



INSTRUMENTOS PARA TESTES ELÉTRICOS

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

Summary

1. Relay connection to CE-6710	4
1.1 <i>Auxiliary Source</i>	4
1.2 <i>Current and Voltage Coils</i>	4
1.3 <i>Binary Inputs</i>	5
2. Communication with 7UM62 relay	5
3. Parameterization of the relay 7UM62	6
3.1 <i>Device Configurations</i>	6
3.2 <i>Masking I/O</i>	7
3.3 <i>Power System Data 1</i>	8
3.4 <i>Power System</i>	9
3.5 <i>Generator/Motor</i>	10
3.6 <i>CT's</i>	10
3.7 <i>VT's</i>	11
3.8 <i>Setting Group A</i>	11
3.9 <i>50/51/67 I>> (with direction)</i>	12
4. Overcurrent software adjustments	13
4.1 <i>Opening the Overcurrent</i>	13
4.2 <i>Configuring the Settings</i>	14
4.3 <i>System</i>	15
5. Directional Overcurrent Adjustment.....	16
5.1 <i>Overcurrent Screen > Definitions</i>	16
5.2 <i>Overcurrent Screen > Overcurrent Elements > Phase</i>	17
6. Channel Direction and Hardware Configurations.....	20
7. Test structure for function 67	22
7.1 <i>Test Settings</i>	22
7.2 <i>Time Screen</i>	23
7.3 <i>Final Result of the Time Test</i>	24
8. Report.....	24
APPENDIX A	26
A.1 Terminal Designations	26
A.2 Technical Data.....	27
APPENDIX B	27

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.

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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.

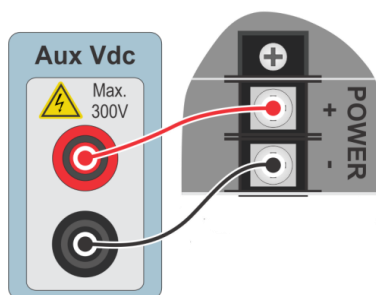


Figure 1

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.

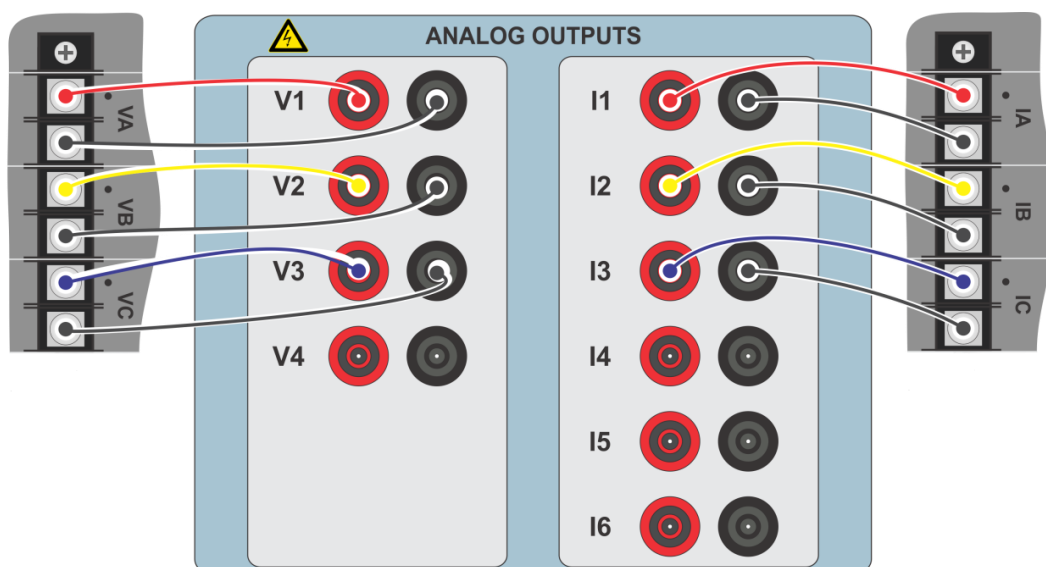


Figure 2

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.

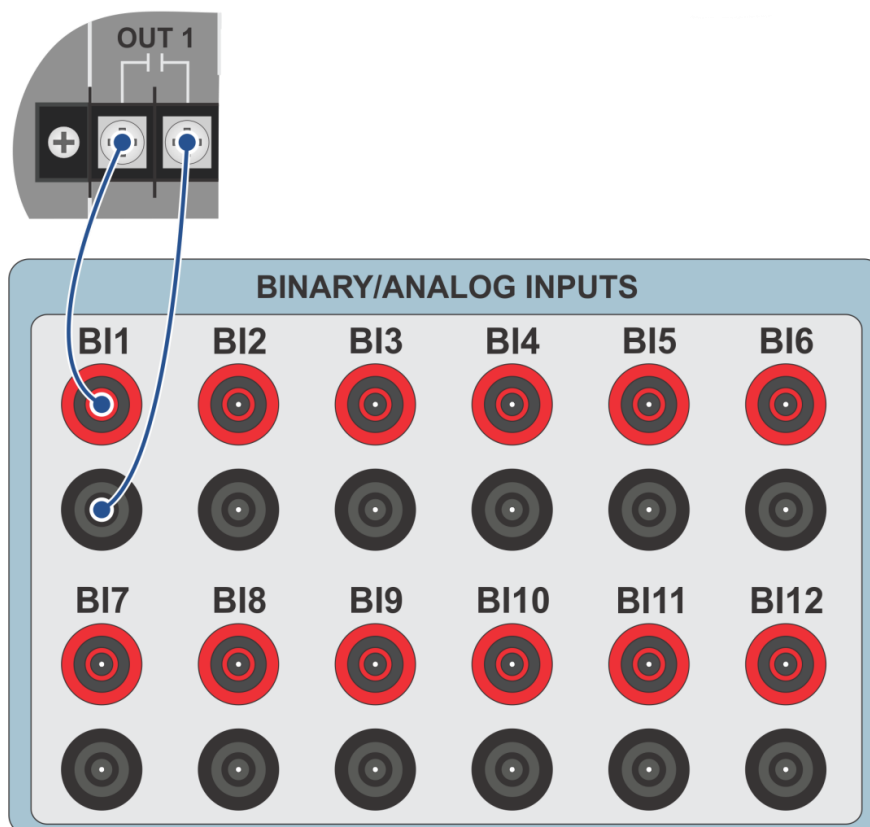


Figure 3

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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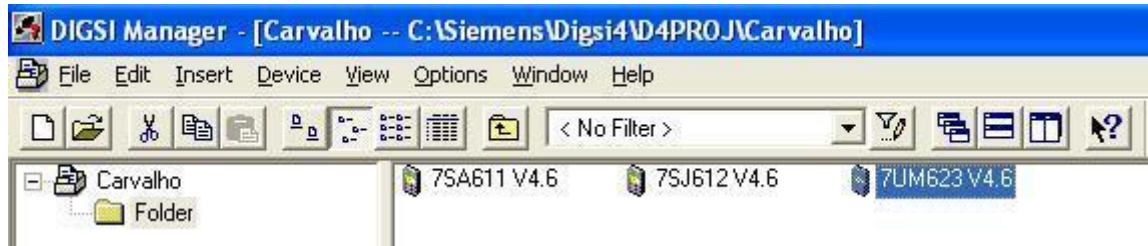


Figure 5

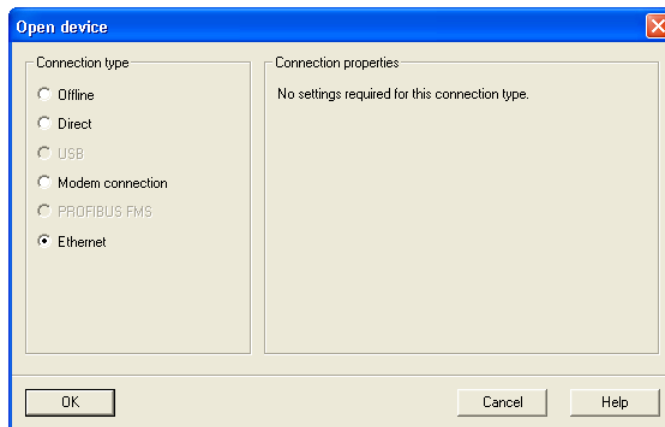


Figure 6

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”.

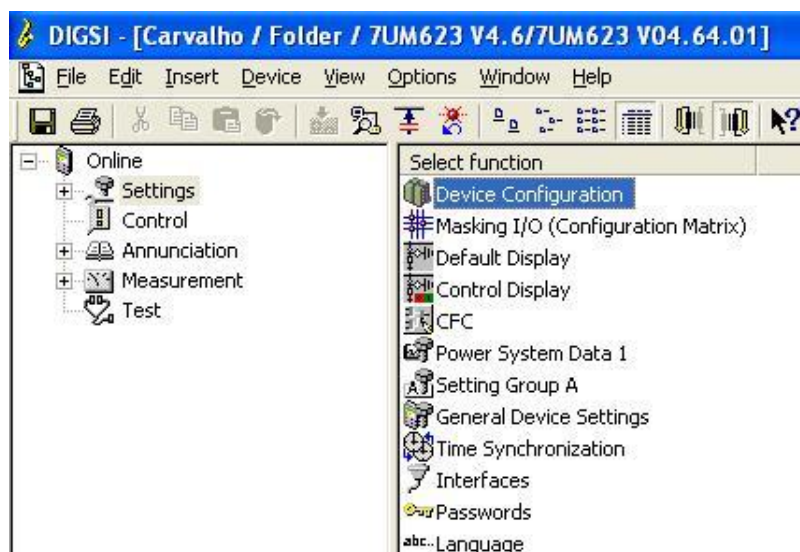


Figure 7

INSTRUMENTOS PARA TESTES ELÉTRICOS

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*”.

