# Test Tutorial

**Equipment Type:** Protection Relay

**Brand:** Siemens

**Model:** 7SA86

**Function:** 67 or PTOC - Directional Overcurrent

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

**Objective:** Perform tests on the directional overcurrent function to prove the operating time and its directionality

## Version control:

| Version | Descriptions | Date | Author | Reviewer |
|---|---|---|---|---|
| 1.0 | Initial release | 17/05/2022 | 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 7SA86 relay in the Overcurrent 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 B1 of *"slot 2B"* of the relay and the negative (black terminal) of the Aux Vdc supply to pin B2 of *"slot 2B"*.

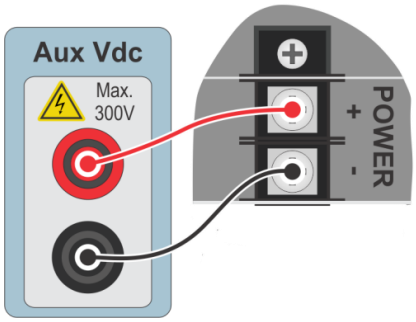



**Figure 1**

### 1.2 *Current and Voltage Coils*

To establish the connection of voltage coils, connect voltage channels V1, V2 and V3 to pins B1, B3 and B5 of *"slot 1B"* of the relay respectively, and their common to pins B2, B4 and B6 respectively. To connect the current coils, connect channels I1, I2 and I3 with pins A1, A3 and A5 of *"slot 1A"* of the relay terminal and common to pins A2, A4 and A6.

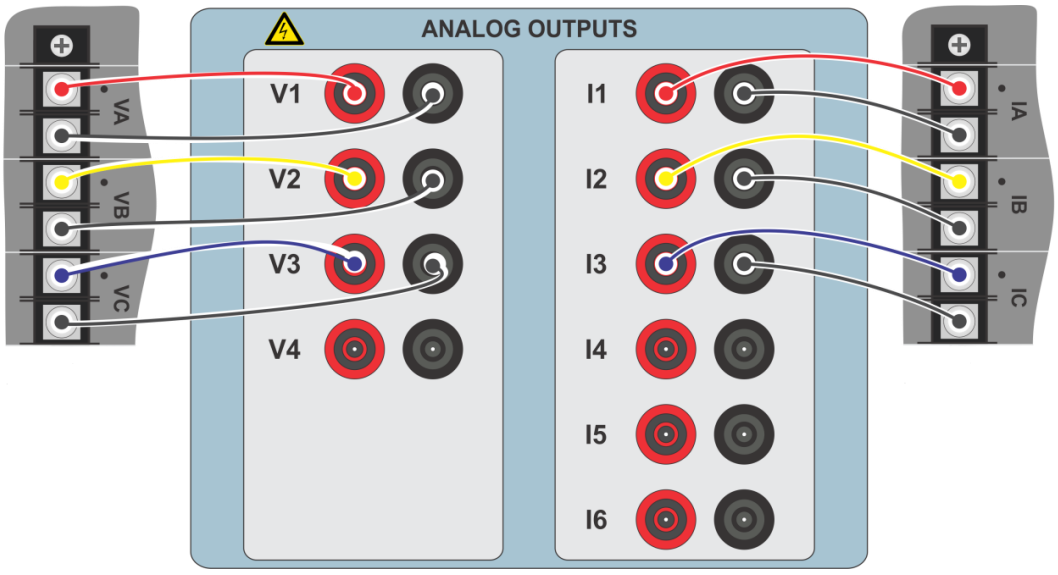


**Figure 2**

### 1.3 *Binary Inputs*

Connect the binary input of the CE-6710 to the binary output in *"slot 1B"* of the relay terminal.

- BI1 to pin B9 and its common to pin B10.

The following figure shows the details of the connection.

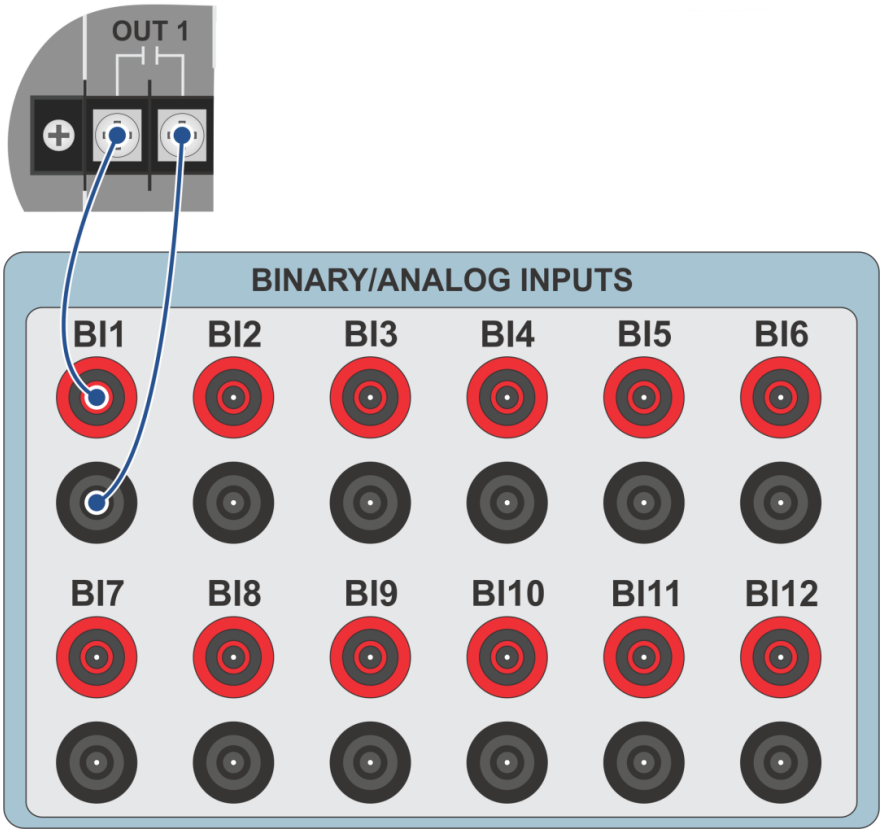



**Figure 3**

## 2. Communication with 7SA86 relay

First connect a USB cable from the notebook with the relay. Then double-click on the software icon and *"DIGSI 5"*.


**Figure 4**

When opening the program, click on the *"Project"* menu then choose the *"New"* option.

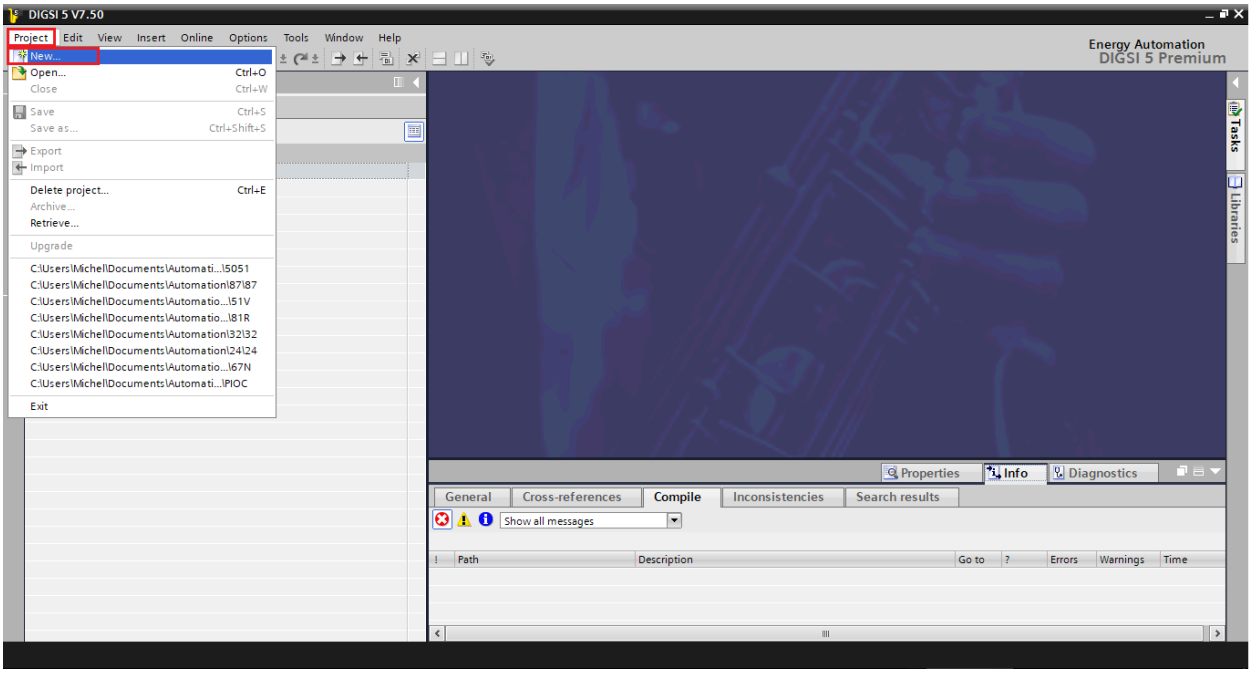



**Figure 5**

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

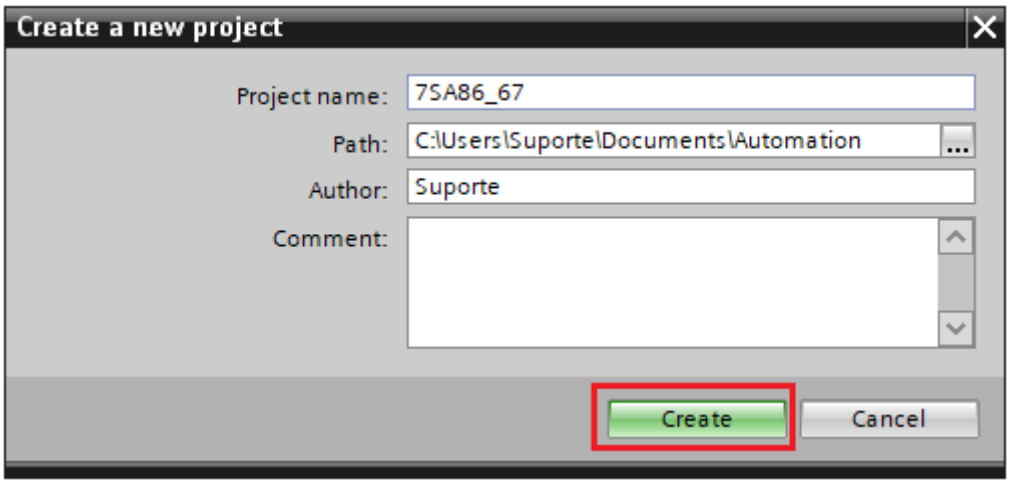



**Figure 6**

When creating the project, add the relay that will be tested, to do this double-click on *"Add New Device"* as highlighted below.

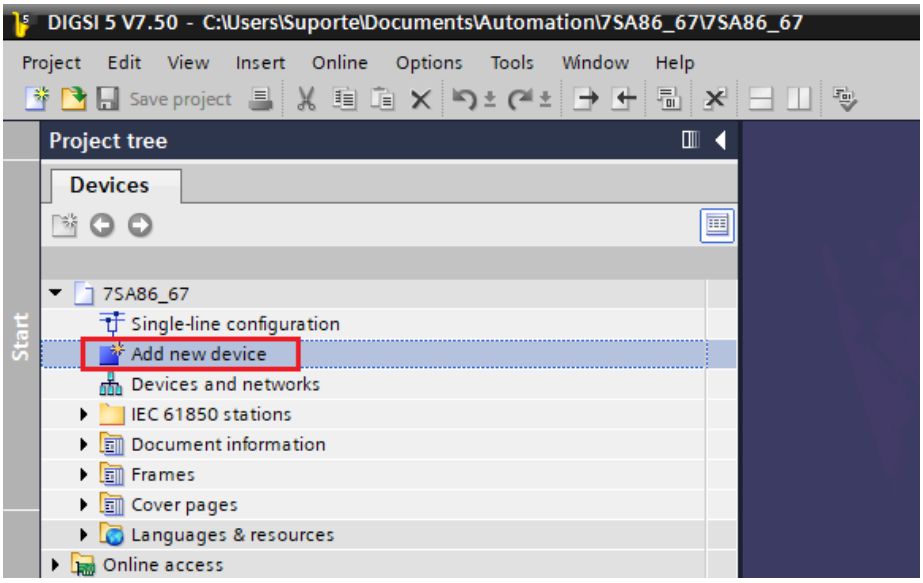



**Figure 7**

Enter the relay short code located on a *"TAG"* side of the relay, then click *"Verify"* as highlighted below.

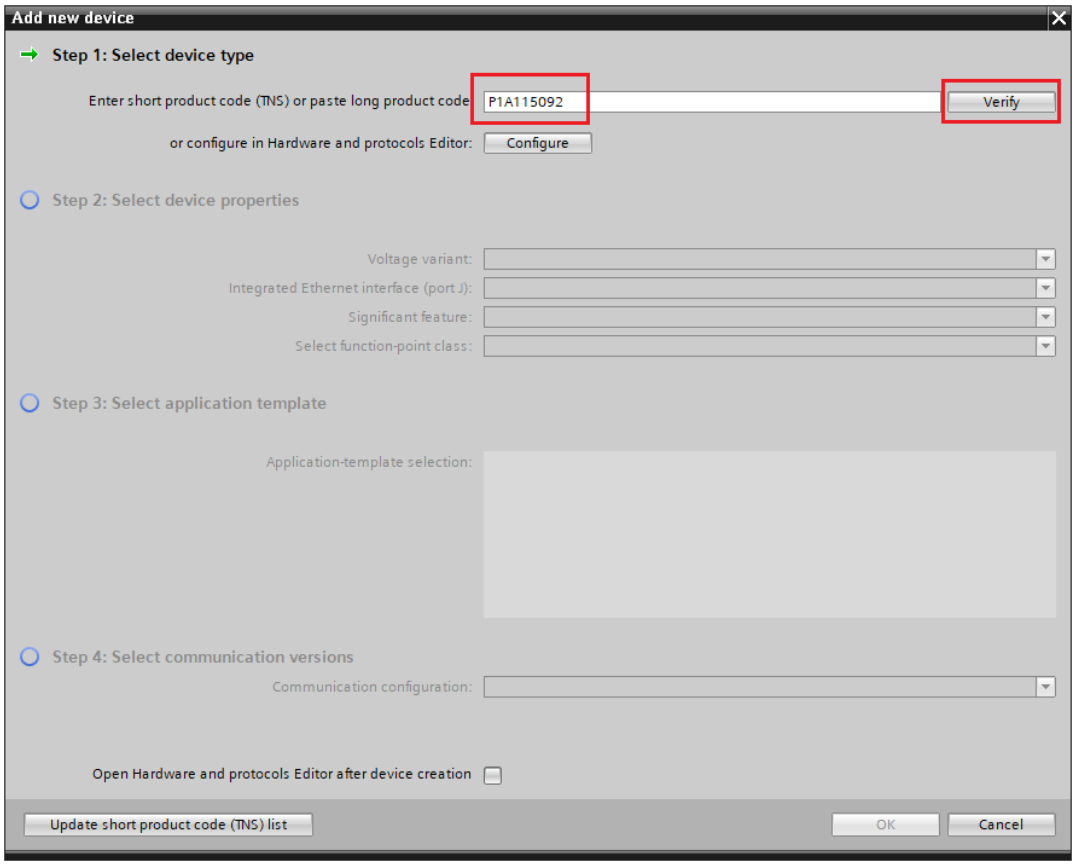



**Figure 8**

Select the basic *"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"*.

