



INSTRUMENTOS PARA TESTES ELÉTRICOS

# Test Tutorial

**Equipment Type:** Protection Relay

**Brand:** SCHWEITZER (SEL)

**Model:** 311C

**Function:** 81u or PTUF – Underfrequency & 81o or PTOF – Overfrequency

**Tool Used:** CE-6003, CE-6006, CE-6707, CE-6710, CE-7012 or CE-7024

**Objective:** Testing the pickup and operating time of the underfrequency and overfrequency elements using the Ramp software.

## Version Control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial Version	21/10/2022	M.R.C.	G.C.D.P.

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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](mailto: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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**INSTRUMENTOS PARA TESTES ELÉTRICOS**  
**Sequence for testing SEL 311C relay in the Ramp software**

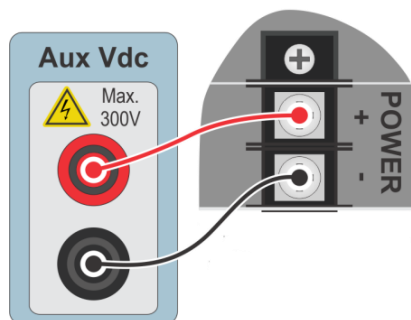
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**1. Relay Connection to CE-6710**

Appendix A-1 shows the relay terminal designations.

**1.1 Auxiliary Source**

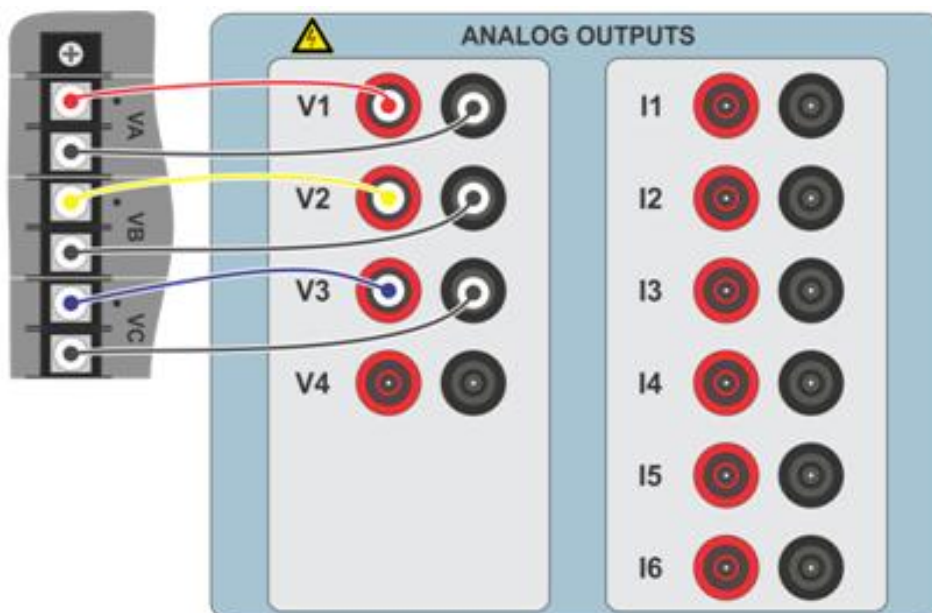
Connect the positive (red terminal) of the Aux Vdc source to the “Power +” (Z25) pin of the relay, connect the negative (black terminal) of the Aux Vdc source to the “Power -” (Z26) pin of the rel.



**Figure 1**

**1.2 Voltage Coils**

To establish the connection of voltage coils, connect voltage channels V1, V2 and V3 to pins Z09, Z10 and Z11 of the relay terminal and connect the commons of voltage channels to pin Z12 of the relay.



**Figure 2**

### 1.3 Binary Inputs

Connect the binary inputs of the CE-6710 to the binary outputs of the relay.

- BI1 to pin B01 and its common to pin B02 of the relay.
- BI2 to pin B03 and its common to pin B04 of the relay.
- BI3 to pin B05 and its common to pin B06 of the relay.
- BI4 to pin B07 and its common to pin B08 of the relay.

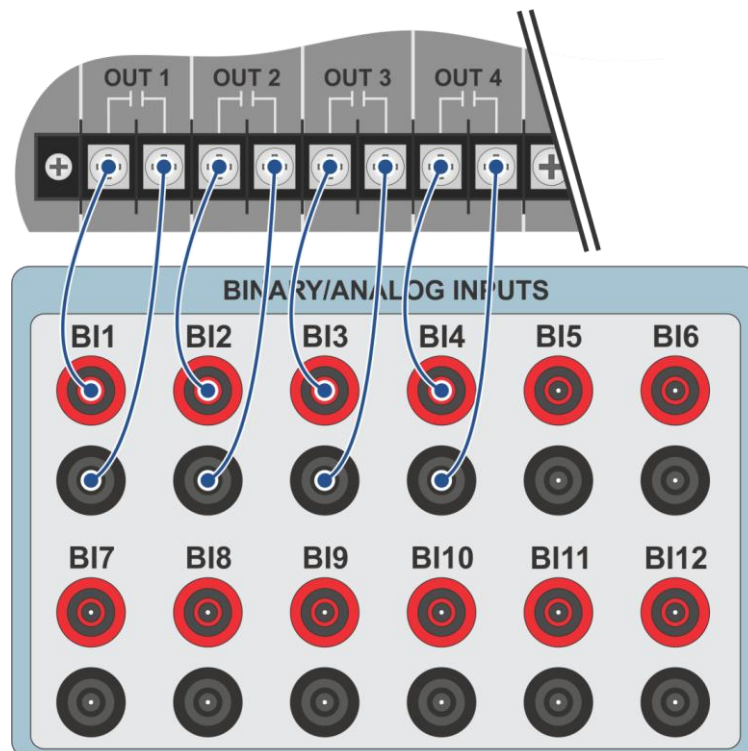


Figure 3

## 2. Communication with the 311C 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.

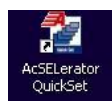
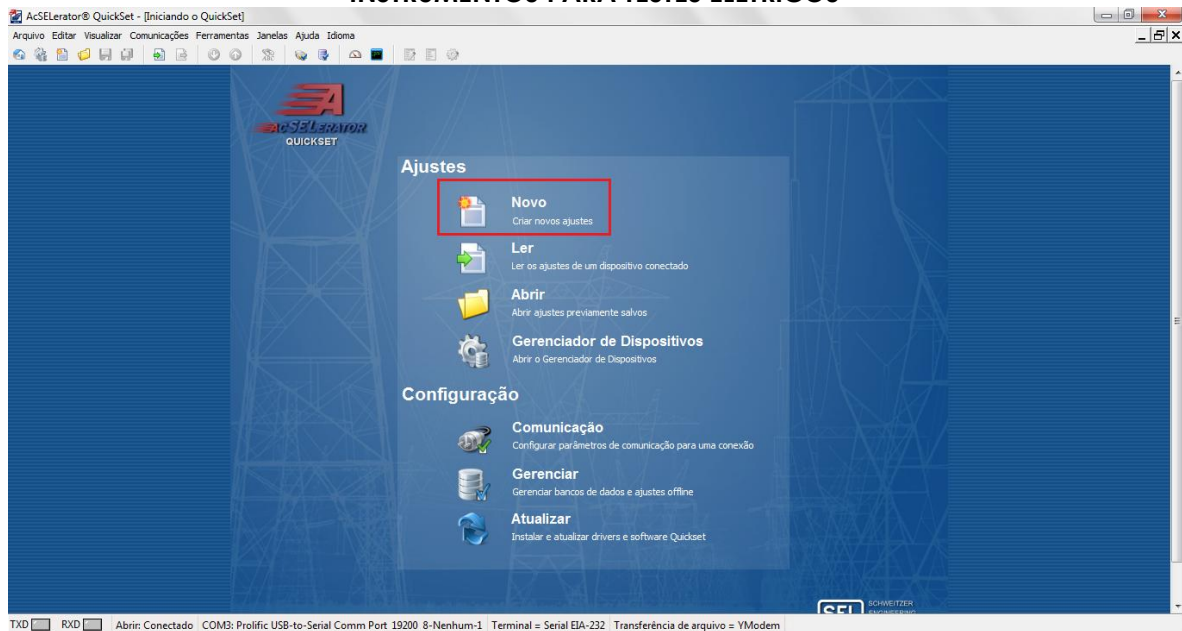


Figure 4

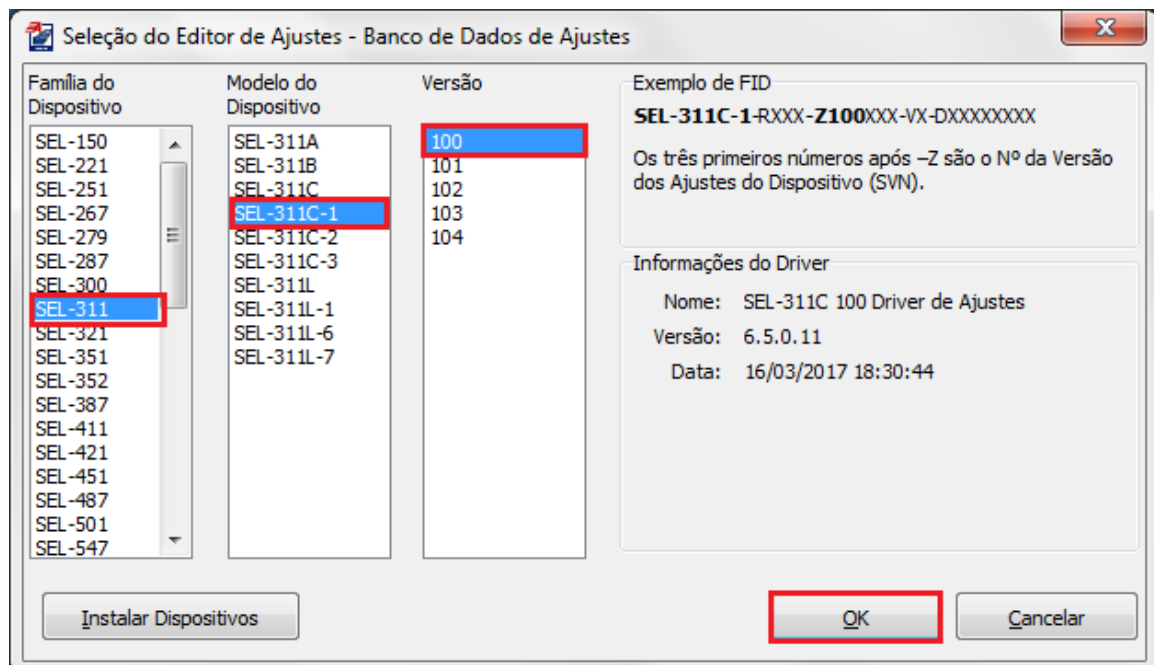
When opening the program, the relay file is selected if communication has already been carried out. Otherwise click on “*New*”.

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**Figure 5**

In the next screen, the model and version of the tested relay are set. Check on the front panel by pressing the “*Status*” button.

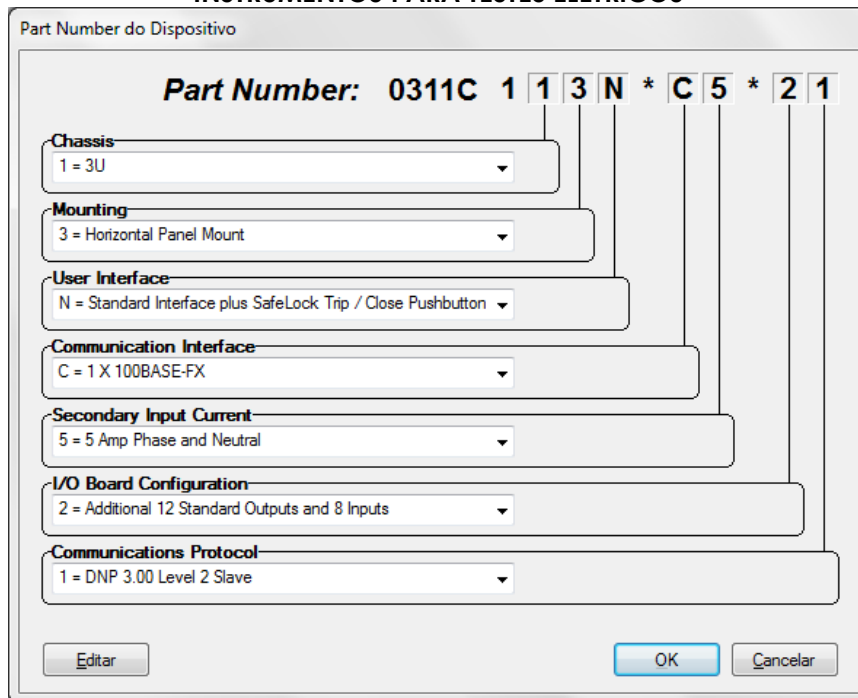


**Figure 6**

Then the “*Part Number*” must be set.

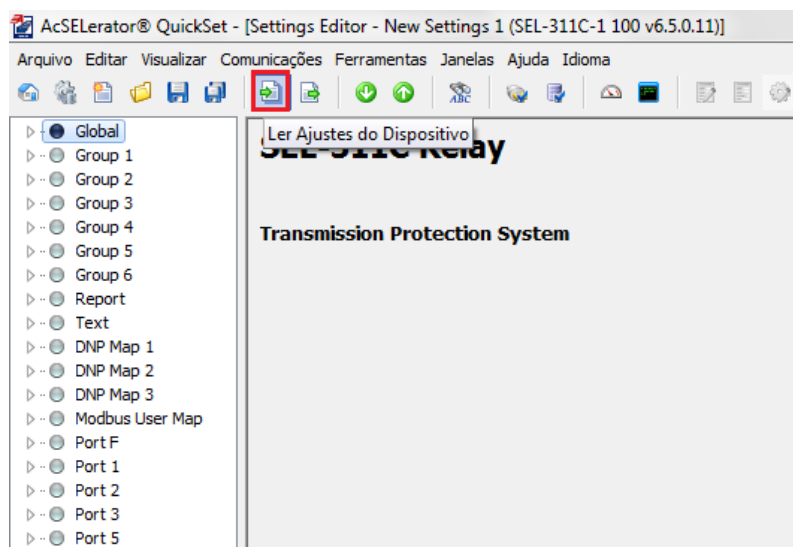


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**Figure 7**

Then click on the highlighted icon according to the figure below:



**Figure 8**

### 3. Parameterization of the SEL 311C relay

#### 3.1 General

After the connection has been established, click on “Global” and “General” and adjust the connection of the voltage channels, the frequency value and the phase sequence.



