NSG 439/NSG 439A ESD SIMULATOR FOR ROBOTIC SOLUTION

USER MANUAL

601-271C

TESEQ

Advanced Test Solutions for EMC

NSG 439/NSG 439A ESD SIMULATOR FOR ROBOTIC SOLUTION

USER MANUAL

CONTENTS

1 EXPLANATION OF THE SYMBOLS USED IN THIS MANUAL

Please take note of the following explanations of the symbols used in order to achieve the optimum benefit from this manual and to ensure safety during operation of the equipment.

The following symbol draws your attention to a circumstance where non-observation of the warning could lead to inconvenience or impairment in the performance.

Example:

→ **This connection must not be confused with the main power input.**

The following symbol draws your attention to a circumstance where non-observation of the warning could lead to component damage or danger to the operating personnel.

Example:

! **Never connect or disconnect the pistol while system is performing a test.**

Symbols used on the product:

Danger high voltage

Protective earth terminal

Attention refer to manual

2 SAFETY

This item of equipment, together with its accessories, works at high voltages of up to 30 kV. Any careless handling or non-observance of the operating instructions can have dangerous consequences.

The NSG 439 simulator is not a toy! It is a professional tool and belongs only in the hands of specialists and appropriately trained personnel.

When powered by its own batteries the simulator can be active even without any power cable being connected.

The instrument must not be switched on unless a correctly connected earth or earth cable (pulse current return path) is in place. The original earth cable supplied with the instrument is to be used. Any replacement cables must be fabricated in such a way that they cannot be accidentally connected to a mains outlet socket. Do not touch the test finger! There is a danger of an unpleasant electric shock if the instrument is switched on (LC-display active).

Only trained personnel may operate the instrument.

Personnel fitted with a heart-pacemaker must not operate the instrument nor approach the test rig while it is in operation.

These operating instructions form an integral part of the instrument and must be available to the operating personnel at all times.

The instrument must not be used for any purpose other than testing the ESD immunity of electronic equipment.

Since the purpose of the simulator is to generate electrostatic discharges, the spark over caused by a discharge is not designed for use in an explosive environment. However, the simulator itself may resist forces caused by small flare-up.

Each electrostatic discharge produces powerful electromagnetic interference.

Nearby electronic equipment can be seriously disrupted unless the appropriate counter-measures are taken. Perform ESD tests preferably in a shielded room.

If a network needs to be exchanged, the test has to be stopped first, followed by a waiting time of at least 5 s to ensure the voltage being internally discharged.

The rechargeable batteries in the base station must not be short-circuited under any circumstances. They must only be recharged with the original charging unit supplied with the simulator. Should they have to be replaced, kindly observe the relevant recommendations for their correct disposal.

The instrument must not be opened. Repairs, maintenance work and internal adjustments are only to be carried out by a qualified service engineer.

Use the instrument only in dry surroundings. Any condensation that occurs must be allowed to evaporate before putting the simulator into operation. Long periods of exposure to sunlight and excessive warming by external energy sources are to be avoided.

Do not continue to use the instrument should any mechanical damage occur. The instrument's housing and the cable have both an insulating and a screening function, which can only be assured while the housing is intact. Return a damaged simulator to a Teseq service centre immediately for repair.

Teseq AG Luterbach, Switzerland and the associated sales organization accept no responsibility for personal or material damage nor for any consequential damage that results from irresponsible operation of this instrument.

3 INTRODUCTION

Under appropriate ambient conditions, both material objects and even the human body itself can become charged with electrical energy. This effect is due to «electrostatics», a phenomenon that has been known since the earliest times. Thales von Milet (600 BC) noticed how amber attracted very light particles when it was rubbed. Touching a charged item against a conductive object leads to a charge equalization through a spark discharge, which produces a brief but powerful electromagnetic field.

3.1. Electrostatic discharge (ESD)

This effect can be explained as follows: Two insulating substances with differing dielectric constants become charged when rubbed together, i.e. one material gives electrons to the other one. This effect is known as electrostatic charging. The same can happen to a person. When somebody walks around in a dry atmosphere on carpet while wearing shoes with good insulating properties, a charge of several thousand volts can be built up. If, now, that person comes close to a conductive surface, the charge that he or she is carrying flows away through a hefty spark discharge.

The high equalizing current that flows, and the associated large electromagnetic field that hence results, can cause electronic devices (computers, terminals, process controllers, vehicle electronics, solid state devices, credit or memory cards, etc.) to malfunction or even be destroyed.

3.2. Simulation

A systematic investigation of electronic equipment and installations to determine their electromagnetic compatibility (EMC) is, today, a necessity if one is not prepared to suffer the economic disadvantages that could otherwise ensue. As a logical consequence, appropriate testing is now a legal requirement for the sale of electronic products within the EU.

The ESD test plays an important role in the range of interference sensitivity tests. It simulates frequently occurring effects and guides the development engineer to any weak spots in an instrument or item of equipment through a combination of high voltage and high frequency properties.

A simulation device must be constructed such that it reproduces practical conditions realistically. Furthermore, the results obtained (interference sensitivity threshold) must be reproducible.

The interference immunity of an instrument is not only dependent on its construction, it is also largely dependent on the quality or the consistency of the mass production techniques used. Knowing this has led to the demand for individual testing or at least random sample testing.

Further weak spots, which could affect the overall interference immunity, can arise through the assembly of instruments into complete systems because of the installation method used, the cabling and the earthing. An ESD check on systems is therefore also prescribed. Such tests provide valuable information about the immunity of the system to effects that occur only sporadically under operating conditions and hence represent difficult to detect sources of disruption.

The ESD simulator NSG 439 fulfils the requirements of numerous applications in an ideal manner, thus:

Robust housing	To withstand large velocity forces
Operation	Operating via software, however they are manual selectable via touch panel.
Battery-powered	Independence from a mains power feed.
Microprocessor-control	All the functions are «on-board», including a presettable counter, preprogrammed test values, discharge voltage measurement, etc.
Precision	The test parameters are maintained precisely for reliably reproducible tests.

Flexibility	The specifications prescribed in the standards are more than fulfilled in every respect. The instrument also offers many additional handy features.
Safety	The high voltage simulator is automatically deactivated if the instrument remains unused for a period of time.
Application field	Development optimization, type-approval, EMC certification, batch testing (individually), testing of fully installed systems.

3.3. Effects on the EUT

The most significant interference components of an electrostatic discharge are of a high frequency nature. The interference paths and effects have to be assessed in the range from about 30 MHz to multi-GHz.

The extremely rapid rise time of a discharge affects an object under test mostly through:

- magnetic HF-coupling between electrical conductors in the electronics and the discharge current path.

- electrical coupling between the discharge current and signal lines. A discharge current to the EUT flows proportionally through all the associated conductors (earth, mains, data lines, screening, etc.) according to their relative impedance.

Malfunctions in insufficiently immune electronic equipment and systems make themselves apparent through:

- Program crashes
- blocking of command sequences
- incorrect commands, statuses or data being further processed
- partial system resets (e.g. only in peripheral modules, which lead to errors that the system does not recognize)
- disturbance or destruction of interface modules
- destruction of insufficiently protected MOS components.

ESD (electrostatic discharge) testing usually shows up all the weak spots in the HF-range of a piece of equipment simultaneously. The uses to which the NSG 439 ESD simulator can be put hence go way beyond those called for in standard-conform applications.

This instrument provides the engineer with a means to detect sources of error caused by unsuitable earthing, poor ground connections, insulation problems, etc.

The simulator also serves as a reliable aid for localizing hidden wiring faults during acceptance trials on installations.

Use can also be made of the instrument as an insulation tester to determine the breakdown voltage of switches, relay contacts, insulators, etc.

4 THE NSG 439

By using the latest materials, construction methods and manufacturing techniques for the robust housing shell, together with highly insulated modules, the newest high voltage technology, the touch-sensitive operating panel and a control unit built using the SMD technique, it has been possible to integrate all the functions that a comprehensive simulator system should offer into one compact instrument.

As supplied in the basic set, the system is equipped with a 150 pF / 330 Ω discharge network for the IEC/EN 61000-4-2 (2001) standard.

The discharge voltage of up to 30 kV for both air-discharges and contact-discharges ensure a comfortable test margin over and above the levels called for in the standards.

