

OPERATION MANUAL

ESD - GENERATORS



SESD 216

SESD 230

OPERATION MANUAL

ELECTROSTATIC DISCHARGE

GENERATORS

SESD 216 16,5 kV

SESD 230 30,0 kV

Warning:

This unit generates high voltages and is inherently dangerous. The local, national and all applicable safety regulations must be obeyed for operation of this unit. The device must only be used by experienced electric technicians (see VDE 0140) respectively through qualified operating personal (electrotechnical instructed person). People using cardiac pacemakers should be removed from the test area.

**Before using the generator please read this manual
and the warnings to the safety points under item 1**

This generator contains a Li-Ion battery.

Please note also Section 5.13.1 "Note for internal battery:"

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1 Safety regulations

1.1 Warnings

The test simulators SESD 216 and SESD 230 generate high voltages up to 16.500 Volts and 30.000 Volts respectively. The energy of these high voltages is limited, but injury might occur if the probe tip is touched.

The handling of the generator is only allowed to experienced and instructed persons according to DIN 570105 / VDE 0105 part 1.

Persons with a cardiac pacemaker are not allowed to handle this unit.

The use of the ESD generator assumes, like all measurement tasks and verifications, that the local and branch specific directions are considered. Precautions should be taken that any part that carries high voltage and can be touched should be shielded. This is important with both the ESD Generator and the object under test.

While using the ESD generators it *must be* made sure that the ground / earth connection is fastened at the generators ground and connected to earth potential.

It is not allowed to use the tripod connector for grounding!

The tests with the SESD generator on test specimens shall be carried out by a qualified electrician as defined in DIN 570105 / VDE 0105 part 1 or VBG 4. Care must be taken to ensure that the power supply unit is operated only with the appropriate protective grounded sockets; the breaking of the grounding connection is not permitted. The housing and the grounding jack are connected to the protective conductor of the mains. Attention is drawn to the observance of the accident prevention regulations "Electrical systems and equipment" (VBG1 and VBG2) with implementing instructions.

The absence of a protective earth connection presents **a danger to the user** and can also destroy the power supply of the ESD generator. **Damage to the power supply due to lack of protective earth is not covered by the warranty.**

The ESD generators SESD 216 and SESD 230 are according to its specifications designed only for laboratory use in the industrial surrounding (tests in a Faraday's cage).

1.2 Safety

If the unit has visible damage so that a safe operation is no longer possible, it has to be set out of operation. It has to be ensured against unauthorized usage. The unit has to be sent immediately to the manufacture / dealer with a description of the damage!

We warn from untrained staff opening the unit. There is high voltage inside EVEN WHEN SWITCHED OFF. The warranty will be void if the unit is opened.

2 Introduction

The test generators SESD 216 / SESD 230 simulate "Electrostatic Discharge" as defined in the standard IEC /EN 61000-4-2. The standard defines two test modes:

a) Air Discharge

The discharge electrode with the domed point should first be connected to the SESD. The high voltage discharge of the generator is into an air gap. The very short rise time of each single pulse generates a wide RF spectrum and interference's. This can be the reason for an influenced EUT.

b) Contact Discharge

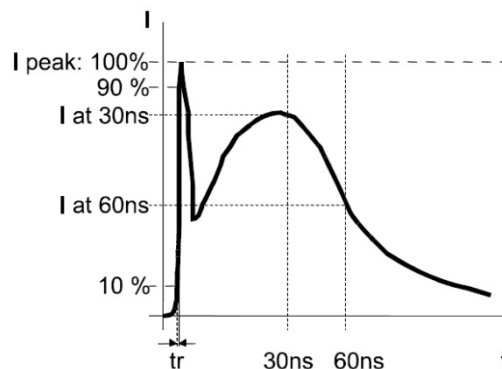
The discharge electrode with a sharp point is connected to the EUT. The discharge switch is operated by a vacuum relay allowing a better reproduction of the test results.

