

INSTRUMENTOS PARA TESTES ELÉTRICOS Test Tutorial

Equipment Type: Protection Relay

Brand: General Electric - GE

Model: <u>SR 469</u>

Function: <u>32R or PDOP – Power Directional</u>

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

Objective: Perform tests on the reverse power function to verify its directionality.

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial release	12/05/2022	M.R.C.	G.C.D.P.



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Suggestions for improvement of this material are welcome, just user contacts us via email suporte@conprove.com.br.

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

This document is intended as a guide only; the manual of the equipment under test should always be consulted.



The equipment generates high current and voltage values during its operation. Improper use of the equipment can result in material and physical damage.

Only suitably qualified people should handle the instrument. It should be noted that the user must have satisfactory training in maintenance procedures a good knowledge of the equipment under test and also be aware of safety standards and regulations.

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Sequence for testing the GE SR469 relay in the Power Directional 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 H12 on the relay terminal and the negative (black terminal) of the Aux Source Vdc to pin H11 of the relay terminal.



1.2 Current and Voltage Coils

To establish the connection of current coils, connect current channels I1, I2 and I3 to pins G6, G7 and G8 and connect the commons of current channels to pins H6, H7 and H8 of the relay terminal. In the same way, to establish the connection of the voltage coils, connect the voltage channels V1, V2 and V3 to the relay pins G2, H1 and H2 respectively, connecting the three common ones to the G1 pin.



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1.3 Binary Inputs

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

• BI1 to pin E2 and its common to pin F1.

The following figure shows the details of the connection.



1.4 Access

To gain access to the relay parameters without the need to use a password, short circuit pins C1 and C2.



KTD3 RTD9 RTD11 RTD11 RTD12 III IIII RTD12 IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	A16(A17)A18 	A19/A20/A21 3+ 4+4 OUTPUTS SHO -POT !	A22(A23)A2 +24 11+ 72 vide ANULC vccess - c2 TEST + c3 - c4	
ାରରରାରରରାରରେ ଭାରରରାରରେ ଭାରରରାରରେ ଭାରରରାର ଭାର				

2. Communication with the SR 469 relay

Before starting the test, open the "*EnerVista*" software and download the SR 469 relay software, if you already have it, click on the icon below:



In the "EnerVista SR 469" software select: "Communications -> Quick Connect".

<u>File Setpoint</u> Actual	Communications View Help			
🖻 🖻 🔊 🖏 🕼	🖶 🔁 Device Setup			
	😥 Quick Connect			
A Device Setup	Troubleshooting			
Device	Upgrade Firmware			
	Load Analyzer Data			
- (Solar - Solar - Sol	Save Analyzer Data			



On the next screen choose the serial option, check which port is being used (in this case COM 1) and in "*Baud Rate*" choose 9600.

Quick	ly connect 469 Setup to a 469 Device
Interface	Serial
COM Port	СОМ1
Baud Rate	9600
	Connect Cancel
	Etamo 7



Then click on "Connect". The following figure shows the message after connecting.



Figure 8

3. SR 469 Relay Settings

3.1 469 Quick Connect

General relay settings will be available after clicking the "+" sign next to "Quick Connect" and "469 Quick Connect" as shown below.



3.2 System Setup

The next step is to configure the voltage, current, rated frequency, voltage and current transformer ratio as well as the phase sequence. To do this, click on the "+" signs next to "Settings" and "System Setup".



3.3 Current Sensing



With a double click on "*Current Sensing*" the window below will be opened, where the values of the CT, the nominal current of the motor must be adjusted and the option to enable two speeds for the motor must be turned off.

Current Sensing		
SETTING	PARAMETER	
Phase CT Primary	250 A	Save
Motor Full Load Amps	211 A	
Ground CT Type	5 A Secondary	Restar
Ground CT Primary	250 A	
Phase Differential CT Type	5 A Secondary	🔛 Defau
Phase Differential CT Primary	250 A	
Enable Two Speed Motor Option	Off/No	

Figure 11

After the necessary modifications, click on "*Save*" and in the following message, click on "*Yes*" (This process must be repeated whenever a change is made to any parameter).



Figure 12

3.4 Voltage Sensing

Now double click on *"Voltage Sensing"* the following screen should be adjusted. It adjusts the type of connection with the VT, the transformation ratio, remembering that 3300/115 is equal to 28.69, and finally the rated voltage of the motor.