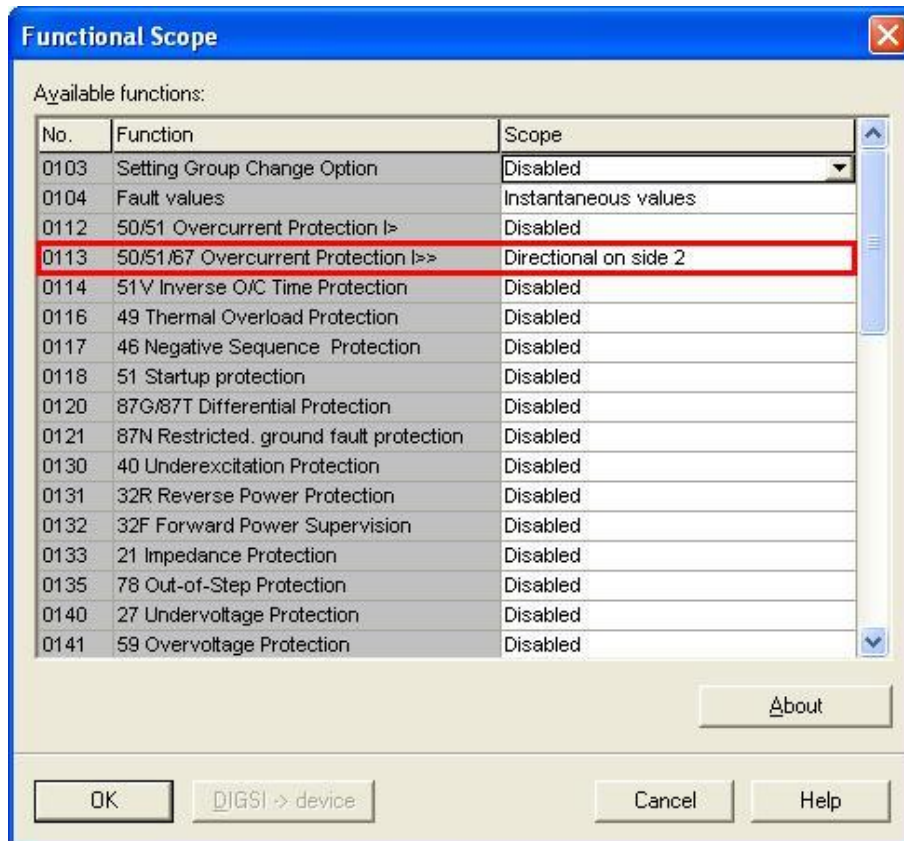


Figure 8

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

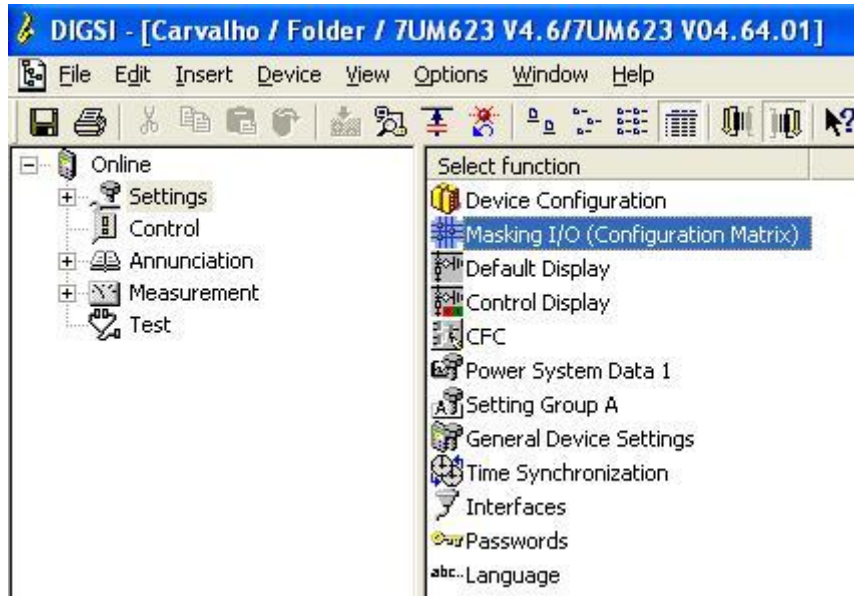
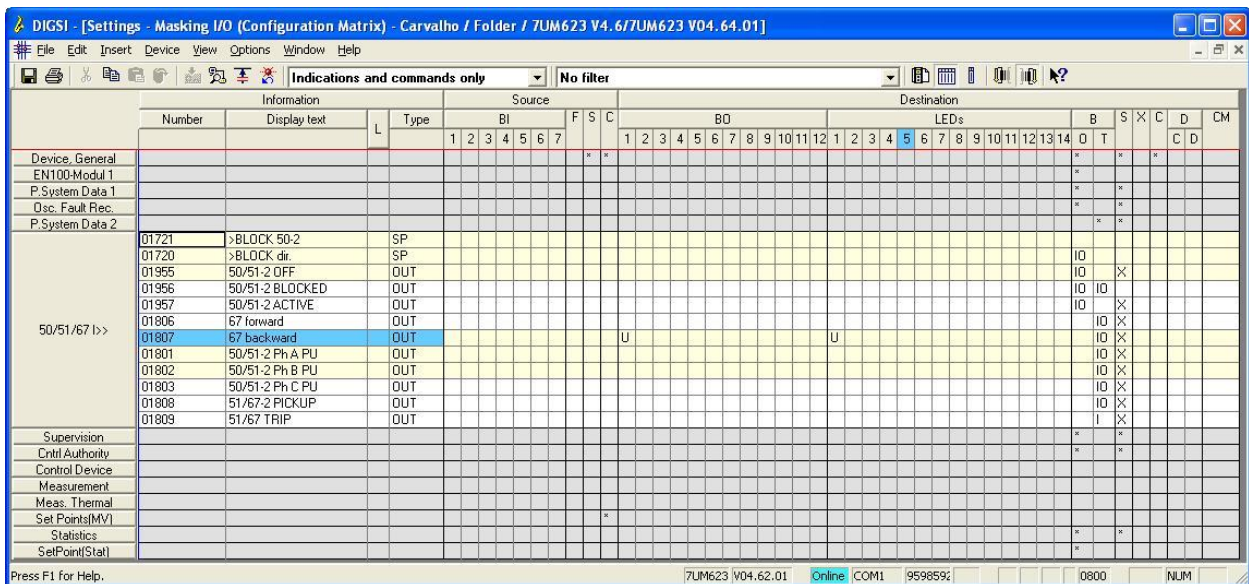


Figure 9

Binary output “BOI” 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.



The screenshot shows the 'Masking I/O (Configuration Matrix)' window in DIGSI. The window title is 'DIGSI - [Settings - Masking I/O (Configuration Matrix) - Carvalho / Folder / 7UM623 V4.6/7UM623 V04.64.01]'. The interface includes a menu bar, a toolbar, and a dropdown menu set to 'Indications and commands only'. Below the toolbar is a table with columns for 'Information', 'Source', and 'Destination'. The 'Information' column has sub-columns for 'Number' and 'Display text'. The 'Source' column has sub-columns for 'L', 'Type', and 'BI' (1-7). The 'Destination' column has sub-columns for 'LEDs' (1-14), 'B', 'S', 'X', 'C', 'D', and 'CM'. The table contains various entries, with '50/51/67' expanded to show a list of functions. The function '67 backward' is highlighted in blue. The status bar at the bottom shows '7UM623 V04.62.01 Online COM1 959859: 0800 NUM'.

Information	Source	Destination																																				
		LEDs																																				
Number	Display text	L	Type	1	2	3	4	5	6	7	F	S	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	B	S	X	C	D	CM					
Device_General											*	*																										
EN100-Modul 1																																						
P.System Data 1																																						
Dsc. Fault Rec.																																						
P.System Data 2																																						
50/51/67 >>	01721	>BLOCK 50-2		SP																																		
	01720	>BLOCK dir.		SP																																		
	01955	50/51-2 OFF		OUT																																		
	01956	50/51-2 BLOCKED		OUT																																		
	01957	50/51-2 ACTIVE		OUT																																		
	01806	67 forward		OUT																																		
	01807	67 backward		OUT																																		
	01801	50/51-2 Ph A PU		OUT																																		
	01802	50/51-2 Ph B PU		OUT																																		
	01803	50/51-2 Ph C PU		OUT																																		
01808	51/67-2 PICKUP		OUT																																			
01809	51/67 TRIP		OUT																																			
Supervision																																						
Cntrl Authority																																						
Control Device																																						
Measurement																																						
Meas. Thermal																																						
Set Points(MV)																																						
Statistics																																						
SetPoint(Stat)																																						

Figure 10

3.3 Power System Data 1

Double-click on “Power System Data 1” to access the system settings.

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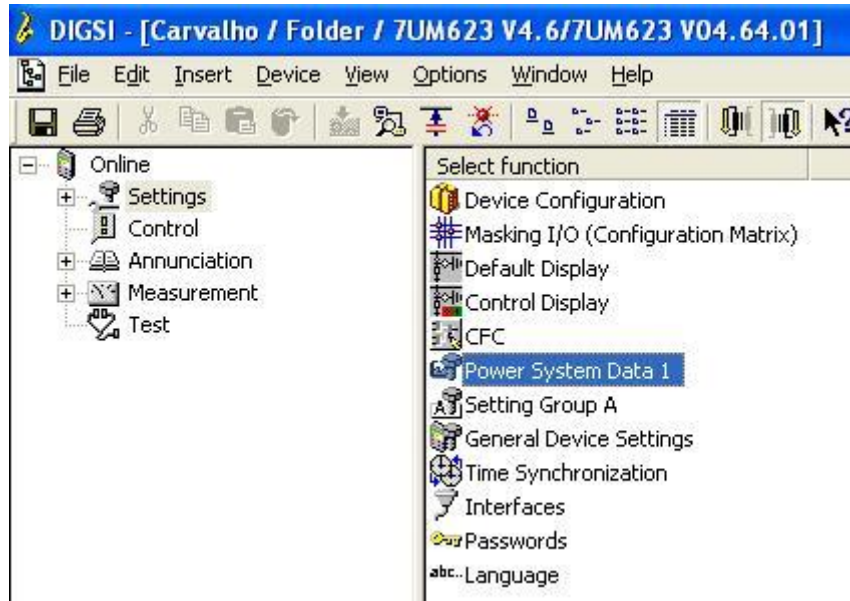


Figure 11

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.

