



INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: Schweitzer (SEL)

Model: 751A

Function: 25 or RSYN – Synchronism Check

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

Objective: Test when two systems can connect, respecting voltage, frequency and angle limits, that is, if they are in synchronism.

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial Version	24/11/2021	M.R.C.	M.P.S

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Statement of responsibility

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Suggestions for improvement of this material are welcome, just user contacts us via email suporte@conprove.com.br.

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 must 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 must 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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Sequence for testing the SEL 751A relay in the Synchronism software

1. Relay connection to CE-6006

Appendix A-1 shows the relay terminal designations.

1.1 Auxiliary Source

Connect the positive (red terminal) of the Vdc Aux. Source to pin A01 on the relay terminal and the negative (black terminal) of the Vdc Aux. Source to pin A02 on the relay terminal.

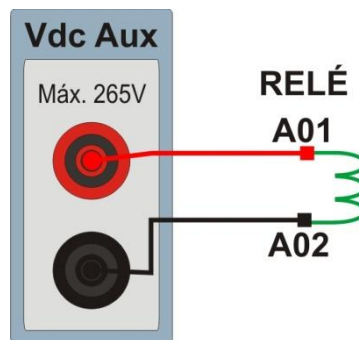


Figura 1

1.2 Voltage Coils

To connect the voltage coils, connect the voltage channels V1, V2 and V3 to pins E01, E02 and E03 of the relay terminal and connect the common of the voltage channels to pin E04 of the relay terminal. Then connect channel V4 with pin E05 of the relay terminal and its common to pin E06.

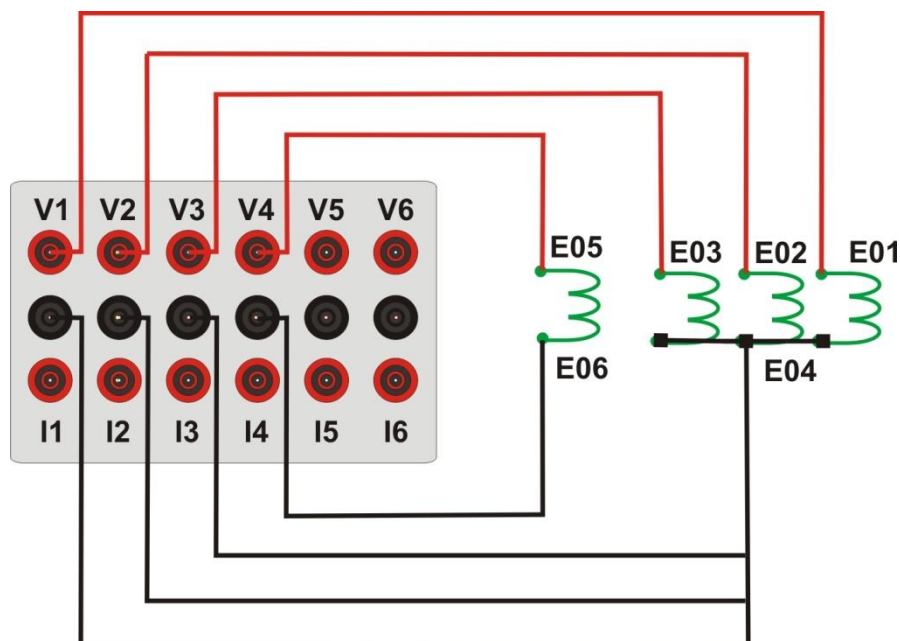


Figure 2

1.3 Binary Input

Connect CE-6006 binary input to relay binary output.

- BI1 to pin 301 and its common to pin 302;

The following figure shows the details of these connections.

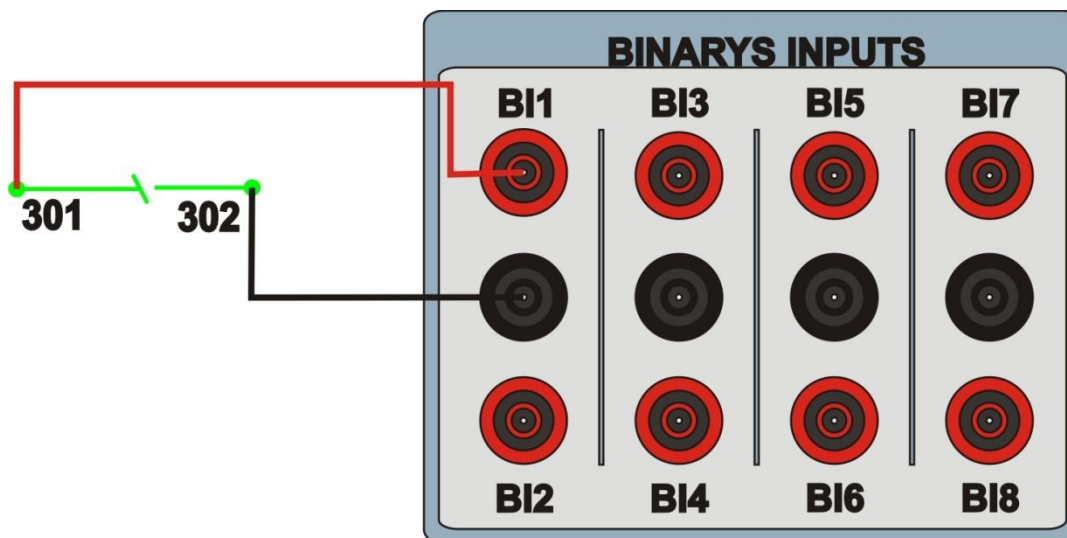


Figure 3

2. Communication with the SEL 751A relay

First open the “AcSELerator QuickSet” and connect an Ethernet (or serial) cable from the notebook to the relay. Then double click on the software icon.



Figure 4

Click on the icon highlighted below to parameterize the communication settings.

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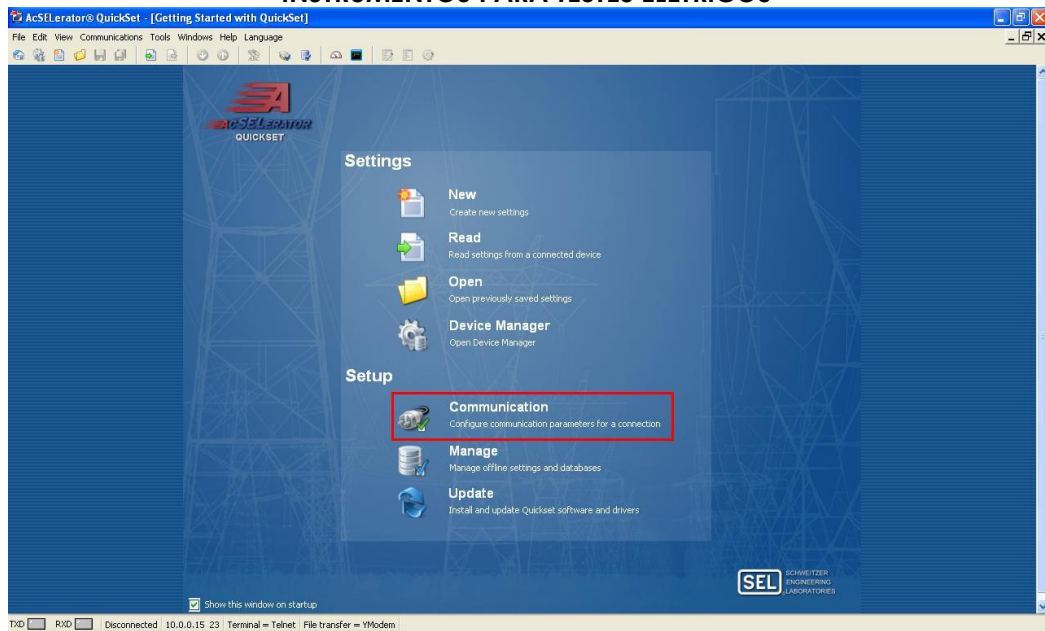


Figure 5

This relay allows three communication options: via serial cable, Ethernet cable and via modem. In this tutorial we used the communication via Ethernet, in this first case visualized on the front panel of the relay through the path “*SET / Show > Port> I> Port 1 Settings*” the adjustment “*IPADDR*” equivalent to setting “*Host IP Address*” and the “*TPORT*” option equivalent to the “*Port Number (Telnet)*” setting.

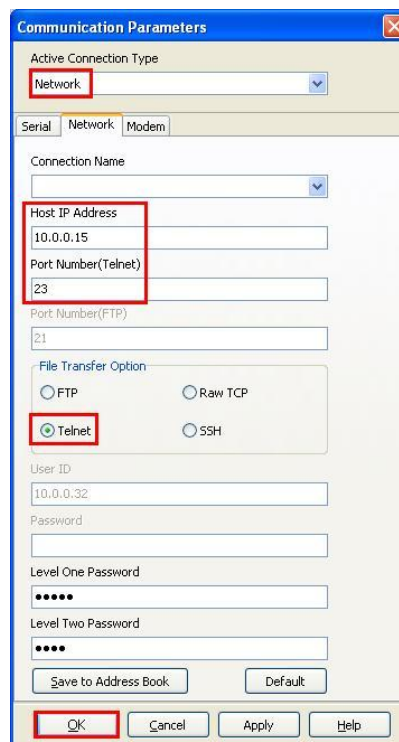


Figure 6

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To read the relay settings click on the icon highlighted below.

