NSG 5600

HARDWARE GUIDE

601-303C

TESEQ

Advanced Test Solutions for EMC

NSG 5600

HARDWARE GUIDE

CONTENTS

1 SAFETY INSTRUCTIONS

DANGER!
It is imperative that you read the following safety instructions and all safety instructions in the manuals of connected peripheral systems before installing and starting this test system for the first time.

DANGER!
The electrical and mechanical safety equipment must not be removed, put out of operation or bypassed. Handle all safety equipment with care. If a safety device should be broken or is not working, the system must be put out of operation until the safety device is repaired or exchanged and fully in working order again.

DANGER!
The NSG 5600 is used primarily to control amplifiers. The settings in Autostar of the gain of the amplifier must be closely observed and the output of the amplifier tested with these settings. Failures to set, or set correctly, these parameters can result in the amplifier being driven to maximum voltage.

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.

1.1 Classification of dangers

The safety instructions in this manual are classified in different levels. The table below shows a survey over the relation of symbols (ideograms) and signal words to the specific risk and the (possible) consequences.

Warning symbol	Signal word	Definition
	**DANGER!**	Possibly dangerous situation, that may cause damage to persons or heavy damage to the tester and/or the equipment
	**CAUTION!**	Situation, that may cause damage to the tester and/or the equipment
	**NOTE!**	User tips and other important or useful information and comments

Table 1-1: Classification of dangers

1.2 Warning symbols on the Test System

Different warning symbols are placed on the test system. The following table shows the assignment of symbols and signal words to the specific risk.

Warning symbol	Signal word	Definition
	**DANGER!**	Warning of voltages that might involve the risk of electric shock
	**CAUTION!**	Warning of a danger spot (refer to the documentation)

Table 1-2: Warning symbols on the Test System

Caution symbol	Definition
	Warning of voltages that might involve the risk of electric shock
	Warning of a danger spot (refer to the documentation)

Table 1-2: Warning symbols on the Test System

1.3 Excess voltage category

The test system NSG 5600, as described in this manual, is related to the **excess voltage category II** according IEC 60664.

1.4 Range of validity

These instructions are valid for the complete installation. Further safety regulations for components installed in this test system or additional installed devices are not suspended by these instructions.

1.5 Safety of operation

Reliable function and safe operation of the test equipment are ensured only if the relevant general precautions as well as all safety instructions given in this manual are observed. In particular, observe the following:

- Connect the generator only to line voltage that confirms to the power specification given on the type label (on the back of the test system).
- Do not touch any conductive parts at the test point connectors, the fixture and the test object during a test run.
- Never apply external voltage to the system's output connectors.
- Disconnect the generator from the mains before opening the casing for maintenance, repair or exchange of modules.
- Check that the voltage selector on the back panel of the system is set to the correct position, refer to chapter 3.4.1 Mains voltage selector.
- For power magnetics, the user is recommended to keep a safe distance from the system while in operation.
- During operating the generator always observe the relevant rules of ESD (Electro Static Discharge) protection.
- To guarantee the EMC features of the NSG 5600, the control computer must meet the requirements of the EN 50082, 55011, 61000 standard.
- The operation of radio equipment or other high frequency emitting devices near the DUT or adaptation cables, may possibly lead to wrong test results (while HF energy is emitted).
- Observe the environmental conditions as described in chapter 6.2 Environmental conditions.

1.6 Personnel

The generator may be operated by qualified personnel only. It may be opened for adjustment, maintenance or repair by authorized staff only. Teseq or its representative may not be held responsible for service not performed by Teseq personnel.

1.7 Responsibility for safety precaution

The owner, operation supervisor and/or operator of the equipment are responsible for safety. The owner, operation supervisor and/or operator are in charge of any safety measures that do not directly concern the generator itself. For details, see the relevant accident prevention regulations. See also the safety instructions in the manufacturer's manual included with any additional instrument or device you intend to use with your Teseq equipment.

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

1.8 Safety regulations

According to the EN 50191 standard, this equipment may involve the risk of electric shock. The owner, operation supervisor and/or operator are responsible to build-up and operate the equipment according to the EN 50191 standard. Conductive parts must not be touched, and the test station must have appropriate warning labels and signs. In general, observe the industrial health and safety standards pertaining to electrical test installations in your country.

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

The EMC compatibility has been tested with EN 61326 version 03/2002.

1.9 Reduction of operational safety

If you have any reasons to suppose that the test equipment is not completely safe, you must shut it down and put it out of operation. Moreover, you must mark or label the equipment appropriately so it will not inadvertently be put into operation again. You should then call authorized service personnel for assistance.

1.10 As agreed use

The tester may be used exclusively for simulation of automotive EMC events.

1.11 General instructions

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

The generator is to be used only for the purposes set down by the manufacturer. It is the user's responsibility to ensure that the test set-up does not emit excessive radiation that may effect other equipment.

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

DANGER!
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.

1.11.1 Electrical safety

The NSG 5600 system is fitted with protective panels and covers that fully enclose any electrical mechanisms to reduce the risk of direct contact with live parts that may harm the user during normal use. The NSG 5600 system is clearly labelled for electrical safety:

WARNING!
LETHAL DANGER THROUGH HIGH VOLTAGE. DO NOT OPEN. NO USER SERVICABLE PARTS INSIDE. SERVICE WORK TO BE CARRIED OUT ONLY BY FACTORY TRAINED PERSONNEL.

Picture 1–1: Electrical warning label on the rear side of the NSG 5600

1.11.2 Safety testing

The following safety precaution label specifies that the NSG 5600 system is tested to safety standards. The CE mark label is situated on the rear of the system, which states that the system meets the European Economic Community requirements.

Picture 1–2: CE mark label on the rear side of the NSG 5600

1.12 Installation

The instrument conforms to protection class 1.

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

DANGER!
Operation without a protective earth connection is forbidden!

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. It is important that there is 0 V difference of potential between «neutral» and «ground» on the power plug for all instruments in the test, and that all instruments use the same mains source and ground. Due to complex mains wiring and grounding in many EMC labs, failure to observe these may result in instrument damage or unsafe conditions when the various instruments are connected together.

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.

1.13 Test execution

The test area must be so organised that no unauthorised persons have access during execution of a test. 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.

DANGER!
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).

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

CAUTION!
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 conforming manner.

1.14 Dangers concerning the generator

DANGER!
Local burning, arcing, ignition of explosive gases in the event of DUT failure.

DANGER!
Danger from the resultant DUT supply current caused by a flashover or breakdown resulting from the superimposed high voltage effects.

DANGER!
Dangers from a disrupted DUT.

DANGER!
Disturbance of unrelated electronics, telecommunications, navigational systems and heart pacemakers through unnoticed radiation of high frequency energy.

1.15 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.

CAUTION!
As soon as the DUT shows signs of being disrupted the test must be stopped and the power to the DUT switched off.

DANGER!
Internal disruption of the electronics can result in the interference voltage or the DUT supply voltage being present on the DUT's housing.

CAUTION!
Electrical breakdown or arcing from and in plugged connections that are over-stressed voltage-wise during the test.

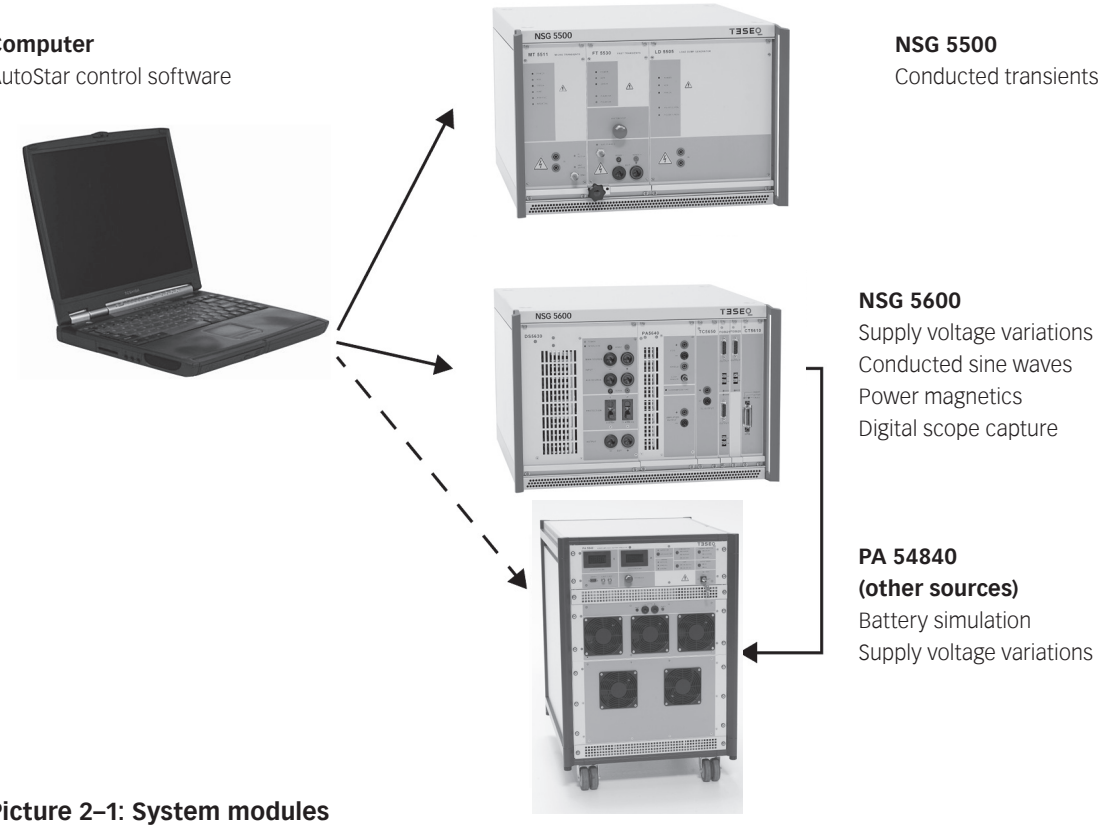
DANGER!
Explosion of electronic components with fire or fragmentation as a result of the energy dissipated, e.g. from the resultant supply current or ignition of vaporised plastics materials.

CAUTION!
Faulty behaviour by the DUT, e.g. robot device strikes out, temperature controller fails, etc.

2 INTRODUCTION

2.1 NSG 5600 overview

The NSG 5600 system performs EMC immunity testing for the automotive market and complements the NSG 5500 system. Emphasis has been placed on the modularity of the NSG 5600 to facilitate the configuration of a variety of systems. This solid platform allows for further system expansion and future developments.



Picture 2–1: System modules

System modules are housed in a chassis, providing power and inter-module interaction. A control module provides communication between system modules and a remote PC. Modules are front mounted in the chassis, which provides the operator with easy access to all controls.

Autostar software is a testmanagement platform, which controls the NSG 5500, NSG 5600 and a variety of Sources, combining them into one system. In a uniform environment, Autostar provides predefined test parameters, test sequencing, autoconfiguration, reporting in Word and storage of user-defined tests. Test waveforms are displayed graphically and a facility exists for the capture of waveforms from a digital oscilloscope. For more details refer to the Autostar software manual.

The NSG 5600 can be operated as a free-standing system or cabinet mounted. Four basic configurations are offered which are described in chapter 2.3 NSG 5600 system configuration.

2.2 NSG 5600 automotive conducted immunity EMC standard types

2.2.1 Supply voltage variations (SVV)

Supply Voltage Variations are voltage variations of the battery supply caused by engine cranking, alternator ripple, battery charging, jump start etc. There are several types of supply voltage variation pulses and these are categorised by Schaffner as:

2.2.1.1 Pulse 4c (Pulse 4)

- 4c pulses are those arbitrary waveforms that can be built up using sine, square, triangle, exponential, Clone™ and ramp wave segments
- The majority of SVV tests are of type 4c
- The "c" refers to the customization of pulse 4 pulses available from the NSG 5600 system.

2.2.1.2 Pulse 4d

- 4d pulses are known as dips and drops
- A dip is a fast (~1 µs) change form one DC level to another DC level.
- A drop is a dip to 0 V
- It is difficult to achieve a 1 µs rise and fall time using an amplifier. Thus two DC sources and a fast semiconductor switch are used to achieve the required rise and fall time specs.

2.2.1.3 Pulse 2b

- Pulse 2b is defined in SAEJ1113/11 and ISO 7637-2
- Pulse 2b is created using a series of segments, like 4c, but requires additional control over the pulse impedance in some cases. For example, SAEJ1113/11 requires the pulse to have an impedance of 0.5 to 3 Ω. Before the pulse and after the pulse has fired the impedance should be < 0.01 Ω.
- Pulse 2b is caused by transients from DC motors which act as generators after the ignition is switched off.

2.2.1.4 Pulses CI260, CI250A, fuel pump transient (FPT)

- Some 4c type pulses (special pulses) cannot be generated using the standard waveform segments (sine, square, triangle, ramp), which is generally due to the high speed or short duration of the pulse.
- To generate these pulses the particular wave pattern is created as a bit pattern and clocked out at high speed.

2.2.2 Power magnetics (PM)

Power magnetics are low frequency magnetic fields generated by devices such as electric motors and also from external mains (50 Hz) sources.

- Frequency range is 10 Hz to 100 kHz.
- Magnetic field density is from 180 dBpT at the fundamental frequency to ~52 dBpT at the highest frequency where 0 dBpT = 1 picoTesla (pT) = 7.96 10^{-7} A/m.
- The test requirements generally follow the frequency spectrum of a square wave at the fundamental frequency.

The ability to perform these tests depends on the amplifier and coil used.

There are 2 test methods used for generating the magnetic fields:

2.2.2.1 Helmholtz coil

- With this method it is only necessary to know the current through the loop, because a Helmholtz coil sets up a uniform magnetic field within a defined region for a given current.

2.2.2.2 Radiating loop

- A small loop of wire is used to produce the magnetic field. A loop sensor may be fitted to it during calibration and the magnetic field strength read back.
- The DUT is marked off into small areas and the radiating loop is moved around the DUT.
- Less expensive than the Helmholtz coil and particularly useful if the DUT is large.

2.2.3 Conducted sine waves (CSW)

Conducted Sine Waves are low amplitude sinusoids, which are superimposed upon the DC battery.

- Frequencies from 30 Hz to 250 kHz.
- Due to the high frequency nature of the sine waves it may not be possible to generate them using a DC amplifier, instead they are generated separately and transformer coupled to the battery using an isolation transformer.

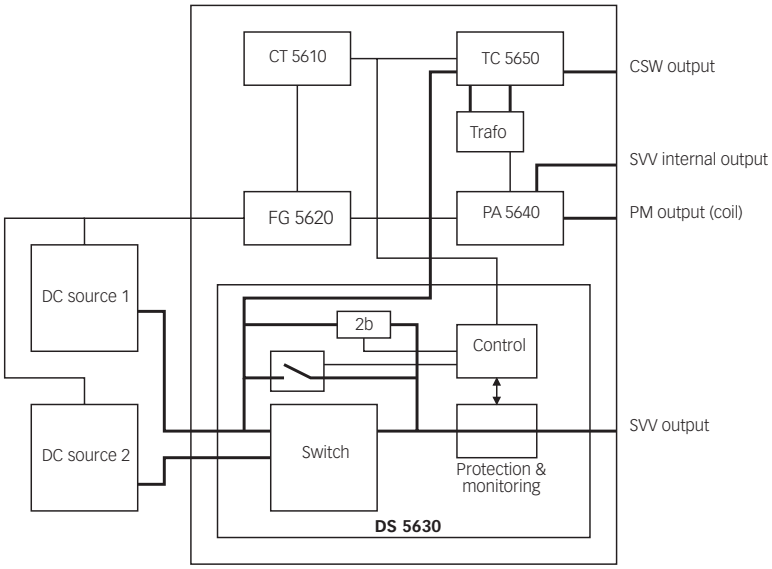
2.3 NSG 5600 system configuration

The NSG 5600 includes the minimum system requirements to operate:

- CT 5610 Digital controller module
- FG 5620 (single arb card)

Additional components are available for the NSG 5600, which provide extra pulse test functionalities:

- DS 5630 DC switch module
- PA 5640 Power amplifier module
- TC 5650 Transformer coupler module for conducted sine waves
- Multiple arb cards (2, 3 or 4 Arbs) e.g. FG 5621



Picture 2-2: Functional block diagram of the NSG 5600 system

Customer systems can be configured by ordering from the following list of items:

- NSG 5601 Basic mainframe chassis
- INA 5601 TC / CSW Transformer coupler upgrade
- NSG 5602 Mainframe chassis with TC / CSW
- FG 5620 Function generator for arbitrary waveforms with 1 FG card
- FG 5621 Function generator for arbitrary waveforms with 2 FG cards
- INA 5621 FG card upgrade kit
- DS 5630 DC switch module
- PA 5640 Power amplifier module
- TC 5650 Transformer coupler for CSW

There are four basic types of system configurations, which are as follows:

1. Voltage variation configuration (VV)
   NSG 5601 / CT 5610 / FG 5620 / Autostar software / internal/external power amplifier

2. Power magnetics configuration (PM)
   NSG 5601 / CT 5610 / FG 5620 / DS 5630 / PA 5640 / Autostar software / internal/external power amplifier

3. Conducted sine wave configuration (CSW)
   NSG 5602 / CT 5610 / FG 5620 / DS 5630 / PA 5640 / TC 5650 / Autostar software / internal/external power amplifier

4. Dips and drops configuration (DD)
   NSG 5601 / CT 5610 / FG 5620 / DS 5630 / Autostar software / internal/external power amplifier

3 INSTALLATION

3.1 Checking the shipment

Upon receiving the shipment, first check the packaging and outer equipment cover for visible damage. Also, check packaging and casings of peripherals (if you ordered any). Record in writing any defects which were possibly caused in transit. If the shipment shows damage or is not complete, immediately advise the shipping agency and/or your dealer.

3.2 Delivery contents

The standard delivery contains the NSG 5600 with connection cables and the instruction manual. Optional modules are installed in the NSG 5600 if ordered. Possibly, there is also optional equipment, e.g. computer or printer.

3.3 Operating position

The NSG 5600 must be placed in upright position firmly and securely during operation.

3.4 Line voltage connection and grounding

DANGER!
Connect the NSG 5600 only to line voltage conforming to the power specification given on the type label.

If the grounding is interrupted inside or outside of the equipment, the NSG 5600 will become a source of danger. Additionally, the output of the device may not conform with the relevant test standards when the grounding of the power plug is interrupted. Carefully observe grounding precautions. The plug on the power cord may be replaced by qualified personnel only.

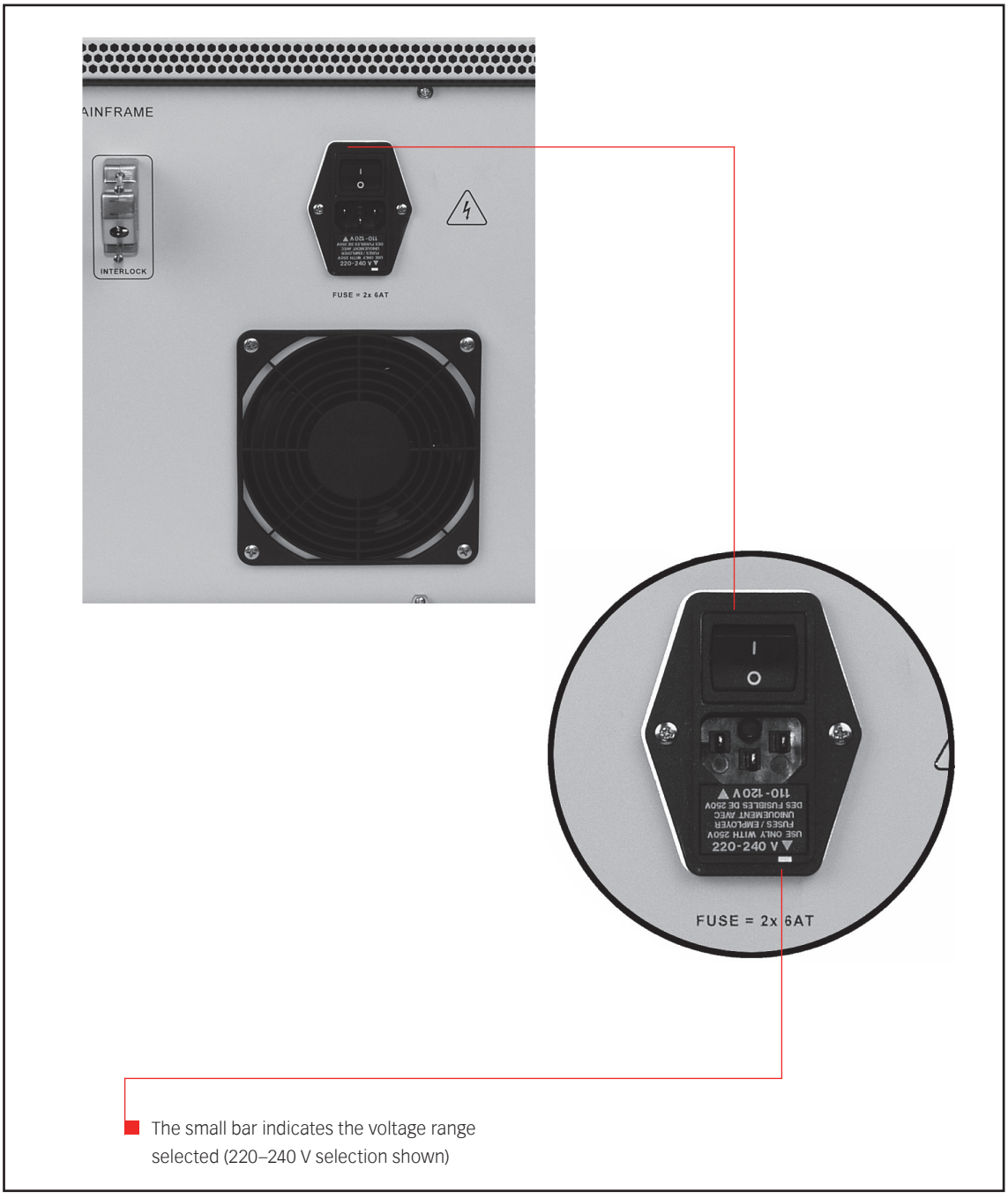
The power input of the equipment is located on the rear side of the NSG 5600 (see picture 3-1). The power input is secured by two 6 A time-lag fuses. For details, refer to chapter 5.3 Protection/fuses.

The power plug and outlet must have grounding contacts. When the NSG 5600 is brought from cold to warm environment, the ensuing condensation may bring about dangerous conditions.

DANGER!
The NSG 5600 may only be switched on after all parts have fully acclimatized.

3.4.1 Mains voltage selector

The mains voltage selector is a small drawer placed in the mains input / main switch module. The user can select the regional input voltage range (110 - 120 V or 220 - 240 V) by pulling out the selector (using a small screwdriver) and turning it. The selected voltage range is marked by the small arrow on the module that points to the white mark at the input connector assembly.



Picture 3-1: Mains voltage selector (220–240 V range selected in the picture)

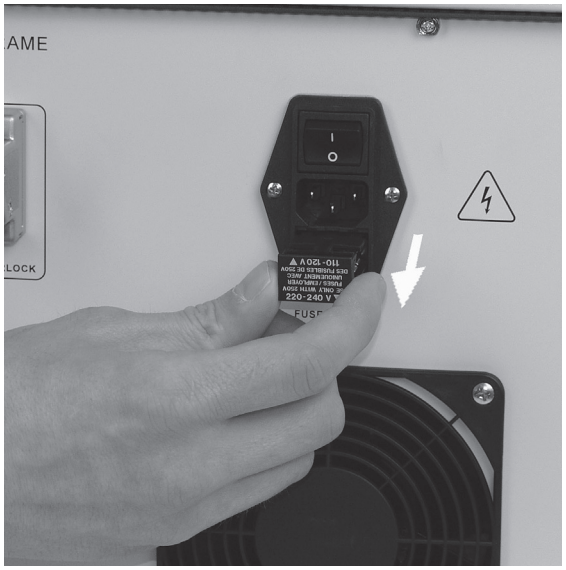
To select the other voltage range, proceed as follows:

DANGER!
The NSG 5600 must be disconnected from the mains before working on the mains voltage selector by disconnecting the power cord!

- Carefully loosen the drawer from the input connector assembly using a screwdriver and turning it slightly in both directions as shown in the picture below.

Picture 3-2: Loosen the drawer using a screwdriver

- Pull out the drawer from the input connector assembly.

