



NSG 438 / 438A ESD SIMULATOR

USER MANUAL 601-2411

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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**

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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 may result in dangerous consequences.

The NSG 438 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 generator 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.

NSG 438/438A ESD simulator

The construction of the simulator is not designed for use in an explosive environment.

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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 generator. 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 generator 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 generator 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 depending 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 438 fulfils the requirements of numerous applications in an ideal manner, thus:

Ergonomic shape:	For non-tiring use.
Operation:	Operating elements and display always in view of the user. Constant check on the test values.
Battery-powered:	Independence from a mains power feed.
Carrying case:	Generator and its accessories can be readily packed and conveniently transported.
Microprocessor-control:	All the functions are "on-board", including a pre-settable counter, pre-programmed test values, discharge voltage detection, 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 generator is automatically deactivated if the instrument remains unused for a period of time.
Longterm operation:	Automatic longterm operation for stationary applications with the generator mounted on a tripod.
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 438 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 generator 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 438 SYSTEM



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.

Professional industrial designers have ensured an optimized ergonomic concept. The instrument, with its well-balanced handgrip, sits comfortably in the user's hand and guarantees non-tiring operation. Both the operating elements and the display window remain in view of the user while work is in progress.

The NSG 438 offers optimal freedom of movement around the work-place and is an ideal test instrument not just for the development engineer but also for quality control purposes, system tests and for investigations in the field.

The NSG 438A features additionally a build in, switched, 1 MOhm bleed off function. This function is particularly useful in applications where the EUT discharge point is not connected to ground (ex: battery powered equipment, connector pins, etc.). In such cases a build in bleed off function can avoid external manual bleed off to be done between 2 discharges.

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 and ISO 10605 standards.

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.

NSG 438/438A ESD simulator

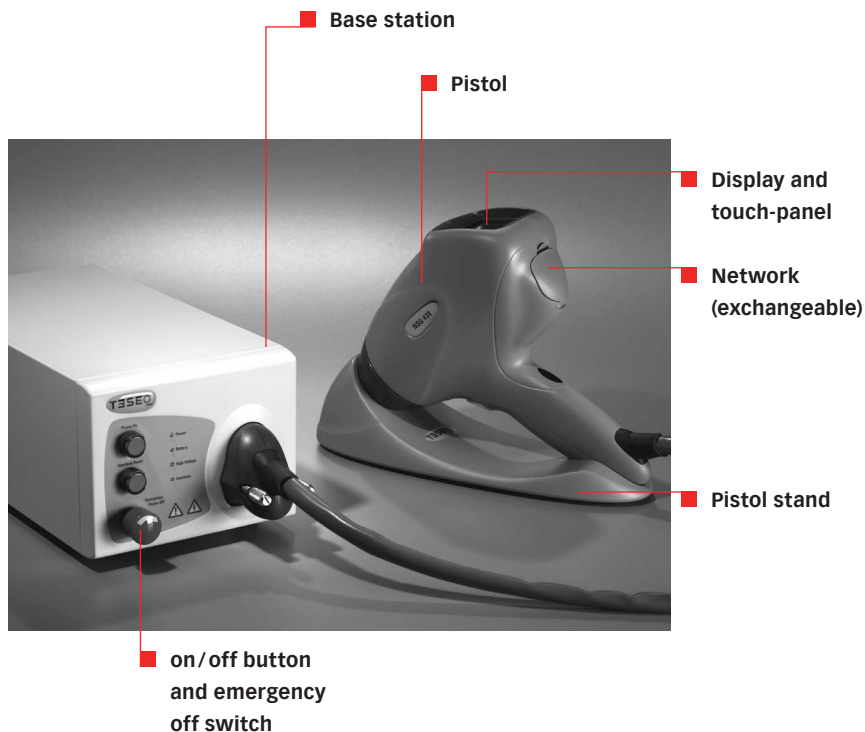
The basic set contains everything necessary for general use. A rich assortment of accessories for special tasks is available such as a remote triggering unit, further discharge networks, an ergonomically shaped carrying case, a tripod adapter, test fingers, etc.

4.1 The simulator

The NSG 438 simulator is modularly constructed from a number of discrete function units.

4.1.1 Function modules

The base station contains the battery supply, the high voltage generator and regulator as well as several safety features.

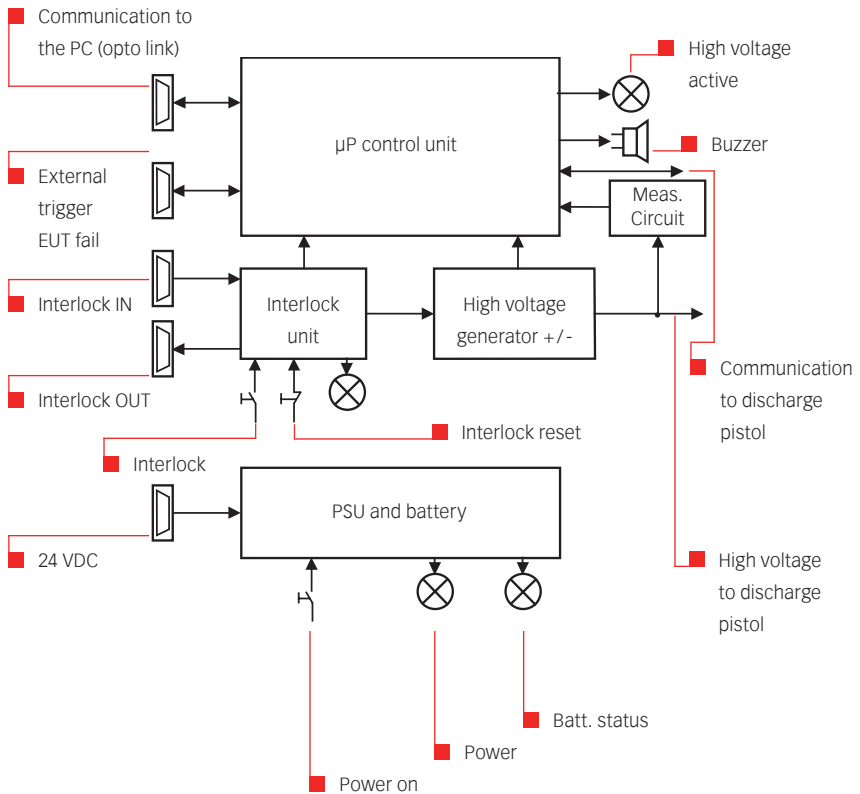


The pistol houses the interchangeable pulse network, high voltage relay, the exchangeable test finger, measuring electronics and the touch sensitive input/display panel.

