NSG 5200

Hardware Manual

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Revision History

Revision	Nature of Change	Author	Date	ECO No.
1.00	New Release	L.Stapleton	August 2001	900256
2.00	Update	L.Stapleton	September 2001	900395
2.50	Update	S.Power	June 2002	900419

1. NSG 5200 Overview

1.1 Introduction

The NSG 5200 system performs EMC Immunity Testing for the Automotive market and complements the NSG 5000 system. Emphasis has been placed on the modularity of the NSG 5200 to facilitate the configuration of a variety of systems. This solid platform allows for further system expansion and future developments.

Figure 1.1 - 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 Test-Management Platform, which controls the NSG 5000, NSG 5200 and a variety of Sources, combining them into one system. In a uniform environment, Autostar provides predefined test parameters, test sequencing, auto-configuration, 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 5200 can be operated as a free-standing system or cabinet mounted. Three basic configurations are offered which are described in section 1.3 ‘System 5200 Configurations’.

1.2 Automotive Conducted Immunity EMC Standard Types

The NSG 5200 consists of several different modules and in conjunction with external DC sources is designed to meet the four classes of Automotive Conducted Immunity EMC Standard types:

Conducted Transients (CT)

Conducted Transients are generally High Voltage pulses on the Battery caused by Motors, the Alternator and various switching devices.

There are several types of Conducted Transient pulses;

Surge Pulses

Surge Class 1

- Known as Pulse 1 (as defined in ISO7637)
- Caused by the Battery being disconnected from an inductive load
- The pulse is directly coupled to the Battery
- Negative Pulse
- Rise Time (10% to 90%) is approximately 1µs
- Pulse Width (10% to 10%) from 50µs to 2ms
- Pulse Amplitude from –10V to –600V
- Impedance is 4Ω to 200Ω
- Generated using the NSG 5001A

Surge Class 2

- Known as Pulse 2a (as defined in ISO7637)
- Caused by a device (such as a lamp) in parallel with the DUT being switched off
- The pulse is directly coupled to the Battery
- Positive Pulse
- Rise Time (10% to 90%) is approximately 1µs
- Pulse Width (10% to 10%) is typically 50µs
- Pulse Amplitude from +10V to +600V
- Impedance is 2Ω to 200Ω
- Generated using the NSG 5001A

Surge Class 3

- Known as Pulse 6 (as defined in ISO7637 1990)
- Caused by current interruption in the ignition coil
- The pulse is directly coupled to the Battery
- Negative Pulse
- Rise Time (10% to 90%) is approximately 60µs
- Pulse Width (10% to 10%) is approximately 300µs
- Pulse Amplitude from –20V to –300V
- Impedance is 30Ω
- Generated using the NSG 5001A

Surge Class 4

- Pulse S1 in Peugeot B21 7090
- Caused by the Battery being disconnected from an inductive load
- The pulse is directly coupled to the Battery
- Negative Pulse
- Rise Time (10% to 90%) is 1µs
- Pulse Width (10% to 10%) is 20ms
- Pulse Amplitude is – 80V
- Impedance is 10Ω

Surge Class 5

- Pulse S2 in Peugeot B21 7090
- Caused by the Battery being disconnected from an inductive load
- The pulse is directly coupled to the Battery
- Negative Pulse
- Rise Time (10% to 90%) is 200ns
- Pulse Width (10% to 10%) is 1µs
- Pulse Amplitude is – 400V
- Impedance is 30Ω

Burst Pulses

Burst Class 1

- Known as Pulses 3a and 3b (as defined in ISO7637)
- Caused by the various switching processes
- The pulses are capacitively coupled to the Battery
- 3a is a Negative Pulse
- 3b is a Positive Pulse
- Rise Time (10% to 90%) is 5ns
- Pulse Width (10% to 10%) is 100ns
- Pulse Amplitude from 20V to 800V
- Impedance is 50Ω
- Generated using the NSG 5003

Load Dump Pulses

Voltage Load Dump

- Known as Pulses 5a and 5b (as defined in ISO7637)
- Caused by the discharged battery being disconnected from the alternator while the alternator is generating charging current
- 5a is a Positive Pulse
- 5b is a Suppressed version of 5a
- Rise Time (10% to 90%) is 1ms to 10ms
- Pulse Width (10% to 10%) is typically 40ms to 400ms
- Unsuppressed Pulse Amplitude from 20V to 200V
- Suppressed Pulse Amplitude typically 30V to 50V
- Impedance is 0.5Ω to 10Ω
- Generated using the NSG 5005A

Current Load Dump

- Defined in SAEJ1113/11 1995 and GM9105P
- Rise Time (10% to 90%) is approximately 10ms
- Pulse Width (10% to 10%) is 260ms
- Current Pulse Amplitude is 84A
- Positive Pulse
- Requires External Parallel Impedance of 0.6Ω across the DUT
- Generated using the NSG 5005B

Alternator Field Decay

- Known as Pulse 7 (as defined in ISO7637 1990)
- Simulates the effects of the alternator magnetic field decay at the moment of engine switch off
- Negative Pulse
- Rise Time (10% to 90%) is 5ms to 10ms
- Pulse Width (10% to 10%) is 100ms
- Pulse Amplitude from – 20V to – 80V
- Impedance is 10Ω
- Generated using the NSG 5005A

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;

Pulse 4c

- 4c pulses are those arbitrary waveforms that can be built up using Sine, Square, Triangle and Ramp wave segments
- Other segment types (e.g. exponential) may be added as required
- The majority of SVV tests are of type 4c

Pulse 4d

- 4d pulses are known as Dips and Drops
- A Dip is a fast (~1μs) change form one DC level to another DC level.
- A Drop is a Dip to 0V
- It is difficult to achieve a 1μs 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.

Pulse 2b

- Pulse 2b is defined in SAEJ1113/11 and ISO7637-2 1999
- Pulse 2b is created using a series of segments, like 4c, but requires additional control over the pulse impedance
- SAEJ1113/11 requires the pulse to have an impedance of 0.5Ω to 3Ω. Before the pulse and after the pulse has fired the impedance should be 0.01Ω.
- Pulse 2b is caused by transients from DC Motors which act as generators after the ignition is switched off.

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.

Power Magnetics (PM)

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

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

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

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.

Radiating Loop

- A small loop of wire is used to produce the magnetic field. A loop sensor is 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.

Conducted Sine Waves (CSW)

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

- Frequencies from 30Hz to 250kHz.
- 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.

1.3 System 5200 Configurations

A customer's minimum system requirements to operate a NSG 5200 consist of the following components;

- NSG 5201 or NSG 5202
- CTR 5210 Digital Controller Module
- ARB 5220 (single Arb card)

Additional components are available for the NSG 5200, which provide extra Pulse Test functionalities;

- DCS 5230 DC Switch Module
- AMP 5240 Power Amplifier Module
- CSW 5250 Conducted Sine Waves Module
- Multiple Arb Cards (2, 3 or 4 Arbs) eg. Arb 5221

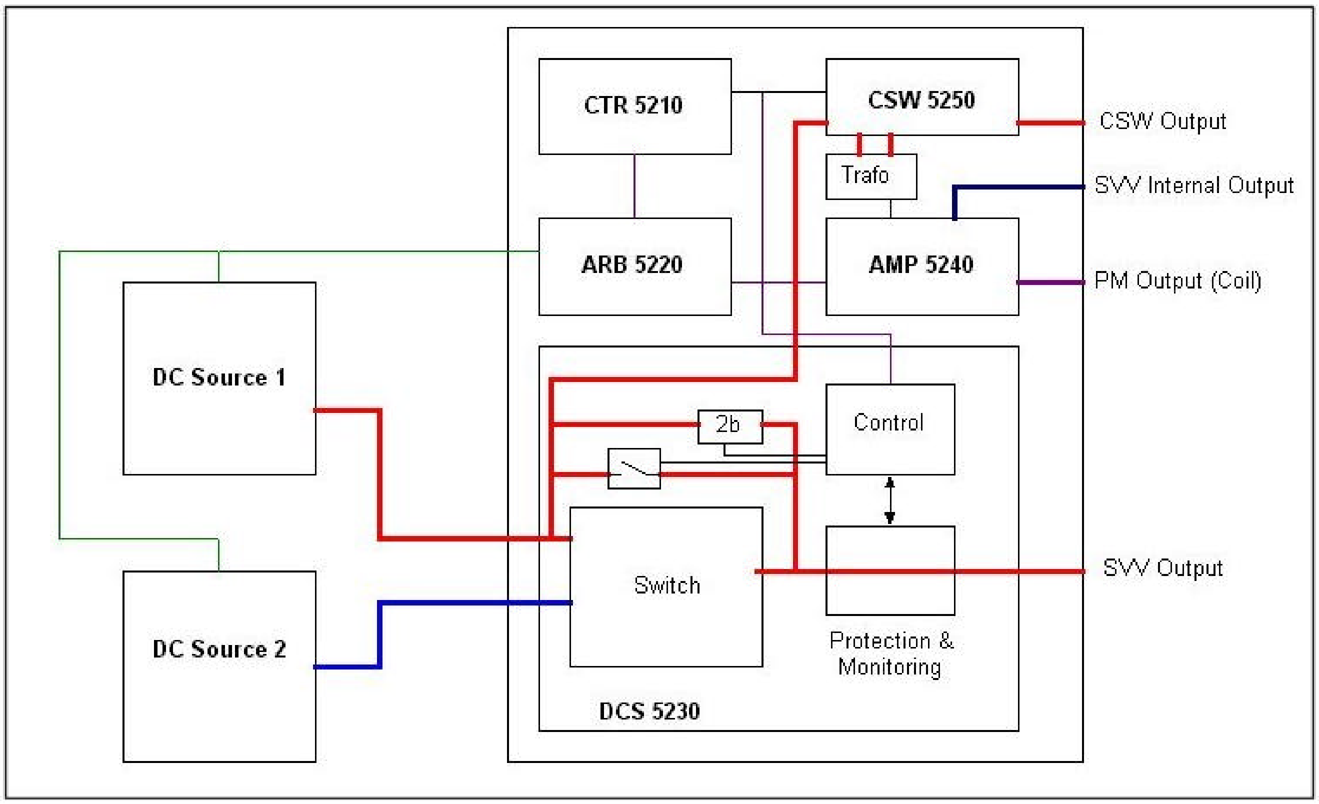


Figure 1.2 - Functional Block Diagram of the NSG 5200 System

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

- NSG 5201 Basic Mainframe Chassis
- INA 5201 CSW Transformer Upgrade
- NSG 5202 Mainframe Chassis with CSW
- CTR 5210 Digital Controller with RS 232 and IEEE 488
- ARB 5220 Arbitrary Waveform Generator with 1 ARB Card
- ARB 5221 Arbitrary Waveform Generator with 2 ARB Cards
- INA 5221 ARB Card Upgrade Kit
- DCS 5230 DC Switch Module
- AMP 5240 Power Amplifier Module
- CSW 5250 Conducted Sine Waves Module

There are three basic types of System Configurations, which are as follows;

1. Voltage Variation Configuration
   NSG 5201 / CTR 5210 / ARB 5220 / DCS 5230 / Autostar software / NSG 5004A

2. Power Magnetics Configuration
   NSG 5201 / CTR 5210 / ARB 5220 / DCS 5230 / AMP 5240 / Autostar software / NSG 5004A

3. Conducted Sine Wave Configuration
   NSG 5202 / CTR 5210 / ARB 5220 / DCS 5230 / AMP 5240 / CSW 5250 / Autostar software / NSG 5004A or other DC Source

1.4 Safety

The following information describes the various safety features that are incorporated into the NSG 5200 system to provide a safe environment for the operator. The system is designed so that during the course of normal operation the user is never required to work in or have exposure to areas where they could cause harm to themselves or others.
The NSG 5200 safety features are designed for the protection of all people working on the system, both operations and maintenance. Neither Schaffner Elektronik AG, Luterbach, Switzerland nor any of the subsidiary sales organisations can accept any responsibility for personal, material or consequential injury, loss or damage that results from improper use of the equipment and accessories. It is highly important that the user reads this section before using the system.

Electrical Safety

The NSG 5200 system is fitted with protective panels and cover 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 5200 system is clearly labelled for electical safety, refer to figure 1.3.

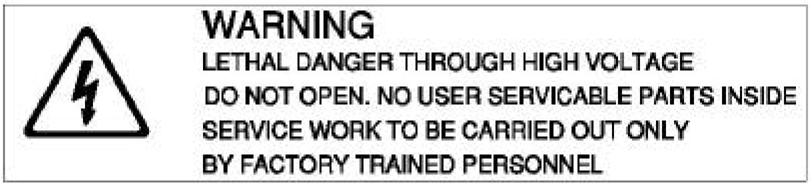


Figure 1.3 – Electrical Warning Label

Handling Devices

The location of the following label (figure 1.4) states that an anti-static strap should be connected before handling electrostatic sensitive devices.

Figure 1.4 – Electrostatic Attention Label

Safety Testing

The following safety precaution label specifies that the NSG 5200 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.

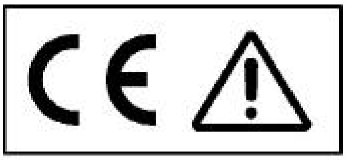


Figure 1.5 – CE mark label

General Safety

- Local Installation regulations must be respected to ensure the safe flow of leakage currents.
- Operation without a protective earth connection is forbidden.
- Operate the system only in dry surroundings. Any condensation that occurs must be allowed to evaporate before putting the system into operation. Do not exceed the permissible ambient temperature, humidity or altitude. The system must not be used in an enclosed space that would restrict the airflow through the system.
- Use only legally approved connectors and accessory items. The system must be powered from a mains supply that provides a properly earthed mains socket.
- Turn off the system and disconnect from mains before replacing any modules'.
- Do not operate the system unless all front panel slots are either occupied by modules or covered by the blanking panels supplied.
- Check that the voltage selector on the back panel of the system is set to the correct position, refer to section ‘Setting Mains Voltage Selector’.
- For Power Magnetics, the user is recommended to keep a safe distance from the system while in operation.

Disposal Of Lithium Battery

The NSG 5200 system contains a Lithium Battery. If the user requires to change or dispose of the lithium battery, please adhere to the following;

- The lithium battery is hazardous if damaged or if leakage occurs.
- Do not incinerate or dispose of in general waste collection.
- Check state and local regulations dealing with the disposal of these materials. The user is responsible for the hazards created while the lithium battery is being disposed.

Overvoltage Category II

The NSG 5200 system is in the Overvoltage Category II in accordance with Annex J of EN61010-1.

Setting Mains Voltage Selector

Remove the Warning label (figure 1.6) from the Mains Voltage Selector to set the correct mains voltage.

Figure 1.6 – Mains Voltage Selector Label

Check that the 4 way Mains Voltage Selector is at the correct voltage setting for the particular country.

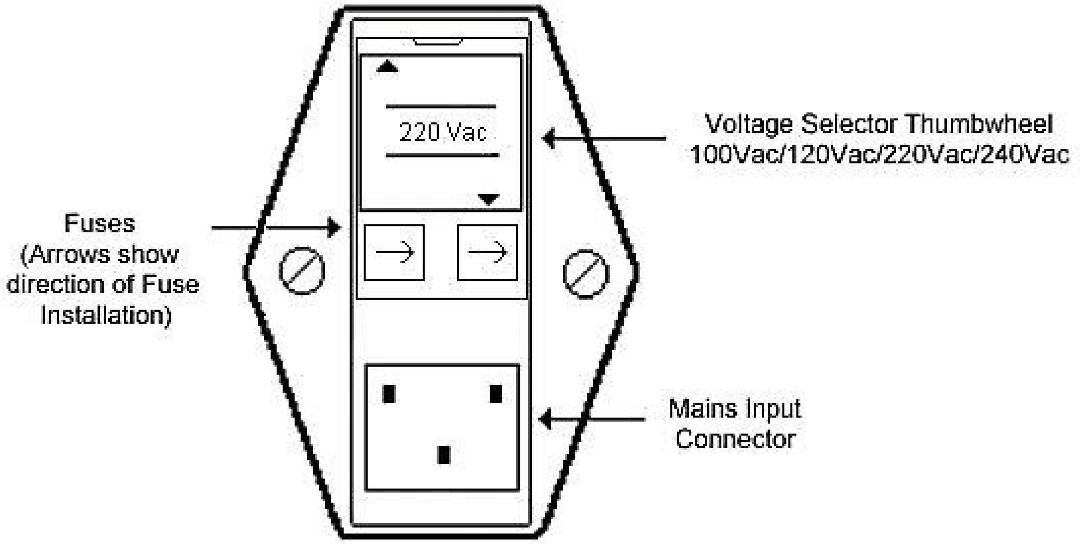


Figure 1.7 – Mains I/P Voltage Selector

If the Mains Voltage Selector is not set to the correct voltage, perform the following:

1. Using a screwdriver, click open the Mains Voltage Selector cover.
2. Rotate the voltage selector thumbwheel to the correct voltage of the particular country or to the nearest setting (100/120/220/240 Vac).
3. Close the voltage selector cover securely.
4. The voltage selected will be shown through an open slot in the Voltage Selector cover.

Mains Input

The back panel of the system is clearly labelled stating the fuses to be used at all voltages and currents.

<table>
<tr><th>Voltage</th><th>Max. Current (A)</th><th>Fuse X2</th><th>Freq.</th></tr>
<tr><td>100</td><td>5.0</td><td rowspan="4">6AT</td><td rowspan="4">47-63Hz</td></tr>
<tr><td>120</td><td>4.2</td></tr>
<tr><td>220</td><td>2.3</td></tr>
<tr><td>240</td><td>2.1</td></tr>
</table>

Table 1.1 – Mains Input Voltages / Currents

Fuses are installed in the Mains Input Filter Socket. The arrows show the direction of installation of the fuses, refer to figure 1.7.

1.5 Transportation / UnPacking

This section outlines the general procedure for unpacking and installing the NSG 5200 system.

Required Environmental Conditions

This NSG 5200 system has been designed to operate safely under the conditions listed below. It is imperative that these conditions exist before you install and use the system;

- Indoor use only.
- Good Ventilation.
- Operating Temperature at 10° to 40°C.
- Storage Temperature at – 10 to 50°C.
- Max. Relative Humidity 0 to 95% R.H – non condensing
- Mains supply voltage fluctuations not to exceed +/- 10% of the nominal voltage (refer to section 2.5 ‘ Basic Chassis Technical Specifications’).

Receiving & Unpacking the System

The system is shipped in a sturdy wooden protective crate. To remove the system from its crate, proceed as follows;

- Inspect the Packaging/Equipment for damage during transit. Any damage found should be reported to the carrier immediately.
- Please read the section ‘Handling the system’, before removing the system from its crate.
- Remove the crate top panel by unscrewing the screws at the top of the crate using the appropriate screwdriver.
- Retain the packaging, for returning/upgrading items.

Handling the System

- The system is designed for transportation and handling by hydraulic pallet truck or forklift.
- The system is heavy and designed to be lifted by the handles provided on either side of the system by 2 persons.
- When lowering the system from an elevated position the user must ensure that all sides of the system are clear from obstructions.
- Check that all items and accessories, that are ordered, have been delivered. A Packing List is provided with the system.

Installation Checklist

- Carefully study the documentation and operating instructions supplied.
- The Mains Voltage Selector on the rear of the system must agree with the local mains voltage (mains frequency 47-63Hz), refer to safety section ‘Setting Mains Voltage Selector’.
- 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.

2. Basic Chassis

2.1 Basic Chassis Overview

The basic system is housed in a 6U 84HP chassis, weighing approximately 18kg to 26kg depending whether the system is an NSG 5201 or NSG 5202. 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 DCS 5230 and AMP 5240 modules.

Chassis Features:

- Modular Structure to system
- Internal CAN Bus
- Standard Auxiliary Signals (DUT_FAIL etc.)
- Interlock Connectors

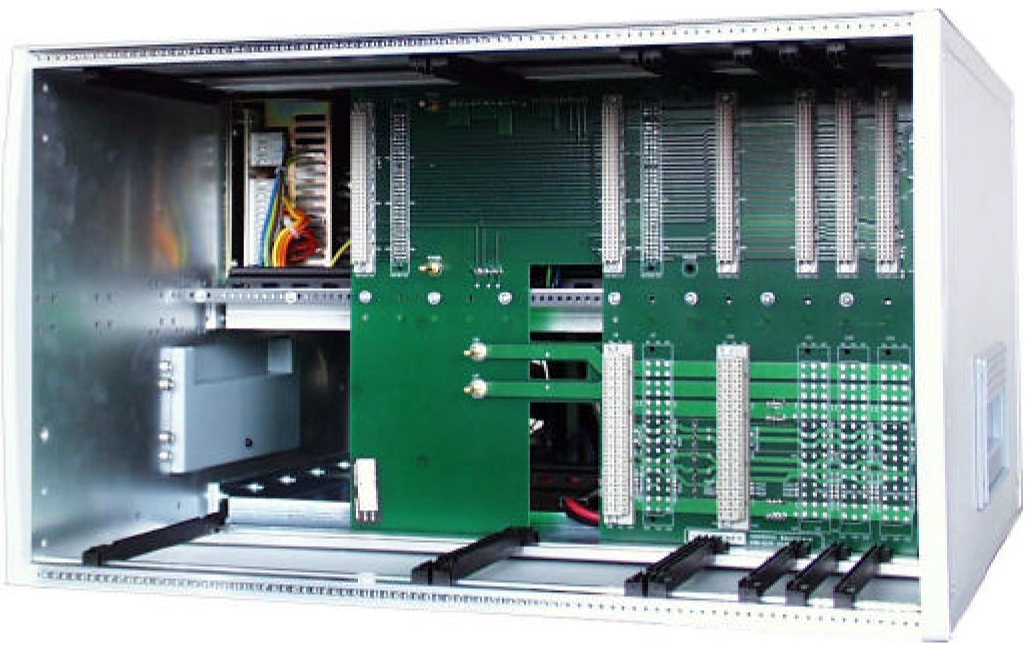


Figure 2.1 – NSG 5200 System Basic Chassis showing the Backplane and the Module Guide Rails

2.2 Basic Chassis Types

NSG 5200 is a generic name used for the NSG 5201 and NSG 5202 chassis's due to the similarity between them.

The NSG 5201 can be upgraded to an NSG 5202 using an INA 5201 Upgrade Kit (Service Centre Upgrade). The NSG 5202 contains an audio isolation transformer, which is used during Conducted Sine Wave testing (CSW). The NSG 5201 has every feature the NSG 5202 has except the transformer and the mounting plate.

In the NSG 5202, DC Power to the transformer is first passed through the CSW 5250 module and then to the transformer via the backplane which is to allow the transfomer be connected to the positive or negative side of the battery. The primary of the transformer is connected to the AMP 5240 output via the backplane.

2.3 NSG 5200 Chassis Components

The NSG 5200 system chassis contains a number of components, which are described as follows;

Backplane

The purpose of the backplane is to pass common signals and power between the various modules within the NSG 5200 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 41612C connectors. The bottom half of the backplane contains positions for six 48 way DIN 41612E connectors.
Power from the DC Power Supplies and from the Mains Transformer is brought onto the backplane to be distributed to the various modules.

Modules

The modules (CTR 5210, ARB 5220, ARB 5221, DCS 5230, AMP 5240 and CSW 5250) 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.

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.

AC Mains Power

AC Mains power is fed into the rear of the system via a standard IEC socket, which has a built-in filter. This IEC socket also has a 4 way voltage selector, which should be set to the correct level, depending on the operator's location worldwide. There are four voltage selection options – 100V, 120V, 220V and 240V. Refer to 'Setting Mains Voltage Selector' in section one. The AC power is distributed to various internal power supplies, which provide the DC Power for the system Modules.

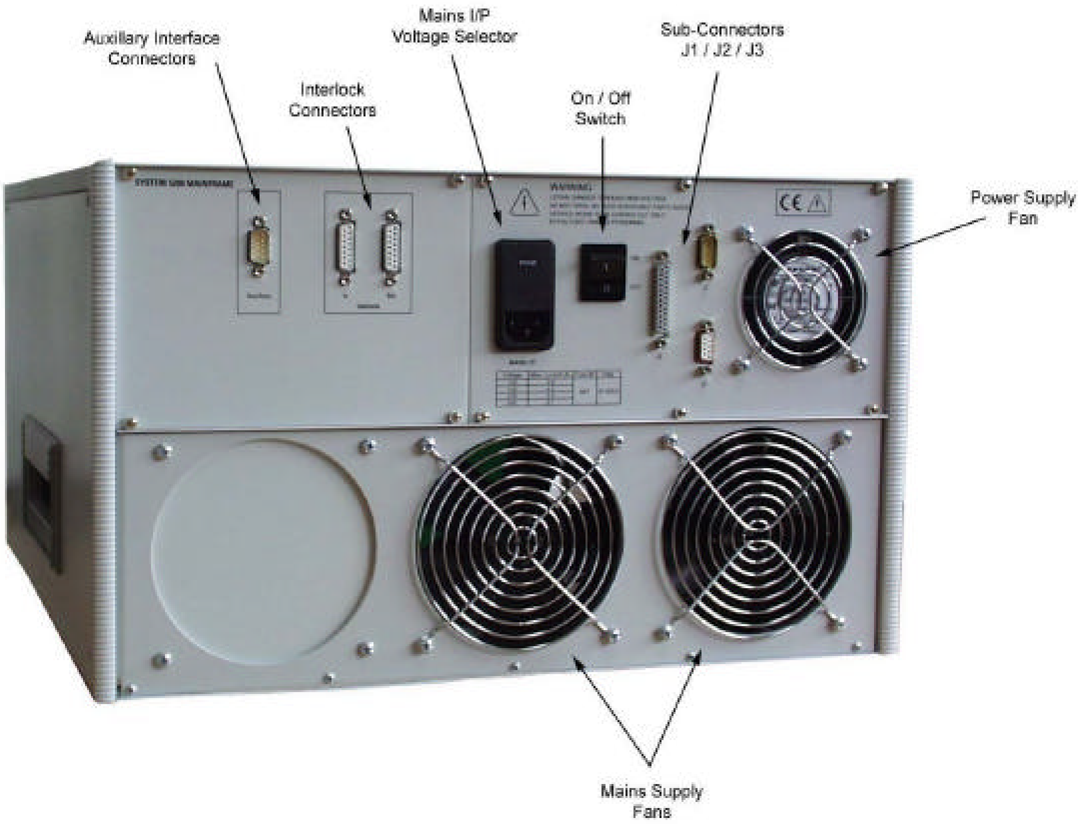


Figure 2.2 – NSG 5200 System Rear View

On/Off Switch

An On/Off switch on the back panel is used to switch ON and OFF the system mains power.

