



INSTRUMENTOS PARA TESTES ELÉTRICOS

# Test Tutorial

**Equipment Type:** Protection Relay

**Brand:** ABB

**Model:** RET670

**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	30/05/2022	M.R.C.	G.C.D.P.

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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](mailto: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.

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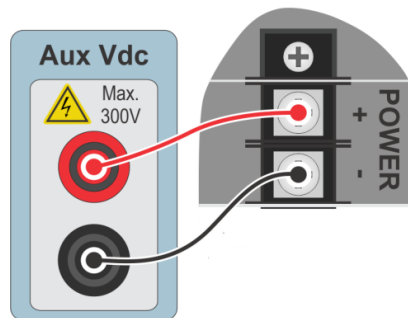
**INSTRUMENTOS PARA TESTES ELÉTRICOS**  
**Sequence for testing the RET670 relay in the Power Directional software**

**1. Relay connection to CE-6710**

Appendix A shows the relay terminal designations.

**1.1 Auxiliary Source**

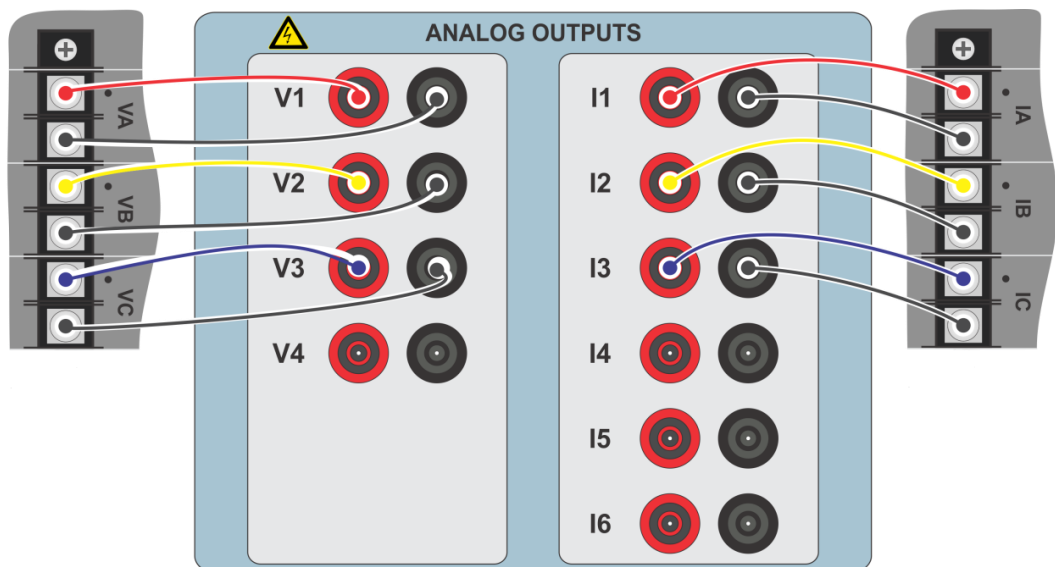
Connect the positive (red terminal) of the Aux Source. Vdc to pin 4 on the relay terminal X11 and the negative (black terminal) of the Aux Source Vdc to pin 5 of the relay terminal X11.



**Figure 1**

**1.2 Current and Voltage Coils**

To establish the connection of the voltage coils, connect channels V1, V2 and V3 with pins 19, 21 and 23 of the relay terminal X401 and those common to pins 20, 22 and 24. If these last three points are short-circuited, connect all common to that point. To establish the connection of the current coils, connect channels I1, I2 and I3 with pins 1, 3 and 5 of the relay terminal X401 and the common ones to pins 2, 4 and 6. If these last three points are short-circuited, connect all common to that point.



**Figure 2**

### 1.3 Binary Inputs

Connect the binary input of the CE-6710 to the binary output of the relay slot X31.

- BI1 to pin 01 and its common to pin 02.

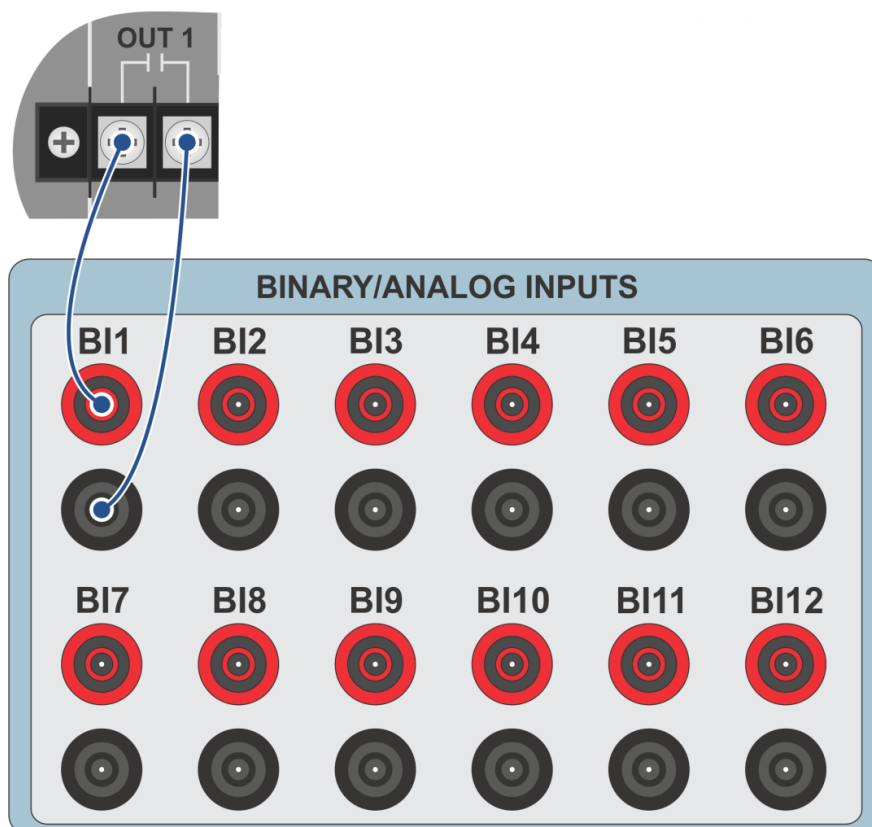


Figure 3

## 2. Configuration of the RET670 relay

Connect a notebook Ethernet cable to the relay. Then open PCM600 by double clicking on the software icon.



Figure 4

**Note: In this tutorial, it is considered that there is no configuration in the relay, so that all parameterization will be inserted in the relay.**

## 2.1 Creating a new file

First, a new project must be added. Click on “File” and then “New Project...”.

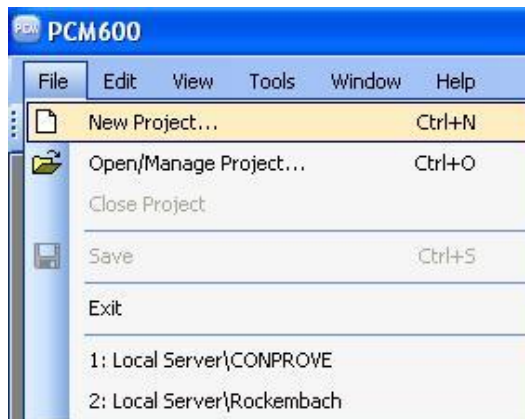


Figure 5

Choose a name for the project, in which case “32R” was used and then click on “Create”.

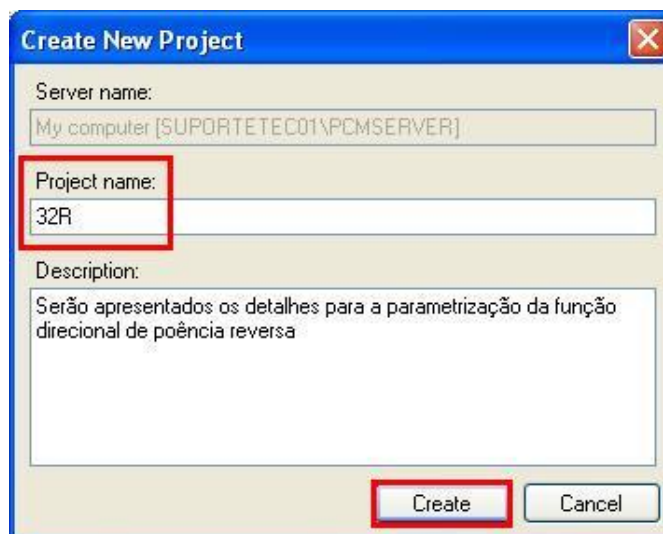
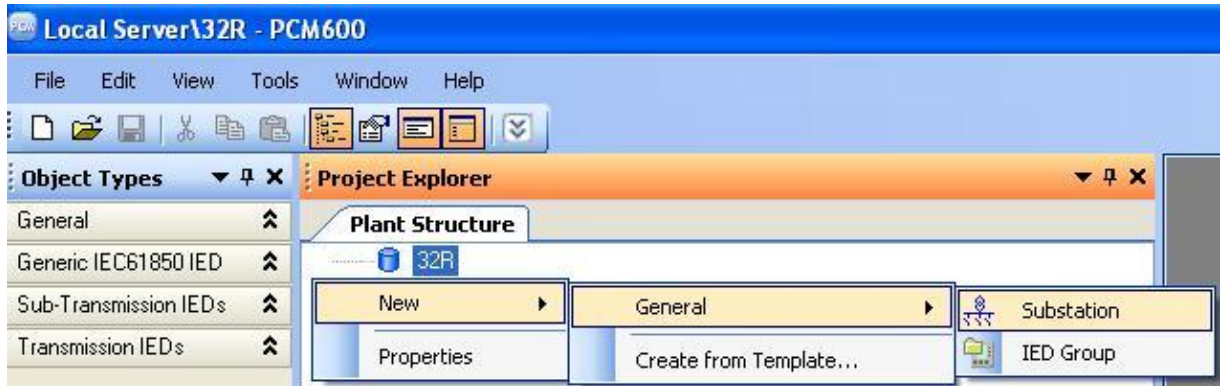


Figure 6

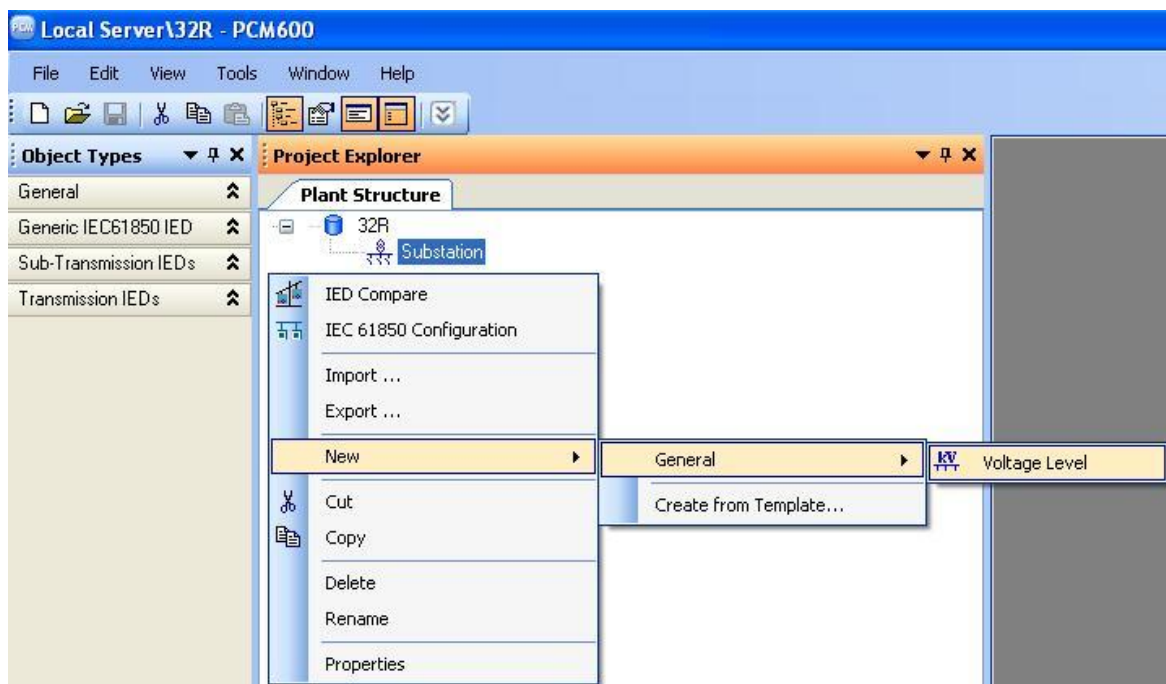
Right click on the created plant and insert a substation.

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**Figure 7**

Inside the created substation, enter the voltage level according to the following figure:

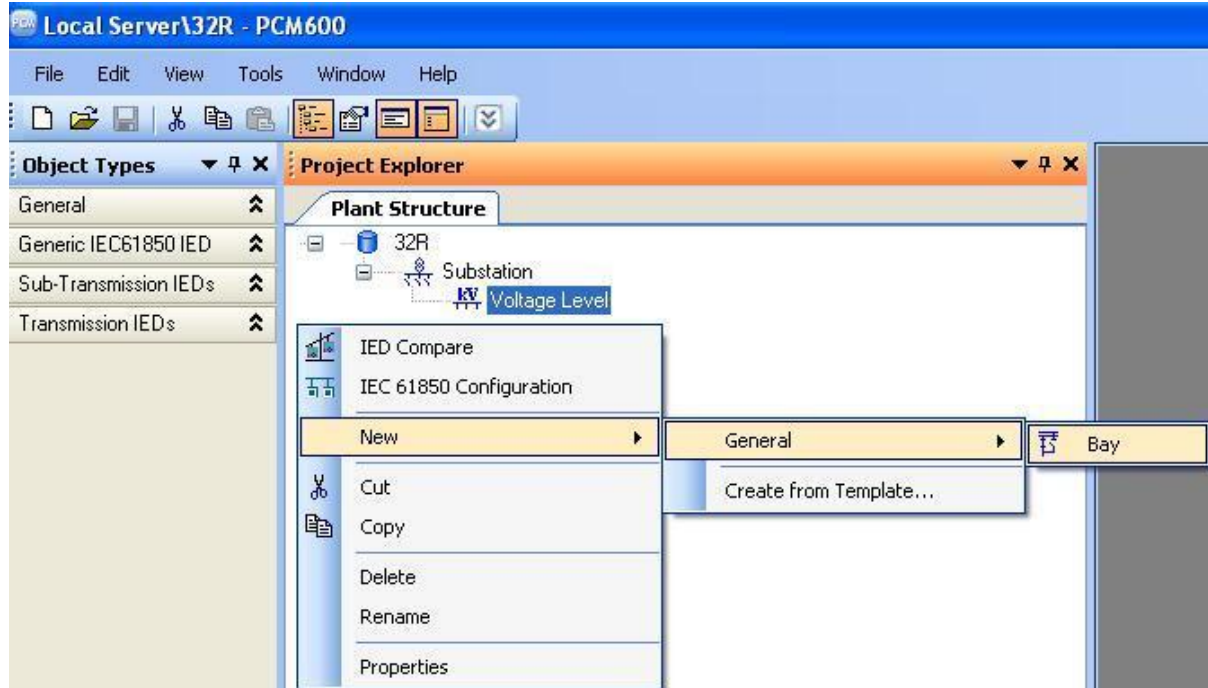


**Figure 8**

Within the voltage level, insert a bay.

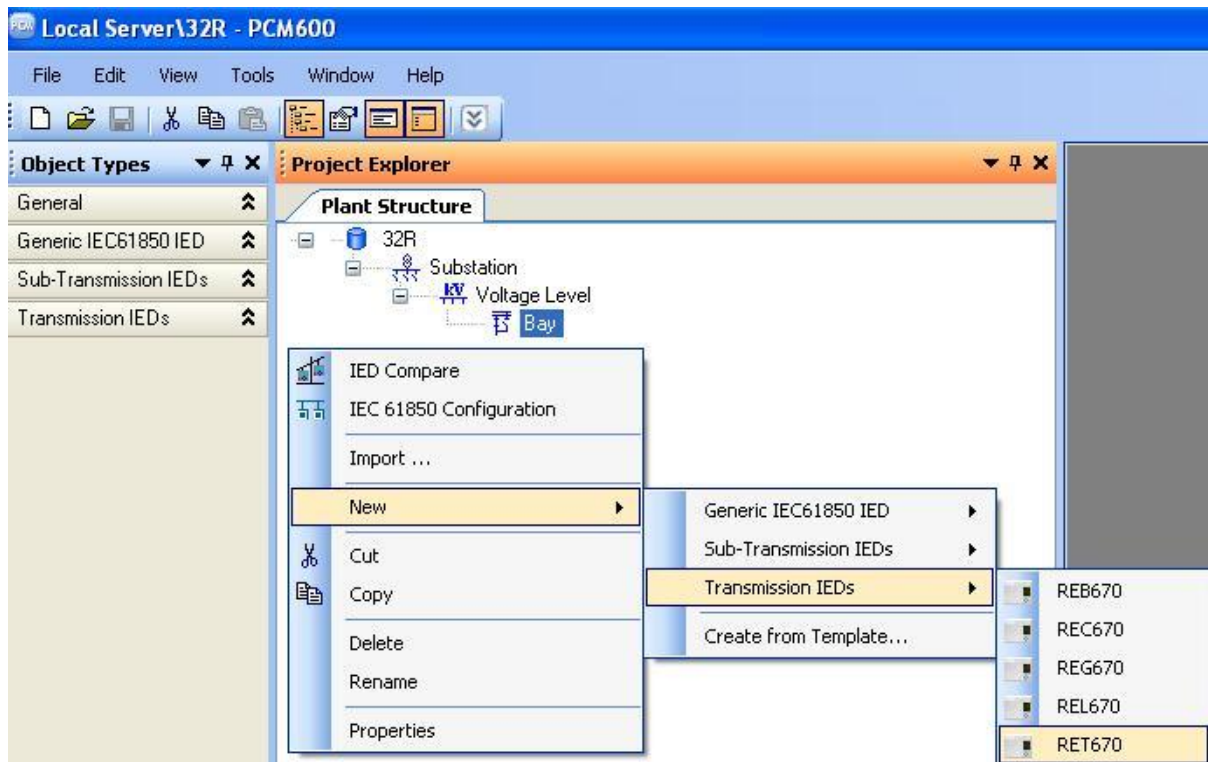


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**Figure 9**

The RET670 relay is inserted inside the bay.



**Figure 10**

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2.2 Configuring Communication

Choose the option “*Online Configuration*” and click “*Next >*”.

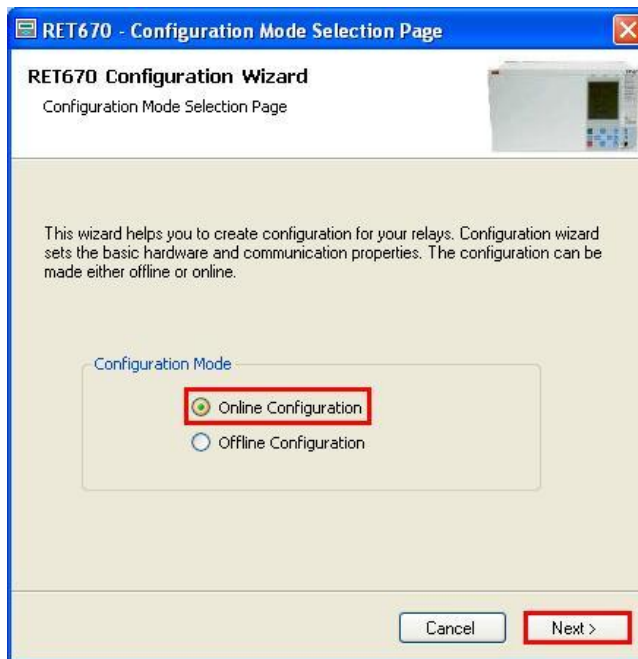


Figure 11

Choose the “*Next >*” option again.