Voltage Sensing		
SETTING	PARAMETER	
VoltageTransformer Connection Type	Wye	量 Save
Enable Single VT Connection	Off	
Voltage Transformer Ratio	28.69 :1	Besto
Motor Nameplate Voltage	3300 V	
		🖽 Defau

3.5 Power System



With a double click on "Power System" the nominal frequency and the phase sequence are set.

Power System		
SETTING	PARAMETER	T. There are a second s
Nominal System Frequency	60 Hz	Save
System Phase Sequence		
		B Restore
		🔛 Default

Figure 14

3.6 Reverse Power

The next step is to configure the pickup and actuation time values of the underfrequency and overfrequency functions. To do this, click on the "+" signs next to "*Protection*" and "*Power Elements*".





With a double click on *"Reverse Power"* perform the following adjustments. Pay attention for the value of 100 kW referred to the primary.

📓 Reverse Power // Q	uick Connec	t: 469 Quick Connect: S	🗖	
Reverse Power				
SETTING	i i i i i i i i i i i i i i i i i i i	PARAMETER		L
Block Reverse Power	From Start	0 s		🛗 Save
Reverse Power Alarm		Off		
Reverse Power Trip		Unlatched		Restore
Reverse Power Trip R	elays	Trip		
Reverse Power Trip L	evel	100 kW		🔛 Default
Reverse Power Trip D	elay	1.0 s 🚔 🕽		
469 Quick Connect S	ettings: Prote	ection: Power Elements		11.

Figure 16

4. Power Directional software adjustments

4.1 Opening the Power Directional

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



Click on the Power Directional software icon.



	Conprove Test Ce Version 2.02.182	enter	
General General Tests Quick QUICK	Secondary Secondary Tests	Measurement Applications for measurement R Multimeter	
Primary Primary Tests	Master ∰ Meter ∰ Power Quality ↓ PSB OoS Mamp ↓ Harmonic Restraint Sequencer	Setup Equipment Set. / Tests Settings Update Firmware Software Language	¥
 € CT ☆ VT ☆ Transformer Ω Resistance ♀☆ PMaster 	 Synchronism Overcurrent Transducer Transient Playback Volts/Hertz 	Support Documentation and assistance Diffunctionals Videos	
	Other Additional applications Transient View Validate PDF Reports Statistical Analysis 	Contact 로 Forum 델 User Manual 《 Quick Guide 오 Self-diagnosis 요금 Remote Access	`

Figure 18

Config Hrd 😵 Config GOOSE	ettings		×
Direc S hannels () Connection	General	General Inform. System Notes & Obs. Explanatory Figures Check List Others Conn Test:	nections
hooting Search Route Test Settings	Directional Power	Desor. Date:	
Insert / Edit Points		Tested device:	
Insert / Edit General Options		Identif: Model	Туре АВС
Edit Point Definitions		Type: V Manufacturer:	Subtile:
NEW Point			Untested Points
Load: Ind V cosØ		Substation	Tested Points
Sequence P: 0,00 W Q:		Bay:	Colors NT OK Erro
Remove I: 0.00 A V		Address:	5: 1,305 VA ; Ø: 131,399*
System Angle		City:	State:
Remove All		Responsible:	
		Name:	
Test Points ested Points		Sector: Registry:	
		Tool Test:	
No. S [VA] AngS ["] P [W] Q		CE-6710 Series Num.: 09703227CCM33222211U5F	IVRGLGLGL2Z0RXD
L		<u></u>	
Tipo: Points 🗸 🗌 General Info 🔽 Powe	Default 🔽		OK Cancel
Error List Destastion Status		1 1 to manual	

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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.

	General Inform	Sustem N	tes & Obe	Evolution	Figures 1	Check List	Other	Connections		
General		System IV	ites a obs.	Explanatory	rigues	CHECK LISU	Others	Connections		
Directional Power	Descr:	Reverse Powe	r Directional			I	Date:	12/05/2022 09:1	1:18	
	Tested device:									
		Identif:	23031982		~	N	Nodel	SR469		~
		Type:	Motor Prote	ction	~	Manufac	turer:	GE		~
	Location:									
		Substation:	Conprove							~
		Bay:	1		~					
		Address:	Visconde de	e Ouro Preto 7	5, Custódio Pe	ereira				~
		City:	Uberlândia				~		State:	MG ~
	Responsible:									
		Name:	Michel Roc	kembach de C	arvalho					~
		Sector:	Engineering	1	~	Reg	gistry:	00001		~
	Tool Test:									
	CE-6710			\$	Series Num.:	097032270	CM3322	22211U5HVRGLO	GLGL2Z	RXD

Figure 21



4.3 System

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



Figure 22

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.