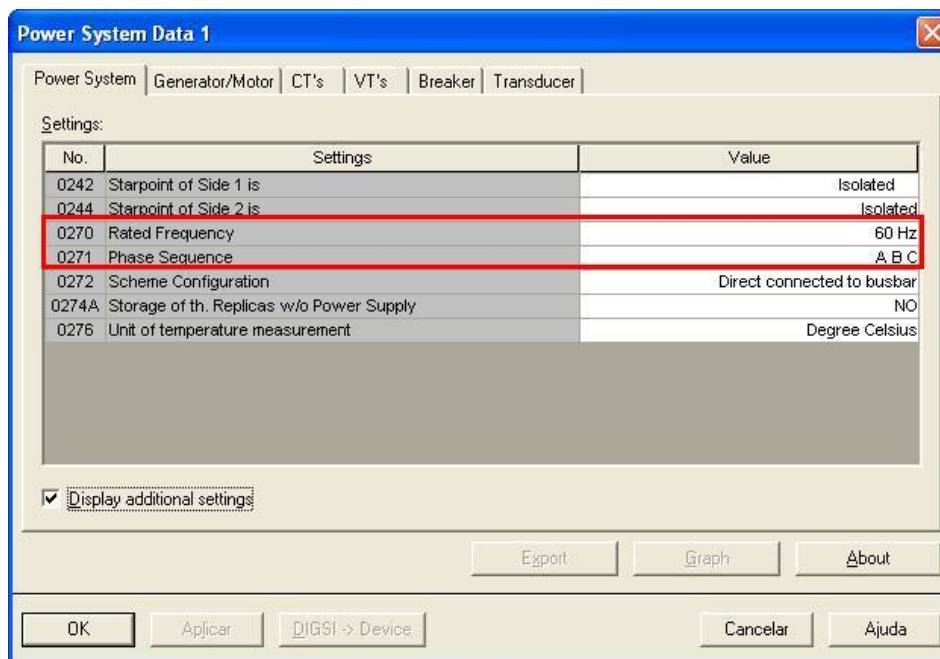


Figure 12

3.5 Generator/Motor

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

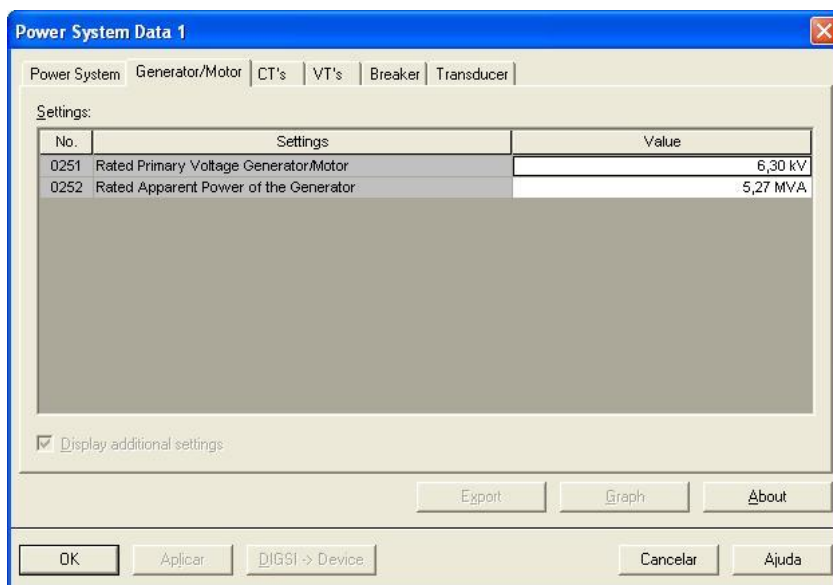


Figure 13

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.

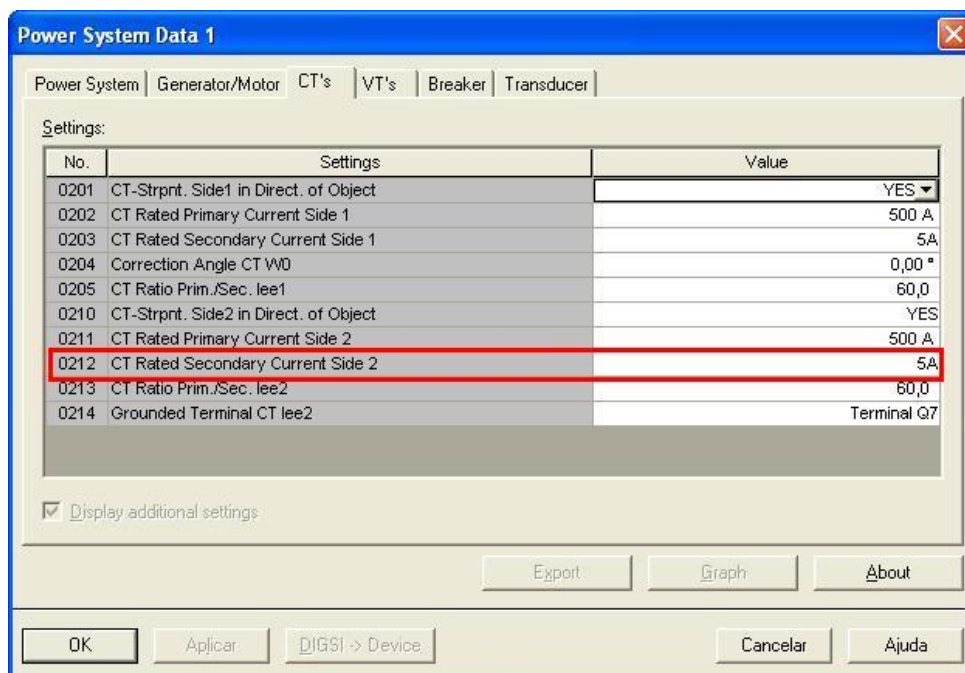


Figure 14

3.7 VT's

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

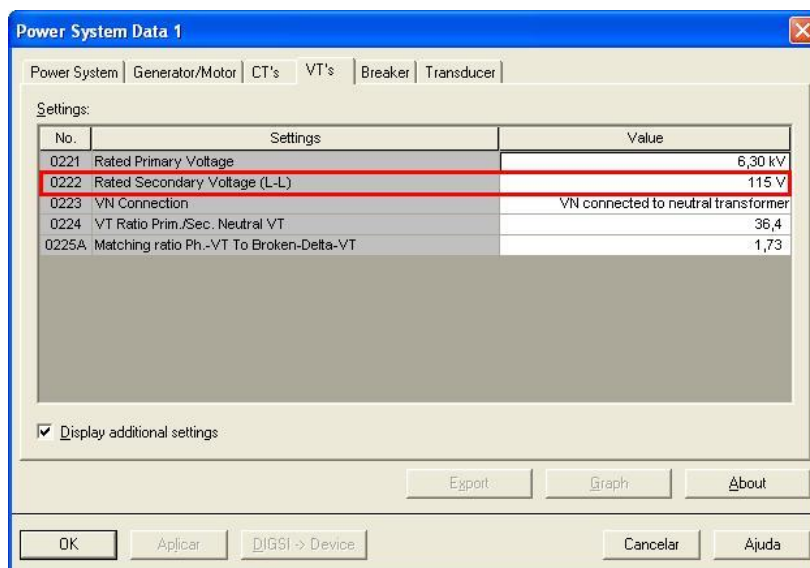


Figure 15

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.

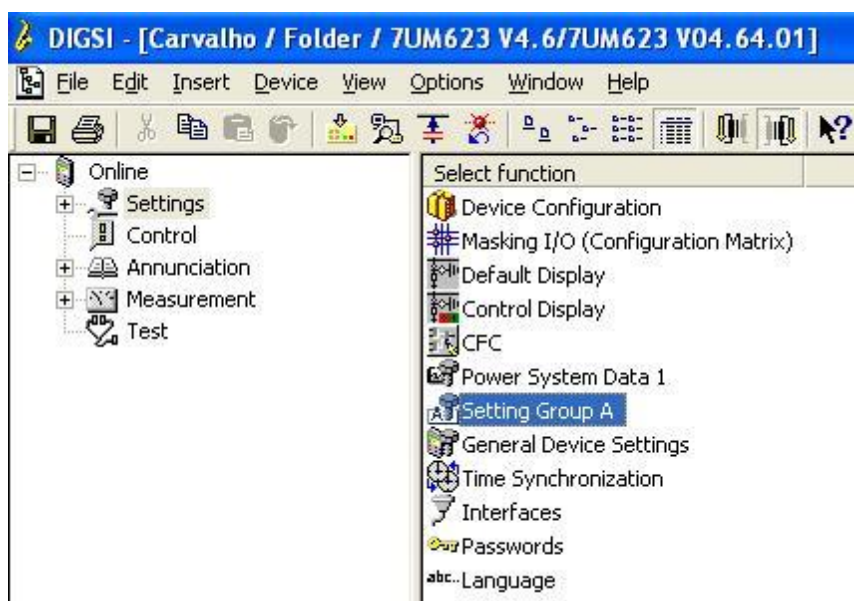


Figure 16

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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.

