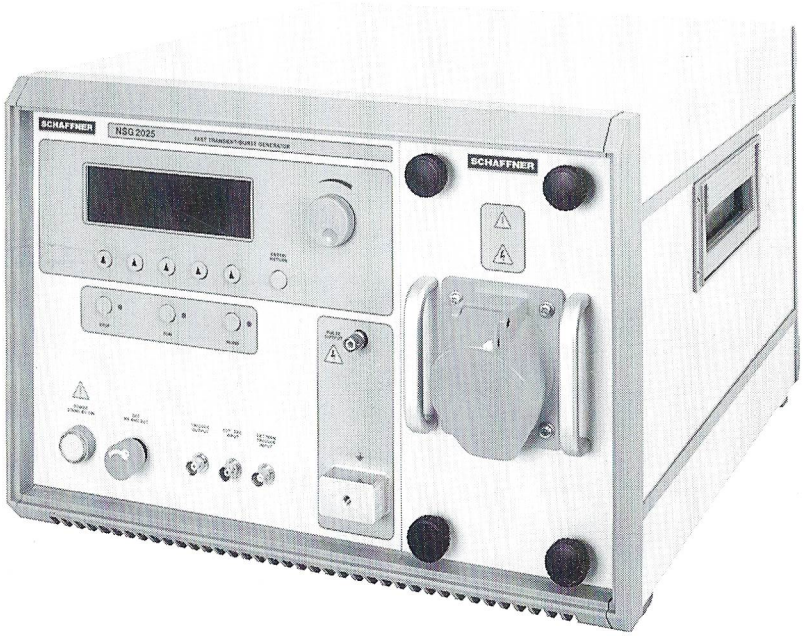
EMC High Frequency Burst Test System

NSG 2025

OPERATING INSTRUCTIONS



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1	**Safety advice**	1 - 1
	1.1 General	1 - 1
	1.2 Installation	1 - 2
	1.3 Test execution	1 - 2
	1.4 Danger concerning the generator	1 - 3
	1.5 Danger concerning the EUT	1 - 4
	1.6 Applicable safety standards	1 - 4
2	**Unpacking, storage and transport**	2 - 1
	2.1 General	2 - 1
	2.2 Storage and transport	2 - 1
	2.3 Unpacking	2 - 2
3	**Description of the instrument**	3 - 1
	3.1 Introduction	3 - 1
	3.2 Operating elements	3 - 2
	3.2.1 Front panel	3 - 2
	3.2.2 Rear panel	3 - 4
4	**Installation and power supply**	4 - 1
	4.1 Installation	4 - 1
	4.2 Location	4 - 1
	4.3 Power supply	4 - 1
	4.3.1 Instrument power supply	4 - 2
	4.3.2 EUT power supply	4 - 2
	4.3.3 Connections	4 - 3
	4.4 Front panel connections	4 - 4
	4.4.1 Coupling via the pulse output	4 - 4
	4.4.2 Trigger inputs and outputs	4 - 5
	4.4.3 EUT monitoring input	4 - 6
	4.4.4 Monitor output	4 - 6
	4.5 EUT connection	4 - 7
	4.5.1 EUT connection to banana sockets	4 - 8
	4.5.2 Connection via INA 25x output module	4 - 9

4.6 Connections to rear panel 4 - 10

4.6.1 EUT supply 4 - 10
4.6.2 Remote control port (RS 232) 4 - 11
4.6.3 External controlled CDN connection 4 - 12
4.6.4 Interlock 4 - 15

5 Description of functions 5 - 1
5.1 System configurations 5 - 1
5.2 Modular instrument construction 5 - 3
5.3 Block diagram 5 - 5
5.4 HV circuit diagram 5 - 6
5.5 EUT supply circuit 5 - 7

6 Operating instructions
6.1 Local operation 6 - 1
6.2 Operating states 6 - 1
6.3 Menu I: Normal, continuously shown display 6 - 2
6.4 Menu II: Setting the pulse data options 6 - 5
6.5 Validity range of data settings 6 - 6
6.6 System messages 6 - 7
6.7 Flow diagram with typical operating procedures 6 - 9

7 Function check 7 - 1
7.1 Function check 7 - 1

7.1.2 Pulse generator 7 - 2
7.1.3 Remote control 7 - 2
7.1.4 Mains coupling 7 - 2

7.2 Faults 7 - 3
7.3 Trouble shooting 7 - 5

8 Rack installation 8 - 1

9 Standards 9 - 1
9.1 Safety measures as per VDE 0104 9 - 1
9.2 Typical applications and standards 9 - 2
9.3 Summary of standards for the application 9 - 3
9.4 IEC 1000-4-4 (801-4) standard 9 - 4

10	**Maintenance**	10 - 1
10.1	Service	10 - 1
10.2	External care	10 - 1
11	**Replacement parts**	11 - 1
12	**Disposal**	12 - 1
13	**Technical specifications**	13 - 1
13.1	Electrical specifications	13 - 1
13.2	Dimensions	13 - 4
13.3	Environmental conditions	13 - 4
14	**Ordering information, Options**	14 - 1
14.1	Ordering information	14 - 1
14.2	Options	14 - 1
15	**Definition**	15 - 1
15.1	Abbreviations	15 - 1
15.2	Standards cited	15 - 3
16	**Addresses**	16 - 1

Manufacturer

SCHAFFNER ELEKTRONIK AG

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WARNING:

Lethal danger from high voltages and the risk of radiating illegal electromagnetic interference.

The NSG 2025 may only be installed and used by authorised and trained EMC specialists (electrical engineers).

The NSG 2025 must only be used for EMC tests as set down in these operating instructions.

1 Safety advice

The generators and their accessories work at high voltages.

Improper or careless handling can be fatal!

These operating instructions form an integral part of the equipment and must be available to the operating personnel at all times. All the safety instructions and advice notes are to be observed.

Neither SCHAFFNER Elektronik AG, Luterbach, Switzerland nor any of the subsidiary sales organisations can accept any responsibility for personal, material or consequential injury, loss or damage that results from improper use of the equipment and accessories.

1.1 General

Use of the generator is restricted to authorised and trained specialists.

The generator is to be used only for the purposes set down by the manufacturer.

The construction of the unit renders it unsuitable for use in an explosive atmosphere.

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

Only approved accessory items, connectors, adapters, etc. are to be used to ensure safe operation.

Advisory measures are described in these instructions as follows:

WARNING: For potential dangers that could result in serious injury or death.

CAUTION: For potential dangers or mishandlings that could cause light injuries or material damage.

1.2 Installation

The instrument conforms to protection class 1, but with an increased leakage current.

Local installation regulations must be respected to ensure the safe flow of leakage currents.

Operation without a protective earth connection is forbidden!

Two independent protective earth connections are necessary (instrument and EUT supply) connected back to the local permanent installation or to a fixed, permanent protective earth conductor.

Operate the equipment only in dry surroundings. Any condensation that occurs must be allowed to evaporate before putting the equipment into operation. Do not exceed the permissible ambient temperature, humidity or altitude.

Use only legally approved connectors and accessory items.

Ensure that a reliable return path for the interference current is provided between the EUT and the generator. The reference ground plane and the earth connections to the instruments as described in the relevant test standard serve this purpose well.

The instruments must generally not be opened. This may only be undertaken by a qualified specialist if specifically instructed to do so in the operating manual. Since the equipment generally works with two independent power supplies for the generator and the EUT, the instrument must first be disconnected from both sources before any changes are made. Besides the mains supply itself, certain instruments or parts thereof, also operate at high voltages which are not provided with any internal form of extra protection against being touched.

1.3 Test execution

The test area must be so organised that no unauthorised persons have access during execution of a test. If the safety contact (interlock) is used as a means of access control to the test zone (e.g. Faraday cage), then an additional contact in series is necessary to provide protection for parts of the EUT that are in danger of being touched.

EUTs, together with their accessories and cables, are to be considered as being live during a test. The test generator must be stopped and the EUT supply interrupted before any work is carried out on the EUT. This can be implemented by opening the interlock circuit, but depends on the type of generator in use.

The EUT is to be tested only in a protective cage or under a hood which provides protection against electric shock and all manner of other dangers pertaining to the particular EUT (see Dangers concerning the EUT).

The safety instructions concerning all the instruments and associated equipment involved in the test rig are to be observed.

The configuration of the test rig is strictly to be in compliance with the methods described in the relevant standard to ensure that the test is executed in a standard-conform manner.

1.4 Dangers concerning the generator

- Local burning, arcing, ignition of explosive gases.
- Danger from the resultant EUT supply current caused by a flash-over or breakdown resulting from the superimposed high voltage effects.
- Dangers from a disrupted EUT.
- Disturbance of unrelated electronics, telecommunications, navigational systems and heart pacemakers through unnoticed radiation of high frequency energy.
- In most test rigs the interference voltage is superimposed on the protective earth conductor of the EUT in accordance with the requirements of the test standard. Earth contacts or pins (e.g. in German and French connectors) as well as the EUT earth can hence be at a dangerous to touch voltage. The screws, too, in certain connectors are also linked to the protective earth conductor.

1.5 Dangers concerning the EUT

EUTs are often simply functional samples that have not previously been subjected to any safety tests. It can therefore happen that in some cases that the EUT is quickly damaged by internal overloads caused by the control electronics being disrupted or it may even start to burn.

- As soon as the EUT shows signs of being disrupted the test should be stopped and the power to the EUT switched off.
- Internal disruption of the electronics can result in the interference voltage or the EUT supply voltage being present on the EUTs housing.
- Electrical breakdown or arcing from and in plugged connections that are over-stressed voltage-wise during the test.
- Explosion of electronic components with fire or fragmentation as a result of the energy dissipated, e.g. from the resultant supply current or ignition of vaporised plastics materials.
- Faulty behaviour by the EUT, e.g. robot device strikes out, temperature controller fails, etc.

1.6 Applicable safety standards

Development and manufacture is in compliance with ISO 9001.

The equipment conforms to the safety requirements of IEC 1010-1/EN 61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use). The switching power supply conforms to IEC 950.

All mains driven types of generators are equipped for high voltage working safety in accordance with VDE 0104. Details see chapter "Standards".

The interference immunity has been tested in conformity with EN 50 082-1.

It is the user's responsibility to ensure that the test set up does not emit excessive radiation that may affect other equipment.

The generator itself does not produce excessive radiation, however applying Burst-pulses to an EUT may cause that EUT and its cables start radiating EMI.

The method recommended by standardisation bodies to prevent unwanted emission is to operate the test rig in a Faraday cage.

2 Unpacking, storage and transport

2.1 General

☞ Throw nothing away!

Packaging either:
- Keep for despatching the instrument to the calibration service
- Return to the relevant sales outlet
- Dispose of in an environmentally friendly manner, thus:

Packaging materials:		
	Carton:	cardboard
	Padding:	CFC-free polystyrene foam
	Plastic bags:	polyethylene

☞ Avoid the possibility of condensation occurring!

If a large temperature difference has been experienced, allow some hours to elapse to permit the temperature to stabilise before opening the package.

2.2 Storage and transport

- Do not stack, either packaged or out of the packing.
- Do not up-end, arrows on the packaging must always point upwards.
- Protect from dampness, heat, cold and rain.
- Do not throw.
- Do not sit or stand on the instrument and packaging.
- Despatch only in the original packaging or its equivalent.

2.3 Unpacking

- Is the packaging intact?
  If NO ✆ ➡ **transportation company**
- Are all the packages present and correct?
  If NO ✆ ➡ **transportation company**
- Open the packaging, remove the accessories.
- Lift the instrument out of the packaging by its side hand-grips.
- Are the instrument and the accessories intact?
  If NO ✆ ➡ **transportation company**
- Are the contents of the package complete according to the picking list?
  If NO ✆ ➡ **sales outlet**
- Keep the operating instructions with the instrument.
  (Copies can be ordered from the sales outlet)
  ✆ ➡ **sales outlet**
- Save the packaging.
  (Inform the sales outlet in advance if you intend to return the instrument)
  ✆ ➡ **sales outlet**

ATTENTION: An electrical function check is only permissible and possible by a trained specialist.

3 Description of the instrument

3.1 Introduction

This top class EMC test instrument for burst or electrical fast transient tests provides you with an efficient means to perform functional examinations on all types of electronic equipment to determine their susceptibility to electromagnetic disturbances.

The unit enables tests to be run that far exceed the requirements called for in the standards. All conceivable requirements have already been incorporated into the concept of the modular basic instrument which means that the need to purchase further modules and couplers can be dispensed with.

The instrument generates bursts of interference pulses simulating those produced by inductively loaded switches. Such interference pulses, with their very fast rise times, have a spectrum that extends to over 300 MHz and occur everywhere where currents are switched by means of electromechanical devices or connectors, e.g. with motors, circuit breakers and relays, fluorescent lamps, etc. Burst tests are hence demanded by practically all the relevant standards for the testing of electronic equipment in addition to testing with electrostatic discharges using the NSG 435.

