



INSTRUMENTOS PARA TESTES ELÉTRICOS

# Test Tutorial

**Equipment Type:** Protection Relay

**Brand:** Schneider

**Model:** SEPAM T87

**Function:** 87 or PDIF Differential Percentage

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

**Objective:** Test Settings, Testing Point and Survey of Feature Slope

**Version control:**

Version	Descriptions	Date	Author	Reviewer
1.0	Initial release	27/10/2021	M.R.C.	M.P.S

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### **Statement of responsibility**

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Suggestions for improvement of this material are welcome, just user contacts us via email [suporte@conprove.com.br](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 tested should always be consulted.



### **ATTENTION!**

The equipment generates high current and voltage values during its operation. Improper use of the equipment can result in material and physical damage.

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

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**INSTRUMENTOS PARA TESTES ELÉTRICOS**  
**Sequence for T87 relay tests in Differential software**

**1. Relay connection to CE-6006**

Appendix A shows the relay terminal designations.

**1.1 Auxiliary Source**

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

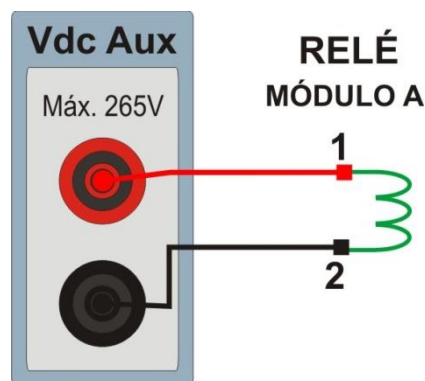


Figure 1

**1.2 Current Coils**

To establish the connection of the current coils, connect the current channels I1, I2 and I3 to pins 4, 5 and 6 of the relay module B1 (Appendix A) and connect the common of the current channels to pins 1, 2 and 3 of relay module B1. For current channels I4, I5 and I6 to pins 4, 5 and 6 of module B2 (Appendix A) of the relay and connect the commons of current channels to pins 1, 2 and 3 of module B2 of the relay.

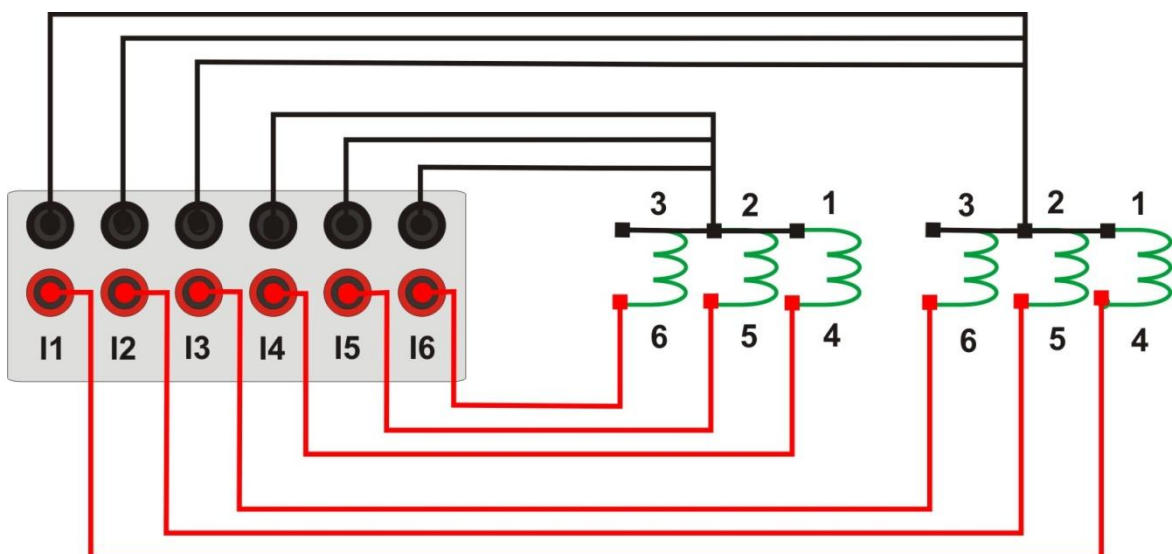


Figure 2

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**1.3 Binary Inputs**

Connect the CE-6006 binary inputs to the relay binary outputs.

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

The following figure shows the details of the connections.

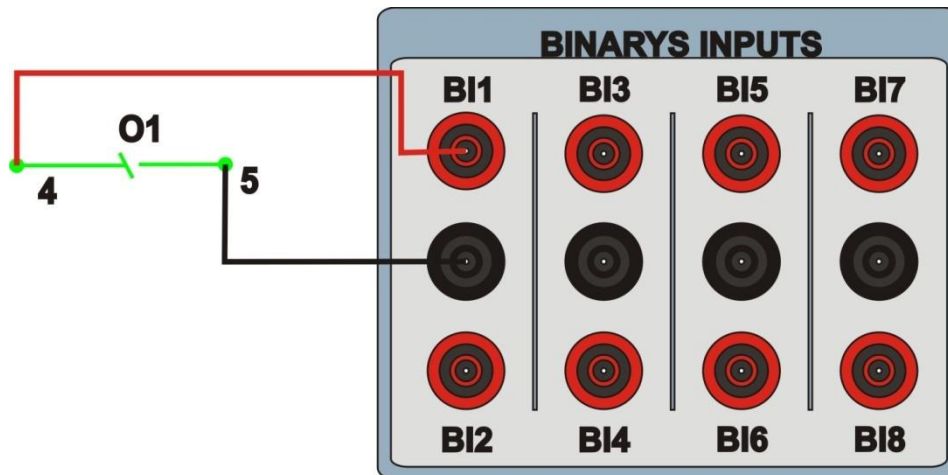


Figure 3

**2. Communication with the SEPAM T87 relay**

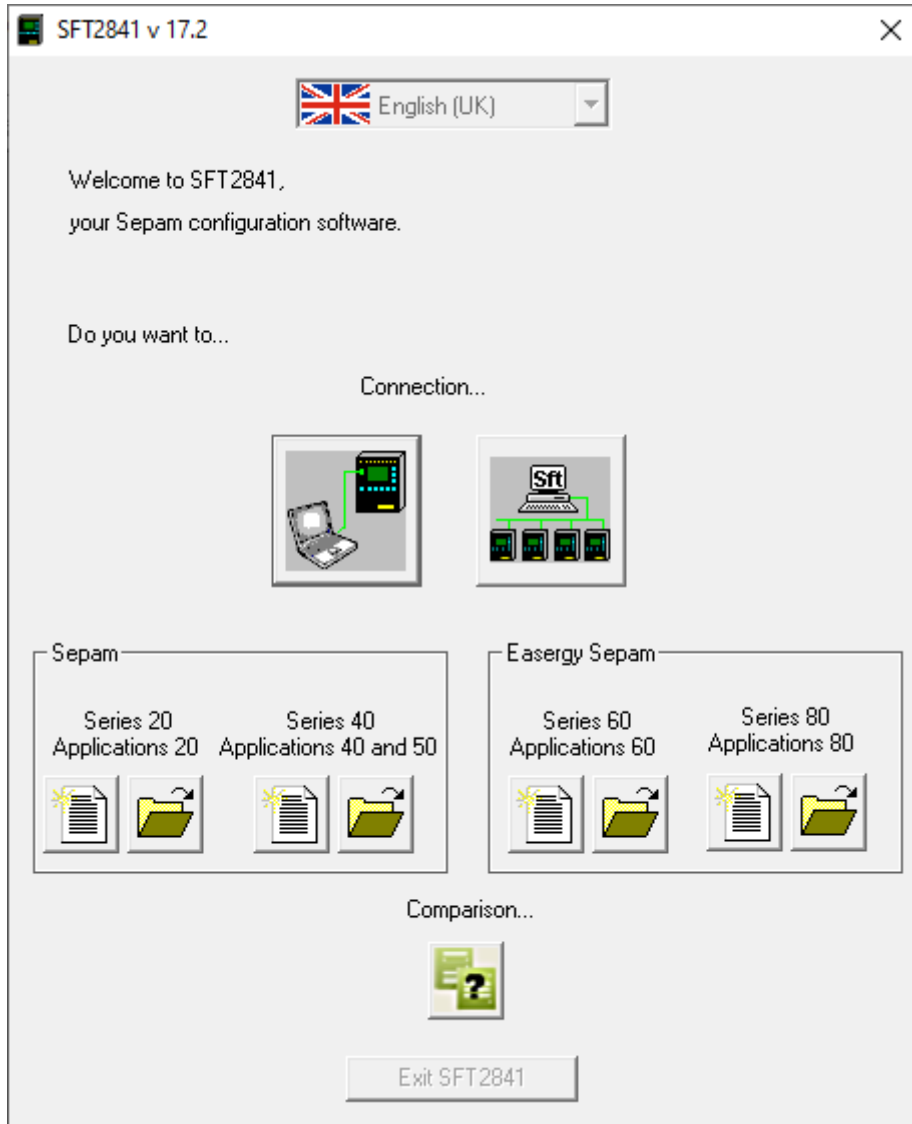
First, a serial cable from the notebook is connected to the relay. Then double-click on the *SFT2841* software icon.



Figure 4

When opening the program, the following screen is shown:

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**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:

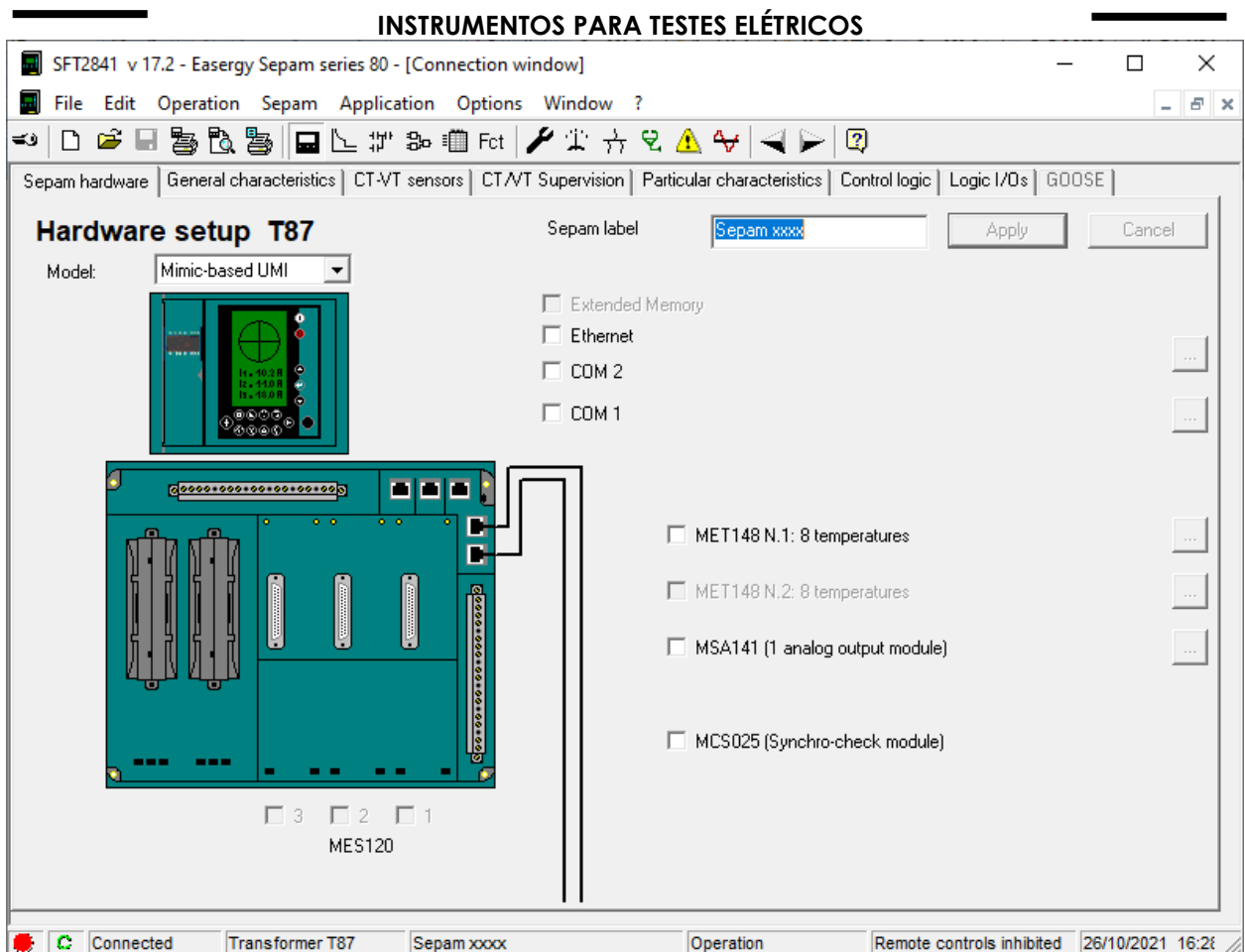


Figure 7

### 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

<b>Network frequency</b>	60Hz
<b>Phase rotation direction</b>	1_2_3
<b>Active setting group</b>	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.

