POWERTEST 535 Series
Hardware Reference Manual

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Document History

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FOR YOUR SAFETY

NH Research has made every effort to ensure that our product complies with relevant safety requirements. However, It is highly recommended that the following precautions should be taken:

HAZARDOUS VOLTAGES

It is of **PARAMOUNT IMPORTANCE** that only properly trained service personnel are allowed to gain access to the interior of the equipment as this may expose areas that are at hazardous potentials.

The Unit Under Test (UUT) and the Interface Test Adapter (ITA) may have relatively high voltages present. As this part of the test system is customer specified it must remain the responsibility of the customer to inform their operating personnel of any hazards that may exist.

MOTORIZED ASSEMBLIES

Service personnel should always ensure that the equipment is switched off to avoid exposure to motorized assemblies such as fans and variacs.

TOXIC MATERIALS

Some manufacturers use beryllium oxide, a high toxicity compound that provides a thermally conducting electrically insulating washer, between a power transistor and its heat sink. Before attempting to repair any such item, the customer should read the appropriate manufacturer's handbook.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Overview

This document, the POWERTEST 500 series Hardware Reference Manual, provides information for installation and operation of the POWERTEST 500 series Automatic Power Supply Test Work Stations designed and manufactured by NH Research, 16601 Hale Ave, Irvine, California 92606 USA.

This manual is divided into four sections.

Section 1: Introduction; a brief description of the system.

Section 2: Unpacking, installation and preparation for use.

Section 3: System Overview.

Section 4: Hardware Description.

1.2. Introduction To The POWERTEST 500 Series Testers

The **POWERTEST 500 series** is a simple to use family of programmable power supply testers. AC-DC as well as DC-DC power supplies with up to eight outputs can easily be tested using these testers. A standard PC performs all controlling functions and communicates with the **POWERTEST 500 Series** instrumentation module (test workstation) over an RS-232 line.

The **POWERTEST 500 series** test workstation contains all stimuli and measurement instrumentation needed for high volume low wattage power supply testing. All instruments are mounted and interconnected in the equipment cabinet. The instruments fall into the following categories:

- Programmable Dynamic DC Loads
- Programmable AC source
- Programmable DC sources
- Control Instrumentation
- Measurement Instrumentation
- UUT interface via the front panel
- Facility power control and distribution.

The family of POWERTEST **500 Series** consists of the following 3 models:

PT535 Full height single bay cabinet with a 2.4 KVA AC Source, 1 ea 100 Amps load, 1 ea 50 Amps Load and 6 ea 12.5 Amps loads. A DC Source is available as an option.

PT505T Desktop height cabinet with a 1 KVA AC Source, 1 ea 50 Amps load and 5 ea 12.5 Amps loads.

PT505DCT Desktop height cabinet similar to the PT505T except that PT505DCT is equipped with a 10A DC Source instead of the AC Source.

All models are equipped with a 12 input channel multiplexer, 8 general-purpose relays, 8 digital outputs, 7 digital inputs, a timer, a built-in DMM and an overvoltage power supply.

All software needed to develop and run a test program is supplied with the system. Please refer to the *em**Power***® manuals for details on usage and programming.

2. UNPACKING AND INSTALLATION INSTRUCTIONS

2.1. Unpacking

The POWERTEST workstation is shipped via padded van to our domestic users. The workstation leaves our factory fully assembled and tested. The test controller, the CRT and the keyboard are packed in their original cartons; another carton contains miscellaneous accessories.

Miscellaneous Accessories:

- A service cord for connection to facility power
- A RS-232 interface cable
- Installation CD-ROM for the *em**Power***® Software

2.2. Inspection

Upon receipt of the system, inspect the workstation for shipping damage. Report any damage immediately to the carrier and our factory. If no damage is found, the POWERTEST 500 Series workstation may be placed in the work area prepared for it. Refer to the following paragraphs, Facility Preparation, for guidance in proper site location.

Due to the high voltages that this system handles, it is extremely important that the proper service and work area of at least 2 feet be provided.

2.3. PT535 Crate Unpacking Instructions

The following procedure should be used to unpack and setup the test system if the received system was shipped in a crate.

The power cord, RS-232 cable, generic harness and manuals are shipped in a small box. The large shipping crate contains the POWERTEST 535 workstation.

Since the front of the crate rotates down to provide a removal ramp for the workstation, it is recommended that the workstation be removed in an open area with plenty of room.

The workstation cabinet is equipped with four casters so that it can be rolled and moved as required.

1) Locate and remove the eleven bolts that hold the top and front of the shipping crate. The top section rotates upward and backward on two external hinges. The front of the crate rotates forward and downward to provide a removal ramp.

2) The test system can now be pulled upward and out over a small interior lip and down the front ramp. Roll the system to the prepared area where it is to be used.

3) Plug the supplied power cable into the test system. The other end of the power cable may need modification to mate with the local power source.

4) Unpack the computer and connect the computer to the POWERTEST 535 with the RS-232 cable. The PT535's RS-232 connector is located at the back bottom of the cabinet and is labeled "computer". The controller's RS-232 connector is located in the back of the controller.

Note: ***DO NOT DESTROY THE SHIPPING CRATE.*** *It can be used to move the test system should it become necessary.*

2.4. PT505T and 505DCT Unpacking Instructions

The POWERTEST 505T and 505DCT workstations are shipped in a single shock resistant box. The following procedure should be used to set up the test system.

