

INSTRUMENTOS PARA TESTES ELÉTRICOS Test Tutorial

Equipment Type: Protection Relay

Brand: Siemens

Model: <u>7UT61</u>

Function: 87 or PDIF Differential Protection

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

Objective: <u>Test Settings, Testing Point and Survey of</u> <u>Feature Slope</u>

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial release	10/08/2021	M.R.C.	M.P.S



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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 tested should always be consulted.



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 tested and also be aware of safety standards and regulations.

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INSTRUMENTOS PARA TESTES ELÉTRICOS Sequence for 7UT61 relay tests in DIFFERENTIAL software

1. Relay connection to CE-6006

Appendix A shows the relay terminal designations.

1.1 Auxiliary Source

Connect the positive (red terminal) of the Vdc Aux. Source to pin F1 (UH+) of the relay and the negative (black terminal) of the Vdc Aux. Source to pin F2 (UH-) of the relay.



1.2 Current Coils

Connect the I1, I2 and I3 current channels of the CE-6006 to pins Q1, Q3 and Q5 of the relay respectively, if the commons of the relay are short circuited, just connect the commons of the channels to that point, otherwise connect the three common CE-6006 to pins Q2, Q4 and Q6 relay then forming the winding dial 1. Likewise, to establish the winding 2 connection, connect I4, I5 and I6 current channels to relay pins R1, R3 and R5 respectively, connecting the common three to pins R2, R4 and R6.



Rua Visconde de Ouro Preto, 77 - Bairro Custódio Pereira - Uberlândia – MG - CEP 38405-202.
Fone (34) 3218-6800Fone (34) 3218-6800Fax (34) 3218-6810Home Page: www.conprove.com.br-E-mail: conprove@conprove.com.br



1.3 Binary Input

Connect the binary input of the CE-6006 to the binary output relay.

• BI1 to pin P1 and its common to pin P5;



2. Communication with 7UT61 relay

First open the "*DIGSI*" and connect an Ethernet cable (or serial) from the notebook with the relay. Then double click on the software icon.



When opening the program, the substation that contains the relay is selected (7UT61). After selecting the relay, click the right button and select the "*Open Object*" and then select the connection mode, as is shown in s following figures.





0	pen device		\times
	Connection type	Connection properties	
	C Offline	No settings required for this connection type.	
	C Direct		
	C USB		
	C Modem connection		
	C PROFIBUS FMS		
	 Ethernet 		
	OK	Cancel Help	
		Figure 6	

3. Tested System Data

Transformer, CT and differential function data are in the following tables:

3.1 Protected Equipment Data / CT's

Table 1	
General data	Values
Number of Windings	two
Protected Equipment	Transformer
Primary Voltage (Side 1)	110 kV
Primary Power (Side 1)	38.1 MVA
Secondary Voltage (Side 2)	11 kV
Secondary Power (Side 2)	38.1 MVA
Connection (Side 1)	Δ
Connection (Side 2)	Y
Vector Group	1
RTC 1	200/1
RTC 2	2000/1

3.2 Protection Data

Table 2

General data	Values
Differential Pickup (87-1)	0.3 In
Differential Time	0 s *
Snapshot Pickup (87-2)	7 In
Snapshot Time	0 s *
Base Point 1	0
Base Point 2	5
slope 1	30%
slope 2	60%

*Theoretical value varies in practice between 20 ms to 50 ms depending on the relay.



4. Parameterization of the relay 7UT61

4.1 Device Configuration

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



In the *"Functional Scope"* screen, disable all functions leaving only the *"87 Differential Protection"* function enabled. This does testing easier as it prevents the use of the trip signal from other functions. After the adjustments click *"OK"*.

No.	Function	Scope
0103	Setting Group Change Option	Disabled
0105	Protection Object	3 phase Transformer
0112	87 Differential Protection	Enabled
0117	Cold Load Pickup	Disabled
0120	50/51	Disabled
0122	50N/51N	Disabled
0124	50G/51G	Disabled
0142	49 Thermal Overload Protection	Disabled
0180	Disconnect measurment location	Disabled
0181	Measured Values Supervision	Enabled
0186	External Trip Function 1	Disabled
0187	External Trip Function 2	Disabled
		About





4.2 Masking I/O

The next step is to adjust the binary outputs of the relay. To access these parameters, double-click with the left button on "Masking I/O (Configuration Matrix)" as illustrated in the next figure.



