INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: Schneider

Model: SEPAM T42

Functions: 27 or PTUV – Undervoltage & 59 or PTOV – Overvoltage

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

Objective: Test the pick-up and actuation time of the undervoltage and overvoltage elements using the Quick software

Version Control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial Version	25/07/2022	M.R.C.	G.C.D.P.

Summary

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Statement of responsibility

The information contained in this tutorial is constantly verified. However, differences in description cannot be completely excluded; in this way, CONPROVE disclaims any responsibility for errors or omissions contained in the information transmitted.

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.

Copyright

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 Source. Vdc to pin 1 on the CSH terminal of the relay and the negative (black terminal) of the Aux Source Vdc to pin 2 of the CSH terminal of the relay.

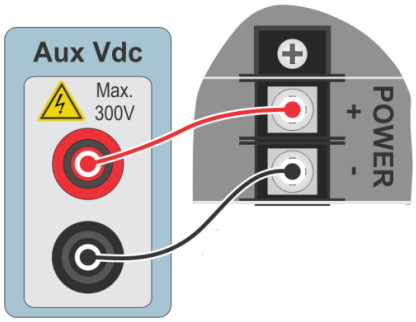

Figure 1

1.2 *Voltage Coils*

Connect voltage channels V1, V2 and V3 to pins 1, 2 and 6 of the relay respectively, connecting the three common ones to pin 3. **Note: Voltage pins 3 and 5 must be short-circuited.**

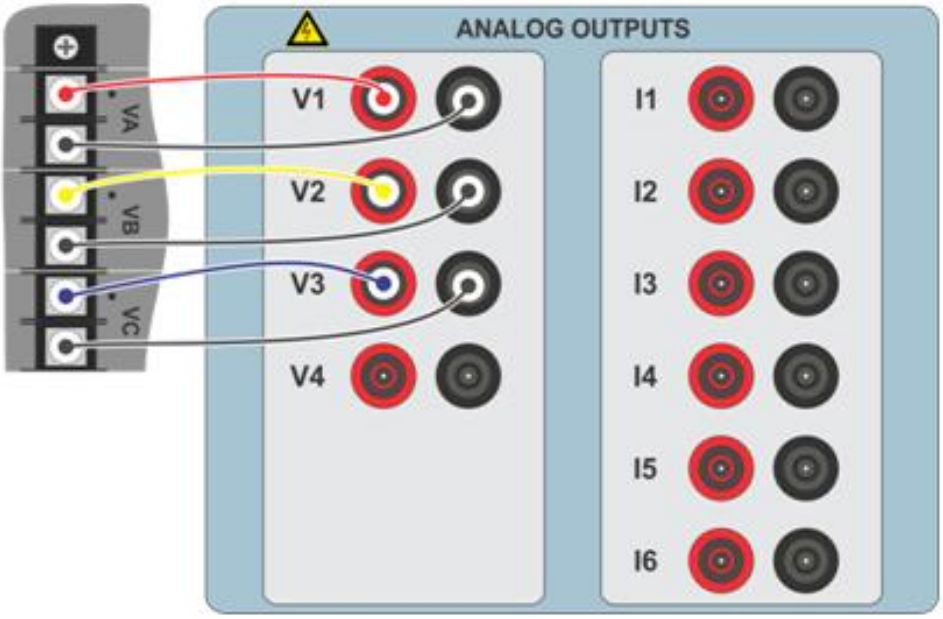

Figure 2

1.3 *Binary Inputs*

Connect the binary input of the CE-6710 to the binary output of the relay slot CSH.

- BI1 to pin 05 and its common to pin 04;
- BI2 to pin 08 and its common to pin 07;
- BI3 to pin 11 and its common to pin 10;
- BI4 to pin 14 and its common to pin 13.

The following figure shows the details of these connections.

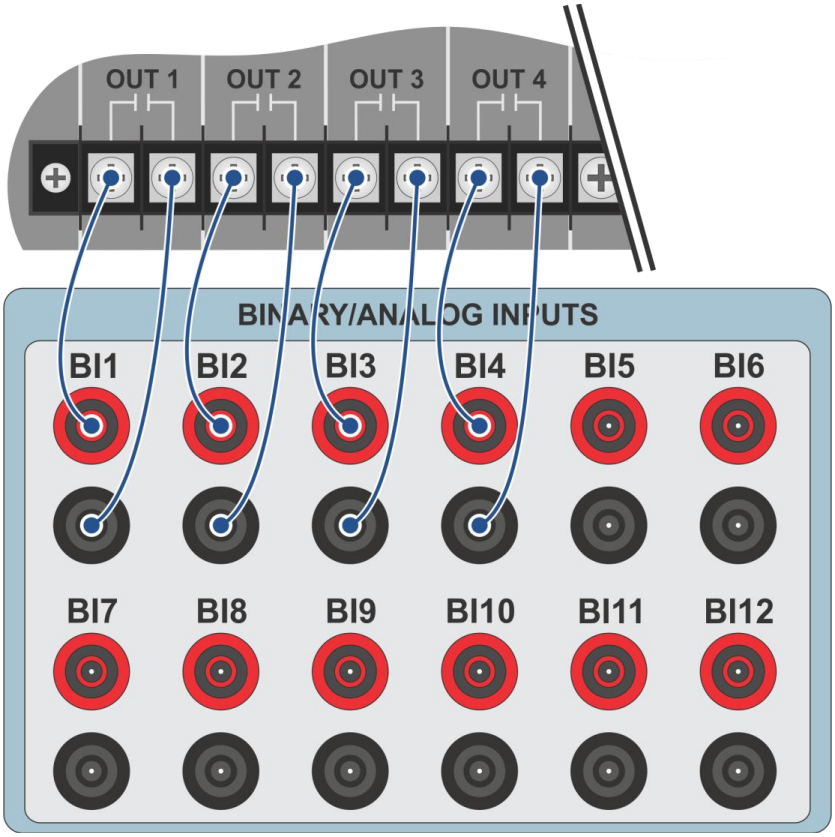

Figure 3

2. Communication with the SEPAM T42 relay

First, connect a serial cable from the notebook to the relay. Then double-click the *SFT2841* software icon.

Figure 4

When opening the program the following screen is shown:

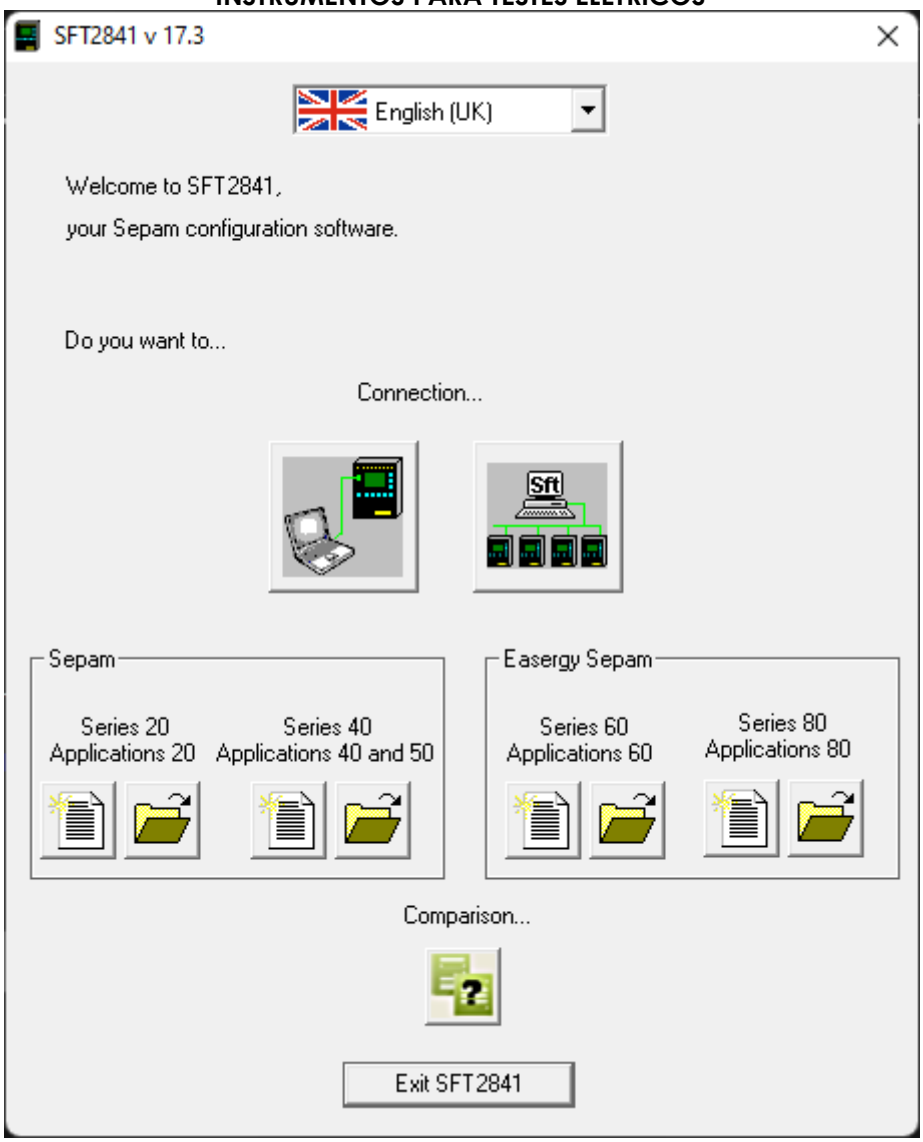

Figure 5

To initiate communication click on the icon illustrated below:

Figure 6

Then, the main screen appears, where the *"Sepam hardware configuration"* tab is already selected. In this tab, the user indicates whether there are additional modules in the relay for the software. The relay used for this tutorial has the following settings:

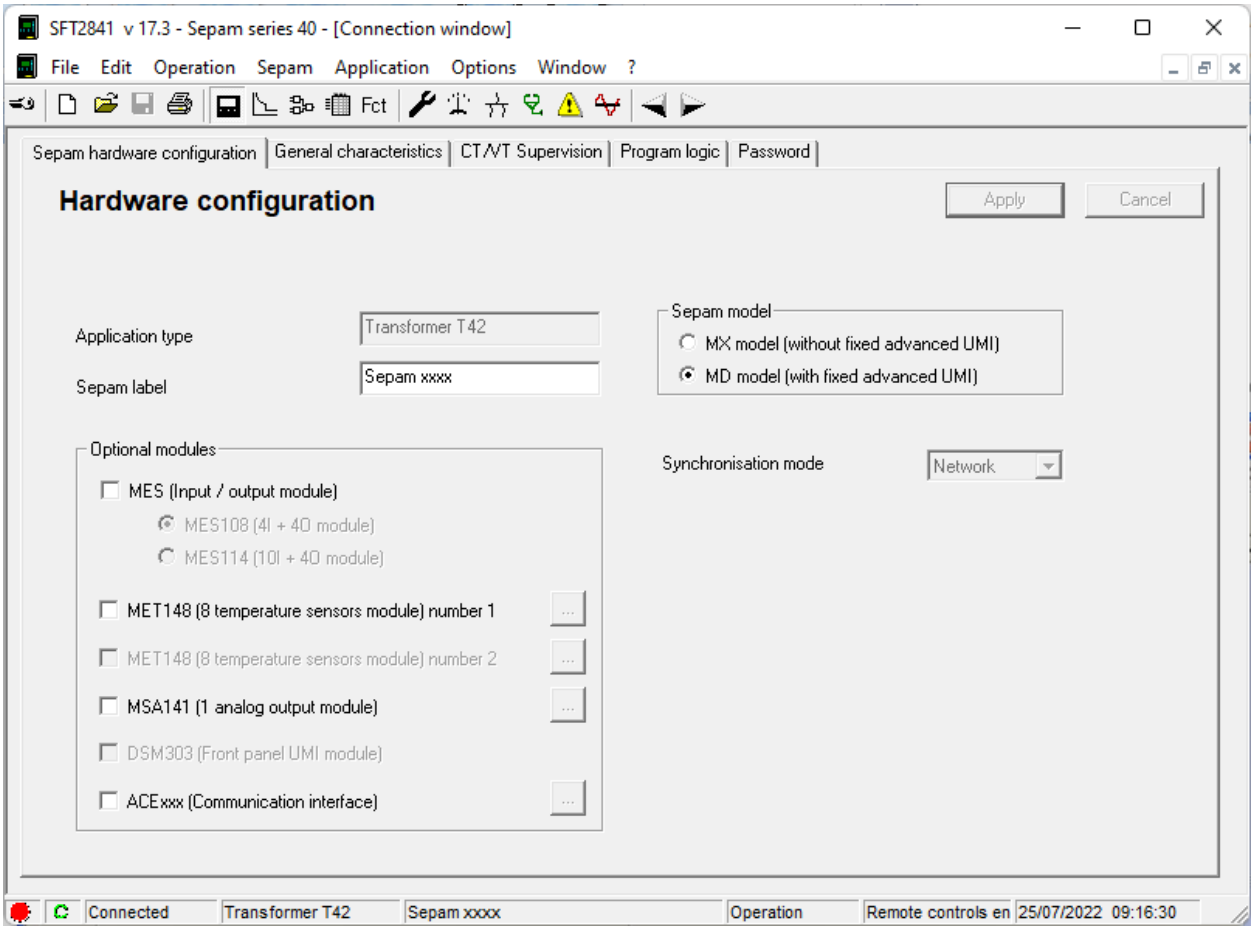

Figure 7

3. Parameterization of the SEPAM_T42 relay

The next step is to adjust the rated frequency, rated primary voltage and rated secondary voltage values. The values of these parameters are in the table below:

Table 1

Network frequency	60Hz
Rated primary voltage	13,8KV
Rated secondary voltage	115V

3.1 *General characteristics*

In this tab, the values described above are adjusted, in addition to other fields. What is highlighted in red is vitally important for the test to run properly.