§ Before you can inscribe your electronic products with the legally demanded CE symbol you must have performed an EMC test in conformity with **EN 50 082-1** or the appropriate product standard.

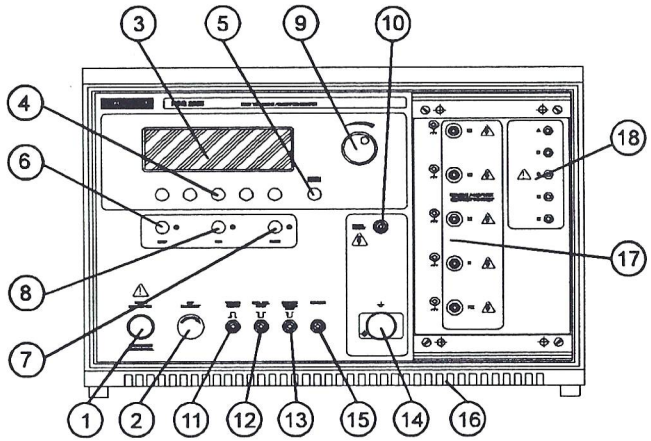
The NSG 2025 is the best choice for executing the interference immunity test with burst pulses called for in IEC 801-4 and the further standards that have been developed from it such as EN 55101-4, IEC 1000-4-4, Draft IEC 1000-4-4/2 third edition, VDE 0843, VDE 0846 Part 11, FTZ 12 TR 1, NAMUR, ANSI/IEEE C 62.41, RAI 12 etc.

The NSG 2025 test system fulfils not only the requirements of the IEC 801-4 (1988) standard and its derivatives but far exceeds them. Close to reality burst parameters without any compromises are hence available to you.

Many suggestions have been discussed internationally concerning the revision of the IEC 1000-4-4 standard. The NSG 2025 already incorporates the changes to the standard that have been discussed so that the investment in the instrument will hold good even when the standard is amended.

3.2 Operating elements

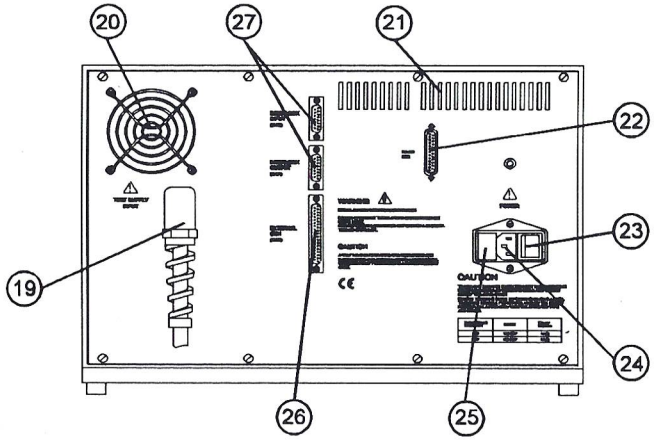
3.2.1 Front panel



1	"POWER" button	Toggle function "STAND-BY" < > "ON" with STAND-BY indicator. Push the button 10 secs after the mains has been activated.
2	"EMERGENCY OFF"	Emergency off function for use under computer and manual control. Switches the EUT supply off and puts the pulse generator into the "STOP" mode.
3	LCD display	Shows set values and system messages.
4	Function keys	Their active function is shown in the display.
5	"ENTER" key	Terminates each input and activates the selected function. Return to the basic menu.
6	"STOP" key	Stops the current test, switches the high voltage off and resets the timer for the test time. The green LED "STOP" indicates the 'stop' state.
7	"PAUSE" key	Puts the current test on hold and stops the timer for the test time without resetting it. Switches the HV on and enables the external trigger for single spikes. The HV switches off if no further function is executed within a period of 2 minutes. Orange "PAUSE" LED indicates the 'pause' state.

8	"RUN" key	Switches the high voltage on and, once the set level has been attained, starts the test running for the duration defined by the "Test time" timer. If the test time is set to 0 seconds then only the HV is switched on and a single burst is generated each time the key is pressed. The generator goes into the "STOP" state in the absence of any triggering. Red "RUN" LED Indicates the 'run' state.
9	Hand-wheel	To alter the selected parameter.
10	HV socket	HV-OUT for direct pulse output to a coupling clamp and for calibration of the pulse characteristics.
11	Trigger output	Trigger pulse approx. 20 ns before the first spike in a burst for CRO synchronisation.
12	EUT-Fail input	To monitor the state of the EUT. The generator is put into the "STOP" state and message 115 is displayed when this input is activated.
13	Trigger input	To trigger single spikes in the "PAUSE" state.
14	Earth connection	Return path from the ground reference plane.
15	Monitor output	Attenuated pulse output. (See calibration data for precise value into 50 Ω load)
16	Ventilation slots	
17	EUT connections	The earth socket beside each connector serves as the measurement earth point during calibration of the pulse data on the EUT supply.
18	Indicators	For interlock, voltage limitation and 1 or 3-phase coupling settings.

3.2.2 Rear panel



19 Connecting cable for EUT supply

CAUTION: Yellow/green is the protective earth, blue the neutral line and brown the reference phase

20 Fan, air outlet

21 Ventilation slots

22 Remote control connector, 25-pin RS 232, DCE, without HW control lines 9600 baud, 8-bit, even parity, 1 stop bit

23 Mains switch

24 Mains input for generator power supply

25 Voltage selector with fuse for the generator supply

26 Connector for controlling an external coupling device

27 Connectors for interlock

4 Installation and power supply

4.1 Installation

Apart from the power connections, no further installation is necessary for manual operation of the instrument.

The test rig itself must, however, be configured precisely in accordance with the relevant standard and test plan to enable standard-conform burst tests to be carried out. An earth reference plane of at least 1 m² is necessary together with a minimum spacing from nearby walls of 0.5 m.

4.2 Location

A screened room (Faraday cage) is the only location that may be considered. Only trained, authorised personnel without a heart pacemaker should be granted access. The ambient conditions should be within the specifications of all the equipment involved.

An environment as per IEC 68-1-(1988) is recommended:

Ambient temperature:	15 °C	to	35 °C
Relative humidity:	25 %	to	75 %
Air pressure:	86 kPa	to	106 kPa

The ventilation slots on the instrument must not be blocked.

The free space should be large enough so that a tidy, standard-conform test rig can be arranged for all the expected types of EUT, equipped with a ground reference plane and providing at least 0.5 m distance from any walls.

4.3 Power supply

The NSG 2025 has two independent power supply inputs:

(1) Instrument supply via an IEC 320/IV equipment connector

(2) EUT supply via mains cable, 3 or 5 poles

WARNING: The EUT supply produces earth leakage currents of up to 30 mAmps with 50/60 Hz supplies and up to about 150 mAmps with 400 Hz / 120 V supplies because of the coupling capacitors and filter involved. The NSG 2025 must hence by efficiently earthed.

One of the following additional protective measures is likely to be necessary, depending on local regulations:

- Permanent connection of the EUT supply cable incl. the earth conductor.
- Permanently connected additional earth conductor.
- Both power feeds as well as the earth lines to be connected separately to the building's fixed installation.

CAUTION: RCD circuit breakers rated at ≤ 30 mAmps can be triggered by the EUT supply. This may happen while the instrument is in operation.

4.3.1 Instrument power supply

This can be connected to a 100, 115, 220, 230 or 240 Volt, 50/60 Hz mains outlet. The voltage selector is to be set to suit the local conditions (for 100/115 V set to 115 V and for 220-240 V set to 230 V).

Permissible mains voltage tolerances:	100 and 220 V	- 10% +15%
	115 and 230 V	± 10 %
	240 V	+6% -15%

It is imperative that a protective earth connection is also provided.

4.3.2 EUT power supply

CAUTION: The instrument is only equipped with a temperature sensor on the mains coupling. A suitable fuse must be provided separately in the external installation.
Maximum permissible nominal rating for the fuse, according to the CDN specification: either 16 Amps or 25 Amps.

We recommend a permanent connection to a junction box with a fuse and switch. This box can also provide a protective earth connection for the reference ground plane as well as outlet sockets for the instrument supply (1) and further equipment. The switch enables the whole test rig to be rendered voltage-free.

The fuse can be selected to suit the EUT so that the damage can be minimised in the event of a failure occurring. The nominal fuse rating must never be higher than that of the CDN, however. **The current in the neutral line must never exceed the nominal current rating of the CDN.**

Typical EUT supplies: (1 or 3-phase, 4-wire supply, 16 Amps CDN version)

$V_{L\rightarrow N}$	$V_{L\rightarrow L}$	Frequency Hz	Imax 1 min (L and N)	Imax cont. (L and N)	Max. fuse rating (slow blow)
24...240 V	24...440 V	40...70	20 Amps	16 Amps	16 Amps
5 ... 50 V	5 ... 60 V	DC...40	16 Amps	16 Amps	16 Amps
48...120 V	48...210 V	70...400	10 Amps	10 Amps	10 Amps

Typical EUT supplies: (1 or 3-phase, 4-wire supply, 25 Amps CDN version)

$V_{L\rightarrow N}$	$V_{L\rightarrow L}$	Frequency Hz	Imax 1 min (L and N)	Imax cont. (L and N)	Max. fuse rating (slow blow)
24...240 V	24...440 V	40...70	32 Amps	25 Amps	25 Amps
5 ... 50 V	5...120 V	DC...40	25 Amps	25 Amps	25 Amps
48...120 V	48...210 V	70...400	25 Amps	16 Amps	16 Amps

CAUTION: Electronic frequency inverters and dc power supply units can be disrupted or damaged by the feedback effects of the burst signal.

The link between the protective earth connection and a protective earth conductor is to be established before any other connections are made.

4.3.3 Connections:

Cable:	Protective earth	PE:	yellow / green
	Neutral line	N:	blue
	Phase (reference)	L1:	brown
	Phase	L2:	black (3-phase units only)
	Phase	L3:	black (3-phase units only)

Terminals on the unit: *3-phase or 25 Amps instrument:*

Protective earth	PE:	Screw terminal on the side panel
Neutral line	N:	Terminal 14 ND
Phase (reference)	L1:	Terminal 3 T1
Phase	L2:	Terminal 4 T2
Phase	L3:	Terminal 6 T3

1-phase 16 Amps instrument:
6.3 mm spade connectors on the relay,
colours as neighbouring conductors.

L1 must always be used as the phase line in single phase connections.

4.4 Front panel connections

4.4.1 Coupling via the Pulse Output

CAUTION: The majority of the accessories for burst generators are only designed for use up to 4.4 kV.

Voltage settings of more than 4.4 kV are only permissible for accessory items that have been designated for that purpose.

The appropriate connector should always be mounted directly and carefully on the cable. Adapters do not generally have a sufficiently high voltage rating.

Do not set the burst voltage higher than the breakdown voltage rating of the connected parts.

Coupling clamp

If the burst interference is to be injected into signal lines by means of a coupling clamp then this should be plugged into the "PULSE OUTPUT" of the NSG 2025. An SHV socket has been provided in order to withstand the maximum open-circuit voltage of the 8 kV version.

The coupling clamp type CDN 126, which is available as an accessory, is constructed in conformity with the requirements of IEC 1000-4-4 (IEC 801-4). Mechanically it is the same as the CDN 125 but has SHV connectors for the signal and an interlock switch for additional touch-danger prevention which forces the NSG 2025 into the "STOP" state if the clamp is opened.

Select "OUT" in the coupling menu to feed the burst pulses to the coupling clamp. This automatically de-selects any other line coupling.

If the interlock facility is not required then the CDN 125 coupling clamp with the INA 263 connecting cable can be used with the 4.4 kV version.

NOTE:

We recommend powering the EUT through the integral CDN even when working with a coupling clamp. The EUT power supply is thereby still fed through the decoupling circuit and is hence connected to a reproducible source impedance. Any tendency for interference currents to creep back to the mains supply will be prevented by the mains filter in the CDN.

Attenuators and terminations

Carefully check the load capability of any attenuators or terminating elements that are to be connected to the "PULSE Output". Even apparently robust attenuators can quickly deteriorate and burn out.

In the majority of cases only those components with a continuous rating of 500 to 2000 Watts are sufficient for the task. In order to detect any degradation at an early stage, a regular and very accurate check should be made on the ohmic value of the impedance from input to earth, input to output and output to earth. Any change that is detected points to small breakdowns in or on the resistor bodies and is a warning of imminent destruction.

4.4.2 Trigger inputs and outputs

External triggering:

The BNC connector "EXT/MAN TRIGGER Input" on the front panel is active when the instrument is in the PAUSE mode.

The external trigger causes a spike to be generated. The delay is about 150 ns. The maximum permissible spike density (frequency as well as duty ratio) is monitored. System message 119 is displayed if the permissible value is exceeded and spike generation is inhibited at the same time.