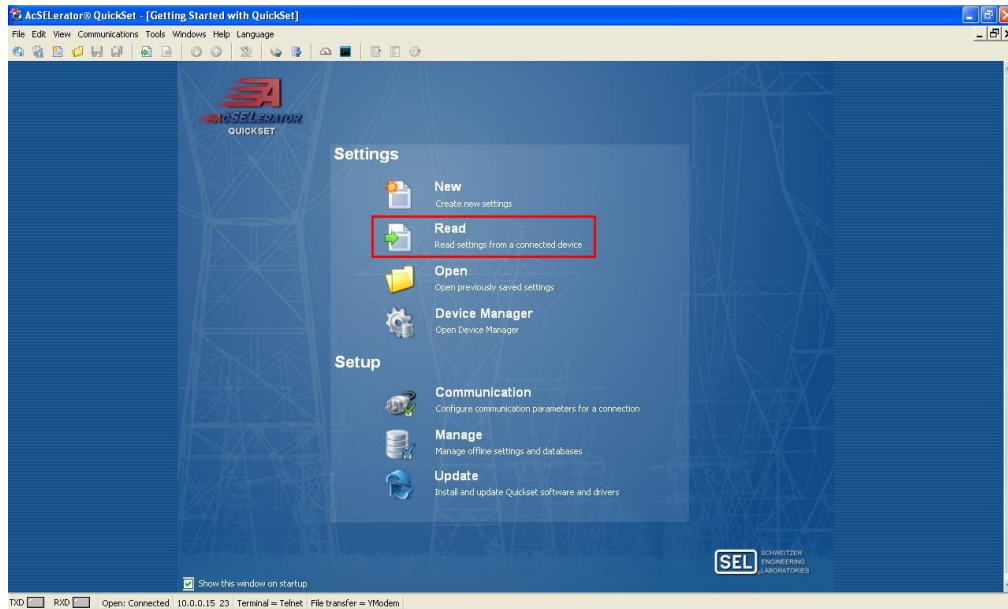


Figure 7

3. Parameterization of the SEL 751A relay

3.1 General

After reading the relay data click on the “+” sign near to “Global” and then “General”. This tab set up the nominal values of phase sequence and frequency.

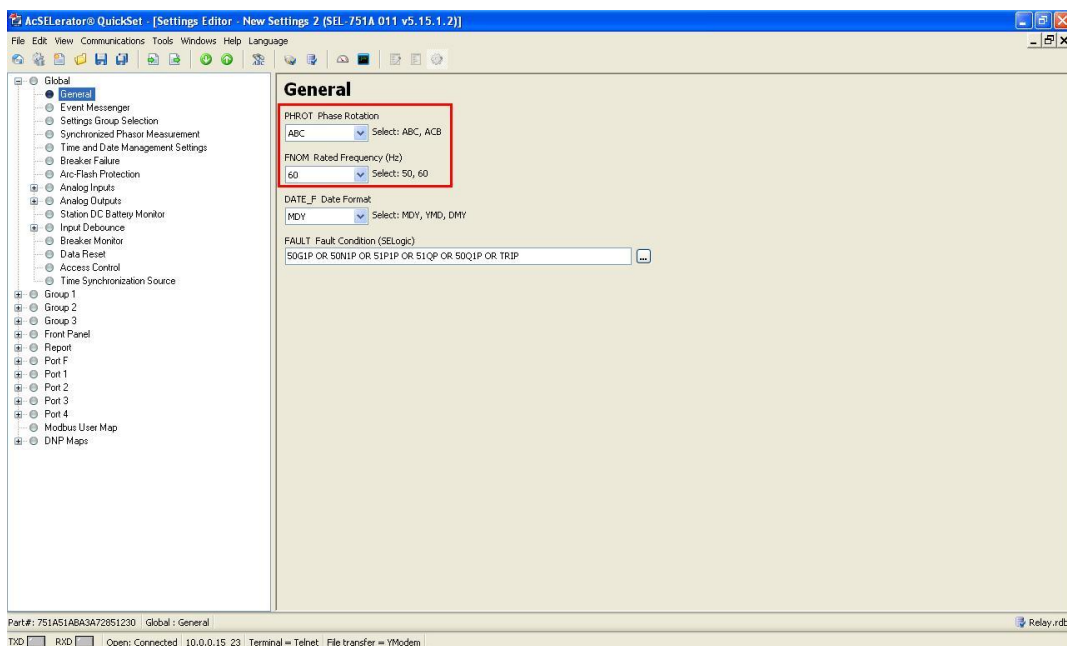


Figure 8

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3.2 Main

Click on “+” signs near to “Group 1” and “Set 1” and choose the option “Main” in this window set up the values of transformation ratios both CT and PT.

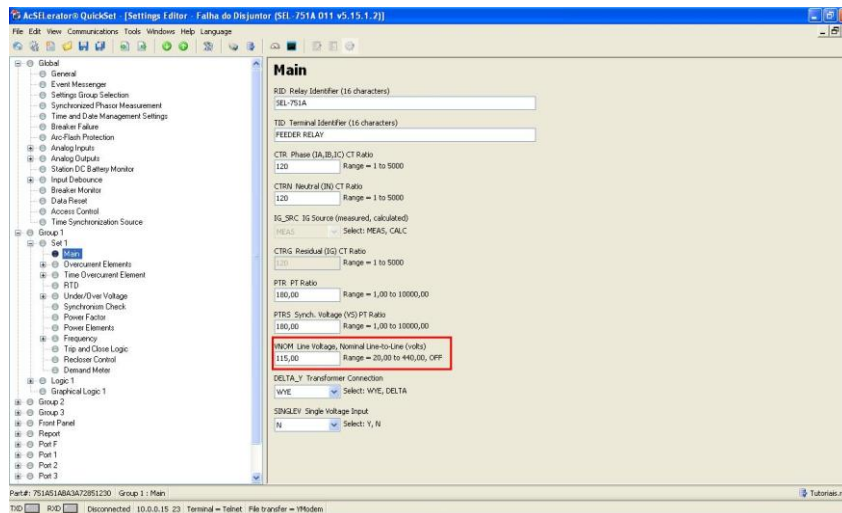


Figure 9

3.3 Synchronism Check

Choose the “Synchronism Check” option and adjust the maximum and minimum voltage value allowed, adjust the maximum frequency and angle difference so that synchronism occurs. Parameterize which phase is used for reference and the breaker closing time. The “BSYNCH” setting must be parameterized as zero so that it does not block the synchronism function.

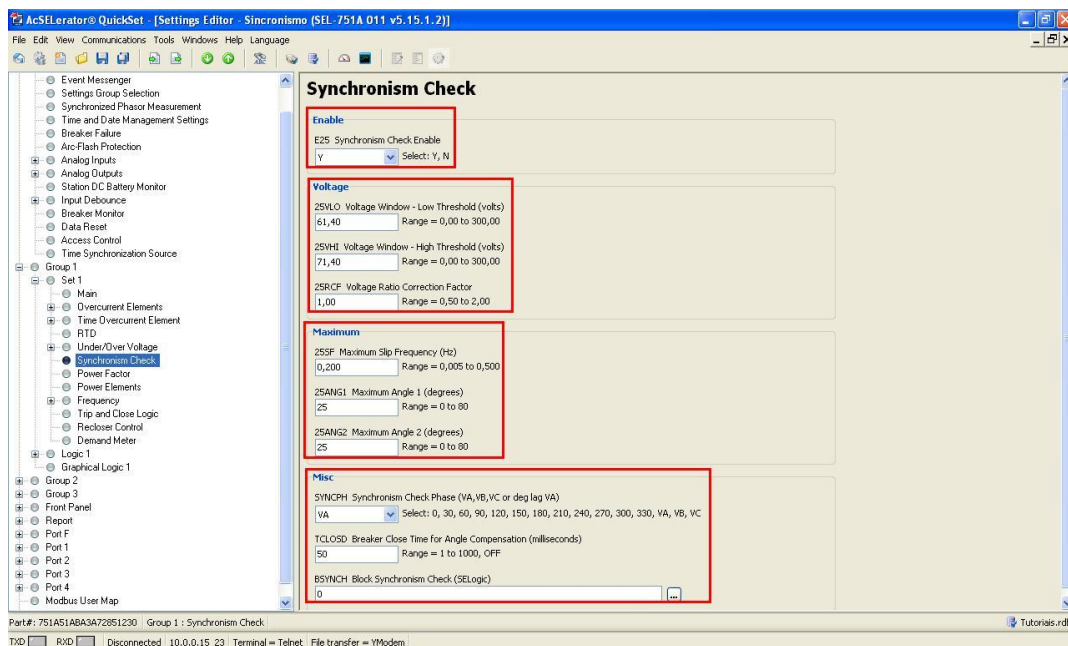


Figure 10

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3.4 Slot C

By clicking the “+” sign next to “Logic 1” and then “Slot C” you can assign the function trips to each output using “Relay Word Bits”. The output has been associated as follows:

- OUT301 – Synchronism element trip 25-1;