1) Remove the following items from the inner crate pocket.
   - The RS-232 cable.
   - The power cord.
   - The maintenance manual.
2) Remove the shipping crate sidewalls. This four sided, single piece cardboard structure is not fastened to the wooden base. Simply lift it off the base and over the instrumentation module.
3) Cut the steel bands holding the instrumentation module to the wooden base and tear the plastic protective cover at the top and push it down around the wooden base, exposing the modules side handles.
4) Lift the instrumentation module off the wooden base and place it on the test bench where it will be used. Moving the system requires at least two people, as the system weighs about 150 pounds.
5) Plug the supplied power cable into the test system. The other end of the power cable may need modification to mate with the local power source.
6) Connect the computer to the test workstation with the RS-232 cable. The RS-232 connector is located at the back bottom of the cabinet and is labeled "computer". The computer RS-232 connector is located in the back of the computer.

Note: ***DO NOT DESTROY THE SHIPPING CRATE.*** *It can be used to move the test system should it become necessary.*

2.5. Facility preparation

Before installing the POWERTEST 500 series workstation, the assigned facility area must be prepared to accommodate the workstation. The following preparation and considerations must be made:

- **Electrical requirements**
- **Adequate floor space**
- **Environmental conditions**

2.5.1. Electrical requirements

The model number of the specific station determines the POWERTEST 500 series workstation input power electrical requirements.

- PT535 three-phase 30A per phase
- PT505T single-phase 15A
- PT505DCT single-phase 15A

2.5.2. Adequate floor space

Adequate floor space should be assigned to the workstation to provide sufficient work and service area. Shown below in figure 2.1, is a top view of the test workstation.

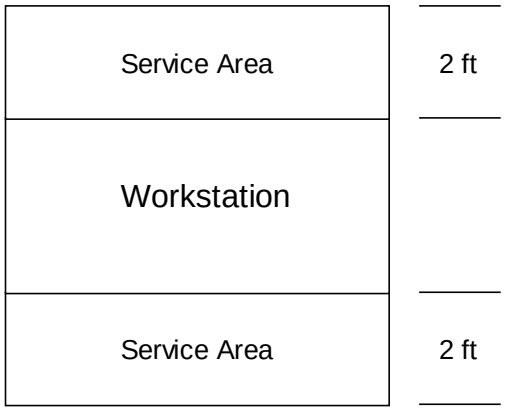

Figure 2.1

The minimum recommended floor area is 2 feet in addition to the workstation footprint in order to provide an adequate work and service area. Additional floor space should be provided to accommodate test fixtures, manuals, test procedures and misc. equipment and accessories.

2.5.3. Environmental conditions

The assigned area for the POWERTEST workstation should conform to the following environmental conditions:

Temperature:	0 to 25 degree C (32F to 77F)
Humidity:	Maximum 80%, non-condensing
Dust control:	Computer grade environment

The airflow direction is from the front of the cabinet to the rear.

2.6. Initial Power-Up Instructions

1) Unpack the computer, monitor and the keyboard, and place them in a convenient location on a stand or on a worktable next to the workstation. Connect the monitor cable, the keyboard, the RS-232 cable and the power cables to both the controller and the monitor to the connectors and sockets at the rear of the controller.
2) Open the rear door of the workstation and check all cable connections to insure no cables came loose during shipment.
3) Connect the AC service cord from the connector on the AC Control panel to the facility power outlet.
4) Secondary Safety Ground Preparation:
   - Connect a 10-gauge wire from the ground stud on the AC Control panel to a facility safety ground, such as a water pipe. Verify that the safety grounds are at earth potential.
5) Press the POWER ON/OFF switch on the workstation front panel. The POWER ON indicator should illuminate.

WARNING:

Damage to the computer due to transients could occur if the computer or any of the other electrical devices in the workstation, such as the printer, are not provided proper grounding.

*Note: If the power did **NOT** come on, check the safety interlock switch on the rear door. The system cannot be powered up with the door open or ajar.*

2.7. Software Installation and Preparation

Normally, the *em**Power***® software package is installed at the factory. But if it is required to reinstall the software, please refer to the *em**Power*** ®Users manual for details with regards to *em**Power***®.

2.8. Maintenance Schedule

In order to maintain reliable test results, the system must be properly maintained. Vacuuming, cleaning and calibration should be performed regularly. The maintenance intervals may vary from company to company according to internal requirements and environmental conditions.

The following maintenance schedule is a suggested as an absolute minimum schedule:

Every week	- vacuum filters and bottom of cabinet
Every 3 Months	- Cal verification at the front panel
Every Year	- Calibrate all system devices - Thoroughly clean (blow out) the system

All removable panels and doors can easily be detached from the system to ease access to devices for preventive maintenance and inspection.

3. SYSTEM OVERVIEW

3.1. System Power Up

There are no special precautions required to power up the tester after the system has been properly installed. Refer to the unpacking and installation chapter for system setup instructions.

WARNING:

Lethal voltage potentials are present within the tester and at the front panel of the source(s). Failure to apply safety precautions or, overriding the system interlocks can subject the operator to potential injury or death.

3.2. The Power Up Sequence

1) Press the System Power switch located on the workstation front panel and turn on the computer and monitor.
2) If the workstation fails to power up, check:
   - Power connections
   - If you have a PT535, check the rear door interlock to insure that the door is not ajar. (The PT505T and the PT505DCT are not equipped with rear door interlocks).

3.3. Safety Interlocks

In order to prevent high voltage exposure to the user, the system is equipped with several interlocks:

Door Interlock

The PT535 rear door interlock disables system power if open. To override the interlock switch simply pull the switch to its outer locked position.

Source Safety Interlock

A safety interlock is also provided on the AC Source (Pin 1 and 9 of the interlock plug located on the front panel of the AC source). If the workstation is equipped with a DC Source, the interlock is located between pin 3 and 4 of the DC output connector.

Source Output Enable

The AC Source has an enable switch located on the AC source front panel. In the **Enable** position, the AC source voltage can be applied to the UUT under program control. In the **Disable** position, the AC source output cannot be turned on.

3.4. POWERTEST Workstation Usage

The **POWERTEST workstation** is designed to operate in four types of test environments:

1) Engineering qualification and characterization of new power supplies.
2) Test program generation.
3) Production / incoming power supply testing.
4) Custom test program generation.

