

Operating Manual

High Voltage Test Devices

for system operation

Series HA50xxL and HA60xxL



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1 General

The high-voltage test is one of the most important safety tests. Its purpose is to measure the device under test with a high voltage. By means of the high voltage, it is checked if there is sufficient separation between the voltage carrying parts and the touchable parts of the housing. If the separation is sufficient in all places, no voltage breakthrough will occur, and the DUT can be labeled as „PASSED“.

The high voltage test devices series HA 50xxL and HA 60xxL are exclusively designed for application in automatic test systems. Due to the multiple interfaces and their intended usage, the possibilities of manual operation are limited.

The device series contains the following variants:

HA 5002L	operation with alternate voltage, base device
HA 5012L	4-wire-technique with detached refeeding of high voltage
HA 6003L	operation with DC and AC voltage, switching between measurement of real current or apparent current for AC operation. DC voltage is filtered, DUT gets discharged after testing
HA 6013L	same as HA6003L, however with 4-wire-technique

Optional:

IW 08	Optional switching between real/apparent current measurement for HA 5002L (standard for HA 6003L)
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Explanation of the function „4-wire-technique“ :

Since the high-voltage test is one of the most important test methods, caring for safety is essential while applying the high voltage. In case of a broken line or a loose connection, the device is unable to detect an error, since the current flow needed for evaluation won't build up. Therefore, finding that $I \approx 0$ is no sufficient reason to draw the conclusion that the tested product is in order, since system failures might lead to the same conclusion.

With the 4-wire method, the high voltage is applied to the DUT by 2 source connections, and gets measured back by 2 separated sense connections. Through this method, voltage being present on the sense connections leads to the assured conclusion that the DUT indeed was supplied with voltage during the test run.

2 Safety equipment

- potential-free output voltage
- transformer and transducer are double-shielded
- two-fold status indicator
- external warning lights possible
- four on-positions
- two independand de-energizing circuits

3 Overview

	AC	DC	4-wire- technique	Current meas. range	Voltage meas. range
HA5002L	X	—	—	10/100 mA	2.5/5.0 kV
HA5012L	X	—	X	10/100 mA	2.5/5.0 kV
HA6003L	X	X	—	10/100 mA	2.5/5.0 kV
HA6013L	X	X	X	10/100 mA	2.5/5.0 kV

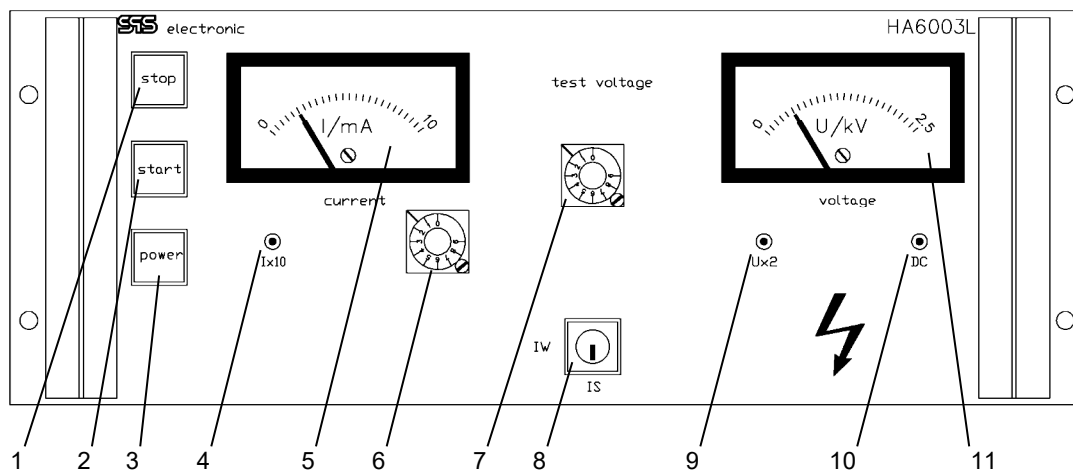
General properties:

- High voltage test device for system application
- Plug-in 19" / 4 HU
- potential-free output voltage
- potential-free interface:
 - * measurement data via analogue signals
 - * status signals by digital signal transmission
- secondary sided acquisition of measurement data
- electronic current release:
 - * adjustable on device front plate
 - * programmable
- continuous power 500VA in all operating modes
- integrated buffer amplifier with test voltage 15000 VAC for
 - * voltage
 - * apparent current
- monitoring instruments for programmed parameters

4 Operation

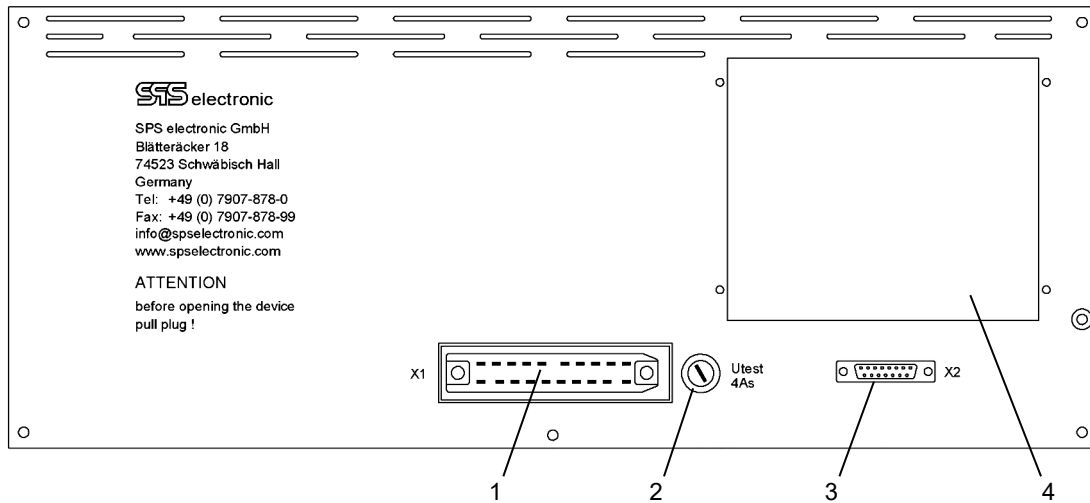
4.1 Operating Controls

4.1.1 Front panel



Pos	Name	Function
1	Illuminated button "stop"	Interrupts the high voltage generation by two separated circuits. Also, this button deals as emergency switch .
2	Illuminated button "start"	Puts the device into „ready to switch on“ state.
3	Illuminated switch "power"	Switches the device on.
4	LED (* 10) range switch indicator	The glowing LED indicates that the measurement range of 100 mA is in use.
5	meter "current"	Displays the actual current values in mA.
6	Setting scale "current"	Setting of maximum release current
7	Setting scale "test voltage"	Setting of test voltage (Not for HA5300L)
8	switch real/apparent current	Key switch for switching between measurement of real current and apparent current (only HA 60xxL)
9	LED (* 2) range switch	The glowing LED indicates that the measurement range of 5000 V instead of 2500 V is in use
10	LED (DC)	The glowing LED indicates operation with DC-voltage (only HA 60xxL)
11	meter "test voltage"	Displays the actual test voltage values in kV

4.1.2 Rear panel



Pos	Name	Function
1	X1: mains interface	Mains connection (pin assignment: see chap. 5.4.2)
2	Lead fuse	Device main fuse (6,3 As)
3	X2: control interface	Connection possibility for external control (pin assignment: see chap. 5.4.3)
4	Cut-out	Recess clearance for device options

4.2 Switching the device on

The high voltage test devices are put into „ready to operate“ state by the mains switch „power“ (3) on the device’s front panel. The state „ready to operate“ is indicated by the yellow light „power“ and the green light „start“.

According to EN 50191, the device cannot generate any high voltage while it is in „ready to operate“ state. For that, the device must be put into „ready to switch on“ state. This state is activated by pressing the „start“ key (2).

The state „ready to switch on“ also can be achieved by the signal „set“ on the control interface. The superordinated controlling unit should apply an impuls of at least 0.5s on the control interface, prior to each high voltage test.

The device state „ready to switch on“ is indicated by the following elements:

- yellow control light of the key "power"
- red control light of the key "stop"

After that, the device is ready to perform the first test run.

