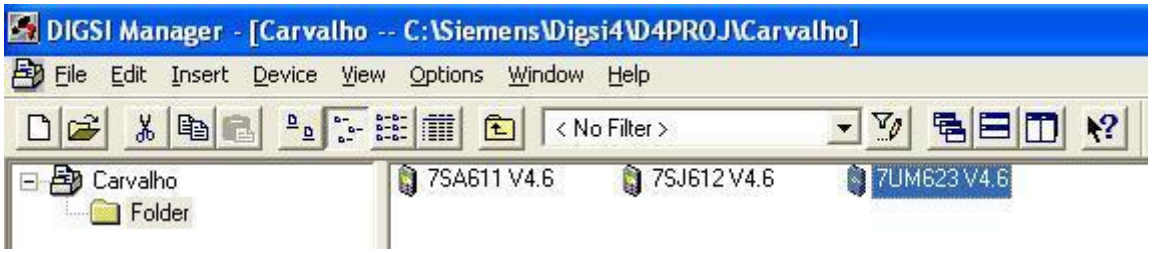

Figure 5

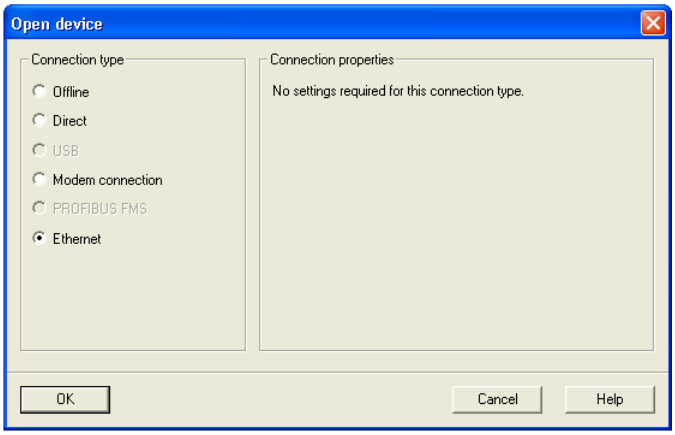

Figure 6

3. Parameterization of the relay 7UM62

3.1 *Device Configurations*

After the connection has been established, access the relay's general settings by double-clicking the left button on *"Settings"* and repeat the operation for *"Device Configuration"*.

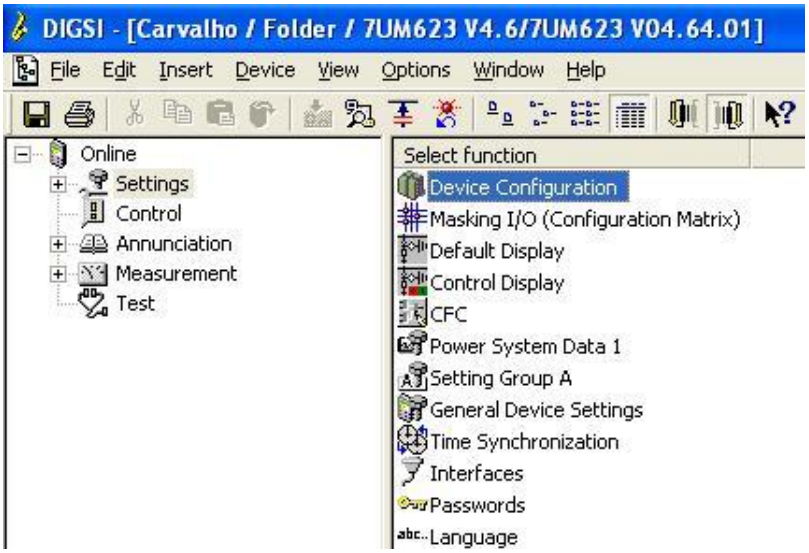

Figure 7

On the *"Functional Scope"* screen, disable all functions leaving only the *"32 Reverse Power Protection"* function enabled. This prevents trips from other functions from interfering with the test. After the adjustments, click *"OK"*.

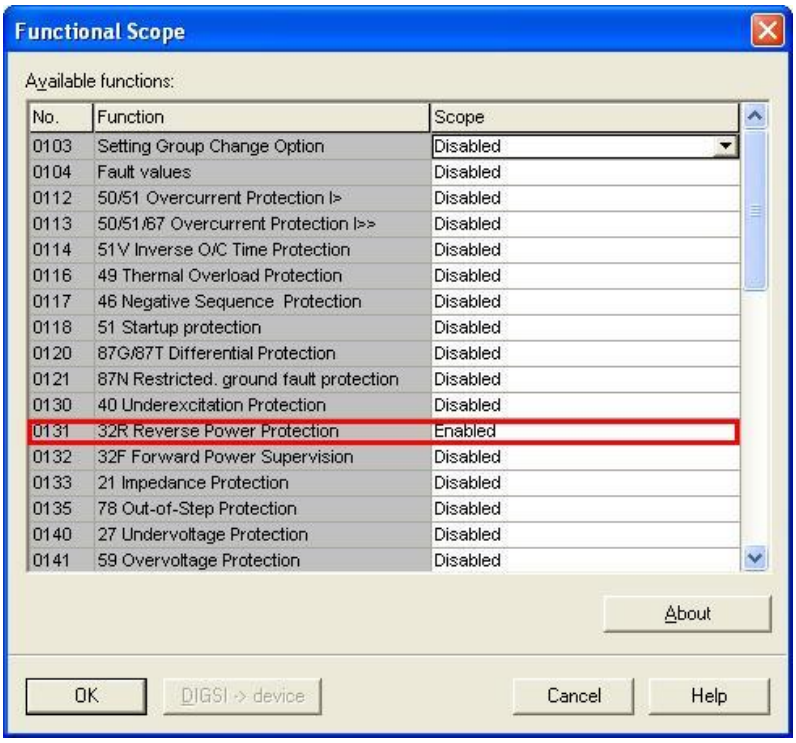

Figure 8

3.2 *Masking I/O*

The next step is to adjust the relay output. To access these parameters, double-click the left button on *"Masking I/O (Configuration Matrix)"* as shown in the next figure.

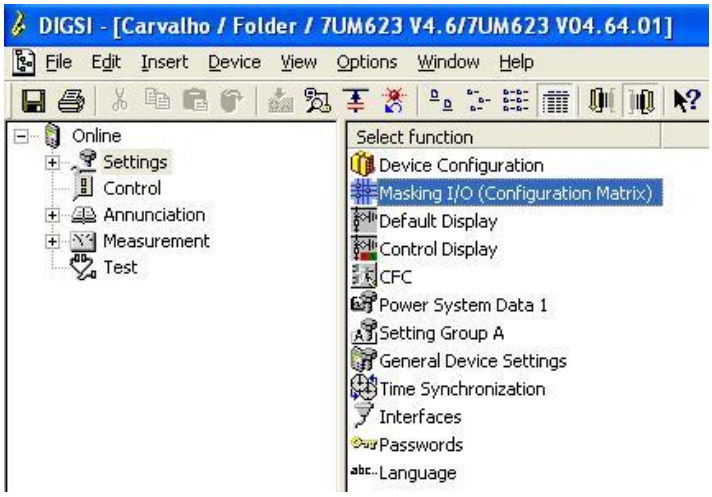

Figure 9

Binary output *"BO1"* is designated for sending the trip of function *"32R"*. In order to assist the test, LED 1 is used to signal the sending of TRIP.

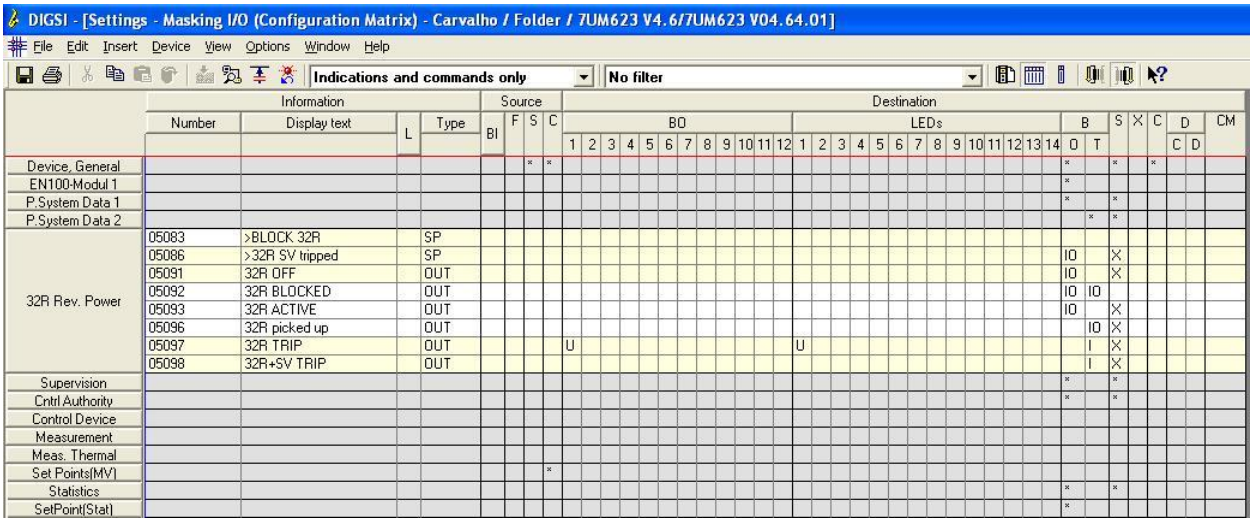

Figure 10

3.3 *Power System Data 1*

Double-click on *"Power System Data 1"* to access the system settings.

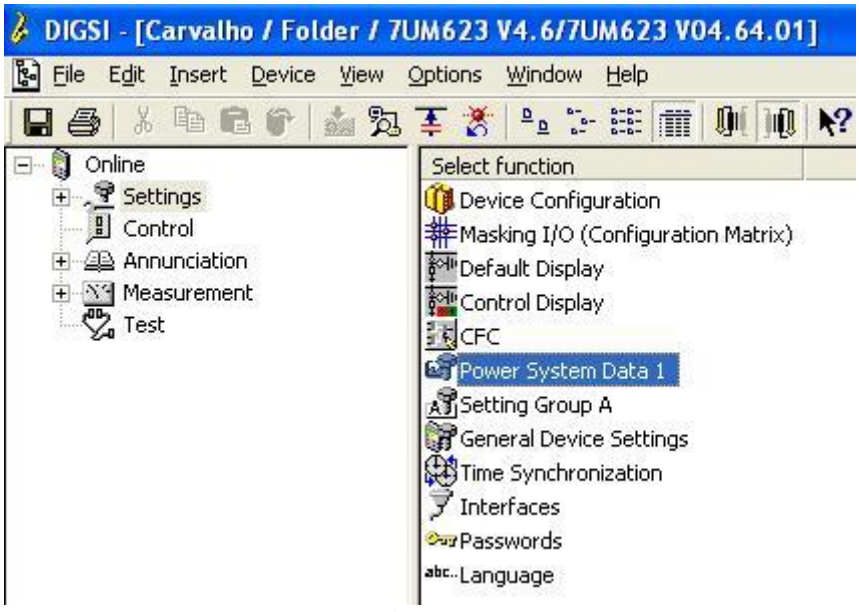

Figure 11

Those settings highlighted in red need special attention. First, the general data of the system are shown, then the generator or engine data and finally the transformation ratios of both CT's and VT's.