3.4.1. Engineering Characterization

In this environment, the test engineer operates the test system using the *em**Power*** ® CONTROL program. Using CONTROL, various load and source states are displayed on the CRT at the same time, along with instructions and any possible error messages. Using the mouse, a test system operating parameter is selected. The parameter's new value is either typed in or chosen from a list of alternatives. The effect of the changed parameter is immediately apparent if the appropriate metering functions have been enabled.

*em**Power*** ® CONTROL is designed to provide the power supply design and test engineer with a fast and repeatable method for verifying the performance characteristics of the UUT.

3.4.2. Production Test Program Generation

In this environment, *em**Power*** ® EDIT test program generator is used to produce a test program that describes a particular unit under test (UUT), the algorithms to exercise the UUT, and to what specifications pass/fail decisions are made. EDIT is an interactive fill-in-the-blanks type program presented in a familiar spreadsheet format.

3.4.3. Production Test

*em**Power*** ® TEST is used to execute the test program generated in *em**Power*** ® EDIT. An operator with little or no programming or computer skills can run a test program to test power supplies once the test engineer has developed the UUT's test program.

3.4.4. Custom Test Program Generation

In this environment, the test engineer can write a test program for a supply that requires more than what is contained in the standard test library set. The test engineer can use Microsoft Visual Basic, Visual C++, or any language that supports Microsoft's ActiveX components to generate new test routines. These test routines can be installed into the test library and used for generating new test programs.

3.5. System Description

The **POWERTEST** Automatic Power Supply Test Workstation consists of two functionally separable assemblies:

- Test Controller with monitor and printer
- Test Workstation with devices

The Test Controller supplied with the system is equipped with Test Controller-Workstation interface module to provide communication between the controller and the workstation using RS-232.

The Test Workstation consists of various stimulus and measurement devices capable of extensive testing of any power supply when controlled by the test controller and its software, *em**Power***®.

A simplified block diagram of the test controller and the workstation is shown below in figure 3.1.

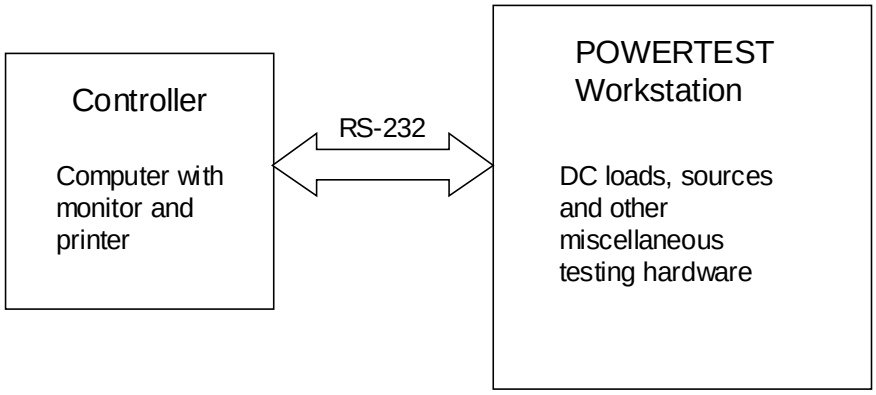

Figure 3.1

3.6. Test Workstation

3.6.1. Test Workstation Cabinet

The size of the Test Workstation cabinet depends on the workstation model number that is selected based on customer needs.

NHR P/N Description

- 1050684 POWERTEST 535, 1 bay full height upright
- 1050151 POWERTEST 505T, Desktop model
- 1050173 POWERTEST 505DCT, Desktop model

3.6.2. Test Workstation Devices

The Test Workstation consists of various stimulus and measurement devices. The following types of stimulus and measurement devices are available:

- Programmable DC Dynamic Loads
- Programmable AC Source
- Programmable DC Source (option)
- 12 Input Multiplexer
- Peak Detector
- 8 Digital Output
- 7 Digital Inputs
- 8 General Purpose Relays
- Threshold Detector and Timer

4. HARDWARE DESCRIPTIONS

4.1. System Communication

As described in the previous chapters, the system controller communicates with the system devices using the RS-232 bus which is buffered inside the workstation and distributed to all the devices as shown below in figure 4.1.