4.3 Setting the Test Voltage

Devices equipped with manual voltage setting have to be set by the scale wheel (6). The setting of the test voltage is only possible when the device is empowered, and therefore requires the device to have been started. The test voltage needed for the high voltage test is set by the fixable scale wheel „test voltage“ (6) on the front panel. The scale range 0 – 10 refers to a test voltage of 0 to 2500 VAC. By means of the fixing screw, the adjusted voltage value can be locked.

4.4 Setting the Release Current

The maximum tolerable leakage current is set by the scale wheel (5). The scale range 0 – 10 refers to a leakage current of 0 to 10 mA, or 0 to 100 mA depending on which measurement range is active. By means of the fixing screw, the adjusted leakage current can be locked. If the set value is exceeded during a test run, the device will cut off the high voltage, and change over to the dangerless „ready to switch on“ state. After that, the test sequence has to be re-started.

4.5 Performing Tests

In order to run a high voltage test, the following actions are required:

- a) Switch the device on by the key „power“.
- b) The external safety contact input (X2/9) has to be triggered with +24 V
- c) The „set“-signal has to be set by an impulse on (X2/2).
- d) Now the red signal light and the red warning light (if connected) are glowing
⇒ the device is ready for operation.

- e) The range for current measurement must be activated :

100mA (X2/11) :	0 :	⇒	0-10 mA
100mA (X2/11) :	1 :	⇒	0-100 mA

- f) The voltage range has to be specified :

5 kV (X2/1) :	0 :	⇒	0-2500 V
5 kV (X2/1) :	1 :	⇒	0-5000 V

- g) The kind of voltage has to be specified :

DC (X2/3) :	0 :	⇒	AC
DC (X2/3) :	1 :	⇒	DC

- h) Now the following status is active:

FI (X2/4)	⇒	1 (the minimal current is not achieved)
FU (X2/5)	⇒	1 (the minimal voltage is not achieved)
AGI (X2/7)	⇒	0 V : current = 0 mA
AGU (X2/14)	⇒	0 V : voltage = 0 V

- i) Apply AC voltage (0 – 230 V) to the plug (X1/b9+b8).
See 5.1 / test voltage supply.
- j) Apply start signal to (X2/10) – now high voltage is generated.
In case that the AC voltage at X1/b9+b8 is altered during the test time, the value of the high voltage will change, too.
- k) Now the following status is present:
- | | |
|---------------|--|
| FI (X2/4) | ⇒ 1 (in case minimal current is not reached) |
| FU (X2/5) | ⇒ 0 (minimal voltage is not reached) |
| AGI (X2/7) | ⇒ x V : current = x mA |
| AGU (X2/14) | ⇒ y V : voltage = y V |
| warning light | ⇒ red |
- l) The start signal must be applied throughout the test time !
- m) In case a high voltage error occurs during the test time, or a current greater than I_{max} specified on the front panel (5), the device will cut off autonomously, thus making the outputs idle. Now the following status is present:
- | | |
|---------------|--|
| FI (X2/4) | ⇒ 1 (in case minimal current is not reached) |
| FU (X2/5) | ⇒ 1 (minimal voltage is not reached) |
| AGI (X2/7) | ⇒ 0 V : current = 0 mA |
| AGU (X2/14) | ⇒ 0 V : voltage = 0 V |
| warning light | ⇒ green („ready to switch on“) |
- The actual test run is interrupted, and the procedure has to be re-started.
- n) If no overcurrent occurs during the test time, the actual values of current and voltage can be read and evaluated.
- | | |
|---------------|------------------------|
| AGI (X2/7) | ⇒ x V : current = x mA |
| AGU (X2/14) | ⇒ y V : voltage = y V |
- o) When the end of the test time is reached, the signal „start“ (X2/19) is deactivated, and the voltage on the outputs is cut off.
- | | |
|---------------|--|
| FI (X2/4) | ⇒ 1 (minimal current is not reached) |
| FU (X2/5) | ⇒ 1 (minimal voltage is not reached) |
| AGI (X2/7) | ⇒ 0 V : current = 0 mA |
| AGU (X2/14) | ⇒ 0 V : voltage = 0 V |
- p) With activated DC voltage, the voltage lying at the DUT’s capacity now gets discharged by an internal resistance.
For safety reasons, the DUT should stay connected for a short time, in order to complete the discharging process.

