



INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: Siemens

Model: 7UT86

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	17/09/2021	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 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 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 7UT86 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 B1 of slot 2B of the relay and the negative (black terminal) of the Vdc Aux. Source to pin B2 of slot 2B.

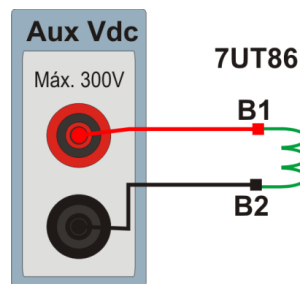


Figure 1

1.2 Current Coils

Connect I1, I2 and I3 current channels of the CE-6006 to pins A1, A3 and A5 of slot 1A of the relay respectively, if the commons of the relay are short circuited, just connect the commons of the channels to that point, otherwise connect the three common of the CE-6006 to pins A2, A4 and A6 of slot 1A of the relay thus forming the winding 1 connection. Similarly, to establish the winding 2 connection, connect I4, I5 and I6 current channels to pins B1, B3 and B5 of the relay slot 1B respectively, connecting the three common to pins B2, B4 and B6.

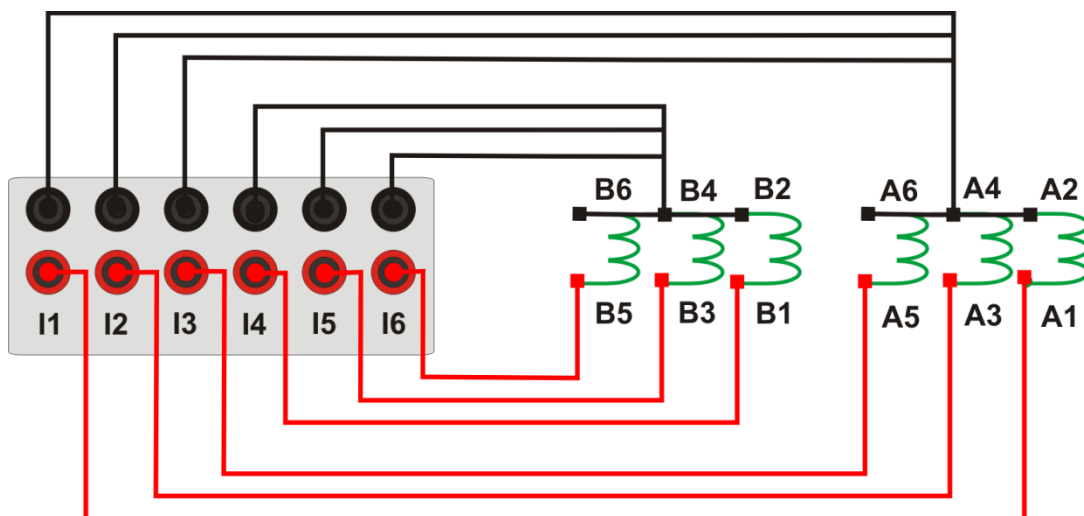


Figure 2

1.3 Binary Inputs

Connect the binary input of the CE-6006 to the binary output relay.

- BI1 to pin D1 and its common to pin D2;

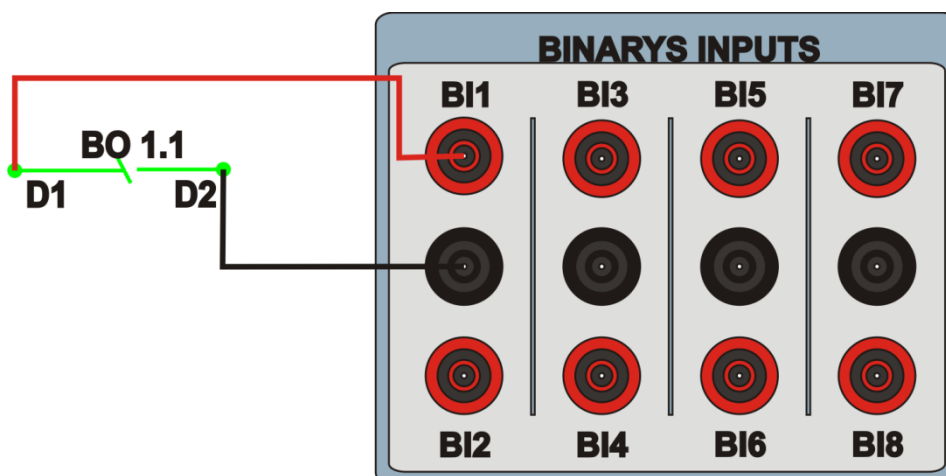


Figure 3

2. Communication with 7UT86 relay

First connect a USB cable from the notebook with the relay. Then double-click on the relay software icon.



Figure 4

When opening the program, click on the "Project" option and choose the "New" option.

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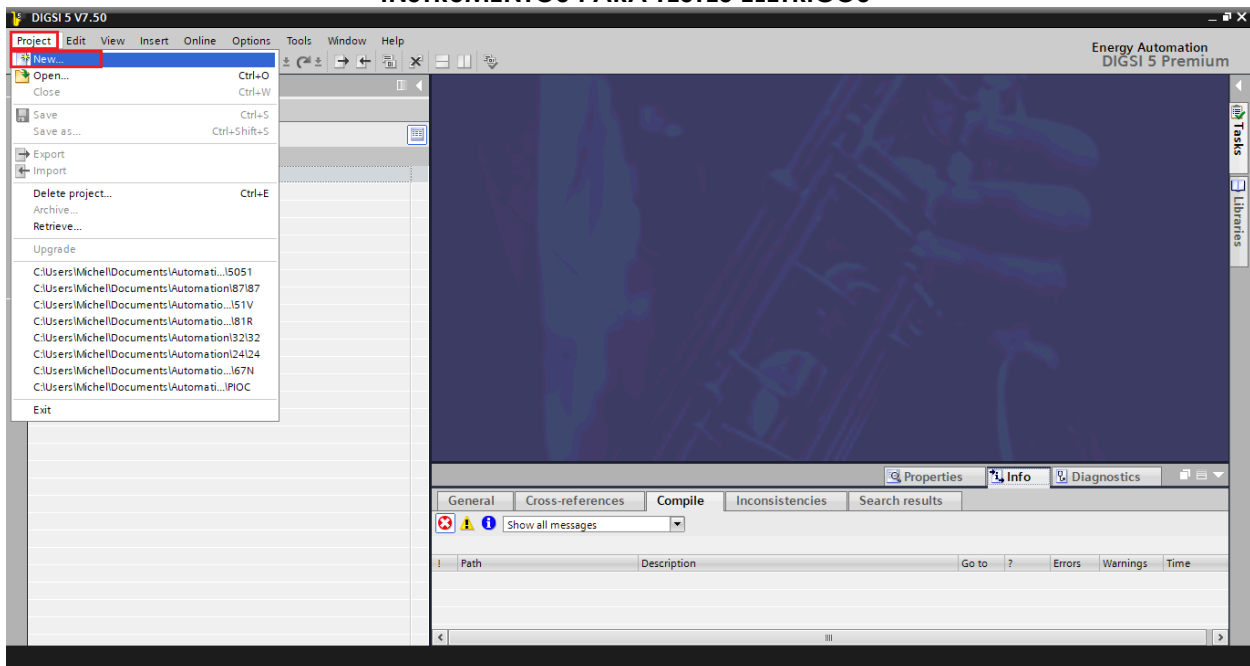


Figure 5

Enter a name for the project and then click “*Create*” as highlighted below.

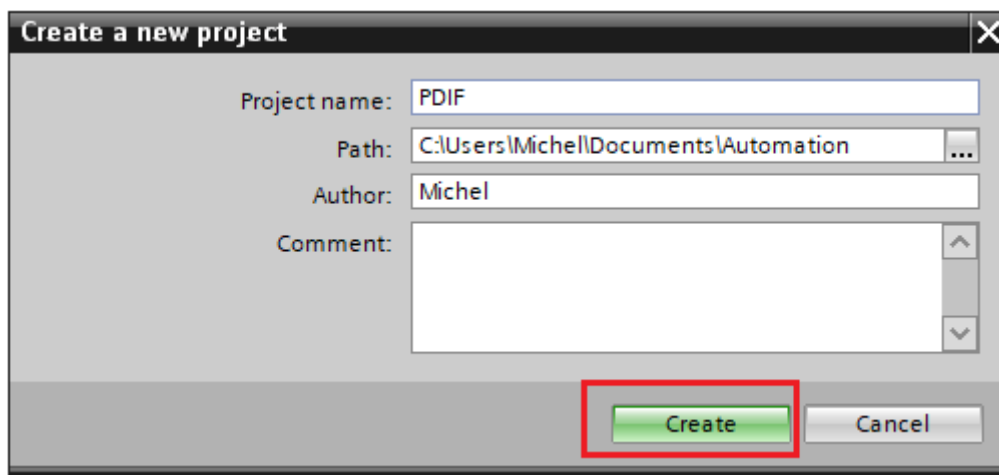


Figure 6

When creating the project, add the relay that will be tested, double-click on “*Add New Device*” as highlighted below.

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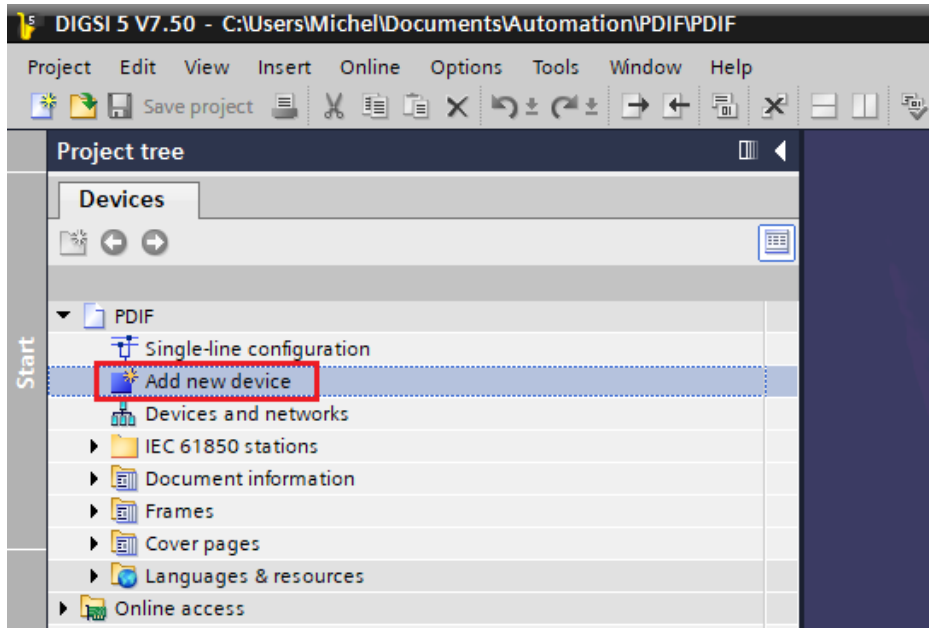


Figure 7

Enter the relay short code located on its side, then click “Verify” as highlighted below.

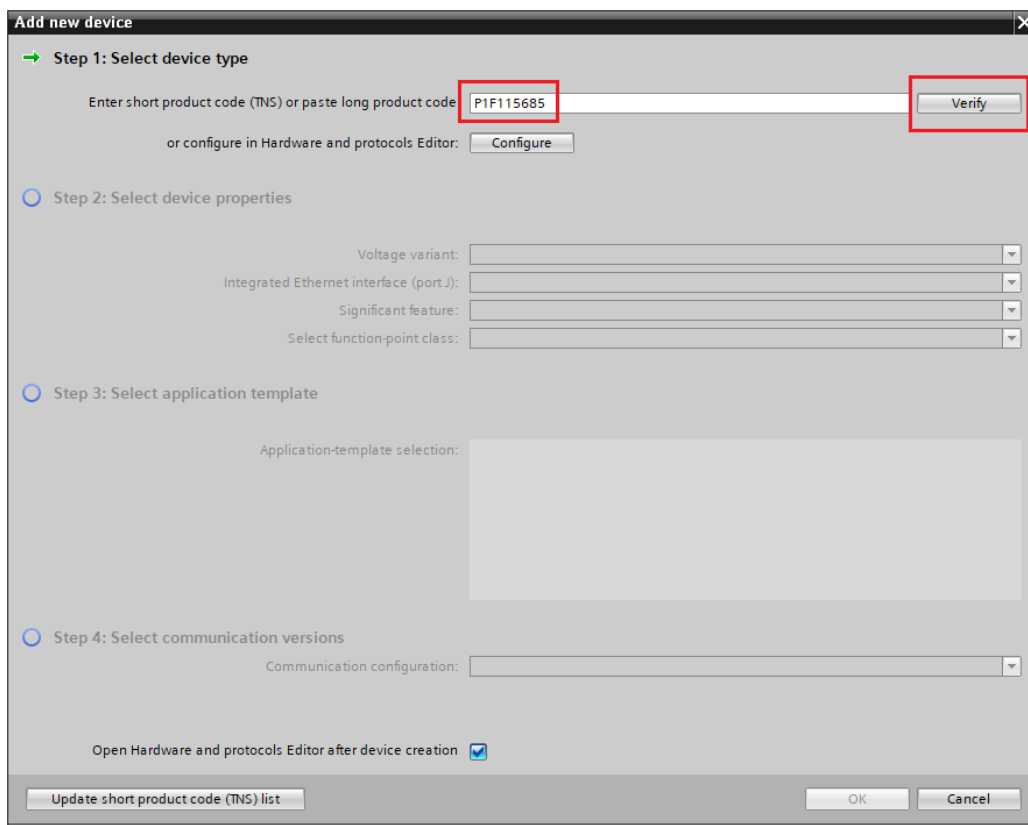
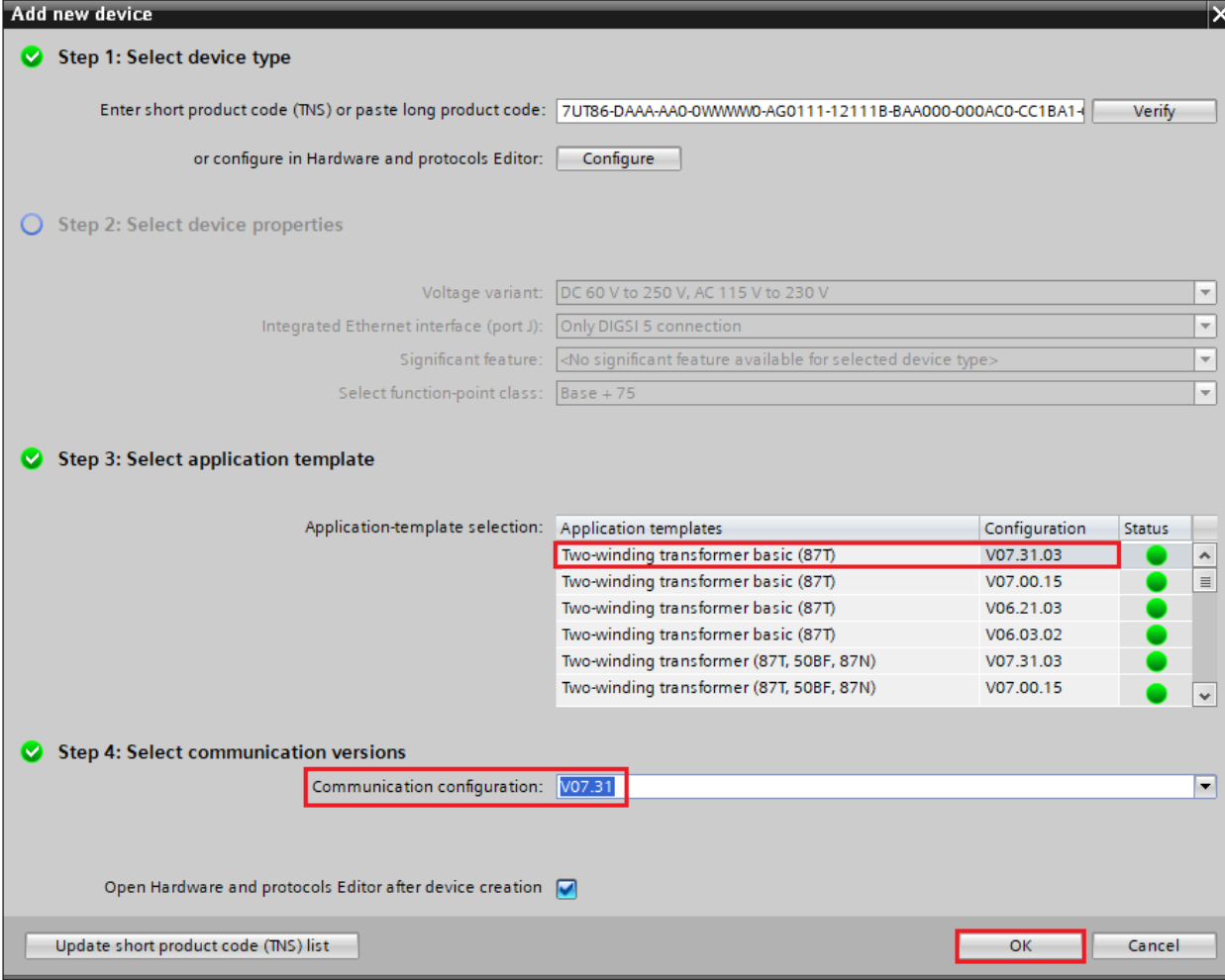


Figure 8

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Select the highlighted “*Template*” whose firmware version is consistent with that of the relay (To verify, just look at the relay HMI when it is turned on). Then click “*OK*”.



Add new device

Step 1: Select device type

Enter short product code (TNS) or paste long product code: 7UT86-DAAA-AA0-0WWW0-AG0111-12111B-BAA000-000AC0-CC1BA1-1

or configure in Hardware and protocols Editor:

Step 2: Select device properties

Voltage variant: DC 60 V to 250 V, AC 115 V to 230 V

Integrated Ethernet interface (port J): Only DIGSI 5 connection

Significant feature: <No significant feature available for selected device type>

Select function-point class: Base + 75

Step 3: Select application template

Application-template selection:

Application templates	Configuration	Status
Two-winding transformer basic (87T)	V07.31.03	●
Two-winding transformer basic (87T)	V07.00.15	●
Two-winding transformer basic (87T)	V06.21.03	●
Two-winding transformer basic (87T)	V06.03.02	●
Two-winding transformer (87T, 50BF, 87N)	V07.31.03	●
Two-winding transformer (87T, 50BF, 87N)	V07.00.15	●

Step 4: Select communication versions

Communication configuration: V07.31

Open Hardware and protocols Editor after device creation

Figure 9

Note that a generic relay has been added (highlighted in green below). The next step is to establish communication with the equipment, for that go to the “*Online*” menu and choose the option “*Connect to device and retrieve data*”.

