PROTECTION
Consulting Manufacturing Commissioning

CH - 5430 Wettingen
Fax ++41 56 4266834
Relay Publication E

UNIVERSAL RELAY TEST SET SYSTEM PGX10E/SYN99C

Products: **Relay test set PGX10E**
Synchroscope SYN99C
Version: **2000**
Manufacturer: ***PROTECTION - CH***

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BASIC INDICATIONS

Secondary injections are a very secure way to test the functionality of electrical equipments. These injections are used to simulate the signals coming from the voltage and current transformers. Depending on kind of injection – voltage or/and current, intensity of injection – over/under current/voltage, power of injection – inductive power, capacitive power, real positive power, real negative power different power plant conditions can be tested.

As primary plant values are simulated deep theoretical knowledge of simulated object (power transformer, generator, high voltage line, synchronizing system, motor…) is required.

The relay test set PGX10E is able to check:

I>	46, 49, 50, 51
U>, U<	27, 59, 59/81, 81<, 81>
P, Z	32, 21, 40, 78 (REG316)
U	25

Injecting current and voltage a permanent risk of overload or short circuit is existing. Both situations can damage the relay test set or/ and the relay under test.

Current overload is a very severe condition for the relay under test and may damage the input transformers of the relay because of excessive heating.

Voltage overload is leading the relay input transformer in saturation. Therefore the magnetizing current increases drastically and is heating the magnetic core of the input transformer. Overheating is the final result which also may destroy the input transformer. Short circuits are dangerous for the relay under test and the relay test set. Normally short circuits may occur when connecting by mistake a voltage output of the test set PGX10E with a current input of the protection relay.

Overload limits

A current protection relay is able to handle:
4 * In (In=relay nominal current)

A voltage protection relay is able to handle:
1.3 * Un (Un=relay nominal voltage)

If the testing to be effected is near nominated values the test has to be limited to a minimum in time.

Each protection relay has indications about its technical data where the limits of overload in intensity and time can be found.

The synchroscope SYN99C is mainly intended for testing synchronizing systems. It is also useful as metering instrument when working with the PGX10E test equipment. Detailed application information can be found in the synchroscope manual.

Only if the test set, the principle of the protection relay, the limits of load for both of them and the values for trip operation are known testing can be executed without danger for the very expensive protection relays.

LOAD LIMITS OF RELAY TEST SET

Hotline

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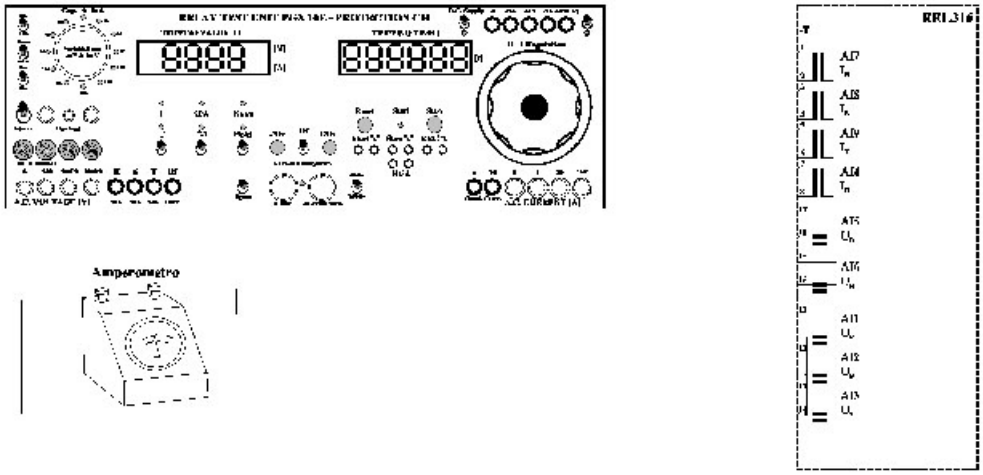
5430 WETTINGEN
SWITZERLAND

FAX: +41 56 426 68 34
MOBILE: +41 79 423 31 60
+41 79 400 86 55

E-MAIL: cmc_protection@bluewin.ch

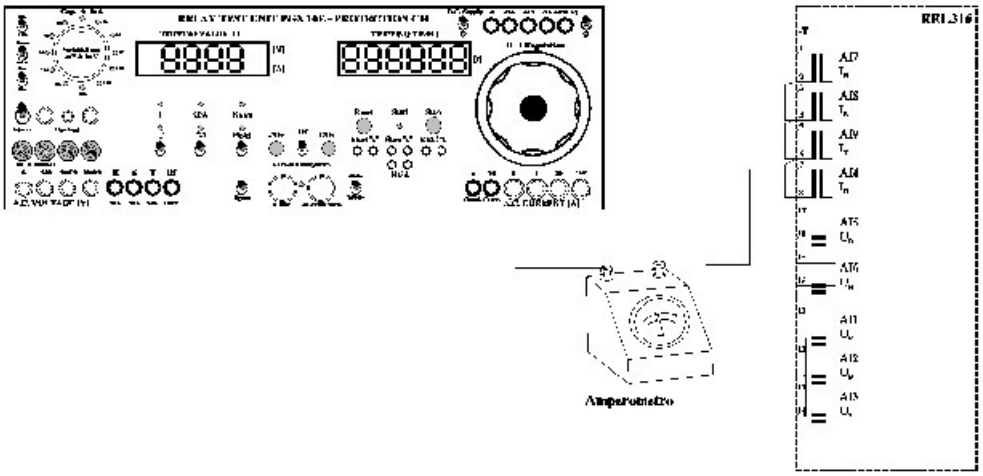
CURRENT SUPERVISION DURING VOLTAGE INJECTION



When injecting voltage its is to be recommended to supervise the current. Always start voltage injection from 0V. Supervision connection can be seen from the figure above.
The 20V and 100V variable phase voltage outputs are fix. When switching on the entire voltage will be applicated to the relay under test. If any doubts are existing connect first the variable 0…200 V voltage output and start inject from 0V supervisioning the current.

NEVER USE THE VARIABLE 0...2A~ OR 0...20A~ CURRENT OUTPUT SIMULTANEOUSLY WITH THE VARIABLE VOLTAGE OUTPUT 0...200V~ WITHOUT ADDITIONAL SUPERVISION OF BOTH OUTPUT SOURCES.

CONTROL OF THE CURRENT MEASUREMENT



The variable current metering range 0...20A~ has a accuracy of 5%. The absolute tolerance is of +/- 1 A. If a precise metering is required a FLUKE multimeter may be connected in series to the current output.

Pay attention to the duration of the injection when working with currents bigger then 4 x In (overload).

STEP BY STEP INSTRUCTION

1) Open voltage terminals
2) Disable breaker failure protection 50BF
3) Check relay thermal capability
4) Check setting calculation of the protection relay
5) Quantizise the trip value e.g. Z_{zone1}=1.0 Ohm U=?, I=?
6) Draw the secondary testing connection circuit
7) Connect according to the prepared drawing
8) Before injecting verify that variac is in 0V position
9) If the result is not as expected check connections and/or your setting calculation

TRIP TIME MEASUREMENT

1) Insert bridge in “start” terminals
2) Reset the timer
3) Inject (automatic starting of the timer)
4) The trip contact will stop automatically the timer

The trip contact has to be connected to the “stop” terminals.
It’s very important that the trip contacts are potential free.

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UNIVERSAL PROTECTION RELAY TEST EQUIPMENT

Product: **Relais test set**
Version: **PGX10E**
Manufacturer: ***PROTECTION - CH***

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1 DESCRIPTION - TEST SET PGX10E

1.1 APPLICATION

- Periodic Secondary Testing of Relays
- Commissioning
- Laboratory and Working Area Use

1.2 FEATURES

- Variable Current and Voltage Source
- Constant Voltage Source with Variable Phase
- Variable Frequency Source
- Constant Voltage Source 3-Phase
- Additional Constant Current Source
- Variable 100 Hz Current Source
- Regulated D.C. Supplies
- Digital Displays for Voltage, Current and time

1.3 FUNCTION

Fig. 2 shows the principle shematic of the test-set. The variac supplies, via the separating transformer, the test currents and voltages.
The built-in digital display shows, by switch over, the values of „U“(V) or „I“(A).
Two constant voltages of 20 and 100 V are available with adjustable phase angle from 0^o...360^o in steps of 30^o, for testing of impedance and power relays.
Additional constant current sources of 2 A and 10 A are provided for the verification of the differential relay derated tripping sensitivity versus holding current.
Variable 100 Hz current source, realised with powerfull half wave rectifier is provided for inrush current stability test of the differential relays.
3-phase constant voltage source makes the functional test of the distance protection possible.
A built-in timer enables precise time delay measurement. Starting of the time is effected

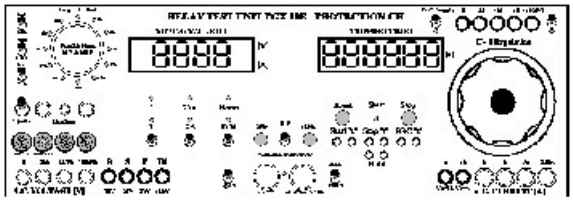


fig.1 graphical front view PGX10E

synchronously with activation of the injection switch.
The start of time measurement can be selected dependent on the relay mode, i.e., for minimum or maximum relay types (pick-up or drop-out).
The stabilized D.C. supplies are separated from line disturbances by means of a special suppression filter.
The input to the test-set electronics is also filtered.
The starting value can be stored via a potential free starting contact, connected to the corresponding terminals.
The time delay can be similarly stored by means of a potential free relay output contact and also be started by an auxiliary potential free contact.

1.4 CIRCUIT DIAGRAM PGX10E

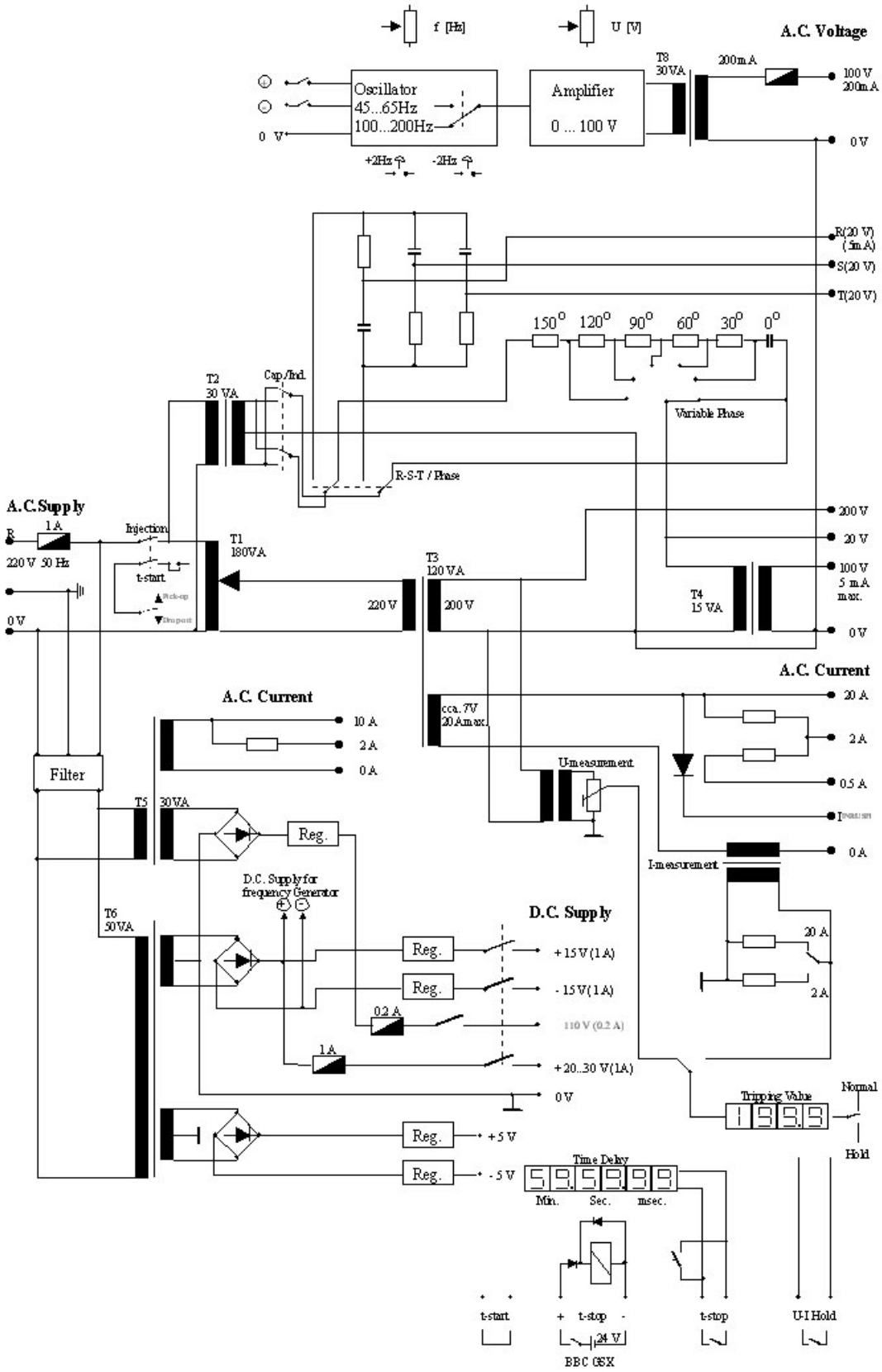


fig. 2 functional block diagram - circuit diagram PGX10E

1.5 TECHNICAL DATA PGX10E

Auxiliary supply

Auxiliary voltage supply.....	220V, 50Hz (60Hz and/or 110V special request)

