NSG 5000

Part No.: 590-0200

Issue 1.4 February 1998

SR No. : 3351

DECLARATION OF CONFORMITY

SCHAFFNER

CE

Manufacturer:	Schaffner Limited.
Address	Schaffner Limited. National Technological Park, Castletroy, Limerick, Ireland.
	Declares that the following product
Product:	NSG 5000 INTERFERENCE TEST SYSTEM
Options	All
	Conforms to the following Directives and Regulations
EMC	Directive 89/336/EEC
Generic Standards:	EN 55 011 EN 50 082-1
	The relevant technical file is available for inspection.
Technical File:	No. 094135 Quality Assurance, Schaffner Limited, Limerick, Ireland.

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

Schaffner Limited
Quality Assurance

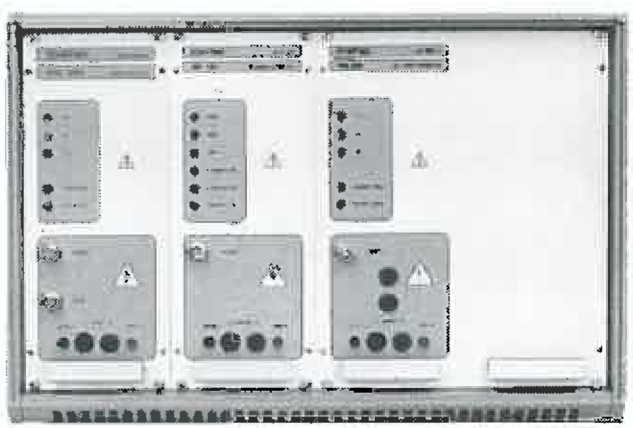
Peter O'Riordan

P. O'Riordan

Interference Test System

NSG 5000

Operating Instructions



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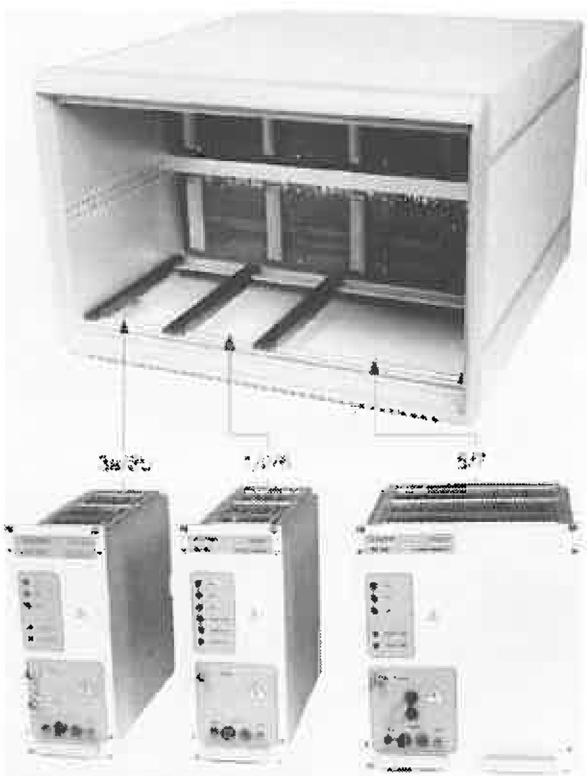
1 Introduction

The NSG 5000 EMC test system is designed for testing automotive electronic components and parts. Automotive EMC test requirements are covered primarily in the ISO 7637-1 and the ISO 7637-2 standards. These standards outline seven basic pulse types that are used for automotive EMC testing. The NSG 5000 system is a modular instrument that can generate all of the pulses described in the ISO standard and in many cases to a higher specification than that specified in the standard.

The NSG 5000 is a modular instrument where the pulse generators are designed as plug-in modules that fit into the NSG 5000 mainframe.



Due to the modular structure of the NSG 5000 you configure a test system that provides only the pulse requirements that are required for your application.

- It should be noted that pulses of similar specification and energy requirements are usually housed in the same plug-in unit. For example the ISO pulses 1, 2 and 6 are all supplied within the same plug-in.

The NSG 5000 is fully programmable over an RS232 or (optional) IEEE488 interface bus. A graphical Windows program "Win5000" is available to provide full remote control via a PC computer. This program allows you to generate pulse sequences, including dynamic ramping, and to generate hardcopy printouts of the test results.

The main features of the NSG 5000 could be summarised as follows,

- Modular construction, pulse modules plug into main chassis.

- Exceeds specifications set out in the ISO, DIN and SAE standards.

- Remote controllable via RS232 or IEEE488 interface.

- Built in selftest to verify basic pulse operation

- Internal multiplex bus system (all pulses available from the front of NSG 5003 plug in).

- Remote control protocol uses SCPI standard.

- Compact construction, 12 inches high (30 cm).

- 19 inch rack mountable.

- Windows software program available (as option).

- DUT FAIL, Start/Stop, Test End, and CRO Trig signals available for interfacing with other test equipment.

- 68000 based control unit provides flexible and fast operation.

2 NSG 5000 System Overview

The NSG 5000 mainframe is designed to take the pulse plug in units from the front. The system support electronics are plugged in from the rear.

These rear plug in units are not generally removed by the user. These units have a modular construction to facilitate easy maintenance and to allow for future upgrades to the NSG 5000 system. The plug-in units in question are,

- **HV Supply** this is a solid state high voltage programmable power supply that provides the required charging voltage to the pulse generators.

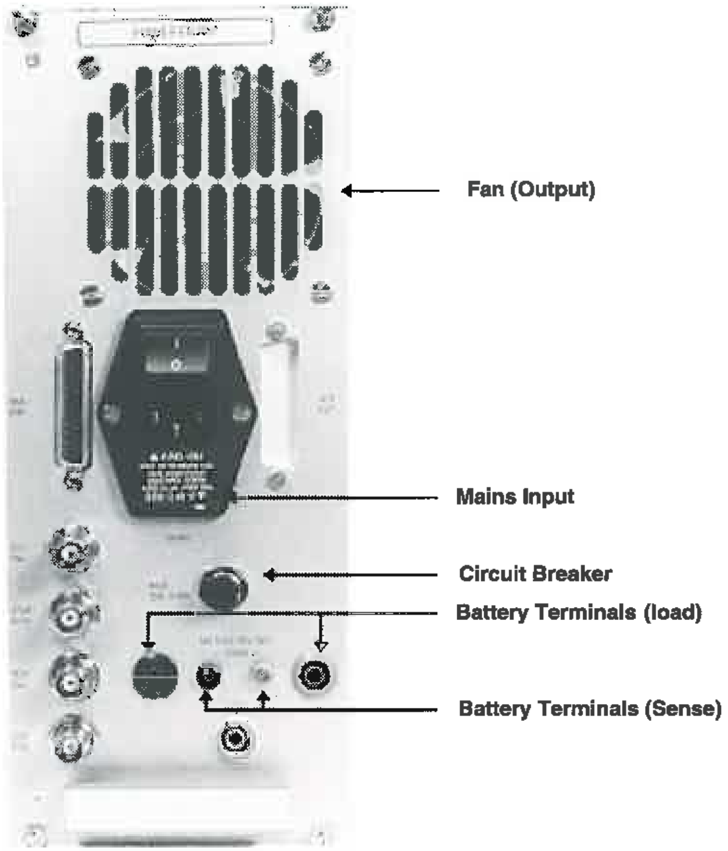
- **Power Entry** this unit facilitates the connection of the mains input to the system and the connection of the battery supply to the power bus. In addition it also provides the input/output connections for the external control signals DUT FAIL, START/STOP, TEST END and CRO. TRIG

- **Battery Switch** this unit contains a solid state switch and timing electronics which are used for precise timing control of the ON and OFF periods of the battery power supplied to the Device Under Test (DUT). This is required to meet some of the timing requirements specified in the standards, particularly for pulses 1, 2 and 6.

- **Control** this unit contains the 68000 based processor board that controls the complete system. The remote control interfaces RS232 and IEEE488 are also available via this unit, as well as the optional Pulse 4/4c control board.

2.1 Power Entry unit

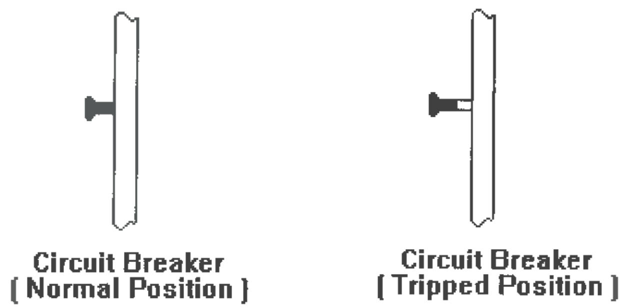
This unit is used to bring mains input into the system and to connect the battery input to the system power bus.



If a DC source with remote sense is being used to simulate the battery input (i.e. supply power to the DUT) then the **Sense** terminal inputs can be used to ensure that the voltage at the DUT is accurate by compensating for voltage drops in the lines. If an NSG 5004 Pulse 4/4c amplifier is supplied with the test system then this can also be used as the battery input for all the other pulses.

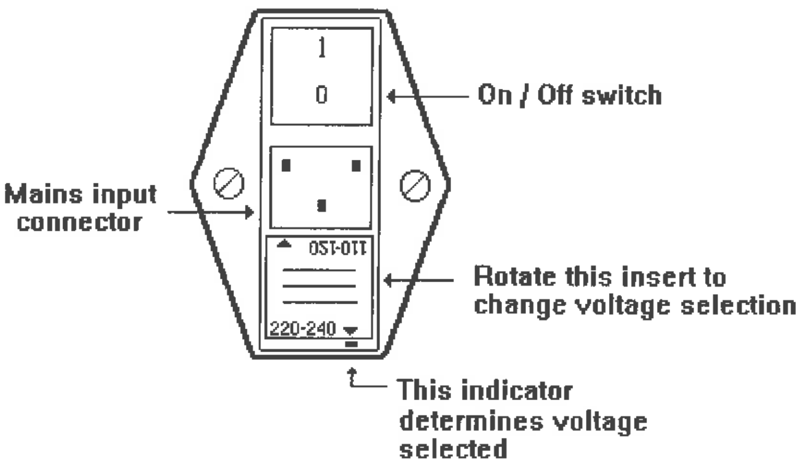
The Power Entry unit is fitted with a circuit breaker. This is designed to trip at approximately 30 Amps and is intended to protect the internal power bus in the case of an overload condition.

Power Entry - Side View



If the circuit breaker trips the button will pop out and a white band is exposed to indicate the tripped position.

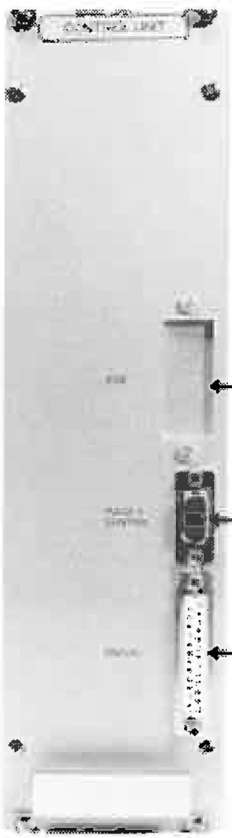
Mains input power is brought into the system via the Power Entry module. The Power Entry module has a mains input power filter socket that allows for adjustment between 110/120 Vac and 220/240 Vac operation.



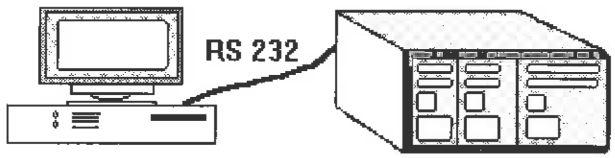
2.2 Control Unit

The Control Unit houses the 68000 based processor board which controls the complete NSG 5000 system. The remote control interfaces are also mounted on this unit. The RS232 interface is supplied as standard on all NSG 5000 systems. An optional IEEE488 interface can also be supplied with the unit as required.

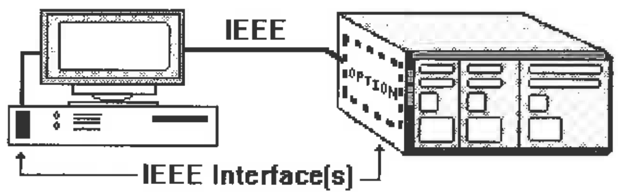
The optional NSG 5004 Pulse 4/4c arbitrary waveform generator card is also mounted within the Control Unit.



The RS232 interface is the simplest and most cost effective method of remote control of the NSG 5000 system because all PC computers also have an RS232 port as standard.



Use of the IEEE488 interface requires an interface to be fitted to the PC and the NSG 5000 chassis.



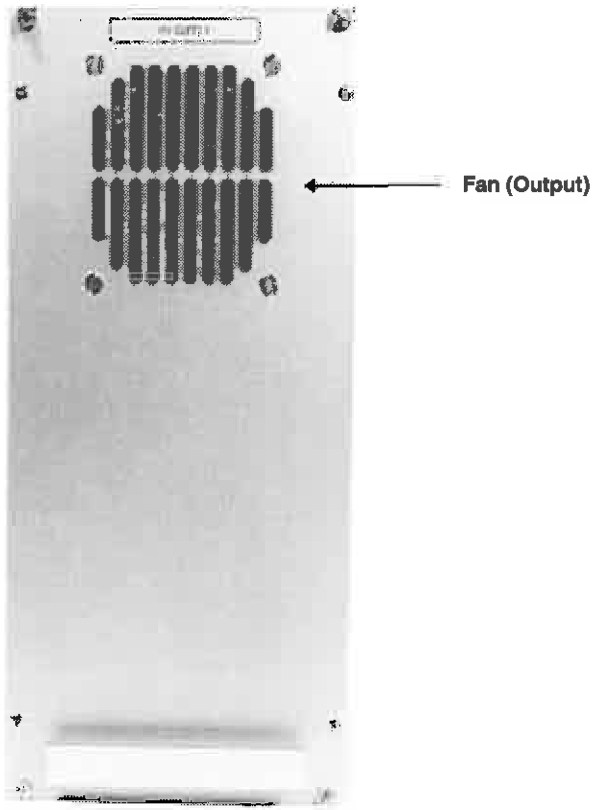
Clearly this is a more expensive interface solution but it may be of interest in some applications where the NSG 5000 is being integrated into a system with some other IEEE based instruments.

The remote control command syntax is identical in both interface methods and is SCPI based.

- The Windows based application program "Win5000" allows full remote control and test sequences to be developed within the graphical Windows environment.

2.3 HV - Supply

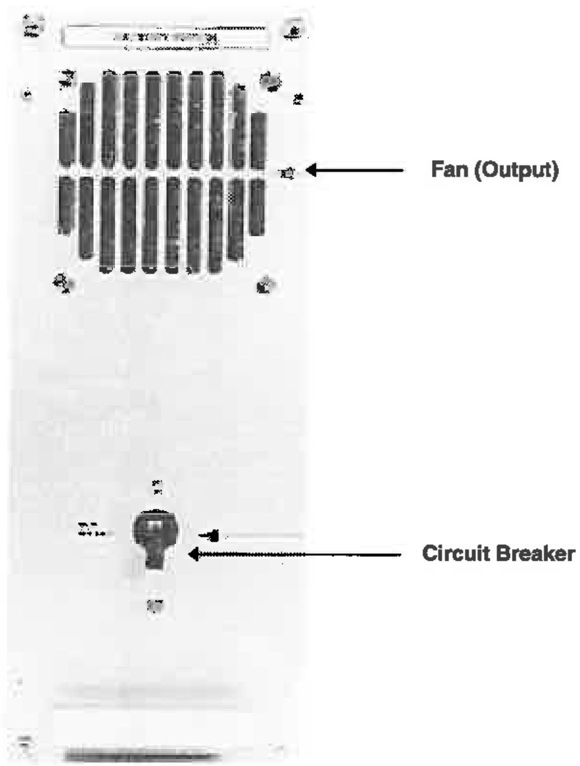
This unit is used to charge the pulse generators. It is a solid state electronic power supply that is capable of supplying the necessary high energy bursts of power required to charge all of the pulse generators supported by the NSG5000 mainframe system.



The HV - Supply is fully programmable and is controlled on the internal bus by the Control Unit.

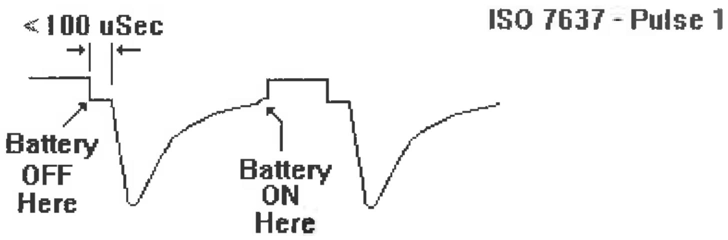
2.4 Battery Switch

The battery switch unit is required with the NSG5001 or NSG5005 plug-in units. This is an electronic solid state switch that allows flexible control of the power bus output during the generation of interference pulses 1, 2, 6 and 7. (ref. ISO standard 7637).



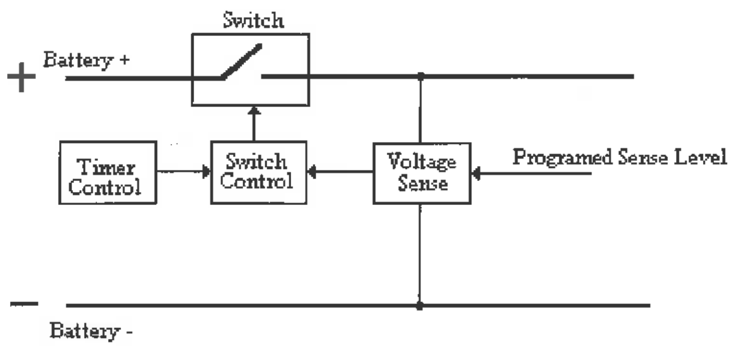
The requirement for sophisticated switch control when generating ISO 7637 pulses is not immediately apparent. However, upon deeper examination it will become apparent that the requirement for turning ON and OFF the battery power (i.e. power bus) can only be met with a complicated solid state switch arrangement. This is because high power current needs to be switched over very short periods of time and by different control mechanisms.

Take for example Pulse 1 of the ISO 7637-1 specification.



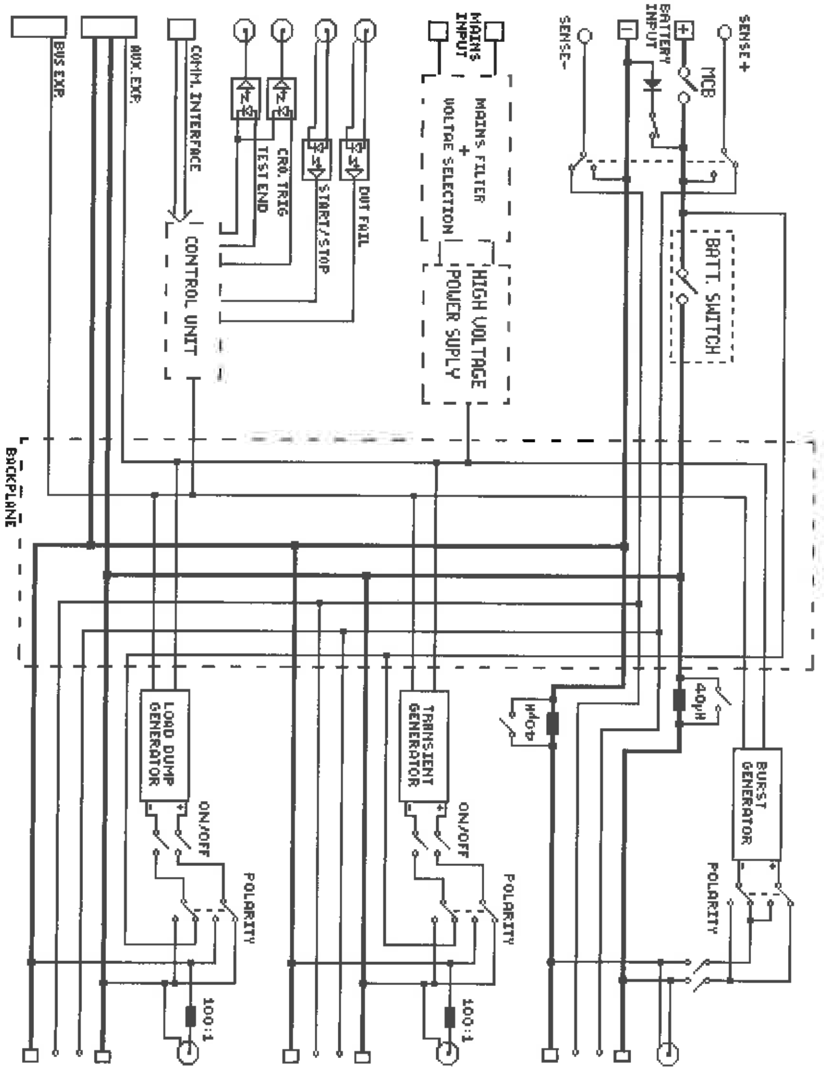
Upon detailed analysis of this pulse requirement it becomes clear that there is an implied requirement for the battery power to switch ON and OFF during pulse generation. The point at which the Battery Power is turned ON should really be determined by the voltage level of the pulse. Once it has decayed to a point of zero volts the battery power must be turned on rapidly and with minimal discontinuities.

A general block diagram of the Battery Switch unit for the NSG5000 system could be represented as follows.



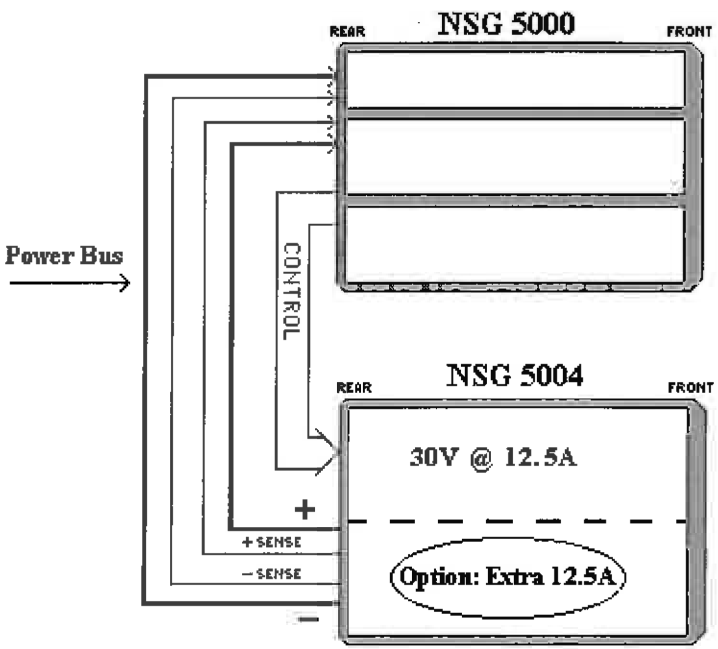
The switch has facilities for being controlled by a voltage sense circuit or a timer circuit. While it is obvious that the control of the Battery Switch to the required specification requires complicated timing and monitoring controls, all of this activity is generally transparent to the user. The Control Unit in the NSG5000 manages all of these requirements internally and automatically, as required, during pulse generation.

2.5 System Block Diagram



2.6 External Connection of Pulse 4 Amplifiers (NSG5004/NSG5004A)

The Pulse 4/4c amplifiers (if supplied with the system) are housed in an external chassis. This external chassis is controlled by the NSG5000 mainframe. The diagram below shows in conceptual form how the two units are connected and interact.



The Pulse 4/4c unit is available in a 12.5 Amp and 25 Amp version. The NSG 5004/NSG5004A chassis is 19 inch rack mountable and is 6U high.

3 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.

3.1 General

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

During pulse generation, high voltages and currents are present at the output terminals. BNC output connectors are accessible and can have hazardous live voltages present while in operation.

Therefore output connections must not be handled while pulses are being generated.

The generator is to be used only for the purposes set down by the manufacturer. It is the user's responsibility to ensure that the test set-up does not emit excessive radiation that may effect other equipment. The instrument itself does not produce excessive radiation. However, applying interference pulses to an DUT may cause that DUT and its cables to start radiating EMI. The method recommended by standards bodies to prevent unwanted emission is to operate the test set-up in a Faraday cage.

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 mishandling that could cause light injuries or material damage.**

3.2 Installation

The instrument conforms to protection class 1.

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 DUT 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. This equipment must not be used in an enclosed space that would restrict the air flow through the instrument.

Use only legally approved connectors and accessory items. The instrument must be powered from a mains supply that provides a properly earthed mains socket. Before the unit is powered up check that the voltage selector on the instrument is set to the correct position.

Ensure that a reliable return path for the interference current is provided between the DUT 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 not in principle 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 DUT, the instrument must first be disconnected from both sources before any changes are made. Besides the mains supply itself, certain instruments also operate at high voltages which are not provided with any internal form of extra protection against being touched.

Ensure that all unused slots are blanked off before powering up.

3.3 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 DUT that are in danger of being touched.

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

The DUT 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 DUT (see Dangers concerning the DUT).

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

3.4 Dangers concerning the generator

- Local burning, arcing, ignition of explosive gases.

- Danger from the resultant DUT supply current caused by a flash-over or breakdown resulting from the superimposed high voltage effects.

- Dangers from a disrupted DUT.

- 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 DUT in accordance with the requirements of the test standard. Earth contacts or pins (e.g. in German and French connectors) as well as the DUT earth can hence be at a dangerous to touch voltage. The screws, too, in certain connectors are also linked to the protective earth conductor.

3.5 Dangers concerning the DUT

DUTs 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 DUT is quickly damaged by internal overloads caused by the control electronics being disrupted or it may even start to burn.

- As soon as the DUT shows signs of being disrupted the test should be stopped and the power to the DUT switched off.

- Internal disruption of the electronics can result in the interference voltage or the DUT supply voltage being present on the DUT's 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 DUT, e.g. robot device strikes out, temperature controller fails, etc.

3.6 Applicable safety standards

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

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 generator are equipped for high voltage working safety in accordance with VDE 0104.

The interference immunity has been tested in conformity with EN50082-1.

Since the purpose of this instrument is the generation of interference signals to test for interference immunity, the regulations concerning the limitation of interference radiation contained in EN 50082-1 can only be complied with when the equipment is operated in a Faraday cage.

3.7 General Specifications

Supply Voltage:	100V - 120V AC ± 10%
	220V - 240V AC ± 10%
Frequency Range:	47-63 Hz
Input Current:	< 2 Amps
Operating Temperature Range:	10 to 35°C
Storage Temperature Range:	0 to 70°C
Humidity	20 to 70 % R.H. (non-condensing)
Fuse Type:	2AT x 2

4 Putting into service

This section outlines a brief checklist of items that should be done before the unit is powered up and put into service.

- Check that all items and accessories which have been ordered have been delivered.
- Inspect the equipment for damage during transit. Any damage found should be reported to the carrier immediately.
- Carefully study the documentation and operating instructions supplied.
- The mains voltage selector on the rear of the instrument must agree with the local mains voltage (mains frequency : 47 - 63 Hz)
- Connect the mains cable to a mains outlet that has a good earth connection.
- Ensure that all modules are inserted correctly and screwed home tightly.
- Observe, and adhere to, the polarity of all input and output connections.
- Power up and operate according to the instructions supplied.

NOTE:

The WIN5000 software for use with this system has a facility for running the internal selftest. It is recommended that selftest be run on each plugin generator unit before any testing on a DUT is carried out. Selftest does not check the unit to calibration tolerances but it will perform a functional check on all main operating parts.

5 Remote Programming

All instrument functions, except for the setting of the IEEE 488 address and the signals DUT Fail and START/STOP, are programmable over the remote control bus. An RS 232 interface is supplied as standard on all instruments. An IEEE 488 interface is available as an option.

The remote control program syntax, "Standard Commands for Programmable Instruments" (SCPI) is used with both the RS 232 and IEEE 488 interfaces.

5.1 Conventions

The following conventions are used throughout this chapter.

Angle Brackets < >	The characters inside the brackets represent something other than themselves. For example, <NR1> represents a specific form of numerical data.
Vertical bar I	The vertical bar can be read as "or" and is used to separate alternative parameter options. For example, FIXED I LIST indicates that the parameter FIXED or LIST may be selected.
Square Brackets [ ]	Square brackets are used to enclose a keyword that is optional when programming the command.
Colon :	This is used to indicate a descending level in the SCPI hierarchy.

5.2 Short and Long Forms

All SCPI commands in this chapter indicate their short form by the use of upper case letters. For example, the keyword **SOURce** indicates that the short form of this keyword is **SOUR** and the long form is **SOURCE.** Transmitting either of these keyword forms will achieve the same effect.

5.3 SCPI messages

There are two types of SCPI messages, program and response.

- A program message goes from the controller to the generator and consists of one or more properly formatted SCPI commands. The message gives the generator an instruction to perform some action. The controller may send a program message at any time.

- A response message goes from the generator to the controller and is a collection of data in a specific SCPI format. The data can be information concerning operating parameters, generator state, or error conditions. The generator may send a response message only when commanded by a special program message called a "query". A query program message is identified by the **?** (question mark) character.

SCPI messages consist of one or more message units ending in a message terminator. The message terminator used in the NSG 5000 is the <CR> (carriage return ASCII character). The terminator is not part of the syntax but is implicit in the way your program language indicates the end of a line.

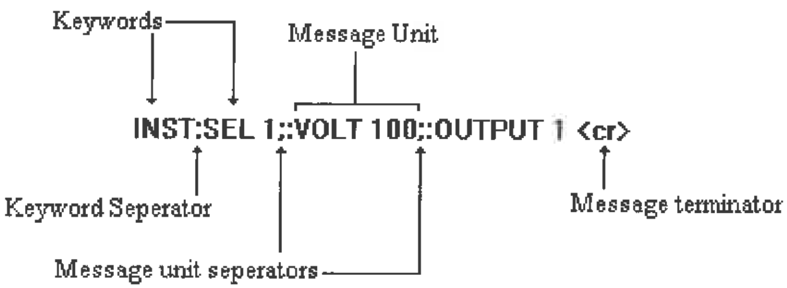
The simplest SCPI command is a single message unit consisting of a command or query keyword. For example,

:INIT <cr>

The message unit may include a parameter after the keyword.

:Voltage 100 <cr>

Message units may be combined using a semi-colon (;) as a separator. The following example indicates the main components of a SCPI message.



Any command that has a parameter form may be issued as a query command by appending a question mark to the syntax. For example,

:VOLT?

would return the current amplitude setting.

5.4 NSG 5000 Command Description

Table A: Syntax of SCPI Confirmed commands (SCPI Version 1993).

Keywords	Parameter Form	Notes
[:SOURce]		
:PULSe		
:COUNt	<numeric_value>	
:POLarity	NORMal / INVerted	
:TRANsition		
:STATe	<Boolean>	
[:LEADing]	<numeric_value>	
:WIDTh	<numeric_value>	
:INITiate		
[:IMMediate]		[no query]
:CONTinuous	<Boolean>	
:ABORt		[no query]
:TRIGger		
:COUNt	<numeric value>	
:INSTrument		
[:SELect]	PONe/PTWo/PTHRee/PFOur/ PFIve/PSIX/PSEVen	
:NSELect	<numeric value>	
:OUTPut		
:IMPedance	<numeric_value>	
[:STATe]	<Boolean>	
:CURRent		
:LIMit		
[:AMPLitude]	<numeric_value>	
:LIST		
:VOLTage	<numeric_value>{,<numeric_value>}	
:DWELl	<numeric_value>{,<numeric_value>}	
:COUNt	<numeric_value>	
:VOLTage		
[:LEVel]		
[:IMMediate]		
[:AMPLitude]	<numeric_value>	
:CALibration		
:STATe	<Boolean>	

Table B: Syntax of commands which are not currently part of SCPI definition (awaiting approval).