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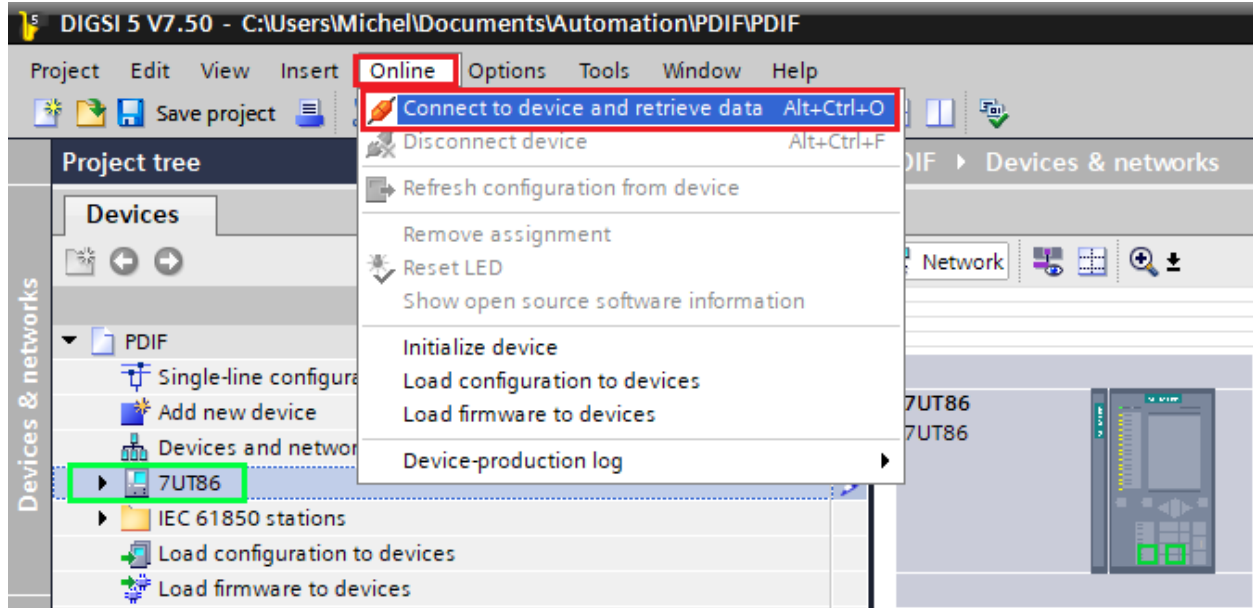


Figure 10

After establishing communication with the relay, it is necessary to read the parameterized settings. Right-click on the relay icon (highlighted in green in the previous figure) and choose the option “*Update configuration from target device*”.

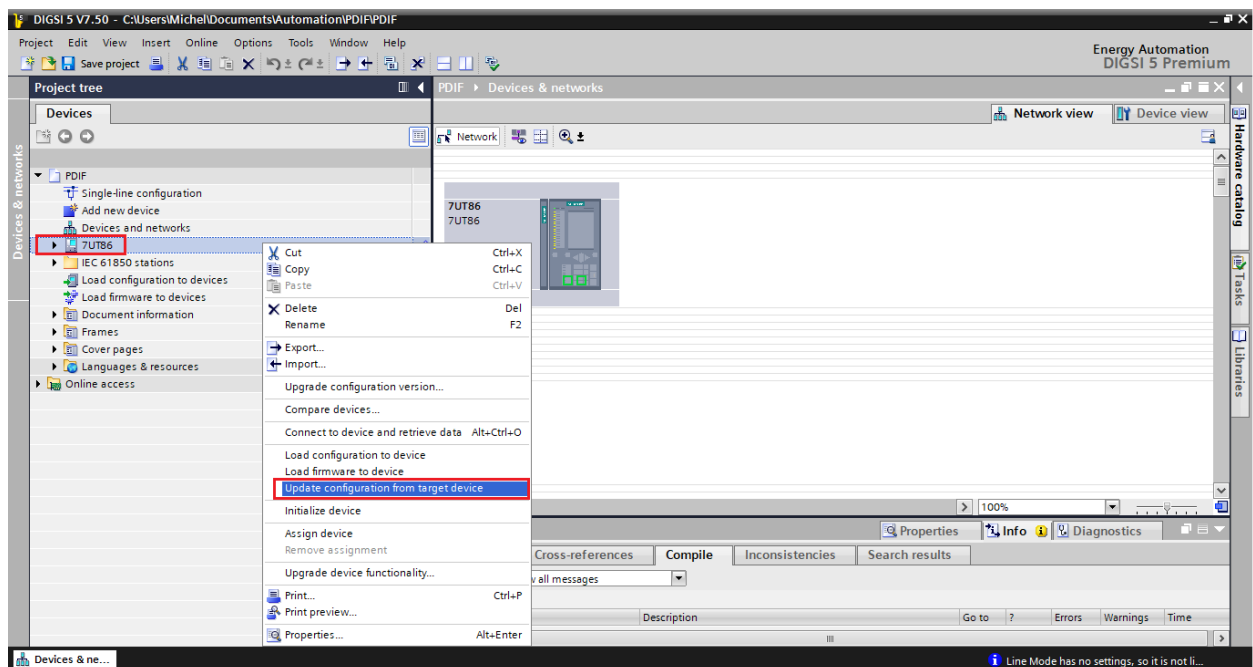


Figure 11

Click on “Yes” for the following message:

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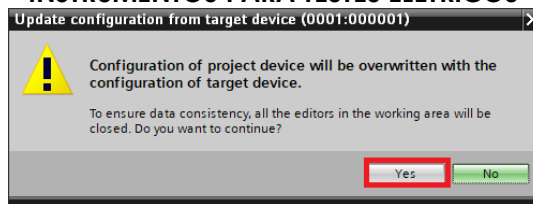


Figure 12

There will be other warning messages (didn't shown), click "Yes" on all. If the procedure is carried out properly, the following screen will be reached.

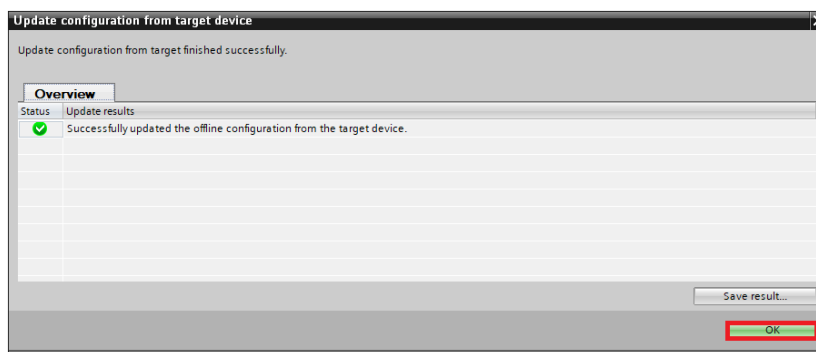


Figure 13

Export the created file in .dex5 format in order to have a backup of the settings. Right-click on the relay icon and choose the "Export..." option.

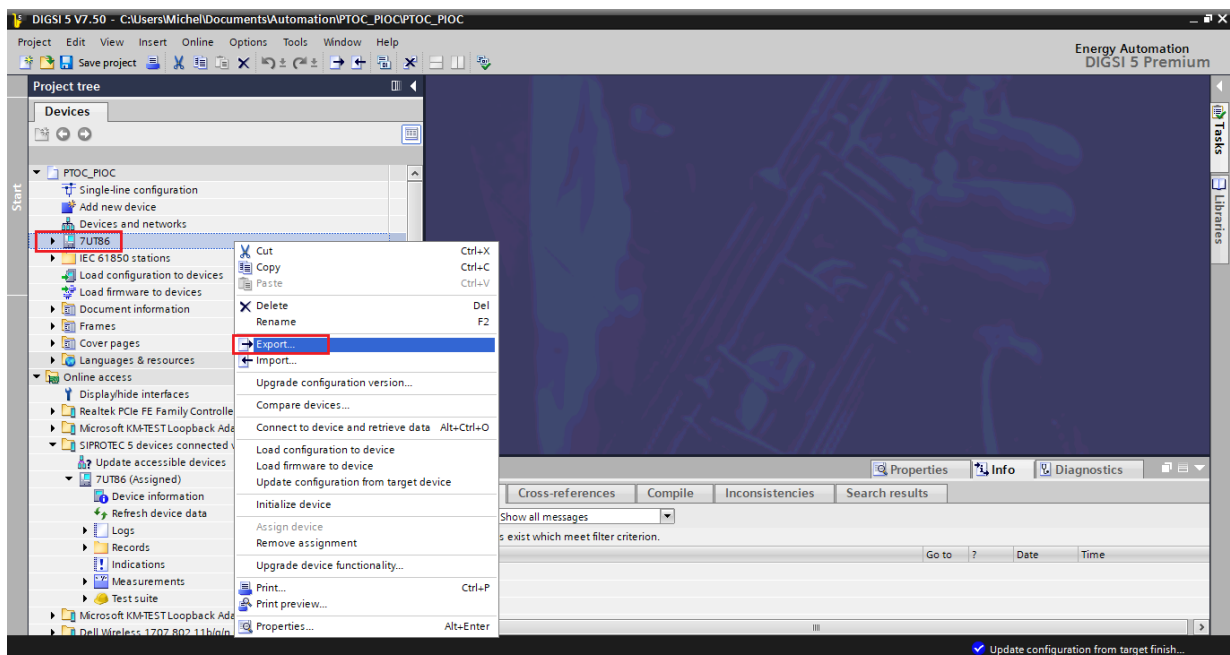


Figure 14

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There are other ways to extract information from Siemens Siprotec 5 relays, but the displayed mode is practical for those who will commission a relay already parameterized and installed in a panel.

3. Parameterization of the 7UT86 relay

3.1 Device Settings

After the connection has been established, open the device section “7UT86”. Then open the “Settings” section, finally choose the “Device Settings” option. Check that group 1 is active, that the nominal frequency is 60Hz and the minimum operating time is zero seconds.

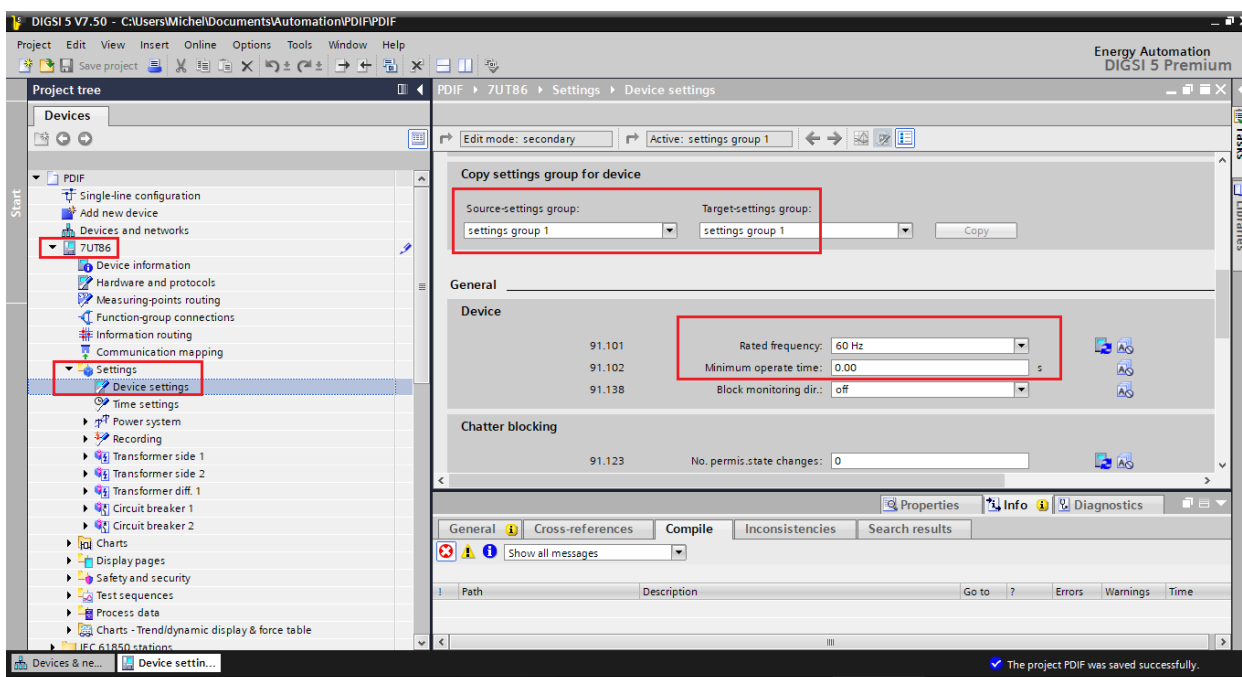


Figure 15

3.2 Power System - General

Open the “Power System” section and select the “General” option. Check the parameterized phase sequence.

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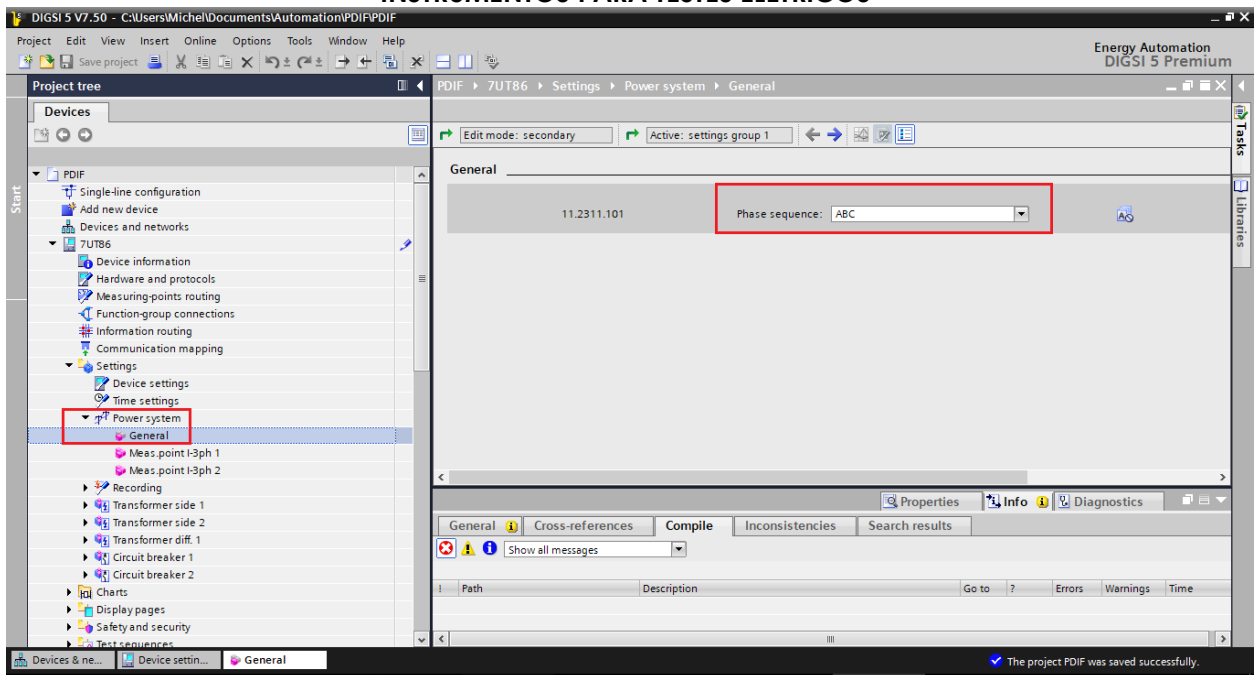


Figure 16

3.3 Meas. Point I-3ph 1

Select the option “Meas. Point I-3ph 1”. Adjust the values of primary, secondary and magnitude compensation factor for the first winding and disable the supervision functions. Click on the “Info” tab to hide it and enlarge the settings window.

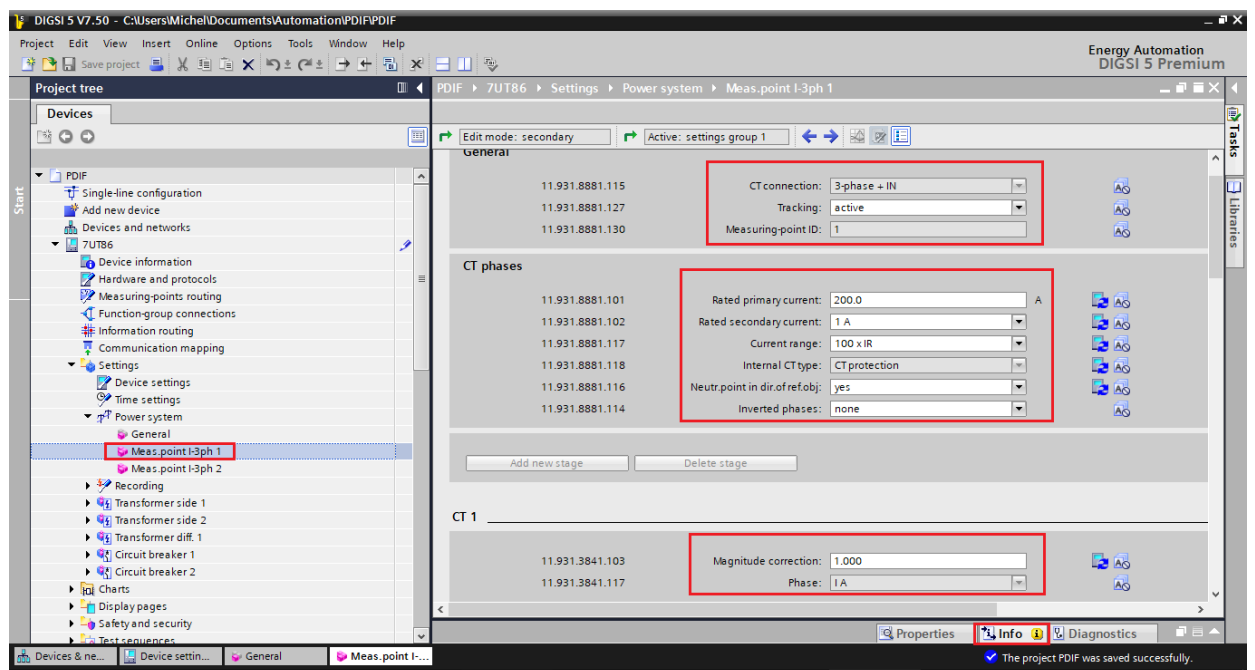


Figure 17

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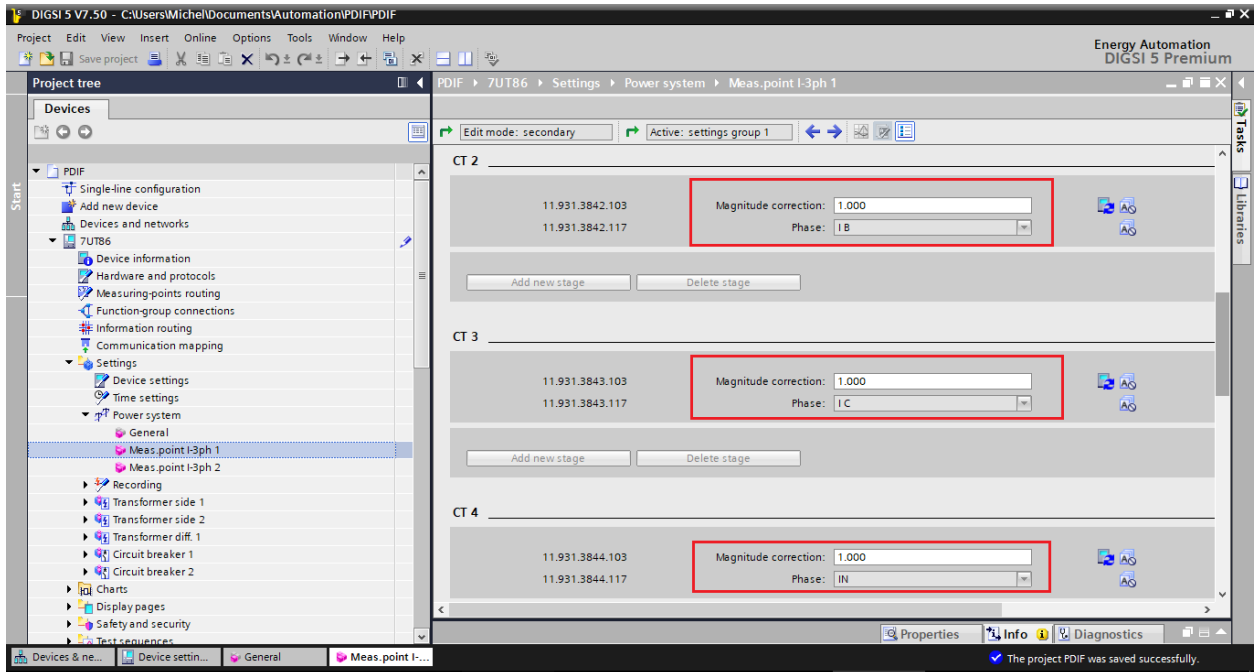