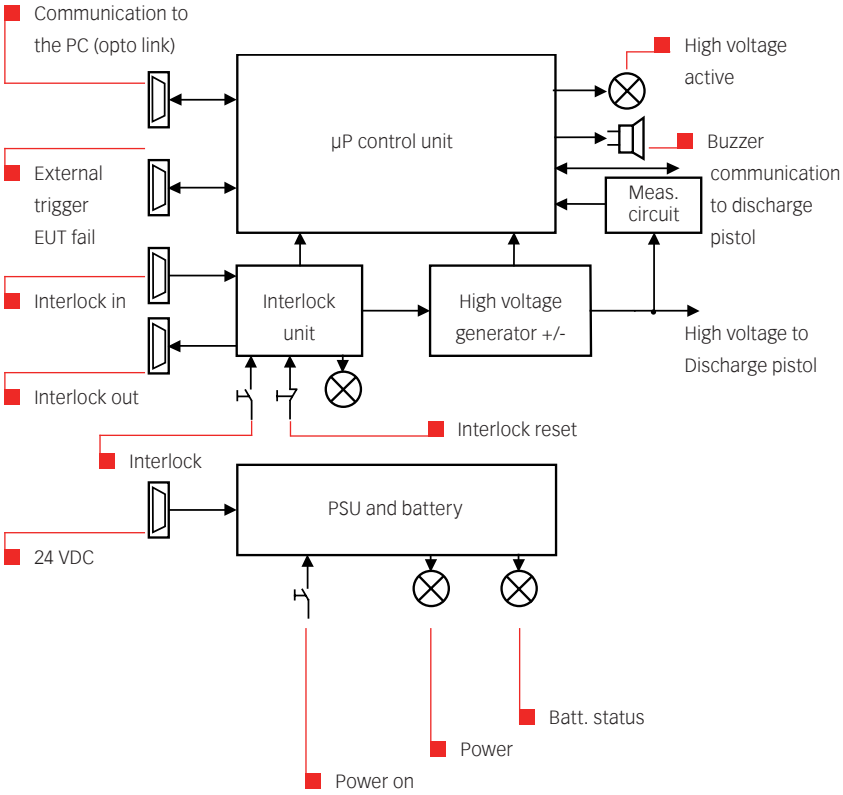
The instrument is well equipped to cope with other (and future) standards. The accessories include various networks and test fingers that can be attached by the user himself.

The basic set contains everything necessary for general use. A rich assortment of accessories for special tasks is available such as a remote triggering unit, further discharge networks, an ergonomically shaped carrying case, a tripod adapter, test fingers, etc.

4.1. The simulator

The pistol houses the interchangeable pulse network, high voltage relay, the exchangeable test finger, measuring electronics and the touch-sensitive input/ display panel.

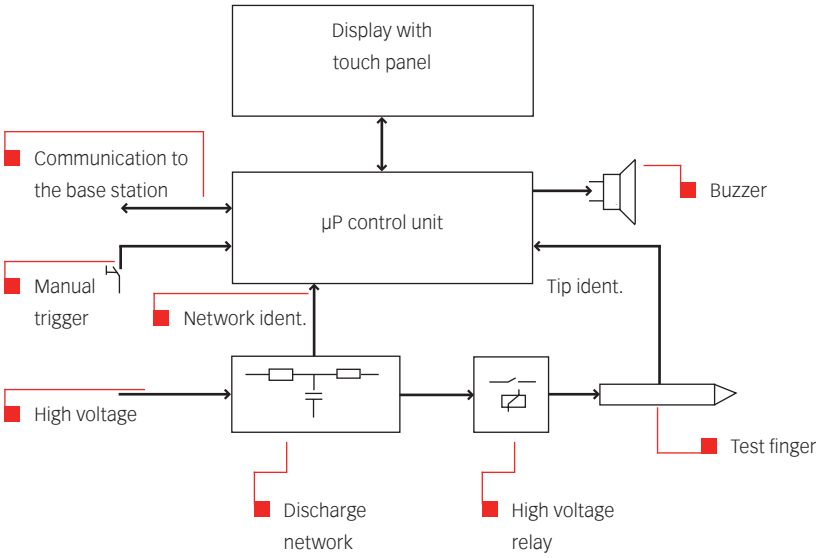
4.1.1. Block diagram



The various function units are shown in the block diagram:

Block diagram of the base station:

Block diagram of the pistol:



The microprocessor controls and monitors all the simulator functions:

- All entries are checked for plausibility. Unacceptable entries are rejected and an acoustic warning notifies the user of the error.
- Values entered are clearly shown on the large display screen. Further information shows the operating status and the counter settings.
- The battery charge state is continuously monitored. The display warns if there is a tendency towards low voltage. The instrument's functions are inhibited once the battery voltage is insufficient to guarantee the pulse parameters.
- High voltage generation is dynamically controlled by the processor. Varying load conditions, supply voltages, etc. can thus be taken into account and have no effect on the pulse parameters.
- The instrument switches itself off automatically if it is not used for a while. The pulse parameters and operating mode remain stored and ready for reuse.

- The charge voltage to the network is kept constant as long as the trigger is active. The high voltage is discharged internally when the trigger is reset.
- If no discharge occurs when set for an air-discharge and the trigger is active, the processor waits for about 30 s then autonomously resets the trigger and discharges the network internally with simultaneous acoustic warning.
- A measurement facility detects an actual valid air-discharge and shows it on the display.
- Pulse triggering is monitored. Once an arc has occurred the network is discharged internally so that no further arcing is possible.

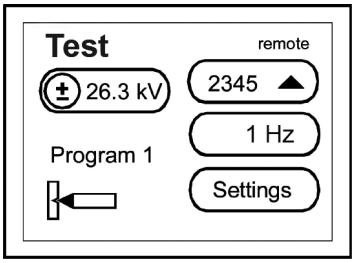
4.1.2. Operating elements

Apart from the trigger button itself (pulse triggering), all the operating elements, test relevant setting and user information are presented on the touch-sensitive display panel facing the operator.

The NSG 439 is switched on and off with the main power switch. The significance of the elements in the display field can be seen in the following picture. Further information can be found in section «operation».

All operations are performed via the touchpanel.

The following display is shown on the panel when the pistol is switched on.



The function of the trigger button on the handgrip depends on the operating mode currently selected:

- As a pulse button in single discharge mode (1 pulse each time it is pressed).
- As an on/off switch in repetitive mode (discharges while button is pressed).
- As a pausing on/off switch in repetitive mode with the preset counter in operation (start the discharges by pressing the button/stop the discharges by pressing the button again).

The remote control facility replicates the action of the trigger button by means of appropriate control signals.

4.2. System components

The basic set is packaged in a practical carrying case and comprises:

- Carrying case
- ESD simulator NSG 439 consisting of a pistol and a base station with a battery power supply
- Discharge network 150 pF/330 Ω / IEC/EN 61000-4-2 (2001)
- 1 test finger each for air and contact discharges
- Battery charger/mains power pack
- Operating instructions

This set contains all the items necessary under normal conditions to conduct tests conforming to the IEC/EN 61000-4-2 (2001) standard.

4.2.1. Battery charger/power supply unit

Power to the instrument is provided through a universal mains unit suitable for input voltages between 80 and 240 VAC. This same unit also serves as a charger for the integral battery pack.

Charging of the battery takes about three hours. At this point a timer switches the charger to a reduced charging current and the indicator lamp changes from red to green.

The battery will also charge up when the instrument is switched off.

A full battery charge will suffice for several days of normal test operation.

Battery life expectancy:

- Ambient temperatures over 50°C can lead to degradation of the battery. If treated carefully, more than 300 charge/discharge cycles can be expected without a noticeable reduction in capacity.
- The charger and battery-pack form a matched entity. The battery must not be charged from any other unit and the charger is to be used exclusively for the intended purpose.

Operating advice:

- Use the equipment only in dry surroundings.
- Recharge the battery about every 6 months even if the instrument is not being used.

4.2.2. Options

A range of additional accessories is available for special applications and for testing to alternative standards:

- Discharge networks and test fingers for other standards
- Fast rise time tip
- Coaxial measurement adapter type MD 101 or MD 103
- Opto link to a PC
- H-field adapter
- Flexible test tips
- Discharge remover

4.2.3. Discharge networks

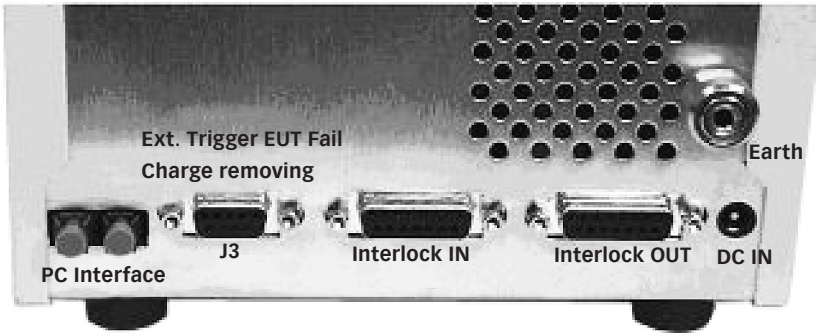
The basic set contains a discharge network and test fingers for conducting tests that conform to IEC/EN 61000-4-2 (2001) alternative networks can be installed for testing in accordance with other standards.

