INSTRUMENTOS PARA TESTES ELÉTRICOS

Test Tutorial

Equipment Type: Protection Relay

Brand: General Electric -GE

Model: D60

Function: 67 or PTOC - Directional Overcurrent

Tool Used: CE-6006; CE-6707; CE-6710; CE-7012 or CE-7024

Objective: Perform tests on the directional overcurrent function using the Overcurrent software to evaluate the directionality of the overcurrent function.

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial release	13/05/2022	M.R.C.	G.C.D.P.

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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

Sequence for testing the GE D60 relay in the Overcurrent software

1. Relay connection to CE-6710

Appendix A shows the relay terminal designations.

1.1 *Auxiliary Source*

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

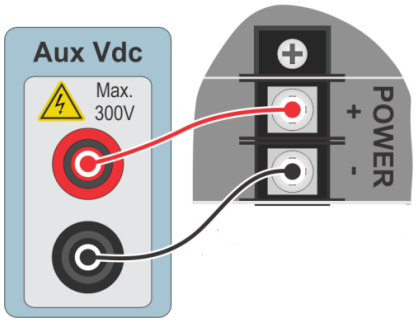

Figure 1

1.2 *Current and Voltage Coils*

To establish the connection of voltage coils, connect voltage channels V1, V2 and V3 to pins F5a, F6a and F7a of the relay and connect the commons of voltage channels to pins F5c, F6c and F7c of the relay. Connect the current channels I1, I2 and I3 of the CE-6710 to the relay pins F1a, F2a and F3a respectively, connect the three commons of the CE-6710 to the relay pins F1b, F2b and F3b, completing the connection.

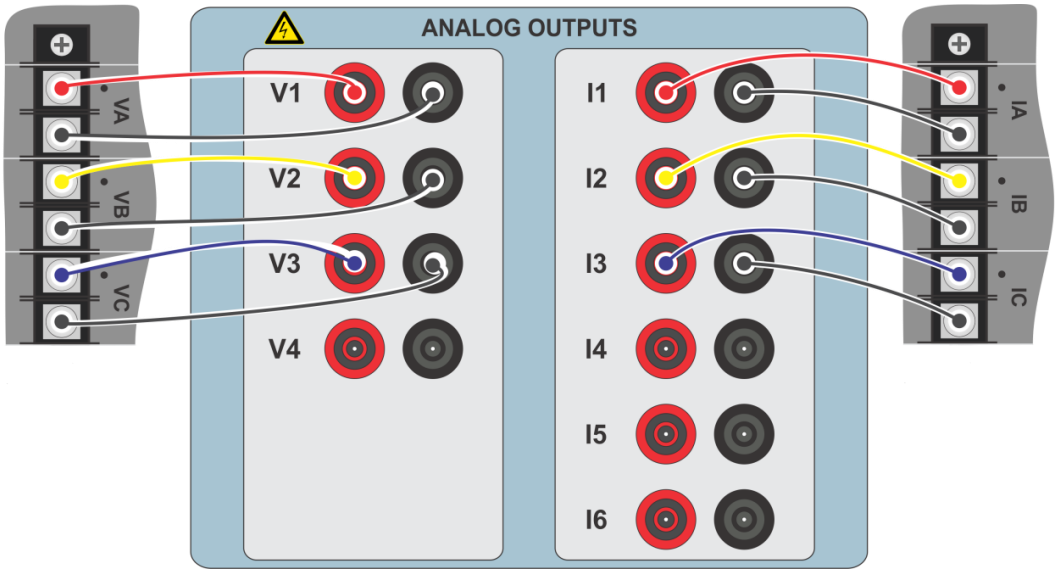

Figure 2

1.3 *Binary Inputs*

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

- BI1 to pin P1b and its common to pin P1c;

The following figure shows the details of the connection.

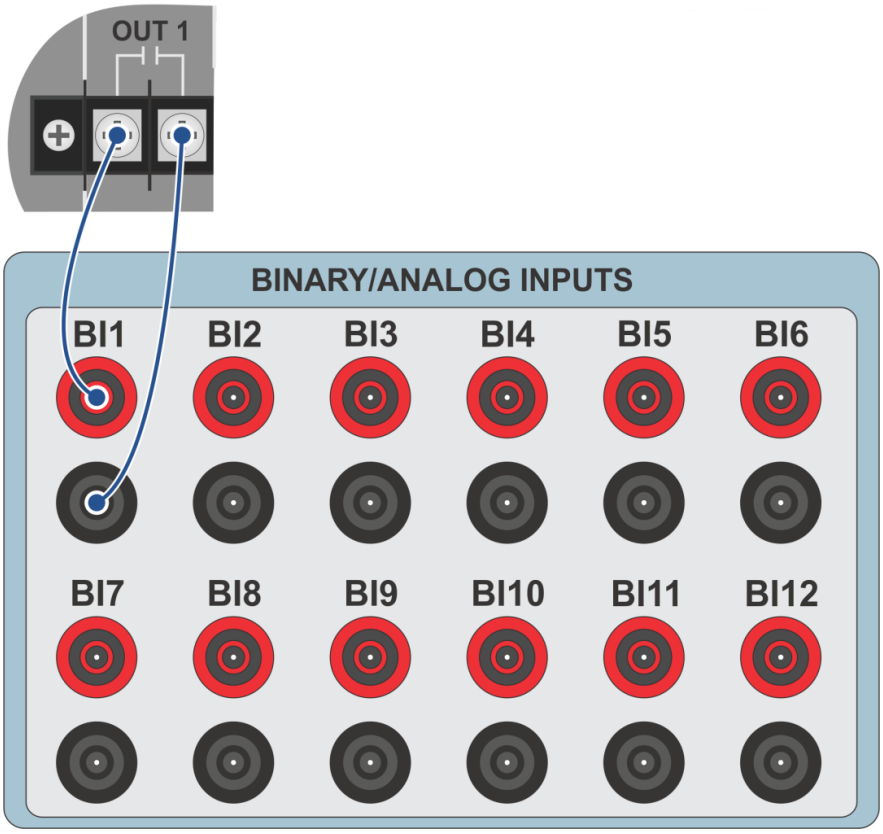

Figure 3

2. Communication with relay D60

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

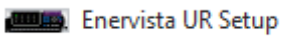

Figure 4

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

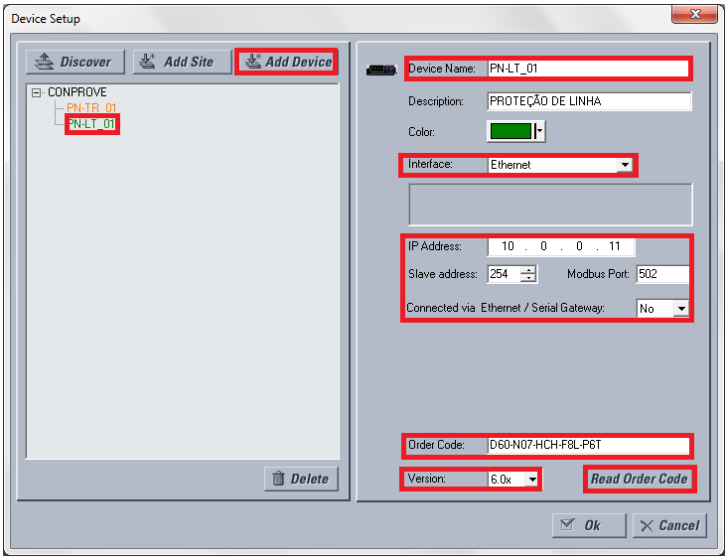

Figure 5

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

Figure 6

3. Parameterization of relay D60

3.1 *Current*

After the connection has been established, click on the *"+"* signs next to *"Settings"* > *"System Setup"* > *"AC Input"* and double-click on *"Current"*, in which adjust the primary and secondary current values of the current transformer.

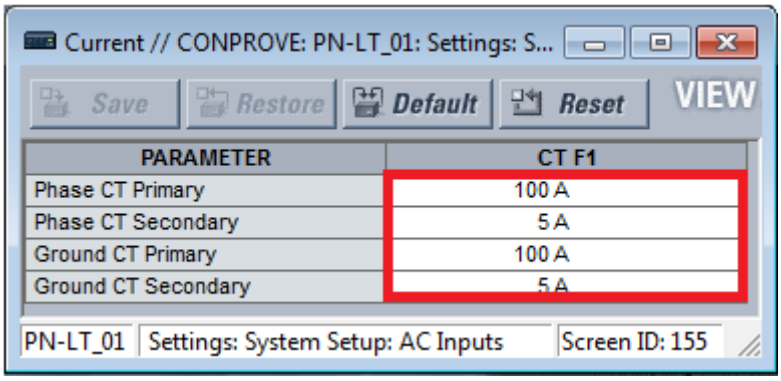

Figure 7

3.2 *Voltage*

Click on *"Voltage"* and adjust the voltage transformer primary and secondary voltage values.