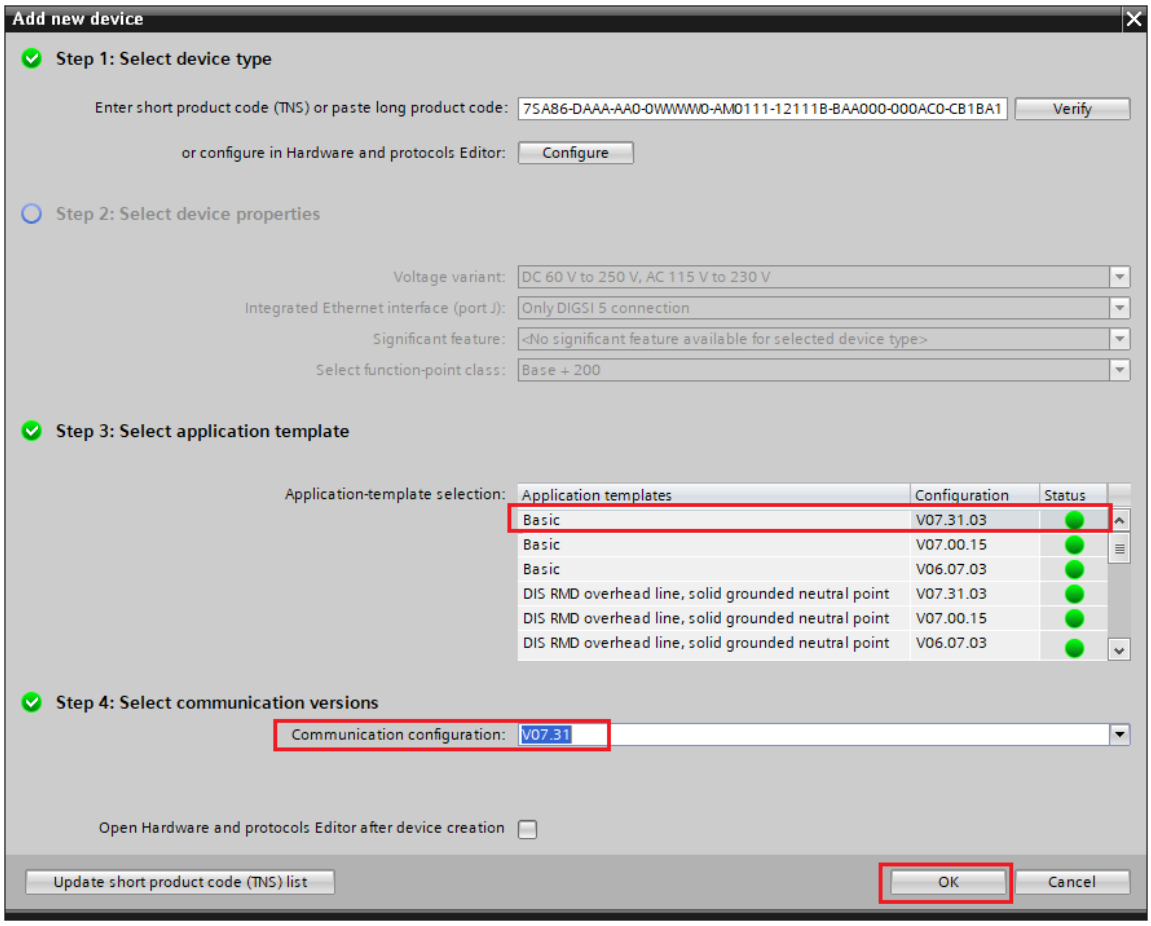



**Figure 9**

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"*.

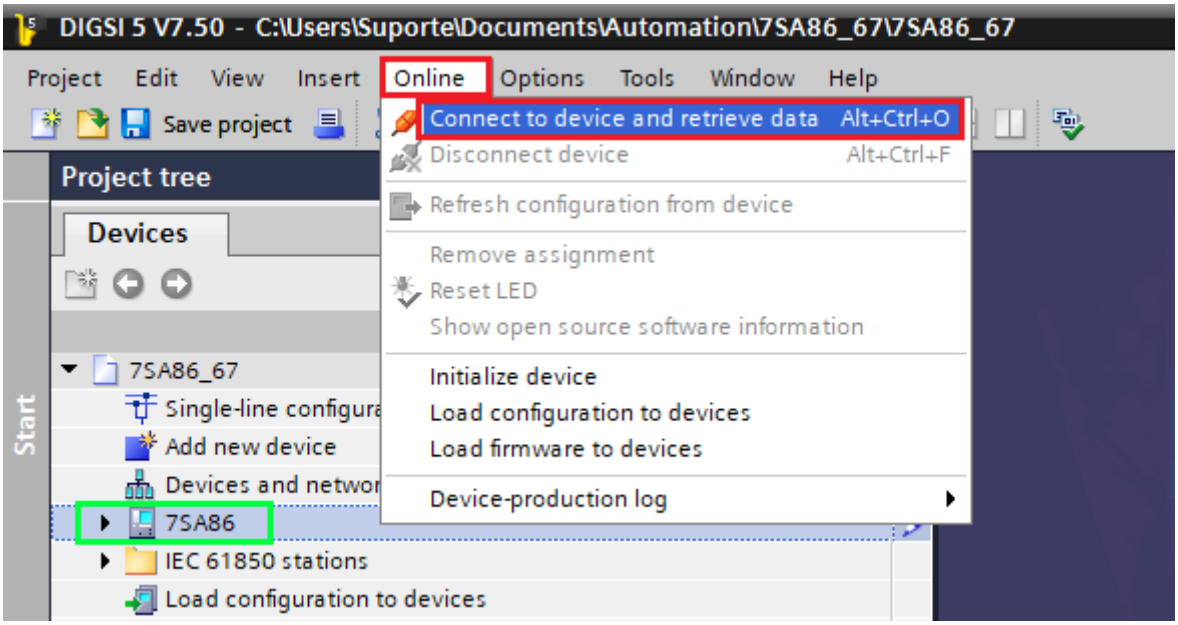



**Figure 10**

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

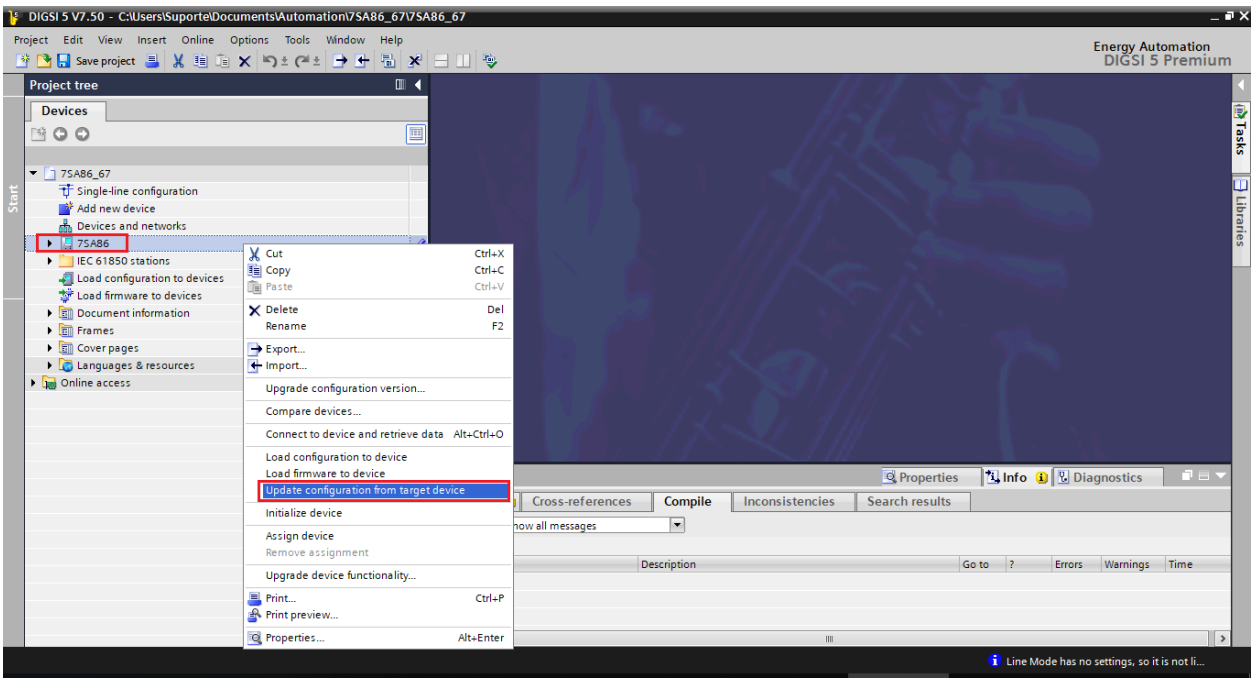



**Figure 11**

Click *"Yes"* to the following message:

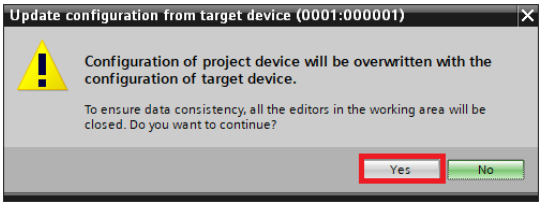



**Figure 12**

There were other warning messages (not shown), click *"Yes"* on all. If the procedure works, the following screen will appear.

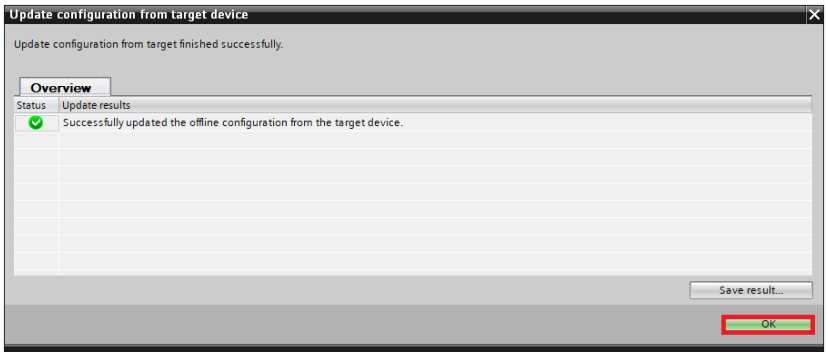



**Figure 13**

Export the created file in *".dex5"* format in order to have a backup of the settings.

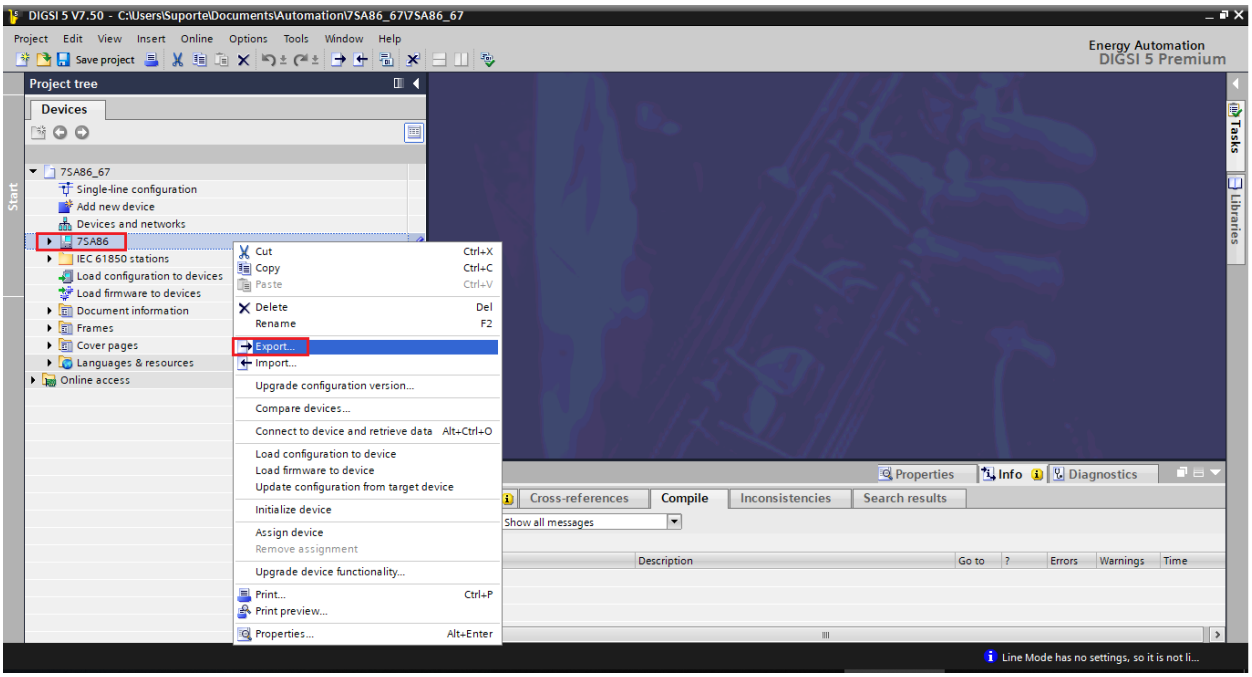



**Figure 14**

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

## 3. Parameterization of the 7SA86 relay

### 3.1 *Device Settings*

After the connection has been established, open the *"7SA86"* device section. Then open the *"Settings"* section, finally choose the *"Device Settings"* option. Check that group 1 is active, the rated frequency is 60Hz and the minimum operating time is zero seconds.

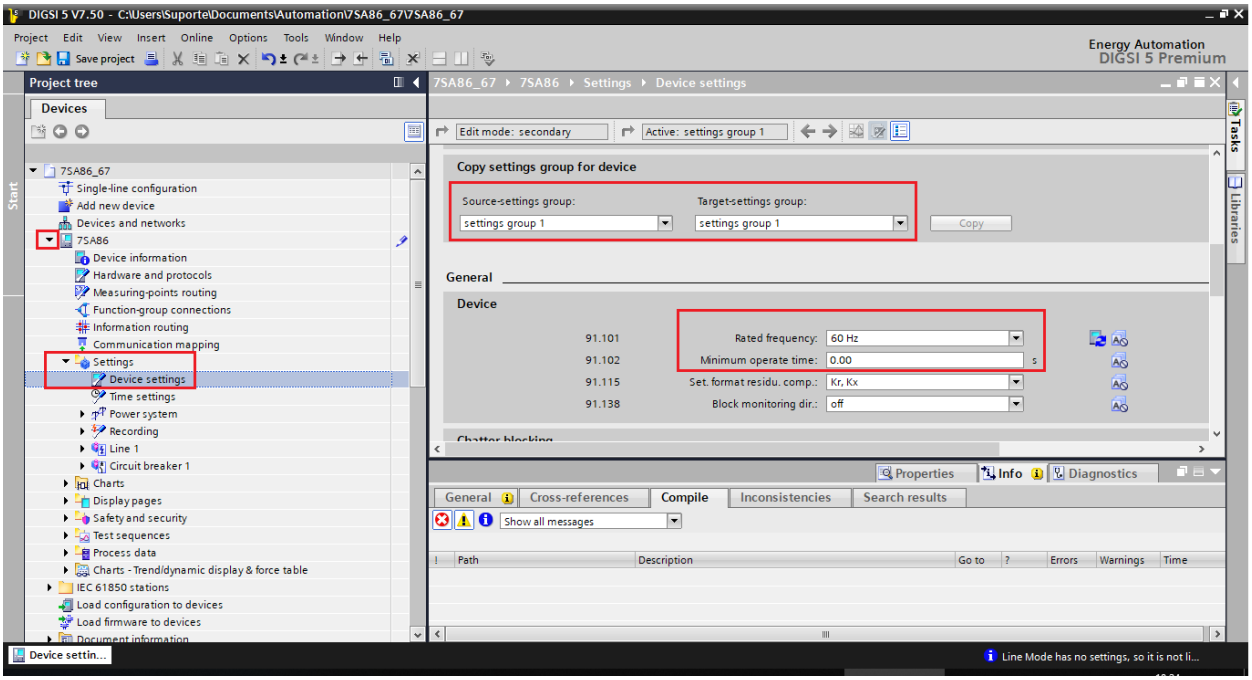



**Figure 15**

### 3.2 *General*

Open the *"Power System"* section and select the *"General"* option. Check the parameterized phase sequence.