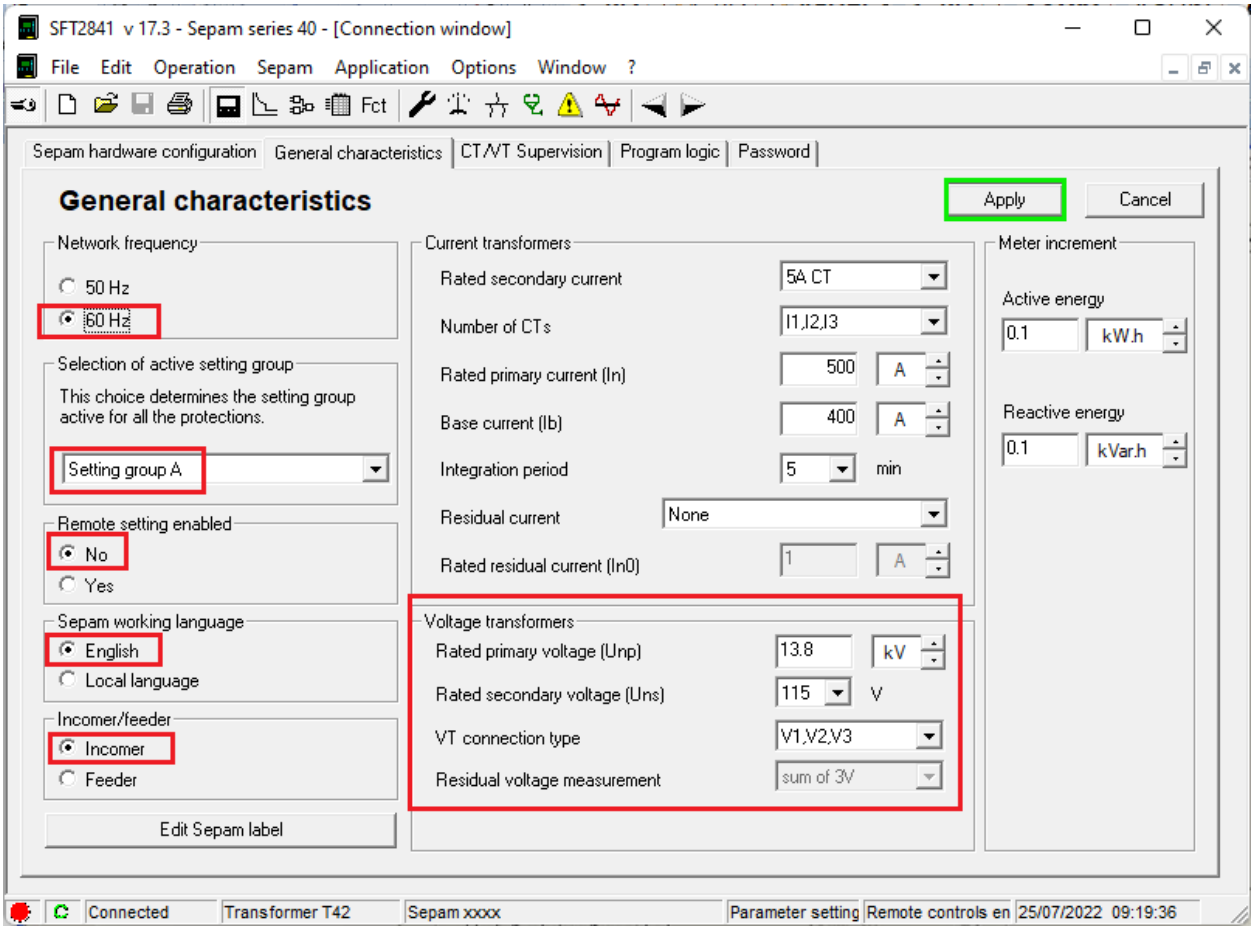

Figure 8

After the settings are configured, click on the *"Apply"* icon highlighted in green in the previous figure so that the software sends the changes to the relay. Before this occurs a password is required.

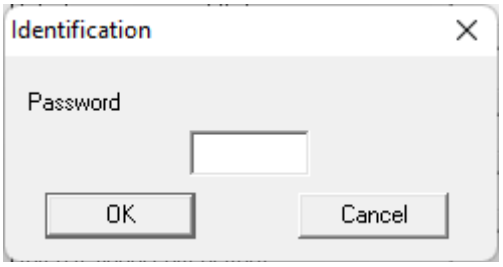

Figure 9

Enter your password for the changes to take effect. Whenever a parameter is changed its password must be entered.

Note: the default password is 0000.

3.2 *CT/VT Supervision*

In this field, disable all functions, so that they do not interfere with the test.

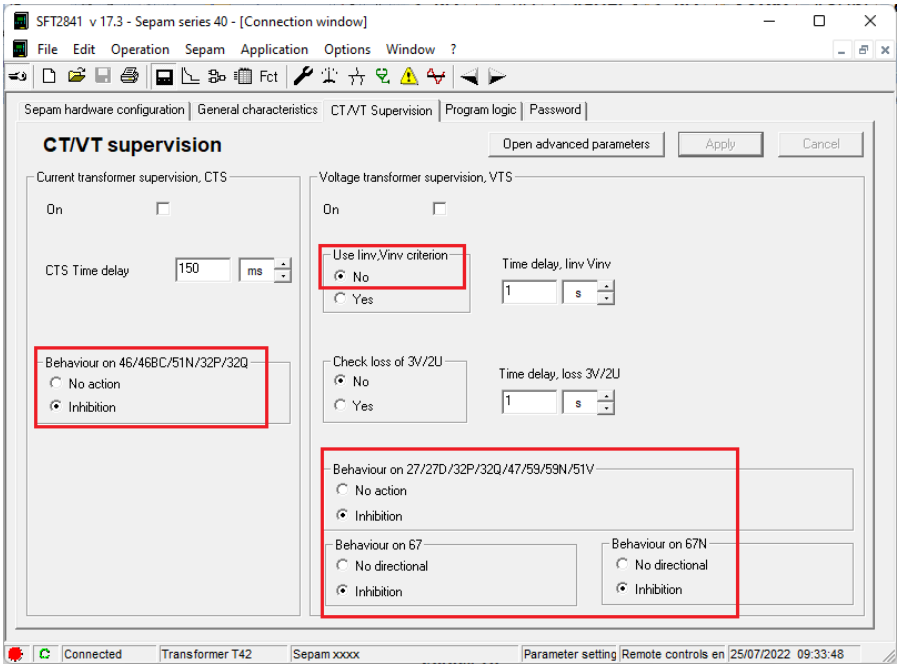

Figure 10

3.3 *Program logic*

In this field, the nominal state of the binary outputs is set.

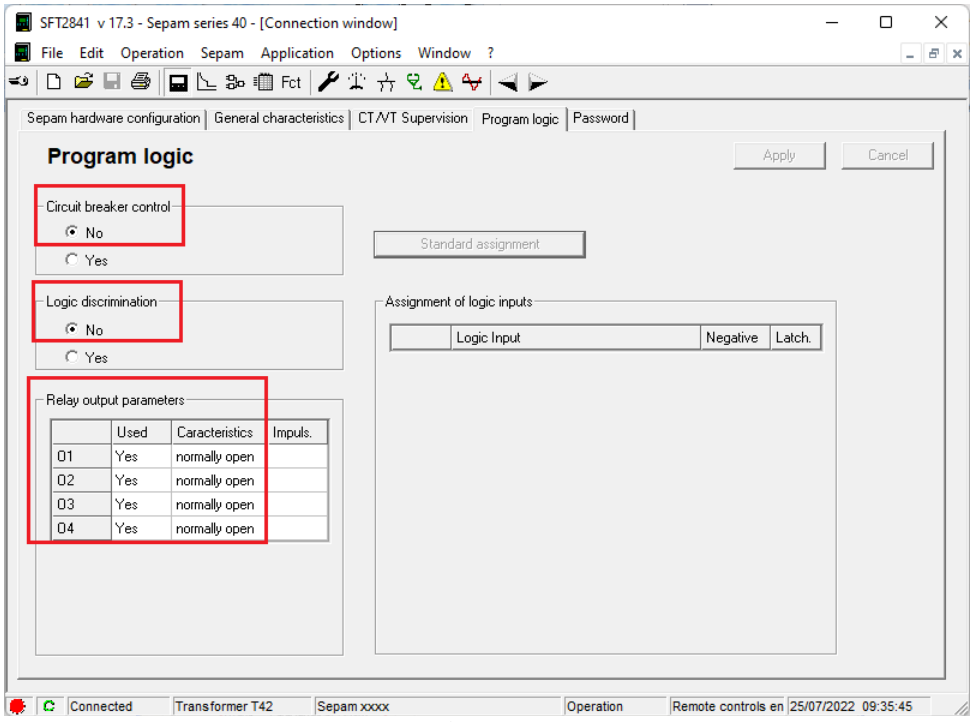

Figure 11

The next step is to adjust the undervoltage and overvoltage functions. To do this click on the icon below:

Figure 12

3.4 *27/27S: Undervoltage*

Up to two definite-time stages can be set for this function. For this tutorial, the settings shown in the following table are used. Where element 27-1 uses binary output O3 and element 27-2 uses binary output O4 for trip signals.

Table 2

Element	Voltage %	Voltage	Delay
27-1	90% Vnp	59,76V	2s
27-2	60% Vnp	39,84V	1s

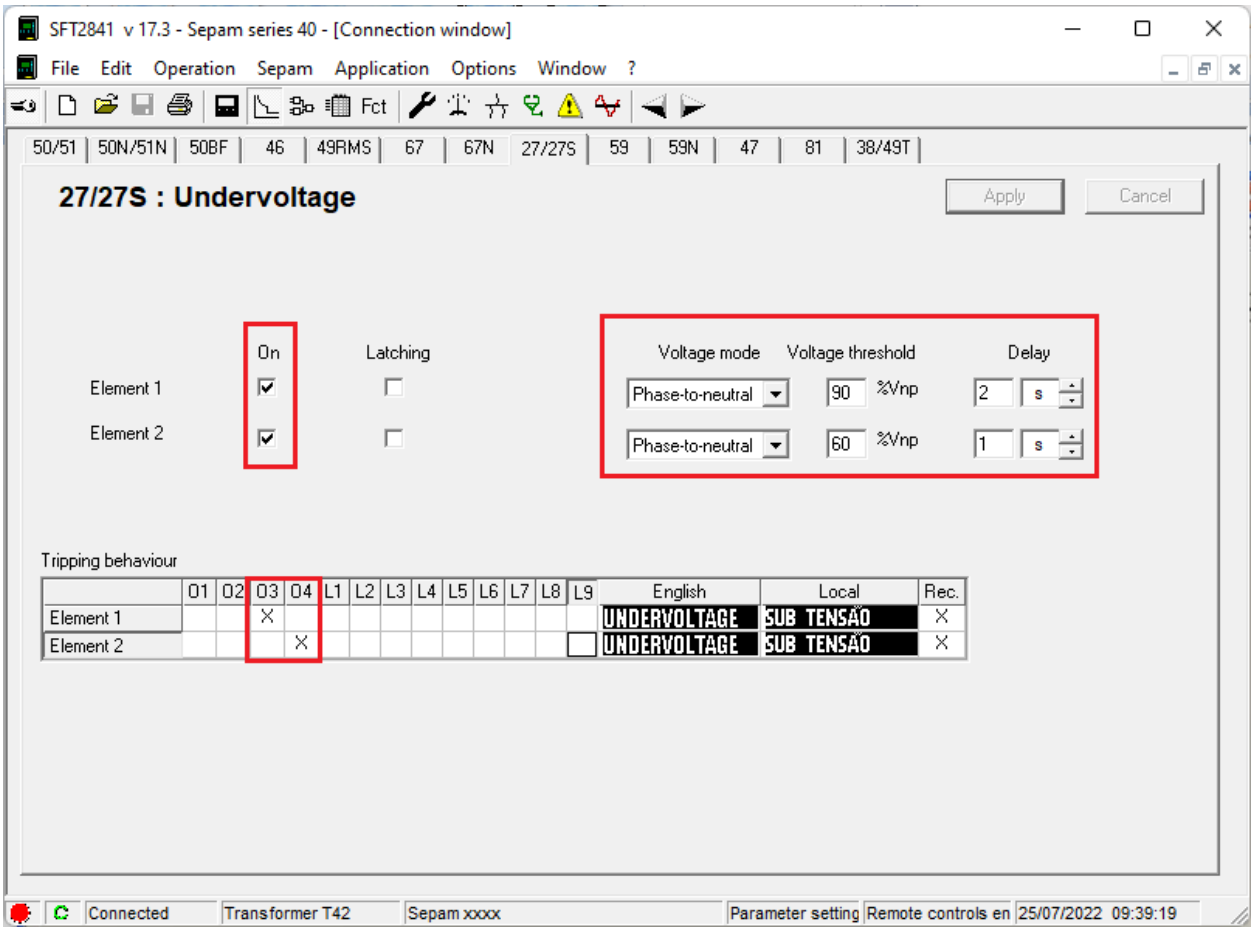

Figure 13

Note: The other functions are all disabled so as not to interfere with the function 27 test.

3.5 *59: Overvoltage*

Up to two definite-time stages can be set for this function. For this tutorial, the settings shown in the following table are used. Where element 59-1 uses binary output O1 and element 59-2 uses binary output O2 for trip signals.

Table 3

Element	Voltage %	Voltage	Delay
59-1	110% Vnp	73,04	2s
59-2	140% Vnp	92,96	1s

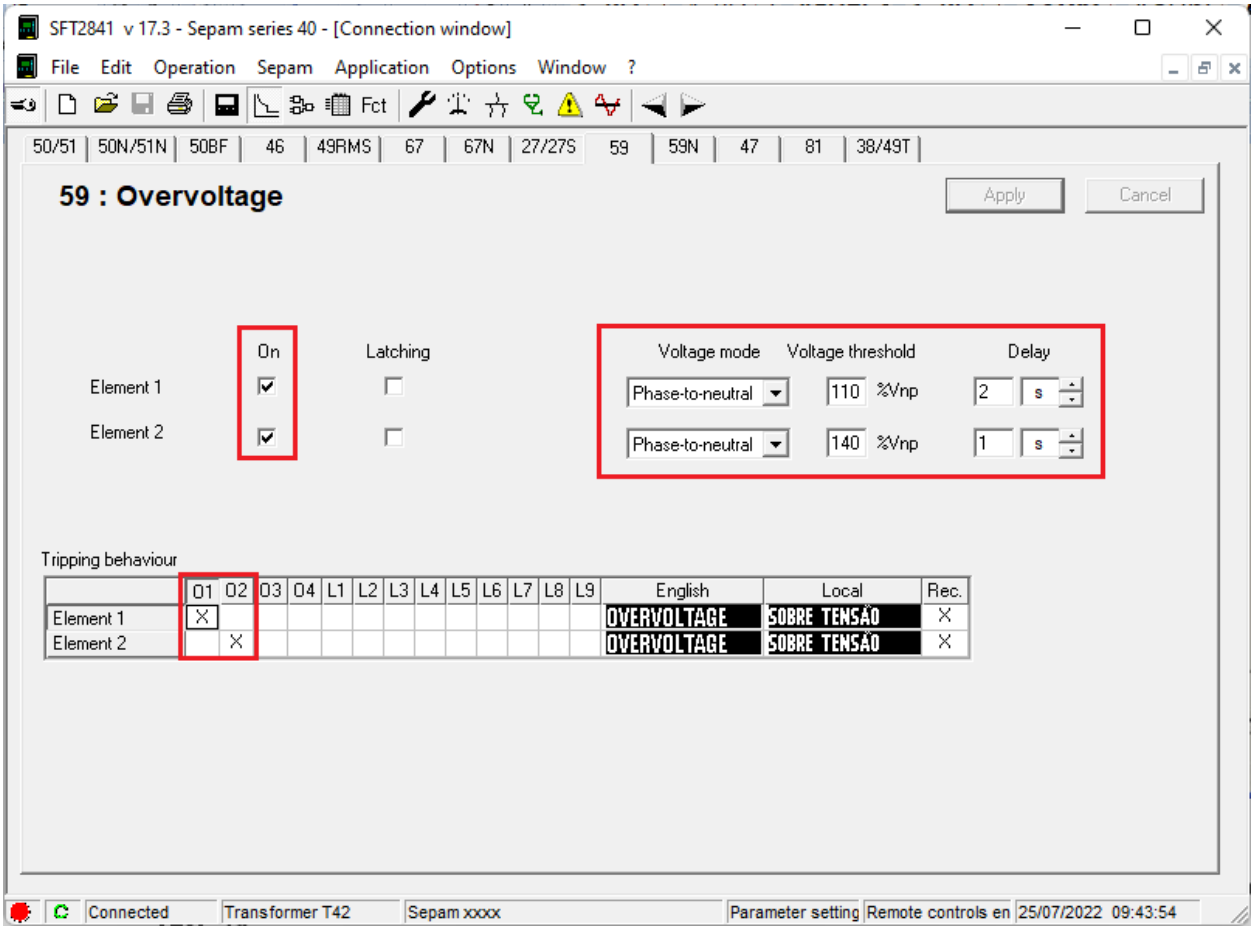

Figure 14

Note: The other functions are all disabled so as not to interfere with the function 59 test.