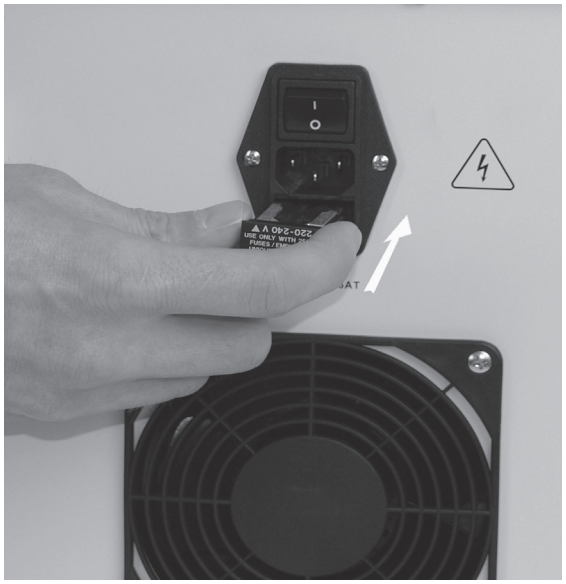


Picture 3-3: Pull out the drawer

- Turn the drawer until the text of the desired voltage range and its arrow is on the bottom of the drawer.

Picture 3-4: Turn the drawer

- Push the drawer back in...



Picture 3-5: Push the drawer back in

- ...until it is fixed to the input connector assembly again.

Picture 3-6: Fix the drawer to the input connector assembly

- Now reconnect the NSG 5600 to the mains.

3.5 Installation/set-up NSG 5600

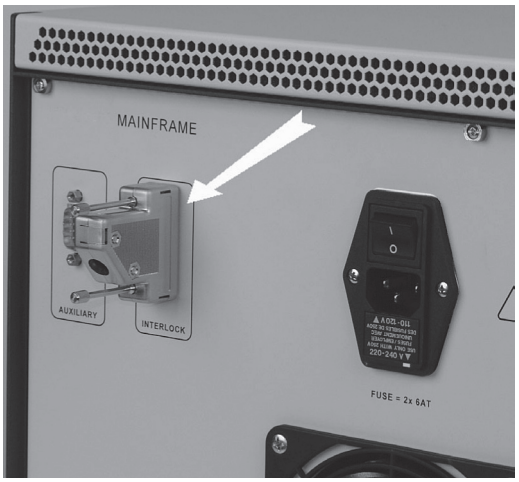
This section outlines a brief checklist of items that should be done before the unit is powered up and put into service. The NSG 5600 may be set up by qualified personnel only. It is imperative to observe the safety instructions at the beginning of this manual.

- Check that all items and accessories 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.

3.5.1 The interlock connector

CAUTION!
AutoStar will not properly communicate with the NSG 5600 if the Interlock connector is not fitted.

Connect the Interlock connector to the plug labelled “INTERLOCK” on the rear side of the NSG 5600.



Picture 3-7: The interlock connector on the rear side of the NSG 5600

3.6 Installation/set-up controller module CT 5610

3.6.1 Handling & safety

3.6.1.1 Storage and transport

The CT 5610 module is preinstalled in the NSG 5600 system upon delivery. If an exchange is required, a module can be ordered separately and it is shipped individually in a transparent static shielding bag and box.

3.6.1.2 Handling

ATTENTION!
Observe precautions for handling electrostatic discharge sensitive devices.

3.6.1.3 General module protection

The CT 5610 digital controller module meets the safety guidelines in the IEC 1010 standard.

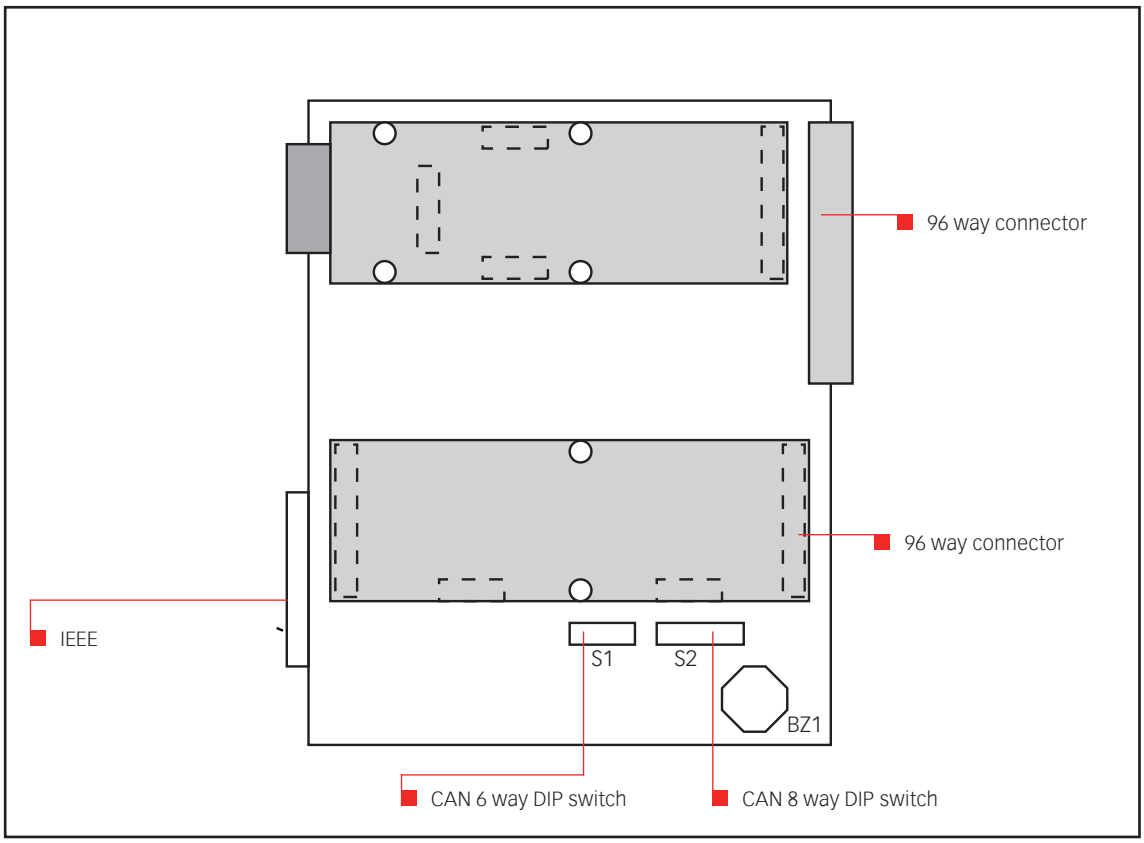
3.6.2 Configuration

3.6.2.1 GPIB address

To change the GPIB address of the module, complete the following steps:

1. Remove the module from the NSG 5600 chassis.

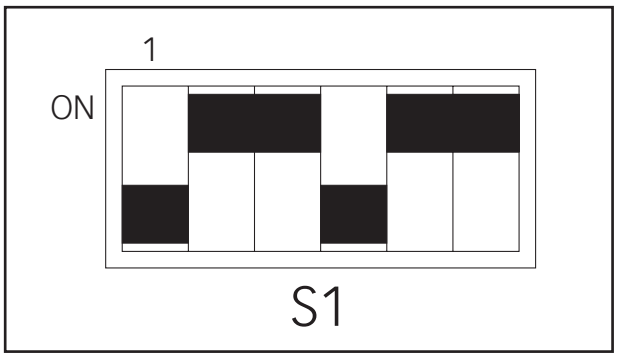
2. Locate DIP switch S1 on the carrier card.



Picture 3-8: CT 5610 Module top view with DIP switches S1 and S2

3. For a "HIGH" bit, set the corresponding switch to "OFF", for a "LOW" bit, set the corresponding switch to "ON". Switch 1 is the LSB.

4. For GPIB address 9, set switches 2 and 4 to "OFF" and the remaining switches to "ON". Default address is 9. Setting IEEE address 9 : 9 = 1 + 8 = 20 + 23. The default system address is 9.



Picture 3-9: Switch S1 - GPIB address

5. Ensure that the system configuration utility in Autostar coincide's with the hardware address change. Refer to the AutoStar user manual for details on the system configuration utility.

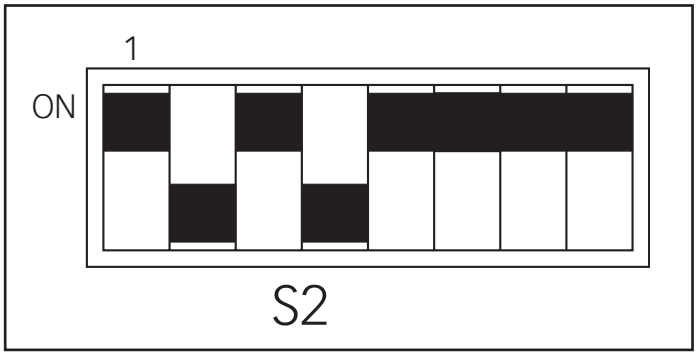
3.6.2.2 CAN address

To change the CAN address of the CT 5610 module, complete the following steps:

1. Remove the card from the NSG 5600 chassis.

2. Locate DIP switch S2.

3. For a "HIGH" bit, set the corresponding switch to "OFF", for a "LOW" bit, set the corresponding switch to "ON". Switch 1 is the LSB.



Picture 3-10: Switch S2 - CAN address

4. Setting CAN address 0A : 10 = 2 + 8 = 21 + 23. Thus switches 2 and 4 are turned "OFF". (An internal pull-up sets a bit "HIGH" when the switch is set to the "OFF" position).

5. To delete the application firmware set all switches to "OFF".

3.6.3 Installation

To install the CT 5610 in the chassis the following steps should be performed;

1. Before removing the module from it's packaging or handling it, observe anti-static procedures.
2. Turn off the system and disconnect from mains before installing/replacing the module.
3. Slide the module carefully on the guide rails in the right-most slot of the NSG 5600 chassis.
4. Push the 96 way DIN 41612, type C plug securely into the mating socket on the backplane.
5. The module should be pushed firmly home and screwed in using the 4 collar screws mounted to the front panel of the CT 5610 module.

Picture 3-11: CT 5610 Module installed in the right-most slot in the basic chassis

3.6.4 Verification

After inserting the CT 5610 module, power on the chassis. The green and amber LEDs on the front panel of the CT 5610 module should flash for a few seconds while the system is initialising and the green LED should remain on. Any IEEE communication will result in amber LED flashing briefly.

LED colour	LED function
Red	Lights continuously, only when there is a fault.
Amber	Flashes to indicate an IEEE command being received/sent. Flashes rapidly when the board is initialising / resetting.
Green	Lights continuously, only when the board is ready to receive an IEEE command. Flashes rapidly when the board is initialising / resetting.

Table 3-1: LED functions

NOTE!
If the green LED is not illuminated, this indicates "NO POWER" to the card.

NOTE!
The CT 5610 may require up to 10 seconds to boot. No software communications will be available until the "Ready" LED is illuminated and the other LEDs have stopped blinking. Please wait until the CT 5610 is completely initialized before starting AutoStar.

3.7 Installation / set-up function generators FG 5620 / FG 5621 (option)

3.7.1 Handling & safety

3.7.1.1 Storage and transport

The FG 5620 module is preinstalled in the NSG 5600 system upon delivery. If an upgrade is required, an INA 5621 can be ordered separately and it is shipped individually in a transparent static shielding bag and box. Refer to document ISO 702-0126 «ARB 5220 / ARB 5221 module configuration in multiple arb card systems». Normally this upgrade will be performed by local service staff.

3.7.1.2 Handling

ATTENTION!
Observe precautions for handling electrostatic discharge sensitive devices.

3.7.1.3 General module protection

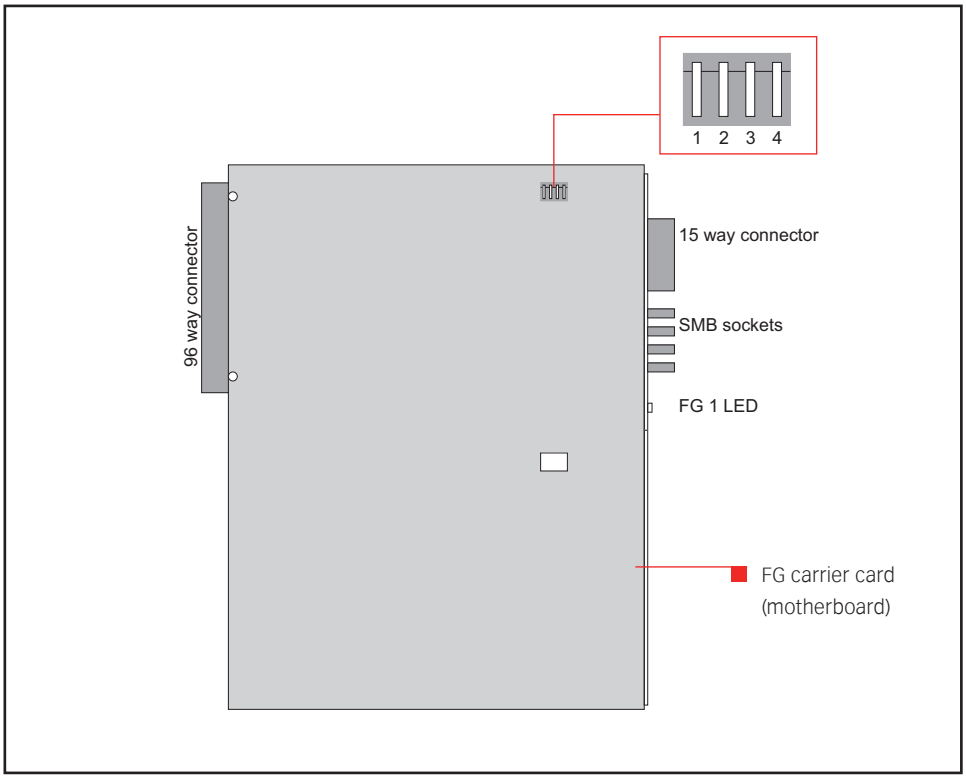
The FG 5620 / FG 5621 Function generator modules meet the safety guidelines in the IEC 1010 standard.

3.7.2 Configuration

3.7.2.1 Setting the FG 5620 CAN address

Before installing the FG 5620, the CAN address must be set. A cut-out has been designed on the solder side of the FG 5620 carrier card to allow easy access for the user to set the CAN addresses.

1. Locate the 4 way DIP switch on the solder side of the FG 5620 carrier card, refer to picture 3-12.



Picture 3-12: FG 5620 solder view showing the 4 way DIP switch

NOTE!
On some older versions of the FG (ARB) cards the switch used is numbered differently. Therefore, picture 3-13 should be used as a reference to determine SW1... SW4 positions.

2. Using a screwdriver, press the appropriate DIP switch within the 4 way DIP switch to set the CAN address.

3. When the DIP switch is pressed in, the DIP switch is "ON" and the CAN Address is set.
   The table below shows the CAN Addresses and the DIP switch to set.

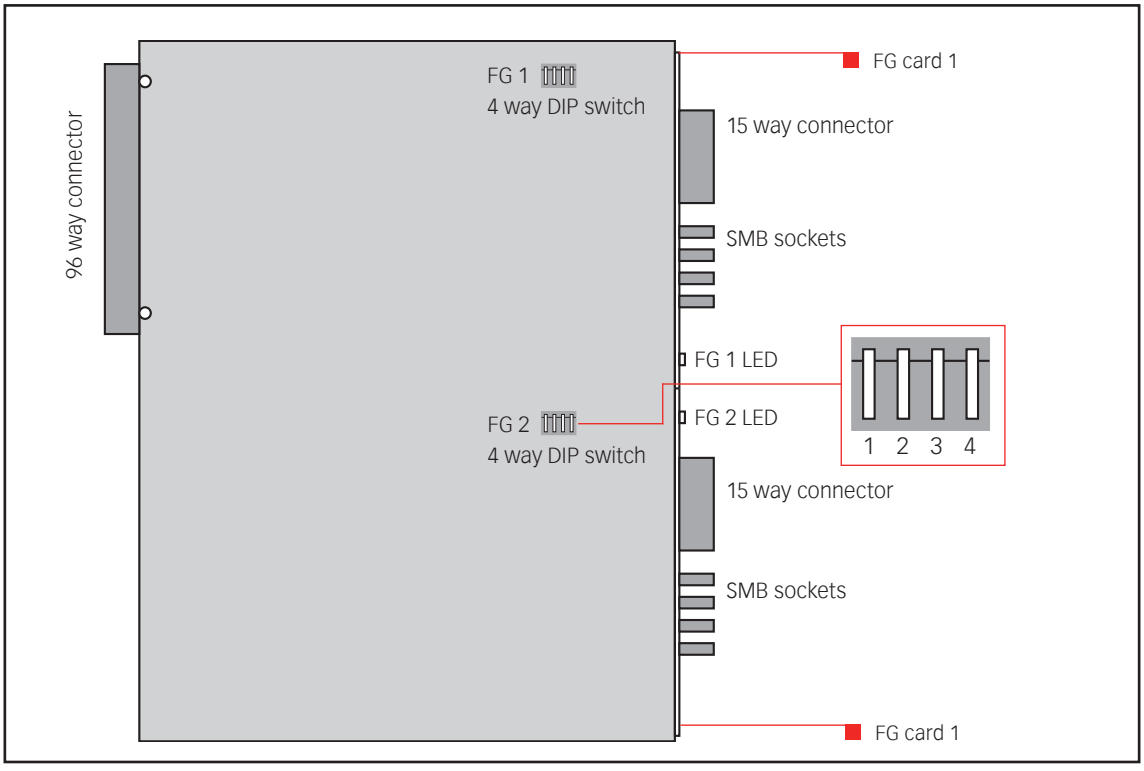
		SW1	SW2	SW3	SW4	Address
ARB1	MASTER	On	Off	Off	Off	1
ARB2	SLAVE1	Off	On	Off	Off	2
ARB3	SLAVE2	On	On	Off	Off	3

Table 3-2: FG 5620 4 way DIP switch CAN addresses

3.7.2.2 Setting the FG 5621 CAN address

Before installing the FG 5621, the CAN addresses of the FG cards must be set. Two cutouts have been designed on the solder side of the FG 5621 carrier card to allow easy access for the user to set the CAN addresses. 1. Locate the 4 way DIP switches on the solder side of the ARB 5221 carrier card, refer to picture 3-13.

1. Locate the 4 way DIP switches on the solder side of the ARB 5221 carrier card, refer to picture 3-13.



Picture 3-13: FG 5620 solder view showing the 4 way DIP switch

NOTE!
On some older versions of the FG (ARB) cards the switch used is numbered differently. Therefore, picture 3-13 should be used as a reference to determine SW1...W4 positions.

2. Using a screwdriver, press the appropriate DIP switch within the 4 way DIP switches to set the CAN addresses.

3. When the DIP switch is pressed in, the DIP switch is ON and the CAN address is set. The table below shows the CAN Addresses and the DIP switches to set.

		SW1	SW2	SW3	SW4	Address
ARB1	MASTER	On	Off	Off	Off	1
ARB2	SLAVE1	Off	On	Off	Off	2
ARB3	SLAVE2	On	On	Off	Off	3
ARB4	SLAVE3	Off	Off	On	Off	4

Table 3-3: FG 5621 4 way DIP switch CAN addresses

3.7.2.3 FG 5620 / FG 5621 module configuration in multiple FG card systems

This document describes how to configure the FG 5620 and FG 5621 modules for operation in a multiple FG card system.

If a user has only a FG 5620 (1 FG card in one 4 HP module) then the module should already be configured correctly and the instructions below in **section 1** are provided for reference only.

If a user has only one FG 5621 (2 individual FG cards in one 4 HP module) then the module should already be configured correctly and the details in **section 2** are provided for reference only.

If a user has one FG 5621 and one FG 5620 then the FG 5620 module shall need to be configured correctly as detailed in **section 3.**

If a user has two FG 5621 modules then the second FG 5621 module (the one that plugs into the left slot) shall need to be configured correctly as detailed in **section 4.**

If a user has a FG 5620 but has bought an INA 5221 upgrade then the instructions in **section 5** should be followed.

Note that anti-static procedures should always be observed when handling the FG cards and FG modules.

Section 1: Single FG 5620 module configuration (1 FG card)

The following details are provided for reference only. If the user has a single ARB 5220 then the module should be configured correctly on receipt.

(a) The following connections should be linked on the FG carrier card, 701-0126

J6.1 to J6.2
J7.1 to J7.2
J21.1 to J21.2, J21.3 to J21.4, J21.5 to J21.6, J21.7 to J21.8, J21.9 to J21.10
J22.1 to J22.2, J22.3 to J22.4, J22.5 to J22.6, J22.7 to J22.8, J22.9 to J22.10
J23.1 to J23.2, J23.3 to J23.4
J24.1 to J24.2, J24.3 to J24.4
J25.1 to J25.2, J25.3 to J25.4
J26.1 to J26.2, J26.3 to J26.4
J27.1 to J27.2, J27.3 to J27.4
J28.1 to J28.2, J28.3 to J28.4
J29.1 to J29.2, J29.3 to J29.4
J30.1 to J30.2, J30.3 to J30.4
J31.1 to J31.2, J31.3 to J31.4

(b) On the FG card, S1 switch no. 1 should be set to “ON” and switches 2 to 4 should be “OFF”, as per chapter 3.7.2.1 Setting the FG 5620 CAN address.

Section 2: Single FG 5621 Module configuration (2 FG cards)

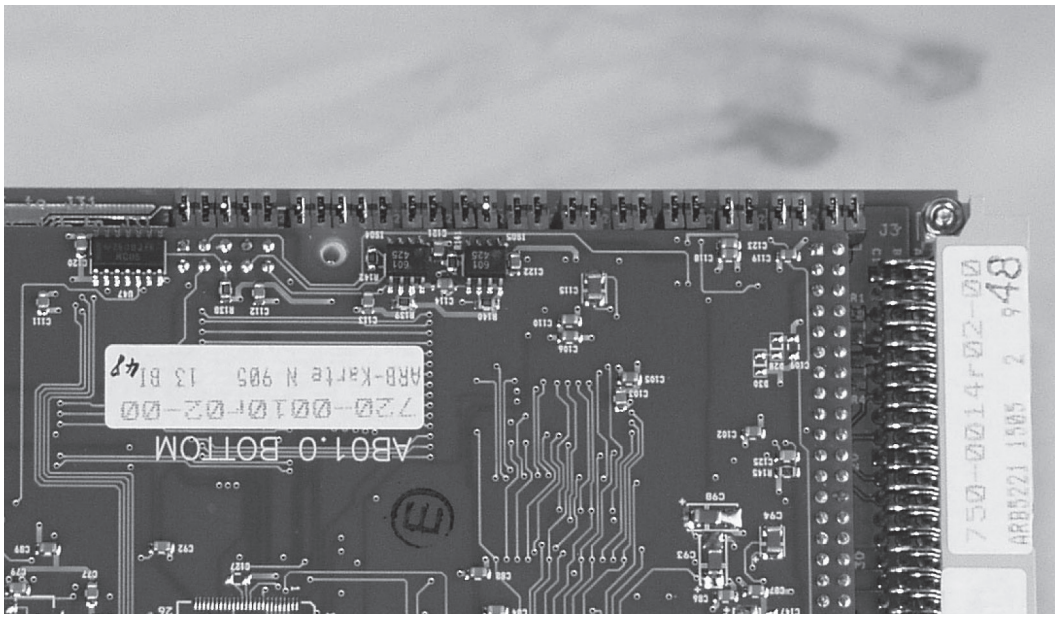
The following details are provided for reference only. If the user has a single FG 5621 then the module should be configured correctly on receipt.

