



INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: GE

Model: D60

Function: 81R or PFRC – Rate of Change of Frequency or df/dt

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

Objective: Testing the pickup and operating time of the rate of change of frequency elements using the Ramp software

Version Control:

| Version | Descriptions | Date | Author | Reviewer |
|---------|-----------------|------------|--------|----------|
| 1.0 | Initial Version | 23/10/2022 | 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

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 D60 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 relay pin B5b and the negative (black terminal) of the Auxiliary Source to relay pin B6a.

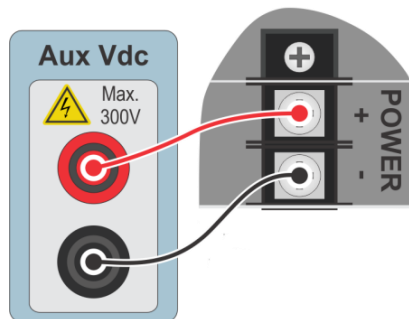


Figure 1

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.

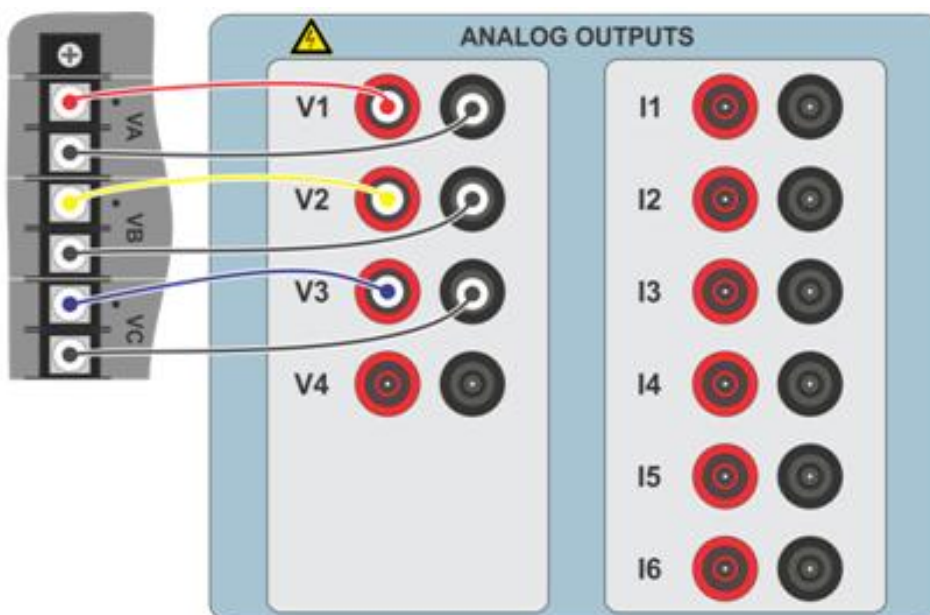


Figure 2

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.

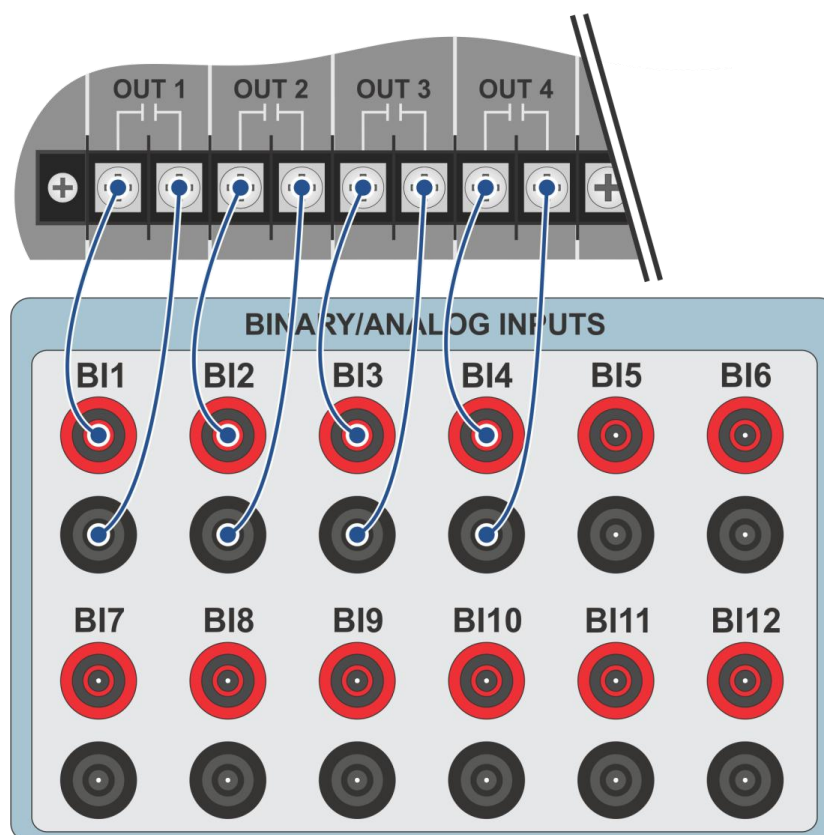


Figure 3

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:

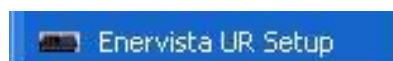


Figure 4

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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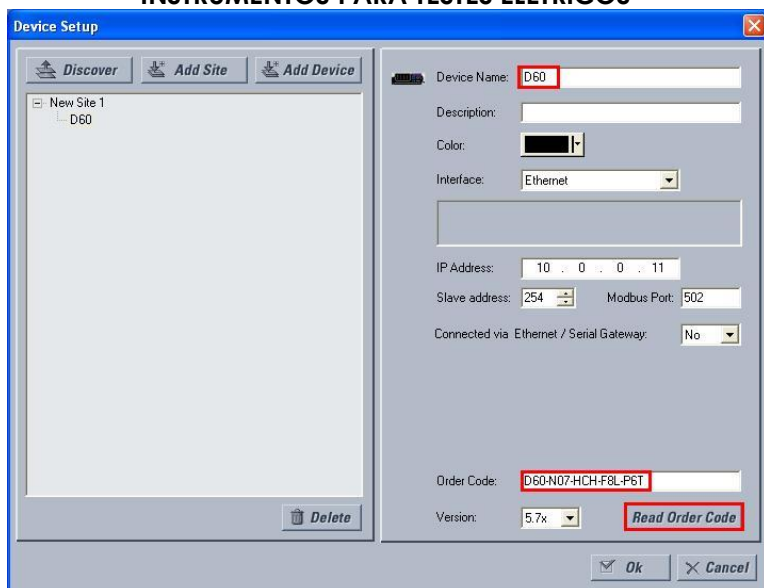


Figure 5

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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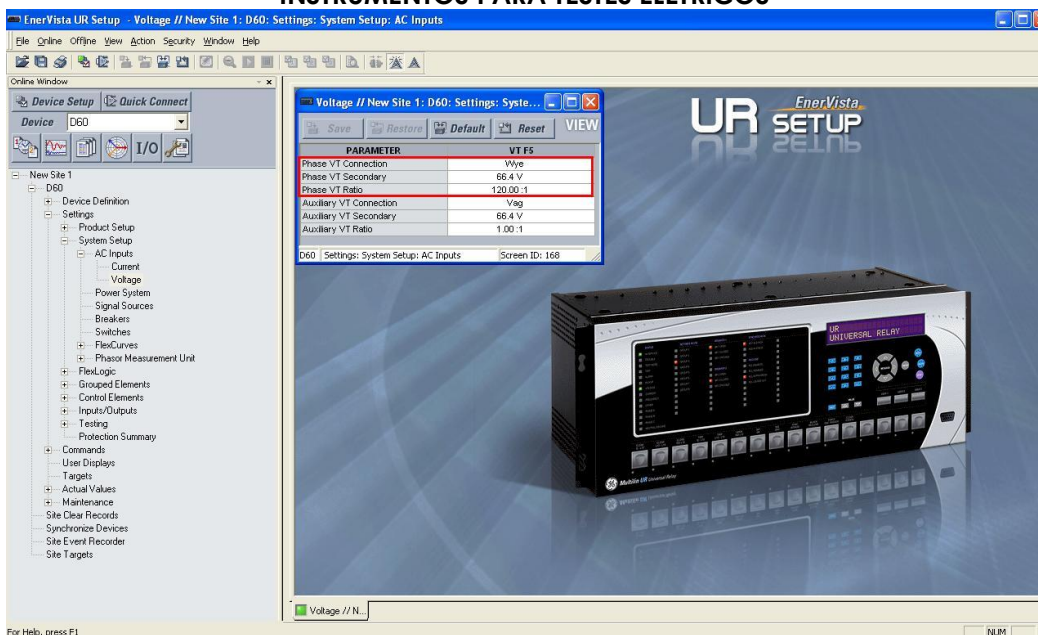


Figure 7

3.2 Power system

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

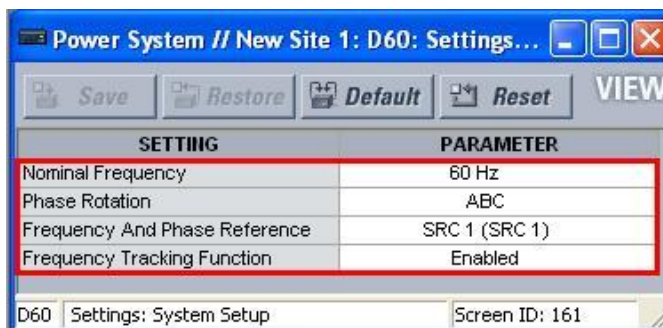


Figure 8

3.3 Signal Source

Set the potential transformer to "F5".

