Test Tutorial

Equipment Type: Protection Relay

Brand: Siemens

Model: 7UM6

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 using the Overcurrent software to evaluate the directionality of the overcurrent function.

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial release	10/05/2022	M.R.C.	G.C.D.P.

Rua Visconde de Ouro Preto, 77 - Bairro Custódio Pereira - Uberlândia – MG - CEP 38405-202.
Phone (34) 3218-6800   Fax (34) 3218-6810
Home Page: www.conprove.com   -   E-mail: conprove@conprove.com.br

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Summary

Rua Visconde de Ouro Preto, 77 - Bairro Custódio Pereira - Uberlândia – MG - CEP 38405-202.
Phone (34) 3218-6800   Fax (34) 3218-6810
Home Page: www.conprove.com   -   E-mail: conprove@conprove.com.br

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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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Sequence for testing the Siemens 7UM6 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 F1 (UH+) of the relay and the negative (black terminal) of the Aux Vdc Source to pin F2 (UH-) of the relay.
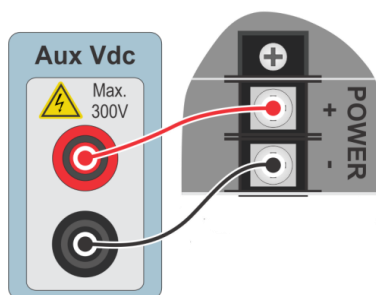

Figure 1

1.2 *Current and Voltage Coils*

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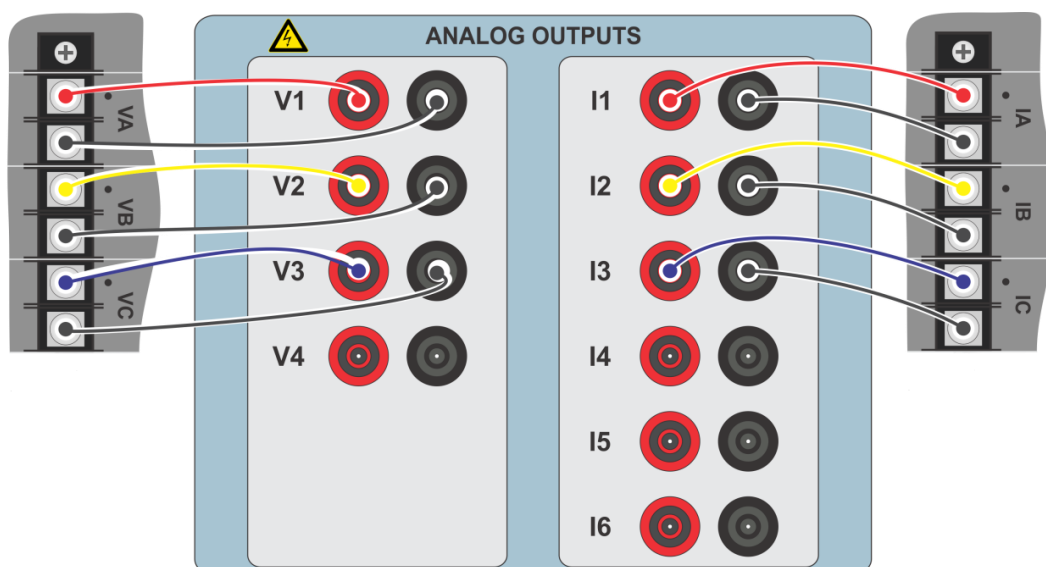

Figure 2

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1.3 *Binary Inputs*

Connect the CE-6710 binary inputs to the relay binary outputs.
- BI1 to pin R1 and its common to pin R5;

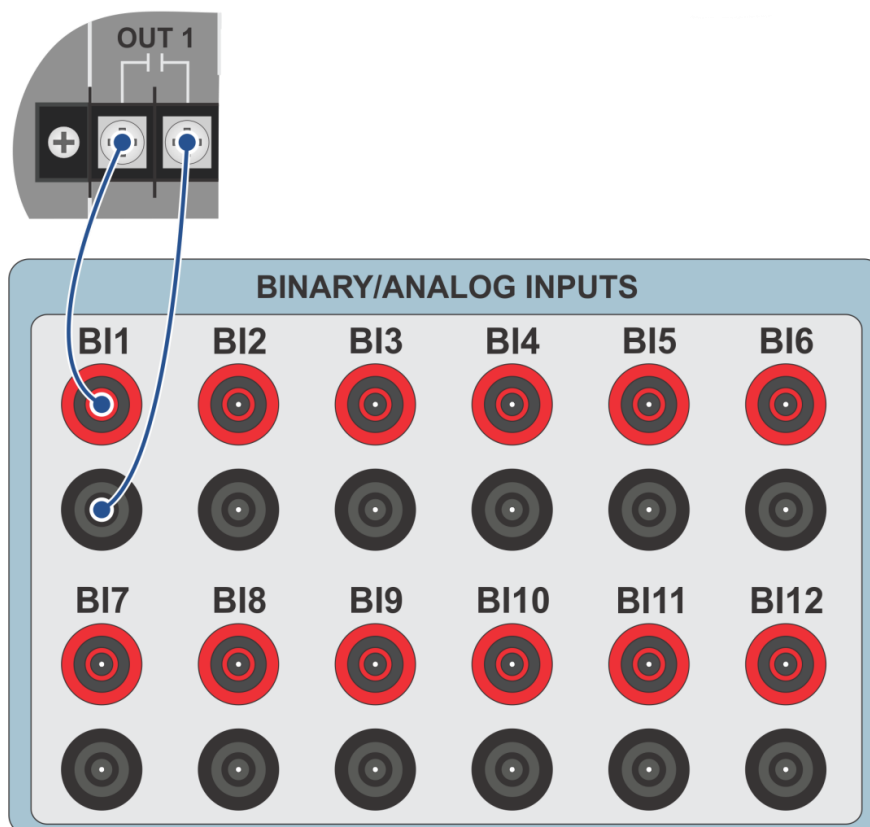The following figure shows the details of the connection.

Figure 3

2. Communication with 7UM62 relay

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

Figure 4

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

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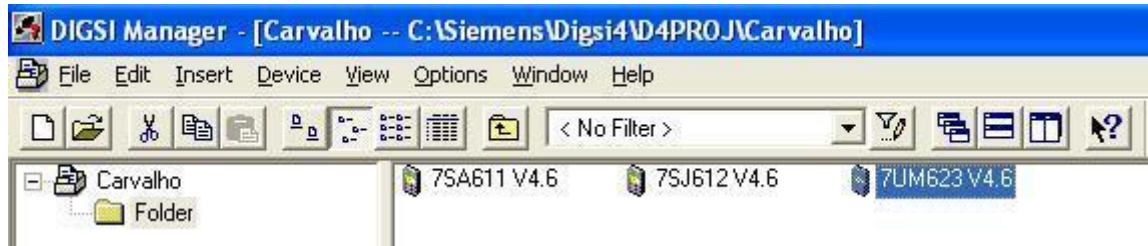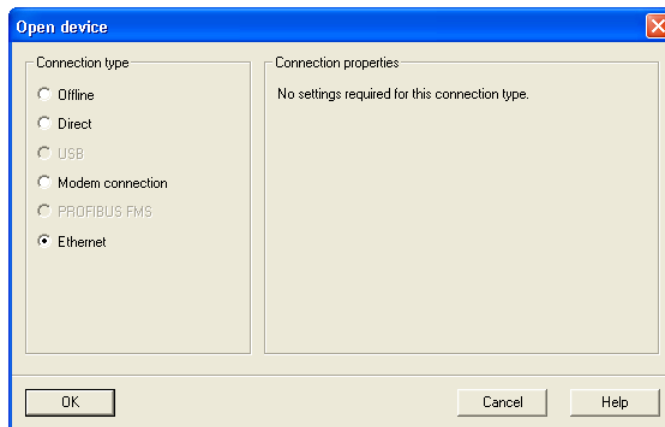
5

Figure 5

Figure 6

3. Parameterization of the relay 7UM62

3.1 *Device Configurations*

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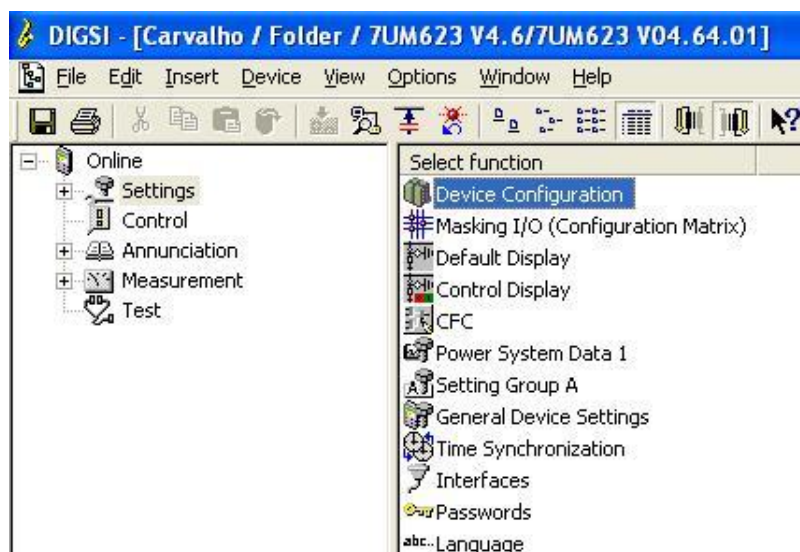