The trip signal from function 87 will be routed to output binary "BO1" of the relay. To facilitate the monitoring of this test, led 1 was designated for this function. The option "U" must be used, which means "Unlatched", that is, the relay activates and when the problem ceases, it automatically returns to the initial binary state. If the user chooses the "L" or "Latched" option, the relay activates and remains activated even if the problem has been extinguished. (This option is not suitable for testing).

🎸 DIGSI - [Setting	s - Masking I/	O (Configuration M	atrix)	- Carva	lho	/ Fo	lde	er /	701	F61	3 V	/4.6	/7	JT6	131	V04	. 60	.06]											-	
Eile Edit Insert	Device View	Options Window He	lp																												- 6 :
🖬 🎒 🐰 🖻 👔	2 🕼 📩 🎘	🛯 暮 🅈 Indication	ns and	l comman	ds	only	_		•	Co	onfig	gure	d te	o BI,	BO	, or	LED)	_		_	_	_] [1	0	()1	1	?
		Information	11-2		1		So	urce	1												De	estin	atior	1			- 				1
	Number	Display text	1	Туре		В	II.		F	S (BO	1							LE	Ds	~				В	S	XC	CM
					1	2 3	3 4	5			1	2	3	4 5	6	7	8 1	2	3	4 5	5 6	7	8	9 10	0 11	12 13 1	4 0	T			
Device, General							1		,	¢ ×	対応						i i										×		×	×	
P.System Data 1														2.10							1		2 10				×				
Osc. Fault Rec.				8																	1						×		×		
P.System Data 2				14					×	×																	×	×	×	×	
87 Diff. Prot	05671	87 TRIP		OUT							U						U														
Measurem.Superv						1 1								1													×				
Supervision																											×		×		
Ext. Tansf.Ann.																											×				
EN100-Modul 1																											ж				
Cntrl Authority									2					2.10							1		2 10				×		×		
Control Device				8					,	<											1						×		×	×	×
Measurement																															
Meas. Dif/Rest.									_																						
ThreshSwitch																											×				
Set Points(MV)				L)																											
Energy																															
Statistics																											ж		×	1	
SetPoint(Stat)																											*				
ress F1 for Help.				8					7	UT6	13	V04.	60.1	06	Or	nline	CON	41	18	3598	50				ŤП	000)7			NUM	





4.3 Power System Data 1

Continuing the settings, double-click on "Power System Data 1".



In the tab "CT-Number" the number of transformer windings is configured.

	rstem Data 1				D
CT-Num	pers CT-Assign Power System Transf. NotA	ssigMeasLoc Fi	unct. CT's	CB	
<u>S</u> ettings	:				
No.	Settings			Value	
0211	Number of connected Measuring Locations				2 🕶
0212	Number of assigned Measuring Locations		1		2
0213	Number of Sides				2
pig V	lay additional settings				
Dist	lay additional settings				
pist	lay additional settings	Export		Graph	About

Figure 12

4.4 CT-Assign

In this tab you can insert how the auxiliary current transformers are connected. In this example, auxiliary CTs are not used.



	Settings	Value
0220	Assignment at 2 assig.Meas.Loc./ 2 Sides	S1:M1, S2:M2
0251	Auxiliary CT IX1 is used as	Not connecte
0252	Auxiliary CT IX2 is used as	Not connecte
0233	Auxiliary CT IAb Is used as Tune of auxiliary CT IV3	1 A /S A current incu
<u>D</u> isp	ay additional settings	

4.5 Power System

On the "*Power System*" tab, the nominal voltage, the phase sequence and the temperature unit are configured.