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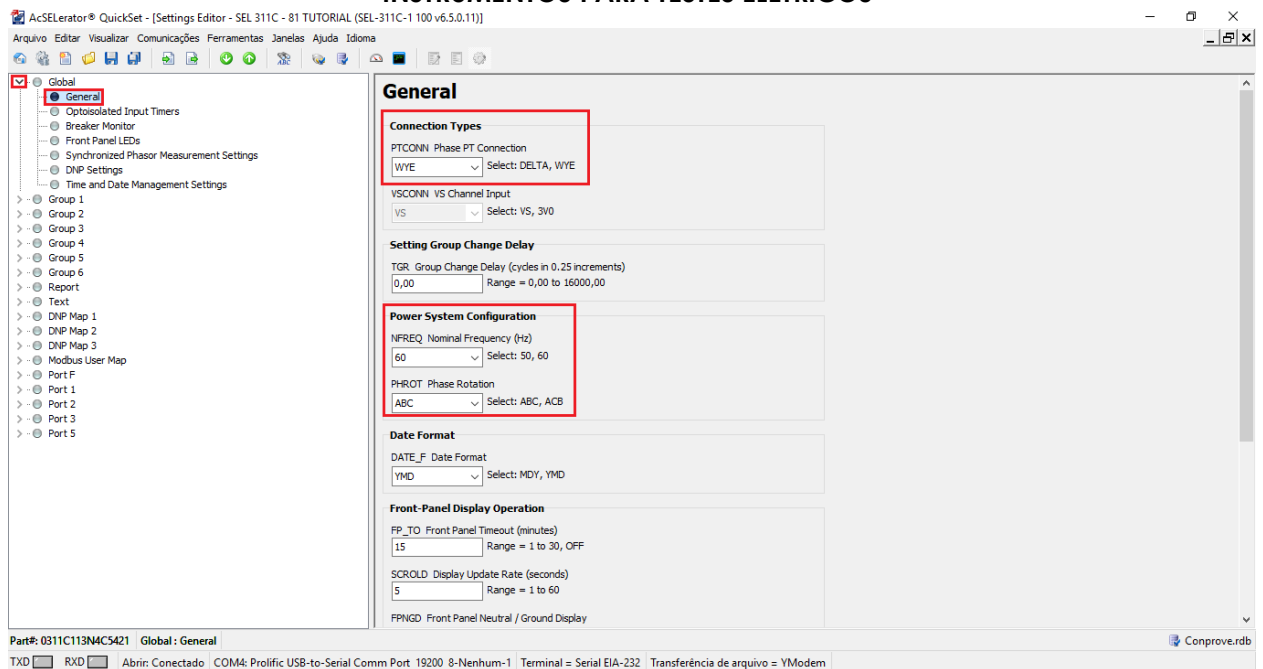


Figure 9

### 3.2 General Settings

Click next to “Group1 > Set 1” then “General Settings”. In this window, the identification of the relay and its terminal, the current and voltage transformation ratios are adjusted. Configure the nominal secondary phase voltage and leave the last two settings disabled.

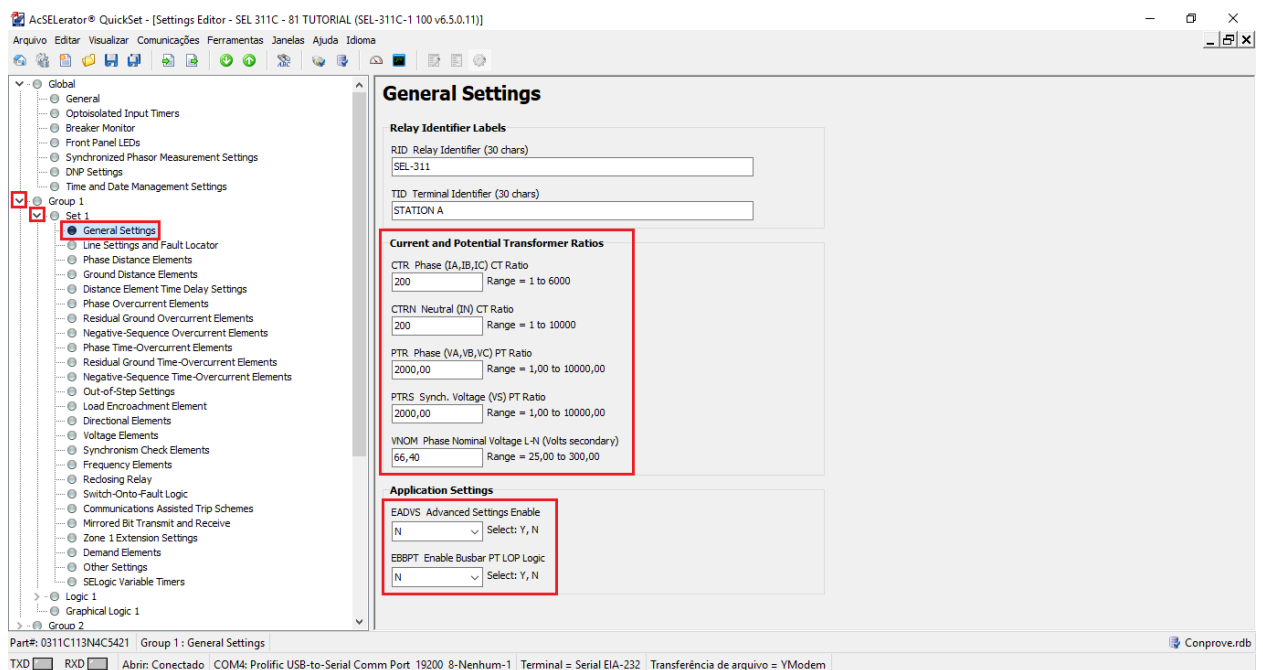


Figure 10

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### 3.3 Frequency Elements

Click on “*Frequency Elements*” and set 4 frequency elements with the following pick-up values and operating times.

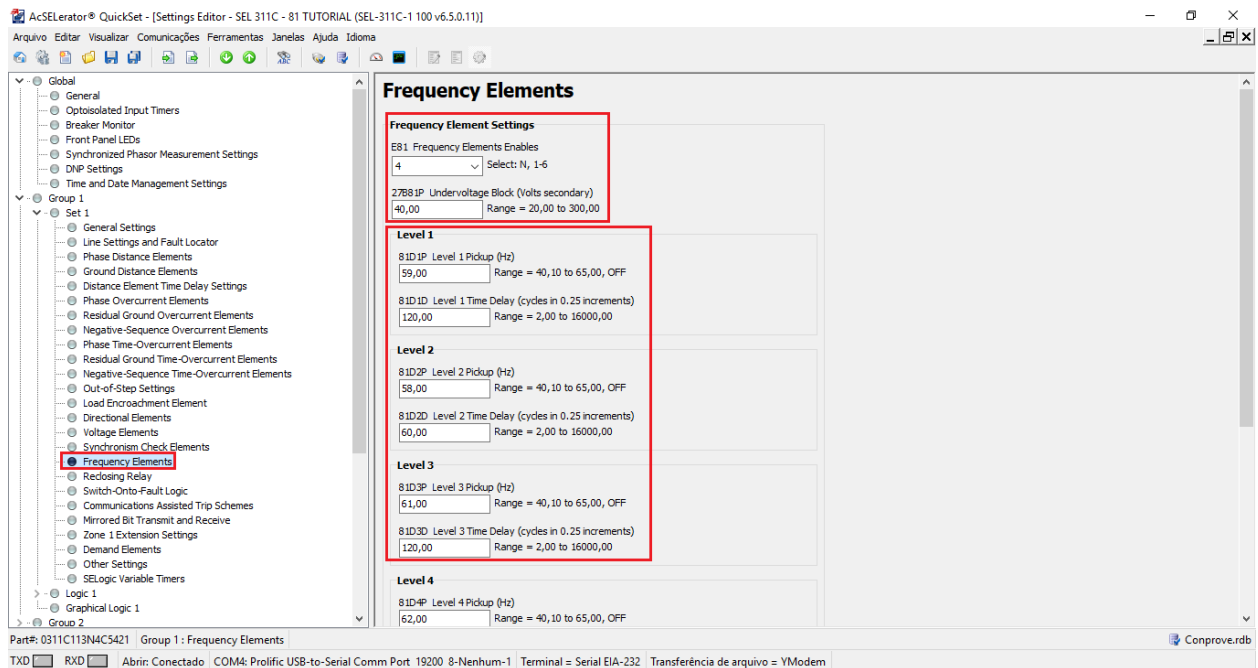


Figure 11

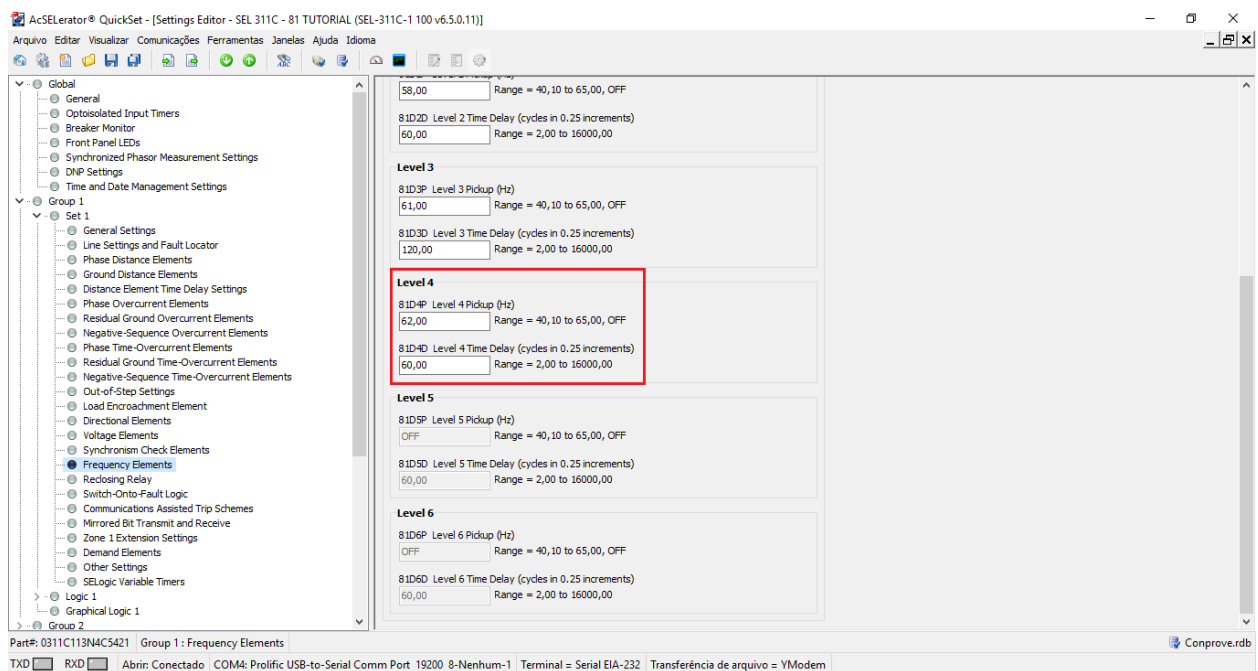


Figure 12

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### 4. Binary Output Adjustments

#### 4.1 Output Contacts

Click next to “Logic 1” and select the “Output Contacts” option and make the following adjustments.

- OUT201 – “81D1T” signal equivalent to tripping element 81-1.
- OUT202 – “81D2T” signal equivalent to tripping element 81-2.
- OUT203 – “81D3T” signal equivalent to tripping element 81-3.
- OUT204 – “81D4T” signal equivalent to tripping element 81-4.

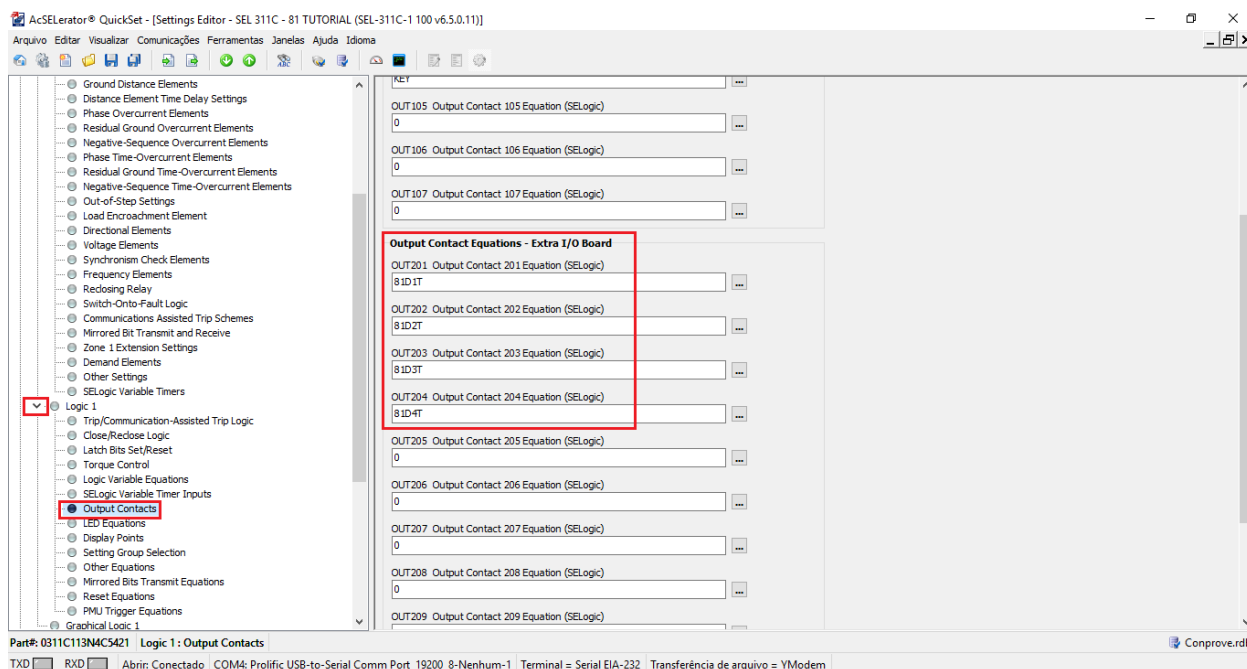


Figure 13

#### 4.2 Submitting the Adjustments

Click on the selected icon and submit at least the following adjustments.

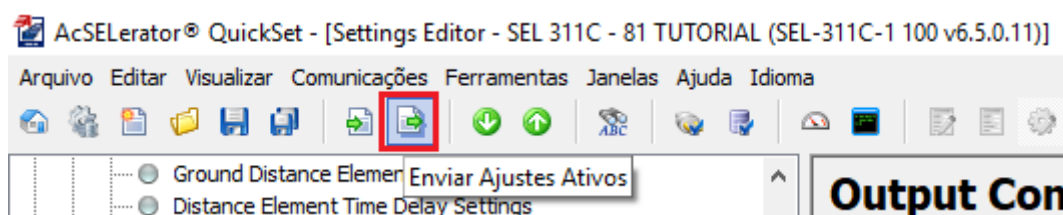


Figure 14

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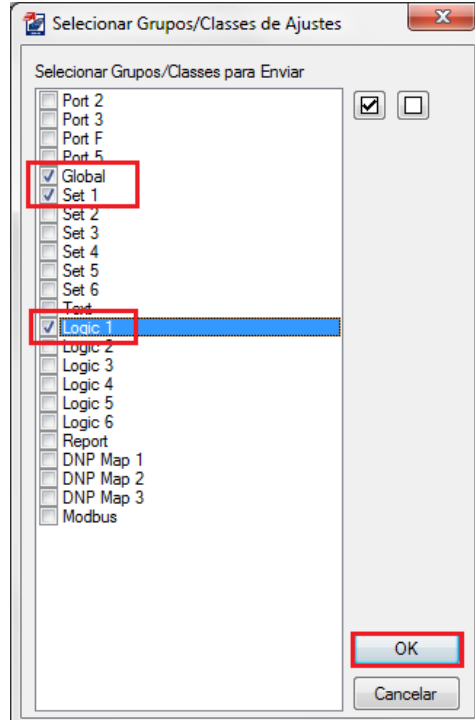


Figure 15

## 5. Ramp software adjustments

### 5.1 Opening the ramp

Click on the “CTC” application manager icon.



Figure 16

Click on the “Ramp” software icon.