5. Channel Direction and Hardware Configurations

Click on the icon illustrated below.





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".



ings	
aster Slave 1 Slave 2	Main Sampled Value Others
Model CE-6710 Serial Number 09703227CCM33222211U5HVRGLGLGL2Z0RXD Analog Outputs:	Binary Outputs: Auxiliar Source: Initial State Initial State BO1: NO BO2: NO BO4: NC
2 x 600 V; 180 VA V1 V1 V1 2 x 300 V; 150 VA V2 V1 V2 1 x 600 V; 350 VA V3 V3 V3 1 x 300 V; 250 VA V4 V4 V4	BO5 and BO6 type: Conventional BO5: NO ∨ BO6: NO ∨ IRIG (BO5) /Clock (BO6) - 24 V O IRIG (BO5) /Clock (BO6) - 0ther
Customized Assoc.	Transistor O TTL 110,00 V Binary / Analog Inputs: BI1: BI - Contact BI2: BI - Contact
3 x 64 A; 400 VA 2 x 96 A; 550 VA 2 x 10.00 A; 300 VA 1 x 192 A; 1100 VA 1 x 6,00 A; 360 VA	BI3: BI - Contact BI4: BI - Contact BI5: BI - Contact BI6: BI - Contact BI7: BI - Contact BI8: BI - Contact
Electromechanical:	BI9: BI - Contact BI10: BI - Contact BI11: BI - Contact BI12: BI - Contact Considers absolute values to Voltage-BI AI 1-6 : 2V; 20V; 600V AI 7-12 : 200mV; 2V; 600V
Customized Assoc. Connect CTs Range 1,25 A	OK Cancel

Figure 25

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

Cha	nnels Direct.			×
Local	Model Reset for Hard. © Basic		Confirm	
	CE-6710 V Connected Set O Advanced		Cancel	
ote	Serial Number:			
Rem	09703227CCM33222211U5HVRGLGLGL2Z0RXD V IN ON Line So S. Value	Exp	port	

Figure 26

6. Power Directional Adjustment

6.1 Directional Power Screen > Definitions

In this tab you can adjust the pickup definition, power, time and angle tolerances. These tolerances should be consulted in the relay manufacturer's manual (available in Appendix A). There is also the option of limiting a maximum value for both voltage and current.





Figure 27

6.2 Directional Power Screen > Directional Power Elements > Active

Here the reverse power directional element is configured. Click once on the highlighted "+" icon.





Figure 28

For the first element change the name to 32R, choose the directionality as reverse, set the pickup value and the run time. Remembering that the pickup value must be referenced to the secondary according to the following formula:

$$P_{secundary} = \frac{P_{primary}}{VTR * CTR}$$
$$P_{secundary} = \frac{100k}{(28,69) * (\frac{250}{5})}$$
$$P_{secundary} = 69,71W$$

In the "Individual Directionality" tab set the "Reverse" option, the maximum torque angle "ATM" should be set "Normal" and the positive and negative angular offset as 90° and -90° .





Figure 29

7. Test Structure for function 32

7.1 Test Settings

In this tab, you must configure the trip signal directed to the binary input, in addition to configuring the generation channels. Enter a pre-fault with rated voltage and current with a time of 100ms.