(a) The following connections should be linked on the FG carrier card, 701-0126

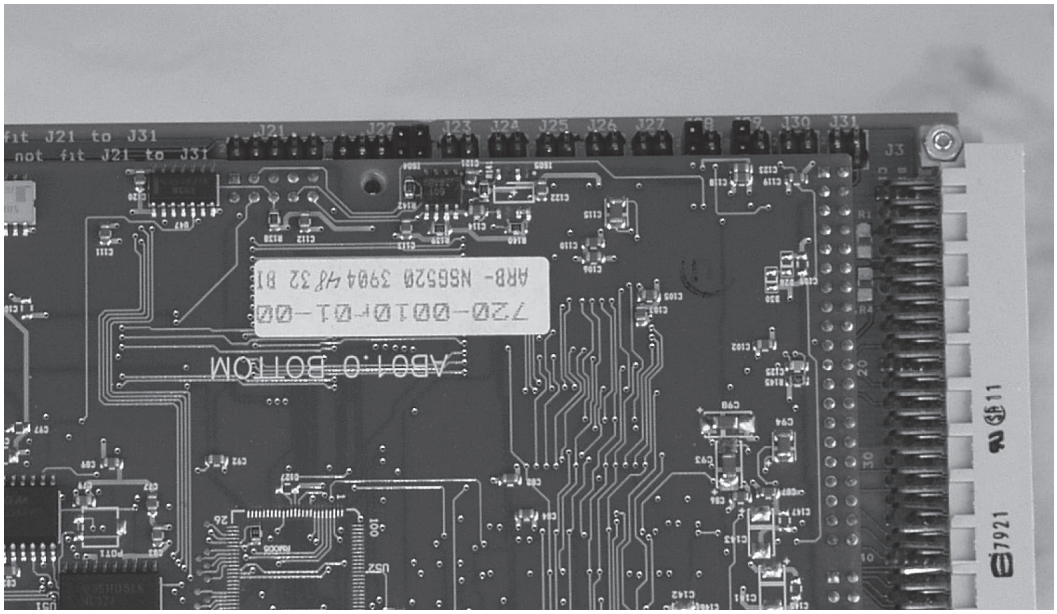
J6.1 to J6.2
J7.1 to J7.2
J21.1 to J21.2, J21.3 to J21.4, J21.5 to J21.6, J21.7 to J21.8, J21.9 to J21.10
J22.1 to J22.2, J22.3 to J22.4, J22.5 to J22.6, J22.7 to J22.8, J22.9 to J22.10
J23.1 to J23.2, J23.3 to J23.4
J24.1 to J24.2, J24.3 to J24.4
J25.1 to J25.2, J25.3 to J25.4
J26.1 to J26.2, J26.3 to J26.4
J27.1 to J27.2, J27.3 to J27.4
J28.1 to J28.2, J28.3 to J28.4
J29.1 to J29.2, J29.3 to J29.4
J30.1 to J30.2, J30.3 to J30.4
J31.1 to J31.2, J31.3 to J31.4

(b) On the master FG card, S1 switch no. 1 should be set to "ON" and switches 2 to 4 should be "OFF". The master FG card is the FG card in the upper position.

(c) On the slave FG card, S1 switch no. 2 should be set to "ON" and switches 1, 3 and 4 should be "OFF". The slave FG card is the arb card in the lower position.



Picture 3-14: Master (ARB 1 or ARB 1 and 2)



Picture 3-15: Slave (ARB 3 or ARB 3 and 4)

Section 3: FG 5621 Module and FG 5620 module configuration (3 FG cards)

If the user has a FG 5621 and a FG 5620 then the FG 5620 module shall need configuration upon receipt. The FG 5621 module should not need configuration and should be set-up as per section 2 above.

The Master FG card should reside in the FG 5621 and the module should slot into the right position in the chassis. See picture 3-17. The module should also contain slave 1.

The FG 5620 module should contain slave 2 and should slot into the left position in the chassis. See picture 3-17.

To configure the FG 5620 it is necessary to do the following:

(a) Remove the following links on the FG carrier card, 701-0126

J21.1 to J21.2, J21.3 to J21.4, J21.5 to J21.6, J21.7 to J21.8, J21.9 to J21.10
J22.1 to J22.2, J22.3 to J22.4, J22.5 to J22.6
J23.1 to J23.2, J23.3 to J23.4
J24.1 to J24.2, J24.3 to J24.4
J25.1 to J25.2, J25.3 to J25.4
J26.1 to J26.2, J26.3 to J26.4
J27.1 to J27.2, J27.3 to J27.4
J28.3 to J28.4
J29.3 to J29.4
J30.1 to J30.2, J30.3 to J30.4
J31.1 to J31.2, J31.3 to J31.4

(b) On the FG card, set S1 switches no. 1 and 2 to the "ON" position and switches 3 and 4 to "OFF". This sets up a CAN ID address of 3. See chapter 3.7.2.1 Setting the FG 5620 CAN address.

Section 4: 2 ARB 5621 Modules configuration (4 FG cards)

If the user has two FG 5621 modules then one FG 5621 module shall need configuration upon receipt. One FG 5621 module should be designated for the right slot and will not require configuration. The master FG card should reside in this FG 5621 the module should also contain slave 1.

The second FG 5621 module should contain slave 2 and slave 3 and should slot into the left position in the chassis. See picture 3-17.

To configure the second FG 5621 it is necessary to do the following:

(a) Remove the following links on the FG carrier card, 701-0126

J21.1 to J21.2, J21.3 to J21.4, J21.5 to J21.6, J21.7 to J21.8, J21.9 to J21.10
J22.1 to J22.2, J22.3 to J22.4, J22.5 to J22.6
J23.1 to J23.2, J23.3 to J23.4
J24.1 to J24.2, J24.3 to J24.4
J25.1 to J25.2, J25.3 to J25.4
J26.1 to J26.2, J26.3 to J26.4
J27.1 to J27.2, J27.3 to J27.4
J28.3 to J28.4
J29.3 to J29.4
J30.1 to J30.2, J30.3 to J30.4
J31.1 to J31.2, J31.3 to J31.4

(b) On the FG card closest to the 96w DIN41612C connector, set S1 switches no. 1 and 2 to "ON" and switches 3 and 4 to "OFF". This sets up a CAN ID address of 3. See chapter 3.7.2.2 Setting the FG 5621 CAN address.

(c) On the other FG card, set S1 switch no. 3 to "ON" and switches 1, 2 and 4 to "OFF." This sets up a CAN ID address of 4. See chapter 3.7.2.2 Setting the FG 5621 CAN address.

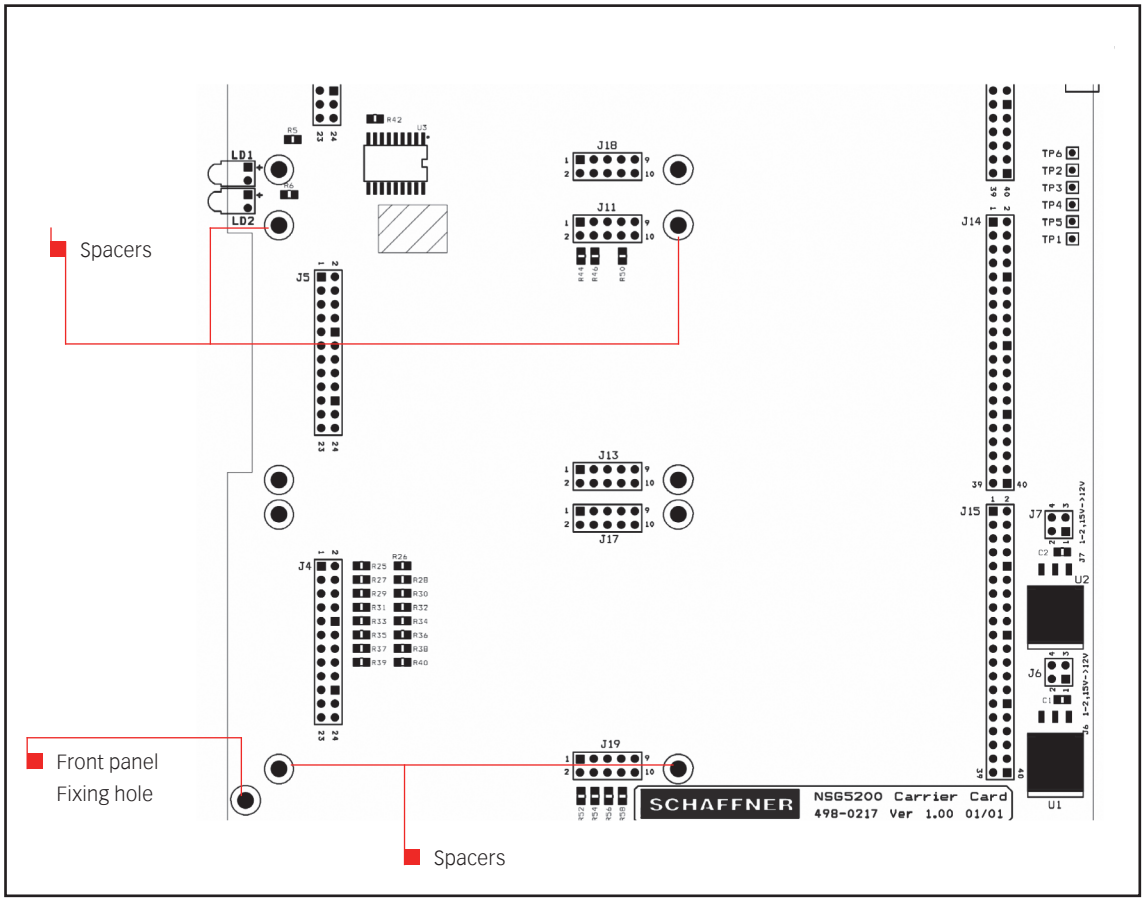
Section 5: Upgrading a FG 5620 to a FG 5621 using the INA 5621

If the user has a FG 5620 module (single arb system) and wishes to upgrade to a FG 5621 (dual arb system) this can be achieved by purchasing an INA 5621 upgrade kit. The kit consists of an Arb card, an assembled front panel and the various fixing parts needed to upgrade the FG 5620.

The following instructions should be followed when upgrading the module.

a) Get the FG 5620 module. Remove the two screws holding the front panel to the FG carrier PCB. Keep the screws as they are needed during assembly of the FG 5621.

b) Get the 4 spacers and 4 M2.5x6 screws from the INA 5621 kit. Fit the spacers to the mounting holes as shown in picture 3-16.



Picture 3-16: Spacer positions for the second FG card

c) Get the FG card from the INA 5621 kit. Set the CAN address to 2 by setting S1 switch no. 1 to “OFF” and S1 switch no. 2 to “ON”. S1 switches no.’s 3 and 4 should be “OFF”.

d) Carefully assemble the FG card to the FG 5620 carrier card. The card fits upside down with the 15w D-sub connector facing in the same direction as the master FG card. Ensure that the card fits snugly into all of the connectors.

e) Screw the remaining 4 M2.5x6 screws from the INA 5621 kit into the 4 spacers and gently tighten.

f) Get the assembled front panel from the INA 5621 kit. Using the 2 screws removed in step (a) above fit the panel to the FG carrier card.

g) The 15w D-sub cable in the INA 5621 kit is for the second arb card.

h) The SMB cable assemblies and T-piece are for use in multiple arb systems. Refer to the NSG 5600 hardware manual regarding how to connect up multiple FG cards.

3.7.3 Installation

To install the FG module in the chassis the following steps should be performed;

1. Before removing the module from it's packaging or handling it, observe anti-static procedures.

2. Turn off the system and disconnect it from the mains before installing/replacing the module.

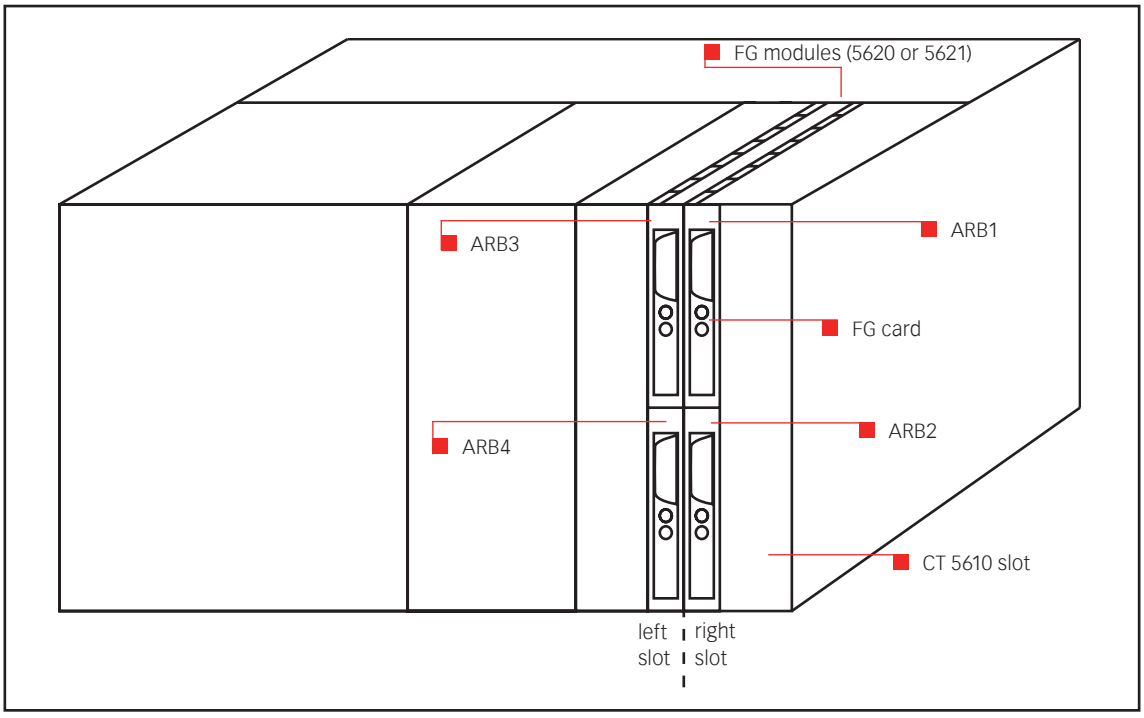
3. Check if it is necessary to set the CAN address. Refer to chapter 3.7.2 Configuration.

4. Check if it is necessary to configure the FG modules in multiple FG card systems. Refer to chapter 3.7.2.3 FG 5620 / FG 5621 Module configuration in multiple FG card systems.

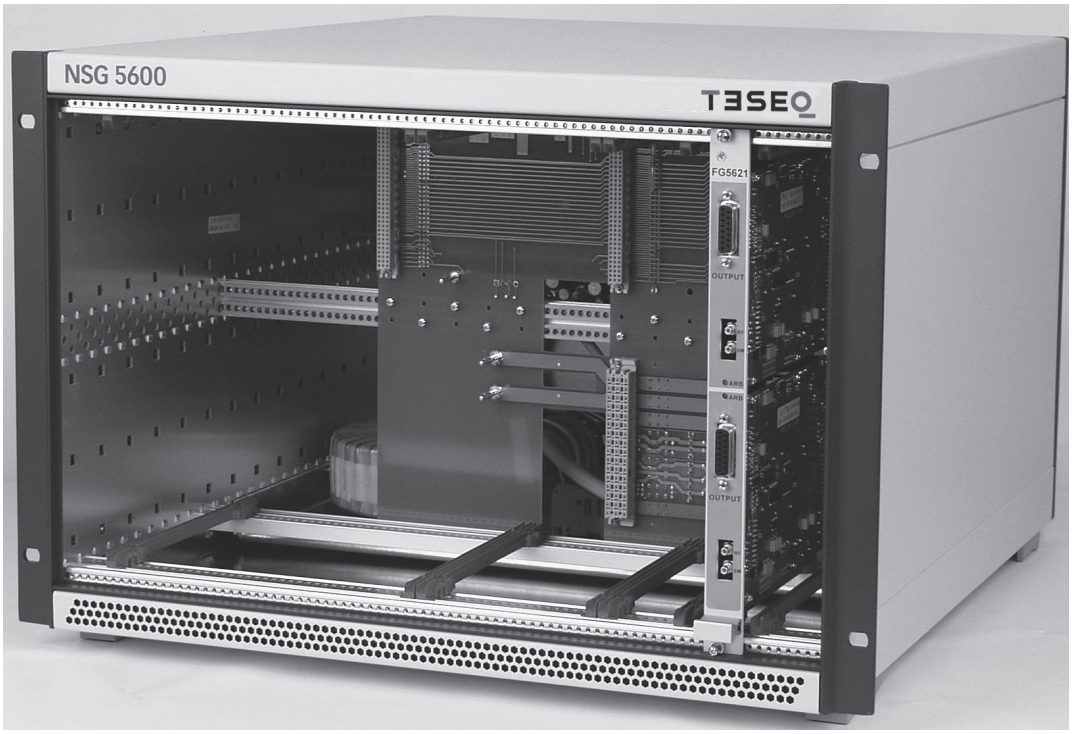
5. Slide the FG module carefully on the guide rails in either of the two slots to the left of the CT 5610 slot in the NSG 5600 chassis. Refer to table 3-4 and picture 3-17.

6. Push the 96 way DIN 41612 type C connector securely into mating socket on the backplane.

7. The module should be pushed firmly home and screwed in using the 2 collar screws mounted on the front panel of the FG 5620 or FG 5621 modules.



Picture 3-17: Basic chassis containing 2 FG 5621 (4 ARB cards) in left and right slots



Picture 3-17: Basic chassis containing 2 FG 5621 (4 ARB cards) in left and right slots.

No of ARBs	FG modules	Slot	CAN Address
1	FG 5620	right/ARB1	1
2	FG 5621	right/ARB1 right/ARB2	1 2
3	FG 5621 (2 ARBs)	right/ARB1 right/ARB2	1 2
	FG 5620 (1 ARBs)	left/ARB1	3
4	FG 5621 (2 ARBs)	right/ARB1 right/ARB2	1 2
	FG 5621 (2 ARBs)	left/ARB3 left/ARB4	3 4

Table 3-4: Lists the no. of FG cards and their location in the chassis slots

3.7.4 Verification

A single green LED is mounted on the front panel of the FG 5620 as it has a single FG card. There are two green LEDs on the front panel of the FG 5621 as there are two FG cards. The green LEDs are activated on the front panel of the module when a user selects a FG card using the Autostar software.

LED colour	LED function
1	Power up system and open Autostar, each green LED flashes for a short period. Flashes continously throughout the waveform generation.

Table 3-5: LED functions

3.8 Installation / set-up DC switch module DS 5630 (option)

3.8.1 Handling & safety

3.8.1.1 Storage and transport

The DS 5630 module is preinstalled in the NSG 5600 system upon delivery. If an upgrade is required, a module can be ordered separately and it is shipped individually in a transparent static shielding bag and box.

3.8.1.2 Handling

As the module is quite heavy (approx. 6 kg), care should be taken when removing the system from it's box and inserting it into the chassis.

ATTENTION!
Observe precautions for handling electrostatic discharge sensitive devices.

3.8.1.3 General module protection

Overcurrent	Front panel 75 A MCB protects against current overload for supply voltage variations. Overcurrent is indicated by Autostar. A Power "OFF/ON" is required if overcurrent occurs.
Overvoltage	Internal crowbar circuit senses overvoltage >75 volts. Overvoltage is indicated by Autostar. A power "OFF/ON" is required if overvoltage occurs.
Reverse connection Protection action	Internal crowbar senses reverse voltages > -15 V. A power "OFF/ON" is not required if reverse voltage crowbar occurs.
Inductive load protection	As with reverse voltage, inductive load kickback is protected against by an internal crowbar circuit.
Overtemperature	An overtemperature switch cuts out the main DC power path when the heatsink temperature exceeds 80 degrees.
Safety	The DS 5630 DC switch module meets the safety guidelines in the IEC 1010 standard.

3.8.2 Configuration

The configuration of the module, cables, inputs, etc. is explained in chapter 4.1.2 Basic chassis types and in chapter 4.4.2 Functional description.

3.8.3 Installation

To install the DS 5630 in the chassis the following steps should be performed:

1. Before removing the module from it's packaging or handling it, observe anti-static procedures.

2. Turn off the system and disconnect from mains before installing/replacing the module.

3. Slide the module carefully on the guide rails in the left most slot of the NSG 5600 chassis.

4. The module will align itself using the four 4 mm banana plugs on the NSG 5601 or NSG 5602 backplane.

5. The module should be pushed firmly home and screwed in using the 4 collar screws mounted to the front panel of the DS 5630.

Picture 3-19: DS 5630 Module installed in the left-most slot in the basic chassis

3.8.4 Verification

There are two LEDs on the front panel of the DS 5630 module.

LED colour	LED function
Green	LED "ON" if power is present in the module.
Red	LED "ON" when an interlock error occurs.

Table 3-6: LED functions

3.9 Installation / set-up power amplifier module PA 5640 (option)

3.9.1 Handling & safety

3.9.1.1 Storage and transport

The PA 5640 module is preinstalled in the NSG 5600 system upon delivery. If an upgrade is required, a module can be ordered separately and it is shipped individually in a transparent static shielding bag and box.

3.9.1.2 Handling

ATTENTION!
Observe precautions for handling electrostatic discharge sensitive devices.

3.9.1.3 General module protection

The PA 5640 Power amplifier module meets the safety guidelines in the IEC 1010 standard.

3.9.2 Installation

To install the PA 5640 in the chassis the following steps should be performed:

1. Before removing the module from it's packaging or handling it, observe anti-static procedures.

2. Turn off the system and disconnect from mains before installing / replacing the module.

3. Slide the module carefully on the guide rails into the slot beside the DS 5630 module in the centre of the NSG 5600 chassis.

4. Push the 96 way and 48 way plugs securely into the mating socket on the backplane.

5. The module should be pushed firmly home and screwed in using the 4 collar screws mounted to the front panel of the PA 5640.

Picture 3-19: DS 5630 Module installed in the left-most slot in the basic chassis

3.8.4 Verification

There are two LEDs on the front panel of the DS 5630 module.

LED colour	LED function
Red	The overtemperature LED illuminates when the temperature on the heatsink exceeds 75°C. This will cause the output to go to zero (shutdown) and will remain so until temperature of heatsink drops below 70°C.

Table 3-7: LED functions

3.10 Installation / set-up transformer coupler module TC 5650 (option)

3.10.1 Handling & safety

3.10.1.1 Storage and transport

The TC 5650 module is preinstalled in the NSG 5602 system upon delivery. If an exchange is required, a module can be ordered separately and it is shipped individually in a transparent static shielding bag and box.

3.10.1.2 Handling

ATTENTION!
Observe precautions for handling electrostatic discharge sensitive devices.

3.10.1.3 General module protection

The TC 5650 Transformer coupler module to switch on conducted sine waves meets the safety guidelines in the IEC 1010 standard.

3.10.2 Installation

NOTE!
The NSG 5602 contains the necessary internal audio transformer to be used with this module. An NSG 5602, DS 5630 and PA 5640 are required for use with this module.

To install the TC 5650 module in the chassis the following steps should be performed:

1. Before removing the module from it's packaging or handling it, observe anti-static procedures.
2. Turn off the system and disconnect from mains before installing/replacing the module.
3. Slide the module carefully on the guide rails into the slot between the PA 5640 module and the FG 5621 module (optional) in the NSG 5600 chassis.
4. Push the 96 way and 48 way plugs securely into the mating sockets on the backplane.
5. The module should be pushed firmly home and screwed in using the 4 collar screws mounted to the front panel of the TC 5650 module.

Picture 3-21: TC 5650 Module installed in the basic chassis

4 OPERATION

4.1 NSG 5600 basic chassis

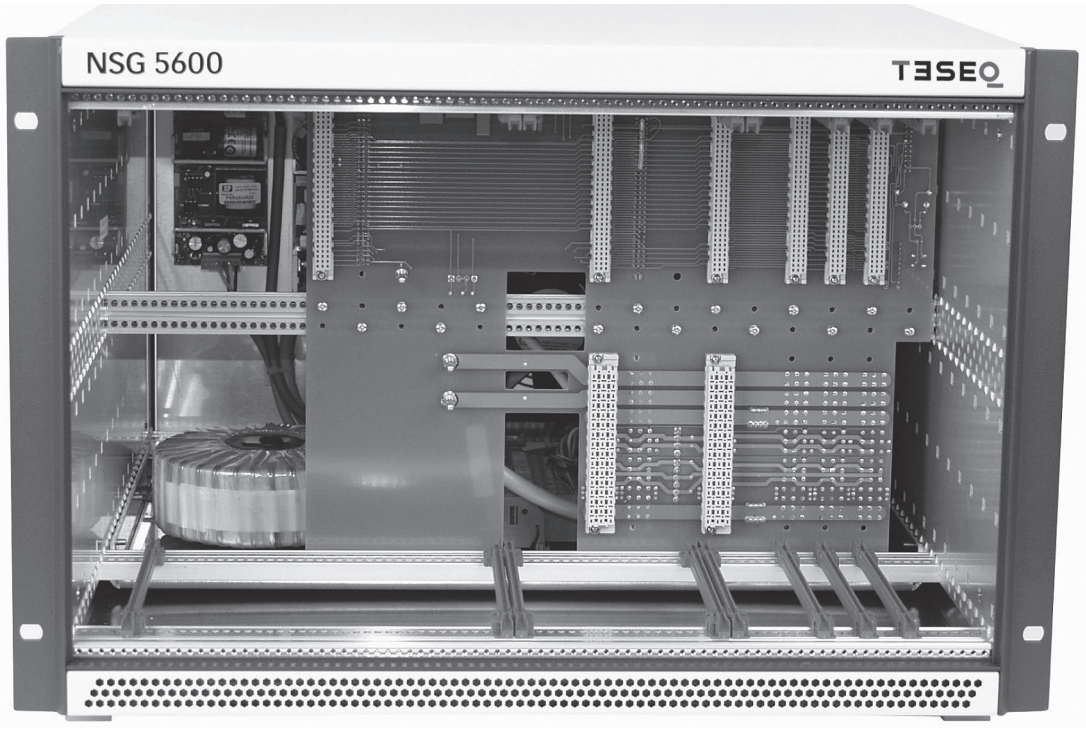
4.1.1 Basic chassis overview

The basic system is housed in a 7U 84HP chassis, weighing approximately 18 to 26 kg depending whether the system is a NSG 5601 or NSG 5602. The chassis has positions at the front for various modules to plug into a backplane which routes the signals used by the modules.