Control is by means of TTL/CMOS logic up to 15 V or a contact to ground, current approx. 1mAmps.

This function allows you, for example, to perforrm the following modes of operation:

- Externally generated frequency modulations
- Synchronisation of spikes on external signal line
- Simulation of noise by pulse modulated transmitter (Digital-phone)

Arbitrary or random spike triggering can also be generated via this input within the constraints of the maximum permissible spike density.

Trigger output:

The "TRIGGER OUTPUT" BNC connector on the front panel serves to synchronise an oscilloscope. A trigger pulse of >1.5 V into 50 Ω (open-circuit up to 15 V) and approx. 1 µs pulse width is produced about 20 ns before the first spike of each pulse burst.

4.4.3 EUT monitoring input:

The "EUT-Fail INPUT" BNC connector on the front panel serves to enable integrity monitoring of the device under test.

The generator is set to the "STOP" state when this input is activated and the system message "INFO 115" is displayed.

Control is by means of TTL/CMOS logic up to 15 V or a contact to ground, current approx. 1mAmps.

The circuitry for recognising faulty EUT operation is dependent on the type of EUT involved in each case and is generally different for every test. An EMC-friendly means of connection to the system must be provided.

4.4.4 Monitor output

This output has an attenuation of 1000 : 1 and permits an oscilloscope to be connected to display the spikes or burst packages. The oscilloscope needs to be set to 50 Ω input impedance otherwise reflections might give rise to a corrupt picture of the pulse.

This output is not designed for calibration measurement purposes.

4.5 EUT connection

The NSG 2025 is equipped with an integral coupling network (CDN) to superimpose spikes on a single or three-phase supply.

The following possibilities are available for connecting the EUT:

1 Connection via the safety laboratory connectors incorporated in the basic unit.

CAUTION: Only laminated plugs that are rated for 30 Amps may be used.

Respect the sequence: PE → N → Phase line

2 Use of an output adapter with the relevant connector arrangement. The maximum pulse voltage is restricted to 4.5 kV for the majority of connector types and hence the use of IEC 309 types is recommended for bursts > 4.5 kV.

It is imperative that the effective value of the neutral line current is monitored in the case of electronic 3-phase loads. It must not continuously exceed the nominal current rating of the CDN.

The supply is switched by either an isolating relay (16Amps version) or a circuit breaker in the NSG 2025. This relay or circuit breaker is actuated by the control circuitry in series with a supplementary hardware contact on the emergency off button.

WARNING: The supply can be switched on automatically and be time-controlled by the software when the generator is under remote control by a computer.

Potential-free conditions can only be assured if the emergency off button is latched in or the supply to the instrument is switched off at the mains switch on the rear panel. A burst voltage of 8 kV can break down or arc across normal mains insulation.

The type of connector used depends on the requirements of the test, thus:

The banana connectors directly on the instrument are available to the specialist who demands the highest technical performance from the test rig. An earth socket next to each connector enables coaxial cables also to be used for the EUT supply. Further, pulse verification for measurement purposes can be carried out via commercially available banana-coax adapters exactly at the EUT connection point.

The output module INA 25x with a country-specific standard outlet can be used for routine tests with greater convenience. This provides the user with the highest degree of safety while permitting the EUT to be changed quickly.

The mode of coupling must be in conformity with the relevant standard. There are standards in existence that only ever subject one line to the interference signal and others that superimpose the signal on all the lines simultaneously. Any mode of coupling can be freely chosen with the NSG 2025.

4.5.1 EUT connection to the banana sockets

1 Press the emergency off button

2 Pull out the fixings on the cover plate

3 Remove the plate

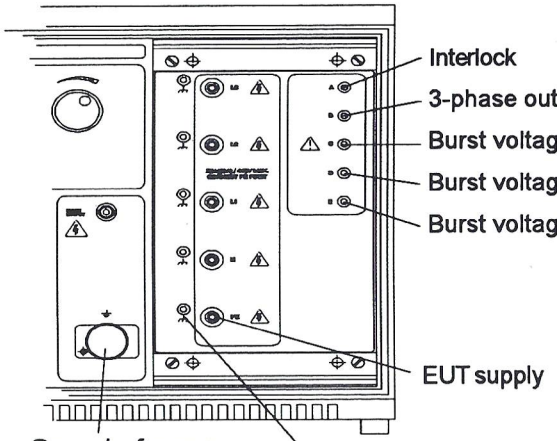
4 Connect the EUT cable
CAUTION: Only laminated plugs that are rated for 30 Amps may be used.
Respect the sequence: PE → N → Phase line

5 Replace the cover plate, press in the fixings. (The interlock system inhibits the instrument if the cover plate is missing)

6 Release the emergency off button by turning it to the right.
> The instrument is ready to operate. The EUT supply can be switched On and Off in the menu "COUPLING".

The cable type RG 213 is recommended if tests are to be made using coaxial cables for the EUT supply. The cross-section of the core conductor is adequate for 16 Amps.

EUT connection field



Vmax	V1	V2	V3
8 kV	•	•	•
6 kV		•	•
4.5 kV	•		•
3 kV			•
1.5 kV	•	•	
800 V		•	
500 V	•		
0 V			

4.5.2 Connection via an INA 25x output module

Installing the INA 25x:

1 Latch-in the emergency off button
2 Pull out the cover plate fixings
3 Remove the plate
4 Carefully plug in the output module
5 Press in the fixings
6 EUT can be connected to/disconnected from the standard connector

WARNING: In the case of plugs with exposed earth connections (Schuko and F/B sockets, INA 252 and 254) or any plug with exposed metal parts, e.g. screws, there is a danger of coming into contact with the pulse voltage if coupling is made into the protective earth line. Depending on the type of pulse involved, this could mean the danger of local burning or a potentially lethal shock.

CAUTION: It is essential to use good quality, well mounted plugs since otherwise the necessary breakdown and arcing strengths will not be achieved amongst other problems.

Output modules available:

Type	Country	Plug type	Mains	Imax.	Max. burst voltage	Lines	Housing colour
INA250	all	IEC 309 CEE-17/32-6h	400 V	32 Amps	8 kV	L1/L2/L3/ N/PE	red
INA251	all	IEC 309 CEE-17/16-6h	230 V	16 Amps	8 kV	L1/N/PE	blue
INA252	D/NL/S/ I/E/N/ SF/A	SCHUKO CEE-7/IV IEC-83/C2b	230 V	16 Amps	4.5 kV	L1/N/PE	brown
INA253	CH	Type 13	230 V	10 Amps	4.5 kV	L1/N/PE	brown
INA254	F/B	53019 NFC 61303	230 V	16 Amps	4.5 kV	L1/N/PE	brown
INA255	GB	BS 1363 A IEC-83/B2	240 V	13 Amps	4.5 kV	L1/N/PE	brown
INA256	USA	UL 498/13 NEMA 5-15 P IEC-83/A5-15	115 V	15 Amps	4.5 kV	L1/N/PE	white
INA257	all	IEC320/C13	115/ 230 V	10 Amps	4.5 kV	L1/N/PE	black or grey

Other connectors in the IEC 309 family as well as signal and telecom plugs are possible upon request. The voltage limitation is coded according to the specific type or application.

4.6 Connections to rear panel

4.6.1 EUT supply

The supply is normally permanently connected to the instrument. It is to be protected by a fuse ahead of the generator to suit the user's application but with a rating that does not exceed the nominal current rating of the CDN. A temperature monitoring facility supervises the decoupling chokes inside the NSG 2025 itself. Should this be triggered the EUT supply is switched off and the display shows INFO 114.

4.6.2 Remote control port (RS 232)

Remote control from a computer is achieved through the RS 232 port.

Since the primary function of the NSG 2025 is the generation of high energy interference pulses, any electrically connected interface must work with an optical link to prevent EMC problems or even destruction occurring. Such an opto-link also enables the computer to be operated outside the Faraday cage.

Opto-link modules are available from SCHAFFNER as accessories.

The interface port is configured as follows:

Baud rate:	9600
Parity:	even
Data-bits:	8
Stop-bits:	1
Mode:	DCE

Pin-out:

Pin 1	Protective ground
Pin 2	Input (Rx)
Pin 3	Output (Tx)
Pin 7	Signal ground
Pin 18	+ 12 V
Pin 25	- 12 V

Remote control

A number of control software possibilities can be considered:

1 SCHAFFNER Program **WIN 2025**:

This is a complete, comprehensive, "ready-to-work" Windows™-based control surface which offers the possibility to store whole control sequences, ramping functions and result logging.

2 SCHAFFNER-INTEPRO **POWERSTAR™**:

This is a very versatile software system that enables whole test rigs with instruments from various manufacturers to be controlled. All types of measurement and evaluation are supported so that a comprehensive assessment of the state of the EUT is possible.

3 Application with standard programming environments for measuring instruments:

Programming environments that may be considered are: VEE™ from *hp* as well as LabWindows™ from *National Instruments*.

4.6.3 External controlled CDN connection

The 37-pin D-subminiature socket contains all the necessary signals which are needed for control and supervision of an external CDN.

Outputs: Following outputs are available
- K0-K4 for selection of the required coupling mode
- EUT_POW for controlling the power switch of the EUT supply
- WL_GRN signal equipment ready (software signal)

Signal type: Potential-free opto-isolator output ("a" and "b")
Nominal voltage 400 Vdc max., current 500 mAmps max.
Internal impedance 250 Ω
A number of outputs of this type may be connected together in parallel or in series.

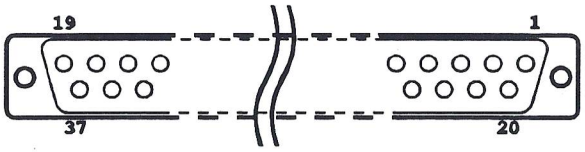
Input: Following inputs are available
CDN temperature control (supervision of limiting value)
CDN single phase
External limitation of burst voltage setting range

Signal type: Active high (+6 V to +24 V)
Threshold level: 1 to 4 V
Source voltage: 12 V with a source impedance of 120 Ω which is available at the connector on Pins 1, 14, 20 and 33.

Pin	Signal	Description
1	PP 12 V	12 V DC Supply (max. 100 mAmps)
2	GND	Connected to ground via choke
3	EUT_POW1	AC/DC switch for EUT power in an external CDN
4	K4 1	AC/DC switch for EUT coupling PE in external CDN
5	K3 1	AC/DC switch for EUT coupling L1 in external CDN
6	K2 1	AC/DC switch for EUT coupling N in external CDN
7	K1 1	AC/DC switch for EUT coupling L2 in external CDN
8	K0 1	AC/DC switch for EUT coupling L3 in external CDN
9	WL_GRN 1	AC/DC switch for warning lamp
10	NC	---
11	RES	JS 1
12	RES	JS 3
13	GND	Connected to ground via choke
14	PP 12 V	12 V DC-Supply (max. 100 mAmps)
15	GND	Connected to ground via choke
16	V1PH	External CDN: Selection of phases
		High (12V) = PE, N, L1 Low (0V) = PE, N, L1, L2, L3
17	V3KV	External CDN: Voltage limitation High (12V) = active Low (0V) = inactive
18	TEMP	External CDN: Temp. overload High (12V) = active Low (0V) = inactive
19	GND	Connected to ground via choke
20	PP 12 V	12 V DC-Supply (max. 100 mAmps)
21	GND	Connected to ground via an inductor
22	EUT_POW2	AC/DC switch for EUT power in external CDN
23	K4 2	AC/DC switch for EUT coupling PE in an external CDN
24	K3 2	AC/DC switch for EUT coupling L1 in external CDN
25	K2 2	AC/DC switch for EUT coupling N in external CDN
26	K1 2	AC/DC switch for EUT coupling L2 in external CDN
27	K0 2	AC/DC switch for EUT coupling L3 in external CDN
28	WL_GRN 2	AC/DC switch for warning lamp
29	NC	---
30	RES	JS2
31	NC	---
32	GND	Connected to ground via choke
33	PP12V	12 V DC-Supply (max. 100 mAmps)
34	GND	Connected with a inductivity to ground
35	V2KV	External CDN: Voltage limitation High (12V) = active Low (0V) = inactive
36	V1KV	External CDN: Voltage limitation High (12V) = active Low (0V) = inactive
37	GND	Connected to ground via choke

EUT power and coupling are optically insulated (max. 400 Vdc, max.150 mAmps)

Pin assignment



The input that results in the severest limitation on the operation of the instrument, internal or external, always carries the highest priority.

The CDN overheat input will prevent the EUT supply being switched on and is indicated by a system message.

Activating the CDN 1-phase input (+6 V to +24 V) has the effect of precluding the setting possibilities for L2 and L3 (for internal and external CDN).

