Megger

SVERKER 900

Relay and substation test system

User guide

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Megger

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Relay and substation test system

User guide

Megger Sweden AB is certified according to ISO 9001 and 14001.

Postal address:
Megger Sweden AB
Box 724
SE-182 17 DANDERYD
SWEDEN

Visiting address:
Megger Sweden AB
Rinkebyvägen 19
SE-182 36 DANDERYD
SWEDEN

T +46 8 510 195 00
E seinfo@megger.com

www.megger.com

CE

Contents

1 Safety

1.1 General

Important
Read and comply with the following instructions.
Always comply with local safety regulations.

Symbols on the instrument

Caution, refer to accompanying documents.

Protective conductor terminal.

WEEE, Waste Electronic Equipment. Please utilize your local WEEE collection facilities in the disposition of this product and otherwise observe all applicable requirements.
The unit can also be returned to Megger at any time at no charge for the disposal.

Information duty regarding substances on REACH article 33, SVHC-list

This product contains a coin cell battery which contains 1,2- dimethoxyethane (CAS 110-71-4) above 0.1% by weight.

1.2 Safety instructions

Warning

1. High voltage/current on output terminals.
2. The instrument is equipped with a power cord with integral safety ground pin. The equipment must be connected to a grounded mains outlet. The instrument case must also be grounded by the separate protective ground wire with connection to the protective earth terminal on the rear panel. This is to eliminate difference in earth potential between the instrument and the device to be tested. Check the continuity of the protective ground wire before each use.
3. Do not attempt to service the instrument yourself. Opening or removing covers may expose you to dangerous voltage. If you attempt to service the instrument yourself the warranty is no longer valid.
4. Do not use any accessories that are not intended for use together with the instrument.
5. Do not use the instrument for any purpose other than indicated by the manufacturer.
6. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
7. Disconnect the instrument from the mains before cleaning. Use a damp cloth for cleaning. Do not use liquid cleaners or aerosol cleaners.

Important

1. Always turn the equipment off before connecting.
2. Always use manufacturer approved and supplied cable sets.
3. Always connect protective earth (ground).
4. Slots and openings in the instrument are provided for ventilation. They ensure reliable operations, keeping it from overheating. These openings must not be blocked nor covered during operation.
5. The instrument may not be positioned so that the mains switch is blocked.
6. The mains connector may not be used as disconnecting device.
7. The plug to the mains inlet is to be used as disconnector.
8. Never leave the instrument unattended while it is turned on and in the high-current mode.

9. Use only approved mains detachable cable set with the instrument. Main supply cables shall be rated for the maximum current for the equipment and the cable shall meet the requirements of IEC60799 (Cord sets and interconnection cord sets). Mains supply cables certified or approved by a recognized testing authority are regarded as meeting this requirement.
10. Unplug the instrument from the mains supply when it is left unattended or not in use.
11. Do not expose the instrument to rain or moisture.
12. Refer all servicing to Megger authorized personnel.
13. If you need to return the instrument, please use either the original crate or one of equivalent strength

2 Introduction

2.1 General

The SVERKER 900 is an instrument designed for testing of electrical equipment e.g. protective relay systems in substations and industrial plants.

SVERKER 900 comes in three models.

Model	Test instruments
Basic	Main instrument Prefault-Fault instrument
Standard	Main instrument Prefault-Fault instrument Ramping instrument Sequencer instrument CT magnetization instrument
Expert	Main instrument Prefault-Fault instrument Ramping instrument Sequencer instrument CT magnetization instrument Impedance instrument

The rugged hardware design is built for field use over a wide temperature range.

SVERKER 900 is a three-phase test equipment. It can generate voltage and current from its four voltage generators and three current generators respectively, receive binary inputs and a binary output that is a make/brake contact.

SVERKER 900 can measure external voltages and currents as well, and properties like level, phase, power factor and frequency of each. The voltage and current generator outputs can be activated in many combinations. It also includes an external timer with various start and stop conditions.

All setting for the instrument are made using the touch screen. The main instrument includes the "ON+TIME" and "OFF + TIME" functionality.

Another instrument is the prefault fault sequence with binary input used for trip signals.

The Ramping instrument is used to ramp voltage, current, angle and frequency. One or several parameters can be ramped at the same time..

The Sequencer instrument has 16 states that can be individually configured for parameter value, timing and BI/BO. Equipment for multi task purpose can be automatically tested here, e.g. different protections and parameter limit values.

The CT magnetization instrument is used for manual or automatic "knee point" control on current transformers.

The Impedance instrument is used for testing in so called impedance plane, where the conversion from the impedance into voltage and current is done automatically .

2.2 Unpack system

Unpack the unit and check for evidence of any shipping damage. If there is any visual damage, immediately notify the freight carrier to make a damage claim, and notify Megger of the damage.

2.3 Service and support

For technical assistance please contact your local representative or direct your request to Megger in Sweden.

When sending the instrument, please use either the original crate or one of equivalent strength.

Add the return authorization number to the address label of the shipping container for proper identification and quicker handling.

Note *Ship the equipment without nonessential items such as test leads, etc. These items are not needed by the factory to perform service.*

Training

For information about training courses contact your local distributor or the Megger Sweden office.

Contact information

Internet:	www.megger.com
E-mail:	support-sweden@megger.com
Tel:	+46 8 510 195 00

3 Instrument description

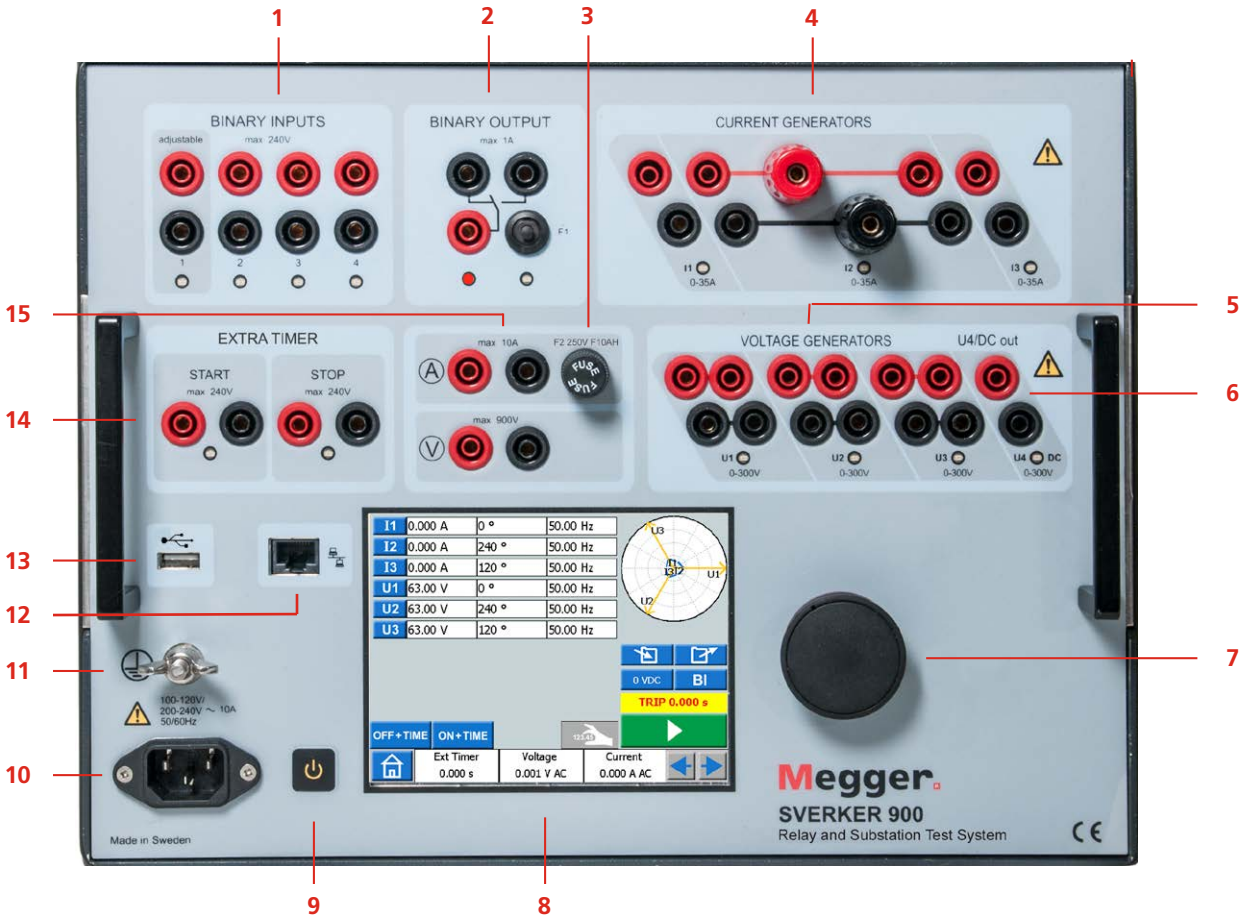
3.1 Panel

1. Binary inputs
2. Binary output
3. F2 fuse
4. Current generators I1, I2, I3
5. Voltage generators U1, U2, U3
6. Voltage generator U4 or AUX supply
7. Control knob
8. Touch screen
9. Power ON/OFF switch
10. Mains inlet socket
11. Protective earth terminal
12. Ethernet port
    The Ethernet port is used for service of the instrument only.
13. USB port
14. Extra timer
15. Ammeter & voltmeter

3.2 The lid

Inside the lid are:

- Jumpers
- CTM-box for use with the CT magnetization instrument
- Pen to use for the touch screen



3.3 Binary Inputs

The SVERKER 900 have 4 binary inputs, independent programmable gate circuits that permit simple selection of the desired mode for voltage or contact monitoring operation. Binary input 1 has a selectable threshold voltage.

The binary inputs are used to monitor relay trip contacts for performing pickup and dropout tests as well as for performing timing functions.

The binary inputs are specifically designed to measure high speed operation of electromechanical, solid-state and microprocessor-based protection relays. All binary inputs are default set to monitor mode, contact /voltage change of state.

To change a binary input state from contact sensing to voltage applied / removed, touch the "BI" button.

At each binary input there is an input state indicator lamp that shows the state of the input. It indicates either a closed circuit (for contact mode) or the presence of a voltage (for voltage mode). These indicators permit (for example) to check the circuits involved before starting a sequence.

Dry contacts Open	Timer stops and a continuity indicator goes out at the opening of normally closed contacts.
Dry contacts Close	Timer stops and a continuity indicator glows at the closing of the normally open contacts.
Application or removal of AC or DC voltage	Timer stops. The continuity indicator will glow (application) or darkens (removal) upon the application or removal of either an AC or DC voltage. A higher threshold voltage helps to eliminate false triggers due to a noisy source. Lower thresholds allow starting and stopping of timer from TTL voltage signals. Binary input 1 has a settable threshold value for pickup & dropout and minimum settable threshold voltage is 5 V

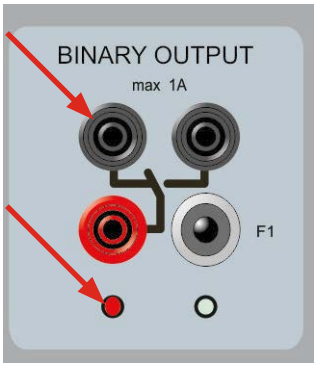
3.4 Binary Output

The binary output is a make/break contact that is actuated when the SVERKER 900 is set to ON-generating or OFF-generating mode.

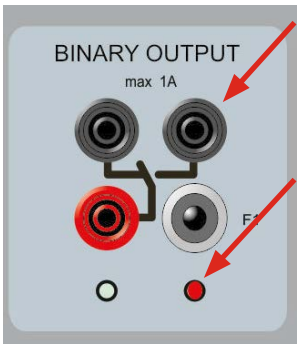
Note *In the "Sequence instrument" the make/break contact position can be set for each state individually.*

The binary output is used to simulate normally open/normally closed contacts for testing breaker failure schemes, or similar power system operations. In addition it may also be used to switch AC/DC voltages and currents.

For maximum switching capacity see the specification section.



BO position when SVERKER 900 is OFF (not generating). Left terminal is on.



BO position when SVERKER 900 is ON (generating) Right terminal is on..

3.5 Current generators

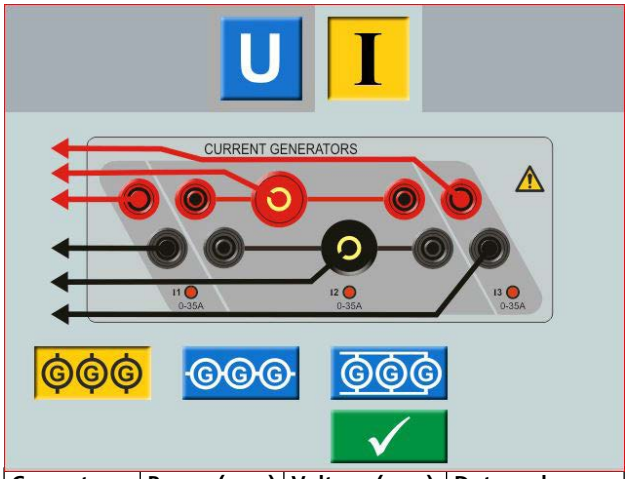
The current generators I1, I2, I3 can be used separately, in parallel or in series. Constant power output in many cases eliminates the need to connect the current channels in parallel or series to test high burden relays.

- All outputs are isolated or floating and provide variable frequency.
- The current generators delivers maximum compliance voltage to the load constantly during the test, and range changing is done automatically, on-the-fly, under load.

The per channel output current and power ratings are specified in AC rms values. Specified duty cycles are based upon ambient temperature of 20°C.

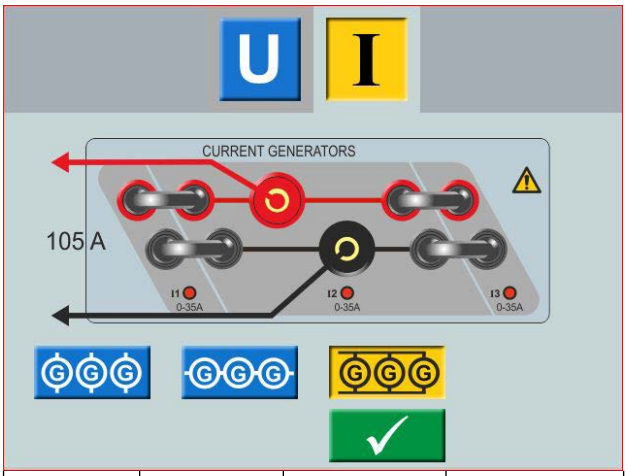
1] To change current configuration, go to home menu and select Configuration of Voltage/Current generators

Current generators separately: I1, I2, I3



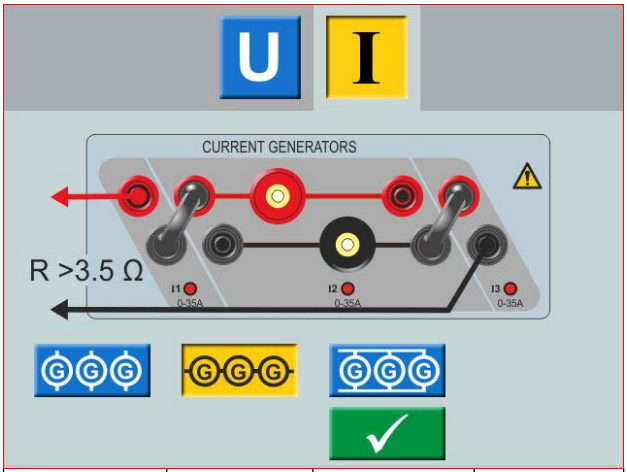
Current	Power (max)	Voltage (max)	Duty cycle
5 A	250 VA	50 V	Continuous
10 A	250 VA	25 V	Continuous
20 A	200 VA	10 V	Continuous
35 A	100 VA	2.8 V	10 s ON/20 s OFF*
*Thermo protected			

Current generators in parallel: I1 // I2 // I3



Current	Power (max)	Voltage (max)	Duty cycle
15 A	750 VA	50 V	Continuous
45 A	750 VA	16.5 V	Continuous
60 A	600 VA	10 V	Continuous
105 A	300 VA	2.8 V	10 s ON/20 s OFF*
*Thermo protected			

Current generators in series: I1 – I2 – I3



Current (max)	Power (max)	Voltage (max)	Duty cycle
18 A	625 VA	140 V	Continuous
With external inductive load. Frequency: max 200 Hz			
15 A	625 VA	140 V	Continuous
With minimum 3.5 Ω external resistive load. Frequency: max 200 Hz.			

Note *The current amplifiers outputs are protected from open circuits and thermally protected against prolonged overloads. In case of an open circuit or a thermal overload, the amplifier will automatically turn off, and an error message will be displayed.*

3.6 Voltage generators

The voltage generators U1, U2, U3 and U4 can be used separately, in parallel or in series.

- All outputs are independent from sudden changes in mains voltage and frequency, and are regulated so changes in load impedance do not affect the output.
- All outputs are isolated or floating.
- All outputs provide variable frequency.

1] To change voltage configuration, go to home menu and select Configuration of Voltage/Current generators

Voltage generator U4 as auxiliary supply

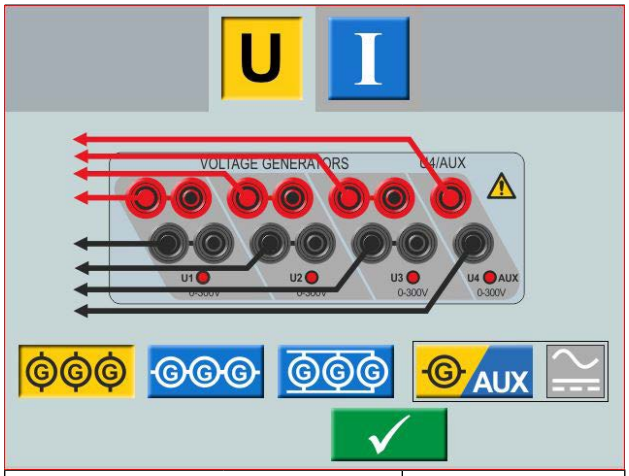
The primary application for U4 is to provide auxiliary voltage for protective relays. U4 provides a variable output from 0 to 300 V AC/DC.

Warning

Do not plug or insert any test lead into the voltage outputs without first connecting the test leads to the load.

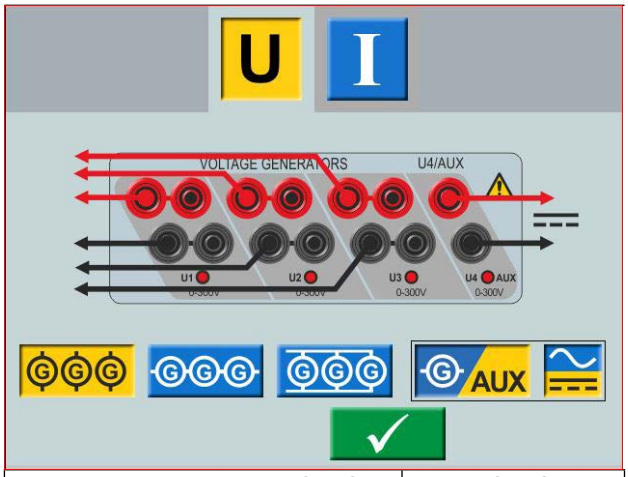
When voltage generators are connected in series for output over 600 V the special test leads (brown and purple) must be used.