Auxiliary Interface Card

The rear panel of the NSG 5200 contains an Auxiliary Interface card. This board provides an Interface to a number of auxiliary signals. Refer to section 2.5 'Auxiliary Interface Signals Description'.

Fans

Two mains operated fans are mounted on the rear of the chassis to aid in the cooling of the DCS 5230 and AMP 5240 modules. A +12V DC fan helps to keep the SMPS cool. The two mains fans are 4 wire devices, which operate at nominally either 115V or 230V. The speed of the fans changes as the mains voltage changes for particular settings.

Mains Transformer

The mains transformer is a 4-wire device, which is designed to operate at nominally either 115V or 230V. If the voltage is higher or lower than these two levels, the outputs of the transformer will change proportionally.

D-Sub Connectors

There are 3 D-Sub connectors, J1, J2 and J3 on the same rear panel as the mains input connector. J2 and J3 are currently unused. J1 is connected to the internal CAN bus generated by the NSG 5200.

2.4 Chassis Connectors

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 +12V (with respect to the 0V available on pin 1 of the 9 way D-Sub connector).

CRO_TRIG
This output signal is currently not available.

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 ARB Card.
- TESTEND is Active LOW in the NSG 5200 and is an output.
- TESTEND goes LOW <1ms before the event and goes HIGH again <1ms 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 5200 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, 0V) the user indicates to the NSG 5200 (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 H8 processor, not the ARB card(s). Thus, a time lag is expected before the system reacts to the DUT_FAIL. This time is <50ms.

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 figure 2.3.

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 H8 processor, not the ARB card(s). Thus, a time lag is expected before the system reacts to the PAUSE_CONT. This time is <50ms.

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 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 H8 processor, not the ARB card(s). Thus, a time lag is expected before the system reacts to the EXT_TRIG. This time shall not be <50ms.

The pin-out of the 9 way Auxiliary D-Sub connector is as follows;

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

Table 2.1 – 9 way D-Sub Connector Pin-Outs

Interlock Signals

The rear panel of the NSG 5200 contains an Auxiliary Interface card. This board provides an Interface to two 15 way D-Sub Interlock connectors. All Interlock signals are isolated from any other power supply lines within the system. A HIGH on a signal line corresponds to +5V (with respect to the 0V available on pin 1 of both of the 15 way D-Sub connectors).

The function of Interlock is to provide a safety mechanism for the user during normal operation. Two connectors are provided to allow daisy chaining of the NSG 5200 with other systems where applicable.

To ensure system operation pins 1 and 3 must be linked on the 'Interlock In' D-Sub plug and pins 3 and 5 must be linked on the 'Interlock Out' D-Sub connector. If either 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 DCS 5230 Module indicates that an Interlock error has occurred.

The signal INTERLOCK1 returns from the Auxiliary Interface card to the H8 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 100ms.

The pin-outs of the 15 way D-Sub Interlock connectors are as follows;

Pin	Signal	Function
1	0VINT	
2	Interlock In linked to Interlock Out.	NC
3	Interlock In linked to Interlock Out.	Connect to pin 1 on Interlock In plug, pin 5 on Interlock out plug.
4	Interlock In linked to Interlock Out.	NC
5	Interlock In linked to Interlock Out.	Interlock Signal to Microprocessor
6	Interlock In linked to Interlock Out.	NC
7	Interlock In linked to Interlock Out.	NC
8	Interlock In linked to Interlock Out.	NC
9	Interlock in linked to Interlock Out.	Goes LOW if Power to system. Available as a User signal.
10	Interlock In linked to Interlock Out.	NC
11	Interlock In linked to Interlock Out.	NC
12	Interlock In linked to Interlock Out.	NC
13	Interlock In linked to Interlock Out.	NC
14	Interlock In linked to Interlock Out.	NC
15	Interlock In linked to Interlock Out.	NC

Table 2.2 – 15 way D-Sub Interlock Connector Pin-Outs

D-Sub Connector Pin-Outs

Connectors; J1: 9 way Male D-Sub Connectors
J2: 9 way Female D-Sub currently unused (spare)
J3: 25 way Female D-Sub currently unused (spare)

Pin No.	Signal Name
1	NC
2	NC
3	NC
4	NC
5	NC
6	NC
7	NC
8	CANHI
9	CANLO

Table 2.3 – J1 D-Sub Connector Pin-Outs

2.5 Basic Chassis Technical Specifications

Parameter		Min	Max	Units	Notes
AC Operating Voltage Range		90	264	volts	4 Operating Ranges, 100V, 120V, 220V, 240V. User selectable
AC Operating Current	110V	4.2		amps	2 x 6A 20mm fuses fitted as standard
	220V	2.1			
AC Operating Frequency		47	63	Hz	
Chassis Dimensions	Width	84		HP	1HP = 5.08mm
	Height	6		U	1U = 44.45mm
	Depth	500		mm	
Chassis Weight	NSG5201	18		kg	No modules fitted
	NSG5202	26			
Control Bus		CAN			
Safety Interlocks		Yes			
Auxiliary Input Signals	DUT FAIL	Yes			
	EXT_TRIG	Yes			
	PAUSE/ RESUME	Yes			
Auxiliary Output Signals	CRO_TRIG	No			
	TESTEND	Yes			
Minimum pulse width	t_{min}	10		µS	All 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

Parameter		Min	Max	Units	Notes
Test Stop to TESTEND in-active	t_{stp}		1	mS	Test Stop to TESTEND in-active
Connectors	J1	CAN bus			
	J2	Unused			
	J3	Unused			

Table 2.4 – Basic Chassis Technical Specifications

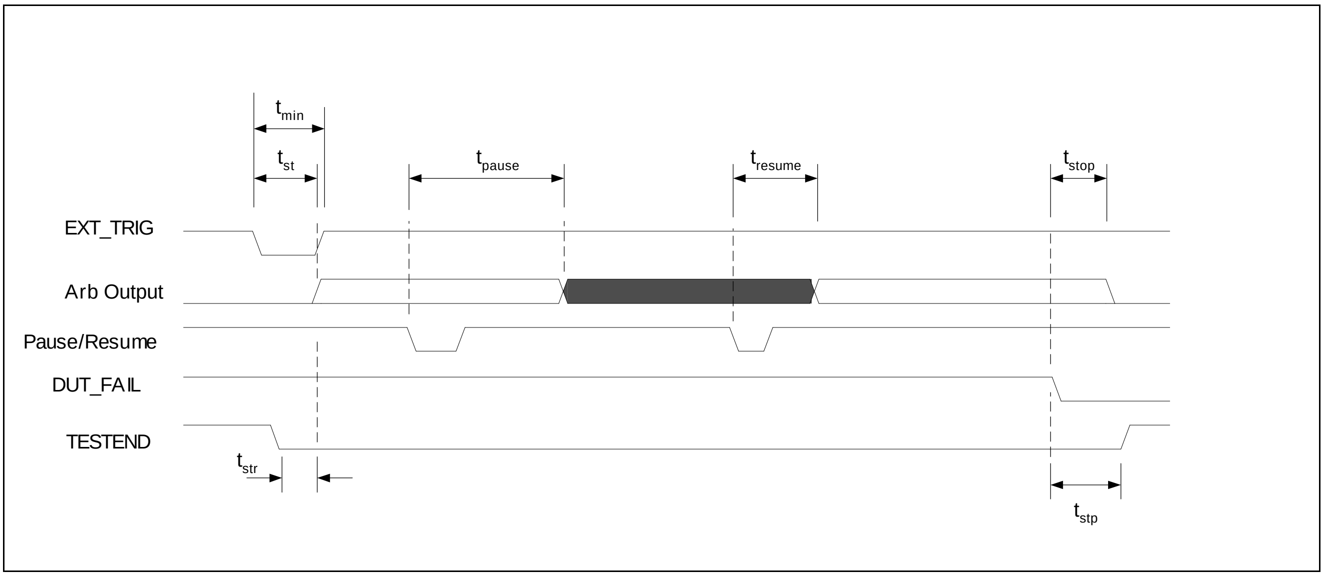


Figure 2.3 – Auxiliary Signals Timing Diagram

3. CTR 5210 Digital Controller Module

3.1 Introduction

The CTR 5210 Digital Controller Module has been designed to meet the high performance levels achievable with the NSG 5200 system. This module is the central controller for the NSG 5200 system and is capable of controlling up to 4 Arb cards over the internal CAN bus, as well as all other NSG 5200 modules in the system. One controller is required in each test system.

Figure 3.1 – CTR 5210 Controller Module

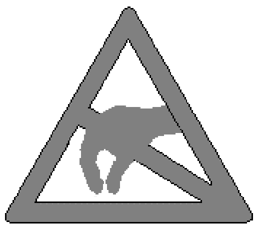
The CTR 5210 module is capable of controlling all test system resources over a single IEEE address. Although both RS 232C and IEEE 488 interfaces are available as standard, the IEEE 488 interface is a preferable method due to it’s superior speed and performance. The CTR 5210 contains a Hitachi H8 series M-Module Microprocessor card, which is at the heart of the module. The CTR 5210 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 CTR 5210 also reacts to various auxiliary user signals such as DUT_FAIL.

3.2 Handling & Safety

Storage and Transport

The CTR 5210 module is pre-installed in the NSG 5200 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.

Handling

	**ATTENTION** **OBSERVE PRECAUTIONS FOR HANDLING** **ELECTROSTATIC DISCHARGE SENSITIVE DEVICE**

General Module Protection

Safety	The CTR 5210 Digital Controller Module meets the safety guidelines in the IEC 1010 standard.

3.3 Functional Description

The CTR 5210 module consists of a Carrier Card and two daughter cards. One daughter card is the H8 Microprocessor card and the second daughter card is an RS232C Interface card. This CTR 5210 card is M-Module standard compliant, which provides scope for additional functionality in the future, e.g. USB.

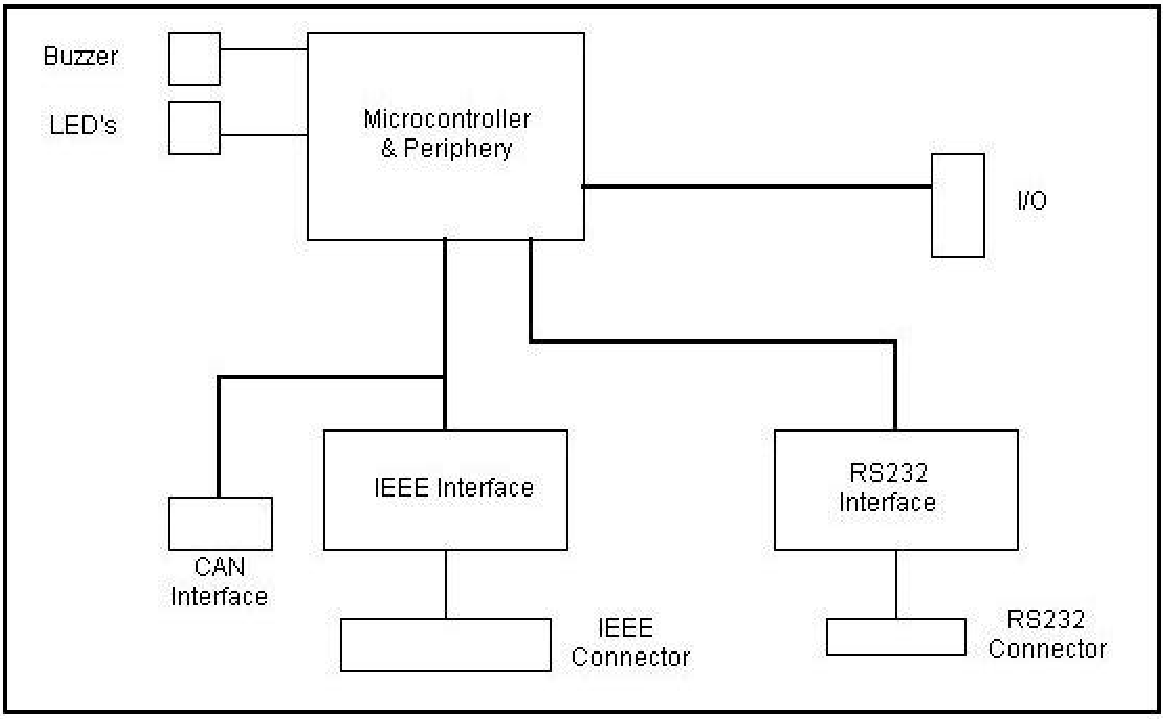


Figure 3.2 – CTR 5210 Controller Module Functional Block Diagram

Carrier Card

The Carrier Card connects to the backplane of the NSG 5200 and provides an interface from the H8 Microprocessor card to the system. In order for the H8 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
- RS232 chipset for communication to the Host PC
- Additional RAM (128K x16) or (512K x 16) and Flash (128K x 16) for expansion and code downloads
- DIP switches for GPIB and CAN identifiers
- Input and output latches
- Diagnostic LED's
- Buzzer

All of the above functional blocks interface with the H8 Microprocessor card through two 60 pin connectors, as per the MA module standard.

H8 Microprocessor Card

The NSG 5200 firmware resides on the H8 Microprocessor card, which is mounted on the CTR 5210 Carrier card. The main function of the firmware is to provide a control interface between the NSG 5200 software and hardware.

The CTR 5210 module is controlled from the PC via the high speed GPIB interface or the RS232 serial interface on the carrier card and processes messages to and from the software. Currently, up to four Arbitrary Waveform Generator (ARB) cards can be controlled via the CAN bus, although up to sixteen is possible. The CTR 5210 also interfaces with the DCS 5230 DC Switch module, the AMP 5240 Power Amplifier module and the CSW 5250 Conducted Sine Wave (CSW) module.

H8 Microprocessor Card Features:

- H8 16 bit microprocessor operating at 16MHz
- 2 Flash which contain the NSG 5200 firmware
- 2 RAM
- 1 Watchdog
- 1 DIL switch, SW2, to select between the RAM on the H8 or/and carrier card

RS232 Interface Card

The RS232 Interface card is a single M-Module card designed to provide an RS232 interface from the NSG 5200 to a PC. The connection from the card to the PC is via a 9 way female D-Sub connector. As the card meets the M-Module standard, it can be used in other systems.

3.4 Configuration

GPIB address

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

1. Remove the module from the NSG 5200 chassis.
2. Locate DIP Switch S1 on the Carrier Card.

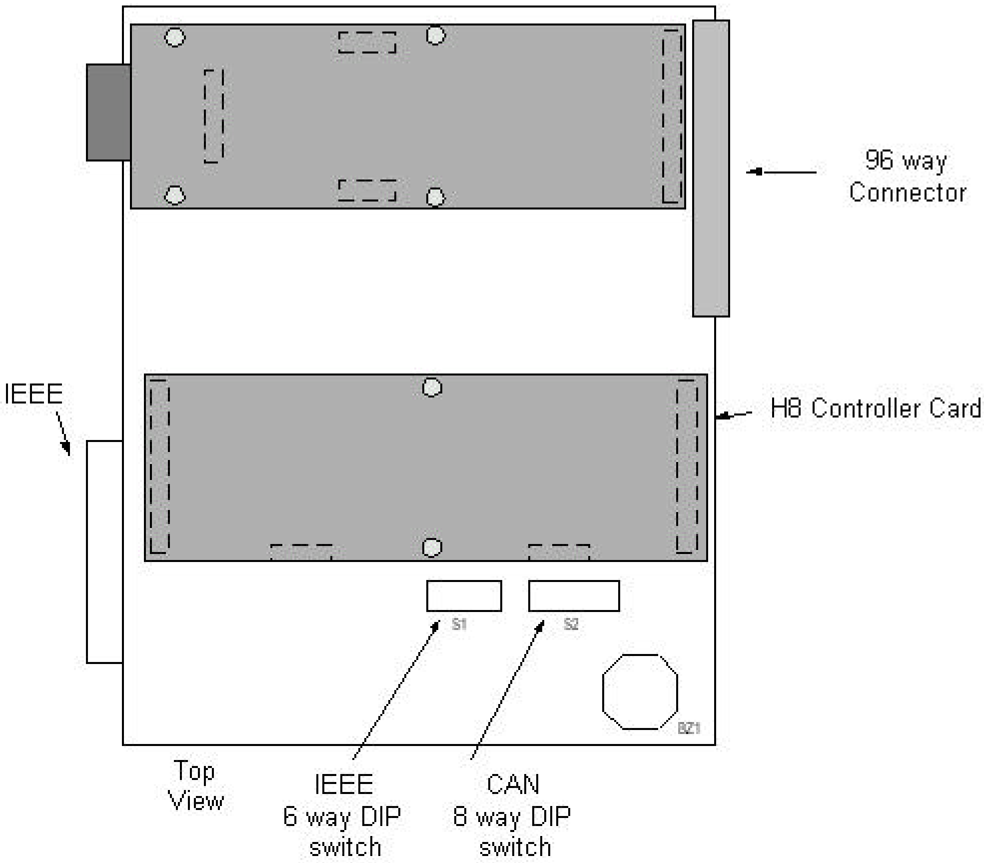


Figure 3.3 – CTR 5210 ModuleTop View showing Switches S1 and S2

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 = $2^0 + 2^3$. The default system address is 9.

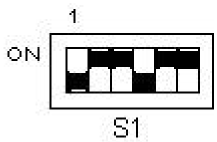


Figure 3.4 – Switch S1 CAN Address

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.

CAN address

To change the CAN address of the CTR 5210 Module, complete the following steps;

1. Remove the card from the NSG 5200 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.

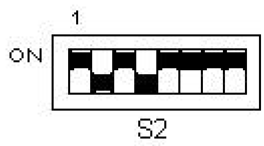


Figure 3.5 – Switch S2 CAN Address

4. Setting CAN Address 0A : 10 = 2 + 8 = $2^1 + 2^3$. 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.

Additional RAM

To make additional RAM available complete the following steps;

1. Remove the card from the NSG 5200 chassis.

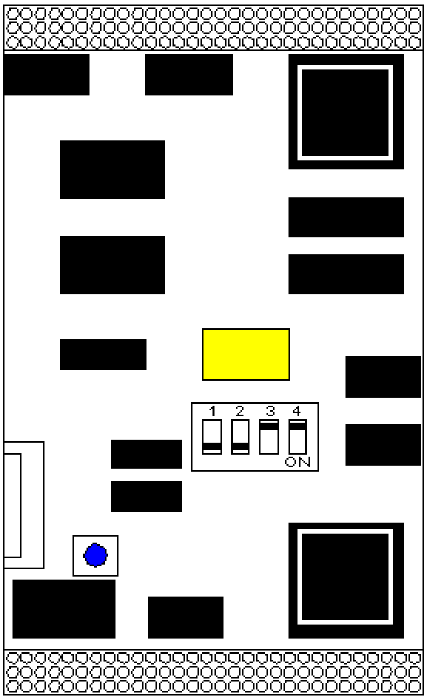


Figure 3.6 – H8 Module, DIP switch settings

2. Locate 4 way DIP switch mounted on H8 Module as shown in the diagram above.

   - For extra RAM on the H8 card, set switch 1 to ON.
   - For extra RAM on the Carrier card set switch 2 to ON.

3.5 Installation

To install the CTR 5210 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 5200 chassis.
4. Push the 96 way DIN41612C 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 CTR 5210 module.

Figure 3.7 – CTR 5210 Module Installed in Right-Most Slot in Basic Chassis

3.6 Verification

After inserting the CTR 5210 module, power on the chassis. The green and amber LEDs on the front panel of the CTR 5210 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 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. Note: If the Green LED is not illuminated, this indicates No Power to the card.

Table 3.1 – LED Functions

3.7 Connector Pin-Outs

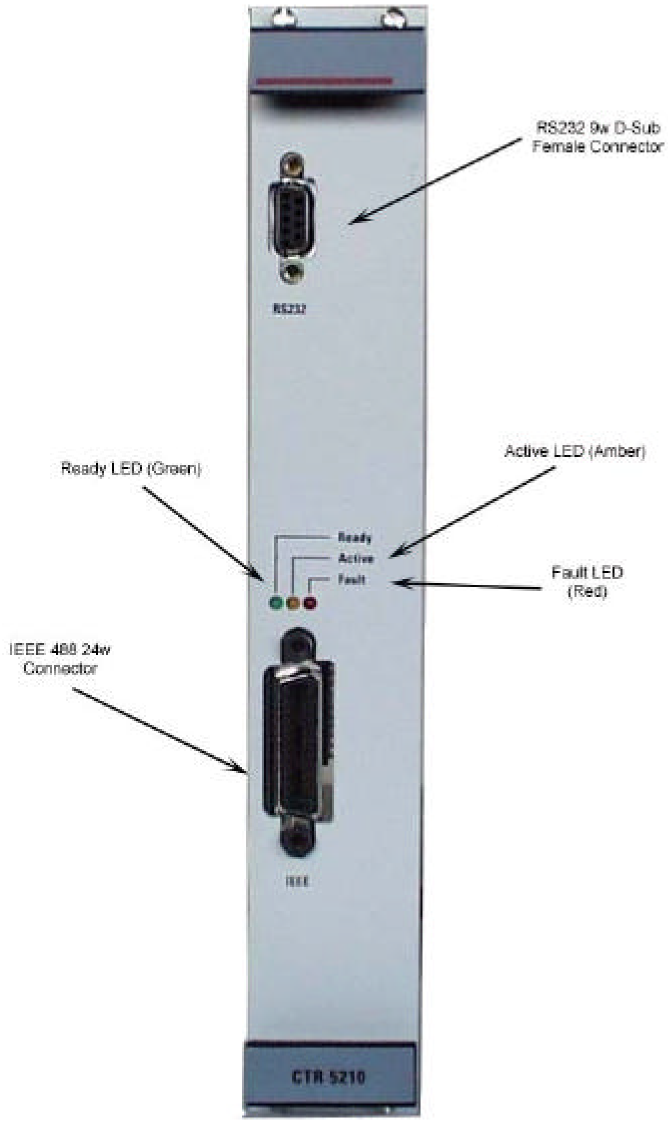


Figure 3.8 – CTR 5210 Module Front Panel showing Connectors

Connector RS232: 9 way Female D-Sub

Pin No.	Signal Name
1	NCa
2	R1_IN
3	T1_OUT
4	NC
5	0V1
6	NC
7	NC
8	NC
9	NC

Table 3.2 – 9 way D-Sub Connectors

Connector IEEE 488: 24 way

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 3.3 – 24 way IEEE Connector

3.8 CTR 5210 Controller Commands

Refer to Appendix A – Controller Card Commands.

3.9 CTR 5210 Controller Technical Specifications

<table>
<tr><th colspan="2">Parameter</th><th>Min</th><th>Max</th><th>Units</th><th>Notes</th></tr>
<tr><td rowspan="3">Module Dimensions</td><td>Width</td><td colspan="2">8</td><td>HP</td><td>1HP = 5.08mm</td></tr>
<tr><td>Height</td><td colspan="2">6</td><td>U</td><td>1U = 44.45mm</td></tr>
<tr><td>Depth</td><td colspan="2">170</td><td>mm</td><td></td></tr>
<tr><td>Internal Control Bus</td><td></td><td colspan="2">CAN</td><td></td><td></td></tr>
<tr><td>IEEE488 (GPIB)</td><td></td><td colspan="2">Yes</td><td></td><td>Default Address = 9</td></tr>
<tr><td>RS232</td><td></td><td colspan="2">Yes</td><td></td><td></td></tr>
<tr><td rowspan="3">Front Panel Indicators</td><td>Ready</td><td colspan="2">Green led</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>Active</td><td colspan="2">Amber led</td></tr>
<tr><td>Fault</td><td colspan="2">Red led</td></tr>
</table>

Table 3.4 – CTR 5210 Technical Specifications

4. ARB 5220/ ARB 5221 Arbitrary Waveform Generator Modules

4.1 Introduction

The Arbitrary Waveform function generators are used universally throughout the system 5200 for the control of Sources. The ARB 5220 Arbitrary Waveform 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 5200 system, combined with Autostar software, meets all industry standard SVV requirements.

Figure 4.1 - ARB 5220 Arbitrary Waveform Generator Module

All the generators used are programmed separately in the Autostar software and operate synchronously. The ARB 5221 is an Arbitrary Waveform Generator Module with two Arb cards, which operate in synchrony. Each NSG 5200 system can house from one to four Arb cards by selecting the type of Arb module required. For example three Arb cards require one ARB 5221 and one ARB 5220 modules.

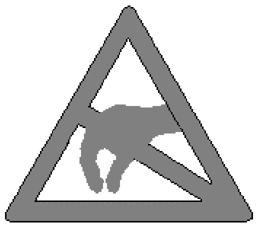
4.2 Handling & Safety

Storage and Transport

The ARB 5220 module is pre-installed in the NSG 5200 system upon delivery.

If an upgrade is required, an INA 5221 can be ordered separately and it is shipped individually in a transparent Static Shielding Bag and box. Refer to document ISO702-0126 ‘ARB 5220 / ARB 5221 Module Configuration in Multiple Arb Card Systems’, which is provided with the module.

Handling

	**ATTENTION** **OBSERVE PRECAUTIONS** **FOR HANDLING** **ELECTROSTATIC DISCHARGE SENSITIVE DEVICE**

General Module Protection

Safety	The ARB 5220 / ARB 5221 Arbitrary Waveform Generator Modules meet the safety guidelines in the IEC 1010 standard.