The maximum possible setting for the burst voltage can be reduced by means of the voltage limitation facility inputs 1 to 3 (activation with +6 V to +24 V). The voltage limitation facility is used for connection systems whose insulation is not suitable for the full burst voltage of 8 kV. The inputs can also be used as an external limiting device to protect the EUT.

The following table shows the possible stages of voltage limitation:

Maximum voltage	Voltage limitation 3	Voltage limitation 2	Voltage limitation 1
8000 V (8 kV type only)	0	0	0
6000 V (8 kV type only)	0	0	1
4500 V	0	1	0
3000 V	0	1	1
1500 V	1	0	0
800 V	1	0	1
500 V	1	1	0
0 V	1	1	1

4.6.4 Interlock

The NSG 2025 has an integral interlock system in keeping with the kind of safety standard expected of a high voltage test instrument.

This system has the following functions:

Inputs:

1 Monitoring the presence of the cover plate over the banana sockets for connecting the EUT.

Prevents live connectors from being touched as well as stopping plugs from being inserted in or withdrawn from them.

This function is dispensed with when working with tested standard mains connectors and suitably adjusted maximum burst voltage. (IEC 309 types up to 8 kV, conventional 16 Amps / 250 V domestic plugs up to 4.5 kV).

2 Input for external monitoring, e.g. from special coupling networks and access control restrictions.

3 Emergency off opens the interlock circuit.

Outputs:

1 Operating mode: The NSG 2025 cannot be switched to RUN or PAUSE if the interlock circuit is not closed. The STOP function is activated if the interlock circuit is opened while the generator is in the RUN state.

2 EUT-Power: The EUT power supply cannot be switched on if the interlock circuit is not closed. The EUT supply is switched off if the interlock circuit is opened while the supply is switched on.

3 Warning lamps: The green lamp is switched off and the red one on when the interlock circuit is closed.

4 Display: An open interlock circuit is shown on the display by an open switch symbol.

5 Status messages to the remote control computer.

6 Interlock output for other system equipment.

The interlock system for all the equipment in the ProfLine range has the same configuration and hence numerous items can be successfully connected together.

Each instrument is equipped with two 15-pin connectors which serve as the interlock input and output respectively. The interlock circuit must always be terminated at both ends with the relevant conductors being looped through the various safety contacts in the system. This is achieved automatically when using original SCHAFFNER accessories by making the connections to the interlock connectors with 15-way standard cables wired on a 1:1 basis. An arbitrary number of instruments and/or accessory devices can be incorporated in the safety concept.

The high voltage and the EUT supply are only enabled if the safety conditions are fulfilled at every unit that is connected (emergency stop button unlocked, safety concept closed, etc.)

The interlock function must be implemented for the control of warning lamps to comply with VDE 0104. Once the interlock circuit is closed, the instruments are able to be switched on and the red lamp lights up.

If an instrument is to be used without an external interlock contact then the two terminating connectors supplied must be inserted.

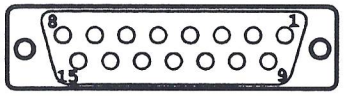
Signal levels:	Voltage	48 Vdc max.
	Current	20 mAmps min. /1 Amp max.
Connector:	15-pin sub-min D-socket	
Max. permissible cable length:	3 m each, screened (safe operation is guaranteed up to 10 m)	

Actuation is via potential-free switch contacts.

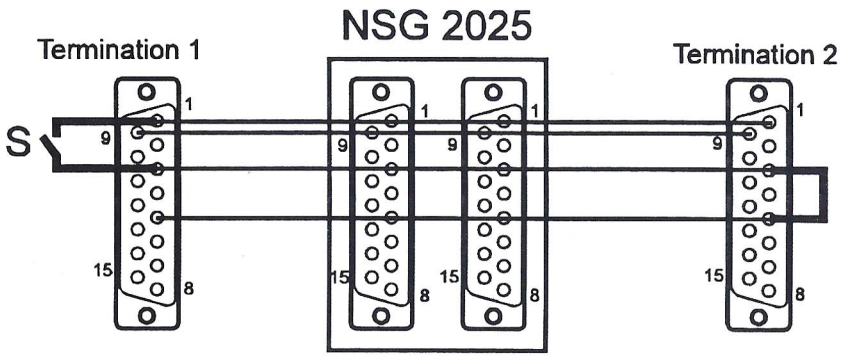
All signals are active LOW, i.e. switched to GND.

The pin-out at the interlock input and output connectors is identical. All the pins are individually interlinked whereby the internal connection between the two pins 3 can be interrupted by the emergency stop button or the internal interlock facility when either is activated.

Pin No.	Function
1	GND, 0 V
2	NC, linked to the other interlock connector
3	Interlock input/output (internal switch)
4	NC, linked to the other interlock connector
5	Interlock status (triggers the interlock function in the instrument and switches the relay at +12 to +48 V for this purpose)
6	NC, linked to the other interlock connector
7	NC, linked to the other interlock connector
8	NC, linked to the other interlock connector
9	Switch warning lamps and peripherials on (Active as soon as the NSG 2025 is switched from Standby to ON)
10	NC, linked to the other interlock connector
11	NC, linked to the other interlock connector
12	NC, linked to the other interlock connector
13	NC, linked to the other interlock connector
14	NC, linked to the other interlock connector
15	NC, linked to the other interlock connector
Housing	Screen



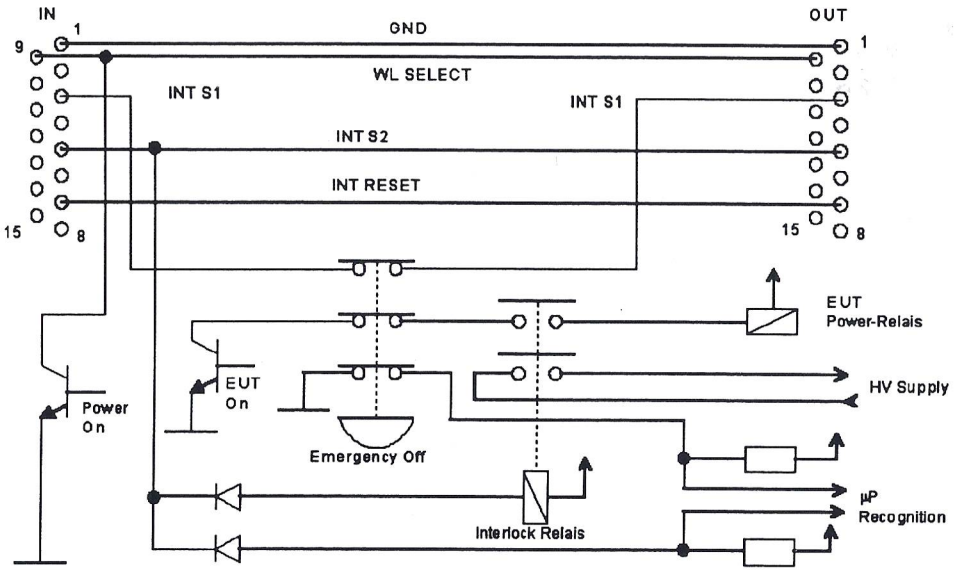
15-pin Connector



Circuit diagram of the interlock system
S: external safety switch (e.g. test hood, door-switch, safety button, etc.)

A number of such interlock inputs can be connected in parallel.

The safety contacts must be connected in series when several access safety barriers are necessary. An open contact or an input raised to more than 1.5 V is enough to inhibit the instrument.



Internal circuit diagram of the instrument

5 Description of functions

The NSG 2025 belongs to the new family of SCHAFFNER ProfLine system units. These instruments have high performance microprocessor control and generously dimensioned high voltage and power components.

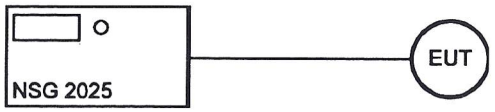
Following is a description of the functions from the outside to inside.

5.1 System configurations

A Autonomous manual control

of the test instrument to execute tests with one type of interference

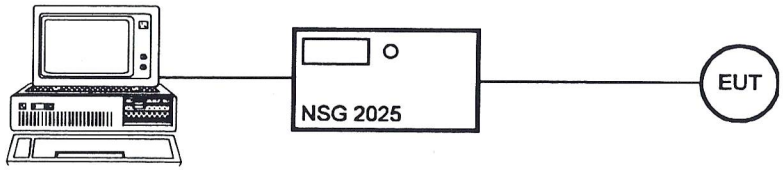
- Economical
- Simple
- Fast



B Computer control of the instrument

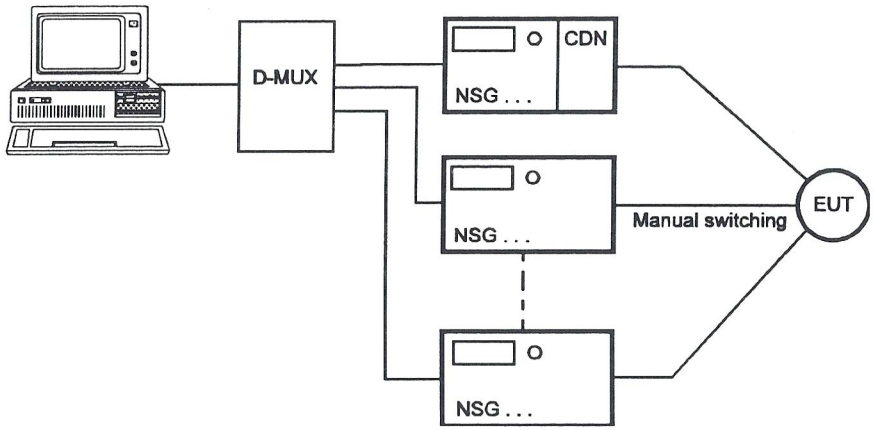
Automatic running of test sequences incl. coupling switching under software control.

- "Ramping" of the set parameters
- Printout of the test results
- Remote control
- Large, clearer display screen
- Cost-effective system



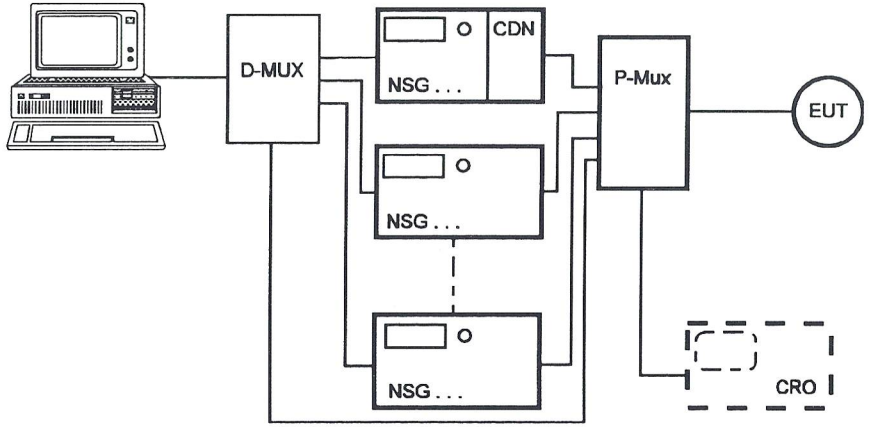
C Test system with multiple types of interference

- Common Windows™ user-interface for all types of instrument
- Test sequences are programmable
- The EUT is connected directly to the relevant test instrument hence making "reference" test results possible without the unavoidable effects on the fast pulses caused by reflections in connecting cables and multiplexers

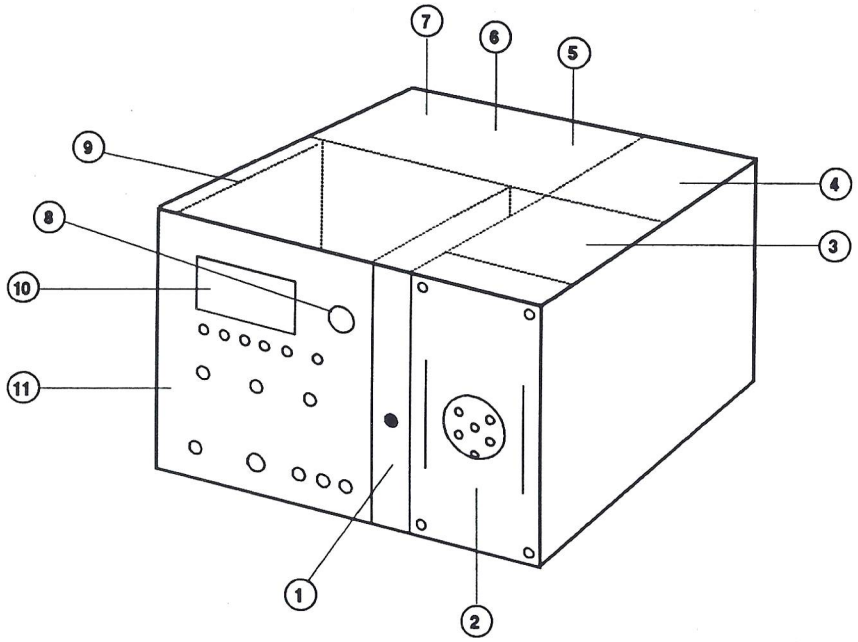


D Test system with automatic switching of the interference type by means of multiplexers

- Complete interference immunity tests with all mains-superimposed types of interference can be executed automatically
- Complete test report on an EUT



5.2 Modular instrument construction



1 **Pulse generator** with proven solid state high voltage switch and vacuum relay for polarity selection and switching between the coaxial pulse output and the coupling network. The pulse generator is available in two versions:

Version 1:	200 Volt ... 4400 Volt	up to 1 MHz
Version 2:	200 Volt ... 8000 Volt	up to 500 kHz

2 **The EUT connector** is available as MC safety sockets in a recess in the front panel. In addition there is the interlock and coding for the maximum permissible pulse voltage setting.