Figure 7

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On the *"Functional Scope"* screen, disable all functions leaving only the *"50/51/67 Overcurrent Protection I>>"* function enabled for side 2. This prevents trips from other functions from interfering with the test. After the adjustments click *"OK"*.
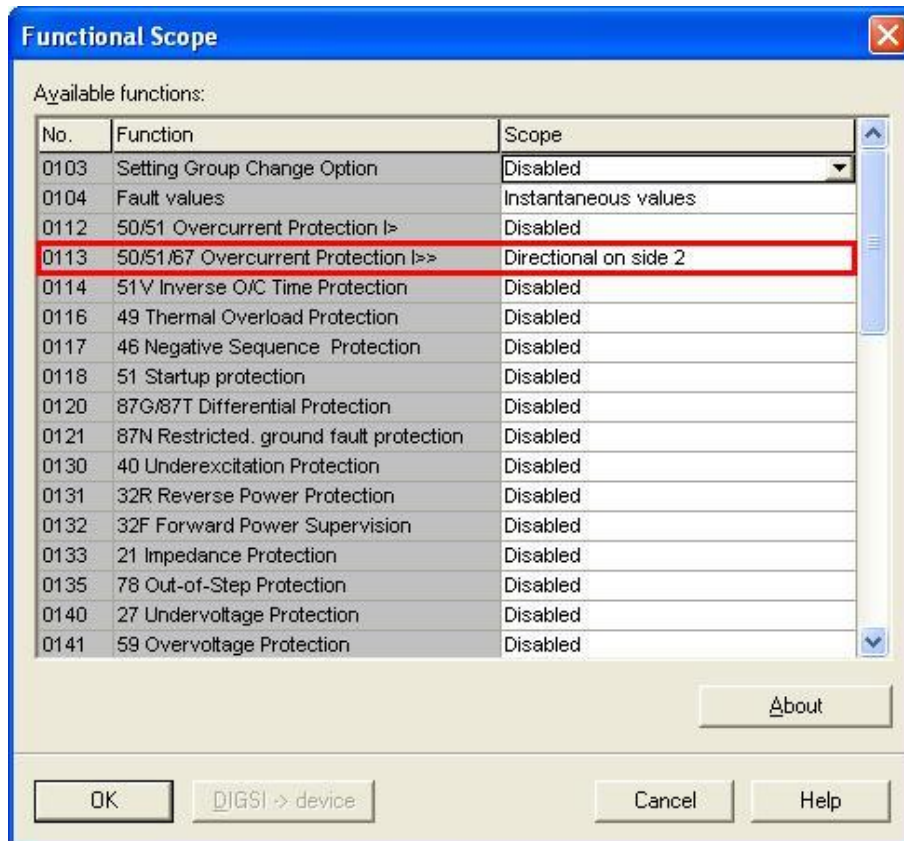

Figure 8

3.2 *Masking I/O*

The next step is to adjust the relay output. To access these parameters, double-click the left button on *"Masking I/O (Configuration Matrix)"* as shown in the next figure.
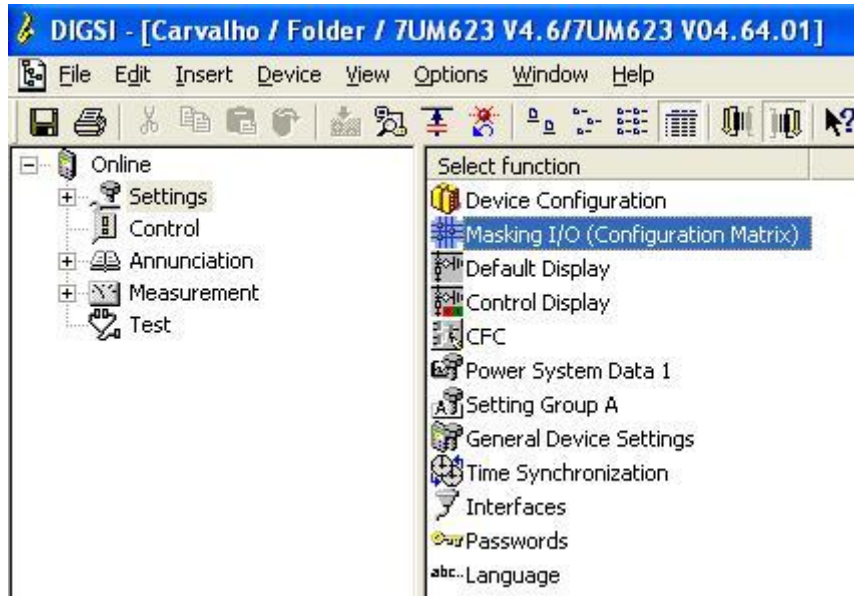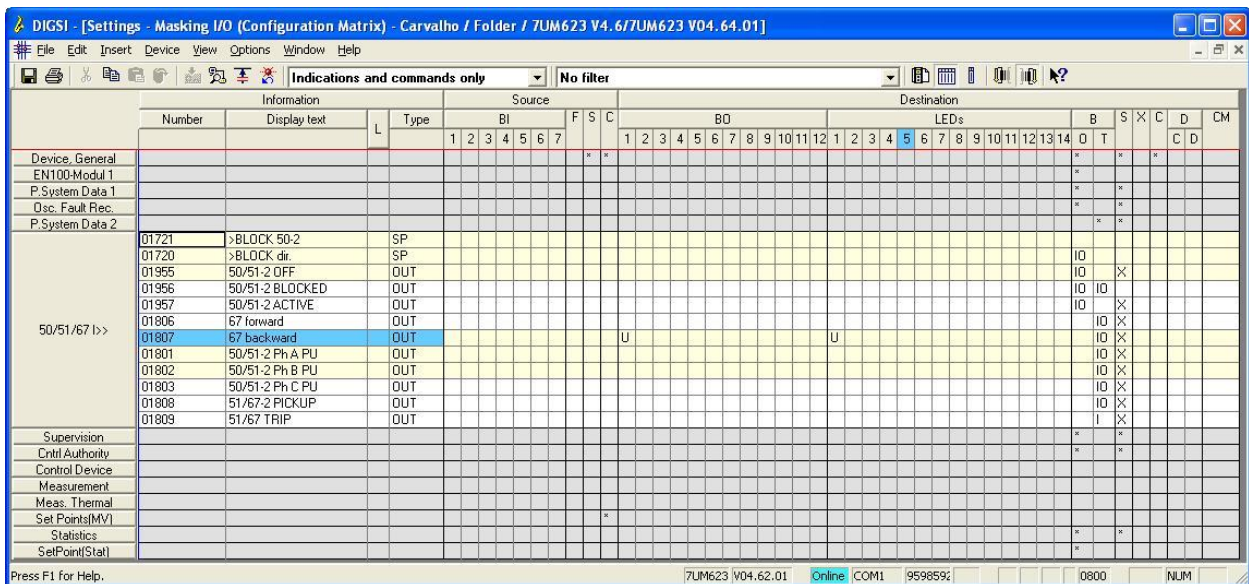
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Figure 9

Binary output *"BO1"* is designated for sending the trip of the reverse *"backward"* function 67. In order to assist the test, *"LED 1"* is used to signal the sending of TRIP.

Figure 10

3.3 *Power System Data 1*

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

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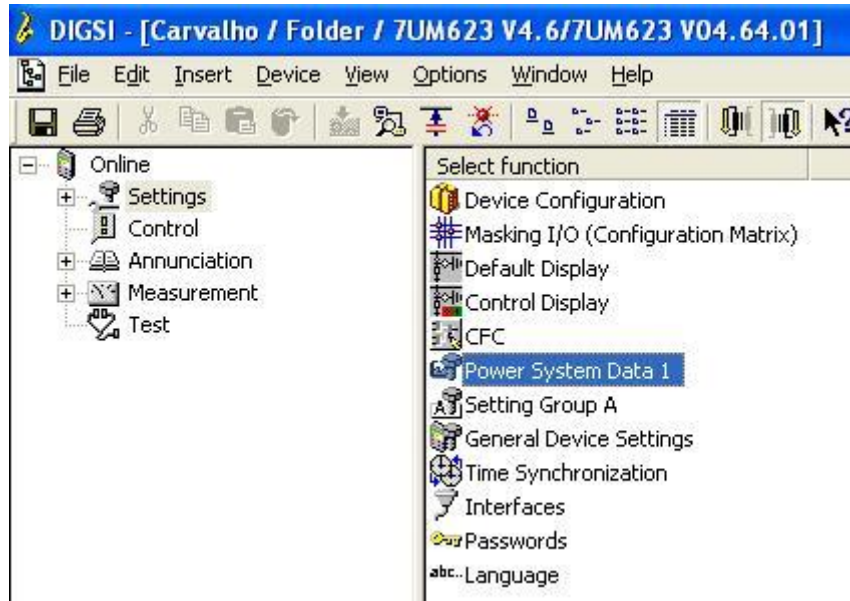
Figure 11