Figure 17

## INSTRUMENTOS PARA TESTES ELÉTRICOS

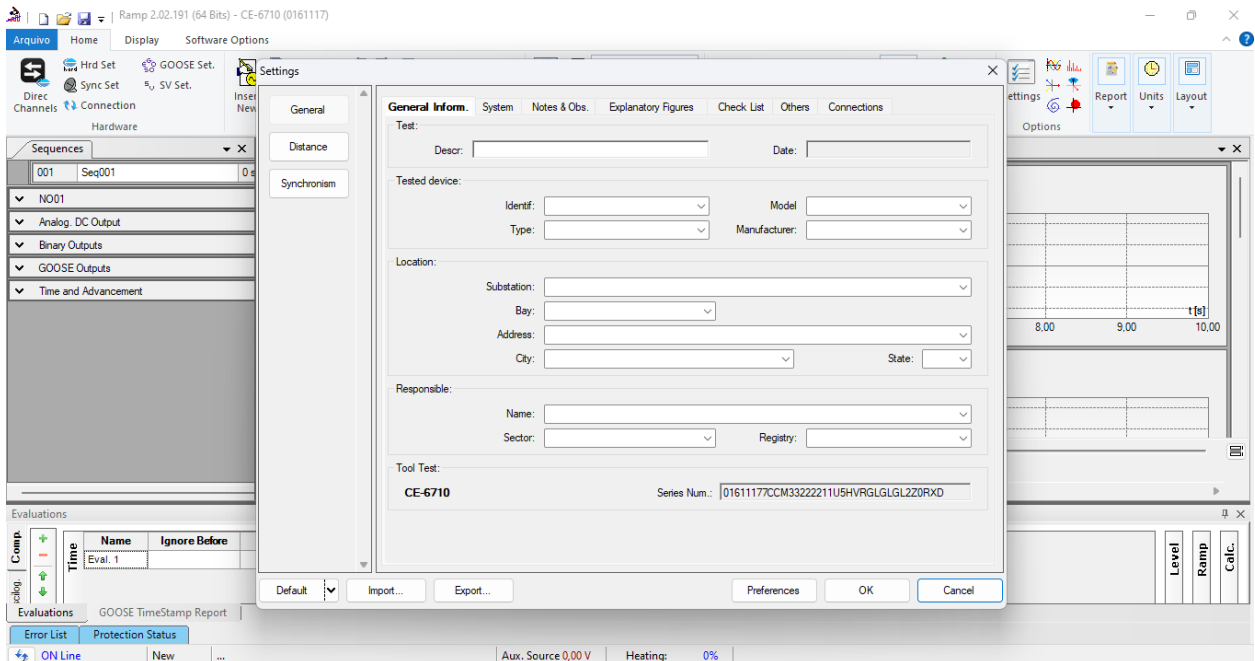


Figure 18

### 5.2 Configuring the Settings

When opening the software, the “*Settings*” screen will open automatically (as long as the “*Open Settings when Starting*” option found in the “*Software Options*” menu is selected). Otherwise click directly on the “*Settings*” icon.

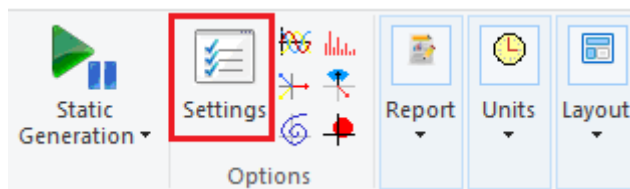


Figure 19

Inside the “*Settings*” screen, fill in the “*General Inform.*” with data on the “*Tested device*”, “*Location*” and the “*Responsible*”. This facilitates the elaboration of the report and this tab will be the first page to be shown in the report.

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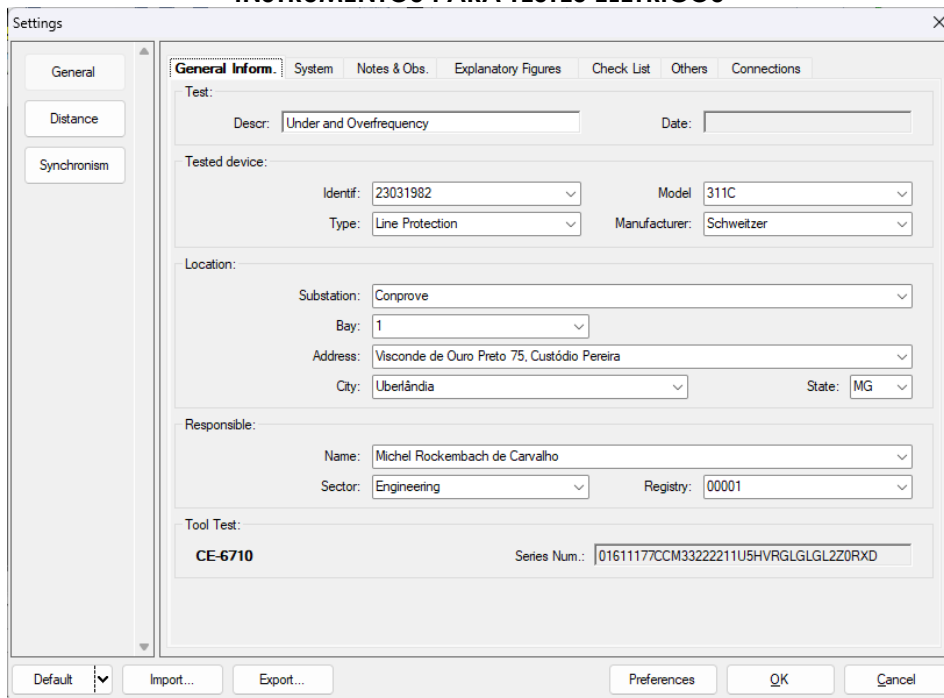
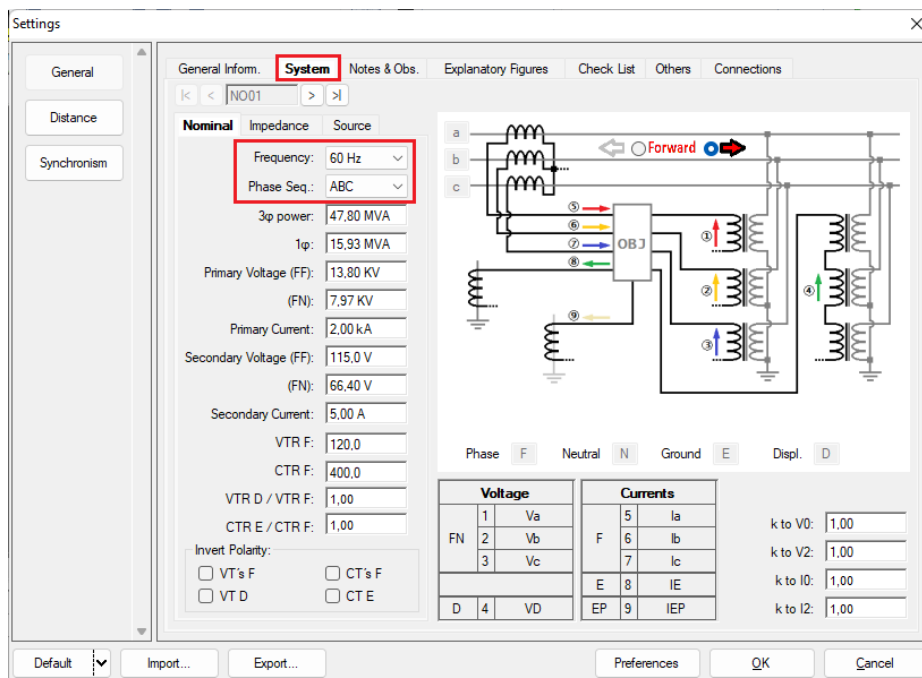


Figure 20

**5.3 System**

On the following screen, within the “Nominal” sub tab, the values of frequency, phase sequence, primary and secondary voltages, primary and secondary currents, VTs and CTs transformation ratios are configured. There are also two sub tabs “Impedance” and “Source” whose data are not relevant for this test.



Voltage		Currents		k to V/I	
1	Va	5	Ia	k to V0:	1.00
2	Vb	6	Ib	k to V2:	1.00
3	Vc	7	Ic	k to I0:	1.00
FN		E	IE	k to I2:	1.00
D	4	EP	IEP		

Figure 21



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There are other tabs where the user can insert “Notes & Obs., Explanatory Figures”, can create a “Check List” of the procedures for carrying out tests and also create a schematic with all the connections between the test set and the test equipment.

### 6. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

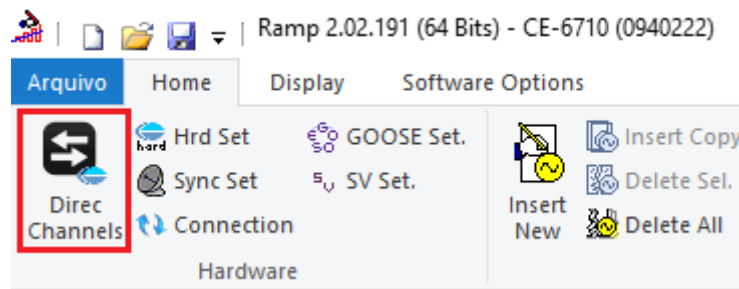


Figure 22

Then click on the highlighted icon to configure the hardware.

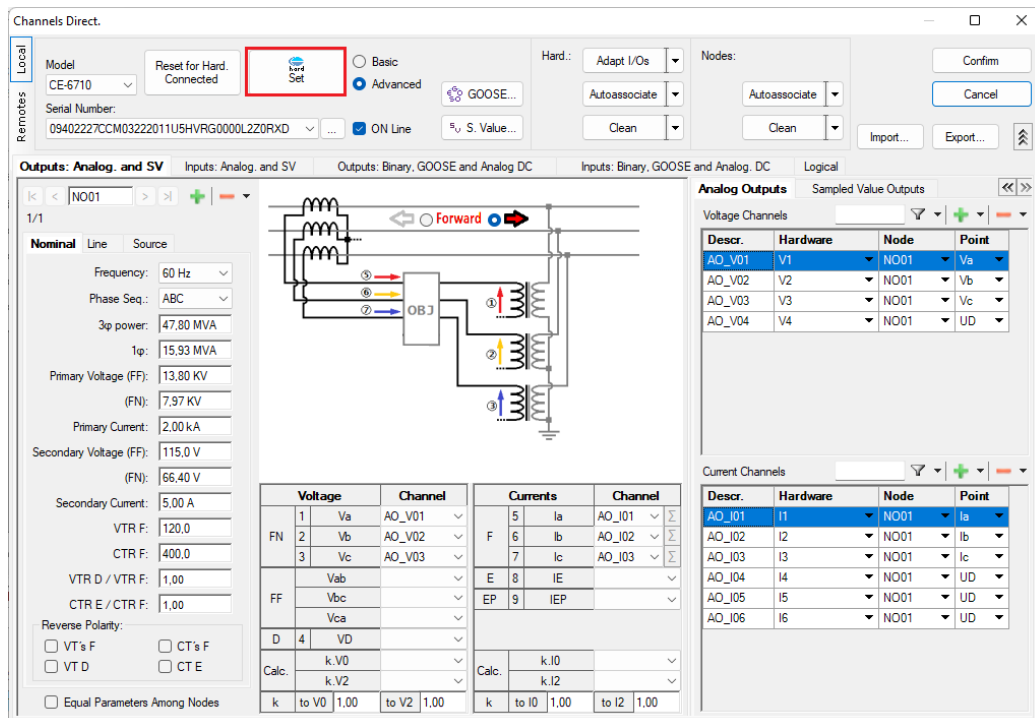


Figure 23

Choose channel configuration, adjust auxiliary source and stop method of binary inputs. Finally, click on “OK”.

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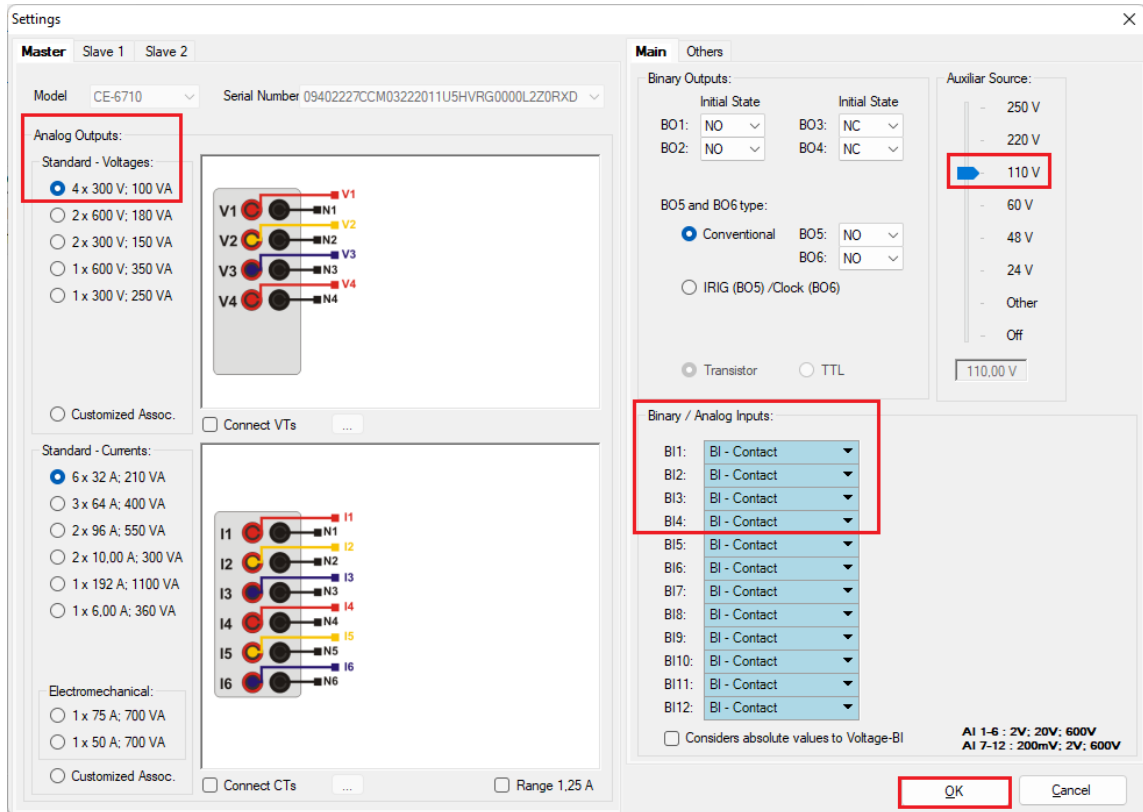


Figure 24

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

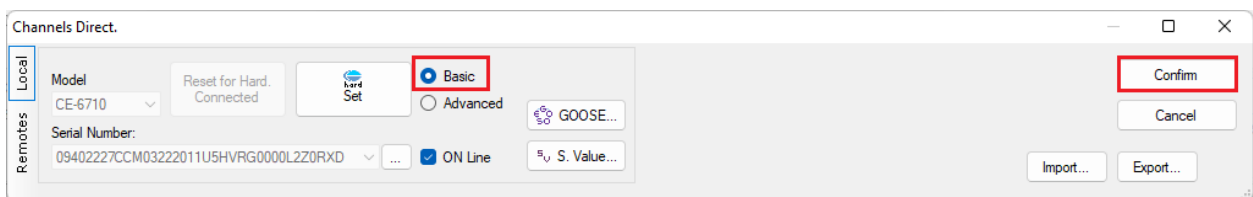


Figure 25

### 7. Restore Layout

Due to the great flexibility that the software presents, allowing the user to choose the windows that will be presented and their positions, the command is used to restore the default settings. Click on the “Layout” button and then on “Recreate Charts” repeat the process by clicking on “Layout” and on “Restore Layout”. During the test, windows that are not relevant are excluded.

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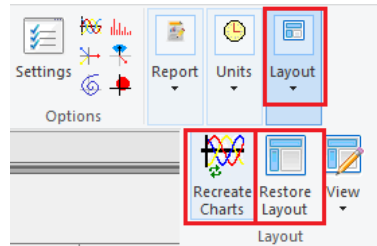


Figure 26

Following is the default structure after the previous commands.