3.6 *Set control matrix*

Click the icon illustrated below to specify the binary output of each relay function.

Figure 15

In the *"Protections"* field and in the *"Outputs"* tab, the tripping of the functions with the binary outputs is configured.

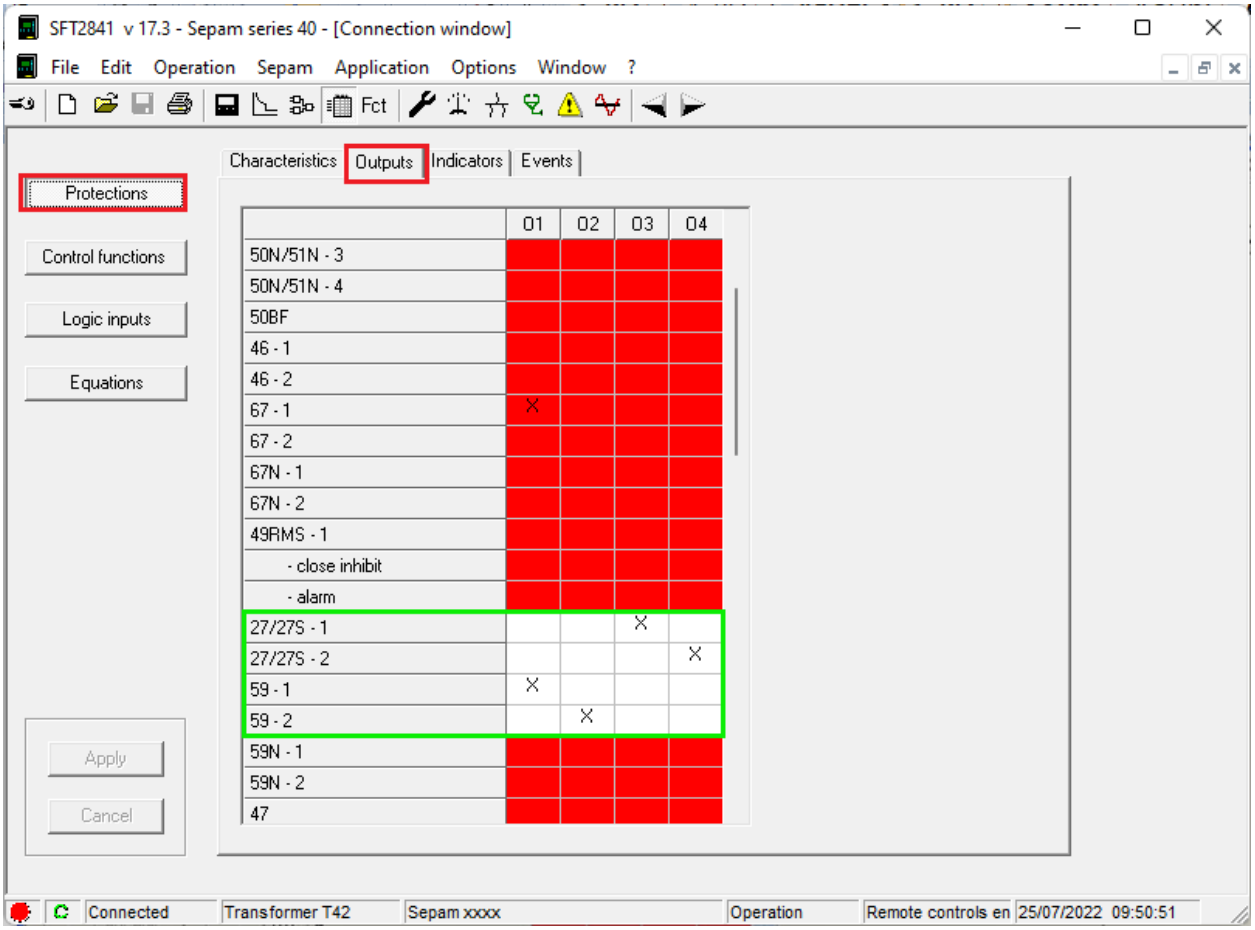

Figure 16

4. Quick software adjustments

4.1 *Opening the Quick*

Click on the *"CTC"* application manager icon.

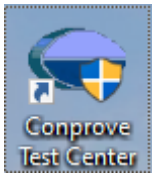

Figure 17

Click on the *"Quick"* software icon.

Figure 18

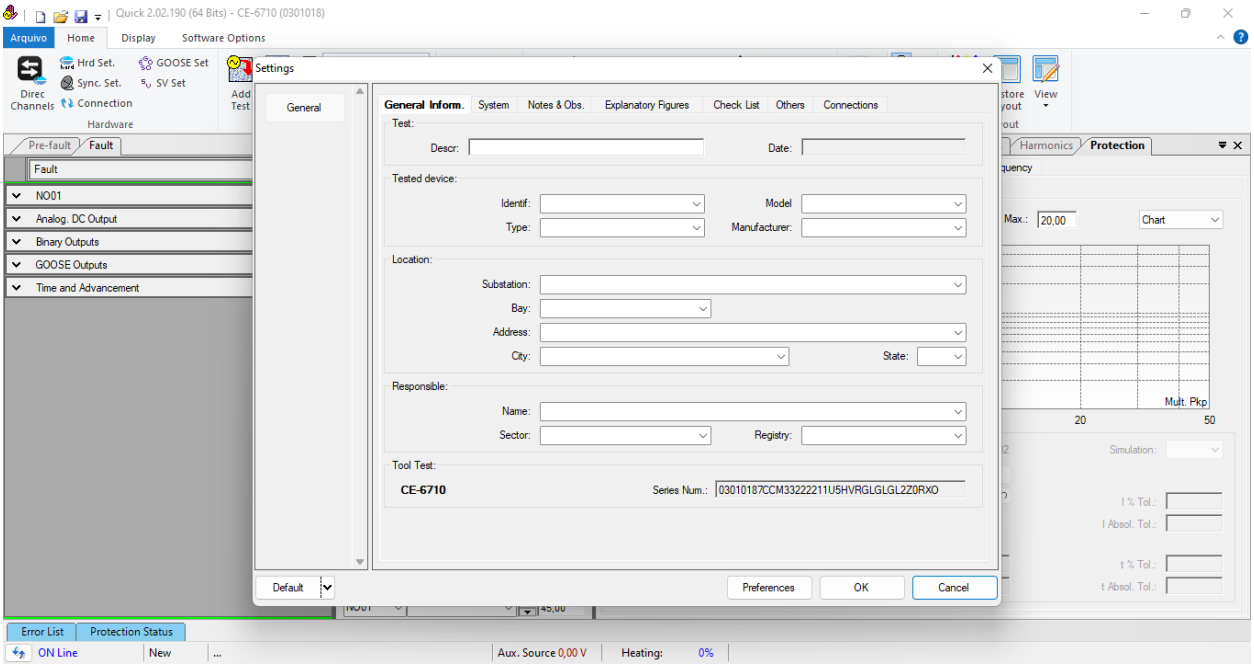

Figure 19

4.2 *Configuring the Settings*

When opening the software the *"Settings"* screen will open automatically (provided that the option *"Open Settings when Start"* found in the *"Software Options"* menu is selected). Otherwise click directly on the *"Settings"* icon.

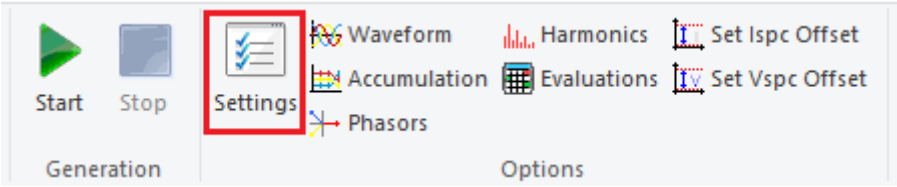

Figure 20

Inside the *"Settings"* screen, fill in the *"General Inform."* with data from the *"Tested device", "Installation location"* and the *"Responsible".* This makes reporting easier, as this tab will be the first to be shown.

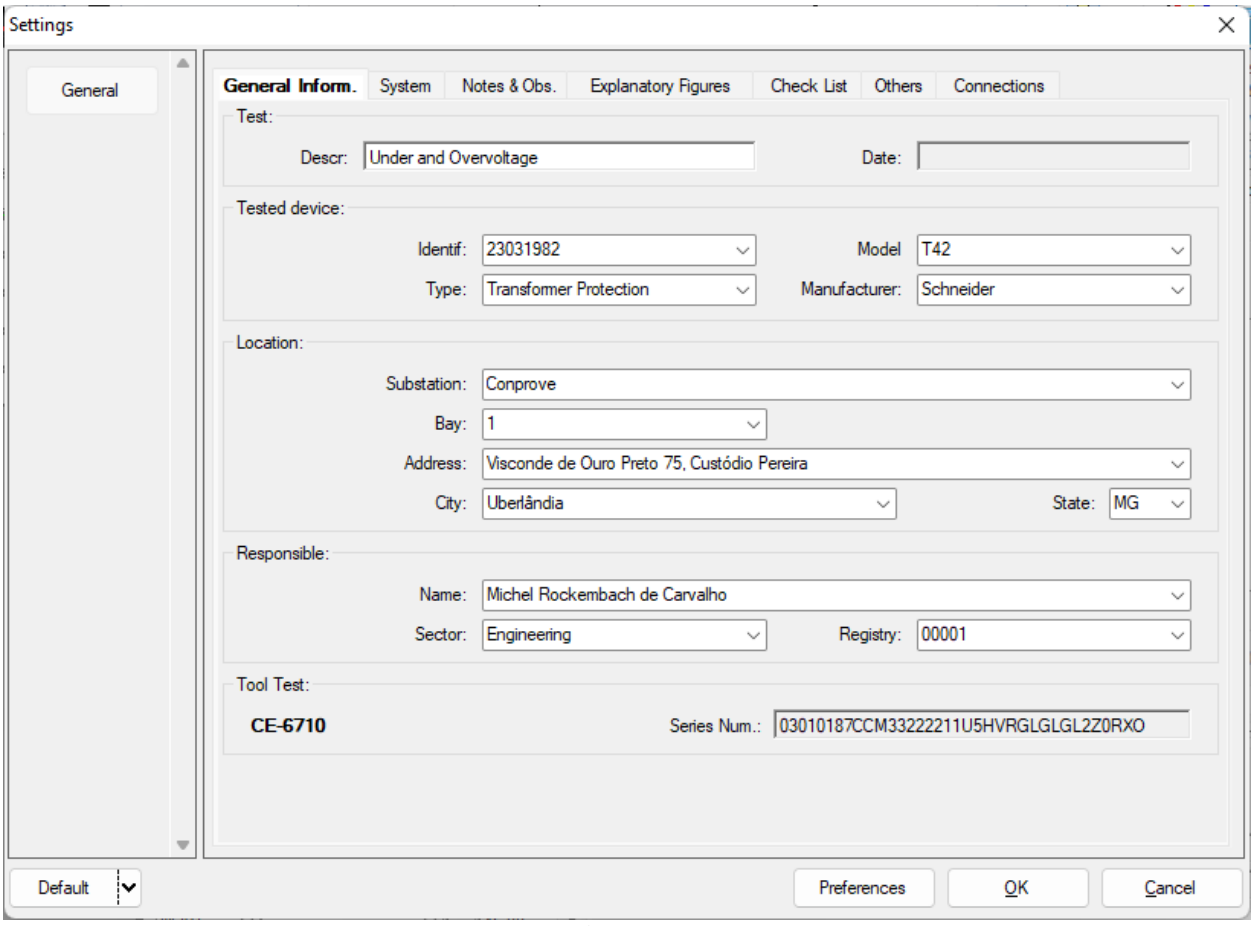

Figure 21

4.3 *System*

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

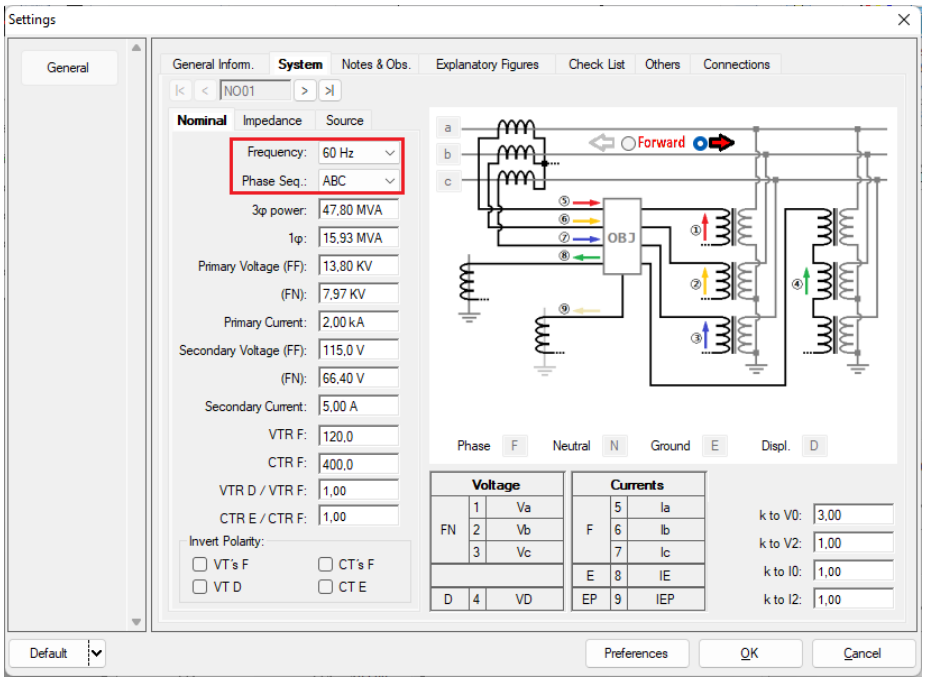

Figure 22

There are other tabs where the user can enter notes and observations, explanatory figures, can create a *"check list"* of the procedures for carrying out the test and even create a schematic with all the schematic of the connections between the test set and the test equipment.

5. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

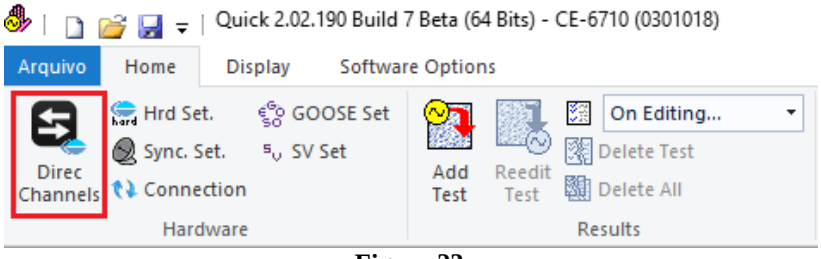

Figure 23

Then click on the highlighted icon to configure the hardware.

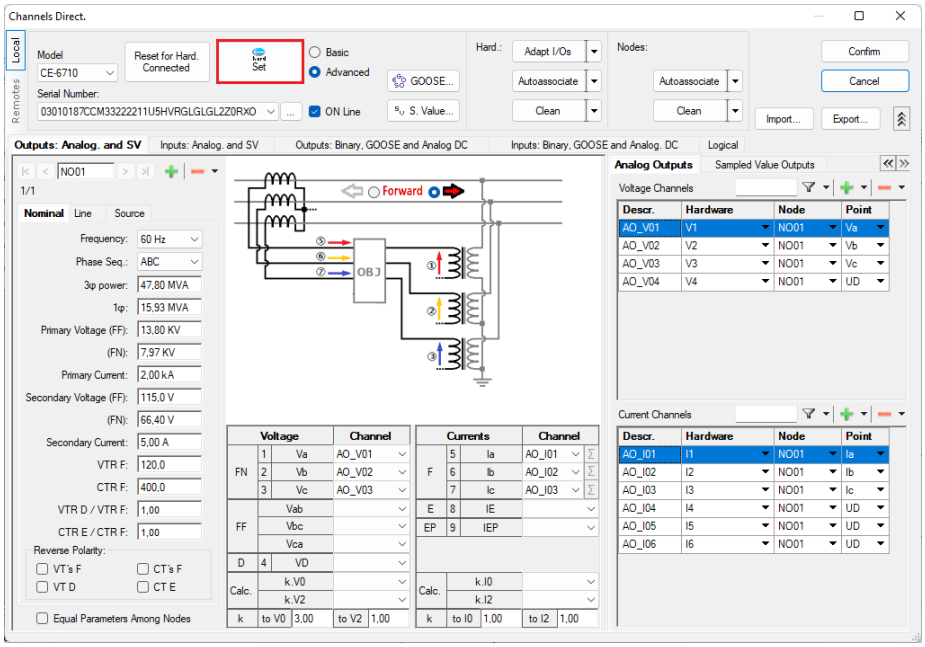

Figure 24

Choose the channel configuration; adjust the auxiliary source and the method of stopping the binary inputs. To finish click on *"OK"*.

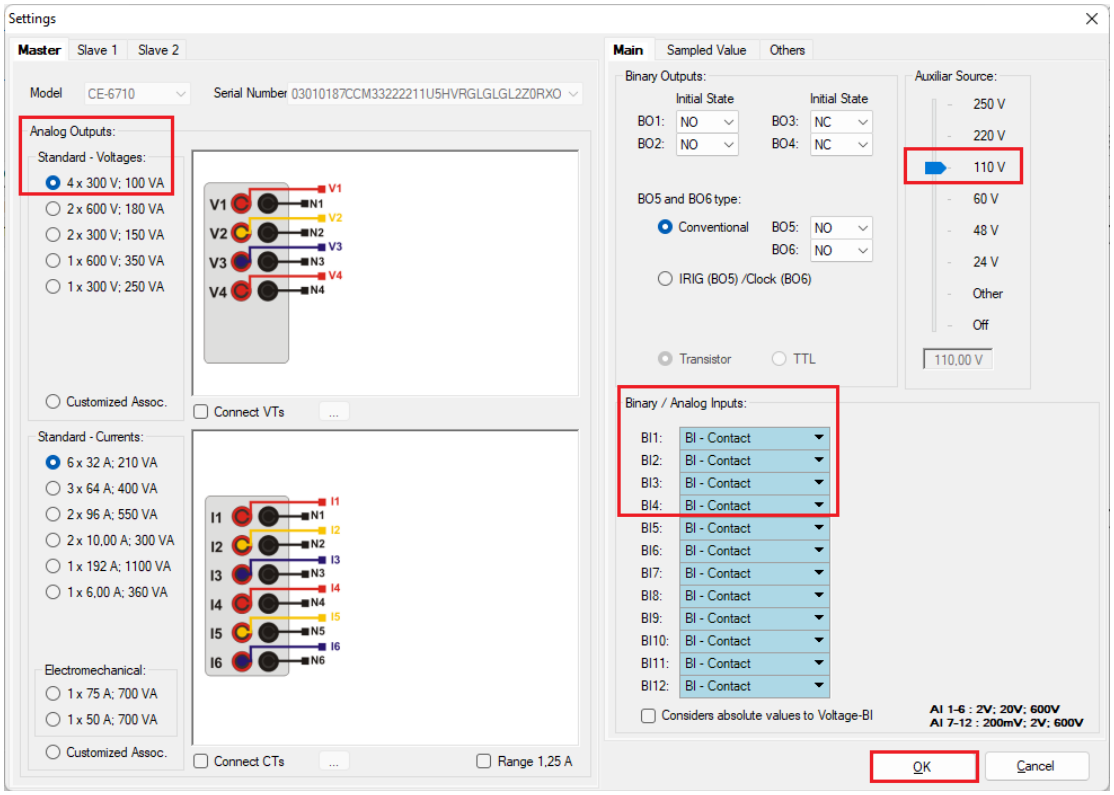

Figure 25

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

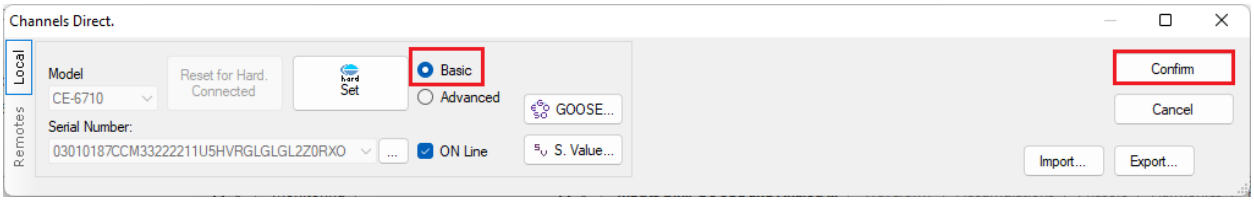

Figure 26

6. Test structure for function 27/59

6.1 *Voltage x Time > Overvoltage screen*

Click on the tab *"Protection > Voltage x time >Overvoltage"* so that the data set in the relay are configured in the software. Next to the voltage *"V"* chooses a node as a reference, in this case *"AO_V01"*. Only after choosing the node are the fields for setting function 59 active.

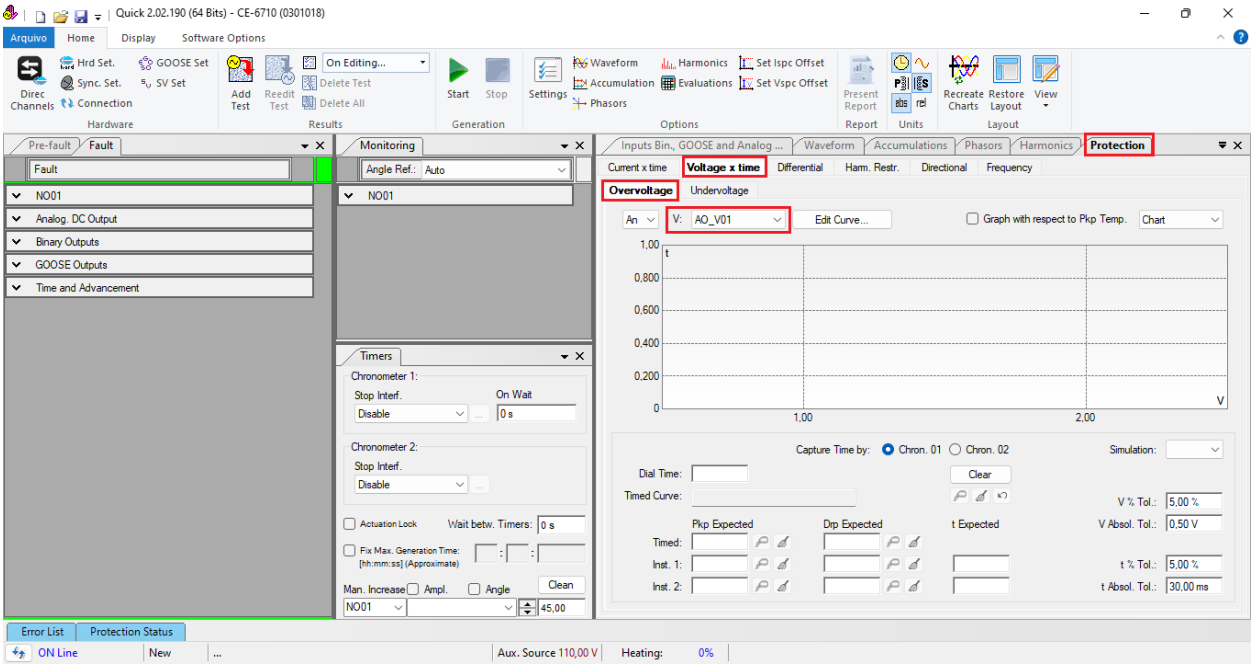

Figure 27

6.2 *General Adjustments 59*

According to the relay software settings, these values are entered in the Quick software. The 59-1 element pick-up is equal to 73.04V (1.1* V_{np}) with actuation time equal to 2.0s and the pick-up of the element 59-2 is equal to 92.96V (1.40 * V_{np}) with actuation time equal to 1.0s.

There are also fields where the absolute and relative tolerances for both voltage and time must be entered. These values are taken from Appendix A.2. There is also a field where the type of simulation is required, being possible single-phase-ground, two-phase and three-phase.

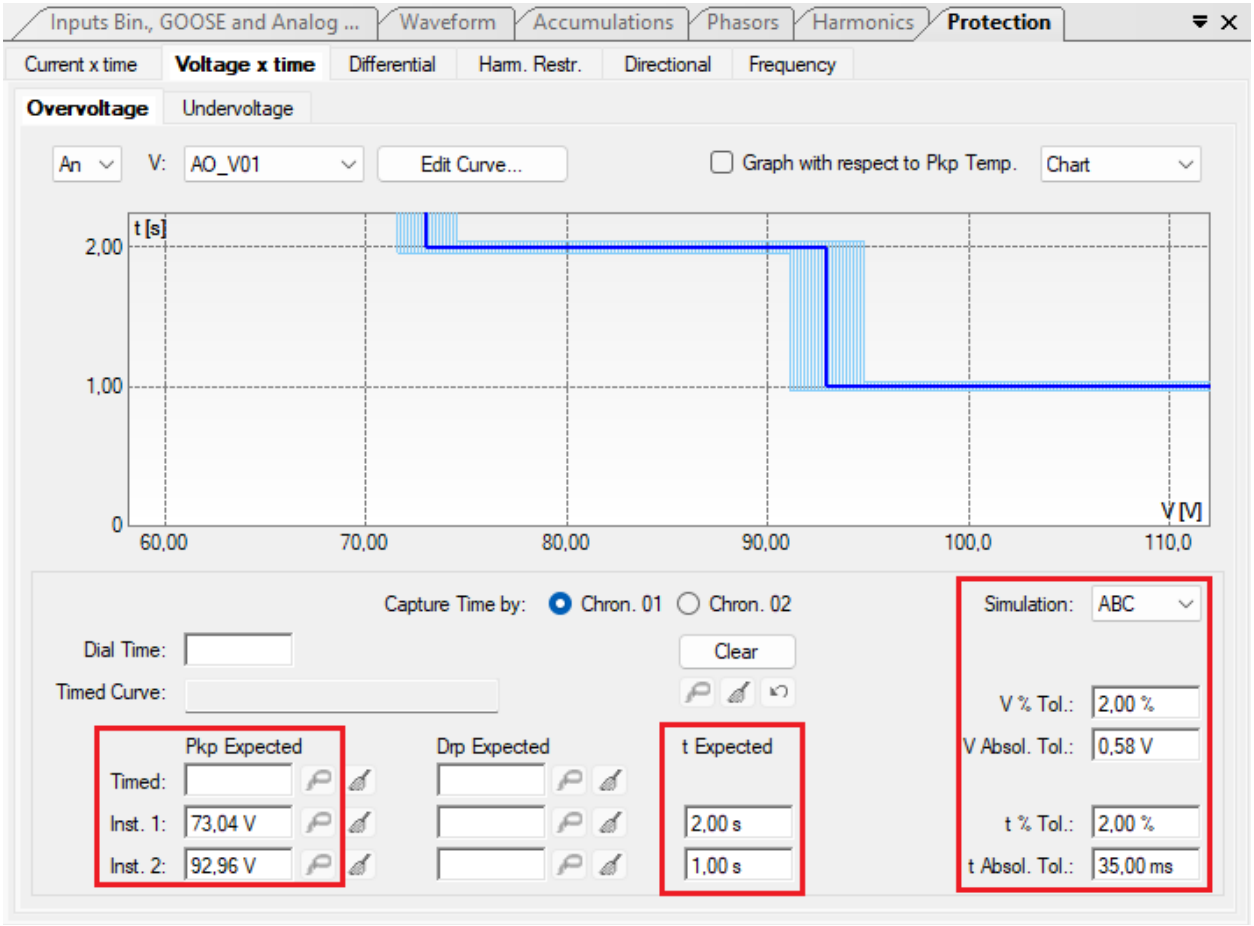

Figure 28

6.3 *Timed Element 59-1 Pick-up Test*

For the pick-up test, a ramp is used to increase the voltage value. To do this, choose the *"Ramp"* option on the *"Fault > N01"* tab and click on the highlighted icon.