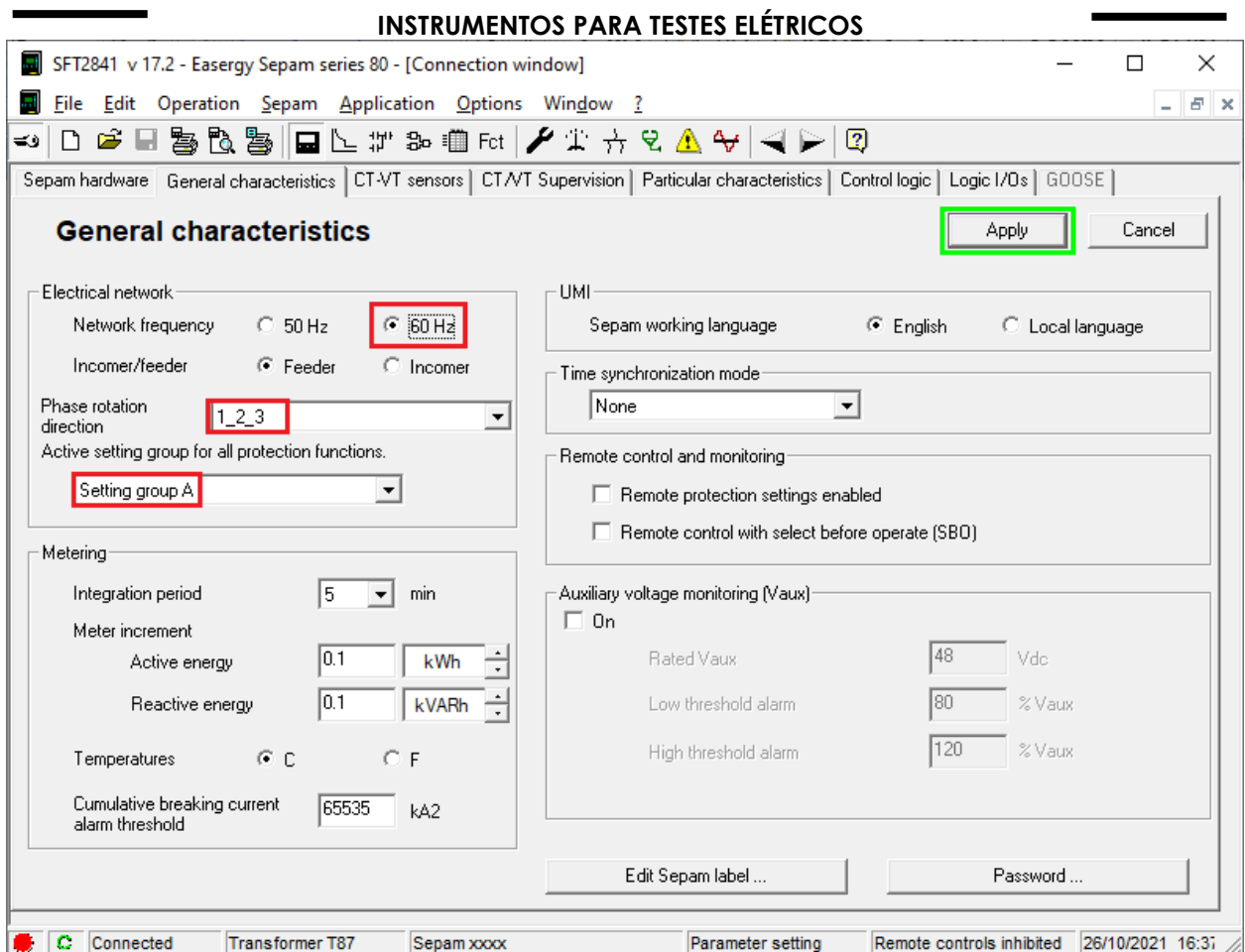


Figure 8

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.

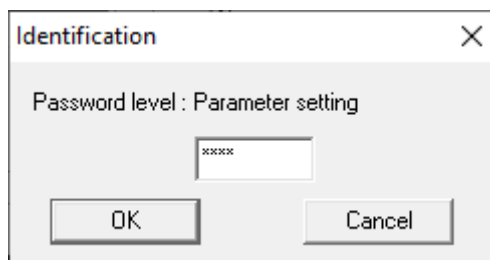


Figure 9

Enter your password for the changes to take place.

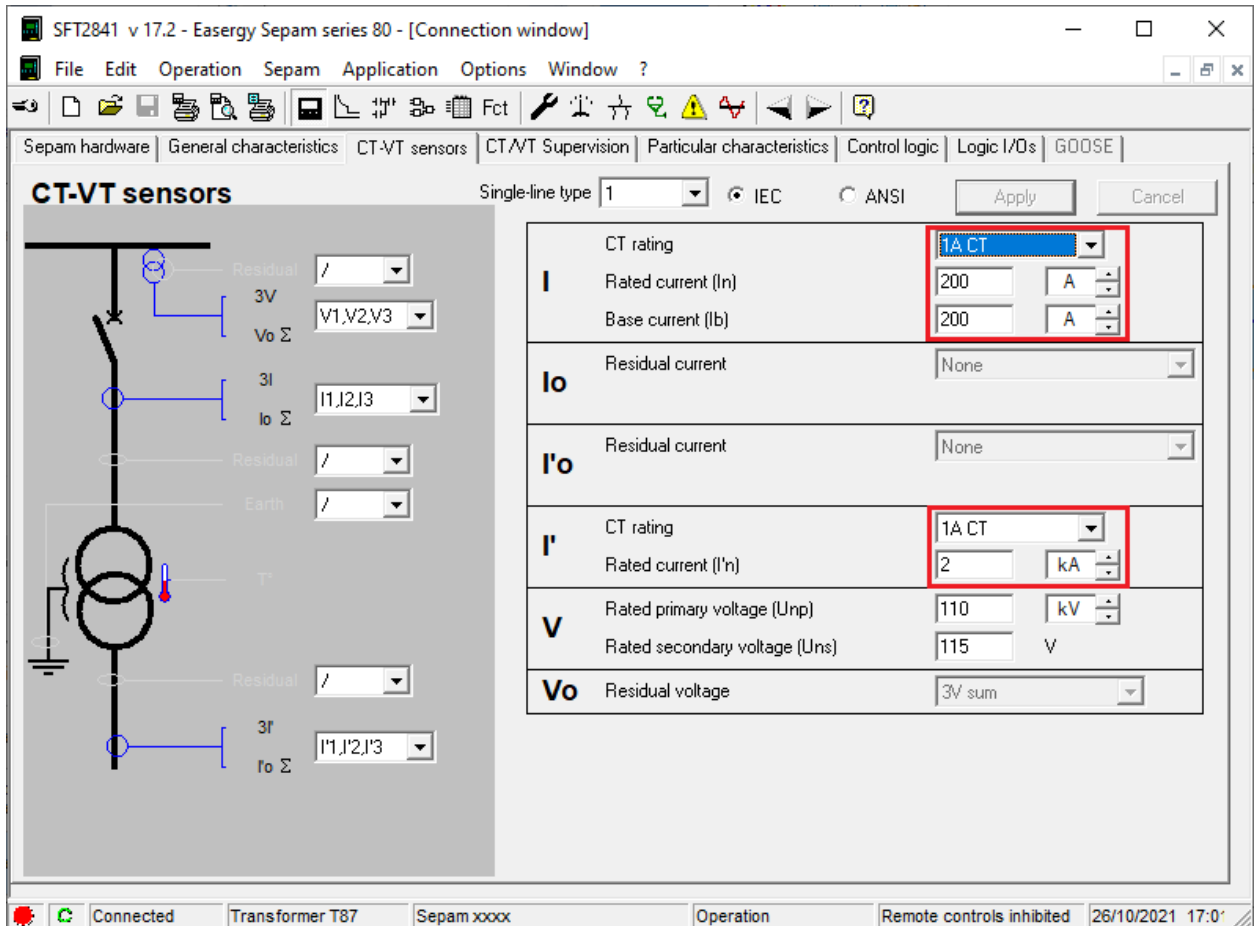
**Note: The default password is 0000.**



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**3.2 CT-VT sensors**

In this field, adjust the nominal currents of the CTs and the transformation ratios.



**Figure 10**

**3.3 CT/VT Supervision**

In this tutorial this functionality is not used.

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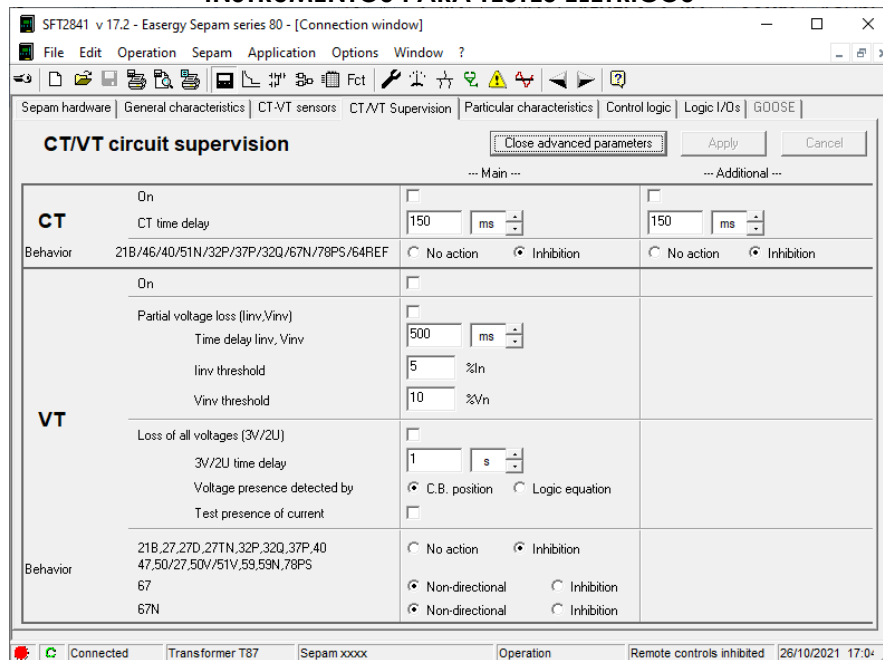


Figure 11

### 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.

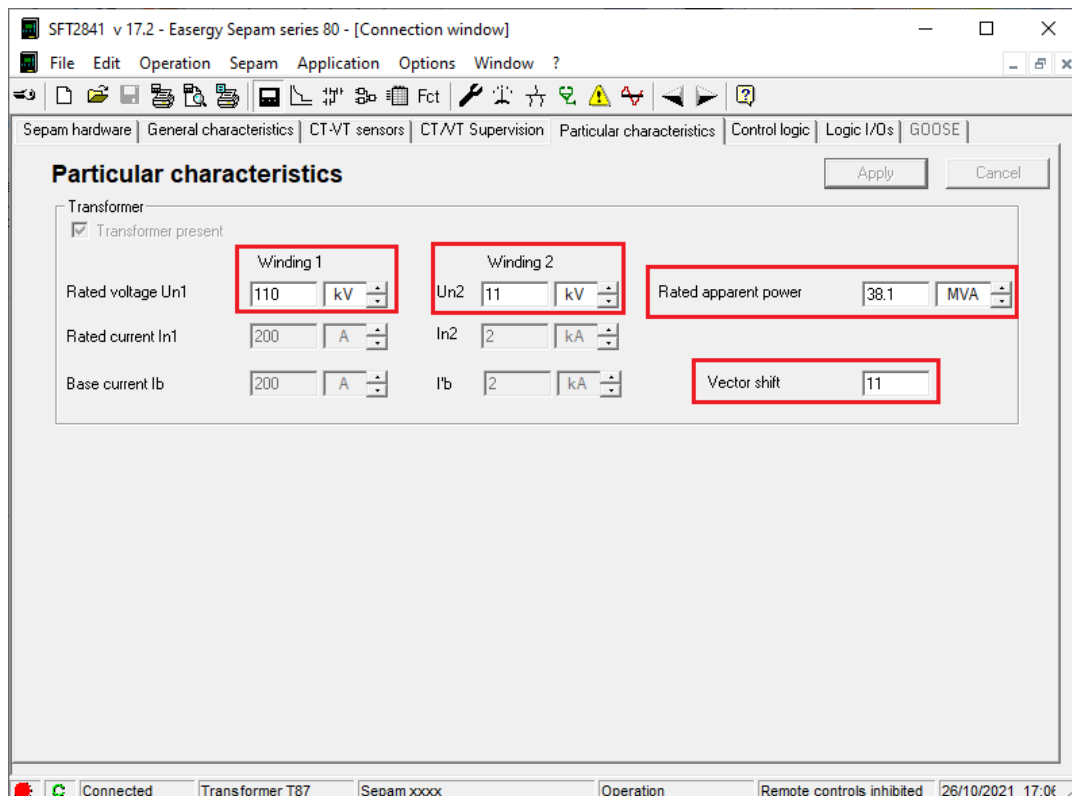


Figure 12

### 3.5 Control logic

Disable the options in this field.