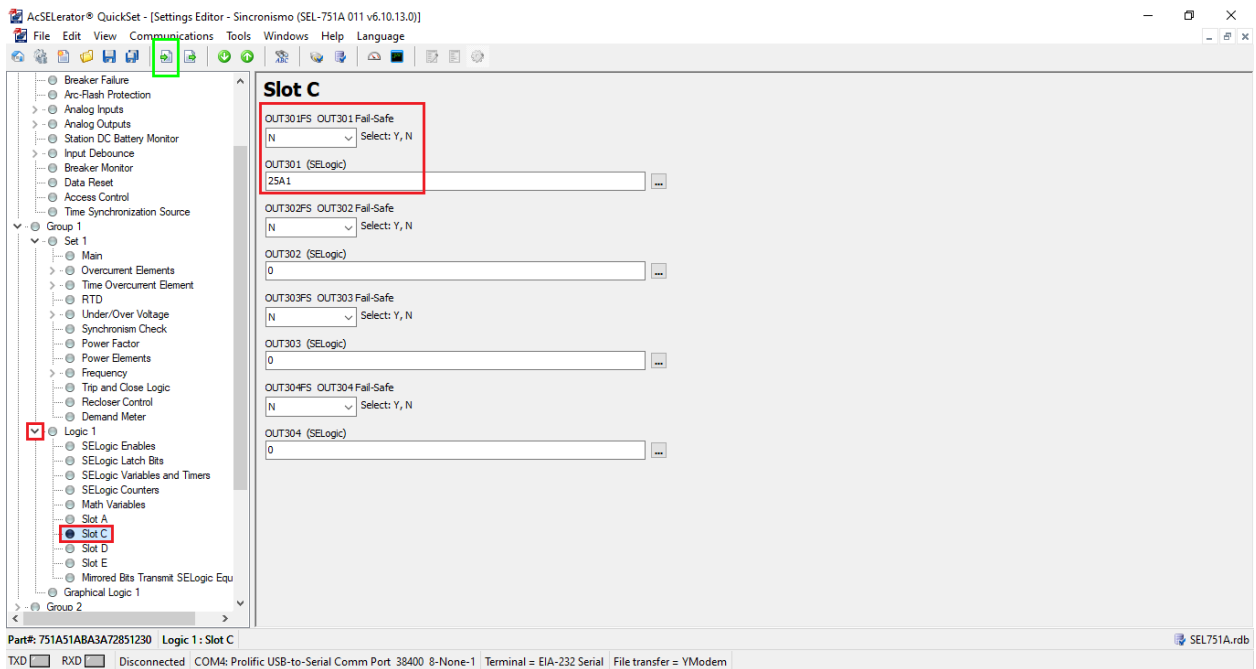


Figure 11

After making all the adjustments, click on the icon highlighted in green in the previous figure to send the modifications to the relay. The next figure shows the options that have been modified. To send the changes click “OK”.



Figure 12

4. Synchronism software adjustment

4.1 Opening the software

Open the Conprove Test Center (CTC) software, shown in the figure below.



Figure 13

Click on the Synchronism software icon.

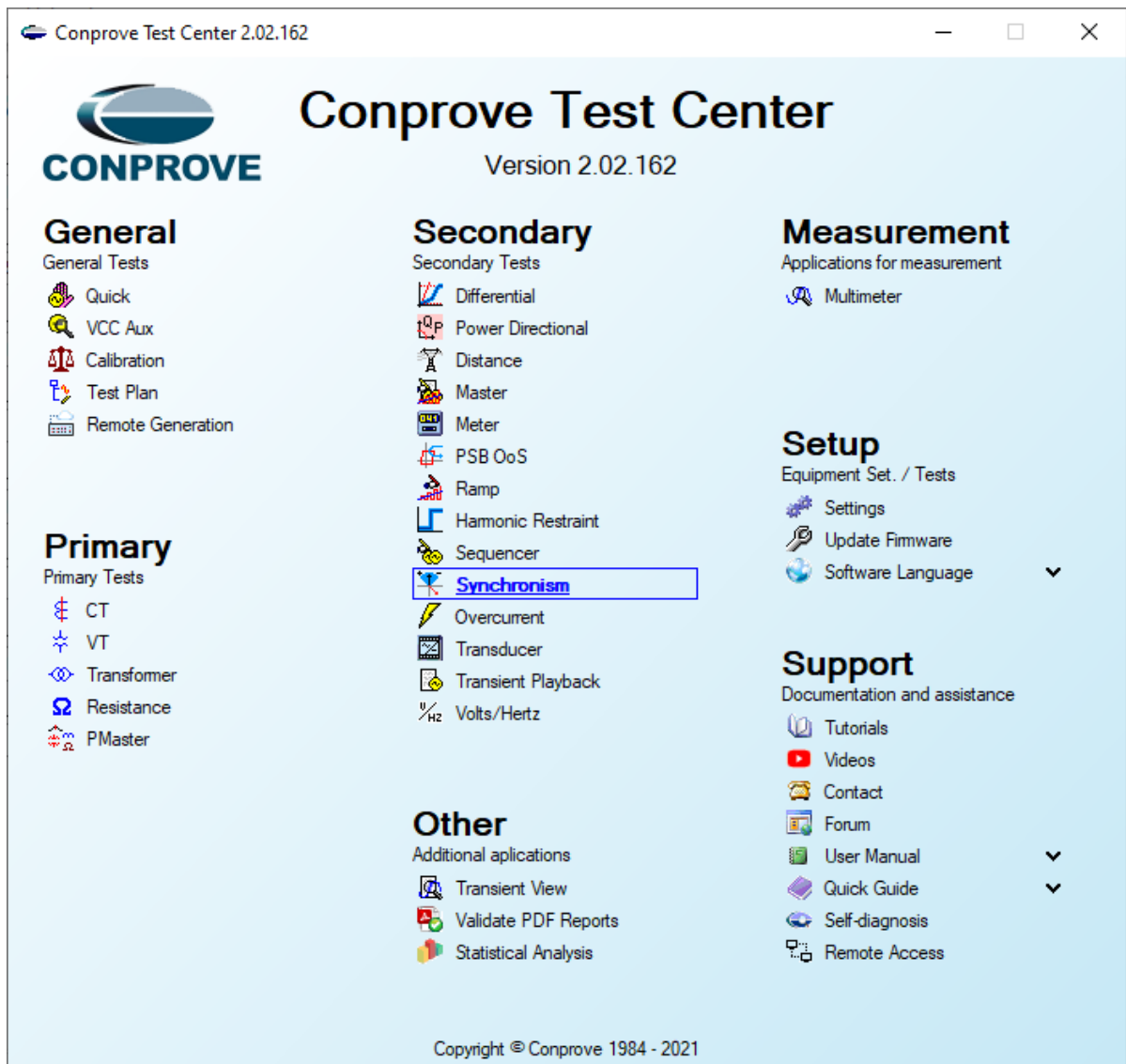


Figure 14

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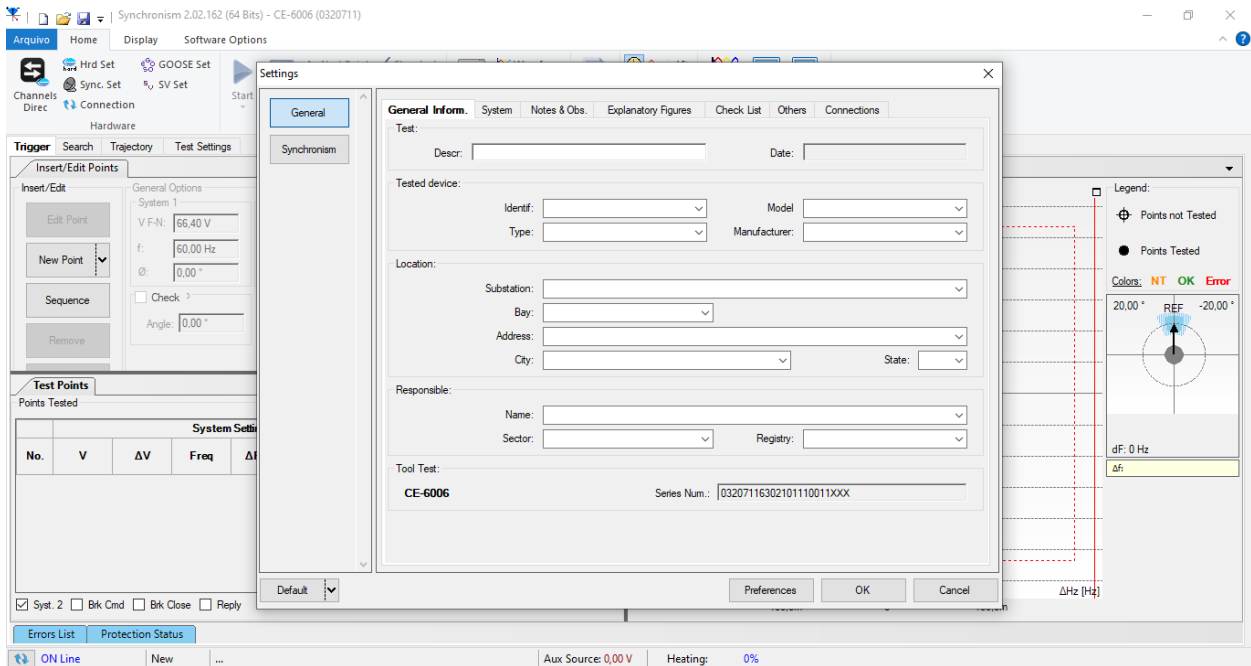


Figure 15

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.