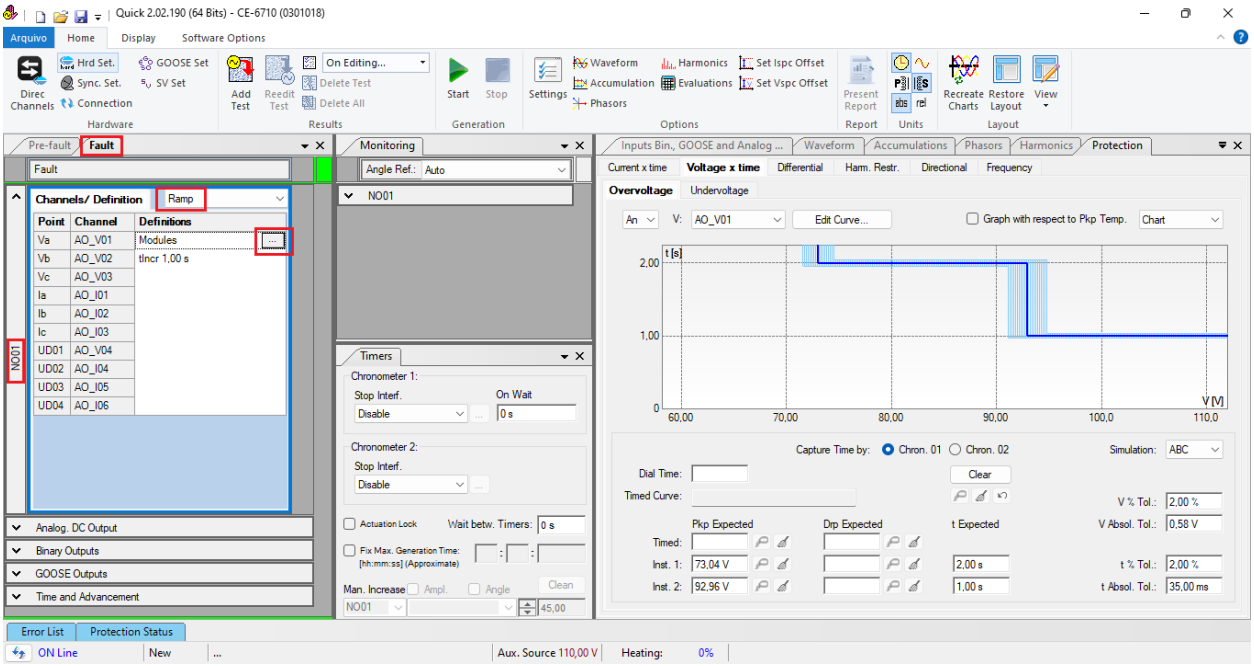

Figure 29

For the initial value, set 72.54V, for limit value 73.54V, with an increment of 100mV and a time of 3.0s.

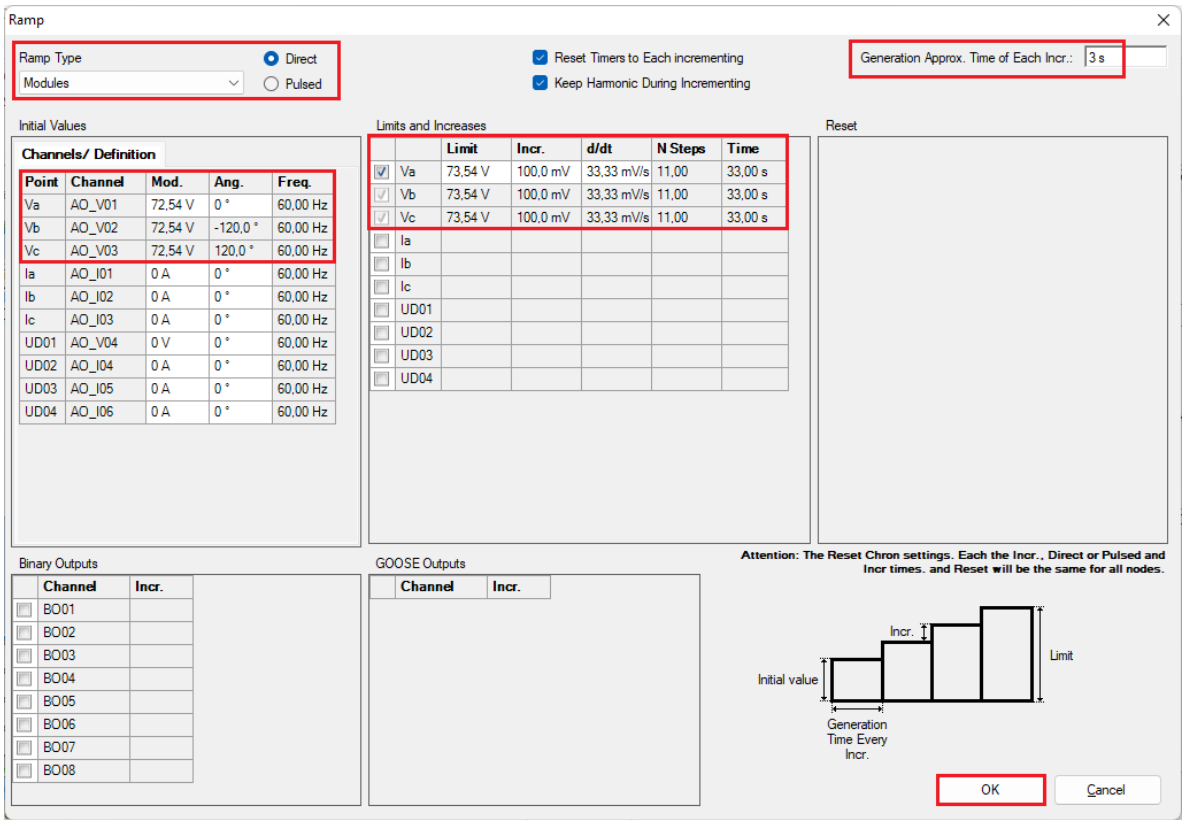

Figure 30

Set the stop interface, which in this case is *"BI01"* and start the generation by clicking on the icon highlighted below or using the shortcut *"Alt + G"*.

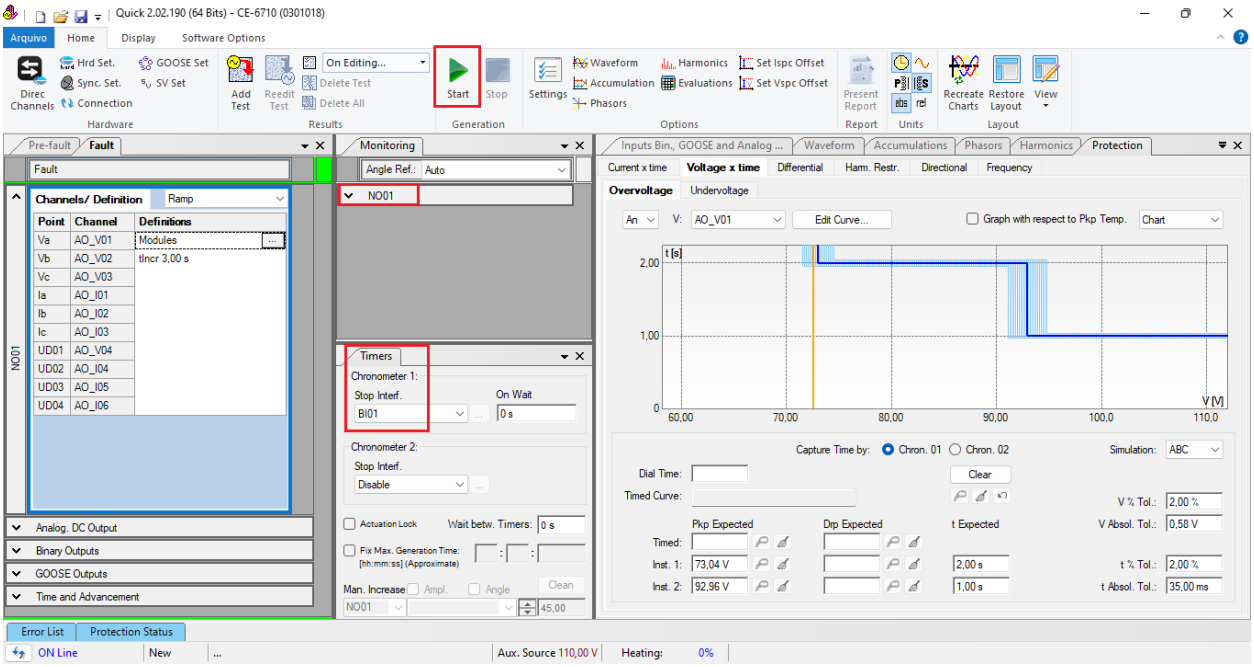

Figure 31

To view the values being generated, click on *"N01"* within the *"Monitoring"* tab. After the actuation, click on the highlighted icon to capture the point.

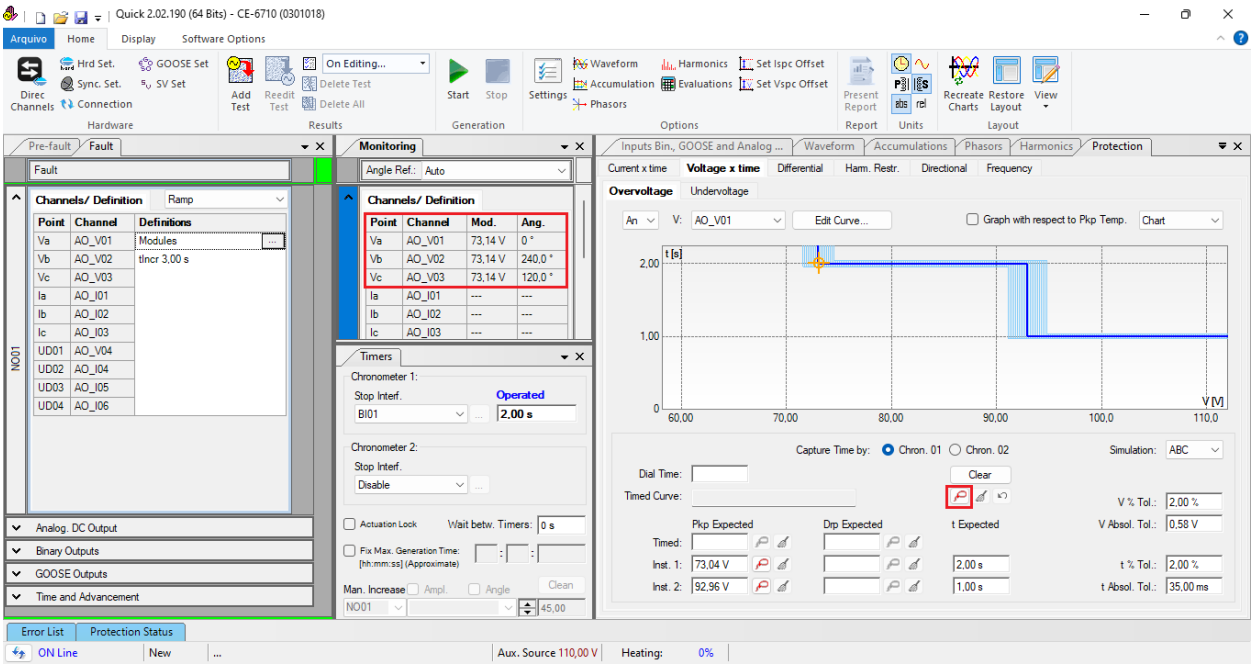

Figure 32

In this case, the pickup found was 73.14V, being within the tolerance range given by the relay manufacturer.

6.4 *Element 59-1 point test*

To check the operating time of element 59-1, remove the *"Ramp"* by choosing the *"Direct"* option and inject voltage values above the pick-up value. Keep the stop interface at *"BI01"*. The following figure shows the value of 75.00V already captured and the value of 90.00V to be captured.

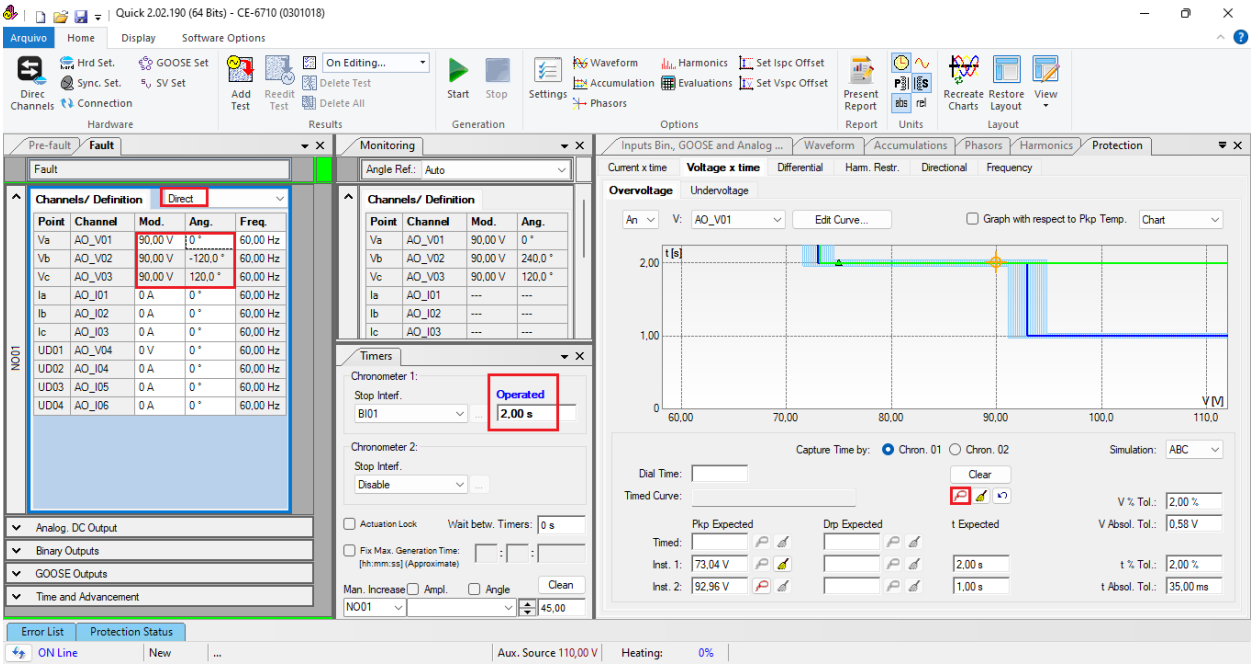

Figure 33

It is verified that the operating times are within the tolerance provided by the manufacturer.

6.5 *Timed Element 59-2 Pick-up Test*

Click on the *"Fault"* tab, choose the *"Ramp"* option and the *"..."* icon and enter an initial value of 92.46V, limit value of 93.46V, with an increment of 100.0mV and a time of 2.0s.