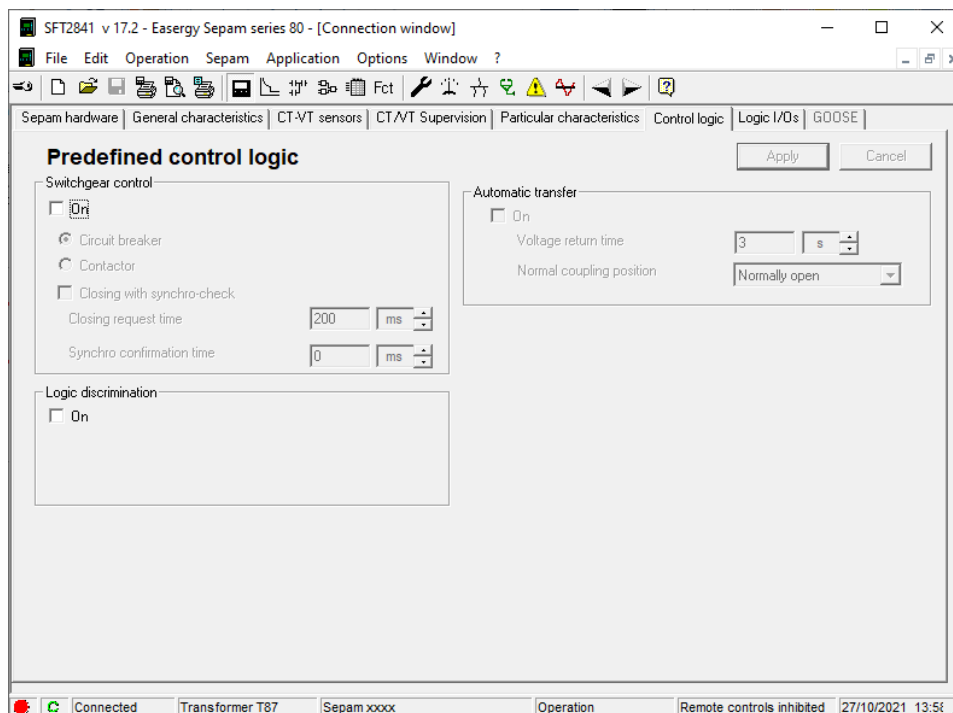


Figure 13

### 3.6 Logic I/O s

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

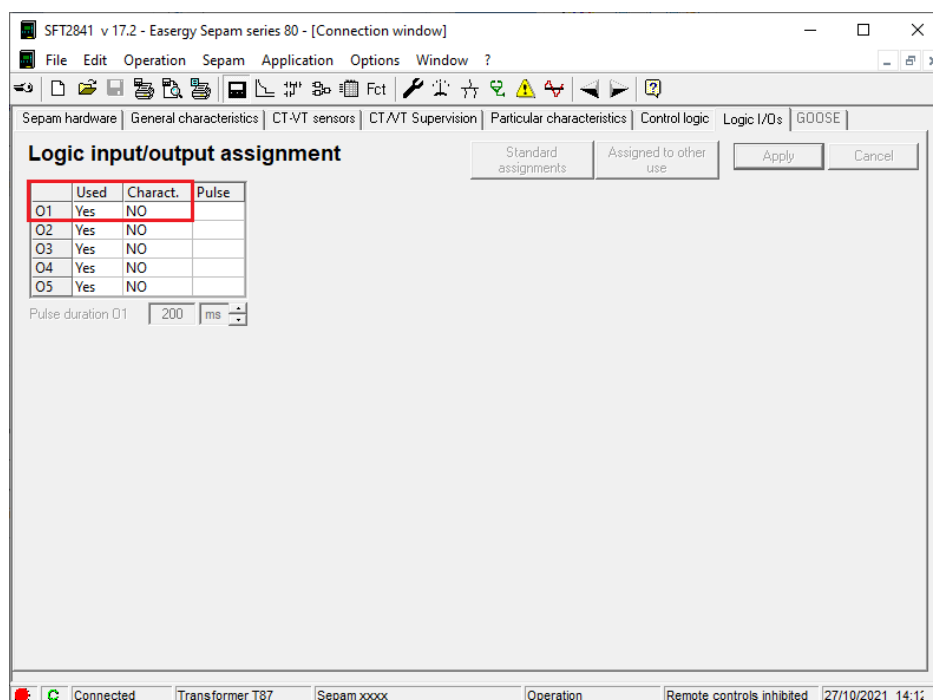


Figure 14

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The next step is to adjust the parameters of the differential function. To do this click on the icon below:

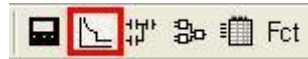


Figure 15

#### 3.7 87T: Transformer differential

In this window, configure the data of the differential function. There is the possibility to choose the “Conventional” option that releases the harmonic restraint settings, or the “Adaptive” option whose harmonic restraint adjustments are made by the relay. The purpose of this tutorial is to test function 87 so this adjustment will not influence the test. The table below shows the slope settings, the shift point, the percent differential element pick-up setting, and the instantaneous.

Table 2

<b>87-1</b>	30% In1
<b>87-2</b>	5,0In1
<b>Slope 1</b>	30%
<b>Slope 2</b>	60%
<b>Slope change point</b>	3In1