3.4 *Power System*

In the *"Power System"* tab, you can configure the frequency and phase sequence.

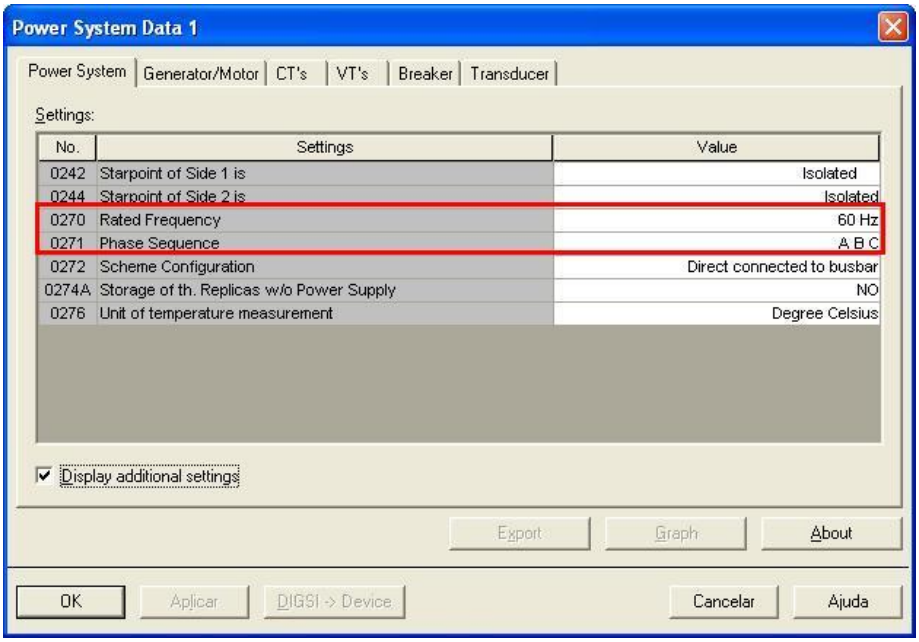

Figure 12

3.5 *Generator/Motor*

In the *"Generator/Motor"* tab, the primary voltage and the rated apparent power are adjusted.

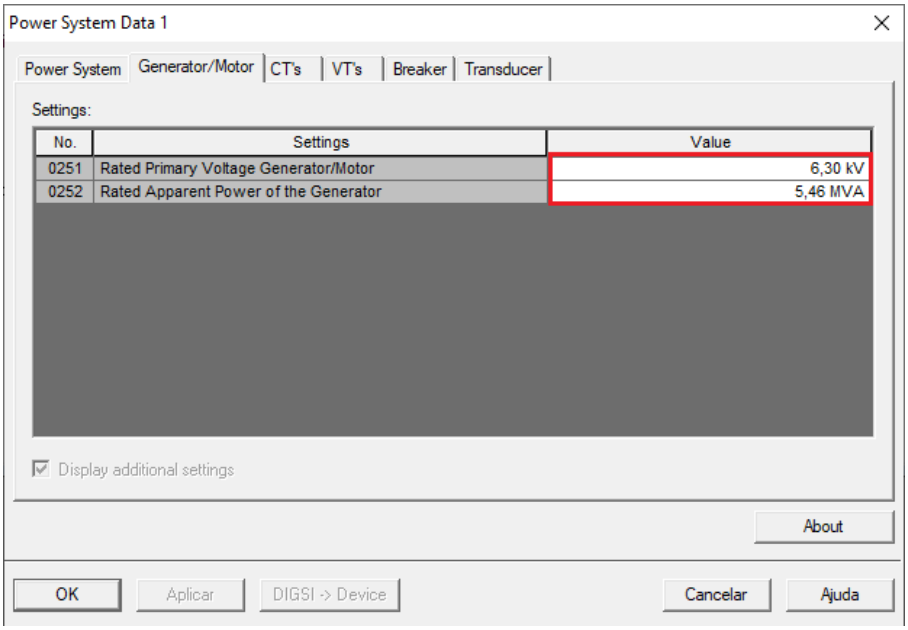

Figure 13

3.6 *CT's*

In this tab, the current transformer transformation ratio is adjusted. For the reverse power function, the current monitored is that of side 2.

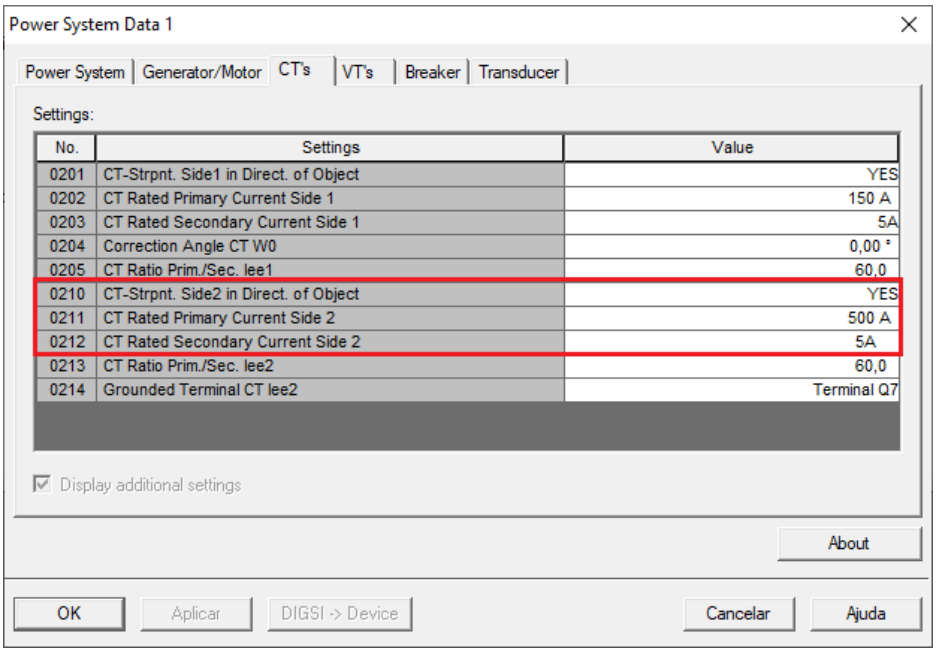

Figure 14

3.7 *VT's*

This tab is used to adjust the transformation ratio of the potential transformer.

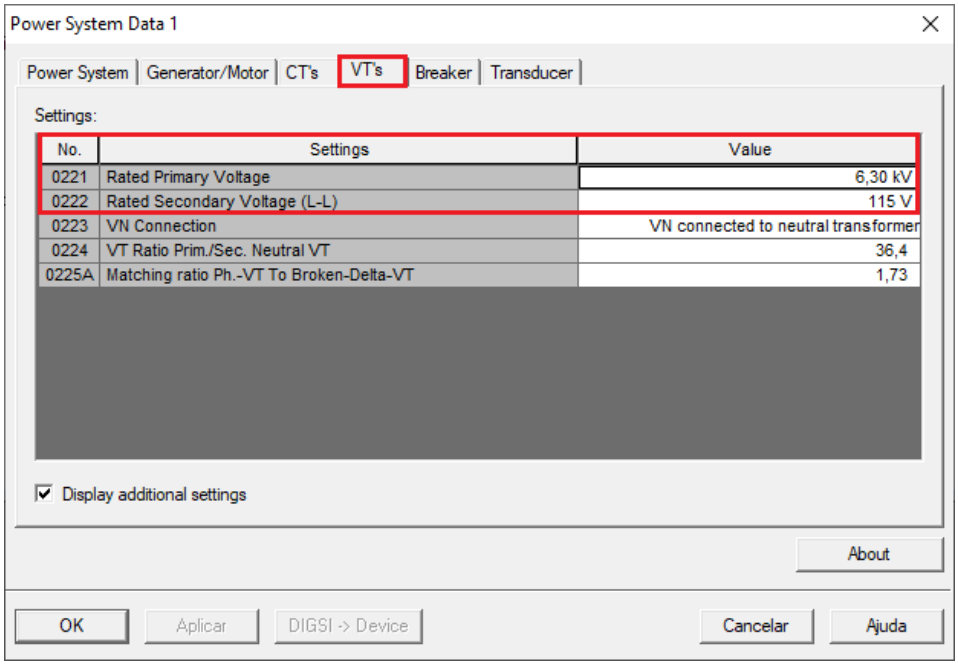

Figure 15

3.8 *Setting Group A*

In this option, you choose the type of protected equipment and the adjustment of the power reversal function.

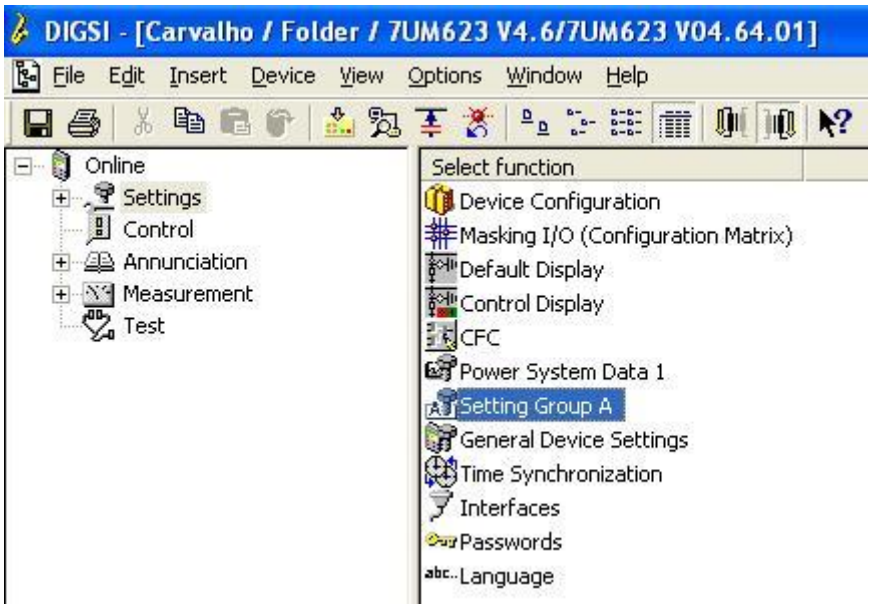

Figure 16

With a double click on the option *"Power System Data 2"*.

