

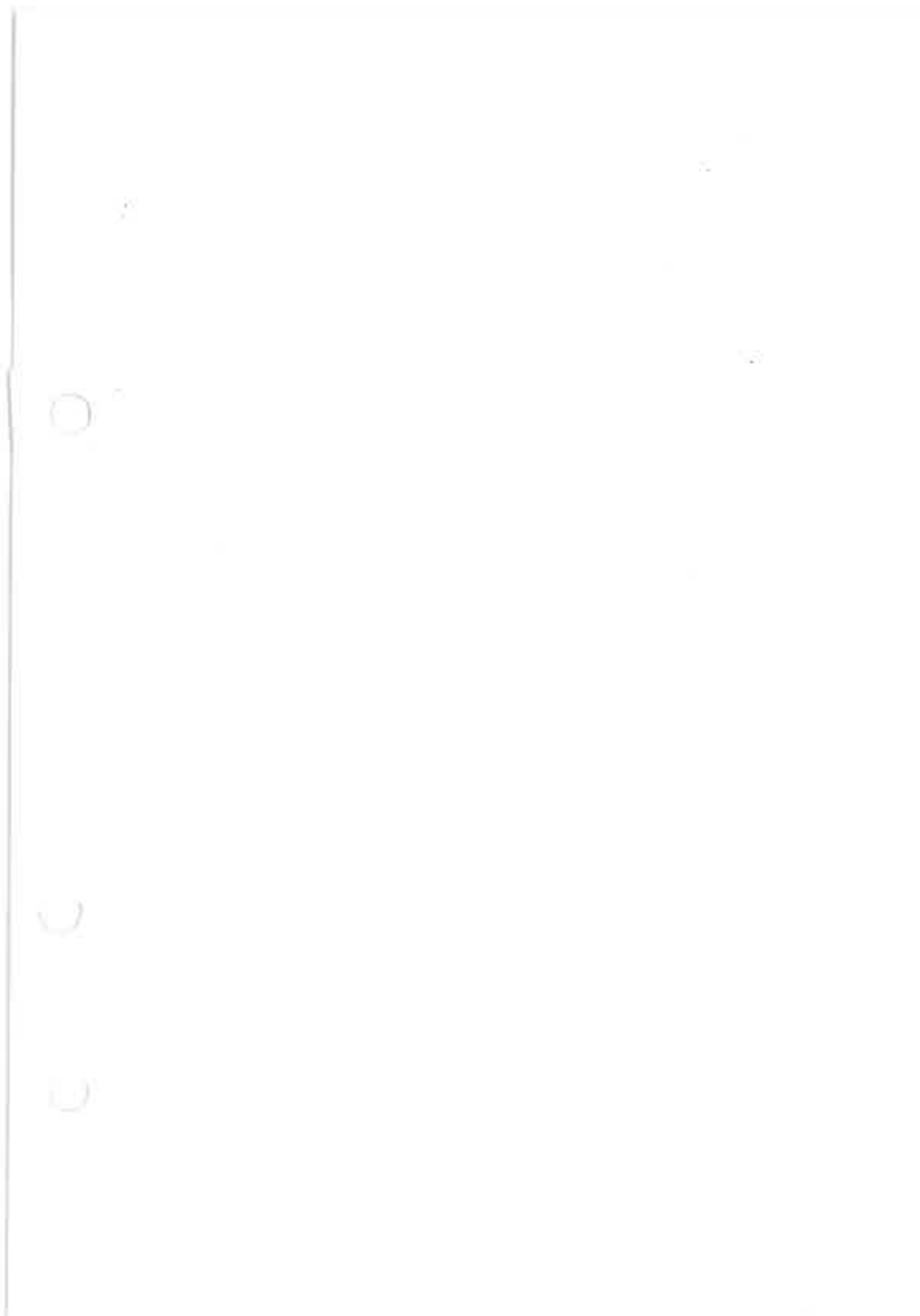
FAST TRANSIENT/ BURST GENERATOR

NSG 1025

OPERATING INSTRUCTIONS



Publ. 0803E



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1 Introduction

Inductively loaded mechanical switches, relays, etc. generate interference in the form of pulse bursts. The pulses have a fast rise time and hence cover a wide interference frequency spectrum that extends to over 200 MHz. Both digital and analogue electronic circuitry react sensitively to this type of interference. The summing effect of the pulse bursts makes the interference immunity requirements for analogue circuits even more critical.

Leading Standards, such as IEC 801-4, VDE 0843/4, CENELEC HD 481/4, define the necessary interference immunity levels for various classes of equipment. The burst tests refer not only to the mains connections but also to data and control lines.

The NSG 1025 Generator simulates such interference sources. The specifications of the pertinent Standards are met and, particularly where precision and reproducibility are concerned, are often exceeded.

The fully solid-state construction, which includes the high voltage switch, ensures excellent pulse parameter stability and maintenance-free continuous operation.

The instrument is equally suitable for laboratory and field tests as well as for routine testing for quality assurance purposes. Routine tests are made easier by a selection switch with fixed settings for the pulse parameters in conformity with the test classes contained in IEC 801-4. A further switch combination permits the continuous setting of the test voltage and the free choice of the burst frequency for development work and analytical measurements.