4.1.2 Block diagram

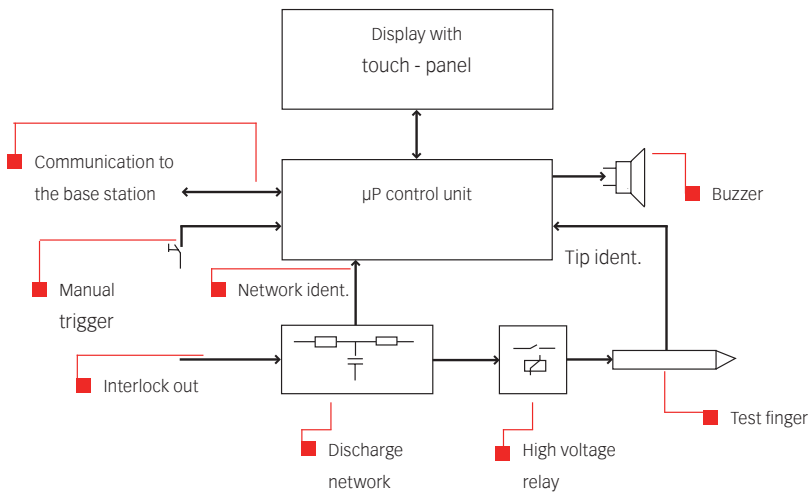
The various function units are shown in the block diagram:

Block diagram of the base station:

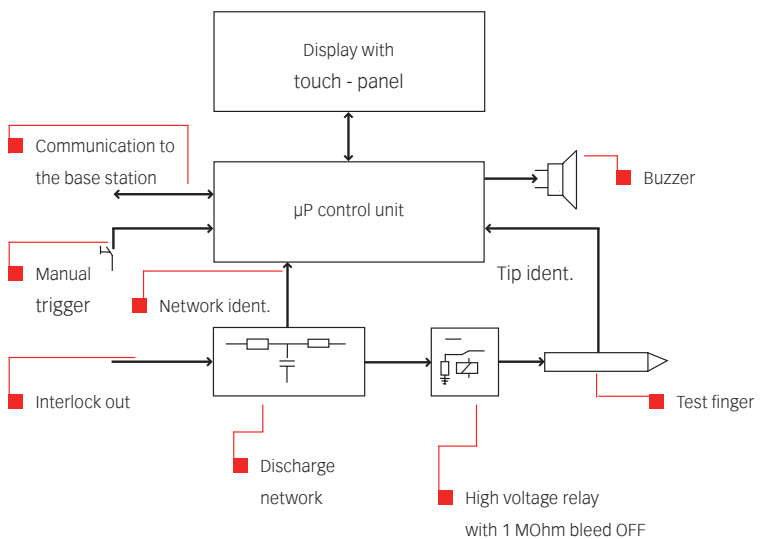


Block diagram of the NSG 438 pistol:

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Block diagram of the NSG 438A pistol:



The microprocessor controls and monitors all the simulator functions:

- Touch-panel 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.
- The actual tip is detected and the actual discharge mode will be shown.
- 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 re-use.
- 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.
- Pulse triggering is monitored. Once an arc has occurred the network is discharged internally so that no further arcing is possible.

4.1.3 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 438 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 touch-panel.

This is an example of a display 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 (starts the discharges by pressing the button and stops 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 438 consisting of pistol and base station with battery power supply
- Discharge network 150 pF/330 Ω to IEC/EN 61000-4-2 and ISO 10605
- 1 test finger each for air and contact discharges
- Battery charger/mains power pack
- Pistol stand
- Operating instructions

This set contains all the items necessary under normal conditions to conduct tests conforming to the IEC/EN 61000-4-2 and ISO 10605 standards.

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 tips for other standards
- Fast rise time tip
- Coaxial measurement adapter type MD 101 or MD 103
- Carry-bag for base unit
- Tripod adapter
- Opto link to a PC
- H-field adapter
- Flexible test tips
- Discharge remover
- Etc.

See detailed options list at the end of this manual.

NSG 438/438A ESD simulator

4.2.3 Discharge networks

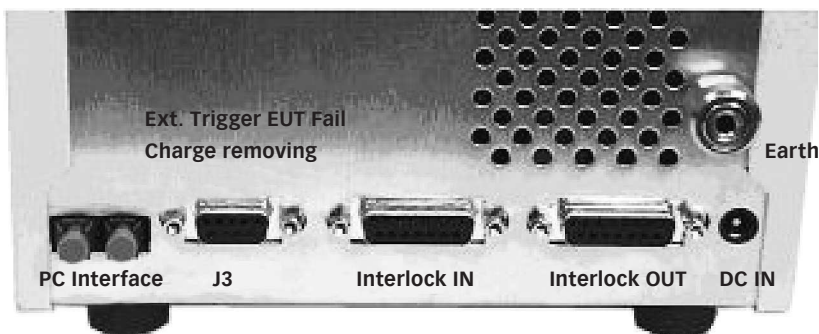
The basic set contains a discharge network and test fingers for conducting tests that conform to IEC / EN 61000-4-2 (2008). Alternative networks can be installed for testing in accordance with other standards.

Several networks are given in the order list. 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

This port is intended to allow the user to connect external signals in order to remote control the NSG 438 generator, as well as to connect external accessories like the charge removing device INA 4430. See tables and graphs below for detailed signal description and drive circuitry information.