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

3.4 *Power System*

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

Figure 12

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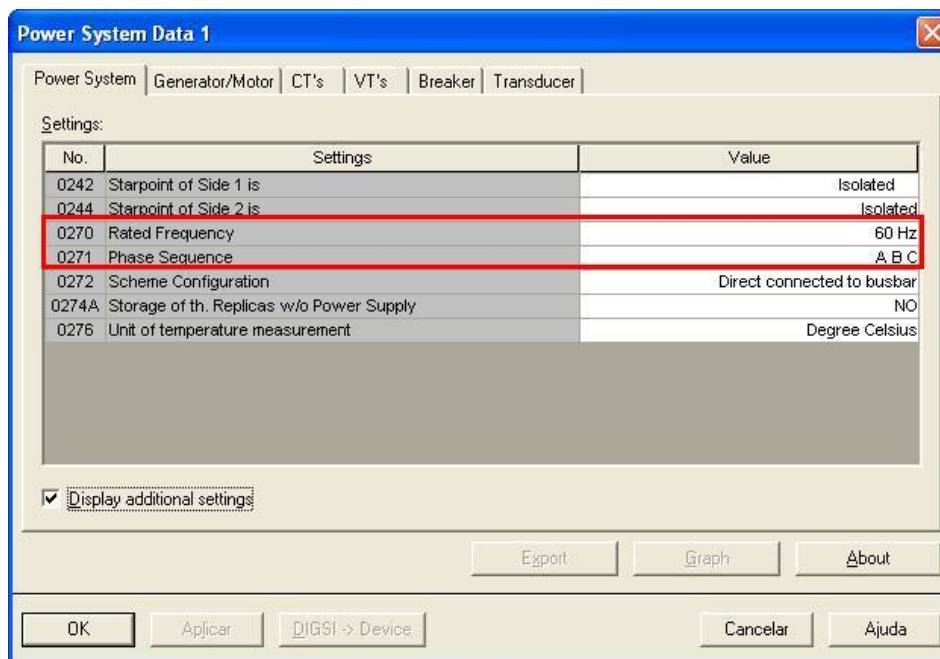
3.5 *Generator/Motor*

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

Figure 13

3.6 *CT's*

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

Figure 14

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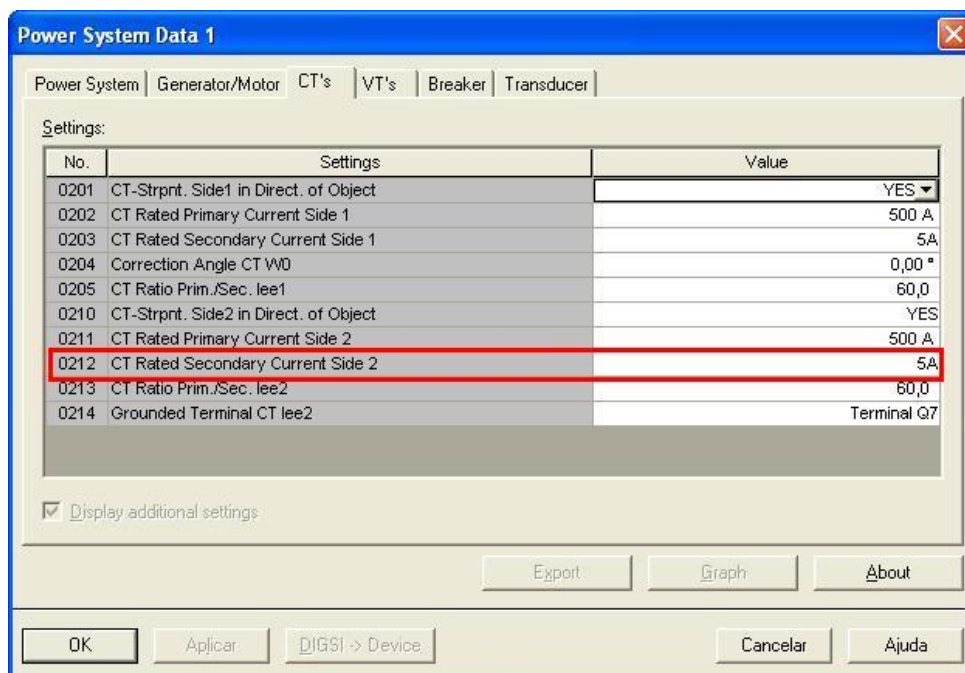
3.7 *VT's*

In this tab, the adjustment of the potential transformer ratio is performed.

Figure 15

The other options are not used for this test.
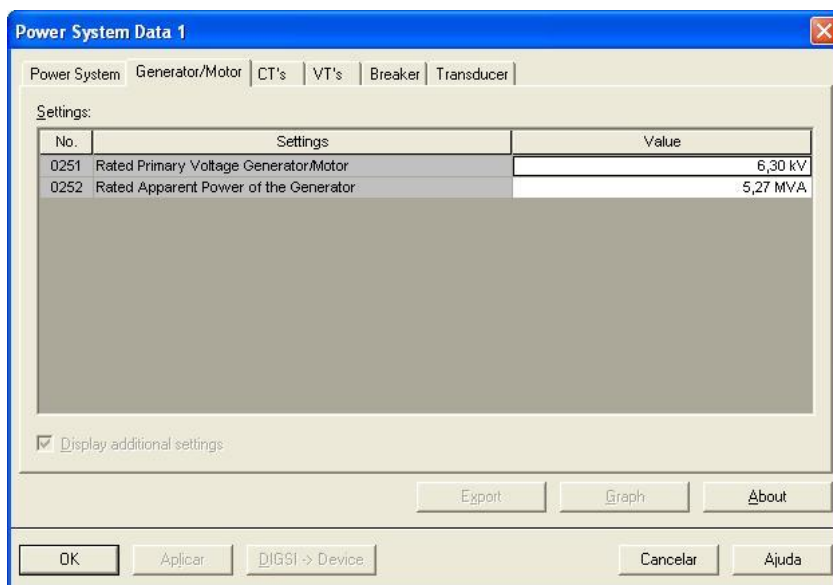
3.8 *Setting Group A*

In this option, the parameters of the directional overcurrent function are adjusted.

Figure 16

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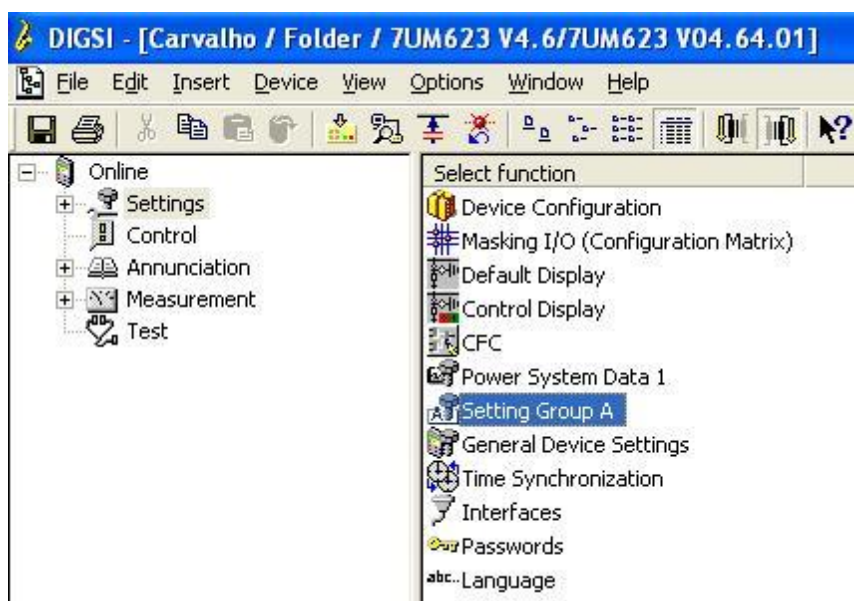
Double click on the option *"50/51/67 I>> (with direction)"*.

Figure 17

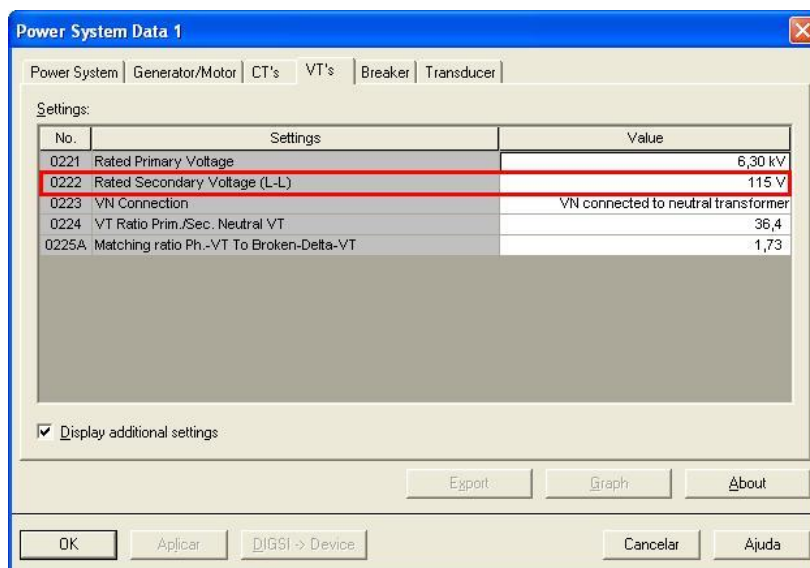### 3.9 50/51/67 I>> (with direction)

On this screen, the directional function, its pick-up value, the actuation time, the line angle and the directionality are adjusted.

Figure 18

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4. Overcurrent software adjustments

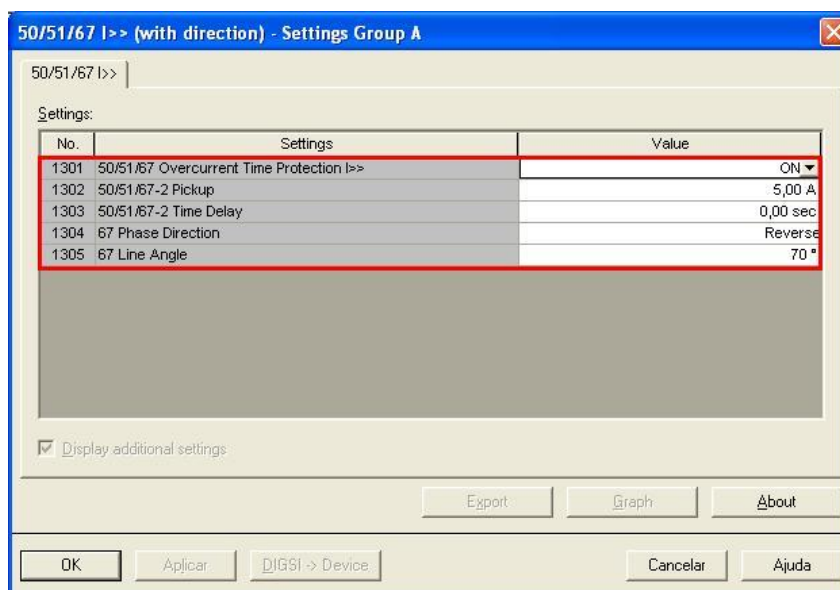### 4.1 *Opening the Overcurrent*

Click on the *"Conprove Test Center"* application manager icon.
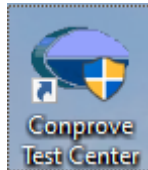
Figure 19

Click on the Overcurrent software icon.