4.3 Functional Description

The ARB 5220 is a double M-Module sized Arb card, which is mounted on a carrier card. The Arb card has built-in standard arbitrary waveform segments (sine, square, triangle and ramp) and a large memory capacity for waveforms, which cannot easily be defined by these standard waveform segments.

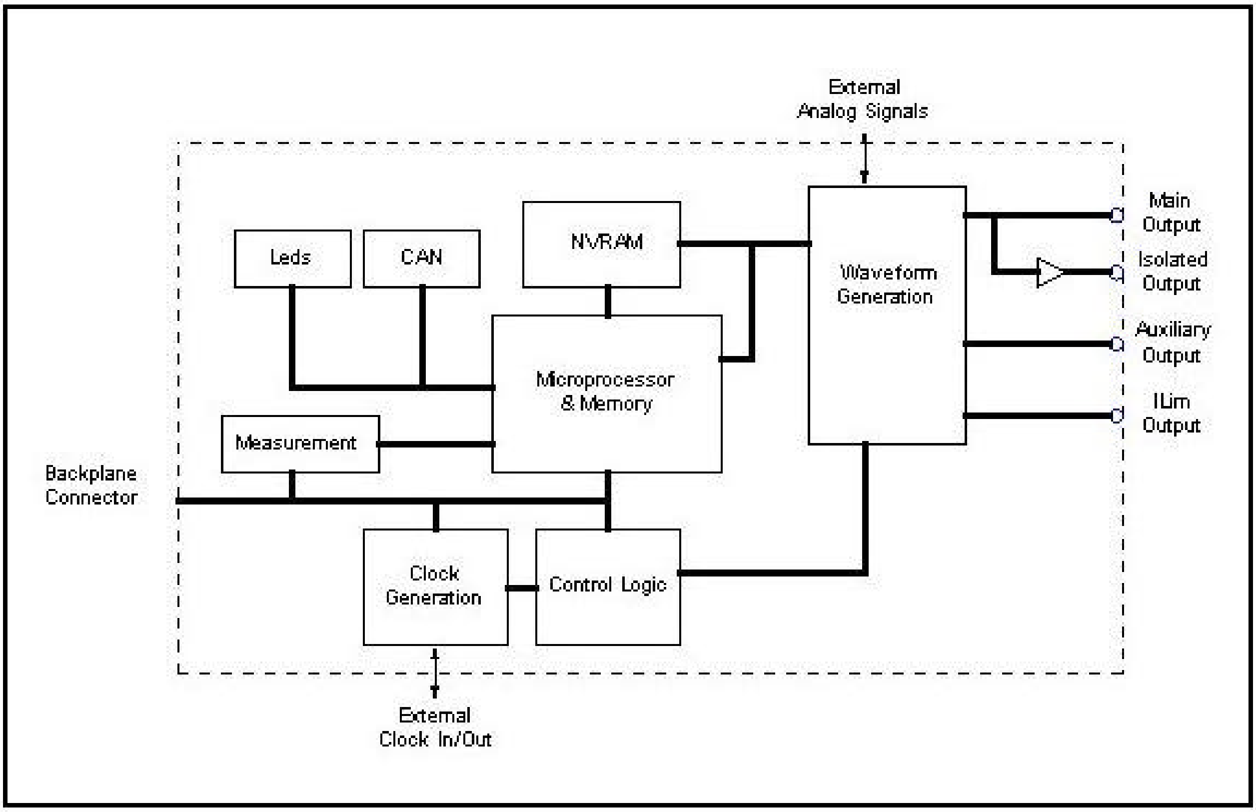


Figure 4.2 – ARB 5220 Module Functional Block Diagram

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 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.

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 5ms to 9999 hours (0.5ms 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 5kHz while it is 320kHz in time mode.

If the operator has a waveform that cannot be programmed by Autostar, the waveform can be downloaded from a PC into the ARB 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 Arb card for replay or distributed to suppliers who can then, using the NSG 5200 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 Comma Delimited file, it can be read in by Autostar and downloaded to the Arb 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 ARB 5221, one Arb card can generate an output signal, which is fed into the other Arb. 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 Arb card can control two DC Power supplies. Finally, a programmable current limit output is provided for DC Sources that have this feature.

The ARB 5220 receives a voltage and current readback from either a DCS 5230, AMP 5240 or CSW 5250 module during operation, depending upon which application is running. It passes these values to the CTR 5210 via the CAN bus and from there back to the PC via IEEE488.

The ARB 5220 ARB card can be configured as either a Master or a Slave for use in multiple Arb card applications. As a Master it provides a 20MHz synchronisation clock to all other Arb cards while as a Slave it receives this clock from another Master Arb card. Using two ARB 5221’s, four synchronous Arb cards are possible. Autostar supports four Arb cards as standard and the Scope supports one Arb card (Master).

The ARB Carrier card provides a platform for either one or two Arb cards, depending upon whether the operator has an ARB 5220 or an ARB 5221. The ARB 5220 Module plugs into the NSG 5200 chassis, deriving power from the backplane. There is no configuration required for the ARB 5220 or single ARB 5221. For three or four Arb cards, refer to section 4.4 or document IS702-0126.

4.4 Configuration

Setting ARB 5220 CAN Address

Before installing the ARB 5220, the CAN address must be set. A cut-out has been designed on the solder side of the ARB 5220 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 ARB 5220 Carrier Card, refer to figure 4.3.

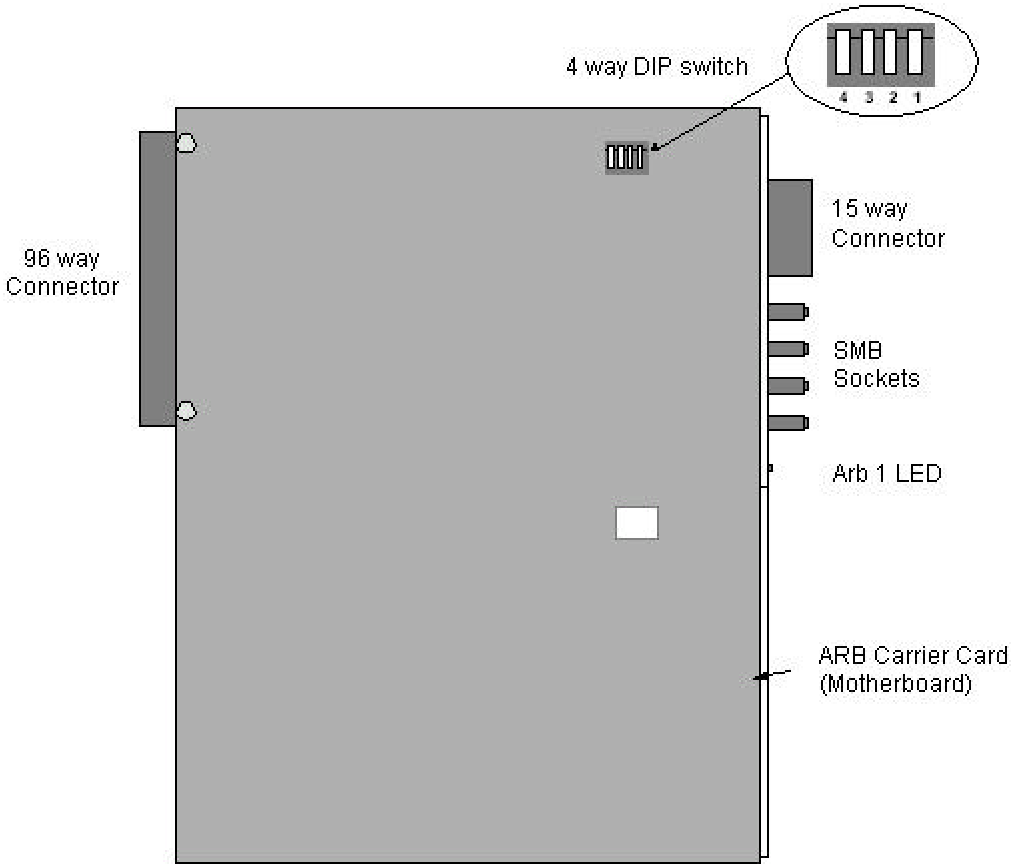


Figure 4.3 – ARB 5220 Solder View showing 4 way DIP switch

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.

SW4	SW3	SW2	SW1	Address
Off	Off	Off	Off	0
On	Off	Off	Off	1
Off	On	Off	Off	2
On	On	Off	Off	3
Off	Off	On	Off	4

Table 4.1 – ARB 5220 CAN Addresses

Setting ARB 5221 CAN Address

Before installing the ARB 5221, the CAN addresses of the ARB Cards must be set. Two cut-outs have been designed on the solder side of the ARB 5221 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 figure 4.4.

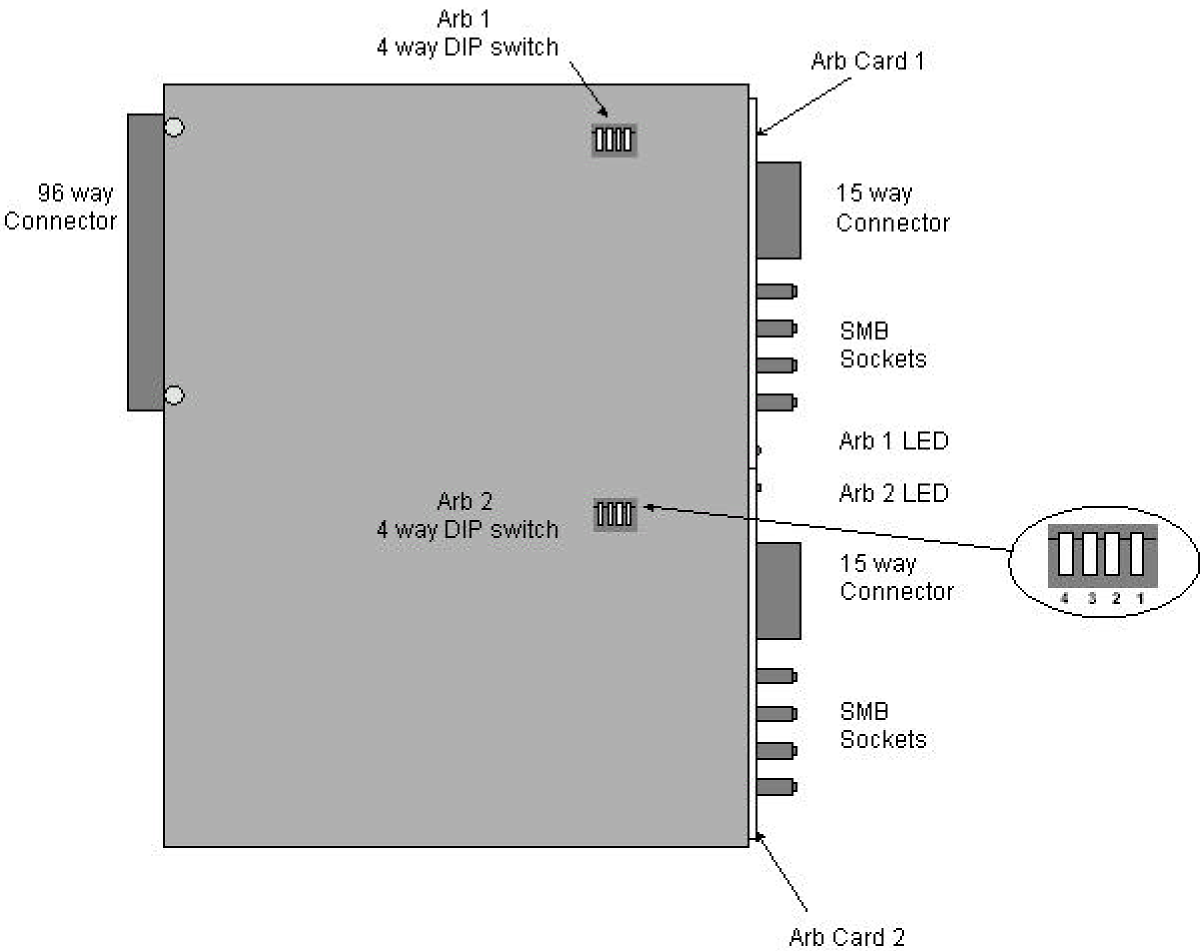


Figure 4.4 – ARB 5221 Solder View showing 2x 4 way DIP switches

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.

SW4	SW3	SW2	SW1	Address
Off	Off	Off	Off	0
On	Off	Off	Off	1
Off	On	Off	Off	2
On	On	Off	Off	3
Off	Off	On	Off	4

Table 4.2 - ARB 5221 4 way DIP Switch CAN Address

Programming the NVRAM

The standard waveform segments are stored on NVRAM for normal use. The memory contents of NVRAM depends upon battery back-up when the arb card is powered OFF. The typical lifetime of each batery is 10 years. If a battery does fail, however, it is necessary to re-program the NVRAM with the waveform segments. This can be accomplished using Autostar V2.50 or greater (see Autostar software manual V2.50) or alternatively in hardware. The hardware steps are as follows :

1. Ensure the ARB module is powered OFF.
2. Locate the 4 way DIP switches on the solder side of the ARB 5220 Carrier Card, refer to figure 4.3 (figure 4.4 if the module is an ARB 5221). Record the CAN address for each arb card.
3. Set the CAN address to 0 (all switches OFF) on each arb card.
4. Power ON the ARB module for at least 20 seconds.
5. Power OFF the ARB module and set the CAN address back to it’s original setting, for each card.
6. Power ON the ARB module. Each card should now have it’s NVRAM re-programmed.

Deleting the Application firmware

This section only applies to arb cards with boot code V1.50 and application firmware V1.50 or greater. If an earlier version of firmware is present then the EEPROM will have to be removed and programmed externally.

If the application firmware becomes corrupted for any reason (for example, a power down in the middle of a firmware download) it is necessary to delete the application code. This is done as follows :

1. Power OFF the ARB module and close Autostar.
2. Locate the 4 way DIP switches on the solder side of the ARB 5220 Carrier Card, refer to figure 4.3 (figure 4.4 if the module is an ARB 5221).
3. Set the CAN address to 15 (all switches ON) on each arb card.
4. Power ON the ARB module.
5. Open Autostar. A ‘No Arb Present’ message will be returned from the NSG 5200 system indicating that the arb card has no firmware present.
6. Select the Firmware Download centre. Download the firmware to the arb card. This will take approximately half an hour. Do not attempt to cancel the download as this will corrupt the firmware and you will have to restart the process.

4.5 Installation

To install the ARB 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. Check if it is necessary to set the CAN Address. Refer to section 4.4 - Configuration.
4. Slide the ARB module carefully on the guide rails in either of the two slots to the left of the CTR 5210 slot in the NSG 5200 chassis. Refer to Table 4.3 and Figure 4.5.
5. Push the 96 way DIN41612C plug securely into mating socket on the backplane.
6. The module should be pushed firmly home and screwed in using the 2 collar screws mounted on the front panel of the ARB 5220 or ARB 5221 modules.

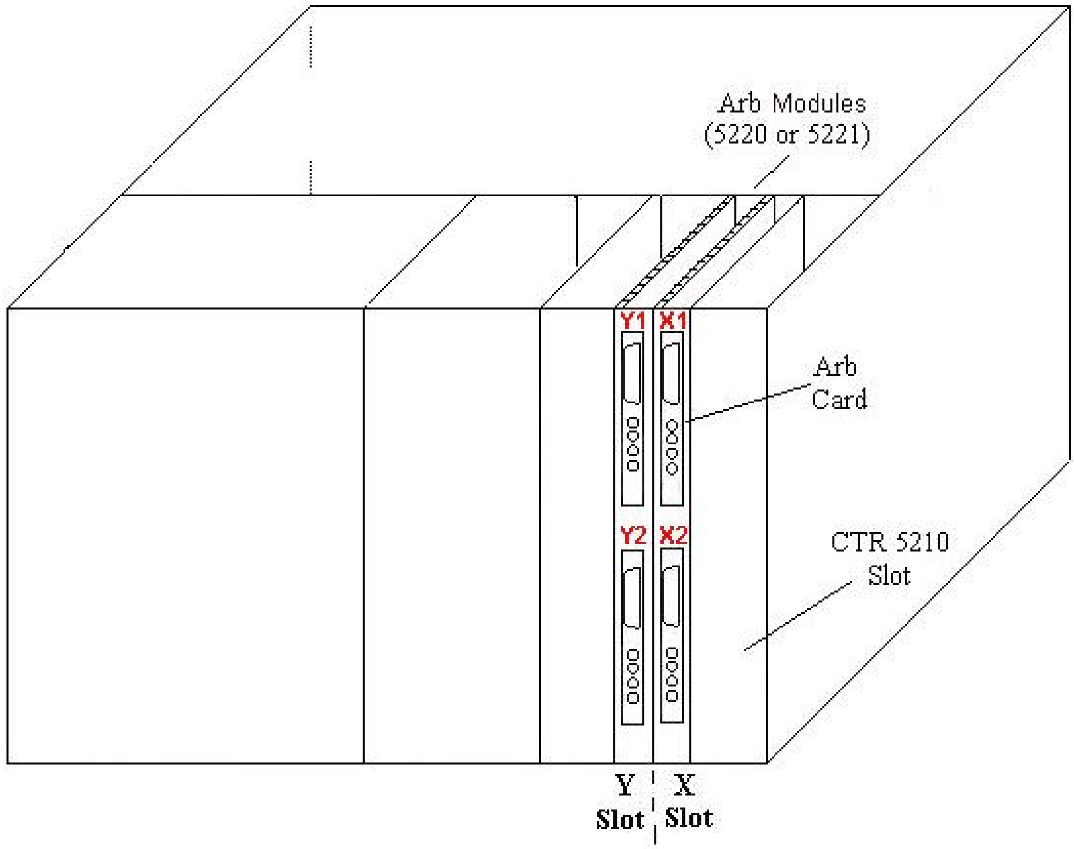


Figure 4.5 - Basic Chassis containing two ARB 5221 (four Arb Cards) in Slots X and Y

No. Of Arb	Module	Slot	CAN Address
1	ARB 5220	X1	1
2	ARB 5221	X1 X2	1 2
3	ARB 5221 (2 ARB Cards)	X1 X2	1 2
	ARB 5220 (1 ARB Card)	Y1	3
4	ARB 5221 (2 ARB Cards)	X1 X2	1 2
	ARB 5221 (2 ARB Cards)	Y1 Y2	3 4

Table 4.3 - Lists the No. of ARBs and location in Chassis Slots

4.6 Verification

A single green LED is mounted on the front panel of the ARB 5220 as it has a single Arb card. There are two green LEDs on the front panel of the ARB 5221 as there are two Arb cards.
The green LEDs are activated on the front panel of the module when a user selects an ARB card using the Autostar software.

LED Colour	LED Function
Green	Power up system and open Autostar, each green LED flashes for short period. Flashes continuously throughout the waveform operation

Table 4.4 – LED Verfication Functions

4.7 ARB 5220 Module Pin Outs

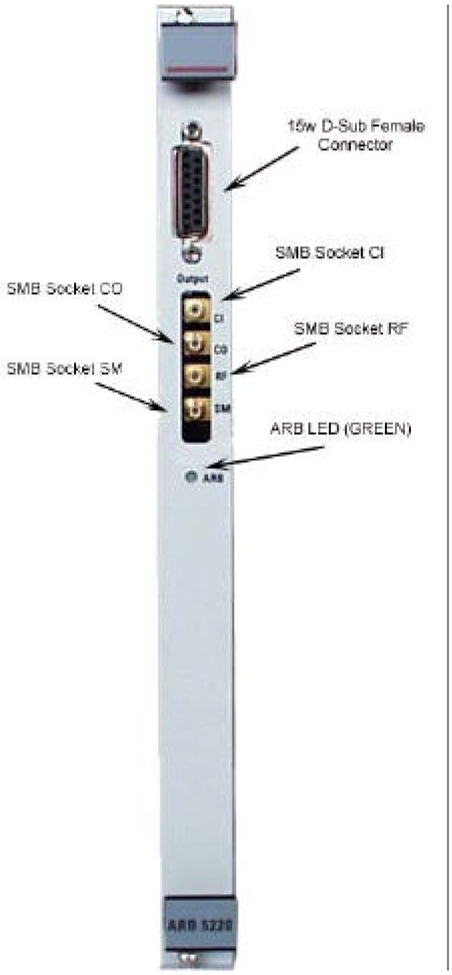


Figure 4.6 - ARB 5220 Front Panel showing Connectors

15 way D-Sub Female

Pin No.	Pin Name	Function
1	+ILim	-10V to +10V output used for programming the current limit of a source
2	+Aux	-10V to +10V output used for programming an auxiliary source in Pulse 4d applications
3	+Vout_Isol	Isolated version of main output with reduced specification
4	+Vout	Main Output from Arb 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	-Vout_Isol	Reference for +Vout_Isol
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

Talbe 4.5 – 15 way D-Sub Female Connector Pin Out

SMB socket CO

Pin No.	Pin Name	Function
Centre	Master Clock Out	Used in the Master as the output clock for synchronising multiple arb cards.
Case	Reference	

Table 4.6 – SMB Socket CO Connector Pin Out

SMB socket CI

Pin No.	Pin Name	Function
Centre	External Clock In	Used in the Slave as the input clock for synchronising multiple arb cards.
Case	Reference	

Table 4.7 – SMB Socket CI Connector Pin Out

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 4.8 – SMB Socket SM Connector Pin Out

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 4.9 – SMB Socket RF Connector Pin Out

4.8 ARB 5220/5221 Technical Specifications

Parameter		Min	Max	Units	Notes
Main Output					
Output Voltage	Range	-10	+10	V	
	Resolution	10		mV	
	Accuracy	± (0.1% + 10mV)		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 5kHz
Frequency Resolution		0.01			
Frequency Accuracy		± (0.01% + 0.01Hz)			
Slew Rate	-10V to 10V	120		V/µs	1k load
	10V to –10V	120			
Full scale settling time, 1%	0V to 10V		0.5	µs	1k load
Isolated Output					
Output Voltage	Range	-10	+10	V	
	Resolution	10		mV	
	Accuracy	± (0.5% + 50mV)			
Output Current		±15		mA	
Output Isolation		1.5		kV	
Short Circuit Protection		No			
Frequency Range	All	0.01	50000	Hz	Limited in Cycle mode to 5kHz
Frequency Resolution	All	0.01			
Frequency Accuracy	All	± (0.1% + 0.05Hz)			
Slew Rate	-10V to 10V		2	V/µs	1k load
	10V to –10V		2		
Full scale settling time, 0.1%	0 to +10V		50	µs	1k load
	0 to –10V		50		
Programmable Current Limit Output					
Output Voltage	Range	-10	+10	V	
	Resolution	10		mV	
	Accuracy	± (0.5% + 10mV)			
Output Impedance			1	Ω	
Output Current		±25		mA	
Short Circuit Protection		Yes			
Auxiliary Output					
Output Voltage	Range	-10	+10	V	
	Resolution	10		mV	
	Accuracy	± (0.5% + 10mV)			
Output Impedance			1	Ω	
Output Current		±25		mA	
Short Circuit Protection		Yes			

Parameter			Min	Max	Units	Notes
General						
Standard Segment Types			Sine, Square, Triangle and Ramp (including DC)			Others available upon request
Number of Segments per waveform			1	100		
Arbitrary Waveform Storage		Memory Capacity	80		KB	
		Step Resolution	200ns	1	secs	Up to 200s 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}			Frequency Ramping is only available in time mode
Segment Duration		Sine, Square, Triangle	5	9995	ms	Resolution 5ms
		Ramp	0.5	1000		Resolution 0.1 ms
		All	0.1	9999	secs	Resolution 0.1 second
			0.1	9999	mins	Resolution 0.1 minute
			0.1	9999	Hours	Resolution 0.1 hour
			1	10000	Cycles	Resolution 1 cycle.
		Accuracy	± (1% + 1ms)			Not applicable to cycle mode
Overall Test Duration		Range	1	9999	Count	
			Continuous			
Start Phase Angle		Value	0	345	degrees	Refer to Figure 4.7
		Resolution	15			
		Accuracy	1° or ± 2µs			
Stop Phase Angle		Value	15	360		Refer to Figure 4.8
		Resolution	15			
		Accuracy	1° or ± 2µs			
Square Wave Duty Cycle Variation	Range	0.01Hz to 160kHz	5	95	%	
		160kHz to 320kHz	25	75		
	Resolution	0.01Hz to 160kHz	5		%	
		160kHz to 320kHz	25			
	Accuracy	0.01Hz to 5kHz	± 0.05		%	
		5kHz to 10kHz	± 0.1			
		10kHz to 20kHz	± 0.2			
		20kHz to 40kHz	± 0.4			
		40kHz to 80kHz	± 0.8			
		80kHz to 160kHz	± 1.6			
		160kHz to 320kHz	± 3.2			

Parameter		Min	Max	Units	Notes
Rectification	Sine, Square, Triangle	None, Positive, Negative			
External Clock Output	Drive	TTL Compatible			
	Frequency	20		MHz	
External Clock In	Drive	TTL Compatible			
	Frequency	20		MHz	
Voltage Distortion	Range	-10	+10	Volts	
	Frequency	DC	1	MHz	
Amplitude Modulation	Range	-10	+10	Volts	
	Frequency	DC	1	MHz	
Operating Temperature Range		10	40	degrees	
Connectors	Main Output	15 way D-Sub Socket			
	CLK Out	SMB Socket			
	CLK In	SMB Socket			
	Vref	SMB Socket			
	Vsum	SMB Socket			
	Control	32x3 way DIN41612C			Plugs into NSG 5200 backplane
Number of ARB Cards	ARB 5220	1			
	ARB 5221	2			
Multiple ARB Card Synchronisation Delay			100	ns	
Event Timing	ZeroCross	+5v for positive values 0v for negative values			Only valid for 0V offset Sine, Square and Triangle
	Start Trigger	Goes LOW at Start			Only valid for Multiple ARB Cards
Module Dimensions	Width	4		HP	1HP = 5.08mm
	Height	6		U	1U = 44.45mm
	Depth	170		mm	
Control Bus	Type	CAN			
	Protocol	CANOpen			
	Speed	125		kbits/s	
	ID Range	1 to 15			0 reprograms the NVRam. 1 is the Master ARB card 4w DIP switch S1 sets the address
Front Panel Indicators	ARB 5220	1 x Green led			
	ARB 5221	2 x Green led			

