PA 5840 - AUTOMOTIVE BATTERY SIMULATORS

USER MANUAL

601-306A

TESEQ

Advanced Test Solutions for EMC

PA 5840 - AUTOMOTIVE BATTERY SIMULATORS

USER MANUAL

CONTENTS

1 SAFETY INSTRUCTIONS

1.1 Classification of dangers

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

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

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

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

1.2 Warning symbols on the test system

Different warning symbols are placed on the test system. The table below shows a survey over the relation of symbols (ideograms) and keywords to the specific risk and the (possible) consequences.

Pictogramm	Definition
	Possibly dangerous situation that can result in injuries and serious damage to the equipment.
	Situation that can result in damage to the equipment.

1.3 Excess voltage category

The test equipment PA 5840, as described in this manual, is related to the excess voltage category II according IEC 60664.

1.4 Range of validity

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

1.5 Safety of operation

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

In particular, observe the following:

- Connect the device only to line voltage that confirms to the power specification given on the type label (on the back of the test equipment).
- Do not touch any conductive parts at the output connectors, the fixture and the test object during a test run.
- Disconnect the device from the mains before opening the casing for main tenance or repair.
- During the operation of the test equipment always observe the relevant rules of ESD (Electro Static Discharge) protection.
- To guarantee the EMC features of the device, the control computer must meet the requirements of the EN 50082, 55011, 61000 standard.
- Make sure the environmental conditions described in chapter 7.1 Environmental conditions exist.

1.6 Personnel

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

1.7 Responsibility for safety precaution

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

1.8 Reduction in operational safety

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

1.9 As agreed use

The test equipment must exclusively be used for testing electrical devices and components indicated in the technical specifications.

2 INTRODUCTION

2.1 Introduction

The PA 5840 range of battery simulators are high performance power amplifiers providing a stable and rugged power source for laboratory applications. The amplifiers have been designed specifically to simulate battery supplies such as 12, 24 and 42 V vehicle electrical systems. They may be used on their own or integrated with the Teseq Automotive EMC Test System consisting of NSG 5000, NSG 5200, NSG 5500, NSG 5600 (hereafter referred to as NSG 5000 series) and AutoStar Software. The amplifiers are offered in three frame sizes with nominal output currents of 75, 150 and 300 A (peak values).

Designed to meet EMC immunity testing requirements for the automotive industry. Applicable standards include: ISO 7637, ISO 16750, JASO D001, MIL-STD-461E, SAE J1113 as well as automobile manufacturer specifications.

Types of testing include supply voltage variations, dips and drops, ISO pulses 2b and 4, load dump pulse, starting profiles, power cycling, battery recovery, reset behaviour, fuel pump transient, conducted sine waves, ground shift, jump start and over voltage, as well as providing a programmable DUT power source during all phases of testing.

2.2 Features

The output is programmable over a minimum voltage range from - 15 to + 60 V which allows the simulation of a large range of pulses and voltage variations. A remote sensing input is provided to compensate for output cable voltage drop (up to 4 V). The output provides a wide bandwidth (DC to >150 kHz), a fast output slew rate, low source impedance (<10 mΩ), and high peak output current (typically 3 times nominal).

and visibility. These facilities include: voltage input; current limit input, current limit indicator and display, compensation mode, gain setting, output range, current limitation, system stop and output and sense connectors.

For convenience, voltage and current control and monitoring interfaces have been duplicated. BNC connectors are provided for general purpose connection to signal generators and an integrated control D-type connector for direct connection to the Teseq NSG 5000 series. The output terminals are duplicated with 6 mm socket type connectors for push-in termination as supplied with the Teseq Automotive test systems.

Power dissipation is always a consideration with amplifiers. To avoid excessive heat the PA 5840 range includes a range selection switch on the front panel to enable the amplifier to deliver more power continuously when simulating a 12 V system the low voltage range is selected which can provide a reduction in power dissipation which allows continuous operation for longer under high load conditions.

The amplifier inputs are over voltage protected and outputs short circuit protected. Overtemperature protection is monitored on the internal heat sink and transformer.

There are three selectable ranges for compensation / bandwidth for the PA 5840. Bandwidths are high, allowing fast slew rates as required by numerous standards.

The current limit is programmable from 10 to 100% of the output current capability.