Voltage generators separately: U1, U2, U3, U4



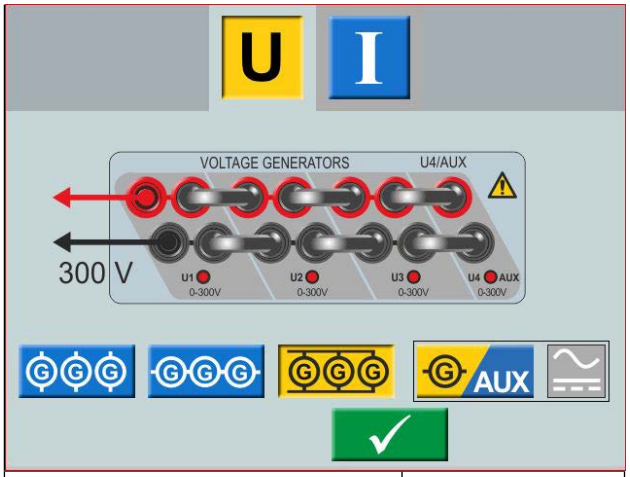
Voltage range	Power (max)	Current (max)
300 V	125 VA	0.42 A
100 V	100 VA	1.0 A
67 V	100 VA	1.5 A
External load: min. 25 Ω		

Voltage generators separately: U1, U2, U3 (U4 AUX)



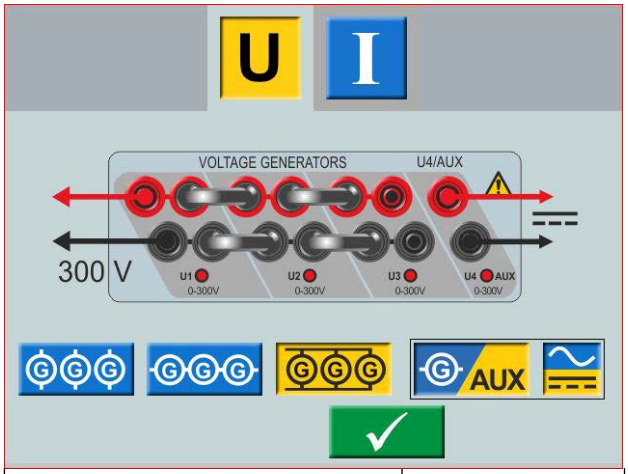
Voltage range	Power (max)	Current (max)
300 V*	125 VA	0.42 A
* U4 DC		

Voltage generators in parallel: U1 // U2 // U3 // U4



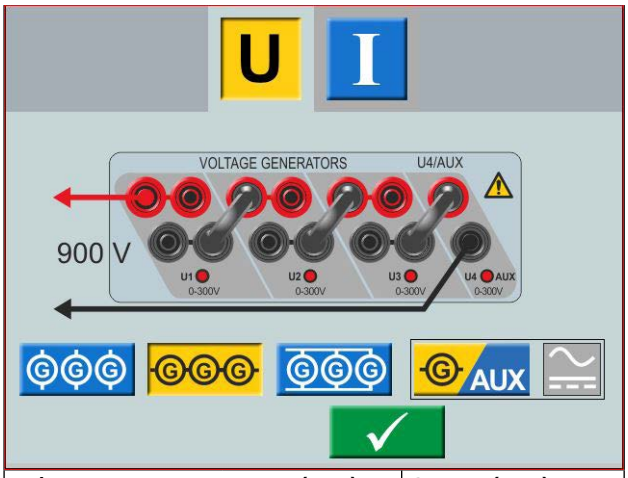
Voltage range	Power (max)	Current (max)
300 V	375 VA	1.2 A
100 V	300 VA	3.0 A
67 V	300 VA	4.5 A
External load: min. 7 Ω Frequency: max. 200 Hz		

Voltage generators in parallel: U1 // U2 // U3 (U4 DC)



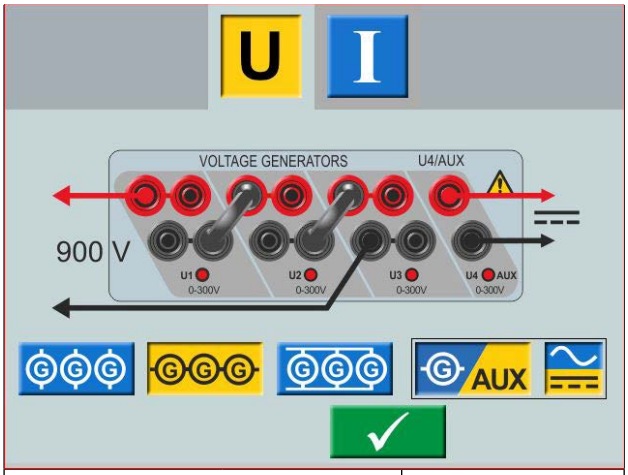
Voltage range	Power (max)	Current (max)
300 V	312 VA	1.0 A
100 V	250 VA	2.5 A
67 V	250 VA	3.7 A
External load: min. 9 Ω Frequency: max. 200 Hz		

Voltage generators in series: U1–U2–U3–U4



Voltage range	Power (max)	Current (max)
900 V	450 VA	0.5 A
400 V	360 VA	0.9 A
268 V	350 VA	1.3 A
External load: min. 100 Ω Frequency: max. 200 Hz		

Voltage generators in series: U1–U2–U3 (U4 AUX)



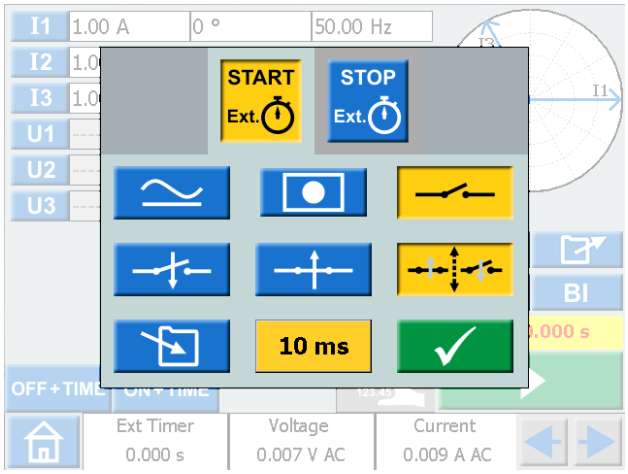
Voltage range	Power (max)	Current (max)
900 V	350 VA	0.4 A
300 V	280 VA	0.9 A
200 V	275 VA	1.4 A
External load: min. 75 Ω Frequency: max 200 Hz		

3.7 Extra timer

The SVERKER 900 has two independent gate inputs that permit simple selection of the desired mode for timing operation.

To monitor operation of the contacts in the device under test, a light is provided for each gate. The gate circuit is isolated for voltage-sensing and can monitor solid-state logic signals. Each light will illuminate once contacts close or voltage is applied to the gate.

1] Press "Ext Timer" at bottom of display, from any of the instruments.
A new window opens.



2] Make settings for the START and STOP conditions.
The conditions can be set different for START and STOP.

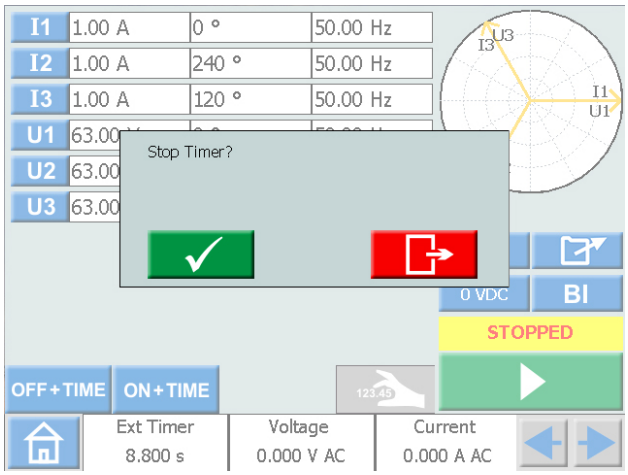
Start and Stop conditions

Condition	START Ext. / STOP Ext.
	The settings for starting and stopping are done independently..
	At application of either an AC or DC voltage.
	At removal of either an AC or DC voltage.
	At application or removal of AC or DC voltage.
	At the opening of normally closed contacts
	At the closing of normally open contacts

	At the opening or closing of contacts.
	When a generator is turned on or off, or that a trip signal stops the generating or that an open current circuit is detected.

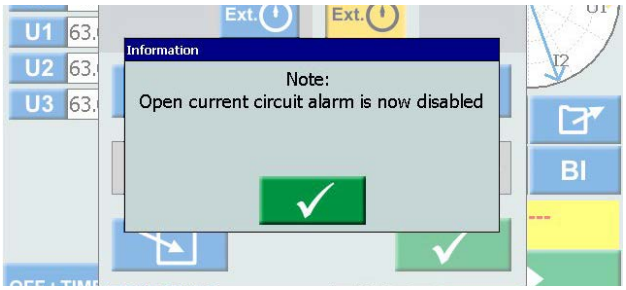
Other functions

10 ms	Filter time can be set from 0 to 999 ms.
	The timer value is stored Note: The timer value can not be saved separately only together with a test made in any instrument.

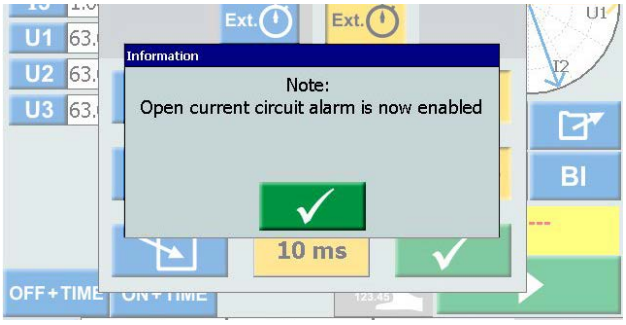


If the "Ext.timer" has failed to stop, it can be manually stopped and reset.

1] Press "Ext Timer" and then ✓



When internal start and stopp are selected the open current circuit alarm is disabled.



When one of the internal start/stop settings is removed the open circuit alarm is enabled.

MCB Mode

This mode is possible to activate in Main instrument, Prefault-Fault instrument,Ramp instrument and Sequencer instrument.

MCB mode is used for timing test on Low voltage breakers such as; MCB (Miniature Circuit Breaker) or MCCB (Molded Case Circuit Breaker).

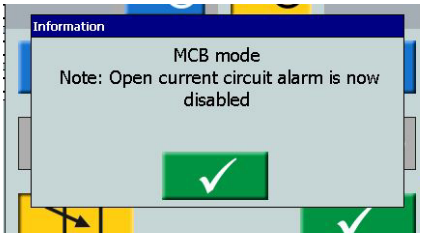
Activate MCB mode

1] Press "Ext Timer" at bottom of display, from any of the instruments.
A new window opens.

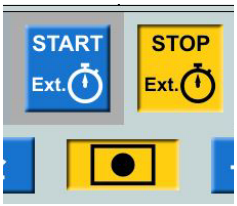
2] Press START Ext. and then ●

Both buttons shall be yellow.

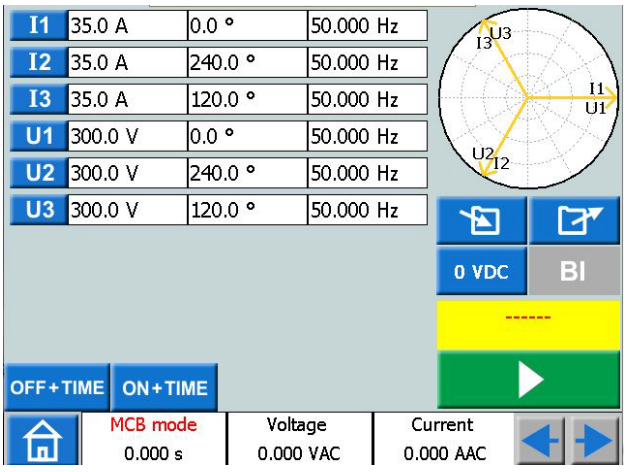
3] Press STOP Ext. and then ●



4] Press ✓
Both buttons shall be yellow.



5] Press ✓



Deactivate MCB mode

1] Press ~ or —

2] In popup window press ✓

3.8 A-meter / V-meter

SVERKER is equipped with an ammeter and voltmeter.

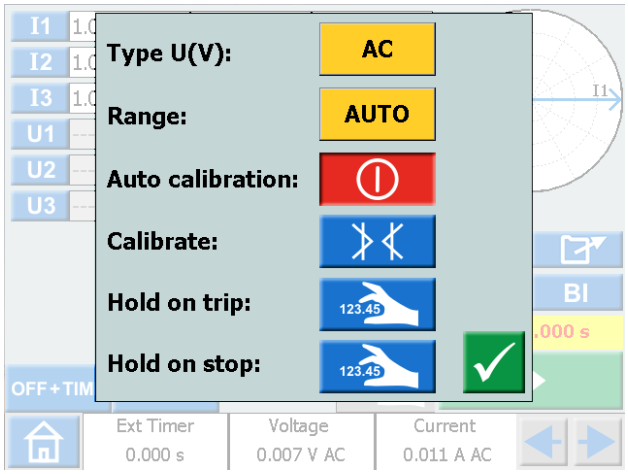
These instruments can also be used to display resistance, frequency, impedance, phase angle, power and power factor. Moreover, these instruments can be used to perform measurements in external circuits. In both cases, the values appear on the display.

The ammeter input (marked "A") measures 0–10 A (ACrms or DC) in an external circuit.

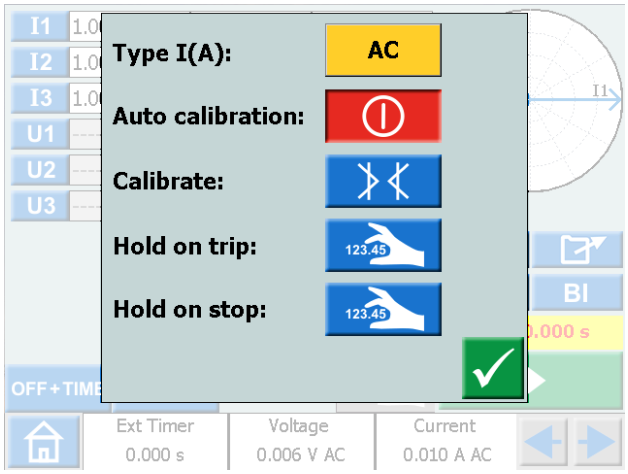
The voltmeter input (marked "V") shows the voltage connected to the voltmeter on the panel. The voltmeter can be used to measure up to 900 V AC or DC. It can be set in ranges or automatically mode.

1] Press "Voltage" or "Current" at bottom of display, from any of the instruments. You will see the respective new windows below.

Voltage



Current



Ammeter and Voltmeter windows

Type U (V)	Select AC or DC
Range	Auto, 0-9 V, 9-90 V, 90-900 V
Type I (A)	Select AC or DC
Auto calibration	The auto calibration can be set to on or off individually (Ammeter/ Voltmeter). If auto calibration is set to "ON" it will recalibrate the offset each 10 minutes period and also do an offset calibration within 5 minutes if the temperature is changed.
Calibrate	The AC and DC offset will be calibrated.
Hold on trip	The value measured on the volt and/or ammeter is frozen when a trip signal has been detected. The "ON+TIME" has to be activated. **1]** Press  to activate the HOLD function in the volt and/or current menu. The Voltage and/or Current field turns blue and at trip it turns yellow. The voltage and current values can be stored to a test file. **A]** In the Main menu, the voltage and current values for pick-up or drop-off, can also be locked. **B]** In the Ramp instrument this will be valid for a whole ramp sequence. **C]** In the Prefault/fault instrument this will be valid for fault state and prefault+fault state

Hold on stop	Values from the volt and/or ammeter are held after stop of generating. **1]** Press  to activate the HOLD function in the volt and/or current menu. The Voltage and/or Current field turns blue and at stop it turns yellow. The volt and current values can be stored to a test file. **A]** In the Main menu, the voltage and current values for pick-up or drop-off, can also be locked. **B]** In the Ramp instrument this will be valid for the start ramp value and for the whole ramp sequence. **C]** In the Prefault/fault instrument this will be valid for prefault state, fault state and prefault+fault state

Note *If O.L. (Over Load) appears, the cycle being measured may have been so fast that there was not time for automatic range changing, or that the range was overridden.*
If over 900 V or 10 A, it gets +OL.

Other entities

1] By pressing the  buttons you can view the Frequency (Hz), Power (VA and W) , Impedance (R and Z) and phase angle values.

3.9 USB port

USB 2.0 Interface

The USB port is used to:

- Update the firmware in the SVERKER 900
- Update the software
- Connect a mouse or keyboard
- Download test files from the SVERKER 900 Local for transfer data, e.g. to a PC for storage or printing.
- Copy test files from USB to SVERKER 900

Firmware upgrade via SVERKER 900 USB port

1] Contact Megger Sweden AB technical support to get a USB memory stick with upgraded files.

USB software upgrade

1] Before startup, insert USB memory stick, with new software, to the USB port.
SVERKER 900 scans the available files in the USB memory. If a bootable image can be found and the image signature is newer than the currently installed image, you are asked to upgrade SVERKER 900.
After loading new software you must reboot.

2] Press and hold (5 s) the  button to reboot.

3.10 Low current generation (Optional)

An optional accessory (CR-90010) is the Low Current Adapter. The adapter consists of two boxes LCA1 and LCA2. It is used to test e.g. sensitive earth fault protection, capacitor unbalance protection and three phase reverse power protection.

The LCA1 and LCA2 are to be connected to the current generator outputs, see figure below, for generation of low currents, 0–50 mA. The built in ammeter, in SVERKER 900, is connected to measure the current injected into the test object.

The ratio between the input and output currents is somewhat depending on the load, e.g. a 0.5 Ω load and 1 A current generation gives an output of 9 mA.

Max current input is 5 A.

4 Operating SVERKER 900

4.1 Local interface

The SVERKER 900 local interface is the manual control and user interface for the unit. All manual entries will be made through the SVERKER 900 local interface.

Display buttons

The buttons are of two types, momentary and switch.

Momentary buttons

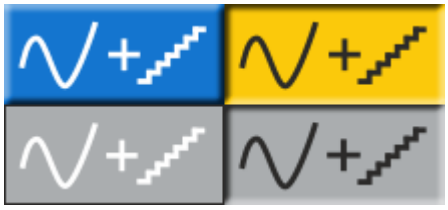
- A momentary button keep the colour when it is pressed.
- When it is gray, the button is disabled.

Examples:

Switch buttons

- When a switch button is pressed the background colour change from blue to yellow and foreground change from white to black. – the function is active.
- A button with gray background is disabled.
  - If the foreground is black the function is active, but you cannot use the button to make changes.
  - If the foreground is white the function is disabled.

Examples:



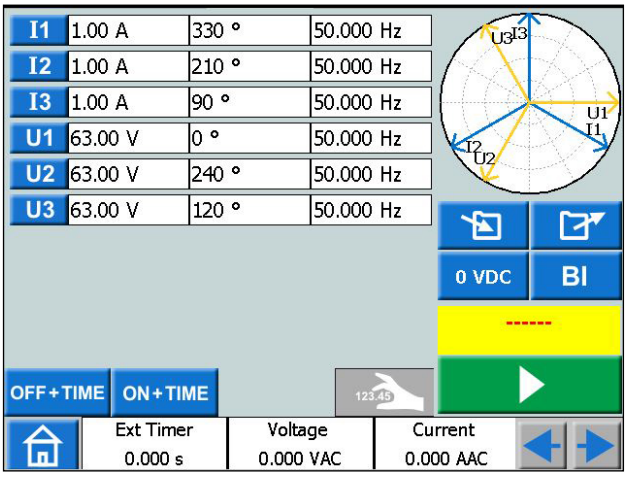
On/Off button

Run/Stop button

Start SVERKER 900

1] Plug the unit line cord into an appropriate power source and press the button  .

During the power up sequence the test system automatically run a self-test to insure everything is operating properly. When this is done the Main instrument screen is presented. This is the default screen and depending on how the channels are configured the SVERKER 900 will display and provide the appropriate number.



From the Main instrument you can perform the general tests with SVERKER, see section "4.3 Main instrument" on page 23

Note *The basic description of how to use the SVERKER is in section "Main instrument". It also applies to several of the other instruments.*

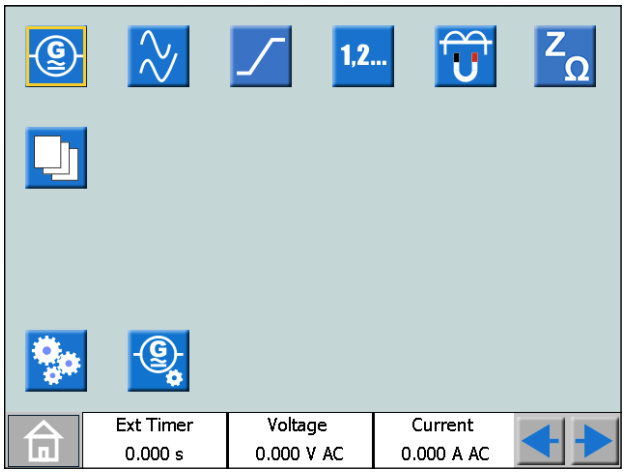
The other instruments are available from the Home menu.

1] Press  for the Home menu

4.2 Home menu

In Home menu you can:

- Select type of test instrument
- Select system configuration
- Activate already saved test files or download on external memory (USB)
- Select Voltage / Current and External Timer configuration. This can also be done in all the test menus.



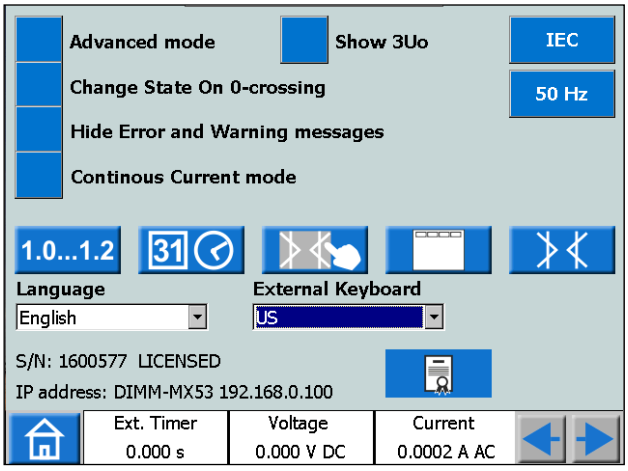
Home menu buttons

Symbol	Description
	Main instrument The Main instrument screen is the default screen for SVERKER 900, and is presented when started.
	Prefault -> Fault instrument
	Ramping instrument
	Sequencer instrument
	CT-Magnetization instrument
	Impedance instrument
	Test file management
	System configuration
	Configuration of Voltage / Current generators
	Browse left/right

System configuration

1] Press for the Home menu

2] Press



- **Advanced mode**
  When advanced mode is ON the following functions are enabled in certain instruments: Harmonics and Event recording.

- **Show 3U0**
  When this setting is ON the residual voltage 3U0 should be calculated and shown in the instruments; Main, Prefault Fault and Ramp. 3U0 is the sum of the generated values from U1, U2, U3. In the graph the 3U0 vector is shown.

- **Change State On 0-crossing**
  Setting of how to change state in the Sequencer instrument.
  When "**Change State On 0-crossing**" is OFF it means that the curve form (amplitude, phase, frequency) is changed immediately if amplitude or phase or frequency is changed between the different states.
  When "**Change State On 0-crossing**" is ON it means that the state is not finished until the curve form of phase I1 reaches the zero crossing (If I1 is not included in the test I2 is the master). Then the state is completed.

- **Hide error and warning messages**
  When this setting is OFF all the error and warning messages will be displyed.
  When this setting is ON the error and warning messages listed in Troubleshooting section of this User's manual will be hidden.

- **Continuous Current mode**
  With this function is it possible to generate a current in a loop and open the current circuit and than again close the current circuit and the Current Generator start generate again, continuous repeatable.
  Note Only one CG, from 0 A to 15 A
  Only in Main Instrument
  Not in parallel or serial connection

■ **IEC / IEEE30 / IEEE45**

- IEC – voltage channels will be depicted "U"
  Time values will be referenced in seconds and milliseconds.
- IEEE30 / IEEE45 – voltage channels will be depicted "V"
  Time values will be referenced to cycle times.
- The CT instrument can be set for the standards IEC, IEEE30 or IEEE45.

■ **50 Hz / 60 Hz / 16 2/3 Hz**
Select frequency
The trip times will be based on the selected frequency.

■ The same is valid when trip results are set to cycles when IEEE30 or IEEE45 standard is set

■ **Versions**

About SVERKER 900: year manufactured etc.

■ **Date and time setting**

■ **TouchCal**

Follow instructions for calibration of touch screen.
If no keyboard is used, press middle of the screen or press the control knob when new calibration is done.

■ **Labels for test files**

Setting of four fields for report handling.
Note: The language setting for the volt and ammeter is shifted when instrument is restarted.

■ **Field calibration**

For detailed information and instructions see section "4.11 Calibration" on page 47.

■ **Language**
Czech, English, French, German, Spanish, Swedish

■ **Ext.KeyBoard**
Select language for an external keyboard.