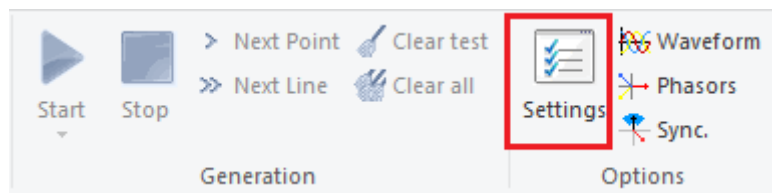
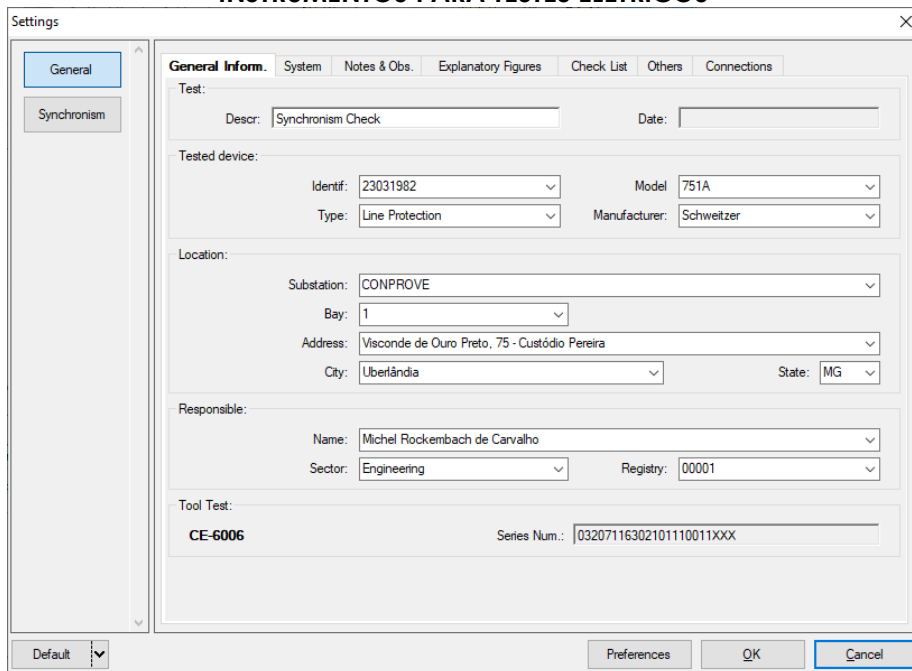


Figure 16

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

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Settings

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

Test:
 Descr: Synchronism Check Date:

Tested device:
 Identif: 23031982 Model: 751A
 Type: Line Protection Manufacturer: Schweitzer

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: 00001

Tool Test:
CE-6006 Series Num.: 03207116302101110011XXX

Default Preferences OK Cancel

Figure 17

4.3 System

In the following screen, within the Nominal sub tab, the frequency values, 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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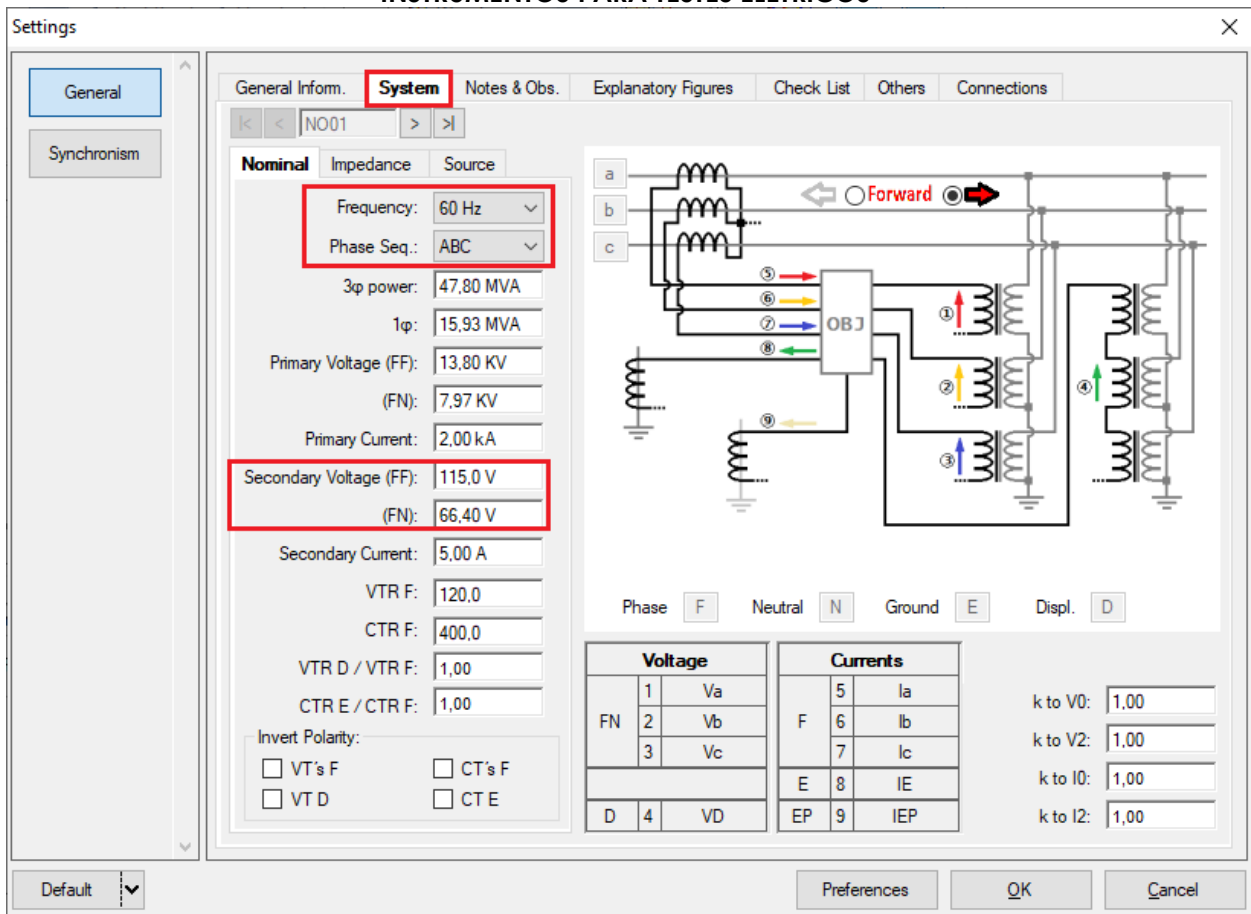


Figure 18

There are other tabs where the user can enter “Notes & Obs., Explanatory Figures,” can create a “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. Channel Targeting and Hardware Configurations

Click on the icon illustrated below.

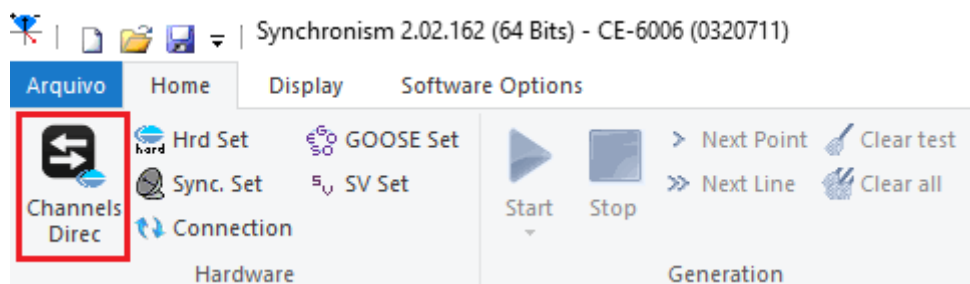


Figure 19

Then click on the highlighted icon to configure the hardware.

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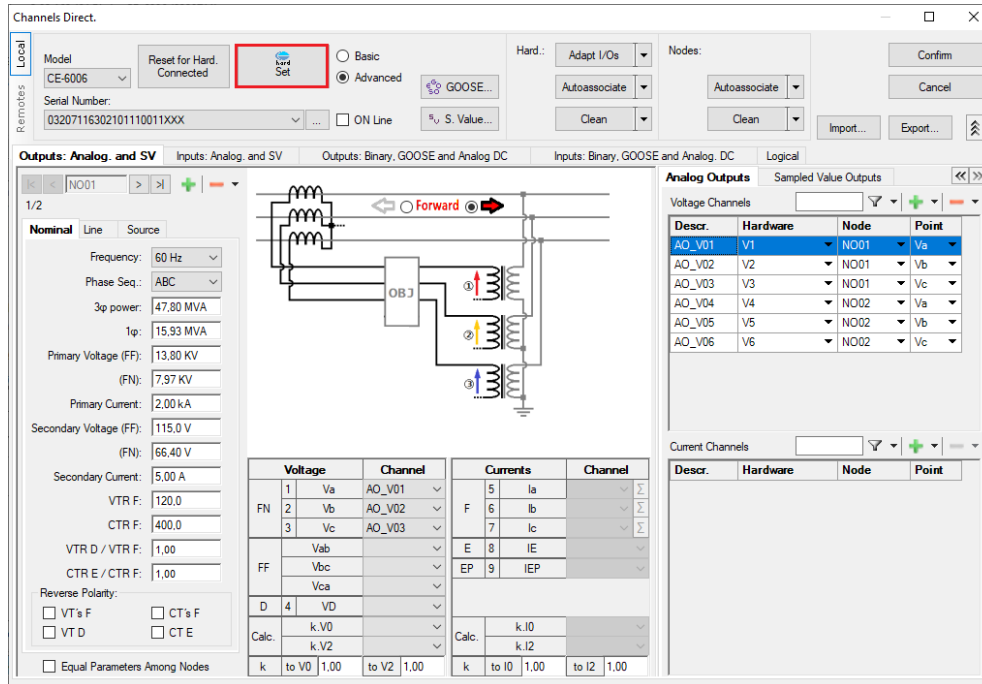