3 INSTALLATION/SET-UP

3.1 Checking the shipment

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

3.2 Delivery contents

The standard delivery contains the basic unit as well as several attachments and accessories.

3.2.1 Standard accessories

- One power cable

3.2.2 Documentation

The following manuals are supplied:

- This PA 5840 Automotive battery simulators hardware guide

3.3 Set-up

CAUTION! The equipment may be set-up by qualified personnel only. It is imperative to observe the safety instructions at the beginning of this manual. The equipment will be safe to operate and perform to its specifications only under the environmental conditions found in chapter 7.1 Environmental conditions.

3.3.1 Operating postition

CAUTION! The equipment must be set-up stable. Operating is only allowed in vertical position. There must be enough space around the equipment to ensure a sufficient air flow for cooling. The ventilation grilles must be kept free.

3.3.2 Line voltage connection and grounding

DANGER! Connect the equipment only to line voltage conforming to the power specification given on the type label (on the back of the equipment). If the grounding is interrupted inside or outside the equipment, the PA 5840 will become a source of danger. Carefully observe grounding precautions. The plug on the power cord may be replaced by qualified personnel only.

The power cord of the equipment is located on the back of the equipment. The power input is secured with a thermal magnetic circuit breaker (for details, refer to chapter 6.3 Protection).

The power plug and outlet must have grounding contacts.

The supplied mains cable may be configured on request or with 3-phase connectors or it is left with only the connector to the PA 5840 and on the other end can be wired per the user's needs.

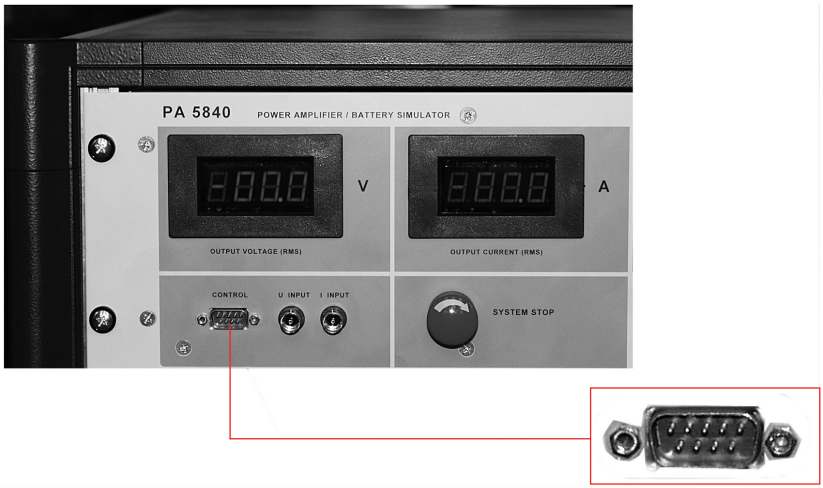
CAUTION! 3-phase mains connectors must be installed only by qualified personnel.

When the equipment is brought from cold to warm environment, the ensuing condensation may bring about dangerous conditions.

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

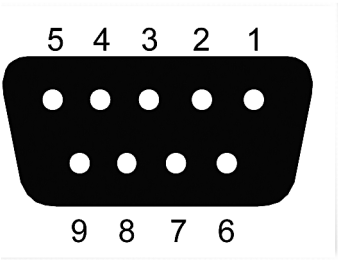
3.4 PA 5840 Front panel connectors

3.4.1 The control connector



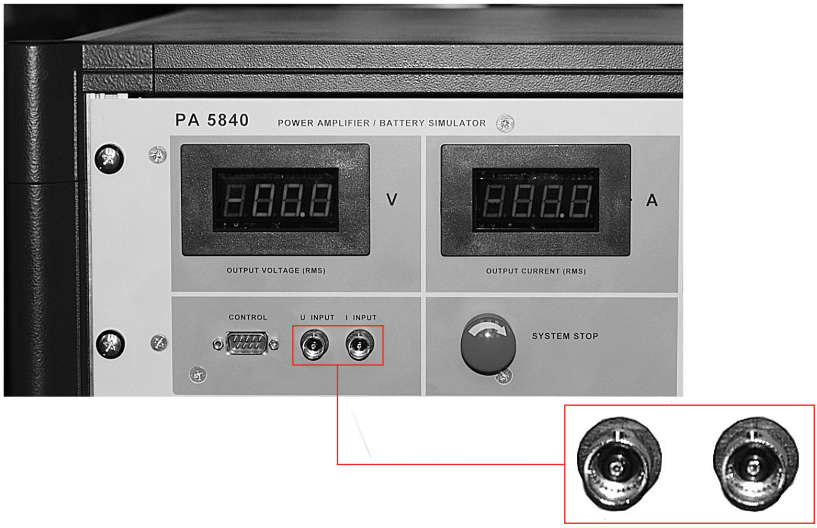
The “CONTROL” connector is an input port from the function generator card. Connect the 9-pin DSub “CONTROL” connector to the appropriate connector at the function generator card of your NSG 5000 series.

