



INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: Siemens

Model: 7SA6

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	09/09/2022	M.R.C.	G.C.D.P.

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Statement of responsibility

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The tutorial contains knowledge gained from the resources and technical data at the time was writing. Therefore, CONPROVE reserves the right to make changes to this document without prior notice.

This document is intended as a guide only; the manual of the equipment under test should always be consulted.



ATTENTION!

The equipment generates high current and voltage values during its operation. Improper use of the equipment can result in material and physical damage.

Only suitably qualified people should handle the instrument. It should be noted that the user must have satisfactory training in maintenance procedures a good knowledge of the equipment under test and also be aware of safety standards and regulations.

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Sequence for testing the 7SA86 relay in the Ramp software

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 pin F1 (U_{H+}) of the relay and the negative (black terminal) of the Auxiliary Source to pin F2 (U_{H-}).

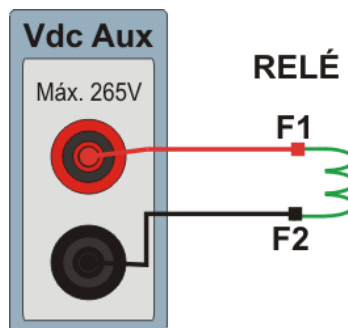


Figure 1

1.2 Voltage Coils

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.

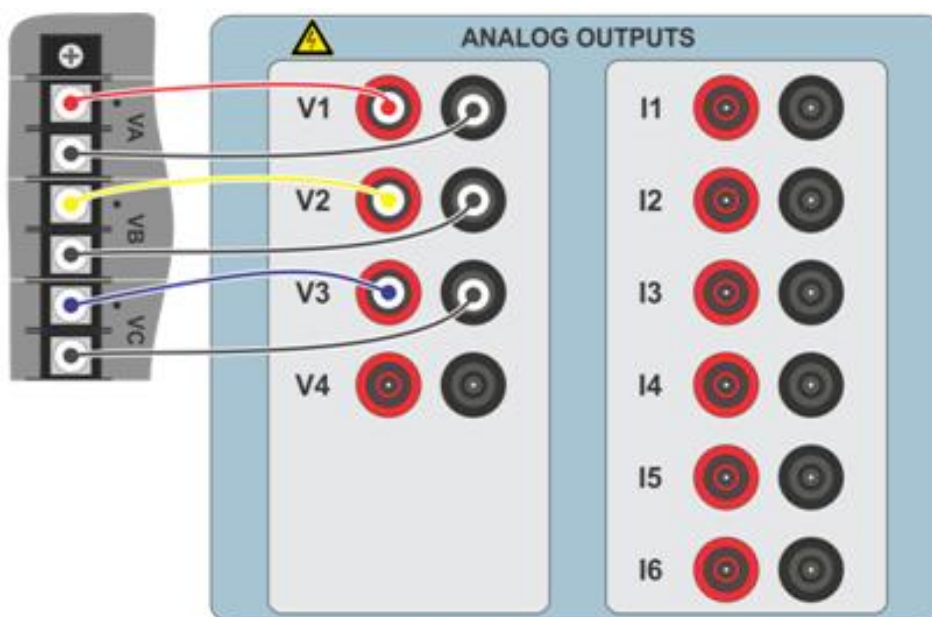


Figure 2

1.3 Binary Inputs

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

- BI1 to pin R1 and its common to pin R5.
- BI2 to pin R2 and its common to pin R5.
- BI3 to pin R3 and its common to pin R5.
- BI4 to pin R4 and its common to pin R5.

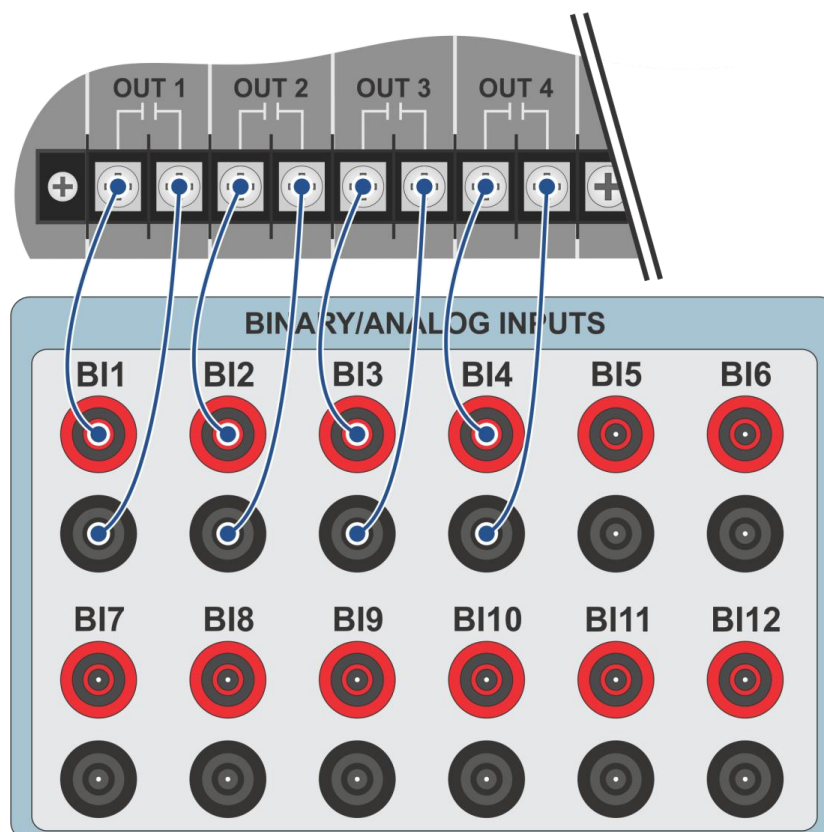


Figure 3

2. Communication with the 7SA6 relay

First, open “DIGSI” 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, select the substation that contains the relay in question (7SA6). After selecting the relay, right-click and select the “Open Object” option and then select the connection mode, as shown in the following figures.

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Figure 5

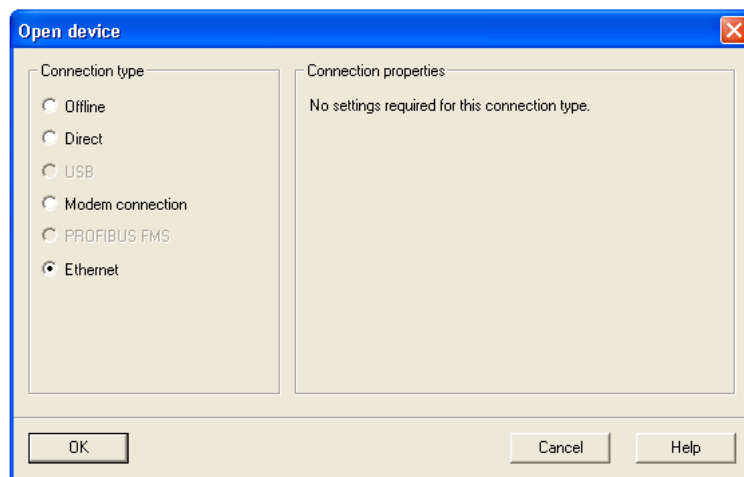


Figure 6

3. Parameterization of relay 7SA6

3.1 Device Configuration

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

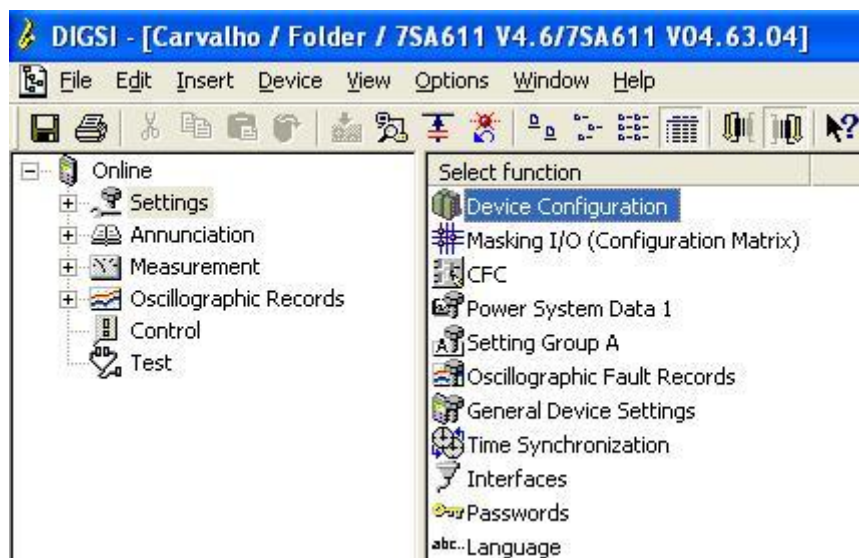


Figure 7

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On the “*Functional Scope*” screen, disable all functions leaving only the “81 *Over/Underfrequency Protection*” function enabled. This prevents trips from other functions from interfering with the test. After the adjustments click “OK”.

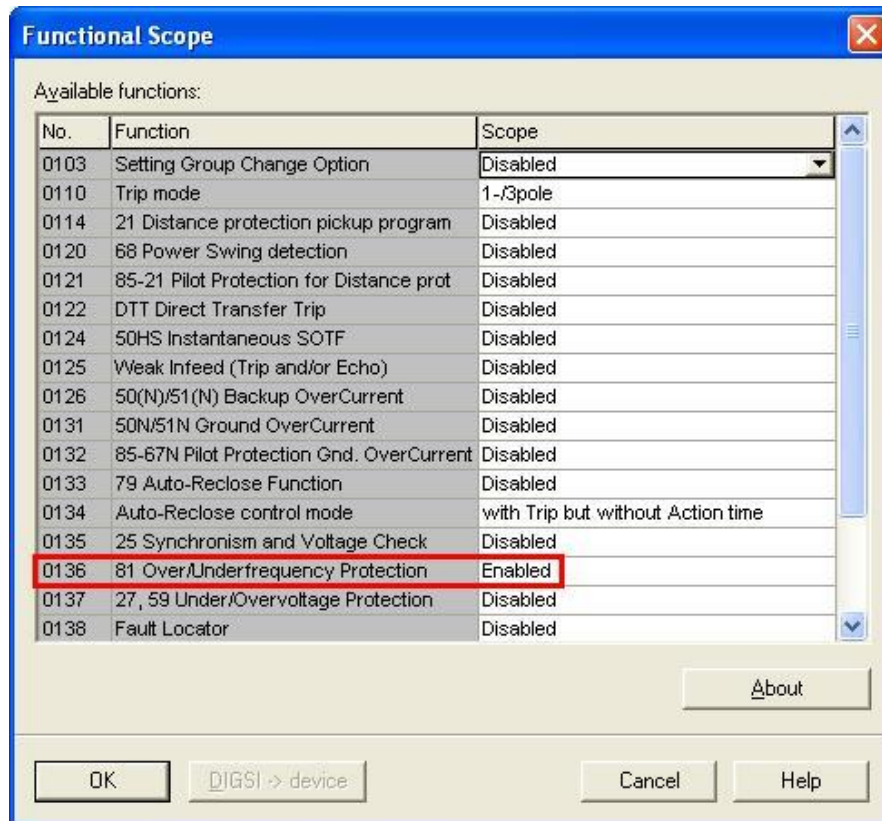


Figure 8

3.2 Masking I/O

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

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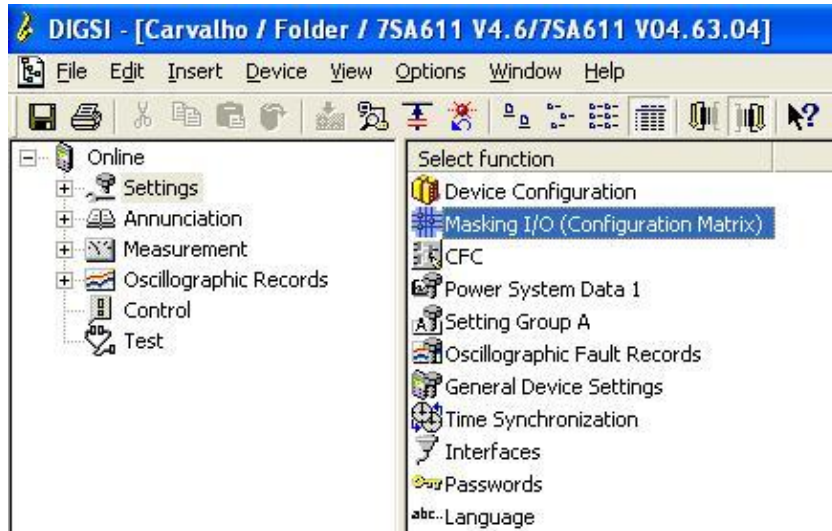
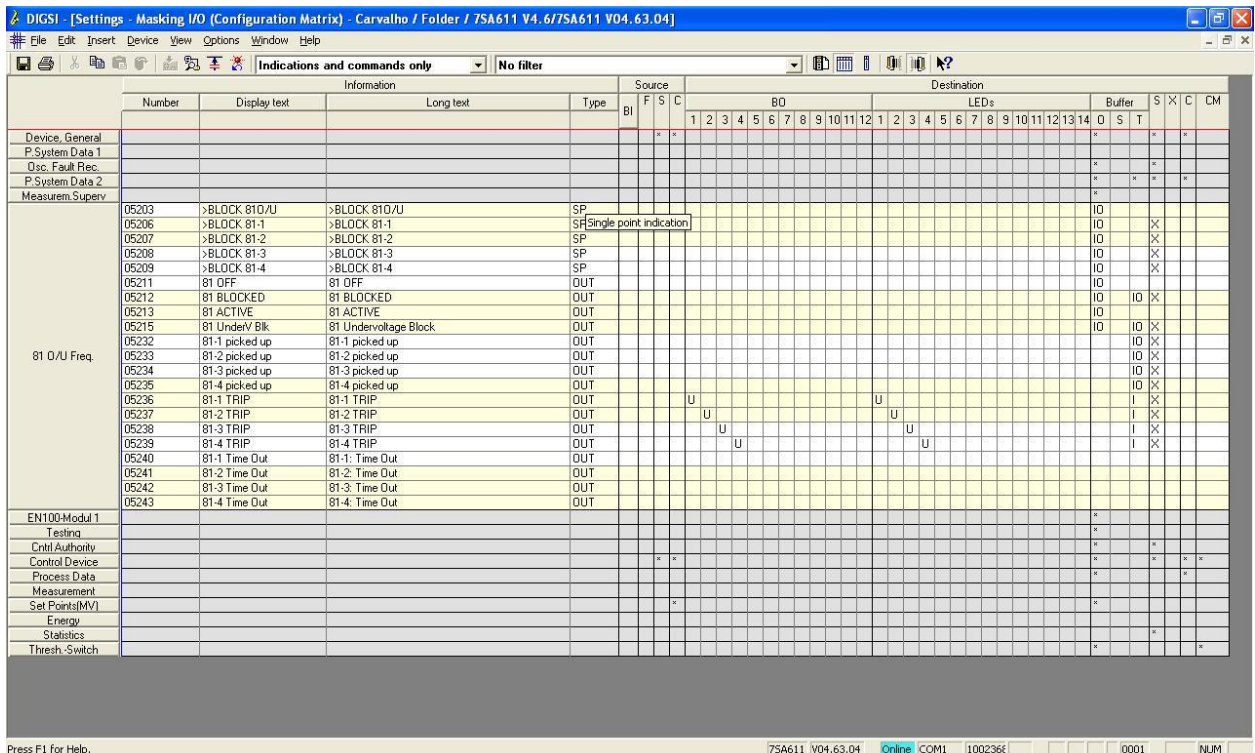


Figure 9

Binary outputs BO1, BO2, BO3 and BO4 are assigned to send trips of functions 81-1, 81-2, 81-3 and 81-4 respectively. In order to assist the test, LEDs 1, 2, 3 and 4 are used to signal the sending of TRIP.