■ **License file**

To add additional instruments to the SVERKER 900, press the "License file" button. Insert the USB stick with the license file and follow instructions on the display.

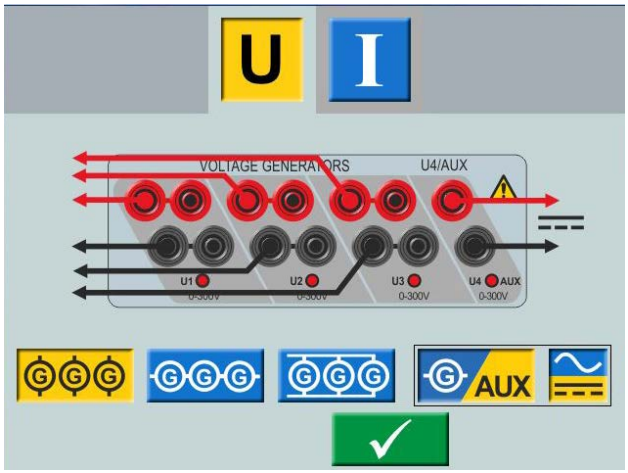
Generator configuration

1] Press  for the Home menu

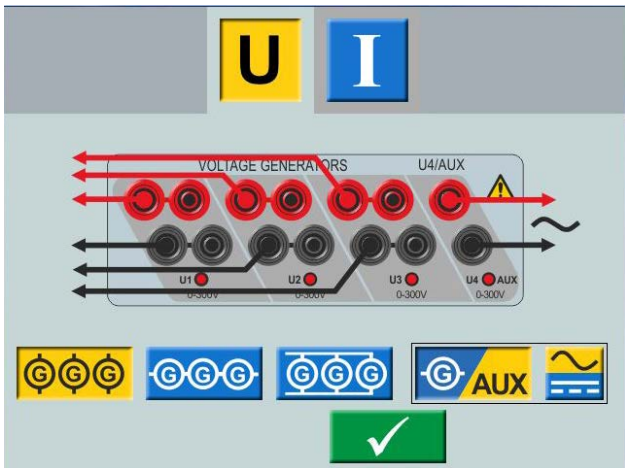
2] Press 

The generators can be configured in three different connections: individual, serial or parallell. Voltage generators can be used as 3AC+1AUX (AC/DC) or 4AC. Use the supplied jumpers to make the connections. See page 12 and page 13.

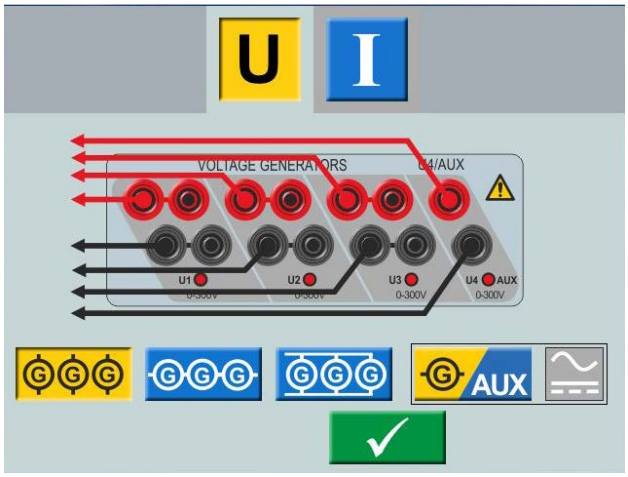
	Generators individual
	Generators in serial
	Generators in parallel
	Use as a fourth generator or as an auxiliary power source
	Select AC or DC



Voltage generator in individual connection 3 AC + AUX DC



Voltage generator in individual connection 3 AC + AUX AC

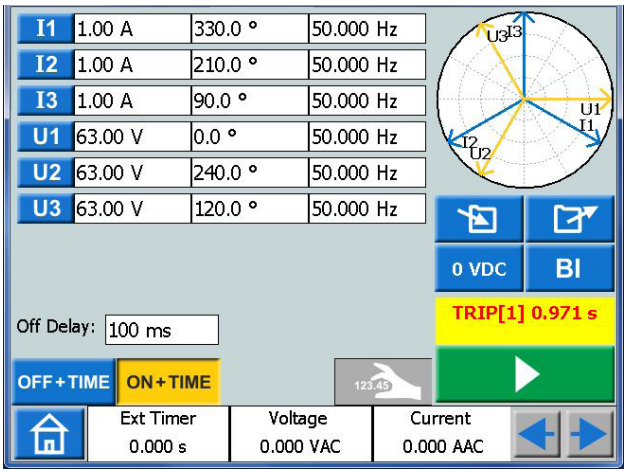


Voltage generator in individual connection 4 AC

4.3 Main instrument

The Main instrument screen is the default screen for SVERKER 900, and is presented when started.

SVERKER 900 will be opened with the settings from last time it was run.



In the example above all current and voltage generators are set to work separately. See sections "Current generators separately" page 12 and "Voltage generators separately "page 13. for configuration.

Main instrument buttons

Symbol	Description
U1 U2 U3 U4 I1 I2 I3	**Voltage and current generators** Parameter table rows turns into green for active generators. Press parameter to make settings.
OFF+TIME	**OFF+TIME:** Generators are turned off when a valid trip indication occurs, the yellow Trip time field shows the trip time and the binary input that detected the trip signal
ON+TIME	**ON+TIME:** Generators are is activated until the object being tested has operated. When a valid trip indication occurs, the yellow Trip time field shows the trip time and the binary input that detected the trip signal.
	Multiple timing test: Multiple instances of ON+TIME can be initiated while this function is selected.
	Max time: Setting maximum time to wait for registering an operation on binary inputs.
123.45	**HOLD:** Captures voltage or current value at trip signal.
	SAVE Test
	OPEN Test
0 VDC	**U4-DC/AC:** Setting the voltage for the U4 generator When used as AUX supply in voltage configuration

	Measuring: Sets the instrument into measurement mode. To stop measurement mode, press the button again. Measurement mode is not settable if Advanced mode is selected in the system configuration menu.
BI	**BI:** Configuration of the binary inputs
=	Equals values for current, voltage and frequency
	Balances the phase angle values
	Switching to graphical presentation of test result
	Run
	Stop
	Returns to Home menu

Non-generating mode

This is the default state for the Main instrument. All generator outputs are inactive, not generating output.

1] In non-generating mode, you can choose to activate one or more generators and configure the voltage, current, phase and frequency parameters, for each.

2] Select a parameter to configure, the on-screen numerical keypad will show up.

Numerical keypad

The keypad view always shows up when you select a configurable parameter on screen but only when the generators are inactive.

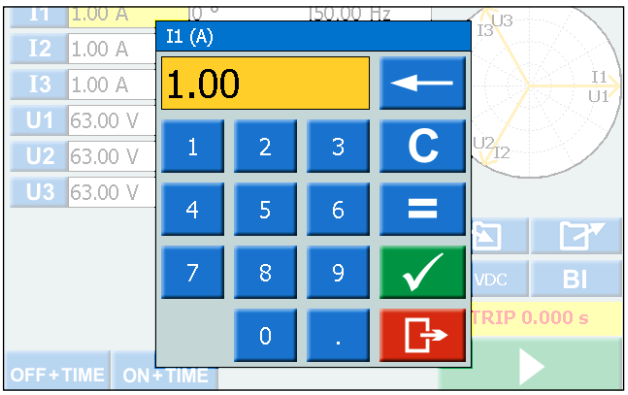
1] Use the on-screen numerical keypad for configuration of test parameters.

2] Use the ✓ button to confirm the entered value or the ⎋ button to abort and exit.

Equals

When you select to configure the voltage level, current level or the frequency parameter, you will find the button =

1] Enter desired value and press =
All three VGs or CGs will be configured with the same value.



Setting frequency to DC

A] Press "0" and then twice the ✓ to set DC output on the selected channel.

B] Press "0" and then press twice on the button = to set DC output on all channels.

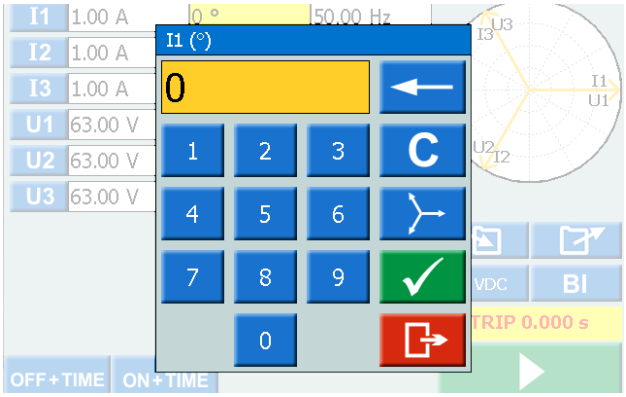
Balance

When you select to configure the phase angle parameter for a selected generator, you will find the button

1] Enter desired value and press button.
The phase angle between the VGs or CGs will be balanced by 120 degrees.

Example:

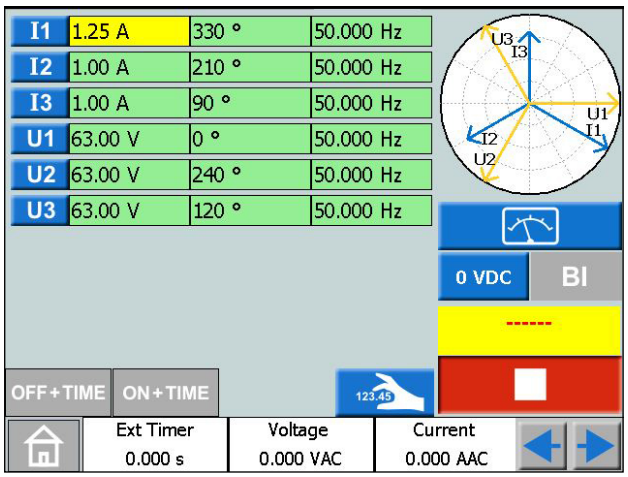
You configure the UL2 angle to 240 degrees and press the BALANCE button.
UL1 = 0 deg (= 240 + 120)
UL2 = 240 deg
UL3 = 120 deg (= 240 - 120)



Generating mode

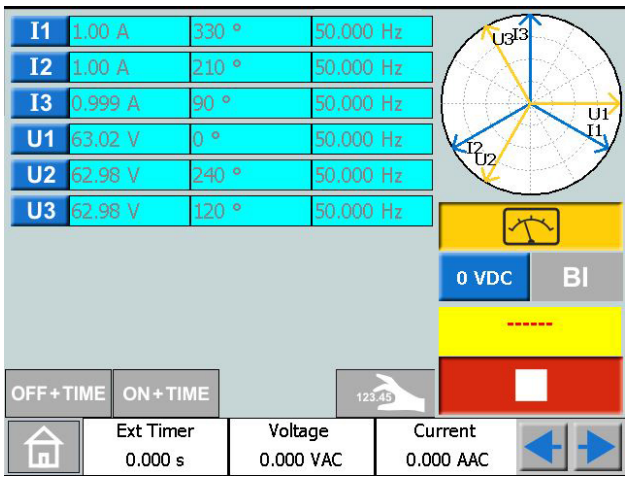
Selected generators will be activated.

1] Press
You can manually increase or decrease a selected parameter using the control knob and observe the output.



2] Press the  to set the instrument to measurement mode. The generator table change colour and the measured amplitude values vill be presented.

Note *"Off+time", "On+time" or the pick-up/ drop-off functionality cannot be used.*



3] To stop measurement mode press  .

Note *Any combination of parameters can be selected to be manually operated when generating is on. Press on the desired parameters to change and turn the control knob.*

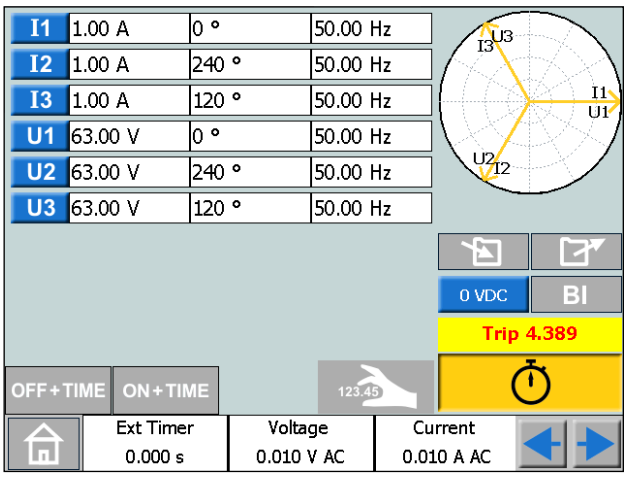
Press  to stop the output

OFF+TIME

1] Press OFF+TIME

2] Press 

3] Press  to stop the output. The button changes to  and the timer starts counting.



4] When a trip has been identified on any of the binary inputs the sequence is ended, clock stops and result is displayed.

Picture shows trip on binary input 2 after 3.044 s.

ON+TIME

1] Press ON+TIME

2] Press 

3] When a trip has been identified on any of the binary inputs the sequence is ended, clock stops and result is displayed.

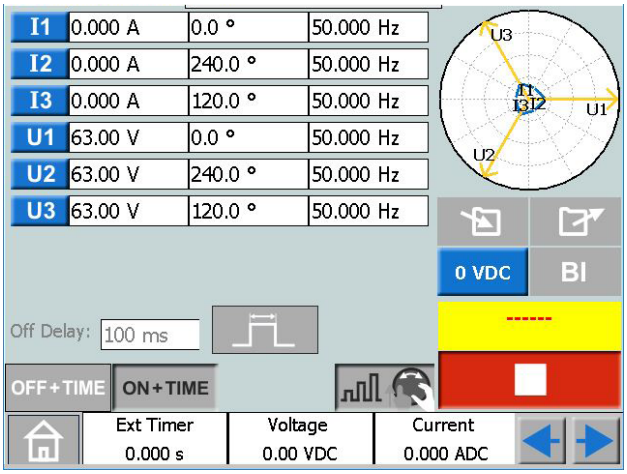
Note *The configured off delay time period is to be added before turning off generation.*

Multiple timing test

1] Press ON+TIME

2] Press 

3] Press 



4] Select a parameter to configure, the on screen numerical keypad will show up.

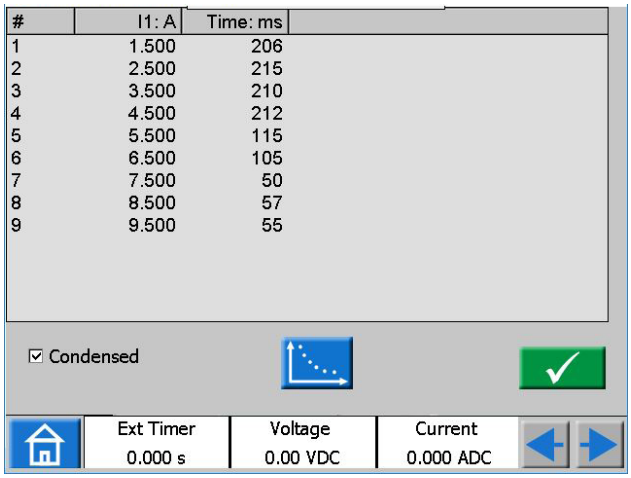
5] Type in desired number or turn the control knob to change the value.

6] Press ✓ button or press the control knob to confirm the entered value.

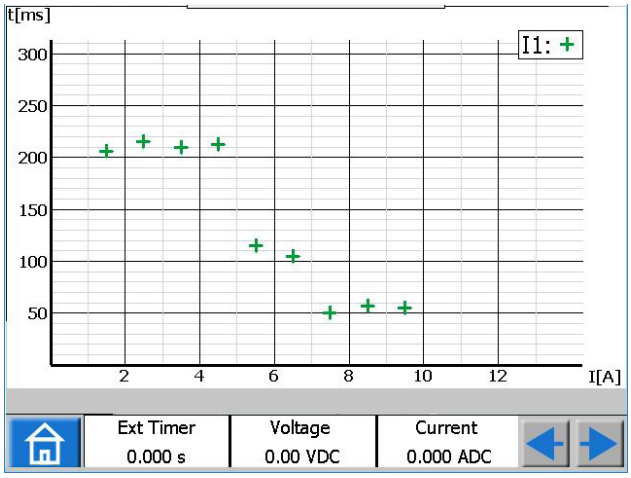
7] Press the control knob to generate set values.

8] When an operation has been identified on any of the binary inputs the generators stop and operation time is displayed.

9] Press ■ or continue testing by repeating step 4 to 8.
The result table is shown on display,



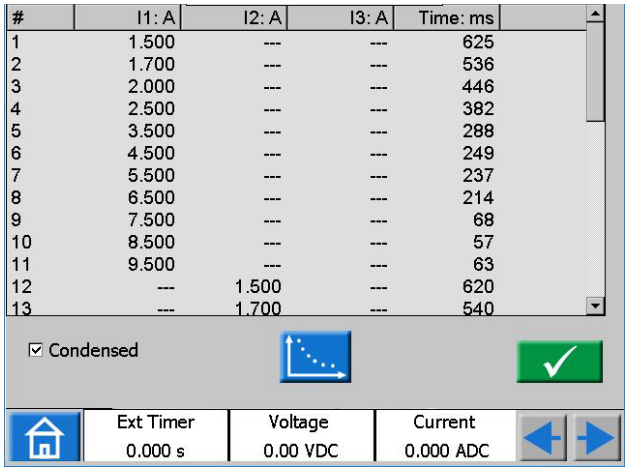
10] If applicable press for graphical presentation of results.



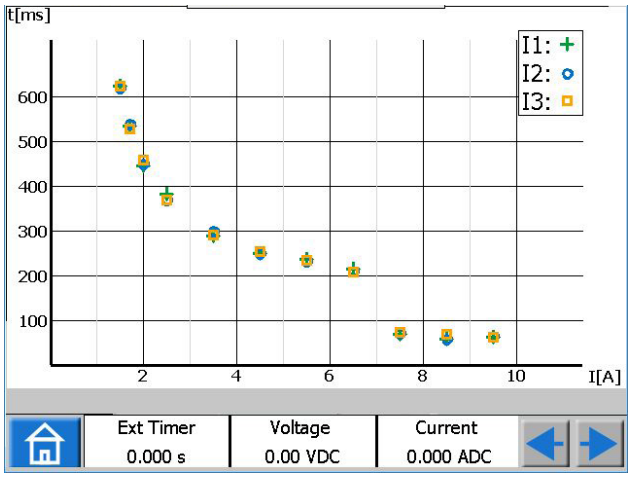
11] Tap anywhere on the graph to return to result table

Note *You can return to the result window by pressing the yellow field above the button.*

12] While is selected it is even possible to continue testing after pressing ■ by repeating step 3 to 7 and new results will be added to the old ones.



13] In the example above one current generator at a time is activated before each time pressing . The graphical presentation of results for this example is shown in below picture.



Tip!
The desired maximum duration of pulses can also be set by pressing . (i.e. maximum time to wait for registering an operation on binary inputs while generating set values).

Finding the pick-up and drop-off value using the hold function

1] Press

2] Press

3] Select parameter(s) by pressing the field(s). The field(s) turns yellow.

4] Turn the control knob clockwise to increase parameter(s), value(s).
When a trip signal is detected on a binary

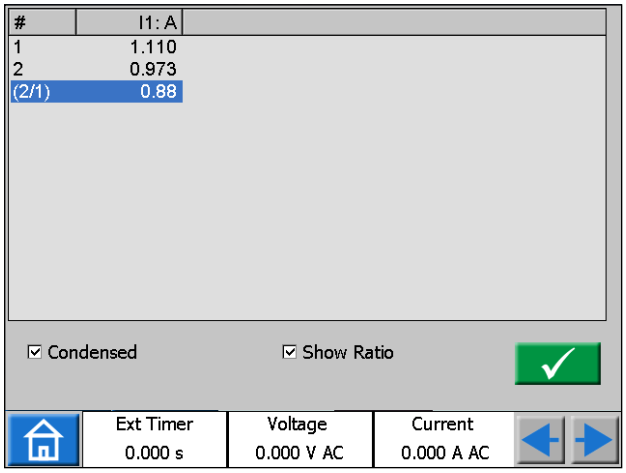
input, the amplitude value is saved and a pick-up value is obtained.

5] Press  again.

6] Turn the control knob anticlockwise to decrease parameter(s), value(s).
When a trip signal is detected on a binary input, the amplitude value is saved and a drop-off value is obtained.

7] Press  to stop the output.
The result is shown on display, the pick-up and drop-off value and the ratio between the values.

Note *You can return to the result window by pressing the yellow or red field above the*  *button.*
When a test is saved the field is red.



When the "condensed" view is selected, only the generators used are shown. The check box "Condensed" is in bottom of the result window.

Note *You can return to the result window by pressing the yellow field above the*  *button.*

Binary Inputs

The binary inputs are polarity sensitive when used in voltage DC mode. The continuity indicator will light if in right polarity and the contact condition is met. When the BI is set to voltage sense and a DC or AC signal is applied on the BI contact. A constant light is seen.

For binary input BI1 the trigger level can be defined (both from low to high and high to low level change) when voltage mode are selected. For BI2-BI4 the levels are fixed.

BI window buttons

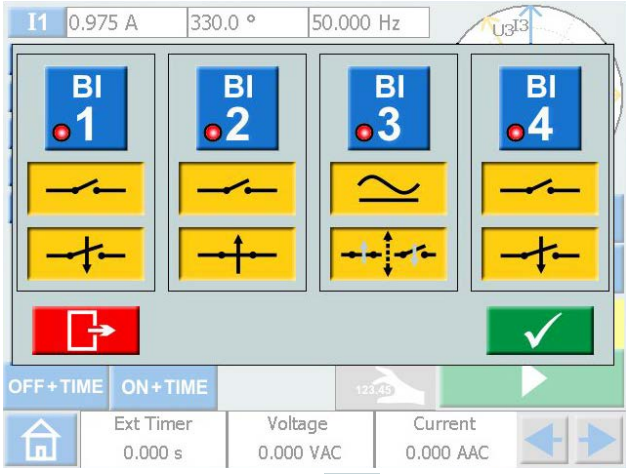
Symbol	Description
   	**Binary input** **BI1.** The trigger level can be defined (both from low to high and high to low level change) when voltage mode are selected. **BI2–BI4.** The trigger levels are fixed. **Red dot.** Indicates that input is active. **≥1** Indicates that the input is logic connected to another input with OR function (only in advanced mode). **&** Indicates that the input is logic connected to another input with AND function (only in advanced mode).  indicates that the input is recording all the events. (only in advanced mode)
	**Voltage mode**. Detects if voltage is applied or not.
	**Contact mode**. Detects if circuit is closed or not.
	**Make.** Trig when a voltage is applied to the start input or when a contact is closed.
	**Break.** Trig when a voltage applied to the start input vanishes or when a contact is opened.
	**Make / Break.** Trig when the state of the input changes.
	**BI OFF.** Turns off the selected binary input
	**BI ON.** Turns on the selected binary input
	**Confirm.** Settings are confirmed and window closes

Make BI settings

The procedure for BI-setting are the same in all menus except sequence instrument.