Figure 20

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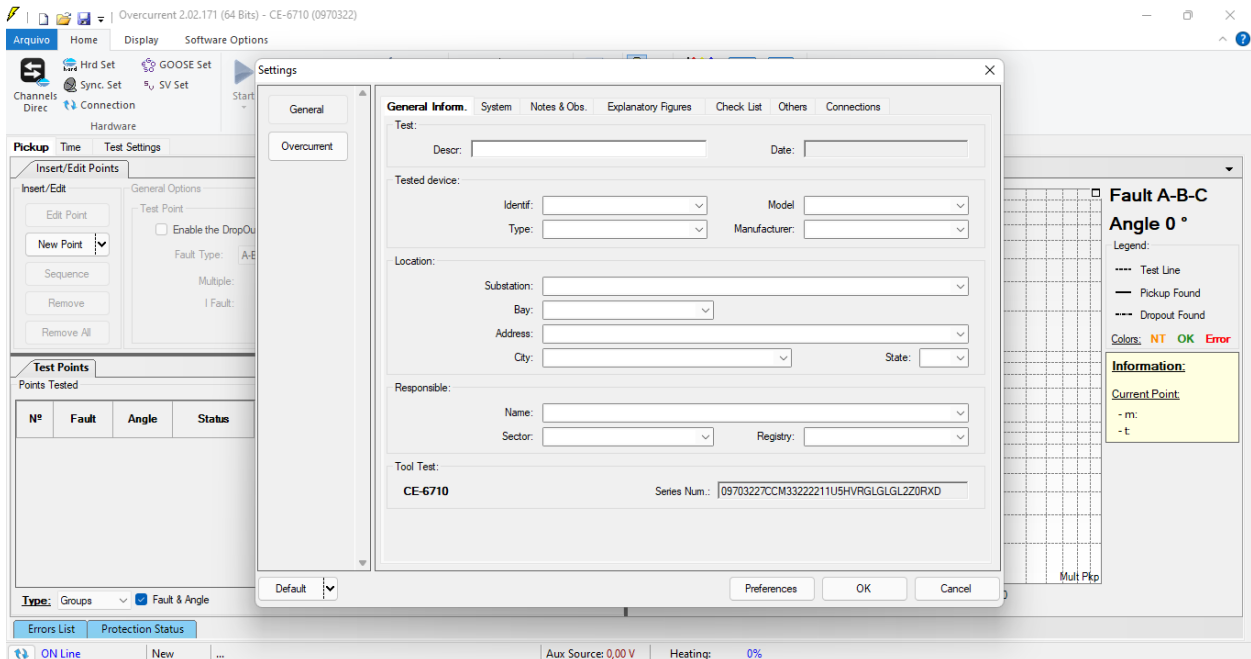**Home Page: www.conprove.com   -   E-mail: conprove@conprove.com.br**

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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.
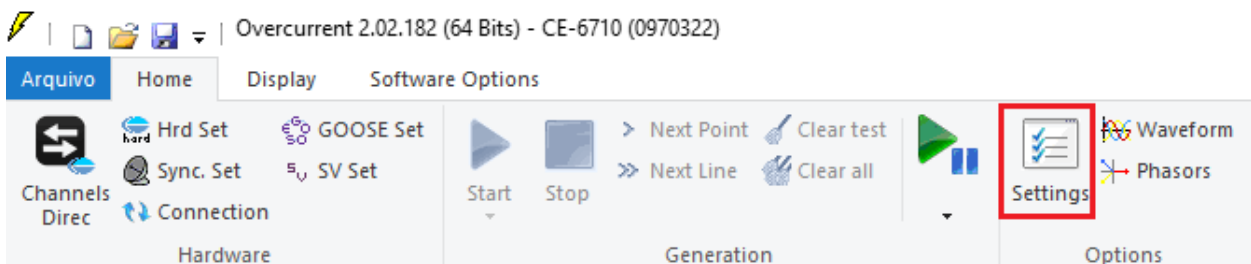

Figure 22

Inside the *"Settings"* screen, fill in the *"General Inform."* with details of the tested device, installation location and the person responsible. This makes 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.

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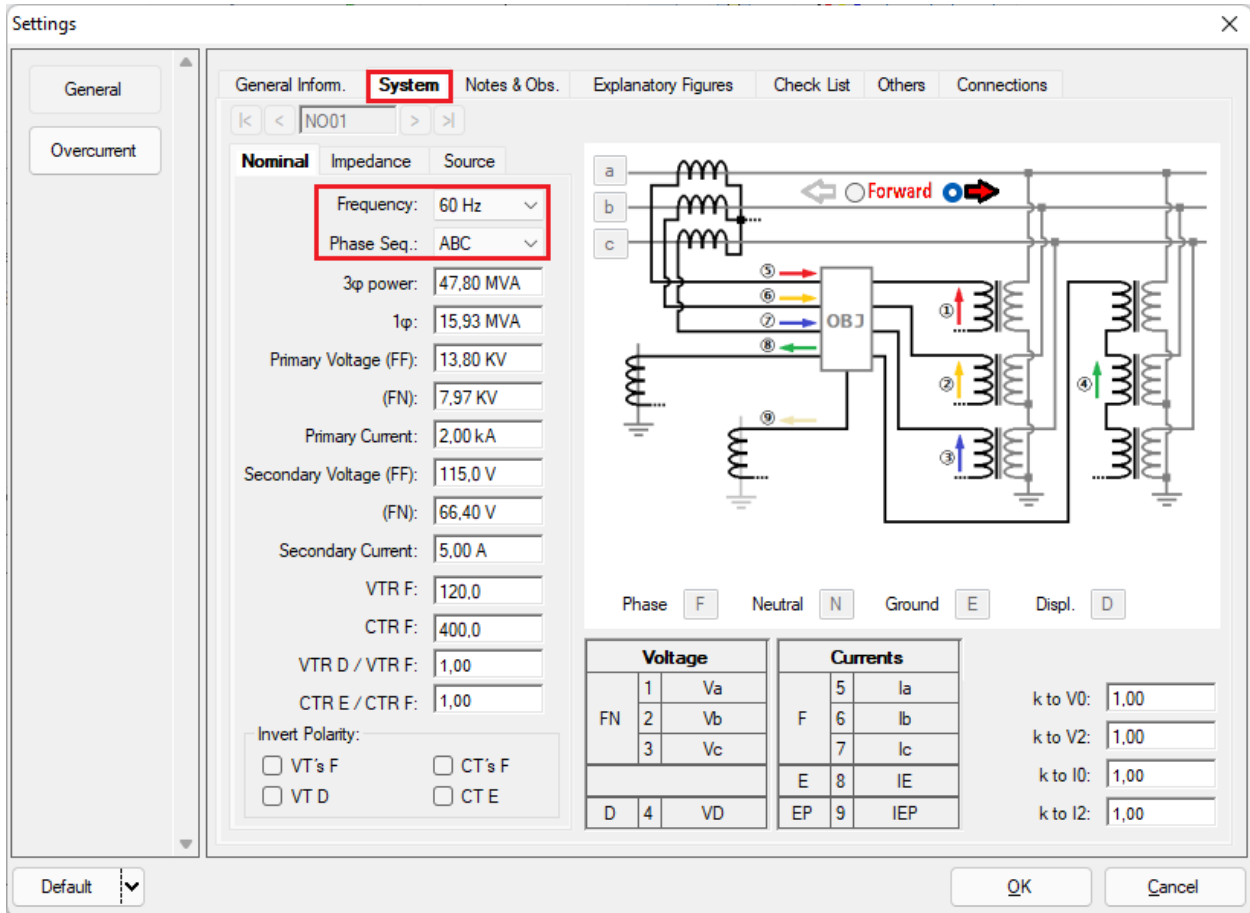
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Figure 24

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).