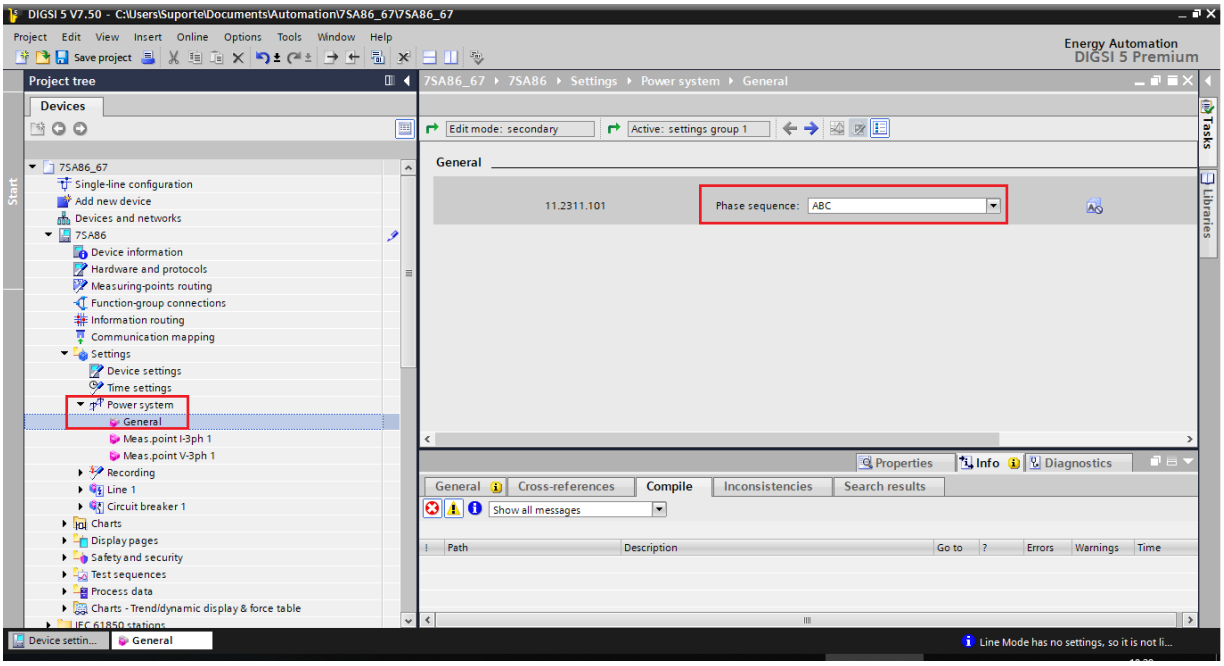



**Figure 16**

### 3.3 *Meas. Point I-3ph 1*

Select the option *"Meas. Point I-3ph 1"*. Adjust primary and secondary current values, magnitude compensation factors and **disable supervision functions.**

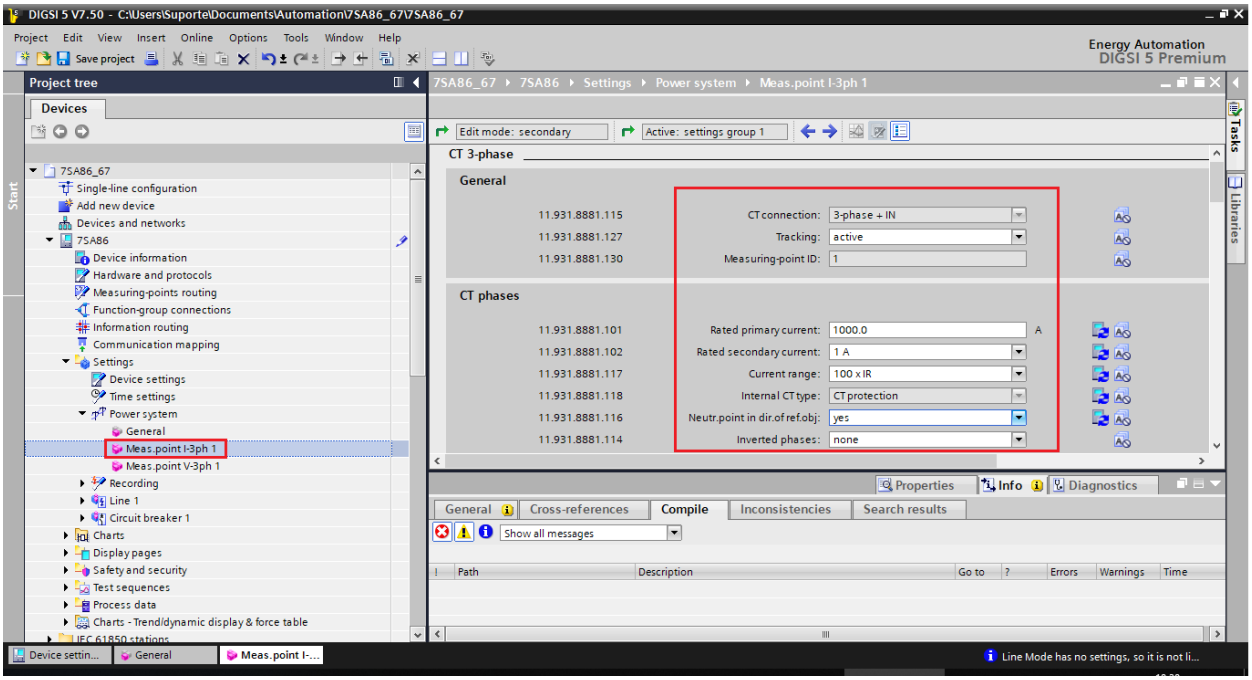



**Figure 17**

Click on the *"Info"* tab to hide it and enlarge the settings window.

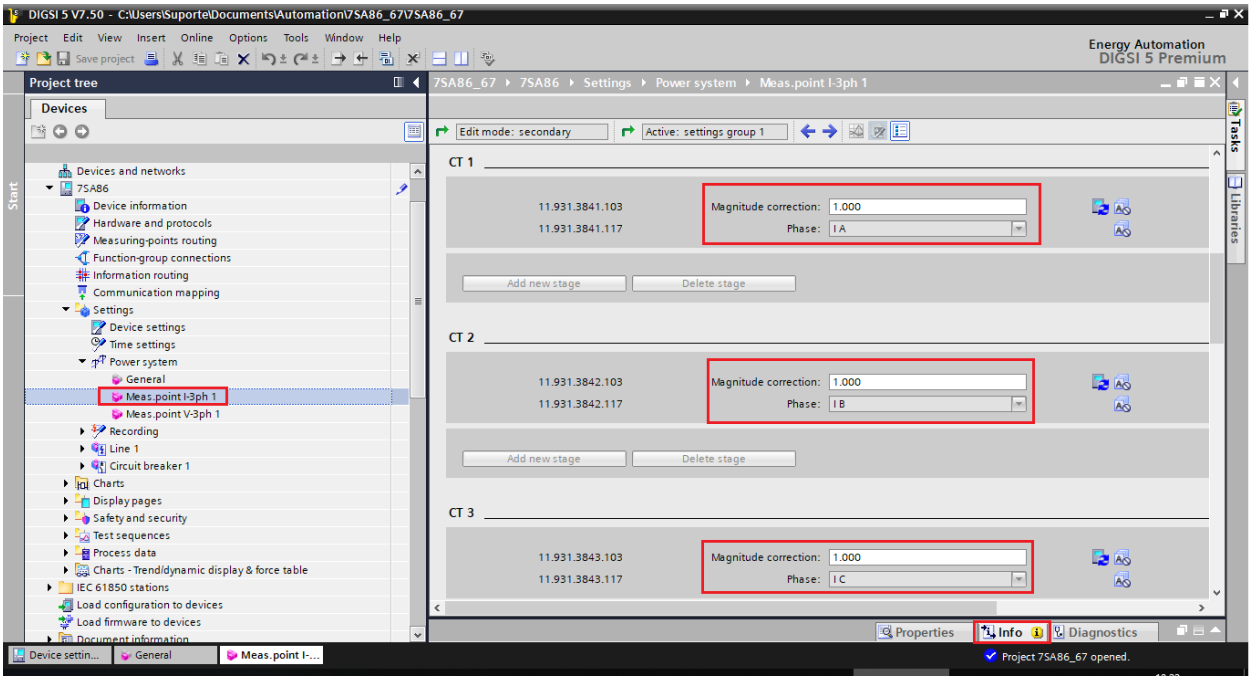



**Figure 18**

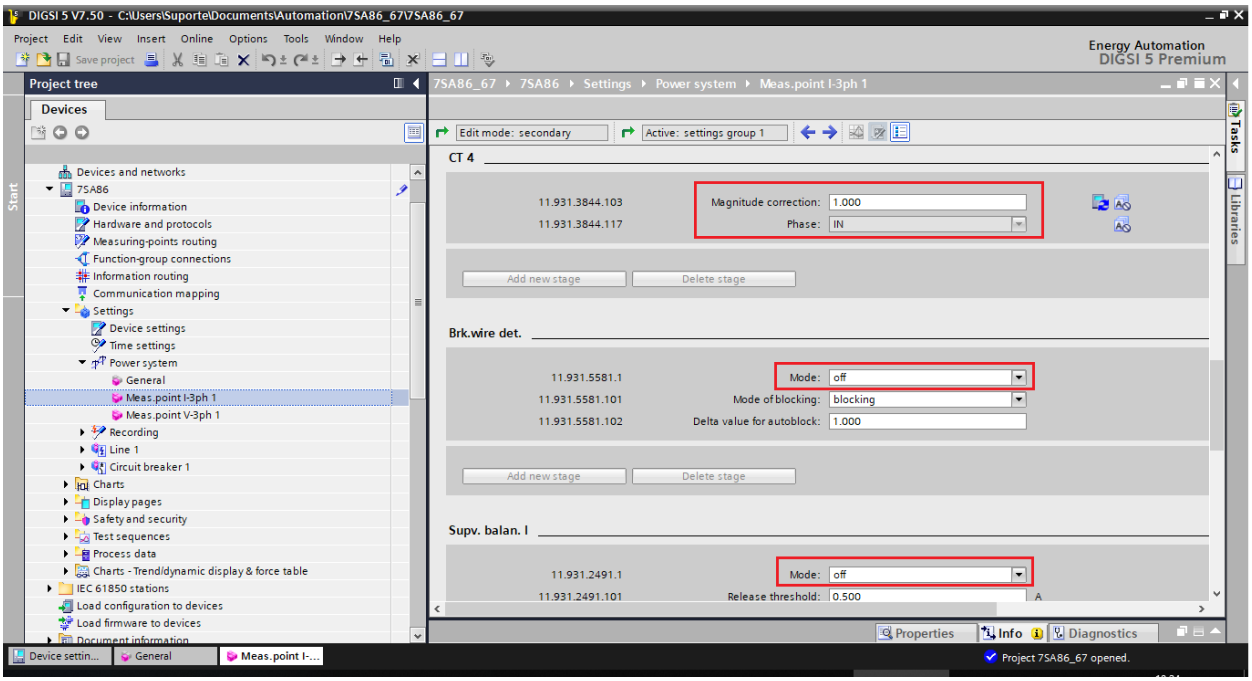



**Figure 19**

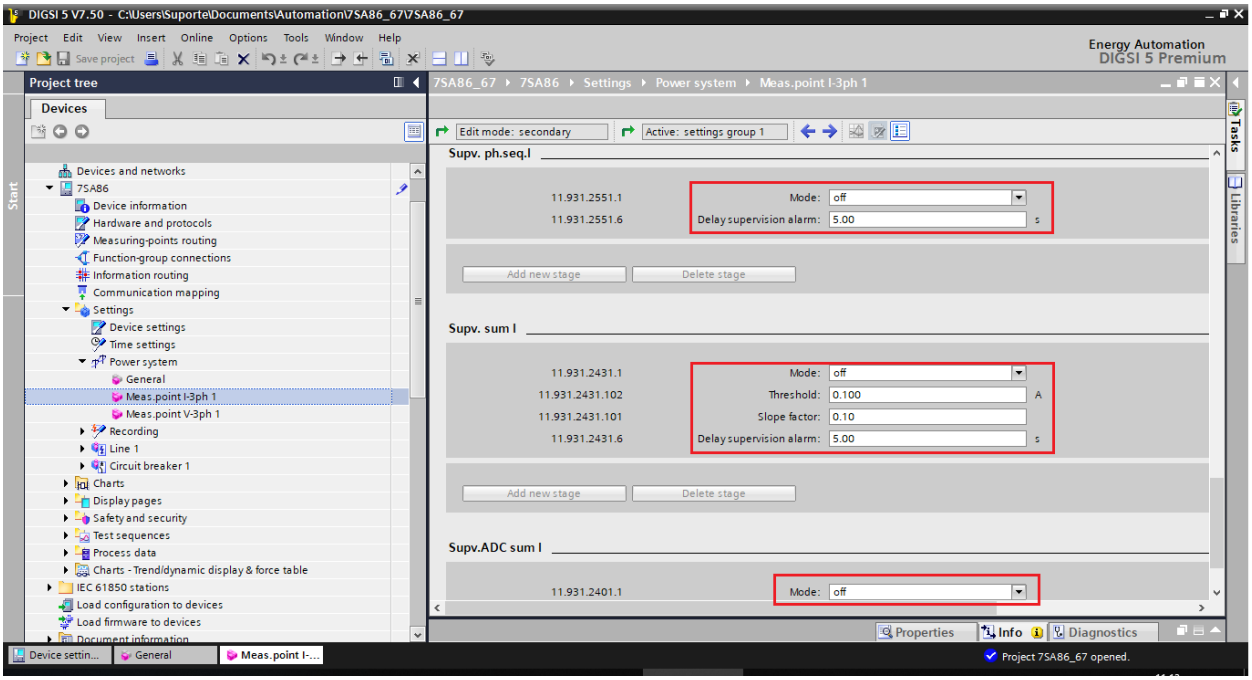



**Figure 20**

### 3.4 *Meas. Point V-3ph 1*

Select the option *"Meas. Point V-3ph 1"*. Set the values of primary, secondary voltages and magnitude compensation factor for the first winding and **disable supervision functions.**