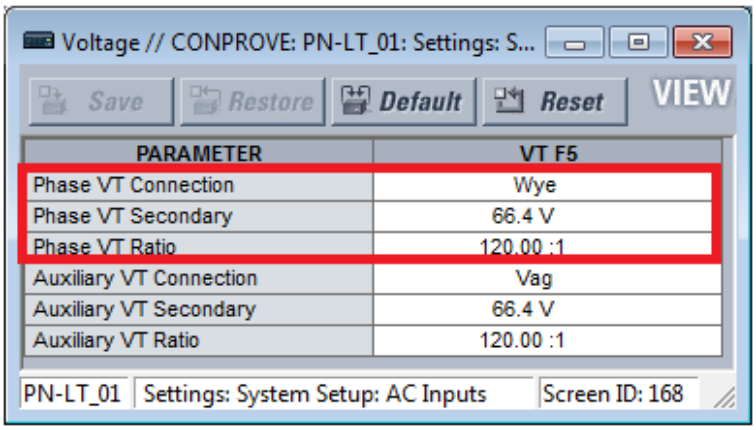

Figure 8

3.3 *Power system*

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

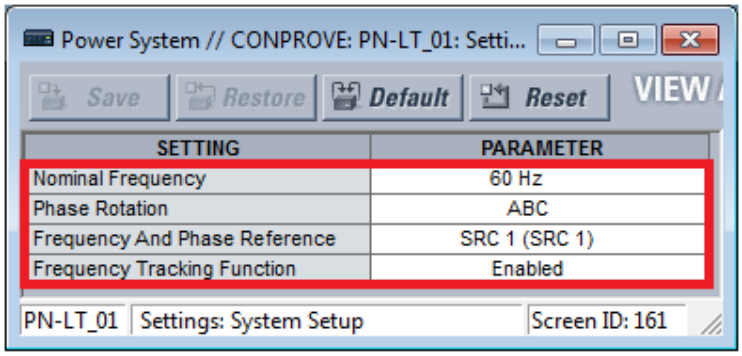

Figure 9

3.4 *Signal Source*

Set the current transformer as *"F1"* in *"Source 1"*.

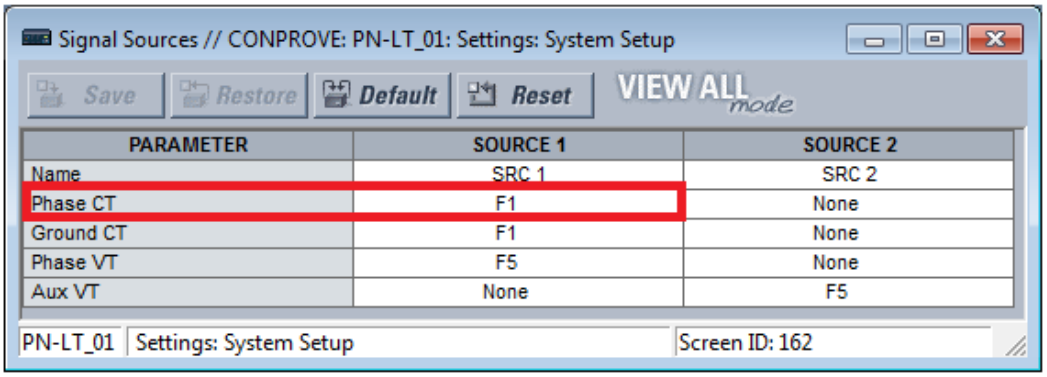

Figure 10

3.5 *Phase Directional*

Click the *"+"* sign next to *"Grouped Elements"* > *"Group1"* > *"Phase Current"* and double-click *"Phase Directional"*. In this option, the maximum torque angle is defined or in this case the *"ECA"* of the relay and the minimum value for polarization voltage.

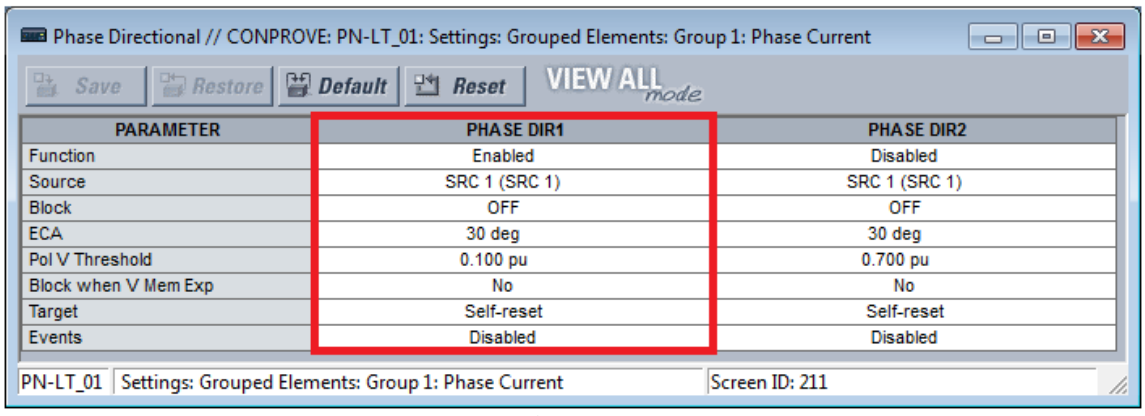

Figure 11

3.6 *Phase IOC*

In this tab, the pick-up values of the defined time elements are adjusted. Being possible to use up to 2 elements, in this test only one element is used with the following parameters.

Table 1

	Defined Time
Pick-up	10A
Delay	500ms

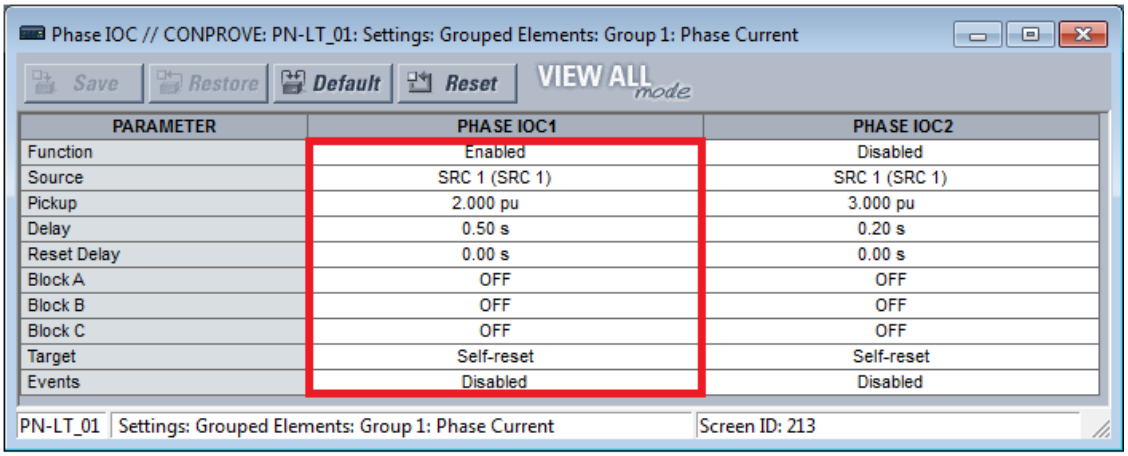

Figure 12

The following figure shows how the directionality is done.

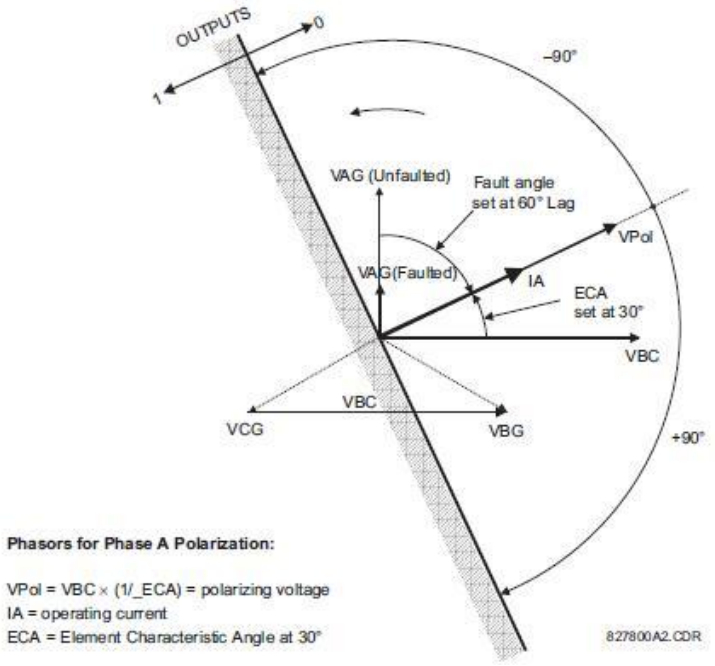

Figure 13

The polarization is done by voltage and obeys the following table:

Table 2

PHASE	OPERATING SIGNAL	POLARIZING SIGNAL V_{pol}	
		ABC PHASE SEQUENCE	ACB PHASE SEQUENCE
A	angle of IA	angle of VBC × (1∠ECA)	angle of VCB × (1∠ECA)
B	angle of IB	angle of VCA × (1∠ECA)	angle of VAC × 1∠ECA)
C	angle of IC	angle of VAB × (1∠ECA)	angle of VBA × (1∠ECA)

4. Binary Output Adjustments

4.1 *FlexLogic Equation Editor*

Click the *"+"* sign next to *"FlexLogic"* and double-click *"FlexLogic Equation Editor"*. On this screen, two logics are programmed. The first creates a *"NOT"* logic with the blocking element generated by the directionality. The second is an *"AND"* logic associating the *"NOT"* logic output with the trip of function 50.

