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INSTRUMENTOS PARA TESTES ELÉTRICOS

# Test Tutorial

**Equipment Type:** Protection Relay

**Brand:** GE

**Model:** D60

**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	22/11/2022	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 D60 relay in the Ramp software**

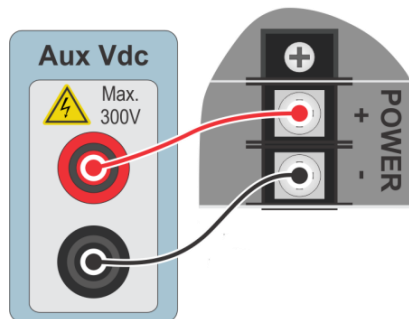
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**1. Relay connection to CE-6710**

Appendix A-1 shows the relay terminal designations.

**1.1 Auxiliary Source**

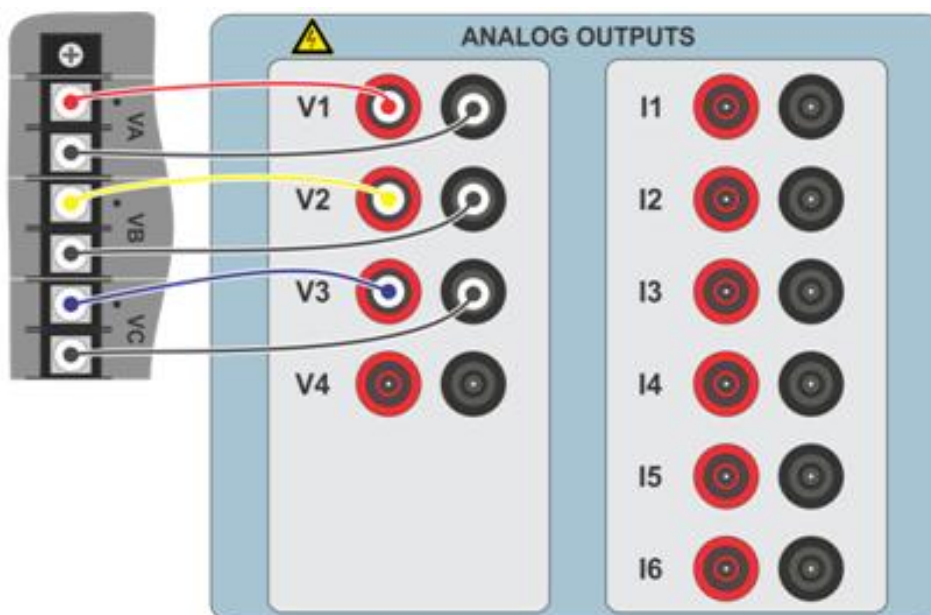
Connect the positive (red terminal) of the Auxiliary Source to relay pin B5b and the negative (black terminal) of the Auxiliary Source to relay pin B6a.



**Figure 1**

**1.2 Voltage Coils**

To connect the voltage coils, connect the voltage channels V1, V2 and V3 to the relay pins F5a, F6a and F7a and connect the commons of the voltage channels to the relay pins F5c, F6c and F7c.



**Figure 2**

### 1.3 Binary Inputs

Connect the CE-6710's binary inputs to the relay's binary outputs.

- BI1 to pin P1b and its common to pin P1c.
- BI2 to pin P2b and its common to pin P2c.
- BI3 to pin P3b and its common to pin P3c.
- BI4 to pin P4b and its common to pin P4c.

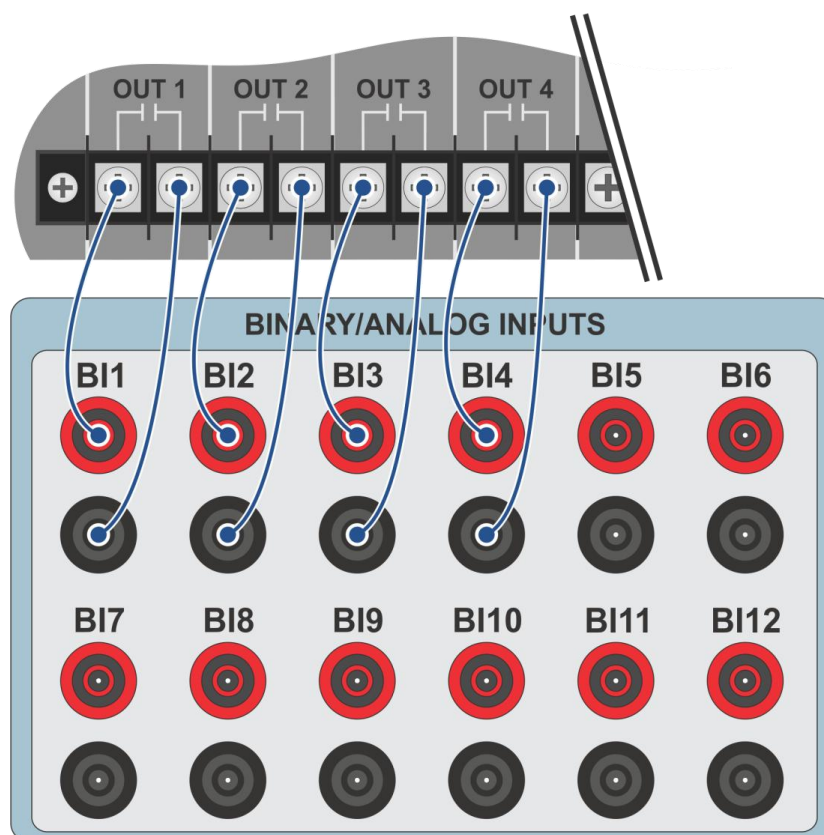


Figure 3

## 2. Communication with the D60 relay

Before starting the D60 relay test, open the “*EnerVista*” software and download the “*UR*” series software, if you already have it click directly on:

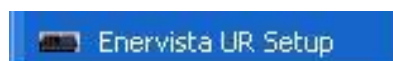


Figure 4

Check the relay IP and adjust this value in “*Device Setup*” after entering a new system. Then read the relay code by clicking on “*Read Order Code*” and finish by clicking on “*OK*”.

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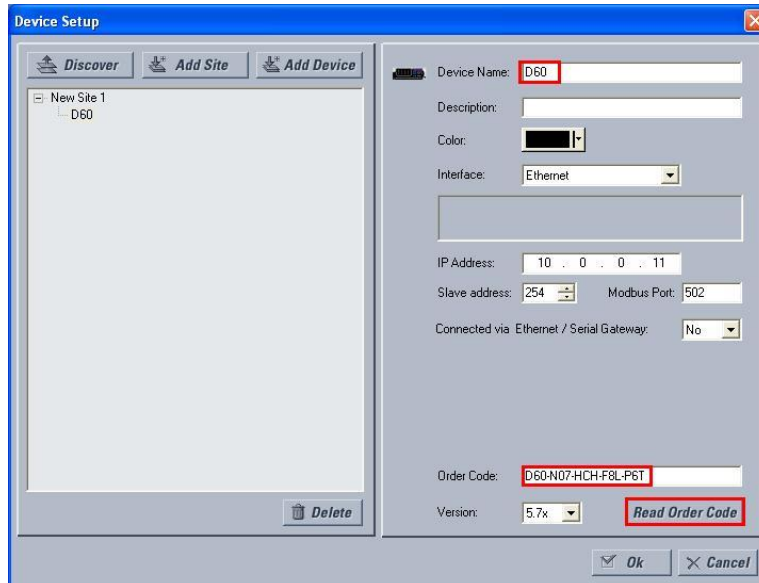


Figure 5

Then click on “New Site 1” and “D60” to access the relay configuration and close the “Offline Window” by clicking on the button highlighted in green.



Figure 6

### 3. D60 relay parameterization

#### 3.1 Voltage

After the connection has been established, click on the “+” signs next to “Settings > System Setup > AC Input” and double-click on “Voltage” and adjust the primary and secondary voltage values of the transformer of potential.

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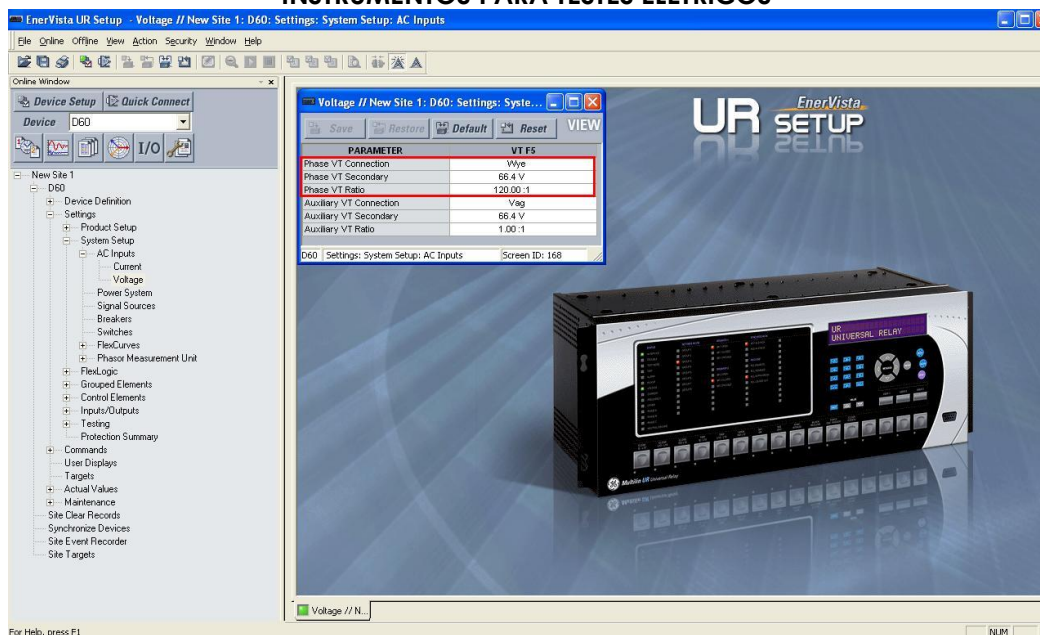


Figure 7

### 3.2 Power system

In this field, the nominal frequency, the phase sequence and the side used as reference are set.

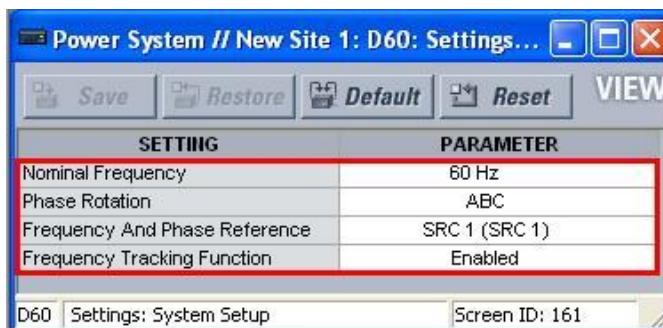


Figure 8

### 3.3 Signal Source

Set the potential transformer to "F5".

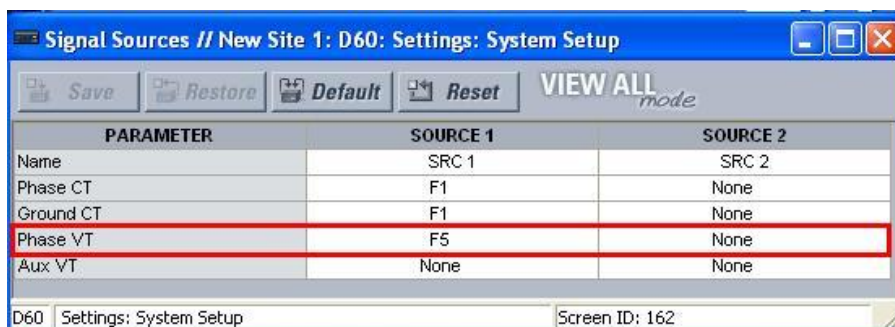


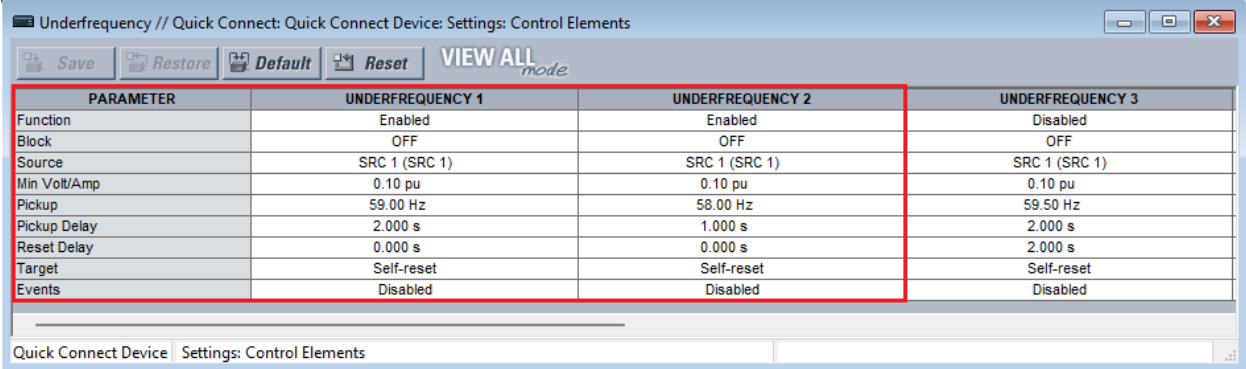
Figure 9



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**3.4 Underfrequency**

Click on the “+” sign next to “Control Elements” and double click on “Underfrequency”. This option allows you to activate up to six underfrequency elements. In this tutorial two elements are used. You must adjust the pickup value and the actuation time.