If the probe is not in electrical contact with the EUT (e.g. varnished or oxidized surfaces) there will be no triggering of impulses. The display will show "NO contact". This feature makes sure that a discharge took place in the contact discharge mode

Important! The approach at air discharge has to be started from a distance of at least 20 cm, otherwise there is the danger of multiple discharge at the single shot mode (discharge voltage can't rise high enough and is recharged).

You can use the generator either with the built in batteries or with the mains operated power supply. Automatic tests can be programmed and are easy to activate.

3 ESD - Definition



Drawing 1

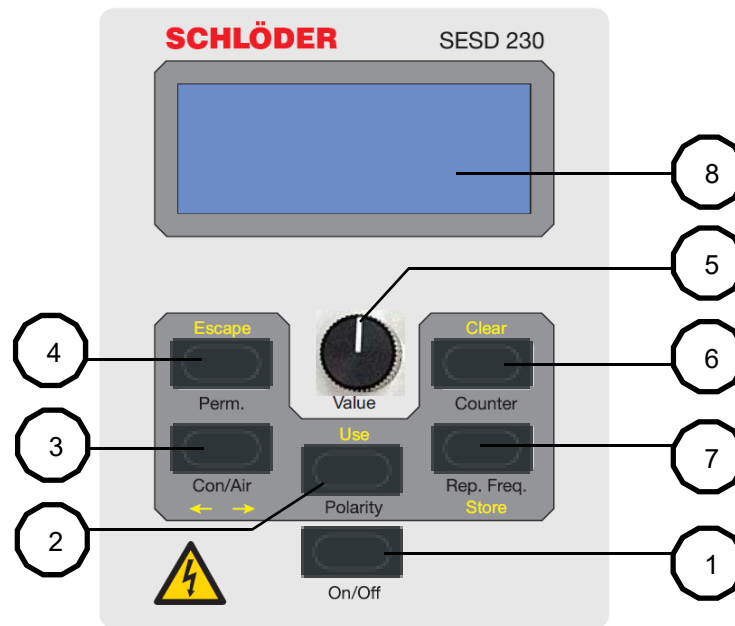
Test level	Test voltage Air discharge	Test voltage Con discharge	Rise time CON ($\pm 25\%$)	1. peak current ($\pm 15\%$)	Current 30 ns ($\pm 30\%$)	Current 60 ns ($\pm 30\%$)
1	2 kV	2 kV	0,8 ns	7,5 A	4 A	2 A
2	4 kV	4 kV	0,8 ns	15,0 A	8 A	4 A
3	8 kV	6 kV	0,8 ns	22,5 A	12 A	6 A
4	15 kV	8 kV	0,8 ns	30,0 A	16 A	8 A
X*	special	special				

* Level "X" is an open level.

Table 1: Severity level and waveform parameters at contact discharge

4 Unit function

4.1 Front panel function



Nr.	Normal Mode		Setup Mode	
1	On / Off	ON / OFF switch		ON / OFF switch
2	Polarity	Polarity of the pulse, positive and negative	Use	Use the adjusted parameters
3	Con/Air	Mode CON / AIR Contact discharge or air discharge	← →	Selection of various parameters
4	Perm	Selection test level, Continuous mode and Setup - Mode	Escape	Back without saving the adjusted parameters
5	Value	Potentiometer for output voltage adjust	Value	Adjustment test level 1 – 4 and pre-selection parameters
6	Counter	Counter pre-selectable	Clear	Clear of the setup values
7	Rep. Freq.	Repetition frequency	Store	Store of the setup values
8	LCD Display	4 lines		

4.2 Case

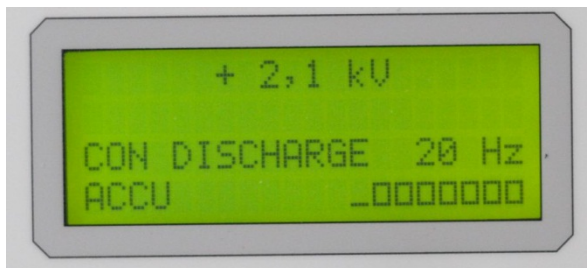


Drawing 2

5 Description of function

5.1 ON / OFF - switch

After switching on the generator, the LCD display shows the last used parameters. The bottom line shows the charge status of the accumulator (drawing 3). The accumulator should be charged if the bottom line shows two boxes only. An operation of the generator during the charging process is possible at any time. In accumulator mode the generator should be switched off after usage.