Current AC outputs

Variable AC current outputs

· source I.....	0.0...2.0A Display 0...1.99A - (120VAmax)
· source II.....	0.0...20.0A Display 0...19.99A - (120VAmax)
· source III.....	0.0...20.0A No display (15VA max) 2nd harmonic for Inrush current test

Constant current outputs

· source IV.....	2.0 A - no display (30VA max)
· source V.....	10.0A - no display (30 VA max)

Current display accuracy

· 0 ... 1.99 A scale.....	2 %
· 0 ... 19.99 A scale.....	5 %

Voltage AC outputs

· 0...200V (source I).....	Display 0...199.9V - (120VAmax)
· 20V (source II).....	variable phase 0^o...360^o-(30^o steps) no display phase reference voltage source I
· 100V (source III).....	variable phase 0^o...360^o-(30^o steps) no display phase reference voltage source I
· 0.0 ... 0.7 V (source IV).....	0.0...7.0V Current output 0.0...20V - High resolution - no display
· 3 x 33V ph-ph (source V).....	three phase - no display (max. 5mA)

Voltage display accuracy

· 0 ... 199.9 V scale.....	2 %

Voltage DC outputs

· +24V (source I).....	not stabilized 20V...30V (alone 1A max)
· +15V (source II).....	stibilized 0.2% 500mA (alone 1A max)
· -15V (source III).....	stibilized 0.2% 500mA (alone 1A max)
· +110V (source IV).....	30W stabilized

Variable frequency generator

· voltage regulation range.....	0 ... 100V AC
· 1 step frequency regulation range.....	45Hz 63Hz
· 2nd step frequency regulation range.....	90Hz 163Hz

Timer

· timer range.....	10ms .... 59min.
· timer display.....	max. display 59’59’’99’’’ (step 10ms)
· timer start.....	injection „on“ pick-up injection „off“ drop out frequency step -2Hz frequency step +2Hz manual start
· timer stop.....	potential free device under test output contact switched by external +24V= supply (protection systems with tripping matrix) manual stop

Switches

· injection switch.....	for all AC outputs (except frequency gen.)
· DC supply switch.....	for all DC outputs
· variable frequency generator switch.....	for frequency generator

Fuses

· main fuse.....	1 A
· DC supply fuse..... (output of supplying transformer - AC)	500mA (+24V, +15V, -15V, +5V, -5V)
· 110VDC output fuse.....	200mA
· frequency generator output fuse.....	200mA

General data

Temperature range.....	according to IEC 68-2-1/2
· within guaranteed limit.....	-10°C. . .+55°C
· storage temperature.....	-40°C . . . +70°C
Humidity test.....	+55°C, periods according to IEC 68-2-30
Salt spraying test.....	according to IEC 68-2-11
SO2 test.....	according to IEC 68-2-42
Vibration test.....	5-13.3 Hz ± 1 mm
Shock and earthquake test.....	13.3-100Hz 6.8m/s2 according IEC68-2-6
Shockresistance.....	10 g; 4-7ms; 1 m/s2 number of shocks 1000: acc. to IEC 68-2-29 5g ; according to IEC 68-2-27
Test voltages	kV, 50 Hz, 1 min
· insulation	5kV, 1.2/50ms, 0.5J Acc. IEC 255-1-00
· impulse	1 MHz/400Hz (Acc. IEC 255-4)
· interference.....	2.5kV longitudinally, 1 kV transversally

Mechanical design

· relay test set.....	19 inch kmodures rack
· height.....	155mm
· width.....	440mm
· depth.....	180mm
· mounting.....	in rack 19''
· casing of relay test set.....	portable aluminium case
· height.....	180mm
· width.....	500mm
· depth.....	230mm (synchroscope version 300mm)
Mass synchroscope version.....	12 kg
Mass stand alone version.....	10 kg

Versions

· standard.....	PGX10E & SYN99C
· stand alone.....	PGX10E

2 INSTRUCTION FOR USE TEST-SET PGX

2.1 VOLTAGE SUPPLY CONNECTION

Connect the supply voltage 220 V. 50 Hz to the corresponding terminals „R“ and „0“. Both displays and some LED's will be illuminated.

2.2 INJECTION

The red switch interrupts all A.C. current and voltage outputs. Switch „ON“ or “OFF” can activate the timer. The miniature switch provided on the left side enables a pick-up or drop-out time measurement (“▲” position is used for max. and “▼” for min. voltage or current relay).

2.3 CURRENT RELAY TEST

Put „U & I“ selector switch in position „I“. Choose the appropriate current range for measurement (2 A or 20 A) and suitable output (0.5, 2 or 20 A). Set the desired current value by means of „U - I“ regulator.

2.4 VOLTAGE RELAY TEST

Put „U - I“ selector switch in position „U“. Set the desired voltage in the range 0...200 V. If High resolution is desired, use the current output 0.5 A as voltage source of 0...5 V. No display is available in this case. A separate voltmeter has to be used.

2.5 VOLTAGE CURRENT RELAY TEST

For the control of power, impedance or directional relay the constant voltage and variable current outputs will be used simultaneously. It is possible to use simultaneously also two voltages with the phasing of 60^{o}, as a simplified replica of a 3-phase voltage system (V-connection).

2.6 THREE PH VOLTAGE AND 1 PH CURRENT

Distance relay test can be carried out by using the three phase constant voltage output of 20 V (Uph-o) and one variable phase current source simultaneously. Successive three voltage rotating connection is required for complete relay test.

2.7 SYNCHRONIZING DEVICE TEST

Using two different voltages, the complete test of any synchronizing device is possible. Variable amplitude, phase and frequency are available.

2.8 TIME DELAY MEASUREMENT

A „START - STOP“ push-button enables manual measurement in the sequence „START-STOP-RESET“. Start is activated automatically by the Injection Switch, while stop is initiated by means of a potential free output contact of the relay under test, connected to the corresponding terminals. Push RESET before starting any measurement. Don't forget to put the short circuit bridge into the “o_o” automatic start terminals.

1.9 USE OF THE STOP-WATCH INDEPENDETLY

Replace the short circuit bridge with your potential free Start-contact. Switch on the injection switch. Stop the time with another potential free stop-contact.

2.10 D.C. SUPPLY

Connection at the A.C. supply provides simultaneously +24...30, +15 and -15 V D.C. and +110V D.C. supply. Stand-by switch enables momentary rise of the D.C. voltage on the output. The provided pilot lamp serves as a simple short circuit or overload detector (the light intensity should not decrease under load). The D.C. voltage source has internally a 1 A fuse.

2.11 HOLD

„U“ or „I“ values can be stored by means of the „HOLD“ miniature selector manually. „U“ or „I“ values can also be stored automatically by means of the potential free relay’s start contact connected on the corresponding terminals “Stop U-I”. To avoid a possible overload of the testing unit, keep the selector in the position “NORMAL“ during injection.

2.12 CALIBRATION (BY MANUFACTURER)

Ampermeter calibration is done with TP1 potentiometer placed on the „U - I“ display board. Test current value is 1 A on the 2 A range. Voltmeter calibration is done afterwards by means of the potentiometer. Test point is 100 V. A 20 A doesn’t need to be calibrated.

3 RECOMMENDATIONS FOR USE

3.1 IMPEDANCE RELAY TEST

Use reduced voltage of 20 V in order to keep the current as low as possible. Don't forget that more or less all impedance relays have minimal current blocking.

3.2 POWER OR I*COSJ RELAY TEST

Use the rated voltage. Don't forget that I*cosj BBC relay PPX 105b doesn't depend from the voltage amplitude. Voltage phase or zero crossing is enough but it needs at least 0.5x Un for proper functioning.

3.3 SYNCHCHROCHECK TEST

Variable 100V and constant 100V with corresponding phase angle from 0° to 60° for injection will be used. A variable frequency generator (0 ... 100 V / 45 ... 65 Hz) completes the test.

3.4 NEG. SEQUENCE VOLTAGE RELAY TEST

One variable 100 V voltage and 100 ë60° V constant voltage in „V" connection offers a symetrical system. The negative sequence will be created by varying the amplitude of the first one. Another way of testing this type of relay is to use 3-phase 20 V with normal phasing and afterwards reversing two phase sequences.

3.5 60 HZ APLICATION

60 Hz version has to be ordered in advance. Otherwise it's necessary to replace internally the phase shift capacitor C= 20 mF with 16 mF. Farther the three phase voltage output has to be tuned replacing three resistors in the corresponding loop (or simply take new phase shift in account).

3.6 CURRENT OUTPUT

This output can be driven open or short circuited, taking care that max. current of 20A is not exceeded.

3.7 VARIABLE FREQUENCY OUTPUT

This output is limited with a 200mA fuse between 45...65 Hz or 100 ... 200Hz on max. 20W. The output voltage for both ranges can be set from 0...100 V This output has to be controlled with a separated instrument for voltage and frequency measurement. The frequency regulation is analog and suitable for functional synchrotackt check.

The frequency generator is equipped with 2 push buttons +2Hz and -2Hz. Each one of them activates the time measurement. The trip of the measured unit (for example a min. frequency relay) stops the time.

3.8 VOLTAGE OUTPUT

See technical data considering loading and don't make short circuits. 1 A common fuse for all A.C. output situated near injection switch is provided. The voltage measurement uses the tertiar winding on the separating transformer is applicable only for low loads like voltage input of the standard protection relays.

3.9 110V A.C. MAIN SUPPLY

220 V version works also with 110 V line without any trouble. Lower digital display intensity will appear. The max. voltage and current limits reduces to one half. Better resolution can be in special applications even considered as advantage. Normal use with 110 V A.C network supposes applications of additional step-up transformer. Note that ABB protection

system „GSX“ incorporates usually 220 V plug, even in countries with 110 V A.C. rated voltage.

3.10 VARIABLE 100 HZ CURRENT SOURCE (2ND HARMONIC)

Half wave power rectifier from 20 A current output provides 2nd harmonic component for inrush current test of the differential relays.

3.11 2A AND 10A A.C. CONSTANT CURRENT SOURCE

This output is supposed to be used as 2 x In holding current source. To check derating tripping characteristic of the differential relay. Differential and holding currents can be supplied independently in this way. This can be used for type-test.

4.1 PGX10 CONNECTION WITH ABB-GENERATOR PROTECTION SYSTEM GSX5

The connection between the ABB generator protection GSX5 and your relay test equipment PGX10 is shown as example for an automatic time delay measurement, where the timer-clock can be stopped by a voltage signal (+24V).

Connection to the ABB generator protection GSX 5 tripping matrix

Measurement of the time delay of a relay, using the common „Start“ and „Stop“ terminals for right and left side of the relay group.