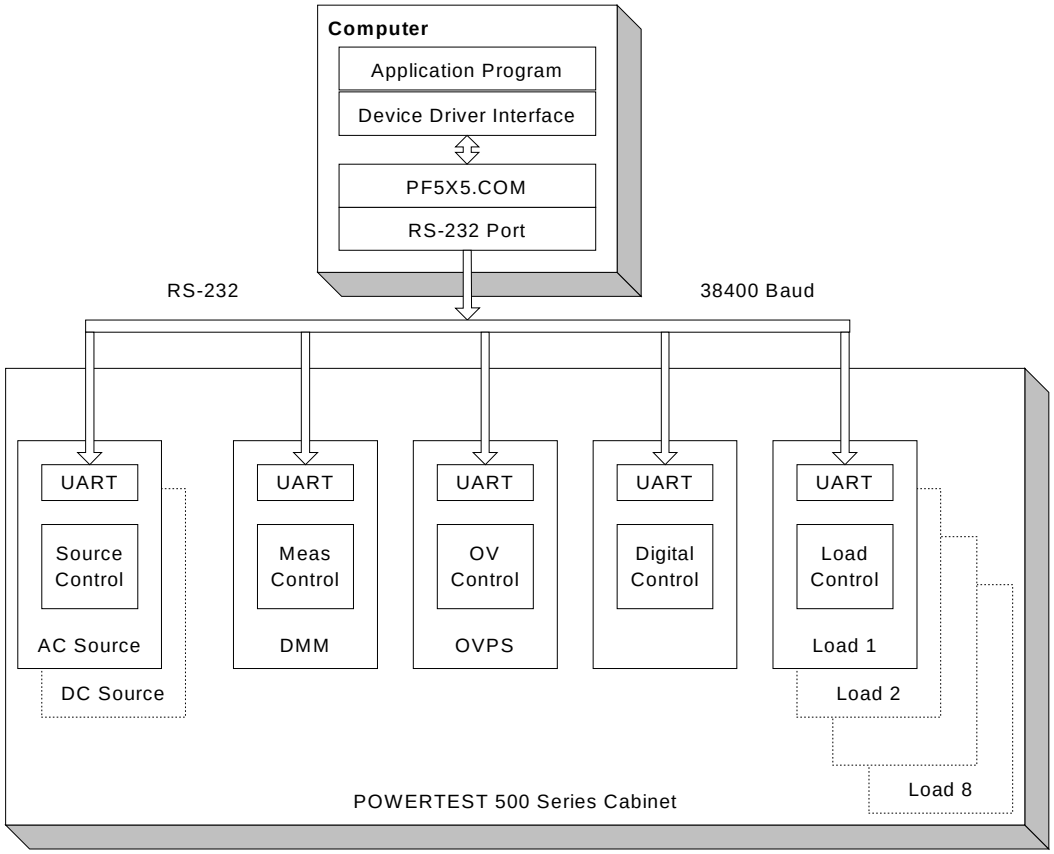

Figure 4.1

4.2. Loads

4.2.1. Dynamic DC Load Programmable Features

All loads in the 500 Series workstations are fully programmable.

The following commands are available for control of the loads:

1) Set Load Current
2) Set Load Voltage
3) Set Load Mode
   - Constant current
   - Constant resistance
   - Short Circuit
   - Constant voltage
4) Set Current Response - fast or slow
5) Set Current Range
6) Read Load Current

4.2.2. Dynamic DC Load Operating Modes

4.2.2.1. Constant current mode

All loads may be operated in constant current mode. This mode uses a fixed reference voltage 8-bit DAC to set an operating current. This current remains constant throughout the load's operational voltage range.

4.2.2.2. Constant resistance mode

All loads may be operated in constant resistance mode. This capability is necessary in many applications where a unit under test will go into current limit when powered up if loaded by a constant current. To function as a constant resistance load, the load uses an 8-bit DAC that is programmed to a reference voltage (V_{PROG}) that is proportional to the actual voltage (V_{ACT}) applied to the load. This reference voltage is used as a substitute for the fixed reference voltage used by the 8-bit current control DAC for setting the load current. Thus for a programmed current (I_{PROG}), the actual current drawn (I_{ACT}) is determined by the following equation: $I_{ACT} = (V_{ACT} \div V_{PROG}) \times I_{PROG}$

4.2.2.3. Constant voltage mode

The 500 series 80V load family may be operated in constant voltage mode. This capability allows the load regulate its current draw based on the voltage that is applied by the UUT. To function as a constant voltage load, the load uses an 8-bit DAC that is programmed to the voltage (V_{PROG}) that the load will attempt to regulate the actual voltage (V_{ACT}) applied to the load by drawing as much current as necessary (I_{REG}) until the voltage $V_{PROG} = V_{ACT}$. The 8-bit current control DAC is set to the maximum current (I_{MAX}) that the load may draw. Based on the relationship between V_{ACT} and V_{PROG}, the

load will either draw no current (I_{ACT} = 0 when $V_{ACT} < V_{PROG}$) or I_{ACT} = Minimum (I_{REG}, I_{MAX}) when $V_{ACT} > V_{PROG}$.

4.2.2.4. Short Circuit mode

In short circuit mode, the UUT terminals connected to the load are shorted together via a relay. The short is done through the current shunt in order to provide UUT output current measurement during the short circuit condition.

4.2.3. Current programming ranges

In order to provide the user with the capabilities of testing low output current power supplies, the loads are designed with two current ranges, a high range (up to 100% of rated current) and a low range (up to 10% of rated current). This allows the full resolution of the current DAC to be used for 10% of the range. The active range is determined by software commands.

4.2.4. Dynamic current change response

The DC loads can be operated at two transient speeds (slew rates) when changing from one load current value to another. This dynamic response, fast or slow is determined by software commands.

4.2.5. Dynamic Load Specifications

4.2.5.1. 100 Amp Load Specifications

Voltage Range: 1.5 VDC to 60 VDC {configuration 7}
1.5 VDC to 80 VDC {configuration 13}

Resolution: 0.235 volts {configuration 7}
0.314 volts {configuration 13}

Maximum Power: Continuous 500 Watts
30 seconds 1000 Watts

Current Ranges: 0 to 10 Amps
0 to 100 Amps

Accuracy: 1% of full scale

Resolution: 10 Amp Range - 39.2 milliamps
100 Amps range - 392 milliamps

Dynamic Response:

Fast 10A Range	0.2 Amps/microsecond
Slow 10A Range	2 Amps/millisecond
Fast 100A Range	2 Amps/microsecond
Slow 100A Range	20 Amps/millisecond

Operating Modes: Constant Resistance
Constant Current
Short Circuit (on/off)
Constant Voltage {configuration 13}
Shut down (high Z)
Low or high range
Dynamic Response Fast and Slow

Protection: Over temperature > 70 deg C
Over power > 200%
Reverse voltage

Resistance Mode:

Accuracy: 2% (Volts/Amps)

Voltage Mode:

Accuracy: 1% of full scale

4.2.5.2. 50 Amp Load Specifications

Voltage Range: 1.5 VDC to 60 VDC {configuration 5}
1.5 VDC to 80 VDC {configuration 12}

Resolution: 0.235 volts {configuration 5}
0.314 volts {configuration 12}

Maximum Power: Continuous 250 Watts
30 seconds 500 Watts

Current Ranges: 0 to 5 Amps
0 to 50 Amps

Accuracy: 1% of full scale

Resolution: **5** Amp Range - 19.6 milliamps
50 Amps range - 196 milliamps

Dynamic Response:

Fast 5A Range	0.1 Amps/microsecond
Slow 5A Range	1 Amp/millisecond
Fast 50A Range	1 Amp/microsecond
Slow 50A Range	10 Amps/millisecond

Operating Modes: Constant Resistance
Constant Current
Constant Voltage {configuration 12}
Short Circuit (on/off)
Shut down (high Z)
Low or high range
Dynamic Response Fast and Slow

Protection: Over temperature > 70 deg C
Over power > 200%
Reverse voltage

Resistance Mode:

Accuracy: 2% (Volts/Amps)

Voltage Mode:

Accuracy: 1% of full scale

4.2.5.3. 12.5 Amp Load Specifications

Voltage Range: 1.5 VDC to 60 VDC {configuration 6}
1.5 VDC to 80 VDC {configuration 11}

Resolution: 0.235 volts {configuration 6}
0.314 volts {configuration 11}

Maximum Power: Continuous 75 Watts
30 seconds 180 Watts

Current Ranges: 0 to 1.25 Amps
0 to 12.5 Amps

Accuracy: 1% of full scale

Resolution: 1.25 Amp Range - 4.9 milliamps
12.5 Amps range - 49 milliamps

Dynamic Response:

Fast 5A Range	0.025 Amps/microsecond
Slow 5A Range	0.25 Amps/millisecond
Fast 50A Range	0.25 Amps/microsecond
Slow 50A Range	2.5 Amps/millisecond

Operating Modes: Constant Resistance
Constant Current
Constant Voltage {configuration 11}
Short Circuit (on/off)
Shut down (high Z)
Low or high range
Dynamic Response Fast and Slow

Protection: Over temperature > 70 deg C
Over power > 200%
Reverse voltage

Resistance Mode:

Accuracy: 2% (Volts/Amps)

Voltage Mode:

Accuracy: 1% of full scale

4.3. Overvoltage Power Supply

4.3.1. Overvoltage Power Supply Programmable Features

The overvoltage power supply (OVPS) is a DC source that is used to back drive the UUT outputs. It may be connected to one load at a time through an internal multiplexer relay.

The following commands are available for control of the OVPS:

1) Set the OVPS output voltage
2) Connect the OVPS output to a load
3) Turn OVPS output voltage on
4) Turn OVPS output voltage off

Since the OVPS is connected to all loads via internal multiplexer relays, no special external wiring is required to connect the OVPS output voltage to a load.

4.3.1.1. Overvoltage Power Supply Specifications

Voltage Range:	0 to 60 VDC
Accuracy:	10mV + /- 0.5% of FS
Resolution:	14.7mV
Current Limit:	3A maximum, not programmable
Protection:	Over temperature Over current

4.3.2. AC Source

4.3.2.1. AC Source Programmable Features

The AC source provides the unit under test with AC power. By providing a programmable AC Source and an optional programmable DC Source, the UUT input power is fully controllable via software control.

The following commands are available for control of the AC Source:

1) Set output voltage
2) Set current limit
3) Set frequency
4) Set voltage range (0-140 or 0-280)
5) Set turn on phase angle
6) Set voltage slew rate
7) Turn AC source output voltage on
8) Turn AC source output voltage off

4.3.3. AC Source Specifications

4.3.3.1. 2.4KVA PWM AC Source Specifications - 535 AC Source

Input Power:	
Voltage:	208VAC (L-L), 3 phase Delta or Y
Current:	20 Amps per phase
Output Power:	2400 VA
Output Voltage:	0 to 140 VAC
	0 to 280 VAC
Accuracy	0.25% of FS
Resolution	140 VAC Range - 35 mV
	280 VAC Range - 70 mV
Frequency Range:	45 Hz to 655.34 Hz
Accuracy	0.02% of setting
Resolution	0.01 Hz
Current Limit (RMS):	140 VAC Range – 0 to 20 Amps
	280 VAC Range – 0 to 10 Amps
Accuracy	± 200 milliamps of setting

Resolution	80 milliamps
Peak Current:	140 VAC Range **–** 60 Amps 280 VAC Range **–** 30 Amps
Accuracy	2% of FS
Turn-on Phase Angle:	0 to 360 degrees
Resolution:	1.4 degrees
Voltage Slew Rate:	140 VAC Range (Volts/Second) 90, 190, 400, 930, 2000, 4300, 9300, 22000, 43500 280 VAC Range – Double of 140 VAC Range

4.3.3.2. 1 KVA PWM AC Source Specifications - PT505 AC Source

Input Power:

Voltage:	115VAC (L-N), single phase
Current:	15 Amps
Output Power:	1000 VA
Output Voltage:	0 to 135 VAC 0 to 270 VAC
Accuracy	1% of FS
Resolution	135 VAC Range – 0.52 V 270 VAC Range – 1.05 V
Regulation	1% Line/Load
Frequency Range:	47 Hz to 63 Hz
Accuracy	0.02% of setting
Resolution	0.01 Hz
Current Range (RMS):	135 VAC Range – 0 to 9 Amps 270 VAC Range – 0 to 4.5 Amps
Peak Current:	135 VAC Range **–** 18 Amps 270 VAC Range **–** 9 Amps
Efficiency:	> 85%
Protection:	Overvoltage Overtemperature

4.4. DC Sources

4.4.1. General

Both the PT535 and the PT505T offer a DC Source as an option:

- 50 Amps - 80 VDC Source for the PT535
- 10 Amps - 80 VDC Source for the PT505DCT

The DC Source option provides the user with a programmable DC power supply for use in testing DC-DC type power supplies, as well as providing DC bias signals for AC to DC power supplies.