Information	Number	Display text	Long text	Type	Source			Destination																																		
					BI	F	C	BO				LEDs				Buffer		S	X	C	CM																					
								1	2	3	4	5	6	7	8	9	10	11	12	13	14	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14						
Device, General						*	*																*	*	*	*																
P System Data 1																							*	*	*	*																
Osc. Fault Rec.																							*	*	*	*																
P System Data 2																							*	*	*	*																
Measurment Superv																							*	*	*	*																
81 O/U Freq.	05203	>BLOCK 810/U	>BLOCK 810/U	SP																																						
	05206	>BLOCK 81-1	>BLOCK 81-1	SP																																						
	05207	>BLOCK 81-2	>BLOCK 81-2	SP																																						
	05208	>BLOCK 81-3	>BLOCK 81-3	SP																																						
	05209	>BLOCK 81-4	>BLOCK 81-4	SP																																						
	05211	81 OFF	81 OFF	OUT																																						
	05212	81 BLOCKED	81 BLOCKED	OUT																																						
	05213	81 ACTIVE	81 ACTIVE	OUT																																						
	05215	81 Underv Blk	81 Undervoltage Block	OUT																																						
	05232	81-1 picked up	81-1 picked up	OUT																																						
	05233	81-2 picked up	81-2 picked up	OUT																																						
	05234	81-3 picked up	81-3 picked up	OUT																																						
	05235	81-4 picked up	81-4 picked up	OUT																																						
	05236	81-1 TRIP	81-1 TRIP	OUT						U																																
05237	81-2 TRIP	81-2 TRIP	OUT																																							
05238	81-3 TRIP	81-3 TRIP	OUT							U																																
05239	81-4 TRIP	81-4 TRIP	OUT																																							
05240	81-1 Time Out	81-1: Time Out	OUT																																							
05241	81-2 Time Out	81-2: Time Out	OUT																																							
05242	81-3 Time Out	81-3: Time Out	OUT																																							
05243	81-4 Time Out	81-4: Time Out	OUT																																							

Figure 10

3.3 Power System Data 1

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

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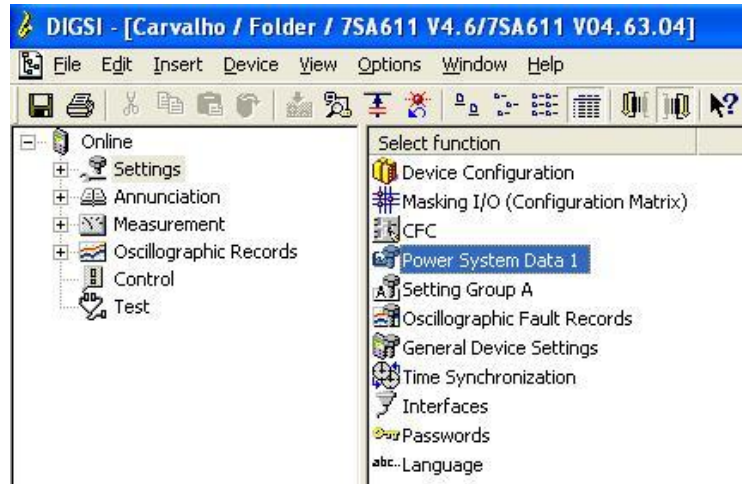


Figure 11

Those adjustments highlighted in red need special attention so that if the adjustments are not made correctly the results may be inconsistent or even not work.

3.4 Transformers

In this tab, configure the nominal line voltage value on the secondary.

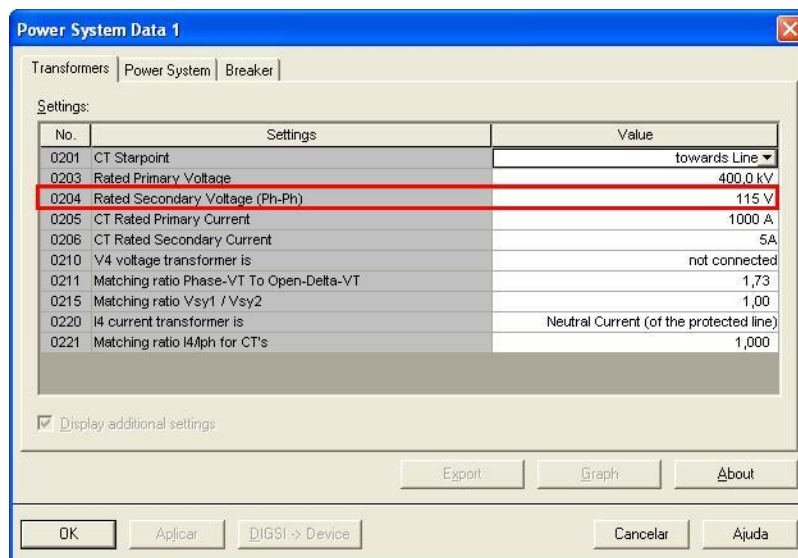


Figure 12

3.5 Power System

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

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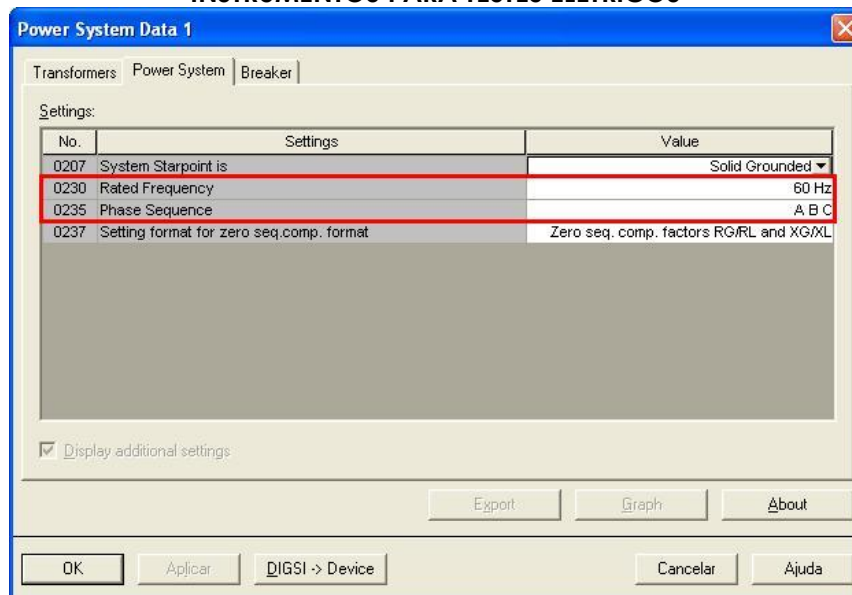


Figure 13

3.6 Breaker

In this tab you can keep the default settings.

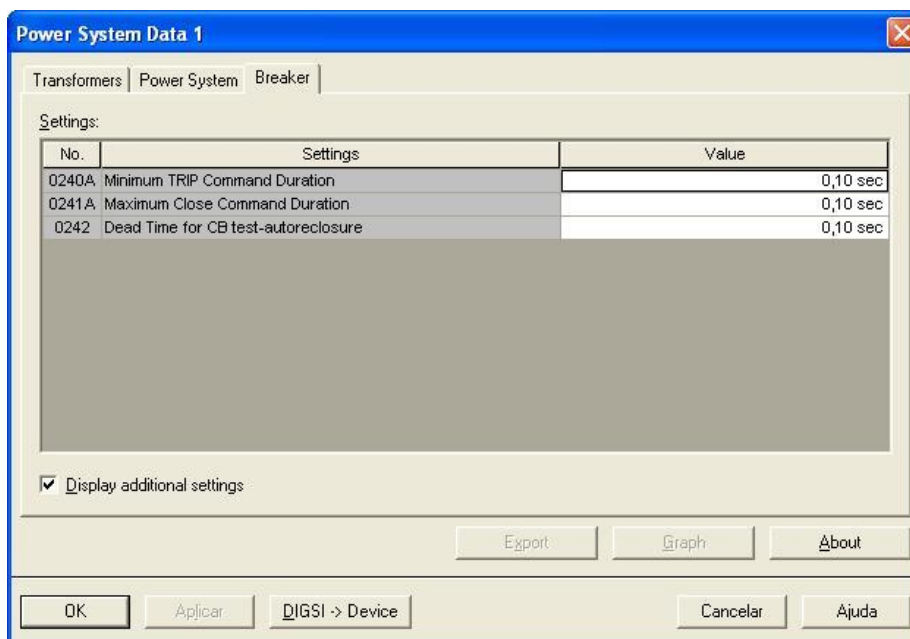


Figure 14

3.7 Setting Group A

In this option the sub and overfrequency functions are adjusted.

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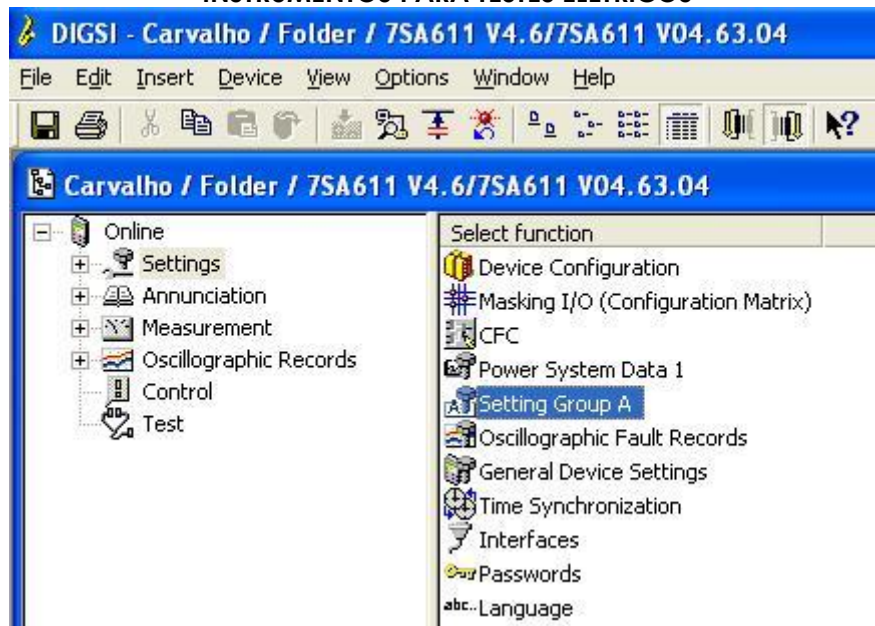


Figure 15

The “Power System 2” option settings are irrelevant for this test.

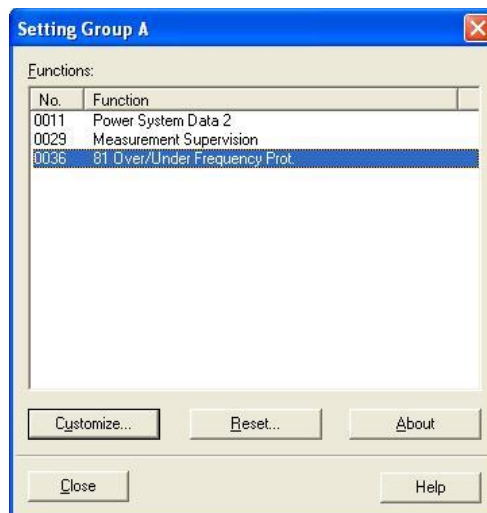


Figure 16

3.8 81 Over/Under Frequency Prot.

In this field, the frequency pick-ups are set along with the timing.

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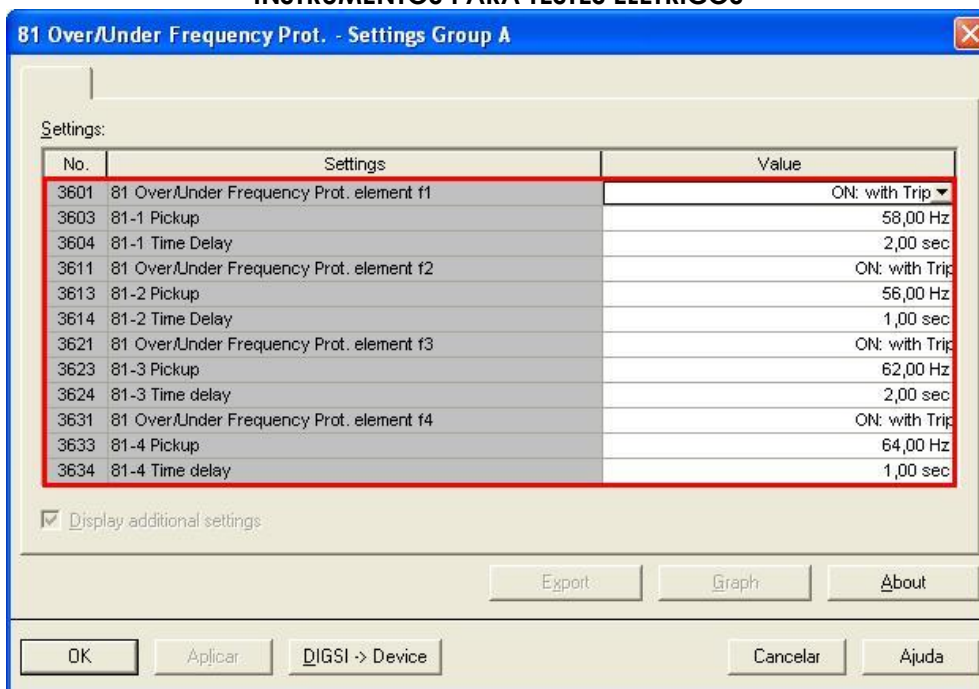


Figure 17

Note: The highest of the 3 phase-to-phase voltages is used for frequency measurement. It must reach at least 65 % of the nominal voltage set in parameter 204, Rated Secondary Voltage (Ph-Ph). Below this value, frequency measurement does not occur.

4. Ramp software adjustments

4.1 Opening the Ramp

Click on the “CTC” application manager icon.

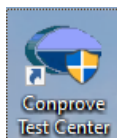


Figure 18

Click on the “Ramp” software icon.