„Start“	Yellow (+24V)	Blue (0 V)
„Stop“	Red (+24 V)	Blue (0 V)

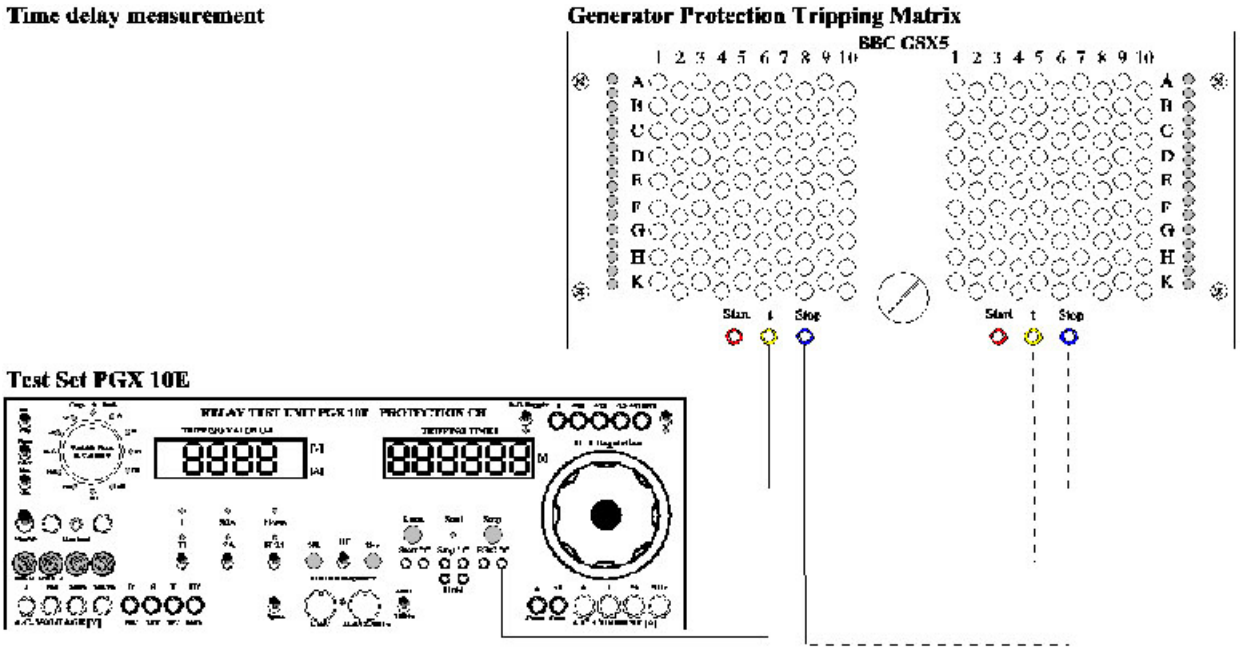


fig. 3 time delay measurement connection example

Measurement steps

- Connect the PGX to the corresponding relay input
- Set the tripping value (current or voltage)
- Choose the proper switch position (▲ or ▼) for pick-up or drop-out time delay measurement
- Reset the stop watch
- Activate the injection switch
- Time delay will be displayed after tripping

Þ Caution: The proper polarity connection is requiered Ü
(wrong polarity protection diode is integrated)

4.2 INDIVIDUAL RELAY TIME DELAY MEASUREMENT

- Connect the current or voltage to the relay input
- Put the "Start bridge" into the stop watch section
- Choose the pick-up or drop-out mode
- Connect the relay output contact to the "t stop" terminals
- Activating the "Injection" switch the time delay measurement starts automatically
- Given time delay value represent the total time. Generally this time consists of the input filter inverse time and a fix time delay setting given by the relays time delay block.

4.3 INDEPENDENT STOP-WATCH USE

- Potential free „start contact" is to connect instead of start bridge and „stop contact" on the t-stop terminal
- After activating the injection switch the stop watch is ready to start as soon as the start contact close
- The potential free stop contact stops the time

4.4 VARIABLE FREQUENCY GENERATOR USE RECOMMENDATION

±15 V internal electronic supply is protected with a 1.5 A slow smelting fuse. The output is protected with a 200 mA slow smelting fuse. Any how take care to not overload the output. Especially during the complete test of the synchronizing device together with the synchronoscope built in the command room we propose to work with reduced voltage (80%) and to complete the test as fast as possible (less then 1 minute - because of the high consumption, about 20 W on the nominal voltage, of the old electromechanical synchronoscope).

During the alone synchronizing device test no limits exist considering the voltage level or time duration. The consumption of the modern synchronizing device is only a few mA on the nominal input voltage.

Control the connection before switching on, to avoid a short circuit at the output.

The frequency generator is equipped with 2 push buttons +2Hz and -2Hz. Each one of them activates the time measurement. The trip of the measured unit (for example a min. frequency relay) stops the time.

Procedure for time measurement:

- Remove the start time short circuit bridge
- Injection on
- Push the reset button
- Push one of the two buttons (+2Hz or -2Hz) - time measurement starts
- Keep on pushing until the trip of tested device stops the measurement

The 45 to 65 Hz frequency range is provided for testing devices like Synchronoscope, Synchrotact, Synchrocheck.

The 100 to 200 Hz frequency range is provided as a generator of the third harmonic for testing Stator-Earth-Fault-Protection-Units (for example: 100% stator-EFP made by ABB)

5 Optional Equipment For PGX10 Test Set

5.1 Isolating 120 VA voltage & current injection transformer

Application

- Voltage range extension up to 400V (regulated from 200V...400V)
- Current source extension from 7V/20A to 14V/20A.
- Step down transformer

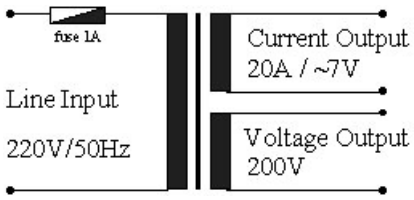


fig. 4 external extension nsformer

Technical Data

Function	additional isolation transformer
Power	120 VA
Input	220/230 V 50/60Hz ... 200Hz
Output	200V / 120VA
Line fuse	1 A
Weight	2 Kg
Dimension	115x150x70 mm
Casing	Aluminium

5.2 High frequency anti-disturbance filter

Technical Data

Function	current compensated High Frequency filter
Application	line high frequency input filter
Power	230V / 2A 50Hz
Size	65 x 100 x 50 mm

5.3 Optional multiple digital instrument Syn 99C

features:

- two voltmeters U1 & U 2
- two frequency meters
- diff. vector voltmeter
- phase angle display
- bar graph for phase angle

The main application of our SYN 99C product is as a manual synchronizing control device for electrical power plants. It's also very useful during testing of protection relays and as control instrument for electromechanical synchroscope, synchrocheck and synchrotact as shown in Fig. 9.

fig. 5 synchroscope type SYN99A/SYN99C

5.4 CONNECTION EXAMPLES WITH PGX EXTENSION TRANSFORMER & SYN A98

VOLTAGE RANGE EXTENSION

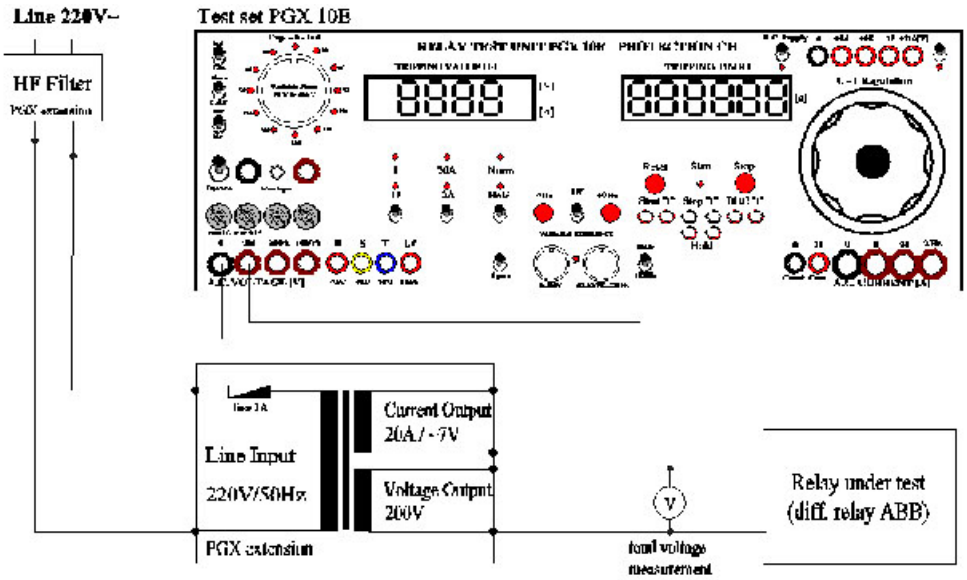


fig. 6 Connection of external extension transformer for voltage range

The connection to be realized is shown in Fig. 6. It is necessary to control the total voltage with a separate voltage meter. Pay attention on the right polarity connection of the PGX extension transformer.

CURRENT RANGE EXTENSION

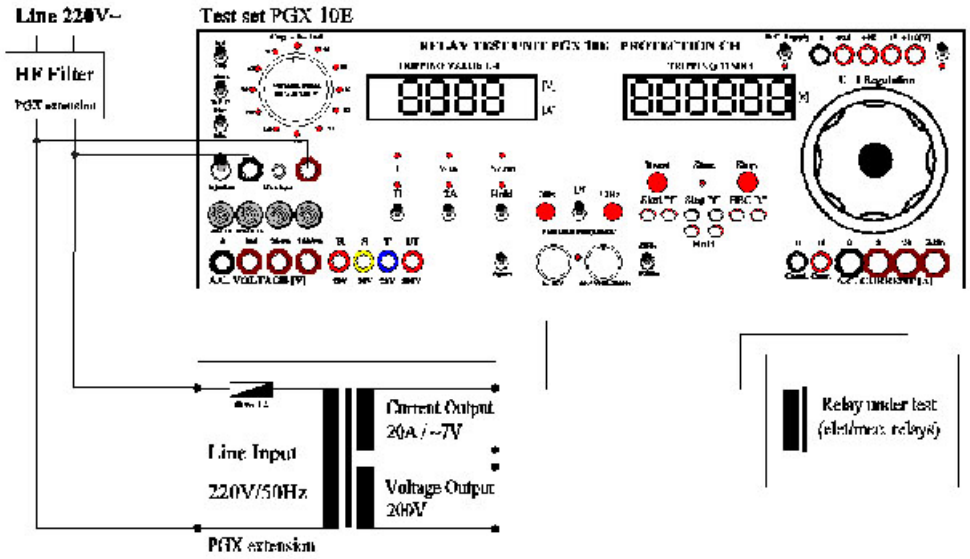


fig. 7 Connection of external extension transformer for current range extension

Connecting the current output of the PGX10 in series with the current output of the PGX transformer extension it's possible to get a more powerful current source, which allows the testing of electromechanical current relays.

STEP DOWN TRANSFORMER

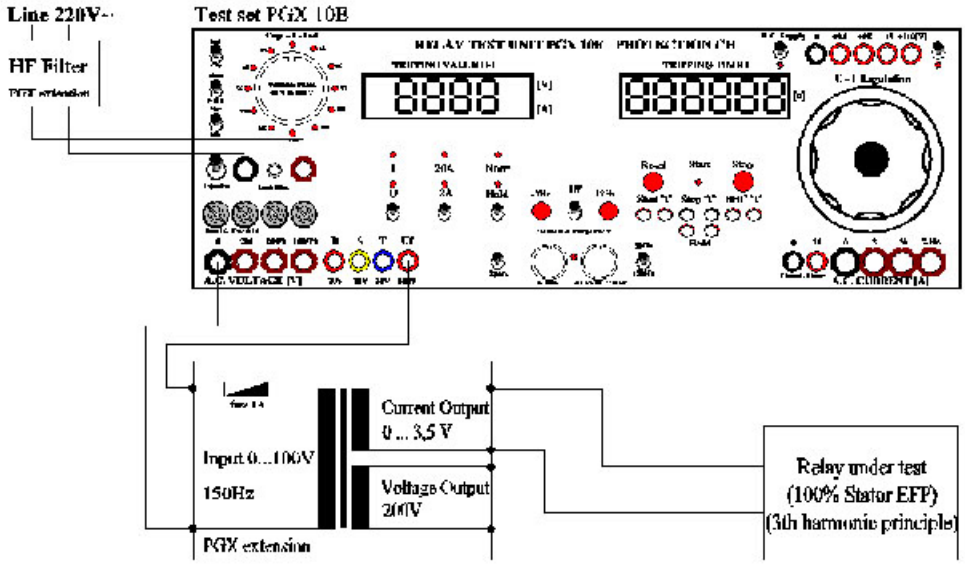


fig. 8 Connection of external extension transformer for voltage range reduction (step down)

Using the PGX extension transformer as step down transformer allows a more sensitive regulation of the injecting voltage.