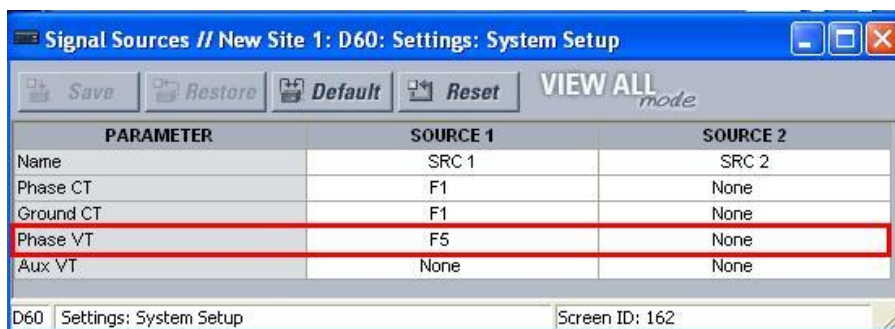
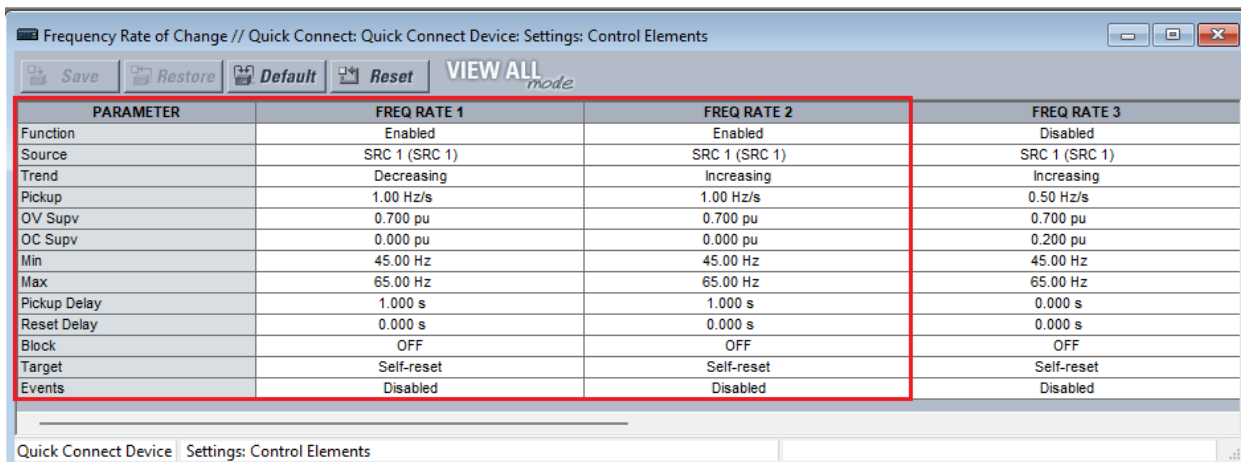


Figure 9

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3.4 Frequency Rate of Change

Click on the “+” sign next to “Control Elements” and double-click on “Frequency Rate of Change”. This option allows you to activate up to four frequency variation elements. In this tutorial two elements are used adjusting the pickup values and the actuation times, one has a decreasing trend and the other an increasing trend.

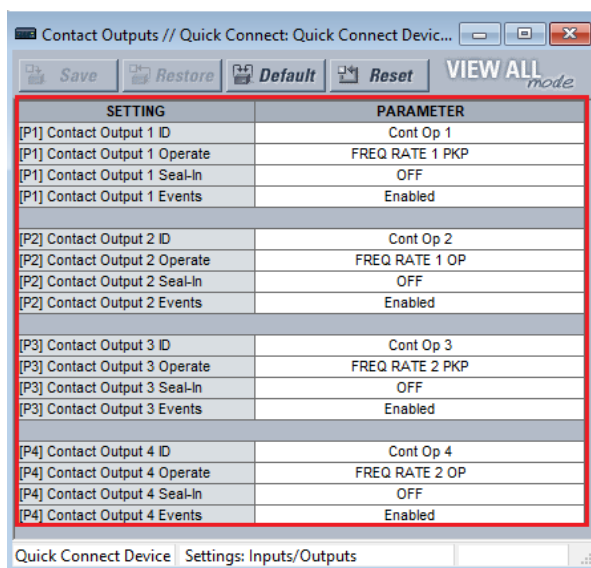


| PARAMETER | FREQ RATE 1 | FREQ RATE 2 | FREQ RATE 3 |
|--------------|---------------|---------------|---------------|
| Function | Enabled | Enabled | Disabled |
| Source | SRC 1 (SRC 1) | SRC 1 (SRC 1) | SRC 1 (SRC 1) |
| Trend | Decreasing | Increasing | Increasing |
| Pickup | 1.00 Hz/s | 1.00 Hz/s | 0.50 Hz/s |
| OV Supv | 0.700 pu | 0.700 pu | 0.700 pu |
| OC Supv | 0.000 pu | 0.000 pu | 0.200 pu |
| Min | 45.00 Hz | 45.00 Hz | 45.00 Hz |
| Max | 65.00 Hz | 65.00 Hz | 65.00 Hz |
| Pickup Delay | 1.000 s | 1.000 s | 0.000 s |
| Reset Delay | 0.000 s | 0.000 s | 0.000 s |
| Block | OFF | OFF | OFF |
| Target | Self-reset | Self-reset | Self-reset |
| Events | Disabled | Disabled | Disabled |

Figure 10

3.5 Contact Outputs

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



| SETTING | PARAMETER |
|-------------------------------|-----------------|
| [P1] Contact Output 1 ID | Cont Op 1 |
| [P1] Contact Output 1 Operate | FREQ RATE 1 PKP |
| [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 | FREQ RATE 1 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 | FREQ RATE 2 PKP |
| [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 | FREQ RATE 2 OP |
| [P4] Contact Output 4 Seal-In | OFF |
| [P4] Contact Output 4 Events | Enabled |

Figure 11

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 12

Click on the “Ramp” software icon.



Figure 13

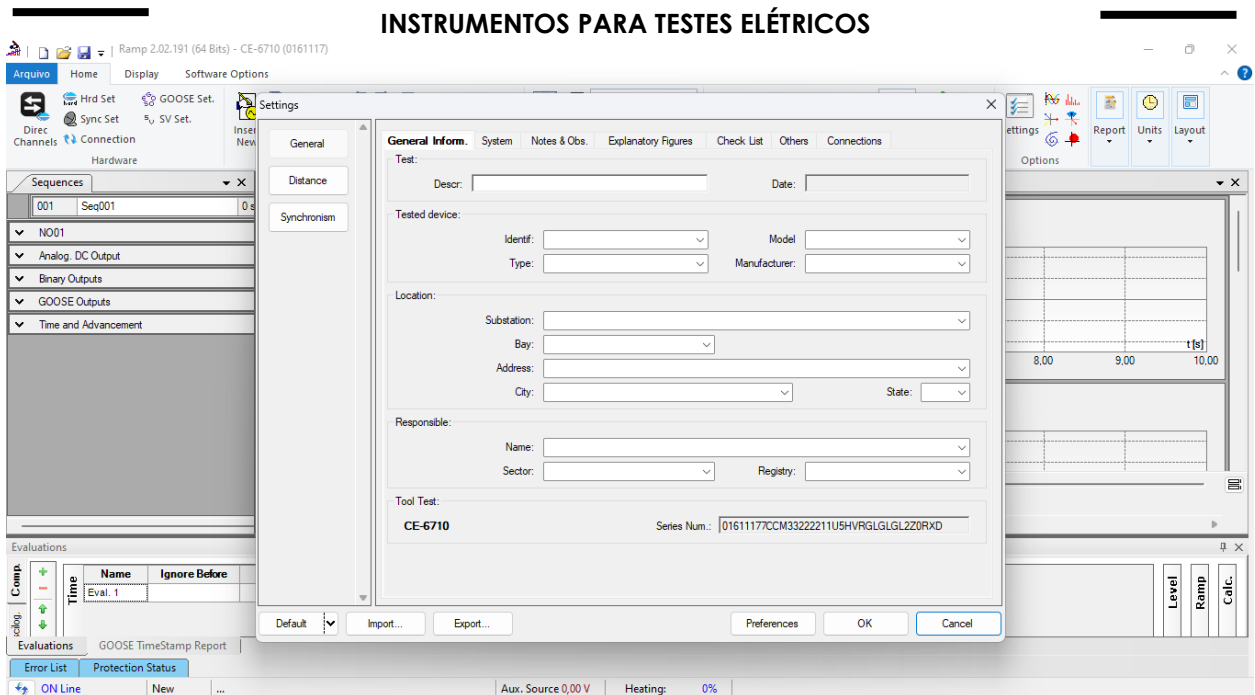


Figure 14

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.

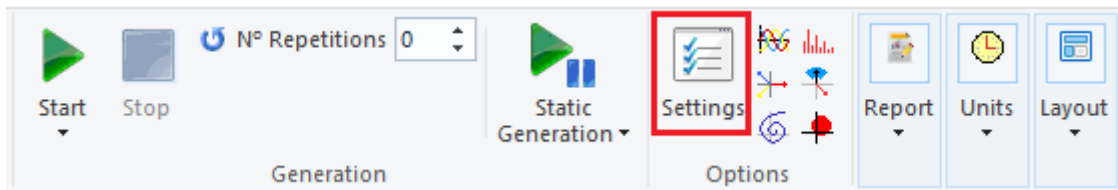


Figure 15

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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Settings

General

Distance

Synchronism

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

Test:

Descr: Rate of Change of Frequency Date:

Tested device:

Identif: 23031982 Model: D60

Type: Line Protection Manufacturer: GE

Location:

Substation: Conprove

Bay: 1

Address: Visconde de Ouro Preto 75, Custódio Pereira

City: Uberlândia State: MG

Responsible:

Name: Michel Rockembach de Carvalho

Sector: Engineering Registry: 00001

Tool Test:

CE-6710 Series Num.: 01611177CCM33222211U5HVRGLGLGL2Z0RXD

Default Import... Export... Preferences OK Cancel

Figure 16

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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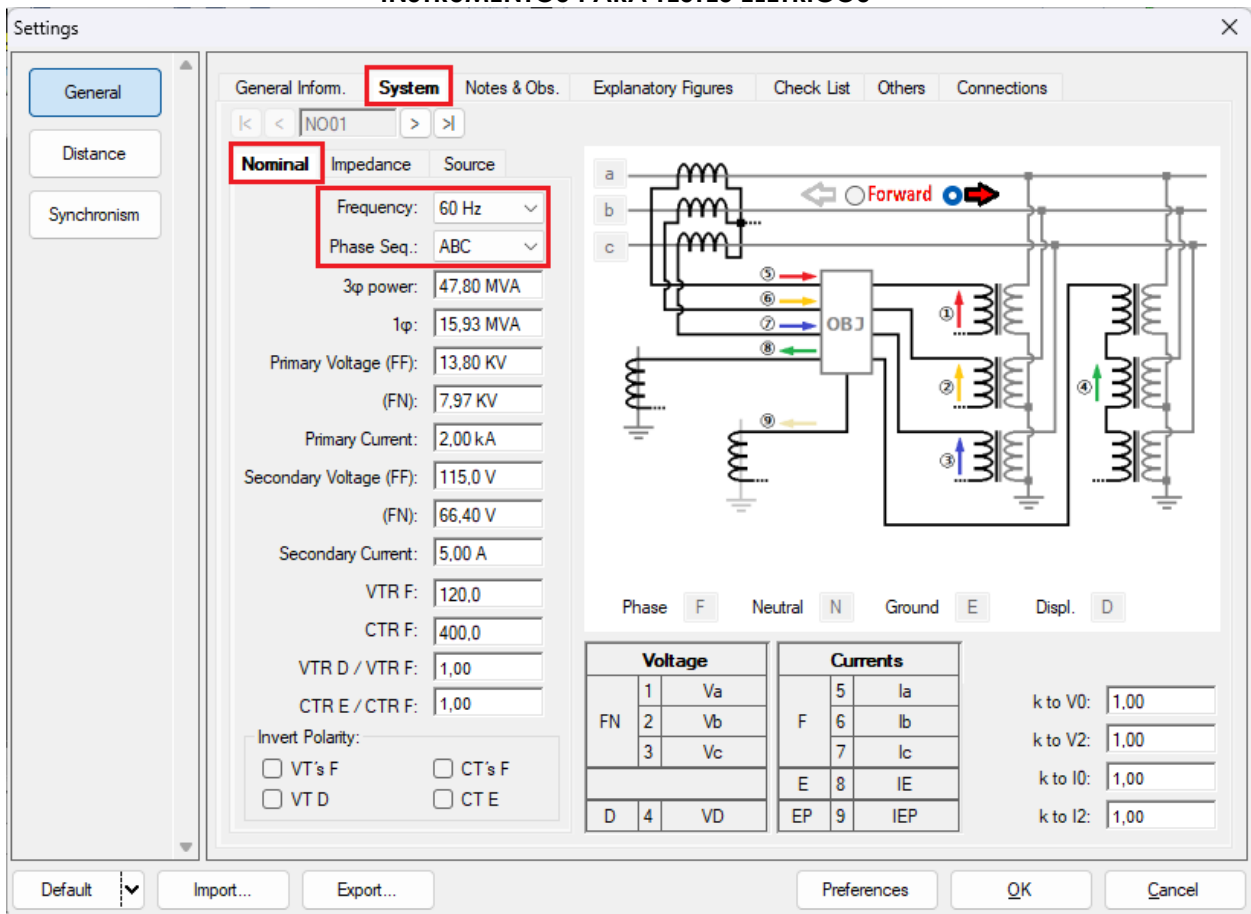


Figure 17

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.