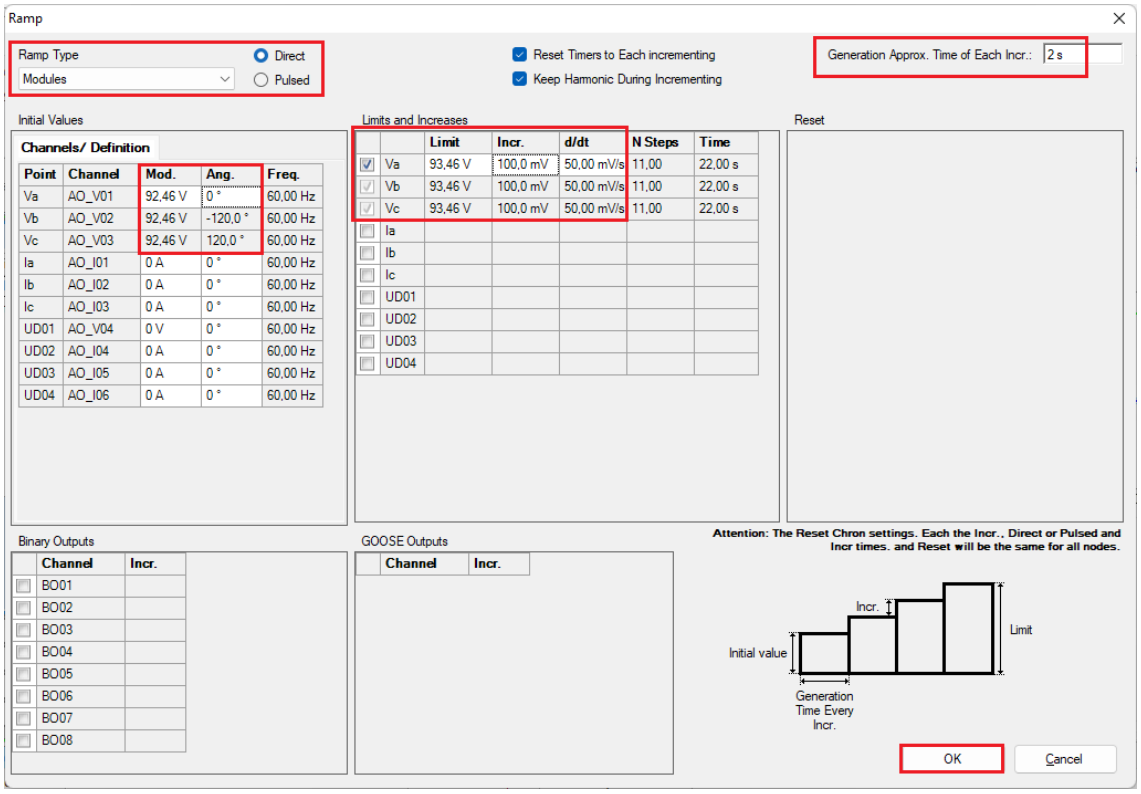

Figure 34

Change the interface to *"BI02"* and start the generation through the shortcut *"Alt + G"*.

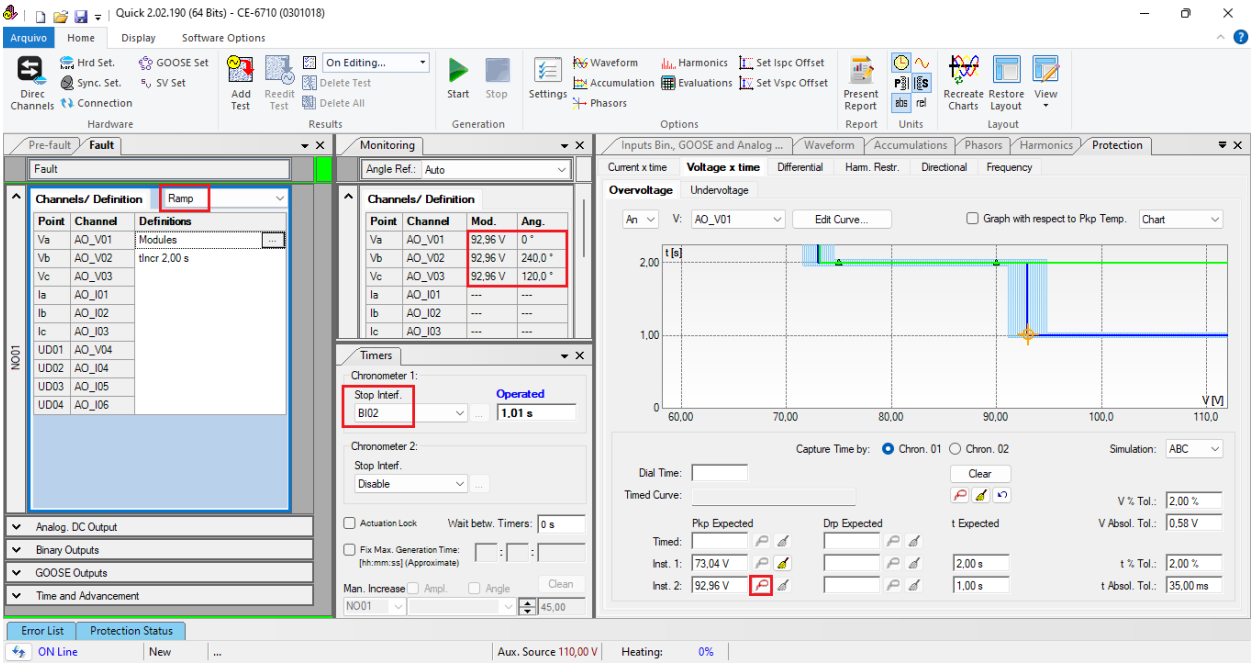

Figure 35

The pick-up value found for element 59-2 was 92.96V, being exactly the value set in the relay.

6.6 *Element 59-2 point test*

Return the *"Channels/Definition"* field to *"Direct"* to check the operating time of element 59-2. Points with voltage values above the pick-up must be tested. The following figure shows the value of 95.00V already captured and the value of 110.00V not yet captured.

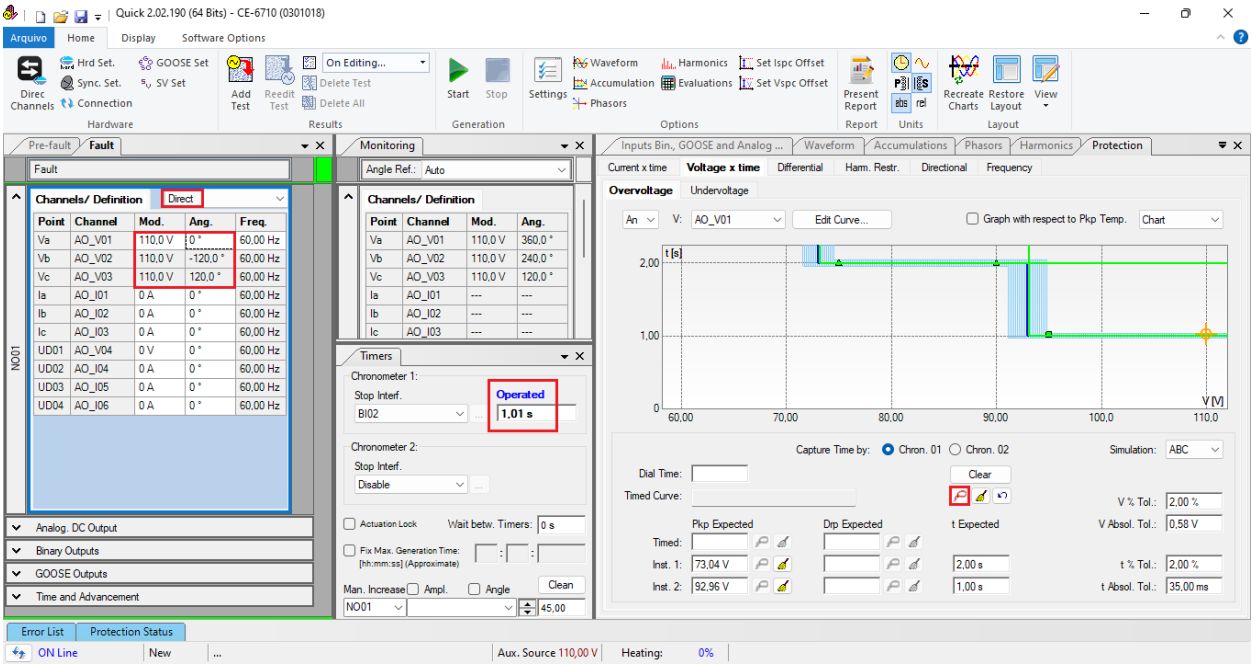

Figure 36

It is verified that the operating times are within the tolerance provided by the relay manufacturer.

6.7 *Voltage x Time > Undervoltage screen*

First, click on the tab *"Protection > Voltage x time > Undervoltage"* so that the data set in the relay are configured in the software. Next to the voltage *"V"* chooses a node as a reference, in this case *"AO_V01"*. Only after choosing the node are the fields for setting function 27 active.

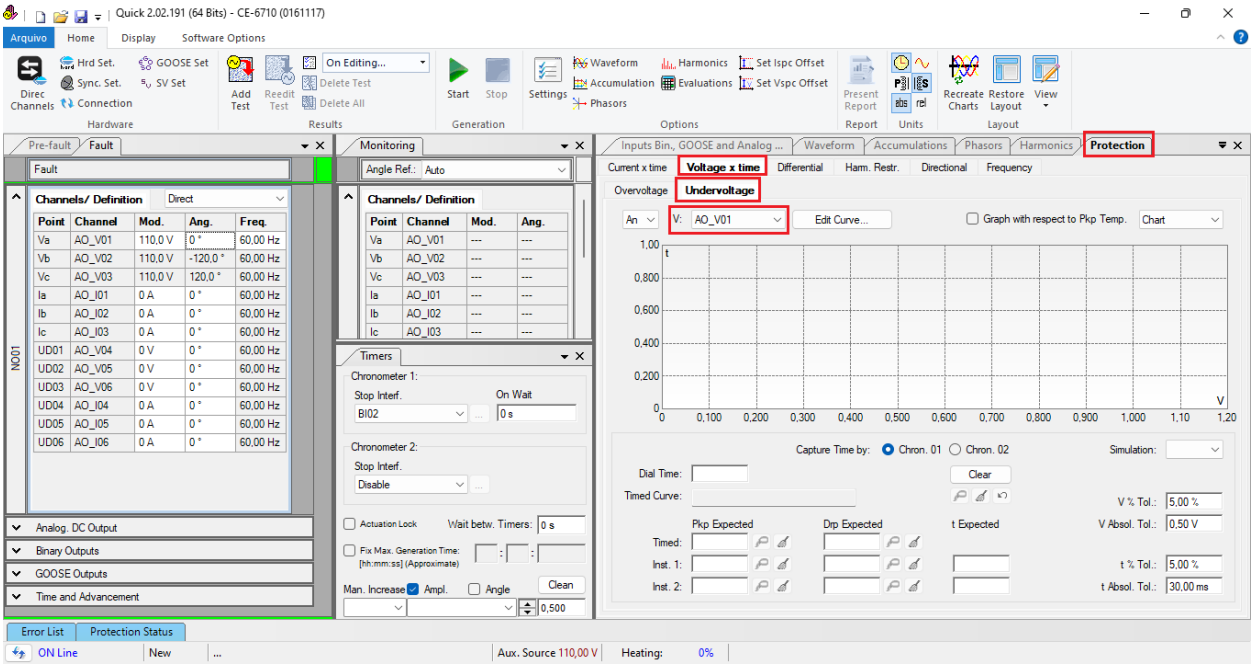

Figure 37

6.8 *General Adjustments 27*

According to the relay software settings, these values are entered in the Quick software. The element 27-1 pick-up equal to 59.76V (0.90* V_{np}) with actuation time equal to 2.0s and element 27-2 equal to 39.84V (0.60 * V_{np}) with actuation time equal to 1.0s.

There are also fields where the absolute and relative tolerances for both voltage and time must be entered. These values are taken from Appendix A.2. There is also a field where the type of simulation is required, being possible single-phase-ground, two-phase and three-phase.

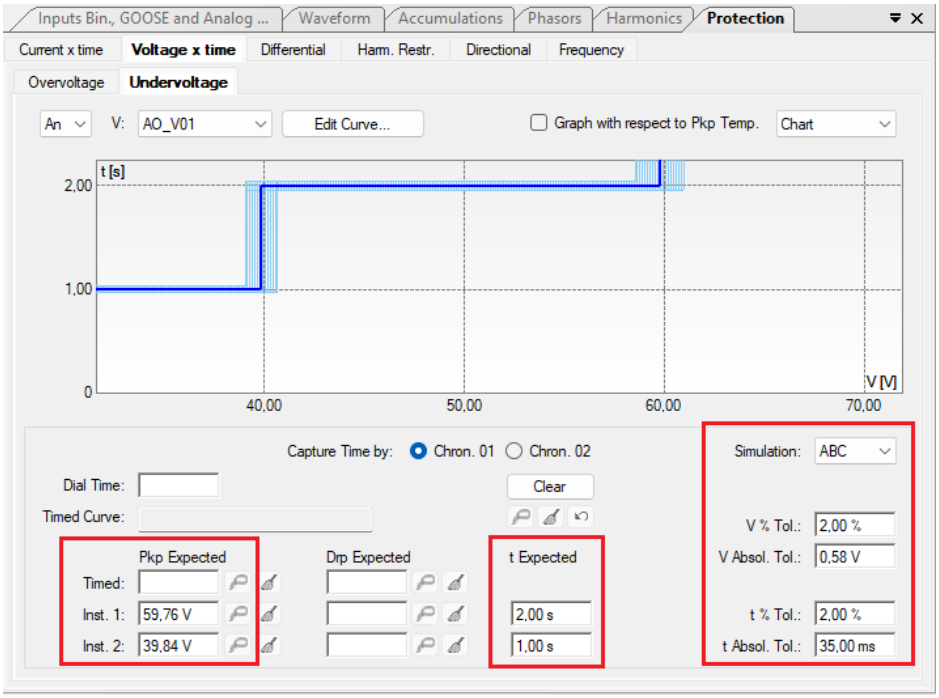

Figure 38

6.9 *Timed Element 27-1 Pick-up Test*

First change the stop binary to *"BI03"*. For the pick-up test, a ramp is used to decrease the voltage value. To do this, choose the *"Ramp"* option on the *"Fault > N01"* tab and click on the highlighted icon.

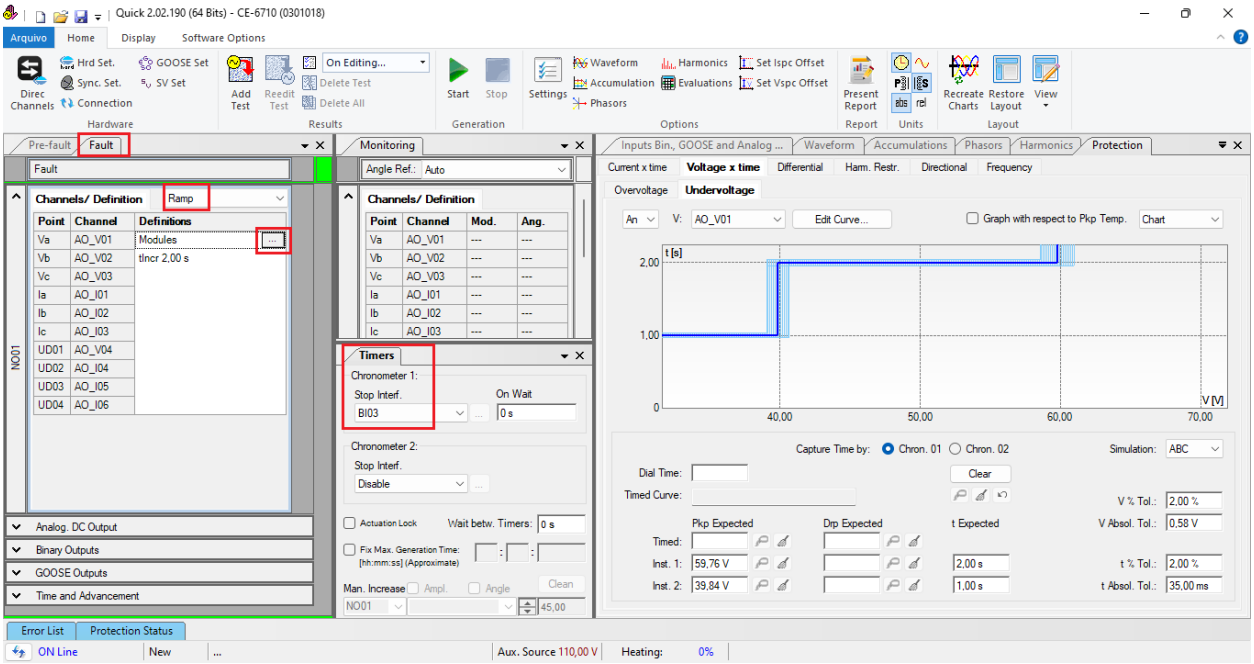

Figure 39

Enter an initial value of 60.26V, threshold value of 59.26V, with a decrement of -100.0mV and a time of 3.0s.