Both of the programmable DC power supplies have the following features:

1) Full voltage and current metering
2) Programmable current limit
3) Remote sensing (4 wire)
4) Split input power circuits
5) High efficiency phase controlled switching regulators
6) Overvoltage protection
7) Fully isolated output voltage

4.4.1.1. DC Source Programmable Features

The following commands are available for control of the DC source:

1) Set output voltage
2) Set output current limit
3) Set voltage slew rate
4) Turn DC ON
5) Turn DC OFF

The default settings of the DC source are:

- Zero voltage
- Output off
- Current limit set to maximum
- Voltage slew rate set to maximum

4.4.2. DC Source Specifications

Input Power:	10 Amp – 115 VAC Single phase 10 Amps 50 Amp – 208 VAC 3 Phase 10 Amps/Phase
Output Power:	10 Amp – 800 Watts 50 Amp – 4000 Watts
Output Voltage:	0 to 80 VDC
Accuracy	0.1% of setting ± 20 mV
Resolution	20 mV
Ripple	3 mV
Regulation	0.1% line/load
Response	Fast < 50 microseconds Slow < 50 milliseconds
Current Limit:	10 Amp – 0 to 10 Amps 50 Amp – 0 to 50 Amps
Accuracy	1% of FS
Resolution	0.4% of FS
Protection:	Overvoltage Overtemperature

4.5. Digital Multimeter

4.5.1. General

The digital multimeter (DMM) performs all measurements in the workstation except for DC source measurements. The DMM has a 12 input front panel external signal multiplexer as well as internal multiplexers to handle load current and AC source measurements.

The DMM has the capability to perform the following measurement functions:

Function

1 DC volts read through the external multiplexer.
2 DC current read from a load.
3 RMS noise read through the external multiplexer.
4 Peak-peak noise read through the external multiplexer.
5 Positive peak noise read through the external multiplexer.
6 Negative peak noise read through the external multiplexer.
7 AC source current read internally.
8 AC source voltage read internally.
9 AC source power read internally.
10 AC source peak inrush read internally.
11 DC source current read internally.
12 DC source voltage read internally.
13 DC source peak inrush read internally.
14 DC channel peak voltage read through the external multiplexer.

4.5.1.1. DMM Programmable Features

The following commands are available for control of the DMM:

1) Read the DMM measurement
2) Connect external multiplexer for voltage readings
3) Connect internal current multiplexer for current readings
4) Set a measurement range
5) Set a measurement function
6) Set the timer to take a measurement after a specified amount of time

4.5.2. DMM Specifications

4.5.2.1. DC Voltage Measurement

Voltage Range: 0 to ±20V, 0 to ±200V

Accuracy: 0.02% of full scale

Resolution: 20 Volt Range: 1 mV
200 Volt Range: 12mV

4.5.2.2. Load Current Measurement

100 Amp Load 0 to 10.4 Amps, 0 to 104 Amps

Accuracy: 1% of full scale

Resolution: 10.4 Amp Range: 0.63 milliamps
104 Amp Range: 6.35 milliamps

50 Amp Load 0 to 5.2 Amps, 0 to 52 Amps

Accuracy: 1% of full scale

Resolution: 5.2 Amp Range: 0.32 milliamps
52 Amp Range: 3.17 milliamps

12.5 Amp Load 0 to 1.3 Amps, 0 to 13 Amps

Accuracy: 1% of full scale

Resolution: 1.3 Amp Range: 0.08 milliamps
13 Amp Range: 0.79 milliamps

4.5.2.3. Noise Measurement

Peak-Peak Range: 0.2 V, 1 V, 5 V

Accuracy: 1% of full scale (120Hz to 1 MHz)

Resolution: 0.006% of full scale

Bandwidth: 45Hz to 20MHz (-3dB)

RMS Noise Range: 0.2 V, 1 V, 5 V

Accuracy: 1% of full scale (120Hz to 100 KHz)

Resolution: 0.006% of full scale

Bandwidth: 45Hz to 1MHz (-3dB)

4.5.2.4. RMS AC Source Measurement

Voltage Range: 0 to 142 VAC, 0 to 284 VAC

Accuracy: 0.25% of full scale

Resolution: 142 VAC Range: 8.5mV
284 VAC Range: 17mV

Current Range (RMS): 2.4 KVA Source: 0 to .5 Amps, 0 to 5 Amps, 0 to 25 Amps
1 KVA Source: 0 to 2 Amps, 0 to 10Amps

Accuracy: 0.5% of full scale

Resolution: 0.006% of full scale

Peak Current Range: 0 to 65 Amps

Accuracy: **2**% of full scale

Resolution: 0.006% of full scale

2.4 KVA Power Range: 71 W, 142 W, 710 W, 1420 W, 3550 W, 7100 W

1 KVA Power Range: 284 W, 568 W, 1420 W, 2840 W

Accuracy: 1.0% of full scale

Resolution: 0.006% of full scale

4.5.2.5. DC Source Measurement

Voltage Range: 0 to 81.9 VDC

Accuracy: 0.5% of full scale

Resolution: 20 mV

Current Range: 10 Amp: 0 to 10 Amps
50 Amp: 0 to 50 Amps

Accuracy: 0.5% of full scale

Resolution: 0.024% of full scale

4.5.2.6. Timed Measurement

Delay Range: 1.6 microseconds to 13.4 seconds

Accuracy: 0.02% of setting + 3.2 microseconds

Resolution: 1.6 microseconds

4.6. Digital Unit

4.6.1. General

The digital unit contains the test system general purpose I/O hardware plus the counter timer circuitry. The I/O hardware consists of the following:

- 8 General Purpose Relays
- 8 Digital Outputs (DOUT)
- 7 Digital Inputs (DIN)
- Counter Timer

4.6.1.1. Digital Unit Programmable Features

The following commands are available for control of the Digital unit:

1) Energize or de-energize a general purpose relay
2) Set a digital output high or low
3) Set a digital input voltage reference
4) Read a digital input state
5) Setup the counter to measure time between two events
6) Read the counter
7) Control the front panel lights and switches

The default settings of the DMM are:

- No relays energized
- All digital outputs low
- All digital input reference voltages set to 0V
- Counter disabled

4.6.2. Usage

The General Purpose Relays (GPRE) can be used to control other relays (i.e. in the test fixture), to control soft restart functions in UUT's etc.