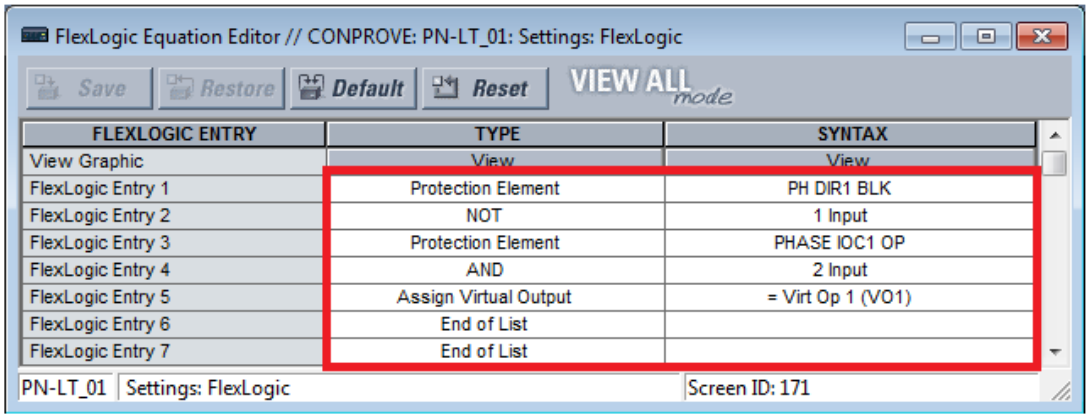

Figure 14

4.2 *Contact Outputs*

Click on the *"+"* sign next to *"Inputs/Outputs"* and double-click on *"Contact Outputs"*. On this screen, the trips of the virtual outputs are designated as the binary outputs of the relay.

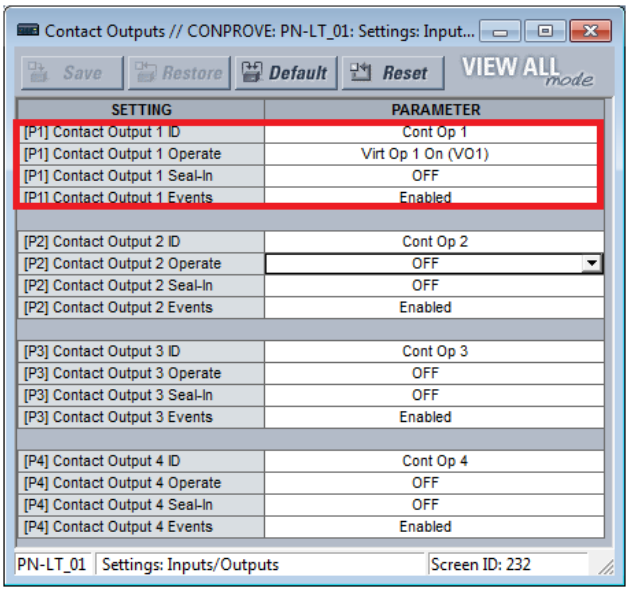

Figure 15

In appendix A the user finds an equivalence table between the relay software settings and the test case.

5. Overcurrent software adjustments

5.1 *Opening the Overcurrent*

Click on the *"Conprove Test Center"* application manager icon.

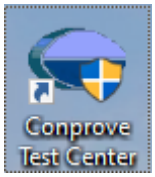

Figure 16

Click on the Overcurrent software icon.

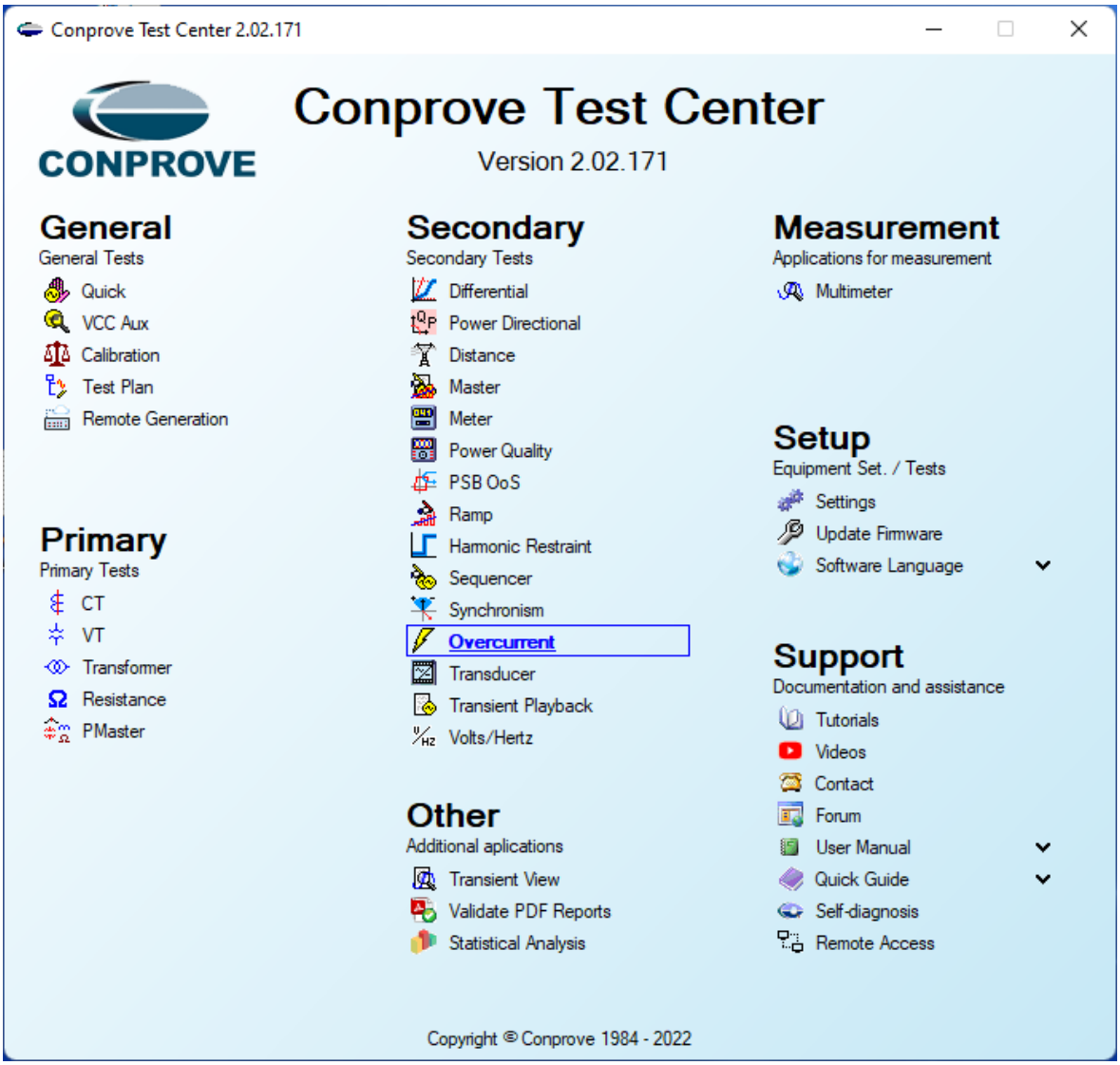

Figure 17

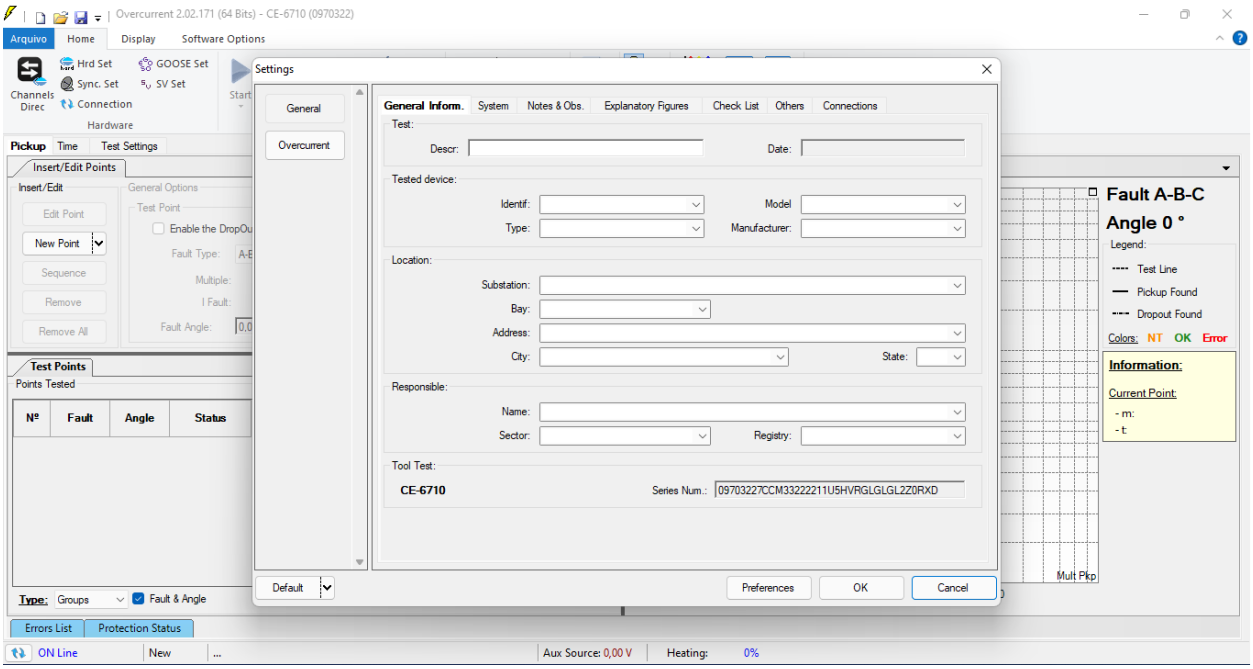

Figure 18

5.2 *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.