Remark : Option 4-wire-technique

If the device is equipped with 4-wire-technique, for all voltages the values of the sense voltage gets used. In this case, the source voltage generated by the device won’t get evaluated.

5 Technical Data

5.1 Dimensions, Weights and Performance Data

Dimensions

Width:	464 mm
Depth:	310 mm
Height:	195 mm (= 19" / 4 HU)
Weight:	ca.172 N
Protection class:	IP21

Mains supply

Phase:	L, X1/a9
Neutral:	N, X1/a8
Ground wire:	PE, X1/a0
Voltage:	230 V \pm 10 %
Frequency:	50 - 60 Hz
Current:	max. 0.5 A
Fuse:	2 A, sluggish

The mains supply deals for the device's internal voltage supply only.

Warning lights

Red	X1/b7
Green	X1/a7
Neutral:	X1/a6
Voltage	230 V \pm 10 %
Frequency:	50 - 60 Hz
Current:	max. 1 A
Fuse:	1 A, sluggish

The output on these sockets corresponds to the status indicators on the device front panel (red and green signal lamps). Hereby the device state is indicated in accordance to EN50191.

Test voltage supply

The voltage needed for the high voltage generation has to be applied to the following pins:

Phase:	L, X1/b9
Neutral:	N, X1/b8
Ground wire:	PE, X1/a0
Voltage:	0 - 230 V
Frequency:	50 - 60 Hz
Current:	max. 2 A
Fuse:	6.3 A, sluggish

Depending on the test requirement, the high voltage can be produced as follows:

- a) Voltage is set in the device manually:
By means of a jumper in the socket (a8–b8 and a9–b9), the mains voltage is also used for the high voltage generation, and can be set by the variable transformer through the front panel control.
- b) Voltage is set externally:
Here, a variable voltage proportional to the high voltage is fed in through the abovementioned connectors. From external, one can connect either an adjustable or programmable voltage source, or a transformer with several tappings.
The external voltage processing is not part of the test device. If this kind of voltage feed-in is used, the transformer has to be set to maximum by the scale on the device's front panel.

Voltage measurement

Range 1:	0 V – 2500 V (3500 VDC)
Range 2:	0 V – 5000 V (7000 VDC)
Scale:	105°
Class:	1.5
Remark:	potential free by active buffer amplifier
Analogue output :	0 – 10 V ; X2/14

Current measurement

Range 1:	0 – 10 mA
Range 2:	0 – 100 mA
Scale:	105°
Class:	1.5
Remark:	potential free by active buffer amplifier
Analogue output:	0 – 10 V ; X2/7

Output voltage

Range 2500 V:	0 – 2500 V _{eff} (3500 VDC)
Range 5000 V:	0 – 5000 V _{eff} (7000 VDC), filtered
Distortion factor:	< 5 %
Frequency:	Acc. to test voltage supply
Potential:	Acc. to test voltage supply, else potential free

Output current

Range 10 mA:	0 - 10 mA _{eff}
Range 100 mA:	0 - 100 mA _{eff}
Distortion factor:	< 5 %
Frequency:	Acc. to test voltage supply
Potential:	Acc. to test voltage supply, else potential free

5.2 Fuses

Device fuses



Danger !

Before opening the device, pull plug.



Main fuse:	6.3 A, sluggish
External warning light:	230 V / per 1 A

The device fuses are located at the device's rear panel.

Elektronic safeguarding

Range:	10 mA and 100 mA
Reaction time:	20 ms
Circuit:	2 detached circuits

When reaching the pre-setted threshold for I_{\max} the devices cuts off and deactivates the high voltage.

5.3 Control signals

5.3.1 General

All analogue signals are potential-free in relation to digital signals, mains voltage, supply voltage and test voltage.