The CAN-bus, well known in automotive technology circles is used as the system bus. The chassis contains two power supplies and one mains transformer, which provide all of the power required by the plug-in modules. Two mains operated fans are mounted on the rear of the chassis to aid in the cooling of the DS 5630 and PA 5640 modules.

Chassis features:

- Modular structure to system
- Internal CAN bus
- Standard auxiliary signals (DUT_FAIL etc.)
- Interlock connector

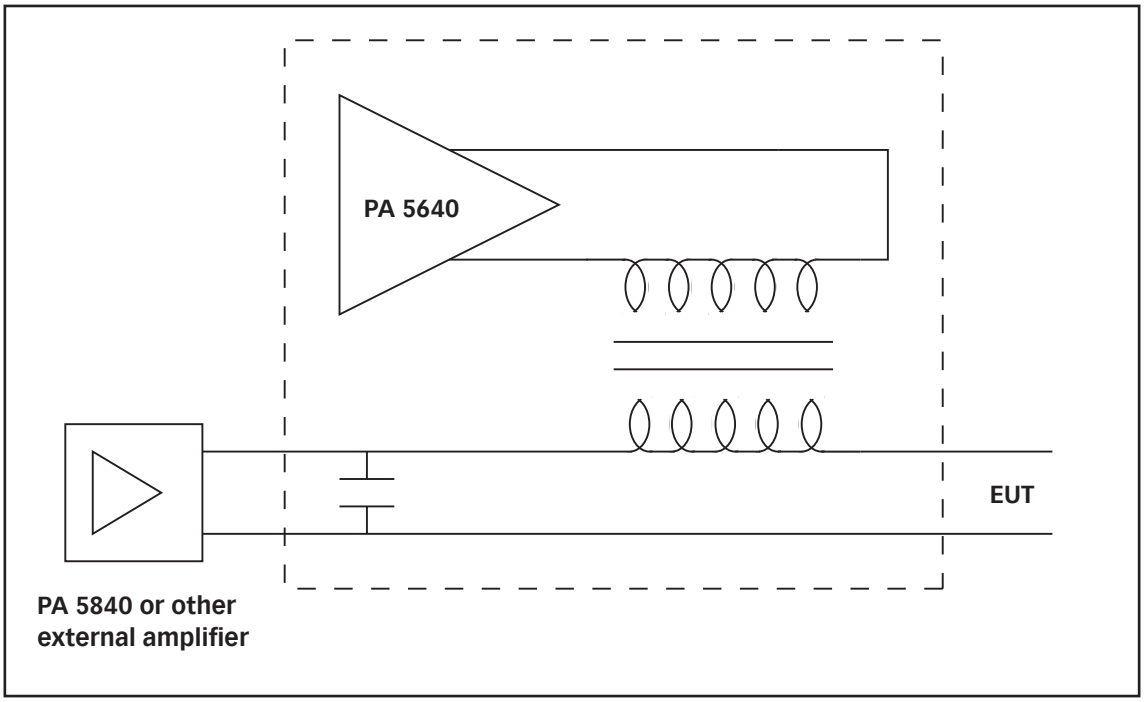


Picture 4-1: NSG 5600 system basic chassis showing the backplane and the module guide rails

4.1.2 Basic chassis types

NSG 5600 is a generic name used for the NSG 5601 and NSG 5602 chassis due to the similarity between them. The NSG 5601 can be upgraded to an NSG 5602 using an INA 5601 upgrade kit (service center upgrade). The NSG 5602 contains an audio isolation transformer, which is used during conducted sine wave testing (CSW). The NSG 5601 has every feature the NSG 5602 has except the transformer and the mounting plate.

In the NSG 5602, DC power to the transformer is first passed from the DS 5630 through the TC 5650 (conducted sine waves) module and then to the transformer via the backplane which is to allow the transformer be connected to the positive or negative side of the battery. The primary of the transformer is connected to the PA 5640 or another amplifier output via the backplane. The amplifier is an integral part of the test circuit. Irregular output will result in performing a CSW test without a low-impedance amplifier connected to "MAIN SOURCE INPUT" on the DS 5630.



Picture 4-2: Conducted sine waves from the NSG 5602

CAUTION!
As you can see from picture 4-2, the transformer coupling method of the CSW test uses coupling that may not be stable with all power amplifiers. While all Teseq power amplifiers are tested with this function, other power amplifiers are not. If an amplifier begins to oscillate, damage may result to the DS 5630.
It is the user's responsibility to ensure that the power amplifier used is stable under this complex coupling. Certain Teseq amplifiers contain a "capacitive mode" which should be used for best results.

4.1.3 NSG 5600 chassis components

The NSG 5600 system chassis contains a number of components, which are described as follows:

4.1.3.1 Backplane

The purpose of the backplane is to pass common signals and power between the various modules within the NSG 5600 system. The backplane is an 84HP 6U backplane with an L-shaped cut-out. The top half of the backplane contains positions for seven 96 way DIN 41612 type C connectors. The bottom half of the backplane contains positions for six 48 way DIN 41612 type E connectors. Power from the DC power supplies and from the mains transformer is brought onto the backplane to be distributed to the various modules.

4.1.3.2 Modules

The modules (CT 5610, FG 5620, FG 5621, DS 5630, PA 5640 and TC 5650) are installed in the front of the chassis. Each module is installed by sliding it along the guide rails and slotting it into the connectors on the backplane. For more details, refer to the appropriate module sections in this manual.

4.1.3.3 Blanking panels

Before the system is powered up ensure that all unused slots are blanked off, using blanking panels. The blanking panels are fitted on the chassis when the user receives the system.

Picture 3-3: NSG 5500 Rear view

4.1.3.4 On/off switch

An on/off switch on the back panel is used to switch “ON” and “OFF” the system mains power.

4.1.3.5 Auxiliary interface card

The rear panel of the NSG 5600 contains an auxiliary interface card. This board provides an interface to a number of auxiliary signals. Refer to chapter 4.1.4.1 Auxiliary interface signals description.

4.1.3.6 Fans

A mains operated fan is mounted on the rear of the chassis to aid in the cooling of the modules. The fan is 4 wire device, which operates at nominally either 115 or 230 V. The speed of the fan changes as the mains voltage changes for particular settings.

4.1.4 Chassis connectors

4.1.4.1 Auxiliary interface signals description
All auxiliary signals are isolated from any other power supply lines within the system. A "HIGH" on a signal line corresponds to +12 V (with respect to the 0 V available on pin 1 of the 9 way D-Sub connector).

- **CRO_TRIG**
  This output signal is reserved for future use.

- **TESTEND**
  The purpose of TESTEND is to indicate when a test begins and when it ends. TESTEND goes LOW at the start of every test and goes HIGH again at the end of the test.

  – The signal for TESTEND originates on the FG card.

  – TESTEND is active LOW in the NSG 5600 and is an output.

  – TESTEND goes LOW <1 ms before the event and goes HIGH again <1 ms after the event.

  – TESTEND is available on pin 4 of the 9 way D-Sub connector.

- **DUT_FAIL**
  The purpose of DUT_FAIL is to indicate to the NSG 5600 that a failure has occurred within the DUT (Device Under Test).

  – DUT_FAIL is thus an input.

  – If the DUT has an output which indicates when the DUT fails, then this line may be used when such a failure occurs.

  – By pulling pin 5 of the 9 way D-Sub LOW (i.e. by shorting it to pin 1, 0 V) the user indicates to the NSG 5600 (and Autostar) that a failure has occurred.

Depending upon the software condition set-up the system may react in three ways:

a) Do nothing

b) Stop the test

c) Pause the test

The DUT_FAIL signal indicates a failure to the processor, not the FG card(s). Thus, a time lag is expected before the system reacts to the DUT_FAIL. This time is <50 ms.

If the test is paused upon detection of a DUT_FAIL signal then it can be resumed either within Autostar by pressing the pause (amber) button in the Run Time Control or by sending another active low pulse to the auxiliary signal, as shown in chapter 6.3.1 "Auxiliary signals timing diagram."

PAUSE_CONT

The purpose of PAUSE_CONT is to allow the user to pause a test at any time and then continue it some time later.

- This signal is available on pin 7 of the D-Sub and is active LOW.
- When a LOW going pulse is put on this pin the system pauses the test upon detection of it. It remains paused until another LOW going pulse is put on the pin, at which time the test shall continue. The test resumes from the point it was paused. Thus, sending the pin HIGH does not resume the test.
- The PAUSE_CONT signal indicates a test pause to the processor, not the FG card(s). Thus, a time lag is expected before the system reacts to the PAUSE_CONT. This time is <50 ms.

EXT_TRIG

The purpose of EXT_TRIG is to allow the user to start a test externally.

- This signal is available on pin 6 of the 9 way D-Sub.
- If a user wishes to start a test with an external signal, the external trigger option must first be enabled in Autostar.
- The test may be then set-up to run as normal. However, if the external trigger feature is enabled, then the system will not begin the test until the EXT_TRIG signal goes LOW. After it goes LOW the test begins as normal. While waiting for the external trigger event, Autostar will display a waiting for external trigger message.
- Once a test has started with EXT_TRIG LOW, pulling it HIGH does nothing as the system ignores any further state transitions.
- The EXT_TRIG signal indicates a test start to the processor, not the FG card(s). Thus, a time lag is expected before the system reacts to the EXT_TRIG. This time shall not be <50 ms.

Pin assignment

The pin-out of the 9 way auxiliary D-Sub connector is as follows:

Pin	Signal
1	0 V Aux
2	+12 V Aux
3	CRO_TRIG
4	TESTEND
5	DUT_FAIL
6	EXT_TRIG
7	PAUSE_CONT
8	NC
9	NC

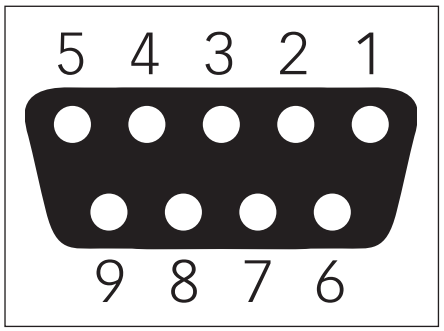


Table 4-1: 9 way D-Sub connector pin-outs

4.1.4.2 Interlock signals

The rear panel of the NSG 5600 contains an auxiliary interface card. This board provides an interface to one 15 way D-Sub Interlock connector. All interlock signals are isolated from any other power supply lines within the system.

The function of Interlock is to provide a safety mechanism for the user during normal operation.

To ensure system operation pins 1 and 5 must be linked on the 'Interlock' D-Sub connector. If the connection is missing the test running shall stop (or not commence) and all output connections shall be disabled. A LOW indicates an interlock error. A red LED on the DS 5630 module indicates that an interlock error has occurred.

The signal INTERLOCK1 returns from the Auxiliary Interface card to the processor. The system reacts immediately to an interlock error, whereas a short delay may be expected before the software reacts to the interlock error. This delay should not exceed 100 ms.

CAUTION!
AutoStar will not properly communicate with the NSG 5600 if the Interlock connector is not fitted.

The pin-outs of the 15 way D-Sub Interlock connector is as follows:

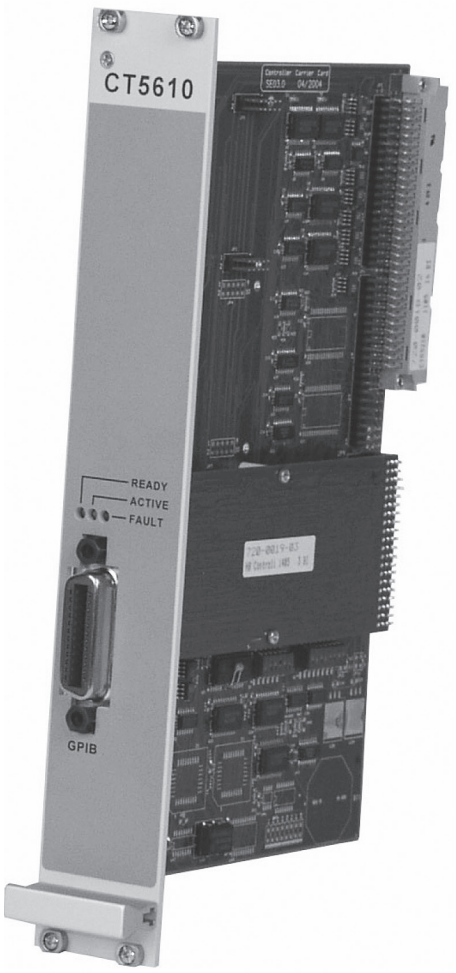
Pin	Signal	Function
1	0 V INT	
2	Interlock IN linked to Interlock	NC
3	Interlock IN linked to Interlock	Microprocessor GND
4	Interlock IN linked to Interlock	NC
5	Interlock IN linked to Interlock	Interlock signal to microprocessor
6	Interlock IN linked to Interlock	NC
7	Interlock IN linked to Interlock	NC
8	Interlock IN linked to Interlock	NC
9	Interlock IN linked to Interlock	NC
10	Interlock IN linked to Interlock	NC
11	Interlock IN linked to Interlock	NC
12	Interlock IN linked to Interlock	NC
13	Interlock IN linked to Interlock	NC
14	Interlock IN linked to Interlock	NC
15	Interlock IN linked to Interlock	NC

Table 4-2: 15 way D-Sub Interlock connector pin assignment

4.2 CT 5610 digital controller module

4.2.1 Introduction

The CT 5610 digital controller module has been designed to meet the high performance levels achievable with the NSG 5600 system. This module is the central controller for the NSG 5600 system and is capable of controlling up to 4 function generator cards over the internal CAN bus, as well as all other NSG 5600 modules in the system. One controller is required in each test system.

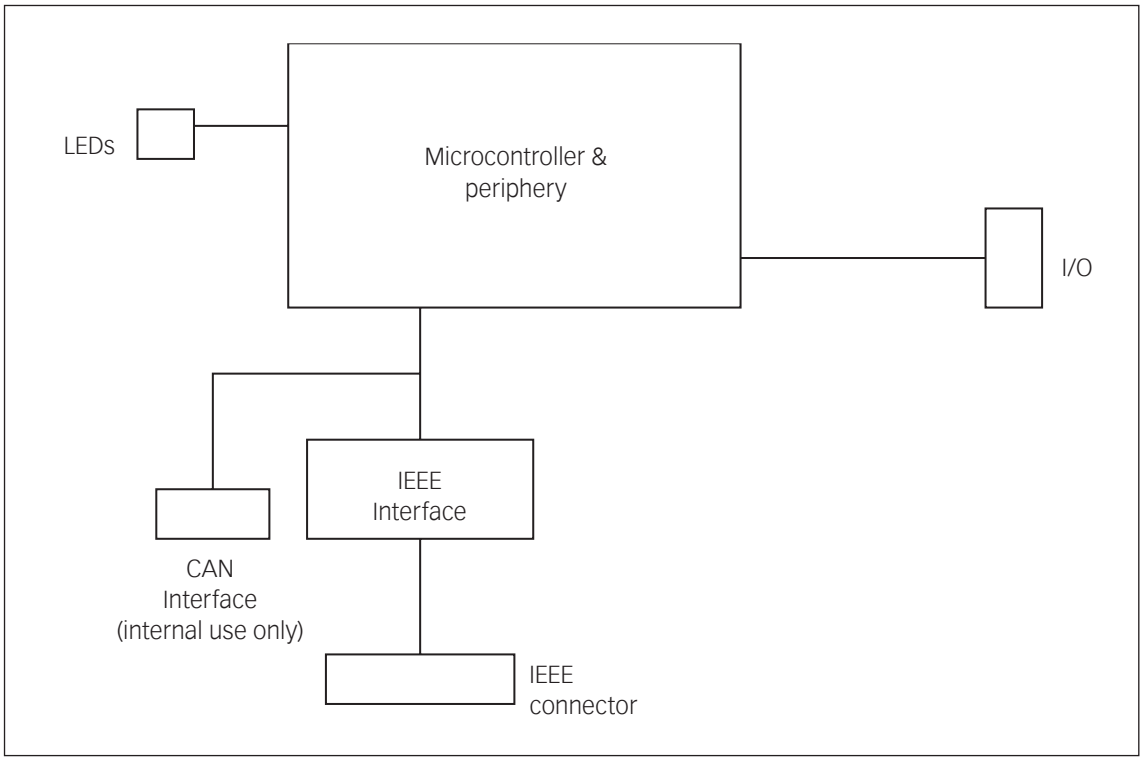


Picture 4-4: CT 5610 controller module

The CT 5610 module is capable of controlling all test system resources over a single IEEE address. The CT 5610 module controls all the addressing, real-time and synchronisation tasks on the CAN-bus as well as maintaining communication with the PC and hence with the Autostar user software. The CT 5610 also reacts to various auxiliary user signals such as DUT_FAIL.

4.2.2 Functional description

The CT 5610 module consists of a carrier card and the microprocessor daughter card.



Picture 4-5: CT 5610 Controller module functional block diagram

4.2.2.1 Carrier card

The carrier card connects to the backplane of the NSG 5600 and provides an interface from the microprocessor card to the system. In order for the microprocessor card to operate as the main system controller, the carrier card contains additional circuitry whose main function blocks are listed below:

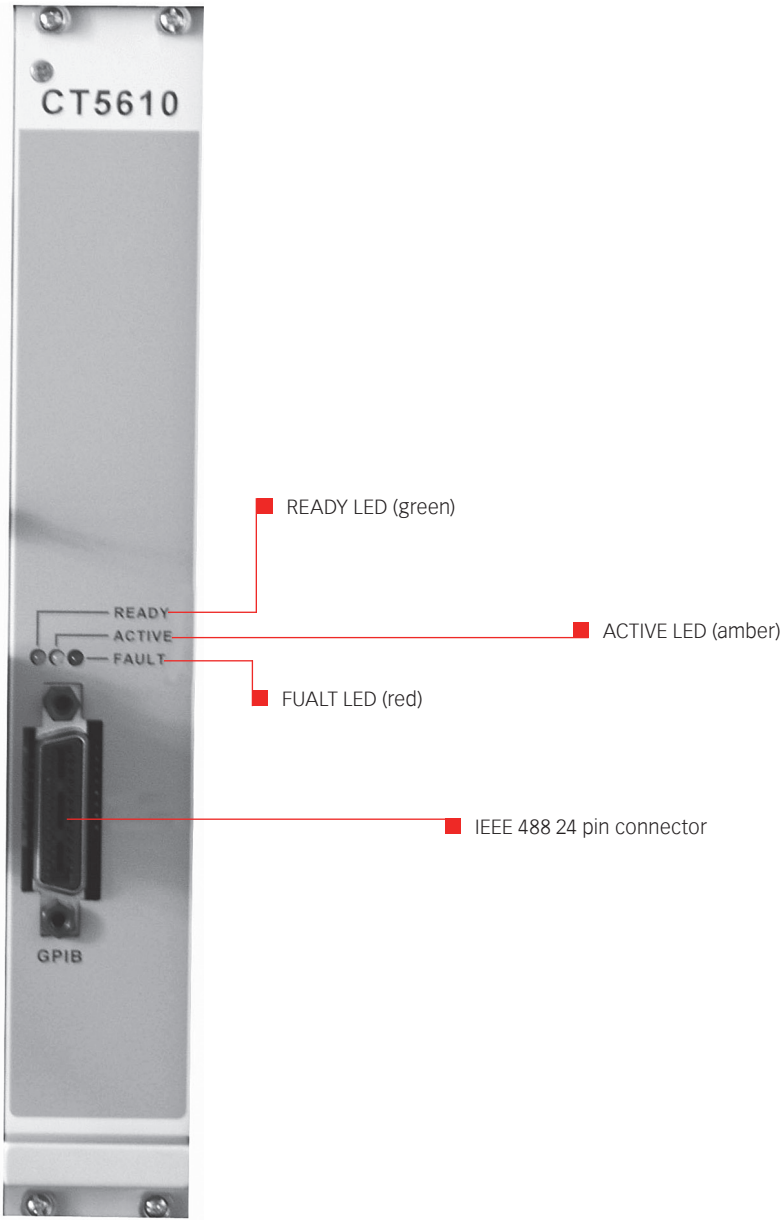
- CAN controller and transceiver
- GPIB chipset for communication to the host PC
- DIP switches for GPIB and CAN identifiers
- Input and output latches
- Diagnostic LEDs

All of the above functional blocks interface with the microprocessor card through two 60 pin connectors, as per the MA module standard.

4.2.2.2 Microprocessor card

The NSG 5600 firmware resides on the microprocessor card, which is mounted on the CT 5610 carrier card. The main function of the firmware is to provide a control interface between the NSG 5600 software and hardware. The CT 5610 module is controlled from the PC via the high speed GPIB interface on the carrier card and processes messages to and from the software. Up to four function generator (FG) cards can be controlled via the CAN bus. The CT 5610 also interfaces with the DC 5630 DC switch module, the PA 5240 power amplifier module and the TC 5650 transformer coupler module for conducted sine waves (CSW).

4.2.3 Connector pin-outs



Picture 4-6: CT 5610 Module front panel connector

4.2.3.1 Connector IEEE 488: 24 pin

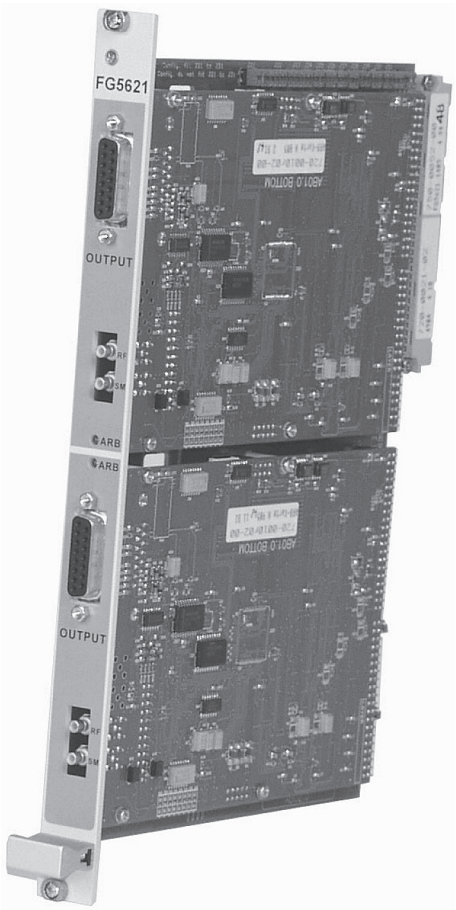
Pin no.	Signal name
1	DIO1N
2	DIO2N
3	DIO3N
4	DIO4N
5	EOIN
6	DAVN
7	NRFDN
8	NDACN
9	IFCN
10	SRQN
11	ATNN
12	DGND
13	DIO5N
14	DIO6N
15	DIO7N
16	DIO8N
17	RENN
18	DGND
19	DGND
20	DGND
21	DGND
22	DGND
23	DGND
24	DGND

Table 4-3: 24 pin IEEE connector

4.3 FG 5620/ FG 5621 function generator modules

4.3.1 Introduction

The function generator modules for arbitrary waveform functions are used universally throughout the system 5600 for the control of sources. The FG 5620 function generator module is designed to provide the various types of supply voltage variation (SVV) signals required for the automotive industry. This high-performance component of the NSG 5600 system, combined with Autostar software, meets all industry standard SVV requirements.