Care has to be taken that the cable used to connect to this port is made with good shielding concept.

The shield it self needs to be linked with the housing such as to prevent any ESD hazard to the controller board.

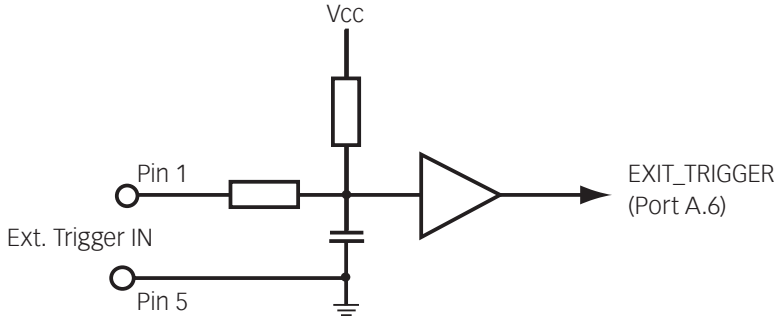
The extended operating function of "charge removing" on J3 connector is included in NSG 438 products from serial number 577 (June 2006) upwards. Therefore different pin assignment is allocated as follows:

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	NC	–
8	NC	–
9	NC	–

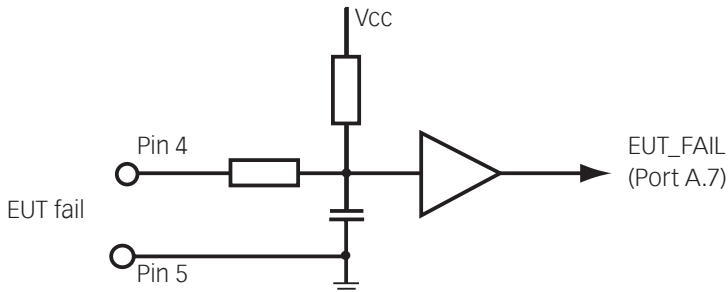
Connector J3: Pin assignment >SN 577		
Pin	Signal name	Description
1	EXT_TRIGGER	External trigger input
2	NC	–
3	NC	–
4	EUT_FAIL	EUT failure input
5	GND	Earth
6	NC	–
7	Charge remove	Charge remove drive output
8	GND	Earth
9	+15V	Voltage output (max 500 mA)

Ext. Trigger:

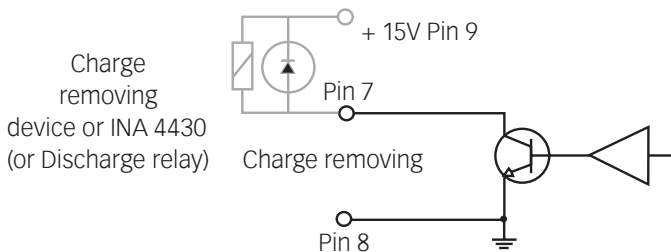
The following circuit is built in behind the external trigger input connector. This function is similar to the function of the yellow trigger knob on the handle. Trigger signal active low, i.e. to be pulled to ground.

**EUT failure input:**

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

**Charge removing connection:**

This function is to drive the INA 4430 option or an external relay.



4.2.5 Interlock

The NSG 438 has an integrated interlock system in accordance 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 438 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.

Note: This function is not available for instruments with:

NSG 438 Snr.: > 1112

NSG 438A Snr.: > 107

3. Interlock output for other system devices.

The interlock system is common to NSG 2000 series of Schaffner and 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 Schaffner and 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).

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 closed.

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

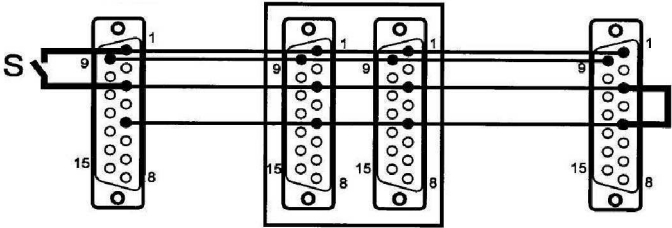
Signal specifications: Voltage 48 VDC max.	
Current 20 mA min., 1 A max.	
Connector:	Socket, D-sub. 15-pin
Max. permissible	3 m each, screened cable
cable length:	(correct operation guaranteed up to 10 m)

Operation should be insured via potential-free switch contacts.

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

The pin-out 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 number	Function
1	Earth (GND), 0V
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 (triggers the interlock function in the instrument by 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 438 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

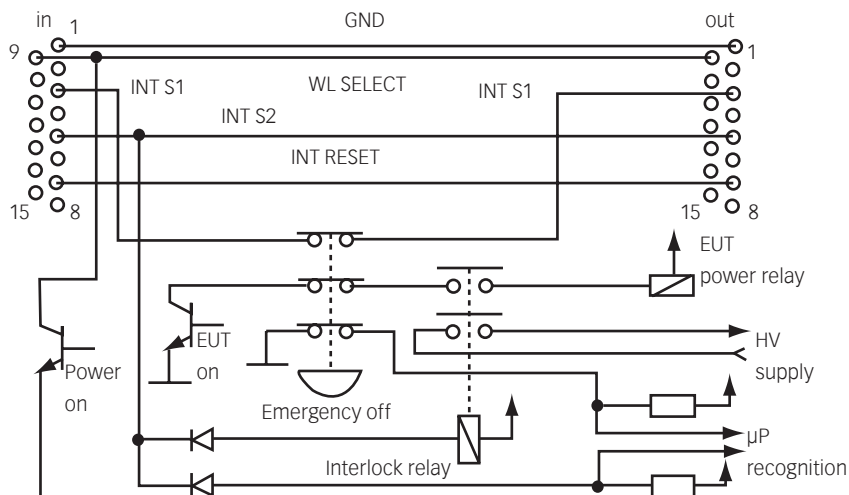


Wiring diagram for the interlock system:

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

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

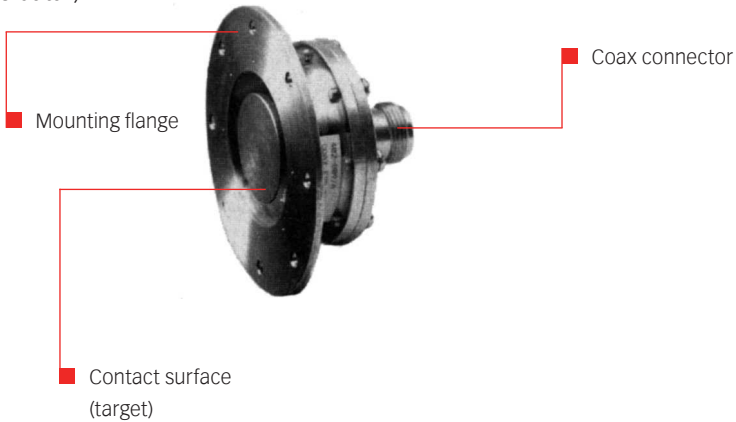
The contacts should be connected in series if numerous access barriers are necessary. Either one open contact or a voltage of more than 1.5 V at the input is sufficient to disable the simulator.



4.2.6 Measurement adapters

The measurement adapter type MD 101 as per IEC/EN 61000-4-2 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 this 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 is a more advanced coaxial measuring target with flat response characteristics up to the multi-GHz range. It is required in the IEC 61000-4-2 Ed 2.0.



5 COMMISSIONING

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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:

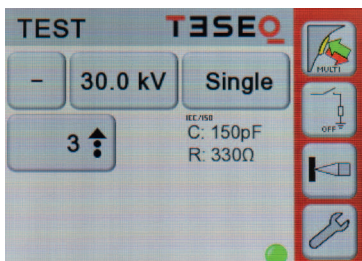
- Study the manual
- Take the necessary safety precautions
- Charge the battery (see section "Battery charger")
- Plug the interlock terminators into the base station
- Connect the earth cable correctly (the NSG 438 must never be switched on without a solid earth connection being made).
- Allow the instrument 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 self-test routines have been completed.

The display comes up with last used settings, and will look like this:



High voltage generation is activated by pushing the trigger button and keeping it pressed. By bringing the test finger close to the earthing point an arc discharge occurs which is acknowledged acoustically.

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6 OPERATION



This section of the manual provides a guide through the numerous operating possibilities of the NSG 438.

The operation, 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.

For safety reason, 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!).

6.1 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 earth cable for the pulse return path is 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 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.

Successful air discharges are detected. A differentiation is made between this and the set value by the display "kV" flashing green. If no valid discharge occurred, the display shows a "0" value and the kV symbol will flash red. 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 non-use.

6.2 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 30'000 discharges can be generated

6.3 Operation and settings

The operation of the instrument and all settings are carried out by way of the touch-panel 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 trigger button always takes you up one menu level higher.
- A virtual keypad appears in parameter setting menus.
- R/C value shown on main screen for convenient direct reading.

6.3.1 Display mode

When adjusting some parameters a keyboard and up/down buttons can be selected.

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.

6.3.2 Voltage

Touching the voltage indication brings you to the submenu for adjusting the discharge voltage. Set the required value and press "Ok".

6.3.3 Polarity

The polarity indication brings you into the relevant submenu. Choose between + or -. If the pre-select 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-changing-recharging).

6.3.4 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. When the simulator is in operation the preset counter counts down until it reaches 0, which then terminates the selected test sequence.

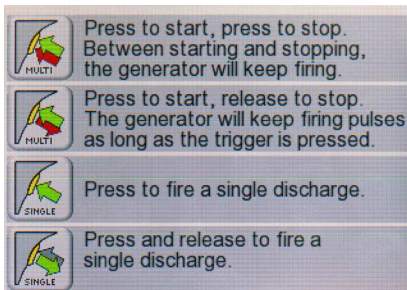


Reset counter sets the counter content to 0 or it reloads the preset counter with the previously selected value.

Pulse release behaviour

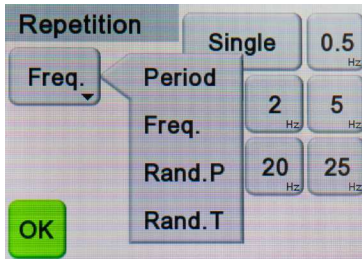
Four modes of triggering are supported:

- Press to Start, Press to Stop
- Press to Start, Release to Stop
- Single (on Press)
- Single (on Release)



6.3.5 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.



Four 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 prestored 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.

EUT discharge on NSG 438A: To remove the charged energy of a EUT, the NSG 438A has an internal bleed off resistor which is activated via the contact discharge relay activated. With the time of the charge removing procedure can be programmed. All timing parameters can be set from 0.1 up to 99 s in 0.1 s steps. With the NSG 438A, the DUT will be discharged during T2 and T3.

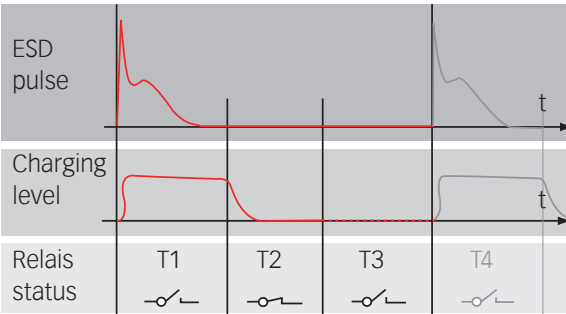
EUT discharge on NSG 438: To remove the charged energy of a EUT, an external charge removing box (INA 4430) can be connected to the base station and will operate similarly to the NSG 438A version.



This method works well and easy for contact mode discharge testing.