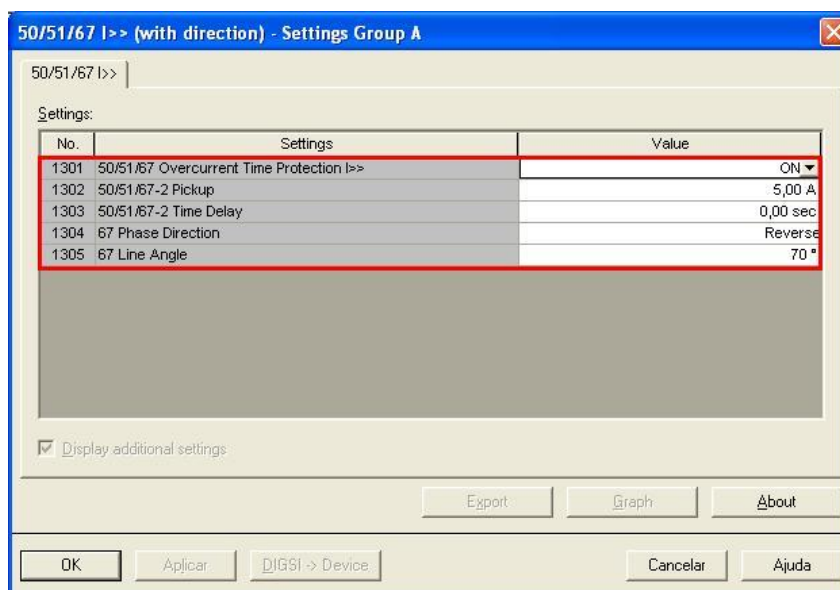


Figure 18

4. Overcurrent software adjustments

4.1 Opening the Overcurrent

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

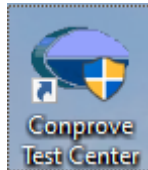


Figure 19

Click on the Overcurrent software icon.



Figure 20

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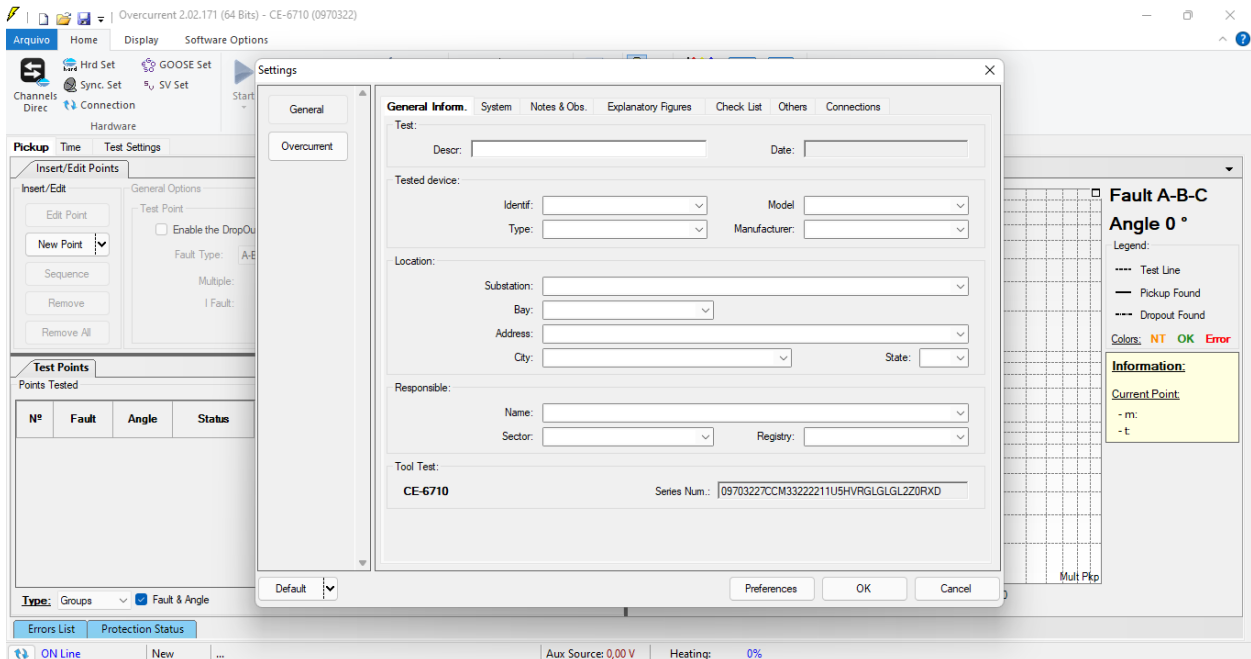


Figure 21

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.

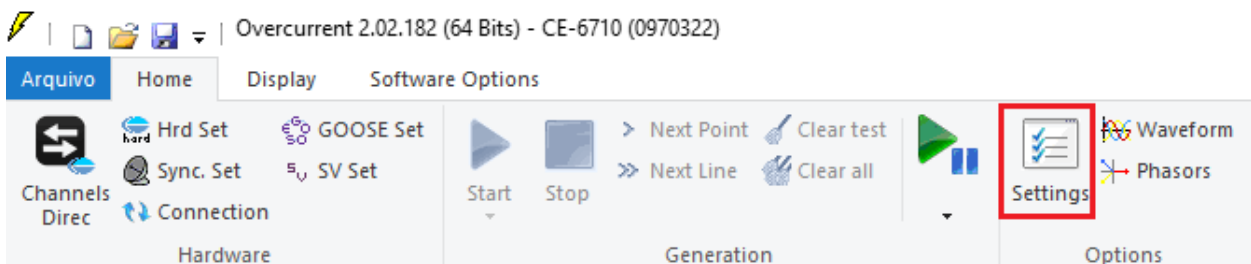


Figure 22

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

Settings

General

Overcurrent

General Inform. System Notes & Obs. Explanatory Figures Check List Others Connections

Test:

Descr: Directional Overcurrent Date: 09/05/2022 16:25:01

Tested device:

Identif: 23031982 Model: 7UM62

Type: Generator Protection Manufacturer: Siemens

Location:

Substation: Conprove

Bay: 1

Address: Visconde de Ouro Preto 75, Custódio Pereira

City: Uberlândia State: MG

Responsible:

Name: Michel Rockembach de Carvalho

Sector: Engineering Registry:

Tool Test:

CE-6710 Series Num.: 09703227CCM33222211U5HVRGLGLL2Z0RXD

Default

Preferences OK Cancel

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

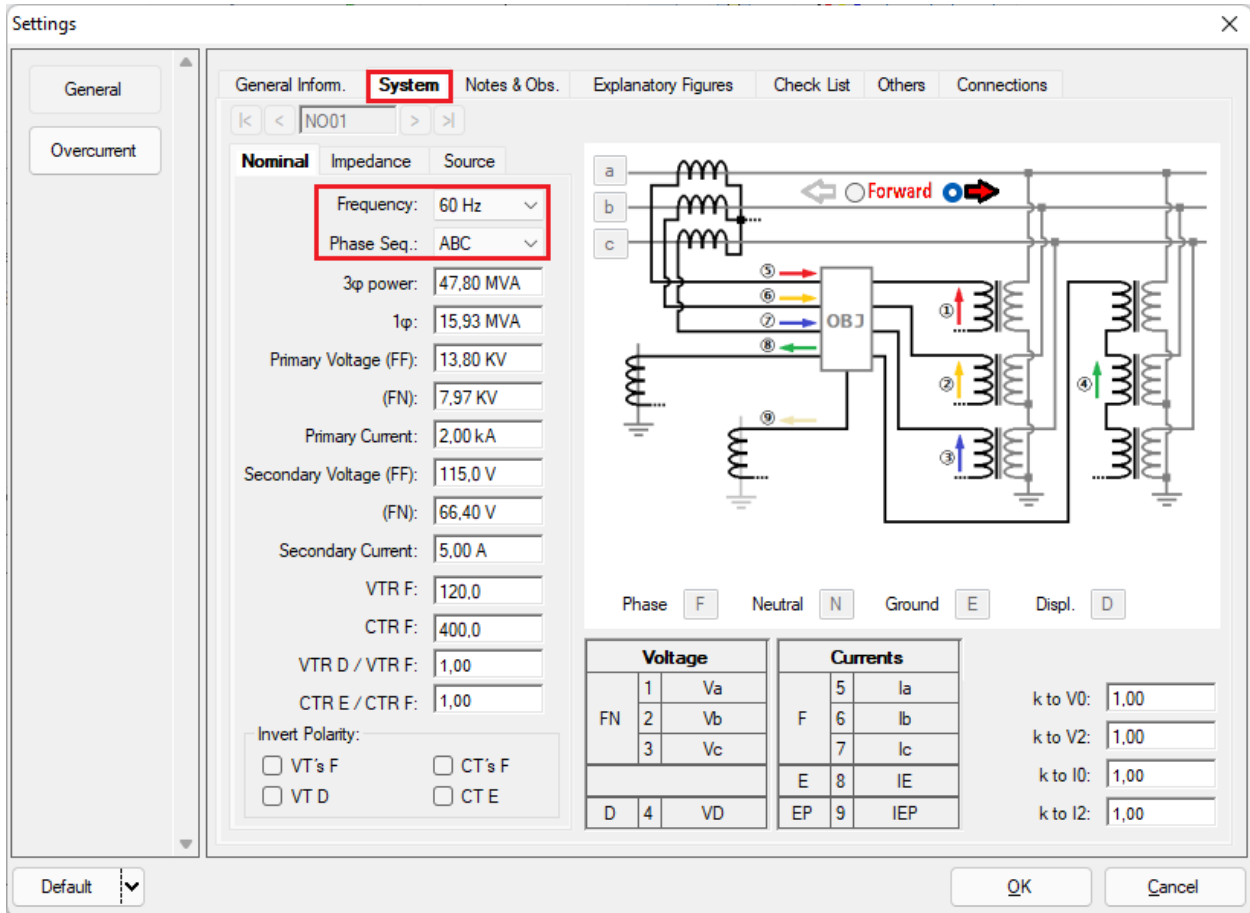


Figure 24

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).