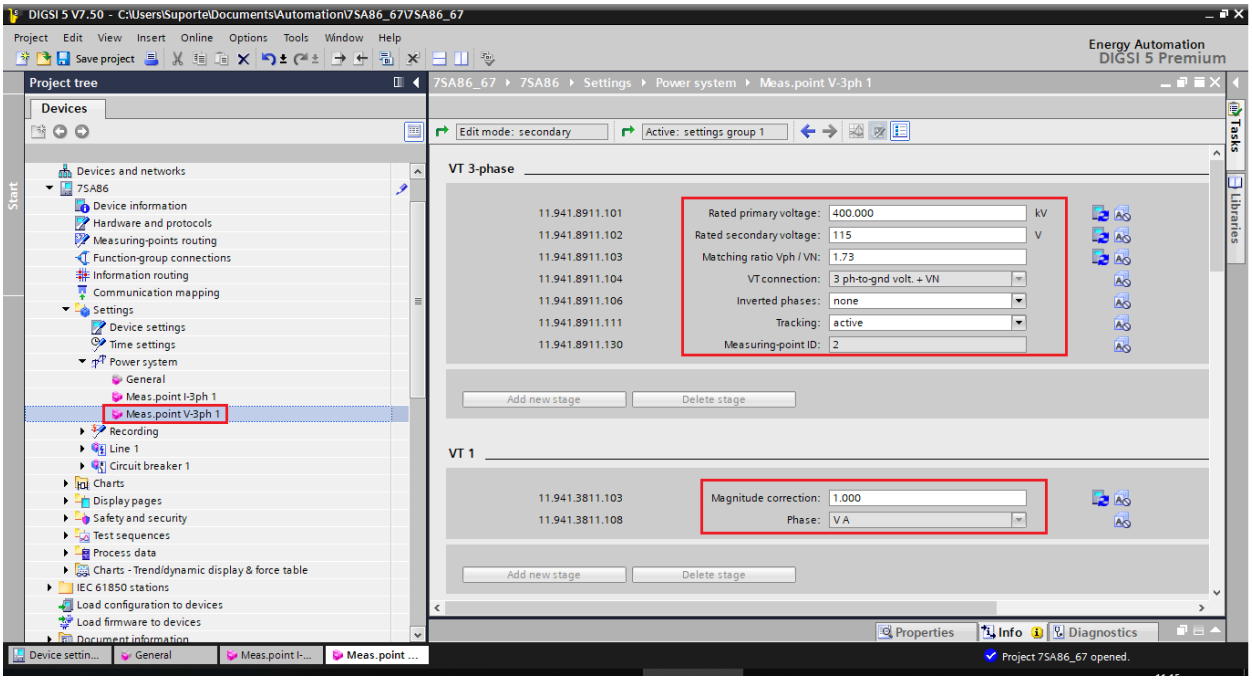



**Figure 21**

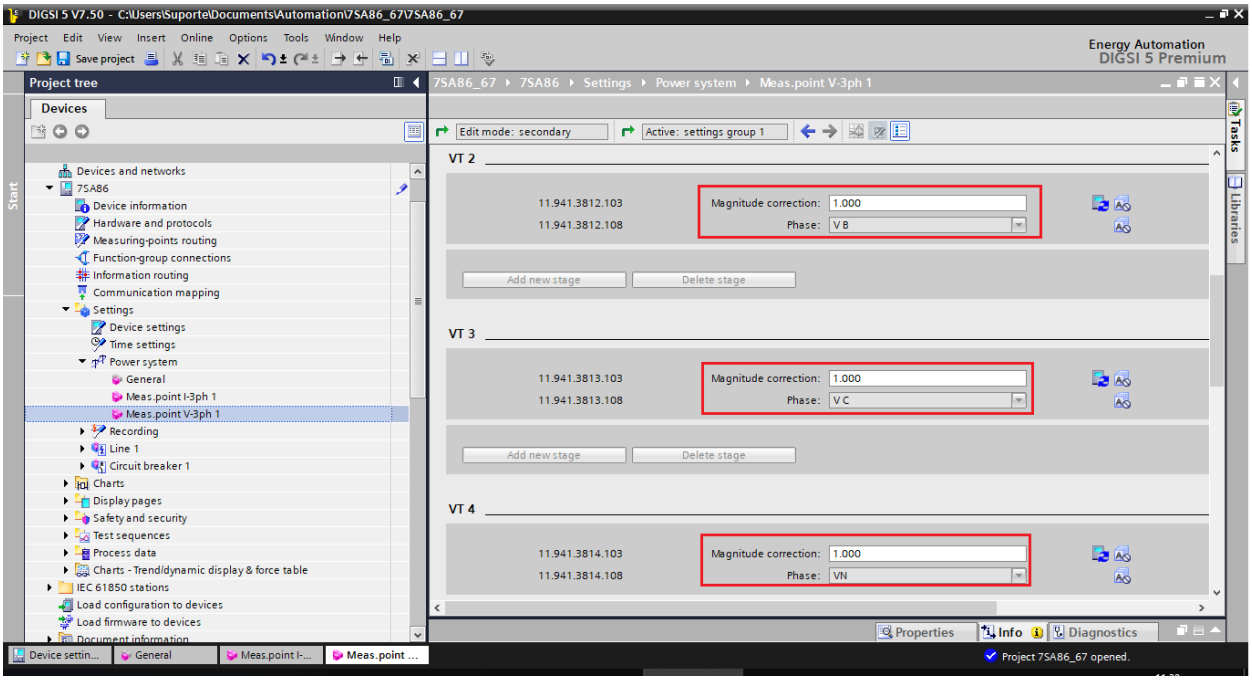



**Figure 22**

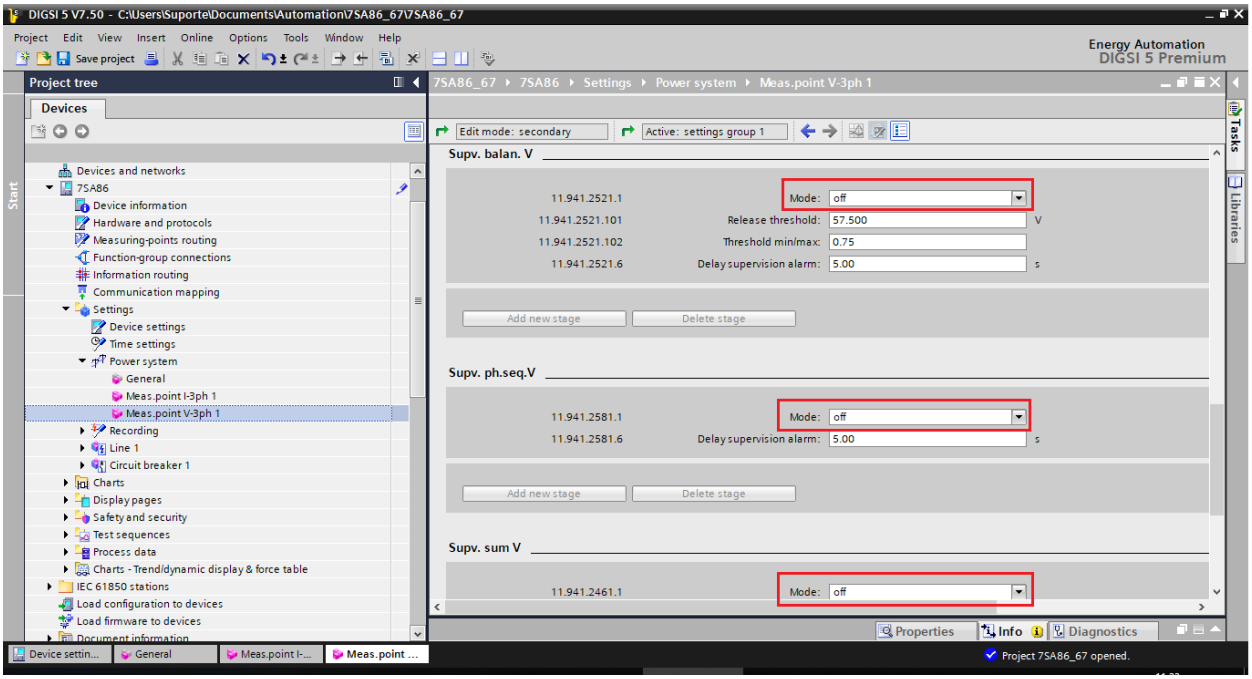



**Figure 23**

## 3.5 *General*

Open the *"Line 1"* option and double-click on the *"General"* option to make the current and voltage adjustments.

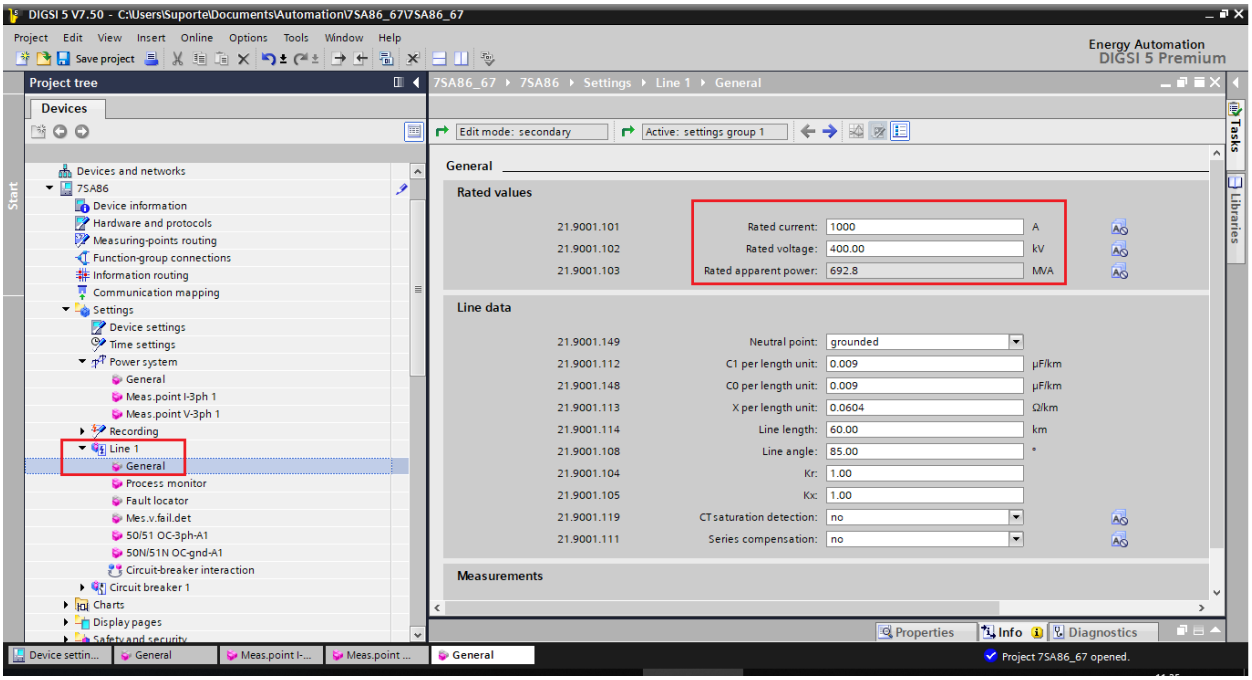



**Figure 24**

## 3.6 *Inserting function 67*

Click on the *"Libraries"* option and follow the path *"Global DIGSI 5 Library > Types > Line protection > 7SA86 Distance prot. 3pole > FG Line > Current protection >67 Dir. OC-3ph-A"*. Drag the sign *"67 Dir. OC-3ph A."* above the *"Line 1"* icon and release.

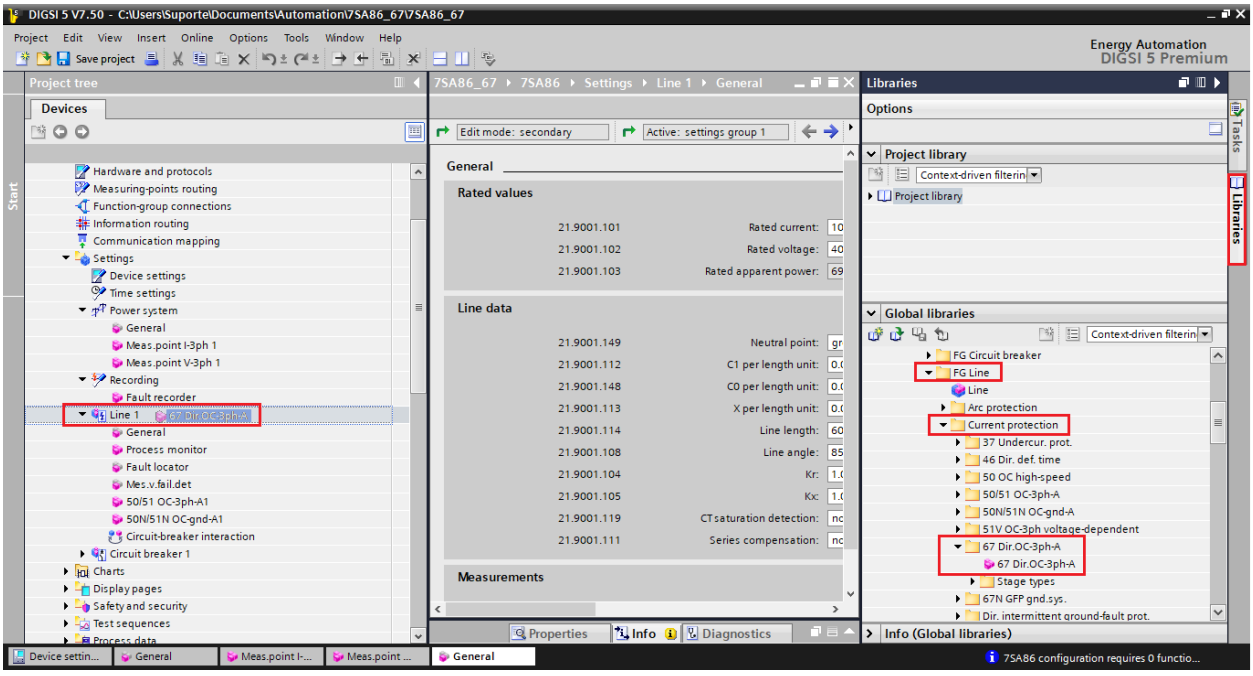



**Figure 25**

### 3.7 *67 Dir. OC-3ph-A1*

Double click on *"67 Dir. OC-3ph-A1"* to make adjustments to the directional overcurrent function.

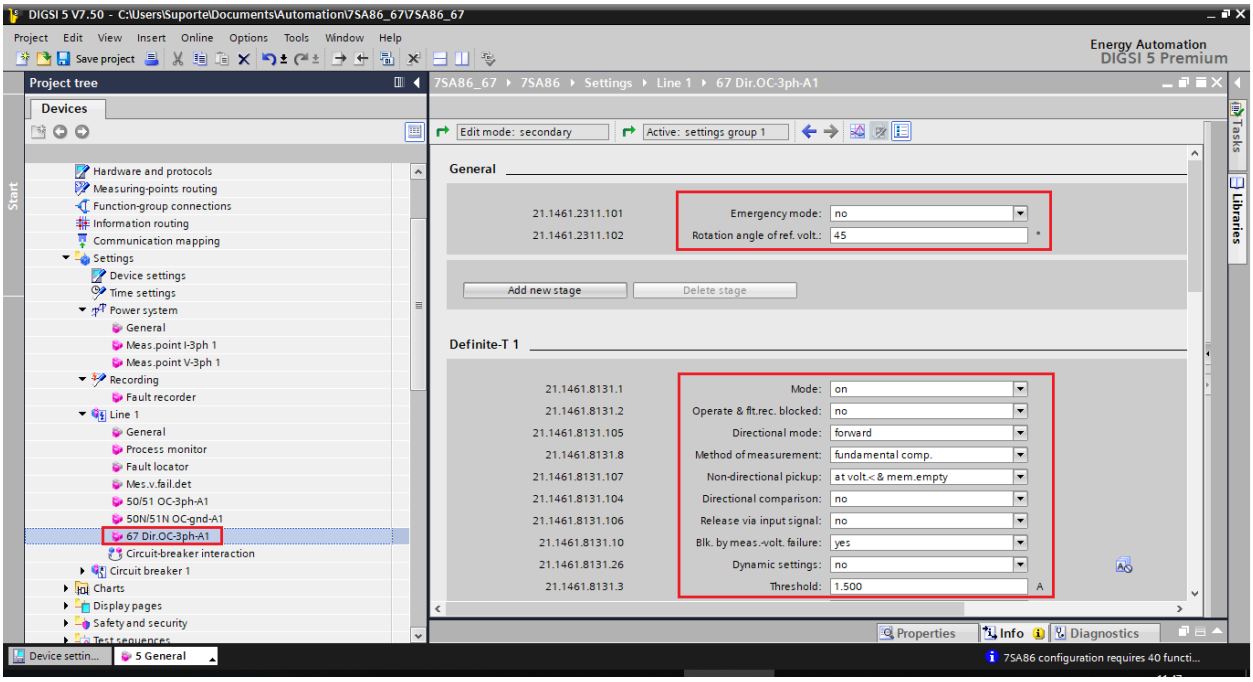



**Figure 26**

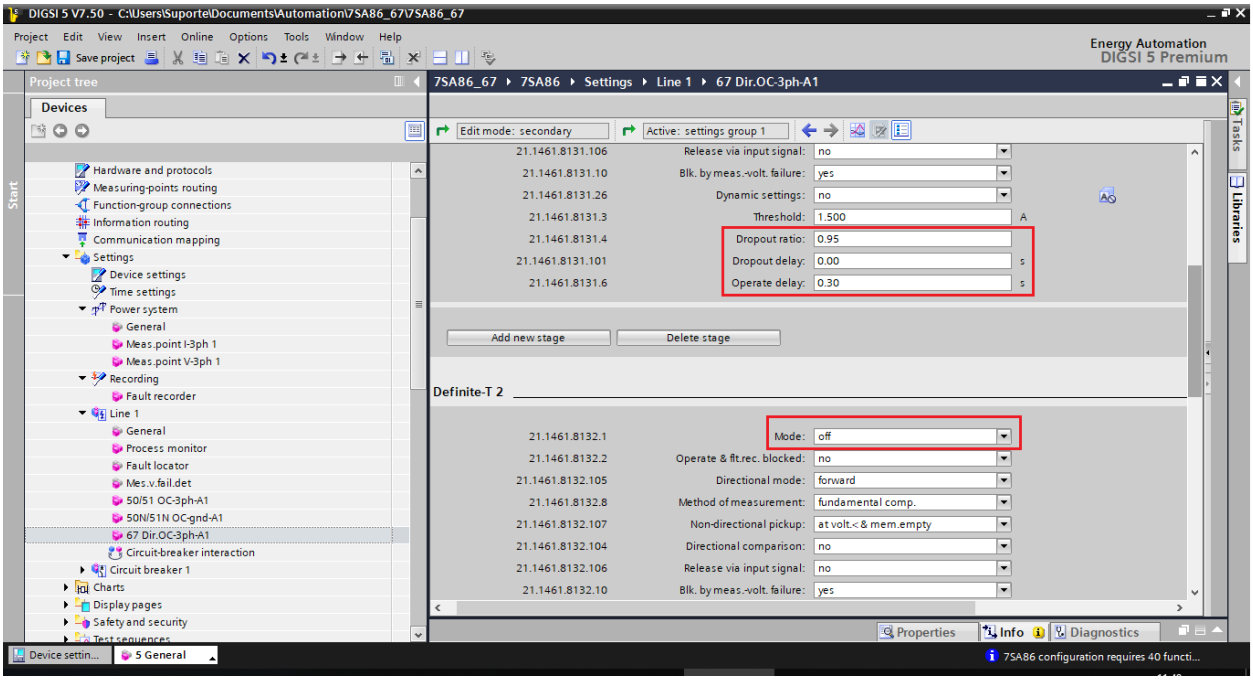



**Figure 27**

## 3.8 *Information Routing*

In the *"Information Routing"* option, the trip signal of function 67 is associated with the physical output. For easier viewing, maximize the window.