CT-Numbers CT-Assign Power System Transf. NotAssigMeasLoc Funct. CT's CB Settings: No. Settings Value 0270 Rated Frequency 60 Hz 0271 Phase Sequence A 0276 Unit of temperature measurement Degree Cets ✓ Display additional settings Export Graph	wer Sy	rstem Data 1	
Settings: Value No. Settings Value 0270 Rated Frequency 60 Hz 0271 Phase Sequence A 0276 Unit of temperature measurement Degree Cets Image: Settings Image: Settings Image: Settings Egport Graph About Settings A	CT-Numb	ers CT-Assign Power System Transf. NotAssigMeasL	oc Funct. CT's CB
No. Settings Value 0270 Rated Frequency 60 Hz 0271 Phase Sequence A 0276 Unit of temperature measurement Degree Cels	<u>S</u> ettings	:	
0270 Rated Frequency 60 Hz 0271 Phase Sequence A 0276 Unit of temperature measurement Degree Cets ✓ Display additional settings Egport Graph ▲bout	No.	Settings	Value
0271 Phase Sequence A 0276 Unit of temperature measurement Degree Cels ✓ Display additional settings Egport Graph About	0270	Rated Frequency	60 Hz 🗾
0276 Unit of temperature measurement Degree Cels ✓ Display additional settings	0271	Phase Sequence	ABC
☑ Display additional settings Export Graph	0276	Unit of temperature measurement	Degree Celsius
Export Graph About	⊽ <u>D</u> isp	lay additional settings	
OK DICCLA Davies Consults Aire	04		port Graph About





4.6 Transf.

In this option, the nominal values of the voltages and power of the transformer, the connection and the offset of the power transformer windings are adjusted.

No.	Settings	Value
0311	Rated Primary Voltage Side 1	110,0 k ¹
0312	Rated Apparent Power of Transf. Side 1	38,10 MV/
0313	Starpoint of Side 1 is	Isolate
0314	Transf. Winding Connection Side 1	D (Dette
0321	Rated Primary Voltage Side 2	11,0 kV
0322	Rated Apparent Power of Transf. Side 2	38,10 MV/
0323	Starpoint of Side 2 is	Grounde
0324	Transf. Winding Connection Side 2	Y (Wye
0325	Vector Group Numeral of Side 2	
<u>D</u> isp	lay additional settings	_



4.7 CT's

In this tab, the nominal values of primary and secondary current of the current transformers must be adjusted, as well as their polarities.

	Settings	Value
0511	CT-Strpnt. Meas. Loc.1 in Dir. of Object	YES
0512	CT Rated Primary Current Meas. Loc. 1	200
0513	CT Rated Secondary Current Meas, Loc. 1	
0521	CT-Strpint, Weas, Loc.2 In Dir, of Object	2000
0522	CT Rated Secondary Current Meas, Loc. 2	2000
D isp	ay additional settings	-

Note: The tabs "*NotAssigMeasLoc*", "*Funct*." and "*CB*" are not used in this tutorial.



4.8 Setting Group A

In this option are the protection settings.



4.9 Differential Protection

The last step is to make the differential adjustments.

unctio	ns:	
No.	Function	
0011	Power System Data 2	
0012	87 Differential Protection	
0081 0084	Measurement Supervision Supervision	
Cus	stomize <u>R</u> eset	About



4.10 General

Address 1201 activates the differential function. The other options will not be tested and must be set to "*OFF*".

87 Differ	ential Protection - Settings Group A			×
General	I-Diff Characteristic Inrush 2.HM Restr. n.	нм		
<u>S</u> ettings	1			
No.	Settings		Value	
1201	87 Differential Protection			ON 🔻
1205	87 Increase of Trip Char. During Start			OFF
1206	87 Inrush with 2. Harmonic Restraint			OFF
1207	87 n-th Harmonic Restraint			OFF
asi <u>d</u> N	lay additional settings			
		Egport	Graph	About
OK	Aplicar DIGSI -> Device		Cancelar	Ajuda



4.11 *I-Diff*

In this field the pick-up values of the percent differential element (87-1) and instantaneous differential element (87-2) are configured, as well as both acting times.

ettings:		
No.	Settings	Value
1221 8	7-1 Pickup Value of Differential Curr.	0,30 Mn
1226A 8	7-1 T I-DIFF> Time Delay	0,00 se
1231 8	7-2 Pickup Value of High Set Trip	7,0 Mn
1236A 87	7-2 T I-DIFF>> Time Delay	0,00 se
⁷ <u>D</u> isplay	additional settings	

Figure 20



4.12 Characteristic

This option adjusts the values of "Slope 1" and "Slope 2" as well as the "Base Points" values.