Figure 18

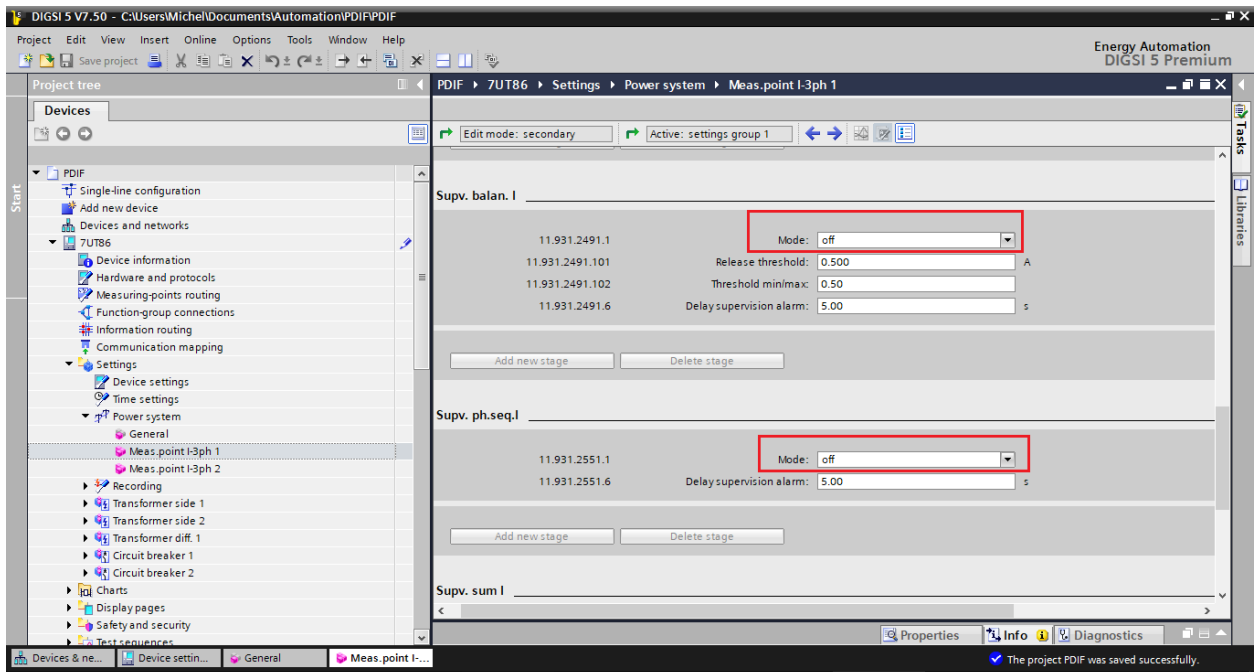


Figure 19

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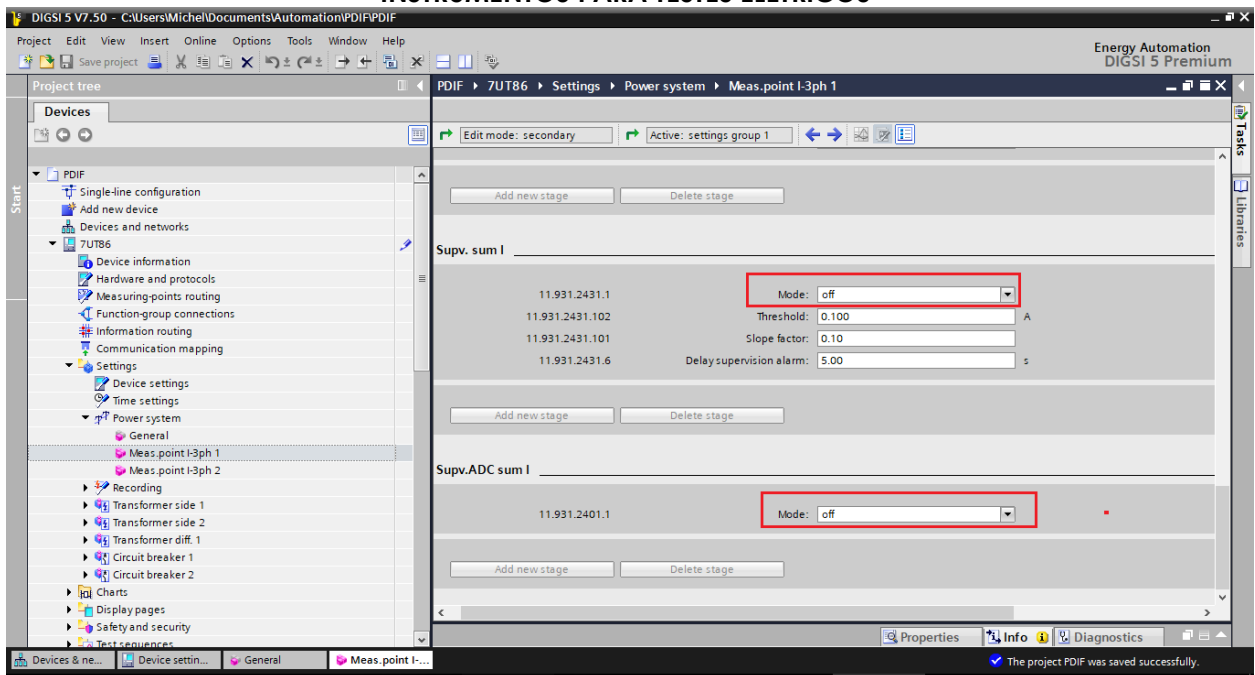


Figure 20

3.4 Meas. Point I-3ph 2

Select the option “Meas. Point I-3ph 2”. Adjust the values of primary, secondary and magnitude compensation factor for the second winding and disable the supervision functions.

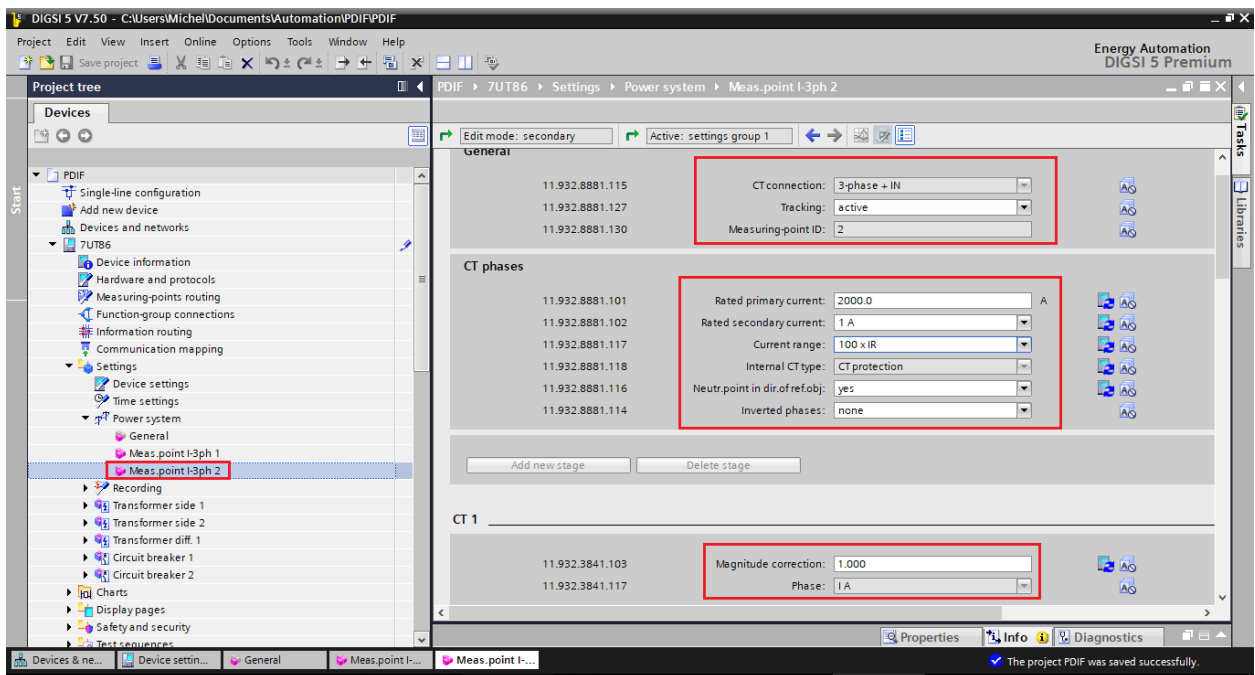


Figure 21

INSTRUMENTOS PARA TESTES ELÉTRICOS

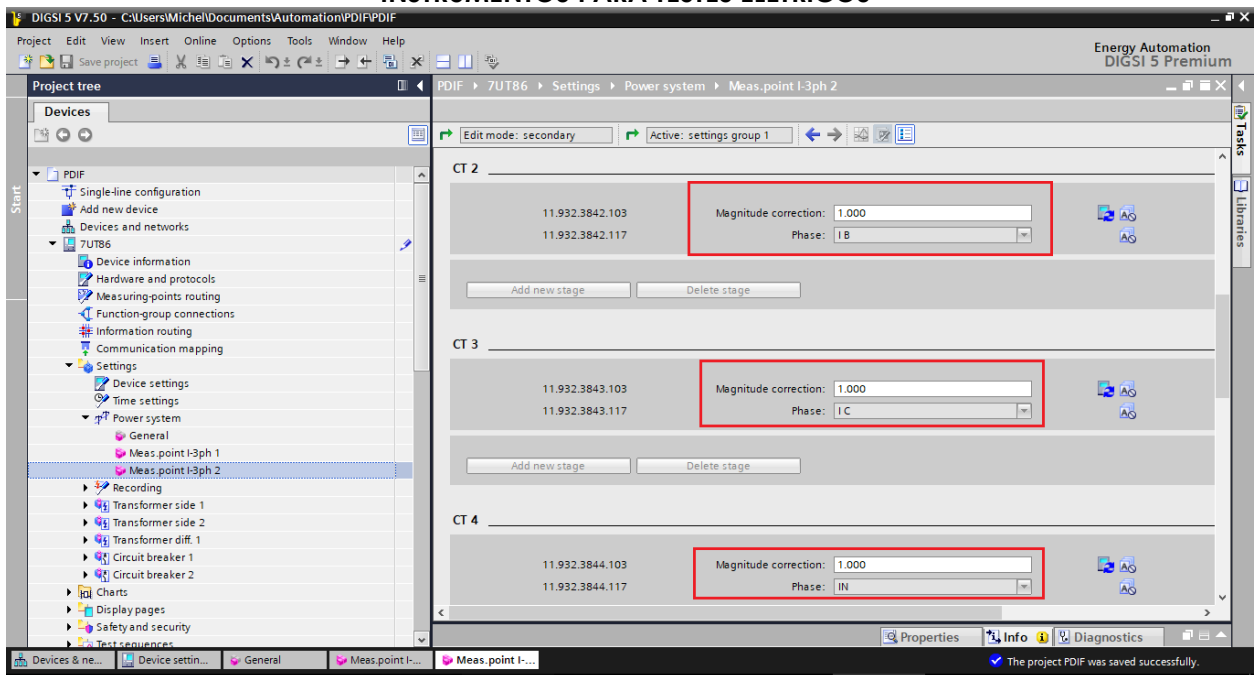


Figure 22

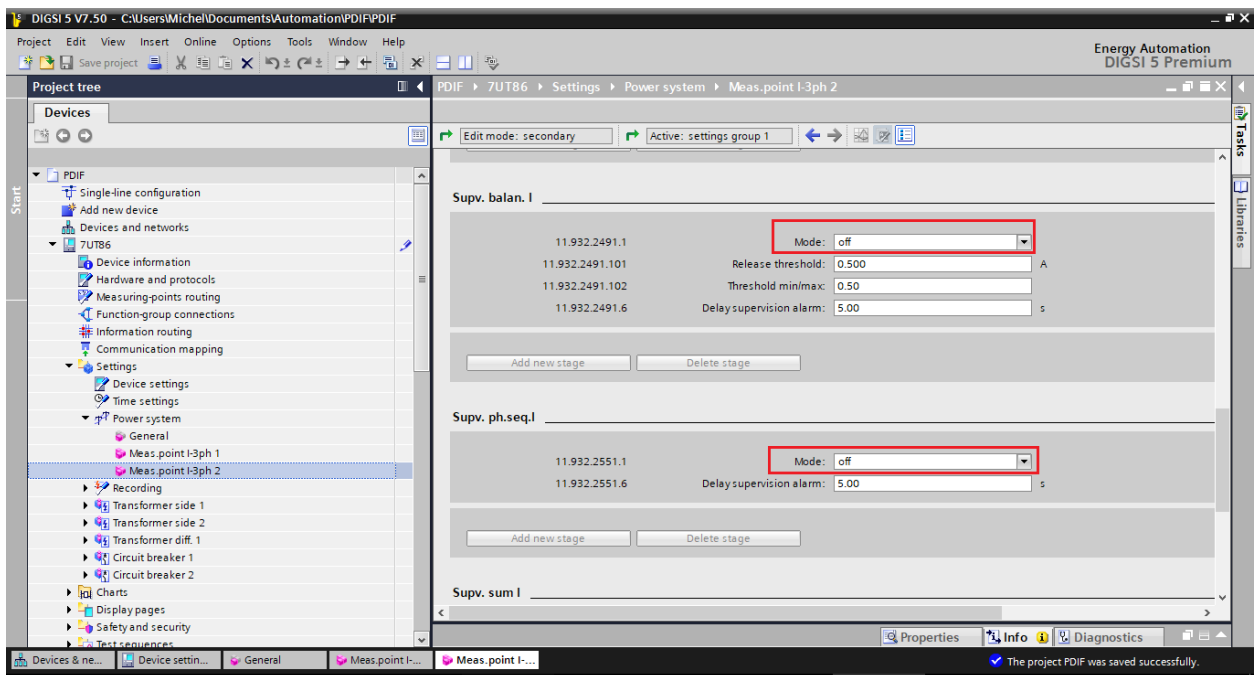


Figure 23

INSTRUMENTOS PARA TESTES ELÉTRICOS

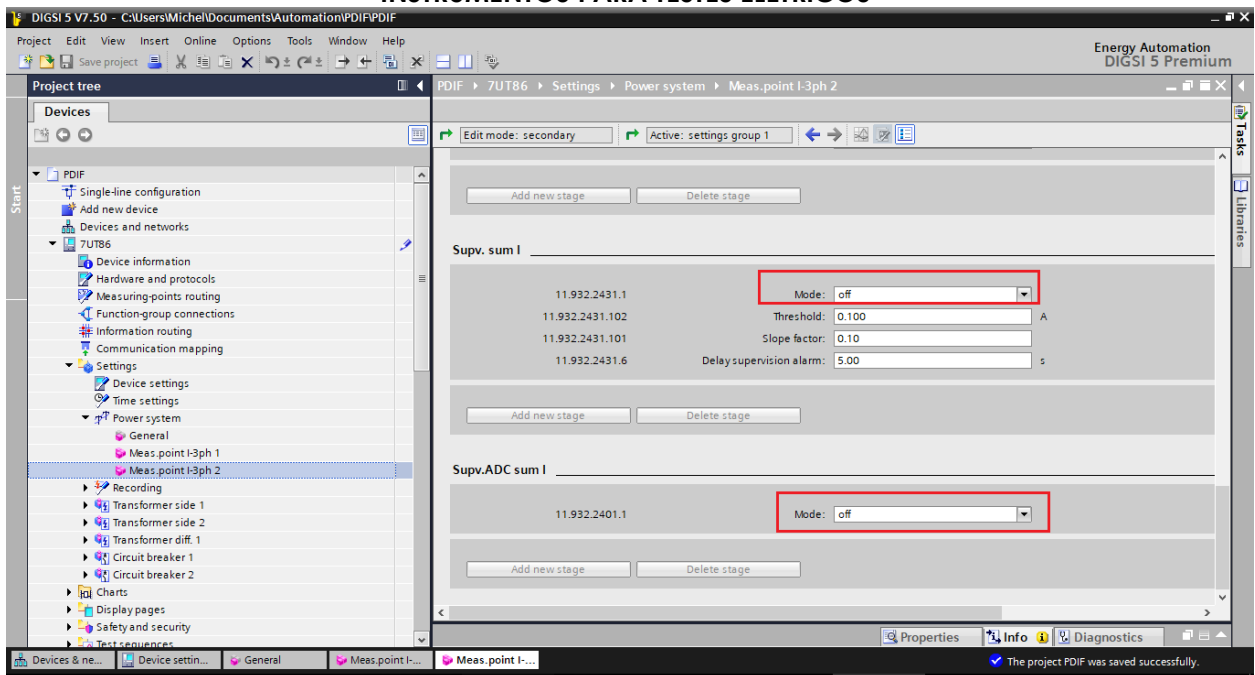


Figure 24

3.5 General

Open the “*Transformer side 1*” option and double-click the “*General*” option to adjust the voltage, power, winding type and vector group.