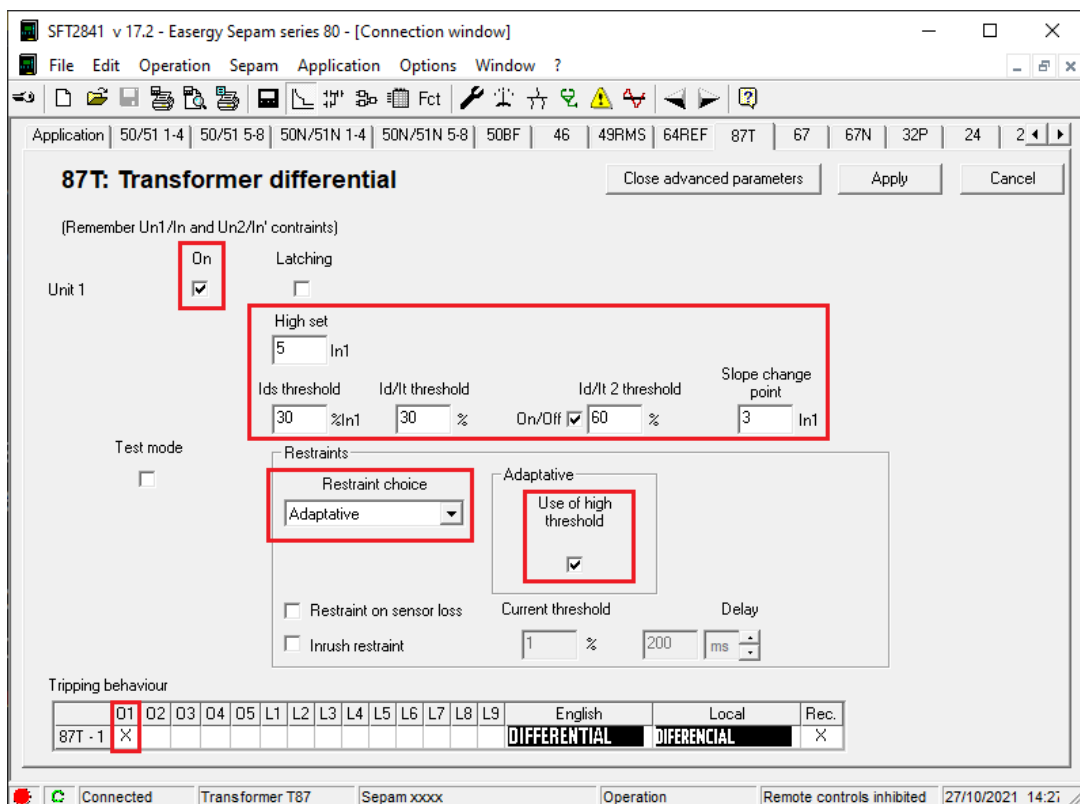


Figure 16

**Note:** The other functions are all disabled so as not to interfere with the 87 test.

### 3.8 Matrix

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

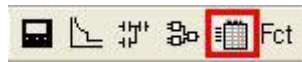


Figure 17

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

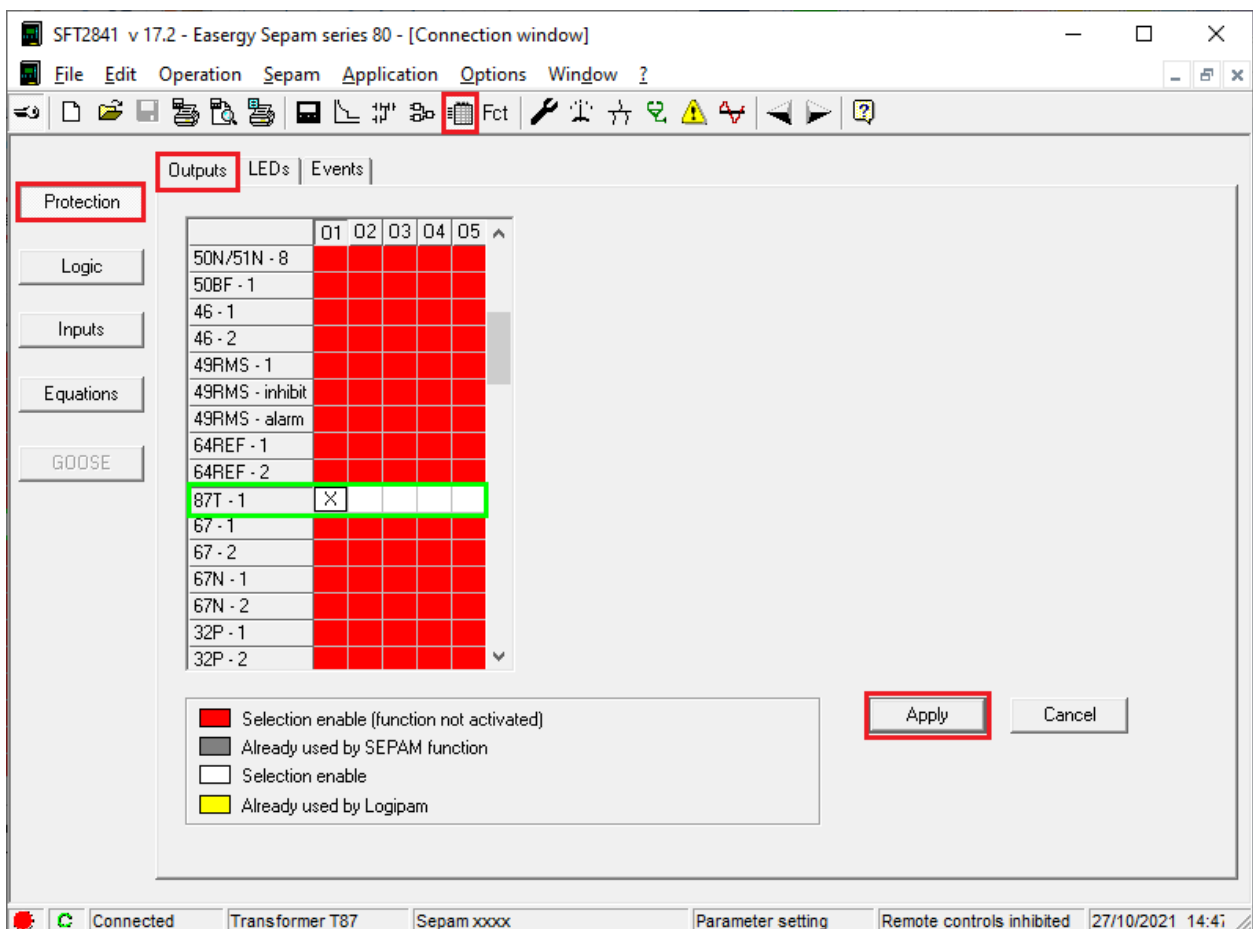


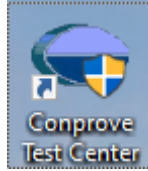
Figure 18

## 4. Differential software adjustments

### 4.1 Opening the Differential

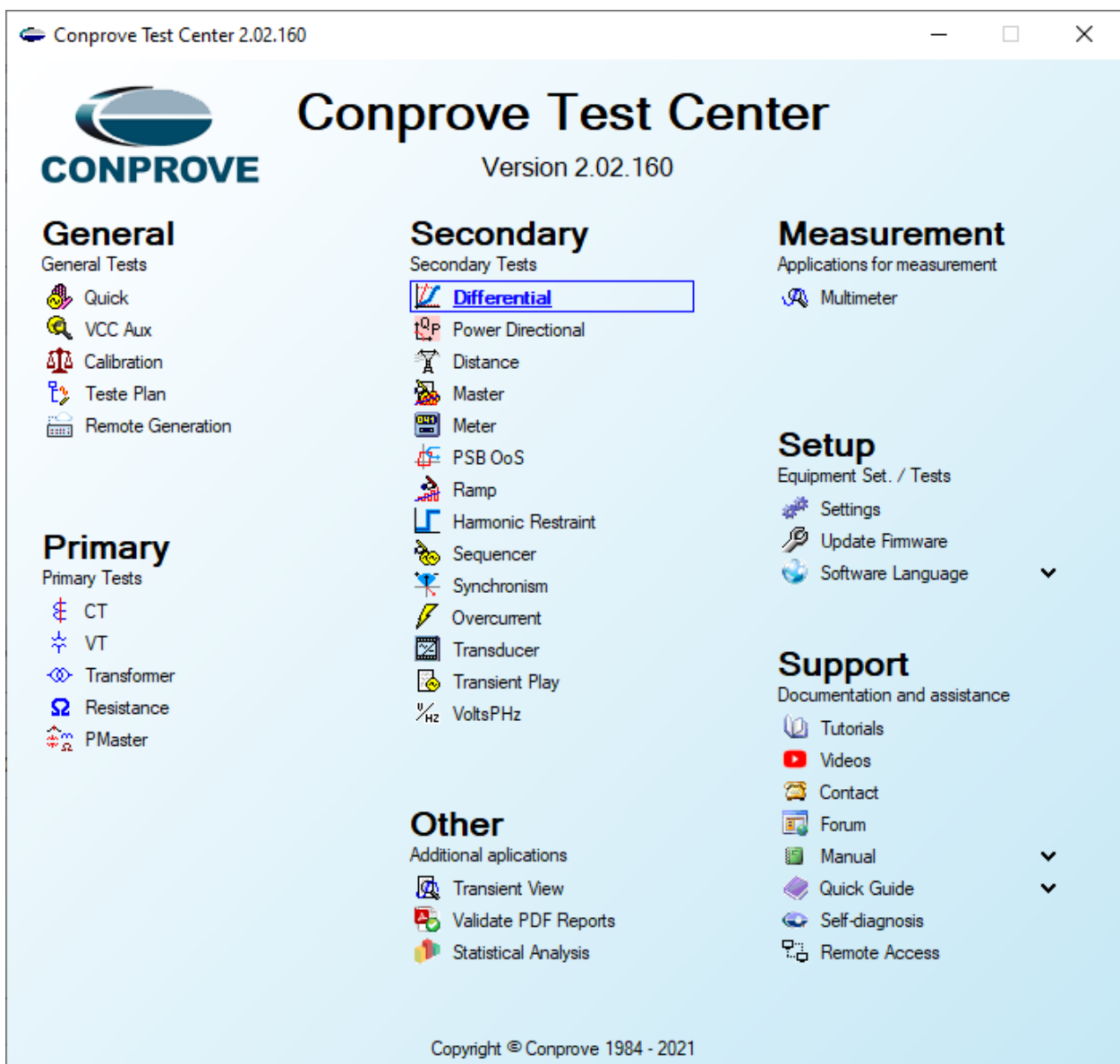
Click on the “Conprove Test Center” application manager icon.

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**Figure 19**

Click on the Differential software icon.



**Figure 20**

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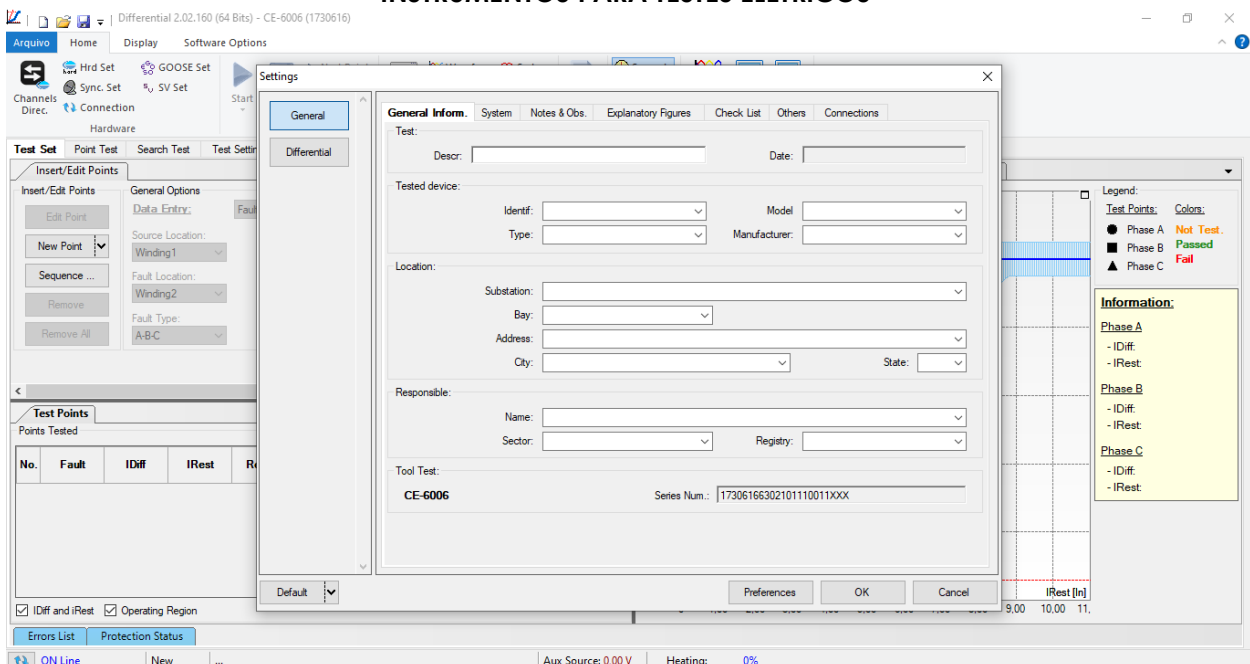


Figure 21

### 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.

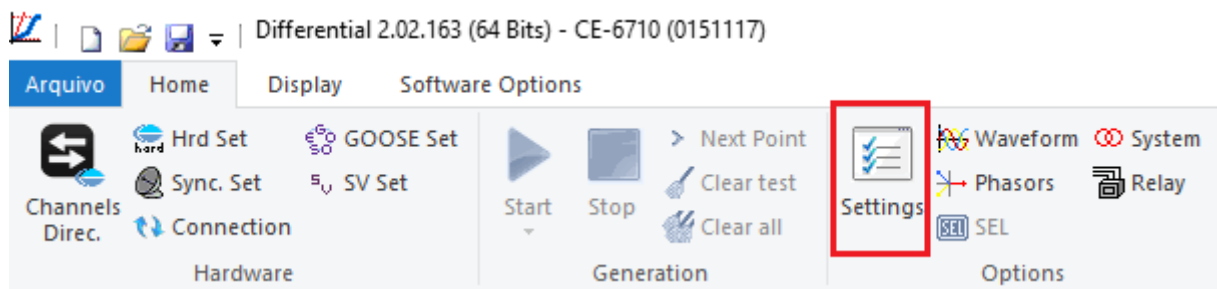


Figure 22

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

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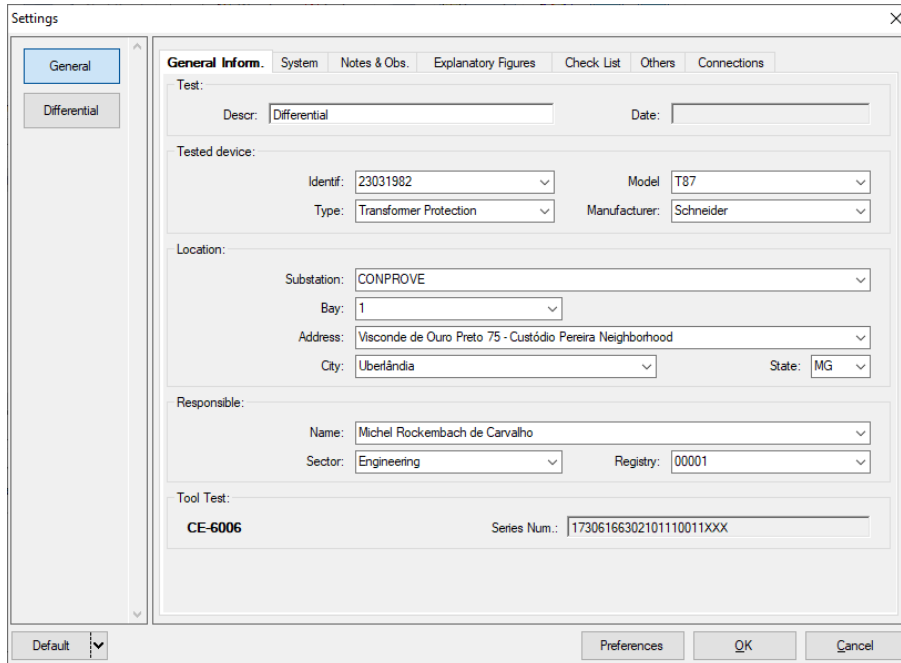
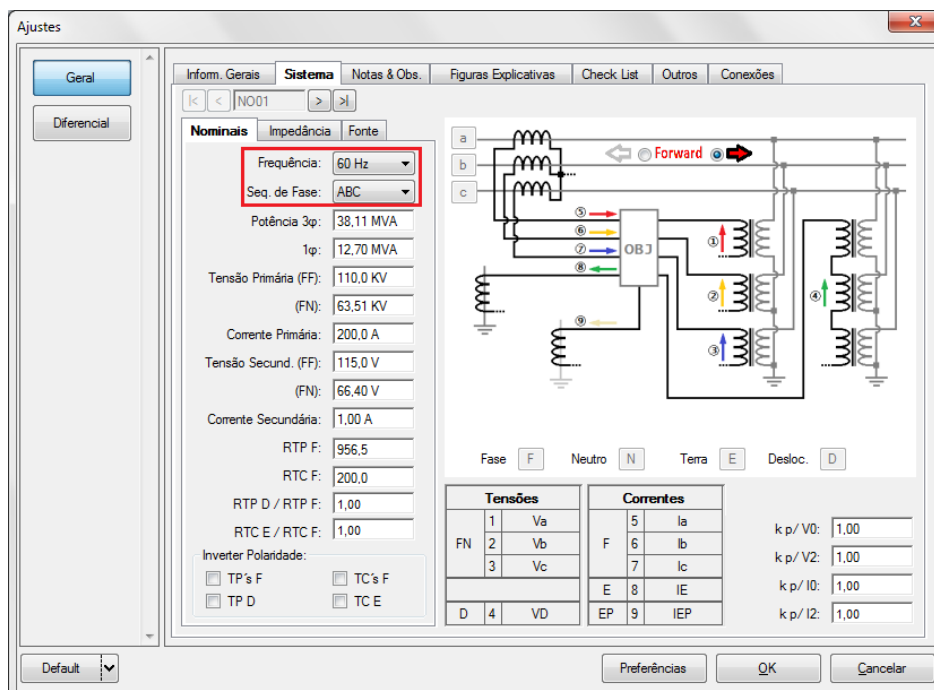


Figure 23

**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.



Tensões		Correntes		
1	Va	5	Ia	k p / V0: 1,00
2	Vb	6	Ib	k p / V2: 1,00
3	Vc	7	Ic	k p / I0: 1,00
		8	IE	k p / I2: 1,00
D	VD	EP	IEP	

Figure 24



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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. Differential Adjustments**

**5.1 Differential screen > Protected Equipment / CT’s**

This tab should inform the protected equipment, the number of windings, nominal voltage, nominal power, the primary and secondary currents of the main CTs and the currents of the auxiliary CT, if necessary. This test uses the settings for a relay that is protecting a transformer. However, it is possible to test protections of bus, generator, motor and line. For transformer protection there is the possibility of testing up to four windings automatically.