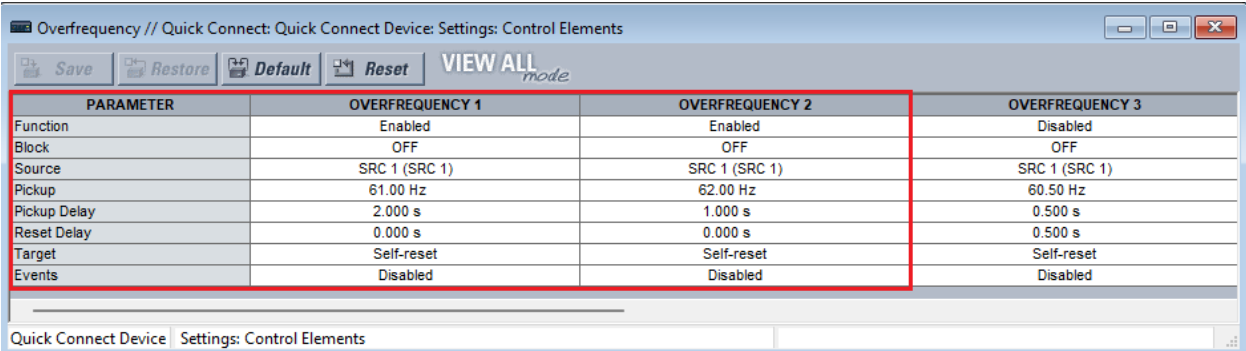


PARAMETER	UNDERFREQUENCY 1	UNDERFREQUENCY 2	UNDERFREQUENCY 3
Function	Enabled	Enabled	Disabled
Block	OFF	OFF	OFF
Source	SRC 1 (SRC 1)	SRC 1 (SRC 1)	SRC 1 (SRC 1)
Min Volt/Amp	0.10 pu	0.10 pu	0.10 pu
Pickup	59.00 Hz	58.00 Hz	59.50 Hz
Pickup Delay	2.000 s	1.000 s	2.000 s
Reset Delay	0.000 s	0.000 s	2.000 s
Target	Self-reset	Self-reset	Self-reset
Events	Disabled	Disabled	Disabled

**Figure 10**

**3.5 Overfrequency**

Double-click on “Overfrequency” and adjust the overfrequency elements.



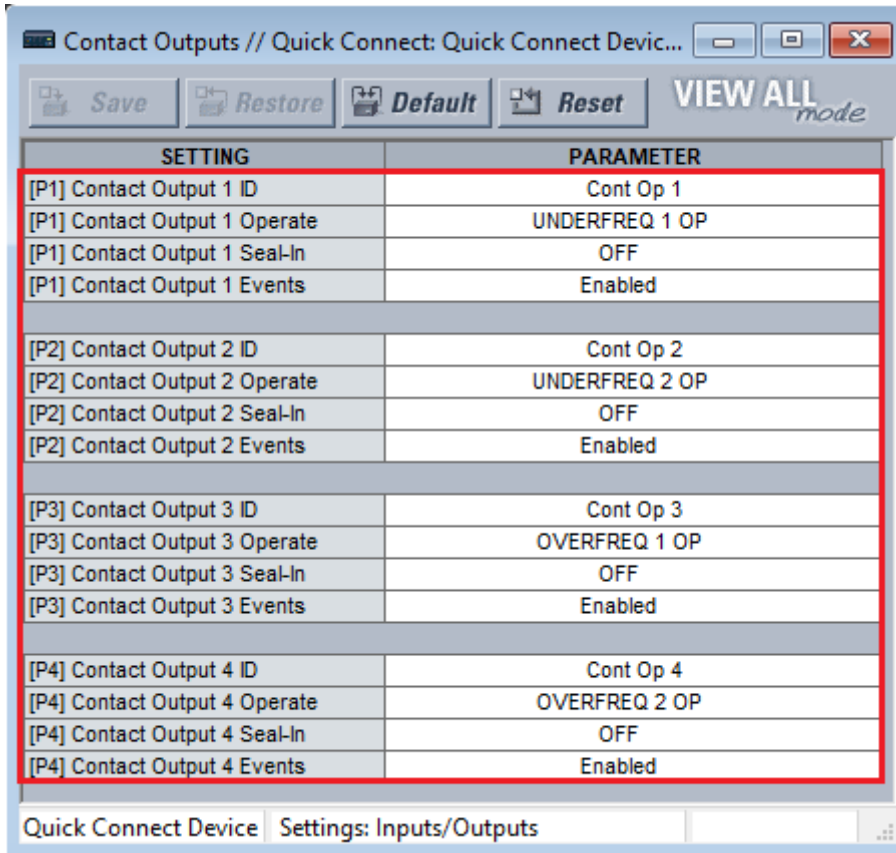
PARAMETER	OVERFREQUENCY 1	OVERFREQUENCY 2	OVERFREQUENCY 3
Function	Enabled	Enabled	Disabled
Block	OFF	OFF	OFF
Source	SRC 1 (SRC 1)	SRC 1 (SRC 1)	SRC 1 (SRC 1)
Pickup	61.00 Hz	62.00 Hz	60.50 Hz
Pickup Delay	2.000 s	1.000 s	0.500 s
Reset Delay	0.000 s	0.000 s	0.500 s
Target	Self-reset	Self-reset	Self-reset
Events	Disabled	Disabled	Disabled

**Figure 11**

**3.6 Contact Outputs**

Click the “+” next to “Inputs/Outputs” and double-click “Contact Outputs”. On this screen, the trips of the functions are assigned to the binary outputs of the relay.

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SETTING	PARAMETER
[P1] Contact Output 1 ID	Cont Op 1
[P1] Contact Output 1 Operate	UNDERFREQ 1 OP
[P1] Contact Output 1 Seal-In	OFF
[P1] Contact Output 1 Events	Enabled
[P2] Contact Output 2 ID	Cont Op 2
[P2] Contact Output 2 Operate	UNDERFREQ 2 OP
[P2] Contact Output 2 Seal-In	OFF
[P2] Contact Output 2 Events	Enabled
[P3] Contact Output 3 ID	Cont Op 3
[P3] Contact Output 3 Operate	OVERFREQ 1 OP
[P3] Contact Output 3 Seal-In	OFF
[P3] Contact Output 3 Events	Enabled
[P4] Contact Output 4 ID	Cont Op 4
[P4] Contact Output 4 Operate	OVERFREQ 2 OP
[P4] Contact Output 4 Seal-In	OFF
[P4] Contact Output 4 Events	Enabled

Figure 12

In Appendix B, the user will find an equivalence table between the software settings of the relay and the test set.

#### 4. Ramp software adjustments

##### 4.1 Opening the ramp

Click on the “CTC” application manager icon.



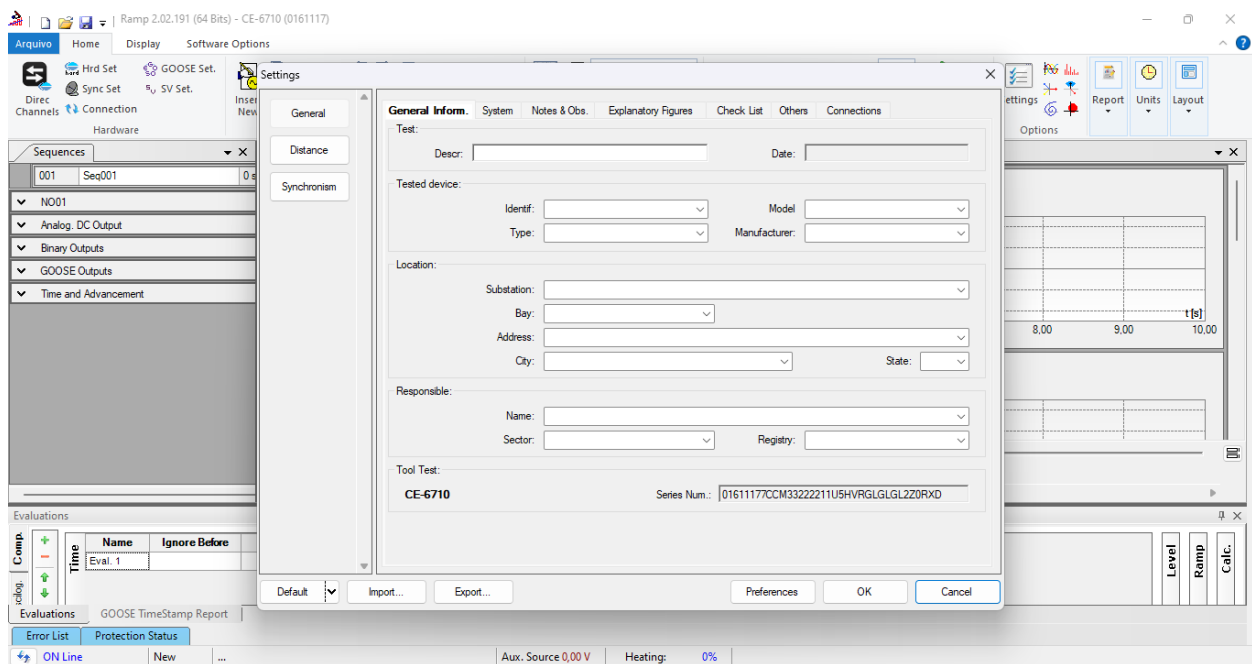
Figure 13

Click on the “Ramp” software icon.

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**Figure 14**



**Figure 15**

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### 4.2 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.

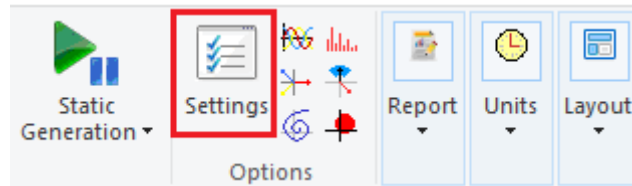


Figure 16

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.

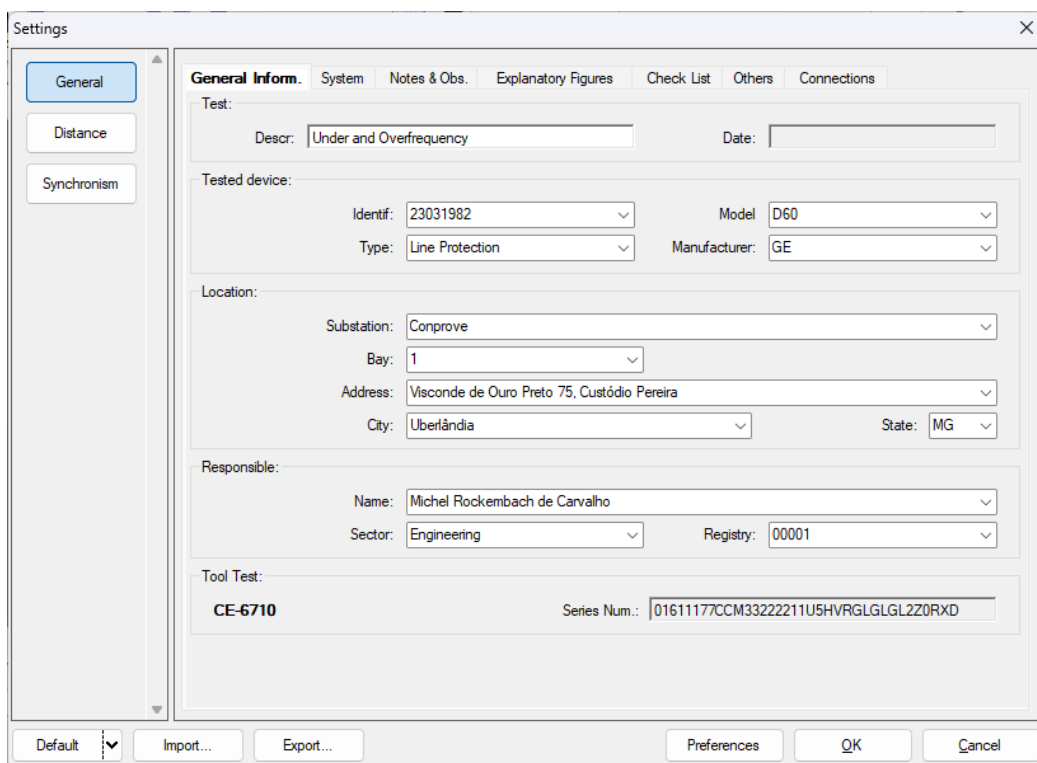
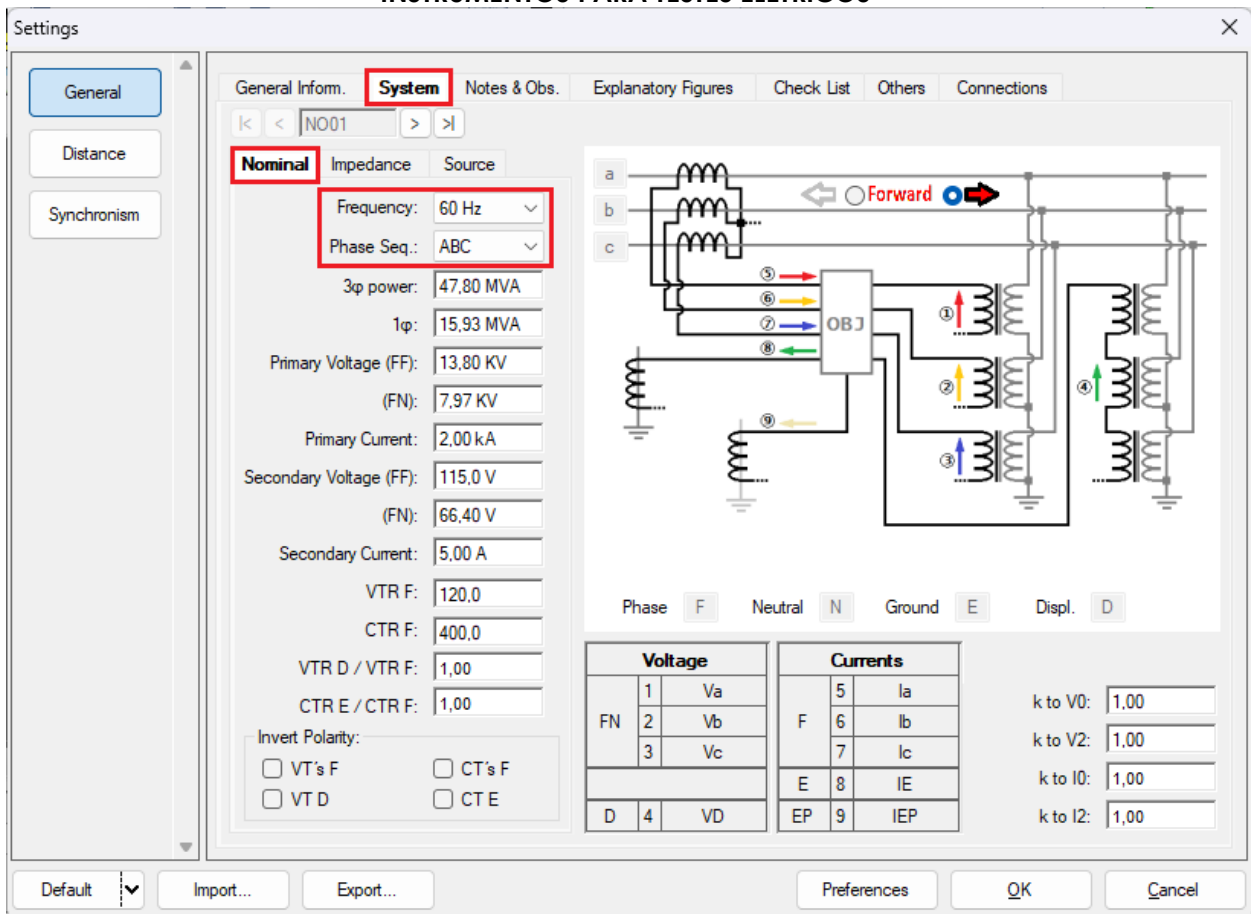