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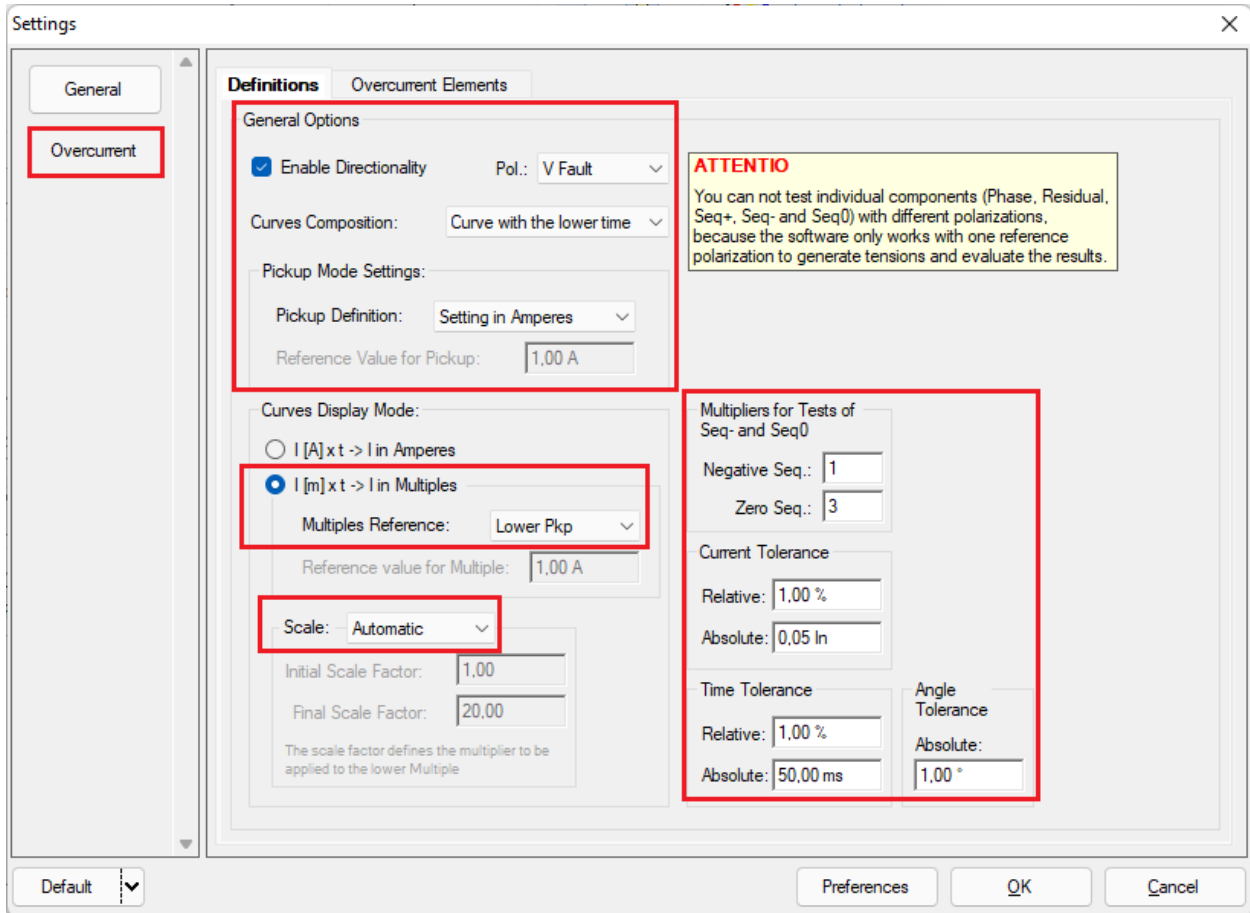Home Page: www.conprove.com   -   E-mail: conprove@conprove.com.br

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Figure 25

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.

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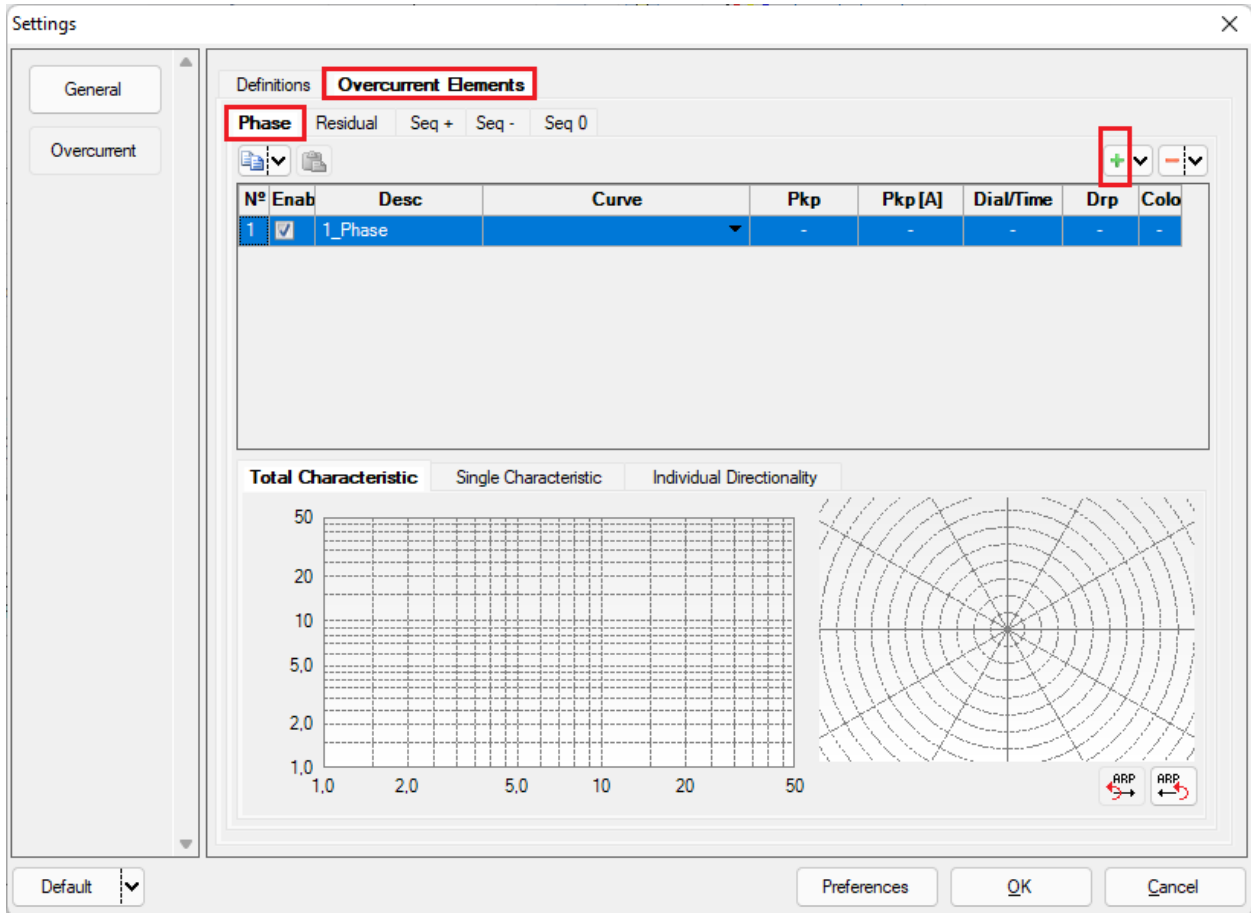
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Figure 26

Change the name to 67, set curve type equal to *"Defined Time"*, pickup value equal to 5.0A, time to 0.0s seconds and dropout factor equal to 0.95.

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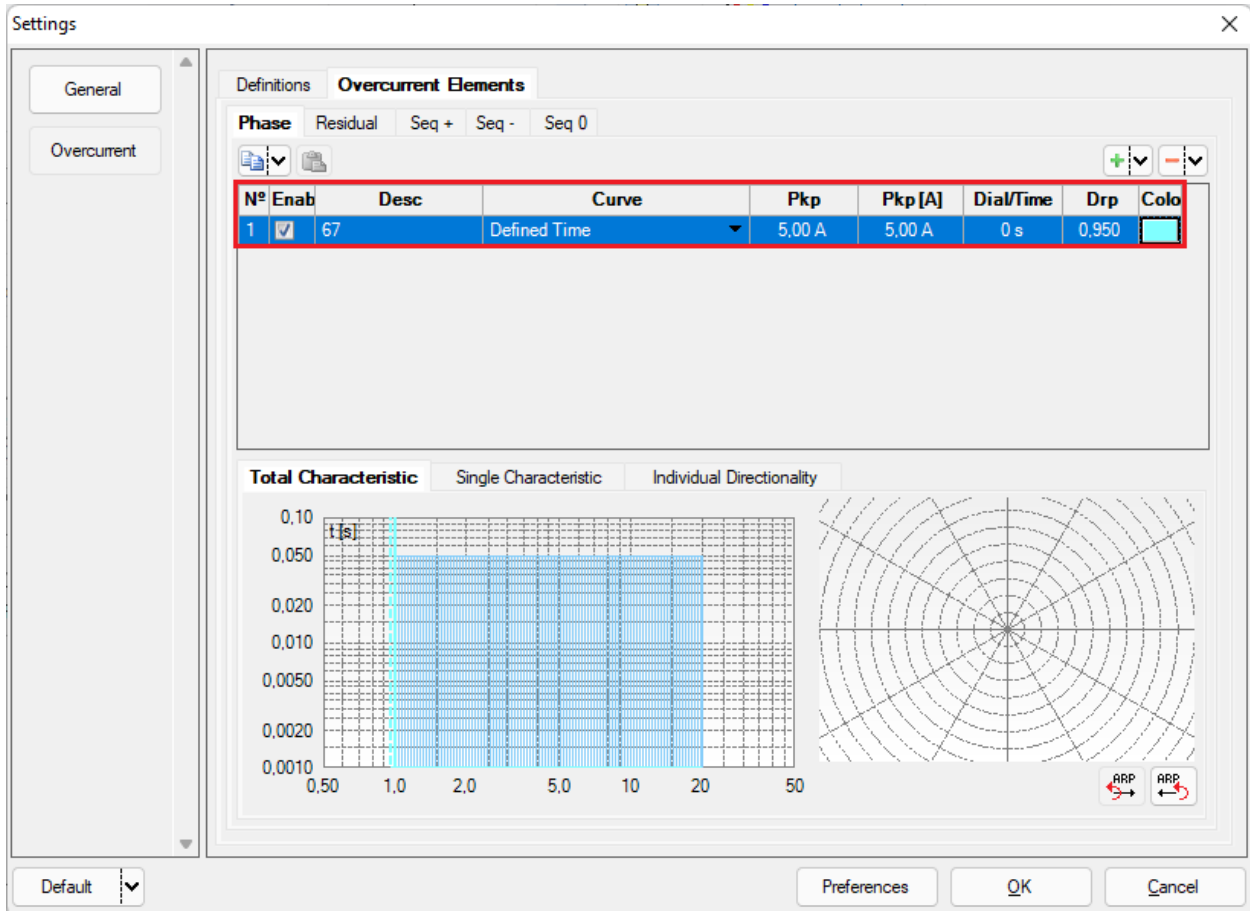
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Figure 27

In the software Overcurrent there is the parameter maximum torque angle (ATM) which is given by the angular difference between current and voltage. Therefore, for the line angle to be equivalent to the ATM, you must insert a negative sign in the angle before filling in the *"ATM"* field. For this example -70° or 290°.