Keywords	Parameter Form	Notes
[:SOURce]		
:PULSe		
:PERiod		
[:INTerval]	<numeric_value>	
:MODE	FIXed/RAMP	
:TRIGger		
:TIMer		[no query]
[:INTerval]	<numeric_value>	
:MODe	FIXed/NRAMp/TRAMp	
:RAMP		
:TIMer		
:STARt	<numeric_value>	
:STOP	<numeric_value>	
:STEP	<numeric_value>	
:DWELl	<numeric_value>	
:DELay	<numeric_value>	
:PAUSe		[no query]
:INSTrument		
:IDENtify?		[query only]
:OUTPut		
:OFFSet		
[:STATe]	<Boolean>	
:OFFMode	VOLTage/TIMe	
:OFFTime	<numeric_value>	
:DIAGnostic		
:SELect	<numeric_value>	
:REPort		[query only]
:RECall		
:VOLTage		[query only]
:PPERiod		[query only]
:TRIGperiod		[query only]

Keywords	Parameter Form	Notes
:RAMP		
:VOLTage		
:STARt	<numeric_value>	
:STOP	<numeric_value>	
:STEP	<numeric_value>	
:DWELl	<numeric_value>	
:DELay	<numeric_value>	
:PPERiod		
:STARt	<numeric_value>	
:STOP	<numeric_value>	
:STEP	<numeric_value>	
:DWELl	<numeric_value>	
:DELay	<numeric_value>	
:CALibration		
:MODe	VOLTage	
:DATa	<programmed_value1, measured_value1,programmed_value2,measured_value2>	
:RISe	UP/DOWN	
:WIDTh	UP/DOWN	
:IMPedance	UP/DOWN	
:SAVe		[query only]
:RESTore		[query only]
:VOLT	+/- <numeric_value>	

NOTES: (1) A Boolean parameter type may be specified as either ON or 1 to indicate an "on" (logic high) condition and as OFF or 0 to indicate an "off (logic low) condition.

(2) The full path to any "leaf" command must always be specified. For example,

:COUNT 100

is not a legal command and should be specified as

:PULSE:COUNT 100

i.e. the command must be specified from the root node.

5.4.1 Source Subsystem

This subsystem controls the setting up of pulse parameters including amplitude, rise time, pulse width, repetition rate and mode.

SOURce
This is the root keyword. It may proceed all of the source subsystem commands or it may be left out if preferred (i.e. it is an optional parameter)

SOURce:PULSe
These are the commands that are used to control the pulse shape on all pulse generators other than pulse 4.

:PULSe:COUNt <numeric>

This is used to indicate the number of pulses (t4) in the burst. If 100 pulses were required in a burst then this could be specified as,

PULS:COUNT 100
Relevant pulse type(s): 3a, 3b.

:PULSe:WIDTh <numeric>
This command allows you to specify the pulse width (td) required. A list of options are available for each pulse type. The following table specifies the allowed values in each case.

Pulse	Allowed Parameters
1	50E-6,200E-6,500E-6,1E-3,2E-3
2	50E-6,200E-6,500E-6,1E-3,2E-3
5	40E-3,100E-3,150E-3,200E-3,250E-3, 300E-3, 350E-3,400E-3
6	300E-6
7	40E-3,100E-3,150E-3,200E-3,250E-3, 300E-3, 350E-3,400E-3

Relevant pulse type(s): 1, 2, 5, 6, 7.

:PULSe:PERiod:INTerval <numeric>
This command is used to specify the burst frequency (t1). The t1 value transmitted should be the reciprocal of the frequency required. For example, to set a pulse frequency of 10Khz the command would be,

PULS:PER:INT 100E-6
Relevant pulse type(s): 3a, 3b.

:PULSe:PERiod:MODE
This command can have two qualifiers FIXED or RAMP. The command
PULS:PER:MODE:FIXED
is transmitted to generate pulses at a repetition rate. If ramping is required then the command
PULS:PER:MODE:RAMP
is transmitted. This instructs the controller to go into ramping mode. The parameters for controlling the ramp are specified with the SOURce:RAMP command described later.
Relevant pulse type(s): 3a, 3b.

:PULSe:POLarity
Assuming that a unit has been selected with the INSTrument:SELect command then the command
PULS:POL NORM
would indicate to the controller that 3b (positive) mode was required.
PULS:POL INV
would indicate that 3a (negative) mode was required.
Relevant pulse type(s): 1, 2, 3, 5, 6, 7.

:PULSe:TRANsition:STATe
The transition state can be set to either ON or OFF. If the STATe is OFF, then the rise time parameter will be set to the minimum transition time available for the device. If the STATe is set to ON the rise time will be set by the value specified by LEADing. In reality this command only applies to pulse types 1 and 2 because all other pulse type have a fixed rise time.

:PULSe:TRANsition[:LEADing]<numeric>

This command set the rise time for pulse type 1 and 2. Only two parameter values are accepted,
PULS:TRAN 1E-6
will set the rise time to 1 uSecond.
PULS:TRAN 3E-6
will set the rise time to 3 uSeconds.

Note that because LEADing is an optional keyword it may be left out of the command if preferred.
Relevant pulse type(s): 1, 2, 5, 6, 7.

SOURce:VOLTage
These commands are used to control the pulse amplitude and also the mode in which amplitude is controlled.

:VOLTage[:LEVel][:IMMediate][:AMPlitude]
This command allows you to specify the amplitude of the pulse currently selected. The shortest allowable form of this command would be

:VOLT 100
This would set the amplitude to 100 Volts.
Relevant pulse type(s): All except 4.

:VOLTage:MODe
This command has two parameters FIXED and RAMP. FIXED indicates to the controller that the pulses will be generated at a constant amplitude. The RAMP parameter indicates that the pulse voltage is to Ramp and the parameters necessary to control the ramp are specified with the RAMP:VOLTage command.
Relevant pulse type(s): All except 4.

SOURce:CURRent

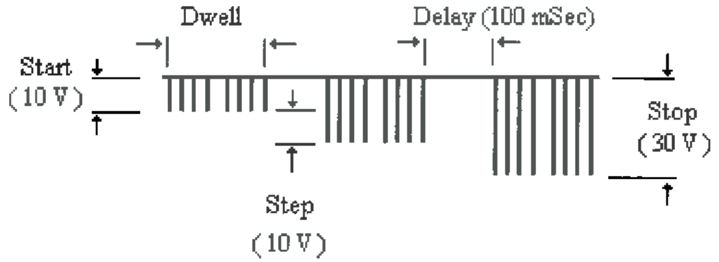
:CURRent:LIMit[:AMPLitude]
Sets the current limit. The shortest allowable form of this command would be
:CURR:LIM 12.5
This would set the current limit to 12.5 Amps.
Relevant pulse type(s): 4, 5, 7

CURRent:LIMit:FULLscale
Sets the current limit fullscale. The shortest allowable form of this command would be
:CURR:LIM:FULL 12.5
This would set the current limit fullscale to 12.5 Amps.

Relevant pulse type(s): 4, 5, 7.

SOURce:RAMP
These commands specify the parameters necessary to control the ramping of Voltage and Period.

:RAMP:VOLTage
The diagram below is useful in explaining the terminology used for ramp control. It represents diagramatically a ramp from 10 Volts to 30 Volts in 10 Volt steps. There are two bursts in each step and a delay between steps of 100 mSeconds. There are four pulses in each burst.



:RAMP:VOLTage:STARt
This command specifies the initial voltage during a VOLTage ramp.This is the first level in the ramp.The unit for STARt is volts.
Relevant pulse type(s): 1,2,3,5,6,7.

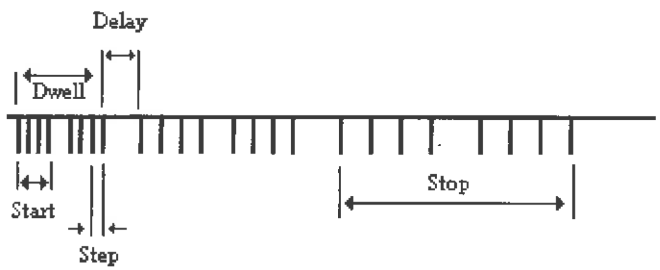
:RAMP:VOLTage:STOP
This command specifies the final voltage during a VOLTage ramp.This is the final level in the ramp. The unit for STOP is volts.
Relevant pulse type(s): 1,2,3,5,6,7.

:RAMP:VOLTage:STEP
This command specifies the voltage increment during a VOLTage ramp. The unit for STEP is volts.
Relevant pulse type(s): 1,2,3,5,6,7.

:RAMP:VOLTage:DWELl
This command specifies the dwell time for each level in a VOLTage ramp. The unit for DWELl is a count of bursts.
Relevant pulse type(s): 1,2,3,5,6,7.

:RAMP:VOLTage:DELay
This command specifies the delay time between steps during a VOLTage ramp. The unit for DELay is seconds.
Relevant pulse type(s): 1,2,3,5,6,7.

:RAMP:PPERiod
This command is similar to the RAMP:VOLTage command. However in this case it is the period of the pulse bursts that is varied.



:RAMP:PPERiod:STARt
This command specifies the time period at which the pulse period starts during a pulse period ramp.This is the first level in the ramp.The unit for STARt is seconds.
Relevant pulse type(s): 3a, 3b.

:RAMP:PPERiod:STOP
This command specifies the time period at which the internal hardware timer stops during a ramp.This is the final level in the ramp. The unit for STOP is seconds.
Relevant pulse type(s): 3a, 3b.

:RAMP:PPERiod:STEP
This command specifies the time interval at which the pulse period increments during a ramp. The unit for STEP is seconds.
Relevant pulse type(s): 3a, 3b.

:RAMP:PPERiod:DWELl
This command specifies the dwell time for each level in a pulse period ramp.The unit for DWELl is a count of bursts.
Relevant pulse type(s): 3a, 3b.

:RAMP:PPERiod:DELay
This command specifies the delay time between steps during a pulse period ramp. The unit for DELay is seconds.
Relevant pulse type(s): 3a, 3b.

5.4.2 INITiate Subsystem

This subsystem controls the execution of pulses. These commands are common to all pulse types.

INITiate
This is the root command. It must proceed all of the Initiate subsystem commands.

INITiate[:IMMediate]
This command will start a pulse (or burst of pulses) that has been previously defined by the SOURce commands. INITiate is gated by the TRIGger:COUNt command and will issue the number of bursts specified by this command. The simplest form of this command is,

INIT

because the IMMediate keyword is optional.

INITiate:CONTinuous
This command has a Boolean parameter form so it may be specified as ON or OFF. The command,

INIT:CONT ON

will generate a continuous stream of pulses as specified by the SOURce commands. The stream of pulses will continue indefinitely until an

INIT:CONT OFF

command is received.

5.4.3 INSTrument Subsystem

This subsystem controls the selection and identification of different pulse types.

INSTrument
This is the subsystem keyword and must preceed all subsystem command sets.

INSTstrument[:SELect]
This command has seven optional parameters NODevice,PONE,PTWo,PTHRee,PFOUr,PFIVe,PSIX,PSEVen. This command indicates to the controller which pulse generator will receive the subsequent set-up and control commands. For example the command

INST PONE

indicates that subsequent commands are to be interpreted for use with the Pulse 1 generator.

INSTrument:NSELect
This command has a similar function to the INSTrument[:SELect] command. However, this command has a numeric parameter form and the allowed values are 0,1,2,3,4,5,6 or 7. To select the pulse 1 generator the command would be

INST:NSEL 1

INSTrument:IDENtify?
This command can be issued as a query only. It can be used to identify which plugin units are actually fitted in the NSG5000 rack. For example, if only the NSG5003 unit was fitted in the rack the response to this command would be

0,"Identified;PSU,3"

If all plugin modules where identified the response would be,

0,"Identified;PSU,1,3,4,5,B"

5.4.4 OUTPut Subsystem

This subsystem controls the setting of output impedance on the selected generator.

OUTPut
This is the subsystem root keyword and must proceed all subsystem commands.

OUTPut:IMPedance
This command sets the output impedance. The following table shows the allowed values of impedance setting for each type of pulse.

Pulse	Allowed Impedance Value(s) (Ohms)
1	4, 10, 50
2	4, 10, 50
3	50
4	Not relevant
5	0.5 to 10 in 0.25 step increments
6	10, 30
7	0.5 to 10 in 0.25 step increments
2b	0.5 - 3

For example, to set the impedance to 10 ohms the command would be,

OUTP:IMP 10
Relevant pulse type(s): 1, 2, 6.

OUTPut:STATe
This command turns on or turns off the output of a selected pulse module.
Relevant pulse type(s): 4.

OUTPut:OFFSet
This command turns on or turns off the battery switch (offset).
Relevant pulse type(s): All pulses.

:OUTPut:OFFSet:OFFMode
This command specified whether the battery voltage turns on when the pulse voltage reaches zero after pulse generation(VOLTage mode) or after a predefined time (TIMe mode).

Relevant pulse type(s): 1, 2, 6.

:OUTPut:OFFSet:OFFTime
This command specifies the predefined time to turn on the battery voltage after pulse generation.
Relevant pulse type(s): 1, 2, 6.

5.4.5 TRIGger Subsystem

This subsystem controls the synchronisation of pulse generation. These commands are relevant to all pulse types

TRIGger
This is the subsystem root keyword and must proceed all subsystem commands.

TRIGger:COUNt
This command will determine how many pulses (or bursts if 3a or 3b) will be issued. If a TRIGger:COUNt is specified and an INITiate[:IMMediate] command is issued the specified number of pulses will be generated. To specify five synchronised pulses the command would be,

TRIG:COUN 5

TRIGer:TIMer:[INTERVAL]
This command is used to specify the time interval between pulses (or bursts). The units are in seconds so to specify a pulse interval of 500 mSeconds the command would be

TRIG:TIM:INTERVAL 500E-3

TRIGger:TIMer:MODE
This command has three optional parameters, FIXED, NRAMP or TRAMP. If FIXED is specified it indicates that the time between pulses is fixed and is specified by the TRIGger:TIMer:INTERVAL command.
If NRAMP is specified it indicates that the DWELI parameter for the ramp contains the number of pulses (or bursts) that each ramp level is held for.
If TRAMP is specified it indicates that the DWELI parameter for the ramp contains the time that each ramp level is held for.
The parameters for NRAMP and TRAMP are specified with the TRIGger:RAMP command.

TRIGger:RAMP:TIMER
There are five subcommands associated with this command. They are START, STOP, STEP, DWELL and DELAY. All of these commands have a numeric form and are used together to specify the control parameters for TRIGger ramping.

:TRIGger:RAMP:TIMer:STARt
Specifies the time period at which the internal hardware timer starts during a ramp.This is the first level in the ramp. The unit of STARt is seconds.
Relevant pulse type(s): 1,2,3,5,6,7.

:TRIGger:RAMP:TIMer:STOP
Specifies the time period at which the internal hardware timer stops during a ramp.This is the final level in the ramp. The unit for STOP is seconds.
Relevant pulse type(s): 1,2,3,5,6,7.

:TRIGger:RAMP:TIMer:STEP
Specifies the time increment at which the internal hardware timer increments during a ramp. The unit for STEP is seconds.
Relevant pulse type(s): 1,2,3,5,6,7.

:TRIGger:RAMP:TIMer:DWELl
Specifies the dwell time for each level in a TIMer ramp.
If TRIGger:TIMer:MODe NRAMP is selected, the unit for DWELl is a count of bursts.
If TRIGger:TIMer:MODe TRAMP is selected, the unit for DWELl is seconds.
Relevant pulse type(s): 1,2,3,5,6,7.

:TRIGger:RAMP:TIMer:DELay
Specifies the delay time between steps during a ramp. The unit for DELay is seconds.
Relevant pulse type(s): 1,2,3,5,6,7.

5.4.6 ABORT Command

This Command controls the termination of pulse generation. This command takes only the simple form

ABORT

Once this command is issued the generation of pulses will stop immediately and the generator output will be disconnected from the internal power bus.

5.4.7 PAUSE Command

This Command suspends the generation of pulses. This command takes only the simplest form

PAUSE

Once this command is issued the generation of pulses stops immediately but the generator output is still connected to the internal power bus.

5.4.8 DIAGnostic Subsystem

This subsystem controls the execution of the internal selftest in the NSG5000 system. The internal selftest provides a functional check of the main component parts of the system.

DIAGnostic
This is the root keyword and must proceed all DIAGnostic subsystem commands.

DIAGnostic:SELect
This selects the plugin unit that is to be selftested. The allowed values are 1, 3 or 5.

DIAG:SEL 1 .... selects the NSG5001 plugin for selftest
DIAG:SEL 3 .... selects the NSG5003 plugin for selftest
DIAG:SEL 5 .... selects the NSG5005 plugin for selftest

DIAGnostic:REPORT?
This query command will perform selftest on the SELected unit and return a text message that indicates whether the unit has passed or failed on each parameter tested. For example, the message returned after selftest of the NSG5003 unit is as follows,

```
0,"MPU test;PASS"
0,"Hvpsu test 50;PASS"
0,"Hvpsu test 100;PASS"
0,"Hvpsu test 500;PASS"
0,"Pulse generation test 200 V; Lo,PASS; Hi,PASS"
0,"Pulse generation test 400 V; Lo,PASS; Hi,PASS"
0,"Pulse generation test 600 V; Lo,PASS; Hi,PASS"
```

:DIAGnostic:RECall
This subsystem recalls the selected instrument settings prior to issuing an :ABORT command.

:DIAGnostic:RECall:VOLTage?
This command reports the programmed voltage value.

:DIAGnostic:RECall:PPERiod?
This command reports the pulse period value.

:DIAGnostic:RECall:TRIGperiod?
This command reports the repeat period of each burst of pulses.

5.4.9 List Subsystem

:LIST:VOLTage
This command contains a list of voltages which when used in conjunction with :LIST:DWELl defines a unique voltage/time arbitrary waveform.
Relevant pulse type(s): 4.

:LIST:DWELl
This command contains a list of dwell times for each voltage point specified in the LIST:VOLTage command.
with :LIST:DWELl defines a unique voltage/time arbitrary waveform.
Relevant pulse type(s): 4.

:LIST:COUNt
This command contains the count of the number of times the waveform repeats when pulse is run with the INITiate:IMMediate command.
with :LIST:DWELl defines a unique voltage/time arbitrary waveform.
Relevant pulse type(s): 4.

5.4.10 Calibration Subsystem

:CALibration:STATe
This command is used to select if the calibration data is applied or not. If STATe is ON then the instrument uses the calibration data for correction. If STATe is OFF, then no correction using the calibration data shall be made.
Relevant to pulse(s): 1,2,4,6.

:CALibration:MODe
Only voltage mode can be calibrated.
Relevant to pulse(s): 4 only.

CALibration:DATa
This command specifies two sets of calibration data. Each set contains a programmed value and measured value.
Relevant to pulse(s): 4 only.

CALibration:RISe
This commands calibrates the pulse rise time UP or DOWN for the selected pulse
Relevant to pulse(s): 1,2,6.

CALibration:WIDTh
Calibrates the pulse width time UP or DOWN for the selected pulse
Relevant to pulse(s): 1,2,6.

CALibration:IMPedance
Calibrates the output impedance UP or DOWN for the selected pulse
Relevant to pulse(s): 1,2,6.

CALibration:SAVe?
Saves the internal calibration constants to non-volatile memory.
Relevant to pulse(s): 1,2,6.

CALibration:RESTore?
Retrieves the internal calibration constants from non-volatile memory.
Relevant to pulse(s): 1,2,6.

5.5 Table of SCPI Mandatory commands

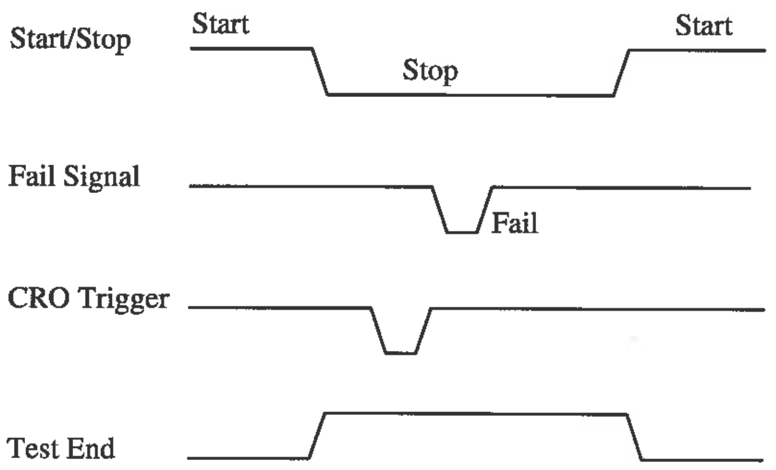
Keywords	Parameter Form
:	
SYSTem	
:ERRor	...... query only ....
:VERSion	...... query only ....
STATUS	
:OPERation	
[:EVENt?]	...... query only ....
:CONDition?	...... query only ....
:ENABle	<NRf>
:QUEStionable	
[:EVENt?]	...... query only ....
:CONDition?	...... query only ....
:ENABle	<NRf>
:PRESet	No query

5.6 Table of IEEE 488.2 Mandatory commands

Command	Description
*CLS	Clear status data structures
*ESE	Standard event status enable
*ESR?	Standard event status query
*IDN?	Identification query
*OPC	Operation complete
*RST	Device reset
*SRE	Service Request enable
*STB?	Read status byte query
*TST?	Selftest query
*WAI	Wait to continue

6 External trigger and control signals

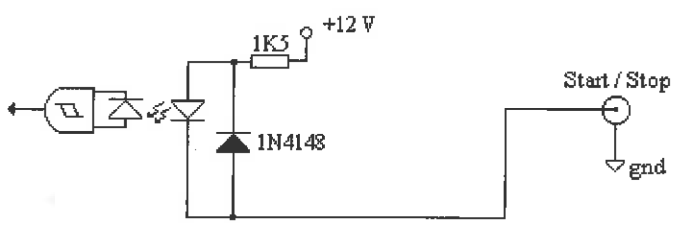
There are four signal input/output signals available on the rear of the NSG 5000 mainframe that can be used for syncronisation with external equipment. The logic levels on these signals are as follows.



6.1 Start/Stop Signal

This is an input signal. If this input is pulled to a logic low level the present sequence of pulses will be halted. The unit remains in this halted state until the signal returns to a high state. The WIN5000 software can automatically detect the state of this input and pause the program until the level returns high.

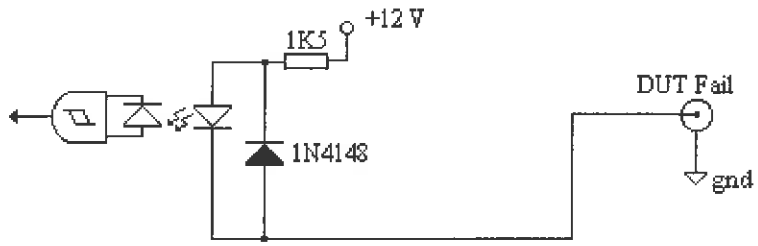
The Start/Stop signal is optically isolated. The schematic for this signal input is as follows.



6.2 DUT FAIL Signal

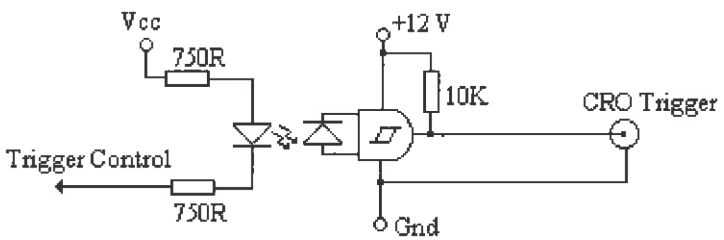
This is an input signal. It can be used to indicate that an DUT failure has occured. Once this signal input is pulled low the present pulse generation pattern will be aborted and testing will end. The WIN5000 software can automatically detect the state of the DUT FAIL Signal input and will stop the program execution automatically if it detects a low signal.

The DUT FAIL input signal is optically isolated. The schematic for this input is as follows.



6.3 CRO Trigger

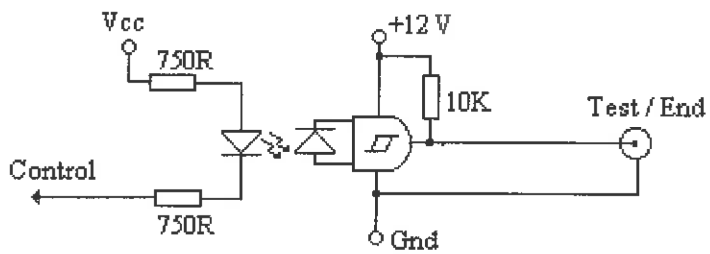
This is an output signal. Its main purpose is for triggering an oscilloscope. The CRO trigger output will go low at the start of a pulse, or burst of pulses. If a burst of pulses is being generated with the 3a or 3b generators the trigger output will stay low for the duration of the burst. The CRO trigger is an optically isolated output and the schematic for this output is as follows.



6.4 Test End

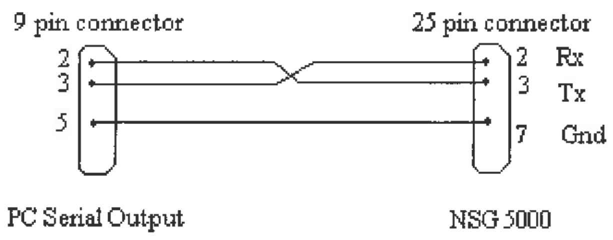
The Test End signal is an output from the NSG 5000. This signal goes high at the start of a pulse, or series of pulses. The signal will stay high until the end of pulse generation. When using the WIN5000 software, if a ramp pulse has been programmed and the STEP execution mode is selected then the Test End signal will return to zero at the end of each step.

The Test End signal is optically isolated and the schematic for this output is as follows.



7.0 RS232 Wiring Diagram

An RS232 interface cable is supplied as standard with the NSG 5000 system. The relevant wiring diagram for this harness is as follows.



7.1 Optical Interface

Because the primary function of the NSG5000 Instrument is to generate interference pulses, the interference pulses may effect the communication link between the instrument and the PC, and corrupt the data being transferred.

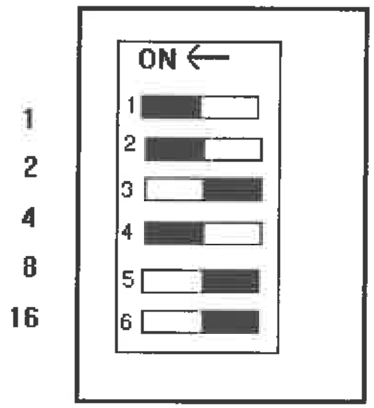
For this reason, it is recommended when using the RS232 link, to protect this link using two optically isolated interfaces, one at each end of the connecting cable. These interfaces, available from Schaffner, will prevent corruption of the data by the interference pulses generated.

8 IEEE Address Setting

When communicating with the NSG5000 via the IEEE 488 Interface it is necessary that the address set in the WIN5000 Comm Setup screen corresponds with the IEEE 488 address set on the Control Unit.

A DIP Switch array on the front panel of the Control Unit is used to set the NSG5000 IEEE Address. There may be five or six switches on this DIP switch, depending on the hardware version. Only the first five switches are used.

These first five switches correspond to the binary weighted address values 1, 2, 4, 8, and 16. The total sum of the values corresponding to the switches in the ON position is the IEEE address. For example, in the illustration below, the address set is 1 + 2 + 8 = 11.



Note: The address is read only at power on. Therefore, after changing the address setting, the NSG5000 must be powered off and then on to accept the new setting.

9 Schaffner Offices World-wide

Schaffner Elektronik AG
Nordstrasse 11,
4542 Luterbach,
Switzerland.
Phone: +41 32 681 6626
Fax: +41 32 681 6641

Schaffner Altrac AG
Muehlehaldenstrasse 6,
8953 Dietikon,
Switzerland.
Phone: +41 1 7446111
Fax: +41 1 7446161

Schaffner Ltd.
National Technological Park,
Castletroy,
Limerick.
Ireland.
Phone: +353 61 332233
Fax: +353 61 332584

Schaffner EMC, Inc.
9B Fadem Road,
Springfield,
NJ 07081,
USA.
Phone: +1 973 3797778
Fax: +1 973 3791151

Schaffner EMC Inc.
12 Hughes Street,
D-106 Irvine,
CA 92718,
USA.
Phone: +1 714 4579400
Fax: +1 714 4579510

Schaffner EMC Ltd.
Ashville Way,
Molly Millar's Lane,
Wokingham
United Kingdom, RG41 2PL
Phone: +44 118 9770070
Fax: +44 118 9792969

Schaffner S.A.
43 rue Michel Carre,
Boite postale 133,
F-95103 Argenteuil,
France.
Phone: +33 1 34343060
Fax: +33 1 39470228

Schaffner Elektronik GmbH
Schoemperlenstrasse 12B,
D-76185 Karlsruhe,
Germany.
Phone: +49 721 56910
Fax: +49 721 569110

Schaffner EMC S.r.l
Via Galileo Galilei, 47,
20092 Cinisello Balsamo (Mi),
Italy.
Phone: +39 2 6604 3045
Fax: +39 2 6123 943

Schaffner Beijing LO
Room No. 203, Bright China Chang An Bld.,
No. 7 Jianguomennei Dajie,
Post Code 100005,
Beijing,
China.
Phone: +86 10 65101761/62
Fax: +86 10 65101763

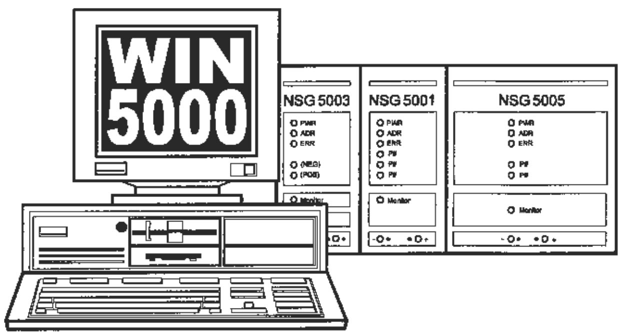
Schaffner EMC KK
2-31-6 Kamiuma,
Setagaya-Ku,
Tokyo 154,
Japan.
Phone: +81 3 3418 5822
Fax: +81 3 3418 3013

Schaffner EMC AB
Turebergstorg 1,6,
19186 Sollentuna,
Sweden.
Phone: +46 8 92 1121
Fax: +46 8 92 9690

WIN5000 SOFTWARE
Operating Instructions

for

NSG 5000
Interference Test System



WIN5000 for the NSG 5000 Interference Test System

1.1 Introduction

WIN5000 provides full front panel control and sequencing of operations for the NSG 5000 Interference Generator and the modules contained therein. WIN5000 uses the Windows graphical user interface providing a quick and easy way of building up complex pulse sequences which can be stored for use again and again.

1.2 Installing WIN5000

1.2.1 Hardware and system requirements

Before running WIN5000 on your PC there are certain minimum software and hardware requirements that need to be met. These are :

- An IBM compatible PC with a 486 processor or higher. *(Pentium recommended)*
- A hard disk with at least 3MB free.
- A mouse.
- An VGA or higher resolution monitor. *(SVGA recommended)*
- MS-DOS version 3.1 or higher. *(Windows 95 recommended)*
- Microsoft Windows version 3.1 or higher. *(Windows 95 recommended)*
- 4 MB RAM. *(8 MB recommended)*

1.2.2 Installing WIN5000 from DOS.

- Insert the WIN5000 diskette into drive A.
- At the DOS prompt type `win a:setup [enter]`
- Follow the setup instructions on the screen.

1.2.3 Installing WIN5000 from Windows 3.1 and 3.11.

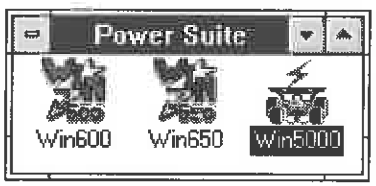
- Insert the WIN5000 diskette into drive A.
- In the Program Manager window select **Run...** from the **File** menu.
- Type `a:setup` and click on **OK.**
- Follow the setup instructions on the screen.

1.2.4 Installing WIN5000 from Windows 95.

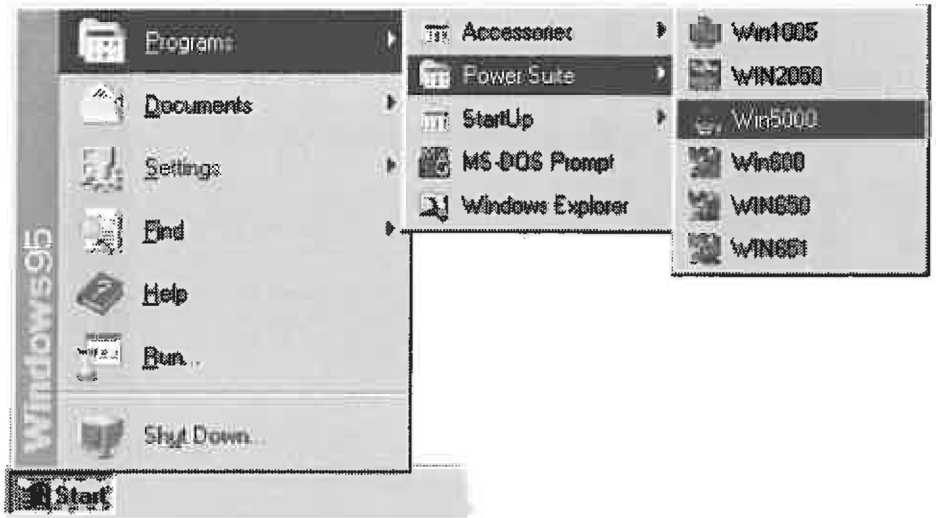
- Insert the WIN5000 diskette into drive A.
- From the start menu, select **Run...**
- Type `a:setup` and click on **OK**.
- Follow the setup instructions on the screen.