Figure 17

### 4.3 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.

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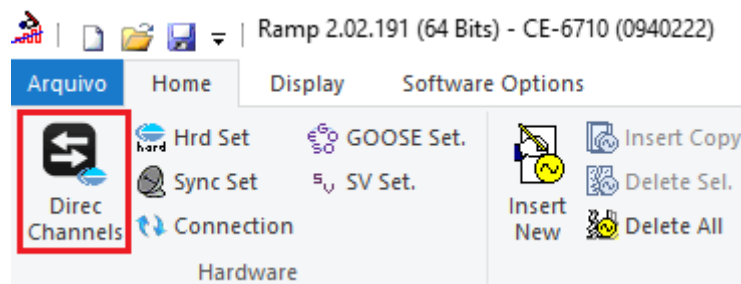


**Figure 18**

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.

## 5. Channel Direction 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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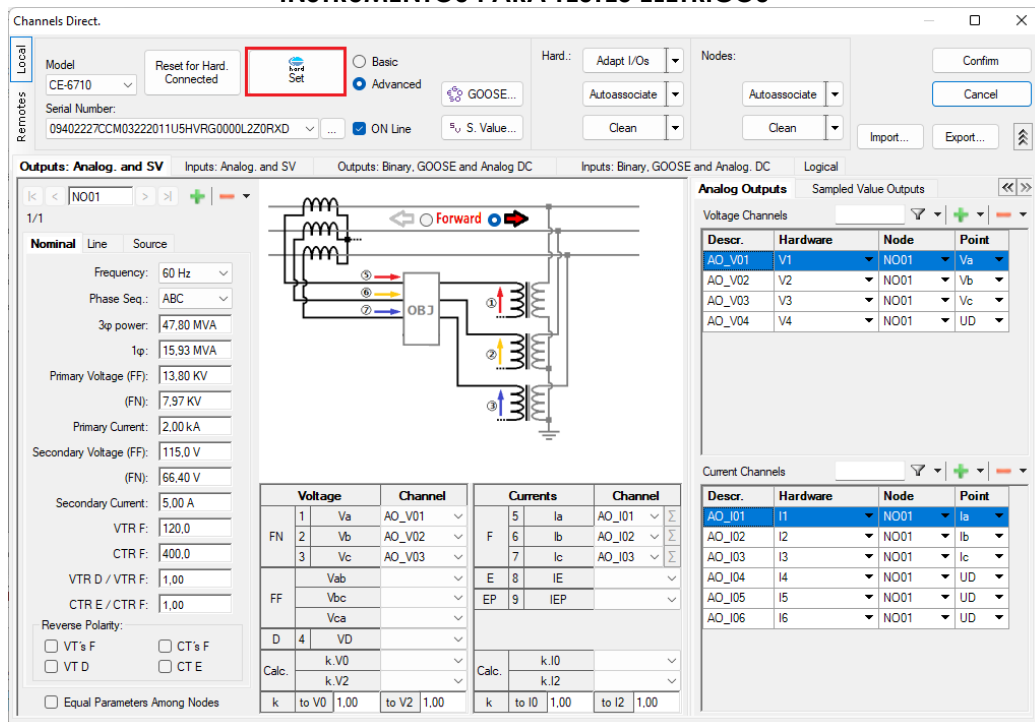
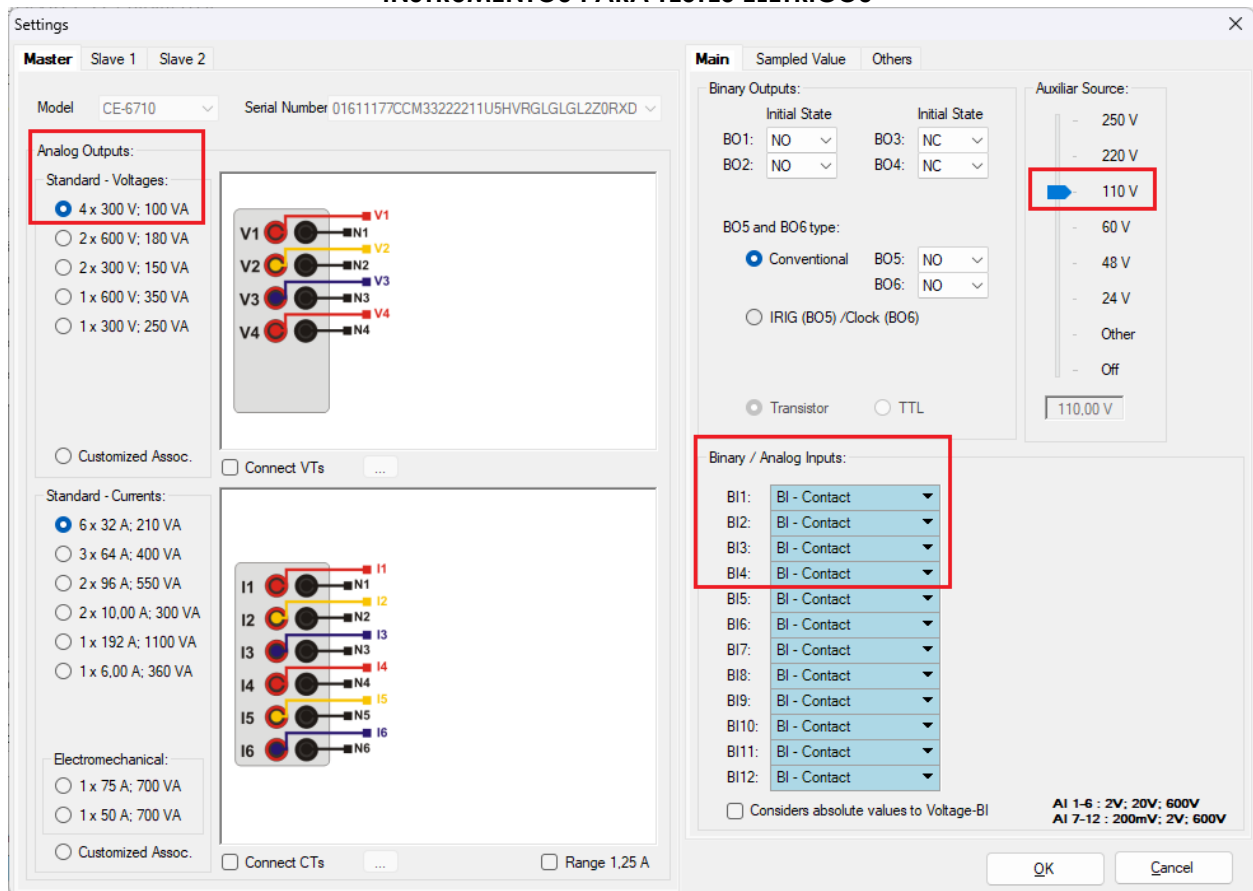


Figure 20

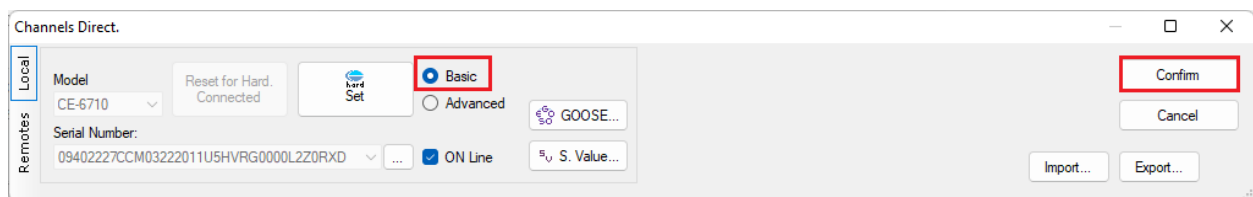
Choose channel configuration, adjust auxiliary source and stop method of binary inputs. Finally, click on "OK".

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**Figure 21**

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



**Figure 22**

## 6. 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.

### INSTRUMENTOS PARA TESTES ELÉTRICOS

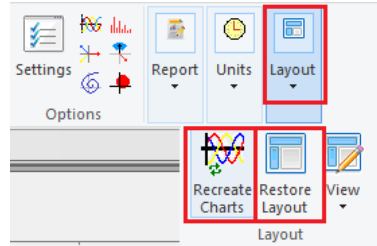


Figure 23

Following is the default structure after the previous commands.

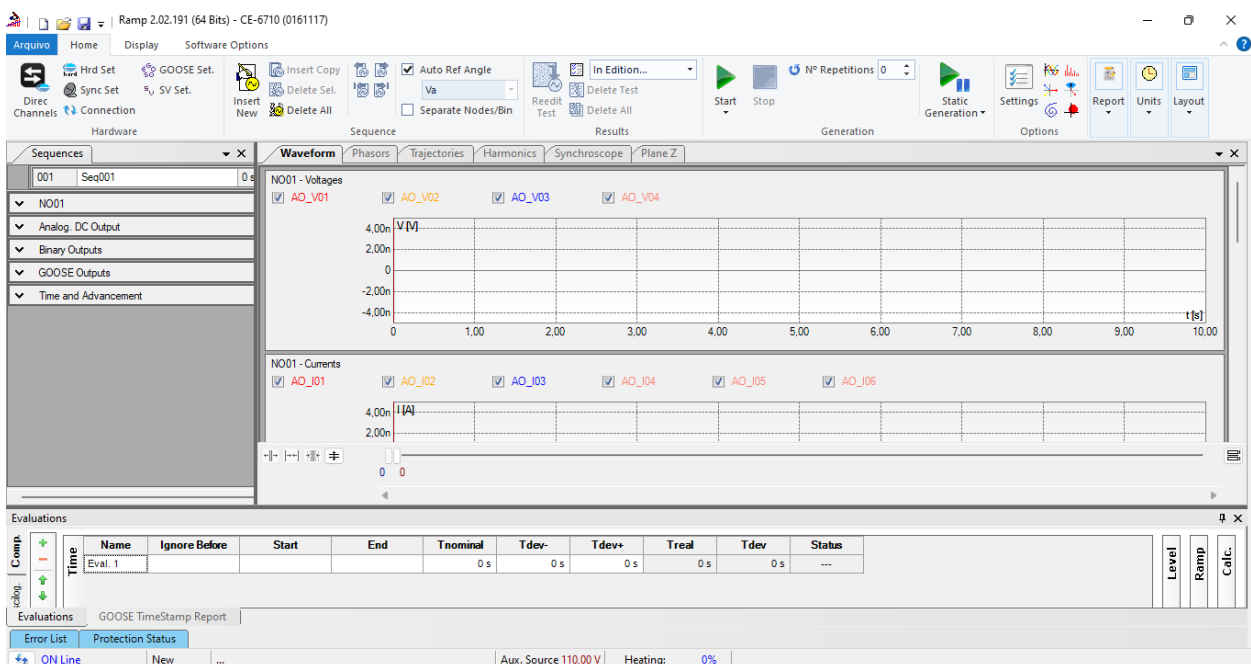


Figure 24

## 7. Test structure for function 81

Click the “Insert New” button until you have created four test sequences. Click on the “NO01” option and move the window to the right, making it easier to see.