Digital input signals

Voltage:	10 VDC - 30 VDC
Internal resistance:	> 1 kOhm
Ripple:	max 10 %
Active:	At input signal, positive logic
Reference potential:	GND

Digitale output signals

Voltage:	max. 28 VDC
Current:	max. 0.1 ADC
Active:	If condition fulfilled, connected against GND, negative logic
Reference potential:	GND

Analogue input signals

Voltage:	Normalized to 0 - 10 VDC
Internal resistance:	10 kOhm
Function:	Signal specific
Reference potential:	GNA

Analogue output signals

Voltage:	Normalized to 0 - 10 VDC
Current:	max. 1 mA
Function:	Signal specific
Reference potential:	GNA

5.3.2 Digital input signals

Signal	Function
<u>Voltage range</u> (5 kV, X2/1)	Signal passive (0 V) = range 2.5 kV Signal active = range 5.0 kV This input switches both the high voltage source and the measuring amplifier for the instrument and the normalized output.
<u>Current range</u> (0, 1 A, X2/11)	Signal passive (0 V) = range 10 mA Signal aktive = range 100 mA Switches the measurement range for the instrument, the normalized output, and the release curent.
<u>Signal "set"</u> (X1/b3 and X2/2)	With this signal active, the device is set to „ready to switch on“ state. The signal has to be set after each switching-on and after each high-voltage error. If the device is already set, the signal has no effect. Therefore, the signal may be set after each test step in a cyclic manner. An impulse of 50ms is sufficient.
<u>Signal "start"</u> (X1/b2 and X2/10)	When the device is in „ready to switch on“ state and the safety contact is activated as well, then a high voltage is generated as long as a signal is applying on this input. The charging and discharging is applied during the zero crossing of the mains voltage.
<u>Direct voltage</u> (DC, X2/3)	Signal passive (0 V) = operation with AC voltage Signal active = operation with DC voltage
<u>Safety contact</u> (SK, X2/9)	The generation of high voltage is only possible if this signal applies. The safety contact primarily deals for the safety of the testing personnel.
<u>GND</u> (X2/12)	Reference potential for all digital signals.

5.3.3 Digital output signals

Signal	Function
<u>Stop signal</u> (Stop, X2/6)	This signal is not meant for the user, and is only needed in conjunction with the device option PA5002L.
<u>Voltage error</u> (FU, X2/5)	A signal is generated on this PIN, if an (adjustable) minimum voltage is not present at the device's output. This is the case e.g. after a high voltage arc-over, when the device has cut off, when any fuse has blown, or when the generated high voltage is too low. The threshold can be adjusted on the circuit HA-102L, where the range 0 – 10 VDC corresponds to a high voltage of 0.0–2.5 kV or 0.0–5.0 kV resp. Default value: 1 V = 10% of measurement range
<u>Current error</u> (FI, X2/4)	A signal is generated on this PIN, if an (adjustable) minimum value of leakage current is not reached. This can be used e.g. for checking for broken lines. The threshold can be adjusted on the circuit HA 102L, where the range 0–10 VDC corresponds to a leakage current of 0–10 mA, or 0–100 mA resp. Default value: 1 V = 10% of measurement range.
<u>GND</u> (X2/12)	Reference potential for all digital signals. Can be connected with GNA, if needed.

5.3.4 Analogue output signals

Signal	Function
<u>Output voltage</u> (AGU, X2/14)	From this output, a potential-free low voltage proportional to the high voltage can be taken from. Reference potential is GNA. For the range 2.5 kV applies: $U(V) = U_{\text{test}}(V) \times 1/250$ For the range 5.0 kV applies: $U(V) = U_{\text{test}}(V) \times 1/500$
<u>Output current</u> (AGI, X2/7)	From this output, a potential-free low voltage proportional to the high voltage can be taken from. Reference potential is GNA. For the 10 mA range applies: $U(V) = I_{\text{test}}(\text{mA}) \times V/\text{mA}$ For the 100 mA range applies: $U(V) = I_{\text{test}}(\text{mA}) \times V/10 \text{ mA}$
<u>GNA</u> (X2/8)	Reference potential for all analogue signals. Can be connected with GND, if needed.