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Figure 19

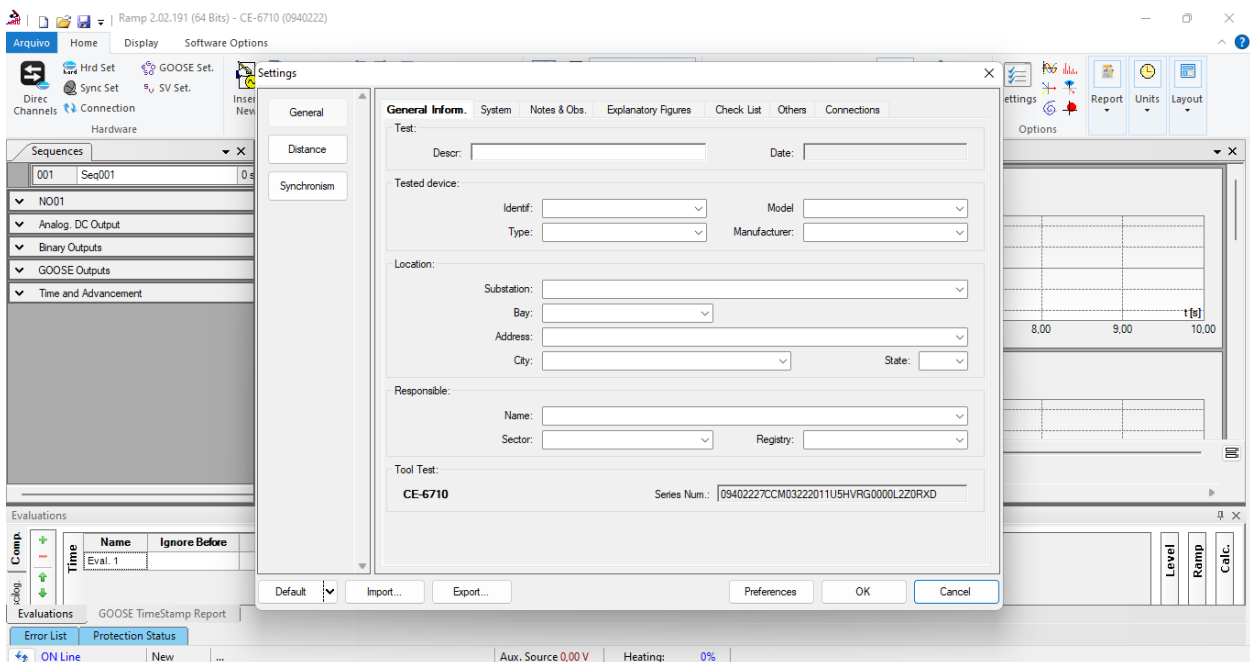


Figure 20

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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.

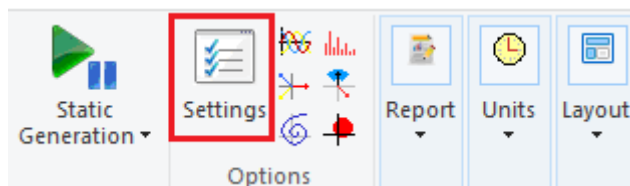


Figure 21

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.

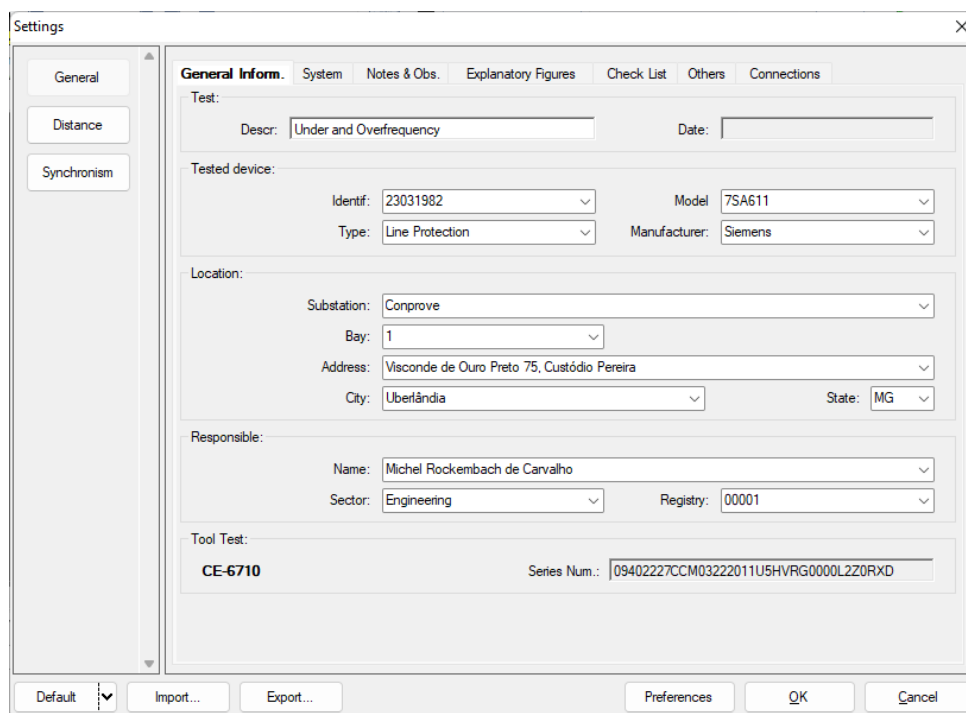


Figure 22

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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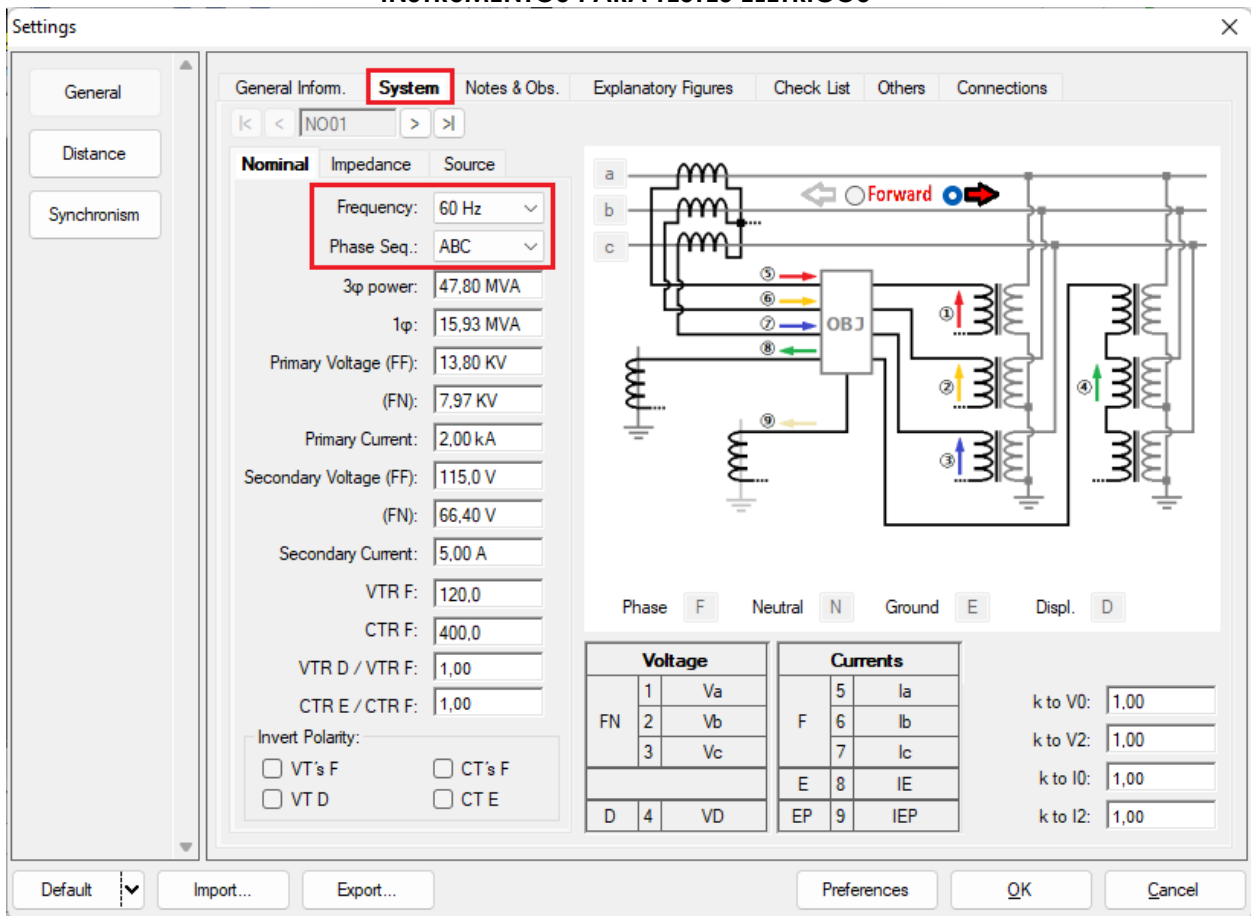


Figure 23

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.

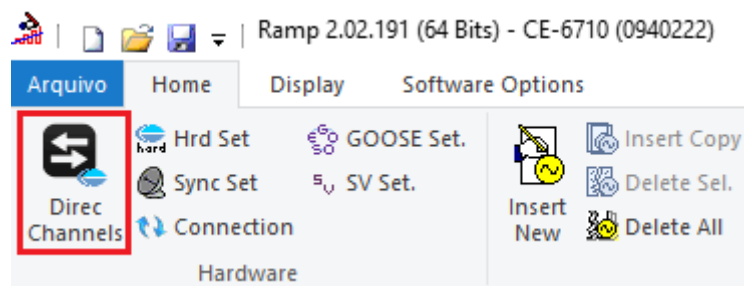


Figure 24

Then click on the highlighted icon to configure the hardware.

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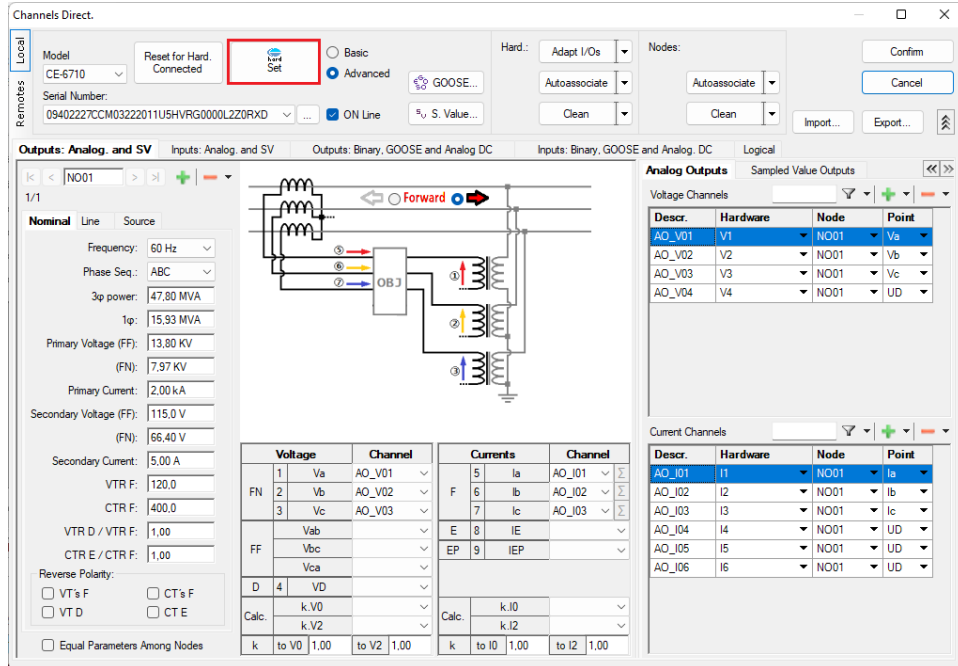


Figure 25

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

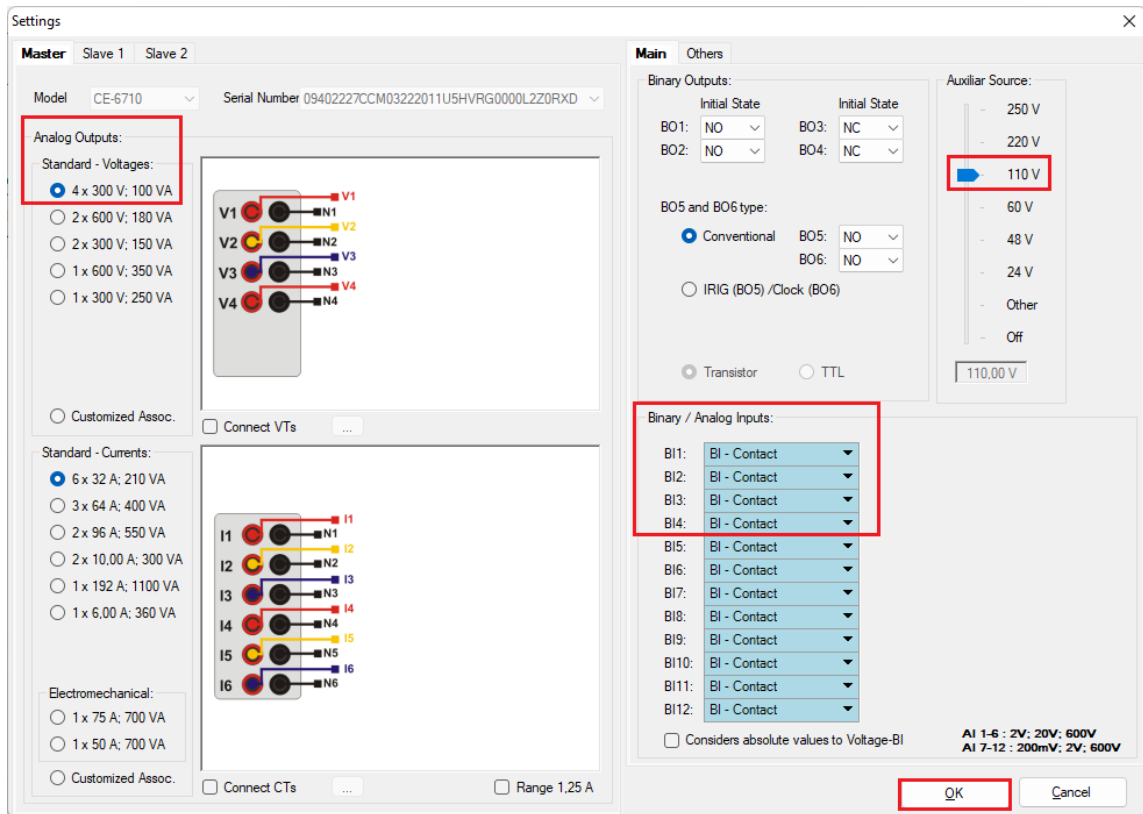


Figure 26

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

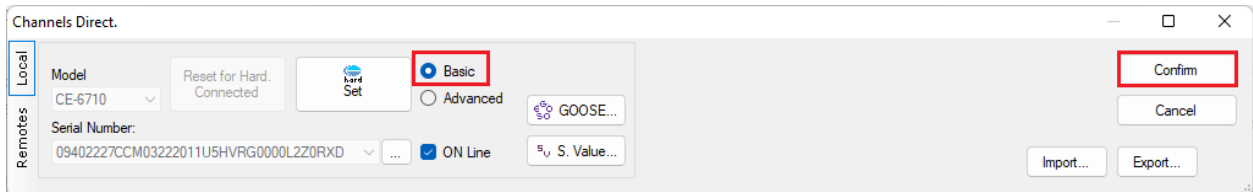


Figure 27

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.

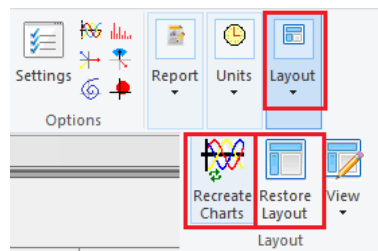


Figure 28

Following is the default structure after the previous commands.