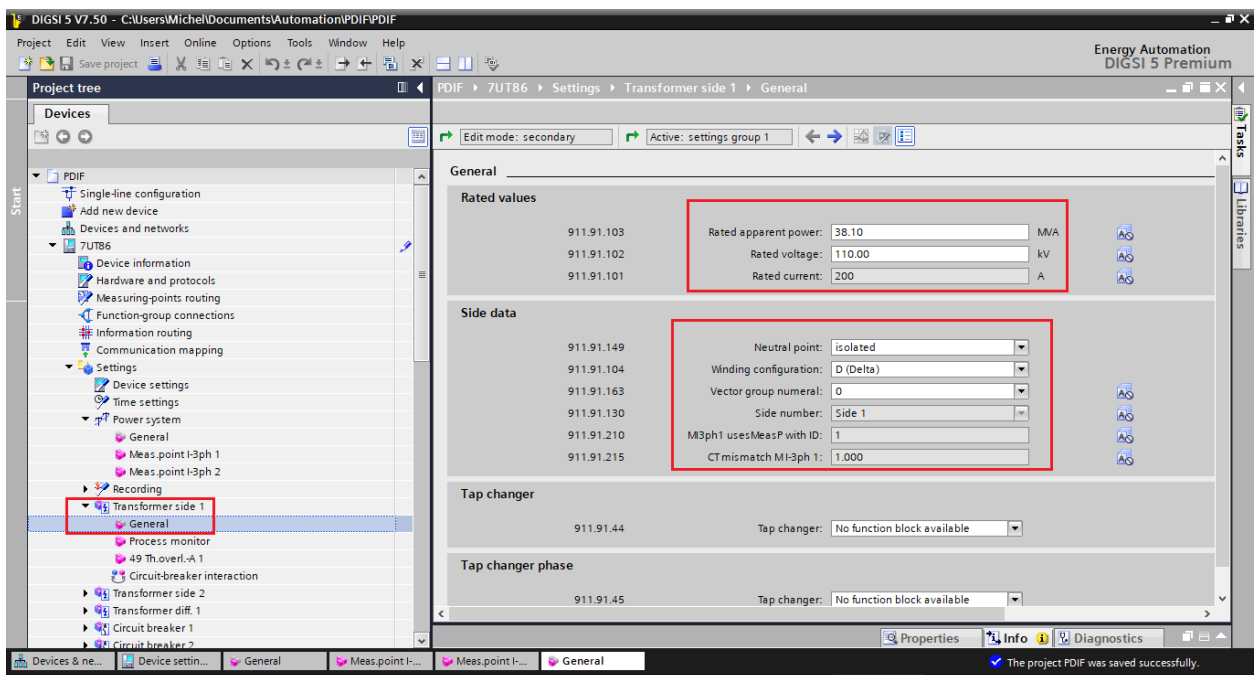


Figure 25

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3.6 General

Open the “*Transformer side 2*” option and double-click the “*General*” option to adjust the voltage, power, winding type and vector group.

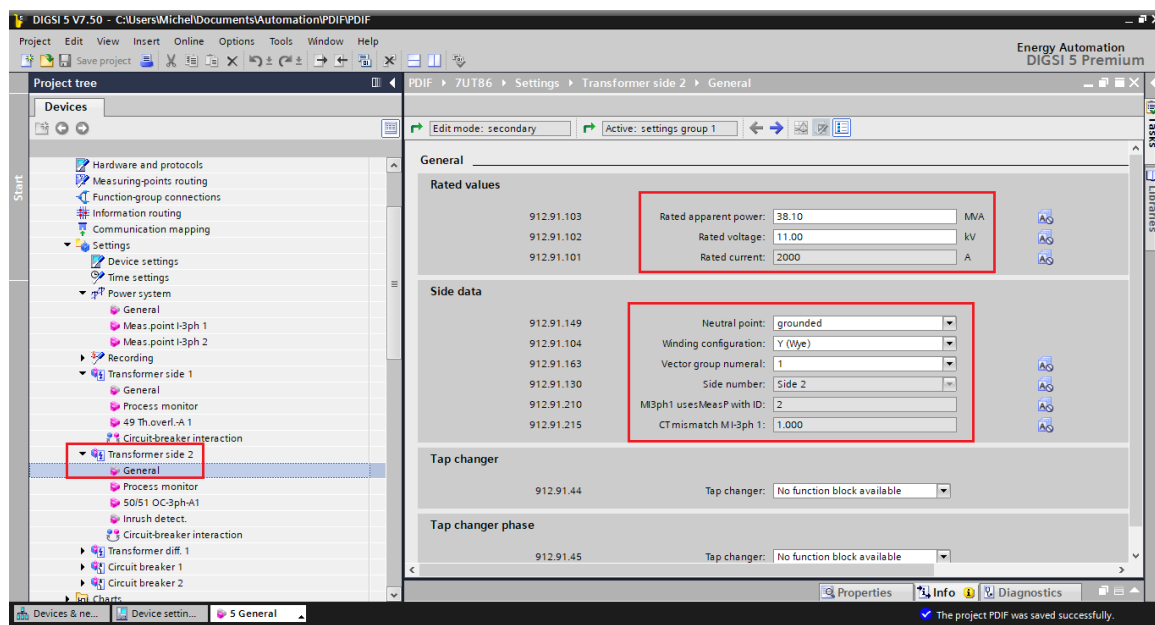


Figure 26

3.7 87T diff. Prot. 1

Open the option “*Transformer diff. 1*” and double-click the “*87T diff. Prot. 1*” to perform differential function adjustments.

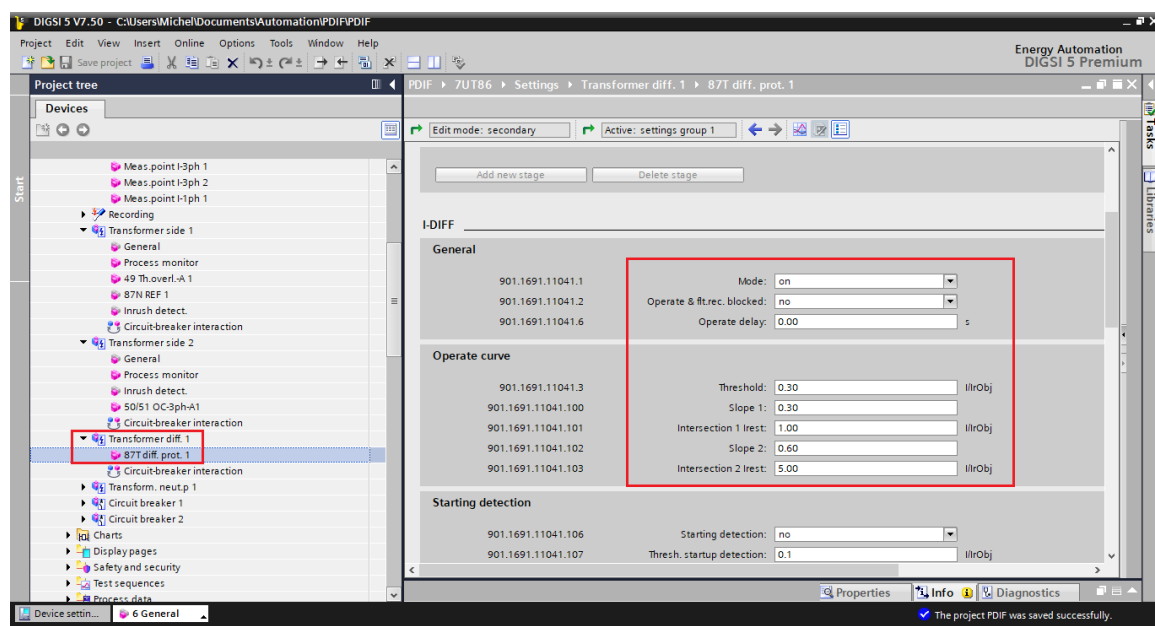


Figure 27

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Adjust the field “*Threshold add-on stabiliz.*” to 20.00 so this feature will not influence the test. Disable “*I-DIFF fast*” and set “*I-DIFF unrestr*” to 7.50A.

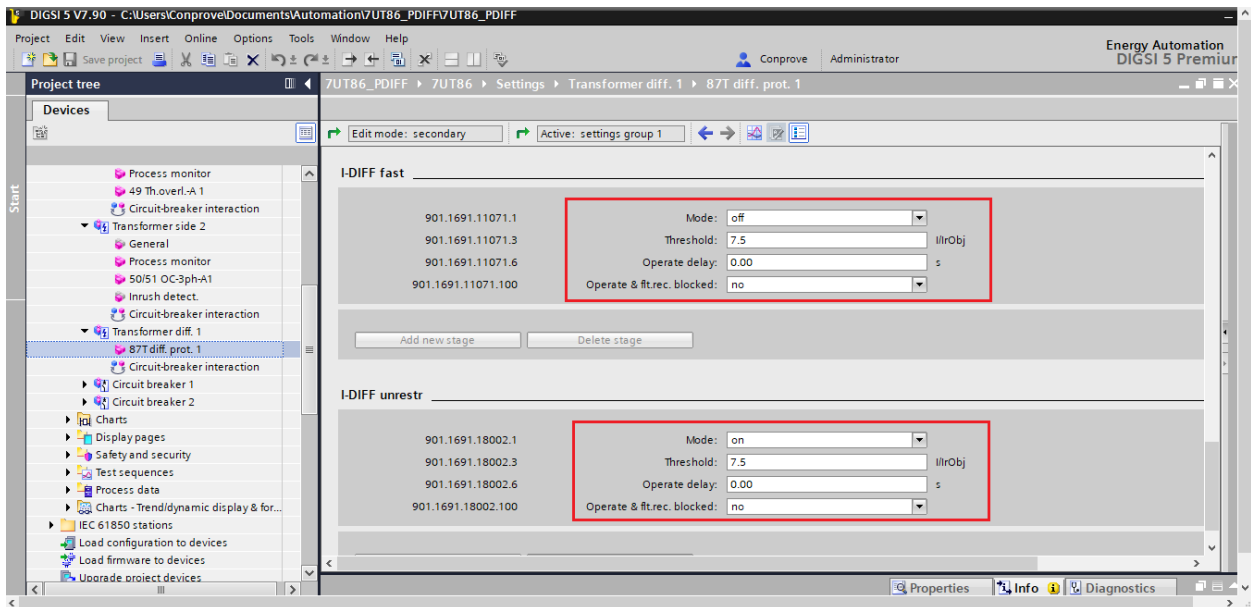


Figure 28

3.8 Information Routing

In the “*Information Routing*” option, the trip signal of the differential function is associated with the physical outputs of the relay. For easier viewing maximize the window.

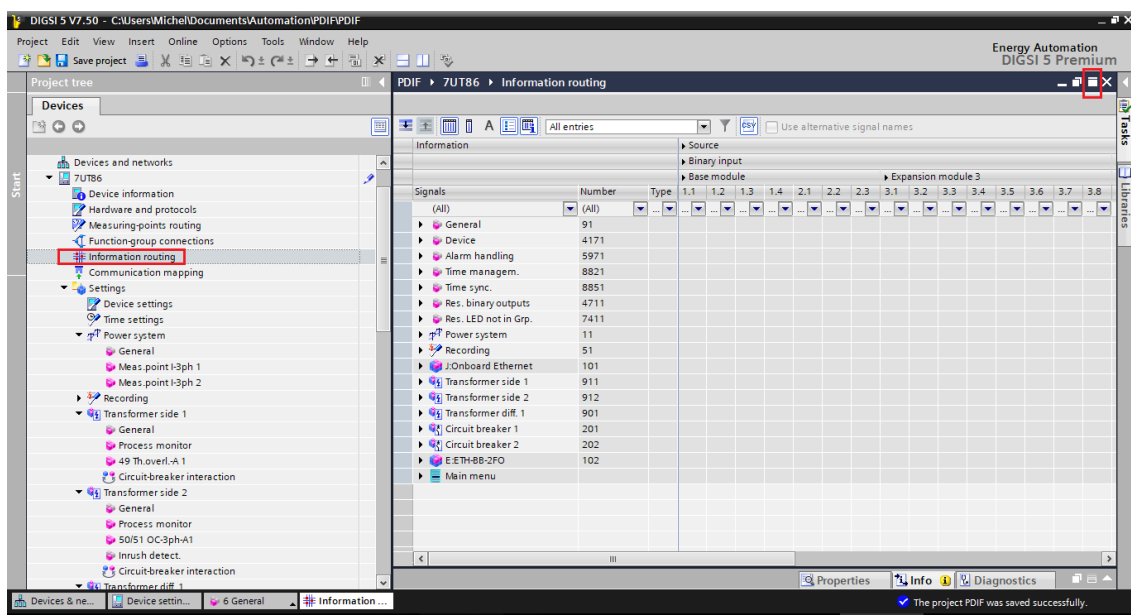


Figure 29

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The first columns are associated with the binary inputs of the relay. In that case they will not be used. Double click on the “Source” option to hide these adjustments.

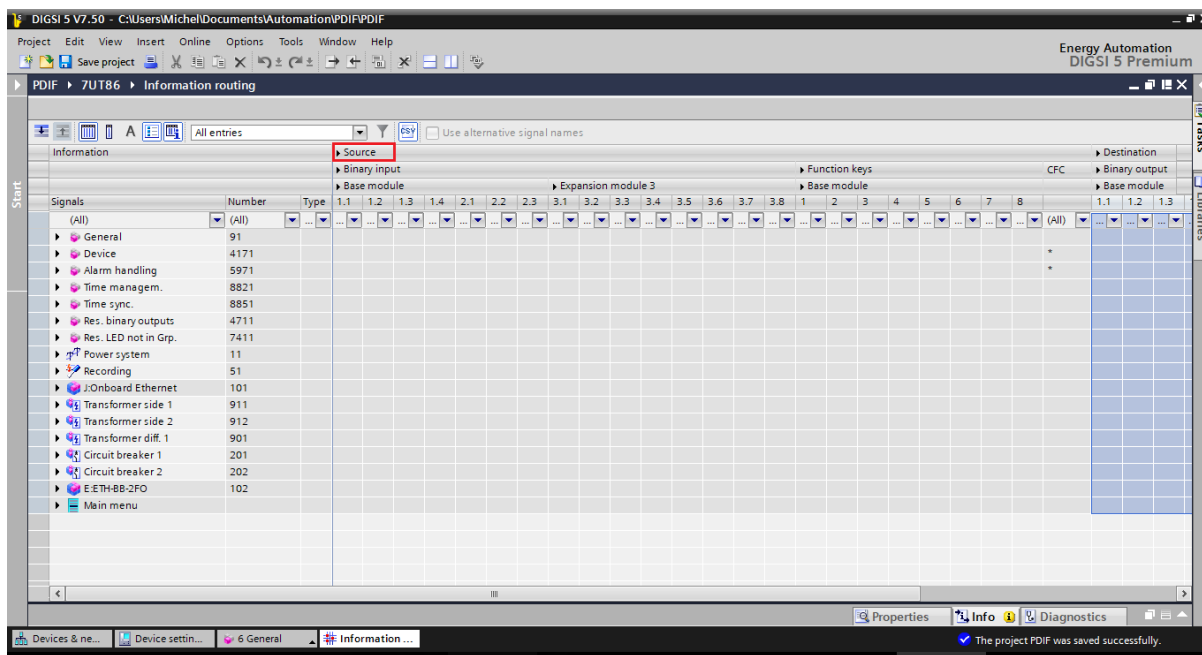


Figure 30

Enter the options “Transformer diff. 1 > 87T diff. Protection 1 > I-DIFF”.

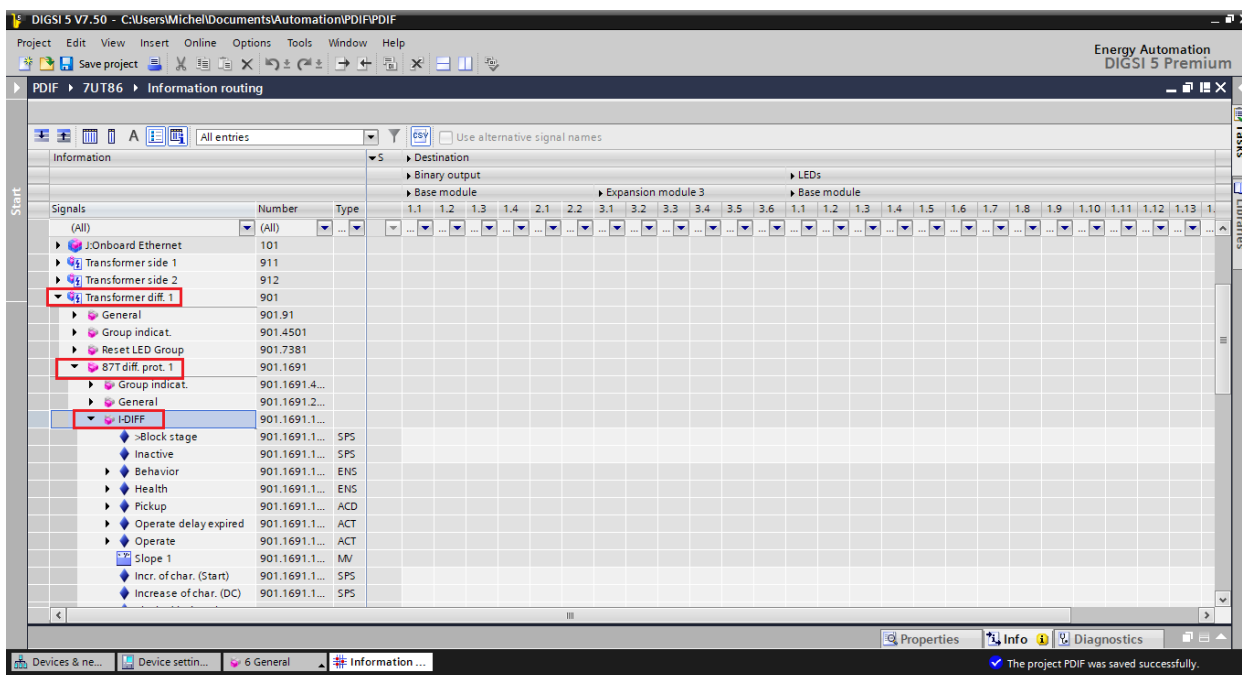


Figure 31

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Associate the “*general*” signal within “*Operate delay expired*” to output 1.1. Look at the columns for this signal “*Destination > Binary output > Base module*”.