- A touch preventative cover with interlock is fitted as standard
- Modules with the various standard sockets are available optionally. The maximum burst voltage is set to suit the particular connectors.

3 **CDN module**: This is available in three versions:

Version 1:	1-phase, 3-wire up to 16 A continuous
Version 2:	1-phase, 3-wire up to 32 A (25 A continuous)
Version 3:	3-phase, 5-wire up to 32 A (25 A continuous)

4 **EUT power connection**: The mains cable for the EUT power connection is wired to a terminal strip and is hence easily exchangeable. This is the safest and most space-saving method of connection.

5 **HV capacitor**: The high power peak demanded by a 4.4 kV / 1 MHz or an 8 kV 500 kHz burst is delivered from the high voltage storage capacitor.

6 **HV supply**: A 50/60 Hz transformer with voltage switching on the primary side generates the supply voltage for the fly back converter which produces the high voltage.

7 **Power unit**: The supply to the instrument's electronics is provided by a switching power supply unit having an input voltage range from 85 to 264 V. The power unit complies with the requirements of IEC 950.

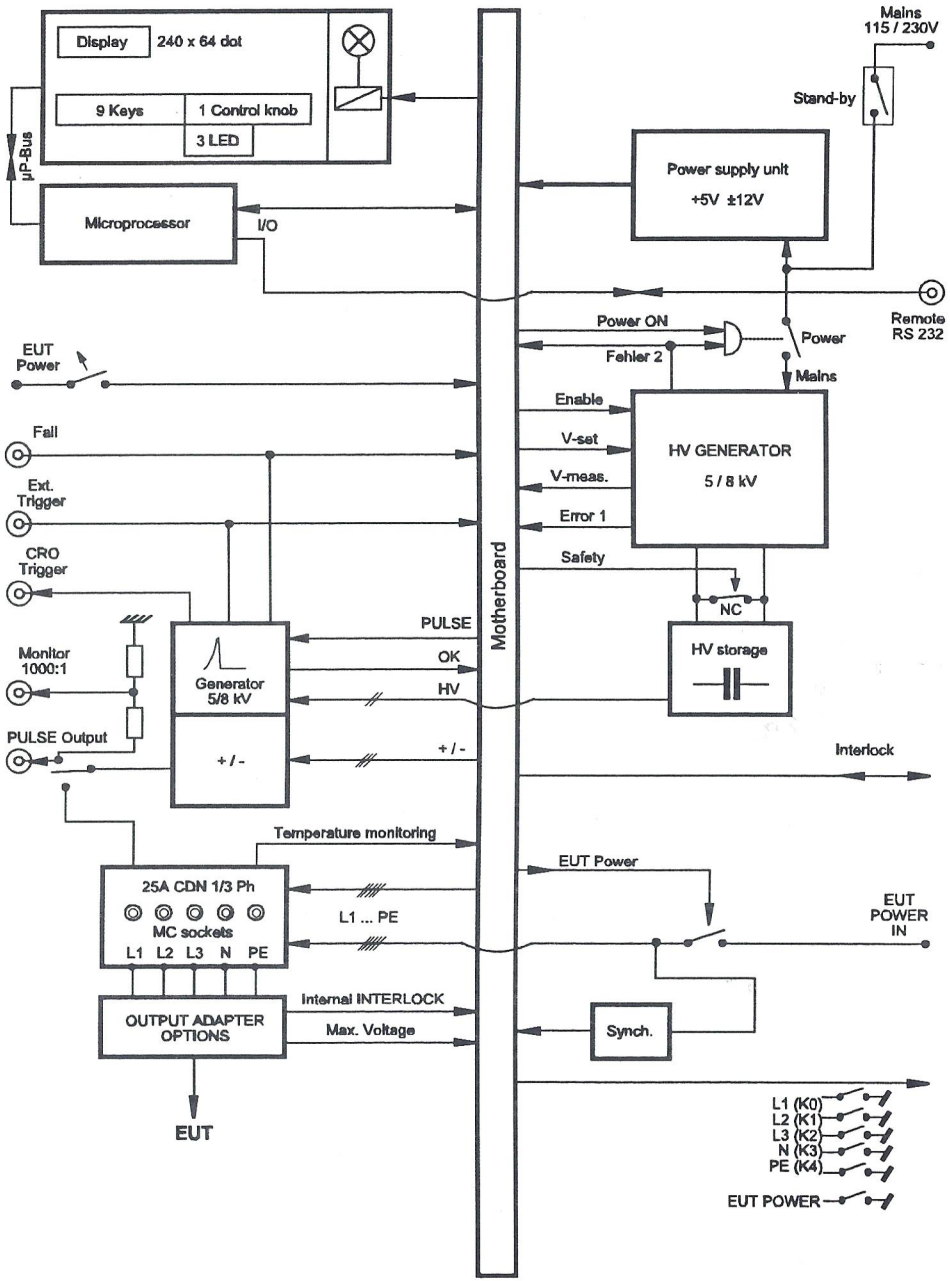
8 **Hand-wheel**: This permits the simple, quick and quasi analogue setting of the test data. Important parameters can be continuously altered during operation as though by a potentiometer.

9 **µP-control**: The heart of the control circuitry is a state of the art, efficient 16-bit microprocessor in SMD technology.

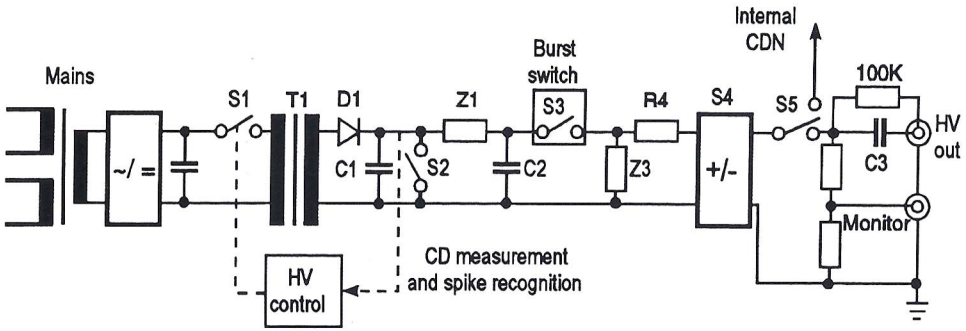
10 A large, graphical **LCD display** panel with background lighting, shows the currently set values and enables local operation to be carried out rapidly and simply. A three-coloured background display is available as an option (INA 2025).

11 The generously dimensioned **EMC casing** provides adequate space for a tidy, service-friendly form of construction with good ventilation and screening.

5.4 HV circuit diagram

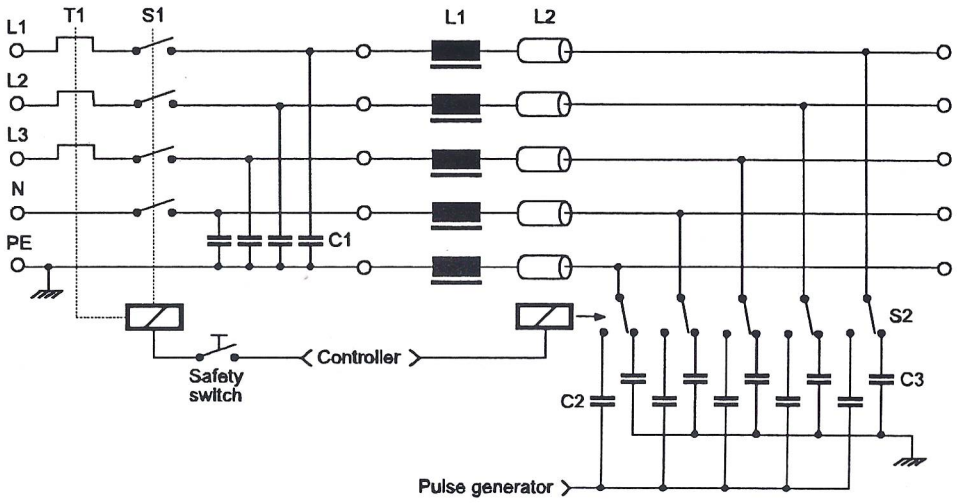


5.4 HV circuit diagram



S1 HV On/Off relay and voltage regulator
T1 HV transformer
D1 HV rectifier
C1 HV energy storage
S2 Safety discharge switch
Z1 Decoupling
C2 Spike storage capacitor
S3 Fast solid state switch
Z3 Impedance for pulse width stabilisation
R4 Source resistor
S4 Polarity changeover
S5 Changeover relay for pulse output coax socket ∫ internal CDN
C3 Decoupling capacitor

5.5 EUT supply circuit



T1 Thermal overload protection (option)
S1 EUT supply circuit breaker / relay
C1 Reverse filter
L1 Decoupling chokes with temperature monitoring
L2 HF ferrite choke
S2 Individually controllable coupling relays
C2 Coupling capacitor
C3 Defined stray capacity to earth. Stabilises the crosstalk attenuation (can be omitted if necessary)

This CDN permits unsymmetric (single conductor) and asymmetric (all conductors together) coupling.

The paths for L2 and L3 are omitted in the single phase version.

6 Operating instructions

6.1 Local operation

This chapter presents an introduction into the multitude of possibilities that can be achieved with the NSG 2025.

Operation is condensed in a clear manner into just two menus.

Menu I Normally displayed continuously. Contains all the elements necessary to set up and monitor standard-conform tests.

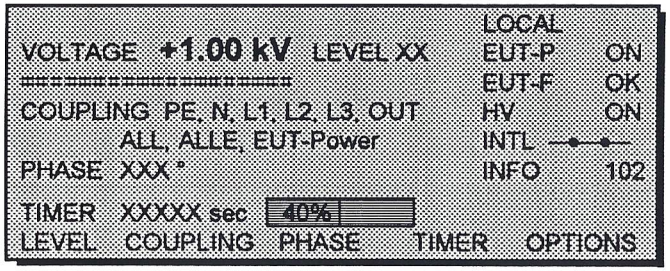
Menu II Serves to set the supplementary NSG 2025 functions.

6.2 Operating states

The instrument can be switched into the following states:

- OFF **Not in operation**
  The mains supply is switched off at the mains switch on the rear panel. No lamps are alight.
- STAND-BY **Ready to operate**
  The mains supply is switched on, the controller is active and hence operation can be started via the remote control facility. Only the "Power" button is lit up.
- STOP Interlock open: • **ready to switch on**
  Interlock closed: • **in operation**
  The instrument is active, the display is in operation. The EUT supply can be switched on, all settings are possible. The HV is switched off.
  The green LED by the STOP key is alight.
- PAUSE **In operation**
  High voltage is switched on, the instrument is waiting, the test time remains frozen, external triggering is possible. This operating state is cancelled after 2 minutes (provided there is no triggering in the meanwhile), the instrument goes into the STOP state, the test time is reset to zero.
- RUN **In operation**
  The instrument triggers burst pulses automatically. The instrument switches itself into the STOP state at the expiry of the test time.

6.3 Menu I: Normal, continuously shown display



The function selected by means of the function keys is highlighted in inverse video. Attention to a timeout reaction is always demanded by a beep signal.

Only the PHASE and OPTIONS keys are active in the RUN and PAUSE states.

F1: Level

The hand-wheel rotates through the standard settings of 1p, 1n, 2p, 2n, 3p, 3n, 4p, 4n (p = positive / n = negative) as well as the free user-settings referred to as USER1, USER2, ... ,USER8.

The ENTER key accepts the corresponding complete setting.

The previous setting is reinstated after a timeout of 10 seconds.

The display shows LEVEL xx or USER x

	Norm-LEVEL							
	1p	2p	3p	4p	1n	2n	3n	4n
Vpeak (Volts)	+500	+1000	+2000	+4000	-500	-1000	-2000	-4000
Fburst (kHz)	5	5	5	2.5	5	5	5	2.5
Repetition (ms)	300	300	300	300	300	300	300	300
Spikes	75	75	75	38	75	75	75	38
Polarity	pos.	pos.	pos.	pos.	neg.	neg.	neg.	neg.