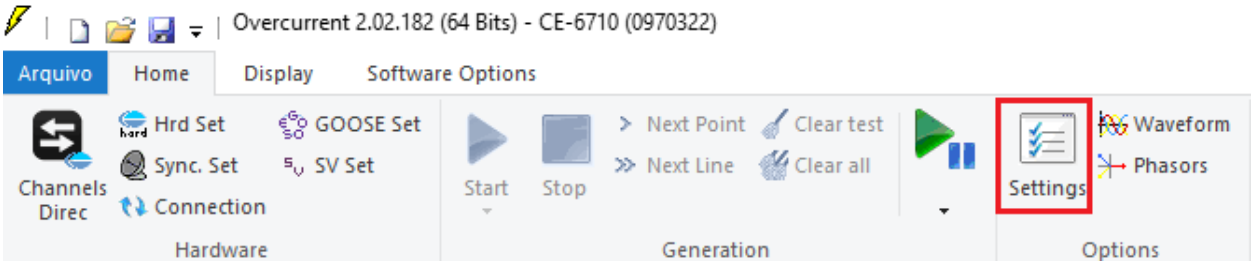

Figure 19

Inside the *"Settings"* screen, fill in the *"General Inform."* with details of the tested device, installation location and the person responsible. This makes reporting easier, as this tab will be the first to be shown.

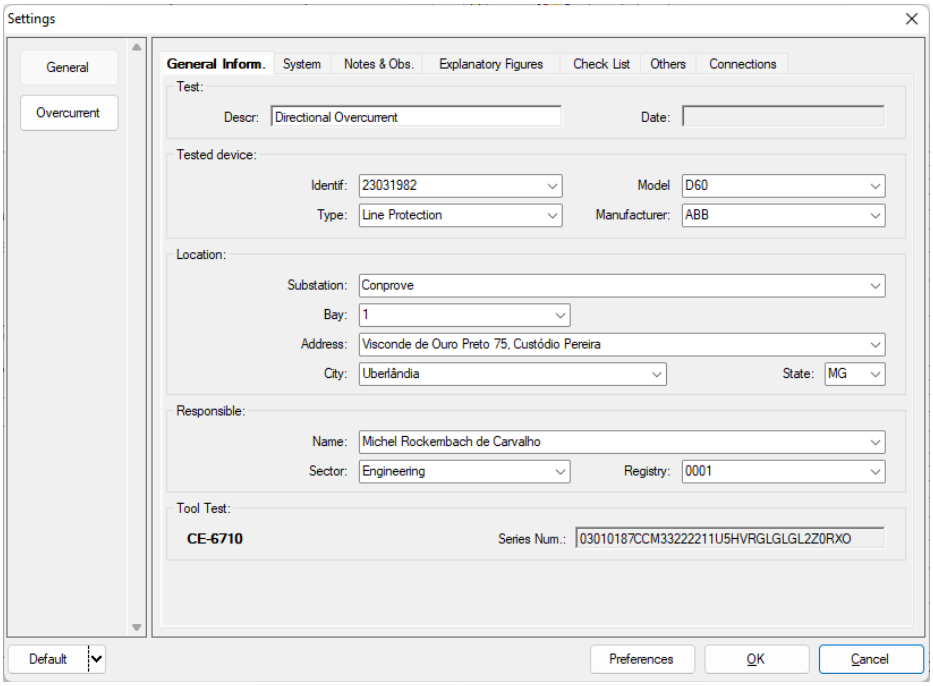

Figure 20

5.3 *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 are not relevant for this test.

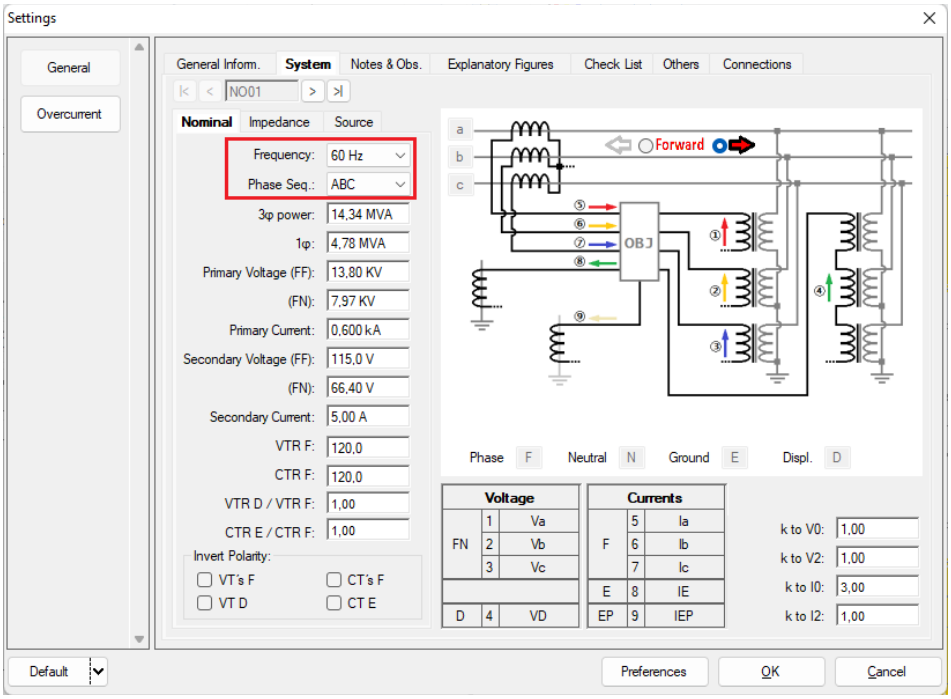

Figure 21

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

6. Directional Overcurrent Adjustment

6.1 *Overcurrent Screen > Definitions*

In this you must enable the directionality, the curves display mode, the scale used and the time, current and angle tolerances. These tolerances should be taken from the relay manufacturer's manual (Appendix A).

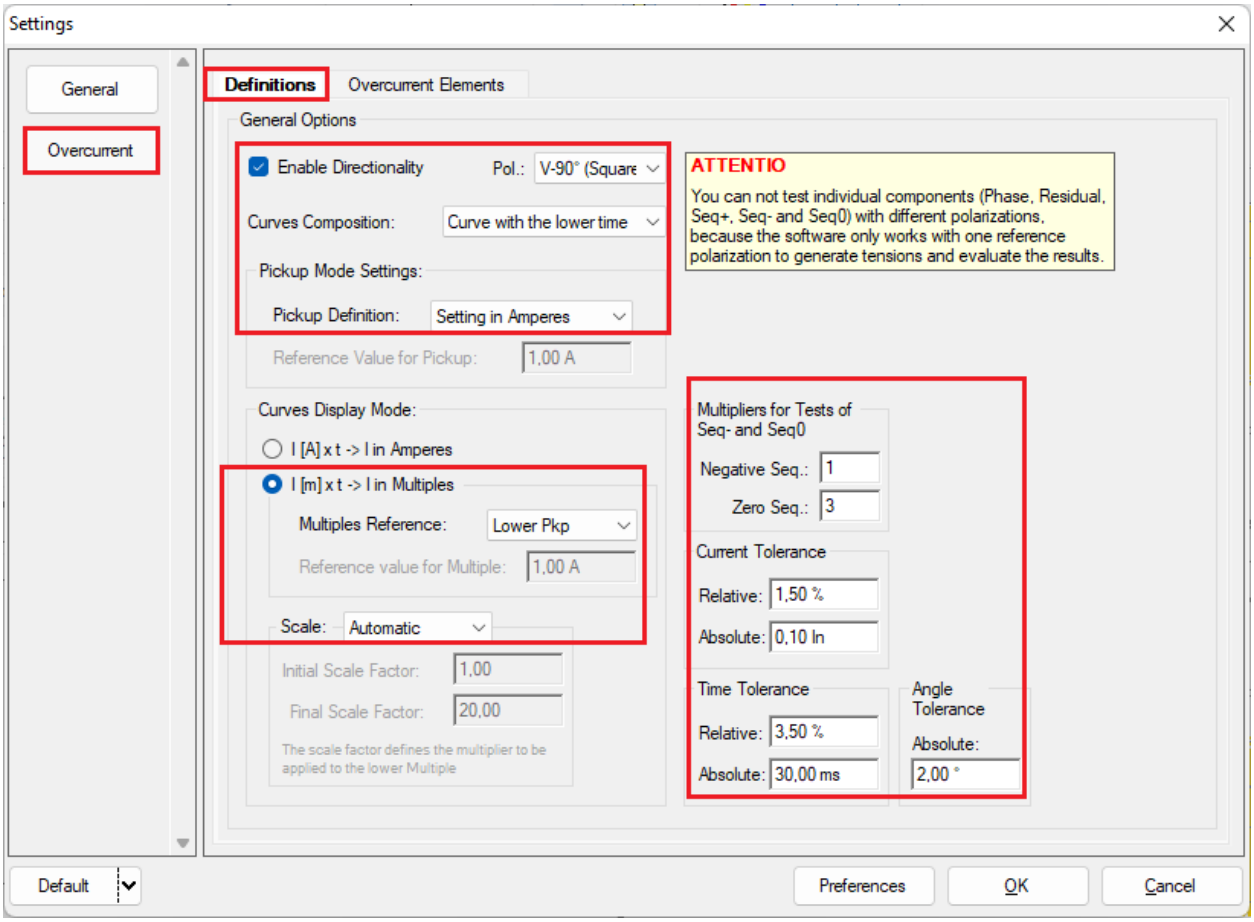

Figure 22

6.2 *Overcurrent Screen > Overcurrent Elements > Phase*

Here the overcurrent element must be configured. To do this, click on *"Phase"* and click once on the highlighted icon.