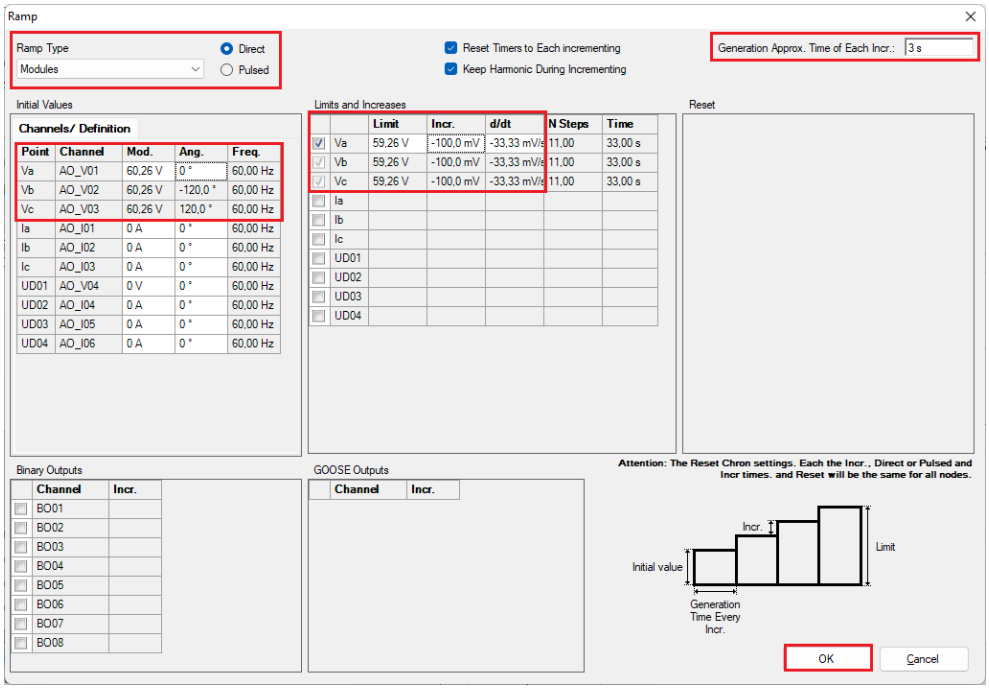

Figure 40

<u>NOTE: An important detail is that pre-fault voltage must be entered so that the relay performs the drop-out. For this, click on “Actuation Lock”.</u>

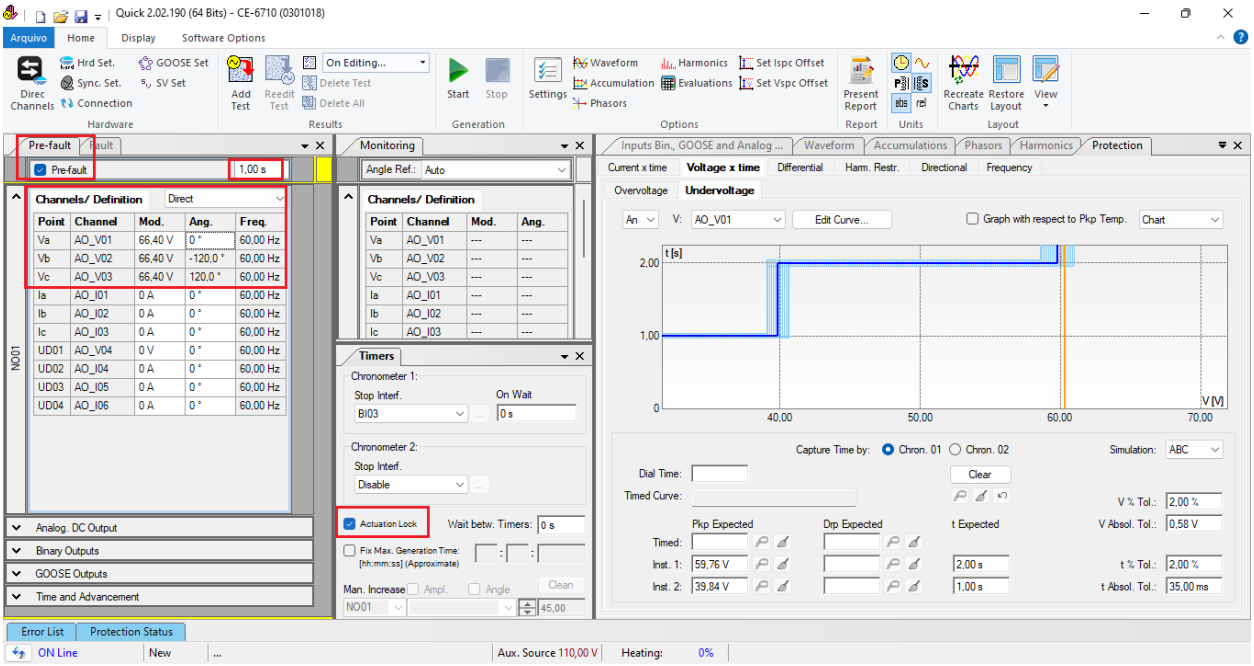

Figure 41

Start the generation by clicking on the *"Start"* icon or via the shortcut *"Alt + G"*.

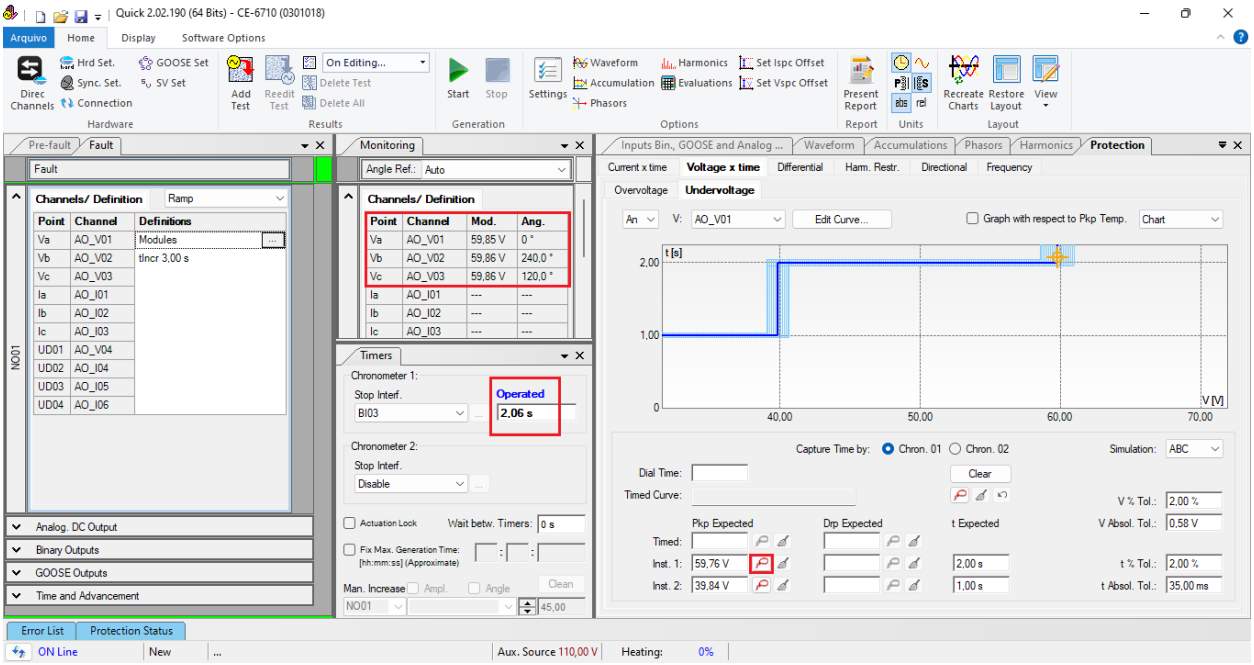

Figure 42

In this case, the pickup found was 59.86V, being within the tolerance range given by the relay manufacturer.

6.10 *Element 27-1 point test*

Return the *"Channels/Definition"* field to *"Direct"* to check the operating time of element 27-1. Points with voltage values below the pick-up must be tested. The figure below shows the value of 55.00V already captured and the value of 41.00V not yet captured.

NOTE: Remember to always block the first actuation.

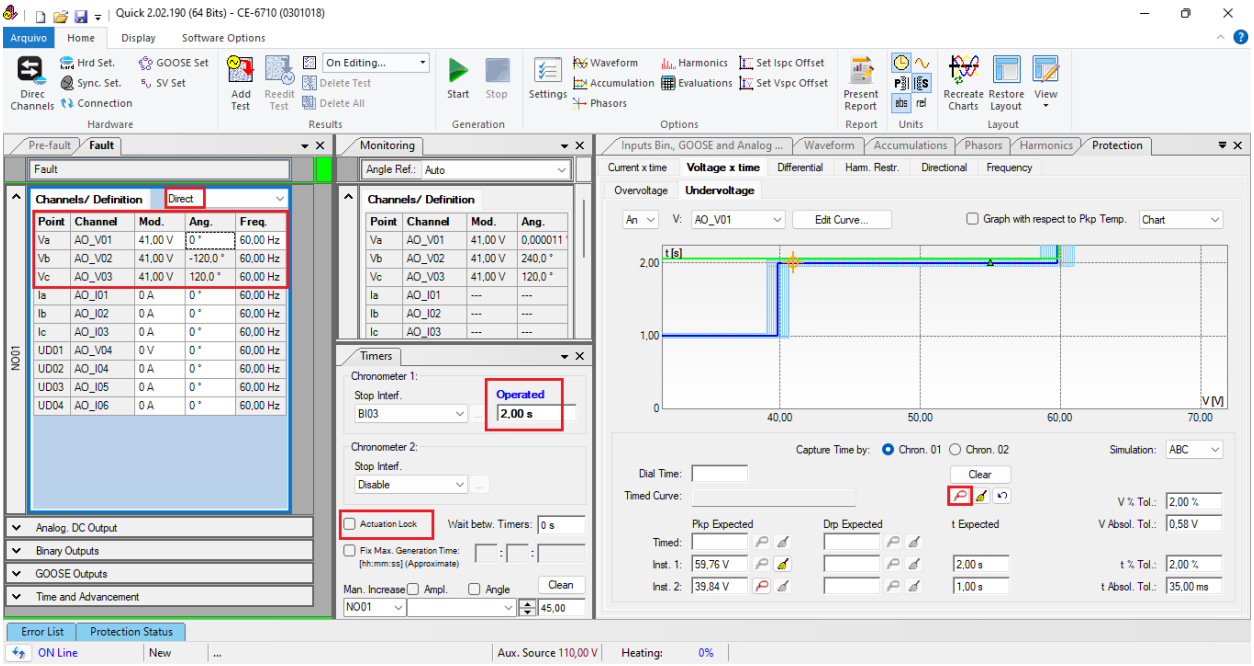

Figure 43

It is verified that the operating times are within the tolerance provided by the manufacturer.

6.11 *Timed Element 27-2 Pick-up Test*

Change the binary to BI04, click on the *"Fault"* tab, choose the *"Ramp"* option and the *"..."* icon and enter an initial value of 40.34V, limit value of 39.34V, with a decrement of -100,0mV and the time of 2.0s.

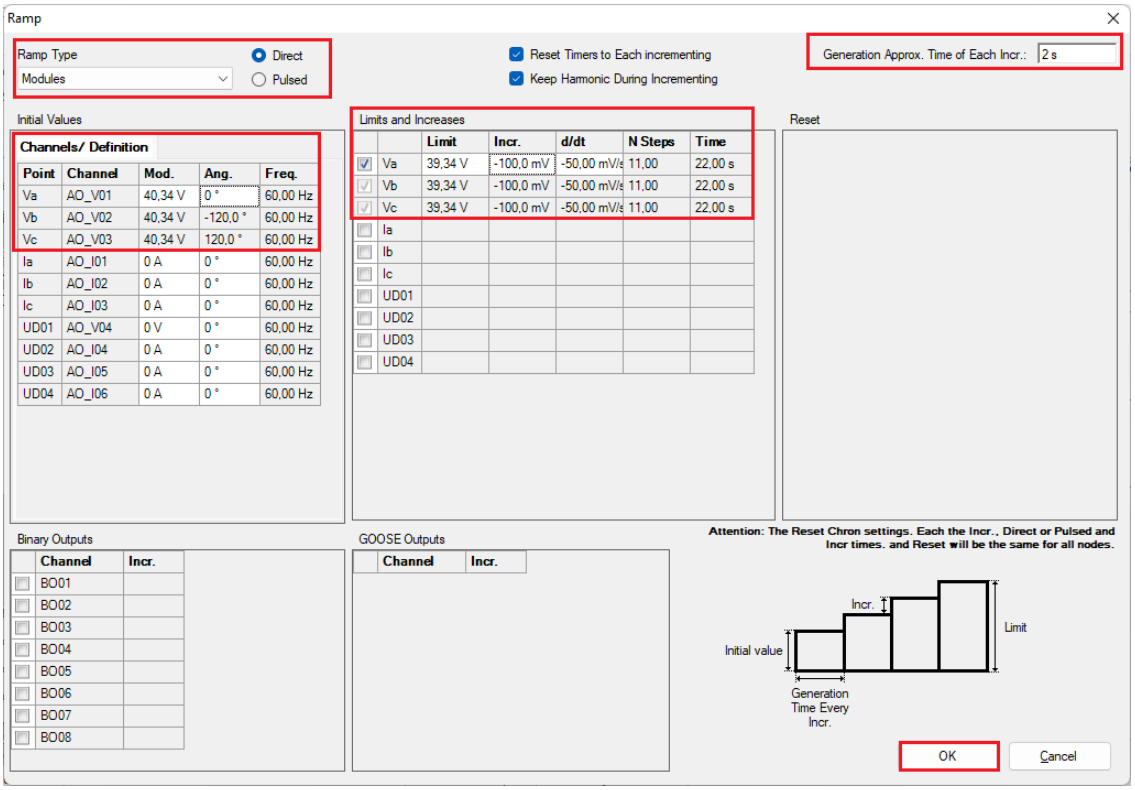

Figure 44

Check the field *"Actuation Lock"* and start the generation through the shortcut *"Alt + G"*.