1] In Main instrument press 

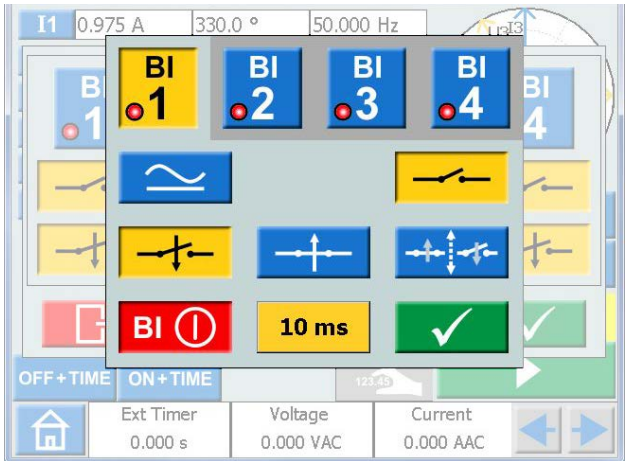
The window shown below appears. Here you can se how the binary inputs are configured.



2] Press a BI button e.g. 
The button turns yellow and settings can be

done.
The small red indicator tells that the BI is active.

The BI setting window is shown. Below is an example for settings of the binary inputs.



3] Press buttons for desired conditions for each BI, e.g. Contact or Voltage mode, Make or Break, or Make/Break.

4] Press BI to turn off a BI.
The button is greyed out and the red indicator is turned off.

Trig condition

The trig condition for the binary inputs is normally "OR" logic but you can set two or more of the binary inputs to a logic "AND" when SVERKER 900 is set to "Advanced mode" (see "System configuration" on page 21).

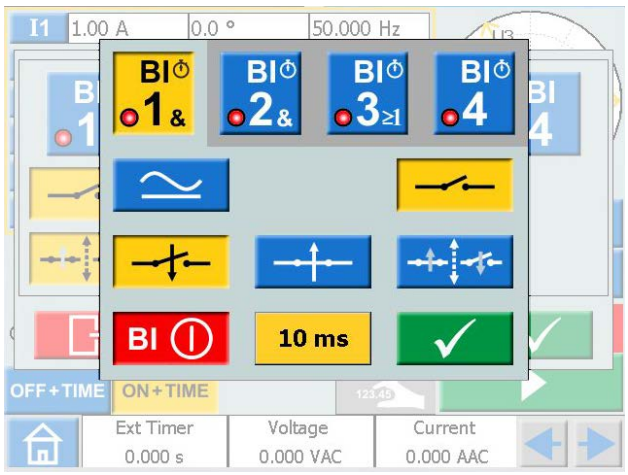
1] Press on BI number button to toggle between trig logic conditions.

Event recording

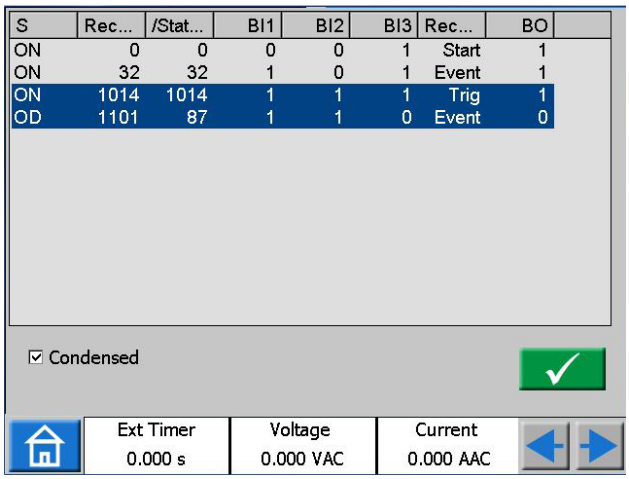
If SVERKER 900 is set to "Advanced mode", all events on individual active binary inputs will be recorded during the test period.

Each BI can be set to only event record mode if it shall not be included in trig condition.

1] Press on BI number button to toggle between different modes.



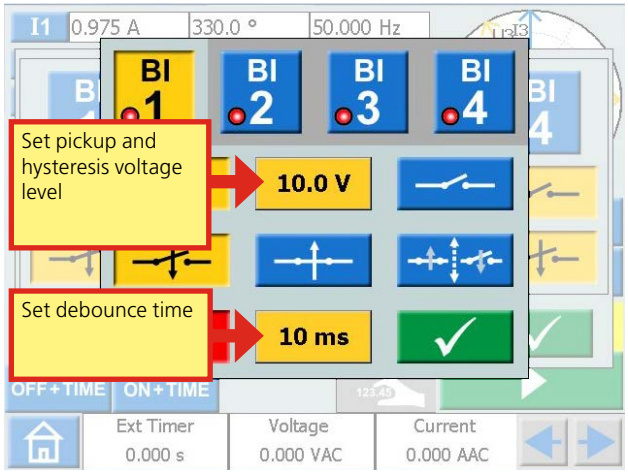
2] Recorded events will be displayed on the screen and can be also saved as test results in the report.



Note *Event recording is available only in certain instruments.*

Debounce filter

1] Press the "10 ms" button to set the debounce time.



The debounce time for DC voltage can be set from 0 to 999 ms.

For AC voltage the debounce time has to be set to maximum 5 ms.

Note *When set to zero, it actually means 2–3 ms. A debounce time of 0 ms is not a realistic value.*

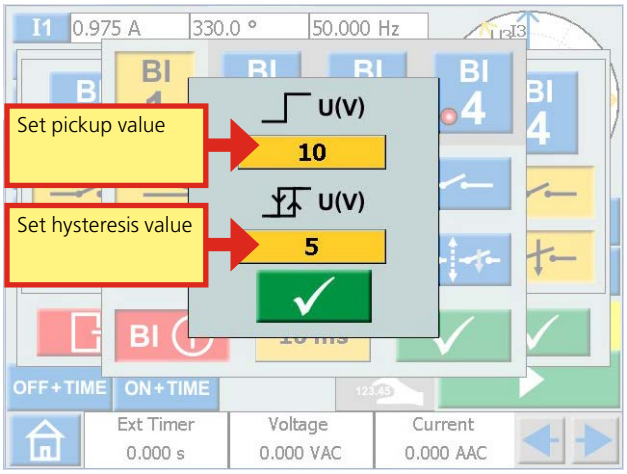
The debounce time means that as soon as a signal (voltage or contact sense) is detected on the binary input, SVERKER awaits the set debounce time. If the signal is active during the whole debounce time the signal is acknowledged as a valid signal, a "true" trip signal is confirmed.

Special settings available for BI1

Adjustable threshold voltage

When voltage sense is chosen for BI1, the adjustable **pickup and dropout** threshold values can be set between 5 to 240 V and 0 to 235 V.

1] Press the "10.0 V" button, see picture above, to set the threshold pickup and hysteresis value.



Hysteresis voltage

The hysteresis voltage is the difference between the pickup and dropout threshold voltages. If the pickup threshold voltage e.g. is set to 48 V and the hysteresis voltage is set to 5 V, the dropout voltage is 43 V.

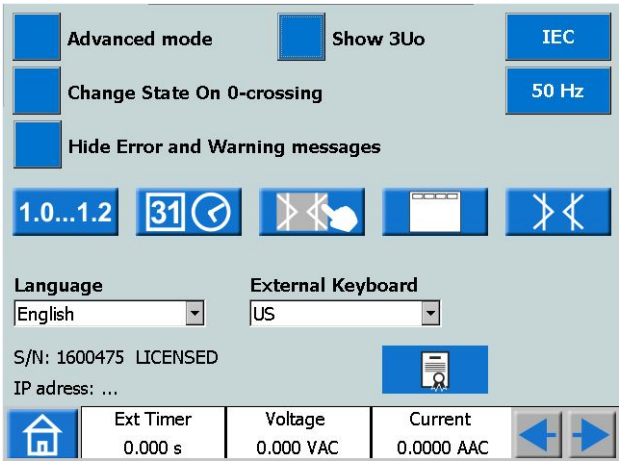
1] Press the "10" buttons (see picture above) to set the hysteresis voltage.

Harmonics

To use the harmonics function SVERKER 900 has to be set to "Advanced mode"

1] Press for the Home menu.

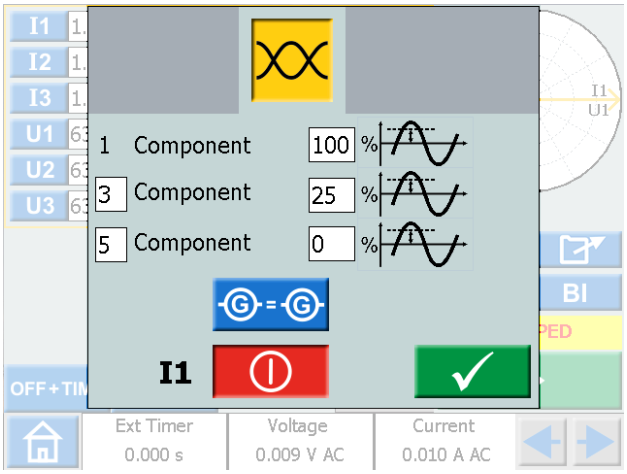
2] Press



3] Press button **Advanced mode** (OFF). It will change to **Advanced mode** (ON). Each individual generator can now be set to generate a harmonic waveform.

Note *When the harmonics is enabled the parameter table has an orange outline.*

4] Press on e.g. I1. The harmonics instrument is shown.



In this example you can see that a fault current at fundamental frequency with a superimposed third harmonic of 25% will be injected on generator I1. Highest possible "Component" to set is 10.

5] Press the button to impose the same harmonics on the voltage or current channels.

6] Press to turn off a generator.

4.4 Prefault->Fault instrument

The Prefault->Fault instrument is selected from the Home menu using the button

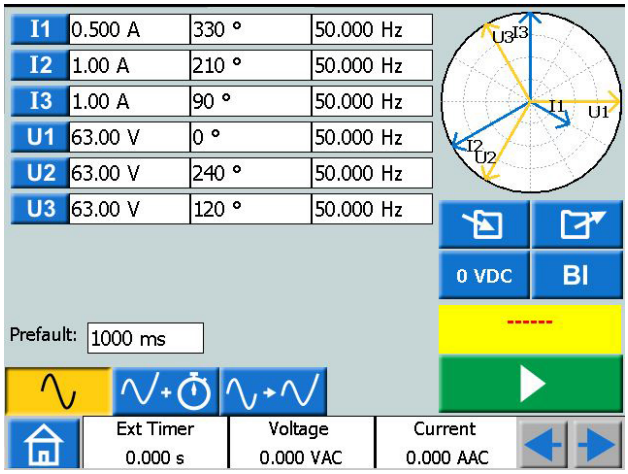
Using the Prefault->Fault instrument you configure two different states for the device, Prefault and Fault. You can configure and activate both stages individually and make SVERKER 900 execute the test and automatically change from Prefault to Fault state.

The Prefault state configuration is a valid condition for the test object, meaning it does not trigger during operation.

The Fault state is an invalid condition and it will trig the test object.

Measurement mode, see main instrument, can only be set in prefault mode.

Prefault->Fault view



Navigation

The Prefault->Fault screen scenario includes two views to configure the conditions for Prefault and Fault parameters, respectively. For test mode the third view "Prefault->Fault" is selected.

Prefault-> Fault instrument buttons

Symbol	Description
	Prefault
	Fault + Time
	Prefault-Fault

Prefault view

1] Press the Prefault button to enter prefault view.

2] Select generators to be active and configure the voltage, current, phase and frequency parameters for each.

3] Set the time duration for how long to generate the Prefault state before SVERKER 900 is automatically entering Fault state.

4] Press the button if you want to activate the selected generators.

Note *The time duration condition is not valid, during this operation, and the generators can only be turned off by pushing the button.*

Fault view

1] Press the FAULT+TIME button from the Prefault view, for the FAULT view screen. Here you can configure the parameters for the Fault state.

2] Select generators to be active and configure the voltage, current, phase and frequency parameters for each.

3] Configure the two timing parameters; the max time duration, for how long the Fault state will be generated and the off delay duration, which is the time period after the test object has triggered and until the output generation will be switched off.

Note:

The condition maximum duration does not apply during this process; the generators can only be switched off by pressing the button or by triggering the test object. After the duration of the configured off-delay time, the tripping time is displayed on the screen.

Automatic Prefault->Fault button

The third view "Prefault->Fault is selected for the test mode. No values can be changed.

1] Press the button to generate the Prefault condition for the set time duration and then change to Fault state.

The device will generate the Fault state until any of the following conditions are met:

A] Maximum configured time duration has timeout

B] Test object trips

C] You press the  button

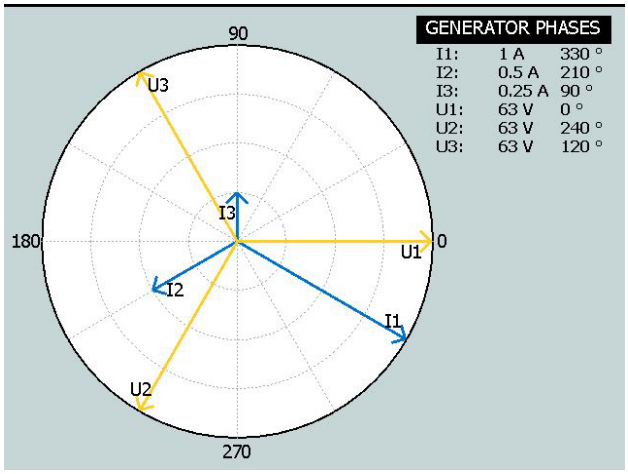
Note *The configured off delay time period is added if condition B is met, before turning off generation.*

The phase angle graph

On both screen views, Prefault and Fault, a phase diagram is displayed which illustrates I and U phase relationship for both states.

1] Press the graph to make it full screen.

2] Tap on full screen to minimize.



Multiple Timing Test – MTT

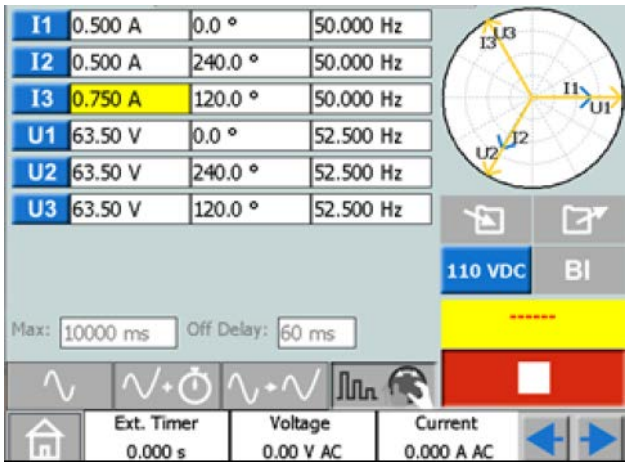
When running a MTT in the Pre Fault->Fault instrument you get more possibilities for analysis compared to run it in the Main instrument.

1] Set prefault values 

2] Set fault values 

3] Press 

4] Press 



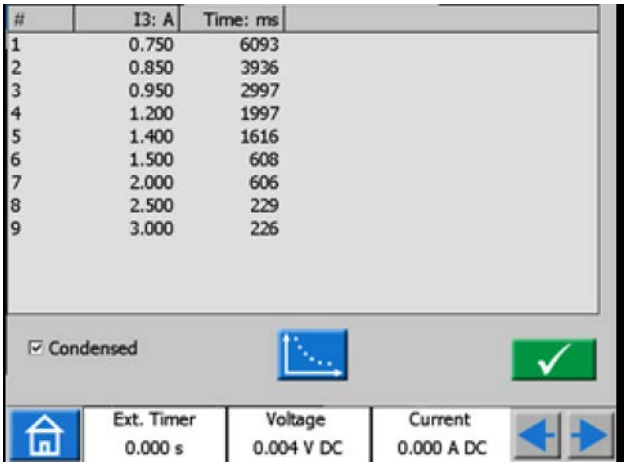
5] Select a parameter to set.

6] Turn the control knob to change the value.

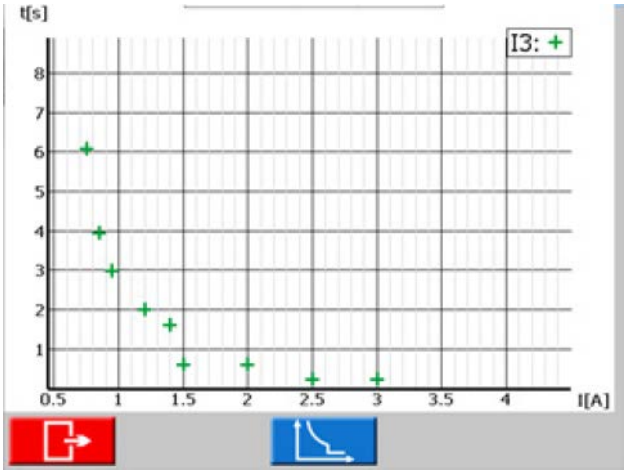
7] Press the control knob to generate set values.

8] When an operation has been identified on any of the binary inputs the generators stop and operation time is displayed.

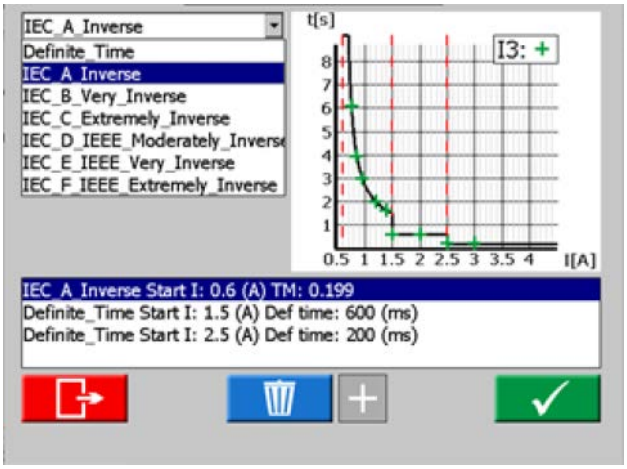
9] Press  or continue testing by repeating step 6 to 8.
The result table is shown on display,



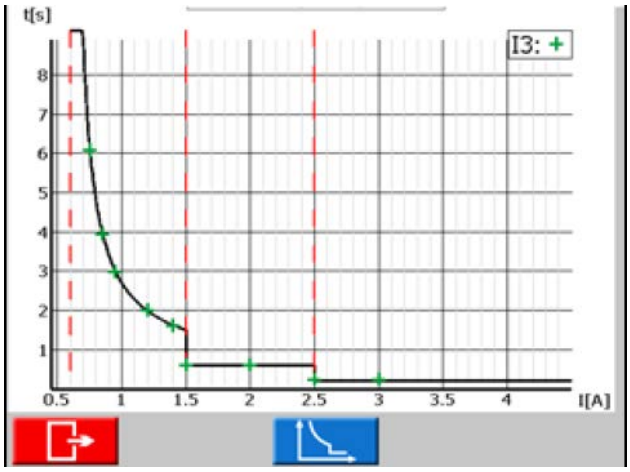
10] If applicable press  for graphical presentation of results.



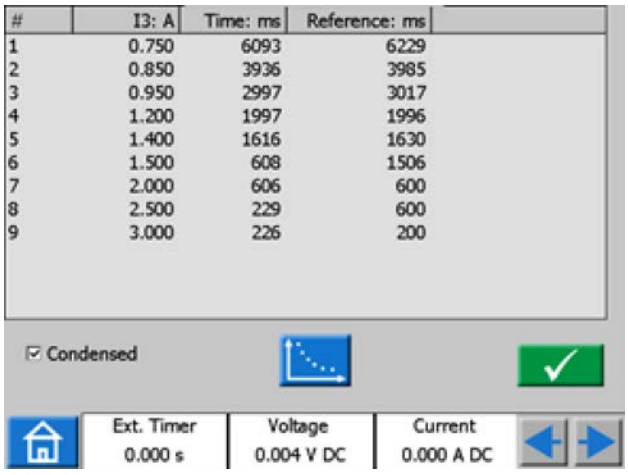
11] If applicable press  to set the reference curve.



12] Select the Definite time curve or the IDMT curve.
It is possible to have three thresholds. The lowest threshold could be selected as IDMT curve or Definite time curve. The other two thresholds could only be selected as Definite time curve.



13] Press  to go back to the result table.
There is also a column with the values for the test point according to the selected curves.



#	I3: A	Time: ms	Reference: ms
1	0.750	6093	6229
2	0.850	3936	3985
3	0.950	2997	3017
4	1.200	1997	1996
5	1.400	1616	1630
6	1.500	608	1506
7	2.000	606	600
8	2.500	229	600
9	3.000	226	200

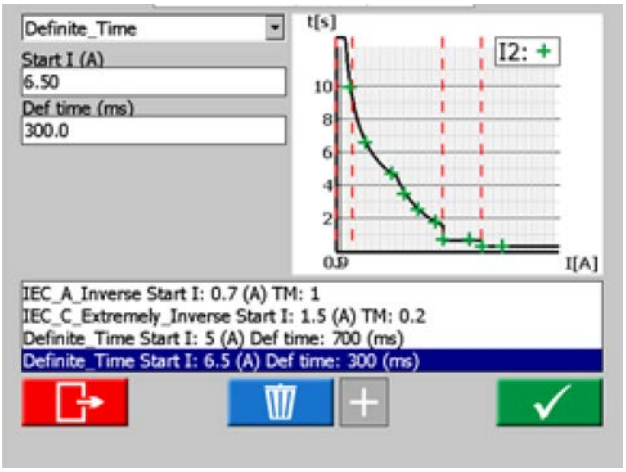
14] Press  to return to the start view.