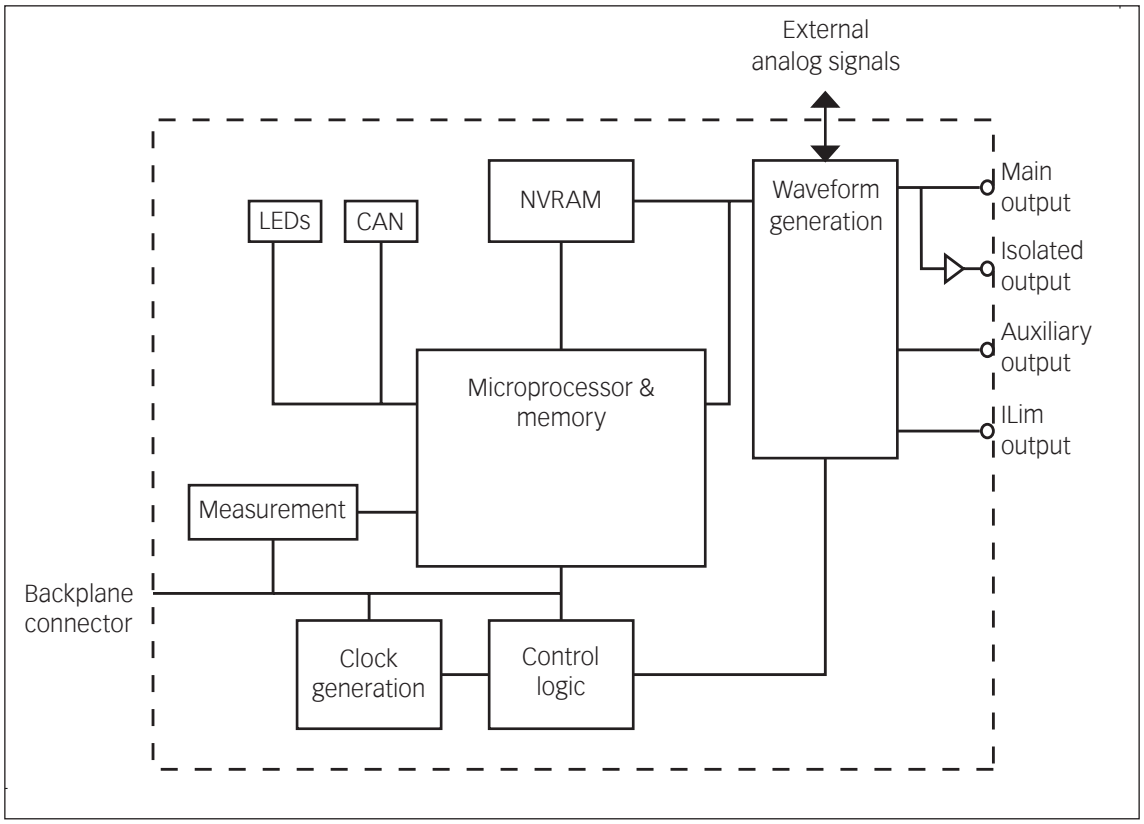


Picture 4-7: FG 5620 Function generator module for arbitrary waveforms

All the generators used are programmed separately in the Autostar software and operate synchronously. The FG 5621 is a function generator module for arbitrary waveforms with two FG cards, which operate in synchrony. Each NSG 5600 system can house from one to four FG cards by selecting the type of module required. For example three FG cards require one FG 5621 module and one FG 5620.

4.3.2 Functional description

The FG 5620 is a double M-module sized FG card, which is mounted on a carrier card. The FG card has built-in standard arbitrary waveform segments (sine, square, triangle, exponential and ramp) and a large memory capacity for waveforms, which cannot easily be defined by these standard waveform segments.



Picture 4-8: FG 5620 Module functional block diagram

Using Autostar, the operator can quickly and easily build up any combination of the standard segment types (Pulse 4c) or select one of the built-in special waveform types required in the industry. Alternatively, by choosing a waveform from the built-in standards database, the operator can simply “click and play”. Refer to the Autostar software user manual for more details on the standards database.

Each waveform can consist of up to 100 segments, with each segment effectively independent from any other. Segments may be inserted at any point within a waveform, allowing the user flexibility while creating a waveform. Segments may also be copied and moved as needed.

Each 4c segment can be of type sine, square, triangle, exponential, clone™ or ramp (ramp includes DC). The amplitude of the sine, square and triangle segment types may be linearly ramped from one value to the next in a continuous mode. In a similar fashion, an offset may be added to any of the three segment types and this offset can be linearly ramped. The frequency of sine, square and triangle segments may be ramped either linearly or logarithmically (base 10). Any combination of ramping of amplitude, offset and frequency is possible. Other ramping options or segment types may be available upon request. Only one clone™ segment is allowed during each test, and only in single channel mode.

Other wave segment features are also available as standard, including variation of the start and stop phase angles (stop phase angle is only valid for cycle mode) and pulse width modulation (only valid for square waves).

The ramp waveform segment allows the operator to build up segments of DC variation as required. If the operator chooses static amplitude, then the familiar DC voltage is created; if required a linear ramp from one DC value to another can be selected.

The duration of each segment within a waveform is programmable from 5 ms to 9999 hours (0.5 ms to 9999 hours for ramp), allowing the operator enormous flexibility over the test time. For sine, square and triangle waveforms a cycle mode is available, allowing the operator to program a precise number of cycles of a segment. However, the maximum frequency available in cycle mode is 4 or 5 kHz while it is 320 kHz in time mode.

NOTE!
The hardware switches automatically at max 5 kHz from cycle to time mode during frequency sweeping. Because of this, there is a brief delay at 5 kHz during frequency sweep.

If the operator has a waveform that cannot be programmed by Autostar, the waveform can be downloaded from a PC into the FG card. Autostar provides the ability to capture a waveform from an oscilloscope, display it and save it to a file. It may then be downloaded to the FG card for replay or distributed to suppliers who can then, using the NSG 5600 and Autostar, also download and replay the waveform. This provides the Automotive manufacturer with an easy way to detail a complex waveform. The user may also create complex waveforms using packages such as Microsoft® Excel, MathSoft Mathcad etc. Once the output is saved as a text file, it can be read in by Autostar and downloaded to the FG card.

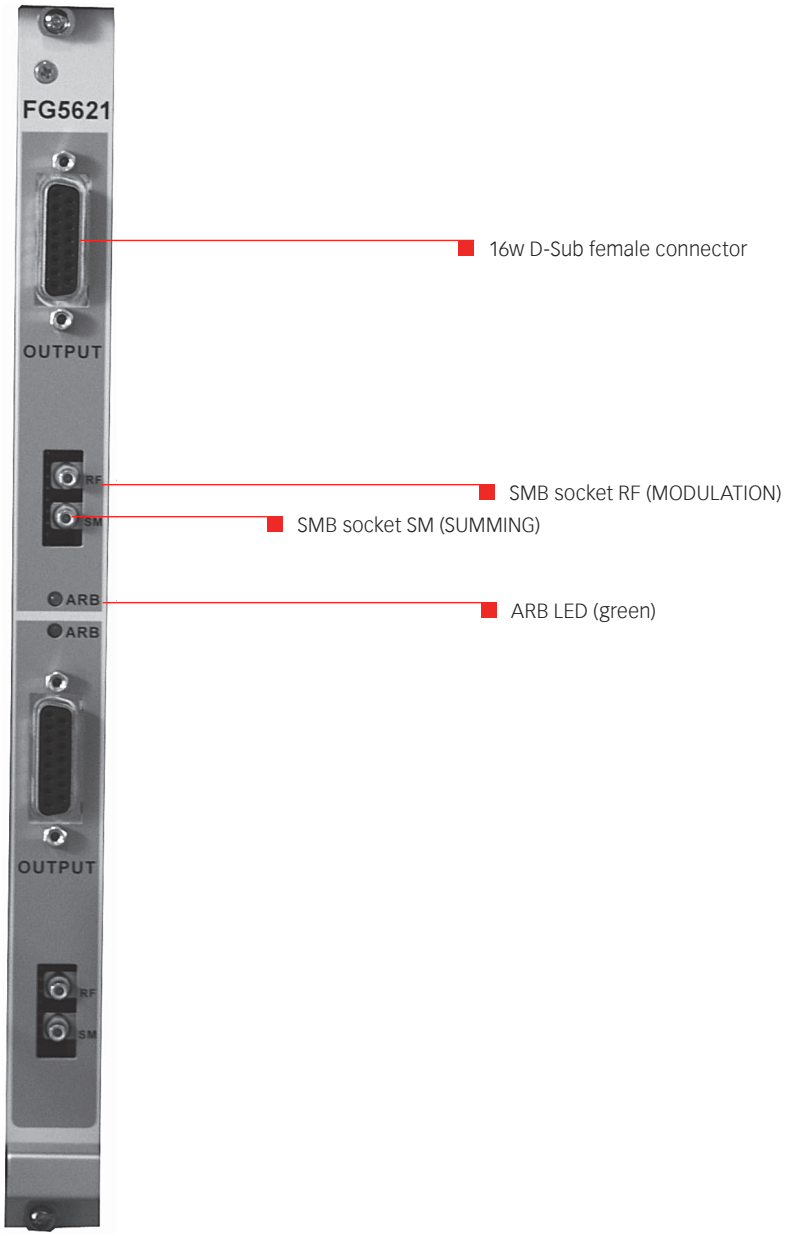
Other features available to the operator are external amplitude variation (useful for (AM) amplitude modulation) and external offset adjustment (useful for generating ripple noise). With an FG 5621, one FG card can generate an output signal, which is fed into the other FG. An isolated output is also provided if this is required although the frequency bandwidth is reduced. An auxiliary programmable DC output is also available. This is used for pulse 4d applications, where fast switching between two DC sources is required. Thus, one FG card can control two DC power supplies. Finally, a programmable current limit output is provided for DC sources that have this feature.

During Power Magnetics testing the FG 5620 receives a voltage and current readback from either a DS 5630 or PA 5640 module during operation, depending upon which application is running. It passes these values to the CT 5610 via the CAN bus and from there back to the PC via IEEE 488.

The FG 5620 card can be configured as either a master or a slave for use in multiple FG card applications. Using two FG 5621 modules, four synchronous FG cards are possible. Autostar supports four FG cards as standard and the scope supports one FG card (master).

The FG carrier card provides a platform for either one or two FG cards, depending upon whether the operator has a FG 5620 or an FG 5621. The FG 5620 module plugs into the NSG 5600 chassis, deriving power from the backplane. There is no configuration required for the FG 5620 or FG 5621. For three or four FG cards, refer to chapter 3.7.2 Configuration or document IS702-0126.

4.3.3 FG 5620 module pin assignments



Picture 4-9: FG 5620 Front panel connectors

4.3.3.1 15 way D-Sub female

Pin no.	Pin name	Function
1	+ILim	-10 to +10 V output used for programming the current limit of a source
2	+Aux	-10 to +10 V output used for programming an auxiliary source in pulse 4d applications
3		
4	+Vout	Main output from FG card
5	0V1	Reference for CroTrig and Zerocross
6	CroTrig	Goes LOW at the start of a test
7	-Vmeas	Currently unused
8	-IMeas	Currently unused
9	-ILim	Reference for +ILim
10	-Aux	Reference for +Aux
11		
12	-Vout	Reference for +Vout
13	ZeroCross	Changes state as the main output voltage toggles above or below zero. Only valid for zero offset waveforms
14	+Vmeas	Currently unused
15	+Imeas	Currently unused

4.3.3.2 SMB socket SM

Pin no.	Pin name	Function
Centre	Distortion	Allows an external signal to be summed with the generated waveform, e.g. distortion
Case	Reference	

Table 4-5: SMB Socket SM connector pin assignment

4.3.3.3 SMB socket RF

Pin no.	Pin name	Function
Centre	Amplitude modulation	Allows an external signal to control the amplitude of the generated waveform, e.g. amplitude modulation
Case	Reference	

Table 4-6: SMB Socket RF connector pin assignment

4.3.4 Using the arbitrary waveform memory

The FG card generates arbitrary waveforms by two different methods. For pulse 4c, the waveform is created within Autostar using standard waveform segments (e.g. sine, square, triangle and ramp), Autostar then passes the information about each segment to the instrument and the instrument acts accordingly. So, to generate a sine wave Autostar tells the instrument that the waveform is of type sine, is of a certain amplitude and frequency etc. It does not download the actual voltage level at each time interval into the FG card.

Complex waveforms using the scope utility are generated differently. The following limitations also apply to the Clone™ feature. Autostar does not know (or try to determine) the mathematical representation of the complex waveform. Instead it passes the voltage level at each point in time to the instrument. The instrument stores these values (or bits) in NVRAM on the master FG card. The instrument then determines (based on the duration of the waveform) how fast to clock out the stored bits.

The FG card has 80 kB (limited to 30 kilosamples) of memory reserved for complex waveform generation. The time between 2 individual bits (known as the step resolution) can be varied (by varying the waveform time) from 80 ns to 10 s (up to 200 s at reduced accuracy). Thus, a waveform of 50 kB could have a minimum duration of 10 ms (200 ns x 50 kBytes) and a maximum duration of 50 ks (at the optimum resolution).

For most applications the user wishes to know the opposite: given a particular waveform duration the user wishes to know whether a waveform can be generated correctly by the FG card.

For example, if the duration of a complex waveform is 5 ms then, by defining 25 kBytes of data the waveform can be clocked out with 200 ns resolution (5 ms / 200 ns = 25 kBytes). If 200 ns resolution is not required, the user may decide to clock out 5 kBytes of data with 1 µs resolution.

It is important to understand, however, the limitations of the 80 kB memory storage. Say a user wanted to generate a sine wave of 80 kHz for 10 seconds (forget for a moment that this can easily be generated by the arb card using the sine function definition as explained above). Could it be stored in the memory and successfully replayed? The answer is No. To generate a single sine wave cycle it is generally agreed requires at least 16 points. An 80 kHz sine wave generates 80,000 cycles every second and so generates 800,000 cycles in 10 seconds. If each cycle is 16 bytes, this implies that 12.8 MB of memory would be needed to accurately produce the sine wave!

It is also worth noting that at 200 ns step resolution the maximum duration of a waveform is 16 ms. This is because 200 ns x 80 kB = 16 ms. To increase the duration requires a reduction in step resolution.

In summary, if the waveform is very fast (and therefore requires a high resolution) or of very long duration the memory capacity of the arb card may not be sufficient to accurately replay the waveform.

NOTE!
Using Clone™ memory during a pulse 4c test is a special hardware mode that works with only one channel. It is necessary to restart the NSG 5600 before multi-channel tests may be run.

4.4 DS 5630 DC switch module

4.4.1 Introduction

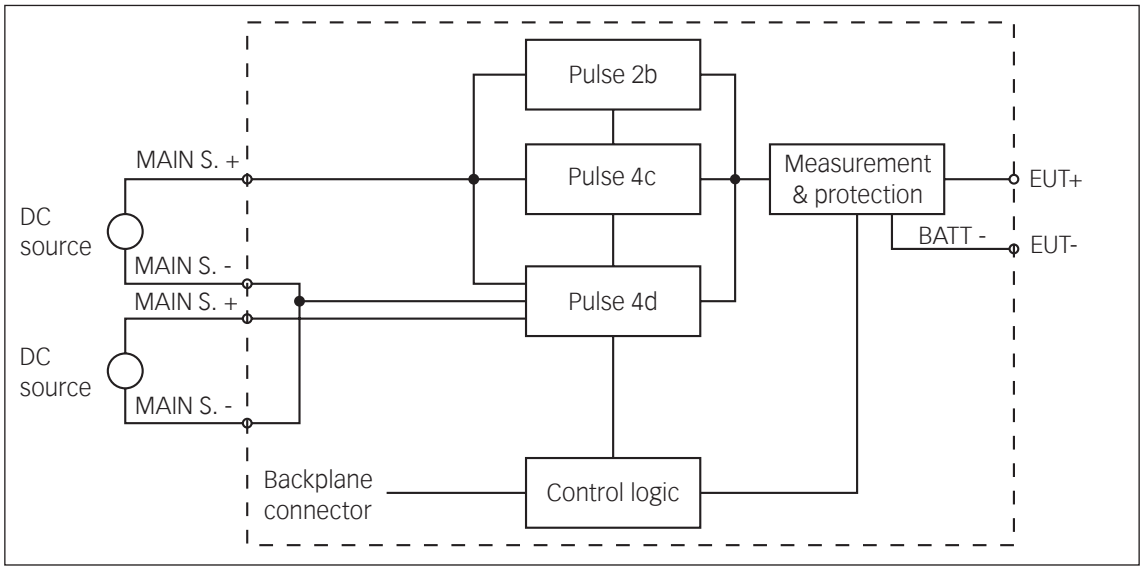
The DS 5630 DC switch module is designed to provide a high power DC switch for automotive industry EMC testing applications. This high-performance component of the NSG 5600 system combined with Autostar software meets all industry standard DC switching requirements.

Picture 4-10: DS 5630 DC Switch module

4.4.2 Functional description

The DCS 5230 module accepts two DC inputs and provides an output, which can be rapidly switched between the two inputs. The switching parameters are controlled by the master FG card within the NSG 5600 system and ultimately by the user through Autostar.

The module also accepts the battery input for pulse types 4c (arbitrary waveform) and 2b. For pulse 4c the battery is simply passed from input to output with no pulse modification, while for pulse 2b the system houses the required 2 Ω impedance that may be necessary during the pulse generation.



Picture 4-11: Block diagram of DS 5630 showing 2 external sources connected to it for pulse 4d

The main battery input is fed into the 6 mm connectors labelled “Main source input“ on the front panel. For pulse 4d applications, the second DC source should be connected to the 6 mm connectors labelled “Auxiliary source input“ on the front panel. For all other pulse applications, other than pulse 4d, the **auxiliary shorting plug** should be connected from “Auxiliary Input +“ to “Auxiliary Input -“.

The two DC source voltages are combined in the DS 5630 to provide a single output, which is brought out on 6 mm connectors labelled “EUT“ on the front panel.

The front panel also has two circuit breakers, one rated for 75 A and the other for 25 A. The 75 A MCB provides overcurrent protection in the main battery path for SVV tests while the 25 A MCB provides overcurrent protection for CSW and PM tests. For correct operation ensure that these MCBs are switched to “ON“.

The DS 5630 provides a voltage and current readback of the battery during operation. It also has built in overcurrent, overvoltage, reverse voltage, inductive load and overtemperature protection for all pulse types.

The DS 5630 module plugs into the NSG 5600 chassis, deriving power from the backplane.

NOTE!
The measurement and protection subcircuit has approximately 20 Ω impedance. Therefore it is not possible to provide a completely open circuit test during dips and drops testing.

4.4.3 Connectors

Picture 4-12: DS 5630 Front panel connectors

Connector	Description	Function
Main source +	Round 6 mm red connector	These connectors connect the battery source to the DS 5630.
Main source -	Round 6 mm black connector	
Main source + sense	Round 2 mm red connector	
Main source - sense	Round 2 mm black connector	
Auxiliary source +	Round 6 mm blue connector	These connectors connect the auxiliary source to the DS 5630 for use in dips and drops (4d).
Auxiliary source -	Round 6 mm black connector	
Auxiliary source + sense	Round 2 mm red connector	
Auxiliary source - sense	Round 2 mm black connector	
EUT +	Round 6 mm red connector	These connectors connect the DS 5630 to the EUT or to the NSG 5500 battery Input, if present.
EUT -	Round 6 mm black connector	
Backplane control connector	96 way DIN 41612 type C	This connector connects the DS 5630 to the NSG 5600 backplane.
Blackplan power connector +	Round 4 mm red connector	These connectors connect the battery to the backplane of the NSG 5600 for use in power magnetics and conducted sine waves.
Blackplane power connector -	Round 4 mm black connector	

Table 4-7: DS 5630 Connector descriptions

4.5 PA 5640 power amplifier module

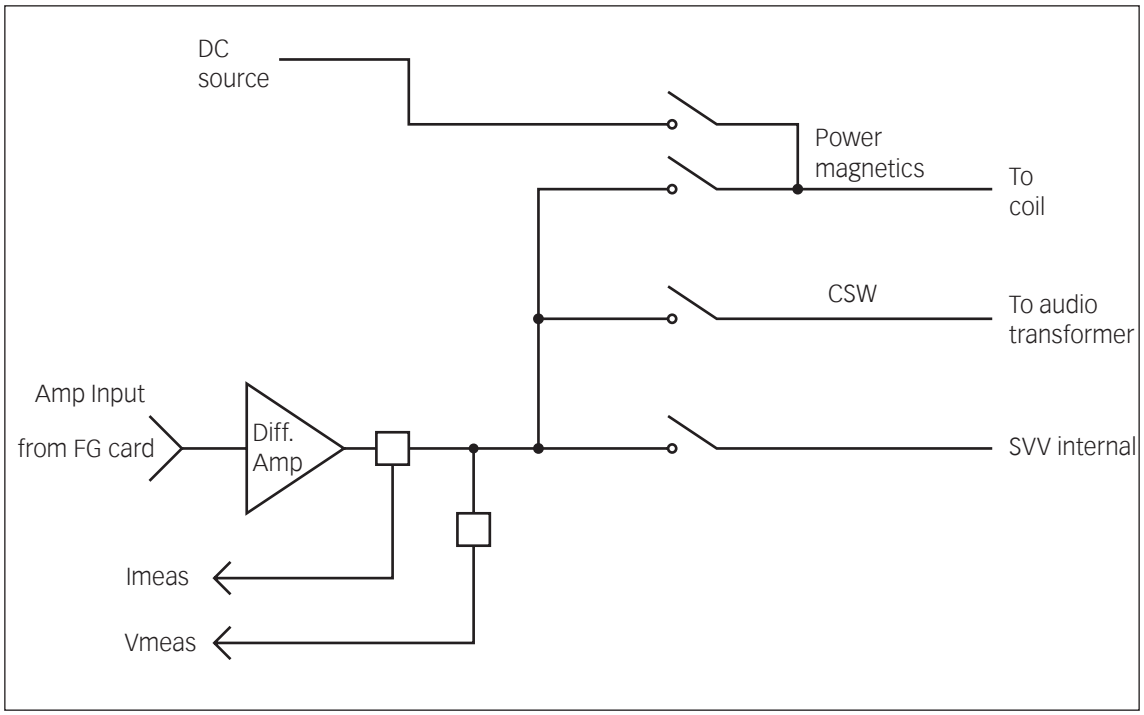
4.5.1 Introduction

The PA 5640 power amplifier module is designed to provide a high frequency power amplifier for particular tests defined within the automotive industry, namely power magnetic immunity testing (PM) and conducted sine wave testing (CSW). This high performance component of the NSG 5600 system combined with AutoStar software meets all industry standard requirements for these tests. The PA 5640 has the same bandwidth as the FG cards (320 kHz).

Picture 4-13: PA 5640 Power amplifier

4.5.2 Functional description

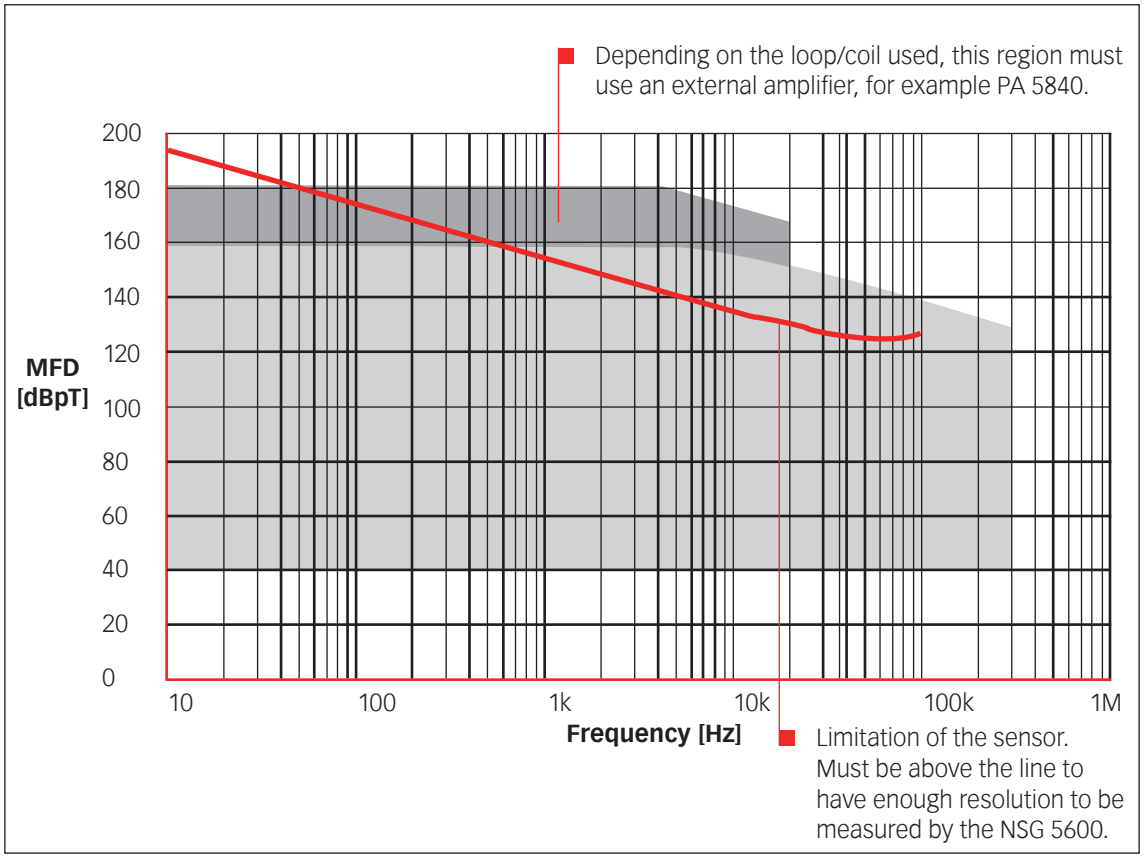
The PA 5640 module accepts an input from the master arb card within the NSG 5600 system and produces an amplified version of the signal at one of it's three outputs, depending upon the application chosen in Autostar. The switching parameters are controlled by the ARB card and ultimately by the user through Autostar.