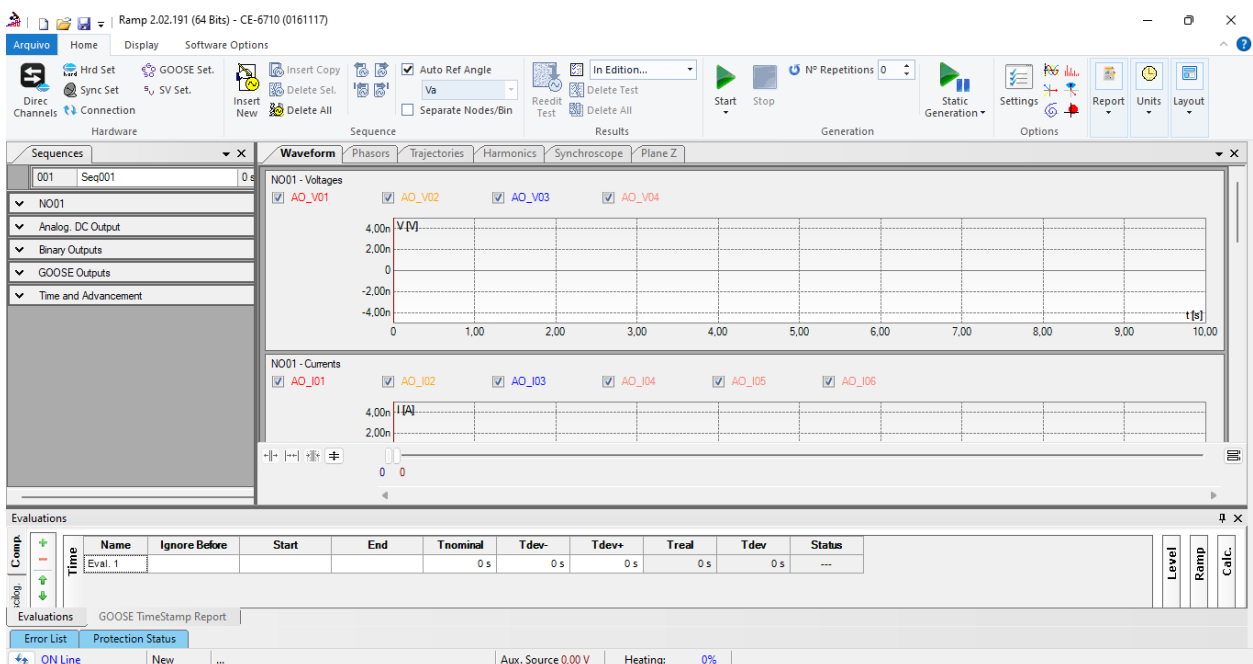
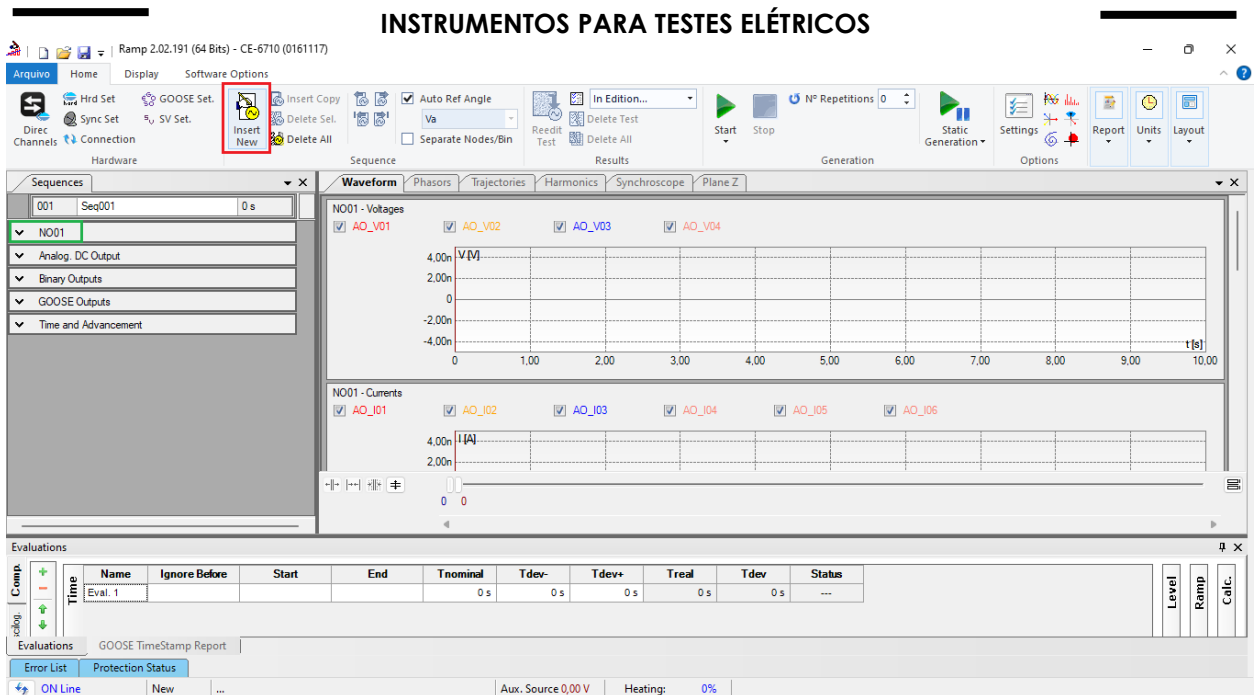


Figure 27

### 8. Test structure for function 81

Click the button highlighted in red until you create 4 test sequences.



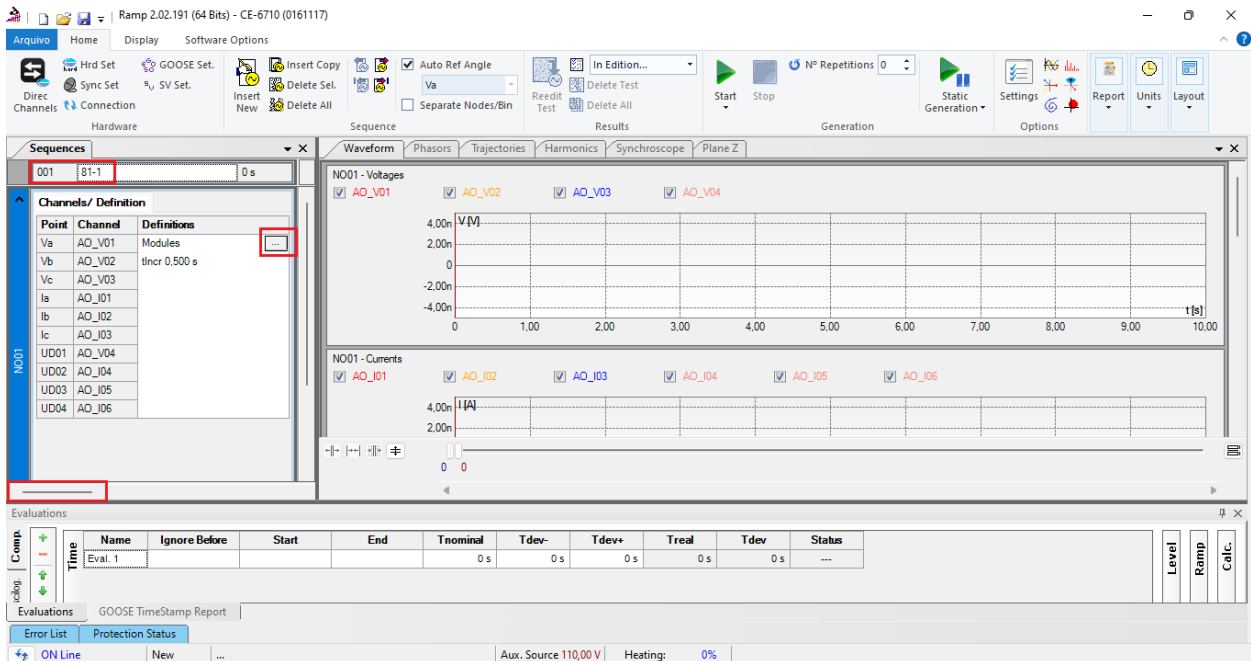
**Figure 28**

Click on the option “NO01” highlighted in green and decrease the size of the right window for easier viewing.

### 8.1 Main Screen 81-1

In the first sequence, configure a situation to check the underfrequency of the 81-1 element whose adjustment is at 59.0Hz and 2.0 s. In place of “Seq 001” write “81-1”. Then click on the highlighted button in the figure below.

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**Figure 29**

**8.2 Screen for incrementing 81-1**

On this screen, in the “Ramp Type” field, choose the “Frequency” option and then select the “Pulsed” option. For the voltage value, either initial or reset use the nominal voltage of 66.4V balanced three-phase ABC. For the initial frequency use 59.02Hz and for the final frequency 58.98Hz with a step of -5.0mHz. In the field “Generation Time in Each Incr.” the user must configure a time that is always longer than the actuation time. In this case, a time of 2.25 seconds was chosen. “Reset Time” has been set to 0.25 seconds.

**INSTRUMENTOS PARA TESTES ELÉTRICOS**

Ramp

Ramp Type:  Direct  Pulsed

Frequency:

Generation Time in Each Incr.:  Reset Time:

Initial Values

Channels/ Definition				
Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	66,40 V	0 °	59,02 Hz
Vb	AO_V02	66,40 V	-120,0 °	59,02 Hz
Vc	AO_V03	66,40 V	120,0 °	59,02 Hz
Ia	AO_I01	0 A	0 °	60,00 Hz
Ib	AO_I02	0 A	0 °	60,00 Hz
Ic	AO_I03	0 A	0 °	60,00 Hz
UD01	AO_V04	0 V	0 °	60,00 Hz
UD02	AO_I04	0 A	0 °	60,00 Hz
UD03	AO_I05	0 A	0 °	60,00 Hz
UD04	AO_I06	0 A	0 °	60,00 Hz

Limits and Increases

	Limit	Incr.	d/dt	N Steps	Time
<input checked="" type="checkbox"/> Va	58,98 Hz	-5,00 mHz	-2,22 mHz/s	19,00	22,75 s
<input checked="" type="checkbox"/> Vb	58,98 Hz	-5,00 mHz	-2,22 mHz/s	19,00	22,75 s
<input checked="" type="checkbox"/> Vc	58,98 Hz	-5,00 mHz	-2,22 mHz/s	19,00	22,75 s
<input type="checkbox"/> Ia					
<input type="checkbox"/> Ib					
<input type="checkbox"/> Ic					
<input type="checkbox"/> UD01					
<input type="checkbox"/> UD02					
<input type="checkbox"/> UD03					
<input type="checkbox"/> UD04					

Reset

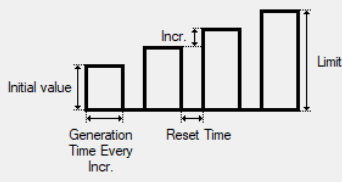
Channels/ Definition				
Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	66,40 V	0 °	60,00 Hz
Vb	AO_V02	66,40 V	-120,0 °	60,00 Hz
Vc	AO_V03	66,40 V	120,0 °	60,00 Hz
Ia	AO_I01	0 A	0 °	60,00 Hz
Ib	AO_I02	0 A	0 °	60,00 Hz
Ic	AO_I03	0 A	0 °	60,00 Hz
UD01	AO_V04	0 V	0 °	60,00 Hz
UD02	AO_I04	0 A	0 °	60,00 Hz
UD03	AO_I05	0 A	0 °	60,00 Hz
UD04	AO_I06	0 A	0 °	60,00 Hz

Binary Outputs

Channel	Incr.	Reset
<input type="checkbox"/> BO01		
<input type="checkbox"/> BO02		
<input type="checkbox"/> BO03		
<input type="checkbox"/> BO04		
<input type="checkbox"/> BO05		
<input type="checkbox"/> BO06		
<input type="checkbox"/> BO07		
<input type="checkbox"/> BO08		

GOOSE Outputs

Channel	Incr.	Reset



OK Cancel

Figure 30

**8.3 Main screen 81-2**

In the second sequence, a situation is configured to check the underfrequency of element 81-2 whose adjustment is at 58.0 Hz and 1.0 second. In place of “Seq 002” write “81-2”. Then click on the highlighted button in the figure below.

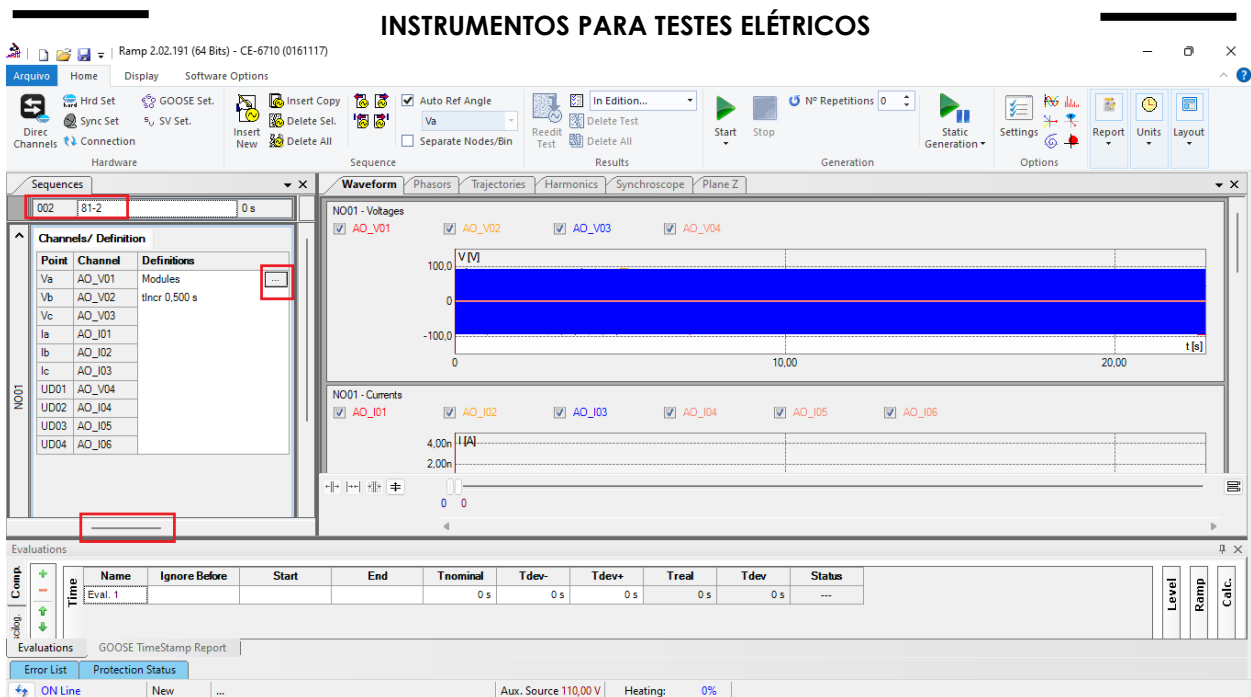


Figure 31

#### 8.4 Screen for increment 81-2

On this screen, in the “Ramp Type” field, choose the “Frequency” option then select the “Pulsed” option. For the voltage value either initial or reset, use the rated voltage of 66.4V balanced three-phase ABC. For the initial frequency use 58.02Hz and for the final frequency 57.98Hz with a step of -5.0mHz. In the field “Generation Time in Each Incr.” the user must configure a time that is always longer than the actuation time. In this case, a time of 1.25 seconds was chosen “Reset Time” has been set to 0.25 seconds.



