

INSTRUMENTOS PARA TESTES ELÉTRICOS Test Tutorial

Equipment Type: Protection Relay

Brand: ABB

Model: REL650

Function: <u>25 or RSYN – Synchronism Check</u>

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

Objective: <u>Test when two systems can connect, respecting</u> voltage, frequency and angle limits, that is, if they are in synchronism.

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial Version	17/01/2022	M.R.C.	M.P.S



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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.

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

This document is intended as a guide only; the manual of the equipment under tested must 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 must 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 testing the ABB REL650 relay in the Synchronism software

1. Relay connection to CE-6006

Appendix A-1 shows the relay terminal designations.

1.1 Auxiliary Source

Connect the positive (red terminal) of the Vdc Aux. Source to pin 3 on the relay terminal X410 and the negative (black terminal) of the Vdc Aux. Source to pin 1 on the relay terminal X410.



1.2 Voltage Coils

To establish the connection of the voltage coils, connect channels V1, V2 and V3 with pins 1, 3 and 5 of the relay terminal X102 and the common ones to pins 2, 4 and 6. If these last three points are short-circuited, connect all common to that point. To establish the connection of the second system, connect channel V4 to pin A7 of the relay terminal and connect its common to pin A8 of the relay terminal.



Figure 2

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1.3 Binary Inputs

Connect CE-6006 binary input to X307 relay slot binary output.

BI1 to pin 07 and its common to pin 08. •



2. REL650 Relay Configuration

Connect an Ethernet cable from the notebook with the relay. Then open *PCM600* by double clicking on the software icon.



Note: In this tutorial it is considered that there is no configuration in the relay, so all parameterization will be inserted in the relay.

2.1 Creating a new file

First, a new project must be included. Click on the "File" option and then "New Project ... "



Figure 5

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Choose a name for the project, in this case "25" was used and then click on "Create".

Server name:	
My computer [(SUPORTETECO1\PCMSERVER)
Project name:	7
25	
Description:	
perau apreser	ilauu uelaines vala a cunildulacao da luncao de
sincronismo.	

Right-click on the created plant and insert a substation.

🔤 Local Server\25 - PCA	1600		
File Edit View Tools	s Window Help		
i 🗅 🚅 🖬 % 🖻 🛍			
Object Types 🛛 🔻 🖡 🗙	Project Explorer		▼ ₽ X
General A Plant Structure			
Generic IEC61850 IED	25		
Sub-Transmission IEDs 🛛 🗙	New 🕨	General	Substation
Transmission IEDs	Properties	Create from Template	IED Group

Figure 7

Within the substation created, enter the voltage level according to the following figure:



Local Server\25 - PCM	600		
File Edit View Tools	Window Help		
i 🗅 🚅 🔛 X 🖻 🖻			
Object Types 🛛 🔻 🕈 🗙	Project Explorer		▼ ₽ ×
General 🎗	Plant Structure		
Generic IEC61850 IED	-= -0 25		
Sub-Transmission IEDs 🛛 🗙	रर्रेर Substation		
Transmission IEDs 🗶	IED Compare		
	표표 IEC 61850 Configuration		
	Import		
	Export		
	New 🔸	General 🔸	KY Voltage Level
	ኤ Cut	Create from Template	
	🗈 Сору		, I
	Delete		
	Rename		
	Properties		
	Figure	e 8	

Within the voltage level a bay must be inserted.

🕮 Local Server\25 - PC/	M600		
File Edit View Tool:	s Window Help		
0 🗃 🖬 👗 🖻 🛍			
Object Types 🔷 🔻 🛱 🗙	Project Explorer		→ ₽ ×
General 🖍	Plant Structure		
Generic IEC61850 IED	-🖃 - 📵 25		
Sub-Transmission IEDs 🛛 🛠	Substation	Level	
Transmission IEDs	TTT VOROGE	Level	
	IED Compare TEC 61850 Configuration	n	
	New	General	► 📅 Bay
	Cut Cut Copy	Create from Templa	ate
	Delete Rename		
	Properties		
		Figure 9	

The REL650 relay is inserted inside the bay.



Ele Edit View Tools	1600 Window Help				
Object Types 🔷 🔻 🕈 🗙	Project Explorer			▼ ₽ X	
General 🗙	Plant Structure				
Generic IEC61850 IED 🛛 🗙	-🖃 📵 25				
Sub-Transmission IEDs 🛛 🗙	🖻 _र र्देर Substation	aval			
Transmission IEDs 🛛 🗙	⊡ — Ī Bay				
	IED Compare				
	Import				
	New	•	Generic IEC61850 IED	•	
	K Cut		Sub-Transmission IEDs	• 😓 RE	L650
	Сору		Transmission IEDs	•	
	Delete		Create from Template		
	Rename				
	Properties				

2.2 Setting up communication

Choose the option "Online Configuration" and click on "Next >".

REL650 - Configuration Mode Selection Page	
REL650 Configuration Wizard Configuration Mode Selection Page	
This wizard helps you to create configuration for your relays. Configuration sets the basic hardware and communication properties. The configuration made either offline or online. Configuration Mode Online Configuration Offline Configuration	on wizard on can be
Cancel	Next >

Figure 11

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Choose the *"Next > "* option again.

REL650 - Communication proto	ocol selection page	
REL650 Configuration Wizard Communication protocol selection page		
IED protocol:	IEC 61850	~
Communication provider:	PCM600	×.
Ca	ncel < Back	Next >

Figure 12

On the next screen, the user chooses between two options "LAN1" or "Front Port", then he must see in the relay which IP is configured. To do this, go to "Settings > General settings > Communication > Ethernet configuration" and view the desired IP. Adjust this value in PCM and in this tutorial the option "Front Port" was chosen.

PCM600 communica	tion	-
Port:	Front Port	~
IP address:	10 . 1 .150 . 3	

Figure 13



Then click on *"Next >"* and on the next screen on *"Scan"*.

REL650 - Version Selecti	on Page 🛛 🔀
REL650 Configuration W Version Selection Page	izard
Online Mode IED Type Product Version	Scan
	Cancel < Back Next >

Figure 14

If the settings are correct, the software identifies the relay model and its version as shown in the following screen.

REL6 Ver:	550 Configuration Wiza sion Selection Page	ard	
Online	Mode		
	IED Type	REL650	
	Product Version	1.0.0 Scan	
	(Cancel < Back	Next >

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On the next screen, the relay identifies the type of housing and display.

🖻 REL 650 - H	ousing\Displa	y Selection Page	
REL650 Con Housing\Displa	figuration W by Selection Page	izard	
-Online Mode	using Type :	6U 1/2 19" rack casing]
Dis	olay Type :	IEC, 1/2 19", 6U, Basic) Next >

Figure 16

Finally, the complete relay information.

Setup is complete. The con	figuration that is made for the selected	IED is below :
IED Type	REL650	
Product Version	1.0.0	
IP Address	10.1.150.3	
Order Option	Online Option Selected	
NOTE: Once configuration w	izard is finished it can't be reopened.	

Figure 17

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2.3 TRM_2

Click on the "+" signs near to "*IED Configuration*" and "*HW Configuration*". Within the last option the relay shows all slots that are inserted in the relay. Right click on the "*TRM 2*" option and select "*Parameter Setting*".