t <mark>⁰</mark> ₽	🗋 泸 🛃 🚽 Power Directi	ional 2	.02.171 (64 Bits) - CE-67	710 (0970322)							- 0 ×
Arqui	vo Start Display S	Softwa	re Optio	ns								^ ()
Dire	Config Hrd 😵 Conf Config Sync 5, Conf ec the Connection Hardware	fig GO fig SV	OSE	Start Stop	> Next Point >> Next Line	✔ Clear test ∰ Clear all	Settings	Report	Image Service Serv	Rebuild Restor Graphics Layout	re View	
Shoot	ing Search Route Test	t Setti	ngs									
Dire	c. Generation Channels		🕑 Ena	ble Pre-Simulatio	n 1	Enable I	Pre-Simulation 2	Enable	Post-Simu	lation		Modo de Teste
	Generation Channel		Mode	Trif. E	Ea, ABC							Mode V Const. ▼
Va	AO_V01 (Hrd: V1)	•	V1	66,40 V	0 *							V-FN 50,00 V
VE	AO_V02 (Hrd: V2)	•	V2	66,40 V	240,0 °							
Vo	AO_V03 (Hrd: V3)	•	V3	66,40 V	120,0 °							RTPDesloc / RTPPhase:
VE)	•										1,00
la	AO_I01 (Hrd: I1)	•	11	5,00 A	0 °							RTCTerra / RTCPhase:
lb	AO_102 (Hrd: 12)	•	12	5,00 A	240,0 °							1,00
lc	AO_103 (Hrd: 13)	-	13	5,00 A	120,0 °							Dry TP's Phase
IE		•										□ Inv. TP Shift
Bina BC GC	ary & Goose Outputs - Missing 0 0; 0; 0; 0; 0; 0; 0 0 Simulate Error Sampled Value	- - - / GO	Binary & BO GO Sin	re-Simulation Tim Goose Outputs 0; 0; 0; ulate Error Sam	ne 1: 100,00 ms - Pre-Simulation 1 : 0; 0; 0							☐ Inv. TC's Phase ☐ Inv. TC Terra
Dire	c. of the Interfaces of Operation				Initial NA 🗸	7						Initial step: Absolute Resolution: 100,00 mA
	Apparent			Interal Tria		1						Min Resolution V Relative Resolution: 0,10 %
	Id Curve 32R Start Interf. Software Wait for PPS	×	Starti	Interf. Trip BI01 (Hrd: E	BI1) V							Max Wat Time Region NO Operation: [2,00 s Wating Overline Operation Region: [100,00 ms Reset time; [100,00 ms Number of renations in case of nemeration arror:] > > Based Only on Generated Values @ Cyclet to Cycle Generation @
63	ON Line New						Aux font	110,00 V	Heat	ing: 0%		

Figure 30

7.2 Shooting Screen

In this tab click on *"Sequence"* and choose the value of the initial and final power and the step. Repeat the process for the angles as shown in the following figure.

🥵 🗋 🚔 🚽 Power Directional 2.02.171 (64 Bits) - CE-6710 (0970322)	х
Arquivo Start Display Software Options	^ (
Channels & Connection	Waveform Phasors Trajectory Report Liblit Report Liblit Report Liblit Report Liblit Report Liblit Report Liblit Report Liblit Report Liblit Report Liblit Report Liblit
Shooting Search Boute Test Settings	ins Report Onius Layout
Insert / Edit Points	Graphic Waveform Phasors Trajectories
Inset / Edit General Options Edit Point Text Type ABC NEW Point Definitions Sequence Sequence Ist: 300.00 VA Ø 330.00 ** Bemove P: 259.81 W 0: 150.00 V/e Remove All System Angle (0) Stat: 300.00 V/e Remove All System Angle (0) Stat: 300.00 V/e	We vite Numerican Numerican <th< th=""></th<>
Test Points	$\overline{}$
Tested Points No. S [VA] AngS [*] P [w] Q [VAr] Element Reference Region Acted Time Nominal Impo: Points ··· General Info Power FP Ref Ben. Performance Time V & I Error List Protection Status	
New	Aux font: 110,00 V Heating: 0%
	Figure 31



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



Figure 32

7.3 Final Result of the Shooting Test

In this test, it can be verified that within the operating region the relay operates within the predicted time plus its tolerance. In the case of the non-operation region, the relay does not act, proving the correct functioning of the function.

Direc Channe	Config Config Is () Conne	Hrd § Co Sync 5, Co ction	onfig GOOSE	Start	Stop	ext Point 🧃 ext Line 🤞	Clear test Clear all	Settings	Waveform Phasors Trajectory	image: seport image: seport image: seport image: seport image: seport image: seport image: seport image: seport	
Shootii	Ha Search	Route .	Fast Sattings		Gene	ration		opti	ons	(eport Unids Layout	
	ert / Edit Poir	nts	reat Jettinga							Graphic Waveform Phasors Trajectories	•
NE NE Tested	Edit Point W Point Qequence Remove t Points Points	Test Typ Definiti ISI: Load: P: I:	ABC a ABC ABC ABC ABC ABC ABC ABC ABC	 ⊘: 330,0 cos⊗: 0,87 Q: 150,0 ∨: 50,00 	0 ° 0 VAr V					- W/ +V/ar Type ABC Subtle:	TOF 12 ° /Ar
No.	S [VA]	AngS [*]	P [W]	Q [VAr]	Region	Acted	Time Nominal	Time Real	Status		
81	0 VA	330,0 °	0 W	0 VAr	Not Operation	Not	-	-	Approved		
82	-100,0 VA	330,0 °	-86,60 W	50,00 VAr	Operation	Yes	1,00 s	1,08 s	Approved		
	-200,0 VA	330.0 °	-173,2 W	100.0 VAr	Operation	Yes	1.00 s	1,06 s	Approved		
83			-259,8 W	150,0 VAr	Operation	Yes	1,00 s	1,05 s	Approved		
83 84	-300,0 VA	330,0 *									