In air discharge mode testing the user has to take care to: (recommended method)

- Set the preselect counter to OFF
- Set the T1, T2, T3 values to minimum 1 or 2 seconds in order to give enough time for manipulation
- The discharging indicator on the TEST screen will show a closed relay and light green during DUT discharging



T3 is only possible with an NSG 438 using the INA 4430.

6.3.6 Settings

This further branches into a range of submenus, thus:

6.3.7 Language

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

6.3.8 Device info

Gives information separately for the pistol and the base station regarding the versions of the equipment and its firmware.

6.3.9 Discharge

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

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, the appropriate type of test finger must, of course, be mounted to suit the type of discharge:

Air-discharge = round test tip

Contact-discharge = sharp point test tip

6.3.10 Activity Log

An activity log is provided, allowing the user to scroll through the tests shown in hours and minutes before the present. Changing the relevant test parameters will cause a new entry into the log to be created.



The Log is in volatile RAM and will be reset each time the gun is switched off!



6.3.11 Threshold

This function permits different 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

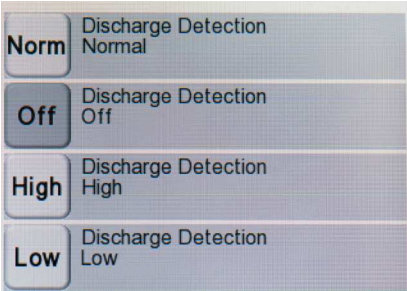
Arcing is detected and is indicated by the kV symbol on the display blinking provided 10% (or more) of the charge voltage is dissipated.

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).



6.3.12 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.

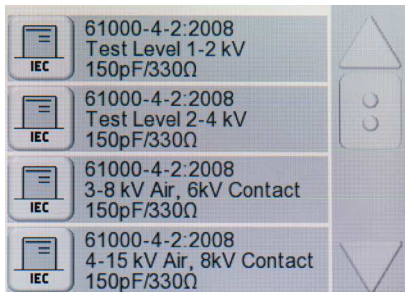
During the calibration procedure the HV module is strained up to 30 kV in steps, and the charge voltage is measured, checked if in tolerances and validated for each step.

If somehow the maximum voltage could not be reached or hold, the NSG 438 comes out with an error message Nr. 210 cal. Failed. The calibration procedure is diagnosing, to which voltage level the instrument works properly. This voltage value will be shown on screen.

The instrument can be used for tests up to this voltage value, but it is recommended to return it to a Teseq service center for repair.

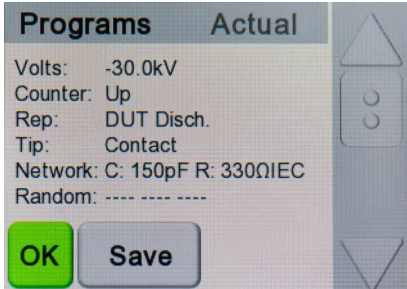
6.3.13 Standards

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



6.3.14 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 OK loads the selection ready for execution.



6.3.15 Continuous operation

Continuous operation can be established to produce a repetitive stream of discharges.

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 battery the duration of the test is naturally limited.



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

7.1 Standard-compliant procedures

The ESD simulator system type NSG 438 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.

7.2 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 generator's earth cable.

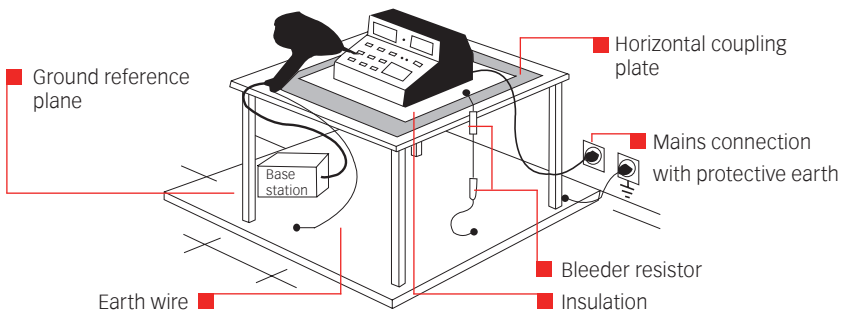
Due to better reproducibility the contact-discharge method is to be preferred

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

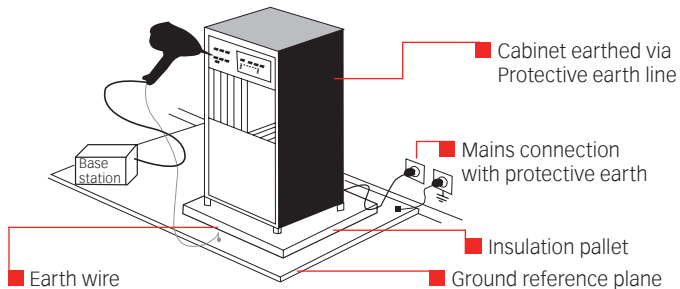
Fast repetitive discharges are only of real use to quickly localize weak spots in construction or to pin-point critical situations in program routines. Single pulses are then to be used for detailed investigations and to assess the sensitivity to interference.

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.

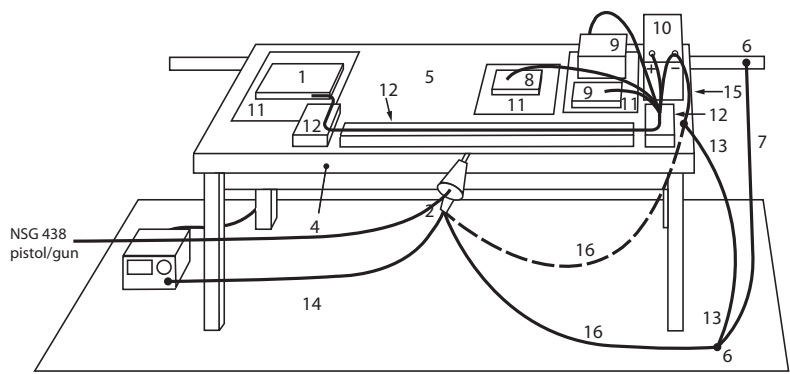
Example of test set-up for automotive EUTs including harnesses and



Example of test set-up for floor-standing equipment - laboratory tests



Example of test set-up for automotive EUTs including harness and auxilliary equipment.