1.3 Starting WIN5000

To start WIN5000 in Windows 3.1 and 3.11 double-click on the WIN5000 icon inside the Windows Program Manager window.

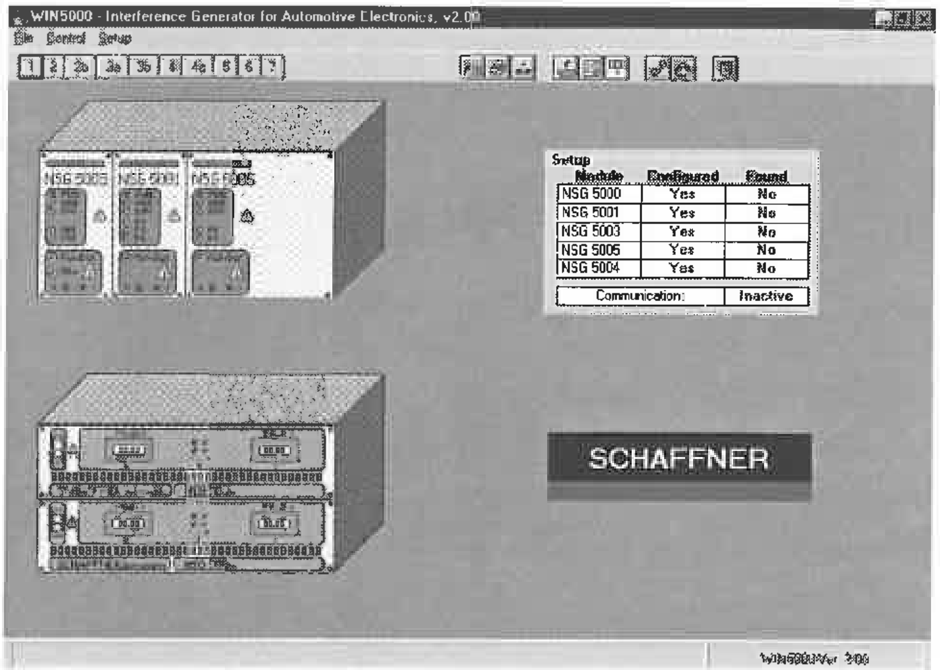


To Start WIN5000 in Windows 95 click the start button and select the programs menu and then, in the Power Suite sub-menu select the WIN5000 item.



1.4 The WIN5000 Window

The WIN5000 window provides control over the setup and configuration of the different NSG5000 modules and provides access to the different functions of the individual modules.



The WIN5000 window shows a representation of the front panel of the unit, initially all slots are shown empty. The unit setup is also shown, and again there will initially be no modules configured except the NSG 5000 itself.

1.4.1 Tool Bar

The tool bar provides quick access to the most commonly used menu items, from left to right the function of each button is as follows:

--------------------opens the Pulse 1 window

--------------------opens the Pulse 2 window

 ---------------- opens the Pulse 2b window

 ---------------- open the Pulse 3a window

 ---------------- open the Pulse 3b window

 ---------------- opens the Pulse 4 window

 ---------------- opens the Pulse 4c window

 ---------------- opens the Pulse 5 window

 ---------------- opens the Pulse 6 window

 ---------------- opens the Pulse 7 window

 ---------------- opens the Sequencer window

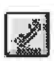
 ---------------- prints reports

 ---------------- downloads new firmware to the NSG 5000

 ---------------- enables the serial / IEEE link between the PC and the Win5000 to be set up

 ---------------- provides access to system settings

 ---------------- opens the dialog box for changing the system configuration

 ---------------- shows a map of Schaffner support offices

--------------------performs self-test

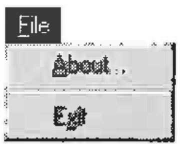
--------------------exits WIN5000

It should be noted that when a particular module is not included in the configuration then the push-button(s) for the corresponding pulse types will appear greyed and be inactive.

1.4.2 Menu Items

There are three drop-down menus on the WIN5000 window; File, Control and Setup.

1.4.3 File Menu

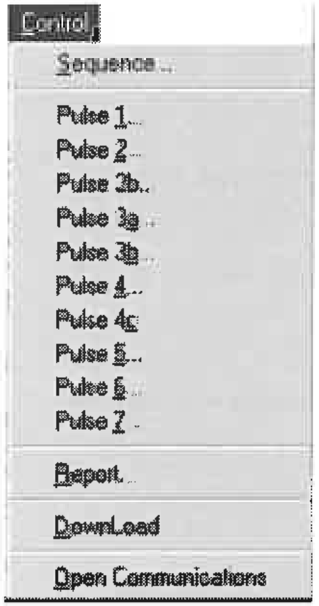


This menu has two options.

- About, shows the software version number.

- Exit, closes the WIN5000 software.

1.4.4 Control Menu



This menu has fourteen options :

- Sequence, this opens the sequencer window. The sequencer lets sequences be built up using pulses from all the different WIN5000 modules.
- Pulse 1, if an NSG 5001 is installed this will open the Pulse 1 window.
- Pulse 2, if an NSG 5001 is installed this will open the Pulse 2 window.
- Pulse 2b, if an NSG 5004 is installed this will open the Pulse 2b window.
- Pulse 3a, if an NSG 5003 is installed this will open the Pulse 3a window.
- Pulse 3b, if an NSG 5003 is installed this will open the Pulse 3b window.
- Pulse 4, if an NSG 5004 is installed this will open the Pulse 4 window.
- Pulse 4c, if an NSG 5004 is installed this will open the Pulse 4c window.
- Pulse 5, if an NSG 5005 is installed this will open the Pulse 5 window.

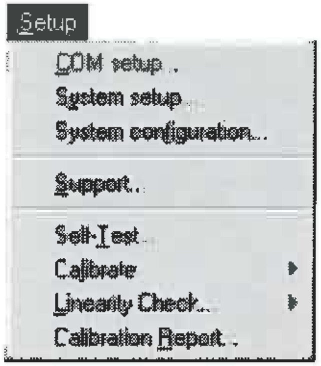
- Pulse 6, if an NSG 5001 is installed this will open the Pulse 6 window.
- Pulse 7, if an NSG 5005 is installed this will open the Pulse 7 window.
- Report, enables reports to be printed out.
- Download, this enables firmware to be downloaded to the NSG 5000 hardware.
- Open/Close Communications, this opens and closes communications with the NSG5000.

If advanced hardware or software is present then these pulses may also be available:

- Pulse 1c, if a special NSG 5001 is installed this will open the Pulse 1c window.
- Pulse 4b, if the software option is available this will open the Pulse 4b window.
- Pulse 4d, if specially modified NSG 5000 hardware is available this will open the Pulse 4d window.
- Pulse 5b, if an NSG 5005B is installed this will open the Pulse 5b window.

Note that when a particular module has not been included in the configuration then the menu items for the corresponding pulse types will appear greyed and be inactive.

1.4.5 Setup Menu



There are eight options in the setup menu :

- Com setup, this opens a dialog box for setting the serial / IEEE link between the PC and the WIN5000.

- System setup, opens a dialog box for entering different system settings.

- System configuration, enables modules to be added and removed from the system configuration.

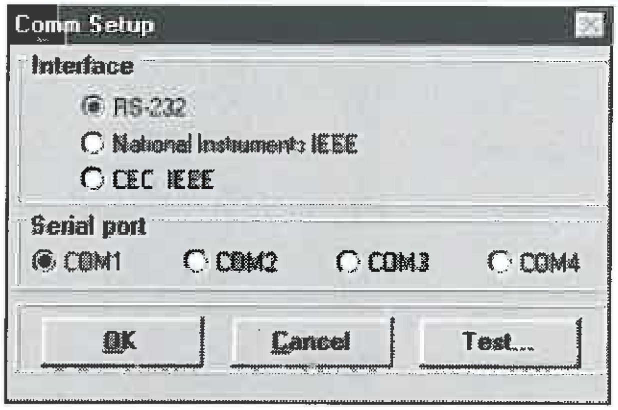
- Support, opens a window with the addresses and phone numbers of the different Schaffner support offices.

- Self-test, this performs a self-test routine on the NSG 5000 and the installed modules.

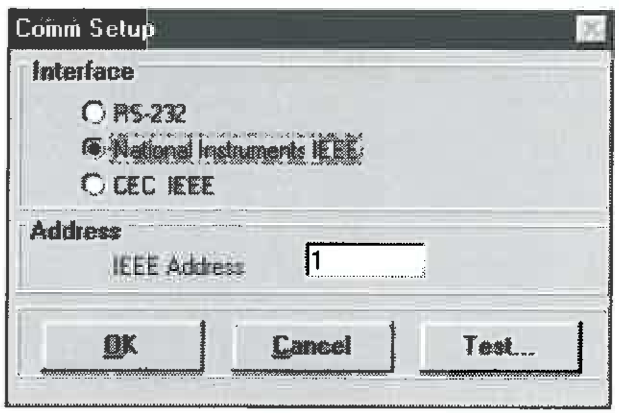
2.1 Comm Setup

By clicking on this option in the tool bar or by selecting it from the setup menu, a dialog box is opened for selecting either RS232 or IEEE as the communications link.

On selecting RS232, select the COM port on the PC to which the NSG5000 is connected.

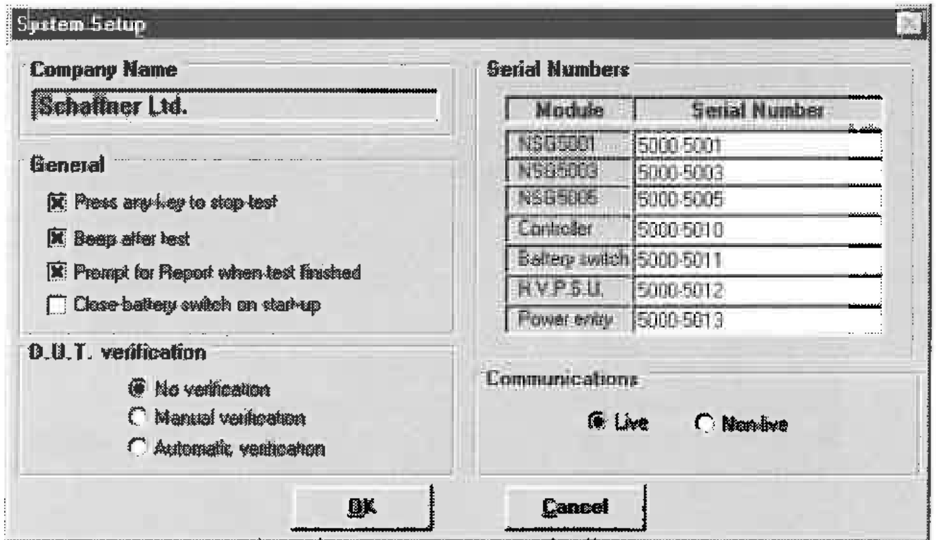


If using an IEEE link, select the type of card installed in the PC, and type in the address which is set on the DIP switch on the Control Unit of the NSG5000.



3.1 System Setup

The system setup dialog box enables assorted general and run-time settings be made.



- Company Name, this is entered during the installation of WIN5000 and will appear in all reports.

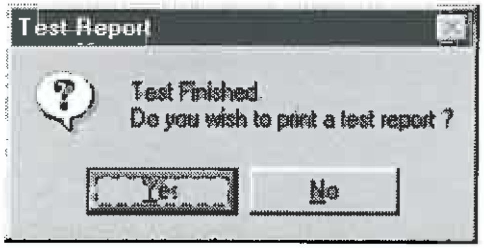
- Serial Numbers, enter the serial numbers of the fitted modules.

- Operational Mode, select either live or non-live mode.

- Press any key to stop test, place a cross in the check box to enable pulse/test sequences to be halted when any key is pressed.

- Beep after test, place a cross in the check box to sound a beep at the end of a test.

- Prompt for report when test finished, when selected, this option asks whether to generate a report after each pulse or pulse sequence.

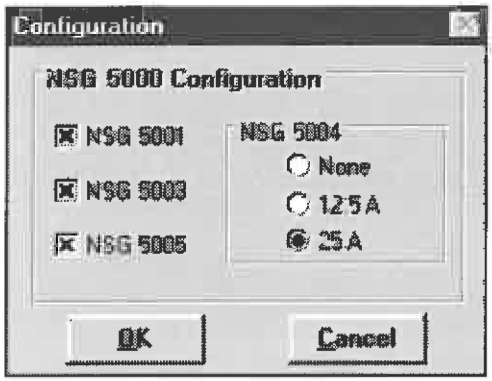


- DUT verification, there are two options for checking whether the device under test has passed or failed a test:
  (i) automatic verification is carried out by WIN5000 using the DUT Fail input on the rear of the Power Entry module,
  (ii) in manual verification WIN5000 will pause and ask whether the device under test is still functional after each pulse (i.e. when ramping it will request a **"yes"** or **"no"** between each step).

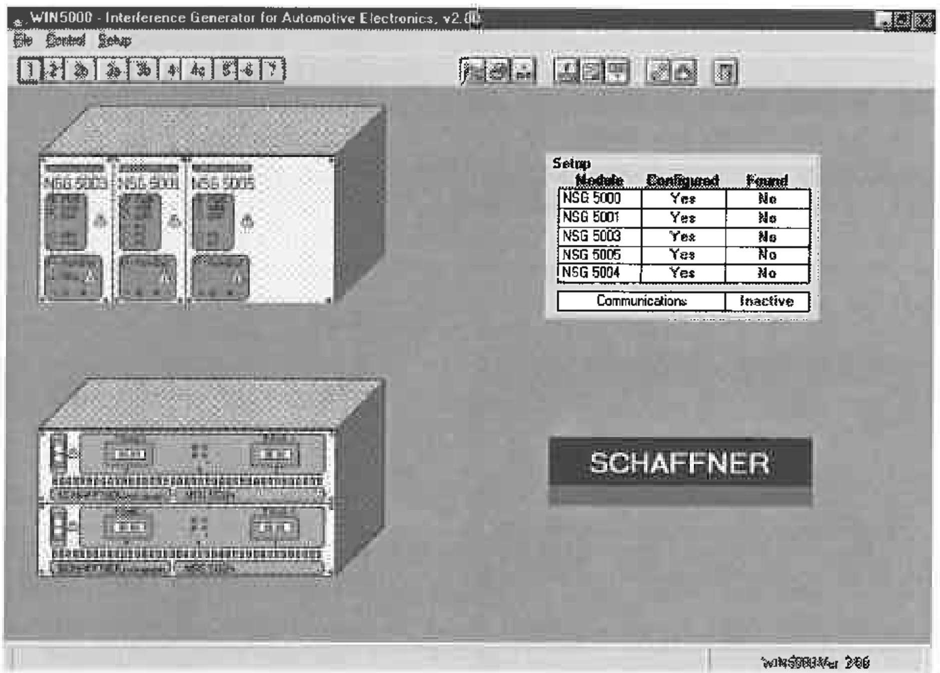
4.1 Configuration

Pulse screens can only be accessed when the appropriate module is configured. To change the system configuration click on the configuration push-button on the tool bar, select System Configuration from the Options menu or click on the picture of the unit itself.

The configuration dialog box, configures the WIN5000 software according to the hardware setup.



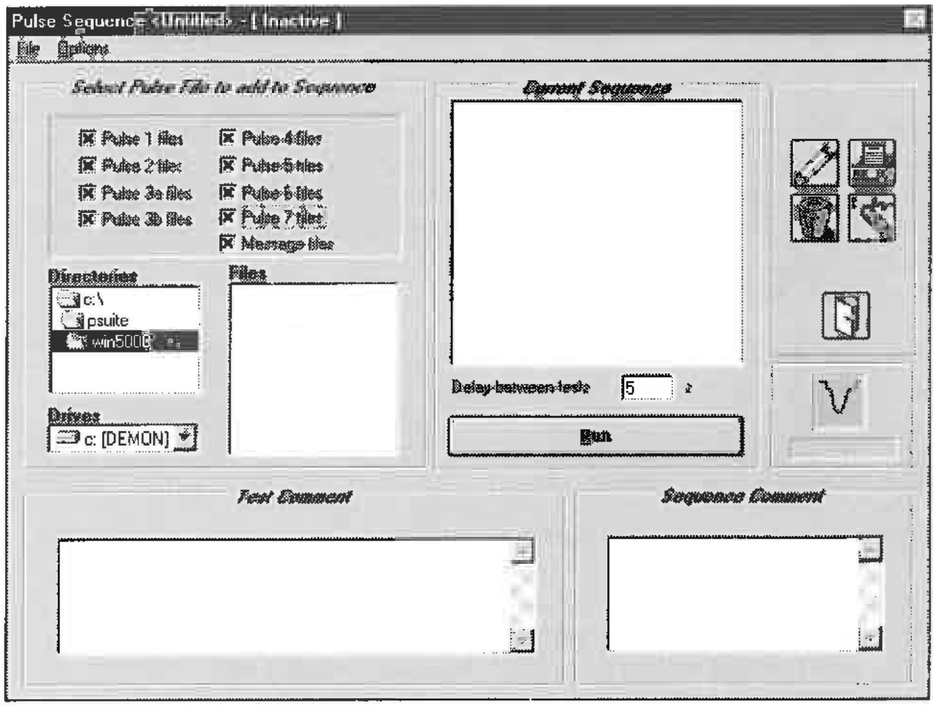
To configure the different WIN5000 modules simply place a cross in the check box adjacent to each module currently fitted in the system, for the NSG5004 (or NSG5004A) select none, 12.5A or 25A as appropriate.



Changes made to the configuration in the dialog box are reflected in the WIN5000 main window as the graphic representation of the NSG5000 changes to show which modules are currently fitted.

5.1 Sequencer

The sequencer window is accessed by selecting Sequencer from the control menu or by clicking on the sequencer push-button.



The sequencer enables sequences of pulses to be built up using different pulse settings from all the different WIN5000 modules.

The window is divided into a number of sections.

5.2 Select Pulse File to add to Sequence

This section shows the current drive and directory and the files therein. The check boxes at the top of this section dictate which file types will be displayed, by default the files for all the different WIN5000 modules and messages will be shown.

To add a file to the pulse sequence simply click on its filename (the mouse cursor changes from an arrow to a paper file) and drag it into the desired location within the current sequence, alternatively double-click on its name to place it in the current position within the pulse sequence.

5.3 Current Sequence

This is a scrolling list of the files making up the current pulse/test sequence. To perform the test sequence click on the RUN push-button.

On the right hand side are four further push-buttons.


PENCIL, click on this push-button to open the currently highlighted test, this will automatically open the appropriate module screen, and set the parameters according to the test. Dragging tests on disk or tests in the sequence list into this button also allows them to be edited.


TRASH-CAN, to delete a file from the sequence, click on its filename within the sequence and drag it over to the trash-can button. To delete a test from disk, drag the file into this button. Click on this button to delete the currently highlighted test in the sequence list.


PRINT, clicking on this button prints out a hard copy of each test in the sequence to the current windows printer. Dragging a test into this button will print a hard-copy of information on that test only.


ERASER, click on this button to clear the entire pulse sequence.

5.4 Test Comments

This box displays any comments that have been associated with the currently highlighted file in the current sequence, these comments have been made while setting up a pulse and cannot be edited from this window.

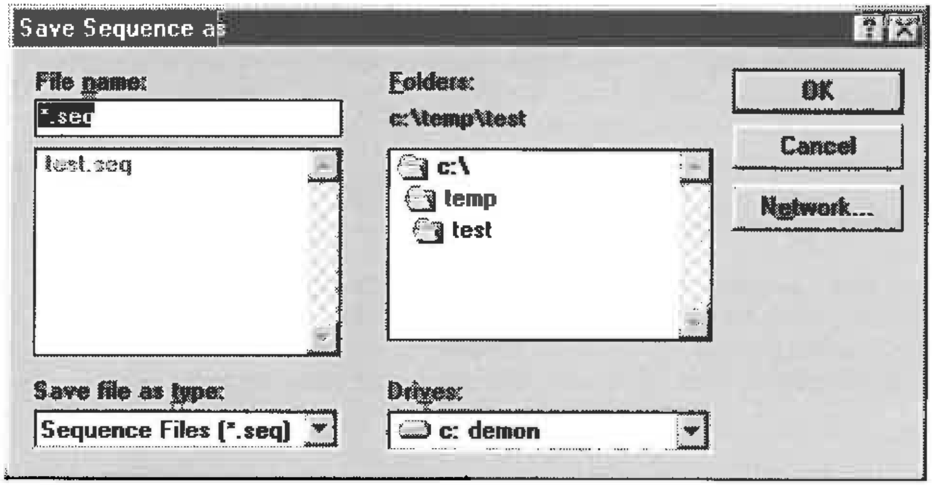
5.5 Sequence Comments

This shows comments associated with the current pulse sequence.
To enter a new comment or change an old one, simply click in the sequence comments box and the text cursor will appear allowing text to be typed in. The comments will be saved along with the pulse sequence in the sequencer file.

5.6 File Menu

There is only the one menu item in the sequencer window, the File Menu.

- New, clears all the settings and tests for a new sequence to be created.
- Open Setting, opens a previously saved pulse sequence.
- Save Setting, saves the current pulse sequence with its current name.
- Save Setting as... , opens a dialog box enabling the current pulse to be saved with a different filename, and/or to a different drive or directory.



Sequencer files contain the pulse sequence and any comments associated with it, the default extension given to sequencer files is **.SEQ**

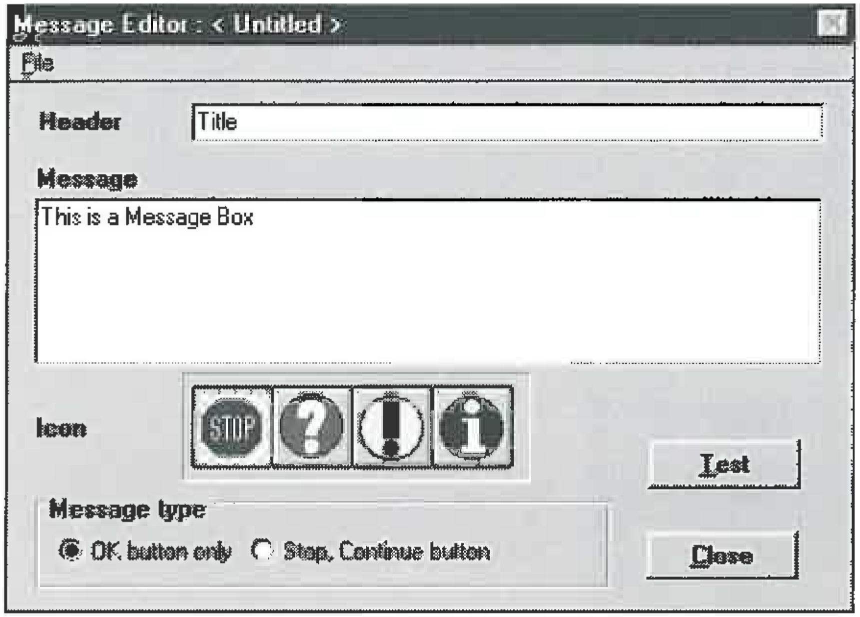
- Messages, this opens up the Message Editor.

- Print, prints out a hard copy of the current pulse sequence to the current windows printer.

- Exit, closes the sequencer and return to the WIN5000 main window.

5.7 The Message Editor

This is a handy utility which enables messages to be incorporated into pulse sequences.



When a pulse sequence is running and encounters a message file a message box will open containing the message, which could for example request some action to be performed such as a physical connection.

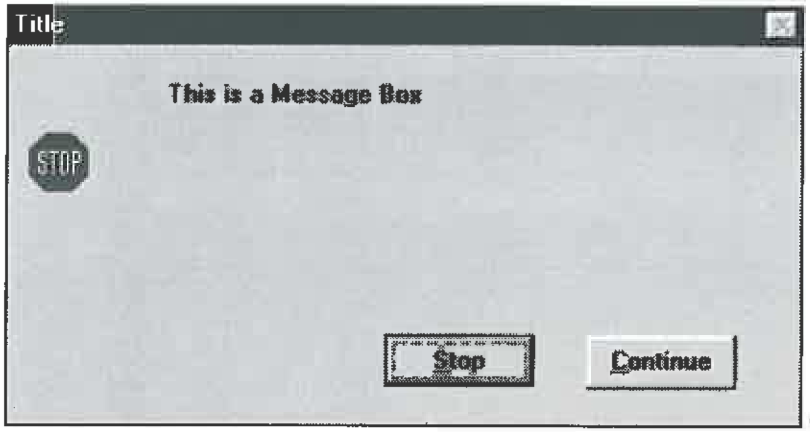
The header section is what will appear in the title bar of the message box.

Type into the message section the message or instruction.

There is a choice of four different message icons that can appear in the box to reflect the nature of the message, simply click on the required icon.

The message type section provides the option of having just an OK push-button within the message box, which when clicked will continue the pulse sequence or three different push-buttons; one to restart the pulse sequence from the beginning, one to stop the sequence and one to continue the sequence from the current position.

Clicking on the Test push-button displays the message box.



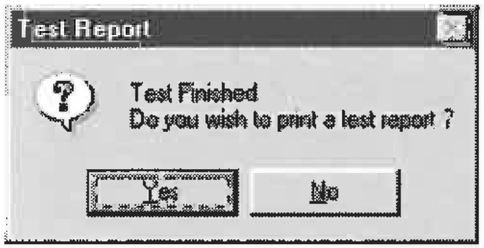
or

There is a File menu in the Message Editor dialog box for saving and retrieving message files.

Message files are saved as separate files and are given the default extension of **.MSG**

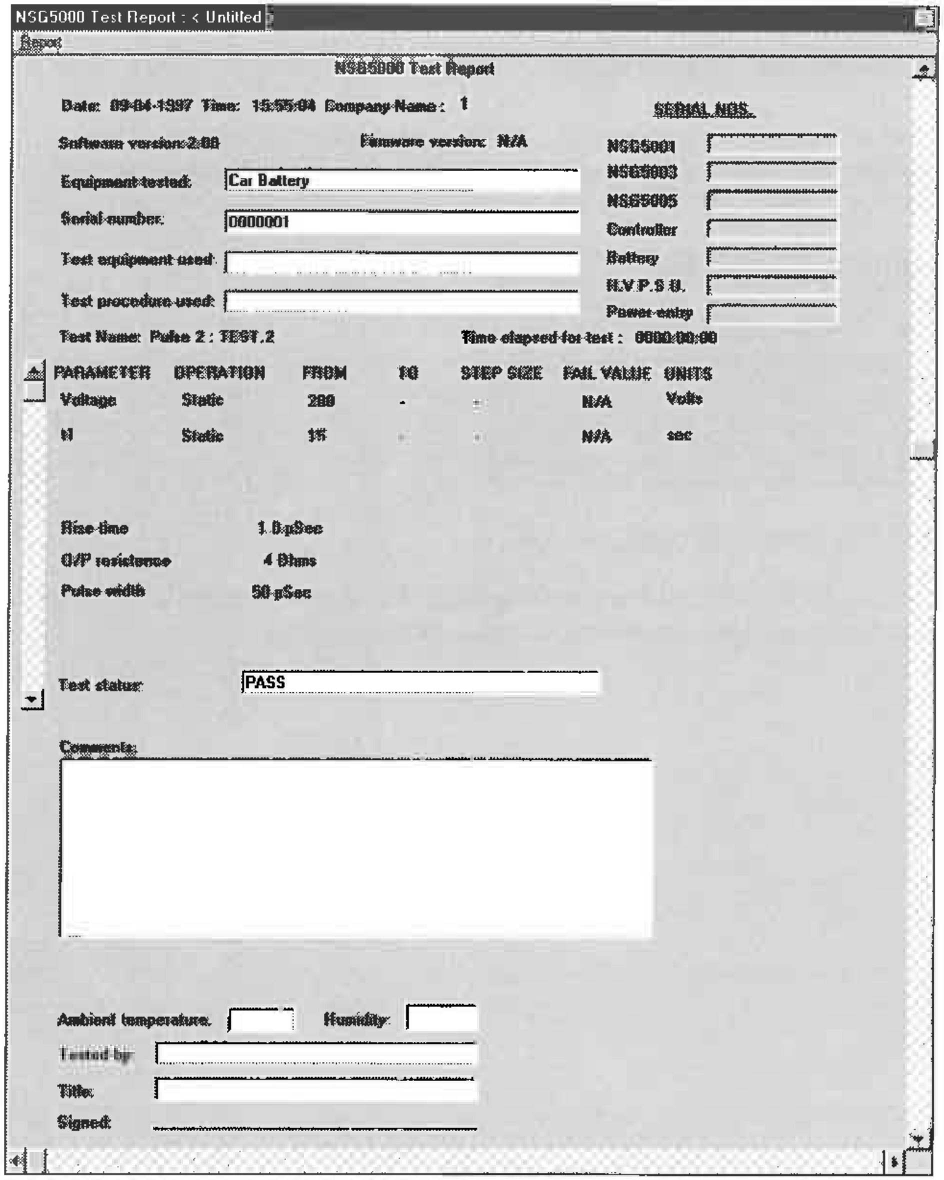
6.1 Generating reports

If **Prompt for report when test finished ?** is enabled in the System Setup, then upon completion of a test or test sequence a box will pop up asking if you would like to create a report.



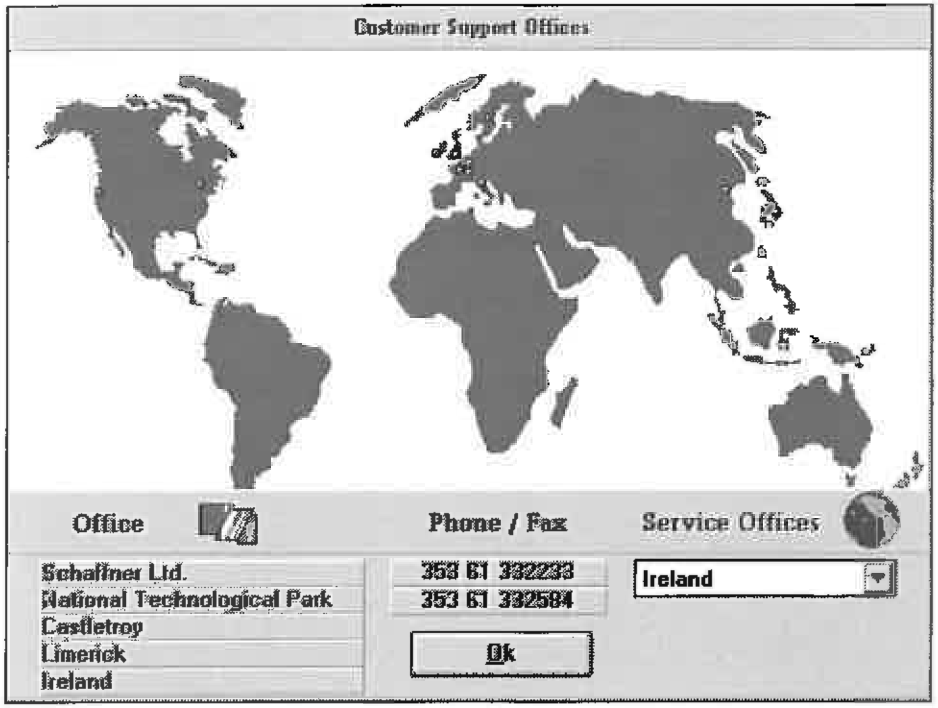
Select **Yes** to open the report window.

Within the Report window there is a File menu that enables reports to be saved and printed, previously created reports may also be retrieved.