Figure 12

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On the next screen, the user chooses between two options “LANI” or “Front Port” and then the IP is configured on the relay itself. To do so, go to “Settings > General settings > Communication > Ethernet configuration” and view the desired IP. Adjust this value in the PCM and in this tutorial the “Front Port” option was chosen.



Figure 13

Em seguida clique em “Next >” e na tela próxima tela em “Scan”.

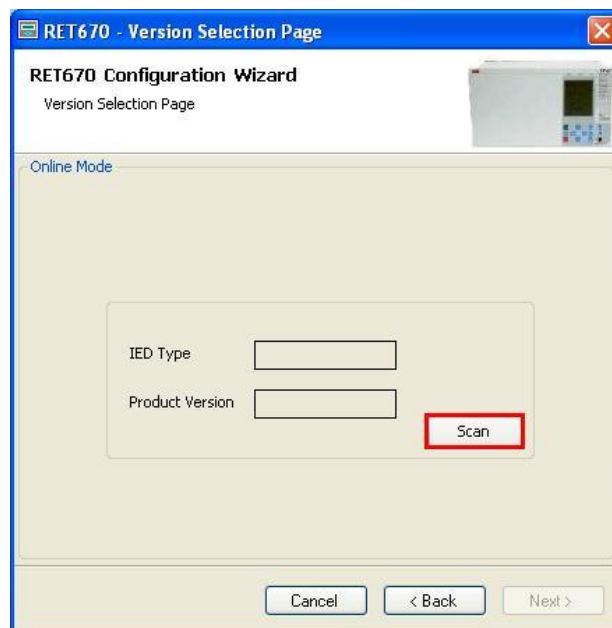
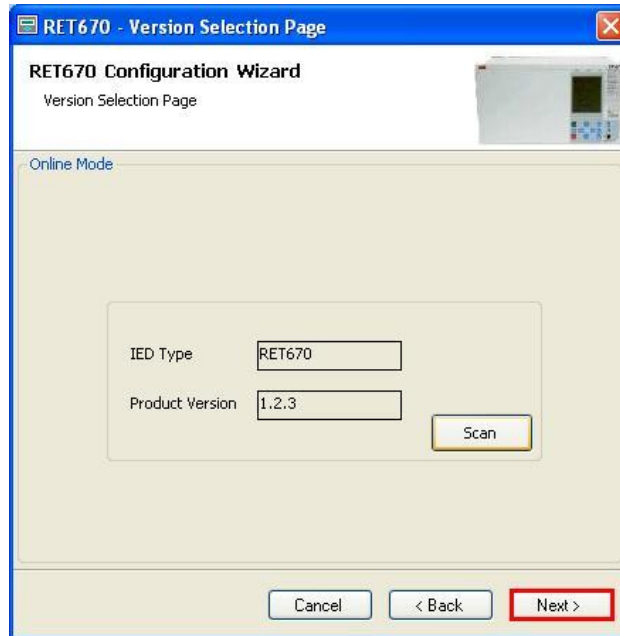


Figure 14

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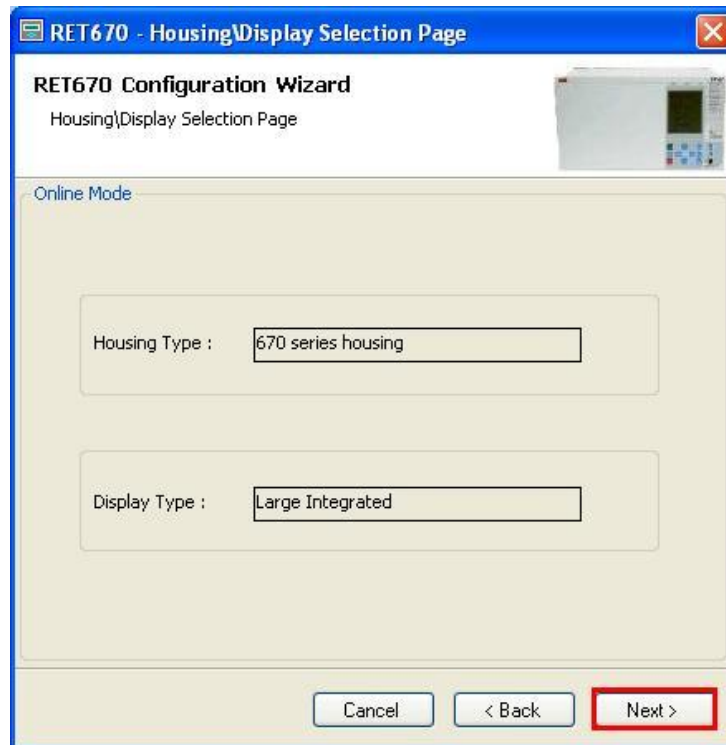
**INSTRUMENTOS PARA TESTES ELÉTRICOS**

If the settings are correct, the software identifies the relay model and its version according to the following screen.



**Figure 15**

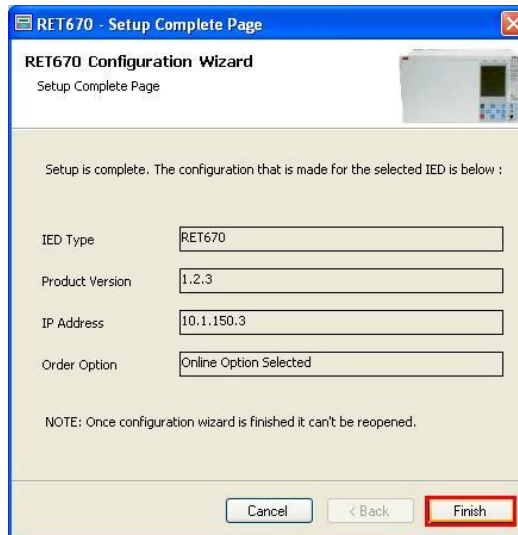
On the next screen, the relay identifies the type of rack and display.



**Figure 16**

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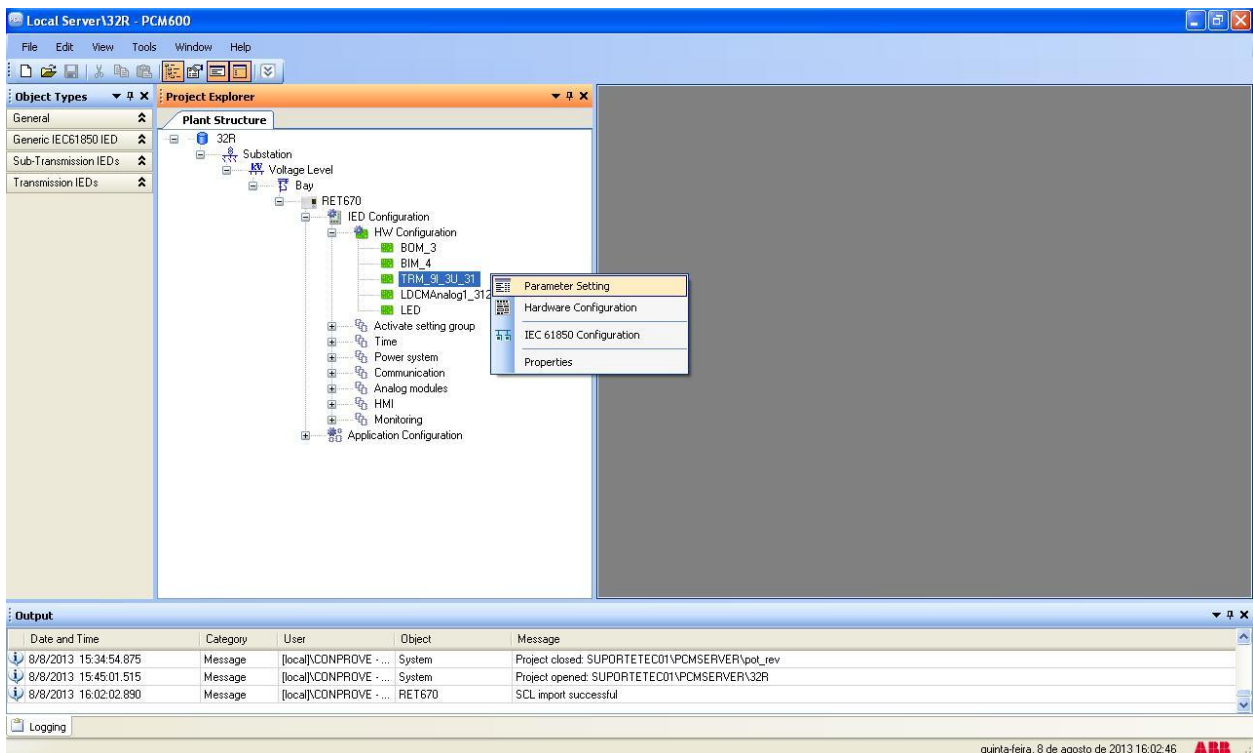
Finally the complete relay information.



**Figure 17**

**2.3 TRM\_9I\_3U\_31**

Click on the “+” signs next to “*IED Configuration*” and “*HW Configuration*”. Right-click on the “*TRM\_9I\_3U\_31*” option and select “*Parameter Setting*”.



**Figure 18**

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In this window, the current and voltage transformation relationships must be configured. In this case, the first three current channels and the last three voltage channels (not shown) will be configured with a ratio of 3000A to 5A and 400KV to 115V, respectively

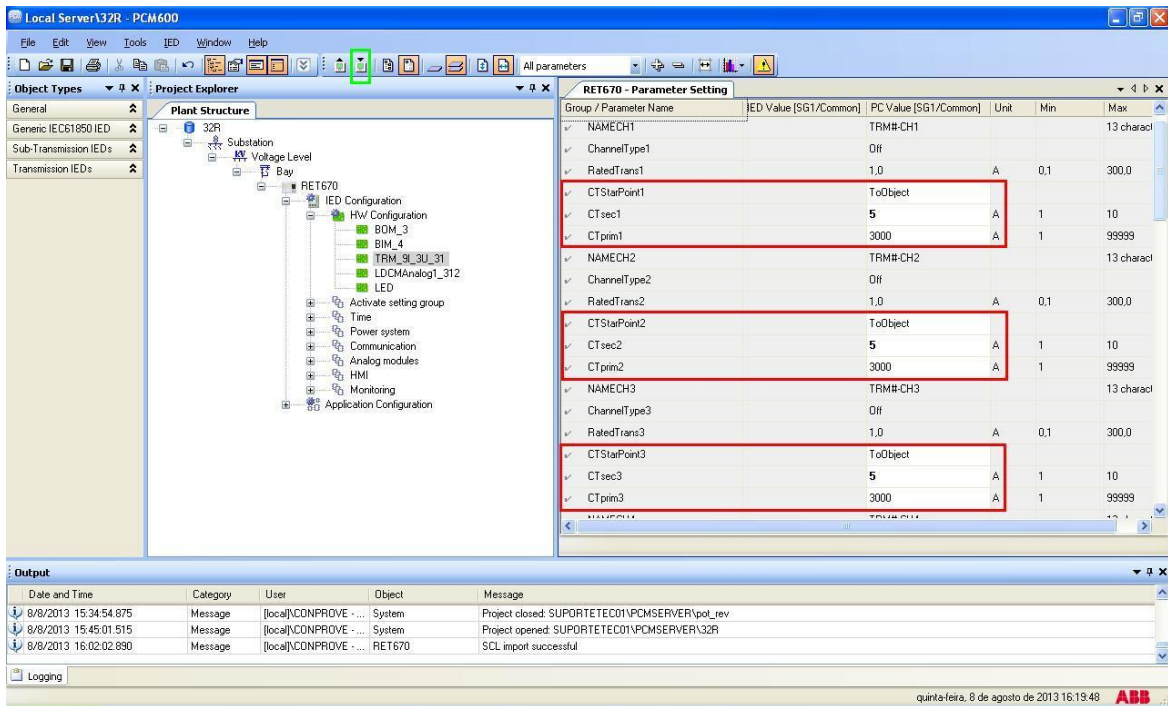


Figure 19

In the icon highlighted in green in the previous figure, the changes are sent to the relay. There are three shipping options:

1. Send only a specific value.
2. Submit all changes made within a settings group.
3. Send all parameterized settings within the group.

In this case, only the settings that have been changed are sent.

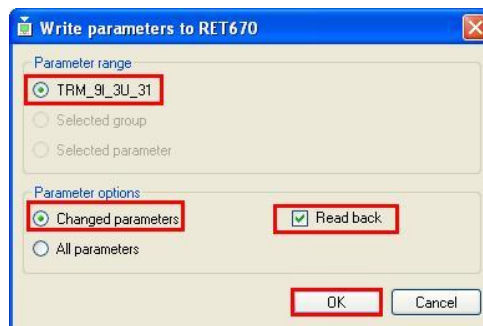


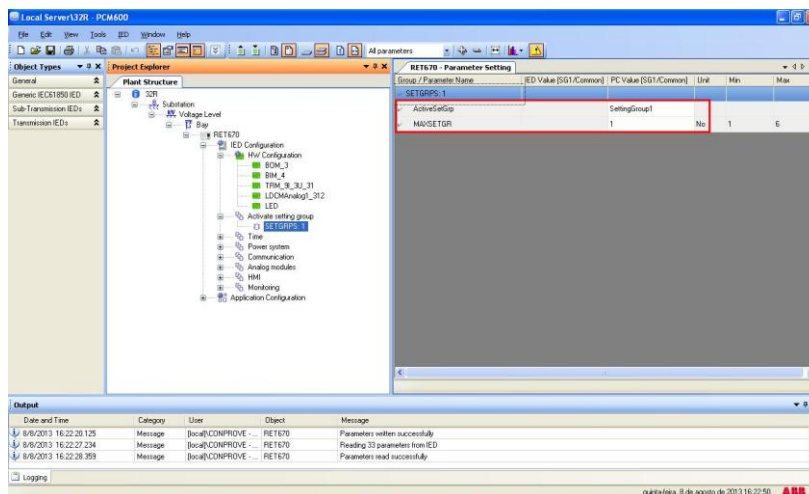
Figure 20

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**NOTE: Whenever the user makes a change in any adjustment group, this procedure must be repeated.**

**2.4 SETGRPS: 1**

Click the “+” sign next to “*Activate setting group*” and then “*SETGRPS: 1*” and make sure that group one is active.



**Figure 21**

**2.5 PRIMVAL: 1**

Click the “+” sign next to “*Power System*” and select the “*PRIMVAL:1*” option. In this group, the frequency value is adjusted, the standard value in this relay is 50.0Hz. Change the value to 60.0Hz and send the settings to the relay.

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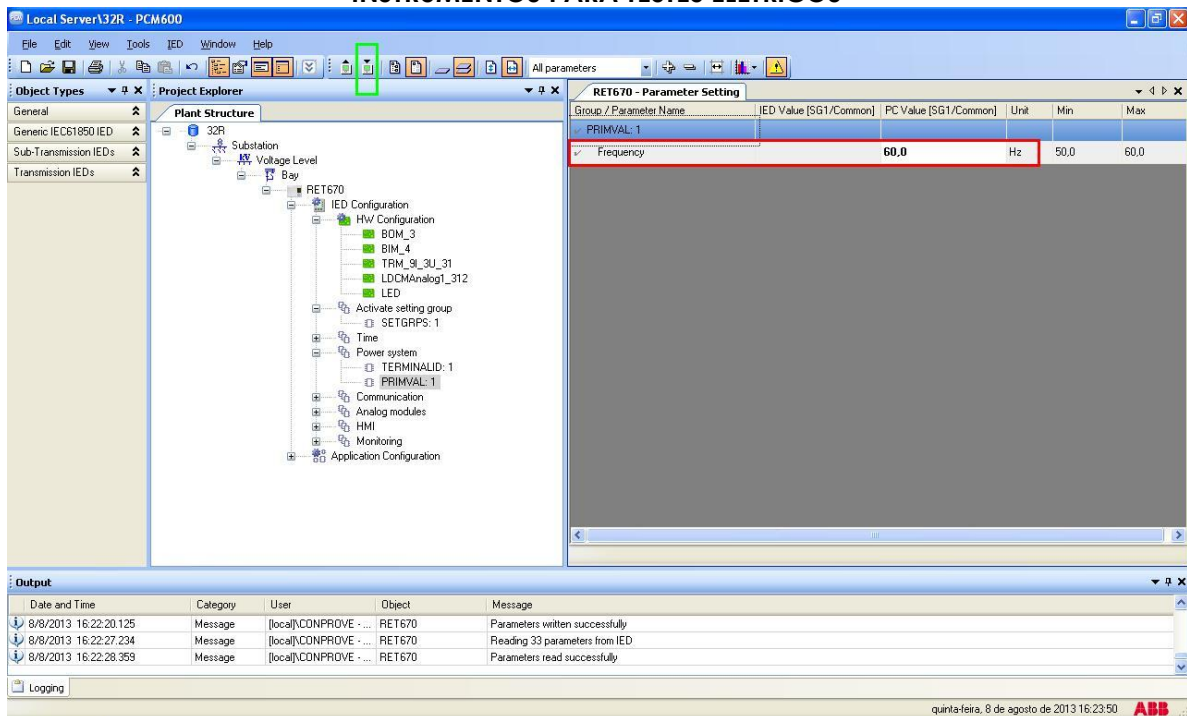


Figure 22

### 2.6 AISVBAS: 1

Click on the “+” signs next to “Analog modules” and select the option “AISVBAS: 1” and set the channel “TRM40-Ch1” as the reference channel, which is equivalent to the phase of current A. Then click on the highlighted icon in green to save these settings.

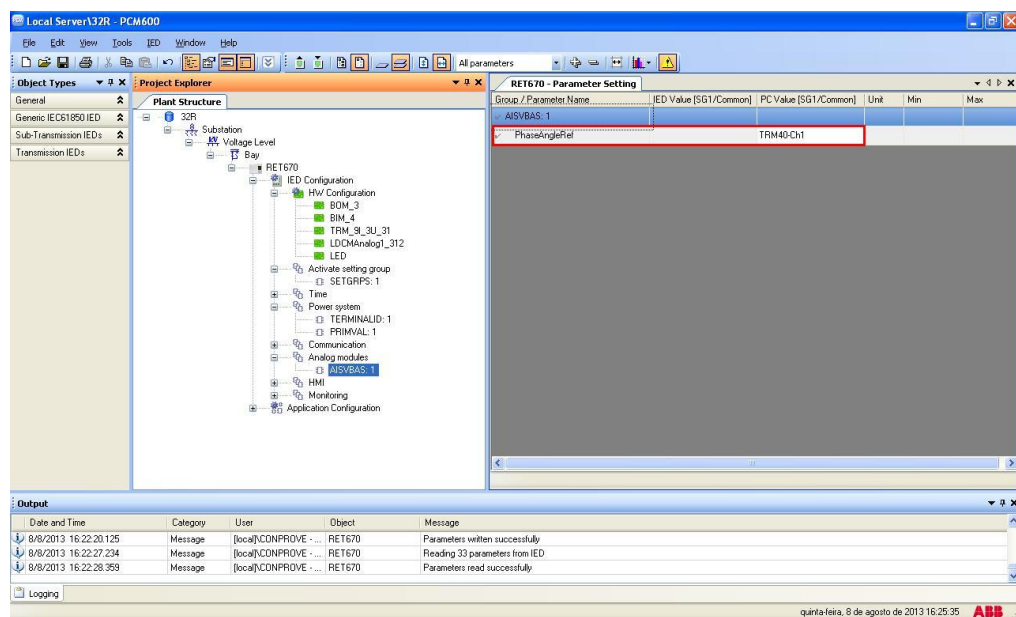


Figure 23



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### 2.7 Application Configuration

Select the “*Application Configuration*” option, right-click and choose “*Application Configuration*” again. This tab is used to insert the protection logic blocks.