🔤 Local Server\25 - PCA	4600			
File Edit View Tools	s Window Help			
0 🛩 🖬 🗴 🖻 🕲		3		
Object Types 🛛 🔻 🖡 🗙	Project Explorer	_		▼ # X
General 🛠	Plant Structure			
Generic IEC61850 IED	-🗃 - 🟮 25			
Sub-Transmission IEDs 🕱	ि स्रिं Subsl	ation Moltage Level		
Transmission IEDs 🎗	а.	Image: Second	alion refiguration DM_101 HILO SM_102 HILO SM_102 HILO SM_102 HILO SM_102 HILO	ter Satling re Configuration 150 Configuration 165
Outout				
Date and Time	Category	Ulser OI	biect	Mercare
1/7/2013 14:29:49:234	Message	IncallyCONPROVE - BE	EL 650	Parameters read successfully
1/7/2013 14:44:29:359	Message	[local]\CONPROVE Sy	/stem	Project closed: SUPORTETEC01\PCMSERVER\SINCRONISMO
1/7/2013 14:45:06:250	Message	[local]\CONPROVE Sy	vstem	Project opened: SUPORTETEC01\PCMSERVER\25
Logging				secunde/eira 1 de julho de 2013 15:15:36

Figure 18

In this window, the current and voltage transformation relationships must be configured. In this case, only channels 6, 7, 8, and 9 will be configured since the protection to be analyzed is the synchronism.

📟 Local Server\25 - PCM60	00									
File Edit View Tools	IED Window	Help								
0 🛩 🖬 😹 🛝 🖻 🕯	N 💽 🗗			All paran	neters 🔹 🗣 🔂 🖼 🖬	- 🔥				
Object Types 🔻 🕂 🗙 P	roject Explorer	-		- + ×	REL650 - Parameter Setting					- 4 Þ -
General 🗙	Plant Structure	1			Group / Parameter Name	IED Value [SG1/Common]	PC Value [SG1/Common]	Unit	Min	Max 🖌
Generic IEC61850 IED 🕱	∋ - () 25				NAMECH6		CH6			13 charac
Sub-Transmission IEDs 🕱	Subs	tation			InputType6		Voltage			
Transmission IEDs	8	Bay			VTsec6		115,000	V	0,001	999,999
		😑 😡 REL650			VTprim6		138,000	k∀	0,001	9999,999
		E to Cont	liguration / Configuration		NAMECH7		CH7			13 charac
			8 COM_101		InputType7		Voltage			
			8 PSM_102 1 TBM 2		VTsec7		115.000	v	0.001	999,999
			BIO_3		VTorim7	-	138.000	kΨ	0.001	9999 999
		E D Ad	BIO_4		NAMECHS		CH8		-,	13 charac
		⊞ ~ % Tim	ne		InputTupe8		Voltage			
		B Po	wer system		1/Toes9		115 000	v	0.001	999 999
		⊞ % An	alog modules		VTseco VTsein9		129.000	W	0.001	0000 000
		B G HM	11		NAMEGUO	-	CU0	N.T	0,001	10 shares
		E S Applicati	nitoling on Configuration		NAMECHS		UH3			15 charac
					InputType9		Voltage			
					VI sec9		115,000	v	0,001	999,999
					VTprim9		138,000	k¥	0,001	9999,999
					NAMECH10		CH10			13 charac
					InputType10		Voltage			
					VTsec10		110.000	V	0.001	999.999
					Selected parameter: TRM 2/VTprim9 [0.0019999,999] kV				
Output										• 0
Date and Time	Category	Uper	Object	Massage				-		
i) 1/7/2013 14:29:49:234	Message	llocall\CONPBOVE -	BEL650	Parameters read o	uccessfullu					
1/7/2013 14:44:29:359	Message	[local]\CONPROVE ·	System	Project closed: SL	PORTETECO1\PCMSERVER\SINCRO	INISMO				
1/7/2013 14:45:06.250	Message	[local]\CONPROVE	System	Project opened: S	UPORTETECO1\PCMSERVER\25					
Logging										

Figure 19

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In the icon highlighted in green in the previous figure, the changes are sent to the relay. There are three shipping options:

- 1. Submit only a specific value;
- 2. Submit all changes made within a setting group.
- 3. Send all parameterized settings within the group.

In this case, only the settings that have been changed are sent.

Parameter range	
TRM_2	
Selected group	
Selected parameter	
Parameter options	
Ochanged parameters	Read back
All parameters	

Note: Whenever the user makes a change in any setting group, this procedure must be repeated.

2.4 SETGRPS: 1

Click the "+" sign near to "Activate setting group" and then "SETGRPS: 1" and make sure that group one is active.

Local Server\25	PCM600									- 7 🗙
Eile Edit View	Tools IED Window	Help								
	B B 0 0			Al parar	neters - 🕹 🛥 🖼	- N				
Object Types 🔻	X Project Explore			* 4 X	REL 650 - Parameter Sett	ting				- 4 Þ X
General	2 Plant Structu	ra]			Group / Parameter Name	IED Value (SG1/Common	1 PC Value [SG1/Common]	Unit	Min	Max
Generic IEC61850 IED	3 ⊟ - 1 25				SETGRPS: 1					
Sub-Transmission IEDs	2 E 👯 Su	bstation			 ActiveSetGrn 		SettingGroup1	1		
Transmission IEDs	*	Voltage Level			MarAloSatGro		1		1	4
		■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■	gualon Congualon L'Ondration PSM_102 TRM_2 BIO_3 BIO_4 BIO_3 BIO_4 BIO_3 BIO_4 BIO_3 BIO_4 BIO_3 BIO_4 BIO_3 BIO_3 BIO_3 BIO_4 BIO_3		< 					
Output										→ # X
Date and Time	Category	User	Object	Message						^
1/7/2013 14:45:06.2	50 Message	[local]\CONPROVE	System	Project opened: S	UPORTETEC01\PCMSERVER\25					
1/7/2013 15:21:51.2	50 Message	[local]\CONPROVE	REL650	Parameters writter	i successfully					
V 1/7/2013 15:21:52.7	65 Message	[local]\CONPROVE	REL650	Parameters read s	uccessfully					~
🖺 Logging										
							segunda-feira, 1 c	de julho de 2	013 15:22:05	ABB

Figure 21

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2.5 PRIMVAL: 1

Click on the "+" signs near to "*Power System*" and "*Primary values*" and select the "*PRIMVAL*: 1" option. In this group, the frequency and phase sequence values are adjusted. Send the settings to the relay if there is any change.

Local Server\25 - PCM	4600									
Ele Edit View Icols	s [ED <u>W</u> indow <u>H</u>	elp								
00000				Al paran	neters 🔹 🗣 🖶 🚺	· 🔥				
Object Types 🔻 🕈 🗙	Project Explorer			→ # X	REL650 - Parameter Setting					- 4 b ×
General 🕱	Plant Structure				Group / Parameter Name	IED Value (SG1/Common)	PC Value (SG1/Common)	Unit	Min	Max
Generic IEC61850 IED 🕱					PRIMVAL: 1					
Sub-Transmission IEDs 🕱	Subst	ation			 Frequency 		500	Hz	50,0	60,0
Transmission IEDs 🗙	G	Bay			PhaseRotation		Normal=L1L2L3			
		B = 00 HELDSJ B = 00 HELDSJ B = 00 HELDSJ B = 00 Action B = 0	jarabin (Conligation)		C Selected parameter: PRIMVAL: 1/Freque Selected parameter: PRIMVAL: 1/Freque	ncy [50,060,0]Hz				
Output										≁ # ×
Date and Time	Category	User	Object	Message						^
1/7/2013 14:45:06:250	Message	[local]\CONPROVE	System	Project opened: S	UPORTETEC01\PCMSERVER\25					
1/7/2013 15:21:51.250	Message	[local]\LUNPROVE	HEL650	Parameters witten	i successfully					
Logging	message	horabrow.unive	112000	r aramoters redu s	wroenwy.		convertairin 1	de i des d	2012 15 25 59	ARR

Figure 22

2.6 GBASVAL: 1

Click the "+" sign next to "*Global base values*" and then "*GBASVAL: 1*" and adjust the base voltage value. The other base value groups will not be used.