Table 4.10 – ARB 5220 / 5221 Technical Specifications

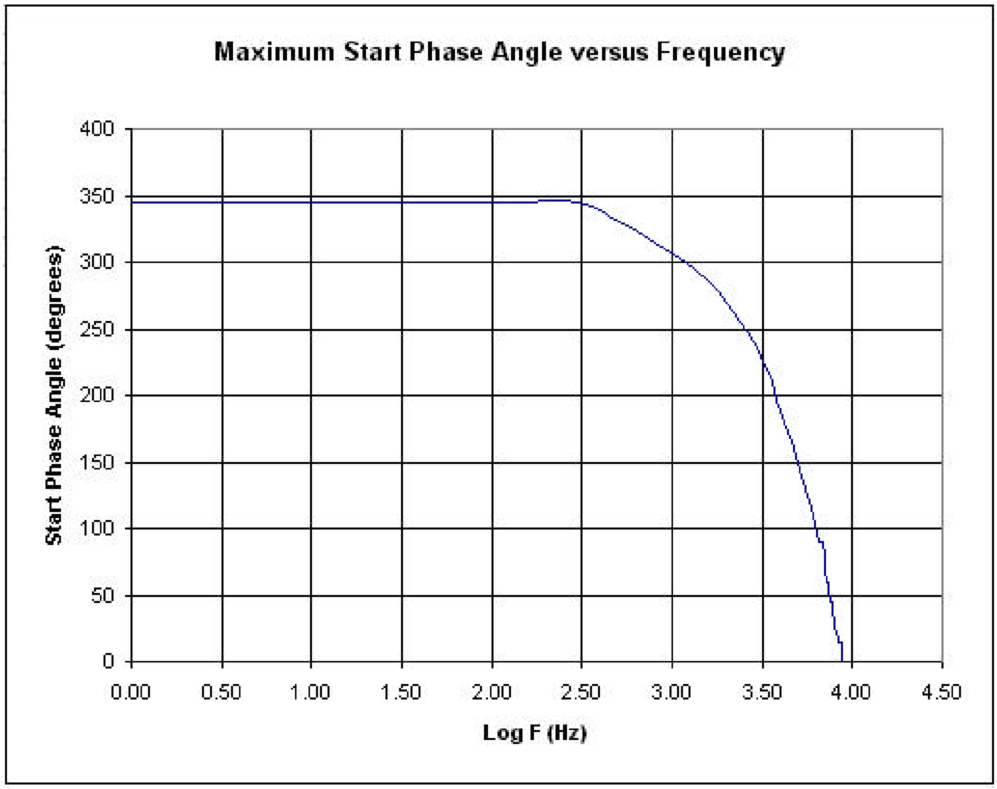


Figure 4.7 – Maximum Start Phase Angle versus Frequency

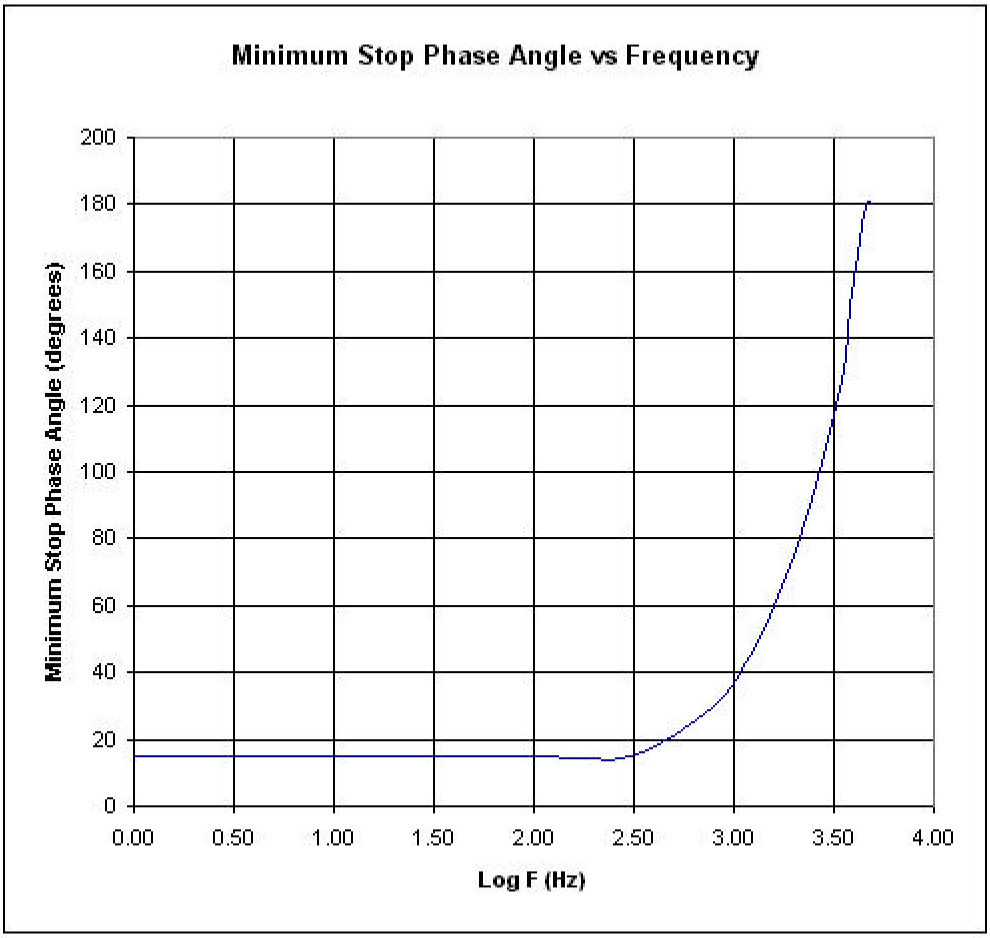


Figure 4.8 – Minimum Stop Phase Angle versus Frequency

4.9 Using the Arbitrary Waveform Memory

The Arb 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 arb card.

Complex waveforms using the scope utility are generated differently. 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 arb card. The instrument then determines (based on the duration of the waveform) how fast to clock out the stored bits.

The current version of the Arb card has 80Kbytes 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 200nS to 1S (up to 200S at reduced accuracy). Thus, a waveform of 50Kbytes could have a minimum duration of 10mS (200nS x 50Kbytes) and a maximum duration of 50Ksecs (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 Arb card.

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

It is important to understand, however, the limitations of the 80Kbytes memory storage. Say a user wanted to generate a sine wave of 80KHz 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 succesfully replayed? The answer is No. To generate a single sine wave cycle it is generally agreed requires at least 16 points. An 80KHz 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 12.8Mbytes of memory would be needed to accurately produce the sine wave!

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

In summary, if the waveform is very fast (& 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.

5. DCS 5230 DC Switch Module

5.1 Introduction

The DCS 5230 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 5200 system combined with Autostar software meets all industry standard DC Switching requirements.

Figure 5.1 - DCS 5230 DC Switch Module.

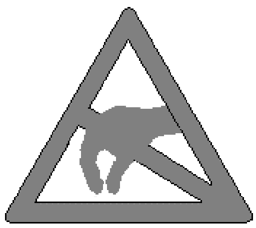
5.2 Handling & Safety

Storage and Transport

The DCS 5230 module is pre-installed in the NSG 5200 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.

Handling

As the module is quite heavy (6kg), 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 DEVICE**

General Module Protection

Overcurrent	Front Panel 75A 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 > -15V. 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 DCS 5230 DC Switch Module meets the safety guidelines in the IEC 1010 standard.

5.3 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 Arb card within the NSG 5200 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 2Ω impedance necessary during the pulse generation.

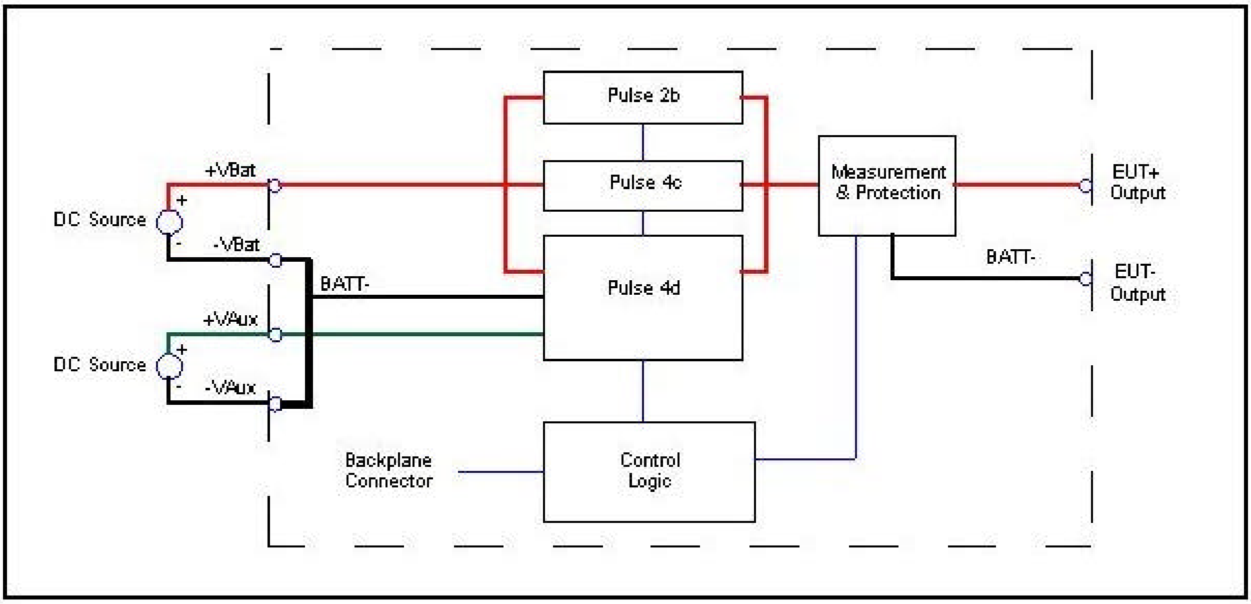


Figure 5.2 - Block Diagram of DCS 5230 showing 2 external sources connected to it for Pulse 4d

The main Battery input is fed into the 6mm connectors labelled 'Main Source Input' on the front panel. For Pulse 4d applications, the second DC Source should be connected to the 6mm 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 DCS 5230 to provide a single output, which is brought out on 6mm connectors labelled 'EUT' on the front panel.

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

The DCS 5230 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 DCS 5230 Module plugs into the NSG 5200 chassis, deriving power from the backplane.

5.4 Configuration

Configuration is performed for all tests except pulse 4d Dips. Use shorting connector assembly for Configuration.

Figure 5.3 – Shorting Connector Assembly Drawing

5.5 Installation

To install the DCS 5230 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 5200 Chassis.
4. The module will align itself using the four 4mm banana plugs on the NSG 5201 or NSG 5202 backplane.
5. The module should be pushed firmly home and screwed in using the 8 collar screws mounted to the front panel of the DCS 5230.

Figure 5.4 – DCS 5230 Module Installed in Left-Most Slot in Basic Chassis

5.6 Verification

There are two Leds on the front panel of the DCS 5230 Module.

LED Colour	LED Function
Green	LED ON if power is present in the module.
Red	LED ON when an Interlock error occurs.

Table 5.1 – LED Verfication Functions

5.7 Connectors

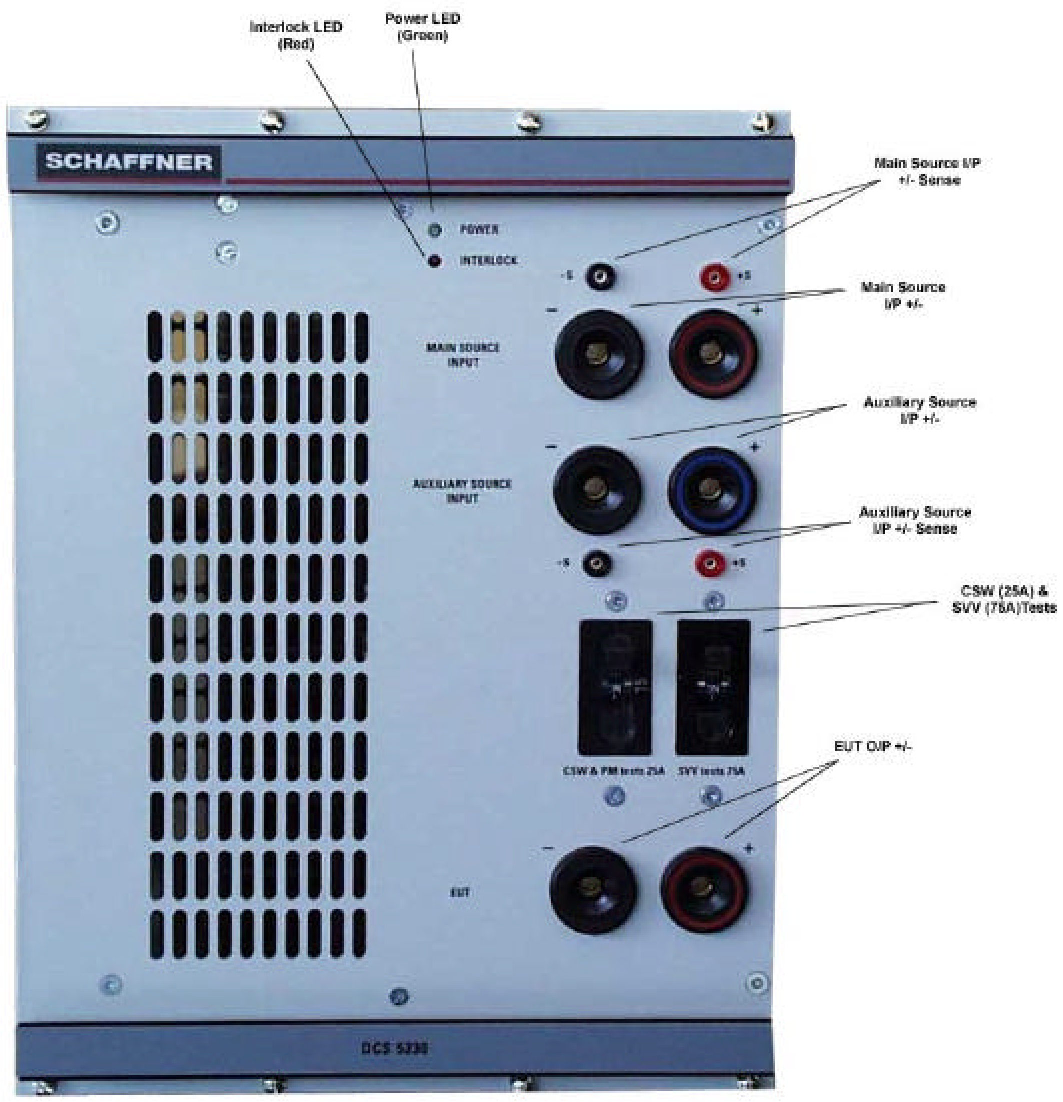


Figure 5.5 – DCS 5230 Front Panel Connectors

Connector	Description	Function
Main Source I/P +	Round 6mm Red Connnector	These connectors connect the Battery Source to the DCS 5230
Main Source I/P -	Round 6mm Black Connector	
Main Source I/P + Sense	Round 2mm Red Connector	
Main Source I/P - Sense	Round 2mm Black Connector	
Auxiliary Source I/P +	Round 6mm Blue Connector	These connectors connect the Auxiliary Source to the DCS 5230 for use in Dips and Drops
Auxiliary Source I/P -	Round 6mm Black Connector	
Auxiliary Source I/P + Sense	Round 2mm Red Connector	
Auxiliary Source I/P - Sense	Round 2mm Black Connector	
EUT O/P +	Round 6mm Red Connector	These connectors connect the DCS 5230 to the EUT or to the NSG 5000 Battery Input, if present
EUT O/P -	Round 6mm Black Connector	
Backplane Control Connector	96 way DIN 41612C	This connector connects the DCS 5230 to the NSG 5200 Backplane
Backplane Power Connector +	Round 4mm Red Connector	These connectors connect the Battery to the Backplane of the NSG 5200 for use in Power Magnetics and Conducted Sine Waves
Backplane Power Connector -	Round 4mm Black Connector	

Table 5.2 – DCS 5230 Front Panel Connector Descriptions

5.8 DCS 5230 Module Technical Specifications

Parameter		Min	Max	Units	Notes
Pulse 4c Path Specifications					
Battery Input Voltage, V_B	Range	-14	70	Volts	
	Resolution	0.1			
	Accuracy	± (1% + 0.2V)			
Battery Input Current	Range	0	75	Amps	
Maximum DC Voltage Drop	I_L = 75A		1	Volts	
Input to Output DC Resistance			10	mΩ	
Inrush Current	t = 100ms		150	Amps	
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		%	0.01Hz to 30kHz
		20			30kHz to 300kHz
	3dB BW	300		kHz	
Battery Current Readback Measurement	Ratio	0.1		A/A	
	Accuracy	5		%	
	Bandwidth	20		kHz	
Pulse 4d Path Specifications					
Battery Input Voltage, V_B	Range	0	60	Volts	Refer to figure 5.7 for Safe Operating Area Curve
	Resolution	0.1			
	Accuracy	± (1% + 0.2V)			
Auxiliary Input Voltage, V_A	Range	0	V_B	Volts	
	Resolution	0.1			
	Accuracy	± (1% + 0.2V)			
Battery Input Current	Range	0	75	Amps	
Auxiliary Input Current	Range	0	75		
Battery Voltage Drop	I_L = 75A		2	Volts	Refer to figure 5.6
Auxiliary Voltage Drop			2		
Quiescent Current	V_B = 60V		3	Amps	Refer to figure 5.8
Inrush Current, Battery and Auxiliary Paths	t = 100ms		100	Amps	
Battery Off Fall time	1kΩ load	0.5	1.5	µs	Measured directly at output of DCS 5230. Purely resistive load
	1Ω load		5		
Battery On Rise time	1kΩ load	0.2	1.5		
	1Ω load		6		
Pulse Width, t_d	Range	3µs	20	secs	
	Resolution	1		µs	
	Accuracy	± (1% + 1µs)			
Pulse Interval, t_1	Range	0.5ms	20	secs	When ramping any parameter, t_1(min) = 1.5mS
	Resolution	0.1		ms	
	Accuracy	± (1% + 1ms)			
Burst Interval Delay	Range	0	9999	secs	Resolution 1 second
		0	9999	minutes	Resolution 1 minute
		0	9999	hours	Resolution 1 hour
	Accuracy	± (1% + 1s)			
No. of pulses per Burst		1	10000		
Pulse Modes		Normal or Inverted			
Auxiliary Voltage Ramping	Range	0	V_B	Volts	
	Step Size	0.1			

Parameter		Min	Max	Units	Notes
Overshoot			2.5	%	
Settling Time, 1%			50	µs	48V to 12V Dip, 10µs pulse, 1Ω load. Refer to figure 5.13.
Sequence Duration or Repetition	Range	1	9999	secs	Resolution 1 second
		1	9999	mins	Resolution 1 minute
		1	9999	hrs	Resolution 1 hour
		1	9999	count	Resolution 1 count.
		Continuous			
	Accuracy	± (1% + 1s)			
Start Up Delay	Range	2	9999	secs	Resolution 1 second
		2 secs	9999	mins	Resolution 1 minute
		2 secs	9999	hrs	Resolution 1 hour
	Accuracy	± (1% + 1s)			
Pulse 2b Path Specifications					
Battery Input Voltage, U_A	Range	0	70	Volts	
	Resolution	0.01			
	Accuracy	± (1% + 0.2V)			
Pulse 2b Output Impedance		2.1 ±10%		Ω	During the pulse
Pulse 2b Current	Range		25	Amps	
End of Test Voltage	Range	0	U_A	Volts	
Pulse Amplitude, U_S	Range	1	U_A	Volts	
	Resolution	0.01			
	Accuracy	± (1% + 0.2V)			
Fall Time, t_f	Range	0.5	10	ms	
	Resolution	0.01			
	Accuracy	± (1% + 0.1ms)			
Rise Time, t_r	Range	0.5	10	ms	
	Resolution	0.1			
	Accuracy	± (1% + 0.1ms)			
Battery Pulse Interval time t_6	Range	0.5	10	ms	
	Resolution	0.1			
	Accuracy	± (1% + 0.1ms)			
Pulse Width, t_d	10% to 10%	50	5000	ms	
	Resolution	0.1			
	Accuracy	± (1% + 1ms)			
Battery Off time, t_2	Range	$2t_d$ +50ms	30	secs	
	Resolution	0.01			
	Accuracy	± (1% + 0.1s)			
Pulse Repetition time, t_1	Range	t_2 + 1s or $30t_d$	1000	secs	
	Resolution	0.1			
	Accuracy	± (1% + 0.1s)			
Sequence Repetition	Range	1	9999	Count	Resolution 1 Count
		Continuous			
Current Limit	Range	0.1	Imax	Amps	Imax is the maximum source current but must be ≤ 25A
	Resolution	0.01			
	Accuracy	± (1% + 0.1A)			

Parameter		Min	Max	Units	Notes
General Specifications					
Overcurrent Protection	Pulse 4c, 4d	75		Amps	Fast 75A MCB
	Pulse 2b	25			Fast 25A MCB
MCB Trip time	75A MCB	0.4	5	sec	I_L = 94A
	25A MCB	0.4	5	sec	I_L = 32A
Overvoltage Protection	All paths	75 ± 1		volts	Voltage sense and crowbar
Inductive Load	I = 75A		300	mH	Derate current accordingly for increased Inductive Load.
Reverse Voltage Protection	Pulse 4c	-15 ± 1		volts	Voltage sense and crowbar
	Pulse 4d	-1			Reverse Voltage Diodes
Module Dimensions	Width	40		HP	1HP = 5.08mm
	Height	6		U	1U = 44.45mm
	Depth	170		mm	
Module Weight		6		kg	
Front Panel Indicators	Power	Green led			
	Interlock	Red led			
Internal Control Bus		CAN			

Table 5.3 – DCS 5230 Technical Specifications

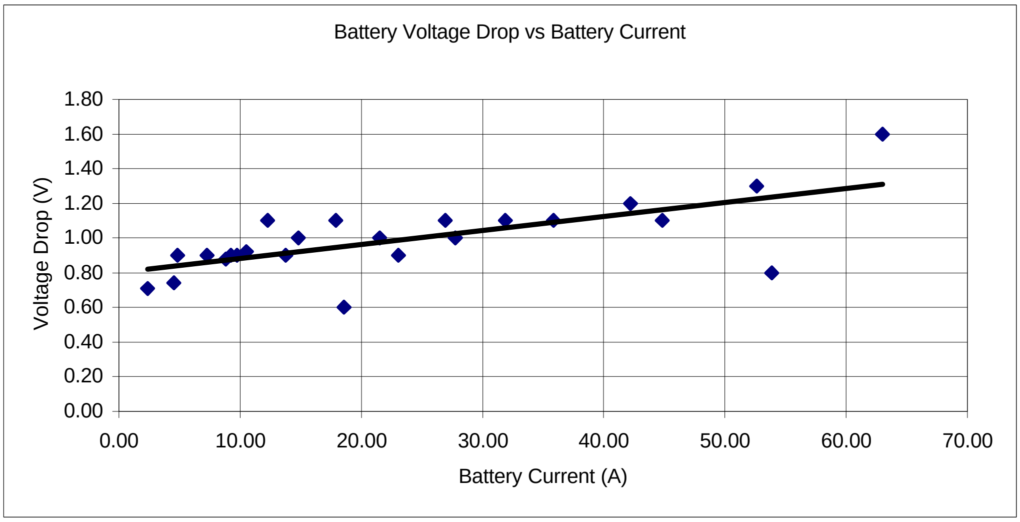


Figure 5.6 - Plot of Pulse 4d Battery Voltage Drop versus Battery Current

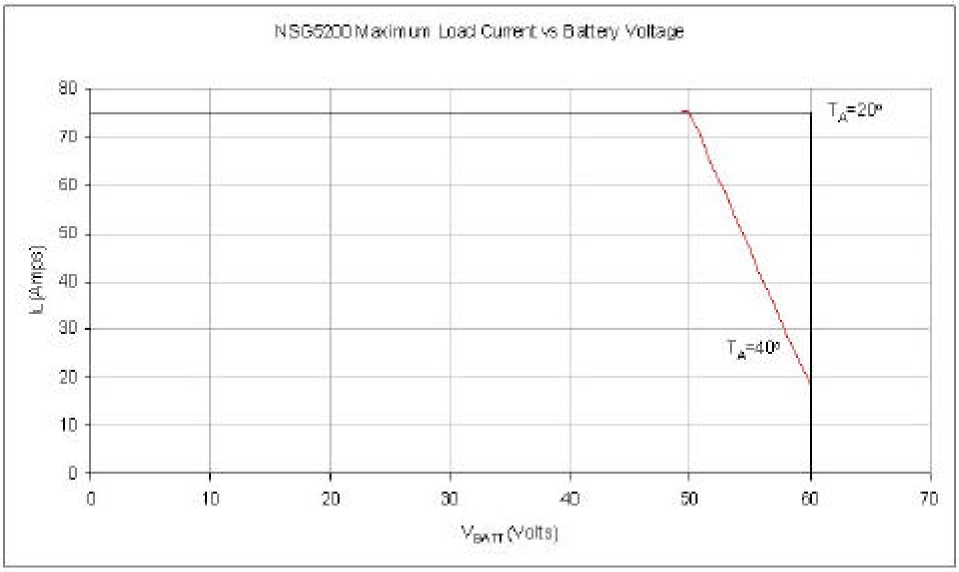


Figure 5.7 - Plot of Pulse 4d Safe Operating Area (Load Current versus Battery Voltage).