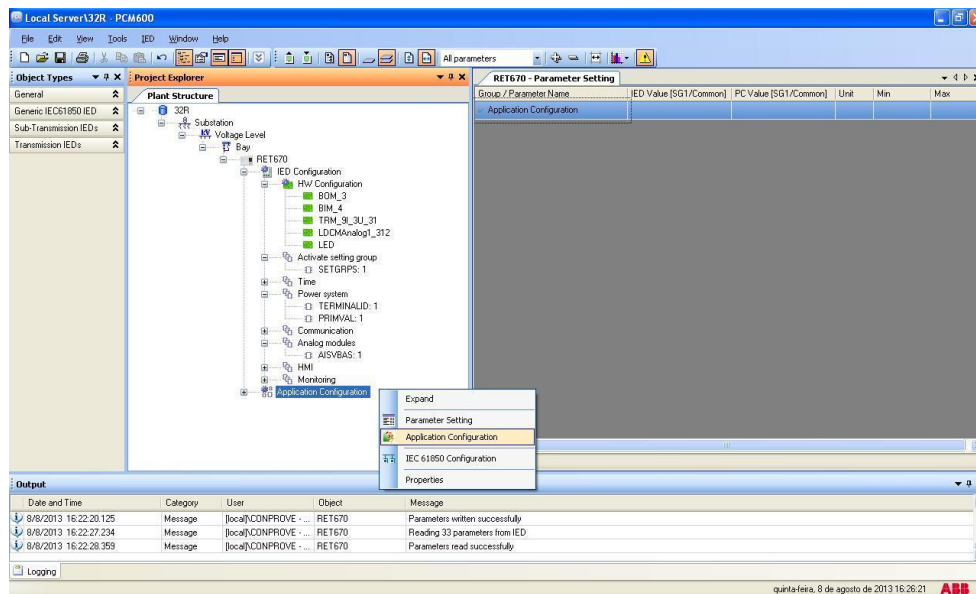
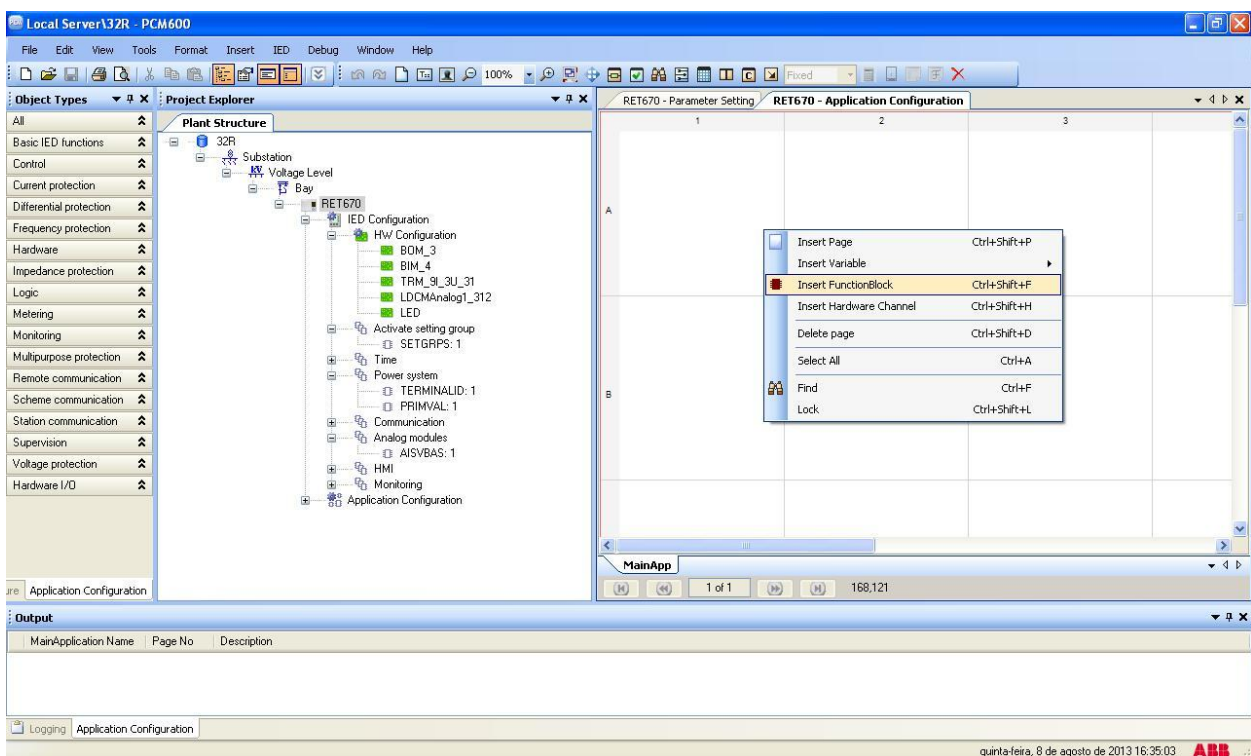


Figure 24

On the screen that opens right-click it and then choose the “*Insert FunctionBlock*” option.



2.8 SMAII (Currents)

Click on the “+” sign next to “Basic IED functions” and insert the “SMAII” block that will be responsible for the current channels of the first winding. To understand the perfect functioning of the various blocks, consult the RET 670 manual.

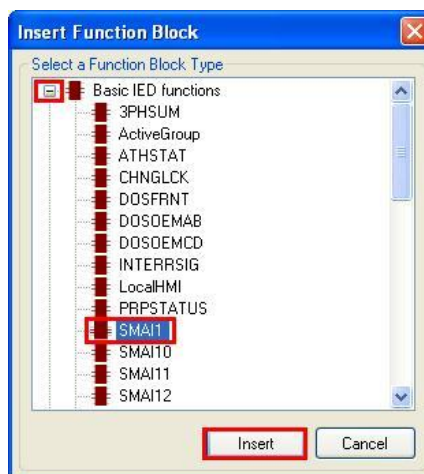


Figure 26

On the next screen set the “Cycle Time” to 8.

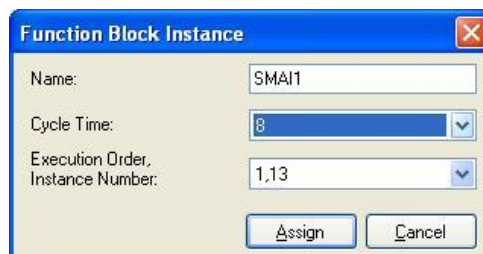


Figure 27

The next step is to route the channel input of the function block with its physical channel. To do this, right-click outside the block and choose the following option.

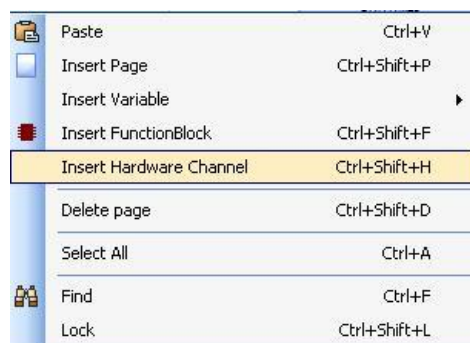
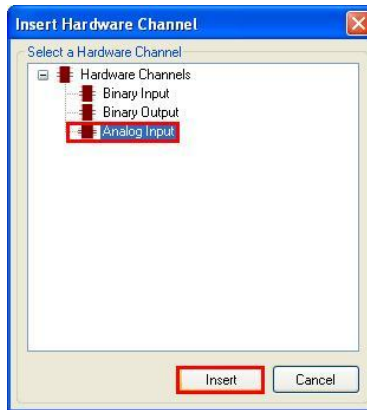


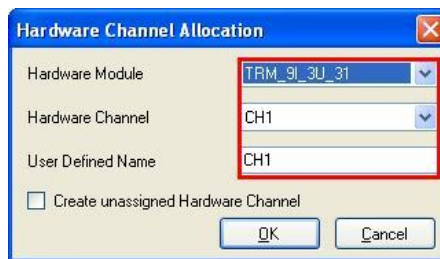
Figure 28

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Choose the “Analog Input” option and click on “Insert”.

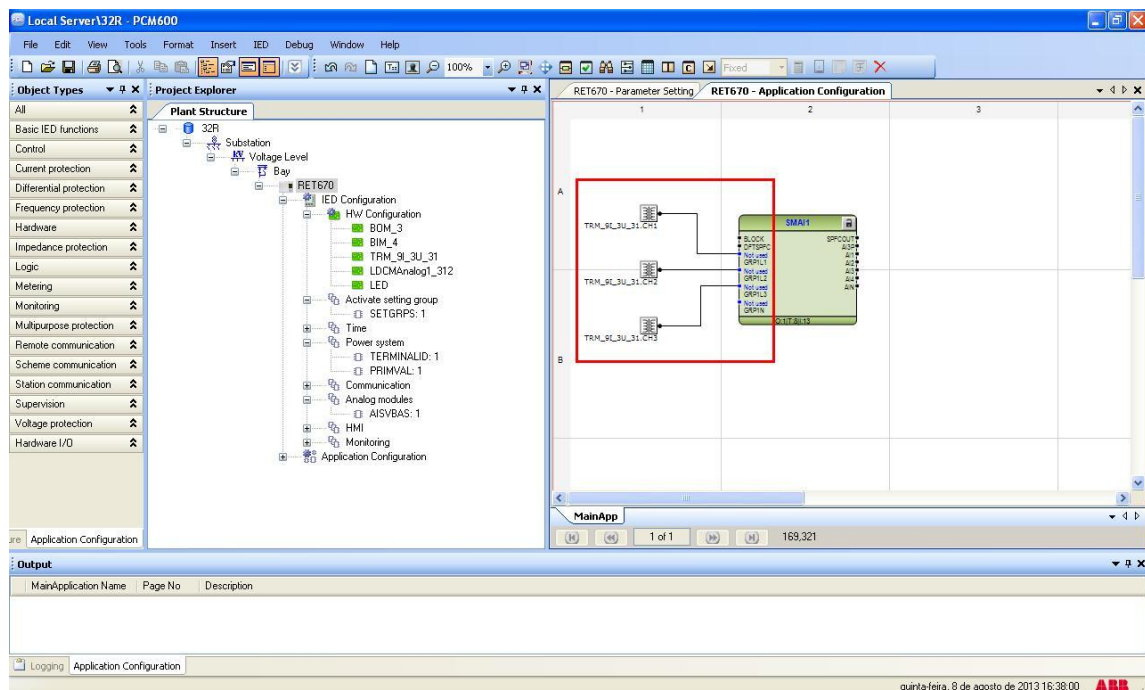


**Figure 29**



**Figure 30**

Repeat the procedure of the 3 previous figures changing the “Hardware Channel” option to CH2 and CH3. Then make the connections with the block.



**Figure 31**

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Assign an output to the “AI3P” option. Right-click and choose “Insert Variable > Output”.

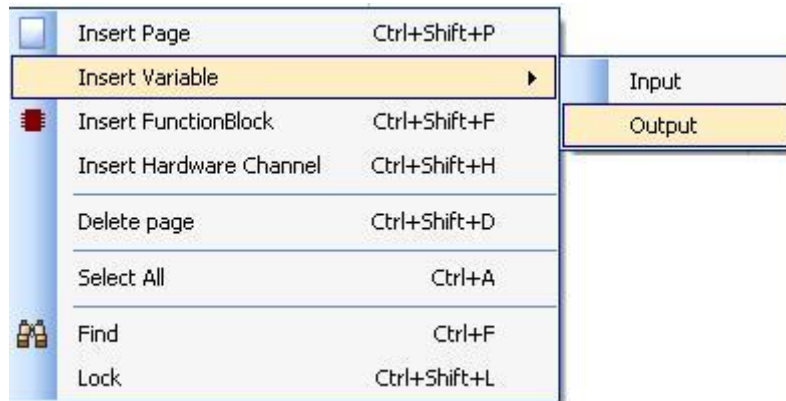


Figure 32

Choose a name for this variable, in this case “AI3P\_TC\_08ms” and connect with the output “AI3P”.

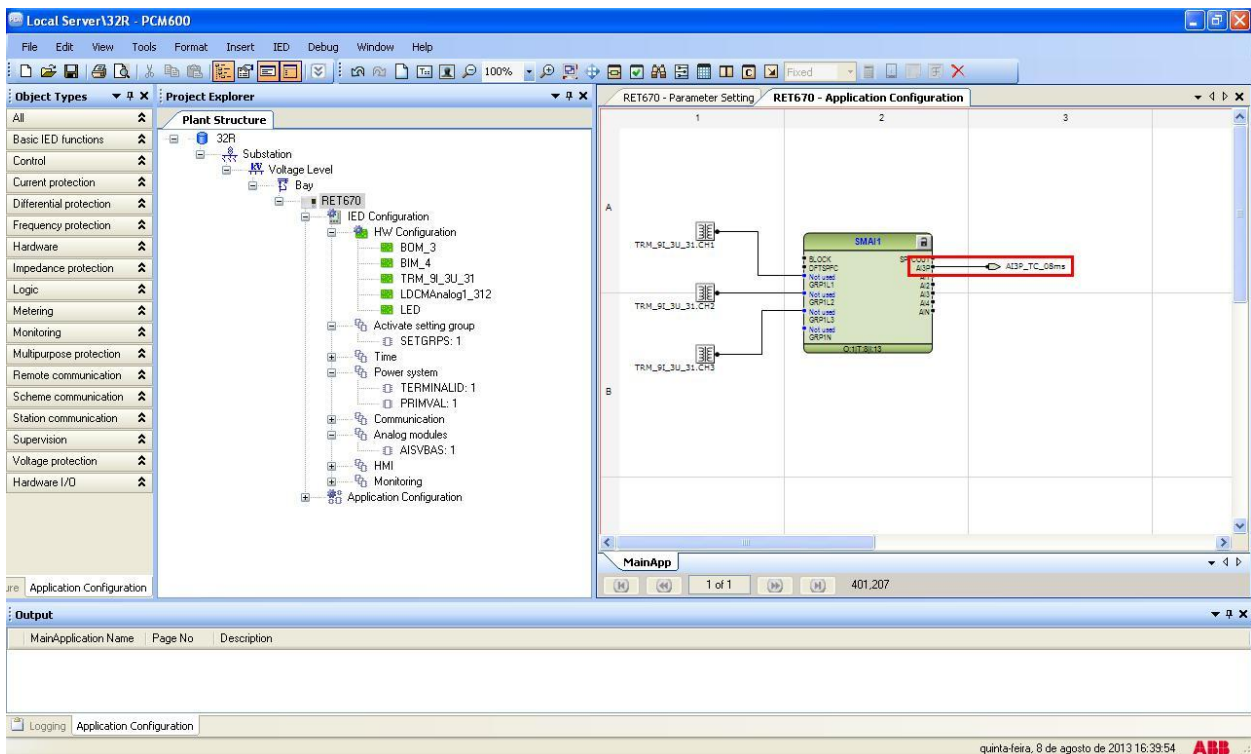
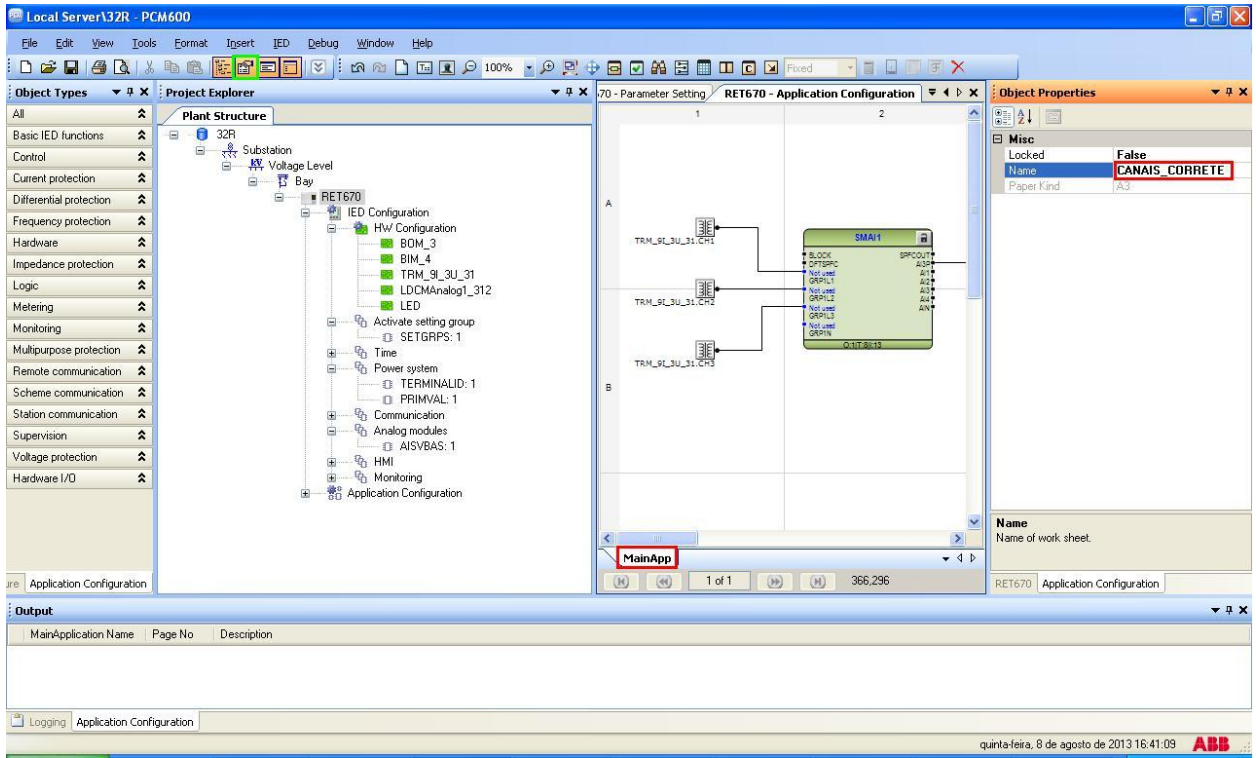


Figure 33

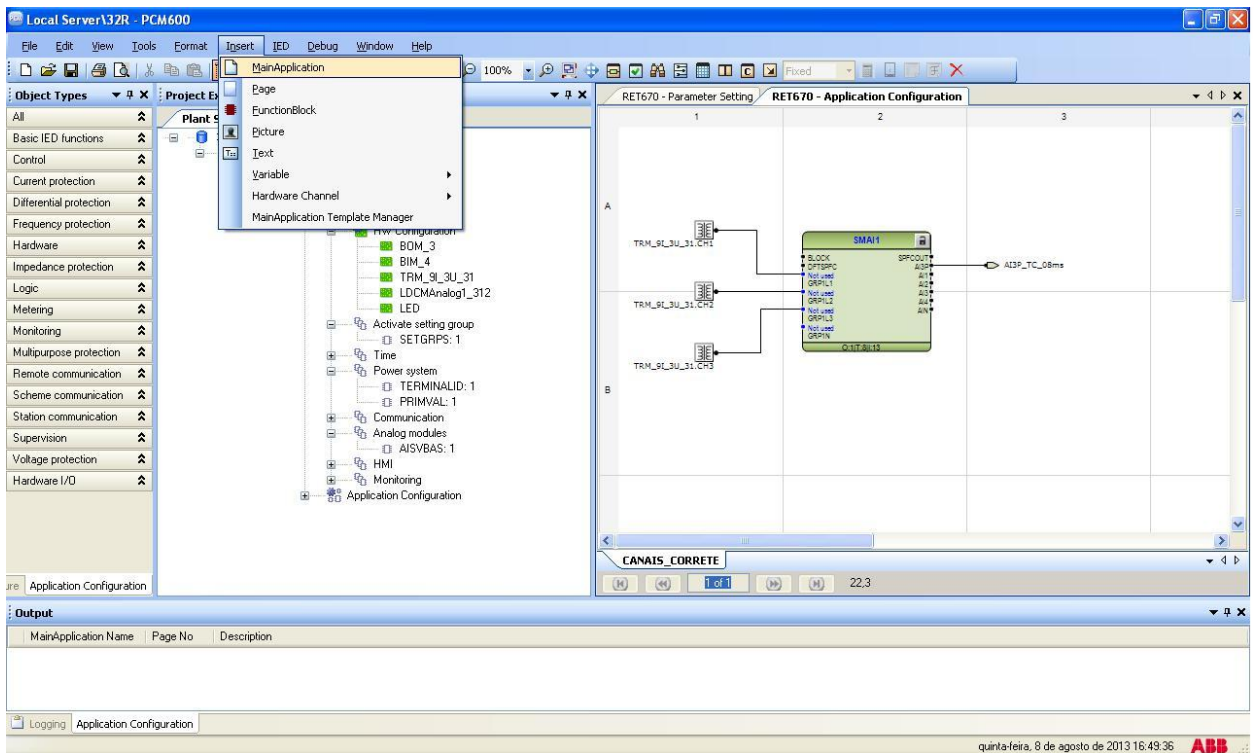
By clicking on the icon highlighted in green and on the “MainApp” tab, then the name of the tab is changed to “CANAI5\_CORRENTE”, for example.