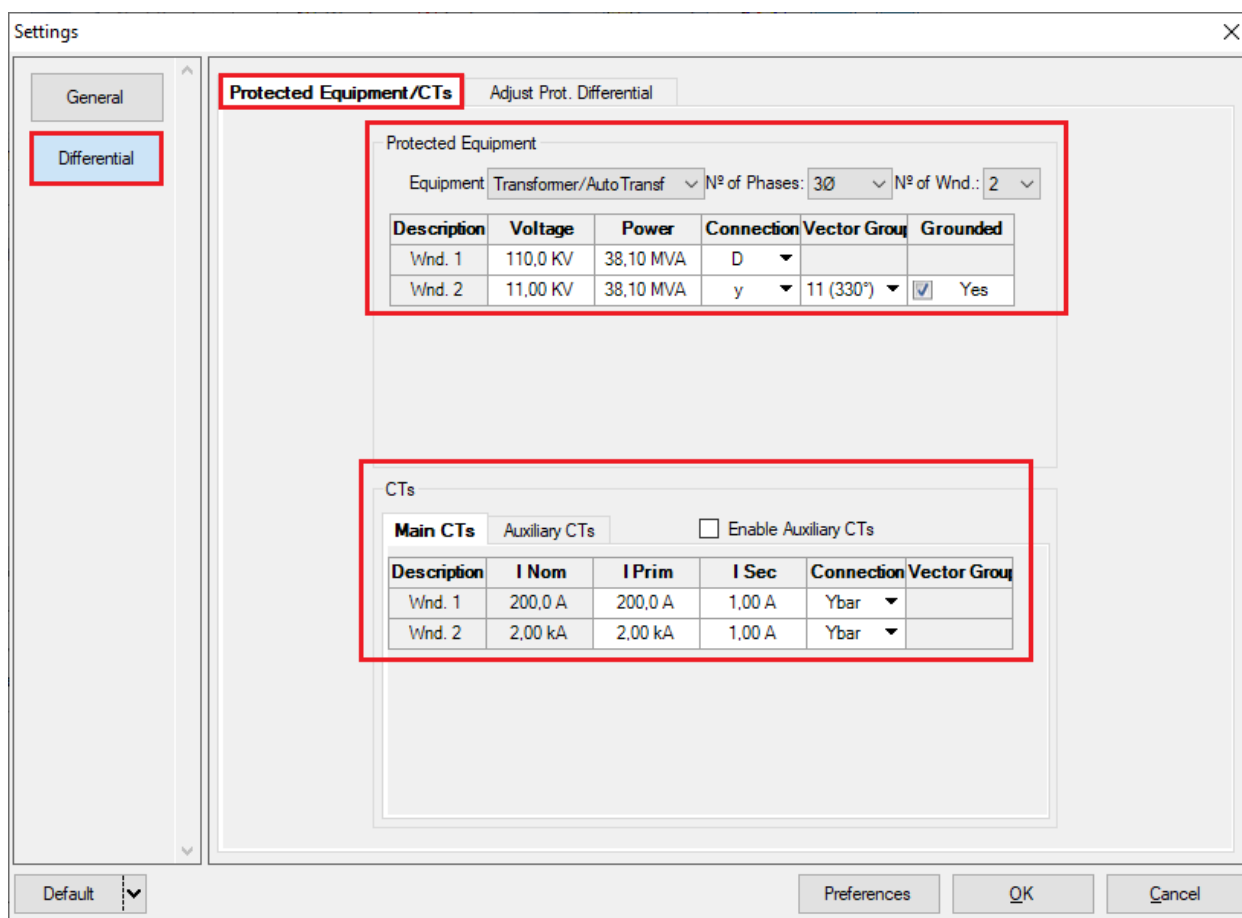


Figure 25

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5.2 Differential Screen > Adjust Prot. Differential > Settings

The initial default for the “Data Entry” field is set to “User”, thus all other settings such as TAP, lag compensation, mismatch correction, measurement current type, reference winding for calculations and Zero sequence elimination options are enabled so that the user can, according to the relay, perform the adjustment correctly (Free Configuration). This method allows the user to test any type of differential relay, but it requires more knowledge of the relay.

To facilitate data entry, the settings of the main relays available on the market have already been standardized. When selecting one of the lists of relays, only the configurable settings are enabled. Choose the “Schneider SEPAM 80 (T)” mask.

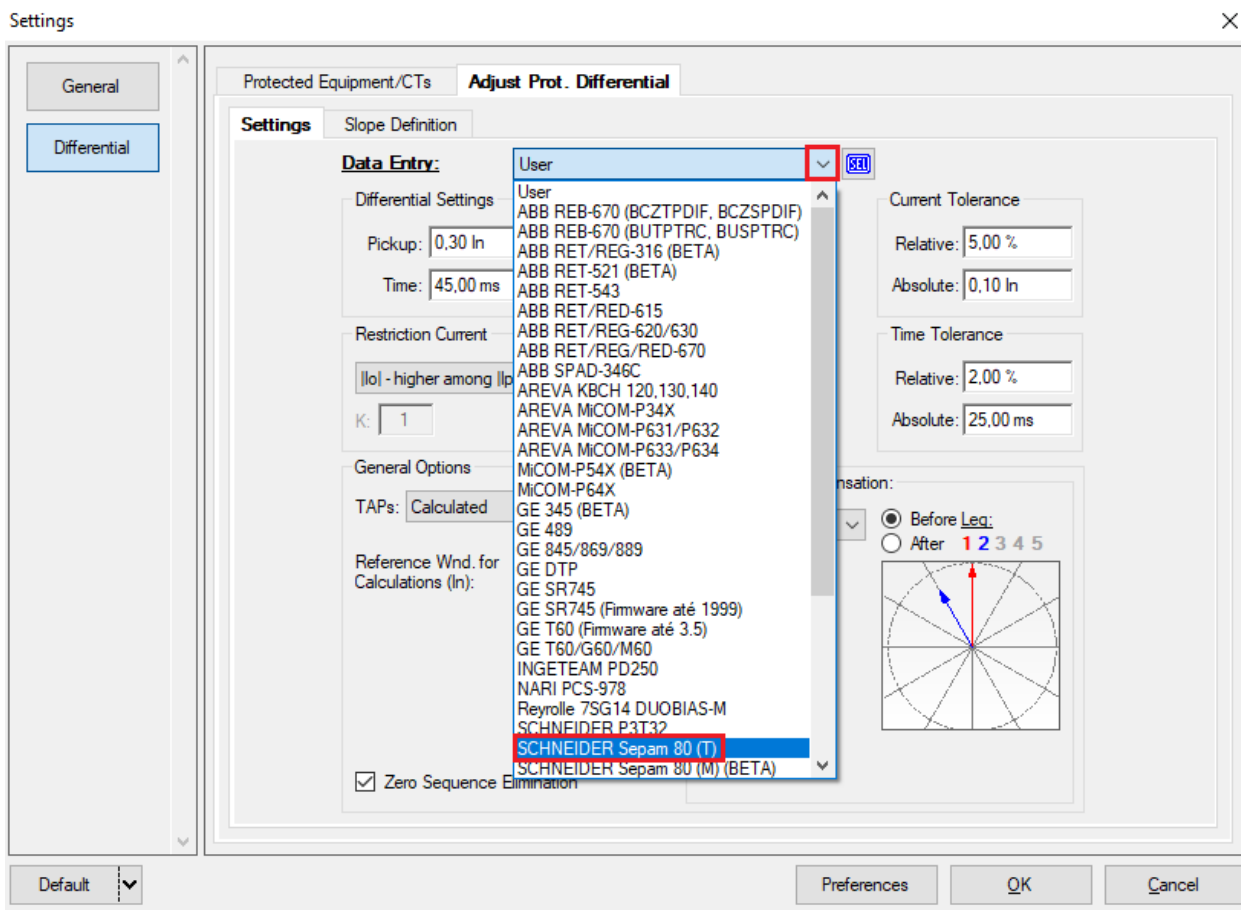


Figure 26

Parameterize the “Differential Settings” and “Instantaneous Settings”. Set the time and use the tolerances for current and time given in the Appendix A.

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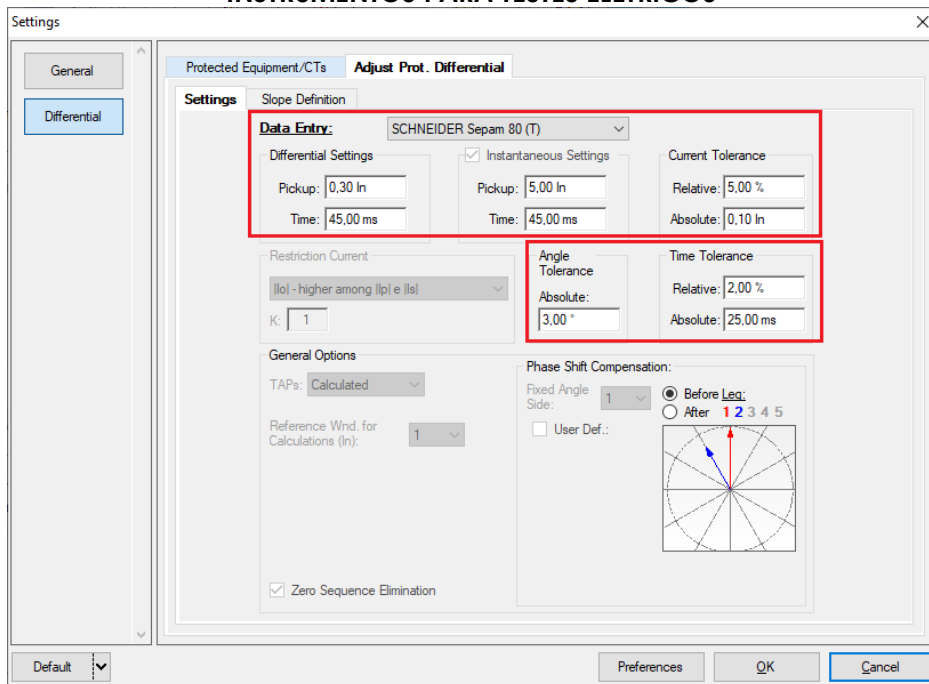


Figure 27

**5.3 Differential Screen > Adjust Prot. Differential > Slope Definition**

On this screen, the values of the slopes and the change in inclination “Change Point” must be entered.

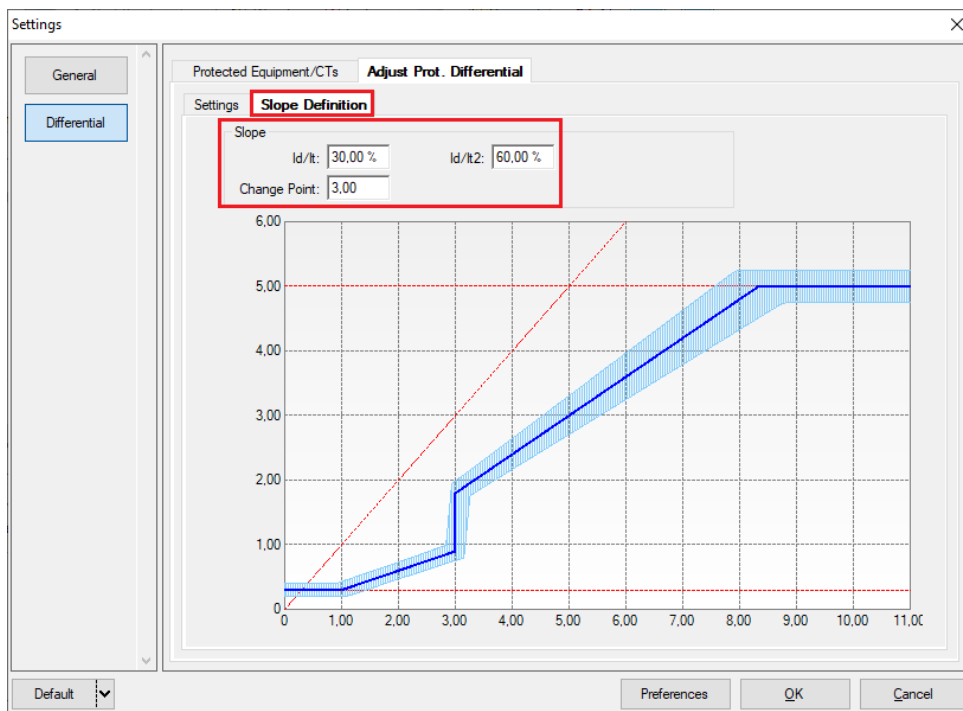
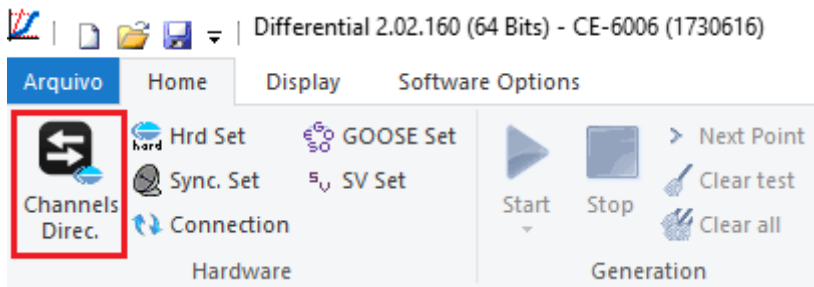