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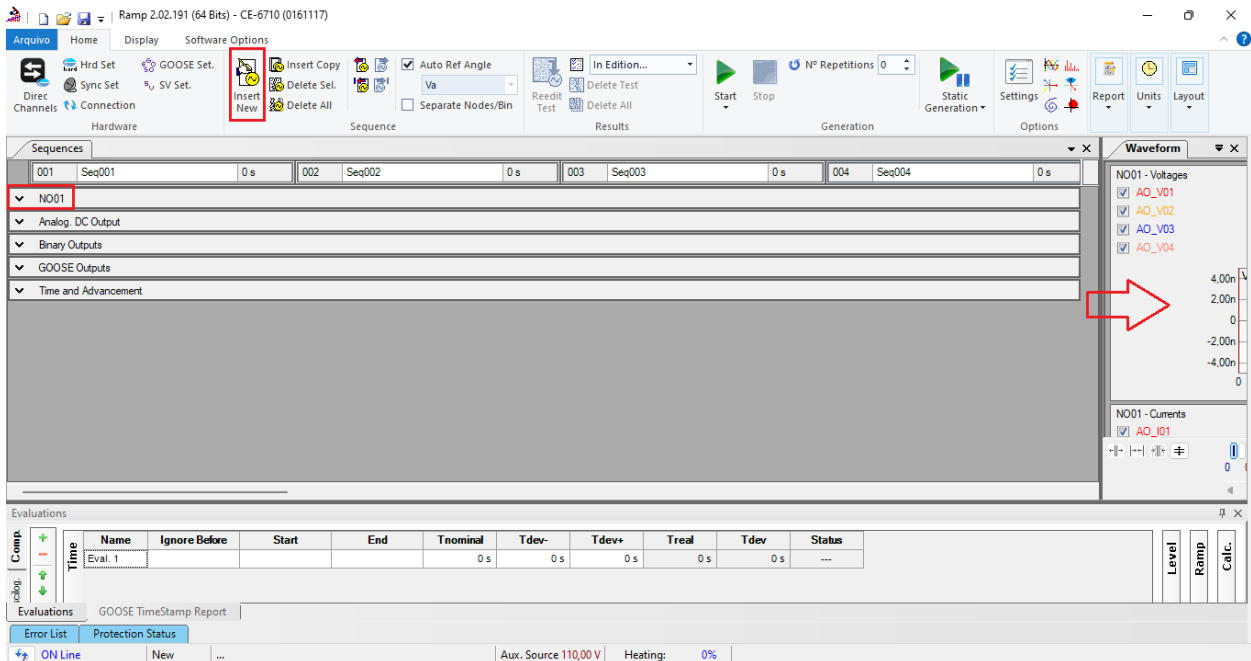


Figure 25

### 7.1 Main Screen 81U-1

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

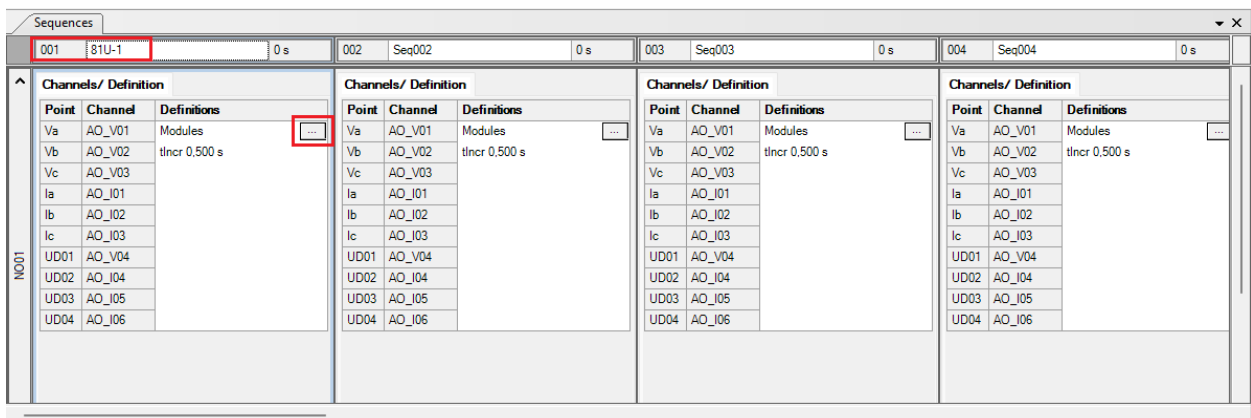


Figure 26

### 7.2 Screen for incrementing 81U-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 59.03Hz and for the final frequency 58.97Hz with a step of -10.0mHz. 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.

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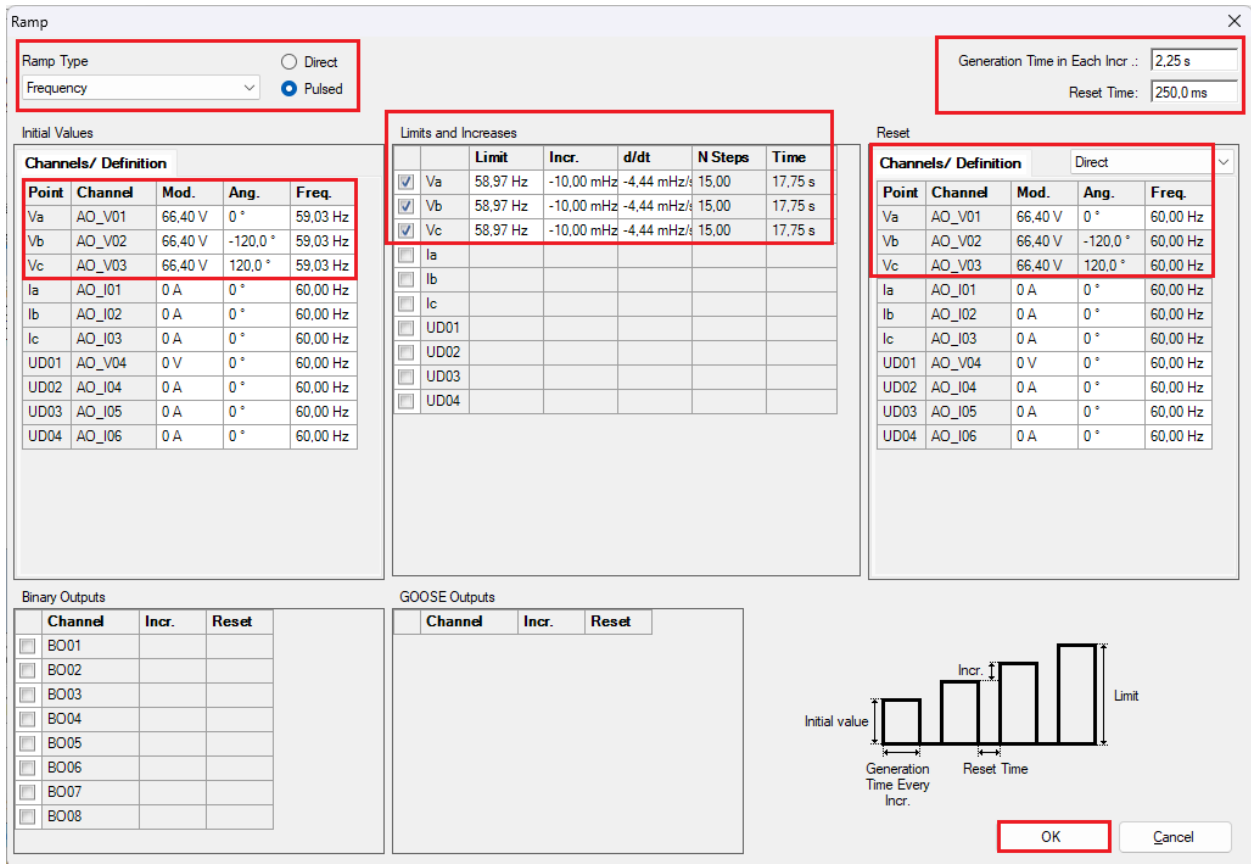


Figure 27

### 7.3 Main Screen 81U-2

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

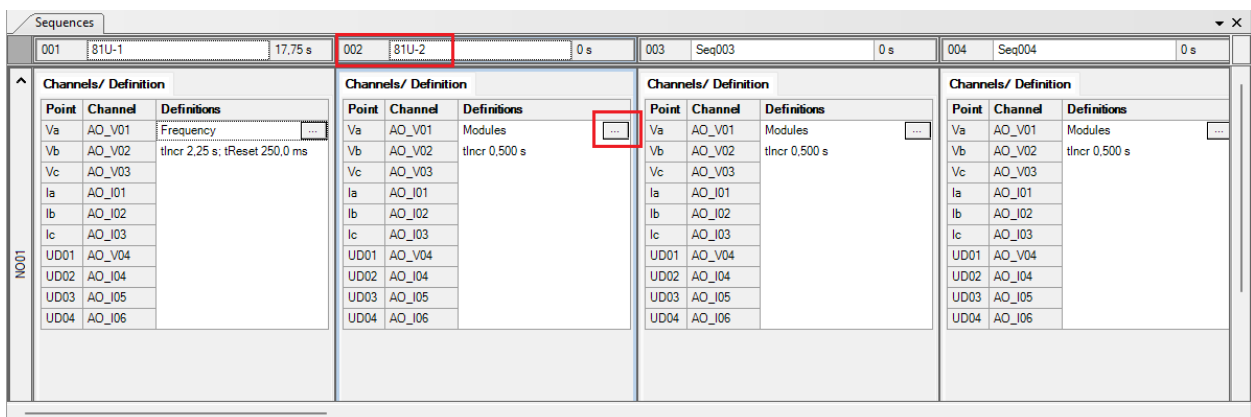
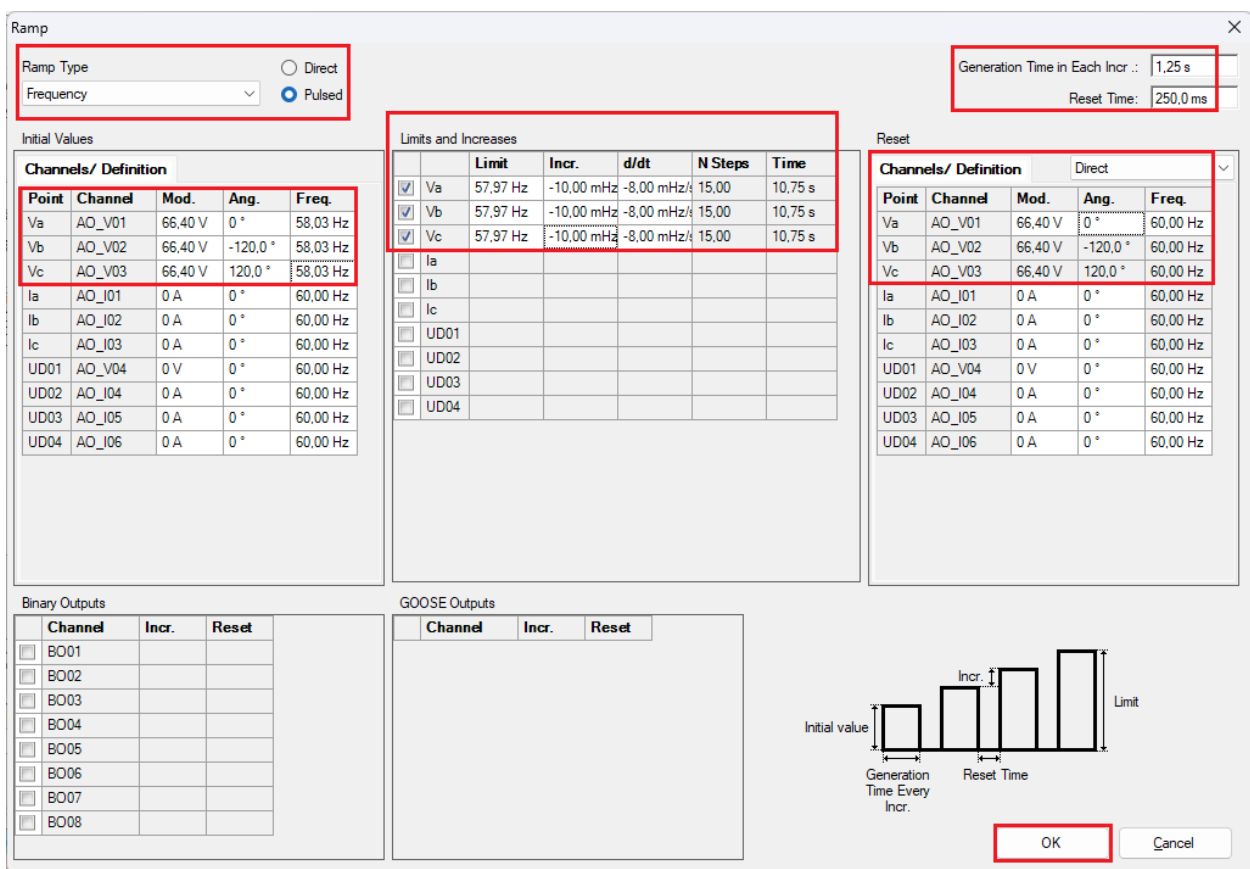


Figure 28

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**7.4 Screen for incrementing 81U-2**

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 58.03 Hz and for the final frequency 57.97Hz with a step of -10.0mHz. 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.



**Figure 29**

**7.5 Main screen 81O-1**

In the third sequence, configure a situation to check the overfrequency of the first element whose setting is at 61.0Hz and 2.0s. In place of “Seq 003” write “81O-1”. Then click on the button highlighted in the figure below.