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**Figure 34**

Close the “Object Properties” window then click on “Insert > MainApplication”.

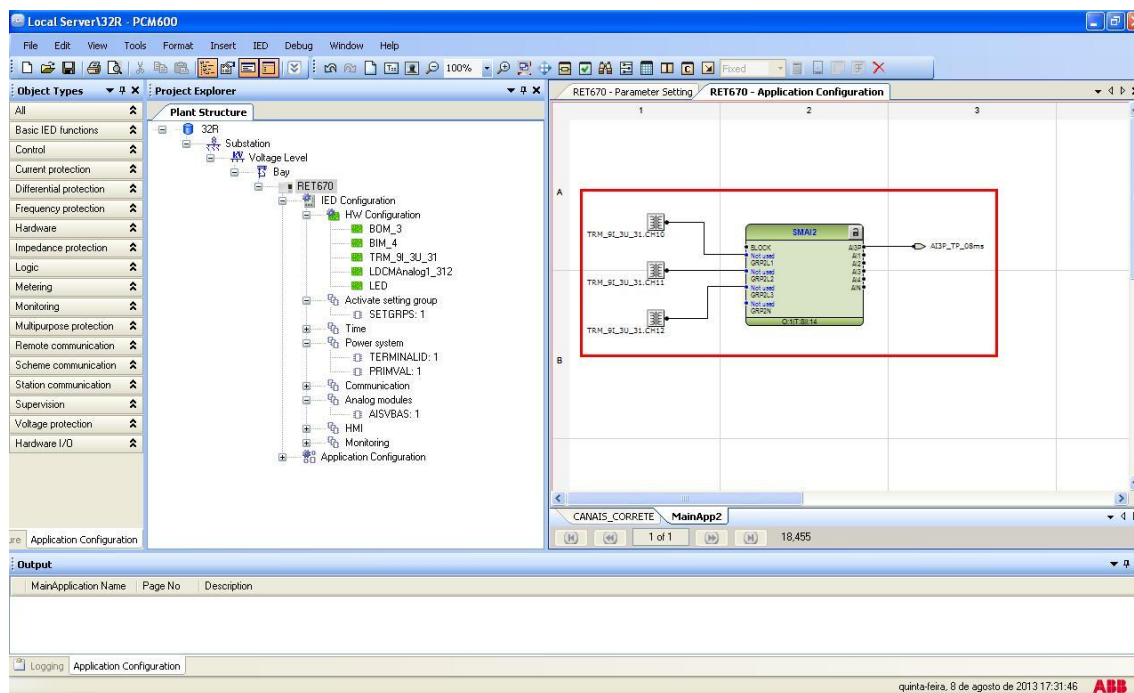


**Figure 35**

## INSTRUMENTOS PARA TESTES ELÉTRICOS

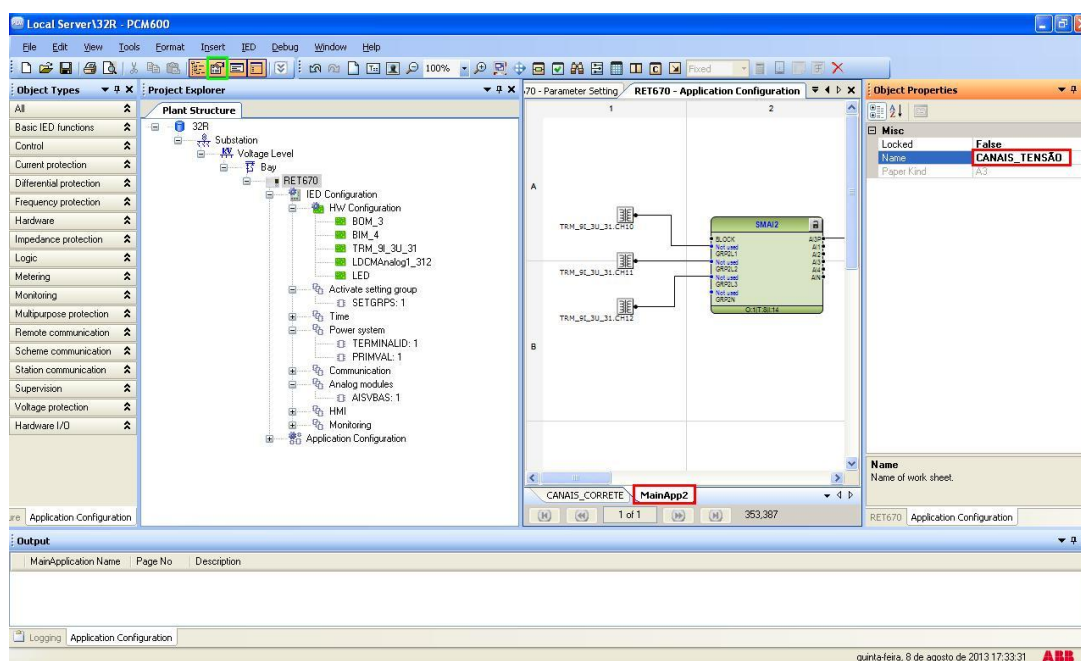
### 2.9 SMAI2 (Voltages)

Repeat the procedure in the previous figures changing the used block to “SMAI2”, the channels to CH10, CH11 and CH12 and the output variable to “AI3P\_TP\_08ms”.



**Figure 36**

Click on the icon highlighted in green, click on the “MainApp2” tab and change the name of the tab to “CANAIS\_TENSÃO”.



**Figure 37**

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Close the “*Object Properties*” window and insert a new tab to create the reverse power function block.

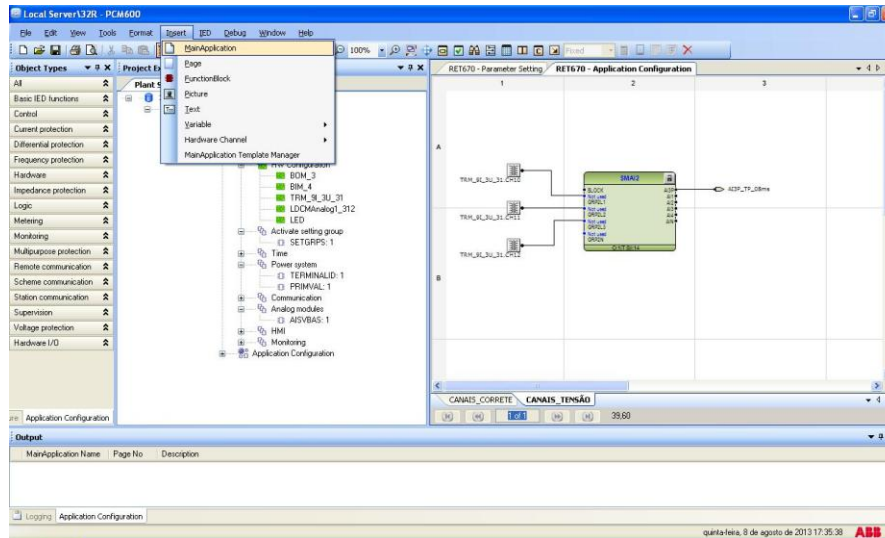


Figure 38

### 2.10 *GOPPDOP (Reverse Power)*

Right-click on the new tab, choose the “*Insert Function Block*” option, click on the “+” sign next to “*Current protection*” and finally choose the “*GOPPDOP*” block.

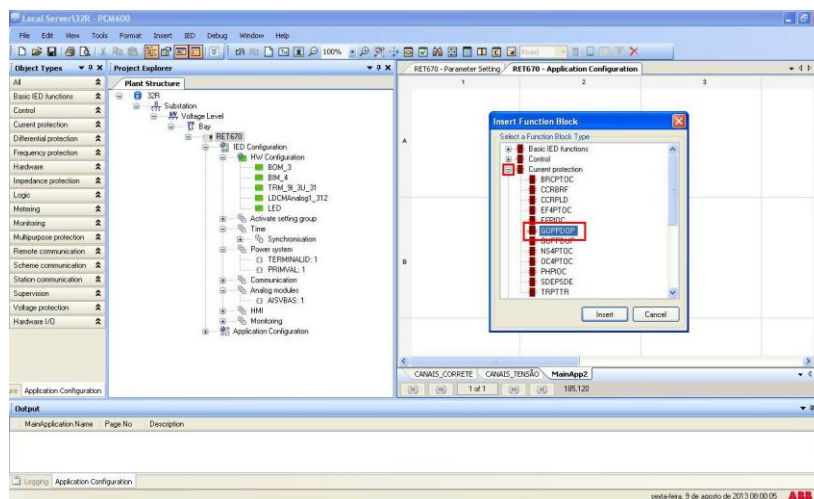


Figure 39

Click on “*Assign*” (picture not shown). Insert two input variables using the same names given for the current and voltage channel outputs and link with the current and voltage inputs respectively. Create an output variable with the following name:

## INSTRUMENTOS PARA TESTES ELÉTRICOS

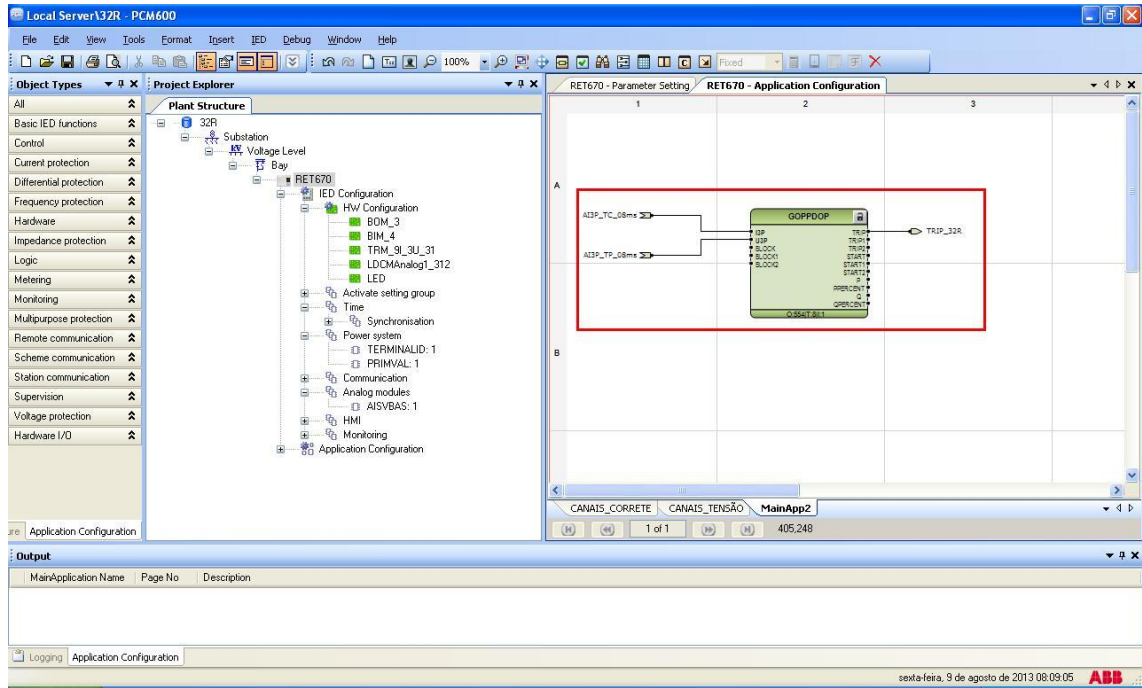


Figure 40

Change the name of the tab to “*POTÊNCIA\_REVERSA*”.

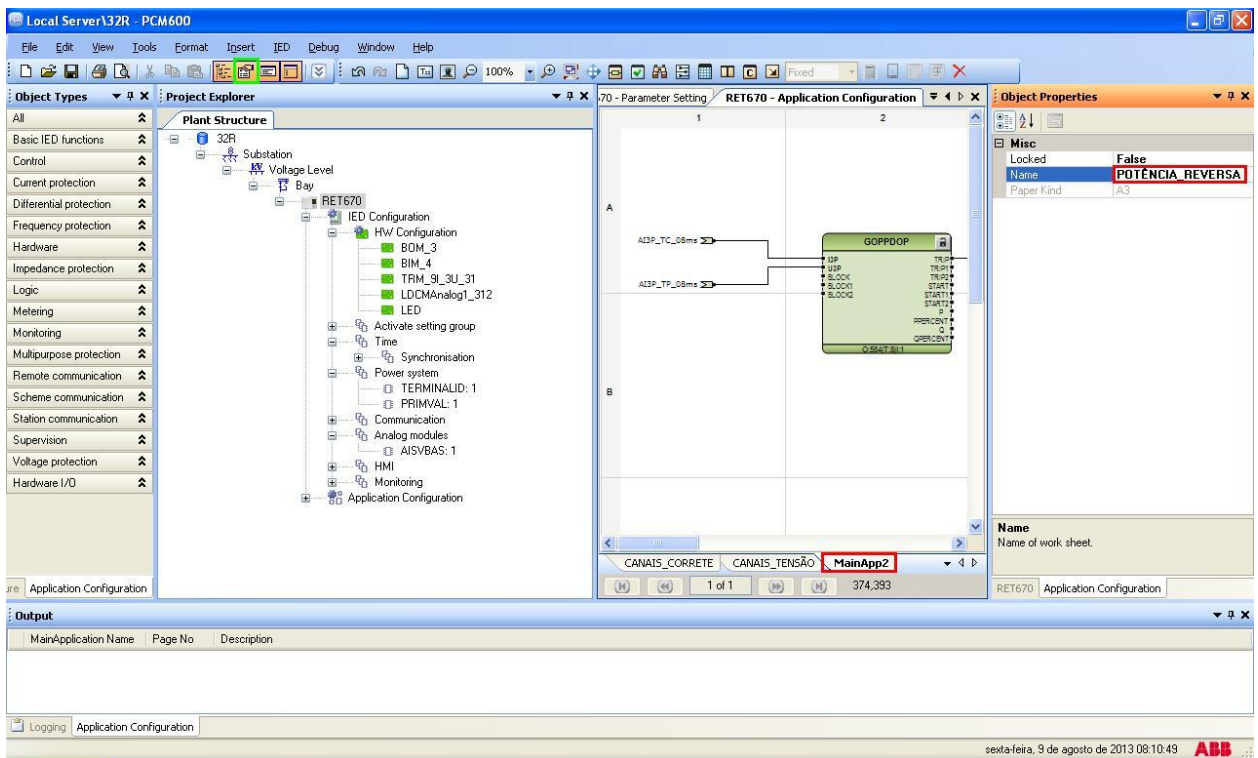


Figure 41



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### 2.11 *Binary Outputs*

The last block to be created is the one for the binary outputs. So create a new tab as shown below.

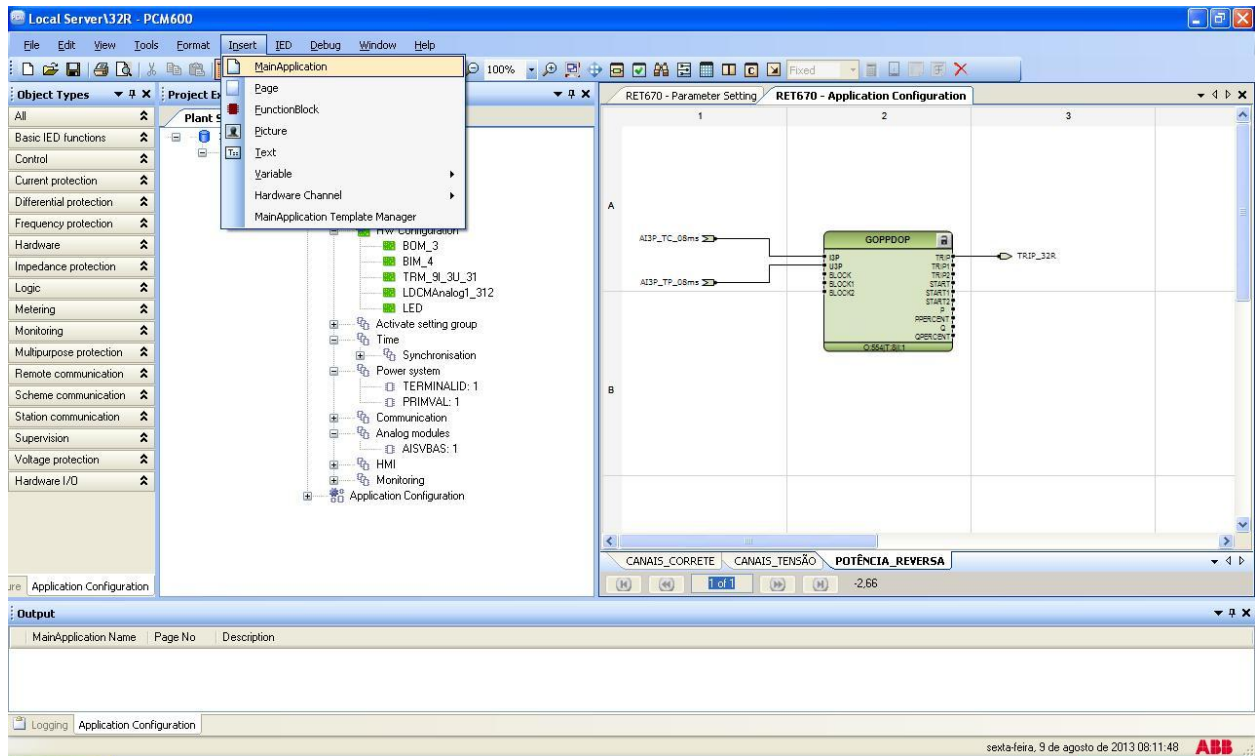


Figure 42

Right-click inside the new tab and choose “*Insert Hardware Channel*”, then “*Binary Output*” and “*Insert*”.