In addition, the NSG 1025 can generate fast single pulses (5/50ns transients) which are called for in various test Standards and which are useful for detailed investigations in development laboratories. Internal and external trigger functions permit the instrument to be flexibly adapted to the various needs.

A single-phase mains coupling network is incorporated in the unit which provides all the asymmetrical coupling modes called for in IEC 801-4 at the touch of a button besides further coupling modes for special applications.

The NSG 1025 is conveniently equipped with a mains socket as well as universal safety sockets for the connection of the test object (EUT). The supply to the test object is separately switchable.

Coupling clamps or coupling units for tests on data lines or an auxiliary unit for three-phase coupling can be connected via the HV coaxial connector.

2 Operating regulations**2.1 Safety advice**

The generator and the accessories work at high voltage.

Incorrect or careless operation can be lethal!

The equipment may only be used by trained personnel.

The operating instructions form an integral part of the equipment and must be available to the operating personnel at all times. The safety regulations and operating instructions are to be carefully followed.

To ensure safe operation, only approved accessories, plugs, adapters, etc. are to be used.

The construction of the instrument conforms to the safety requirements called for in IEC 348 and provides all the prerequisites for safe and reliable operation.

The generator conforms to Protection Class I specifications but with an increased earth leakage current (resulting from the standard-conform coupling capacitors and EUT leakage current). The instrument may only be used with appropriate mains plugs connected to a mains supply which provides a protective earth. In addition, a duplicated earth protection connection is necessary. This requirement can be met by making a reliable connection directly between the earth terminal and the fixed installation (not via a mains distributor or similar items).

The instrument is only to be used in a dry room. In the event of any condensation occurring, this must be allowed to evaporate before the instrument is put into service.

The construction of the instrument is not designed for use in an explosive atmosphere.

The instrument housing must not be opened. Any repair or service work and any internal adjustments must only be carried out by appropriately qualified service personnel.

As high voltage pulses can occur under test conditions, the layout of the test rig is to be so arranged that no dangerous parts can be touched.

Depending on the type of test object (EUT) connected, and especially on the cabling to the EUT, a considerable amount of interference can be radiated which could affect nearby systems and radio communication. These interference effects on the surroundings are to be kept under control by the user through the use of suitable measures such as a Faraday cage, shielded cable runs, etc.

Personnel fitted with a heart pacemaker must not operate the instrument nor remain in the test vicinity when the generator is in operation.

SCHAFFNER ELEKTRONIKAG, Luterbach, Switzerland and the associated sales organisations accept no responsibility for personal or material damage or for any consequential damage that results through irresponsible operation of this instrument.

2.2 Commissioning

The following list highlights the items to be taken into account when checking and putting the generator into operation after delivery and transportation or after radical changes to the test rig.

- Commissioning only by trained personnel.
- Check the goods received for completeness.
- Check the equipment for signs of transport damage. Report any damage to the transportation company immediately.
- Study the manual.
- Mains voltage quoted on the type label must agree with the local voltage (mains frequency 50 - 60 Hz).
- Connect the mains cable only to an outlet with a protective earth.
- Connect the protective earth wire.

- The instrument is now ready to be connected to a previously prepared test rig.

Each test rig should be carefully planned in order to ensure the necessary safety, limitation of interference emissions and reproducibility of the results.

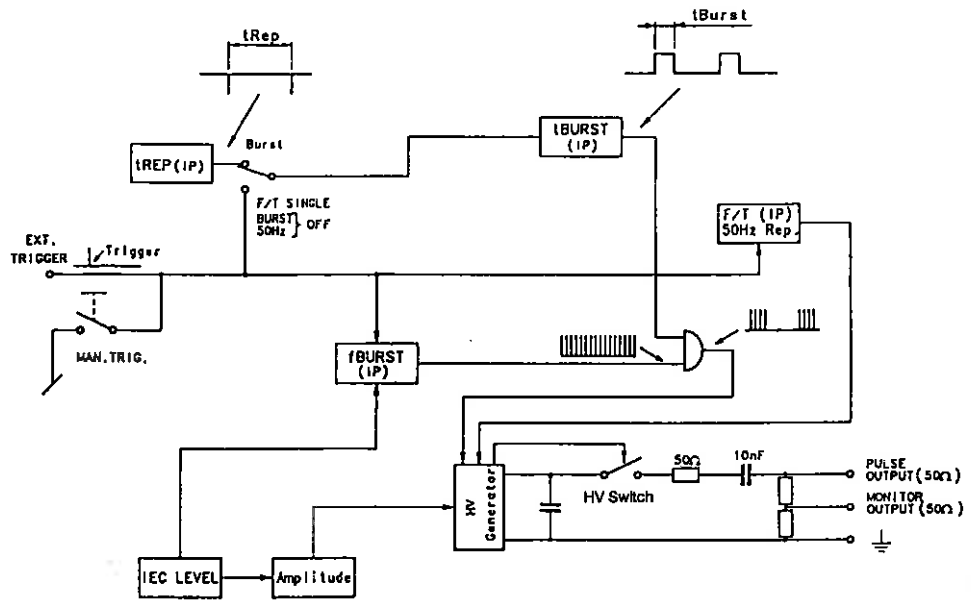
The previously given safety advice is to be respected.