The same SOA applies to the Auxiliary Voltage

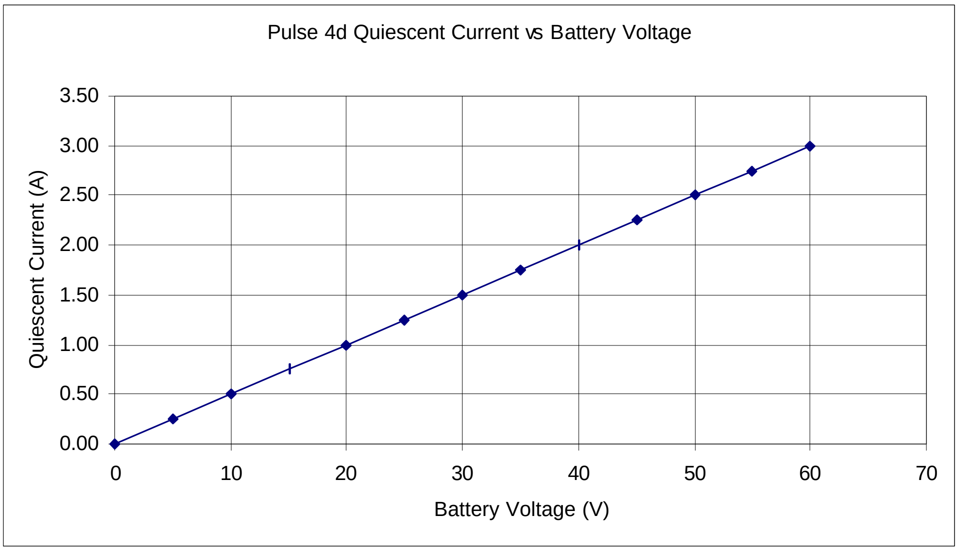


Figure 5.8 - Plot of Pulse 4d Quiescent Current versus Battery Voltage

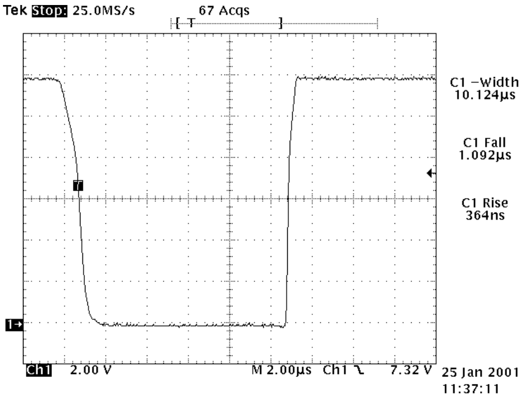


Figure 5.9 – 12V Dropout into 1kW load for 10ms

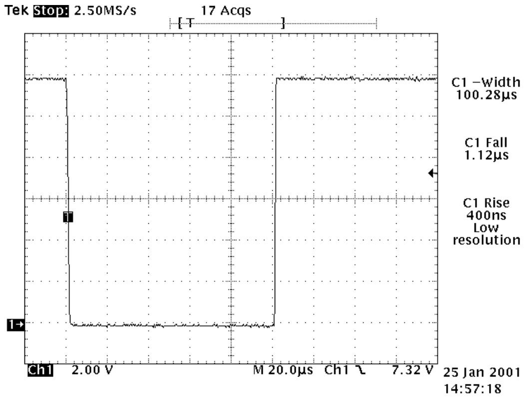


Figure 5.10 – 12V Dropout into 1kW load for 100ms

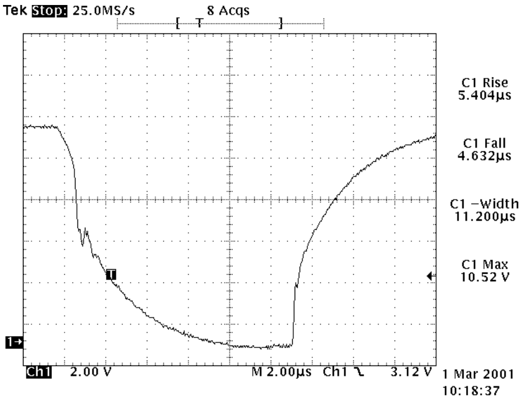


Figure 5.11 – 11V Dropout into 1W load for 10ms

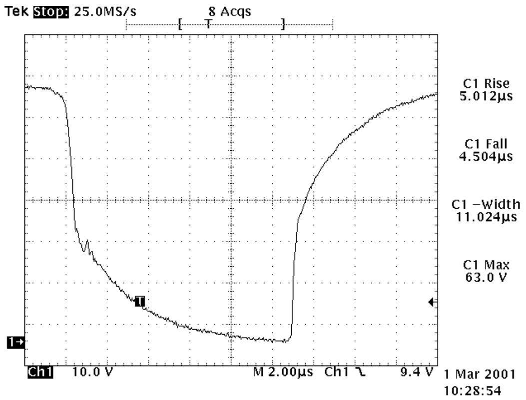


Figure 5.12 - 64V Dropout into 1W load for 10ms

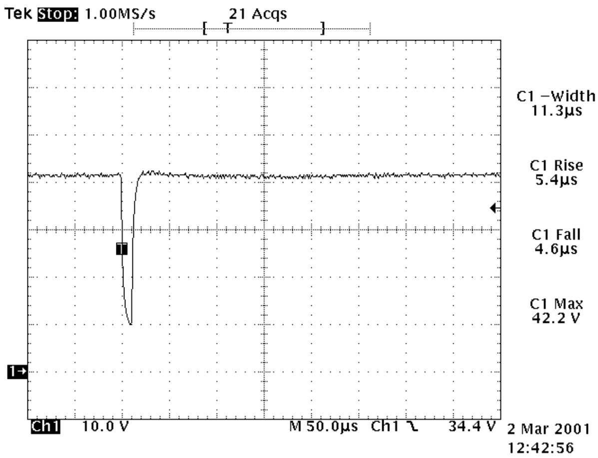


Figure 5.13 - Plot of Pulse 4d Battery Voltage Dip showing Settling Time, 1W load

6. AMP 5240 Power Amplifier Module

6.1 Introduction

The AMP 5240 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 5200 system combined with Autostar software meets all industry standard requirements for these tests.

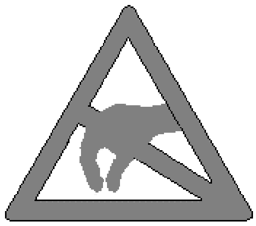
Figure 6.1 - AMP 5240 Power Amplifier Module

6.2 Handling & Safety

Storage and Transport

The AMP 5240 module is pre-installed in the NSG 5200 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.

Handling

	**ATTENTION** **OBSERVE PRECAUTIONS FOR HANDLING** **ELECTROSTATIC DISCHARGE SENSITIVE DEVICE**

General Module Protection

Safety	The AMP 5240 Power Amplifier Module meets the safety guidelines in the IEC 1010 standard.

6.3 Functional Description

The AMP 5240 module accepts an input from the Master Arb card within the NSG 5200 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.

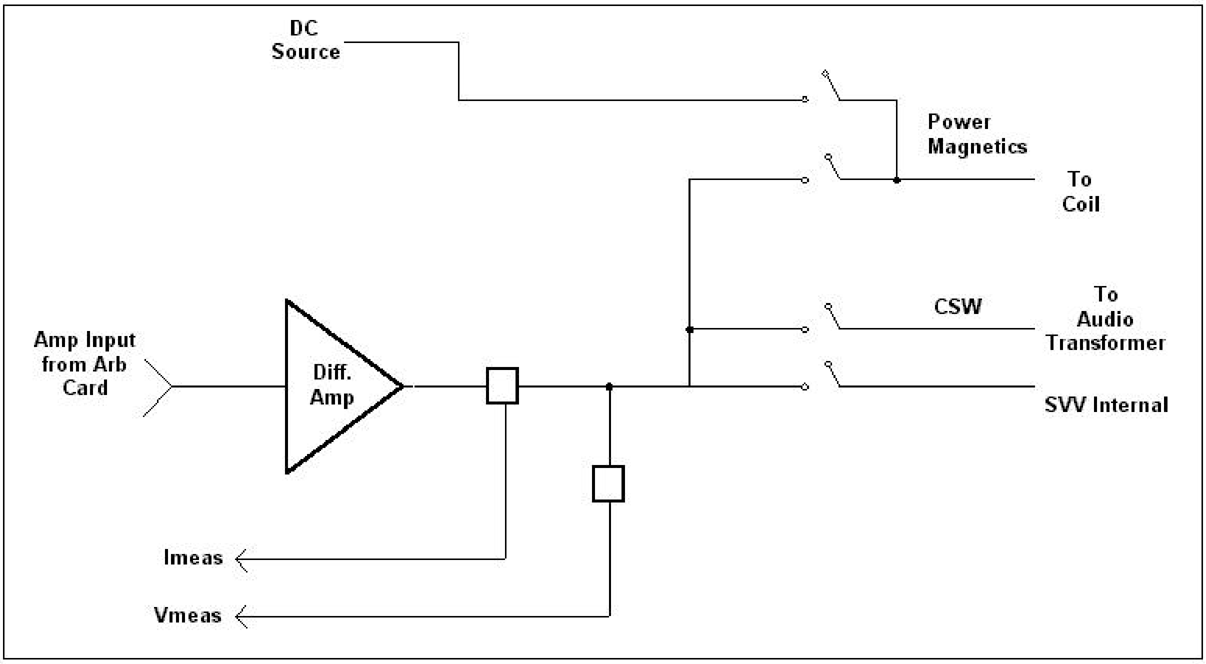


Figure 6.2 – Basic Block Diagram of AMP 5240

If CSW testing is being preformed, then the output of the AMP 5240 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 (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 NSG 5004A or equivalent DC Source. As the frequency increases, the currents needed to generate the required Magnetic Field Density are lower and the AMP 5240 then provides the power source. In Power Magnetics mode the AMP 5240 is set up as a current source rather than a voltage source. The module also contains voltage and current readback circuitry to the Arb card to allow accurate control over these parameters. The AMP 5240 can drive either a Radiating Loop or a Helmholtz Coil, depending upon the standard that is being tested.

A third output on the AMP 5240 is provided where the operator may only need to test up to 13.5V at low current (a few amps). In these situations the direct output of the AMP 5240 may be used as a DC Amplifier, with frequencies from DC to 320kHz and a ±15V 5A output. This is achieved by selecting, within Autostar software, the AMP 5240 as the Battery Source. The output of the Arb card is then directed along the backplane to the AMP 5240. The amplified signal appears on the output connection 'Power Amplifier Output'.

The AMP 5240 Module plugs into the NSG 5200 chassis, deriving power from the backplane. The module does not need to be configured.

6.4 Installation

To install the AMP 5240 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 DCS 5230 module in the centre of the NSG 5200 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 AMP 5240.

Figure 6.3 – AMP 5240 Module Installed in the Centre Slot in the Basic Chassis

6.5 Verification

The Overtemperature LED is located on the front panel of the AMP 5240.

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 6.1 – LED Verification Functions

6.6 Connectors

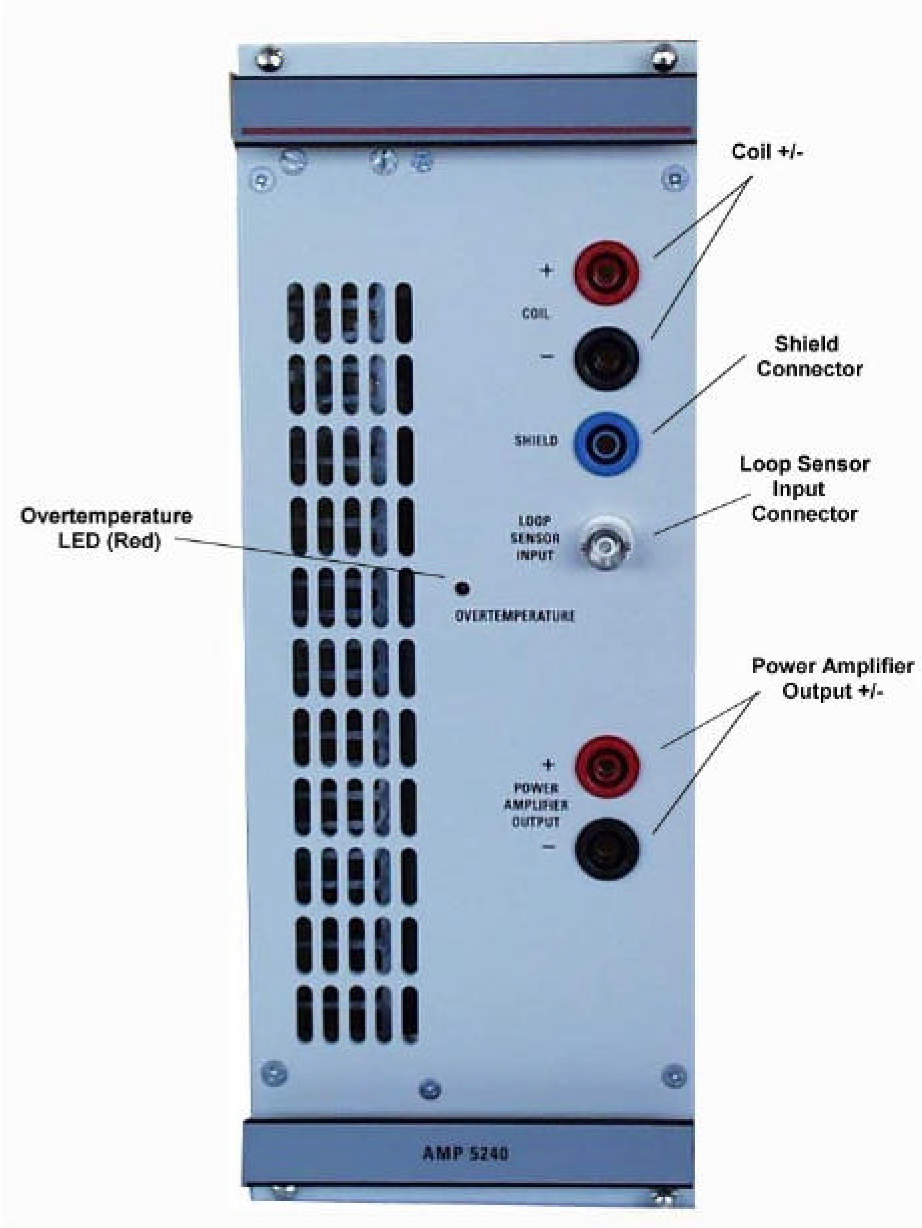


Figure 6.4 – AMP 5240 Front Panel Connectors

<table>
<tr><th>Connector</th><th>Description</th><th>Function</th></tr>
<tr><td>Coil +</td><td>Round Red 4mm Socket</td><td rowspan="3">These connectors are connected to Radiating Loop or Helmholtz Coil in Power Magnetics</td></tr>
<tr><td>Coil -</td><td>Round Black 4mm Socket</td></tr>
<tr><td>Shield</td><td>Round Blue 4mm Socket</td></tr>
<tr><td>Loop Sensor Input</td><td>Female BNC Connector</td><td>This is a voltage input from the Loop Sensor which is attached to the Radiating Loop</td></tr>
<tr><td>Power Amplifier Ouput +</td><td>Round Red 4mm Socket</td><td rowspan="2">These connections bring the voltage directly from the amplifier output during SVV Internal tests</td></tr>
<tr><td>Power Amplifier Output -</td><td>Round Black 4mm Socket</td></tr>
</table>

Table 6.2 – AMP 5240 Front Panel Connectors

6.7 AMP 5240 Power Amplifier Technical Specifications

Parameter		Min	Max	Units	Notes
CSW Application Specifications					
Amplifier Output Voltage	Range	-10	10	Volts	Audio Transformer Ratio is 2:1 so the peak voltage on the transformer secondary is 5V
	Resolution	0.2			
	Accuracy	± (1% + 0.1V)			
Amplifier Output Current			5	Amps	Maximum Output Current at Transformer Secondary is 10A
Amplifier Frequency	Range	0.01	320	kHz	
	Resolution	0.001			
	Accuracy	± (0.01% + 0.01Hz)			
Amplifier Gain		2			
Power Magnetics Application Specifications					
External Amplifier Peak Output Voltage	Range	-70	70	Volts	
	Resolution	0.1			
	Accuracy	Amplifier Dependent			
External Amplifier RMS Output Current			10	Amps	
Internal Amplifier Peak Current	Range 1	30	1200	mA	
	Range 2	1	30		
	Range 3	0	1		
Internal Amplifier Peak Output Voltage	Range 1		6	Volts	R_{int} = 5Ω
	Range 2		5		R_{int} = 166Ω
	Range 3		5		R_{int} = 5K
Internal Amplifier Accuracy	All Ranges	± (1% + 3μA)			
Amplifier Frequency	Range	0.01	100	kHz	
	Resolution	0.001			
	Accuracy	± (0.01% + 0.01Hz)			
Internal Amplifier Gain		1			
Bandwidth	< 0.5dB	320		kHz	1K load. All ranges.
Magnetic Field Density	Range	40	180	dBpT	RMS values
	Resolution	0.01			
	Accuracy	± (1% + 8dBpT)			Radiating Loop 9230-1, 0.05m from loop
Pulse Types		Sine, Square, Triangle			
Step Duration		1	9999	seconds	
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 4mm Banana Socket			
	Coil-	Black 4mm Banana Socket			
	Shield	Blue 4mm Banana Socket			
	Loop Sensor	BNC			

Parameter		Min	Max	Units	Notes
Supply Voltage Variations Internal Application Specifications					
Internal Amplifier Output Voltage	Range	-15	15	Volts	
	Resolution	0.1			
	Accuracy	± (0.1% + 0.01V)			
Internal Amplifier Output Current			5	Amps	
Amplifier Frequency	Range	0.01	320	kHz	
	Resolution	0.001			
	Accuracy	± (0.01% + 0.01Hz)			
Offset Voltage			5	mV	
Bandwidth	< 1dB	320		kHz	1K load
Internal Amplifier Gain		2			
Output impedance		100		mΩ	
Slew Rate	-10V to +10V	43		V/µs	1KΩ load
Settling Time, 1%	-10V to +10V	<1		µs	1KΩ load
Connectors	SVV+	Red 4mm Banana Socket			
	SVV-	Black 4mm Banana Socket			
General Specifications					
Battery Voltage Readback Measurement	Ratio	0.1		V/V	
	Accuracy	5		%	0.01Hz to 30kHz
		20			30kHz to 300kHz
	3dB BW	300		kHz	
Battery Current Readback Measurement	Ratio	0.1		A/A	
	Accuracy	5		%	
	Bandwidth	20		kHz	
Test Duration	Range	1	9999	count	Resolution 1 count.
		Continuous			
Overcurrent Protection	External	25		amps	Fast 75A MCB
	Pulse 2b	25			Fast 25A MCB
Module Dimensions	Width	20		HP	1HP = 5.08mm
	Height	6		U	1U = 44.45mm
	Depth	170		mm	
Module Weight		2		kg	
Front Panel Indicators	OverTemp	Red led			
Internal Control Bus		CAN			
Backplane Connectors	Bus	96w DIN41612C			
	Power	48w DIN41612E			

Table 6.3 – AMP 5240 Technical Specifications

7. CSW 5250 Conducted Sine Waves Module

7.1 Introduction

The CSW 5250 Conducted Sine Wave Module is designed for use when Conducted Sine Wave testing (CSW) is required.

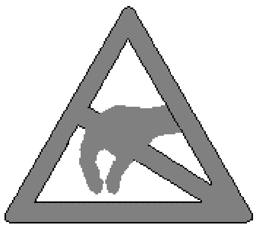
Figure 7.1 - CSW 5250 Conducted Sine Waves Module

7.2 Handling & Safety

Storage and Transport

The CSW 5250 module is pre-installed in the NSG 5200 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.

Handling

	**ATTENTION** **OBSERVE PRECAUTIONS** **FOR HANDLING** **ELECTROSTATIC DISCHARGE SENSITIVE DEVICE**

General Module Protection

Safety	The CSW 5250 Conducted Sine Waves Module meets the safety guidelines in the IEC 1010 standard.

7.3 Functional Description

The CSW 5250 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 CSW 5250, controlled by Autostar, provides this connection automatically. It also provides an option to switch in a 100µF bypass capacitor, as defined in the standards.

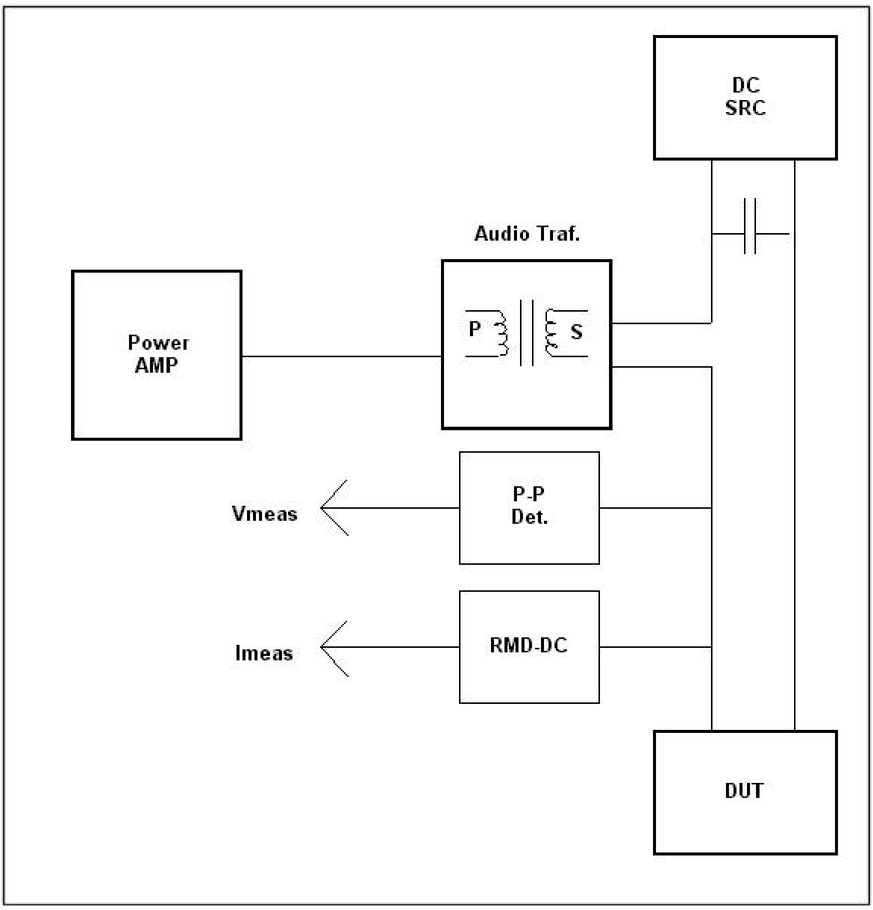


Figure 7.2 – Basic Block Diagram of CSW 5250

The CSW 5250 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 CSW 5250 Module plugs into the NSG 5200 chassis, deriving power from the backplane. The module does not need to be configured.

7.4 Installation

To install the CSW 5250 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 AMP 5240 Module and the ARB 5221 Module (optional) in the NSG 5200 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 CSW 5250 Module.