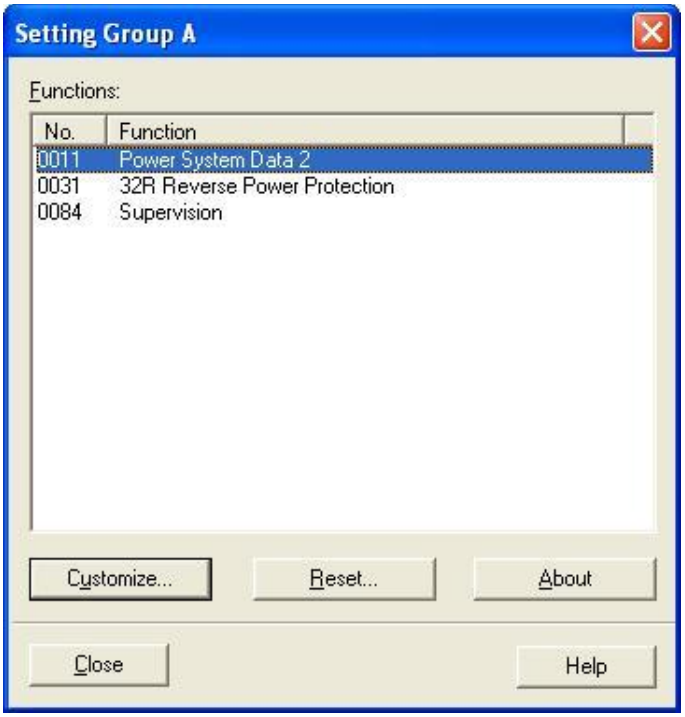

Figure 17

3.9 *Power System Data 2*

Choose protected equipment.

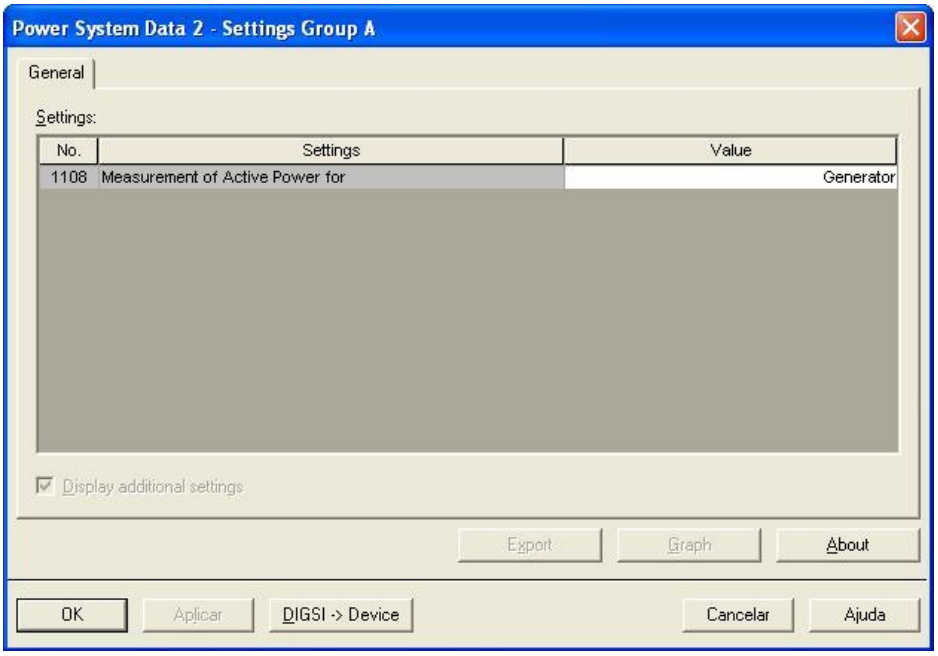

Figure 18

3.10 *32 Reverse Power Protection*

The last step is to make the reverse power function adjustments.

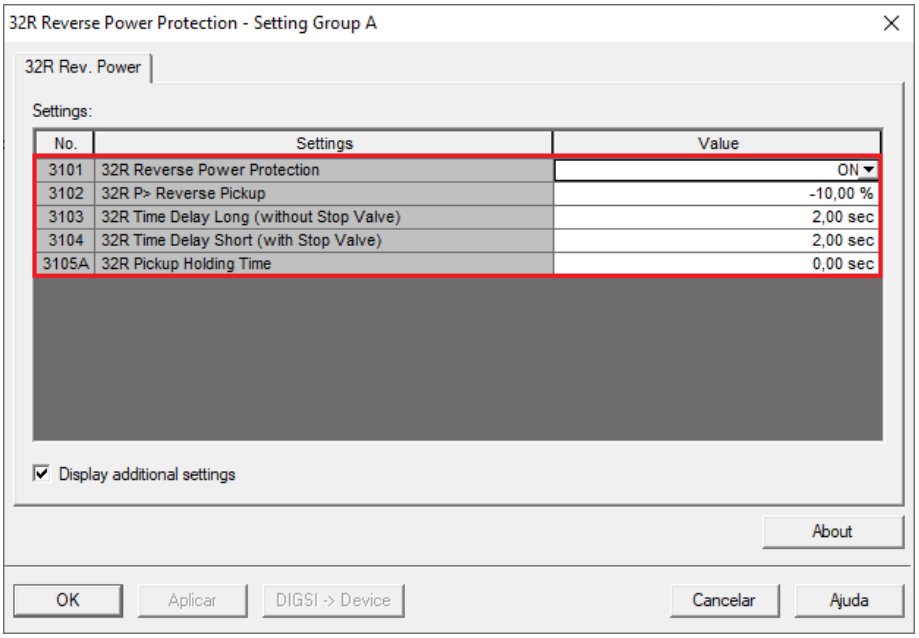

Figure 19

4. Power Directional software adjustments

4.1 *Opening the Power Directional*

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

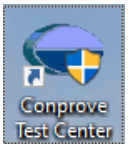

Figure 20

Click on the Power Directional software icon.

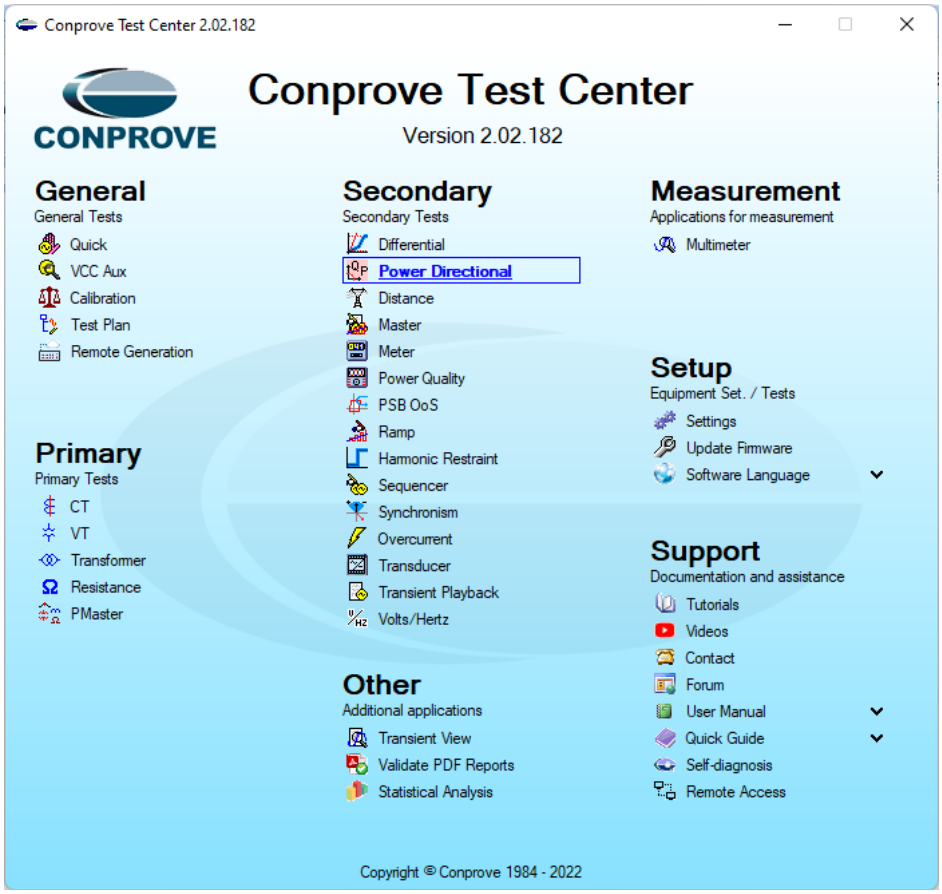

Figure 21

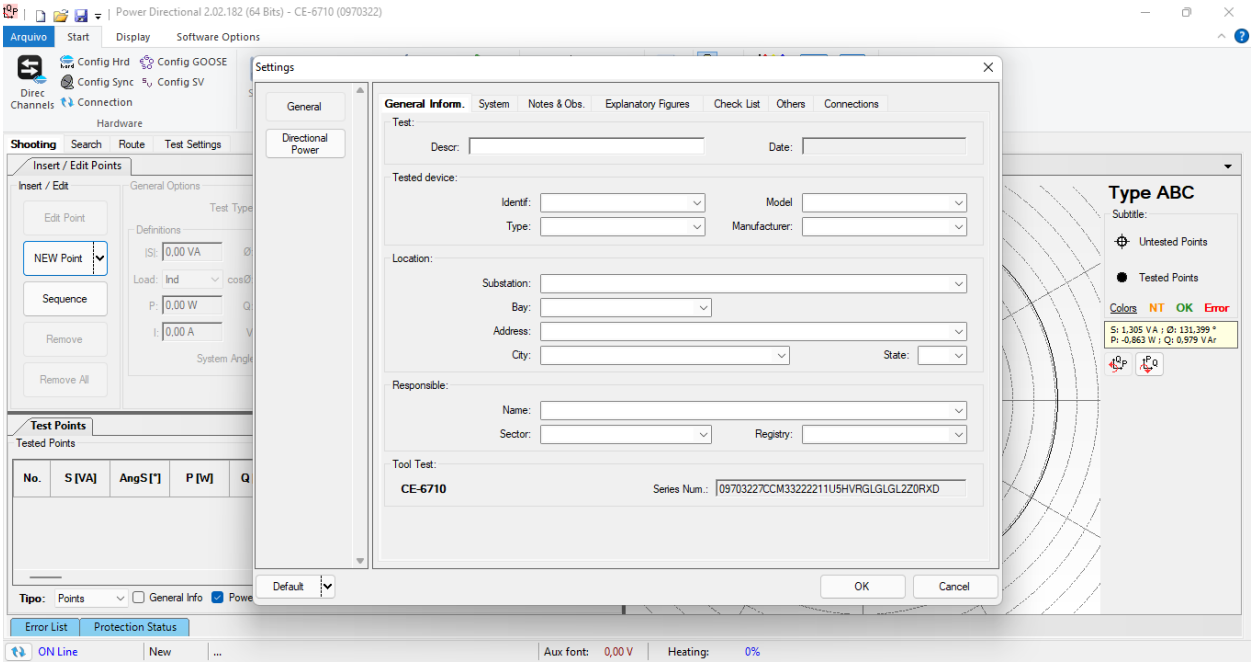

Figure 22

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.