Figure 20

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

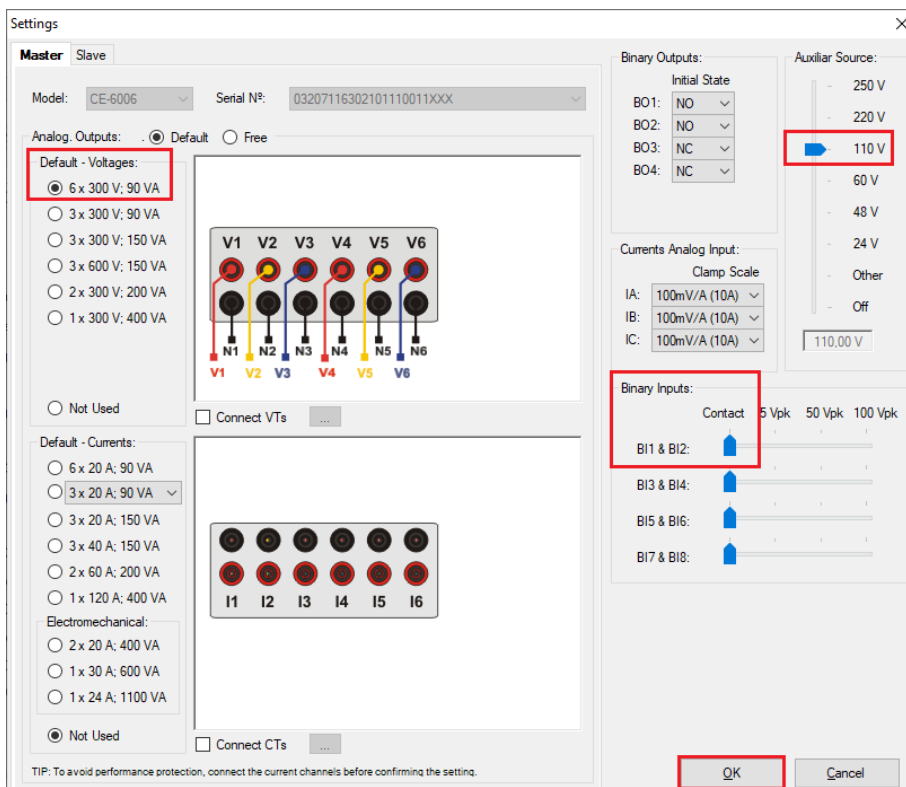


Figure 21

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

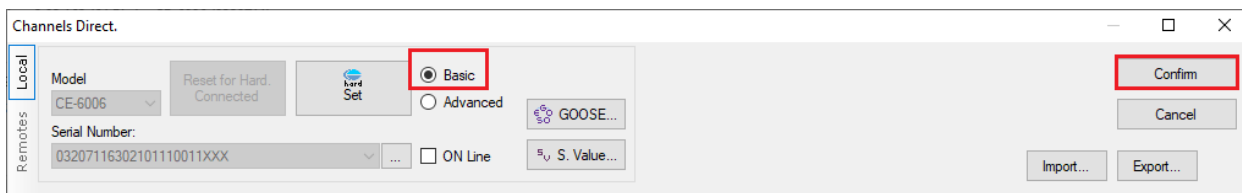


Figure 22

6. Synchronism Adjustments

6.1 Synchronism > Systems Screen

Click again on the “*Settings*” icon and then “*Synchronism > Systems*”. In this tab, the data of system 1 must be inserted, specifying its composition: Single-phase, Three-phase FN or Three-phase FF. The reference voltage must be adjusted, and depending on the case, it is necessary to compensate for the phase shift inserted by the transformer.

For system 2, it must be configured similarly to system 1 regarding its composition and reference voltage. In this same screen, the primary and secondary voltage values are adjusted, in addition to the primary and secondary currents. For the circuit breaker, the time value for its effective closing must be entered. There is also the “*Equal Levels of System 1*” field, which when selected, equals the voltages of system 2 to system 1.

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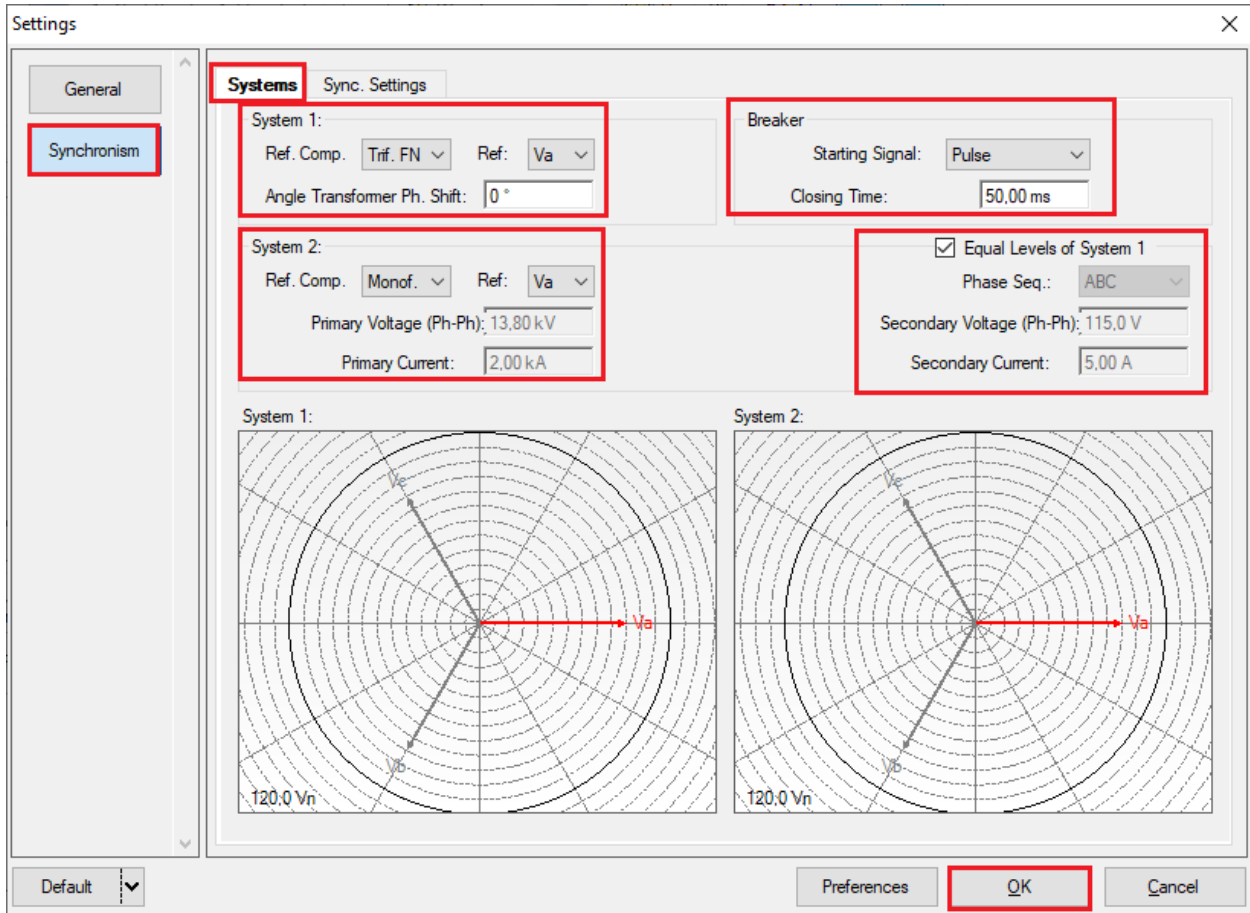


Figure 23

6.2 Synchronism > Sync. Settings

This screen stipulates the differences in voltage, frequency and the maximum tolerable angle for synchronism to occur. The maximum and minimum permitted voltage and frequency values are also adjusted so that synchronism occurs. These values are adjusted in percentage referring to the nominal values of the system 1. Also set the maximum time for synchronism to occur (adopted 15.0s) and the relative and absolute tolerances for voltage, frequency, time and the absolute tolerance for the angle. Tolerances are adjusted according to the values in Appendix A.

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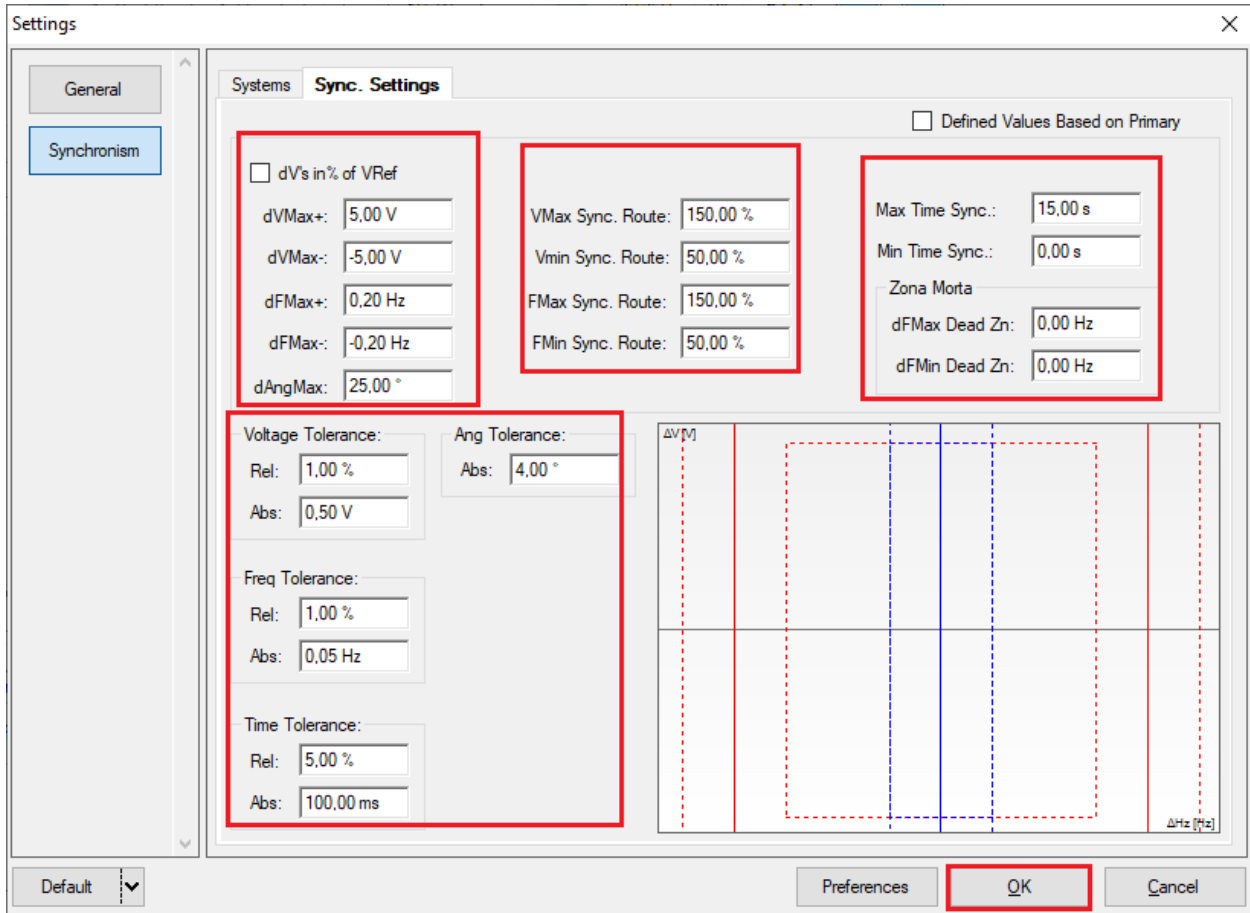


Figure 24

7. Test Settings

In the “*Test Settings*” tab, the correct direction of the voltage generation channels and the stop interface must be done. The binary input responsible for the synchronism function is BI01. Check the option “*Enable Pre-Simulation 1*” in the “*Not Sync.*” mode for 90ms.