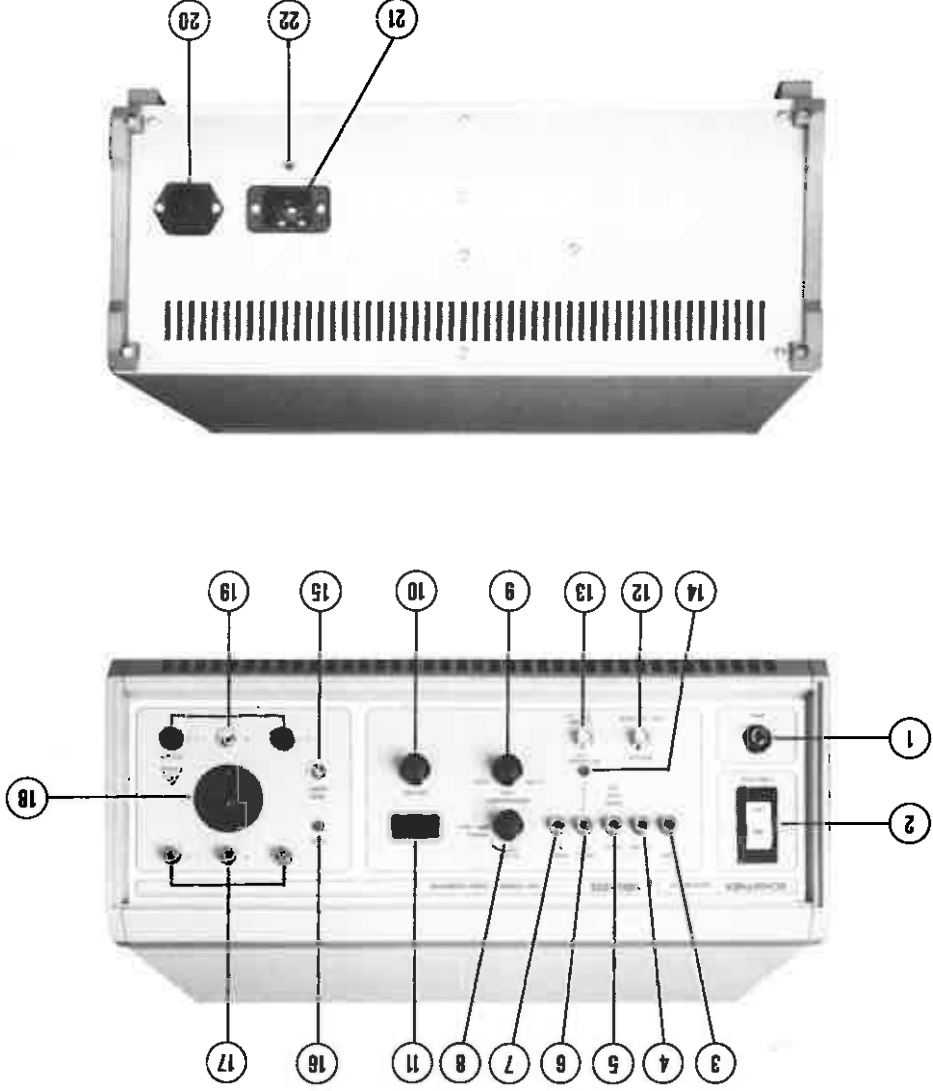
Only the use of a Faraday cage can reliably prevent non-related equipment and installations from being affected by interference radiated from the cabling and the test object.

The layout of the test bench must accord rigidly with the methods prescribed in the relevant publications if Standard-conform tests are to be carried out.

Reproducible results can only be assured if a precise record is kept which covers the test configuration, cabling, test parameters, environmental conditions and behaviour of the test object. Ideally, a photographic record of the test layout should be made.

3 Block diagram





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Operating elements

Front panel

1	MANS	Instrument supply mains switch
2	POWER TO EUT	Switch for supply to the test object, equipped with a 16 A thermal cut-out
3	BURST	Burst generator ON, 3, 4 and 5 are mutually self-releasing
4	F/T	Single pulse generator ON, repetition frequency 50 Hz, asynchronous
5	F/T SINGLE	Burst generator OFF, Single pulse generation OFF, 50 Hz OFF
6	MANUAL TRIG.	Manual single pulse triggering or gate function with 3 or 4 ON
7	POLARITY	Interference pulse polarity selection
8	IEC LEVEL/VARIABLE	Selection switch for IEC test classes I to IV or for free burst frequency choice 9 and continuously variable amplitude setting 10
9	BURST FREQUENCY	Selection switch for burst frequency. Only active when 8 is in the VARIABLE position
10	AMPLITUDE	Multi-turn potentiometer for continuously variable amplitude setting of the interference pulse. Only active when 8 is in the VARIABLE position
11	KV	3-digit DVM to display the open-circuit pulse voltage in kilovolts
12	MONITOR	100:1 / 50 X BNC connector for an oscilloscope