Figure 23



2.7 AISVBAS: 1

Click on the "+" signs beside "Analog modules" > "Reference channel service values", select the option "AISVBAS: 1" and set channel 6 as the reference channel, which is equivalent to the A-phase voltage.

ELocal Server125 - PCA	M600								
Ele Edit View Took	s IED Window	jelo							
	8 10 B			Al parat	neters all the Pill	b - N			
Object Types - 9 X	Project Explorer			* 0 X	RELESSO - Parameter Settin	a			- 4
General 💲	Plant Structure	1			Group / Parameter Name	IED Value [SG1/Common]	PC Value [SG1/Common]	Unit Mir	n Mex
Generic IEC61850 IED		C Bay		~	AISVBAS: 1				
Sub-Transmission IEDs		😑 🔣 REL650			PhaseAndeRet		TRM Channel 6		
Transmission RDs 2			W Configuration PSM, 102 PSM, 102 BIO, 3 BIO, 4 BIO, 5 BIO, 6 BIO, 7 BIO, 7 BIO, 4 BIO, 5 BIO, 6 BIO, 7 BIO, 7	ervice values	٤.				
10.1.1		0 00 repro-	and congridient	M	Selected parameters Alsteads: 1/Pix	asewigenei			
oucput	<u>.</u>							_	• •
Unite and Time	Category	User	Ubject	Message	1.1				
1/7/2013 15:28:46.93/	Message	local/CONPROVE -	RELEGO	Parameters read a	uccessruly				
1/7/2013 15:29:10.468	Message	[local]\CONPROVE -	REL650	Parameters read s	uccessfully				
Carl Logging									
Second Contractory of Contractory							segunda-feira, 1 de	julho de 2013	3 15.30.12 ABB

Figure 24

2.8 Application Configuration

Select the *"Application Configuration"* option, right click and choose *"Application Configuration"* again. In this field, the protection logic blocks must be entered.

Local Server\25 - PCI	M600							
Ele Edit View Tool	is <u>I</u> ED <u>Wi</u> ndow	Help						
0 🛩 🖬 🚳 13 🖣			All parar	neters 🔹 🔂 🛥 🖽 🚺	- 🔥			
Object Types 🔻 🕸 🗙	Project Explorer		* # X	REL650 - Parameter Setting				- 4 Þ ×
General 🛠	Plant Structure			Group / Parameter Name	IED Value [SG1/Common]	PC Value [SG1/Common] U	Init Min	Max
Generic IEC61850 IED	i i	琵 Bay	^	 Application Configuration 				
Sub-Transmission IEDs	1	😑 🔛 REL650				l		
Tranamision IEDa 🏾 🎗		HW Configuration Demonstration HW Configuration Demonstration Demonstration HW Configuration Demonstration HW Configuration HW Configuration Demonstration HW Configuration Demonstration Demonst	40 5. 1. 1. 1. 1. 1. 1. 2. 2. 2. 2. 2. 2. 3. 2. 4. 4. 4. 5. 5. 1. 3. 3. 1. 3. 3. 1. 3. 1. 3. 3. 1. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3. 3.	6				,
		Application Configuration	Expand					
Output			Parameter Setting					▼ ₽>
Date and Time	Category	User Object	Application Configuration					2
1/7/2013 15:29:10.468	Message	[local]\CONPROVE REL650						
1/7/2013 15:30:17.921	Message	local/CONPROVE REL650 in	IEC 61850 Configuration	ly				
17772013 10:30:13.062	intessage	Tincalliconichiove · HEL600	Properties					2
Logging								
						segunda-feira, 1 de j	ulho de 2013 15:32	:08 ABB .

Figure 25



On the screen that opens, right click and then choose the option "Insert FunctionBlock".

Image: Control Image: Contro		REL650 - Parameter Setting R	Fixed	3	× 4 Þ ×
Image: Supersonal and Supersonal a		1	2	3	
Basic IED functions R Control R Current protection R Frequency protection R Hardware R					
Control A Current protection A Frequency protection A Hardware A					
Current protection A Frequency protection A Hardware A	-				
Frequency protection A BCOM_101 Hardware A BPSM_102	A				
Hardware S		601 - C	The second Design	Child Children D	
			Insert Page	Ctri+Shirt+P	
Impedance protection 🛠			Insert FunctionBlock	Ctrl+Sbift+E	
Local HMI functions			Insert Hardware Channel	Ctrl+Shift+H	
Logic A SETGRPS: 1			Delete name	CirlaShiftaD	
Metering			Delete page	Сантышеть	
Monitoring			Select All	Ctrl+A	
Scheme communication PBIMVAL: 1			Find Find	Ctrl+F	
Supervision GBASVAL: 1	Ξ		Lock	Ctrl+Shift+L	
Voltage protection					
Hardware I/O					
GBASVAL: 5					
B → R Identifiers					
ia — % Communication					
□					~
D AISVBAS: 1	<	1			>
± − 90 Honitoring		MainApp			• 4 ▷
are Application Configuration 🕀 🐨 Application Configuration	~	😢 🛞 1 of 1 😥) ()) 201,96		
Output					→ 4 ×
MainApplication Name Page No Description					
Application Configuration					
	_			earunda faira 1 da julho da 2012 15:	22.47 ARP

Figure 26

2.9 SMAI_20_2 (Voltage Lines)

Click on the "+" sign near to "*Basic IED functions*" and insert the " $SMAI_20_2$ " block that will be responsible for the line voltage channels. To understand the perfect functioning of the different blocks, consult the REL650 manual.



Insert Function Block	
Select a Function Block Type	
Basic IED functions ACTVGRP ATHSTAT CHNGLCK DOSFRNT DOSLAN1 INTERRSIG TESTMODE SMAI_20_1 SMAI_20_2 3PHSUM	
SMAI_20_3 SMAI_20_4 SMAI_20_5 SMAI_20_6	Cancel

Figure 27

On the next screen, set the "Cycle Time" to 20.

Function Block Instance	
Name:	SMAI_20_2
Cycle Time:	20 💌
Exec Order, Instance Number:	1.2
	<u>Assign</u>
Figure	e 28

The next step is to route the function block's channel input with its physical channel. To do this right click outside the block and choose the following option.



	Lock Figure 29	Ctrl+Shift+L	
89	Find	Ctrl+F	
	Select All	Ctrl+A	
	Delete page	Ctrl+Shift+D	
	Insert Hardware Channel	Ctrl+Shift+H	
	Insert FunctionBlock	Ctrl+Shift+F	
	Insert Variable		×
	Insert Page	Ctrl+Shift+P	

Choose the "Analog Input" option and click on "Insert".

Insert Hardware Channel	
Select a Hardware Channel	
Insert Can	cel

Figure 30





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Repeat the procedure of the 3 previous figures changing the *"Hardware Channel Allocation"* option to CH7 and CH8. Then make the connections with the block.