Example:

Data: voltage = V|0°; current = I|-70°

Line Angle:

$$Z_{LINE} = \frac{V|0°}{I|-70°} = z|70°$$

ATM:

$$ATM = \theta_{current} - \theta_{voltage} >> ATM = -70° - 0 = -70°$$

Choose the *"Individual Directionality"* tab and set the *"Reverse"* option, the maximum torque angle (ATM) must be set to 290° and the offset of the angles to 90° and – 90°.

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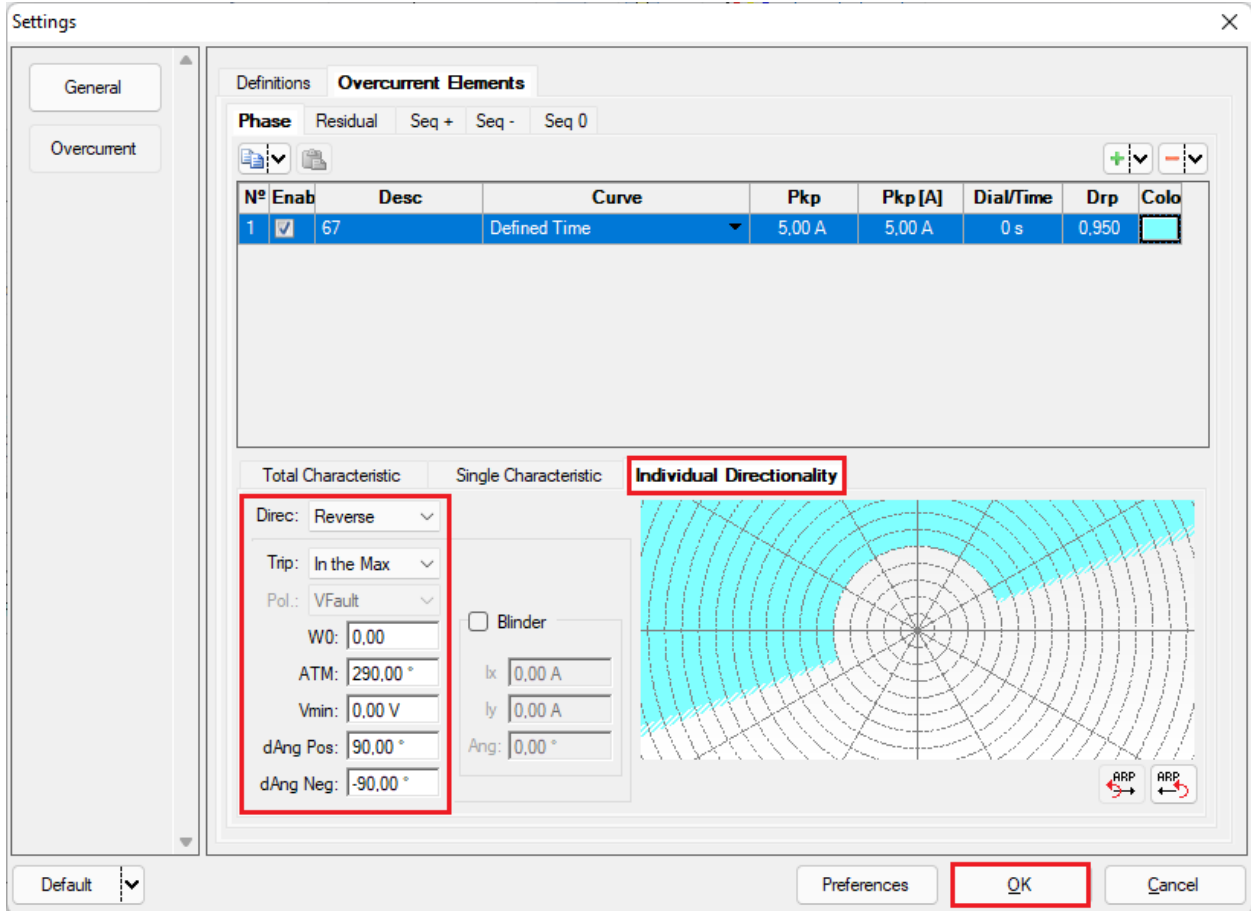Home Page: www.conprove.com   -   E-mail: conprove@conprove.com.br

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Figure 28

6. Channel Direction and Hardware Configurations

Click on the icon illustrated below.
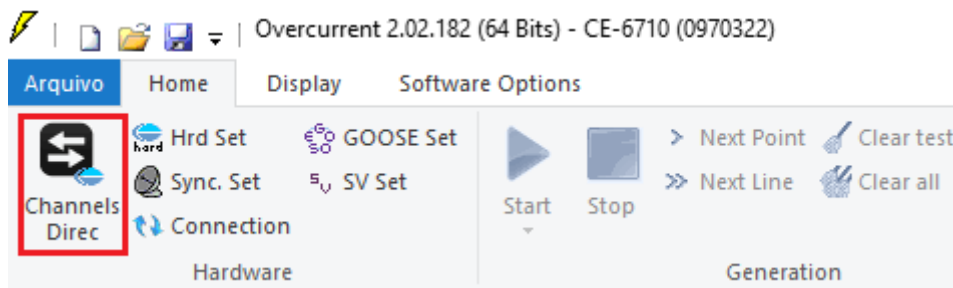
Figure 29

Then click on the highlighted icon to configure the hardware.

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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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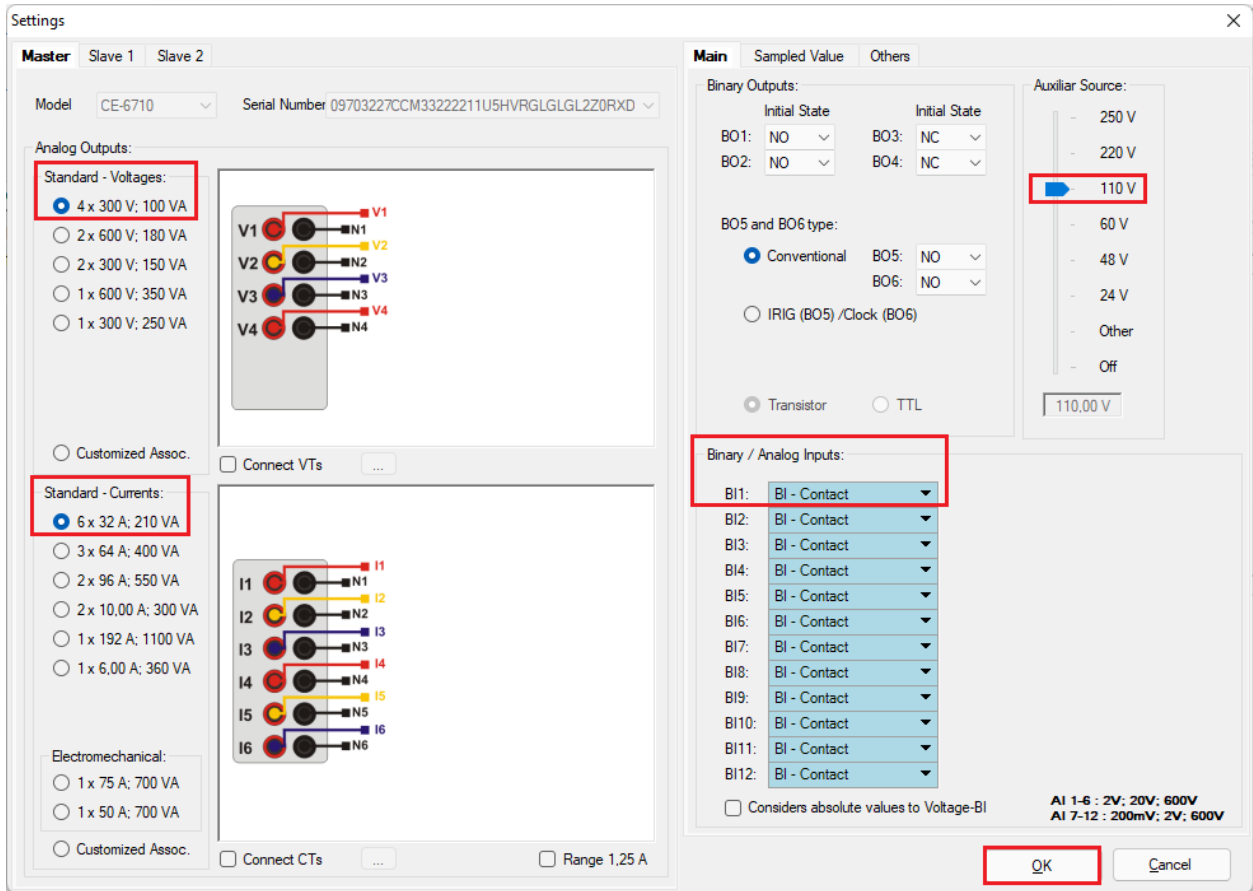Home Page: www.conprove.com   -   E-mail: conprove@conprove.com.br

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Figure 31

On the next screen choose *"Basic"* and on the next window (not shown) choose *"YES",* finally click on *"Confirm".*
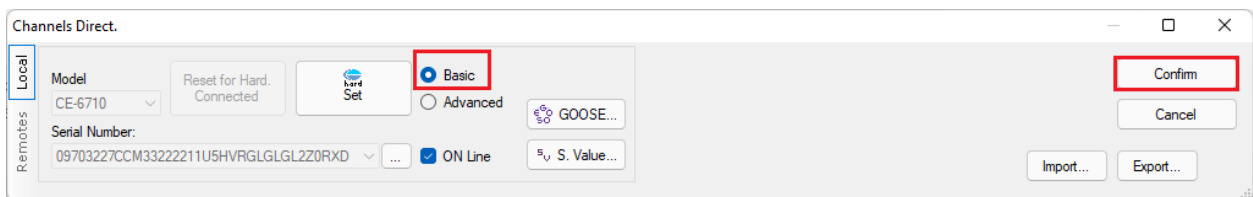
Figure 32

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.