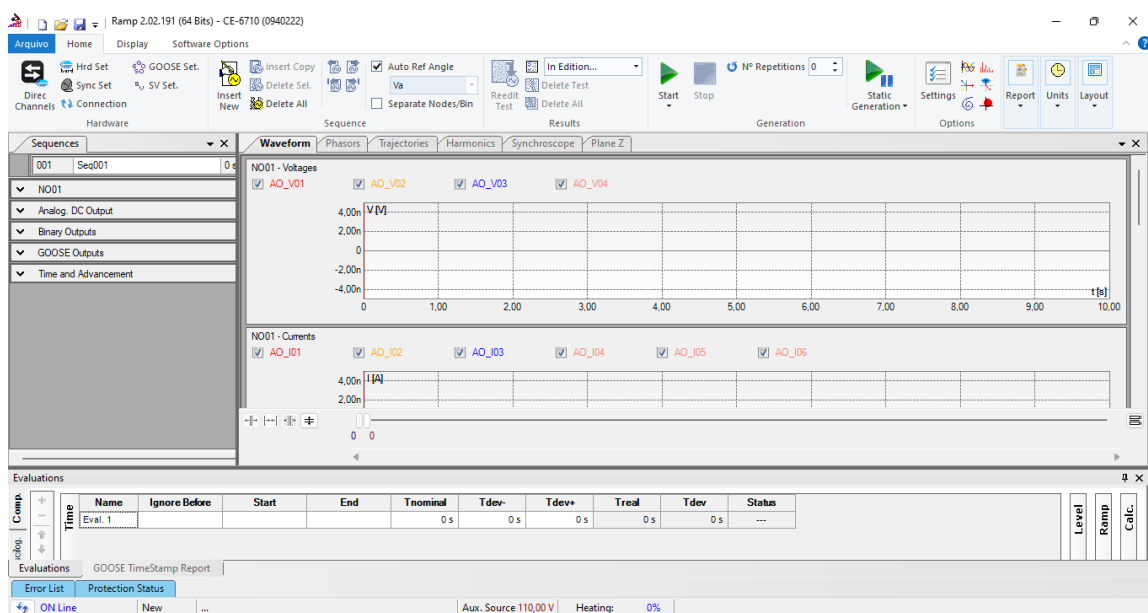


Figure 29

7. Test structure for function 81

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

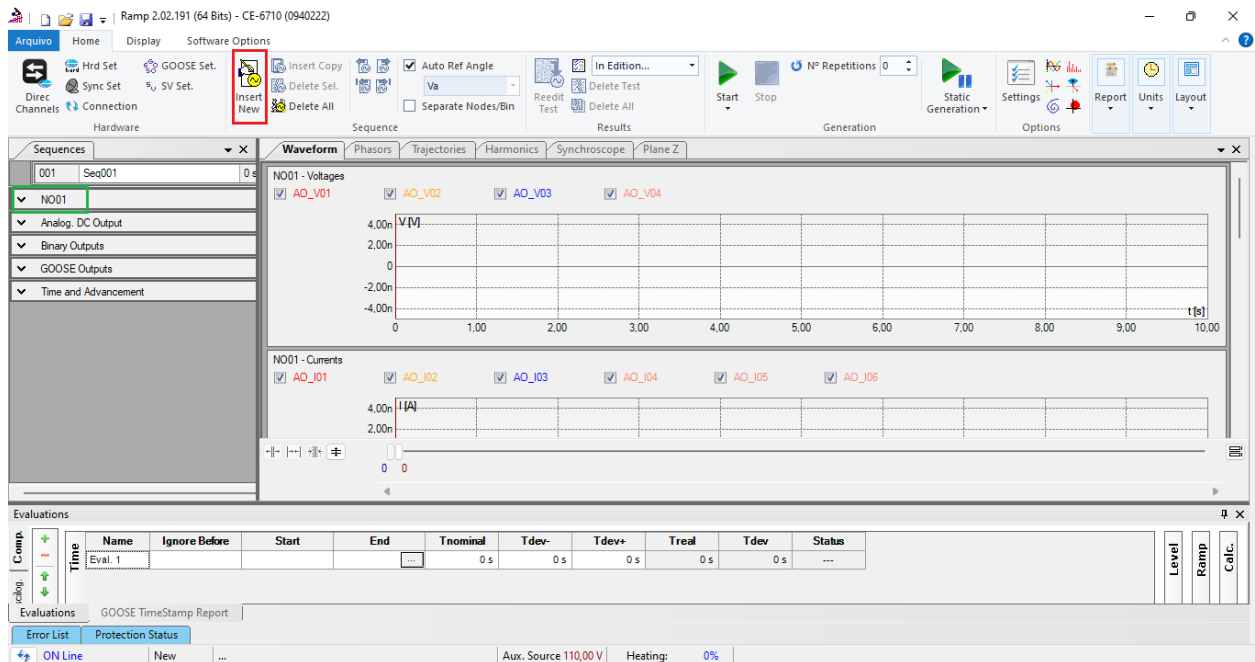


Figure 30

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

7.1 Main Screen 81-1

In the first sequence, a situation is configured to verify the underfrequency of element 81 whose adjustment is at 58.0 Hertz and 2.0 seconds. In place of “Seq 001” write “81-1”. Then click on the highlighted in red button in the figure below.

INSTRUMENTOS PARA TESTES ELÉTRICOS

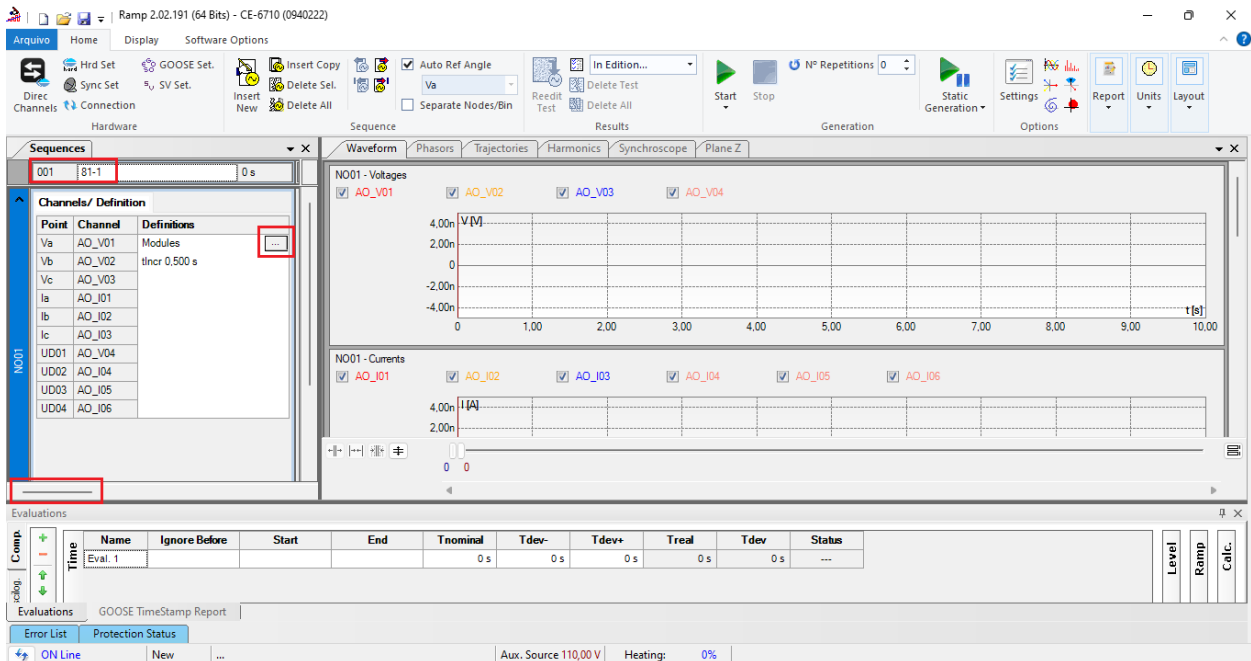


Figure 31

7.2 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 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 2.3 seconds was chosen. “Reset Time” has been set to 0.3 second.

INSTRUMENTOS PARA TESTES ELÉTRICOS

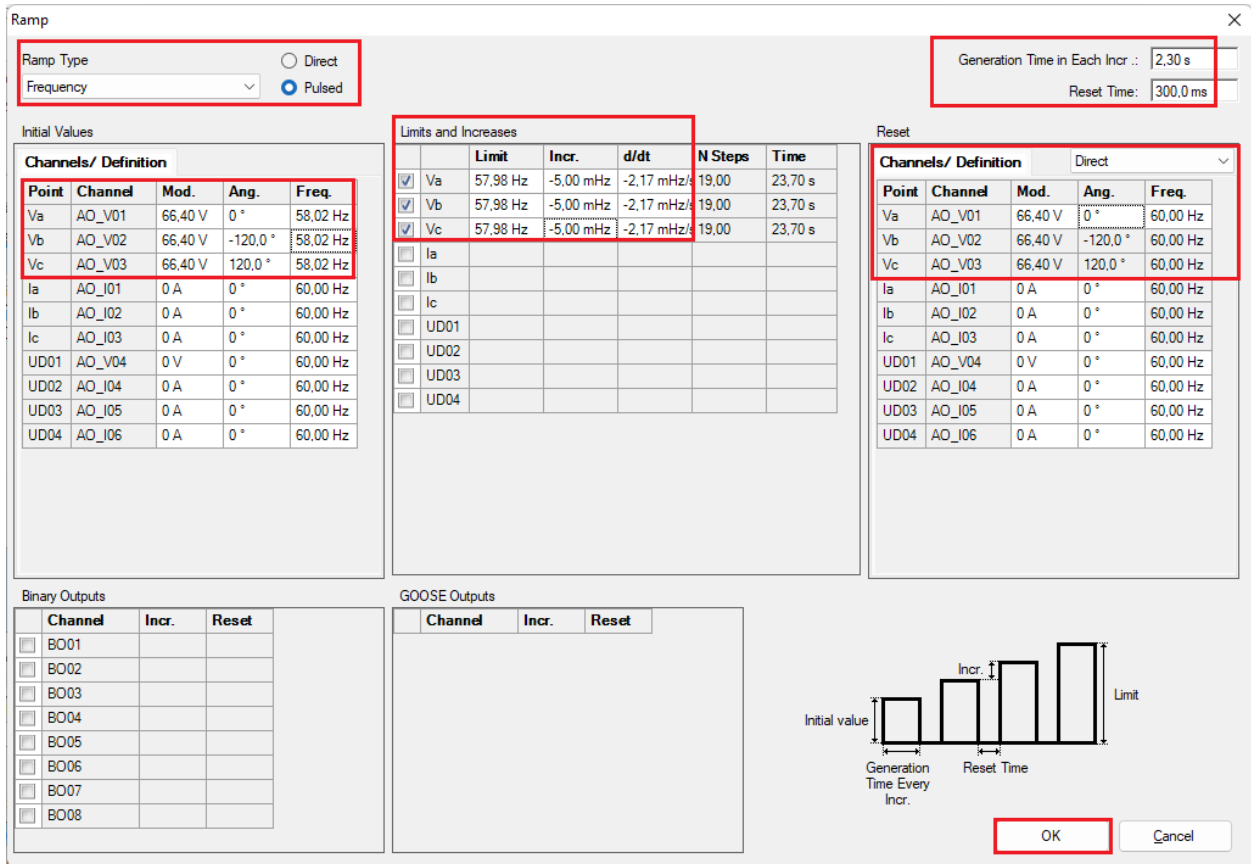


Figure 32

7.3 Main screen 81-2

In the second sequence, configure a situation to verify the underfrequency of the 81-2 element whose adjustment is at 56.0 Hertz and 1.0 second. In place of “Seq 002” write “81-2” then click on the highlighted button in the figure below:

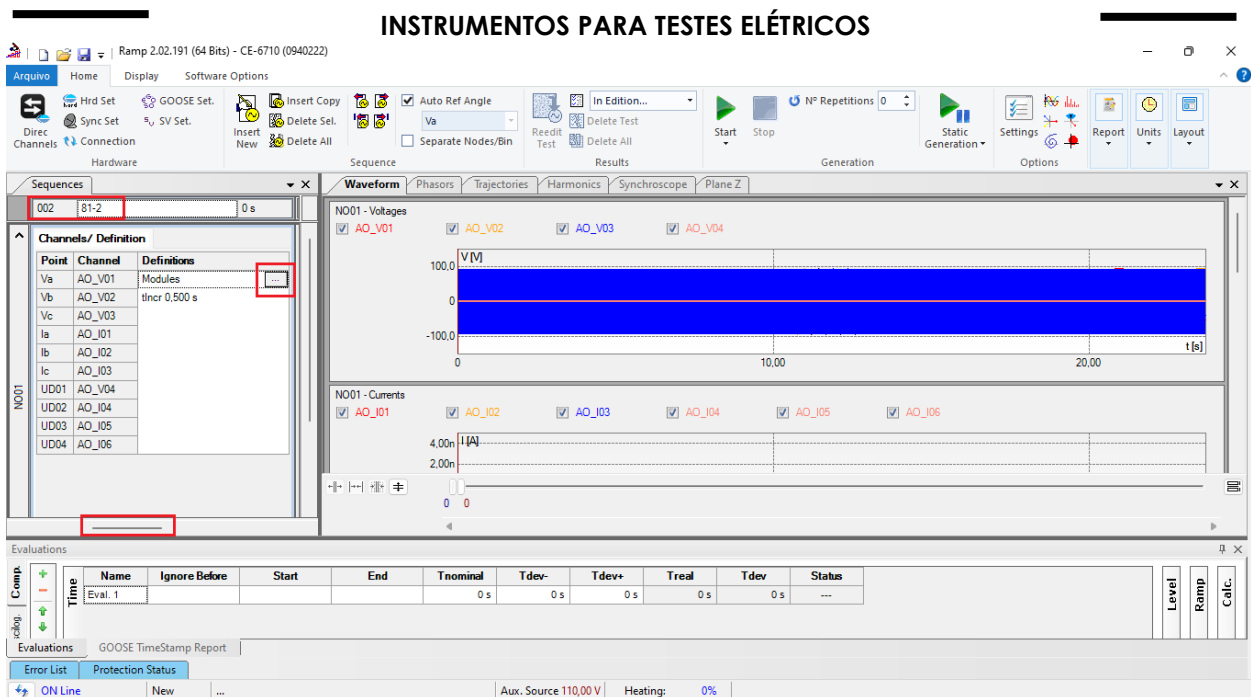


Figure 33

7.4 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 56.02Hz and for the final frequency 55.98Hz 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 1.3 seconds was chosen “Reset Time” has been set to 0.3 seconds.