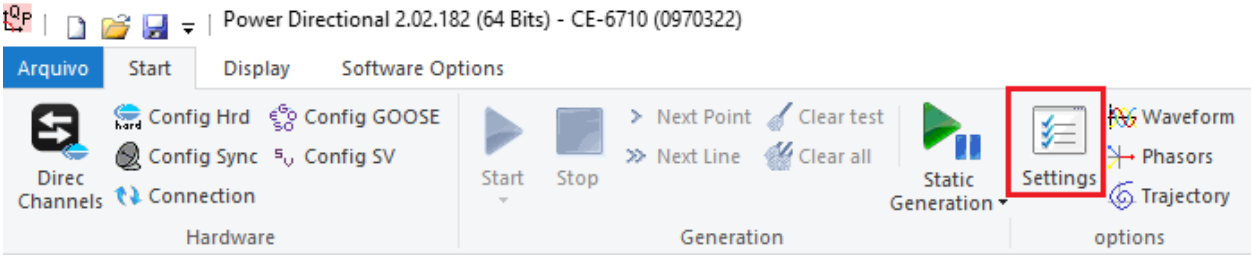

Figure 23

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.

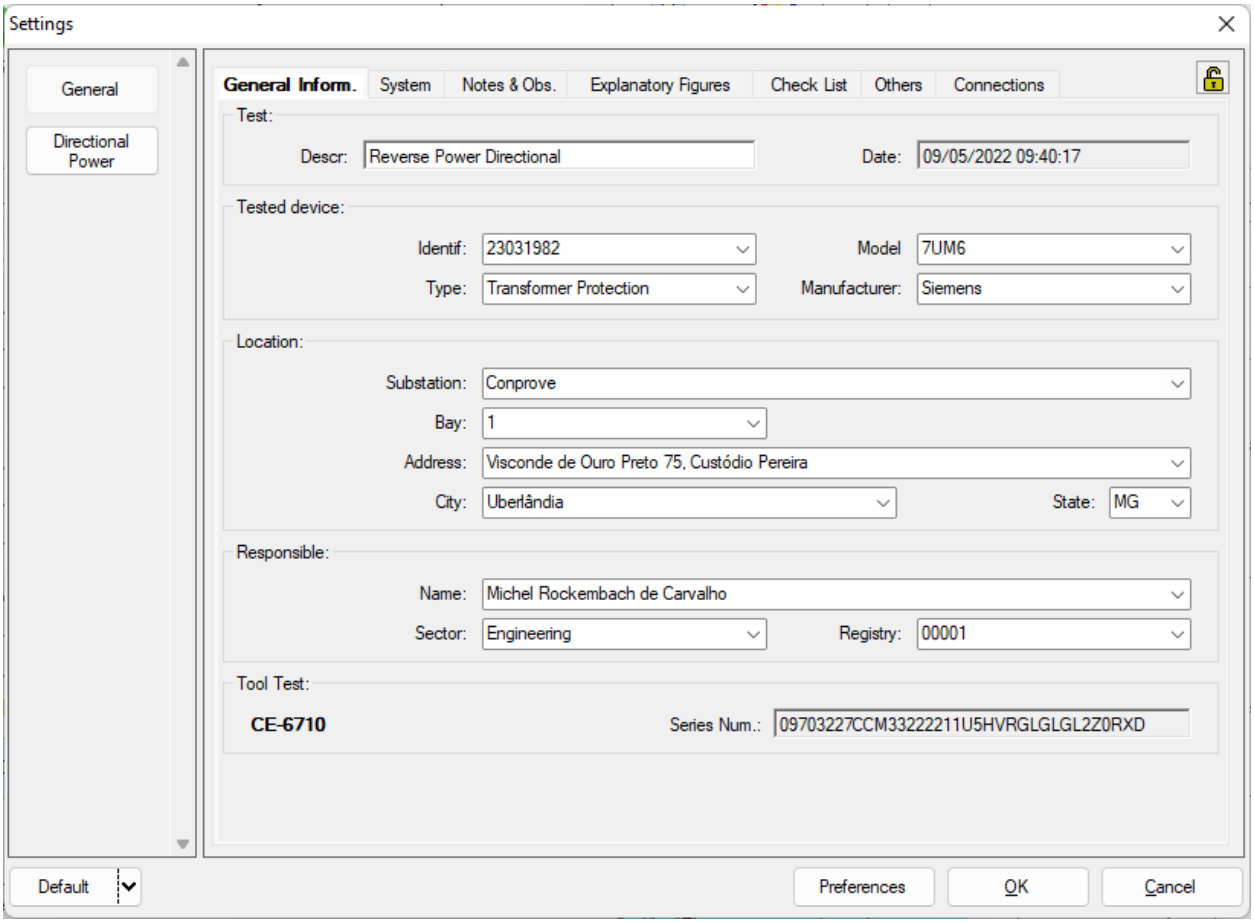

Figure 24

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.

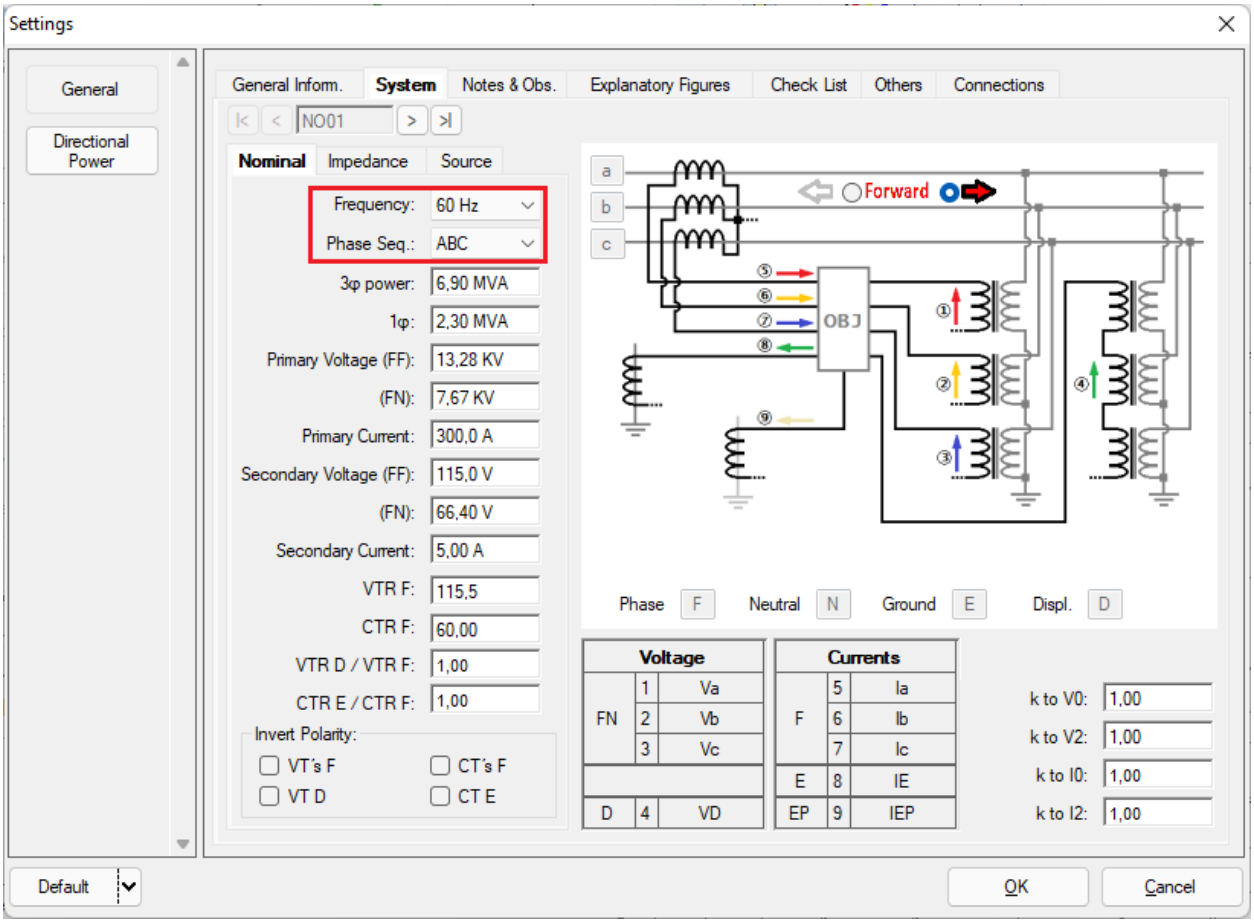

Figure 25

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.

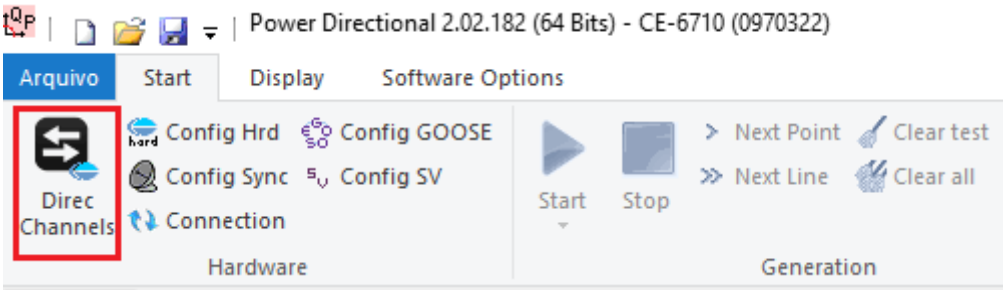

Figure 26

Then click on the highlighted icon to configure the hardware.