87 Differ	ential Protection - Settings Group A	
General	I-Diff Characteristic Inrush 2.HM Restr. n.HM	
<u>S</u> ettings:		
No.	Settings	Value
1241A	87 Slope 1 of Tripping Characteristic	0,30
1242A	87 Base Point for Slope 1 of Charac.	0,00 MnO
1243A	87 Slope 2 of Tripping Characteristic	0,60
1244A	87 Base Point for Slope 2 of Charac.	5,00 l/inO
1251A	87 I-RESTRAINT for Start Detection	0,10 MnO
1252A	87 Factor for Increas. of Char. at Start	1,0
1253	87 Maximum Permissible Starting Time	5,0 sec
1261A	87 Pickup for Add-on Stabilization	4,00 MnO
1262A	87 Duration of Add-on Stabilization	15 Cycle
1263A	87 Time for Cross-block Add-on Stabiliz.	15 Cycle
<mark>⊡</mark> ispl	ay additional settings	
	Export	Graph About
	Aplicar <u>D</u> IGSI -> Device	L'ancelar Ajuda

Figure 21

The options "Inrush 2HM" and "Rest. nHM" are not used. The next step is to submit the changes. To do this click on the icon highlighted below:



Then enter the password and click on "OK".

	L
Password for parameter set:	*****





5. Difference software settings

5.1 Opening the Differential

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



Click on the "Differential" software icon.



Figure 25



🖄 🗋 🗃 🚽 Differential 2.02.152 (64 Bits)	- CE-6006 (0320711)		- 0 ×
Arquivo Home Display Software Optio	Novt Point		^ 🕐
Channels Direc. Connection	Stop	Settings Belay Present Report Cycles Recreate Restore Rectore	
Hardware	Settings	x	
Test Set Point Test Search Test Test Set	^		
Insert/Edit Points	General	General Inform. System Notes & Obs. Explanatory Figures Check List Others Connections	• X
Insert/Edit Points General Options		Test:	TC's
Edit Point	Differential	Descr: Date: Date: P	rincipais
New Point Vinding 1 Vindi		Tested device:	Ybar
Sequence Fault Location:		Identif: Model	4
Remove Winding2 ~		Type: V Manufacturer: V	
Fault Type:		Location:	
<		Substation:	
Test Points		Rave V	
Points Tested		Addense:	
No Foult IDiff IPost			
No. Fault IDill Inest		City: State: V	
		Responsible:	
		Name:	
		Sector: V Registry: V	
		Tool Test:	
		CE-6006 Series Num.: 03207116302101110011XXX	
☐ IDiff and iBest ☐ Operating Begion			
Enternalist Destantion Otatus	~		
ON Line New	Default 🗸	Preferences OK Cancel	

Figure 26

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.

💹 🗋 💕 🛃		(64 Bits) - CE-600	06 (0320711)							
Arquivo Hom	e Display Softwa	are Options								
Channels Direc.	l Set 《양 GOOSE Set Ic. Set 특, SV Set nnection	Start Stop	> Next Point Clear test Clear all	5ettings	₩ Waveform H Phasors I SEL	0 System 🗃 Relay	Present Report	Cycles	Recreate Charts	View
ŀ	lardware	Gene	ration		Options		Report	Units	Layout	

Figure 27

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.



General	General Inform.	System N	otes & Obs.	Explanatory Figures	Check List	Other	s Connections		
	Test:								
Differential	Descr:	Differential Fun	oction			Date:			
	Tested device:								
		Identif:	23031982		~	Model	7UT61		~
		Type:	Transformer P	rotection 、	- Manufa	acturer:	Siemens		~
	Location:								
		Substation:	CONPROVE						~
		Bay:	1		~				
		Address:	Visconde de C	Duro Perto75 - Neighb	orhood Custódi	o Pereira			~
		City:	Uberlândia			~		State:	lG ∽
	Responsible:								
		Name:	Michel Rocke	mbach de Carvalho					~
		Sector:	Engineering		~ R	egistry:	0001		~
	Tool Test:								
	CE-6006			Series Nu	m.: 03207116	3021011	10011XXX		
~									
fault 🗸					Pref	erences	ОК		Cance

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 29

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.

6. Differential Adjustment

6.1 Differential Screen > Protected Equipment/CTs

This tab should inform the protected equipment, the number of windings, nominal voltage, nominal power, the primary and secondary currents of the main CTs and the currents of the auxiliary CT, if necessary. This test uses the settings for a relay that is protecting a transformer. However, it is possible to test protections of bus, generator, motor and line. For transformer protection there is the possibility of testing up to four windings automatically.