Several networks are given in the orderlist. The C and R values of the discharge network can also be specified for other applications. Networks conforming to other standards can be built upon request. The specifications of the standard must be fully defined.

Exchanging the discharge network is described in section «exchanging the R/C network».

4.2.4. Remote triggering

A remote triggering unit can be connected to operate the NSG 439 inside a Faraday cage with external pulse triggering or for test pulse triggering in synchronism with other conditions.



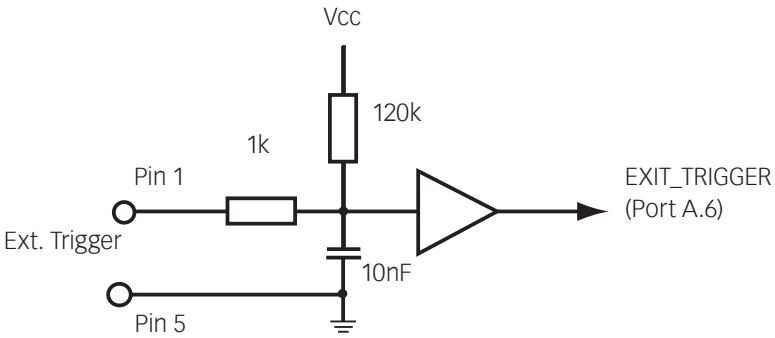
If J3 interface is used, then it has to be make sure that a shielded cable together with a solid shielded connectors has to be plugged.

The shield it self has to be connected to the housing. This to prevent the risk of a ESD hazard of the controller board itself.

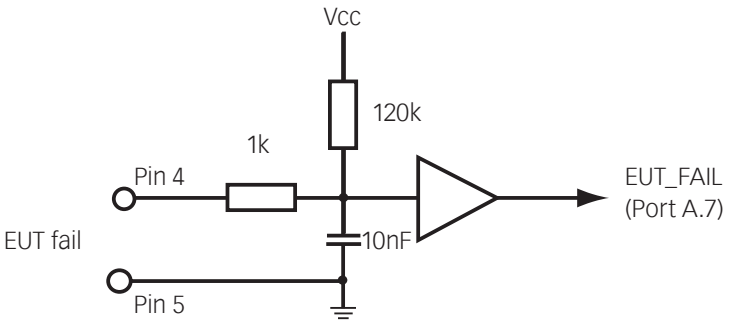
The extended operating function of «Charge Removing» on J3 connector is included in NSG 439 products from serial number 577 (June 2006) upwards. Therefore different pin assignment is given.

Connector J3: Pin assignment >SN 577		
Pin	**Signal name**	**Description**
1	EXT_TRIGGER	External trigger input
2	NC	–
3	NC	–
4	EUT_FAIL	EUT failure input
5	GND	Earth
6	NC	–
7	Charge remove	Charge remove drive output
8	GND	Earth
9	+15 V	Voltage output (max 500 mA)

Ext. Trigger:
The following circuit is built in behind the connector. This function is similar to the function of the yellow trigger knob on the handle.



EUT failure input:
The same circuit is used for the EUT failure input. This function will stop the test procedure.



4.2.5. Interlock

The NSG 439 has an integrated interlock system in keeping with standard practice for high voltage test equipment.

This system has the following functions:

Inputs

1. Input for external monitoring purposes of, for example, special coupling networks and access control.

2. Internal emergency off button opens the interlock.

Outputs

1. Operating mode: the NSG 439 can generate no high voltage as long as the interlock is not closed. High voltage generation is prevented if the interlock is opened during a test procedure.

2. Warning lamps: when the interlock is closed the green lamp is switched off and the red lamp is illuminated.

3. Interlock output for other system devices.

The interlock system is common to all Teseq instruments and hence several devices can be connected together.

The instrument is equipped with two 15-way connectors for interlock input and output. The interlock loop must always be correctly terminated at both ends. In achieving this, the interlock wiring must connect all the safety contacts together.

When using original Teseq accessories this is achieved automatically by using 15-way standard cables wired 1:1 to link the interlock connectors. An arbitrary number of instruments or accessories can be incorporated in this safety concept.

The high voltage supply can only be activated if the safety requirements in all the associated devices are fulfilled (emergency off buttons released, safety contacts closed).

To conform with VDE 0104, the control of the warning lamps must make use of the interlock feature. The instruments can be switched on and the red lamp lights up as soon as the interlock circuit is complete.

The pair of terminating connectors supplied must be utilized in the case of not making use of external interlock contacts.

Signal specifications:	Voltage 48 VDC max. Current 20 mA min., 1 A max.
Connector:	Socket, D-sub. 15-pin
Max. permissible cable length:	3 m each, screened cable (correct operation guaranteed up to 10 m)

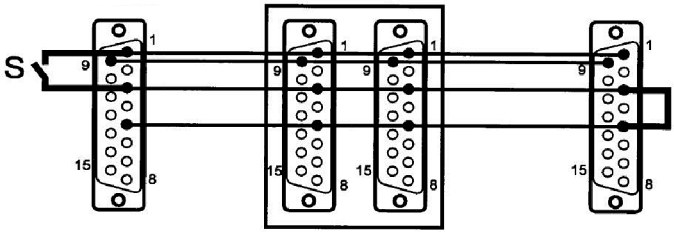
Operation effected via potential-free switch contacts.

All signals are active low, i.e. switched to GND.

The pinout of the interlock input and output connector is identical. All the pins are connected together. The connection to pin 3 is made internally through the emergency off button. This link is broken when the internal interlock is activated.

Pin no.	Function
1	Earth (GND), 0 V
2	NC, linked through to the other interlock socket
3	Interlock input/output (connected inside the instrument)
4	NC, linked through to the other interlock socket
5	Interlock status (trigger the interlock function in the instrument, internal relay from +12 to +48 V)
6	NC, linked through to the other interlock socket
7	NC, linked through to the other interlock socket
8	NC, linked through to the other interlock socket
9	Switches warning lamps and peripherals on (active, provided that NSG 439 is switched from standby to on).
10	NC, linked through to the other interlock socket
11	NC, linked through to the other interlock socket
12	NC, linked through to the other interlock socket
13	NC, linked through to the other interlock socket
14	NC, linked through to the other interlock socket
15	NC, linked through to the other interlock socket
Shell	Screening

Wiring diagram for the interlock system:



S: External safety switch (e.g. test enclosure hood, door contact, panic button, etc...)

Several interlock inputs of this type may be connected in parallel.

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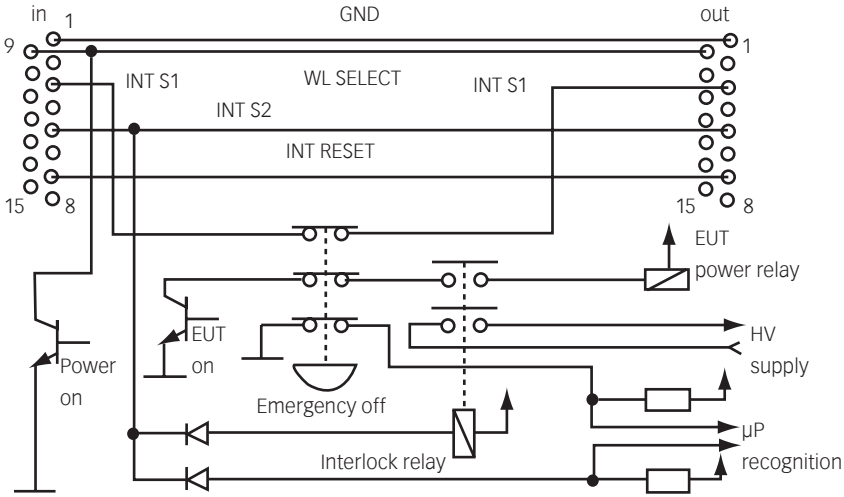
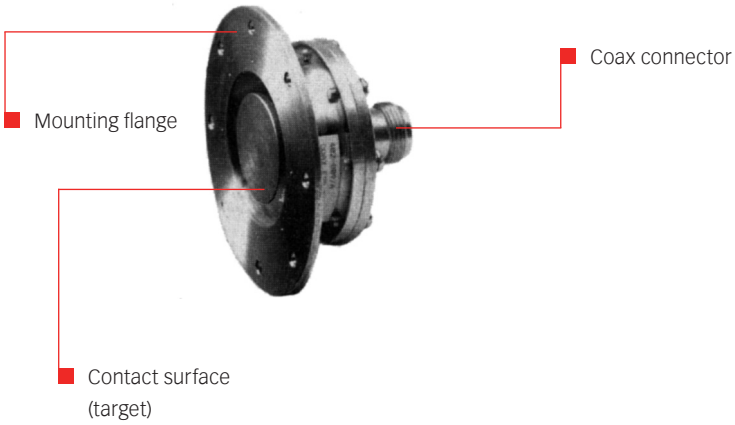
The contacts should be connected in series if numerous access barriers are necessary. Either one open contact or a voltage of more than 1.5 V at the input is sufficient to disable the simulator.