Picture 4-14: Basic block diagram of the PA 5640

If CSW testing is being performed, then the output of the PA 5640 is fed to the primary of an audio isolation transformer, in accordance with the standards defined within the industry. The transformer couples the amplifier output (usually a sine wave) onto the secondary of the transformer, which usually have a DC source attached. Thus a sinusoidal ripple up to several hundred kHz can be produced on top of the DC supply.

For power magnetics testing the amplifier is used in conjunction with an external DC source and automatically controlled using Autostar. At low frequencies the currents needed to generate the required magnetic field density are quite large and can be met using a PA 5840 or equivalent DC source. As the frequency increases, the currents needed to generate the required magnetic field density are lower and the PA 5640 then provides the power source. In power magnetics mode the PA 5640 is set up as a current source rather than a voltage source. The module also contains voltage and current readback circuitry to the FG card to allow accurate control over these parameters. The PA 5640 can drive either a radiating loop or a Helmholtz coil, depending upon the standard that is being tested.



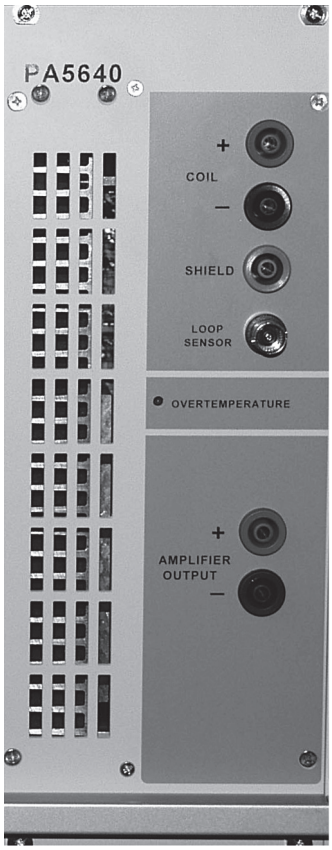
Picture 4-15: Power magnetics limitation using solar 9230-1 and loop sensor

NOTE!
These values will change when using other radiating loops or Helmholtz coils.

A third output on the PA 5640 is provided where the operator may only need to test up to 13.5 V at low current (a few amps). In these situations the direct output of the PA 5640 may be used as a DC amplifier, with frequencies from DC to 320 kHz and a ±15 V 5 A output. This is achieved by selecting, within Autostar software, the PA 5640 as the battery source. The output of the FG card is then directed along the backplane to the PA 5640. The amplified signal appears on the output connection "Power Amplifier Output".

The PA 5640 module plugs into the NSG 5600 chassis, deriving power from the backplane. The module does not need to be configured.

4.5.3 Connectors



Picture 4-16: PA 5640 Front panel connectors

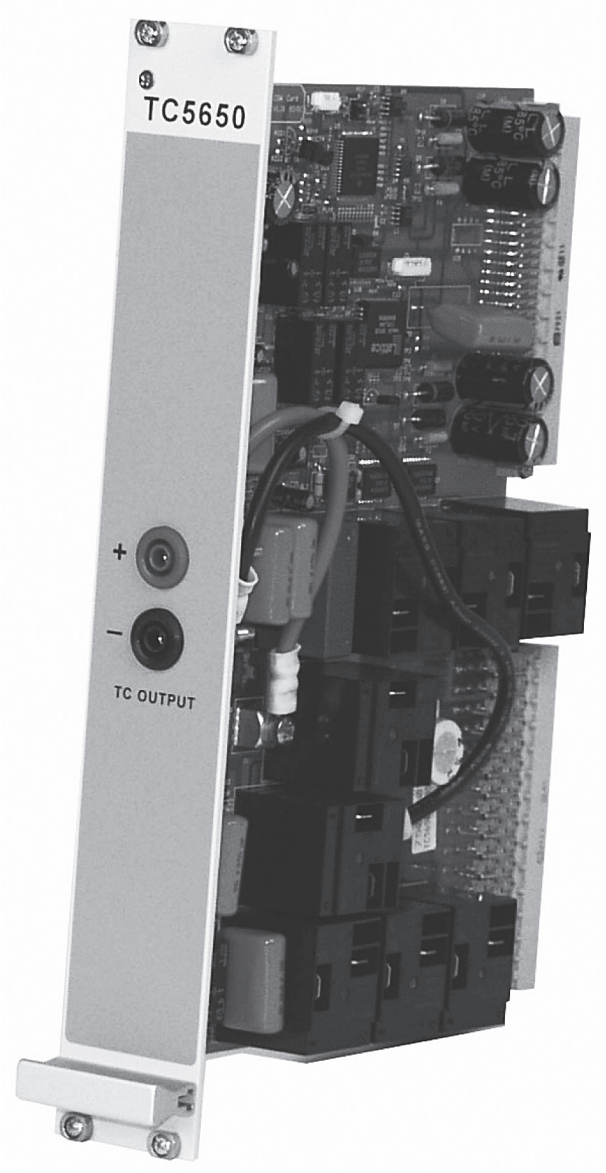
Connector	Description	Function
Coil +	Round red 4 mm socket	These connectors are connected to radiating loop or Helmholtz coil in power magnetics.
Main source -	Round black 4 mm socket	
Main source + sense	Round blue 4 mm socket	
Loop sensor	Female BNC connector	This is a voltage input from the loop sensor which is attached to the radiating loop.
Amplifier output +	Round red 4 mm socket	These connections bring the voltage directly from the amplifier output during SVV internal tests.
Amplifier output -	Round black 4 mm socket	

Table 4-8: PA 5640 Front panel connectors

4.6 TC 5650 conducted sine waves module

4.6.1 Introduction

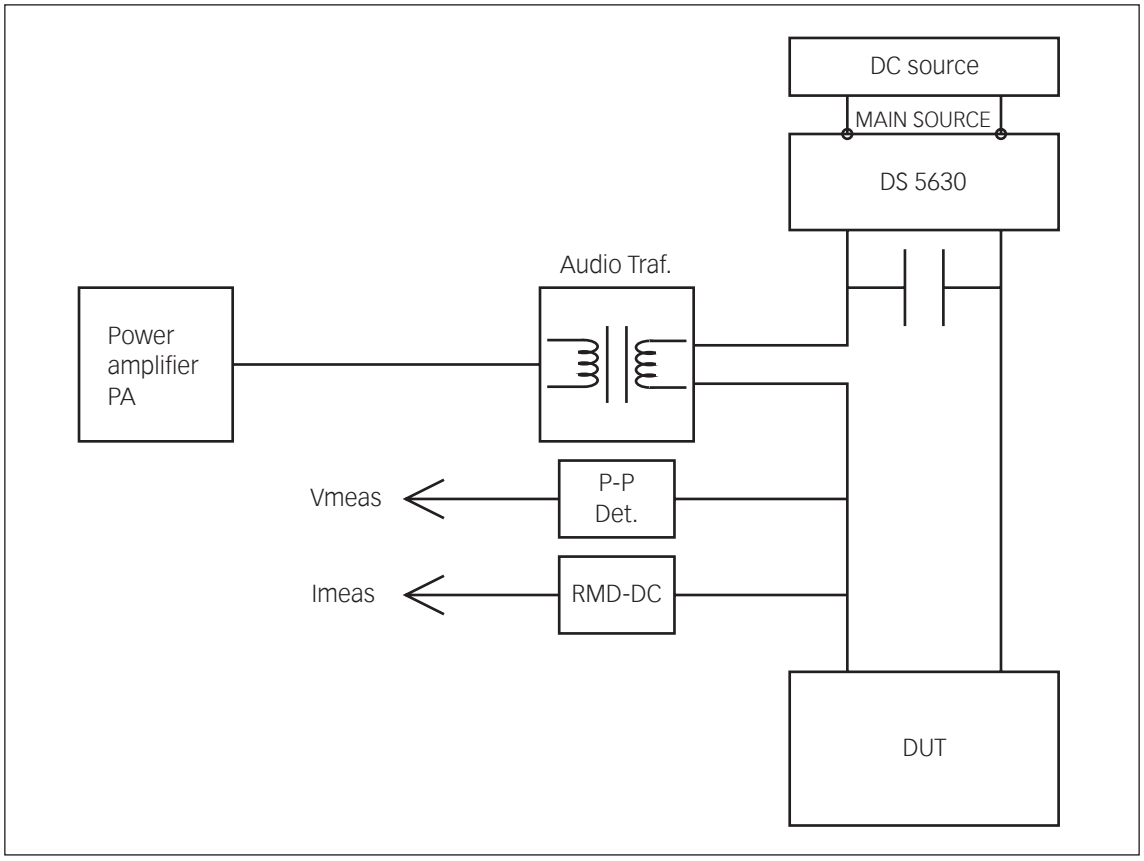
The TC 5650 conducted sine wave module is designed for use when conducted sine wave testing (CSW) is required.



Picture 4-17: TC 5650 Conducted sine waves module

4.6.2 Functional description

The TC 5650 module provides an output, which is effectively the secondary of the audio transformer defined in the CSW automotive standards. Depending upon the standard, the audio transformer secondary may be connected to either the positive or negative side of a DC source. The TC 5650, controlled by Autostar, provides this connection automatically. It also provides an option to switch in a 100 µF bypass capacitor, as defined in the standards.



Picture 4-18: Basic block diagram of the TC 5650

The TC 5650 provides a voltage and current readback to Autostar via the master arb card, during CSW tests. These parameters are displayed on the screen in real time during the test.

The TC 5650 module plugs into the NSG 5600 chassis, deriving power from the backplane. The module does not need to be configured.

4.6.3 Connectors

Picture 4-19: TC 5650 Front panel connectors

Connector	Description	Function
TC Output +	Round red 4 mm socket	These jacks connect the secondary of the audio transformer to the DUT.
TC Output -	Round black 4 mm socket	

Table 4-9: TC 5650 Front panel connectors

5 MAINTENANCE

Under normal conditions, it does not take much effort to keep your test equipment in good working order.

CAUTION!
Protect the equipment against moisture, heat and dust.

5.1 Cleaning the equipment

To clean the equipment, use a dry, clean cloth. Never use water, any other liquid or detergent.

5.2 Moving and storing the device

The device must be installed/uninstalled only by qualified personnel. Before moving the equipment (even over a short distance), you must first turn it off and disconnect it from the mains. Remove any fixturing devices and/or test objects. Also, disconnect the equipment from any peripherals. For longer transit, protect the equipment against humidity, dust and shock by proper packaging.

The equipment must be stored in upright (working) position. Make sure the equipment is protected against humidity, dust and dirt.

Observe the environmental conditions specified in chapter 6.2 Environmental conditions.

5.3 Protection/fuses

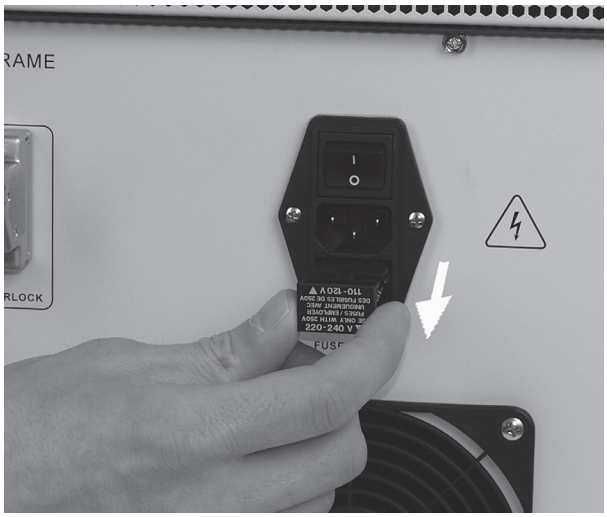
The fuses are placed in the mains voltage selector. To exchange a fuse, proceed as follows:

DANGER!
The NSG 5600 must be disconnected from the mains by disconnecting the power cord before working on the mains voltage selector!

- Carefully loosen the drawer from the input connector assembly using a screwdriver and turning it slightly in both directions as shown in the picture below.

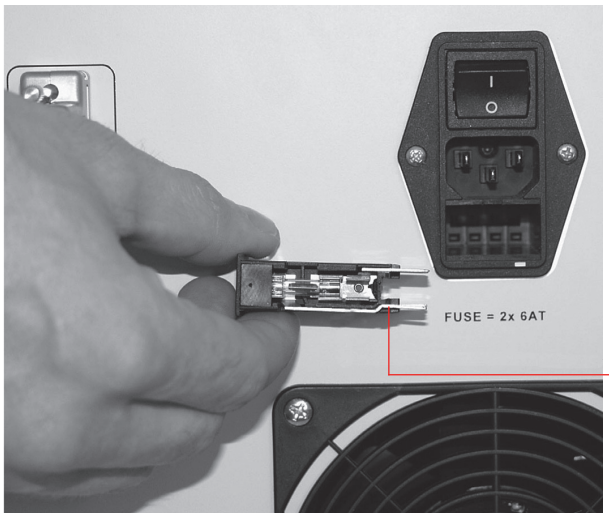
Picture 5-1: Loosen the drawer using a screwdriver

- Pull out the drawer from the input connector assembly.



Picture 5-2: Pull out the drawer

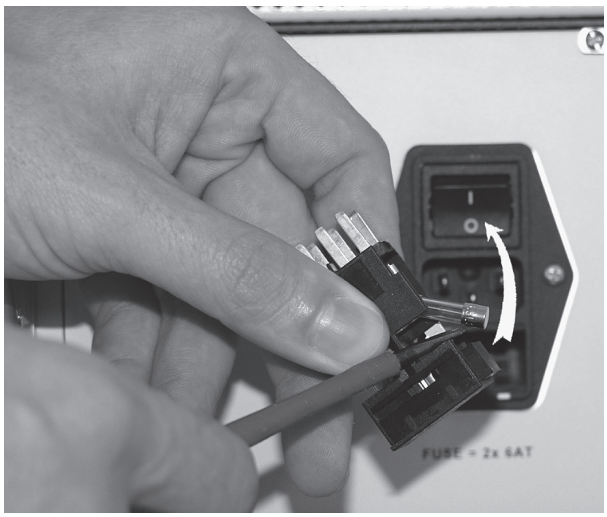
- Remove the defect fuse(s)...



- The defect fuse on the side of the drawer

Picture 5-3: The fuses are placed on the sides of the drawer

- ...probably carefully using a small screwdriver.



Picture 4-5: Remove defect fuses

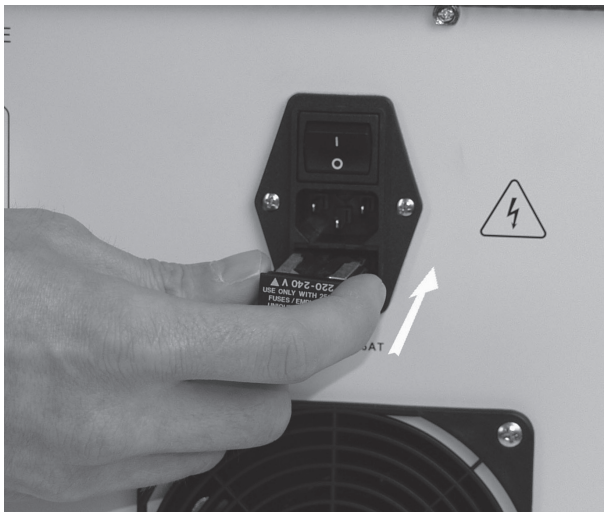
- Replace defect fuses by new ones.

CAUTION!
Use the following fuse types

5 x 20 mm, 6 A, time-lag

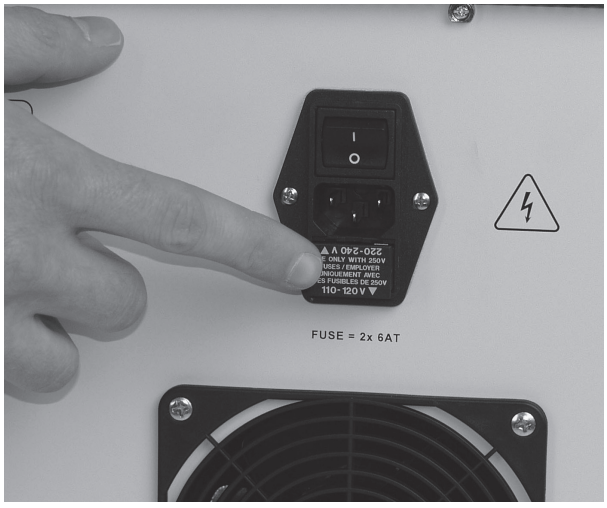
Take care to install the drawer to the correct voltage range when reinstalling the drawer into the input connector assembly.

- Push the drawer back in...



Picture 5-5: Push the drawer back in

- ...until it is fixed to the input connector assembly again.



Picture 5-6: Fix the drawer to the input connector assembly

- Now reconnect the NSG 5600 to the mains.

5.4 Declaration of conformity (CE)

TESEQ
Advanced Test Solutions for EMC

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

Declaration of conformity

CE

Manufacturer:	Teseq AG
Address:	Nordstrasse 11F, 4542 Luterbach, Switzerland
	declares that the following product
Product:	NSG 5600 Battery Disturbance Simulator
Options:	all
	conforms to the following Directives and Regulations
	EMC Directive 2004/108/EEC LVD Directive 2006/95/EEC
Generic standards:	EN61326-1, 2005 EN61326-2-1, 2005 EN61010-1, 2001
	The relevant technical file is available for inspection:
Technical file:	N° EMC_NSG5600_2006 / LVD_NSG5600_2006 Teseq AG CH - 4542 Luterbach

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.

European representative:	Teseq GmbH, Landsberger Str. 255, 12623 Berlin, Germany
Place and Date:	Luterbach, December 12th, 2006

Johannes Schmid
President

6 TECHNICAL SPECIFICATIONS

6.1 Measures and weight

Dimensions:	19“ desktop housing (rack mountable), height 330 mm (13“), depth 510 mm (20“)
Weight:	NSG 5601 18 kg (no modules fitted) NSG 5602 26 kg (no modules fitted)

6.2 Environmental conditions

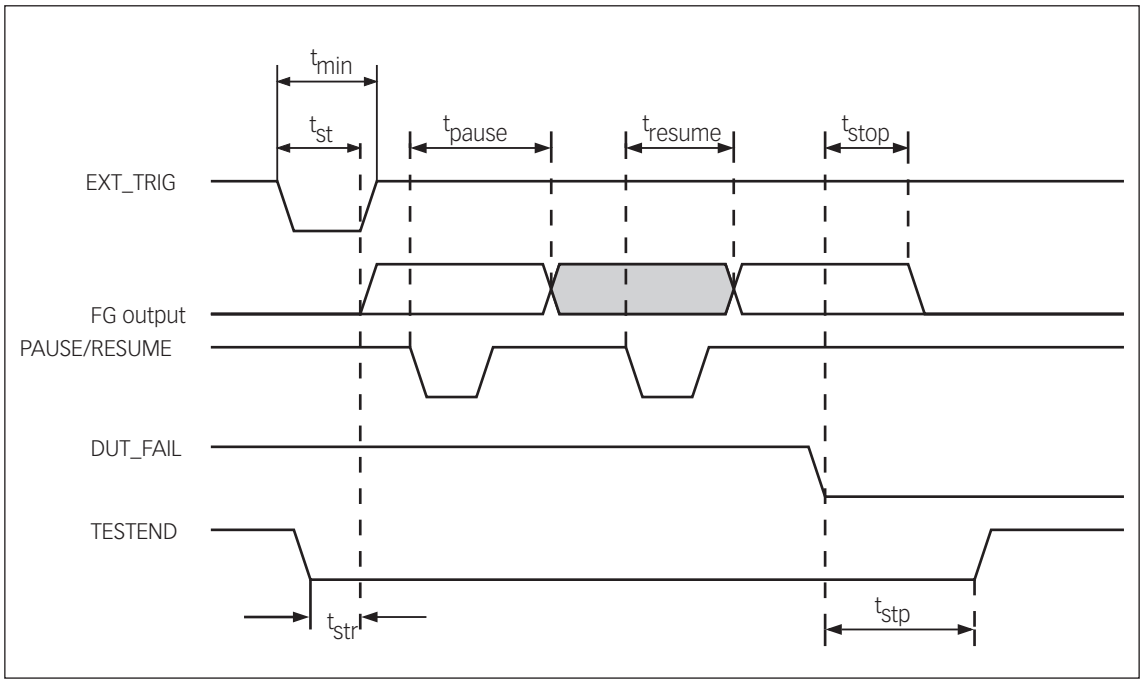
Temperature range:	operation at +10 to +40°C storage at -10 to +60°C
Humidity:	30 to 75% (non condensing)
Air pressure:	860 to 1060 hPa

6.3 Basic chassis technical specifications

Parameter		Min	Max	Units	Notes
AC operating voltage range		90	264	Volts	2 operating ranges, 100 – 120 V 220 – 240 V
AC operating current	110 V	4.2		Amps	2 x 6 A 20 mm fuses fitted as standard
	220 V	2.1			
AC operating frequency		47	63	Hz	
Control bus		CAN			
Safety interlocks		Yes			
Auxiliary input signals	DUT_FAIL	Yes			
	EXT_TRIG	Yes			
	PAUSE/RESUME	Yes			
Minimum pulse width	t_{min}	10		µs	Auxiliary input signals
EXT_TRIG to test start time	t_{st}		50	ms	EXT_TRIG to test start time
PAUSE/RESUME to test pause time	t_{pause}		50	ms	PAUSE/RESUME to test pause time
PAUSE/RESUME to test resume time	t_{resume}		50	ms	PAUSE/RESUME to test resume time
DUT_FAIL to test stop time	t_{stop}		50	ms	DUT_FAIL to test stop time
Test start to TESTEND active	t_{str}		1	ms	Test start to TESTEND active
Test start to TESTEND in-active	t_{stp}		1	ms	Test start to TESTEND in-active
Connectors	J1	CAN bus			
	J2	Unused			
	J3	Unused			

Table 6-1: Basic chassis technical specifications

6.3.1 Auxiliary signals timing diagram



Picture 6-1: Auxiliary signals timing diagram

6.4 CT 5610 technical specifications

Parameter		Min	Max	Units	Notes
Module dimensions	Width	8		HP	1 HP = 5.08 mm
	Height	6		U	1 U = 44.45 mm
	Depth	170		mm	
Internal control bus		CAN			
IEEE 488 (GPIB)		Yes			Default address = 9
Front panel indicators	Ready	Green LED			
	Active	Amber LED			
	Fault	Red LED			

Table 6-2: CT 5610 Technical specifications

6.5 FG 5620 / FG 5621 technical specifications

6.5.1 FG 5620 / FG 5621 main output

Parameter		Min	Max	Units	Notes
Output voltage	Range	-10	+10	V	
	Resolution	10		mV	
	Accuracy	± (0.1% + 10 mV)		mV	
Offset voltage			10	mV	
Output impedance			10	Ω	
Output current		± 100		mA	
Short circuit protection		Yes			
Frequency range	Sine, square, triangle	0.01	320000	Hz	Limited in cycle mode to 4 kHz
Frequency resolution		0.01			
Frequency accuracy		± (0.01% + 0.01 Hz)			
Slew rate	-10 to 10 V	120		V/µs	1 k load
	10 to -10 V	120			
Full scale settling time, 1%	0 to 10 V		0.5	µs	1 k load