Drawing 3

5.2 Output voltage adjust

With the potentiometer [5] the output voltage amplitude can be adjust in a range of:

SESD 216	$\pm 0,2 \text{ kV}$ to $\pm 16,5 \text{ kV}$	AIR discharge
	$\pm 0,2 \text{ kV}$ to $\pm 10,0 \text{ kV}$	Contact discharge
SESD 230	$\pm 0,5 \text{ kV}$ to $\pm 30,0 \text{ kV}$	AIR discharge and Contact discharge

The voltage value is shown in the upper line of the LCD display. The voltage can be changed in steps of 100 Volts by turning the potentiometer slowly. Turning the potentiometer fast will increase the voltage steps.

On the left hand of the voltage display the respective test level "L1" to "L4" is shown

5.3 Polarity

The standard defines that the electrostatic discharges have to be done in positive (+) and negative (-) polarity. The display shows the chosen polarity on the left hand of the voltage value, "+" or "-".

5.4 Mode CON / AIR

With this key the test mode can be changed between Contact discharge and Air discharge. While pressing the key the display shows in the third line the information "CON DISCHARGE" or "AIR DISCHARGE". Simultaneously the admissible voltage ranges are changed - see point [5.2].

Make sure that the right test tips are connected to the generator - air discharge "round" and contact discharge "sharp".

5.4.1 Special function - contact control at CON

If the test mode is set to "CON" the triggering can only be detected if the serial resistance in the test circuit is lower than 4 MΩ. In other cases the display shows "NO CONTACT".

At the level < 1,0 kV (SESD 216) or < 1,5 kV (SESD 230) the display doesn't show "NO CONTACT". At these levels the discharge occur even if the serial resistance is lower than 4 MΩ.

Switch OFF contact control at CON

If you don't want the special function "CM (Contact Mode)", you can "switch OFF" and "switch ON" the function as below:

Switch OFF the ESD generator. Now press and hold the buttons [Perm], [Polarity] and [Counter] and switch on the generator by pressing the button [ON/OFF]. The bottom line shows on the left side CM = ON. With the button Con/Air [3] you can select between ON and OF. With the button „Perm“ [4] = „Escape“ you leave this menu and goes to the normal mode

5.4.2 Special function – displaying of the real discharge voltage at AIR mode

In the test mode "AIR" and "Single" the "real discharge voltage" can be shown in the display.

After the discharge and hold-on the trigger button [9] the voltage in the display changes from the adjusted voltage to the real discharge voltage. This voltage is shown as sparkled information.

Example:

Adjusted voltage: 12.0 kV -> after the discharge the value 9.7 kV is flashing.

That means the value 9.7 kV is the actual discharging voltage a is the difference between the value of the adjusted voltage (12.0 kV) and the residual voltage on the capacitor (2.3 kV).

5.5 Repetition frequency

By pressing the button „Rep. Freq.“ [7], the following repetition frequencies (shown on the right hand in the third line of the display) can be chosen:

Air discharge: SINGLE or REP (single pulse or repeat).

Contact discharge: SINGLE, 0,1 Hz; 0,2 Hz; 1 Hz; 2 Hz; 5 Hz; 10 Hz or 20 Hz.

5.6 Counter Mode

5.6.1 Standard „Counter – Mode“

After pressing the button „Counter“ [6] the display shows in the first and second line

"COUNTER SET"
C: XXXX

The last selected value appears, e.g. C: 140. Using the potentiometer [5] the values can be changed from C: 00 up to C: 9999. After pressing the button „Counter“ [6] again the displayed value is stored in the pre-select counter.