MULTIPLE DIGITAL INSRUMENT SYN 99C

Fig. 9 shows the connection diagram for testing and commissioning of a synchronizing device in a power plant.

As source for U1 use the variable voltage output (0...200V 50Hz) and as source for U2 use the frequency generator which allows a variable voltage (0...100V) and a variable frequency (45…65Hz). The digital measurements of SYN 99C and the analogue measurements of the existing analogue synchroscope must coincide in amplitude and in phase.

Pay attention on the right polarity connection of the involved units.

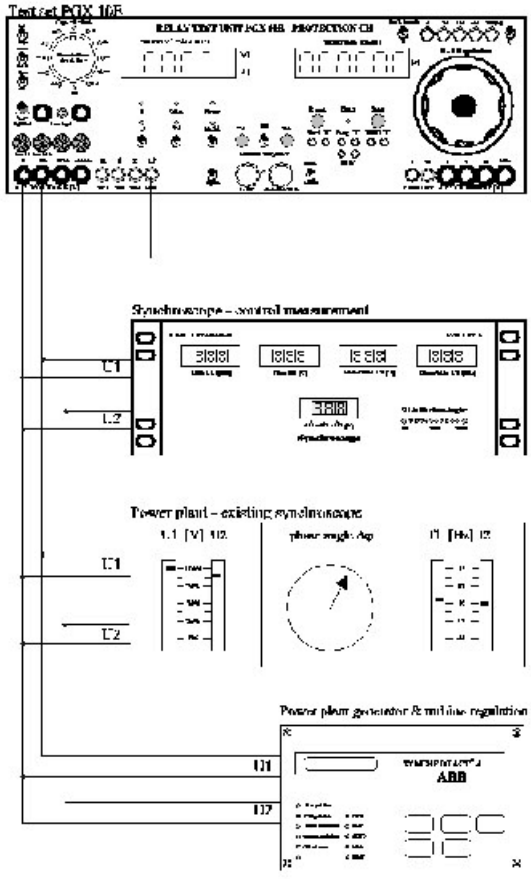


fig. 9 Commissioning of a synchronizing system

6 SHORT DESCRIPTION AND FRONT VIEW OF TEST SET PGX10

6.1 GRAPHICAL FUNCTION ILLUSTRATION - TEST SET PGX10E

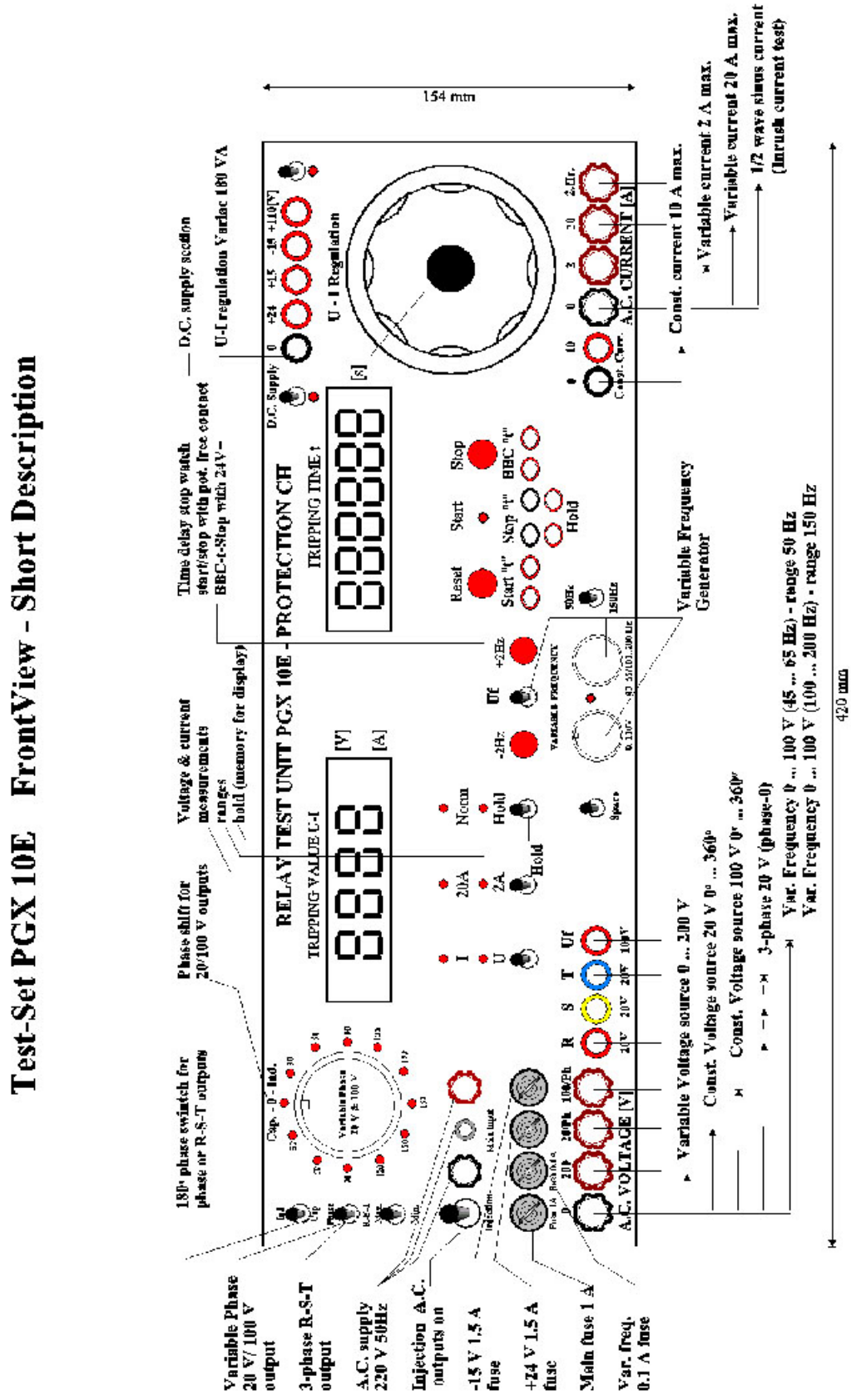


fig. 10 Graphical function illustration of PGX10E

7 PGX10 COMMISSIONING CONNECTION EXAMPLES

7.1 DISTANCE PROTECTION TEST

3-ph constant voltage and 1-ph variable current injection. Don't forget the usual minimal voltage blocking.

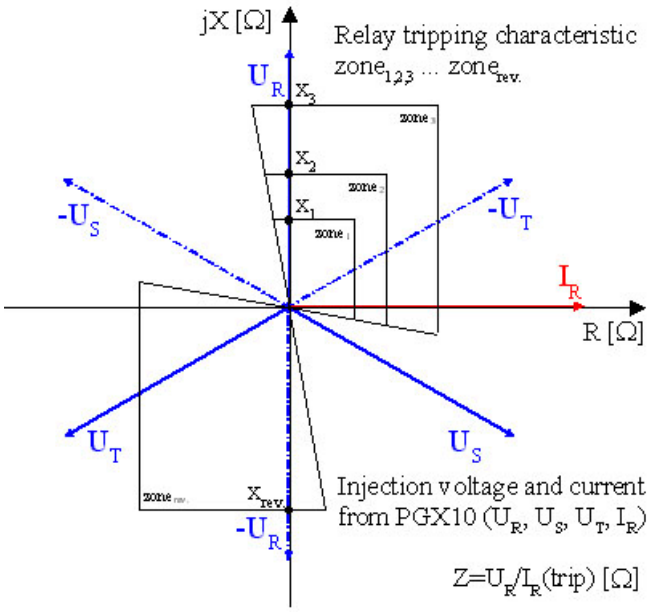


fig.11 One phase gound faulot (vector diagram for tripping characteristic check in x-direction)

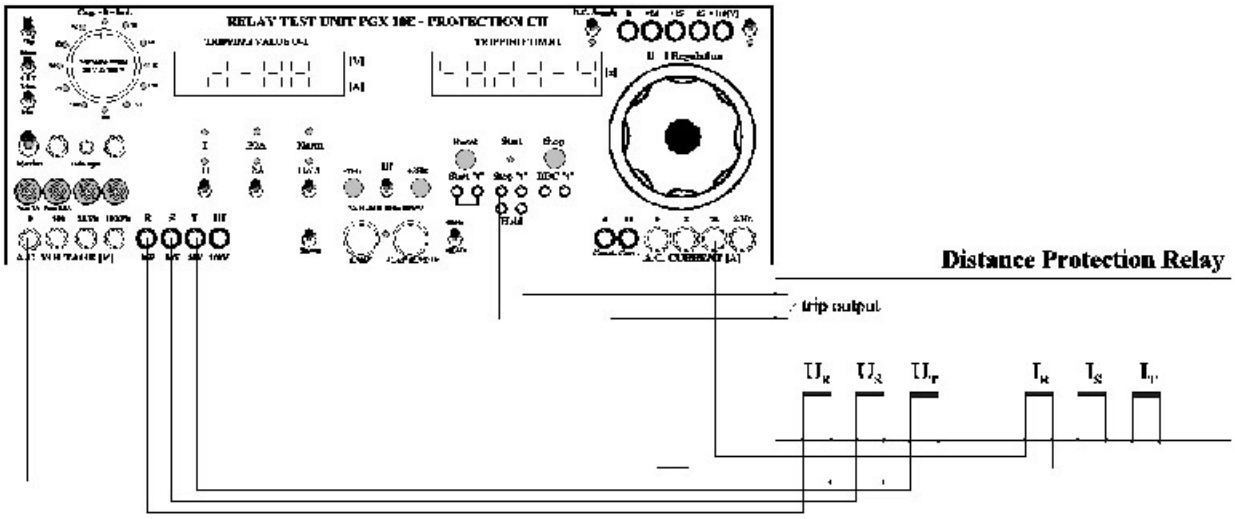


fig. 12 Test connection for 1phase gound faulot tripping characteristic check

PGX10 Settings

- mode switch RST-phase: R-S-T
- phase shifting switch: IND (forward) / CAP (reverse)
- stop time contact: t-stop (potential free contact) and start bridge