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Ramp

Ramp Type: Direct Pulsed

Frequency: [v]

Generation Time in Each Incr.: 1,30 s
Reset Time: 300,0 ms

Initial Values

Channels/ Definition				
Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	66,40 V	0 °	56,02 Hz
Vb	AO_V02	66,40 V	-120,0 °	56,02 Hz
Vc	AO_V03	66,40 V	120,0 °	56,02 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	55,98 Hz	-5,00 mHz	-3,85 mHz/s	19,00	14,70 s
<input checked="" type="checkbox"/> Vb	55,98 Hz	-5,00 mHz	-3,85 mHz/s	19,00	14,70 s
<input checked="" type="checkbox"/> Vc	55,98 Hz	-5,00 mHz	-3,85 mHz/s	19,00	14,70 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

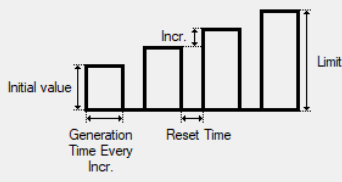
Channels/ Definition				
Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	66,40 V	0 °	60,00 Hz
Vb	AO_V02	66,40 V	-120,0 °	60,00 Hz
Vc	AO_V03	66,40 V	120,0 °	60,00 Hz
Ia	AO_I01	0 A	0 °	60,00 Hz
Ib	AO_I02	0 A	0 °	60,00 Hz
Ic	AO_I03	0 A	0 °	60,00 Hz
UD01	AO_V04	0 V	0 °	60,00 Hz
UD02	AO_I04	0 A	0 °	60,00 Hz
UD03	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 34

7.5 Main Screen 81-3

In the third sequence, configure a situation to check the overfrequency of element 81-3 whose adjustment is at 62.0Hz and 2 seconds. In place of “Seq 003” write “81-3”. Then click on the highlighted button in the figure below:

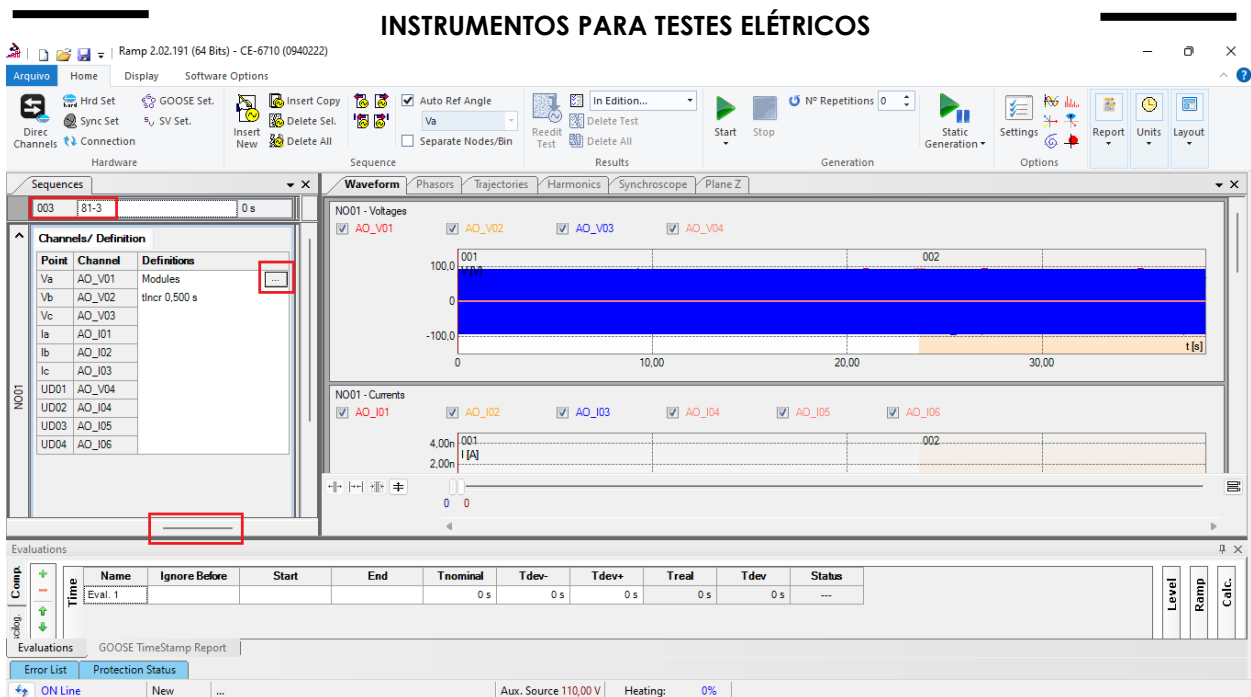


Figure 35

7.6 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 61.98 Hz and for the final frequency 62.02Hz 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 2.3 seconds was chosen. “*Reset Time*” has been set to 0.3 seconds.

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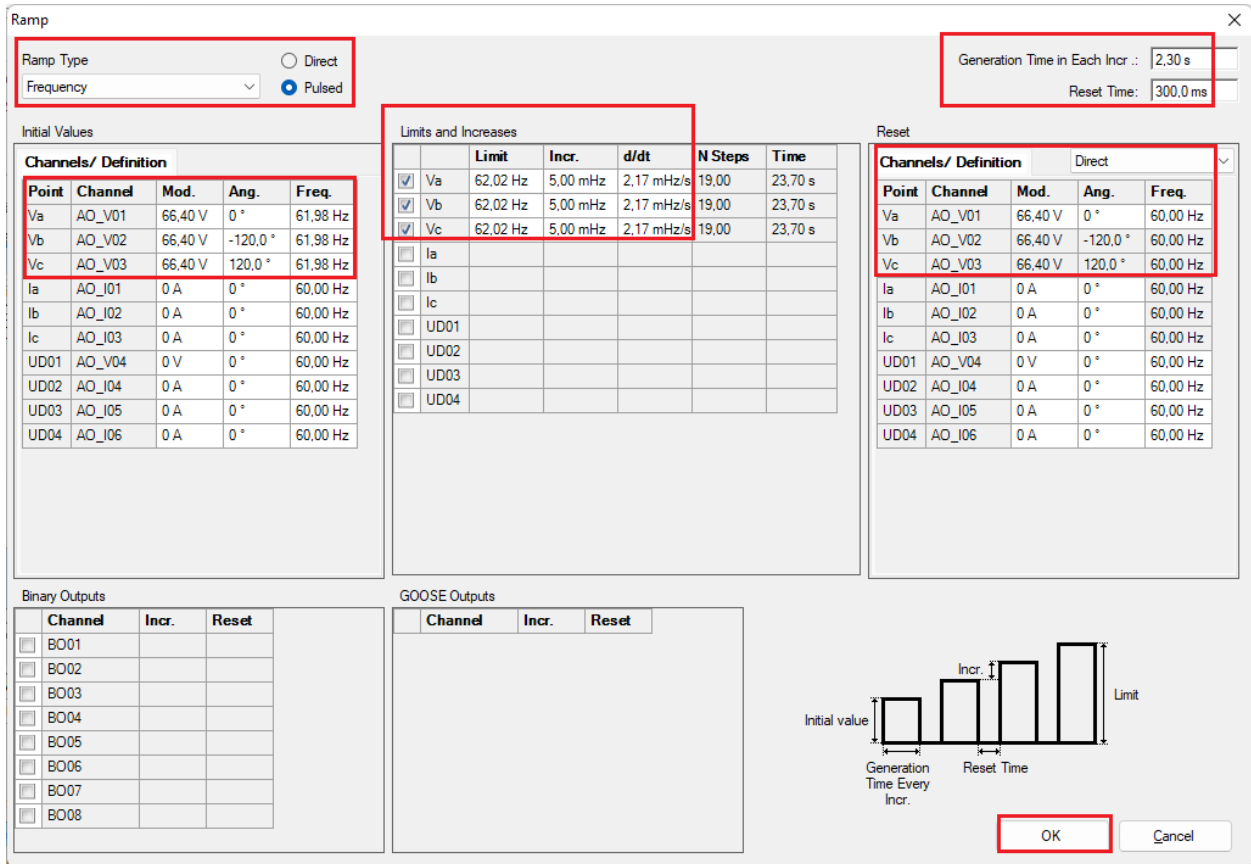


Figure 36

7.7 Main screen 81-4

In the fourth sequence, configure a situation to check the overfrequency of element 81-4 whose adjustment is at 64.0Hz and 1.0 second. In place of “Seq 004” write “81-4” then click on the highlighted button in the figure below:

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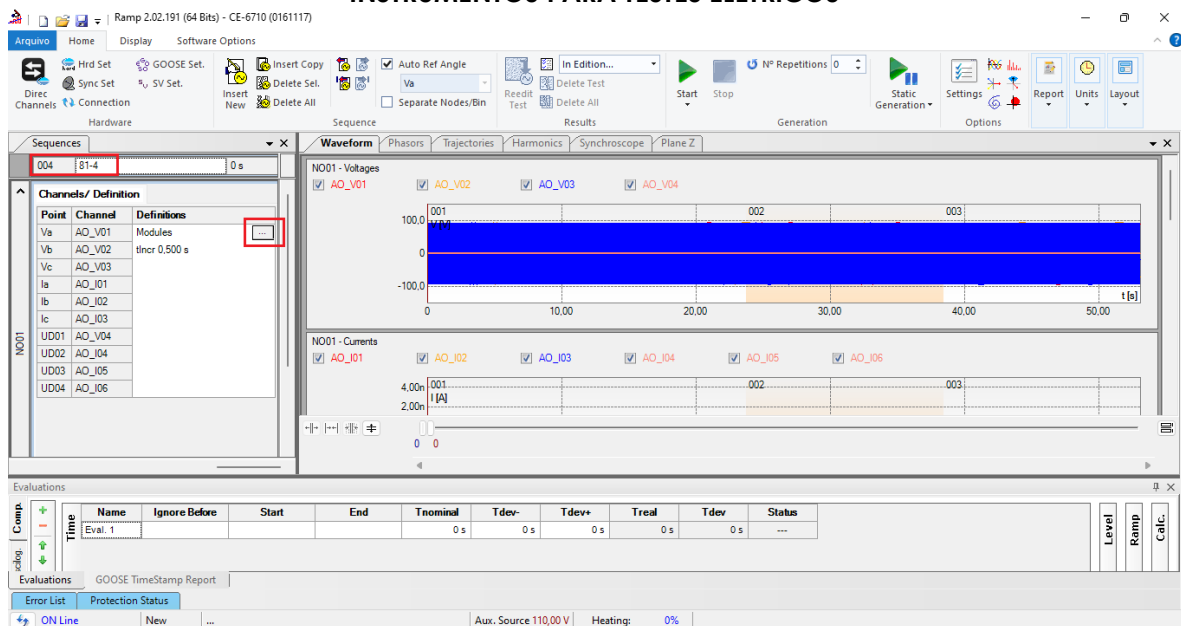


Figure 37

7.8 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 63.98 Hz and for the final frequency 64.02 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 1.3 seconds was chosen. “Reset Time” has been set to 0.3 seconds.

INSTRUMENTOS PARA TESTES ELÉTRICOS

Ramp

Ramp Type: Direct Pulsed

Frequency:

Generation Time in Each Incr.: 1,30 s
Reset Time: 300,0 ms

Initial Values

Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	66,40 V	0 °	63,98 Hz
Vb	AO_V02	66,40 V	-120,0 °	63,98 Hz
Vc	AO_V03	66,40 V	120,0 °	63,98 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	64,02 Hz	5,00 mHz	3,85 mHz/s	19,00	14,70 s
<input checked="" type="checkbox"/> Vb	64,02 Hz	5,00 mHz	3,85 mHz/s	19,00	14,70 s
<input checked="" type="checkbox"/> Vc	64,02 Hz	5,00 mHz	3,85 mHz/s	19,00	14,70 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

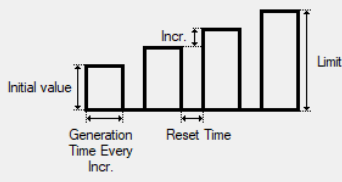
Point	Channel	Mod.	Ang.	Freq.
Va	AO_V01	66,40 V	0 °	60,00 Hz
Vb	AO_V02	66,40 V	-120,0 °	60,00 Hz
Vc	AO_V03	66,40 V	120,0 °	60,00 Hz
Ia	AO_I01	0 A	0 °	60,00 Hz
Ib	AO_I02	0 A	0 °	60,00 Hz
Ic	AO_I03	0 A	0 °	60,00 Hz
UD01	AO_V04	0 V	0 °	60,00 Hz
UD02	AO_I04	0 A	0 °	60,00 Hz
UD03	AO_I05	0 A	0 °	60,00 Hz
UD04	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 38

7.9 Evaluation of pick-ups

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

INSTRUMENTOS PARA TESTES ELÉTRICOS

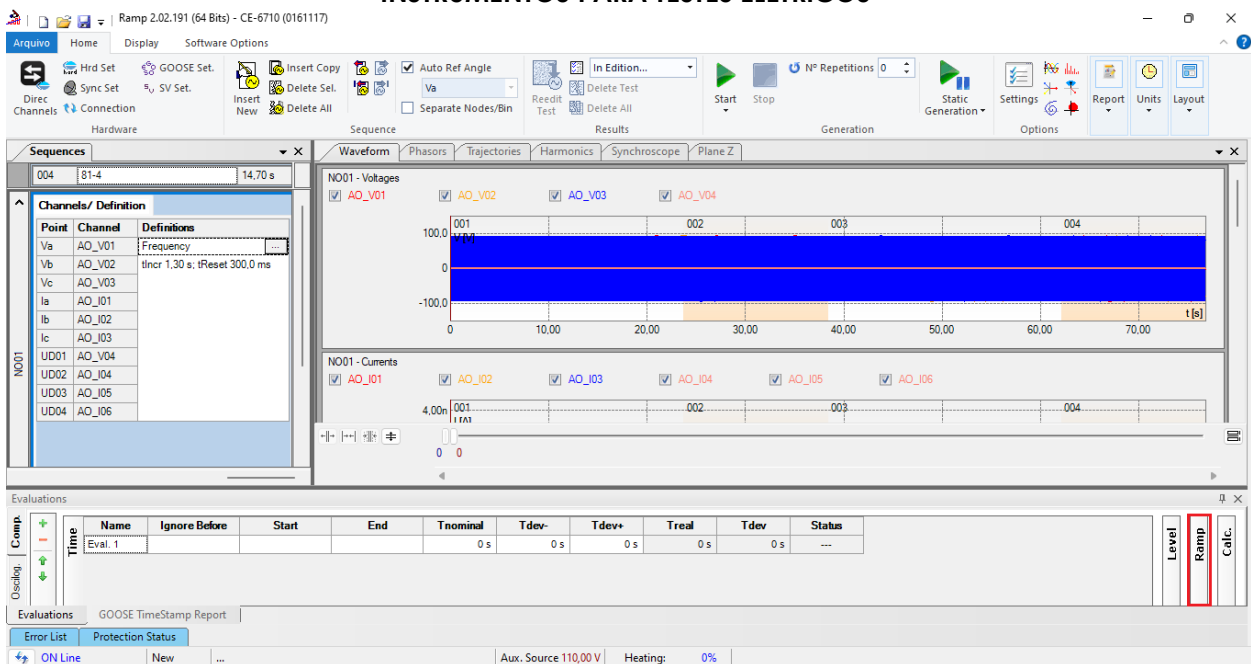


Figure 39

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 58.00Hz and in the fields related to deviations set 10mHz.