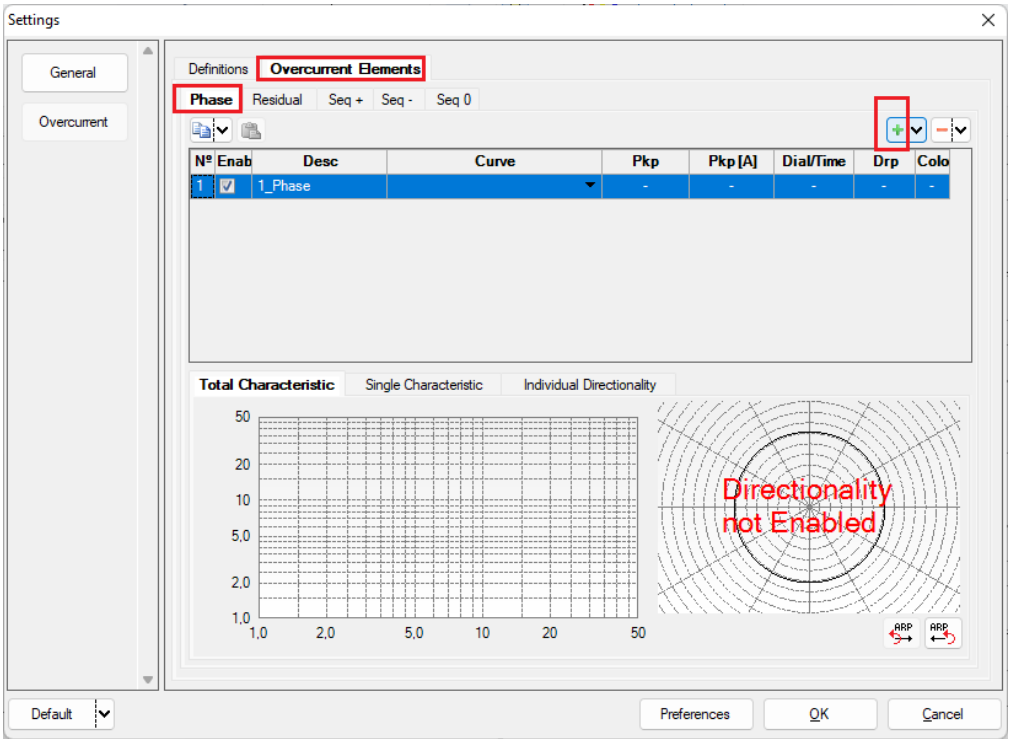

Figure 23

For the element choose the type of curve equal to defined time, pickup value equal to 10.0A, time to 0.5 seconds and dropout factor equal to 0.95.

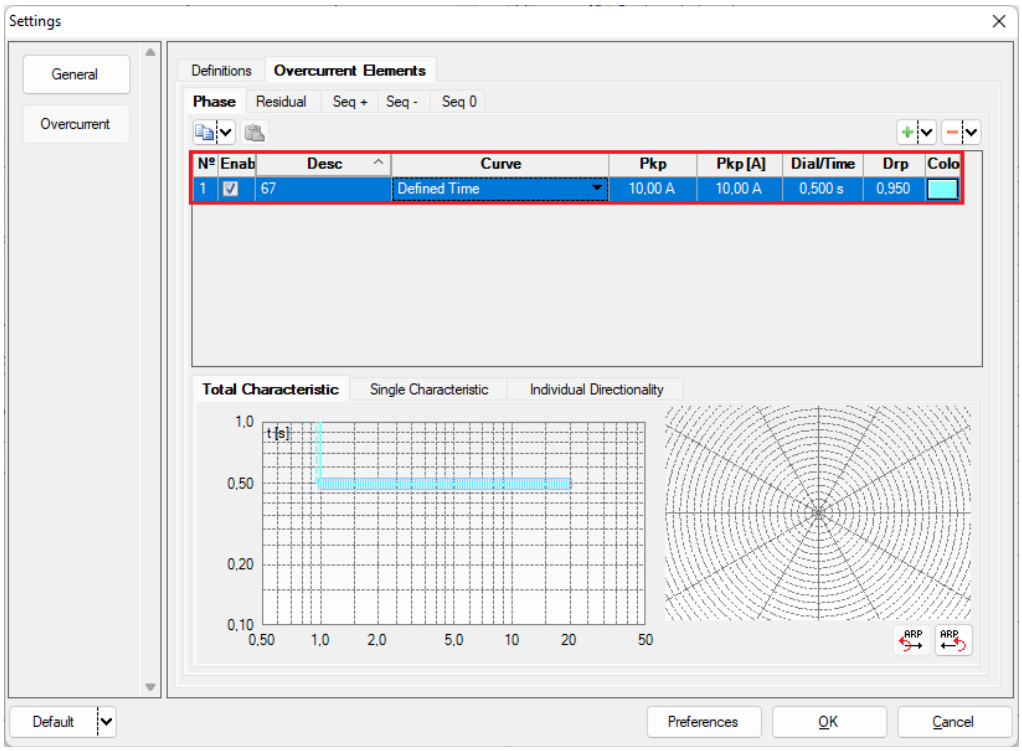

Figure 24

Choose the *"Individual Directionality"* tab and set the *"Forward"* option, the maximum torque angle (ATM) must be set to 30°. Set the minimum voltage value to 6.64V and the angles as 90° and – 90°.

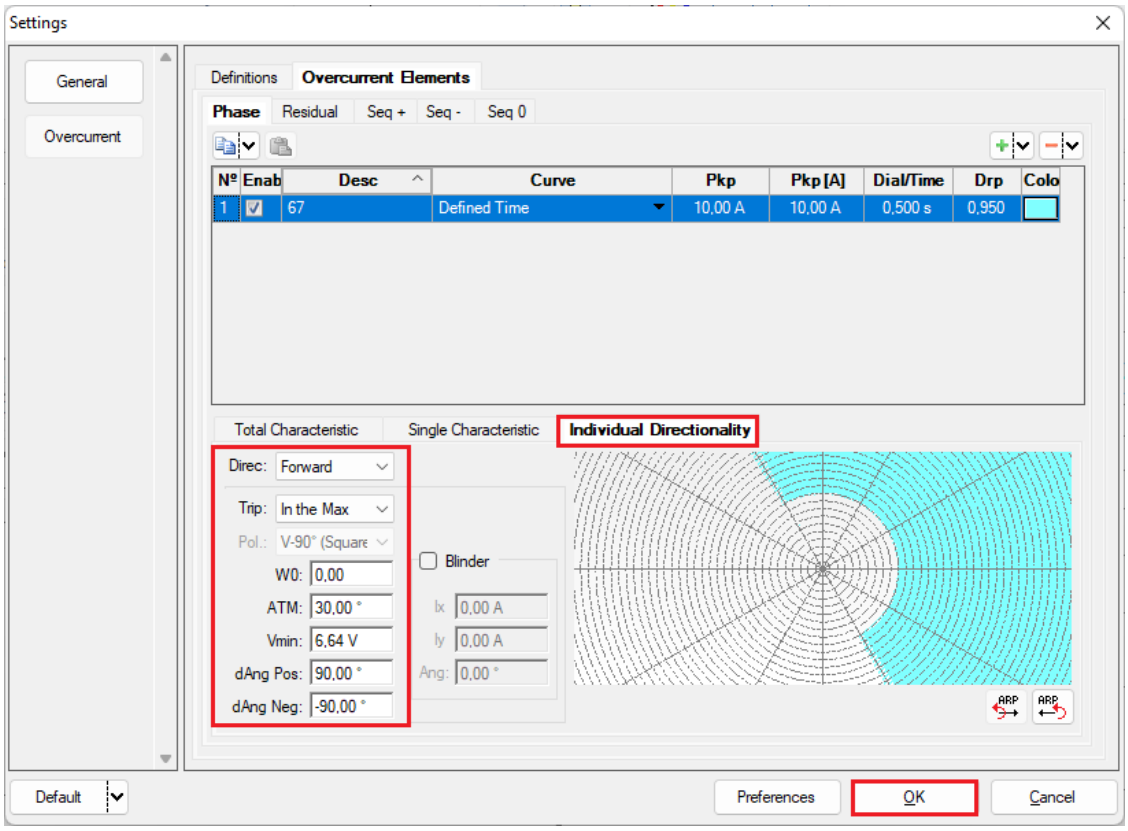

Figure 25

7. Channel Direction and Hardware Configurations

Click on the icon illustrated below.