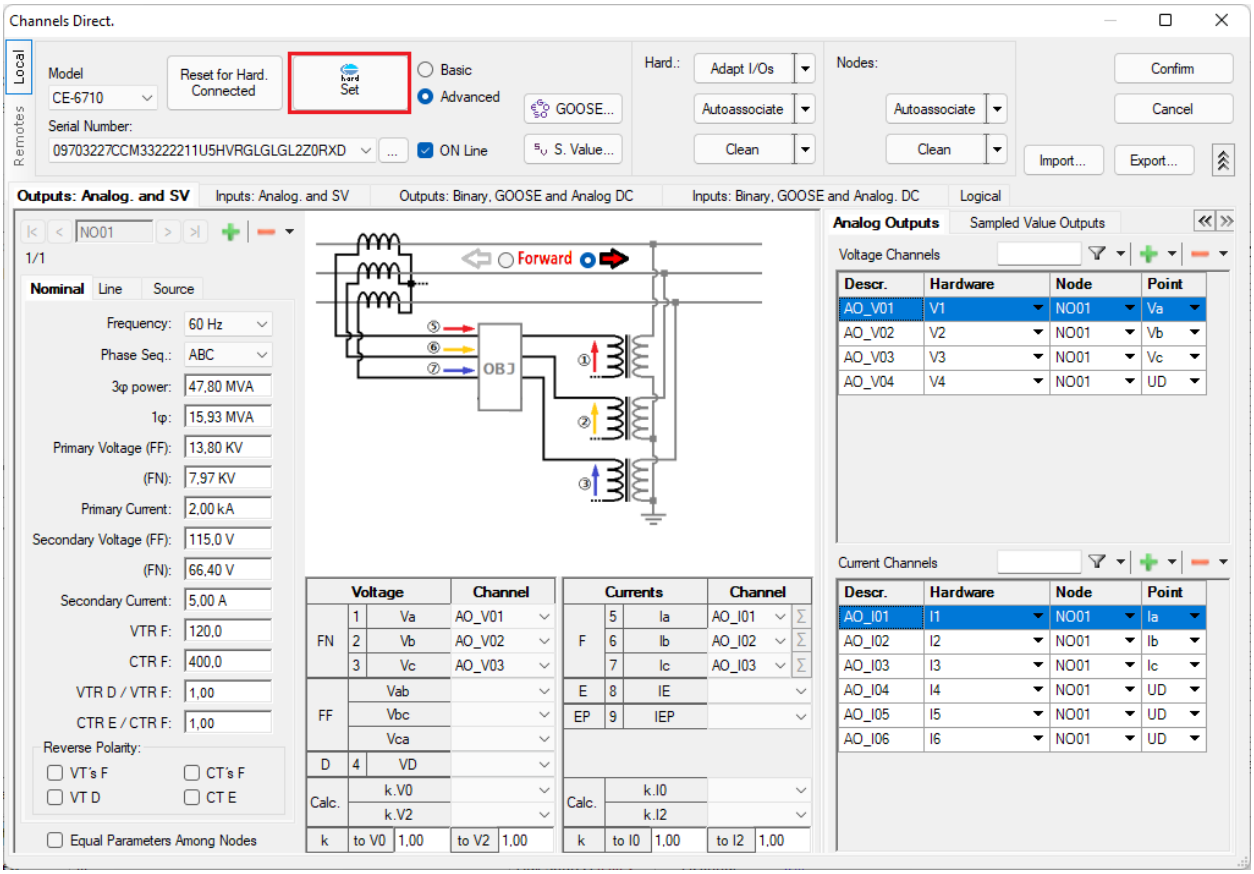

Figure 27

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

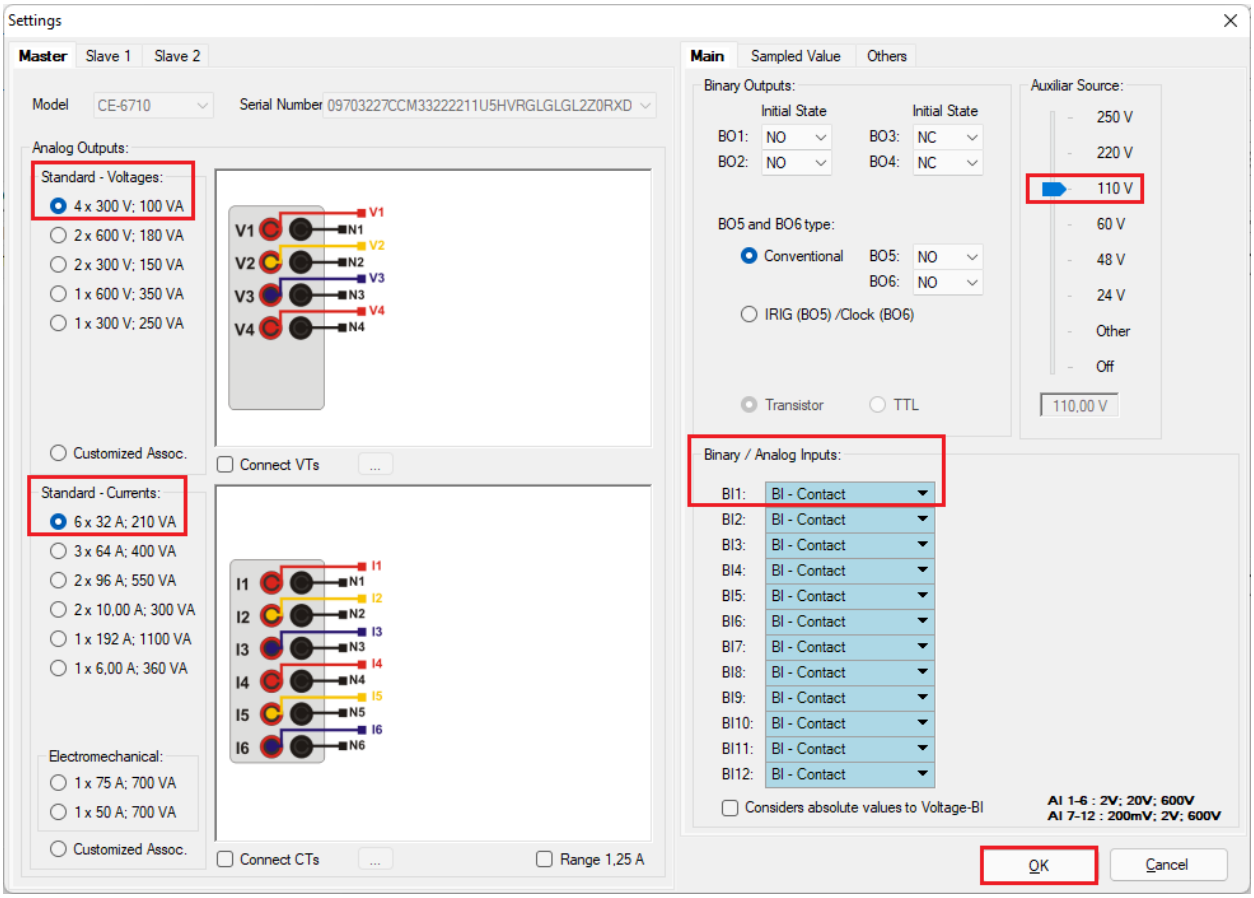

Figure 28

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

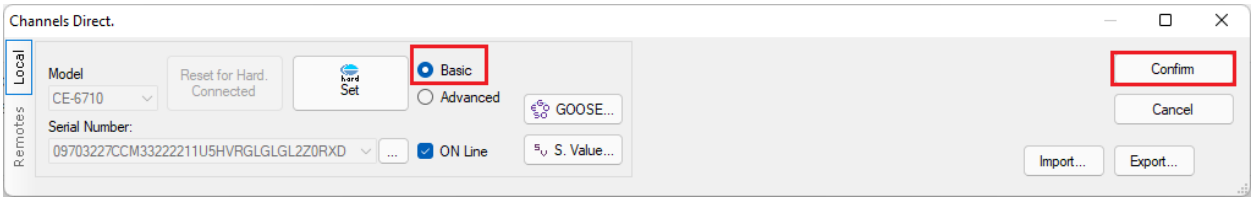

Figure 29

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.

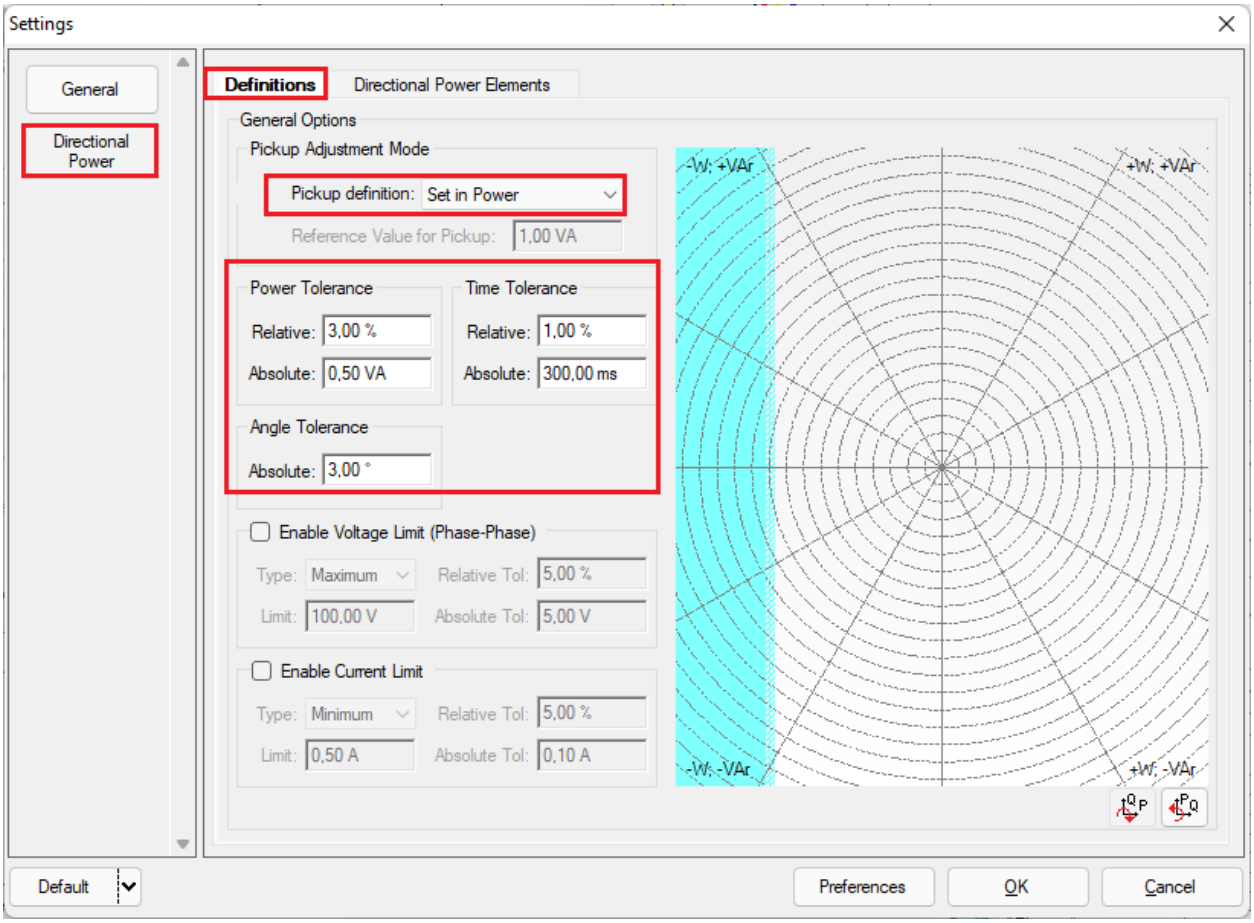

Figure 30

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.