13	EXT.TRIGGER/ GATE	For externally triggered single pulses or the gate function when 3 or 4 is ON
14	LED	Indicates the active state of 13
15	PULSE OUTPUT	HV socket. Interference pulse output without being superimposed on the mains supply
16	PULSE	Indication of active interference pulses at 15
17	L1 / E / L2	Interference pulse coupling into L1 or L2 or E (protective earth)
18		Socket for connecting the EUT
19	L1 / E / L2	Safety laboratory sockets for EUT connection (parallel to 18)

Rear panel

20		Mains input to the instrument. IEC instrument socket with filter and fuse
21		Power input to EUT. IEC instrument socket, 16 A
22		Supplementary connection for protective earth

5.1.1 Instrument supply / EUT supply

The supply to the instrument itself and the supply to the EUT are two independent circuits which are switched separately.

The instrument supply input must agree with the local mains voltage and be appropriately fuse-protected at the socket 20.

230 Vac, +15%/-20%, 50/60 Hz: fuse 500 mA slow-blow, 5 x 20 mm
 115 Vac, +15%/-20%, 50/60 Hz: fuse 2 A slow-blow, 5 x 20 mm

Switching off the supply to the instrument with 1 does not disconnect the supply from the EUT!

Attention: The button 5 (BURST/50 Hz OFF) must be pressed in before the instrument is switched on otherwise the interference pulses, as determined by the other settings, will be fed directly to the outputs 15 or 18 and 19.

The switch 2 for the EUT supply is combined with a 16 A thermal cut-out.

In the majority of cases, power to the EUT is also taken from the local mains supply and the two mains feeds 20 and 21 are both plugged into the same fixed mains outlet.

The EUT supply may, however, be of any other value within the following limits:

5 ... 264 Vac, 15 ... 400 Hz, 16 A max.
 5 ... 50 Vdc, 16 A max.

The following extended specification applies on condition that switch 2 is not operated under load:

5 ... 250 Vdc, 6A max.

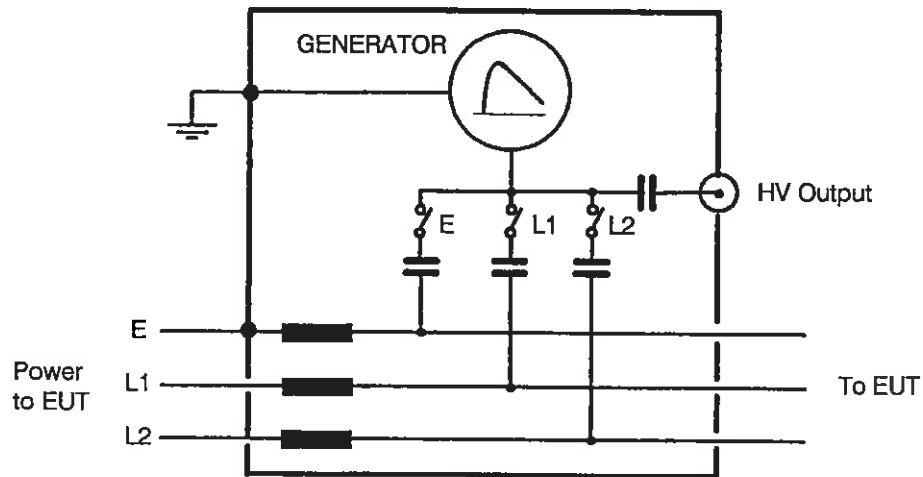
5.1.2 Coupling network

A number of possibilities are provided for the connection of the EUT:

- a country-specific outlet socket 18
- safety laboratory banana sockets 19

These outputs are connected together in parallel. The supply to the EUT at these outlets is switched on and off with switch 2.

A coupling network is incorporated which complies in all respects with the requirements of IEC 801-4 for single-phase coupling of the interference pulse into the EUT supply.



Diagrammatic representation of the coupling network

The LED, 16, gives a visual indication of the active state of the interference pulse at the output, 15.

When using the PULSE OUTPUT, 15, the coupling settings made with 17 must always be switched off correctly otherwise changes in the pulse specifications could occur.

The pure interference pulse is available at the HV connector, 15, for tests without superimposition on the EUT supply or for connection to external coupling devices. The pulse is always present at this output when the generator is active irrespective of the setting made with the buttons, 17.

5.1.3 Pulse output

Depending on the actual configuration used, the interference sensitivity of a test object can appear to be quite different if its protective earth is wired "solidly" to the reference earth. To check this behaviour in another way, connect the protective earth from the EUT to the earth socket of the generator with the shortest possible connection.

Because of the inductivity in the earth line circuit, the RF-wise earth potential in the EUT is also raised when coupling into L1 or L2.

Remark:

- L1 Reference earth -->
- L2 Reference earth -->
- E Reference earth -->
- L1+L2 Reference earth -->
- L1+L2+E Reference earth -->

Coupling modes: No coupling

IEC 801-4 only calls for coupling into one line in each case. The buttons, 17, can however be pressed in independently so that other coupling modes can also be achieved.