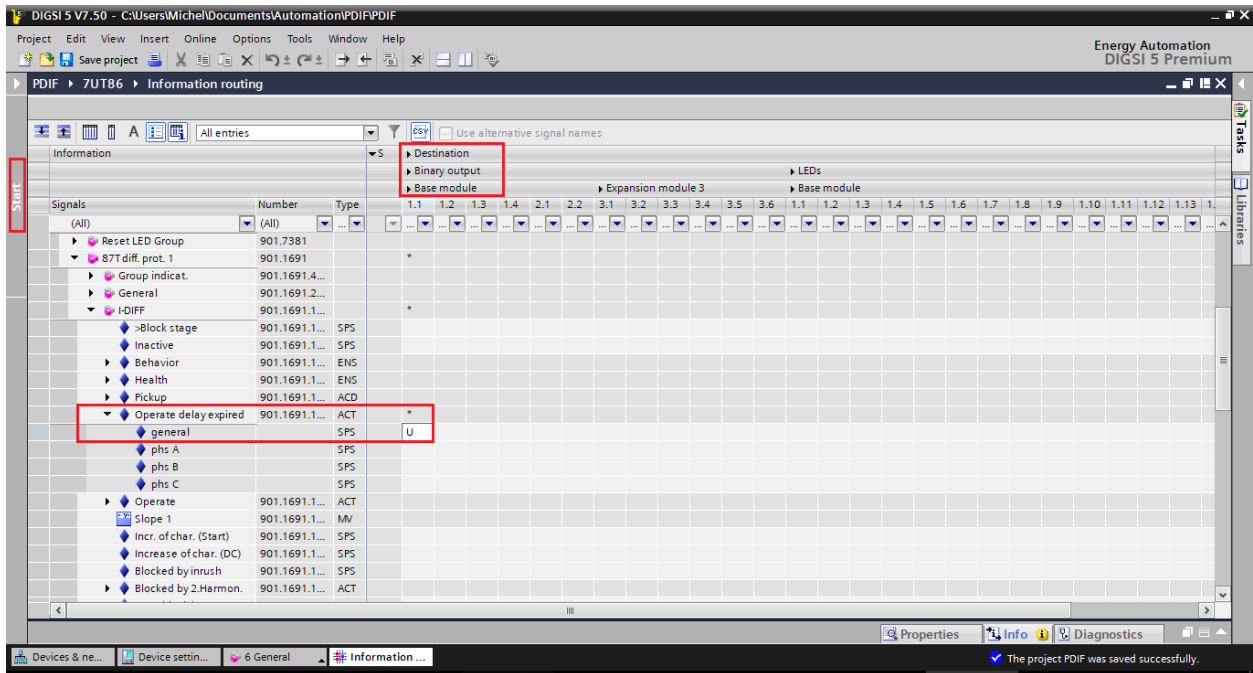


Figure 32

The option “*U*” must be used, which means “*Unlatched*”, that is, the relay activates and when the fault ceases, it automatically returns to the initial binary state. If the user chooses the “*L*” or “*Latched*” option, the relay activates and remains activated even if the fault has been extinguished. (This option is not suitable for testing).

Click on the “*Start*” option to show the main window again.

3.9 Sending adjustments

To send the parameterization changes, right-click on the “*7UT86*” relay icon and choose the “*Load configuration to device*” option.

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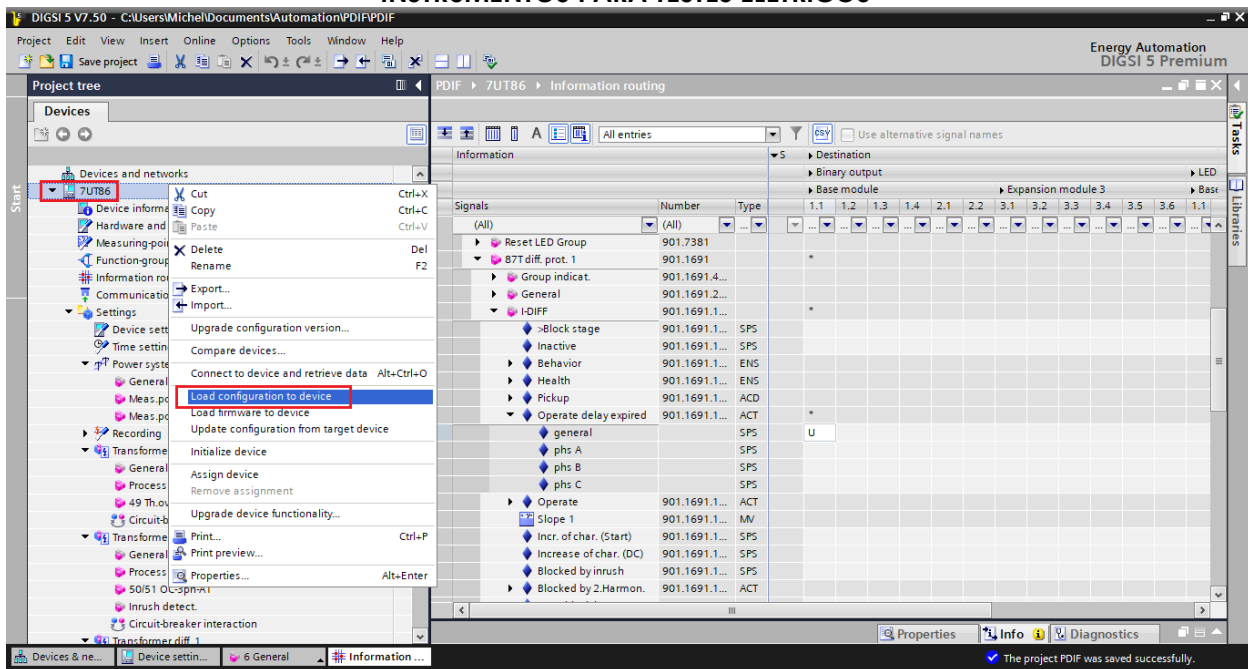


Figure 33

Remembering the default password of Siemens SIPROTE 5: “222222”.

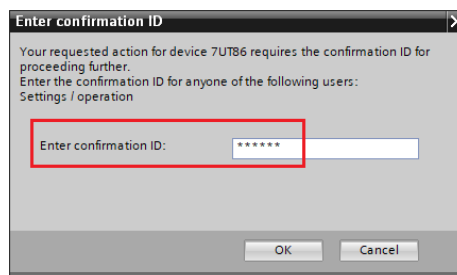


Figure 34

In the next two windows didn't shown, choose the option “Yes”.

4. Difference software settings

4.1 Opening the Differential

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



Figure 35

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Make a click on the software icon “Differential”.

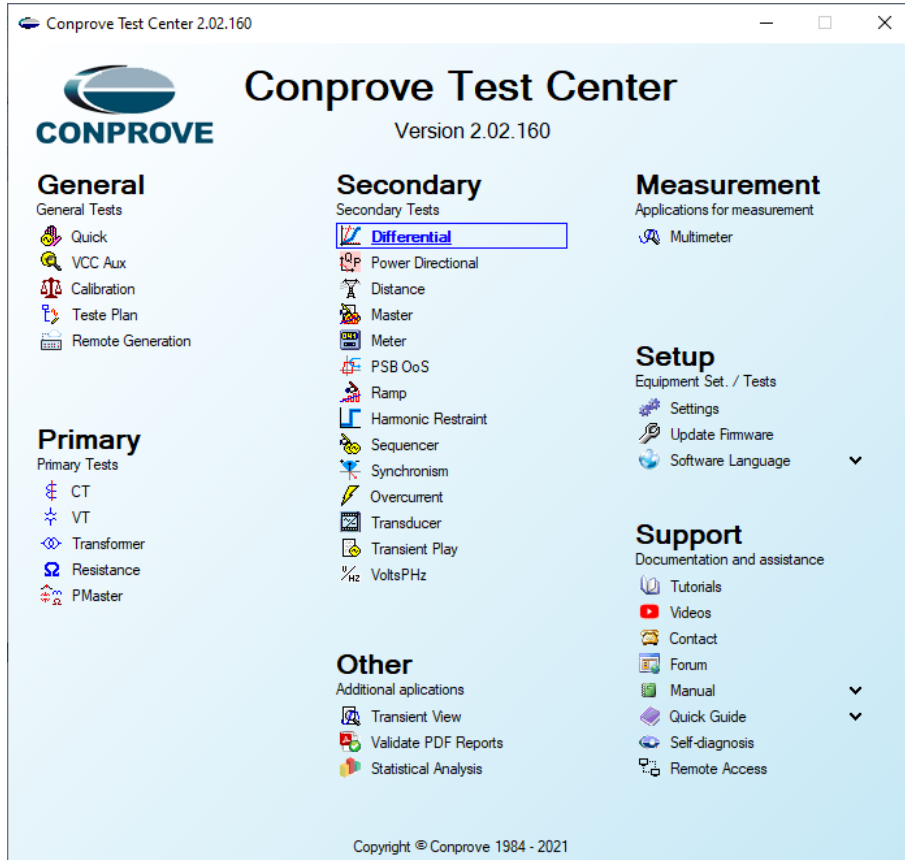


Figure 36

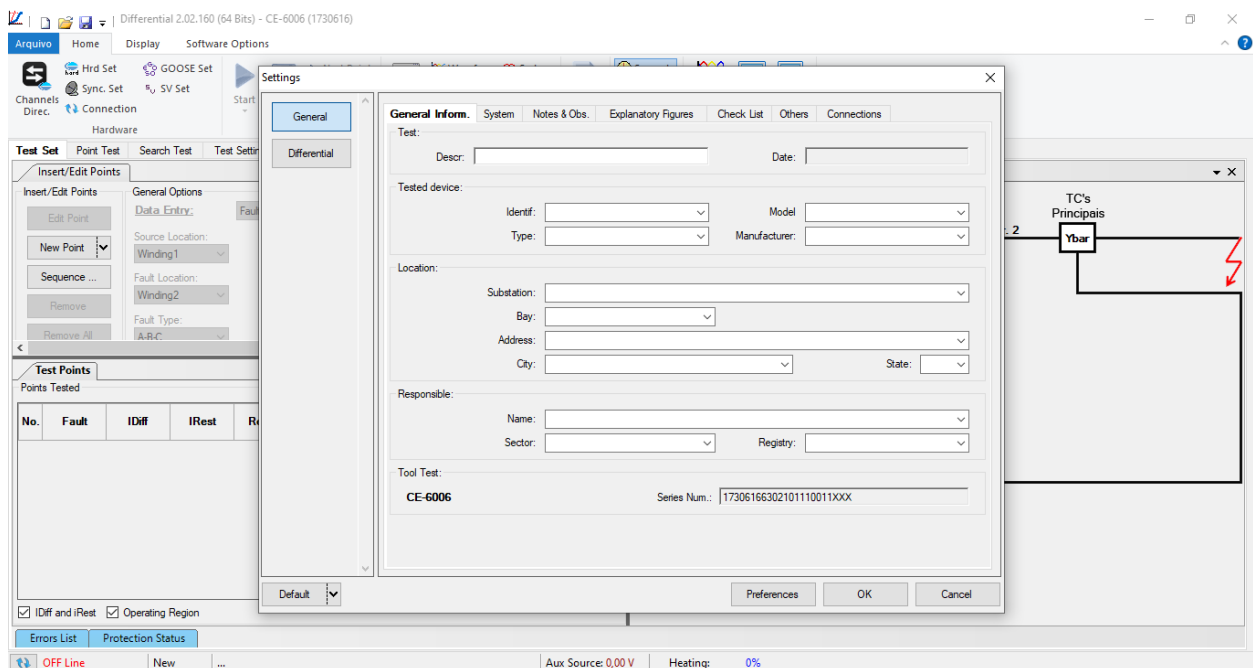


Figure 37

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.

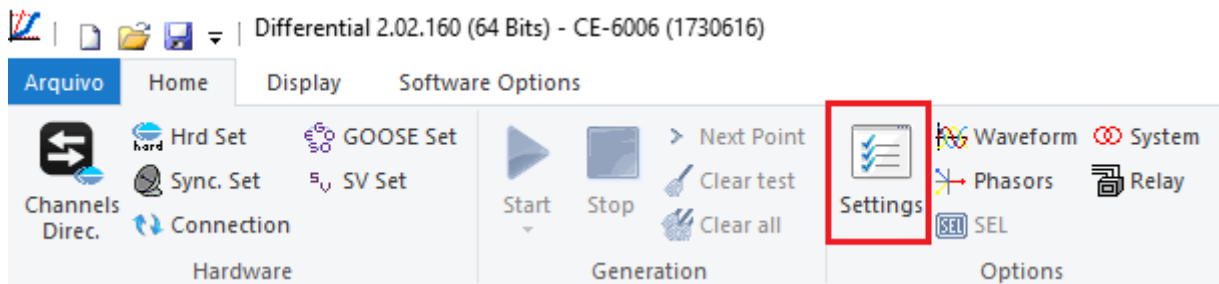


Figure 38

Inside the “Settings” screen, fill in the “General Inform.” with data from the “Tested device”, “Installation location” and the “Responsible”. This makes reporting easier, as this tab will be the first to be shown.

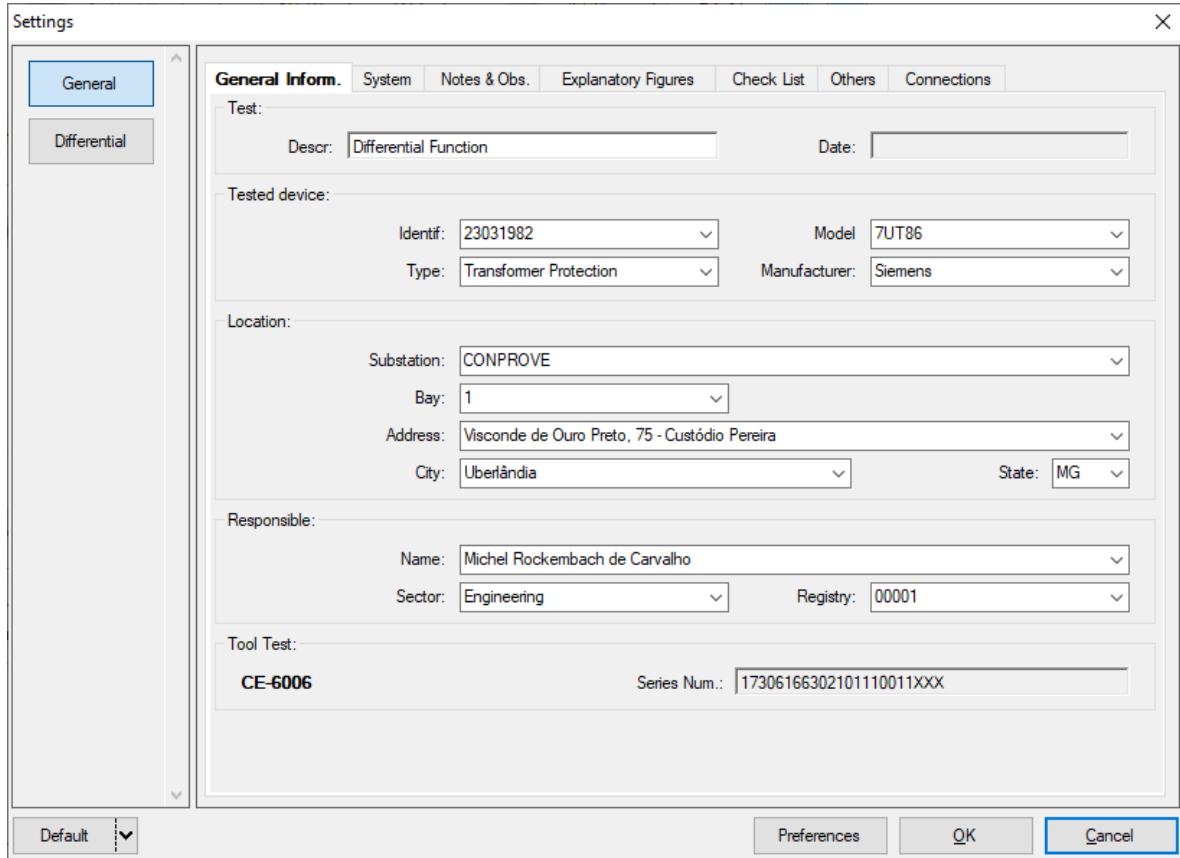


Figure 39

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 is not relevant for this test.

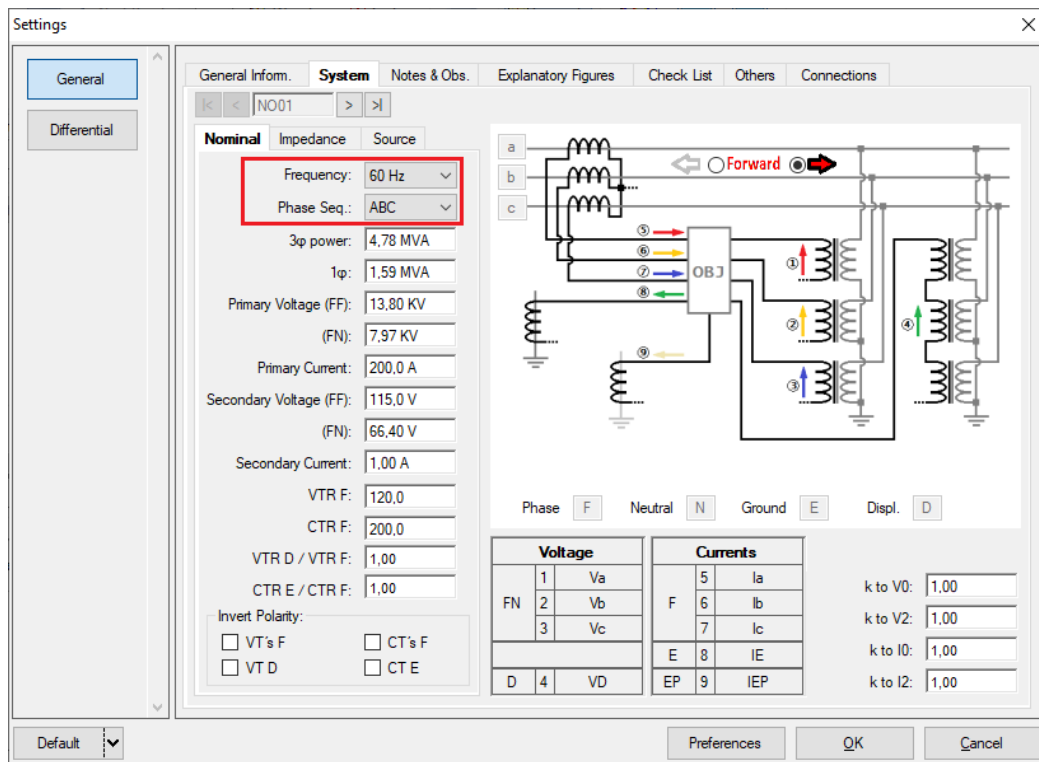


Figure 40

There are other tabs where the user can enter notes and observations, explanatory figures, can create a “check list” of the procedures for carrying out the test and even create a schematic with all the schematic of the connections between the test set and the test equipment.