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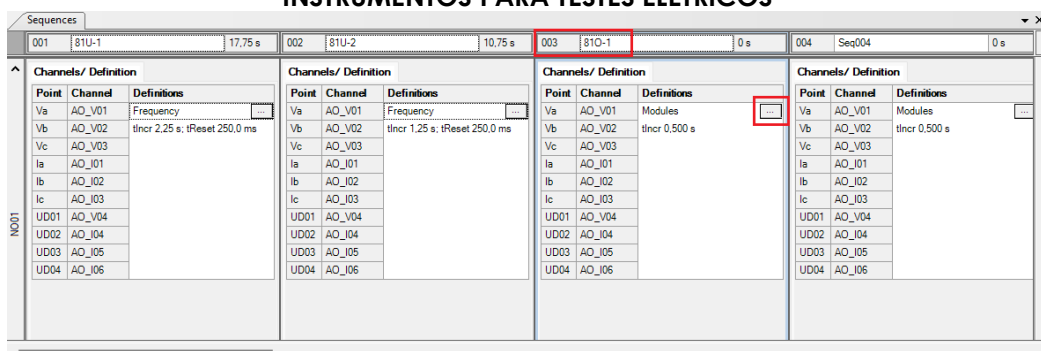


Figure 30

#### 7.6 Screen for incrementing 810-1

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 60.97Hz and for the final frequency 61.03Hz with a step of 10.0mHz. 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.

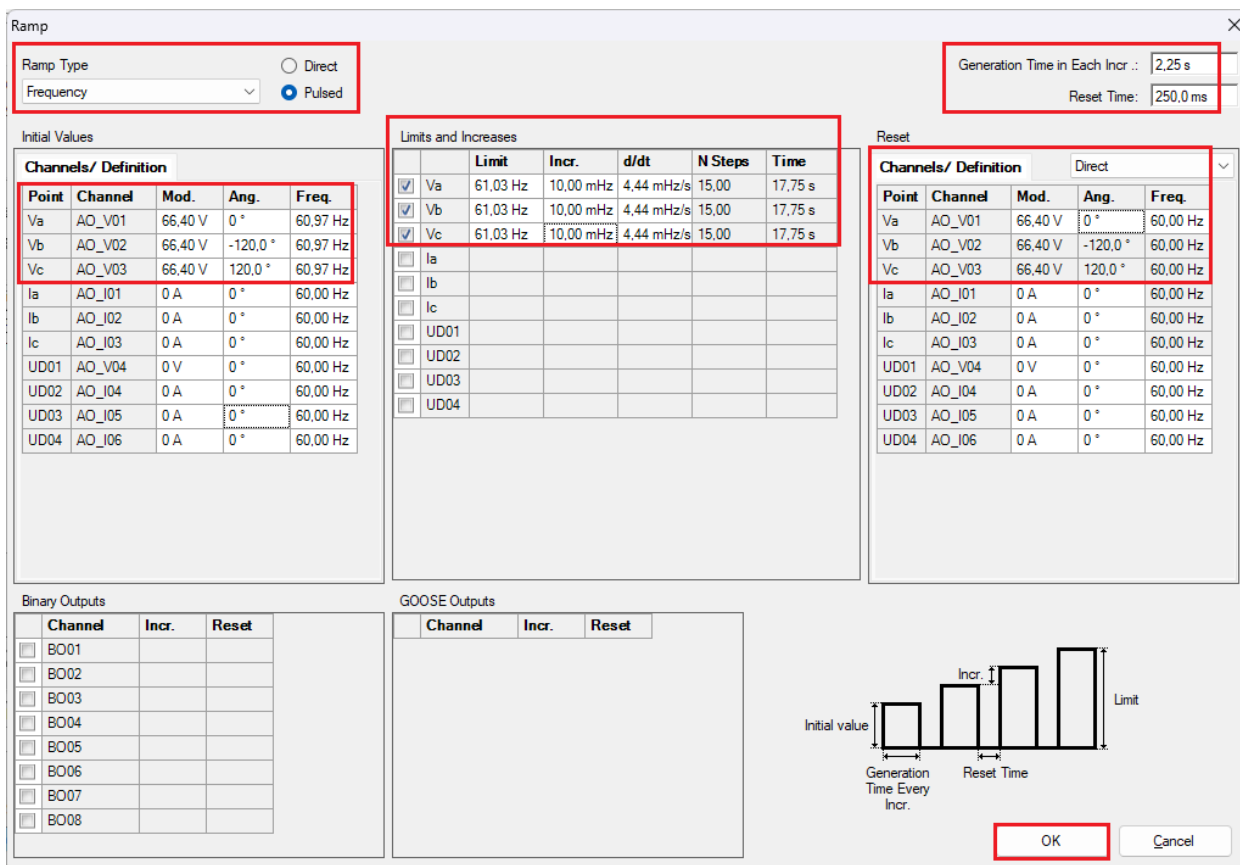
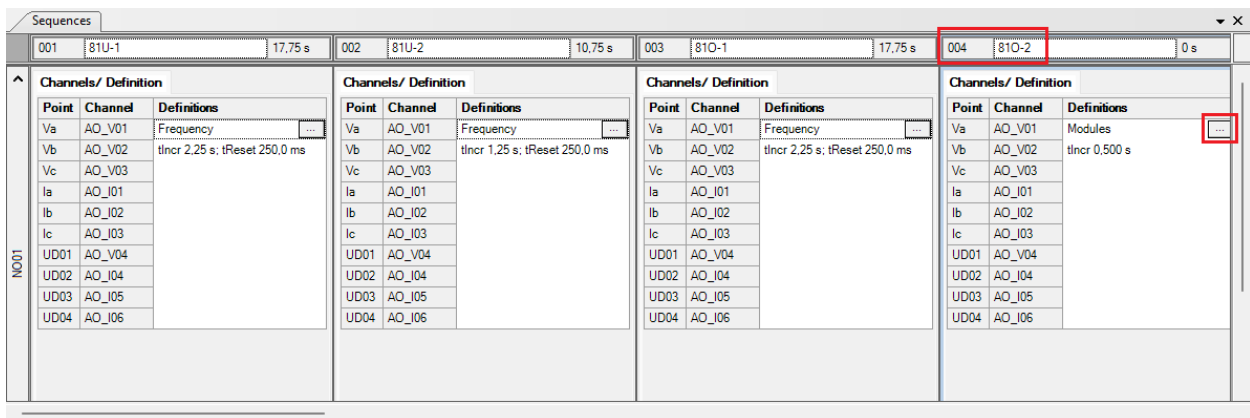


Figure 31

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**7.7 Main screen 810-2**

In the fourth sequence, configure a situation to check the overfrequency of the second element whose setting is at 62.0Hz and 1.0s. In place of “Seq 004” write “810-2”. Then click on the button highlighted in the figure below.



**Figure 32**

**7.8 Screen for incrementing 810-2**

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 61.97 Hz and for the final frequency 62.03Hz with a step of 10.0mHz. 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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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 °	61,97 Hz
Vb	AO_V02	66,40 V	-120,0 °	61,97 Hz
Vc	AO_V03	66,40 V	120,0 °	61,97 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	62,03 Hz	10,00 mHz	8,00 mHz/s	15,00	10,75 s
<input checked="" type="checkbox"/> Vb	62,03 Hz	10,00 mHz	8,00 mHz/s	15,00	10,75 s
<input checked="" type="checkbox"/> Vc	62,03 Hz	10,00 mHz	8,00 mHz/s	15,00	10,75 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

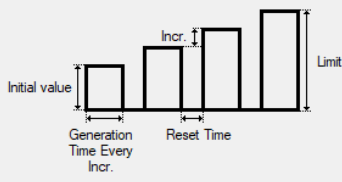
Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	0 V	0 °	60,00 Hz
Vb	AO_V02	0 V	-120,0 °	60,00 Hz
Vc	AO_V03	0 V	120,0 °	60,00 Hz
Ia	AO_I01	0 A	0 °	60,00 Hz
Ib	AO_I02	0 A	0 °	60,00 Hz
Ic	AO_I03	0 A	0 °	60,00 Hz
UD01	AO_V04	0 V	0 °	60,00 Hz
UD02	AO_I04	0 A	0 °	60,00 Hz
UD03	AO_I05	0 A	0 °	60,00 Hz
UD04	AO_I06	0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



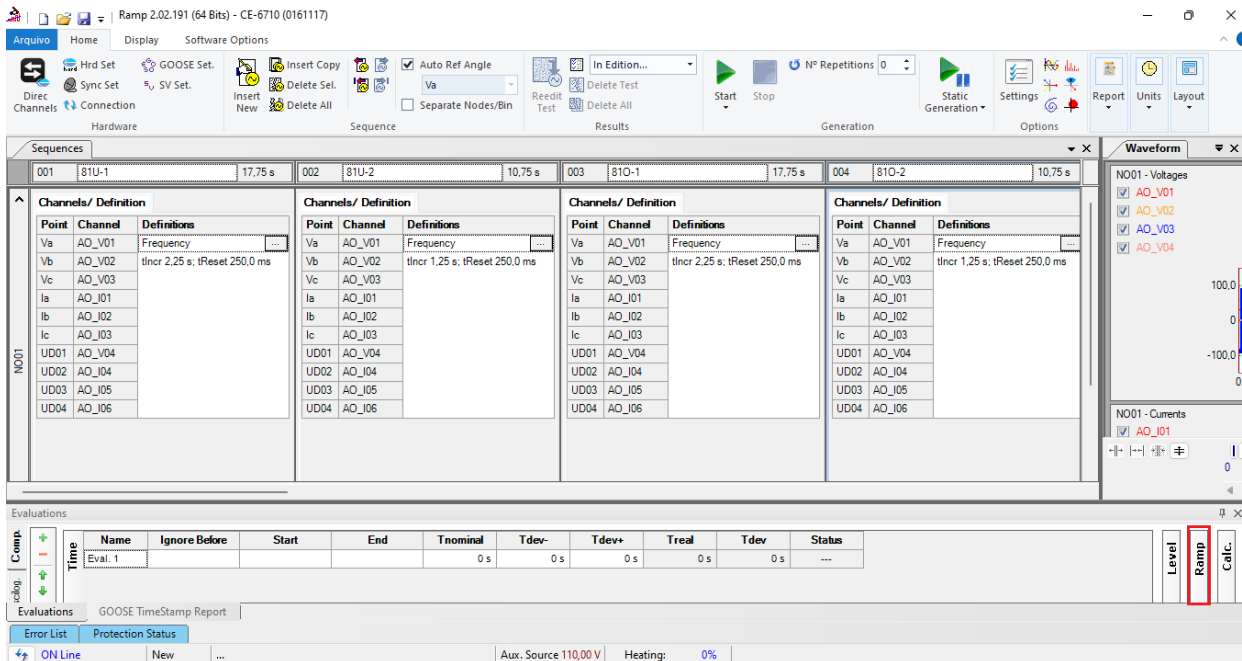
OK Cancel

Figure 33

**7.9 Evaluation of pick-ups**

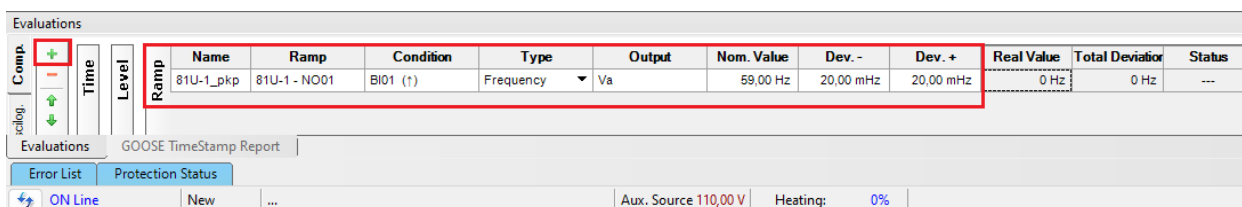
By clicking on the “Ramp” field, as shown in the next figure, four pick-up evaluations can be configured as follows.

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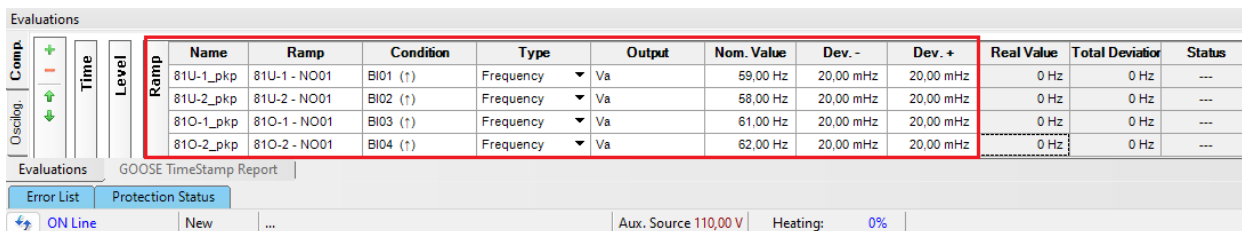
**Figure 34**

In place of “Eval.1” write “81U-1\_pkp”, in Ramp select “81U-1 > NO01” for “Condition” adjust “BI01 (↑)”, for “Type” choose “Frequency”, for “Output” adjust “Va”, in the field “Nom Value” configure 59.00Hz and in the fields related to deviations adjust 20mHz.



**Figure 35**

Clicking on the “+” icon in the previous figure insert three 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.