4.2.6. Measurement adapters

The measurement adapter type MD 101 as per IEC/EN 61000-4-2 (2001) serves to verify pulse amplitudes and pulse shapes. It is designed for mounting in the side wall of a Faraday cage in which an oscilloscope has been installed. This measurement adapter has the flat impedance curve to well over 1 GHz that is necessary for the purpose.

Use of this adapter is only worthwhile in conjunction with a test rig that is laid out in strict conformity with the relevant standard (see section «verification of pulse data»).



MD 103 («Pommerenke» target) is a more advanced coaxial measuring target with flat response characteristics up to the multi-GHz range. It may be used instead of MD 101.

MD 103 with INA 103

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5 COMMISSIONING

Immediately upon receipt, check the instrument and the accessories for completeness and look for any transport damage. Damage incurred in transit must be reported to the transportation undertaking without delay.

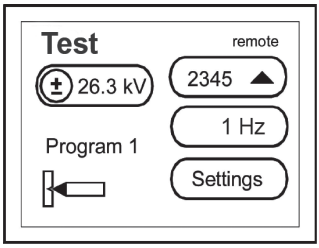
Before putting the instrument into operation:

- Study the manual
- Take the necessary safety precautions
- Charge the battery (see section «battery charger»)
- Plug the interlock terminators into the base station
- Connect the earth cable correctly (the NSG 439 must never be switched on without a solid earth connection being made).
- Allow the instrument to dry out if any condensation has occurred

5.1. Function test

Switch the simulator on with the on/off switch.
The instrument performs audible switching operations for a few moments as it runs through a self-test and calibration procedure.
The instrument is ready for use once the selftest routines have been completed.

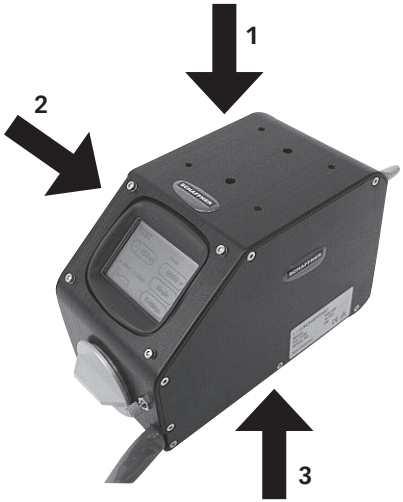
The default display looks like this:



High voltage generation is activated by pushing the trigger button and keeping it depressed.
By bringing the test finger close to the earthing point an arc discharge occurs which is acknowledged acoustically and the display shows the preset discharge voltage in a frame. (This applies under the following conditions: air-discharge, single pulse, preselect counter off).

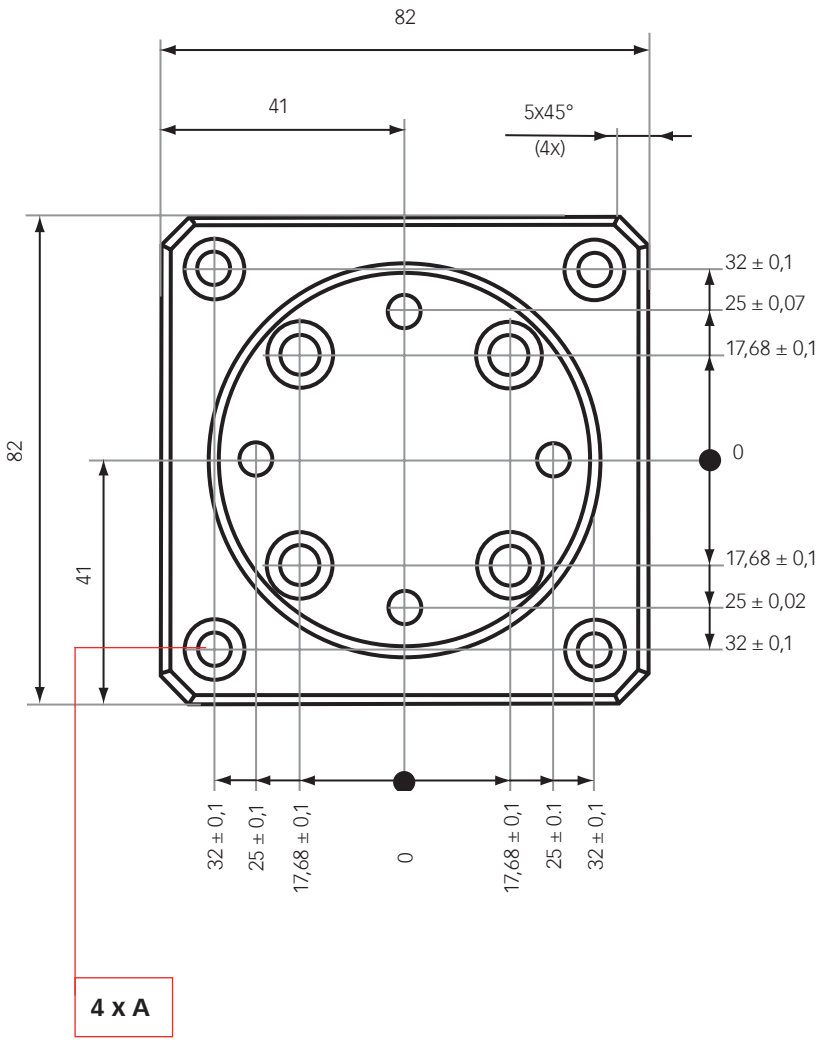
6 MECHANICAL MOUNTING

The mechanical mounting plate to the robot arm can be easily exchanged. There are three possibilities (1, 2, 3) to mount it on the ESD housing itself.



The actual robot adaptor is made for a STÄBLI robot type TX90. The fixture to the ESD housing needs only the four screws, shown in the following picture.

The inner clearance circle with the thread and positioning holes is tailored to the STÄBLI robot.


82
41
5x45°
(4x)
32 ± 0,1
25 ± 0,07
17,68 ± 0,1
0
17,68 ± 0,1
25 ± 0,02
32 ± 0,1
82
41
32 ± 0,1
25 ± 0,1
17,68 ± 0,1
0
17,68 ± 0,1
25 ± 0,1
32 ± 0,1
4 x A

7 OPERATION

This section of the manual provides a guide through the numerous operating possibilities of the NSG 439.

The operation, which is strictly logical and hierarchically arranged, is therefore easy to remember. The display shows unmistakable information about the parameters that have been set and the operating status of the simulator. Equally, the instrument refuses to accept any invalid entries.

It is recommended to carry out the examples directly on the instrument (not forgetting to connect the earth cable!).

7.1. Switching on

Ensure the interlock terminators are plugged into the rear of the base station or otherwise the interlock loop is complete.

Plug the pistol HV connector into the base station and tighten the screws.

Ascertain that the base station as well as the earth cable for the pulse return path are solidly connected to the fixed installation's earth point.

There is a danger of electric shock if this is neglected!

Ensure the emergency power off **button is pulled out.**

Press the **power on** button. The green **power** LED will light up.

Press the **interlock reset** button. The red **interlock** LED will extinguish and the red **high voltage** LED blinks while the pistol runs its self-test and calibration routine.

The instrument is ready for use immediately after self-test and calibration procedures have been completed. High voltage generation is activated by pressing and holding the trigger button. The active high voltage state is indicated on the base station by a blinking red LED.

Should a parameter need changing the operator has only to press on the relevant field in order to call up the appropriate menu.