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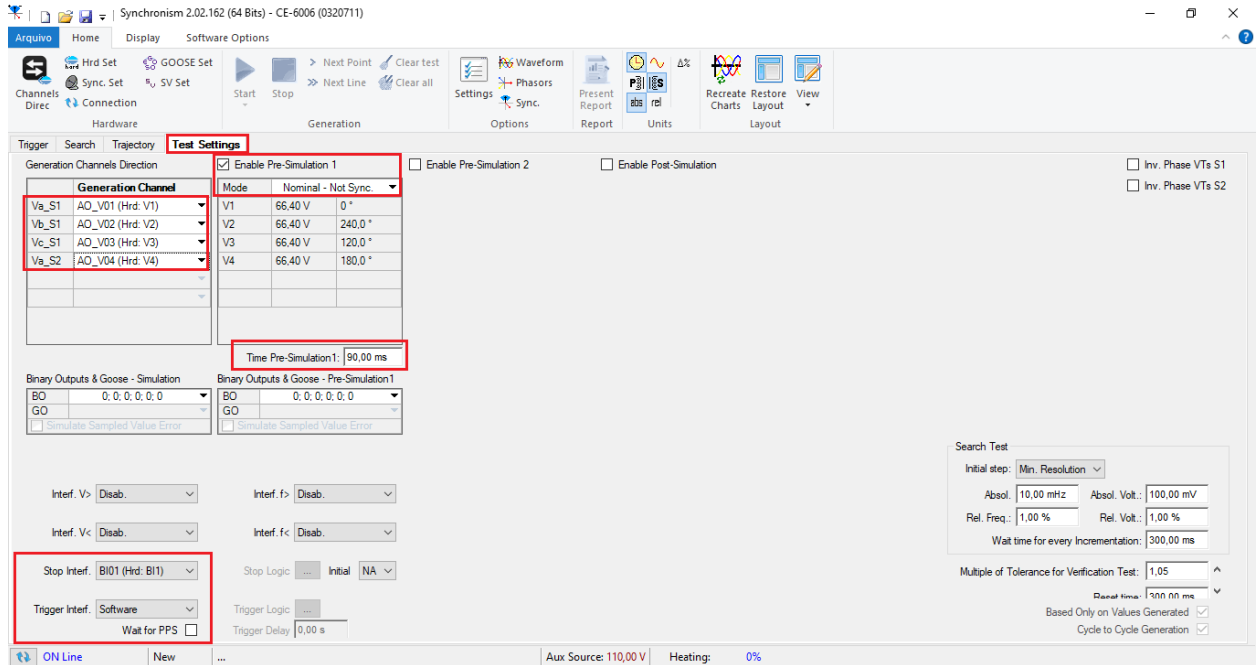


Figure 25

8. Trigger Test

In the trigger test, points inside and outside the synchronism zone are verified. The points represent the difference in voltage and frequency with respect to system 1. You can also specify an angle difference for the two systems. To insert the points click on “New Point” and choose a point directly on the graph and then on the item “Confirm”. Another option is to choose the voltage, frequency and angle difference values by writing these values in their respective fields. The last option would be to click on the “Sequence” option and choose an angle step so that several points are automatically created on the edges of the sync zone. The nominal values of voltage and frequency of system 1 must be adjusted. The figure below illustrates this situation.

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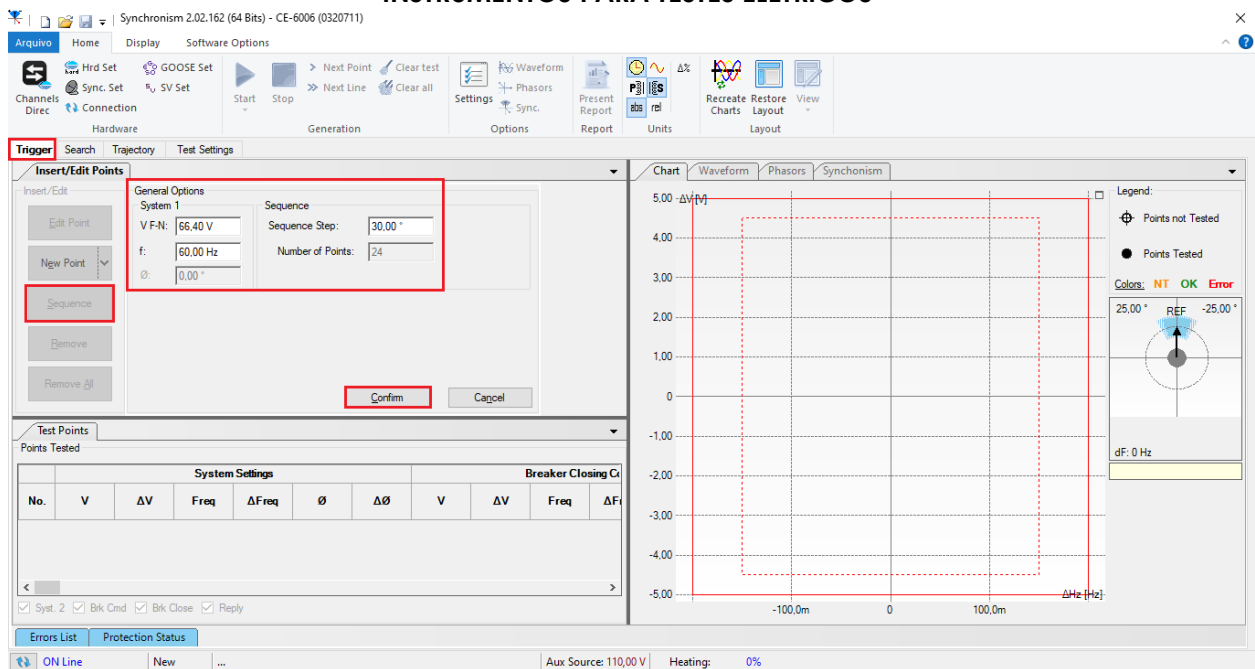


Figure 26

Choosing the sequence with a step of 30.00° , phase-neutral voltage of 66.40 volts, frequency of 60.00Hz and clicking on the button “*Confirm*” the following points are create:

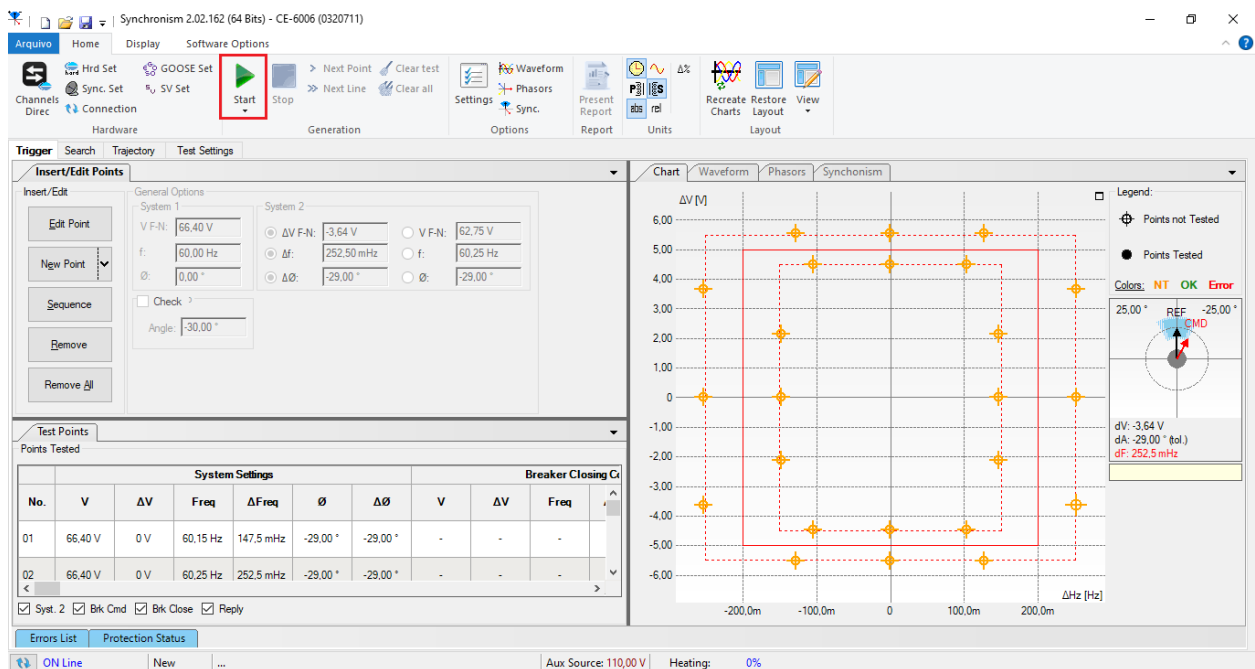


Figure 27

The next step is to start the generation through the “*Start*” button or the shortcut “*Alt + G*”. The figure below shows the final test result.