- Key**
- | | |
|--|---|
| 1 DUT | 9 Periphery |
| 2 ESD generator | 10 Battery |
| 3 ESD generator main unit | 11 Isolating support, if required |
| 4 Non-conductive table | 12 Insulating blocks |
| 5 HCP | 13 470 kΩ resistors |
| 6 Ground point | 14 GRP optional |
| 7 Ground connection | 15 HCP ground connection |
| 8 Remotely accessible parts of the DUT | 16 ESD gun ground connection to HCP or GRP (refer to test plan) |

Test set-up example for testing powered DUT immunity to indirect ESD

Note that in case cable (16) gets connected to HCP (5), the bleed off resistors 13 have no more effect for the ESD phenomenon. They can be kept away or replaced by a direct (0 Ohm) connection to ground, an alternative is to connect grounding wire 6 directly to the HCP.

8 VERIFICATION OF THE PULSE DATA



The calibration and verification of the pulse data requires a special 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. 2 GHz
- Coaxial measurement adapter MD 103
- 26 dB attenuator covering the range from dc to 12.4 GHz
- SUCOFLEX-HF-coaxial cable
- High voltage DC voltmeter ($R_i > 30 \text{ G}\Omega$)

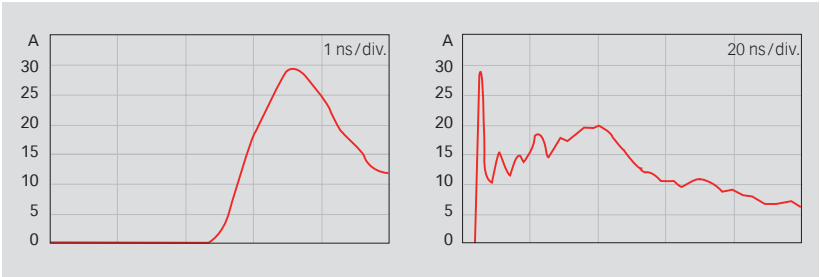
The instruments are periodically recalibrated in accordance with the requirements of ISO 17025.

Calibration installation with oscilloscope in a Faraday cage:



NSG 438/438A ESD simulator

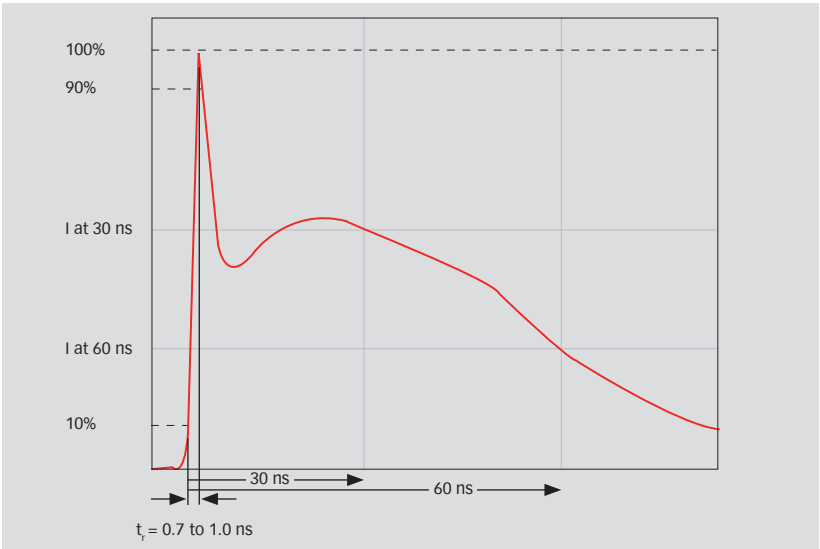
9 TYPICAL PULSE DATA



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

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

Reference figure quoted in IEC/EN 61000-4-2



10 MAINTENANCE



Cleaning

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.

10.1 Calibration

Trimming procedures in the NSG 438 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 under 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

NSG 438/438A ESD simulator

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

Remark

Teseq offers an accredited service for this kind of work!

10.2 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.

Open the flap under the display and rotate the pistol backwards until the network drops out under its own weight. Take care! Catch the network in the other hand.



10.2.1 Reduction of the pulse repetition rate through higher capacity

The maximum achievable pulse repetition rate will automatically derate as a result of using special discharge networks having a higher capacity. No other limiting effects occur, however.

10.3 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.

10.4 NSG 438 system error messages

Nr.	Text	Explanation	Action
006	INTERLOCK OPEN	The "Interlock-circuit" is open.	Press "Interlock Reset" 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 been activated. Reset EUT first and then press return on screen.
125	HV SUPPLY TIMEOUT	The HV capacitor in the pulse network cannot be loaded in the specified time.	HV voltage module has detected some losses. 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	HV 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 Teseq 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	CALIBRATION FAILED	HV module can not reach the max. voltage during calibration procedure.	The voltage can be selected to the displayed maximum value. Contact your 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 438 and wait about 1 h.

10.5 Disposal

The following list shows the principal materials used in the construction of the NSG 438. The relevant national regulations are to be observed when disposing of the instrument.