Note *You can return to the result window by pressing the yellow field above the*  *button. If it is an open saved test this field is red. Also, from there you can return to the result windows.*

15] While  is selected it is even possible to continue testing after pressing  by repeating step 6 to 8 and new results will be added to the old ones.

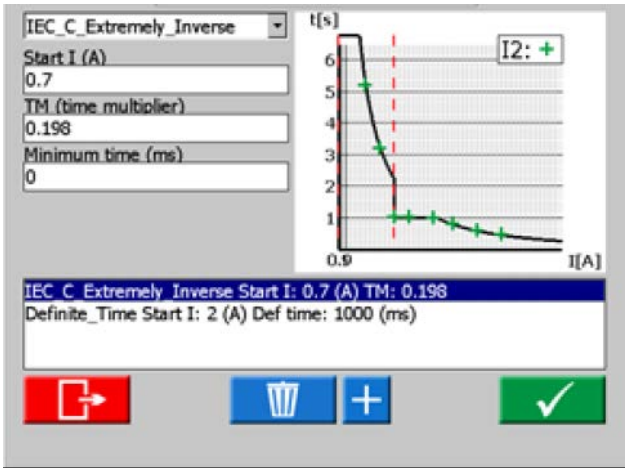
Multiple Timing Test in Advanced mode

In advanced mode it is possible to have four thresholds. Definite time curves and IDMT curves can be mixed independent of each other.

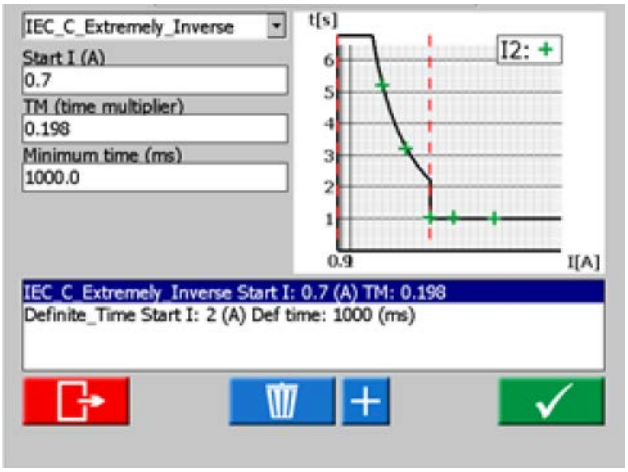


In advanced mode the Minimum time setting is to limit an IDMT curve to a certain minimum time.

Minimum time = 0 ms



Minimum time = 1000 ms



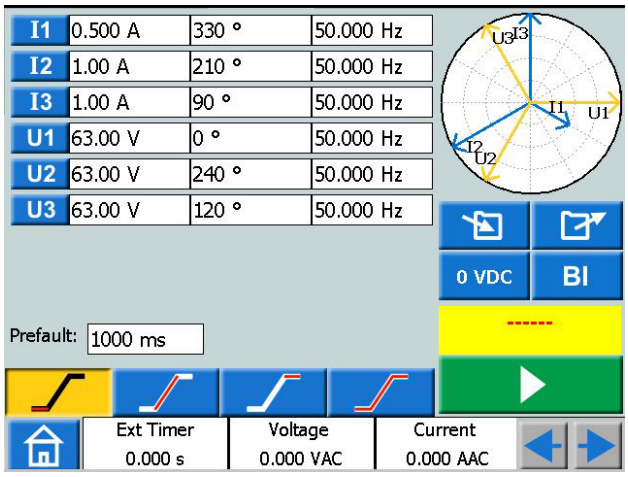
4.5 Ramping instrument

The Ramp instrument is selected from the Home menu using the button

The Ramping test is very similar to the Prefault->Fault scenario. The difference is that you can configure a ramping condition, between the Prefault and the Fault state. This includes the step-changes in voltage, current, phase and/or frequency, as well as the ramping time duration.

Measurement mode, see main instrument, can only be set in "Set ramp start" mode.

Ramping view



Navigation

Ramping includes four views; Start, Speed, Stop and Test mode view. You can navigate back and forth between these four views, by pressing the respective buttons.

Ramping instrument buttons

Symbol	Description
	Set ramp start
	Set ramp speed
	Set ramp stop
	Test mode (initiate a ramp test) No values can be changed

1] Select the generators to be active and configure the voltage, current, phase and frequency parameters for each.

2] Press to set the preferred start values in the parameter table. The prefault time can also be set here.

3] Press to set ramp speed.

Note *For the phase angle, the direction is indicated by setting "-" or not in the keypad menu.*

4] Press to set stop values.

5] To initiate a ramp sequence, press

Start a ramp test

1] In the views "Set ramp start" and "Test mode" you can start generating by pressing

In "Set ramp start" generating can only be stopped by pressing

For "Test mode view" the output generating is turned off if any of the following conditions are met.

B] Pressing the button

C] The ramping state has reached any end condition

D] The test object trips

If test object trips, the measured trip time is displayed on screen.

Speed and Stop ramping set views

The Speed and Stop ramping views are only a configuration views, no output generation can be activated from these screens. Here you configure the ramping conditions. This includes the ramping step-changes for the voltage level, current level, phase angle and frequency.

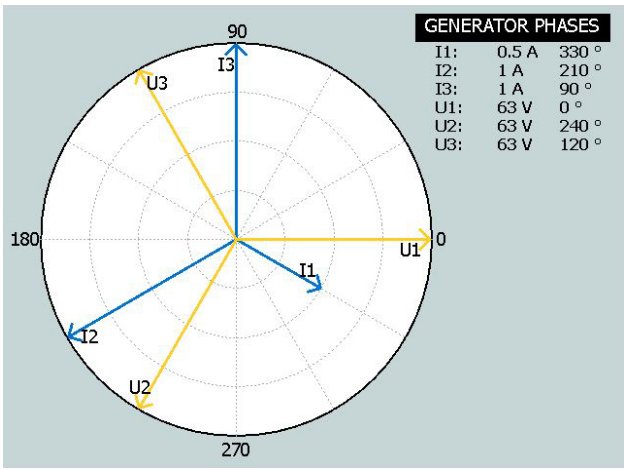
Note *You have to configure the ramping parameters before activating the test.*
If the settings for ramping have been sat wrong, e.g. start and stop settings are in conflict it is not possible to start a ramp test.

The phase angle graph

The phasor diagram in ramping instrument shows the I and U phase relationship both for prefault state as well as the end condition state after ramping.

1] Press the graph to make it full screen.

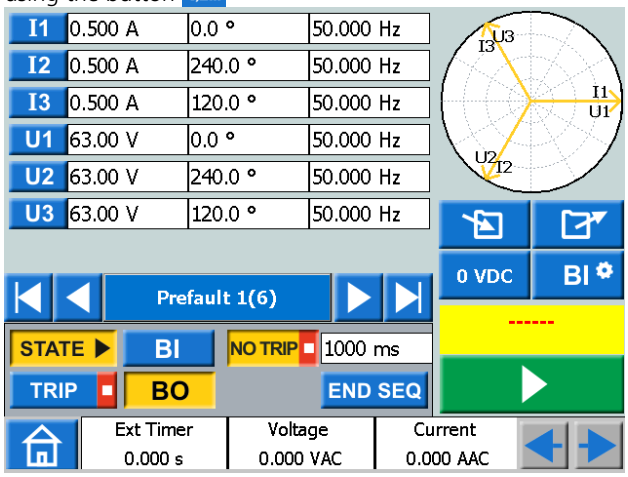
2] Tap on full screen to minimize.



4.6 Sequencer instrument

1,2...

The sequencer instrument is used to test several conditions in a system, e.g. the automatic recloser.
The sequencer instrument is selected from the Home menu using the button 1,2...



Navigation

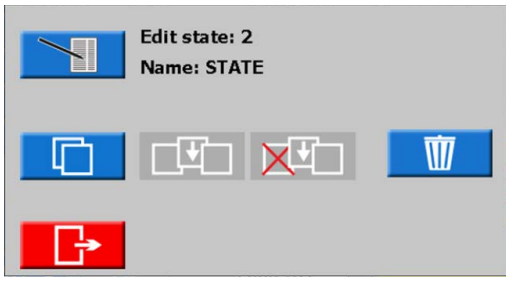
There are 16 programmable states in the sequence instrument. In each state you can set values for voltage, current, phase angles, frequency.
The following configurations/changes can be made in each state.

Sequencer instrument buttons

Symbol	Description
STATE 1(16)	**Copy or delete state**
	Go to first / last state
	Go forward / backward between states
STATE	**Activates or deactivates BI for each state individually**
250 ms	**Set the time for selected state.**
TRIP	**Stop condition for selected state**
NO TRIP	**Stop condition for selected state**
END SEQ	**Set the end of sequence**
BI	**Make voltage/contact sensing configuration for the binary input**
STATE	**Stop condition for selected state**
BI	**Set contact condition for the binary inputs for each state individually**
BO	**Set position for binary outputs for each state individually**
	Edit
	Copy selected state
	Insert selected state
	Insert and replace state
	Delete state

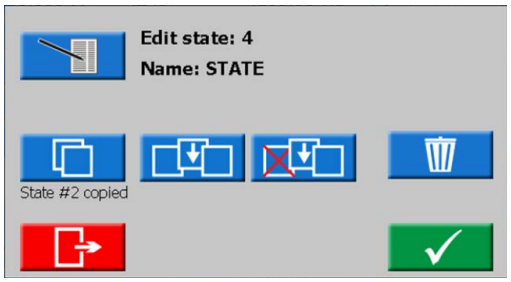
1] Press STATE 1(16) to copy/paste, delete/ replace or rename a state.

2] Press to make a copy of the selected state.



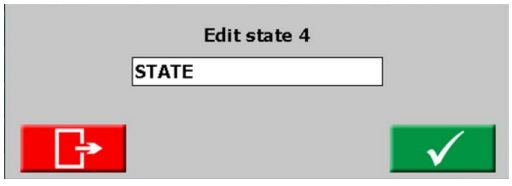
3] Go to the state were you want to insert the state.

4] Press " STATE ..... (16) ".
In the picture below, state 4 has been selected. As seen underlined text "State #2 is copied".



- Press to insert the state. State #2 will be inserted as #4 and all higher states will be moved upwards.
  If for example 10 states are used (State 10 is marked as "END SEQ") the inserted state will be added and there will be at total of 11 states.
  If there are 16 states (maximum number) the last state will be lost.
- Press to insert state #2. State #4 will be deleted.
- Press to delete the state.

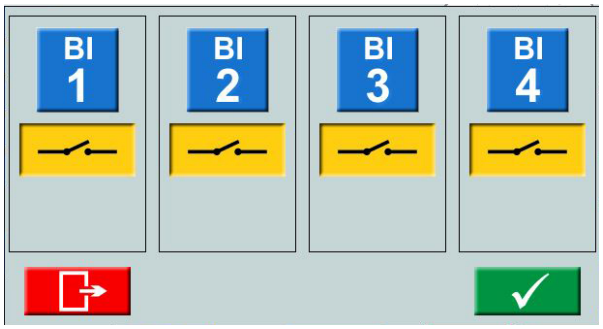
5] Press to edit the state name, for example "Prefault 1(16)".



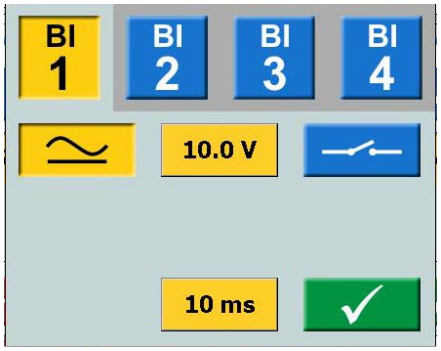
6] Press 250 ms to set the time (milliseconds).

7] Press BI button to configure, voltage/ contact sensing, Hysteresis and Debounce.

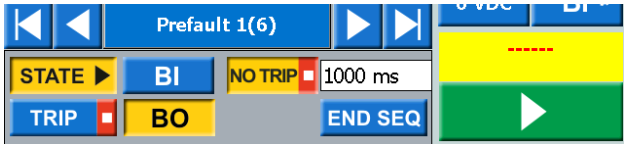
Note *When this is changed in any "state" it will automatically be valid for all states.*



8] Select binary inputs and make the settings. Voltage or contact sense.
Hysteresis voltage (BI 1 only), see page 29
Debounce filter, see page 28



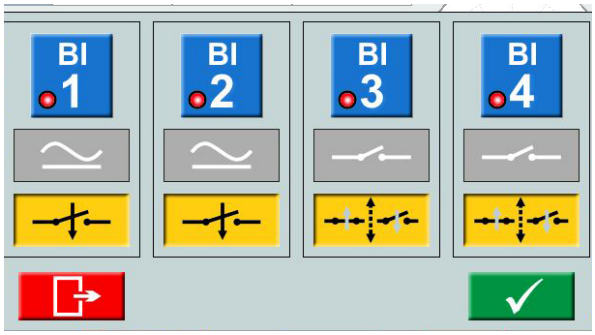
9] Press STATE button to activate the BI and TRIP and NO TRIP

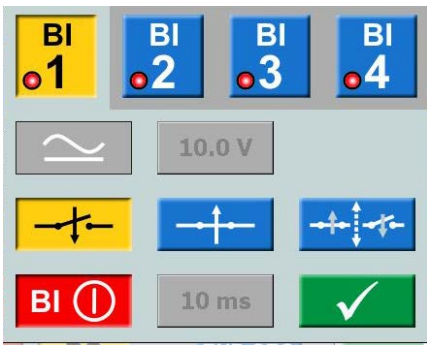


10] Press BI

11] Select binary inputs and make the settings.

Note *For setting BI, see explanation in BI menu, page 27.*





12] Press STATE to set a stop condition for the selected state.
The sequence is terminated when a trip signal is detected in that particular state

13] Press END SEQ to set the current state to be the last state in the sequence. It also stops to step further up to a higher numbered state.

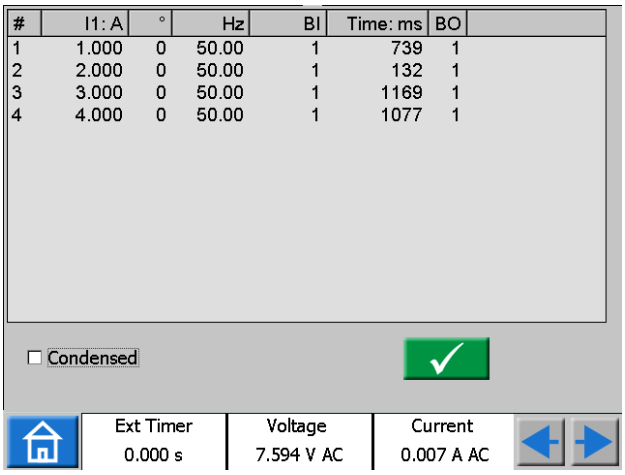
14] Press BO to set the binary output position for each state, see "3.4 Binary Output" on page 11.

15] Start a sequence by pressing
As soon as the condition for a state has been fulfilled the sequencer goes to next state, irrespective of set time (max time for each state).

The results are shown in new window when any of the following occurred:

- After stop on a trip signal
- The sequence is terminated with the stop button
- All the states have passed.

When the "condensed" view is selected, only the generators used are shown.



The check box "Condensed" is in bottom of the result window.

Note *You can return to the result window by pressing the yellow or red field above the button.*
When a test is saved the field is red.

Note *The BO relay has a switching time at opening or closing of relay contact that is not compensated for. The switching time is normally around 3 to 4 ms. When doing a sequence the BO relay will be switched directly after the change of sequence state. Meaning that the switching relay time extends this transition between the states with this 3 to 4 ms.*

4.7 CT magnetization instrument

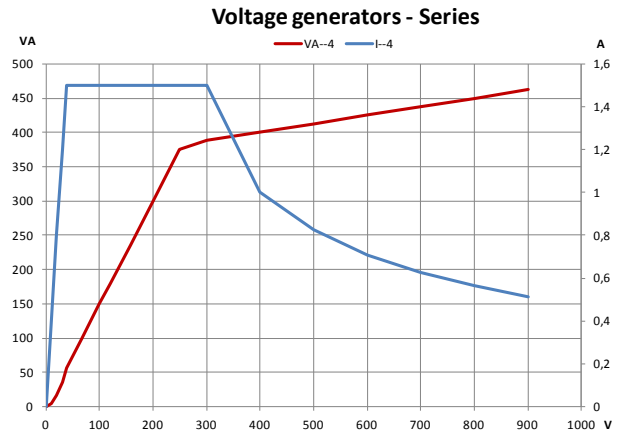
In the lid is an accessory placed that is to be used for the CT magnetization instrument.

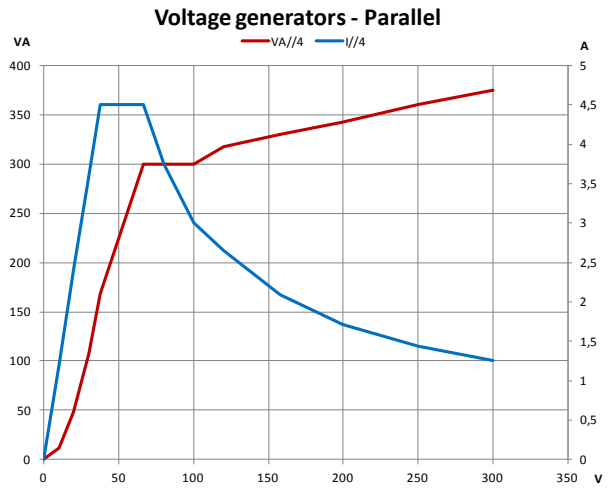
The CT magnetization instrument is used to determine the knee point voltage of a current transformer.

In CT-mode SVERKER 900 can generate up to 900 V by connecting the four voltage generators in series and 300 V by connecting the four voltage in parallel.

The magnetization can be made manual or automatic or as a combination, to start in manual mode and then switch to auto for the demagnetization part. This method is good to use for the first test on a CT.

CTM-box to be used in serial with volt/ampere meter and CT.





CT magnetization instrument buttons

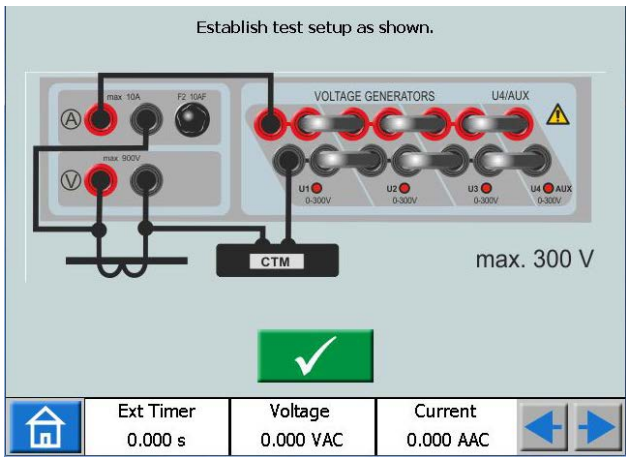
Symbol	Description
---V	**Set maximum voltage** **Possible in all test modes**
---A	**Set maximum current** **Possible in all test modes**
	Manual mode for the test
AUTO	**Automatic mode for the test**

Set-up

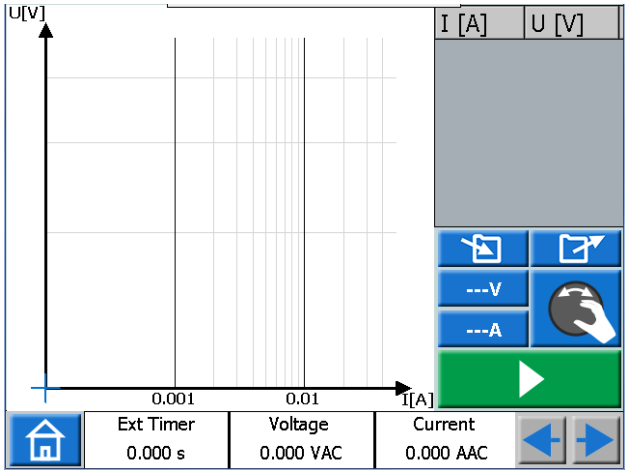
1] From the Home menu you press to configure the voltage generators.
Two configurations are possible to use, 4 generators in parallel (300 V) or serial (900 V) mode, depending on desired output voltage and power. See adjacent diagrams for guidance.

2] From the Home menu you press
Select IEC or IEEE(45° or 30°) standard.

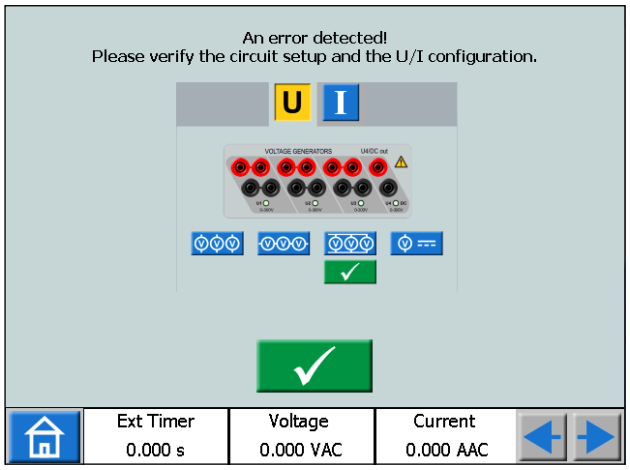
3] From the Home menu you press the CT instrument button
When the CT instrument is opened, a picture shows how to connect the voltage output to the CT.



4] Press to confirm the connection.
The screen will show as below.



Note *If the screen will show as below you must correct your configuration, see step 1 above.*

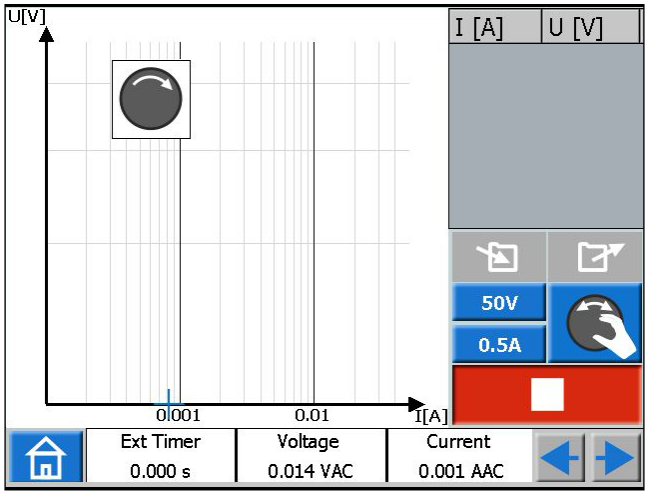


Manual test

1] The default mode is manual mode
If not, press the button.