Figure 7.3 - CSW 5250 Module Installed in the Basic Chassis

7.5 Connectors

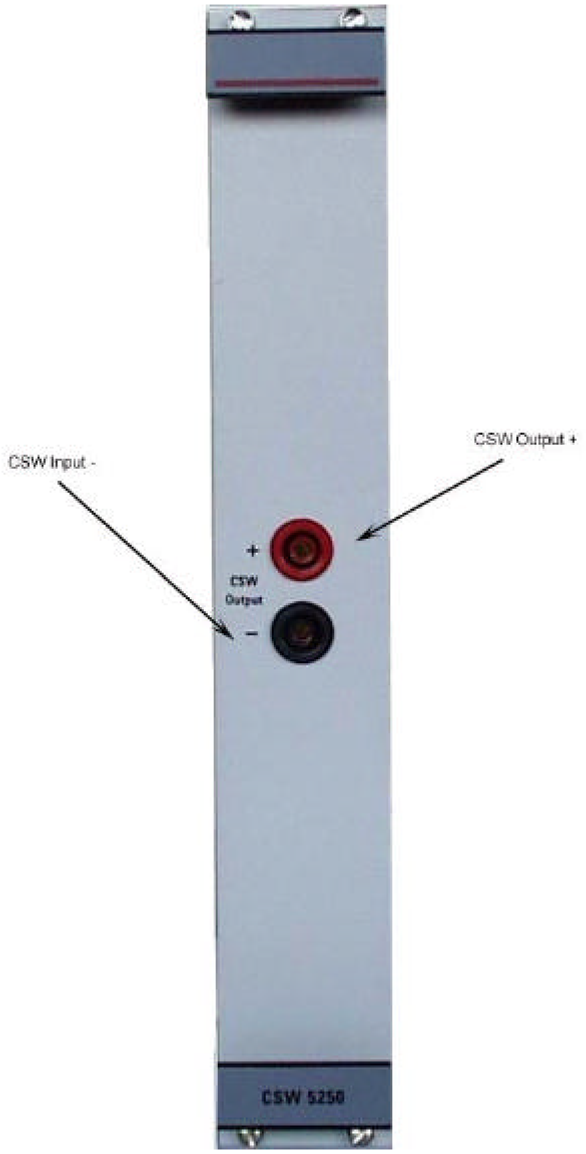


Figure 7.4 – CSW 5250 Front Panel showing Connectors

Connector	Description	Description
CSW Output +	Round Red 4mm Socket	These connections connect the secondary of Audio Transformer to the DUT
CSW Output -	Round Black 4mm Socket	

Table 7.1 – CSW 5250 Front Panel Connectors

7.6 CSW 5250 Conducted Sine Waves Technical Specifications

Parameter		Min	Max	Units	Notes
Battery Voltage	Range	0	70	Volts	
	Resolution	0.1			
	Accuracy	± (1% + 0.2V)			
Maximum Battery DC Current			25	Amps	
DUT AC Voltage	Range	0.05	15	Vpk-pk	
	Resolution	0.01		Volts	
	Accuracy				
DUT AC Current	Range	0	7	Arms	
DUT Output Frequency	Range	10	250000	Hz	Limited to 5kHz in Cycle mode
	Resolution	0.01			
	Accuracy	± (0.01% + 0.01Hz)			
Transformer Saturation Voltage		Refer to figure 7.8			
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 5ms
		1	9999	secs	Resolution 1 second
		1	6000	mins	Resolution 1 minute
		1	100	Hours	Resolution 1 hour
		1	9999	Cycles	Resolution 1 cycle.
	Accuracy	± (1% + 1ms)			Not applicable to cycle mode
Start Phase Angle	Value	0	345	degrees	Maximum Start Angle = 15 x Integer Part of {24 x (1– 0.00003 x freq[Hz])}
	Resolution	15			
	Accuracy	1° or ± 2µs			
Stop Phase Angle	Value	15	360		Only available in Cycle mode. Minimum Stop Angle = 15 x {1 + Integer Part of (0.00648 x freq[Hz])}
Internal Peak to Peak Voltage Measurement	Range	0.05	15	Volts	Peak to Peak Voltage is displayed by Autostar during a test
	Accuracy	± (2% + 0.1V)			
Internal RMS Current Measurement	Range	0	7	Arms	RMS Current is displayed by Autostar during a test
	Accuracy	± (2% + 0.1A)			
Programmable Current Limit	Range	0.1	7	Arms	
	Accuracy	± (10% + 0.3A)			

Parameter		Min	Max	Units	Notes
Bypass Capacitor		100µF ± 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	1HP = 5.08mm
	Height	6		U	1U = 44.45mm
	Depth	170		mm	
Module Weight				kg	
Front Panel Indicators	Power	Green led			
	Interlock	Red led			
Internal Control Bus		CAN			

Table 7.2 – CSW 5250 Technical Specifications

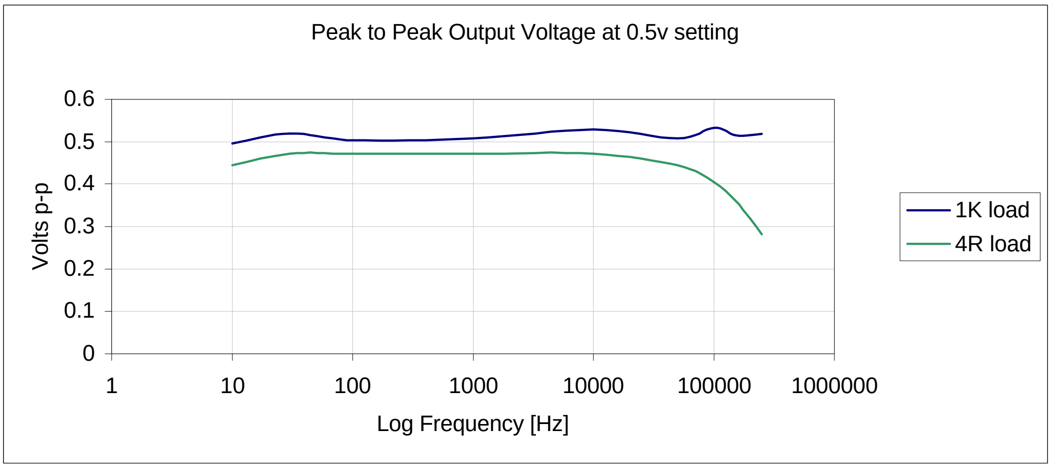


Figure 7.5 - Plot of Output Voltage versus Frequency for a voltage setting of 0.5V pk-pk at 1kW and 4W loads

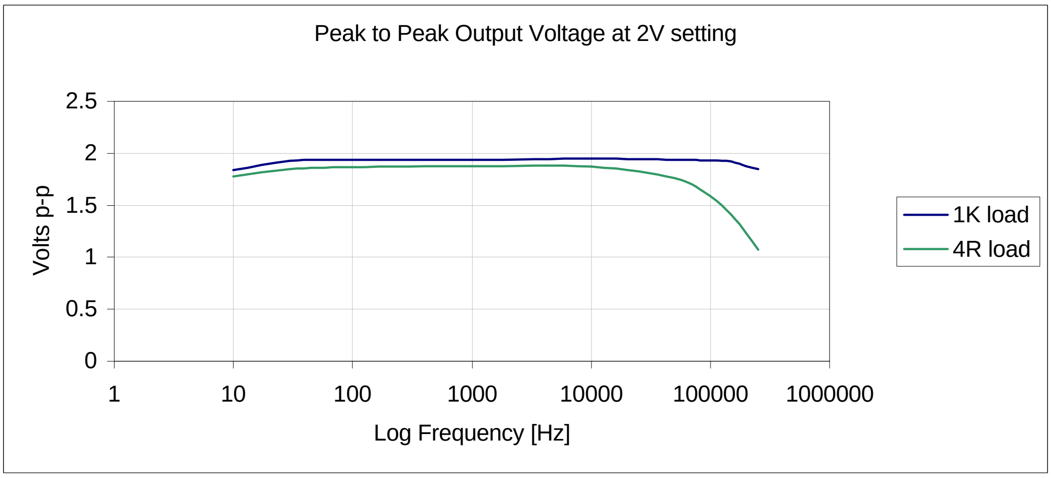


Figure 7.6 - Plot of Output Voltage versus Frequency for a voltage setting of 2V pk-pk at 1kW and 4W loads

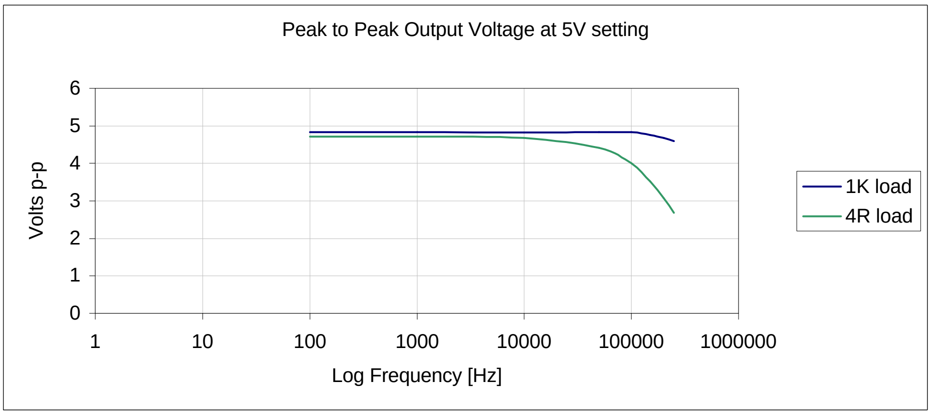


Figure 7.7 - Plot of Output Voltage versus Frequency for a voltage setting of 5V pk-pk at 1kW and 4W loads

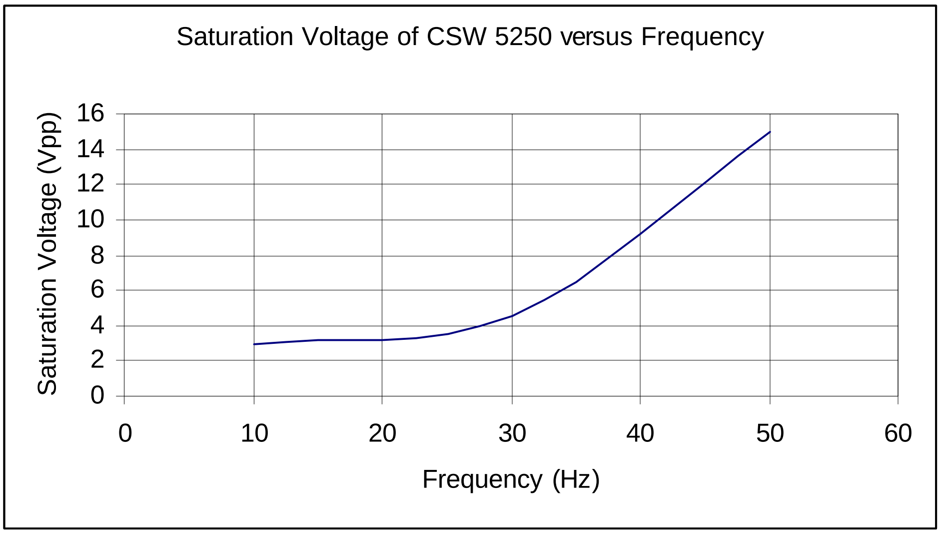


Figure 7.8 - Plot of CSW 5250 Transformer Saturation Voltage versus Frequency

Appendix A - Controller Card Commands

Introduction

Communication between the Carrier Card and the Host PC is possible via a serial interface (RS232) or via an IEEE interface (GPIB).

Protocol

The communication protocol used is SCPI-1999 (Standard Commands for Programmable Systems).

Technical Specification of the Serial Interface

The RS232 port has the following technical specification:

- Transmission rate: 19200 bits/sec
- Data bits: 8
- Parity: even
- Stop bits: 2
- Flow control: XON/XOFF
- Receive buffer size: 1024 byte

Error Handling

If the user wishes to know whether a command sent to the Carrier Card was received and executed correctly, the <SYSTem:ERRor?> command is to be used.

Command Structure

All commands are structured according to the SCPI standard.

Command Summary

Command	Remark	Permitted in the operation modes
SCPI mandatory commands		
*IDN?	Query only	Stop, Run, Pause
*RST	No query	Stop, Run, Pause
INSTrument subsystem		
:INSTrument		
:[SELect] <string>	No query	Stop
:NSELect <integer>	No query	Stop
:CONFig?	Query only	Stop, Run, Pause
:[SELect]?	Query only	Stop, Run, Pause
:NSELect?	Query only	Stop, Run, Pause
:CATalog		
:FULL?	Query only	Stop, Run, Pause
INITiate subsystem		
:INITiate		
:[IMMediate]	No query	Stop
:CONTinous	No query	Stop
:SINGle	No query	Stop
:ALL		
:[IMMediate]	No query	Stop
:CONTinuous	No query	Stop
:SINGle	No query	Stop
ABORT subsystem		
:ABORT		
:[SELected]	No query	Stop, Run, Pause
:ALL	No query	Stop, Run, Pause
PAUSE subsystem		
:PAUSE		
:[SELected]	No query	Run, Pause
:ALL	No query	Run, Pause
LIST subsystem		
LIST		
:MODE <string>	No query	Stop
:FUNCtion <string>	No query	Stop
:VOLTage <float>{,<float>}	No query	Stop
:FREQuency < float >{,<float>}	No query	Stop
:DWELl		Stop
:DURation <float>	No query	Stop
:CYCLes <integer>	No query	Stop
:SWEep		
:TIME <float>	No query	Stop
:POINts < float >		
:PHASe <integer>, <integer>	No query	Stop
:PULSe		
:DCYCle <integer>	No query	Stop
:WIDTh <float>	No query	Stop
:PERiod <float>	No query	Stop
:POLarity <string>	No query	Stop
:POLarity <string>	No query	Stop
:REPeat		
:COUNt <integer>	No query	Stop
:DWELl <float>	No query	Stop
:COUNt?	Query only	Stop, Run, Pause
:DWELl?	Query only	Stop, Run, Pause

Command	Remark	Permitted in the operation modes
PROGram subsystem		
:PROG		
:DEFine <integer>	No query	Stop
:DELete		
:SELected <integer>	No query	Stop
:ALL	No query	Stop
:EXEC	No query	Stop
TRIGger subsystem		
:TRIG		
:SOURce <boolean>	No query	Stop
:SOURce?	Query only	Stop, Run, Pause
OUTPut subsystem		
:OUTPut		
:TYPE <string>	No query	Stop, Run, Pause
:DAC <boolean>	No query	Stop
:EXTMod <boolean>	No query	Stop
:EXTTrig <boolean>	No query	Stop
:CURRent		
:LIMit <float>	No query	Stop
:WINdow		
:High <float>	No query	Stop
:LOw <float>	No query	Stop
:VOLTage		
:WINdow		
:HIgh <float>	No query	Stop
:LOw <float>	No query	Stop
:LEVel		
:IMMediate <float>	No query	Stop
:END <float>, <int>	No query	Stop
:TYPE		
:DAC?	Query only	Stop, Run, Pause
:EXTMod?	Query only	Stop, Run, Pause
:EXTTrig?	Query only	Stop, Run, Pause
SOURce subsystem		
:SOURce		
:CURRent		
:LIMit <float>	No query	Stop, Run, Pause
:VOLTage		
:LEVel < float>	No query	Stop
CONTrol subsystem		
:CONTrol		
:SWITch		
:IMMediate <string>	No query	Stop
:PROGram <integer, integer>	No query	Stop
:RELay	No query	Stop, Run, Pause
:CSWCAP <string>	No query	Stop, Run, Pause
:CSWAT <string>	No query	Stop, Run, Pause
:CSWCAL <string>		
:LED	No query	Stop, Run, Pause
:ON <integer>	No query	Stop, Run, Pause
:FLAsh <integer>		

CONFigure subsystem

:CONFigure		
:MODE		
:TEST <string >	No query	Stop
:PULSe <string>	No query	Stop
:RANGE <range>	No query	Stop

Command	Remark	Permitted in the operation modes
MMEMory subsystem		
:MMEMory		
:LOAD <string>	No query	Stop
:DELete	No query	Stop
MEMory subsystem		
:MEMory		
:DATA <string>	No query	Stop
:DELete	No query	Stop
:TABLe		
:TIME <float>	No query	Stop
:VOLT <float>	No query	Stop
:WFMID <integer>	No query	Stop
:WFMID?	Query only	Stop
SYSTem subsystem		
:SYSTem		
:ERRor?	Query only	Stop, Run, Pause
:VERSion?	Query only	Stop, Run, Pause
:SET	No query	Stop
Root commands		
:FLASH	No query	Stop
:STATus?	Query only	Stop, Run, Pause
:WAVE:REGEN	Command	Stop

Commands Description

SCPI mandatory commands

Command	*IDN?
Description	Send identification request to the instrument
Remarks	query only
Syntax	*IDN?
Response	<Manufacturer>,<Model Name>, <Controller Module Identifier>,< Firmware level >, <*n* Module Identifier>,< Firmware level >…. Manufacturer: SCHAFFNER LTD. Model Name: NSG5200 Controller Module Identifier: CTR5210 *n* Module Identifier: (*n* = 0) ARB CARD MASTER (*n* > 0) ARB CARD (*n+1)* Firmware level: <Bootprom version> <separator> <Firmware version> Bootprom version: 6 ASCII characters Firmware version: 6 ASCII characters Hardware version: 6 ASCII characters Separator: “,” (comma)
Example (2 arb cards)	*IDN? SCHAFFNER LTD., NSG5200, CTR5210,V1.00,V1.50, ARB CARD MASTER, V1.50, V1.50, ARB CARD 2, V1.50, V1.50
Command	*RST
Description	Resets the Instrument
Remarks	no query
Syntax	*RST
Response	none
Example	*RST

INSTrument subsystem

Command	:CATalog:FULL?
Description:	Returns a list of all instruments detected.
Remarks:	query only
Syntax:	:INST:CAT:FULL?
Response:	<instrument name>,<instrument identifier> instrument name = ARB instrument identifier = 001| 010…016
Example:	:INST:CAT:FULL? ARB,001, ARB,010
Command	:SELect
Description:	The ARB Card with the specified identifier is selected and all subsequent commands sent to the instrument refer to the selected ARB Card.
Remarks:	no query
Syntax:	:INST:SEL <name> name = ARB CARD MASTER | ARB Card Master is selected

	ARB CARD 1 ARB Card 1 is selected … ARB CARD 16 ARB Card 16 is selected
Response:	None
Example:	:INST:SEL ARB CARD 1 (select ARB Card 1)

Command	:NSELect
Description:	The ARB Card with the specified identifier is selected and all subsequent commands sent to the instrument refer to the selected ARB Card.
Remarks:	no query
Syntax:	:INST:NSEL <identifier> identifier = 001| 010…016
Response:	none
Example:	:INST:NSEL 001 (select ARB Card 1)
Command	:SELect?
Description:	Returns the name of the selected instrument.
Remarks:	query only
Syntax:	:INST:SEL?
Response:	<instrument name> instrument name = ARB CARD MASTER | ARB CARD 1 … ARB CARD 16
Example:	:INST:SEL? ARB CARD MASTER
Command	:NSEL?
Description:	Returns the identifier of the selected instrument.
Remarks:	query only
Syntax:	:INST:NSEL?
Response:	<instrument identifier> instrument identifier = ARB CARD MASTER | ARB CARD 1 … ARB CARD 16
Example:	:INST:NSEL? 001
Command	:CONFiguration?
Description:	Returns the configuration of the selected instrument.
Remarks:	query only
Syntax:	:INST:CONF?
Response:	none
Example:	:INST:CONF?

INITiate subsystem

Command	:SINGle
Description:	Fire the waveform once, regardless of the number of repetitions specified by the <LIST:REP:COUN> command or the repetition time specified by the <LIST:REP:DWEL> command.
Remarks:	no query
Syntax:	:INIT:SING
Response:	None
Example:	:INIT:SING
Command	:CONTinuous
Description:	Fire and repeat the waveform continuously, regardless of the number of repetitions specified by the <LIST:REP:COUN> command or the repetition time specified by the <LIST:REP:DWEL> command. The waveform generation can be aborted using the ABORT command or paused using the PAUSE command.
Remarks:	no query
Syntax:	:INIT:CONT
Response:	None
Example:	:INIT:CONT
Command	[:IMMediate]
Description:	Fire and repeat the waveform according to the number of repetitions specified by the <LIST:REP:COUN> command or the repetition time specified by the <LIST:REP:DWEL> command.
Remarks:	no query
Syntax:	:INIT:IMM
Response:	None
Example:	:INIT:IMM
Command	:ALL [:IMMediate]
Description:	In a multiple ARB Card system, fire and repeat the waveforms in each card synchronously according to the number of repetitions specified by the <LIST:REP:COUN> command or the repetition time specified by the <LIST:REP:DWEL> command.
Remarks:	no query
Syntax:	:INIT:ALL:IMM
Response:	none
Example:	:INIT:ALL:IMM
Command	:SINGle
Description:	In a multiple ARB Card system, fire the waveforms in each card synchronously once, regardless of the number of repetitions specified by the <LIST:REP:COUN> command or the repetition time specified by the <LIST:REP:DWEL> command.
Remarks:	no query
Syntax:	:INIT: ALL:SING
Response:	none
Example:	:INIT: ALL:SING
Command	:CONTinuous
Description:	In a multiple ARB Card system, fire and repeat the waveforms in each card synchronously and continuously, regardless of the number of repetitions specified by the <LIST:REP:COUN> command or the repetition time specified by the <LIST:REP:DWEL> command. The waveform generation can be aborted using the ABORT:ALL command or paused using the PAUSE:ALL command.
Remarks:	no query
Syntax:	:INIT:ALL:CONT
Response:	none
Example:	:INIT: ALL:CONT

ABORT subsystem

Command	:[SELected]
Description:	Abort the waveform generation of the currently selected ARB Card. The output voltage will be set to the level specified by the OUTP:VOLT:LEV:END command (default: 0V).
Remarks:	no query
Syntax:	:ABORT:SEL
Response:	none
Example:	:ABORT:SEL
Command	:ALL
Description:	Abort the waveform generation of all ARB Cards in a multiple ARB Card system. The output voltages will be set to the levels specified by the OUTP:VOLT:LEV:END command for each card (default: 0V).
Remarks:	no query
Syntax:	:ABORT:ALL
Response:	none
Example:	:ABORT:ALL

PAUSE subsystem

Command	:[SELected]
Description:	Pause the waveform generation of the currently selected ARB Card. The output voltage will remain at the latest level. If this command is sent again it will resume the waveform generation.
Remarks:	no query
Syntax:	:PAUSE:SEL
Response:	none
Example:	:PAUSE:SEL (pause waveform generation) :PAUSE:SEL (resume waveform generation)
Command	:ALL
Description:	Pause the waveform generation of all ARB Cards in a multiple ARB Card system. The output voltages will remain at the latest level. If this command is sent again it will resume the waveform generation.
Remarks:	no query
Syntax:	:PAUSE:ALL
Response:	none
Example:	:PAUSE:ALL (pause waveform generation) :PAUSE:ALL (resume waveform generation)

LIST subsystem

The List subsystem is used to specify all necessary parameters for one segment. Depending on the mode of the segment, only the parameters which describe the segment need to be sent. A complete list will be followed by the <PROGram:EXECute> command which sends the segment parameters from the controller card to the Arbitrary Waveform Generator Card where the segment is assigned an index. If a waveform consists of more than one segment, consecutive lists can be sent, each followed by the <PROGram:EXECute> command. The segment indexes in the Arbitrary Waveform Generator Card will start from 0 for the first segment, 1 for the second and so on. A maximum of 100 segments can be sent.

Command	:MODE
Description:	Set the mode for the segment.
Remarks:	no query
Syntax:	:LIST:MODE <mode> mode = ACDC | (ACDC segment) FSWITCH | (fast switch segment) FPULSE | (fast pulse segment) CI260A | (CI260A test segment) CI260B | (CI260B test segment) SCOPE | (scope segment) REN3423 | (Renault 3.4.2.3. test segment) VOL531 (Volvo 5.3.1. test segment)
Response:	none
Example:	:LIST:MODE FSWITCH
Command	:FUNCtion
Description:	Set the waveform function for the segment.
Remarks:	no query, applicable for ACDC segments only
Syntax:	:LIST:FUNC <function> function = SINE | (sine wave) SQUARE | (square wave) TRIANGLE | (triangular wave) RAMP sawtooth wave)
Response:	none
Example:	:LIST:FUNC SINE

Command	:VOLTage
Description:	Set the voltage values for the segment.
Remarks:	no query, syntax depending on segment mode Note: ramping is currently not supported for FPULSE, REN3423, VOL531 segments
Syntax:	for segment mode ACDC, REN3423, VOL531: :LIST:VOLT <initial amplitude>,<final amplitude>,amplitude ramp mode>, <initial offset>,<final offset>,<offset ramp mode> initial amplitude: valid range: –10…10 unit: volts data format: float final amplitude: valid range: -10…10 unit: volts data format: float amplitude ramp mode: 0 | (static) 1 | (linear) 3 (logarithmic) initial offset: valid range: -10…10 unit: volts data format: float final offset: valid range: -10…10 unit: volts data format: float offset ramp mode: 0 | (static) 1 | (linear) 3 (logarithmic) for segment mode FSWITCH: :LIST:VOLT <battery voltage>,<initial auxiliary voltage>, <final auxiliary voltage>,auxiliary voltage ramp step size> battery voltage: valid range: -10…10 unit: volts data format: float initial auxiliary voltage: valid range: -10…10 unit: volts data format: float final auxiliary voltage: valid range: -10…10 unit: volts data format: float aux voltage ramp step size: valid range: 0…10 unit: volts data format: float for segment mode FPULSE: :LIST:VOLT <auxiliary voltage>,<initial offset>,<final offset>, <offset voltage ramp step size>,<initial amplitude>, <final amplitude>,<amplitude ramp step size> auxiliary voltage: valid range: -10…10 unit: volts data format: float initial offset voltage: valid range: -10…10 unit: volts data format: float final offset voltage: valid range: -10…10 unit: volts data format: float

	offset voltage ramp step size: valid range: 0…10 unit: volts data format: float initial amplitude: valid range: 0…10 unit: volts data format: float final amplitude: valid range: 0…10 unit: volts data format: float amplitude ramp step size: valid range: 0…10 unit: volts data format: float for segment mode CI260A, CI260B: :LIST:VOLT <battery voltage>,<auxiliary voltage> battery voltage: valid range: -10…10 unit: volts data format: float auxiliary voltage: valid range: -10…10 unit: volts data format: float
Response:	none
Example:	:LIST:VOLT 1.5,1.5,0,5,2,1 (for ACDCsegment)
Command	:FREQuency
Description:	Set the frequency values for the segment.
Remarks:	no query, applicable for ACDC, REN3423, VOL531 segments only. Note: ramping is currently not supported for REN3423, VOL531 segments.
Syntax:	:LIST:VOLT <initial frequency>,<final frequency>,frequency ramp mode>, initial frequency: valid range: 0.01…320000 unit: hertz data format: float final frequency: valid range: 0.01…320000 unit: hertz data format: float frequency ramp mode: 0 | (static) 1 | (linear) 3 (logarithmic)
Response:	None
Example:	:LIST:FREQ 10,1000,2 (ramp frequency logarithmicly from 10Hz to 1kHz)
Command	:SWEep :TIME
Description:	Set the sweep interval time (ramp interval) for the segment.
Remarks:	no query
Syntax:	:LIST:SWE:TIME <interval time> interval time = 0 | (set shortest possible interval, depends on firmware) valid range: 0.005…100 unit: seconds data format: float
Response:	none
Example:	:LIST:SWE:TIME 0.01 (ramp in intervals of 10ms)

Command	:DWELl :DURation
Description:	Set the duration time for the segment.
Remarks:	no query

Syntax:	:LIST:DWEL:DUR <duration> duration: valid range: 0.0003…1000000 unit: seconds data format: float
Response:	none
Example:	:LIST:DWEL:DUR 10 (segment duration 10 seconds)
Command	:CYCLes
Description:	Set the number of cycles (periods) for the segment.
Remarks:	no query, applicable for ACDC segments with AC component only
Syntax:	:LIST:DWEL:CYCL <cycles> cycles: valid range: 1…65000 data format: integer
Response:	none
Example:	:LIST:DWEL:CYCL 10 (10 cycles of the segment waveform)
Command	:PHASe
Description:	Set the phase angles for the segment.
Remarks:	no query, applicable for ACDC segments with AC component only
Syntax:	:LIST:PHAS <start angle>,<stop angle> start angle: valid range: 0…345 unit: degrees data format: integer stop angle: valid range: 15…360 unit: degrees data format: integer
Response:	none
Example:	:LIST:PHAS 0,360
Command	:PULSe :DCYCle
Description:	Set the duty cycle for the segment
Remarks:	no query, applicable for square wave functions only
Syntax:	:LIST:PULS:DCYC <ratio> ratio: valid range: 1…99 unit: percent data format: integer
Response:	none
Example:	:LIST:PULS:DCYC 25