INSTRUMENTOS PARA TESTES ELÉTRICOS

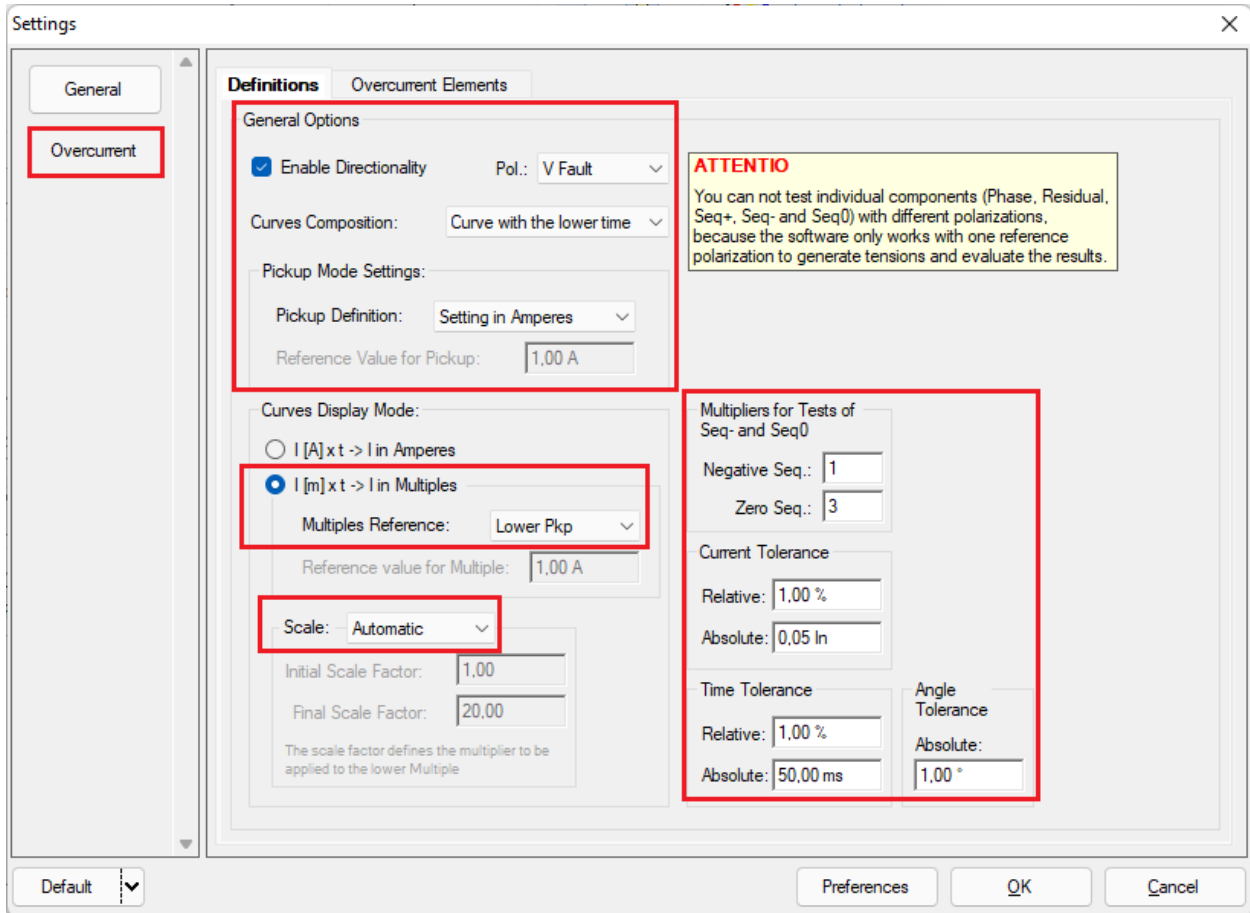


Figure 25

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

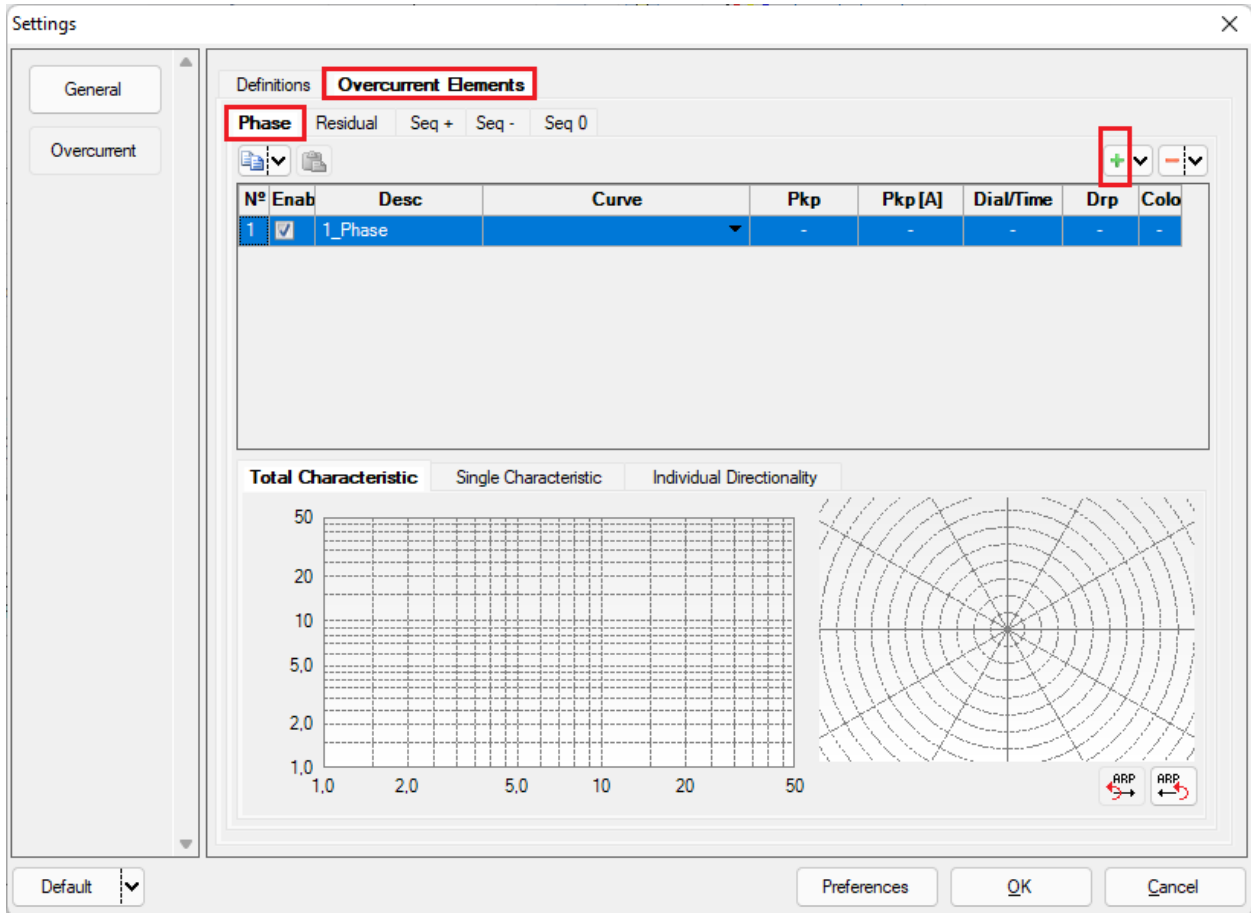


Figure 26

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

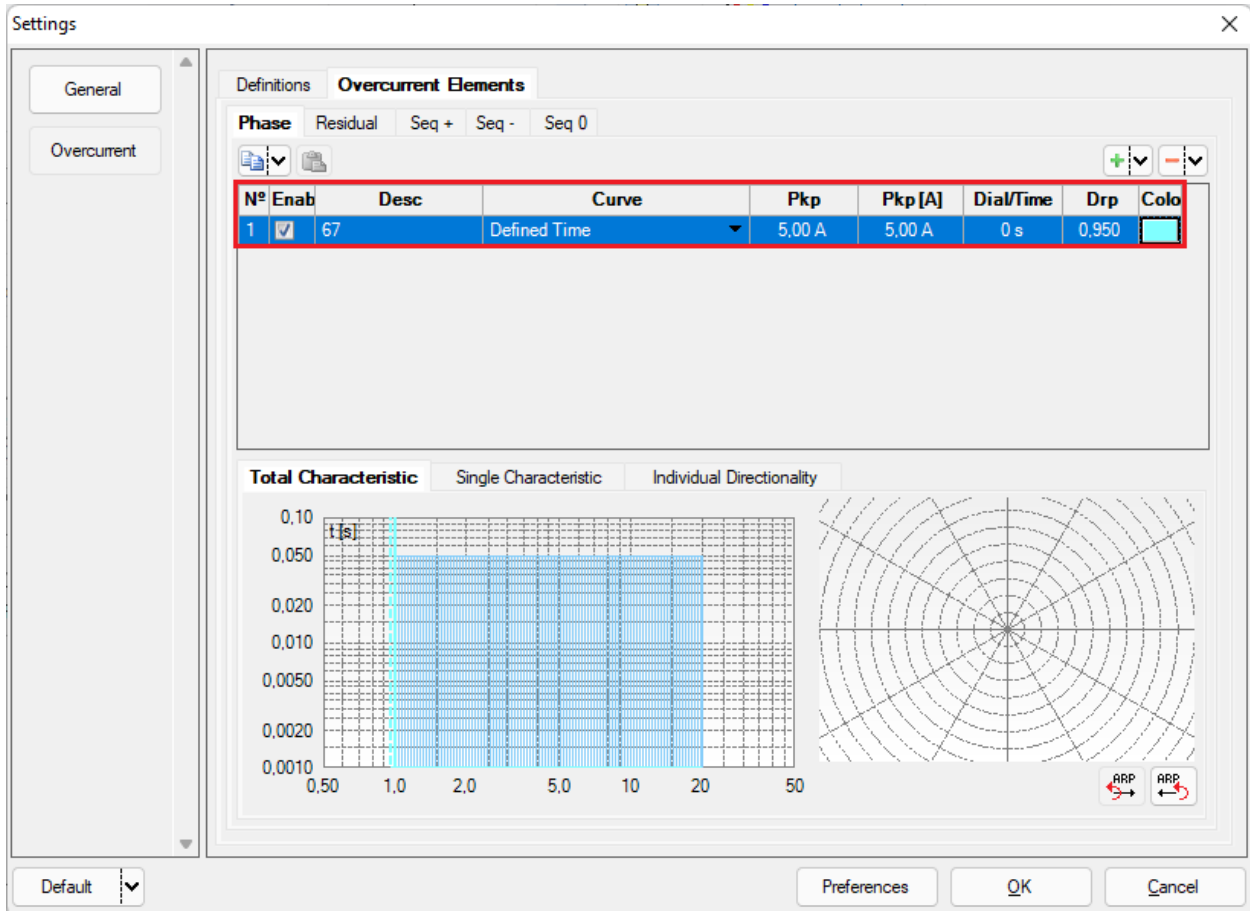


Figure 27

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 = $V|0^\circ$; current = $I|-70^\circ$

Line Angle:

$$Z_{\text{LINE}} = \frac{V|0^\circ}{I|-70^\circ} = Z|70^\circ$$

ATM:

$$ATM = \theta_{\text{current}} - \theta_{\text{voltage}} \gg ATM = -70^\circ - 0 = -70^\circ$$

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° .