3.4.2 Pin count of the control I/O DSub connector



1. $I_{lim}+$
2. I_{ref}
3. $V_{prog}+$
4. V_{ref}
5.
6.
7.
8.
9.

3.4.3 The function generator input connector



This inputs may be used in special applications when the NSG 5000 series is not used. Another function generator may be used to control the DC amplifier. 1 V input is 7 V output.

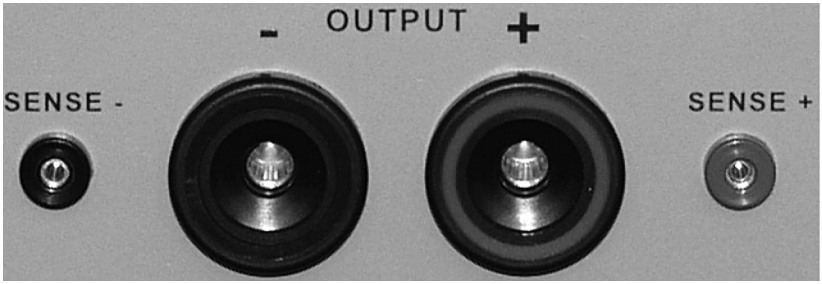
The U INPUT is the driving voltage of the battery simulator. The output of the battery simulator can be described as U OUTPUT = U INPUT x GAIN

I INPUT is the analog control of the current limit. The input limitation is 1-10 V as a ration of the available current limit where 1 V = 10% and 10 V = 100% current limit. For example, for a PA 5840-150, which has a maximum constant current of 50 A, a 5 V input will set a current limit of 25 A, and a maximum peak current of 75 A when the "CURRENT LIMITATION" selection is 3x I CONTROL.

CAUTION! Do not use both I Input and control connectors at the same time. Use either the I Input BNC connector or the I Input of the control D-Subconnector. Never terminate the I input BNC or D-Sub connectors!

CAUTION! If used, the input voltage at the I Input connector must be at least 1 V (10% output limitation).

3.4.4 The output connectors



3.4.5 The power output connectors

The “POSITIVE / NEGATIVE POWER” connectors are used to connect the output to the DUT (device under test) or to the NSG 5000 series.

NOTE! See the hardware guide of the appropriate test system for more details.

NOTE! The PA 5840-300 has two output connectors (modularity). For greatest accuracy. Please use the upper connector

3.4.6 The sense output connectors

The “SENSE” connectors may be connected to compensate for voltage drop of the cables to the DUT or to the NSG 5000 series.

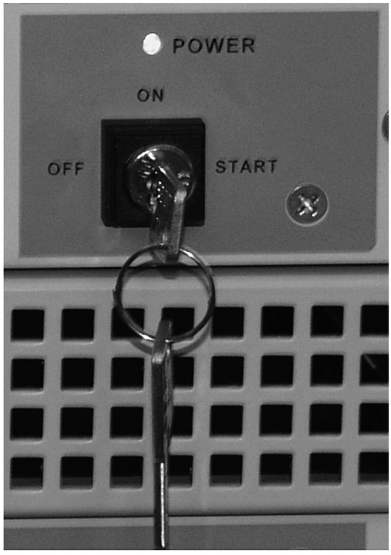
3.4.7 Rear panel connectors

The connectors on the rear panel normally are configured by the factory. Please ensure the connections are made as shown in the picture below.

4 OPERATION

4.1 The main switch

The test system PA 5840 can be switched “ON” and “OFF” with the main switch. The output range is selectable between 30 and 60 V by pressing the output range button.



NOTE! The 30 Volts range is for greater efficiency during normal 12 and 24 V battery voltage operation.