2] You can set limits for maximal voltage and current if needed. Press the buttons ---V or ---A and make the settings.

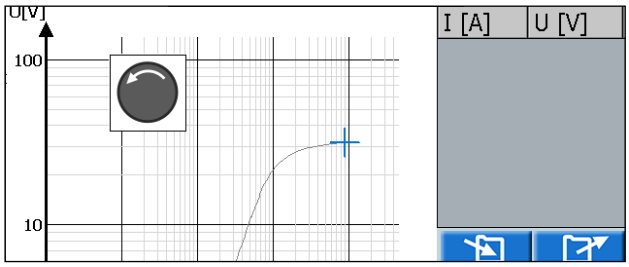
3] Start test by pressing ▶ and then slowly turn the control knob clockwise until knee point is reached.



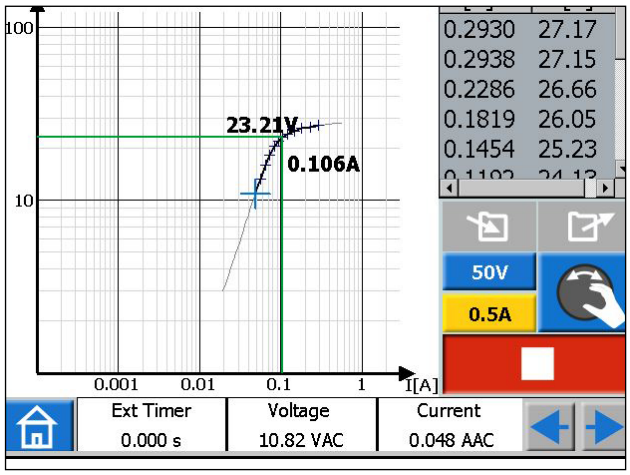
Note *If the control knob is not turned a knob symbol will pop-up in upper left corner to indicate that turning should be done.*

Note *The magnetization can be stopped manually by turning the control knob back to zero.*

4] When the arrow on the control knob symbol changes direction, from clockwise to anticlockwise, you should start the demagnetization by turning the control knob anticlockwise.



5] Press the control knob repeatedly to plot the graph during the demagnetization.
The graph is plotted and the knee point with plotting values presented.



6] Press the diagram to get full screen.
Press again to return.

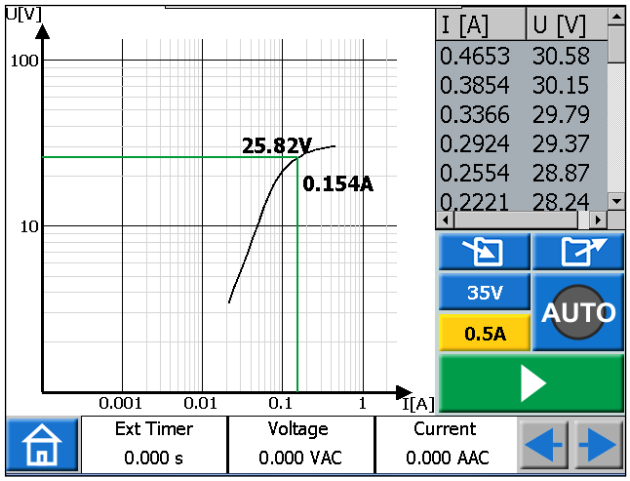
7] The test is completed and ready to save.

Manual/auto test

1] Start in the same way as for the manual test

2] When the arrow on the control knob symbol changes direction, from clockwise to anticlockwise, press

3] The demagnetization and plotting will be made automatically.



4] The test is completed and ready to save.

Auto test

1] Press the  button to position 

2] Press ▶ to start a test.

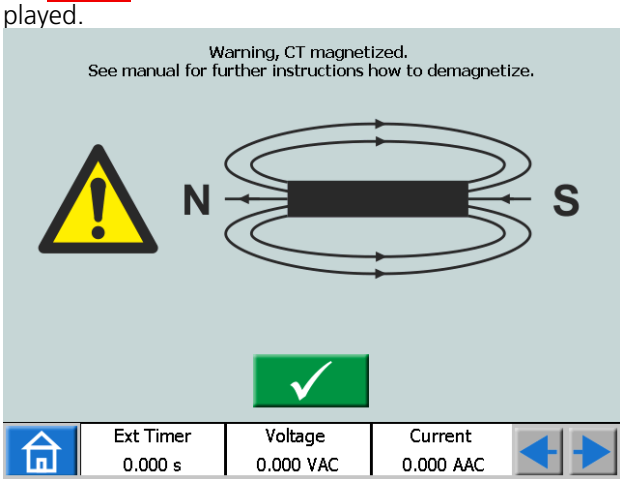
3] Magnetization starts and when the predefined relationship between voltage and current for the knee-point has been reached the demagnetization will start.

The graph is plotted automatically and the knee point and plotted values are presented.

4] The test is completed and ready to save.

Demagnetization

If the demagnetization is interrupted by e.g. pressing the button a warning message will be displayed.



Important

Make a couple of magnetization and demagnetization sequences manually before you continue with the test.

4.8 Impedance instrument

The Impedance instrument is selected from the Home menu using the button

Using the Impedance instrument you configure sequence(s) with different states including Fault state(s) with support for impedance entry mode.

Prefault and Fault state can be configured and activated individually or you can also make SVERKER 900 to execute the test and automatically/manually change from Prefault to Fault state.

Navigation

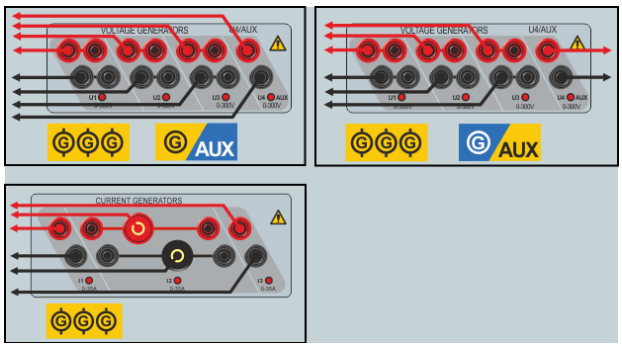
The Prefault->Fault sequence includes two views to configure the conditions for Prefault and Fault parameters, respectively. For test mode Prefault->Fault and/or Manual binary search views are selected.

Impedance instrument buttons

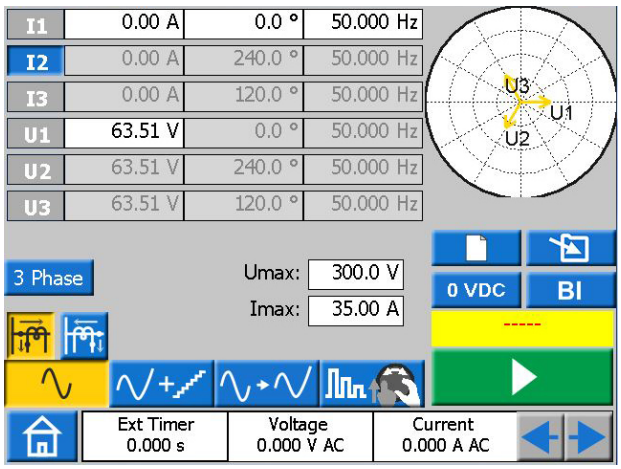
Symbol	Description
	Prefault
	Fault + Manual pickup search
	Prefault-Fault
	Manual binary search
	CT direction
	Configuration
	Advanced configuration
	Cartesian diagram
	Polar diagram
	Reset to factory settings

Important

Following generator configurations are valid for Impedance instrument. Please verify your generator configuration before start testing in this instrument.



Prefault view



1] Press the ∿ button to enter prefault view.

2] Select number of phases and generators to be active throughout the test and configure the prefault voltage, current, phase and frequency parameters using the knob or keypad.

Tip!

Voltage, phase and frequency parameters can be set individually for U4 generator if it is configured as an AC generator and it can be used as a reference voltage source throughout the entire test.

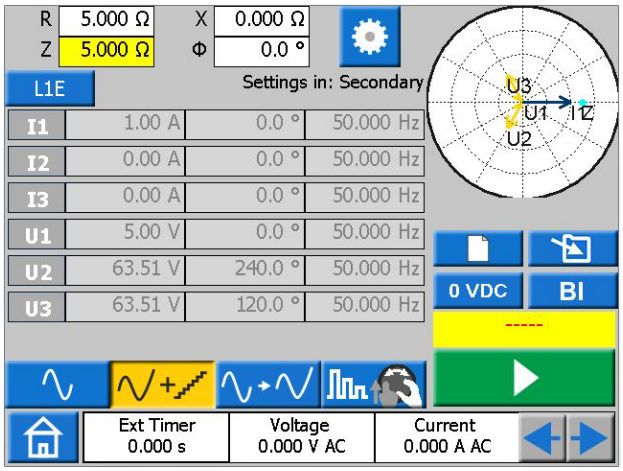
3] Select CTdirection to be also used throughout the test by pressing the or button.

4] You can set limits for maximum voltage and current if needed by configuring Umax and Imax parameters, respectively. These settings will be applied to all test modes within this instrument.

5] Press to activate the selected generators.

Note *The generators can only be turned off by pressing the button and no timer is applied in prefault view.*

Fault + Manual pickup search view



1] Press the button to enter Fault view.

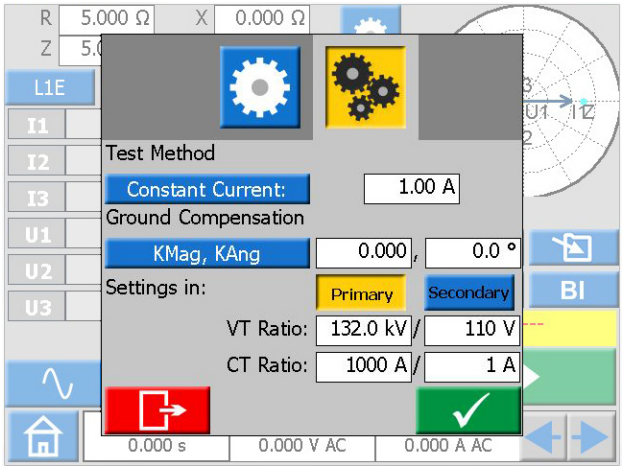
2] Select the fault type by pushing the L1E button.

3] Set the fault impedance by configuring R and X or Z and Φ parameters.

Tip!

Press the ± on keypad while setting the Z parameter to move your test point by 180 degrees.

Note *Fault voltage and current phasors are by default calculated using 1A constant current method. Moreover for one phase fault the phasor calculations are by default done in so called ohm/loop domain. In order to change these default settings and/or testing in primary domain press button and configure relevant parameters.*

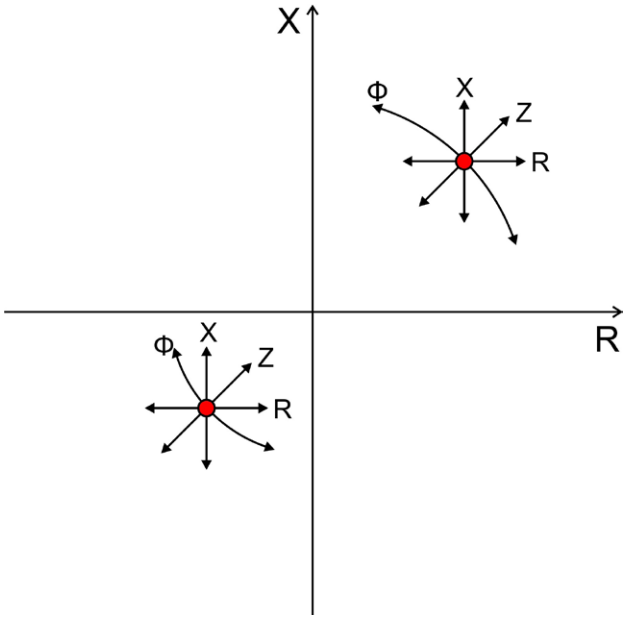


4] Press BI to select binary inputs and make the settings.

Note *For setting BI, see "Make BI settings" on page 27.*

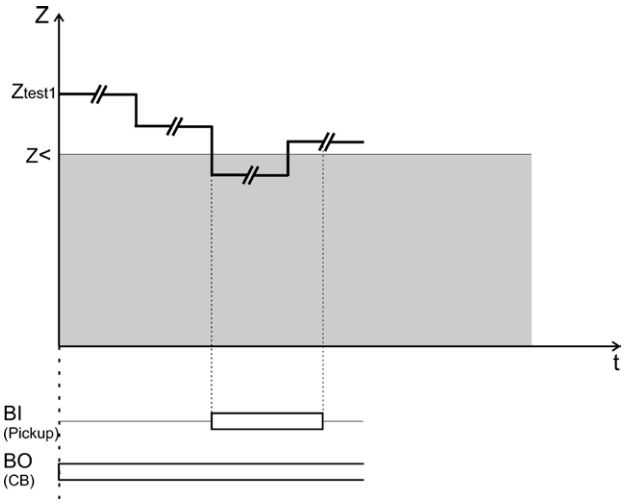
5] Press the ▶ button to activate the generators with calculated fault phasors shown in this view.

6] During generation the R,X,Z and Φ parameters can be selected and changed one at a time by turning the knob as shown in following picture in order to manually search for pickups in the impedance plane.



As soon as the configured binary input is activated the trig is registered. You can continue changing the above parameters to further evaluate the behaviour of your test object.

Following figure illustrates a possible scenario for searching a pickup value.



Note *The registered trig will not be saved as test results.*

The generators can only be turned off by pressing the ■ button and no timer is applied in fault view.

Prefault – Fault view

1] Press the ∿→∿ button to enter Prefault –> Fault view.

2] Press the ▶ button to generate prefault-> fault sequence with your previous configured settings done in Prefault and Fault views, respectively or follow the following steps to configure and test a new test point.

3] Press the L1E button to select the fault type.

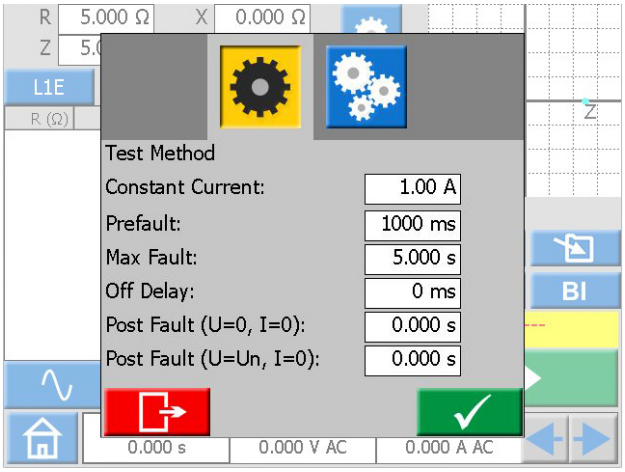
4] Set the fault impedance by configuring R and X or Z and Φ parameters

Note *Fault voltage and current phasors are by default calculated using 1A constant current method. Moreover for one phase fault the phasor calculations are by default done in so called ohm/loop domain. In order to change these default settings and/or testing in primary domain press ⚙ button and configure relevant parameters.*

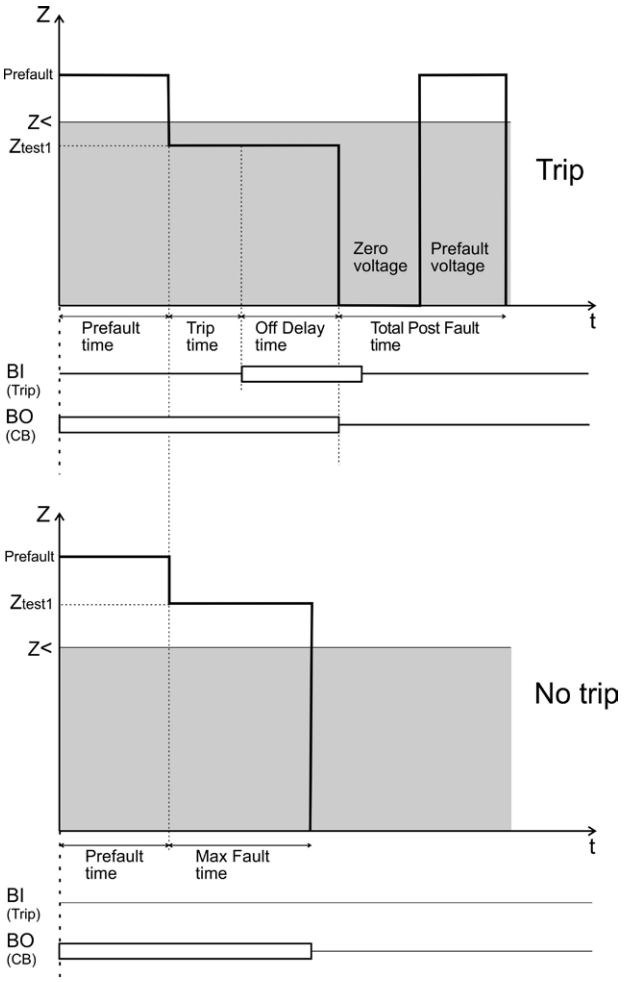
Tip!
Factory default settings can be restored by pressing the 📄 button following with pressing the ↺ button

5] Press the ▶ button to generate prefault-> fault sequence.
The device will generate the Prefault state following by Fault state until any of the following conditions are met:

- Default Prefault time + Maximum Fault time duration (1+5 sec) has timeout.
- Test object trips.
- You press the ■ button.

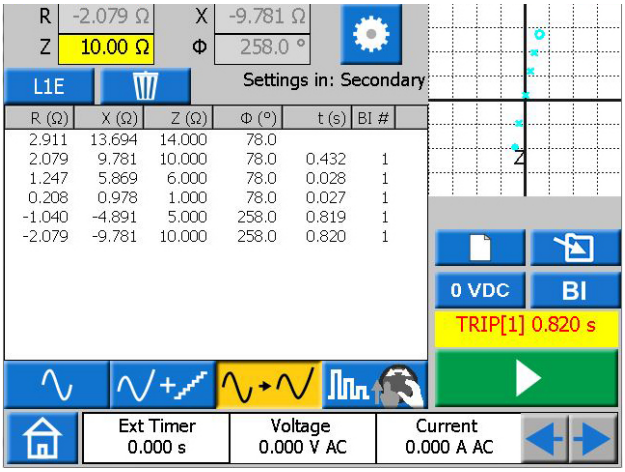


The default Prefault and Fault durations can be changed by pressing the button and configuring the relevant settings. Moreover, Off Delay and/or Post Fault state(s) can be added to the sequence. Following figures illustrate two possible scenarios when all the states are configured.



6] The result will be displayed and added to the result table for relevant fault type

7] Continue testing the next test point by repeating step 3 to 6 or move to step 8



8] You can save and/or delete the registered results in the table by pressing the and/or the button, respectively.

Note *Pressing the button will save all your results disregarding which fault type is selected.*
Pressing the button only deletes the results for the selected row in the table.
In order to delete all available results disregarding which fault type is selected and to start a new test press the button.

Manual binary search view

1] Press the button to enter this view.

2] Select the fault type by pushing the L1E button.

3] Press the button to generate prefault state.

Important
No Prefault timer is applied in this view and the generators can only be turned off by pressing the button if no more action is done.

4] Set the fault impedance by selecting and configuring R and X or Z and Φ parameters using the knob.

5] Press the knob to apply your settings and generate the Fault state.

Note *Fault voltage and current phasors are by default calculated using 1A constant current method. Moreover for one phase fault the phasor calculations are by default done in so called ohm/loop domain. In order to change these default settings and/or testing in primary domain press button and configure relevant parameters.*

The device will generate the Fault state until any of the following conditions are met:

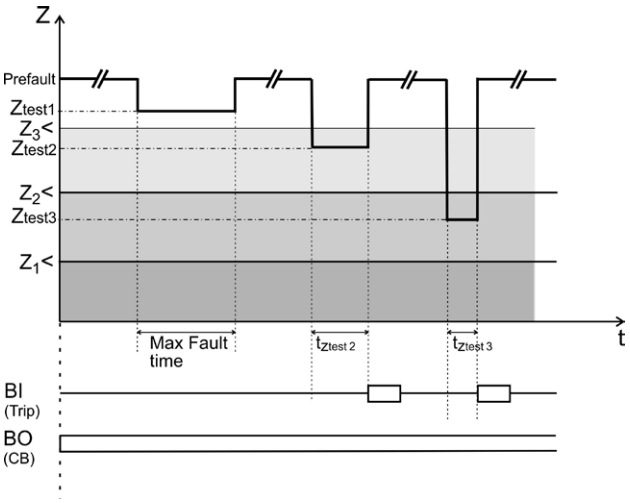
- Default (5 s) or the previously configured Maximum Fault time duration has timeout
- Test object trips

6] **The result will be displayed and added to the result table for relevant fault type.**

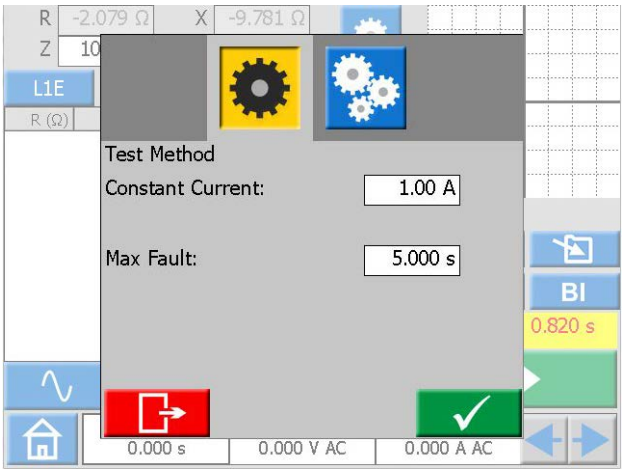
7] **The device will generate again Prefault state directly after fault state**

8] **You can press the button to stop the generators or continue testing the next test point by repeating step 4 to 7.**

Following figure illustrates possible scenario for evaluating the behavior of a test object in different impedance zones.