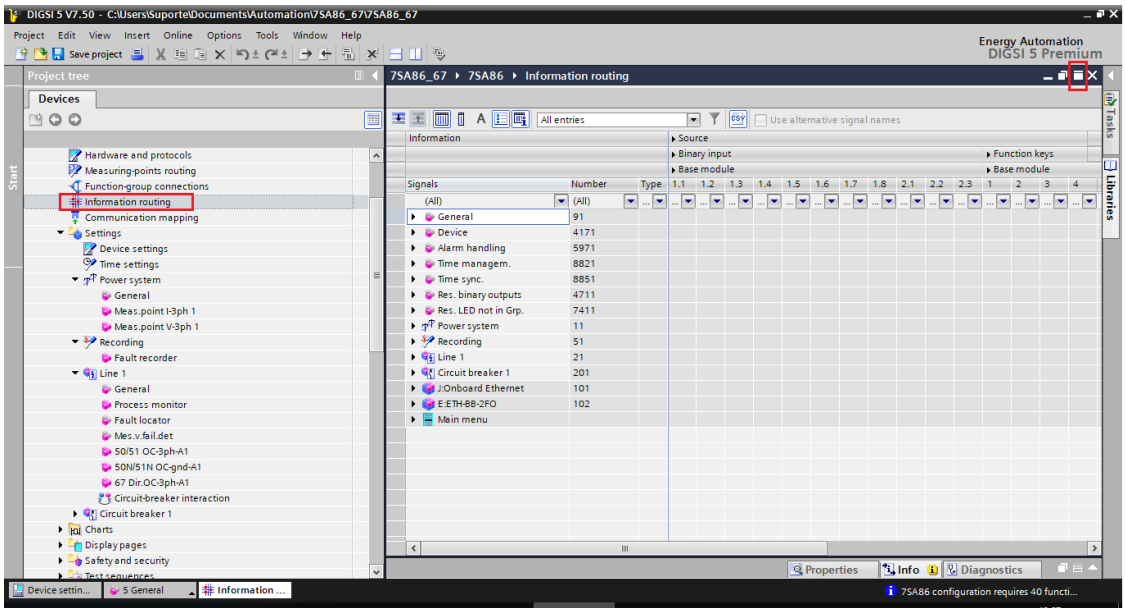



**Figure 28**

The first columns are associated with the binary inputs of the relay. In that case they will not be used. Double-click the *"Source"* option to hide these settings.

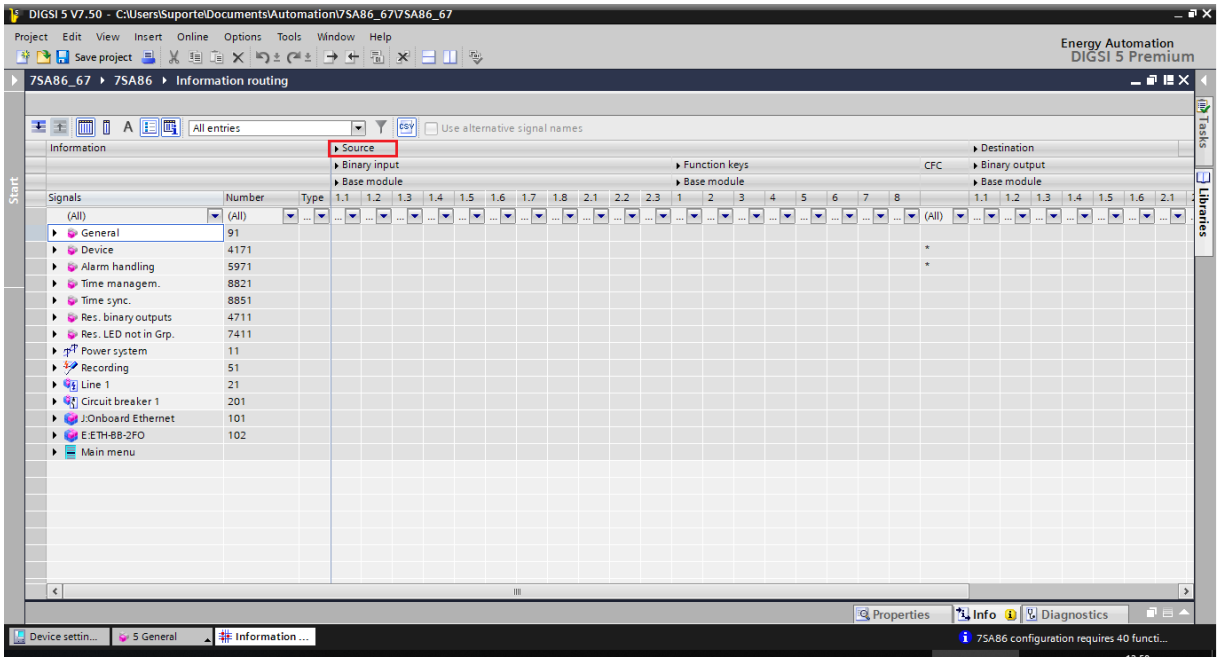



**Figure 29**

Enter the options *"Line 1 > 67 Dir. OC-3ph-A1 > Definite-T 1"*.

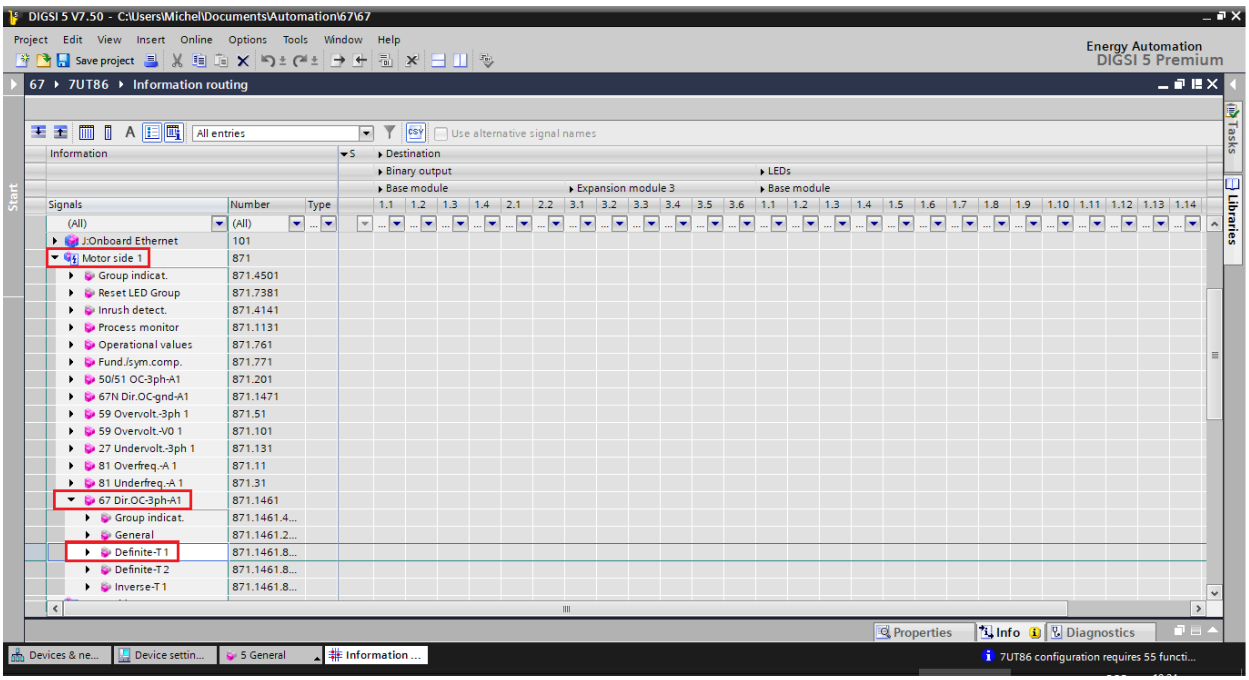



**Figure 30**

Assign the *"general"* signal within the *"Operate delay expired"* to the 1.1 output. Look at the columns for that signal *"Destination > Binary output > Base module"*.

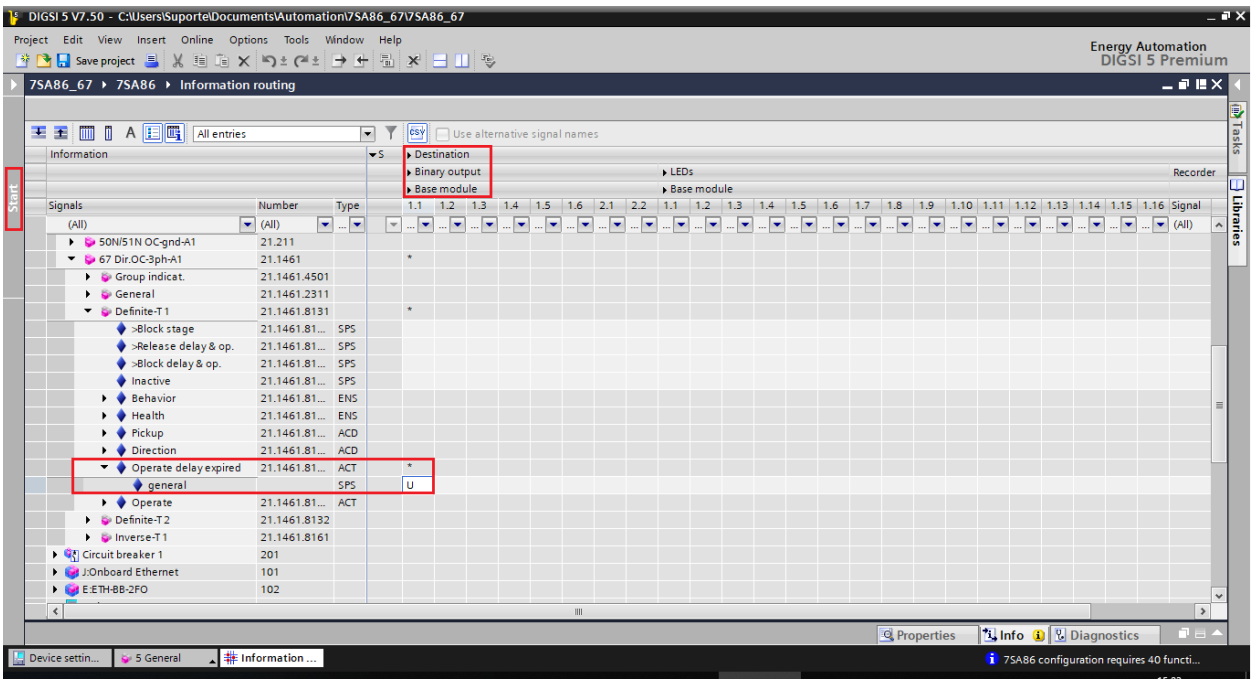



**Figure 31**

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 state of the binary. 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 indicated for the test).

Click on the *"Start"* option so that the main window is shown again.

### 3.9 *Sending adjustments*

To send the changes in the parameterization right-click on the relay icon *"7SA86"* and choose the option *"Load configuration to device"*.

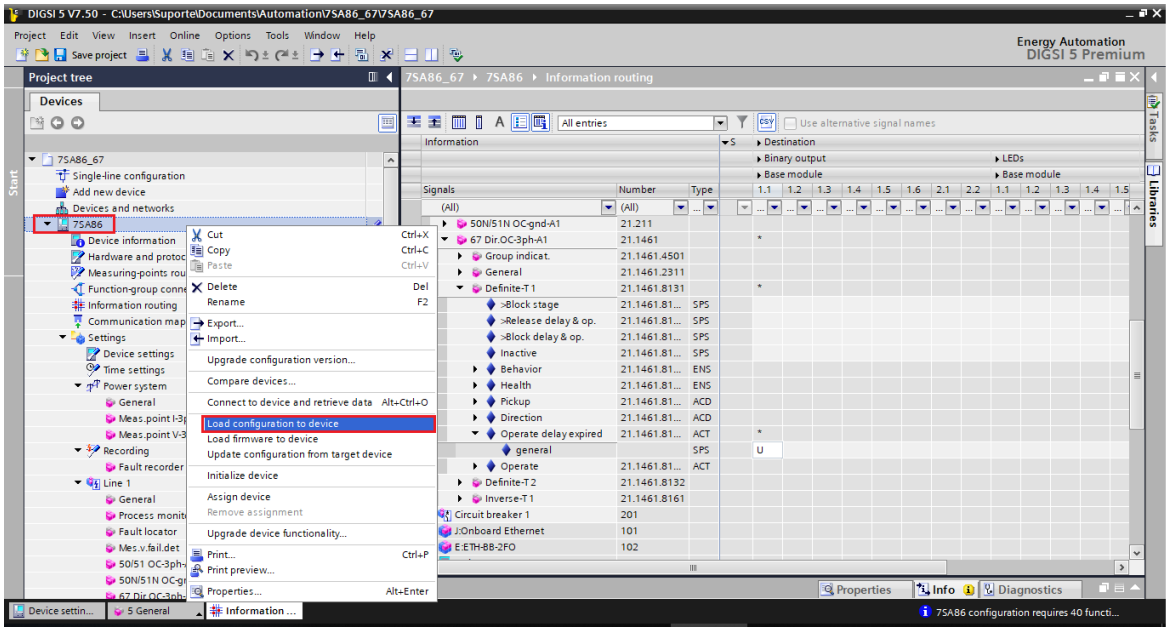



**Figure 32**

Reminding that the default password for Siemens SIPROTEC 5 is: **"222222".**

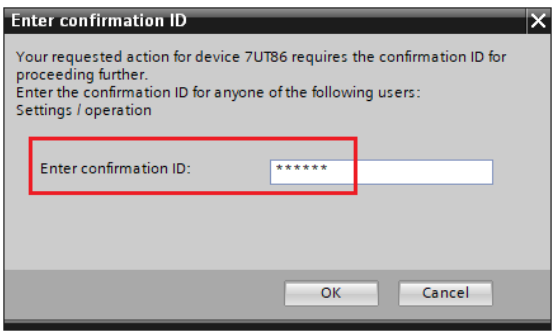



**Figure 33**

In the next two windows not shown, choose the *"Yes"* option.

## 4. Overcurrent software adjustments

### 4.1 *Opening the Overcurrent*

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

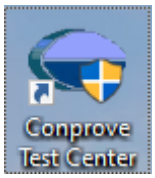



**Figure 34**

Click the Overcurrent software icon.