🕮 Local Server\25 - PC	A600				- 7 🛛
File Edit View Tool:	Format Insert IED Debug Window Help				
i 🗅 🚅 🖬 🎒 🔃 🐰	🗄 🛍 🖬 🖬 🖬 🐨 🖾 🗠 🖄 🖬 🖬 🖬 👘		Fixed		
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Control	E REL650				
Current protection	E W Configuration	TOM 3 (14	SMAL 20 2		
Frequency protection	COM_101	A	BLOCK AI3P		
Hardware 🎗	B TBM 2		GR2L1 A11 GR2L1 A12		
Impedance protection	BIO_3	ikn_z.cm	GR92L3 A4 GR92N AN		
Local HMI functions	BID_4		0:1(1.20)/2		
Logic 🎗	Activate setting gloup SETGRPS: 1	IKM_2.CH8			
Metering	⊞— ⁶ b Time				_
Monitoring	B Power system				
Scheme communication	PRIMVAL: 1				
Station communication	□ Global base values				
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Output					▼ ₽ X
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Figure 32

Assign an output variable to the "AI3P" option. Right-click and choose "Insert Variable > Output".

		Figure 33	
	Lock	Ctrl+Shift+L	
89	Find	Ctrl+F	
	Select All	Ctrl+A	
	Delete page	Ctrl+Shift+D	
	Insert Hardware Channel	Ctrl+Shift+H	
	Insert FunctionBlock	Ctrl+Shift+F	Output
	Insert Variable	•	Input
	Insert Page	Ctrl+Shift+P	

Choose a name for this variable, in this case, "*Tensão_Linha*" and connect it with the output "*AI3P*".





Figure 34

2.10 SMAI_20_3 (Voltage Bus)

Repeat the procedure in item "2.9" and insert the block "*SMAI_20_3*" which will be responsible for the bus voltage channels.

🔤 Local Server\25 - PCM6	500				
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All 🗙	Plant Structure	1	2	3	^
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Control	REL650 Rel Configuration				
Current protection	B W Configuration	TRM 2 500	SMAI 20 2 8		
Frequency protection		A	8.00K 43P	Tensão_Linha	
Hardware 🎗	PSM_102		GR211 A2 GR212 A2		11
Impedance protection	BIO_3	IKM_2.CH7	GRP2L3 A4 GRP2N AN		
Local HMI functions	BIO_4		0:1[1:20]/2		
Logic 🏠	SETGRPS: 1	TKM_2.Ch8			
Metering	⊞®n Time				
Monitoring	Power system Power system Power system		_		
Scheme communication	PRIMVAL: 1		SMAI_20_3		
Station communication	Global base values		BLOCK AUSP REVROT AUT	Tensão_Barra	
Supervision 🗙	D GBASVAL:1	B TRM_2.CH9	GRP3L1 A/2 GRP3L2 A/3		
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Output					→ # X
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Figure 35

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Clicking on the icon highlighted in green and on the "*MainApp*" tab changes the name of the tab to "*CANAIS TENSÃO*", for example.

Local Server\25 - PCW	600			
<u>Eile E</u> dit <u>V</u> iew <u>T</u> ools	Eormat Insert IED Debug Window Help			
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Basic IED functions	🖃 🏮 25			E Misc
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Hardware 🏠	Choose Control (Dort (D)			
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			se	gunda-feira, 1 de julho de 2013 15:51:45 🛛 🕂 🥵

Figure 36

Close the "*Object Properties*" window and insert a new tab to create the fixed signals block.



Figure 37

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2.11 FXDSIGN (Fixed Signals)

Right-click on the new tab, choose the "*Insert Function Block*" option, click on the "+" sign near to "Logic" and finally choose the "*FXDSIGN*" block. In this block, the names of the variables for the logic level 1 state and for the off signals group are assigned.



Figure 38

Click on "Assign" in the next figure (didn't show) and assign two output variables one "*TRUE*" for logic level 1 and "*GRP_OFF*" for signal group off. These signals are needed for the next synchronization block.



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Change the name of the tab to "SINAIS_FIXOS".

🔤 Local Server\25 - PCI	4600			
Eile Edit View Tools	s Eormat Insert IED Debug Window Help			
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Logging Application Confi	guration			
			şı	egunda-feira, 1 de julho de 2013 16:16:21 ABB

Figure 40

Close the "Object Properties" window and insert a new tab to create the sync function block.

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Logging Application Confi	iguration							
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2.12 SESRSYN (Synchronism)

Right-click on the new tab, choose the "Insert Function Block" option, click on the "+" sign near to "Control" and finally choose the "SESRSYN" block. On the next screen (didn't show) click on "Assign".

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Metering	*	B Power system				QCBAY		
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Figure 42

Enter four input variables and one output variable and use the following nomenclature.



Figure 43

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Change the name of the tab to "SINCRONISMO".

🔤 Local Server\25 - PC/	4600			
Ele Edit View Look	s Eormat Insert IED Debug Window Help			
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Impedance protection	BIO_3	Tensão_Linha 🌫	BLKSYNCH MAA BLKSC TSTS	
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Figure 44

2.13 Binary Outputs

The last block to be created is the one for the binary outputs. So create a new tab as shown below.



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*	Plant 9			1	2	3	
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Figure 45

Right-click inside the new tab and choose "Insert Hardware Channel", then "Binary Output" and "Insert".

	Insert Page	Ctrl+Shift+P	
	Insert Variable		•
	Insert FunctionBlock	Ctrl+Shift+F	
	Insert Hardware Channel	Ctrl+Shift+H	
	Delete page	Ctrl+Shift+D	
	Select All	Ctrl+A	
89	Find	Ctrl+F	
	Lock	Ctrl+Shift+L	
	Figure 46		



Insert Hardware Channel	
Select a Hardware Channel Hardware Channels Binary Input Analog Input	
	Cancel

Figure 47

The next step is to choose the channel module " PSM_102 " and the binary output (BO4).

The Set Verw Tools Forms Deef III Debug Windwick Ibject Types Ibject Types <	🕮 Local Server\25 - PCM	600			. 7 X
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Comput Consistence channel Consistence ch	Hardware I/O	GBASVAL: 4		User Defined Name B04_P0	
Compute Configuration Concel Cancel Cancel Concel		GBASVAL: 6			
Application Configuration		⊞® Identifiers			
Application Configuration Application Configuration Application Configuration Application Configuration Application Configuration		Analog modules		UK Cancel	
Application Configuration		Reference channel service values ACVIDACE 1			×
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segundadeira 1 de julio de 2013 16 35 19 🔒 👪	- coases (oppication coming			secun	da feira 1 de julho de 2013 16:35:19 💧 🏦

Figure 48

Create an input variable using the name "*TRIP_25*". Change the name of the tab to "*BINARY_OUTPUTS*".



Local Server\25 - PCI	4600				
Eile Edit View Iook	; Eormat Insert IED Debug Window Help				
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Impedance protection					
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Logic 🎗	BIO_3				
Metering	BIO_4		PSM	_102.804_P0	
Monitoring	G SETGBPS 1				
Scheme communication 🕱	B → C Time	=			
Station communication	B Power system				
Supervision 🎗	Primary values PRIMVAL: 1		в		
Voltage protection	😑 — 😗 Global base values				
Hardware I/O	GBASVAL: 1				
	GBASVAL: 3				
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	GBASVAL: 6				
	a Communication		<	×	Name Name of work sheet
	B Analog modules		ANAIS_TENSÃO SINAIS_FIXOS	SINCRONISMO MainApp2 = 4 b	
re Application Configuration	AlsvBAS: 1	~	(H) (e) 1 of 1 (H)	()) 324,460	REL650 Application Configuration
Output					▲ ± ×
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Application Conf	nuration				
	geranori			se	gunda-feira, 1 de julho de 2013 16:37:47 ABB ::

Figure 49

Click on the icon highlighted in green in the following figure to validate the configuration then click on "OK" and save the configuration.