The value of discharge voltage is displayed following a successful air discharge. A differentiation is made between this and the set value by the display **kV** being inversed. If no valid discharge occurred, the display shows a 0 value. The **threshold** function (see section «threshold») permits various settings for the sensitivity of the breakdown voltage detector.

The effective discharge voltage depends on various factors such as the distance to the discharge point, speed of approach, nature of the EUT, etc.

In the case of a contact discharge this measurement is not carried out since only a discharge current can occur.

The instrument switches itself off automatically after 15 minutes of nonuse.

7.2. Battery monitoring

The battery charge state is monitored continuously. An insufficiently charged or an empty battery is shown on the display.

Recharge the battery soon when this symbol is displayed. Correct operation and valid pulse parameters are still assured.

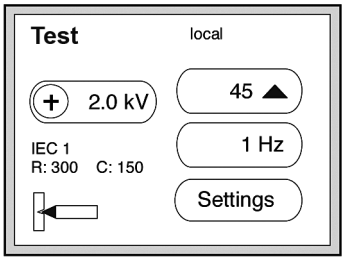
The battery is more or less empty; its capacity is insufficient to maintain all the instrument's functions. An appropriate warning message is shown on the screen and all the instrument's functions are inhibited.

Remark
A full battery will provide sufficient power for several days of normal test usage. The actual operating time depends, of course, to a large extent on the conditions prevailing at the time.

The following figures have been obtained by way of reference:
- Battery freshly charged
- Contact-discharge with 30 kV
- More than 20'000 discharges can be generated

7.3. Operation and settings

The operation of the instrument and all settings are carried out by way of the touchpanel starting from the menu «test». Generally, the following applies:



- Frames symbolize push buttons. Touching these sensitive areas causes a reaction, usually branching into another menu.

- Values and indications that are not in frames are for information only. Pressing the «return» button ⏎ always takes you up one menu level higher.

- A virtual rotary control wheel appears in parameter setting menus. Sensitivity and lent weight are matched to the parameter to be adjusted. Stroking the «wheel» with the finger tip causes it to «rotate» and changes the selected parameter. When you wish to alter the setting for either the voltage or the preselect counter you can let the wheel spinning at different speeds. Activating it energetically will cause it – just like a mechanical one – to run on and thereby set the particular parameter higher or lower correspondingly more quickly.

- Only stroke the portion of the wheel displayed otherwise you might prevent it from running on freely.

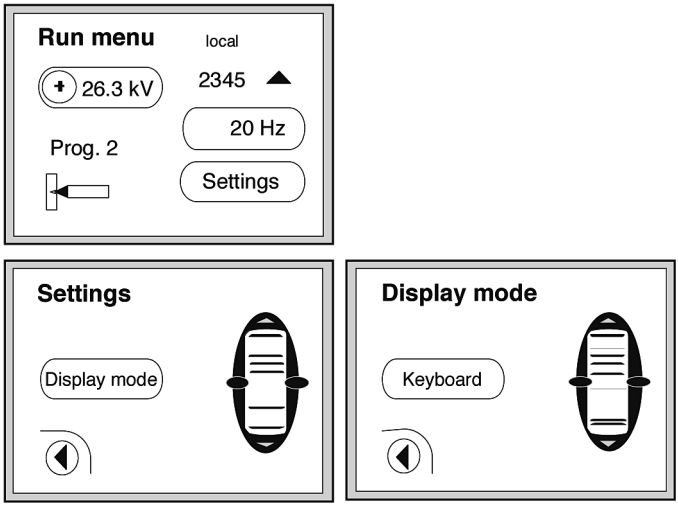
- There are pressure sensitive areas (invisible) at the top and bottom edge of the display associated with the wheel with which you can adjust the relevant parameter by +1 or –1. Try it out. Play with it and you will quickly get the feel of it and how it best functions.

- R/C value shown on main screen for more convenient direct reading.

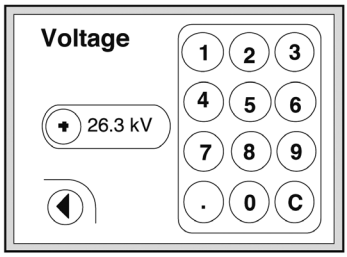
7.3.1. Display mode

An alternative method to the virtual thumb-wheel to control the instrument has been incorporated.

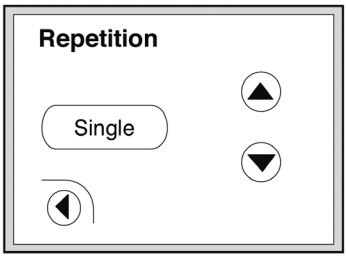
Via the button «settings» and «display mode» a keyboard and up/down buttons can be selected instead of the thumb-wheel.



Numerical values (voltage, preset counter, random repetition times) can be entered just the same as with a pocket calculator.



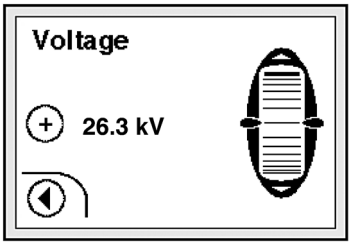
Selection functions (such as language, type of discharge, program number, etc.) are handled by up/down buttons to scroll through the settings.



This extended operating function is included in NSG 439 products from serial number 339 (August 2004) upwards.

7.3.2. Voltage

Touching the voltage indication brings you to the submenu for adjusting the discharge voltage. Set the required value with the wheel and press return.



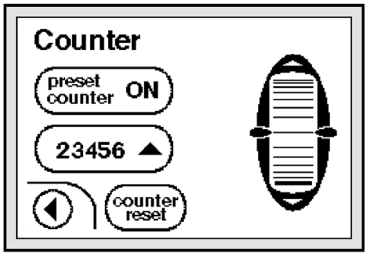
7.3.3. Polarity

Touching the polarity indication brings you into the relevant submenu. Choose between + or – with the wheel. If the preselect counter function is active there is the further option of choosing alternating +/- polarity.

Around the max. voltage range some minor delay for triggering shall have to be expected (fully discharging-changeing-recharging).

7.3.4. Counter

Use the counter button to branch into the corresponding menu. Choose the counter mode: Preset counter on/off. In the on state the counter content can be set by means of the wheel. When the simulator is in operation the preset counter counts down until it reaches 0, which then terminates the selected test sequence.

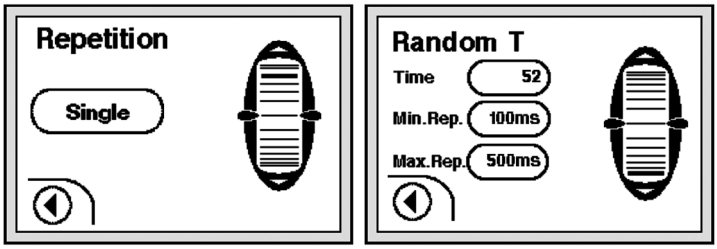


Note: - - - - means continuous operation without any preset counter function. Pressing the trigger button starts the simulator operating; a second press on the same button stops the operation.

Reset counter sets the counter content to 0 or it reloads the preset counter with the previously selected value.

7.3.5. Repetition

The Repetition button takes you into the menu to select either single pulses or a repetition rate from 0.5 to 25 Hz in air-discharge, or from 0.5 to 20 Hz in contact discharge mode.

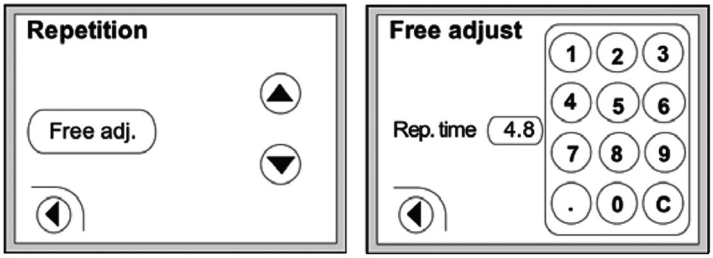


Two further repetition modes are available that trigger pulses with a statistical distribution over a specified period:

Random P: 1 – 9999 pulses are triggered with a statistically distributed repetition rate ranging from a minimum of > 20 ms to a maximum repetition rate of < 2000 ms.

Random T: Pulses are triggered during a period of 1 – 9999 seconds with a statistically distributed repetition rate ranging from a minimum of > 20 ms to a maximum repetition rate of < 2000 ms.