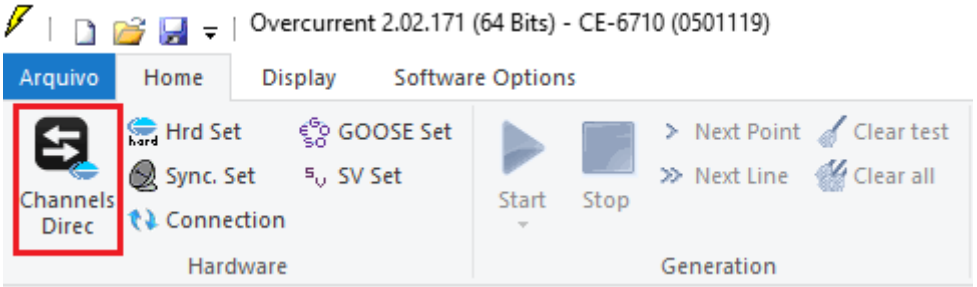

Figure 26

Then click on the highlighted icon to configure the hardware.

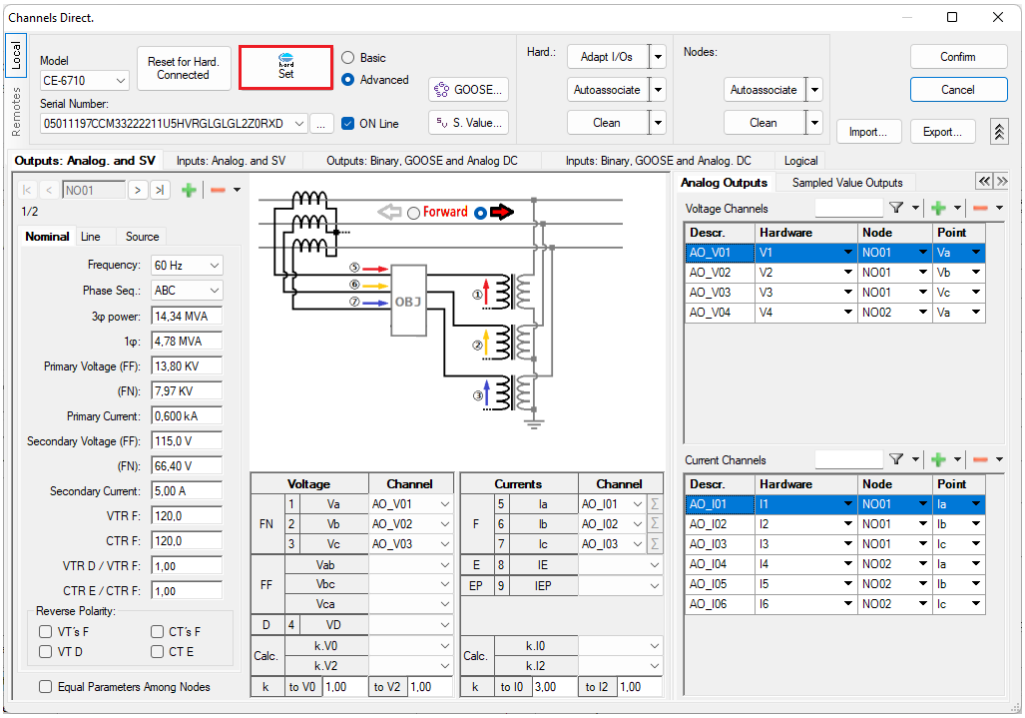

Figure 27

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

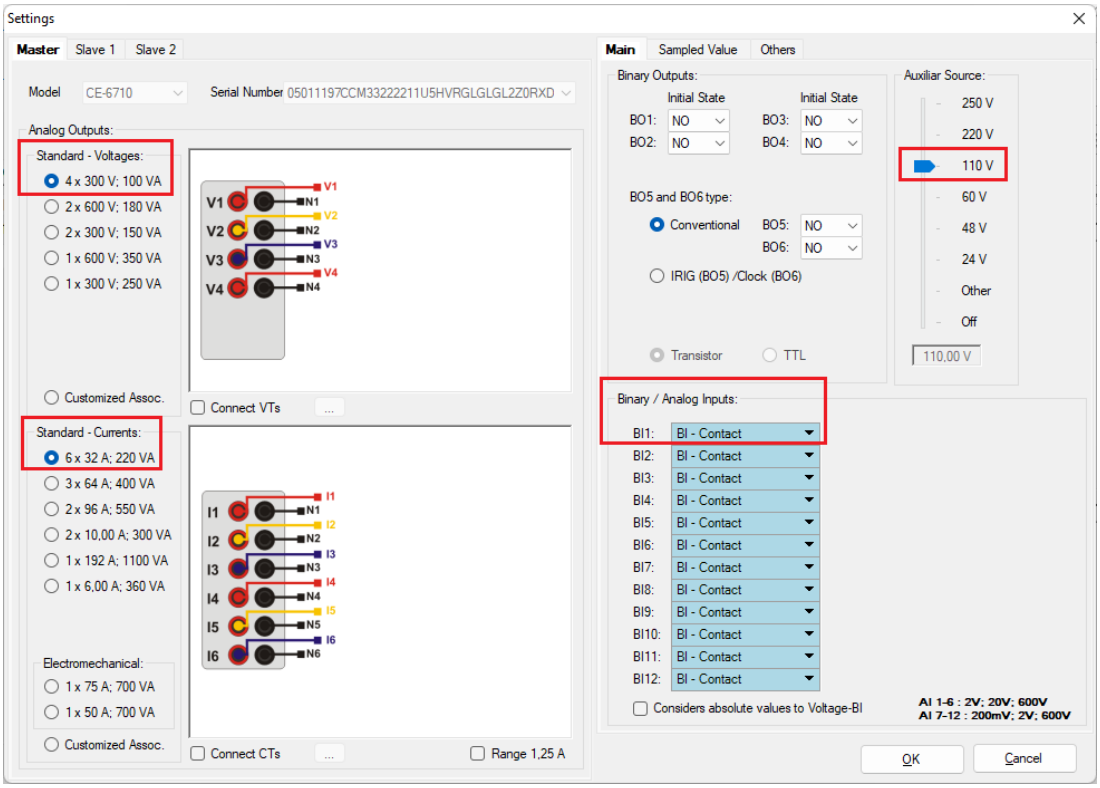

Figure 28

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

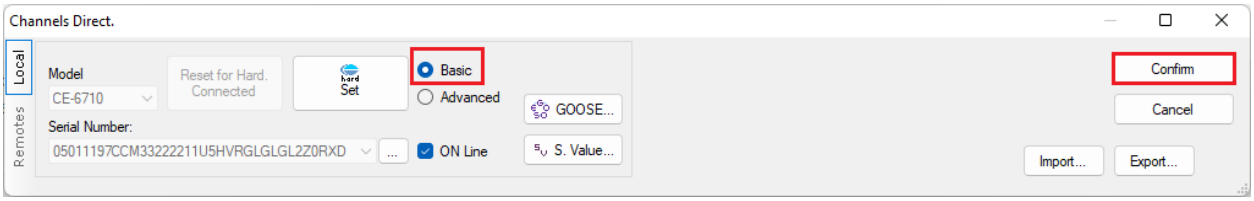

Figure 29

8. Test structure for function 67

8.1 *Test Settings*

On this tab you must configure the pickup and trip signals with the binary inputs. If necessary, it is possible to enable up to two pre-fault conditions and one post-fault condition. The only test that will be performed is the time test and consequently the directionality test.

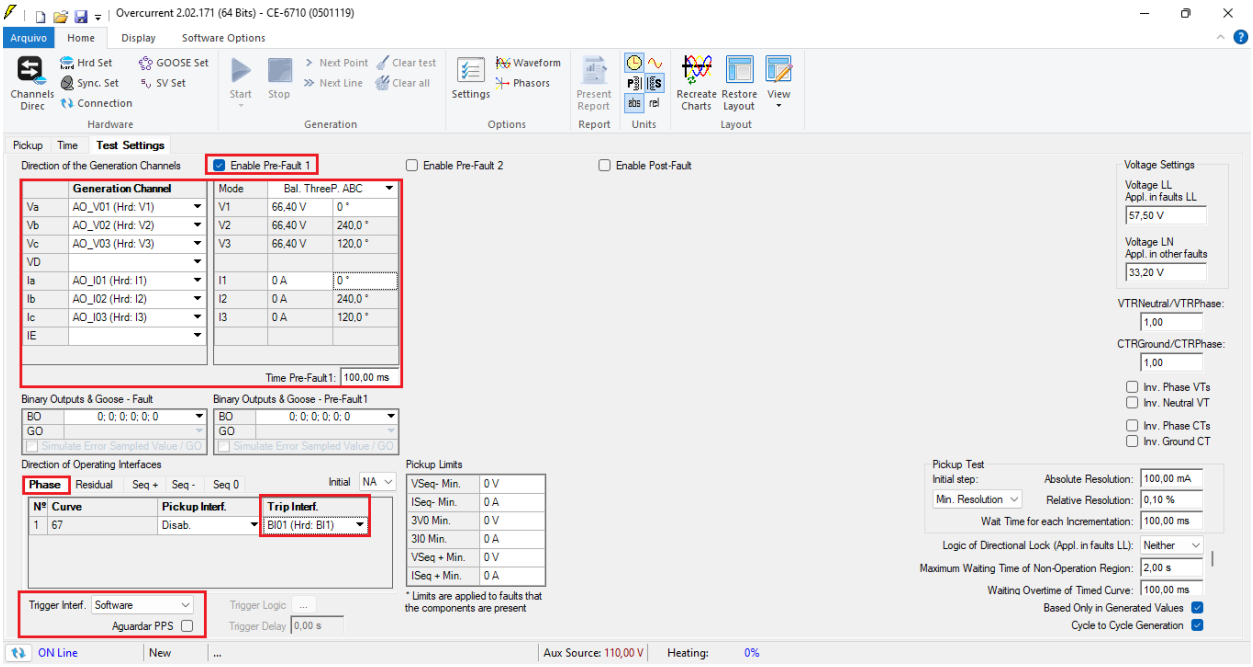

Figure 30

8.2 *Time Screen*

In this tab, the operating time and directionality are evaluated. For convenience, a sequence of values will be inserted. The value 15.00A was chosen as the initial value, 15.00A as the final value and 1.0A as the increment step and the AE, BE, CE and

ABC fault. In the angles choose 0.0° as initial value, for the step chooses 35° and final value chooses 360.0°. Choose the *"Directionality"* tab.