The required form of coupling is selected by means of the buttons, 17. Coupling is always with respect to the reference earth (earth plane / instrument earth socket).

5.1.4 Monitor output

An oscilloscope can be hooked up to the BNC connector, **12** (MONITOR) in order to be able to examine the output pulse shape. The monitor output is equipped with an attenuator so that a 100:1 voltage reduction results when an oscilloscope with a conventional 50 X input impedance is connected.

The oscilloscope must have a bandwidth of at least 250 MHz if meaningful measurements are to be achieved.

It should be noted that the specified pulse shape is only obtained if the HV output, **15**, is loaded with a 50 X power attenuator.

The MONITOR output is not suitable for calibrations checks. Such a task needs considerably greater effort as explained in Section 10.

5.2 Burst generator

The burst generator produces bursts of pulses as defined in Section 9.

Two operating modes are possible with the generator:

- Pulse generation with fixed amplitude and frequency values in accordance with the definitions of IEC 801-4 for Levels I to IV. This operating mode is practical for quality assurance tests and for the purposes of certifying a product.

The rotary switch, **8**, selects the following fixed parameters when set to the various IEC levels 1 ... 4:

IEC LEVEL	AMPLITUDE	FREQUENCY
1	500 V	5 kHz
2	1000 V	5 kHz
3	2000 V	5 kHz
4	4000 V	2.5 kHz

- The digital voltmeter, **11**, shows the corresponding voltage values.

The frequency selection switch, **9**, and the potentiometer, **10**, for amplitude adjustment are inoperative for the above settings. Button **7** serves to select the pulse polarity.

- Pulse generation with continuously adjustable amplitude and freely selectable pulse frequency.

This operating mode is used in laboratories to determine the interference sensitivity limits of a test object and to localize the causes.

The rotary switch, 8, has to be set to the position VARIABLE AMPL./FREQ.

Burst frequencies of 2.5, 5 or 10 kHz can be set by means of the selection switch, 9. The amplitude can be continuously varied between 225 V and 400 V by means of the multi-turn potentiometer, 10.

The digital voltmeter, 11, shows the corresponding voltage values. Button 7 serves to select the pulse polarity.

The burst generator is activated with button 3, i.e. the pulse bursts are fed to the HV output, 15, and, depending on the setting of the coupling switch, 17, also to the EUT connections, 18 and 19.

Generation of the pulse bursts can be inhibited by applying a 'logic 0' signal to the BNC socket, 13, EXT. TRIGGER/GATE (gate function).

Button 5 (BURST/50 Hz OFF) de-activates the generation of pulses. In order to avoid unforeseen interference pulse injections it is advisable to switch off the generation of pulses whenever any manipulation of the EUT, the coupling mode or the operating mode is carried out.

5.3 Single pulse generator

The single pulse generator produces pulses having the form 5/50 ns as defined in Section 9. The pulse conforms, amongst other things, to the requirements of the tests laid down by the EEC for measuring instruments that are subject to official calibration.

This type of generation serves the development engineer in the execution of targeted erroneous operation analyses. The effects of single pulses are much easier to observe on an oscilloscope than is possible with those obtained from pulse bursts. Furthermore, these single pulses can be readily synchronised with a logic analyzer. The external triggering facility enables fault investigations to be carried out on microprocessor systems and logic circuitry by correlating with the system clock.

Button 4 (F/T 50 Hz REP.) activates pulse repetition at a rate of 50 Hz. The pulses are fed to the HV output, 15, and to the EUT connections, 18 and 19, as defined by the setting of the coupling switches, 17.

The rotary switch, 8, permits one of the four possible fixed amplitude settings of 500 / 1000 / 2000 / 4000 V to be selected. In the VARIABLE position, the pulse voltage can be continuously varied by means of the potentiometer, 10. The digital voltmeter, 11, shows the corresponding voltage value in each case.

The frequency selection switch, 9, has no effect in the single pulse mode of operation.

Button 7 serves to select the pulse polarity.

The internal oscillator and hence the generation of the pulses can be inhibited by applying a 'logic 0' signal to the BNC socket, 13, EXT. TRIGGER/GATE (gate function).

Button 5 (BURST/50 Hz OFF) de-activates the generation of pulses. In order to avoid unforeseen interference pulse injections it is advisable to switch off the generation of pulses whenever any manipulation of the EUT, the coupling mode or the operating mode is carried out.

In the inactive state (button 5) the generator is nevertheless ready to produce an externally triggered pulse. The BNC socket, 13, can now act as a trigger input. Every switching edge down to 'logic 0' triggers a single 5/50 ns pulse. The maximum switching frequency is set at 1 kHz. The same trigger function can also be achieved manually by means of button 6.