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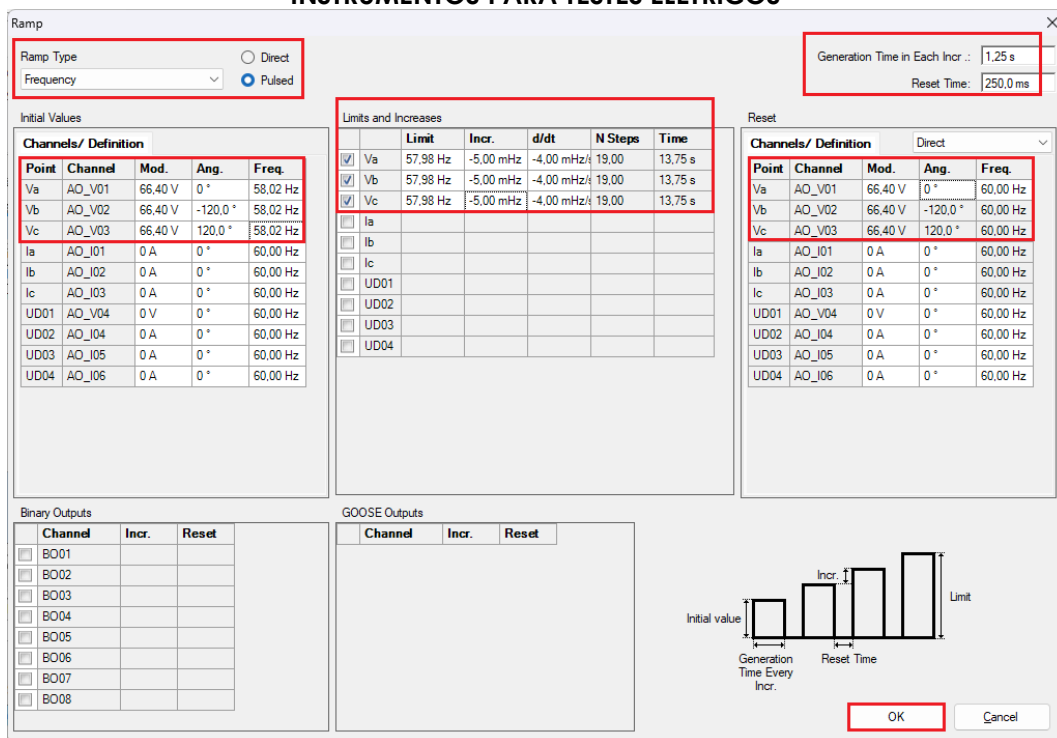


Figure 32

8.5 Main Screen 81-3

In the third sequence, configure a situation to check the overfrequency of element 81-3 whose adjustment is at 61.0 Hz and 2.0s. In place of “Seq 003” write “81-3”. Then click on the highlighted button in the figure below.

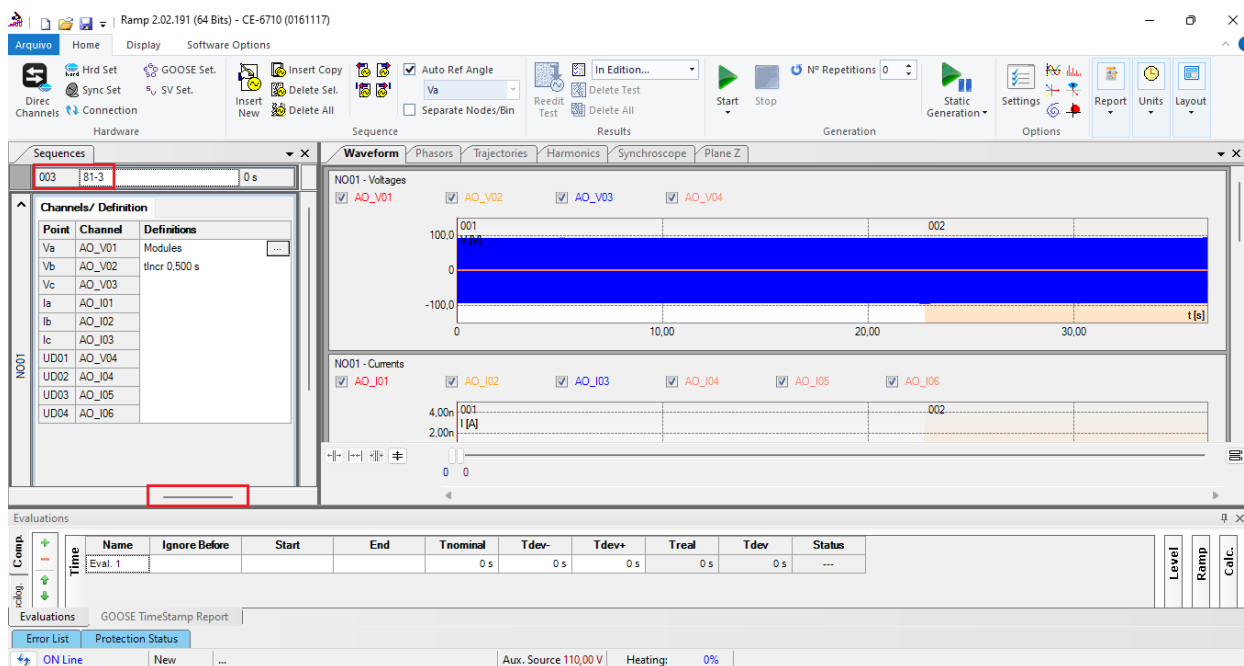


Figure 33

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8.6 Screen for incrementing 81-3

On this screen, in the “Ramp Type” field, choose the “Frequency” option and then select the “Pulsed” option. For the voltage value either initial or reset, use the rated voltage of 66.4V balanced three-phase ABC. For the initial frequency use 60.98 Hz and for the final frequency 61.02Hz with a step of 5.0mHz. In the field “Generation Time in Each Incr.” the user must configure a time that is always longer than the actuation time. In this case, a time of 2.25 seconds was chosen. “Reset Time” has been set to 0.25 seconds.

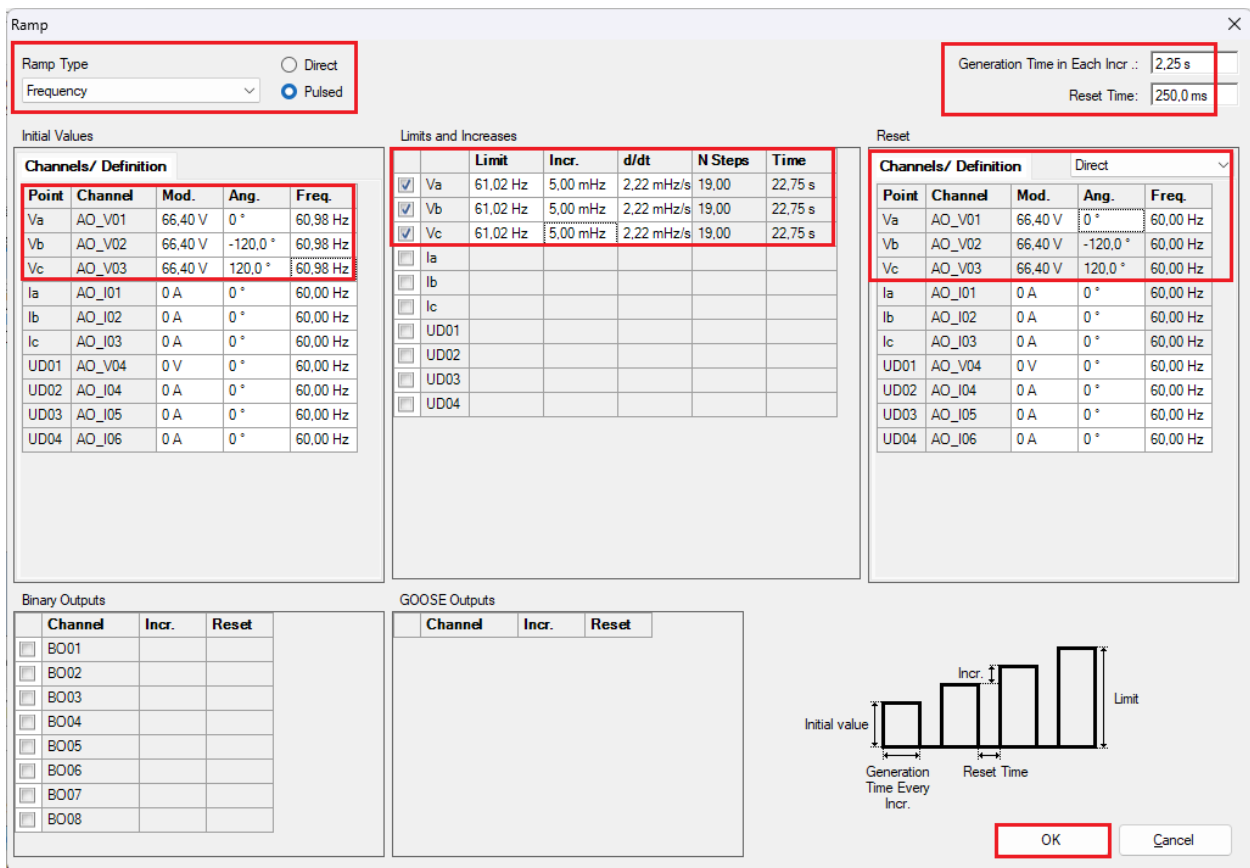
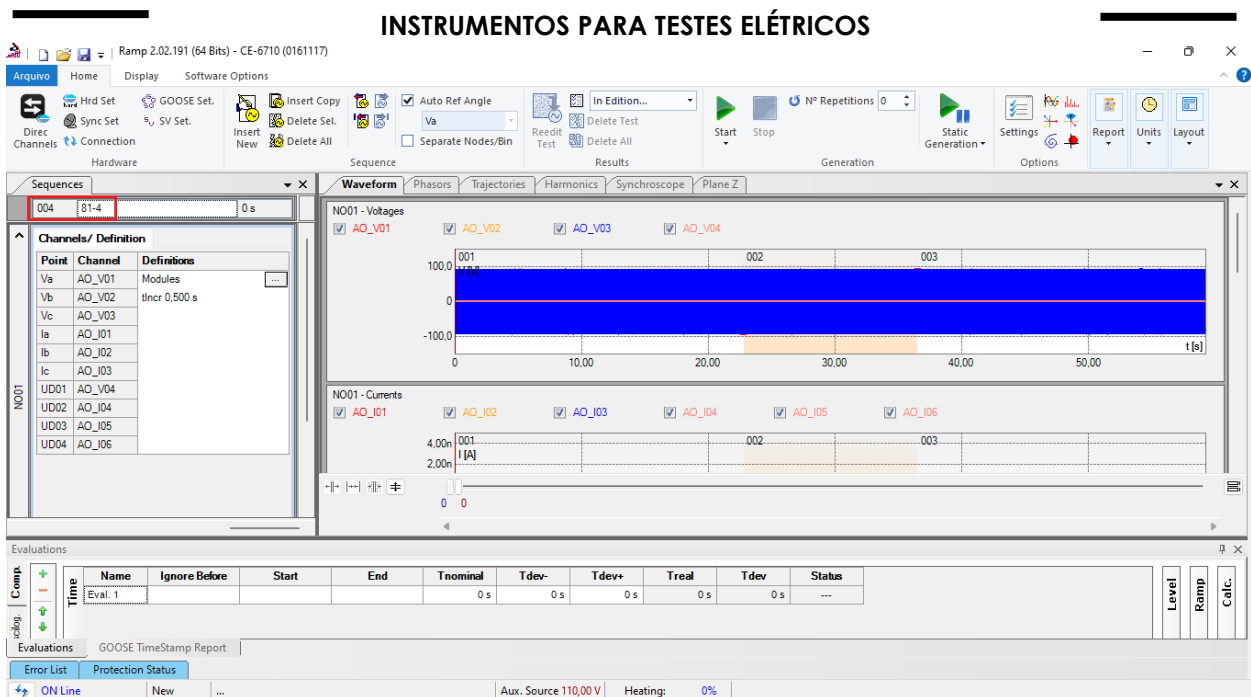


Figure 34

8.7 Main screen 81-4

In the fourth sequence, configure a situation to check the overfrequency of element 81-4 whose adjustment is at 62.0 Hz and 1.0s. In place of “Seq 004” write “81-4”. Then click on the highlighted button in the figure below.



**Figure 35**

### 8.8 Screen for incrementing 81-4

On this screen, in the “Ramp Type” field, choose the “Frequency” option then select the “Pulsed” option. For the voltage value, either initial or reset use the nominal voltage of 66.4V balanced three-phase ABC. For the initial frequency use 61.98 Hz and for the final frequency 62.02 Hz with a step of 5,0mHz. In the field “Generation Time in Each Incr.” the user must configure a time that is always longer than the actuation time. In this case, a time of 1.25 seconds was chosen. “Reset Time” has been set to 0.25 seconds.

**INSTRUMENTOS PARA TESTES ELÉTRICOS**

Ramp

Ramp Type:  Direct  Pulsed  
 Frequency:

Generation Time in Each Incr.:   
 Reset Time:

Initial Values

Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	66,40 V	0 °	61,98 Hz
Vb	AO_V02	66,40 V	-120,0 °	61,98 Hz
Vc	AO_V03	66,40 V	120,0 °	61,98 Hz
Ia	AO_I01	0 A	0 °	60,00 Hz
Ib	AO_I02	0 A	0 °	60,00 Hz
Ic	AO_I03	0 A	0 °	60,00 Hz
UD01	AO_V04	0 V	0 °	60,00 Hz
UD02	AO_I04	0 A	0 °	60,00 Hz
UD03	AO_I05	0 A	0 °	60,00 Hz
UD04	AO_I06	0 A	0 °	60,00 Hz

Limits and Increases

	Limit	Incr.	d/dt	N Steps	Time
<input checked="" type="checkbox"/> Va	62,02 Hz	5,00 mHz	4,00 mHz/s	19,00	13,75 s
<input checked="" type="checkbox"/> Vb	62,02 Hz	5,00 mHz	4,00 mHz/s	19,00	13,75 s
<input checked="" type="checkbox"/> Vc	62,02 Hz	5,00 mHz	4,00 mHz/s	19,00	13,75 s
<input type="checkbox"/> Ia					
<input type="checkbox"/> Ib					
<input type="checkbox"/> Ic					
<input type="checkbox"/> UD01					
<input type="checkbox"/> UD02					
<input type="checkbox"/> UD03					
<input type="checkbox"/> UD04					

Reset

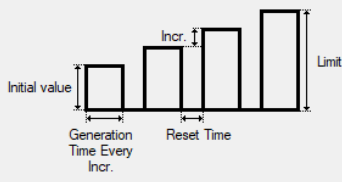
Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	66,40 V	0 °	60,00 Hz
Vb	AO_V02	66,40 V	-120,0 °	60,00 Hz
Vc	AO_V03	66,40 V	120,0 °	60,00 Hz
Ia	AO_I01	0 A	0 °	60,00 Hz
Ib	AO_I02	0 A	0 °	60,00 Hz
Ic	AO_I03	0 A	0 °	60,00 Hz
UD01	AO_V04	0 V	0 °	60,00 Hz
UD02	AO_I04	0 A	0 °	60,00 Hz
UD03	AO_I05	0 A	0 °	60,00 Hz
UD04	AO_I06	0 A	0 °	60,00 Hz

Binary Outputs

Channel	Incr.	Reset
<input type="checkbox"/> BO01		
<input type="checkbox"/> BO02		
<input type="checkbox"/> BO03		
<input type="checkbox"/> BO04		
<input type="checkbox"/> BO05		
<input type="checkbox"/> BO06		
<input type="checkbox"/> BO07		
<input type="checkbox"/> BO08		