🕮 Local Server\25 - PCM	1600		
Eile Edit View Tools	: Eormat Insert IED Debug Window Help		
i D 🚅 🔲 🖪 🖪 🕷	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	• 🗃 🖬 🏭 💷 🖬 🖬 🖬 🖬 🖬 🖉 🗮 🗙	
Object Types 🔻 🕈 🗙	Project Explorer 🗸 🕈 🗙	50 - Parameter Setting REL650 - Application Configuration 🛡 📢 🗡	i Object Properties 🔷 🕈 🗙
All 🏠	Plant Structure	1 2 🔨	
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Logic 🗙	BIO 3		
Metering	BIO_4	TRIP_25 2 PSM_102.804_P0	
Monitoring	Control C		
Scheme communication	B Time		
Station communication	Power system		
Supervision 🕱	□	8	
Voltage protection	Global base values		
Hardware I/0	GBASVAL: 1		
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	GBASVAL: 4		
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re Application Configuration	□ AISVBAS: 1	(K) (K) 1 of 1 (H) (H) 11,-2	REL650 Application Configuration
Output			→ ‡ X
MainApplication Name F	Page No Description		
Cogging Application Confi	guration		
		\$	egunda-feira, 1 de julho de 2013 16:39:08 🛛 🕂 🤮

Figure 50

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



INSTRUMENTOS PARA TESTES ELÉTRICOS 3. Parameterization of the ABB REL650 relay

3.1 REL 650 Parameter Setting

Choose the top tab "*REL 650 Parameter Setting*" and click on the "+" signs near to "*Application Configuration* > *SINCRONISMO* > *Control*" and finally "*SESRSYN:1*".

	Project Explorer 🔻 🕈 🗙	REL650 - Parameter Setting	REL650 - Application Configuration			÷ 4 1
neral 🕱	Plant Structure	Group / Parameter Name	[ED Value [SG1/Common] PC Value [SG1/Common	n] Unit	Min	Max
neric IEC61850 IED 🔹	-B - 🖯 25	🖌 SESRSYN: 1				
b-Transmission IEDs 🛛 🗙		✓ GlobalBaseSel	1		1	6
insmission IEDs 🗶	B Bay	 Setting Group1 				
	REL650 IED Configuration	✓ Operation	Off			
	HW Configuration	✓ SelPhaseBus1	phase2			
		✓ SelPhaseBus2	phase2			
	B Power system	✓ SelPhaseLine	phase2			
	Communication Analog modules	✓ PhaseShift	0	Deg	-180	180
	i → S HMI	✓ URatio	1,00		0,20	5,00
	Annication	✓ OperationSynch	Off			
	CANAIS_TENSÃO	✓ FreqDiffMin	0,010	Hz	0,003	0,250
		✓ FreqDiffMax	0,200	Hz	0,050	0,500
		✓ FreqRateChange	0,300	Hz/s	0,000	5,000
	SESRSYN: 1	⊮ tBreaker	0,080	s	0,000	60,000
	ST REPORT OF ST	✓ tClosePulse	0,200	s	0,050	60,000
		✓ tMaxSynch	600,00	s	0,00	6000,0
		✓ tMinSynch	2,000	s	0,000	60,000
		✓ OperationSC	On			
		V UDIFISC	15.0	%UB	2.0	50.0
		<				

Figure 51

Activate the function and make the following adjustments:



iect Types 🗸 🗐	Project Explorer	T A X DEL 650 - Parameter Setting	PEL650 - Application Configu	ration			- 4
eral	Plant Structure	Group / Parameter Name	IED Value [SG1/Common]	PC Value [SG1/Common]	Unit	Min	Max
eric IEC61850 IED		SESRSYN: 1					1
Transmission IEDs	B Substation	GlobalBaseSel		1		1	6
smission IEDs	B Bay	Setting Group1					
	🖨 — 🔝 REL650	Operation	1	Dn			
	IED Configuration IED Configuration	SelPhaseBus1		phase1			
	Activate setting group	SelPhaseBus2		phase1			↓ ↓
	tarining Time tarining Power system	SelPhaseLine		phase1			
	Communication	PhaseShift)	Deg	-180	
	B R HMI	URatio		1,00		0,20	5,00
	🕀 😵 Monitoring	OperationSynch		Diff			
	CANAIS_TENSÃO	FreqDiffMin		0,010	Hz	0,003	0,250
		FreqDiffMax		0,200	Hz	0,050	0,500
	E Gontrol	FreqRateChange		0,300	Hz/s	0,000	5,000
	SESRSYN: 1	tBreaker		0,080	s	0,000	60,000
		tClosePulse		0,200	s	0,050	60,000
		tMaxSynch		10,00	s	0,00	6000,0
		tMinSynch		D,000	s	0,000	60,000
		OperationSC		Dn			
		UDiffSC		25.0	%UB	2.0	50.0
		Celerted parameter: SESD SVN: 1/Settin	og Group 1/MapEperg [0,000, 6	0.0001 c			_
sut			a a status version à l'ofonorio				_
nuc	l II						
7/2013 17:02:19	Parameter (SESBSYN: 1/Setting Group1/Operation	n) value modification has effected to parameter (SESBSY)	N: 1/Setting Group1/MapEperg	OBDI 1 properties	_		
	a anasor (aconta the machine properties	rano mounoaren nas enotida lo parameter (o contro n	re. In covering an output interforge	s o o el propositios.			

Figure 52

Click on the highlighted button in the figure below to save the adjustments after performing the parameterizations.