Command	:WIDTh
Description:	Set the pulse width for the segment.
Remarks:	no query, applicable for FSWITCH, FPULSE, CI260A and CI260B segments only Note: ramping is currently not supported for FPULSE segments
Syntax:	for FSWITCH and FPULSE segments: :LIST:PULS:WIDT <initial pulse width>,<final pulse width>, <pulse width ramp step> initial pulse width: valid range: 0.00001…50 unit: seconds data format: float final pulse width: valid range: 0.00001…50 unit: seconds data format: float pulse width ramp step: valid range: 0.00001…50 unit: seconds data format: float for CI260A and CI260B segments: :LIST:PULS:WIDT <pulse width> pulse width: valid range: 0.0001…0.05 unit: seconds data format: float
Response:	none
Example:	:LIST:PULS:WIDT 0.001,0.005,0.001 (1ms to 5ms pulse width in 1ms steps, FSWITCH or FPULSE) :LIST:PULS:WIDT 0.001 (1ms pulse width, CI260A or CI260B)
Command	:PERiod
Description:	Set the pulse repetition period for the segment.
Remarks:	no query, applicable for FSWITCH and FPULSE segments only Note: ramping is currently not supported for FPULSE segments
Syntax:	:LIST:PULS:PER <initial interval>,<final interval>,<interval ramp step> initial interval: valid range: 0.005…50 unit: seconds data format: float final interval: valid range: 0.005…50 unit: seconds data format: float interval ramp step: valid range: 0.005…50 unit: seconds data format: float
Response:	none
Example:	:LIST:PULS:PER 10,10,0 (pulse every 10s)
Command	:COUNt
Description:	Set the number of pulses per ramp step for the segment.
Remarks:	no query, applicable for square wave functions only
Syntax:	:LIST:PULS:COUN <ratio> ratio: valid range: 1…65000 data format: integer
Response:	none
Example:	:LIST:PULS:COUN 2 (2 pulses per step)

Command	:POLarity
Description:	Set the polarity for the segment.
Remarks:	no query, applicable for FSWITCH and FPULSE segments only
Syntax:	:LIST:PULS:POL <polarity> polarity = POS | (dips) NEG (dropouts)
Response:	none
Example:	:LIST:PULS:POL NEG
Command	:POLarity
Description:	Set the polarity for the segment.
Remarks:	no query, applicable for ACDC segments only
Syntax:	:LIST:POL <polarity> polarity = POS | (positive rectification) NEG | (negative rectification) ALT (no rectification)
Response:	none
Example:	:LIST:POL ALT
Command	:REPeat :COUNt
Description:	Set the number of repetitions of the entire waveform.
Remarks:	no query
Syntax:	:LIST:REP:COUN <repetitions> repetitions: valid range: 1…65000 data format: integer
Response:	none
Example:	:LIST:REP:COUN 2 (fire waveform 2 times)
Command	:DWELl
Description:	Set the repetition time for the entire waveform.
Remarks:	no query
Syntax:	:LIST:REP:DWEL <repetition time> repetition time: valid range: 0.005…1000000 unit: seconds data format: float
Response:	None
Example:	:LIST:REP:DWEL 100 (repeat waveform for 100s)

PROGram subsystem

Command	:DEFine
Description:	Insert a new segment into the waveform according to the specified segment index. The positions of all segments with an index equal to or higher than the specified index will move up, i.e. segment 1 will become segment 2 and so on.
Remarks:	no query, for future use
Syntax:	:PROG:DEF <index> index: valid range: 0…99 data format: integer
Response:	none
Example:	:PROG:DEF 2 (insert segment at index 2)
Command	:DELete :SELected
Description:	Delete the segment with the specified index. The positions of all segments with an index higher than the specified index will move down, i.e. segment 5 will become segment 4 and so on.
Remarks:	no query
Syntax:	:PROG:DEL:SEL <index> index: valid range: 0…99 data format: integer
Response:	none
Example:	:PROG:DEL:SEL 5 (delete segment 5)
Command	:ALL
Description:	Delete all segments present in memory.
Remarks:	no query
Syntax:	:PROG:DEL:ALL
Response:	none
Example:	:PROG:DEL:ALL
Command	:EXECute
Description:	Load the segment with the parameters specified by the LIST subsystem into the Arb Card.
Remarks:	no query A complete segment must have been built up previously using the LIST subsystem.
Syntax:	:PROG:EXEC
Response:	None
Example:	:PROG:EXEC

TRIGger subsystem

Command	:SOURce
Description:	Selects whether a test is started using an external trigger signal.
Remarks:	no query
Syntax:	:TRIG:SOUR <trigger> trigger = 0 | (external trigger OFF) 1 (external trigger ON)
Response:	none
Example:	:TRIG:SOUR 1
Command	:SOURce?
Description:	Returns the state of the synchronisation with the external trigger.
Remarks:	query only
Syntax:	:TRIG:SOUR?
Response:	<trigger> trigger = ON | (external trigger ON) OFF (external trigger OFF)
Example:	:TRIG:SOUR? ON

OUTPut subsystem

Command	:TYPE
Description:	Select which output channel is used.
Remarks:	no query
Syntax:	:OUTP:TYPE <channel> channel = NOISOL | (non isolated output) ISOL | (isolated output) BKPLANE (backplane)
Response:	none
Example:	:OUTP:TYPE BKPLANE
Command	:DAC
Description:	Select the DAC for programming the amplitude.
Remarks:	no query
Syntax:	:OUTP:TYPE:DAC <dac> dac = 0 | (internal DAC) 1 (external input)
Response:	none
Example:	:OUTP:TYPE:DAC 0
Command	:EXTMod
Description:	Switch the external modulation input relay.
Remarks:	no query
Syntax:	:OUTP:TYPE:EXTM <extmod> extmod = 0 | (external modulation relay OFF) 1 (external modulation relay ON)
Response:	none
Example:	:OUTP:TYPE:EXTM 0

Command	:EXTTrig
Description:	Selects whether in a multiple ARB Card system the ARB Card waits for the synchronisation signal from the other cards to start a test. This command should be sent to all ARB Cards in the system *before* sending the waveform data.
Remarks:	no query
Syntax:	:OUTP:TYPE:EXTT <exttrig> exttrig = 0 | (synchronisation OFF, i.e. configured as single module) 1 (synchronisation ON, i.e. configured as multiple module)
Response:	none
Example:	:OUTP:TYPE:EXTT 1 (synchronisation with external trigger ON)
Command	:DAC?
Description:	Returns the selected DAC for programming the amplitude.
Remarks:	query only
Syntax:	:OUTP:TYPE:DAC?
Response:	<dac> dac = INT | (internal DAC) EXT (external input)
Example:	:OUTP:TYPE:DAC? INT
Command	:EXTMod?
Description:	Returns the state of the external modulation relay.
Remarks:	query only
Syntax:	:OUTP:TYPE:EXTM?
Response:	<status> status = ON | (external modulation relay ON) OFF (external modulation relay OFF)
Example:	:OUTP:TYPE:EXTM? ON
Command	:EXTTrig?
Description:	Returns the state of the external trigger.
Remarks:	query only
Syntax:	:OUTP:TYPE:EXTT?
Response:	<status> status = ON | (synchronisation ON) OFF (synchronisation OFF)
Example:	:OUTP:TYPE:EXTT? OFF
Command	:CURRent :LIMit
Description:	Set the output current limit of the Power Amplifier.
Remarks:	no query
Syntax:	:OUTP:CURR:LIM <limit> limit: valid range: 0…10 unit: ampere data format: float
Response:	none
Example:	:OUTP:CURR:LIM 2.5
Command	:WINdow :High
Description:	Set upper limit of output current.
Remarks:	no query
Syntax:	:OUTP:CURR:WIN:HI <limit> limit: valid range: 0…10 unit: ampere data format: float
Response:	none
Example:	:OUTP:CURR:WIN:HI 7.2
Command	:LOw

Description:	Set lower limit of output current.
Remarks:	no query
Syntax:	:OUTP:CURR:WIN:LO <limit> limit: valid range: 0…10 unit: ampere data format: float
Response:	none
Example:	:OUTP:CURR:WIN:LO 0.5
Command	:VOLTage :WINdow :HIgh
Description:	Set upper limit of output voltage.
Remarks:	no query
Syntax:	:OUTP:VOLT:WIN:HI <limit> limit: valid range: -10…10 unit: volts data format: float
Response:	none
Example:	:OUTP:VOLT:WIN:HI 9
Command	:LOw
Description:	Set lower limit of output voltage.
Remarks:	no query
Syntax:	:OUTP:VOLT:WIN:LO <limit> limit: valid range: -10…10 unit: volts data format: float
Response:	none
Example:	:OUTP:VOLT:WIN:LO 2
Command	:LEVel :IMMediate
Description:	Set the main output voltage.
Remarks:	no query
Syntax:	:OUTP:VOLT:LEV:IMM <level> level: valid range: -10…10 unit: volts data format: float
Response:	none
Example:	:OUTP:VOLT:LEV:IMM 10
Command	:END
Description:	Set main output voltage after end of test. Voltage stays on indefinitely if time parameter is excluded or equal to zero. Otherwise, the voltage drops to zero once the time duration elapses.
Remarks:	no query
Syntax:	:OUTP:VOLT:LEV:END <level>,<Time> level: valid range: -10…10 unit: volts data format: float Time(Optional): valid range: 0….9999 Unit: seconds Data format: integer
Response:	none
Example:	:OUTP:VOLT:LEV:END 4.5

SOURce subsystem

Command	:CURRent :LIMit		
Description:	Set output current limit of the DC source.		
Remarks:	no query		
Syntax:	:SOUR:CURR:LIM <limit> limit:	valid range: unit: data format:	0…10 ampere float
Response:	none		
Example:	:SOUR:CURR:LIM 5		
Command	:VOLTage :LEVel		
Description:	Set output voltage level of the DC source.		
Remarks:	no query		
Syntax:	:SOUR:VOLT:LEV <level> level:	valid range: unit: data format:	-10…10 ampere float
Response:	none		
Example:	:SOUR:VOLT:LEV 7.4		

CONTrol subsystem

Command	:SWITch :IMMediate		
Description:	Sets or resets the DC switch control signal for the FET.		
Remarks:	no query		
Syntax:	:CONT:SWIT:IMM <switch> switch = ON | OFF	 (FET control signal ON) (FET control signal OFF)	
Response:	none		
Example:	:CONT:SWIT:IMM ON (switch FET signal on)		
Command	:PROGram		
Description:	Programs the segments for which the DC switch control signal has to be set.		
Remarks:	no query		
Syntax:	:CONT:SWIT:PROG <on>,<off> on: off:	 valid range: data format: valid range: data format:	 0…99 integer 1…99 integer
Response:	none		
Example:	:CONT:SWIT:PROG 2,4 (Set FET control signal ON for segments 2 through 4)		

Command	:RELay :CSWCAP
Description:	Switches the relay which determines whether or not the bypass capacitor across the DC supply is switched in.
Remarks:	no query
Syntax:	:CONT:REL:CSWCAP <state> state = ON | (bypass cap in) OFF (bypass cap out)
Response:	none
Example:	:CONT:REL:CSWCAP ON (switch bypass cap in)
Command	:CSWAT
Description:	Determines whether the audio transformer is on the positive side or the negative side of the DC supply.
Remarks:	no query
Syntax:	:CONT:REL:CSWAT <state> state = POS | (audio transformer on positive lead) NEG (audio transformer on negative lead)
Response:	none
Example:	:CONT:REL:CSWAT POS (audio transformer on positive lead)
Command	:CSWCAL
Description:	Connects the DUT outputs to the measurement circuitry.
Remarks:	no query
Syntax:	:CONT:REL:CSWCAL <state> state = ON | (DUT outputs directly connected to measurement circuitry) OFF (DUT outputs not directly connected to measurement circuitry)
Response:	none
Example:	:CONT:REL:CSWCAL OFF (DUT outputs not directly connected to measurement circuitry)
Command	:LED :ON
Description:	Switches the status LED on the ARB Carrier Card on for a specified time.
Remarks:	no query
Syntax:	:CONT:LED:ON <time> time: valid range: 1…60 unit: seconds data format: integer
Response:	none
Example:	:CONT:LED:ON 5 (LED on for 5 seconds)

Command	:FLAsh
Description:	Lets the status LED on the ARB Carrier Card flash for the specified time.
Remarks:	no query
Syntax:	:CONT:LED:FLASH <time> time: valid range: 1…60 unit: seconds data format: integer
Response:	none
Example:	:CONT:LED:FLASH 10 (LED flashes for 10 seconds)

CONFigure subsystem

Command	:MODE :TEST
Description:	Configures the system settings for the selected test.
Remarks:	no query
Syntax:	:CONF:MODE:TEST <test> test = SVV | (configure system for Supply Voltage Variations Test) CSW | (configure system for Conducted Sine Wave Test) PM | (configure system for Power Magnetics Test) SVI (configure system for Supply Voltage Variations Internal Test)
Response:	none
Example:	:CONF:MODE:TEST CSW
Command	:PULSe
Description:	Configures the system settings for the selected pulse.
Remarks:	no query
Syntax:	:CONF:MODE:PULS <pulse> pulse = DEF | (configure system for default pulse tests) 2B | (configure system for Pulse 2B tests) 4D (configure system for Pulse 4B tests)
Response:	none
Example:	:CONF:MODE:PULS 2B
Command	:RANGE
Description:	Configures the current range on the Power Amplifier for a Power Magnetics (PM) test.
Remarks:	no query
Syntax:	:CONF:MODE:RANGE <range> range = PMI1 | (select internal, 1A range) PMI2 | (select internal, 10mA range) PME (select external)
Response:	None
Example:	:CONF:MODE:TEST CSW

MMEMory subsystem

The MMEMory (mass memory) subsystem is used for firmware updates of the ARB Card. It should only be used within a download tool, which reads an INTEL Hex file and sends it record by record continuously to the Carrier Card, which in turn sends it on to the ARB Card.

Command	:DELete
Description:	Delete the main application code in the ARB Card’s flash and wait for new firmware to be downloaded. After sending this command the ARB Card should be given at least 2 sec to reboot.
Remarks:	no query
Syntax:	:MMEM:DEL
Response:	none
Example:	:MMEM:DEL
Command	:LOAD
Description:	Download one record of an INTEL Hex file to the ARB Card via the Carrier Card. After the last record has been sent the ARB Card will reset.
Remarks:	no query
Syntax:	:MMEM:LOAD <record> record = one line of an INTEL Hex file
Response:	none
Example:	:MMEM:LOAD :10448000A758A7A7E6030300DC09A8282D3E088249

MEMory subsystem

The MEMory subsystem is used to copy waveform data into the non-volatile memory of the ARB Card. The main purpose is to download waveform data from oscilloscopes or spreadsheet files to the ARB Card and then regenerate these waveforms.

Command	:DELete
Description:	Delete all waveform data in the ARB Card’s non-volatile memory.
Remarks:	no query
Syntax:	:MEM:DEL
Response:	none
Example:	:MEM:DEL
Command	:DATA
Description:	Download one record of waveform data to the ARB Cards non-volatile memory. One record is a string of up to 10 values in the format 0XXX with XXX the 12bit hexadecimal representation of the data point.
Remarks:	no query
Syntax:	:MEM:DATA <record> record = one record of waveform data
Response:	none
Example:	:MEM:DATA 00000123045607890ABC0DEF

Command	:TABLe :TIME
Description:	Set the sampling interval for the waveform data (time between data points).
Remarks:	no query
Syntax:	:MEM:TABL:TIME <interval> interval: valid range: 0.0000002…200 unit: seconds data format: float
Response:	none
Example:	:MEM:TABL:TIME 0.0002
Command	:VOLT
Description:	Set the voltage gain for the waveform data.
Remarks:	no query
Syntax:	:MEM:TABL:VOLT <gain> gain: valid range: 0.001…10 unit: volts data format: float
Response:	None
Example:	:MEM:TABL:VOLT 7.44
Command	:WFMID
Description:	Set the waveform identifier in non-volatile memory.
Remarks:	no query
Syntax:	:MEM:TABL:WFMID <id> id: valid range: 1…65535 data format: integer
Response:	none
Example:	:MEM:TABL: WFMID 412
Command	:WFMID?
Description:	Read the waveform identifier in non-volatile memory.
Remarks:	query only
Syntax:	:MEM:TABL:WFMID?
Response:	<id> id: valid range: 1…65535 data format: integer
Example:	:MEM:TABL: WFMID? 412

SYSTem subsystem

Command	:ERRor?
Description:	Returns the error caused by the previously sent command.
Remarks:	query only
Syntax:	:SYST:ERR?
Response:	string
Example:	:SYST:ERR? -360,"CAN OPEN ERROR Service Error. Illegal Parameter. Error Code: 0x31" :SYST:ERR? ARB CARD MASTER 0,"NO ERROR"
Command	:VERSion?
Description:	Returns the bootcode version, software version and hardware version of the selected ARB Card.
Remarks:	query only
Syntax:	:SYST:VERS?
Response:	<CAN Address> <separator> <bootcode version> <separator> <Application code version> CAN Address = 3 ascii characters (600 + Arb card #) bootcode version = 6 ASCII characters firmware version = 6 ASCII characters hardware version = 6 ASCII characters separator = " " (space)
Example:	:SYST:VERS? Arb Card Addr: 601 AF:V1.50 BC: V1.50
Command	SET
Description:	Define the actions upon several events triggered by the auxillary signals (DUT failed, Interlock error, Pause/Continue). Note that for safelt reasons control of the interlock is handled by the firmware only.
Remarks:	no query
Syntax:	:SET <exttrig>,<dutfail>,<interlock>,<pausecont> exttrig = 0 | Disabled 1 Enabled (Test starts on active Low). dutfail = 0 | (abort waveform generation upon DUT fail) 1 | (pause waveform generation upon DUT fail) 2 (do nothing upon DUT fail) interlock = 0 | (abort waveform generation upon interlock error) 1 | (pause waveform generation upon interlock error) 2 (do nothing upon interlock error) pausecont = 0 | (abort waveform generation upon pause/continue signal) 1 | (pause waveform generation upon pause/continue signal) 2 (do nothing upon pause/continue signal)
Response:	none
Example:	:SYST:SET 0,1,2,0

Root commands

Command	FLASH
Description:	This command deletes the main application firmware in the Carrier Card and prepares for the download of new firmware.
Remarks:	no query
Syntax:	:FLASH
Response:	none
Example:	:FLASH
Command	STATus?
Description:	Returns the status of the ARB Card.
Remarks:	query only
Syntax:	:STAT?
Response:	For ACDC, CI260A and CI260B segments: <run status>,<segment pc>,<waveform pc>,<test pc>,<outpvolt>,<outpcurr> run status = 0 | (waveform generation running) 1 | (waveform generation paused) 2 (waveform generation stopped) segment pc: valid range: 0…100 (percentage of currently generated waveform segment finished, currently unused) waveform pc: valid range: 0…100 (percentage of currently generated waveform finished) test pc: valid range: 0…100 (percentage of currently generated test finished) outpvolt: data format: float (present value of output voltage) outpcurr: data format: float (present value of output current) For FSWITCH and FPULSE segments: <run status>,<0>,<ramp value>,<pulses>,<outpvolt>,<outpcurr> run status = 0 | (waveform generation running) 1 | (waveform generation paused) 2 (waveform generation stopped) 3 ramp value: data format: float (value of the currently ramped parameter) pulses: data format: integer (overall number of pulses generated in the test) outpvolt: data format: float (present value of output voltage) outpcurr: data format: float (present value of output current)
Example:	:STAT? 0,0,24,78,2.001953,5.5 (for ACDC, CI260A, CI260B and FPULSE segments) :STAT? 0,0,4.1,63445,1.489,2.4 (for FSWITCH segments)
Command	WAVE:REGEN
Description:	This command reprograms the NVRAM for the selected ARB card. **Note** that the green led on the front panel switches on for the duration of the programming process. Normal operation can continue only when the led turns off.
Remarks:	Command only
Syntax:	WAVE:REGEN
Response:	None
Example:	:INST:NSEL 001 :WAVE:REGEN

Appendix B – Connecting Up

Appendix B contains various system configurations for the NSG 5200, NSG 5000, CDN 5010 and Sources. The contents of Appendix are as follows;

NSG 5000	NSG 5200 (1 Arb)	NSG 5200 (2 Arbs)	NSG 5200 (3 Arbs)	NSG 5200 (4 Arbs)	CDN 5010	Refer to Figure
X						B.1
	X					B.2
X					X	B.3
X	X					B.4
		X				B.5
			X			B.6
				X		B.7
X	X				X	B.8