5.3.5 Analogue input signals

Signal	Function
<u>Set voltage</u> (setU, X2/13)	<p>This functionality is only optionally available:</p> <p>By this input, the output voltage can be programmed through a potential-free low voltage in the range of 0 – 10 VDC.</p> <p>For the 5.0 kV range applies: $U_{\text{test}}(\text{V}) = U(\text{V}) \times 500$</p> <p>(only possible with device HA5300L.)</p>
<u>Set current</u> (setI, X2/15)	<p>If desired, the value for release current can be programmed by the interface instead of using the operation controls on the front panel. The release current can be programmed by applying a potential-free low voltage of 0–10 VDC to this input.</p> <p>For the 10 mA range applies: $I_{\text{test}}(\text{mA}) = U \times 1 \text{ mA/V}$</p> <p>For the 100 mA range applies: $I_{\text{test}}(\text{mA}) = U \times 10 \text{ mA/V}$</p> <p>In case that the possibility of programming the release current is not desired, that value can be set by the potentiometer on the front panel.</p> <p>The selection is made by means of the DIP switches located on the bus card:</p> <p>Programming by front panel: DIP1=0 / DIP2=1</p> <p>Programming by interface : DIP1=1 / DIP2=0</p>

5.4 Interface Configuration

5.4.1 High voltage connector

Faston 6.3 mm on high voltage transducer Wdl 201 resp. 301.

Devices with 2-wire-technique:

Name	Pin	Assignment
HVL		Source output (hot end)
HVN		Source output (cold end)

Devices with 4-wire-technique:

Name	Pin	Assignment
HVL		Source output (hot end)
HVN		Source output (cold end)
HVL'		Sense input
HVN'		Sense input

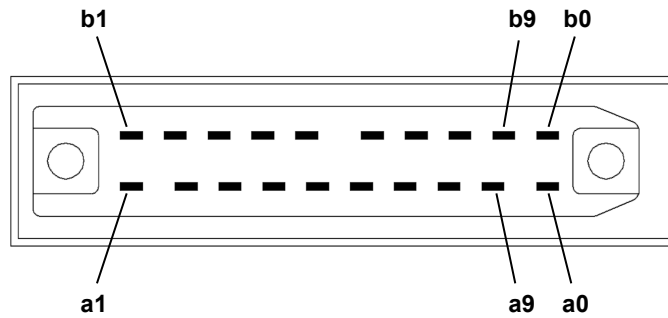
Only the "cold" high-voltage connection (no brushing against protective conductor) may be applied to the protective conductor.

Grounding on the "hot" side (red point on the high-voltage transducer Wdl 201) inevitably results in destruction of the device !



5.4.2 Plug-in interface X1

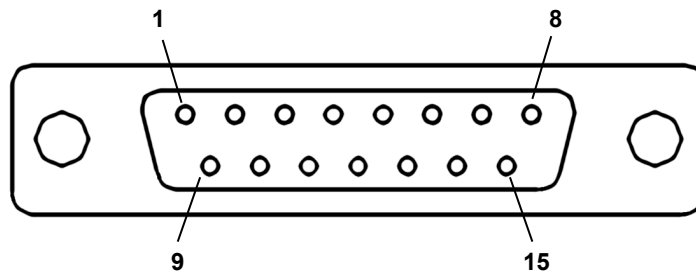
Design acc. to DIN 41622 (20-pole pin connector)



Name	PIN	Assignment
PE	a0	Ground wire connector
L in	a9	Mains phase (230 VAC \pm 10%, max. 4 A)
N in	a8	Neutral of mains supply
LRT	b9	Test voltage supply (0 – 230 V)
NRT	b8	Test voltage supply (0 – 230 V)
L1LA	a6	Reference potential for warning lights
LAon	b7	Connector for warning lights (red) (230 Vac / max.1A)
LAout	a7	Connector for warning lights (green) (230 Vac / max.1A)

5.4.3 Control interface X2

Design: 15-pole d-sub, plug



Name	PIN	Assignment
5 kV	1	Switch to range 5.0 kV
Set	2	Signal „set“ to achieve „ready to switch on“ state
DC	3	Switches to DC operation
F.I.	4	Error I : I min not reached
F.U.	5	Error U : U min not reached
/Stop	6	Custom output : This output enables to reckognize if a release has happened. (12 V output against GNA)
AGI	7	Monitoring output for current, normalized to 0–10 VDC
GNA	8	Reference potential for analogue signals
SK	9	Safety contact
Start	10	Start signal
100mA	11	Switches to range 100 mA
GND	12	Reference potential for digital signals
Set U	13	Analogue signal: target test voltage
AGU	14	Monitoring output for voltage, normalized to 0–10 VDC
Set I	15	Analogue signal: release current threshold