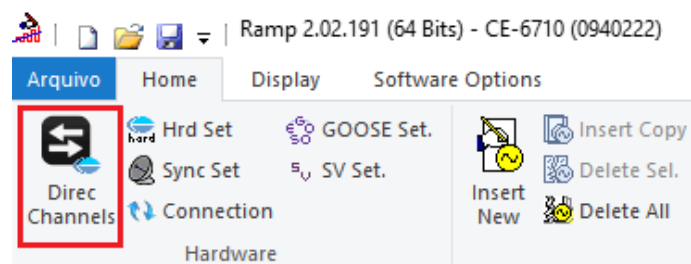


Figure 18

Then click on the highlighted icon to configure the hardware.

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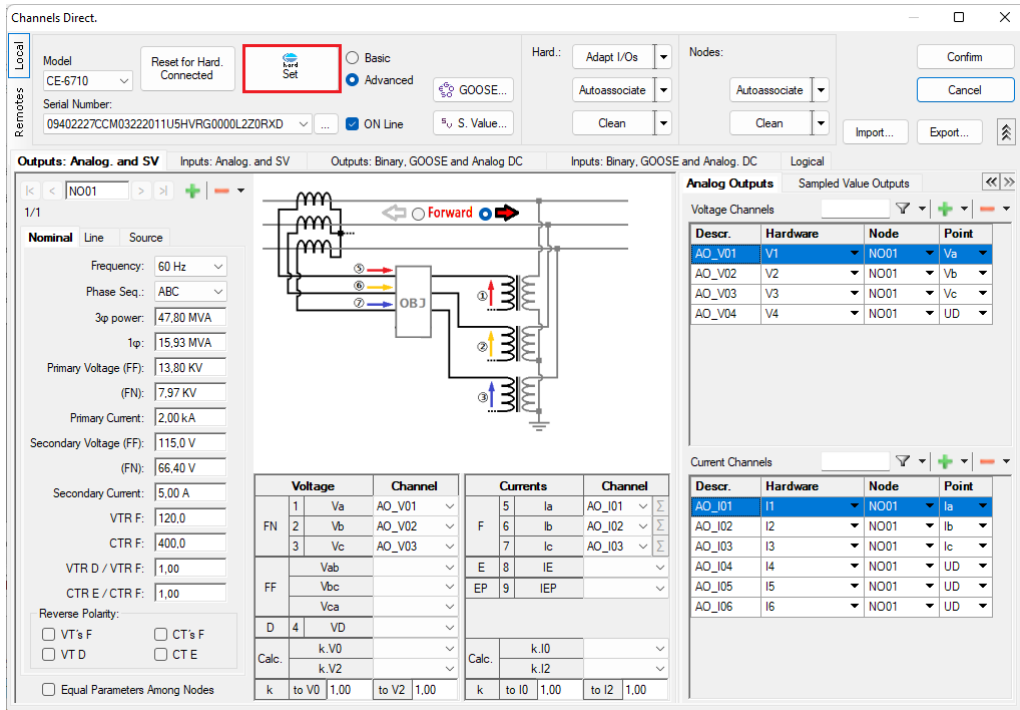


Figure 19

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

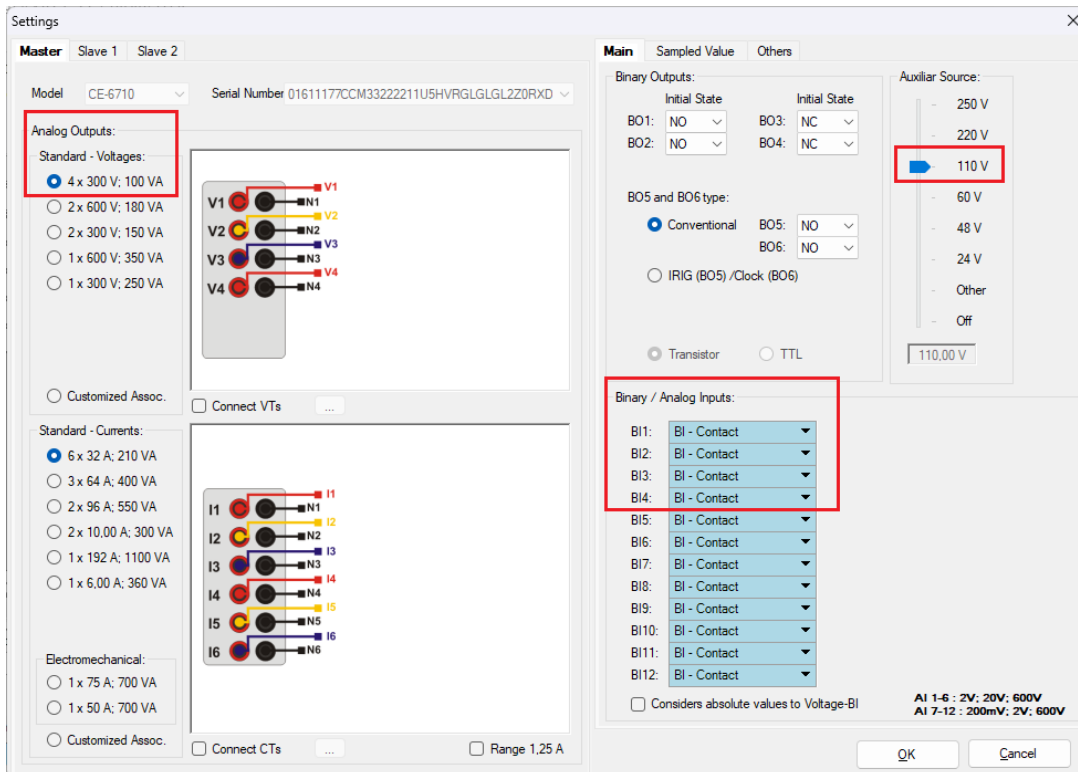


Figure 20

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

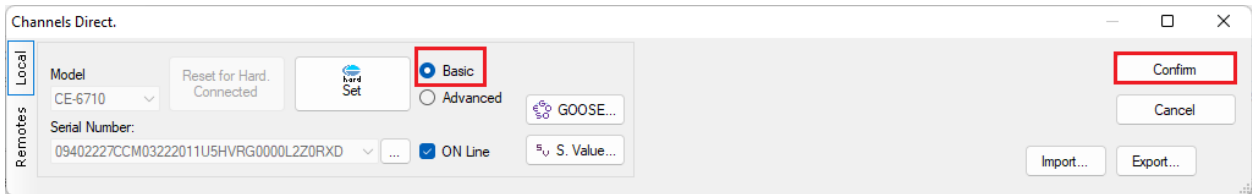


Figure 21

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.

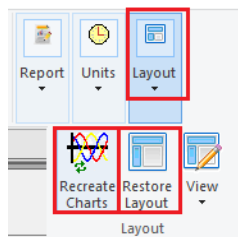


Figure 22

Following is the default structure after the previous commands.

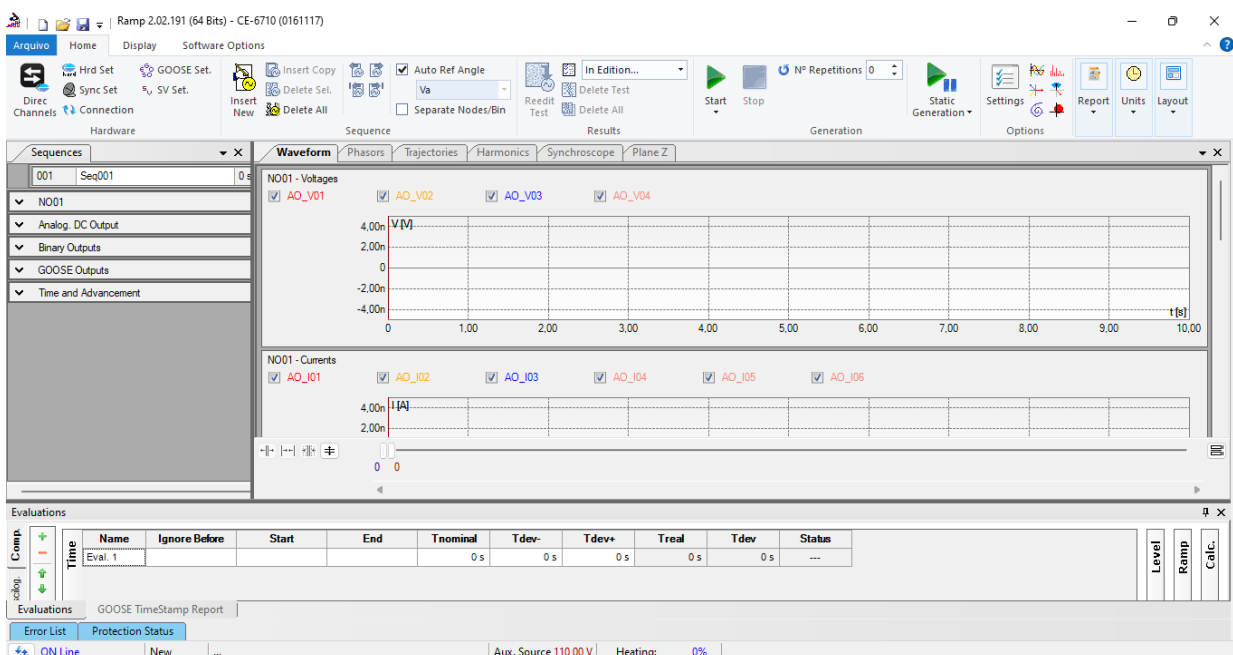


Figure 23

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7. Test structure for function 81R

Click on the option “NO1” highlighted in green and increase the size of the “Sequences” window for easier viewing. Then, insert a new sequence and expand the NO01 tab.