GOOSE Outputs

Channel	Incr.	Reset



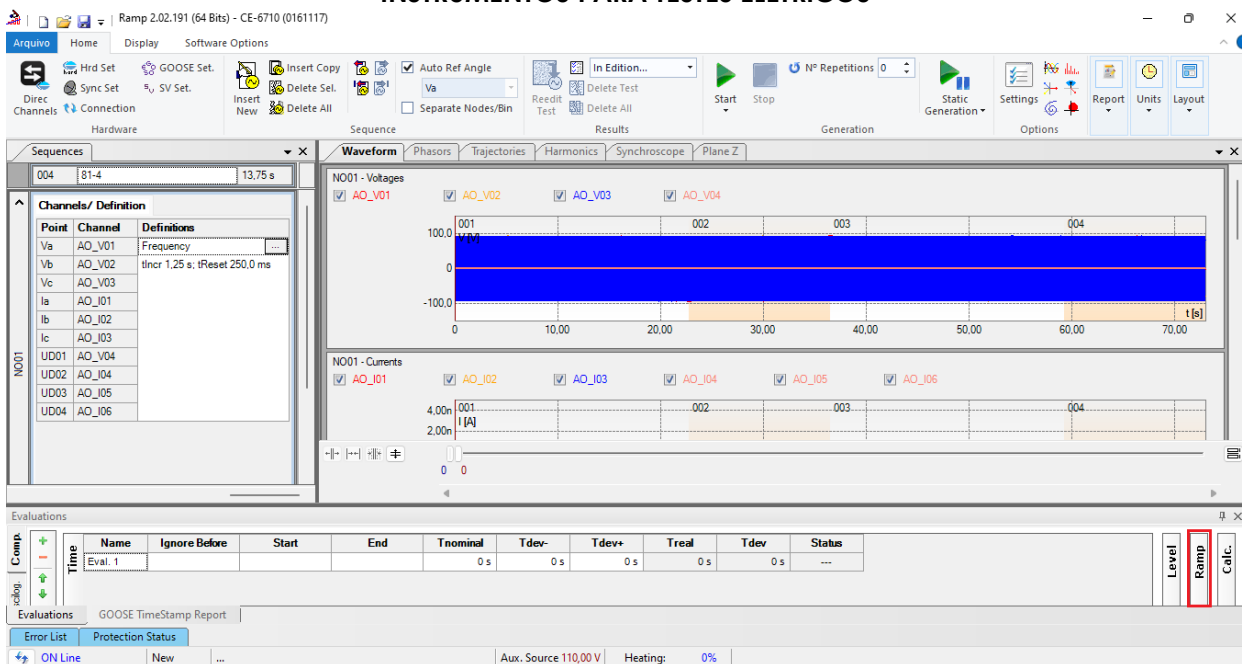
OK Cancel

Figure 36

**8.9 Evaluation of pick-ups**

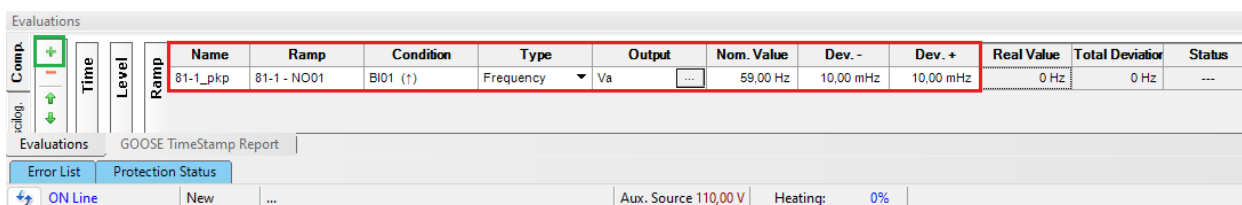
Clicking on the “Ramp” field, as shown in the next figure, you can configure 4 pick-up evaluations as follows.

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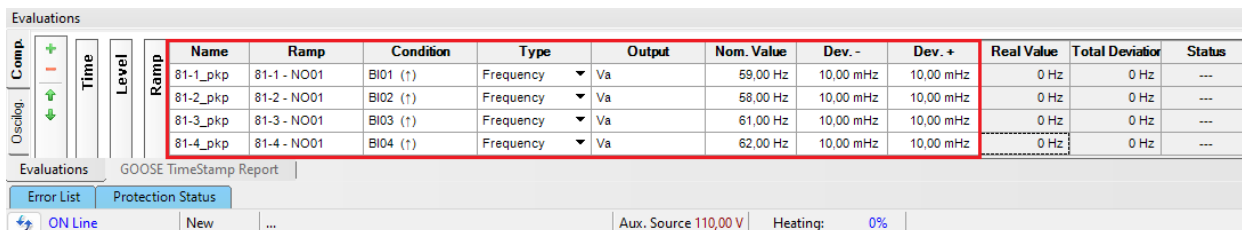
**Figure 37**

Instead of “Eval.1” write “81-1\_pkp”, in Ramp select “81-1 > NO01” for “Condition” set “BI01 (↑)”, for “Type” choose “Frequency”, for “Output” set “Va”, in the field “Nom Value” set 59.00Hz and in the fields related to deviations set 10mHz.



**Figure 38**

Clicking on the “+” icon of the previous figure inserts 3 more evaluations. The configuration must be done in a similar way to the first evaluation with changes in the binary inputs and values of the pick-ups.



**Figure 39**

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8.10 *Adjusting graphics*

Double click on the “Waveform” option of the right window and maximize the screen to choose the relevant signals and insert time analysis markings.

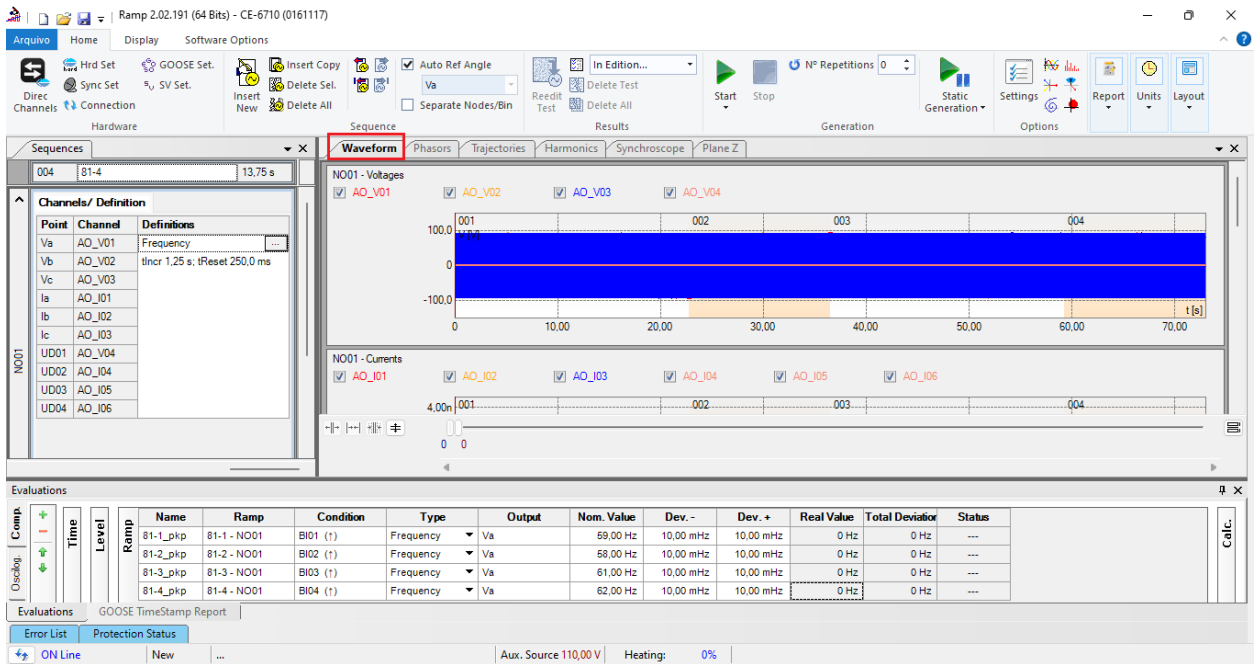


Figure 40

Right click on the voltage graph and choose the highlighted option.

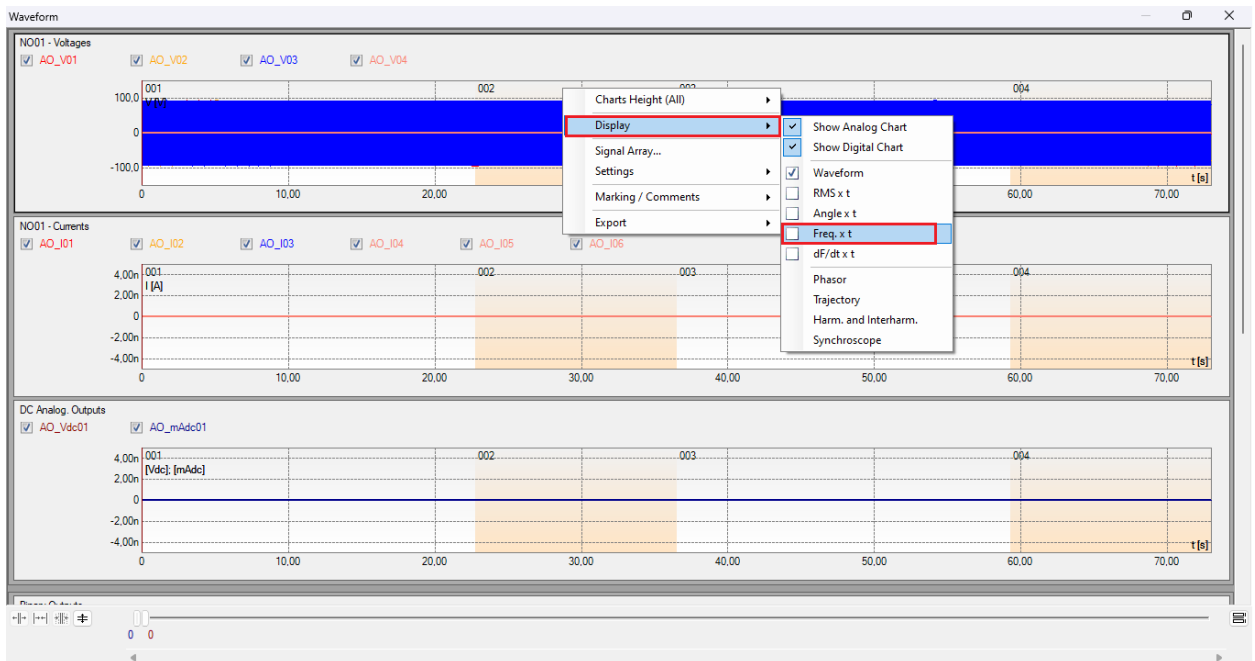
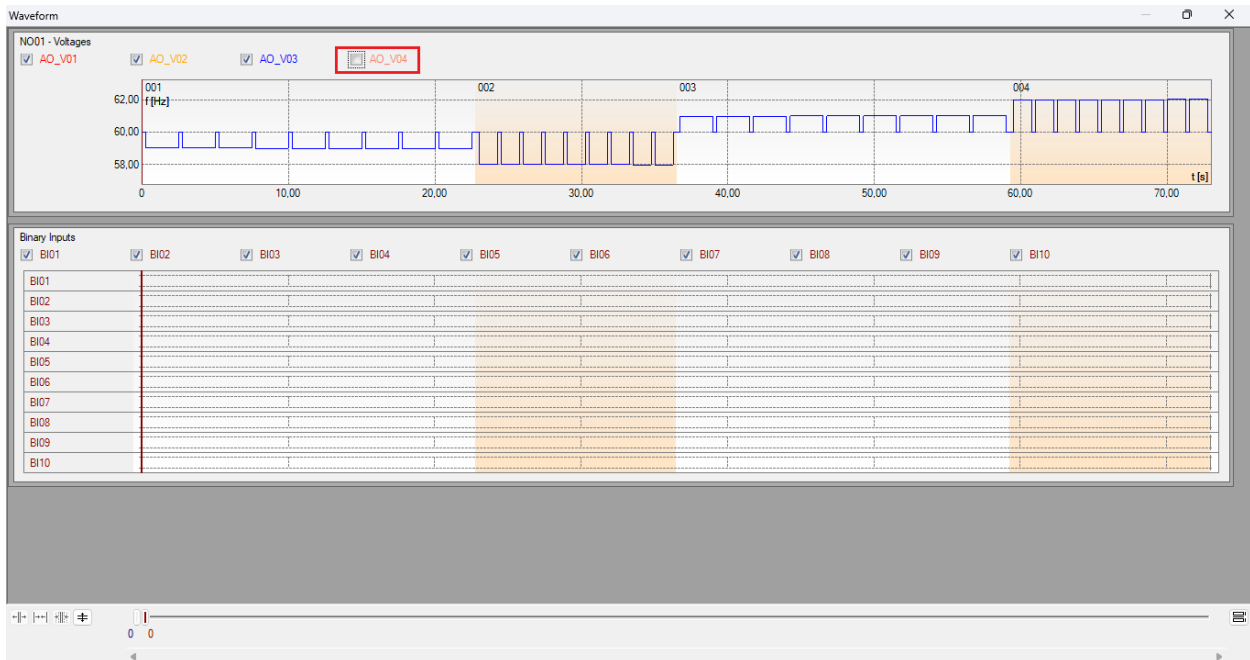


Figure 41

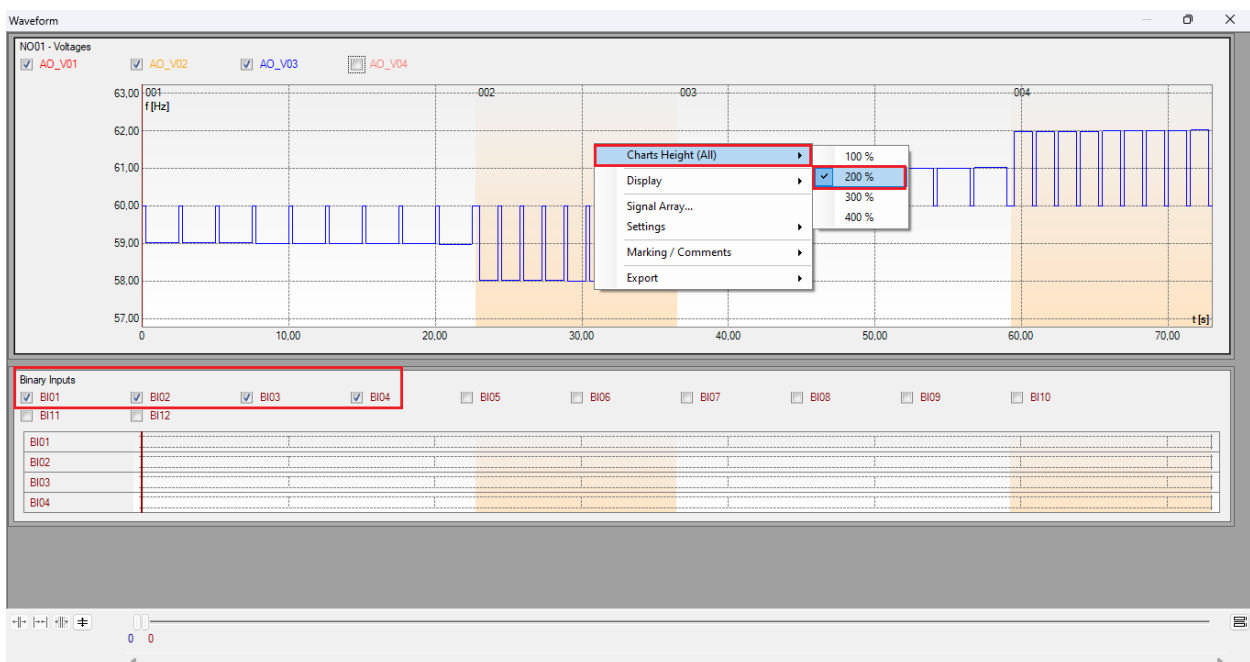
**INSTRUMENTOS PARA TESTES ELÉTRICOS**

Select the current graph and click on the “Delete” key repeat the procedure for the DC analog outputs and binary output graph. Uncheck the option “V04”.



**Figure 42**

Right click and increase the height of the graphics. The next step is to select only the binaries “BI01”, “BI02”, “BI03” and “BI04”.



**Figure 43**



### 8.11 *Time analysis*

To evaluate the time, the value of the frequency where the last increment or decrement of each sequence occurs must be marked. To find these values, cursors are used. If necessary, a zoom can be performed to verify the moment of time where the marking must be carried out. To do this, left-click and drag the desired region. To remove the zoom, just double-click on the graph. The following figure shows the time for the first two elements.