For example the second line shows **C: 140/ 140**

Now you can start the test by pressing the trigger button [12]. Depending of the adjusted repetition frequency the counter counts down the first value of the displayed 140/ 140.

The second value will never change. It shows always the adjusted total number of pulses. When the counter counts to zero "00", no discharge is possible. After releasing the trigger button, the display show again the originally value, e.g. C: 140/ 140.

A further test with is possible by pressing the trigger button again. The test voltage can change every time.

To change the counter adjustment, press the button „Counter“ [6] to go into the „Counter Set-Program“. Now you can change the values.

For further usage of the generator, the pre-select counter must either be programmed again or cleared. By pressing and holding button [6] for > 1 sec the pre-select counter will be cleared after the key is released.

5.6.2 Polarity changing during the „Counter-Mode“

In the standard mode the ESD pulse discharge positive „+“ or negative „-“. The display shows:

+ 6,5 kV
C: 140/ 140

By using the counter mode it is possible to change the polarity after half of the nominal discharges happened:

Activate the „Counter“ mode with button [6]. On the right side in the second line the last selection is shown. Push the button „Polarity“ [2]. Behind the letter „C“ the symbols + - or - +. Was the polarity before adjust „positive“, you see +-. Was the polarity before adjust „negative“, you see -+. By pressing the button „Counter“ [6] the display show:

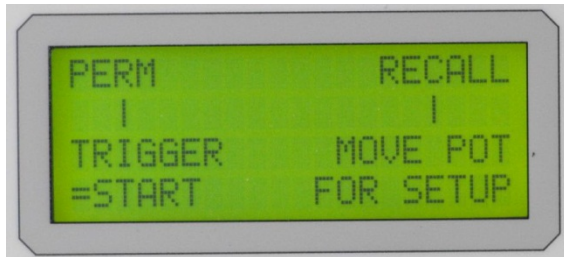
+ 6,5 kV		or	- 6,5 kV
C: + - 140/ 140			C: - + 140/ 140

With this adjustment and pressing the trigger button the counter counts down and changes the polarity after the half of the adjusted discharges happened (70 in our example)

5.7 Continuous discharge

At longer tests or by using the tripod it is useful to work in automatic mode.

Switch on: Push button "Perm." [4]. The display show the picture below. Push the trigger button [12] and release it. The function "continuous discharge" is activated. The display shows in the first line „Perm“.



Switch off: Press the trigger button [12] – the function "continuous discharge" is stopped.

The function "continuous discharge" is always possible – in a normal mode and in the counter mode. Simply press the button „Perm“ [4] and the trigger button [12]. In the counter mode the information „Perm“ is also displayed.

Information:

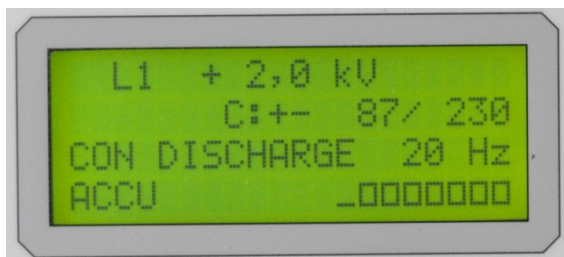
Regarding the function „RECALL → MOVE POT FOR SETUP“ please see chapter 6 and 7.

5.8 LCD - Display

The upper line of the display shows the test voltage in kV and polarity. The second line is empty. In the counter mode – see chapter 5.6 – the display shows the quantity of discharged pulses.

The left side of the third line gives information about the test mode (CON / AIR), the right side shows the selected repetition frequency.

The bottom line informs about the status of the accumulator charge. The accumulator should be charged if the display shows two squares only.



Special information " * " and " _ " :

The " * " - sign in the left hand side of the upper line signifies "Attention! High Voltage" at the test tip. The information is displayed as long as the trigger button [12] is pressed. After releasing the button [12] the sign " _ " appears for two or three seconds. During this time the high voltage is discharged internally. While the symbol " _ " is displayed, you should not try to change the test tips.

5.9 Trigger button

With the button [12] the discharge is released. There are also special functions that are shown in previous chapters.