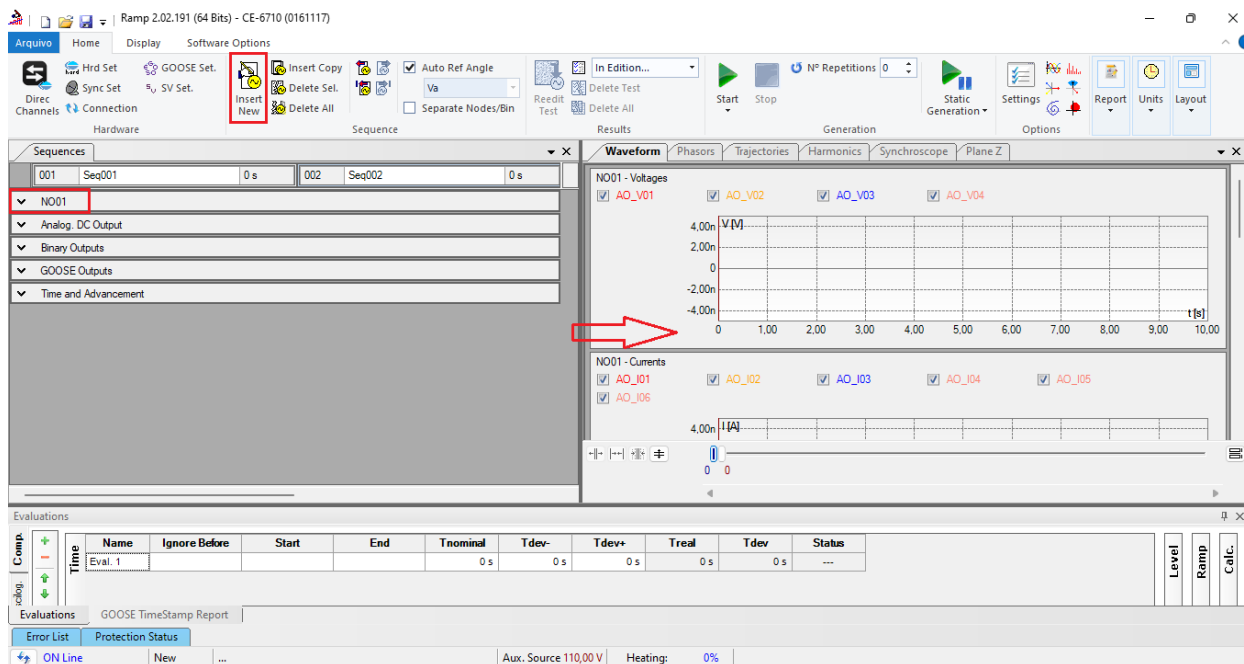


Figure 24

7.1 Main Screen 81R-1

In the first sequence, configure a situation to check the first element whose setting is - 1.00Hz/s and 1.0s. In place of “Seq 001” write “81R-1” then click on the highlighted button in the figure below.

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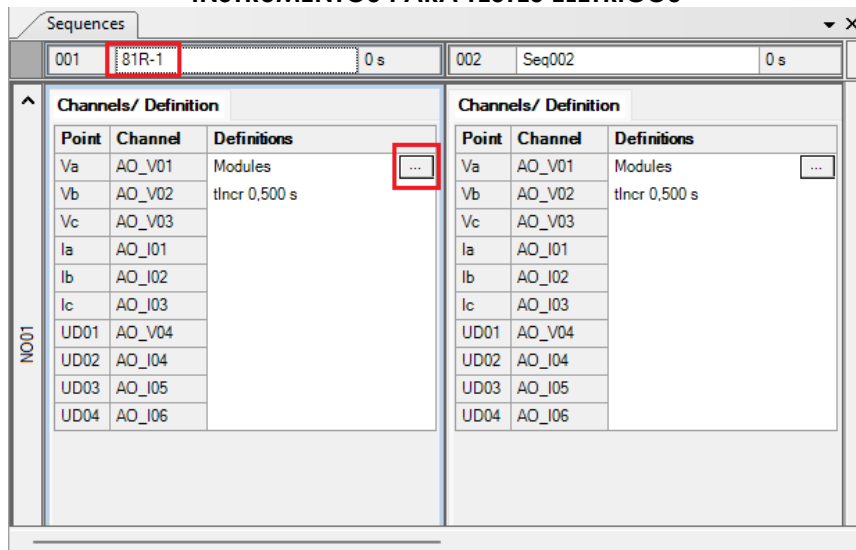


Figure 25

7.2 Screen for 81R-1 incrementation

On this screen, in the “Ramp Type” field, choose the “ dF/dt ” option. For the voltage values, either initial or reset, use the balanced three-phase nominal voltage, that is, 66.4V. For the dF/dt increment, set the start to -0.76Hz/s the limit to -1.24Hz/s and a step of -80.0mHz/s. 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 1.5 seconds was chosen. The “Reset Time” was set to 0.25s.

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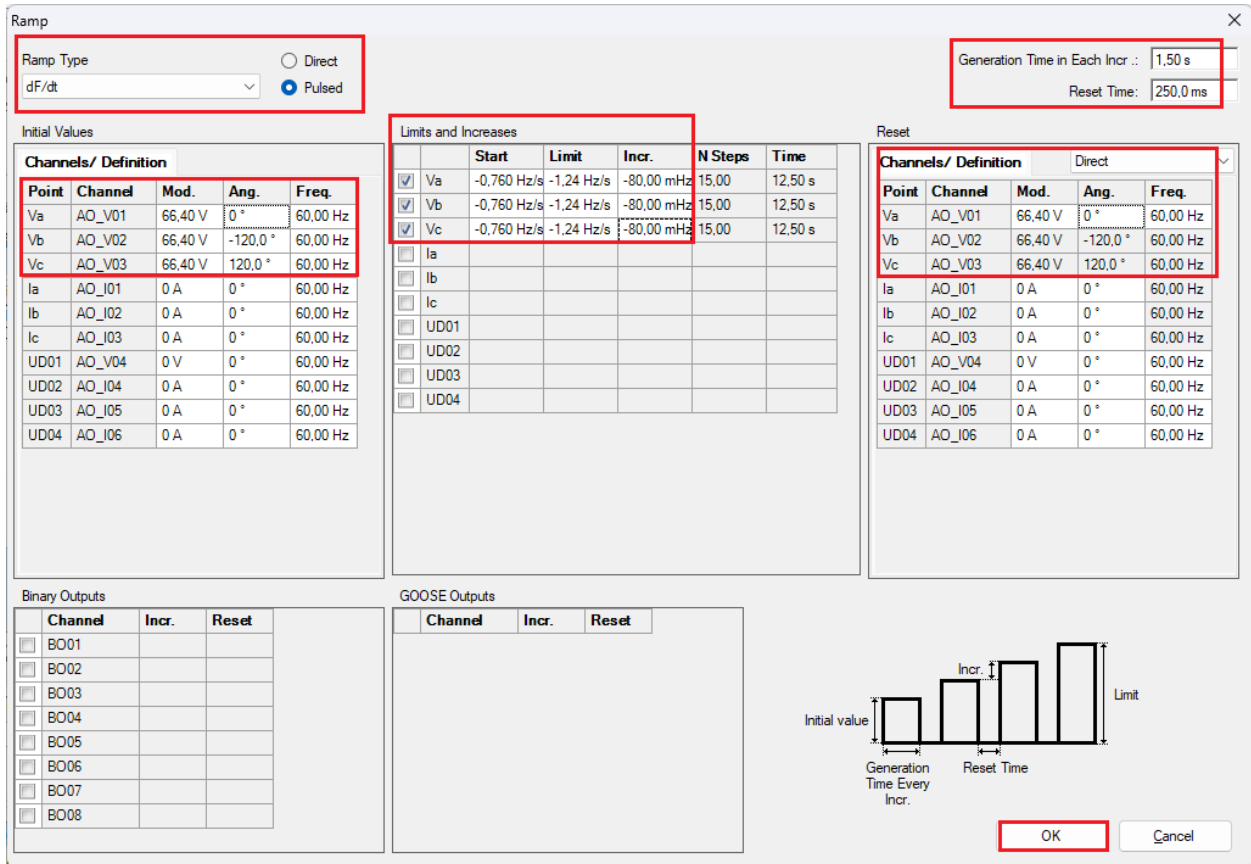


Figure 26

7.3 Main screen 81R-2

In the second sequence, configure a situation to check the second element whose setting is at 1.00Hz/s and 1.0s. In place of “Seq 002” write “81R-2”. Then click on the button highlighted in the figure below.

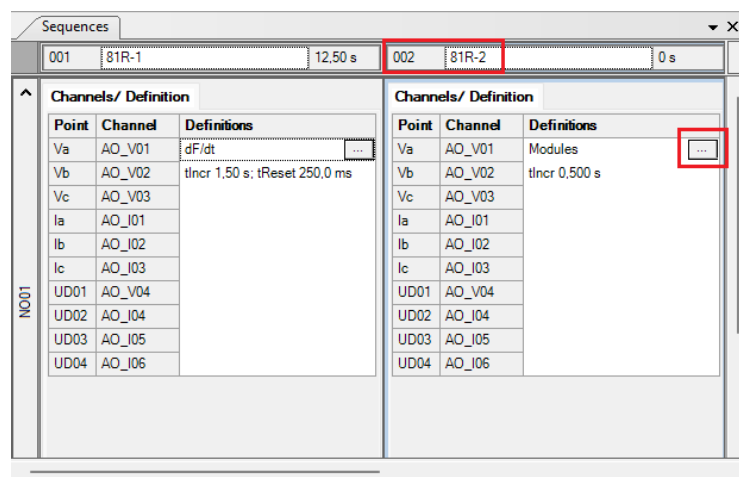


Figure 27

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7.4 Screen for 81R-2 incrementation

On this screen, in the “Ramp Type” field, choose the “dF/dt” option and then select the “Pulsed” option. For voltage values, whether initial or reset, use the nominal voltage of 66.40V three-phase balanced ABC and frequency 60.0Hz. For initial frequency variation use 0.76Hz/s and for final frequency 1.24Hz/s with a step of 80mHz/s. In the field “Generation Time in Each Incr.” the user must configure a time that is always greater than the actuation time. In this case, a time of 1.50 seconds was chosen. The “Reset Time” was set to 0.25 seconds.