NSG5000 Test Report : < Untitled >
Report
NSG5000 Test Report
Date: 09-04-1997 Time: 15:55:04 Company Name : 1
SERIAL NOS.
Software version: 2.00
Firmware version: N/A
NSG5001
NSG5003
NSG5005
Controller
Battery
H.V.P.S.U.
Power entry
Equipment tested: Car Battery
Serial number: 0000001
Test equipment used:
Test procedure used:
Test Name: Pulse 2 : TEST.2
Time elapsed for test : 0000:00:00
PARAMETER OPERATION FROM TO STEP SIZE FAIL VALUE UNITS
Voltage Static 200 - - N/A Volts
t1 Static 15 - - N/A sec
Rise time 1.0 µSec
O/P resistance 4 Ohms
Pulse width 50 µSec
Test status: PASS
Comments:
Ambient temperature:
Humidity:
Tested by:
Title:
Signed:

7.1 Support

Clicking on the Support push-button or by selecting Support from the Setup menu opens the Schaffner Support Offices window.



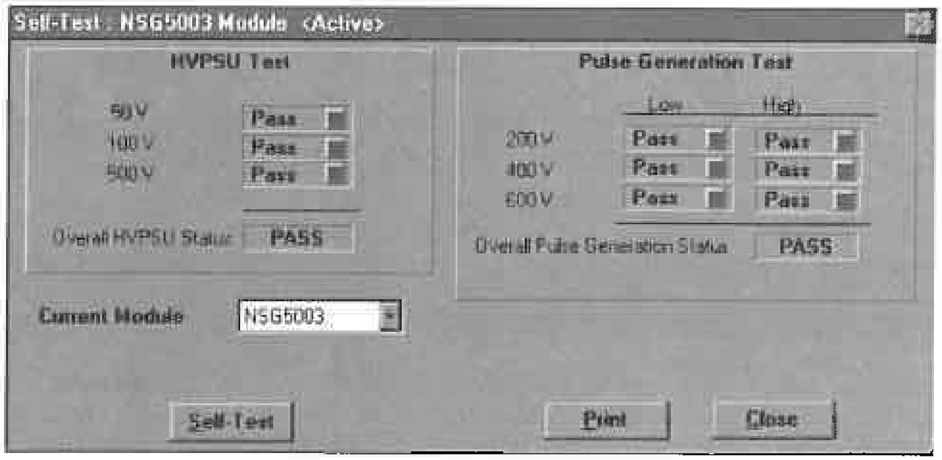
Locate the mouse cursor at the required location on the map and the address, phone and fax numbers of the nearest Schaffner support office will be displayed, alternatively use the drop down list on the right hand side to select a specific office.

8.1 Self-test

By clicking on the Self-test push-button or by selecting Self-test from the Setup menu, WIN5000 will present the user with a list of the installed modules. The user can then select which of the modules they wish to test (from a drop-down list box) and click the Self-Test button to run the test. Self-test is slightly different for each of the modules.

Note that communications have to be in live mode for self-test to work. If the user runs self-test in non-live mode, then the tests will randomly pass and fail. The <Inactive> in the Self-Test window indicates that the software is operating in non-live mode.

The following is the screen which appears when the user runs self-test for the NSG5003:



The NSG5003 has two types of tests, namely HVPSU (at 50, 100 and 500 V) and Pulse Generation (at 200, 400 and 600 V). The NSG5001 also has HVPSU and Pulse Generation tests as well as a Calibration EEPROM test, while the NSG5005 only has pulse generation tests.

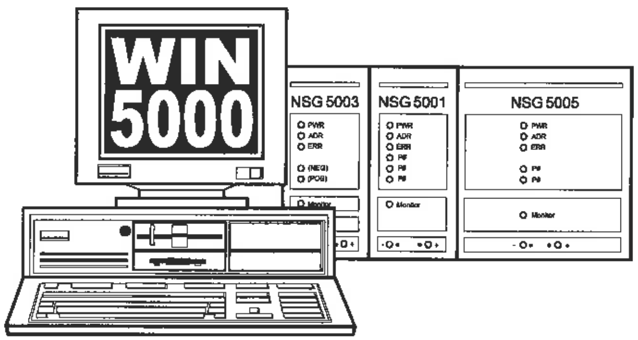
Clicking Self-Test will run self-test for the currently selected module. Use the Current Module list box to change modules.

Clicking Print will run self-test for the current modules and then print out the self-test results along with the date, time and the serial number of the module.

WIN5000 SOFTWARE
Operating Instructions

for

NSG 5001
Transient Generator

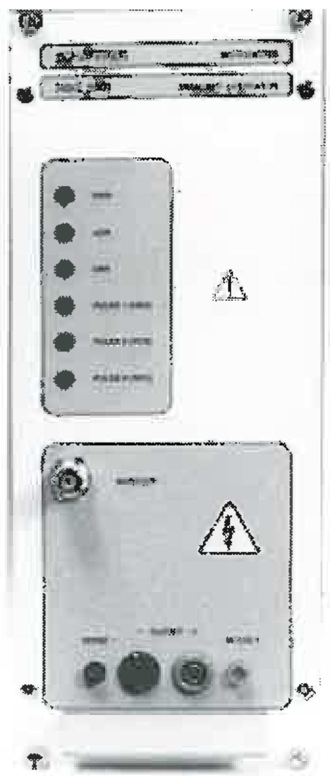


NSG 5001 Transient Generator Software Operating Instructions

Transient Generator

NSG 5001

Operating Instructions



CONTENTS

1 Introduction

The NSG 5001 is a plug-in transient generator module designed for use with the NSG 5000 mainframe system. This generator is designed primarily to meet the specification requirements for the ISO 7637 standard for pulses 1,2, and 6. In many cases the specification of this generator exceeds those specified in the ISO 7637 standard.

When slotted into an NSG 5000 mainframe the NSG 5001 transient generator is fully programmable via an RS232 or the optional IEEE 488 interface. Parameters such as amplitude, pulse frequency, number of pulses, are all under program control. This allows flexible test patterns to be generated which can facilitate rapid analysis of susceptibility limits of a device under test.

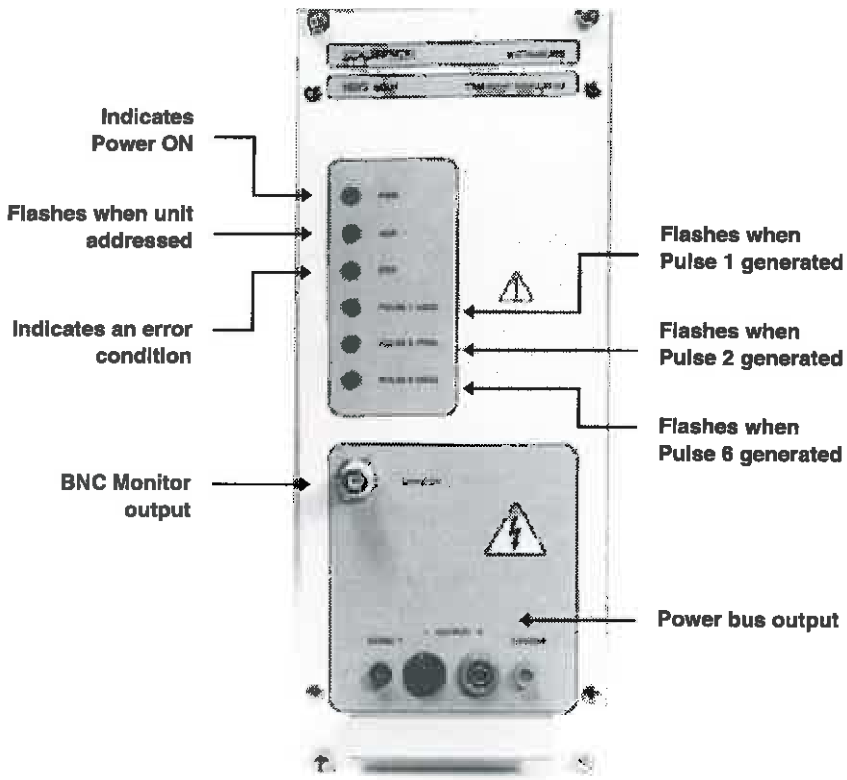
The NSG5001 generates pulses of types 1,2, and 6, as specified in the ISO 7637 standard, which defines how these pulses are generated in relation to the vehicle battery voltage. When operating with a battery or battery simulator connected to the NSG5000 mainframe, the NSG5000 Battery Switch Module should also be mounted in the rear of the NSG5000 chassis. This module provides the necessary switching on and off of the battery voltage according to the standard.

The NSG 5001 is designed using state of the art semi-conductor technology. This means repeatable performance and maintenance free operation. It also means that test results can be repeated accurately.

The output pulses of the generator are available on two power banana sockets on the front of the NSG5001 module, and also on the internal multiplexed power bus of the NSG5000 instrument. The pulses from this generator are also available on the banana output sockets of any other pulse generator module fitted to the NSG500 main chassis. This can simplify fixturing to the device under test.
There is also a 100:1 monitor output signal available on a BNC connector on the front of the NSG5001 module.

The NSG 5001 module is designed with internal selftest measurement circuitry which performs a functional check of the main operating parts of the module. It does not check the unit to calibration tolerances. However, it is a very useful facility for quickly checking if the unit is operational.

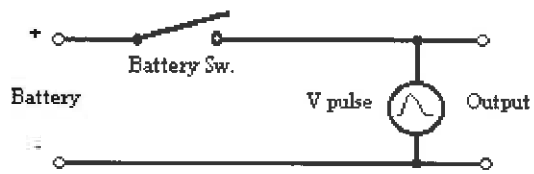
NOTE:
The WIN5000 program available from Schaffner is a Windows based graphical program which allows full control of all programmable features via an intuitive graphical windows front panel.



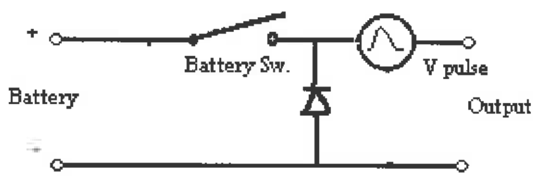
NSG 5001 Front Panel Layout

2 Specification

Parameter	Specification	Tolerance
Polarity	Negative (1,6) Positive (2)	
Amplitude (Vs)	Minimum 10V Maximum 600V Min. Increment 1V	+ 10%
Impedance (Ri)	4,10,50 ohms (1,2) 10,30 ohms (6)	+/- 10% RL = Ri => Vo = Vs/2
Rise time (tr)	1, 3 uSeconds (1,2) 60 uSeconds (6)	- 35% (1uS) - 40% (3uS, 60uS) (all open loop)
Pulse Width (td)	50,200,500,1000,2000 uS (1,2) 300 uS (6)	+/- 10%
Repetition time (t1)	Minimum 0.5 S 1.0 S (200<Vs≤300V) 1.5 S (300<Vs≤400V) 2.0 S (400<Vs≤600V) Maximum 15 S Min. Increment 0.1 S	+/- 10%
Battery Off to Pulse Time (t3)	< 100µS	
Battery Off Time	200mS, or for pulse duration (voltage controlled)	+/- 10%
Pulse Mode	Single Continuous Count: Min 1 Max 99999 time : 1 to 99999 secs 1 to 6000 mins 1 to 100 hrs	 +/- 10%
Monitor Output	100:1	+/- 10%

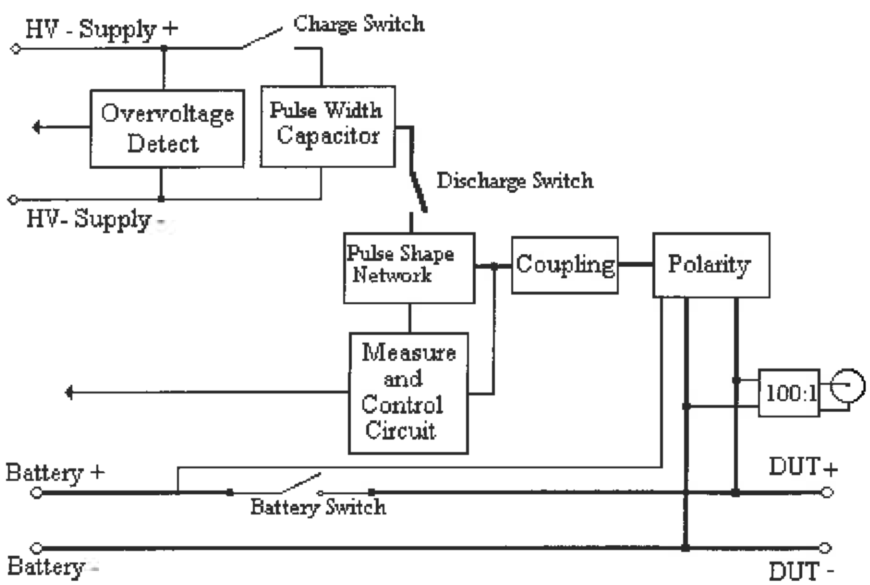


Pulse 1, 6 Generation Mechanism



Pulse 2 Generation Mechanism

3 Block Diagram



4 Installation / Setup

Check the instrument for any mechanical damage. Report any damage found to the carrier immediately.

Ensure that the power is turned off on the NSG5000 mainframe and that the battery input is disconnected. Insert the cassette in the second slot from the left, and push in fully. Screw in the four retaining screws fully.
If using the Battery Switch, ensure this module is present and inserted fully in the rear of the NSG5000 mainframe.

It is vitally important that the unit is connected to a good, through-going, protective earth.

Turn on the mains input power on the NSG5000 mainframe. After approximately a two second delay the power LED (red) on the NSG5001 generator should light. After a further two second initialisation period, the unit is ready for operation.

At this point it is recommended to run selftest to ensure that the main functional parts of the NSG5001 are operational. The easiest way to run selftest is via the WIN5000 software package.

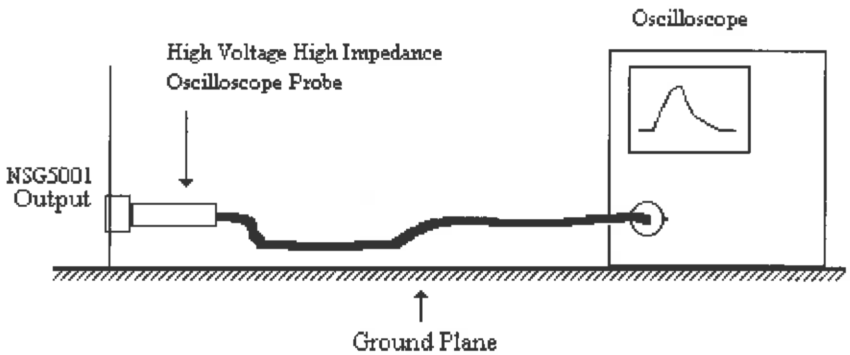
NOTE: Selftest should only be run with all fixtures, attenuators and adapters disconnected from the front of the NSG5001.

Once selftest has been run, the scope test setup shown in 5.1 should be connected and the output pulses should be quickly checked to ensure that they are of the correct form and shape. As pulses are generated the relevant green LED (1, 2 or 6, whichever is selected) should flash as pulses are output.

When correct operation has been verified, the DUT can be connected to the OUTPUT terminals at the front of the unit, and the required tests can be carried out.

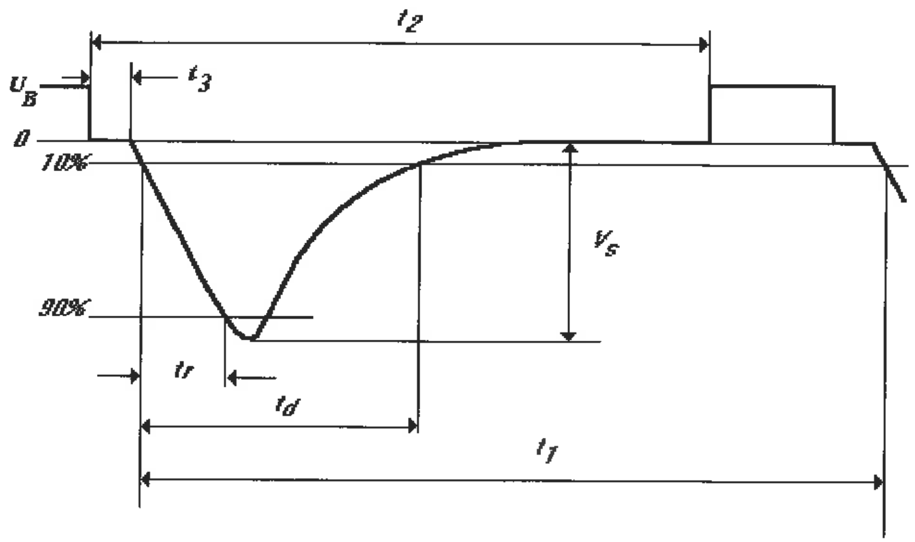
4.1 Test set-up

The following set-up may be used to check the integrity of the output pulses. The scope probe should allow measurement of pulse voltages of up to 600V peak, input impedance of > 10k ohm at a frequency of > 2MHz.

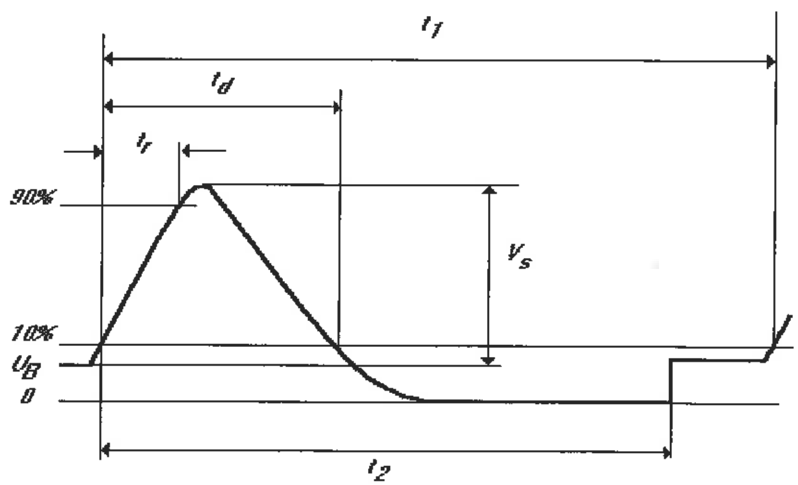


4.2 Parameter references

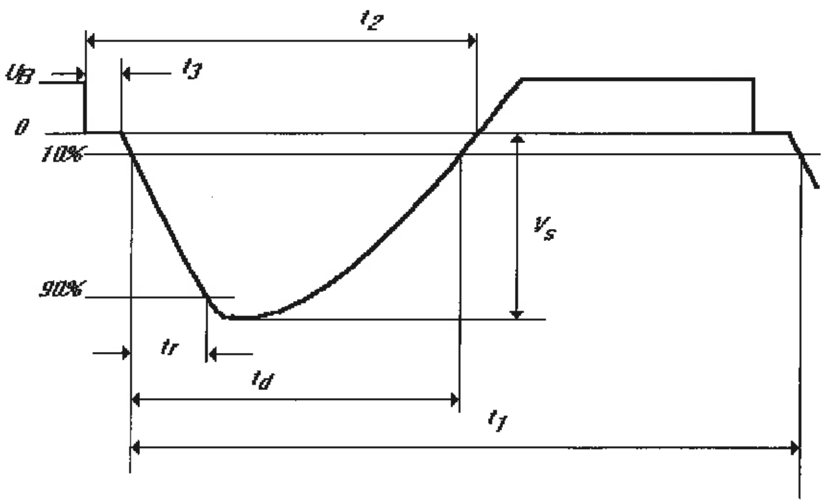
The following diagrams show the reference points that are used for parameter specifications on the NSG 5001.



Pulse 1



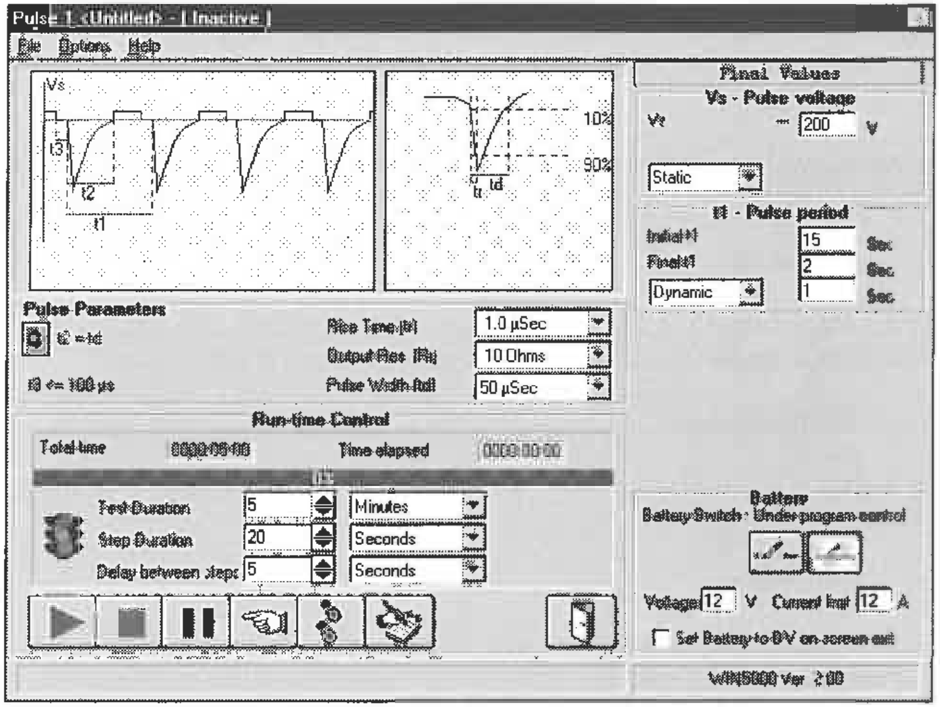
Pulse 2



Pulse 6

1.1 NSG5001 Main Window

There are three different pulse types available on the NSG5001 module, these are types **1**, **2** and **6**. When one of these pulses is selected from the WIN5000 tool bar or the Control menu the NSG5001 window is opened, although similar each pulse type has its own window.



The window above is the WIN5000 Pulse 1 window.

From this window tests can be built up from pulses. Sequences of bursts can be performed by ramping either the pulse voltage or pulse period. It should be noted that only one parameter may be ramped at a time and that ramping will always range from low to high pulse energy.

Once created tests can be saved for future use, and in conjunction with the WIN5000 sequencer they may be used to perform tests made up of different pulses and pulse sequences from different modules.
The window is divided into seven sections.

1.2 Graphical display

At the top of the window there is a graphical display showing the pulse parameters, the two graphs change according to how the pulse is setup.

1.3 Pulse Voltage

Sets the pulse voltage, this can show a single value or for tests where the voltage is to be ramped there will be start and finish values and step size.

1.4 Pulse Period

Sets the pulse period, this can show a single value or for tests where the period is to be ramped there will be start and finish values and step size.

1.5 Pulse Parameters

This section of the window controls discreet settings such as rise times, pulse widths.

1.6 Battery Switch

With this push-button the Battery Voltage can be disconnected completely or the connection can be under program control. The battery voltage and its current limit can also be set here.

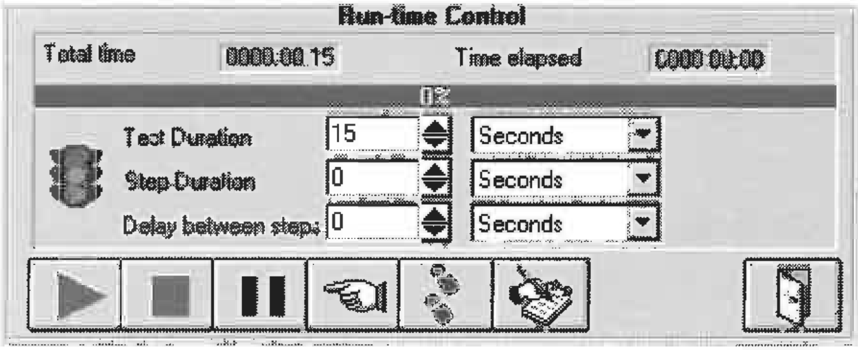
1.7 Control

This part of the window governs the test duration, step duration and delay time between steps. There are push-buttons for starting and stopping tests as well as proceeding one step at a time.

1.8 Information Bar

The information bar at the bottom of the screen shows the specification for the pulse parameter which currently has the focus.

2.1 Control



This section of the window governs the run-time operation of tests, the overall test duration may be set by selecting the units from the drop down list (accessed by clicking on the push-button), and then typing the value into the adjacent text box.

- seconds/minutes/hours, this is the actual amount of time to spend running the test. The test will keep cycling until the specified time has elapsed.

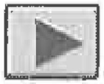
- count allows a specific number of cycles to be specified, that is the number of times a test will be performed.

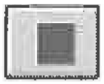
- continuous will repeat the entire test until the stop or pause buttons are pressed.

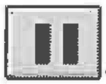
Values may also be adjusted in single steps by clicking on the up and down arrows in the box itself.

The same procedure is used to set the step duration and the delay time between steps. Count refers to the number of times to perform each step before ramping to the next

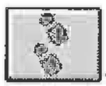
2.2 Push-button functions

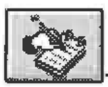

----- Starts a test.

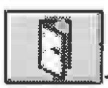

----- Stops a test.


----- Pauses execution of a test.


----- Manually sends a single burst at the current settings.


----- Steps through test sequence one step at a time, useful when compiling tests and during de-bugging.


----- Opens a window into which notes pertinent to the particular test may be entered for future reference.


----- Exits from the pulse window and returns to the main screen.

Both the total test time and the elapsed test time are displayed in the top of this section, and a graphical percentage done indicator shows the progress of the test sequence (the red bar is gradually replaced by a green bar as well as displaying the percentage done in figures). When paused the elapsed time and the percentage done indicator are also paused.

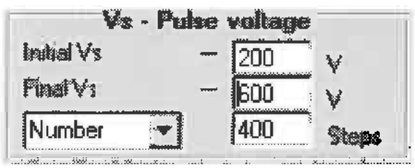
3.1 Pulse Voltage

This sets the pulse voltage (Vs). When the voltage is to remain static throughout the test only one box is displayed, enter the desired voltage into this box (i.e. 200 in the above example).

Pulse types 1 and 6 are negative pulses therefore the pulse voltage is a negative value, pulse type 2 is a positive pulse thus the pulse voltage is a positive value.

The pulse voltage may be ramped during the test in one of two ways, the ramping method is selected from a drop down list that is accessed by pressing the push-button.

Two more boxes appear in the voltage section when the voltage is to be ramped.



The top box is now the initial voltage (i.e. the pulse voltage at the start of the test), the middle box is the final voltage and the lower box is the increment, depending on the ramping method the increment may be a specific number of steps or a value in volts.

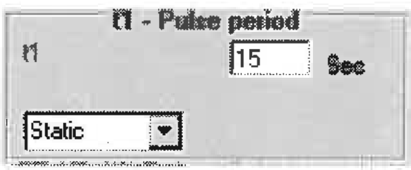
3.2 Dynamic ramping

To ramp the pulse voltage dynamically, select dynamic from the drop-down menu. Enter the initial and final pulse voltages and then the increment size in volts. During execution the voltage will start at the initial voltage and be incremented in steps until the final voltage is reached.

3.3 Numeric ramping

To ramp the pulse voltage in a specific number of steps select number from the drop-down menu. Enter the initial and final burst voltages and the number of steps. During operation the voltage will be incremented in uniform amounts according to the number of steps.

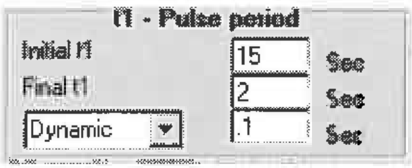
4.1 Pulse period



This sets the pulse period (T1). When it is to remain static throughout the test only one box is displayed, enter the desired period into this box.

The pulse period may be ramped during the test in one of two ways, the ramping method is selected from a drop down list that is accessed by pressing the push-button.

Two more boxes appear in the pulse period section when the it is to be ramped, as shown below.



The top box is now the initial pulse period (i.e. the pulse period at the start of the test), the middle box is the final pulse period and the lower box is the increment. Depending on the ramping method the increment may be a specific number of steps or a value in seconds.

4.2 Dynamic ramping

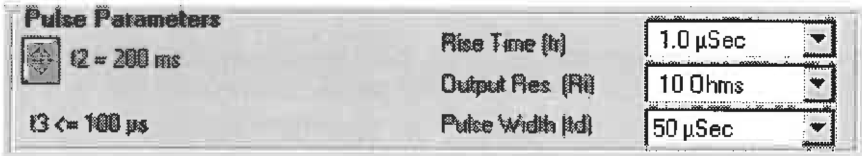
To ramp the pulse period dynamically select dynamic from the drop-down menu. Enter the initial and final pulse periods and then the increment size in seconds. During execution the period will start at the initial period and be incremented until the final period is reached.

4.3 Numeric ramping

To ramp the pulse period in a specific number of steps, select number from the drop-down menu. Enter the initial and final burst periods and the number of steps. During operation the period will be incremented in uniform amounts according to the number of steps.

5.1 Pulse Parameters

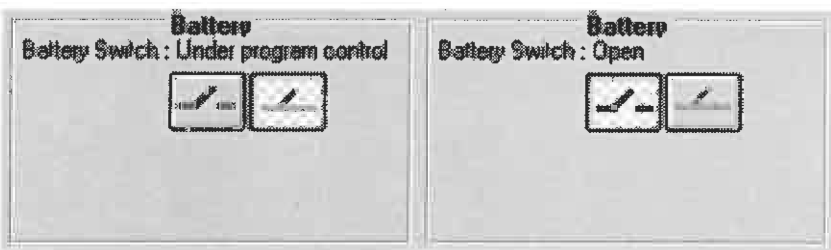
This section controls settings which have a range of discrete values.



To change a setting click on the adjacent push-button and select the required value, these vary between pulse types.

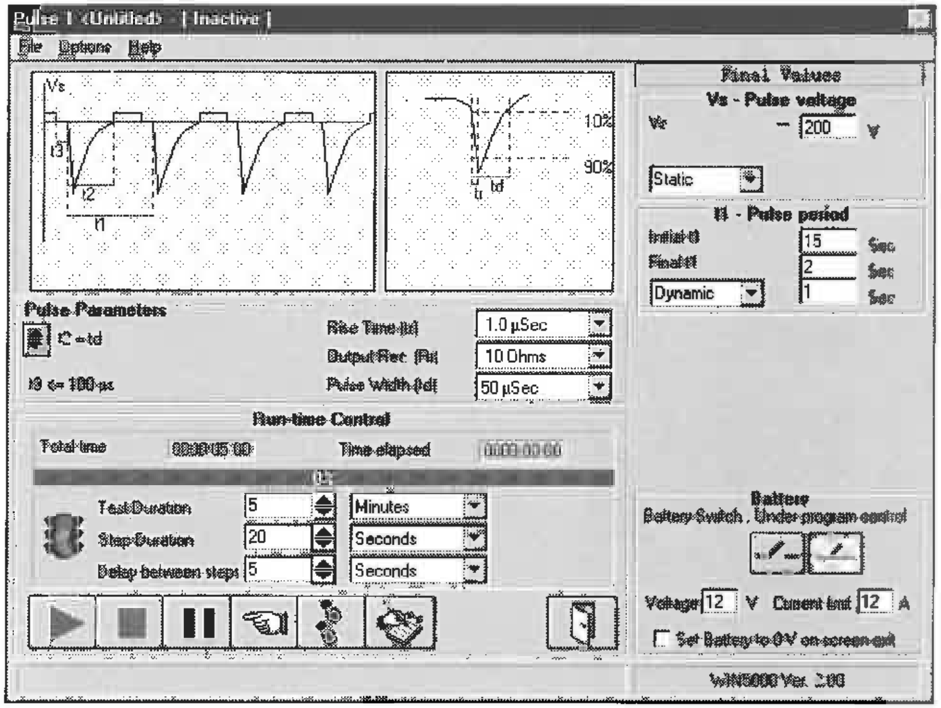
6.1 Battery Switch

The Battery Switch controls the connection of the DC Source between the device under test and the NSG 5000. Clicking on the push-button toggles between **open** and **under program control**. Pulse 2 also includes the closed option. Note that these settings can be saved as part of the test, the changes are implemented when the user starts the test by clicking the GO button.