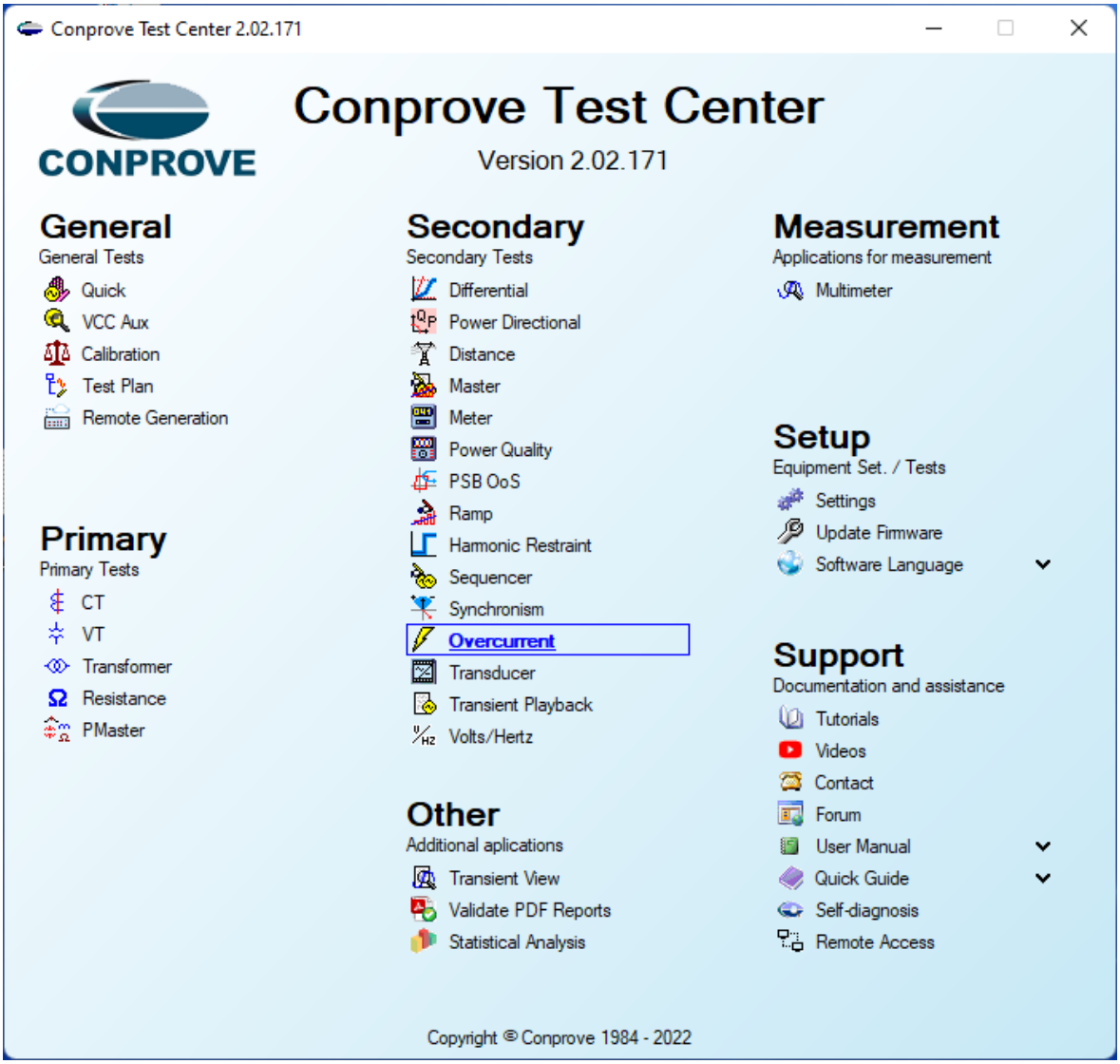



**Figure 35**

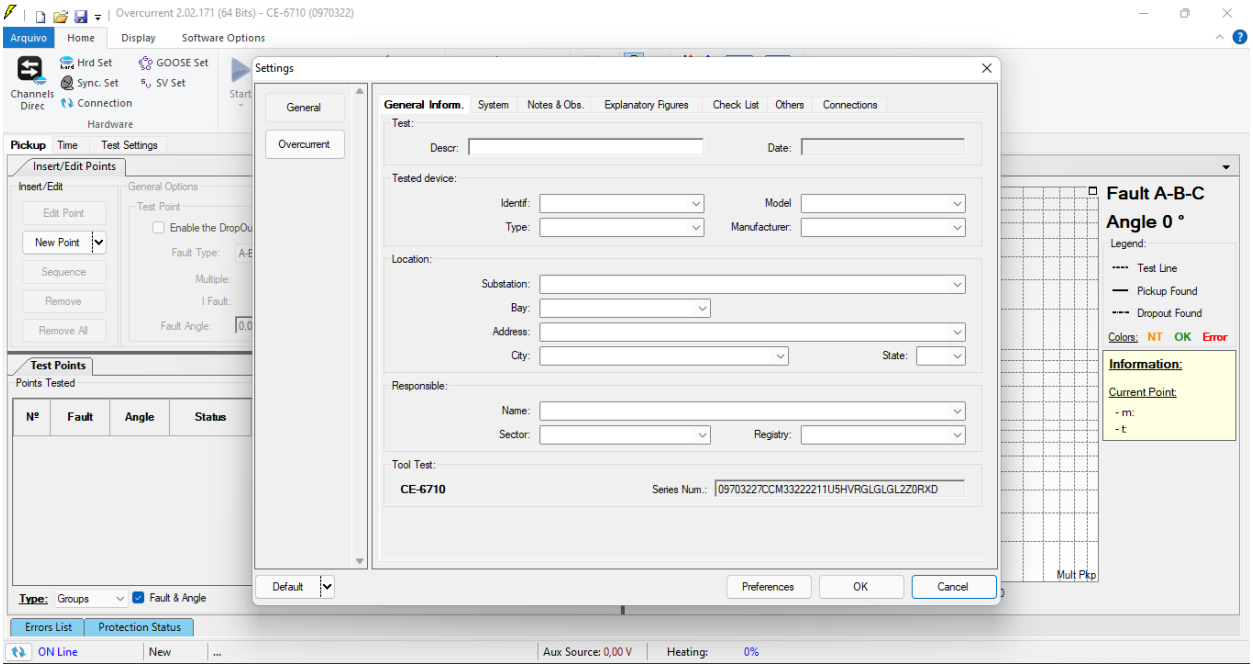



**Figure 36**

## 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.

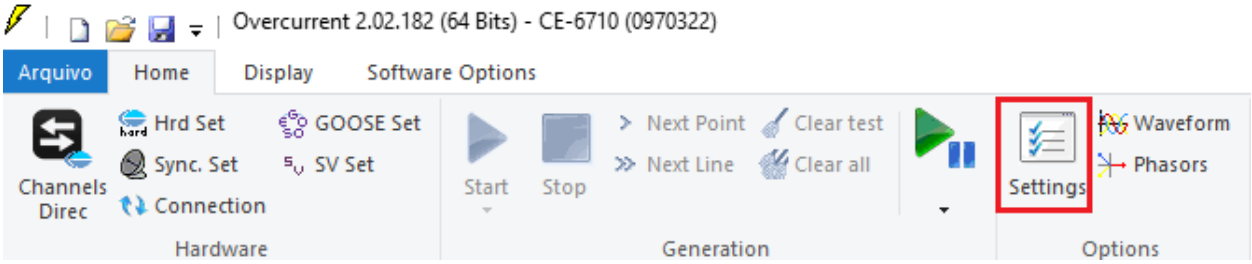



**Figure 37**

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.

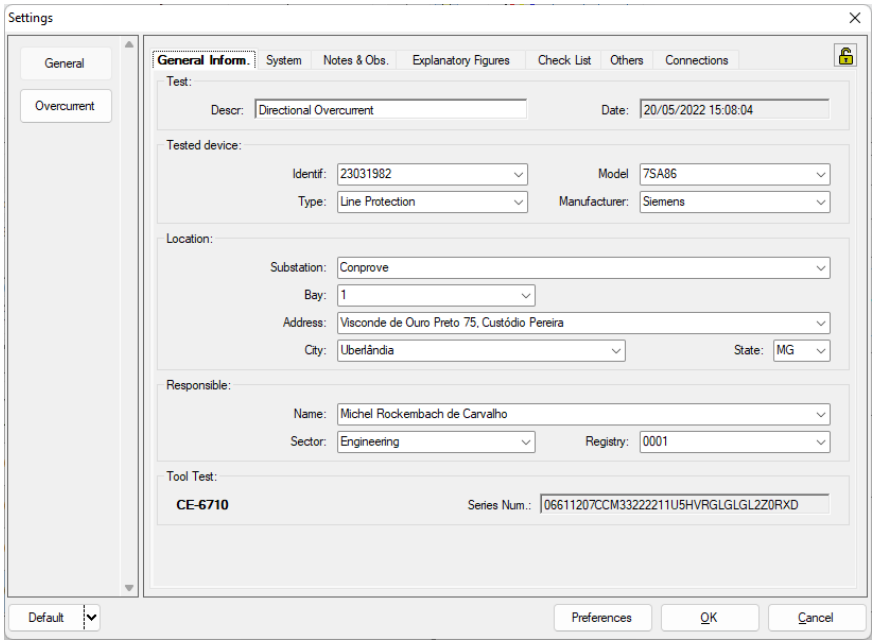



**Figure 38**

## 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.

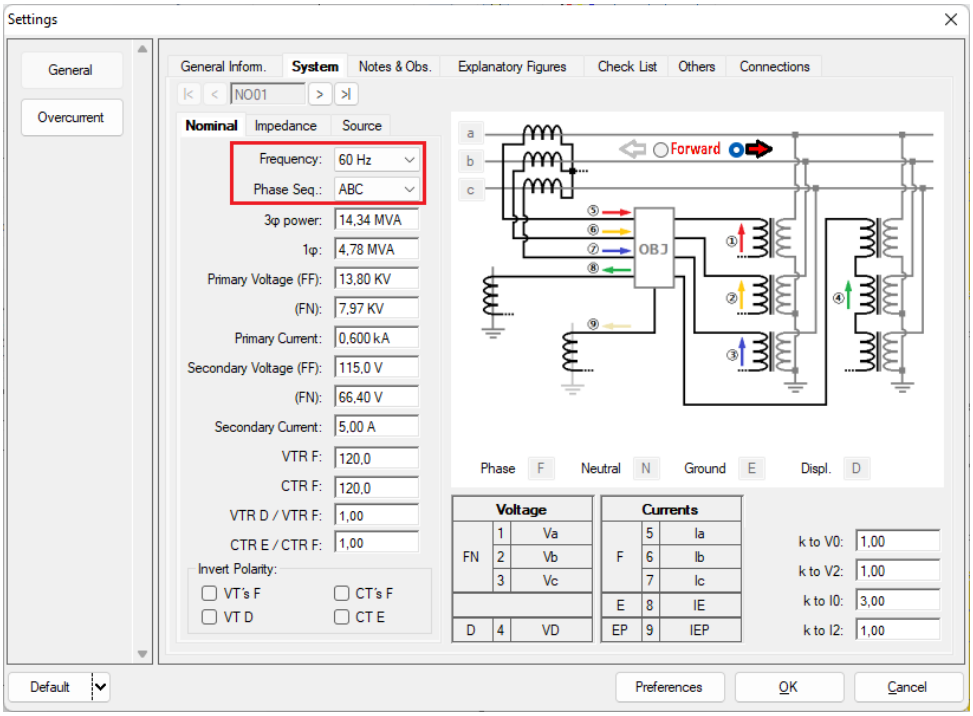



**Figure 39**

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. Directional Overcurrent Adjustment

### 5.1 *Overcurrent Screen > Definitions*

In this you must enable the directionality, the curves display mode, the scale used and the time, current and angle tolerances. These tolerances should be taken from the relay manufacturer's manual (Appendix A).

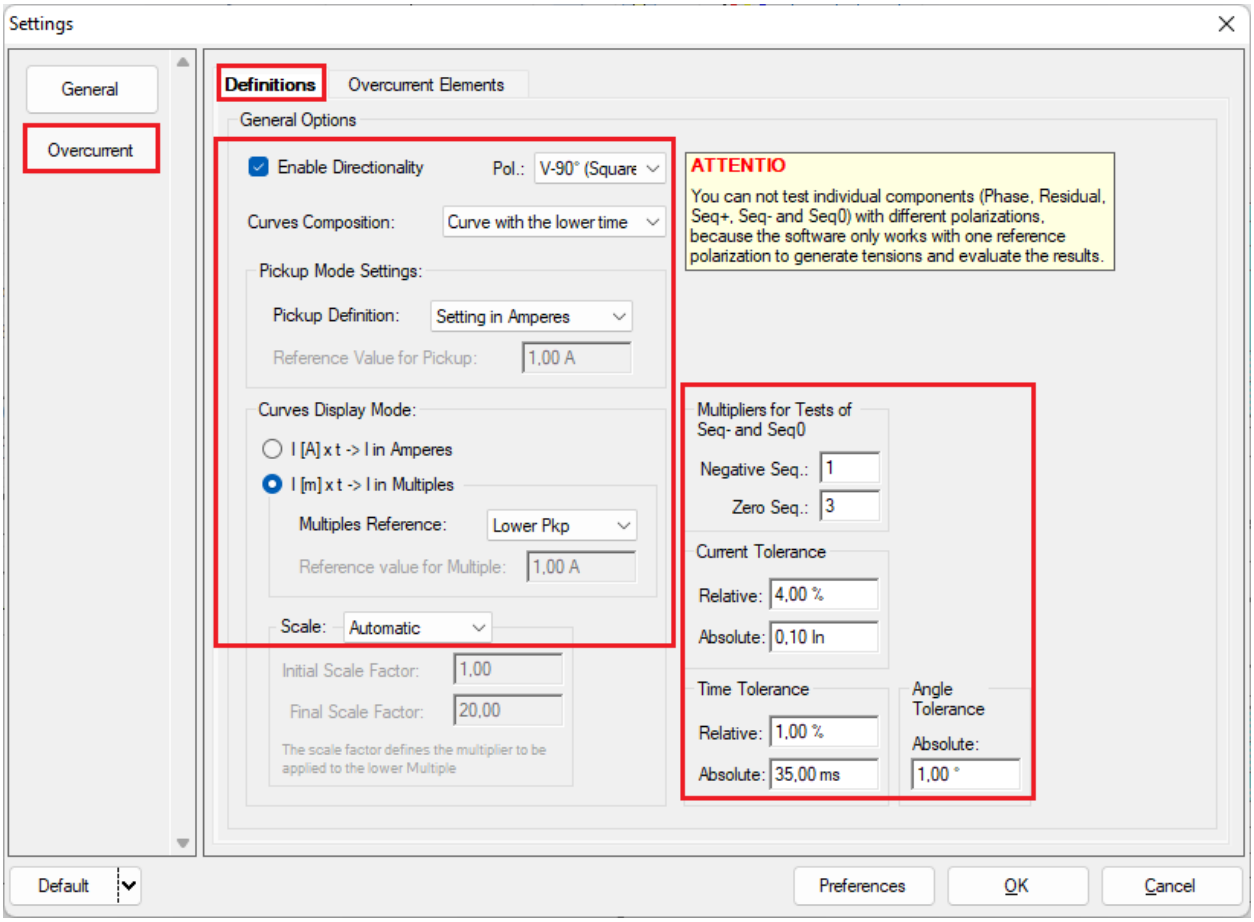



**Figure 40**

### 5.2 *Overcurrent Screen > Overcurrent Elements > Phase*

Here the overcurrent element must be configured. To do this, click on *"Phase"* and once on the highlighted icon.

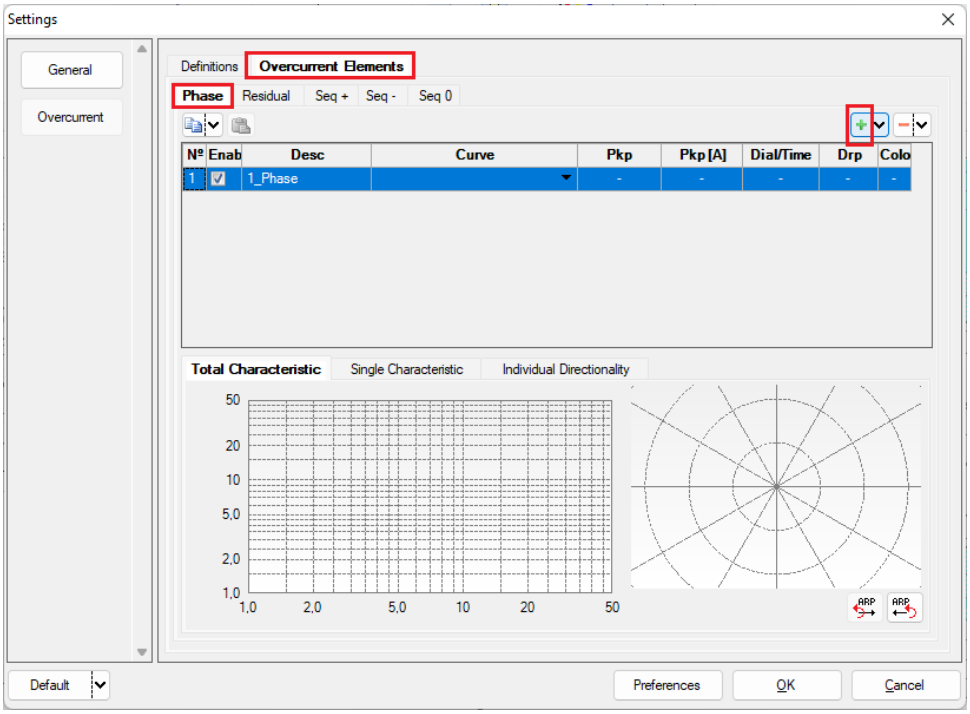



**Figure 41**

For the element choose the type of curve equal to definite time, pickup value equal to 1.5A, time to 0.5 seconds and dropout factor equal to 0.95.