Figure 28

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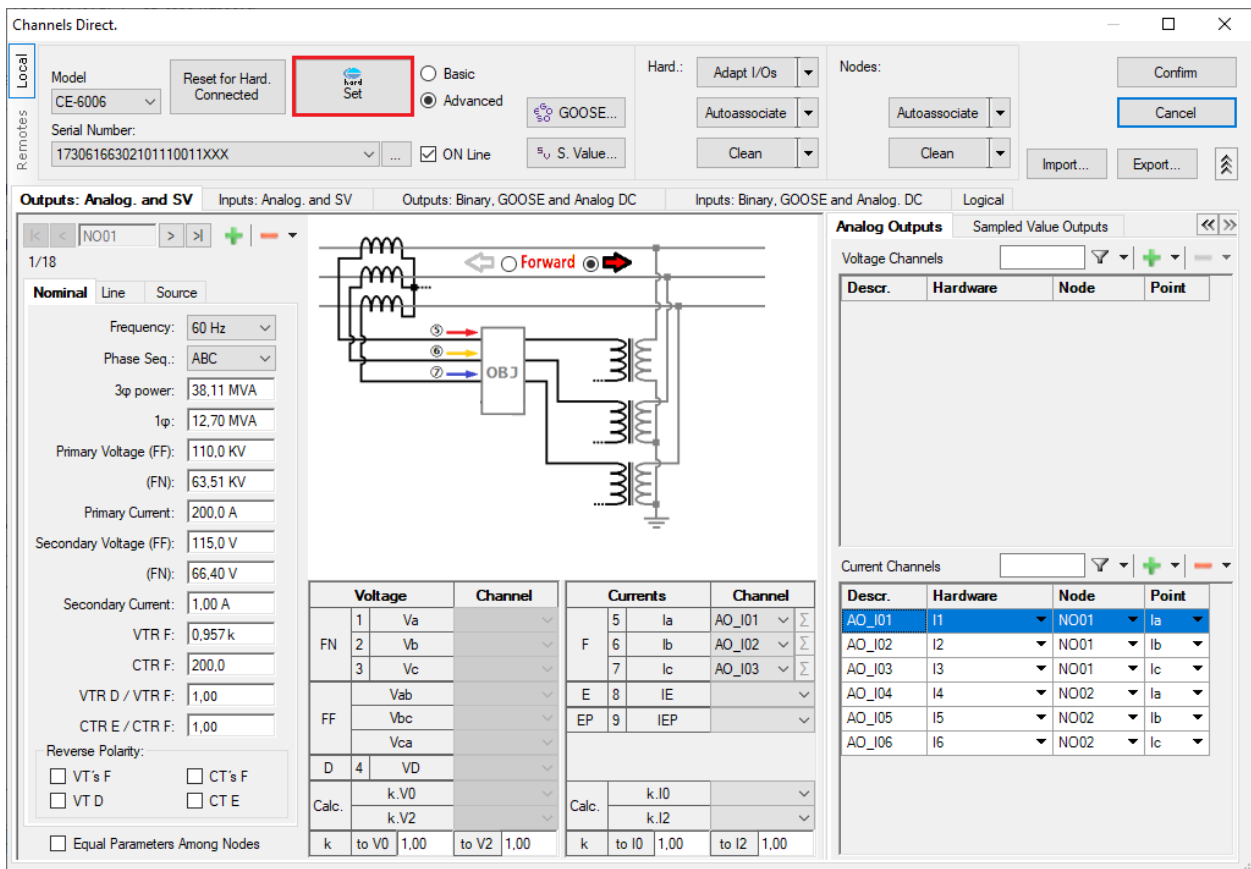
**6. Channel Direction and Hardware Configurations**

Click on the icon illustrated below.



**Figure 29**

Then click on the highlighted icon to configure the hardware.



**Figure 30**

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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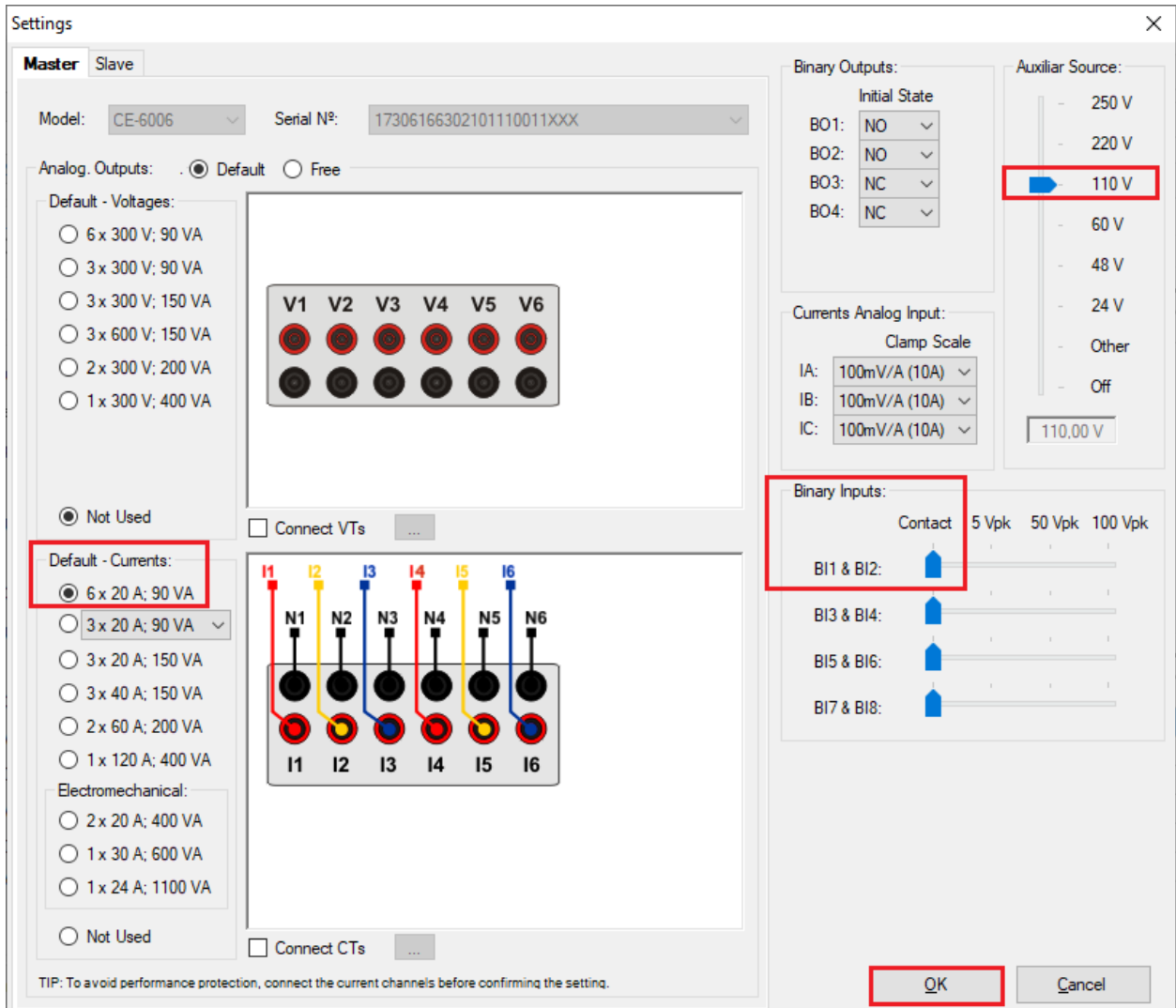


Figure 31

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



Figure 32

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### 7. Test Structure for Function 87

#### 7.1 Test Settings

On this tab, the correct direction of the current generation channels and the stop interface must be done. The binary input responsible for stopping the stopwatch due to the trip signal is BI01. Insert a pre-fault with nominal currents.

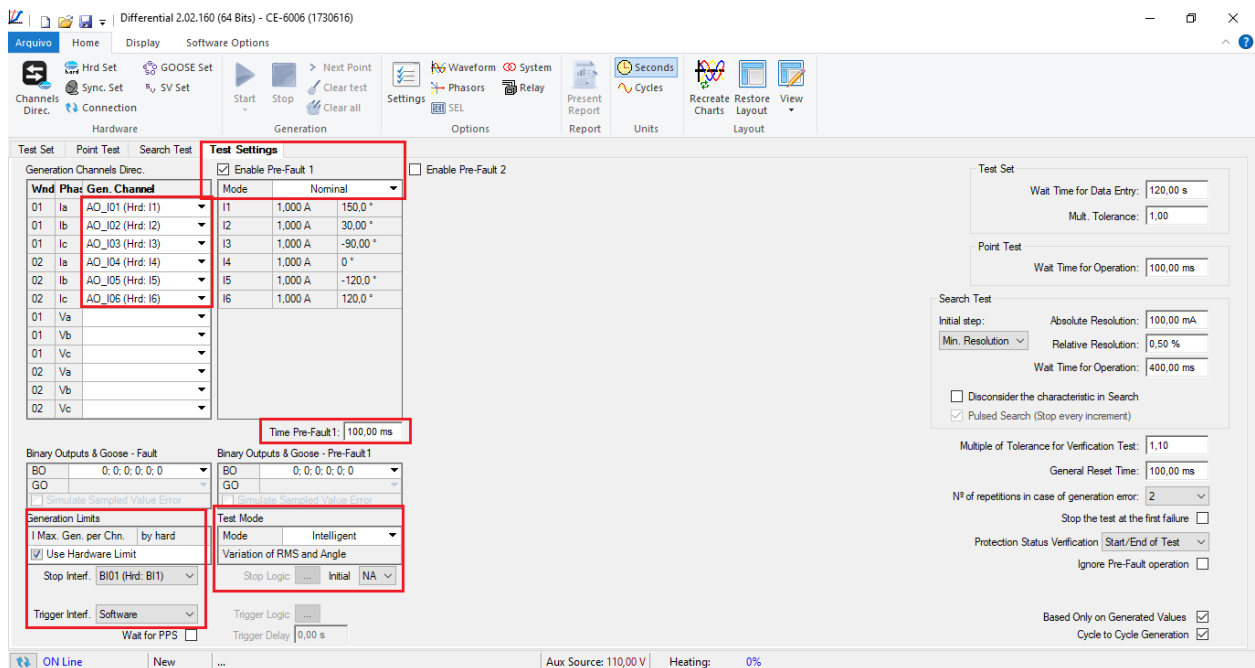


Figure 33

#### 7.2 Point Test

For the point test, click on the “New Point” field and choose the fault type, and the differential and restraint current values. Then click on the confirm button. To visualize the point, click on the “Chat” tab.

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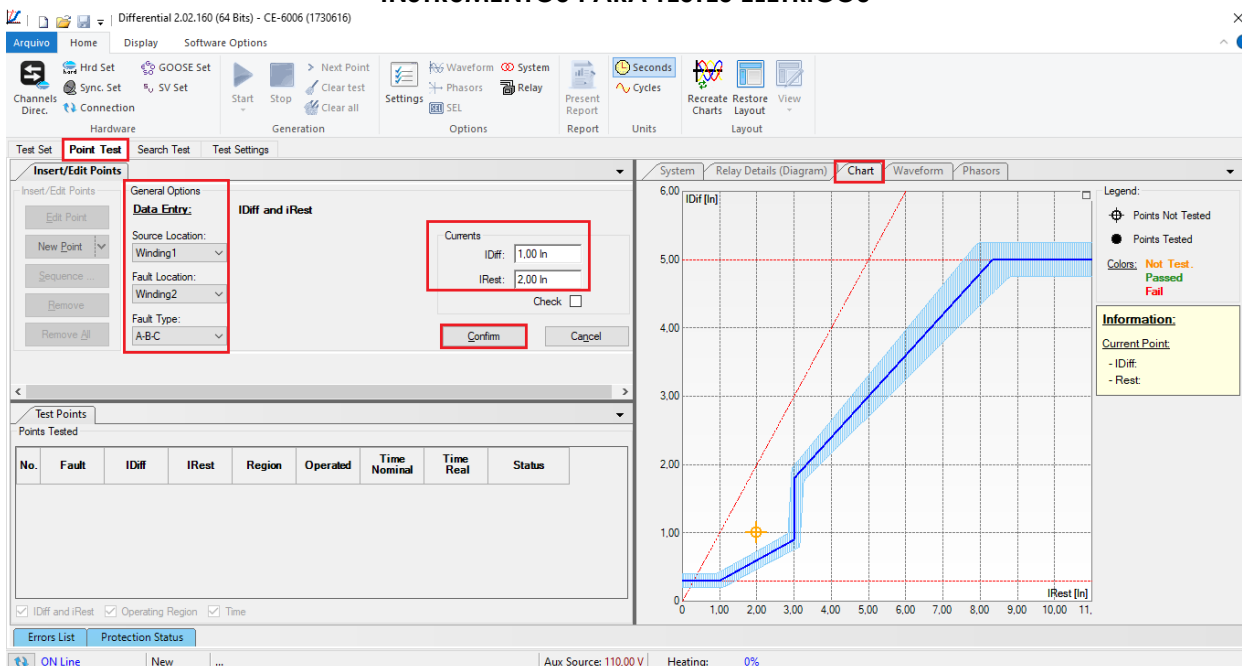


Figure 34

Another way is to use the “Sequence” feature of points by choosing the “Initial”, “Final” and “Step” values. This way the software automatically creates the points.