INSTRUMENTOS PARA TESTES ELÉTRICOS

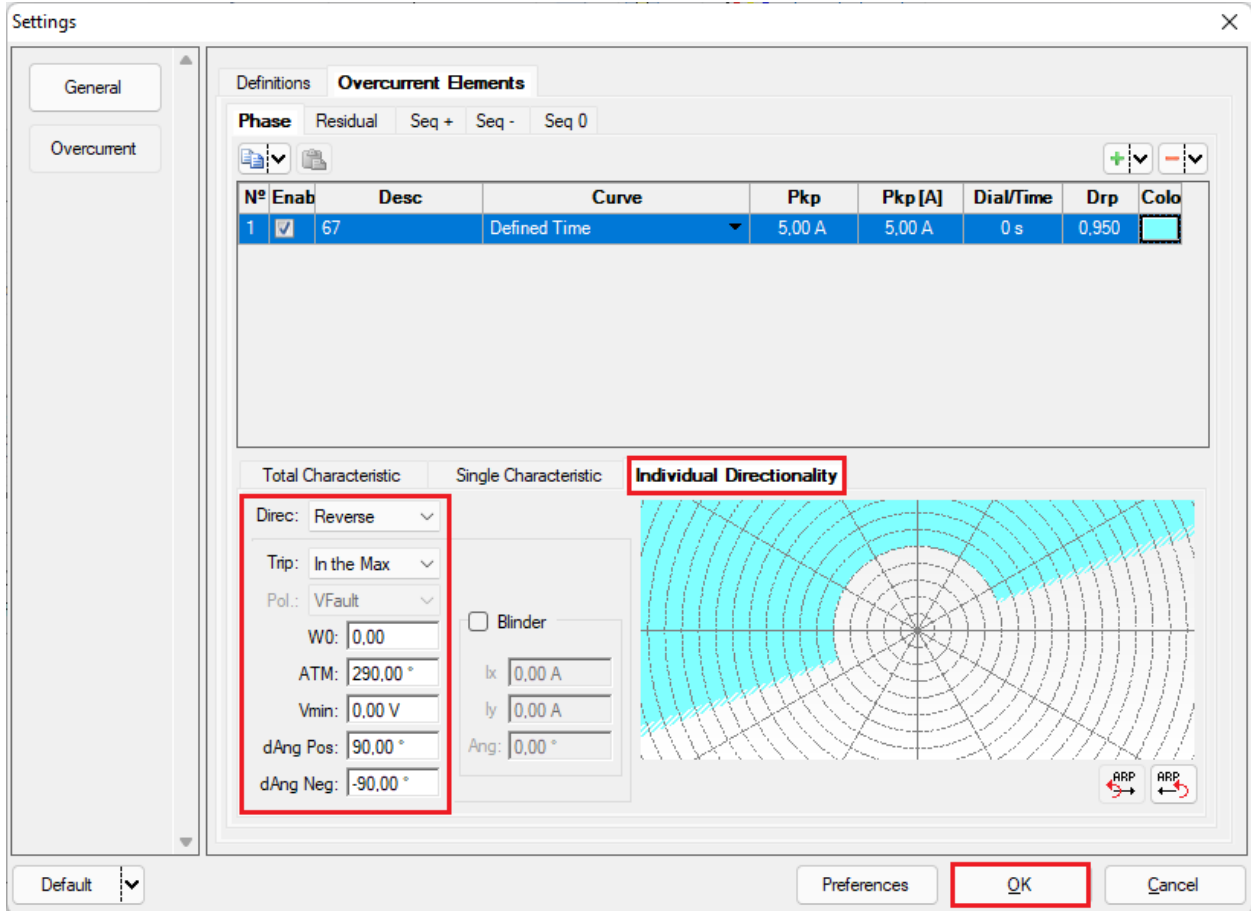


Figure 28

6. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

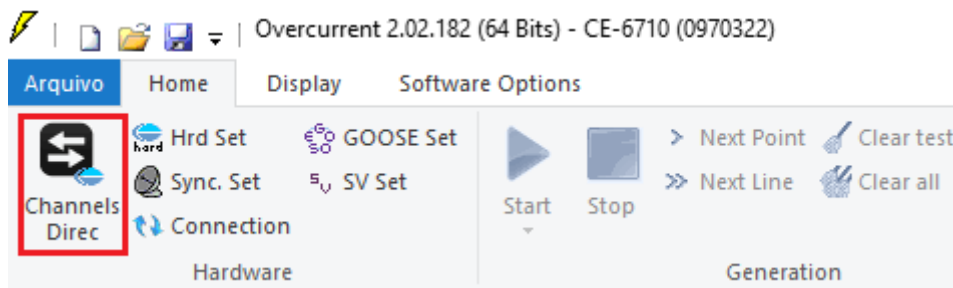


Figure 29

Then click on the highlighted icon to configure the hardware.

INSTRUMENTOS PARA TESTES ELÉTRICOS

Channels Direct.

Local | Remotes

Model: CE-6710 | Reset for Hard. Connected | **Hard Set** | Basic | Advanced | Hard.: Adapt I/Os | Nodes: | Confirm | Cancel

Serial Number: 09703227CCM3322211U5HVRGLGLZ20RXD | ON Line | GOOSE... | S. Value... | Autoassociate | Clean | Import... | Export...

Outputs: Analog. and SV | Inputs: Analog. and SV | Outputs: Binary, GOOSE and Analog DC | Inputs: Binary, GOOSE and Analog DC | Logical

1/1

Nominal Line Source

Frequency: 60 Hz

Phase Seq.: ABC

3φ power: 47,80 MVA

1φ: 15,93 MVA

Primary Voltage (FF): 13,80 KV

(FN): 7,97 KV

Primary Current: 2,00 kA

Secondary Voltage (FF): 115,0 V

(FN): 66,40 V

Secondary Current: 5,00 A

VTR F: 120,0

CTR F: 400,0

VTR D / VTR F: 1,00

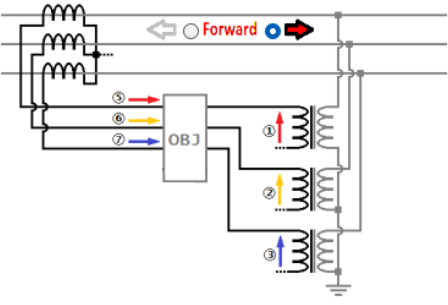
CTR E / CTR F: 1,00

Reverse Polarity:

VT's F CT's F

VT D CT E

Equal Parameters Among Nodes



Forward

Voltage		Channel	Currents		Channel
1	Va	AO_V01	5	Ia	AO_I01
2	Vb	AO_V02	6	Ib	AO_I02
3	Vc	AO_V03	7	Ic	AO_I03
	Vab		8	IE	
	Vbc		9	IEP	
	Vca				
D	4	VD			
Calc.		k.V0	Calc.		k.I0
		k.V2			k.I2
k	to V0	1,00	to I0	1,00	to I2
			to V2	1,00	

Analog Outputs | Sampled Value Outputs

Voltage Channels

Descr.	Hardware	Node	Point
AO_V01	V1	NO01	Va
AO_V02	V2	NO01	Vb
AO_V03	V3	NO01	Vc
AO_V04	V4	NO01	UD

Current Channels

Descr.	Hardware	Node	Point
AO_I01	I1	NO01	Ia
AO_I02	I2	NO01	Ib
AO_I03	I3	NO01	Ic
AO_I04	I4	NO01	UD
AO_I05	I5	NO01	UD
AO_I06	I6	NO01	UD