7.4 Search screen

In this tab, the power value that starts the relay is evaluated. For convenience, a sequence of values will be inserted, set the *"Test Type"* field to *"ABC"*. The field *"Line Definition"* was defined as *"P"*, with an initial value of 0.0W and a final value of -150.0W. In the *"Variable (Q)"* field, the initial value was 600.0Var, the final value was -600.0Var and with a step of -200.0Var.





Figure 34

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



Figure 35

7.5 Final search test result



Direc annels	Config Config Config	g Hrd ≰% Co g Sync ⁵, Co ection	nfig GOOSE nfig SV	Start	Stop > N	ext Point 🤞 ext Line 🛛 🐇	Clear test Clear all	Settings	• Phasors • Trajectory	Report	● ~ P3 ISS abs rel	Rebuild Graphics	Restore Vie	2						
	Ha	ardware			Gene	ration		opti	ons	Report	Unids		Layout							
ooting	Search	Route 1	est Settings							_	(
E Ne Test sted F	dit Line w line Points Points	Isl: 0.	e ABC t 60 kVA	Ø: -90,00						-	-W; +VAr		X	0,600 k 0,500 k 400,0 300,0		X		weight -	ar Type A Subtitle: ⊕ Unte ● Point Sear	ABC ted Points Found h Lines
o.	Test	S [VA]	AngS [°]	P [W]	Q [VAr]	Element Reference	Time Nominal	Time Real	Status			γ		200,0		\sum	X	$\left\{ \right\}$	S: 100,975 V P: -93,399 W	Q: 38,373
	ABC	406,3 VA	100,1 *	-71,36 W	400,0 VAr	32R	1,00 s	1,17 s	Approve	d					X	T			€ ₽ ₹ 0	
	ABC	212,3 VA	109.6 *	-71,21 W	200,0 VAr	32R	1.00 s	1,08 s	Approve	d				X	X	\mathbf{J}				
	ABC	70,58 VA	180,0 °	-70,58 W	0.0224 pVAr	32R	1,00 s	1,08 s	Approve	d			K	V.	\square	\searrow	$\int \int$			
	ABC	211,8 VA	-109,2 °	-69,81 W	-200,0 VAr	32R	1,00 s	1,09 s	Approve	d		X	\sum	\nearrow			\sim	$\sum L$		
	ABC	406,0 VA	-99,84 °	-69,41 W	-400,0 VAr	32R	1.00 s	1,07 s	Approve	d	XX		\bigtriangledown			K		\sim	4	
	ABC	0,604 kVA	-96,60 *	-69,41 W	-0,600 kVAr	32R	1,00 s	1,05 s	Approve	d			\checkmark							
	Points	V 🗹 Gen	eral Info 🔽	Power 🔽 F	Ref Elem. 🔽	Time 🗌 V 8	1				-W-VAr		\mathcal{A}^{\sim}				\sum	++++->	/	

It is verified that all active power values are then within the tolerance region provided by the manufacturer.

8. 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.

Presentation Setting	×
Language Inglês En-US 🗸 🗸	
 All General Data Test General Data of Tested Device Local of Installation Reference Values Hardware Settings Test Settings Overcurrent Settings Test Results Selected Simulation Charts Notes and Observations Explanatory Figures Check List Connections 	
OK Cano	el

Figure 37





Figure 38



APPENDIX A

A.1 Terminal Designations



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A.2 Technical Data

THREE-PHASE REAL POWER

Range:	0 to ±99999 kW
Pickup:	1 to 25000 kW in steps of 1
Time delay:	1 to 30 s in steps of 1
Block from start:	0 to 15000 s in steps of 1
Pickup Accuracy:	at I _{ava} < 2 × CT:±1% of $\sqrt{3}$ × 2 × CT × VT × VT _{full scale}
	at $I_{avg} > 2 \times CT \pm 1.5\%$ of $\sqrt{3} \times 20 \times CT \times VT \times VT_{full scale}$
Timing accuracy:	\pm 0.5 s or \pm 0.5% of total time

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 1										
Power Direction	al Software	GE SR 469 Relay								
Parameter	Figure	Parameter	Figure							
Ркр 3Ф	29	Reverse Power Trip Level	16							