7.2 DIFFERENTIAL RELAY PROTECTION TEST

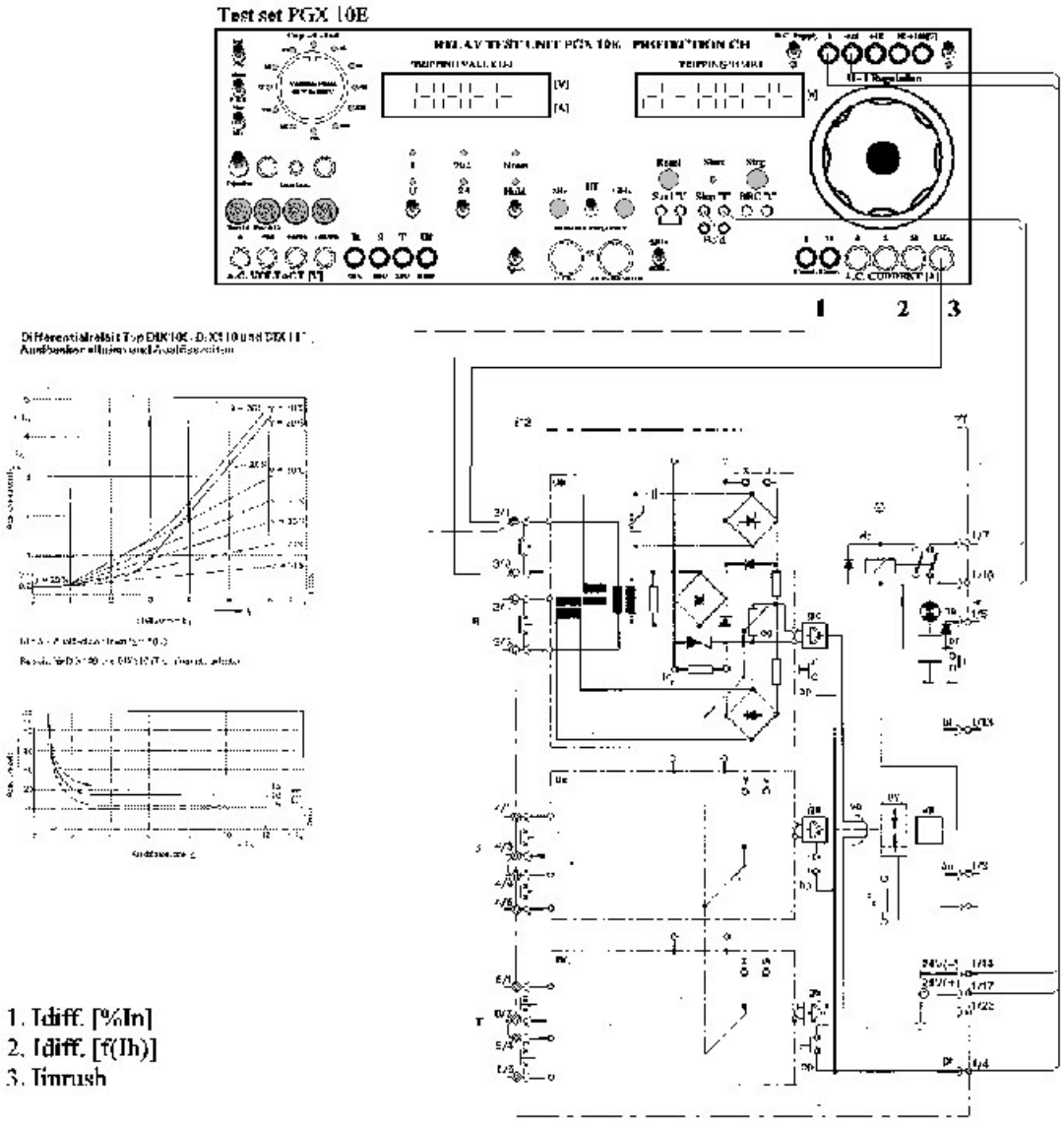


fig. 13 Test connection for commissioning of the differential relay DIX109 protection

PGX10 settings:

- stop time contact: t-stop (pot. free contact) and start bridge
- for Idiff [%In] use 0 ... 20 A_{AC} variable current source
- for Idiff [f(Ih)] use 0 ... 20 A_{AC} variable current source and 10 A_{AC} fix current source
- for I_{INRUSH} use the ½ wave sinus current output

7.3 LOSS OF FIELD RELAY PROTECTION TEST

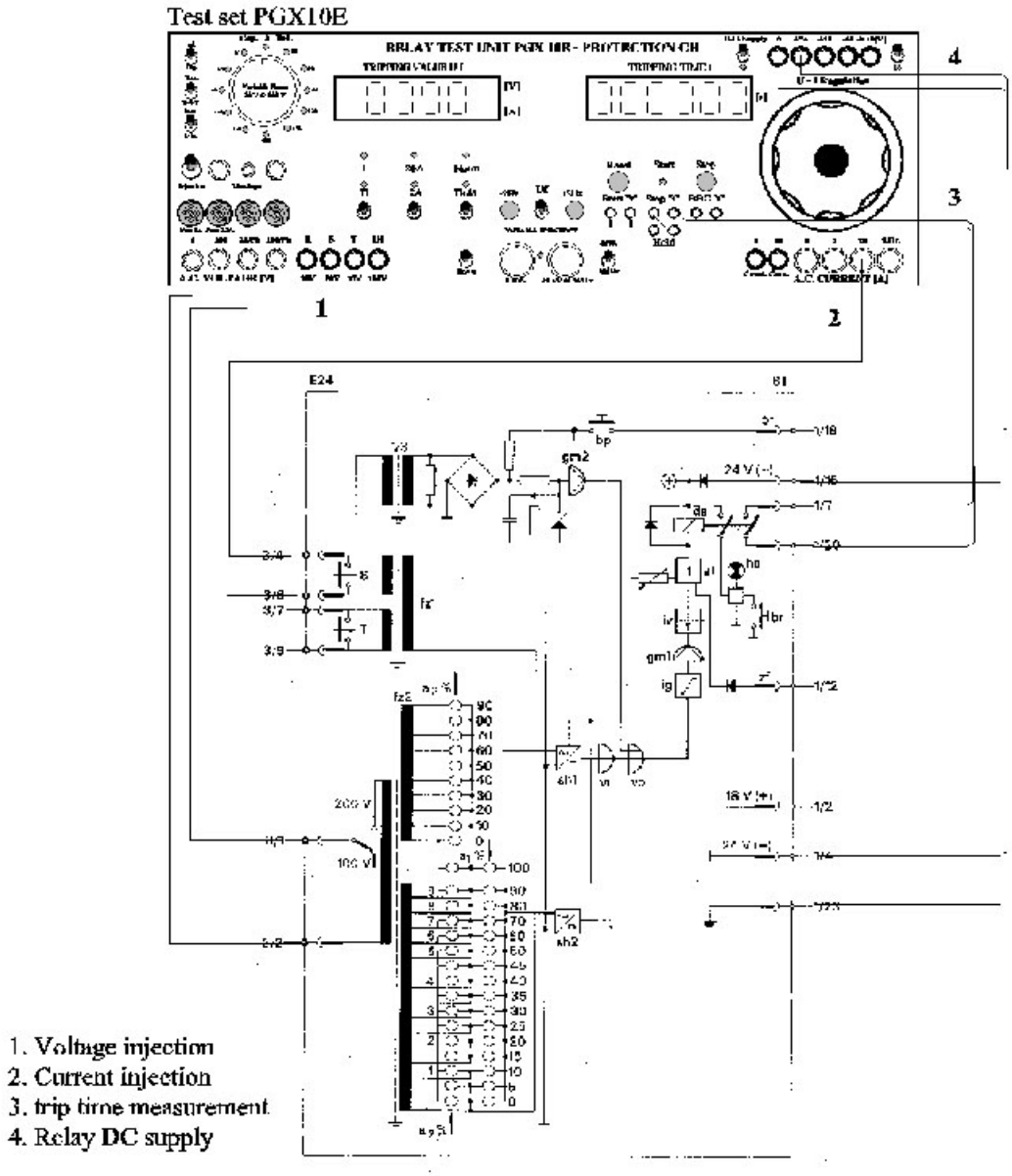


fig.14 Test connection for commissioning of the field loss relay ZPX102

PGX10 settings:

- stop time contact: t-stop (pot. free contact) and start bridge
- current injection by 0 ... 20 A_{AC} variable current source
- voltage injection by constant 20V variable phase source

7.4 UNIDIRECTIONAL MIN. IMPEDANCE RELAY PROTECTION TEST

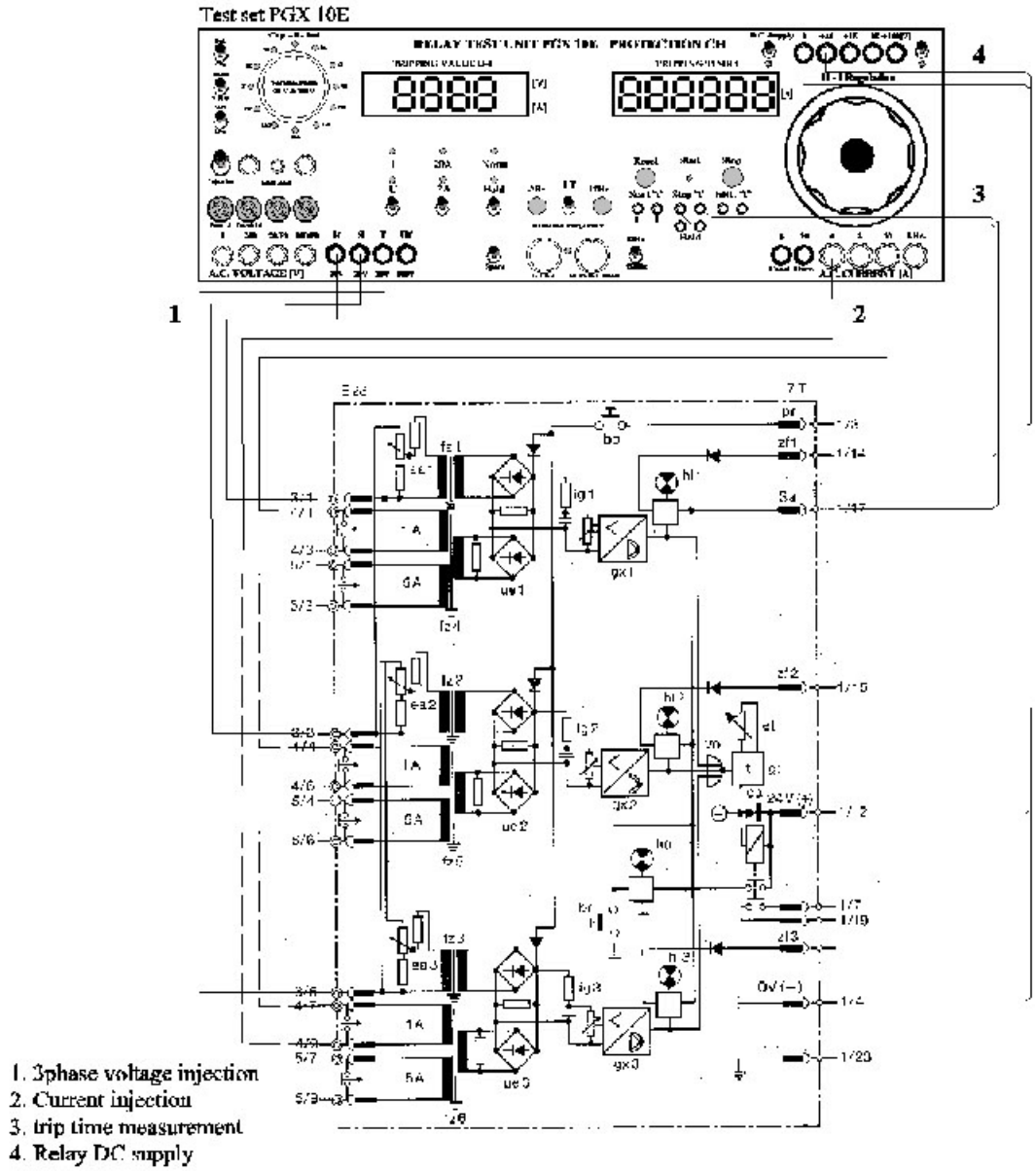


fig.15 Test connection for commissioning of the unidirectional under impedance relay ZSX103

PGX10 settings:

- stop time contact: t-stop (pot. free contact) and start bridge
- current injection by 0 ... 20 A_{AC} variable current source
- voltage injection by constant 33V_{ph-ph} 3 phase voltage source