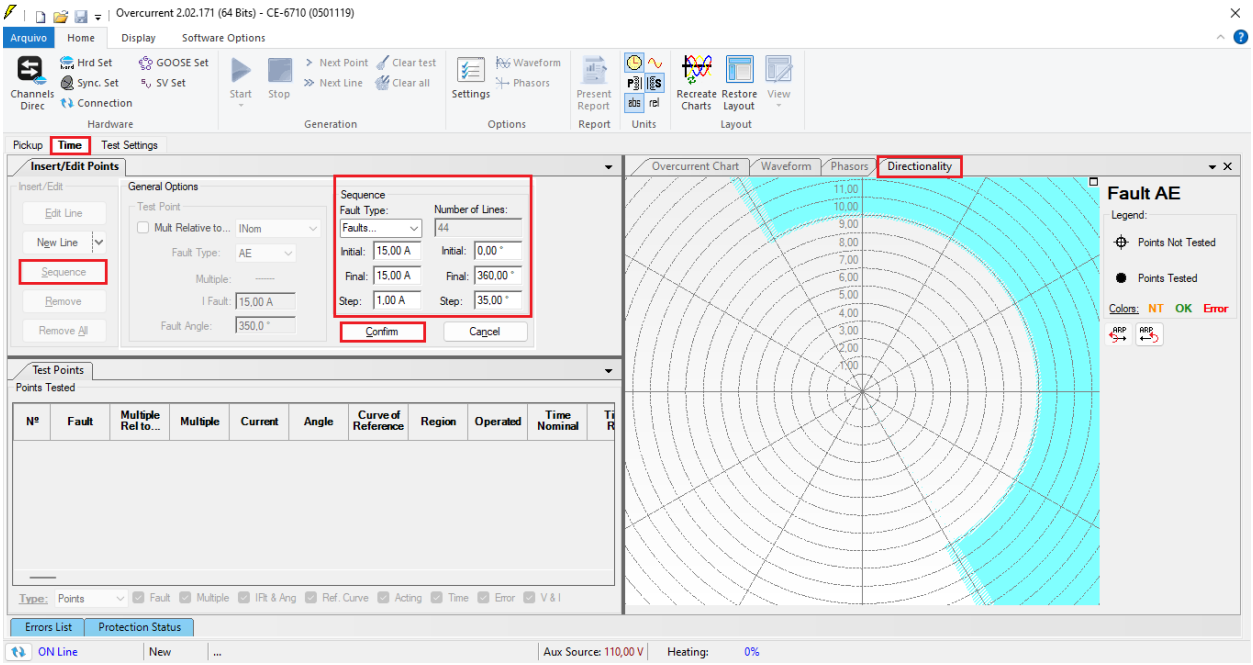

Figure 31

Start the generation by clicking on the icon highlighted below or using the command *"Alt +G"*.

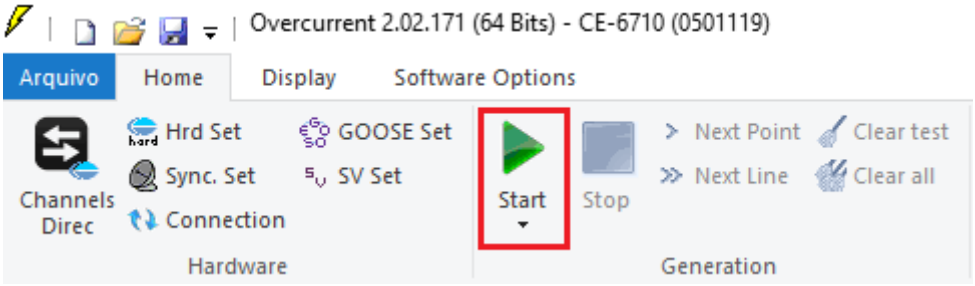

Figure 32

8.3 *Final Result of the Time Test*

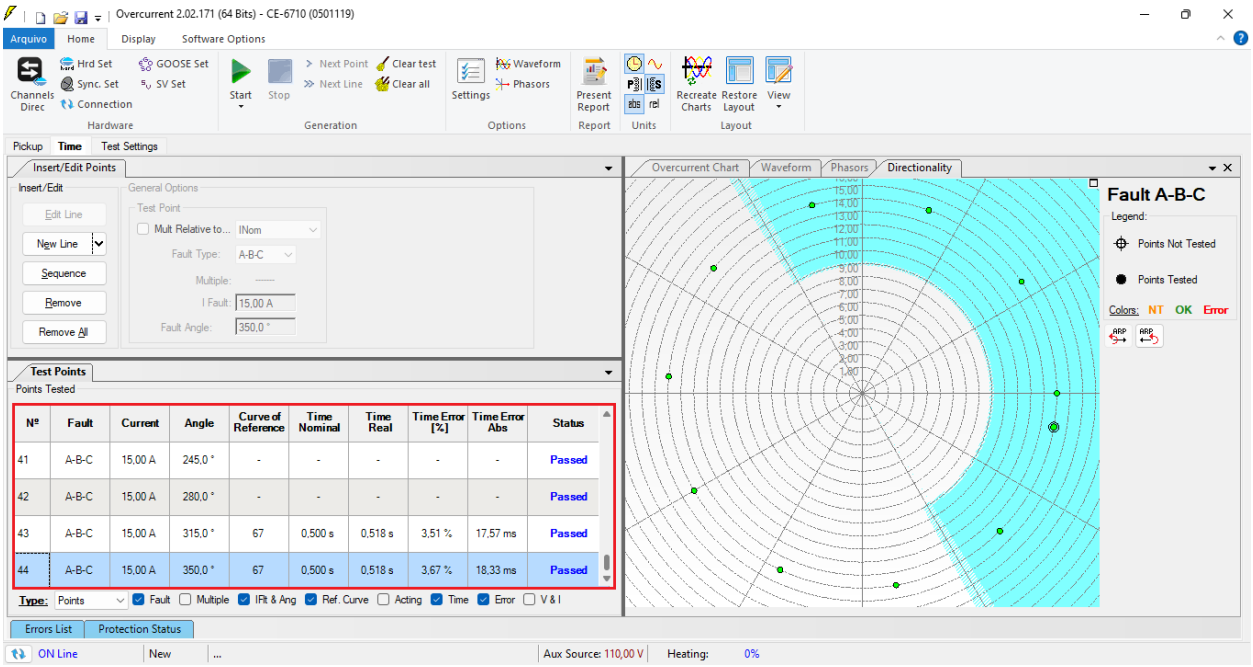

Figure 33

It is verified that all points in the operating region acted with times within the tolerance given by the relay manufacturer.