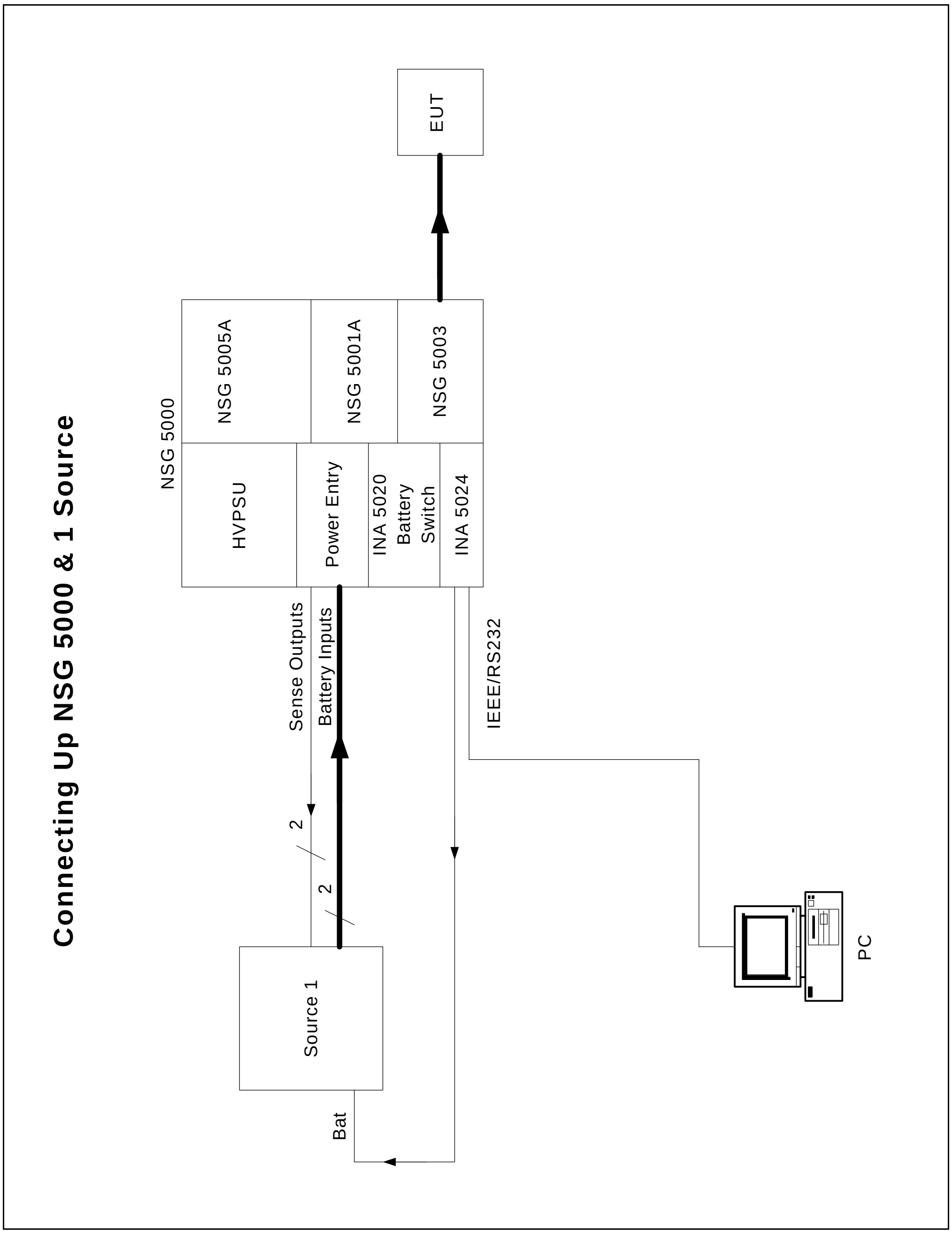


Figure B.1 – Connecting Up the NSG 5000 System and 1 Source

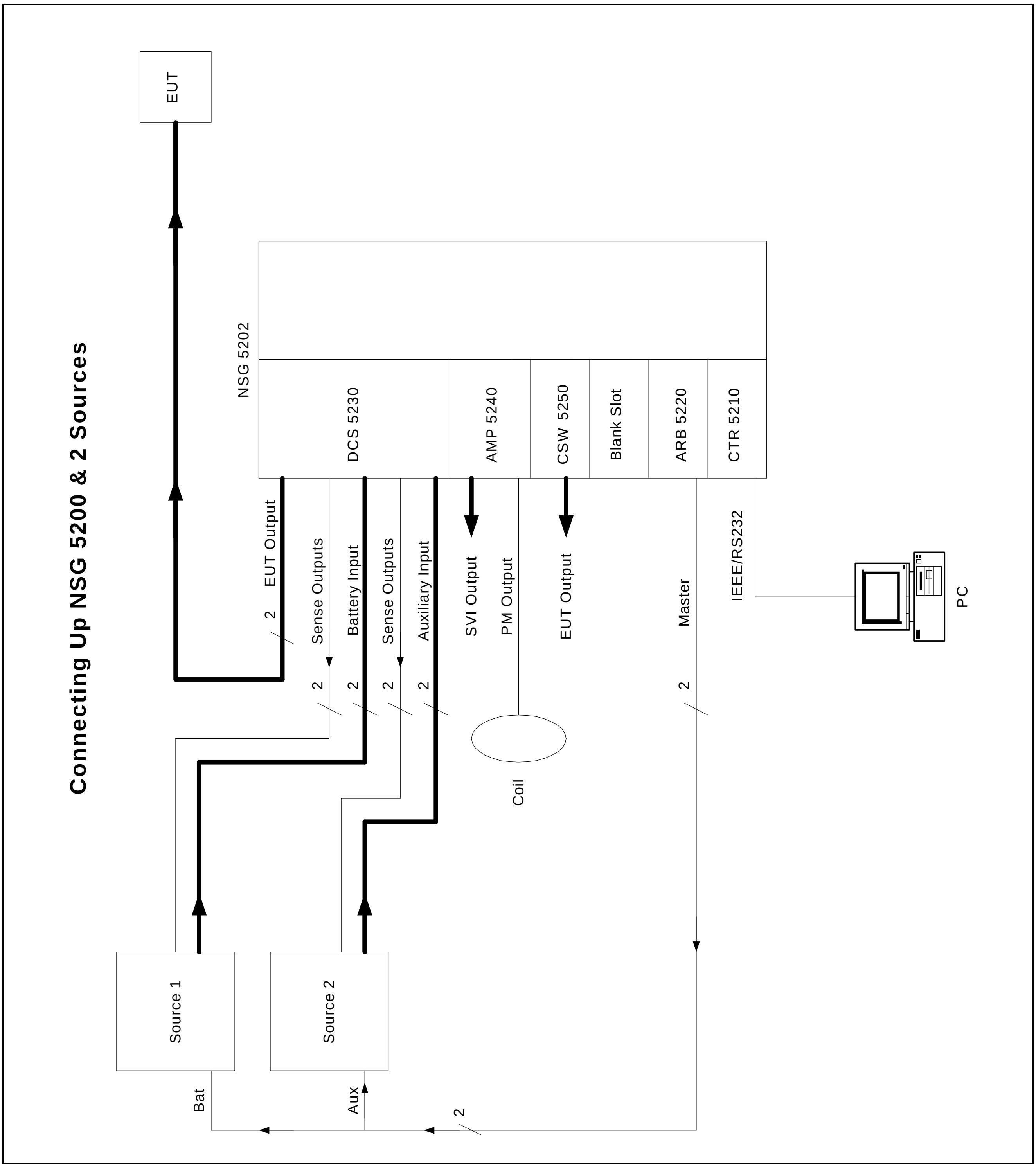


Figure B.2 – Connecting Up the NSG 5200 System and 2 Sources

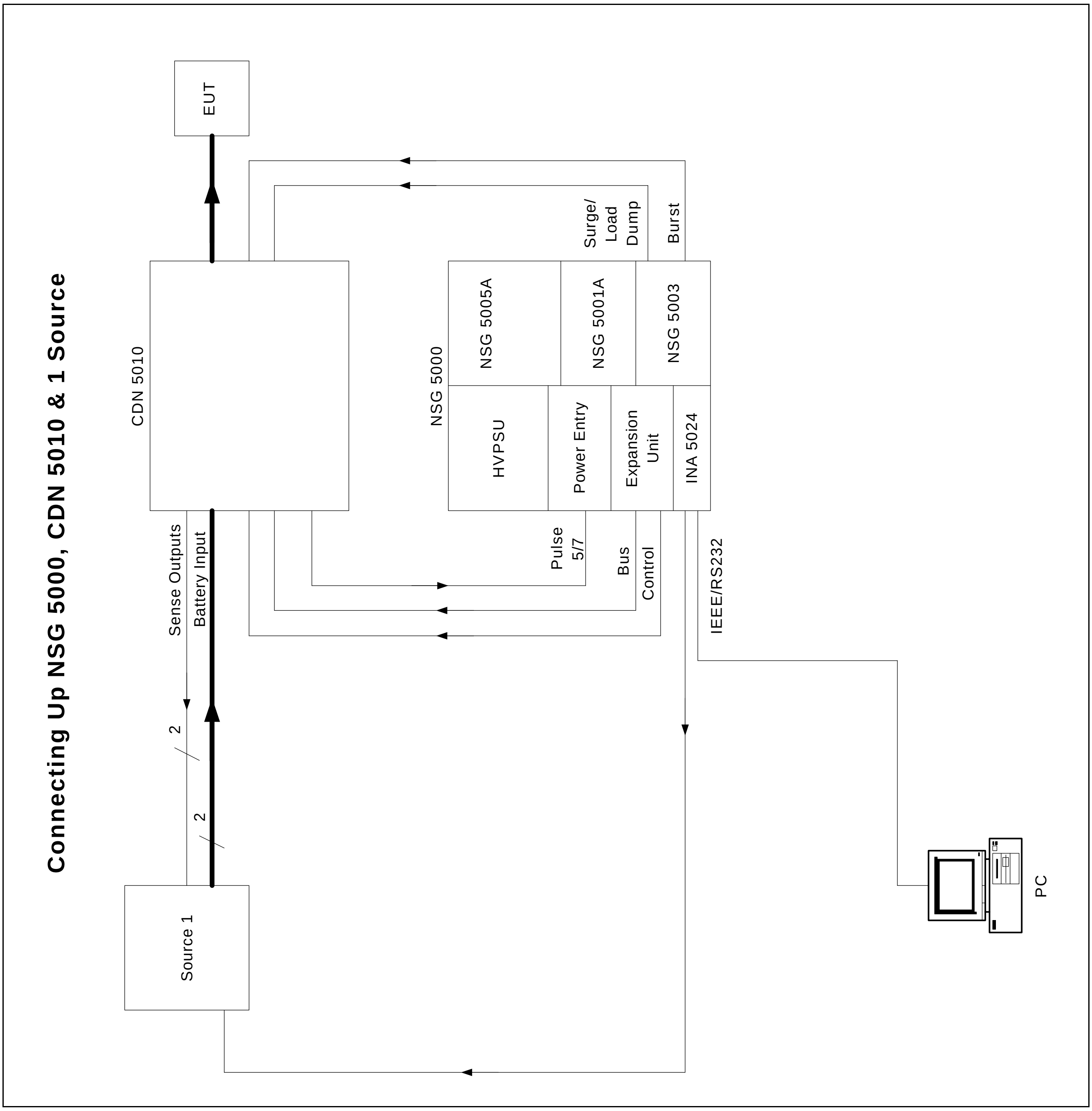


Figure B.3 - Connecting Up the NSG 5000 System CDN 5010 and 1 Source

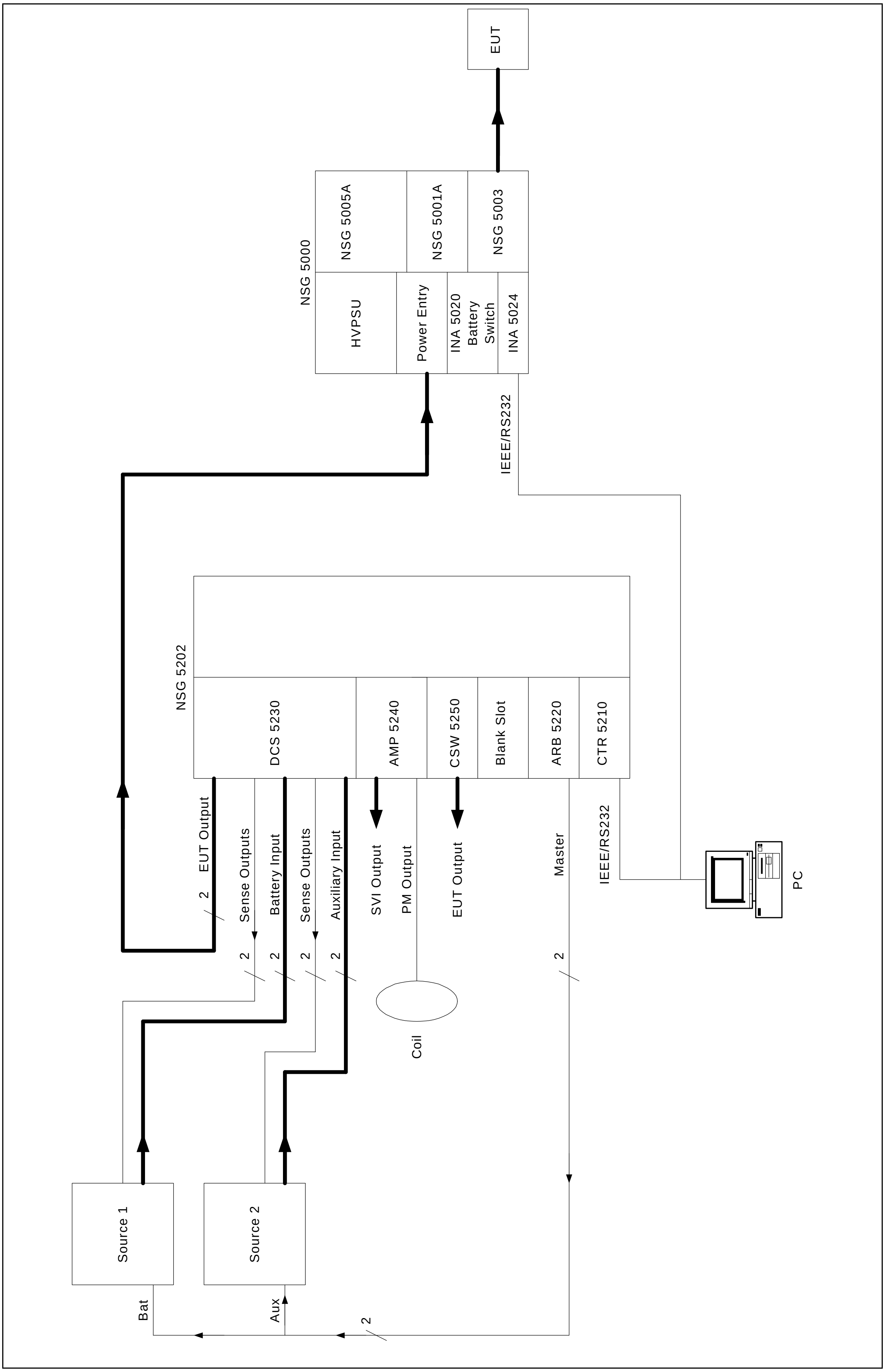


Figure B.4 – Connecting Up the NSG 5200 System NSG 5000 System and 2 Sources

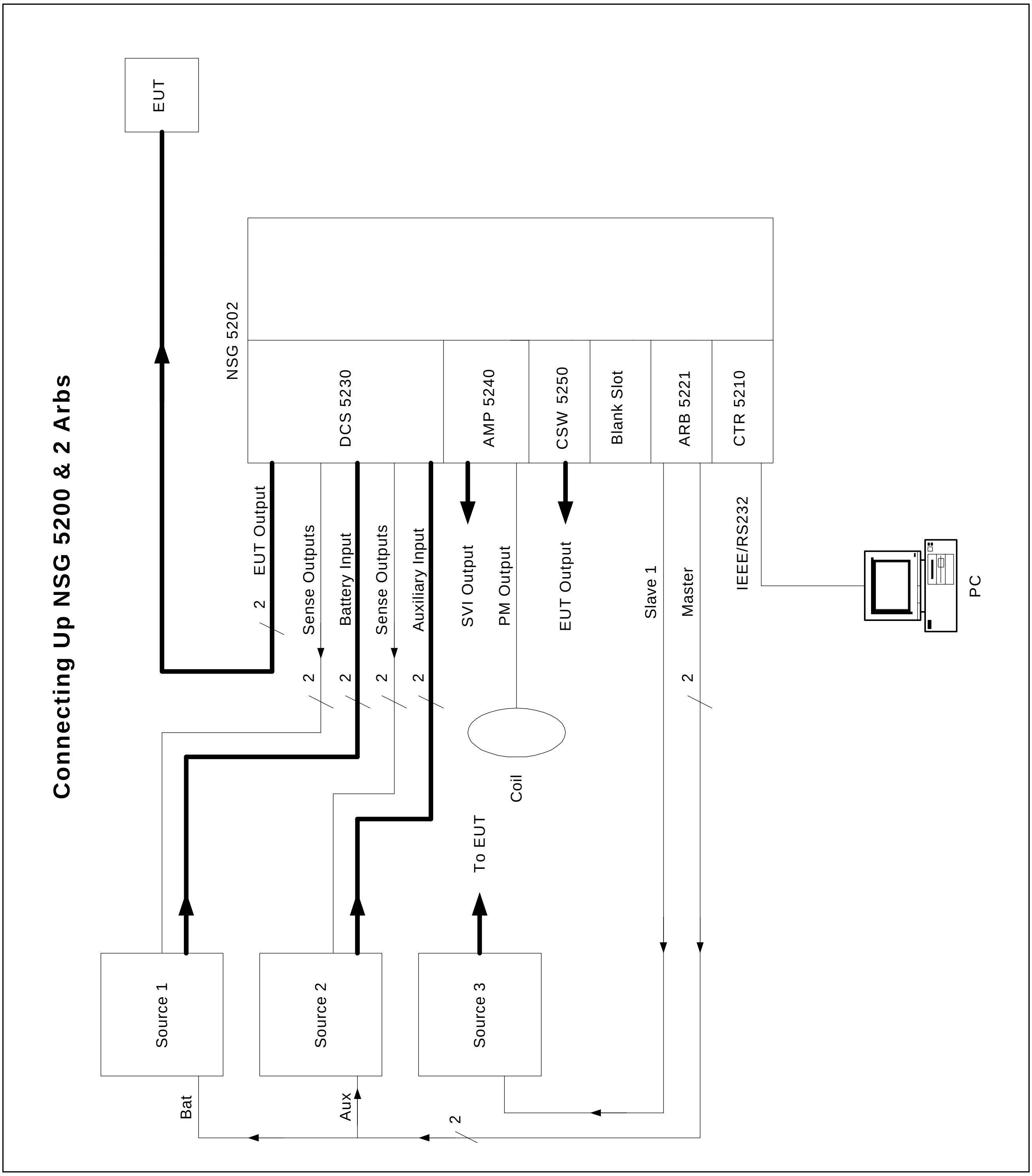


Figure B.5 – Connecting Up the NSG 5200 System and 2 Arbs

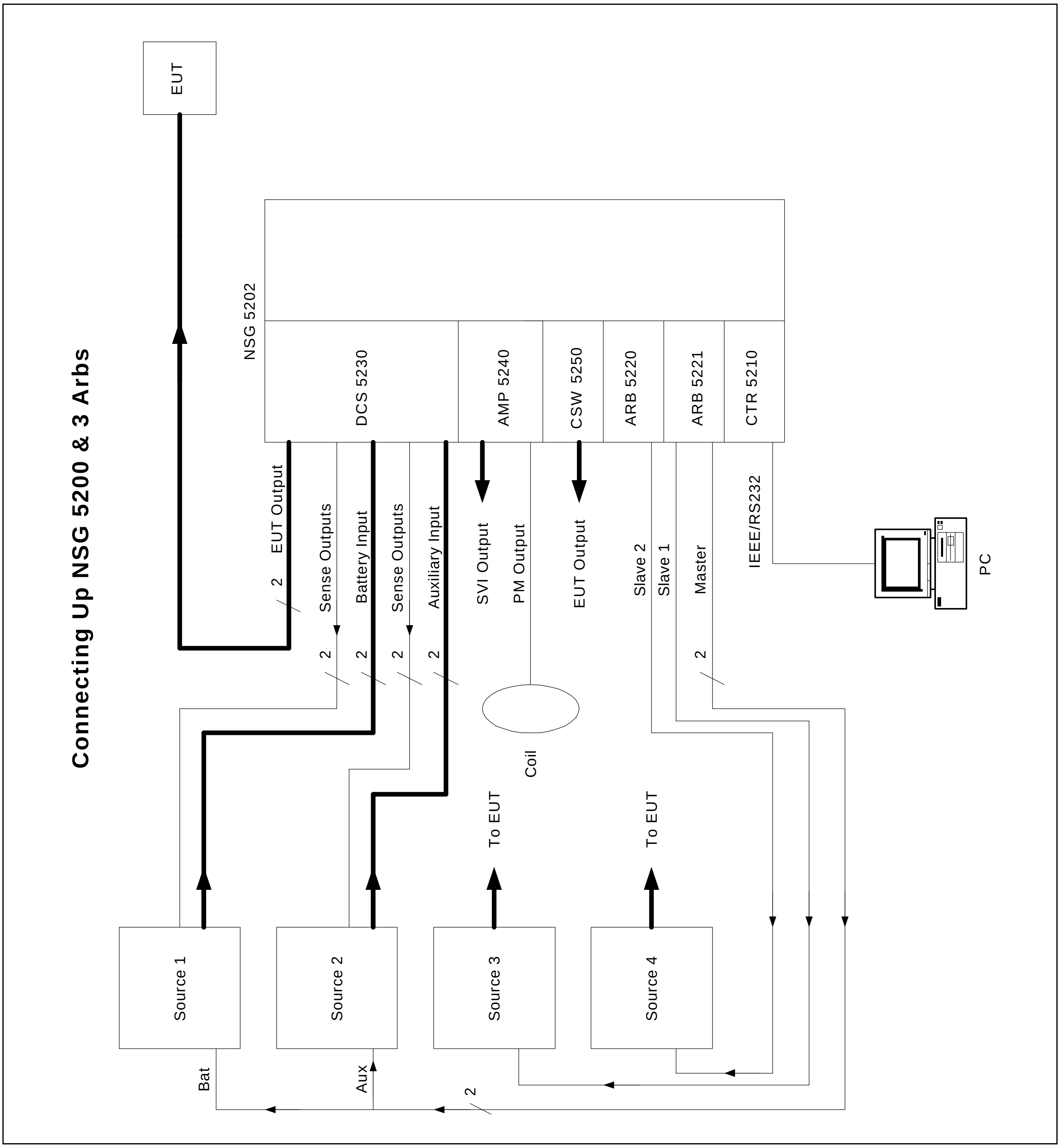


Figure B.6 – Connecting Up the NSG 5200 System and 3 Arbs

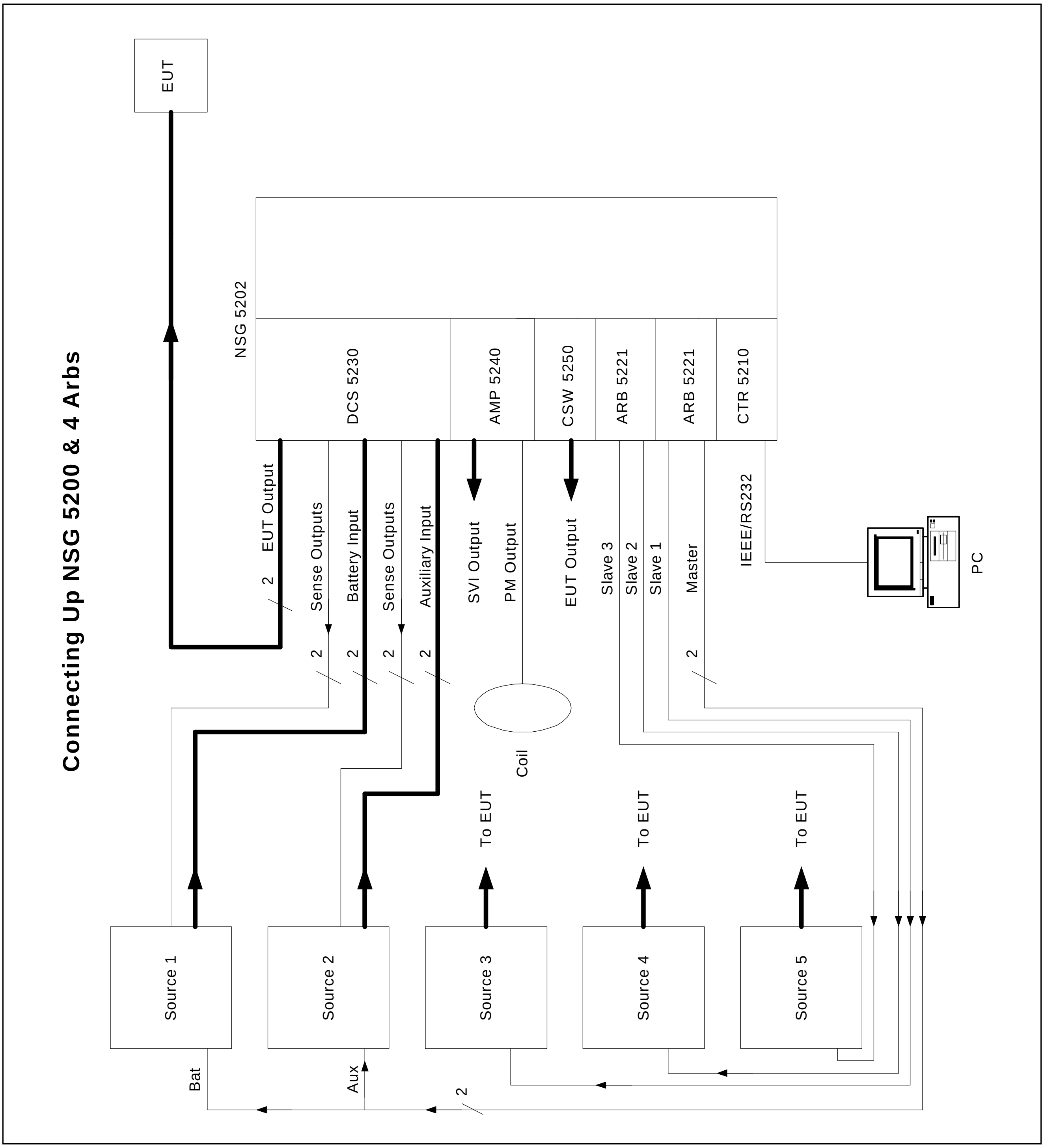


Figure B.7 – Connecting Up the NSG 5200 System and 4 Arbs

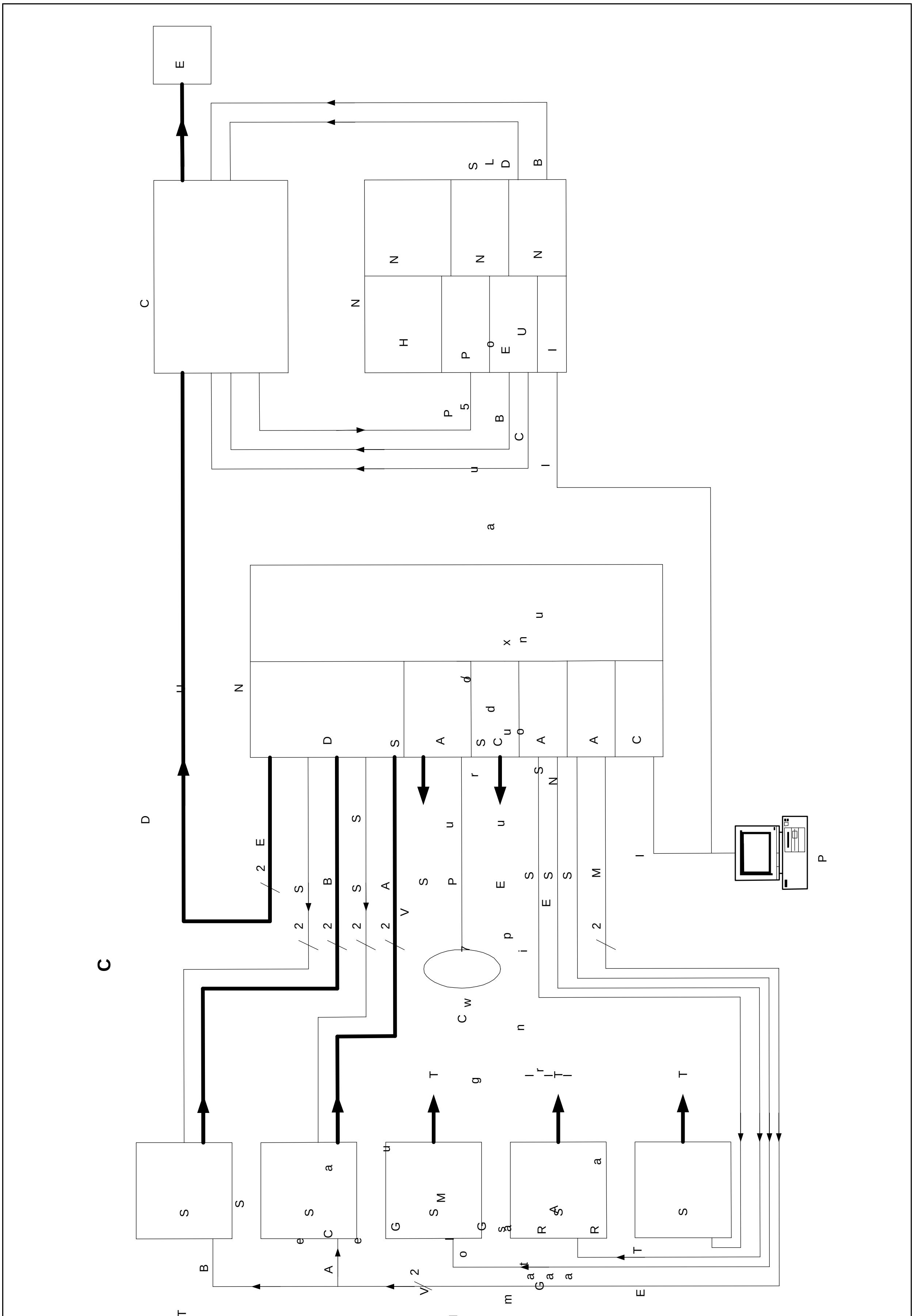


Figure B.8 – Connecting Up the NSG 5200 System NSG 5000 System CDN 5010 and 5 Sources