5.10 Discharge return cable

The discharge return cable has to be connected to the ground connector [11]. The other end has to be connected to ground, either to the ground plane of the test bay or directly to the EUT

5.11 Discharge electrodes CON / AIR

Attention ! Before the discharge electrodes are changed, please switch the generator off and wait for two or three seconds to allow the high voltages to be internally discharged

The discharge electrodes can be changed simply by pull and insert. Please use the correct electrodes according to the test modes – “sharp” for CON, “round” for AIR.

5.12 Power supply

The generator is connected to the power supply via the socket [13]. The ESD generator can be used either independently, using the built in batteries or while connected to the mains supply.

After the charging of the accumulator (the charge line is than showing full on the display), the power supply can be removed and the testing can go on with the accumulator only.

The charging of the accumulator can be interrupted at any time in case the power supply cord is hindering the use of the generator.

The default usage of the generator is in the accumulator-supply

The power supply can be used in a wide range of voltage (85 V to 264 V) and frequency (47 Hz to 63 Hz).

5.13 Display the accumulator charge

The ESD generator has a Lithium-Ion accumulator. A special electronic is responsible to control and charge the batteries.

During the charging of the accumulator the display shows in the bottom line:

LINE CHARGE _ _ _ _ _ □□□

The continuous under lines shows the charge function. During the charging the ESD generator can be used without restrictions.

In case the generator is switched off during the charging, the display continuously shows the charging procedure.

5.13.1 Note for internal battery:

The generator is equipped with a high-quality lithium-ion battery. This battery has a long lifetime and is designed for several hundred charging cycles. However, the battery shall never be deeply discharged. For this reason the generator is switched off automatically at a certain minimum voltage and only a small technically related leakage current of approx. 100 µA flows. This however has the consequence that, after a certain time, the self-discharge of the battery would still cause the deep discharge. For safety reasons, a deeply discharged battery will be protected permanently from further charging by an internal protection circuit and thus must be replaced by the manufacturer.

To prevent this from occurring, the user has to ensure that, when not using the generator, the battery has always to be charged previously. We recommend in addition the check the charge level at least every 8 weeks and reload in case of need.

5.14 Connector for a tripod

Normal tripods can be used for continuous testing. The continuous discharge is explained in chapter 5.7

5.15 Adjust the contrast of the LCD - Displays

Switch OFF the ESD generator. Press the [Rep. Req.] button [7] and hold down, then press shortly the "ON / OFF" button. The display shows "ADJUSTMENT OF CONTRAST". With the potentiometer [5] the contrast can be changed. By pressing the button [Rep. Freq.] again, the new parameters are saved.

5.16 Serial number

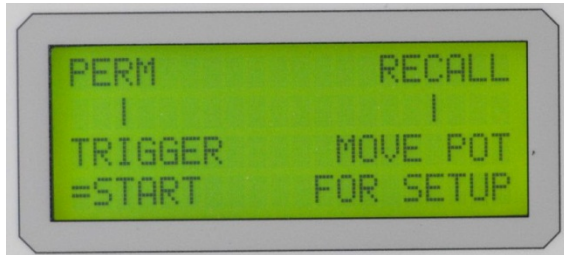
Each ESD generator has a serial number written into the software. You can display the number on the LCD display as follows:

Switch OFF the ESD generator. Press and hold down the buttons [Perm], [Polarity] and [Counter], then press shortly the "ON/OFF" button. The display shows now the serial number in the upper line on the right side. This will be displayed for some seconds

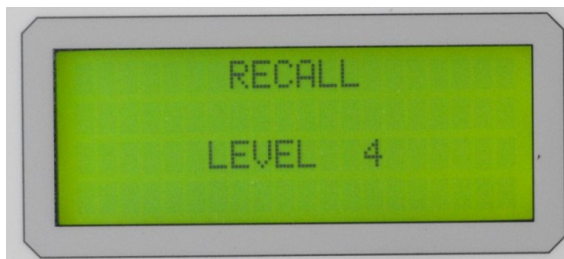
6 RECALL – Test levels 1 – 4 according to IEC/EN 61000-4-2

6.1 Activation of the function

Push button „Perm“ [4], the display shows:



Turn the potentiometer [5] to left for activating the test level according to the standard. Successively the test level 4, 3, 2, 1 are displayed. Turn the potentiometer to right, the test level are displayed increasing.