🔤 Local Server\25 - PC	M600						
Eile Edit View Ioo	s <u>I</u> ED <u>Wi</u> ndow <u>H</u> elp						
	🛍 🗠 🚼 🖬 📰 🔍 🤅 🖞 🖞 🖪 🗖 🖃 🛃 Al paran	neters 🔹 🚽 🖶 🚺	•				
Object Types 🛛 🔻 🛱 🗙	Project Explorer 🗸 🗘 🗙	REL650 - Parameter Setting	REL650 - Application Config	uration			* 4 Þ *
General 🎗	Plant Structure	Group / Parameter Name	IED Value [SG1/Common]	PC Value [SG1/Common]	Unit	Min	Max 🔥
Generic IEC61850 IED		FreqRateChange		0,300	Hz/s	0,000	5,000
Sub-Transmission IEDs	Substation	tBreaker		0,080	s	0,000	60,000
Transmission IEDs	B Bay	tClosePulse		0,200			
	🖻 — 🜄 REL650	tMaxSynch		10,00	s	0,00	6000,00
	HeD Configuration	tMinSynch		0,000	s	0,000	60,000
	G Activate setting group	OperationSC		On			
	tal — 10 Time ⊛ — 10 Power system	UDiffSC		25,0	%UB	2,0	50,0
	Generation	FreqDiffA		0,300	Hz	0,003	1,000
B → Co Analog modules B → Co HMI B → Co Monitoring B → St Application Configuration	talinini vo Analog modules talinini vo Analog modules	FreqDiffM		0,300	Hz	0,003	1,000
	Product ED Window Help Image: Substation Image: Substation Image: Substation Image: Substation	PhaseDilfA		25,0	Deg	5,0	90,0
	Application Configuration Advals_TENSÃO	PhaseDiffM		25,0	Deg	5,0	90,0
	SINAIS_FIXOS	ISCA		0,000	s	0,000	60,000
	B SINCHUNISMU	ISCM		0,000	s	0,000	60,000
	O SESRSYN: 1	AutoEnerg		Off			
	SAIDAS_BINAHIAS	ManEnerg		Both			
		ManEnergDBDL		Off			
		tAutoEnerg		10.000	8	0.000	60.000
		v tManEnerg		0.100	s	0.000	60.000
				2023			
		<					>
		Selected parameter: SESRSYN: 1/Setting	g Group1/tManEnerg [0,000.	60,000] s			
Output							→ 4 ×
Date and Time	User Message						^
1/7/2013 17:02:19	Parameter [SESRSYN: 1/Setting Group1/Operation] value modification	ition has effected to parameter [SESRSYN	I: 1/Setting Group1/ManEner	gDBDL] properties.			
1/7/2013 17:02:19	Parameter (SESRSYN: 1/Setting Group1/Operation) value modifica	ition has effected to parameter [SESRSYN	1: 1/Setting Group1/tAutoEne	rg] properties.			
1///2013 1/:02:19	rarameter (5005111: 1/Setting Group 1/Operation) value modifica	ition has enected to parameter [555H511N	i. 175etting tatoup17tManEne	ig) propences.			~
Logging Application Con	iguration Ell REL650 - Parameter Setting						
				segunda-feira, 1 (de julho de	e 2013 17:08:	39 ABB

Figure 53

Right-click on the relay icon and submit the changes. In the following message click on "Yes".



📟 Local Server\25 - PC	M600							
File Edit View Too	ils IED Window Help							
0 🗃 🖬 🍯 🐒 🖻	b 🛍 🗠 🔃 🗗 🗖 🗍	🛛 🗄 🧯		parameters 💦 🚽 🔂 🛥 🛙 🖽 🚺	• 🚹			
Object Types 🛛 🔻 🛱 🗙	Project Explorer		Collapse	REL650 - Parameter Setting	REL650 - Application Config	juration		- 4 Þ ×
General Constraints of the termination of terminatio of termination of termination of termination of	Plant Structure		Signal Monitoring Disturbance Handling Event Viewer Parameter Setting Application Configuration Signal Matrix Graphical Display Editor Hardware Configuration IED Users IED Compare IEC 61850 Configuration Communication Management License Update Tool Set Technical Key Create Template Liport Export Export Read from IED Write to Exameters	Group / Parameter Name REL650	L IED Value (SG 1/Common)	PC Value (SG1/Common) Unit	Min	Max
			Configuration Language		Ω.			
Output			Documentation I					→ 中 ×
Date and Time	User Mess	age 🐰	Cut					^
1/7/2013 17:02:19	Paran	neter [SESF	Сору	fication has effected to parameter [SESRSY	N: 1/Setting Group1/FreqDiffN	1] properties.		
1/7/2013 17:02:19	Paran	neter (SESP	Delete	fication has effected to parameter ISESBSY	N: 1/Setting Group1/AutoEne	g properaes. ral properties.		-
Concernent Application Con	figuration Ell REL650 - Parameter	Setting	Rename			31 holes (max		<u>×</u>
aller al relations (ou co)	and a resource of the second		Properties			segunda-feira, 1 de julh	o de 2013 17:12:25	ABB





4. Synchronism software adjustment

4.1 Opening the software

Open the Conprove Test Center (CTC) software, shown in the figure below.





Click on the Synchronism software icon.







Figure 58

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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.



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.

tings	
General	General Inform. System Notes & Obs. Explanatory Figures Check List Others Connections
Synchronism	Descr: Check Synchronism Date:
	Tested device:
	Identif: 23031982 Model REL650 Type: Line Protection Manufacturer: ABB
	Location:
	Bay: CONPROVE
	Address: Visconde de Ouro Preto, N°75 - Custódio Pereira Neighborhood
	City: Uberlândia
	Name: Michel Rockembach de Carvalho V
	Sector: Engineering V Registry: 00001 V
	CE-6006 Series Num.: 16501166302101110011XXX
~	
Default 🗸	Preferences <u>O</u> K <u>C</u> ancel

Figure 60

4.3 System

In the following screen, within the Nominal sub tab, the frequency values, 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 61

There are other tabs where the user can enter "*Notes & Obs., Explanatory Figures,*" can create a "*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.

5. Channel Targeting and Hardware Configurations

Click on the icon illustrated below.

👯 🗋	<i>i</i> 🚽 🗧	Synchronism	n 2.02.163	3 (64 Bits)	- CE-60	006 (1650116)	
Arquivo	Home	Display	Softwar	e Option	s		
Channels Direc	😭 Hrd Se Ø Sync. S 📢 Conne Hare	:t ् ^s o GOC Set ⁵, SV S :ction dware	OSE Set Set	Start	Stop	 Next Point Next Line Generation 	✓ Clear test ✓ Clear all



Then click on the highlighted icon to configure the hardware.





Figure 63

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



ster Slave	Binary Outputs: Auxiliar Source	e:
	Initial State 25	0 V
odel: CE-6006 ∨ Senal Nº: 16501166302101110011XXX	BO1: NO ~	o v o
nalog. Outputs: . () Default () Free	BO2: NO V	
Default - Voltages:	BO3: NC ~ - 11	0 V
● 6 x 300 V; 90 VA	- 60	V
O 3 x 300 V; 90 VA	- 48	v
O 3 x 300 V; 150 VA	- 24	v
O 3 x 600 V; 150 VA	Clamp Scale	
O 2 x 300 V; 200 VA	IA: 100mV/A (10A) ~	ner
	IB: 100mV/A (10A) ~ Off	f
	IC: 100mV/A (10A) V 220.00 V	_
	Binary Inputs:	
O Not Used Connect VTs	Contact 5 Vpk 50 Vpk 10	10 Vp
Default - Currents:	BI1 & BI2:	
O 6 x 20 A; 90 VA		
○ 3 x 20 A; 90 VA ∨	BI3 & BI4:	
O 3 x 20 A; 150 VA	BI5 & BI6:	
○ 3 x 40 A; 150 VA	BI7 & DI2	
🔾 2 x 60 A; 200 VA		
O 1 x 120 A; 400 VA 11 12 13 14 15 16		
Electromechanical:		
O 2 x 20 A; 400 VA		
O 1 x 30 A; 600 VA		
○ 1 x 24 A; 1100 VA		

Figure 64

On the next screen choose "Basic" and on the next window (didn't show) choose "YES", finally click on "Confirm".

Cha	nnels Direct.			– 🗆 X
Local	Model Reset for Hard. CE-6006 V Connected	Set O Advanced	- ⁶ - 0005	Confirm
Remotes	Serial Number: 16501166302101110011XXX	 ON Line 	^s _o S. Value	Import Export

Figure 65

6. Synchronism Adjustments

6.1 Synchronism > Systems Screen

Click again on the "Settings" icon and then "Synchronism > Systems". In this tab, the data of system 1 must be inserted, specifying its composition: Single-phase, Three-phase FN or Three-phase FF. The reference voltage must be adjusted, and depending on the case, it is necessary to compensate for the phase shift inserted by the transformer.