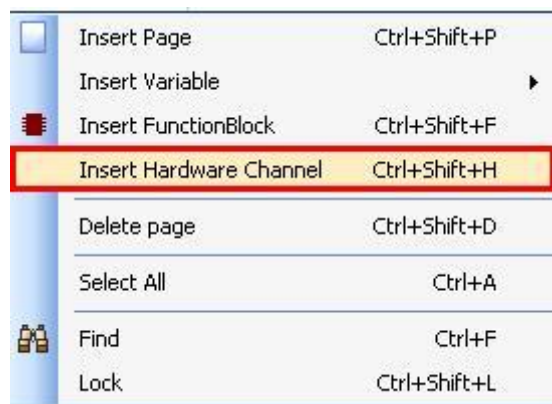


Figure 43

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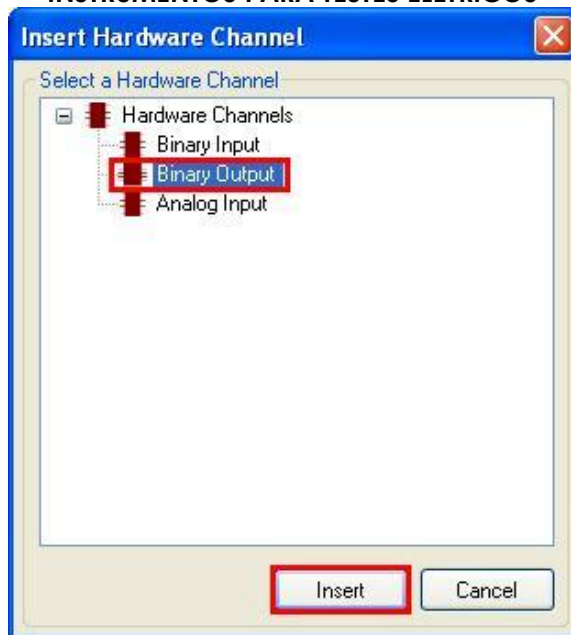


Figure 44

The next step is to choose the channel module “BOM\_3” and the binary output “BO1”.

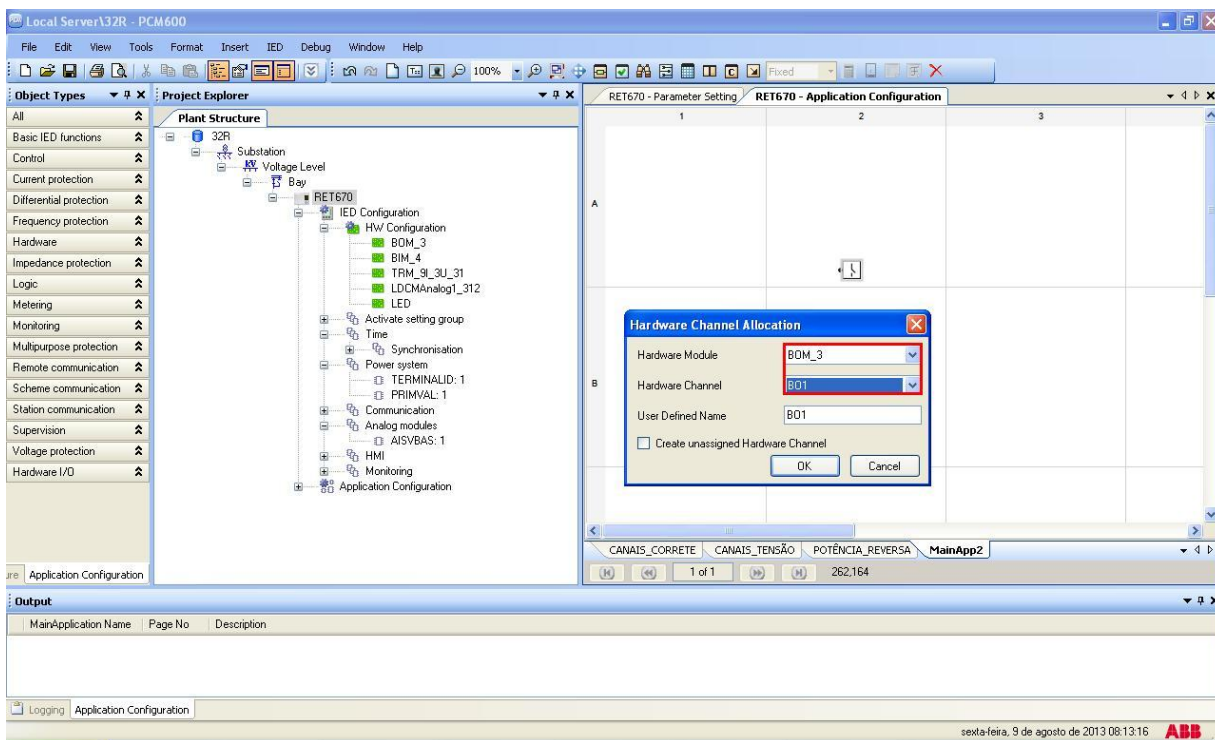


Figure 45

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Create an input variable using the name of the output variable of the power directional block and associate the binary output. Change the name of the tab to “SAÍDAS\_BINÁRIAS”.

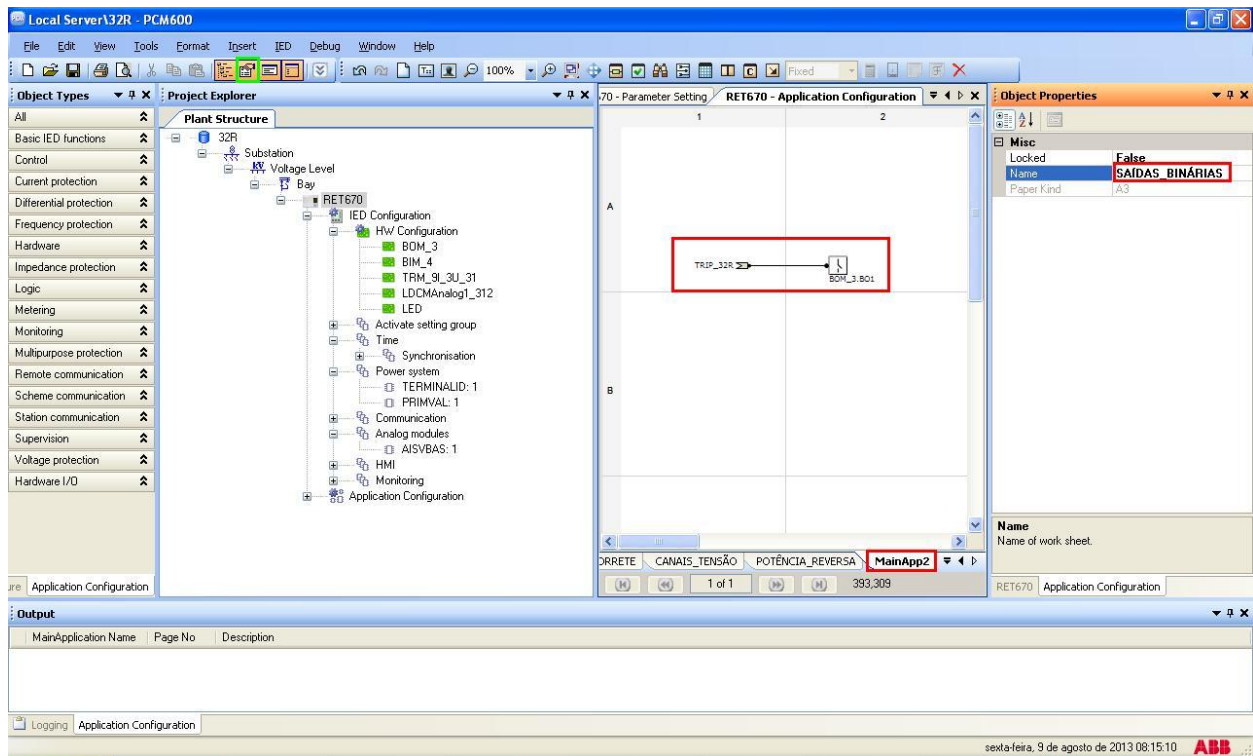


Figure 46

Click on the icon highlighted in green to validate the configuration, then on “OK” and save the configuration.

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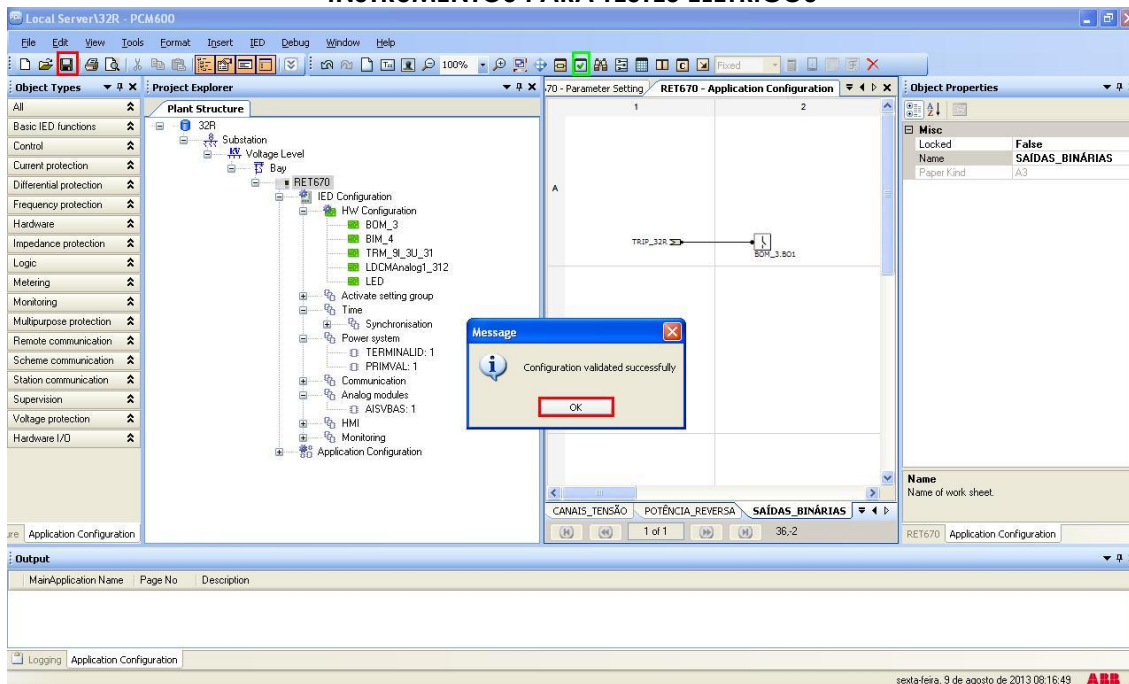


Figure 47

### 3. Parameterization of the ABB RET670 relay

#### 3.1 RET 670 Parameter Setting

Choose the upper tab “RET 670 Parameter Setting” and click on the “+” signs next to “Application Configuration > POTÊNCIA\_REVERSA > Current protection > PhaseOverCurrent4Step(PTOC,51\_67)” and finally “OC4PTOC:1”.

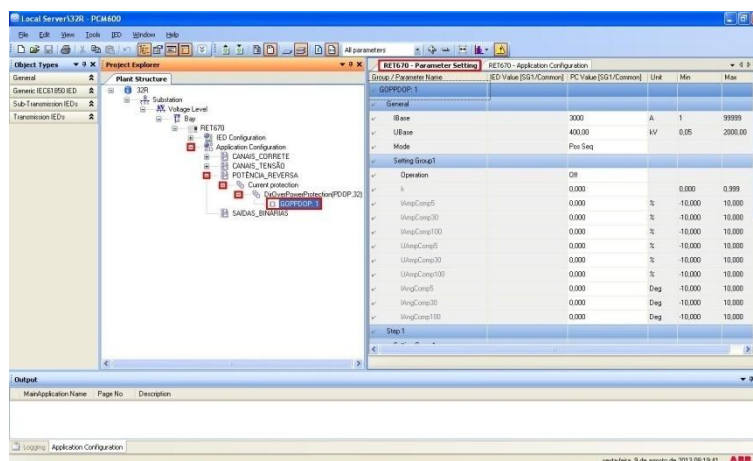


Figure 48

Activate the function and make the following adjustments:

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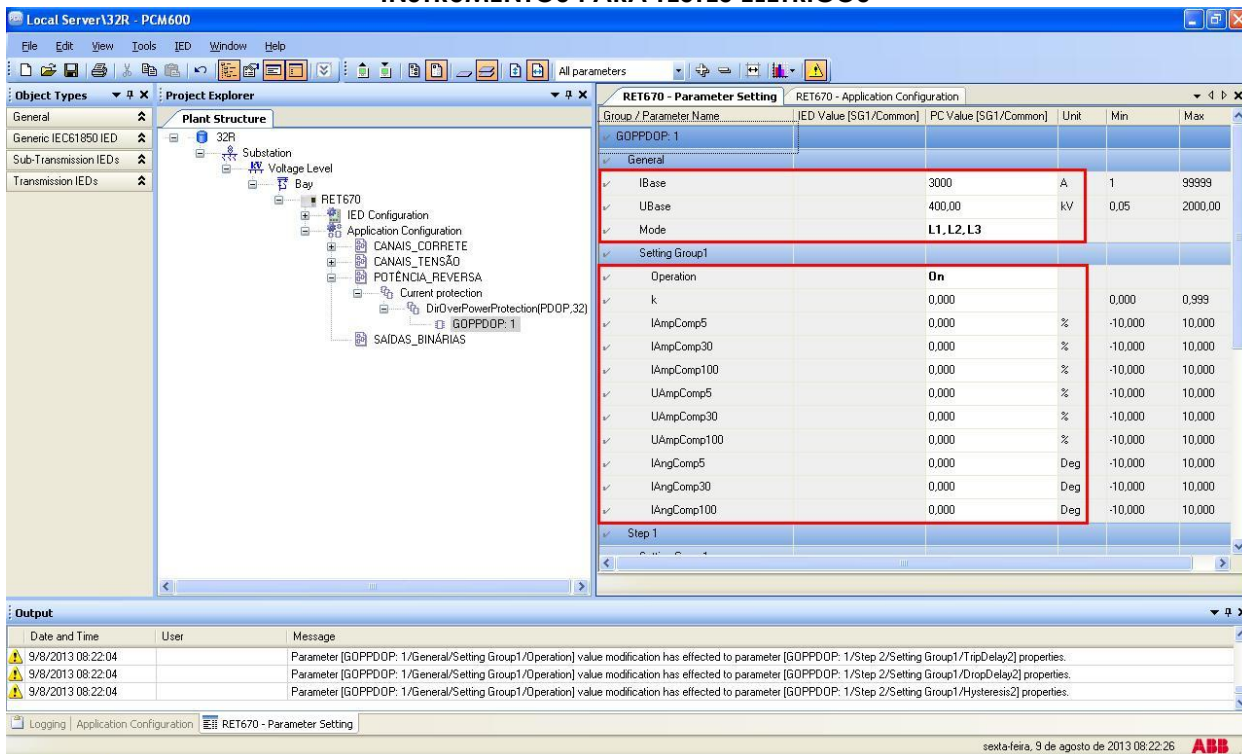


Figure 49

Disable step 2 and click on the icon highlighted in green color to save the changes:

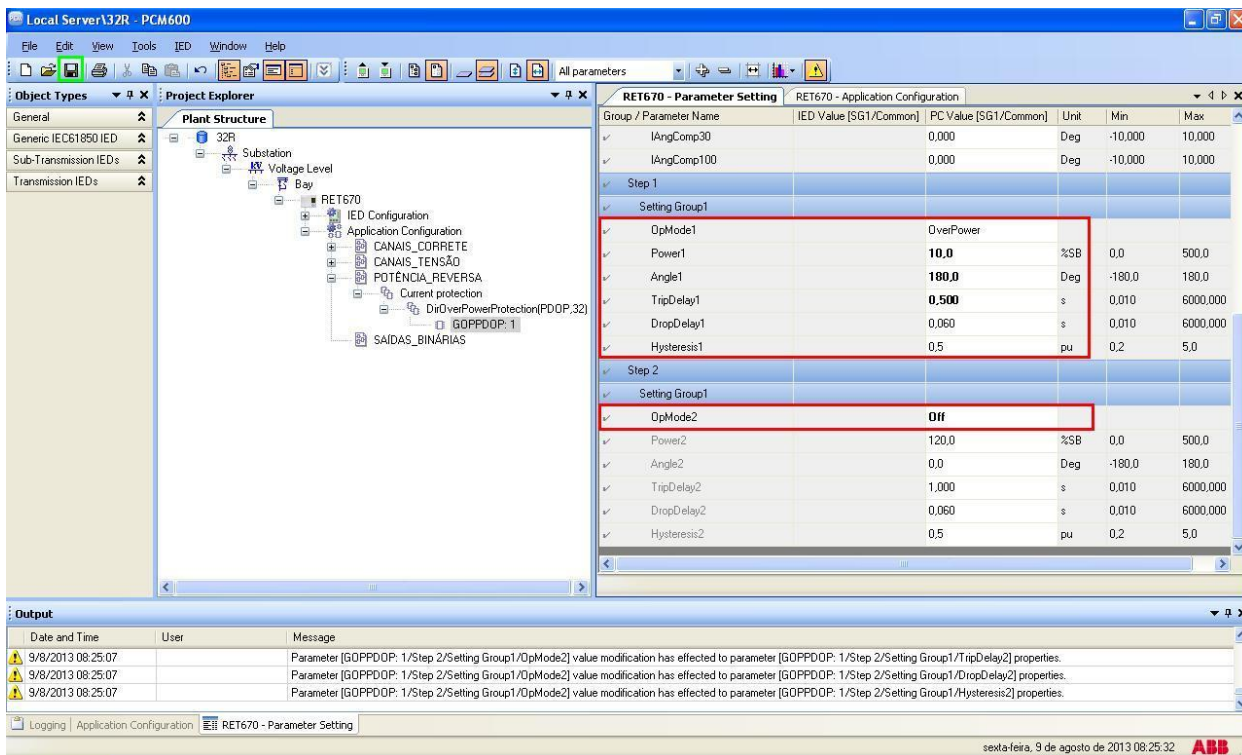


Figure 50

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Right-click on the relay icon and submit the changes. In the following messages click on “Sim”.