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Figure 33

7.2 *Time Screen*

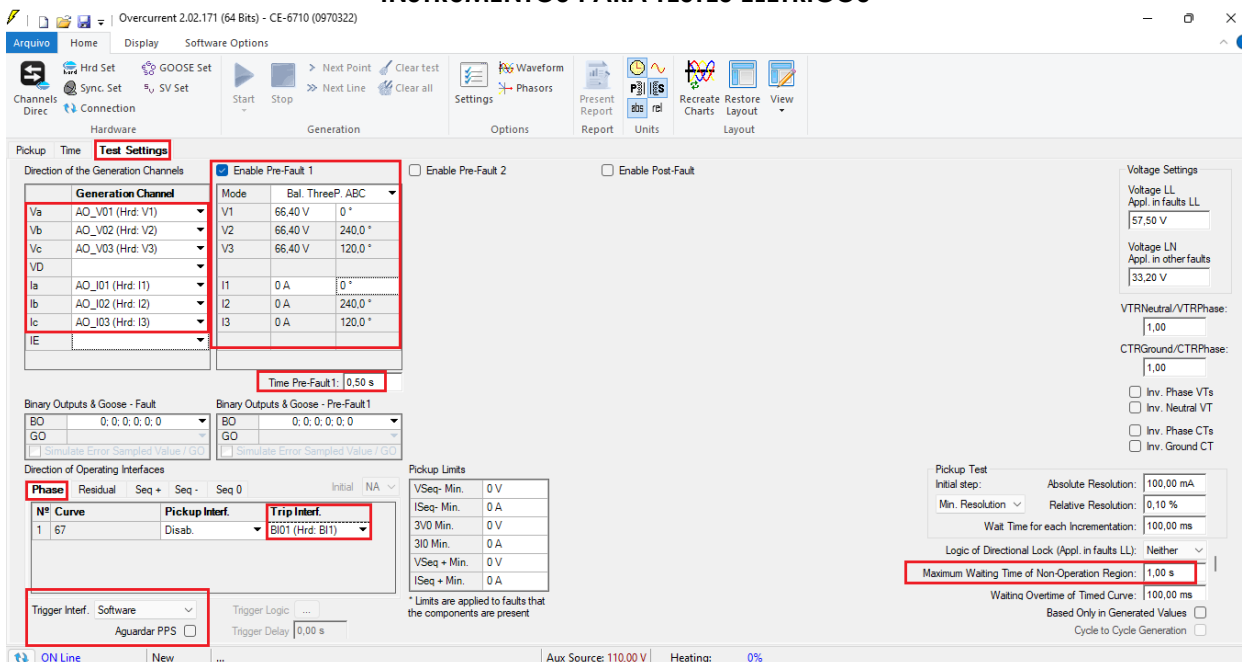In this tab, the operating time and directionality are evaluated. For convenience, a sequence of values will be inserted. The value 10.00A was chosen as the initial value, 10.00A as the final value and 1.0A as the increment step and the fault of AE, BE and CE. In the angles choose 0.0° as the initial value for the step choose 30° and final value choose 360.0°. Choose the *"Directionality"* tab.
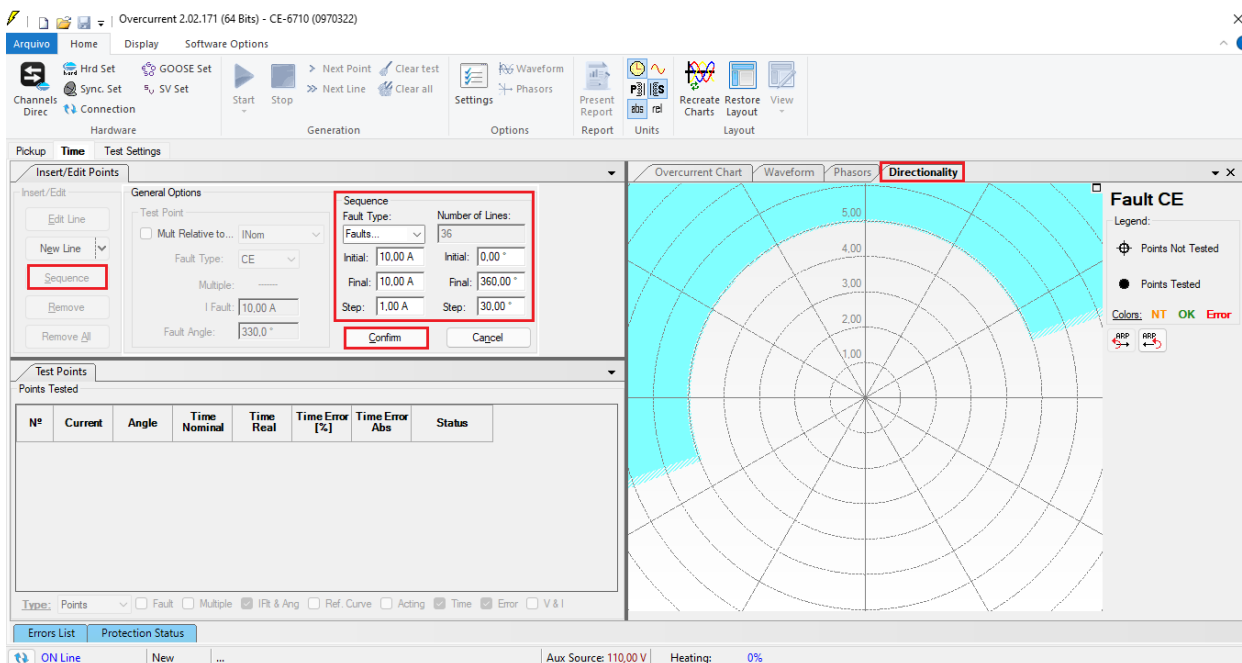

Figure 34

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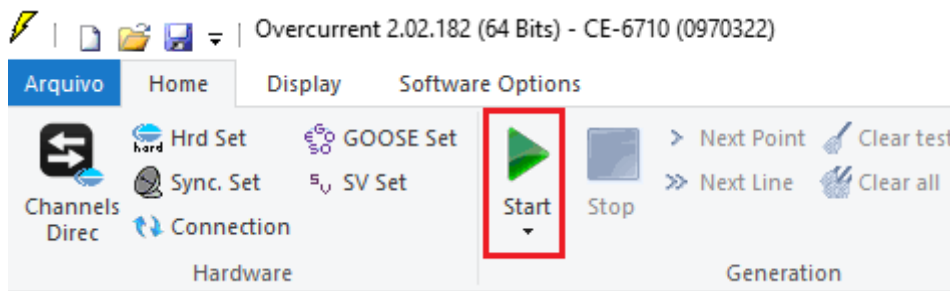

Figure 35
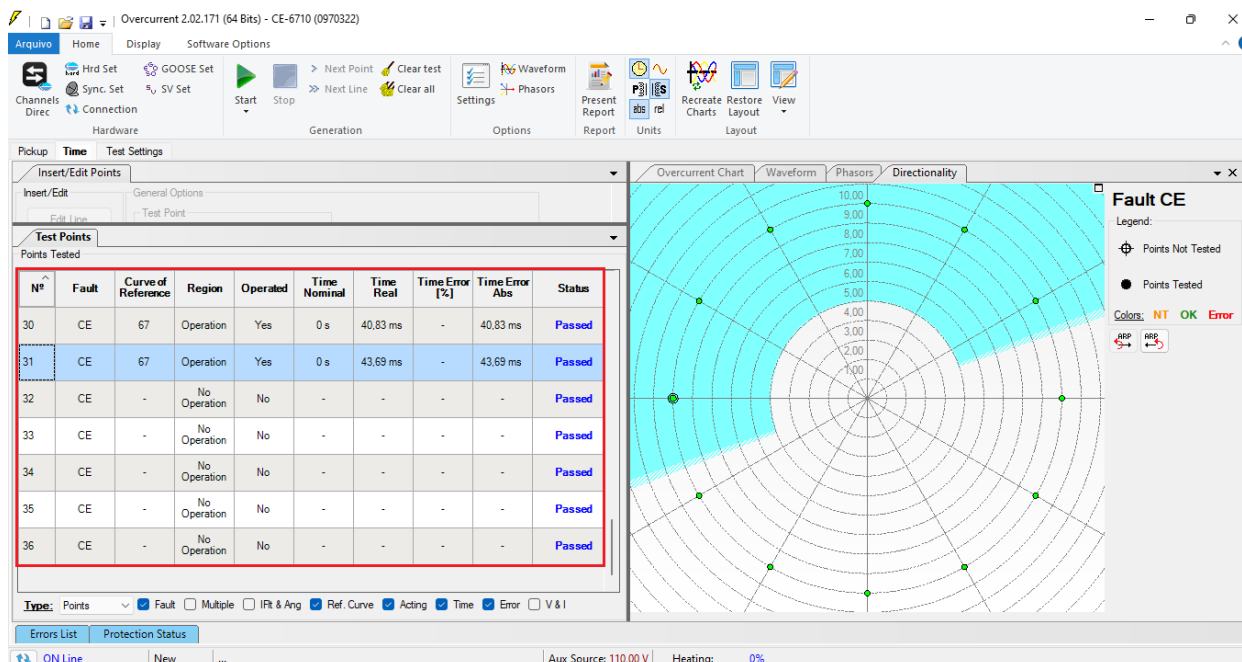
.