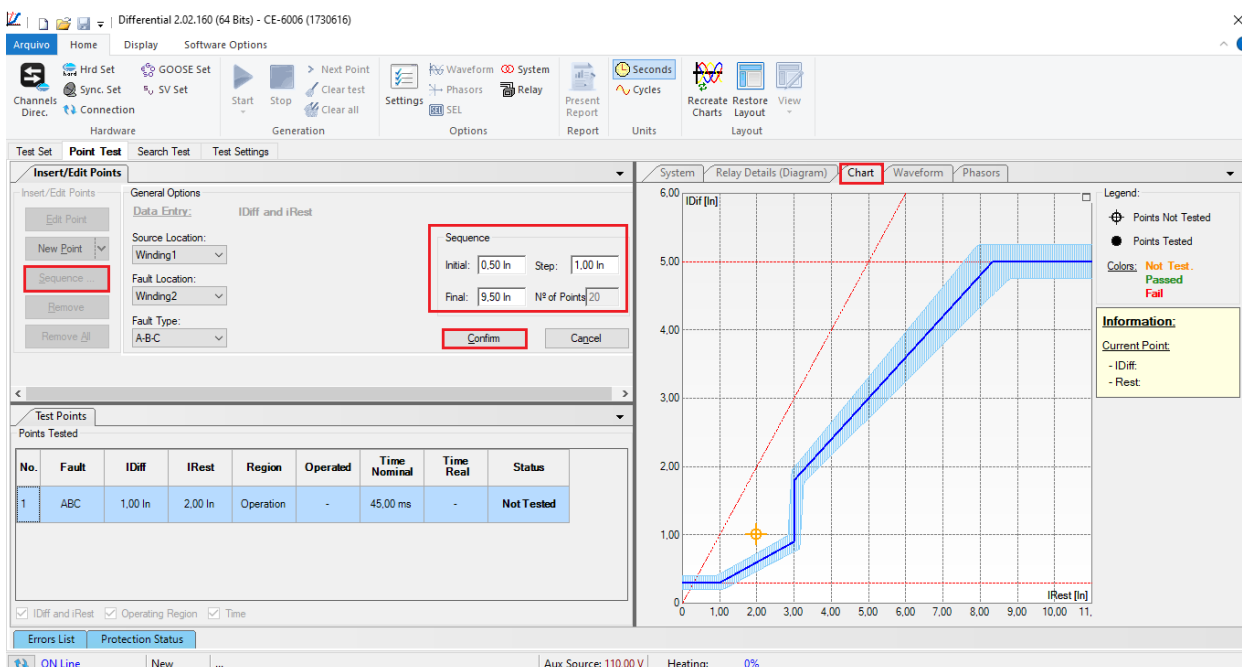


Figure 35

Click on the icon highlighted below or use the command “Alt + G”.

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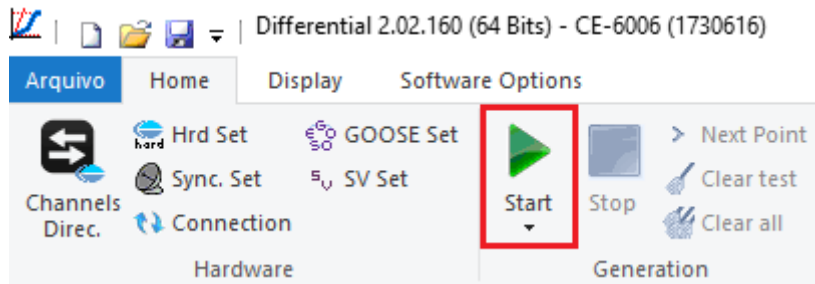


Figure 36

It is verified that all points were successfully approved.

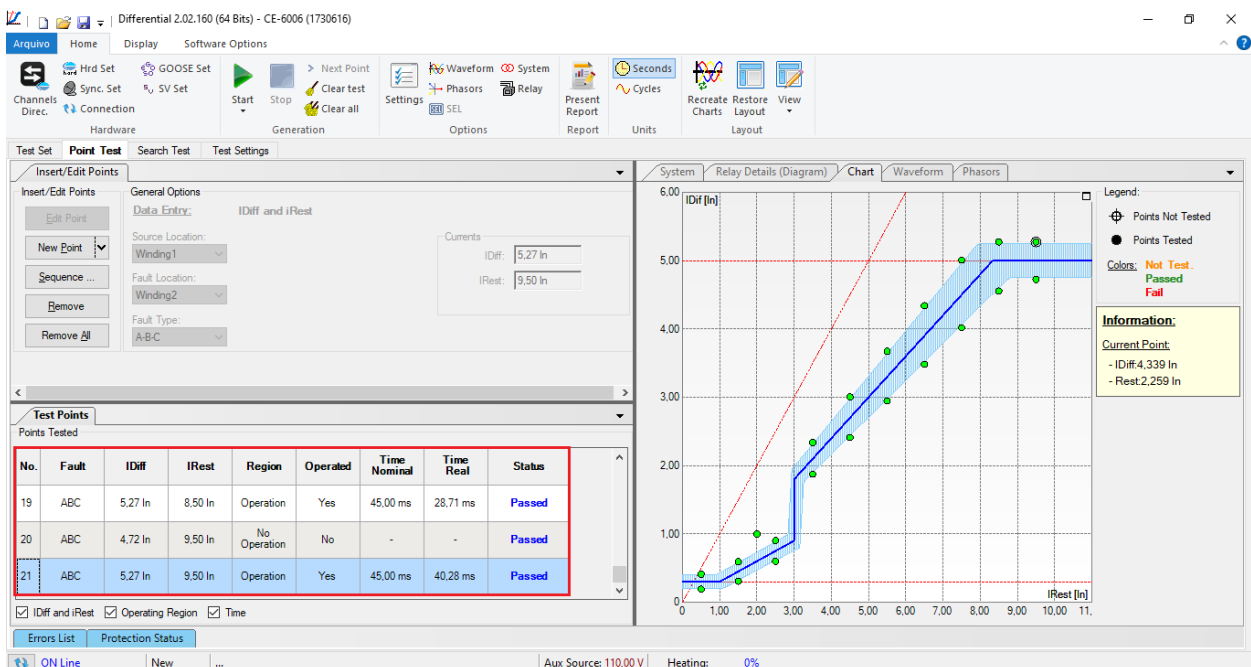


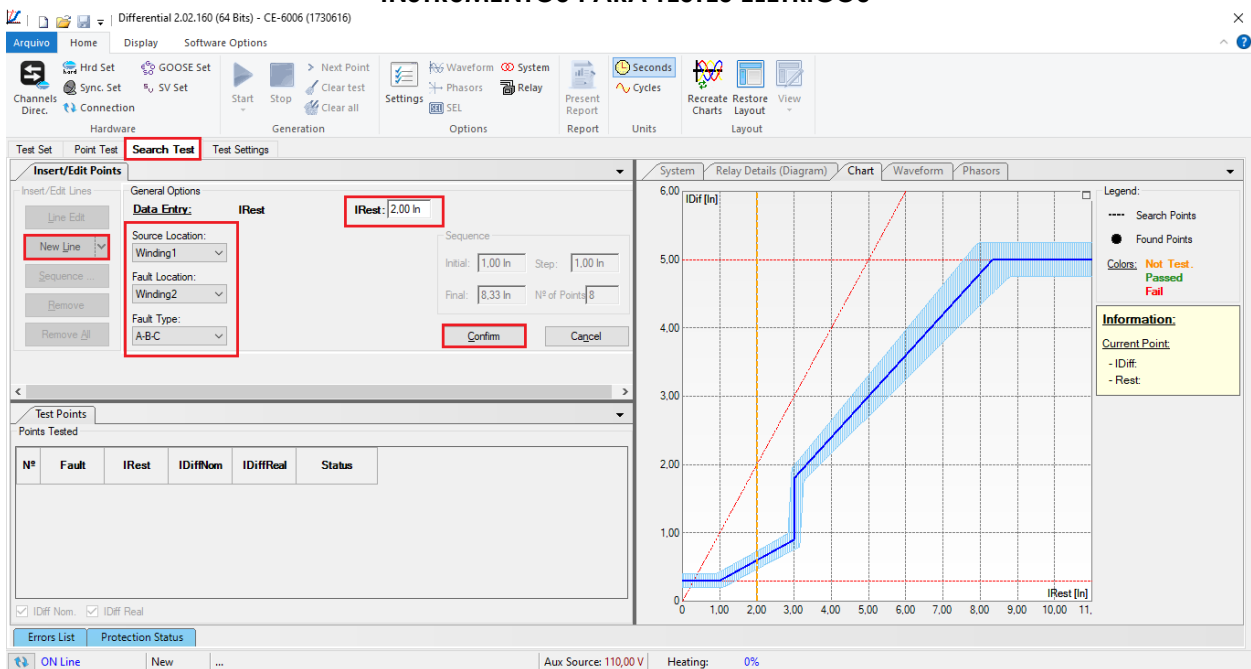
Figure 37

### 7.3 Search Test

To carry out the search test, click on the “New Line” field, choose the type of fault, the restraint current value and confirm.

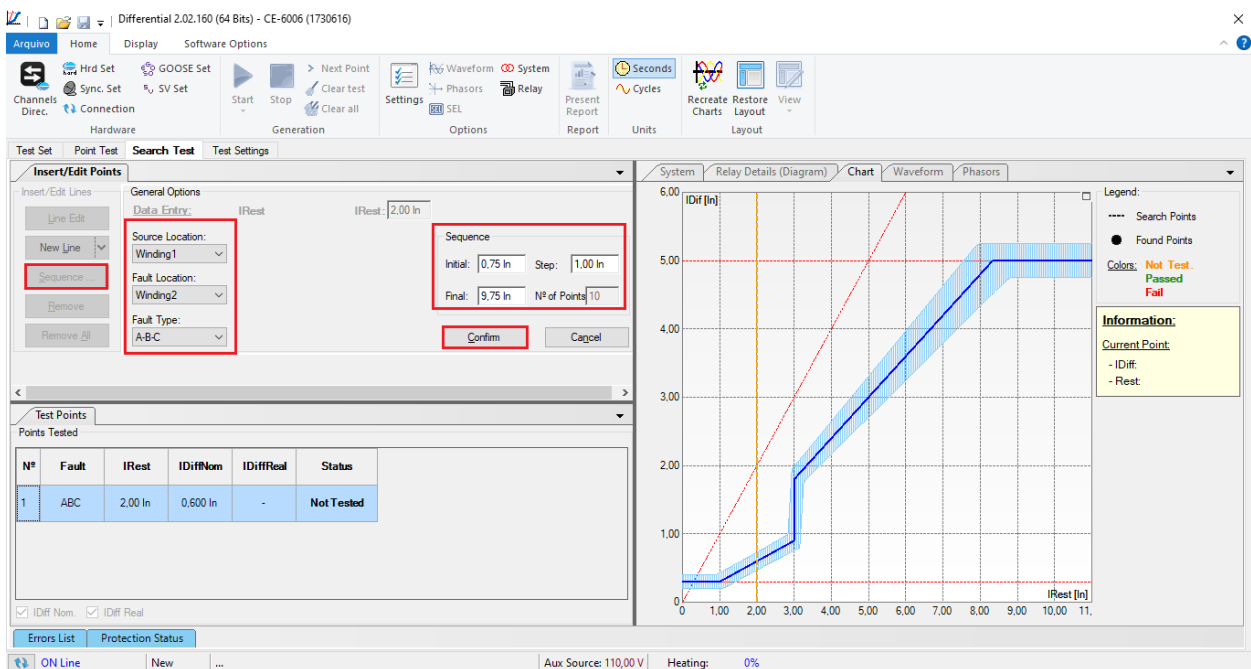


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**Figure 38**

There is also another way to add test lines, by adding a search string. To do this, just click on the “Sequence” button and select the initial and final restriction current of the search and the step between them.



**Figure 39**

Click on the icon highlighted below or use the command “Alt + G”.