7.5 DEFINITE TIME OVERCURRENT RELAY PROTECTION TEST

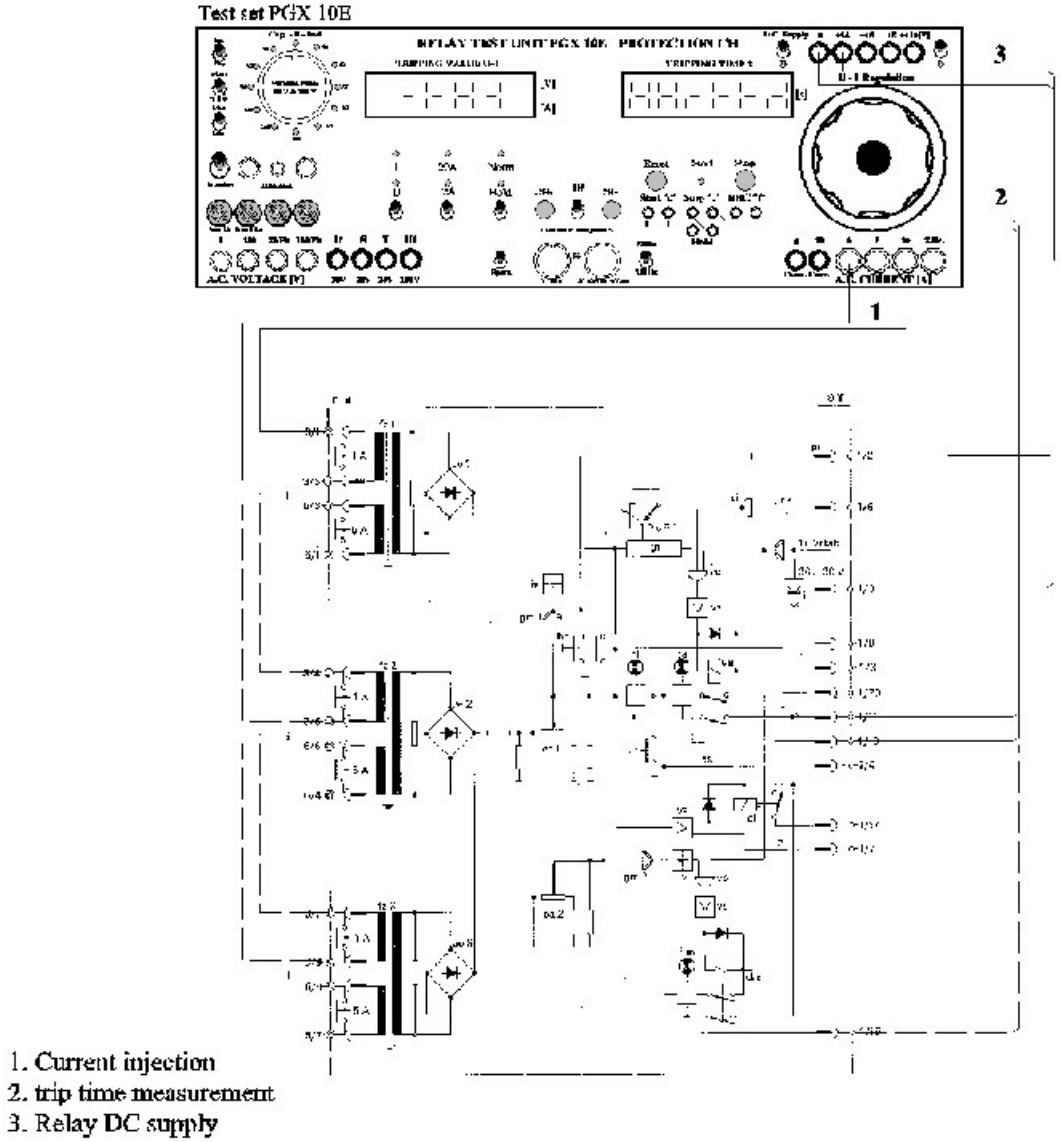
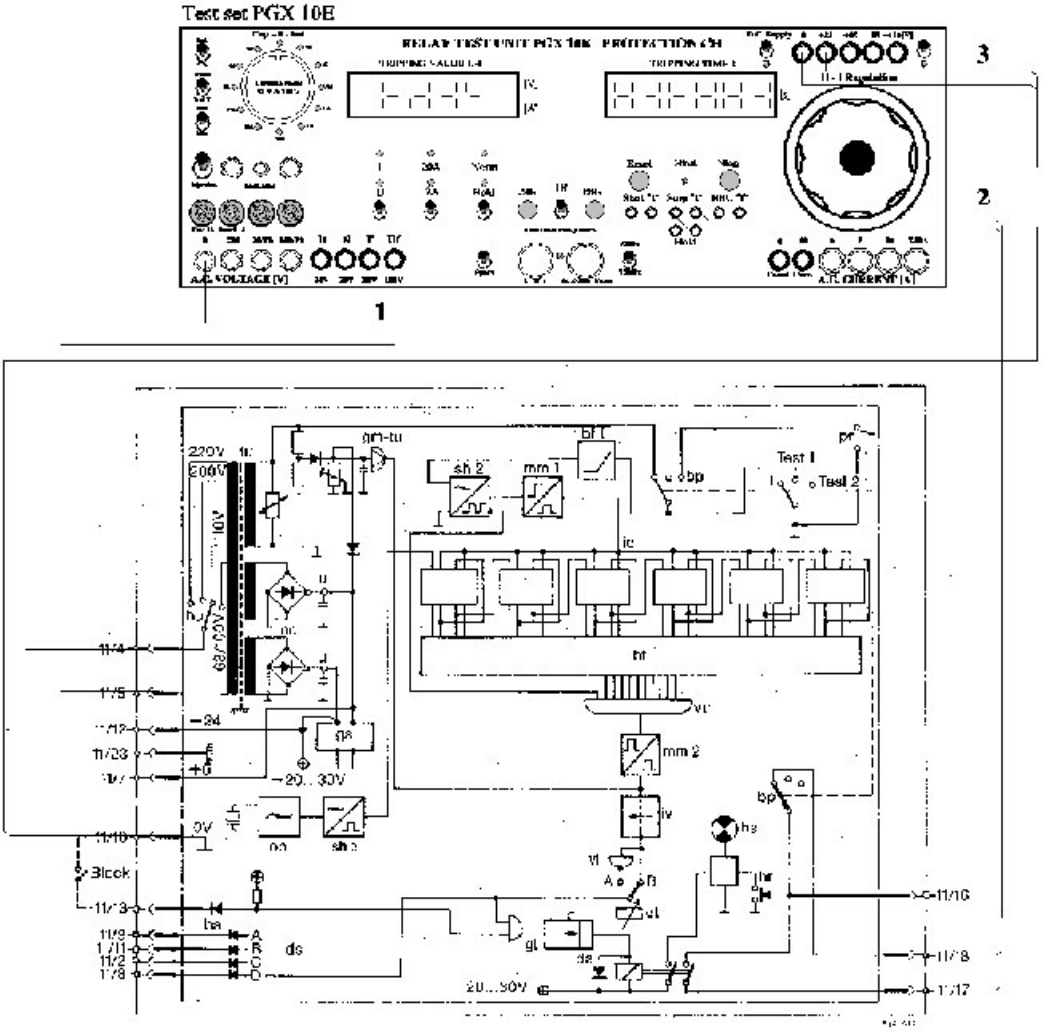


fig.16 Test connection for commissioning of the definite time overcurrent relay ISX148

PGX10 settings:

- stop time contact: t-stop (pot. free contact) and start bridge
- current injection by 0 ... 20 A_{AC} variable current source

7.6 MAX./MIN. FREQUENCY RELAY PROTECTION TEST



1. **Variable voltage/frequency injection**
2. **trip time measurement**
3. **Relay DC supply**

fig.17 Test connection for commissioning of the max/min frequency relay FCX103b

PGX10 settings:

- stop time contact: t-stop (pot. free contact) and **no** start bridge
- voltage injection by variable voltage/frequency source
  - for time measurement use the ±D2Hz push buttons (see chapter 4.4)

7.7 UNSYMETRICAL LOAD RELAY PROTECTION TEST

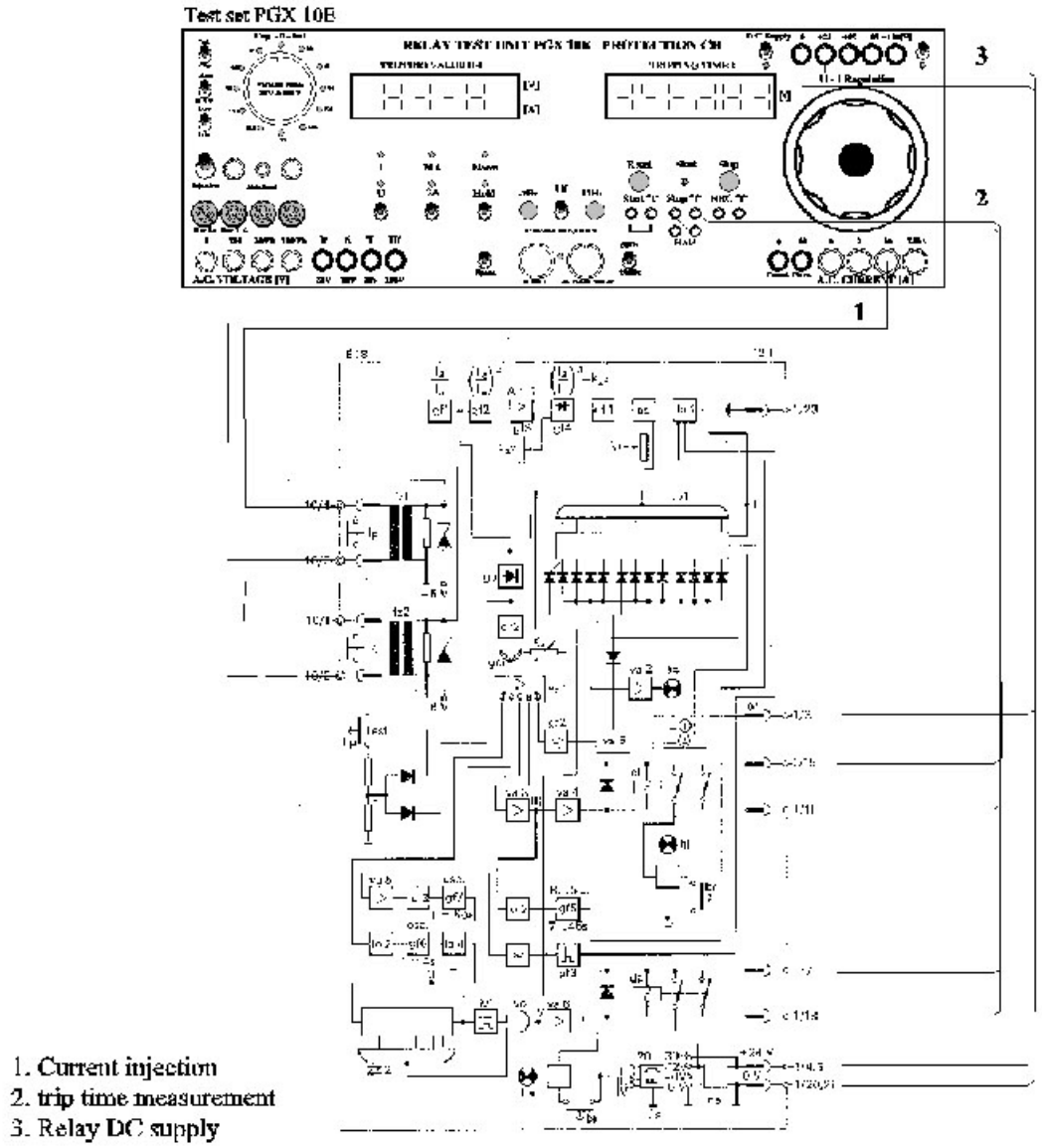


fig.18 Test connection for commissioning of the unsymetrical load relay IPX146

PGX10 settings:

- stop time contact: t-stop (pot. free contact) and start bridge
- current injection by 0 ... $2A_{AC}$ variable current source