When using pulses 1, 2, and 6 the battery switch can be under program control or open. In this state Win5000 will make and break the connection as required whilst performing tests. When open it remains disconnected.

7.1 Pulse 1 window

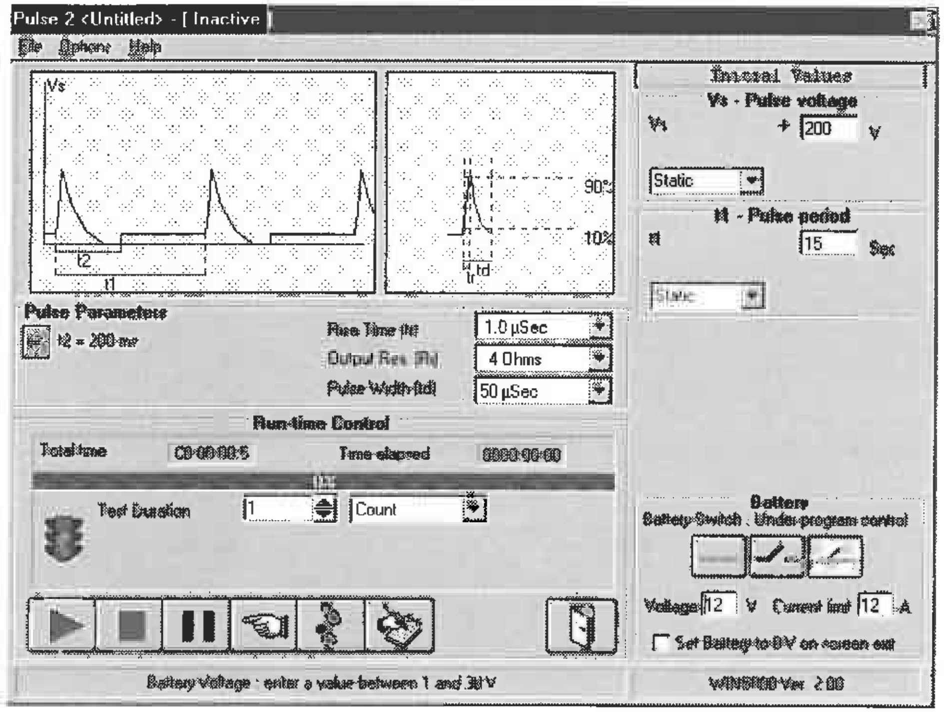


7.2 Pulse 1 parameters

The range of specifications for pulse type 1 are as follows:

- **Vs** -10V to -600V in 1V steps
- **t1** 0.5s to 15s in 0.1s steps
- **t2** 200ms
- **td** 50µs, 200µs, 500µs, 1ms, 2ms
- **tr** 1µs, 3µs
- **Ri** 4Ω, 10Ω, 50Ω

8.1 Pulse 2 window

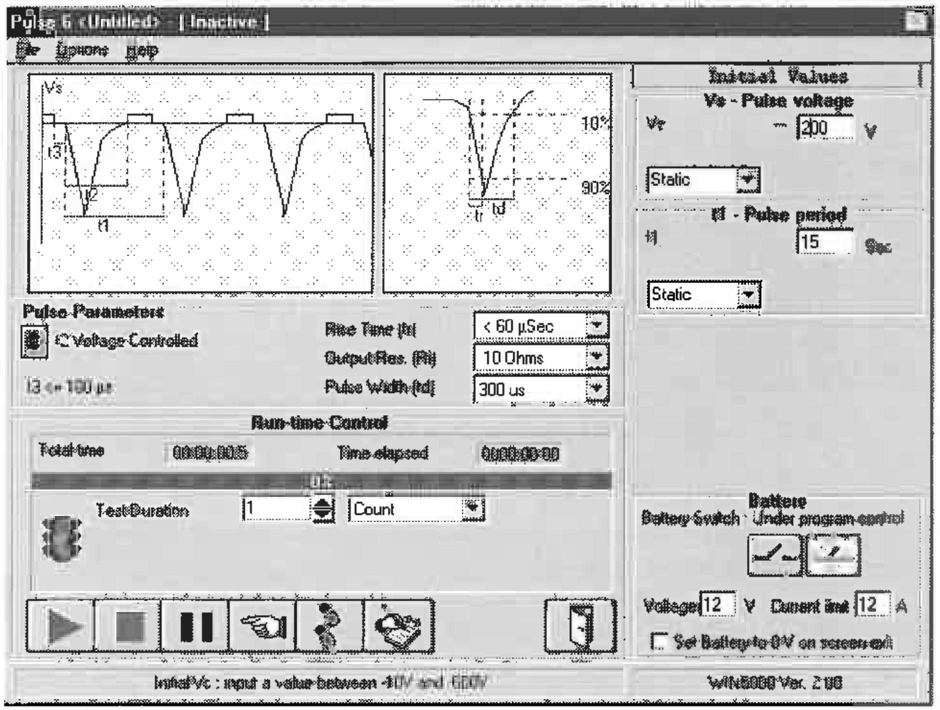


8.2 Pulse 2 parameters

The range of specifications for pulse type 2 are as follows:

- **Vs** +10V to +600V in 1V steps
- **t1** 0.5s to 15s in 0.1s steps
- **t2** 200ms
- **td** 50µs, 200µs, 500µs, 1ms, 2ms
- **tr** 1µs, 3µs
- **Ri** 4Ω, 10Ω, 50Ω

9.1 Pulse 6 window



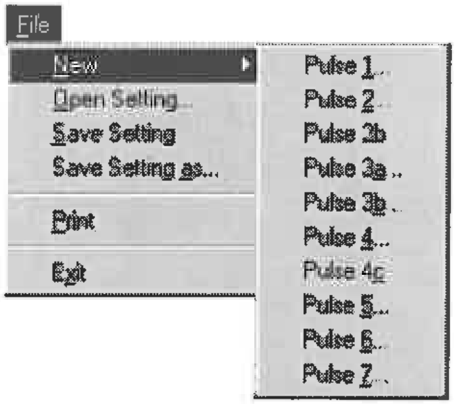
9.2 Pulse 6 parameters

The range of specifications for pulse type 6 are as follows:

- **Vs** -10V to -600V in 1V steps
- **t1** 0.5s to 15s in 0.1s steps
- **td** 300µs
- **tr** < 60µs
- **Ri** 10Ω, 30Ω

10.1 Pulse Window Menu Options

10.2 File menu



- New, opens a sub menu enabling a new pulse screen setting to be created, the current setting will be cleared.

- Open Setting…, this will load a previously created pulse screen setting.

- Save Setting, will save the current pulse screen setting with its current filename.

- Save Setting as..., allows the current pulse screen setting to be saved with a different filename.

- Print, this prints out a hard copy of the parameters for the current pulse screen setting.

- Exit, closes the pulse window and returns to the WIN5000 window.

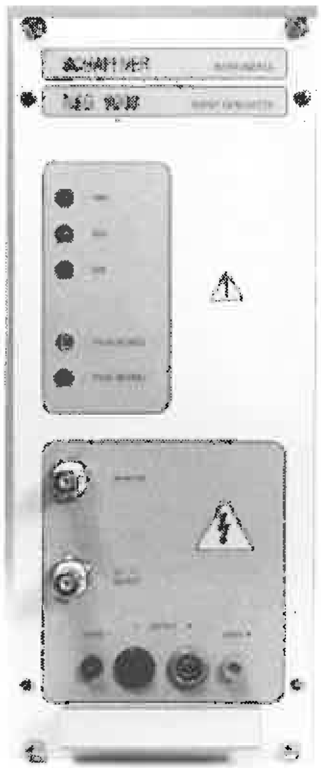
10.3 Options menu

- Battery Control, this allows real-time control of the battery. The difference between this and the battery switch control described in 6.1 above is that this battery control is instantaneous - it is **not** part of the test and is only used while no test is running.

Burst Generator

NSG 5003

Operating Instructions



CONTENTS

1 Introduction

The NSG 5003 is a plug-in burst generator design for use with the NSG 5000 mainframe system. This generator is designed primarily to meet the specification requirements for the ISO 7637 standard for pulses 3a and 3b. In many cases the specification of this generator exceeds those specified in the ISO 7637 standard.

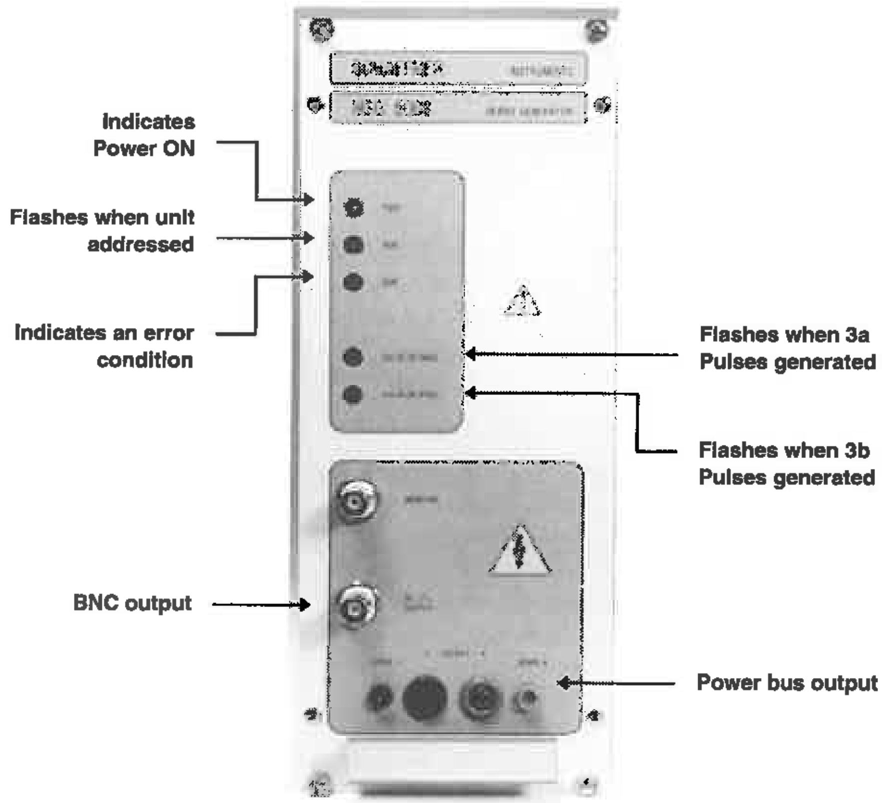
When slotted into an NSG 5000 mainframe the NSG 5003 burst generator is fully programmable via an RS232 or IEEE 488 interface. Parameters such as amplitude, burst frequency, pulse frequency, number of pulses in the burst, number of bursts are all under program control. This allows flexible test patterns to be generated which can facilitate rapid analysis of susceptibility limits of a device under test.

The NSG 5003 is designed using state of the art semi-conductor technology. This means repeatable performance and maintenance free operation. It also means that test results can be repeated accurately.

The output pulses of the generator are available on two connectors, a 50 Ohm BNC connector and a power banana socket pair. The banana socket output has the added advantage in that it forms part of the multiplexed power bus within the NSG 5000 system. This means that output pulses for other plug-in units, like the NSG 5001 are also available on the banana socket output of the NSG 50003 cassette. This can simplify fixturing to the device under test.

The NSG 5003 unit is also designed with internal selftest measurement circuitry. This selftest is designed to perform a functional check of the main operating parts of the units. It does not check the unit to calibration tolerances. However, it is a very useful facility for quickly checking if the unit is operational.

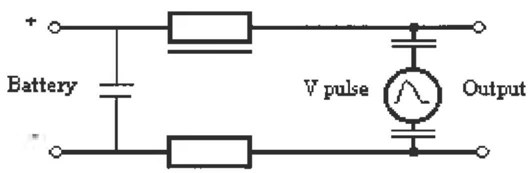
NOTE:
The WIN5000 program available from Schaffner is a Windows based graphical program which allows full control of all programmable features via an intuitive graphical windows front panel.



NSG 5003 Front Panel Layout

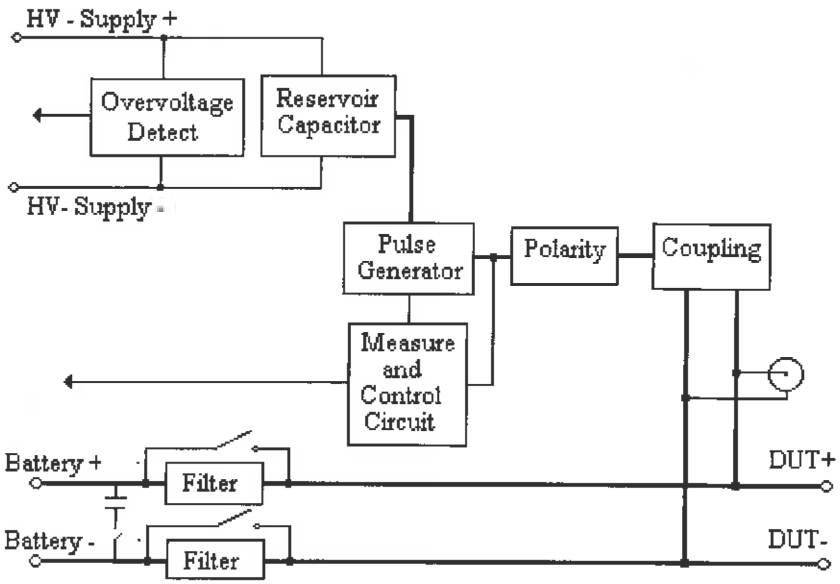
2 Specification

Parameter	Specification	Tolerance
Polarity	Negative (3a) Positive (3b)	
Amplititude (Vs)	Minimum 20V Maximum 800V Min. Increment 1V	+ 10%
Impedance (Ri)	50 Ohms	+/- 10% RL = Ri => Vo = Vs/2
Rise time (tr)	5 nSecs	+/- 30% (open loop) -30% (RL = 50 Ω)
Pulse Width (td)	100 nSecs 100 - 200 nSecs	+/- 20% (RL = 50 Ω) RL > 10K Ω
Burst Freq. (t1)	Minimum 1 Khz Maximum 100Khz Min. Increment 0.1 Khz	+/- 10%
Number of pulses per burst (t4)	Minimum 1 Maximum 200	
Repitition time (t5)	Minimum 0.09 Secs Maximum 99.9 Secs Min. Increment 0.01 Secs	+/- 10%
Burst Mode	Single Continuous Count : Min 1 Max 99999 time : 1 to 99999 secs 1 to 6000 mins 1 to 100 hrs	+/- 10%
Pulse Output BNC (Coupling)	50 Ohms	+/- 10%



Pulse Generation Mechanism

3 Block Diagram



4 Installation / Setup

Check the instrument for any mechanical damage. Report any damage found to the carrier immediately.

Ensure that the power is turned off on the NSG5000 mainframe and that the battery input is disconnected. Insert the cassette in the left most slot and push in fully. Screw in the four retaining screws fully.

Turn on the mains input power on the NSG5000 mainframe. After approximately a two second delay the power LED (red) on the NSG5003 generator should light.

At this point it is recommended to run selftest to ensure that the main functional parts of the NSG5003 are operational. The easiest way to run selftest is via the WIN5000 software package.

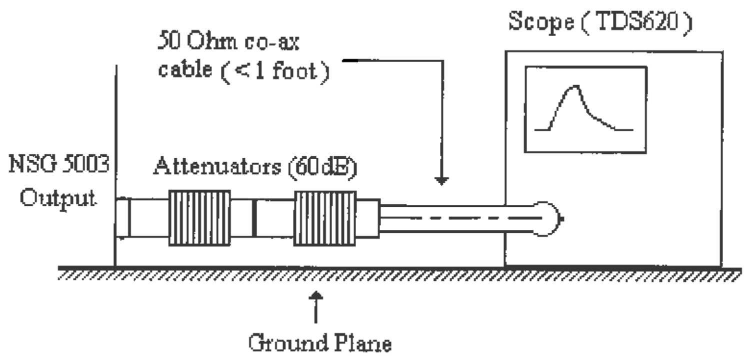
NOTE: Selftest should only be run with all fixtures, attenuators and adapters disconnected from the front of the NSG5003.

Once selftest has been run the scope calibration setup shown in 5.1 should be connected and the output pulses should be quickly checked to ensure that they are of the correct form and shape. When pulses are generated the green LED (3a or 3b, whichever is selected) flashes as pulses are output.

4.1 Test set-up

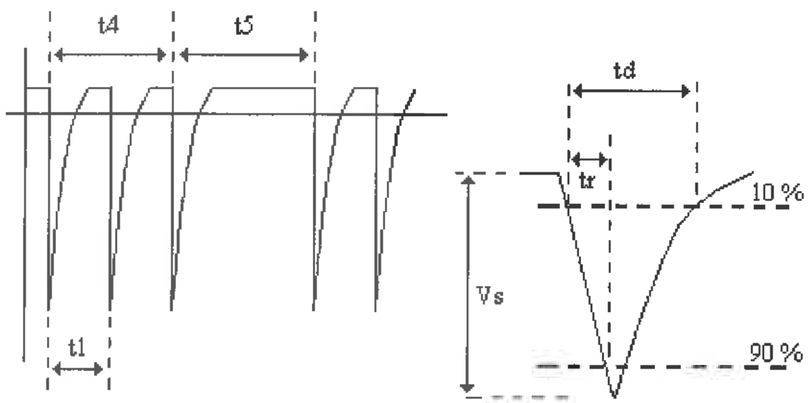
The following set-up can be used to check the integrity of the output pulses. Due to the high frequency nature of the 3a and 3b pulses it is critically important that cable lengths are kept to a minimum and that the test set-up is rigorously adhered to.

The attenuator used in this test set-up is a series combination of two Bird 8304 - 300 30dB attenuators. This gives a total attenuation factor of 60dB. The oscilloscope used needs to a have a high sampling rate and bandwidth. A Tektronix TDS 620 or equivalent is recommended.



4.2 Parameter references

The following diagram shows the reference points used for parameter specifications on the NSG 5003.

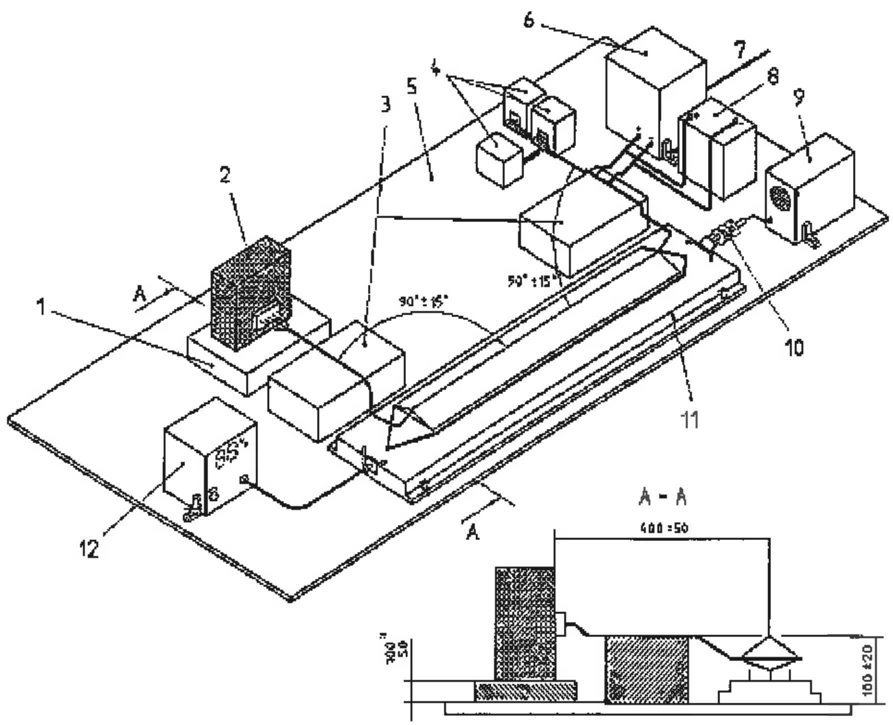


5 Tests with a Coupling Clamp

A capacitive coupling clamp is used when the bursts have to be injected into control and data lines.

The following diagram illustrates the arrangement of the test rig recommended by ISO and DIN.

Dimensions in millimetres

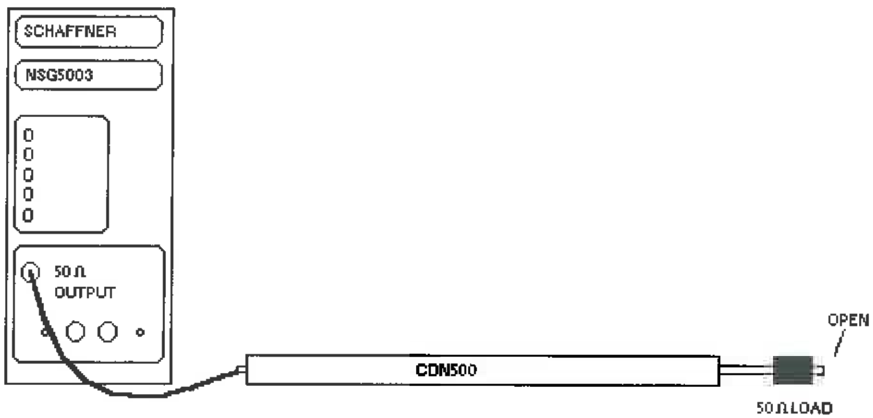


Key

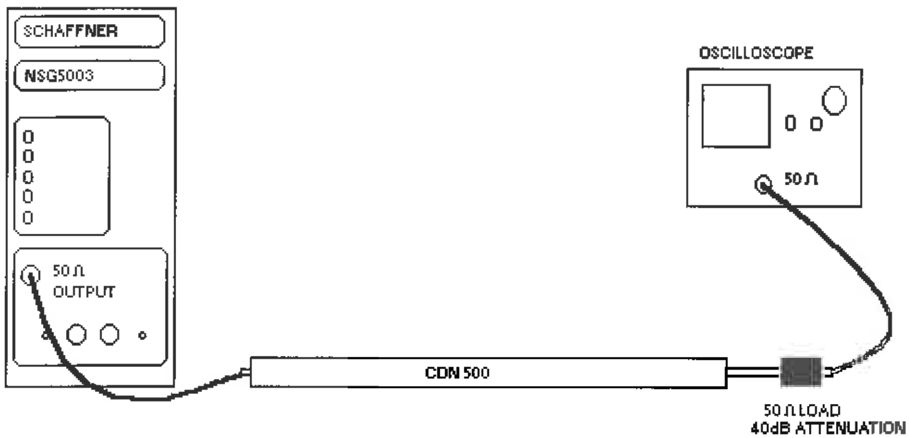
1. Insulating support if device under test is not to be connected to ground in the vehicle.
2. Device under test.
3. Insulating supports for the test harness.
4. Peripheral items (such as sensors, load, accessories) mounted as in the vehicle.
5. Ground plane.
6. Power supply 12V or 24V.
7. a.c. power supply.
8. Battery.
9. Oscilloscope.
10. 50 Ω attenuator.
11. Coupling clamp.
12. Test pulse generator.

A Standard-conforming coupling clamp is available from SCHAFFNER under the type number CDN 500. The clamp has a 50 Ohm BNC connector at both sides. The test circuit must be terminated with 50 Ohms on the side opposite to the generator.

The termination and attenuator type INA 220 can be used for this purpose.



Arrangement with the NSG 5003, CDN 500 and the INA 220 as a 50 Ohm termination.



Arrangement with the NSG 5003, CDN 500, INA 220 as a 50 Ohm termination with integrated 40 dB attenuator and an oscilloscope.

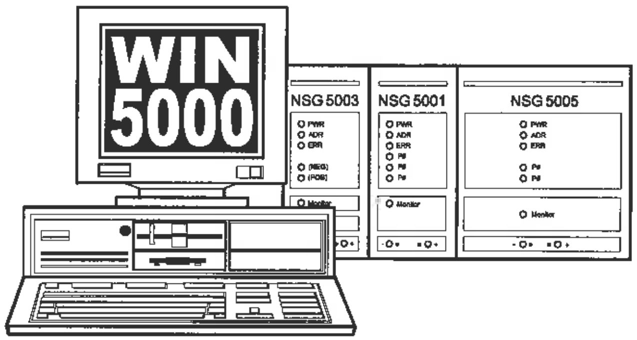
In keeping with the specifications, the following relationships result during calibration measurements:

Pulse at generator output:	120 V
Pulse at 50 Ohm connection:	60 V
Pulse at the oscilloscope:	0.6 V

WIN5000 SOFTWARE
Operating Instructions

for

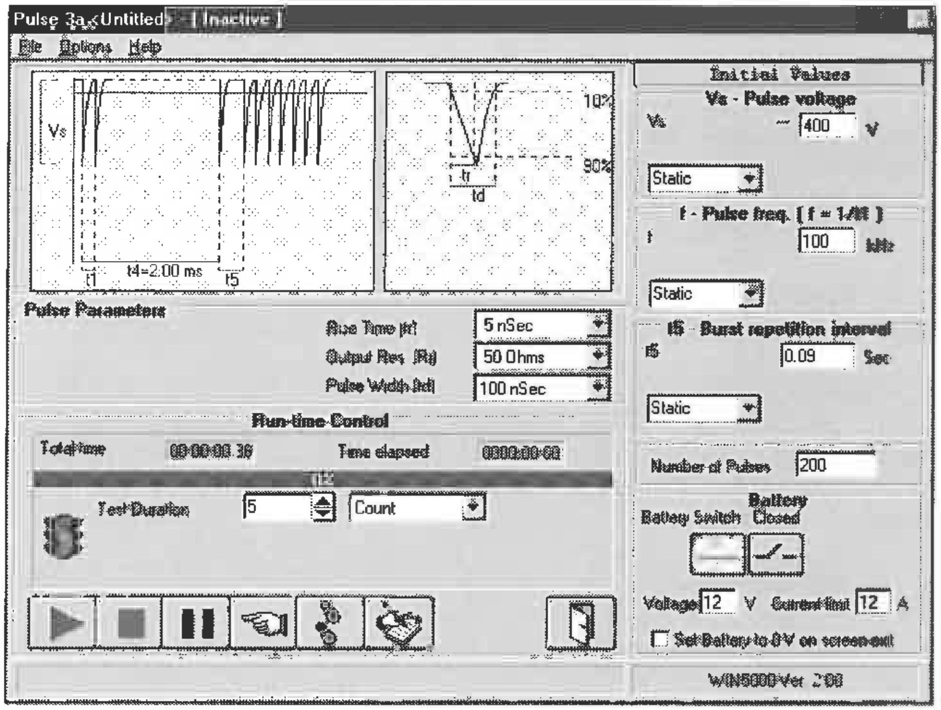
NSG 5003
Burst Generator



NSG 5003 Burst Generator Software Operating Instructions

1.1 NSG 5003 Main Window

There are two different pulse types available on the NSG5003 module, these are types **3a** which is a negative pulse and **3b** which is a positive pulse. When one of these pulses is selected from the WIN5000 tool bar or the Control menu the NSG5003 window is opened. Although similar, each pulse type has its own window.



The window above is the WIN5000 pulse 3a window.

From this window tests can be made up from pulses. Bursts of pulses can be performed by ramping the pulse voltage, the pulse frequency or the burst repetition interval. It should be noted that only one parameter may be ramped at a time and that ramping always ranges from low to high pulse energy.

Once created tests can be saved for future use, and, in conjunction with the WIN5000 sequencer, they may be used to perform tests made up of different pulses and pulse sequences from different modules.
The window is divided into eight sections.

1.2 Graphical display

At the top of the window there is a graphical display showing the pulse parameters, the two graphs change according to how the pulse is setup.

1.3 Pulse Voltage

Sets the pulse voltage, this can show a single value or for tests where the voltage is to be ramped there will be start and finish values and step size.

1.4 Pulse Frequency

Sets the pulse frequency, this can show a single value or for tests where the frequency is to be ramped there will be start and finish values and step size.

1.5 Burst Repetition interval

This sets the burst repetition interval, this can show a single value or for tests where the interval is to be ramped there will be start and finish values and step size.

1.6 Pulse Parameters

This section of the window controls discreet settings such as rise times. pulse widths.

1.7 Battery Switch

With this push-button the Battery Voltage can be connected to the device under test or disconnected completely.

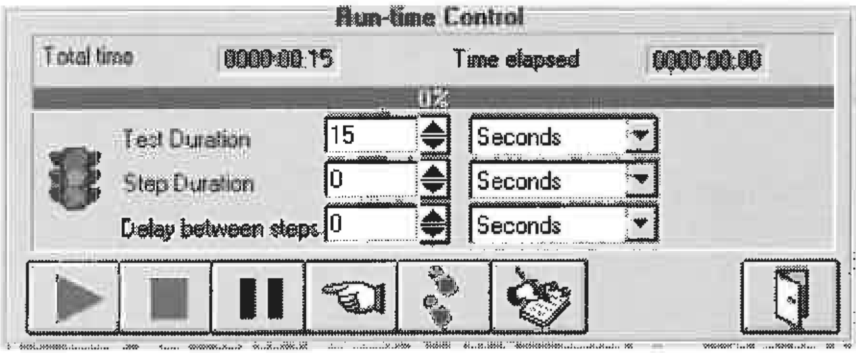
1.8 Control

This part of the window governs the test duration, step duration and delay time between steps. There are push-buttons for starting and stopping tests as well as proceeding one step at a time.

1.9 Information Bar

The information bar at the bottom of the screen shows the specification for the pulse parameter which currently has the focus.

2.1 Control



This section of the window governs the run-time operation of tests. The overall test duration may be set by selecting the units from the drop down list (accessed by clicking on the push-button), and then typing the value into the adjacent text box.

- seconds/minutes/hours, this is the actual amount of time to spend running this test. The test will keep cycling until the specified time has elapsed.

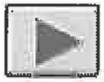
- count allows a specific number of cycles to be specified, that is the number of times a test will be performed.

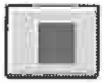
- Step Duration in the Control window specifies the duration on each step before ramping to the next step. If step duration is a Count then there will be the specified number of bursts before proceeding to the next step. If step duration is a time, then the number of bursts is determined by this time and the value of t5.

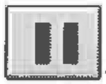
- continuous will repeat the entire test until the stop or pause buttons are pressed.

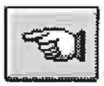
Values may be adjusted in single steps by clicking on the up and down arrows in the box itself. The same procedure is used to set the step duration and the delay time between steps. Count refers to the number of times to perform each step before ramping to the next

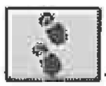
2.2 Push-button functions

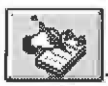

----- Starts a test.

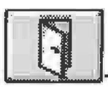

----- Stops a test.


----- Pauses execution of a test.


----- Manually sends a single burst at the current settings.

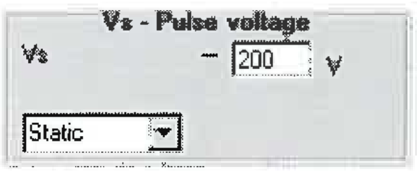

----- Steps through test sequence one step at a time, useful when compiling tests and during de-bugging.


----- Opens a window into which notes pertinent to the particular test may be entered for future reference.


----- Exits from the pulse window and returns to WIN5000

Both the total test time and the elapsed test time are displayed in the top of this section, and a graphical percentage done indicator shows the progress of the test sequence (the red bar is gradually replaced by a green bar as well as displaying the percentage done in figures). When paused the elapsed time and the percentage done indicator are also paused.

3.1 Pulse Voltage (Vs)

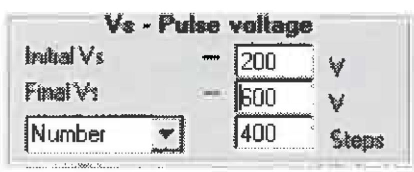


This sets the pulse voltage (Vs). When the voltage is to remain static throughout the test only one box is displayed, enter the desired voltage into this box (i.e. 200 in the above example).

Pulse type 3a is negative therefore the pulse voltage is a negative value, pulse type 3b is a positive pulse thus the pulse voltage has a positive value.

The pulse voltage may be ramped during the test in one of two ways, the ramping method is selected from a drop down list that is accessed by pressing the push-button.

Two more boxes appear in the voltage section when the voltage is to be ramped.



The top box is now the initial voltage (i.e. the pulse voltage at the start of the test), the middle box is the final voltage and the lower box is the increment, depending on the ramping method the increment may be a specific number of steps or a value in volts.