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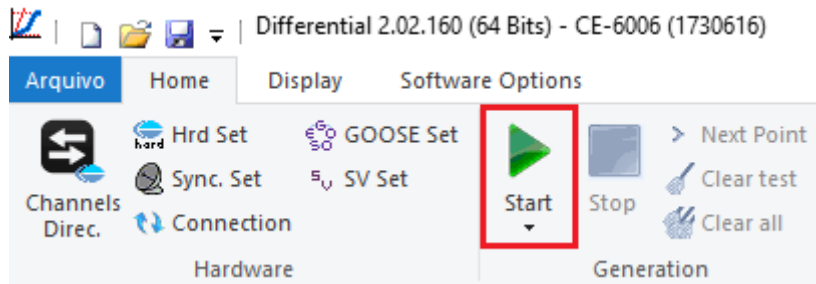


Figura 40

It is verified that all lines were successfully approved

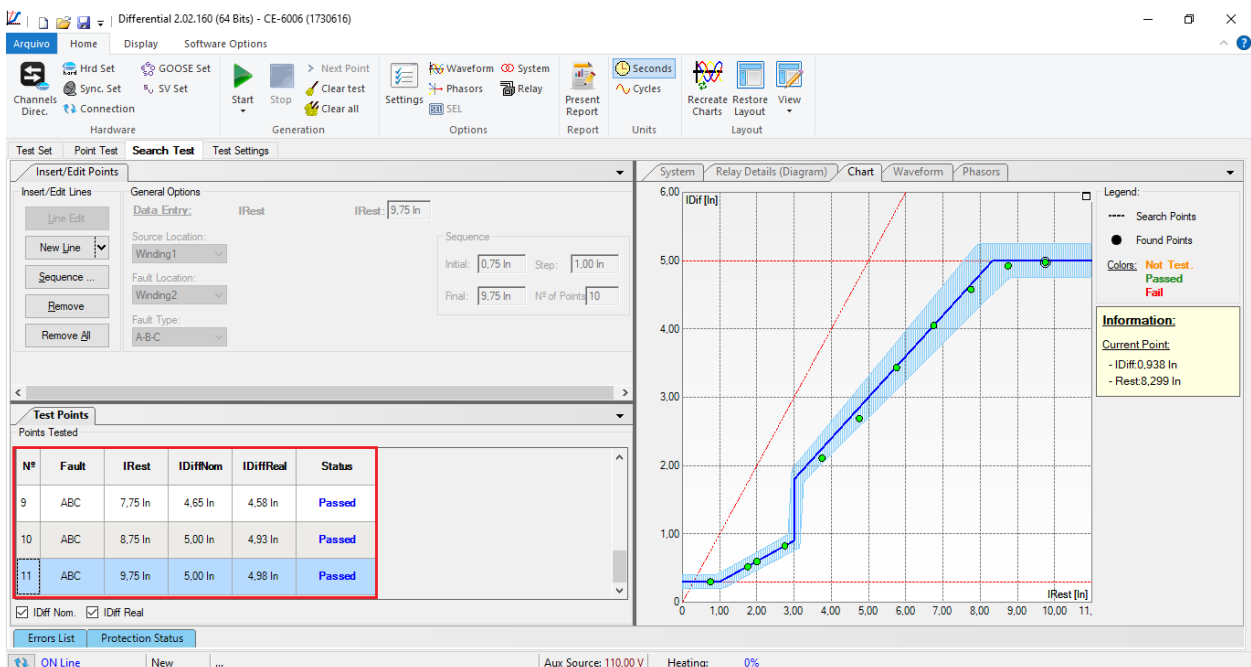


Figure 41

## 8. Report

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

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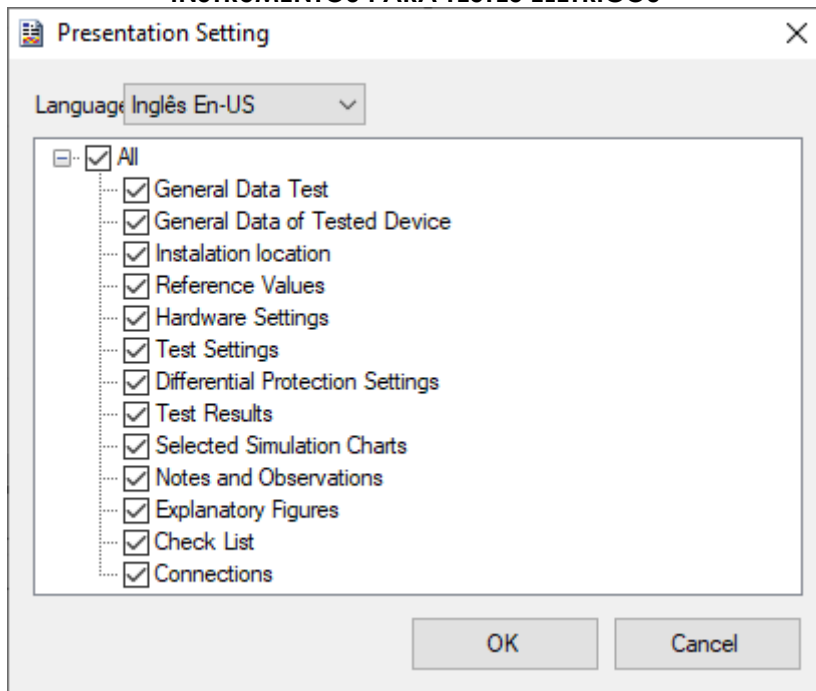


Figure 42

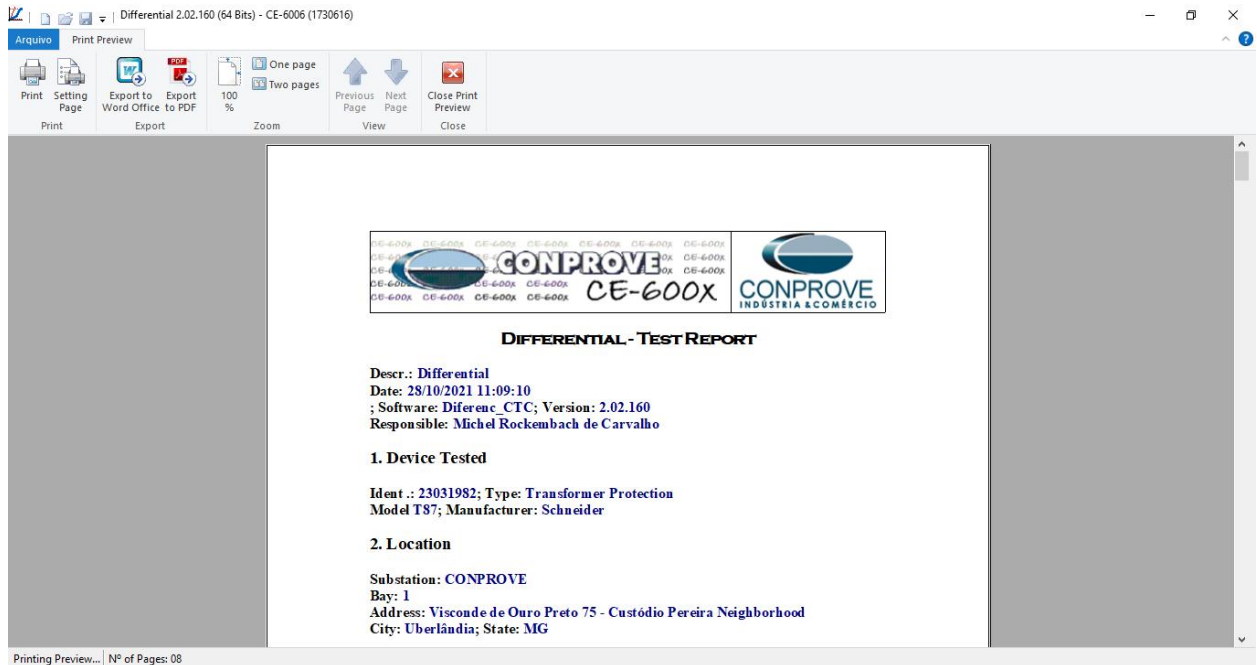


Figure 43

APPENDIX A

A.1 Terminal Designations

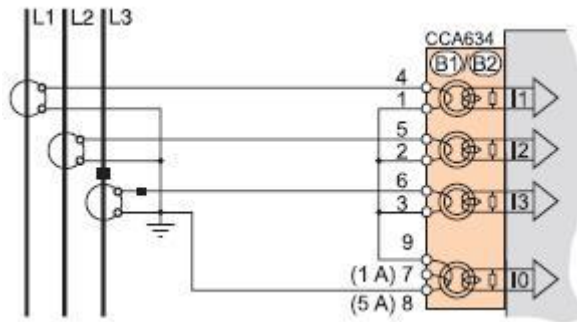


Figure 44

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**A.2 Technical Data**

**Characteristics**

<b>Settings</b>				
<b>Low set point Ids</b>				
Setting range	30 % to 100 % of In1			
Accuracy <sup>(1)</sup>	±2 %			
Resolution	1 %			
Drop-out/pick-up ratio	93.5 % ±5 %			
<b>Percentage-based characteristic Id/It</b>				
Setting range	15 % to 50 %			
Accuracy <sup>(1)</sup>	±2 %			
Resolution	1 %			
Drop-out/pick-up ratio	93.5 % ±5 %			
<b>Percentage-based characteristic Id/It2</b>				
Setting range	None, 50 % to 100 %			
Accuracy <sup>(1)</sup>	±2 %			
Resolution	1 %			
Drop-out/pick-up ratio	93.5 % ±5 %			
<b>Slope change point</b>				
Setting range	None, In1 to 18 In1			
Accuracy <sup>(1)</sup>	±5 %			
Resolution	0.1 In1			
Drop-out/pick-up ratio	93.5 % ±5 %			
<b>Test mode</b>				
Setting range	Active/Not active			
<b>Advanced settings</b>				
Selection of restraint	Conventional/Self-adaptive			
<b>Restraint on CT loss</b>				
Setting range	Active/Not active			
<b>Restraint on closing</b>				
Setting range	Active/Not active			
Magnetization current set point Isinr	Setting range 1 % to 10 % Accuracy <sup>(1)</sup> ±5 % Resolution 1 % Drop-out/pick-up ratio 90 % ±5 % or 0.5 % In1			
Time delay	Setting range 0 to 300 s Accuracy <sup>(1)</sup> ±2 % or -10 ms to +25 ms Resolution 10 ms			
<b>High set point Idmax</b>				
Setting range	Conventional restraint 3 to 18 In1 Self-adaptive restraint None, 3 to 18 In1			
Accuracy <sup>(1)</sup>	±2 %			
Resolution	1 %			
Drop-out/pick-up ratio	93.5 % ±5 %			
<b>Second-harmonic set point for conventional restraint</b>				
Setting range	None, 5 to 40 %			
Accuracy <sup>(1)</sup>	±5 %			
Resolution	1 %			
Drop-out/pick-up ratio	90 % ±5 %			
<b>Second-harmonic restraint for conventional restraint</b>				
Setting range	Phase-specific/Global			
<b>Fifth-harmonic set point for conventional restraint</b>				
Setting range	None, 5 to 40 %			
Accuracy <sup>(1)</sup>	±5 %			
Resolution	1 %			
Drop-out/pick-up ratio	90 % ±5 %			
<b>Fifth-harmonic restraint for conventional restraint</b>				
Setting range	Phase-specific/Global			
<b>Characteristic times</b>				
Operating time high set point	< 45 ms at 2 Id			
Operating time percentage-based curve	< 45 ms at 2 Id			
Reset time	< 45 ms at 2 Id			
<b>Inputs</b>				
<b>Designation</b>	<b>Syntax</b>	<b>Equations</b>	<b>Logipam</b>	
Protection reset	P87T_1_101	■	■	
Protection inhibition	P87T_1_113	■	■	
Restraint on closing	P87T_1_118	■	■	
<b>Outputs</b>				
<b>Designation</b>	<b>Syntax</b>	<b>Equations</b>	<b>Logipam</b>	<b>Matrix</b>
Protection output	P87T_1_3	■	■	■
Protection inhibited	P87T_1_16	■	■	-
High set point	P87T_1_33	■	■	-
Percentage-based threshold	P87T_1_34	■	■	-
CT loss	P87T_1_39	■	■	-
Test mode	P87T_1_41	■	■	-

Equivalence of software parameters and the relay under test.

Table 3

Differential Software		SEPAM T87 Relay	
Parameter	Figure	Parameter	Figure
Voltage (Wind. 1)	25	Rated Voltage Un1	12
Voltage (Wind. 2)	25	Rated Voltage Un2	12
Power (Wind. 1 and 2)	25	Rated apparent power	12
Vector group	25	Vector shift	12
I Prim (Wind. 1)	25	Rated current (In)	10
I Prim (Wind. 2)	25	Rated current (I'n)	10
I Sec (Wind. 1)	25	CT rating	10
I Sec (Wind. 2)	25	CT rating	10
Differential Settings (pickup)	27	Ids threshold	16
Instantaneous Settings (pickup)	27	High set	16
Id/It	28	Id/It threshold	16
Id/It2	28	Id/It2 threshold	16
Change Point	28	Slope change point	16