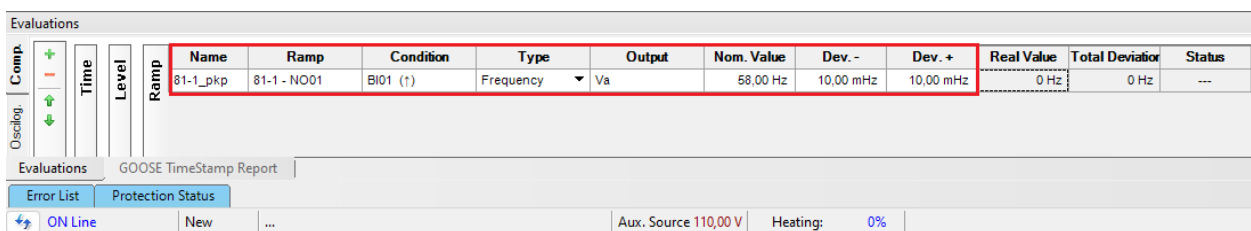


Figure 40

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.

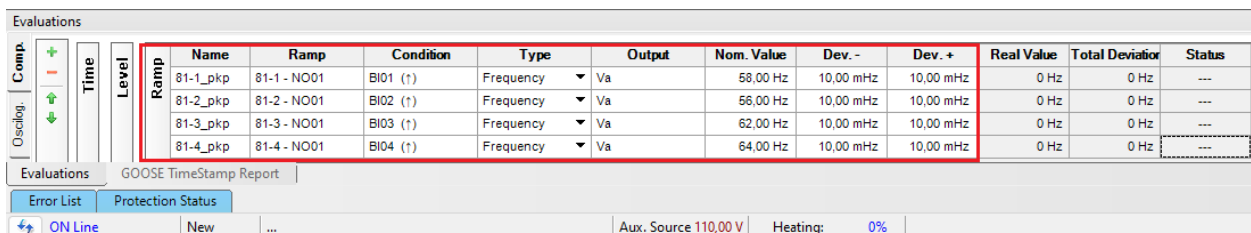


Figure 41

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.

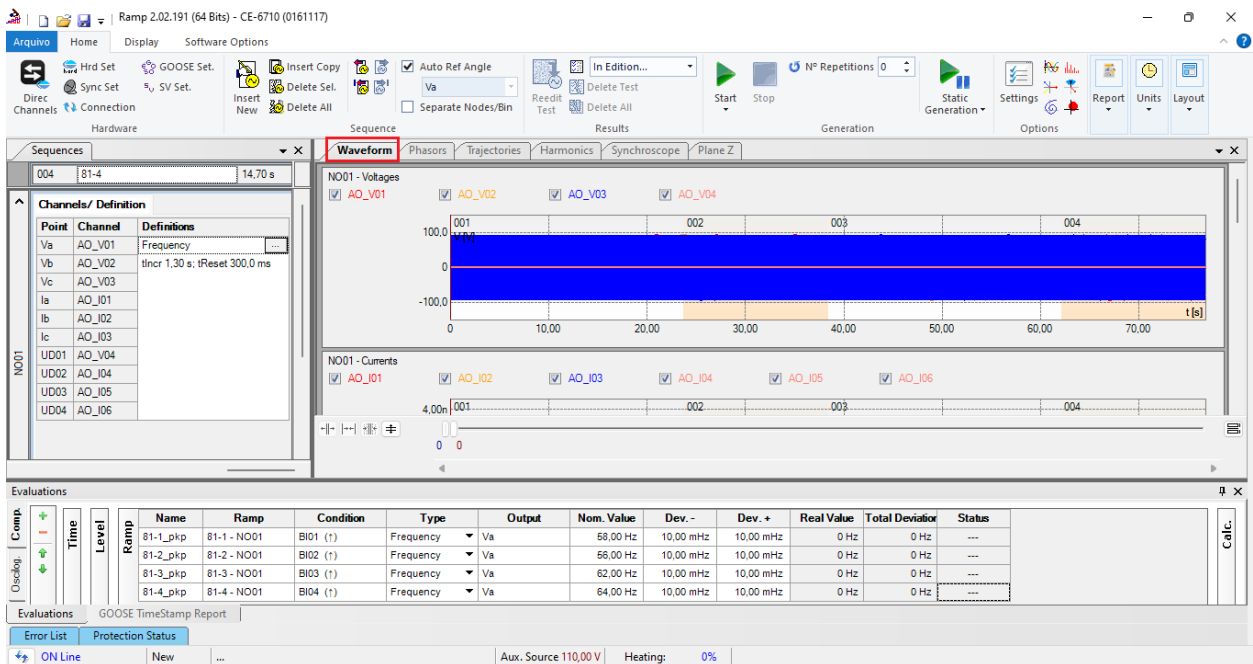


Figure 42

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

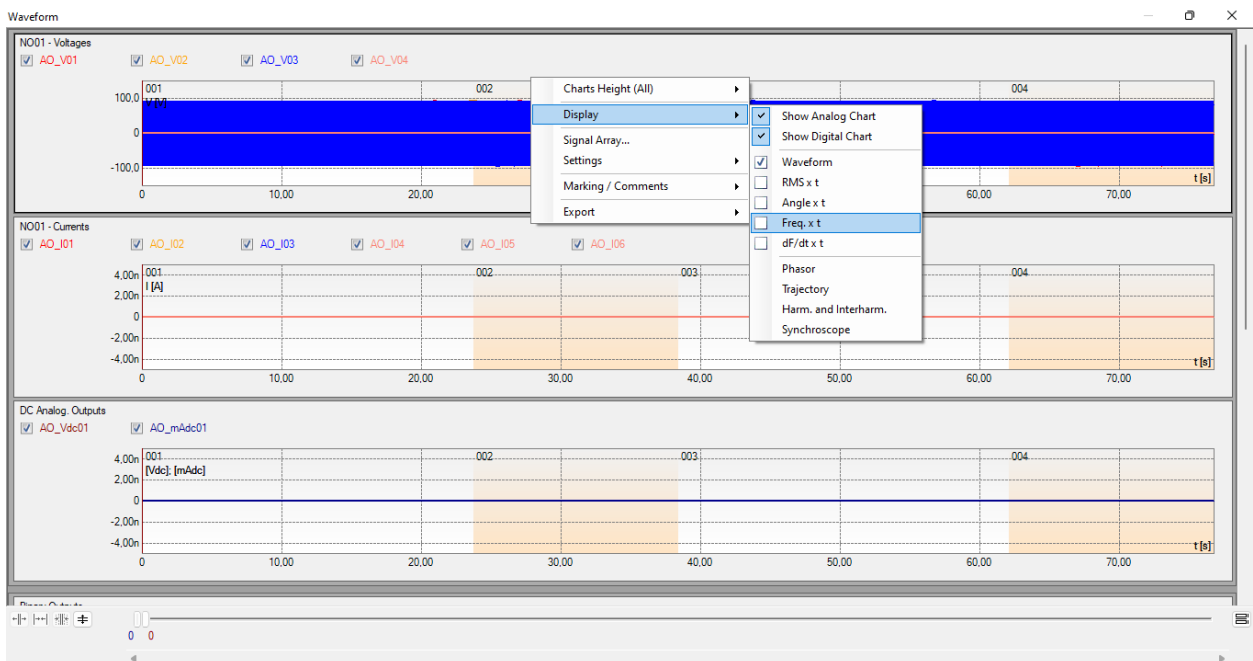


Figure 43

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”.

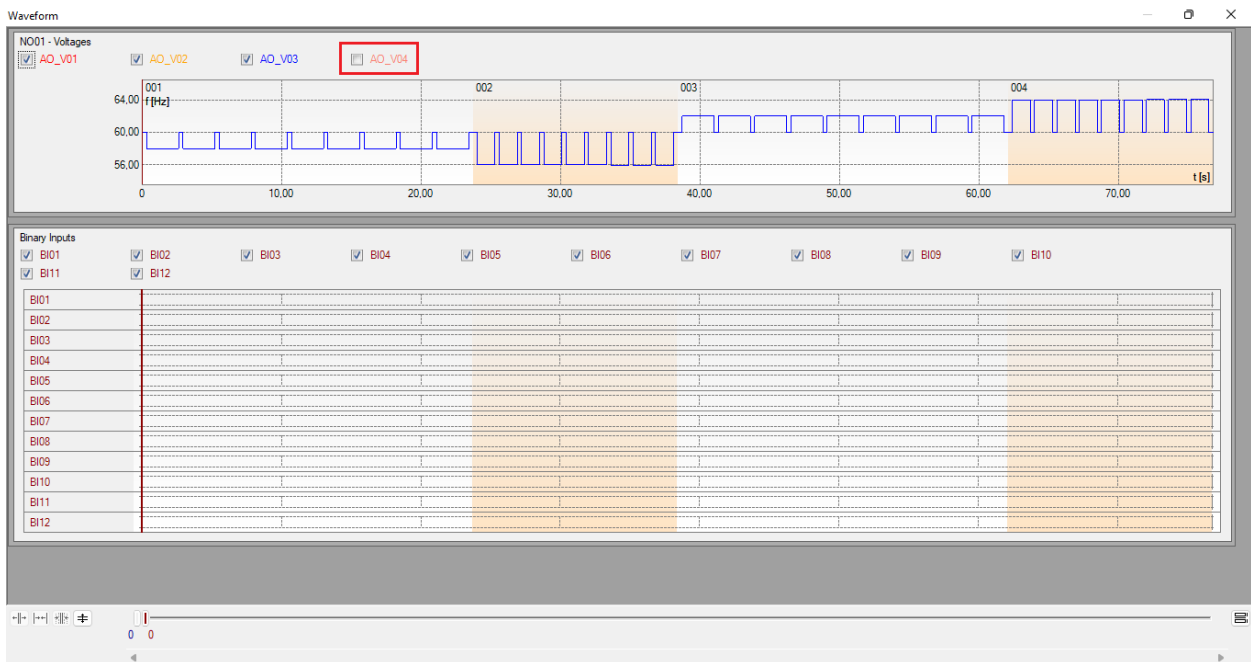


Figure 44

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

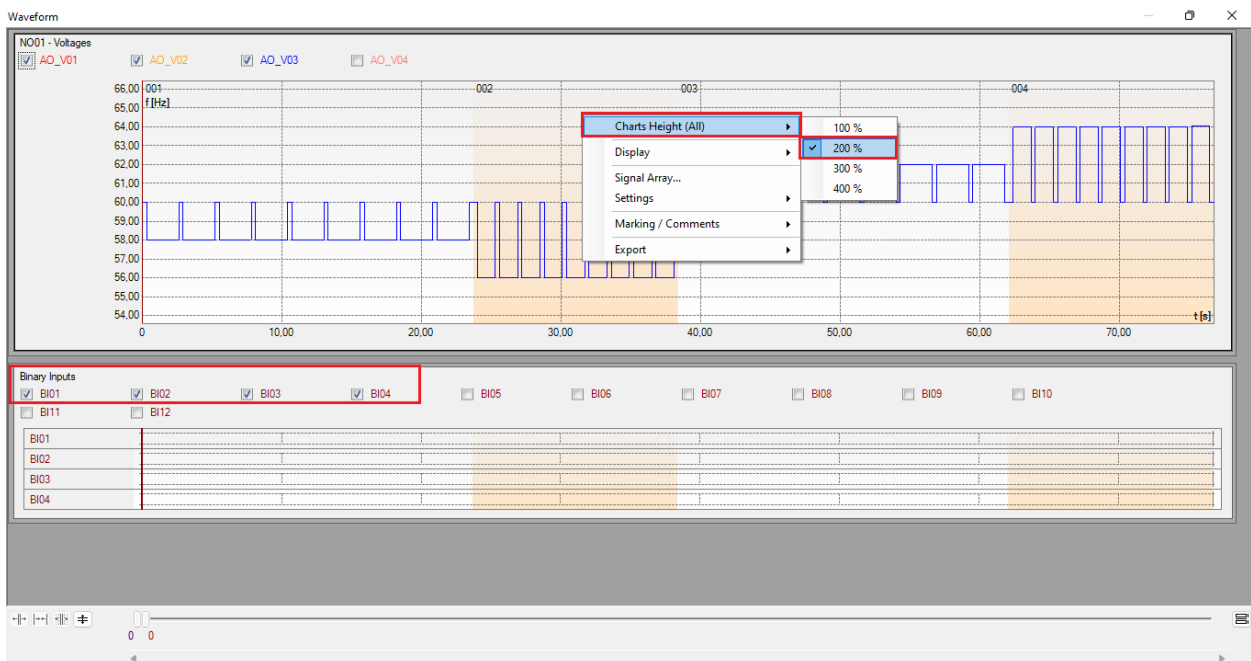


Figure 45

7.11 *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.

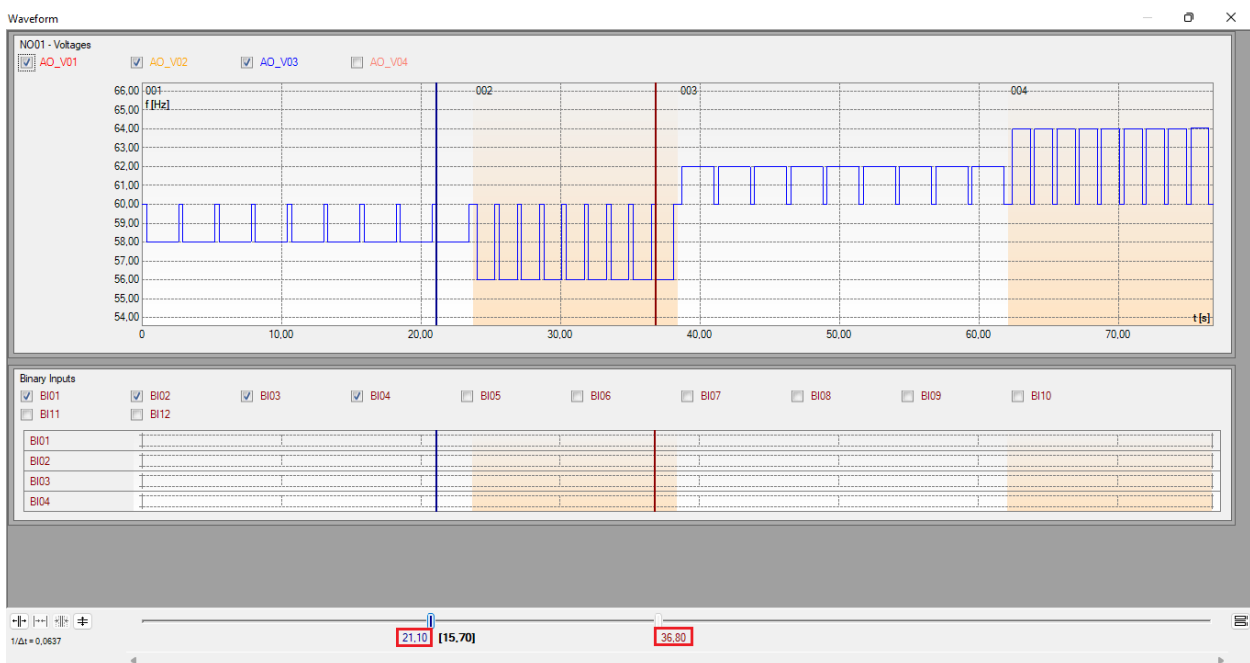


Figure 46

According to the previous figure, it can be concluded that the time for marking 1 is 21.10 seconds and for the second, 36.80 seconds. The next figure shows the position of the last two elements.