OFF The system is completely powered off

ON The system is in standby mode when first starting the system or after an error condition. In order to start the system the first time, or after an error condition, the key must temporarily be placed in the "START" position

START (Momentary) Used to enable the amplifier output

CAUTION! For safety, the "POWER" switch is keyed. The key can be removed in either the "ON" or "OFF" position. Please do not lose this key, as the system will be unusable without it!

4.2 The system stop button

In case, an EUT needs to be exchanged frequently, the optional safety banana plug set INA 163 gives the possibility to connect the EUT in an easy and safe way. With this option the max. current consumption of the EUT must not exceed 32 A.

DANGER! The "STOP" button does not disconnect the tester from the line voltage.

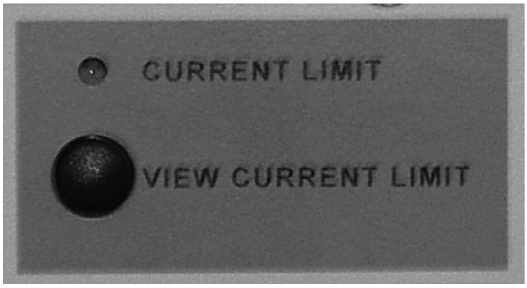
4.3 The output voltage (RMS) display

This display shows the output voltage in RMS.

4.4 The output current (RMS) display

This display shows the actual output current or the programmed current limit when pressing the “VIEW CURRENT LIMIT” button.

4.5 The view current limit button



This LED indicates that the current limit has been reached. The current does not take effect until the conditions from the “CURRENT LIMITATION” field are met. Pressing the “VIEW CURRENT LIMIT” button displays the current limit on the “OUTPUT CURRENT” display.

4.6 The errors LED

SAFETY FAIL — This LED lights in the event of the “SYSTEM STOP” button being pressed.

POWER FAIL — this LED will light if any of the internal system voltage check fails.

OVERTEMP — this LED blinks as a warning that the internal operating temperature is reaching shutdown range. This LED stays constant when the internal operating range reaches critical and the system is turned to a special cooling mode that means that the amplifier is turned on, and the fans are cooling, but no output is allowed. Turning the “POWER” key to “START” after allowing a suitable cooling time will return to normal operation.

NOTE! Turning the “POWER” key to “START” will clear all errors and return the system to normal operation.

NOTE! During the system power up, the LEDs and the temperature warning beeper will be tested for approximately one second.

4.7 The compensation button

Pressing this button toggles between the available compensation modes.

STANDARD	This is the normal operating mode with a good compromise between stability and bandwidth. The bandwidth in this selection is approximately 40 kHz.
CAPACITIVE	This mode is specifically designed for capacitive and/or reactive loads. This reduced bandwidth, high stability mode is perfect for using during normal transient testing, conducted sine wave (CSW) testing. The bandwith in this mode is limited to approximately 3 kHz.
HIGH FREQ	This mode is for testing where high bandwidths are required. This mode allows frequencies up to 150 kHz.

CAUTION! As with all fast amplifiers, the user should monitor the DUT to ensure no ringing or excessive overshoot is present that could result in damage to the DUT or couplers. In case there is a question the "CAPACITIVE" mode should be used.

4.8 The gain button

This button toggles between the available gain options of the amplifier:

GAIN HIGH (x7) Indicates a gain of seven. 1 V in will result in 7 V output voltage.

GAIN LOW (x1) Indicates a gain of one. 1 V in will result in 1 V output voltage.

4.9 The current limitation button

This button toggles between the three current limitation modes:

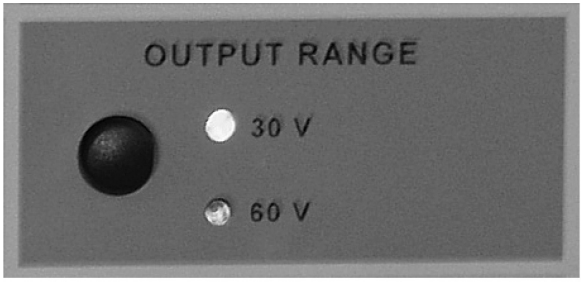
PEAK OFF this selection enables no inrush current above what is set by the current limit control from the DB9 or to the I INPUT BNC connector. The current limit circuitry will start immediately.

3x I CONTROL this selection will allow an inrush current of three times the programmed current limit for 200 ms before the current limitation starts.