7.3 *Final Result of the Time Test*

Figure 36

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.

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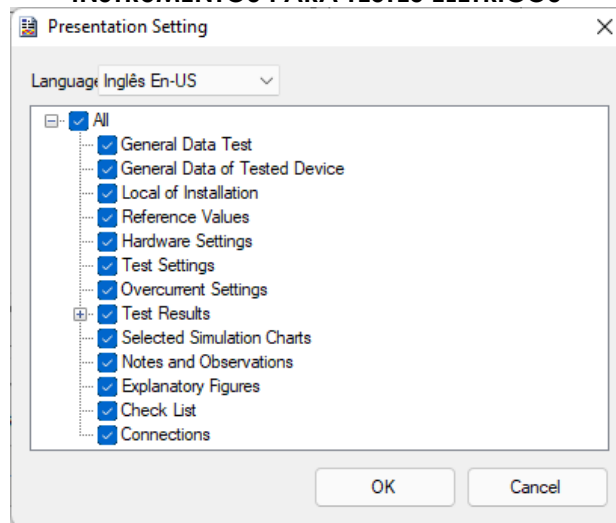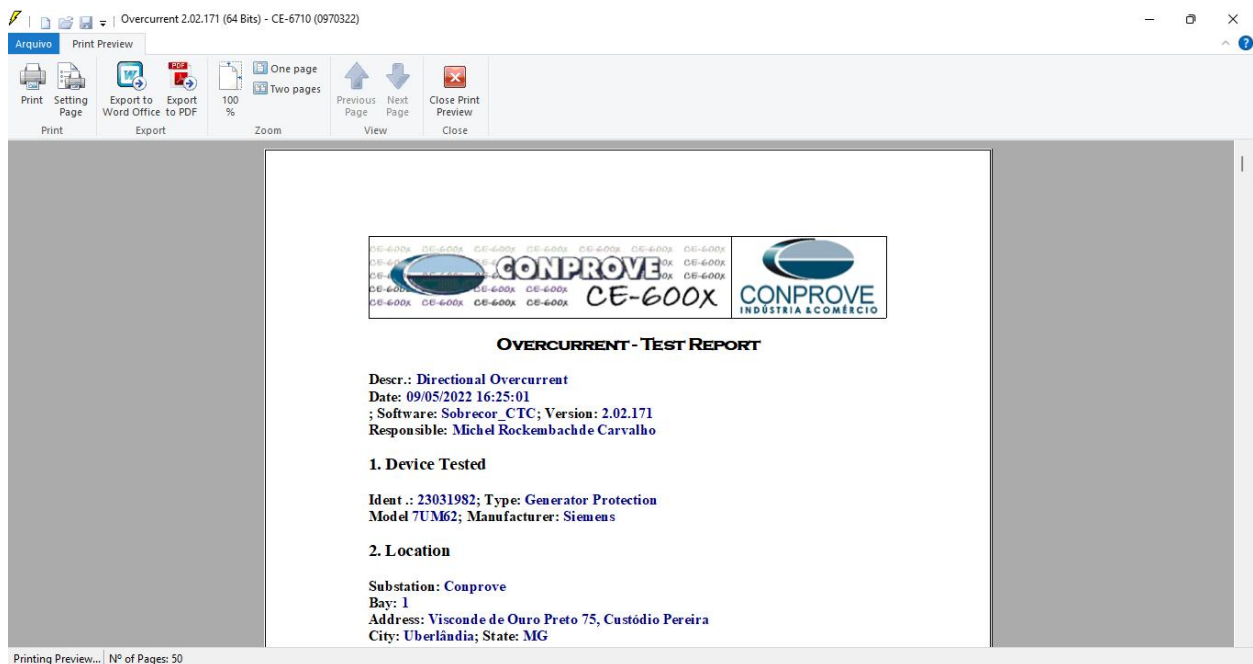
Figure 37

Figure 38

APPENDIX A

A.1 Terminal Designations

7UM621/623*-*D/E
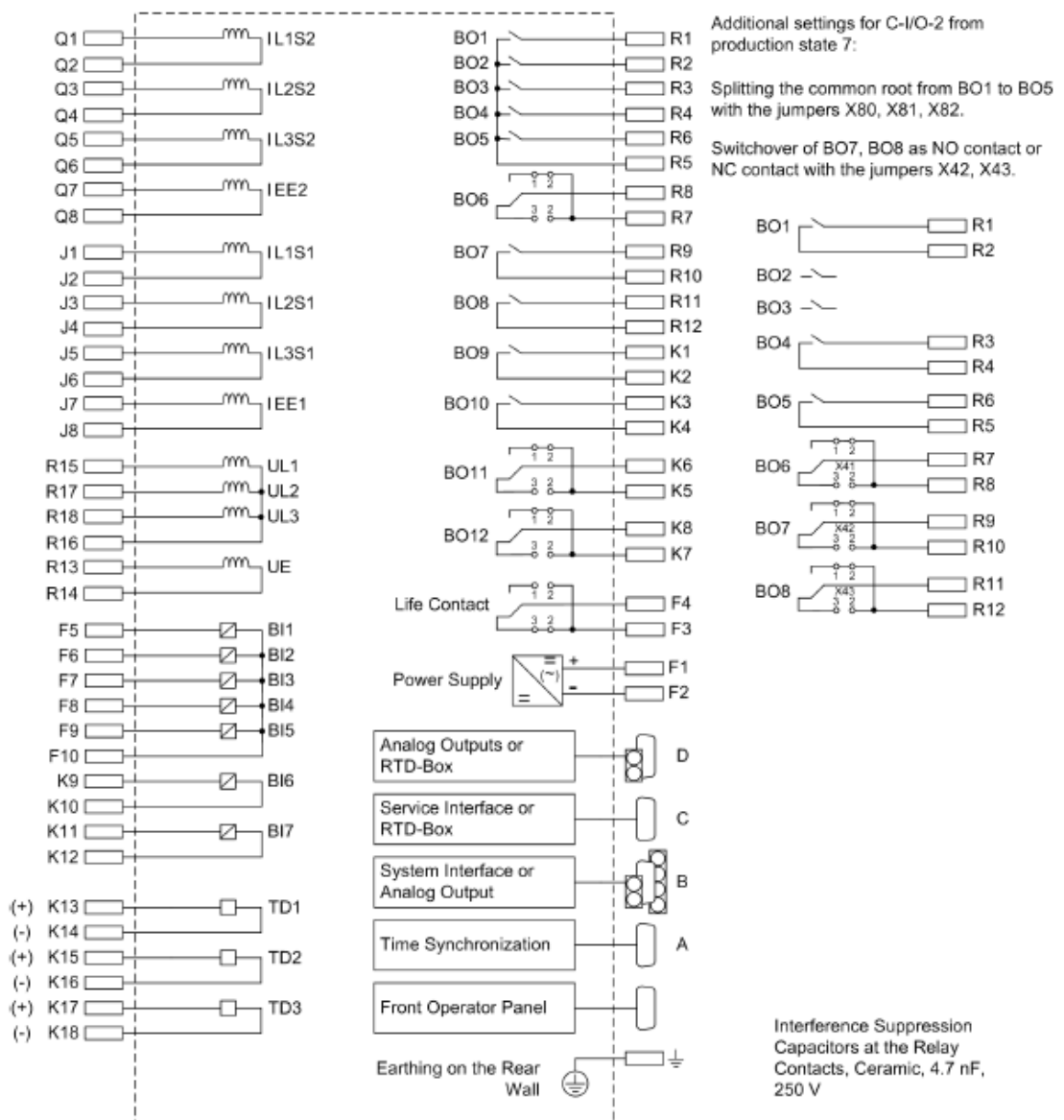
Figure 39

A.2 Technical Data

Times

Pickup times	
I >, I>> Current = 2 × Pickup Value Current = 10 × Pickup Value	approx. 35 ms approx. 25 ms
Dropout times I >, I>>	approx. 50 ms

Dropout Ratio

Dropout ratio overcurren I>	0.90 to 0.99	
Dropout ratio overcurren I>>	approx. 0.95 for $I/I_N \geq 0.3$	(Increments 0.01)
Dropout ratio undervoltage	approx. 1.05	
Dropout difference $\Delta\varphi$	2° elektrical	

Tolerances

Pickup current I >, I>>	for I_N = 1 A	1 % of setting value or 10 mA
	for I_N = 5 A	1 % of setting value or 50 mA
Undervoltage seal–in U<		1 % of setting value or 0.5 V
Delay times T		1 % or 10 ms
Directional limit lines angle		1° electrical

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 1

Overcurrent Software		Siemens 7UM Relay		
Parameter	Figure	Parameter	No.	Figure
Pkp	27	50/51/57-2 Pickup	1302	18
ATM (negative sign)	28	67 Line Angle	1305	18

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