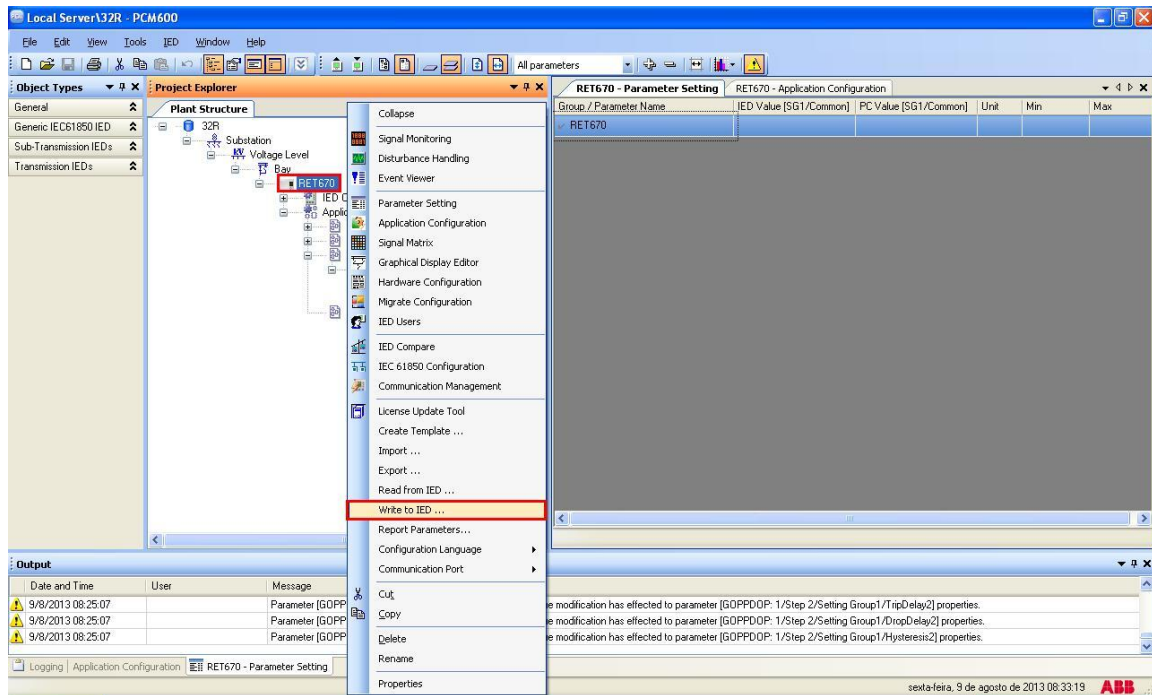


Figure 51



Figure 52

## 4. Power Directional software adjustments

### 4.1 Opening the Power Directional

Click on the “Conprove Test Center” application manager icon.



Figure 53

Click on the Power Directional software icon.

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Figure 54

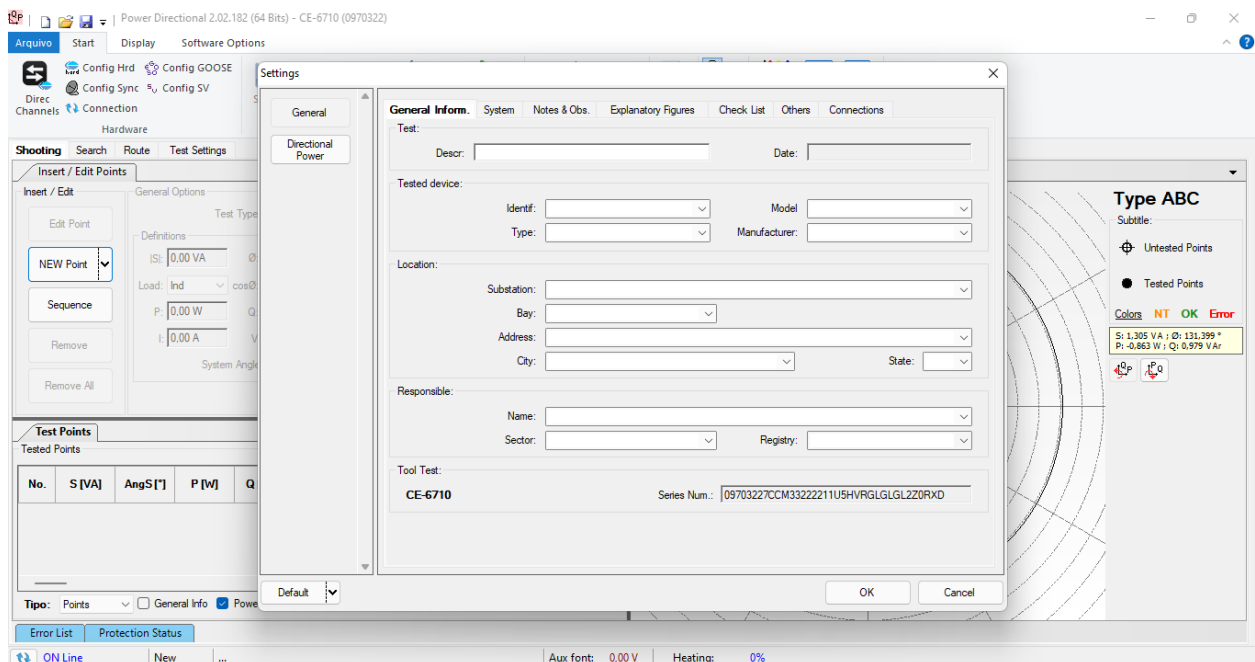


Figure 55

#### 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.

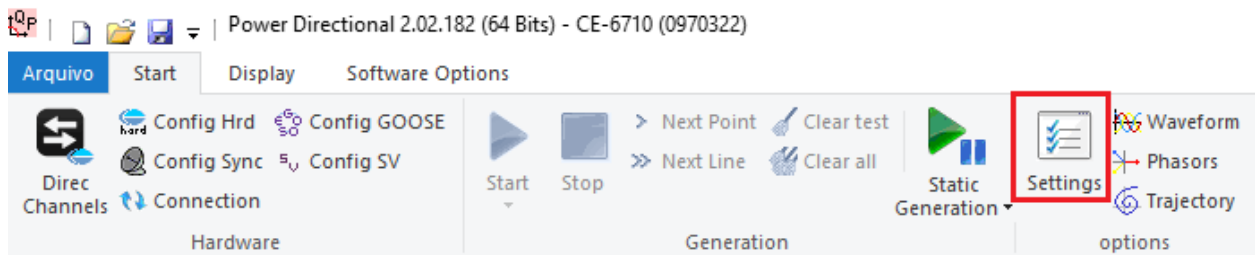


Figure 56

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

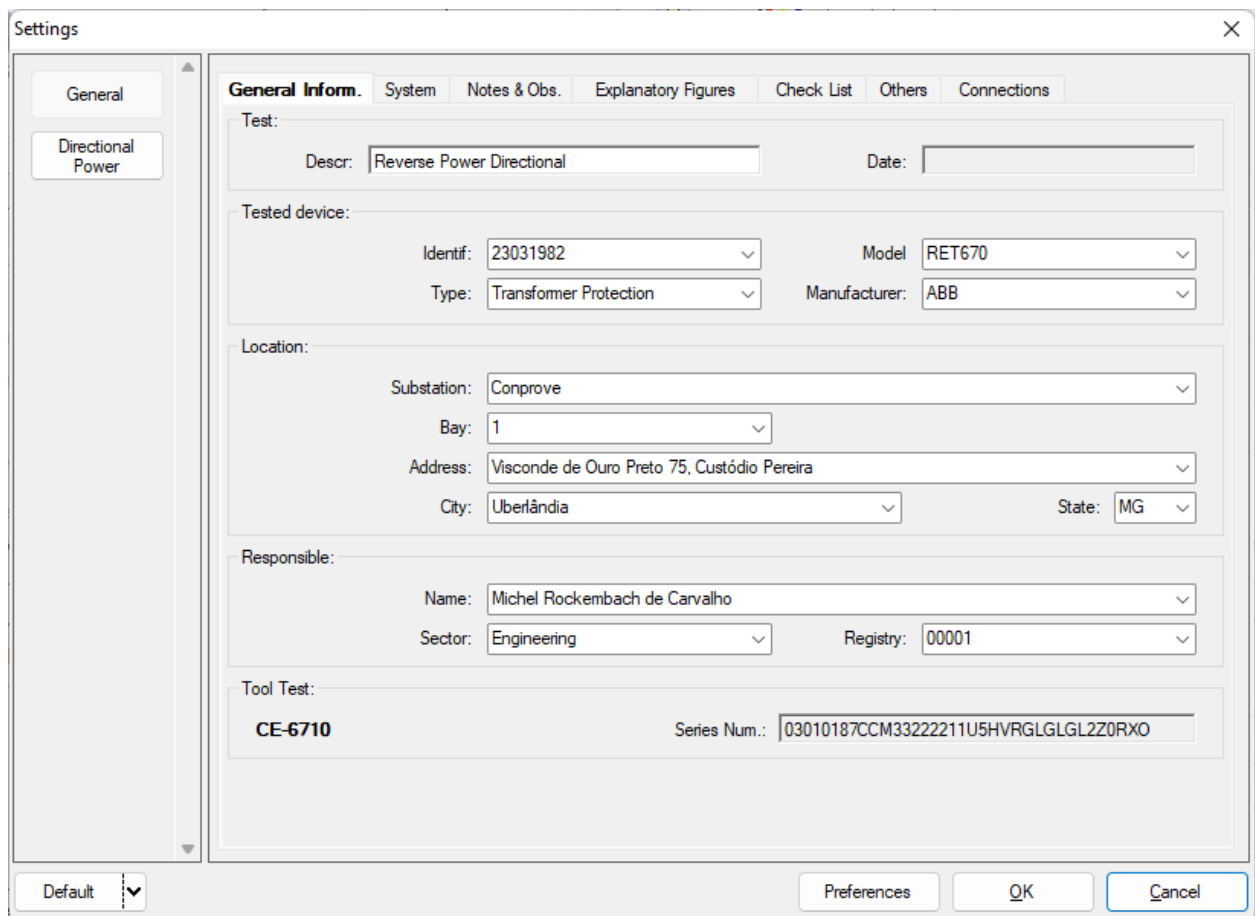


Figure 57



### 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.

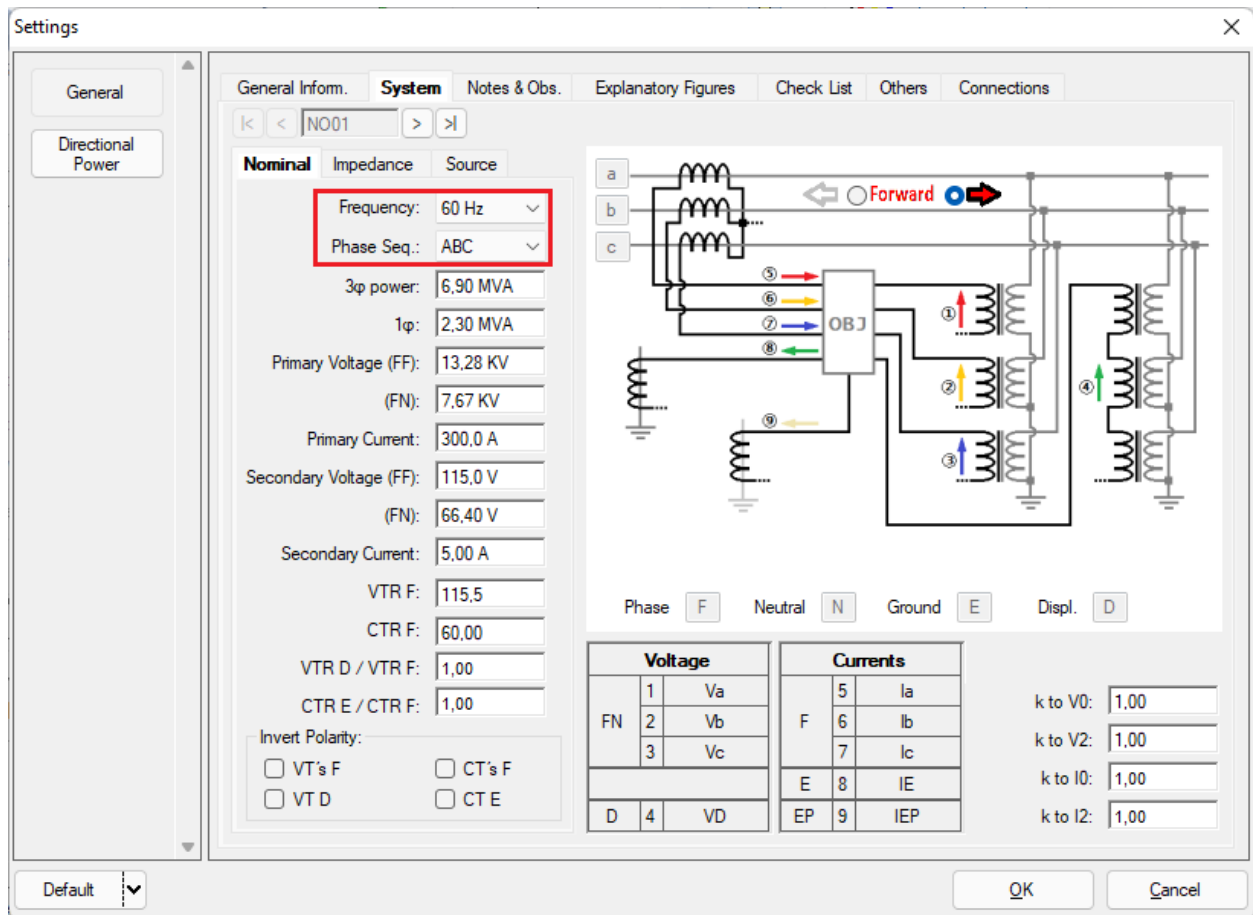


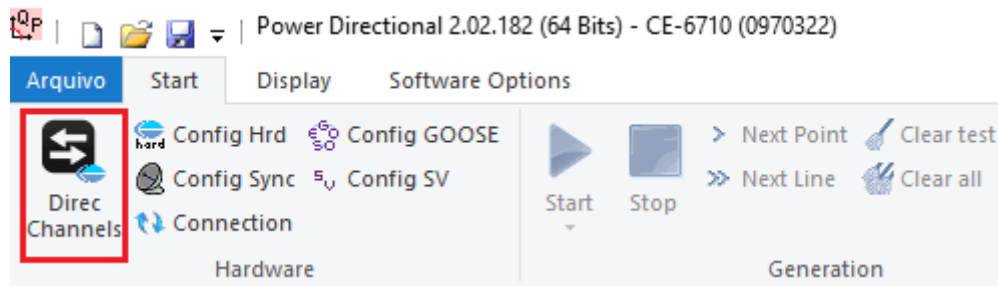
Figure 58

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

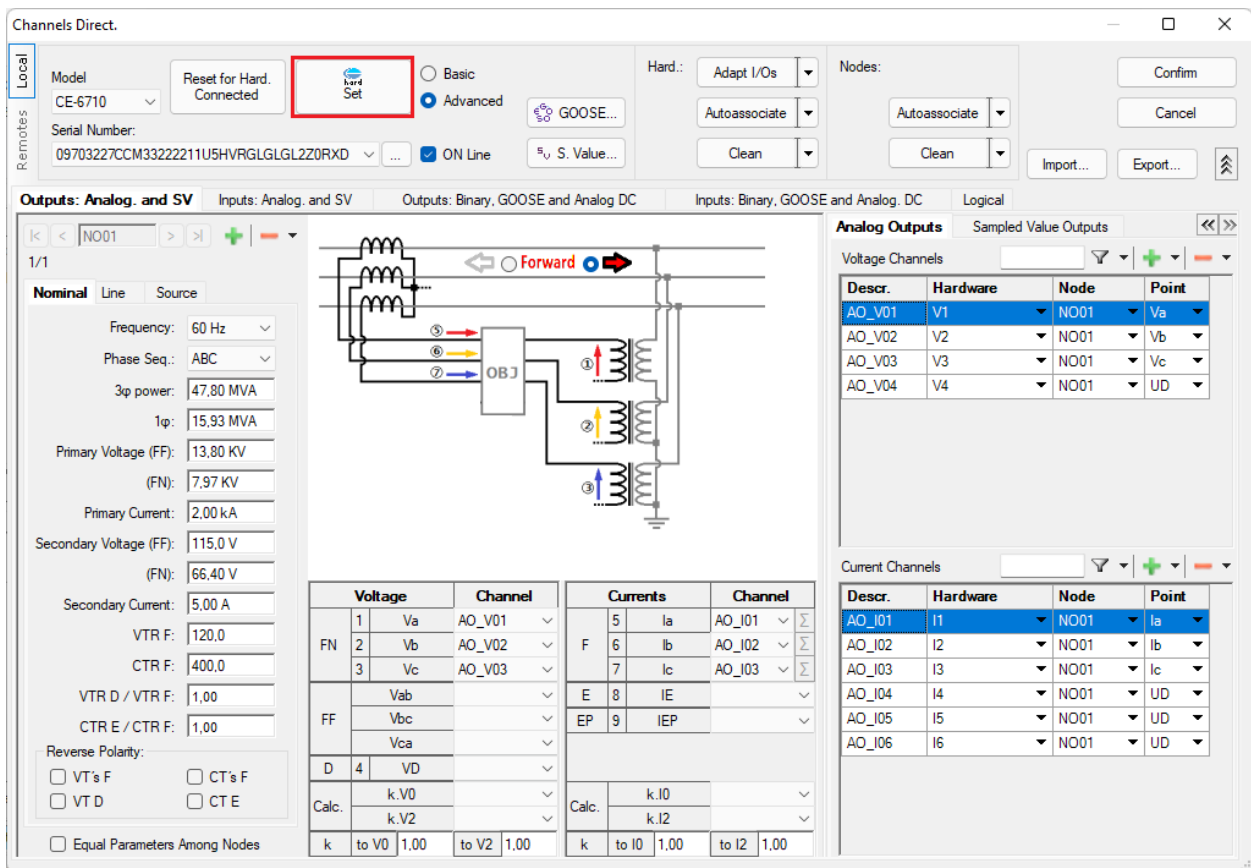
Click on the icon illustrated below.

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**Figure 59**

Then click on the highlighted icon to configure the hardware.