3x I MAX this selection will allow an inrush current of three times the maximum current available from the battery simulator for 200 ms before the current limitation starts.

4.10 The output range button

This button toggles between the two available output ranges:



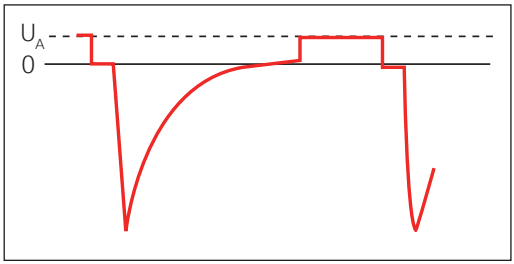
30 V this option selects a maximum usable range of +30 /-15 V for greater efficiency.

60 V this options selects a maximum usable range of +60 /-15 V for testing up to the full power of the battery simulator.

5 APPLICATIONS

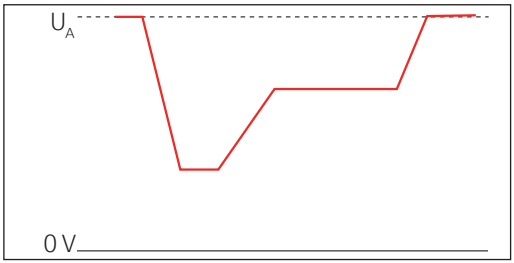
5.1 Compliant with ISO 7637 (and similar) for transient immunity

The PA 5840 is designed to act as the battery source for transient immunity tests. Most transients must be coupled onto battery voltage and the NSG 5000 series with its internal coupling couples the transient and the DC voltage as required by the standards. Designed with low internal resistance, low noise and high inrush current, the PA 5840 is compliant with section 5.4 of ISO 7637-2:2004.



5.2 Voltage variations for starting profiles

The PA 5840 series is often used for starting profile simulation (pulse 4 and variants). In addition, several standards require synchronized starting profiles. Utilizing the NSG 5000 series for control, the PA 5840 is the best solution for all known starting profiles with up to four synchronized starting profiles. See the specifications of the NSG 5000 series for details.



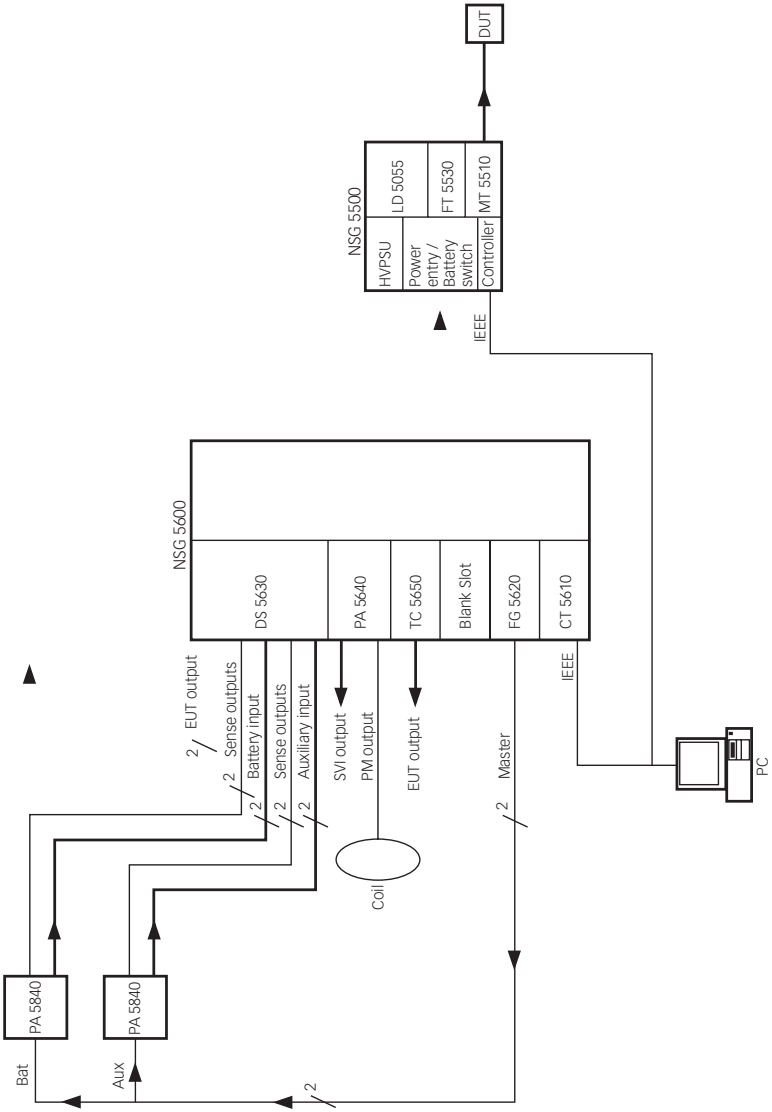
5.3 Fast rise time for challanging voltage dip applications