Component material listing

Pistol housing:	ABS
Base station front panel:	ABS
Base station housing:	Galvanized steel, lacquered
Circuit boards:	Epoxi with SMD components
LCD display and touch-panel:	Glass
HV module:	Polyurethane potting compound with electronic 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
Pistol stand:	ABS

10.6 Declaration of conformity CE



Advanced Test Solutions for EMC

Teseq AG Nordstrasse 11F, 4542 Luterbach, Switzerland
T +41 32 681 40 40 F +41 32 681 40 48 www.teseq.com

Declaration of conformity



Manufacturer:	Teseq AG
Address:	Nordstrasse 11F, 4542 Luterbach, Switzerland
	declares that the following product
Product:	NSG 437 and NSG 438
Options/Variants:	all
	conforms to the following Directives and Regulations
	EMC Directive 2004/108/EEC
	LVD Directive 2006/95/EEC
Generic standards:	EN 61326-1, 2013
	EN 61326-2-1, 2013
	EN 61010-1, 2010

The purpose of this instrument is the generation of defined interference signals for EMI immunity testing. Depending on the arrangement of the test rig, the configuration, the cabling and the properties of the EUT itself, a significant amount of electromagnetic radiation may result that could also affect other equipment and systems. The user himself or herself is ultimately responsible for the correct and controlled operation of the rig. In case of doubt, the tests should be carried out in a Faraday cage.

Place and Date: Luterbach, April 1st, 2014



Chuck Milligan
Vice President
AMETEK Compliance Test Solutions

NSG 438/438A ESD simulator

11 TECHNICAL SPECIFICATIONS

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Description:	Compact ESD simulator with microprocessor controller, large-surface touch-sensitive LC-display, built-in HV-relay for contact-discharges, built-in bleed off (NSG 438A) mains-independent operation
Pulse data -standard:	Conforms to IEC / EN 61000-4-2 and ISO 10605
-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 k Ω Range C = 50 ... 2000 pF
Air-discharge voltage:	200 V ... 30 kV (in 100 V steps) (Tolerance < \pm 5% (typical 2%), 1 ... 30 kV)
Contact-discharge voltage:	200 V ... 30 kV (in 100 V steps) (Tolerance < \pm 5% (typical 2%), 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 Rch:	> 50 M Ω
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 Random P EUT discharge (bleed OFF mode) Free adjustable 0.04 to 300 s in 0.01 s steps
Discharge voltage:	Preprogrammed levels (IEC/EN and ISO standards)
Auto-shut-off:	After 15 minutes idle time (without loss of the test parameters)
Display:	Large LCD panel showing: Discharge voltage Breakdown voltage Polarity Air- / Contact-discharge Counter / preselect counter content Battery state monitor
Weight:	NSG 438: 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

12 ESD STANDARDS

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

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

The following documents are either identical or largely compatible:

IEC/EN 61000-6-1	Generic immunity standard for residential and light industrial environments.
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IEC/EN 61000-6-2	Generic immunity standard for industrial environments as well as others.
------------------	--

Major standard for automotive industry:

ISO 10605	Road vehicles – Test methods for electrical disturbances from electrostatic discharge
-----------	---

13 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.

14 ORDERING INFORMATION

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NSG 438 Stand alone generator for immunity testing in compliance with IEC 61000-4-2 and ISO 10605, up to 30 kV. Large graphical display and easy interchangeable networks. Features high impedance switched bleed off. Includes air discharge and contact discharge tips, pulse network per IEC 61000-4-2, powerful battery for long time testing, mains power supply/battery charging unit, gun cradle, 25 mm discharge ball, optical interface for PC control, Interlock interface and emergency power OFF switch, suitcase, user manual, traceable calibration certificate.

NSG 438-AUTO Stand alone generator for immunity testing in compliance with IEC 61000-4-2 and ISO 10605, up to 30 kV. Large graphical display and easy interchangeable networks. Features high impedance switched bleed off. Includes air discharge and contact discharge tips, pulse network per IEC 61000-4-2, **3 additional pulse networks for compliance to ISO 10605, powerful battery** for long time testing, mains power supply/battery charging unit,

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gun cradle, 25 mm discharge ball, optical interface for PC control, Interlock interface and emergency power OFF switch, suitcase, user manual, traceable calibration certificate.

NSG 438A Stand alone generator for Immunity testing in compliance with IEC 61000-4-2 and ISO 10605, up to 30 kV, with built in, **switchable and programmable 1 MOhm bleed OFF function**. Large graphical display and easy interchangeable networks. Includes air discharge and contact discharge tips, pulse network per IEC 61000-4-2, powerful battery for long time testing, mains power supply / battery charging unit, gun cradle, 25 mm discharge ball, optical interface for PC control, Interlock interface and emergency power OFF switch, suitcase, user manual, traceable calibration certificate.

NSG 438A-Auto Stand alone generator for Immunity testing in compliance with IEC 61000-4-2 and ISO 10605, up to 30 kV, with built in, switchable and **programmable 1 MOhm bleed OFF function**. Large graphical display and easy interchangeable networks. Includes Air discharge and contact discharge tips, pulse network per IEC 61000-4-2, **3 additional pulse networks for compliance to ISO 10605**, powerful battery for long time testing, mains power supply / battery charging unit, gun cradle, 25 mm discharge ball, optical interface for PC control, Interlock interface and emergency power OFF switch, suitcase, user manual, traceable calibration certificate.

15 OPTIONS AND ACCESSORIES

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15.1 Discharge networks



INA 4380	Discharge network 150 pF / 330 Ohm, per: IEC 61000-4-2(2001), (2008) ISO 10605 (2001), (2008)
INA 4381	Discharge network 150 pF / 2 kOhm, per: ISO 10605 (2001), (2008) SAEJ1113-13 GMW3091, GMW3094, GMW3097, GMW3100
INA 4382	Discharge network 330 pF / 2 kOhm, per: ISO 10605 (2001), (2008) SAEJ1113-13
INA 4383	Discharge network 150 pF / 330 Ohm, per: ANSI C63.16 - Hand / metal model
INA 4384	Discharge network 150 pF / 75 Ohm, per: ANSI C63.16 - Air discharge furniture model