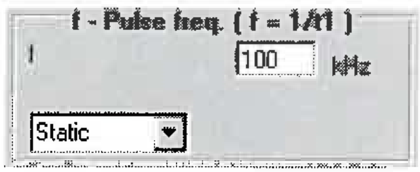
3.2 Dynamic ramping

To ramp the pulse voltage dynamically select dynamic from the drop-down menu. Enter the initial and final pulse voltages and then the increment size in volts, during execution the voltage will start at the initial voltage and be incremented until the final voltage is reached.

3.3 Numeric ramping

To ramp the pulse voltage in a specific number of steps select number from the drop-down menu. Enter the initial and final burst voltages and the number of steps. During operation the voltage will be incremented in uniform amounts according to the number of steps.

4.1 Pulse frequency (f)



This sets the pulse frequency (f). When the frequency is to remain static throughout the test only one box is displayed, enter the desired frequency into this box.

The pulse frequency may be ramped during the test in one of two ways, the ramping method is selected from a drop down list that is accessed by pressing the push-button.

Two more boxes appear in the pulse frequency section when it is to be ramped, as shown below.

The top box is now the initial pulse frequency (i.e. the pulse frequency at the start of the test), the middle box is the final pulse frequency and the lower box is the increment, depending on the ramping method the increment may be a specific number of steps or a value in kHz.

4.2 Dynamic ramping

To ramp the pulse frequency dynamically select dynamic from the drop-down menu. Enter the initial and final pulse frequencies and then the increment size in KHz. During execution the frequency will start at the initial frequency and be incremented until the final frequency is reached.

4.3 Numeric ramping

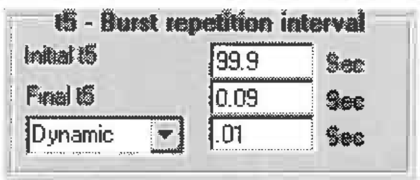
To ramp the pulse frequency in a specific number of steps select number from the drop-down menu. Enter the initial and final frequency and the number of steps. During operation the frequency will be incremented in uniform amounts according to the number of steps.

5.1 Burst Repetition Interval (t5)

This sets the burst repetition interval (t5). When it is to remain static throughout the test only one box is displayed, enter the desired interval into this box.

The burst repetition interval may be ramped during the test in one of two ways, the ramping method is selected from a drop down list that is accessed by pressing the push-button.

Two more boxes appear in the burst repetition interval section when it is to be ramped, as shown below.



The top box is now the initial burst repetition interval (i.e. the interval at the start of the test), the middle box is the final burst repetition interval and the lower box is the increment. Depending on the ramping method the increment may be a specific number of steps or a value in seconds.

5.2 Dynamic ramping

To ramp the burst repetition interval dynamically select dynamic from the drop-down menu. Enter the initial and final intervals and then the increment size in volts. During execution the interval will start at the initial interval and be incremented until the final interval is reached.

5.3 Numeric ramping

To ramp the burst repetition interval in a specific number of steps select number from the drop-down menu. Enter the initial and final interval and the number of steps. During operation the interval will be incremented in uniform amounts according to the number of steps.

5.4 Number of Pulses

Enter the number of pulses for each burst in the range 1 to 200.

6.1 Pulse Parameters

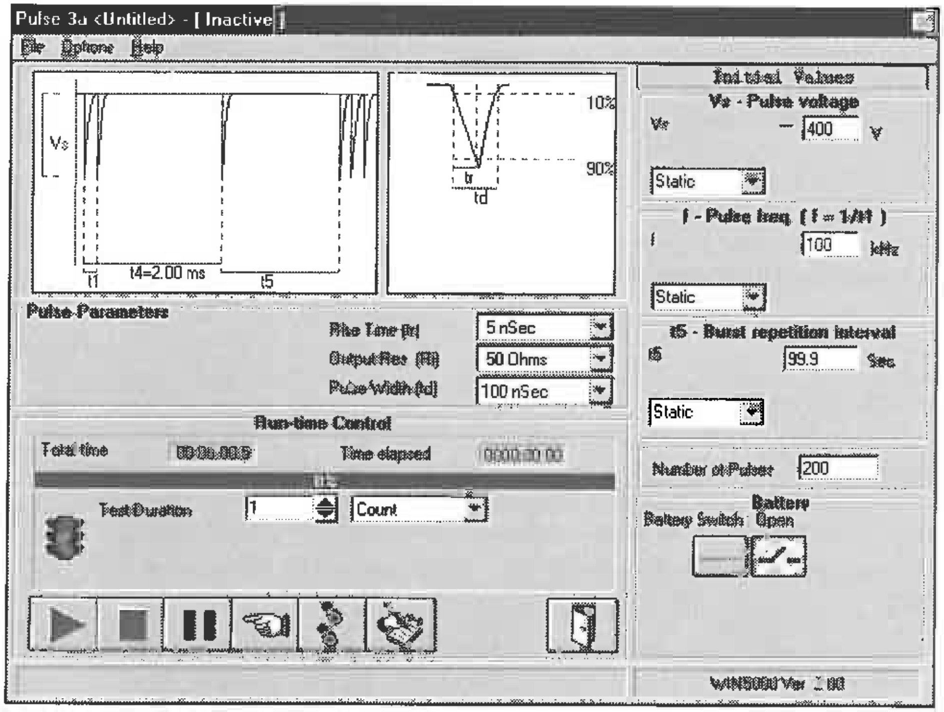
This section controls settings that have a range of discreet values.

To change a setting click on the adjacent push-button and select the required value, these vary between pulse types.

7.1 Battery Switch

This controls the connection of the DC Source between the device under test and the NSG5000. Clicking on the push-buttons toggles between open and closed. Note that these settings can be saved as part of the test, and the changes are implemented when the user starts the test by clicking the GO button.

8.1 Pulse 3a window

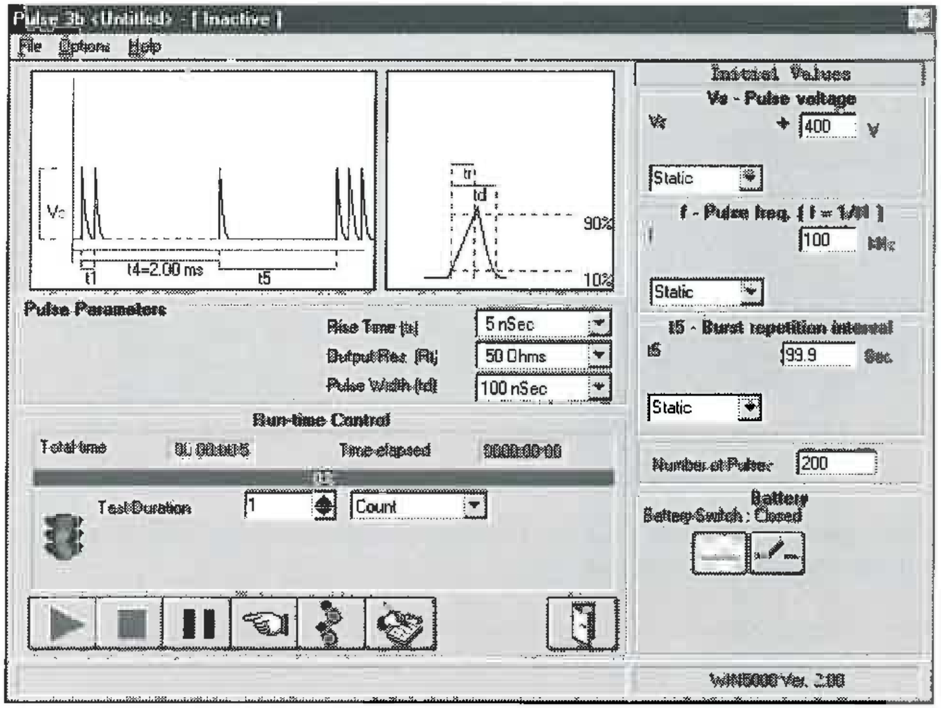


8.2 Pulse 3a parameters

The range of specifications for pulse type 3a are as follows:

- **Vs** -20V to -800V in 1V steps
- **f1** 1KHz to 100KHz in 100Hz steps (= 1/t1)
- **t5** 0.1s to 99s in 0.1s steps
- **t4** 10µs to 200ms (= Np x t1)
- **td** 100ns
- **tr** 5ns
- **Ri** 50Ω
- **Number of Pulses, Np** 1 to 200

9.1 Pulse 3b window



9.2 Pulse 3b parameters

The range of specifications for pulse type 3b are as follows:

- **Vs** +20V to +800V in 1V steps
- **f1** 1KHz to 100KHz in 100Hz steps (= 1/t1)
- **t5** 0.1s to 99s in 0.1s steps
- **t4** 10µs to 200ms (= Np x t1)
- **td** 100ns
- **tr** 5ns
- **Ri** 50Ω
- **Number of Pulses, Np** 1 to 200

10.1 Pulse Window Menu Options

10.2 File menu

- New, opens a sub menu enabling a new pulse screen setting to be created, the current setting will be cleared.

- Open Setting, this will load a previously created pulse screen setting.

- Save Setting, will save the current pulse screen setting with its current filename.

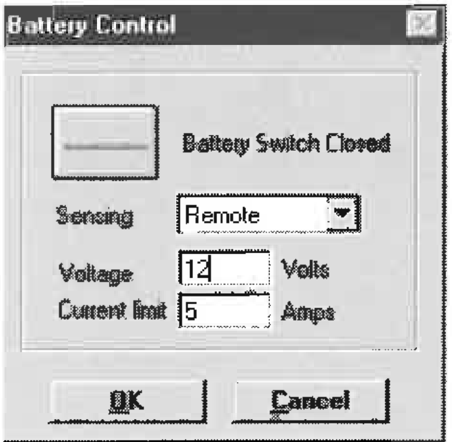
- Save Setting as..., allows the current pulse screen setting to be saved with a different filename.

- Print, this prints out a hard copy of the parameters for the current pulse screen setting.

- Exit, closes the pulse window and returns the WIN5000 window.

10.3 Options menu

- Battery Control, this allows real-time control of the battery. The difference between this and the battery switch control described in 7.1 above is that this battery control is instantaneous - it is **not** part of the test and is only used while no test is running.



Addendum to Version 1.4

The NSG5004 described in this manual has been replaced by an NSG5004A.

The NSG5004A has an equivalent specification to the NSG5004. All connections to and from each are the same. Thus, users of the new NSG5004A should read NSG5004A for any reference to the NSG5004 in this manual.

The main difference between the NSG5004 and the NSG5004A is that for a 25A version there is a single set of front panel meters in the NSG5004A instead of two sets as in the NSG5004. This simplifies user monitoring of both voltage and current.

Battery Simulator

NSG 5004

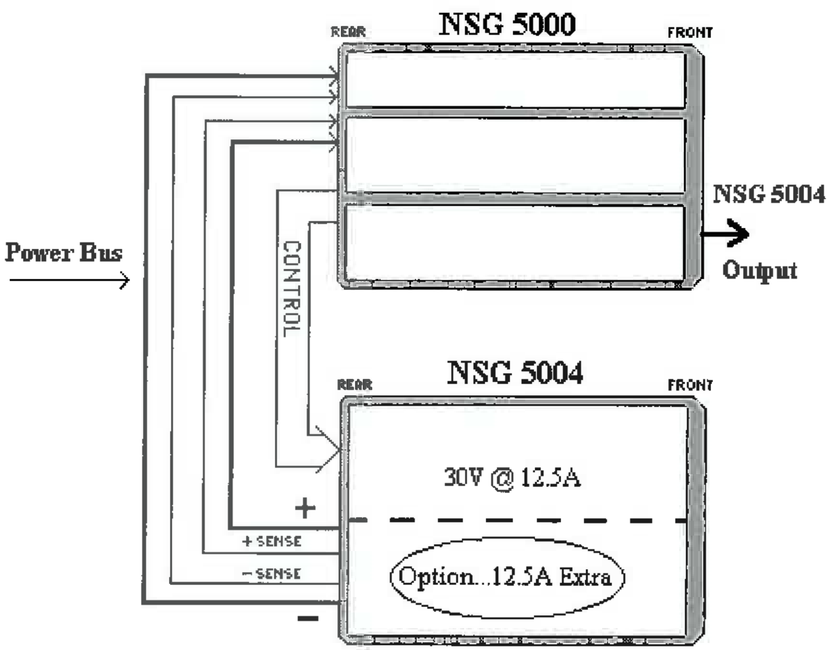
Operating Instructions

CONTENTS

1 Introduction

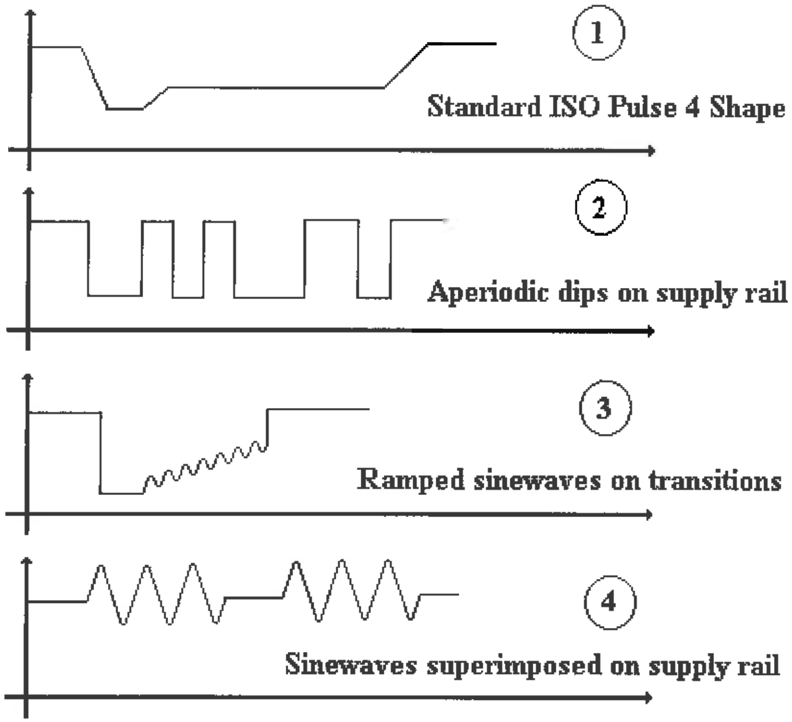
The NSG 5004 is a battery simulator designed for use with the NSG 5000 mainframe system. The NSG 5004 is a fully programmable solid state source that has an output capacity of 30V DC at 25A (750 Watts). This simulator is designed primarily to meet the ISO 7637 standard requirements for pulse 4 (i.e. cranking pulse).

The NSG 5004 is controlled by a driver card that is located in the control unit in the NSG 5000 mainframe. The output of the battery simulator connects through the power entry module and onto the multiplexed pulse output available on the front of the NSG 5003 cassette.



The battery simulator is also fitted with a programmable current limit facility. This can be very useful for protecting the DUT from power overload, in situations where the DUT develops an input failure or short circuit. In addition the simulator is fitted with remote sense compensation, voltage and current meters, and over voltage / over current limit LED indicators.

The driver board fitted in the NSG 5000 mainframe is basically an arbitrary waveform generator. This means that in addition to the standard ISO 7637 pulse shape requirements the NSG 5004 simulator is able to produce a variety of different power cycle waveforms. For example,



NOTE:

(i) Waveforms 2, 3 & 4 require special option "Pulse 4C" available from Schaffner.

(ii) The WIN5000 program available from Schaffner is a windows based graphical program which allows full control of all NSG 5004 programmable functions via an intuitive windows front panel.

2 Specifications

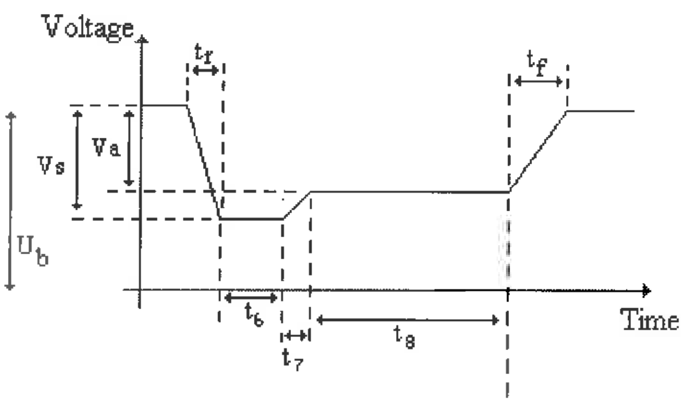
Parameter	Specification	Tolerance
Output Voltage (Ub)	Minimum 0V Maximum 30V Increment 0.1V	+/- (1% + 50mV)
Voltage Drop (Vs)	Minimum 0V Maximum 30V Increment 0.1V	+/- (1% + 50mV)
Voltage drop (Va)	Minimum 0V Maximum 30V Increment 0.1V	+/- (1% + 50mV)
Impedance (Ri)	0.01R effective (with remote sense active)	
Timing (t6)	Minimum 5mSec Maximum 999mSec Increment 1mSec	+/- 10%
Timing (t7)	50mSec or 100mSec	+/- 10%
Timing (t8)	Minimum 0.1Sec Maximum 99.9Sec Increment 0.1Sec	+/- 10%
Timing (tf)	Minimum 5mSec Maximum 999mSec Increment 1mSec	+/- 10%
Timing (tr)	5mSec 10mSec	+/- 10%
Current max	25 Amps	
Current Peak	75 Amps for 100mSec	
Time Interval (t10)	Minimum 1Sec Maximum 99Sec	+/- 10%
Pulse Mode	Single Continuous (with interval t10) Count : Min 1 Max 99999 Time : 1 to 99999 secs 1 to 6000 mins 1 to 100 hrs	+/- 10%
Battery Current Limit	0.1 to 25A, 0.1A resolution	+/- 10%

Parameter	Specification	Tolerance
Maximum Output voltage frequency	20Khz	
Maximum slew rate (Voltage)	3.5V / µSec	+/- 10%
Maximum slew rate (Current)	2 A / µSec	+/- 10%

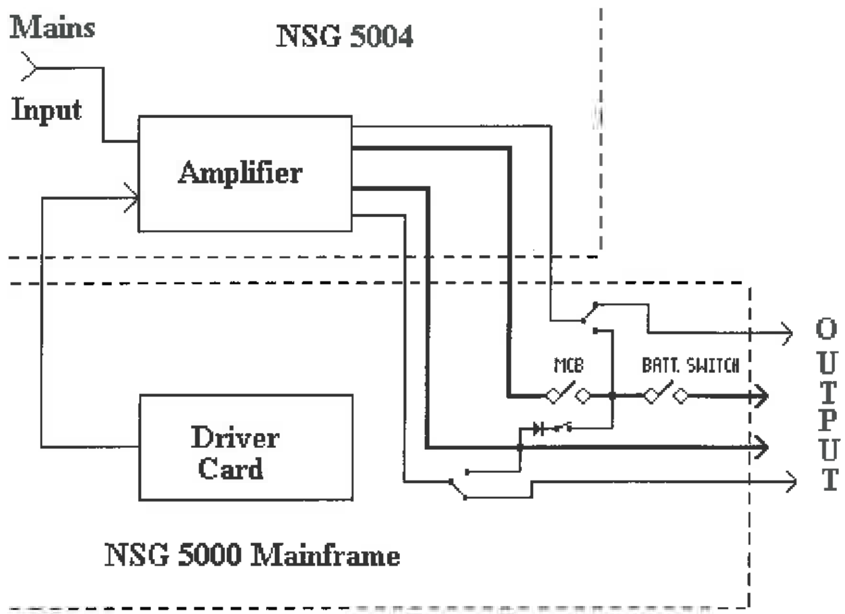
NOTE: Contact the factory for specifications on pulse shapes that are different to the ISO 7637 standard pulse 4.

2.1 Parameter References

The following diagram shows the pulse 4 parameter references as described in the ISO 7637 standard.



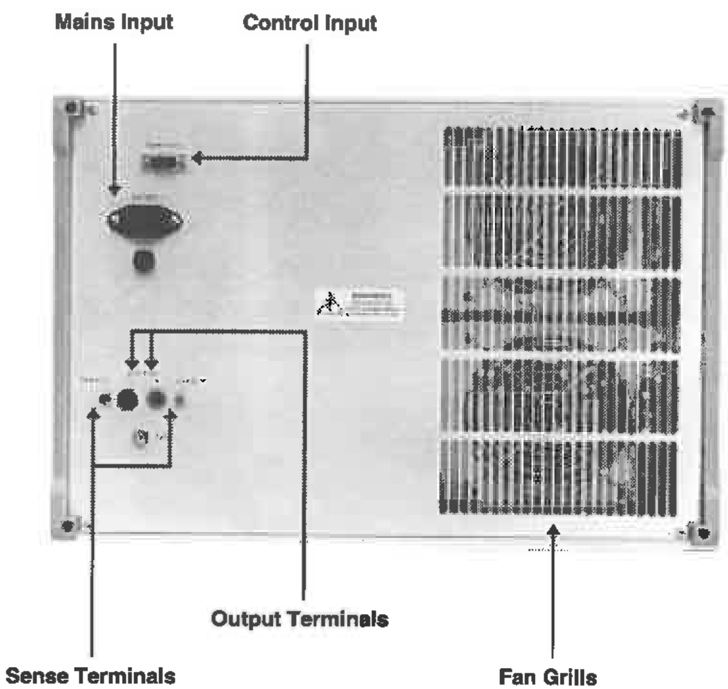
3 Block Diagram



4 Installation / Set-up

4.1 Connections to NSG 5000 Mainframe

The rear panel of the NSG 5004 has output terminals and a control connector.



There are two sets of cables supplied with the NSG 5004 to facilitate connection to the NSG 5000 mainframe. These are as follows :

OUTPUT/SENSE cable harness

(a) Output

This must be connected between the "Output" connectors on the NSG 5004 and the "Battery Voltage" connectors on the POWER ENTRY module at the rear of the NSG 5000 mainframe.

NOTE: The positive of this cable harness is marked with a red connector on both sides.

(b) Sense

This must be connected between the "Sense" connectors on the NSG 5004 and the "Battery Voltage Sense" connectors on the POWER ENTRY module at the rear of the NSG 5000 mainframe.

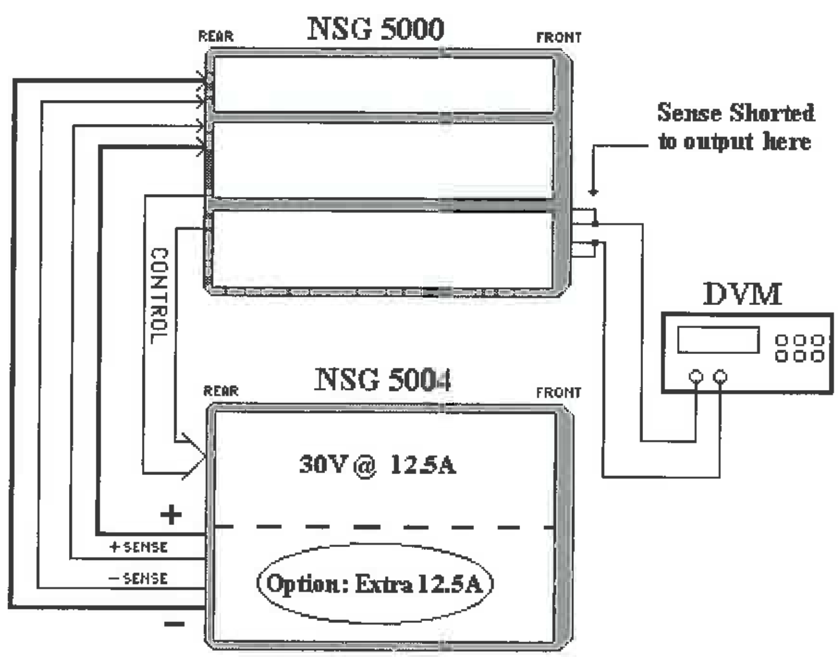
NOTE: The positive of this cable harness is marked with a red connector on both sides.

CONTROL cable.
This must be connected between the "Control" connector on the NSG 5004 and the "Pulse 4 Control" connector on the CONTROL UNIT module at the rear of the NSG 5000 mainframe.

4.2 Calibration Set-up

The driver card located in the control unit of the NSG 5000 mainframe can be calibrated to account for any drift or inaccuracies which may arise over time in the NSG 5004 amplifier. There are no potentiometers fitted to the driver card as calibration is achieved with software routines and EEPROM constants stored on the MPU card.

The WIN 5000 software available from Schaffner has a menu option guides the operator through the procedure of calibrating the NSG 5004. The calibration set-up for this procedure is simple and should be implemented as follows.



The WIN5000 software will automatically calibrate the zero and full scale adjust points on the driver card. It will then run a linearity check on the output values. The user is requested to input the actual voltage setting at each point and this is automatically checked against the specification limits. A printout of the calibration results is available at the end. This printout indicates the overall calibration status of the instrument and any failures which may have occurred. An example calibration printout is shown below:

NSG5000 Calibration Report: <C:\WIN5000\TEST.CAL>

Company Name: Smart Technologies

DATE: 12/12/93 **Time:** 15:11:59

DVM Type: Fluke 8840A
DVM Serial Number: 2728152

NSG5004 Calibration results Limits are +/-(1% + 50mV)

Module Serial Number 1234
Module Part Number NSG 5004

Set Value	Min. Limit	Result	Max. Limit	Status
0 V	-.05	.0008	.05	PASS
5 V	4.9	5.003	5.1	PASS
10 V	9.85	10.006	10.15	PASS
15 V	14.8	15.009	15.2	PASS
20 V	19.75	20.004	20.25	PASS
25 V	24.7	25.0002	25.3	PASS
30 V	29.65	30.005	30.35	PASS

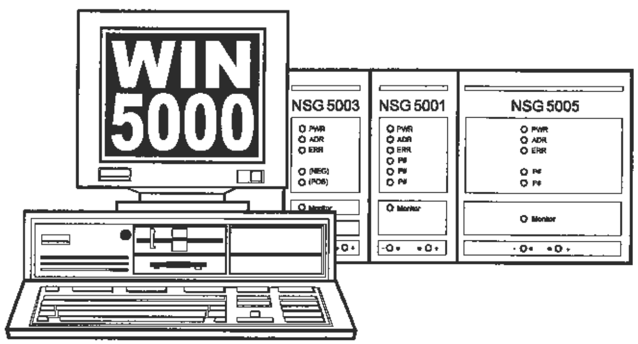
Overall Status: PASS
Calibrated By: Sherlock Holmes

Signed: ____________________

WIN5000 SOFTWARE
Operating Instructions

for

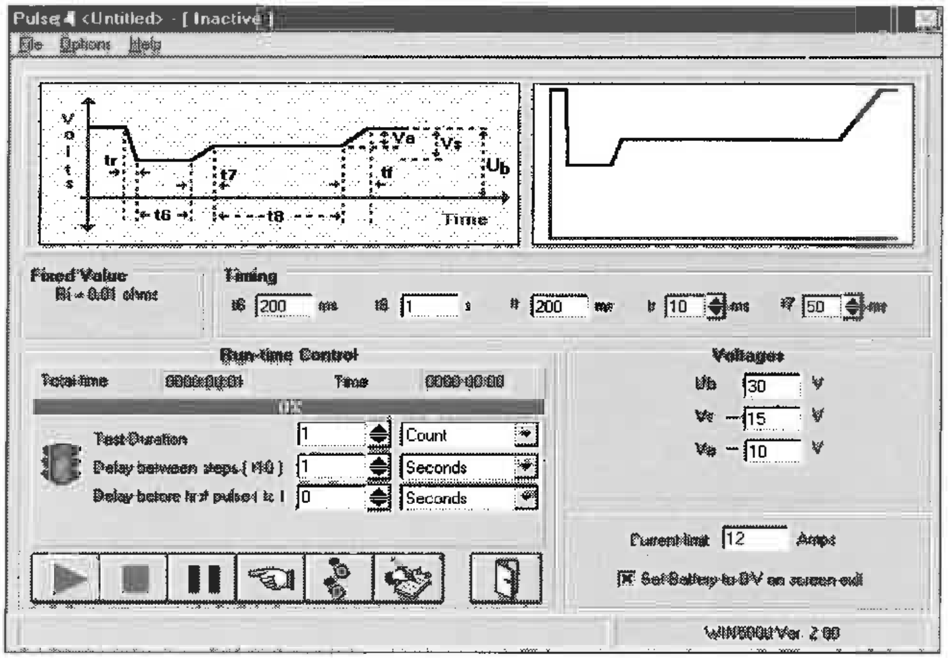
NSG 5004
Battery Simulator



NSG 5004 Battery Simulator Software Operating Instructions

1.1 Pulse 4 Main Window

Pulse type 4 is available on the NSG 5004 module, when it is selected from the WIN5000 tool bar or the Control menu the Pulse 4 window is opened.



From this window tests can be made up from pulses. Once created tests may be saved for future use, and in conjunction the WIN5000 sequencer, may be used to perform tests made up of different pulses and pulse sequences from different modules.

1.2 Timing

These values are represented on the graph. Values from 5 to 999 mSec may be entered for the time (t6) at Ub-Vs voltage. Values from 0 to 999 mSec may be entered for the time (t8) at Ub-Va voltage. The Battery final step time (tf) has the same range as t6. The Battery initial fall time (tr) can be either 5mSec or 10 mSec and the battery off-on time (t7) can be either 50mSec or 100mSec.

1.3 Voltages

Enter the desired voltages for **Ub** (battery Voltage), **Vs** (Battery Drop-Out Voltage) and **Va** (Battery Initial Voltage). Note that |Va| is always less than |Vs|.

1.4 Control

This part of the window governs the test duration, step duration and delay time between steps. There are push-buttons for starting and stopping tests as well as proceeding one step at a time. (see 2.1)

1.5 Current Limit

The battery current limit is programmable from 0.1A to 25A. The programming resolution is 0.1A.

2.1 Control

This section of the window governs the run-time operation of tests, the overall test duration may be set by selecting the units from the drop down list (accessed by clicking on the push-button), and then typing the value into the adjacent text box.

- **Seconds/Minutes/Hours**, this is the actual amount of time to spend running the test. The test will keep cycling until the specified time has elapsed.

- **Count** allows a specific number of cycles to be specified, that is the number of times a test will be performed.

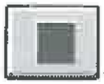
- **Continuous** will repeat the entire test until the stop or pause buttons are pressed.

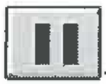
For the step delay enter the amount of delay time in seconds, minutes or hours.

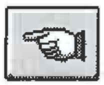
Values may also be adjusted in single steps by clicking on the up and down arrows at the end of the box.

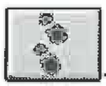
2.2 Push-button functions

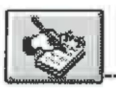

----- Starts a test sequence.

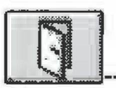

----- Stops a test sequence.


----- Pauses execution of a test sequence.


----- Manually sends a single burst at the current settings.

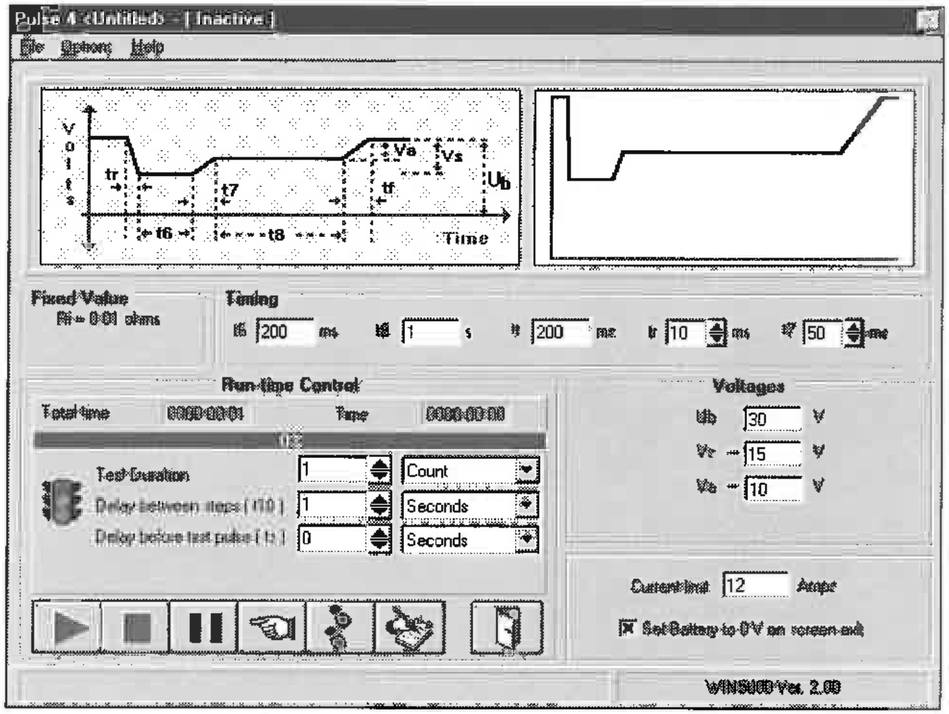

----- Steps through test sequence one step at a time, useful when compiling tests and during de-bugging.