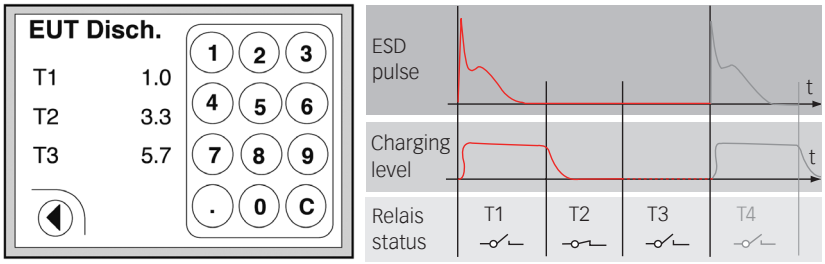
Free adjust: For some specific requirements like R&D jobs or product standards, the pre-stored repetition times provided in Hz may not match all needs. Allows entering values between 0.04 up to 300.00 s in 0.01 s steps.



The «Free adjust» operating function is included in NSG 439 products from serial number 521 (March 2006) upwards.

EUT discharge on NSG 439 A: To remove the charged energy of a EUT, the NSG 439 A has an internal bleed of resistor which can be via internal relay activated. With the time T1, T2 and T3 the charge removing procedure can be flexible programmed. Al time value can be set from 0.1 up to 99 s in 0.1 s step.

EUT discharge on NSG 439: To remove the charged energy of a EUT, an external charge removing box can be connected to the base station and will operate the same way as in the NSG 439 A version.



7.3.6. Settings

This branches into a range of submenus, thus:

7.3.7. Language

Touch the button and choose the language you wish to use with the wheel.

Note: Language looks like this in Japanese: 言 語

7.3.8. Device info

Gives information separately for the pistol and the base station regarding the version of the equipment and its software.

7.3.9. Discharge

Depending on mounted finger tip the sign shows the actual discharge-mode.

Air-discharge: 

or contact-discharge: 

The R/C values for the relevant network are also shown.

The corresponding value is automatically loaded.
The mode can be changed using the up/down buttons to select the desired mode.

Air-discharge	= ball-shaped test finger
Contact-discharge	= sharp point test finger

7.3.10. Threshold

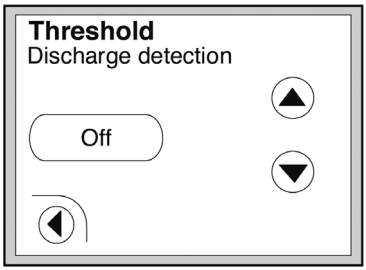
This function permits differing sensitivity levels to be set for the arcing detector whereby a differentiation can be made between stray discharges and a true discharge onto the EUT.

Normal Arcing is detected and is indicated by the **kV** symbol on the display blinking provided 20% (or more) of the charge voltage is dissipated.

Low Arcing is detected and is indicated by the **kV** symbol on the display blinking provided 10% (or more) of the charge voltage is dissipated.

High Arcing is detected and is indicated by the **kV** symbol on the display blinking provided 30% (or more) of the charge voltage is dissipated.

Off This position is made for EUTs with non-conductive surfaces (housings).



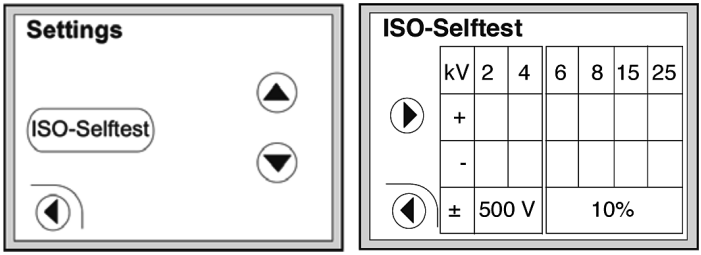
This means in contact-discharge mode, the arcing detection is disregarded and the counter counts up/down as per settings in the repetition or counter menu respectively.

In air-discharges, this feature is available only in single mode. Pushing the trigger once, the HV is activated and the gun is to be approached to the EUT until either an arcing happens or the EUT being touched. Then the trigger needs to be pushed a second time resulting in HV off and increasing/decreasing the counts, depending on counter setting.

The «off» operating function is included in NSG 439 products from serial number 521 (March 2006) upwards.

7.3.11. ISO-Selftest

Just starting the ISO-Selftest gives a quick response of the proper operation of the ESD simulator. The screen reflects all required voltage levels as well as the tolerances in table form, based on the ISO 10605 standard.

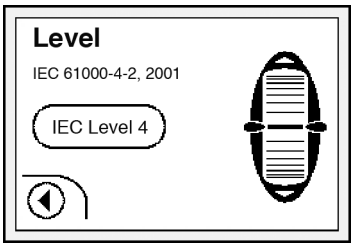


During the calibration procedure the HV module is strained up to 30 kV. If somehow the maximum voltage could not be reached or hold, the NSG 439 come out correctly with an HV error message. The calibration procedure is diagnosing, to which voltage level the HV module will work properly. This voltage value will be shown on screen while it will not be possible to set a higher voltage value.

This extended operating function is included in NSG 439 products from serial number 521 (March 2006) upwards.

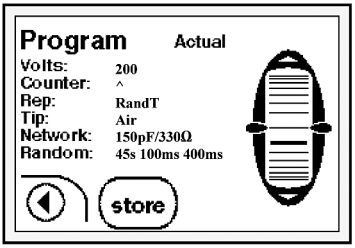
7.3.12 Level

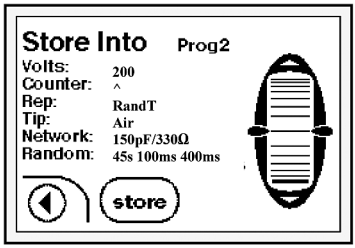
Provides the means to select the required, pre-programmed standard test (e.g. IEC/EN 61000-4-2, level 4).



7.3.13. Program

Shows all the details of the currently selected settings in the «actual» state. These values can be saved in one of the eight memory places by pressing store. Alternatively, a previously saved set of values can be recalled using the wheel in the **actual** program. Touching **return** loads the selection ready for execution.





7.3.14. Trigger button (manual triggered)

This button functions in three ways:

In the **single** discharge mode just one discharge is made each time the button is pressed.

In the **repetitive** mode pulses are generated at the pre-determined rate for as long as the button is pressed.

In the **preset** counter mode pulses start to be generated when the button is pressed and continue until the button is pressed again or until the counter decrements to zero, whichever comes first.

7.3.15. Continuous operation

Continuous operation can be established to produce a repetitive stream of discharges, thus:
Set the preset counter to read - - - - in the counter menu. This enables continuous operation without any intervention by the counter.

Pushing the trigger button starts the continuous operation; pressing it again stops the operation.

- **Continuous operation should only be utilized in cases of real necessity since every ESD radiates electromagnetic disturbance the effect of which on the environment must be taken into consideration.**
- **The test area should be made out of bounds for unauthorized personnel.**
- **The test must be monitored throughout its duration.**
- **When running on batteries alone the duration of the test is naturally limited.**

8 TEST PROCEDURES

Test standards, such as IEC/EN 61000-4-2 (2001) for example, give detailed information about the assembly of the test rig, the associated organization, the EUT itself and the documentation.

8.1. Standard-compliant procedures

The ESD simulator system type NSG 439 is constructed in accordance with the requirements called for in the standard and is calibrated in a standard-conform manner.

The test engineer is duty-bound to study the relevant test requirements and adapt the facilities to suit the EUT in question.

The necessary documents can be obtained directly from the offices of CENELEC (www.cenelec.org), the IEC (www.iec.ch), the ANSI (www.ansi.org), the IEEE (www.ieee.org) etc., or they are available from national standards bureau.

8.2. Other situations

It is not always possible to arrange a test rig in exact conformity with the relevant standards. However, by abiding by some basic rules, it is still possible to obtain meaningful assessments of a EUT's sensitivity to interference and to obtain valuable pointers to improving its immunity.

An electrostatic discharge is always associated with high frequency properties, which extend well above the 1 GHz range. Screening, earthing and filtering measures must therefore also be effective up into this range of frequencies.

The possible paths the pulse energy might take need to be thought about. It is absolutely essential the pulse return path is fed back through the simulator's earth cable.

The contact-discharge method is to be preferred over the air-discharge method.

The former must, however, be arranged so that true metal-to-metal contact with the EUT is achieved.

Repetitive discharges are only of real use to quickly localize weak spots in construction or to pin-point critical situations in program routines. Single pulses are then to be used for detailed investigations and to assess the sensitivity to interference.