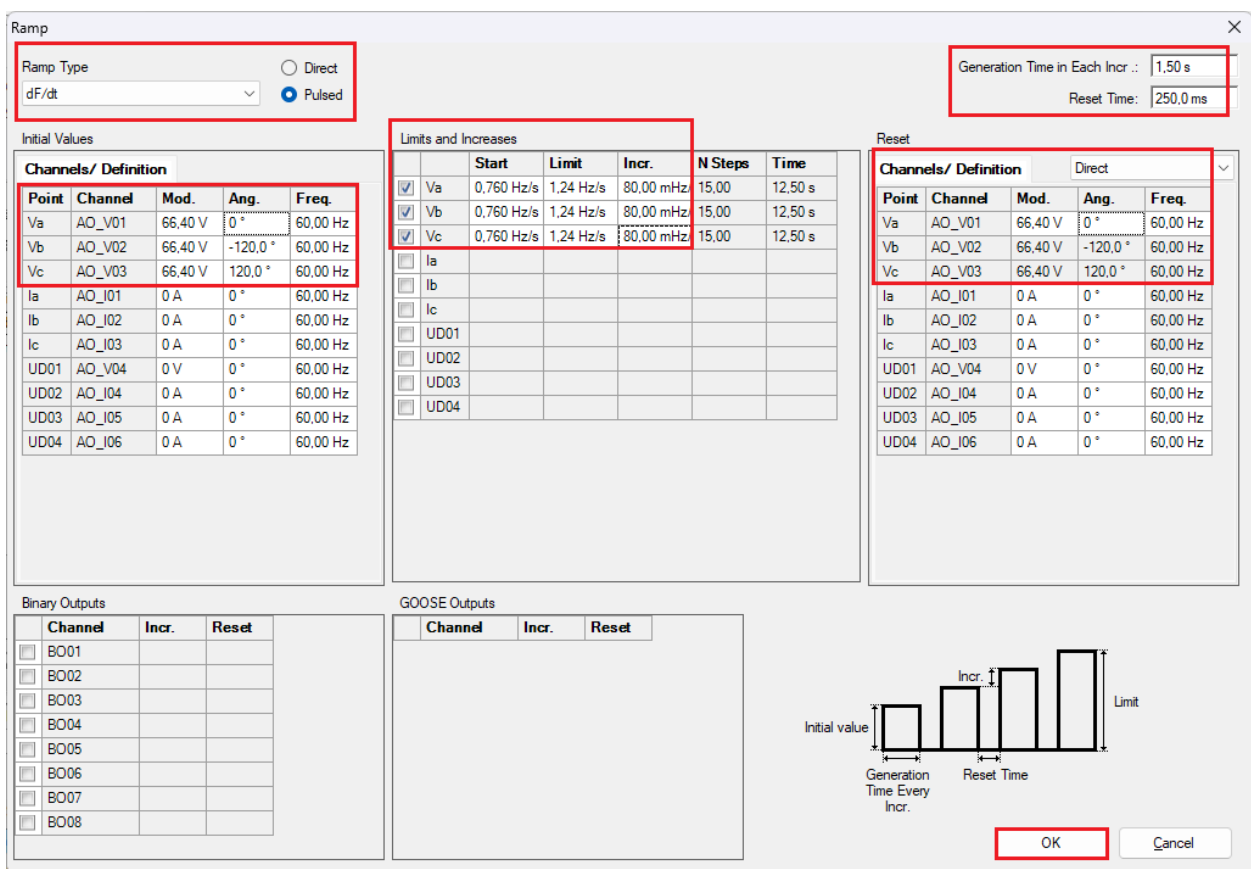


Figure 28

7.5 Evaluation of pick-ups

By clicking on the “Ramp” field, configure two pick-up evaluations as follows.

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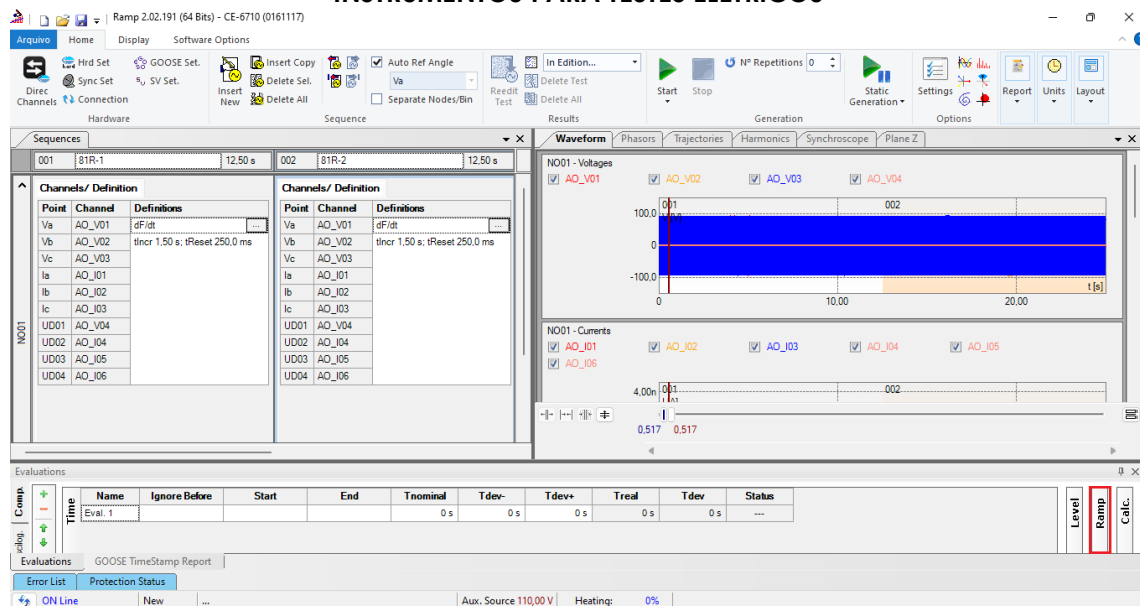


Figure 29

In place of “Eval.1” write “81R-1_pkp”, in Ramp select “81R-1 > NO01” for “Condition” adjust “Binary Input > BI01 (↑)”, for “Type” choose “dFdt”, for “Output” adjust “Va”, in the field “Nom. Value” configure -1.00Hz/s and in the fields related to deviations adjust 80mHz/s.

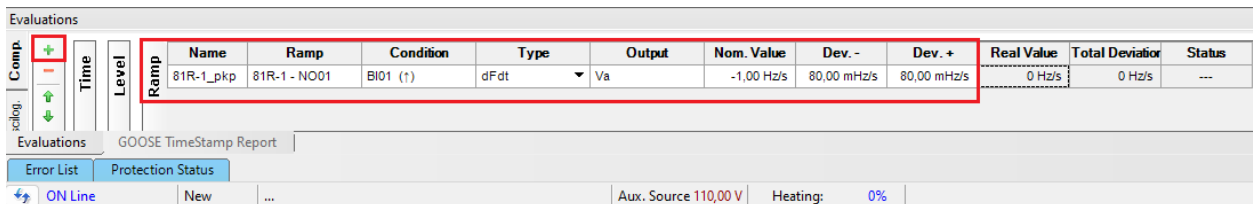


Figure 30

Clicking on the “+” icon in the previous figure insert one more evaluation. The configuration must be done in a similar way to the first evaluation with changes in the binary input and value of the pick-up.

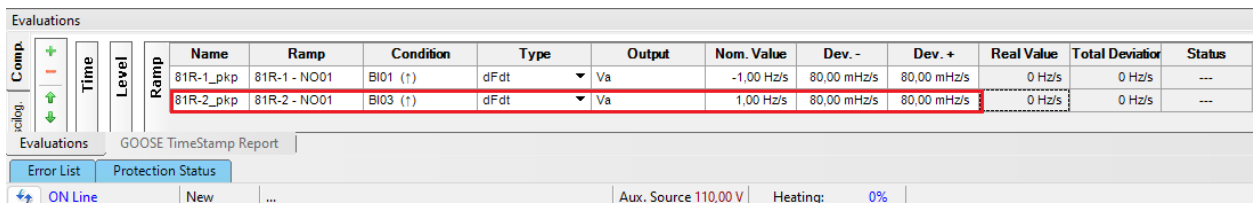


Figure 31

7.6 Adjusting graphics

Double click on the “Waveform” option and maximize the screen to choose relevant signals and insert marks for time analysis.

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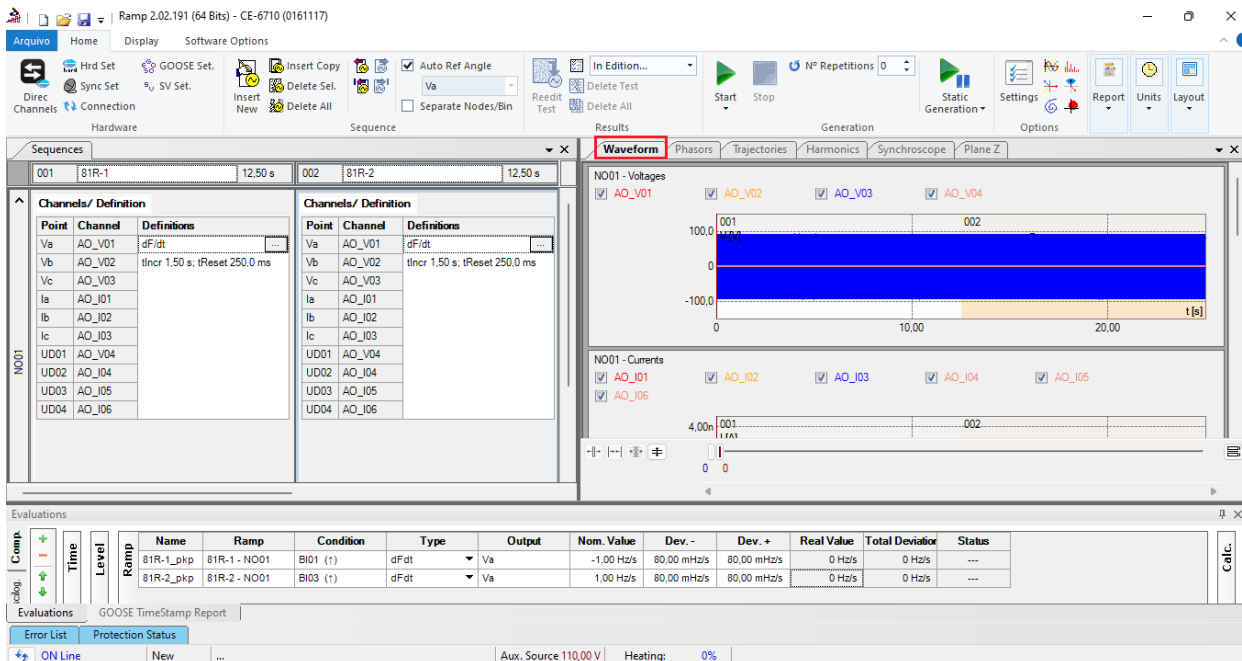