----- Opens a window into which notes pertinent to the particular test may be entered for future reference.


----- Exits from the pulse window and returns to WIN 5000.

Both the total test time and the elapsed test time are displayed in the top of this section, and a graphical percentage done indicator shows the progress of the test sequence (the red bar is gradually replaced by a green bar as well as displaying the percentage done in figures). When paused the elapsed time also pauses.

3.1 Pulse 4 window

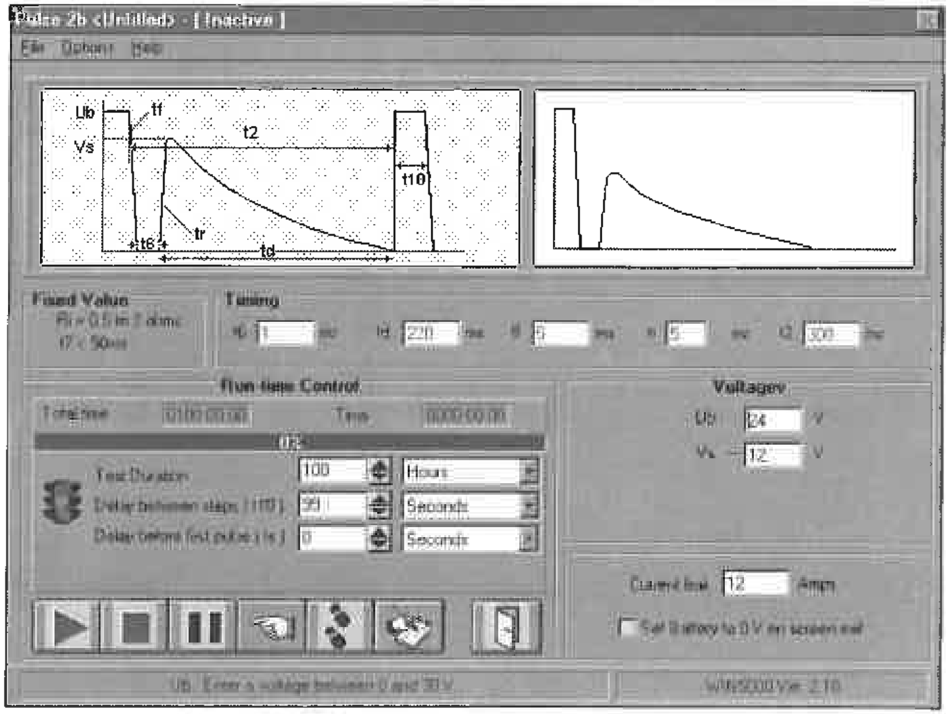


3.2 Pulse 4 parameters

The range of specifications for pulse type 4 are as follows:

- **Ub** 0 to 30V
- **Vs** 0 to Ub
- **Va** 0 to Vs
- **t6** 5 to 999ms
- **t7** 50ms, 100mS
- **t8** 0.1 to 99.9s
- **tf** 5 to 999ms
- **tr** 5, 10ms

4.1 Pulse 2b window



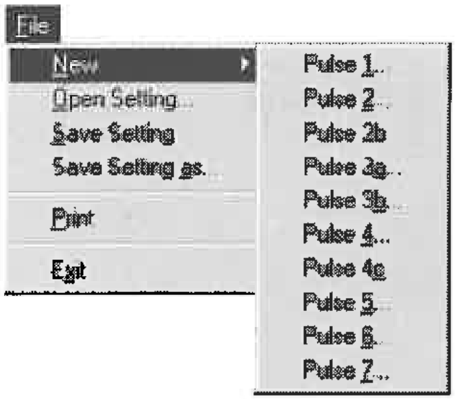
4.2 Pulse 2b parameters

The range of specifications for pulse type 4 are as follows:

- **Ub** 0.1 to 30V
- **Vs** 0 to -Ub in 0.1V steps
- **t6** 1mS
- **td** 220mS
- **tf** 5mS
- **tr** 5mS
- **t2** 300mS
- **t7** < 50mS
- **Ri** 0.5 to 3 Ω
- **t10** 1 to 99 seconds
- **ts** 0 to 300 seconds

5.1 Pulse window menu options

5.2 File menu



- New, opens a sub menu enabling a new pulse screen setting to be created, the current setting will be cleared.

- Open Setting…, this will load a previously created pulse screen setting.

- Save Setting, will save the current pulse screen setting with its current filename.

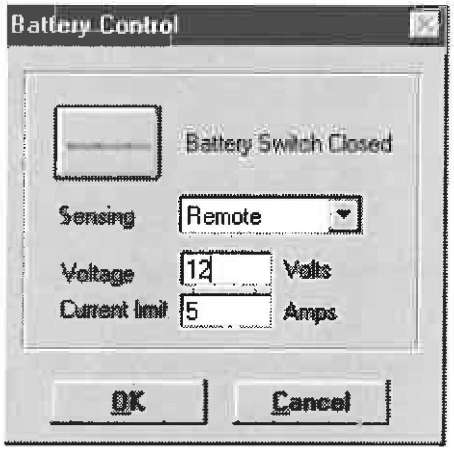
- Save Setting as..., allows the current pulse screen setting to be saved with a different filename.

- Print, this prints out a hard copy of the parameters for the current pulse screen setting.

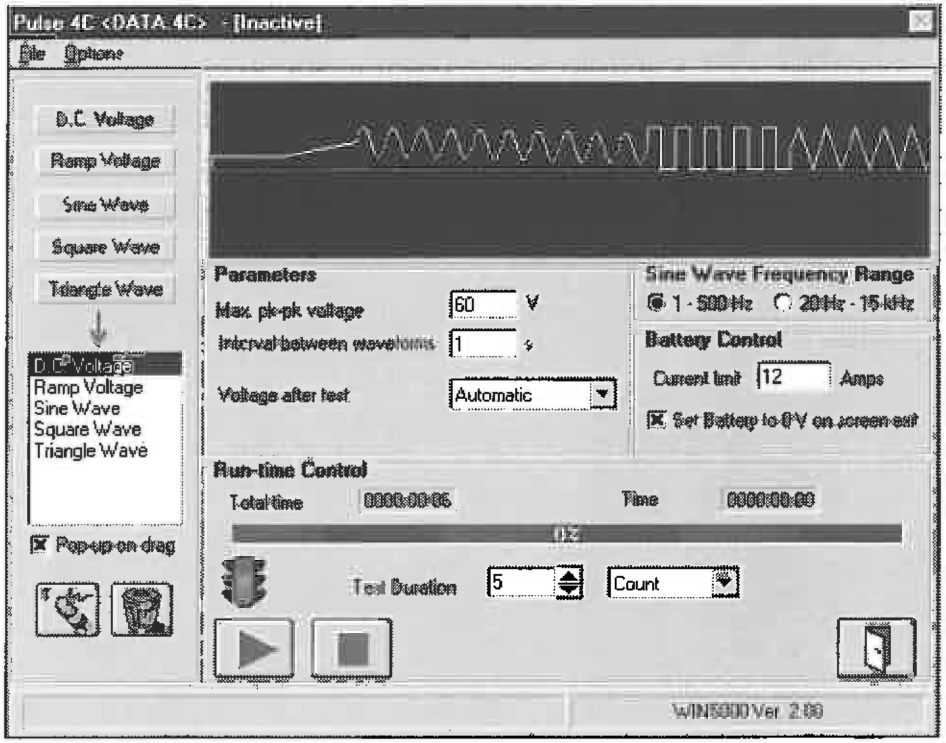
- Exit, closes the pulse window and returns the NSG5000 window.

5.3 Options menu

- Battery Control, this allows real-time control of the battery. This battery control is instantaneous - it is **not** part of the test and is only used while no test is running.



6.0 Pulse 4c



6.1 Introduction

Pulse 4c is an Arbitrary Wave-form Generator, which uses the NSG5004 hardware, (with special INA5027 controller card) to generate arbitrary wave-forms at the NSG5000 output.

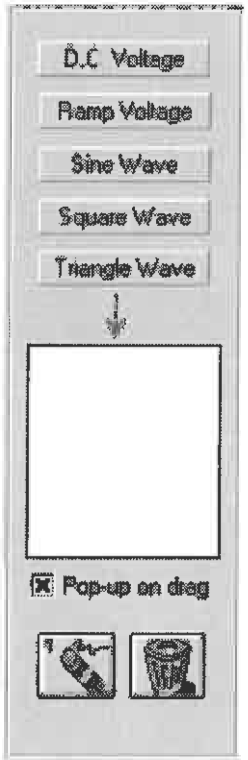
This card is similar to the standard Pulse 4 Driver Card (INA5024), but has extra circuitry and memory to allow arbitrary wave-form generation.

The WIN5000 control screen allows the user to create arbitrary wave-forms, made up from individual wave-form segments. The available segment types are DC Voltage, Ramp Voltage, Sine Wave, Square Wave, and Triangle Wave.

The wave-form is created by dragging the wave-form types into a wave-form list, as described below.

The sequence of the wave-form list can be altered by dragging existing segments in the list to a different position in the list.

6.2 Wave-form Build



This part of the screen is used to build up an arbitrary wave-form. Place the cursor on the required wave-form type, select it using the left-mouse button, and drag it into the wave-form list.

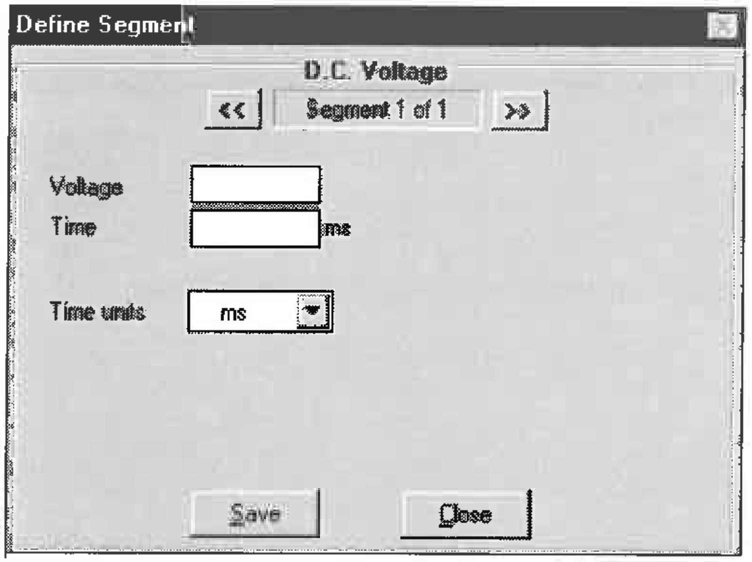
To clear the entire wave-form, press the erase key.

To remove the current highlighted wave-form segment from the list, press the delete key.

Each different wave-form type is described in detail below:

6.2.1 DC Voltage

Inserts a DC voltage segment into the wave-form list. The following window is opened, allowing the DC Voltage parameters to be set:



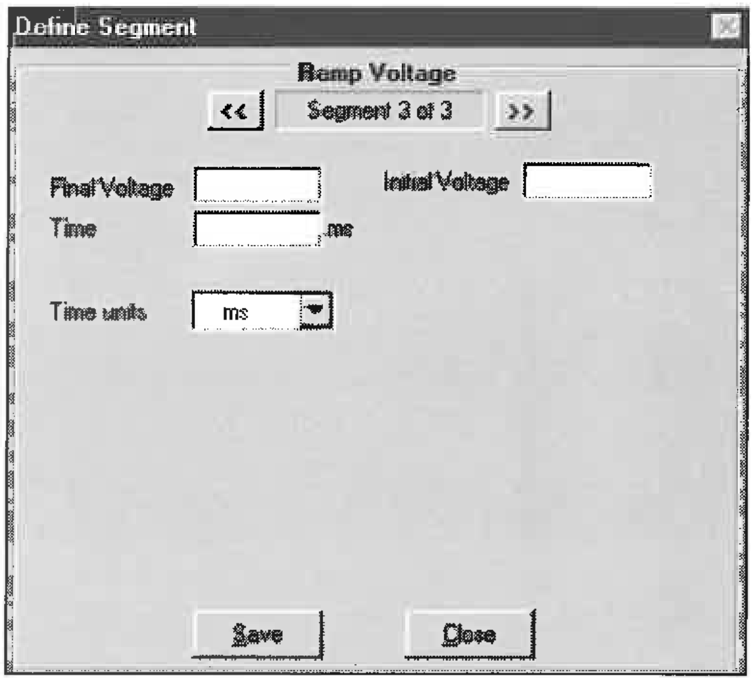
Enter the desired DC voltage, in volts, and the length of time it should last for. The time unit is ms.

When finished, select Save to save the parameters, and Close to close the window.

Note:
When in any segment screen, it is possible to move to the next or previous segment by pressing on the >> or << buttons at the top of the segment window.

6.2.2 Ramp Voltage

Inserts a ramping voltage segment into the wave-form list. The following window is opened, allowing the Ramp Voltage parameters to be set:

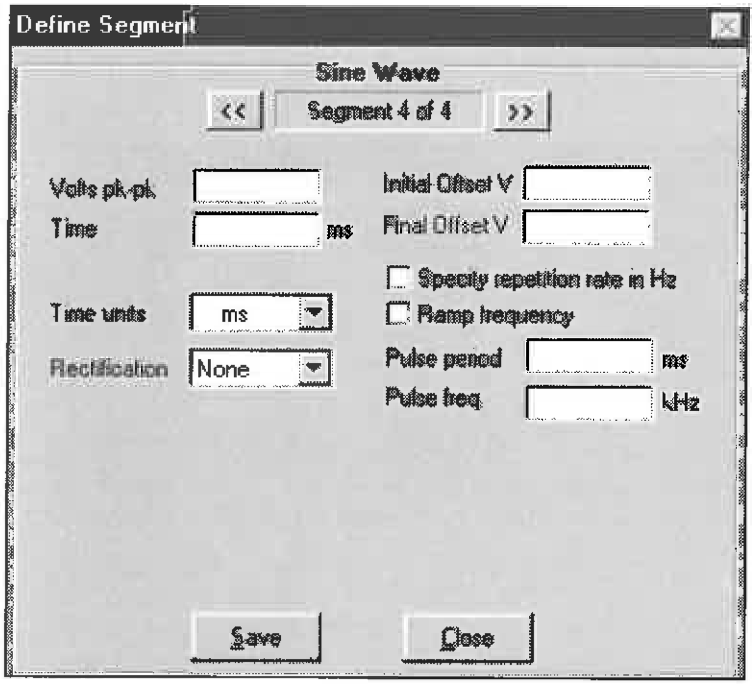


Enter the desired initial and final voltages, in volts, and the length of time the ramp should last. The time unit is ms.

When finished select Save to save the parameters, and Close to close the window.

6.2.3 Sine Wave

Inserts a sine-wave voltage signal segment into the wave-form list. The following window is opened, allowing the Sine Wave parameters to be set:



Enter the desired sine wave parameters, as follows:

Volts pk-pk:	the sine wave peak-to-peak voltage, in volts
Time:	time length of signal
Initial Offset:	initial DC offset voltage

Final Offset: final DC offset voltage
(the above two parameters allow creation of a ramping sine wave)

Time units:	specifies time as ms.
Rectification:	specifies whether the sine wave is full-wave rectified or not. Three options are available; none, positive, or negative.
Ramp Frequency:	when selected enables repeated generation of the ramp sine wave, each time with a different frequency. When selected, the following options are available:
Pulse freq:	initial frequency of the signal
Final freq:	final frequency of the signal
Step freq:	step difference from one frequency to the next.
Delay between steps:	delay from one frequency to the next.

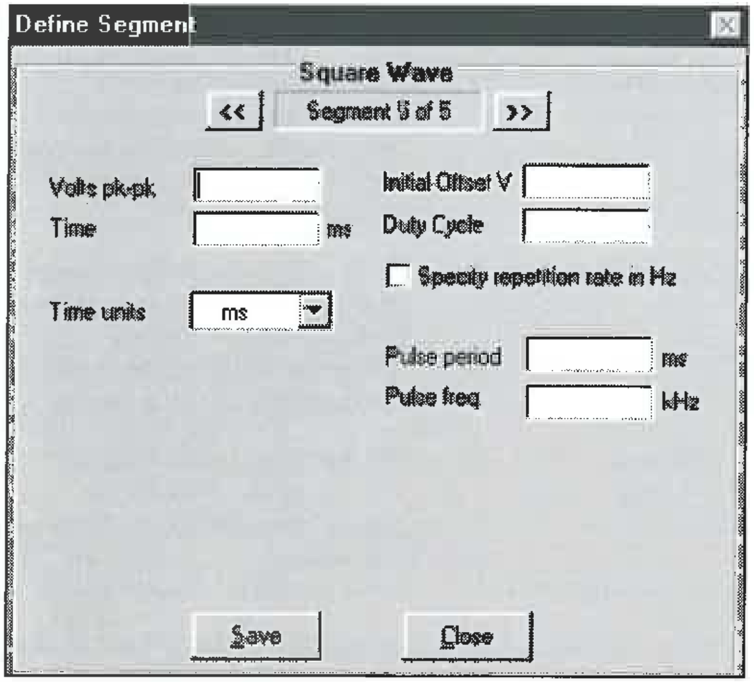
When Ramp Frequency has not being selected, one of the following parameters can be entered:

Pulse Period:	sine-wave period
Pulse Freq:	sine-wave frequency (Enter either one or the other as desired.)

When all parameters have been satisfactorily entered, press Save to save, followed by Close to close window.

6.2.4 Square Wave

Inserts a square-wave voltage signal segment into the wave-form list. The following window is opened, allowing the Square Wave parameters to be set:



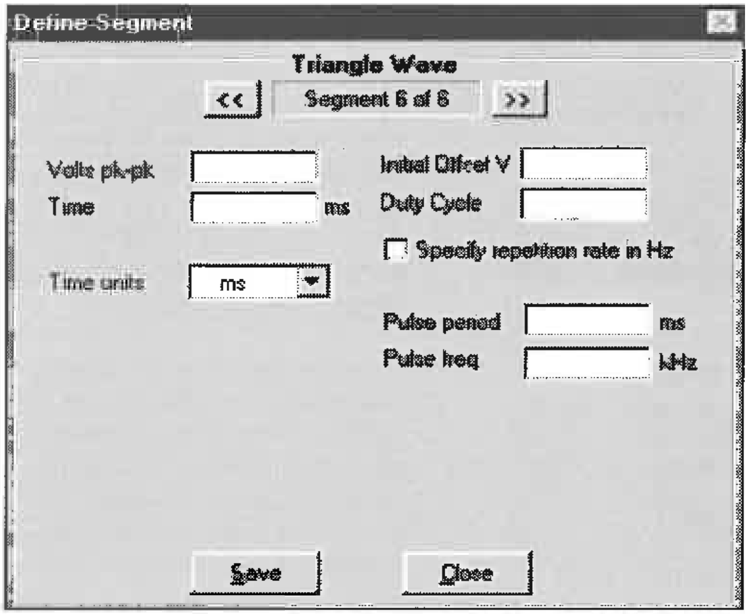
Enter the desired square wave parameters, as follows:

Volts pk-pk:	the square wave peak-to-peak voltage, in volts
Time:	time length of signal
Initial Offset:	initial DC offset voltage
Duty Cycle:	duty cycle of square wave, i.e. ratio (in percent) of mark to space.
Time units:	specifies time in ms.
Pulse Period:	square-wave period
Pulse Freq:	square-wave frequency (Enter either one or the other as desired.)

When all parameters have been satisfactorily entered, press Save to save, followed by Close to close window.

6.2.5 Triangle Wave

Inserts a triangular-wave voltage signal segment into the wave-form list. The following window is opened, allowing the Triangle Wave parameters to be set:



Enter the desired square wave parameters, as follows:

Volts pk-pk:	the triangle wave peak-to-peak voltage, in volts
Time:	time length of signal
Initial Offset:	initial DC offset voltage
Duty Cycle:	duty cycle of triangle wave, i.e. ratio (in percent) of mark to space.
Time units:	specifies time in ms.
Pulse Period:	triangle-wave period
Pulse Freq:	triangle-wave frequency (Enter either one or the other as desired).

When all parameters have been satisfactorily entered, press Save to save, followed by Close to close window.

6.3 Parameters

This window allows certain general parameters to be set, as follows:

Max. pk-pk voltage:	sets a maximum peak to peak voltage for the software. Values greater than this value cannot be entered into the segment screens.
Interval between waveforms:	Sets the delay, in seconds, between segments in the wave-form
Voltage after test:	specifies what level the battery voltage should return to after the test has finished. Options are **automatic**, whereby the battery voltage will remain at the last voltage of the last segment in the test, or **programmed**, whereby, a user voltage can be entered in the End of Test voltage field.

6.4 Sine Wave Frequency range

This parameter allows the setting of a range for the sine wave generator, in order to optimise signal resolution. If the sine wave is less than 500Hz, set this parameter to 1-500 Hz. Otherwise, set it to 20 Hz - 15 kHz.

6.5 Battery Control

Allows control over the current limit and screen exit conditions of the NSG5004 output.

Set the current limit as required.

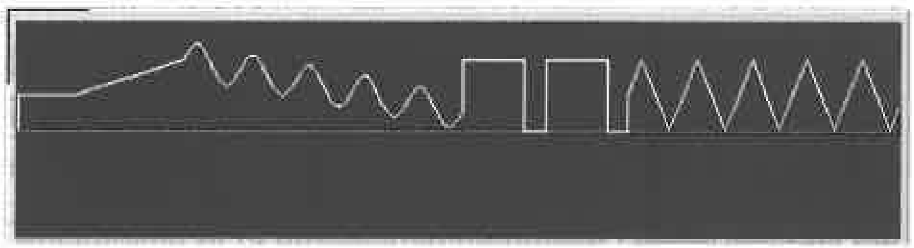
Click whether battery voltage should be set to zero volts on screen exit.

6.6 Run-time Control

This window controls the running of the test. The parameters operate in similar fashion to the run-time control window described for Pulse 4 above.

6.7 Waveform Diagram

The top right section of the Pulse 4c Screen displays an image of the existing waveform. If the waveform is too large to fit in the window, use the < and > buttons on the window to scroll through.



6.8 Specifications

Function	Parameter	Value		Units	Tol %
		Min	Max		
Test Duration, T_d	Continuous	-	-	-	-
	Count	1	99999	-	-
	Seconds	1	36000	seconds	-
	Minutes	1	6000	minutes	-
	Hours	1	100	hours	-
DC Signal	Voltage	0	30	volts	+/- 1
	Duration	1	T_d	ms	-
Ramp Signal	Final Voltage	0	30	volts	+/- 1
	Initial Voltage	0	30	volts	+/- 1
	Ramp time	1	T_d [1]	ms	-
Sin Wave	Voltage, pk-pk, Vpp	0.1	30	volts	+/- 1
	Voltage resolution	0.1		volts	-
	Frequency	1	15000	Hz	+/- 1
	Frequency resolution	1		Hz	-
	Duration, D_s	1	T_d	ms	-
	Initial offset	Vpp/2	30	volts	+/- 1
	Final offset	Vpp/2	30	volts	+/- 1
	Initial ramp freq, I_f	1	15000	Hz	+/- 1
	Final ramp freq, F_f	I_f	15	KHz	+/- 1
	Step frequency	1	F_f - I_f	Hz	+/- 10
	Delay between ramp steps	10	T_d - D_s	ms	-
	Rectification	Positive			
		Negative			
		None			

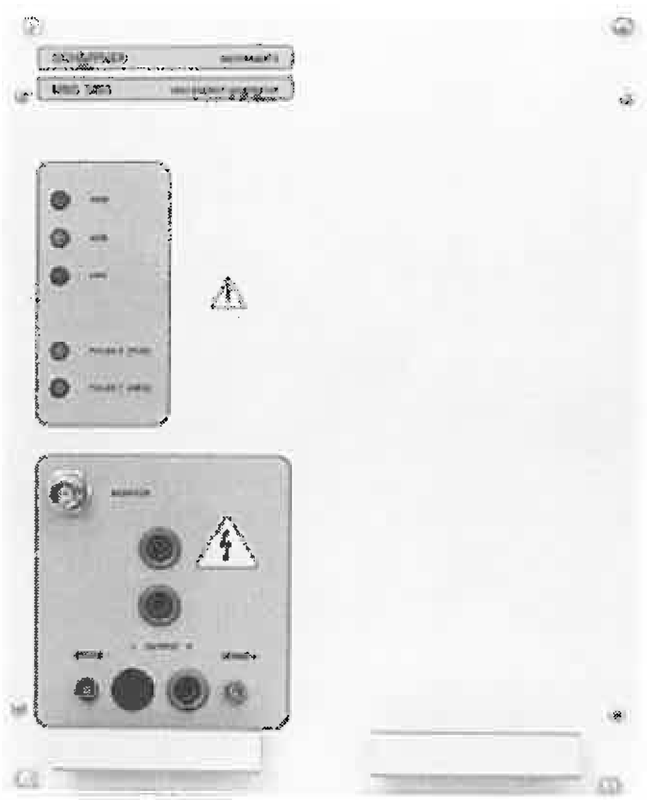
Function	Parameter	Value		Units	Tol %
		Min	Max		
Square Wave	Voltage, pk-pk, Vpp	0.1	30	volts	+/- 1
	Voltage resolution	0.1		volts	-
	Frequency	1	15000	Hz	+/- 1
	Frequency resolution	1		Hz	-
	Duty Cycle	1	99	%	-
	Offset Voltage	Vpp/2	30	volts	+/- 1
	Duration	1	T_d	ms	-
Triangle Wave	Voltage, pk-pk, Vpp	0.1	30	volts	+/- 1
	Voltage resolution	0.1		volts	-
	Frequency	1	2500	Hz	+/- 1
	Frequency resolution	1		Hz	-
	Duty Cycle	1	99	%	-
	Offset Voltage	Vpp/2	30	volts	+/- 1
	Duration	1	T_d	ms	-
Test	Interval between wave-form segments	0.01	9999	s	+/- 10%

[1] to a maximum Td of 45.5 hours.

High Energy Generator

NSG 5005

Operating Instructions



CONTENTS

1 Introduction

The NSG 5005 is a plug-in High Energy generator module designed for use with the NSG 5000 mainframe system. It is designed primarily to meet the specification requirements for the ISO 7637 standard for pulses 5 and 7. In many cases the specification of this generator exceeds those specified in the ISO 7637 standard.

When slotted into an NSG 5000 mainframe the NSG 5005 High Energy generator is fully programmable via an RS232 or IEEE 488 interface. Parameters such as amplitude, pulse frequency, pulse width, are all under program control. This allows flexible test patterns to be generated which can facilitate rapid analysis of susceptibility limits of a device under test.

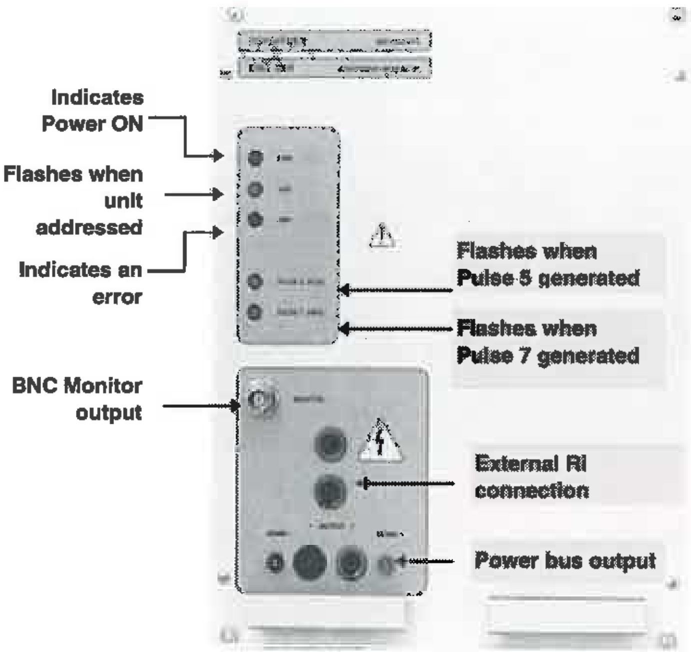
The NSG5005 generates pulses of types 5, and 7, as specified in the ISO 7637 standard, which defines how these pulses are generated in relation to the vehicle battery voltage. When operating with a battery or battery simulator connected to the NSG5000 mainframe, the NSG5000 Battery Switch Module should also be mounted in the rear of the NSG5000 chassis. This module provides the necessary switching on and off of the battery voltage according to the standard.

The NSG 5005 is designed using state of the art semi-conductor technology. This means repeatable performance and maintenance free operation. It also means that test results can be repeated accurately.

The output pulses of the generator are available on two power banana sockets on the front of the NSG5005 module, as well as on the internal multiplexed power bus of the NSG5000 instrument. This means that the pulses from this generator are also available on the banana output sockets of any other pulse generator module fitted to the NSG5000 main chassis. This can simplify connection to the device under test. There is also a 100:1 monitor output signal available on a BNC connector on the front of the NSG5005 module.

The NSG 5005 unit is also designed with internal selftest measurement circuitry. This selftest is designed to perform a functional check of the main operating parts of the units. It does not check the unit to calibration tolerances. However, it is a very useful facility for quickly checking if the unit is operational.

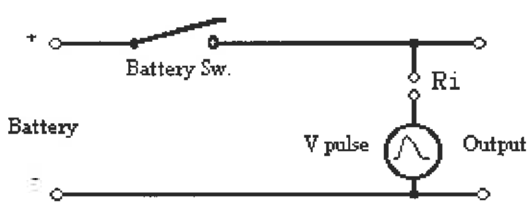
NOTE:
The WIN5000 program available from Schaffner is a Windows based graphical program which allows full control of all programmable features via an intuitive graphical windows front panel.



NSG 5005 Front Panel Layout

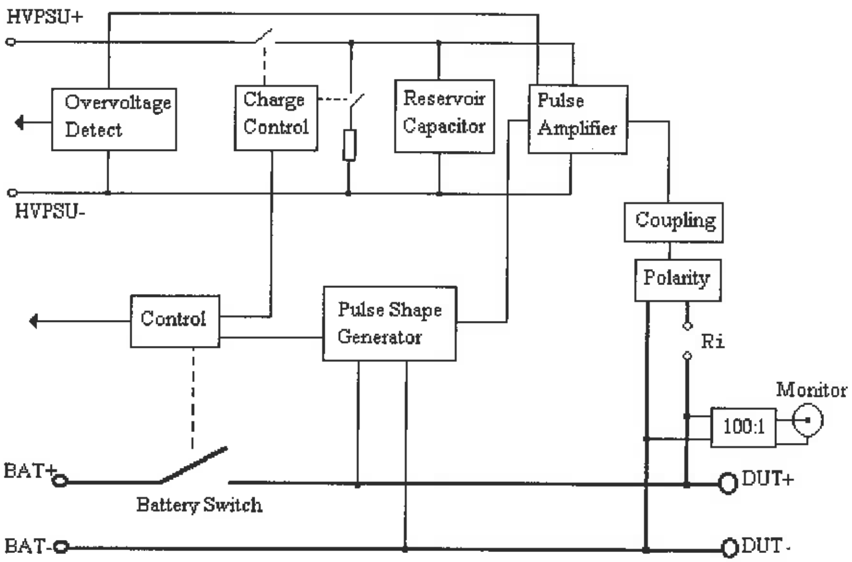
2 Specification

Parameter	Specification	Tolerance
Polarity	Positive (5) Negative (7)	
Amplitude (Vs)	Minimum 20V Maximum 200V Min. Increment 0.5V	+ 10%
Rise time (tr)	5-10 mSeconds	
Output Current Limit	Minimum 1A Maximum 120A	+/- 10%
Pulse Width (td)	40, 100, 150, 200, 250, 300, 350, 400 ms	+/- 10%
Repetition time (t1)	Minimum 15s Maximum 600s Min. Increment 0.1s	+/- 10%
Battery Off to Pulse Time (t3)	< 100µs (7)	
Battery Off Time (t2)	t1 x 0.5 (7)	+/- 10%
Pulse Mode	Single Continuous Count : Min 1 Max 99999 time : 1 to 99999 secs 1 to 6000 mins 1 to 100 hrs	+/- 10%
Monitor Output	100:1	+/- 10%
Output Impedance	Equivalent or External Resistor (INA5025)	



Pulse Generation Mechanism

3 Block Diagram



4 Installation / Setup

Check the instrument for any mechanical damage. Report any damage found to the carrier immediately.