The Digital Outputs (DOUTS) can be used to control the UUT's control lines such as output inhibit lines, margining control lines etc. Please note that the DOUTs are open collector output and require external pullups.

The Digital Inputs (DIN) can be used to monitor UUT logic output signals such as status signals (Power Fail, Power Good etc). The monitoring is performed as a comparison between an input DIN voltage and the internal references voltage. The DINs have two reference voltages available, 1 of DINs 1 through 4 and one for DINs 5 through 7. The DINs can also be used to start and stop the counter for measuring time intervals such as power on turn on time etc.

4.6.3. Digital Unit Specifications

General Purpose Relays:

Number: 8, double pole, double throw

Rating: 5 Amps, 130VAC or 40VDC switched
200VDC carry

Digital Outputs:

Number: 8, open collector, isolated

Rating: 300 milliamps, 70 VDC, 0.5 watts
Common isolated signal returns

Comparators:

Number: 7 organized in two groups - DIN 1-4 and DIN 5-7.
Programmable reference DAC for each group.

Input Characteristics:

Range: ± 10 VDC
Resolution: 39 millivolts
Impedance: 100 K Ohms minimum
Capacitance: 30 pF
Hysterisis: 50 mV

Counter:

Range: 100nsec to 13.4sec

Accuracy: 0.02% of reading ± 200 nanoseconds

Resolution: 100 nanoseconds

Trigger: Rising or falling edge of any comparator
AC source on/off
DC source on/off

Test Control Status: 1 Test In Progress Light
1 Ready Light
1 Pass Light
1 Fail Light

Input Control: 1 Start Key (lights when pressed)
1 Stop Key (lights when pressed)

APPENDIX A

Fixturing

A cable harness (fixture or Interface Test Adapter) is required to interface a power supply to the POWERTEST 500 series workstation. Connection to the AC Source, DC Source, Loads, GP Relays, Digital Outputs, Digital Inputs and multiplexer inputs are provided on the front of the system.

The following list specifies the mating connector type and part number of the connectors.

Front Panel Connectors

Front Panel Connection	Quantity	NH Research Part Number	Manufacturer Part Number
AC Source	1	6400026	Hubbel 3331C
Multiplexer	1-12	6000078	UG88B/U (BNC)
12.5 Amp Load and OVPS	1 1 2	6200616 6200777 6200622	AMP # 53894-4 Red Housing AMP # 53894-2 Black Housing AMP # 53892-4 Contacts
100 Amp Load, 50 Amp Load	2-4 2-4	6200066 6200050	AMP # 53884-1 Blue Housing AMP # 53880-5 Contacts
GP Relay	1-2	6200644	DB25-P
DIN/DOUT	1	6200650	DB25-S

RG58A/U, RG174 or equivalent 50 ohm coaxial cable should be used for the multiplexer inputs. Please note that in order to reduce noise pickup the center conductor and shield of the coaxial cable should not be stripped back any further than necessary at the connection point in either end.

UUT Wire Gauge Versus Load Current

To minimize I/R loss in the fixture wiring, the following table lists recommended wire gauges based on the expected current.

Maximum Current	Wire Gauge
Less than 1 amp	18 Gauge
1 to 2 amps	16 Gauge
2 to 5 amps	14 Gauge
5 to 15 amps	12 Gauge
15 to 30 amps	10 Gauge
30 to 50 amps	8 Gauge
50 to 100 amps	2 each 8 Gauge

General Purpose Relay Connector A

Table 1 outlines the General Purpose Relay pin-out for Front Panel G.P. Relay A connector. See figure 1.

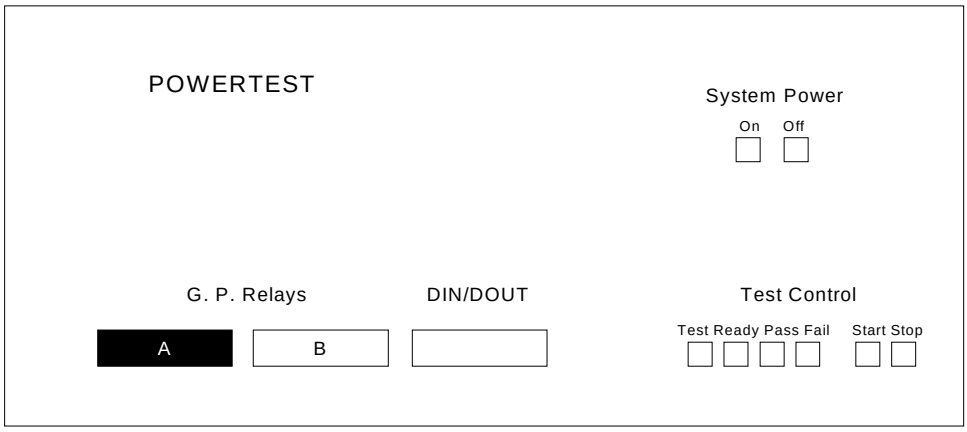

Figure 1 Appendix B

PIN	SIGNAL	CONTACT	PIN	SIGNAL	CONTACT
1	GP 3A	C	14	GP 3A	NO
2	GP 3A	NC	15	GP 4A	C
3	GP 4A	NO	16	GP 4A	NC
4	GP 4B	NC	17	GP 4B	NC
5	GP 4B	C	18	GP 3B	NC
6	GP 3B	NO	19	GP 3B	C
7			20	GP 1A	C
8	GP 1A	NO	21	GP 1A	NC
9	GP 2A	C	22	GP 2A	NO
10	GP 2A	NC	23	GP 2B	NC
11	GP 2B	NO	24	GP 2B	C
12	GP 1B	NC	25	GP 1B	NO
13	GP 1B	C			

Table 1 Appendix B

General Purpose Relay Connector B

Table 2 outlines the General Purpose Relay pin-out for Front Panel G.P. Relay B connector. See figure 2.