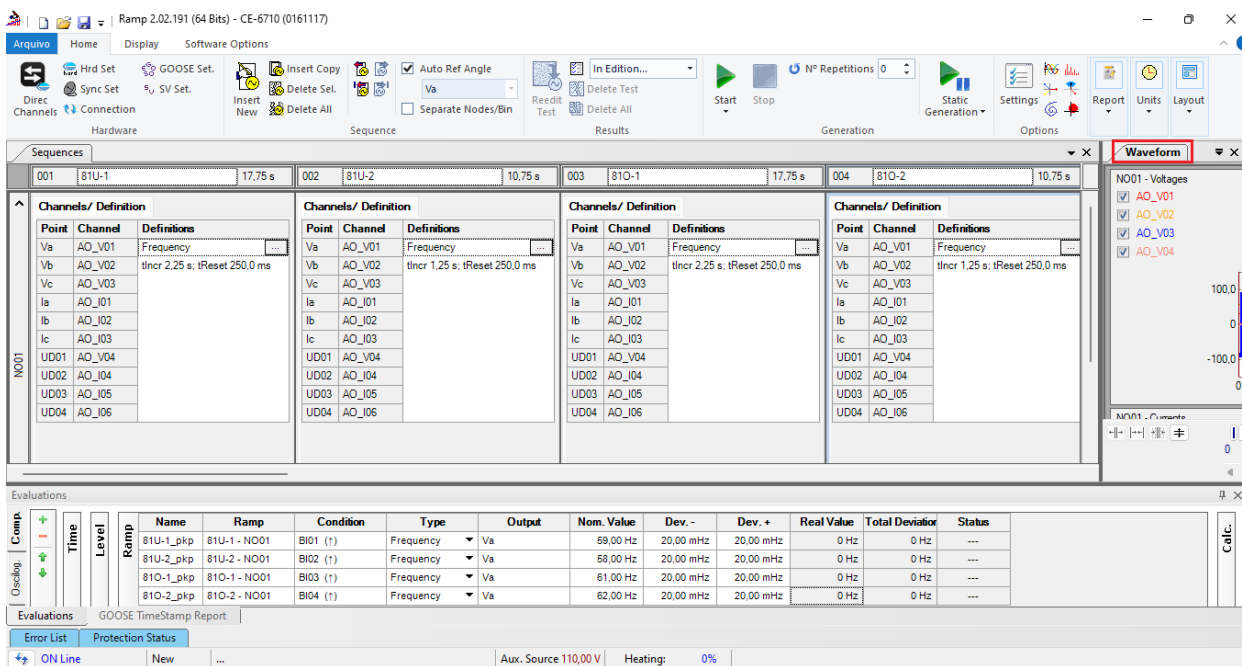


**Figure 36**

**INSTRUMENTOS PARA TESTES ELÉTRICOS**

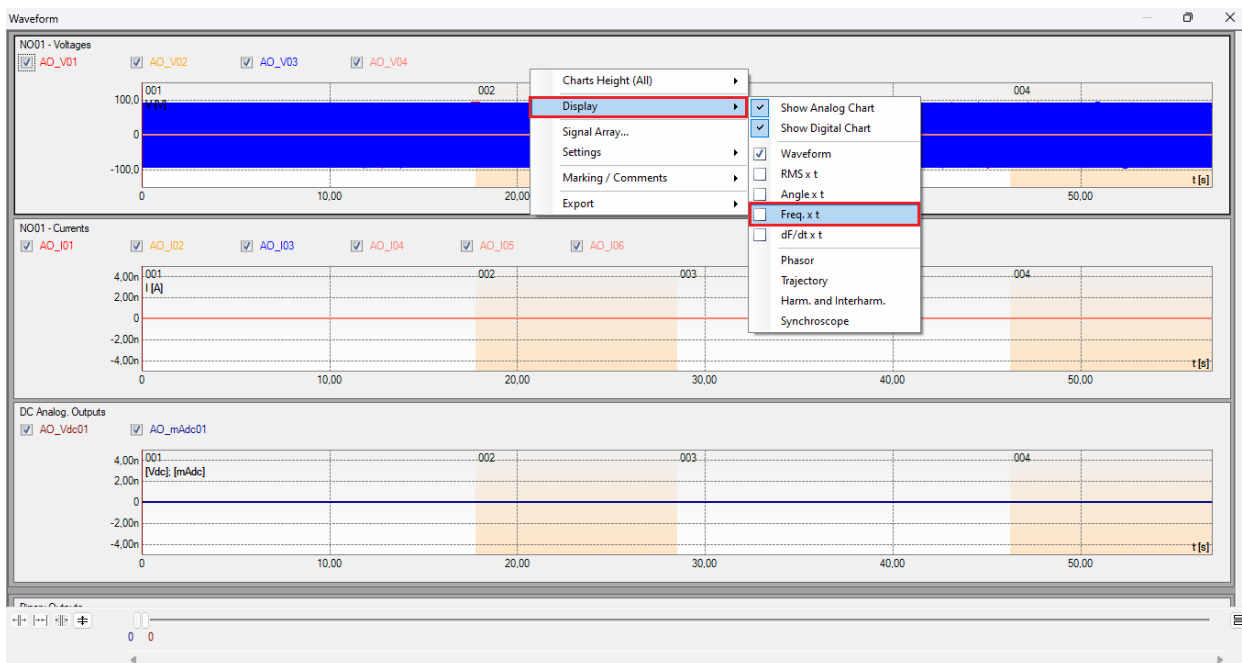
**7.10 Adjusting graphics**

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 37**

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

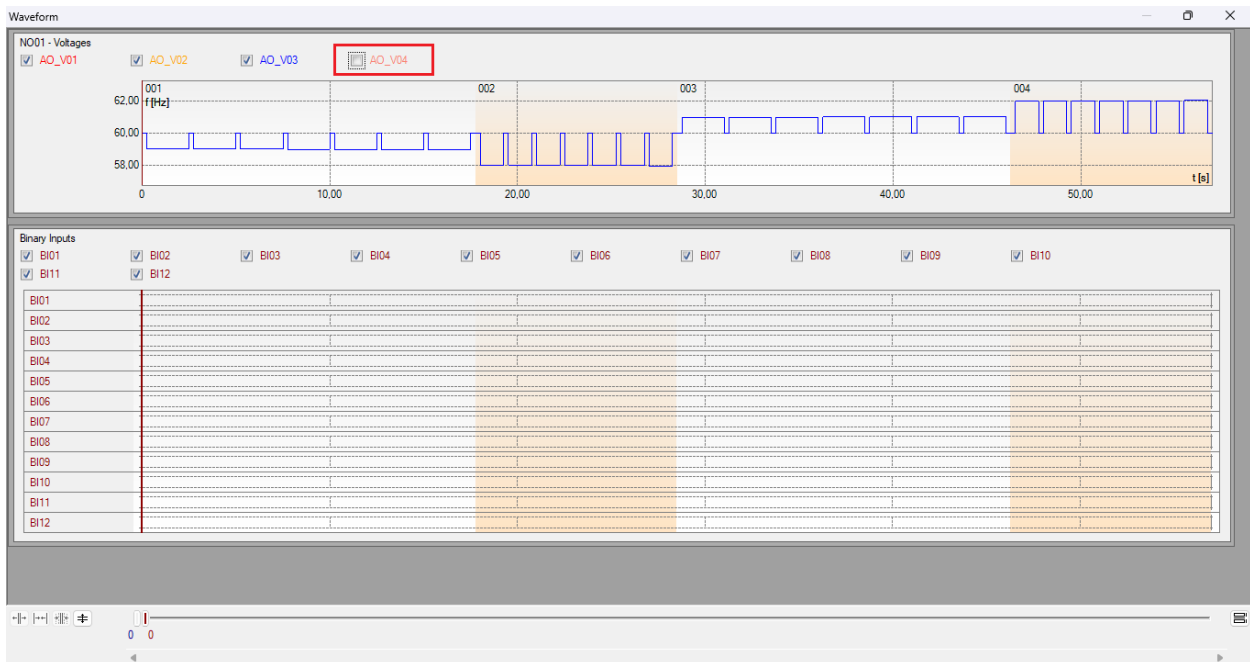


**Figure 38**



**INSTRUMENTOS PARA TESTES ELÉTRICOS**

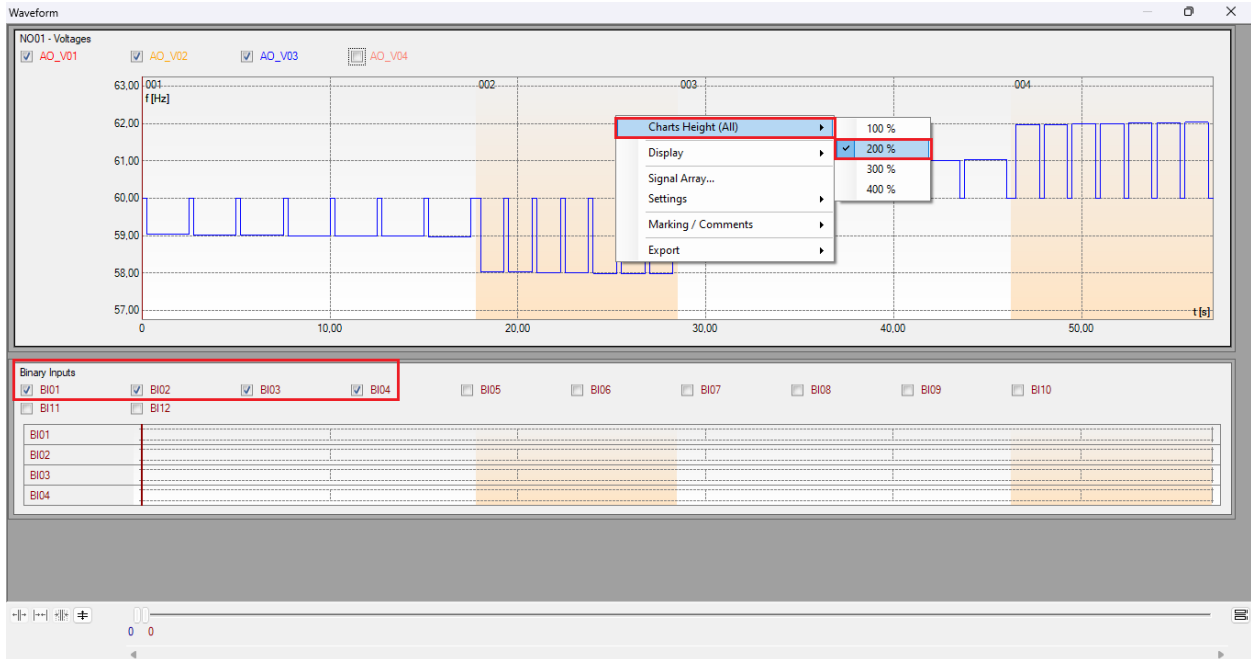
Select the current graph “NO01-Currents” and click on the “Delete” button. Repeat the procedure for the graphics of “Outputs An. Dc” and “Binary Outputs”. Also, uncheck the unused voltage channel AO\_V04.



**Figure 39**

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

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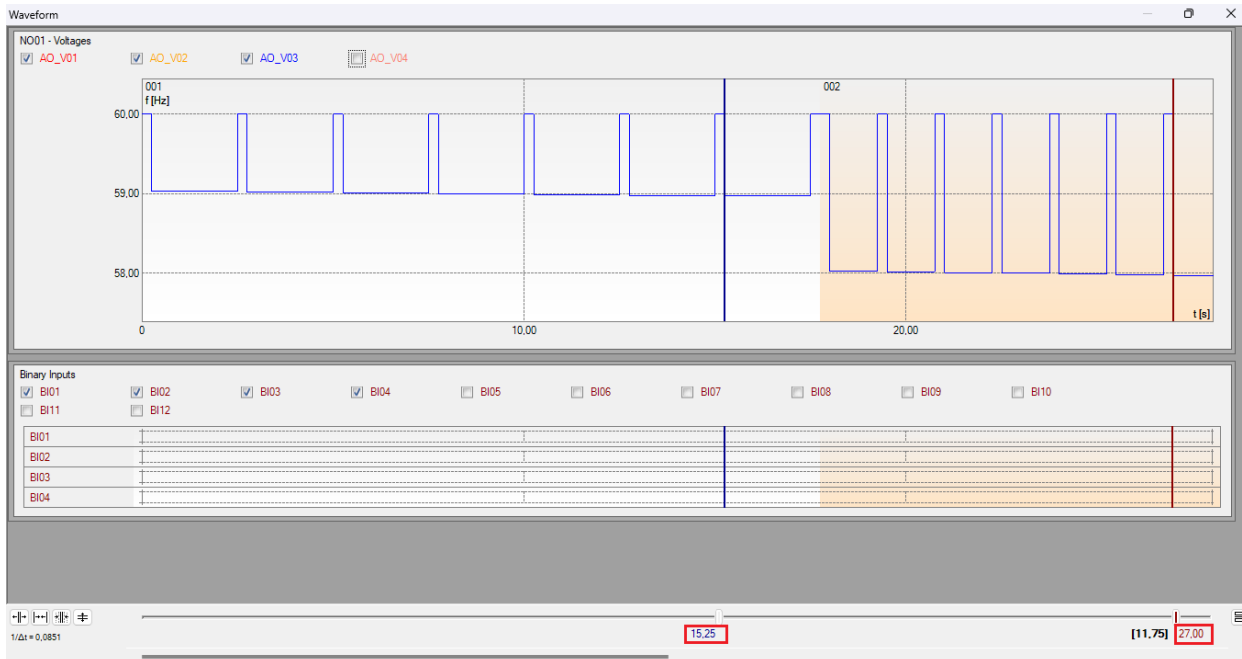


**Figure 40**

**7.11 Time analysis**

To evaluate the time, mark the value of the time when the last increment or decrement of each sequence occurs. To find these values, cursors are used. If necessary, you can zoom in to check the moment in time where the marking should be done. To do so, left-click and drag over the desired region. To remove the zoom, just double click on the graph. The following figure shows the time for the first two elements.

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**Figure 41**

According to the previous figure, it is concluded that the time to be done for marking 1 is 15.25 seconds and for the second in 27.00 seconds. The next figure shows the position of the last two elements.