INSTRUMENTOS PARA TESTES ELÉTRICOS

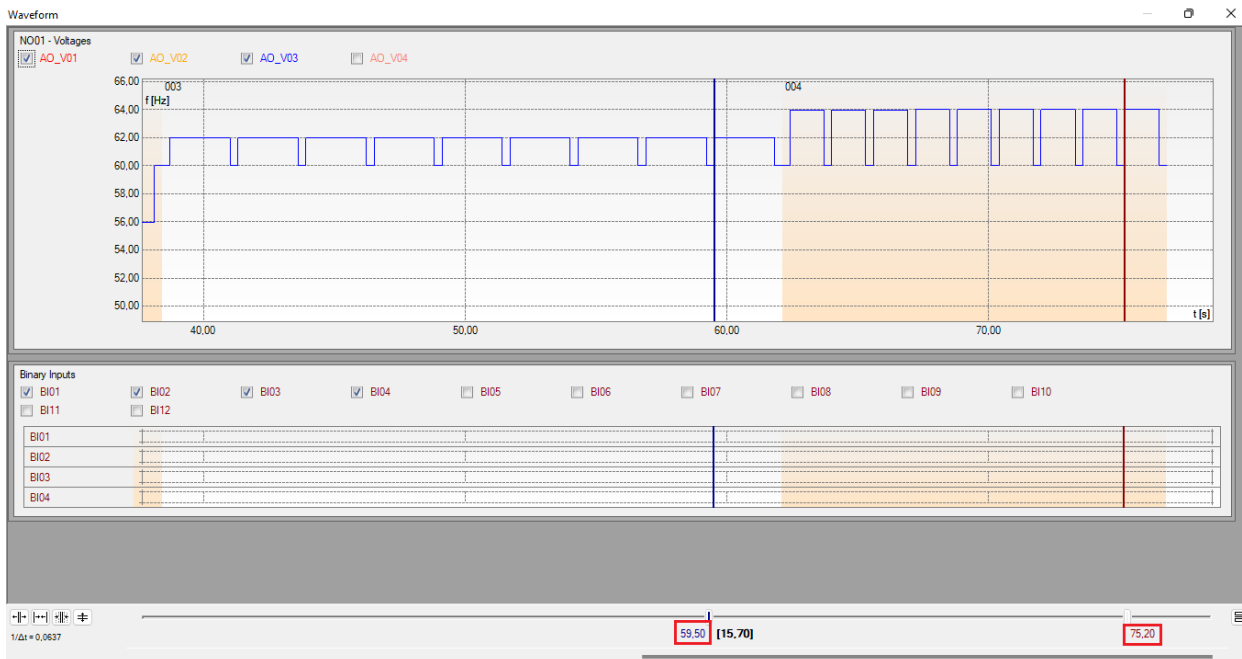


Figure 47

According to the previous figure, it can be concluded that the time for marking 3 is 59.50 seconds and for marking 4 it is 75.20 seconds.

7.12 *Inserting marking*

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

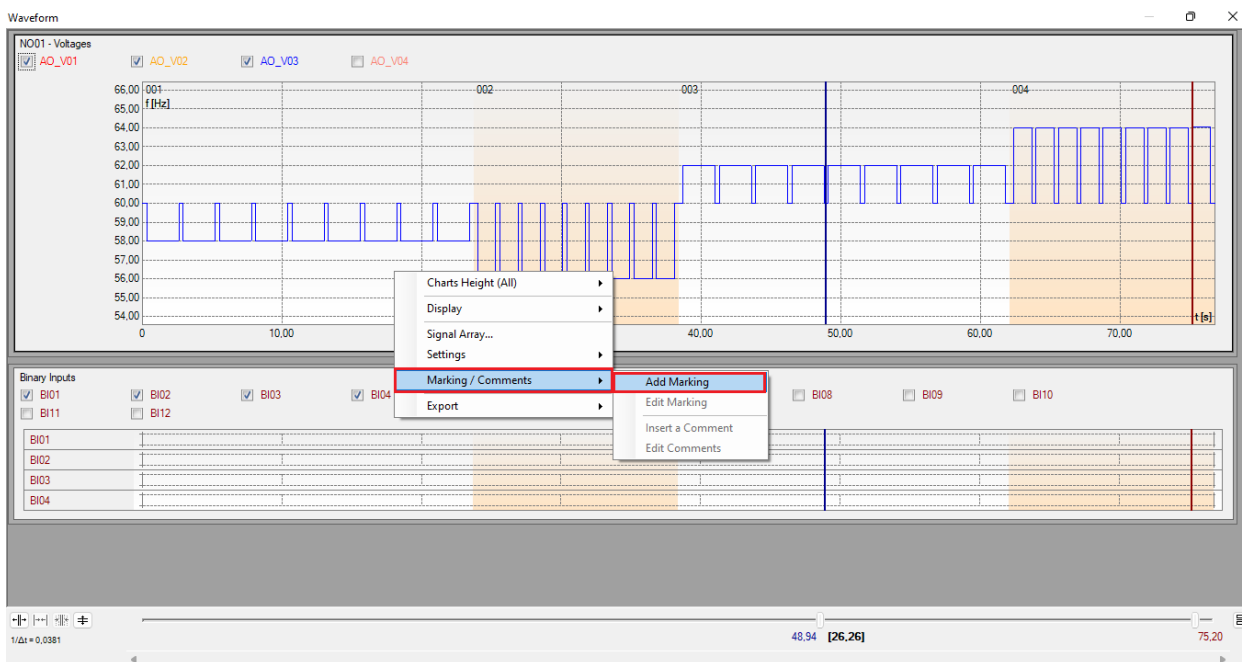
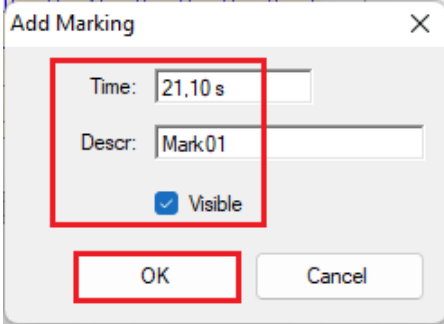


Figure 48

INSTRUMENTOS PARA TESTES ELÉTRICOS

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



Add Marking

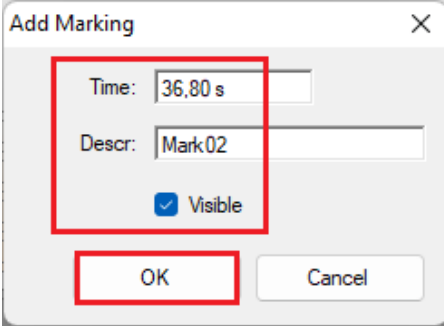
Time: 21,10 s

Descr: Mark01

Visible

OK Cancel

Figure 49



Add Marking

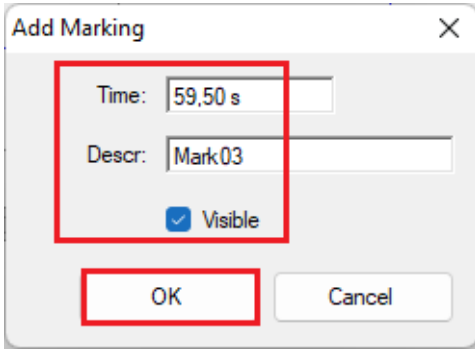
Time: 36,80 s

Descr: Mark02

Visible

OK Cancel

Figure 50



Add Marking

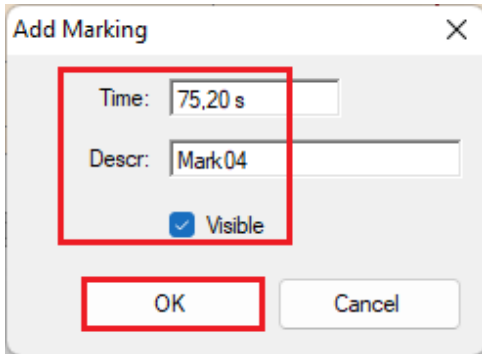
Time: 59,50 s

Descr: Mark03

Visible

OK Cancel

Figure 51



Add Marking

Time: 75,20 s

Descr: Mark04

Visible

OK Cancel

Figure 52

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).

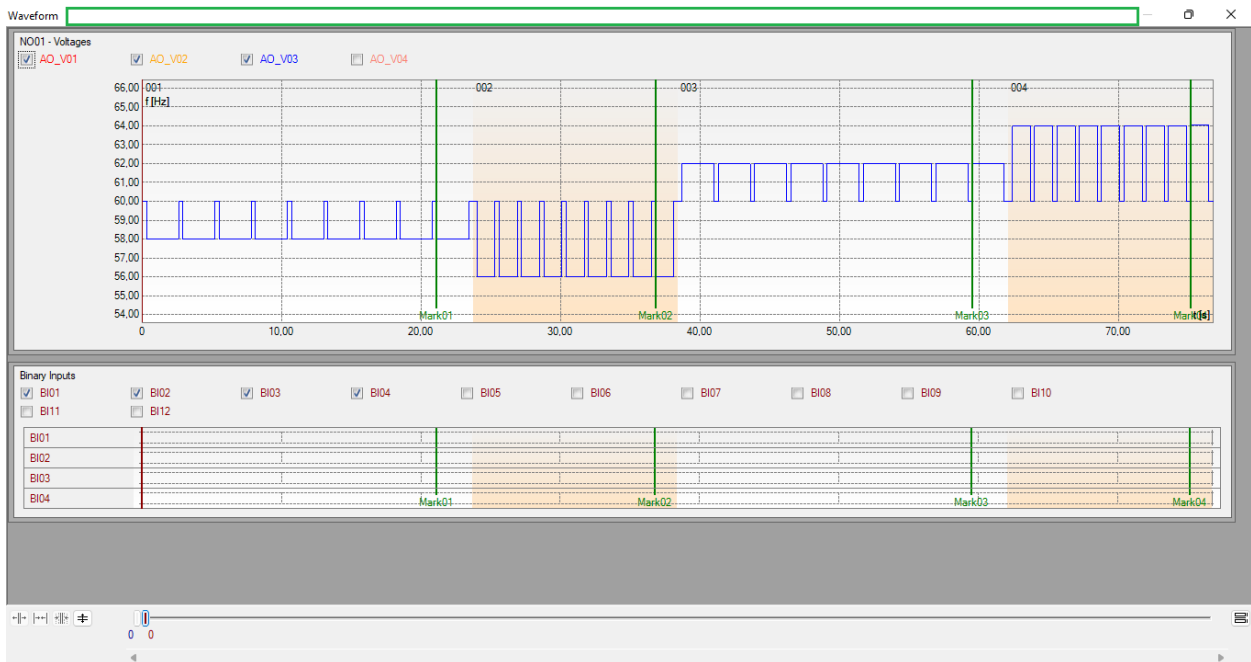


Figure 53

7.13 Time evaluation

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

INSTRUMENTOS PARA TESTES ELÉTRICOS

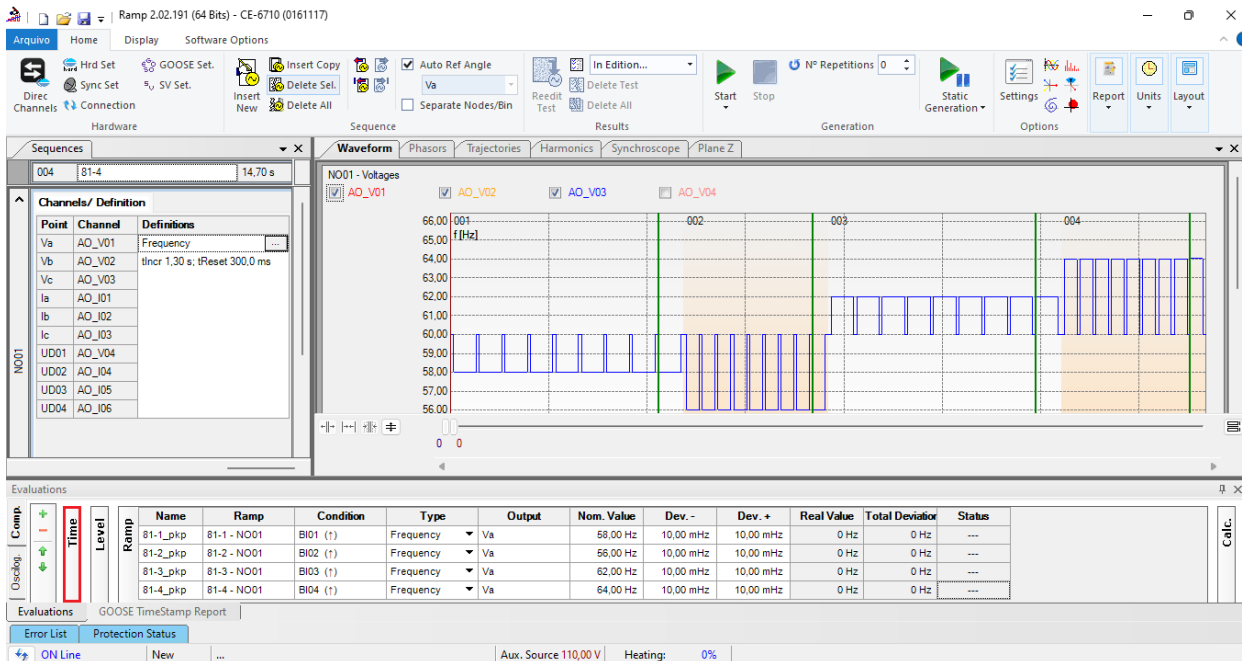


Figure 54

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 105ms. The figure below shows these settings.