5. Differential Adjustment

5.1 Differential Screen > Protected Equipment/CTs

In this tab you must inform the protected equipment, the number of windings, rated voltages, rated powers, the primary and secondary currents of the main CTs and the currents of the auxiliary CTs if necessary. This test uses the settings for a relay that is protecting a transformer. However, it is possible to test the bus, generator, motor and line protections. For transformer protection there is the possibility of testing up to four windings automatically.

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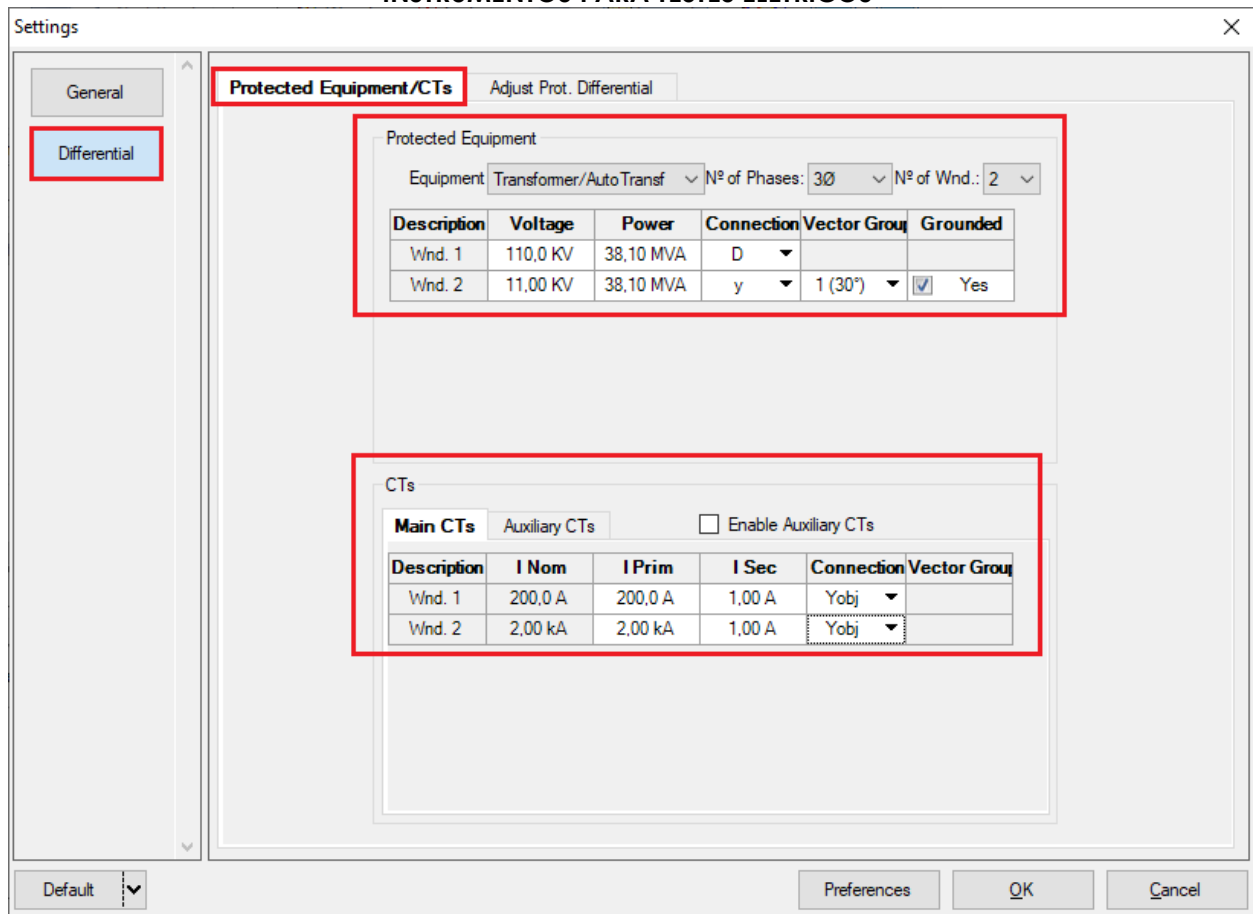


Figure 41

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 relays from the list, only parameterizable settings will be enabled. Choose the mask “SIEMENS 7UT8x (Siprotec 5)”.

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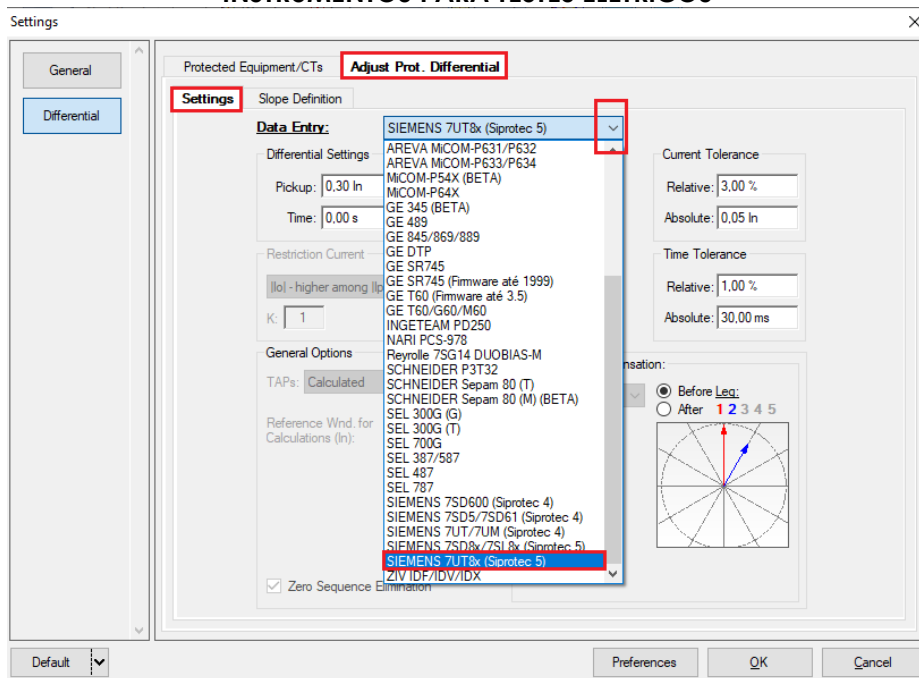


Figure 42

Parameterize the “*Differential Settings*” and “*Instantaneous Settings*”. Set the time to 0.0s. Use the tolerances for current and time given in the Appendix A.

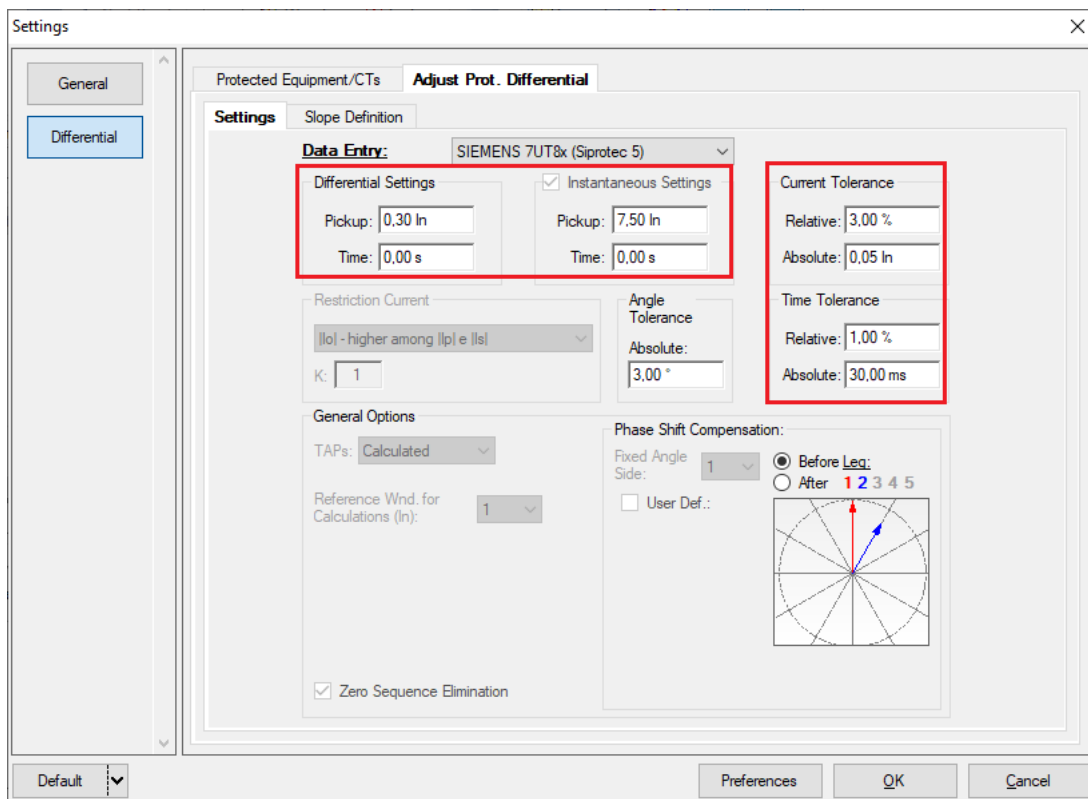


Figure 43

5.3 Differential Screen > Adjust Prot. Differential > Slope Definition

In this screen, the values of the Slopes and Intersection must be entered.

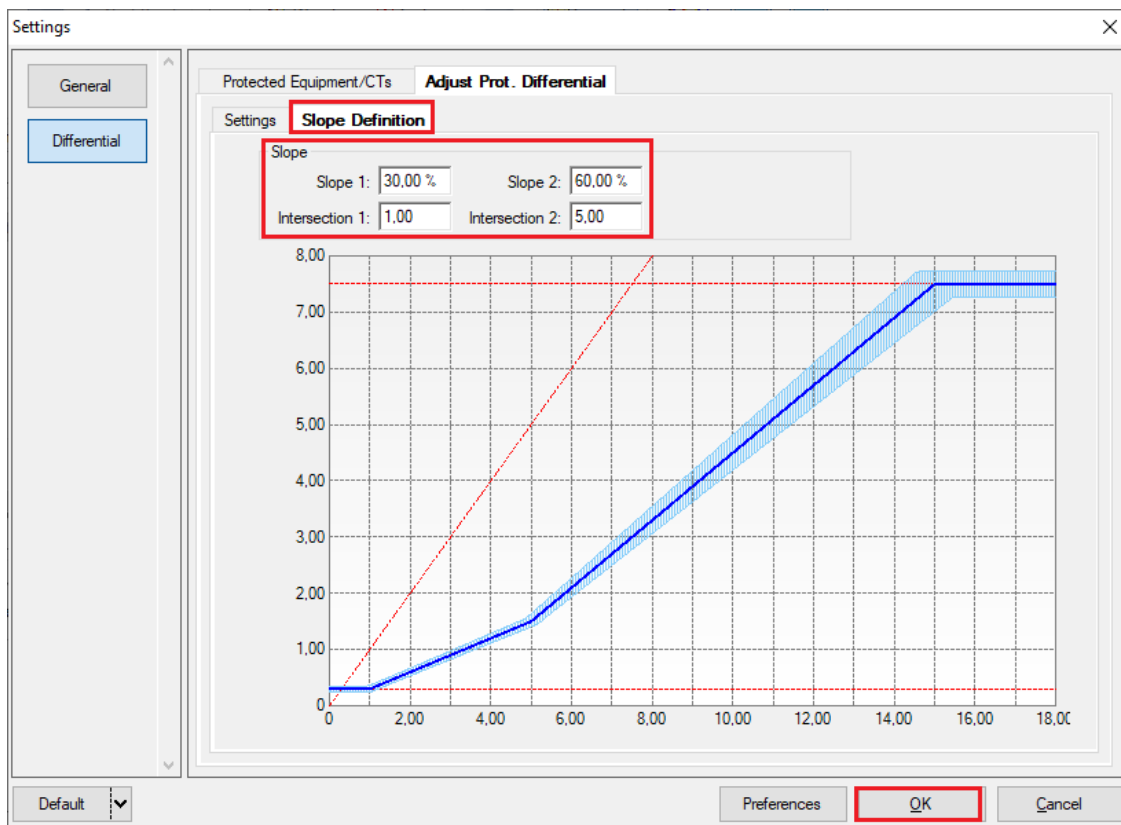


Figure 44

6. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

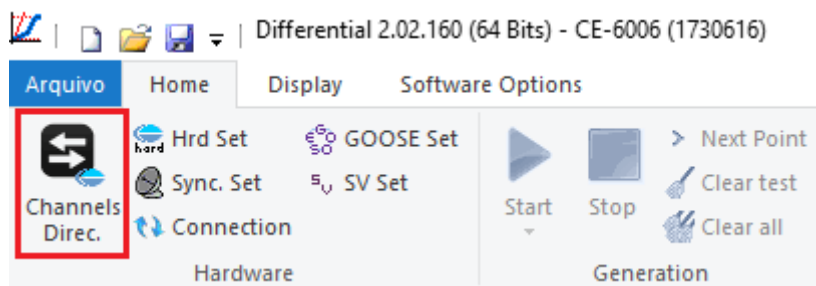


Figure 45

Then click on the highlighted icon to configure the hardware.

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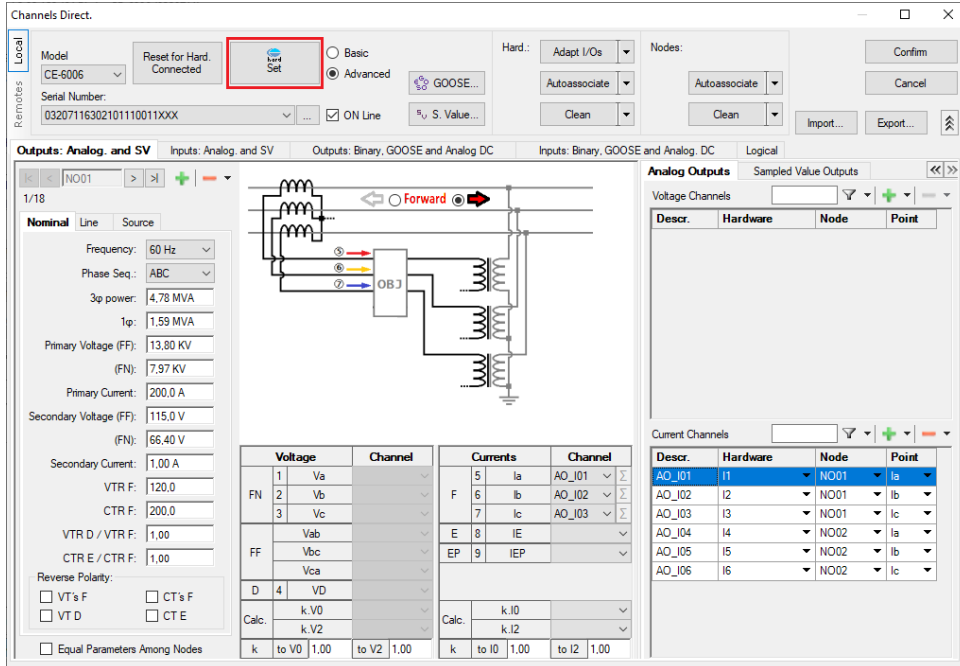


Figure 46

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

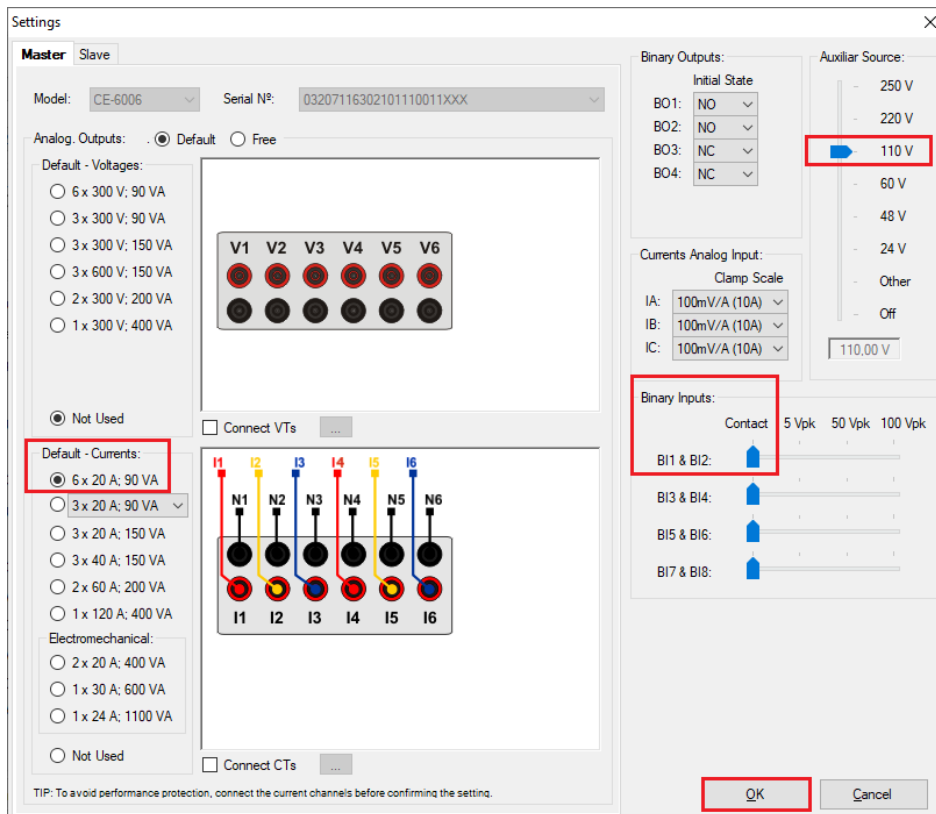


Figure 47

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

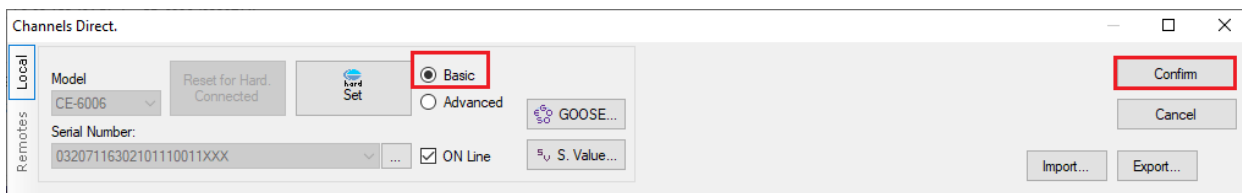


Figure 48

7. Test Structure for Function 87

7.1 Test Settings

In this tab, the trunk channels are associated with the relay phases, configure the trip signal with the binary input. An important detail is to insert a pre-fault with nominal values as shown below.