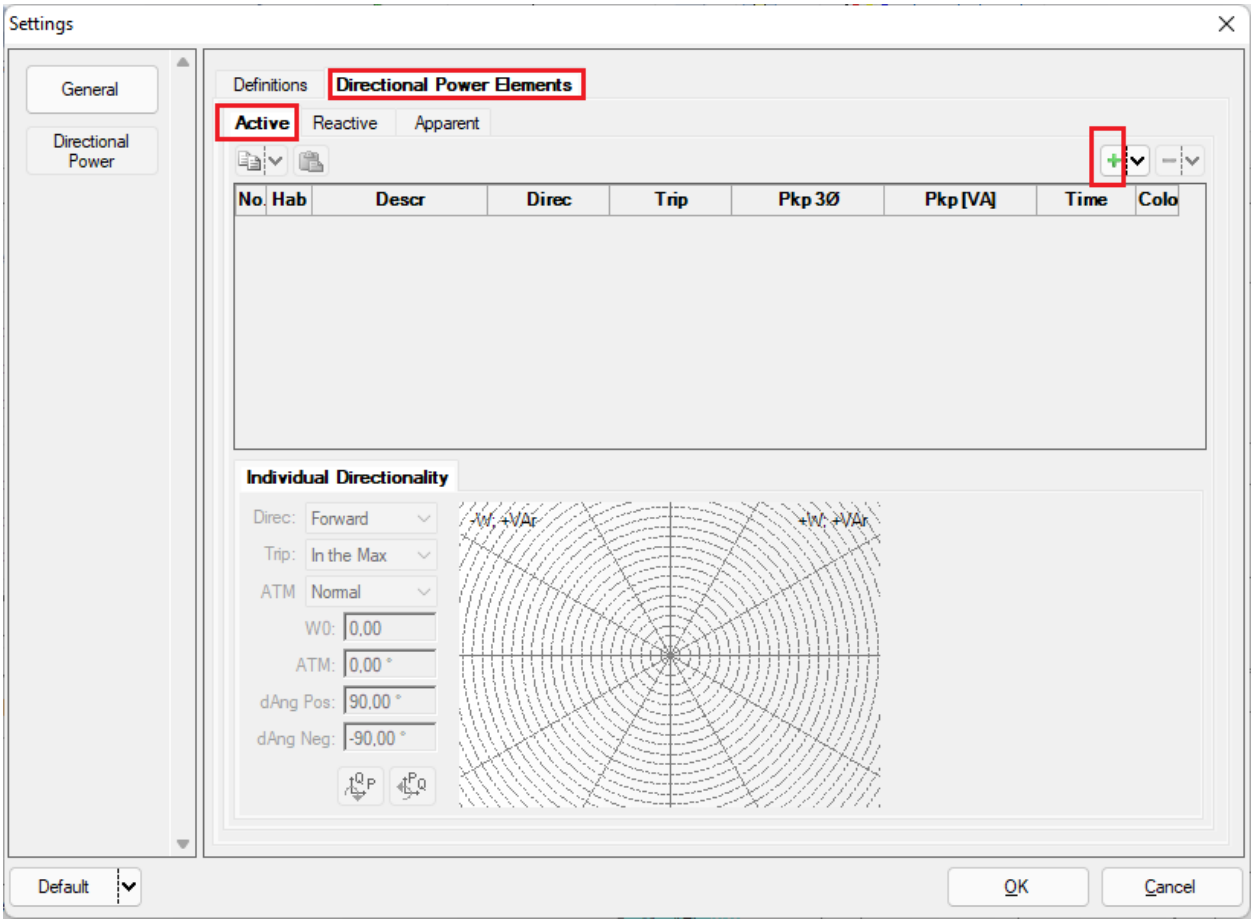

Figure 31

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 equation:

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

$$P_{secundary} = \frac{5{,}46M}{\left(\frac{6{,}3K}{115}\right) * \left(\frac{500}{5}\right)}$$

$$P_{secundary} = 996{,}67W$$

$$P_{secundary} = 0{,}1 * 996{,}67 = 99{,}66W$$

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°.

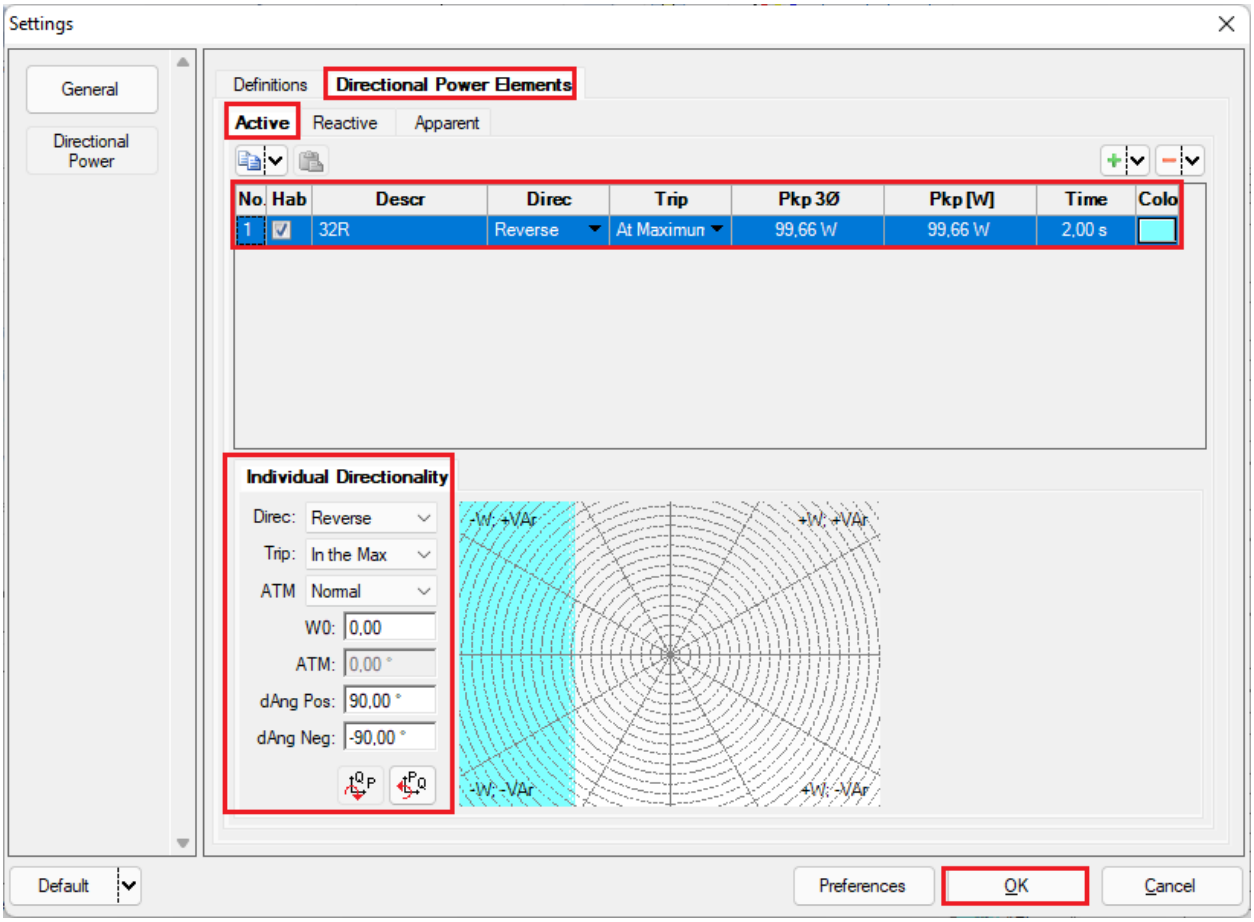

Figure 32

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.

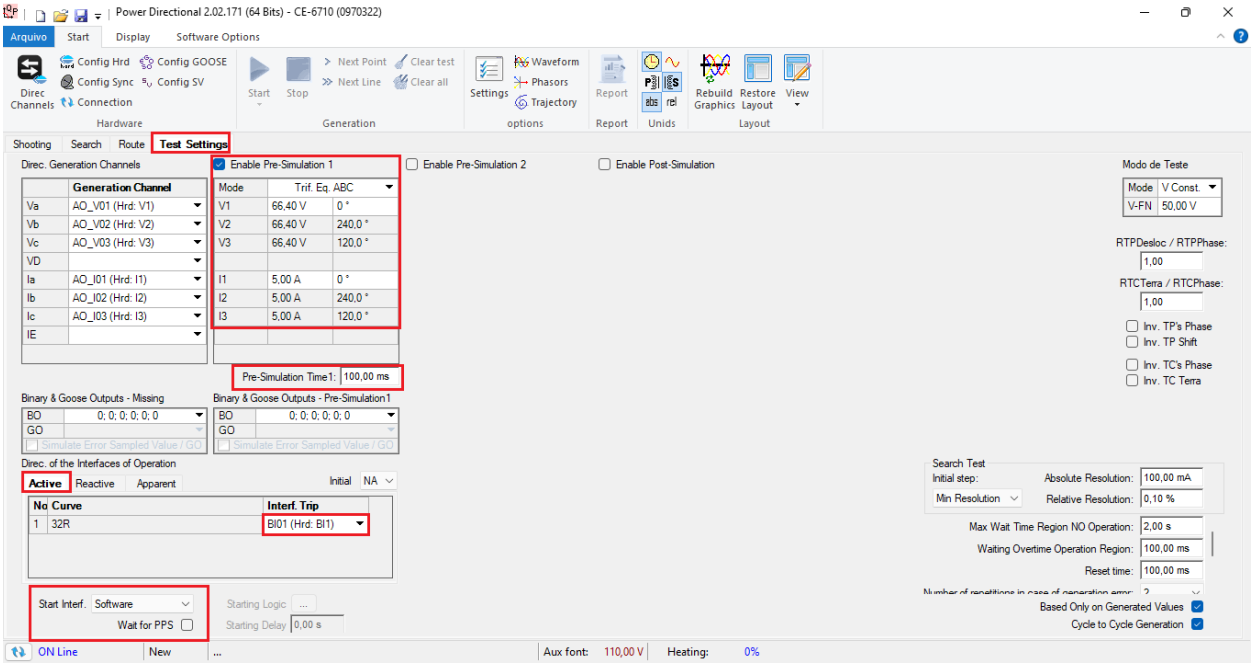

Figure 33

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.