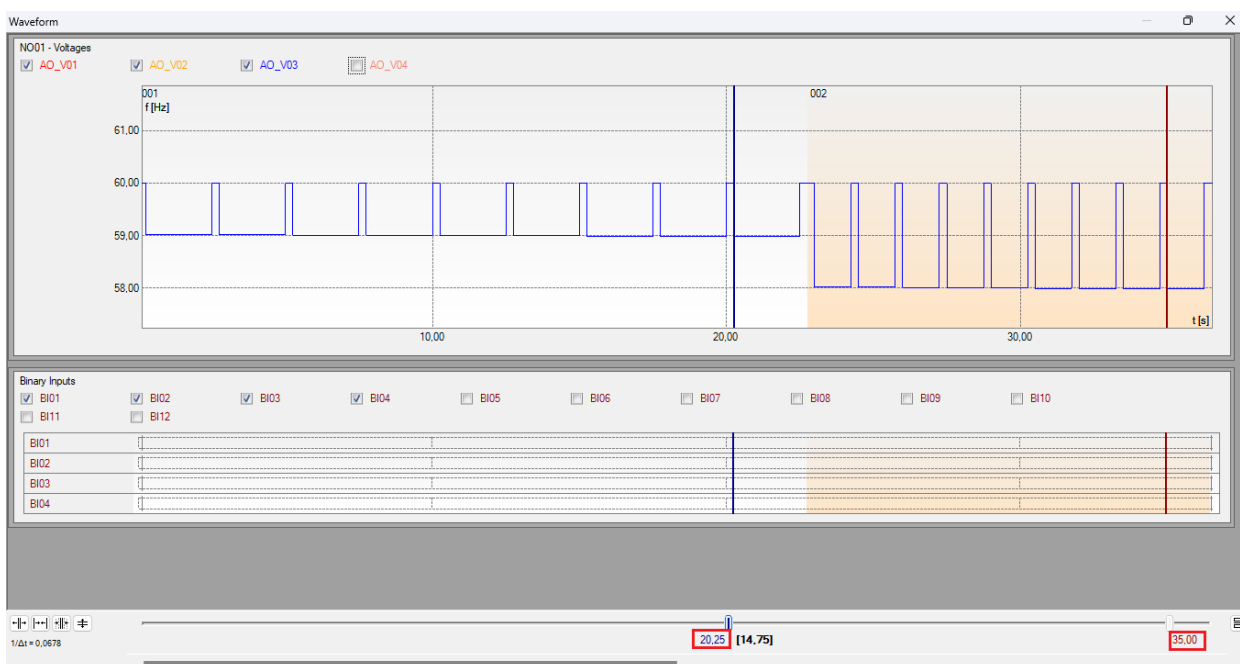


Figure 44

According to the previous figure, it can be concluded that the time for marking 1 is 20.25 seconds and for the second, 35.00 seconds. The next figure shows the position of the last two elements.

**INSTRUMENTOS PARA TESTES ELÉTRICOS**

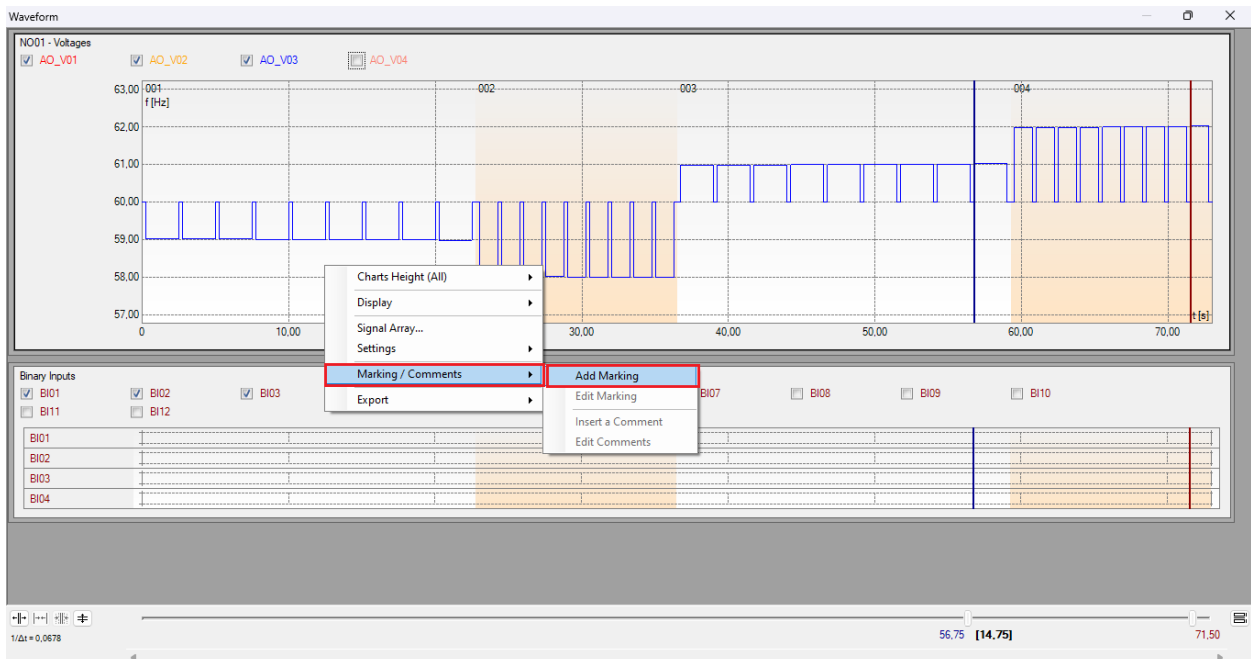


**Figure 45**

According to the previous figure, it can be concluded that the time for marking 3 is 56.75 seconds and for marking 4 it is 71.50 seconds.

## 8.12 *Inserting marking*

To insert the mark, right-click on the graphic and choose the following option.



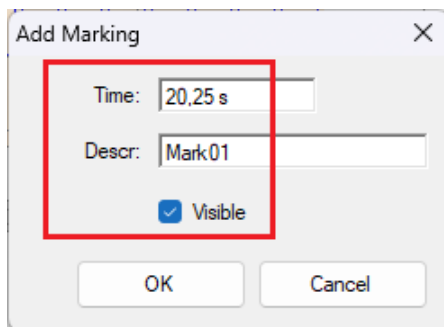
**Figure 46**

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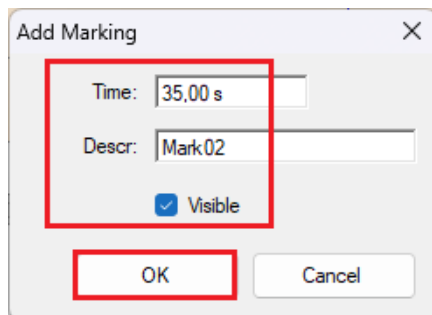
---

Adjust the first time and repeat the procedure for the other markings.



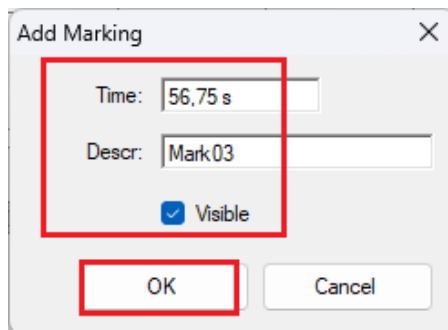
The screenshot shows a dialog box titled "Add Marking" with a close button (X) in the top right corner. It contains three input fields: "Time" with the value "20,25 s", "Descr" with the value "Mark01", and a checked checkbox labeled "Visible". The "Time" field, the "Descr" field, and the "Visible" checkbox are enclosed in a red rectangular box. At the bottom, there are two buttons: "OK" and "Cancel".

Figure 47



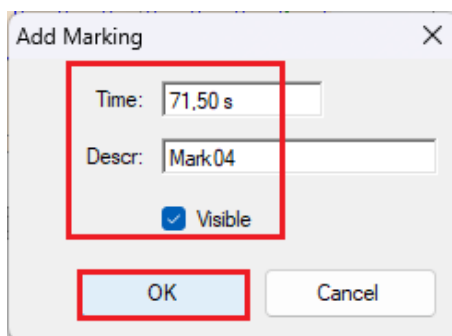
The screenshot shows a dialog box titled "Add Marking" with a close button (X) in the top right corner. It contains three input fields: "Time" with the value "35,00 s", "Descr" with the value "Mark02", and a checked checkbox labeled "Visible". The "Time" field, the "Descr" field, and the "Visible" checkbox are enclosed in a red rectangular box. The "OK" button at the bottom is also enclosed in a red rectangular box. There is a "Cancel" button to the right of the "OK" button.

Figure 48



The screenshot shows a dialog box titled "Add Marking" with a close button (X) in the top right corner. It contains three input fields: "Time" with the value "56,75 s", "Descr" with the value "Mark03", and a checked checkbox labeled "Visible". The "Time" field, the "Descr" field, and the "Visible" checkbox are enclosed in a red rectangular box. The "OK" button at the bottom is also enclosed in a red rectangular box. There is a "Cancel" button to the right of the "OK" button.

Figure 49



The screenshot shows a dialog box titled "Add Marking" with a close button (X) in the top right corner. It contains three input fields: "Time" with the value "71,50 s", "Descr" with the value "Mark04", and a checked checkbox labeled "Visible". The "Time" field, the "Descr" field, and the "Visible" checkbox are enclosed in a red rectangular box. The "OK" button at the bottom is also enclosed in a red rectangular box. There is a "Cancel" button to the right of the "OK" button.

Figure 50

### INSTRUMENTOS PARA TESTES ELÉTRICOS

The markings are shown in the following figure. To return this window to its initial position, double-click on the top bar (highlighted in green).

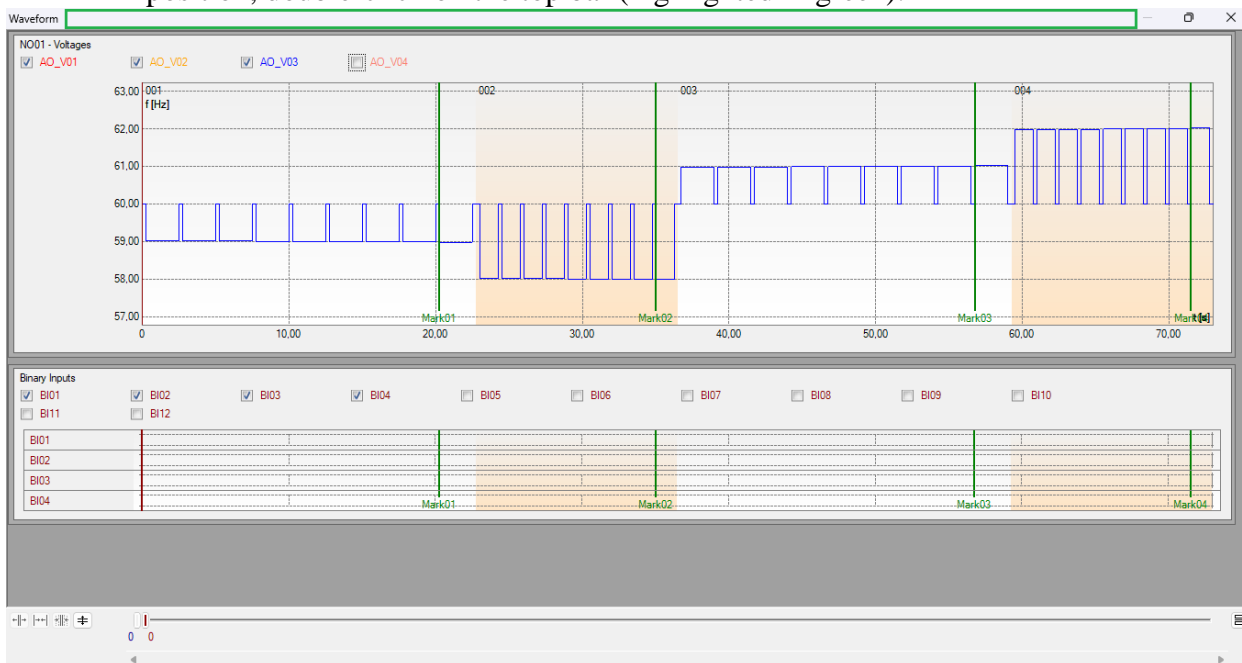


Figure 51

### 8.13 Time evaluation

Clicking on the “Time” field, as shown in the next figure, you can configure 4 time evaluations of operations as follows.

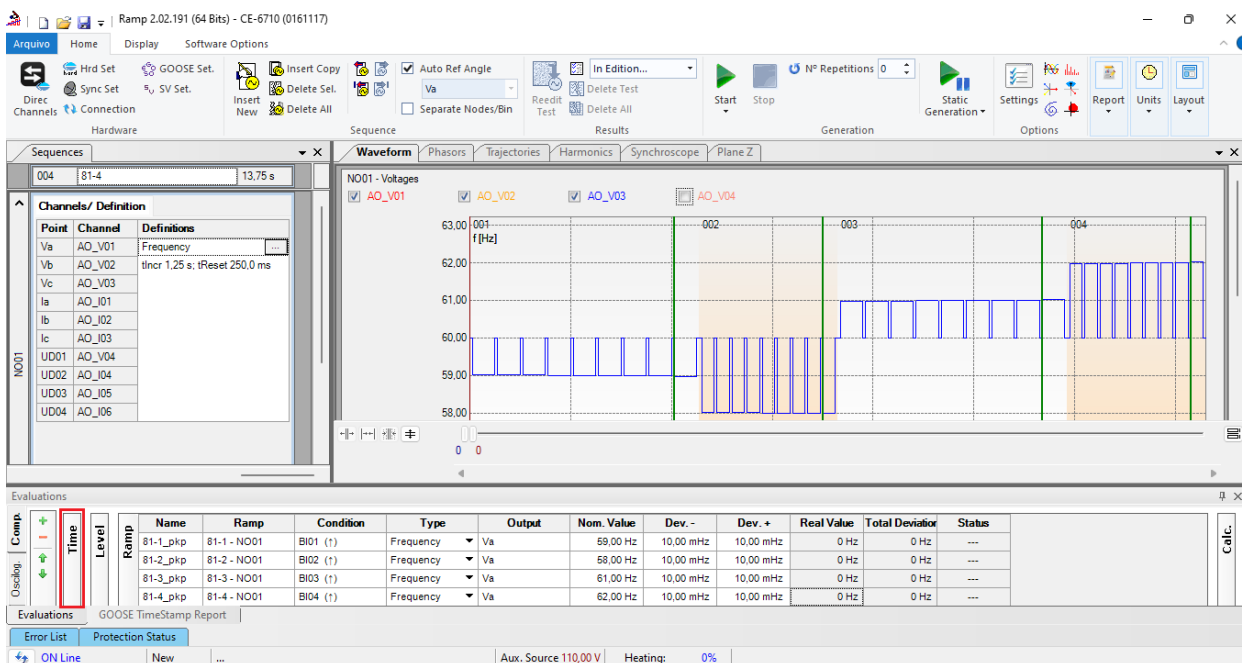
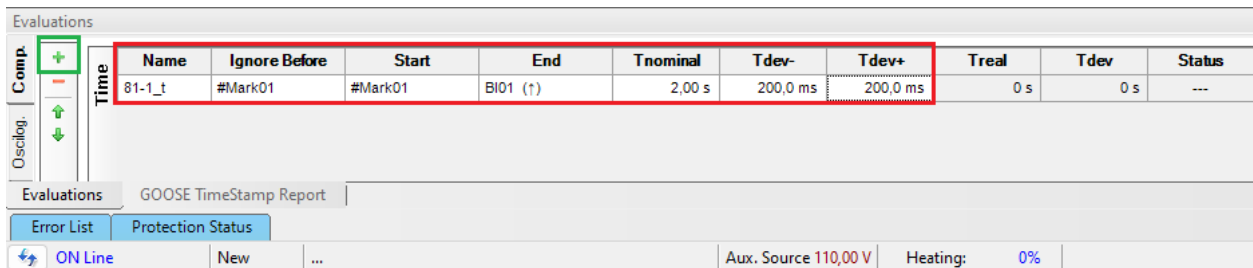


Figure 52

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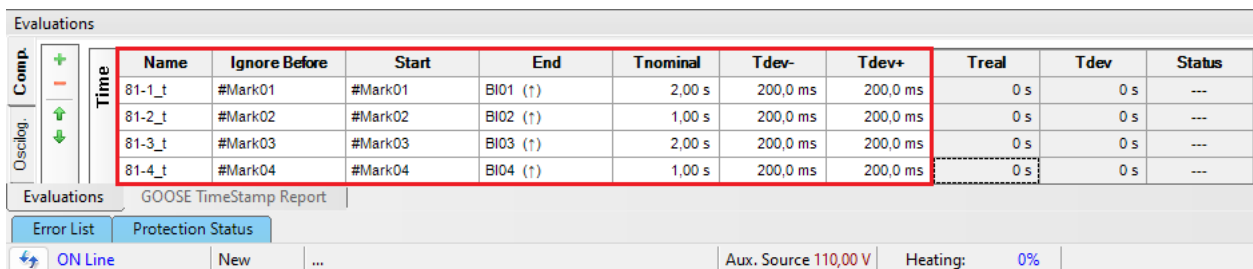
Change the name “*Eval. 1*” to “*81-1\_t*” in the “*Ignore before*” option choose “*Tagging > Mark01*” in the “*Start*” option choose “*Tagging > Mark01*” in the “*End*” option choose “*Binary Input > BI01 (↑)*”. In nominal time, set 2.0s with deviations of 200ms. The figure below shows these settings.