7.8 95% STATOR EARTH FAULT RELAY PROTECTION TEST

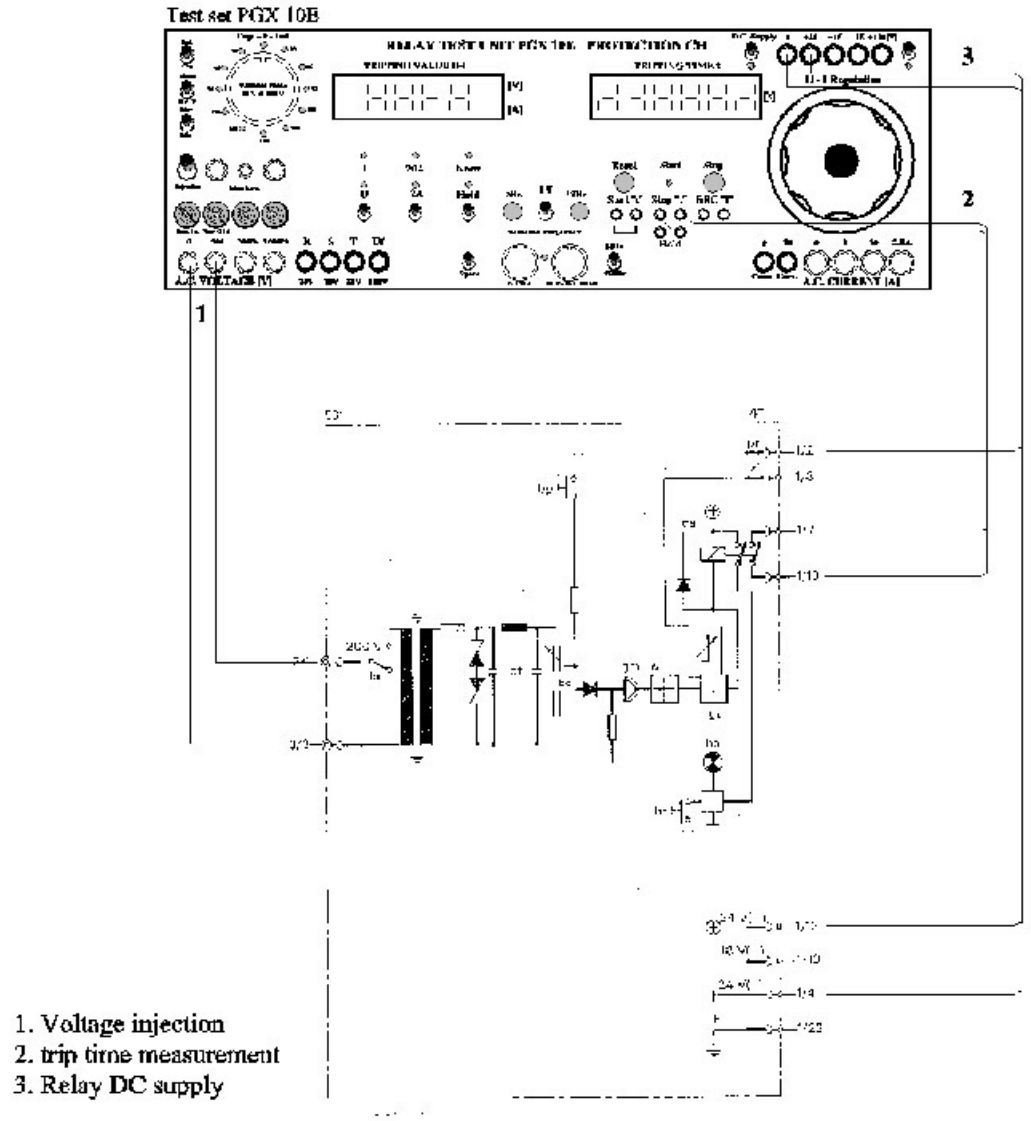
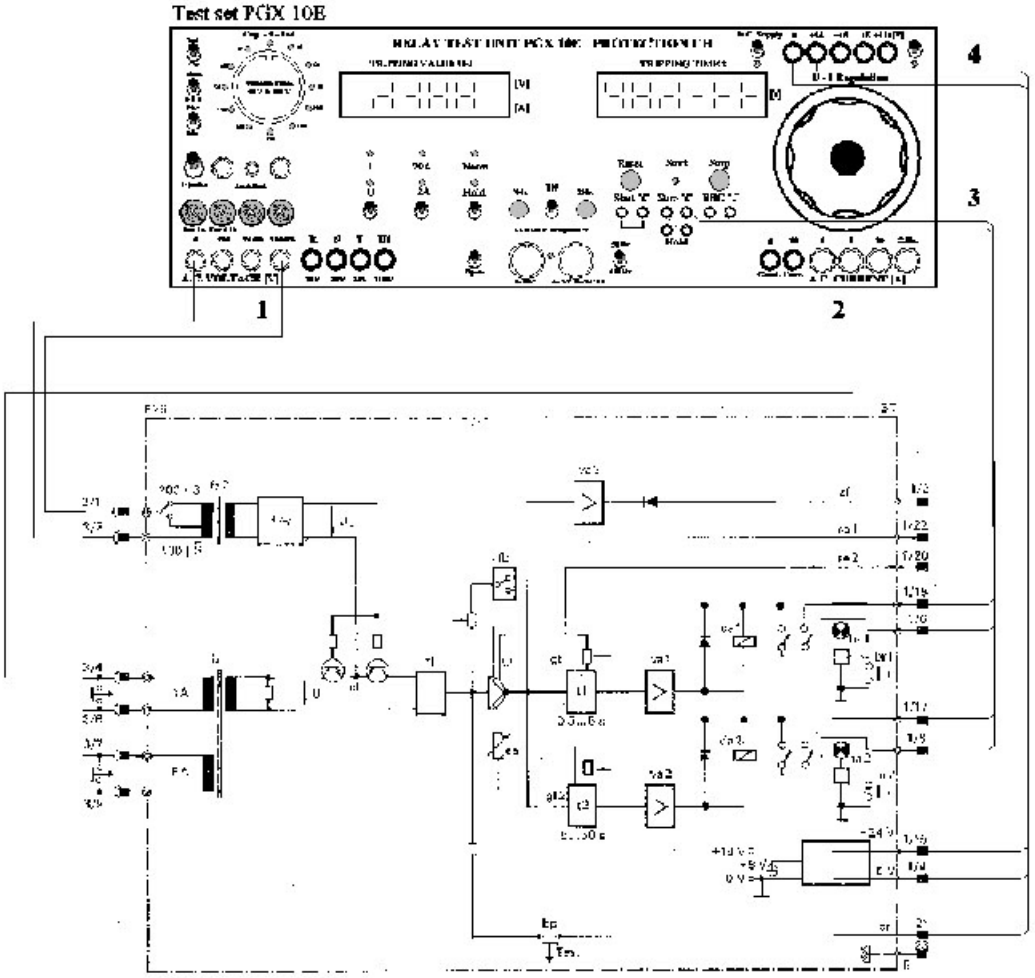


fig.19 Test connection for commissioning of the earth fault protection relay UBX117

PGX10 settings:

- stop time contact: t-stop (pot. free contact) and start bridge
- voltage injection by 0 ... 200V_{AC} variable voltage source

7.9 REVERSE POWER RELAY PROTECTION TEST



1. Variable phase voltage injection
2. Current injection
3. trip time measurement
4. Relay DC supply

fig.20 Test connection for commissioning of the reverse power relay PPX105

PGX10 settings:

- stop time contact: t-stop (pot. free contact) and start bridge
- current injection by 0 ... 0.5A_{AC} variable current source
- voltage injection by variable voltage/frequency source

CH - 5430 Wettingen
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Relay Publication E

TEST CERTIFICATE: *DEVICE: PGX10E*

General data

Relay No.	Relay test set PGX10E
Client	
Delivery ABB reference	
Supply	

Amperemeter setting value (calibration point)	1.000 A
Voltmeter setting value (calibration point)	100 V

Functional test for Hold & Timer

Hold function for „t“ and „U-I“	☒
Time delay start	☒
Time delay stop	☒
Permanent test 1h U_{out}= 100.0V (Burn-in)	☒

DC supply section

DC supply indicated	+110 V	+24 V	+18 V	+15 V	- 15 V
DC supply measured			Not applicated		

Phase shift outputs (voltage & phase control-inductive mode)

AC outputs indicated	20V / 0°	20V / 30°	20V / 60°	20V / 90°	20V / 120°	20V / 150°
AC outputs measured						
AC outputs indicated	100V/0°	100V/30°	100V/60°	100V/90°	100V/120°	100V/150°
AC outputs measured						

Phase shift outputs (voltage & phase control-capacitive mode)

AC outputs indicated	20V / 30°	20V / 60°	20V / 90°	20V / 120°	20V / 150°	20V / 180°
AC outputs measured						
AC outputs indicated	100V/30°	100V/60°	100V/90°	100V/120°	100V/150°	100V/180°
AC outputs measured						

Voltage output - display accuracy

Instr. Fluke 87	10.0 V	30.0 V	60.0 V	100.0 V	150.0 V	197.0 V
PGX display						

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Relay Publication E

TEST CERTIFICATE: *DEVICE: PGX10E*

Current output (range 2A) - display accuracy

Instr. Fluke 87	200 mA	500 mA	1000 mA	1500 mA	1900 mA
PGX display					

Current output (range 20A) - display accuracy

Instr. Fluke 87	1.00 A	2.00 A	5.00 A	7.00 A	10.0 A
PGX display					

Control instruments: Fluke Digital Multimeter Type 87 and Tektronix KO Type 564

Frequency generator

Voltage range	
Frequency range f1	
Frequency range f1	

Fucntional check ☒ ok
Polarity check ☒ ok
Instrument control ☒ ok
Test function control ☒ ok
Visual inspection (visual control) ☒ ok
Mechanical inspection ☒ ok

Date and place: Wettingen, xx.yy.200x (Protection Laboratories)

Checked by: ☒ control passed

PROTECTION
Consulting Manufacturing Commissioning

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Relay Publication E

SYNCHROSCOPE TYPE SYN 99C

fig. 1 - Picture front view digital Synchroscope SYN 99C

Product: **Synchroscope**
Version: **SYN 99C**
Manufacturer: **PROTECTION - CH**

List of contents

ILLUSTRATION INDEX

APPLICATION

- Manual synchronizing control device for electrical power plants.
- Compact multiple digital instrument assembly, highly useful during testing of protection relays.
- Optional multiple display for test set PGX10
- Control instrument for electromechanical synchroscope, synchrocheck, synchrotact.

MAIN FEATURES

- Assembly of multiple digital instruments:
- Two digital frequencymeters
- Two digital voltmeters
- Vector differential input digital voltmeter
- Digital phase angle meter
- LED bargraphs display for phase angle
- High accuracy measurement for voltages and frequency
- Built-in AC/DC supply unit
- High efficacy radio frequency anti disturbance filter, offering free disturbance operation and long life
- Two input voltage transformers with 0.2 VA consumption at rated voltage
- High illuminated 7-segment LED's display
- Alu-case
- Available in two versions
- Version SYN 99C - portable
- Version SYN 99C - rack
- Internal facility of exact tuning of all voltage measurements at rated voltage (100V or 100/1.73 V)

PRINCIPAL OF OPERATION

CMC SSyn 99C digital instrument assembly for voltage, frequency, differential voltage and phase angle measurement during synchronizing offers the possibility of precise voltage and speed regulation as well as exact manual closing of the circuit breaker. After having tuned speed and voltage of a generator the operator has to watch the frequency slip on the differential voltmeter and phase angle bar graph. If the slip is low enough (10 sec. / one period) the operator is allowed to close

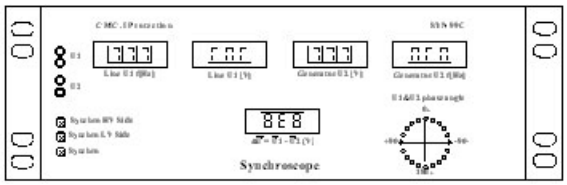

fig. 2 - front view digital Synchroscope SYN 99C

the circuit breaker in the zero crossing of the differential voltmeter.
To facilitate fast simultaneous control of all six displays each instrument is equipped with only three digits.

The device is supposed to replace the electromechanical synchronizing devices, which are very vulnerable during transportation and commissioning.

Low consumption of the measuring inputs offers additional advantages to the recent units.