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INA 4385	Discharge network 150 pF / 15 Ohm, per: ANSI C63.16 - Contact discharge furniture model
INA 4550	Discharge network 1000 pF / 2 kOhm, per: ES-X 44017 HMC (Hyundai Motor Company)
INA 4551	Discharge network 150 pF / 500 Ohm, per: JASO D001-87 and 94
INA 4552	Discharge network 500 pF / 330 Ohm
INA 4553	Discharge network 330 pF / 330 Ohm, per: ISO 10605 (2001), (2008) TL 824 66 (VolksWagen)
INA 4554	Discharge network 150 pF / 150 Ohm, per: SAEJ1455 A94
INA 4555	Discharge network 500 pF / 500 Ohm, per: MIL-STD-464 Stanag 4239
INA 4556	Discharge network 500 pF / 100 Ohm
INA 4557	Discharge network 2000 pF / 0 Ohm
INA 4558	Discharge network 200 pF / 150 Ohm
INA 4559	Discharge network 500 pF / 5 kOhm, per: Stanag 4239
INA 4560	Discharge network 200 pF / 100 Ohm
INA 4561	Discharge network 100 pF / 1500 Ohm, per: MIL 883
INA 4562	Discharge network 330 pF / 0 Ohm
INA 4563	Discharge network 50 pF / 0 Ohm
INA 4564	Discharge network 100 pF / 500 Ohm, per: Chrysler PF9326-D-May 00 Chrysler LP388-C-42
INA 4565	Discharge network 1500 pF / 2200 Ohm, per: VW 80972: 2001-10
INA 4566	Discharge network 150 pF / 1000 Ohm
INA 4567	Discharge network 150 pF / 0 Ohm
INA 4568	Discharge network 1000 pF / 0 Ohm
INA 4569	Discharge network 200 pF / 0 Ohm
INA 4570	Discharge network 500 pF / 2000 Ohm
INA 4571	Discharge network 500 pF / 0 Ohm
INA 4572	Discharge network 330 pF / 27 Ohm

INA 4573	Discharge network 1000 pF / 1000 Ohm
INA 4574	Discharge network 50 pF / 100 Ohm
INA 4575	Discharge network 100 pF / 50 Ohm
INA 4576	Discharge network 350 pF / 200 Ohm
INA 4577	Discharge network 100 pF / 0 Ohm
INA 4578	Discharge network 50 pF / 200 Ohm
INA 4579	Discharge network 650 pF / 350 Ohm
INA 4580	Discharge network 500 pF / 500 Ohm
INA 4581	Discharge network 400 pF / 250 Ohm
INA 4582	Discharge network 50 pF / 10 Ohm
INA 4583	Discharge network 50 pF / 3500 Ohm
INA 4584	Discharge network 250 pF / 1500 Ohm, per: UL 1023
INA 4585	Discharge network 150 pF / 300 Ohm
INA 4586	Discharge network 200 pF / 500 Ohm
INA 4587	Discharge network 330 pF / 500 Ohm
INA 4588	Discharge network 60 pF / 100 Ohm
INA 4589	Discharge network 50 pF / 10 kOhm
INA 4590	Discharge network 250 pF / 100 Ohm
INA 4591	Discharge network 250 pF / 500 Ohm
INA 4592	Discharge network 1000 pF / 1 Ohm
INA 4593	Discharge network 500 pF / 1000 Ohm
INA 4594	Discharge network 20 pF / 0 Ohm
INA 4595	Discharge network 1000 pF / 10 Ohm
INA 4596	Discharge network 270 pF / 100 Ohm
INA 4597	Discharge network 100 pF / 47 Ohm
INA 4598	Discharge network 1600 pF / 1500 Ohm
INA 4599	Discharge network 200 pF / 1500 Ohm
INA 4549	Discharge network 2000 pF / 150 Ohm
INA 4548	Discharge network 100 pF / 1000 Ohm
INA 4547	Discharge network 150 pF / 1500 Ohm
INA 4546	Discharge network 300 pF / 30 Ohm
INA 4545	Discharge network 100 pF / 100 Ohm
INA xxx	Special discharge networks according to specification: Specify standard, C and R value

15.2 Other accessories



INA 4411 - Fast risetime test tip. Where the rise time of 0.8 ns specified in most standards represents more than 80% of real cases, in extreme cases an ESD event may be faster. This can be simulated using this fast rise time test finger which generates rise times around 0.4 ns.



INA 4413x - Remote discharge tip with extension (specify R value xx). For applications where ESD pistol needs to stay away from EUT. Consists in Banana tip, HV extension cord of 1.5 meter, ended with resistor unit and set of air and contact test finger.



INA 4414 - Air discharge ball (discharge sphere). 15 mm diameter test tip adapter to be fixed on 8 mm air discharge test finger. To minimise corona discharge when testing in air discharge mode for higher voltages.



INA 4415 - Flexible tip set. Where the application makes access of EUT discharge point difficult. Ca 30 cm flexible extension adapter tips. Set of 2 tips, for air discharge and contact discharge mode.



INA 4416 - Soft touch contact tip. Very convenient adapter tip to test connector pins.



INA 4417 - Banana contact tip. To adapt to 4 mm banana plugs.



INA 4418 - Banana fastrisettime tip. To adapt to 4 mm banana plugs.



INA 4419 - E-Field adapter.



INA 4420 - H-Field adapter.



INA 4421 - Tripod support for NSG 437, 438. To adapt NSG 437 or 438 pistols to classics tripods as generally used for cameras.



INA 4423 - Carry case for NSG 437/438. Includes foam with professional cut outs for NSG 437, 438 and accessories.



INA 4430 - Charge remover (for NSG 438 and NSG 439 series only).



INA 417B - Opto-link to a PC with 10 m opto-cable (for NSG 438 and NSG 439 series only).



MD 103 - Target-Attenuator-Cable chain for ESD pulse calibration conforming to IEC 61000-4-2 and ISO 10605.



INA 103 - Calibration adapter set to MD 103. To calibrate MD 103 per specifications of IEC 61000-4-2 and ISO 10605.



INA 414 - Bleeder resistor cable (2 x 470 kOhm) - lenght 80 cm.



INA 414-2M - Bleeder resistor cable (2 x 470 kOhm) - lenght 2 meter.

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