F2: Coupling

The hand-wheel moves the cursor backwards and forwards; pressing the ENTER key accepts or clears the coupling indicated. All the possibilities are shown during setting but, after a 10 second timeout or a change of menu, only those that are active are shown. The supply lines can be subjected to the interference signal either individually or in any arbitrary combination with one another.

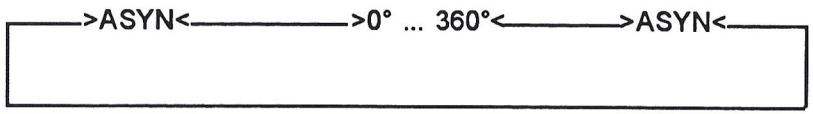
The EUT supply can be switched on and off with the EUT-Power field (switch on is only possible when the emergency off button is released and the "CDN overheat" external input is connected to 0V.

The requisite coupling must always be set for all the standard level settings. The default setting connects the pulse to the "PULSE OUTPUT" HV socket.

Display field	Function	
OUT	Pulse output to coax socket OUT,	CDN switched off
PE	Pulse coupling to PE,	OUT switched off
N	Pulse coupling to N,	OUT switched off
L1	Pulse coupling to L1,	OUT switched off
L2	Pulse coupling to L2,	OUT switched off
L3	Pulse coupling to L3,	OUT switched off
ALL	Pulse coupling to N, L1, L2, L3,	OUT switched off
ALL/E	Pulse coupling to PE, N, L1, L2, L3,	OUT switched off
EUT_Power	Operation of the switch for EUT-supply	ON - OFF

F3: Phase

Hand-wheel determines the 'Angle' set value in rotation as shown in the following diagram:



Pressing the ENTER key accepts the new value.
The previous value is re-instated after a timeout of 10 seconds.

F4: Timer

The hand-wheel determines the time for the preselected test time. The default value is 60 sec.

Pressing the ENTER key accepts the new value.
The previous value is re-instated after a timeout of 10 seconds.

The elapsed time is shown by a dark bar and as a percentage in the RUN state.

Setting the test time to "0" selects Single / Manual operation.

A pulse burst is generated each time the START key is pressed.

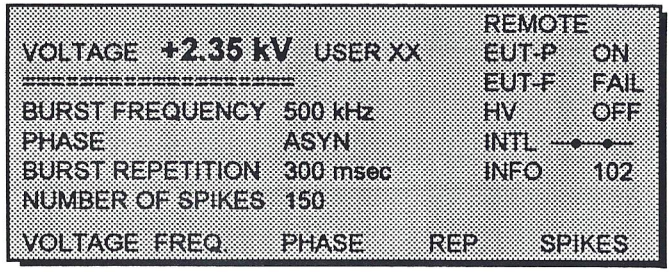
F5: Options

Jumps to Menu II to set supplementary functions.

Status indication on the right of the display:

[1st field]	Remote or local operation
EUT-P	Status of the EUT supply circuit breaker
EUT-F	Status of the EUT-fail input
HV	Indicates the status of the high voltage generator OFF = off, ON blinking = on but not yet ready ON continuous = on, set value attained
INTL	Status of the interlock input as well as that of the EUT connector cover. Indicated by the switch symbol (open or closed resp.)
[6th field]	Shows system messages as they occur by means of their number.

6.4 Menu II: setting the pulse data options



The function selected via the function keys is shown in inverse video.

VOLTAGE, FREQ and PHASE keys only are active in the RUN and PAUSE state.

The display shows the current settings when the OPTIONS key is pressed.

Functions "USER 1...8" are treated the same as the other standard settings. They can, however, be adjusted by the user and are stored in a non-volatile memory.

The expanded data files can be updated with the hand-wheel after being selected via the function keys. The new settings for VOLTAGE, FREQ and PHASE are active immediately. They are stored after a timeout of 10 seconds in the "RUN" state or by pressing the "ENTER" key in the "STOP" state.

F1: Voltage

The VOLTAGE setting ranges from -4.5 kV ... +4.5 kV or -8kV ...+8kV respectively. If a rapid change is made in the "RUN" state pulse generation is interrupted until such times as the high voltage has attained the new set level.

F2: Frequency

The FREQUENCY setting ranges from 0.1kHz ... 1 MHz or 0.1kHz ... 500 kHz respectively for the 8 kV version.

F3: Phase

Phase settings can be between 0 ... 360°.
Only the Phase key is active if a jump has been made to this menu from one of the standard settings ("LEVEL xx"). The other parameters cannot be modified.

F4: Repetition

This key sets the repetition time between the burst packages.

F5: Spikes

Use this key to select the number of spikes in the burst package.

ENTER
A return to the normal menu is effected by pressing the "ENTER" key or if, after a period of 1 minute, no input is made in which case a beep is sounded. The modified USER x data are stored.

A total of 8 self-defined tests is hence available to the user.

6.5 Validity range of the setting data

Parameter		Setting range	
		Minimum	Maximum
Spike idle voltage	(Volts)	200 V	4400 V (8000 V)
Burst frequency	(Freq)	0.1 kHz	1 MHz (500 kHz)
Burst repetition time	(Rep)	100 ms	9999 ms >4.4 kV max. 300 ms
Spikes per burst	(Spikes)	1	150 >4.4 kV max. 100
Test time timer	(Timer)	0 sec (0 ° ≡ 1 burst per start)	29999 sec
Phasing	(Phase)	0°	360° and async
Polarity		positive	negative

Depending on generator type the actual values may deviate slightly.

If mutually excluding inputs are selected, the latest input setting is accepted and the contradictory parameter(s) are set to the permissible values. A beep warns the user. The automatically adjusted value(s) blinks briefly.

The duration of a burst is given by the quotient of Number of spikes / Burst frequency.
Direct setting of the burst duration is not practical in view of the great range possible and its dependency on other factors. The burst duration can range from 1 µs up to 1.5 sec. In the case of standard settings, the burst duration is fixed at a standardised 15 msec by the automatic assignment of the number of spikes and spike frequency relative to the voltage level chosen.

6.6 System messages

All the messages from the system are indicated on the display panel by means of a code number.

These fall into the following groups:

Status messages:	**INFO**
• EUT failure (EUT-Fail)	No. 115
Operating error:	
• "RUN" key pressed with interlock open	No. 006
• Setting of "PHASE 0...360°" without synchronisation signal (phase L1 missing or on dc voltage)	No. 106
• CDN overheat through overloading	No. 114
• External trigger frequency too high	No. 119
• Pulse voltage setting too high	No. 121
• Repetition setting too short	No. 122
• Number of spikes too high	No. 123
• Frequency setting too high	No. 124
• "RUN" key pressed with emergency off latched	No. 200
Remote control error:	
• Invalid characters in command received	No. 000
• Command invalid	No. 001
• Syntax error or command not implemented	No. 002
• Invalid argument	No. 003
• RUN with no preceeding ARM command	No. 004
• Command not valid in present status	No. 012
• Command not valid for current set-up	No. 013

- Interruption of the RUN status No. 014
- Argument missing No. 017
- Command not possible with current hardware No. 018
- Command not valid, because of ADR ON No. 050
- Command not valid, as voltage is too high No. 051
- Command not valid, as EUT Power is OFF No. 053
- Command not executed, due to not OFF, INTERLOCK or CDN overheat No. 054
- Command not executed, invalid start conditions No. 055
- Command not executed, number of spikes too high No. 056
- Command not executed, repetition too high No. 057
- Command not executed, not in SINGLE mode No. 058

Instrument fault:

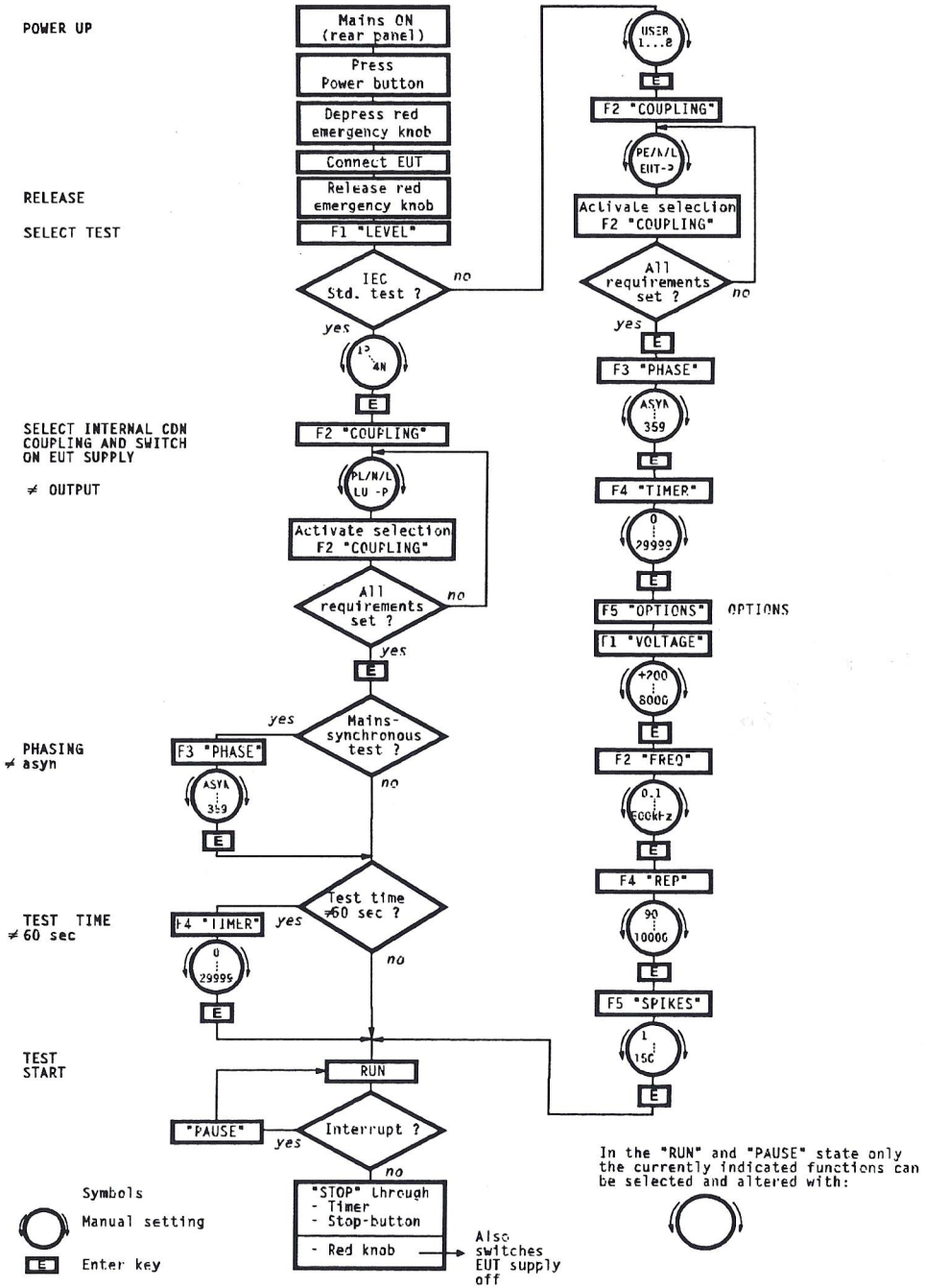
- Fault in high voltage generator No. 008
- Fault in the frequency measurement No. 009
- Fault in the +12 V supply No. 103
- Fault in the +24 V supply No. 128
- Fault in the -12 V supply No. 104
- Fault in the +5 V supply No. 105
- High voltage out of tolerance No. 125
- No acknowledgement to pulse triggering No. 127

(Instrument must not be operated further with any of these faults. Switch off the mains and then try again. If the fault recurs then the instrument is to be sent to an authorised service station to be checked.)

Self-test messages:

- Self-test OK TES 00
- Program memory error TES 01
- Calibration memory error TES 02
- RAM error TES 03
- Boot PROM error TES 04
- Burst generator error TES 05
- High voltage error TES 06

6.7 Flow diagram with typical operating procedures



7. Function check

7.1 Function check

Very many functions are checked automatically by the control module upon power-up or during actual operation so that a simple function check for verification purposes is adequate.

7.1.1 Control

1 Study the section entitled "Advice on safe operation" in the manual.

2 Set the instrument to "STAND-BY" with the mains switch on the rear panel.

- "POWER" button lights up. Wait 10 sec. for processor self-test.