Figure 32

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

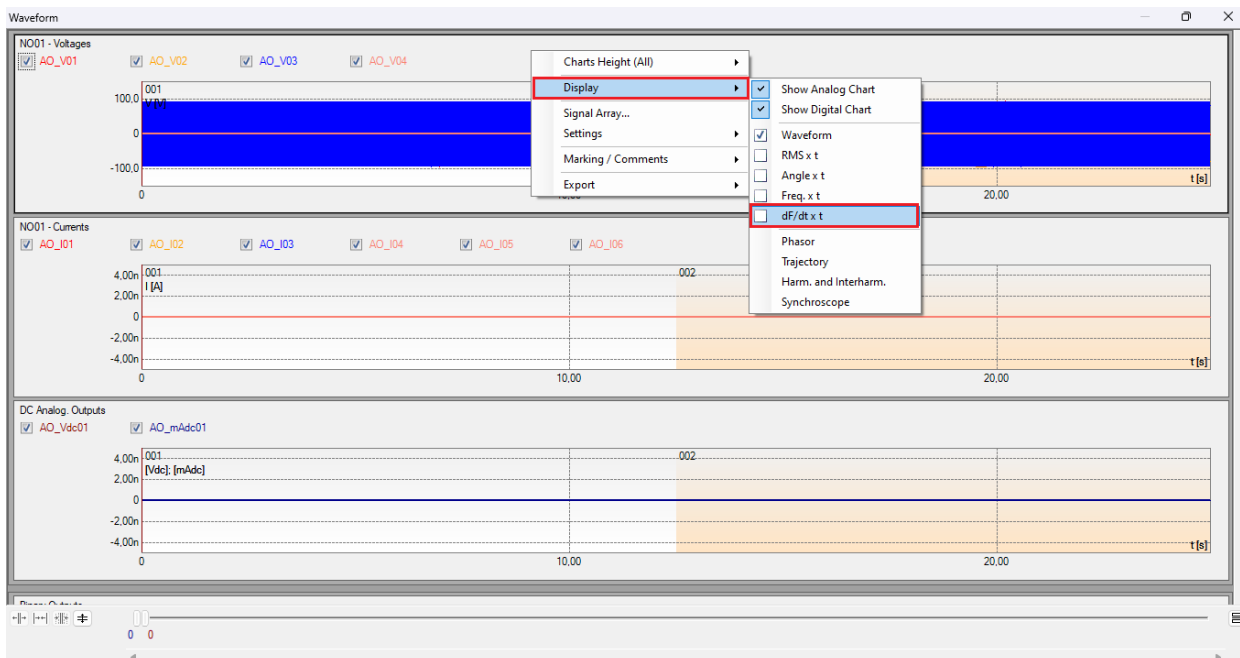


Figure 33

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.

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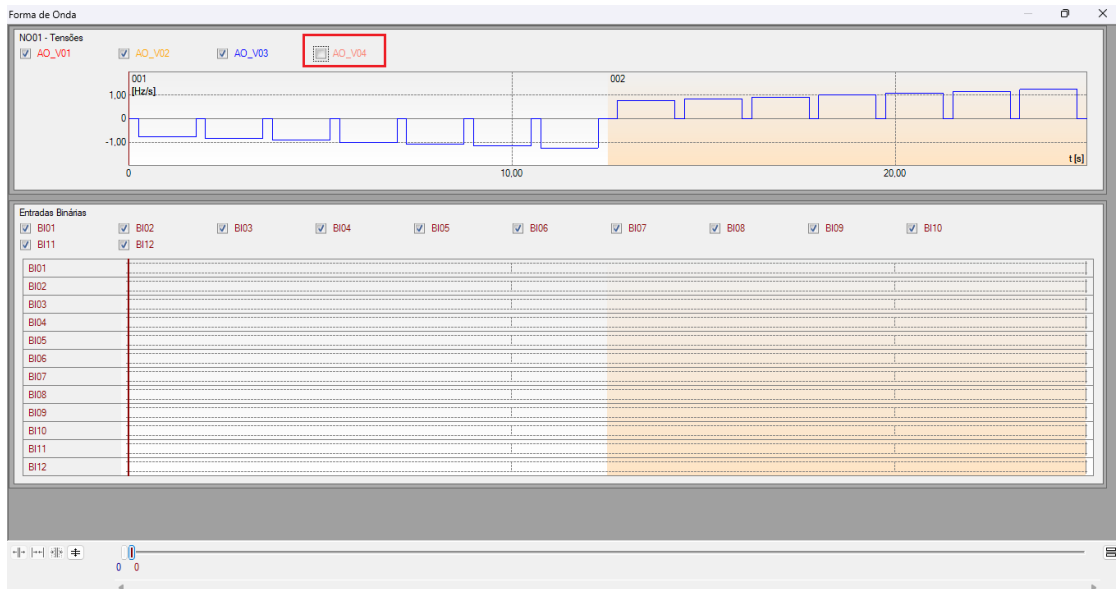


Figure 34

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

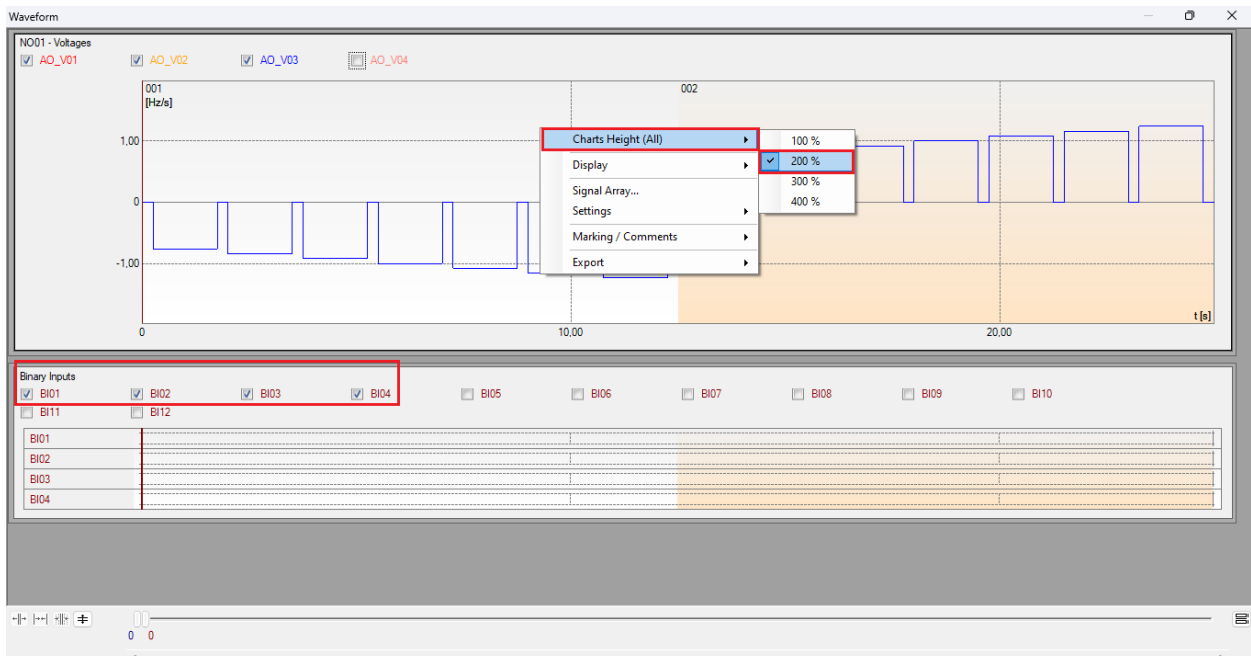


Figure 35

7.7 Time analysis

To evaluate the time, mark the value of the frequency variation where 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

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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 two elements.



Figure 36

7.8 Inserting markup

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

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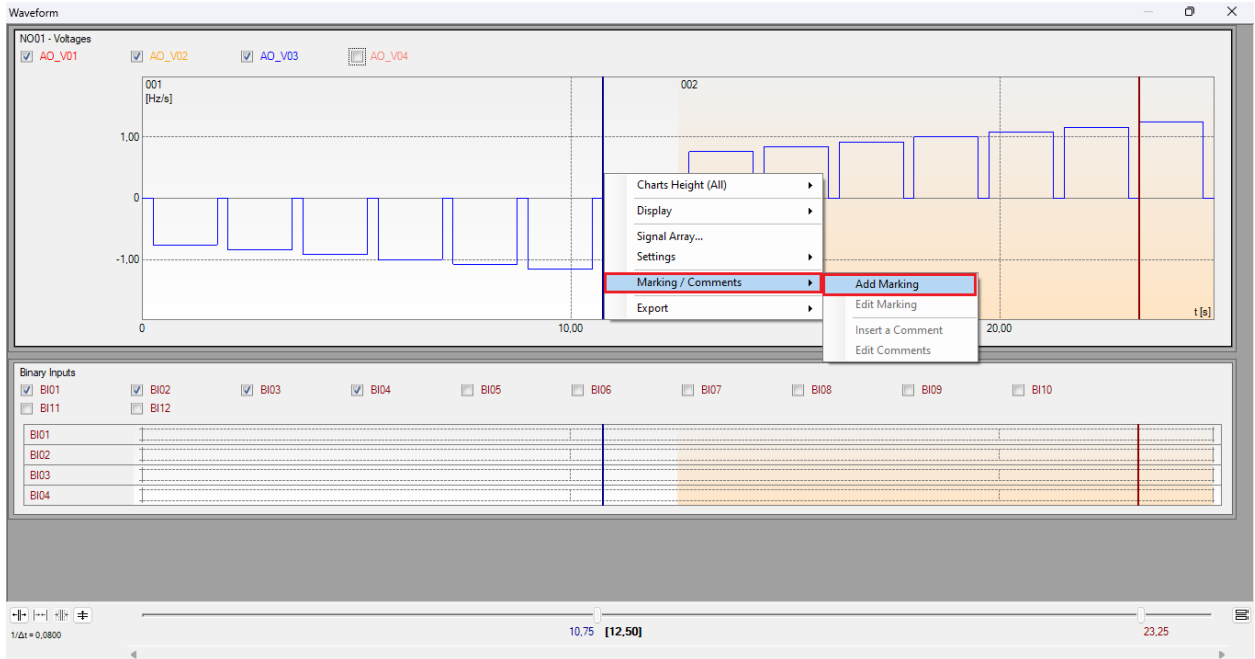


Figure 37

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

The 'Add Marking' dialog box is shown. It has a title bar with a close button. The 'Time' field is set to '10,75 s'. The 'Descr' field is 'Mark01'. The 'Visible' checkbox is checked. There are 'OK' and 'Cancel' buttons at the bottom.

Figure 38

The 'Add Marking' dialog box is shown. It has a title bar with a close button. The 'Time' field is set to '23,25 s'. The 'Descr' field is 'Mark02'. The 'Visible' checkbox is checked. The 'OK' button is highlighted with a red box. There are 'OK' and 'Cancel' buttons at the bottom.