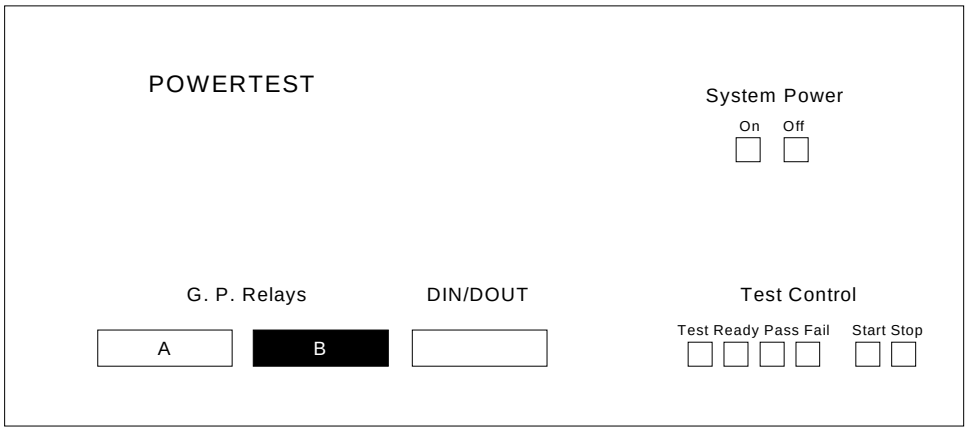

Figure 2 Appendix B

PIN	SIGNAL	CONTACT	PIN	SIGNAL	CONTACT
1	GP 7A	C	14	GP 7A	NO
2	GP 7A	NC	15	GP 8A	C
3	GP 8A	NO	16	GP 8A	NC
4	GP 8B	NC	17	GP 8B	NC
5	GP 8B	C	18	GP 7B	NC
6	GP 7B	NO	19	GP 7B	C
7			20	GP 5A	C
8	GP 5A	NO	21	GP 5A	NC
9	GP 6A	C	22	GP 6A	NO
10	GP 6A	NC	23	GP 6B	NC
11	GP 6B	NO	24	GP 6B	C
12	GP 5B	NC	25	GP 5B	NO
13	GP 5B	C			

Table 2 Appendix B

Digital Input and Digital Output (DIN/DOUT) Connector

Table 3 outlines the Digital Input/Output pin-out for the Front Panel DIN/DOUT connector. See figure 3.

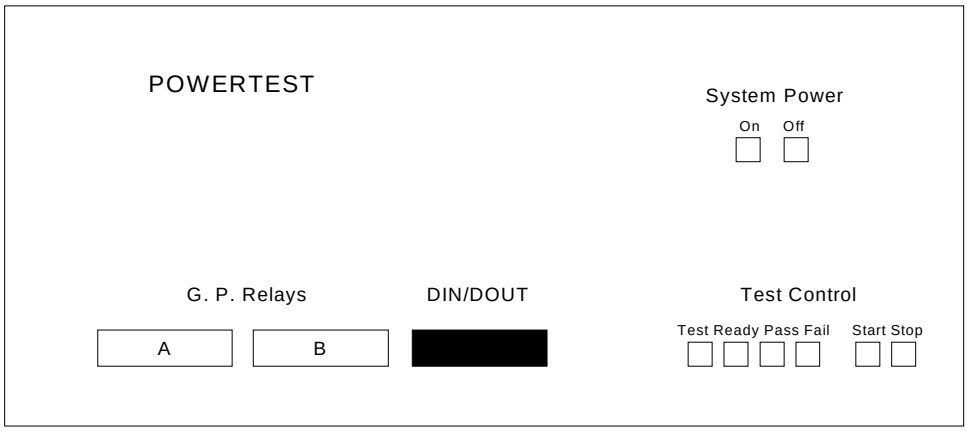

Figure 3 Appendix B

PIN	SIGNAL	PIN	SIGNAL
1	DOUT 1	14	DOUT 2
2	DOUT Common	15	DOUT Common
3	DOUT 3	16	DOUT 4
4	DOUT 5	17	DOUT 6
5	DOUT Common	18	DOUT Common
6	DOUT 7	19	DOUT 8
7		20	DIN Reference 2
8	DIN Reference 1	21	
9	DIN 1	22	DIN 7
10	DIN 2	23	DIN 6
11	DIN 3	24	DIN 5
12	DIN 4	25	DIN Common
13	DIN Common		

Table 3 Appendix B

Physical DB-25 Connector Layout

Figure 4 shows the physical pin-out for the G. P. Relay DB-25 connecters.

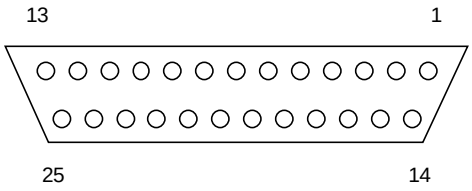

Figure 4 Appendix B

Figure 5 shows the physical pin-out for the DIN/DOUT DB-25 connecter.

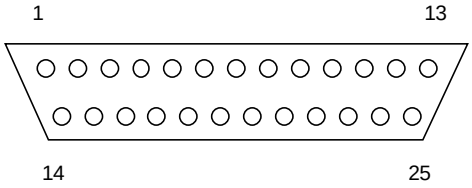

Figure 5 Appendix B