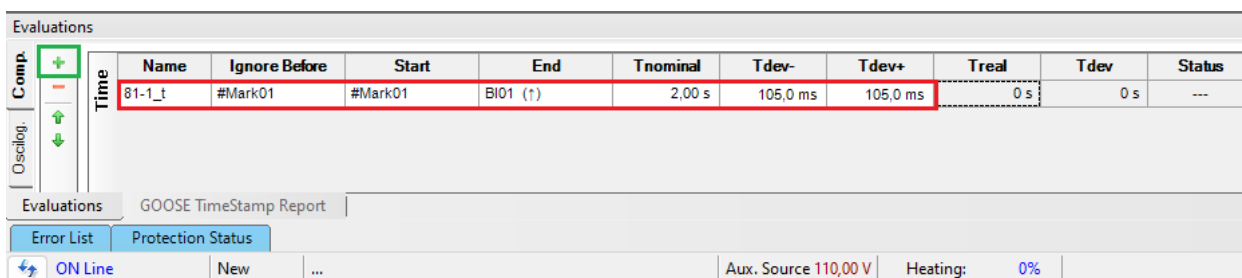


Figure 55

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

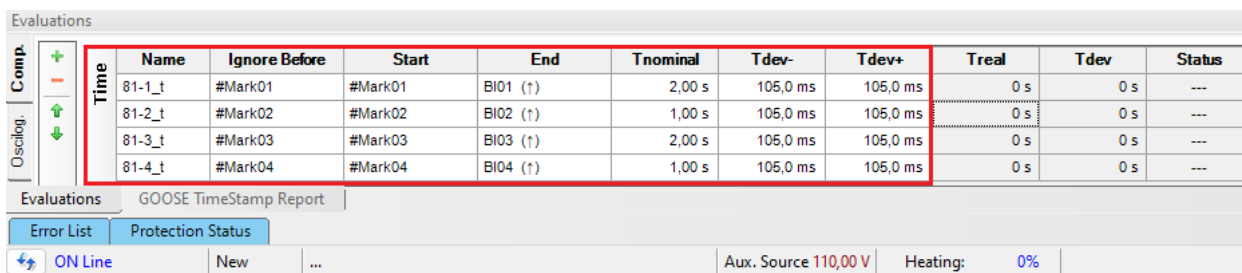


Figure 56

INSTRUMENTOS PARA TESTES ELÉTRICOS

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

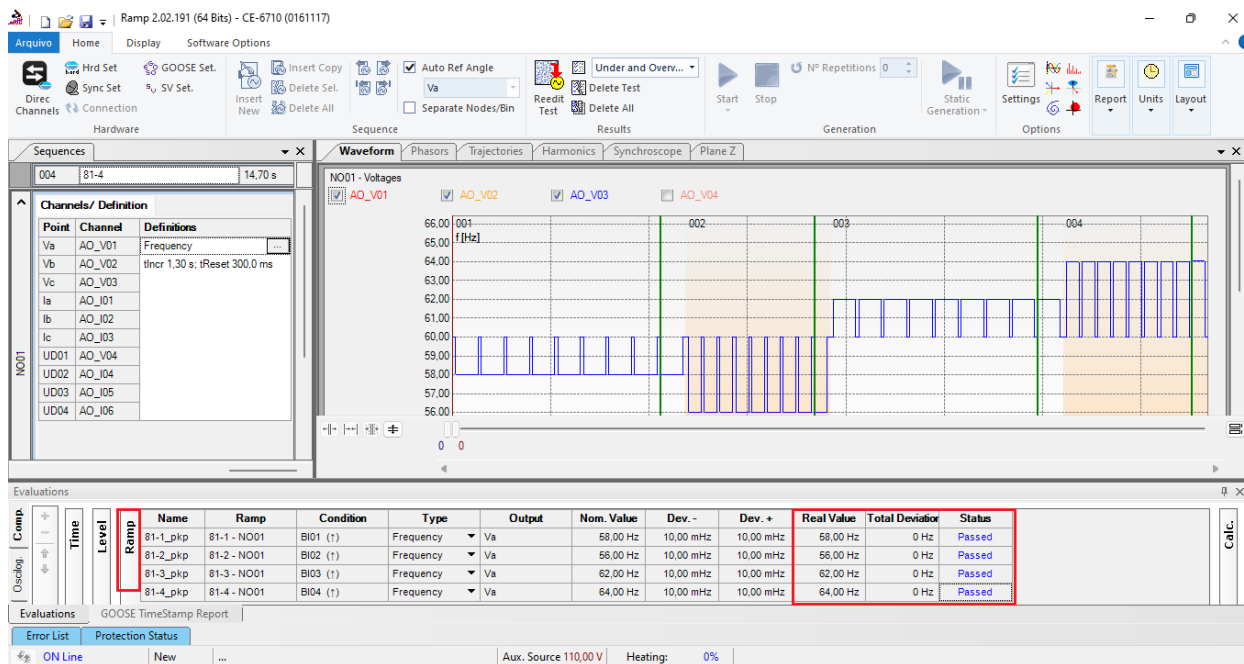


Figure 57

The following figure shows the operating times.

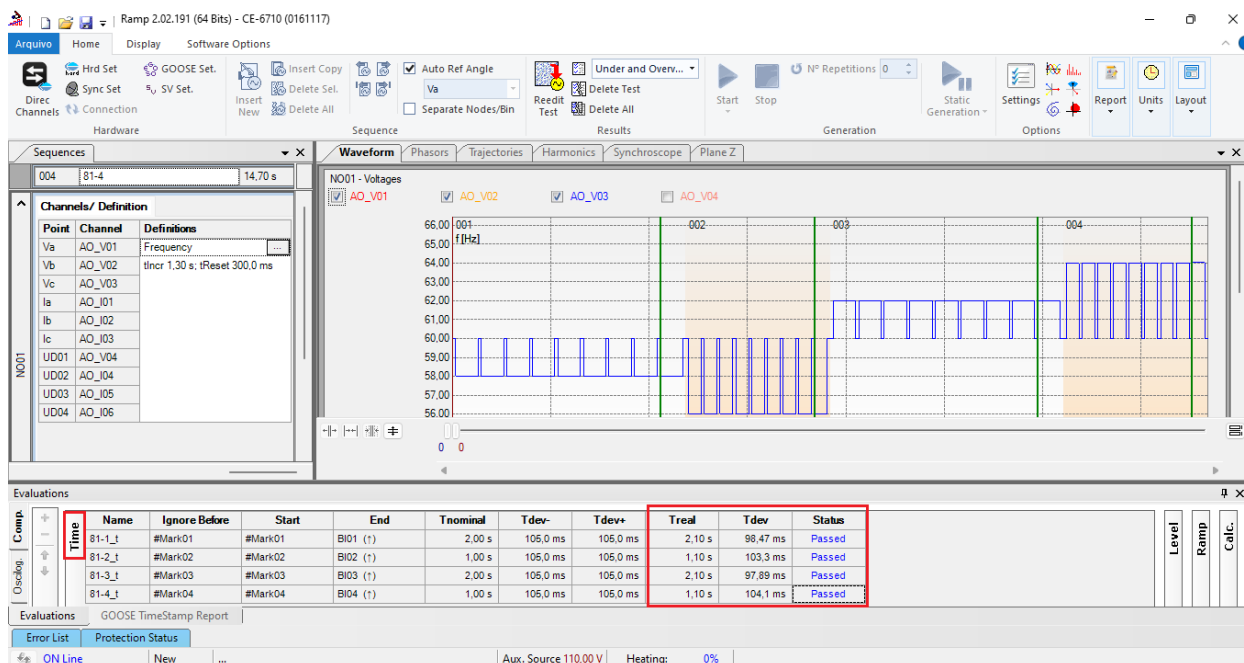


Figure 58

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.

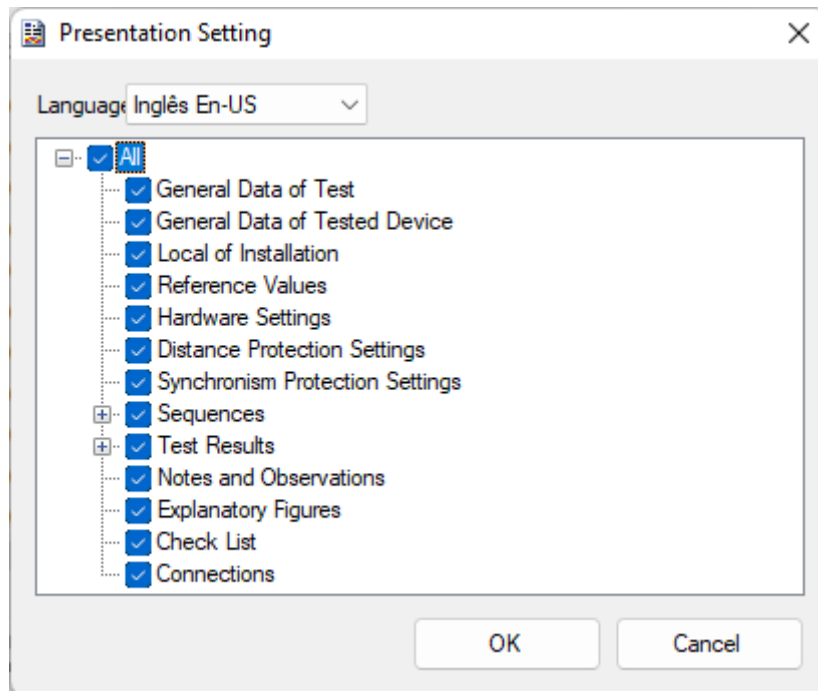


Figure 59

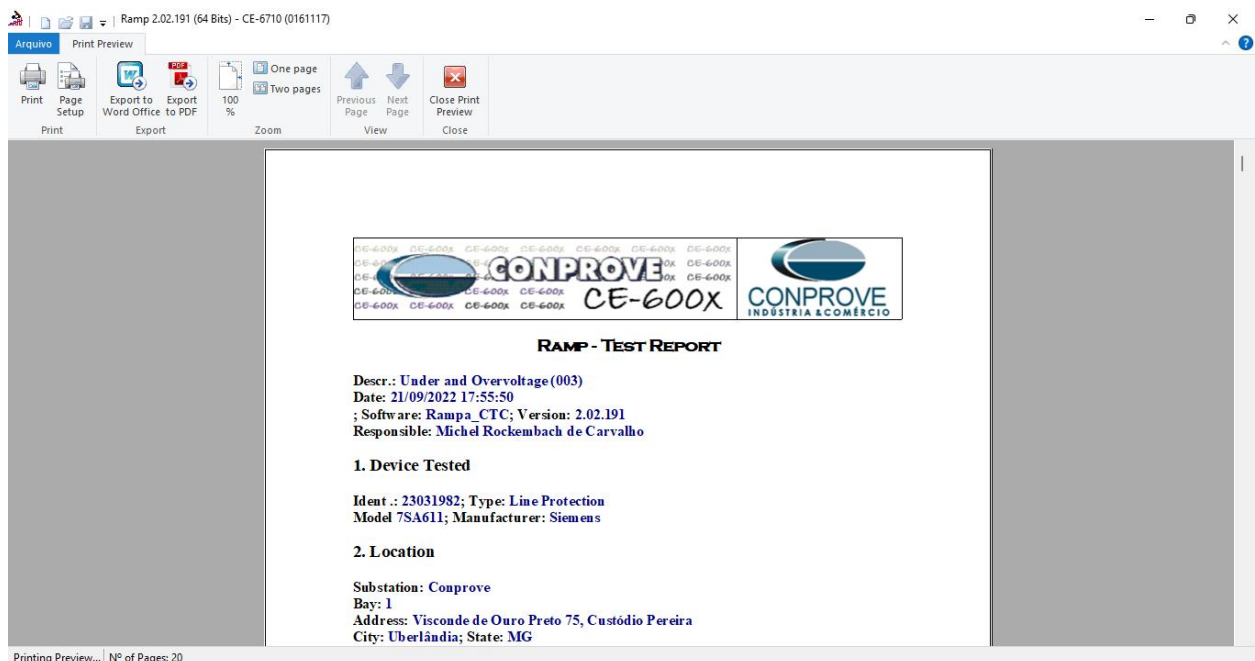


Figure 60

APPENDIX A

A.1 Terminal Designations

7SA6*1*-*B/K

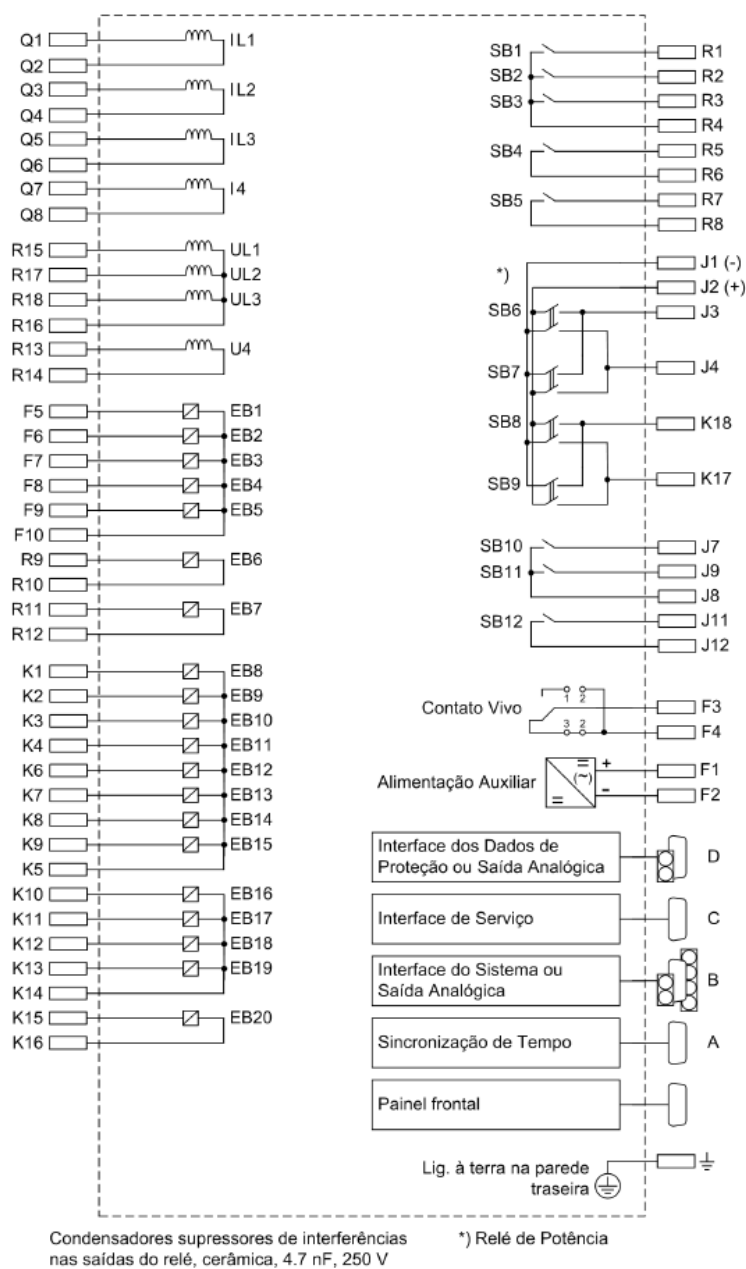


Figura A-4 Diagrama geral para 7SA6*1*-*B/K
(montagem embutida em painel ou montagem em cubículo)

A.2 Technical data

Elementos da Frequência

Quantidade	4, dependendo do ajuste selecionado em f< ou f>
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Valores de Pickup

f> ou f< ajustável para cada elemento		
para $f_N = 50$ Hz	45,50 Hz a 54,50 Hz	incrementos 0.01 Hz
para $f_N = 60$ Hz	55,50 Hz a 64,50 Hz	incrementos 0.01 Hz

Tempos

Tempos de pickup f>, f<	Aprox. 85 ms	
Tempos de dropout f>, f<	Aprox. 30 ms	
Temporizações T	0,00 s a 600,00 s	Incrementos 0.01 s
Os tempos ajustados são puras temporizações. Note em tempos de dropout: Dropout foi obtido pela corrente = 0 A e tensão = 0 V. Ao se obter dropout através de uma mudança de frequência abaixo do limite de dropout, estende os tempos de dropout		

Frequência de Dropout

$\Delta f = \text{valor de pickup} - \text{valor de dropout} $	Aprox. 20 mHz
---	---------------

Faixas Operacionais

Na faixa de tensão	aprox. 0.65 · U_N até 230 V (fase-fase)
Na faixa de frequência	25 Hz a 70 Hz

Tolerâncias

Frequências f>, f< na faixa específica ($f_N \pm 10\%$)	15 mHz na faixa U_{LL} : 50 V a 230 V
Temporizações T(f<, f>)	1% do valor de ajuste ou 10 ms

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 1

Ramp Software		Siemens 7SA6 Relay	
Parameter	Figure	Parameter	Figure
81-1_pkp	40	81- 1 Pickup	17
81-2_pkp	41	81- 2 Pickup	17
81-3_pkp	41	81- 3 Pickup	17
81-4_pkp	41	81- 4 Pickup	17
81-1_t	55	81- 1 Time delay	17
81-2_t	56	81- 2 Time delay	17
81-3_t	56	81- 3 Time delay	17
81-4_t	56	81- 4 Time delay	17