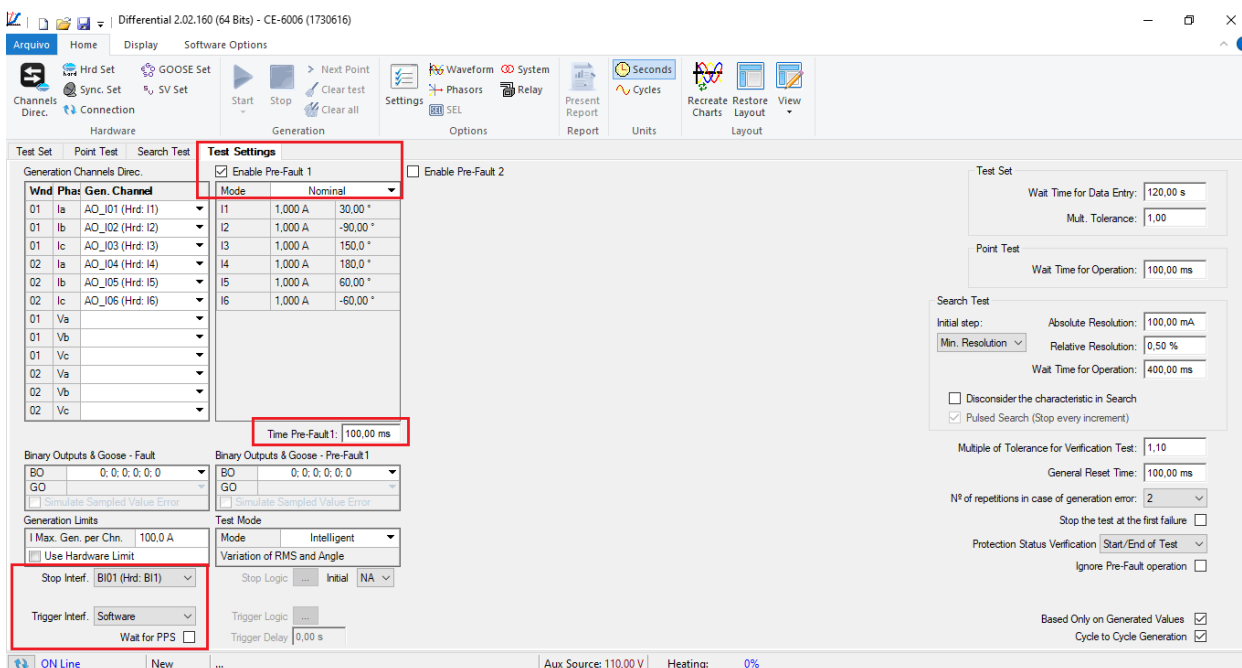


Figure 49

8. Test Set

The general idea of the configuration test is to verify that the relay settings and the settings parameterized in the software are compatible, as the software aims to simulate the behavior of the relay. To do so, enter a “New Point” according to the data below:

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Point 1:

- **Data Entry:** IDiff e iRest
 - IDiff: 1,00 In
 - IRest: 2,00 In
- **Source Location:** Winding 1
- **Fault Location:** Winding 2
- **Fault Type:** ABC

By clicking on the option “Chart” you can see where the tested point is. For this test the point is in the operating region.

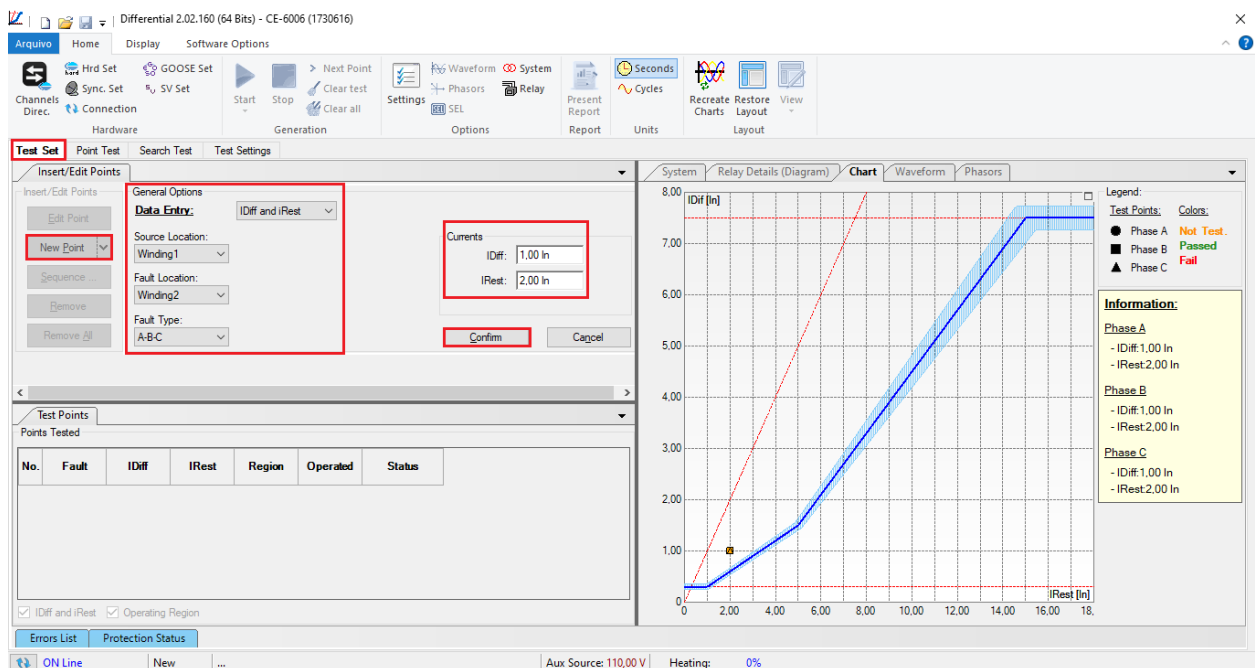


Figure 50

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

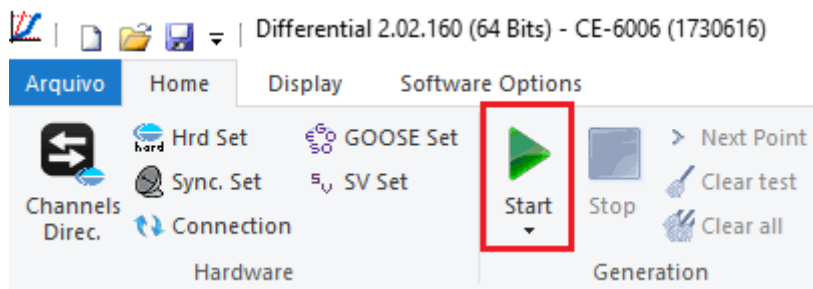


Figure 51

INSTRUMENTOS PARA TESTES ELÉTRICOS

After starting the test, the user must enter the differential and restraint current values read in the relay, which must be in the range of values calculated in the software that will perform the automatic data comparison.

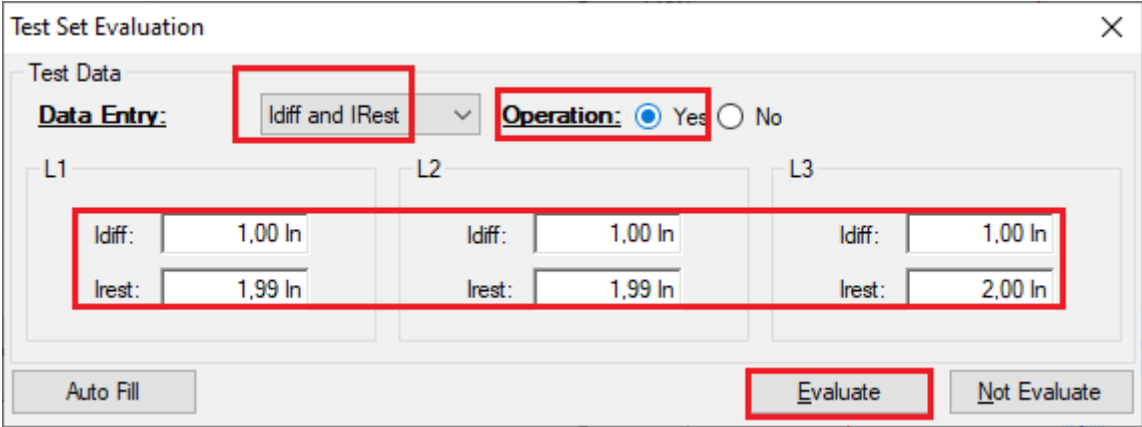


Figure 52

Passing the configuration test makes it possible for the other two tests to be carried out successfully. If there is a discrepancy between the values calculated by the software and those presented by the relay, the user must review its connections and settings.

9. Point Test

After the configuration test has passed, this means that the adjustment parameters passed to the software faithfully correspond to the behavior of the relay, in this way, the point test can be performed, since it analyzes not only the operation of the relay, but also the shooting time.

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

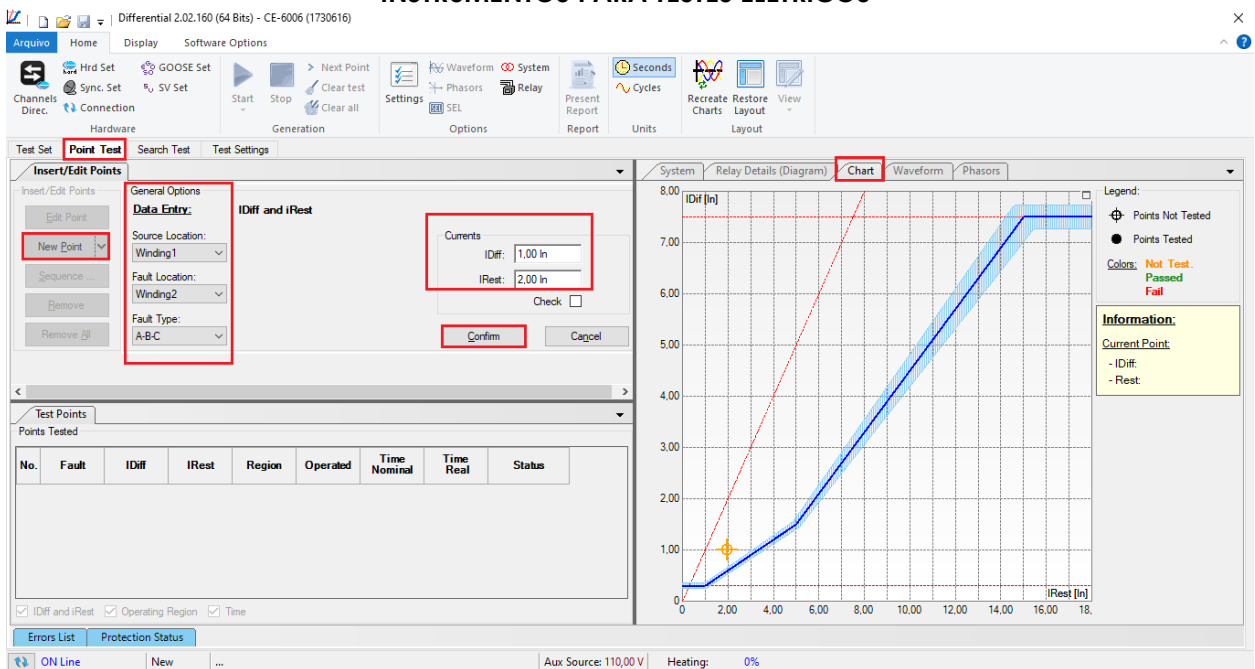


Figure 53

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

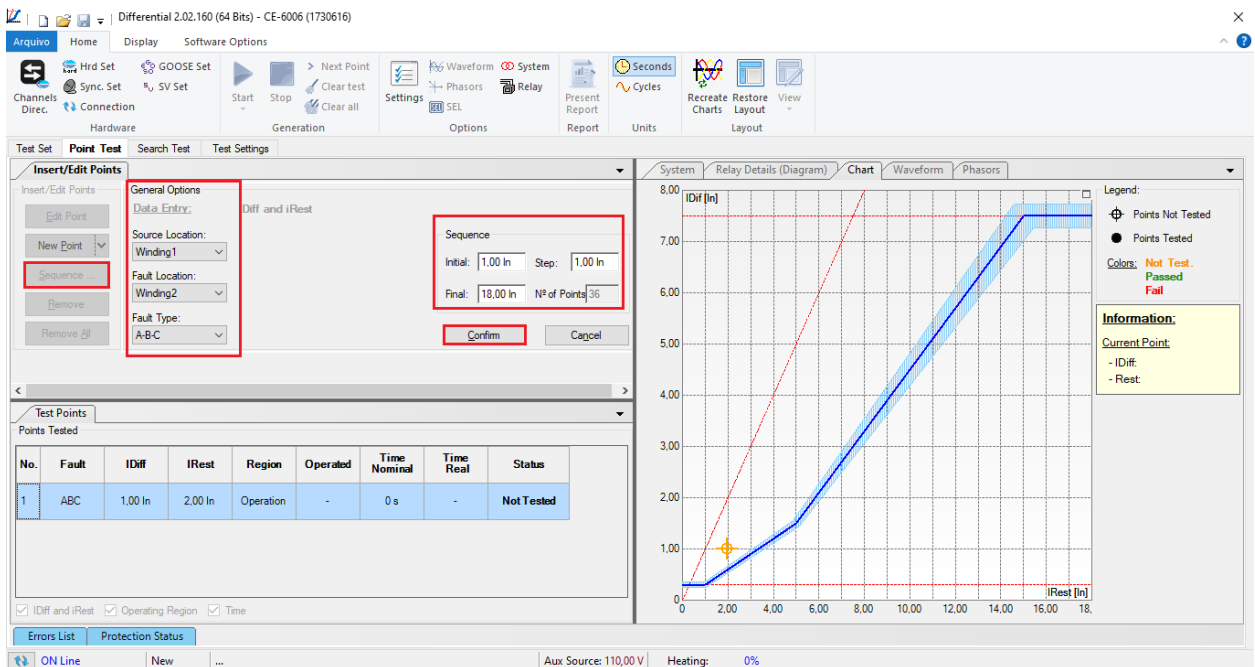


Figure 54

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

INSTRUMENTOS PARA TESTES ELÉTRICOS

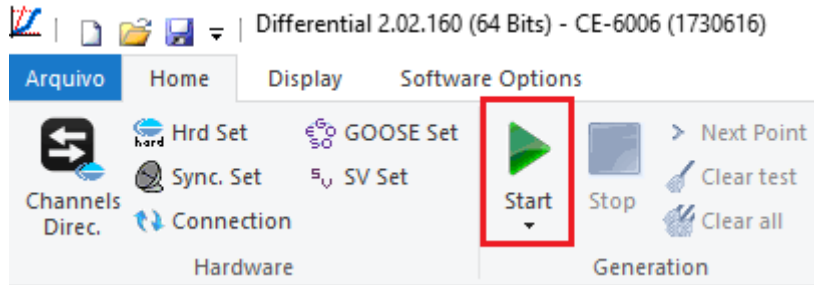


Figure 55

It is verified that all points were successfully approved

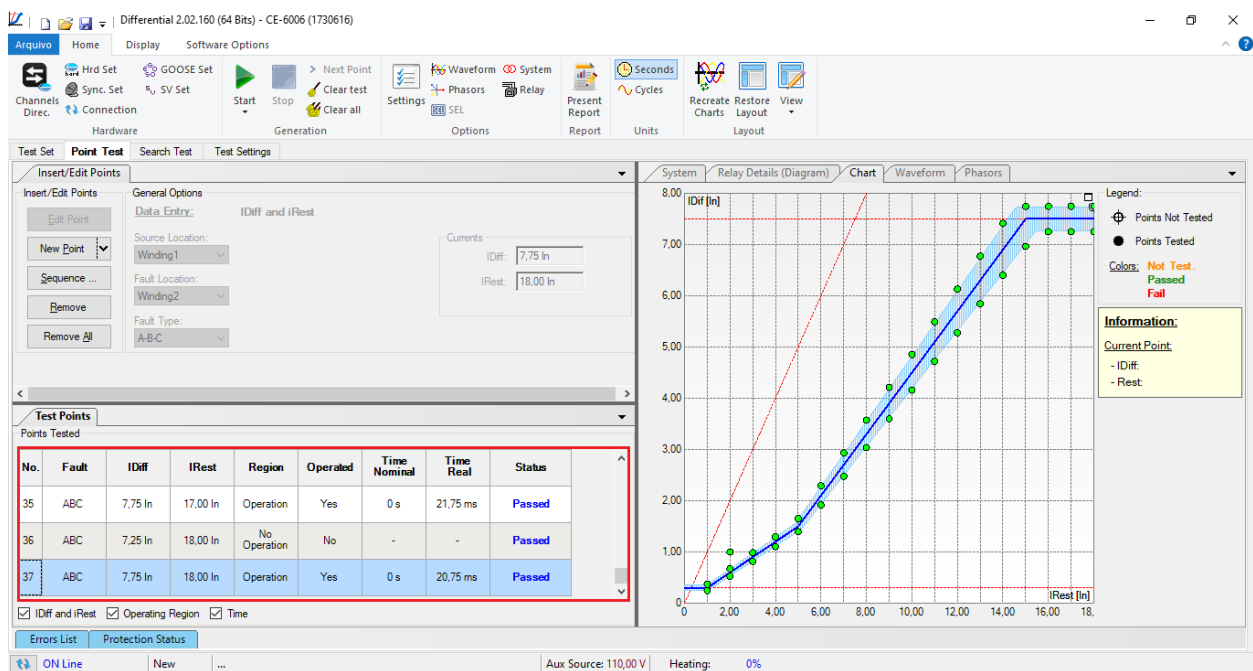


Figure 56

10. 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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

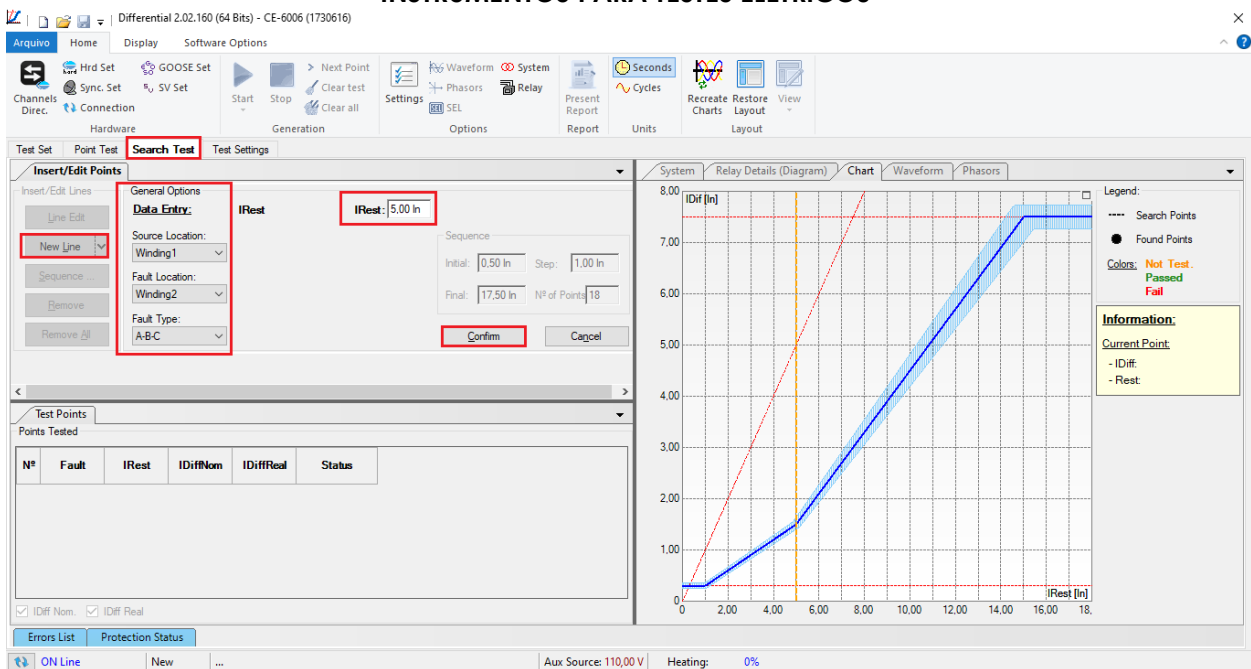


Figure 57

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.