3 Switch from "STAND-BY" to ON with the "Power" button on the front panel.

- Display is activated and shows default settings.
  (Level 1p: 500 Volts positive, pulse coupling to the HV socket)
- Operating state is "STOP"
- There are no system messages in the display field (e.g. INFO 103)

4 Check the interlock circuit

Circuit open: • Display shows ¯• / •¯
Instrument cannot be switched to "RUN" (INFO 006)

Circuit closed: • Display shows ¯• •¯

5 Press the "RUN" button with the safety interlock circuit closed.

- With the emergency off button released, the "RUN" LED is on and the HV indication changes from "OFF" to "ON". The word "ON" blinks for a few seconds until the high voltage has attained its set value.
- A beep is sounded if the emergency off button is still latched, the message "INFO 200" is shown and the "STOP" LED is on.
- Bursts of 500 V, 5 kHz at a duty ratio of 15/300 msec are generated for one minute which can be verified at the Pulse Output socket.

7.1.2 Pulse generator

Measure the spikes set as above (500 V) via a 50 Ω, 20 dB attenuator rated at 6 W or greater together with an oscilloscope having a minimum bandwidth of 400 MHz. The following quantities should be measured:

Peak voltage:	250 V ± 10%, (take measuring system tolerance and uncertainty including the attenuator into account!)
Rise time:	5 ns ± 30%
Spike duration:	50 ns ± 30%

Set the maximum pulse voltage together with the maximum possible repetition rate and number of spikes (i.e. the greatest high voltage power output).

Leave all the outputs open and let the instrument operate for 1 min on "RUN".

- none of the system messages 8, 103, 104, 105, 125, 127 or 128 should appear.

7.1.3 Remote control

The commands are available on request.

7.1.4 Mains coupling

WARNING: Disconnect the EUT supply from the NSG 2025 before proceeding any further!

The following functions are to be checked with mains coupling:

All supply lines:	Switch on instrument and EUT-Power but disconnect the EUT supply before it reaches the instrument: Check the through resistance and the correctness of the connections at the EUT connector.
Function of the internal switch:	L1, L2, L3 and N of the EUT connector must be isolated from the corresponding supply input connections when the emergency off button is latched, i.e. pressed in.

Coupling mode: Select one coupling after another on the supply lines using the default settings established after power-up (attention: "EXT" must not be selected).

This enables the presence of spikes to be verified at the corresponding banana sockets.

A commercially available banana-BNC adapter can be plugged into the supply output and the adjacent earth socket to enable a clean high frequency connection to be made. The measurement should be made with the same equipment arrangement as used for the generator verification.

7.2 Faults

Triggering of a 10 or 30 mAmps RCD switch is not a fault but is caused by the leakage current from the mains coupling.

Remedy: use a 30 mAmps type; possibly use an isolating transformer for the EUT supply.

It is to be assumed that safe operation is no longer possible if:

1. the instrument exhibits electrical flashover
2. the instrument exudes a smell of burning
3. the instrument has been dropped or subjected to severe shaking
4. the instrument shows visible signs of damage
5. the instrument exhibits faulty or missing functions
6. the instrument makes unusual noises
7. the instrument has been stored for a long time under unfavourable conditions.
8. the instrument shows INFO 127 on the display

Measures for 1 - 4: Send the instrument to a service centre to be checked.

5 - 8: Switch the instrument off for a few minutes and then cautiously try switching it on again and carry out a function check. Depending on the result either continue working or send the instrument to a service centre to be checked.

The instrument must be switched off and be sent to your local service centre if any of the following system messages appear on the display panel or operating computer:

No 103, 104, 105, 125, 128

These messages concern supply or function faults in the instrument

7.3 Trouble shooting

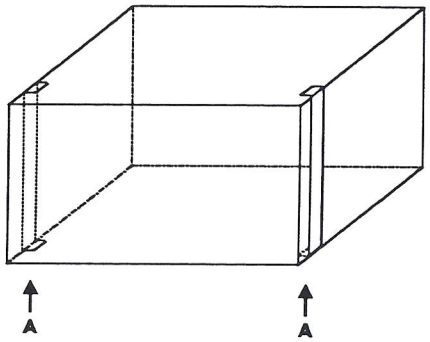
Problem	Possible cause	Remedy
No pulse at power outlet	"EXT" has also been selected for the coupling mode	Delete "EXT"
Instrument cannot be switched to "RUN"	Display shows INFO 200 Display shows INFO 006	Release emergency off button Close interlock circuit
"Power" button lamp does not light up; instrument can be switched on normally	Bulb in the button defective	Insert new bulb
"Power" button lamp does not light up; instrument cannot be switched on	No supply at instrument's mains input or mains switch on rear panel is switched OFF	Check power input, switch on, Check fuse at mains input.
System message No. 006	Interlock circuit open	Close interlock circuit
System message No. 008	High voltage or HV pulse	Send instrument for service
System message No. 103	+ 12 V supply out of tolerance	Send instrument for service
System message No. 104	- 12 V supply out of tolerance	Send instrument for service
System message No. 105	+ 5 V supply out of tolerance	Send instrument for service
System message No. 106	No synchronisation signal	Set "asynchron", connect L1 to EUT ac supply, set EUT on!
System message No. 114	CDN choke too hot	Overload! Switch off EUT supply Switch EUT on only briefly or reduce the current.
System message No. 115	EUT fault	EUT-Fail input activated
System message No. 119	Ext. trigger frequency too high	Choose a lower value
System message No. 121	Pulse voltage set too high	Set only values in validity range
System message No. 122	Repetition value too low	Set only values in validity range
System message No. 123	Number of spikes too high	Set only values in validity range
System message No. 124	Frequency setting too high	Set only values in validity range
System message No. 125	High voltage out of tolerance HV supply transformer too hot. Continuous power output or ambient temperature too high. Possibly component defective.	Send instrument for service Allow to cool for 1 hr and then carry out a function check.
System message No. 127	Hardware fault	Send instrument for service
System message No. 128	+ 24 V supply out of tolerance	Send instrument for service
System message No. 200	Emergency button still latched	If permissible, release the button

8. Rack installation

The instrument is designed for both bench-top use as well as for installation in a 19" rack. The instrument has to be fitted with the mounting brackets available as an option (INA 161) before installation in a rack.

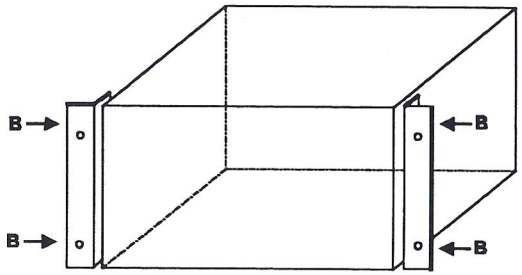
Assembly instructions

1 Remove the side masking strips:



Remove the masking strips by releasing the screws 'A'.

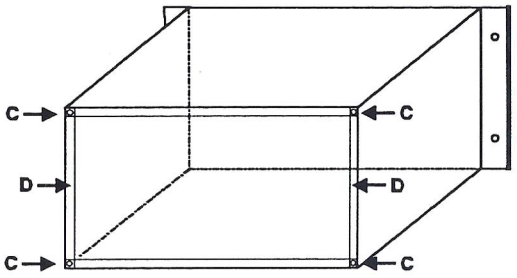
2 Mount option INA 161:



Attach the brackets INA 161 with the screws provided (B).

3 Remove the instrument's feet

The instrument is relatively deep and heavy. It must therefore be built into a rack on guide rails. The feet must be removed to achieve this.



- Lay the unit on its side
- Remove screws 'C'
- Remove plastic strips 'D'
- Pull the bottom cover off backwards
- Unscrew the feet

- Re-assemble the unit in reverse order

4 Mounting in a cabinet or rack

Equip the rack with guide rails.

Insert the instrument and screw firmly into place. The rack mounting screws are not supplied with the brackets as they need to be matched to the local needs regarding length, thread and appearance. It is advantageous if the screws can be obtained from the rack/cabinet supplier.

The ventilation slots below the front panel and in the rear panel must be kept unobstructed. Air circulation must not be restricted in any way. If the cabinet has fan-assisted ventilation then the cooling air must be able to enter at the front of the NSG 2025.

9. Standards

9.1 Safety measures as per VDE 0104

The safety measures contained in VDE 0104 are recommended for the operation of high voltage test installations. The instrument provides all the necessary facilities.
The corresponding operating states of the NSG 2025 are:

Out of operation: The instrument is switched off at the mains switch on the rear panel.

The EUT supply is also isolated from the EUT connector by means of the internal circuit breaker.

No indicator lamps are alight.

Ready: The instrument is switched on but the interlock circuit is still open – the instrument is forced into the STOP-mode.

The external green warning lamp is alight.

Ready to switch: The interlock circuit is closed.
The EUT supply can be switched on and off.
The instrument is in the STOP-mode.
The external red warning lamp is alight.

In operation: The interlock circuit is closed.
The EUT supply can be switched on and off.
The instrument is in the RUN or PAUSE-mode.
The external red warning lamp is alight.

ATTENTION: The colour of the display panel background lighting (optional colour display) does not correspond to the states of the warning lights mentioned above.

GREEN
means STOP; i.e. high voltage OFF but ready to be switched if the interlock circuit is closed.

YELLOW-ORANGE
means Pause; i.e. high voltage ON but no automatic pulse triggering.

RED
means that the high voltage is switched on with automatic pulse triggering.

EMC

CAUTION: A test rig equipped with this instrument can radiate strong electromagnetic interference.
Operation is only permissible in a closed Faraday cage.

The test enclosure must be so configured and be connected to the protective earth such that no pulse current can leave the enclosure by any cable whatsoever.

Sensitive electronic instruments as well as telecom-equipment must not be in the vicinity of, let alone actually inside, the same Faraday cage.

Take the possibility of disruption to flight safety installations into account.

9.2 Typical applications and standards

The NSG 2025 is mostly used for tests in accordance with IEC 1000-4-4 Electrical Fast Transient / Burst Immunity Test, BASIC EMC publication.

All modern EMC standards include the burst test as specified in this standard. Most, however, refer to the earlier standard IEC 801-4.

The other important burst test standard applies to all equipment that is used in road vehicles. This is the ISO 7637-1. The burst test contained therein, Pulse 3a and 3b, are also specified in standards relating to telecommunications equipment. An additional, sufficiently rated attenuator must be used for the test level set at under 200 V.

The following documents must be available for correct execution of standard-conform tests:

- Applicable standard
- Manuals for all the equipment incorporated in the test rig
- Test plan for the relevant EUT
- Test protocol

Every test rig is to be carefully planned in order to ensure that the requirements concerning safety, radiation limitation and reproducibility of results are met.

- The safety instructions given in this manual are to be strictly observed.

- The configuration of the test rig must be strictly in compliance with that specified in the standards in order to ensure standard-conform test execution. Even apparently small deviations can cause considerable differences in the test results.
- Reliable prevention of disruption to unrelated instruments and items of equipment by interference radiation from cables and the EUT can only be assured by working in a Faraday cage.
- In order that the test results can be faithfully reproduced, the test rig, cabling, test parameters, environmental conditions, peripheral equipment as well as the EUT's behaviour must all be precisely recorded. Ideally the whole arrangement should be carefully photographed.

9.3 Summary of standards for the application

The NSG 2025 can be used for the fast transient and burst test portions of the following standards. It should be remarked that today's burst standards are complied with implicitely and their probable revisions have been taken into account as far as known. An additional attenuator may be necessary for the road vehicle standards, depending on the test level concerned. Additional, special coupling networks, for example, may be necessary for certain applications.

- ANSI C62.41-1991 EFT
- BS 6667; Part 4
- CCITT K. 17
- CENELEC HD 481.4
- CIGRE Group 36
- DS 5103 Generator Type 3
- DIN 40839 Parts 1-3 Pulses 3a/b
- EN 50082-1
- EN 50082-2 (prEn 1993)
- EN 55101-4
- EN 61000-4-4
- prEN 55024-4 (1993)
- ETS 300 126 (Draft prETS Nov 1990)
- ETS 300329 (Draft 1994)
- ETS 300340 (Draft 1994)
- ETS 300342-1 (Draft 1994)
- IEC 1000-4-4(and Revision proj.)
- IEC 654-5
- IEC 801-4 (1988)
- ISO 6737 parts 1-3 Pulse 3a/b
- NAMUR (Recommendation Febr. 88)
- NEMA 3-17-1976
- NF C 98020 (500V 5ns 10 Hz Spikes)
- OIML International Doc. N11
- RIA 12
- SEN 361503
- VDE 0113
- VDE 0843 Teil 4
- VDE 0839 Teil 82-2/03.94
- VDE 0846 Teil 11 & 12
- VDE 0847 Teil 2
- VDE 0878 Teil 200
- VG 95373
- VG 95377
- IEC 1000-4-4/23rd. edition (Draft 1994-05-11)
- Numerous product standards

9.4 IEC 1000-4-4 (IEC 801-4) standard

The currently most important standard is the IEC 801-4. The burst test for practically every other standard is derived from this one or it is referred to directly. The standard defines the generator specifications such as the open-circuit or idle voltage, test levels, burst frequency, burst duration, repetition rate and internal impedance. Equally important are the configuration of the test rig and coupling devices which are also described.