The Maximum Fault duration can be changed by pressing the button and configuring the relevant setting. No Off Delay and/or Post Fault state(s) can be added to the sequence in this test mode. To generate a complete sequence Prefault/Fault view to be used.



9] **You can save and/or delete the registered results in the table by pressing the and/or the button, respectively.**

Note *Pressing the button will save all your results disregarding which fault type is selected.*
Pressing the button only deletes the results for the selected row in the table.
In order to delete all available results disregarding which fault type is selected and to start a new test press the button.

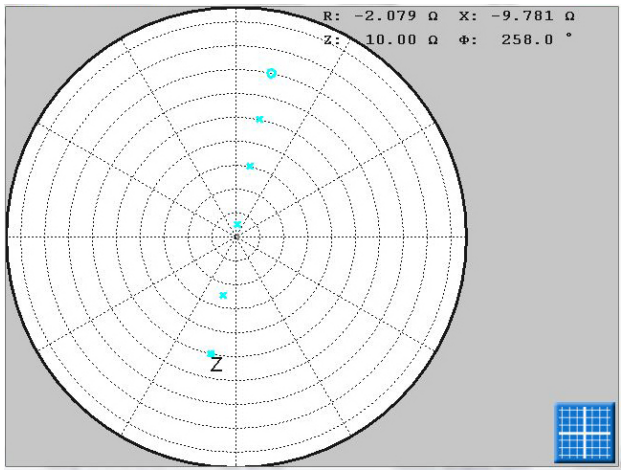
The impedance plane graph

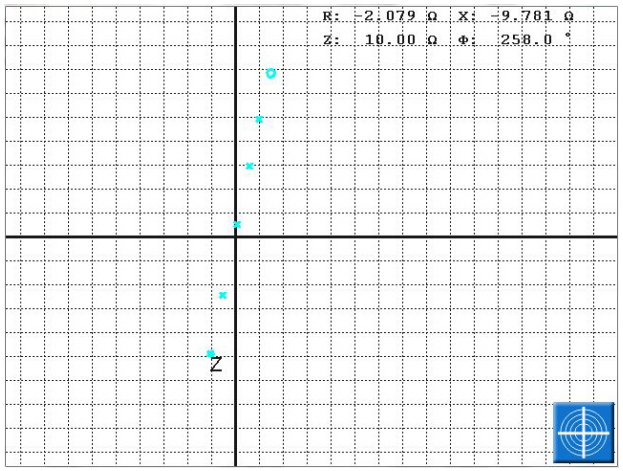
On Prefault-Fault view and Manual binary search view the impedance plane graph always illustrates your present configured test point together with your previous test results, if any. Registered trips will be marked by X and no trips with O.

1] **Tap on the graph to make it full screen.**

2] **Toggle between Polar and Cartesian graph by pressing or**

3] **Tap on full screen to minimize.**





4.9 Test file management

From all instruments you can save any test results or test configuration in SVERKER 900 persistent storage or to an external USB memory.

When you save a test the first time you will have to select where to save the test.

When a second test is to be saved, it will by default be saved in the previous used test file.

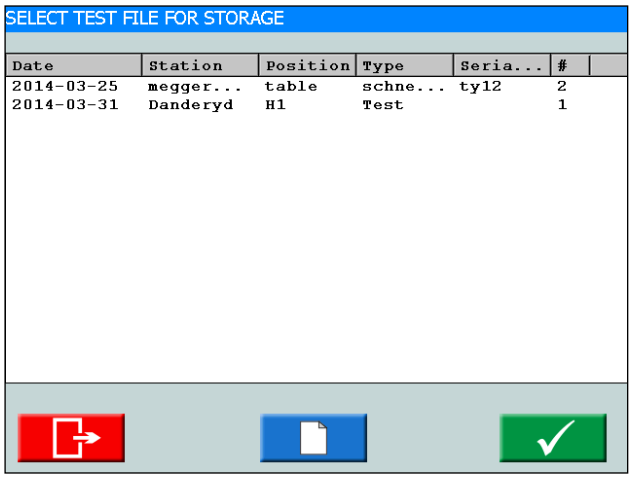
Tip!
In the active windows you can turn the Control knob to browse lists and press the knob to select an item.

Buttons in Test file management

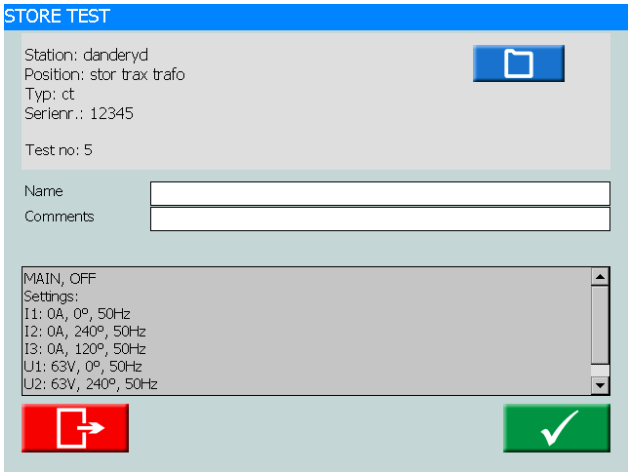
Symbol	Description
	**Save test**
	**Open test**
	**Quick save**
	**View**
	**Edit**
	**Save to USB**
	**Open USB**
	**Open test file library**
	**Create new file**
	**Delete test file**

Save a test

1] Press  to save a test.
If no test file are selected the window below will be shown: "SELECT TEST FILE FOR STORAGE".



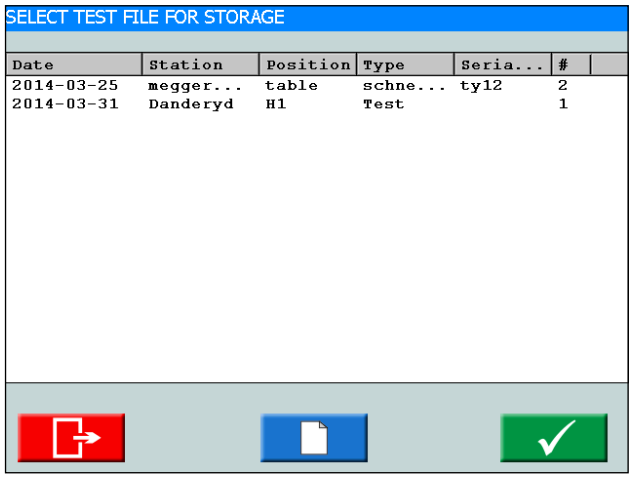
2] Select file by pressing on desired row in table and press 
To save in a new file, see point 5 below.

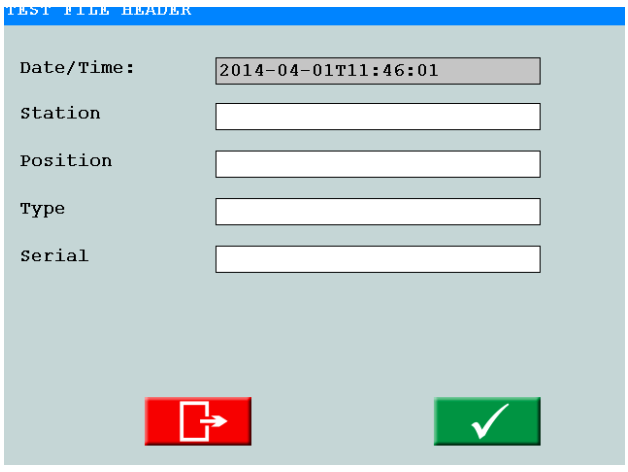


3] Type in the name of the test and add comments.
If you want to select another file to save the test, press 

4] Press  to save.

5] To create a new file, press 





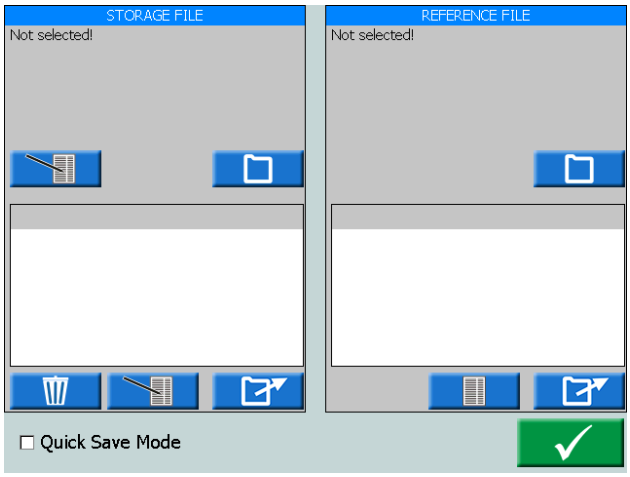
6] Enter the label names.

7] Press  to confirm.

Quick save

Note *By using this option you can save additional tests in the same file. The first test in the file cannot be in quick save mode.*

1] Press  and press the check box "Quick save mode".



2] Press 

3] After each following test press  to save.
The test are not named but placed in the same file as the first test.

4] To leave Quick save mode, press  and press, to uncheck, the check box "Quick save mode.

View and reuse test files

1] Press 

From the "STORAGE FILE" and "REFERENCE FILE" all the test files can be selected and opened. Selected test will be opened in the instrument that is running.

Note *Only tests made for the instrument that is running can be opened.*

Storage file

1] In the "STORAGE FILE"window, press  "SELECT TEST FILE FOR STORAGE" is opened.

2] In "STORAGE FILE" window, press the upper button  to edit the "Test File Header".

3] In "STORAGE FILE" window, press the lower button  to edit test name and comments.

Reference file

In the "REFERENCE FILE" window you can view and open a test for reuse.

1] In the "REFERENCE FILE" window, press  "SELECT REFERENCE TEST FILE" window is opened.

2] Select the test file you want to reuse for your test.

3] Press 

In the "REFERENCE FILE"window a list of the tests will be shown and in the left window "PREVIEW" you can see the test settings.

4] Select the test you want to reuse and press 

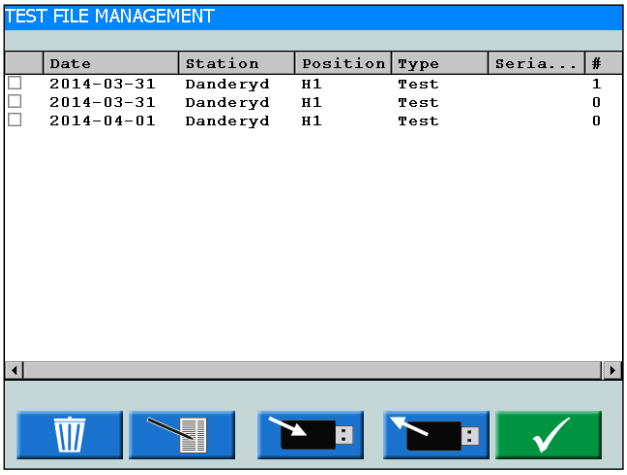
The test settings will be uploaded to the running instrument.

Transfer files to PC

Transfer files to PC for further handling by saving them to an USB stick.

1] Press  for the Home menu.

2] Press  to open the "Test file manager".



3] Here one or more files can be selected and copied to an USB stick.

4] Select file by scrolling the list and press the Control knob, or press on check box to select a test file.

5] Press the  button to save.

Note: *The USB buttons are enabled when a USB stick is connected to SVERKER 900.*

The button  opens an edit file menu for the label data.

The files are saved as ".csv" files in the root directory on the USB stick.

Selected test file can also be put to the waste bin.

The right most column shows how many tests are included for each test file.

The csv file can be opened on a PC by double clicking, or by associate the csv file to be opened in Excel or Word, or other program.

Copy test files from USB stick to SVERKER 900

1] Insert a USB stick to the SVERKER 900.

2] Click the  button.
The test files on the USB stick are shown and can be copied to SVERKER 900.

4.10 SVERKER Viewer

SVERKER Viewer can create graphical test reports in pdf format. It runs on MS windows 7, 8 and 10.

1] Run "SverkerViewerSetup.msi" file on your PC.

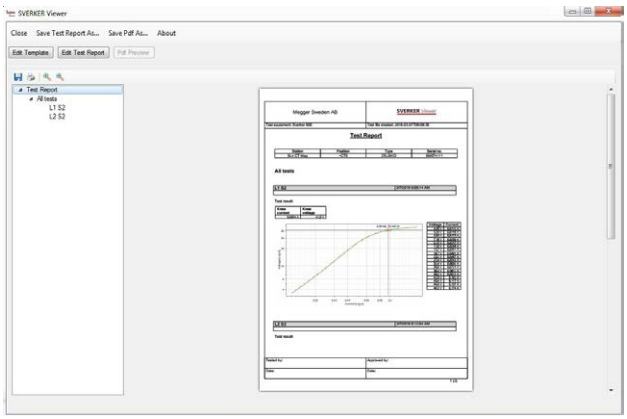
2] Follow instructions and the SVERKER Viewer will be installed on your computer.

3] Click  to open the program.

4] Open a test file with ".s9a" format by clicking on "Open" from the menu bar.
See section "4.9 Test file management" on page 44 for information on how to download test files from SVERKER900.

Note *Viewer license is needed on SVERKER 900 to generate licensed test files. (i.e. Test files from SVERKER 900 without Viewer license can't be opened in the Viewer software).*
Also, the SVERKER 900 software version must be 2.10 or higher.

5] Pdf report is directly generated in "Pdf preview" tab and is ready to be printed and/or saved on your computer.



6] From "Edit Template" and "Edit Test Report" tabs, the template and test report can be modified and/or inspected, respectively.

7] If desired, modified template and test report can be saved from menu bar.

4.11 Calibration

Generally we recommend to calibrate the SVERKER 900 yearly. The parts to calibrate are the voltage and current generators and the voltage and ammeter.

Note *Concerning calibrating the current generators and voltage generators, this method is based on calibrate and adjust by measuring DC. DC accuracies are not specified in the specification for the generators. Typical accuracies for DC are in the same range or close to AC but are not guaranteed.*

Equipment needed:

- Digital Multimeter (DMM) with high accuracy. We recommend the KEYSIGHT 34470A, 34465A, 34461A, 34410A or equal.
- SVERKER 900 calibration box (Art. No. CR-91010).

- To make an automatic calibration you will also need connection via the Ethernet port to a router with DHCP function or to a switch with network connection.

Calibration procedure

1] In the System Configuration menu, press

In the next menu you can select to do a manual calibration or an automatic calibration. The automatic calibration will take about 15 minutes.

Note *If you want to save the calibration report to an USB stick it has to be inserted to SVERKER 900 during calibration.*

Automatic calibration

The automatic calibration is done by connecting SVERKER 900 to a DMM (KEYSIGHT 34410A or equal) via a router or a switch. If you use a switch you also need network connection.

1] To make an automatic calibration the IP address for the DMM has to be obtained.

2] Enter the IP number in the "IP Address:" field.
The TCP port number is by default 5024.

3] Press the button.

4] Connect the router/switch and SVERKER 900 according to the picture.

5] Press to confirm.
If the connection between the DMM and the SVERKER 900 succeeded, it is stated in top of the menu "Connected to measurement equipment".

Now you can proceed with the automatic calibration of the voltage and current generators and the volt/ammeter provided the checkboxes are marked for the specific parts. When a part is calibrated its checkbox will be greyed out.

6] Press
A connection diagram appears that shows how to connect for each part.

7] Make the connections.

8] Press
The measurement table menu is shown.

9] Press to start the calibration process.

When the calibration for e.g. U1 is ready it is shown with a "+" sign for U1 and next calibration will be for U2.

Manual calibration

In the System Configuration menu, press

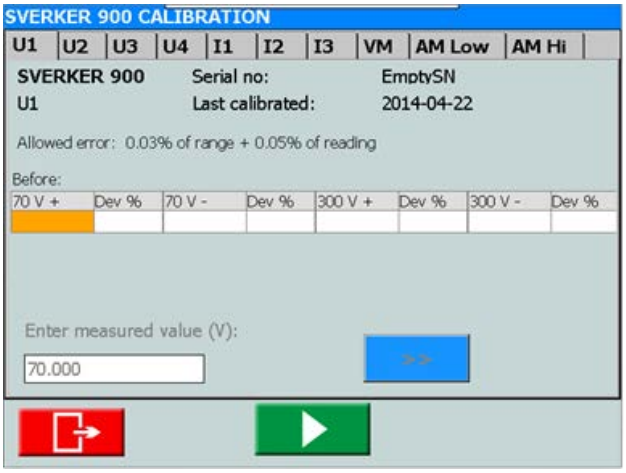
1] Press the

2] Select part to calibrate, by pressing desired part on top of the menu.

3] Press
The connection diagram is shown.

4] Connect the test leads.

5] Press the to continue.



In the picture above, U1 is selected.

6] From the measurement menu press the to start the calibration of "U1".

7] Read out the measured value from the DMM and use the knob to enter the value.

8] **Confirm the entered value by pressing the knob or the " >> " button.**

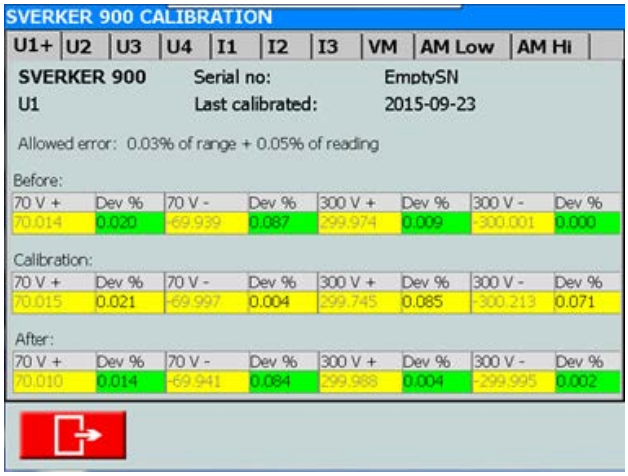
If the values entered before calibration are within limits, then no calibration will be performed for that specific range.

For the voltage and current readings only one measurement are taken for each range.

Several readings are taken for the volt/ammeter. Several measurements are taken for each range.

The values entered will be before calibration, values during calibration and values after calibration. If the calibration succeeded, there will be a "+" indication beside the U1. If some of the values were out of limits and the calibration subsequently failed, it will be marked with a "-" beside the U1. The specific calibration value that failed is presented on a red background.

The picture below shows the measured values after a successful calibration of voltage generator 1.



When the calibration has been made the data can be saved to an USB stick. Using a PC the calibration report can be opened as a Word document or an Excel sheet.

Calibration report

The front page of the report states the calibration dates. If the test values during calibration are within allowed limit, the calibration factors and dates will remain. The verification dates will be updated.

5 Troubleshooting

5.1 Problems

Problem	Cause	Remedy
Outputs		
No current or voltage output	Channel disabled	Activate channel
	The thermal cut-out may have tripped due to an overload	Wait until the unit has cooled
No Binary output	Miniature circuit breaker F1 may have tripped	Check the miniature circuit breaker
Cannot set U4/DC amplitude, grayed out	Voltage generators are set in parallel or serial mode(U1 – U4)	Set generators to work separately
BINARY INPUTS		
Binary Inputs do not operate	Wrong setting in BI menu	Check the BI menu, voltage/contact sense open or closing
	Debounce filter time is inappropriate	Set the debounce filter time to be appropriate
Harmonics		
Cannot set Harmonics	SVERKER is in wrong mode	Go to system configuration menu and select "Advanced mode" ON
Voltmeter / Ammeter		
Built in ammeter malfunction	Fuse F2 faulty	Replace F2
Ammeter / voltmeter shows incorrect values	Wrong settings	Check settings AC/DC and ranges
File handling		
Cannot copy files to USB memory	Test file is not checked in "Test file management"	Check the test files in the "Test file management"
	USB memory not inserted to SVERKER or corrupted USB memory	Verify the USB memory
EXTRA TIMER		
The Extra Timer value is not saved to test file	The "Save test" button is not marked in the Extra Timer setup menu	Mark the "Save test" button
START and STOP does not react on input signals.	Wrong setting for the debounce time	Check the debounce time setting
	Wrong setting for the START/STOP	Check the START/STOP settings menu, voltage/ contact sense open or closing.

5.2 Error messages

Error message	Cause	Remedy
INTERNAL COMMUNICATION	Internal communication error	Restart unit, if same error persist contact Megger representative
FAN #1 FAULTY	Big upper fan faulty	Check fan and if error persists contact Megger representative
FAN #2 FAULTY	Big lower fan faulty	Check fan and if error persists contact Megger representative
FIRMWARE FAULT	Internal firmware error	Restart unit, if same error persist contact Megger representative
MAX POWER	Too high output power demand or power supply hardware fault	Check the connected load and/or decrease the setting value. If same error persist contact Megger representative
OPEN CIRCUIT	The current output circuit has been disconnected	Check connections
SHORT CIRCUIT	The voltage output is short circuit connected	Check connections
HIGH TEMPERATURE	Generator temperature is too high	Wait for cooling down process and/or decrease the connected load
UNCALIBRATED	Calibration data not available	Restart unit, if same error persist contact Megger representative
SHUTDOWN FAULT	Shutdown time for current generator has been exceeded	Restart unit, if same error persist contact Megger representative
HARDWARE FAULT	Current generator hardware fault	Restart unit, if same error persist contact Megger representative
EXTERNAL VOLTAGE	External voltage connected to voltage generator	Check connections and disconnect the external voltage source

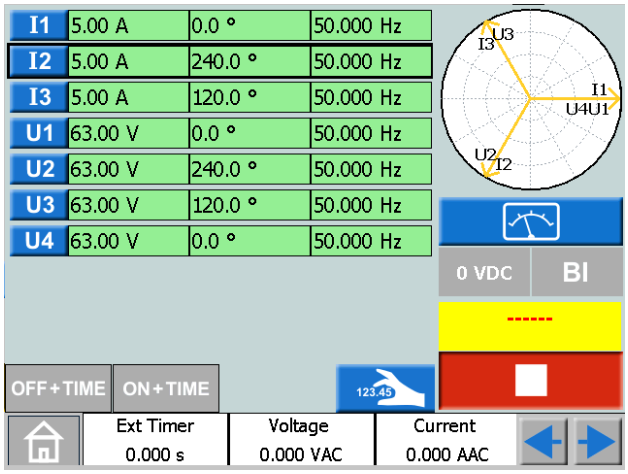
5.3 Warning messages

Warning message (Alarm indication)	Cause	Remedy
DISTORTION (Flashing LED+Black bold frame)	Measured output signal differs from the desired output signal due to high non linear load characteristic or high output power demand.	Check the connected load
MAX POWER (Red bold frame)	The output power demand has been exceeded	Check the connected load and/or decrease the setting values
HIGH TEMPERATURE (Red bold frame)	Generator temperature has been exceeded	Stop generation, wait for cooling down process and/or decrease the connected load

5.4 Alarms

Distortion alarm

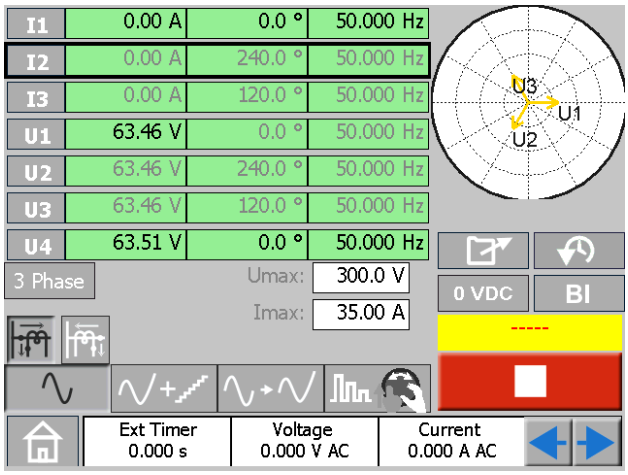
The distortion alarm is activated when the measured values deviates from the set values for a current or voltage generator. The alarm is indicated by flashing LED for the generator in question. Moreover, in all instruments, except CT and Impedance, the distortion alarm is shown with a black bold frame around the generator in question, see example below.