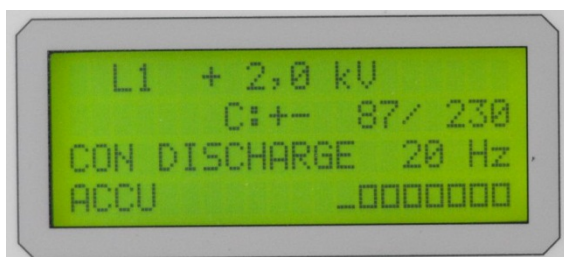


By selecting test level 4 and pressing the key „Polarity“ [5] the test parameters according the standard level 4 will displayed.

A test can be started directly by pressing the trigger button [12]. The adjustment can be changed at any time. The basic parameters of the test levels cannot be changed.

6.2 Standard test in Counter mode

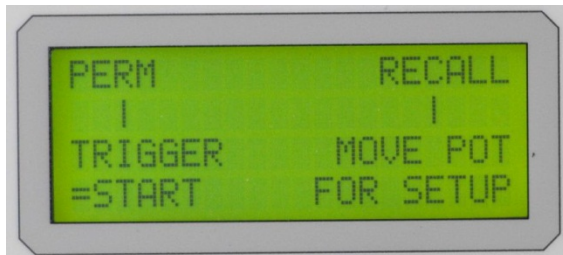
Press button „Perm“ [4] and follow the instruction in chapter 6.1 and set the parameters in the display. Now press button „Counter“ [6] and adjust the quantity of the discharge pulses – see chapter 5.6 “Counter Mode”.



7 Setups - Function

7.1 Activation of the function

After pressing the button „Perm“ [4] the display shows the picture below:

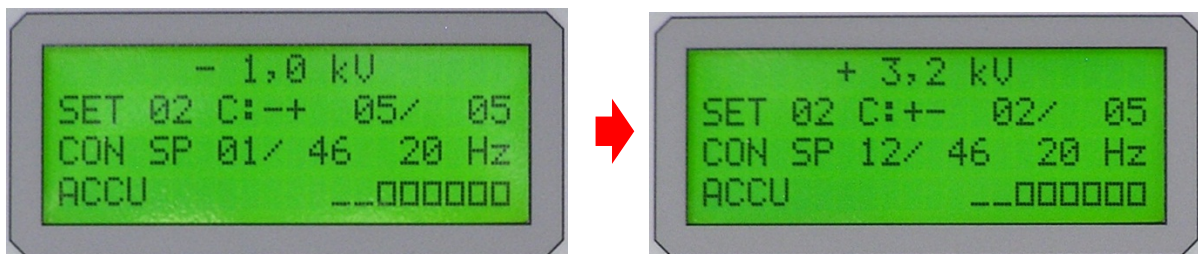


Turn the potentiometer [5] to right for activating several setups. Successively the setups SET 01, SET 02 and so on are displayed. There are maximum 20 setups possible. The picture below shows an example with SET 01.



7.2 Automatic test

After selecting the appropriate setup program - e.g. SET 02 - the stored values are transferred to the display by means of the "Polarity" button [2] - see the following example:



In addition to the usual view, the display shows SET 02 in the second line on the left and the total number of test steps (SP) in the third line next to "CON". The number of test steps "SP" is a calculatory value which results from the parameters initial voltage (STA), final voltage (END) and step size (STE). In the example shown, there are a total of 46 steps, with five ESD discharges per step.

The total test time depends on the selected repetition frequency.
The automatic test procedure is started by means of the release button [12].