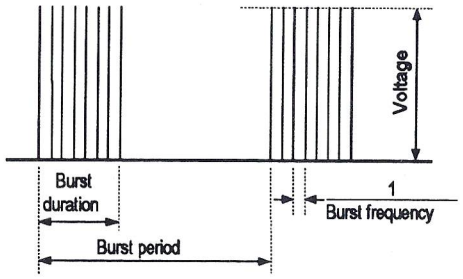
Test level or degree of severity:

	Standard Level				
	1	2	3	4	Special
Idle voltage	±500 V	±1000 V	±2000 V	±4000 V	open
Burst frequency	5 kHz	5 kHz	5 kHz	2.5 kHz	open
Burst period	300 ms	300 ms	300 ms	300 ms	open
Burst duration	15 ms	15 ms	15 ms	15 ms	open
Spikes per burst	75	75	75	38	open

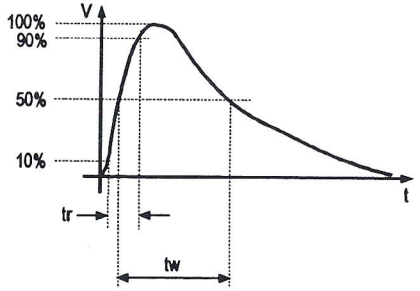
Generator specifications required:

Spike rise time	tr:	5 ns ±30% into 50 Ω load
Spike width	tw:	50 ns ±30% into 50 Ω load
Source impedance	Ri:	50 Ω ±20%
Decoupling capacitor	Cd:	10 nF
Mains reference:		Asynchronous

Burst



Single spike



10 Maintenance

10.1 Service

WARNING: Do not open the instrument.

Contains high voltage capacitors which, in the event of a fault, can still store a dangerous charge even after the instrument has been switched off.

Mains connectors, high voltage connectors together with voltage-carrying electronic components are not additionally protected against being touched inside the instrument.

The instrument does not contain any user-serviceable parts. Work inside the unit may only be carried out by **specialists trained on this instrument**. The service manual is to be carefully studied before any such work is attempted.

No modifications are to be carried out by the user on the NSG 2025. Only original Schaffner parts are to be used for repair purposes. The manufacturer accepts no responsibility whatsoever for damage, injury or other danger that arises through the use of non-original parts or due to modifications.

Servicing is restricted to periodic cleaning of the external surfaces, a function check and verification of the pulse data.

10.2 External care

Clean the instrument housing with a damp cloth using a little mild, non-abrasive household cleanser if necessary.

No chemicals may be used for cleaning purposes. It is imperative to disconnect the instrument from the mains *before* it is cleaned.

Housing colours:	Panels:	light grey	RAL 7035
	Frame:	stone grey	RAL 7030

11 Replacement parts

The NSG 2025 contains no parts that wear which should be kept in stock by the user. Should a repair become necessary, the replacement part may be any arbitrary component or module or a part of the housing. A suitable stock of parts is therefore only possible at a qualified service station.

12 Disposal

The NSG 2025 contains no particularly hazardous materials such as nickel-cadmium batteries or mercury relays.

The instrument is so built that it can be dismantled right down to the component or circuit board level.

13 Technical specifications

13.1 Electrical specifications

Pulse generator:

Pulse voltage:
- NSG 2025-1 to NSG 2025-4:
  open-circuit (into 2500 Ω): 200 to 4400 V tolerance ±10 %
  into 50 Ω: 100 to 2200 V tolerance ±10 %
- NSG 2025-5 to NSG 2025-8:
  open-circuit (into 2500 Ω): 200 to 8000 V tolerance ±10 %
  into 50 Ω: 100 to 4000 V tolerance ±10 %

The max. slew rate under remote control is 1000 V/sec

Burst frequency: 0.1 to 1 MHz, tolerance ±2 % for 4.5 kV version
0.1 to 500 kHz, tolerance ±2 % for 8 kV version
Can be newly set for each burst under remote control

Spikes per burst: 1 to 150 pulses (≥ 4.5 kV: 1 to 100 pulses)
(enables 15 ms burst length as per IE100-4-4 up to 10 kHz)

Burst repetition rate: 0.1 to 10 sec., tolerance < 2 ms (≥4.5 kV: 0.3 to 10 sec.)
Continuous signal at 1.5 kHz max. with overlapping

Phase positioning: (1st. pulse per burst) Asynchronous or synchronous 0-360° ±2° at 50/60 Hz,
Can be newly set for each burst under remote control
(no synchronous operation for f < 15 and > 440 Hz, tolerance is ±60° when ripple control signal is present)

Polarity: Positive or negative (max. 1 polarity change per 5 sec.,
1 sec. pulse interruption during polarity change)

Internal impedance: 50 Ω ±10 % (calculated from the open-circuit voltage measured with 2500 Ω resistive probe, and the voltage into 50 Ω at the coaxial "PULSE" output)

Pulse rise time: 5 ns ±20 % at coaxial output (under 1500 V ±30%)
5 ns ±30 % at EUT power outlet

Pulse width: 50 ns ±30 % into 50 Ω and 1 Ω
100 ns ±50 % into >1 kΩ

Burst length: Derived from Spikes per burst + Burst frequency

Decoupling capacitor: 10 nF Y-type at the pulse output

Connectors:

Outputs:

- Coaxial pulse output with front mounted SHV socket, inhibited when coupling via internal CDN is selected
- Monitor output: - 60 dB approx. via BNC on front panel
- Trigger output for CRO, via BNC on the front panel positive pulse ≥1.5 V into 50 Ω, tw ~ 1µs, tr ~ 5 ns, approx. 140 nsec ahead of 1st. pulse per burst
- External CDN: 37 pin connector

Inputs:

- External trigger, via front mounted BNC connector for asynchronous, single pulse triggering, delay approx. 150 nsec

Interlock:

- Interlock input or output, including warning lamp connection.

Remote control input: RS 232 port on the rear panel

Coupling network built in:

Type: Built-in; conforms to IEC 801-4 for 1 or 3-phase supply with neutral and protective earth line

Pulse input: Internal, direct from generator

EUT supply: CDN nominal rating, 1 or 3 phase. (see chapter 4.3.2)

Connections:

EUT supply input:
Terminals or spade connectors inside the generator with 2m cable; 3-way or 5-way

Outputs:
EUT connection: MC safety banana sockets each with an earth connector. Arranged in a frontal recess to accommodate pluggable adapters having standardised outlet sockets.

Coupling modes:

Unsymmetric: PE or N or L1 or L2 or L3 to PE and
Asymmetric: N+L1+L2+L3 with all lines including PE to ground reference

Coupling attenuation:	Generator pulse data into 50 Ω and open-circuit voltage are kept within tolerance. (Standard calls for < 2 dB which is hence respected)
Decoupling atten.:	1 to 100 MHz: > 20 dB (measured as asym. mains filter attenuation on ground plane, coaxial cable screen at input and output connected to ground plane, coax cable 0.5 m long max. each side)
Crosstalk atten.:	1 to 100 MHz: > 30 dB (measured into 50 Ω as asym. mains filter attenuation on ground plane, between L1/L2/L3/N/E in all combinations)
Termination of non-disrupted lines:	100 pF approx.
Overload protection:	Protection provided by monitoring the temperature of the decoupling chokes
EUT power switch:	Internal relay (16 Amps version) or circuit breaker (32 Amps version). Operated via local or remote control as well as by the emergency off button

Powering and Power supply

Instrument supply:	Switchable nominal ranges: 100-120 and 220-230 V, tolerance: nominal ±10 % (240 V tolerance: nominal +6 %-10 %) Connection via mains filter with IEC plug, voltage selector and switch
Frequency range:	50 / 60 Hz ±5 %
Mains switches:	• Primary: in rear-mounted filter → OFF – Standby • Button: on front panel → Standby – ON • The instrument can be switched on or off under remote control while in the "Standby" state.
Protection class:	1 (one), with increased leakage current of up to 30 mA due to coupling capacitors and EUT supply filter.
EMC:	• Certificate of conformity with EU regulations (CE-Mark)

13.2 Dimensions

Housing type:	19", 7HU with hand-grips at the sides Rack-mounting brackets can be added subsequently.
Dimensions:	Width: 449 mm, Height: 310 mm, Depth: 500 mm
Weight:	35 kg approx.

13.3 Environmental conditions

Intended for use only inside a building.

Ambient temperature:	Operation range:	+5° ... +40° C
	Storage and transport:	-20° ... +70° C
Relative humidity:	Operation range:	20 % ... 80 %
	> 31° C linear reduction to	50 % at 40° C
Condensation:	Not permissible during use.	
Altitude:	Operation range:	< 2200 m a.s.l.
	Storage and transport:	< 12000 m a.s.l.

14 Ordering information, Options

14.1 Ordering information

Type	Max. burst amplitude	Max. burst frequency	Coupling phases	Coup. Netw. current	Key-pad/ Display
NSG 2025-1	4.4kV	1MHz	1	16 Amps	yes
NSG 2025-2	4.4kV	1MHz	1	16 Amps	no
NSG 2025-3	4.4kV	1MHz	1	30 Amps	yes
NSG 2025-4	4.4kV	1MHz	3	30 Amps	yes
NSG 2025-5	8.0kV	500kHz	1	16 Amps	yes
NSG 2025-6	8.0kV	500kHz	1	16 Amps	no
NSG 2025-7	8.0kV	500kHz	1	30 Amps	yes
NSG 2025-8	8.0kV	500kHz	3	30 Amps	yes
NSG 2025-10	4.4kV	1MHz	–	–	yes
NSG 2025-20	4.4kV	1MHz	–	–	no
NSG 2025-50	8.0kV	500kHz	–	–	yes
NSG 2025-60	8.0kV	500kHz	–	–	no

Included:
1 Mains cable
1 Earth braid
1 CDN cover plate
1 Interlock connector, 15-pin
1 Operating manual

14.2 Options

WIN 2025	Windows™ Software control package
CAS 2025	Calibration set
CDN 126	Coupling clamp in accordance with IEC 1000-4-4 with SHV connector and interlock
INA 2025	3-colour display
INA 161	Rack mounting brackets

Adapters for EUT connections with national plugs:

INA 250	IEC 309 32Amps 3-phase (red) for max. burst voltage 8kV
INA 251	IEC 309 16Amps 1-phase (blue) for max. burst voltage 8kV
INA 252	Germany SCHUKO 1-phase 16Amps up to 4.4kV pulses
INA 253	Switzerland CH, 1-phase 10Amps up to 4.4kV pulses
INA 254	France F, 1-phase 16Amps up to 4.4kV pulses
INA 255	England GB, 1-phase 13Amps up to 4.4 kV pulses
INA 256	USA US, 1-phase 15Amps up to 4.4kV pulses
INA 257	IEC 320 10Amps up to 4.4kV pulses
INA 260	Warning lamp assembly
INA 261	Separate SHV plug for 5mm coaxial cables
INA 262	Universal safety plug set
INA 303A	Optical link set (230V) Europe, 10m opto cable
INA 304A	Optical link set (115V) USA, 10m opto cable
INA 305A	Optical link set (110V) Japan, 10m opto cable

15 Definitions

15.1 Abbreviations

The following abbreviations and expressions have been used in this manual:

asym. interference	Interference signal imposed between all the conductors in a cable or connection point of an item of electrical equipment and the reference HF potential.
Burst	Sequence of a limited number of spikes during a defined time.
CDN	Combined network designed to inject an interference signal into an electrical conductor and to decouple the same from other items not forming part of the object under test.
Coupling	Interaction between circuits through which energy is transferred from the one to the other.
Coupling clamp	(Coupling path), Assembly having specified dimensions and characteristics for the purpose of asymmetric / unsymmetric injection of the interference signal into the EUT without being electrically connected to it.
Coupling network	Network to transfer interference energy from one circuit to another.
Decoupling network	Electrical circuit to suppress mutual influence
RCD	Residual Current Detector (also referred to as an Earth Leakage Current Detector)
EFT / B	Electrical fast transient, low energy interference signal, group of interference pulses, burst
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference

ESD	Electrostatic discharge
EUT	***E**quipment **U**nder **T**est*: the electrical test object.
Faraday cage	Fully hf-impervious screened room.
HF	High frequency (also hf).
HV	High voltage.
HW	Hardware
Pulse width	Time interval between the instant when the momentary voltage of a pulse reaches 50 % of the peak value for the first and last time.
Rise time	Time interval between the instant when the momentary value of the pulse voltage first reaches 10% and then 90 % of the peak value.
Spike	Single pulse
SW	Software
Transient	Non-periodic and relatively short and/or negative voltage or current change between two static states.
Unsym. interference	Interference signal between one conductor in a cable or one electrical connection point to an item of equipment and the reference potential.

15.2 Standards cited

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EN 61000-4-4
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