**Figure 60**

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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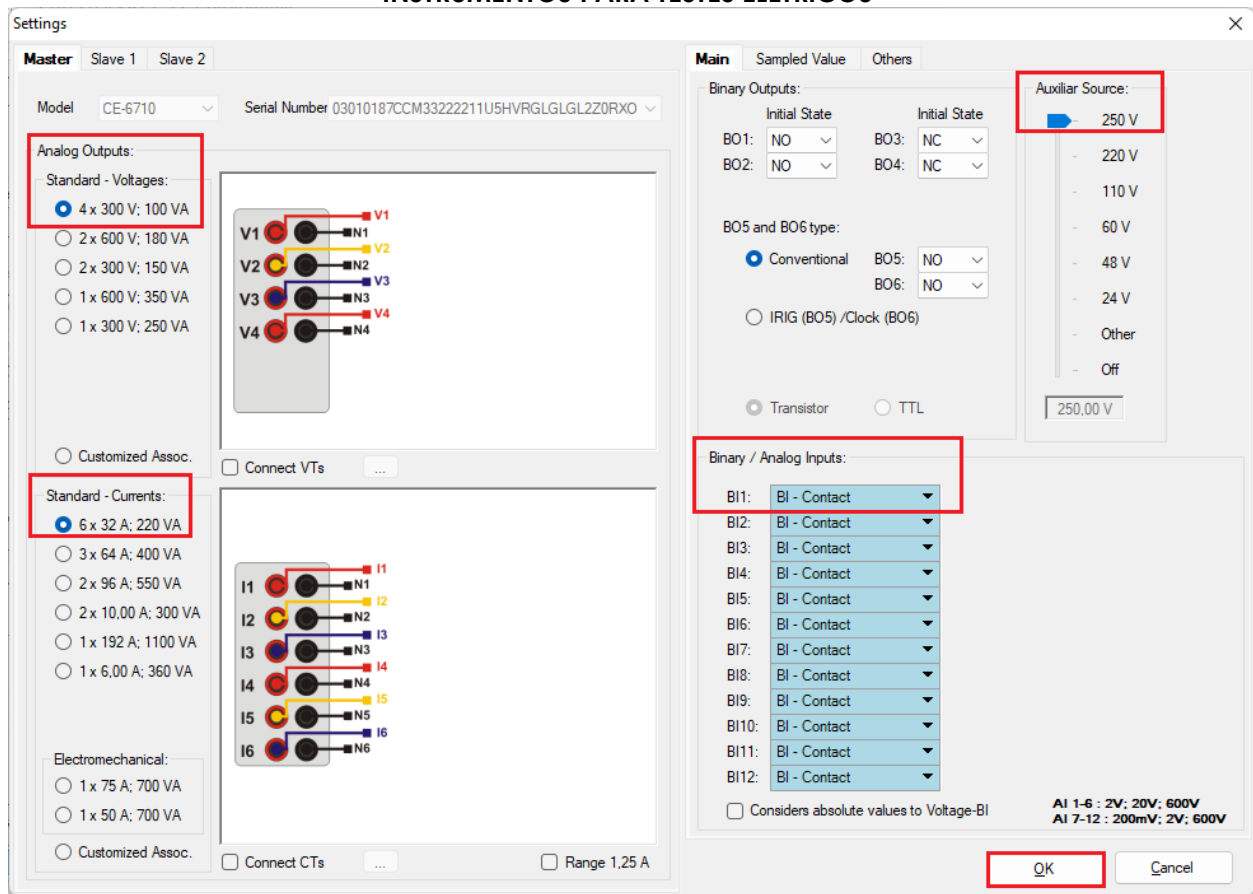


Figure 61

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

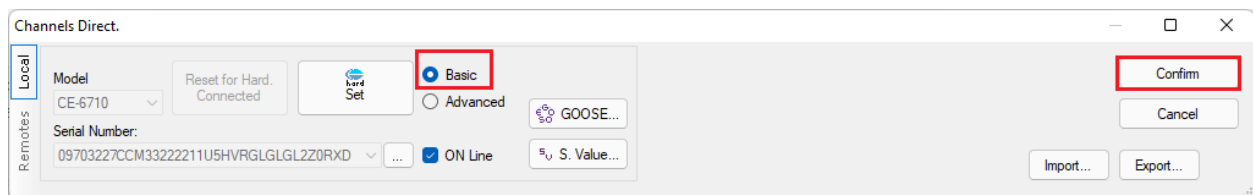


Figure 62

## 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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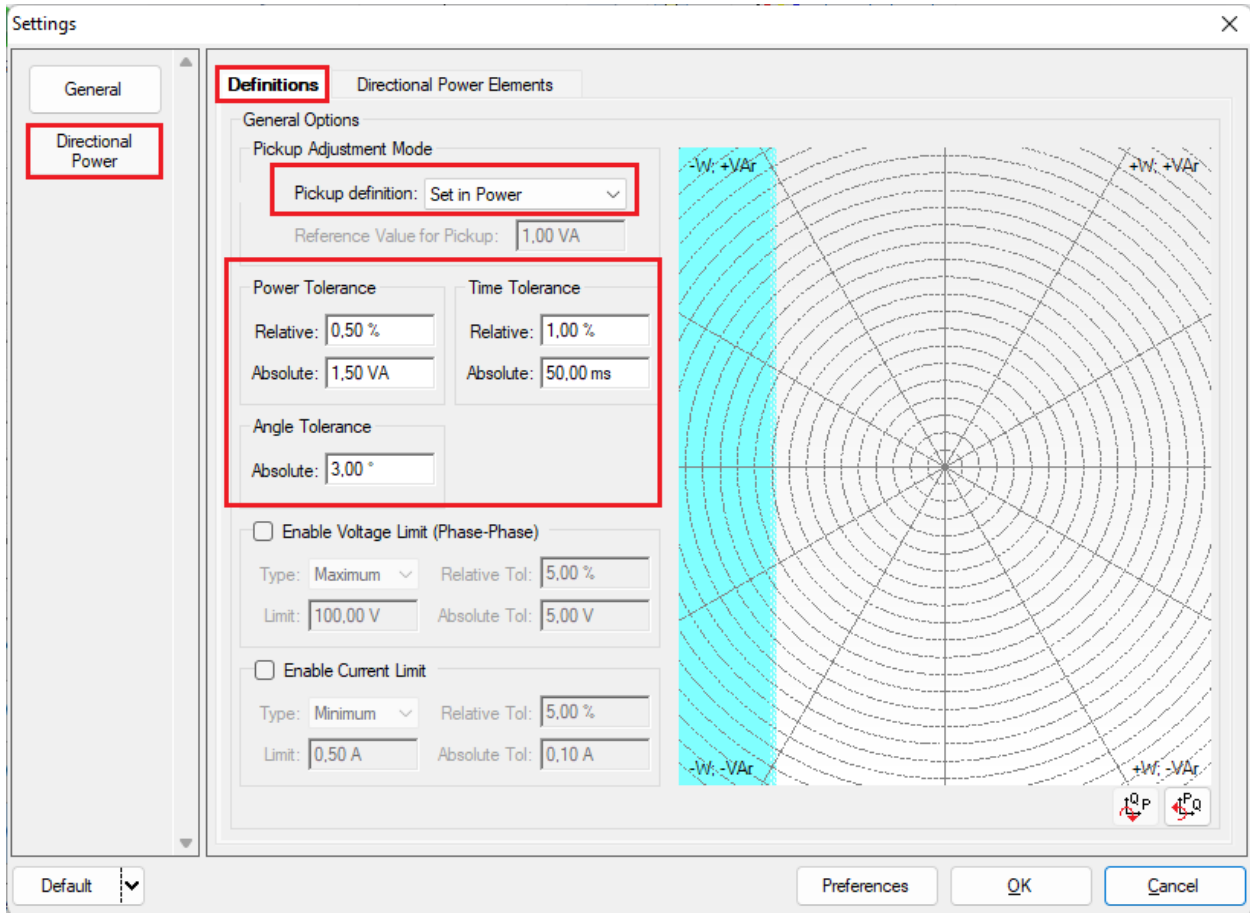
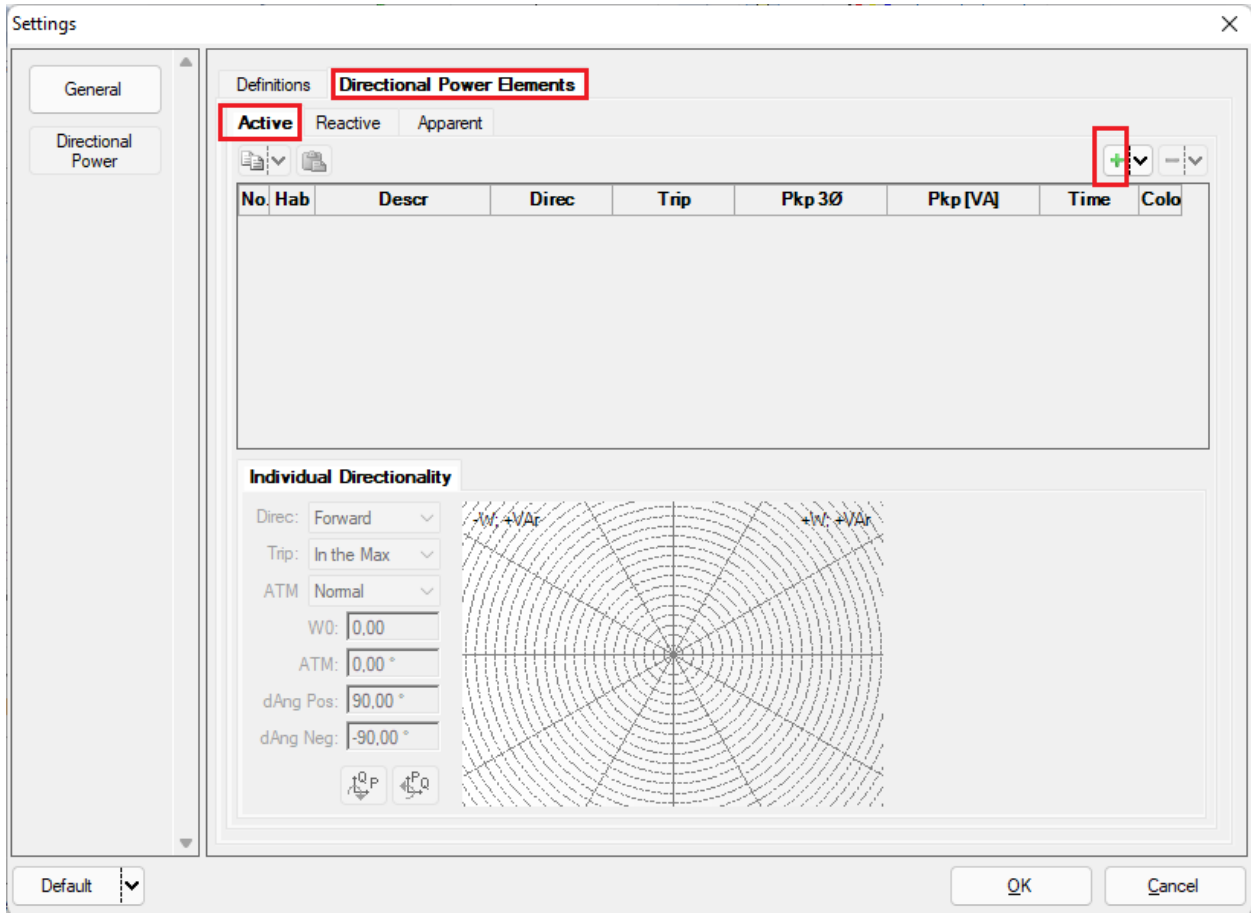


Figure 63

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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**Figure 64**

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:

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

$$P_{secondary} = \frac{1200M}{\left(\frac{400K}{115}\right) * \left(\frac{3K}{5}\right)}$$

$$P_{secondary} = 995,92W$$

$$P_{secondary} = 0,1 * 995,92 \approx 99,60W$$

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

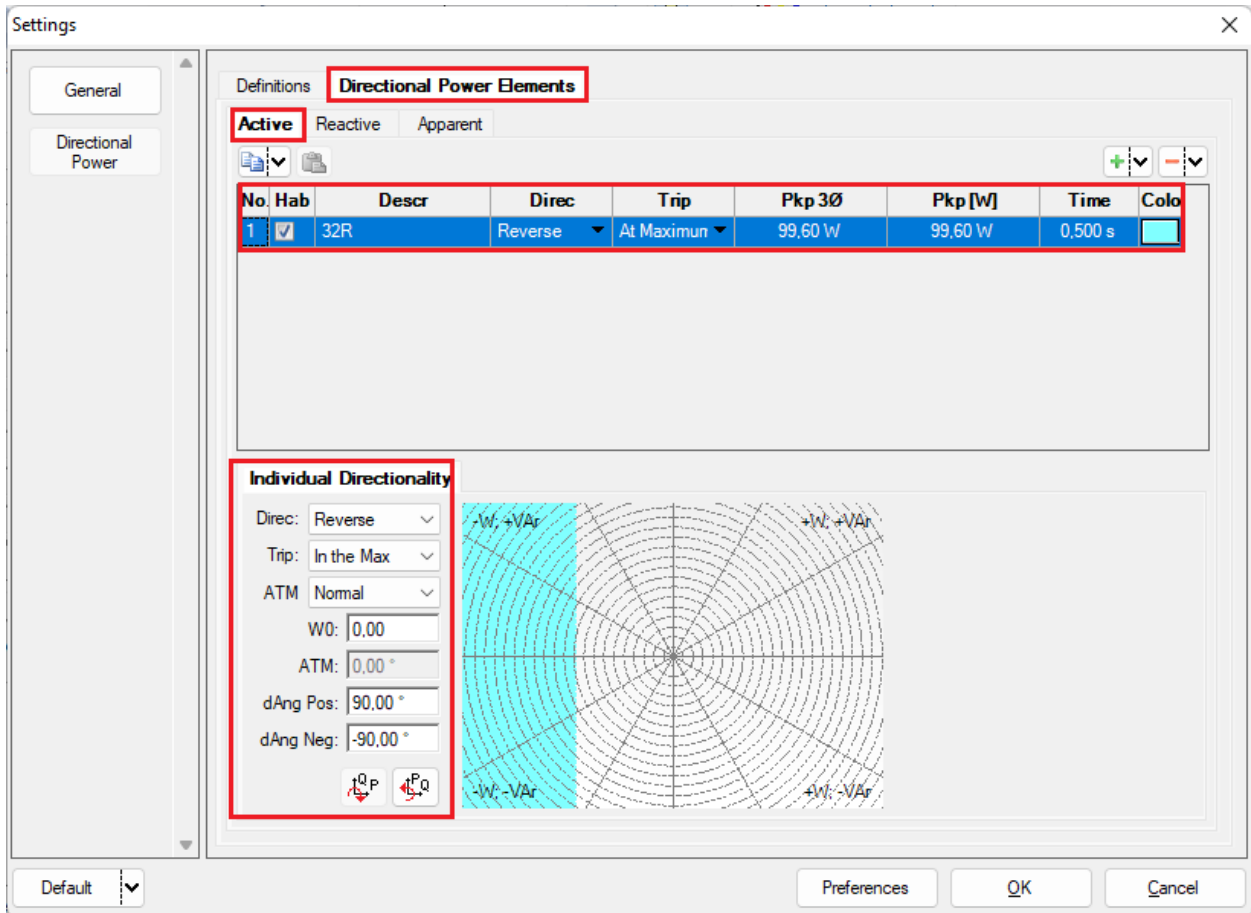


Figure 65

## 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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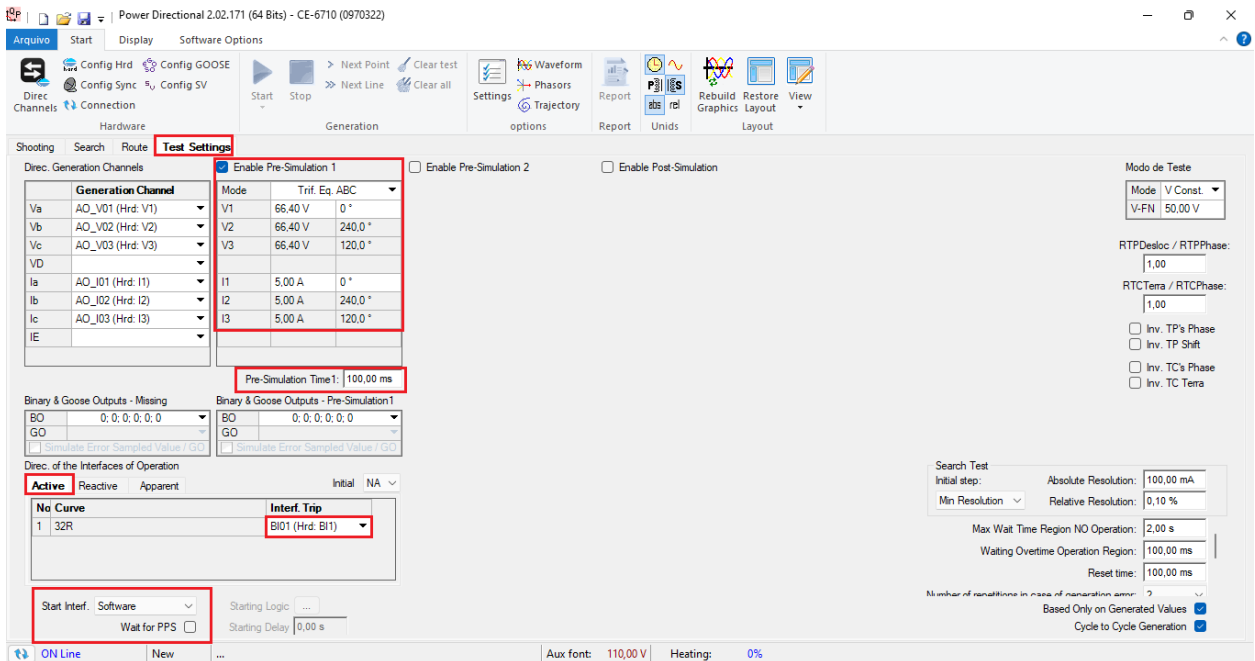