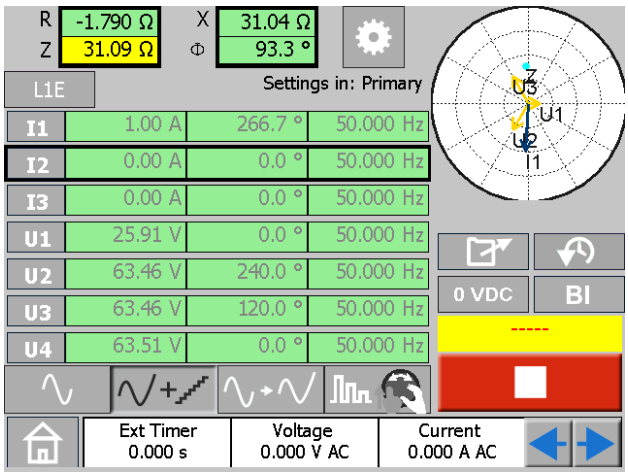
Tip!

You can compare the set values for the generator with distortion alarm by pressing 

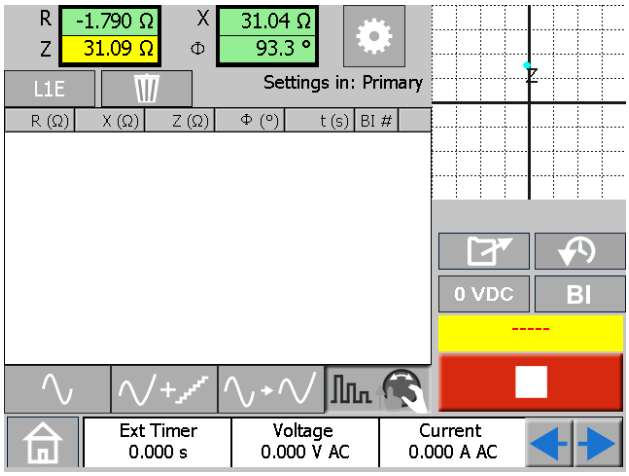
In the Impedance instrument the distortion alarm can be shown in three different ways depending active screen, see examples below.



The alarm is shown with a black bold frame around the generator in question.



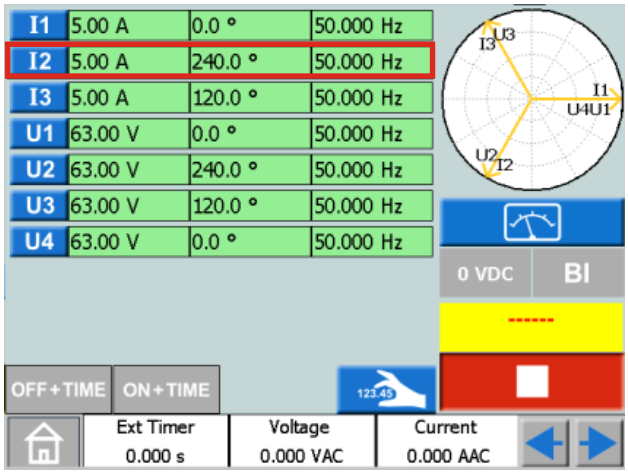
The alarm is shown with a black bold frame around the calculated values and the generator in question.



Here the alarm is shown with a black bold frame around the calculated values.

Other generator alarms

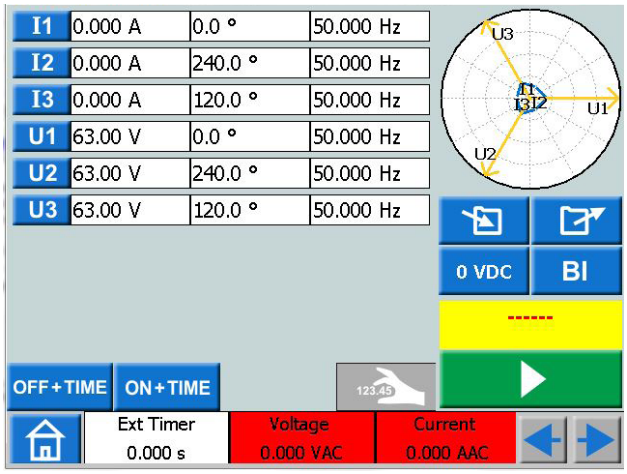
A red bold frame with the same style as described for distortion alarm indicates other generator related alarms such as max power or high temperature, see example below.



The alarm is shown with a red bold frame around the generator in question.

A-meter / V-meter alarm

This alarm is activated when the meters have faulty operation and indicated by flashing red color on the meter in question, see example below.



The alarm is shown with flashing red color on both A-meter and V-meter.

6 Specifications

SPECIFICATIONS SVERKER 900

Specifications are valid for resistive load, at 170-240 voltage supply and ambient temperature +25°C ±3°C, (77°F ±5.4°F) after 30 minutes warm up time and in the frequency range 15 Hz to 70 Hz.
All hardware data are for full scale values.
Specifications are subject to change without notice.

Environment

Application field	For use in high-voltage substations and industrial environments.
Temperature	
Operating	0°C to +50°C (32°F to +122°F)
Storage & transport	-40°C to +70°C (-40°F to +158°F)
Humidity	5% – 95% RH, non-condensing
Altitude (operational)	2000 m (6500 ft)

CE-marking

LVD	2014/35/EU
EMC	2014/30/EU
RoHS	2011/65/EU

Classifications and standards

Shock and vibration	IEC 60068-2-27
Vibration	IEC 60068-2-6
Voltage frequency ramp	IEC 60255-181:2019

General

Mains input	100 - 240 V AC, 50 / 60 Hz
Current consumption	10 A (max)
Power consumption	1800 VA (max)
Dimensions	
Instrument	350 x 270 x 220 mm (13.8” x 10.6” x 8.7”)
Flight case with wheels	615 x 295 x 500 mm (24.2” x 11.6” x 19.7”)
Flight case	620 x 295 x 365 mm (24.4” x 11.6” x 14.4”)
Weight	15.2 kg (33.5 lbs) Instrument only 29.2 kg (64.4 lbs) with accessories and flight case (with wheels, GD-00185) 24.1 kg (53.1 lbs) with accessories and flight case (GD-00182)
Display	5.7” LCD Touch screen
Available languages	Czech, English, French, German, Spanish, Swedish

Measurement section

BINARY INPUTS 1, 2, 3 ,4 and EXTERNAL TIMER Start/ Stop

Number	6
Type	Dry or wet contacts max, 240 V AC or 340 V DC
Galvanic Isolation	Galvanically separated
Max measuring time	35 minutes
Debounce filter	Settable, 0 to 999 ms
BINARY INPUT 1	Adjustable threshold and hysteresis
Timer	

Range	Inaccuracy
0 – 50 ms	≤ 1 ms
50 – 500 ms	≤ 2 ms
> 500 ms	≤ 1%

Resolution	1 ms
Voltmeter	
Measurement method: AC true RMS, DC mean value	
Insulation	900 V, 1273 Vpeak
Input rating	900 V
Inaccuracy	
Ranges DC	
0-1 V	±0.5% of reading + 3 mV
0-10 V	±0.5% of reading + 7 mV
0-100 V	±0.5% of reading + 30 mV
0-900 V	±0.5% of reading + 300 mV
Ranges AC	
0-1 V	±1% of reading + 5 mV
0-10 V	±1% of reading + 10 mV
0-100 V	±1% of reading + 50 mV
0-900 V	±1% of reading + 300 mV
Resolution	1 mV
Frequency	
Range	10 Hz – 600 Hz
Inaccuracy	< 0.01%
Resolution	< 10 mHz

Ammeter

Measurement method: AC true RMS, DC mean value	
Inaccuracy	
Ranges DC	
0-200 mA	±0.5% of reading + 2 mA
0-1.5 A	±0.5% of reading + 3 mA
0-10 A	±0.5% of reading + 10 mA
Ranges AC	
0-200 mA	±1% of reading + 2 mA
0-1.5 A	±1% of reading + 3 mA
0-10 A	±1% of reading + 20 mA
Resolution	0.1 mA
Frequency	
Range	10 Hz – 600 Hz
Inaccuracy	< 0.01%
Resolution	< 10 mHz

Extra measurements

Power factor and phase angle measurements

	Ranges	Resolution	Inaccuracy
Power factor cosφ	-0.01 (cap) to 1 to +0.01 (ind)	< 0.01	<0.04
Phase angle (°) [1]	0° - 360°	<0.1°	<0.8°

Impedance and power measurement

AC	Z(Ω), R(Ω),X (Ω), P(W), S(VA), Q(VAR)
DC	R(Ω), P(W)
Range	Up to 999 kX (X=unit)

1) Valid with current >1 A and voltage >10 V

BINARY OUTPUTS

Voltage	250 V AC/DC
Current	1 A (1 A fuse)
Breaking capacity, resistive DC	75W

Generation section

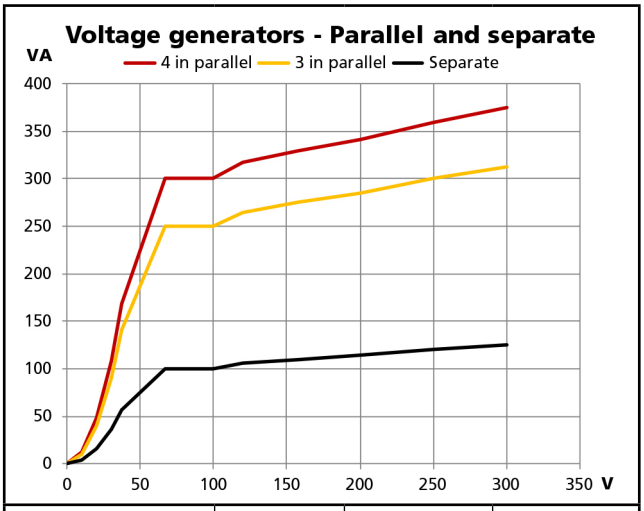
Voltage generators

Voltage outputs U1, U2, U3 and U4/DC out
All voltage sources/generators are galvanically separated from each other and from ground.
Floating common return is made by using jumper connectors

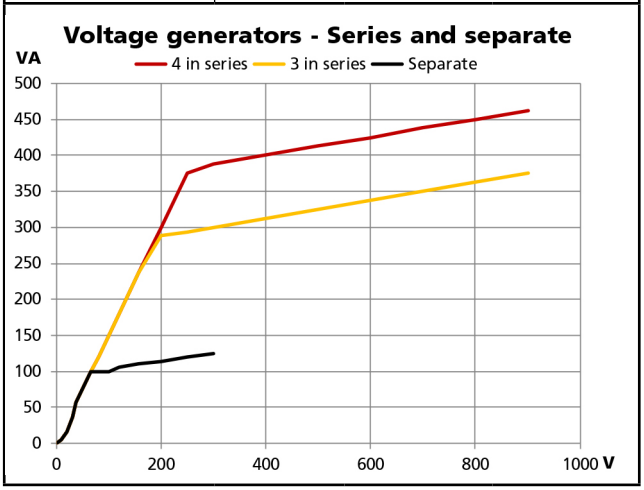
Range	
4-phase AC	4 x 300 V
4-channel DC	4 x 300 V
Power	
4-phase AC	4 x 125 VA (max)
4-channel DC	4 x 125 W (max)
Inaccuracy AC	
Typical	0.03% of reading + 0.01% of range
Guaranteed	0.05% of reading + 0.03% of range
Distortion (THD+N)[1]	< 0.14% typical (0.25% max)
Resolution	10 mV
Phase	
Angle range	0° - 360°
Inaccuracy [2]	< 0.5° (at 50 and 60 Hz)
Resolution	0.1°
Frequency	
Range	10 Hz - 600 Hz
Inaccuracy [2]	<0.03 % (45 Hz - 66 Hz)
Resolution	1 mHz

1) THD+N: Values at 50/60 Hz, 200-300 V, ≥1500 Ω load. Measurement band with 22 Hz – 22 kHz.

2) The specification is valid for resistive load >2000 Ω for voltage output separately U1,U2, U3 and U4/DC out.



4 Voltage generators in series: U1 – U2 – U3 – U4	**Voltage**	**Power (max)**	**Current (max)**
	900 V	450 VA	0.5 A
	400 V	360 VA	0.9 A
	268 V	350 VA	1.3 A
	External load: min. 100 Ω		
3 Voltage generators in series: U1 – U2 – U3	**Voltage**	**Power (max)**	**Current (max)**
	900 V	350 VA	0.4 A
	300 V	280 VA	0.9 A
	200 V	275 VA	1.4 A
	External load: min. 75 Ω		



Voltage generators in single-phase mode, AC or DC			
4 Voltage generators in parallel: U1 // U2 // U3 // U4	**Voltage**	**Power (max)**	**Current (max)**
	300 V	375 VA	1.2 A
	100 V	300 VA	3.0 A
	67 V	300 VA	4.5 A
	External load: min. 7 Ω		
3 Voltage generators in parallel: U1 // U2 // U3	**Voltage**	**Power (max)**	**Current (max)**
	300 V	312 VA	1.0 A
	100 V	250 VA	2.5 A
	67 V	250 VA	3.7 A
	External load: min. 9 Ω		

Current generators

Current outputs I1, I2 and I3
All current generators are galvanically separated from each other and from ground
Floating common return, is made by using jumper connectors

Range

3-phase AC	3 x 35 A At least 15 repetitions: 10 s ON and 20 s OFF
3-phase DC	3 x 35 A At least 15 repetitions: 10 s ON and 20 s OFF
3-phase AC	3 x 20 A continuous
3-phase DC	3 x 20 A continuous

Power

3-phase AC (max)	3 x 277 VA
3-phase DC (max)	3 x 275 W

Inaccuracy AC

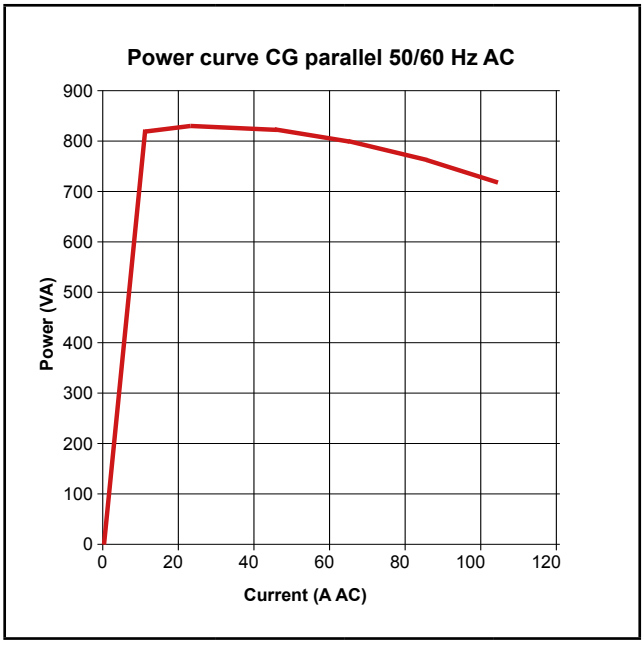
	Range	Error
Typical	<200 mA	<0.5 mA
	200 mA to 35 A	0.1% of reading+0.01% of range
Guaranteed	<200 mA	<3 mA
	200 mA to 35 A	0.4% of reading+0.01% of range

Distortion(THD+N)[4]	< 0.10% typical (0.20% max)
Resolution	1 mA
Compliance voltage	≤50 Vrms
Phase	
Angle range	0° - 360°
Inaccuracy [5]	< 0.2° (at 50 and 60 Hz)
Resolution	0.1°
Frequency	
Range	10 Hz - 600 Hz
Inaccuracy [5]	< 0.03 % (45 – 66 Hz)
Resolution	1 mHz

4) THD+N: Values at 50/60 Hz, 1-5 A, 0.5 VA load. Measurement band with 22 Hz – 22 kHz.

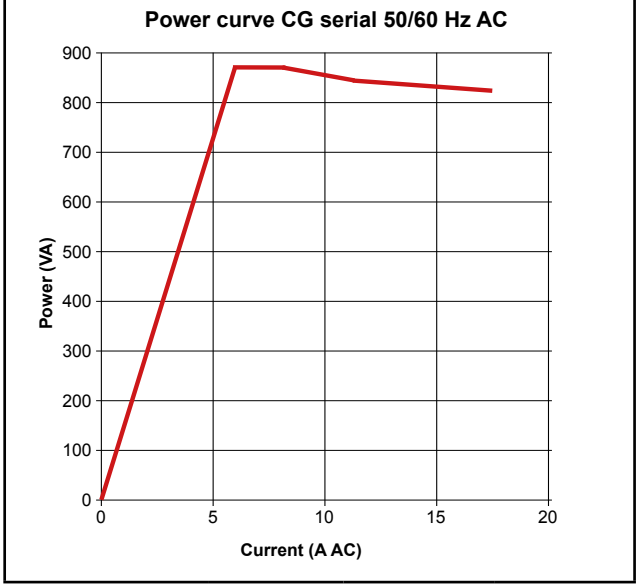
5) The specification is valid for resistive load ≤0.08 Ω and I ≥0.15 A.

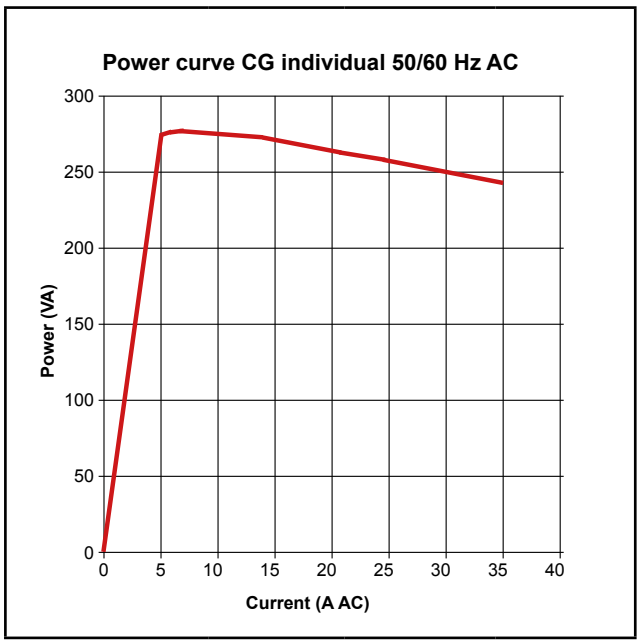
Current generators in single-phase mode AC			
Current generators in parallel: I1 // I2// I3			
Current	**Power (max)**	**Voltage (max)**	**Duty cycle**
2.6 A	198 VA	76 V	Continuous
16 A	816 VA	51 V	Continuous
26.5 A	827 VA	31.2 V	Continuous
45.5 A	819 VA	18 V	Continuous
60 A	800 VA	14 V	Continuous
105 A	721 VA	7 V	At least 15 repetitions: 10 s ON and 20 s OFF



Current generators in series: I1 – I2 – I3 [6]			
Current	**Power (max)**	**Voltage (max)**	**Duty cycle**
2.5 A	403 VA	161 V	Continuous
8.2 A	860 VA	105 V	Continuous
17.6 A	827 VA	47 V	Continuous

6) Max 18 A and 70 Hz





Optional accessories

Low current adapters LCA1 and LCA2

Dimensions

LCA1	110 x 64 x 28 mm (4.3" x 2.5" x 1.1")
LCA2	110 x 64 x 44 mm (4.3" x 2.5" x 1.7")
Weight	0.2 kg (0.4 lbs)
Input	5 A (max)

Index

Megger

Local Sales office

Visit: www.megger.com

Manufacturing sites

Megger Limited
Archcliffe Road
Dover
Kent
CT17 9EN
ENGLAND
T. +44 (0)1 304 502101
F. +44 (0)1 304 207342

Megger GmbH
Weststraße 59
52074 Aachen
T. +49 (0) 241 91380 500
E. info@megger.de

Megger USA - Valley Forge
Valley Forge Corporate Center
2621 Van Buren Avenue
Norristown
Pennsylvania, 19403
USA
T. +1 610 676 8500
F. +1 610 676 8610

Megger USA - Dallas
4545 West Davis Street
Dallas TX 75237
USA
T. 800 723 2861 (USA only)
T. +1 214 333 3201
F. +1 214 331 7399
E. USsales@megger.com

Megger AB
Rinkebyvägen 19, Box 724,
SE-182 17 DANDERYD
SWEDEN
T. +46 08 510 195 00
E. seinfo@megger.com

Megger USA - Fort Collins
4812 McMurry Avenue
Suite 100
Fort Collins CO 80525
USA
T. +1 970 282 1200

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