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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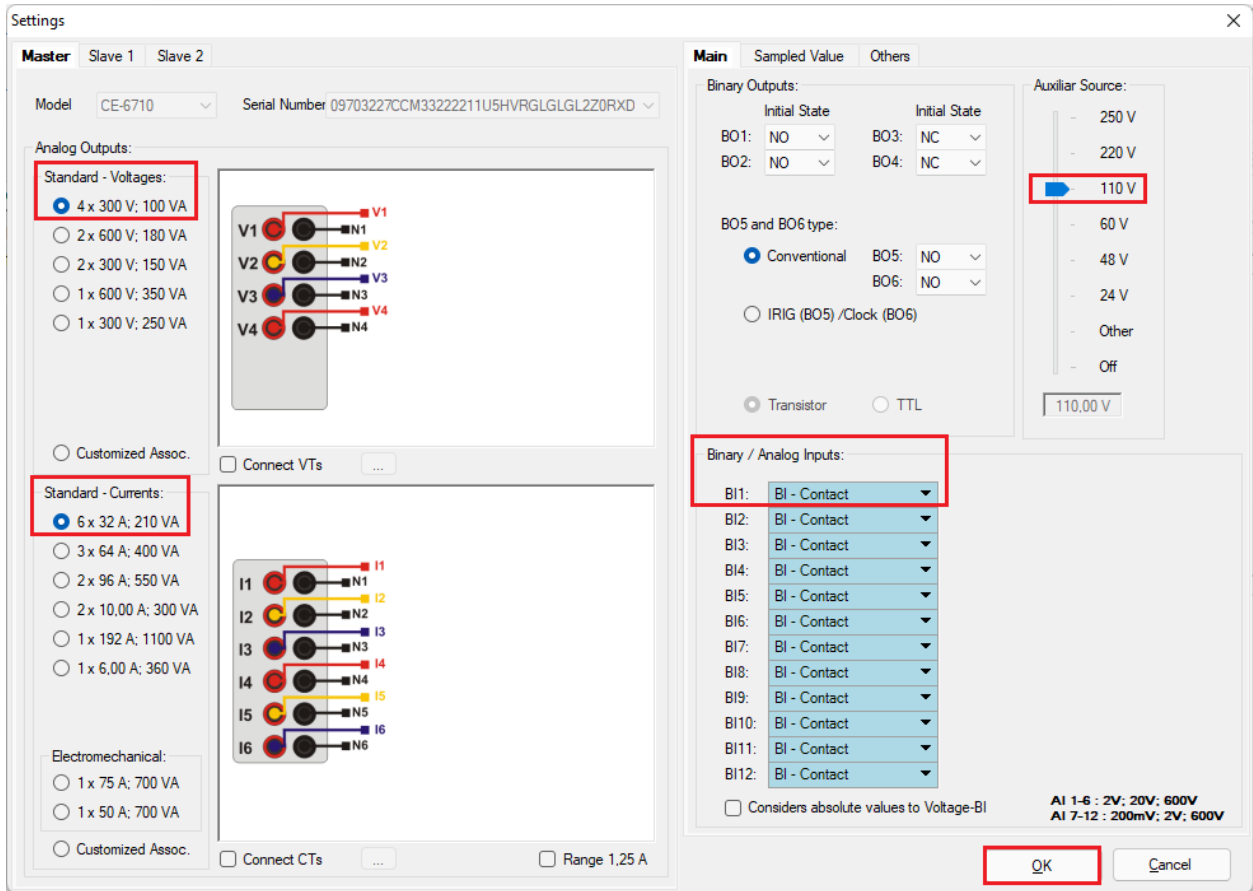


Figure 31

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

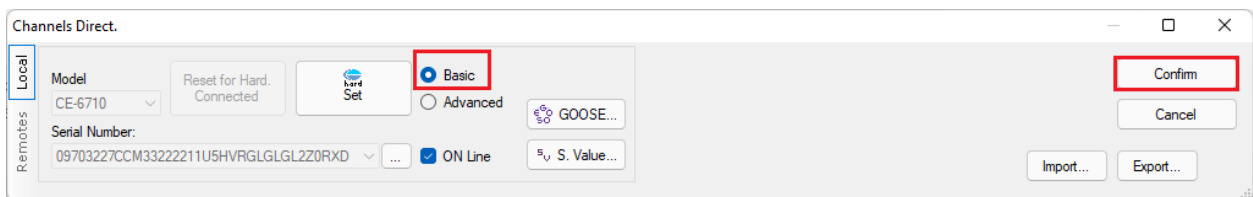


Figure 32

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

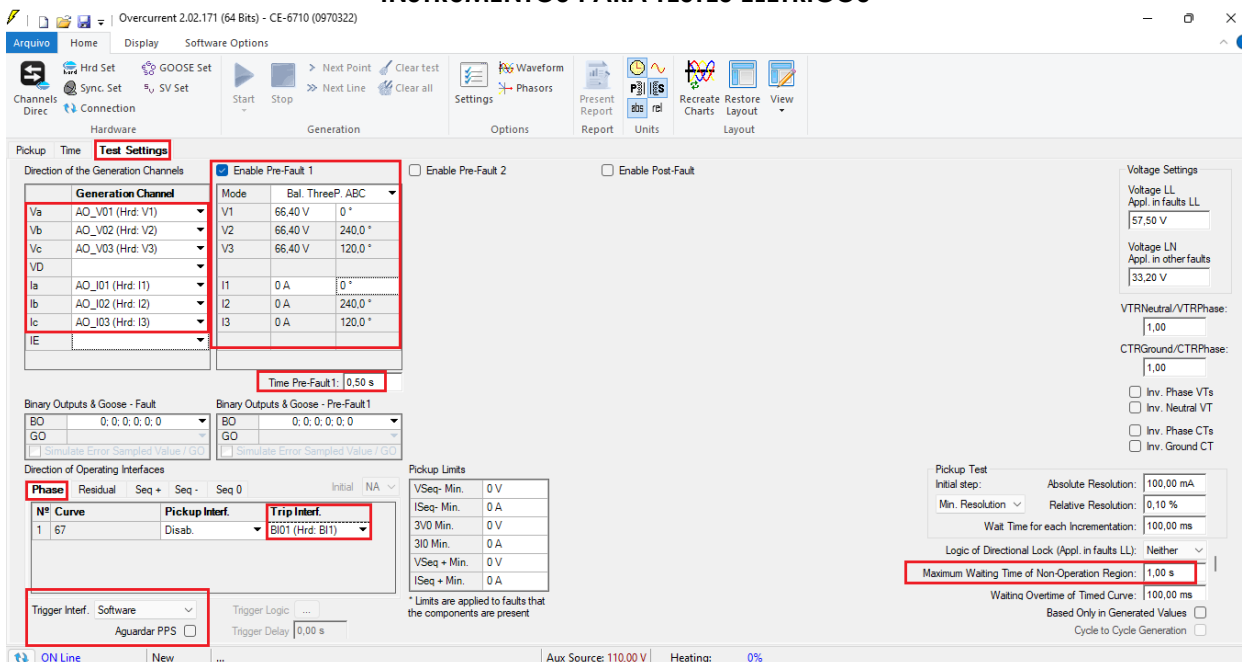


Figure 33

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.