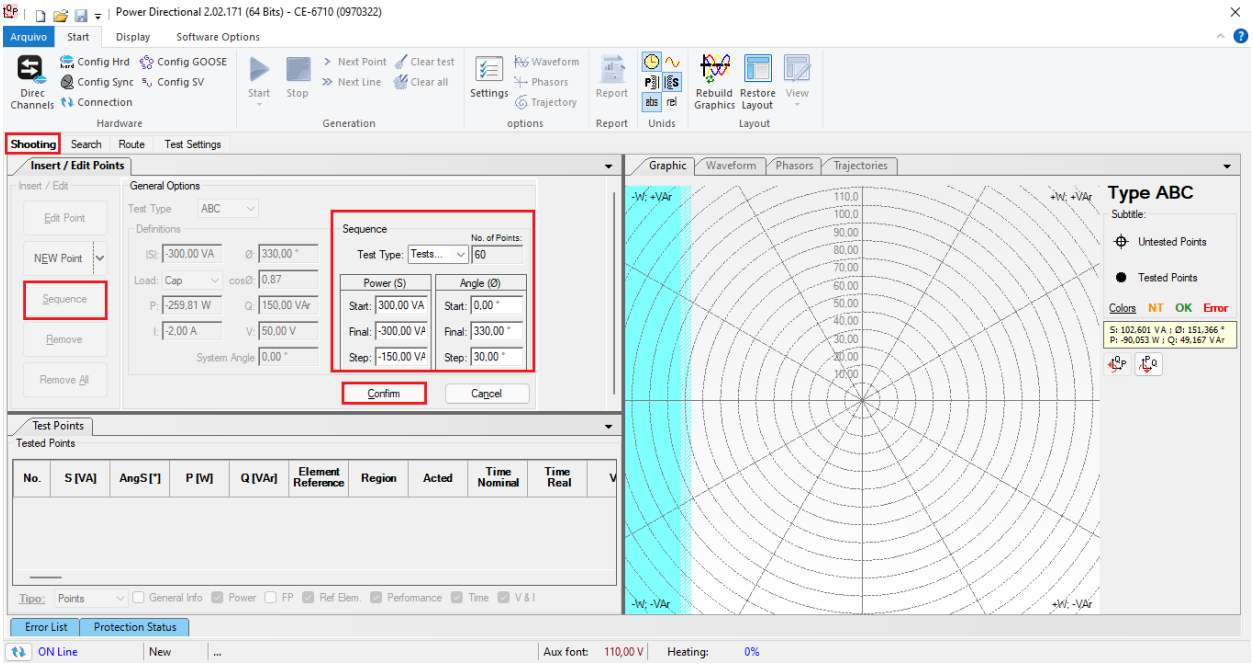

Figure 34

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

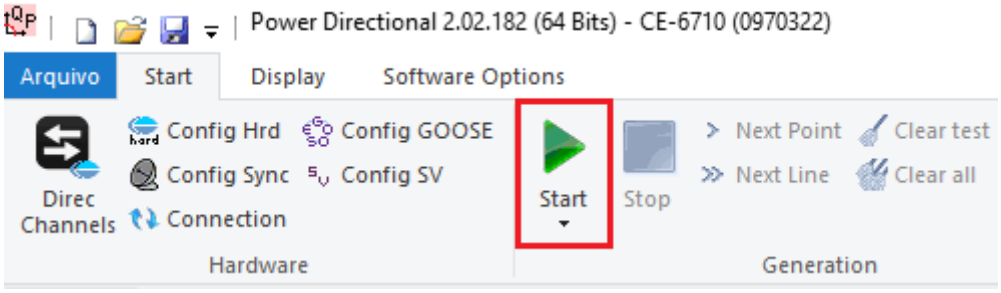

Figure 35

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.

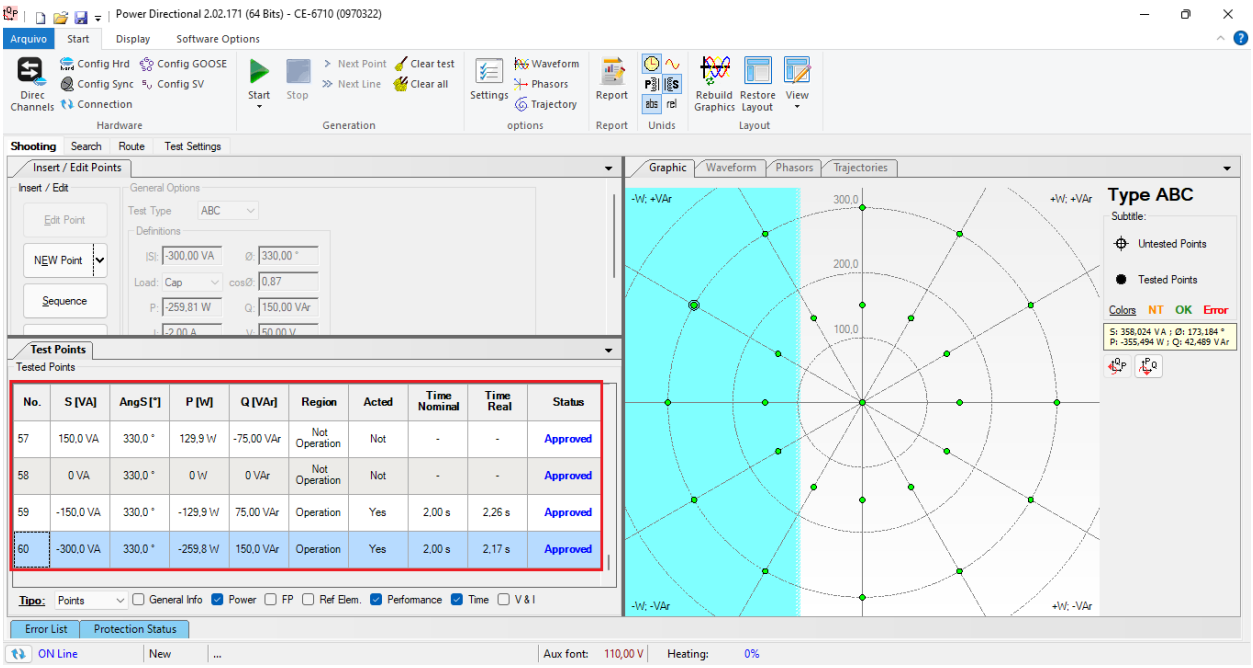

Figure 36

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 0.0W and a final value of -150.0W. In the *"Variable (Q)"* field, the initial value was 600.0Var, the final value was -600.0Var and with a step of -200.0Var.

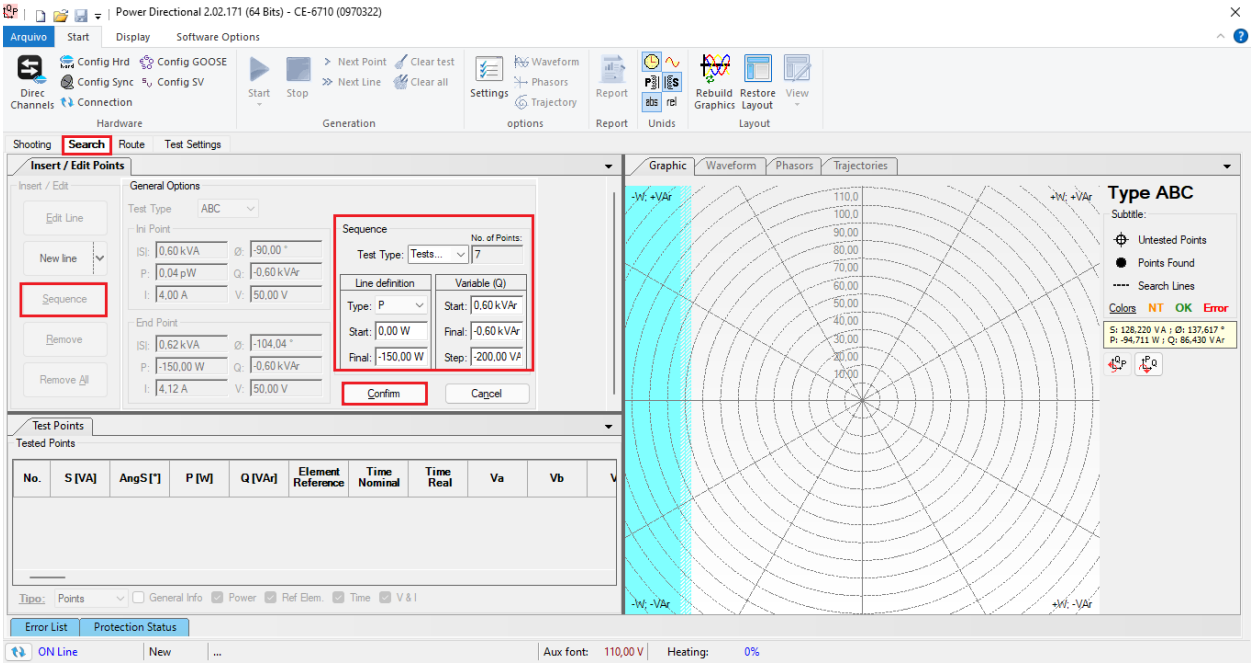

Figure 37

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

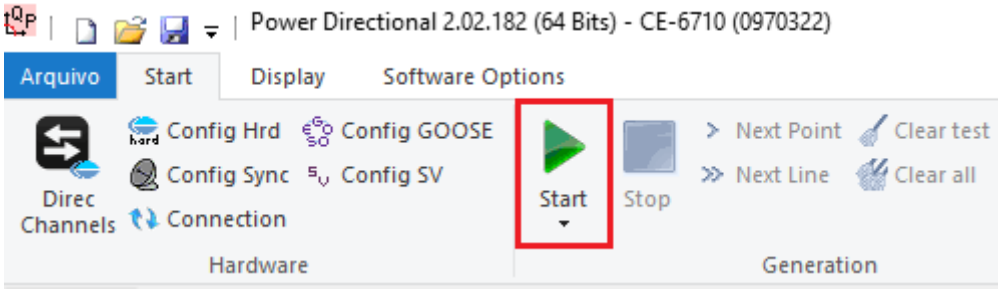

Figure 38

7.5 *Final search test result*

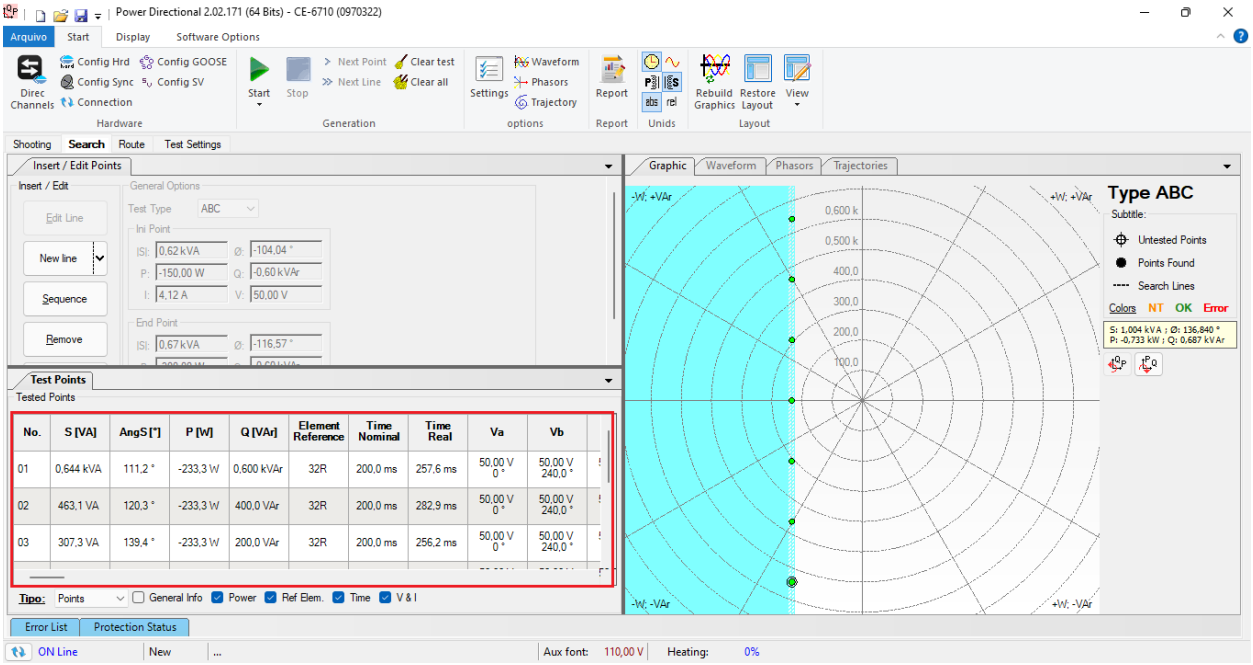

Figure 39

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.