Ensure that the power is turned off on the NSG5000 mainframe and that the battery input is disconnected. Insert the cassette in the left most slot and push in fully. Screw in the four retaining screws fully.
If using the Battery Switch, ensure this module is present and inserted fully in the rear of the NSG5000 mainframe.

It is vitally important that the unit is connected to a good, protective earth.

Turn on the mains input power on the NSG5000 mainframe. After approximately a two second delay the power LED (red) on the NSG5005 generator should light. After a further two seconds of initialisation, the unit is ready for operation.

At this point it is recommended to run selftest to ensure that the main functional parts of the NSG5005 are operational. The easiest way to run selftest is via the WIN5000 software package.

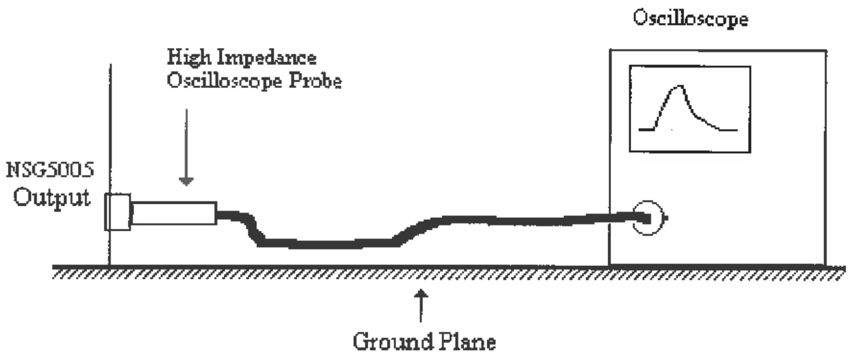
NOTE: Selftest should only be run with all fixtures, attenuators and adapters disconnected from the front of the NSG5005.

Once selftest has been run the scope test setup shown in 5.1 should be connected and the output pulses should be quickly checked to ensure that they are of the correct form and shape. When pulses are being generated the relevant green LED (5 or 7, whichever is selected) should flash as pulses are output.

When correct operation has been verified, the DUT can be connected to the OUTPUT terminals at the front of the unit, and the required tests can be carried out.

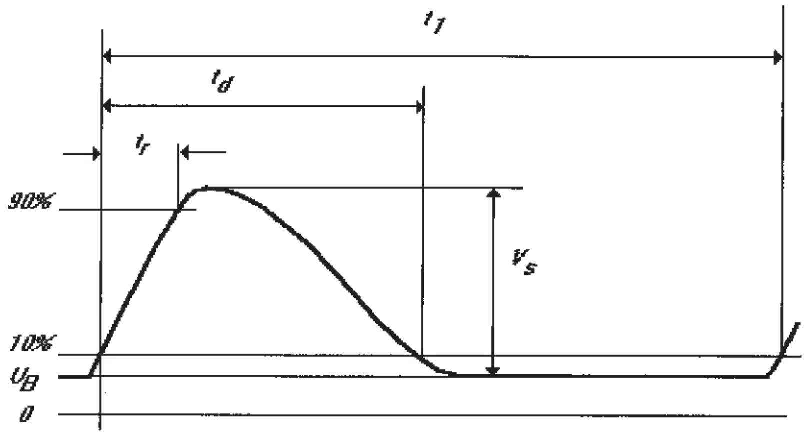
4.1 Test set-up

The following set-up can be used to check the integrity of the output pulses. The scope probe should allow measurement of pulse voltages of up to 200V peak, with an input impedance of > 10k ohm at a frequency of > 1 kHz.

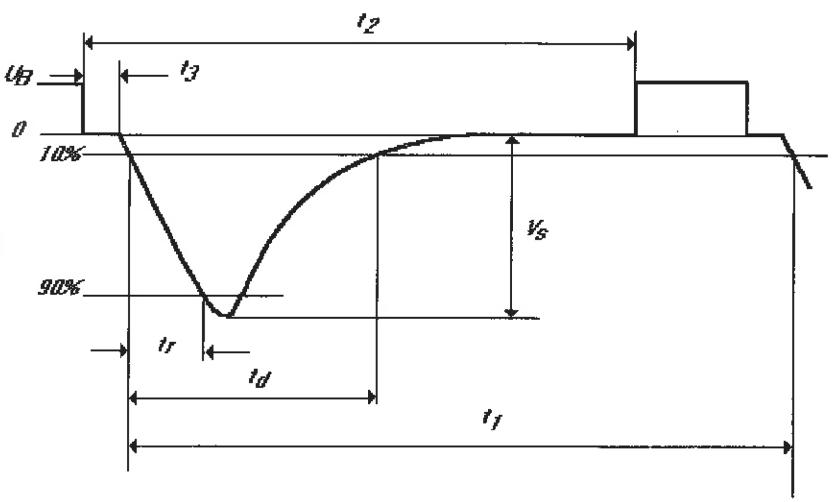


4.2 Parameter references

The following diagrams show the reference points for parameter specifications on the NSG 5005.



Pulse 5

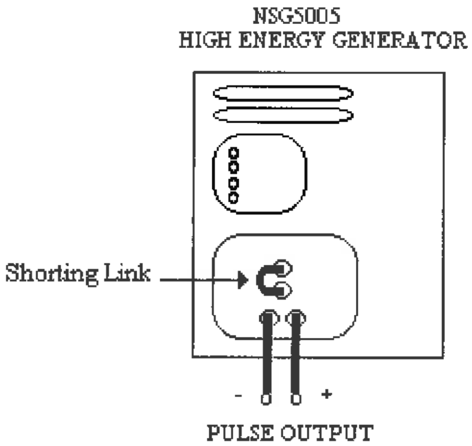


Pulse 7

4.3 External Output Resistance

The circuitry used within the NSG 5005 Module to generate pulse types 5 and 7, uses a solid state active circuit.

Effective output resistance is implemented by internal current limit circuitry. When using this mode, the shorting plug must be inserted in the Ri terminals at the front of the NSG5005 module, as shown below.

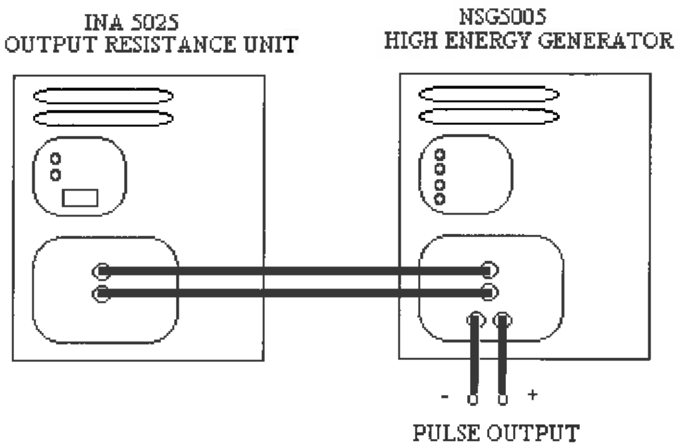


Using the control software, (WIN5000), the actual output current limit value can be set at between 1 and 120 Amps. Once set, the internal NSG 5005 circuitry will ensure that the output current will not exceed this value. In this way, an effective output resistance (equal to Vs/I limit) is implemented.

If the application requires that the actual output resistance is necessary, the shorting plug on the Ri terminals of the NSG 5005 module must be removed, and connections made from these terminals to the optional Output Resistance Unit, INA 5025, as shown below. In this mode, the Output Resistance Unit is controlled by the Control Unit in the NSG5000 Main Chassis (via the BUS EXP. connector on Power Entry Module).

The control software (WIN5000) can set the Output Resistance in this unit to between 0.5 ohms and 10 ohms, in steps of 0.25 ohms. This resistance appears in series with the output of the pulse generation circuit of the NSG 5005 Module.

When using the NSG 5005 unit with the INA 5025 external resistance unit, the output impedance of the NSG 5005 itself is negligible.

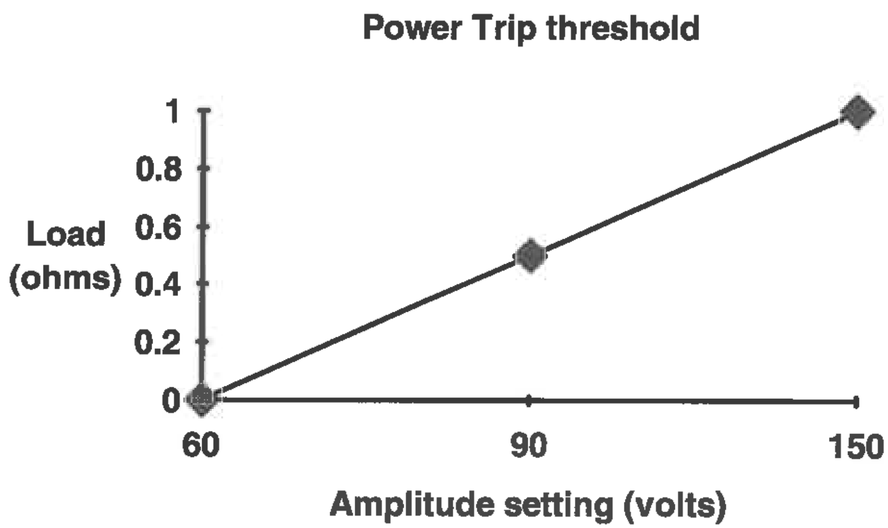


4.4 Power Trip

To protect the internal electronics from breakdown, an internal power-trip mechanism has been implemented.

Effectively this circuit monitors the power across the internal pulse generating switch, and shuts off this switch if this power exceeds the internal limit.

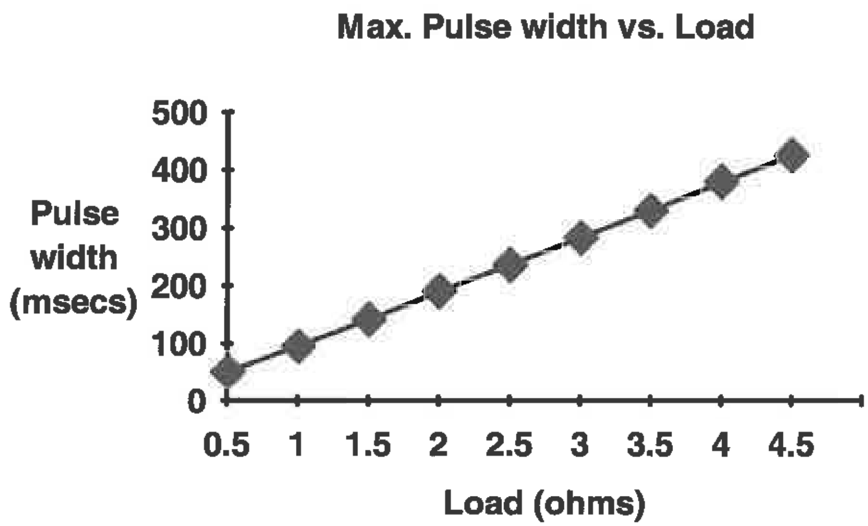
Under normal operating conditions, this power trip will not be activated. The conditions under which it will occur are related to the load presented by the DUT and the open circuit voltage and are outlined in the graph below.



4.5 Operation Under Load

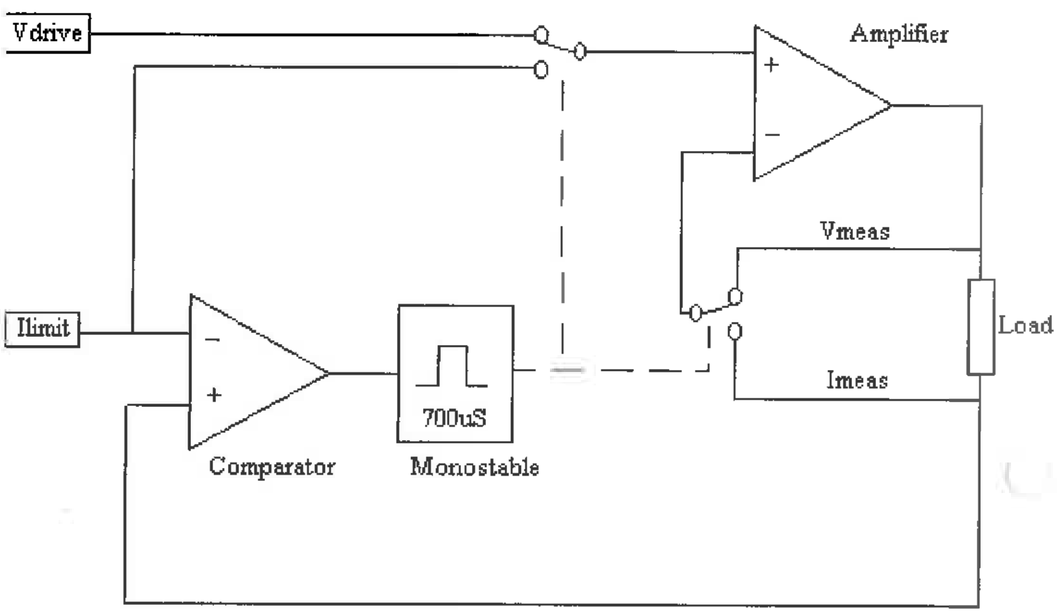
The circuit used to generate the pulses in the NSG 5005 is based on a reservoir of energy stored in a large capacitance.

Under no load conditions, the pulse width will be selected. However, any load which appears across the output of the pulse generator, will reduce the maximum pulse width attainable, because of the finite limit to the value of the internal pulse generation capacitor. The maximum pulse width under certain loads can be determined from the following graph.



4.6 Current Limit

Under normal operation the pulse generation circuit is set up as a voltage amplifier. The amplifier input is a dynamic, exponentially-shaped voltage waveform (Vdrive) and the output is an amplified version of this signal. However, if the current in the output terminals exceeds the current limit setting the amplifier configuration is immediately switched into a constant current mode i.e. the amp. input is now a fixed DC level, 'Ilimit' and the feedback comes from a current measurement, 'Imeas', thereby holding the current at this fixed limit. The current will not be held at this level indefinitely. At regular intervals (approx. 700us) the amplifier returns to voltage mode and, provided the current does not exceed the limit, will remain in this mode.

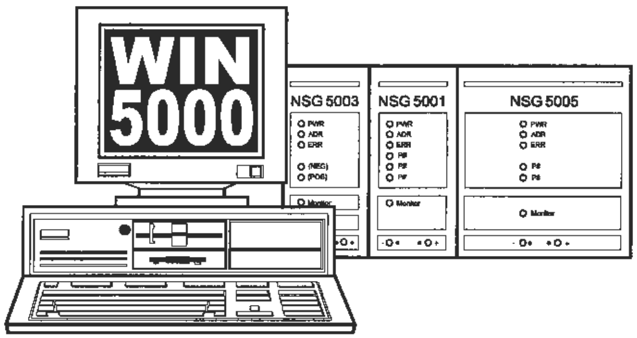


WIN5000 SOFTWARE

Operating Instructions

for

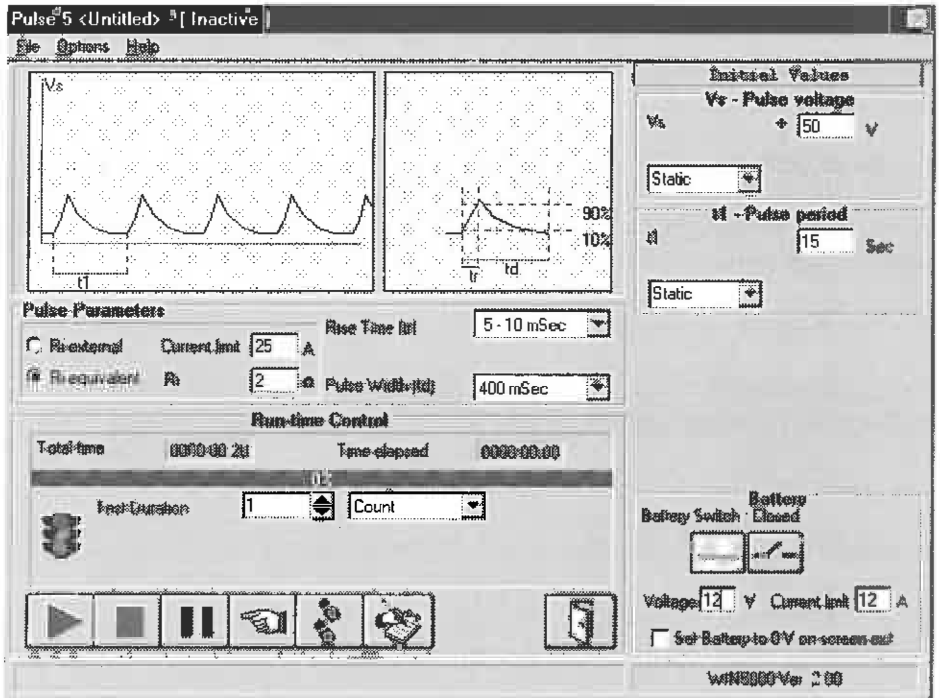
NSG 5005
High Energy Generator



NSG 5005 High Energy Generator Software Operating Instructions

1.1 NSG 5005 Main Window

There are two different pulse types available on the NSG 5005 module, these are types **5** and **7**. When one of these pulses is selected from the WIN5000 tool bar or the Control menu the NSG 5005 window is opened.



The window above is the NSG 5005 pulse 5 window.

From this window tests can be made up from pulses. Bursts of pulses can be performed by ramping the pulse voltage or the pulse period. It should be noted that only one parameter may be ramped at a time and that ramping always ranges from low to high pulse energy.

Once created tests can be saved for future use, and in conjunction with the WIN5000 sequencer they can be used to perform tests made up of different pulses and pulse sequences from different modules.
The window is divided into seven sections.

1.2 Graphical display

At the top of the window there is a graphical display showing the parameters for the current pulse setting, the two graphs change according to how the pulse is setup.

1.3 Pulse Voltage

Sets the pulse voltage, this can show a single value or for tests where the voltage is to be ramped there will be start and finish values and step size.

1.4 Pulse Period

Sets the pulse period, this can show a single value or for tests where the period is to be ramped there will be start and finish values and step size.

1.5 Pulse Parameters

This section of the window controls discreet settings such as rise times. pulse widths.

1.6 Battery Switch

With this pushbutton the device under test can be disconnected completely or the connection can be under program control. The battery voltage and its current limit can also be set here.

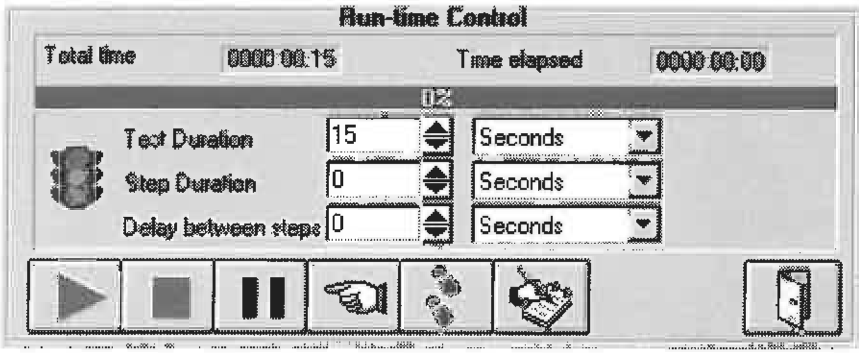
1.7 Control

This part of the window governs the test duration, step duration and delay time between steps. There are push-buttons for starting and stopping tests as well as proceeding one step at a time.

1.8 Information Bar

The information bar at the bottom of the screen shows the specification for the pulse parameter which currently has the focus.

2.1 Control



This section of the window governs the run-time operation of tests, the overall test duration may be set by selecting the units from the drop down list (accessed by clicking on the push-button), and then typing the value into the adjacent text box.

- Seconds/Minutes/Hours, this is the actual amount of time to spend running this test. The test will keep cycling until the specified time has elapsed.

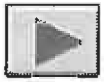
- Count lets a specific number of cycles to be specified, that is the number of times a test will be performed.

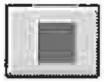
- Continuous will repeat the entire test until the stop or pause buttons are pressed.

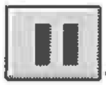
The value may also be adjusted in single steps by clicking on the up and down arrows in the box itself.

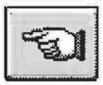
The same procedure is used to set the step duration and the delay time between steps. Count refers to the number of times to perform each step before ramping to the next.

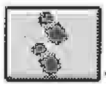
2.2 Push-button functions

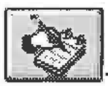

----- Starts a test.

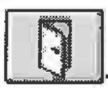

----- Stops a test.


----- Pauses execution of a test.


----- Manually sends a single burst at the current settings.

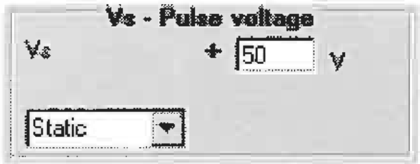

----- Steps through test sequence one step at a time, useful when compiling tests and during de-bugging.


----- Opens a window into which notes pertinent to the particular test may be entered for future reference.


----- Exits from the pulse window and returns to WIN 5000

Both the total test time and the elapsed test time are displayed in the top of this section, and a graphical percentage done indicator shows the progress of the test sequence (the red bar is gradually replaced by a green bar as well as displaying the percentage done in figures). When paused the elapsed time indication is also suspended.

3.1 Pulse Voltage (Vs)

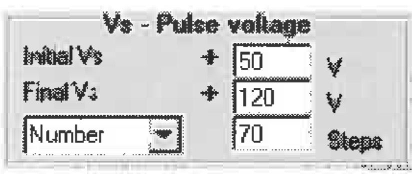


This sets the pulse voltage (Vs). When the voltage is to remain static throughout the test only one box is displayed, enter the desired voltage into this box (i.e. 50 in the above example).

Pulse type 5 is positive therefore the pulse voltage is a positive value, pulse type 7 is a negative pulse thus the pulse voltage has a negative value.

The pulse voltage may be ramped during the test in one of two ways, the ramping method is selected from a drop down list that is accessed by pressing the push-button.

Two more boxes appear in the voltage section when the voltage is to be ramped.



The top box is now the initial voltage (i.e. the pulse voltage at the start of the test), the middle box is the final voltage and the lower box is the increment, depending on the ramping method the increment may be a specific number of steps or a value in volts.

3.2 Dynamic ramping

To ramp the pulse voltage dynamically, select dynamic from the drop-down menu. Enter the initial and final pulse voltages and then the increment size in volts. During execution the voltage will start at the initial voltage and be incremented in steps until the final voltage is reached.

3.3 Numeric ramping

To ramp the pulse voltage in a specific number of steps select number from the drop-down menu. Enter the initial and final burst voltages and the number of steps. During operation the voltage will be incremented in uniform amounts according to the number of steps.

4.1 Pulse period (t1)

This sets the pulse period (T1). If it is to remain static throughout the test only one box is displayed, enter the desired frequency into this box.

The pulse period may be ramped during the test in one of two ways, the ramping method is selected from a drop down list that is accessed by pressing the push-button.

Two more boxes appear in the pulse period section when it is to be ramped, as shown below.

The top box is now the initial pulse period (i.e. the pulse period at the start of the test), the middle box is the final pulse period and the lower box is the increment. Depending on the ramping method the increment may be a specific number of steps or a value in seconds.

4.2 Dynamic ramping

To ramp the pulse period dynamically select dynamic from the drop-down menu. Enter the initial and final pulse periods and then the increment size in seconds During execution the period will start at the initial period and be incremented in steps until the final period is reached.

4.3 Numeric ramping

To ramp the pulse period in a specific number of steps select number from the drop-down menu. Enter the initial and final period and the number of steps. During operation the period will be incremented in uniform amounts according to the number of steps.

5.1 Pulse Parameters

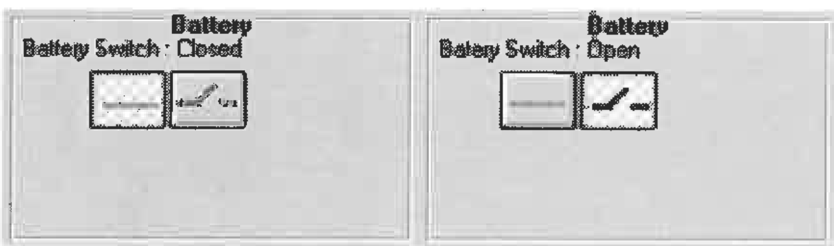
This section controls settings that have a range of discrete values.

To change a setting click on the adjacent push-button and select the required value, these are different for pulse types 5 and 7.

Note that Ri can be **external**, in which case it can be selected from a drop-down list box, or **equivalent**. In the latter case, the user must enter the required Ri in a text box. The equivalent Current Limit is calculated and displayed , using the equation **Vs** = **Current Limit** * **Ri**. The limits on Ri are determined by the current limit which can range from 1 to 120 Amps.

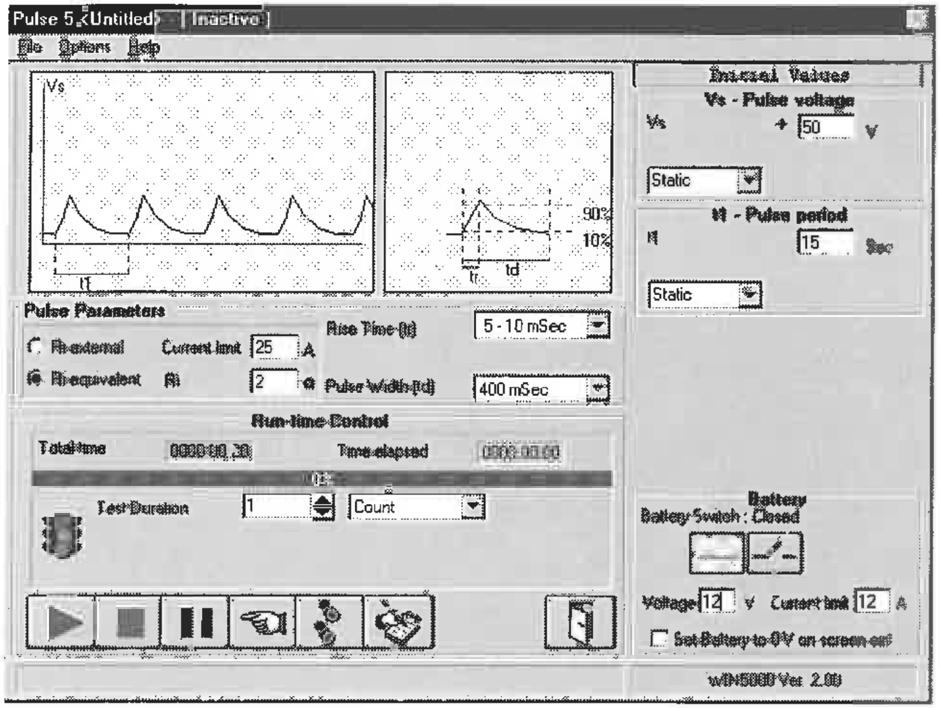
6.1 Battery Switch

This controls the connection of the DC Source between the device under test and the NSG 5000. Clicking on the push-button toggles between open and closed. Note that these settings can be saved as part of the test, and the changes implemented when the user starts the test by clicking the GO button.



When using pulses 1, 2, 6 and 7 the battery switch can be under program control or open. In this state WIN5000 will make and break the connection as required whilst performing tests. When open it remains disconnected.

7.1 Pulse 5 window

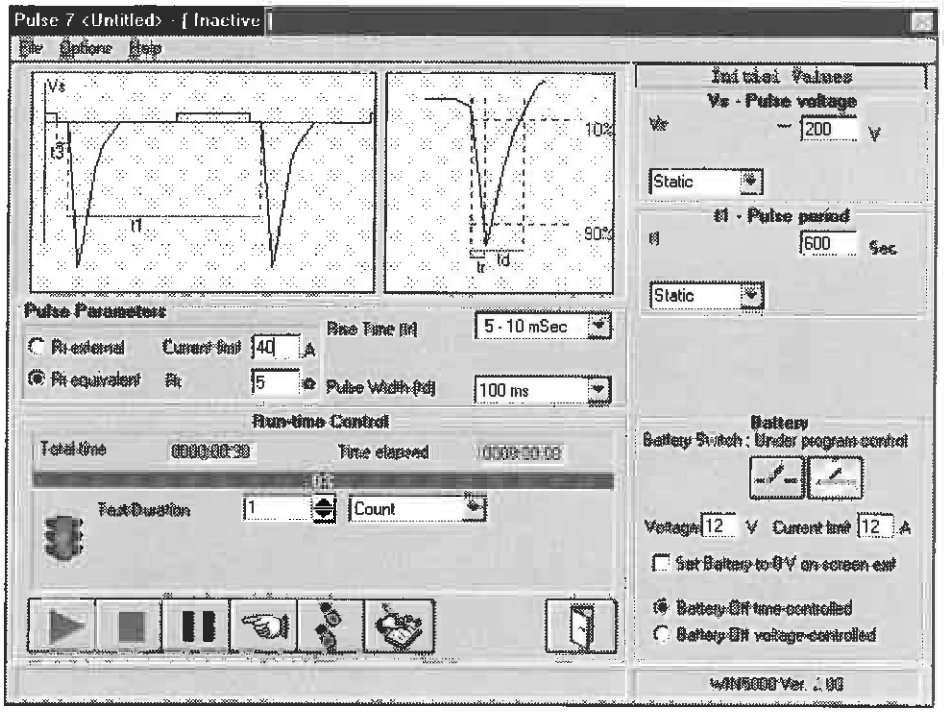


7.2 Pulse 5 parameters

The range of specifications for pulse type 5 are as follows:

- **Vs** +20V to +200V in 0.5V steps
- **t1** 15s to 600s in 0.1s steps
- **td** 40ms, 100ms, 150ms, 200ms, 250ms, 300ms, 350ms, 400ms
- **tr** 5-10ms
- **Ri** 0.5Ω to 10Ω in 0.25Ω steps or Ri equivalent

8.1 Pulse 7 window



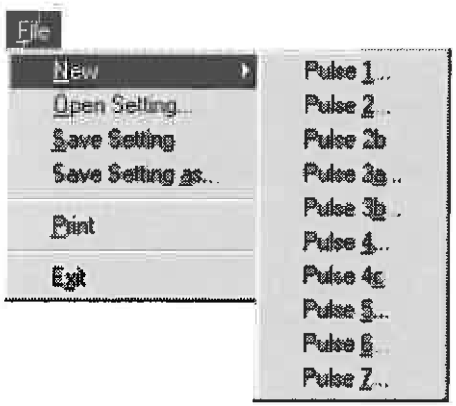
8.2 Pulse 7 parameters

The range of specifications for pulse type 7 are as follows:

- **Vs** -20V to -200V in 1V steps
- **t1** 15s to 600s in 0.1s steps
- **td** 40ms, 100ms, 150ms, 200ms, 250ms, 300ms, 350ms, 400ms
- **tr** 5-10ms
- **Ri** 0.5Ω to 10Ω in 0.25Ω steps or Ri equivalent
- **t3** < 100µS
- **t2** = t1 x 0.5 (Battery Off time), voltage controlled

9.1 Pulse Window Menu Options

9.2 File menu



- New, opens a sub menu enabling a new pulse screen setting to be created, the current setting will be cleared.

- Open Setting..., this will load a previously created pulse screen setting.

- Save Setting, will save the current pulse screen setting with its current filename.

- Save Setting as..., allows the current pulse screen setting to be saved with a different filename.

- Print, this prints out a hard copy of the parameters for the current pulse screen setting.

- Exit, closes the pulse window and returns the WIN5000 window.

9.3 Options menu

- Battery Control, this allows real-time control of the battery. The difference between this and the battery switch control described in 6.1 above is that this battery control is instantaneous - it is **not** part of the test and is only used while no test is running.