Figure 30

6.2 Differential Screen > Adjust Prot. Differential > Settings

The initial default for the "*Data Entry*" field is set to "*User*", thus all other settings such as TAP, lag compensation, mismatch correction, measurement current type, reference winding for calculations and Zero sequence elimination options are enabled so that the user can, according to the relay, perform the adjustment correctly (Free Configuration). This method allows the user to test any type of differential relay, but it requires more knowledge of the relay.

To facilitate data entry, the settings of the main relays available on the market have already been standardized. When selecting one of the lists of relays, only the configurable settings are enabled. Choose the "SIEMENS 7UT/7UM (Siprotec 4)" mask.





Figure 31

Parameterize the "*Differential Settings*" and "*Instantaneous Settings*". Set the time to 0.0s. Use the tolerances for current and time given in the Appendix.



General	ected Equipment/CTs Adjust Prot. Differential
Differential	Data Entry: SIEMENS 7UT/7UM (Siprotec 4)
	Differential Settings Current Tolerance
	Pickup: 0.30 ln Pickup: 7.00 ln Relative: 5.00 %
	Time: 0.00 s Absolute: 0.10 ln
	Restriction Current Angle Time Tolerance
	(lp + lls) / K Absolute: Relative: 1.00 %
	K: 1 3.00 * Absolute: 37,00 ms
	General Options Phase Shift Compensation:
	TAPs: Calculated
	Reference Wnd. for Calculations (In):
	Zero Sequence Elimination
~ L_	

Figure 32

6.3 Differential Screen > Adjust Prot. Differential > Slope Definition

On this screen, the values for "Slopes" and "Base Points" must be entered.





Figure 33

7. Channel Direction and Hardware Configurations

Click on the icon illustrated below.



Figure 34

Then click on the highlighted icon to configure the hardware.





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







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

Cha	nnels Direct.			— C) ×
es Local	Model Reset for Hard. CE-6006 Connected	Set O Advanced	^{କୁତ} ୁ GOOSE	Co	nfim
Remote	Serial Number: 03207116302101110011XXX	V V ON Line	⁵ ₀ S. Value	Import Export	

Figure 37

8. Test Structure for Function 87

8.1 Test Settings

In this tab, the test set channels are associated with the relay phases; the trip signal is configured with the binary input.

Z Differential 2.02.152 (64 Bits) - CE-6006 (0320711) - 🗇						
Arquivo Home Display Sof Image: Sync, Set Sync, Set Sync, Set Sof Sof Channels Connection Connection Sof Sof Sof	tware Options Set Start Stop Clear test Clear all	E Settings ₪ SEL Waveform ♥ System Press Rep	sent	¥ ^		
Hardware	Generation	Options Rep	port Units Layout			
Test Set Point Test Search Test	Test Settings					
Generation Channels Drec. Wind Phat Gen. Channel 01 Ia AO_J01 (Hrd: 11) 01 Ib AO_J02 (Hrd: 12) 01 Ic AO_J02 (Hrd: 13) 02 Ib AO_J03 (Hrd: 15) 02 Ib AO_J05 (Hrd: 15) 02 Ic AO_J05 (Hrd: 16) 01 Va Va 01 Va Va 02 Va Va 02 Va Va	Enable Pre-Fault 1	Enable Pre-Fault 2		Test Set Wait Time for Data Entry: 00.00 s Muit. Tolerance: 1.00 Point Test Wait Time for Operation: 100.00 ms Search Test Initial step: Absolute Resolution: 0.50 % Wait Time for Operation: 0.50 % Wait Time for Operation: 400,00 ms Disconsider the characteristic in Search Point Search (Since wincement) Point Search (Since wincement)		
Binary Outputs & Goose - Fault BO 0: 0: 0: 0: 0: 0: 0 Generation Limits I Max. Gen. per Chn. by hard Vide Hardware Limit Stop Interf. BI01 (Hrd: BI1) ~ Trigger Interf. Software ~ Wat for PPS _	Test Mode Mode Intelligent Variation of RMS and Angle Stop Logic initial N Trigger Logic Trigger Delay 0,00 s	▼ A ∨		Multiple of Tolerance for Verification Test: 1,10 General Reset Time: 100,00 ms N [®] of repetitions in case of generation error: 2 Stop the test at the first failure Protection Status Verification Stat/End of Test Ignore Pre-Fault operation Based Only on Generated Values Cycle to Cycle Generation		
🚯 ON Line New		Aux Sou	rce: 110,00 V Heating: 0%			
		E				