An exact record is to be kept describing the test conditions complete with photos of the test rig, details of the type and quantity of discharges, notes about the ambient climatic conditions, remarks concerning the effects observed etc.

9 VERIFICATION OF THE PULSE DATA

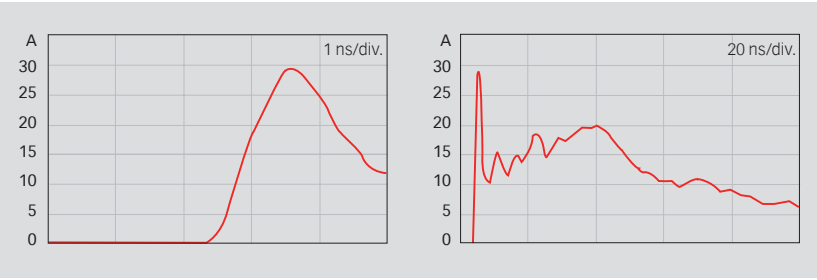
The calibration and verification of the pulse data requires a specialist test and measurement laboratory for which the IEC standard sets out certain minimal requirements.

Teseq uses the following instruments for calibration purposes:

- Oscilloscope with an analogue bandwidth of min. 1 GHz
- Coaxial measurement adapter MD 101 Pellegrini-target as per IEC/EN 61000-4-2 (2001) or MD 103 according to latest draft
- 20 dB attenuator covering the range from dc to 12.4 GHz
- SUCOFLEX-HF-coaxial cable
- High voltage dc voltmeter (Ri > 30 GΩ)

The instruments are periodically re-calibrated in accordance with the requirements of ISO 17025.

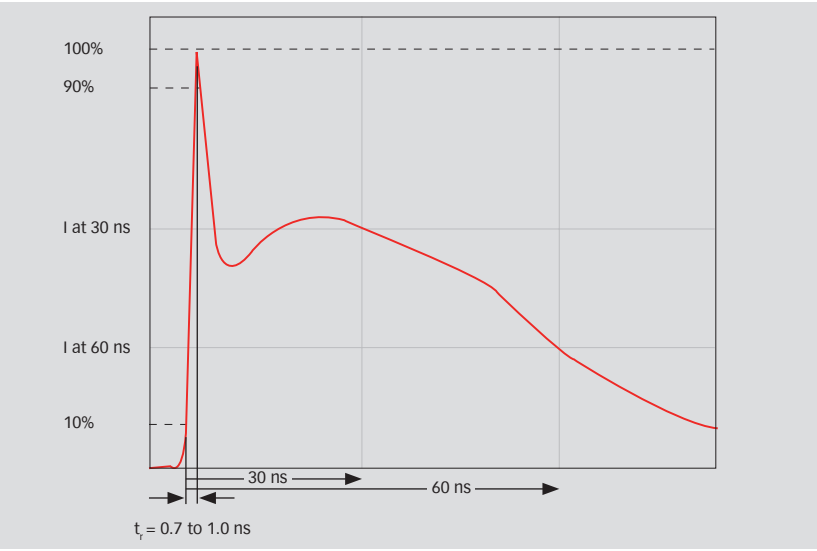
10 TYPICAL PULSE DATA



Contact-discharge 8 kV
pulse rising edge (t_r ca. 0.8 ns)

Contact-discharge 8 kV
current at 30 ns and 60 ns

Reference figure quoted in IEC/EN 61000-4-2 (2001)



11 MAINTENANCE

Care

The housing can be cleaned with a moist cloth with possibly just a trace of detergent liquid.

Industrial spirit is also a suitable cleaning agent.

Other solvents are not permitted.

Fuses

The instrument contains no fuses that are accessible to the user.

11.1. Calibration

Trimming procedures in the NSG 439 are carried out digitally and automatically. The instrument contains no elements that are foreseen for adjustment by the user. A component defect must be suspected if the calibration measurements differ from the published technical data and the instrument is to be returned to an authorized Teseq service centre.

Measurements can only be undertaken by trained specialists. A prerequisite is the availability of the necessary measurement equipment as listed in section «verification of pulse data».

Charge voltage check:

Equipment: EHT voltmeter with 40 kV voltage range
Internal resistance > 20 GΩ.
Measurement accuracy < 1%

Check the voltage level un der the following conditions:

Air-discharge
Single-discharge
Polarity: positive and negative
Voltage settings: 2, 4, 8, 15 and 30 kV
Permissible tolerance < ± 5% of set value

Check the discharge current and pulse form as follows:

Contact-discharge
Single-discharge
Polarity: positive and negative
Voltage settings: 2, 4, 8, 15 and 30 kV

Compare the measured values with the reference data in IEC/EN 61000-4-2 (2001).

These values are valid only for the discharge network that conforms to IEC/EN 61000-4-2 (2001).

Remark
Teseq offers an accredited service for this kind of work!

11.2. Exchanging the R/C network

If a network needs to be exchanged, the test has to be stopped first, followed by a waiting time of at least 5 s to ensure the voltage being internally discharged.

Switch the simulator off.

Turn the aluminum knob and take the network out. It may help if the NSG 439 is rotated backwards, so the network drops out under its own weight. Take care! Catch the network in the other hand.

11.2.1. Reduction of the pulse repetition rate through higher capacity
The maximum achievable pulse repetition rate can suffer as a result of using special discharge networks having a higher capacity. No other limiting effects occur, however.

11.3. Repairs
Repair work is to be carried out exclusively by an authorized Teseq repair department.

Voltages in excess of 30 kV are generated within the instrument: LETHAL DANGER!

Only original replacement parts and accessories are to be used.

Do not continue to use the instrument in the event of mechanical damage occurring. The plastic housing also performs insulating and protective functions, which are only assured as long as it is in its original condition. A damaged instrument should be returned without delay to a Teseq service centre.

11.4 NSG 439 system error messages

Nr.	Text	Explanation	Action
006	INTERLOCK OPEN	The «interlock-circuit» is open.	Press interlock button, or close the interlock circuit at the back of the base unit.
115	EUT FAILURE	The connected EUT has signaled a fault.	EUT input has detected an EUT fault. Reset EUT first and then press return on screen.
125	HV SUPPLY TIMEOUT	The HV cannot be loaded in the specified time.	HV voltage module has detected during measurement an uncertainty. Switch off the base station wait for 10 s, switch on again.
126	HV HOLD TIMEOUT	Unit stops after 30 s without discharge.	Press return on screen. Restart the test.
127	HW FAULT	An internal fault on the processor board has been detected.	Switch off the base station wait for 10 s, switch on again and continue testing. If error persists, contact your nearest Schaffner service centre.
129	A FIELD IS SELECTED	The «run» or the «HV-on» key has been pressed although an operator field is still selected.	Finish the input in the operator field and then start with «run».
201	HV INTERNAL DISCHARGE	During test, an internal discharge has been detected.	Press return on screen and trigger again. If error persists, contact your nearest Teseq service centre.

Nr.	Text	Explanation	Action
202	BATTERY EMPTY	The battery is low and needs to be charged.	Recharge battery with the original power supply.
210	ERROR ADJUST FAILURE < xxx >	HV module can not reach the max. voltage during calibration procedure.	The voltage can be selected to the displayed maximum value. Contact you nearest Teseq service centre.
211	FAULT DETECTED	The software has found erroneous behaviour during generation of the pulse.	Stop the test. Switch off the base station wait for 10 s, switch on again and continue testing. If error persists, contact your nearest Teseq service centre.
217	VOLTAGE TOO HIGH	The selected value is too high.	Reduce the voltage level.
247	HV TRAFO TOO HOT	NTC resistor too hot after endurance runs.	Power off the NSG 439 and wait about 1 h.

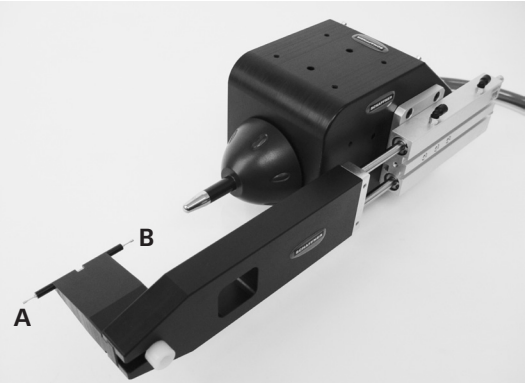
11.5. INA 4431 robotic air-discharge adapter

The INA 4431 robotic air-discharge adapter is a well thought out accessory providing the first practical means to carry out air-discharge tests on individual connector pins unlike conventional test methods which tend to result in unforeseen discharge paths being followed.