Figure 66

### 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.

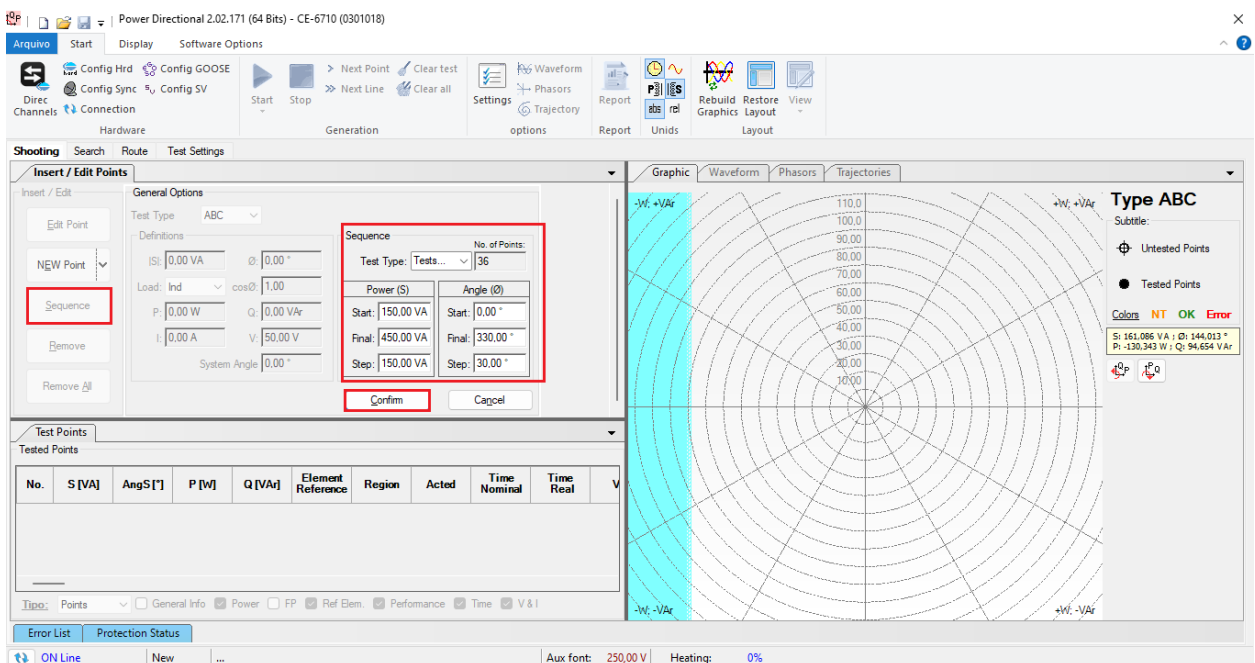


Figure 67

### INSTRUMENTOS PARA TESTES ELÉTRICOS

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

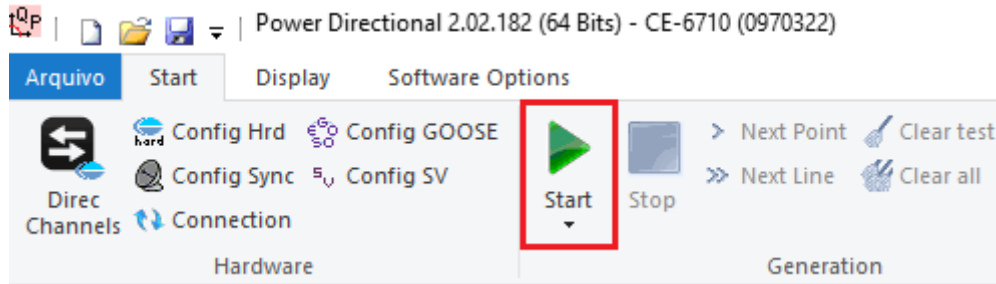


Figure 68

### 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.

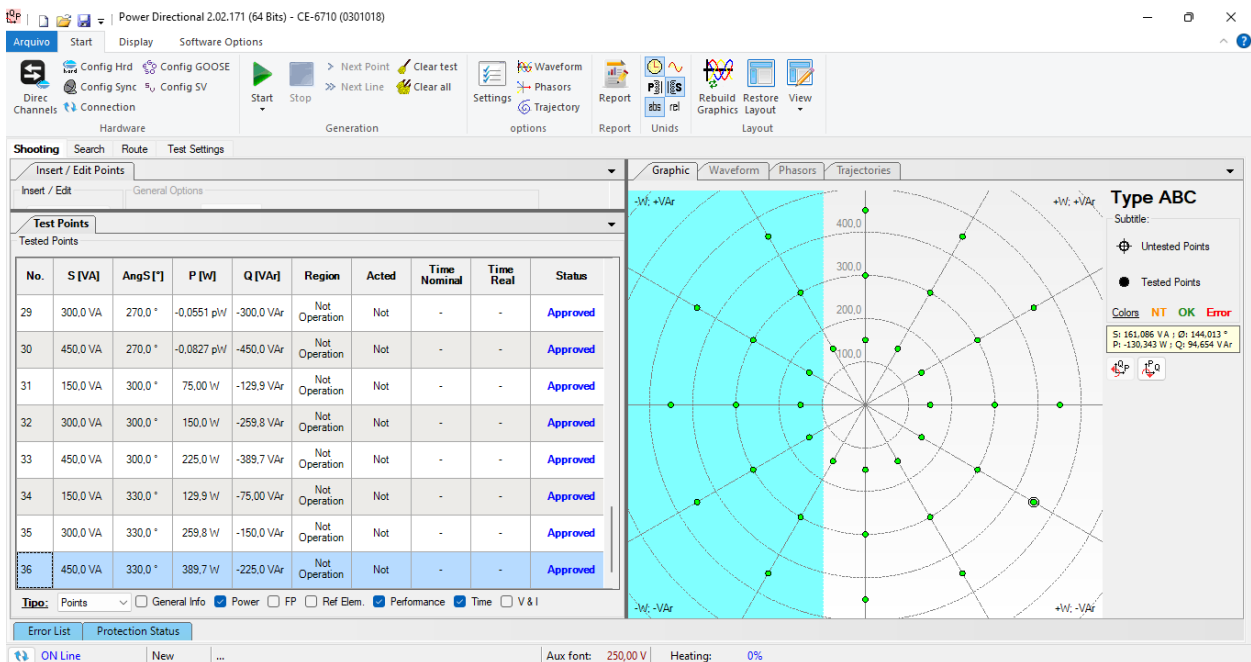


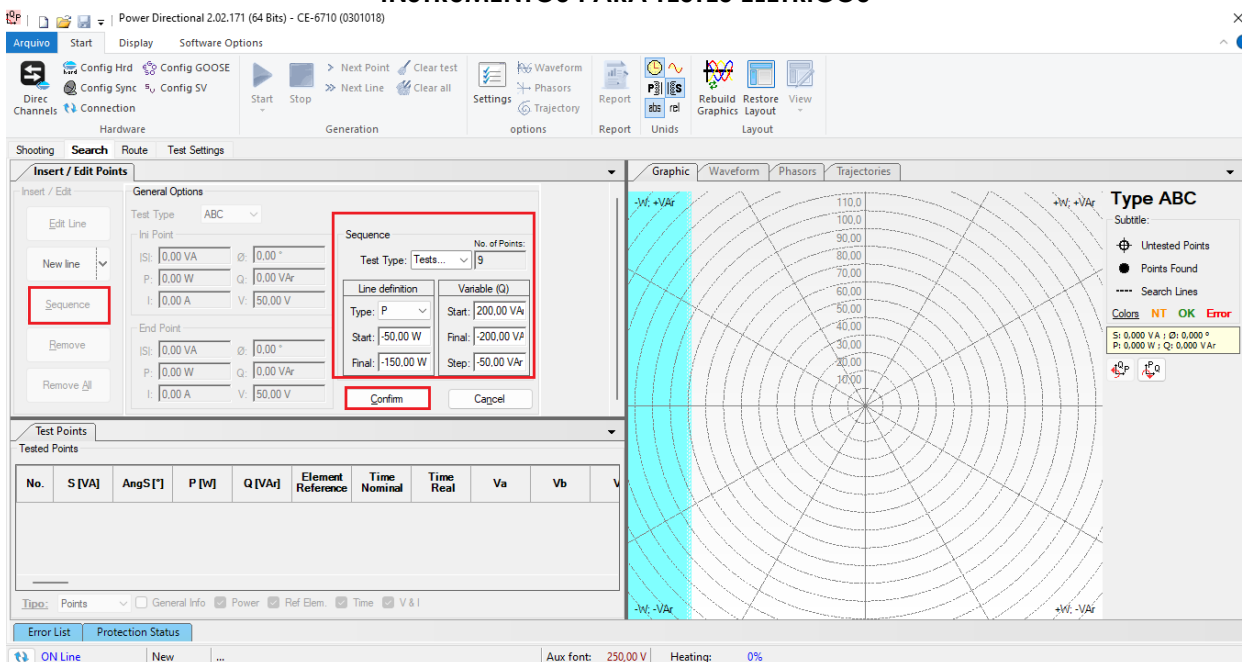
Figure 69

### 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 -50.0W and a final value of -150.0W. In the “*Variable (Q)*” field, the initial value was 200.0VAr, the final value was -200.0VAr and with a step of -50.0VAr.

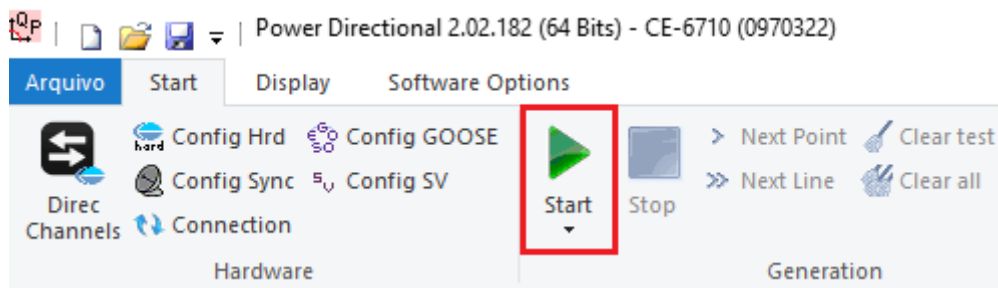


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**Figure 70**

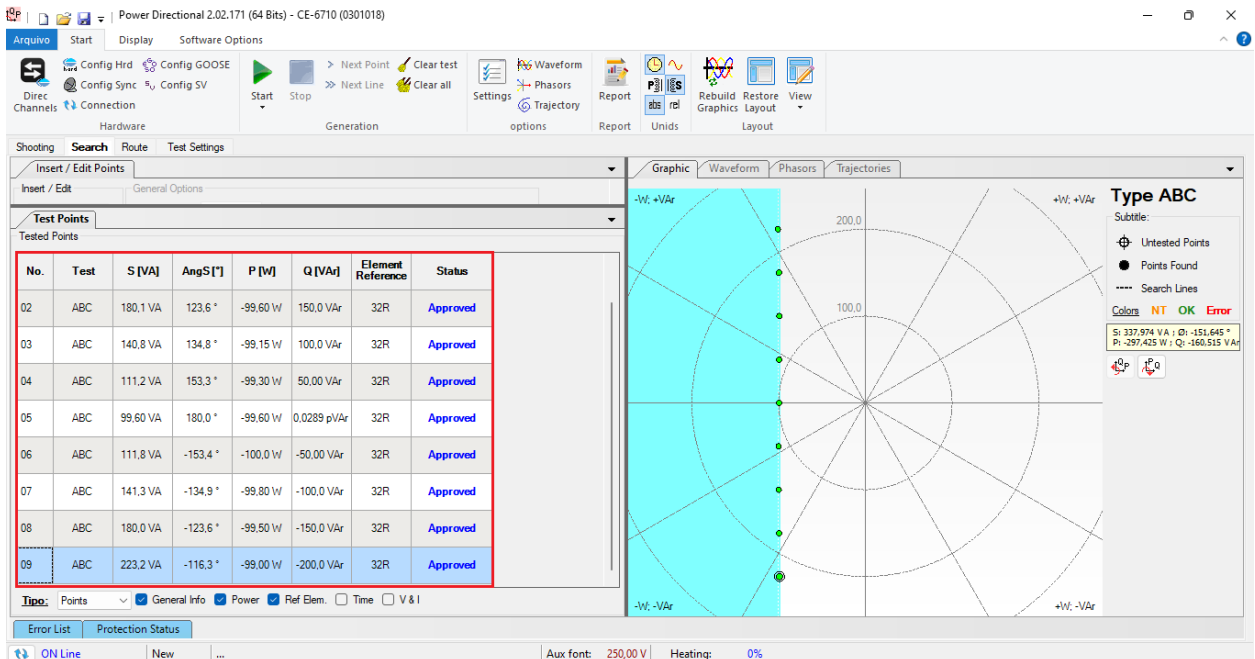
Start the generation by clicking on the icon highlighted below or using the command “*Alt + G*”.



**Figure 71**

### **7.5 Final search test result**

## INSTRUMENTOS PARA TESTES ELÉTRICOS

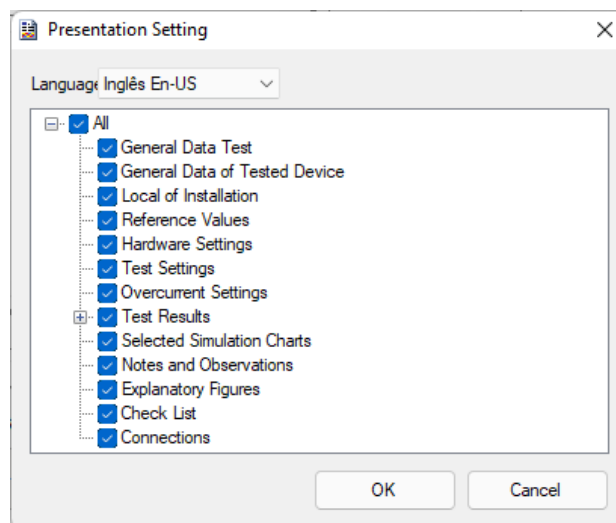


**Figure 72**

It is verified that all active power values are 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 73**

**INSTRUMENTOS PARA TESTES ELÉTRICOS**

Power Directional 2.02.171 (64 Bits) - CE-6710 (0301018)

Arquivo Print preview

Print Page setup Export to Office Word Export to PDF 100 % One page Two pages Previous page Next page Close Print Preview Close



**POWER DIRECTIONAL - TEST REPORT**

**Descr.:** Reverse Power Directional  
**Date:** 27/05/2022 15:30:30  
**Software:** DirecPot\_CTC; Version: 2.02.171  
**Responsible:** Michel Rockenbach de Carvalho

**1. Device Tested**

**Ident.:** 23031982; **Type:** Transformer Protection  
**Model:** RET670; **Manufacturer:** ABB

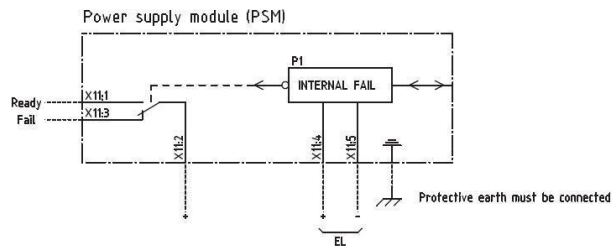
**2. Location**

**Substation:** Conprove  
**Bay:** 1  
**Address:** Visconde de Ouro Preto 75, Custódio Pereira  
**City:** Uberlândia; **State:** MG

Printing Preview... Nº of Pages: 11

APPENDIX A

A.1 Terminal Designations



Power supply module (PSM)

Figure 74

Transformer input module (TRM)

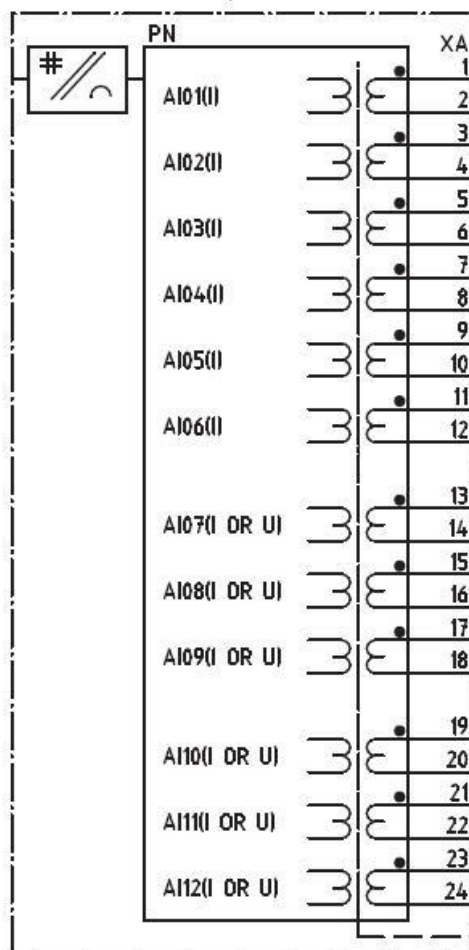


Figure 75

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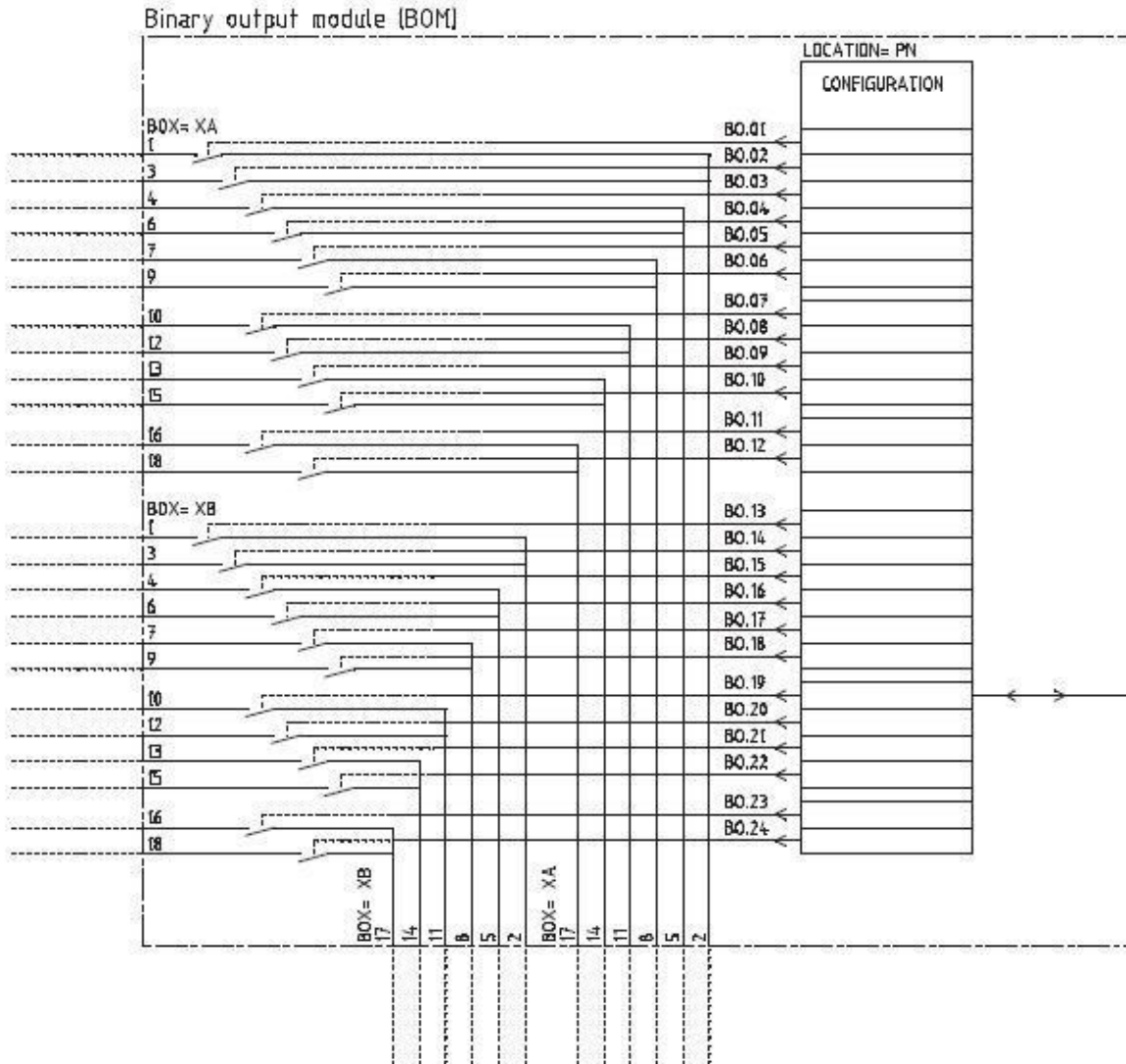


Figure 76

A.2 Technical Data

*GOPDOP technical data*

Function	Range or value	Accuracy
Power level	(0.0-500.0)% of $S_{base}$  At low setting: (0.5-2.0)% of $S_{base}$ (2.0-10)% of $S_{base}$	$\pm 1.0\%$ of $S_r$ at $S < S_r$ $\pm 1.0\%$ of $S$ at $S > S_r$  < $\pm 50\%$ of set value < $\pm 20\%$ of set value
Characteristic angle	(-180.0-180.0) degrees	2 degrees
Timers	(0.00-6000.00) s	$\pm 0.5\% \pm 10$ ms

**APPENDIX B**

**Equivalence of software parameters and the relay under test.**

Table 1

Power Directional Software		RET 670 Relay	
Parameter	Figure	Parameter	Figure
<b>Pkp 3<math>\Phi</math></b>	<b>65</b>	<b>Power 1</b>	<b>50</b>
<b>Time</b>	<b>65</b>	<b>Angle 1</b>	<b>50</b>