Certain standards, such as Ford ES-XW7T-1A278-AC specify ~10 µs rise and fall times for the battery simulator. The PA 5840 is designed to fully meet the relevant standards and is often used for dips and drops applications where <10 µs rise times are specified.

5.4 Voltage ripple and sine wave noise simulations

The PA 5840 is also commonly used to simulate sine wave noise on battery voltage. A user could, for example, simulate a 1 V p/p sine wave onto a 42 V network using high battery current. This is a common requirement of manufacturers' standards.

5.5 Example application with NSG 5500 and NSG 5600



PA 5840

6 MAINTENANCE

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

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

6.1 Cleaning the equipment

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

6.2 Moving and storing the amplifier

The amplifier must be installed/uninstalled only by qualified personnel. Before moving the equipment (even over a short distance), you must first turn it off and disconnect it from the mains. Remove any fixturing devices and/or test objects. Also, disconnect the amplifier from any peripherals. For longer transit, protect the equipment against humidity, dust and shock by proper packaging. The equipment must be stored in upright (working) position. Make sure the equipment is protected against humidity, dust and dirt. Observe the environmental conditions specified in chapter 7.1 Environmental conditions.

6.3 Protection

The PA 5840 Automotive battery simulators are protected with a thermal magnetic circuit breaker. The thermal element is a slow breaker to allow high inrush currents. The magnetic element is a fast breaker but set to a higher current limit than the thermal element. The different versions of the PA 5840 are equipped as follows:

Type	No. of phases	Supply voltage U_{eff}	Primary current I_{eff}
PA 5840-75 / 100 V	1	100 V	25 A
PA 5840-75 / 120 V	1	120 V	24 A
PA 5840-75 / 230 V	1	230 V	12 A
PA 5840-150 / 200 V	3	200 V	24 A
PA 5840-150 / 400 V	3	400 V	12 A
PA 5840-300 / 200 V	3	200 V	2 x 24 A
PA 5840-300 / 400 V	3	400 V	2 x 12 A

7 SPECIFICATIONS

7.1 Environmental conditions

Temperature range: Operation at +10 to +40°C storage at -10 to +60°C
Humidity: 30 to 75% (non condensing)
Air pressure: 860 to 1060 hPa
Protection class: IP20

7.2 Technical capabilities

	PA 5840-75 **75 Amp (pk)**	**PA 5840-150** **150 Amp (pk)**	**PA 5840-300** **300 Amp (pk)**
General			
Forward voltage gain (switchable)	7/1	7/1	7/1
Bandwidth (-3 dB)	DC to 40 kHz (standard) to 150 kHz (high freq)	DC to 40 kHz (standard) to 150 kHz (high freq)	DC to 40 kHz (standard) to 135 kHz (high freq)
Overtemperature shutdown	Several redundant thermal sensors trip at 80 and 90°C		
Supply			
Supply voltage	1-phase 100/120/230 V ±10% L, N, PE	3-phase 200/400 V ±10% L1, L2, L3, PE	
Supply frequency	47 to 63 Hz		
Supply power	3 kVA	6 kVA	12 kVA