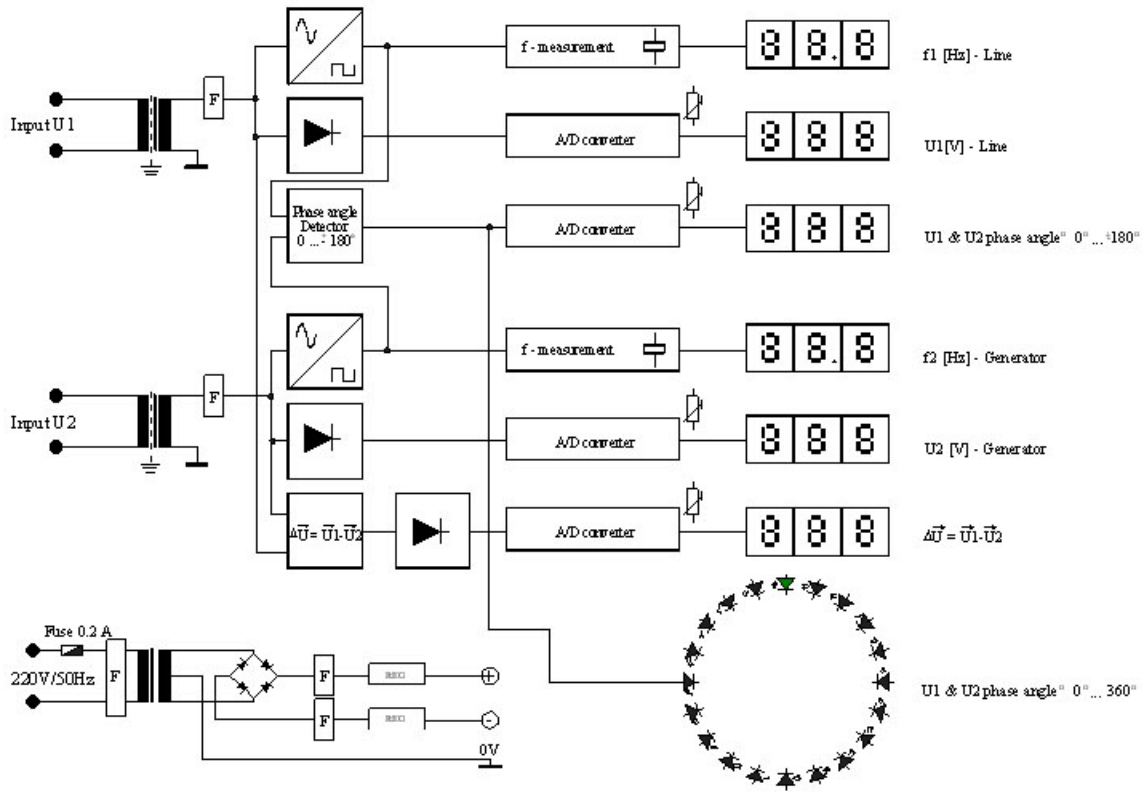

fig. 3 - functional block diagram SYN 99C

VERSIONS – SYN 99C

SYN 99C - RACK VERSION

Features:

- two voltmeters U1 &U2
- two frequency meters
- diff. vector voltmeter
- rotating circular dot graphs

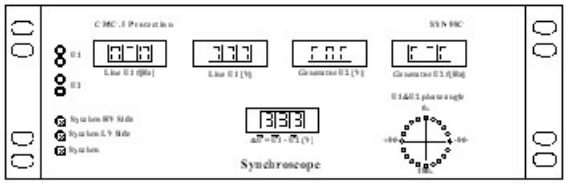

fig. 4 - front view SYN 99C - rack version

SYN 99C - PORTABLE VERSION

Features:

- two voltmeters U1 &U2
- two frequency meters
- diff. vector voltmeter
- rotating circular dot graphs

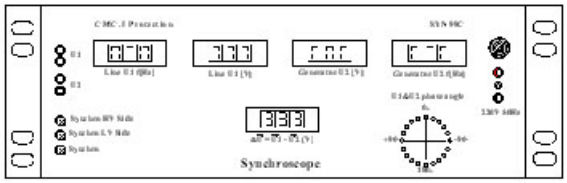

fig. 5 - front view SYN 99C - portable version

Difference between these two versions is mainly that the rack version has a 16-pol plug in connector on the rear side.

The portable version has all connection on the front side. The LED's: SynchroHV side, Synchro LV side, Synchro are not used.

CONNECTION AND MEASUREMENT OPTIONS

The synchroscope SYN 99C can be used as portable or as built in version. Used as built in version all the connections are made by a 16-pol cage clamp plug at the rear of the device. U1 and U2 are accessible on the front plate of the synchroscope. This offers the possibility to supervise the voltage signals U1 and U2 by a simple multimeter. As portable version the A.C. supply connection is realized at the front side and the measurement signals can be connected to the front plate plugs U1 and U2.

Don‘t supply at the same time by the 16-pol. rear cage clamp plug and the ther connection plugs

SYN 99C & PGX 10 FOR COMMISSIONING OF A SYNCHRONIZING DEVICE IN A POWER PLANT

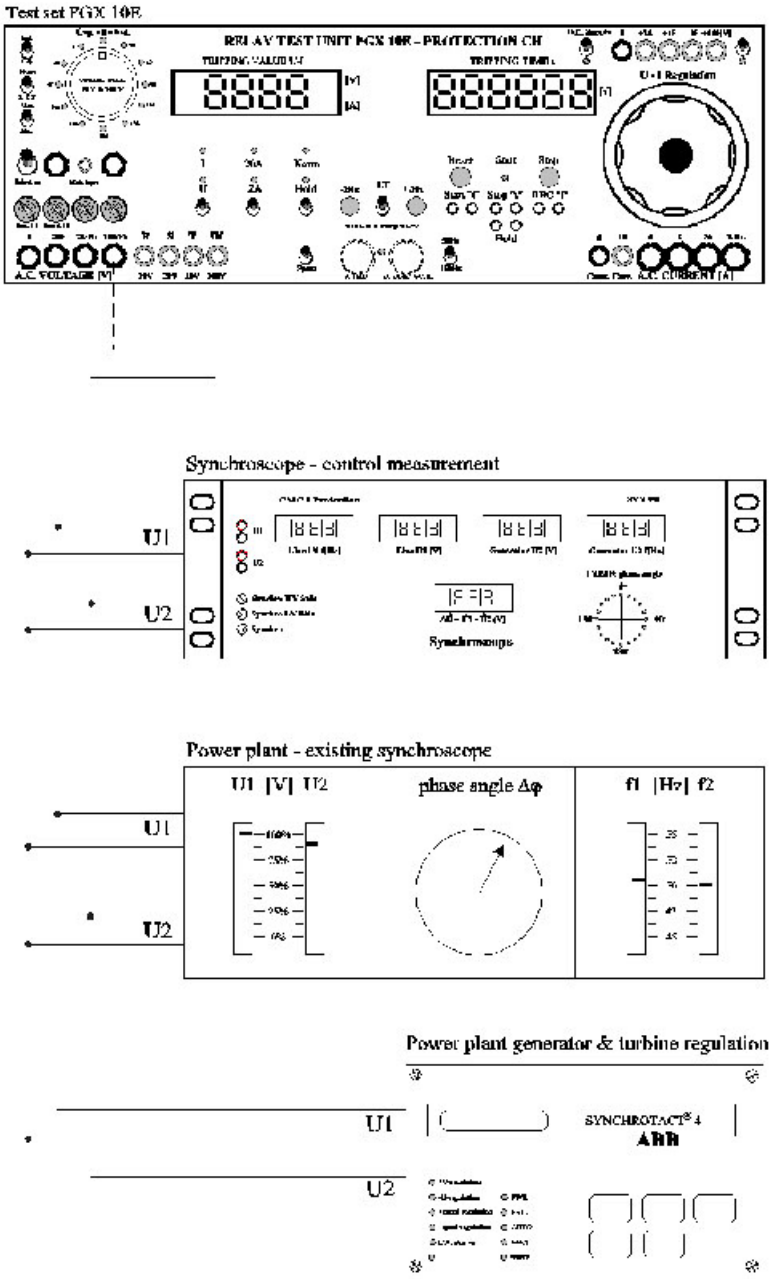

fig. 6 - Connection diagram for commissioning of a synchronizing circuit

SYN99C APPLICATIONS

fig. 7 - portable SYN 99C and PGX10E

fig. 8 - synchronizing system

Integrated in the cover of the PGX10E portable relay test set. Very compact, low cost system for commissioning of entire generator, substation and line protection systems.

Allows very flexible and complete testing on site and also in laboratory.

Used as synchroscope in a station synchronizing system with two possible synchronizing points.

This system doesn't need additional heavy, high burden and expensive interposing potential transformers.

MECHANICAL DIMENSIONS

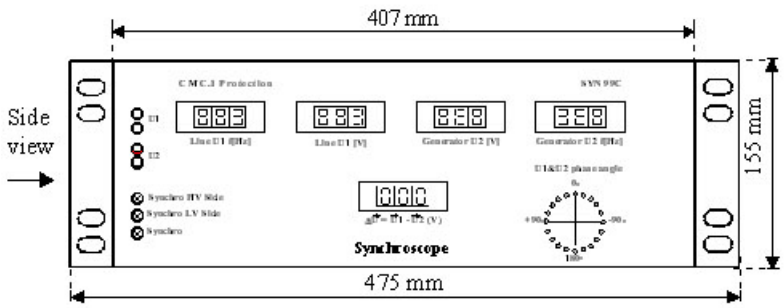

fig. 9 - dimensions front SYN 99C

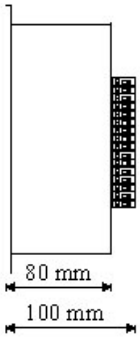

fig. 10 - Side view

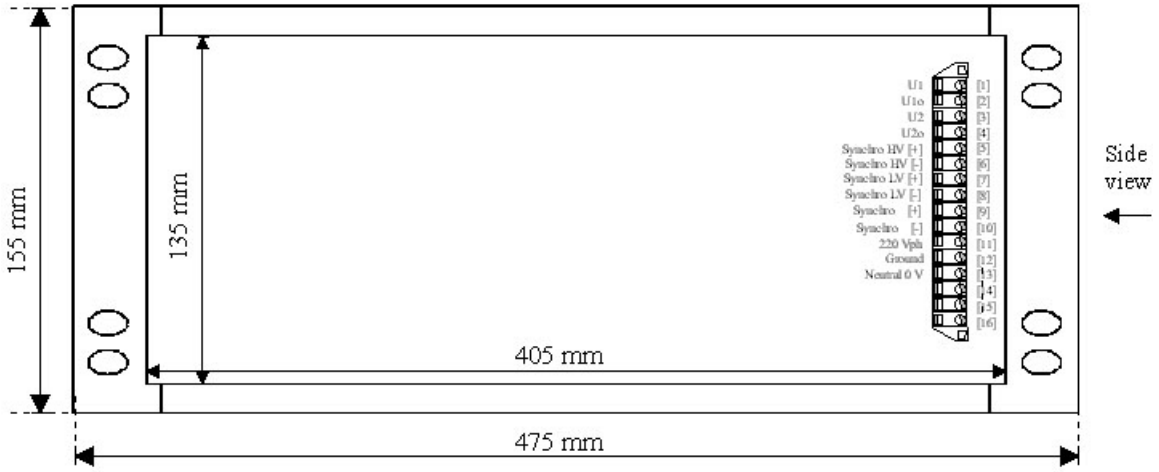

fig. 11 - dimensions rear and connection SYN 99C

The plug in connector on the rear is a 16-pol cage clamp plug type WAGO no.231-316.

TECHNICAL DATA – SYN 99C

Function.....	Synchroscope measurement
Input Voltage U1 (line).....	Un=100V
Input Voltage U2 (generator).....	Un=100V
Input voltage measuring range	10 ... 140 V
Max. input voltage U1 & U2.....	140 V (50Hz)
Consumption measurement inputs.....	100V / 3mA (0.3 VA each input)
Nominal frequency.....	50Hz/60Hz
Measuring frequency range.....	10 ... 100 Hz
Frequency measurement accuracy.....	quarz stabilized
Frequency display resolution.....	0.1 Hz
Diff. vektor voltmeter range.....	0 ... 199 V
Diff. vektor voltmeter accuracy.....	DU = U1n-U2n = 0 ... 1 V
Phase angle circle graph range.....	0 ... 360°, resolution »18°
Aux. supply.....	220V, 50/60 Hz, 10W
Temperature range.....	-5 ... +55 °C - data true
HF Filter.....	Load current compensated
Dimension.....	160 x 360 x 65 mm
Weight.....	3 kg
Casing.....	Aluminium box
Insulation voltage (input transformers).....	2.5kV, 1 minute
Versions.....	Syn 99C - portable
	Syn 99C - rack
Calibration standard.....	voltage measurements in [V]
Calibration special request.....	voltage measurements in UN [%]
Calibration for frequency.....	Hz