9. Report

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

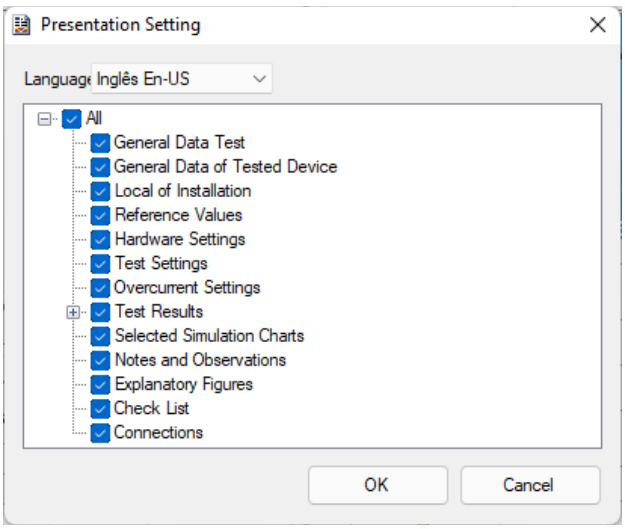

Figure 34

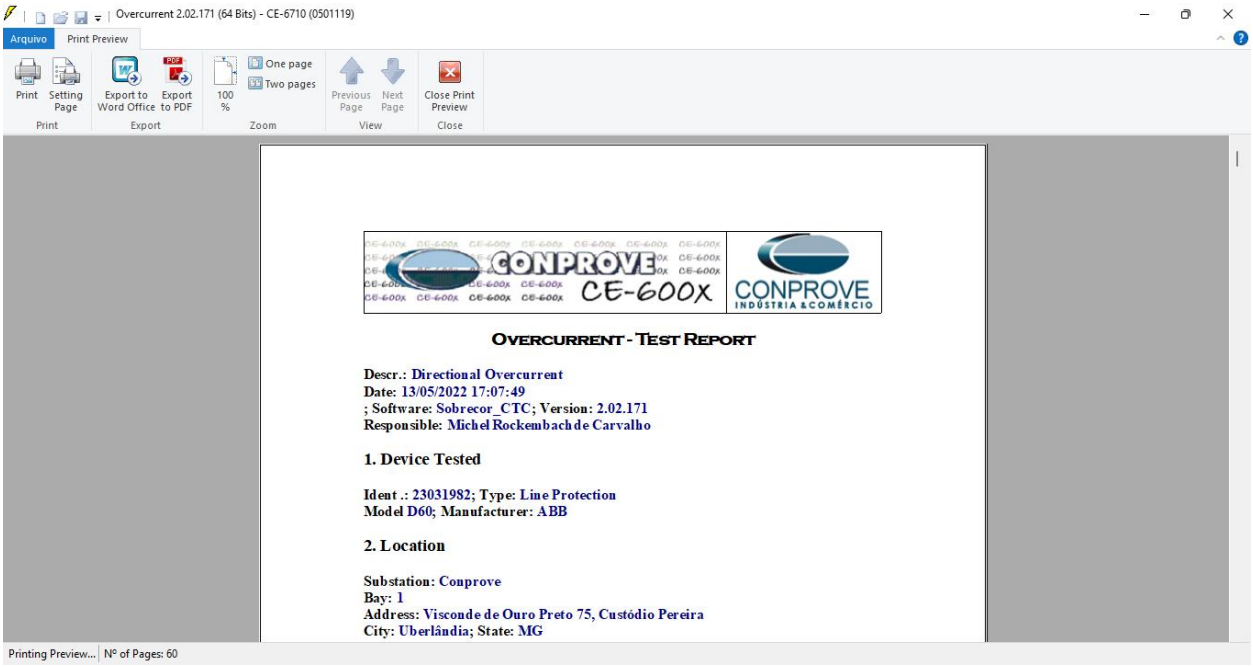
Overcurrent 2.02.171 (64 Bits) - CE-6710 (0501119)
Arquivo
Print Preview
Print
Setting Page
Export to Word Office
Export to PDF
100 %
One page
Two pages
Previous Page
Next Page
Close Print Preview
Zoom
View
Close
CONPROVE
CE-600X
CONPROVE INDÚSTRIA & COMÉRCIO
OVERCURRENT - TEST REPORT
Descr.: Directional Overcurrent
Date: 13/05/2022 17:07:49
; Software: Sobrecor_CTC; Version: 2.02.171
Responsible: Michel Rockembach de Carvalho
1. Device Tested
Ident .: 23031982; Type: Line Protection
Model D60; Manufacturer: ABB
2. Location
Substation: Conprove
Bay: 1
Address: Visconde de Ouro Preto 75, Custódio Pereira
City: Uberlândia; State: MG
Printing Preview... | Nº of Pages: 60

Figure 35

APPENDIX A

A.1 Terminal Designations

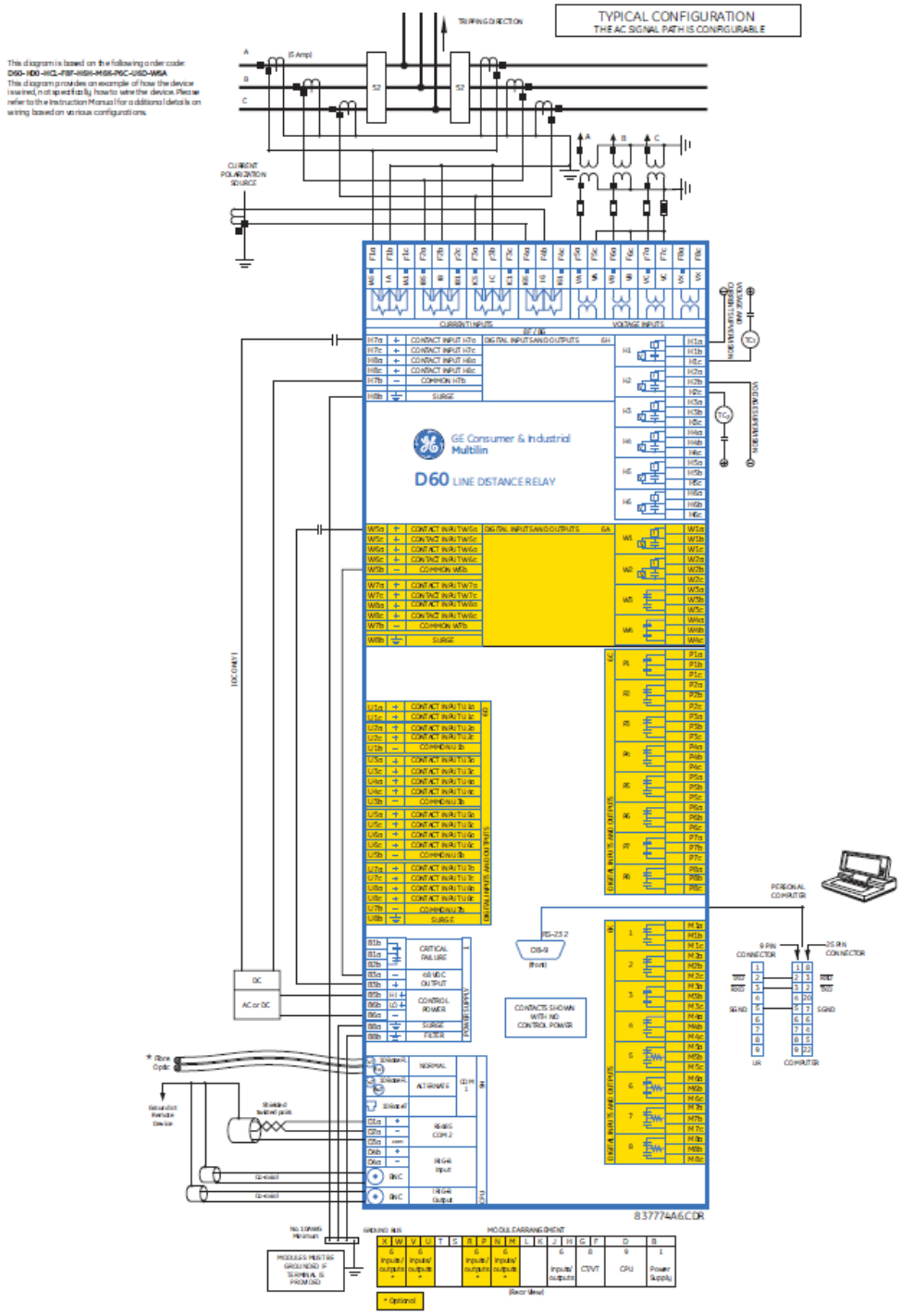

Figure 3–12: TYPICAL WIRING DIAGRAM

Figure 36

A.2 Technical Data

PHASE/NEUTRAL/GROUND IOC

Pickup level:	0.020 to 30.000 pu in steps of 0.001 (standard CT for ground) 0.002 to 3.000 pu in steps of 0.001 (sensitive ground CT) 0.005 to 30.000 pu in steps of 0.001 (Process Bus Module, ground)
Dropout level:	97% of pickup
Level accuracy:	
0.1 to 2.0 × CT rating:	±0.5% of reading or ±0.4% of rated (whichever is greater)
> 2.0 × CT rating:	±1.5% of reading
Overreach:	<2%
Pickup delay:	0.00 to 600.00 s in steps of 0.01
Reset delay:	0.00 to 600.00 s in steps of 0.01
Operate time:	<16 ms at 3 × pickup at 60 Hz (Phase IOC) (see NOTE 1) <20 ms at 3 × pickup at 60 Hz (Neutral IOC) (see NOTE 1) <25 ms at 3 x pickup at 60 Hz (Ground IOC) (see NOTE 1)
Timer accuracy:	±3.5% of operate time or ±1/4 cycle (whichever is greater)

PHASE DIRECTIONAL OVERCURRENT

Relay connection:	90° (quadrature)
Quadrature voltage:	ABC phase seq.: phase A (V_{BC}), phase B (V_{CA}), phase C (V_{AB}); ACB phase seq.: phase A (V_{CB}), phase B (V_{AC}), phase C (V_{BA})
Polarizing voltage threshold:	0.004 to 3.000 pu in steps of 0.001
Current sensitivity threshold:	0.05 pu
Characteristic angle:	0 to 359° in steps of 1
Angle accuracy:	±2°
Operation time (FlexLogic operands):	
Tripping (reverse load, forward fault):	<12 ms, typically (see NOTE 1)
Blocking (forward load, reverse fault):	<8 ms, typically (see NOTE 1)

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 3

Overcurrent Software		D60 Relay	
Parameter	**Figure**	**Parameter**	**Figure**
Pkp	24	Pickup	12
Dial/Time	24	Delay	12
ATM	25	ECA	11
Vmin	25	Pol V Threshold	11