Appendix

A Service Address

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B Important Rules and Regulations

The professional associations and trade unions have, for the safety of persons, published below literature:

- VBG 1 Accident Prevention – General Regulations
- VBG 4 Accident Prevention – Electrical Systems and Production Facilities
- VBG 109 Accident Prevention – First Aid
- DIN VDE 0104 Installation and Operation of Electrical Systems
- DIN VDE 0106 Protection against Electric Shock
part 1 Classification of Electrical and Electronical Production Facilities
- DIN 40 008 part 3 Safety Labels for Electrical Engineering;
Danger Signs and Supplementary Labels
- DIN 40 050 IP-Protective Systems; Contact and/or Foreign Matter, and Water
Protection for Electrical Production Facilities
- DIN VDE 0100 Installation of Power Plants up to 1000 V



This literature will give you additional information and it is an essential part of this operating manual. Their observance therefore is mandatory!

C Terms of warranty

1. Warranty period

The warranty period is 12 months after delivery.

2. Conditions for a guarantee claim

- The device must have been put into operation by qualified personnel at the customer's.
- Inspections must be carried out regularly (once a year) and thoroughly (by SPS electronic GmbH).
- Defective or worn parts have to be replaced immediately. The operation of such parts is forbidden for safety reasons.
- Defective parts, subject to guarantee claims, have to be sent to SPS electronic GmbH for inspection.
- Defects occurred must be reported to SPS electronic GmbH immediately.

3. Beginning of guarantee period

Guarantee starts with the date of delivery note.

4. Guarantee

SPS electronic GmbH guarantees a good function of the high voltage test device, a conscientious and professional design and manufacture as well as the use of high-quality material.

All parts are being replaced free of charge if parts became defective or useless during the guarantee period due to the use of inadequate material, manufacturing faults or an imperfect engineering.

5. Excluded from guarantee

- Damages due to outside influences, above all because of handling malpractices or of local conditions.
- Damages at devices from which the serial number has been removed, destroyed or falsified.
- Wear parts, such as fuses, signal bulbs, etc.

EU-Konformitätserklärung

EU Declaration of Conformity

Wir / we :

SPS electronic GmbH
Steuerungs- und Prüfsysteme
Eugen-Bolz-Straße 8
D-74523 Schwäbisch Hall

erklären hiermit, dass das nachfolgend genannte Gerät den einschlägigen grundlegenden Sicherheitsforderungen der EU-Richtlinien entspricht.

declare, that the following unit complies with all essential safety requirements of the EU Directives.

Geräteart:
Description of device:

Hochspannungsprüfgerät
High Voltage Tester

Typ / Type :

HA 5002 / 5012 / 6003 / 6013 L

EU Richtlinien / *EU Directives:*



EG Maschinenrichtlinie 2006/42/EG mit Änderungen
EC Directive for machinery 2006/42/EC with amendments



EU Niederspannungsrichtlinie 2014/35/EU
EU Directive for low voltage 2014/35/EU



EU Richtlinie Elektromagnetische Verträglichkeit 2014/30/EU mit Änderungen
EU Directive electromagnetic compatibility 2014/30/EU with amendments

Angewandte harmonisierte Normen:

Applicable harmonized standards:

- EN 61 000-3-2; EN 61 000-3-3; EN 55 014-1; EN 55 014-2; EN 50 191

Angewandte nationale Normen und technische Spezifikationen:

Applicable national standards and technical specifications:

30.06.2017

Datum / date:

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ppa. Dipl. Ing. Stefan Ruhl

Dieser Konformitätserklärung unterliegt grundsätzlich nur das von uns gelieferte oder in Betrieb genommene Gerät. Für Änderungen und Erweiterungen ist der Betreiber verantwortlich und damit für die Sicherstellung der Übereinstimmung der veränderten Anlage mit der betreffenden EU-Richtlinie.

Subject to this declaration of conformity is the device as supplied or placed into operation by us. The operator is responsible for subsequent alterations and extensions, and therefore has to ensure the altered unit complies with the corresponding EU directives.