5.4 Operation with a coupling clamp

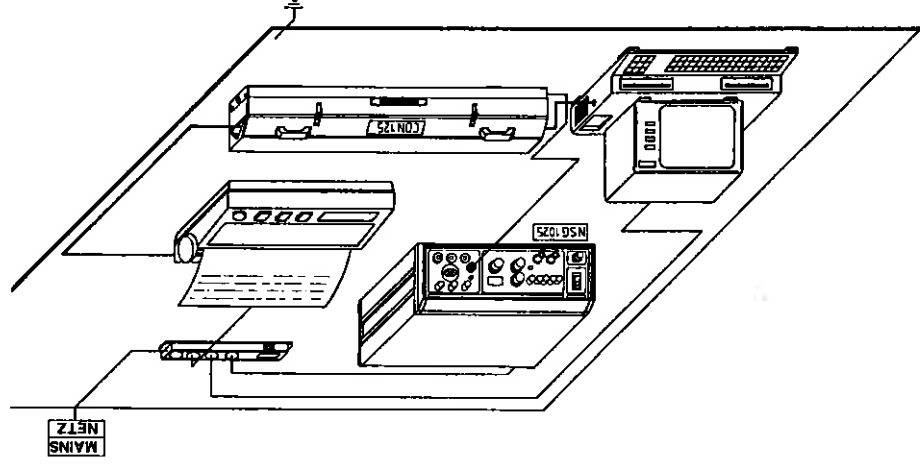
Interference injection into data buses, signal and control lines, etc. is achieved by means of an external coupling device such as:

- Coupling clamp conforming to IEC 801-4 SCHAFFNER No. 400-071
- Coupling device for data line pairs SCHAFFNER No. NSG 426
- Coupling clamp, small SCHAFFNER No. 400-063

These and other similar coupling devices are connected to the HV output, 15. The settings on the generator for either bursts or single pulses are carried out as described previously. The coupling switches, 17, must be switched off in this mode of operation.

Pulse generation is to be switched off by means of button 5 (BURST/50 Hz OFF) whenever any manipulation to the test object, or the coupling device being used is undertaken or when any adjustment to the operating mode is made.

A 6 dB attenuator (SCHAFFNER No. 402-379) can be connected between the HV output, 15, and the coupling clamp. The voltage is thereby set to twice the required level in order to guarantee the setting accuracy of $\pm 10\%$ called for by the IEC even at the lower pulse voltages of 200 ... 500 V.



Operation with a coupling clamp

With the aforementioned 6 dB attenuator connected between the HV output, 15, and the coupling clamp, the IEC fixed values for the amplitude (IEC levels I-IV, 8) thus automatically agree with the requirements for data line tests (see comparison table in Section 6).

5.5 Operation with a 3-phase coupling network

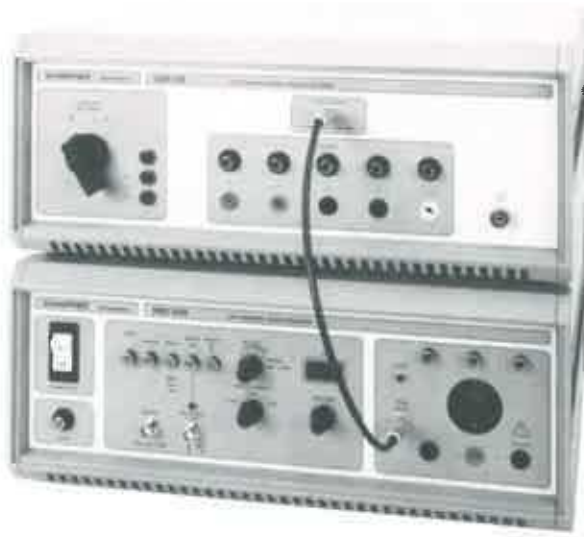
An external coupling network is necessary to couple pulses into test objects driven from a 3-phase supply, such as:

- CDN 300 FT / Burst coupler, 3-phase

The CDN 300 or other coupling unit has to be connected to the HV output, 15. The settings on the generator for burst or single pulse operation are carried out as described previously. The coupling switches, 17, must be switched off for this operating configuration.

The power feed to the EUT and the choice of coupling mode are both effected at the external coupler.

It is advisable to switch off the generation of pulses by means of button 5 (BURST/ 50 Hz OFF) in order to avoid unforeseen interference pulse injections whenever any manipulation of the EUT or the coupling unit, or the operating mode is carried out.

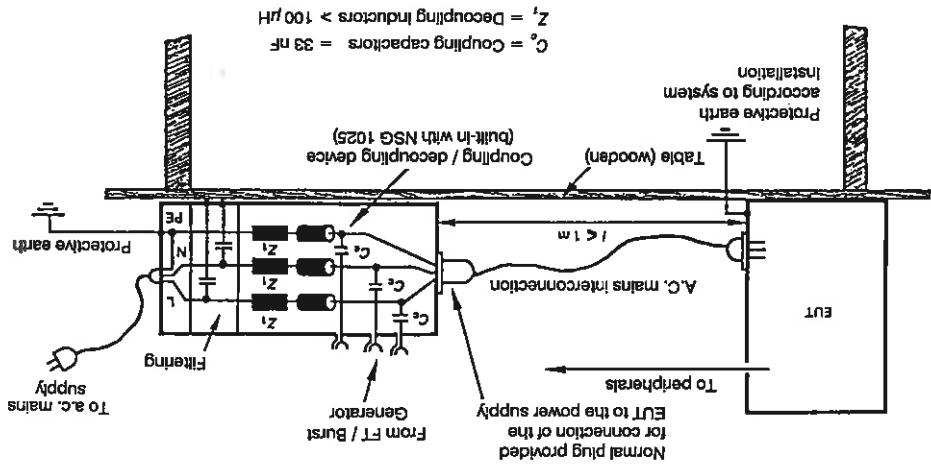


Operation with the CDN 300

Severity level	1	0.5 kV	1 kV	2 kV	4 kV
Test voltage: power supply lines	2	1 kV	0.5 kV	1 kV	2 kV
Test voltage: signal, control and I/O lines	3	1 kV	1 kV	1 kV	2 kV
Frequency	5 kHz	5 kHz	5 kHz	5 kHz	2.5 kHz

Table of severity levels

Example for field test on a.c. mains supply and protective earth terminal for non-stationary mounted EUT.