INSTRUMENTOS PARA TESTES ELÉTRICOS

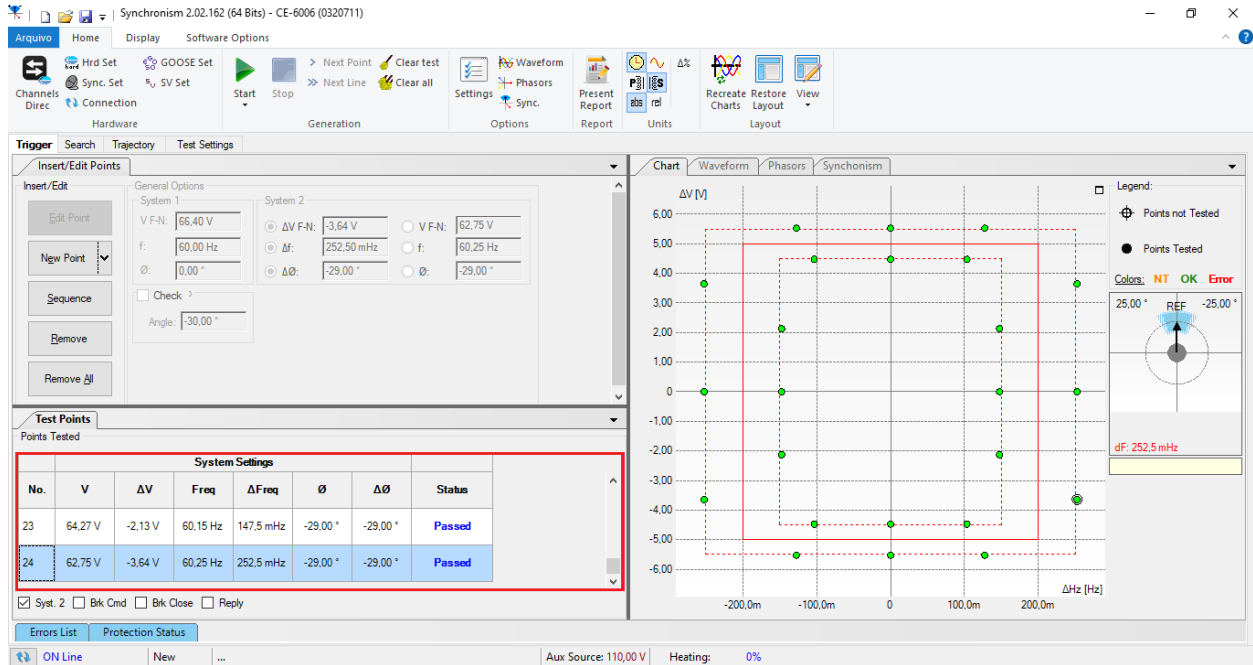


Figure 28

9. Search Test

This test will not be performed as the relay does not have the necessary resources.

10. Trajectory Test

This test has the same objective as the “*Trigger Test*”, finding the moment of synchronism, however the difference is that the voltage and current values of system 2 vary over time. Differently from what happens in the “*Trigger Test*” where these values are fixed. To perform the test, use the “*Sequence*” option with the step equal to 30.0° reaching the following screen.

INSTRUMENTOS PARA TESTES ELÉTRICOS

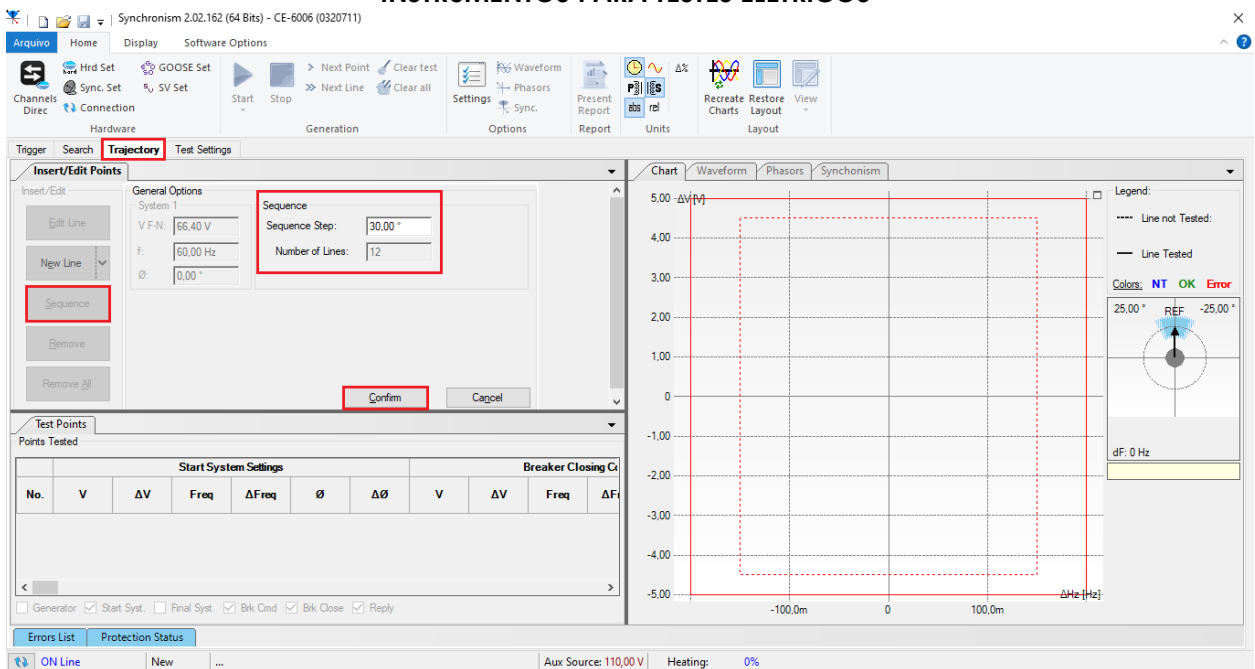


Figure 29

Clicking the “*Confirm*” button automatically creates the lines shown below:

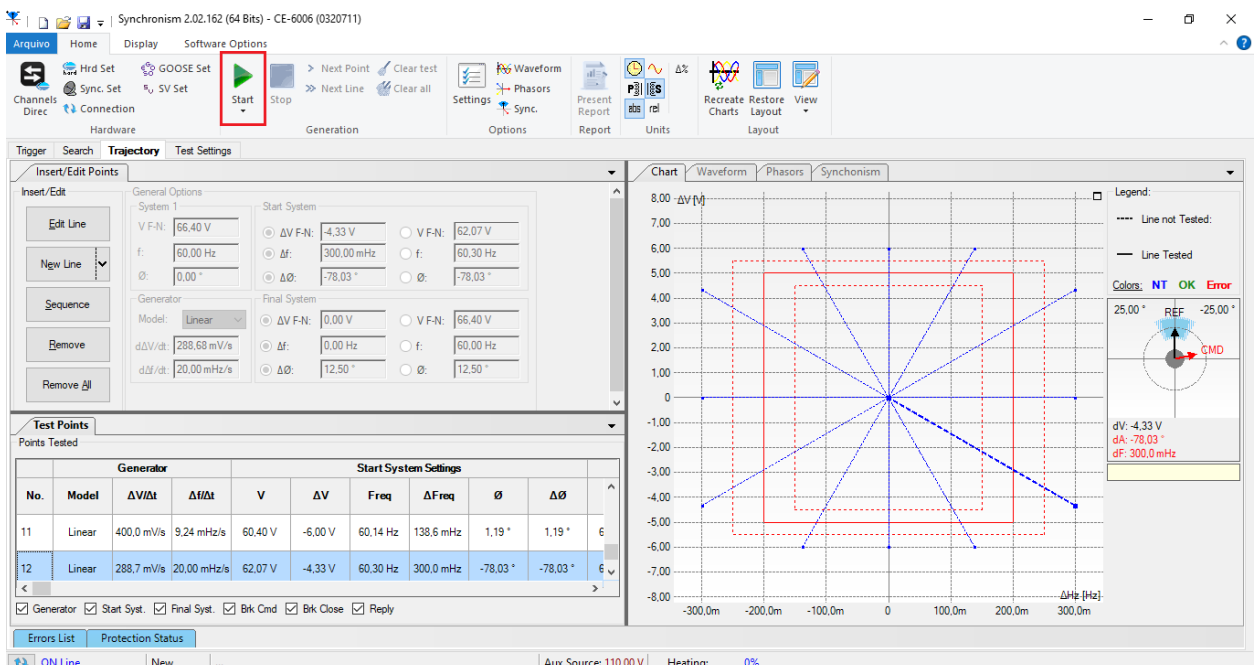


Figure 30

The next step is to start the generation through the “*Start*” button or the shortcut “*Alt + G*”. The figure below shows the final test result.