Figure 38

9. Test Set

The general idea of the configuration test is to verify that the relay settings and the settings parameterized in the software are compatible, as the software aims to simulate the behavior of the relay. To do so, enter a "New Point" according to the data below:



Point 1:

- Data Entry: IDiff e IRest
 - IDiff: 1,00 In
 - IRest: 2,00 In
- Source Location: Winding 1
- Fault Location: Winding 2
- Fault Type: ABC

By clicking on the option "*Chart*" you can see where the tested point is. For this test the point is in the operating region.



Figure 39

Click on the icon highlighted below or use the command "Alt + G".





After starting the test, the user must enter the differential and restraint current values read in the relay, which must be in the range of values calculated in the software that will perform the automatic data comparison.

JIGSI - [Dif Eile Edit	ferential and Restraint Current - 10/08/202 Paste Device View Options Win	1 - CONPROVE_SUPORTE / Folder /	7UT613 V4.6/7UT613 V04.67.00]		- 0 ×
	Pa 🖻 🗊 🚵 🎘 蓬 🕈 Pa 😳	8 = 0 0 10 1			
Number	Measured value	Value			-
07742	IDiff A(I/Inominal object [%])	0,99 l/InO			
07743	Diff B(I/Inominal object [%])	1,00 I/InO			
07745	IBest A(I/Inominal object [%])	2.00 I/InO			
07746	Rest B(I/Inominal object [%])	2,00 I/InO			
07747	IRest C(I/Inominal object [%])	1,99 I/InO			
	Test Set Evaluation		×		
	Test Data				
	Data Entry: Idiff an	d IRest V Operation: 💽 Yes	O No		
		12	L3		
	ldiff: 0,99 ln	ldiff: 1,00 ln	ldiff: 1,00 ln		
	June 200 la		1.00 la		
	11est. 2,00 in	rest. 2,00 m	1,55 m		
	Auto Fill		Evaluate Not Evaluate		
	L				
					•
•					•
					5000 ms
Press FI for He	ip.			701013 V04.67.00 Unline COM3	115200 8E1 0800 NUM

Figure 41

Passing the configuration test makes it possible for the other two tests to be carried out successfully. If there is a discrepancy between the values calculated by the software and those presented by the relay, the user must review its connections and settings.

10. Point Test

After the configuration test has passed, this means that the adjustment parameters passed to the software faithfully correspond to the behavior of the relay, in this way, the point test can be performed, since it analyzes not only the operation of the relay, but also the shooting time.

For the point test, click on the "*New Point*" field and choose the fault type, and the differential and restraint current values. Then click on the confirm button.





Figure 42

Another way is to use the "Sequence" feature of points by choosing the values of "Initial", "Final" and "Step". This way the software automatically creates the points.



Click on the icon highlighted below or use the command "Alt + G".





It is verified that all points were successfully approved.



11. Search Test

To carry out the search test, click on the "New Line" field, choose the type of fault, the restraint current value and confirm.





Figure 46

There is also another way to add test lines, by adding a search string. To do this, just click on the *"Sequence"* button and select the initial and final restriction current of the search and the step between them.



Click on the icon highlighted below or use the command "Alt + G".





It is verified that all lines were successfully approved.





12. Report

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



	Presentation Setting	×
	Languag∈ Inglês En-US ∨	
	All General Data Test General Data of Tested Device General Device Device Device Device Device Device General Device Dev	
	Figure 50	
🔟 📄 📷 🔙 🗸 Differential 2.02.152	(64 Bits) - CE-6006 (0320711)	- ¤ ×
Print Setting Page Word Office to PDF	100 One page 100 Two pages 100 Previous Next Page Page Preview Preview	~ •
Print Export	Zoom View Close DE-600x DE-600x DE-600x DE-600x DE-600x	Î
	CE-600X CE-600X CE-600X CE-600X CE-600X	
	DIFFERENTIAL-TEST REPORT	
	Descr.: Differential Function Date: 11/08/2021 08:25:04 ; Software: Differenc_CTC; Version: 2.02.152 Responsible: Michel Rockembach de Carvalho	
	1. Device Tested Ident .: 23031982; Type: Transformer Protection Model 711761: Manufacturer: Simpler	
	2. Location	
	Substation: CONPROVE Bay: 1 Address: Visconde de Ouro Perto75 - Neighborhood Custódio Pereira City: Uberlândia; State: MG	
Printing Preview Nº of Pages: 08		