7.3 Programming the automatic tests

After activating the setup function - chapter 7.1 - select a memory location that you want to program. In principle, existing memory locations SET 01 - SET 20 can be overwritten or, if not yet occupied, rewritten. All 20 memory locations are numbered, these numbers - SET 01 to SET 20 - cannot be changed.

The 5 buttons and the potentiometer are double assigned. In setup mode they get another function.

Nr.	Normal Mode		Setup Mode	
2	Polarity	Polarity of the pulse, positive and negative	Use	Take over the adjusted parameters
3	Con/Air	Mode CON / AIR Contact discharge or air discharge	← →	Selection of parameters
4	Perm	Selection test level, Continuous mode and Setup - Mode	Escape	Back without saving the adjusted parameters
5	Value	Potentiometer for output voltage adjust	Value	Adjustment test level 1 – 4 and Setup
6	Counter	Counter pre-selectable	Clear	Clear of the setup values
7	Rep. Freq.	Repetition frequency	Store	Store of the setup values
8	LCD Display	4 lines		

7.3.1 Input parameter

The example describes programming an empty memory location - e.g. SET 10.

To the right of "SET 10" is an arrow (arrow on the left). This arrow marks the position of the input fields. The arrow can be "felt through" to any position using the "Con / Air" button. Values on the individual positions can be adjusted with the aid of the potentiometer.

Example:

- MOD The rotation of the potentiometers causes the indication AIR or CON. Similarly some parameters are activated, depending on the choice AIR or CON.
- REP The repetition frequencies are stored and can be selected.
- POL Choice the polarity
- SPA The arrow points to the right, the „Starting voltage“ can be set.
- STE Enter the „voltage step“ or „voltage jump“.
- END Entering the „final voltage“ or the maximum test voltage.
- NBSTEP „Number of steps“ – indicating the number of test pulses per increment.
Depending on the voltage swing (beginning and end) and the step size results in a maximum possible number of discharges per step. A higher number cannot be set.

7.3.2 Store the input

If all settings have been made as described under 7.3.1, these values can be saved. Using the "Rep. Freq." [7] all parameters are saved. The display briefly shows the message "Writing Data - READY".

If a test is to be carried out immediately with the newly entered values, the data is transferred to the display by means of the "Polarity" key [2]. Start with the trigger button [12].

By pressing the Perm button [4] twice, you return to the normal setting menu.

7.3.3 Clear entry

If the entries of a memory location are to be deleted, proceed as follows:

Select the appropriate memory location - e.g. SET 10.

Press the "Counter" key. A security prompt prevents memory from being erased by accidentally pressing a key twice. The display shows:

CLEAR SETUP 10?

COUNTER = NO

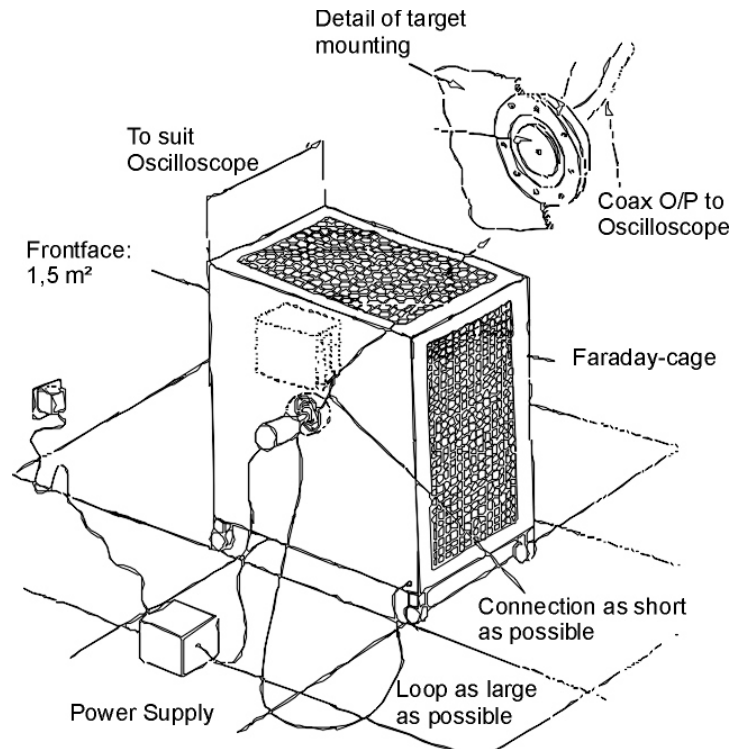
REP.FREQ. = YES

With the confirmation YES = Rep. Freq. If the data is deleted in setup 10, only dashes will appear - - -.