INSTRUMENTOS PARA TESTES ELÉTRICOS

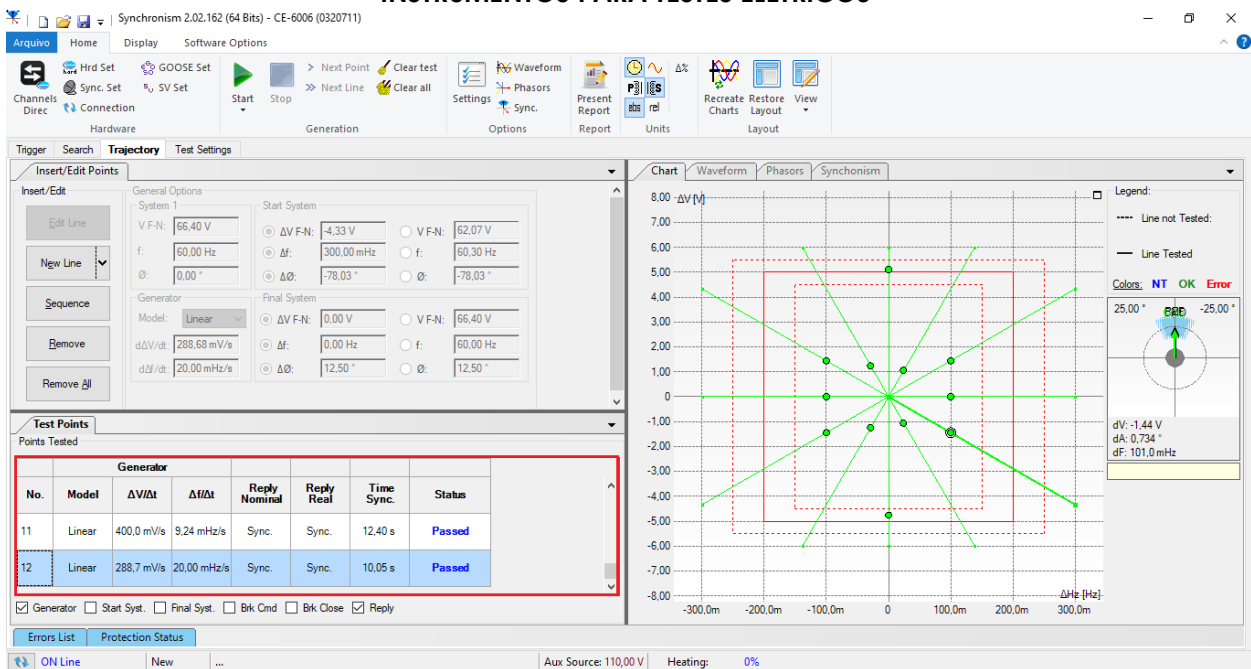


Figure 31

11. Report

After finishing the test, click on the “Present Report” icon 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.

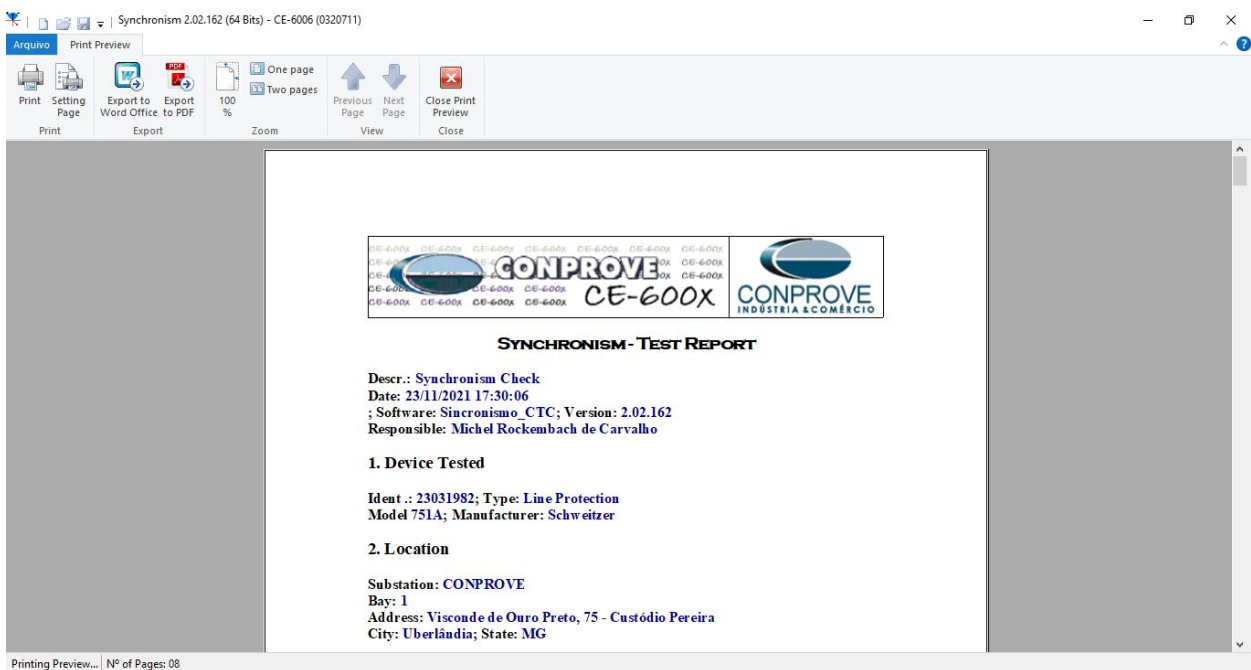


Figure 32

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APPENDIX A

A.1 Terminal Designations

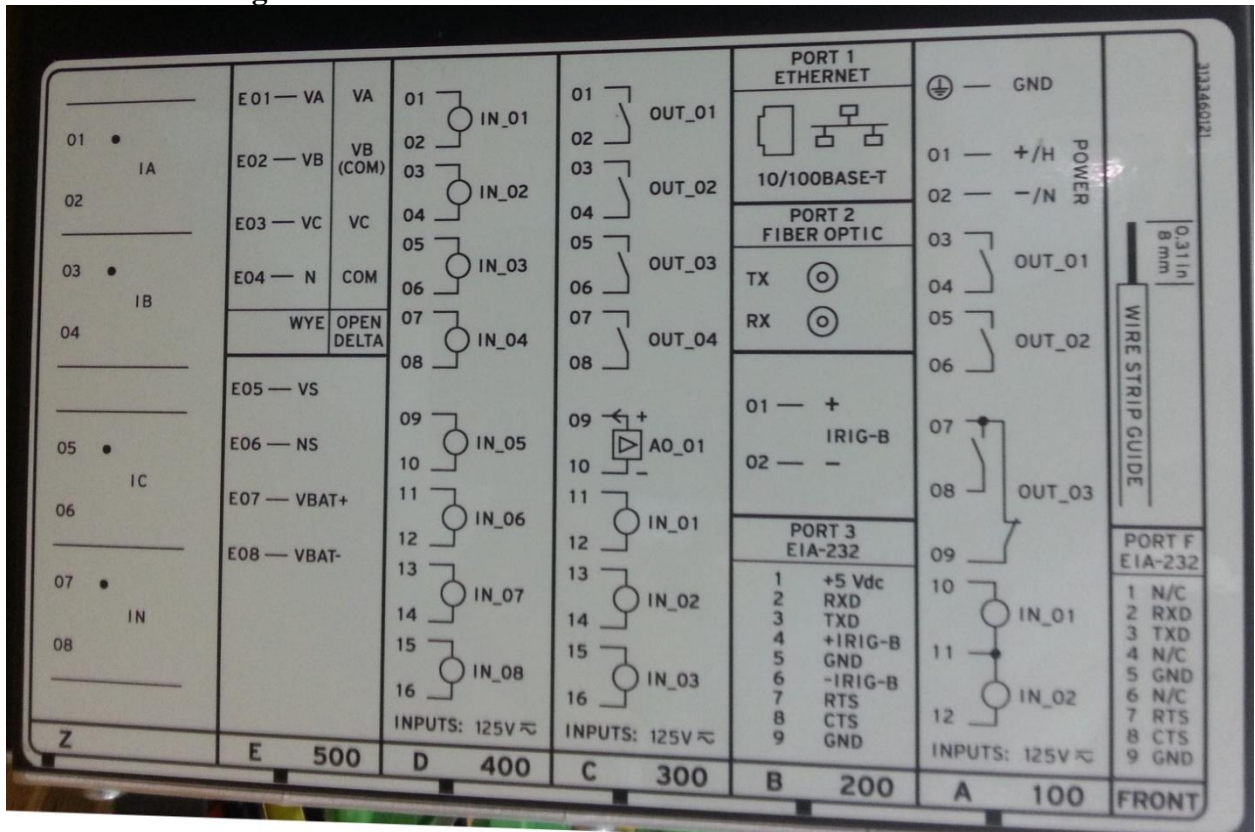


Figure 33

A.2 Technical Data

Synchronism Check (25)

Pickup Range, Secondary Voltage:	0.00–300.00 V
Pickup Accuracy, Secondary Voltage:	±1% ±0.5 volts (over the range of 12.5–300 V)
Slip Frequency Pickup Range:	0.05 Hz–0.50 Hz
Slip Frequency Pickup Accuracy:	±0.05 Hz
Phase Angle Range:	0–80°
Phase Angle Accuracy:	±4°

APPENDIX B

Equivalence of software parameters and the relay under test.

Tables 1

Synchronism Software		SEL 751A Relay	
Parameter	Figure	Parameter	Figure
Secondary Voltage (FF)	18	VNOM Line Voltage, Nominal Line-to-Line	09
dVMax+	23	25 VHI Voltage Window- High Threshold (- 66,4V)	10
dVMax-	23	25 VLO Voltage Window- Low Threshold (- 66,4V)	10
dFMax+	23	25SF Maximum Slip Frequency	10
dFMax-	23	25SF Maximum Slip Frequency (negative sign)	10
dAngMax	23	25ANG1 Maximum Angle1	10