Name	Ignore Before	Start	End	Tnominal	Tdev-	Tdev+	Treal	Tdev	Status
81-1_t	#Mark01	#Mark01	BI01 (↑)	2,00 s	200,0 ms	200,0 ms	0 s	0 s	---

**Figure 53**

By clicking on the “+” icon, 3 more evaluations are added and their adjustments are made in a similar way to the first evaluation.



Name	Ignore Before	Start	End	Tnominal	Tdev-	Tdev+	Treal	Tdev	Status
81-1_t	#Mark01	#Mark01	BI01 (↑)	2,00 s	200,0 ms	200,0 ms	0 s	0 s	---
81-2_t	#Mark02	#Mark02	BI02 (↑)	1,00 s	200,0 ms	200,0 ms	0 s	0 s	---
81-3_t	#Mark03	#Mark03	BI03 (↑)	2,00 s	200,0 ms	200,0 ms	0 s	0 s	---
81-4_t	#Mark04	#Mark04	BI04 (↑)	1,00 s	200,0 ms	200,0 ms	0 s	0 s	---

**Figure 54**

Use the command “*Alt + G*” to start the generation. The next figure shows the result with the pickup values found.

### INSTRUMENTOS PARA TESTES ELÉTRICOS

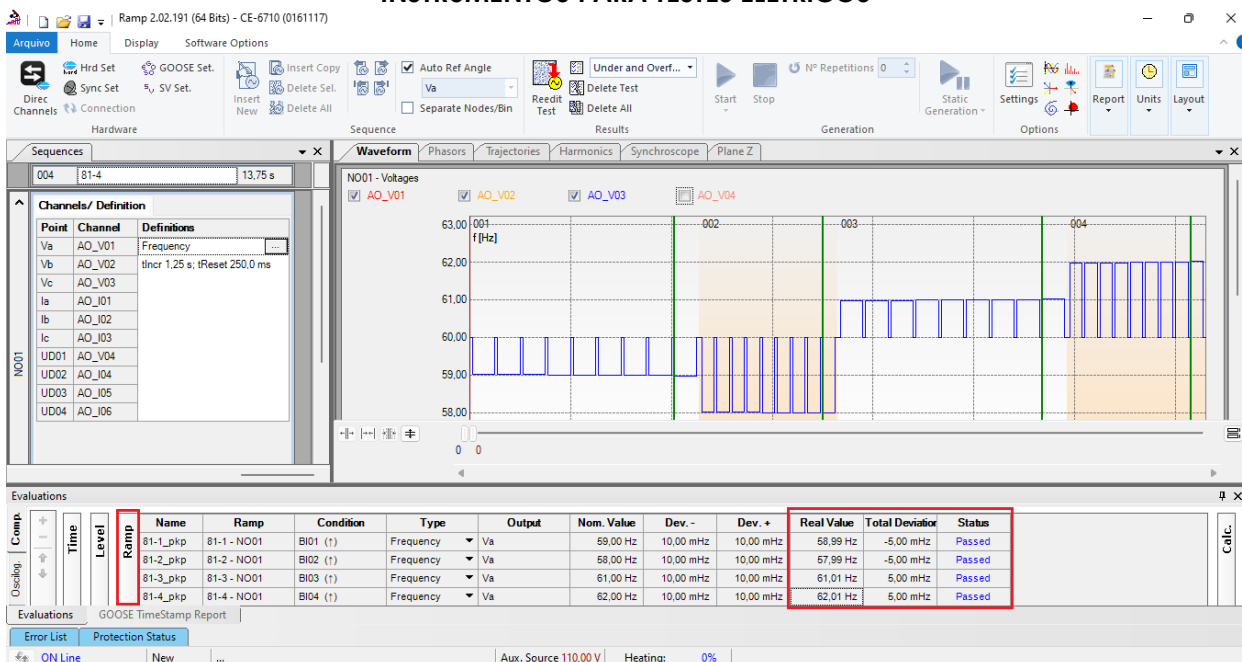


Figure 55

The following figure shows the operating times.

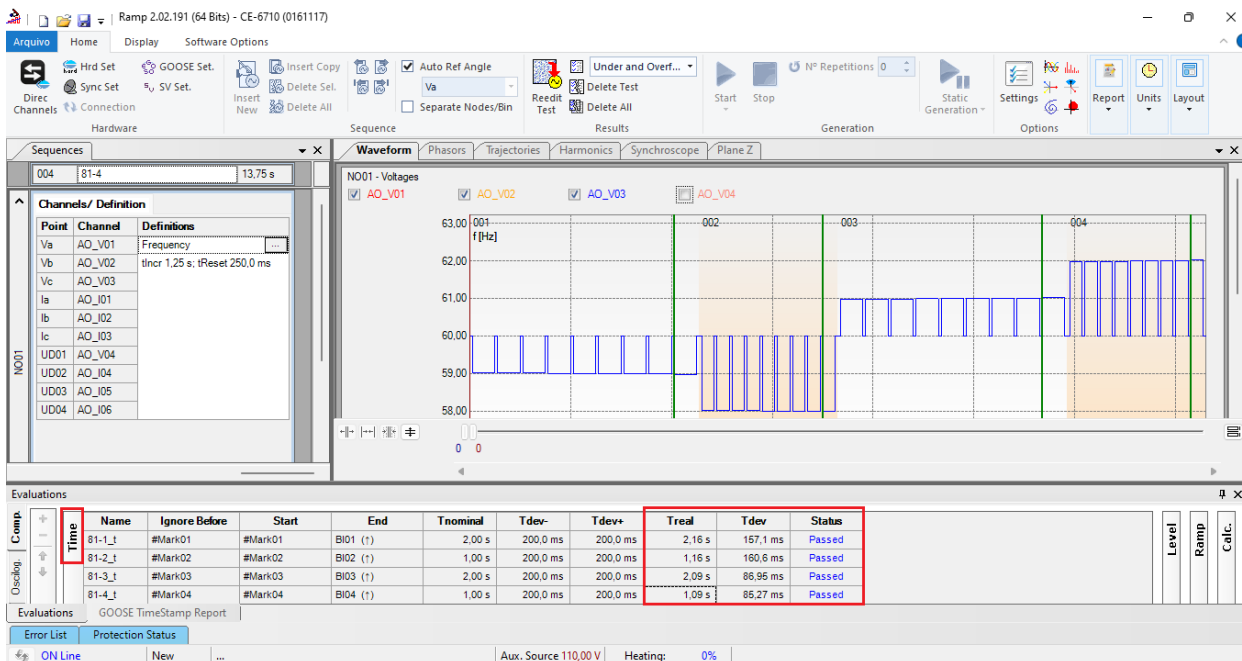


Figure 56

9. Report

After finishing the test, click on the icon highlighted in the previous figure or through the command “Ctrl +R” to call up the report pre-configuration screen. Choose the desired language as well as the options that should be part of the report.

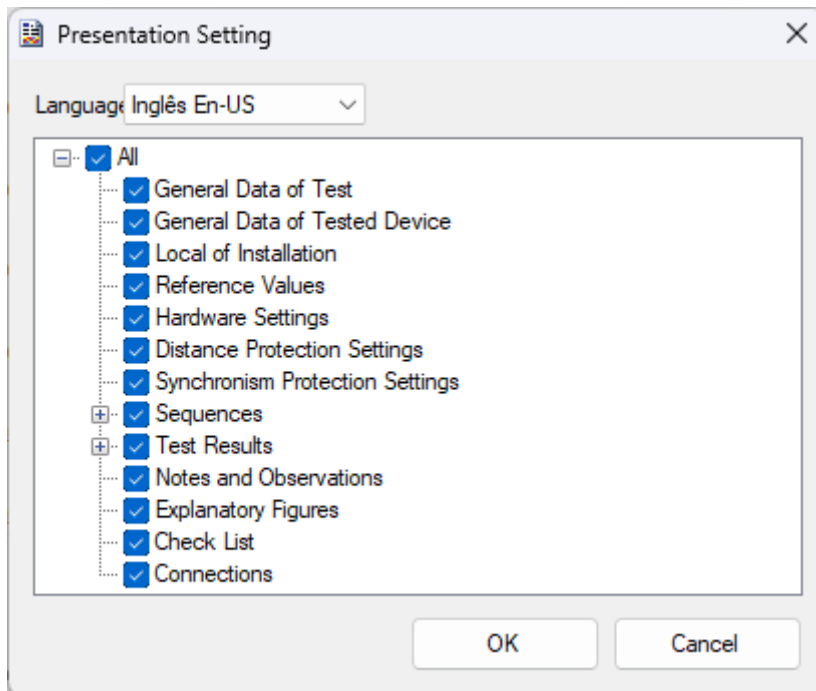


Figure 57

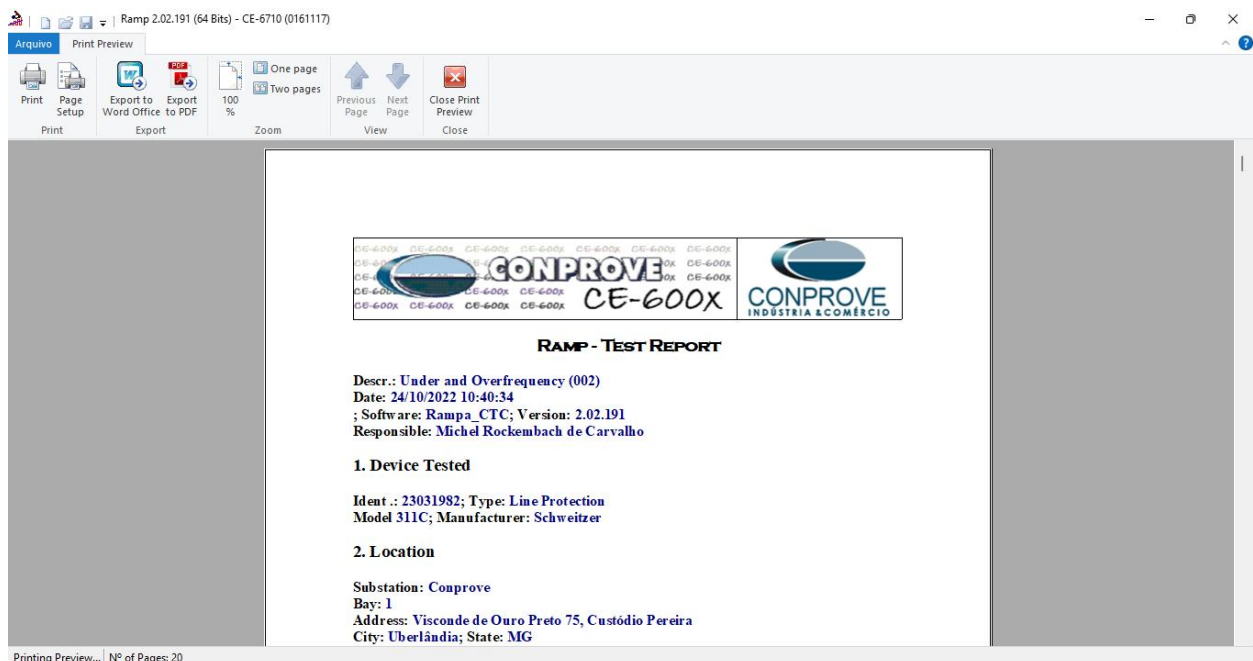


Figure 58



INSTRUMENTOS PARA TESTES ELÉTRICOS

APPENDIX A

A.1 Terminal Designations

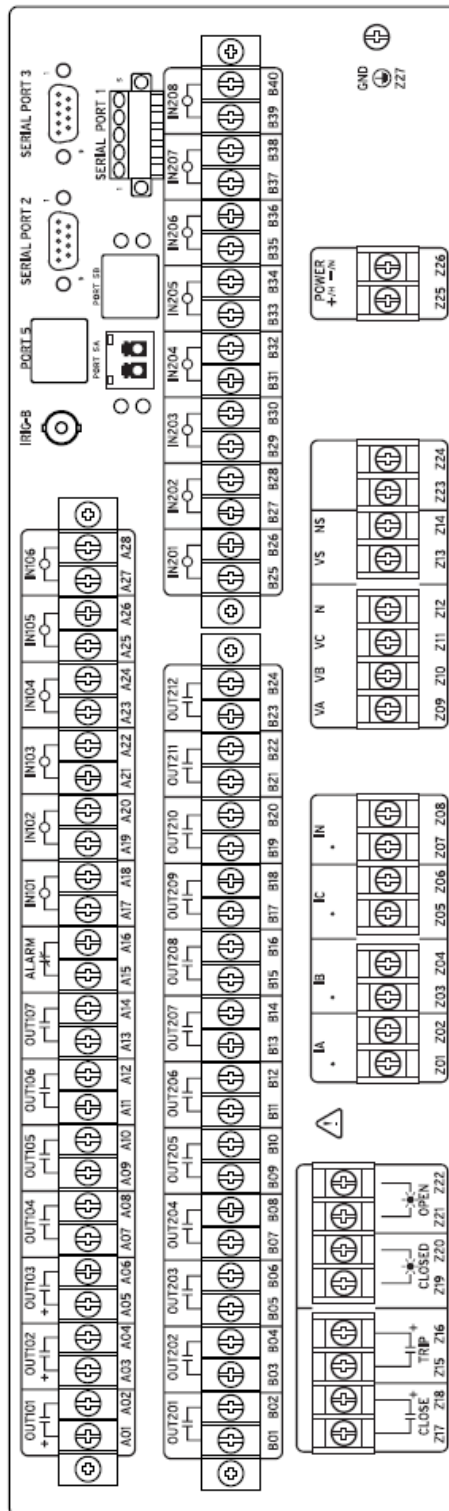


Figure 59

**A.2 Technical data**

**Under- and Overfrequency Elements**

Pickup Range: 40.10–65.00 Hz, 0.01 Hz steps  
 Steady-State *plus*  
 Transient Overshoot:  $\pm 0.01$  Hz for 1 Hz step change  
 Pickup/Dropout Time: Maximum instantaneous element response time to a step change in frequency (dF)

**APPENDIX B**

Equivalence of software parameters and the relay under test.

Table 1

Ramp Software		SEL 311C Relay	
Parameter	Figure	Parameter	Figure
81-1_pkp	39	81D1P Level 1 Pickup	11
81-2_pkp	39	81D2P Level 2 Pickup	11
81-3_pkp	39	81D3P Level 3 Pickup	11
81-4_pkp	39	81D4P Level 4 Pickup	12
81-1_t	54	81D1D Level 1 Time Delay	11
81-2_t	54	81D2D Level 2 Time Delay	11
81-3_t	54	81D3D Level 3 Time Delay	11
81-4_t	54	81D4D Level 4 Time Delay	12