Figure 51



APPENDIX A

A.1 Terminal Designations

7UT613*-*D/E



Figure 52



A.2 Technical Data

Pickup Values

	1	1	1	
Differential current	I _{Diff} >/I _{NObj}	0.05 to 2.00	Steps 0.01	
High-current stage	I _{Diff} >>/I _{NObi}	0.5 to 35.0	Steps 0.1	
		or ∞ (ineffective)		
Increase of the pickup v	alue when connect-	1.0 to 2.0	Steps 0.1	
ing as a factor of I _{Diff} >				
Add-on restraint on external fault				
(I _{stab} > setting value)	I _{Add-on} /I _{NObj}	2.00 to 15.00	Steps 0.01	
Action time		2 to 250 cycles	Increments 1 cycle	
		or ∞ (active until dropout)		
Trip characteristic	•	see Figure 4-1	•	
Tolerances (with preset characteristic parameters, for 2 sides with 1 measuring location each)				
I _{Diff} > stage and characteristic		5 % of set value		
I _{Diff} >> stage		5 % of set value		
		•		

Time Delays

Delay of I _{Diff} > stage	T _{IDiff>}	0.00 s to 60.00 s or ∞ (no trip)	Steps 0.01 s
Delay of I _{Diff} >> stage	T _{IDiff>>}	0.00 s to 60.00 s or ∞ (no trip)	Steps 0.01 s
Time tolerance		1 % of set value or 10 ms	
The set times are pure delay times		•	

Operating Times (Transformers)

Pickup time / dropout time with single-side infeed					
Pickup time at frequency		50 Hz	60 Hz	16.7 Hz	
I _{Diff} > min	high-speed relays	30 ms	27 ms	78 ms	
	high-speed relays	25 ms	22 ms	73 ms	
I _{Diff} >>	high-speed relays	11 ms	11 ms	20 ms	
min	high-speed relays	6 ms	6 ms	15 ms	
Dropout time, approx.		54 ms	46 ms	150 ms	
			·		
Dropout ratio		approx. 0.7	approx. 0.7		



APPENDIX B

Equivalence of software parameters and the relay under test.

		Table 3	
Differential Software		Siemens 7UT61 Relay	
Parameter	Figure	Parameter	Figure
N° of Wind.	30	Number of Sides	12
Voltage (Wind. 1)	30	Rated Primary Voltage Side 1	15
Voltage (Wind. 2)	30	Rated Primary Voltage Side 2	15
Power (Wind. 1)	30	Rated Apparent Power of Transf. Side 1	15
Power (Wind. 2)	30	Rated Apparent Power of Transf. Side 2	15
Connection (Wind. 1)	30	Transf. Winding Connection Side 1	15
Connection (Wind. 2)	30	Transf. Winding Connection Side 2	15
Vector Group (Wind. 2)	30	Vector Group Numeral of Side 2	15
I Prim (Wind. 1)	30	CT Rated Primary Current Meas. Loc. 1	16
l Prim (Wind. 2)	30	CT Rated Primary Current Meas. Loc. 2	16
I Sec (Wind. 1)	30	CT Rated Secondary Current Meas. Loc. 1	16
I Sec (Wind. 2)	30	CT Rated Secondary Current Meas. Loc. 2	16
Connection CT (Wind. 1)	30	CT- Strpnt. Meas. Loc.1 in Dir. of Object	16
Connection CT (Wind. 2)	30	CT- Strpnt. Meas. Loc.2 in Dir. of Object	16
Differential Settings (pickup)	32	87-1 Pickup Value of Differential Curr.	20
Instantaneous Settings (pickup)	32	87-2 Pickup Value of High Set Trip	20
Slope 1	33	87 Slope 1 of Tripping Characteristic	21
Base Point 1	33	87 Base Point for Slope 1 of Charac.	21
Slope 2	33	87 Slope 2 of Tripping Characteristic	21
Base Point 2	33	87 Base Point for Slope 2 of Charac.	21