For system 2, it must be configured similarly to system 1 regarding its composition and reference voltage. In this same screen, the primary and secondary voltage values are adjusted, in addition to the primary and secondary currents. For the circuit breaker, the time value for its effective closing must be entered. There is also the *"Equal Levels of System 1"* field, which when selected, equals the voltages of system 2 to system 1.



Figure 66

6.2 Synchronism > Sync. Settings

This screen stipulates the differences in voltage, frequency and the maximum tolerable angle for synchronism to occur. The maximum and minimum permitted voltage and frequency values are also adjusted so that synchronism occurs. These values are adjusted in percentage referring to the nominal values of the system 1. Also set the maximum time for synchronism to occur (adopted 10.0s) and the relative and absolute tolerances for voltage, frequency, time and the absolute tolerance for the angle. Tolerances are adjusted according to the values in Appendix A.



	INSTRUMENTOS PARA	
Settings		×
General	Systems Sync. Settings	Defined Values Based on Primary
Synchronism	✓ dV's in% of VRef dVMax+: 25,00 % VMax Sync. Rou dVMax-: -20,00 % Vmin Sync. Rou dFMax+: 0.30 Hz FMax Sync. Rou dFMax+: -0.30 Hz FMax Sync. Rou dAngMax: 25,00 ° Voltage Tolerance: Rel: 0.50 % Abs: 0.33 V Freq Tolerance: Rel: 0.50 % Abs: 0.02 Hz Time Tolerance:	ute: 150,00 % Max Time Sync.: 10.00 s .te: 50,00 % Min Time Sync.: 0.00 s .te: 150,00 % Zona Morta dFMax Dead Zn: 0,00 Hz .te: 50,00 % dFMin Dead Zn: 0,00 Hz dFMin Dead Zn: 0,00 Hz
	Rel: 0.50 % Abs: 25,00 ms	
Default 🗸		Preferences <u>Q</u> K <u>C</u> ancel

Figure 67

NOTE: Although the voltage difference is 25% of the nominal, the relay only synchronizes with at least 80% of the voltage value. Therefore, the upper deviation is worth 25% and the lower deviation is 20%.

7. Test Settings

On the "Test Settings" tab, the voltage generation channels and the stopwatch interface must be correctly directed. The binary input responsible for the synchronization function is BI01. Check the options "Enable Pre-Simulation 1", "Enable Post-Simulation" both in "Nominal - Not Sync." for 100ms and 200ms.



¥	163 (64 Bits) - CE-6006 (1650116) ware Options			– a × ^ 0
Channels Direc Hrd Set & Soco Se Se Sync. Set % SV Set Connection Hardware	et Start Stop > Next Point d Clea > Next Line d Clea Generation	r test r all Settings Sync. Options	Present Report Units Layout	
Trigger Search Trajectory Test Se	ettings			
Generation Channels Direction	Enable Pre-Simulation 1	Enable Pre-Simulation 2	Enable Post-Simulation	Inv. Phase VTs S1
Generation Channel Va_S1 A0_V01 (Hd: V1) Vb_S1 A0_V02 (Hd: V2) Vc_S1 A0_V02 (Hd: V2) Va_S2 A0_V04 (Hd: V3) Va_S2 A0_V04 (Hd: V4) Binary Outputs & Goose - Simulation B0 0: 0: 0: 0: 0 GO Simulate Sampled Value Error	Mode Nominal - Not Sync. ✓ V1 66,40 V 0 * V2 66,40 V 280.0* V3 66,40 V 120,0 * V4 66,40 V 180,0 * U4 66,40 V 180,0 * Simple Si		Mode Nominal - Not Sync. V1 66.40 V 0* V2 66.40 V 120.0* V4 66.40 V 180.0* Time Post Simulation: 200.00 ms Binary Outputs & Goode - Post Simulation BO BO 0.0.0.0.0.0	□ Inv. Phase VTs S2 Search Test Initial step: [Mn. Resolution ~
Interf. V> Disab. ~	Interf.f> Disab. ~			Absol. 10.00 mHz Absol. Vol.: 100.00 mV Rel. Freq.: 10.0 % Rel. Vol.: 1.00 % Wait time for every incrementation: 300.00 ms
Stop Interf. BI01 (Hrd: BI1) Trigger Interf. Software Wat for PPS	Stop Logic Initial NA V Trigger Logic Trigger Delay 0,00 s			Protection Status Verification: Statu/End Test ✓ ▲ Ignore Pre-Fault operation □ ✓ Based Only on Values Generated Cycle to Cycle Generation ✓
🚯 ON Line New		Aux S	ource: 220,00 V Heating: 0%	
			Figure 68	

8. Trigger Test

In the trigger test, points inside and outside the synchronism zone are verified. The points represent the difference in voltage and frequency with respect to system 1. You can also specify an angle difference for the two systems. To insert the points click on *"New Point"* and choose a point directly on the graph and then on the item *"Confirm"*. Another option is to choose the voltage, frequency and angle difference values by writing these values in their respective fields. The last option would be to click on the *"Sequence"* option and choose an angle step so that several points are automatically created on the edges of the sync zone. The nominal values of voltage and frequency of system 1 must be adjusted. The figure below illustrates this situation.



🄻 i 🗋 💕 🔙 = i	Synchronism 2.02.163 (6	4 Bits) - CE-6006 (1650	0116)				×
Arquivo Home	Display Software O	ptions					^ (
Channels Direc Hard	୍କୃତି GOOSE Set t କୃତ SV Set tion vare	tart Stop > Next	t Point 🧹 Clear test t Line	Settings	veform sors c. Present Report Report	Control A 20 A 2	t Rereate Restore View Charts Layout - Layout
Trigger Search T	rajectory Test Settings						
Insert/Edit Point Insert/Edit Point Insert/Edit Point Edit Point Sequence Bemove Remove &	General Options System 1 V F-N: 66.40 V f: 60.00 Hz Ø: 0.00 *	Sequence Sequence Step: Number of Poin	30.00* ts: 24 <u>Confirm</u>	Cancel	·	Chart ΔV [ΔV [10.00	Veverorm P Phasors / Synchonism
Test Points					•		
Foints Tested	Curter						dF: 0 Hz
No. V	ΔV Freq	ΔFreq Ø	ΔØ	ν Δν	reakerClosing C Freq ΔFi	-10,00	
 Syst. 2 Brk Cr Errors List Pro ON Line 	id 🕑 Brk Close 🕑 Repl tection Status New	y			> Aux Source: 220	-3 00 V Heatir	-300.0m -200.0m -100.0m 0 100.0m 300.0m ating: 0%

Figure 69

Choosing the sequence with a step of 30.00°, phase-neutral voltage of 66.40 volts, frequency of 60.00Hz and clicking on the button *"Confirm"* the following points are create:



The next step is to start the generation through the "Start" button or the shortcut "Alt + G". The figure below shows the final test result.