**Figure 42**

According to the previous figure, it is concluded that the time to be done for marking 3 is 43.75 seconds and for the fourth one is 55.50 seconds.

### 7.12 *Inserting markup*

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

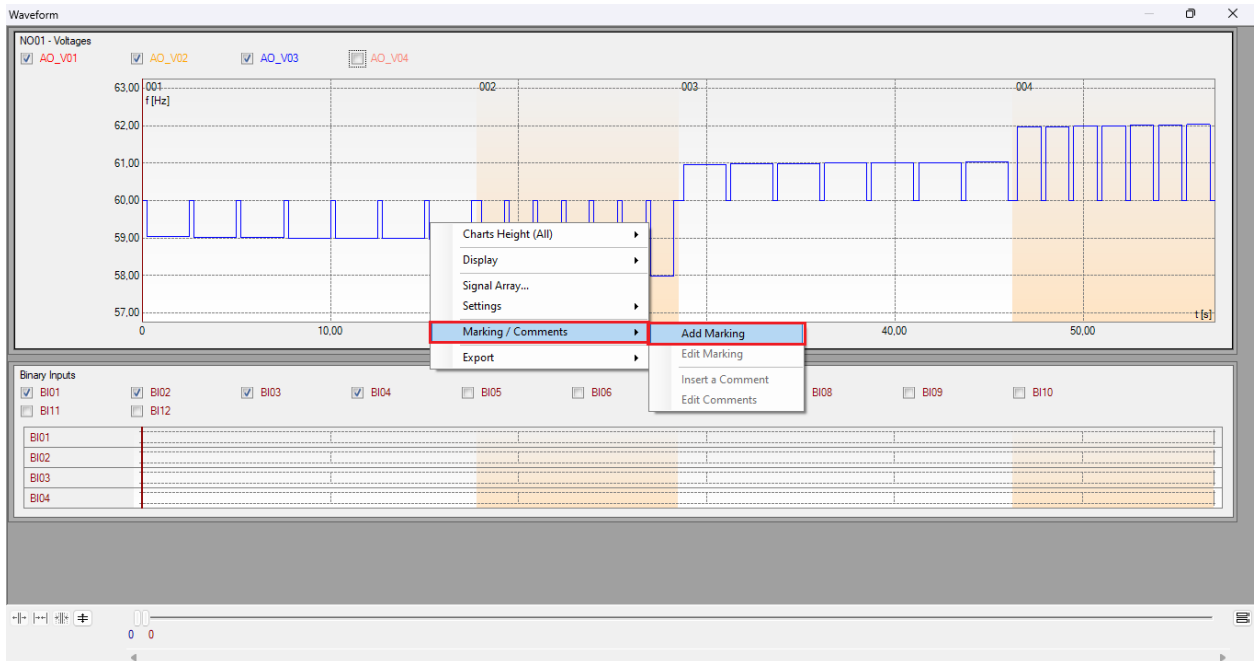


Figure 43

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

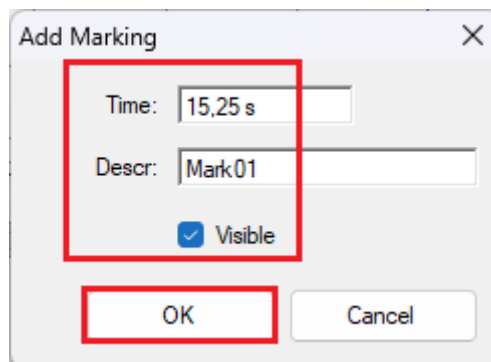
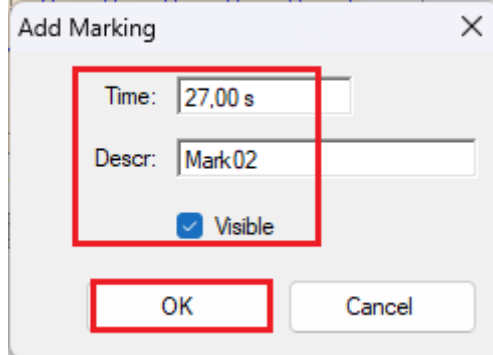


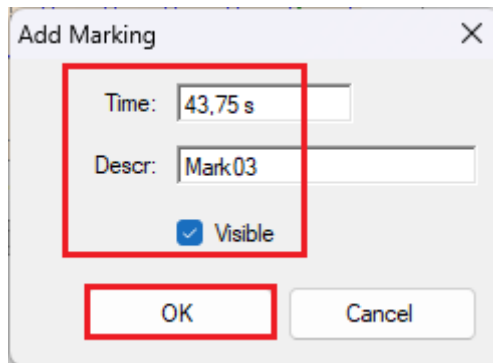
Figure 44

**INSTRUMENTOS PARA TESTES ELÉTRICOS**



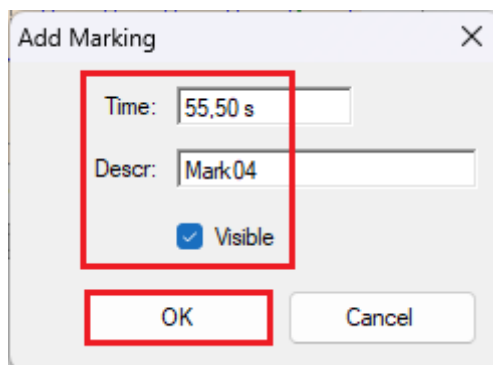
The screenshot shows a dialog box titled "Add Marking" with a close button (X) in the top right corner. The dialog contains three input fields: "Time:" with the value "27,00 s", "Descr:" with the value "Mark02", and a checked checkbox labeled "Visible". Below these fields are two buttons: "OK" and "Cancel". A red rectangular box highlights the "Time:" and "Descr:" fields and the "Visible" checkbox. Another red rectangular box highlights the "OK" button.

**Figure 45**



The screenshot shows a dialog box titled "Add Marking" with a close button (X) in the top right corner. The dialog contains three input fields: "Time:" with the value "43,75 s", "Descr:" with the value "Mark03", and a checked checkbox labeled "Visible". Below these fields are two buttons: "OK" and "Cancel". A red rectangular box highlights the "Time:" and "Descr:" fields and the "Visible" checkbox. Another red rectangular box highlights the "OK" button.

**Figure 46**



The screenshot shows a dialog box titled "Add Marking" with a close button (X) in the top right corner. The dialog contains three input fields: "Time:" with the value "55,50 s", "Descr:" with the value "Mark04", and a checked checkbox labeled "Visible". Below these fields are two buttons: "OK" and "Cancel". A red rectangular box highlights the "Time:" and "Descr:" fields and the "Visible" checkbox. Another red rectangular box highlights the "OK" button.

**Figure 47**

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).

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Figure 48

### 7.13 Time evaluation

By clicking on the “Time” field, as shown in the next figure, four operation time evaluations can be configured as follows.

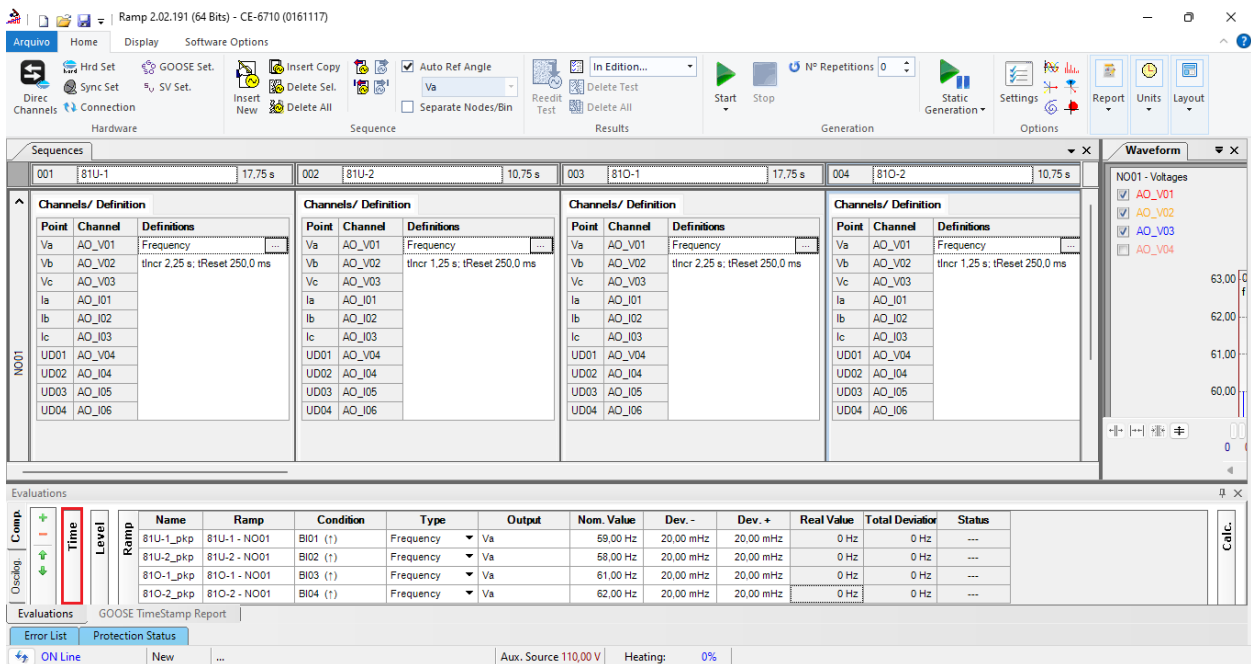
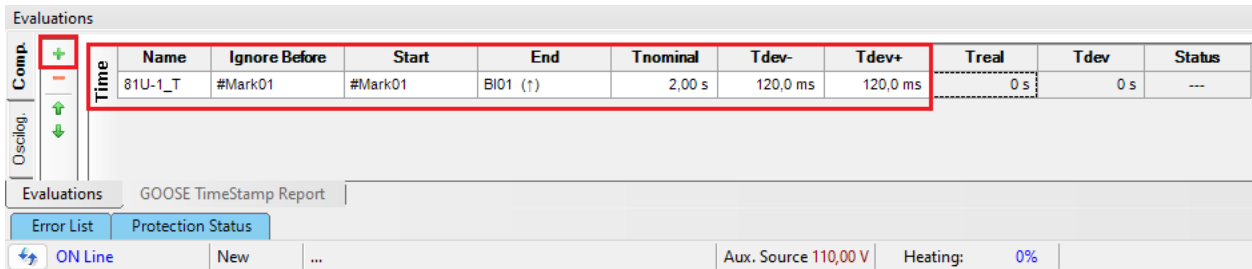


Figure 49

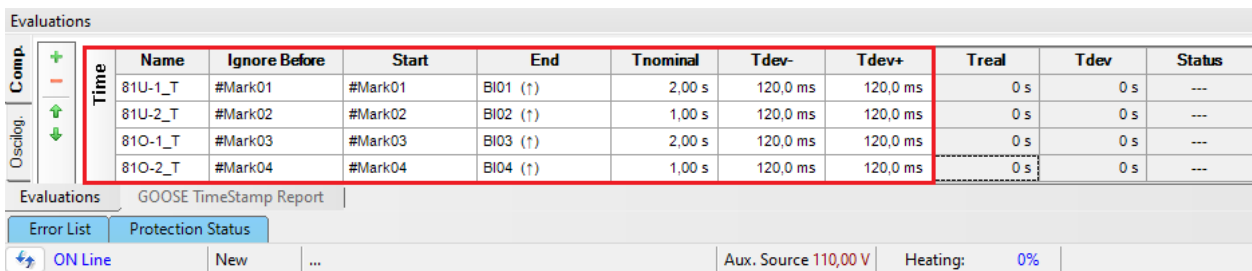
**INSTRUMENTOS PARA TESTES ELÉTRICOS**

Change the name “Eval. 1” to “81U-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 120ms. The figure below shows these settings.



**Figure 50**

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



**Figure 51**

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

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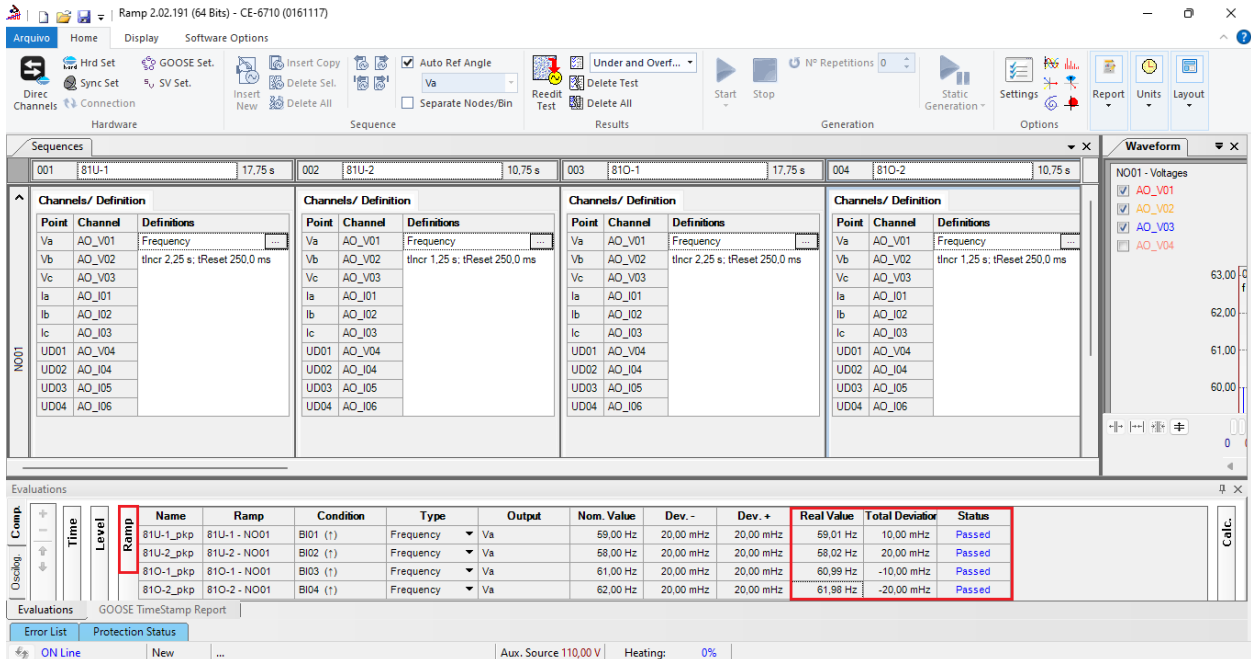


Figure 52

The following figure shows the operating times within the range of values given by the manufacturer.