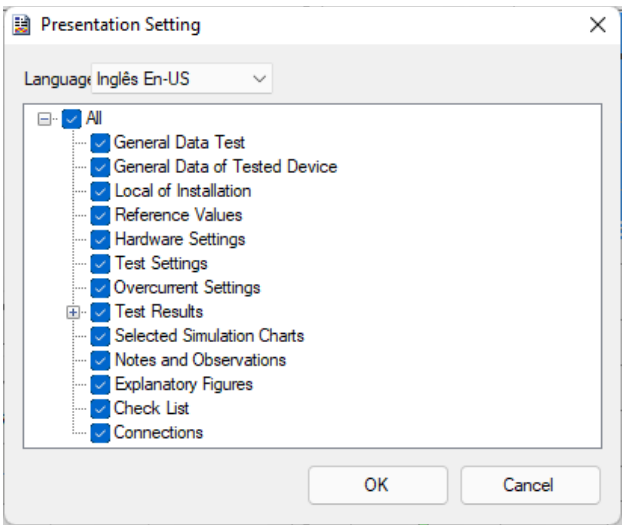

Figure 40

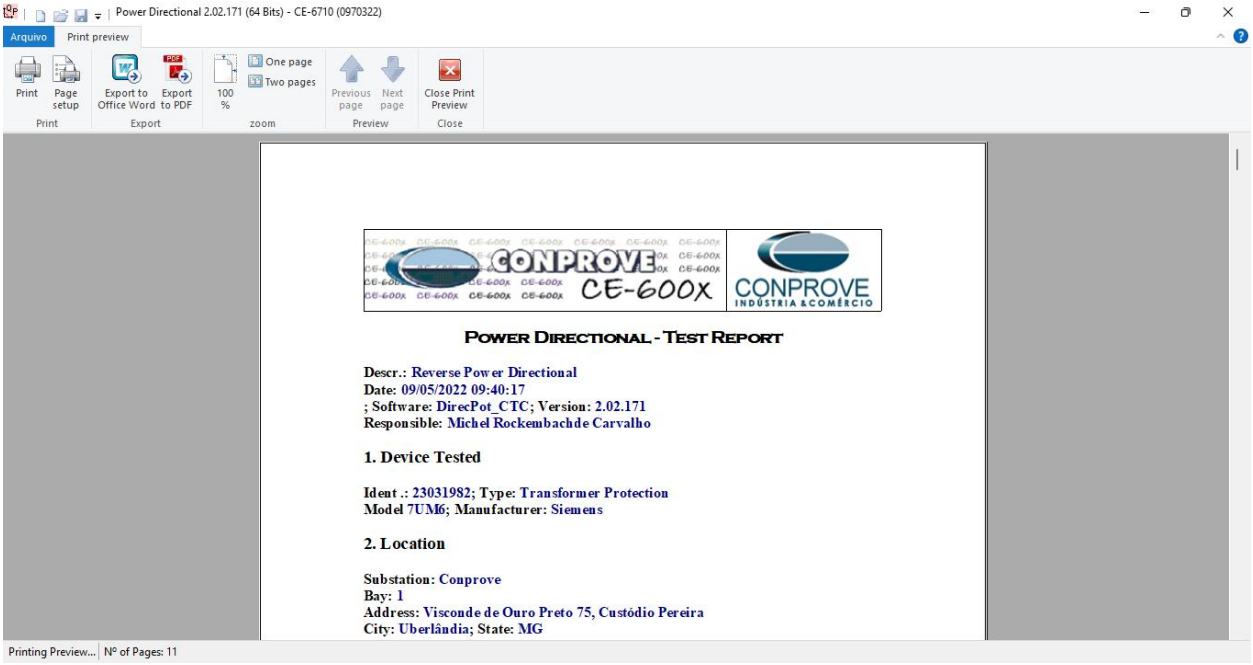
Power Directional 2.02.171 (64 Bits) - CE-6710 (0970322)
Arquivo
Print preview
Print
Page setup
Export to Office Word
Export to PDF
100 %
One page
Two pages
zoom
Previous page
Next page
Preview
Close Print Preview
Close
CONPROVE
CE-600X
CONPROVE
INDÚSTRIA & COMÉRCIO
POWER DIRECTIONAL - TEST REPORT
Descr.: Reverse Power Directional
Date: 09/05/2022 09:40:17
; Software: DirecPot_CTC; Version: 2.02.171
Responsible: Michel Rockembach de Carvalho
1. Device Tested
Ident .: 23031982; Type: Transformer Protection
Model 7UM6; Manufacturer: Siemens
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 41

APPENDIX A

A.1 Terminal Designations

7UM621/623*-*D/E

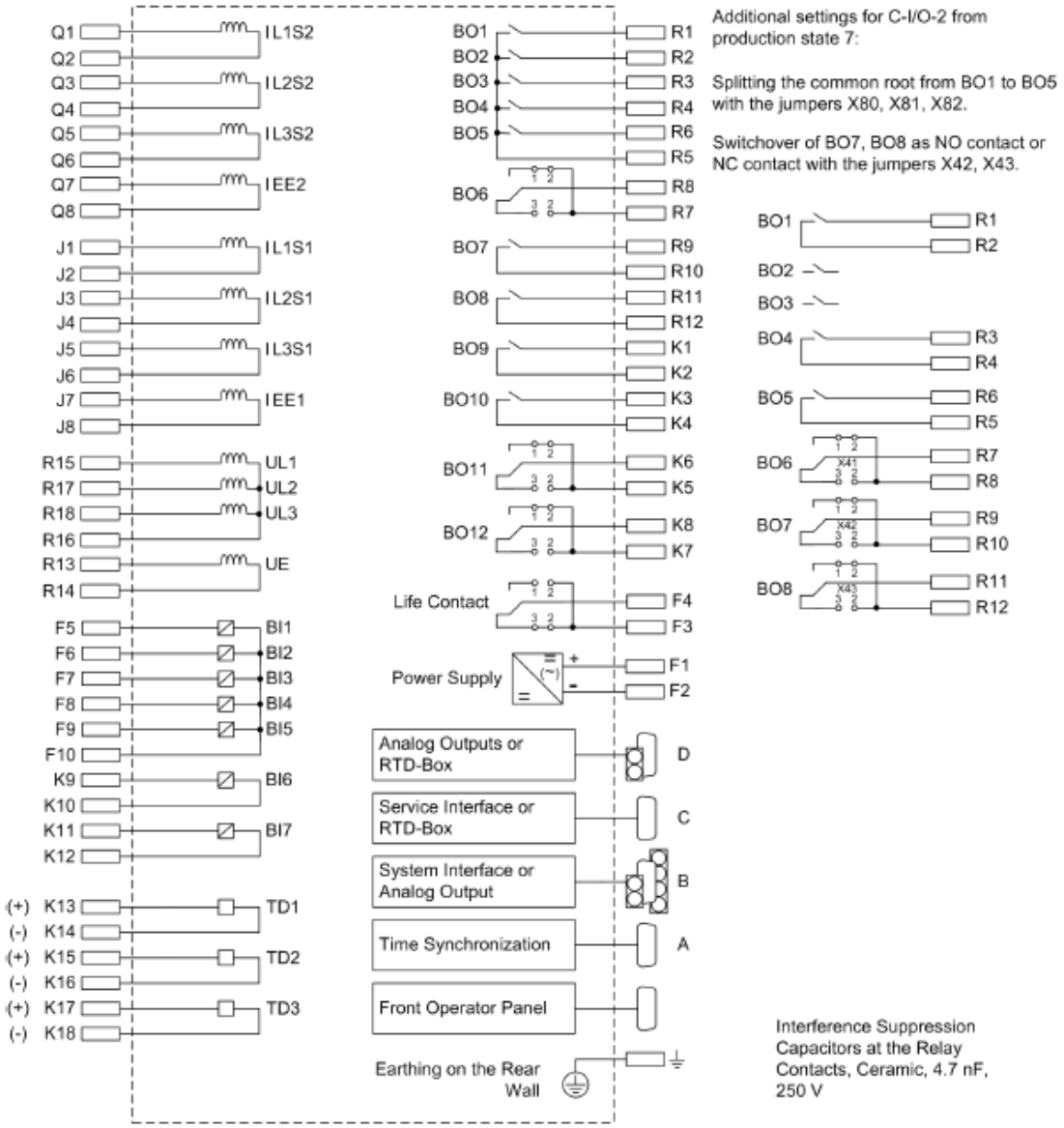

Figure 42

A.2 Technical Data

Times

Pickup Times – Reverse power $P_{reverse}>$	 approx. 360 ms at f = 50 Hz approx. 300 ms at f = 60 Hz
Dropout Times – Reverse power $P_{reverse}>$	 approx. 360 ms at f = 50 Hz approx. 300 ms at f = 60 Hz

Dropout Ratios

– Reverse power $P_{reverse}>$	approx. 0.6

Tolerances

– Reverse power $P_{reverse}>$	0.25 % S_N ± 3 % of setting value for Q < 0.5 S_N (S_N: Rated apparent power, Q: Reactive power
– Delay times T	1 % or 10 ms

Influencing Variables for Pickup Values

Power supply direct voltage in range $0.8 \le U_{Aux}/U_{AuxN} \le 1.15$	≤ 1 %
Temperature in range 23.00 °F (–5 °C) ≤ Θ_{amb} ≤ 131.00 °F (55 °C)	≤ 0.5 % / 10 K
Frequency in range $0.95 \le f/f_N \le 1.05$	≤ 1 %
Harmonics – Up to 10 % 3rd harmonic – Up to 10 % 5th harmonic	 ≤ 1 % ≤ 1 %

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 1

Power Directional Software		Siemens 7UM62 Relay	
Parameter	**Figure**	**Parameter**	**Figure**
Pkp 3Φ	**32**	**32R P> Reverse Pickup**	**19**