11.6. Function of the air discharge adaptor

The adaptor is already preinstalled with the special contacting point as well as the mounting plate.

The moveable contact point A is first brought into contact with the connector pin to be tested, thereby lengthening it.



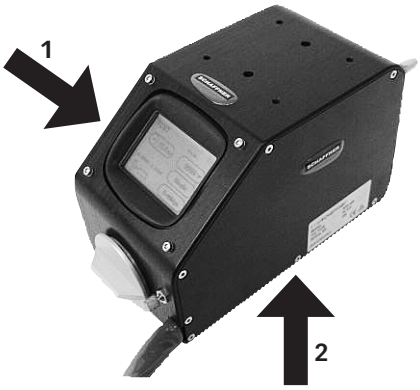
The whole simulator is then brought according the required speed given by the standard close to the extended contact B until the discharge has taken place. Following this, once the whole simulator has been retracted, the adapter is returned to its start position pneumatically.

The slide is driven by air pressure and contains as a base a FESTO piston type DPZ-16-50-P-A-KF-S20 with following specification:

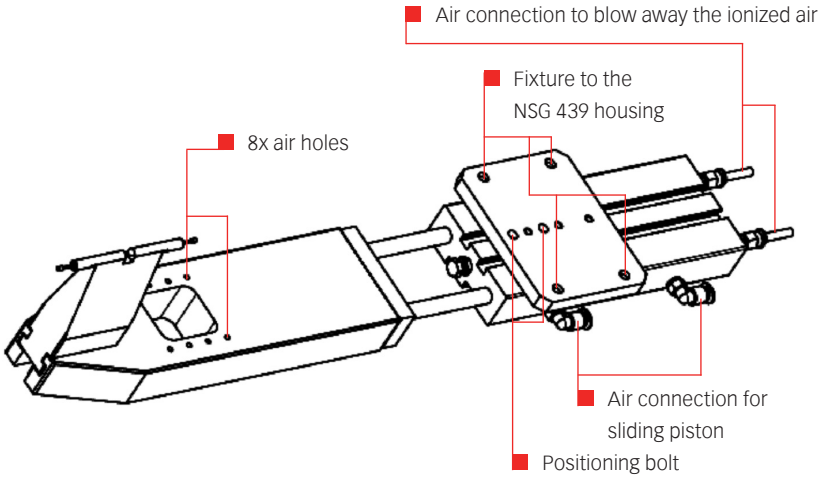
Characteristics	**Value**
Hub	50 mm
Adjustable end value/lenght	10 mm
Piston-diameter	16 mm
Damping	Elastic damping, damping rings both side
Guide	sliding guide
Operating pressure	1 – 10 bar
Functionality	Double action
ATEX-Ambient temperature	-20°C <= Ta <= +60°C
Operating medium	Dry or oiled air
Theoretical force on backward /forward movement on 6 bar	180 N
Pneumatic connection	M5
Material cover	Aluminum forging alloy
Piston material	Stainless high forging alloy

11.7. Mechanical fixture

The adaptor can be placed on position 1 or 2.



The fixture itself has two positioning bolt and four screws.



Each time an air discharge is produced, the ionized air has to be blown away, this to guarantee a high reproducibility in air-discharge mode.

11.8. Disposal

The following list shows the principal materials used in the construction of the NSG 439. The relevant national regulations are to be observed when disposing of the instrument.

Component material listing

Pistol housing	PA6 PMO
Base station front panel	ABS
Base station housing	Galvanized steel, lacquered
Circuit boards	Epoxi with SMD components
LCD display and touchpanel	Glass
HV module	Polyurethane potting compound with elect. network components and copper wire
HV relay	Div. metals, ceramic, div. insulating materials
Test finger	Brass, plastics
Battery	Nickel-metal hydride
Battery charger	ABS housing with transformer and circuit board with electr. components
Carrying case	Aluminum and polyethylene
Air-discharge	PA6 PMO

12 TECHNICAL SPECIFICATIONS

Description		Compact ESD simulator with microprocessor controller, large surface touch-sensitive LC display, built-in HV relay for contact-discharges, mains-independent operation
Pulse data	– standard	Conforms to IEC/EN 61000-4-2 (2001)
	– special	With exchangeable networks for other standards
Pulse network	– standard	150 pF/330 Ω as per IEC, exchangeable networks for other standards as accessories Range R = 0 Ω ... 20 kΩ Range C = 50 pF ... 2000 pF
Air-discharge voltage		200 V ... 30 kV (in 100 V steps) (Tolerance ± 5%, 1 ... 30 kV)
Contact-discharge voltage		200 V ... 30 kV (in 100 V steps) (Tolerance ± 5%, 1 ... 30 kV)
Test finger	– standard	Ball and point as per IEC, exchangeable via threaded connection
Arcing detection		Indicated by the kV symbol being displayed inverse, also acoustically in the «single» operating mode
Holding time		> 5 s
Charge resistor R_{ch}		50 MΩ
Triggering		Trigger button in handgrip or via remote control input
Instrument operation		Via touchpanel and microprocessor
Discharge modes		Air-discharge / contact-discharge
Polarity		Positive, negative and automatic change

Operating modes	Single / Repetitive / Random T (see section «repetition») Pulse counter 0 ... 9999 Preselect counter 0 ... 9999 Continuous operation
Repetition	0.5, 1, 5, 10, 20, 25 Hz (air) 0.5, 1, 5, 10, 20 Hz (contact) or in 1 Hz steps, as well as random (Random P see section «repetition»)
Discharge voltage	Pre-programmed levels (IEC/EN and ISO standards)
Auto-shut-off	After 15 minutes idle time (without loss of the test parameters)
Display	LCD panel showing: Discharge voltage Breakdown voltage Polarity Air-/contact-discharge Counter / preselect counter content Battery state monitor
Weight	NSG 439: 14 kg (30 lbs) approx.
Ambient conditions	Operating +5° ... +40°C 20 ... 80% r.h. (non-condensing) 68 ... 106 kPa
Power supply	Input: 100 – 250 V / 50 – 60 Hz / 1 A Output: DC 24 V / 2.3 A

13 ESD STANDARDS

The IEC/EN 61000-4-2 (2001) standard can be taken as a working basis.

This has been renamed from IEC 801-2, 1991 into IEC/EN 1000-4-2 as well as IEC/EN 61000-4-2 (2001) and will be accepted into national standards as part of the European harmonization.

The following documents are either identical or largely compatible:

EN 61000-6-1 (2001)	Generic Immnity standard for residential and light industrial environments.
EN 61000-6-2 (2001)	Generic Immunity standard for industrial environments as well as others.

14 WARRANTY

Teseq grants a warranty of 2 years on this instrument, effective from the date of purchase.

During this period, any defective component part will be repaired or replaced free of charge or, if necessary, the instrument will be replaced by another of equivalent value.

The decision regarding the method of reinstating the functional capability is at the sole discretion of Teseq.

Excluded from the warranty is damage or consequential damage caused through negligent operation or use as well as the replacement of parts subject to degradation.

The warranty is rendered invalid by any intervention on the part of the customer or a third party.

The goods are to be returned in the original packing or other equivalent packing suitable for the purpose of the foreseen means of transport.

Teseq can accept no responsibility for damage in transit.

15 OPTIONS

Options	Order no.	Qty.
Discharge network ISO 10605, 150 pF/2 kΩ	INA 4391	
Discharge network ISO 10605, 330 pF/2 kΩ	INA 4392	
Discharge network, ANSI C63.16 hand model	INA 4393	
Discharge network, ANSI C63.16 furniture model	INA 4394	
Test finger for fast pulse rise times < 400 ps	INA 4411	
Carrying bag for the base unit	INA 4422	
Special discharge networks, specify standard and/ or values of R and C	xxx	

Options	Order no.	Qty.
ESD measurement target conforming to IEC/EN 61000-4-2 (2001)	MD 101	
ESD measurement target (ANSI/IEC draft)	MD 103	
Earth cable with resistors (2 x 470 kΩ)	INA 414	
Extension cord tip	INA 4413	
Flexible tip set	INA 4415	
Softtouch contact tip	INA 4416	
Banana contact tip	INA 4417	
Banana fast rise time tip	INA 4418	
E-field adapter	INA 4419	
H-field adapter	INA 4420	
Charge remover device (for unit with... A version not applicable)	INA 4430	
Opto-link set to a PC with 10 m opto-cable	INA 417B	

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