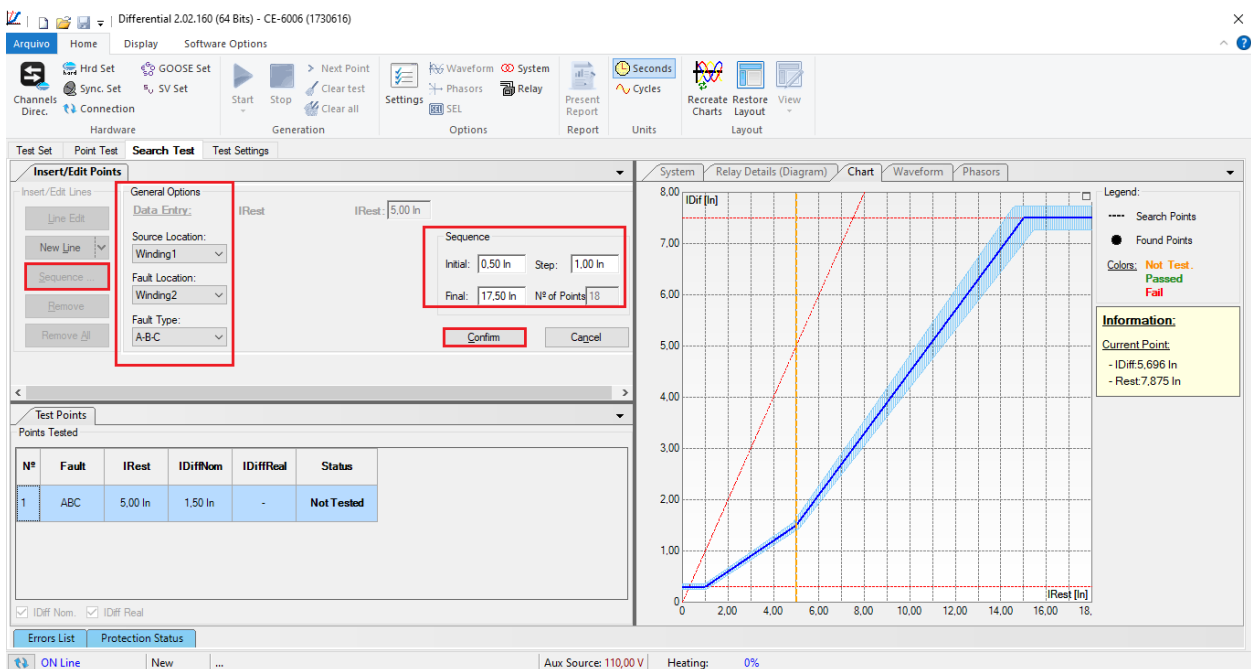


Figure 58

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

INSTRUMENTOS PARA TESTES ELÉTRICOS

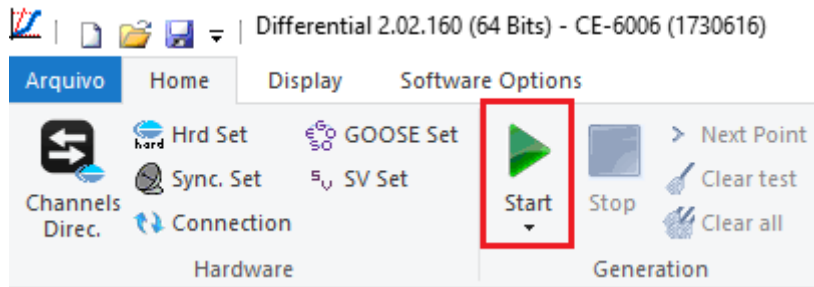


Figure 59

It is verified that all lines were successfully approved

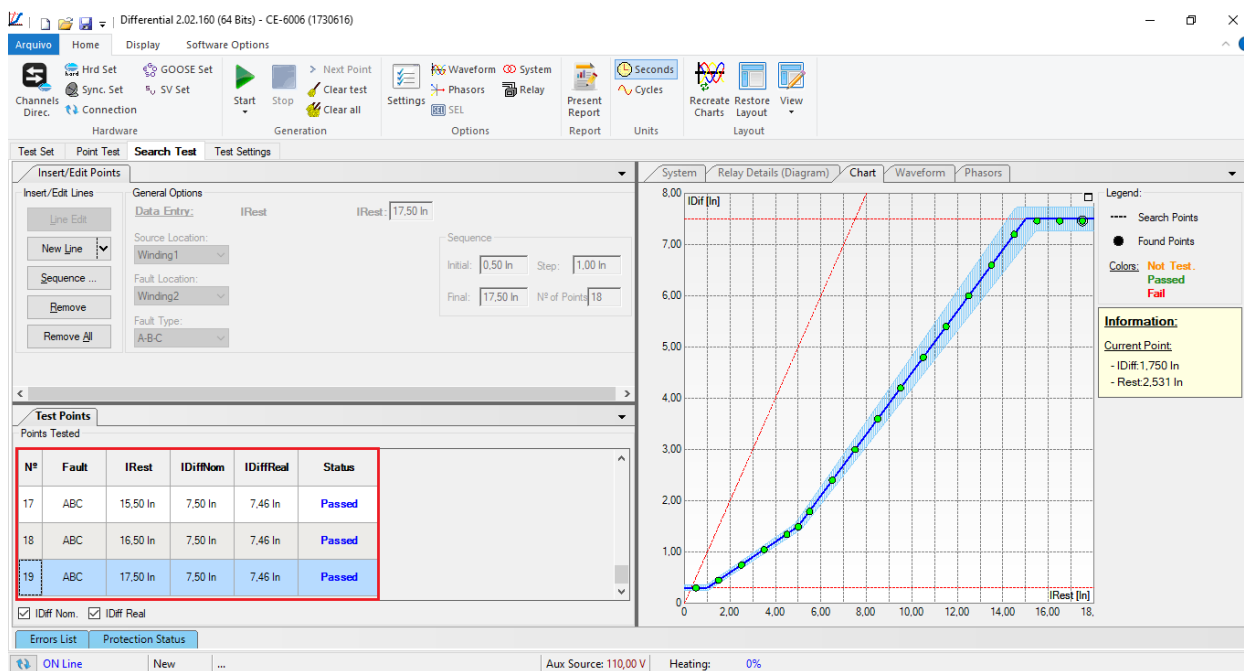


Figure 60

11. 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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

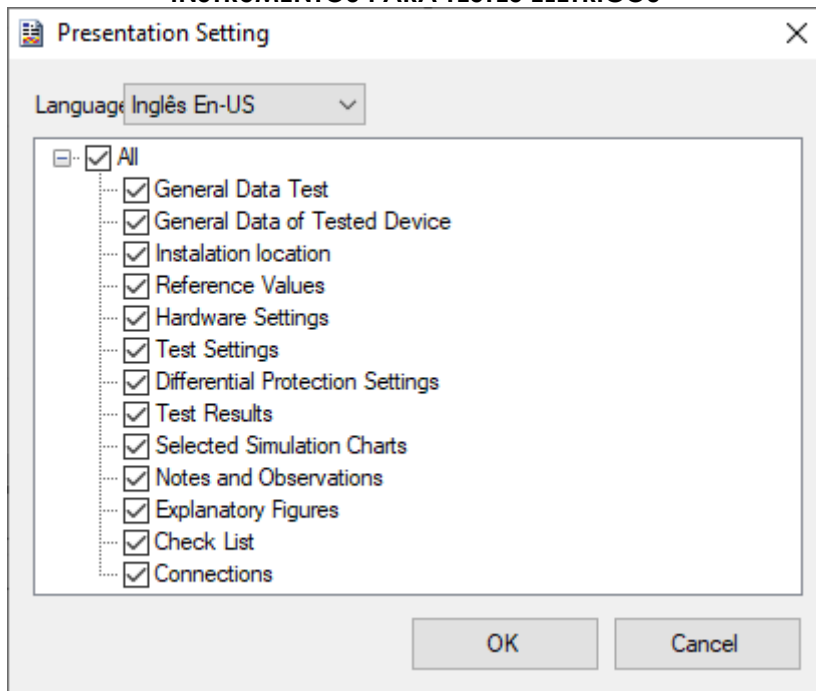


Figure 61

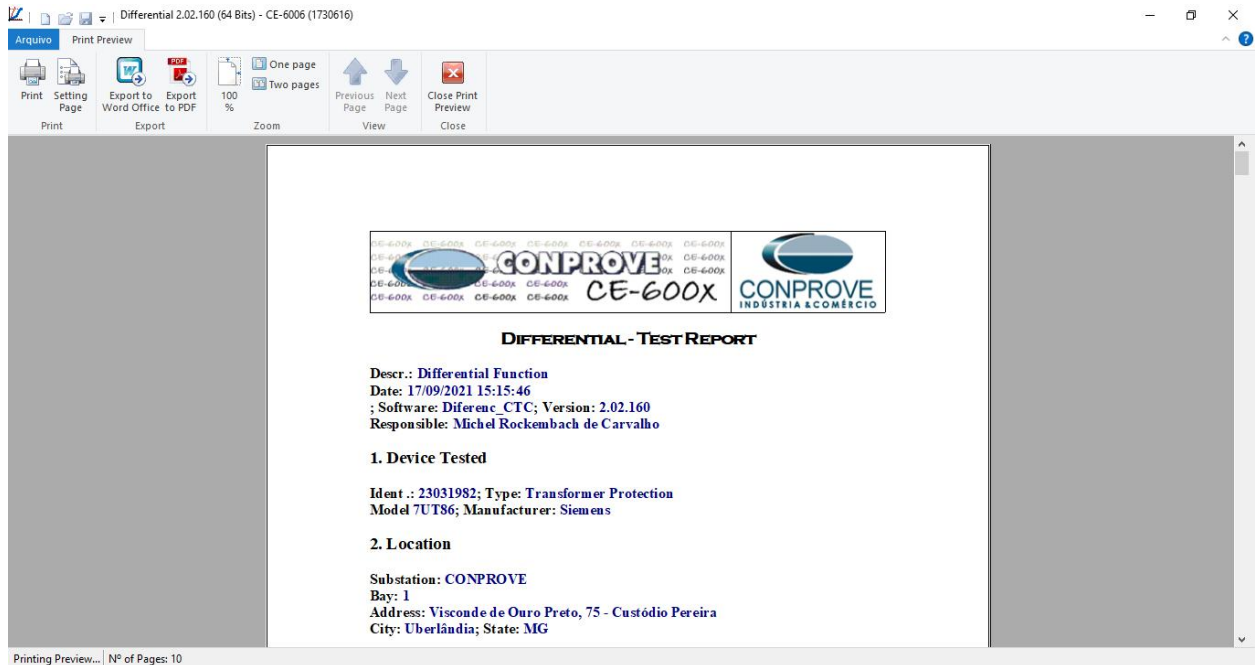


Figure 62

APPENDIX A

A.1 Terminal Designations

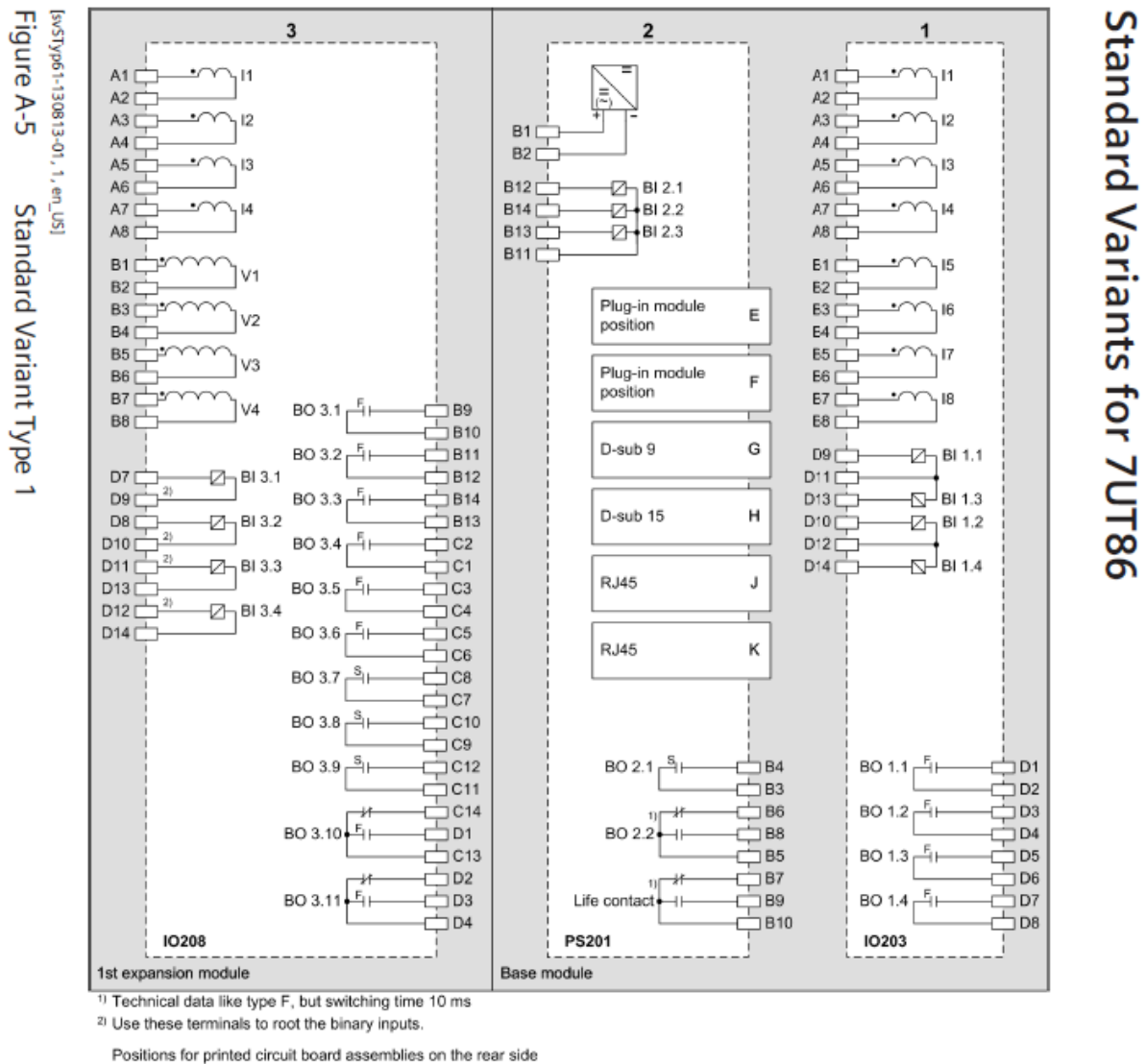


Figure 63

A.2 Technical Data

Differential Units	
Pickup and Reset	$\pm 3\%$ or $\pm 50\text{mA}$ of the theoretical value (the greater) ($I_n = 1\text{A}$ and 5A)

Measurement of average times of the differential unit with restraint				
Type	Enabled	Times I0 (Sensitivity)	Measuring Times (**)	
			50Hz	60Hz
Blocking or Harmonic Restraint	YES	1.5	32 ms	28 ms
		5	31 ms	28 ms
		15	31 ms	28 ms
Blocking or Harmonic Restraint	NO*	1.5	28 ms	27 ms
		5	17 ms	16 ms
		15	15 ms	14 ms

(*) When the **Blocking type / Harmonic Restraint** setting is in Dynamic mode, blocking / restraint by harmonics will be disabled in internal fault conditions.

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 1

Differential Software		Siemens 7UT86 Relay	
Parameter	Figure	Parameter	Figure
Voltage (Wind. 1)	41	Rated Voltage	25
Voltage (Wind. 2)	41	Rated Voltage	26
Power (Wind. 1)	41	Rated apparent power	25
Power (Wind. 2)	41	Rated apparent power	26
Connection (Wind. 1)	41	Winding configuration	25
Connection (Wind. 2)	41	Winding configuration	26
Vector Group (Wind. 2)	41	Vector group numeral	26
I Prim (Wind. 1)	41	Rated primary current	17
I Prim (Wind. 2)	41	Rated primary current	21
I Sec (Wind. 1)	41	Rated secondary current	17
I Sec (Wind. 2)	41	Rated secondary current	21
Connection CT (Wind. 1)	41	Neutr. Point in dir. of ref. obj	17
Connection CT (Wind. 2)	41	Neutr. Point in dir. of ref. obj	21
Differential Settings (pickup)	43	Threshold	27
Instantaneous Settings (pickup)	43	Threshold	28
Slope 1	44	Slope 1	27
Intersection 1	44	Intersection 1 Irest	27
Slope 2	44	Slope 2	27
Intersection 2	44	Intersection 2 Irest	27