Figure 39

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

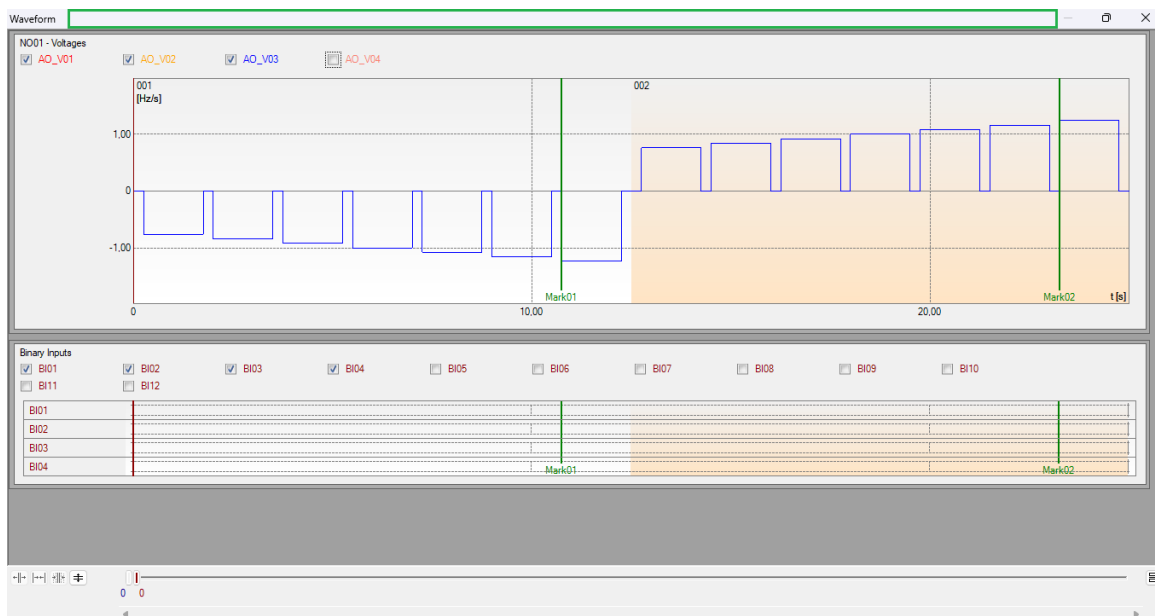


Figure 40

7.9 Time evaluation

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

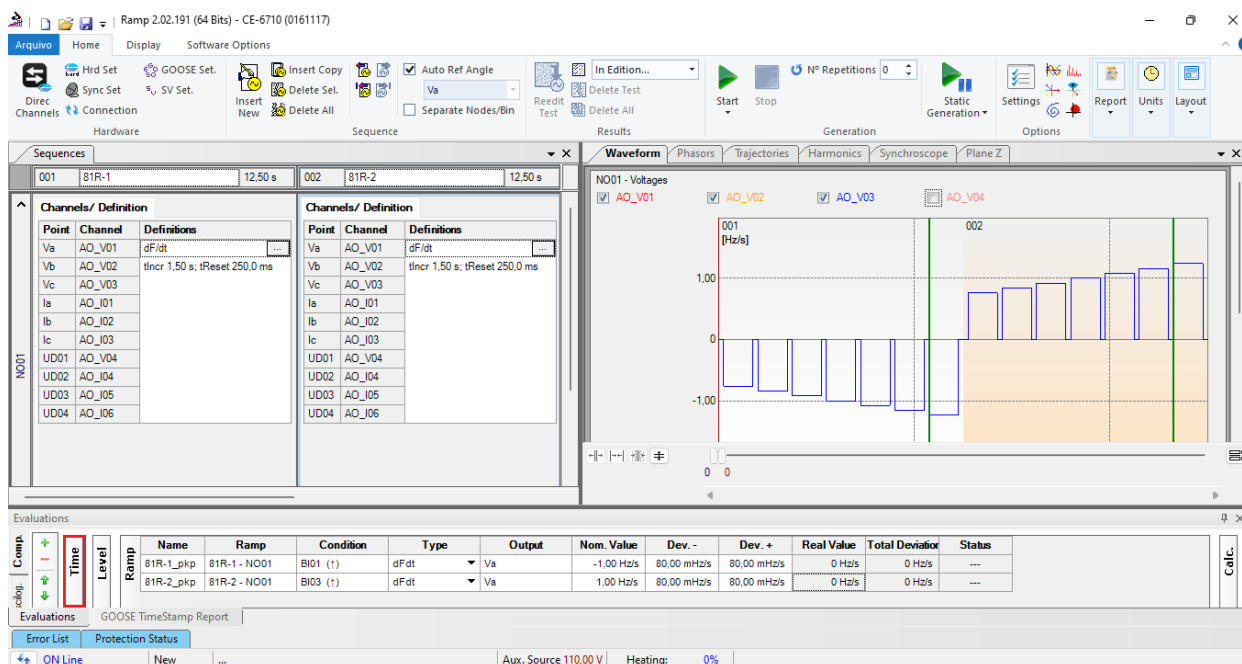
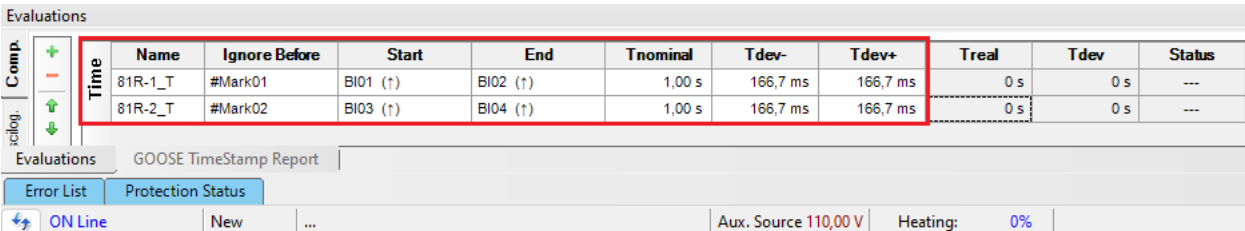


Figure 41

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Change the name “Eval. 1” to “81R-1_T”, in the option “Ignore before” choose “Tagging > Mark01” in the option “Start” choose “Binary Input >BI01 (↑)”, in the “End” option choose “Binary Input >BI02 (↑)”. In nominal time set 1.0s with deviations of 166.7ms. Clicking on the “+” icon add 1 more evaluation and its adjustments are made in a similar way to the first evaluation. The following figure shows these settings.



| Time | Name | Ignore Before | Start | End | Tnominal | Tdev- | Tdev+ | Treal | Tdev | Status |
|---------|---------|---------------|----------|----------|----------|----------|----------|-------|------|--------|
| 81R-1_T | #Mark01 | | BI01 (↑) | BI02 (↑) | 1,00 s | 166,7 ms | 166,7 ms | 0 s | 0 s | --- |
| 81R-2_T | #Mark02 | | BI03 (↑) | BI04 (↑) | 1,00 s | 166,7 ms | 166,7 ms | 0 s | 0 s | --- |

Figure 42

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

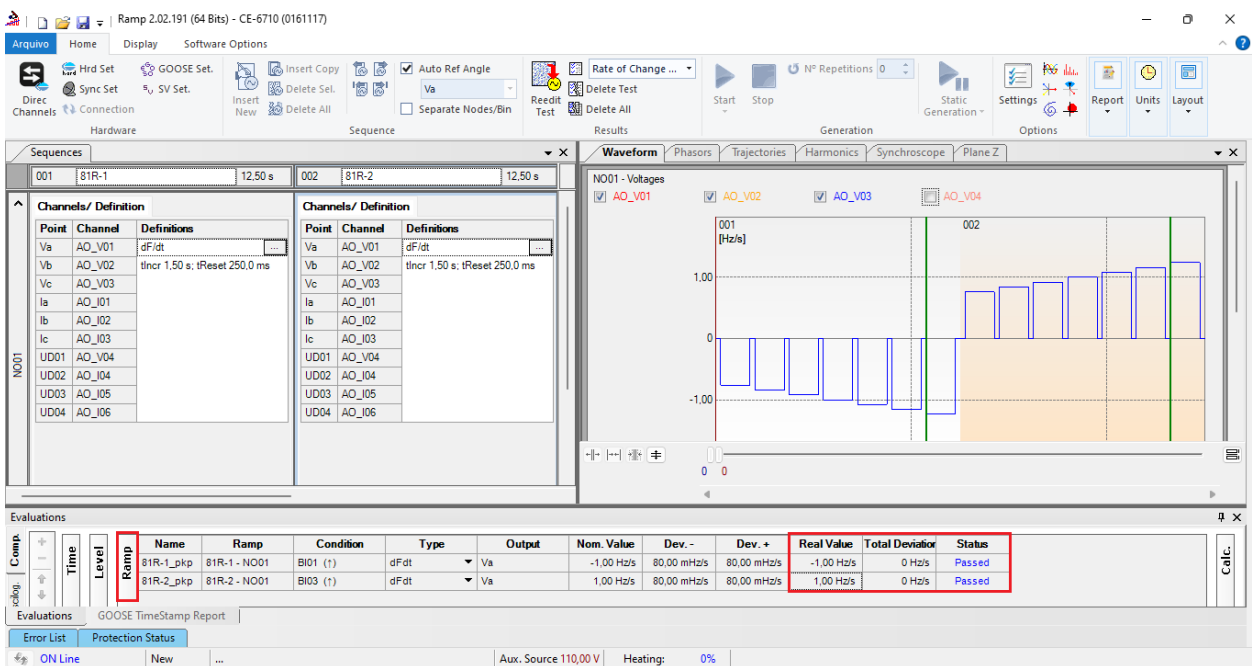


Figure 43

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

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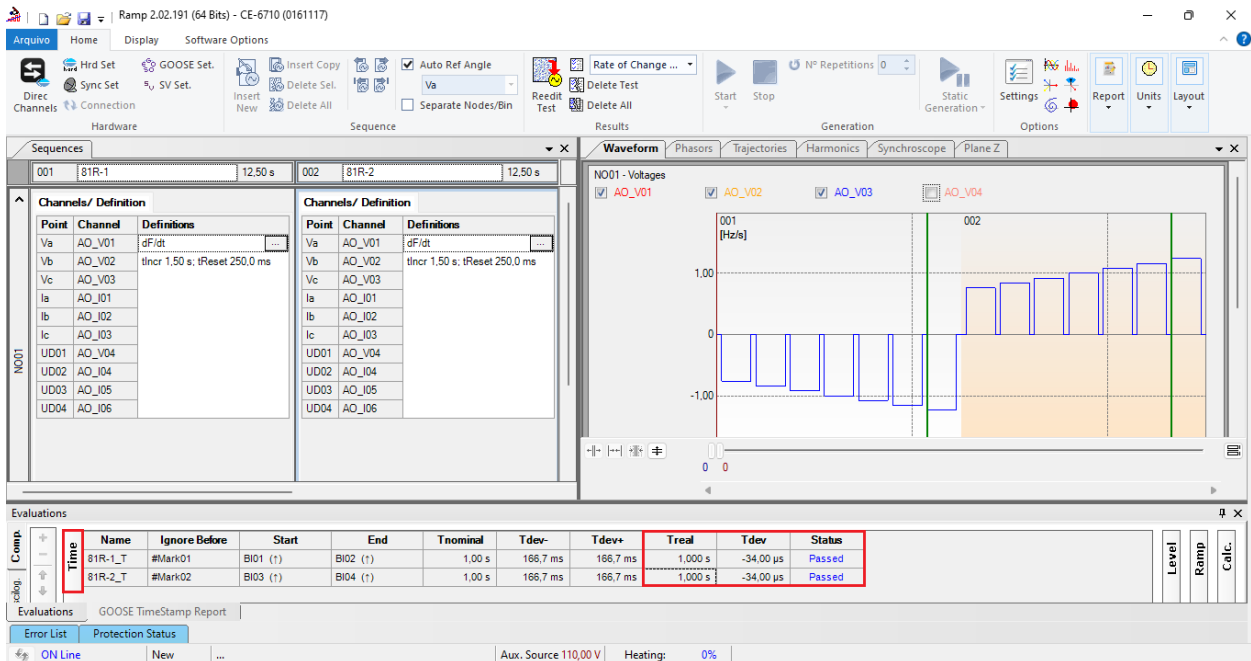


Figure 44

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.