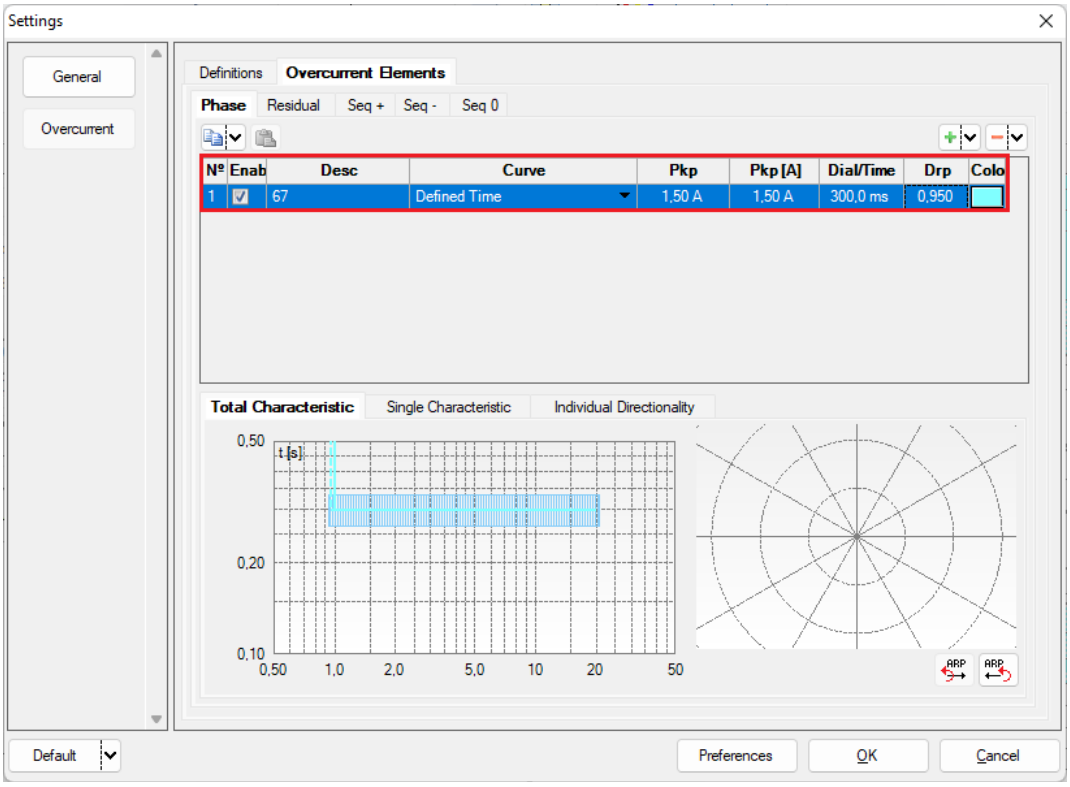



**Figure 42**

Choose the *"Individual Directionality"* tab and set the *"Forward"* option, the maximum torque angle (ATM) must be set to 45°. Set the angles as 88° and – 88°.

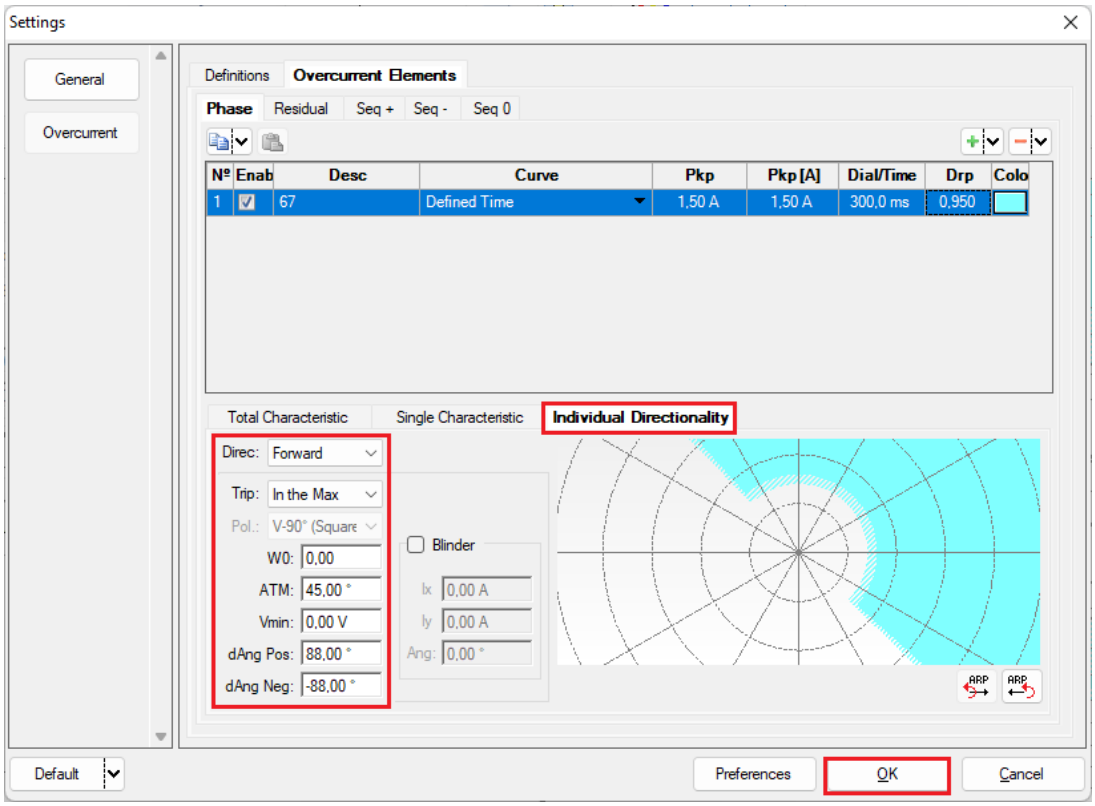



**Figure 43**

## 6. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

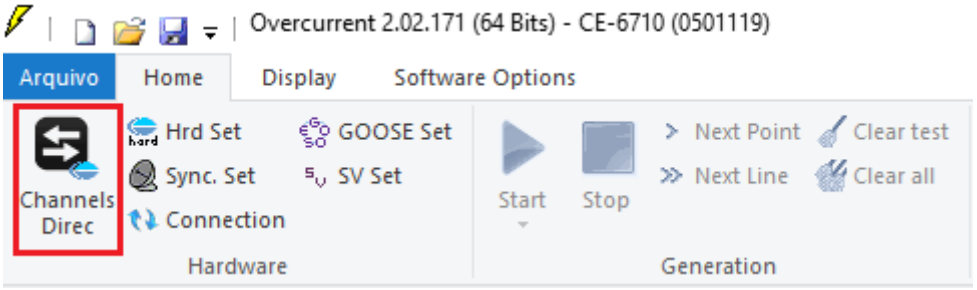



**Figure 44**

Then click on the highlighted icon to configure the hardware.

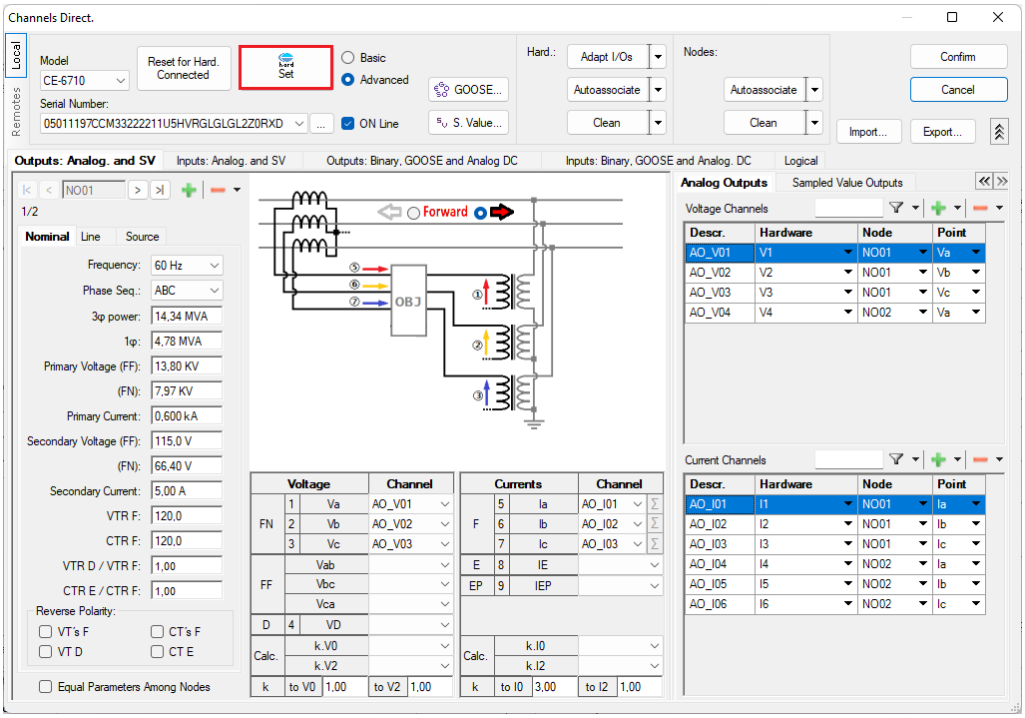



**Figure 45**

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

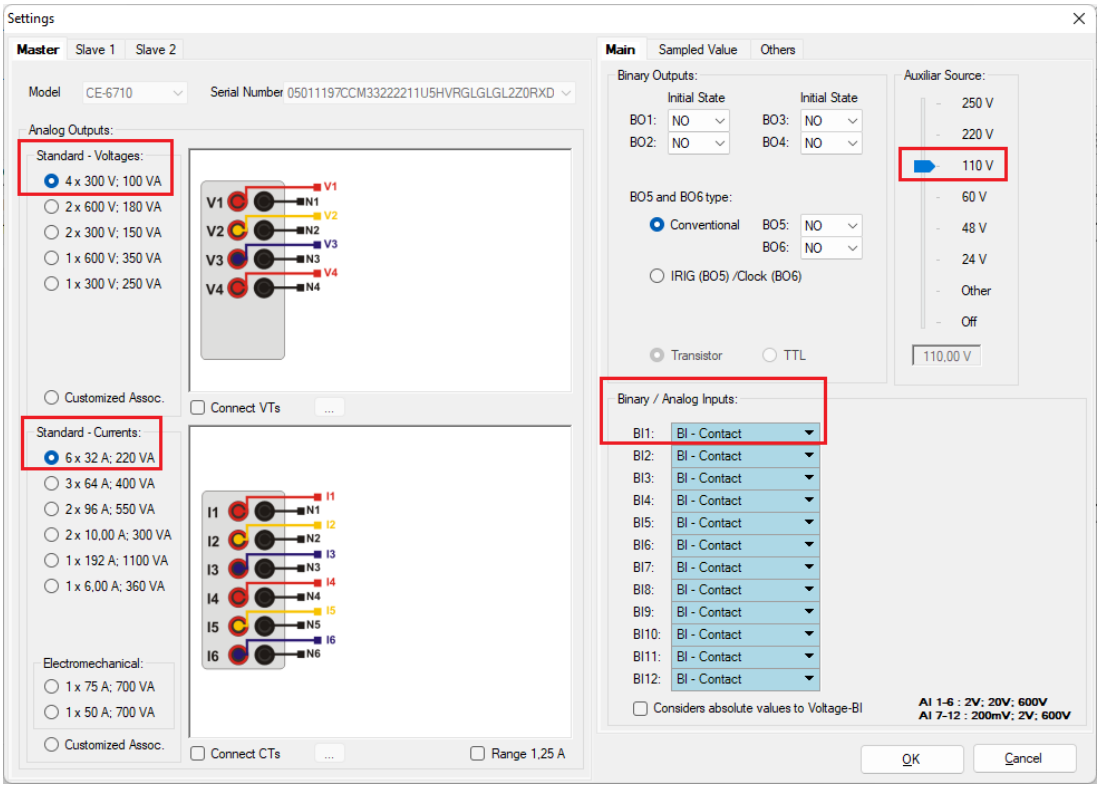



**Figure 46**

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

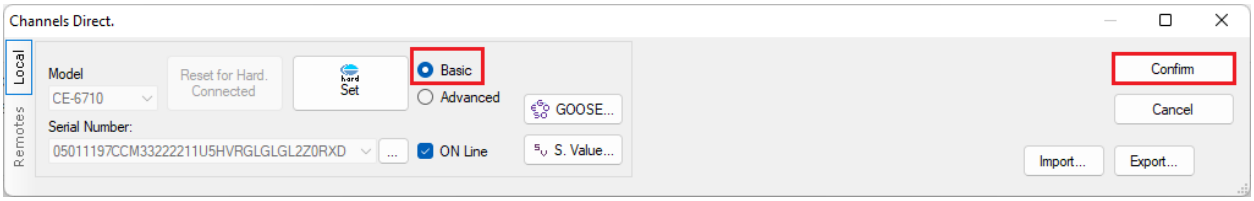



**Figure 47**

## 7. Test structure for function 67

### 7.1 *Test Settings*

On this tab you must configure the pickup and trip signals with the binary inputs. If necessary, it is possible to enable up to two pre-fault conditions and one post-fault condition. The only test that will be performed is the time test and consequently the directionality test.

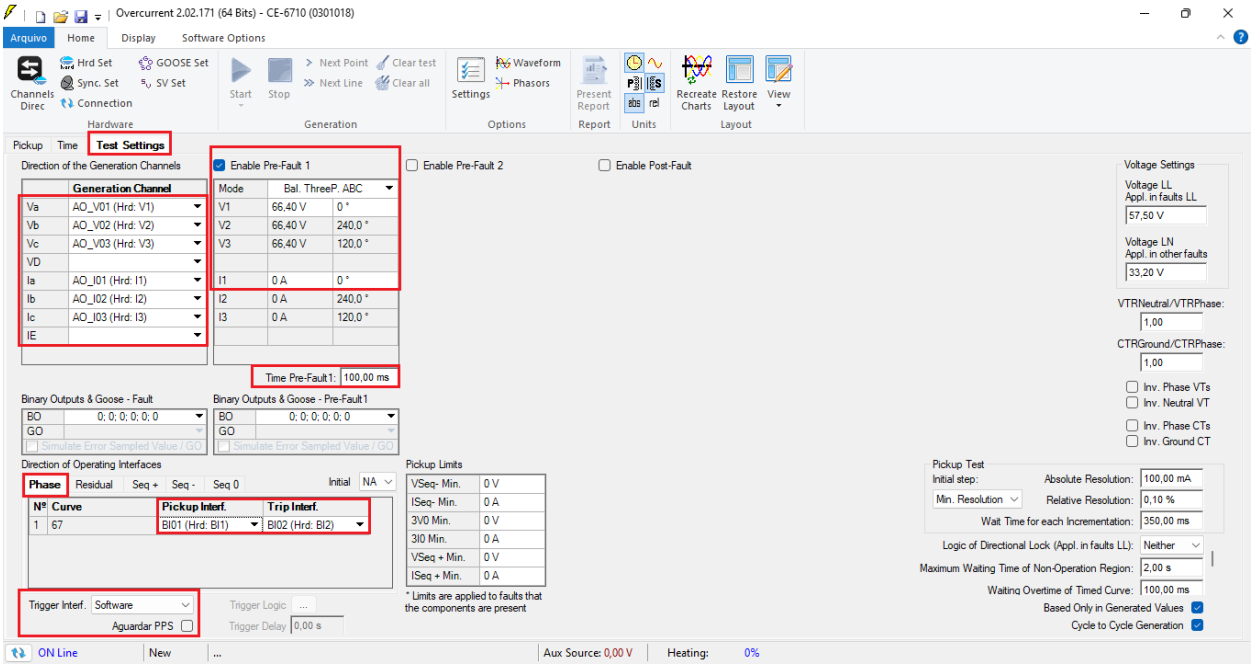



**Figure 48**

## 7.2 *Time Screen*

In this tab, the operating time and directionality are evaluated. For convenience, a sequence of values will be inserted. The value 5.0A was chosen as the initial value, 5.0A as the final value and 1.0A as the increment step and the ABC fault. In the angles choose 0.0° as initial value, for the step choose 10° and final value choose 360.0°. Choose the *"Directionality"* tab.