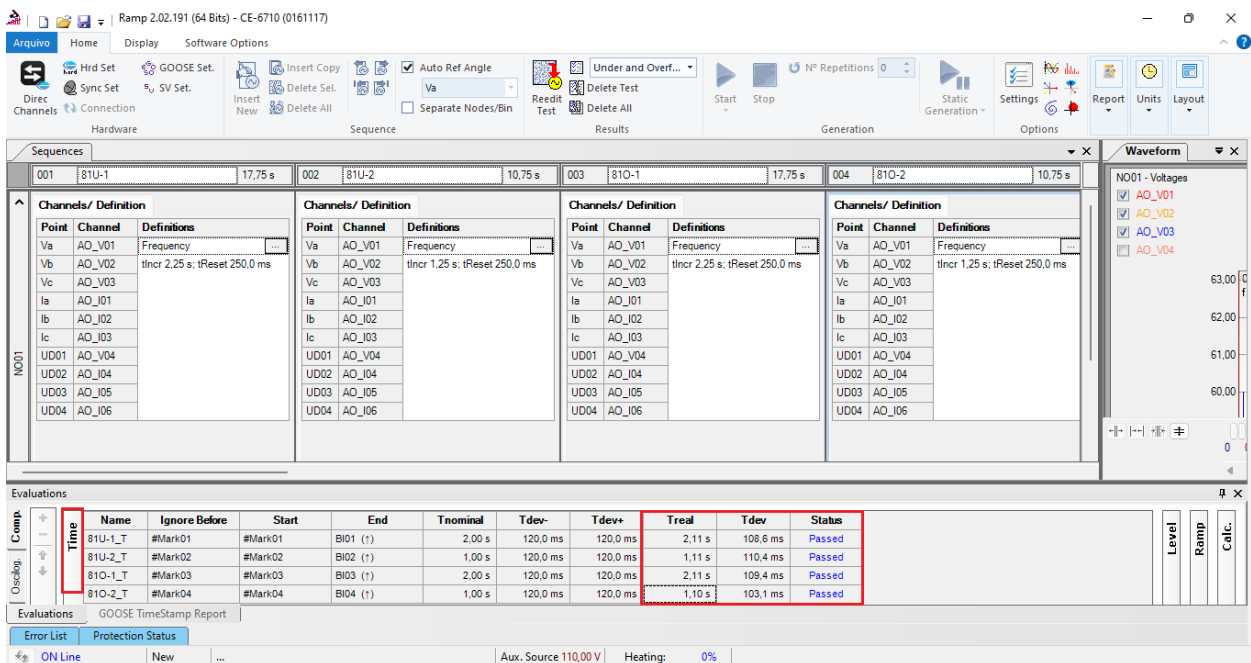


Figure 53



## 8. 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.

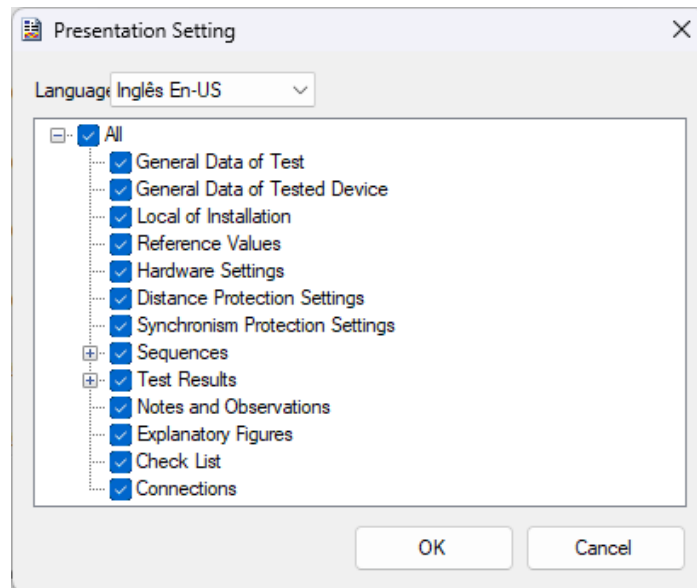


Figure 54

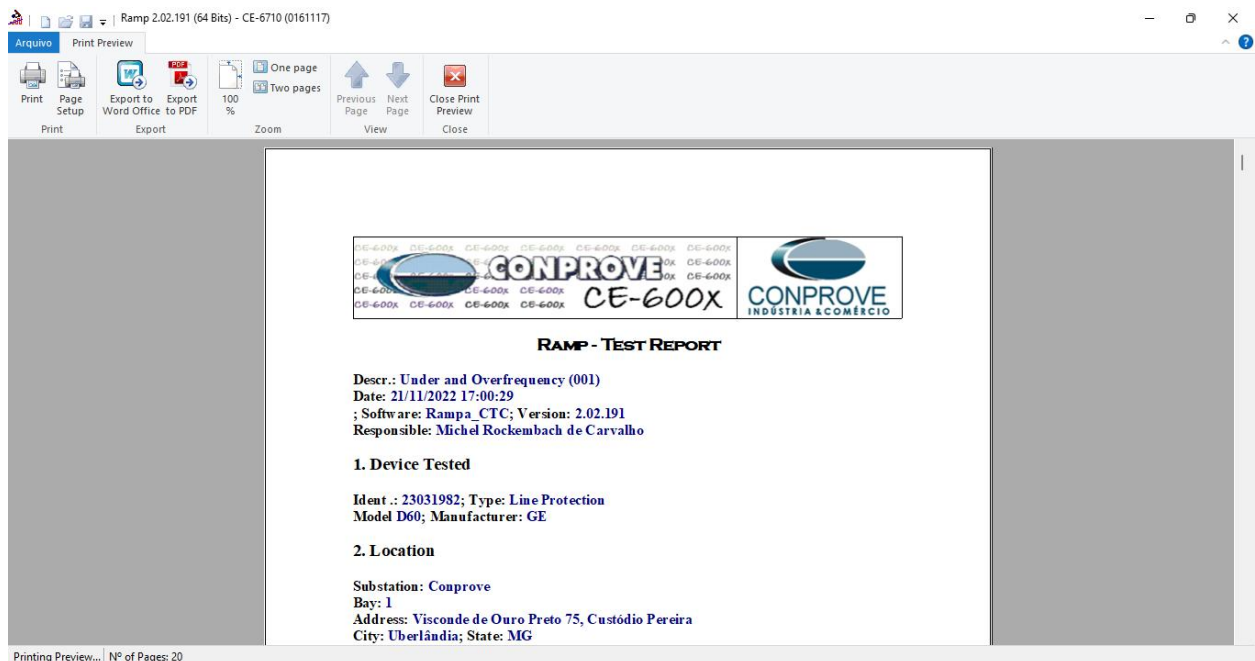


Figure 55

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APPENDIX A

A.1 Terminal Designation

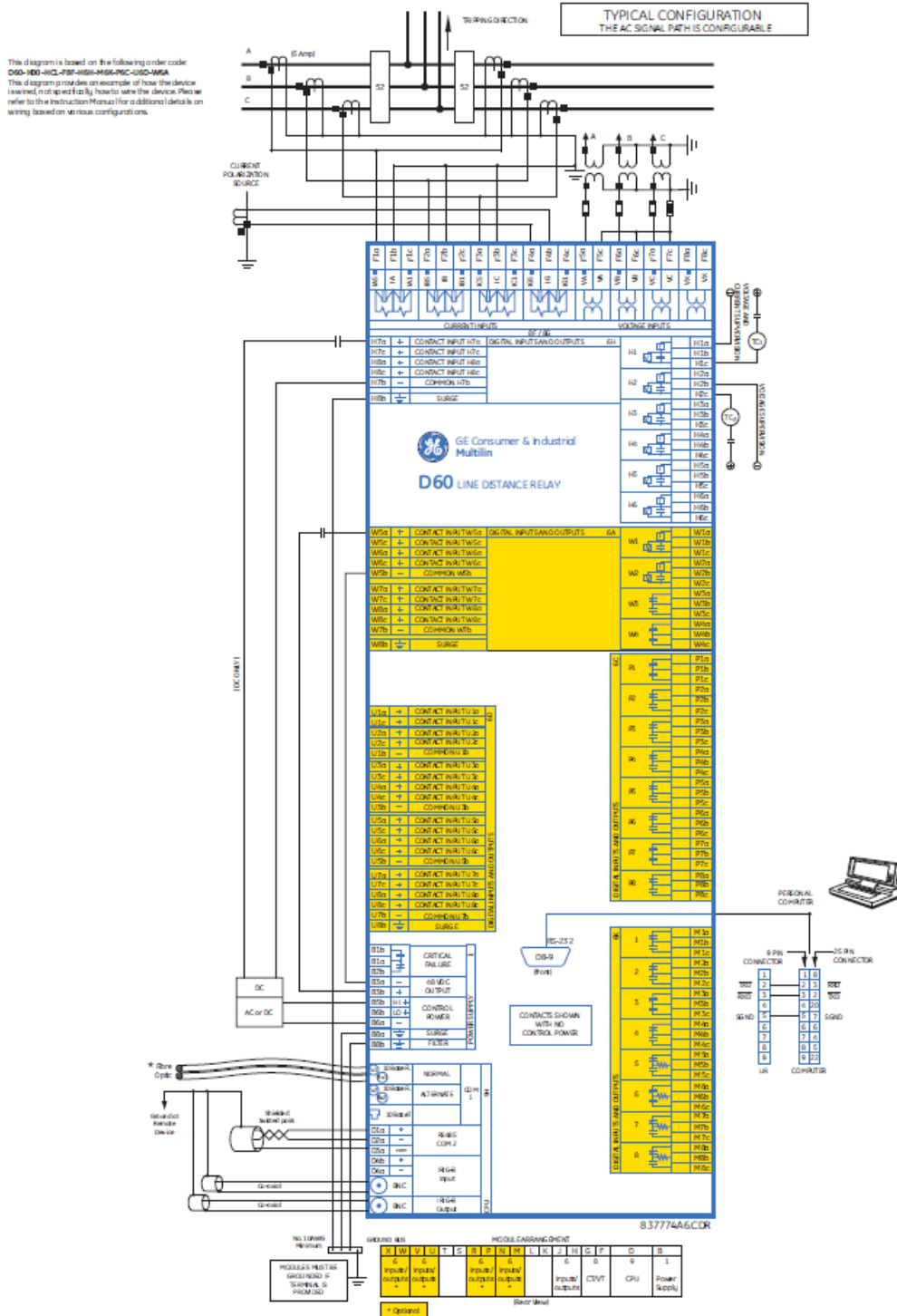


Figure 3-12: TYPICAL WIRING DIAGRAM

Figure 56

**INSTRUMENTOS PARA TESTES ELÉTRICOS**

**A.2 Technical data**

**UNDERFREQUENCY**

Minimum signal: 0.10 to 1.25 pu in steps of 0.01  
 Pickup level: 20.00 to 65.00 Hz in steps of 0.01  
 Dropout level: pickup + 0.03 Hz  
 Level accuracy:  $\pm 0.001$  Hz  
 Time delay: 0 to 65.535 s in steps of 0.001  
 Timer accuracy:  $\pm 3\%$  of operate time or  $\pm 1/4$  cycle (whichever is greater)  
 Operate time: typically 4 cycles at 0.1 Hz/s change  
 typically 3.5 cycles at 0.3 Hz/s change  
 typically 3 cycles at 0.5 Hz/s change

Typical times are average operate times including variables, such as frequency change instance, and test method, and can vary by  $\pm 0.5$  cycles.

**OVERFREQUENCY**

Pickup level: 20.00 to 65.00 Hz in steps of 0.01  
 Dropout level: pickup - 0.03 Hz  
 Level accuracy:  $\pm 0.001$  Hz  
 Time delay: 0 to 65.535 s in steps of 0.001  
 Timer accuracy:  $\pm 3\%$  of operate time or  $\pm 1/4$  cycle (whichever is greater)  
 Operate time: typically 4 cycles at 0.1 Hz/s change  
 typically 3.5 cycles at 0.3 Hz/s change  
 typically 3 cycles at 0.5 Hz/s change

Typical times are average operate times including variables such as frequency change instance, test method, and so on, and can vary by  $\pm 0.5$  cycles.

**APPENDIX B**

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

Table 1

Ramp Software		GE D60 Relay	
Parameter	Figure	Parameter	Figure
81U-1_pkp	35	Pickup	10
81U-2_pkp	36	Pickup	10
81O-1_pkp	36	Pickup	11
81O-2_pkp	36	Pickup	11
81U-1_T	50	Pickup Delay	10
81U-2_T	51	Pickup Delay	10
81O-1_T	51	Pickup Delay	11
81O-2_T	51	Pickup Delay	11