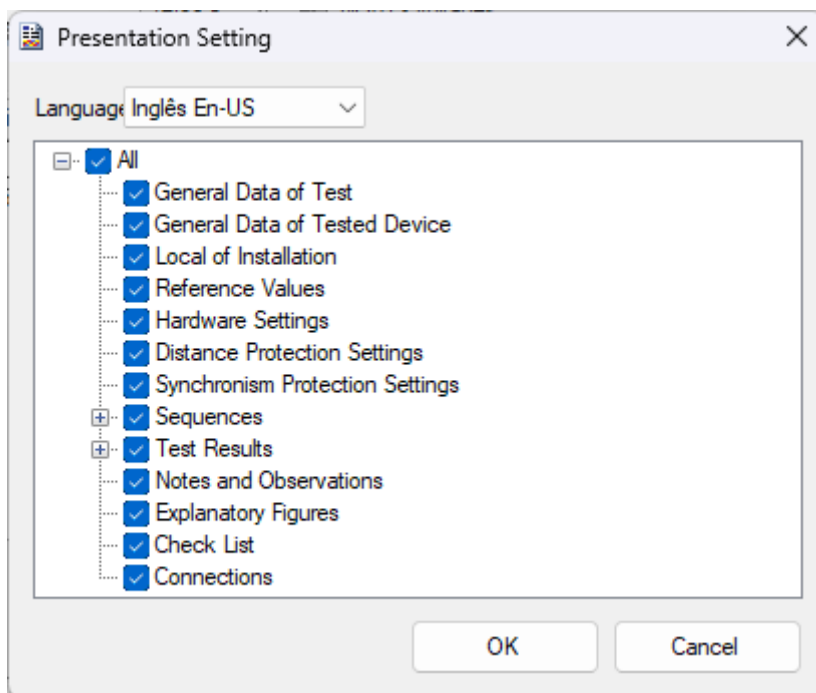


Figure 45

INSTRUMENTOS PARA TESTES ELÉTRICOS

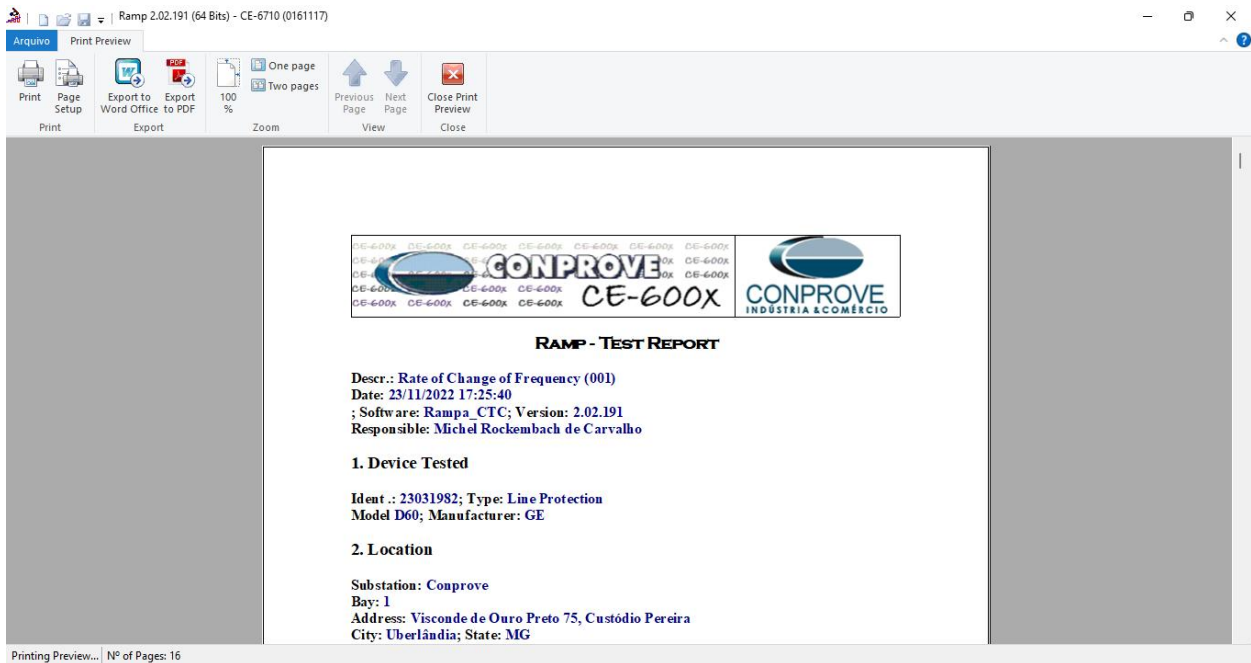


Figure 46

INSTRUMENTOS PARA TESTES ELÉTRICOS

APPENDIX A

A.1 Terminal Designation

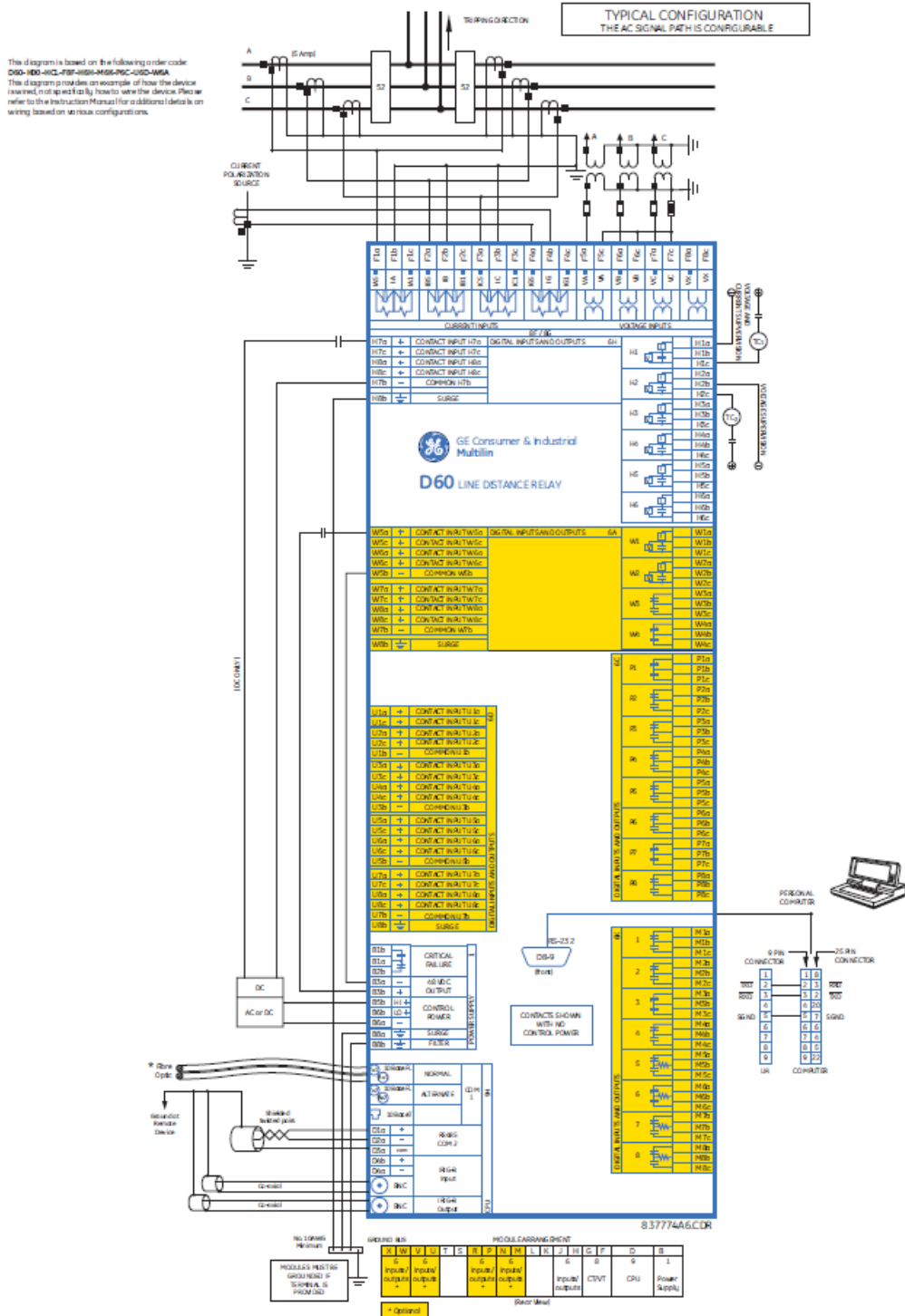


Figure 3-12: TYPICAL WIRING DIAGRAM

Figure 47

INSTRUMENTOS PARA TESTES ELÉTRICOS

A.2 Technical data

RATE OF CHANGE OF FREQUENCY

| | |
|-----------------------|--|
| df/dt trend: | increasing, decreasing, bi-directional |
| df/dt pickup level: | 0.10 to 15.00 Hz/s in steps of 0.01 |
| df/dt dropout level: | 96% of pickup |
| df/dt level accuracy: | 80 mHz/s or 3.5%, whichever is greater (up to df/dt trend of 10 Hz/s) |
| Overvoltage supv.: | 0.100 to 3.000 pu in steps of 0.001 |
| Overcurrent supv.: | 0.020 to 30.000 pu in steps of 0.001 |
| Pickup delay: | 0 to 65.535 s in steps of 0.001 |
| Reset delay: | 0 to 65.535 s in steps of 0.001 |
| Timer accuracy: | ±3% of operate time or ±1/4 cycle (whichever is greater) |
| Operate time: | typically 9.5 cycles at 2 × pickup typically 8.5 cycles at 3 × pickup typically 6.5 cycles at 5 × pickup |

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

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 1

| Software Ramp | | GE D60 Relay | |
|----------------------|---------------|---------------------|---------------|
| Parameter | Figure | Parameter | Figure |
| 81R-1_pkp | 30 | Pickup | 10 |
| 81R-2_pkp | 31 | Pickup | 10 |
| 81R-1_T | 42 | Pickup Delay | 10 |
| 81R-2_T | 42 | Pickup Delay | 10 |