Table 6-3: Technical specifications FG 5620 / FG 5621 main output

6.5.2 FG 5620 / FG 5621 auxiliary output

Parameter		Min	Max	Units	Notes
Output voltage	Range	-10	+10	V	
	Resolution	10		mV	
	Accuracy	± (0.5% + 50 mV)		mV	
Output impedance			1	Ω	
Output current		± 25		mA	
Short circuit protection		Yes			

Table 6-5: Technical specifications FG 5620 / FG 5621 auxiliary output

6.5.3 FG 5620 / FG 5621 general

Parameter		Min	Max	Units	Notes
Standard segment types		Sine, square, exponential, triangle and ramp (including DC)			
Number of segments per waveform		1	100		
Arbitrary waveform storage	Memory capacity	80		kB	30 kilosamples max.
	Step resolution	200 ns	1	s	Up to 200 s step resolution possible at reduced accuracy
	Step accuracy		0.5	%	At a step resolution of 1s
Segment interval delay	Time mode		200	µs	
	Cycle mode		0		
Ramp step time	Sine, square, triangle	5		ms	Does not apply to arbitrary waveform storage types
Amplitude ramping options	Sine, square, triangle	Linear			
Offset ramping options	Sine, square, triangle	Linear			
Frequency ramping options	Sine, square, triangle	Linear, Log_{10}			
Segment duration	Sine, square, triangle	5	9995	ms	Resolution 5 ms
	Ramp	0.5	1000		Resolution 0.1 ms
	All	0.1	9999	s	Resolution 0.1 s
		0.1	9999	min	Resolution 0.1 min
		0.1	9999	h	Resolution 0.1 hour
		1	10000	Cycles	Resolution 1 Cycle
	Accuracy	± (1% + 1 ms)			Not applicable to cycle mode

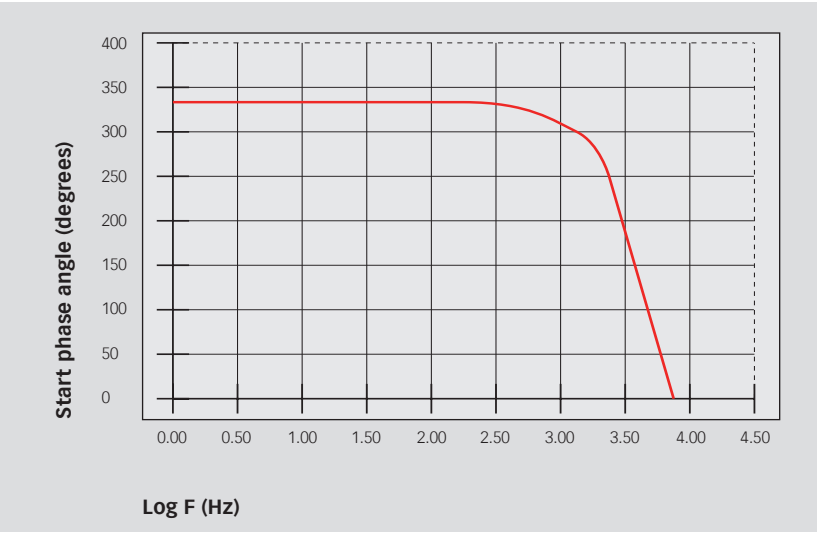
Table 6-6: Technical specifications FG 5620 / FG 5621 general

Parameter			Min	Max	Units	Notes
Overall test duration		Range	1	9999	Count	
			Continuous			
Start phase angle		Value	0	345	Degrees	See figure 6-2
		Resolution	15			
		Accuracy	1° or ± 2 µs			
Stop phase angle		Value	15	360		See figure 6-3
		Resolution	15			
		Accuracy	1° or ± 2 µs			
Square wave duty cycle variation	Range	0.01 to 160 kHz	5	95	%	
		160 to 360 kHz	25	75		
	Resolution	0.01 to 160 kHz	5		%	
		160 to 360 kHz	25			
	Accuracy	0.01 to 5 kHz	± 0.05		%	
		5 to 10 kHz	± 0.1			
		10 to 20 kHz	± 0.2			
		20 to 40 kHz	± 0.4			
		40 to 80 kHz	± 0.8			
		80 to 160 kHz	± 1.6			
		160 to 320 kHz	± 3.2			
Rectification		Sine, square, triangle	None, positive, negative			
Voltage distortion		Range	-10	+10	V	
		Frequency	DC	1	MHZ	

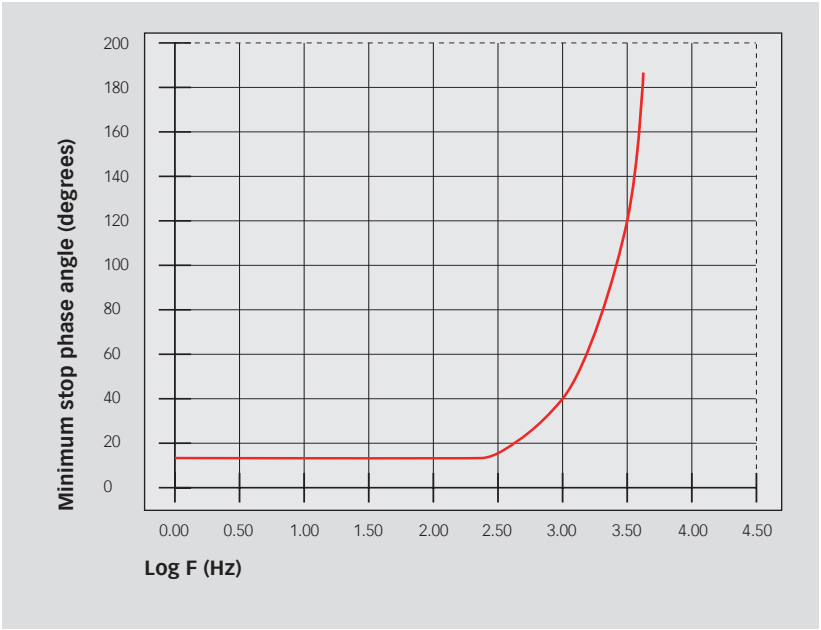
Table 6-6: Technical specifications FG 5620 / FG 5621 general

Parameter		Min	Max	Units	Notes
Amplitude modulation	Range	-10	+10	V	
	Frequency	DC	1	MHz	
Connectors	Main output	15 Way D-sub socket			
	V_{RF}	SMB socket			
	V_{SM}	SMB socket			
	Control	3x 32 Way DIN 41612 Type C			Plugs into NSG 5600 backplane
Number of FG cards	FG 5620	1			
	FG 5621	2			
Multiple FG card synchronisation delay			100	ns	
Event timing	Start trigger	Goes LOW at start			Only valid for multiple FG cards
Module dimensions	Width	4		HP	1 HP = 5.08 mm
	Height	6		U	1 U = 44.45 mm
	Depth	170		mm	
Control bus	Type	CAN			
	Protocol	CANOpen			
	Speed	125		kBits/s	
	ID Range	1 to 15			0 reprogramms the NVRAM, 1 is the master FG card, 4Way DIP switch sets the address
Front panel indicators	FG 5620	1x Green LED			
	FG 5621	2x Green LED			

Table 6-6: Technical specifications FG 5620 / FG 5621 general



Picture 6-2: Maximum start phase angle versus frequency



Picture 6-3: Minimum stop phase angle versus frequency

6.6 DS 5630 technical specifications

6.6.1 DS 5630 - Pulse 4c path specifications

Parameter		Min	Max	Units	Notes
Battery input voltage U_B	Range	-14	70	V	
	Resolution	0.1			
	Accuracy	± (1% + 0.2 V)			
Battery input current	Range	0	75	A	
Maximum DC voltage drop	I_L = 75 A		1	V	
Input to output DC resistance				mΩ	
Inrush current	t = 100 ms		150	A	
Internal quiescent current	Pulse 4c		0.01		
Test duration	Range	1	9999	Count	Resolution 1 count
		Continuous			
Battery voltage readback measurement	Ratio	0.1		V / V	
	Accuracy	5		%	0.01 Hz to 30 kHz
		20			30 to 300 kHz
	3 dB BW	300		kHz	
Battery current readback measurement	Ratio	0.1		A / A	
	Accuracy	5		%	
	Bandwidth	20		kHz	

Table 6-7: Technical specifications DS 5630 - pulse 4c path specifications

6.6.2 DS 5630 - Pulse 4d path specifications

Parameter		Min	Max	Units	Notes
Battery input voltage U_B	Range	0	60	V	See figure 6-5 for safe operating area curve
AC operating current	Resolution	0.1			
	Accuracy	± (1% + 0.2 V)			
Auxiliary input voltage V_A	Range	0	U_B	V	
	Resolution	0.1			
	Accuracy	± (1% + 0.2 V)			
Battery input current	Range	0	75	A	
Auxiliary input current	Range	0	75		
Battery voltage drop	I_L = 75 A		2	V	See figure 6-4
Auxiliary voltage drop			2		
Quiescent current	V_B = 60 V		3	A	See figure 6-6
Inrush current, battery and auxiliary paths	t = 100 ms		100	A	
Battery off fall time	1 kΩ load	0.5	1.5	µs	Measured directly at output of the DS 5630. Purely resistive load
	1 Ω load		5		
Battery on rise time	1 kΩ load	0.2	1.5		
	1 Ω load		6		
Pulse width t_d	Range	3 µ	20	s	
	Resolution	1		µs	
	Accuracy	± (1% + 1 µs)			
Pulse interval t_1	Range	0.5 m	20	s	When ramping any parameter, t_1 (min) = 1.5 ms
	Resolution	0.1		ms	
	Accuracy	± (1% + 1 ms)			
Burst interval delay	Range	0	9999	s	Resolution 1 s
		0	9999	min	Resolution 1 min
		0	9999	h	Resolution 1 h
	Accuracy	± (1% + 1 s)			
No. of pulses per burst		1	10000		
Pulse modes		Normal or inverted			

Table 6-8: Technical specifications DS 5630 - pulse 4d path specifications

Parameter		Min	Max	Units	Notes
Auxiliary voltage ramping	Range	0	U_B	V	
	Step size	0.1.			
Overshoot			2.5	%	
Settling time, 1%			50	µs	48 to 12 V dip, 10 µs pulse, 1 Ω load
Sequence duration or repetition	Range	1	9999	s	Resolution 1 s
		1	9999	min	Resolution 1 min
		1	9999	h	Resolution 1 h
		1	9999	Count	Resolution 1 count
		Continuous			
	Accuracy	± (1% + 1 s)			
Start up delay	Range	2 s	9999	s	Resolution 1 s
		2 s	9999	min	Resolution 1 min
		2 s	9999	h	Resolution 1 h
	Accuracy	± (1% + 1 s)			

Table 6-8: Technical specifications DS 5630 - pulse 4d path specifications

6.6.3 DS 5630 - Pulse 2b path specifications

Parameter		Min	Max	Units	Notes
Battery input voltage U_A	Range	0	U_B	V	
	Resolution	0.01			
	Accuracy	± (1% + 0.2 V)			
Pulse 2b output impedance		2.1 ± 10%		Ω	
Pulse 2b output current	Range		25	A	
End of test voltage	Range	0	U_A	V	
Pulse amplitude U_S	Range	1	U_A	V	
	Resolution	0.01			
	Accuracy	± (1% + 0.2 V)			

Table 6-9: Technical specifications DS 5630 - pulse 2b path specifications

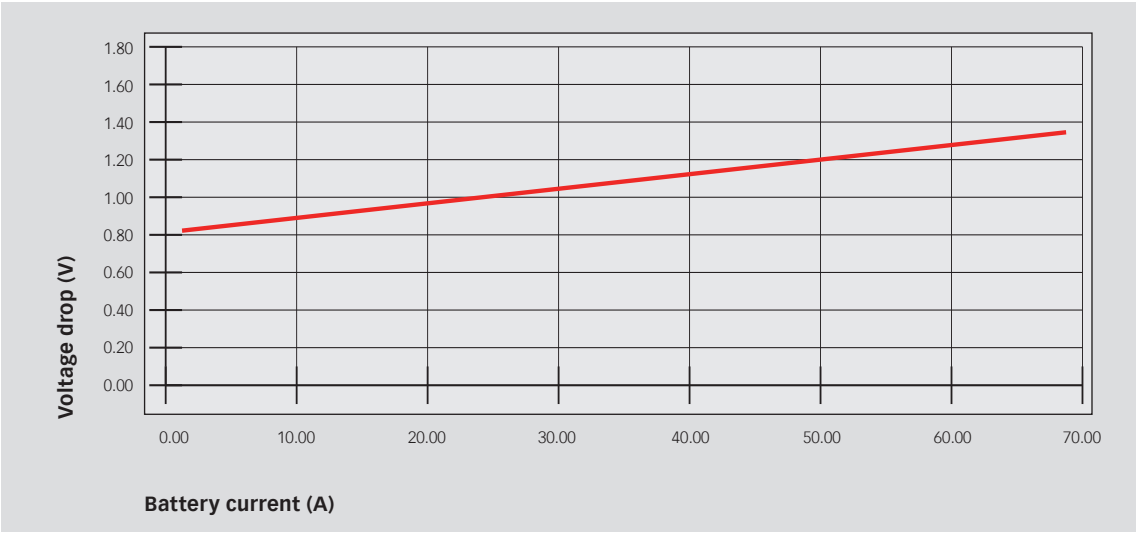
Parameter		Min	Max	Units	Notes
Battery pulse interval time t_6	Range	0	U_B	ms	
	Resolution	0.1			
	Accuracy	± (1% + 0.1 ms)			
Pulse width t_d	10 to 10%	50	5000	ms	
	Resolution	0.1			
	Accuracy	± (1% + 0.1 ms)			
Battery off time t_2	Range	$2t_d$ + 50 ms	30	s	
	Resolution	0.01			
	Accuracy	± (1% + 0.1 ms)			
Pulse repetition time t_1	Range	t_2 + 1 s or $30t_d$	1000	s	
	Resolution	2 s	9999		
	Accuracy	± (1% + 0.1 ms)			
Sequence repetition	Range	1	9999	Count	Resolution 1 count
		Continous			
Current limit	Range	0.1	Imax	A	Imax is the maximum source current but must be <= 25 A
	Resolution	0.01			
	Accuracy	± (1% + 0.1 A)			

Table 6-9: Technical specifications DS 5630 - pulse 2b path specifications

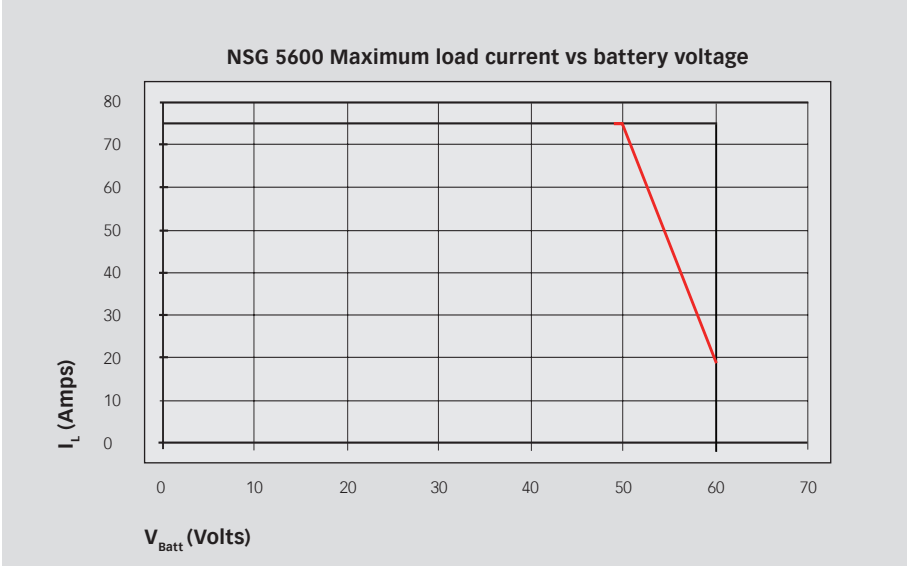
6.6.4 DS 5630 - General specifications

Parameter		Min	Max	Units	Notes
Overcurrent protection	Pulse 4c, 4d	75		A	Fast 75 A MCB
	Pulse 2b	25			Fast 25 A MCB
MCB trip time	75 A MCB	0.4	5	s	Voltage sense and crowbar
	Resolution	0.4	5	s	Reverse voltage diodes
Overvoltage protection	All Paths	75 ±1		V	Voltage sense and crowbar
Inductive load	I = 75 A		300	mH	Derate current accordingly for increased inductive load
Reverse voltage protection	Pulse 4c	-15 ±1		V	Voltage sense and crowbar
	Pulse 4d	-1			Reverse voltage diodes
Module dimensions	Width	40		HP	1 HP = 5.08 mm
	Height	6		U	1 U = 44.45 mm
	Depth	170		mm	
Module weight		6		kg	
Front panel indicators	Power	Green LED			
	Interlock	Red LED			
Internal control bus		CAN			

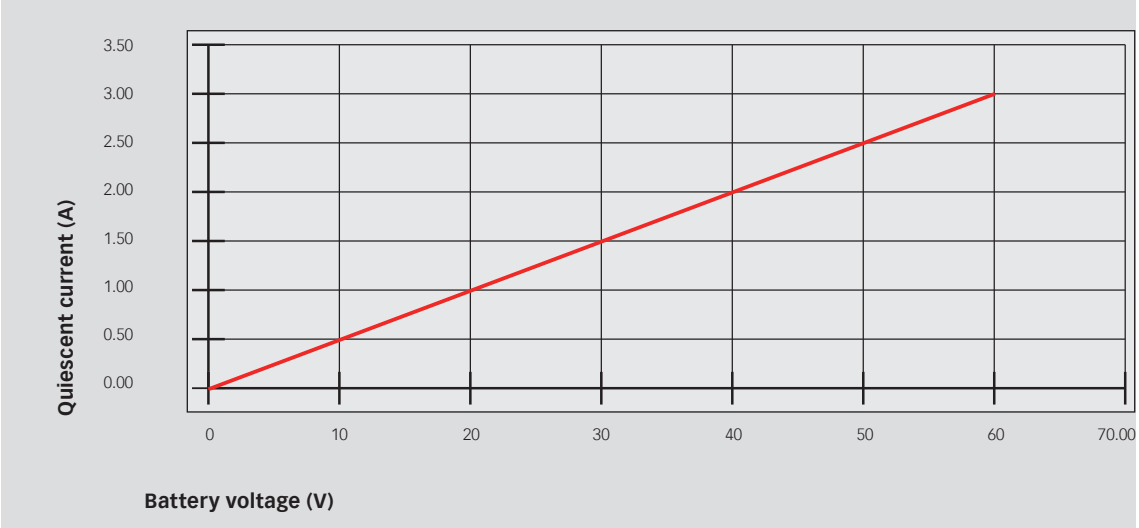
Table 6-10: Technical specifications DS 5630 - pulse 4c path specifications



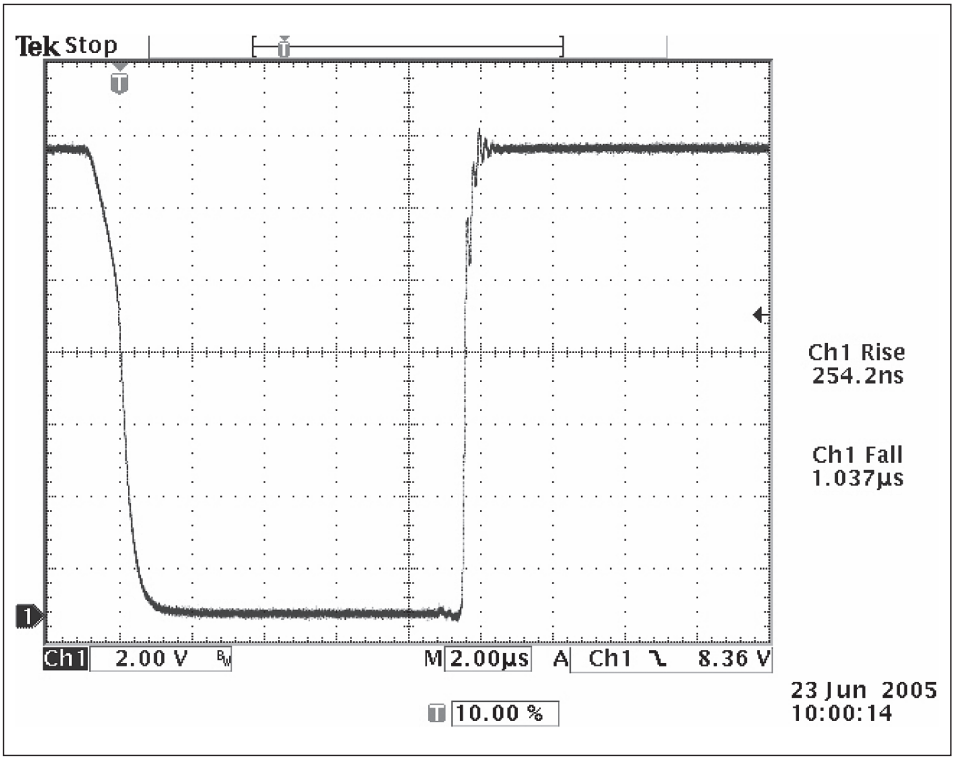
Picture 6-4: Pulse 4d Battery voltage drop vs battery current



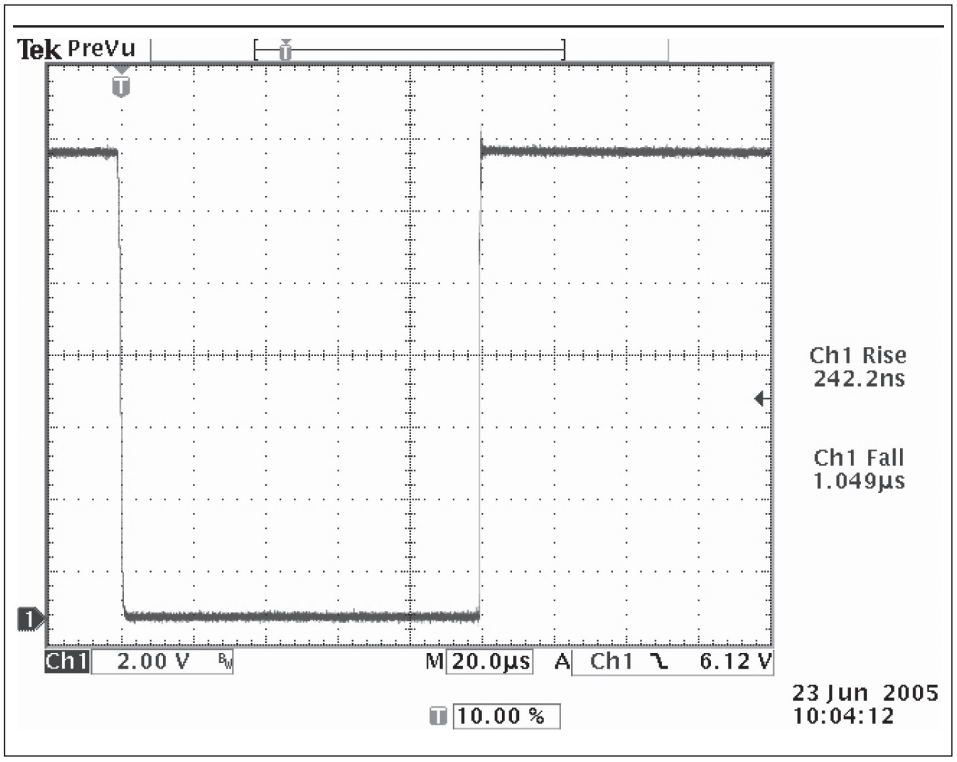
Picture 6-5: Pulse 4d safe operating area (load current vs battery voltage)