No data is changed with NO = Counter, you get back to the setup menu 10.

8 Calibration

8.1 Test equipment for the calibration procedure



Drawing 4

8.2 Checking the ESD-pulse

The waveform of the output current must be verified with an oscilloscope with a minimum bandwidth of 2 GHz. The test setup should correspond to the picture in 8.1. Details of the structure can be found in the standard IEC 61000-4-2 / EN 61000-4-2 - ESD measuring target.

The critical parameters such as rise time and pulse width are defined by standards with a tolerance of $\pm 25\%$ and $\pm 30\%$.

Therefore we recommend a calibration every two years !!

9 Test setup

The correct test setup can be found in the standard:

- | | | |
|----|------------|---------------|
| a) | Industrial | IEC 61000-4-2 |
| | | EN 61000-4-2 |
| b) | Automotive | ISO 10605 |

10 Technical data

10.1 Generator

Output voltage	adjustable in 100 V-steps
• SESD 216 Air discharge AIR	$\pm 0,2 \text{ kV to } \pm 16,5 \text{ kV}$
Contact discharge CON	$\pm 0,2 \text{ kV to } \pm 10,0 \text{ kV}$
• SESD 230 Air discharge AIR	$\pm 0,5 \text{ kV to } \pm 30,0 \text{ kV}$
Contact discharge CON	$\pm 0,5 \text{ kV to } \pm 30,0 \text{ kV}$
Polarity	Positive and negative
Mode	Air- and Contact discharge
Mode of operation	Single and continuous
Repetition frequency	AIR: Single pulse or repeated CON: Single, 0,1 Hz; 0,2 Hz; 1 Hz, 2 Hz, 5 Hz, 10 Hz, 20 Hz
Counter pre-selectable	1 – 9999
Contrast of the LCD display	adjustable
Operation temperature	0 - 40 ° Celsius
Relative humidity	0 - 60 %
Weight of the generators	SESD 216: app. 1300 g SESD 230: app. 1400 g

10.2 Air - / Contact discharge

Discharge electrodes	according IEC / EN 61000-4-2 AIR: 1 x 8mm round CON: 1 x sharp
Energy storage capacitance	150 pF +/- 10 %
Discharge resistance	330 Ω +/- 5 %
Waveform of the discharge current	acc. IEC / EN 61000-4-2
Rise time at Contact discharge	0,8 ns +/- 25% (0,6 to 1,0 ns)

10.3 Power supply

Supply voltage IN	100 -240 VAC / 47 – 63 Hz
Supply voltage OUT	9 VDC / 3 A
Weight	app. 200 g
Accumulator into the generator	Li-Ionen; 7.2 V; 14,04 Wh / 1,95 Ah

11 Scope of delivery

- ESD Generator
- Power supply with special charge cable
- Discharge return cable 2m long
- Test tip for Contact discharge - „sharp“
- Test tip for Air discharge - „round“
- Operation manual
- Transportation case



12 Additional

- SESD 3025 Test tip, 30 mm diameter, for Air discharge > 15 kV
- SESD 3026 Test tip, 50 mm long with spring contact, for Contact discharge
- SESD 271 VCP – vertical coupling plate incl. Earth cable (2 x 470 kOhm)
- SESD 272 Earth cable set incl. 2 x 470 kOhm resistor, 2m long
- SESD 8800-4 ESD Verification Set 2 Ohm (4 GHz) for verification the ESD pulse (With PTB – Certificate)
- SESD 30 S100 Optical set and remote software

13 Block schematic diagram