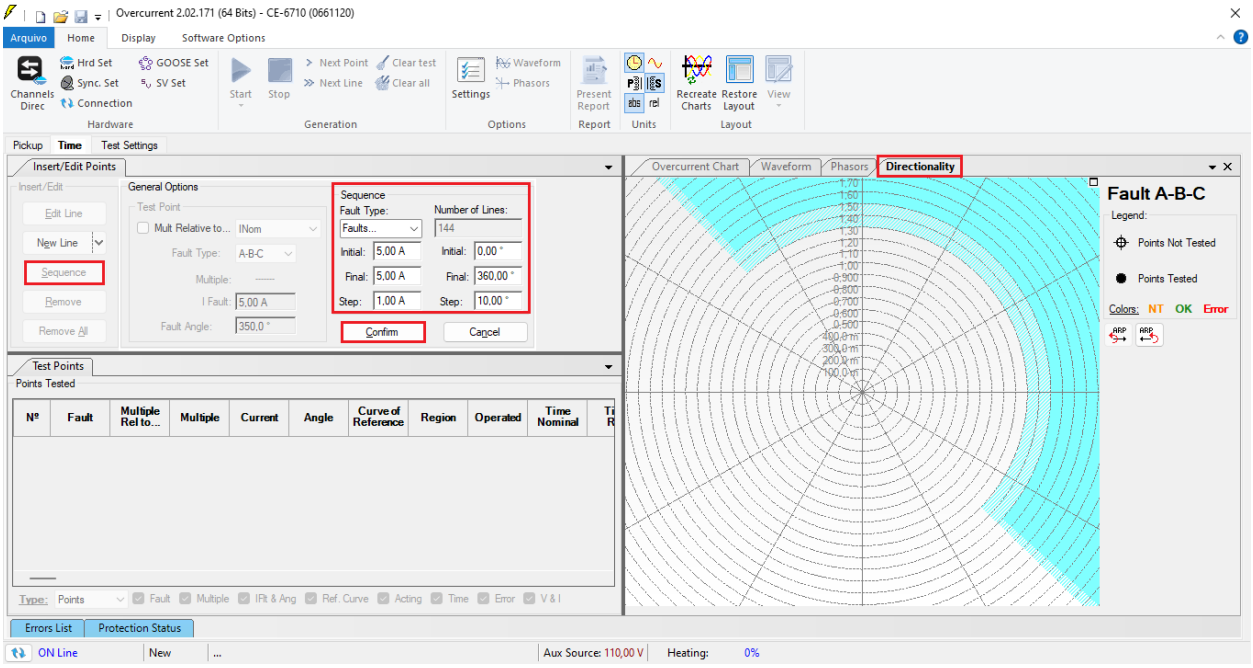



**Figure 49**

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

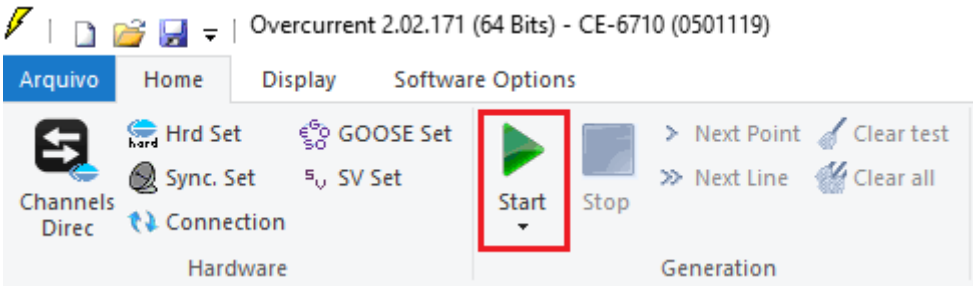
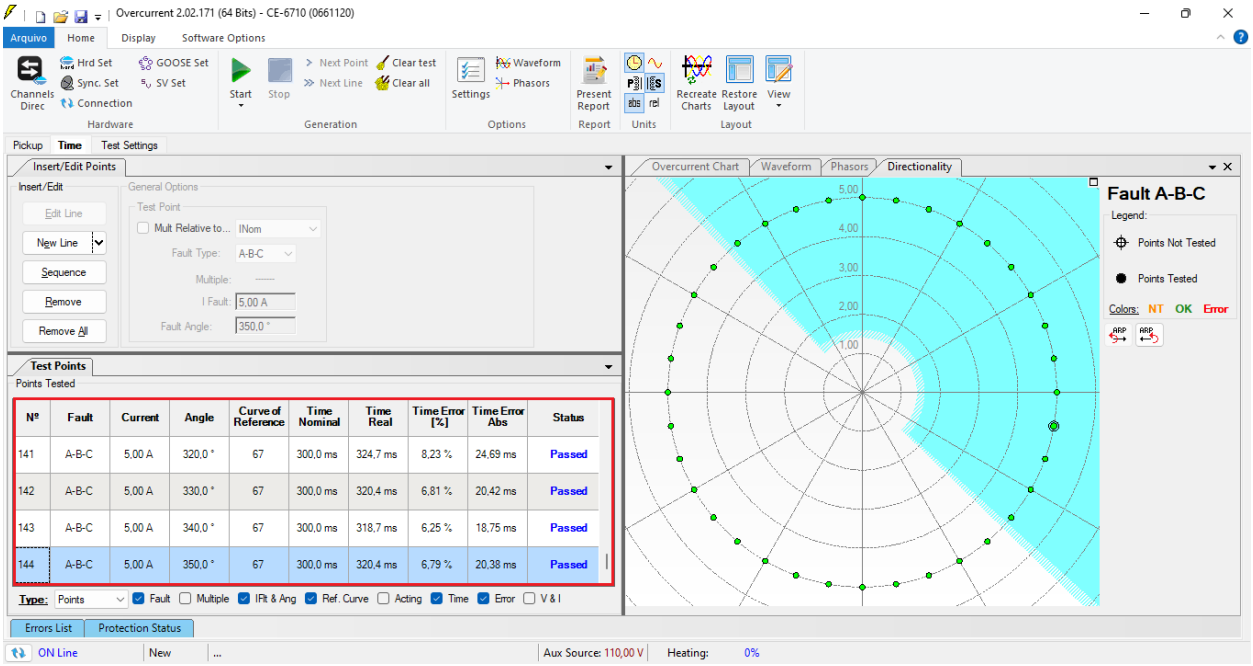



**Figure 50**

## 7.3 *Final Result of the Time Test*




| Nº | Fault | Current | Angle | Curve of Reference | Time Nominal | Time Real | Time Error [%] | Time Error Abs | Status |
|---|---|---|---|---|---|---|---|---|---|
| 141 | A-B-C | 5,00 A | 320,0 ° | 67 | 300,0 ms | 324,7 ms | 8,23 % | 24,69 ms | Passed |
| 142 | A-B-C | 5,00 A | 330,0 ° | 67 | 300,0 ms | 320,4 ms | 6,81 % | 20,42 ms | Passed |
| 143 | A-B-C | 5,00 A | 340,0 ° | 67 | 300,0 ms | 318,7 ms | 6,25 % | 18,75 ms | Passed |
| 144 | A-B-C | 5,00 A | 350,0 ° | 67 | 300,0 ms | 320,4 ms | 6,79 % | 20,38 ms | Passed |

**Figure 51**

It is verified that all points in the operating region acted with times within the tolerance given by the relay 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.

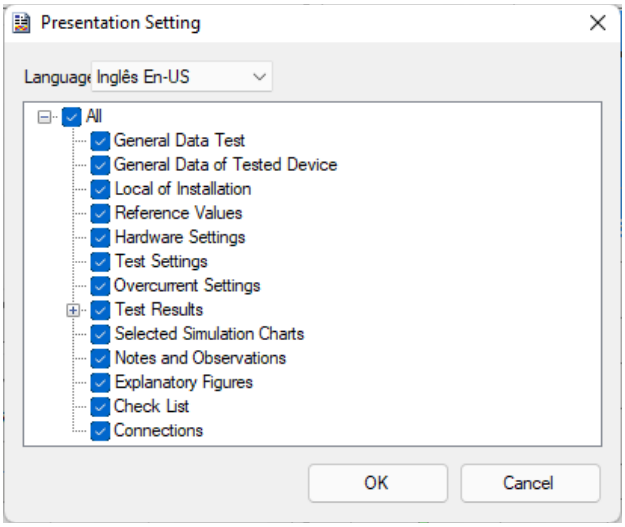



**Figure 52**

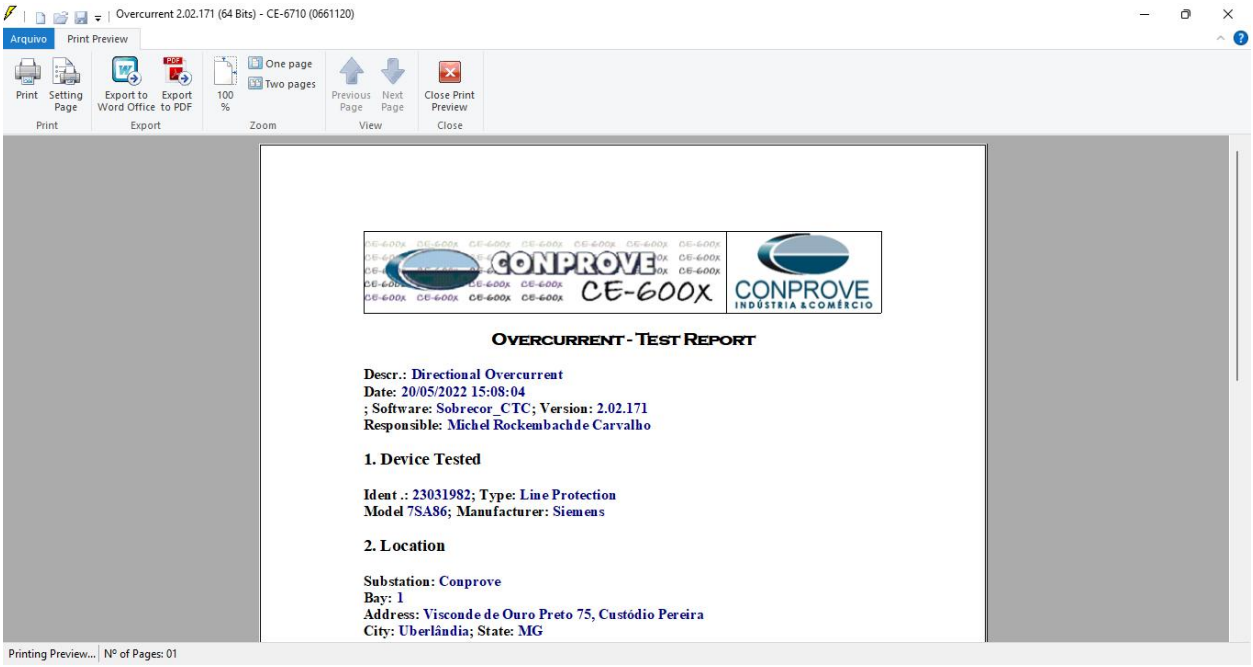
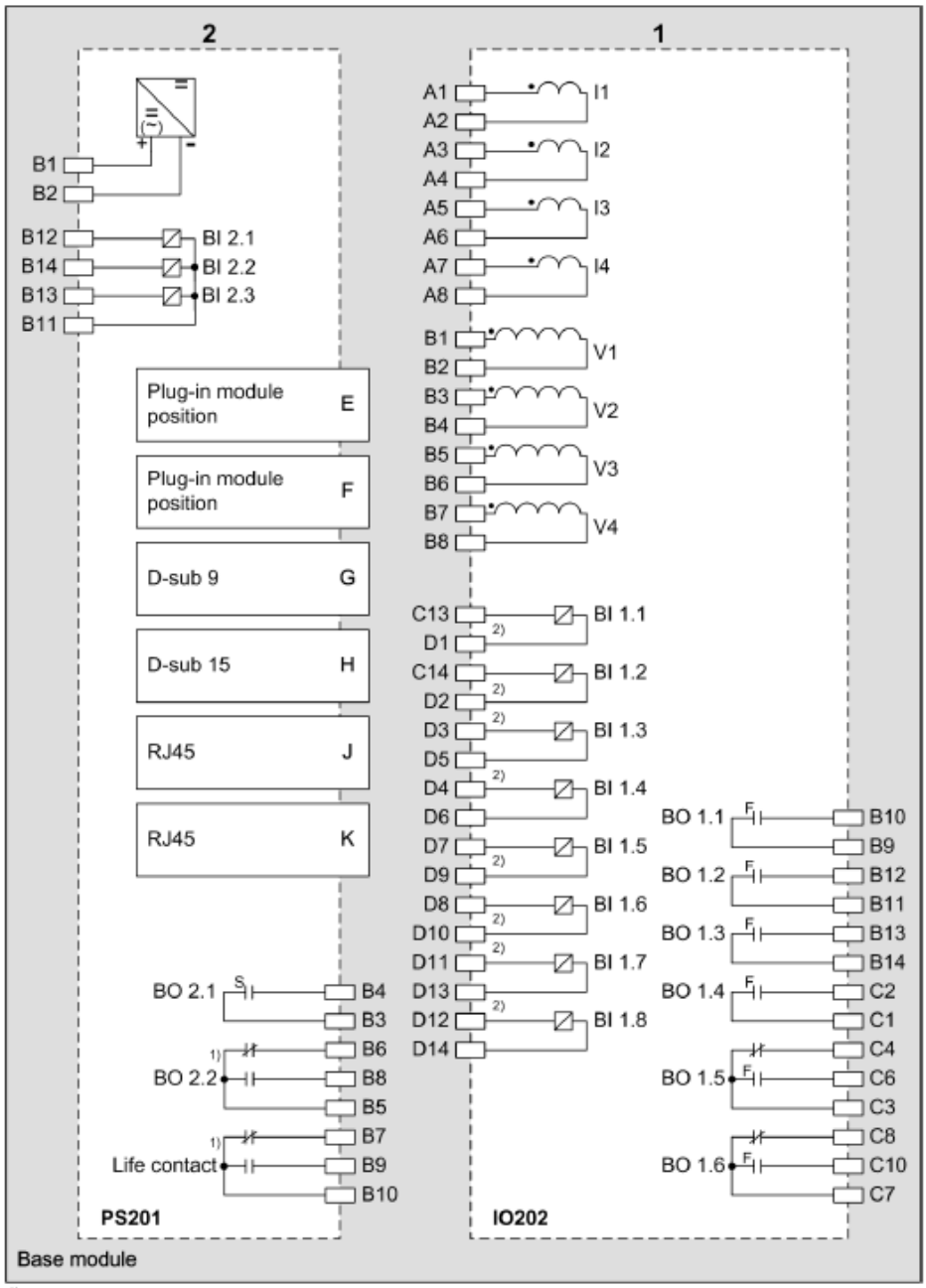

Overcurrent 2.02.171 (64 Bits) - CE-6710 (0661120)
Arquivo
Print Preview
Print
Setting Page
Export to Word Office
Export to PDF
100 %
One page
Two pages
Previous Page
Next Page
Close Print Preview
Print
Export
Zoom
View
Close
CONPROVE
CE-600X
CONPROVE
INDÚSTRIA & COMÉRCIO
OVERCURRENT - TEST REPORT
Descr.: Directional Overcurrent
Date: 20/05/2022 15:08:04
; Software: Sobrecor_CTC; Version: 2.02.171
Responsible: Michel Rockembach de Carvalho
1. Device Tested
Ident .: 23031982; Type: Line Protection
Model 7SA86; 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: 01

**Figure 53**

# APPENDIX A

## A.1 Terminal Designations




[svstyp02-161112-01.tif, 1, en_US]

Figure A-5 Standard Variant Type 2

1) Technical data like type F, but switching time 10 ms

2) Use these terminals to root the binary inputs.

Positions for printed circuit board assemblies on the rear side

**Figure 54**

## A.2 Technical Data

**Direction Determination**

| | |
|---|---|
| Type | With externally generated voltages<br>With voltage memory 2 s |
| Forward range | $V_{ref,rot}$ ±88° |
| Dropout differential forward/reverse range | 1° |
| Directional sensitivity | Unlimited for 1 and 2-phase short circuits<br>Dynamically unlimited, stationary for 3-phase short circuits<br>Approx. 13 V phase-to-phase |

**Times**

| | |
|---|---|
| Operate time with time delay = 0 ms | Approx. 37 ms + OOT [69] at 50 Hz<br>Approx. 22 ms + OOT at 60 Hz |

**Tolerances**

| | |
|---|---|
| Currents, method of measurement = fundamental component | 1 % of the setting value or 5 mA ($I_{rated}$ = 1 A)<br>or 25 mA ($I_{rated}$ = 5 A), ($f_{rated}$ ± 10 %) |
| Currents, method of measurement = RMS value<br>(33 % harmonics, in relation to fundamental component) | |
| Up to 30th harmonic | 1 % of the setting value or 5 mA ($I_{rated}$ = 1 A)<br>or 25 mA ($I_{rated}$ = 5 A), ($f_{rated}$ ± 10 %) |
| Up to 50th harmonic, $f_{rated}$ = 50 Hz | 3 % of the setting value or 20 mA ($I_{rated}$ = 1 A)<br>or 100 mA ($I_{rated}$ = 5 A), ($f_{rated}$ ± 10 %) |
| Up to 50th harmonic, $f_{rated}$ = 60 Hz | 4 % of the setting value or 20 mA ($I_{rated}$ = 1 A)<br>or 100 mA ($I_{rated}$ = 5 A), ($f_{rated}$ ± 10 %) |
| Time delay | 1 % of the setting value or 10 ms |
| Direction-determination angle error | 1 ° |

# APPENDIX B

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

**Table 1**

| Overcurrent Software | | Siemens 7SA86 Relay | |
|---|---|---|---|
| **Parameter** | **Figure** | **Parameter** | **Figure** |
| **Pkp** | **42** | **Threshold** | **26** |
| **Tmp** | **42** | **Operate delay** | **27** |
| **Direc** | **43** | **Directional mode** | **26** |
| **ATM** | **43** | **Rotation angle of ref. Volt.** | **26** |