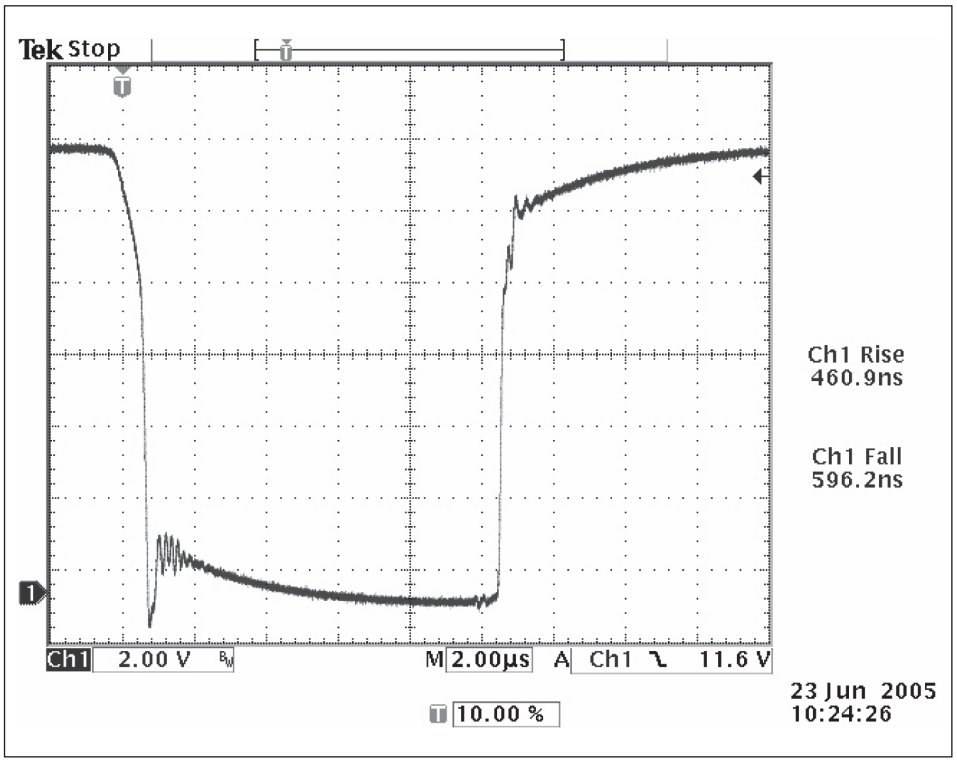
Picture 6-6: Pulse 4d quiescent current vs battery voltage



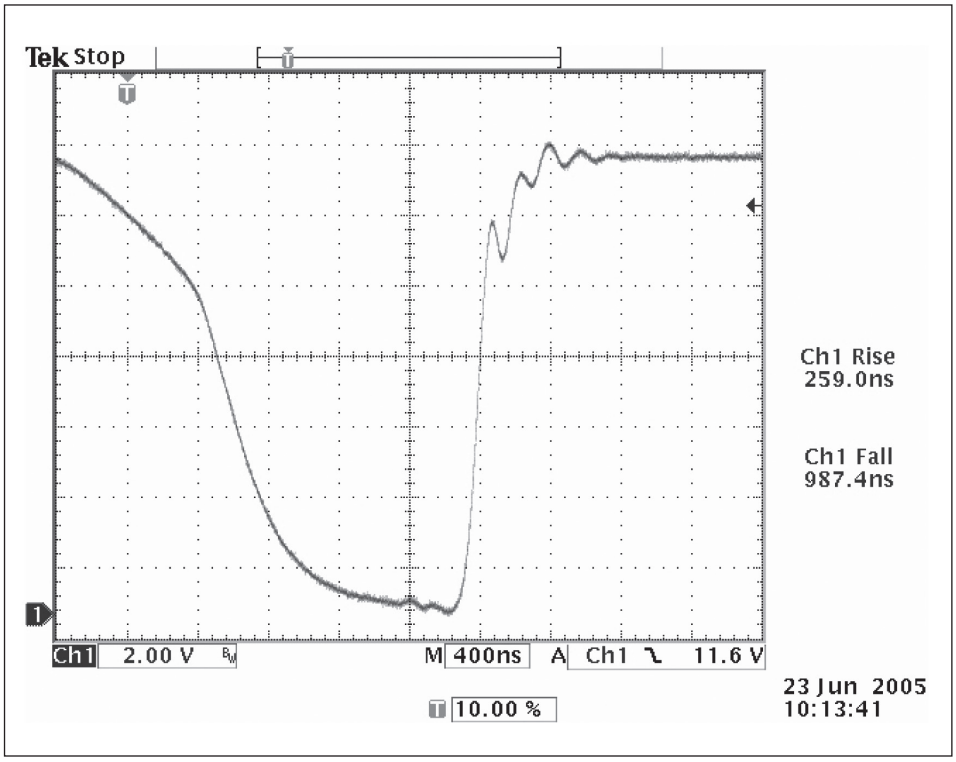
Picture 6-7: 13.5 V Dropout into 1 kΩ load for 10 µs



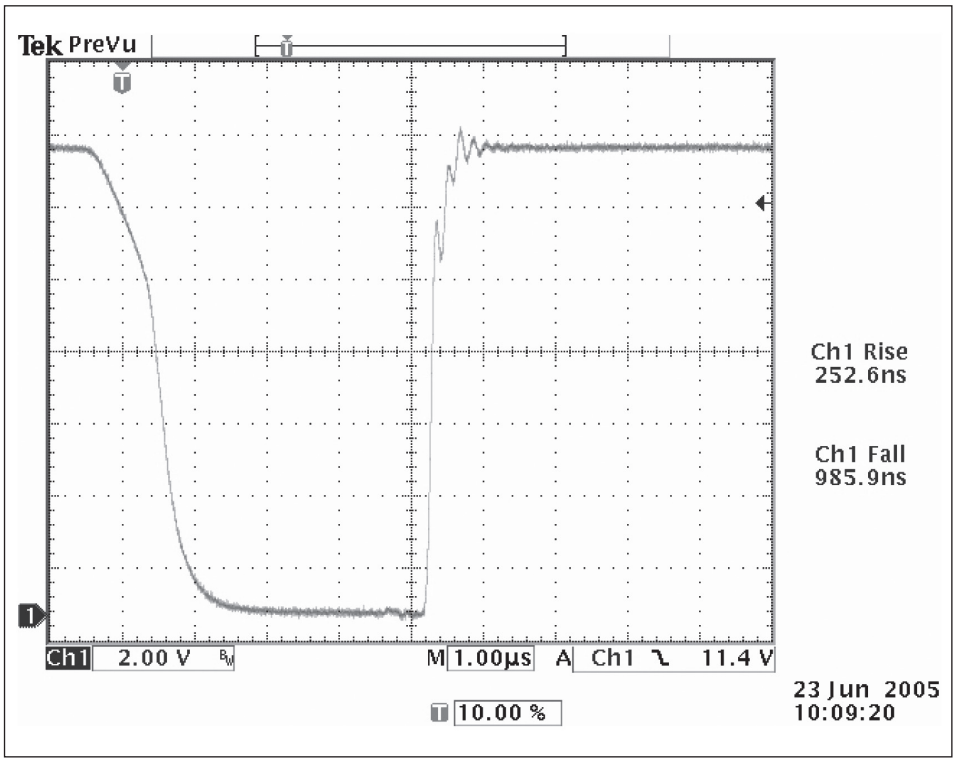
Picture 6-8: 13.5 V Dropout into 1 kΩ load for 100 µs



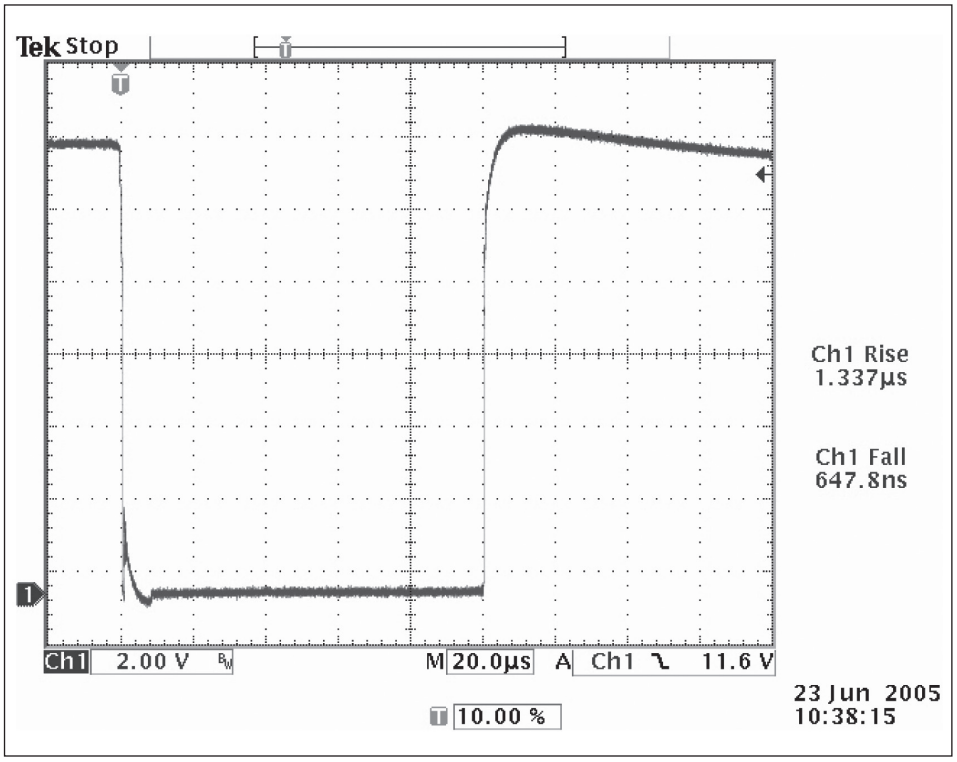
Picture 6-9: 13.5 V Dropout into 1 Ω load for 10 µs



Picture 6-10: 13.5 V Dropout into 1 kΩ load for 3 µs



Picture 6-11: 13.5 V Dropout into 1 kΩ load for 5 µs



Picture 6-12: 13.5 V Dropout into 1 Ω load for 100 µs

6.7 PA 5640 technical specifications

6.7.1 CSW application specifications

Parameter		Min	Max	Units	Notes
Amplifier output voltage	Range	-10	10	V	Audio transformer ratio is 2:1 so the peak voltage on the transformer secondary is 5 V
	Resolution	0.2			
	Accuracy	± (0.01% + 0.01 Hz)			
Amplifier output current			5	A	Maximum output current at the transformer secondary is 10 A
Amplifier frequency	Range	0.01	320	kHz	
	Resolution	0.001			
	Accuracy	± (0.01% + 0.01 Hz)			
Amplifier gain		2			

Table 6-11: Technical specifications CSW application

6.7.2 Power magnetics application specifications

Parameter		Min	Max	Units	Notes
Extern amplifier peak output voltage	Range	-70	70	V	
	Resolution	0.1			
	Accuracy	Amplifier dependant			
External amplifier RMS output current			10	A	
Internal amplifier peak current	Range 1	30	1200	mA	
	Range 2	1	30		
	Range 3	0	1		
Internal amplifier peak output current	Range 1		6	V	R_{int} = 5 Ω
			5		R_{int} = 166 Ω
			5		R_{int} = 5 Ω
Internal amplifier accuracy	All ranges	± (1% + 3 µA)			

Table 6-12: Technical specifications power magnetics application

Parameter		Min	Max	Units	Notes
Amplifier frequency	Range	0.01	>200	kHz	
	Resolution	0.001			
	Accuracy	± (0.01% + 0.01 Hz)			
Internal amplifier gain		1			
Bandwidth	< 5 dB	320		kHz	1 k load. All ranges
Magnetic field density	Range	40	180*	dBpT	RMS Values
	Resolution	0.01			
	Accuracy	± (1% + 0.01 Hz)			Rating loop 9230-1, 0.05 m from loop
Pulse types		Sine			
Step duration		1	9999	s	
Delay between steps		1	9999		
Test types		Point or sweep mode			
Sweep mode step type		Linear, octave, decade			
No. of test points	Point mode	1	100		
	Linear sweep	2	100		
Coil types		Radiating loop/sensor & helmholtz coil			
Connectors	Coil+	Red 4 mm banana socket			
	Coil-	Black 4 mm banana socket			
	Shield	Blue 4 mm banana socket			
	Loop sensor	BNC			

*Example with external loop antenna–I = ID 4)

Table 6-12: Technical specifications power magnetics application

NOTE!
The NSG 5600 supports the loop sensor that is supplied with the solar coil 9230-1 only. See figure 4-15 for limitations.

6.7.3 Supply voltage internal application specifications

Parameter		Min	Max	Units	Notes
Internal amplifier output voltage	Range	-15	15	V	
	Resolution	0.1			
	Accuracy	± (0.1% + 0.01 V)			
Internal amplifier output current		5		A	
Magnetic field density	Range	DC	>200	kHz	
	Resolution	0.01			
Internal amplifier gain		1			
Offset voltage			5	mV	
Bandwidth	< 1 dB	320		kHz	1 k load
Internal amplifier gain		2			
Output impedance		100		mΩ	
Slew rate	-10 to +10 V	43		V/µs	1 kΩ load
Settling time, 1%	-10 to +10 V	<1		µs	1 kΩ load
Connectors	SVV+	Red 4 mm banana socket			
	SVV-	Black 4 mm banana socket			

Table 6-13: Technical specifications supply voltage internal application

6.7.4 General specifications

Parameter		Min	Max	Units	Notes
Battery voltage readback measurement	Ratio	0.1	15	V/V	
	Accuracy	5		%	0.01 Hz to 30 kHz
		20			30 to 300 kHz
	3 dB BW	320		kHz	
Battery current readback measurement	Ratio	0.1		A/A	
	Accuracy	5		%	
	Bandwidth	20		kHz	
Test duration	Range	1	9999	Count	Resolution
		Continous			
Overcurrent protection	External	25		A	Fast 25 a MCB
	Pulse 2b	25			Fast 25 a MCB
Module dimensions	Width	20		HP	1 HP = 5.08 mm
	Height	6		U	1 U = 44.45
	Depth	170		mm	
Module weight		2		kg	
Front panel indicators	OverTemp	Red LED			
Internal control bus		CAN			
Backplane connectors	Bus	96 way DIN 41612, type C			
		48 way DIN 41612, type E			

Table 6-14: General specifications

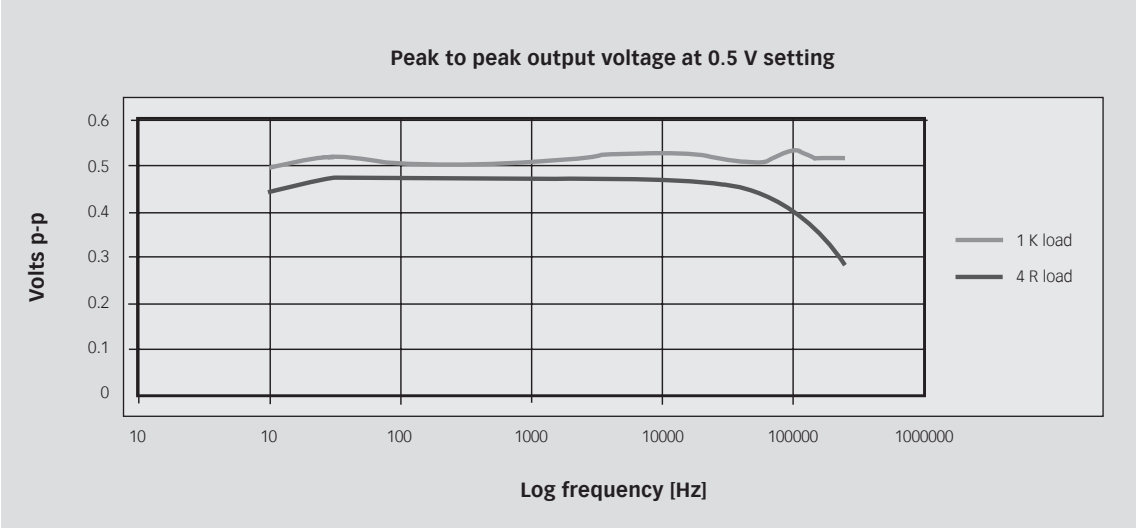
6.8 TC 5650 Technical specifications

Parameter		Min	Max	Units	Notes
Battery voltage	Range	0	70	V	
	Resolution	0.1			
	Accuracy	± (1% + 0.2 V)			
Maximum battery DC current			25	A	
DUT AC voltage	Range	0.05	15	V_{pk-pk}	
	Resolution	0.01		V	
DUT AC current	Range	0	7	A_{RMS}	
DUT output frequency	Range	10	250000	Hz	Limited to 5 kHz in cycle mode
	Resolution	0.01			
	Accuracy	± (0.01% + 0.01 Hz)			
Transformer saturation voltage		See figure 6-16			
Standard segment types		Sine			
Number of segments per waveform		1	100		
Segment delay	Time mode		200	µs	
	Cycle mode		0		
Amplitude ramping options		Linear			Any combination of ramping possible
Frequency ramping options		Linear, Log_{10}			
Segment duration		5	9999	ms	Resolution 5 ms
		1	9999	s	Resolution 1 s
		1	6000	min	Resolution 1 min
		1	100	h	Resolution 1 h
		1	9999	Cycles	Resolution 1 cycle
	Accuracy	± (1% + 1 ms)			Not applicable to cycle mode

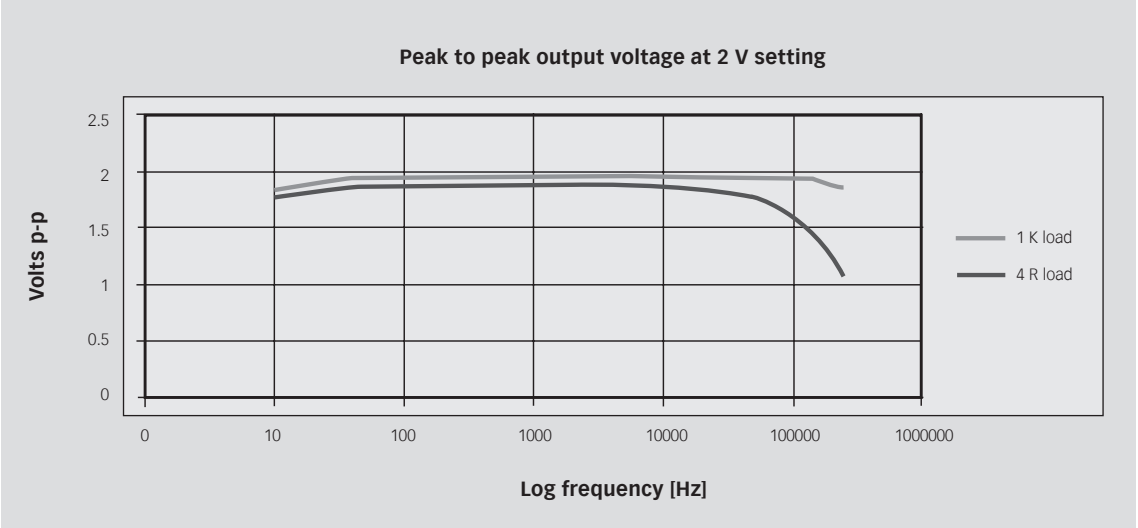
Table 6-15: TC 5650 Technical specifications

Parameter		Min	Max	Units	Notes
Start phase angle	Value	0	345	Degrees	Resolution 15°
	Resolution	15			
	Accuracy	1° or ± 2 µs			
Stop phase angle	Value	15	360	Degrees	Only available in cycle mode. Resolution 15°
Internal peak to peak voltage measurement	Range	0.05	15	V	Peak to peak voltage is displayed by Autostar during a test
	Accuracy	± (2% + 0.1 A)			
Internal RMS current measurement	Range	0	7	A_{RMS}	RMS current is displayed by autostar during a test
	Accuracy	± (2% + 0.1 A)			
Programmable current limit	Range	0.1	7	A_{RMS}	
	Accuracy	± (10% + 0.3 A)			
Bypass capacitor		100 µF ± 20%			Can be switched in or out using AutoStar
Audio transformer connection		Positive battery terminal			Controlled using Autostar. Default is positive battery terminal
		Negative battery terminal			
Module dimensions	Width	8		HP	1 HP = 5.08 mm
	Height	6		U	1 U = 44.45 mm
	Depth	170		mm	
Front panel indicators	Power	Green LED			
	Interlock	Red LED			
Internal control bus		CAN			

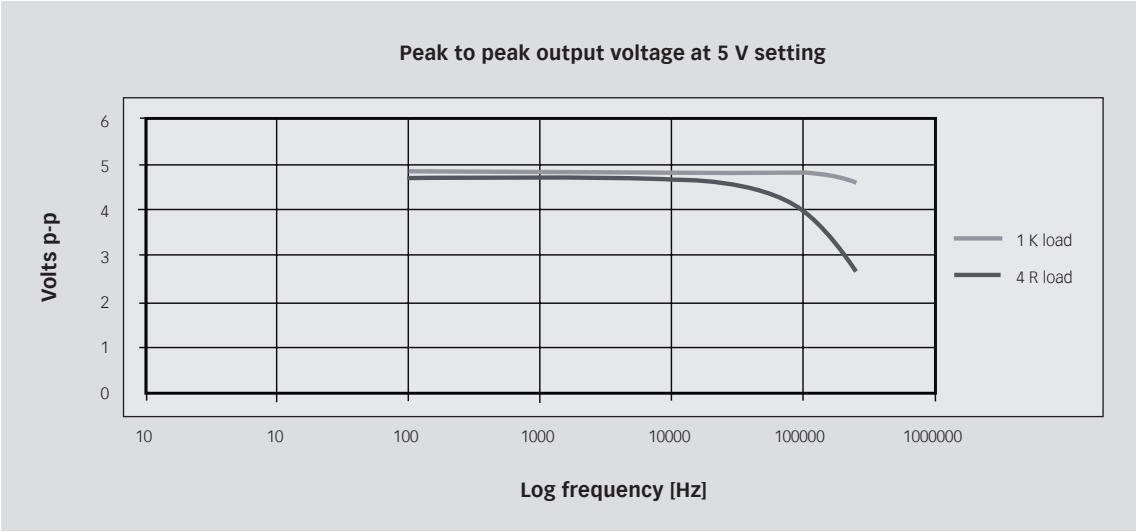
Table 6-15: TC 5650 Technical specifications



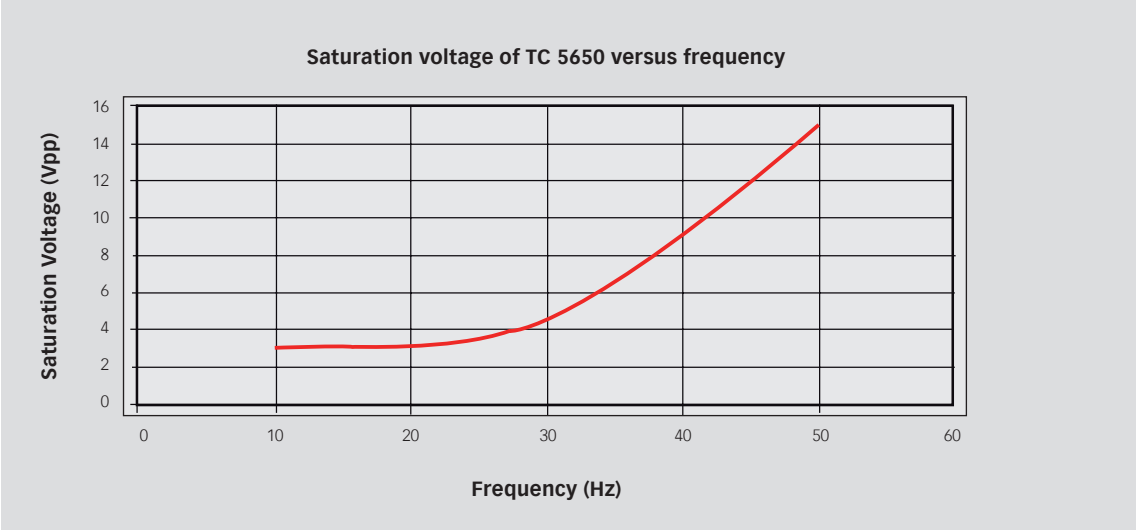
Picture 6-13: Output voltage vs frequency for a voltage setting of 0.5 V_{pk-pk} at 1 kΩ and 4 Ω loads



Picture 6-14: Output voltage vs frequency for a voltage setting of 2 V_{pk-pk} at 1 kΩ and 4 Ω loads



Picture 6-15: Output voltage vs frequency for a voltage setting of 5 Vpk-pk at 1 kΩ and 4 Ω loads



Picture 6-16: TC 5650 Transformer saturation voltage vs frequency

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