	Hrd Se Sync. S Conne Harc	et 🧐 Gi Set ୩୦୦୦୦ ection dware	DOSE Set / Set	Start Stop	> Next >> Next Generati	Point 🧹 Cle Line 🕳 Cle on	artest arall Se	ttings 🕂 Syn	veform sors c. Preser Repor Repo	nt at		Recreate Restore View Charts Layout		
ger	Search	Trajectory	Test Settings											
Ins ert/ Tes nts 1	rt/Edit Poin Edit Points ested	deneral System	Options 1	. Svster	m 2					• • •	Chart	Waveform Phasors Synchonism		□ Legend: •
		Breake	r Closing											Points Tested
D .	Δ٧	Freq	∆Freq	ø	ΔØ	Reply Nominal	Reply Real	Time Sync.	Status	^	10,00			Colors: NT OK E
	-	-		-	-	Not Sync.	Not Sync.	-	Passed					25,00 REF -2
	-12.93 V	60,00 Hz	0 Hz	0 °	0 °	Sync.	Sync.	204,0 ms	Passed					
	-	-	-	-	-	Not Sync.	Not Sync.	-	Passed		0	• •	• •	
	-12,93 V	60,13 Hz	134,0 mHz	-17,49 °	-17.49 °	Sync.	Sync.	217,1 ms	Passed					dE-221.0 mHz
	-	-	-	-	-	Not Sync.	Not Sync.	-	Passed			•	•	
	-8,91 V	60,28 Hz	279,0 mHz	-16,41 °	-16,41 °	Sync.	Sync.	125,4 ms	Passed		-10.00			
	-	-	-	-	-	Not Sync.	Not Sync.	-	Passed					
										`			AU- IL	ia)



9. Trajectory Test

This test has the same objective as the "Trigger Test", finding the moment of synchronism, however the big difference is that the voltage and current values of system 2 vary over time. Differently from what happens in the "Trigger Test" where these values are fixed. To perform the test, use the "Sequence" option with the step equal to 30.0° reaching the following screen.



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Clicking the "Confirm" button automatically creates the lines shown below:



Figure 73

The next step is to start the generation through the "Start" button or the shortcut "Alt + G". The figure below shows the final test result.

annel Direc	Hrd Se Sync. S Conne	t 🧐 GC et ªu SV ction	OOSE Set Set	Start Stop	> Next	Point 🧹 Clei Line 🕌 Clei	ar test ar all Settin	B How Waveform Ho	Present Report	C ∧ ∆% P i is abs rel	Recreate Restore View Charts Layout					
	Hard	ware			Generati	on		Options	Report	Units	Layout					
gger	Search T	rajectory	Test Settings	3					_	Chart	Waveform V Phasors V	Synchonism				
sert/ Ng <u>S</u> Test	Edit Edit Line w Line v equence t Points	General System V F-N: f: Ø: Genera	Options 1 66,40 V 60,00 Hz 0,00 * tor	Start S Δt Δt	System / F-N: [-13,9 : [0,00 ð: [0,00 System	4 V O) V F-N: 52,40 f: 60,00 Ø: 0.00	V Hz	-	20.00 - <u>A</u> ∀-						Legend: Line not Tested: Line Tested Colors: NT OK En 25.00° REF -25/
lo.	·Closing ∆Freq	ø	Δø	Reply Nominal	Reply Real	Time Sync.	Status			o				•	-	dV:-13.06 V (tol.)
	225,4 mHz 0 Hz	-16,34 ° 0 °	-16,34 ° 0 °	Sync. Sync.	Sync. Sync.	3,40 s 494,9 ms	Passed Passed			10.00						dA: 0,000977 ° dF: 0 Hz
	-225,4 mHz	16,14 *	16,14 *	Sync.	Sync.	3,40 s	Passed			-10,00						
	0 Hz	0,000977°	0,000977°	Sync.	Sync.	0,660 s	Passed					•				
Gen	erator ⊡ St	art Syst.	Final Syst.	Brk Cmd	Brk Close	Reply	-		>	-20,00	-300,0m -200,0m -	100.0m 0	100,0m 2	200,0m 3	∆Hz-[Hz] 100,0m	

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10. Report

After finishing the test, click on the "*Present Report*" icon 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	×
Language Inglês En-US 🗸 🗸	
 All General Data Test General Data of Tested Device Location Reference Values Hardware Settings Test Settings Y Test Settings Y Test Results Charts of Selected Simulation Notes and Observations Explanatory Figures Check List Connections 	
OK Cancel	

Figure 75



Figure 76

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APPENDIX A

A.1 Terminal Designations





Table 527: Auxiliary voltage supply of 110...250 V DC or 100...240 V AC

0.022

1912/07/2012

Case	Terminal	Description	
6U half 19"	X410-1	- Input	
	X410-3	+ Input	

able 526:	Analog input i	nodules			
Terminal	TRM 6I + 4U	TRM 8I + 2U	TRM 4I + 1I + 5U	AIM 6I + 4U	AIM 4I + 1I + 5U
X101-1, 2	1/5A	1/5A	1/5A	1/5A	1/5A
X101-3, 4	1/5A	1/5A	1/5A	1/5A	1/5A
X101-5, 6	1/5A	1/5A	1/5A	1/5A	1/5A
X101-7, 8	1/5A	1/5A	1/5A	1/5A	1/5A
X101-9, 10	1/5A	1/5A	0.1/0.5A	1/5A	0.1/0.5A
X102-1, 2	1/5A	1/5A	100/220V	1/5A	100/220V
X102-3, 4	100/220V	1/5A	100/220V	100/220V	100/220V
X102-5, 6	100/220V	1/5A	100/220V	100/220V	100/220V
X102-7, 8	100/220V	100/220V	100/220V	100/220V	100/220V
X102-9, 10	100/220V	100/220V	100/220V	100/220V	100/220V

Terminal	Description	PC	/1600 info
		Hardware module instance	Hardware channel
X307-5	120	PSM_102	BO3_PO_TCS
X307-6	+		
X307-7	Power output 4, normally open	PSM_102	BO4_PO
X307-8			
X307-9	Power output 5, normally open	PSM_102	BO5_PO
X307-10			
X307-11	Power output 6, normally open	PSM_102	BO6_PO
X307-12			



Table 539: Output contacts X307, 6U half 19"

Terminal	Description	PCM	600 info
		Hardware module instance	Hardware channel
X307-13	Signal output 1, normally open	PSM_102	BO7_SO
X307-14			77.02
X307-15	Signal output 2, normally open	PSM_102	BO8_SO
X307-16			
X307-17	Signal output 3, normally open	PSM_102	BO9_SO
X307-18			

A.2 Technical Data

Technical data

Table 223:

SESRSYN technical data

Function	Range or value	Accuracy	
Phase shift, _{qline} - q _{bus}	(-180 to 180) degrees	6. la	
Voltage ratio, U _{bus} /U _{line}	0.2 to 5.0		
Frequency difference limit between bus and line	(0.003-1.000) Hz	± 2.0 mHz	
Phase angle difference limit between bus and line	(5.0-90.0) degrees	± 2.0 degrees	
Voltage difference limit between bus and line		± 0.5% of U _r	
Time delay output for synchrocheck	(0.000-60.000) s	± 0.5% ± 25 ms	8
Time delay for energizing check	(0.000-60.000) s	± 0.5% ± 25 ms	
Closing time for the circuit breaker	(0.000-60.000) s	± 0.5% ± 25 ms	



APPENDIX B

Equivalence of software parameters and the relay under test.

Table 1			
Software Sincronismo		ABB REL 650 Relay	
Parameter	Figure	Parameter	Figure
Secondary Voltage (FF) System 1	61	VT sec6	19
System 2 Ref	66	VT sec9	19
Secondary Voltage (Ph-Ph)System 2	66	URatio* Nominal VABC	52
dVMax+	67	UDIffA	53
dVMax-	67	-20% (Appendix C)	
dFMax+	67	FreqDiffA	53
dFMax-	67	FreqDiffA (negative signal)	53
dAngMax	67	PhaseDiffA	53

APPENDIX C