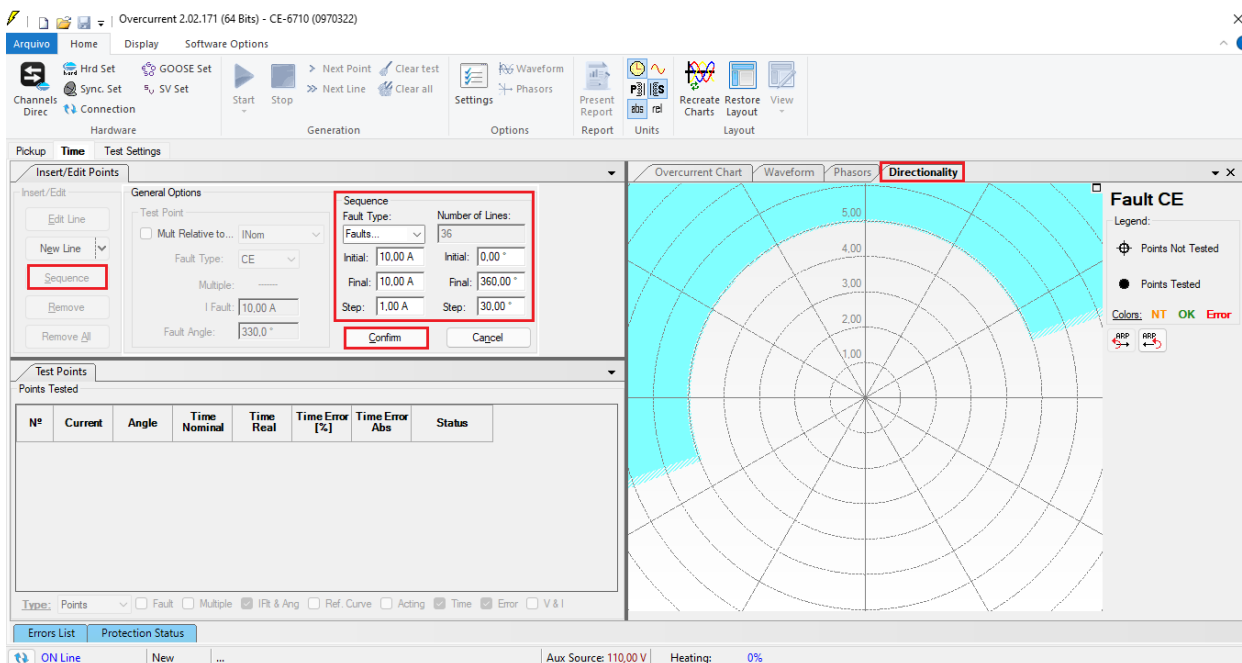


Figure 34

INSTRUMENTOS PARA TESTES ELÉTRICOS

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

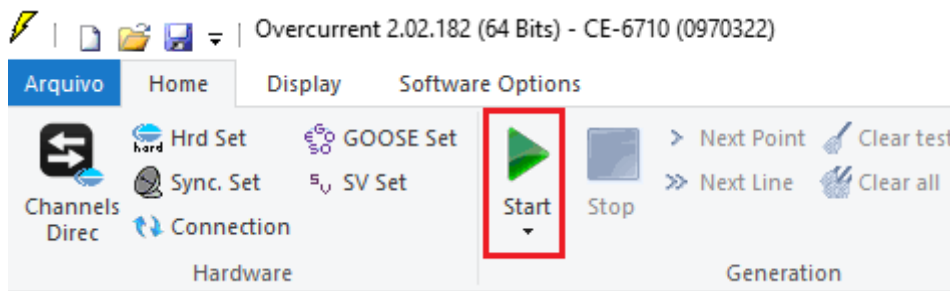


Figure 35

7.3 Final Result of the Time Test

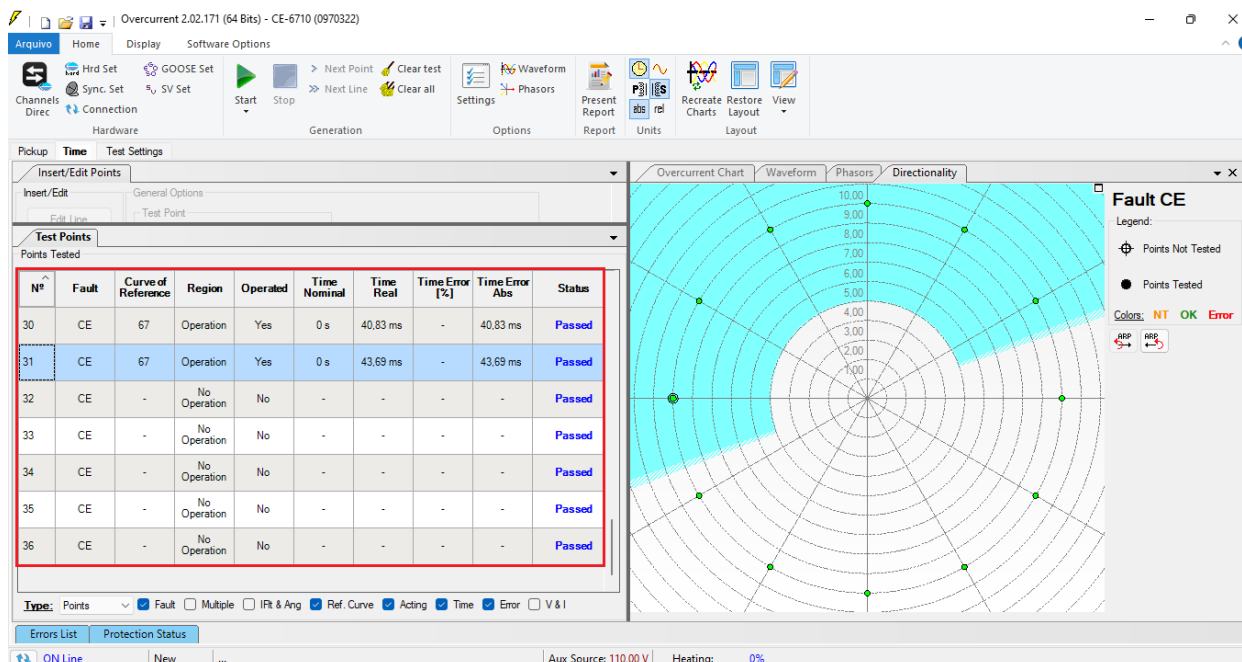


Figure 36

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.

INSTRUMENTOS PARA TESTES ELÉTRICOS

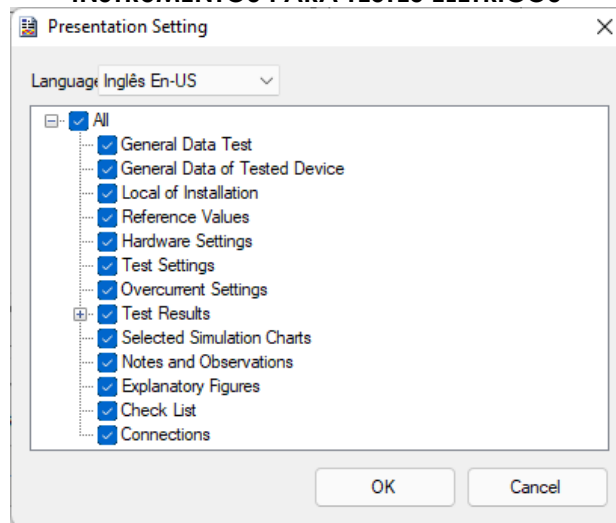


Figure 37

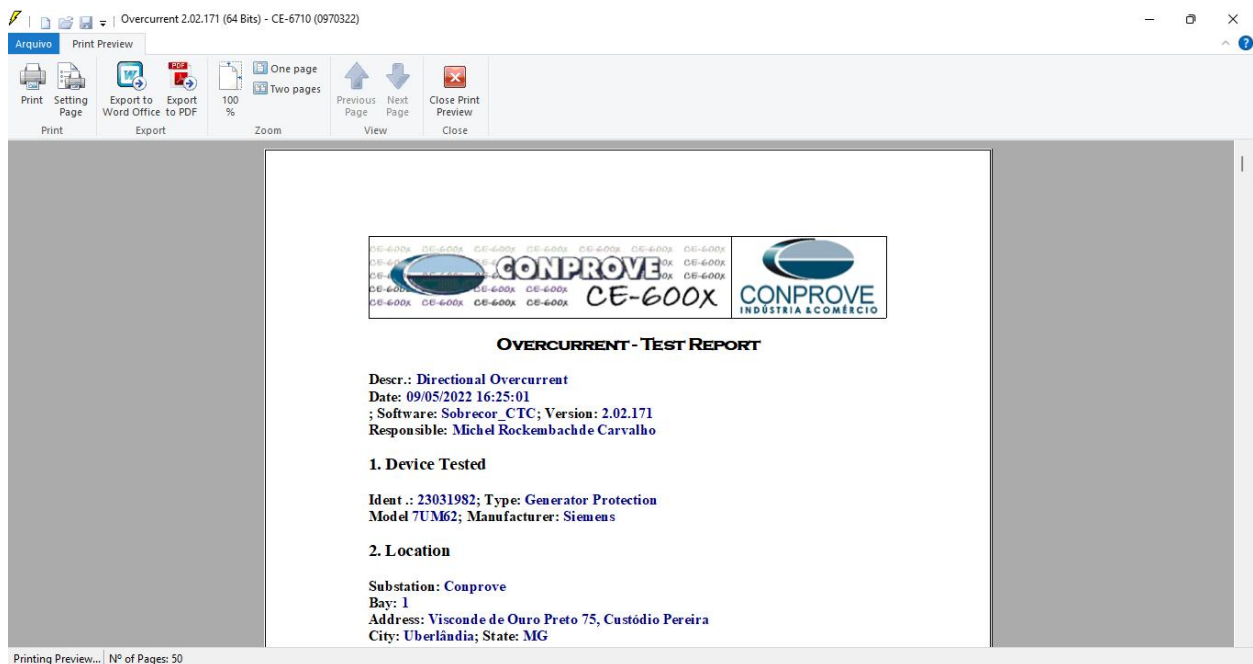


Figure 38

APPENDIX A

A.1 Terminal Designations

7UM621/623*-*D/E

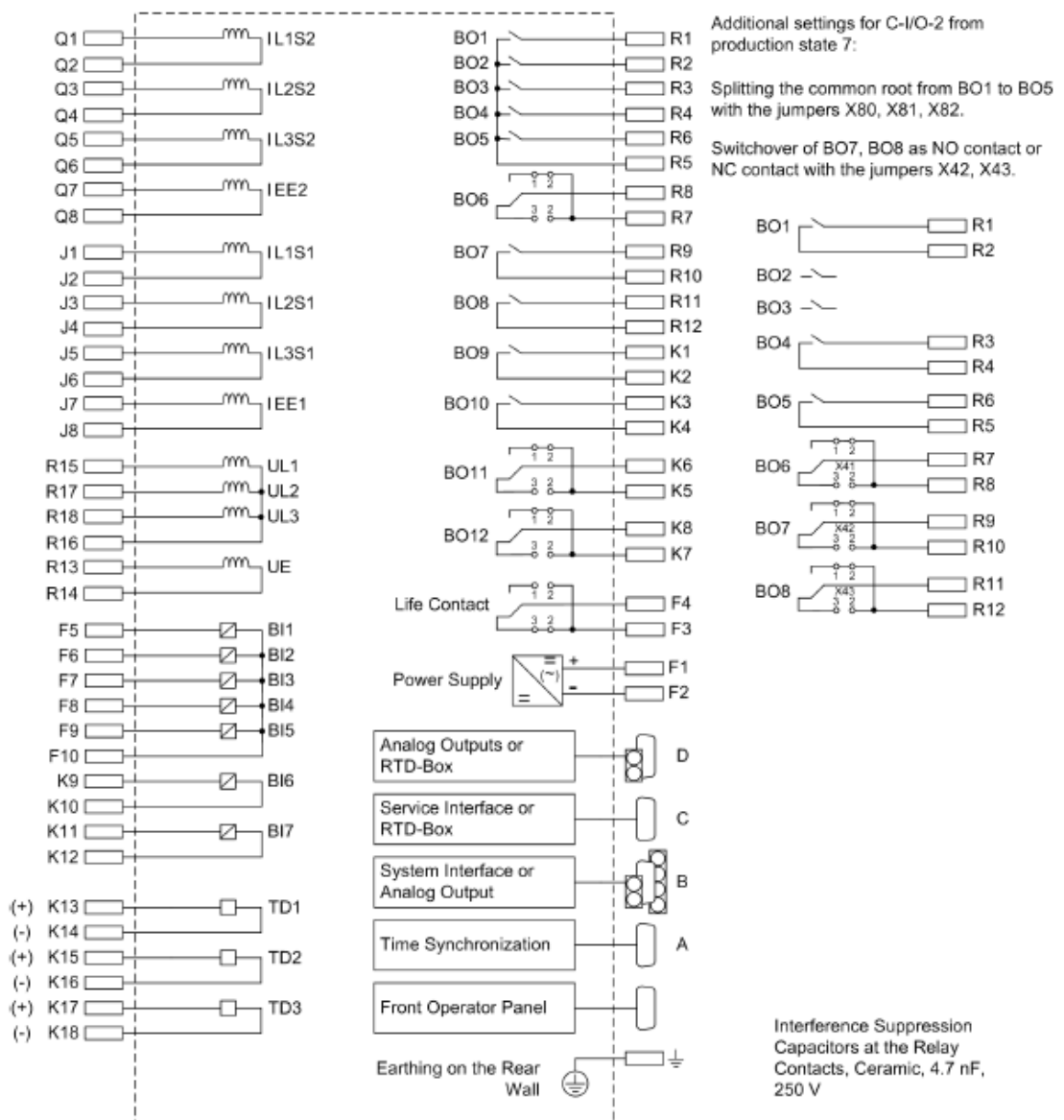


Figure 39

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 overcurrent I >	0.90 to 0.99	
Dropout ratio overcurrent 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° electrical	

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