Extract from the prescriptions for the layout of the test bench as specified in IEC 801-4:

In the interests of reproducibility, every test rig should be accurately documented and, if possible, be photographed. Test that conform fully to the published Standards can only be carried out by observing precisely all the prescriptions concerning the set up of the test rig. The dimensions of the ground plane, the layout of the equipment, length, cross-section and placement of the cabling and, in particular, the earth connections can have a considerable influence on the test results.

7 Standards

The NSG 1025 Generator conforms in all respects exactly to the

IEC 801-4 Standard

and hence to the compatible or subsidiary Standards, such as:

CENELEC HD 481.4
DIN / VDE 0843, Teil 4
NAMUR, Teil 1, Störfestigkeitsanforderungen
etc.

The extended functions of the instrument also enable tests to be carried out according to:

CIGRE, Commission 65
etc.

Contact addresses for copies of the Standards:

IEC International Electrotechnical Commission
3 rue de Varembé, P.O. Box 131
1211 Geneva 20
Switzerland
Tel. (022) 34 01 50 / Telex 28 872

VDE VDE-Verlag GmbH
Bismarckstrasse 33
1000 Berlin 12
Germany
Tel. (030) 3 41 30 41 / Telex 01 81 683

CENELEC General Secretary
CECC
Gartenstrasse 179
D-6000 Frankfurt/M 70
Tel. (69) 63 91 71 / Telex 40 32 175 cecc d

8 Technical specifications

Pulse amplitude
Setting and display
accuracy (DVM)
Polarity
Pulse rise time, t_r
Pulse width, t_p
Burst frequency, f Burst
Burst duration, t Burst
Burst repetition, t Rep
Generator impedance
Single pulse

Coupling network
Test object supply

Coupling modes
Coupling modes
asym.
asym.

Phasing
Coupling capacitor
Decoupling attenuation
Cross-talk attenuation

Instrument supply
Power consumption

225 ... 4400 V (off-load)

±10%

Positive or negative, selectable

5 ns ±20%

50 ns ±30%

2.5 / 5 / 10 kHz ±10%

15 ms ±20%

300 ms ±20%

50 Ω ±20% (dynamic)

5/50 ns

Single triggering or
50 Hz repetition

As per IEC 801-4, built-in

Separately switched via 2-pole

over-current trip-switch

5...264 Vac / 16 A, 15...400 Hz

5...50 Vdc / 16 A (5...250 V / 12 A)

Press-button selection:

L1 --> reference earth

L2 --> reference earth

PE --> reference earth

L1+L2 --> reference earth

L1+L2+PE --> reference earth

Asynchronous

33 nF

> 20 dB

> 30 dB

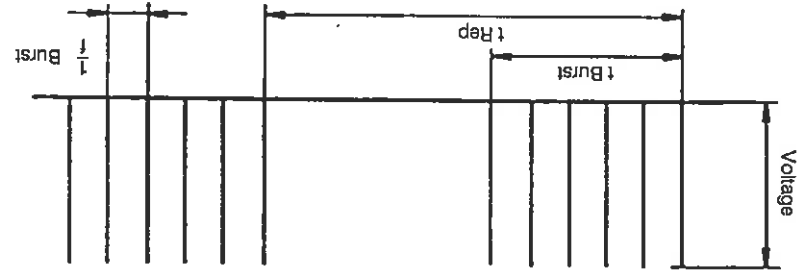
115 V or 230 Vac, +15%/-20%, 50/60 Hz

25 W approx.

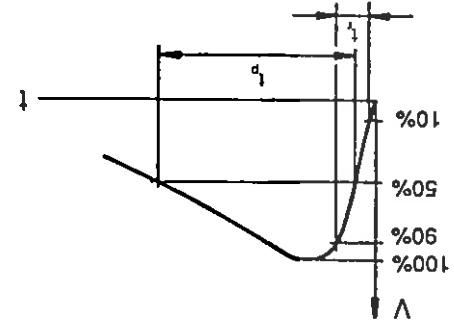
Inputs/outputs	<ul style="list-style-type: none"> - IEC connector for the instrument supply - 16 A connector for the test object supply - Test object connection: country-specific mains socket <ul style="list-style-type: none"> - Schuko - UL - BS 1363 - Swiss type 13 plus universal safety sockets - Gate function for burst and 50Hz pulse: BNC, active 0 - Trigger function for single pulse: BNC, active 0, with LED - Pulse output: HV coaxial connector - Monitoring output: BNC, 100:1 into 50 Ω
Operating and display elements	<ul style="list-style-type: none"> - Mains switch with indicator - 2-pole switch for test object supply with over-current trip - Press-buttons for: <ul style="list-style-type: none"> Burst 50 Hz single pulses Single pulse triggering Polarity, +/- - Fixed setting selection switch: <ul style="list-style-type: none"> IEC Class 1: 500 V / 5 kHz 2: 1000 V / 5 kHz 3: 2000 V / 5 kHz 4: 4000 V / 2.5 kHz and for free voltage/frequency choice - Frequency switch: 2.5 / 5 / 10 kHz - Digital display for pulse amplitude - Multi-turn pot. for pulse amplitude - Selection buttons for coupling mode
Housing Dimensions	<p>19" table-top unit</p> <p>Height: 183 mm (7.2") approx.</p> <p>Width: 449 mm (17.7") approx.</p> <p>Depth: 361 mm (14.2") approx.</p>
Weight	10 kg (22 lbs) approx.
Temperature range	+5...+40 °C (+41 ... +104 °F)
Humidity range	20...80% r.h. (non-condensing)

9 Pulse definitions

Definition of the burst pulse



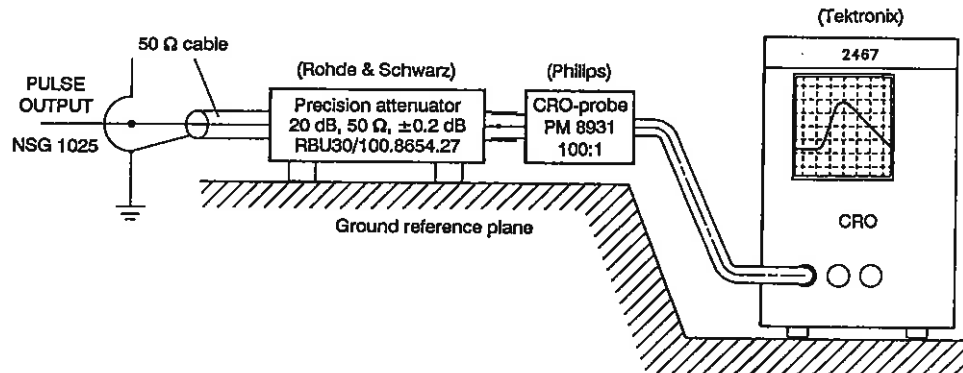
Definition of the single pulse



10 Calibration

Calibration and verification of the generator data demand a certain amount of outlay on equipment and care in setting up the measurement arrangement.

The measurement set-up as used at SCHAFFNER (shown below) can be taken as a reference.



Warning!

This instrument and the accessories work at high voltage. Maintenance work may only be carried out by qualified specialists.

Disconnect the instrument from the mains before opening the housing or when replacing fuses.

Storage capacitors inside the instrument can still be charged to dangerously high voltages long after the mains has been switched off.

The instrument contains no parts subject to wear nor any switches or adjustments that are foreseen for access to the user.

Maintenance work by the user is confined to checking and replacement of fuses.

Mains fuse in the IEC equipment socket, 20:

230 Vac, +15%/-20%, 50/60 Hz: 500 mA slow-blow, 5x20 mm
 115 Vac, +15%/-20%, 50/60 Hz: 2 A slow-blow, 5x20 mm

Fuse on the HV circuit board: 2 A slow-blow

Routine functional checks can be carried out using conventional laboratory instruments such as a multimeter and wide-band oscilloscope (250 MHz). A far greater involvement is necessary, however, for an exact verification of the pulse data and for calibration measurements, as shown in Section 10.

A damp cloth is usually sufficient to clean the housing. Spirit and pure benzine are also permissible cleansing agents as defined by IEC 348.

**The instrument is to be returned to an authorised
 SCHAFNER service depot for any repair work.**

12 Ordering Information

Type	Mains	Mains cable and EUT connection
NSG 1025-01	220 V, 50/60 Hz	Schuko
NSG 1025-02	220 V, 50/60 Hz	Swiss type 13
NSG 1025-04	110 V, 50/60 Hz	498 / 13 UL / CSA
NSG 1025-05	240 V, 50/60 Hz	BS 1363

The instrument is supplied ready-to-use, including a mains cable, test object mains connection and operating instructions.

13 Accessories (not included)

INA 160	Brackets for mounting in a 19" rack
CDN 300	FT/Burst coupling network, 3-phase
400-071	Coupling clamp as per IEC 801-4
NSG 426	Coupling unit for data line pairs
400-063	Coupling clamp, small, for use with NSG 426
156-154	HV coaxial connector (Fischer type S103A 023)
402-379	HV attenuator, 6 dB
402-227	Universal safety connectors (set of 3 pieces)

14 Warranty

SCHAFFNER grants a warranty of 1 year 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 SCHAFFNER.

Excluded from the warranty are 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. SCHAFFNER can accept no responsibility for damage in transit.

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NOTE: CAN NOT CHANGE
THE CINE VOLTAGE PER
SCHAFNER