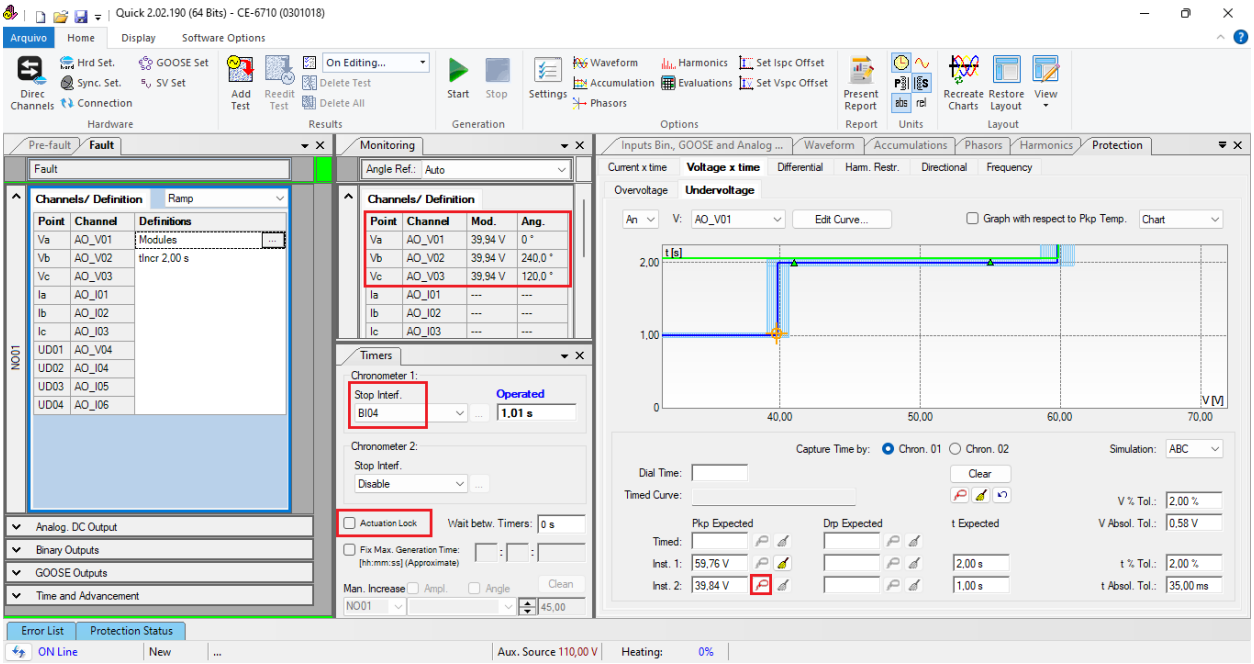

Figure 45

The pick-up found for element 27-2 was 39.94V, within the range of values given by the manufacturer.

6.12 *Element 27-2 point test*

The following figure shows the value of 38.00V already captured and the value of 33.00V not yet captured.

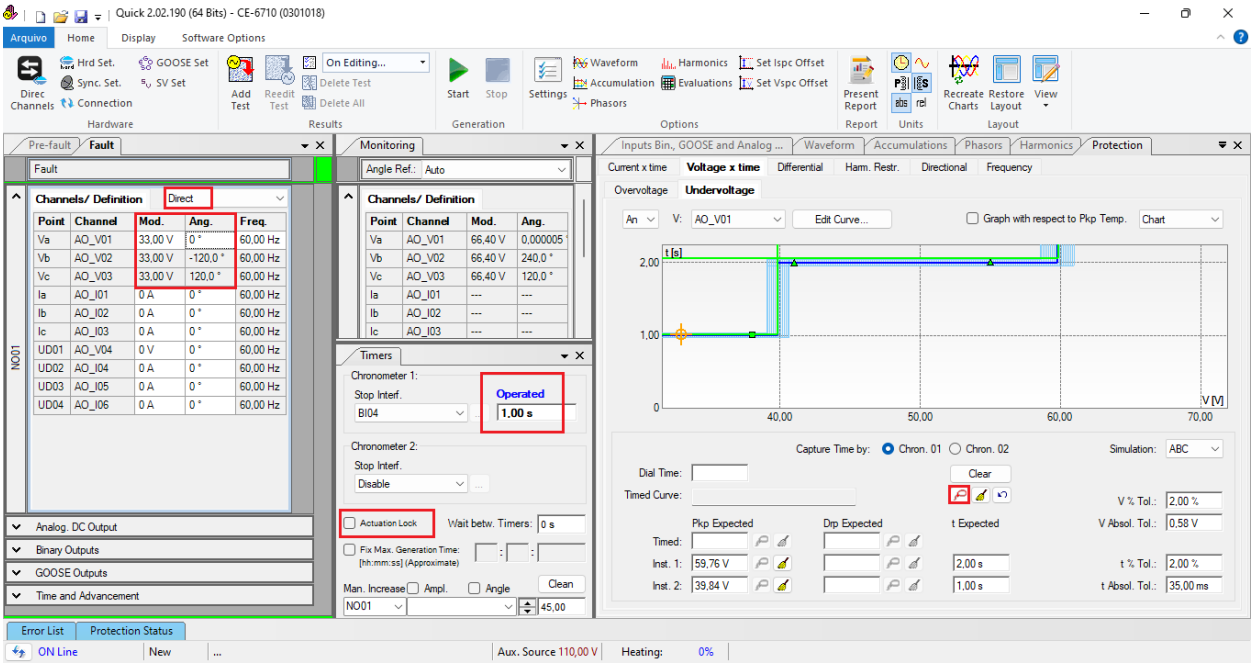

Figure 46

It is verified that the operating times are within the tolerance given by the manufacturer.

7. Report

At the end of the test, you can request an automatic report, just click on the icon illustrated below or use the shortcut *"Ctrl + R"*.

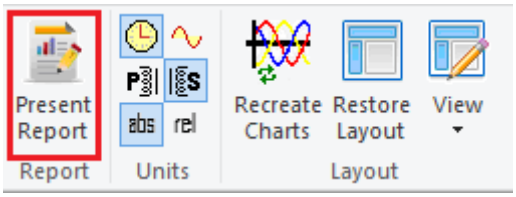

Figure 47

When requesting the report, a screen opens where the user chooses the information that should be shown in the report.

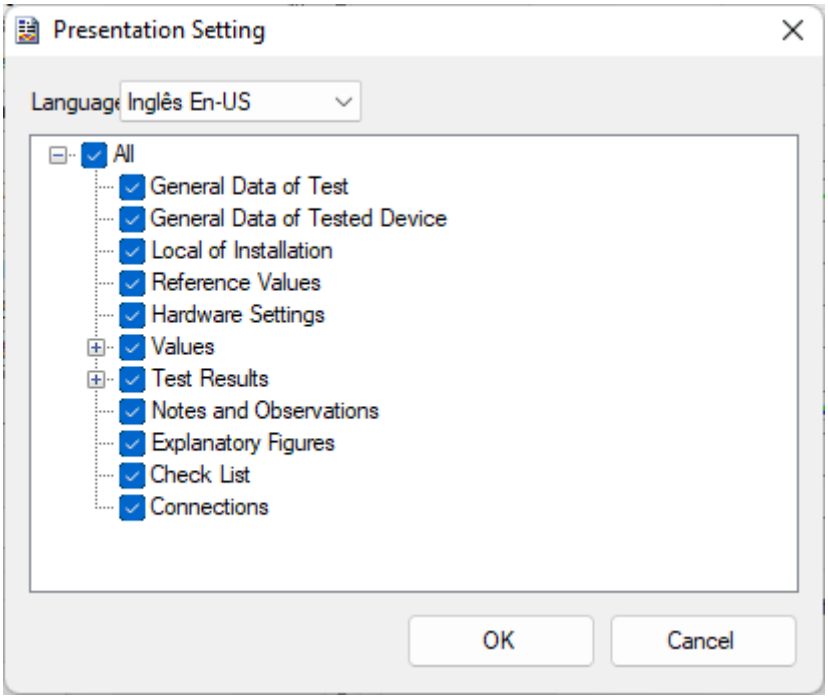

Figure 48

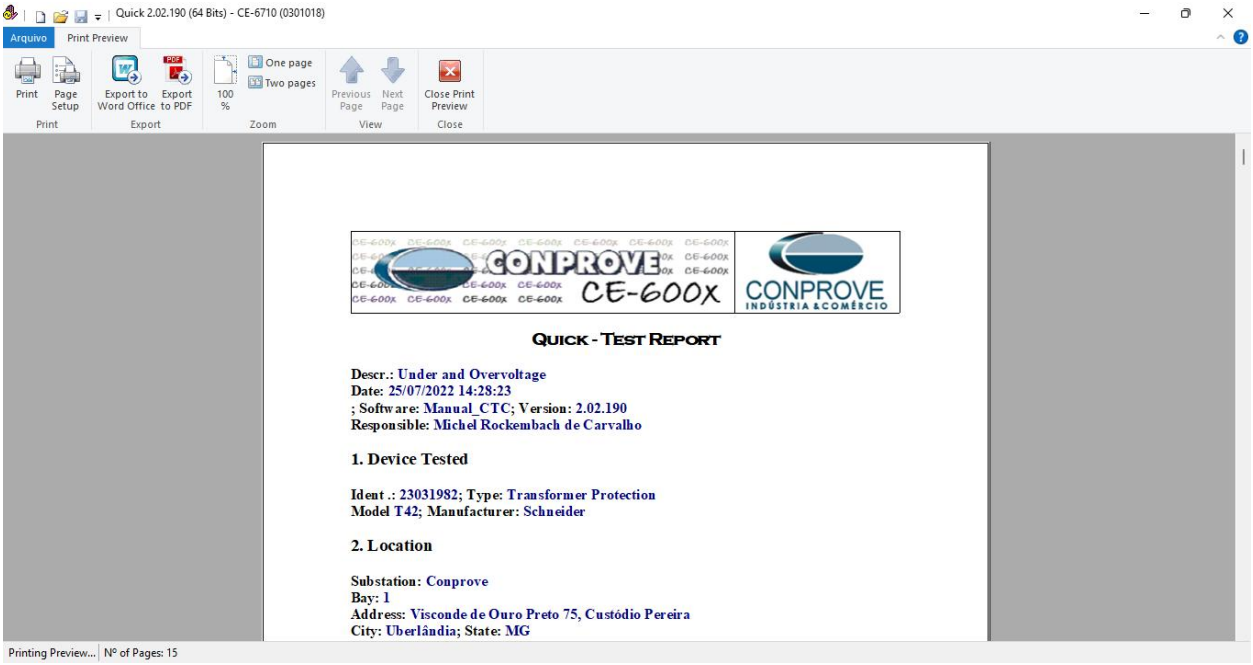

Figure 49

APPENDIX A

A.1 Terminal Designations

Installation

Base unit
Connection

Sepam components

■ base unit ①
□ Ⓐ base unit connector:
- power supply
- output relay
- CSH30, 120, 200 or ACE990 input.

Screw-type connector shown (CCA620), or ring lug connector (CCA622)
□ Ⓑ 1/5 CT A current input connector (CCA630 or CCA634) or LPCT current input connector (CCA670)
□ Ⓒ communication module link connection (green)
□ Ⓓ remote inter-module link connection (black)
□ Ⓔ voltage input connection, screw-type connector shown (CCA626) or ring lug connector (CCA627)
■ optional input/output module ② (MES114)
□ Ⓛ Ⓜ MES114 module connectors
□ Ⓚ MES114 module connector.

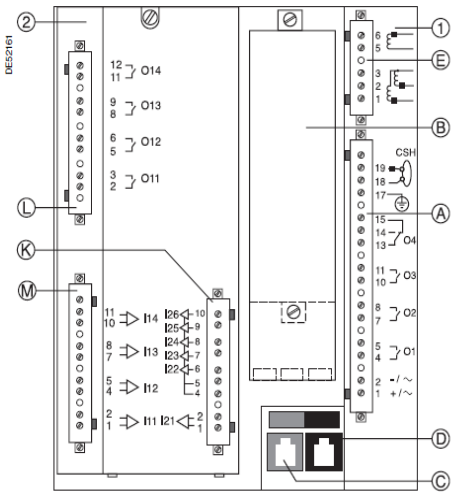

Figure 50

A.2 Technical data

Overvoltage

Characteristics

Settings	
Measurement Origin	
Setting range	Main channels (V_{LL}) / Additional channels (V_{LL}')
Voltage Mode	
Setting range	Phase-to-phase voltage / Phase-to-neutral voltage
V_{LL}s (or V_{Ln}s) Set Point	
Setting range	50% of V_{LL}p (or V_{Ln}p) to 150% of V_{LL}p (or V_{Ln}p)
Accuracy (1)	±2%
Resolution	1%
Drop out/pick up ratio	97% ±1%
Time Delay T	
Setting range	50 ms to 300 s
Accuracy (1)	±2% or ±25 ms
Resolution	10 ms or 1 digit
Characteristic Times	
Operation time	Pick-up < 40 ms from 0.9 V_{LL}s (V_{Ln}s) to 1.1 V_{LL}s (V_{Ln}s) (typically 25 ms)
Overshoot time	< 40 ms from 0.9 V_{LL}s (V_{Ln}s) to 1.1 V_{LL}s (V_{Ln}s)
Reset time	< 50 ms from 1.1 V_{LL}s (V_{Ln}s) to 0.9 V_{LL}s (V_{Ln}s)

Figure 51

Undervoltage

Characteristics

Settings	
Measurement Origin	
Setting range	Main channels (V_{LL}) / Additional channels (V_{LL}')
Voltage Mode	
Setting range	Phase-to-phase voltage / Phase-to-neutral voltage
Tripping Curve	
Setting range	Definite / IDMT
V_{LL}s (or V_{Ln}s) Set Point	
Setting range	5% of V_{LL}p (or V_{Ln}p) to 100% of V_{LL}p (or V_{Ln}p)
Accuracy (1)	±2% or ±0.005 V_{LL}p
Resolution	1%
Drop out/pick up ratio	103% ±2%
Time Delay T (Tripping Time for Zero Voltage)	
Setting range	50 ms to 300 s
Accuracy (1)	±2% or ±25 ms
Resolution	10 ms or 1 digit
Characteristic Times	
Operation time	Pick-up < 40 ms from 1.1 V_{LL}s (V_{Ln}s) to 0.9 V_{LL}s (V_{Ln}s) (typically 25 ms)
Overshoot time	< 40 ms from 1.1 V_{LL}s (V_{Ln}s) to 0.9 V_{LL}s (V_{Ln}s)
Reset time	< 50 ms from 0.9 V_{LL}s (V_{Ln}s) to 1.1 V_{LL}s (V_{Ln}s)

Figure 52

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 4

Quick Software		SEPAM T42 Relay	
Parameter	**Figure**	**Parameter**	**Figure**
Overvoltage			
Pkp_Inst.1	28	Voltage threshold	14
Pkp_Inst.2	28	Voltage threshold	14
t Expected	28	Delay	14
t Expected	28	Delay	14
Undervoltage			
Pkp_Inst.1	38	Voltage threshold	13
Pkp_Inst.2	38	Voltage threshold	13
t Expected	38	Delay	13
t Expected	38	Delay	13