	PA 5840-75 75 Amp (pk)	PA 5840-150 150 Amp (pk)	PA 5840-300 300 Amp (pk)
Output			
Peak output power (200 ms)	4.5 kW	9 kW	18 kW
Ouput voltage range	-15 to +60 V		
Max. continuous output current	±25 A	±50 A	±100 A
Peak output current for 200 ms	+75 A	+150 A	+300 A
Output impedance	<10 mΩ	<10 mΩ	<10 mΩ
Output accuracy DC AC signals	Typical <1% <2% <2%		
Long term drift, Uout	0.1% max		
Temperature drift, Uout	0.02% / °C		
Output ripple, Uout	<10 mVrms for more details, and measurement methods see the calibration report.		
Recovery	>90% of excursion within 25 µs		
Output rise time	<3 µs (high freq) / <10 µs (standard)		
Remote sensing	Auto compensation for up to 4 V cable loss		
Control signals			
Input impedance	10 kOhm		
U Input	gain x1:1 V = 1 V (output) gain x7:1 V = 7 V (output)		
I Input	10 V = 25 A	10 V = 50 A	10 V = 100 A
Display for output voltage	0 to 60 V ±1 digit ±2% of reading		
Display for output current	0 to Imax continuous ±1 digit ±2% of reading		

	PA 5840-75 75 Amp (pk)	PA 5840-150 150 Amp (pk)	PA 5840-300 300 Amp (pk)
Mechanical specification			
Standard housing style / construction	19" wheeled cabinet		
Overall dimensions H x W x D	700x650x720mm 27.6 x 22 x 28.3"	700x650x720mm 27.6 x 22 x 28.3"	700x600x1300mm 27.6 x 23.6 x 51.2"
Masse (kg)	100 kg / 220 lbs	195 kg / 429 lbs	290 kg / 780 lbs
Control panel (top front)			
2 x Display $3^1/_2$ digit red LED	Voltage, current		
1 x Connector 9-pole male D	U_{prog} ; I_{prog}		
2 x Connector BNC	U_{prog} ; I_{prog}		
Front panel (low front)			
Connector for output power	2 x 6 mm 100 A MC female		
Connector for output power sense	2 x 2 mm banana female		
Power switch	3 position OFF – ON – START		
Rear panel			
Protective breaker	2-pole	3-pole	
Connector for line supply	1-phase socket	3-phase socket	
Standard compliance			
Safety	IEC 1010-1		
EMC	EN 50082-1, EN 55011		

7.3 Pictures

7.3.1 Front view

7.3.1 Rear view

7.3.3 DECLARATION OF CONFORMITY (CE)

TESEQ
Advanced Test Solutions for EMC

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

Declaration of conformity

CE

Manufacturer:	Teseq AG
Address:	Nordstrasse 11F, 4542 Luterbach, Switzerland
	declares that the following product
Product:	PA 5840 Automotive Battery Simulator
Options:	all
	conforms to the following Directives and Regulations
	EMC Directive 2004/108/EEC LVD Directive 2006/95/EEC
Generic standards:	EN61326-1, 2005 EN61326-2-1, 2005 EN61010-1, 2001
	The relevant technical file is available for inspection:
Technical file:	N° EMC_PA5840_2006 / LVD_PA5840_2006 Teseq AG CH - 4542 Luterbach

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

Place and Date: Luterbach, December 12th, 2006

Johannes Schmid
President

Headquarters
Teseq AG
4542 Luterbach, Switzerland
T +41 32 681 40 40
F +41 32 681 40 48
sales@teseq.com
www.teseq.com

China
Teseq Company Limited
T +86 10 8460 8080
F +86 10 8460 8078
chinasales@teseq.com

Germany
Teseq GmbH
T +49 30 5659 8835
F +49 30 5659 8834
desales@teseq.com

Singapore
Teseq Pte Ltd.
T +65 6846 2488
F +65 6841 4282
singaporesales@teseq.com

Taiwan
Teseq Ltd.
T +886 2 2917 8080
F +886 2 2917 2626
taiwansales@teseq.com

USA
Teseq Inc.
T +1 732 417 0501
F +1 732 417 0511
Toll free +1 888 417 0501
usasales@teseq.com

To find your local partner within Teseq®'s global network, please go to **www.teseq.com**

Manufacturer
Teseq AG
4542 Luterbach, Switzerland
T +41 32 681 40 40
F +41 32 681 40 48
sales@teseq.com

France
Teseq Sarl
T +33 1 39 47 42 21
F +33 1 39 47 40 92
francesales@teseq.com

Japan
Teseq K.K.
T +81 3 5725 9460
F +81 3 5725 9461
japansales@teseq.com

Switzerland
Teseq AG
T +41 32 681 40 50
F +41 32 681 40 48
sales@teseq.com

UK
Teseq Ltd.
T +44 845 074 0660
F +44 845 074 0656
uksales@teseq.com